



WORKSHOP MANUAL
TRACTOR

L2350

L2650(GST) L2950(GST)

L3450(GST) L3650(GST)

Kubota

SAFETY FIRST



This symbol, the industry's "Safety Alert Symbol," is used throughout this manual to indicate the machine itself to warn of the possibility of personal injury. Read these instructions carefully. It is essential that you read the instructions and safety regulations before attempting to use the machine.

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA Tractors L2350, L2650, L2950, L3450 and L3650. It is divided into two parts, "Mechanism" and "Servicing".

■ Mechanism

Information on the construction and function are included for each section. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

■ Servicing

Under the heading "General" comes general precautions, check and maintenance and special tools. For each section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information, illustrations and specifications contained in this manual are based on the latest production information available at the time of publication.

The right is reserved to make changes in all information at any time without notice.

NOTE
May '91

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SAFETY SERVICING AND REPAIRING

- (1) Before working on the machine:
- Park the machine on a firm and level ground, and set the parking brake.
 - Lower the implement to rest on the ground.
 - Stop the engine and remove the key.
 - Disconnect the battery's ground cable.
 - Clean the work area and machine.
- (2) Do not work on the machine while under the influence of alcohol, medicine or other substances or while fatigued.
- (3) Do not work in a dark, mist, rain, or foggy lighting when you work near machine parts or moving parts.
- (4) Use the appropriate work tools. Improper tools or work methods will not make good work.
- (5) When servicing is performed together by two or more persons, always perform all work safely.
- (6) Do not work under the machine that is supported solely by a jack. Always support the machine by setting stands.



SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals on the machine itself to warn of the possibility of personal injury. Read these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.



DANGER

: Immediate hazards which **WILL** result in severe personal injury or death.



WARNING : Hazards or unsafe practices which **COULD** result in severe personal injury or death.



CAUTION : Hazards or unsafe practices which **COULD** result in minor personal injury.

■ **IMPORTANT** : Indicates that equipment or property damage could result if instructions are not followed.

■ **NOTE** : Gives helpful information.

SAFETY SERVICING AND REPAIRING

- (1) Before working on the machine :
 - Park the machine on a firm and level ground, and set the parking brake.
 - Lower the implement or mower to the ground.
 - **Stop the engine, and remove the key.**
 - Disconnect the battery's ground cable.
 - Clean the work area and machine.
- (2) Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- (3) Do not wear a necktie, scarf, necklace, loose or bulky clothing when you work near machine tools or moving parts.
- (4) Use tools appropriate to the work. Makeshift tools, parts, and procedures will not make good repairs.
- (5) When servicing is performed together by two or more persons, take care to perform all work safely.
- (6) Do not work under the machine that is supported solely by a jack. Always support the machine by safety stands.

- (7) If the engine must be running to do same work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.
- (8) Do not touch the rotating or hot parts and high tension cords while the engine is running.
- (9) Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- (10) To avoid sparks from an accidental short circuit, always disconnect the battery's ground cable first and connect it last.
- (11) Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and cause blindness if splashed into eyes. Keep electrolyte away from eyes, hands and clothing. If you spill electrolyte on yourself, flush with water, and get medical attention immediately.
- (12) Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- (13) Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Wait for more than ten minutes to cool the radiator, before removing the cap.
- (14) Escaping fluid (fuel or hydraulic oil) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- (15) Do not start the engine by shorting across starter terminals.
- (16) Unauthorized modifications to the machine may impair the function and /or safety and affect machine life.
- (17) Do not alter or remove any part of machine safety system.
- (18) Keep a first aid kit and fire extinguisher handy at all times.

SAFETY DECALS

- The following safety decals are installed on the machine.

If a decal becomes damaged, illegible or is not on the machine, replace it. The decal part number is listed in the parts list.

① Part No. 35260-3491-3

⚠ CAUTION

TO AVOID PERSONAL INJURY:

1. Read and understand the operator's manual before operation.
2. Before starting the engine, make sure that everyone is at a safe distance from the tractor and that the PTO is OFF.
3. Do not allow passengers on the tractor at any time.
4. Before allowing other people to use the tractor, have them read the operator's manual.
5. Check the tightness of all nuts and bolts regularly.
6. Keep all shields in place and stay away from all moving parts.
7. Lock the two brake pedals together before driving on the road.
8. Slow down for turns, or rough roads, or when applying individual brakes.
9. On public roads use SMV emblem and hazard lights, if required by local traffic and safety regulations.
10. Pull only from the drawbar.
11. Before dismounting, lower the implement, set the parking brake, stop the engine and remove the key.

② Part No. 35260-2979-1

⚠ WARNING

TO AVOID PERSONAL INJURY:

1. Attach pulled or towed loads to the drawbar only.
2. Use the 3-point hitch only with equipment designed for 3-point hitch usage.

④ Part No. 35820-9863-3

⚠ WARNING

TO AVOID POSSIBLE INJURY OR DEATH FROM A MACHINE RUNAWAY:

1. Do not start engine by shorting across starter terminals or bypassing the safety start switch. Machine may start in gear and move if normal starting circuitry bypassed.
2. Start engine only from operator's seat with transmission and PTO OFF.
Never start engine while standing on the ground.

③ Part No. 35260-2978-2

⚠ WARNING

TO AVOID PERSONAL INJURY OR DEATH FROM ROLL-OVER;

1. Kubota recommends the use of a Roll-Over Protective Structures (ROPS) and seat belt in almost all applications.
2. Remove the ROPS only when it substantially interferes with operation or itself presents a safety risk. (Examples include work in orchards and vineyards.) ALWAYS REINSTALL IT BEFORE USING THE TRACTOR IN OTHER APPLICATIONS.
3. Never use just the seat belt, or just the ROPS. They must be used together. For further details, consult your Operator's Manual or your local dealer.

⑤ Part No. 35200-2534-1

⚠ WARNING

TO AVOID PERSONAL INJURY:

1. Keep PTO shield in place at all times.
2. Do not operate the PTO at speeds faster than the speed recommended by the implement manufacturer.

⑥ [With Glide Shift Transmission]
Part No. 35370-3136-2

▲ WARNING

BEFORE DISMOUNTING TRACTOR:

1. ALWAYS SET PARKING BRAKE
Leaving transmission in gear with the engine stopped will not prevent tractor with shuttle transmission from rolling.
2. LOCK SHUTTLE SHIFT LEVER IN NEUTRAL POSITION
This prevents movement of shuttle shift lever out of neutral position.
3. STOP THE ENGINE

⑧ [With mid-PTO]
Part No. 35070-6575-1

▲ WARNING

TO AVOID PERSONAL INJURY:

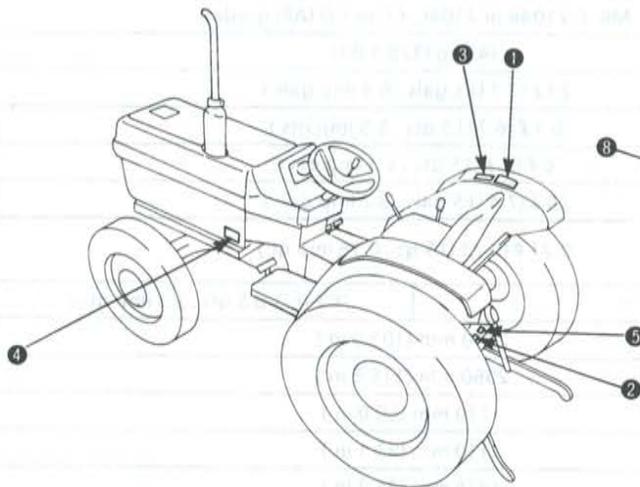
1. Before operation, be sure to read PTO revolution label to select the correct PTO lever (mid/rear) and PTO revolution speed.
2. Do not operate rear-PTO driven implements and mid-PTO driven implements at the same time.

⑦ Part No. 35080-6528-2

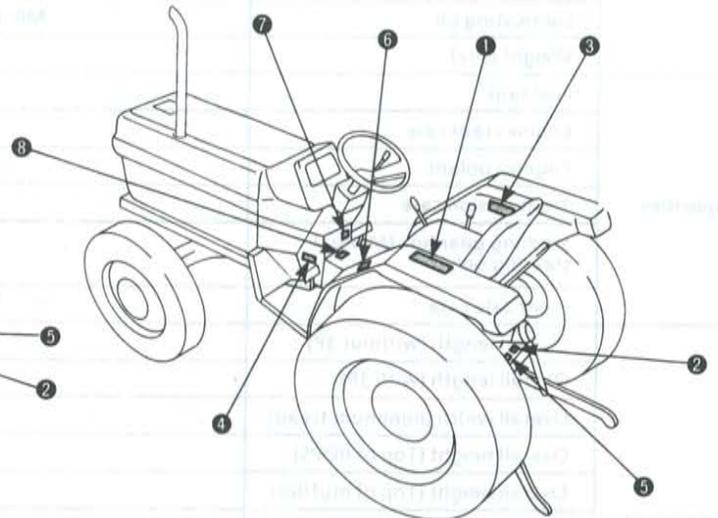
▲ CAUTION

Pull the engine stop knob back and hold it until the engine stops in case of emergency.

[L2350]



[L2650, L2950, L3450, L3650]



B122F072

SPECIFICATIONS

Model		L2350 (2WD)	L2350 (4WD)	
Maximum PTO power		15.3 kW (20.5 HP)		
Engine NET power		16.6 kW (22.2 HP)		
Engine	Model	D1102-AE	D1102-AE-2	
	Type	Vertical, Water-Cooled, 4-cycle diesel		
	Number of cylinders	3		
	Bore and stroke	76 x 82 mm (3.0 x 3.2 in.)		
	Total displacement	1115 cm ³ (68.0 cu.in.)		
	Rated revolution	46.7 r/s (2800 rpm)		
	Maximum torque	77.5 N·m (7.9 kgf·m, 57.5 ft-lbs.)/1600 rpm		
	Combustion chamber	Indirect Injection (Spherical combustion chamber)		
	Fuel injection pump	Bosh K type mini pump		
	Governor	Centrifugal ball mechanical governor		
	Injection nozzle	Throttle type		
	Injection timing	Before T.D.C. 0.40 rad (23°)		
	Injection order	1-2-3		
	Injection pressure	14.22 MPa (145 kgf/cm ² , 2062 psi)		
	Compression ratio	21		
	Lubricating system	Forced lubrication by pump		
	Cooling system	Pressurized radiator, Forced circulation with water pump		
	Starting system	Electric starting with cell starter (12 V, 1.0 kW)		
	Alternator	12 V, 300 W		
	Battery	490- Cold cranking Amps at -18°C (-0.4°F)		
Fuel	Diesel fuel No. 2-D [No. 1 diesel fuel if temperature is below -10°C(14°F)]			
Lubricating oil	MIL-L-2104B or 2104C, CC or CD (API grade)			
Weight (Dry)	149 kg (328.5 lbs)			
Capacities	Fuel tank	29 ℓ (7.7 U.S.gals., 6.4 Imp.gals.)		
	Engine crank case	6.3 ℓ (6.7 U.S.qts., 5.5 Imp.qts.)		
	Engine coolant	6 ℓ (6.3 U.S.qts., 5.3 Imp.qts.)		
	Transmission case	28 ℓ (7.4 U.S.gals., 6.2 Imp.gals.)		
	Steering gear box (Manual steering only)	0.21 ℓ (0.22 U.S.qt., 0.18 Imp.qt.)		
	Front axle case	—	6 ℓ (6.3 U.S.qts., 5.3 Imp.qts.)	
Dimensions	Overall length (without 3P)	2640 mm (103.9 in.)		
	Overall length (with 3P)	2960 mm (116.5 in.)		
	Overall width (minimum tread)	1270 mm (50.0 in.)		
	Overall height (Top of ROPS)	2110 mm (83.1 in.)		
	Overall height (Top of muffler)	1935 mm (76.2 in.)		
	Overall height (Top of steering wheel)	1380 mm (54.3 in.)		
	Wheel base	1555 mm (61.2 in.)	1565 mm (61.6 in.)	
	Min.ground clearance	345 mm (13.6 in.)	311 mm (12.2 in.)	
	Tread (Std tires)	Front	1010 mm (39.8 in.)	
	Rear	1030 mm (40.6 in.)		

(Continued) SPECIFICATIONS

Model			L2350 (2WD)	L2350 (4WD)
Traveling system	Tire size (Std. tires)	Front tires	4.00 - 15	6 - 14
		Rear tire	9.5 - 24	
	Clutch		Dry type single stage with single plate	
	Steering		Recirculating ball type manual steering	Recirculating ball type manual steering or integral type power steering (if equipped)
	Transmission		Gear shift, 8 forward and 2 reverse speeds	
	Brake	Traveling	Wet disk type	
		Parking	Connected with the traveling brake	
Differential		Bevel gear		
Hydraulic system	Hydraulic control system		Position and draft control (if equipped)	
	Pump capacity (at 2800 engine)		17.3 ℓ/min. (4.6 GPM)	27.2 ℓ/min. (7.2 GPM)
	Three point hitch		Category 1	
	Maximum lifting force (24 in. behind lower linkend)		650 kg (1435 lbs.)	
Rear PTO	PTO shaft		SAE 1-3/8 6-splines	
	Revolution		1 speed 9 r/s (540 rpm) / engine 40.5 r/s (2430 rpm)	
Min. turning radius (with brake)			2.4 m (7.9 ft)	2.5 m (8.2 ft)
Traction system			Fixed drawbar or swing drawbar (if equipped)	
Weight (with ROPS)			890 kg (1962 lbs.)	1000 kg (2205 lbs.)
Traveling speed	Forward	1st	1.3 km/h (0.8 mph)	1.3 km/h (0.8 mph)
		2nd	1.6 km/h (1.0 mph)	1.7 km/h (1.0 mph)
		3rd	2.4 km/h (1.5 mph)	2.4 km/h (1.5 mph)
		4th	4.1 km/h (2.5 mph)	4.2 km/h (2.6 mph)
		5th	5.4 km/h (3.4 mph)	5.3 km/h (3.3 mph)
		6th	7.0 km/h (4.4 mph)	6.8 km/h (4.2 mph)
		7th	10.1 km/h (6.3 mph)	9.8 km/h (6.1 mph)
		8th	17.4 km/h (10.8 mph)	17.0 km/h (10.6 mph)
	Reverse	1st	2.1 km/h (1.3 mph)	2.2 km/h (1.4 mph)
		2nd	9.2 km/h (5.7 mph)	8.9 km/h (5.6 mph)

SPECIFICATIONS (Continued)

Model		L2650		L2950	
		2WD	4WD	2WD	4WD
Maximum PTO power		17.5 kW (23.5 HP)		19.4 kW (26.0 HP)	
Engine NET power		19.5 kW (26.1 HP)		21.3 kW (28.6 HP)	
Engine	Model	D1402-DI-AE		D1462-DI-AE	
	Type	Direct Injection, Vertical, Water-Cooled, 4-cycle diesel			
	Number of cylinders	3			
	Bore and stroke	85 x 82 mm (3.3 x 3.2 in.)		87 x 82 mm (3.4 x 3.2 in.)	
	Total displacement	1395 cm ³ (85.1 cu. in.)		1462 cm ³ (89.2 cu. in.)	
	Rated revolution	43.3 r/s (2600 rpm)			
	Maximum torque	89.2 N·m (9.1 kgf·m, 65.8 ft-lbs.) /1600 rpm		95.1 N·m (9.7 kgf·m, 70.2 ft-lbs.) /1600 rpm	
	Combustion chamber	Direct Injection			
	Fuel injection pump	Bosh K type mini pump			
	Governor	Centrifugal ball mechanical governor			
	Injection nozzle	4 hole type (stanadyne pencil nozzle)			
	Injection timing	Before T.D.C. 0.31 rad (18°)			
	Injection order	1-2-3			
	Injection pressure	22.75 MPa (232 kgf/cm ² , 3300 psi)			
	Compression ratio	19			
	Lubricating system	Forced lubrication by pump			
	Cooling system	Pressurized radiator, Forced circulation with water pump			
	Starting system	Electric starting with cell starter (12 V, 1.2 kW)			
	Alternator	12 V, 480 W			
	Battery	490- Cold cranking Amps at -18°C (-0.4°F)			
Fuel	Diesel fuel No. 2-D [No. 1 diesel fuel if temperature is below -10°C(14°F)]				
Lubricating oil	MIL-L-2104B or 2104C, CC or CD (API grade)				
Weight (Dry)	177 kg (390.2 lbs)				
Capacities	Fuel tank	29 ℓ (7.7 U.S.gals., 6.4 Imp. gals.)			
	Engine crankcase	5.7 ℓ (6.0 U.S.qts., 5.0 Imp. qts.)			
	Engine coolant	4.6 ℓ (4.9 U.S.qts., 4.0 Imp. qts.)			
	Transmission case	28.5 ℓ (7.7 U.S.gals., 6.3 Imp. gals.)			
	Steering gear case	0.1 ℓ (0.11 U.S. qt., 0.09 Imp. qt.)	—	0.1 ℓ (0.11 U.S. qt., 0.09 Imp. qt.)	—
	Steering gear box (Manual steering only)	0.2 ℓ (0.21 U.S. qt., 0.18 Imp. qt.)	—	0.2 ℓ (0.21 U.S. qt., 0.18 Imp. qt.)	—
	Front axle case (4WD only)	—	6.5 ℓ (6.9 U.S.qts., 5.7 Imp.qts.)	—	6.5 ℓ (6.9 U.S.qts., 5.7 Imp.qts.)
Dimensions	Overall length (without 3P)	2770 mm (109.1 in.)		2795 mm (110.0 in.)	
	Overall length (with 3P)	2990 mm (117.7 in.)			
	Overall width (minimum tread)	1305 mm (51.4 in.)		1340 mm (52.7 in.)	
	Overall height (Top of ROPS)	2110 mm (83.1 in.)		2125 mm (83.7 in.)	
	Overall height (Top of muffler)	2030 mm (79.9 in.)			
	Overall height (Top of steering wheel)	1475 mm (58.1 in.)			
	Wheel base	1640 mm (64.6 in.)			

L3450		L3650	
2WD	4WD	2WD	4WD
22.4 kW (30.0 HP)		24.6 kW (33.0 HP)	
24.6 kW (33.0 HP)		27.2 kW (36.5 HP)	
V1902-DI-AE		V1902-DI X-AE	
Direct Injection, Vertical, Water-Cooled, 4-cycle diesel			
4			
85 x 82 mm (3.3 x 3.2 in.)			
1861 cm ³ (113.6 cu.in.)			
41.7 r/s (2500 rpm)		43.3 r/s (2600 rpm)	
115.7 N m (11.8 kgf-m, 85.4 ft-lbs.)/1600 rpm		124.5 N m (12.7 kgf-m, 91.9 ft-lbs.)/1600 rpm	
Direct Injection			
Bosh K type mini pump			
Centrifugal ball mechanical governor			
4 hole type (Stanadyne pencil nozzle)			
Before T.D.C. 0.31 rad (18°)			
1-3-4-2			
22.75 MPa (232 kgf/cm ² , 3300 psi)			
19			
Forced lubrication by pump			
Pressurized radiator, Forced circulation with water pump			
Electric starting with cell starter (12 V, 1.4 kW)			
12 V, 480 W			
447-Cold cranking Amps at - 18°C (- 0.4°F)			
Diesel fuel No. 2-D [No. 1 diesel fuel if temperature is below - 10°C(14°F)]			
MIL-L-2104B or 2104C, CC or CD (API grade)			
207 kg (456.4 lbs)			
29 ℓ (7.7 U.S.gals., 6.4 Imp. gals.)			
8.5 ℓ (8.9 U.S.qts., 7.5 Imp. qts.)			
5.6 ℓ (5.9 U.S.qts., 4.9 Imp. qts.)			
28.5 ℓ (7.7 U.S.gals., 6.3 Imp. gals.)			
0.1 ℓ (0.11 U.S. qt. 0.09 Imp. qt.)	—	0.1 ℓ (0.11 U.S. qt. 0.09 Imp. qt.)	—
—	6.5 ℓ (6.9 U.S. qts. 5.7 Imp. qts.)	—	6.5 ℓ (6.9 U.S. qts. 5.7 Imp. qts.)
2900 mm (114.2 in.)		2950 mm (116.1 in.)	
3105 mm (122.2 in.)		3125 mm (123.0 in.)	
1370 mm (53.9 in.)		1480 mm (58.3 in.)	
2105 mm (82.9 in.)		2155 mm (84.8 in.)	
2030 mm (79.9 in.)		2050 mm (80.7 in.)	
1470 mm (57.9 in.)		1510 mm (59.4 in.)	
1735 mm (68.3 in.)			

Model			L2650		L2950	
			2WD	4WD	2WD	4WD
Dimensions	Min. ground clearance		345 mm (13.6 in.)			
	Tread (Std. tires)	Front	960 mm (37.8 in.) 1060 mm (41.7 in.) 1160 mm (45.7 in.) 1260 mm (49.6 in.)	1120 mm (44.1 in.)	960 mm (37.8 in.) 1060 mm (41.7 in.) 1160 mm (45.7 in.) 1260 mm (49.6 in.)	1120 mm (44.1 in.)
		Rear	1030 mm (40.6 in.), 1125 mm (44.3 in.), 1220 mm (48.0 in.), 1305 mm (51.4 in.), 1400 mm (55.1 in.)			
Traveling system	Tire size (Std. tires)	Front	4.00 – 15	7 – 16	5.00 – 15	7 – 16
		Rear	11.2 – 24		12.4 – 24	
	Clutch		Dry type dual stage (Live PTO)			
	Steering		Recirculating ball type manual steering or integral type power steering (if equipped)	Full hydrostatic power steering	Recirculating ball type manual steering or integral type power steering (if equipped)	Full hydrostatic power steering
	Transmission		Mechanical shuttle, 8 forward and 8 reverse speeds			
	Brake	Traveling	Wet disc type			
		Parking	Connected with the traveling brake			
	Differential		Bevel gear			
Hydraulic system	Hydraulic control system		Position and draft control (if equipped)			
	Pump capacity (at rated revolution engine)		Main pump 25.4 ℓ/min (6.7 GPM) Power steering pump 10.5 ℓ/min (2.8 GPM)	Main pump 25.4 ℓ/min (6.7 GPM) Power steering pump 17.1 ℓ/min (4.5 GPM)	Main pump 25.4 ℓ/min (6.7 GPM) Power steering pump 10.5 ℓ/min (2.8 GPM)	Main pump 25.4 ℓ/min (6.7 GPM) Power steering pump 17.1 ℓ/min (4.5 GPM)
	Three point hitch		Category 1			
	Max. lifting force (24 in. behind lower linkend)		900 kg (1985 lbs)			
Rear PTO	PTO shaft		SAE 1-3/8 6-splines			
	Revolution		2 speeds 9 r/s (540 rpm) / engine 38.3 r/s (2298 rpm) 16.7 r/s (1000 rpm) / engine 40.6 r/s (2438 rpm)			
Mid PTO	PTO shaft		USA No.5 (KUBOTA 10 tooth) Involute spline			
	Revolution		2 speeds 18 r/s (1080 rpm) / engine 38.3 r/s (2298 rpm) 33.3 r/s (2000 rpm) / engine 40.6 r/s (2438 rpm)			
Min. turning radius (with brake)			2.3 m (7.5 ft.)			
Traction system			Fixed drawbar or Swing drawbar (if equipped)			
Weight (with ROPS)			1080 kg (2380 lbs.)	1180 kg (2600 lbs.)	1110 kg (2445 lbs.)	1210 kg (2670 lbs.)
Traveling speed	Forward	1st	1.4 km/h (0.9 mph)		1.5 km/h (0.9 mph)	
		2nd	2.0 km/h (1.2 mph)		2.1 km/h (1.3 mph)	
		3rd	3.1 km/h (1.9 mph)		3.2 km/h (2.0 mph)	
		4th	4.4 km/h (2.7 mph)		4.6 km/h (2.9 mph)	
		5th	6.9 km/h (4.3 mph)		7.2 km/h (4.5 mph)	
		6th	9.6 km/h (6.0 mph)		10.0 km/h (6.2 mph)	
		7th	15.2 km/h (9.4 mph)		15.7 km/h (9.8 mph)	
		8th	21.4 km/h (13.3 mph)		22.3 km/h (13.8 mph)	
	Reverse	1st	1.3 km/h (0.8 mph)		1.3 km/h (0.8 mph)	
		2nd	1.8 km/h (1.1 mph)		1.9 km/h (1.2 mph)	
		3rd	2.8 km/h (1.8 mph)		2.9 km/h (1.8 mph)	
		4th	4.0 km/h (2.5 mph)		4.1 km/h (2.6 mph)	
		5th	6.2 km/h (3.9 mph)		6.5 km/h (4.0 mph)	
		6th	8.7 km/h (5.4 mph)		9.0 km/h (5.6 mph)	
		7th	13.7 km/h (8.5 mph)		14.2 km/h (8.8 mph)	
		8th	19.3 km/h (12.0 mph)		20.1 km/h (12.5 mph)	

L3450		L3650	
2WD	4WD	2WD	4WD
345 mm (13.6 in.)		365 mm (14.4 in.)	360 mm (14.2 in.)
1150 mm (45.3 in.) 1250 mm (49.2 in.) 1350 mm (53.1 in.) 1450 mm (57.1 in.)	1120 mm (44.1 in.)	1150 mm (45.3 in.) 1250 mm (49.2 in.) 1350 mm (53.1 in.) 1450 mm (57.1 in.)	1170 mm (46.1 in.)
1050 mm (41.3 in.), 1150 mm (45.3 in.), 1240 mm (48.8 in.) 1335 mm (52.6 in.), 1420 mm (55.9 in.), 1515 mm (59.6 in.)		1155 mm (45.5 in.), 1225 mm (48.2 in.), 1325 mm (52.2 in.) 1350 mm (53.1 in.), 1450 mm (57.1 in.)	
5.00 - 15		6.00 - 16	8-16
12.4 - 24		13.6 - 26	
Dry type dual stage (Live PTO)			
Integral type power steering	Full hydrostatic power steering	Integral type power steering	Full hydrostatic power steering
Mechanical shuttle, 8 forward and 8 reverse speeds			
Wet disc type			
Connected with the traveling brake			
Bevel gear			
Position and draft control (if equipped)			
Main pump 28.4 ℓ/min (7.5 GPM) Power steering pump 11.7 ℓ/min (3.1 GPM)	Main pump 28.4 ℓ/min (7.5 GPM) Power steering pump 14.7 ℓ/min (3.9 GPM)	Main pump 29.5 ℓ/min (7.8 GPM) Power steering pump 12.1 ℓ/min (3.2 GPM)	Main pump 29.5 ℓ/min (7.8 GPM) Power steering pump 15.3 ℓ/min (4.0 GPM)
Category 1			
930 kg (2050 lbs)			
SAE 1-3/8, 6-splines			
2 speeds 9 r/s (540 rpm) / engine 38.3 r/s (2298 rpm) 16.7 r/s (1000 rpm)/engine 40.6 r/s (2438 rpm)		1 speed 9 r/s (540 rpm) / engine 38.3 r/s (2298 rpm)	
USA No.5 (KUBOTA 10 tooth) Involute spline		—	
2 speeds 18 r/s (1080 rpm) / engine 38.3 r/s (2298 rpm) 33.3 r/s (2000 rpm)/engine 40.6 r/s (2438 rpm)		—	
2.4 m (7.9 ft)			
Fixed drawbar or swing drawbar (if equipped)			
1185 kg (2610 lbs)	1290 kg (2845 lbs)	1225 kg (2700 lbs)	1320 kg (2910 lbs)
1.3 km/h (0.8 mph)		1.4 km/h (0.9 mph)	
1.7 km/h (1.1 mph)		2.0 km/h (1.2 mph)	
2.8 km/h (1.7 mph)		3.1 km/h (1.9 mph)	
4.1 km/h (2.5 mph)		4.6 km/h (2.9 mph)	
6.1 km/h (3.8 mph)		6.9 km/h (4.3 mph)	
8.5 km/h (5.3 mph)		9.6 km/h (6.0 mph)	
13.3 km/h (8.3 mph)		15.1 km/h (9.4 mph)	
19.7 km/h (12.2 mph)		22.3 km/h (13.9 mph)	
1.1 km/h (0.7 mph)		1.3 km/h (0.8 mph)	
1.6 km/h (1.0 mph)		1.8 km/h (1.1 mph)	
2.5 km/h (1.5 mph)		2.8 km/h (1.7 mph)	
3.7 km/h (2.3 mph)		4.2 km/h (2.6 mph)	
5.5 km/h (3.4 mph)		6.2 km/h (3.9 mph)	
7.6 km/h (4.7 mph)		8.7 km/h (5.4 mph)	
12.0 km/h (7.5 mph)		13.6 km/h (8.5 mph)	
17.7 km/h (11.0 mph)		20.1 km/h (12.5 mph)	

SPECIFICATIONS (Continued)

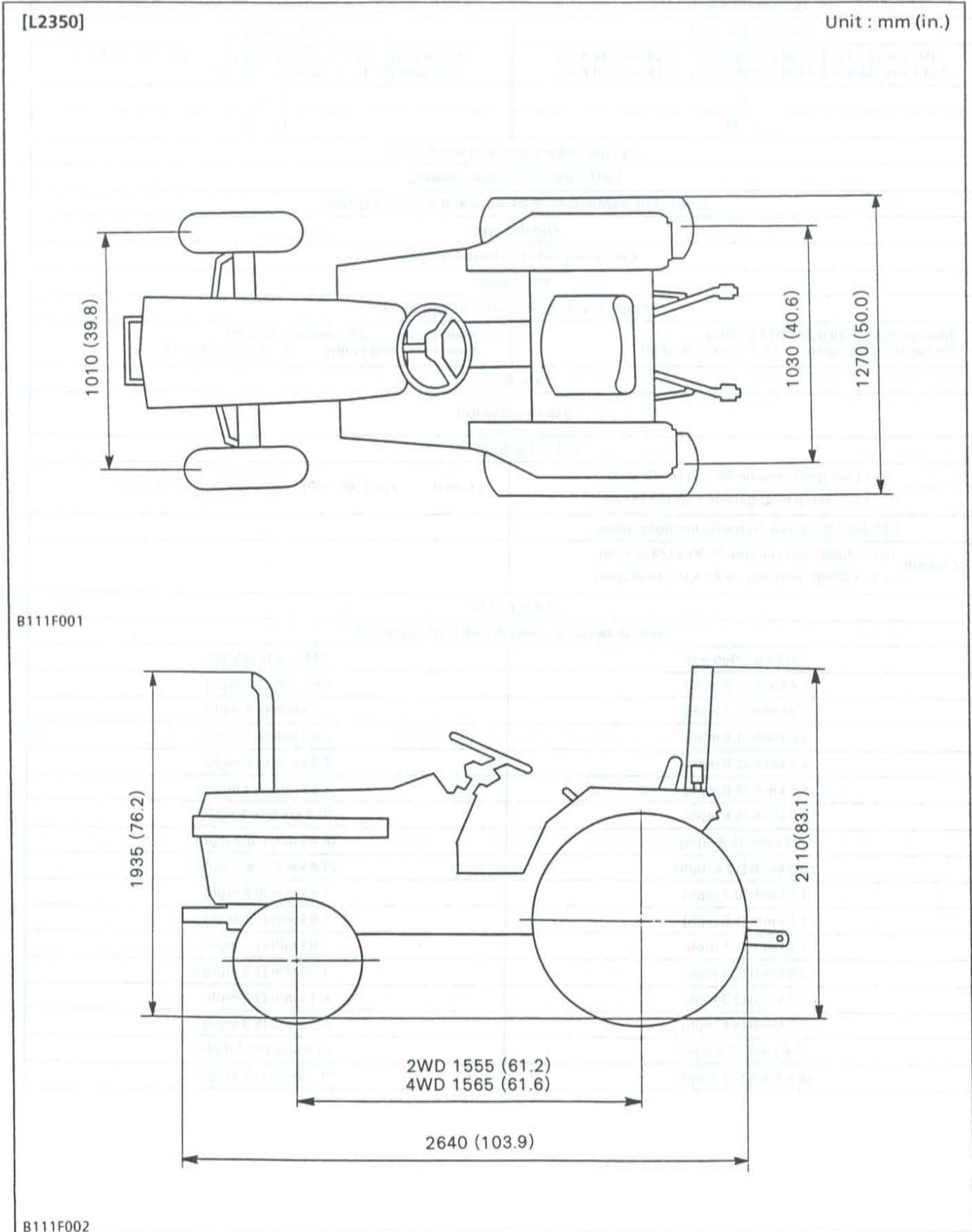
Model		L2650GST	L2950GST
Maximum PTO power		17.5 kW (23.5 HP)	19.4 kW (26.0 HP)
Engine NET power		19.5 kW (26.1 HP)	21.3 kW (28.6 HP)
Engine	Model	D1402-DI-AE	D1462-DI-AE
	Type	Direct injection, Vertical, Water-Cooled, 4-cycle diesel	
	Number of cylinders	3	
	Bore and stroke	85 x 82 mm (3.3 x 3.2 in.)	87 x 82 mm (3.4 x 3.2 in.)
	Total displacement	1395 cm ³ (85.1 cu. in.)	1462 cm ³ (89.2 cu. in.)
	Rated revolution	43.3 r/s (2600 rpm)	
	Maximum torque	89.2 N m (9.1 kgf m, 65.8 ft-lbs) / 1600 rpm	95.1 N m (9.7 kgf m, 70.2 ft-lbs) / 1600 rpm
	Combustion chamber	Direct Injection	
	Fuel injection pump	Bosh K type mini pump	
	Governor	Centrifugal ball mechanical governor	
	Injection nozzle	4 hole type (Stanadyne pencil nozzle)	
	Injection timing	Before T.D.C. 0.31 rad (18°)	
	Injection order	1-2-3	
	Injection pressure	22.75 MPa (232 kgf/cm ² , 3300 psi)	
	Compression ratio	19	
	Lubricating system	Forced lubrication by pump	
	Cooling system	Pressurized radiator, Forced circulation with water pump	
	Starting system	Electric starting with cell starter (12 V, 1.2 kW)	
	Alternator	12 V, 480 W	
	Battery	490- Cold cranking Amps at -18°C (-0.4°F)	
Fuel	Diesel fuel No. 2-D [No. 1 diesel fuel if temperature is below -10°C (14°F)]		
Lubricating oil	MIL-L-2104B or 2104C, CC or CD (API grade)		
Weight (Dry)	177 kg (390.2 lbs)		
Capacities	Fuel tank	29 ℓ (7.7 U.S.gals., 6.4 Imp. gals.)	
	Engine crankcase	5.7 ℓ (6.0 U.S.qts., 5.0 Imp. qts.)	
	Engine coolant	4.6 ℓ (4.9 U.S.qts., 4.0 Imp. qts.)	
	Transmission case	27 ℓ (7.1 U.S.gals., 5.9 Imp. gals.)	
	Front axle case	6.5 ℓ (6.9 U.S.qts., 5.7 Imp. qts.)	
Dimensions	Overall length (without 3P)	2770 mm (109.1 in.)	2795 mm (110.0 in.)
	Overall length (with 3P)	2990 mm (117.7 in.)	
	Overall width (minimum tread)	1305 mm (51.4 in.)	1340 mm (52.7 in.)
	Overall height (Top of ROPS)	2110 mm (83.1 in.)	2125 mm (83.7 in.)
	Overall height (Top of muffler)	2030 mm (79.9 in.)	
	Overall height (Top of steering wheel)	1475 mm (58.1 in.)	
	Wheel base	1640 mm (64.6 in.)	

L3450 GST	L3650 GST
22.4 kW (30.0 HP)	24.6 kW (33.0 HP)
24.6 kW (33.0 HP)	27.2 kW (36.5 HP)
V1902-DI-AE	V1902-DI-X-AE
Direct Injection, Vertical, Water-Cooled, 4-cycle diesel	
4	
85 x 82 mm (3.3 x 3.2 in.)	
1861 cm ³ (113.6 cu.in.)	
41.7 r/s (2500 rpm)	43.3 r/s (2600 rpm)
115.7 N-m (11.8 kgf-m, 85.4 ft-lbs.)/1600 rpm	124.5 N-m (12.7 kgf m, 91.9 ft-lbs.)/1600 rpm
Direct Injection	
Bosh K type mini pump	
Centrifugal ball mechanical governor	
4 hole type (Stanadyne pencil nozzle)	
Before T.D.C. 0.31 rad (18°)	
1-3-4-2	
22.75 MPa (232 kgf/cm ² , 3300 psi)	
19	
Forced lubrication by pump	
Pressurized radiator, Forced circulation with water pump	
Electric starting with cell starter (12 V, 1.4 kW)	
12 V, 480 W	
447 - Cold cranking Amps at -18°C (-0.4°F)	
Diesel fuel No. 2-D [No. 1 diesel fuel if temperature is below -10°C(14°F)]	
MIL-L-2104B or 2104C, CC or CD (API grade)	
207 kg (456.4 lbs)	
29 ℓ (7.7 U.S.gals., 6.4 Imp. gals.)	
8.5 ℓ (8.9 U.S.qts., 7.5 Imp. qts.)	
5.6 ℓ (5.9 U.S.qts., 4.9 Imp. qts.)	
27 ℓ (7.1 U.S.gals., 5.9 Imp. gals.)	
6.5 ℓ (6.9 U.S.qts., 5.7 Imp. qts.)	
2900 mm (114.2 in.)	2950 mm (116.1 in.)
3105 mm (122.2 in.)	3125 mm (123.0 in.)
1370 mm (53.9 in.)	1480 mm (58.3 in.)
2105 mm (82.9 in.)	2155 mm (84.8 in.)
2030 mm (79.9 in.)	2050 mm (80.7 in.)
1470 mm (57.9 in.)	1510 mm (59.4 in.)
1735 mm (68.3 in.)	

Model		L2650 GST		L2950 GST		
Dimensions	Min. ground clearance		345 mm (13.6 in.)			
	Tread (Std. tires)	Front	1120 mm (44.1 in.)			
		Rear	1030 mm (40.6 in.), 1125 mm (44.3 in.), 1220 mm (48.0 in.), 1305 mm (51.4 in.), 1400 mm (55.1 in.)			
Traveling system	Tire size (Std. tires)	Front	7 - 16			
		Rear	11.2 - 24	12.4 - 24		
	Clutch		Dry type single stage With single plate			
	Steering		Full hydrostatic power steering			
	Transmission		Glide shift transmission, 8 forward and 8 reverse speeds			
	Brake	Traveling	Wet disc type			
		Parking	Connected with the traveling brake			
Differential		Bevel gear				
Hydraulic system	Hydraulic control system		Position and draft control (if equipped)			
	Pump capacity (at rated revolution engine)		Main pump 25.4 l/min (6.7 GPM) Power steering pump 17.1 l/min (4.5 GPM)			
	Three point hitch		Category 1			
	Max. lifting force (24 in. behind lower link end)		900 kg (1985 lbs)			
Rear PTO	PTO shaft		SAE 1-3/8 6-splines			
	Revolution		2 speeds 9 r/s (540 rpm) / engine 40 5 r/s (2430 rpm) 16.7 r/s (1000 rpm) / engine 40.6 r/s (2438 rpm)			
Mid PTO	PTO shaft		USA No.5 (KUBOTA 10 tooth) Involute spline			
	Revolution		2 speeds 18 r/s (1080 rpm) / engine 40 5 r/s (2430 rpm) 33.3 r/s (2000 rpm) / engine 40.6 r/s (2438 rpm)			
Min. turning radius (with brake)		2.3 m (7.5 ft.)				
Traction system		Fixed drawbar or swing drawbar (if equipped)				
Weight (with ROPS)		1205 kg (2655 lbs.)		1235 kg (2720 lbs.)		
Traveling speed	Forward	1st	1.6 km/h (1.0 mph)		1.6 km/h (1.0 mph)	
		2nd	2.2 km/h (1.4 mph)		2.2 km/h (1.4 mph)	
		3rd	3.4 km/h (2.1 mph)		3.5 km/h (2.2 mph)	
		4th	4.9 km/h (3.0 mph)		5.0 km/h (3.1 mph)	
		5th	6.9 km/h (4.3 mph)		7.7 km/h (4.8 mph)	
		6th	9.6 km/h (6.0 mph)		10.7 km/h (6.6 mph)	
		7th	15.0 km/h (9.3 mph)		16.7 km/h (10.4 mph)	
		8th	21.4 km/h (13.3 mph)		23.8 km/h (14.8 mph)	
	Reverse	1st	1.4 km/h (0.9 mph)		1.3 km/h (0.8 mph)	
		2nd	2.0 km/h (1.2 mph)		1.8 km/h (1.1 mph)	
		3rd	3.1 km/h (1.9 mph)		2.9 km/h (1.8 mph)	
		4th	4.4 km/h (2.7 mph)		4.1 km/h (2.5 mph)	
		5th	6.2 km/h (3.9 mph)		6.3 km/h (3.9 mph)	
		6th	8.6 km/h (5.3 mph)		8.7 km/h (5.4 mph)	
		7th	13.4 km/h (8.3 mph)		13.7 km/h (8.5 mph)	
8th	19.1 km/h (11.9 mph)		19.5 km/h (12.1 mph)			

L3450GST	L3650GST
345 mm (13.6 in.)	360 mm (14.2 in.)
1120 mm (44.1 in.)	1170 mm (46.1 in.)
1050 mm (41.3 in.), 1150 mm (45.3 in.), 1240 mm (48.8 in.) 1335 mm (52.6 in.), 1420 mm (55.9 in.), 1515 mm (59.6 in.)	1155 mm (45.5 in.), 1225 mm (48.2 in.), 1325 mm (52.2 in.) 1350 mm (53.1 in.), 1450 mm (57.1 in.)
7 - 16	8-16
12.4 - 24	13.6 - 26
Dry type single stage with single plate	
Full hydrostatic power steering	
Glide shift transmission, 8 forward and 8 reverse speeds	
Wet disc type	
Connected with the traveling brake	
Bevel gear	
Position and draft control (if equipped)	
Main pump 28.4 ℓ/min (7.5 GPM) Power steering pump 14.7 ℓ/min (3.9 GPM)	Main pump 29.5 ℓ/min (7.8 GPM) Power steering pump 15.3 ℓ/min (4.0 GPM)
Category 1	
930 kg (2050 lbs)	
SAE 1-3/8, 6-splines	
2 speeds 9 r/s (540 rpm) / engine 40.5 r/s (2430 rpm) 16.7 r/s (1000 rpm)/engine 40.6 r/s (2438 rpm)	1 speed 9 r/s (540 rpm) / engine 40.5 r/s (2430 rpm)
USA No.5 (KUBOTA 10 tooth) Involute spline	—
2 speeds 18 r/s (1080 rpm) / engine 40.5 r/s (2430 rpm) 33.3 r/s (2000 rpm)/engine 40.6 r/s (2438 rpm)	—
2.4 m (7.9 ft)	
Fixed drawbar or swing drawbar (if equipped)	
1315 kg (2900 lbs)	1345 kg (2965 lbs)
1.4 km/h (0.8 mph)	1.6 km/h (1.0 mph)
1.9 km/h (1.2 mph)	2.2 km/h (1.4 mph)
3.0 km/h (1.8 mph)	3.4 km/h (2.1 mph)
4.2 km/h (2.6 mph)	4.9 km/h (3.0 mph)
6.5 km/h (4.0 mph)	7.5 km/h (4.7 mph)
9.0 km/h (5.6 mph)	10.4 km/h (6.5 mph)
14.2 km/h (8.8 mph)	16.4 km/h (10.2 mph)
20.2 km/h (12.6 mph)	23.4 km/h (14.5 mph)
1.1 km/h (0.7 mph)	1.3 km/h (0.8 mph)
1.5 km/h (1.0 mph)	1.8 km/h (1.1 mph)
2.4 km/h (1.5 mph)	2.8 km/h (1.7 mph)
3.5 km/h (2.1 mph)	4.0 km/h (2.5 mph)
5.3 km/h (3.3 mph)	6.1 km/h (3.8 mph)
7.4 km/h (4.6 mph)	8.5 km/h (5.3 mph)
11.6 km/h (7.2 mph)	13.4 km/h (8.3 mph)
16.6 km/h (10.3 mph)	19.1 km/h (11.9 mph)

DIMENSIONS

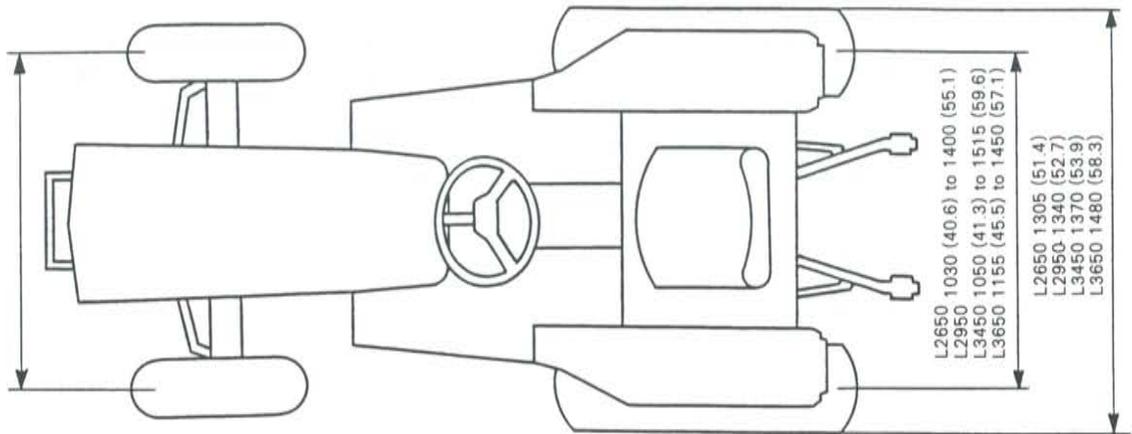


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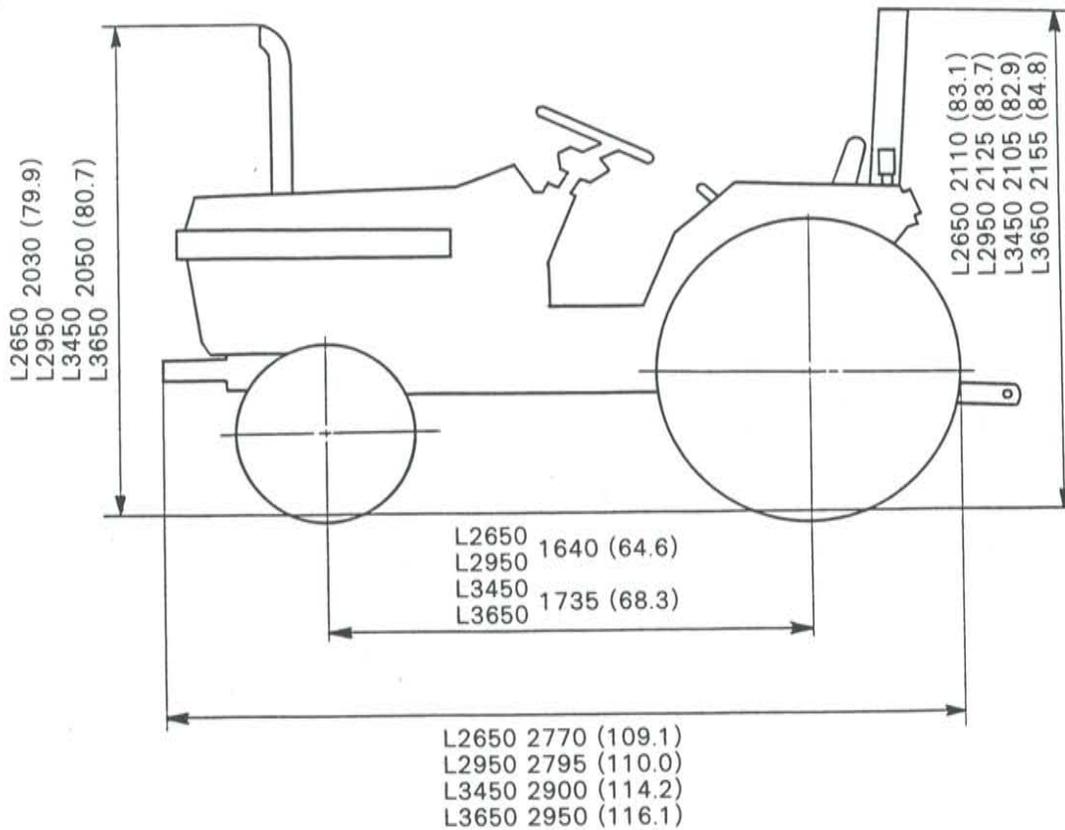
[L2650,L2950,L3450,L3650]

Unit : mm (in.)

L2650 2WD, L2950 2WD 960 (37.8) to 1260(49.6)
 L2650 4WD, L2950 4WD 1120 (44.1)
 L3450 2WD, L3650 2WD 1150 (45.3) to 1450 (57.1)
 L3450 4WD 1120 (44.1)
 L3650 4WD 1170 (46.1)



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M MECHANISM

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1 ENGINE

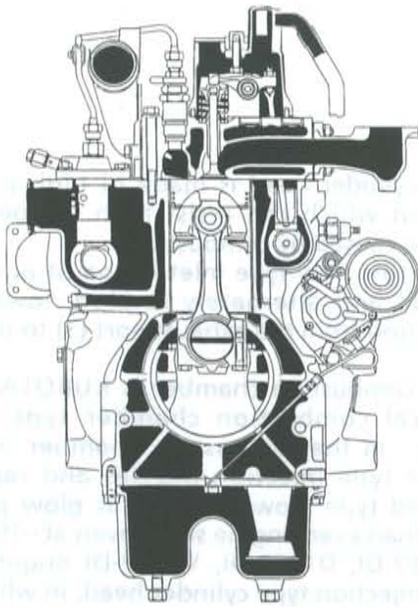
[1] FEATURES

The engines for KUBOTA "L series" tractors are water-cooled, 4-cycle diesel engines. They are designed and built by KUBOTA.

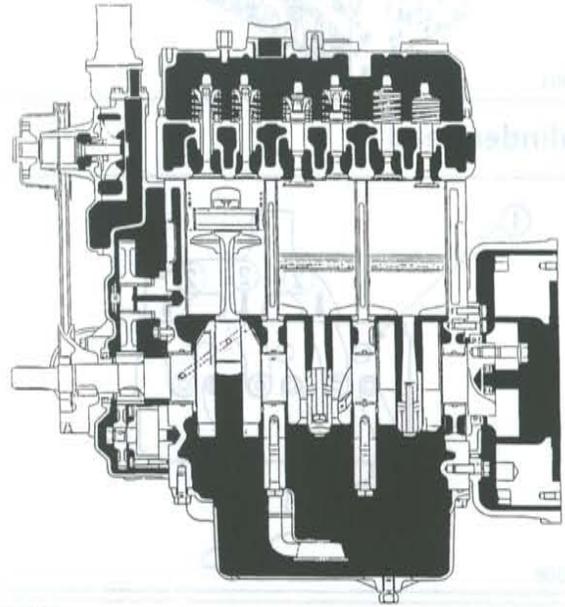
D1102 engine is a hemispherical combustion chamber KUBOTA designed, and the other models (D1402-DI, D1462-DI, V1902-DI) are direct injection types.

These engines are balance-matched to the "L series" tractors with greater power, low fuel consumption, reduced vibration and greater durability.

[D1102]

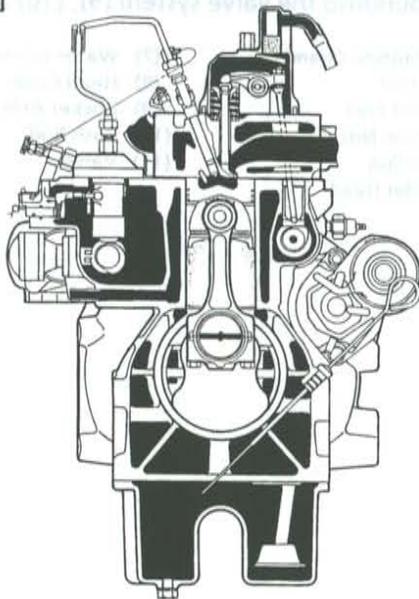


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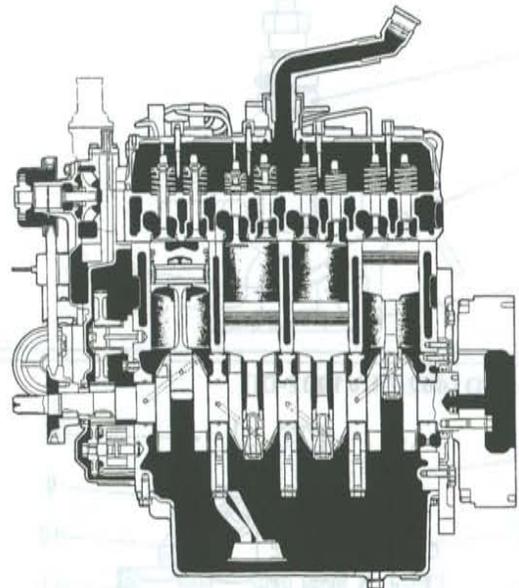


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[V1902-DI]

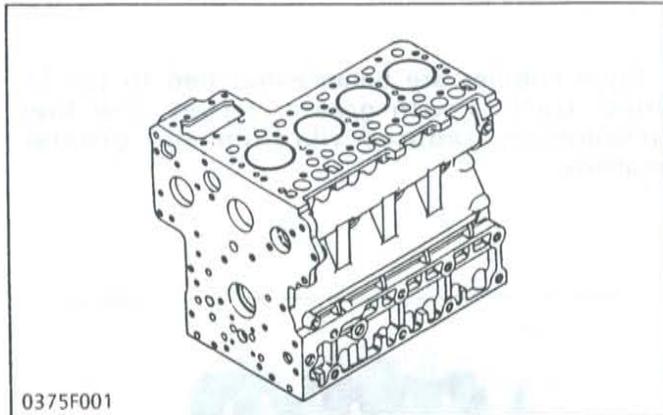


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[2] ENGINE BODY

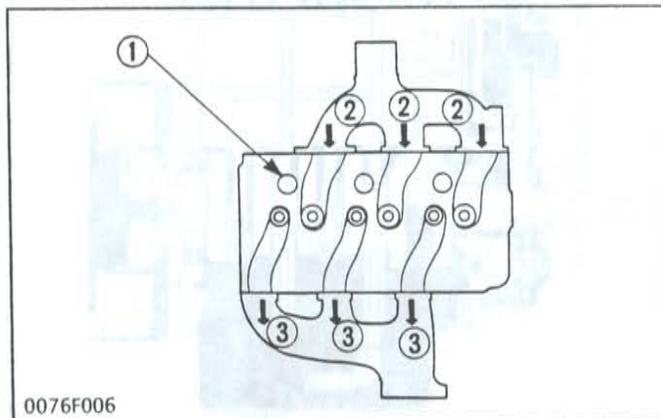
(1) Cylinder Block



The engine features a highly durable tunnel type cylinder block containing the main bearings.

Furthermore, cylinder liners allow effective cooling, less distortion, higher wear-resistance qualities, and each cylinder has its own chamber helps to minimize noise.

(2) Cylinder Head



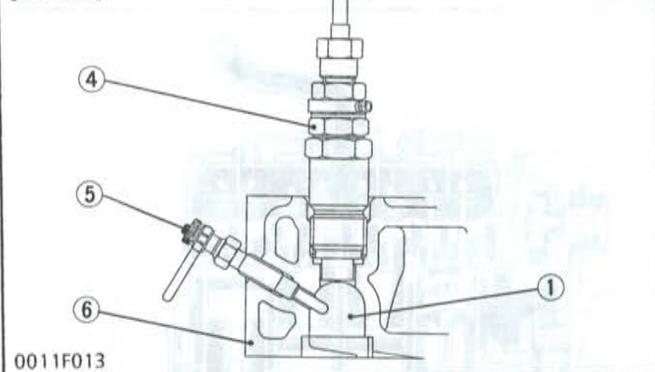
The cylinder head is made of high performance cast iron which can resist high temperature and pressure caused by combustion.

The cross-flow type inlet / exhaust port which are opposite and alternately located, lower the heat conduction from the exhaust port (3) to the inlet port (2).

The combustion chamber is KUBOTA'S exclusive spherical combustion chamber type for D1102 engine. In the combustion chamber are installed throttle type injection nozzles and rapid heating sheathed type glow plugs. This glow plug assures easier than even engine starts even at -15°C (5°F).

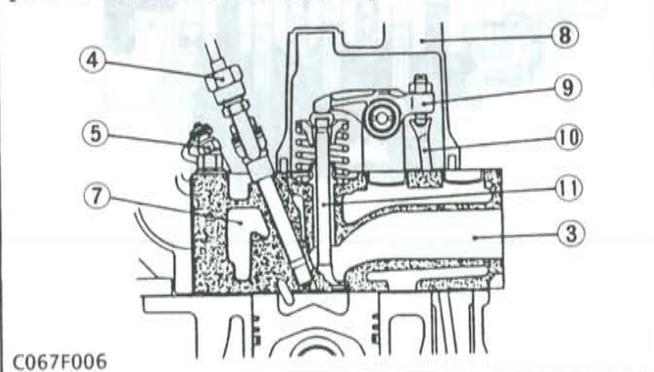
D1402-DI, D1462-DI, V1902-DI engines installed direct injection type cylinder head, in which injection nozzles (4) and glow plugs (5) are installed, has the inlet ports, gas exhaust ports (3) and water jacket (7) surrounding the valve system (9), (10) and (11).

[D1102]

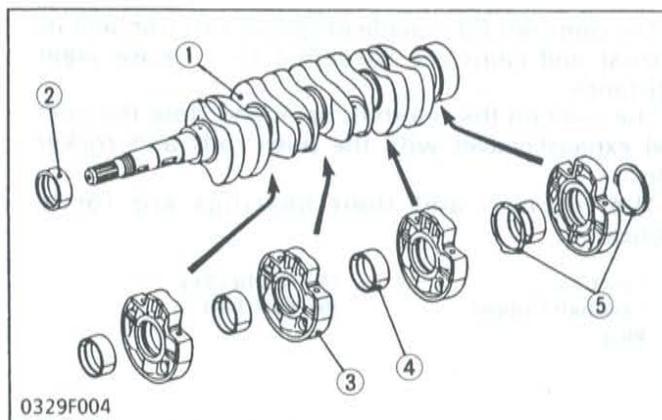


- | | |
|------------------------|------------------|
| (1) Combustion Chamber | (7) Water Jacket |
| (2) Inlet Port | (8) Head Cover |
| (3) Exhaust Port | (9) Rocker Arm |
| (4) Injection Nozzle | (10) Push Rod |
| (5) Glow Plug | (11) Valve |
| (6) Cylinder Head | |

[D1402-DI, D1462-DI, V1902-DI]

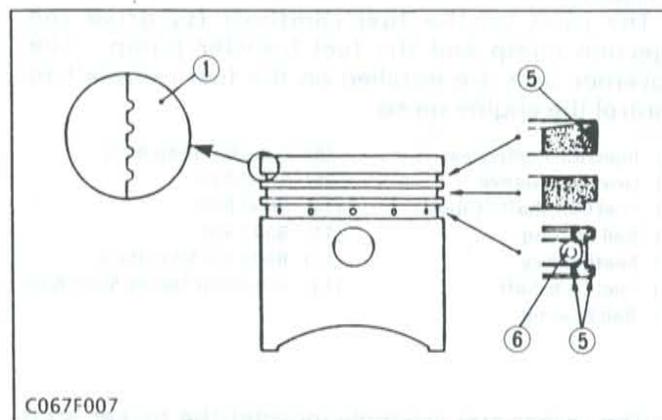


(3) Crankshaft



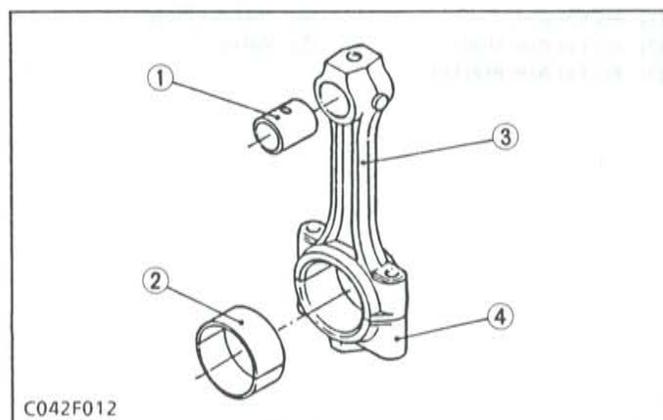
- (1) Crankshaft
 (2) Crankshaft Bearing 1
 (3) Main Bearing Case
 (4) Crankshaft Bearing 2
 (5) Thrust Bearing

(4) Piston and Piston Rings



- (1) Piston Top Land
 (2) Top Ring
 (3) Second Ring
 (4) Oil Ring
 (5) Chrome Plating
 (6) Coil Expander Ring

(5) Connecting Rod



The crankshaft (1) is forged from chrome molybdenum steel, and the journal and pin are induction hardened to provide strength and improve wear resistance. The crankshaft is used to change the reciprocating motion of the piston into the rotational motion and also drives the oil pump, cam shaft, and fuel cam shaft. The counterweight balances the force to reduce vibrations and stress on the bearings.

The journal section of the crankshaft is supported on the sleeve bearing inserted inside the crank case and the four sets of main bearing cases (3) and the bearing metal (4). On both sides of the bearings on the flywheel side are inserted the side metals (5). Oil holes are provided on the crankshaft, bearing section and journal section to flow lubricating oil.

The piston is made of an aluminum alloy which is temperature and pressure resistant.

The head of the piston is flat for indirect injection type (D1102) and direct injection (D1402-DI, D1462-DI, V1902-DI) type has pistons with a cutout swirl cup cavity at their head. Furthermore, ribs (1) are provided between the piston head and top ring (2) to reduce distortion and to help heat radiation.

The piston has three piston rings. The top (2) and the second (3) rings are the compression rings, and the bottom ring (4) is the oil ring.

The top ring (2) is a keystone type, which can withstand heavy loads, and the barrel face on the ring fits well to the cylinder wall.

The second ring (3) is an undercut type, which prevents the oil from being carried up.

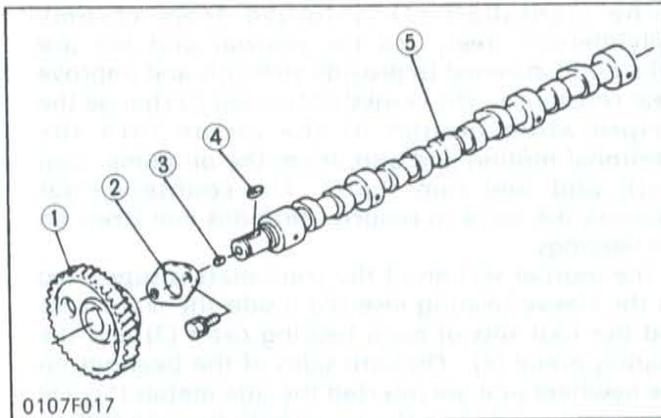
The oil ring (4) has chamfered contact faces and an expander ring (6), which increase the pressure of the oil ring against the cylinder wall to scrape the oil.

The top ring (2) and the oil ring (4) are plated with hard chrome to increase wear resistance.

The connecting rod (3), which converts the reciprocating motion of the pistons caused by the fuel combustion into the rotating motion of the crankshaft, is made of hard forged steel.

The connecting rod has bearings at both ends. The small end has a solid type bearing - small end bushing (1), and the big end has a split type bearing - crankpin bearing (2).

- (1) Small End Bushing
 (2) Crankpin Bearing
 (3) Connecting Rod
 (4) Connecting Rod Cap

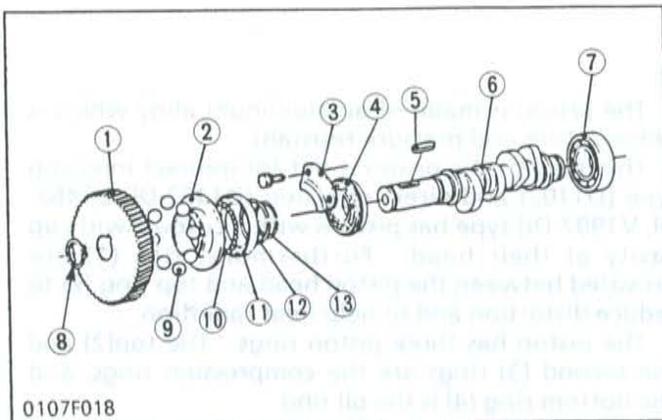
(6) Camshaft

The camshaft (5) is made of special cast iron and its journal and cams are hardened to increase wear resistance.

The cams on the camshaft open and close the inlet and exhaust valves with the push rods and rocker arms.

The journals and their bearings are force-lubricated.

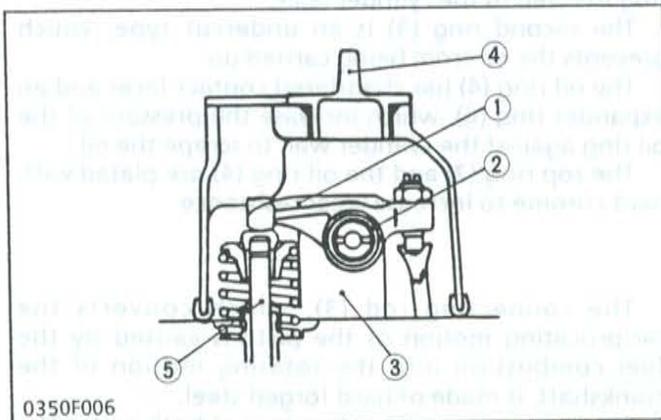
- | | |
|----------------------|-----------------|
| (1) Cam Gear | (4) Feather Key |
| (2) Camshaft Stopper | (5) Camshaft |
| (3) Plug | |

(7) Fuel Camshaft

The fuel camshaft is made of carbon steel and its cams are hardened and tempered to increase wear resistance.

The cams on the fuel camshaft (6) drive the injection pump and the fuel transfer pump. The governor balls are installed on the fuel camshaft to control the engine speed.

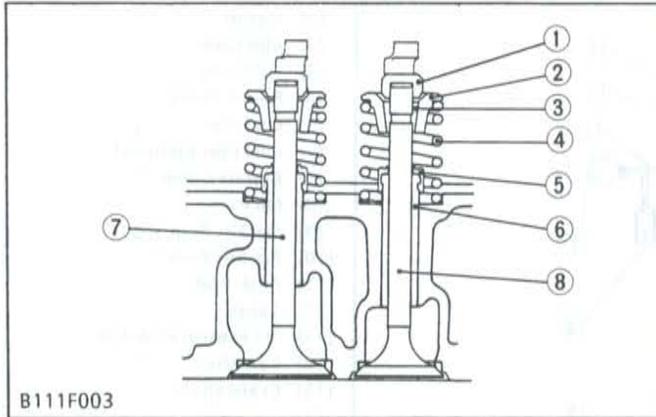
- | | |
|---------------------------|--------------------------------|
| (1) Injection Pump Gear | (8) External Snap Ring |
| (2) Governor Sleeve | (9) Steel Ball |
| (3) Fuel Camshaft Stopper | (10) Steel Ball |
| (4) Ball Bearing | (11) Ball Case |
| (5) Feather Key | (12) Ball Case Snap Ring |
| (6) Fuel Camshaft | (13) Governor Sleeve Snap Ring |
| (7) Ball Bearing | |

(8) Rocker Arm

The rocker arm assembly includes the rocker arms (1), rocker arm brackets (3) and rocker arm shaft (2) and converts the reciprocating motion of the push rods to an open / close movement of the inlet and exhaust valves. Valve control timing must be adjusted with screws on the rocker arms. Lubrication oil is pressure fed through the bracket to the rocker arm shaft so that the rocker arm bearings and the entire system are lubricated sufficiently.

- | | |
|------------------------|--------------------|
| (1) Rocker Arm | (4) Oil Filer Plug |
| (2) Rocker Arm Shaft | (5) Valve |
| (3) Rocker Arm Bracket | |

(9) Inlet and Exhaust Valves

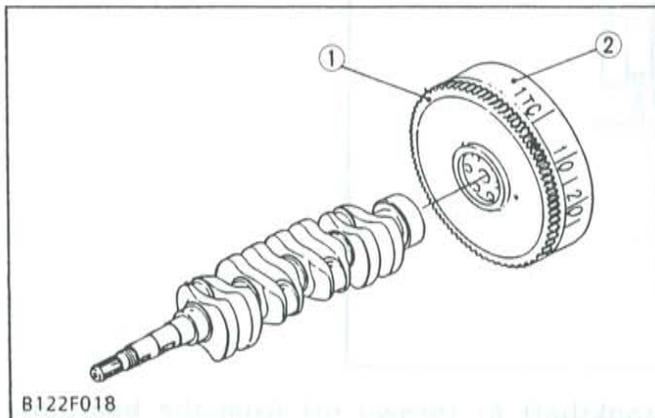


B111F003

The inlet and exhaust valves (7), (8) and their guides (6) are different from each other. Other parts, such as valve springs (4), valve spring retainers (2), valve spring collets (3), valve stem seals (5), and valve caps (1) are the same for both the inlet and exhaust valves. All contact or sliding parts are quenched and tempered to resist wear.

- | | |
|---------------------------|---------------------|
| (1) Valve Cap | (5) Valve Stem Seal |
| (2) Valve Spring Retainer | (6) Valve Guide |
| (3) Valve Spring Collets | (7) Inlet Valve |
| (4) Valve Spring | (8) Exhaust Valve |

(10) Flywheel



B122F018

The flywheel is installed on the rear end of the crankshaft. Its inertia keeps the flywheel turning at a constant speed, while the crankshaft tends to speed up during the power stroke and to slow down during other strokes.

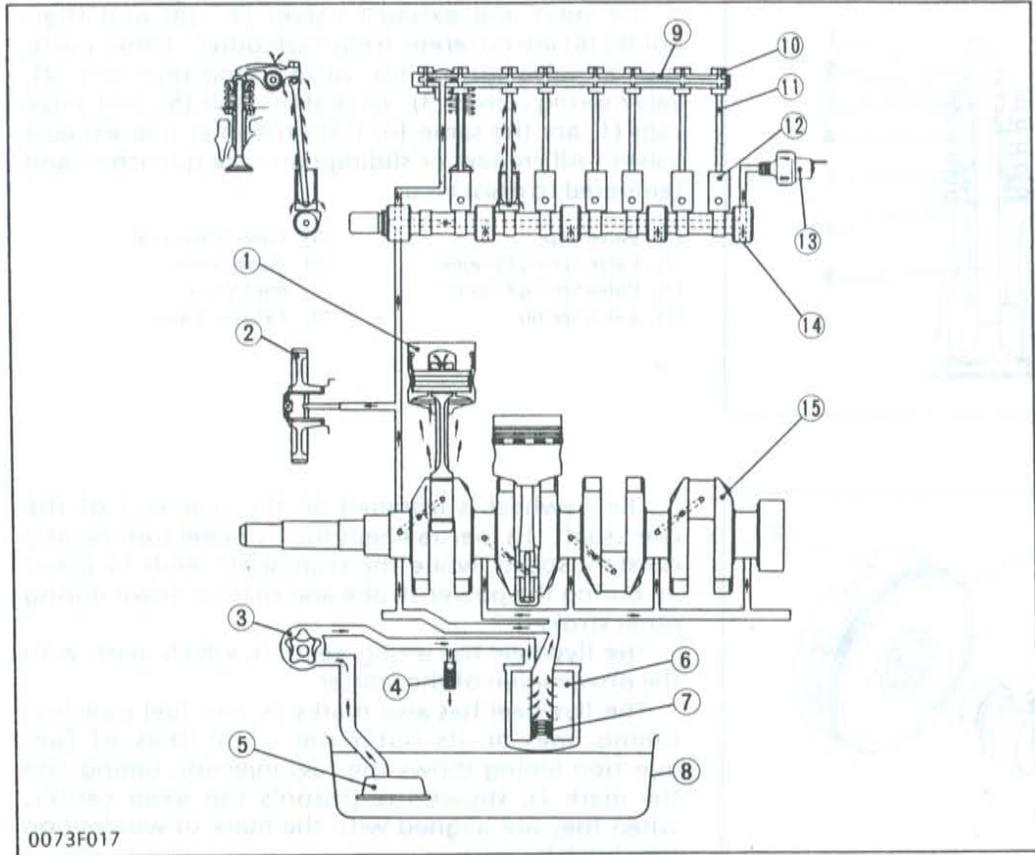
The flywheel has a ring gear (1), which mesh with the drive pinion of the starter.

The flywheel has also marks TC and fuel injection timing lines on its outer rim. The lines of fuel injection timing shows the fuel injection timing and the mark TC shows the piston's top dead center, when they are aligned with the mark of window on the clutch housing.

- | | |
|---------------|--------------|
| (1) Ring Gear | (2) Flywheel |
|---------------|--------------|



[3] LUBRICATING SYSTEM



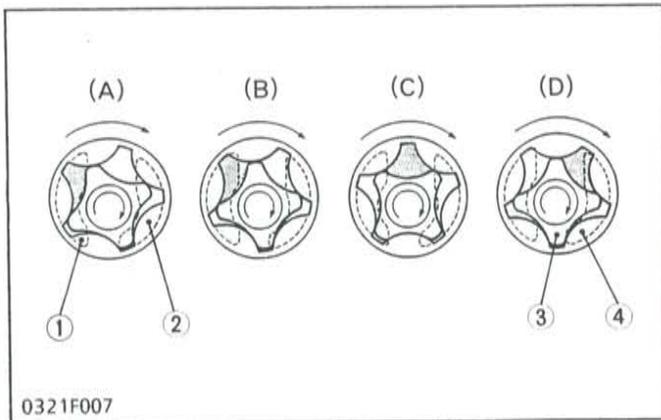
- (1) Piston
- (2) Idle Gear
- (3) Oil Pump
- (4) Relief Valve
- (5) Oil Filter
- (6) Oil Filter Element
- (7) Bypass Valve
- (8) Oil Pan
- (9) Rocker Arm Shaft
- (10) Rocker Arm
- (11) Push Rod
- (12) Tappet
- (13) Oil Pressure Switch
- (14) Camshaft
- (15) Crankshaft

0073F017

The lubricating oil is forced to each journal through the oil passages of the cylinder block, cylinder head and shafts. The oil, splashed by the

crankshaft or thrown off from the bearings, lubricates other engine parts such as the push rods (11), tappets (12), piston pins and timing gears.

(1) Oil Pump



0321F007

- (1) Inlet
- (2) Outlet
- (3) Inner Rotor
- (4) Outer Rotor

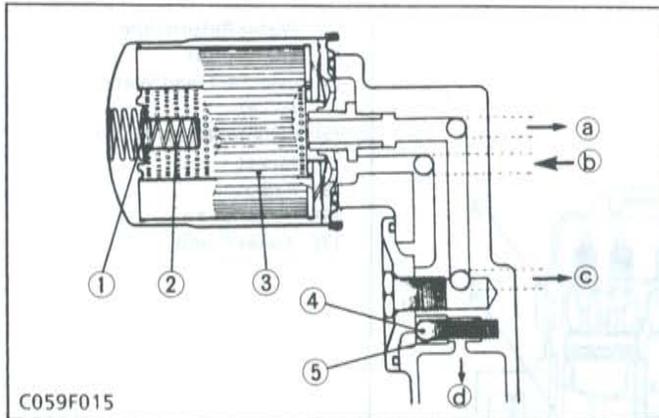
The oil pump is a gear pump, whose rotors have trochoid lobes. The inner rotor (3) has 4 lobes and the outer rotor (4) has 5 lobes, and they are eccentrically engaged with each other. The inner rotor, which is driven by the crankshaft through the gears, rotates the outer rotor in the same direction, varying the space between the lobes.

While the rotors rotate from (A) to (B), the space leading to the inlet port increases, which causes the oil to flow through the inlet port.

When the rotors rotate to (C), the port to which the space leads is changed from inlet to outlet.

At (D), the space decreases and sucked oil is discharged from the outlet port.

(2) Oil Filter and Relief Valve



C059F015

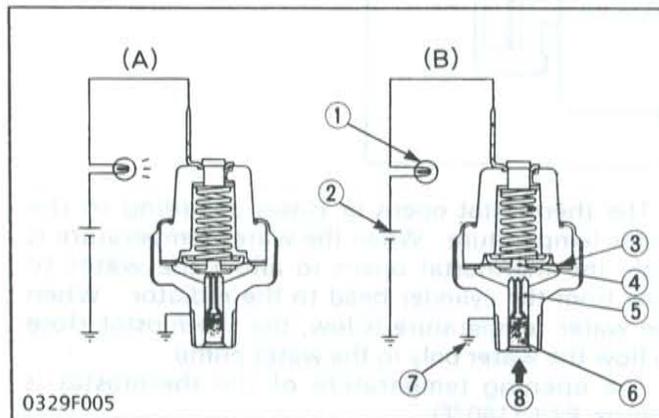
- | | |
|-----------------------------|-----------------------------|
| (1) Bypass Valve | (4) Relief Valve Ball |
| (2) Bypass Adjusting Spring | (5) Relief Adjusting Spring |
| (3) Filter Element | |

The lubricating oil force-fed by the pump is filtered by the filter cartridge, passing through the filter element from the outside to the inside. When the filter element accumulates dirt and the pressure difference between the inside and outside rises more than 98 kPa (1.0 kgf/cm², 14 psi), the bypass valve (1) opens to allow the oil to flow from the inlet line to outlet line, bypassing the filter element.

The relief valve (4) in the inlet line allows oil to prevent damage to the lubricating system, when the oil pressure rises more than 441 kPa (4.5 kgf/cm², 64 psi).

- | |
|---|
| (a) To Idle Gear, Camshaft and Rocker Arm |
| (b) From Oil Pump |
| (c) To Crankshaft Journal and Crankpin |
| (d) Drain of Relief Valve |

(3) Oil Pressure Switch



O329F005

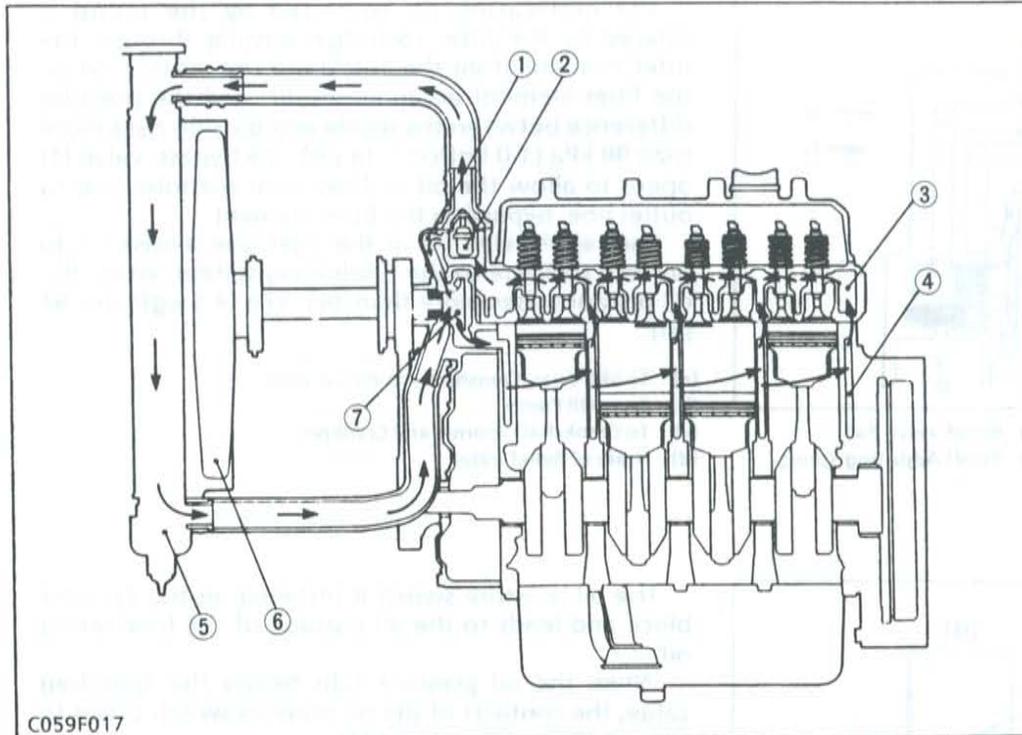
- | | |
|-------------------|--------------------|
| (1) Warning Lamp | (5) Contact |
| (2) Battery | (6) Oil Passage |
| (3) Rubber Gasket | (7) Cylinder Block |
| (4) Contact Rivet | (8) Oil |

The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil.

When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp (1).

- | |
|--|
| (A) At Lower Oil Pressure
(49 kPa, 0.5 kgf/cm ² , 7 psi or less) |
| (B) At Proper Oil Pressure |

[4] COOLING SYSTEM



- (1) Water Return Pipe
- (2) Thermostat
- (3) Cylinder Head Water Jacket
- (4) Cylinder Block Water Jacket
- (5) Radiator
- (6) Cooling Fan
- (7) Water Pump

C059F017

The cooling system consists of a radiator (5), a centrifugal water pump (7), a fan (6) and a thermostat (2).

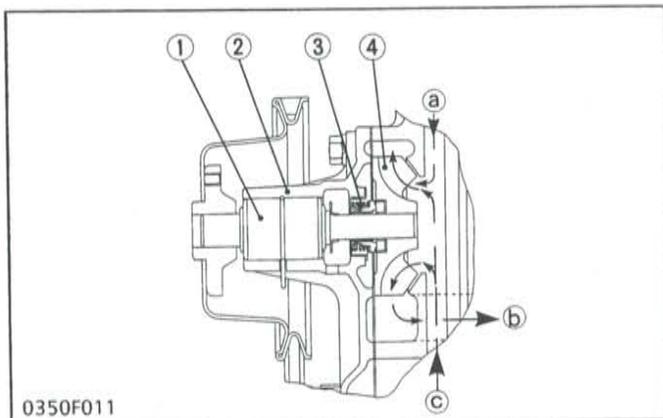
The water is cooled as it flows through the radiator core, and the cooling air through the radiator core by fan.

The water pump receives water from the radiator or from the cylinder head and force it into the cylinder block.

The thermostat opens or closes according to the water temperature. When the water temperature is high, the thermostat opens to allow the water to flow from the cylinder head to the radiator. When the water temperature is low, the thermostat close to flow the water only to the water pump.

The opening temperature of the thermostat is approx. 82°C (180 °F).

(1) Water Pump



0350F011

The water pump is driven with the fan drive pulley, which is on the water pump shaft and driven by the crankshaft with a belt.

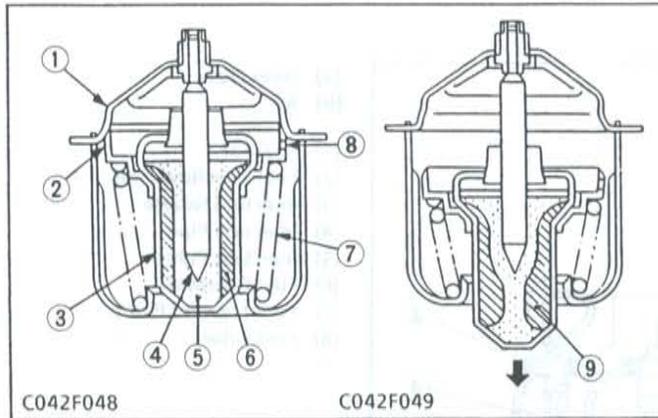
The rotating impeller (4) in the water pump receives cool water from the bottom of the radiator and the water jacket of cylinder head, and sends it into the water jacket in the cylinder block.

The mechanical seal (3) prevents the water from entering the bearing (1).

- (a) From Thermostat
- (b) To Cylinder Block
- (c) From Radiator

- (1) Bearing
- (2) Pump Body
- (3) Mechanical Seal
- (4) Pump Impeller

(2) Thermostat



- | | |
|----------------------|------------------|
| (1) Seat | (6) Wax (solid) |
| (2) Valve | (7) Spring |
| (3) Pellet | (8) Leak Hole |
| (4) Spindle | (9) Wax (liquid) |
| (5) Synthetic Rubber | |

The thermostat is wax pellet type, which controls the flow of the cooling water to the radiator to keep the proper temperature.

The case has a seat (1) and the pellet (3) has a valve (2). The spindle (4) attached to the case is inserted into the synthetic rubber (5) in the pellet. The pellet is charged with wax (6).

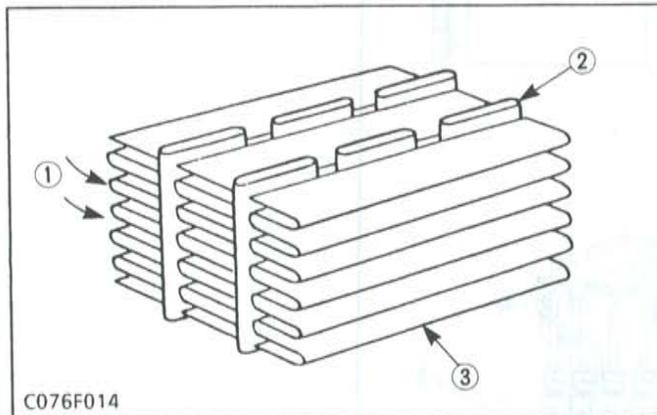
(A) At low temperature (lower than 82°C, 180°F)

The valve (2) is seated by the spring (7) and the cooling water circulates in the engine through the water return pipe but does not enter the radiator.

(B) At high temperature (higher than 82°C, 180°F)

As the water temperature rises, the wax in the pellet (3) turns liquid and expands, repelling the spindle (4). The pellet lowers and the valve (2) opens to send the cooling water to the radiator.

(3) Radiator



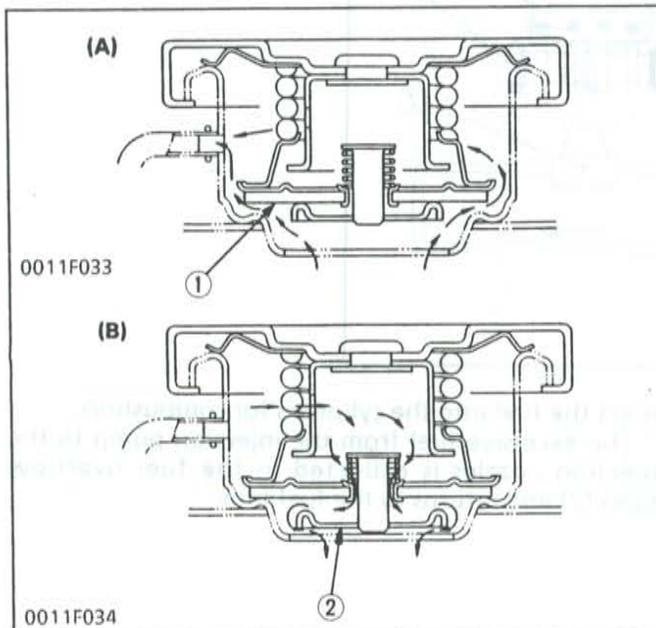
The radiator core consists of water carrying tubes (2) with fins (3) at a right angle to it.

The water in the radiator is cooled by the air flowing through between the tube wall and the fin.

The louverless corrugated fins are light in weight, high in heat exchange ratio and less in clogging by the dust.

- | | |
|-----------------|---------|
| (1) Cooling Air | (3) Fin |
| (2) Tube | |

(4) Radiator Cap



The pressure type cap is installed on the radiator, which prevents the pressure difference between the inside and the outside of the radiator from deforming the radiator.

(A) At high pressure

(higher than 88 kPa, 0.9 kgf/cm², 13 psi)

When the water temperature rises and the pressure in the radiator increase above the specified pressure, the pressure valve (1) opens to reduce the internal pressure.

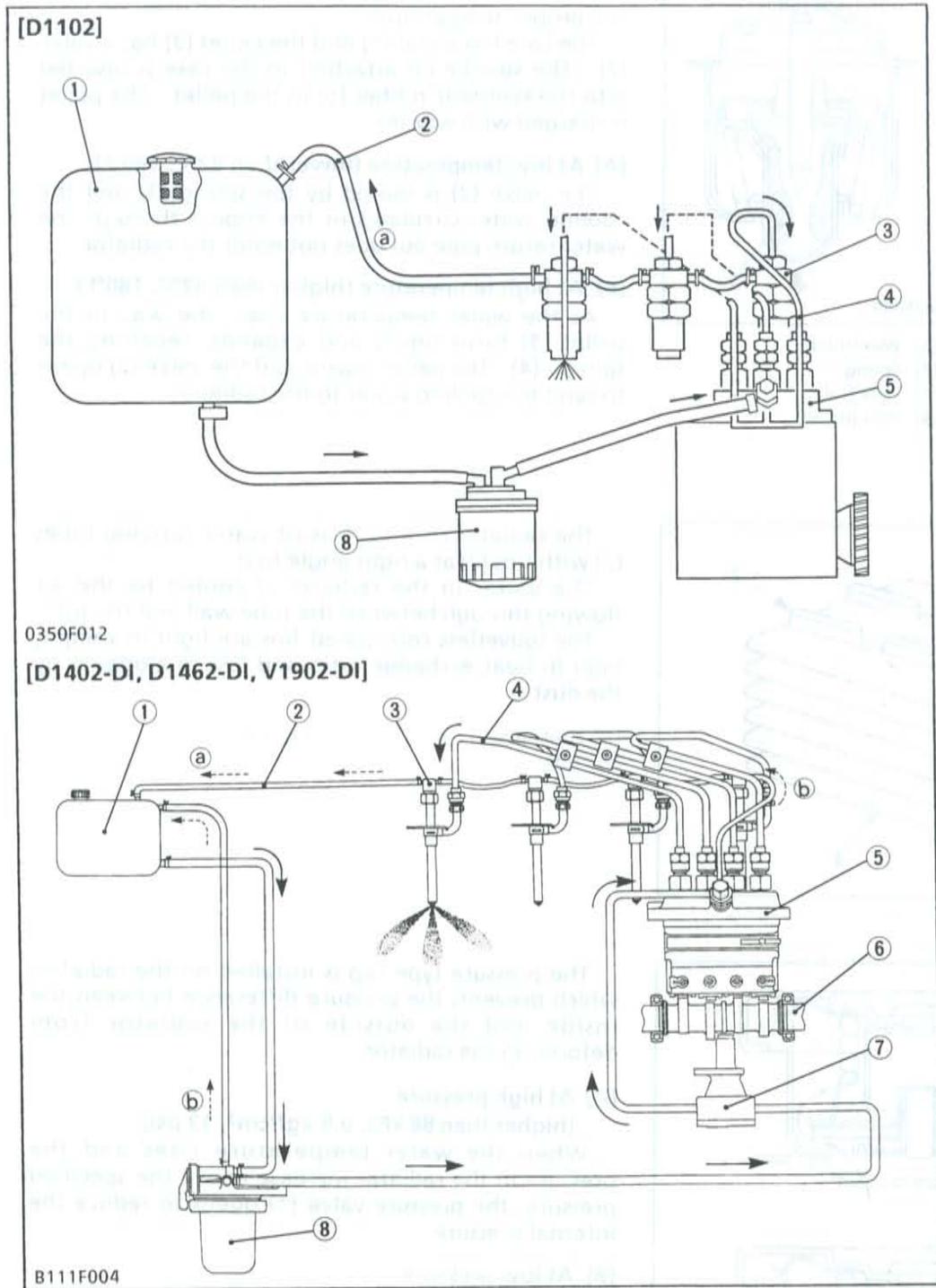
(B) At low pressure

When the water temperature falls and a vacuum is formed in the radiator, the vacuum valve (2) opens to allow the air to enter the radiator.

- | |
|--------------------|
| (1) Pressure Valve |
| (2) Vacuum Valve |

[5] FUEL SYSTEM

(1) Fuel Lines



- (a) Over Flow
- (b) Air
- (1) Fuel Tank
- (2) Fuel Overflow Pipe
- (3) Injection Nozzle
- (4) Injection Pipe
- (5) Injection Pump
- (6) Fuel Camshaft
- (7) Fuel Transfer Pump
- (8) Fuel Filter

0350F012

[D1402-DI, D1462-DI, V1902-DI]

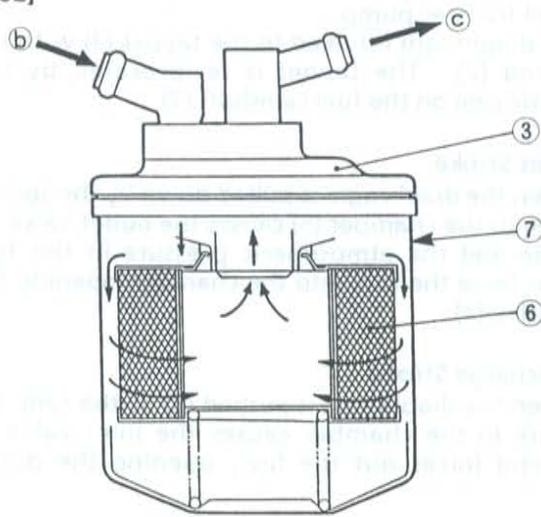
B111F004

The fuel is fed from the tank (1) through the fuel filter (8) to the injection pump (5) by the fuel transfer pump (7) (except L2350). The injection pump force-feeds the fuel through the injection nozzles (3), which

inject the fuel into the cylinders for combustion. The excessive fuel from the injection pump to the injection nozzles is collected in the fuel overflow pipes (2) and returns to the fuel tank.

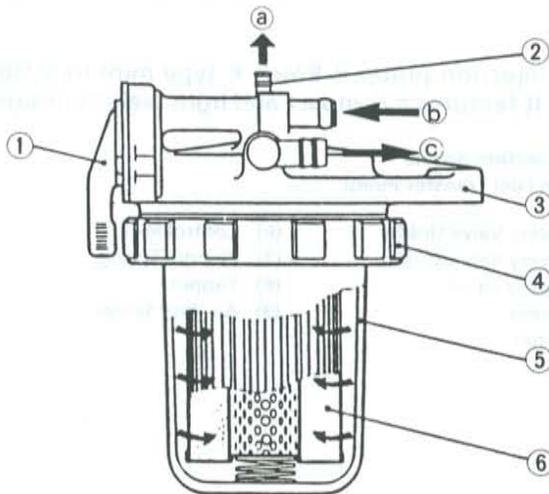
(2) Fuel Filter

[D1102]



0350F013

[D1402-DI, D1462-DI, V1902-DI]



C067F010

The fuel filter removes dirt and water with its fine filter paper, which collects particles of 15 microns (0.00059 in.) at 20 kPa (0.2 kgf/cm², 3 psi).

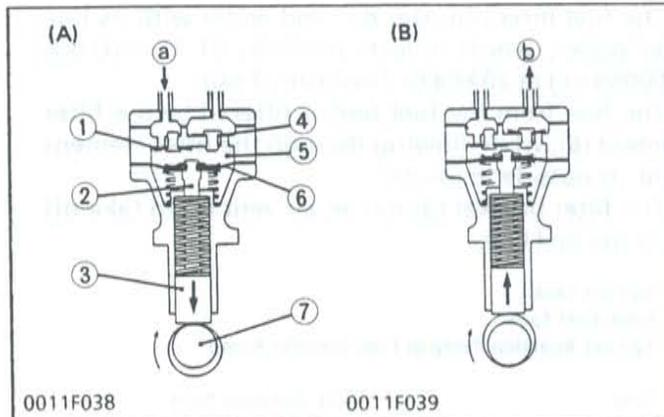
The fuel from the fuel tank is filtered by the filter element (6), while flowing through the filter element from its outside to inside.

The filter bracket (3) has an air vent (2) to take off air in the fuel line.

- (a) To Fuel Tank
- (b) From Fuel Tank
- (c) To Fuel Injection Pump or Fuel Transfer Pump

- (1) Cock
- (2) Air Vent
- (3) Filter Body
- (4) Retainer Ring
- (5) Pot
- (6) Filter Element

(3) Fuel Transfer Pump (for D1402-DI, D1462-DI and V1902-DI)



- | | |
|------------------|-------------------|
| (1) Inlet Valve | (5) Chamber |
| (2) Push Rod | (6) Diaphragm |
| (3) Tappet | (7) Fuel Camshaft |
| (4) Outlet Valve | |

The filtered fuel is fed to the injection pump by the fuel transfer pump.
 The diaphragm is linked to the tappet (3) with the push rod (2). The tappet is reciprocated by the eccentric cam on the fuel camshaft (7).

(A) Inlet Stroke

When the diaphragm is pulled down by the spring, vacuum in the chamber (5) causes the outlet valve (4) to close and the atmospheric pressure in the fuel tank to force the fuel into the chamber, opening the inlet valve (1).

(B) Discharge Stroke

When the diaphragm is pushed up by the cam, the pressure in the chamber causes the inlet valve to close and forces out the fuel, opening the outlet valve.

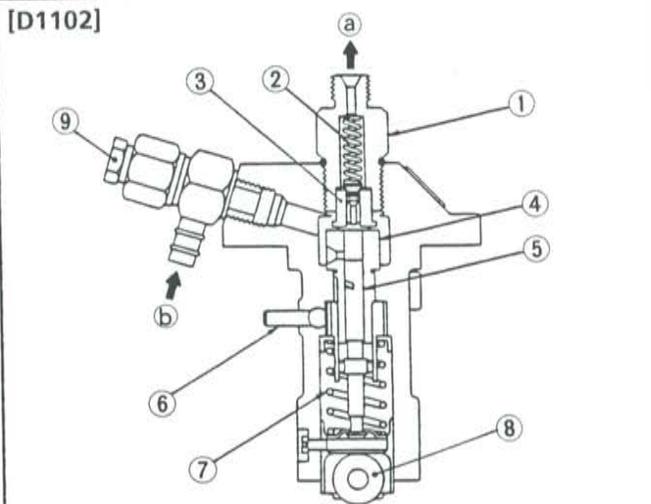
- (a) From Fuel Filter
- (b) To Injection Pump

(4) Fuel Injection Pump

The injection pump is Bosch K type mini injection pump. It features a compact and light weight design.

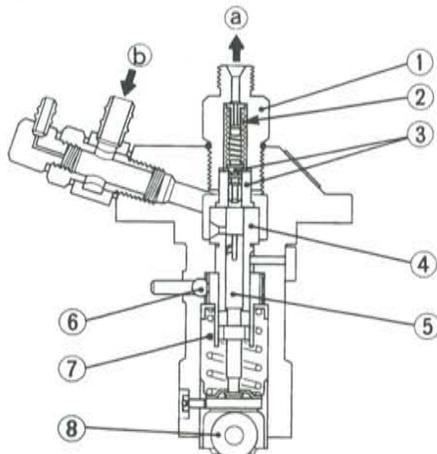
- (a) To Injection Nozzle
- (b) From Fuel Transfer Pump

- | | |
|---------------------------|--------------------|
| (1) Delivery Valve Holder | (6) Control Rack |
| (2) Delivery Valve Spring | (7) Plunger Spring |
| (3) Delivery Valve | (8) Tappet |
| (4) Cylinder | (9) Air Vent Screw |
| (5) Plunger | |

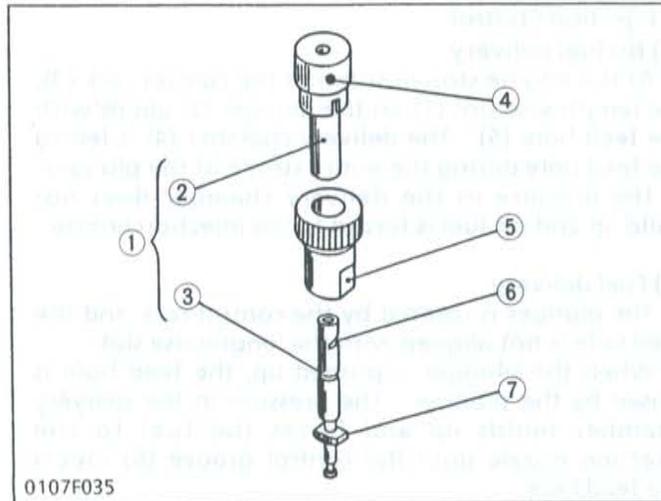


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[D1402-DI, D1462-DI, V1902-DI]



B111F005

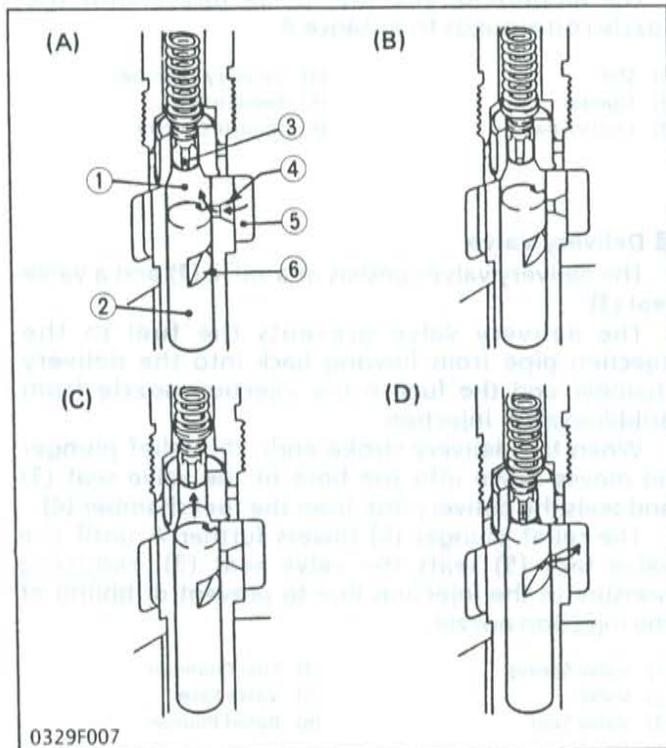


■ Pump Element

The pump element (1) consists of a plunger (3) and cylinder (2), their sliding surfaces are precision-machined to maintain fuel tightness.

The plunger (3) fits in the control sleeves (5) at the driving face (7). The sleeve is engaged with the control rack, which rotate the plunger in the cylinder to control the amount of fuel delivery.

- | | |
|------------------|---------------------|
| (1) Pump Element | (5) Control Sleeve |
| (2) Cylinder | (6) Control Groove |
| (3) Plunger | (7) Driving Surface |
| (4) Feed Hole | |



■ Fuel Pressure-feed

(A) Before delivery

As the taper lowers, the plunger (2) lowers and fuel is drawn into the delivery chamber (1) through the feed hole (4) from the fuel chamber (5).

(B) Beginning of delivery

When the plunger is pushed up by the cam and the head of the plunger closes the feed hole, the pressure in the delivery chamber rises to push the delivery valve (3) open.

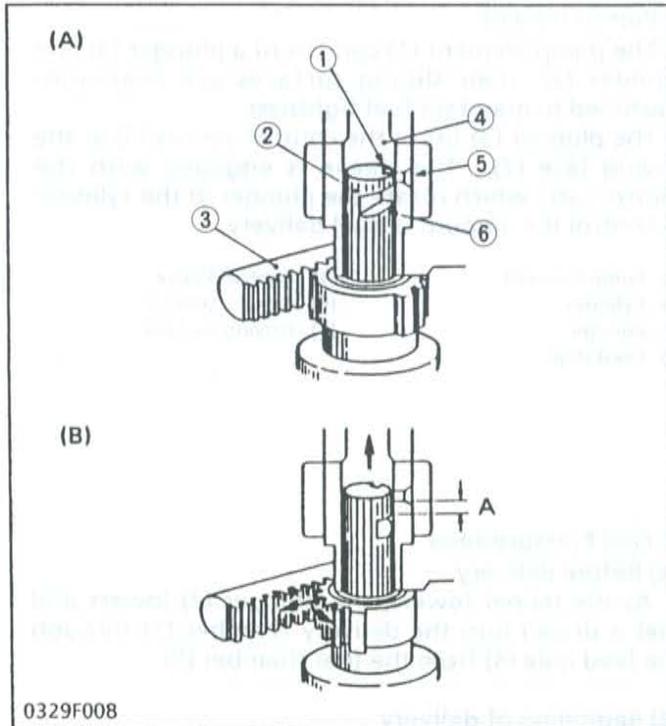
(C) Delivery

While the plunger is rising, delivery of fuel continues.

(D) End of delivery

When the plunger rises further and the control groove (6) on its periphery meets the feed hole, the fuel returns to the fuel chamber from the delivery chamber through the control groove and the feed hole.

- | | |
|----------------------|--------------------|
| (1) Delivery Chamber | (4) Feed Hole |
| (2) Plunger | (5) Fuel Chamber |
| (3) Delivery Valve | (6) Control Groove |



■ Injection Control

(A) No fuel delivery

At the engine stop position of the control rack (3), the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). The delivery chamber (4) is led to the feed hole during the entire stroke of the plunger.

The pressure in the delivery chamber does not build up and no fuel is forced to the injection nozzle.

(B) Fuel delivery

The plunger is rotated by the control rack and the feed hole is not aligned with the lengthwise slot.

When the plunger is pushed up, the feed hole is closed by the plunger. The pressure in the delivery chamber builds up and forces the fuel to the injection nozzle until the control groove (6) meets the feed hole.

The amount of the fuel to be forced into the nozzle corresponds to distance A.

- | | |
|------------------|----------------------|
| (1) Slot | (4) Delivery Chamber |
| (2) Plunger | (5) Feed Hole |
| (3) Control Rack | (6) Control Groove |

■ Delivery Valve

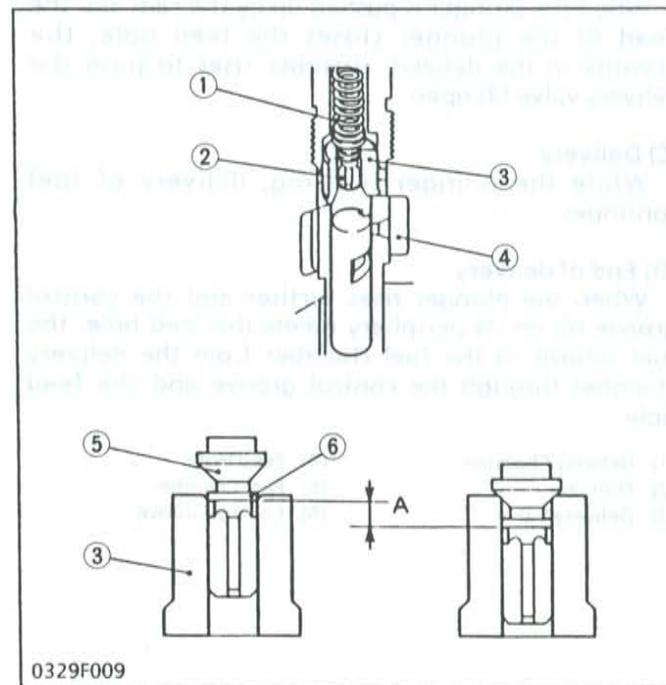
The delivery valve consists of a valve (2) and a valve seat (3).

The delivery valve prevents the fuel in the injection pipe from flowing back into the delivery chamber and the fuel in the injection nozzle from dribbling after injection.

When the delivery stroke ends, the relief plunger (6) moves down into the bore of the valve seat (3) and seals the delivery line from the fuel chamber (4).

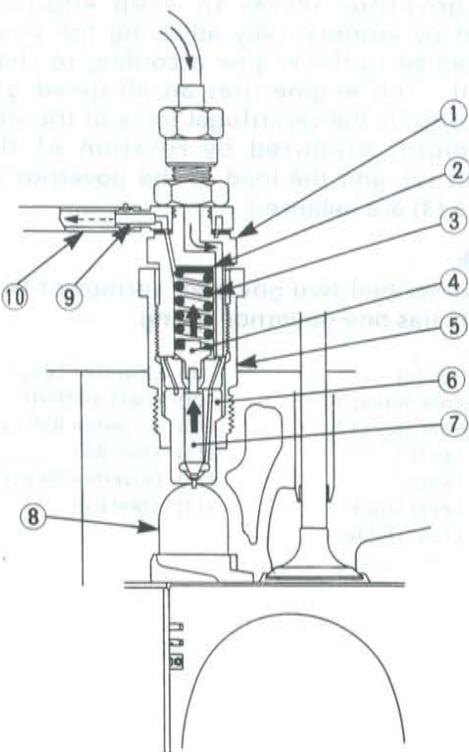
The relief plunger (6) lowers further A until the valve face (5) seats the valve seat (3), reducing pressure in the injection line to prevent dribbling at the injection nozzle.

- | | |
|------------------|--------------------|
| (1) Valve Spring | (4) Fuel Chamber |
| (2) Valve | (5) Valve Face |
| (3) Valve Seat | (6) Relief Plunger |



(5) Fuel Injection Nozzle

[D1102]

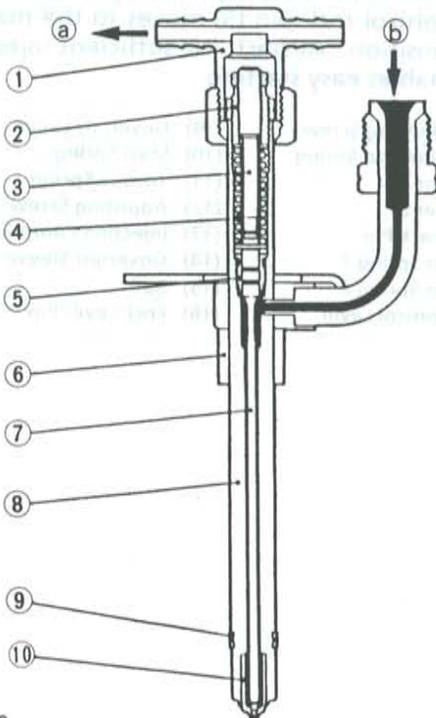


0011F046

This nozzle is throttle-type. Fuel fed from the pump is pressurized to push the needle valve (7) up and the fuel is then injected. The needle valve is pressed by the nozzle spring (3) through the push rod (4). Fuel overflow is passed from nozzle holder center through the fuel overflow nipple (9) and the fuel overflow pipe (10) to the fuel tank. The injection pressure is provided 13.7 to 14.7 MPa (140 to 150 kgf/cm², 1991 to 2133 psi). Injection pressure can be controlled by inserting shims between nozzle holder body (1) and adjusting washers (2). The pressure increases approx. 981 kPa (10 kgf/cm², 142 psi) when inserted a 0.1 mm (0.0039 in.) shim. Injection nozzle is also precision finished as is the injection pump, treat it carefully and protect from water and dust.

- (1) Nozzle Holder Body
- (2) Adjusting Washer
- (3) Nozzle Spring
- (4) Push Rod
- (5) Retaining Nut
- (6) Nozzle Body
- (7) Needle Valve
- (8) Combustion Chamber
- (9) Fuel Overflow Nipple
- (10) Fuel Overflow Pipe

[D1402-DI, D1462-DI, V1902-DI]



C059F030

The nozzle is a pencil type, which is suitable for the direct injection system.

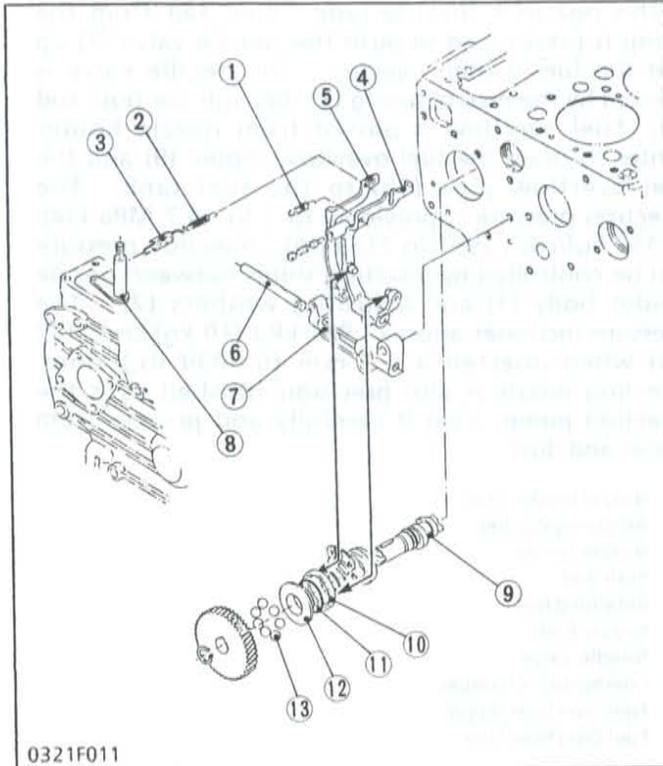
When the fuel is not delivered from the injection pump, the valve (7) is tightly closed against the nozzle tip (10) by the pressure spring (4).

As the injection pump force feeds the fuel to the injection nozzle through the delivery pipe, the fuel pressure in the closed chamber is increases. When the fuel pressure raises and overcomes the tension of the pressure spring (4), the valve is pushed up and the fuel is sprayed through four 0.25 mm (0.00984 in.) diameter holes into the cylinder, where the fuel is ignited by the high-temperature and high-pressure air.

The excessive fuel from the injection pump flows through the space between the valve (7) and the valve guide (5) to the leak-off cap (1), cooling and lubricating the nozzle.

- (a) To Tank
- (b) From Injection Pump

- (1) Leak-off Cap
- (2) Pressure Adjusting Screw
- (3) Lift Adjusting Screw
- (4) Spring
- (5) Valve Guide
- (6) Compression Seal
- (7) Valve
- (8) Valve Body
- (9) Carbon Dam Seal
- (10) Nozzle Tip

(6) Governor

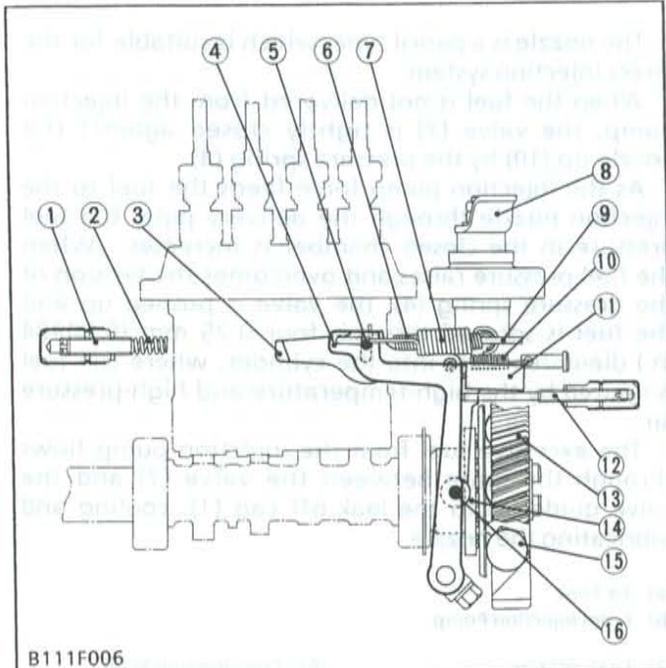
0321F011

The governor serves to keep engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load. This engine uses an all-speed governor which controls the centrifugal force of the steel balls (12) weight, produced by rotation of the fuel camshaft (9), and the load of the governor spring 1 (2) and 2 (3) are balanced.

■ **NOTE**

- It is described two governor springs of DI engine. D1102 has one governor spring.

- | | |
|-----------------------|-------------------------|
| (1) Start Spring | (8) Governor Lever |
| (2) Governor Spring 1 | (9) Fuel Camshaft |
| (3) Governor Spring 2 | (10) Governor Ball Case |
| (4) Fork Lever 1 | (11) Steel Ball |
| (5) Fork Lever 2 | (12) Governor Sleeve |
| (6) Fork Lever Shaft | (13) Steel Ball |
| (7) Fork Lever Holder | |



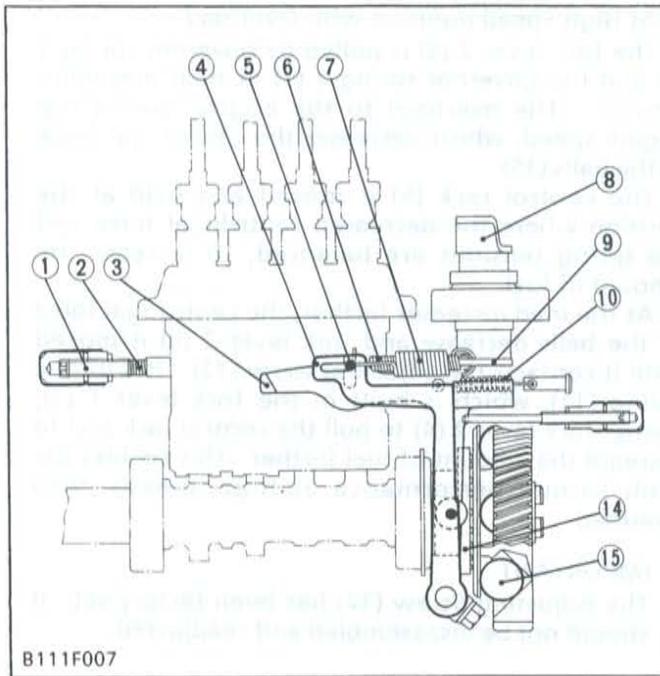
B111F006

■ **At Start**

The steel ball (15) has no centrifugal force.

As the fork lever 1 (3) is pulled by the start spring (10), the control rack pin (5) moves to the maximum injection position. At start, the sufficient injection of the fuel enables easy starting.

- | | |
|-----------------------------|--------------------------|
| (1) Idling Adjusting Screw | (9) Governor Lever |
| (2) Idling Adjusting Spring | (10) Start Spring |
| (3) Fork Lever 1 | (11) Torque Spring |
| (4) Fork Lever 2 | (12) Adjusting Screw |
| (5) Control rack Pin | (13) Injection Pump Gear |
| (6) Governor Spring 1 | (14) Governor Sleeve |
| (7) Governor Spring 2 | (15) Ball |
| (8) Speed Control Lever | (16) Fork Lever Pin |



■ At Idling

At the idling position of the speed control lever (8), the governor spring 2 (7) is free and the governor spring 1 (6) pulls the fork lever 2 (4). Fork lever 1 (3) is pulled by the fork lever 2 (4) and the start spring (10).

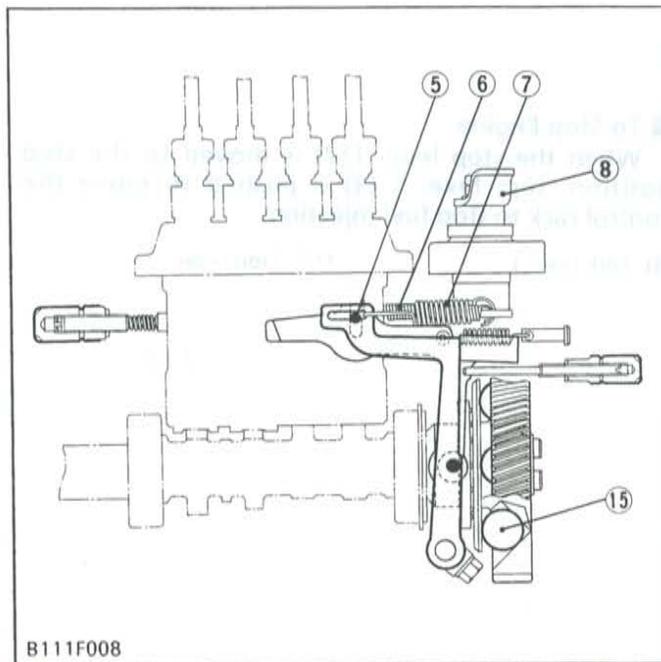
As the camshaft rotates, the balls (15) increase their centrifugal force to push the governor sleeve (14), which in turn pushes the fork lever 1 (3).

The control rack, which is pushed by the idle adjusting spring and the fork lever 1 (3), is kept at a position where these forces are balanced, providing stable idling.

■ IMPORTANT

● The idling speed has been factory-set. The idling adjusting screw (1) and spring (2) should not be disassembled and readjusted.

- | | |
|-----------------------------|-------------------------|
| (1) Idling Adjusting Screw | (7) Governor Spring 2 |
| (2) Idling Adjusting Spring | (8) Speed Control Lever |
| (3) Fork Lever 1 | (9) Governor Lever |
| (4) Fork Lever 2 | (10) Start Spring |
| (5) Control rack Pin | (14) Governor Sleeve |
| (6) Governor Spring 1 | (15) Ball |

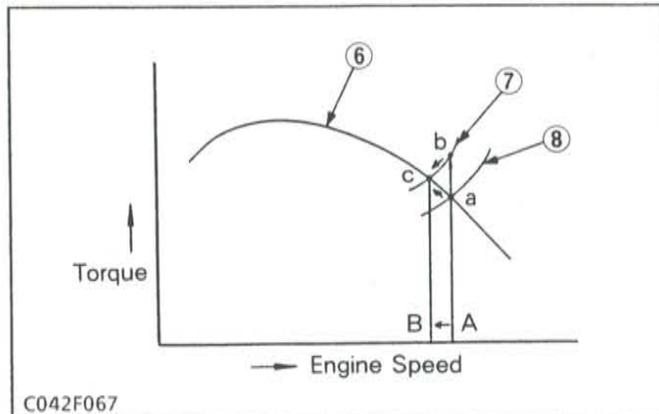


■ At Medium or High Speed Running

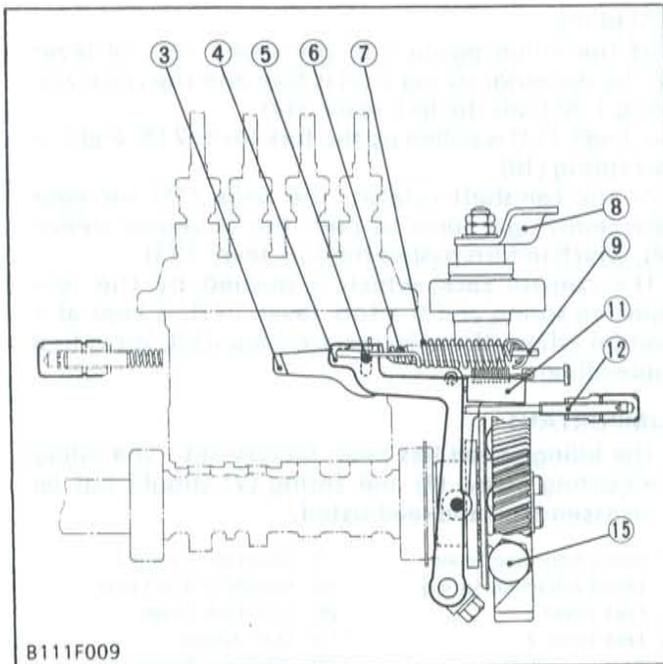
The engine speed is controlled when the tension of governor springs 1 (6) and 2 (7), which are pulled by the speed control lever (8), and the centrifugal force of steel balls (15) are balanced.

When the engine speed is dropped (A→B) with load increased (a→b), the centrifugal force of steel balls becomes smaller than the tension of governor springs 1 and 2. As a result, the control rack pin (5) is moved to the right and amount of fuel injected is increased to produce an engine torque required for the load.

- | | |
|-----------------------|-------------------------|
| (5) Control Rack Pin | (8) Speed Control Lever |
| (6) Governor Spring 1 | (15) Steel Ball |
| (7) Governor Spring 2 | |



- | | |
|-----------------------------|-----------------------------|
| (6) Engine Torque Curve | (8) Small Load Torque Curve |
| (7) Large Load Torque Curve | |



B111F009

- | | |
|-----------------------|-------------------------|
| (3) Fork Lever 1 | (8) Speed Control Lever |
| (4) Fork Lever 2 | (9) Governor Lever |
| (5) Control Rack Pin | (11) Torque Spring |
| (6) Governor Spring 1 | (12) Adjusting Screw |
| (7) Governor Spring 2 | (15) Ball |

■ At High Speed Running with Overload

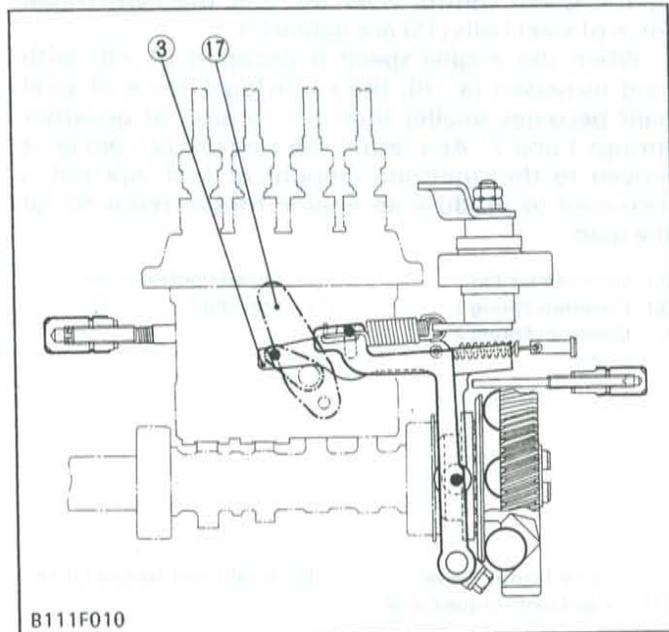
The fork lever 2 (4) is pulled by governor spring 1 (6) and the governor spring 2 (7) at their maximum tension. The overload to the engine lowers the engine speed, which decreases the centrifugal force of the balls (15).

The control rack (5) is moved and held at the position where the decreased centrifugal force and the spring tensions are balanced, to increase the amount of fuel.

As the load increases further, the centrifugal force of the balls decrease and fork lever 2 (4) is moved until it contacts the adjusting screw (12). The torque spring (11), which is built in the fork lever 1 (3), pushes fork lever 2 (4) to pull the control rack and to increase the amount of fuel further. This enables the high torque performance at high speeds with overload.

■ IMPORTANT

- The Adjusting Screw (12) has been factory-set. It should not be disassembled and readjusted.



B111F010

■ To Stop Engine

When the stop lever (17) is moved to the stop position, fork lever 1 (3) is pushed to move the control rack to stop fuel injection.

- | | |
|------------------|-----------------|
| (3) Fork Lever 1 | (17) Stop Lever |
|------------------|-----------------|

2 CLUTCH

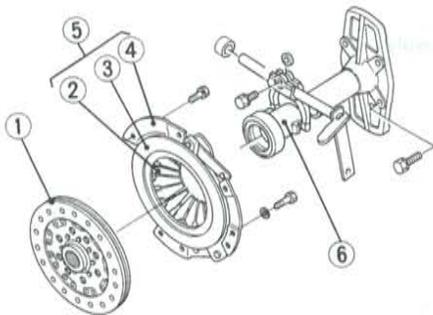
The clutch is located between the engine and transmission and is operated by stepping on the clutch pedal.

When the clutch pedal is depressed, the clutch is disengaged and when it is released, the clutch is engaged and power from the engine is transmitted to the transmission.

There are two types of clutches. One is dry single plate type and the other is dual stage type clutch.

Tractors equipped with dual stage type clutch have a live PTO function which enables stoppage of the power transmission to the traveling system while the PTO is in rotation.

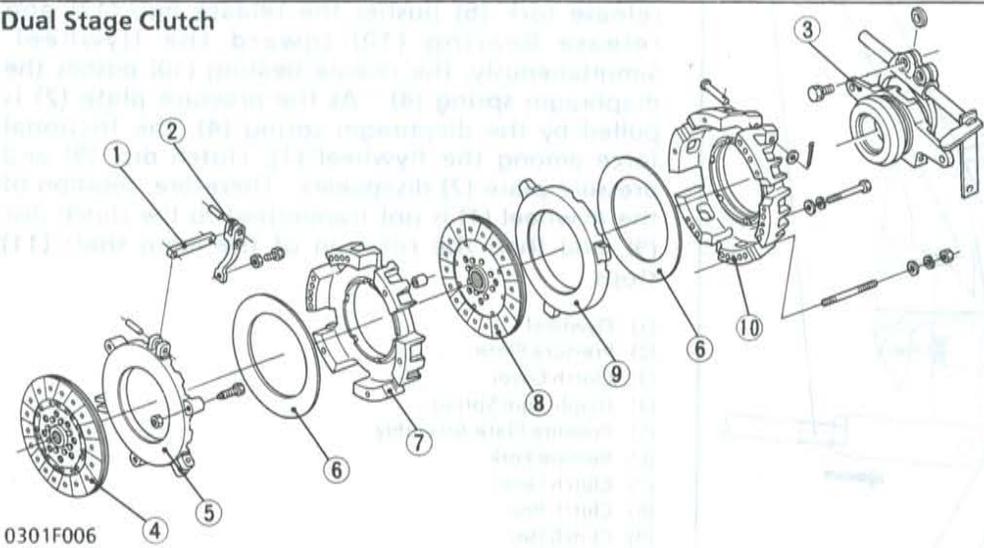
Single Plate Clutch



0301F005

- (1) Clutch Disc
- (2) Diaphragm Spring
- (3) Pressure Plate
- (4) Clutch Cover
- (5) Pressure Plate Assembly
- (6) Release Hub

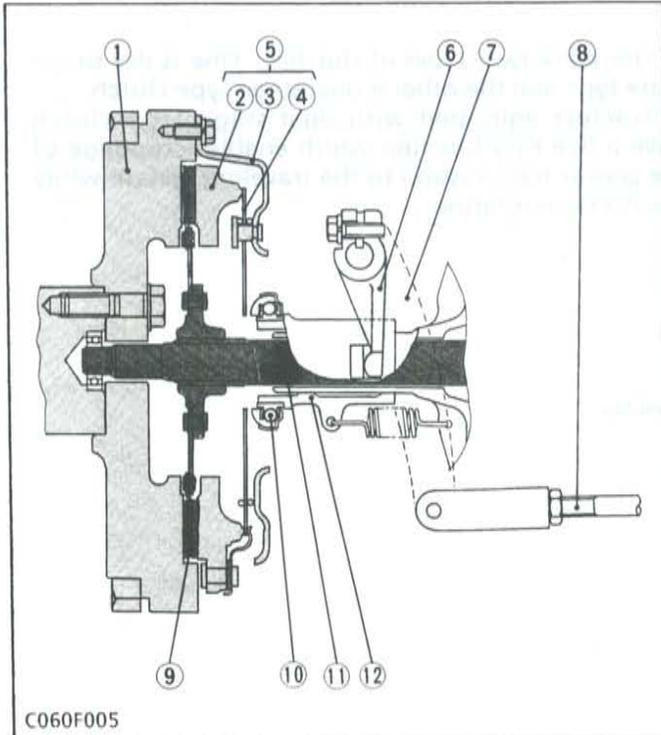
Dual Stage Clutch



0301F006

- (1) Release Rod
- (2) Release Lever
- (3) Release Hub
- (4) Clutch Disc 1 (Traveling)
- (5) Pressure Plate 1
- (6) Belleville Spring
- (7) Clutch Cover 1
- (8) Clutch Disc 2 (PTO)
- (9) Pressure Plate 2
- (10) Clutch Cover 2

[1] DRY TYPE, SINGLE STAGE CLUTCH

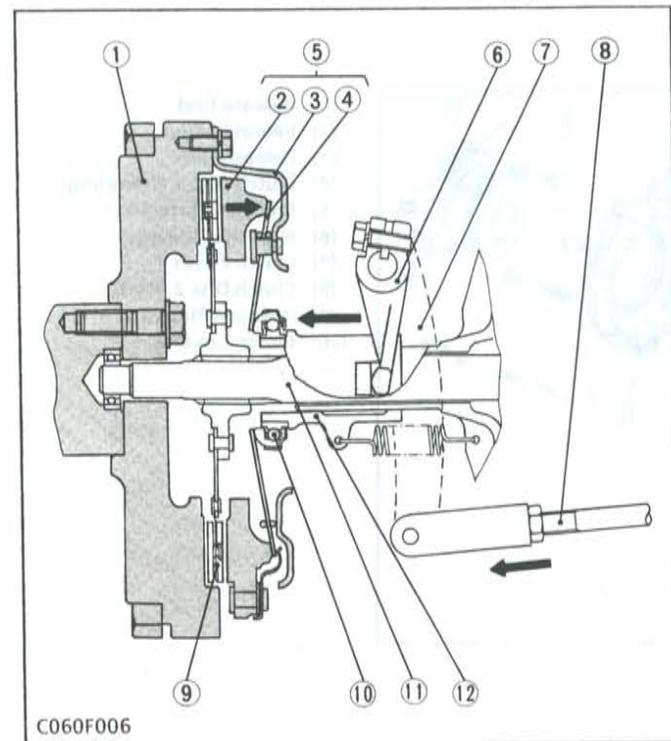


■ Clutch "Engaged"

When the clutch pedal is not depressed, the clutch release bearing (10) and the fingers of diaphragm spring (4) are not connected each other.

Accordingly, the pressure plate (2) is tightly pressed against the flywheel (1) by the diaphragm spring (4). As a result, rotation of the flywheel (1) is transmitted to the transmission through the main shaft (11) due to the frictional force among the flywheel (1), clutch disc (9) and pressure plate (2).

- (1) Flywheel
- (2) Pressure Plate
- (3) Clutch Cover
- (4) Diaphragm Spring
- (5) Pressure Plate Assembly
- (6) Release Fork
- (7) Clutch Lever
- (8) Clutch Rod
- (9) Clutch Disc
- (10) Release Bearing
- (11) Main Shaft
- (12) Release Hub



■ Clutch "Disengaged"

When the clutch pedal is depressed, the clutch rod (8) is pushed to move the clutch lever (7). Then, the release fork (6) pushes the release hub (12) and release bearing (10) toward the flywheel. Simultaneously, the release bearing (10) pushes the diaphragm spring (4). As the pressure plate (2) is pulled by the diaphragm spring (4), the frictional force among the flywheel (1), clutch disc (9) and pressure plate (2) disappears. Therefore, rotation of the flywheel (1) is not transmitted to the clutch disc (9), and then the rotation of the main shaft (11) stops.

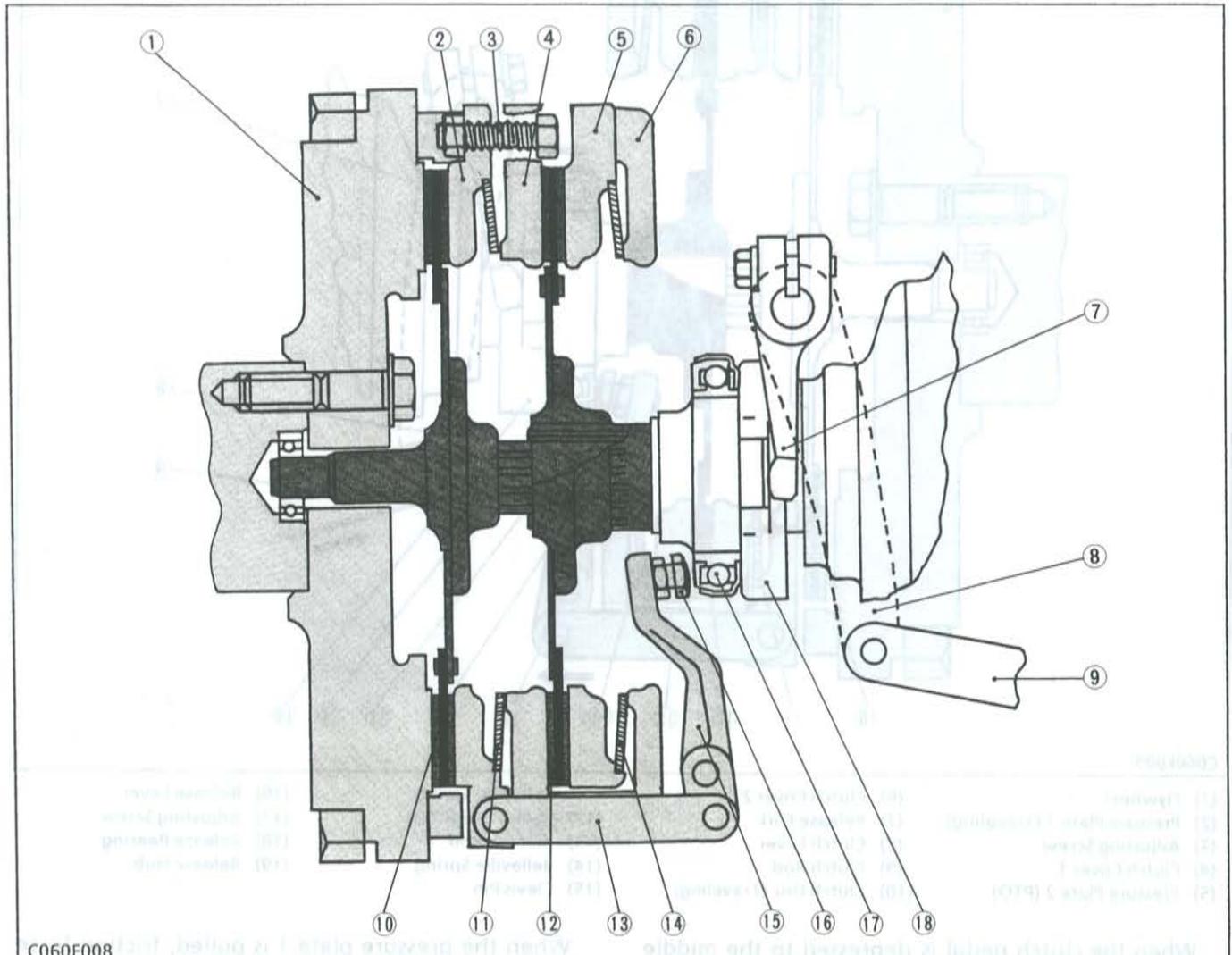
- (1) Flywheel
- (2) Pressure Plate
- (3) Clutch Cover
- (4) Diaphragm Spring
- (5) Pressure Plate Assembly
- (6) Release Fork
- (7) Clutch Lever
- (8) Clutch Rod
- (9) Clutch Disc
- (10) Release Bearing
- (11) Main Shaft
- (12) Release Hub

[2] DRY TYPE, DUAL STAGE CLUTCH

A dual stage clutch is a combination of two single plate clutches. One clutch controls power transmitted to the traveling, and the other to the PTO.

■ Traveling Clutch "Engaged"

■ PTO Clutch "Engaged"



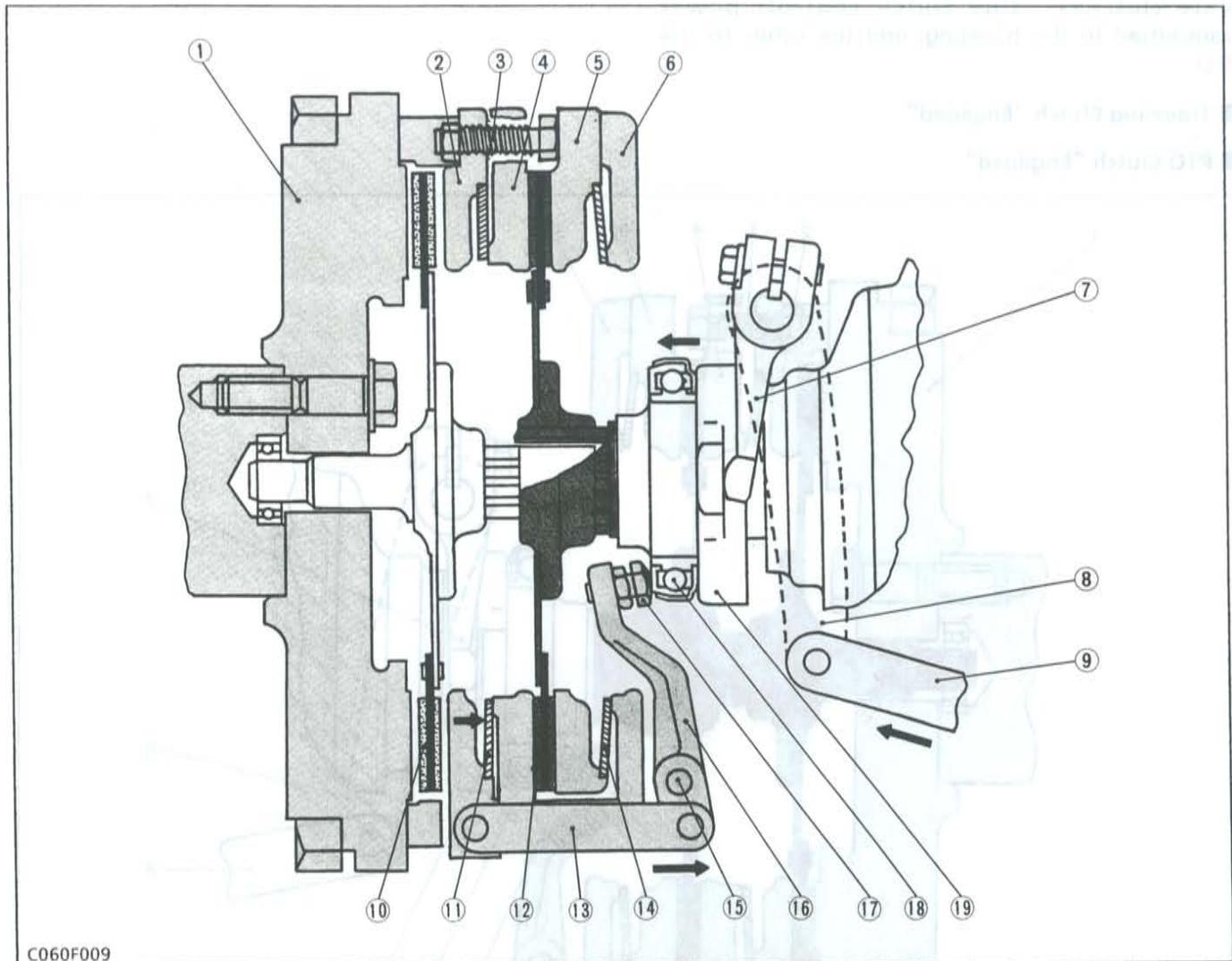
- | | | | |
|----------------------------------|------------------------------|------------------------|----------------------|
| (1) Flywheel | (6) Clutch Cover 2 | (11) Belleville Spring | (16) Adjusting Screw |
| (2) Pressure Plate 1 (Traveling) | (7) Release Fork | (12) Clutch Disc (PTO) | (17) Release Bearing |
| (3) Adjusting Screw | (8) Clutch Lever | (13) Release Rod | (18) Release Hub |
| (4) Clutch Cover 1 | (9) Clutch Rod | (14) Belleville Spring | |
| (5) Pressure Plate 2 (PTO) | (10) Clutch Disc (Traveling) | (15) Release Lever | |

When the clutch pedal is not depressed, there is a certain amount of clearance between the release bearing (17) and the adjusting screw (16) mounted on the release lever (15). Under the conditions above:

- The traveling clutch disc (10) is pressed between the flywheel (1) and the pressure plate 1 (2) by the force of the belleville spring (11).
- The PTO clutch disc (12) is pressed between the clutch cover 1 (4) and the pressure plate 2 (5) by the force of the belleville spring (14). Thus, the rotation of flywheel is transmitted to both the traveling and PTO systems.

■ Traveling Clutch "Disengaged"

■ PTO Clutch "Engaged"



C060F009

- | | | | |
|----------------------------------|------------------------------|------------------------|----------------------|
| (1) Flywheel | (6) Clutch Cover 2 | (11) Belleville Spring | (16) Release Lever |
| (2) Pressure Plate 1 (Traveling) | (7) Release Fork | (12) Clutch Disc (PTO) | (17) Adjusting Screw |
| (3) Adjusting Screw | (8) Clutch Lever | (13) Release Rod | (18) Release Bearing |
| (4) Clutch Cover 1 | (9) Clutch Rod | (14) Belleville Spring | (19) Release Hub |
| (5) Pressure Plate 2 (PTO) | (10) Clutch Disc (Traveling) | (15) Clevis Pin | |

When the clutch pedal is depressed to the middle of the stroke, the clutch rod (9) is pushed to move the clutch lever (8). Then, the release fork (7) pushes the release hub (19) and release bearing (18) toward the flywheel. Simultaneously, the release bearing (18) pushes the adjusting screw (17) attached to the release lever (16).

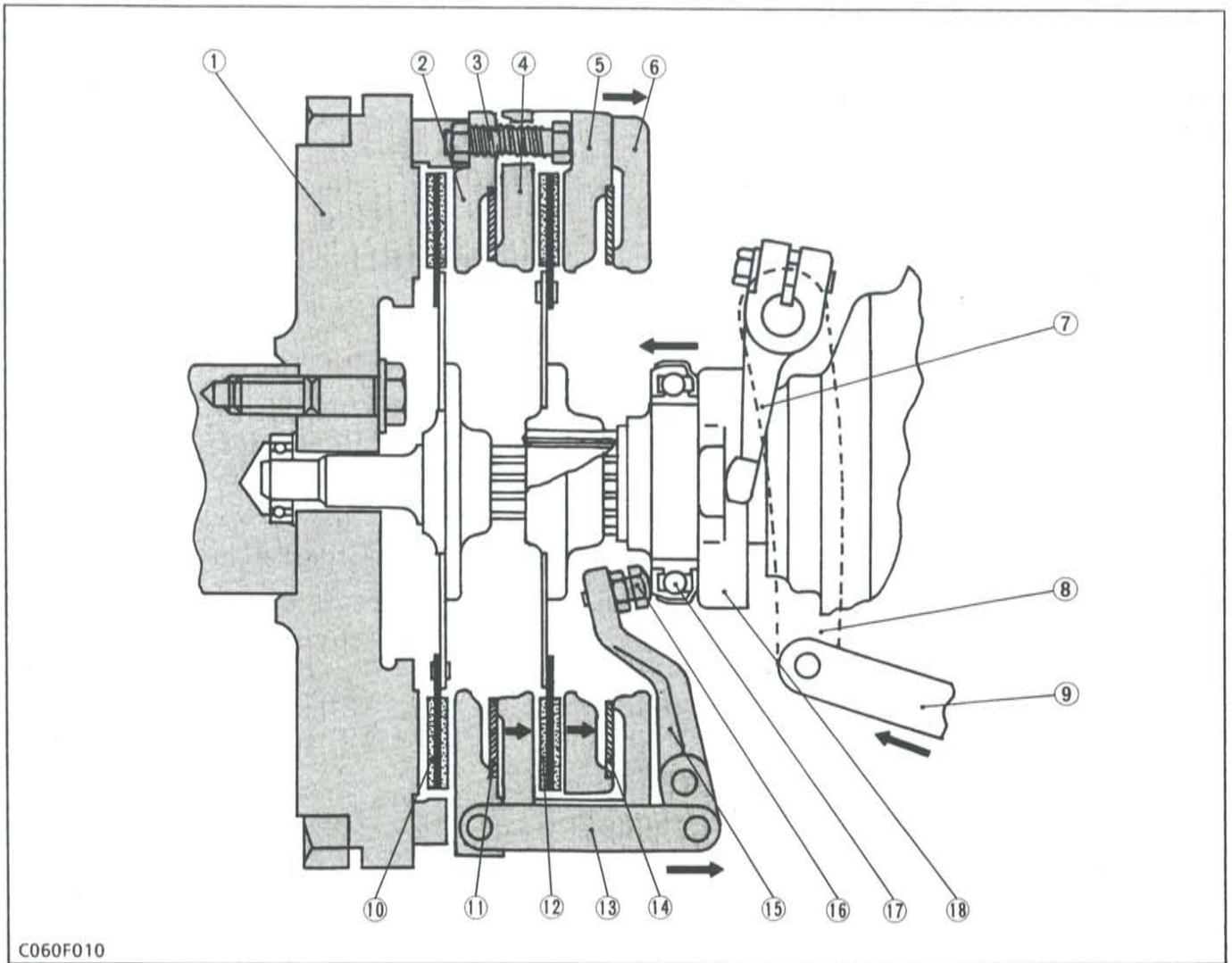
The release lever pulls the pressure plate 1 (2) by means of the release rod (13) as the lever turns at the clevis pin (15) as a fulcrum.

When the pressure plate 1 is pulled, friction force among the clutch cover 1 (4), clutch disc (10) and the pressure plate 1 (2) is lost. The rotation of flywheel is not transmitted to traveling system.

At this time, the pressure plate 2 (5) is in contact with the head of the adjusting screw (3) which serves as a stopper.

■ Traveling Clutch "Disengaged"

■ PTO Clutch "Disengaged"



C060F010

- | | | | |
|----------------------------------|------------------------------|------------------------|----------------------|
| (1) Flywheel | (6) Clutch Cover 2 | (11) Belleville Spring | (16) Adjusting Screw |
| (2) Pressure Plate 1 (Traveling) | (7) Release Fork | (12) Clutch Disc (PTO) | (17) Release Bearing |
| (3) Adjusting Screw | (8) Clutch Lever | (13) Release Rod | (18) Release Hub |
| (4) Clutch Cover 1 | (9) Clutch Rod | (14) Belleville Spring | |
| (5) Pressure Plate 2 (PTO) | (10) Clutch Disc (Traveling) | (15) Release Lever | |

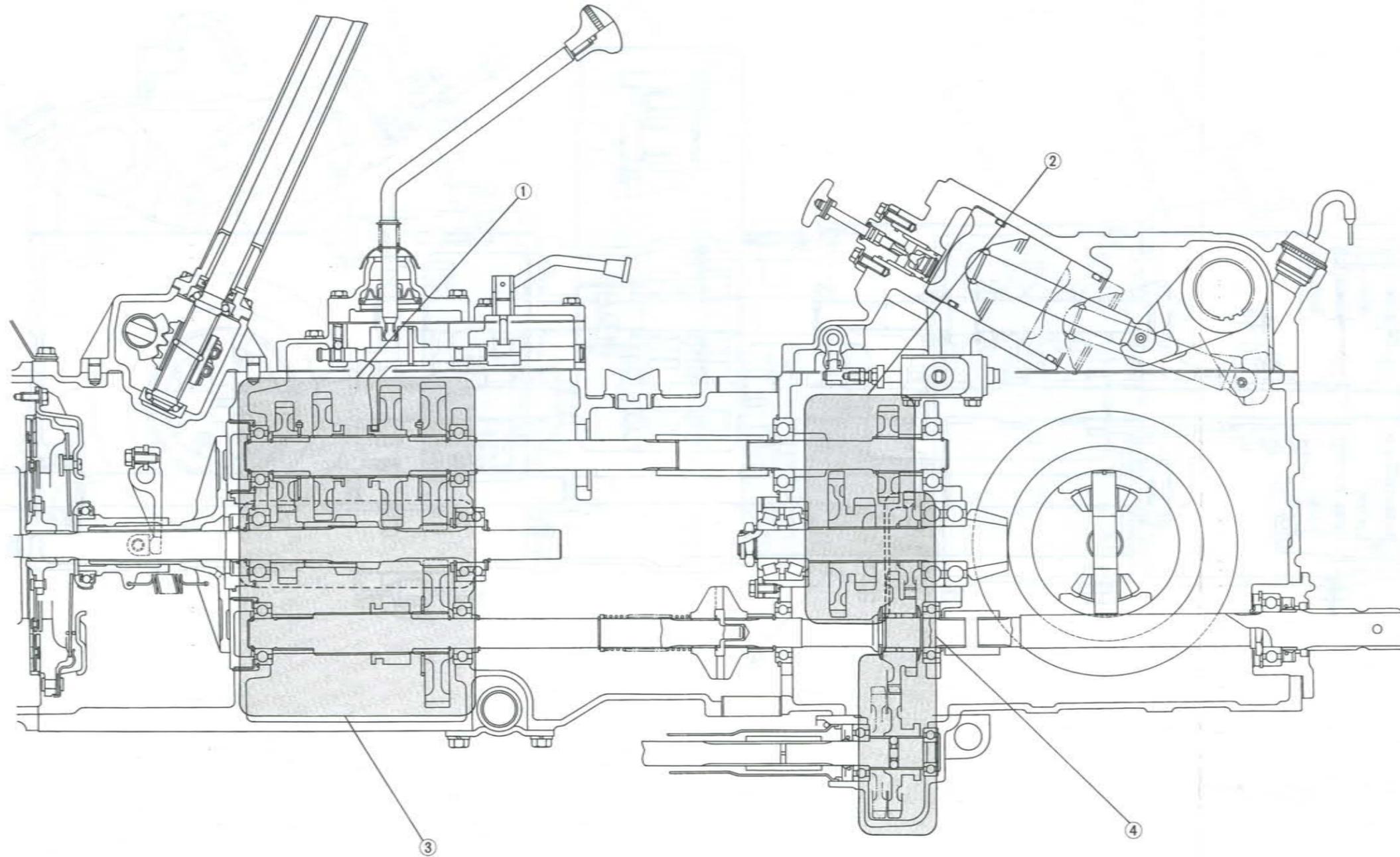
When the clutch pedal is depressed, to the full stroke, the pressure plate 2 (5) is pushed to the right by the adjusting screw (3).

This results in no friction among the flywheel (1), clutch disc (12) and pressure plate 2 (5).

The rotation of flywheel is not transmitted to PTO system and traveling system.

3 TRANSMISSION

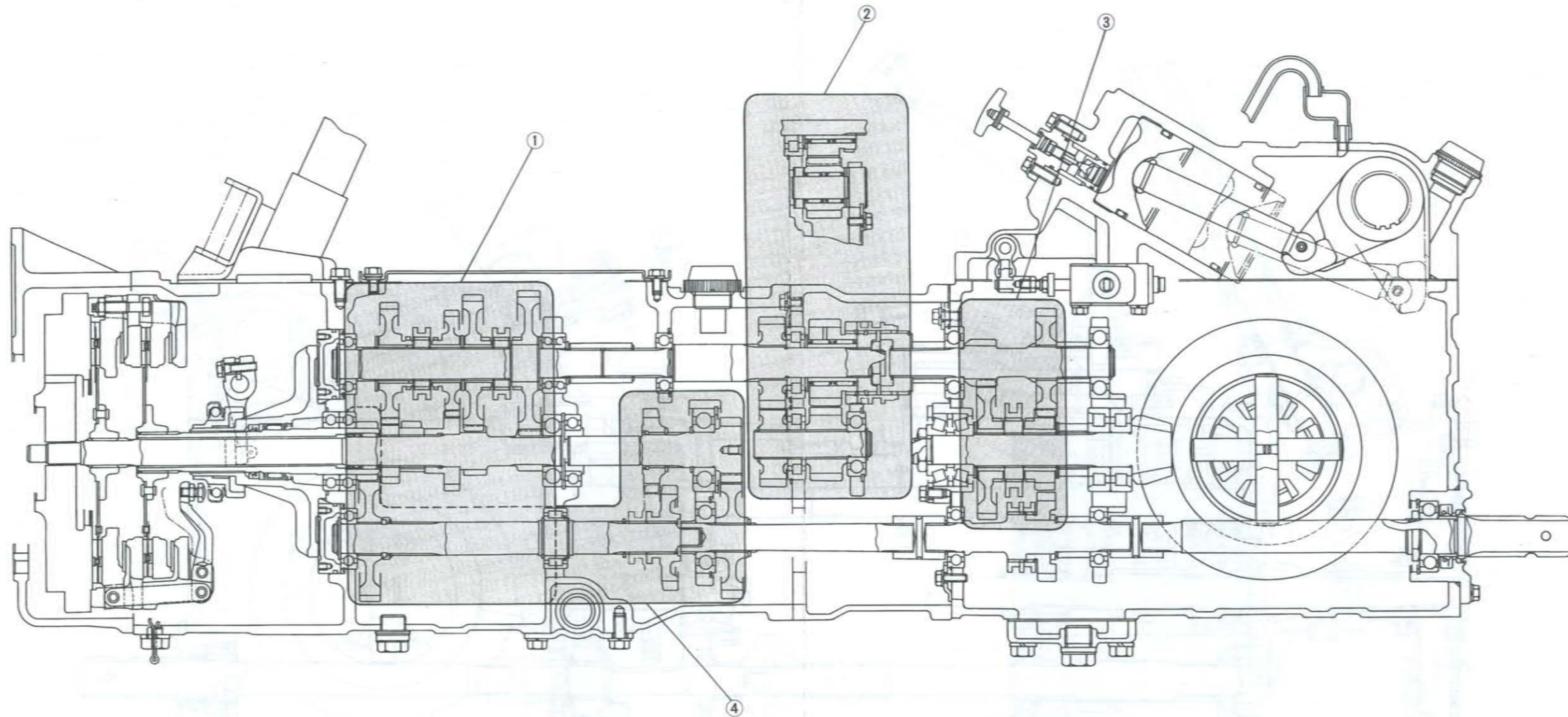
[L2350] (4WD, SINGLE STAGE CLUTCH, PARTIAL CONSTANT-MESH TYPE)



B122F021

- (1) Main Gear Shift Section
- (2) Hi-Lo Range Shift Section
- (3) PTO Gear Shift Section
- (4) Front Wheel Drive Section

[L2950] (2WD, DUAL STAGE CLUTCH, CONSTANT-MESH TYPE)



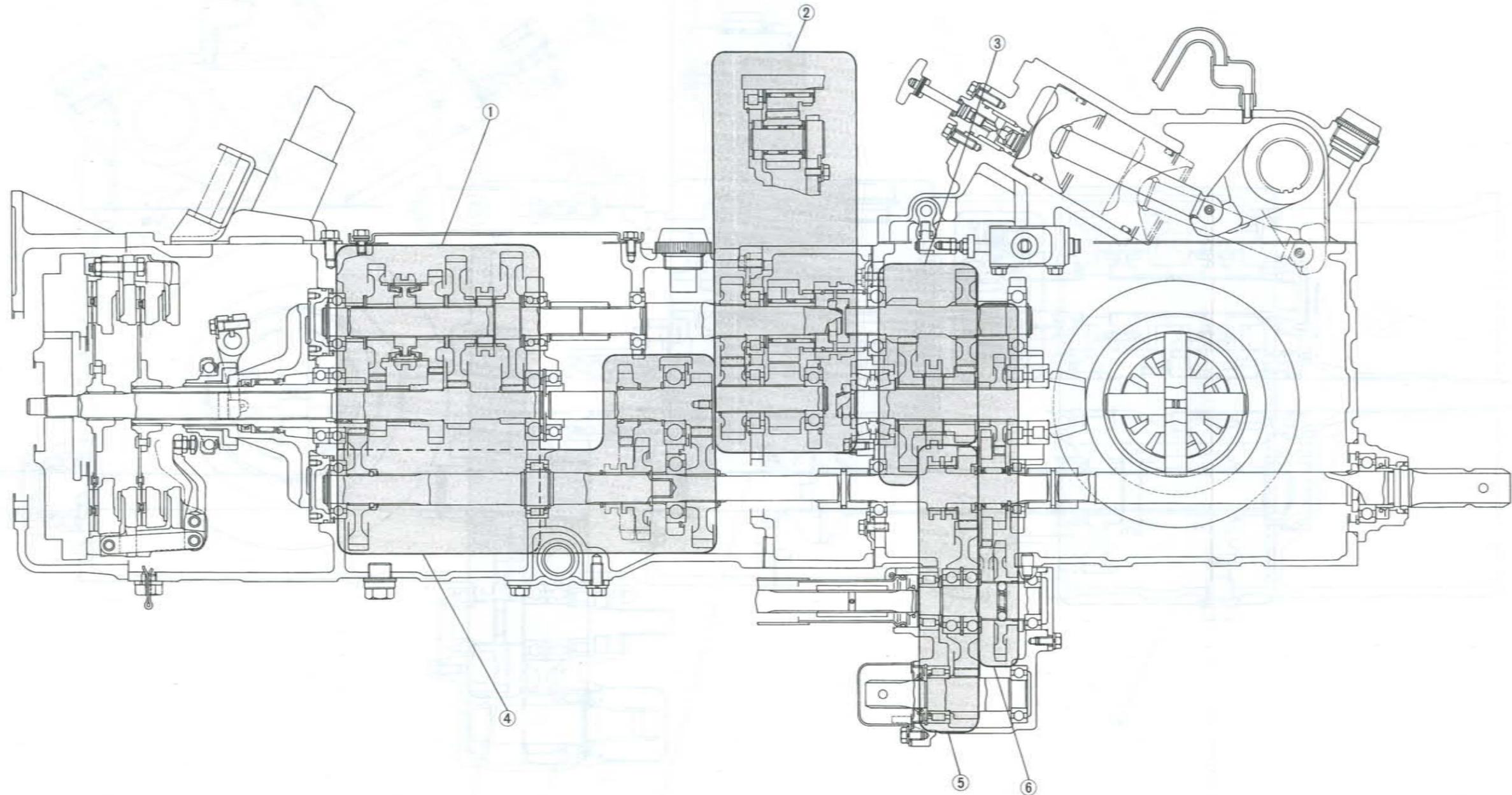
B122F001

(1) Main Gear Shift Section
(2) Shuttle Shift Section

(3) Hi-Lo Range Shift Section
(4) PTO Gear Shift Section

[L3450]

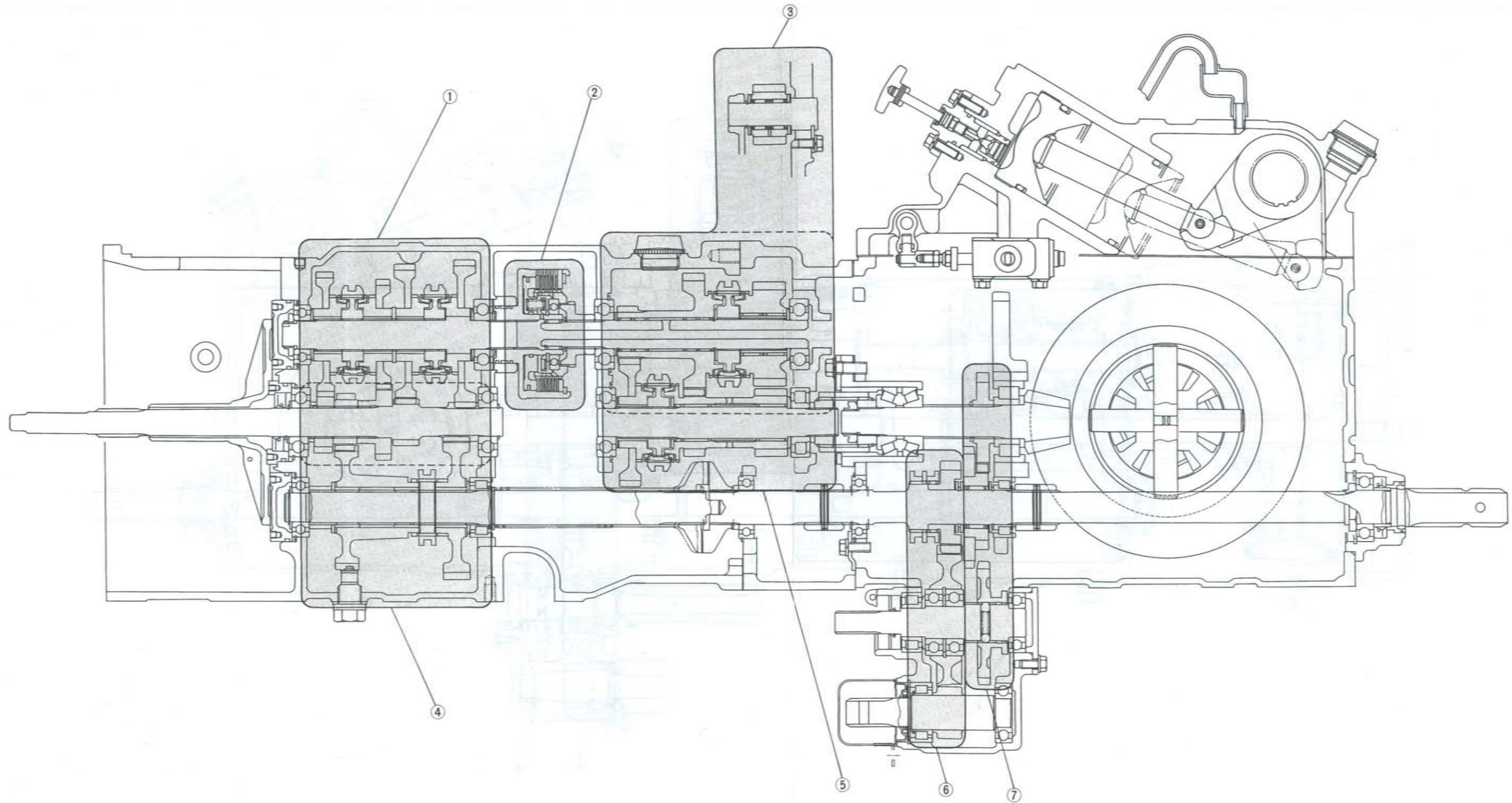
(4WD, DUAL STAGE CLUTCH, PARTIAL SYNCHROMESH, MID PTO TYPE)



B122F002

- (1) Main Gear Shift Section
- (2) Shuttle Shift Section
- (3) Hi-Lo Range Shift Section
- (4) PTO Gear Shift Section
- (5) Mid PTO Section
- (6) Front Wheel Drive Section [4WD Type]

[L3450GST]



B122F001

- (1) Main Gear Shift Section
- (2) Clutch Pack
- (3) Shuttle Shift Section
- (4) PTO Gear Shift Section

- (5) Hi-Lo Range Shift Section
- (6) Mid PTO Shift Section
- (7) Front Wheel Drive Section

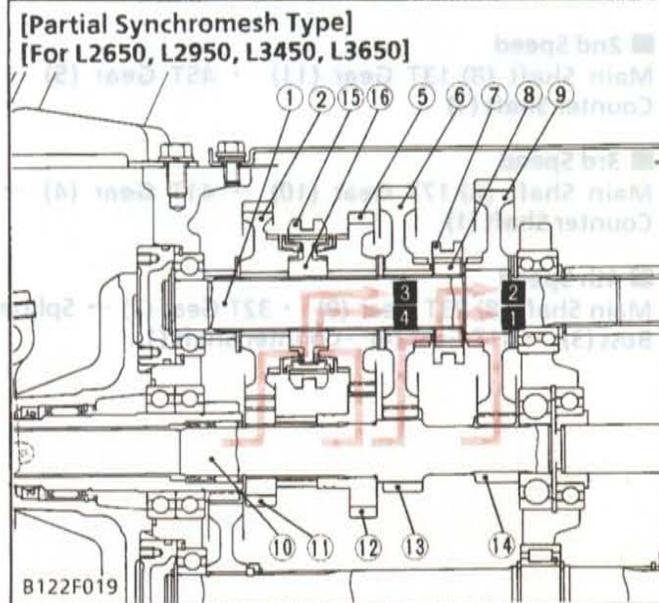
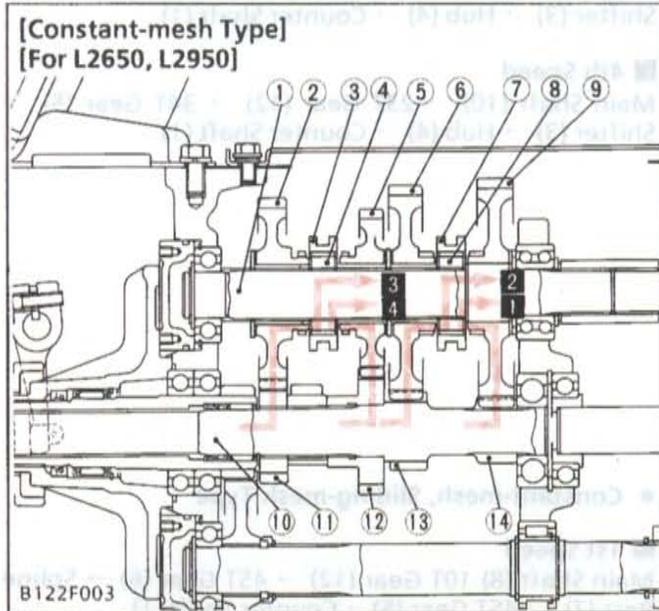
[1] POWER TRAIN

The transmission consists of a series of gears and shafts shown previously. It offers the most suitable speed for traveling and operation by combination of these gears. It transmits power to the front axle [4WD type], rear axle and PTO shaft.

L2350 has 8 forward and 2 revers speeds. L2650, L2950, L3450 and L3650 have 8 forward and 8 revers speeds. The traveling system consists of main gear shift section, shuttle shift section, Hi-Lo range shift section.

The PTO system offers 540 rpm or 540 rpm and 1000 rpm PTO speeds by the PTO gear shift lever.

(1) Main Gear Shift Section



- | | |
|-------------------|---|
| (1) Counter Shaft | (10) Main Shaft |
| (2) 37T Gear | (11) 18T Gear |
| (3) Shifter | (12) 22T Gear [L2650, L2950]
23T Gear [L3450, L3650] |
| (4) Spline Boss | (13) 13T Gear |
| (5) 32T Gear | (14) 10T Gear |
| (6) 42T Gear | (15) Shifter |
| (7) Shifter | (16) Hub |
| (8) Spline Boss | |
| (9) 45T Gear | |

The main shift section is used sliding-mesh type or constant-mesh type or synchronmesh type shift systems. They are used depend upon the models and the specifications.

Rotary power which is transmitted from the engine to the main shaft via the clutch is changed in four ways by operating the main gear shift lever to shift the shifters, and transmits to the counter shaft.

Constant-mesh Type and Partial Synchronmesh Type

■ Constant-mesh Type and Partial Synchronmesh Type

■ 1st Speed

Main Shaft (10) · 10T Gear (14) · 45T Gear (9) → Shifter (7) → Spline Boss (8) · Counter Shaft (1).

■ 2nd Speed

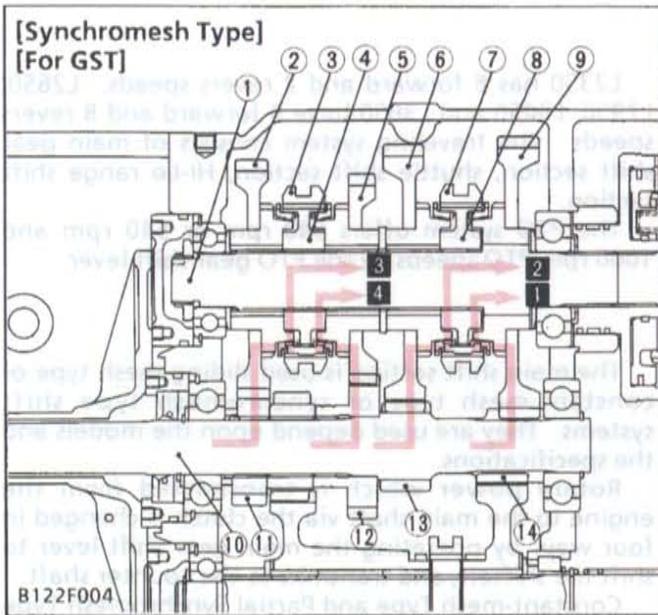
Main Shaft (10) · 13T Gear (13) → 42T Gear (6) → Shifter (7) → Spline Boss (8) → Counter Shaft (1).

■ 3rd Speed

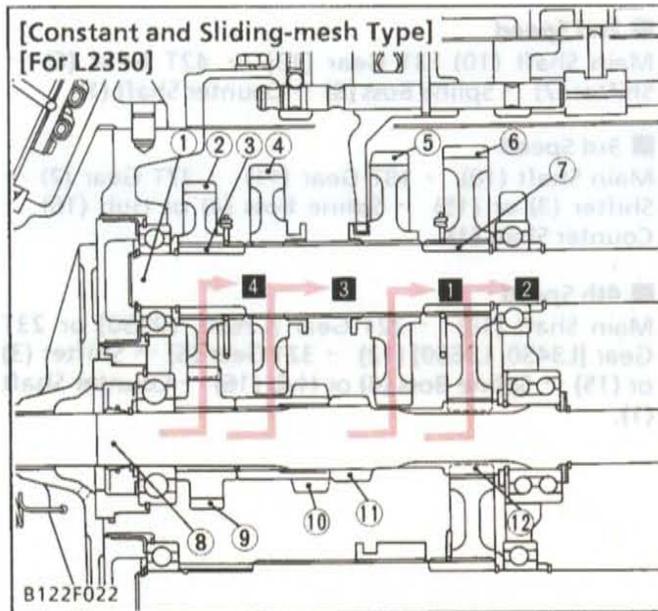
Main Shaft (10) · 18T Gear (11) → 37T Gear (2) → Shifter (3) or (15) · Spline Boss (4) or Hub (16) → Counter Shaft (1).

■ 4th Speed

Main Shaft (10) · 22T Gear [L2650, L2950] or 23T Gear [L3450, L3650] (12) → 32T Gear (5) → Shifter (3) or (15) → Spline Boss (4) or Hub (16) → Counter Shaft (1).



- (1) Counter Shaft
- (2) 38T Gear
- (3) Shifter
- (4) Hub
- (5) 34T Gear
- (6) 43T Gear
- (7) Shifter
- (8) Hub
- (9) 46T Gear
- (10) Main Shaft
- (11) 18T Gear
- (12) 23T Gear
- (13) 13T Gear
- (14) 10T Gear



- (1) Counter Shaft
- (2) 32T Gear
- (3) Spline Boss
- (4) 41T Gear
- (5) 45T Gear
- (6) 45T Gear
- (7) Spline Boss
- (8) Main Shaft
- (9) 23T Gear
- (10) 17T Gear
- (11) 13T Gear
- (12) 10T Gear

● Synchromesh Type

■ 1st Speed

Main Shaft (10) → 10T Gear (14) → 46T Gear (9) → Shifter (7) → Hub (8) → Counter Shaft (1).

■ 2nd Speed

Main Shaft (10) → 13T Gear (13) → 43T Gear (6) → Shifter (7) → Hub (8) → Counter Shaft (1).

■ 3rd Speed

Main Shaft (10) → 18T Gear (11) → 38T Gear (2) → Shifter (3) → Hub (4) → Counter Shaft (1).

■ 4th Speed

Main Shaft (10) → 23T Gear (12) → 34T Gear (5) → Shifter (3) → Hub (4) → Counter Shaft (1).

● Constant-mesh, Sliding-mesh Type

■ 1st Speed

Main Shaft (8) → 10T Gear (12) → 45T Gear (6) → Spline Boss (7) → 45T Gear (5) → Counter Shaft (1).

■ 2nd Speed

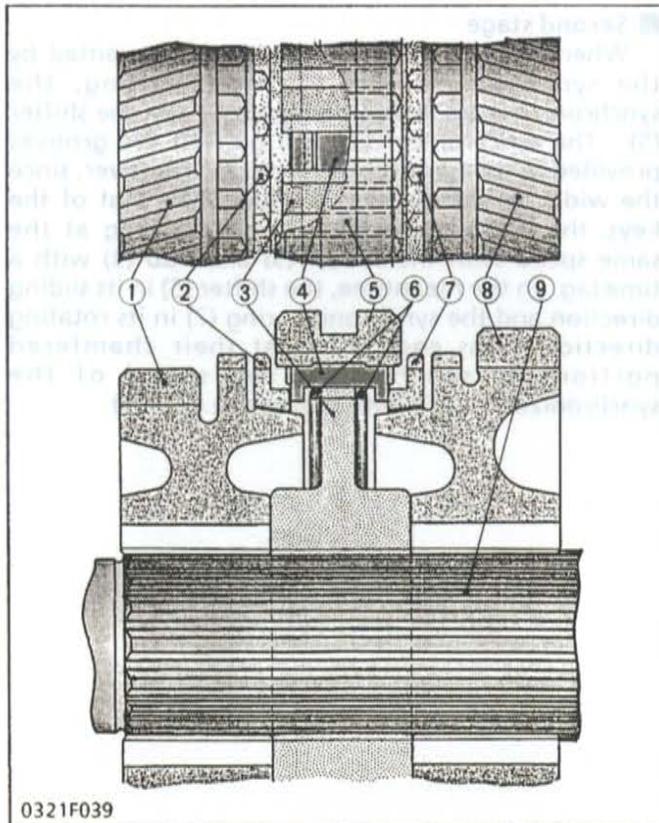
Main Shaft (8) → 13T Gear (11) → 45T Gear (5) → Counter Shaft (1).

■ 3rd Speed

Main Shaft (8) → 17T Gear (10) → 41T Gear (4) → Counter Shaft (1).

■ 4th Speed

Main Shaft (8) → 23T Gear (9) → 32T Gear (2) → Spline Boss (3) → 41T Gear (4) → Counter Shaft (1).

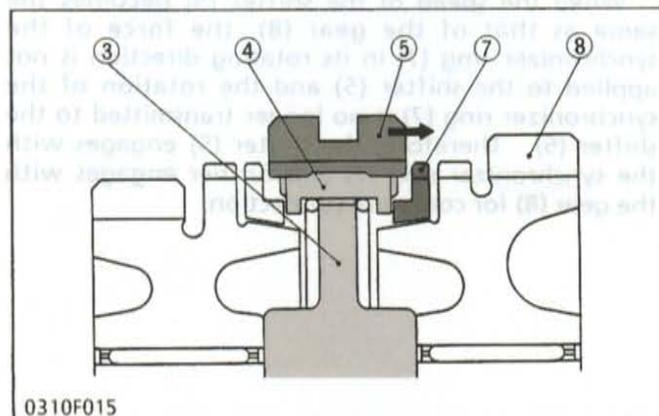
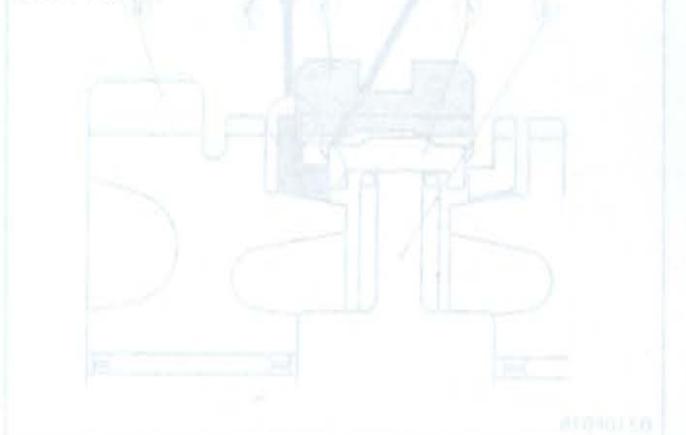


0321F039

- | | |
|-----------------------|-------------------------|
| (1) Gear | (6) Synchronizer Spring |
| (2) Synchronizer Ring | (7) Synchronizer Ring |
| (3) Hub | (8) Gear |
| (4) Synchronizer Key | (9) Counter Shaft |
| (5) Shifter | |

■ **Block-type Synchronismesh Mechanism**

The hub (3) is splined to the counter shaft (9) and the shifter (5) is mounted on the hub (3). The two synchronizer springs (6) hold the synchronizer keys (4) out against the shifter (5). The two synchronizer rings (2), (7) each has three slots into which the ends of the synchronizer keys (4) fit. The inner surfaces of the synchronizer rings (2), (7) are cone-shaped and match the conical shape of the gear (1), (8) shoulders which they contact. These cone-shaped surfaces provide the frictional force to synchronize the speed of the first shaft with the gears (1), (8).

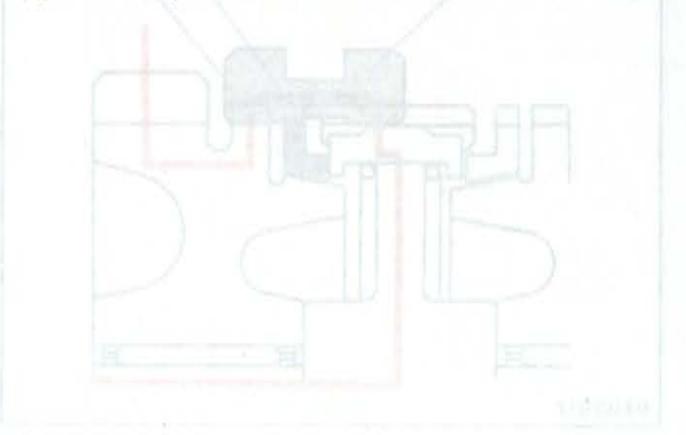


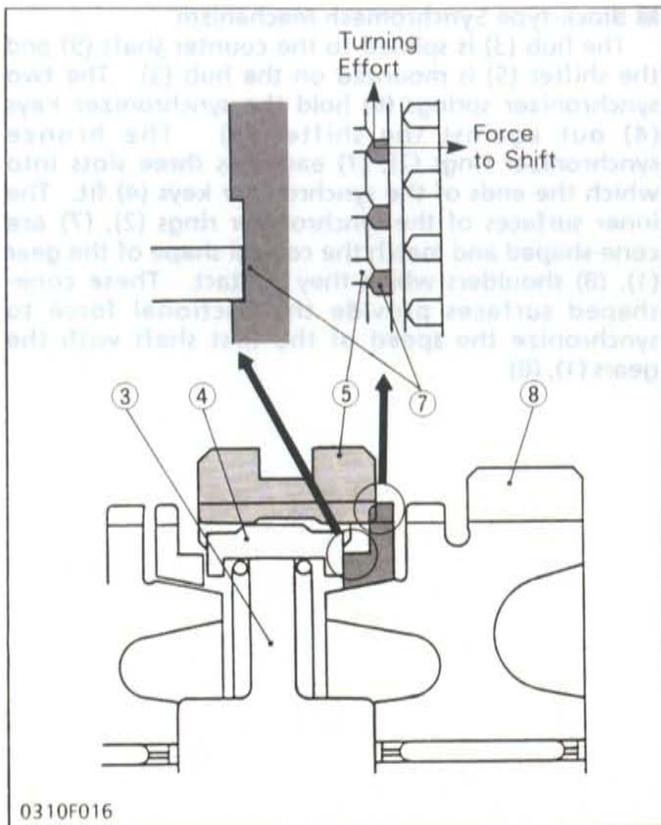
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- | | |
|----------------------|-----------------------|
| (3) Hub | (7) Synchronizer Ring |
| (4) Synchronizer Key | (8) Gear |
| (5) Shifter | |

■ **First stage**

An effort to place the main gear shift lever to the 3rd or 4th speed causes the shifter (5) and synchronizer keys (4) to move slightly. Then, the end surface of the synchronizer key (4) presses the synchronizer ring (7) against the cone-shaped portion of the gear (8). The frictional force generated at the cone-shaped portion rotates the synchronizer ring (7), synchronizer keys (4) and hub (3) which is splined to the counter shaft.



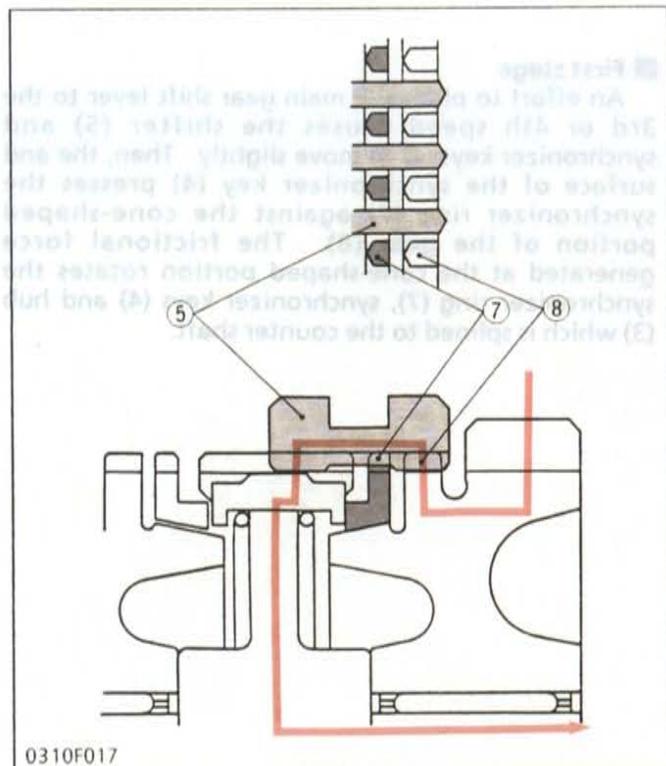
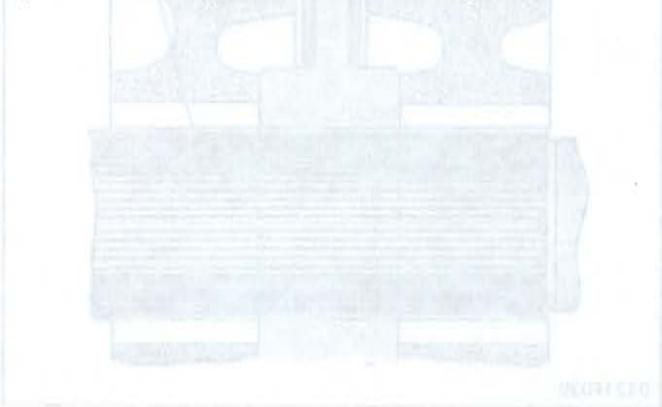


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- (3) Hub
- (4) Synchronizer Key
- (5) Shifter
- (7) Synchronizer Ring
- (8) Gear

■ **Second stage**

When the synchronizer keys (4) are prevented by the synchronizer ring (7) from sliding, the synchronizer keys (4) are disengaged from the shifter (5). The synchronizer keys (4) go into the grooves provided in the synchronizer ring (7). However, since the width of the grooves is wider than that of the keys, the synchronizer keys begin rotating at the same speed with the shifter (5) and hub (3) with a time lag. In the meantime, the shifter (5) in its sliding direction and the synchronizer ring (7) in its rotating direction press each other at their chamfered portions to synchronize the speed of the synchronizer ring (7) with that of the gear (8).



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- (5) Shifter
- (7) Synchronizer Ring
- (8) Gear

■ **Final stage**

When the speed of the shifter (5) becomes the same as that of the gear (8), the force of the synchronizer ring (7) in its rotating direction is not applied to the shifter (5) and the rotation of the synchronizer ring (7) is no longer transmitted to the shifter (5). Therefore, the shifter (5) engages with the synchronizer ring (7) and further engages with the gear (8) for complete connection.

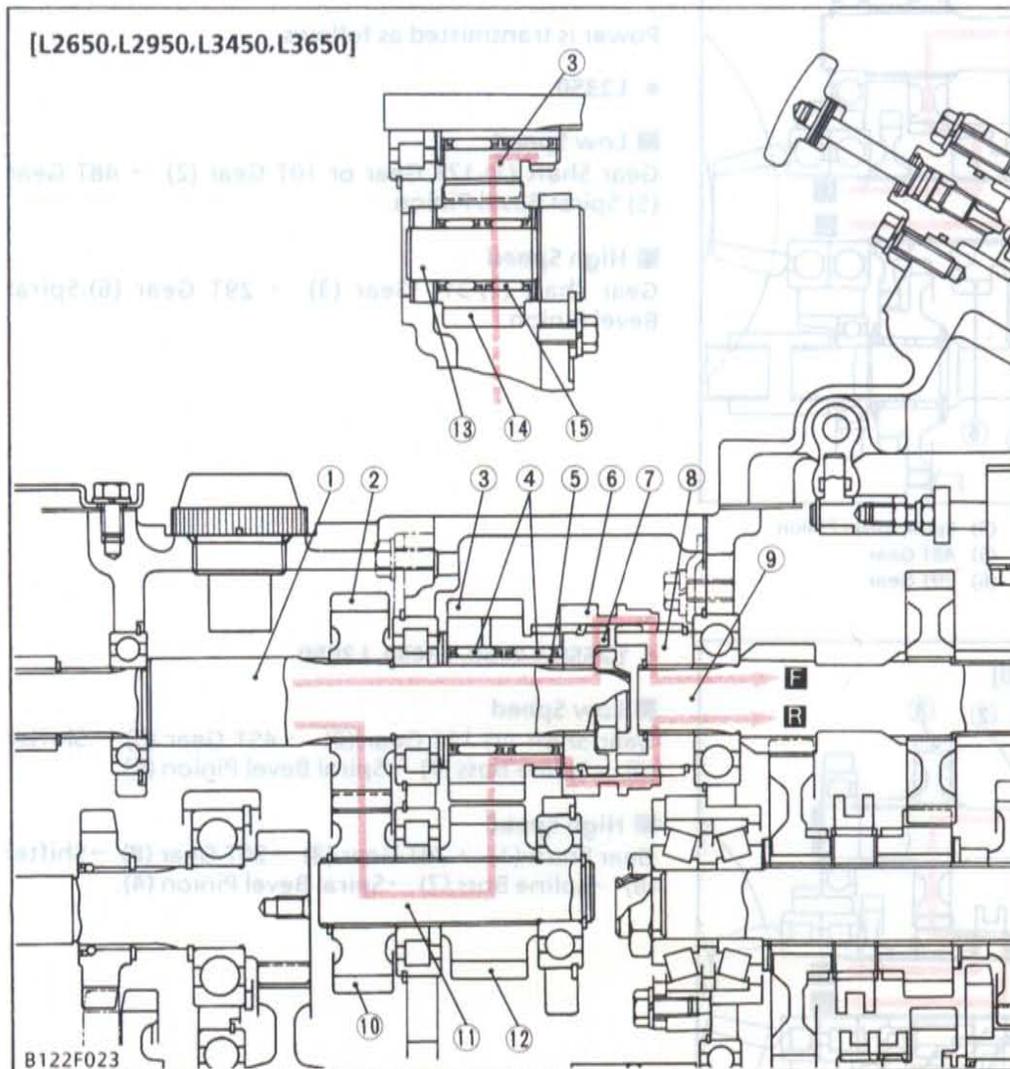


(2) Shuttle Shift Section

For L2650, L2950, L3450 and L3650

The shuttle shift section allows the operator to change forward and reverse for each speed from the first to eighth with a single shift lever.

It also operates as a reduction unit when shifting from forward to reverse.



- (1) Counter Shaft 2
- (2) 24T Gear
- (3) 23T Gear
- (4) Needle Bearing
- (5) Inner Race
- (6) Shifter
- (7) Spline Boss 1
- (8) Spline Boss 2
- (9) 13T Gear Shaft
- (10) 22T Gear
- (11) Reverse Shaft 1
- (12) 19T Gear
- (13) Reverse Shaft 2
- (14) 15T Gear
- (15) Needle Bearing

The 24T gear (2) and spline boss 1 (7) are splined to the counter shaft 2 (1). The 22T gear (10) and 19T gear (12) are splined to the reverse shaft 1 (11). The 24T gear (2) and 22T gear (10), the 19T gear (12) and 15T gear (14), the 15T gear and 23T gear (3) are constantly meshed with each other. Therefore, the 24T gear (2) and 23T gear (3) rotate in the opposite direction whenever the traveling clutch is engaged.

When the shuttle lever is moved to the forward or reverse position, the shifter (6) is slid to the rear or front by the mechanical linkage to be engaged with the spline boss 1 (7) or spline boss of 23T gear (3). Then, the power is transmitted to the 13T gear shaft (9).

Power is transmitted as follows.

■ Forward

Counter Shaft 2 (1) → Spline Boss 1 (7) → Shifter (6)
→ Spline Boss 2 (8) → 13T Gear Shaft (9).

■ Reverse

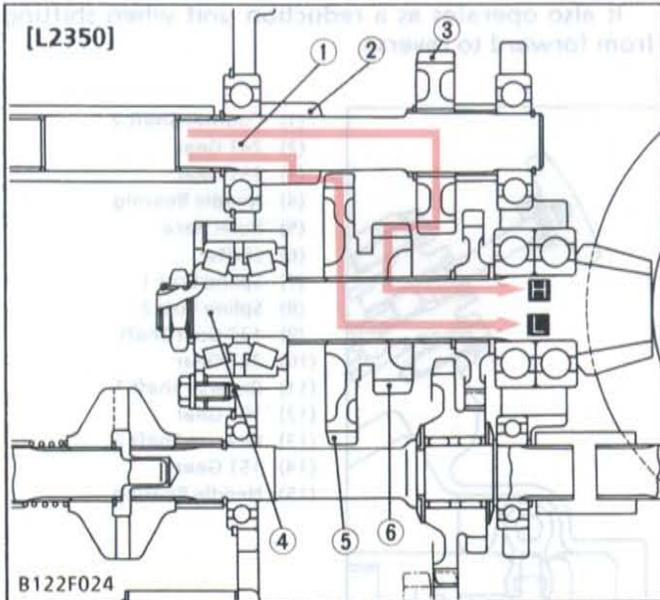
Counter Shaft 2 (1) → 24T Gear (2) → 22T Gear (10) →
Reverse Shaft 1 (11) → 19T Gear (12) → 15T Gear (14)
→ 23T Gear (3) → Shifter (6) → Spline Boss 2 (8) →
13T Gear Shaft (9).

■ IMPORTANT

- Do not shift the shuttle lever when the tractor is moving.

(3) Hi-Lo Range Shift Section

For L2350, L2650, L2950, L3450 and L3650



- | | |
|--------------------------------------|-------------------------|
| (1) Gear Shaft | (4) Spiral Bevel Pinion |
| (2) 12T Gear (2WD)
10T Gear (4WD) | (5) 48T Gear |
| (3) 31T Gear | (6) 29T Gear |

Besides neutral, two ways of power flow from the gear shaft (1) to the spiral bevel pinion (4) are available by operating the auxiliary gear shift lever.

Power is transmitted as follows.

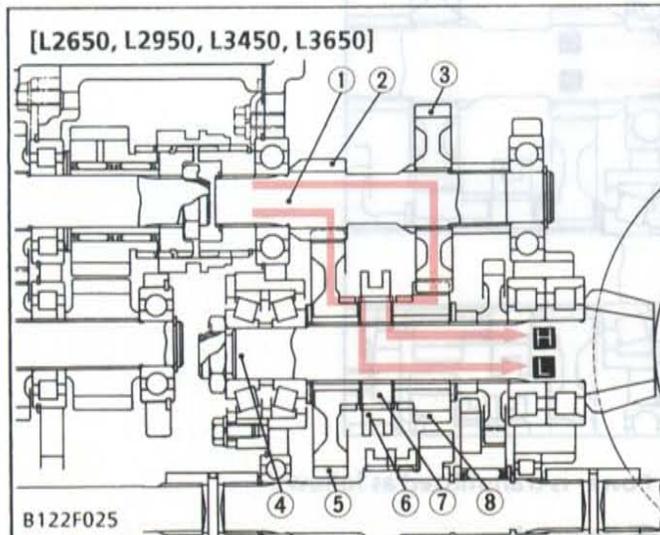
● L2350

■ Low Speed

Gear Shaft (1)-12T Gear or 10T Gear (2) → 48T Gear (5)-Spiral Bevel Pinion.

■ High Speed

Gear Shaft (1)-31T Gear (3) → 29T Gear (6)-Spiral Bevel Pinion.



- | | |
|-------------------------|-----------------|
| (1) Gear Shaft | (5) 45T Gear |
| (2) 13T Gear | (6) Shifter |
| (3) 28T Gear | (7) Spline Boss |
| (4) Spiral Bevel Pinion | (8) 20T Gear |

● L2650, L2950, L3450, L3650

■ Low Speed

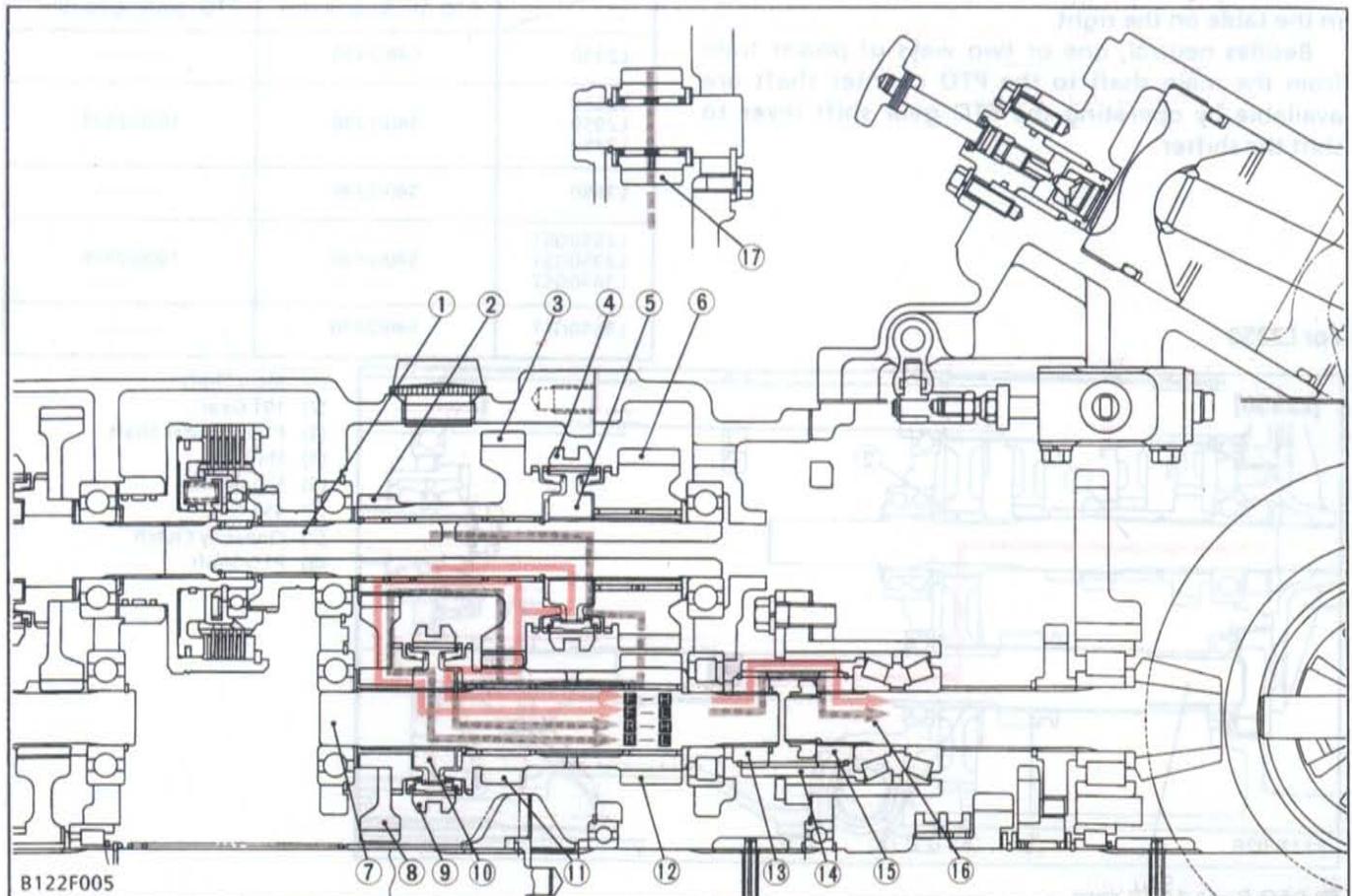
Gear Shaft (1)-13T Gear (2) → 45T Gear (5) → Shifter (6) → Spline Boss (7) → Spiral Bevel Pinion (4).

■ High Speed

Gear Shaft (1) → 28T Gear (3) → 20T Gear (8) → Shifter (6) → Spline Boss (7) → Spiral Bevel Pinion (4).

(4) Shuttle Shift and Hi-Lo Range Shift Section

For GST



- | | | | |
|---|-----------------|--|--------------------------|
| (1) Shuttle Shaft | (5) Hub | (10) Hub | (14) Coupling |
| (2) 17T Gear | (6) 27T Gear | (11) 17T Gear | (15) Spline Boss 2 |
| (3) 32T Gear (Only L2650GST)
33T Gear (other models) | (7) Hi-Lo Shaft | (12) 19T Gear (Only L2650GST)
18T Gear (Other models) | (16) Spiral Bevel Pinion |
| (4) Shifter | (8) 42T Gear | (13) Spline Boss 1 | (17) 23T Gear |
| | (9) Shifter | | |

They are used the synchromesh gears for the Hi-Lo shift and the shuttle shift gears.

Power is transmitted as follows.

■ Low Speed (Forward)

Shuttle Shaft (1) → Hub (5) → Shifter (4) → 32T Gear or 33T Gear (3) · 17T Gear (2) → 42T Gear (8) → Shifter (9) → Hub (10) → Hi-Lo Shaft (7) → Spline Boss 1 (13) → Coupling (14) → Spline Boss 2 (15) → Spiral Bevel Pinion (16).

■ High Speed (Forward)

Shuttle Shaft (1) → Hub (5) → Shifter (4) → 32T Gear or 33T Gear (3) · 17T Gear (11) → Shifter (9) → Hub (10) → Hi-Lo Shaft (7) → Spline Boss 1 (13) → Coupling (14) → Spline Boss 2 (15) → Spiral Bevel Pinion (16).

■ Low Speed (Reverse)

Shuttle Shaft (1) → Hub (5) → Shifter (4) → 27T Gear (6) → 23T Gear (17) → 19T Gear or 18T Gear (12) · 17T Gear (11) → 32T Gear or 33T Gear (3) · 17T Gear (2) → 42T Gear (8) → Shifter (9) → Hub (10) → Hi-Lo Shaft (7) → Spline Boss 1 (13) → Coupling (14) → Spline Boss 2 (15) → Spiral Bevel Pinion (16).

■ Higher Speed (Reverse)

Shuttle Shaft (1) → Hub (5) → Shifter (4) → 27T Gear (6) → 23T Gear (17) → 19T Gear or 18T Gear (12) · 17T Gear (11) → Shifter (9) → Hub (10) → Hi-Lo Shaft (7) → Spline Boss 1 (13) → Coupling (14) → Spline Boss 2 (15) → Spiral Bevel Pinion (16).

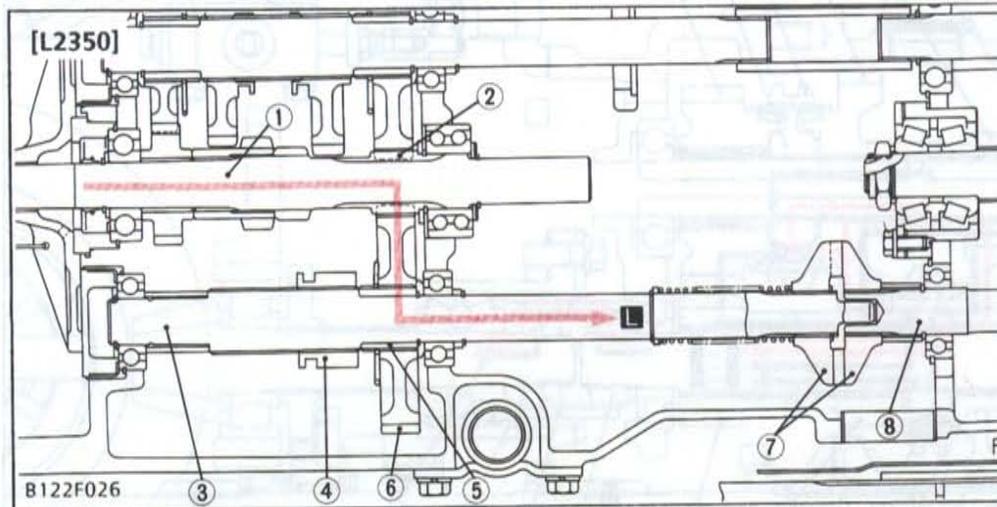
(5) Rear PTO Shift Section

The PTO system offers one or two speeds as shown in the table on the right.

Besides neutral, one or two ways of power train from the main shaft to the PTO counter shaft are available by operating the PTO gear shift lever to shift the shifter.

	Lower Speed PTO rpm/Engine rpm	Higher Speed PTO rpm/Engine rpm
L2350	540/2430	—
L2650 L2950 L3450	540/2298	1000/2438
L3650	540/2298	—
L2650GST L2950GST L3450GST	540/2430	1000/2438
L3650GST	540/2430	—

For L2350

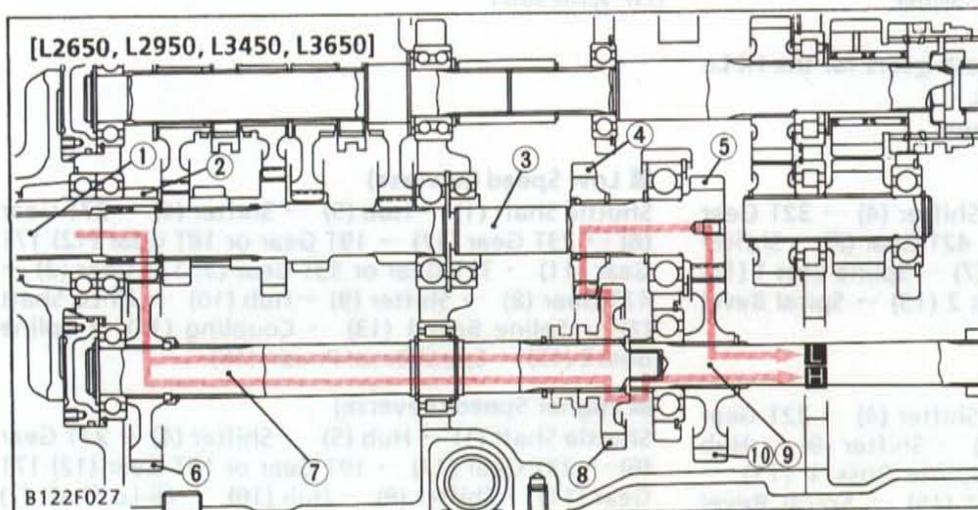


- (1) Main Shaft
- (2) 10T Gear
- (3) PTO Counter Shaft
- (4) Shifter
- (5) Spline Boss
- (6) 45T Gear
- (7) One-way Clutch
- (8) PTO Shaft

■ PTO Speed 540 rpm

Main Shaft (1) - 10T Gear (2) → 45T Gear (6) → Spline Boss (5) → Shifter (4) → PTO Counter Shaft (3) → One-way Clutch (7) → PTO Shaft (8).

For L2650, L2950, L3450 and L3650



- (1) Main Shaft
- (2) 16T Gear (L2650-L2950)
17T Gear (L3450-L3650)
- (3) PTO Gear Shaft
- (4) 18T Gear
- (5) 13T Gear (L2650-L2950)
12T Gear (L3450-L3650)
- (6) 39T Gear (L2650-L2950)
37T Gear (L3450-L3650)
- (7) PTO Counter Shaft 1
- (8) 23T Gear
- (9) PTO Counter Shaft 2
- (10) 29T Gear (L2650-L2950)
30T Gear (L3450-L3650)

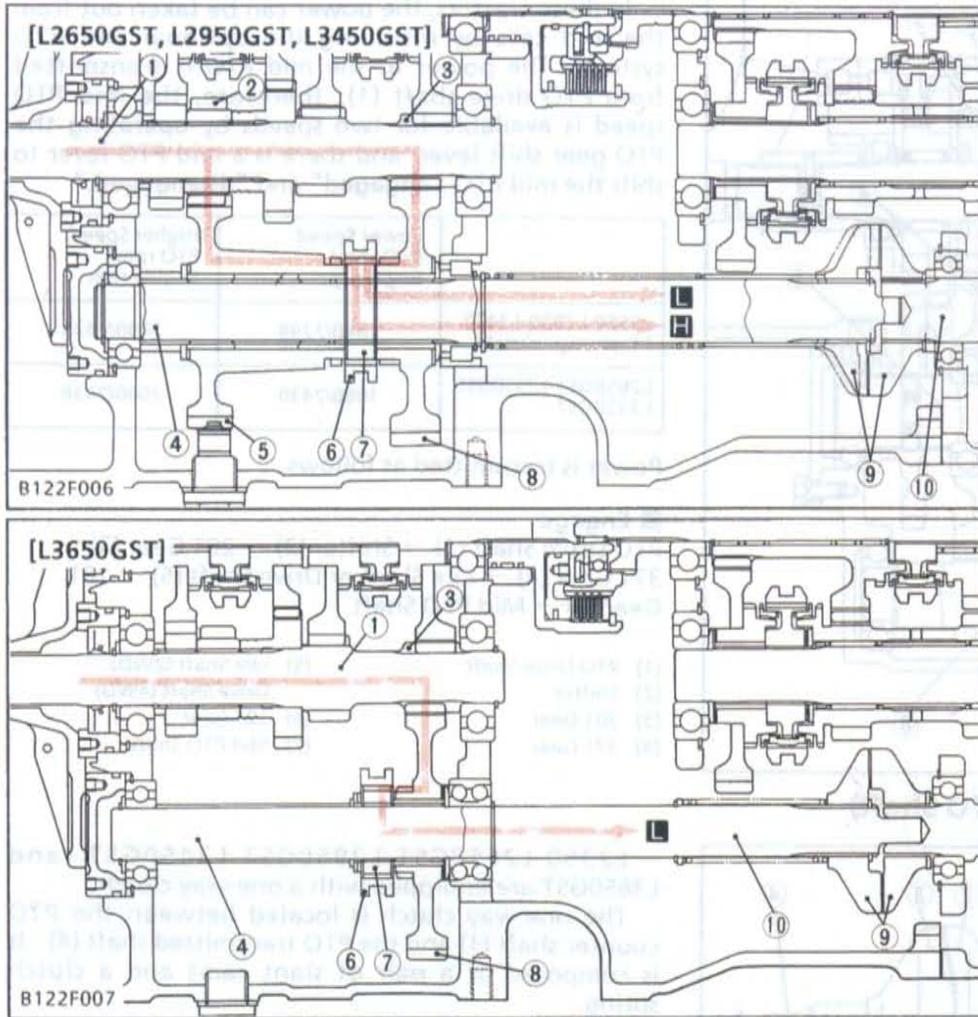
■ PTO Speed 540 rpm

16T Gear or 17T Gear (2) → 39T Gear or 37T Gear (6) → PTO Counter Shaft (7) → 23T Gear (8) → 18T Gear (4) → PTO Gear Shaft (3) → 13T Gear or 12T Gear (5) → 29T Gear or 30T Gear (10) → PTO Counter Shaft 2 (9) → PTO Shaft.

■ PTO Speed 1000 rpm

16T Gear or 17T Gear (2) → 39T Gear or 37T Gear (6) → PTO Counter Shaft 1 (7) → 23T Gear (8) → PTO Counter Shaft 2 (9) → PTO Shaft.

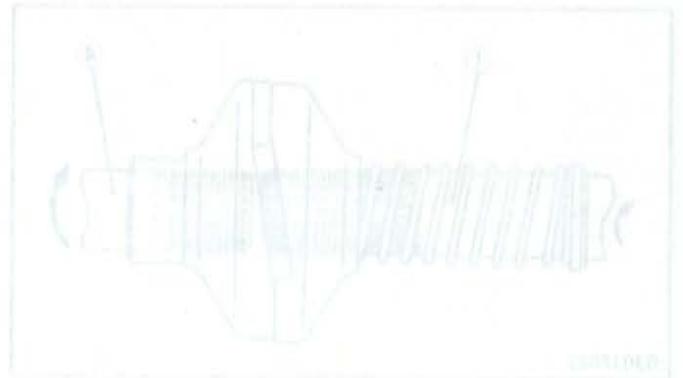
For L2650GST, L2950GST, L3450GST and L3650GST



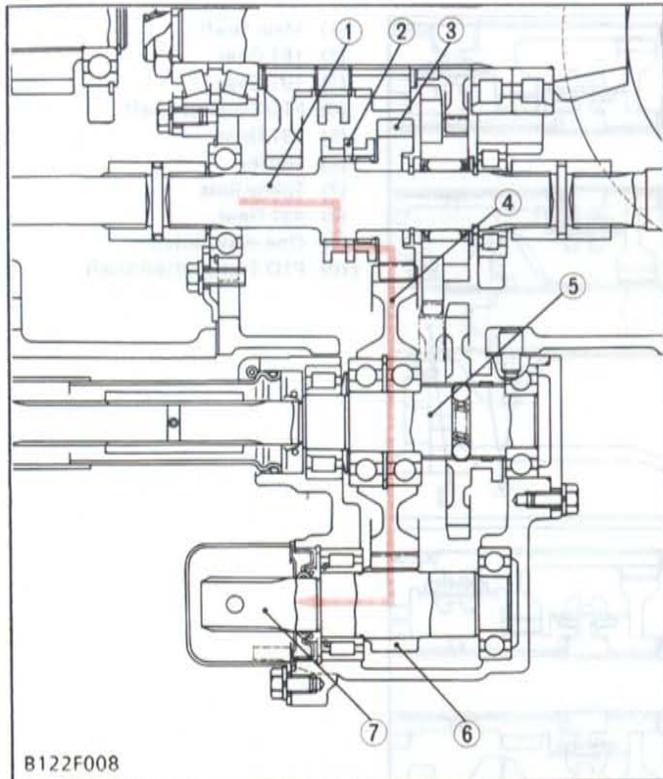
- (1) Main Shaft
- (2) 16T Gear
- (3) 10T Gear
- (4) PTO Counter Shaft
- (5) 39T Gear
- (6) Shifter
- (7) Spline Boss
- (8) 45T Gear
- (9) One-way Clutch
- (10) PTO Transmitted Shaft

■ **PTO Speed 540 rpm**
 Main Shaft (1)-10T Gear (3) → 45T Gear (8) → Shifter (6) → Spline Boss (7) → PTO Counter Shaft (4) → One-way Clutch (9) → PTO Transmitted Shaft (10) → PTO Drive Shaft → PTO Shaft.

■ **PTO Speed 1000 rpm**
 Main Shaft (1)-16T Gear (2) → 39T Gear (5) → Shifter (6) → Spline Boss (7) → PTO Counter Shaft (4) → One-way Clutch (9) → PTO Transmitted Shaft (10) → PTO Drive Shaft → PTO Shaft.



(6) Mid PTO Section (Option For L2650, L2950, L3450)



In these tractors, the power can be taken out from the mid case by installing the optional mid PTO system. The power to the mid PTO is transmitted from PTO drive shaft (1); therefore, the mid PTO speed is available for two speeds by operating the PTO gear shift lever, and there is a mid PTO lever to shift the mid PTO "engaged" and "disengaged."

	Lower Speed PTO rpm/ Engine rpm	Higher Speed PTO rpm/ Engine rpm
L2650 L2950 L3450 (dual stage clutch)	1080/2298	2000/2438
L2650GST L2950GST L3450GST	1080/2430	2000/2438

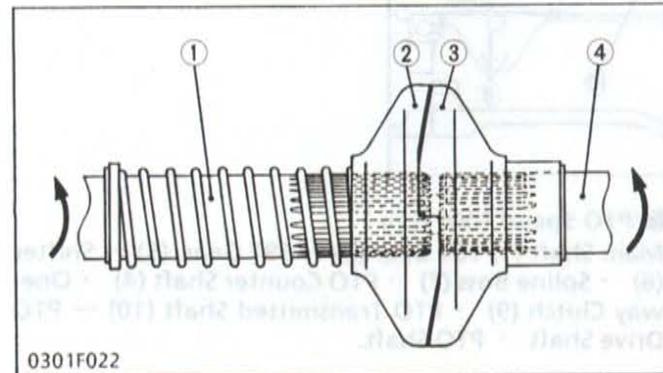
Power is transmitted as follows.

Engage

PTO Drive Shaft (1) → Shifter (2) → 20T Gear (3) → 37T Gear (4) → Idle Shaft or Drive Shaft (5) → 10T Gear (6) → Mid PTO Shaft.

- (1) PTO Drive Shaft
- (2) Shifter
- (3) 20T Gear
- (4) 37T Gear
- (5) Idle Shaft (2WD)
Drive Shaft (4WD)
- (6) 10T Gear
- (7) Mid PTO Shaft

(7) One-way Clutch (For PTO Shaft)

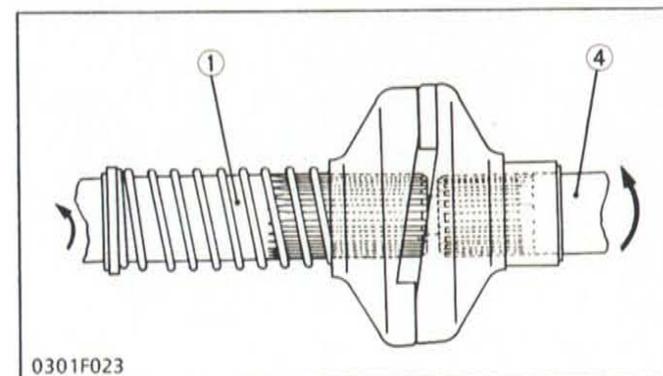


L2350 L2650GST L2950GST L3450GST and L3650GST are equipped with a one-way clutch.

The one-way clutch is located between the PTO counter shaft (1) and the PTO transmitted shaft (4). It is composed of a pair of slant cams and a clutch spring.

One of the slant cams is splined to the PTO counter shaft (1), and the other is splined to the PTO transmitted shaft (4).

These two slant cams are engaged with each other by the force of the clutch spring. While the PTO counter shaft is driving the PTO transmitted shaft, these two slant cams will remain engaged.

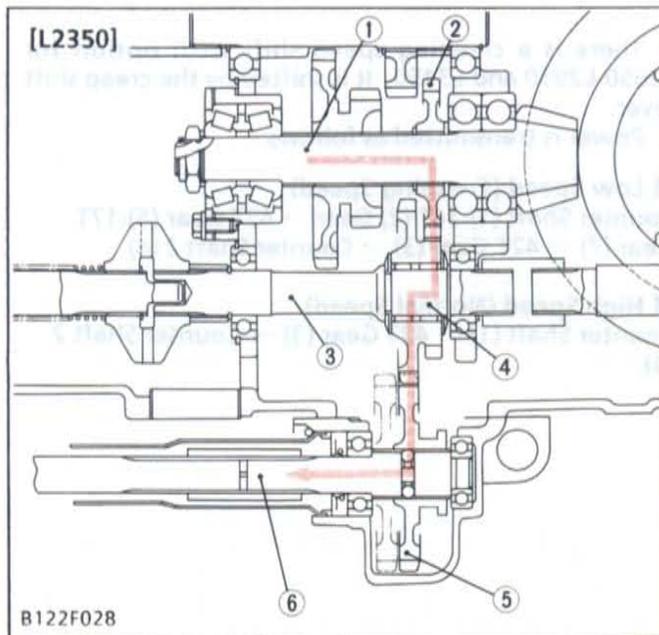


However, when the PTO shaft drives a rotary mower, for example, and if the engine speed is lowered, the slant cam on the PTO transmitted shaft will overrun.

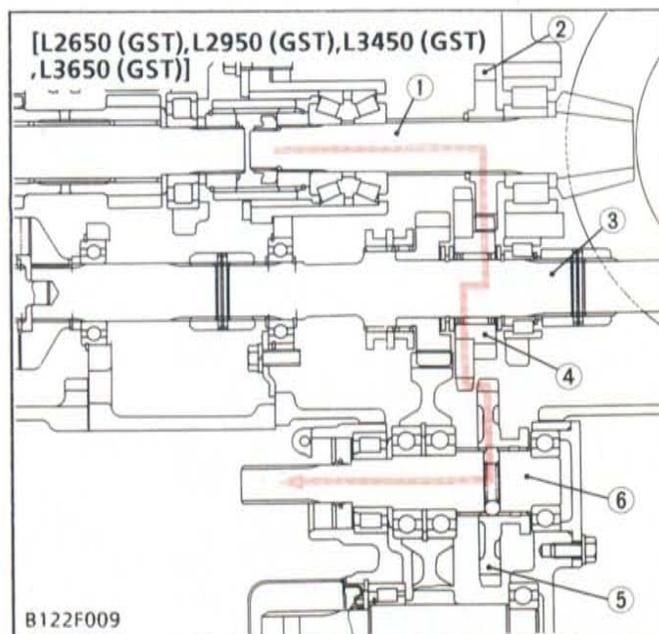
This overrunning is caused by the inertia of the mower's blades. Then, engagement will not take place until the PTO counter shaft is running faster than the PTO transmitted shaft.

In this way, the one-way clutch protects the transmission and engine against damage, by allowing the PTO shaft, PTO drive shaft and PTO transmitted shaft to overrun if PTO shaft overspeeds.

- (1) PTO Counter Shaft
- (2) Slant Cam
- (3) Slant Cam
- (4) PTO Transmitted Shaft

(8) Front Wheel Drive Section

- | | |
|-------------------------|----------------------------|
| (1) Spiral Bevel Pinion | (4) 18-34T Gears |
| (2) 24T Gear | (5) 33T Shift Gear |
| (3) PTO Drive Shaft | (6) Front Axle Drive Shaft |



2-wheel drive or 4-wheel drive is selected by operating the front wheel drive lever to shift the 33T or 35T shift gear (5).

When the front wheel drive lever is set to Disengage, 33T shift gear or 35T shift gear (5) is in neutral and power is not transmitted to the front axle drive shaft (6).

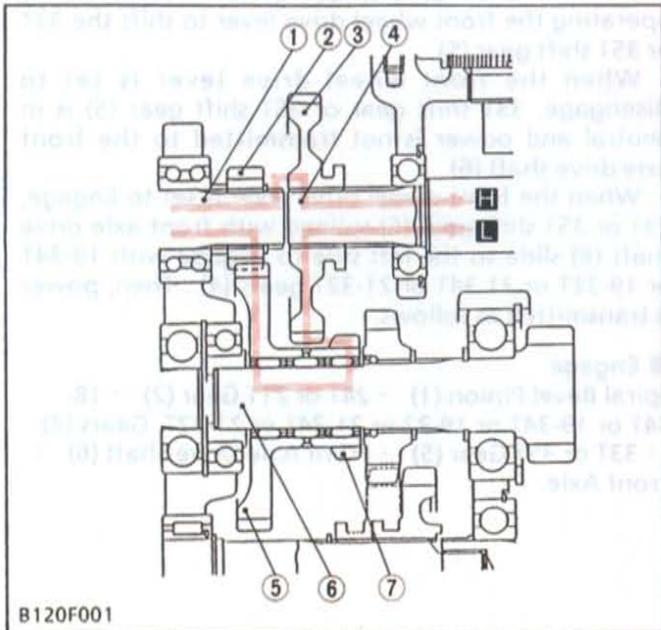
When the front wheel drive lever is set to Engage, 33T or 35T shift gear (5) splined with front axle drive shaft (6) slide to the left side to engage with 19-34T or 19-32T or 21-34T or 21-32T gears (4). Then, power is transmitted as follows.

■ Engage

Spiral Bevel Pinion (1) → 24T or 21T Gear (2) → 18-34T or 19-34T or 19-32 or 21-34T or 21-32T Gears (4)
 · 33T or 35T Gear (5) · Front Axle Drive Shaft (6) → Front Axle.

- | |
|--|
| (1) Spiral Bevel Pinion |
| (2) 24T Gear (L2650 L2950 L3450 L3650)
21T Gear (L2650GST-L2950GST-L3450GST-L3650GST) |
| (3) PTO Drive Shaft |
| (4) 19-34T Gears (L2650 L2950)
19-32T Gears (L3450 L3650)
21-34T Gears (L2650GST L2950GST)
21-32T Gears (L3450GST L3650GST) |
| (5) 33T Gear (L2650 L2950 L2650GST L2950GST)
35T Gear (L3450 L3650 L3450GST L3650GST) |
| (6) Front Axle Drive Shaft |

(9) Creeping Speed Shift Section (Option)



- | | |
|---------------------|--------------------|
| (1) Counter Shaft | (5) 45T Gear |
| (2) 14T Gear | (6) PTO Gear Shaft |
| (3) 42T Gear | (7) 17T Gear |
| (4) Counter Shaft 2 | |

There is a creeping speed shift with option for L2650-L2950 and L3450. It is shifted by the creep shift lever.

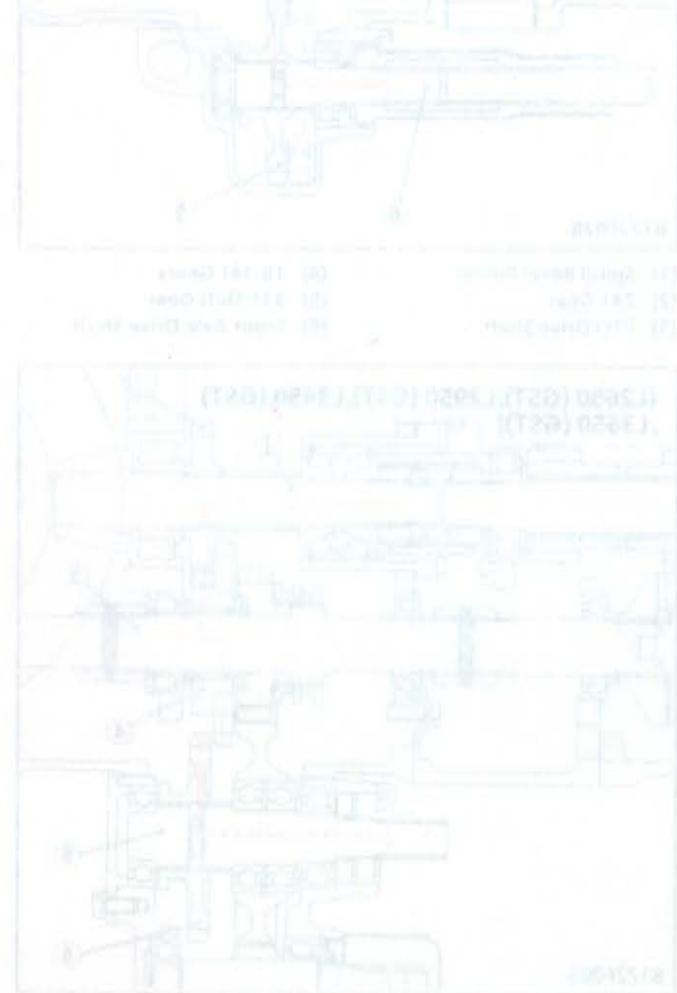
Power is transmitted as follows.

■ **Low Speed (Creeping Speed)**

Counter Shaft (1) · 14T (2) Gear → 45T Gear (5) · 17T Gear (7) → 42T Gear (3) → Counter Shaft 2 (4).

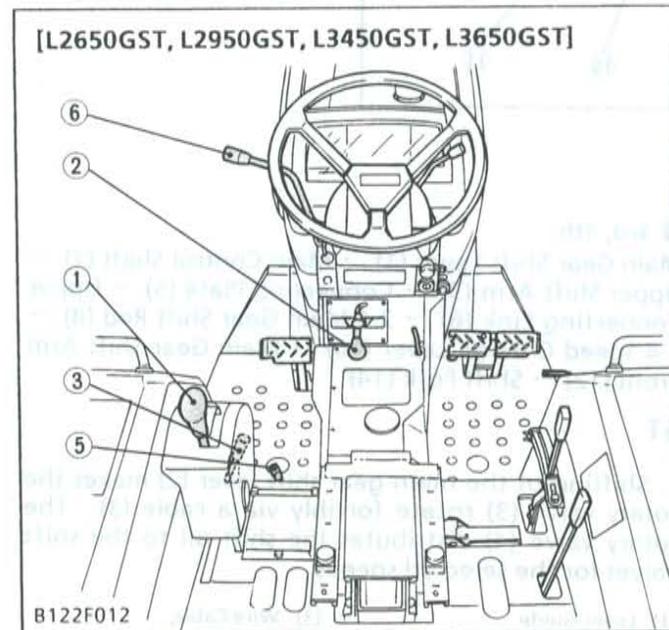
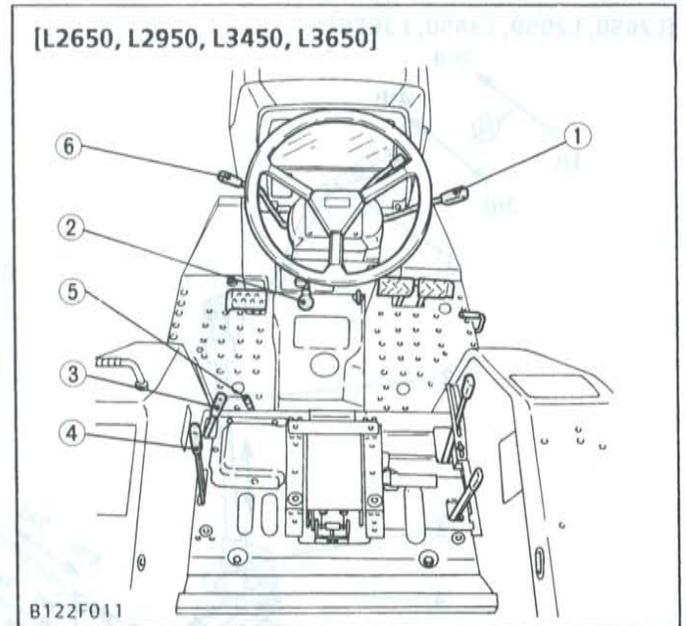
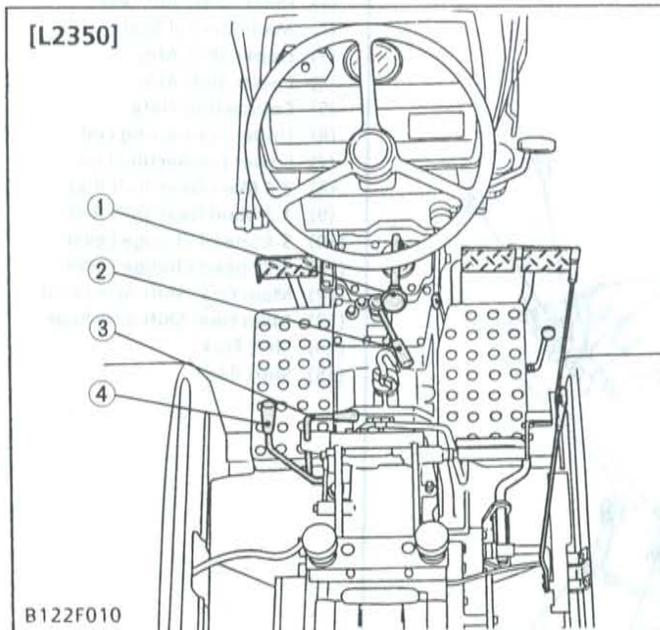
■ **High Speed (Normal Speed)**

Counter Shaft (1) → 42T Gear (3) → Counter Shaft 2 (4).



[2] SHIFT LINKAGE MECHANISM

(1) Shift Levers



- | | |
|-----------------------------|----------------------------|
| (1) Main Gear Shift Lever | (4) Hi-Lo Gear Shift Lever |
| (2) PTO Gear Shift Lever | (5) Mid PTO Lever |
| (3) Front Wheel Drive Lever | (6) Shuttle Shift Lever |

■ L2350

There are gear shift levers on the transmission case and they shift the gear shifters directly.

■ L2650-L2950-L3450-L3650

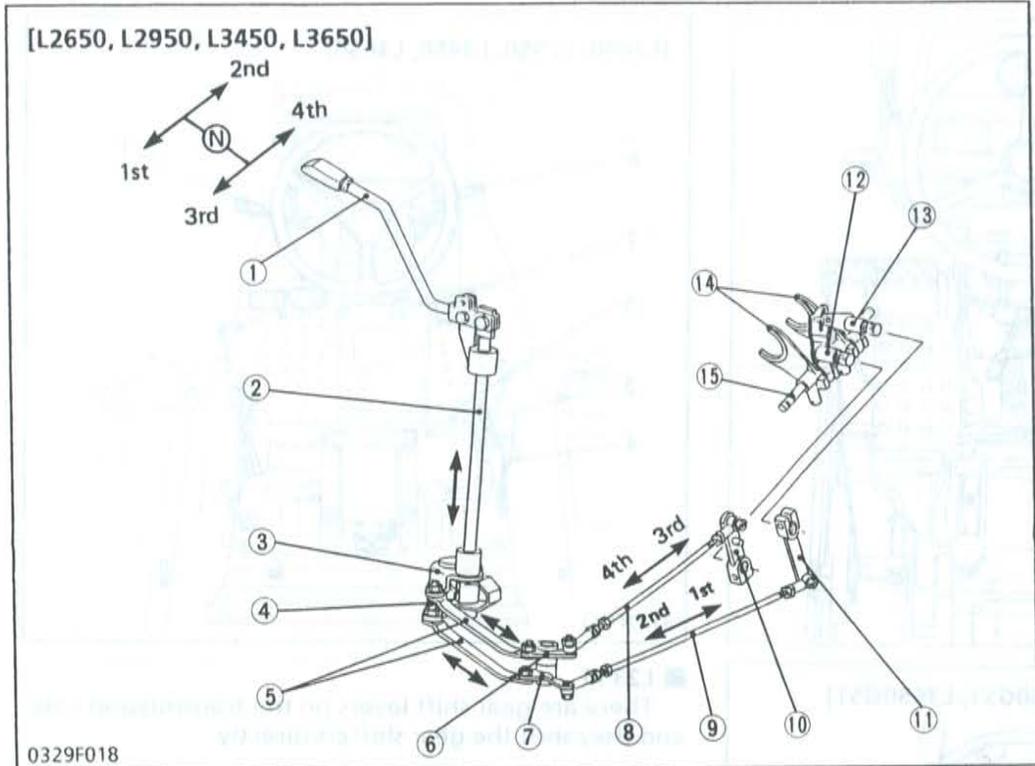
In these tractors, main gear shift lever and shuttle shift lever are arranged at the steering post. They allow for easy operating like the column shift of an

■ L2650GST-L2950GST-L3450GST-L3650GST

The shuttle lever is located at the steering post. The main shift lever is located left side of the seat and it shifts 1st to 8th gears. It is shifted by the rotary valve which is connected with the main shift lever by the shift wire cable.

(2) Main Gear Shift Lever

For L2650, L2950, L3450 and L3650



- (1) Main Gear Shift Lever
- (2) Main Control Shaft
- (3) Upper Shift Arm
- (4) Lower Shift Arm
- (5) Connecting Plate
- (6) Upper Connecting Link
- (7) Lower Connecting Link
- (8) 3-4 Main Gear Shift Rod
- (9) 1-2 Main Gear Shift Rod
- (10) 3-4 Speed Change Lever
- (11) 1-2 Speed Change Lever
- (12) Main Gear Shift Arm Front
- (13) Main Gear Shift Arm Rear
- (14) Shift Fork
- (15) Shift Rod

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The motion of main gear shift lever linkage as follows.

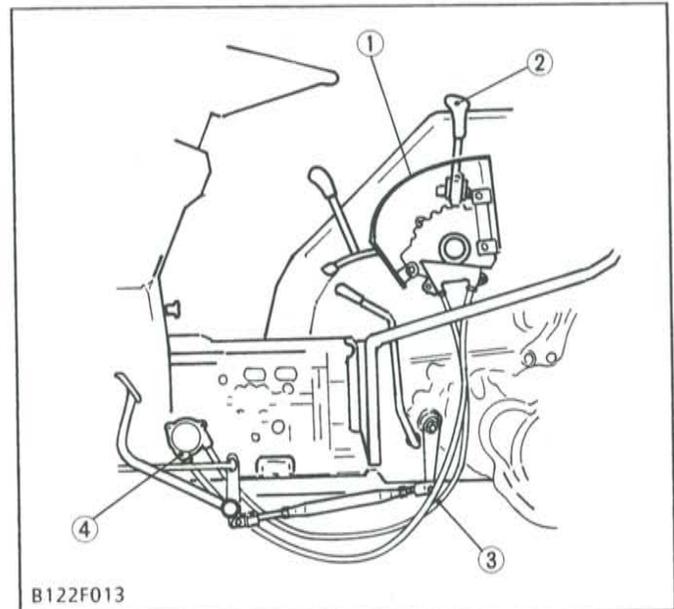
■ 1st, 2nd

Main Gear Shift Lever (1) → Main Control Shaft (2) → Lower Shift Arm (4) → Connecting Plate (5) → Lower Connecting Link (7) → 1-2 Main Gear Shift Rod (9) → 1-2 Speed Change Lever (11) → Main Gear Shift Arm Rear (13) → Shift Fork (14).

■ 3rd, 4th

Main Gear Shift Lever (1) → Main Control Shaft (2) → Upper Shift Arm (3) → Connecting Plate (5) → Upper Connecting Link (6) → 3-4 Main Gear Shift Rod (8) → 3-4 Speed Change Lever (10) → Main Gear Shift Arm Front (12) → Shift Fork (14).

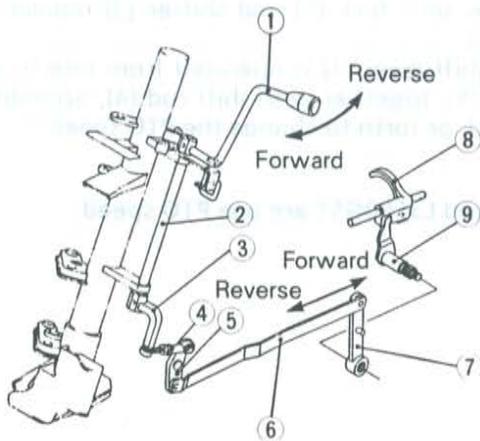
For L2650GST, L2950GST, L3450GST and L3650GST



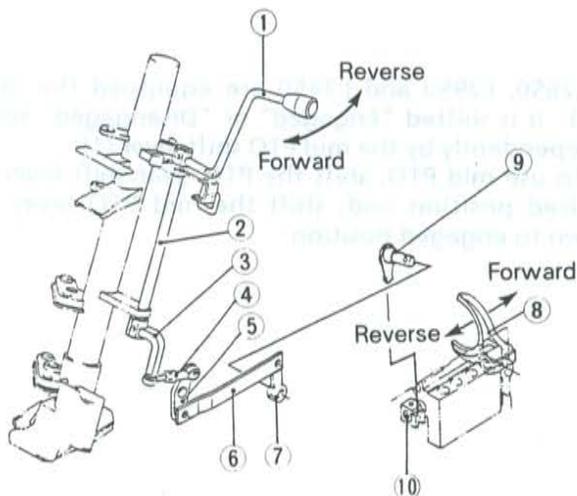
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Shifting of the main gear shift lever (2) makes the rotary valve (4) rotate forcibly via a cable (3). The rotary valve (4) distributes the shift oil to the shift valves for the selected speeds.

- (1) Lever Guide
- (2) Main Shift Lever
- (3) Wire Cable
- (4) Rotary Valve

(3) Shuttle Shift**[L2650, L2950, L3450, L3650]**

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[L2650GST, L2950GST, L3450GST, L3650GST]

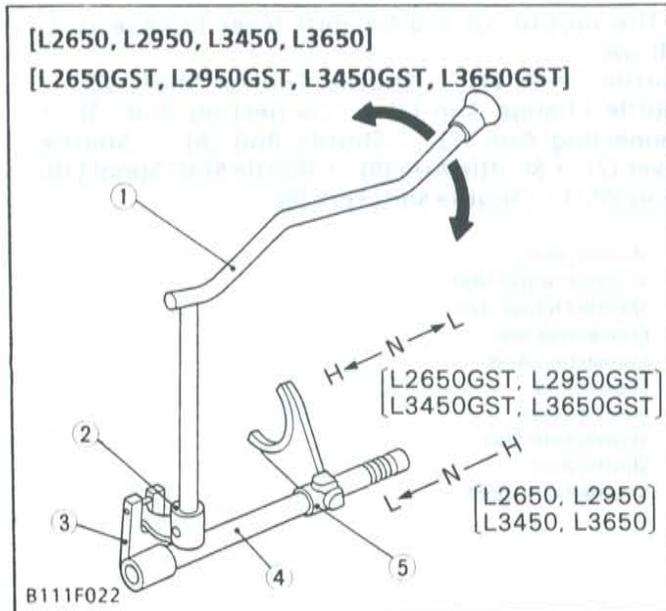
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The motion of shuttle shift lever linkage is as follows.

Shuttle Lever (1) → Shuttle Control Shaft (2) → Shuttle Change Arm (3) → Connecting Rod (4) → Connecting Arm (5) → Shuttle Rod (6) → Shuttle Lever (7) → Shuttle Arm (9) → Shuttle Shift Spool (10) (Only GST) → Shuttle Shift Fork (8).

- (1) Shuttle Lever
- (2) Shuttle Control Shaft
- (3) Shuttle Change Arm
- (4) Connecting Rod
- (5) Connecting Arm
- (6) Shuttle Rod
- (7) Shuttle Lever
- (8) Shuttle Shift Fork
- (9) Shuttle Arm
- (10) Shuttle Shift Spool

(4) PTO Shift



- (1) Shift Lever
- (2) Shift Arm
- (3) Shifter
- (4) Shift Rod
- (5) Shift Fork

The PTO shift offers one or two PTO speeds by the PTO shift lever.

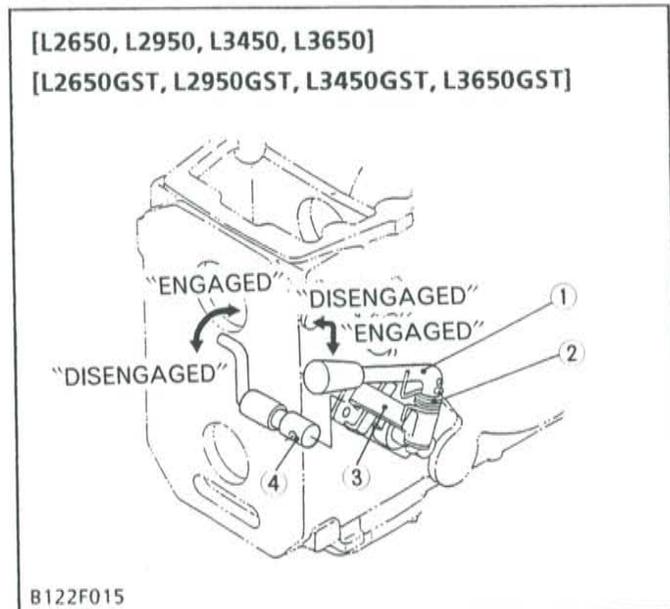
Shift lever (1) has shift arm (2) bolted to it. Shift rod (4) has shift fork (5) and shifter (3) individually bolted to it.

When shift lever (1) is operated from side to side, shift fork (5), together with shift rod (4), accordingly moves back or forth to change the PTO speed.

■ NOTE

- L3650 and L3650GST are one PTO speed.

(5) Mid PTO Shift (Option)



- (1) Mid PTO Lever 1
- (2) Spring
- (3) Mid PTO Lever 2
- (4) Shift Lever

L2650, L2950 and L3450 are equipped the mid-PTO. It is shifted "Engaged" or "Disengaged" semi-independently by the mid PTO shift lever (1).

To use mid PTO, shift the PTO gear shift lever to desired position and, shift the mid PTO lever (1) down to engaged position.

[3] GLIDE SHIFT TRANSMISSION

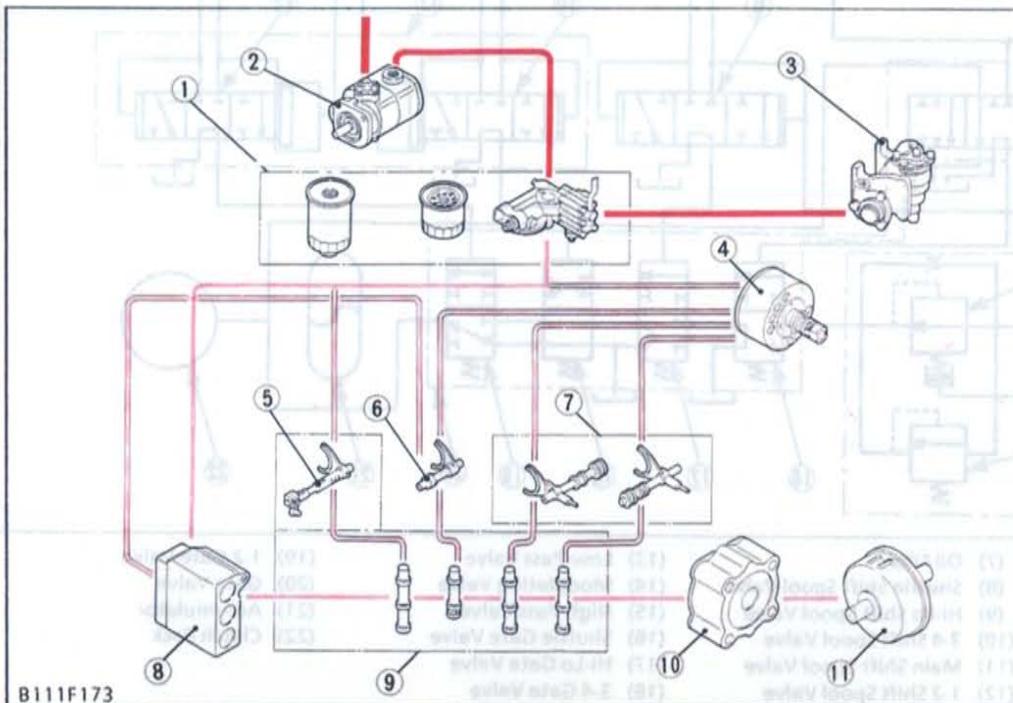
(1) Shift Mechanism

KUBOTA GST eliminates the need to operate a clutch. Axial efficiency and transmission of power to the PTO remain virtually unchanged with the gear shift transmission.

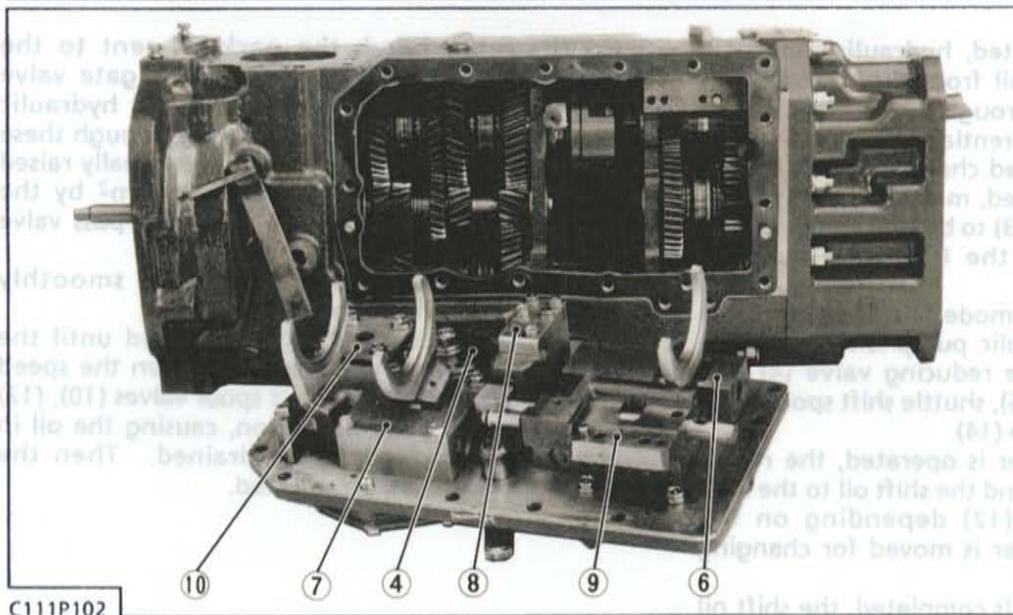
It is consisted with the full-synchromesh gears, one hydraulic clutch and the shift spool valves.

The GST replaces clutch operation with hydraulic pressure. When the operator moves the Speed Change Lever, the GST instantly and automatically performs the correct series of movements.

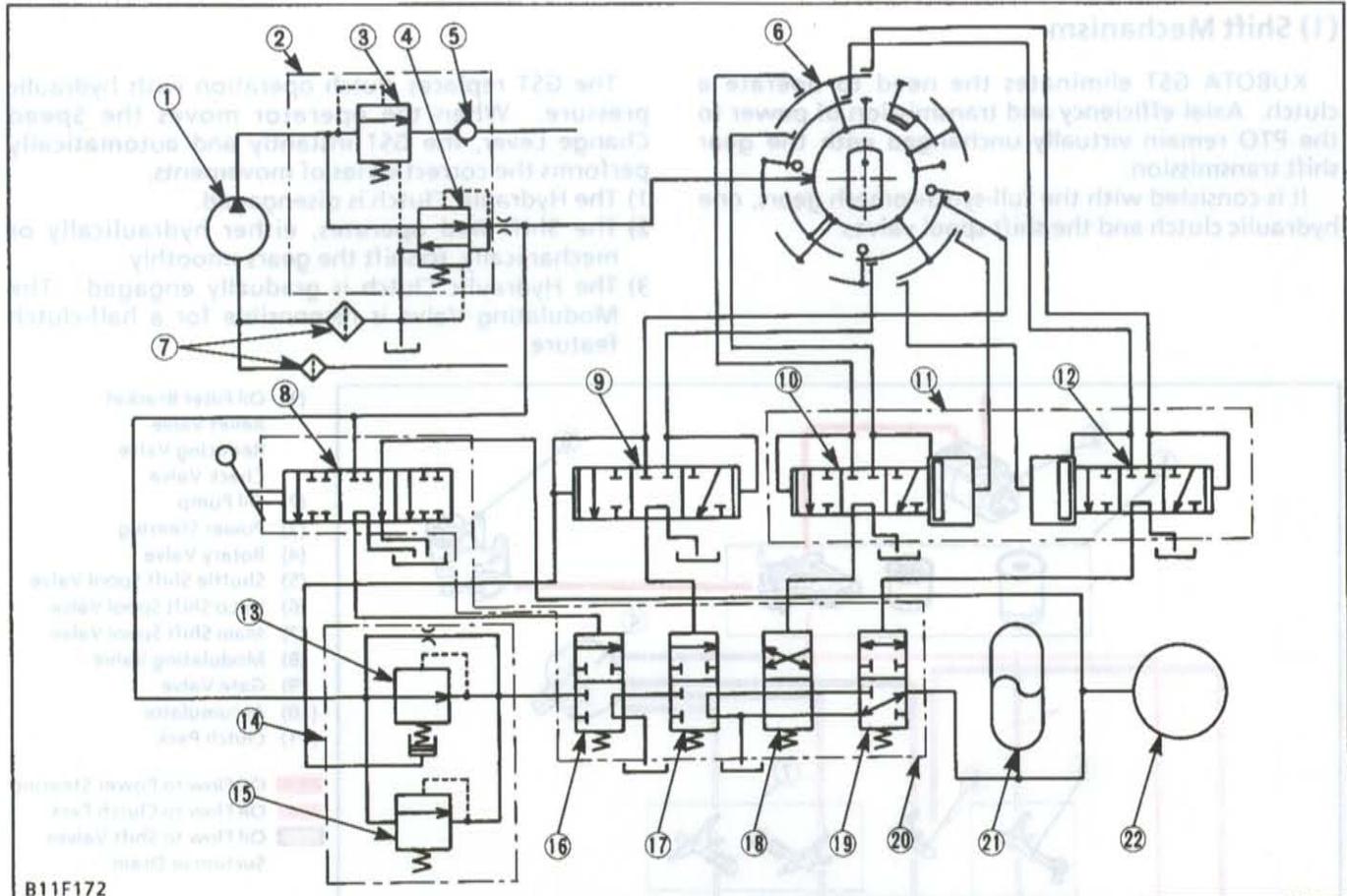
- 1) The Hydraulic Clutch is disengaged.
- 2) The Shift Rod operates, either hydraulically or mechanically, to shift the gears smoothly.
- 3) The Hydraulic Clutch is gradually engaged. The Modulating Valve is responsible for a half-clutch feature.



- (1) Oil Filter Bracket
 - (2) Relief Valve
 - (3) Reducing Valve
 - (4) Check Valve
 - (5) Oil Pump
 - (6) Power Steering
 - (7) Rotary Valve
 - (8) Shuttle Shift Spool Valve
 - (9) Hi-Lo Shift Spool Valve
 - (10) Main Shift Spool Valve
 - (11) Modulating Valve
 - (12) Gate Valve
 - (13) Accumulator
 - (14) Clutch Pack
- █ Oil Flow to Power Steering
█ Oil Flow to Clutch Pack
█ Oil Flow to Shift Valves
█ Suction or Drain



(2) Hydraulic Circuit Diagram

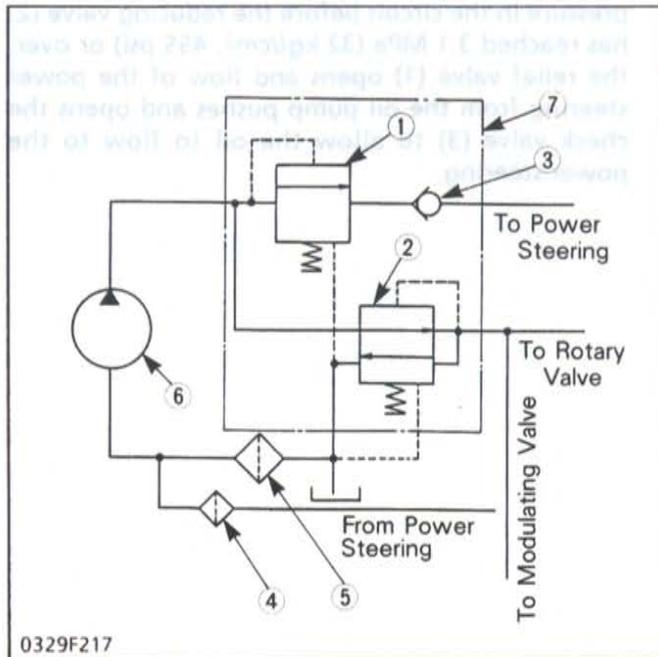


- | | | | |
|--------------------|-------------------------------|-------------------------|---------------------|
| (1) Hydraulic Pump | (7) Oil Filter | (13) Low-Pass Valve | (19) 1-2 Gate Valve |
| (2) Filter Bracket | (8) Shuttle Shift Spool Valve | (14) Modulating Valve | (20) Gate Valve |
| (3) Relief Valve | (9) Hi-Lo Shift Spool Valve | (15) High-Pass Valve | (21) Accumulator |
| (4) Reducing Valve | (10) 3-4 Shift Spool Valve | (16) Shuttle Gate Valve | (22) Clutch Pack |
| (5) Check Valve | (11) Main Shift Spool Valve | (17) Hi-Lo Gate Valve | |
| (6) Rotary Valve | (12) 1-2 Shift Spool Valve | (18) 3-4 Gate Valve | |

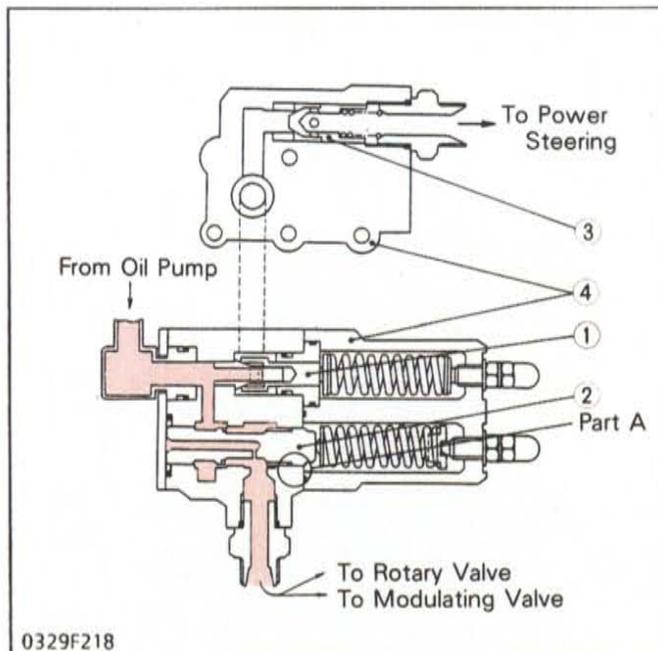
- When the engine is started, hydraulic pump (1) starts and sucks in the oil from the transmission case. The oil is filtered through the oil filter (7).
- The filtered oil is preferentially sent to the GST circuit with the GST speed change mode. Except during changing the speed, most of the oil passes through the relief valve (3) to be sent to the power steering circuit, while the GST side is simply pressurized.
- In the GST speed change mode, the pressure of the oil sent from the hydraulic pump is regulated to about 24 kgf/cm² by the reducing valve (4) and sent to the rotary valve (6), shuttle shift spool valve (8), and modulating valve (14).
- When the GST shift lever is operated, the rotary valve (6) is actuated to send the shift oil to the shift spool valves (9), (10), (12) depending on the operation, and the shifter is moved for changing speeds.
- When the speed change is completed, the shift oil is sent to the gate valve (20), depending on the operation and the gate valves (16), (17), (18), (19), are opened.
- On the other hand, the pack oil sent to the modulating valve flows through the gate valve and sent to the accumulator (21) and hydraulic clutch (22). While the oil is flowing through these components, the pressure of oil is gradually raised to the set pressure of about 24 kgf/cm² by the action of the low-pass valve (13), high-pass valve (15) and accumulator.
- Therefore, the hydraulic clutch is smoothly connected with less shock.
- The hydraulic clutch is kept connected until the next speed changing is started. When the speed changing is started, the shift spool valves (10), (12) are set to the neutral position, causing the oil in the hydraulic clutch to be drained. Then the hydraulic clutch is disconnected.

(3) Oil Flow

(3)-1 Oil Filter Bracket



- | | |
|---|---------------------------------|
| (1) Relief Valve, 3.1 to 3.2 MPa
(32.0 to 33.0 kgf/cm ² , 455 to 469 psi) | (4) Paper Filter Cartridge |
| (2) Reducing Valve, 2.4 to 2.5 MPa
(24.0 to 25.0 kgf/cm ² , 341 to 356 psi) | (5) Oil Filter Cartridge |
| (3) Check Valve | (6) Oil Pump |
| | (7) Oil Filter Bracket Assembly |



- | | |
|---|-------------------------|
| (1) Relief Valve, 3.1 to 3.2 MPa
(32.0 to 33.0 kgf/cm ² , 455 to 469 psi) | (3) Check Valve |
| (2) Reducing Valve, 2.4 to 2.5 MPa
(24.0 to 25.0 kgf/cm ² , 341 to 356 psi) | (4) Reducing Valve Body |

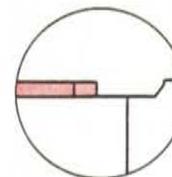
Function

1. The oil filter bracket assembly (7) is directly mounted on the oil pump and comprises the relief valve (1), reducing valve (2), and check valve (3).
2. Oil flow from the oil pump (6) is only distributed to GST system circuit for a moment when changing the speed of the tractor. Normally, the oil flows to the power steering.
3. Part of the power steering oil is used as the GST system oil. A relief valve (1) is installed in the power steering circuit to set the oil pressure at approximately 3.1 MPa (32 kgf/cm², 455 psi) so that the GST system pressure is maintained at approximately 2.4 MPa (24 kgf/cm², 341 psi) by the reducing valve (2).
4. Check valve (3) prevents to drop the power steering oil pressure in the circuit in a moment while shifting.

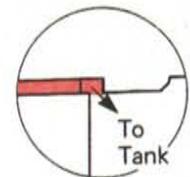
■ GST System Pressure from 0 to 2.4 MPa (0 to 24 kgf/cm², 0 to 341 psi)

1. The flow of the power steering oil pump passes through the reducing valve (2) into the GST system circuit until reaches 2.4 MPa (24 kgf/cm², 341 psi).
2. When oil pressure reaches to 2.4 MPa (24 kgf/cm², 341 psi). The reducing valve (2) moves to right side and it closes the way of oil flow to GST system circuit.
3. When the GST system circuit pressure rises excessively, the safety circuit of the reducing valve (2) actuates to protect the GST system circuit.

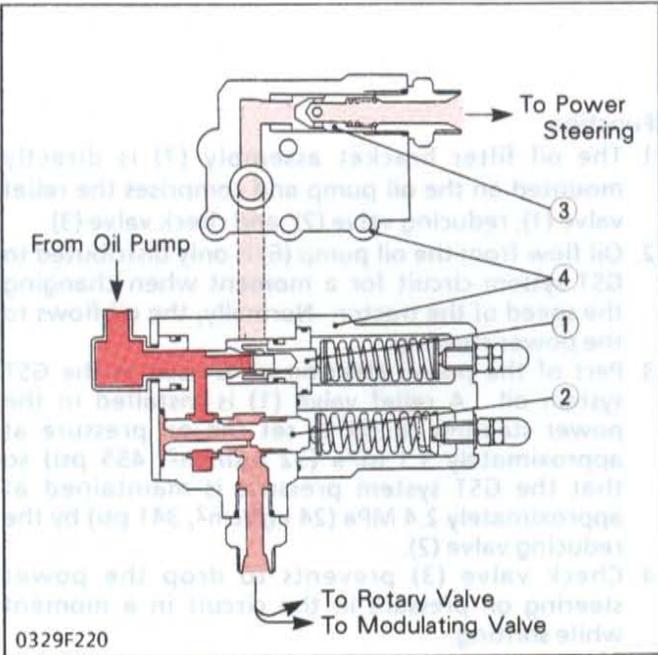
Part A
(Under normal pressure)



Part A
(Under excessive pressure)



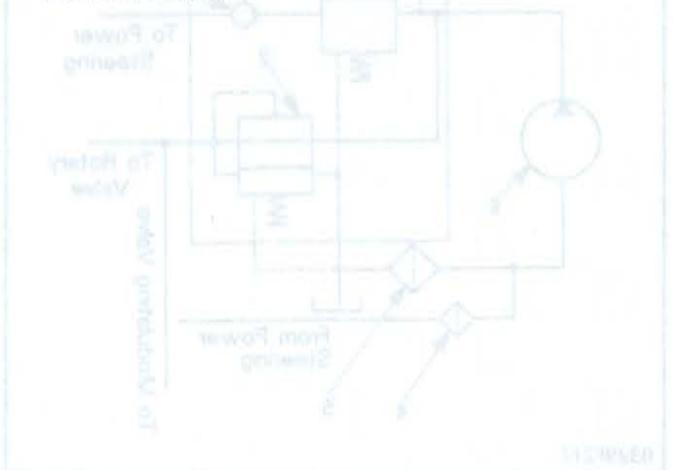
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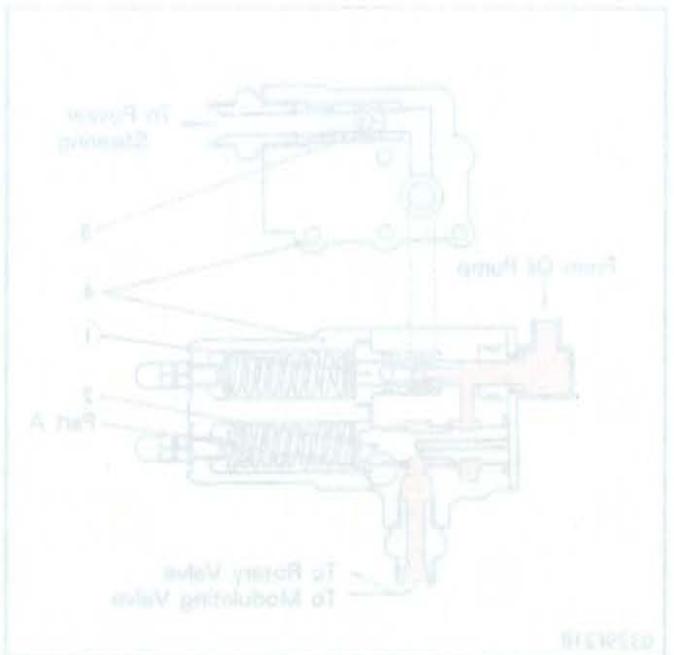
- (1) Relief Valve, 3.1 to 3.2 MPa (32.0 to 33.0 kgf/cm², 455 to 469 psi)
- (2) Reducing Valve, 2.4 to 2.5 MPa (24.0 to 25.0 kgf/cm², 341 to 356 psi)
- (3) Check Valve
- (4) Reducing Valve Body

■ When the Speed is not being changed (during Normal Operation)

1. When the reducing valve (2) is closed and the pressure in the circuit before the reducing valve (2) has reached 3.1 MPa (32 kgf/cm², 455 psi) or over, the relief valve (1) opens and flow of the power steering from the oil pump pushes and opens the check valve (3) to allow the oil to flow to the power steering.

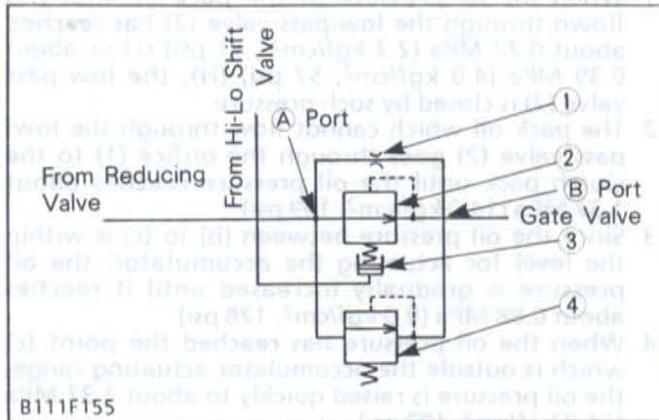


- (1) Relief Valve, 3.1 to 3.2 MPa (32.0 to 33.0 kgf/cm², 455 to 469 psi)
- (2) Reducing Valve, 2.4 to 2.5 MPa (24.0 to 25.0 kgf/cm², 341 to 356 psi)
- (3) Check Valve



- (1) Relief Valve, 3.1 to 3.2 MPa (32.0 to 33.0 kgf/cm², 455 to 469 psi)
- (2) Reducing Valve, 2.4 to 2.5 MPa (24.0 to 25.0 kgf/cm², 341 to 356 psi)
- (3) Check Valve

(3)-2 Modulating Valve (Cut-Off Valve)

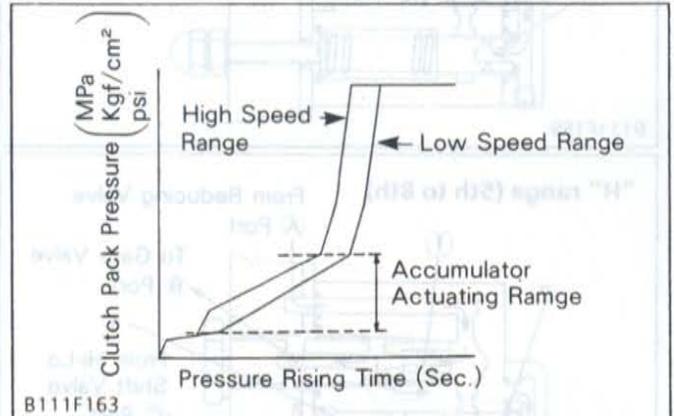


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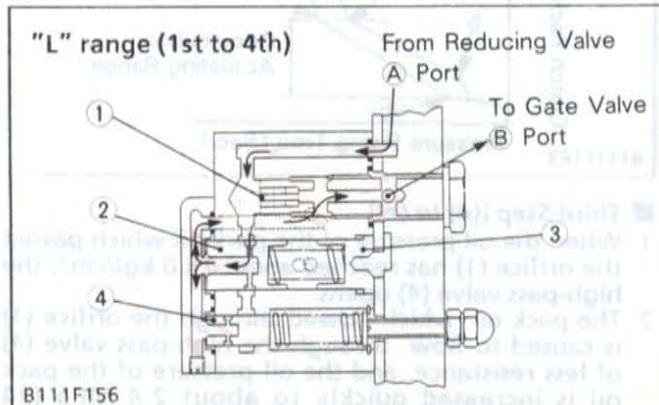
- (1) Orifice
- (2) Low-Pass Valve
- (3) Low-Pass Piston
- (4) High-Pass Valve

Function

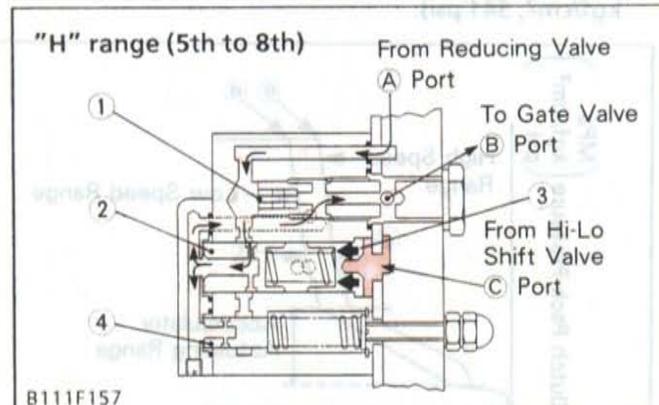
1. The modulating valve makes to reduce starting shock of the tractor by smooth clutch connecting.
2. The pressure in the clutch pack increases as follows in the figure below for smooth starting by the modulating valve. Furthermore pressure rising times are different between "L" (1st to 4th) and "H" (5th to 8th) for better starting.



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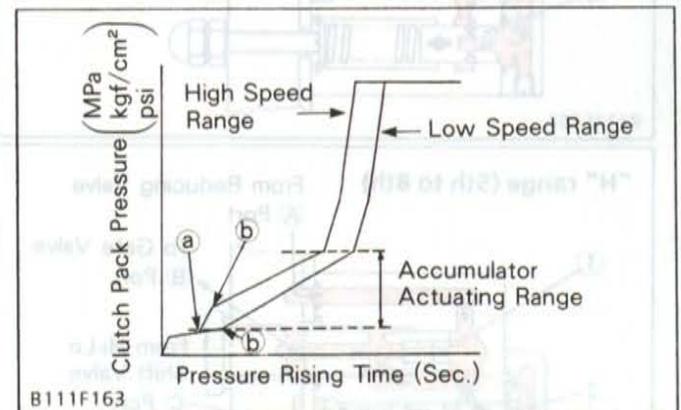


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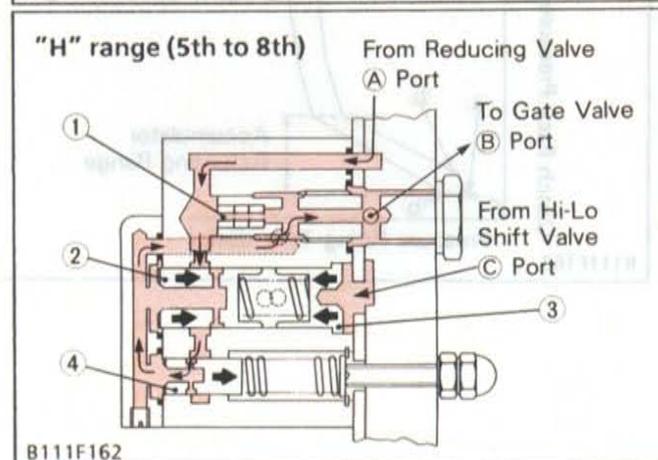
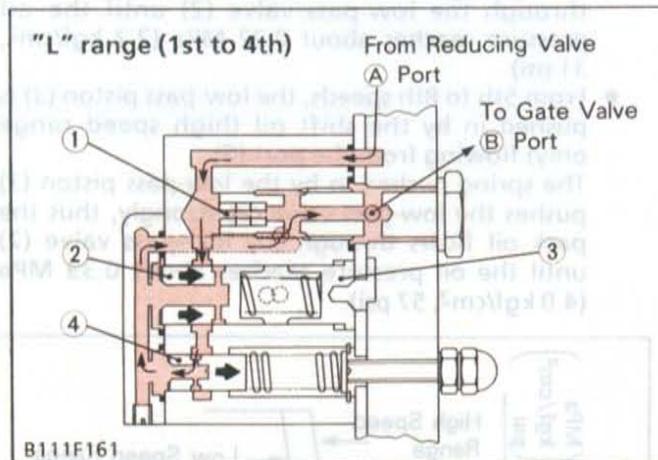
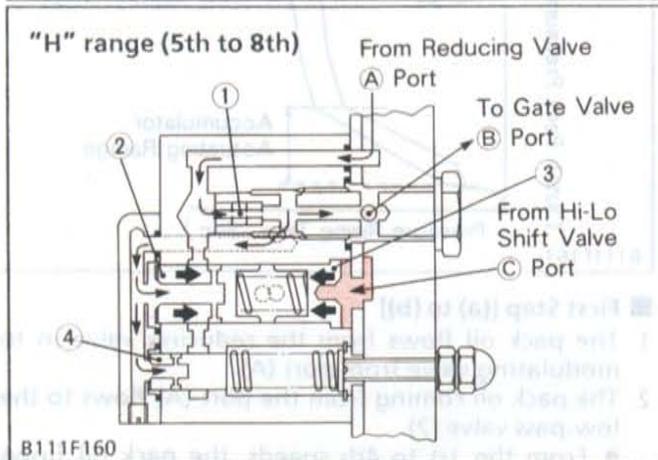
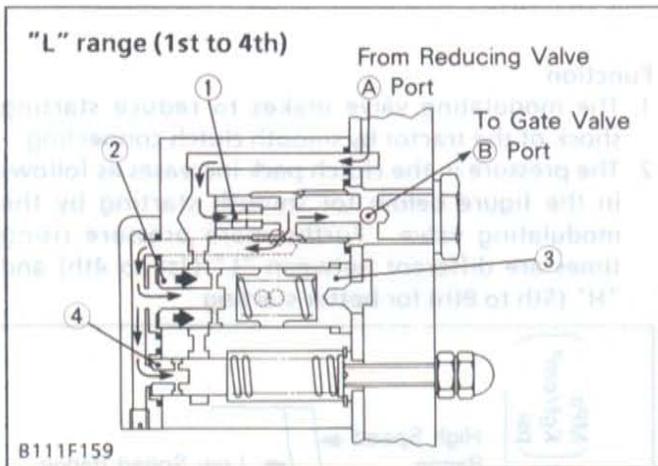
- (1) Orifice
- (2) Low-Pass Valve
- (3) Low-Pass Piston
- (4) High-Pass Valve

First Step [(a) to (b)]

1. The pack oil flows from the reducing valve in to modulating valve from port (A).
2. The pack oil coming from the port (A) flows to the low-pass valve (2).
 - From the 1st to 4th speeds, the pack oil flows through the low-pass valve (2) until the oil pressure reaches about 0.22 MPa (2.2 kgf/cm², 31 psi).
 - From 5th to 8th speeds, the low-pass piston (3) is pushed in by the shift oil (high speed range only) flowing from the port (C). The spring pushed in by the low-pass piston (3) pushes the low-pass valve (2) strongly, thus the pack oil flows through the low-pass valve (2) until the oil pressure reaches about 0.39 MPa (4.0 kgf/cm², 57 psi).

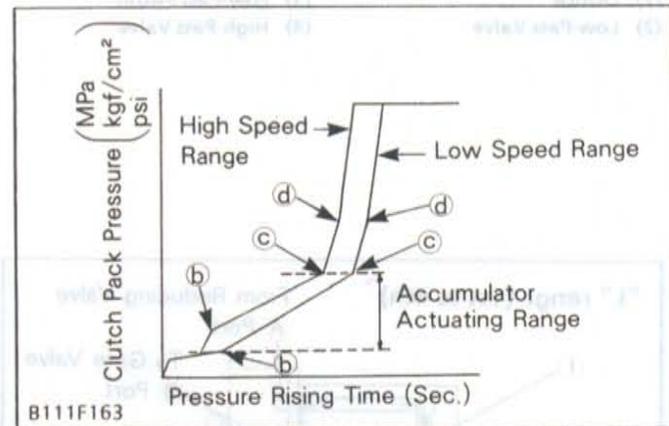


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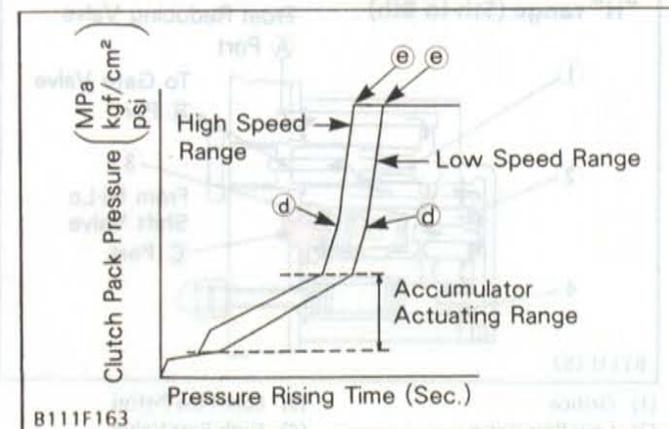
Second Step [(b) to (d)]

1. When the oil pressure of the pack oil that has flown through the low-pass valve (2) has reached about 0.22 MPa (2.2 kgf/cm², 31 psi) (L) or about 0.39 MPa (4.0 kgf/cm², 57 psi) (H), the low-pass valve (2) is closed by such pressure.
2. The pack oil (2) which cannot flow through the low-pass valve (2) goes through the orifice (1) to the clutch pack until the oil pressure reaches about 1.37 MPa (14.0 kgf/cm², 199 psi).
3. Since the oil pressure between (b) to (c) is within the level for actuating the accumulator, the oil pressure is gradually increased until it reaches about 0.88 MPa (9.0 kgf/cm², 128 psi).
4. When the oil pressure has reached the point (c) which is outside the accumulator actuating range, the oil pressure is raised quickly to about 1.37 MPa (14.0 kgf/cm², 199 psi)



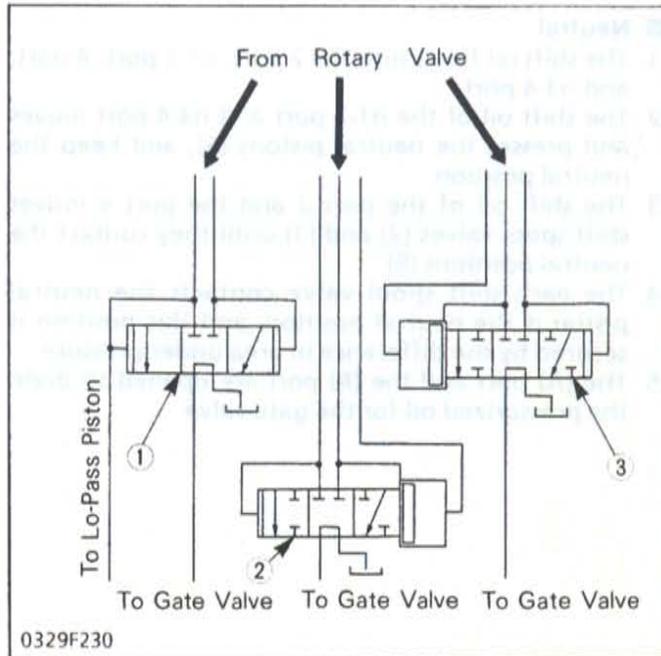
Third Step [(d) to (e)]

1. When the oil pressure of the pack oil which passed the orifice (1) has reached about 14.0 kgf/cm², the high-pass valve (4) opens.
2. The pack oil which flowed through the orifice (1) is caused to flow through the high-pass valve (4) of less resistance, and the oil pressure of the pack oil is increased quickly to about 2.4 MPa (24 kgf/cm², 341 psi).



- | | |
|--------------------|---------------------|
| (1) Orifice | (3) Low-Pass Piston |
| (2) Low-Pass Valve | (4) High-Pass Valve |

(3)-3 Hi-Lo Shift Spool Valve and Main Shift Valve Assembly

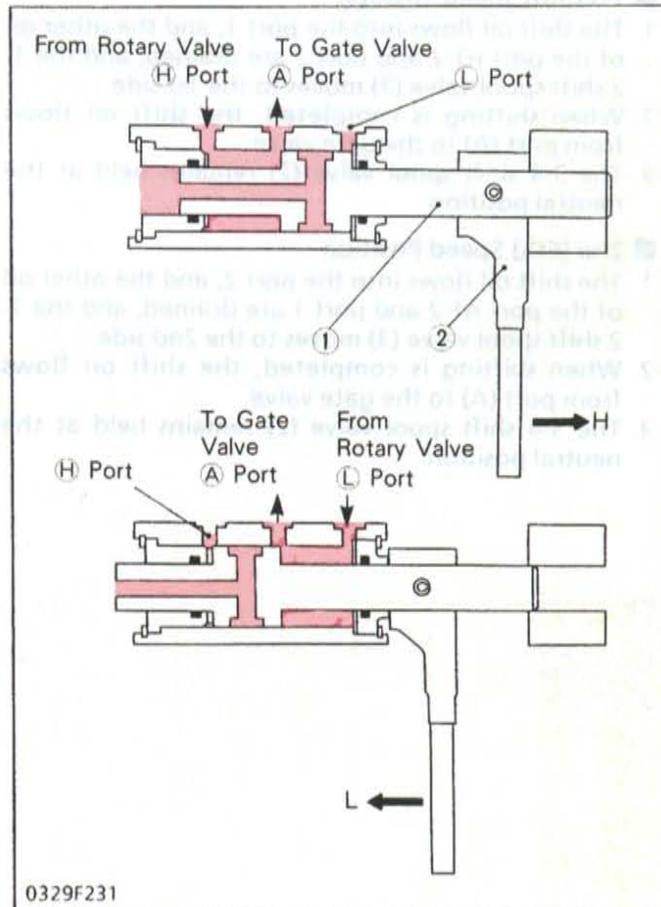


(1) Hi-Lo Shift Spool Valve (3) 1-2 Shift Spool Valve
 (2) 3-4 Shift Spool Valve

Function

1. The shift oil distributed by the rotary valve assembly actuates the Hi-Lo shift spool valve (1), 3-4 shift spool valve (2), and 1-2 shift spool valve (3).
2. Each shift spool valve is equipped with a shift fork to move shifters for shifting speed.
3. When shifting is completed, the shift oil flows to the gate valves.

Hi-Lo Shift Spool Valve



(1) Hi-Lo Shift Spool Valve (2) Shift Fork

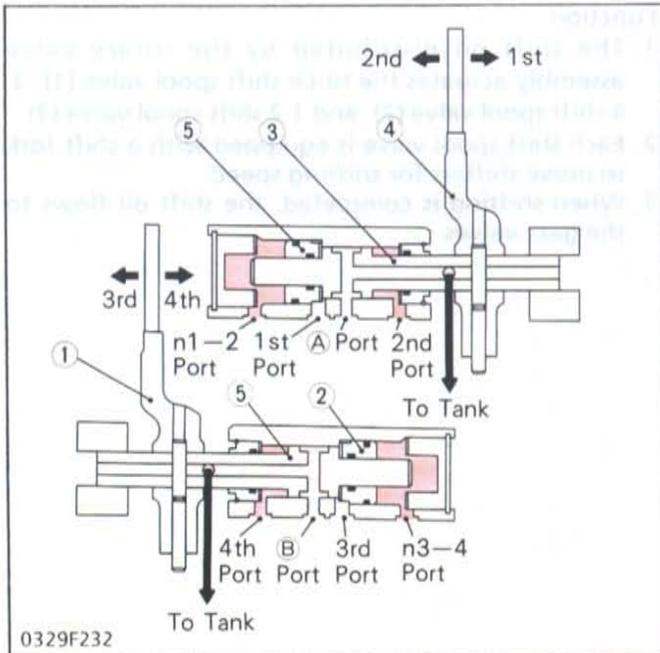
■ **At Low Speed (1st, 2nd, 3rd and 4th shift)**

1. The shift oil flows into port (L), and the Hi-Lo shift spool valve (1) shift to the Lo side.
2. When shifting is completed, the shift oil flows from port (A) to the gate valve.

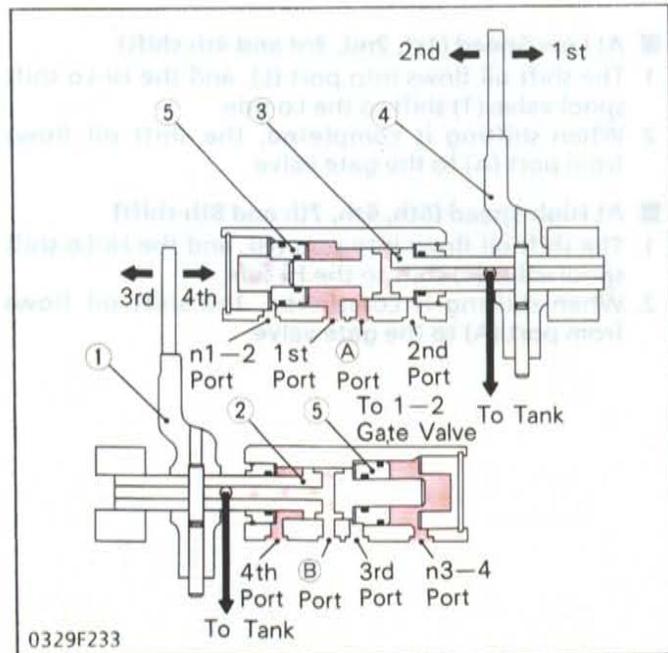
■ **At High Speed (5th, 6th, 7th and 8th shift)**

1. The shift oil flows into port (H), and the Hi-Lo shift spool valve (1) shift to the Hi side.
2. When shifting is completed, the shift oil flows from port (A) to the gate valve.

Main Shift Valve Assembly



- (1) 3-4 Shift Fork
- (2) 3-4 Shift Spool Valve
- (3) 1-2 Shift Spool Valve
- (4) 1-2 Shift Fork
- (5) Neutral Piston



- (1) 3-4 Shift Fork
- (2) 3-4 Shift Spool Valve
- (3) 1-2 Shift Spool Valve
- (4) 1-2 Shift Fork
- (5) Neutral Piston

■ Neutral

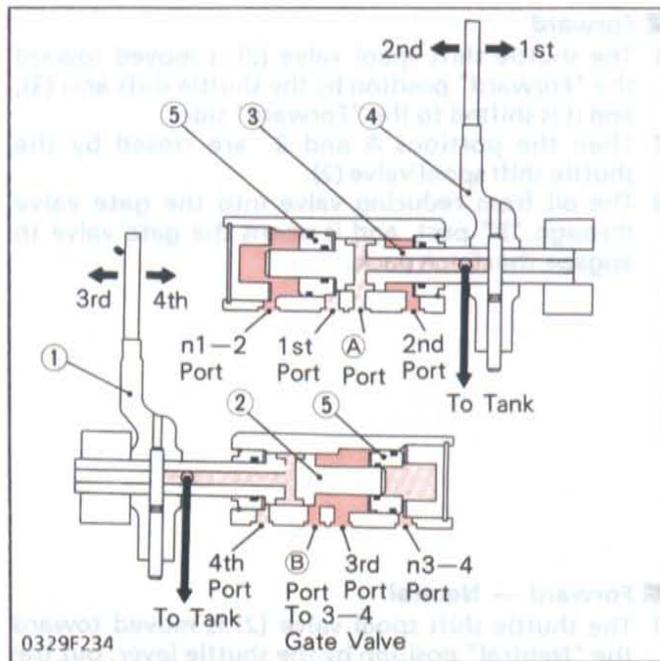
1. The shift oil flows into the 2 port, n1-2 port, 4 port, and n3-4 port.
2. The shift oil of the n1-2 port and n3-4 port moves and presses the neutral pistons (5), and keep the neutral position.
3. The shift oil of the port 2 and the port 4 moves shift spool valves (2) and (3) until they contact the neutral positions (5).
4. The each shift spool valve contacts the neutral piston is the neutral position, and this position is secured by the difference in area under pressure.
5. The (A) port and the (B) port are opened to drain the pressurized oil for the gate valve.

■ 1st (5th) Speed Position

1. The shift oil flows into the port 1, and the other oil of the port n1-2 and port 2 are drained, and the 1-2 shift spool valve (3) moves to the 1st side.
2. When shifting is completed, the shift oil flows from port (A) to the gate valve.
3. The 3-4 shift spool valve (2) remains held at the neutral position.

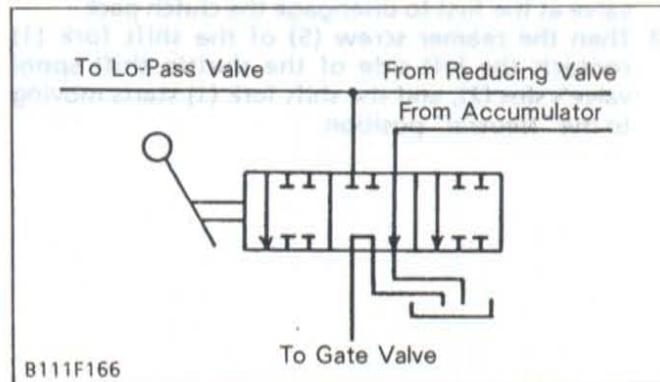
■ 2nd (6th) Speed Position

1. The shift oil flows into the port 2, and the other oil of the port n1-2 and port 1 are drained, and the 1-2 shift spool valve (3) moves to the 2nd side.
2. When shifting is completed, the shift oil flows from port (A) to the gate valve.
3. The 3-4 shift spool valve (2) remains held at the neutral position.

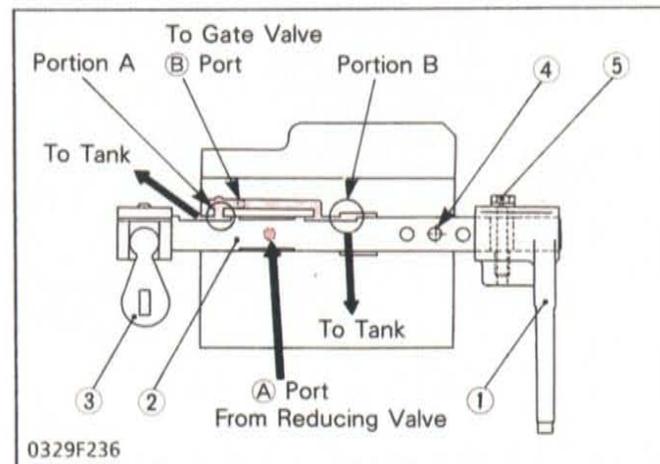


- (1) 3-4 Shift Fork
- (2) 3-4 Shift Spool Valve
- (3) 1-2 Shift Spool Valve
- (4) 1-2 Shift Fork
- (5) Neutral Piston

(3)-4 Shuttle Shift Spool Valve



- (1) Shuttle Lever
- (2) Shuttle Shift Spool Valve



- (1) Shift Fork
- (2) Shuttle Shift Spool Valve
- (3) Shuttle Shift Arm
- (4) Detent
- (5) Reamer Bolt

3rd (7th) Speed Position

1. The shift oil flows into the port 3, and the other oil of the port n3-4 and port 4 are drained, and the 3-4 shift spool valve (2) moves to the 3rd side.
2. When shifting is completed, the shift oil flows from port (B) to the gate valve.
3. The 1-2 shift spool valve (3) is moved to the neutral position by the shift oil flowing from port n1-2 and port 2, and held at that position.

4th (8th) Speed Position

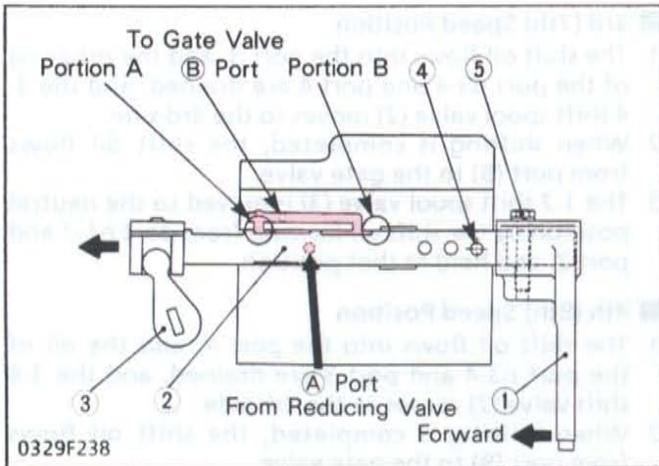
1. The shift oil flows into the port 4, and the oil of the port n3-4 and port 3 are drained, and the 3-4 shift valve (2) moves to the 4th side.
2. When shifting is completed, the shift oil flows from port (B) to the gate valve.
3. The 1-2 shift spool valve (3) remains held at the neutral position.

Function

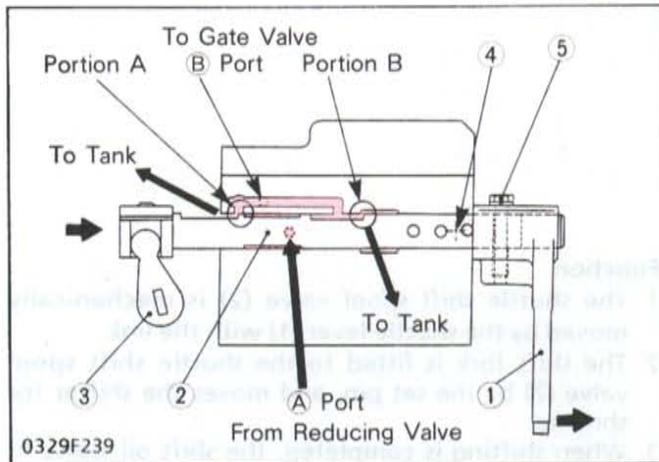
1. The shuttle shift spool valve (2) is mechanically moved by the shuttle lever (1) with the link.
2. The shift fork is fitted to the shuttle shift spool valve (2) by the set pin, and moves the shifter for shifting.
3. When shifting is completed, the shift oil flows to the gate valve.

Neutral

1. The shift oil flows into the port (A), but the shift oil is stopped by the shuttle shift spool valve (2), and the shift oil does not flow to the gate valve.



- (1) Shift Fork
- (2) Shuttle Shift Spool Valve
- (3) Shuttle Shift Arm
- (4) Detent
- (5) Reamer Screw



- (1) Shift Fork
- (2) Shuttle Shift Spool Valve
- (3) Shuttle Shift Arm
- (4) Detent
- (5) Reamer Screw

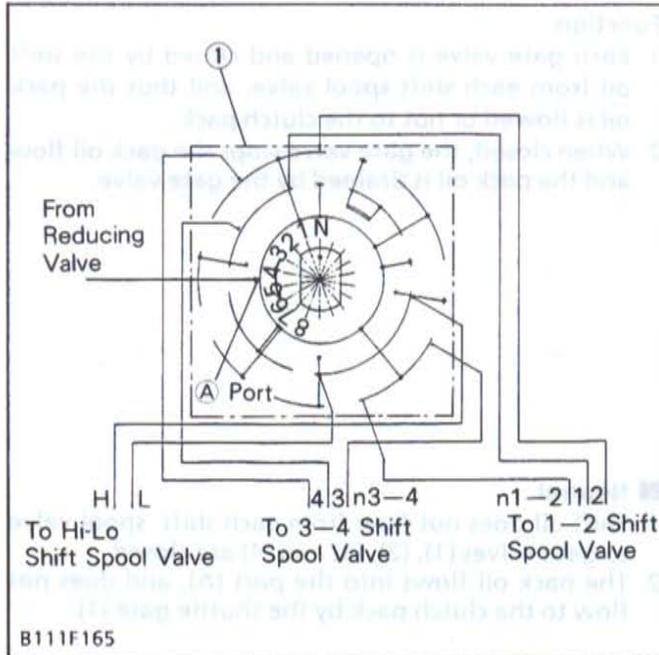
Forward

1. The shuttle shift spool valve (2) is moved toward the "Forward" position by the shuttle shift arm (3), and it is shifted to the "Forward" side.
2. Then the portions A and B are closed by the shuttle shift spool valve (2).
3. The oil from reducing valve into the gate valve through "B" port, and it opens the gate valve to engage the clutch pack.

Forward → Neutral

1. The shuttle shift spool valve (2) is moved toward the "Neutral" position by the shuttle lever, but the shift fork does not move, because the reamer screw (5) does not contact the slot of shuttle shift spool valve (2).
2. The portions A and B are opened (Neutral position) to drain the pressurized oil for the gate valve at the first to disengage the clutch pack.
3. Then the reamer screw (5) of the shift fork (1) contacts the left side of the shuttle shift spool valve's slot (2), and the shift fork (1) starts moving to the "Neutral" position.

(3)-5 Rotary Valve



(1) Rotary Valve Assembly

Function

The rotary valve distributes the shift oil passing through the reducing valve to the shift valves for the selected speed.

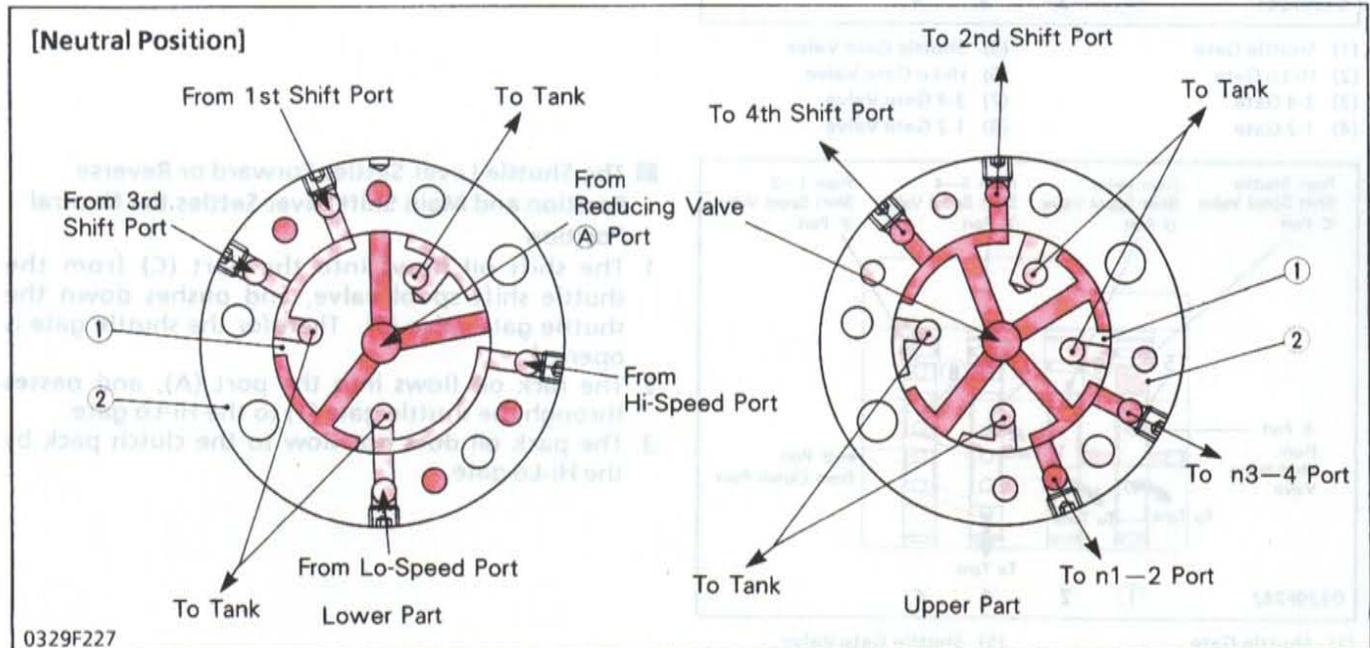
The rotary valve is moved by the shift lever, therefore they are connected with the cables. The oil distribution of the rotary valve as follows in the table below.

Pressurizing Port Table

Shift Range	Ports							
	Hi	Lo	4	3	n3-4	n1-2	1	2
N			o		o	o		o
1		o	o		o		o	
2		o	o		o			o
3		o		o		o		o
4		o	o			o		o
5	o		o		o		o	
6	o		o		o			o
7	o			o		o		o
8	o		o			o		o

* Items marked with "o" denote pressurizing ports and other items denote drain positions.

Neutral

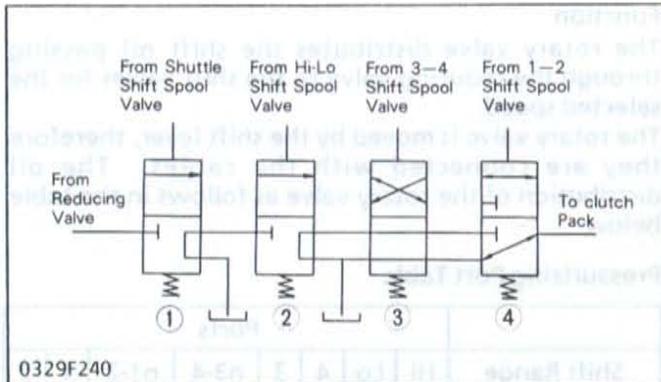


(1) Rotary Valve Body (Mobile) (2) Rotary Valve Case (Fixed)

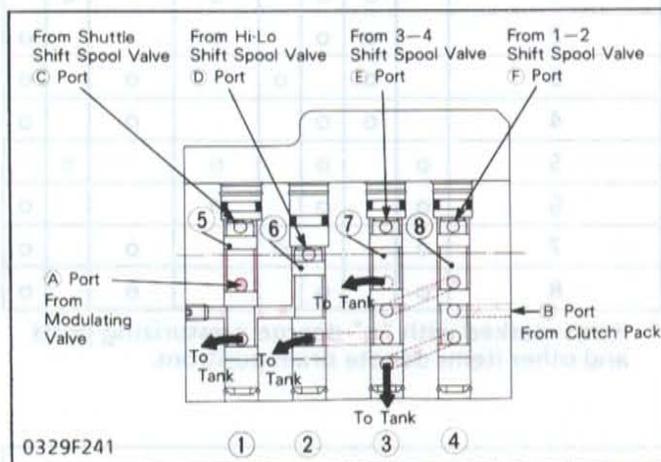
1. The rotary valve makes 9 positions from neutral to 8th by the movement of the rotary body (1) which is shifted by the shift lever.
2. The shift oil flows into the rotary valve body (1) from the reducing valve ("A" port) and it flows into the ports according to pressurizing port table.

3. The shift oil of the other ports (except pressurizing port) are drained by the rotary valve body (1).

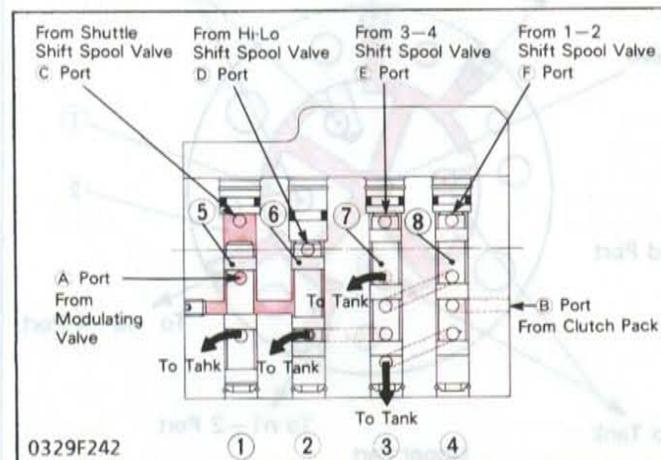
(3)-6 Gate Valve Assembly



0329F240
 (1) Shuttle Gate (3) 3-4 Gate
 (2) Hi-Lo Gate (4) 1-2 Gate



0329F241
 (1) Shuttle Gate (5) Shuttle Gate Valve
 (2) Hi-Lo Gate (6) Hi-Lo Gate Valve
 (3) 3-4 Gate (7) 3-4 Gate Valve
 (4) 1-2 Gate (8) 1-2 Gate Valve



0329F242
 (1) Shuttle Gate (5) Shuttle Gate Valve
 (2) Hi-Lo Gate (6) Hi-Lo Gate Valve
 (3) 3-4 Gate (7) 3-4 Gate Valve
 (4) 1-2 Gate (8) 1-2 Gate Valve

Function

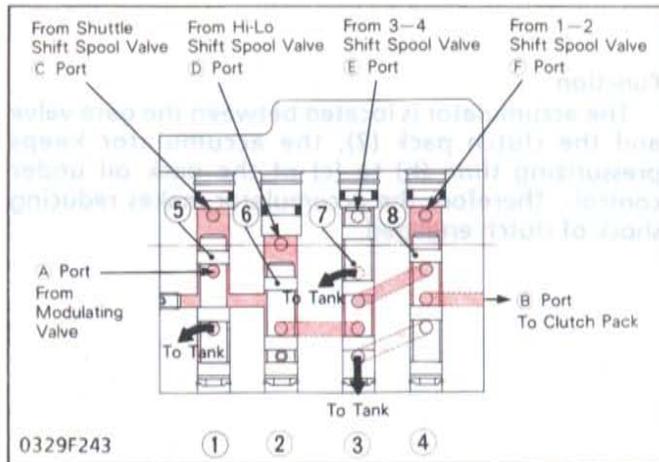
1. Each gate valve is opened and closed by the shift oil from each shift spool valve, and thus the pack oil is flowed or not to the clutch pack.
2. When closed, the gate valve stops the pack oil flow and the pack oil is drained by the gate valve.

Neutral

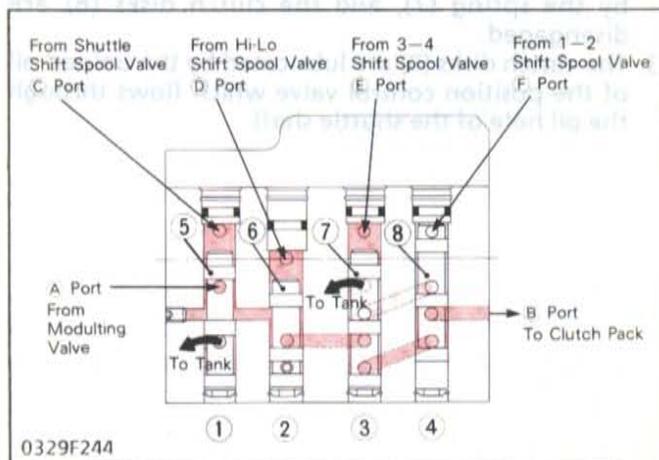
1. Shift oil does not flow from each shift spool valve to gate valves (1), (2), (3) and (4) are closed.
2. The pack oil flows into the port (A), and does not flow to the clutch pack by the shuttle gate (1).

The Shuttle Lever Settles Forward or Reverse Position and Main Shift Lever Settles the Neutral Position

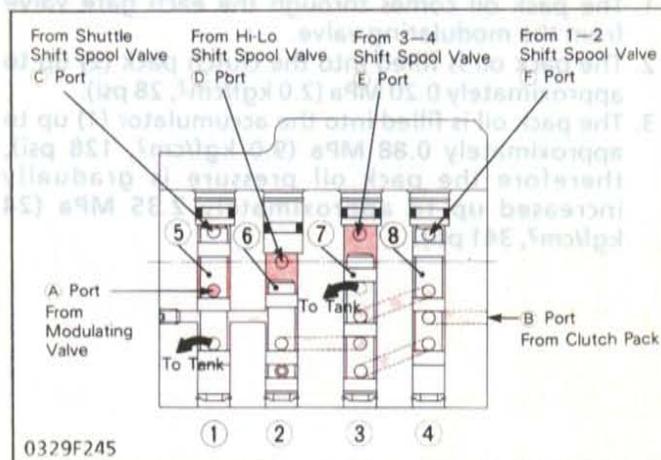
1. The shift oil flows into the port (C) from the shuttle shift spool valve, and pushes down the shuttle gate valve (5). Therefore the shuttle gate is opened.
2. The rack oil flows into the port (A), and passes through the shuttle gate (1) to the Hi-Lo gate.
3. The pack oil does not flow to the clutch pack by the Hi-Lo gate.



- | | |
|------------------|------------------------|
| (1) Shuttle Gate | (5) Shuttle Gate Valve |
| (2) Hi-Lo Gate | (6) Hi-Lo Gate Valve |
| (3) 3-4 Gate | (7) 3-4 Gate Valve |
| (4) 1-2 Gate | (8) 1-2 Gate Valve |



- | | |
|------------------|------------------------|
| (1) Shuttle Gate | (5) Shuttle Gate Valve |
| (2) Hi-Lo Gate | (6) Hi-Lo Gate Valve |
| (3) 3-4 Gate | (7) 3-4 Gate Valve |
| (4) 1-2 Gate | (8) 1-2 Gate Valve |



- | | |
|------------------|------------------------|
| (1) Shuttle Gate | (5) Shuttle Gate Valve |
| (2) Hi-Lo Gate | (6) Hi-Lo Gate Valve |
| (3) 3-4 Gate | (7) 3-4 Gate Valve |
| (4) 1-2 Gate | (8) 1-2 Gate Valve |

■ The Shuttle Lever Settles Forward or Reverse and the Main Shift Lever Settles Position 1, 2, 5 or 6

1. The shift oil flows into the port (C), (D) and (F) from the shuttle, Hi-Lo and 1-2 shift spool valve, and pushes down the shuttle, Hi-Lo and 1-2 gate valve. Therefore each gate valve is opened.
2. The pack oil flows into port (A), and passes through the shuttle gate (1), Hi-Lo gate (2), 3-4 gate (3), and 1-2 gate (4) to the port (B), and flows to the clutch pack, and engages the clutch pack.

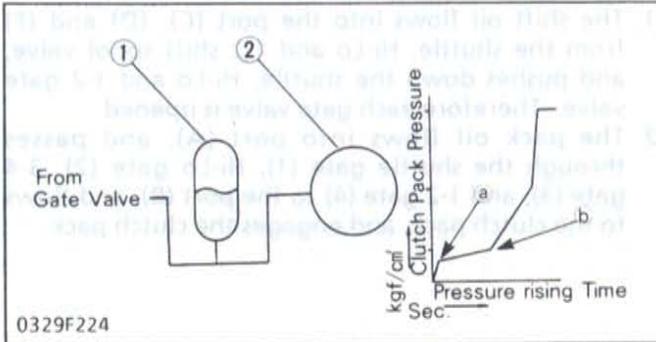
■ The Shuttle Lever Settles Forward or Reverse and the Main Shift Lever Settles Position 3, 4, 7 or 8

1. The shift oil flows into the port (C), (D) and (E) from the shuttle spool valve, Hi-Lo spool valve and 3-4 shift spool valve, and pushes down the shuttle gate valve, Hi-Lo gate valve and 3-4 gate valve. Therefore each gate valve is opened.
2. The pack oil flows into port (A), and passes through the shuttle gate (1), Hi-Lo gate (2), 3-4 gate (3), and 1-2 gate (4) to the port (B), and flows to the clutch pack, and engages the clutch pack.

■ The Shuttle Lever Settles the Neutral and the Main Shift Lever Settles the Neutral Position

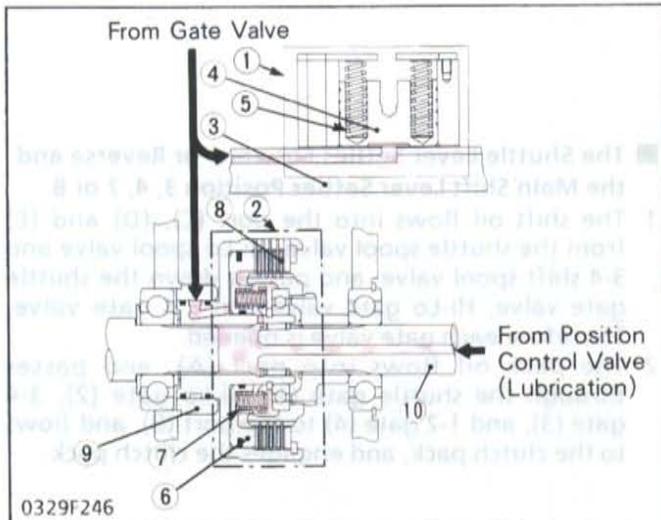
1. Shifting the shuttle lever back to the neutral position causes the shift oil to the port (C) to be drained on the shuttle spool valve side.
2. The shuttle gate valve (5) is returned to close position by the return spring.
3. The pack oil is stopped by the shuttle gate (1).
4. The rack oil on the clutch pack side is drained from the drain port of the shuttle spool valve and shuttle gate valve.

(3)-7 Accumulator and Clutch Pack



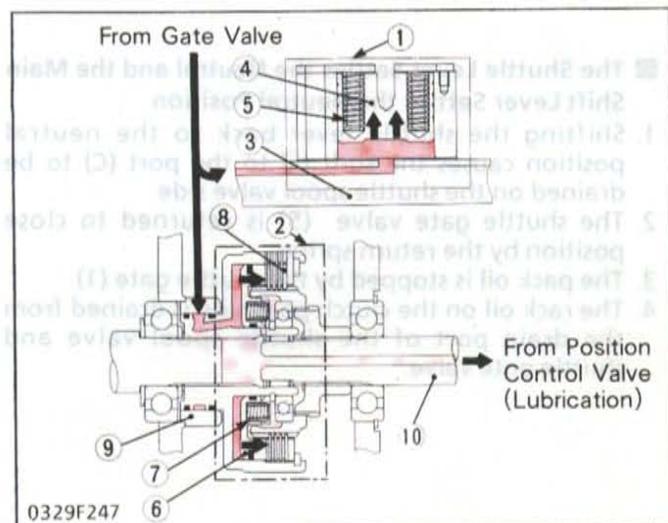
0329F224

(1) Accumulator (2) Clutch Pack



0329F246

(1) Accumulator (2) Clutch Pack (3) Side Cover (4) Piston (5) Spring (6) Piston (7) Spring (8) Clutch Disk (9) Support (10) Shuttle Shaft



0329F247

(1) Accumulator (2) Clutch Pack (3) Side Cover (4) Piston (5) Spring (6) Piston (7) Spring (8) Clutch Disk (9) Support (10) Shuttle Shaft

Function

The accumulator is located between the gate valve and the clutch pack (2), the accumulator keeps pressurizing time (b) to (c) of the pack oil under control. Therefore the accumulator makes reducing shock of clutch engaged.

Neutral

1. The piston (4) of the accumulator is pushed back to the side cover side (3) by the spring (5).
2. Piston (6) of the clutch pack (2) is also pushed back by the spring (7), and the clutch disks (8) are disengaged.
3. The clutch disks (8) are lubricated by the unload oil of the position control valve which flows through the oil hole of the shuttle shaft.

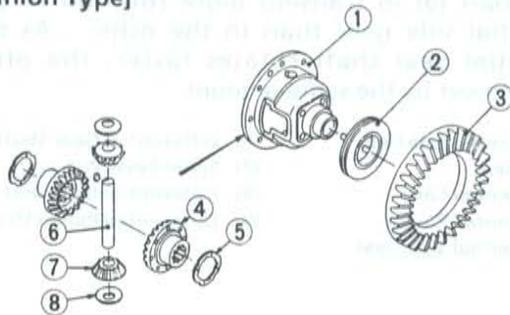
Shifting Position

1. The pack oil comes through the each gate valve from the modulating valve.
2. The pack oil is filled into the clutch pack (2) up to approximately 0.20 MPa (2.0 kgf/cm², 28 psi).
3. The pack oil is filled into the accumulator (1) up to approximately 0.88 MPa (9.0 kgf/cm², 128 psi), therefore the pack oil pressure is gradually increased up to approximately 2.35 MPa (24 kgf/cm², 341 psi).

4 DIFFERENTIAL GEAR

[1] STRUCTURE

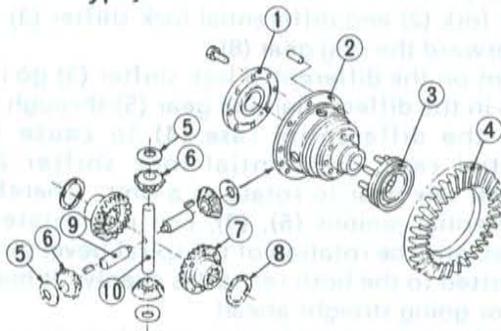
[2 Pinion Type]



C060F032

- | | |
|-------------------------------|-----------------------------------|
| (1) Differential Case | (5) Differential Side Gear Washer |
| (2) Differential Lock Shifter | (6) Differential Pinion Shaft |
| (3) Ring Gear | (7) Differential Pinion |
| (4) Differential Side Gear | (8) Differential Pinion Washer |

[4 Pinion Type]

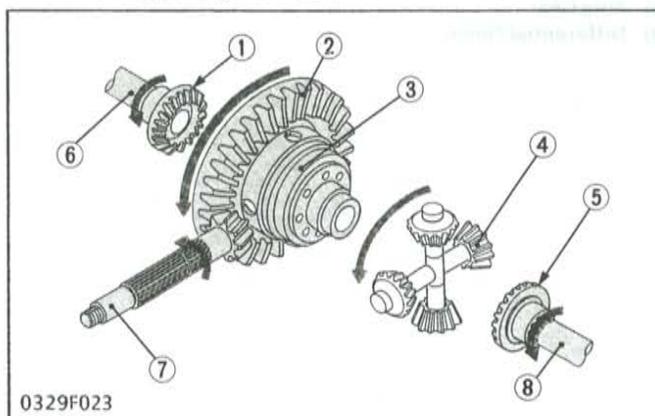


C060F033

- | | |
|--------------------------------|-----------------------------------|
| (1) Differential Case Cover | (7) Differential Side Gear |
| (2) Differential Case | (8) Differential Side Gear Washer |
| (3) Differential Lock Shifter | (9) Differential Pinion Shaft 2 |
| (4) Ring Gear | (10) Differential Pinion Shaft |
| (5) Differential Pinion Washer | |
| (6) Differential Pinion | |

[2] OPERATION

■ Traveling Straight Ahead



0329F023

The differential gear assembly is a mechanism to provide smooth steering. It automatically provides different optimum torques to the right and left wheels according to road resistance and braking friction at the wheels.

The differential gear assembly is composed of the differential case, differential pinions, differential side gears, differential pinion shaft, ring gear, etc..

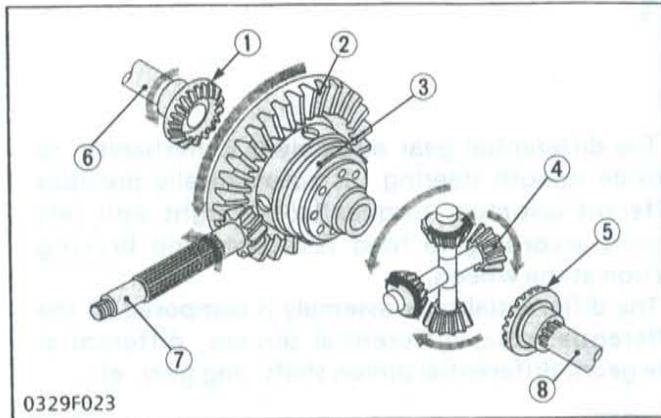
■ NOTE

- 2 Pinion Type : L2350 (2WD, 4WD)
L2650 (2WD) ; 19999 and below
(4WD) ; 59999 and below
- 4 Pinion Type : L2650 (2WD) ; 20001 and above
(4WD) ; 60001 and above
L2950 (2WD, 4WD, GST)
L3450 (2WD, 4WD, GST)
L3650 (2WD, 4WD, GST)

Rotation of the spiral bevel pinion (7) is transmitted to the ring gear (2) bolted to the differential case (3). When road resistance to the right and left wheels are equal, the differential pinions (4), and differential side gears (1), (5) are carried around by the ring gear (2), and differential case (3) rotate as a unit. Differential gear shaft (6), (8) receive the same rotation and both wheels travel at the same speed.

- | | |
|----------------------------|-----------------------------|
| (1) Differential Side Gear | (5) Differential Side Gear |
| (2) Ring Gear | (6) Differential Gear Shaft |
| (3) Differential Case | (7) Spiral Bevel Pinion |
| (4) Differential Pinion | (8) Differential Gear Shaft |

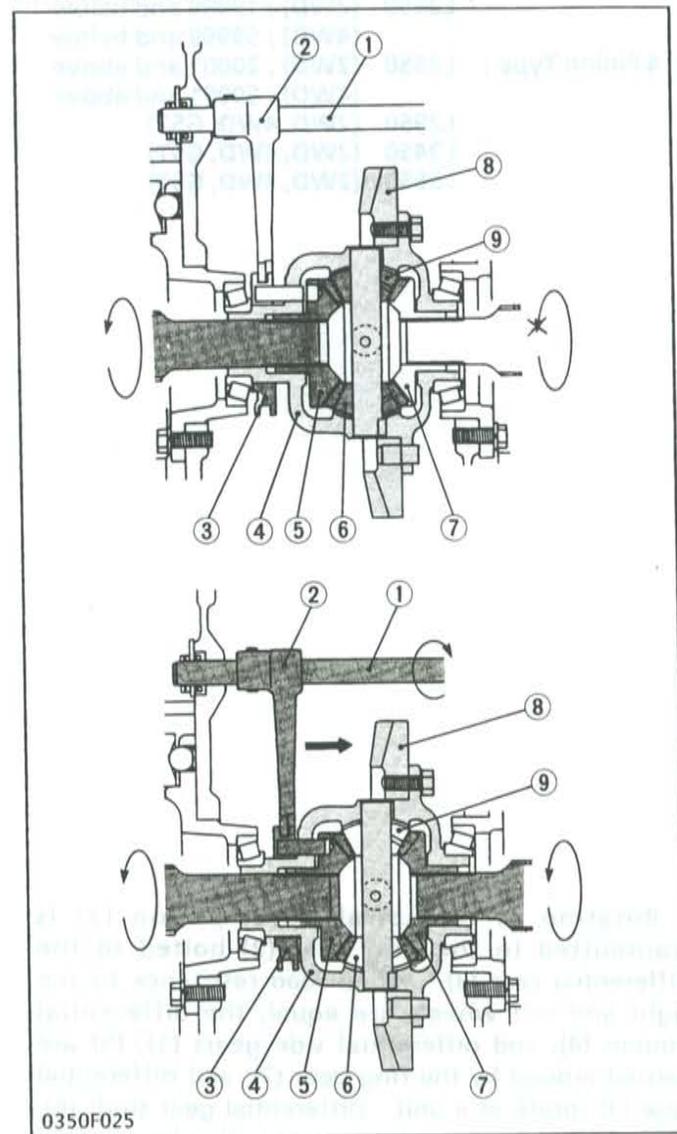
■ Turning a Corner



The power from the engine on spiral bevel pinion shaft (7) rotates ring gear (2). When turning a corner, the outer wheel must travel farther than the inner one. While differential pinions (4) rotate with the differential case (4), they spin on differential pinion shaft (9) to transmit more rotation to one differential side gear than to the other. As one differential gear shaft rotates faster, the other rotates slower by the same amount.

- | | |
|----------------------------|-------------------------------|
| (1) Differential Side Gear | (6) Differential Gear Shaft |
| (2) Ring Gear | (7) Spiral Bevel Pinion |
| (3) Differential Case | (8) Differential Gear Shaft |
| (4) Differential Pinion | (9) Differential Pinion Shaft |
| (5) Differential Side Gear | |

■ Differential Lock



When resistances to the right and left tires are different due to ground conditions or type of work, the wheel with less resistance slips and prevents the tractor from moving ahead. To compensate for this, the differential lock restricts the differential function and causes both rear axles to rotate as a unit.

When the differential lock pedal is stepped on, it causes the differential lock cam shaft (1), differential lock shift fork (2) and differential lock shifter (3) are moved forward the ring gear (8).

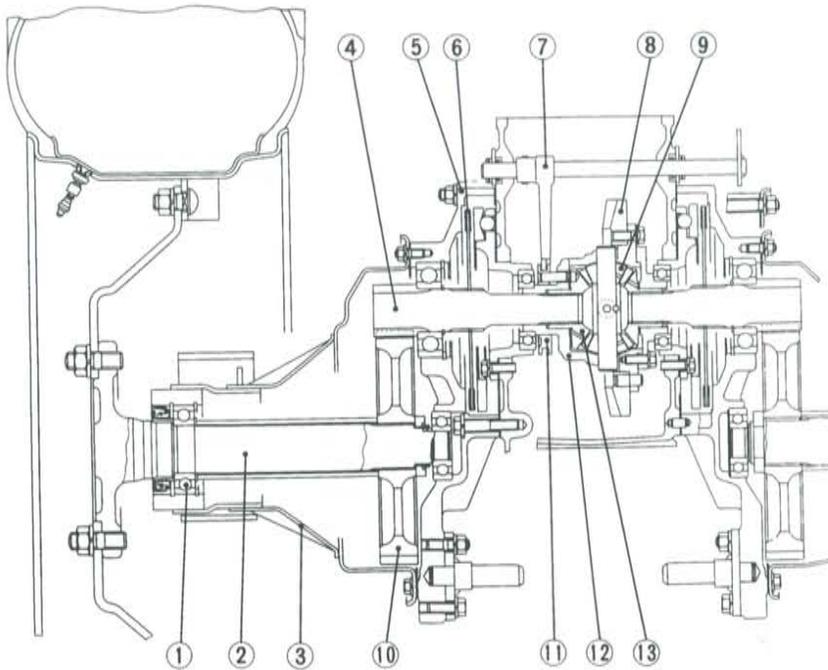
The pins on the differential lock shifter (3) go into the holes in the differential side gear (5) through the holes in the differential case (4) to cause the differential case, differential lock shifter and differential side gear to rotate as a unit. Therefore the differential pinions (6), (9), can not rotate on their axles, and the rotation of the spiral bevel pinion is transmitted to the both rear axles evenly. It means the tractor going straight ahead.

When the drive wheels regain equal traction, the lock will disengage automatically by the force of differential lock pedal return spring, while released differential lock pedal.

- | |
|----------------------------------|
| (1) Differential Lock Cam Shaft |
| (2) Differential Lock Shift Fork |
| (3) Differential Lock Shifter |
| (4) Differential Case |
| (5) Differential Side Gear |
| (6) Differential Pinion |
| (7) Differential Side Gear |
| (8) Ring Gear |
| (9) Differential Pinion |

5 REAR AXLE

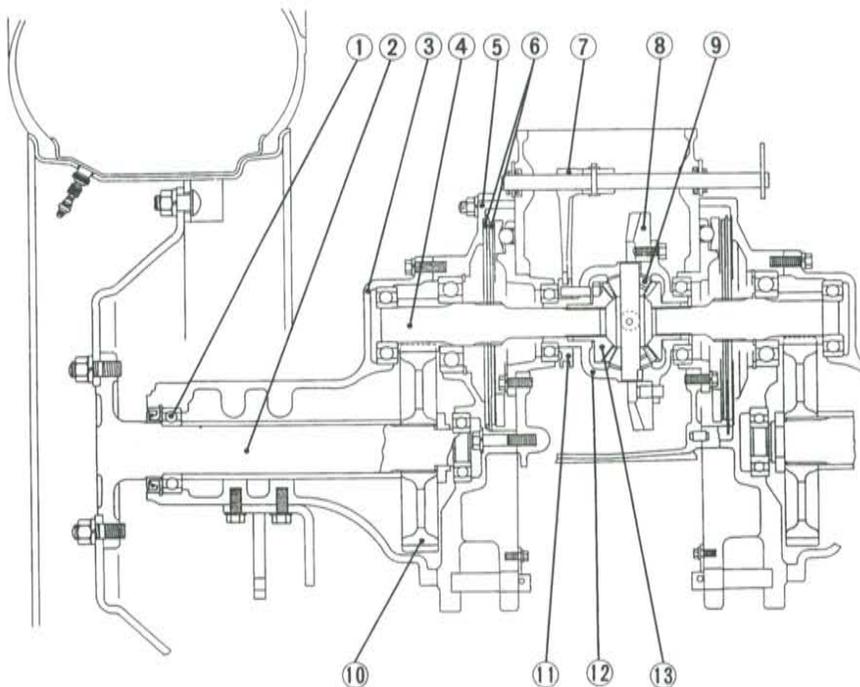
[L2350]



- (1) Ball Bearing
- (2) Rear Axle
- (3) Rear Axle Case
- (4) Differential Gear Shaft
- (5) Brake Case
- (6) Brake Discs
- (7) Differential Lock Shift Fork
- (8) Ring Gear
- (9) Differential Pinion
- (10) Final Gear
- (11) Differential Lock Shifter
- (12) Differential Case
- (13) Differential Side Gear

0350F024

[L2650, L2950, L3450, L3650]



B111F023

The final gears (10) are final reduction mechanism which further reduces the speed of rotation. The direction of power transmitted is changed by the differential gear.

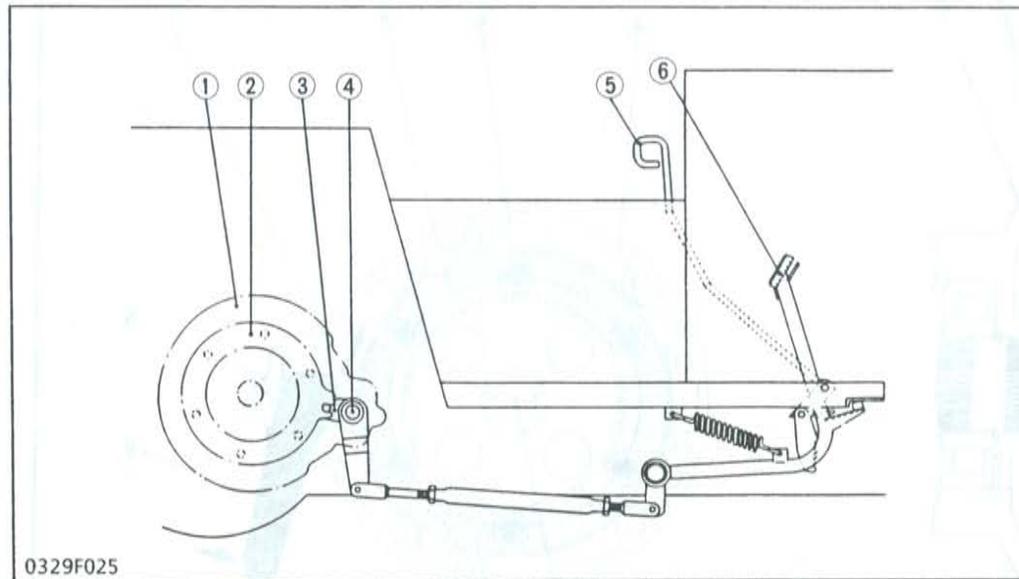
The rear axles (2) are the final transmission mechanisms which transmit the power from the transmission to the rear wheels. The rotation speed

is reduced by the final gears (10).

The rear axles are the semi-floating type with the ball bearing (1) between the rear axle (2) and rear axle case (3), which support the rear wheel load besides transmitting power to the rear wheel. The rear axles also support the weight of the tractor.



6 BRAKES



- (1) Brake Case
- (2) Cam Plate
- (3) Brake Cam
- (4) Brake Cam Lever
- (5) Parking Brake Lever
- (6) Brake Pedal

Independent mechanical wet disc brakes are used for the right and left traveling brakes. They are operated by the brake pedals through the mechanical linkages.

■ Features of Wet Disc Brakes

1. Reduced disc wear

Although wet discs are worn by approx. several tens of microns depending on the accuracy of parts during the initial contact in initial period of 50 hours or so, almost no wear occurs afterwards. This means that very little brake adjustments are required.

2. Stable braking

Since the brake discs are immersed in transmission oil, Fade* is rarely caused even after repeated braking and a stable braking force is obtained.

3. Pedal stroke does not change under influence of heat.

Unlike internal expanding type brakes, the drum-to-shoe clearance of the wet disc brake does not increase due to thermal expansion and the increased pedal stroke does not result. Thus, the wet disc brake provides a constant pedal stroke.

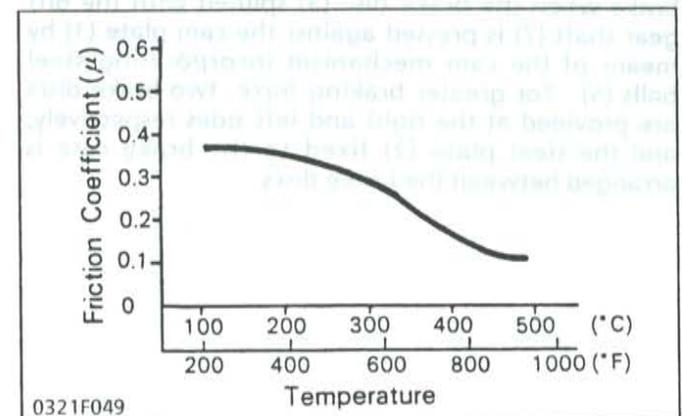
The parking brake is a mechanical type which is designed to actuate the traveling brakes through the linkage. Pulling the parking brake lever (6) results in the same state as that obtained when the brake pedals are pressed.

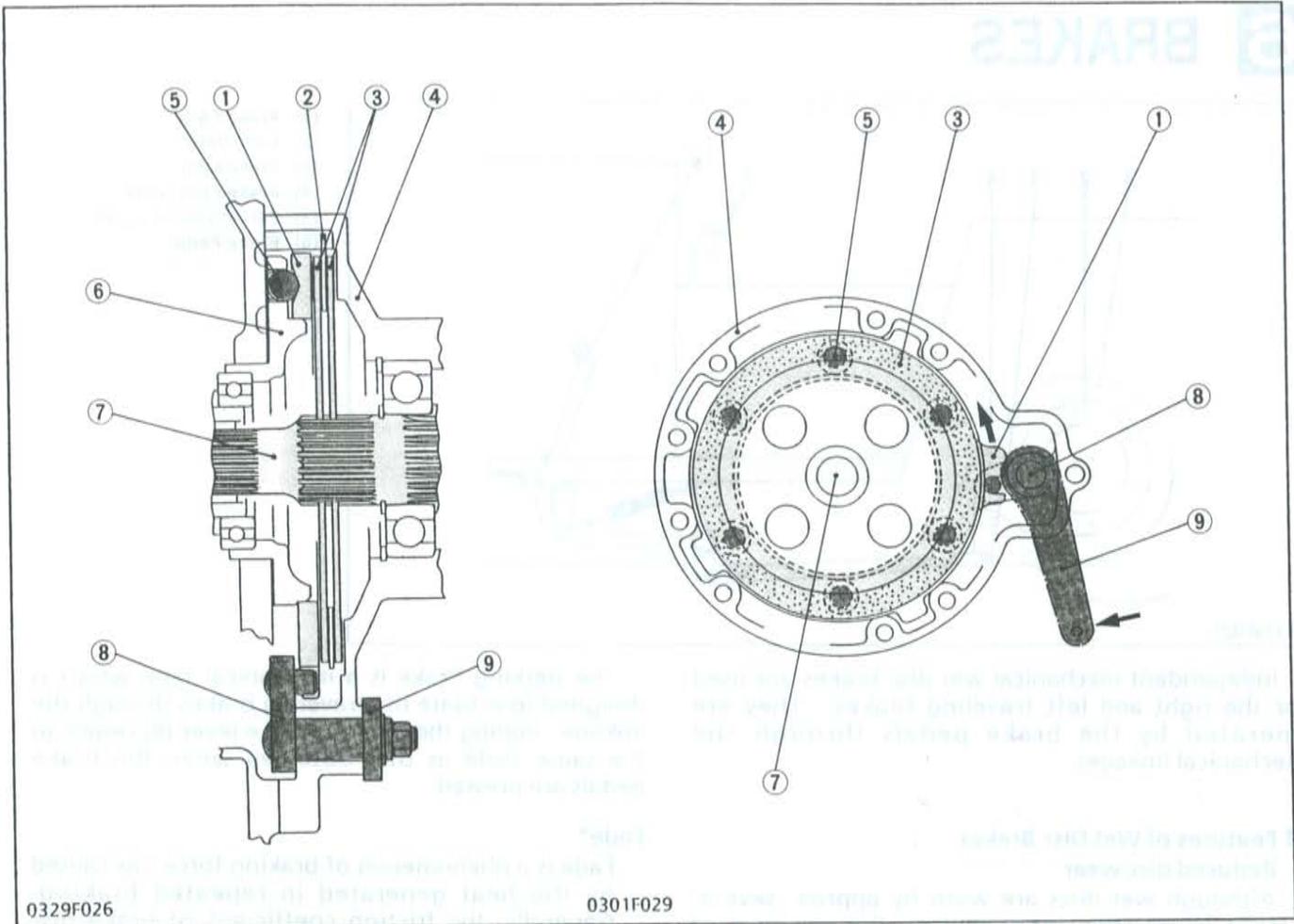
Fade*

Fade is a phenomenon of braking force loss caused by the heat generated in repeated braking. Generally, the friction coefficient of brake disc tends to lower and the braking force reduces with the rise of the temperature of the brake disc.

(Reference)

- Relationship between Temperature and Friction coefficient of brake disc.





0329F026

0301F029

- | | | | |
|----------------|----------------|---|---------------------|
| (1) Cam Plate | (4) Brake Case | (6) Differential Bearing Case | (8) Brake Cam |
| (2) Plate | (5) Steel Ball | (7) Brake Shaft (Differential Gear Shaft) | (9) Brake Cam Lever |
| (3) Brake Disc | | | |

The brake body is incorporated in the brake case (4) filled with transmission oil and is designed to brake when the brake disc (3) splined with the diff gear shaft (7) is pressed against the cam plate (1) by means of the cam mechanism incorporating steel balls (5). For greater braking force, two brake discs are provided at the right and left sides respectively, and the steel plate (2) fixed to the brake case is arranged between the brake discs.

■ During Braking

When the brake pedal is pressed, the linkage causes the brake cam lever (9) and brake cam (8) to turn into the direction of arrow shown in the above diagram. Therefore, the cam plate (1) also moves the direction of arrow. At this time, since the cam plate (1) rides on the steel balls (5) set in the grooves of the diff bearing case (6) to press the brake disc (3), the diff gear shaft (7) is braked by the frictional force generated by the cam plate (1) and brake disc (3).

■ NOTE

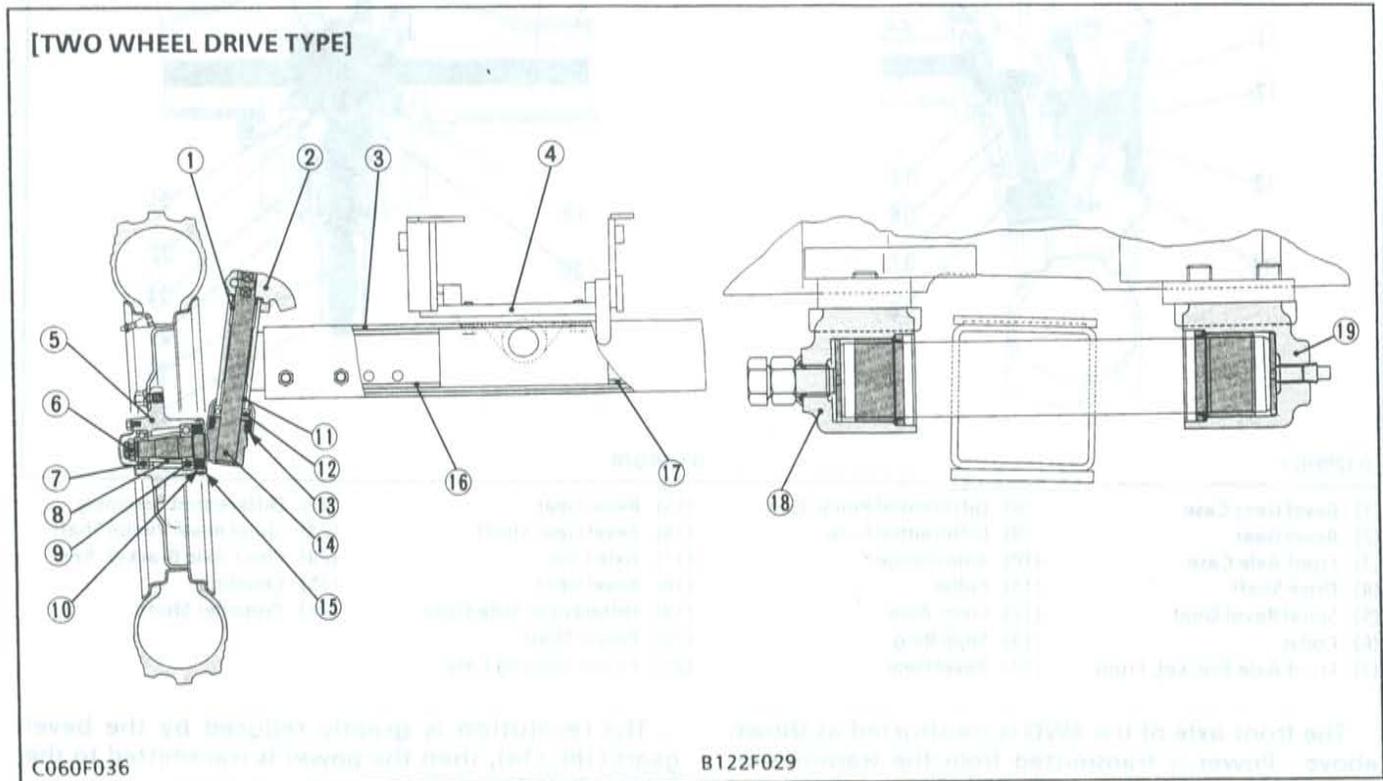
- L2350 2WD one brake disc for each side
- Others two brake discs for each side

7 FRONT AXLE

The front axle supports the front of tractor and facilitates steering. There are two kinds of front axles. The two-wheel drive axle has free-running

front wheels and the four-wheel drive axle has powered front wheels.

[1] STRUCTURE



- (1) Bushing
- (2) Knuckle Arm
- (3) Front Axle Middle
- (4) Front Axle Frame
- (5) Front Wheel Hub

- (6) Slotted Nut
- (7) Ball Bearing
- (8) Spacer
- (9) Ball Bearing
- (10) Oil Seal

- (11) Bushing
- (12) Thrust Ball Bearing
- (13) Oil Seal
- (14) Knuckle Shaft
- (15) Dust Cover

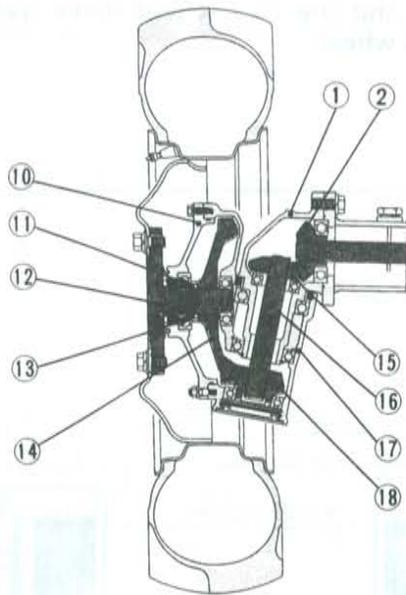
- (16) Front Axle Right
- (17) Front Axle Left
- (18) Front Axle Bracket, Front
- (19) Front Axle Bracket, Rear

The front axle of the 2WD type is constructed as shown above. The shape of the front axle is relatively simple, and the front axle is supported at its center with the front axle brackets (18), (19) on the front axle frame (4), so that steering operation is stable even on uneven grounds in a farm field.

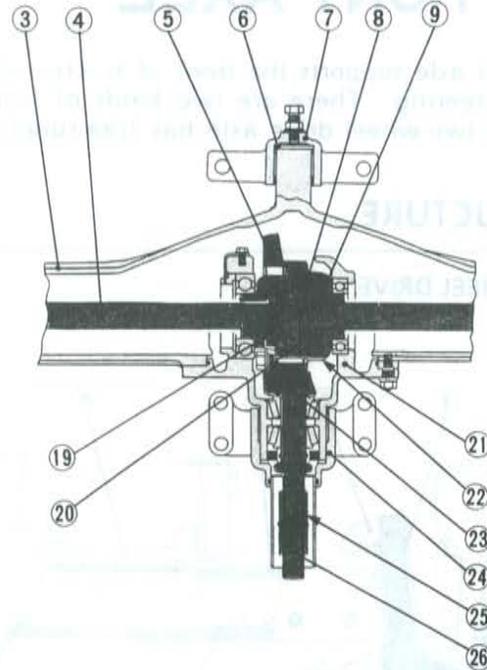
■ NOTE

- L2350 is not adjustable tread type.

[FOUR-WHEEL DRIVE TYPE]



0329F027



0329F028

- | | | | |
|-------------------------------|------------------------------|-----------------------------|--------------------------------|
| (1) Bevel Gear Case | (8) Differential Pinion Gear | (15) Bevel Gear | (22) Differential Assembly |
| (2) Bevel Gear | (9) Differential Case | (16) Bevel Gear Shaft | (23) Spiral Bevel Pinion Shaft |
| (3) Front Axle Case | (10) Axle Flange | (17) Axle Case | (24) Front Axle Bracket, Rear |
| (4) Drive Shaft | (11) Collar | (18) Bevel Gear | (25) Coupling |
| (5) Spiral Bevel Gear | (12) Front Axle | (19) Differential Side Gear | (26) Propeller Shaft |
| (6) Collar | (13) Snap Ring | (20) Pinion Shaft | |
| (7) Front Axle Bracket, Front | (14) Bevel Gear | (21) Pinion Bearing Case | |

The front axle of the 4WD is constructed as shown above. Power is transmitted from the transmission through the propeller shaft (26) and to the spiral bevel pinion shaft (23), then to the spiral bevel gear (5) after that to the differential gear.

The power through the differential is transmitted to the drive shaft (4), and to the bevel gear shaft (16) in the bevel gear case (1).

The revolution is greatly reduced by the bevel gears (18), (14), then the power is transmitted to the front axle (12).

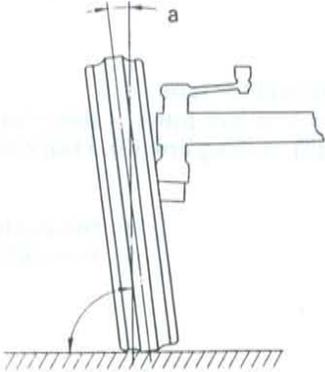
The differential system allows each wheel to rotate at a different speed to make turning easier.

[2] FRONT WHEEL ALIGNMENT

To assure smooth mobility or maneuverability and enhance stable and straight running, the front wheels are mounted at an angle to the right, left and

forward directions. This arrangement is referred to as the Front Wheel Alignment.

Camber

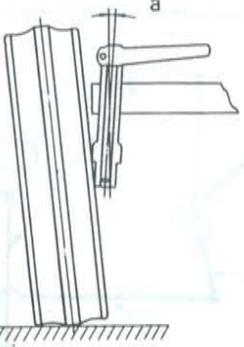


C045F051

The front wheels are tilted from the vertical as viewed from the front, upper wheels are spreader than lower ones. This inclination is called camber (a). Camber reduces bending or twisting of the front axle caused by vertical load or running resistance, and also maintains the stability in running.

Camber	0.026 to 0.044 rad. 1.5 to 2.5°
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Kingpin Angle

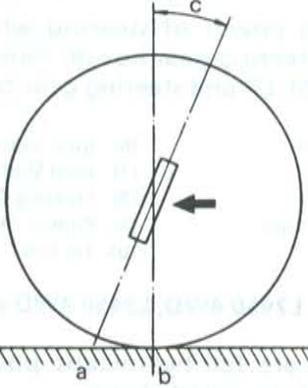


C045F053

The kingpin is tilted from the vertical as viewed from the front. This angle is called kingpin angle (a). As with the camber, kingpin angle reduces rolling resistance of the wheels, and prevents any shimmy motion of the steering wheel. It also reduces steering effort.

	2WD	4WD
Kingpin inclination	0.131 to 0.146 rad. 7.5 to 8.5°	0.166 to 0.183 rad. 9.5 to 10.5°

Caster

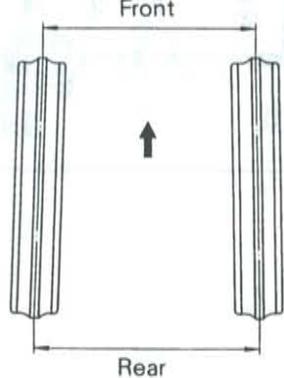


C045F052

The kingpin is tilted forward as viewed from the side. The point (b) of the wheel center line is behind the point (a) of the kingpin shaft center line. This inclination is called caster (c). Caster helps provide steering stability. As with the kingpin inclination, caster reduces steering effort.

	2WD	4WD
Caster	0.026 to 0.044 rad. 1.5 to 2.5°	0.017 to 0.035 rad. 1.0 to 2.0°

Toe-in



C045F054

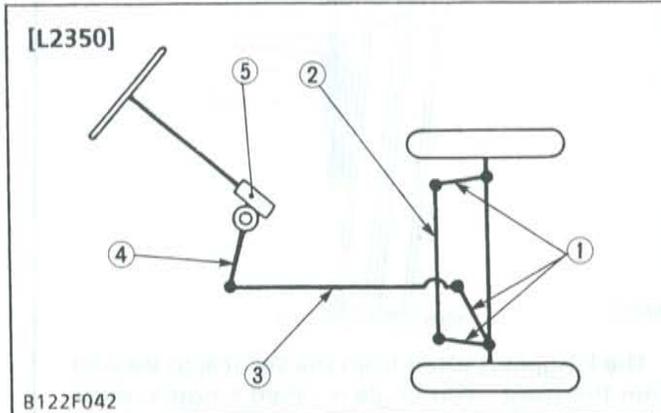
Viewing the front wheels from above reveals that the distance between the toes of the front wheels is smaller than that between the heels. It is called toe-in. The front wheels tend to roll outward due to the camber, but toe-in offsets it and ensures parallel rolling of the front wheels. Another purpose of toe-in is to prevent excessive and uneven wear of tires.

Toe-in	2 to 8 mm 0.08 to 0.32 in.
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8 STEERING

[1] STEERING LINKAGE

L series tractors have three kinds of steering systems.

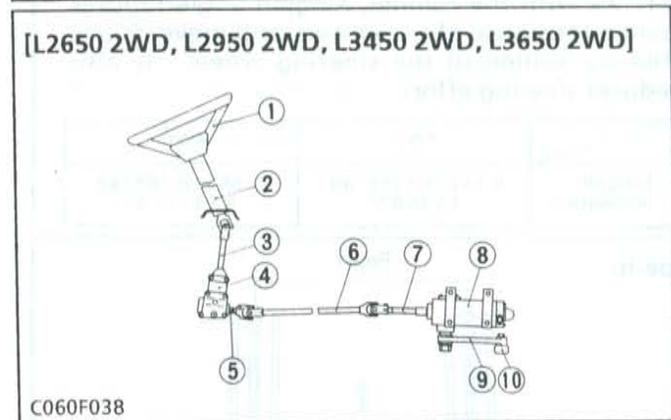


■ L2350

This tractor is drag link type.

This type consists of five parts, a steering gear box (5), a pitman arm (4), a drag link (3), knuckle arms (1) and a tie rod (2).

- | | |
|-----------------|-----------------------|
| (1) Knucle Arms | (4) Pitman Arm |
| (2) Tie Rod | (5) Steering Gear Box |
| (3) Drag Link | |



■ L2650 2WD, L2950 2WD, L3450 2WD and L3650 2WD

The steering system includes the steering gear box (8) at the front of tractor, to which pitman arm (9) and tie rod are coupled directly. Accordingly, this steering system does not employ a drag link which ordinary tractors have, thus making it possible to increase front wheel steering angles and to reduce turning radius.

The steering power of steering wheel is transmitted to the steering gear box (8) through the joint shafts (3), (5), (6), (7) and steering gear case (4).

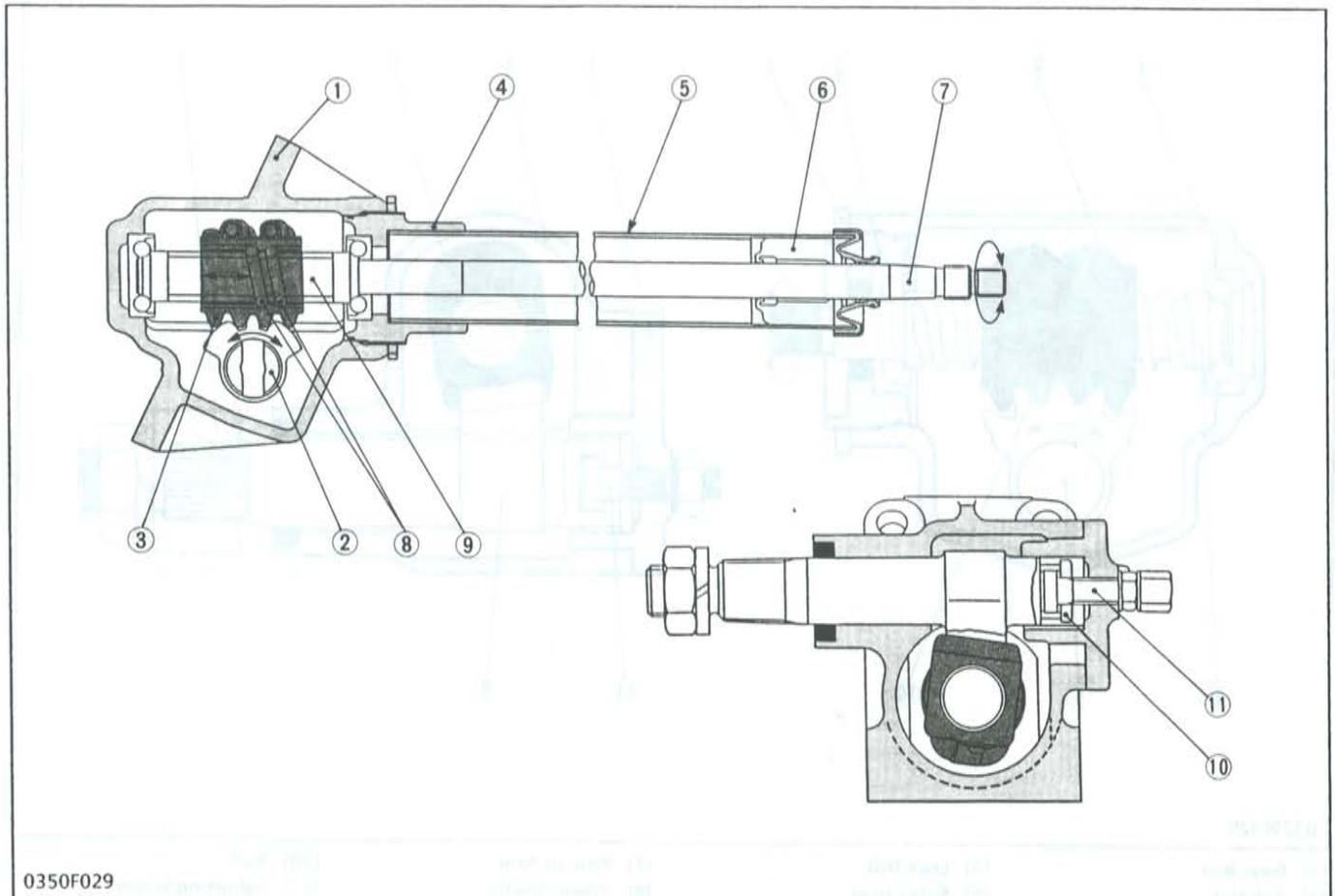
- | | |
|------------------------|-----------------------|
| (1) Steering Wheel | (6) Joint Shaft 3 |
| (2) Steering Post | (7) Joint Shaft 4 |
| (3) Joint Shaft 1 | (8) Steering Gear Box |
| (4) Steering Gear Case | (9) Pitman Arm |
| (5) Joint Shaft 2 | (10) Tie Rod |

■ L2650 4WD, L2950 4WD, L3450 4WD and L3650 4WD

These tractors are full hydrostatic power steering. Because this system is no linkage.

[2] MANUAL STEERING

(1) L2350



0350F029

- | | | | |
|-----------------------|--------------------|--------------------|----------------------|
| (1) Gear Box | (4) Gear Box Cover | (7) Steering Shaft | (10) Shim |
| (2) Sector Gear Shaft | (5) Steering Post | (8) Ball | (11) Adjusting Screw |
| (3) Ball Nut | (6) Column Bushing | (9) Worm Shaft | |

The steering unit mainly consists of two parts, a ball nut (3) and a sector gear shaft (2). When the worm shaft (9) is rotated (by rotation of the steering wheel), the ball nut (3) is moved along the worm shaft, and this action causes the sector gear shaft (2) to rotate. The one end of the sector gear shaft carries the pitman arm. Rotation of the sector gear shaft causes the pitman arm to swing in one direction or the other.

The motion is then carried through the drag link to the knuckle arm at the wheel.

In this unit, friction is kept exceptionally low by interposing balls (8) between the worm teeth and grooves cut in the inner face of a ball nut (3).

As the worm shaft (9) rotates, the balls roll and cause the ball nut to move along the worm shaft.

This motion is carried to the sector gear by teeth on the side of the ball nut.

This forces the sector gear shaft (2) to rotate.

These balls are called "recirculating balls", because they continuously recirculate from one end

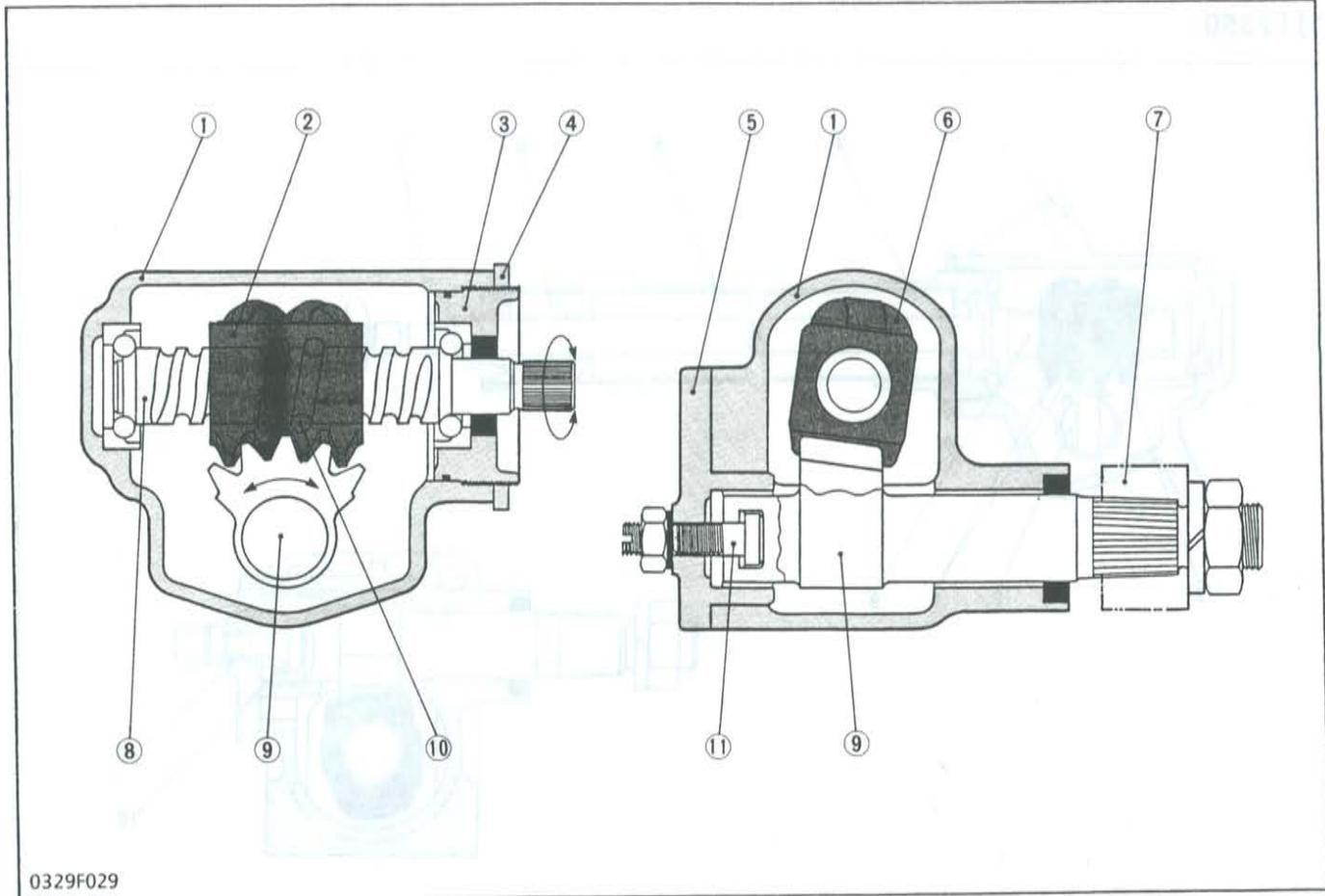
of the ball nut to the other through a pair of ball return guides.

For example, suppose that the operator makes a right turn. The worm gear is rotated in a clockwise direction (viewed from the operator's seat), and this causes the ball nut to move upward. The balls roll between the worm shaft and ball nut and as they reach the upper end of the ball nut, they enter the return guide and then roll back to a lower point, where they reenter the groove between the worm and ball nut.

Steering wheel play can be adjusted by turning an adjusting screw (11) at the end of the sector gear shaft, and with shims (10). As the sector gear shaft is shifted axially by the adjusting screw, the backlash between the sector gear and the ball nut teeth increases or decreases.

When the adjusting screw is turned clockwise, the steering wheel play reduces in proportion to the backlash. Counterclockwise increase the play.

(2) L2650 2WD, L2950 2WD



0329F029

- | | | | |
|----------------|----------------|-----------------------|----------------------|
| (1) Gear Box | (4) Lock Nut | (7) Pitman Arm | (10) Ball |
| (2) Ball Nut | (5) Side Cover | (8) Worm Shaft | (11) Adjusting Screw |
| (3) Rear Cover | (6) Ball Tube | (9) Sector Gear Shaft | |

The steering unit mainly consists of two parts, ball nut (2) and a sector gear shaft (9).

The steering gear box (1) converts the rotating motion of worm shaft (8) by the operator into the swinging motion, and at the same time, increases the torque transmitted to the pitman arm (7). Scores of balls are assembled into the screw groove of ball nut (2) so that the worm shaft (8) rotates lightly.

When the steering wheel is rotated, the worm shaft (8) rotates through the steering shaft, bevel gear, joint shafts. Thus the ball nut (2) is moved along the worm shaft (8). This motion is carried to the sector gear by teeth on the side of the ball nut (2). The end of the sector gear shaft (9) carries the pitman arm. Rotation of the sector gear shaft (9) causes the pitman arm to swing in one direction or the other. The motion is then carried to the knuckle arm at the wheel.

These balls are called "recirculating balls", because

they continuously recirculate from one end of ball nut to the other through a pair of ball return guides.

For example, suppose that the operator makes a right turn. The worm shaft is rotated in a counterclockwise direction (viewed from the operator's seat), and this causes the ball nut to move downward. The balls roll between the worm shaft and ball nut and as they reach the upper end of the ball nut, they enter the return guide and then roll back to a lower point, where they reenter the groove between the worm and ball nut.

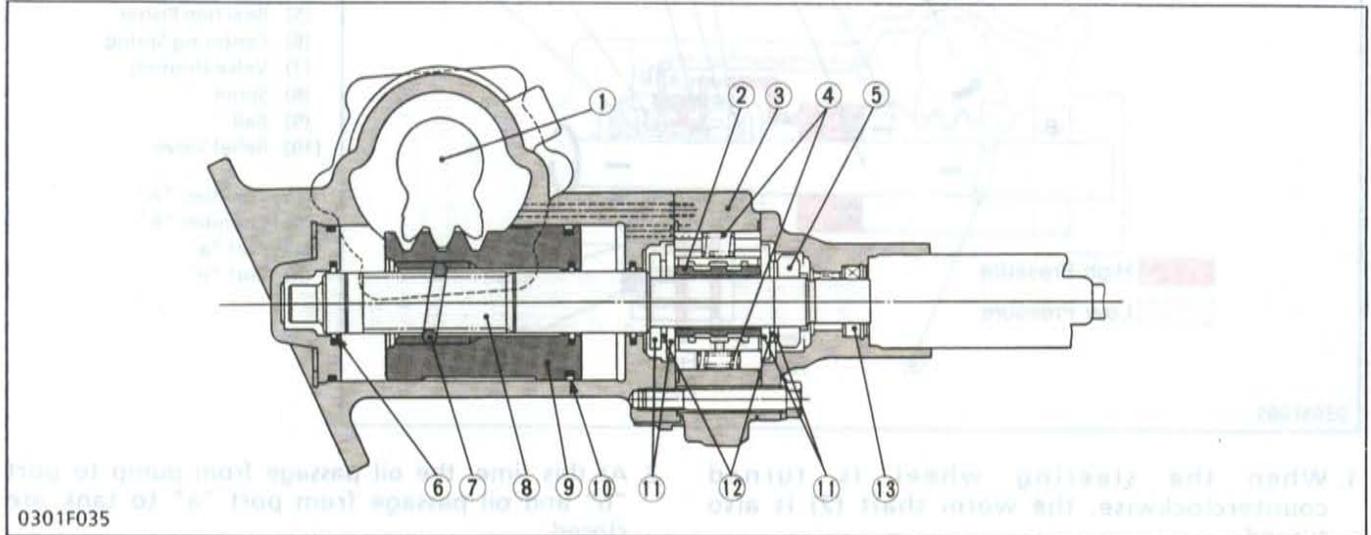
Steering wheel play can be adjusted by turning an adjusting screw (11) at the end of the sector gear shaft. As the sector gear shaft is shifted axially by the adjusting screw, the backlash between the sector gear and the ball nut teeth increases or decreases.

When the adjusting screw is turned clockwise, the steering wheel play reduces in proportion to the backlash. Counterclockwise increases the play.

[2] POWER STEERING (INTEGRAL TYPE)

(1) L2350 4WD

(1)-1 Structure



0301F035

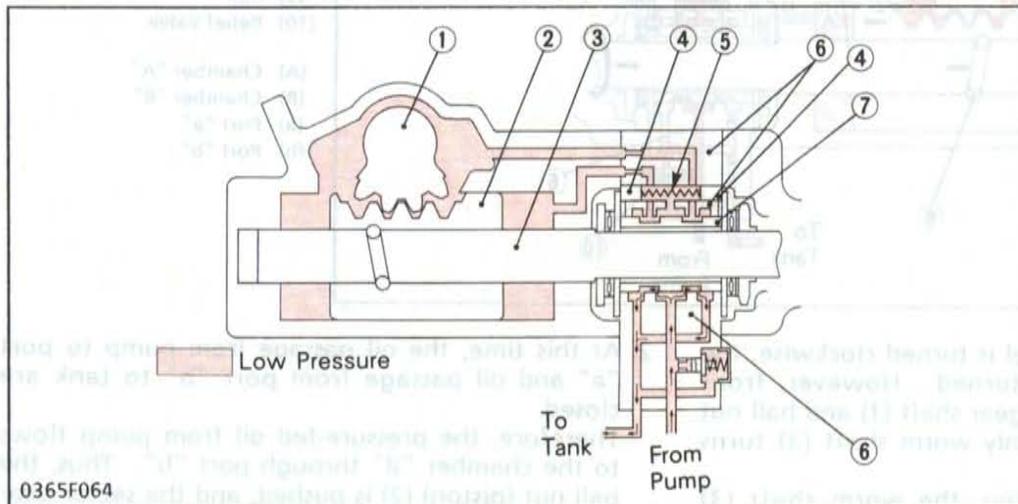
- | | | | |
|-----------------------|-----------------|------------------|---------------------|
| (1) Sector Gear Shaft | (5) Lock Nut | (9) Ball Nut | (12) Needle Bearing |
| (2) Spool | (6) Teflon Ring | (10) Teflon Ring | (Thrust Bearing) |
| (3) Sleeve | (7) Ball | (11) Thrust Race | (13) Oil Seal |
| (4) Centering Spring | (8) Worm Shaft | | |

The mechanical gear section shown above operates in the same way as ordinary manual steering systems. However, with power steering, the worm shaft (8) is supported only by the centering spring (4). When the worm thrust force (turning force of the ball screw section) exceeds centering spring setting load, the worm shaft axially shifts by a specified displacement (stroke: about 1.5 mm 0.0591 in.). When a load is applied to tires and worm thrust

force required for operation is greater than the centering spring setting load, turning the steering wheel does not rotate the sector gear shaft (1), but rather axially moves the worm shaft. The valve spool (2), secured on the worm shaft by a lock nut (5), changes the condition of the three-position, four-way open center (all ports open) valve by sliding in the sleeve (3), to generate pressure as required.

(1)-2 Oil Flow

■ Neutral Position



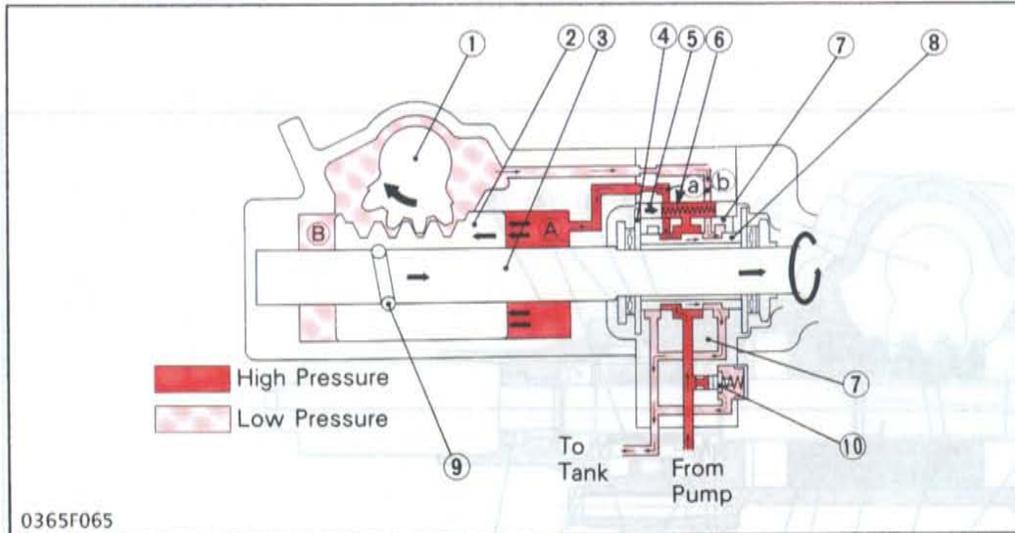
0365F064

- | |
|-----------------------|
| (1) Sector Gear Shaft |
| (2) Ball Nut |
| (3) Worm Shaft |
| (4) Reaction Pistons |
| (5) Centering Spring |
| (6) Valve Housing |
| (7) Spool |

When the steering wheel is not turned, the valve is placed in the neutral position by the centering springs (5) and pressurized reaction pistons (4), and the pressure-fed oil from pump through the flow priority valve flows to the tank.

Therefore, there is no difference between pressures on the right and left cylinder chambers. And the ball nut (2) and sector gear shaft (1) do not move. So, the front wheels keep the direction.

■ Left Turning

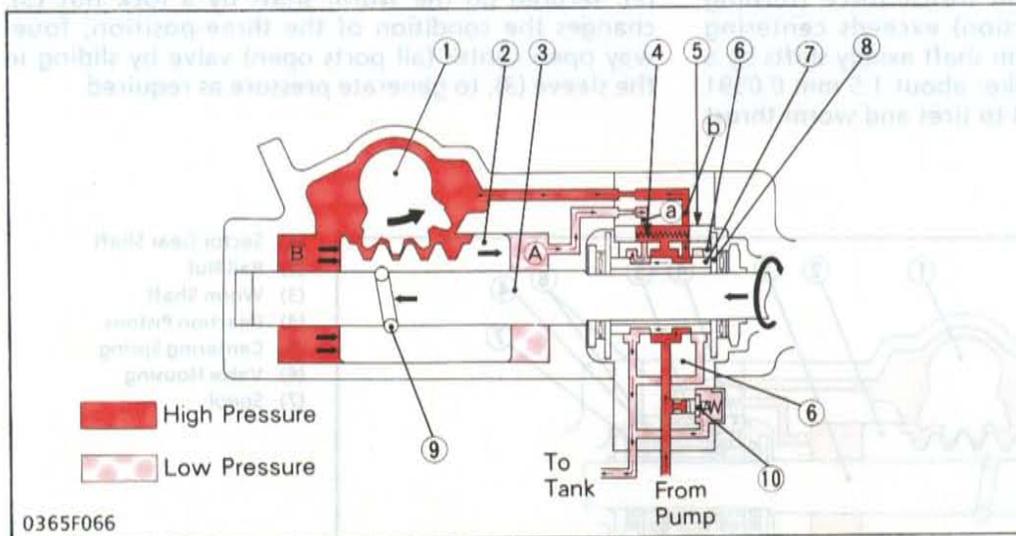


- (1) Sector Gear Shaft
- (2) Ball Nut
- (3) Worm Shaft
- (4) Thrust Race
- (5) Reaction Piston
- (6) Centering Spring
- (7) Valve Housing
- (8) Spool
- (9) Ball
- (10) Relief Valve
- (A) Chamber "A"
- (B) Chamber "B"
- (a) Port "a"
- (b) Port "b"

1. When the steering wheel is turned counterclockwise, the worm shaft (2) is also turned. However, front wheel load stops sectors gear shaft (1) and ball nut (piston) (2) from moving, and only worm shaft (3) turns counterclockwise. Then, due to the reaction, the worm shaft (3) moves upward a little. And the thrust race (4) pushes the spool (8), reaction piston (5) and centering springs (6).

2. At this time, the oil passage from pump to port "b" and oil passage from port "a" to tank are closed. Therefore, the pressure-fed oil from pump flows to the chamber "A" through port "a". Thus, the ball nut (piston) (2) is pushed, and the sector gear shaft (5) is rotated in the direction of the arrow. Oil in chamber "B" flows to the tank through port "b".

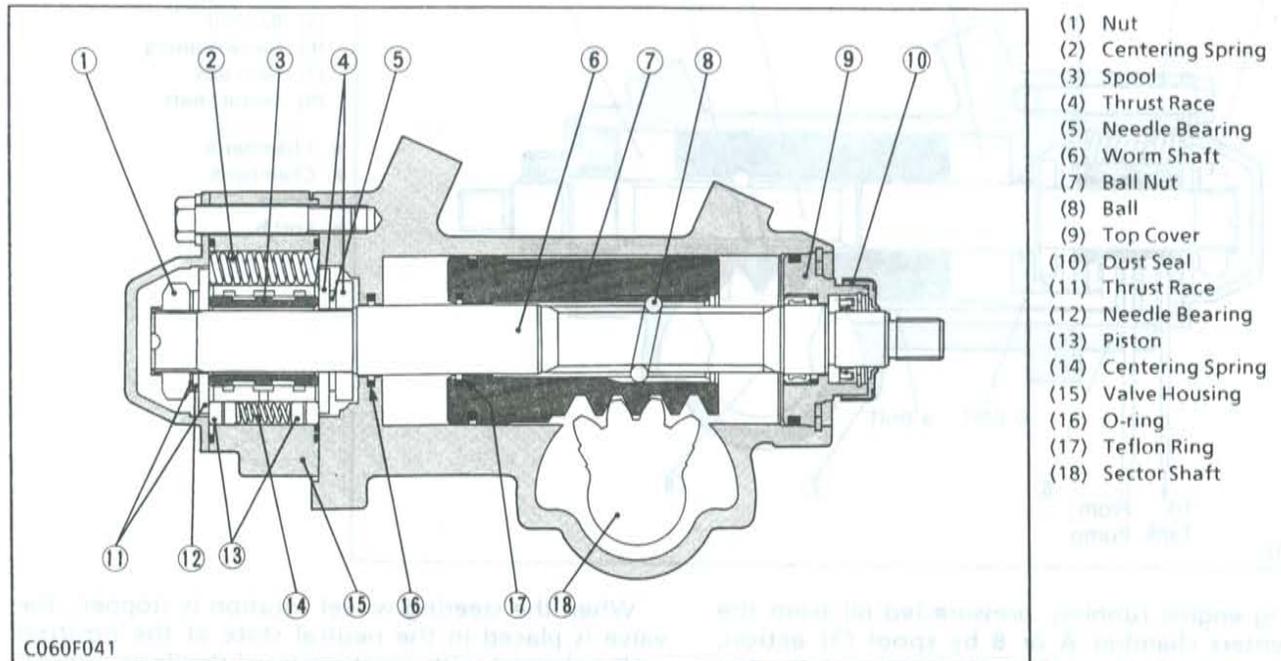
■ Right Turning



- (1) Sector Gear Shaft
- (2) Ball Nut
- (3) Worm Shaft
- (4) Centering Spring
- (5) Reaction Piston
- (6) Valve Housing
- (7) Spool
- (8) Thrust Race
- (9) Ball
- (10) Relief Valve
- (A) Chamber "A"
- (B) Chamber "B"
- (a) Port "a"
- (b) Port "b"

1. When the steering wheel is turned clockwise, the worm shaft (3) is also turned. However, front wheel load stops sector gear shaft (1) and ball nut (2) from moving, and only worm shaft (3) turns clockwise. Then due to the reaction, the worm shaft (3) moves downward a little. And the thrust race (8) pushes the spool (7), reaction piston (5) and centering springs (4).

2. At this time, the oil passage from pump to port "a" and oil passage from port "b" to tank are closed. Therefore, the pressure-fed oil from pump flows to the chamber "B" through port "b". Thus, the ball nut (piston) (2) is pushed, and the sector gear shaft (1) is rotated in the direction of the arrow. Oil in chamber "A" flows to the tank through the port "a".

(2) L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD**(2)-1 Structure**

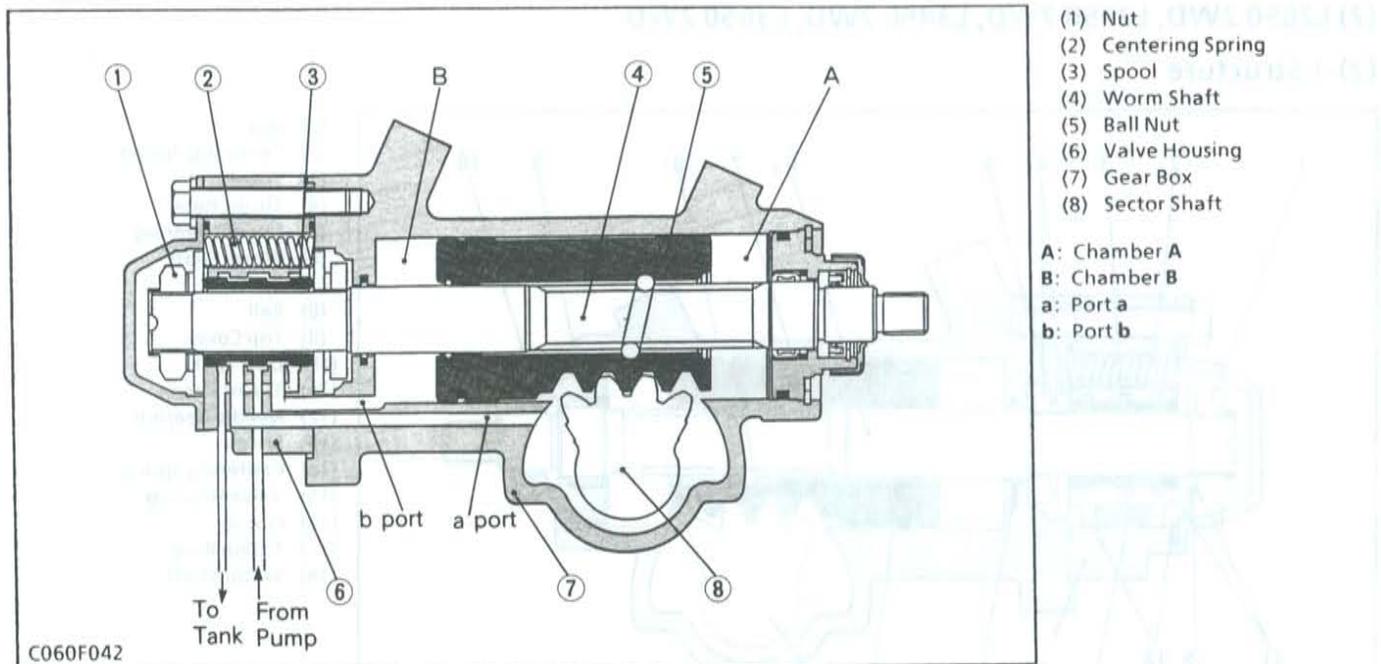
- (1) Nut
- (2) Centering Spring
- (3) Spool
- (4) Thrust Race
- (5) Needle Bearing
- (6) Worm Shaft
- (7) Ball Nut
- (8) Ball
- (9) Top Cover
- (10) Dust Seal
- (11) Thrust Race
- (12) Needle Bearing
- (13) Piston
- (14) Centering Spring
- (15) Valve Housing
- (16) O-ring
- (17) Teflon Ring
- (18) Sector Shaft

The power steering is an integral type and is divided into the two sections as shown above; the control valve section for controlling oil pressure and the hydraulic cylinder section for assisting the steering force.

The control valve section is a centering spring sliding valve type and is consisted of the spool (3),

valve housing (15), centering springs (2), (14) and other parts.

The hydraulic cylinder section is consisted of the gear box which constitutes the cylinder tube and the ball nut (7) and other parts which constitutes the piston.



During engine running, pressure-fed oil from the pump enters chamber A or B by spool (3) action, thereby moving ball nut (5) to the right or left. The spool is moved with a slight rotation of worm shaft (4), thus changing the oil path. Therefore, to move the spool (3) by the steering wheel, thus facilitating easy and smooth steering operation.

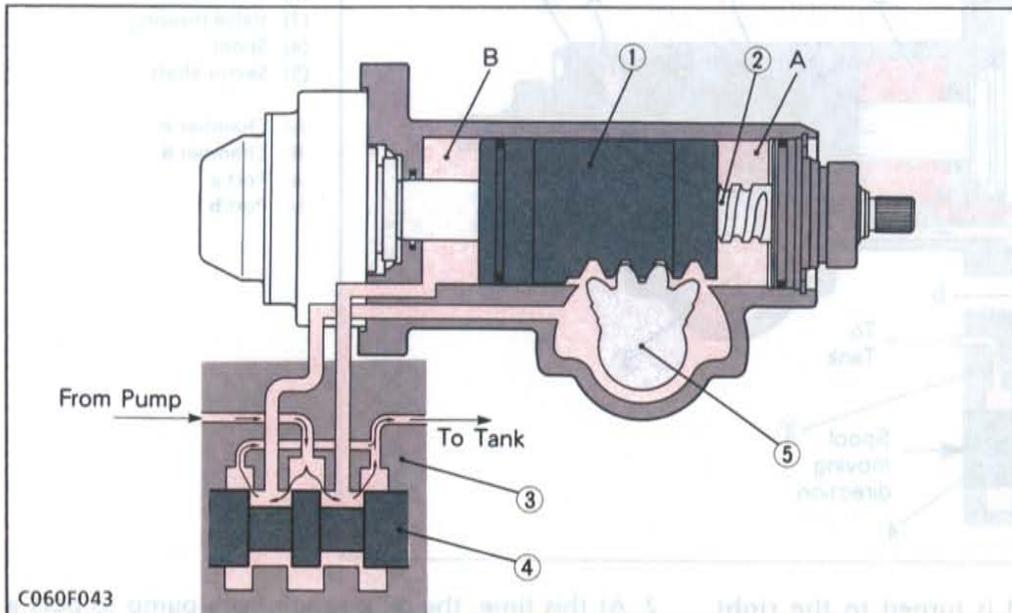
During engine stop or even when hydraulic circuit malfunctions, this system exhibits the same function as in manual steering.

Ports a and b are connected to the left and right cylinder chambers A and B respectively.

Oil fed from the pump pushes ball nut (5) (piston) in the cylinder chamber, thus rotating sector shaft (8). While the steering wheel is continuously rotated, the valve is always open therefore, the piston also follows it up.

When the steering wheel rotation is stopped, the valve is placed in the neutral state at the position well balanced with reaction from the front wheel, whereby the ball nut (5) (piston) stop, and the sector shaft also stops at that position. (Servo mechanism)

If the steering wheel is still rotated, when the front wheel reached the maximum steering angle, or resistance of moving wheel is too large, the relief valve is actuated, thus protecting the hydraulic circuit. Continuous the relief valve actuated causes oil temperature rise, which may perniciously affect each steering section.

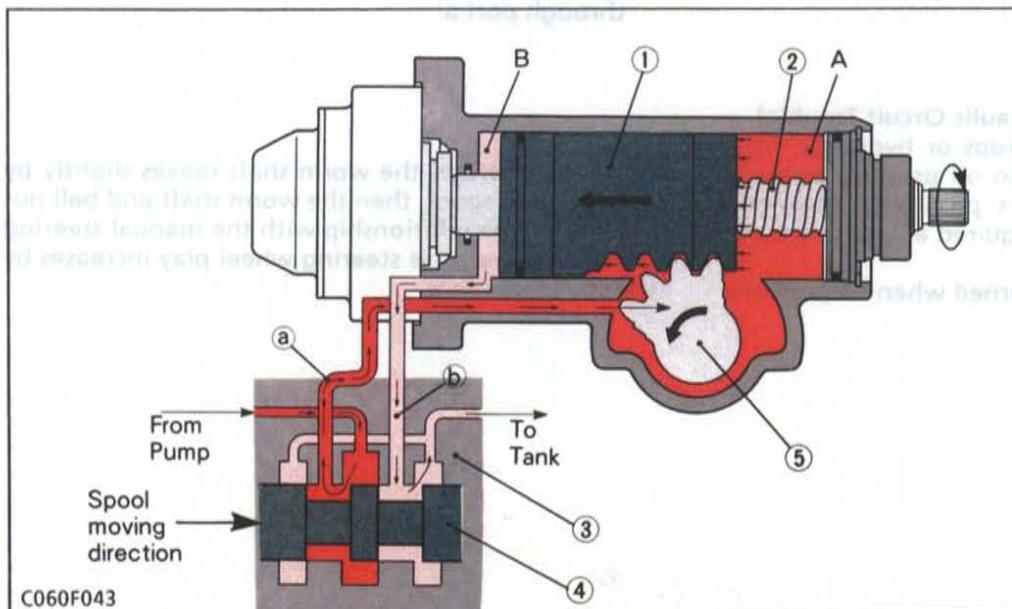
(2)-2 Oil Flow**Neutral Position**

- (1) Ball Nut
- (2) Worm Shaft
- (3) Valve Housing
- (4) Spool
- (5) Sector Shaft

When the steering wheel is not turned, the valve is placed in the neutral position by the centering spring, and the pressure-fed oil from pump returns to

the tank.

Therefore, there is no difference between pressures on the right and left cylinder chambers.

Left Turning

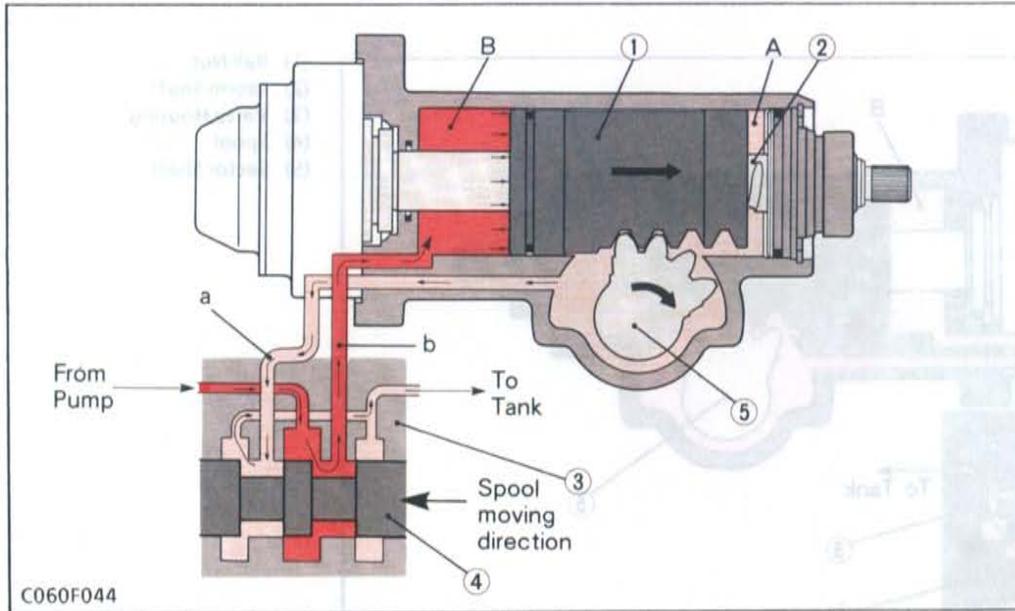
- (1) Ball Nut
- (2) Worm Shaft
- (3) Valve Housing
- (4) Spool
- (5) Sector Shaft

- A: Chamber A
- B: Chamber B
- a: Port a
- b: Port b

1. When the steering wheel is turned to the left, the worm shaft (2) attempts to turn to the right. However, front wheel load stops sector shaft (5) and ball nut (piston) (1) from moving, and only worm shaft (2) turns to the right. Therefore, the spool (4) is moved to the direction of the arrow, deflecting the centering spring.

2. At this time, the oil passage from pump to port b and oil passage from port a to oil tank are closed. Therefore, the pressure-fed oil from pump flows to the chamber A through port a. Thus, the ball nut (piston) (1) is pushed to the left, and the sector shaft (5) is rotated in the direction of the arrow. Oil in chamber B returns to the tank through port b.

■ Right Turning



- (1) Ball Nut
- (2) Worm Shaft
- (3) Valve Housing
- (4) Spool
- (5) Sector Shaft

- A: Chamber A
- B: Chamber B
- a: Port a
- b: Port b

1. When the steering wheel is turned to the right, the worm shaft (2) attempts to turn to the left. However, front wheel load stops sector shaft (5) and ball nut (1) from moving, and only worm shaft (2) turn to the left. Therefore, the spool (4) is moved to the direction of the arrow, deflecting the centering spring.

2. At this time, the oil passage from pump to port a and oil passage from port b to oil tank are closed. Therefore, the pressure-fed oil from pump flows to the chamber B through port b. Thus, the ball nut (piston) (1) is pushed to the right, and the sector shaft (5) is rotated in the direction of the arrow. Oil in chamber A returns to the tank through port a.

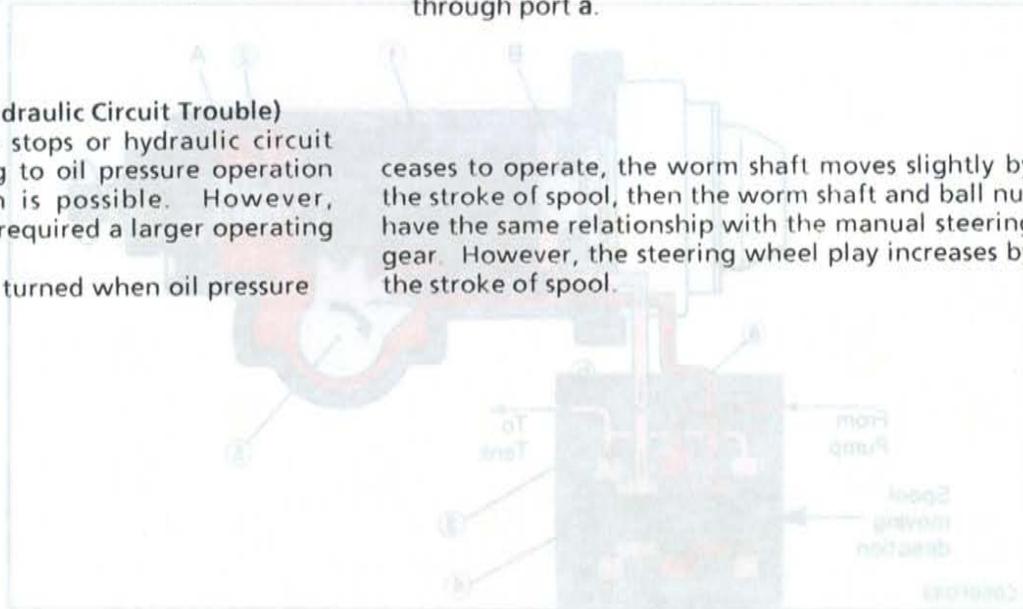
(3) Manual Operation

(When Engine Stops or Hydraulic Circuit Trouble)

Even when the engine stops or hydraulic circuit malfunctions thus leading to oil pressure operation stop, manual operation is possible. However, naturally, steering wheel required a larger operating power.

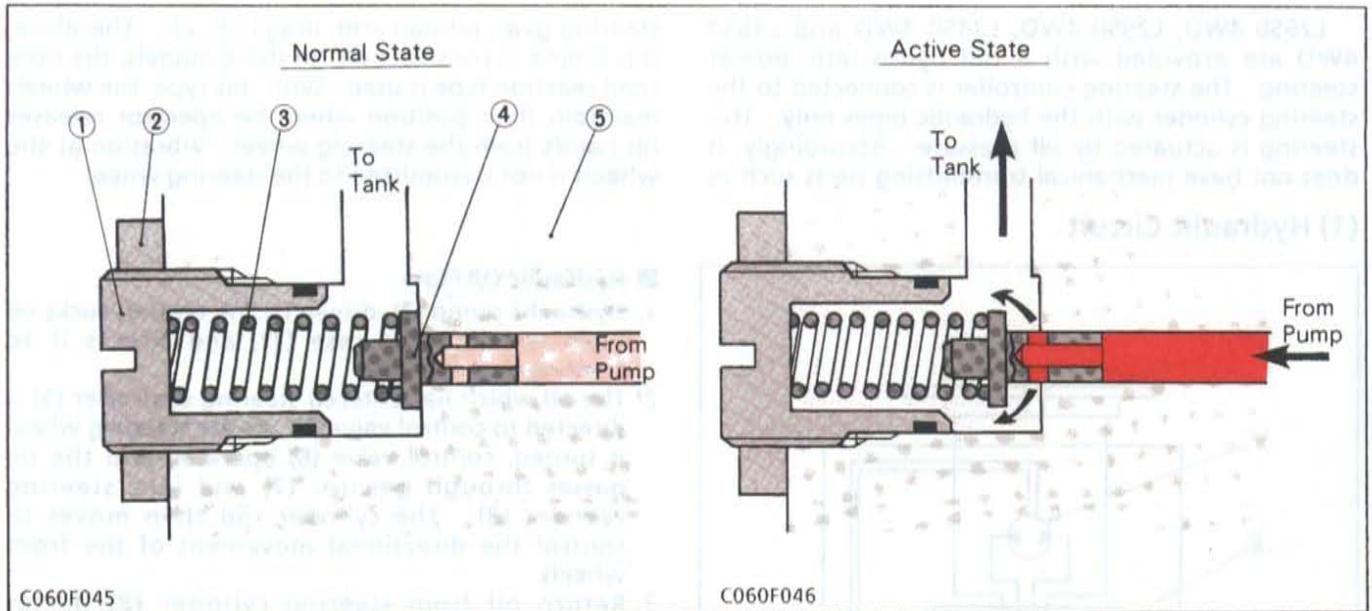
If the steering wheel is turned when oil pressure

ceases to operate, the worm shaft moves slightly by the stroke of spool, then the worm shaft and ball nut have the same relationship with the manual steering gear. However, the steering wheel play increases by the stroke of spool.



3. At this time, the oil passage from pump to port b and oil passage from port a to oil tank are closed. Therefore, the pressure fed oil from pump flows to the chamber B through port b. Thus, the ball nut (piston) (1) is pushed to the left, and the sector shaft (5) is rotated in the direction of the arrow. Oil in chamber A returns to the tank through port a.

1. When the steering wheel is turned to the left, the worm shaft (2) attempts to turn to the right. However, front wheel load stops sector shaft (5) and ball nut (1) from moving, and only worm shaft (2) turn to the right. Therefore, the spool (4) is moved to the direction of the arrow, deflecting the centering spring.

(4) Relief Valve

C060F045

C060F046

(1) Adjusting Screw
(2) Lock Nut

(3) Spring

(4) Poppet

(5) Valve Housing

This power steering is equipped with a direct-acting relief valve to restrict the maximum pressure in the hydraulic circuit and to prevent breakage of the hydraulic equipment.

When the pressure in the hydraulic circuit exceeds the relief valve setting pressure in such a case that the maximum steering angle of the front wheels is reached or road resistance to the front tires is too great, the spring (3) is compressed to generate a gap between the poppet (4) and the valve housing (5). The pressure-fed oil flows to tank port through the gap so that pressure rise is restricted.

The relief valve setting pressure can be adjusted by turning the adjusting screw (1).

(Reference)

- Relief valve setting pressure:

[L2350] 10.0 to 10.6 MPa
102 to 108 kgf/cm²
1451 to 1536 psi

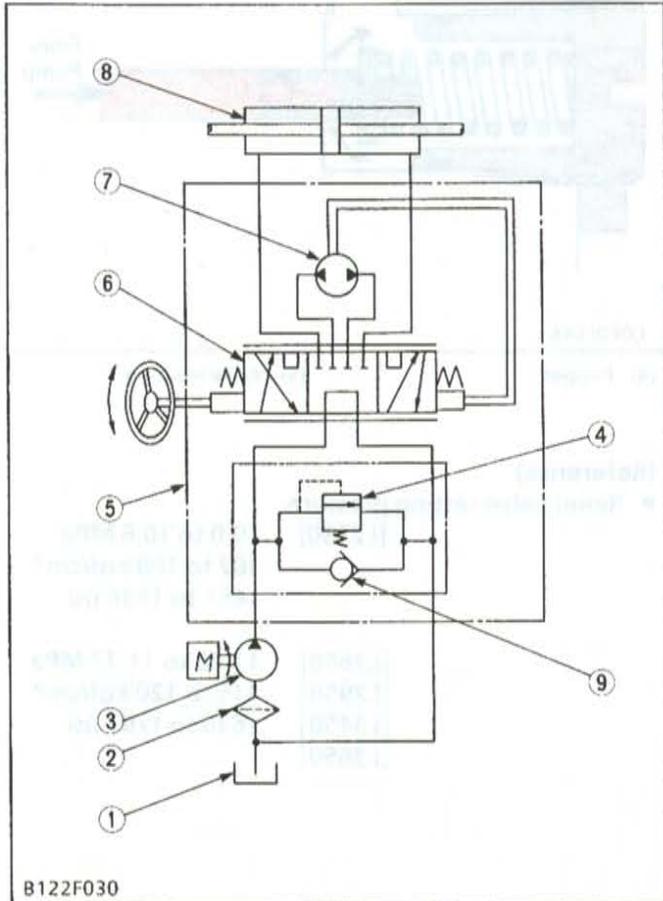
[L2650] 11.28 to 11.77 MPa
[L2950] 115 to 120 kgf/cm²
[L3450] 1636 to 1707 psi
[L3650]

[4] POWER STEERING (FULL HYDROSTATIC TYPE)

L2650 4WD, L2950 4WD, L3450 4WD and L3650 4WD are provided with a full hydrostatic power steering. The steering controller is connected to the steering cylinder with the hydraulic pipes only. This steering is actuated by oil pressure. Accordingly, it does not have mechanical transmitting parts such as

steering gear, pitman arm, drag link, etc. Therefore, it is simple in construction. In these models, the non-road reaction type is used. With this type, the wheels maintain their position when the operator releases his hands from the steering wheel. Vibration at the wheels is not transmitted to the steering wheel.

(1) Hydraulic Circuit



■ Hydraulic Oil Flow

1. Hydraulic pump (3), driven by the engine, sucks oil from transmission case (1), and directs it to steering controller (5).
2. The oil which has entered steering controller (5) is directed to control valve (6). As the steering wheel is turned, control valve (6) operates, and the oil passes through gerotor (7) and into steering cylinder (8). The cylinder rod then moves to control the directional movement of the front wheels.
3. Return oil from steering cylinder (8) passes through control valve (6) and back into transmission case (1).
4. When the engine is not operating, and the steering wheel is turned, gerotor (7) rotates to supply oil in the pipe to steering cylinder (8). Thus the machine can be steered manually. Under this condition, check valve (9) opens, and oil returning from the steering cylinder, which would otherwise return to transmission case (1), flows to the pipe leading to the hydraulic pump.

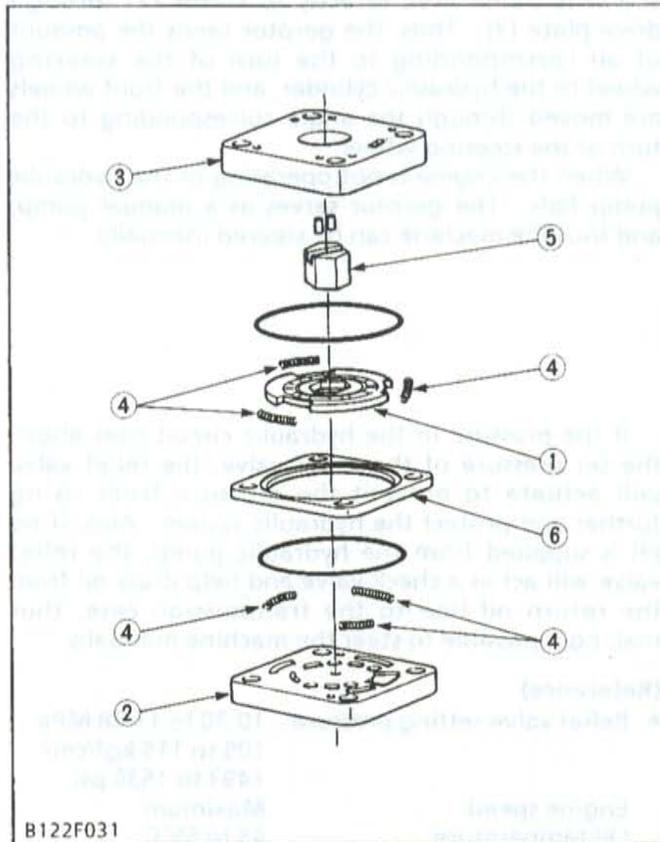
- | | |
|-------------------------|-----------------------|
| (1) Transmission Case | (6) Control Valve |
| (2) Oil Filter | (7) Gerotor |
| (3) Hydraulic Pump | (8) Steering Cylinder |
| (4) Relief Valve | (9) Check Valve |
| (5) Steering Controller | |

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(2) Steering Controller

The steering controller mainly consists of a control valve, a metering device and a relief valve with check valve. The metering device comprises a set of special gear called "Geroter".

(2)-1 Control Valve



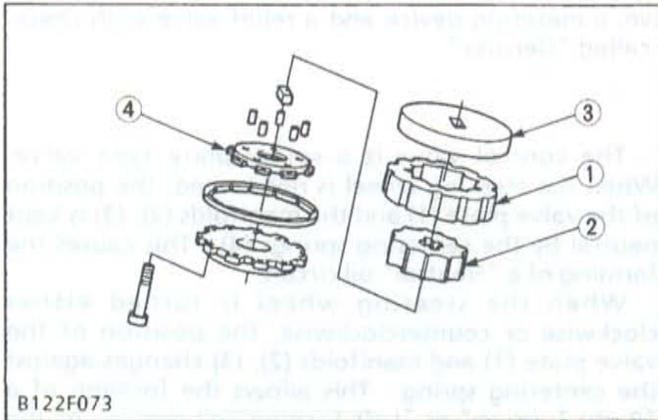
The control valve is a rotary plate type valve. When the steering wheel is not turned, the position of the valve plate (1) and the manifolds (2), (3) is kept neutral by the centering springs (4). This causes the forming of a "Neutral" oil circuit.

When the steering wheel is turned either clockwise or counterclockwise, the position of the valve plate (1) and manifolds (2), (3) changes against the centering spring. This allows the forming of a "Right Turning" or "Left Turning" oil circuit. At the same time, the geroter rotates with the valve plate and sends the oil to the cylinder corresponding to the rotation of the steering wheel.

- | | |
|------------------------|------------------------|
| (1) Valve Plate | (4) Centering Springs |
| (2) Port Manifold | (5) Hex Drive Assembly |
| (3) Isolation Manifold | (6) Valve Ring |



(2)-2 Metering Device (Gerotor)

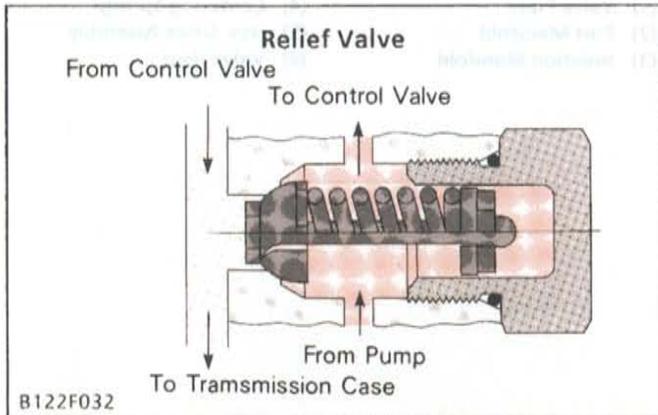


- (1) Stator
- (2) Rotor
- (3) Drive Plate
- (4) Commutator

All oil directed from the hydraulic pump to the steering cylinder passes through the metering device (gerotor) on its way. This metering device is a trochoid pump. As the steering wheel is turned, the action is transmitted directly to stator (1) through drive plate (3). Thus, the gerotor sends the amount of oil corresponding to the turn of the steering wheel to the hydraulic cylinder, and the front wheels are moved through the angle corresponding to the turn of the steering wheel.

When the engine is not operating or the hydraulic pump fails. The gerotor serves as a manual pump, and thus the machine can be steered manually.

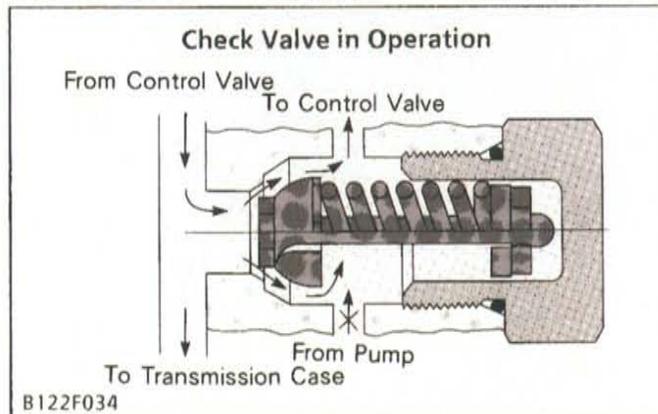
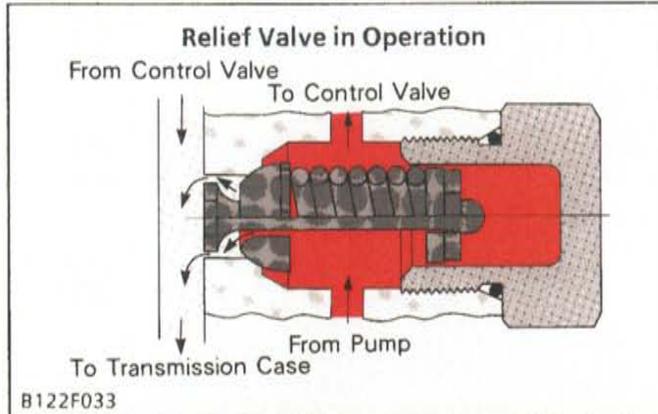
(2)-3 Relief Valve (with Check Valve)



If the pressure in the hydraulic circuit rises above the set pressure of the relief valve, the relief valve will actuate to prevent the pressure from rising further and protect the hydraulic system. Also, if no oil is supplied from the hydraulic pump, the relief valve will act as a check valve and help draw oil from the return oil line to the transmission case, thus making it possible to steer the machine manually.

(Reference)

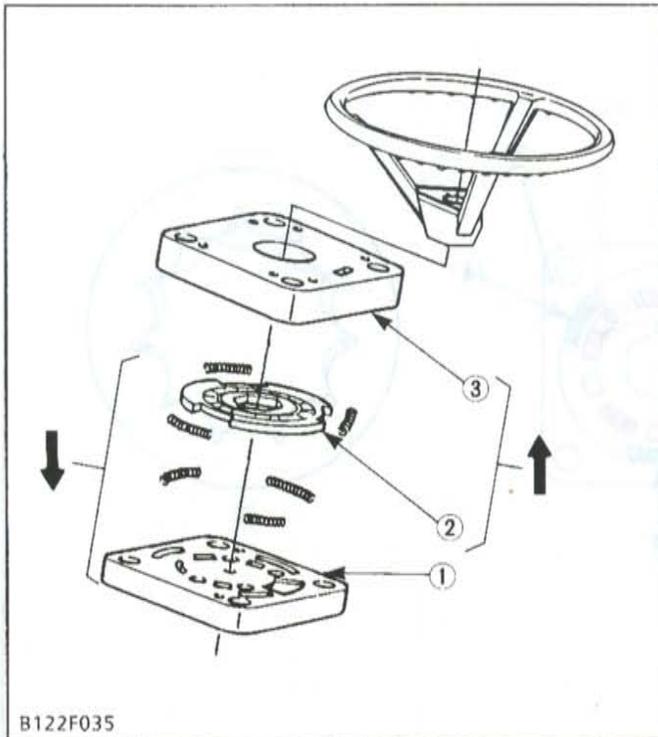
- Relief valve setting pressure: 10.30 to 11.28 MPa
105 to 115 kgf/cm²
1493 to 1636 psi
- Engine speed: Maximum
- Oil temperature: 45 to 55°C
(113 to 131°F)



(3) Oil Flow

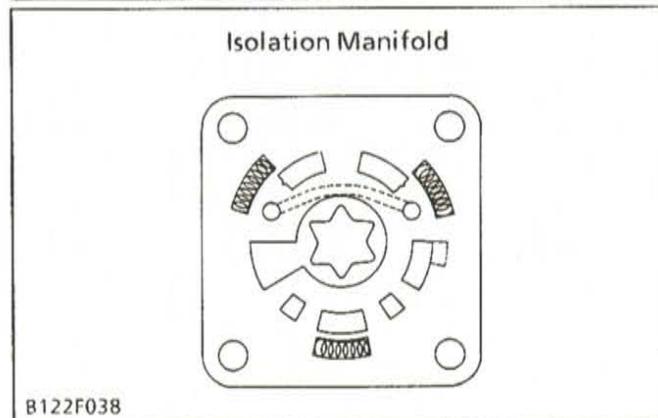
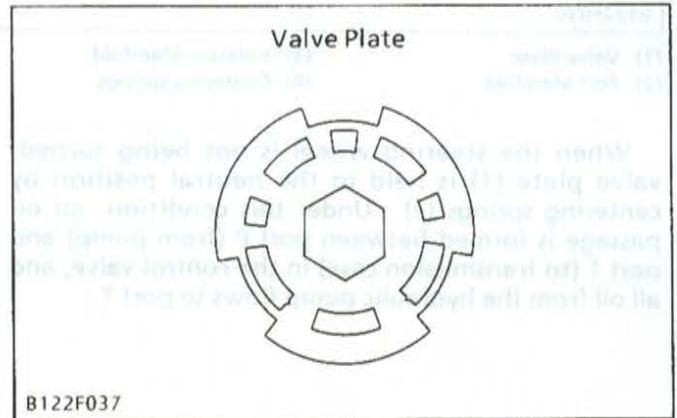
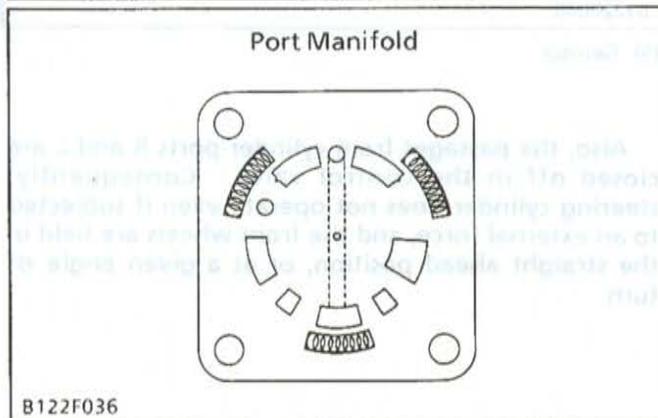
The directions of oil flow shown in the views in the following explanation are those when viewed from the directions indicated just below.

Views of the port manifold, the isolation manifold, and the valve plate are also given below.

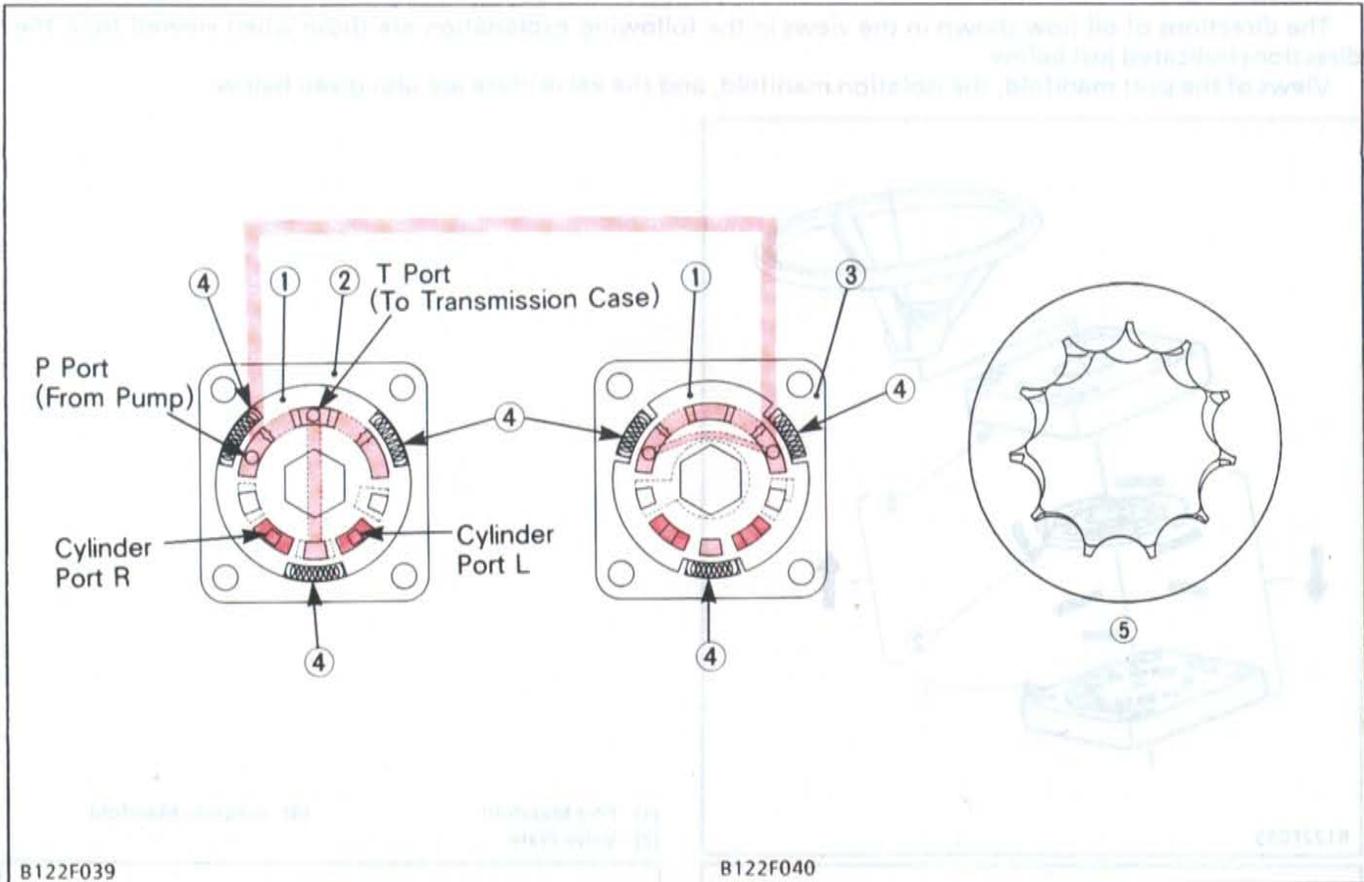


- (1) Port Manifold
- (2) Valve Plate

- (3) Isolation Manifold



■ Neutral Position



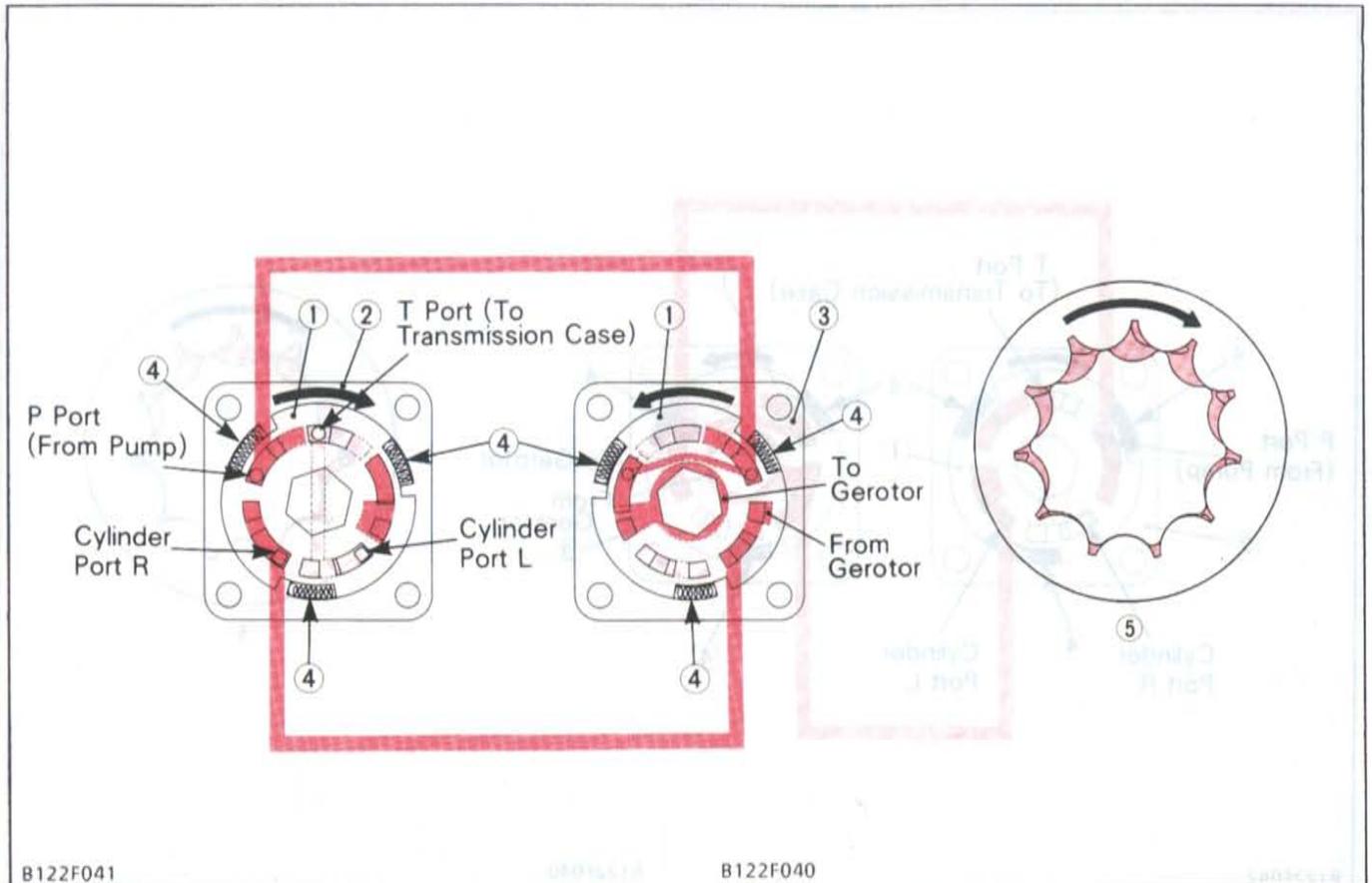
- (1) Valve Plate
- (2) Port Manifold
- (3) Isolation Manifold
- (4) Centering Springs

- (5) Gerotor

When the steering wheel is not being turned, valve plate (1) is held in the neutral position by centering springs (4). Under this condition, an oil passage is formed between port P (from pump) and port T (to transmission case) in the control valve, and all oil from the hydraulic pump flows to port T.

Also, the passages from cylinder ports R and L are closed off in the control valve. Consequently, steering cylinder does not operate even if subjected to an external force, and the front wheels are held in the straight ahead position, or at a given angle of turn.

■ Right Turn



(1) Valve Plate
(2) Port Manifold

(3) Isolation Manifold
(4) Centering Springs

(5) Gerotor

When the steering wheel is turned to the right, the action is transmitted through the drive plate, gerotor, and drive link to the control valve. Valve plate (1) then rotates to the right on manifolds (2) and (3), located on the opposite faces of the valve plate. Thus, the port P passage in the control valve is connected with gerotor (5).

The stator of gerotor (5) turns by the amount corresponding to the turn of the steering wheel, and the gerotor performs the metering function and lets oil through it, the amount of which corresponds to

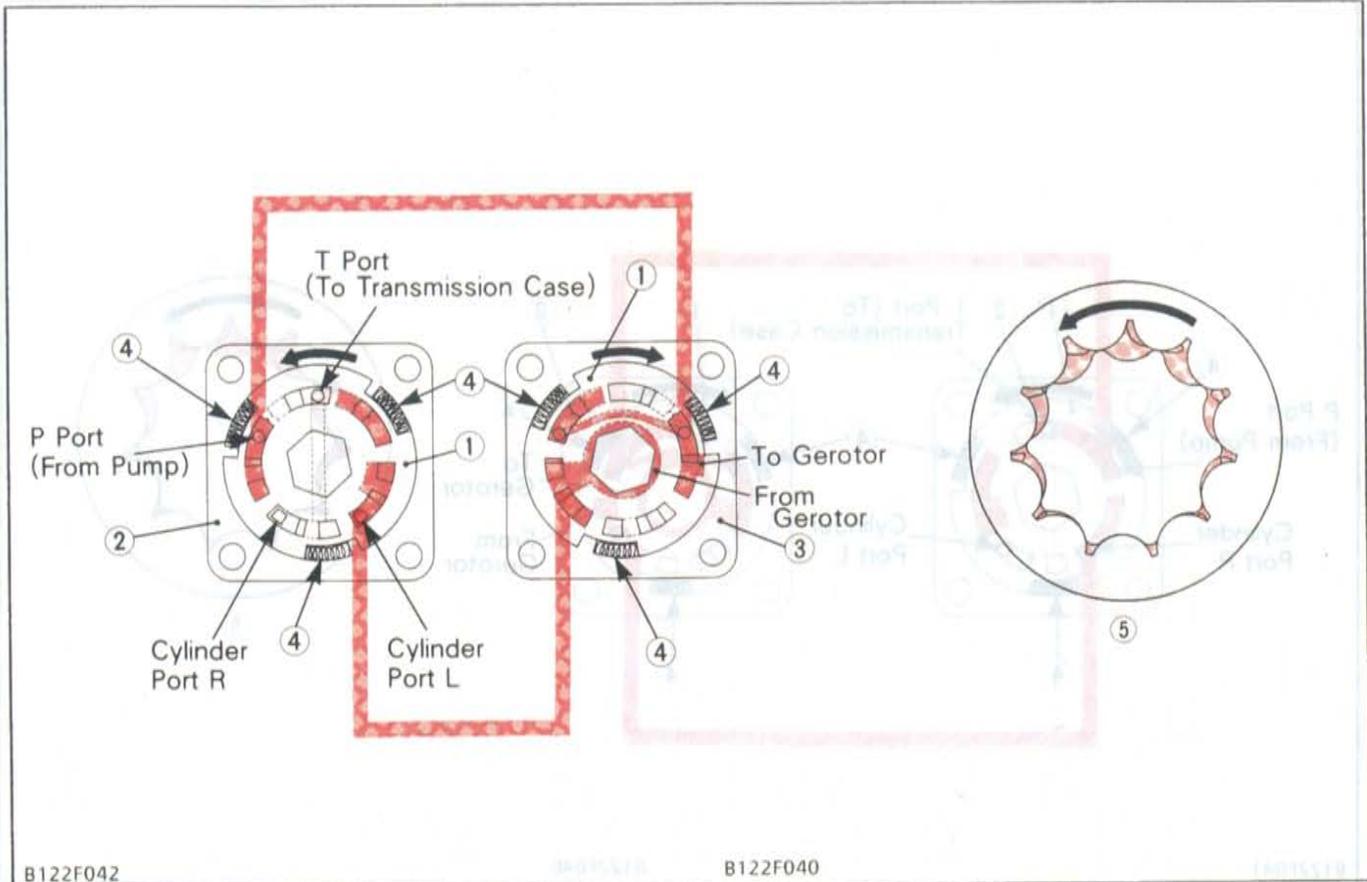
the turn of the steering wheel.

The oil which has passed through gerotor (5) flows back to the control valve, in which it is directed to cylinder port R to operate steering cylinder. Consequently, the front wheels are moved to the right through the angle corresponding to the amount of the oil.

When steering cylinder operates, oil returning to cylinder port L flows back to the transmission case through the passage connected to port T in the control valve.

■ Left Turn

Right Turn



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B122F040

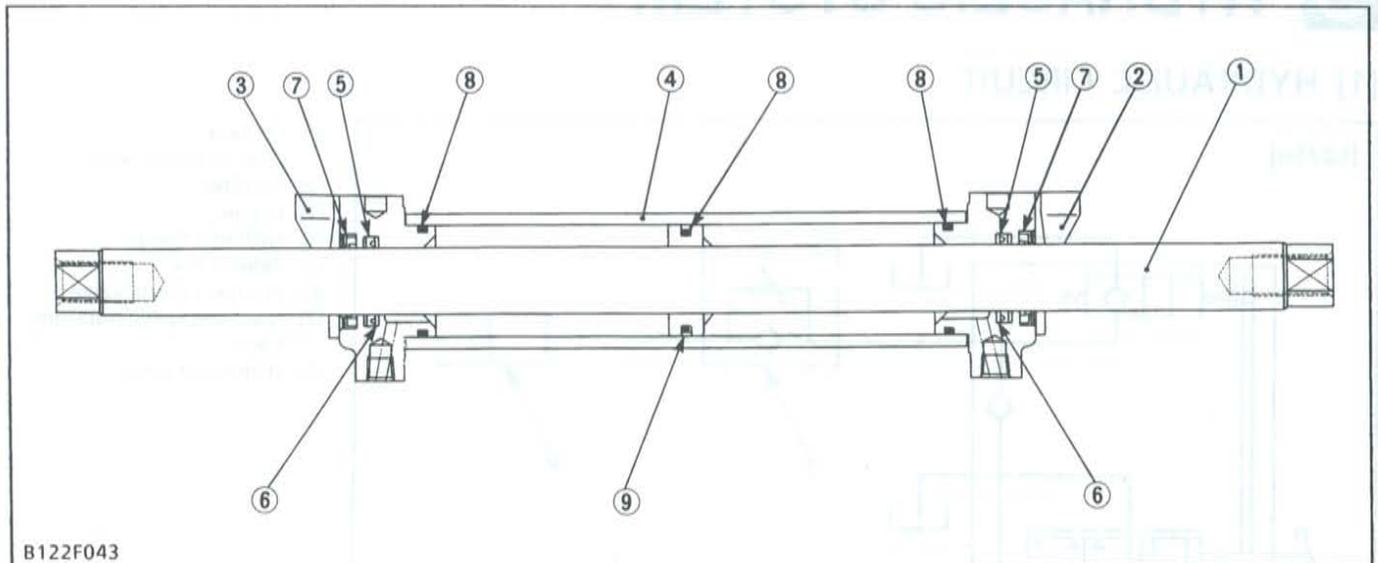
- (1) Valve Plate
- (2) Port Manifold
- (3) Isolation Manifold
- (4) Centering Springs

- (5) Gerotor

The steering system operates in the same way at a left-turn as well, except that oil flows into and out

of steering cylinder in the directions opposite to those at a right-turn.

(4) Steering Cylinder



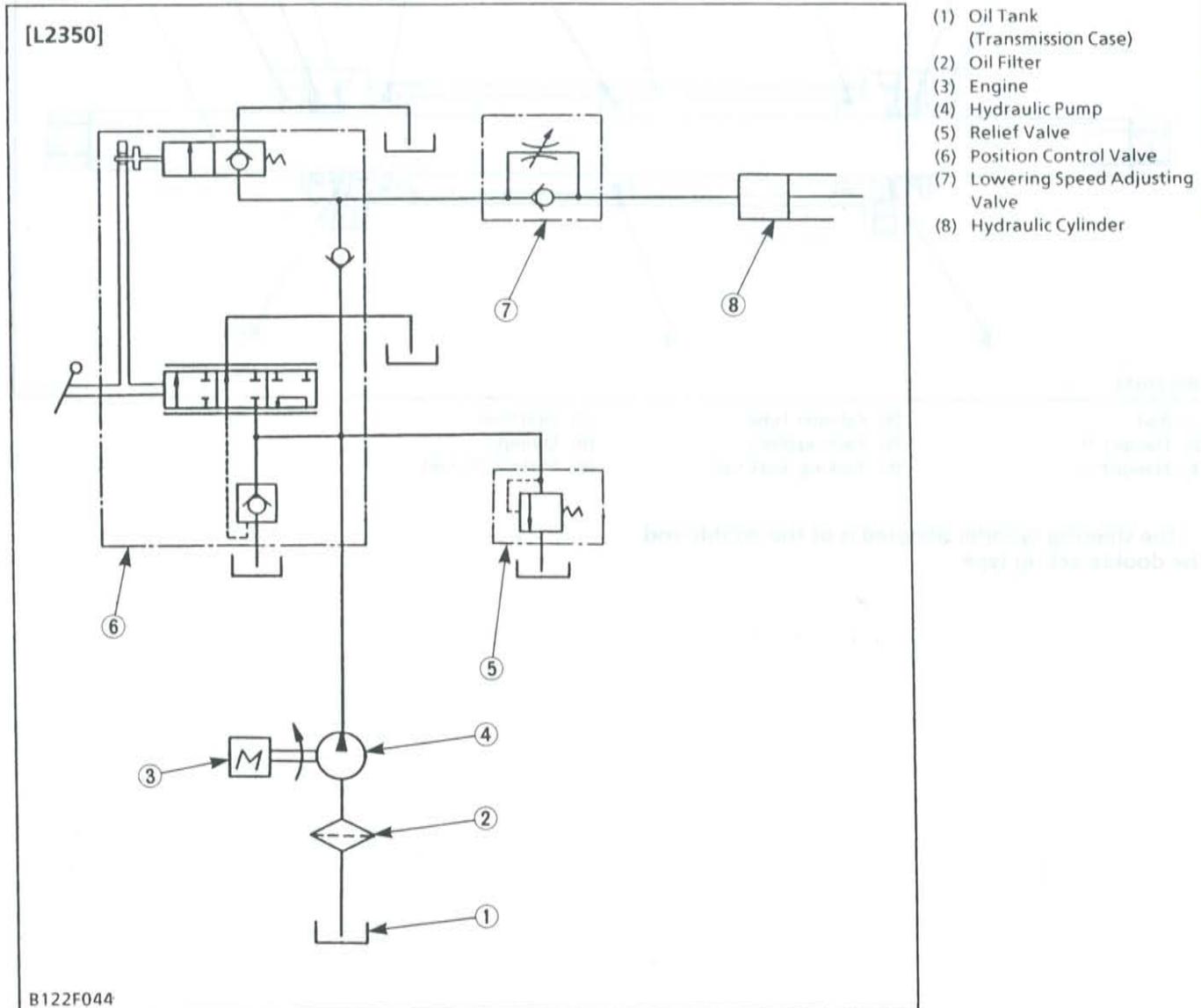
B122F043

- | | | |
|-----------------|-----------------------|----------------------|
| (1) Rod | (4) Cylinder Tube | (7) Dust Seal |
| (2) Flange L.H. | (5) Packing (Rod) | (8) O-rings |
| (3) Flange R.H. | (6) Packing (Back Up) | (9) Packing (Piston) |

The steering cylinder adopted is of the double-rod, the double-acting type.

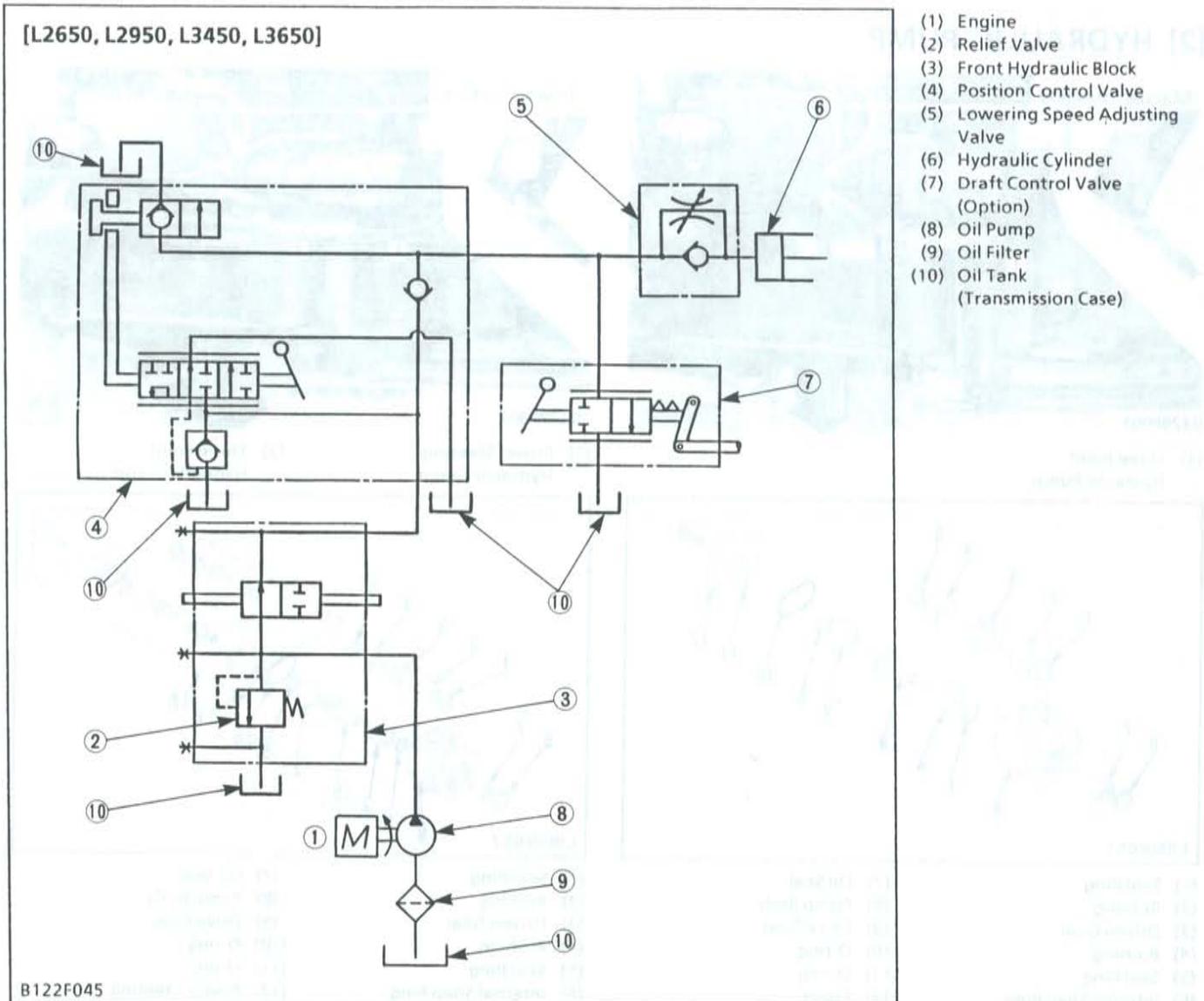
9 HYDRAULIC SYSTEM

[1] HYDRAULIC CIRCUIT



■ Hydraulic Oil Flow

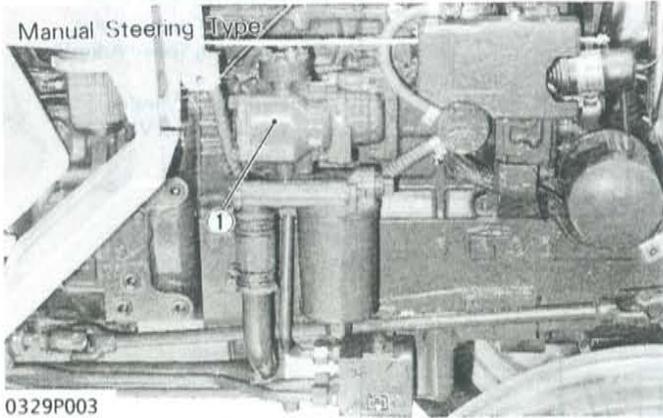
1. When the engine (3) is started, the hydraulic pump (4) is rotated to draw oil from the transmission case (1) through the suction pipe. Supplied oil is filtered by the oil filter (2).
 2. Filtered oil is forced out by the hydraulic pump to the position control valve (6) through the delivery pipe.
 3. The position control valve (6) switches the oil flow, and oil is channeled to the hydraulic cylinder (8) for the three-point hydraulic system or returned to the oil tank (transmission case).
- The hydraulic system has a relief valve (5) which restricts the maximum pressure in the circuit.



■ Hydraulic Oil Flow

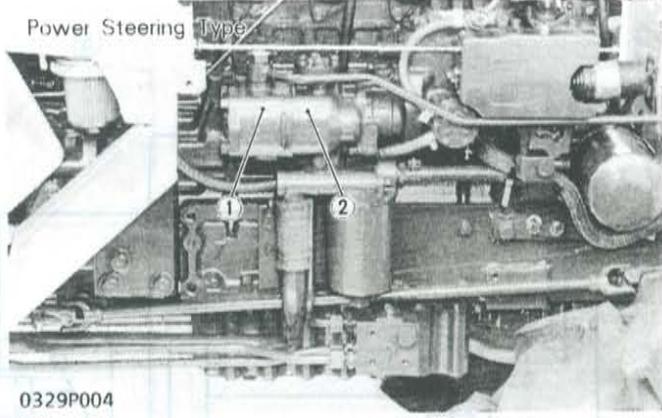
1. When the engine (1) is started, the hydraulic pump (8) is rotated to draw oil from the transmission case (10) through the suction pipe. Supplied oil is filtered by the oil filter (9).
2. Filtered oil is forced out by the hydraulic pump to the front hydraulic block (3). When a front end loader is equipped with the tractor, oil pressure is taken from the front hydraulic block (3), and the return oil from the front end loader flows back to this front hydraulic block (3), to be returned into the oil hydraulic circuit.
3. After that oil into the position control valve (4) through the delivery pipe.
4. The position control valve (4) switches the oil flow, and oil is channeled to the hydraulic cylinder (6) for the three-point hydraulic system or returned to the oil tank (transmission case) (10).
5. The hydraulic system has a relief valve (2) which restricts the maximum pressure in the circuit.

[2] HYDRAULIC PUMP



0329P003

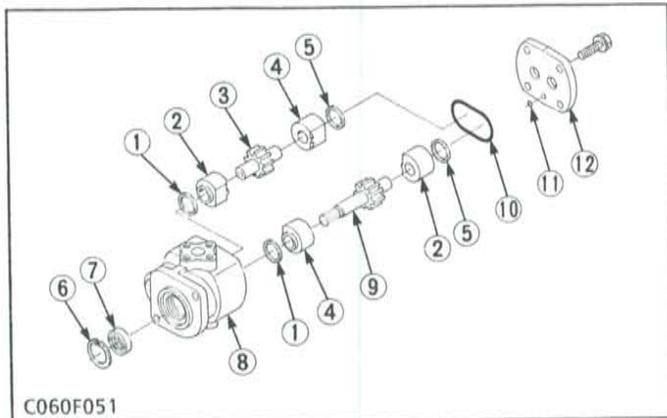
(1) Three Point Hydraulic Pump



0329P004

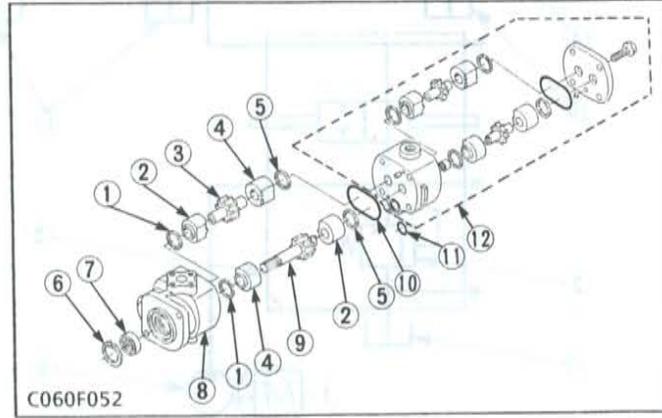
(1) Power Steering Hydraulic Pump

(2) Three Point Hydraulic Pump



C060F051

- (1) Seal Ring
- (2) Bushing
- (3) Driven Gear
- (4) Bushing
- (5) Seal Ring
- (6) Internal Snap Ring
- (7) Oil Seal
- (8) Pump Body
- (9) Drive Gear
- (10) O-ring
- (11) O-ring
- (12) Cover



C060F052

- (1) Seal Ring
- (2) Bushing
- (3) Driven Gear
- (4) Bushing
- (5) Seal Ring
- (6) Internal Snap Ring
- (7) Oil Seal
- (8) Pump Body
- (9) Drive Gear
- (10) O-ring
- (11) O-ring
- (12) Power Steering Hydraulic Pump

The three point hydraulic system pump pressure-feeds the oil drawn from the transmission case through the oil filter to the control valve. The three point hydraulic system pump is driven by the engine fuel camshaft.

The power steering system pump is driven by the drive gear of three point hydraulic system pump. (See the figure above.) This pump pressure-feeds the oil drawn from the three point hydraulic system pump suction line to the power steering system.

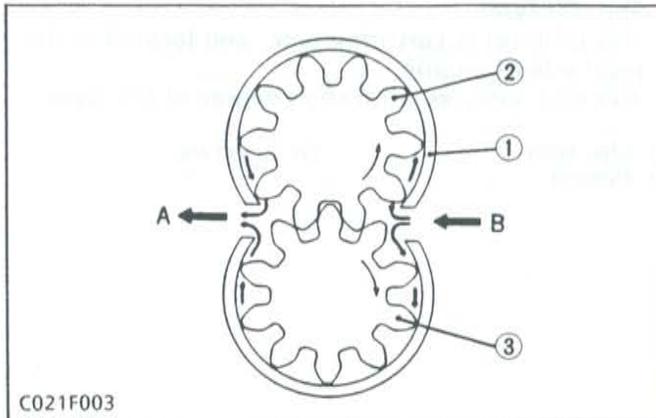
These hydraulic pumps are pressure loading type gear pumps with high volumetric efficiency.

(Reference)

- Pump discharge per revolution.

		Three point hydraulic system pump	Pump steering system pump
L2350	2WD	12.90 cc/rev. 0.787 cu.in./rev.	—
	4WD	9.027 cc/rev. 0.551 cu.in./rev.	—
L2650 L2950	Manual steering type		—
	Integral power steering type	9.027 cc/rev. 0.551 cu.in./rev.	3.703 cc/rev. 0.226 cu.in./rev.
	Full hydrostatic power steering type		6.068 cc/rev. 0.370 cu.in./rev.
L3450 L3650	Integral power steering type	11.72 cc/rev. 0.715 cu.in./rev.	4.778 cc/rev. 0.292 cu.in./rev.
	Full hydrostatic power steering type	11.69 cc/rev. 0.713 cu.in./rev.	6.068 cc/rev. 0.370 cu.in./rev.

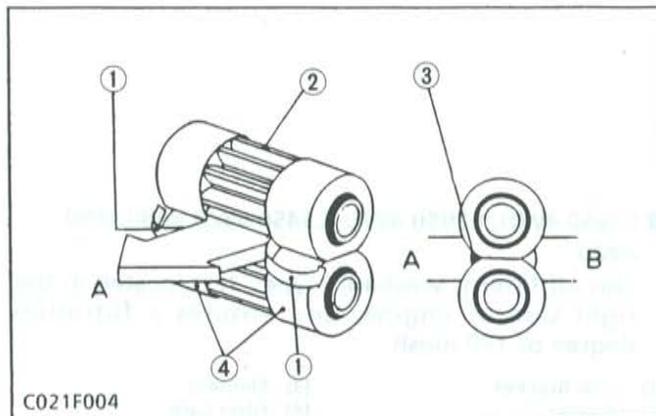
■ Operation



The hydraulic pump has two meshing gears (2), (3) whose teeth run close to the casing (1). One gear is a drive gear which drives the driven gear. When the drive gear is driven in the direction of the arrow by the fuel camshaft, the gear traps oil between the gear teeth and the casing. The higher the engine speed, the more the pump discharges.

- A: Outlet
- B: Inlet
- (1) Casing
- (2) Gear

(3) Gear



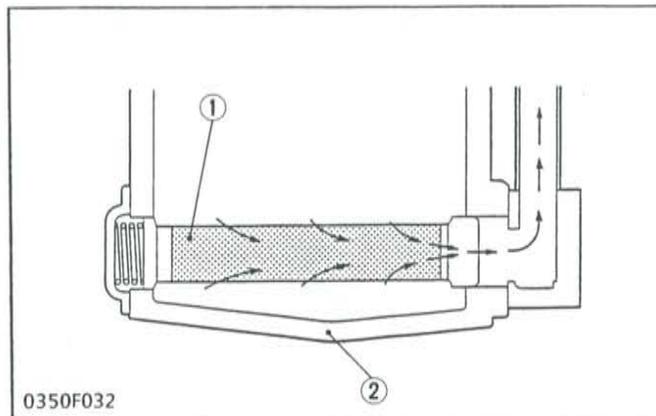
The pressure loading system automatically decreases the clearance between the gear and the bushings. A small amount of pressurized oil is fed behind the bushings, pressing them against the gears and forming a tighter seal against leakage. Therefore, leakage from the delivery side (high pressure) to the inlet side (low pressure) does not increase even if the pressure on the delivery side increases.

- A: Outlet
- B: Inlet
- (1) Loading Pressure
- (2) Gear

(3) Pressure Introducing Port
(4) Bushings

[3] OIL FILTER

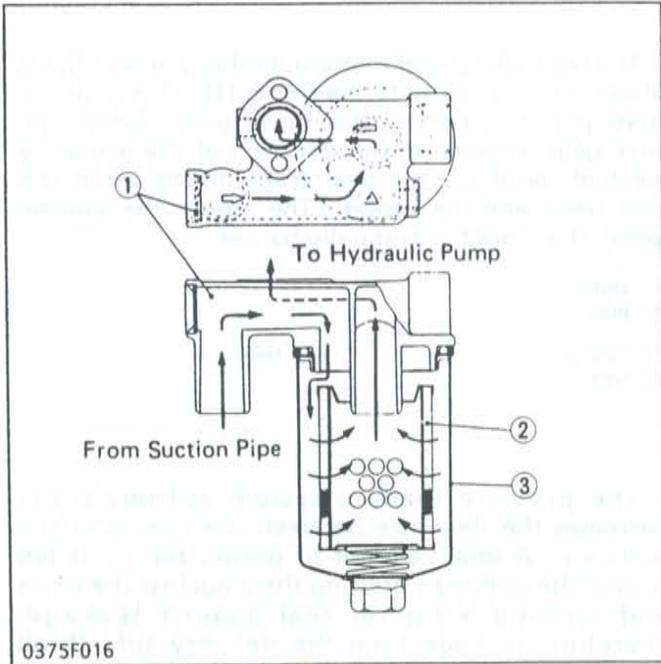
The oil filter is located at the pump suction line.



- (1) Oil Strainer
- (2) Transmission Case

■ L2350

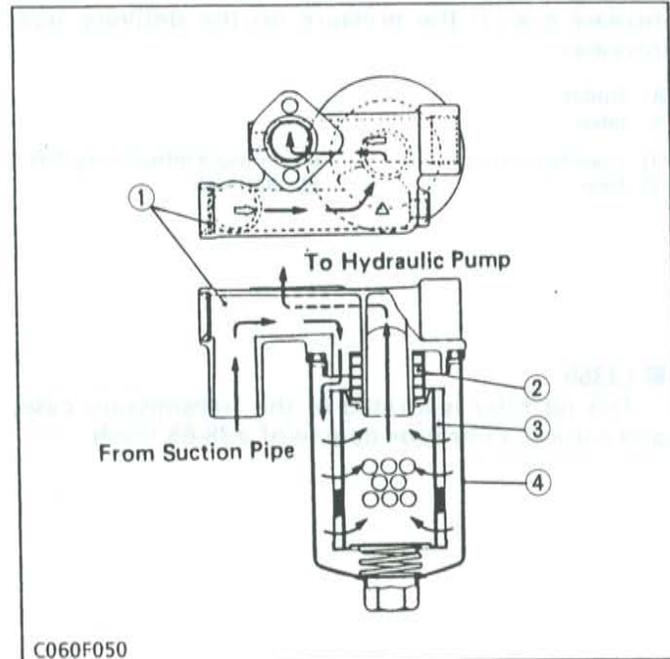
This oil filter is located in the transmission case, and ensures a filtration degree of #38-65 mesh.



■ L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD and GST type

This oil filter is cartridge type, and located in the right side of engine.
This filter ensures a filtration degree of 150 mesh.

- (1) Filter Bracket
- (2) Element
- (3) Filter Case



■ L2650 4WD, L2950 4WD, L3450 4WD and L3650 4WD

This oil filter is washable type. It is located in the right side of engine, and ensures a filtration degree of 140 mesh.

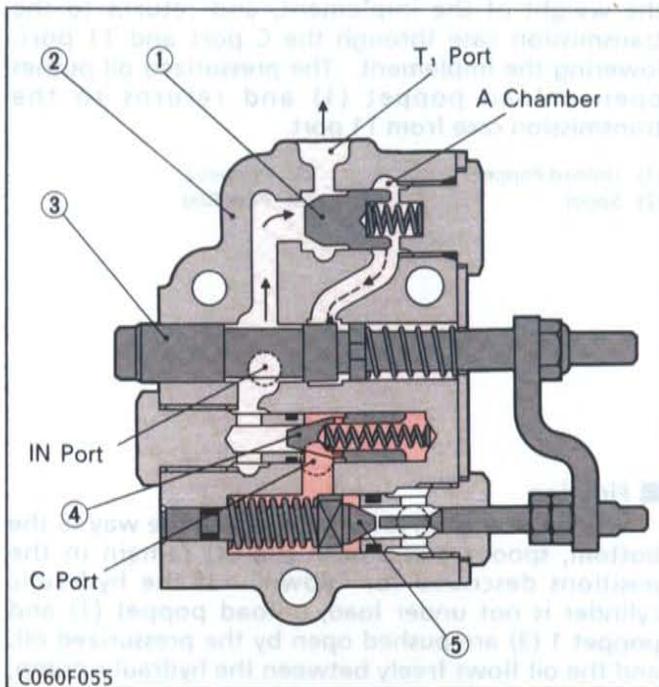
- (1) Filter Bracket
- (2) Magnet
- (3) Element
- (4) Filter Case

[4] POSITION CONTROL VALVE

This position control valve is located under the hydraulic cylinder block.

(1) Oil Flow

[L2350]



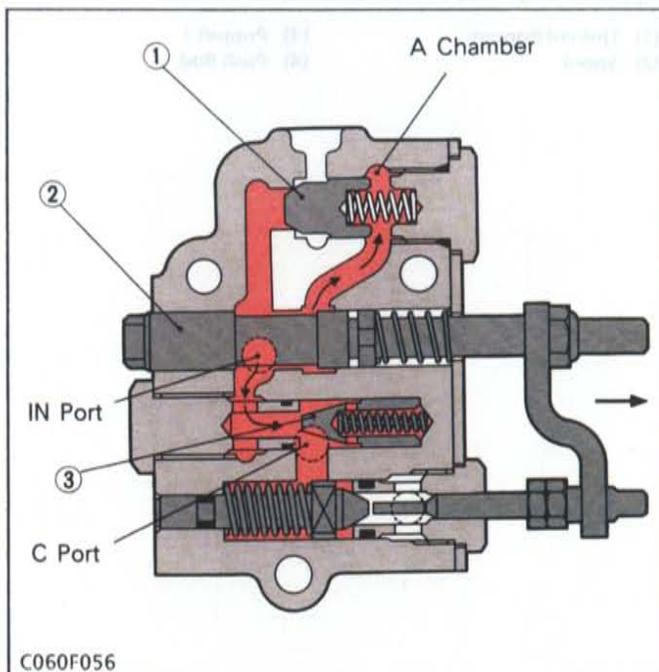
■ Neutral

Pressurized oil flows at the **IN** port, pushes open unload poppet (1) and returns to the transmission case from **T1** port.

The oil in the **A** chamber behind the unload poppet returns to the transmission case through the clearance between spool (3) and control valve (2). The oil in the hydraulic cylinder does not flow out because the circuit is cut off by the actions of poppet 1 (4) and poppet 2 (5).

This allows the implement to be kept at a steady height.

- | | |
|-------------------|--------------|
| (1) Unload Poppet | (4) Poppet 1 |
| (2) Control Valve | (5) Poppet 2 |
| (3) Spool | |



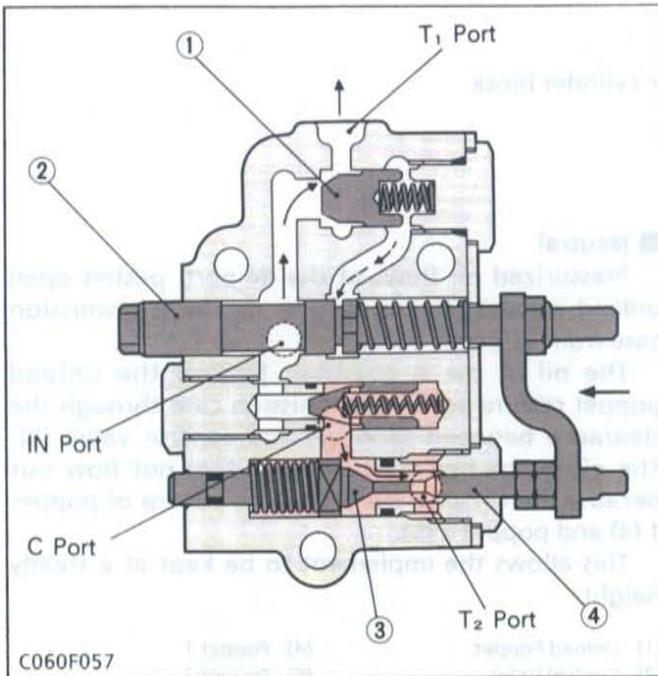
■ Lift

When the control lever is moved to **UP**, spool (2) is pulled by the spool operating lever, forming a circuit with the **IN** port and **A** chamber.

The pressurized oil thus flows into the **A** chamber and closes unload poppet (1).

The pressure in the circuit slowly rises, pushing open poppet 1 (3), and the hydraulic oil flows into the hydraulic cylinder from the **C** port, lifting the implement.

- | | |
|-------------------|--------------|
| (1) Unload Poppet | (3) Poppet 1 |
| (2) Spool | |



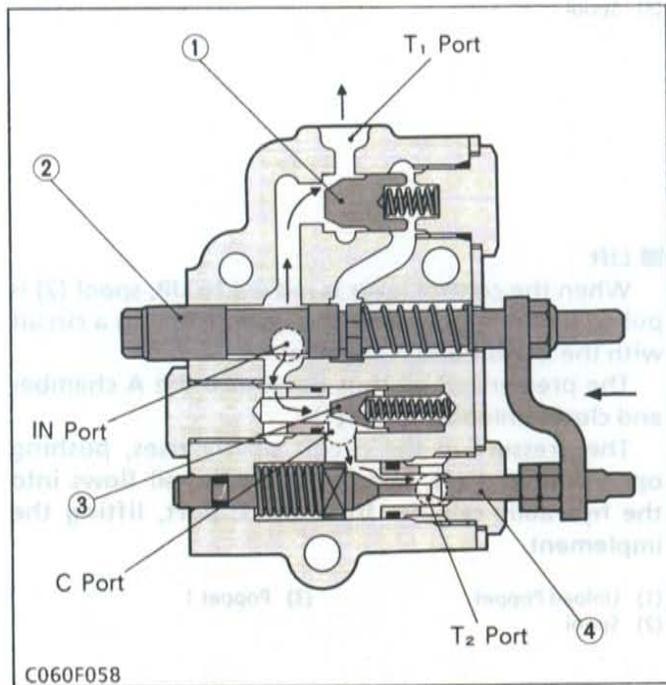
■ **Down**

When the control lever is moved to **DOWN**, spool (2) and push rod (4) are pushed by the spool operating lever.

The push rod pushes open poppet 2 (3), forming a circuit with the C port and T2 port.

The oil in the hydraulic cylinder is forced out by the weight of the implement, and returns to the transmission case through the C port and T1 port, lowering the implement. The pressurized oil pushes open unload poppet (1) and returns to the transmission case from T1 port.

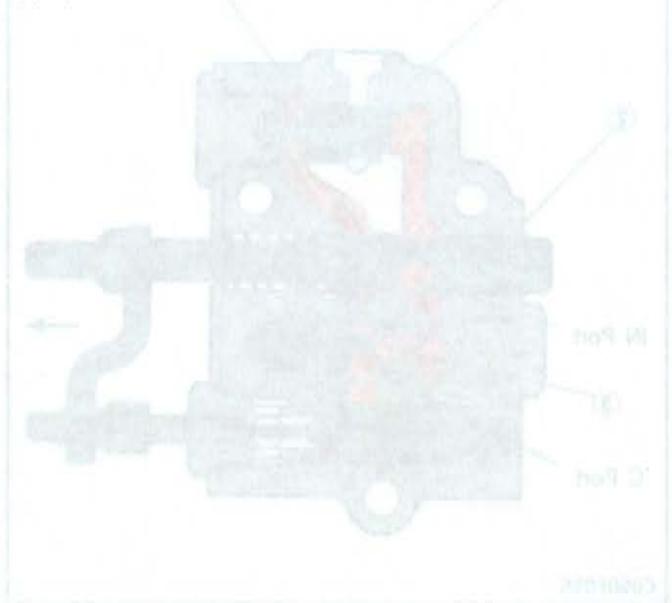
- | | |
|-------------------|--------------|
| (1) Unload Poppet | (3) Poppet 2 |
| (2) Spool | (4) Push Rod |



■ **Floating**

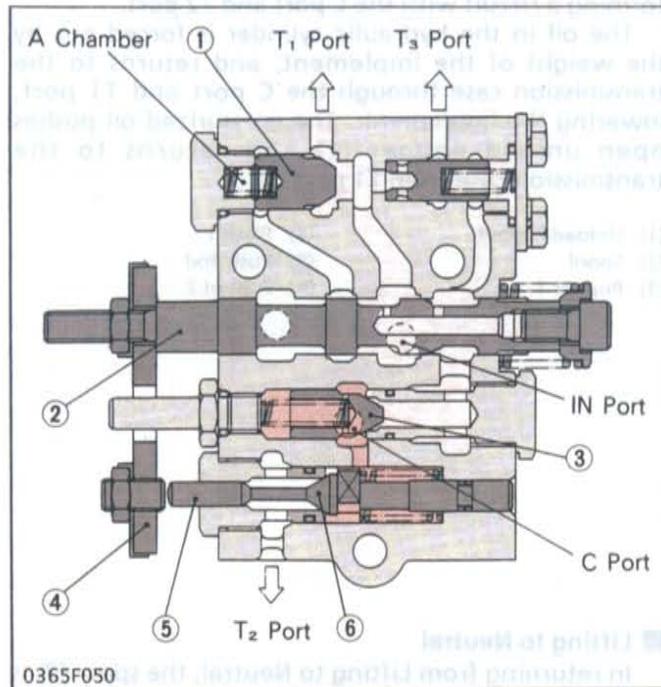
When the control lever is moved all the way to the bottom, spool (2) and push rod (4) remain in the positions described for "down". If the hydraulic cylinder is not under load, unload poppet (1) and poppet 1 (3) are pushed open by the pressurized oil, and the oil flows freely between the hydraulic pump, hydraulic cylinder and transmission case.

- | | |
|-------------------|--------------|
| (1) Unload Poppet | (3) Poppet 1 |
| (2) Spool | (4) Push Rod |



[L2350 with Draft Control]

This valve is used for tractor equipped draft control. (optional)
 It is functioning to absorb shocks when the implement goes up by draft control.

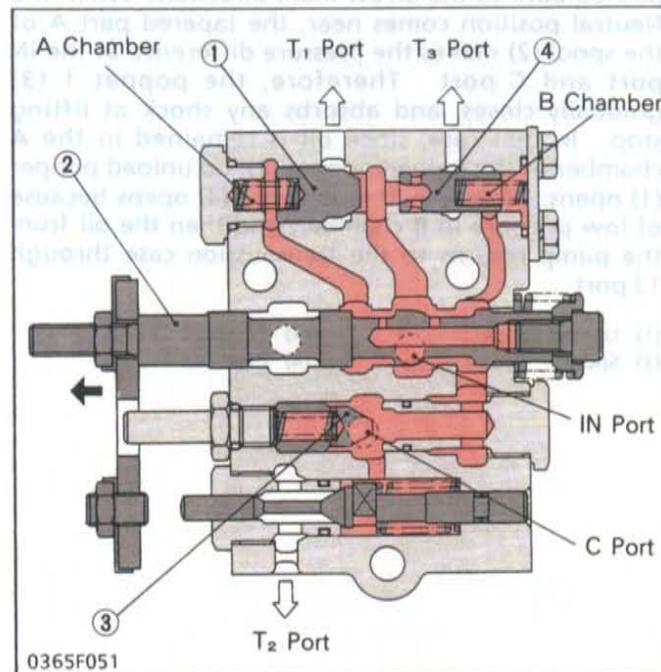


■ **Neutral**

Pressurized oil flows at the IN port, pushes open unload poppet (1) and returns to the transmission case from T1 port.

The oil in the A chamber behind the unload poppet returns to the transmission case through the clearance between spool (2) and control valve. The oil in the hydraulic cylinder does not flow out because the circuit is cut off by the actions of poppet 1 (3) and poppet 2 (6).

- (1) Unload Poppet
- (2) Spool
- (3) Poppet 1
- (4) Plate 1
- (5) Push Rod
- (6) Poppet 2



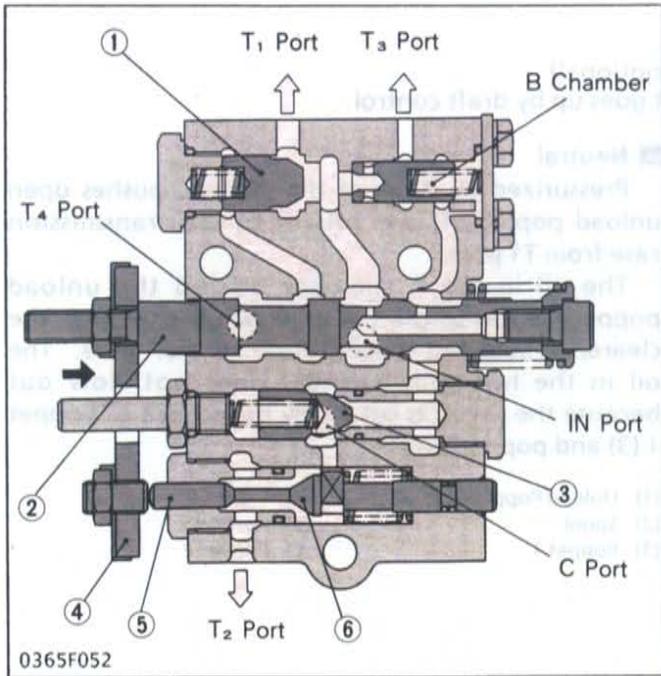
■ **Lift**

When the control lever is moved to UP, spool (2) moves to arrow-mark direction.

The oil entered IN port flows into the A chamber, B chamber and closes unload poppet (1), poppet 3 (4).

The pressure in the circuit slowly rises, pushing open poppet 1 (3), and the hydraulic oil flows into the hydraulic cylinder from the C port, lifting the implement.

- (1) Unload Poppet
- (2) Spool
- (3) Poppet 1
- (4) Poppet 3

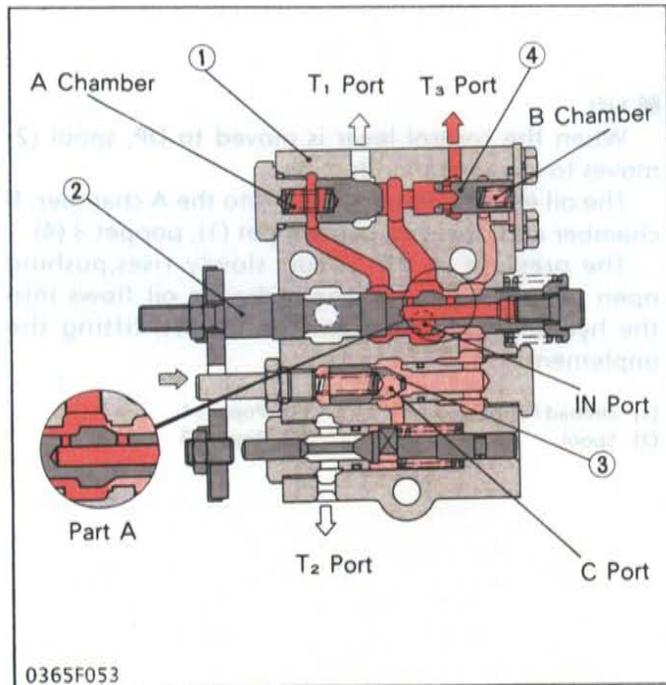


■ Down

When the control lever is moved to **DOWN**, spool (2) moves to arrow-mark direction, and pushes the push rod (5). The push rod pushes open poppet 2 (6), forming a circuit with the C port and T2 port.

The oil in the hydraulic cylinder is forced out by the weight of the implement, and returns to the transmission case through the C port and T1 port, lowering the implement. The pressurized oil pushes open unload poppet (1) and returns to the transmission case from T1 port.

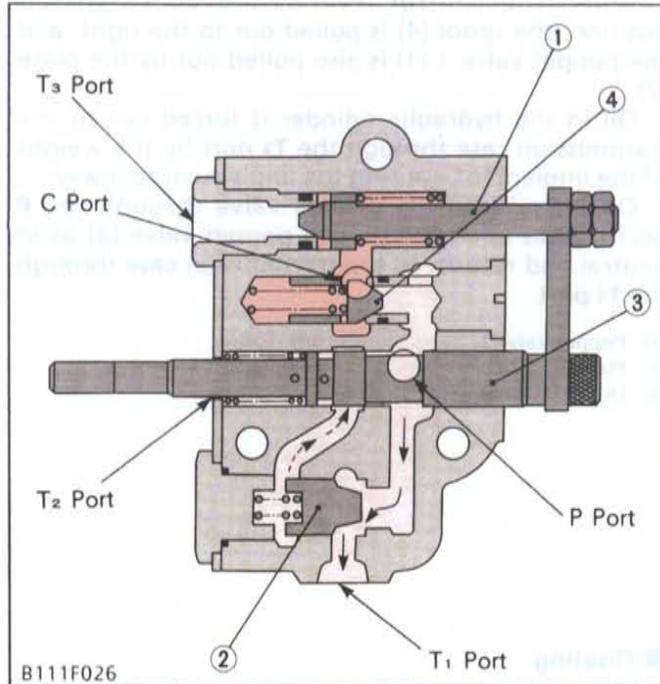
- | | |
|-------------------|--------------|
| (1) Unload Poppet | (4) Plate 1 |
| (2) Spool | (5) Push Rod |
| (3) Poppet 1 | (6) Poppet 2 |



■ Lifting to Neutral

In returning from Lifting to Neutral, the spool (2) is pushed back to the arrow-mark direction. When the Neutral position comes near, the tapered part A of the spool (2) makes the pressure difference at the IN port and C port. Therefore, the poppet 1 (3) gradually closes, and absorbs any shock at lifting stop. In that case, since oil is remained in the A chamber of the unload poppet (1), no unload poppet (1) opens. However, the poppet 3 (4) opens because of low pressure in B chamber, and then the oil from the pump returns to the transmission case through T3 port.

- | | |
|-------------------|--------------|
| (1) Unload Poppet | (3) Poppet 1 |
| (2) Spool | (4) Poppet 3 |

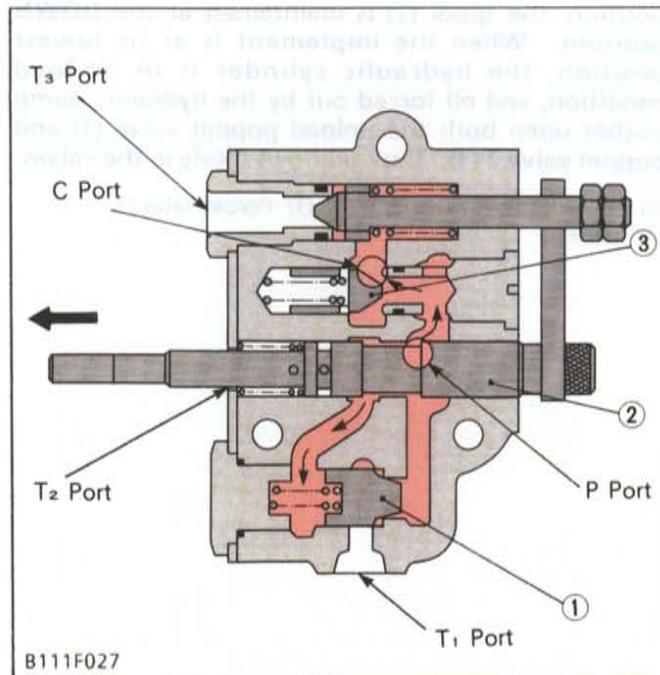
[L2650, L2950, L3450, L3650]**■ Neutral**

Oil forced into the control valve through the **P** port pushes open the unload poppet valve (2) and then returns to the transmission case through the **T1** port.

Oil behind the unload poppet valve (2) returns to the transmission case through the spool (3) and the **T2** port.

Since the poppet valve 2 (4) and poppet valve 1 (1) are closed, oil in the hydraulic cylinder does not flow to the transmission case. Thus, the implement remains at its fixed position.

- | | |
|-------------------------|--------------------|
| (1) Poppet Valve 1 | (3) Spool |
| (2) Unload Poppet Valve | (4) Poppet Valve 2 |

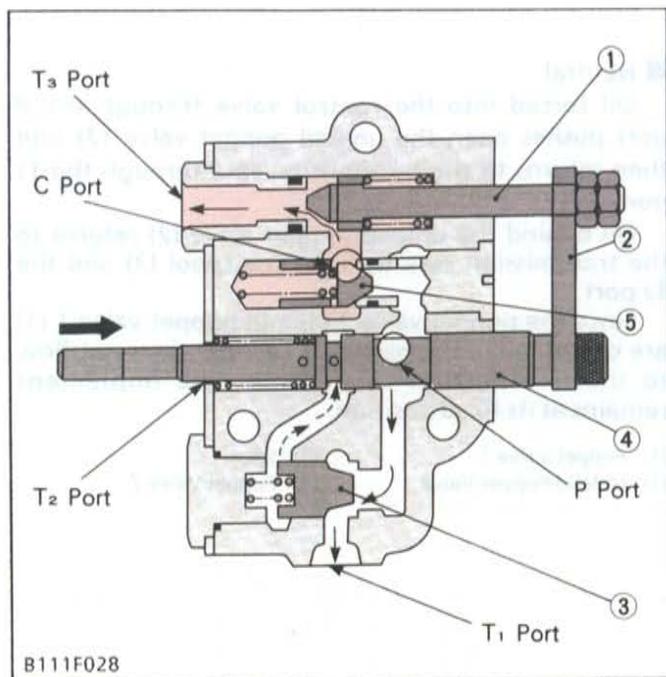
**■ Lift**

When the control lever is set to the **LIFT** position, the spool (2) is pushed to the left.

The oil forced into the control valve through the **P** port flows to the back of the unload poppet valve (1) to close it.

The oil pushes open the poppet valve 2 (3), and flows into the hydraulic cylinder through the **C** port to lift the implement.

- | | |
|-------------------------|--------------------|
| (1) Unload Poppet Valve | (3) Poppet Valve 2 |
| (2) Spool | |



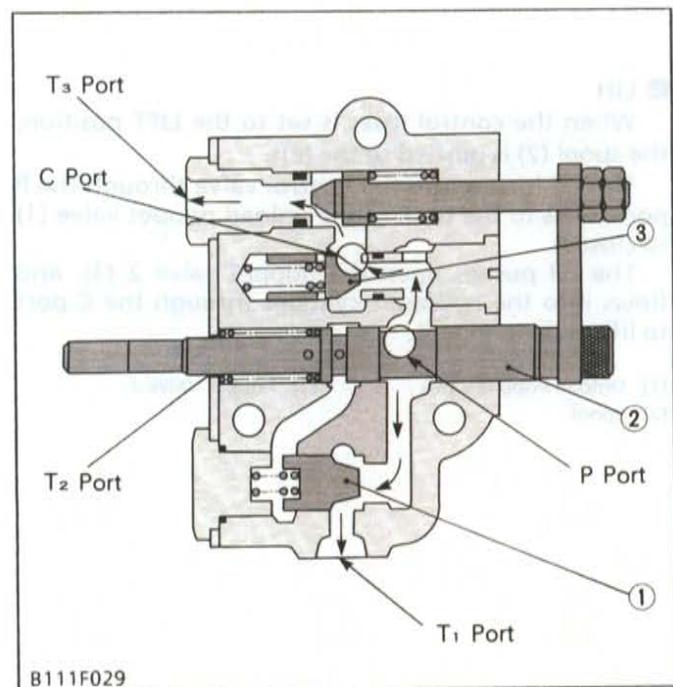
■ Down

When the control lever is moved to **DOWN** position, the spool (4) is pulled out to the right, and the poppet valve 1 (1) is also pulled out by the plate (2).

Oil in the hydraulic cylinder is forced out to the transmission case through the T₃ port by the weight of the implement, causing the implement to lower.

Oil forced into the control valve through the P port pushes open the unload poppet valve (3) as in neutral and returns to the transmission case through the T₁ port.

- (1) Poppet Valve 1
- (2) Plate
- (3) Unload Poppet Valve
- (4) Spool
- (5) Poppet Valve 2

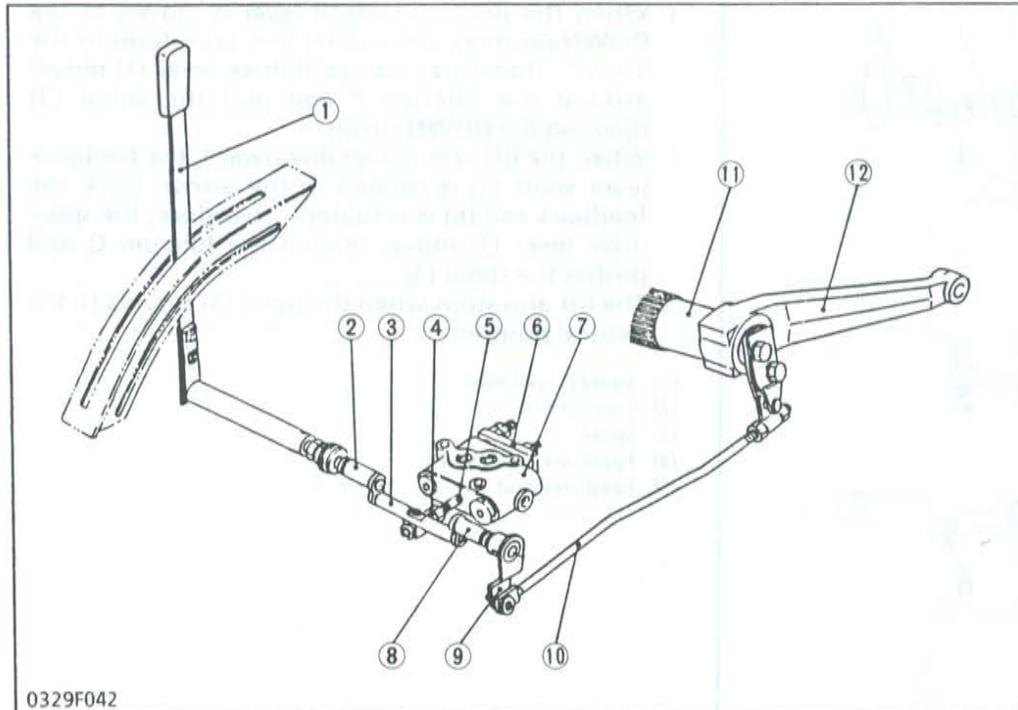


■ Floating

When the control lever is moved to its lowest position, the spool (2) is maintained at the **DOWN** position. When the implement is at its lowest position, the hydraulic cylinder is in no-load condition, and oil forced out by the hydraulic pump pushes open both the unload poppet valve (1) and poppet valve 2 (3). Thus, oil flows freely in the valves.

- (1) Unload Poppet Valve
- (2) Spool
- (3) Poppet Valve 2

[5] POSITION CONTROL LINKAGE



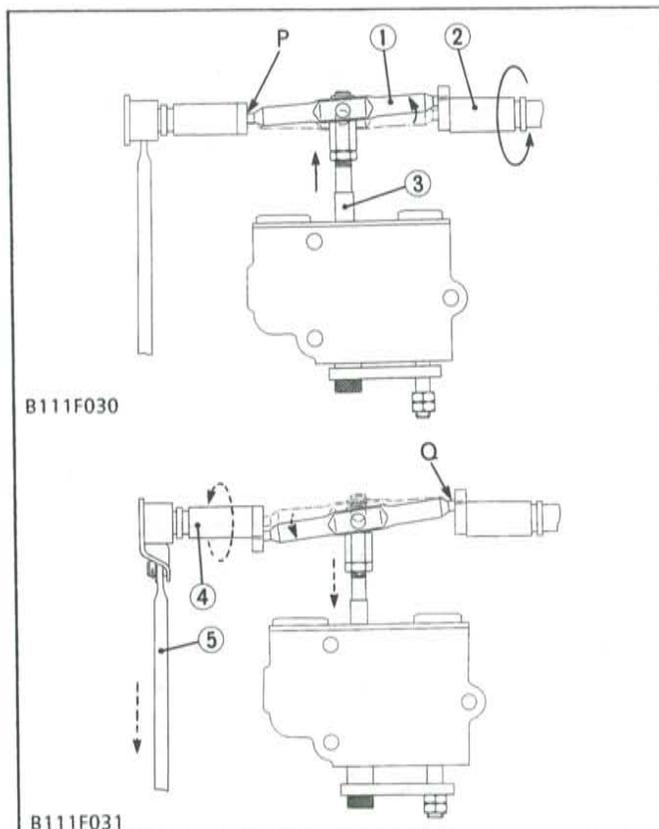
- (1) Position Control Lever
- (2) Control Arm
- (3) Spool Drive Lever
- (4) Spool Joint 1
- (5) Spool Head
- (6) Connecting Plate
- (7) Valve Body
- (8) Feedback Lever Shaft
- (9) Feedback Lever
- (10) Feedback Rod
- (11) Hydraulic Arm Shaft
- (12) Lift Arm

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Position control is a mechanism to raise or lower the implement attached to the tractor in proportion to the movement of the control lever.

The implement can be positioned at any height by moving the position control lever. Fine position adjustment is also easy.

■ Lift



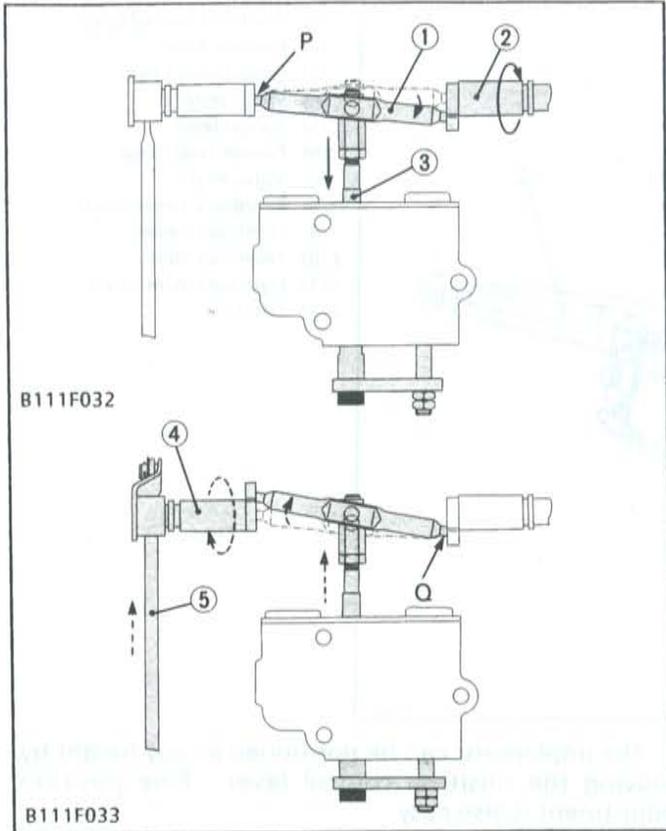
B111F030

B111F031

1. When the position control lever is moved to the **LIFT** position, the control arm (2) rotates to the arrow. Therefore, the spool drive lever (1) moves around the fulcrum P and pull the spool (3) opening the **LIFT** circuit.
2. When the lift arm moves upward, the feed back lever shaft (4) is rotated to the arrow, since the feed back rod (5) is actuated. Therefore, the spool drive lever (1) moves around the fulcrum Q and pushes the spool (3).
3. The lift arm stops when the spool returns to the neutral position.

- (1) Spool Drive Lever
- (2) Control Arm
- (3) Spool
- (4) Feedback Lever Shaft
- (5) Feedback Rod

■ Down



1. When the position control lever is moved to the **DOWN** position, the control arm (2) rotates to the arrow. Therefore, the spool drive lever (1) moves around the fulcrum P and pull the spool (3) opening the **DOWN** circuit.
2. When the lift arm moves downward, the feedback lever shaft (5) is rotated to the arrow, since the feedback rod (6) is actuated. Therefore, the spool drive lever (1) moves around the fulcrum Q and pushes the spool (3).
3. The lift arm stops when the spool (3) returns to the neutral position.

- (1) Spool Drive Lever
- (2) Control Arm
- (3) Spool
- (4) Feedback Lever Shaft
- (5) Feedback Rod

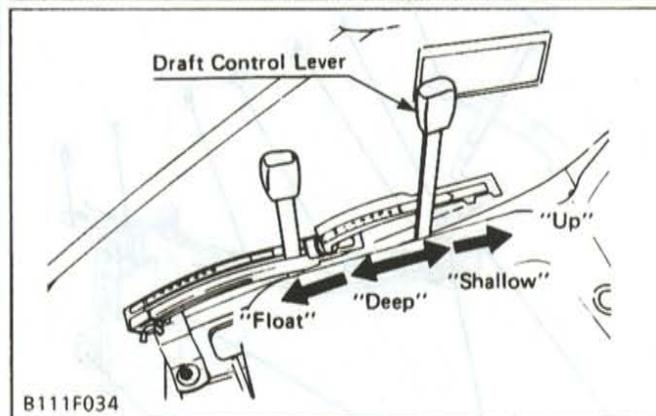
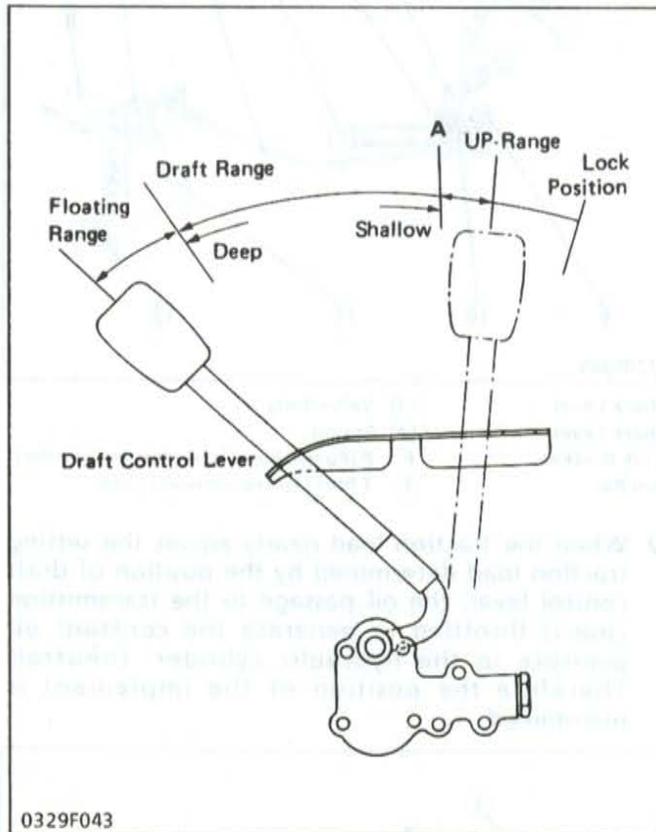
[6] DRAFT CONTROL (Option)

Draft control is a system which maintains a constant traction load, and is suited for the work which needs heavy traction load such as plowing.

The implement is automatically raised when its traction load is increased, and lowers when the traction load is decreased. By maintaining a constant load level, it prevents the slipping and being loaded

excessively on the tractor. The setting traction load can be adjusted by changing the position of the draft control lever.

The draft control system consists of a draft control valve and draft linkage mechanism. It functions when the traction load applied to the tractor from the mechanism is fed back to the draft control valve.



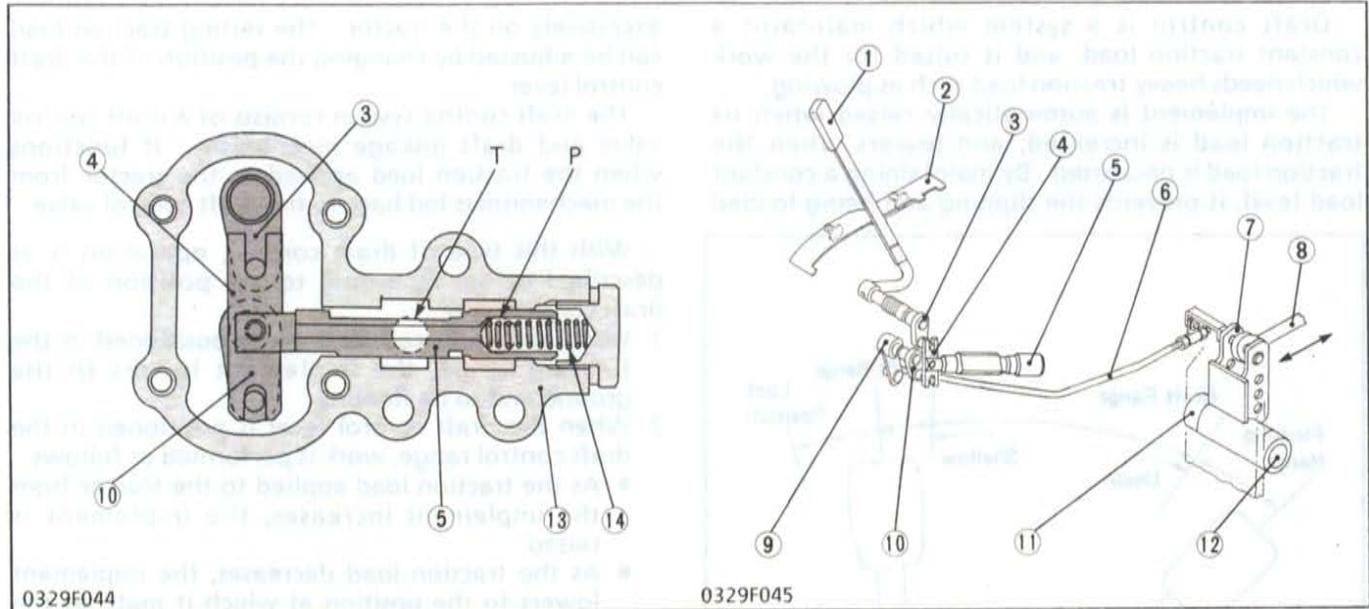
With this type of draft control, operation is as described below according to the position of the draft control lever.

1. When the draft control lever is positioned in the floating range, the implement lowers to the ground and to be floating.
2. When the draft control lever is positioned in the draft control range, work is performed as follows.
 - As the traction load applied to the tractor from the implement increases, the implement is raised.
 - As the traction load decreases, the implement lowers to the position at which it matches the setting traction load.
3. When the implement is raised as described in 2 above, the force to raise the implement is applied to the rear wheels so that the ground pressure of the wheels is momentarily increased to prevent slippage.
4. When the draft control lever is positioned at near A in the draft control range, the implement is raised or lowered according to a slight change in traction load.
5. When the draft control lever is positioned at UP range, the implement is raised at maximum lifting position.

(Reference)

- When the draft control is used, the position control lever must be set at the LIFT position to form the lift circuit in the position control valve. Therefore, in this type of draft control, the implement lowest position cannot be controlled by the position control lever.

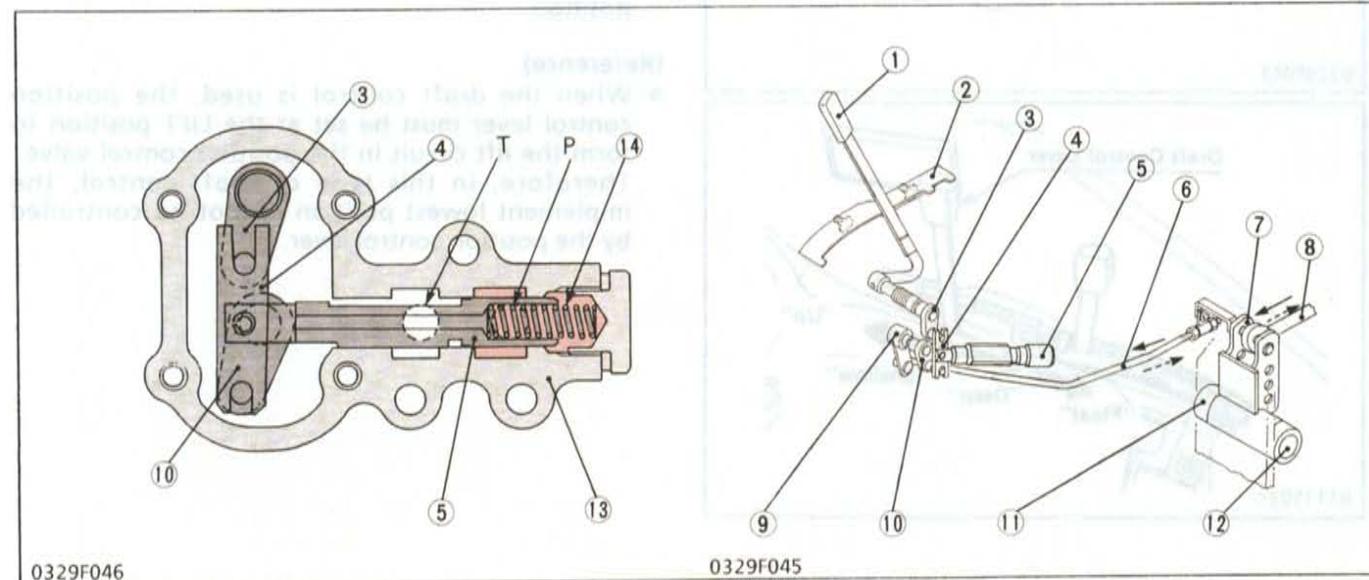
■ Operation



- | | | | |
|-------------------------|-----------------------|---------------------------|---|
| (1) Draft Control Lever | (5) Spool | (9) Feedback Lever | (13) Valve Body |
| (2) Lever Guide | (6) Draft Control Rod | (10) Feedback Lever Shaft | (14) Spring |
| (3) Control Lever Shaft | (7) Top Link Holder | (11) Top Link Bracket | P : P (Pump) Port (To Hydraulic Cylinder) |
| (4) Spool Drive Lever | (8) Top Link | (12) Torsion Bar | T : T Port (To Transmission Case) |

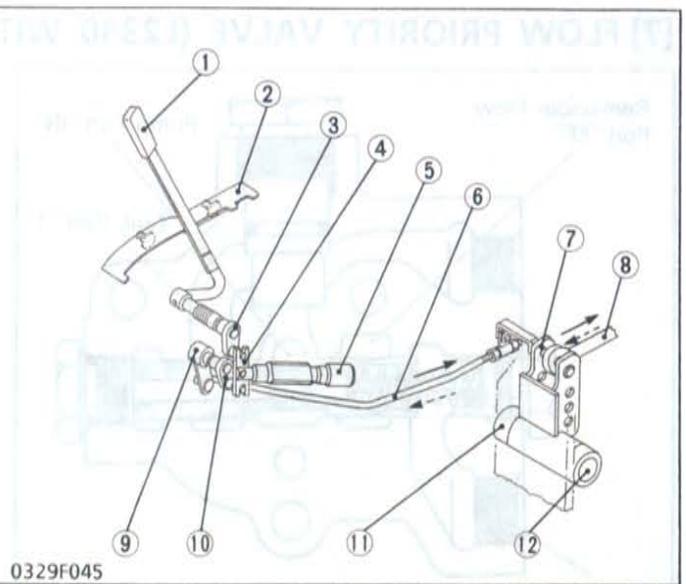
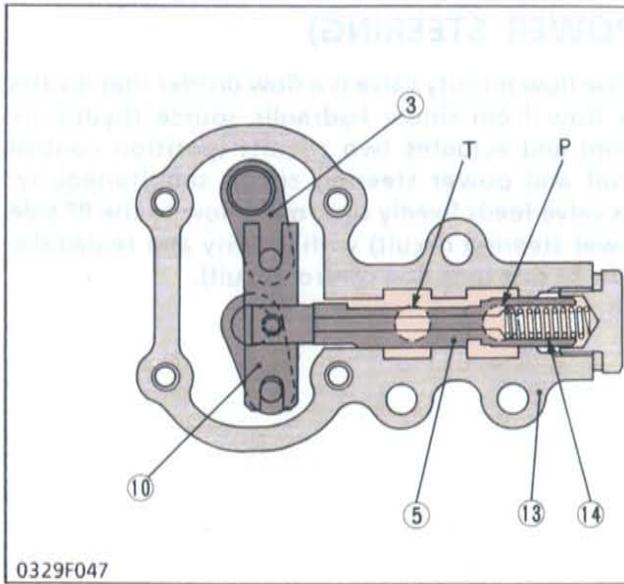
1. The traction load applied to the tractor from the implement acts as a torsional force to the torsion bar (12) via the top link (8) and the top link holder (7). When the torsion bar (12) is twisted, it is transmitted to the draft control valve via the draft control rod (6).

2. When the traction load nearly equals the setting traction load determined by the position of draft control lever, the oil passage to the transmission case is throttled to generate the constant oil pressure in the hydraulic cylinder. (neutral) Therefore the position of the implement is maintained.



3. When the traction load increases, the torsion bar (12) is twisted, and it is transmitted to the draft control valve via the draft control rod (6). As a result, the spool (5) in the draft control valve is pushed in, closing the oil passage to the

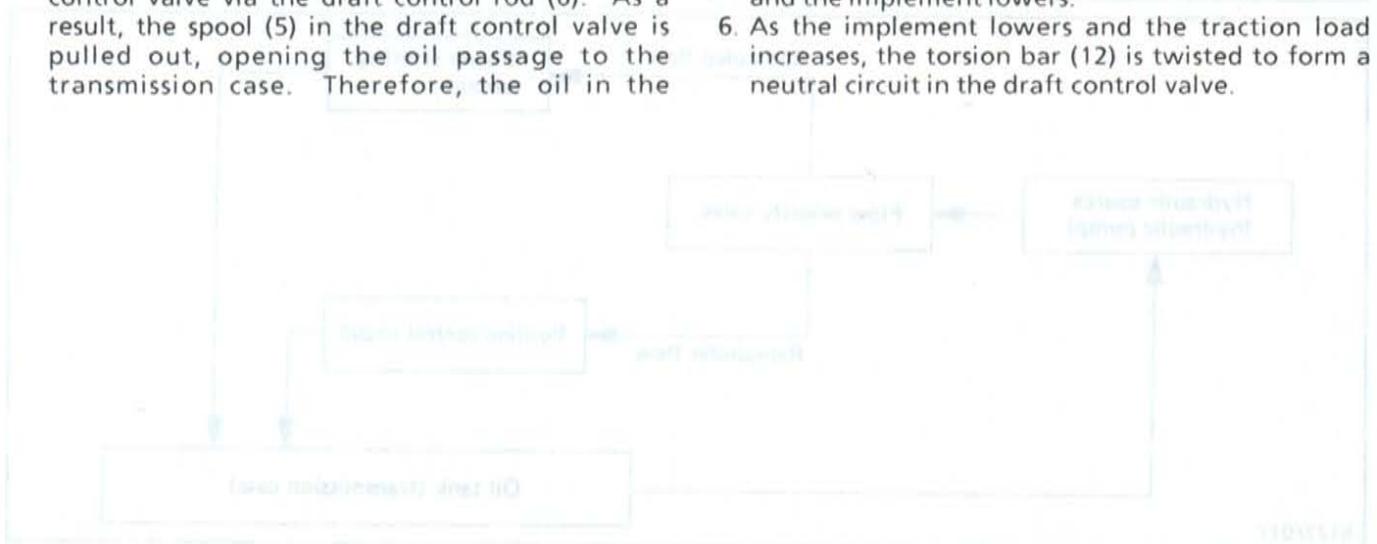
transmission case, so oil flows into the hydraulic cylinder to raise the implement.
4. As the implement is raised and the traction load decrease, the torsion bar (12) is restored to form a neutral circuit in the draft control valve.



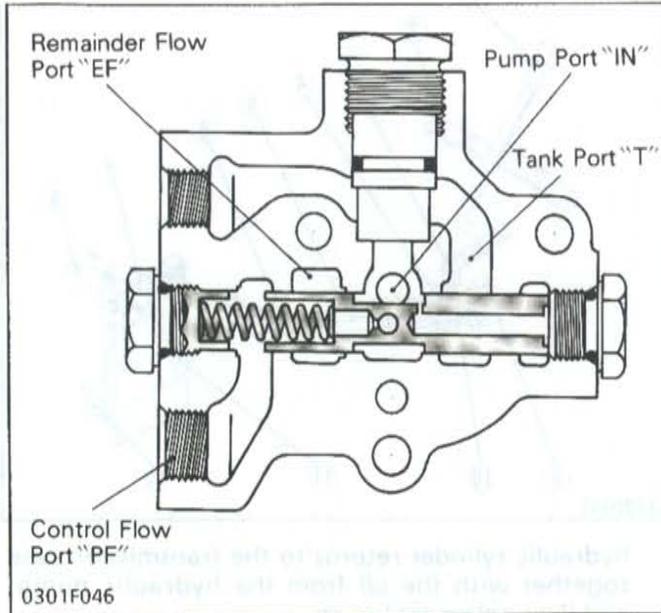
5. When the traction load decreases, the torsion bar (12) is restored and it is transmitted to the draft control valve via the draft control rod (6). As a result, the spool (5) in the draft control valve is pulled out, opening the oil passage to the transmission case. Therefore, the oil in the

hydraulic cylinder returns to the transmission case together with the oil from the hydraulic pump, and the implement lowers.

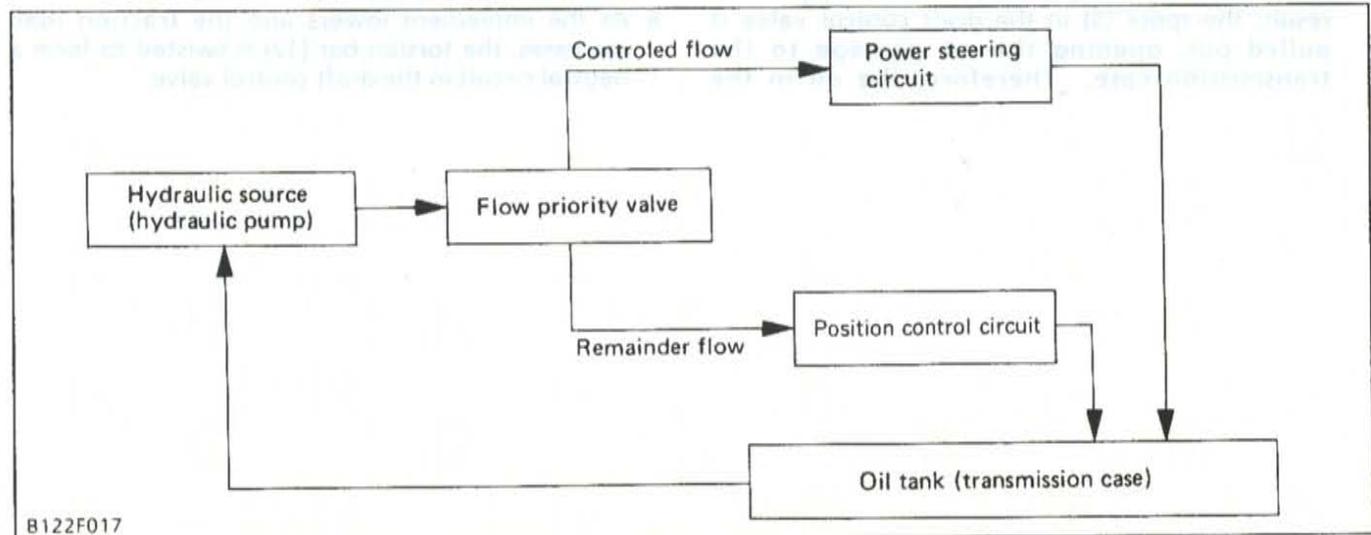
6. As the implement lowers and the traction load increases, the torsion bar (12) is twisted to form a neutral circuit in the draft control valve.

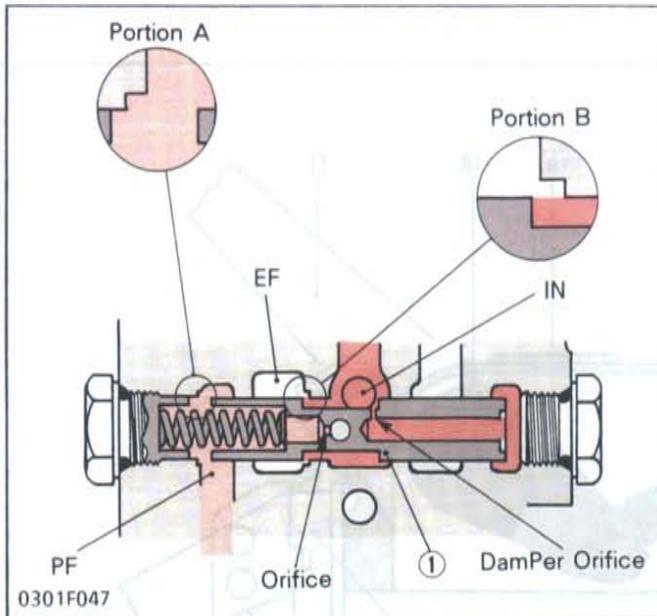


[7] FLOW PRIORITY VALVE (L2350 WITH POWER STEERING)

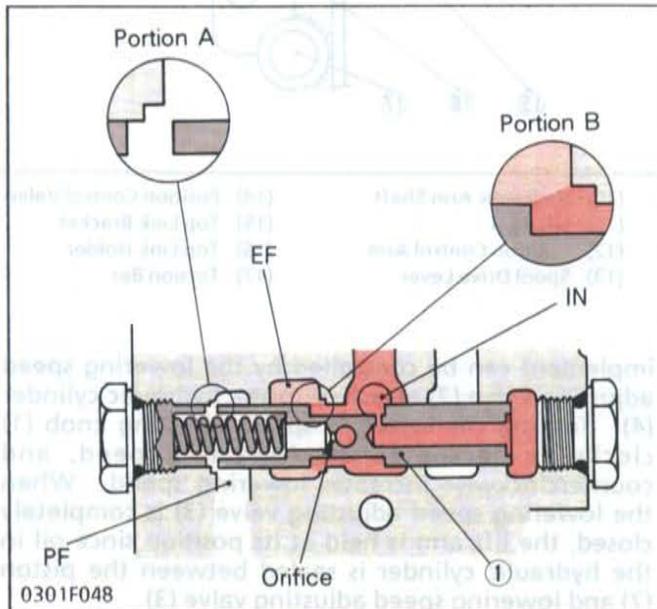


The flow priority valve is a flow divider that divides the flow from single hydraulic source (hydraulic pump) and actuates two circuits (position control circuit and power steering circuit simultaneously. This valve feeds fixedly controlled flow to the PF side (power steering circuit) with priority and remainder to the EF side (position control circuit).





(1) Plunger



(1) Plunger

1. When the engine starts, oil flows into the valve through **IN**-port.
2. A pressure difference is created between the ends of the orifice as the flow passes the orifice. This causes the plunger (1) to move to the left, deflecting the spring.
3. Then the oil passage is formed in portion **B** shown above, and the remainder flows to the **EF** side (position control circuit).
4. The plunger automatically balances itself to maintain the pressure difference between the ends of the orifice. Thus the fixedly controlled flow is fed to the **PF** side (power steering circuit) at all times even if the oil flow from the **IN** port is changes.

(Reference)

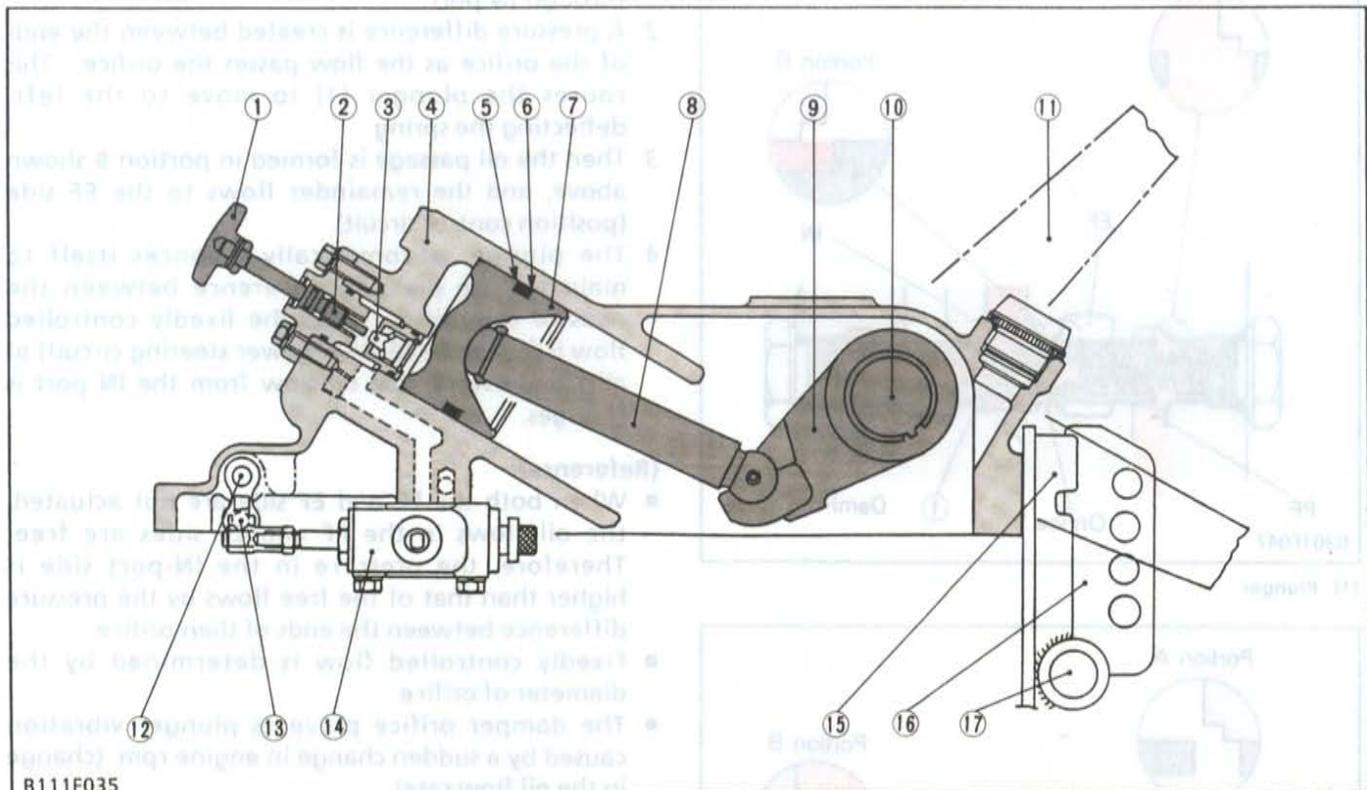
- When both the **PF** and **EF** side are not actuated, the oil flows in the **PF** and **EF** sides are free. Therefore, the pressure in the **IN**-port side is higher than that of the free flows by the pressure difference between the ends of then orifice.
- Fixedly controlled flow is determined by the diameter of orifice.
- The damper orifice prevents plunger vibration caused by a sudden change in engine rpm (change in the oil flow rate).

5. When the **PF** side circuit (power steering circuit) is actuated and the pressure rises, the plunger moves to the right, reducing the opening area of portion **B**, and widening the opening area of portion **A**. Therefore, there is no change in the controlled flow to the **PF** side. This is because the plunger moves in accordance with the balancing of the pressure difference between the ends of the orifice and the spring force, controlling the opening areas of the portions **A** and **B**.

(Reference)

- The pressure in the **IN**-port side is higher than the working pressure of the **PF** side by the pressure difference between the ends of the orifice. When the hydraulic raising/lowering circuit is not in operation, the oil of the **EF** side is a free flow.
6. When the **EF** side circuit (portion control circuit) is actuated and the **PF** side circuit (power steering circuit) is not, the pressure difference between the end of the orifice becomes larger, and causes the plunger to move to the left. Therefore, the opening area of portion **A** becomes larger to automatically prevent any excessive flow to the **PF** side.
 7. When the working pressures of the **PF** side and **EF** side circuits rise simultaneously, the opening areas of portions **A** and **B** are automatically controlled by balancing of the pressure difference between the ends of the orifice and the spring force to maintain the control flow at constant.

[8] HYDRAULIC CYLINDER



B111F035

- | | | | |
|------------------------------------|----------------------|---------------------------|-----------------------------|
| (1) Lowering Speed Adjusting Knob | (6) Back-up Ring | (10) Hydraulic Arm Shaft | (14) Position Control Valve |
| (2) Lowering Speed Adjusting Shaft | (7) Hydraulic Piston | (11) Lift Arm | (15) Top Link Bracket |
| (3) Lowering Speed Adjusting Valve | (8) Hydraulic Rod | (12) Position Control Arm | (16) Top Link Holder |
| (4) Hydraulic Cylinder | (9) Hydraulic Arm | (13) Spool Drive Lever | (17) Torsion Bar |
| (5) O-ring | | | |

The main components of the hydraulic cylinder are shown in the figure above.

While the lift arm (11) is rising, oil from the hydraulic pump flows into the hydraulic cylinder through the control valve. Then oil pushes out the piston (7).

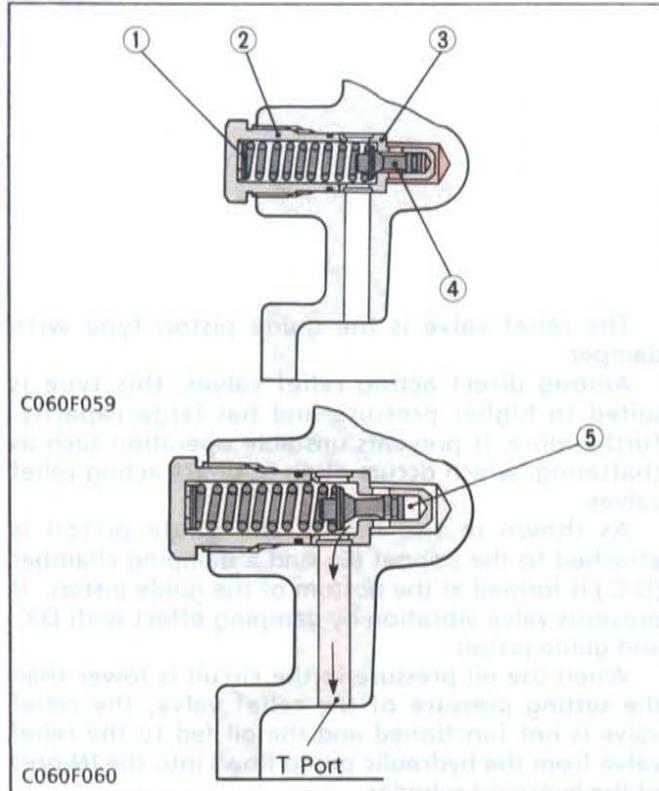
While the lift arm is lowering, oil in the hydraulic cylinder is discharged to the transmission case through the control valve (14) by the weight of the implement. At this time, the lowering speed of the

implement can be controlled by the lowering speed adjusting valve (3) attached to the hydraulic cylinder (4). Turning the lowering speed adjusting knob (1) clockwise decreases the lowering speed, and counterclockwise increases lowering speed. When the lowering speed adjusting valve (3) is completely closed, the lift arm is held at its position since oil in the hydraulic cylinder is sealed between the piston (7) and lowering speed adjusting valve (3).

[9] RELIEF VALVE

The three point hydraulic system circuit has a relief valve to restrict the maximum pressure in the circuit.

[L2350]



- | | |
|----------|---------------------|
| (1) Shim | (4) Poppet |
| (2) Plug | (5) Damping Chamber |
| (3) Seat | |

This relief valve is located in the left side of hydraulic cylinder block.

This is a guide piston relief valve with damper, a direct acting relief valve suitable for relatively high pressure and capacity, and constructed so as to prevent chattering and other unstableness associated with direct acting relief valves. As shown in the diagram, poppet (4) has a guide, and there is a valve chamber called a damping chamber (5) in the base of this guide piston. The valve inlet is connected to this chamber through the clearance between the guide surface and the seat so that the chamber provides a damping effect, controlling valve vibration.

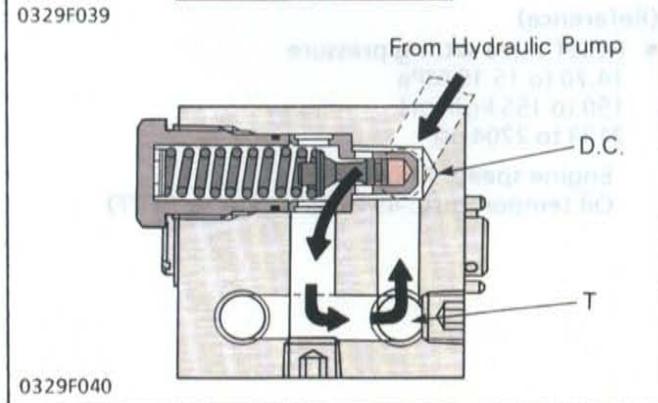
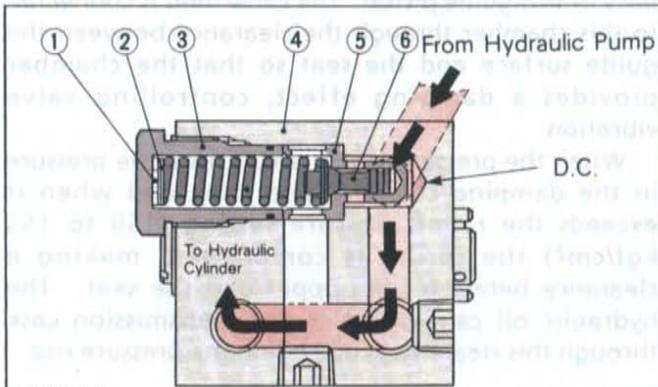
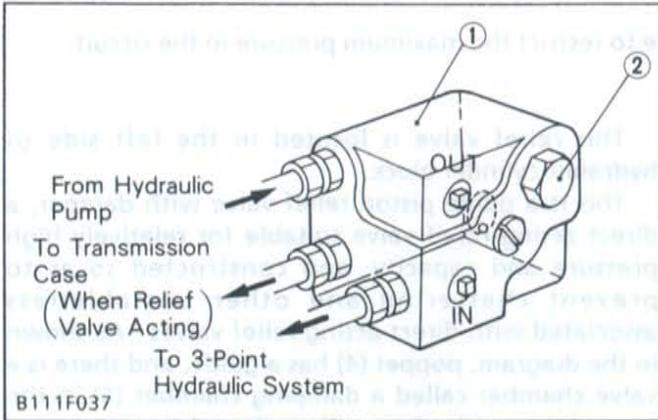
When the pressure in the circuit rises, the pressure in the damping chamber also rises, and when it exceeds the relief pressure setting (150 to 155 kgf/cm²) the spring is compressed, making a clearance between the poppet and the seat. The hydraulic oil can escape to the transmission case through this clearance, controlling the pressure rise.

(Reference)

- Relief valve setting pressure
14.70 to 15.19 MPa
150 to 155 kgf/cm²
2133 to 2204 psi

Engine speed: Maximum
Oil temperature: 45 to 55°C (113 to 131°F)

[L2650, L2950, L3450, L3650]



- (1) Washer
 - (2) Shim
 - (3) Plug
 - (4) Front Hydraulic Block
 - (5) Seat
 - (6) Poppet
- D.C. : Damping Chamber
T : T Port (To Transmission Case)

The relief valve is incorporated in the front hydraulic block.

- (1) Front Hydraulic Block
- (2) Relief Valve Plug

The relief valve is the guide piston type with damper.

Among direct acting relief valves, this type is suited to higher pressure and has large capacity. Furthermore, it prevents unstable operation such as chattering, which occurs often in direct acting relief valves.

As shown in the figure, the guide piston is attached to the poppet (6), and a damping chamber (D.C.) is formed at the bottom of the guide piston. It prevents valve vibration by damping effect with D.C. and guide piston.

When the oil pressure in the circuit is lower than the setting pressure of the relief valve, the relief valve is not functioned and the oil fed to the relief valve from the hydraulic pump flows into the IN-port of the hydraulic cylinder.

When the oil pressure in the circuit is increases more than valve setting. The valve opens and the oil flows to the transmission case through T port to prevent the pressure rising.

(Reference)

- Relief valve setting pressure
 - 16.7 to 17.2 MPa
 - 170 to 175 kgf/cm²
 - 2418 to 2489 psi

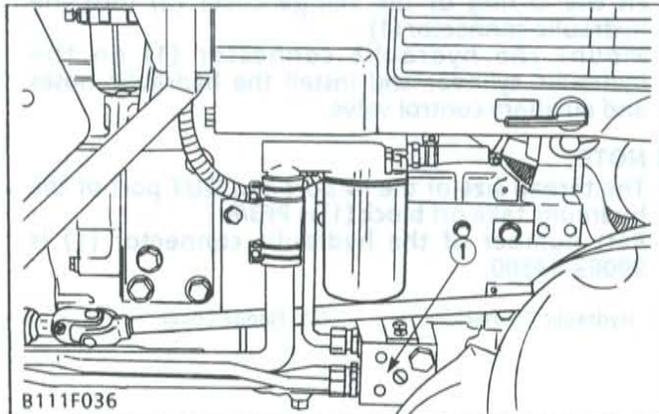
Engine speed: Maximum
Oil temperature: 45 to 55°C (113 to 131°F)

[10] HYDRAULIC POWER TAKE OFF

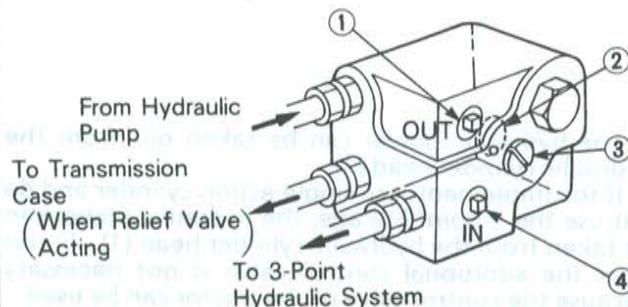
Before taking out hydraulic power, check the following.

- Replenish transmission oil by the quantity equal to the flow rate required for the implement cylinder.
- Before attaching the implement, check the type and contamination of oil in the implement hydraulic circuit.

■ Front Hydraulic Block (L2650, L2950, L3450, L3650)

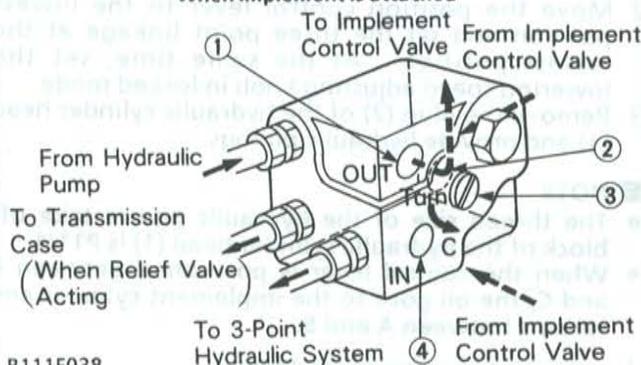


When implement is not attached



B111F037

When implement is attached



B111F038

When an implement which requires hydraulic power is used, the hydraulic power can be taken out by the methods shown below.

When a KUBOTA front loader is mounted on the tractor, take out necessary hydraulic power from this front hydraulic block. Even if the KUBOTA front loader is not mounted on the tractor and you want to take out hydraulic power to other implement, hydraulic power can also be taken from this front hydraulic block, provided that the control valve for the implements are required.

(1) Front Hydraulic Block

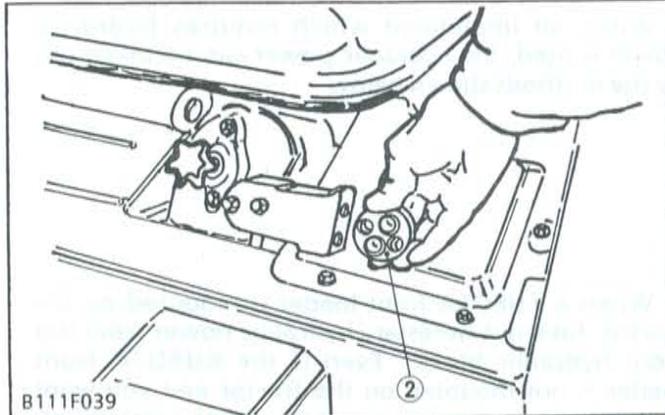
The following are the methods to take out hydraulic power.

1. Remove the plugs from **OUT** port (1) and **IN** port (4) of the front hydraulic block.
2. Install the hydraulic take off adaptors (screw size PT3/8") to **OUT** port (1) and **IN** port (4).
3. Connect the hydraulic hose to the adaptor (**OUT** port side) and to the implement control valve **IN** port.
4. Connect the other hydraulic hose to the adaptor (**IN** port side) and to the implement control valve **TANK** (RETURN) port.
5. Turn the slit on the control spool (3) to the **C** mark side fully as shown in the figure.

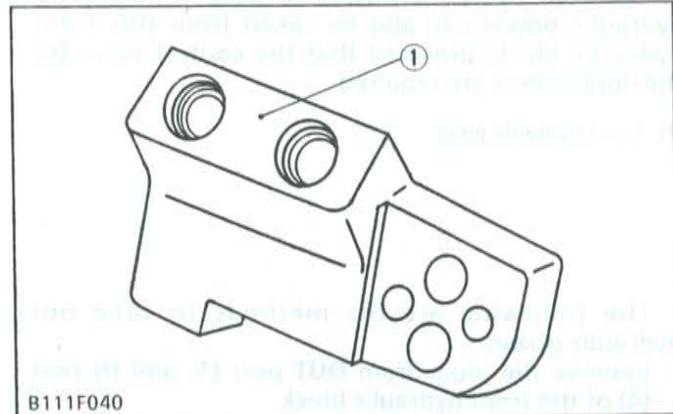
- When implement is not attached, turn the slit on the control spool (3) to the **O** mark side fully.

- (1) **OUT** Port
- (2) **TANK** Port
- (3) Control Spool
- (4) **IN** Port

■ Hydraulic Connector



B111F039



B111F040

When the hydraulic power cannot be taken out from the front hydraulic block or when the hydraulic power is to be used for the implements at the rear of the tractor, mount the hydraulic connector (1) as shown in the left illustration. Necessary hydraulic power can be taken out, provided that the control valves for the implements are required.

Take out the hydraulic power as follows.

1. Remove the flange cover (2) from the hydraulic cylinder.
2. Fit the O-ring of the flange cover (2) into the hydraulic connector (1).
3. Mount the hydraulic connector (1) on the hydraulic cylinder and install the hydraulic hoses and auxiliary control valve.

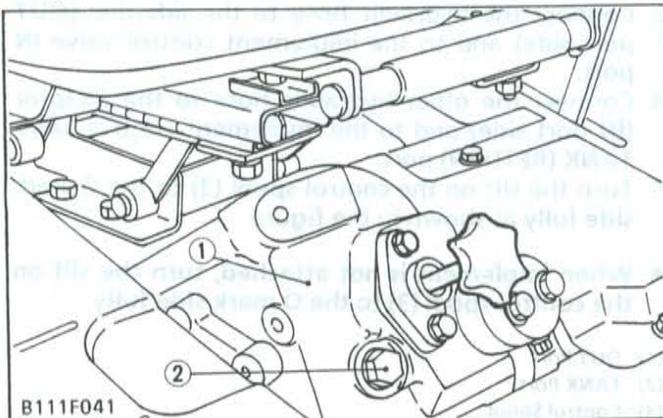
■ NOTE

- The thread size of the IN port and OUT port of the hydraulic take off block (1) is PF3/8.
- Part number of the hydraulic connector (1) is 99063-93300.

(1) Hydraulic Connector

(2) Flange Cover

■ Hydraulic Cylinder Head



B111F041

The hydraulic power can be taken out from the hydraulic cylinder head (1).

If the implements use single action cylinder and do not use the 3-point linkage, the hydraulic power can be taken from the hydraulic cylinder head (1). In this case, the additional control valve is not necessary because the control valve of the tractor can be used.

Take out the hydraulic power as follows.

1. Move the lever guide stopper (4) backward until the relief valve starts actuating.
2. Move the position control lever to the lowest position and set the three point linkage at the lowest position. At the same time, set the lowering speed adjusting knob in locked mode.
3. Remove the plug (2) of the hydraulic cylinder head (1) and provide hydraulic pipings.

■ NOTE

- The thread size of the hydraulic power take off block of the hydraulic cylinder head (1) is PT1/4.
- When the control lever is positioned between B and C, the oil goes to the implement cylinder and returns between A and B.

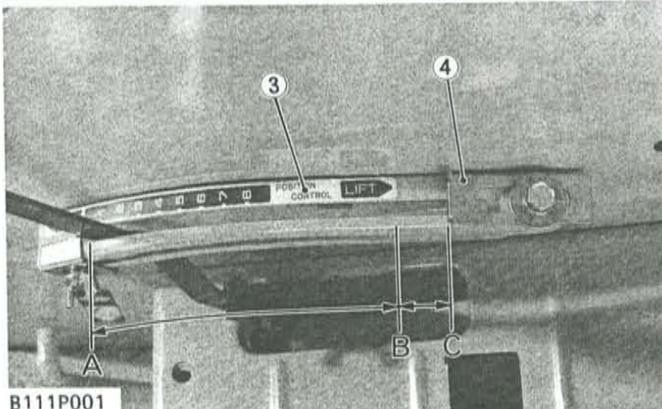
A — Lowest position of the lever

B — Position where the lever guide stopper was.

C — Position where the lever guide stopper is moved backward.

■ IMPORTANT

- If the control lever is always positioned between B and C, relief valve is actuated adversely affecting the hydraulic pump. When the hydraulic power is not used, the control lever must be between A and B.



B111P001

(1) Hydraulic Cylinder Head

(3) Lever Guide

(2) Plug

(4) Lever Guide Stopper

10 ELECTRICAL SYSTEM

[1] WIRING DIAGRAM

• Key Switch

Terminal	B	AC	G1	G2	ST	OFF
Key Position						
HEAT	●	●	●			
OFF	●					●
ON	●	●				
START	●	●		●	●	

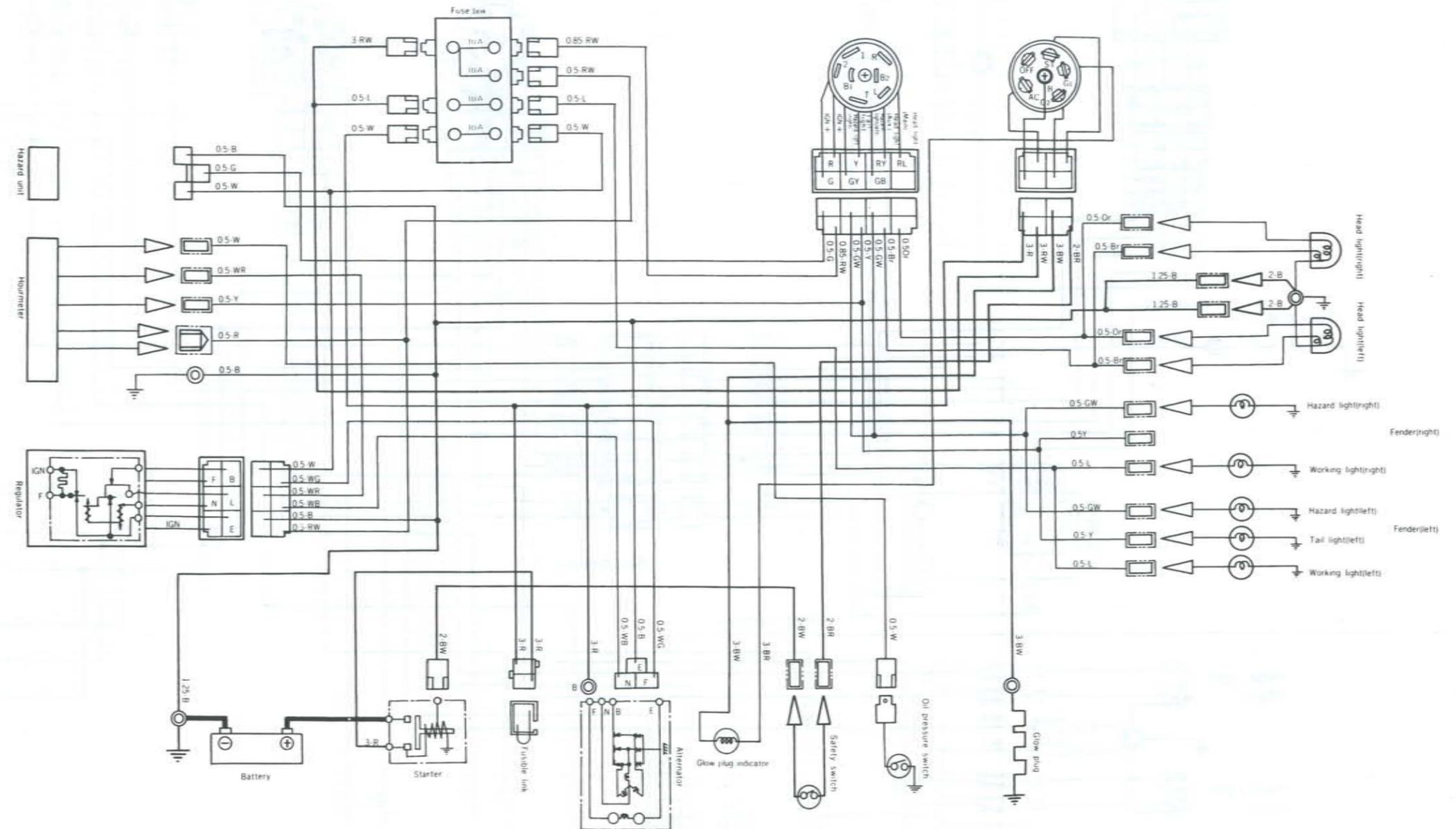
• Combination Switch

Head light switch				Hazard light switch				
Color	R	Y	RL	RY	Color	G	GY	GB
	B1	T	1	2		B2	R	L
OFF					1	●	●	
1	●	●	●		OFF			
2	●	●		●	2	●	●	●

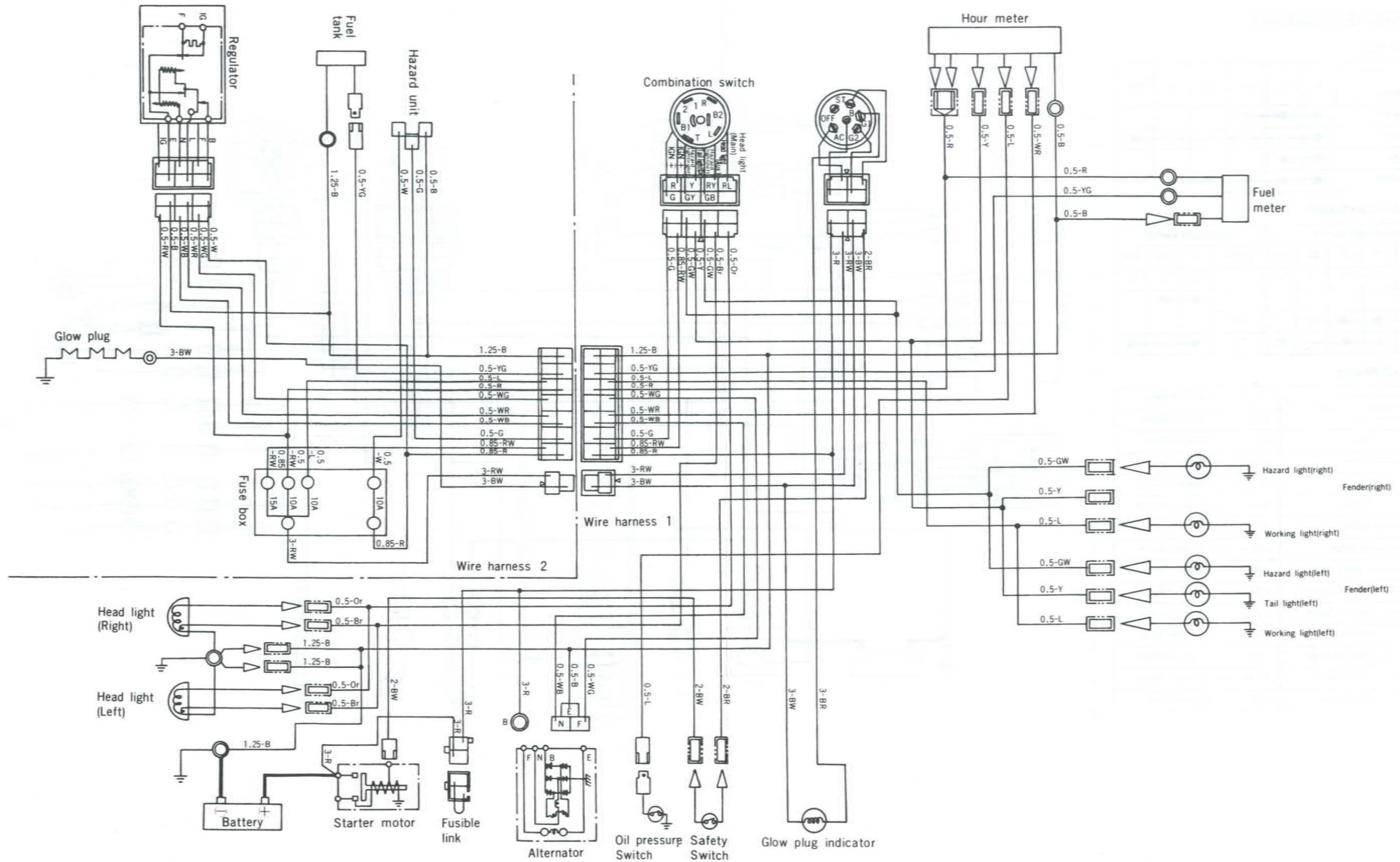
• Color of Wiring

W ----- White	RY ----- Red / Yellow
R ----- Red	BW ----- Black / White
L ----- Blue	BL ----- Black / Blue
Y ----- Yellow	BR ----- Black / Red
B ----- Black	BY ----- Black / Yellow
G ----- Green	GW ----- Green / White
Br ----- Brown	GY ----- Green / Yellow
Or ----- Orange	GB ----- Green / Black
Lg ----- Light green	GR ----- Green / Red
WG ----- White / Green	LW ----- Blue / White
WB ----- White / Black	LY ----- Blue / Yellow
WR ----- White / Red	YL ----- Yellow / Blue
WL ----- White / Blue	YB ----- Yellow / Black
RW ----- Red / White	BrW ----- Brown / White
RL ----- Red / Blue	BrR ----- Brown / Red

[L2350 2WD TYPE]



[L2350 4WD TYPE]



[2] ELECTRICAL CIRCUIT

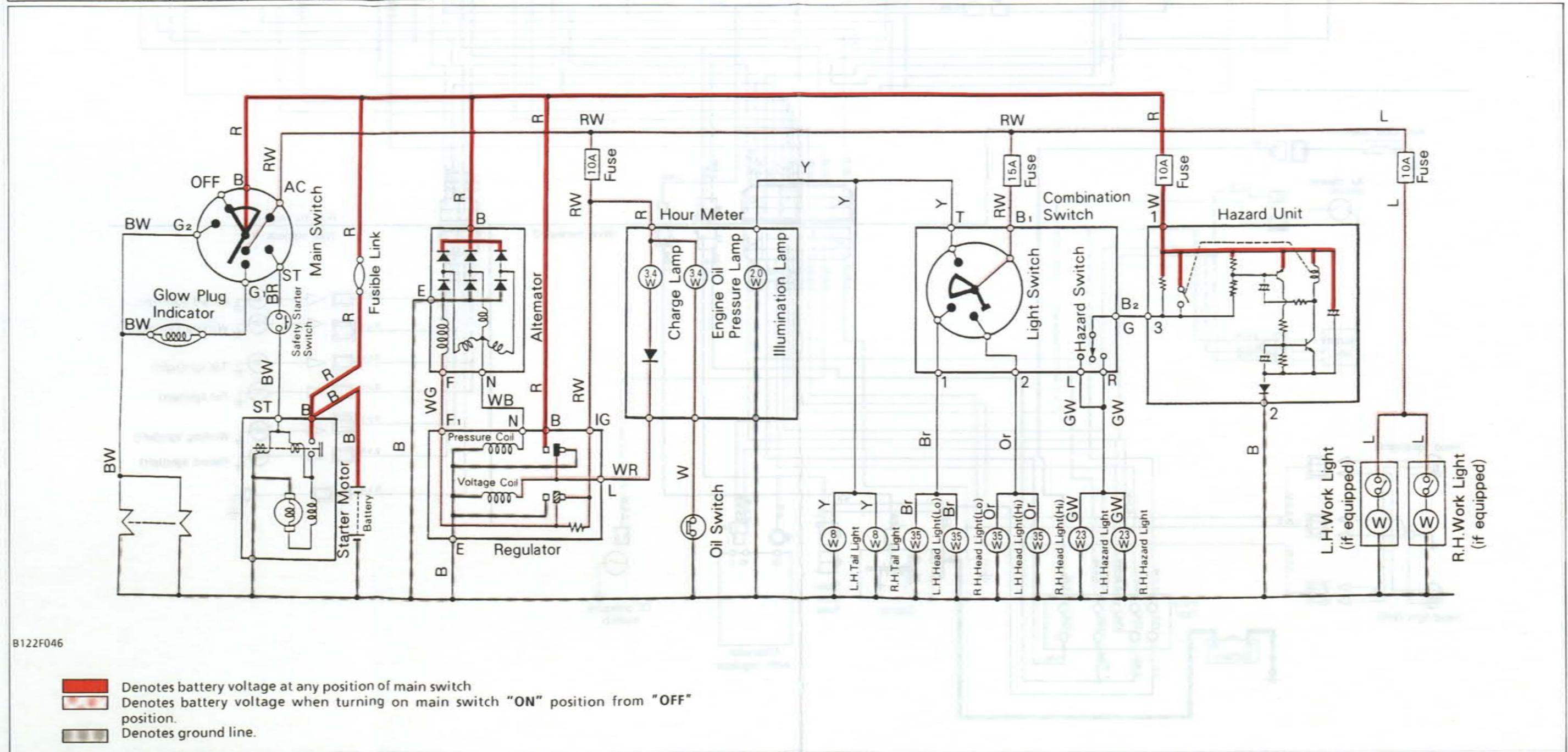
[2]-1 L2350 2WD TYPE

• Main Switch Table

Terminal \ Key Position	B	AC	G1	G2	ST	OFF
OFF	●					●
ON	●	●				
HEAT	●	●	●			
START	●	●		●	●	

• Combination Switch

Head light switch				Hazard light switch				
Color	RW	Y	Br	OR	Color	G	GW	GW
	B1	T	1	2		B2	R	L
OFF					1	●	●	
1	●	●	●		OFF			
2	●	●		●	2	●	●	



B122F046

- Denotes battery voltage at any position of main switch
- Denotes battery voltage when turning on main switch "ON" position from "OFF" position.
- Denotes ground line.

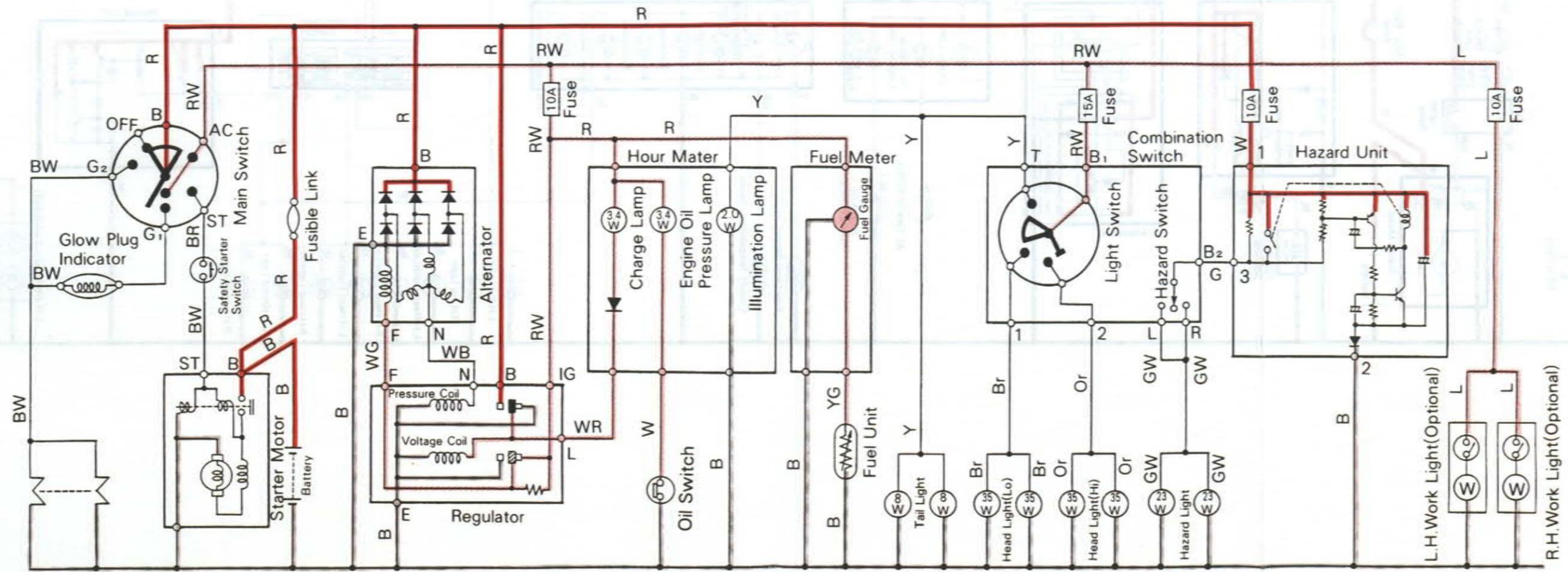
[2]-2 L2350 4WD TYPE

• Main Switch Table

Terminal	B	AC	G1	G2	ST	OFF
Key Position						
OFF	●					●
ON	●	●				
HEAT	●	●	●			
START	●	●		●	●	

• Combination Switch

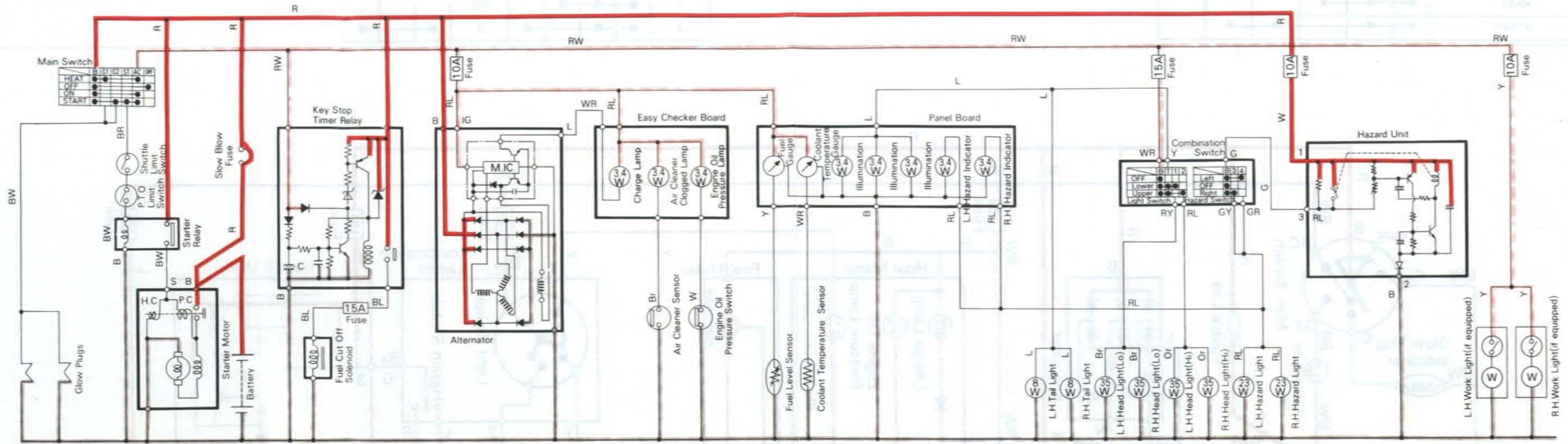
Head light switch				Hazard light switch				
Color	RW	Y	Br	OR	Color	G	GW	GW
	B1	T	1	2		B2	R	L
OFF					1	●	●	
1	●	●	●		OFF			
2	●	●		●	2	●	●	



B122F047

- Denotes battery voltage at any position of main switch
- Denotes battery voltage when turning on main switch "ON" position from "OFF" position.
- Denotes ground line.

[2]-3 L2650, L2950, L3450, L3650

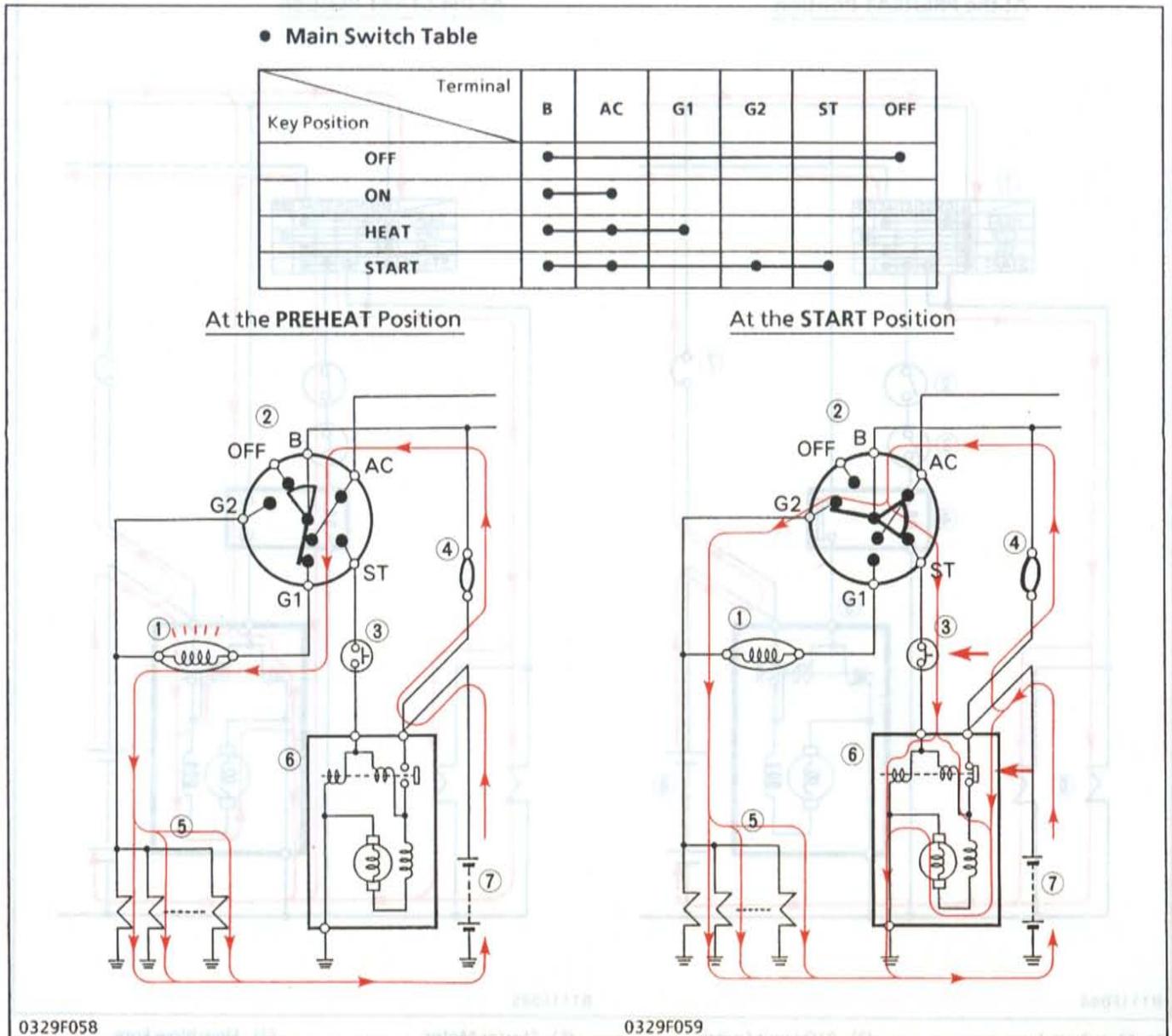


B111F043

- Denotes battery voltage at any position of main switch
- Denotes battery voltage when turning on main switch "ON" position from "OFF" position.
- Denotes ground line.

[3] STARTING SYSTEM

[3]-1 L2350



(1) Glow Plug Indicator
(2) Main Switch

(3) Safety Starter Switch
(4) Fusible Link

(5) Glow Plugs
(6) Starter Motor

(7) Battery

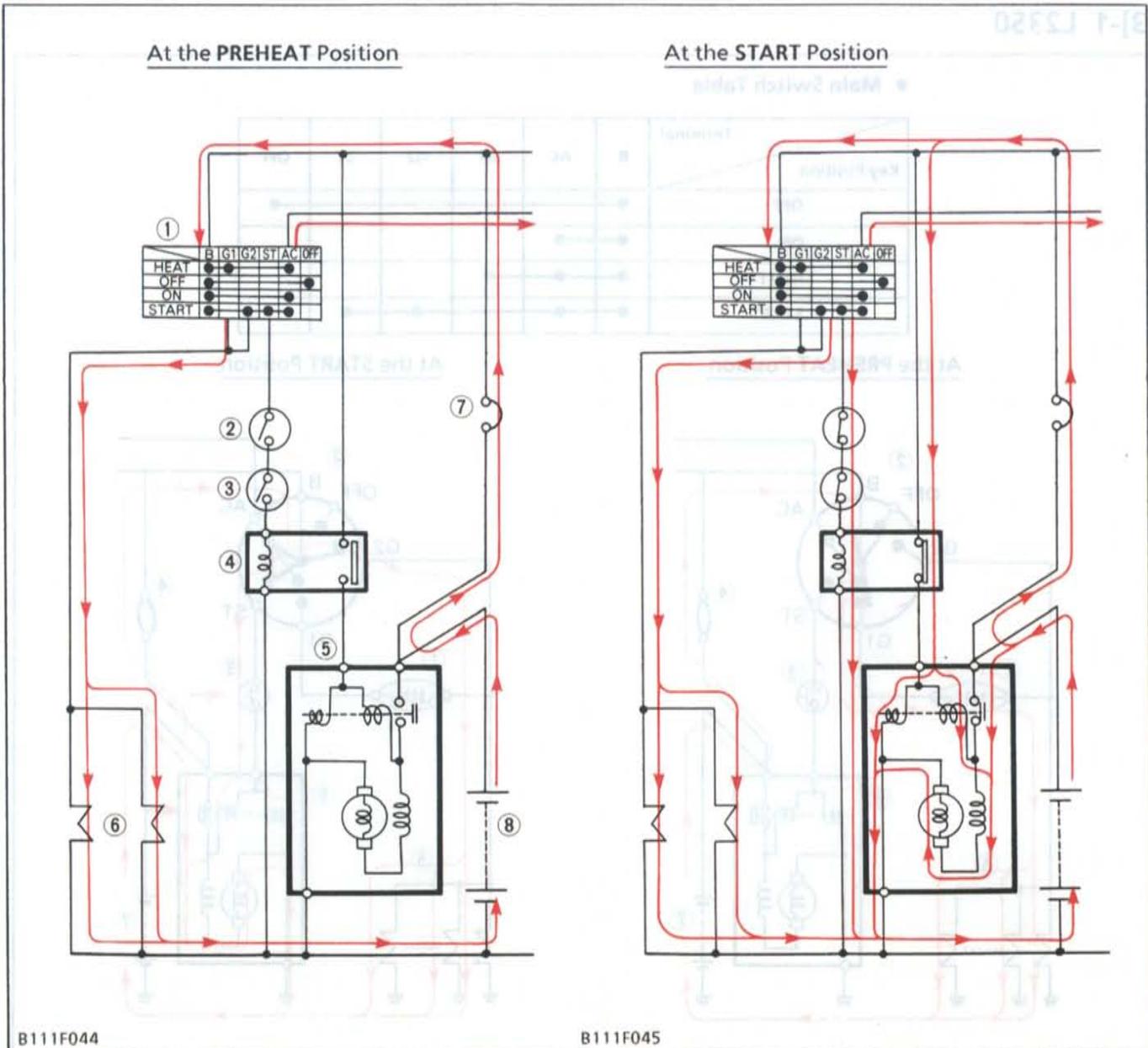
When the main switch (2) is turned to the **PREHEAT** position, the terminal **B** is connected to the terminals **G1** and **AC**. The glow plugs (5) become red-hot, and at the same time, the glow plug indicator (1) also becomes red-hot to indicate the red-hot condition of the glow plugs.

When the main switch is then turned to the **START** position with the safety starter switch (3) on, the

terminal **B** is connected to the terminals **ST**, **G2** and **AC** so that the starter motor (6) begins running and the glow plugs are kept red-hot.

The main switch automatically returns to the **ON** position when it is released after the engine starts. At the **ON** position, the terminal **B** is connected only to the terminal **AC**, thereby causing the starting circuit to be opened, stopping the starter motor.

[3]-2 L2650, L2950, L3450, L3650



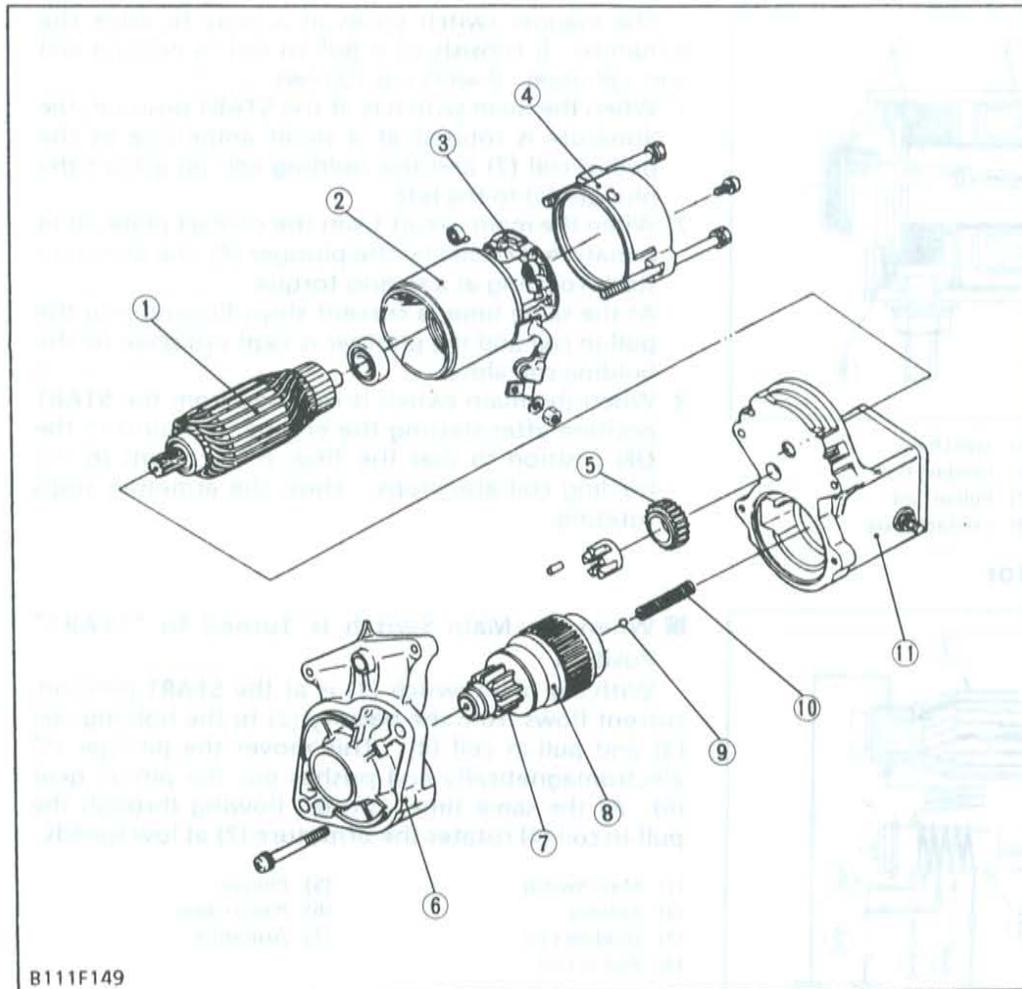
- (1) Main Switch
- (2) Shuttle Limit Switch
- (3) P.T.O. Limit Switch
- (4) Starter Relay
- (5) Starter Motor
- (6) Glow Plugs
- (7) Slow Blow Fuse
- (8) Battery

When the main Switch (1) is turned to the PREHEAT position, the terminal B is connected to the terminals G1 and AC. The glow plugs (6) become red-hot.

When the main switch is turned to START position, the terminal B is connected to the terminals ST, G2 and AC. The current from the terminal ST magnetizes and grounds the coil of the starter relay (4) after the shuttle limit switch (2) and the P.T.O.

limit switch (3) are turned on simultaneously. Therefore, the starter relay (4) is turned on and the starter motor starts. The current from G2 flows to the glow plug (6).

The main switch (1) returns to ON position when it is released after the engine starts. At the ON position, the terminal B is connected only to the terminal AC, thereby causing the starting circuit to be opened, stopping the starter motor.

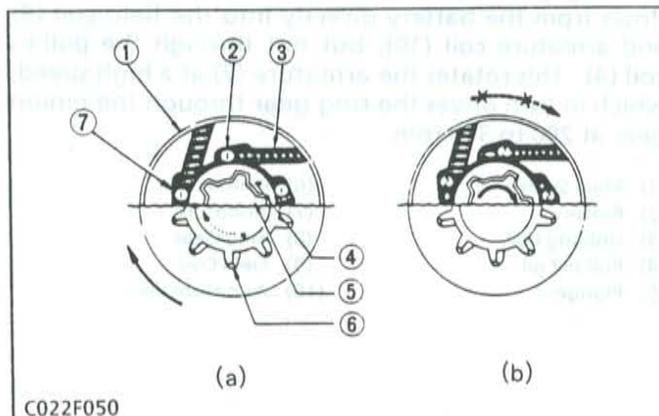
(1) Starter Motor

- (1) Armature
- (2) Yoke
- (3) Brush Holder
- (4) End Frame
- (5) Gear
- (6) Drive End Frame
- (7) Pinion
- (8) Roller Clutch
- (9) Ball
- (10) Spring
- (11) Magnet Switch

B111F149

The starter motor is a reduction type.
The speed of the pinion gear is reduced to approx.

one third of motor one.

Roller Clutch

C022F050

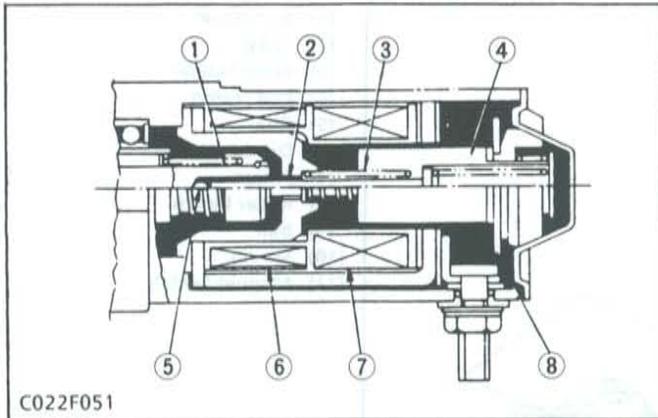
- (a) When power is transmitted
- (b) Idling rotation with pinion shaft speed exceeding that of outer clutch gear

The roller clutch prevents the armature from being driven by the rotational force of the engine when the pinion and the engine flywheel ring gear are in mesh.

- (a) When power is transmitted, the rotational force of the outer clutch gear (1) drives the pinion gear (6) through the roller (2).
- (b) Even when the pinion gear is driven by the engine flywheel ring gear and its speed exceeds that of the outer clutch gear, the rotation force of the ring gear is not transmitted to the outer clutch gear.

- (1) Outer Clutch Gear
- (2) Roller
- (3) Roller Spring
- (4) Inner Spline Tube
- (5) Pinion Shaft, Solid with Pinion Gear
- (6) Pinion Gear
- (7) Locked Position

Magnet Switch



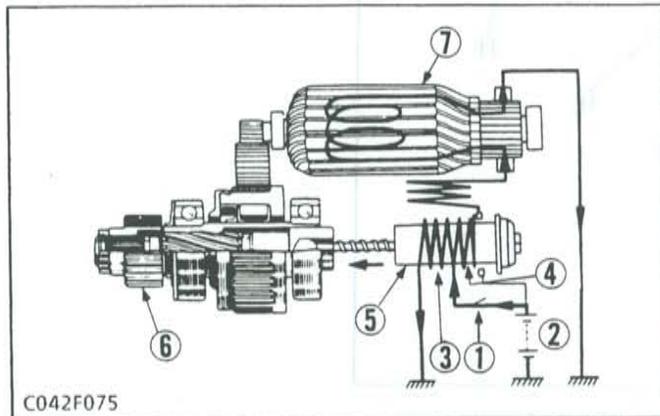
C022F051

- | | |
|-------------------------|-------------------|
| (1) Clutch Pinion Shaft | (5) Steel Ball |
| (2) Plunger Shaft | (6) Holding Coil |
| (3) Return Spring | (7) Pull-in Coil |
| (4) Plunger | (8) Contact Plate |

The magnet switch series as a relay to drive the armature. It consists of a pull-in coil, a holding coil and a plunger. It works as follows.

1. When the main switch is at the **START** position, the armature is rotated at a small amperage as the pull-in coil (7) and the holding coil (6) attract the plunger (4) to the left.
2. When the main circuit from the contact plate (8) to armature is closed by the plunger (4), the armature starts rotating at a strong torque. At the same time, a current stops flowing into the pull-in coil and the plunger is kept attracted by the holding coil alone.
3. When the main switch is released from the **START** position after starting the engine, it returns to the **ON** position so that the flow of a current to the holding coil also stops. Thus, the armature stops rotating.

Operation of Starter Motor



C042F075

■ When the Main Switch is Turned to "START" Position

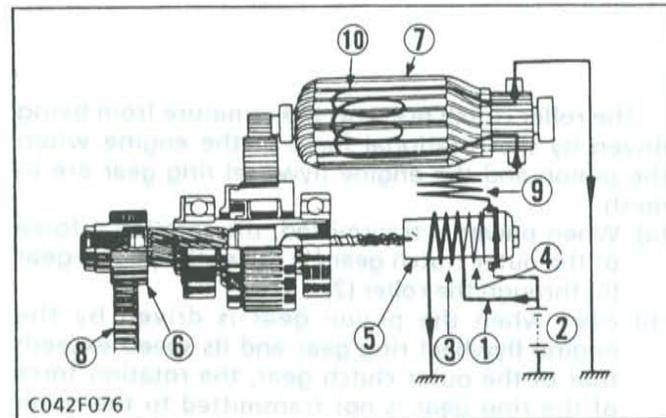
With the main switch (1) is at the **START** position, current flows from the battery (2) to the holding coil (3) and pull-in coil (4). This moves the plunger (5) electromagnetically and pushes out the pinion gear (6). At the same time, current flowing through the pull-in coil (4) rotates the armature (7) at low speeds.

- | | |
|------------------|-----------------|
| (1) Main Switch | (5) Plunger |
| (2) Battery | (6) Pinion Gear |
| (3) Holding Coil | (7) Armature |
| (4) Pull-in Coil | |

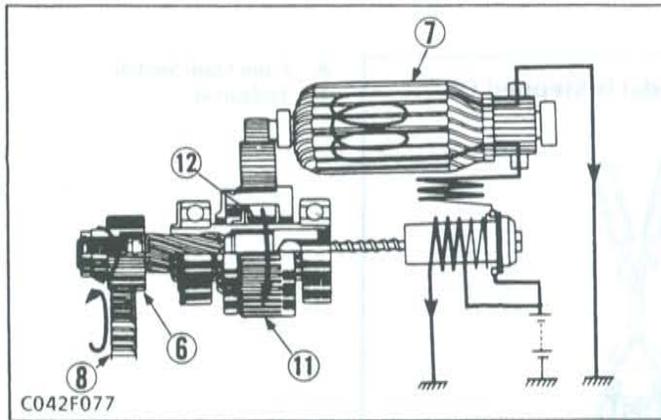
■ When the Pinion Gear Meshes with the Ring Gear

When the pinion gear (6) comes into mesh with the ring gear (8) on the flywheel, a large current flows from the battery directly into the field coil (9) and armature coil (10), but not through the pull-in coil (4). This rotates the armature (7) at a high speed, which in turn drives the ring gear through the pinion gear at 200 to 300 rpm.

- | | |
|------------------|--------------------|
| (1) Main Switch | (6) Pinion Gear |
| (2) Battery | (7) Armature |
| (3) Holding Coil | (8) Ring Gear |
| (4) Pull-in Coil | (9) Field Coil |
| (5) Plunger | (10) Armature Coil |



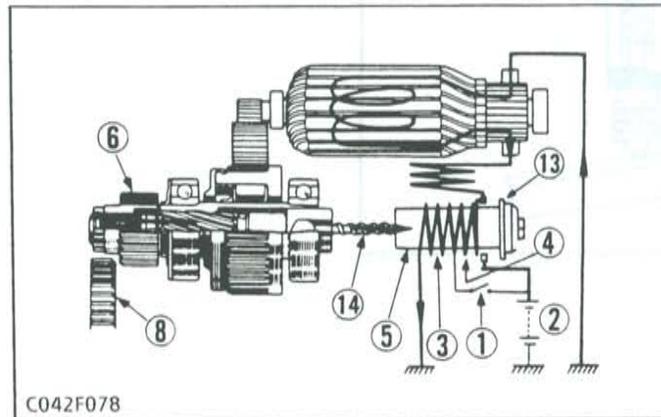
C042F076



■ When the Engine is Running

When the engine runs so fast that the ring gear (8) starts to turn the pinion gear (6), the roller clutch (11), (12) are actuated to prevent excessive high-speed revolutions of the armature (7).

- | | |
|-----------------|------------------|
| (6) Pinion Gear | (11) Clutch Gear |
| (7) Armature | (12) Roller |
| (8) Ring Gear | |



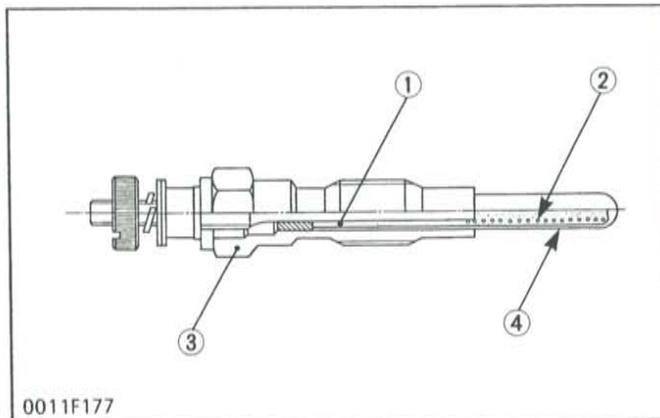
■ When the Main Switch is Released

When the main switch (1) released, the main switch returns from the START to the ON position and opens the starter circuit. Then, current flows from the battery (2) to the pull-in coil (4) and holding coil (3) through the contact plate (13). Since the magnetic forces of the pull-in coil and holding coil become partially opposed and cancel one another, the plunger (5) is restored by the tension of the return spring (14).

This opens the contacts on the contact plate and separates the pinion gear (6) from the ring gear (8), so that the pinion gear stops rotating.

- | | |
|------------------|--------------------|
| (1) Main Switch | (6) Pinion Gear |
| (2) Battery | (8) Ring Gear |
| (3) Holding Coil | (13) Contact Plate |
| (4) Pull-in Coil | (14) Return Spring |
| (5) Plunger | |

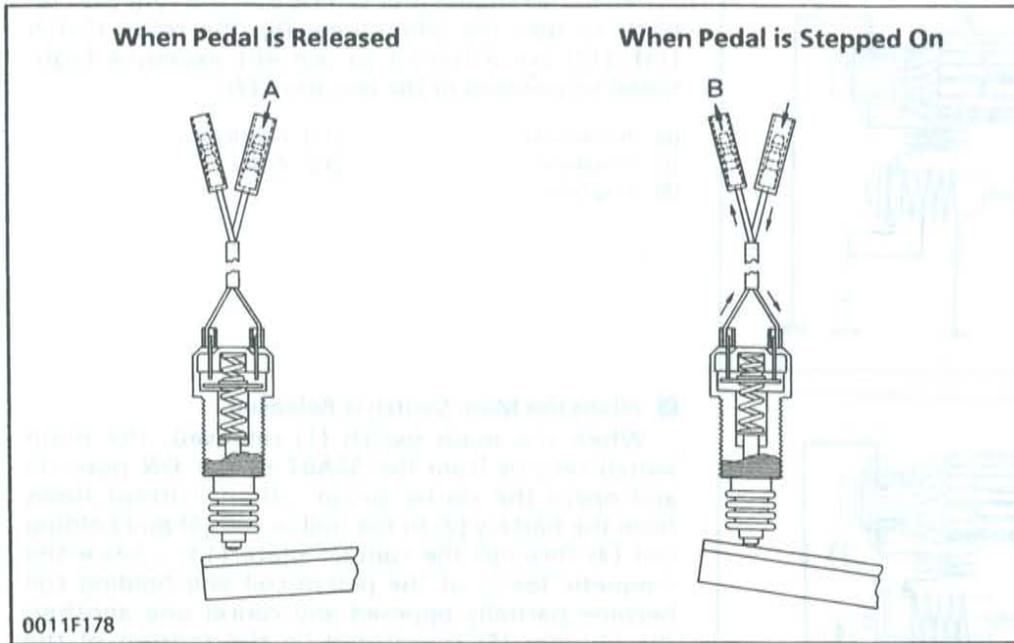
(2) Glow Plug



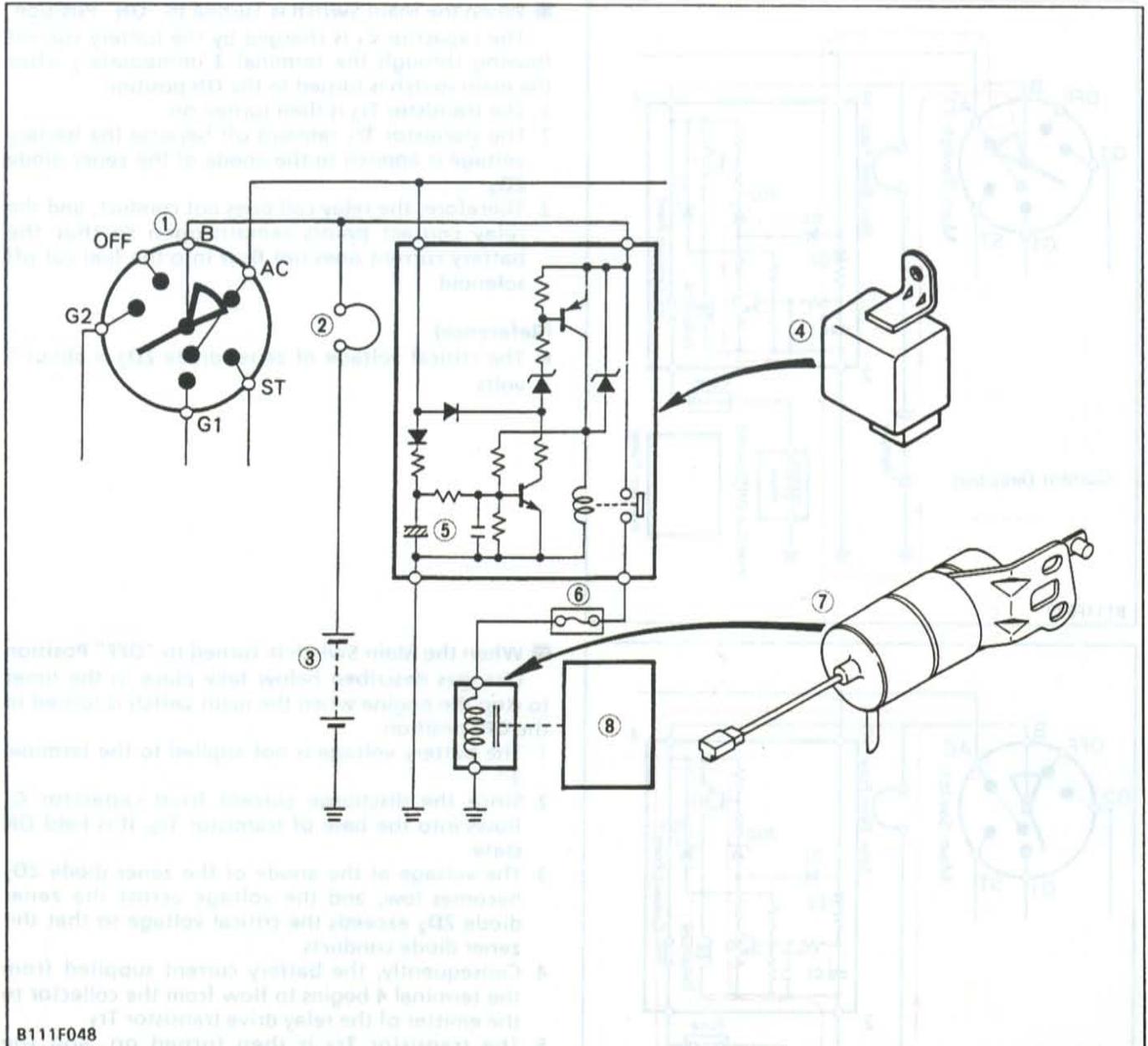
The glow plugs are located in each combustion chamber. They are heated up by the current of the battery to make starting easier.

- | | |
|-----------------------|----------------|
| (1) Insulating Powder | (3) Housing |
| (2) Heat Coil | (4) Metal Tube |

(3) Safety Switch (L2350 Only)



The safety switch prevents current from flowing to the starter when the clutch pedal is not depressed. This is to ensure safe starting.

[4] ENGINE KEY SWITCH SHUT-OFF SYSTEM (L2650, L2950, L3450, L3650)

(1) Main Switch
(2) Slow Blow Fuse

(3) Battery
(4) Timer Relay

(5) Capacitor
(6) Fuse

(7) Fuel Cut Off Solenoid
(8) Fuel Injection Pump

On the engine key switch shut-off system, turning the main switch from the ON position to the OFF position moves the fuel injection pump control rack to the "No Fuel Injection" position through the fuel cut off solenoid and the same linkage as when the stop lever is operated by manual operation.

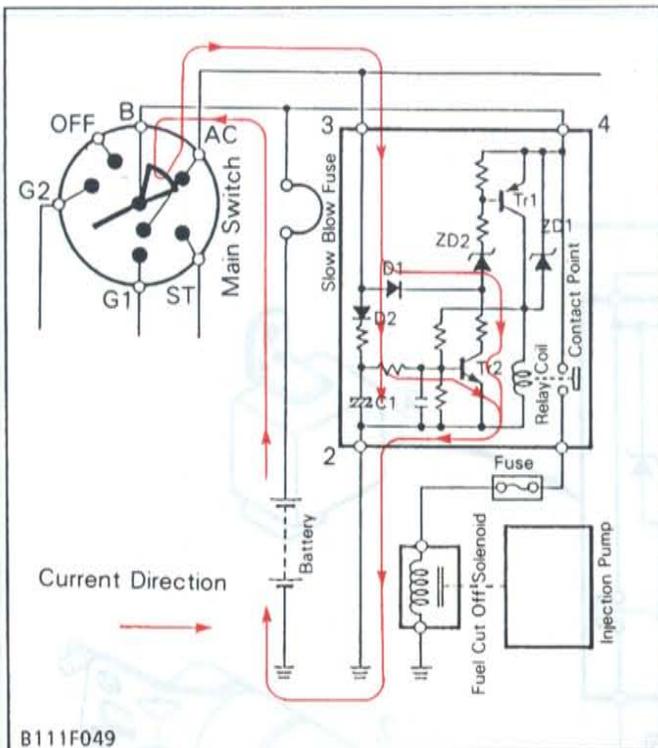
As soon as the main switch (1) is turned from the ON position to the OFF position, the capacitor starts discharging and continues it for approx. 10 seconds.

During the discharging period, the current flows as follows:

Battery (3) → Main Switch (1) → Timer Relay (4)
→ Fuel Cut Off Solenoid (7) → Ground.

Then, the engine stops.

After 10 seconds, the relay contact point in the timer open to prevent the battery from overdischarging.

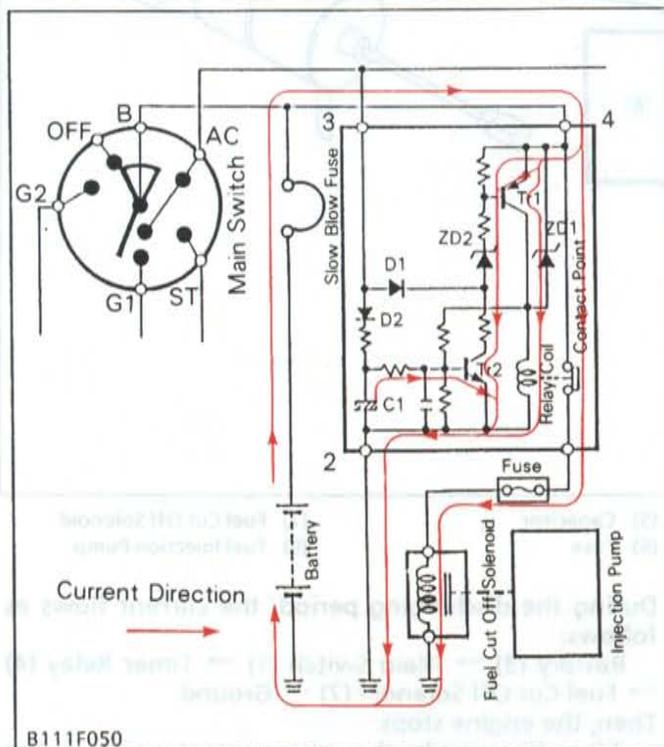
(1) Operation of Timer Relay**■ When the Main Switch is Turned to "ON" Position**

The capacitor C_1 is charged by the battery current flowing through the terminal 3 immediately after the main switch is turned to the ON position.

1. The transistor Tr_2 is then turned on.
2. The transistor Tr_1 remains off because the battery voltage is applied to the anode of the zener diode ZD_2 .
3. Therefore, the relay coil does not conduct, and the relay contact points remain open so that the battery current does not flow into the fuel cut off solenoid.

(Reference)

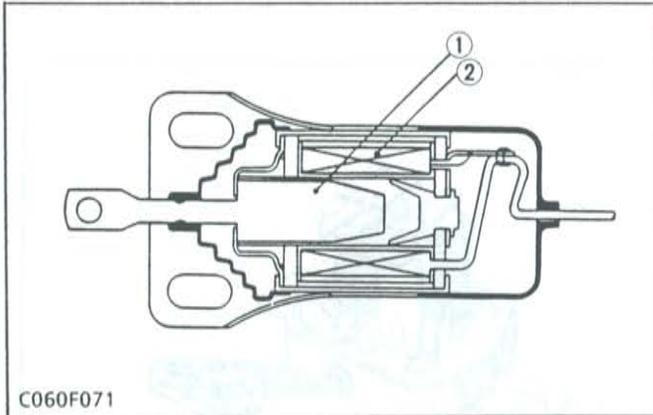
- The critical voltage of zener diode ZD_2 is about 5 volts.

**■ When the Main Switch is Turned to "OFF" Position**

Changes described below take place in the timer to stop the engine when the main switch is turned to the OFF position.

1. The battery voltage is not applied to the terminal 3.
2. Since the discharge current from capacitor C_1 flows into the base of transistor Tr_2 , it is held ON state.
3. The voltage at the anode of the zener diode ZD_2 becomes low, and the voltage across the zener diode ZD_2 exceeds the critical voltage so that this zener diode conducts.
4. Consequently, the battery current supplied from the terminal 4 begins to flow from the collector to the emitter of the relay drive transistor Tr_1 .
5. The transistor Tr_1 is then turned on, and the battery current flows into the relay coil to close relay contact point.
6. The battery current flows into the fuel cut off solenoid via the terminals 4 and 1.
7. As a result, the amount of the fuel injected from the injection pump becomes zero to stop the engine.
8. The transistor Tr_2 turns off after the discharging period approx. 10 seconds of the capacitor C_1 . No current flows through the circuit, and then the relay contact point opens so that the battery current does not flow into the fuel cut off solenoid.

(2) Fuel Cut Off Solenoid



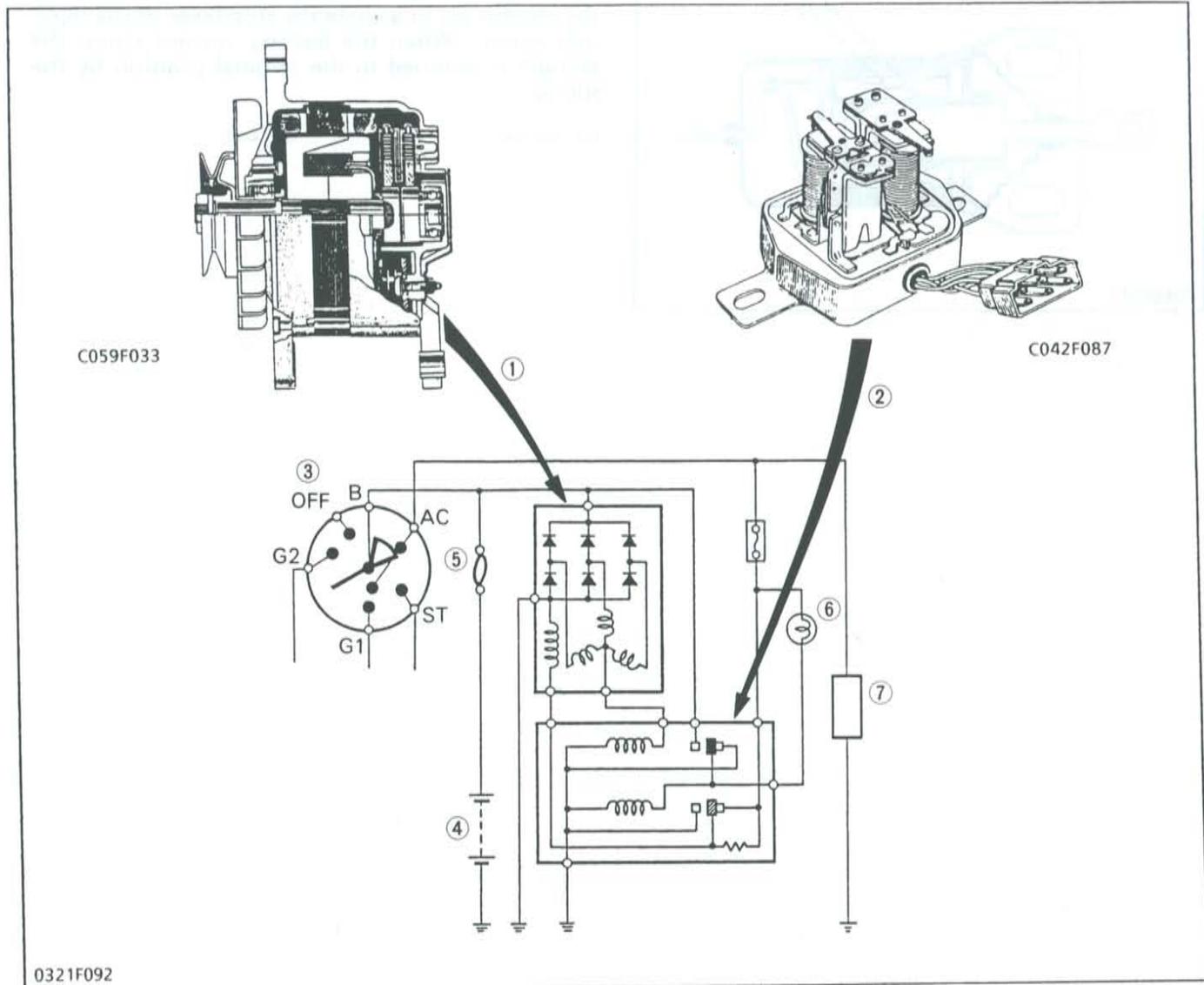
Flowing of the battery current into the coil (2) while the timer relay contact point is closed attracts the plunger (1) to actuate the stop lever of the injection pump. When the battery current stops, the plunger is returned to the original position by the spring.

(1) Plunger

(2) Coil

[5] CHARGING SYSTEM

(1) L2350

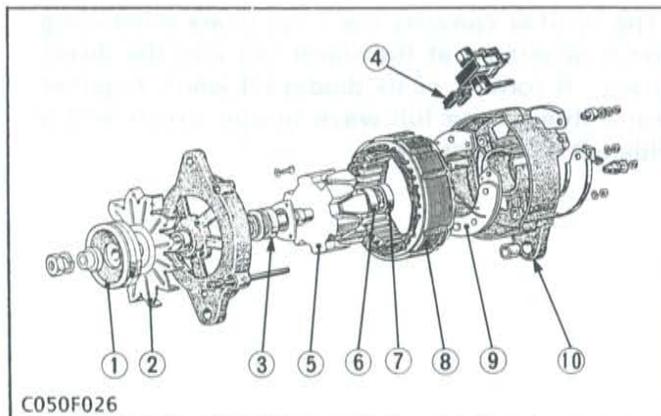


0321F092

- (1) Alternator
- (2) Regulator
- (3) Main Switch
- (4) Battery
- (5) Fusible Link
- (6) Charge Lamp
- (7) Loads

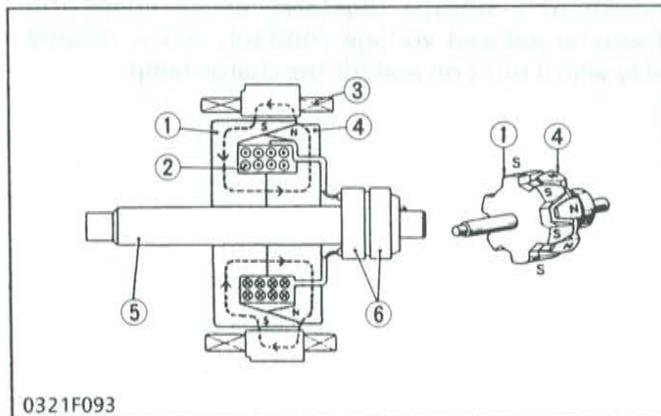
The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs. It consists of an alternator and regulator.

(1)-1 Alternator



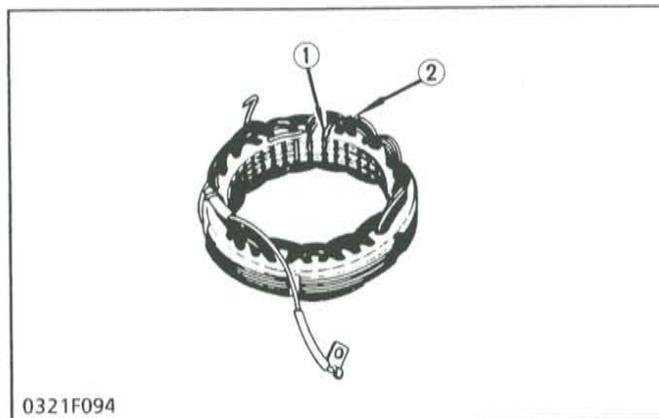
- | | |
|-------------|----------------|
| (1) Pulley | (6) Slip Ring |
| (2) Fan | (7) Bearing |
| (3) Bearing | (8) Stator |
| (4) Brush | (9) Rectifier |
| (5) Rotor | (10) End Plate |

1) Rotor



- | | |
|----------------|---------------|
| (1) Core | (4) Core |
| (2) Rotor Coil | (5) Shaft |
| (3) Stator | (6) Slip Ring |

2) Stator



- | | |
|----------|-----------------|
| (1) Slot | (2) Stator Coil |
|----------|-----------------|

The alternator is a unit that produces electric power to supply the current for each circuit and to charge the battery.

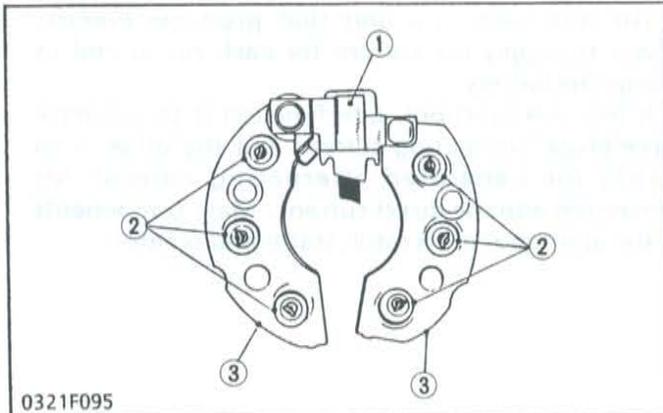
It has two functions, one function is to generate three-phase alternating current and the other is to rectify the generated alternating current for conversion into the direct current. Main components of the alternator are a rotor, stator and rectifier.

The rotor is an assembly of a rotor coil (2), core (1), (4) and shaft (5).

It rotates inside the stator (3) to generate three-phase current in the stator (3). The current flowing through the rotor's rotor coil (2) is regulated to change the magnetic force of the core (1), (4) so that the generated voltage of the stator (3) is controlled to a constant level.

The stator assembly is a laminated soft iron ring with Y-connected stator wiring in the slots (1). Inside the fixed stator, the magnetic rotor rotates to generate three-phase current. The magnitude of the generated voltage is dependent on the amperage that flows through the rotor's rotor coil.

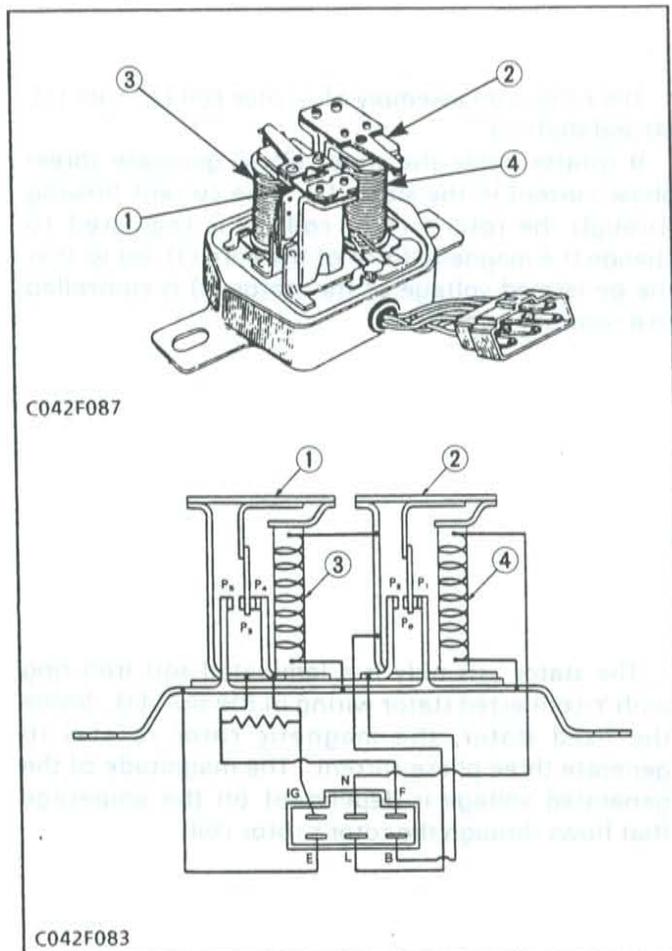
3) Rectifier



The rectifier converts the three-phase alternating current generated at the stator coil into the direct current. It consists of six diodes (2) which together form a three-phase full-wave bridge circuit and a holder (3) that holds them.

- (1) Brush Holder
- (2) Diode
- (3) Holder

(1)-2 Regulator

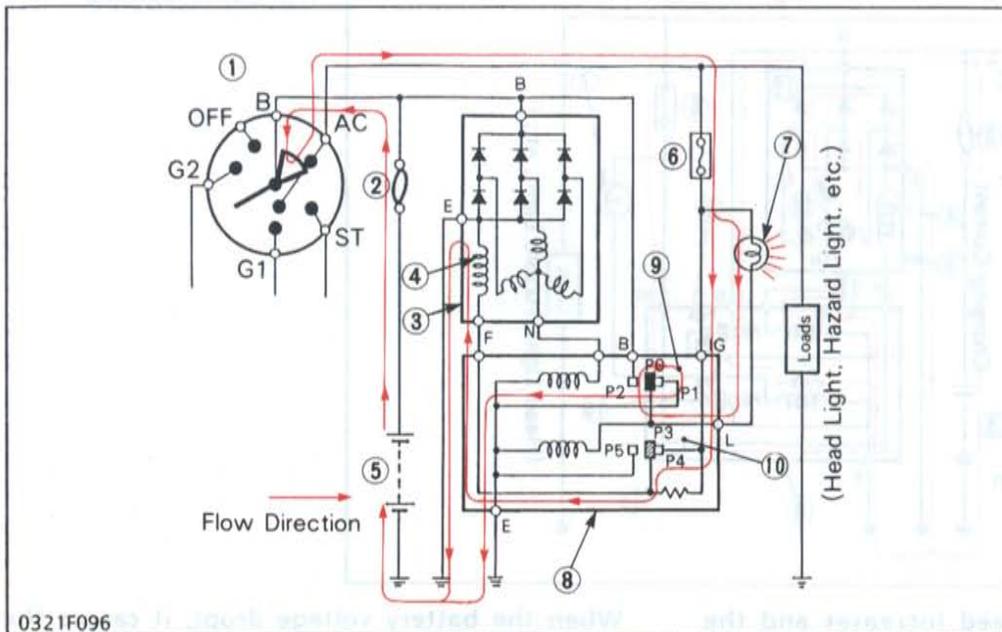


The regulator protects the electrical devices by regulating the voltages induced at the alternator. It consists of a voltage regulator which keeps the alternator-induced voltage constant, and a voltage relay which turns on and off the charge lamp.

- (1) Voltage Regulator
- (2) Voltage Relay
- (3) Voltage Coil
- (4) Pressure Coil

(1)-3 Operation of Charging System

■ When Main Switch is Turned to "ON" Position

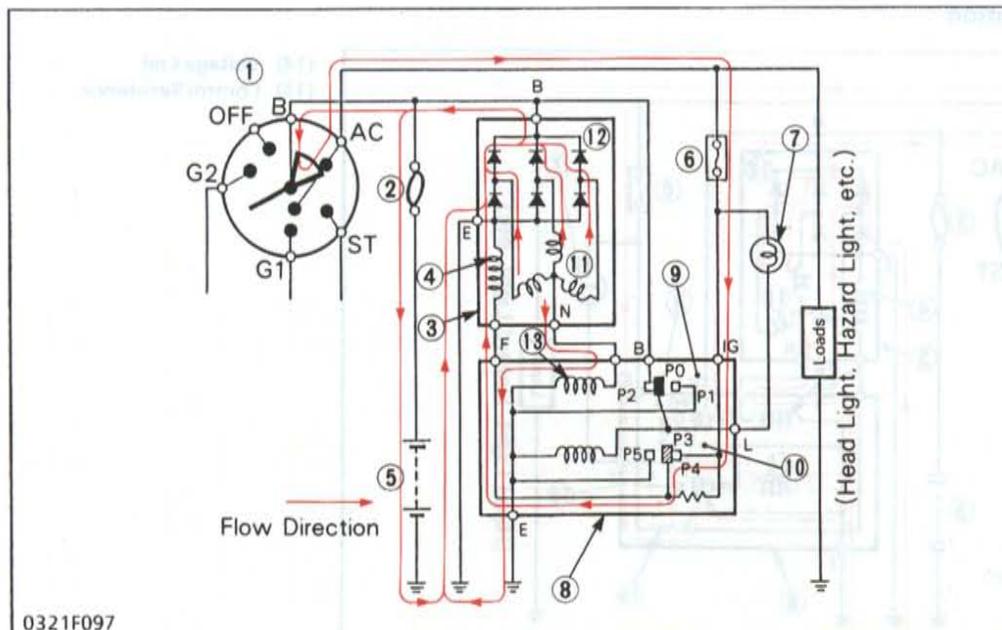


- (1) Main Switch
- (2) Fusible Link
- (3) Alternator
- (4) Rotor Coil
- (5) Battery
- (6) Fuse
- (7) Charge Lamp
- (8) Regulator
- (9) Voltage Relay
- (10) Voltage Regulator

When the main switch (1) is turned to the ON position, the battery voltage causes two flows of the current. As one of the flows, the current flows from the terminal IG of the regulator (8) to the contacts P3 and P4 and flows into the alternator's rotor coil (4)

from the terminal F thus magnetizing the rotor core. Then, it flows to the ground through the terminal E. The other flows from the charge lamp (7) of the easy checker to the ground through the contacts P0 and P1, and lights the charge lamp.

■ When Engine Starts

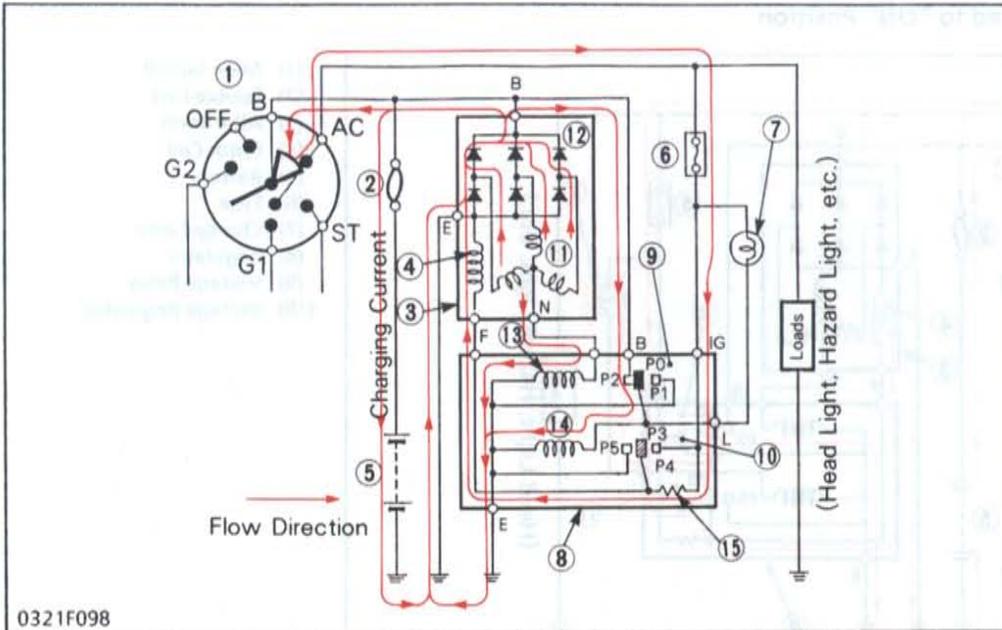


- (11) Stator Coil
- (12) Diodes (Rectifier)
- (13) Pressure Coil

When the engine starts, the three-phase alternating current is generated in the stator coil (11) and rectified by the rectifier (12). If the induced voltage is higher than the battery voltage, the battery is charged. And at the same time, the voltage at the

terminal N is applied to the pressure coil (13). When this voltage becomes higher than the threshold voltage of the voltage relay, contacts P0 and P2 close and turn off the charge lamp (7).

■ When Battery Voltage Rises



- (14) Voltage Coil
- (15) Control Resistance

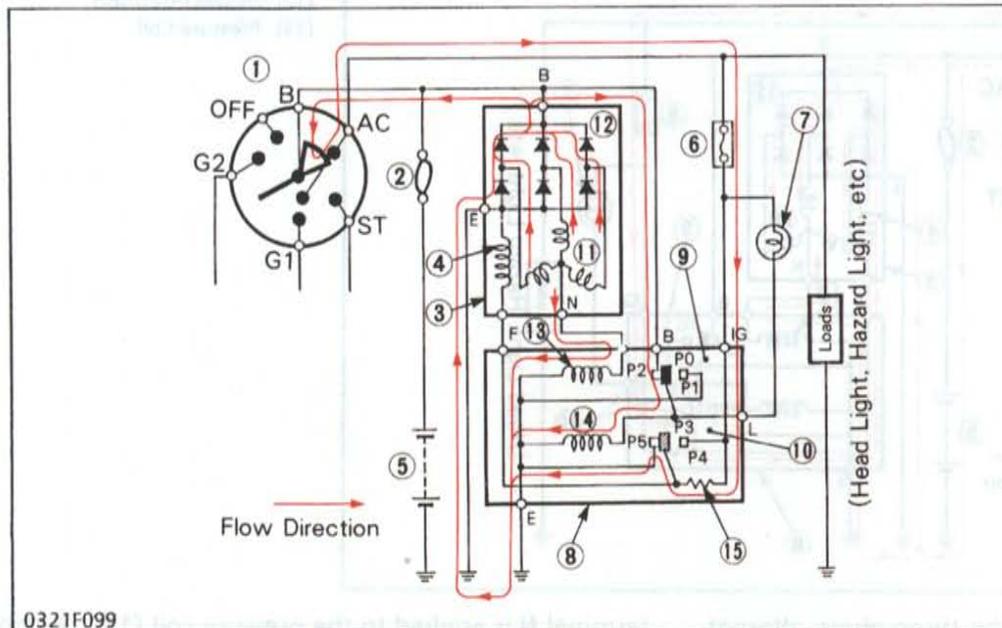
0321F098

When the alternator speed increases and the voltage at the terminal B rises, the voltage coil (14) is excited, and contact P3 is attracted toward the P5 side and held midway between them. In this case, the rotor coil (14) and control resistance (15) are series-connected, so that the current flowing into the rotor coil is reduced. Thus, the rotor's magnetic force is reduced and the generated voltage drops.

When the battery voltage drops, it causes the voltage coil current to decrease and the magnetic force of the voltage coil becomes small, and closes contacts P3 and P4 again, thus increasing the magnetic force of the rotor coil to raise the generated voltage.

The operation above is repeated to maintain the generated voltage at a constant level.

■ When Over Charge Prevention



- (14) Voltage Coil
- (15) Control Resistance

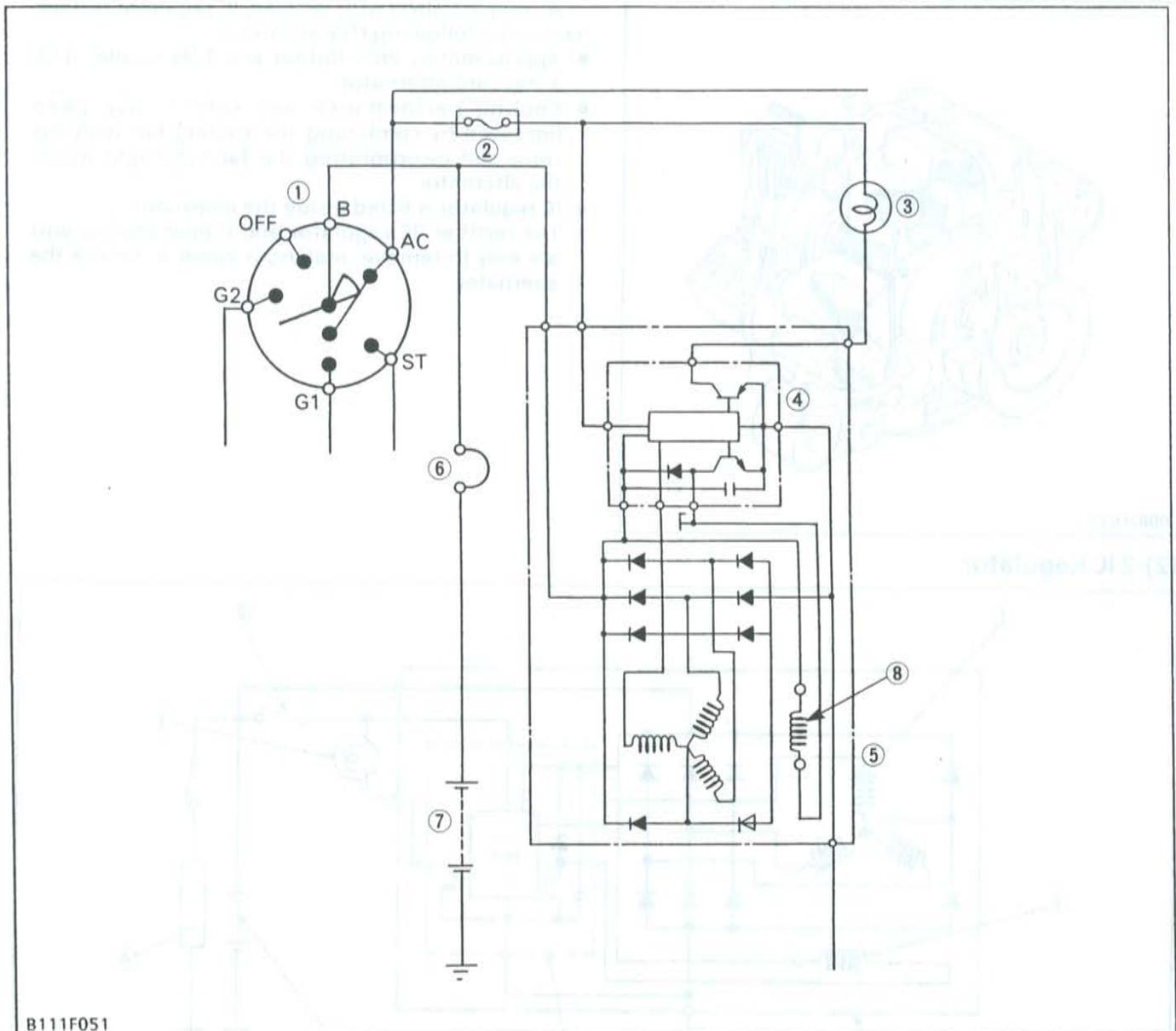
0321F099

When the battery is charged nearly to capacity, the voltage coil (14) increases its attraction force and closes contacts P3 and P5. The current flowing through the control resistance (15) is directly

grounded.

Therefore, the current flowing into the rotor is further reduced, thus the generated voltage is maintained at a constant level.

(2) L2650, L2950, L3450, L3650



B111F051

(1) Main Switch
(2) Fuses

(3) Charge Lamp
(4) IC Regulator

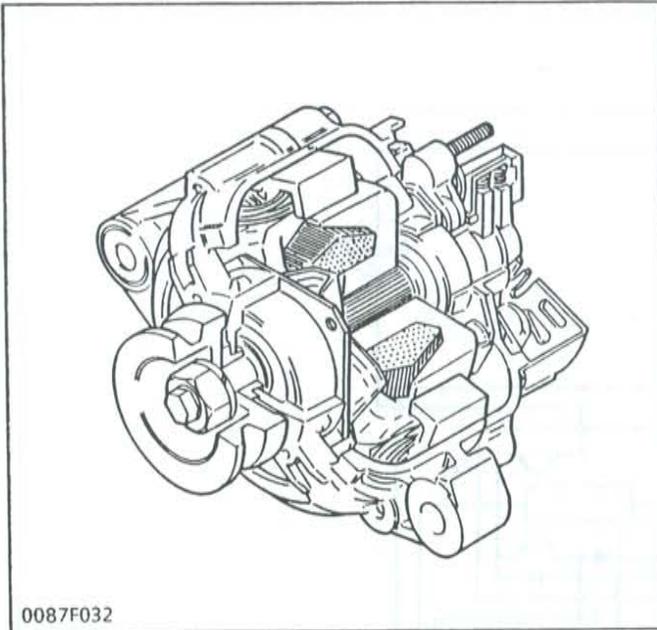
(5) Alternator
(6) Slow Blow Fuse

(7) Battery
(8) Rotor Coil

The charging system supplies electric power for various electrical devices and also charges the battery while the engine runs.

This alternator has IC regulator.

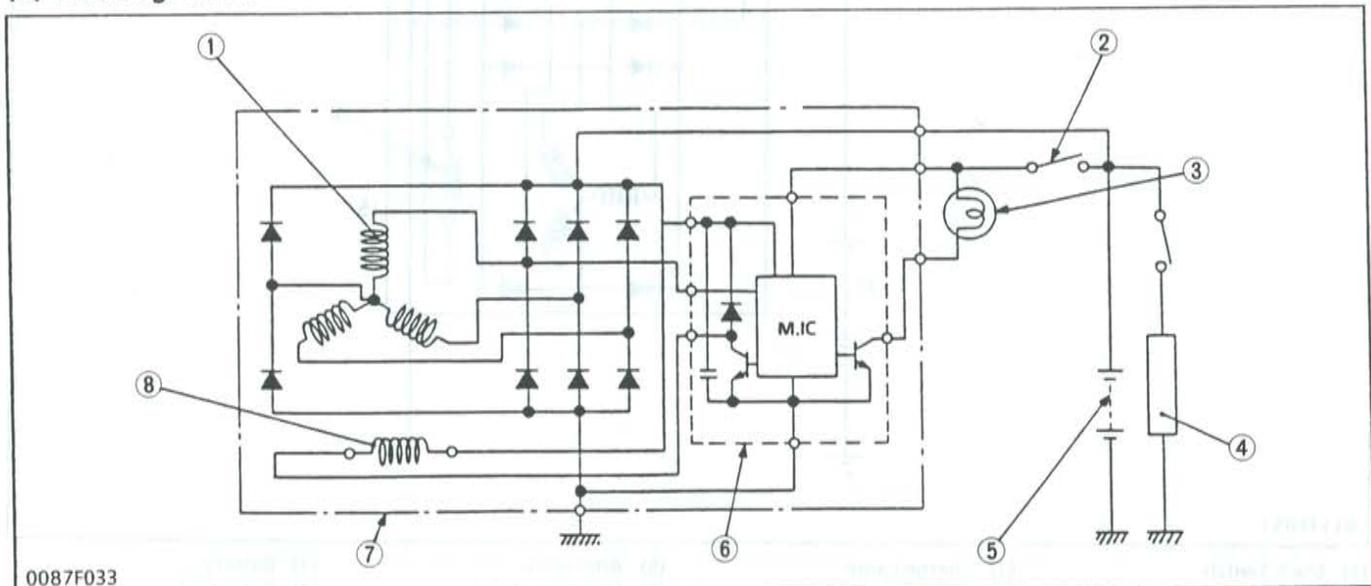
(2)-1 Alternator



A compact alternator with an IC regulator is used, having the following characteristics:

- Approximately 26% lighter and 17% smaller than a standard alternator.
- Cooling performance and safety have been improved by combining the cooling fan with the rotor and incorporating the fan/rotor unit inside the alternator.
- IC regulator is fitted inside the alternator.
- The rectifier, IC regulator and similar components are easy to remove, making it easier to service the alternator.

(2)-2 IC Regulator



- | | | | |
|-----------------|-----------------|------------------|----------------|
| (1) Stator Coil | (3) Charge Lamp | (5) Battery | (7) Alternator |
| (2) Main Switch | (4) Load | (6) IC Regulator | (8) Rotor Coil |

An IC regulator uses solid state transistors, chips or other semiconductor elements instead of the relays in a conventional regulator. Stable characteristics are achieved by cutting off the field current.

IC regulators have the following characteristics:

- The control voltage does not change over time, so the need for readjustment is eliminated. Since there are no moving parts, IC regulators are extremely durable and resistant to vibration.
- The overheat compensation characteristics ensure that the control voltage is reduced as the temperature rises, so the battery is charged at just the right level.

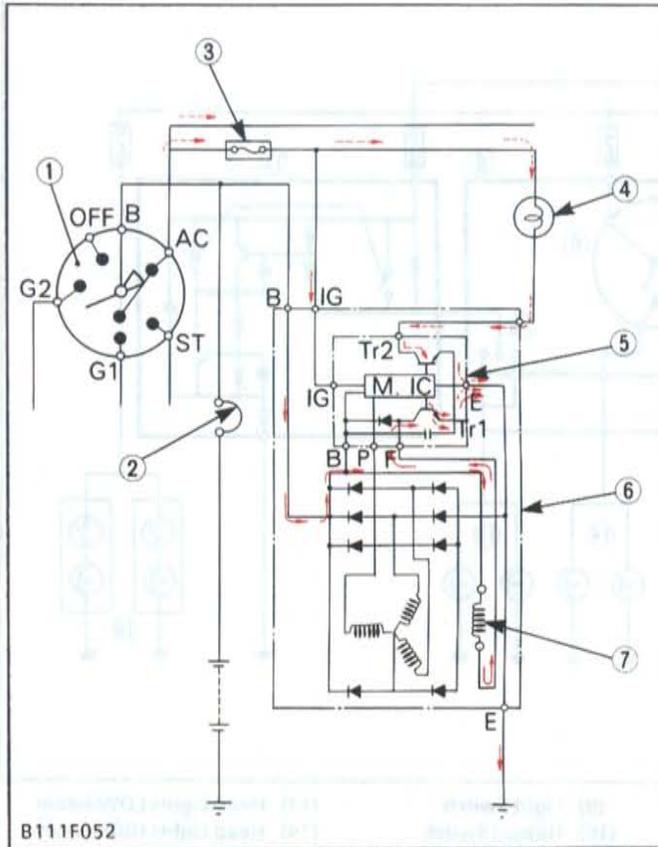
The internal circuitry of the IC regulator is shown in the diagram. It consists of a hybrid IC incorporating a monolithic IC. (The internal circuitry of the monolithic IC is extremely complex, so it is shown as simply "M.IC circuit".

Tr1 acts as the contacts controlling the field current, and Tr2 acts as the charge lamp relay controlling the flashing of the charge lamp.

The M.IC circuit controls Tr1 and Tr2, and monitors the alternator output voltage, and detects any drop in L terminal voltage or breaks in the rotor coil.

(2)-3 Operation of Charging System

■ When Main Switch is Turned To "ON" Position

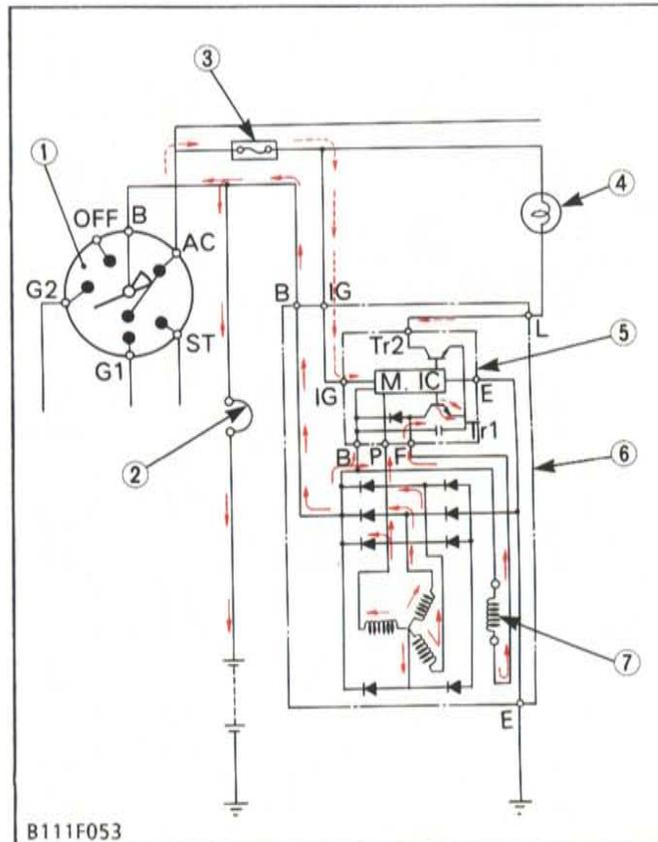


As the battery voltage is added to the terminal IG, M.IC circuit detect it and makes current pour to the Tr1. It results to pour the initial exciting current to the rotor coil. (In this case, M.IC circuit makes current pour on and off the Tr1 in pulse and limits the battery discharging current to small value (Approx. 0.17 A) when the main switch is turned on.)

As the alternator is not rotated, it doesn't generate. Therefore the voltage of terminal P is zero volt. M.IC circuit detects it and makes current pour to the Tr2. It results light on the charge lamp.

- | | |
|--------------------|----------------------|
| (1) Main Switch | (6) Alternator |
| (2) Slow Blow Fuse | (7) Rotor Coil |
| (3) Fuse | M.IC : Monolithic IC |
| (4) Charge Lamp | Tr1 : Transistor |
| (5) IC Regulator | Tr2 : Transistor |

■ When Engine Starts



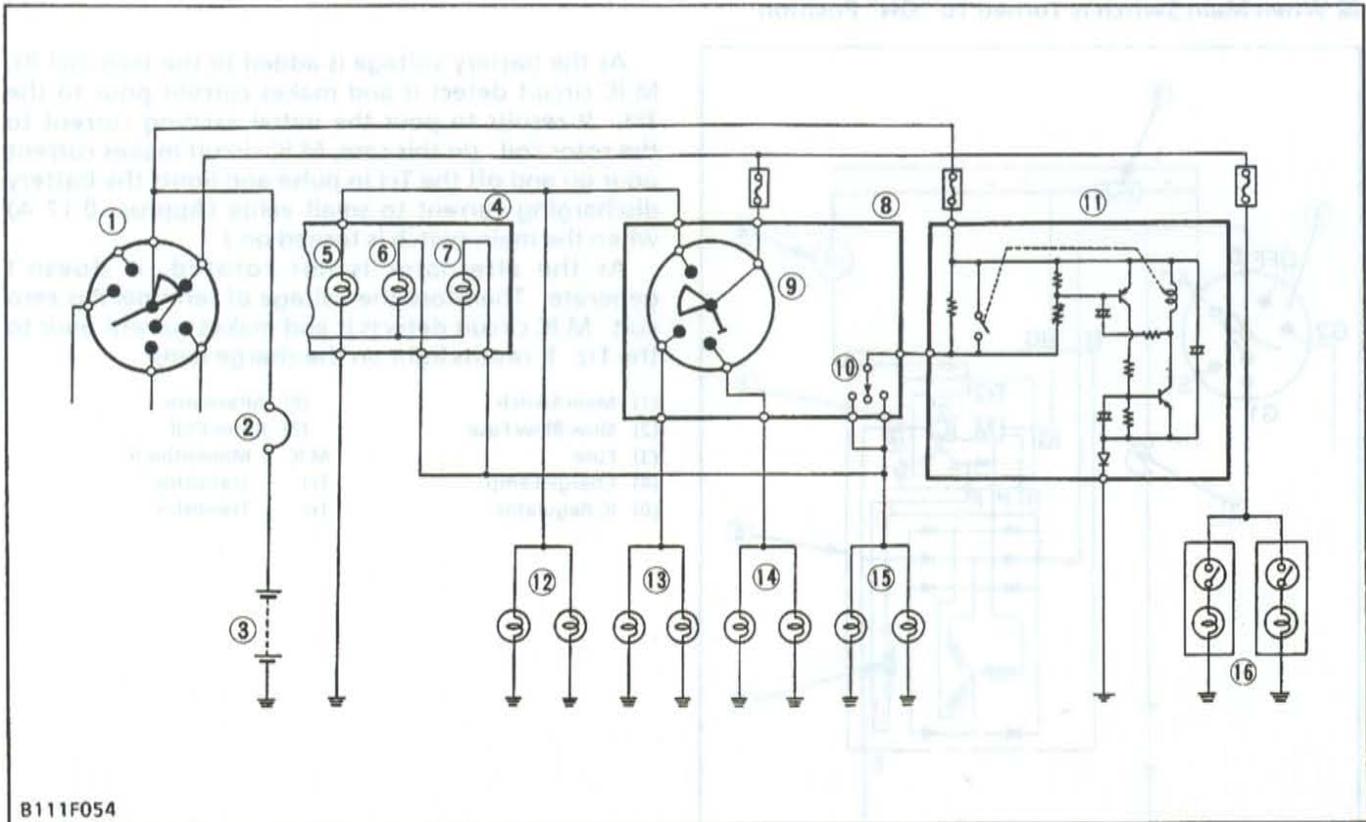
When the engine starts and the alternator rotates, M.IC circuit makes current pour continuously to the Tr1 instead of the uncontinuous (in pulse) current. Therefore a sufficient exciting current flows and a generated voltage rises rapidly. As a result, the current to the Tr2 is shut and lights off the charge lamp.

When terminal B voltage rises over the battery voltage, a charged current flows to the battery.

- | | |
|--------------------|----------------------|
| (1) Main Switch | (6) Alternator |
| (2) Slow Blow Fuse | (7) Rotor Coil |
| (3) Fuse | M.IC : Monolithic IC |
| (4) Charge Lamp | Tr1 : Transistor |
| (5) IC Regulator | Tr2 : Transistor |

[6] LIGHTING SYSTEM

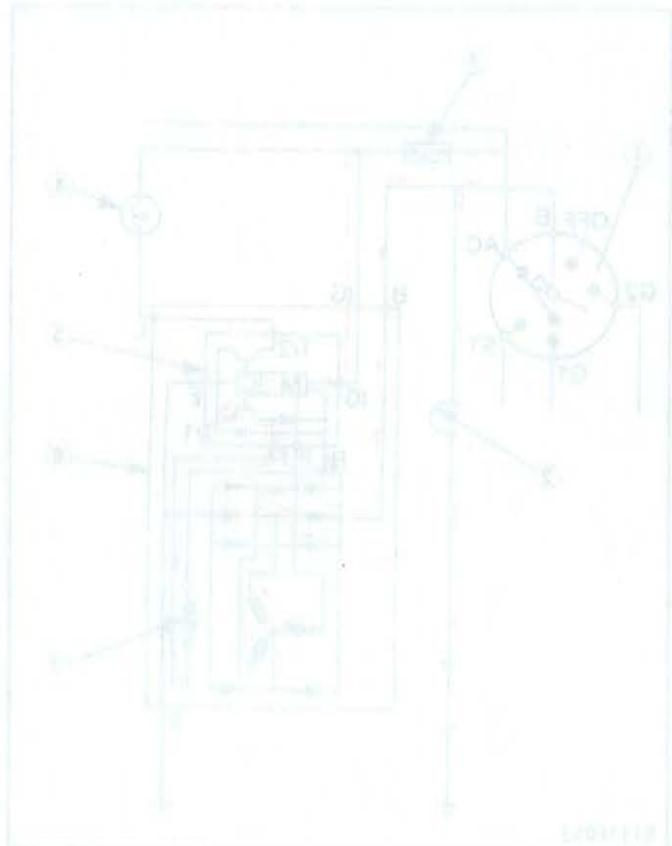
(3)- Operation of Charging System



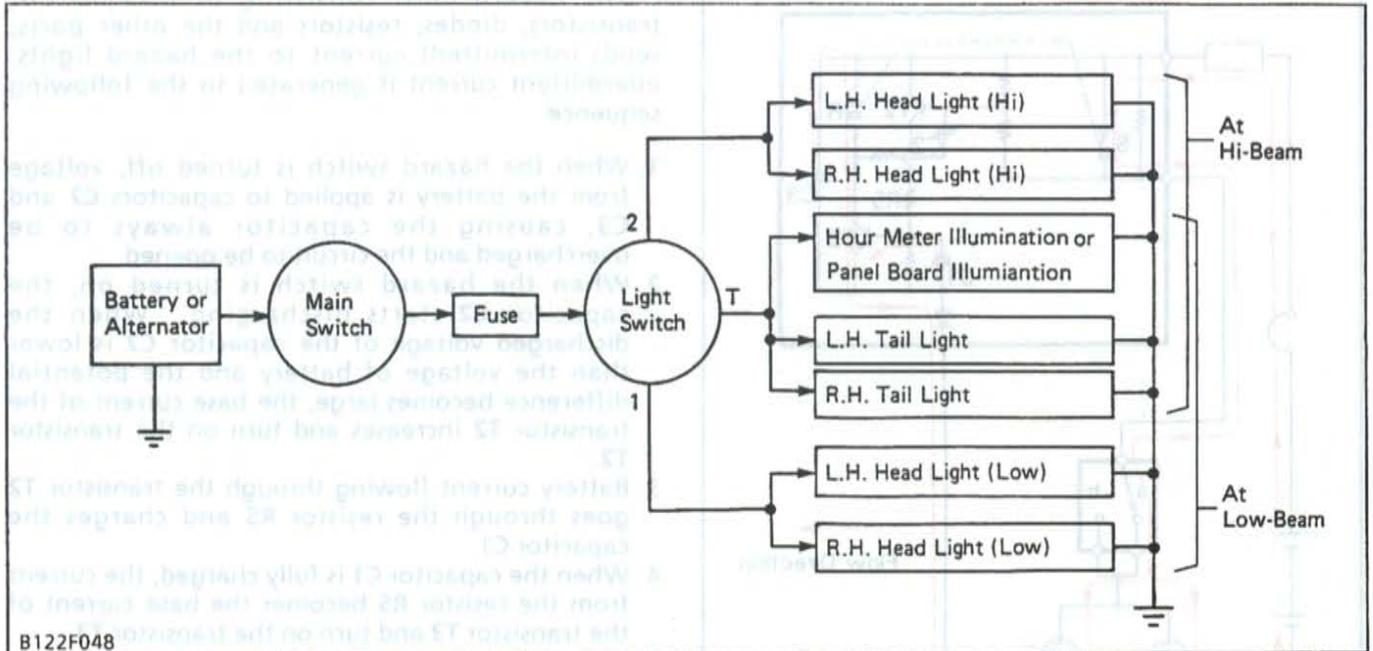
B111F054

- | | | | |
|---|------------------------------|--------------------|--------------------------------|
| (1) Main Switch | (5) Panel Board Illumination | (9) Light Switch | (13) Head Lights LOW-beam |
| (2) Slow Blow Fuse (except L2350)
Fusible Link (L2350) | (6) L.H. Indicator Lamp | (10) Hazard Switch | (14) Head Lights HIGH-beam |
| (3) Battery | (7) R.H. Indicator Lamp | (11) Hazard Unit | (15) Hazard Lights |
| (4) Panel Board | (8) Combination Switch | (12) Tail Lights | (16) Work Lights (if equipped) |

The lighting system consists of combination switch (light switch and hazard switch), head lights, tail lights, panel board illumination, hazard unit, hazard lights, hazard indicator lamps, work lights, etc.



(1) Head Light

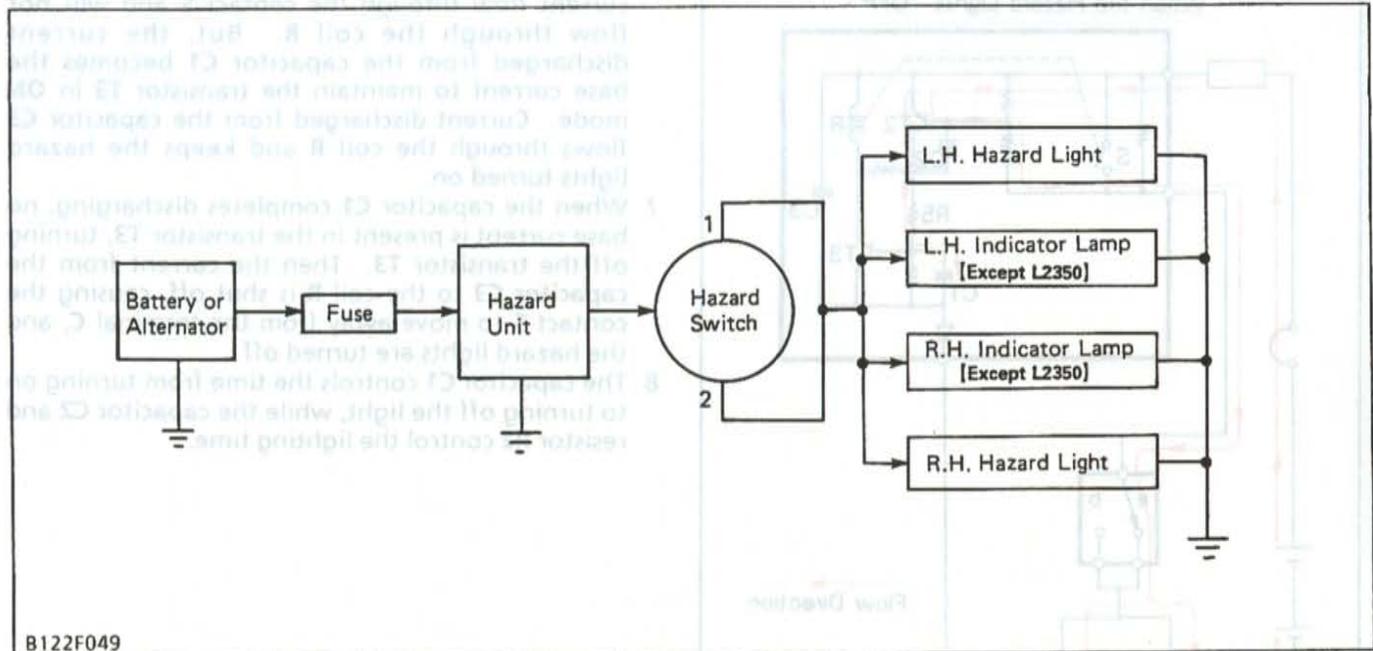


B122F048

The light switch, which forms a combination switch with the hazard switch, has three position; **OFF, LOW-BEAM and HIGH-BEAM.**

Current passes through the light circuit as shown in the figure above.

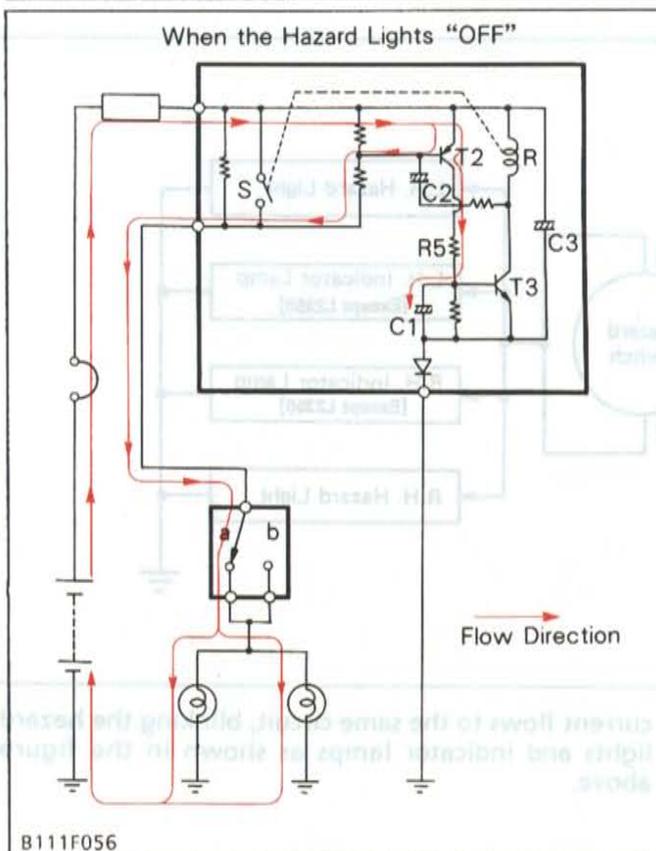
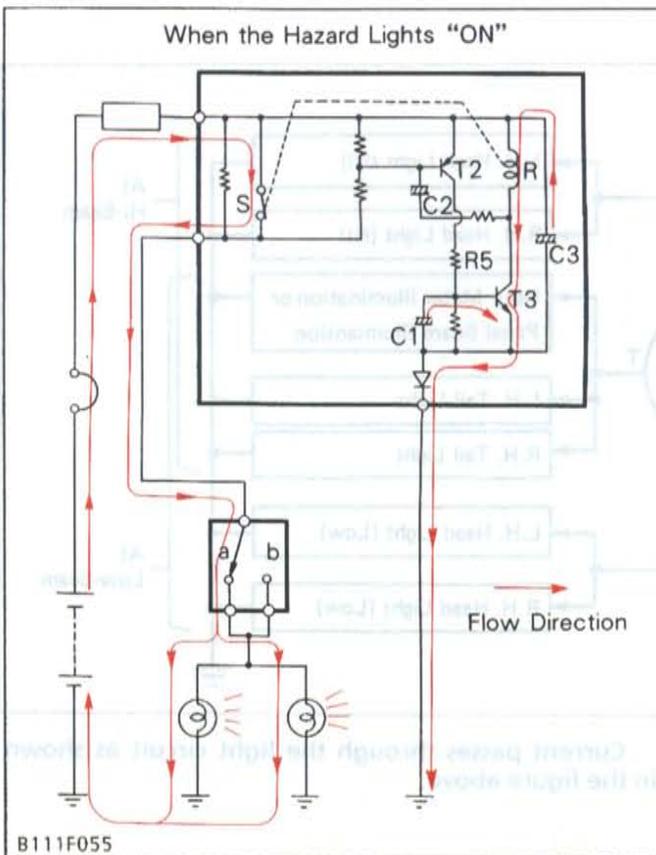
(2) Hazard Light



B122F049

The hazard switch, which forms a combination switch with the light switch, has three positions; **OFF, 1 and 2.** At either switch lever position of 1 or 2,

current flows to the same circuit, blinking the hazard lights and indicator lamps as shown in the figure above.



■ Hazard Unit

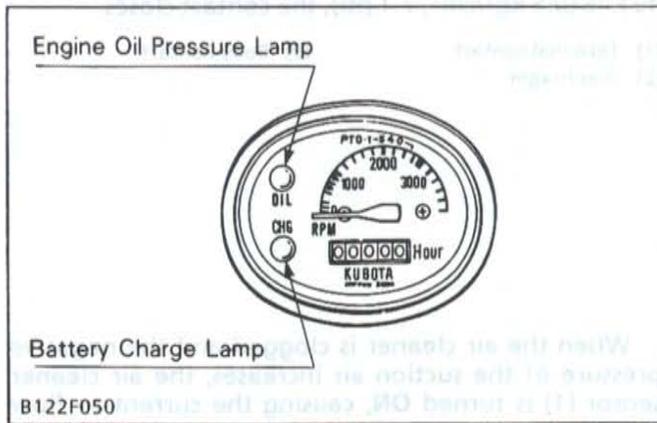
The hazard unit, consisting of a capacitor, transistors, diodes, resistors and the other parts, sends intermittent current to the hazard lights. Intermittent current is generated in the following sequence.

1. When the hazard switch is turned off, voltage from the battery is applied to capacitors **C2** and **C3**, causing the capacitor always to be overcharged and the circuit to be opened.
2. When the hazard switch is turned on, the capacitor **C2** starts discharging. When the discharged voltage of the capacitor **C2** is lower than the voltage of battery and the potential difference becomes large, the base current of the transistor **T2** increases and turn on the transistor **T2**.
3. Battery current flowing through the transistor **T2** goes through the resistor **R5** and charges the capacitor **C1**.
4. When the capacitor **C1** is fully charged, the current from the resistor **R5** becomes the base current of the transistor **T3** and turn on the transistor **T3**.
5. When the transistor **T3** is turned on, battery current magnetizes the coil **R**. As the contact **S** is drawn to be connected with the terminal **C**, the battery current flows through the hazard switch and turns on the hazard lights.
6. When the hazard light is lighted, all the battery current flow through the contact **S** and will not flow through the coil **R**. But, the current discharged from the capacitor **C1** becomes the base current to maintain the transistor **T3** in **ON** mode. Current discharged from the capacitor **C3** flows through the coil **R** and keeps the hazard lights turned on.
7. When the capacitor **C1** completes discharging, no base current is present in the transistor **T3**, turning off the transistor **T3**. Then the current from the capacitor **C3** to the coil **R** is shut off, causing the contact **S** to move away from the terminal **C**, and the hazard lights are turned off.
8. The capacitor **C1** controls the time from turning on to turning off the light, while the capacitor **C2** and resistor **R2** control the lighting time.

[7] WARNING LAMPS

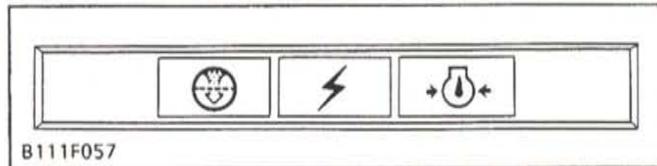
(1) Indication Items

L2350



- Engine oil pressure lamp
Light up when the engine oil pressure drops below approx. 49 kPa (0.5 kgf/cm², 7.1 psi)
- Battery charge lamp
Light up when battery charging is improper.

Except L2350

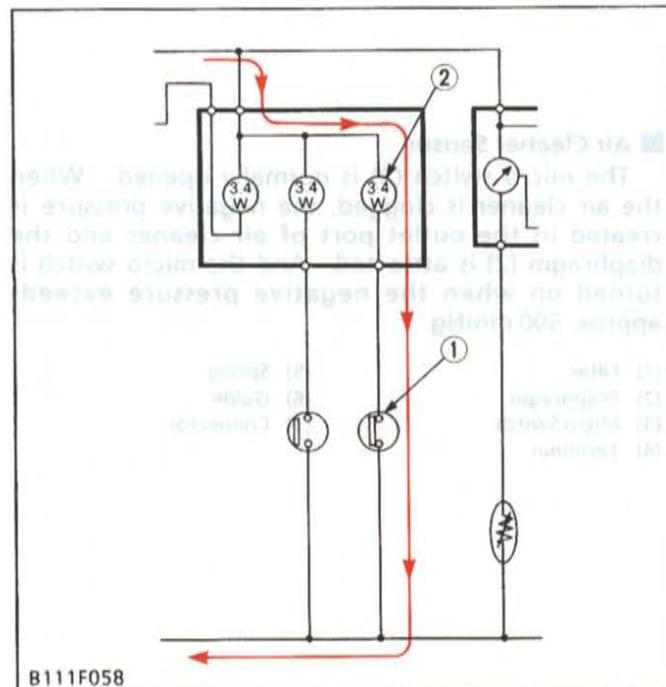


- Air cleaner clogged lamp
Light up when the air cleaner is clogged.

- Battery charge lamp
Light up when battery charging is improper.

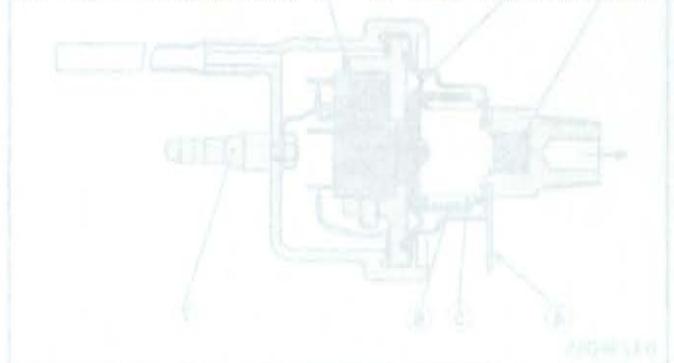
- Engine oil pressure lamp
Light up when the engine oil pressure drops below approx. 49 kPa (0.5 kgf/cm², 7.1 psi)

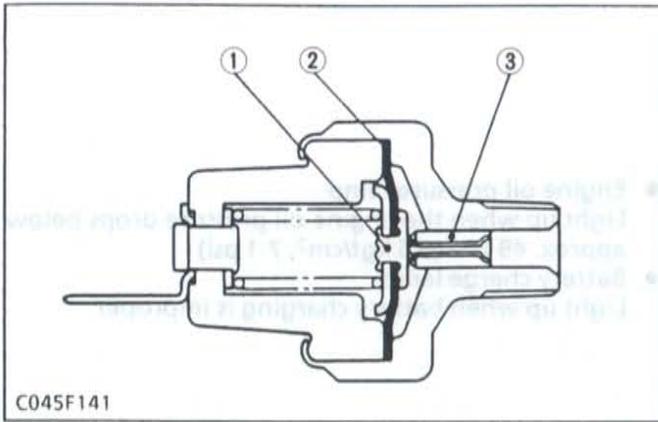
(2) Engine Oil Pressure Alarm



When the engine oil pressure has dropped, the engine oil pressure switch (1) is activated to let the current flow from the main switch and to light up the lamp (2).

- (1) Engine Oil Pressure Switch (2) Engine Oil Pressure Lamp



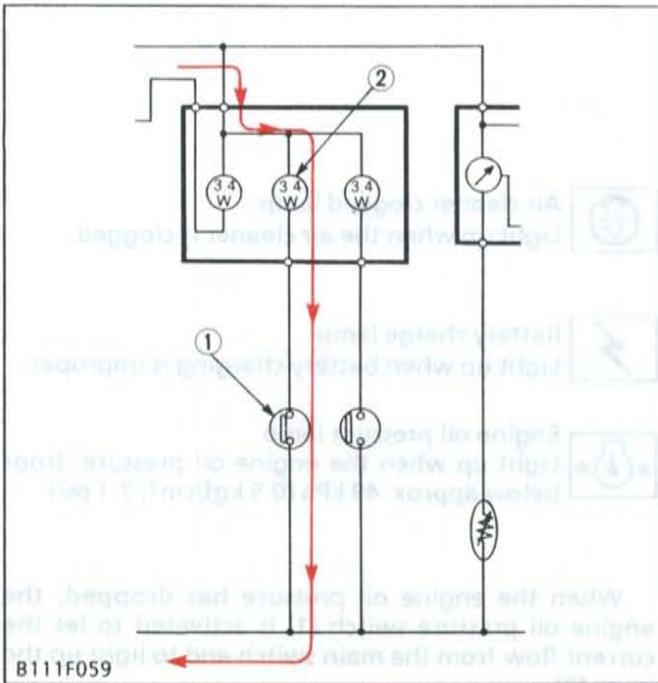


Oil Pressure Switch

While oil pressure is high and the force applied to the diaphragm (2) is larger than the spring tension, the terminal contact (1) is open separated from the body contact (3). If the pressure drops below approx. 49 kPa (0.5 kgf/cm², 7.1 psi), the contact closes.

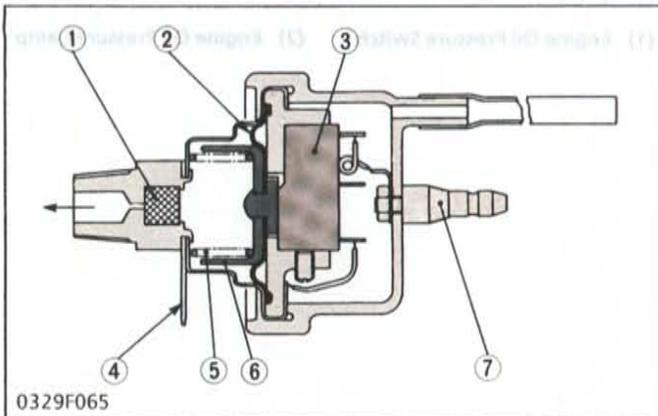
- (1) Terminal contact
- (2) Diaphragm
- (3) Body Contact

(3) Air Cleaner Clogged Lamp



When the air cleaner is clogged and the negative pressure of the suction air increases, the air cleaner sensor (1) is turned **ON**, causing the current to flow from the main switch and the lamp (2) is lighted.

- (1) Air Cleaner Sensor
- (2) Lamp

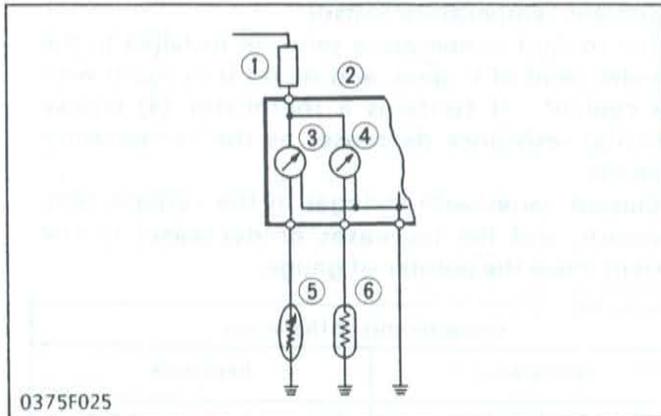


Air Cleaner Sensor

The micro switch (3) is normally opened. When the air cleaner is clogged, the negative pressure is created in the outlet port of air cleaner and the diaphragm (2) is attracted. And the micro switch is turned on when the negative pressure exceeds approx. 500 mmHg.

- (1) Filter
- (2) Diaphragm
- (3) Micro Switch
- (4) Terminal
- (5) Spring
- (6) Guide
- (7) Connector

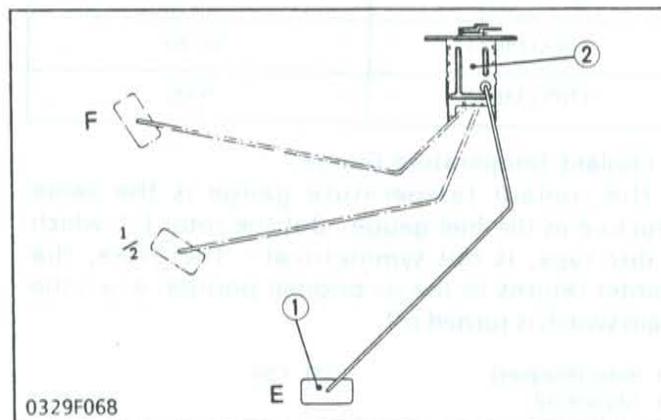
[8] GAUGES



The fuel quantity and coolant temperature are indicated by the ammeters. The ammeters indicate each amperate flowing through the fuel level sensor (5) for the fuel quantity detection and through the coolant temperature sensor (6) for the coolant temperature detection.

- (1) Fuse
- (2) Panel Board
- (3) Fuel Gauge
- (4) Water Temp. Gauge
- (5) Fuel Level Sensor
- (6) Coolant Temp. Sensor

(1) Fuel Gauge



■ Fuel Level Sensor

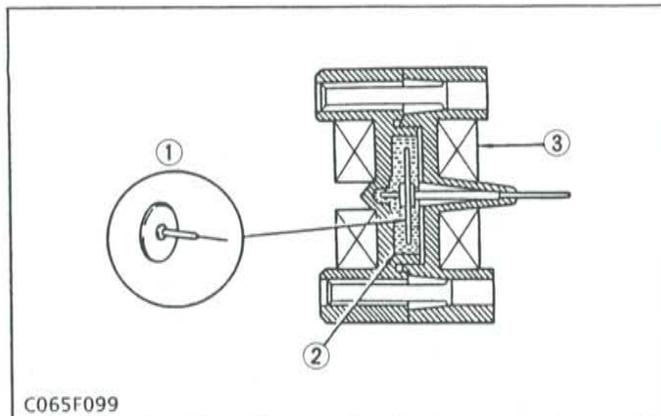
The remaining fuel quantity is detected by the fuel level sensor installed in the fuel tank and indicated on the fuel gauge. For detection, a float and a resistor are used.

As the float (1) lowers, the resistance of the variable resistor (2) varies. The relation between the amount of fuel and the resistance is as follows.

F	1/2	E (Remaining fuel of approx. 2.0ℓ, 0.53 U.S.gal, 0.44 Imp.gal)
1 to 5Ω	28.5 to 36.5Ω	103 to 117Ω

(1) Float

(2) Variable Resistor



■ Fuel Gauge

The gauge has a rotor (magnet) (1) and the shunt windings which cross the rotor with one another to generate magnetic field.

The magnetic field generated by the windings moves the rotor. The rotor is immersed in silicone oil (2) to regulate the rotation of the rotor.

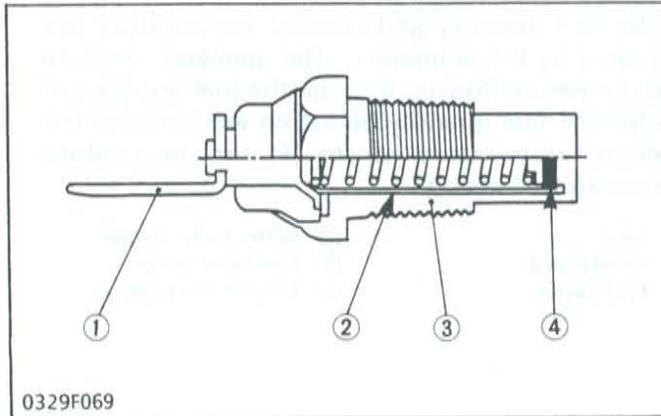
As the rotor is disc type and symmetrical, the pointer stays where it was even when the main switch is turned off.

After filling up the tank and turning the main switch on, it will take about two minutes before the pointer comes to stop.

(1) Rotor (Magnet)
(2) Silicone Oil

(3) Coil

(2) Coolant Temperature Gauge



- (1) Terminal
- (2) Insulator
- (3) Body
- (4) Thermistor

■ Coolant Temperature Sensor

The coolant temperature sensor is installed to the cylinder head of engine, and its tip is in touch with the coolant. It contains a thermistor (4) whose electrical resistance decreases as the temperature increases.

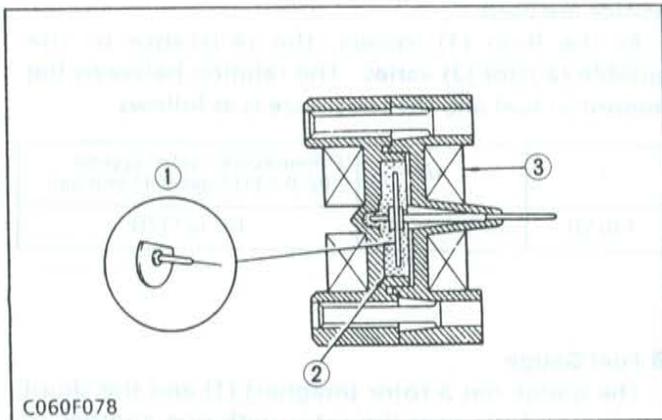
Current varies with changes in the coolant temperature, and the increases or decreases in the current move the pointer of gauge.

Characteristics of Thermistor	
Temperature	Resistance
50°C(122°F)	148.8Ω
80°C(176°F)	50.3Ω
120°C(248°F)	16.0Ω
170°C(338°F)	5.6Ω

■ Coolant Temperature Gauge

The coolant temperature gauge is the same structure as the fuel gauge. But the rotor (1), which is disc type, is not symmetrical. Therefore, the pointer returns to the its original position when the main switch is turned off.

- (1) Rotor (Magnet)
- (2) Silicone Oil
- (3) Coil



11 OTHERS

[1] TIRES

(1) Types of Tire

The following tires can be mounted on models L2350, L2650, L2950, L3450 and L3650.

		
C045F069	C045F070	C045F074
Farm Tire (Front Tire of 2WD only)	FarmTire	Turf Tire

Model	Type of Tire	Front	Rear	Model	Type of Tire	Front	Rear
L2350 2WD	Farm Tire	4.00 - 15 Std.	9.5 - 24 Std.	L2950 2WD	Farm Tire	5.00 - 15 Std.	12.4 - 24 Std.
		4.00 - 15 Opt.	11.2 - 24 Opt.		Turf Tire	23 x 8.50 - 12 Std.	13.6 - 16 Std.
		5.00 - 15 Opt.	11.2 - 24 Opt.			25 x 8.50 - 14 Opt.	355/80-D20 Opt.
	Turf Tire	23 x 8.50 - 12 Std.	13.6 - 16 Std.		L2950 4WD	Farm Tire	7 - 16 Std.
25 x 8.50 - 14 Opt.		355/80-D20 Opt.	Turf Tire	25 x 8.50 - 14 Std.		13.6 - 16 Std.	
L2350 4WD	Farm Tire	6 - 14 Std.	9.5 - 24 Std.	L3450 2WD	Farm Tire	5.00 - 15 Std.	12.4 - 24 Std.
		7 - 16 Opt.	11.2 - 24 Opt.			5.50 - 16 Opt.	13.6 - 24 Opt.
	Turf Tire	24 x 8.50 - 14 Std.	13.6 - 16 Std.	Turf Tire	25 x 8.50 - 14 Std.	355/80-D20 Std.	
L2650 2WD	Farm Tire	4.00 - 15 Std.	11.2 - 24 Opt.	L3450 4WD	Farm Tire	7 - 16 Std.	12.4 - 24 Std.
		5.00 - 15 Opt.	11.2 - 24 Std.			8 - 16 Opt.	13.6 - 24 Opt.
			12.4 - 24 Opt.		Turf Tire	212/80 -D15 Std.	355/80-D20 Std.
	23 x 8.50 - 12 Std.	13.6 - 16 Std.	L3650 2WD			Farm Tire	6.00 - 16 Std.
L2650 4WD	Turf Tire	25 x 8.50 - 14 Opt.	355/80-D20 Opt.	Turf Tire	25 x 8.50 - 14 Std.	355/80-D20 Std.	
		7 - 16 Std.	11.2 - 24 Std.	L3650 4WD	Farm Tire	8 - 16 Std.	13.6 - 26 Std.
		25 x 8.50 - 14 Std.	13.6 - 16 Std.		Turf Tire	212/80 -D15 Std.	355/80-D20 Std.
	212/80 - D15 Opt.	355/80-D20 Opt.					

(2) Tread Adjustment

(2)-1 Front Wheels

[2WD Type]

With 2WD models, the front tread can be adjusted in 4 steps.

⚠ CAUTION

- When working on slopes or working with trailer, set the wheel tread as wide as practical for the job for maximum stability.

[L2350]

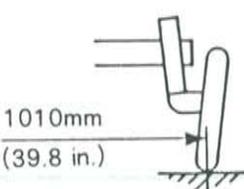
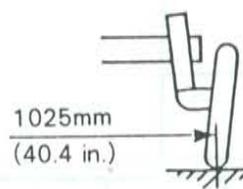
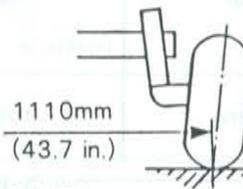
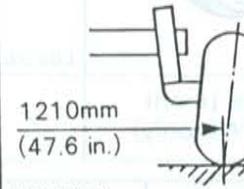
Front axle is not adjustable.

To change the tread

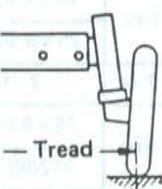
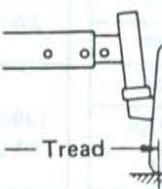
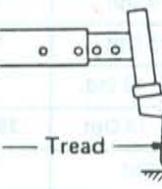
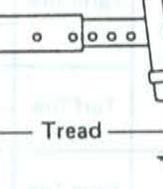
- Lift the front of the tractor with a jack.
- Remove the front axle mounting screws and the tie rod mounting screws.
- Move the front axles (right and left) to the desired position, and tighten them with the screws.

■ IMPORTANT

- After tread adjustment, adjust toe-in.
Toe-in: All models 2 to 8 mm (0.08 to 0.31 in.)

4.00-15 Farm	5.00-15 Farm	23 x 8.50-12 Turf	25 x 8.50-14 Turf
 <p>1010mm (39.8 in.)</p> <p>B122F051</p>	 <p>1025mm (40.4 in.)</p> <p>B122F051</p>	 <p>1110mm (43.7 in.)</p> <p>B122F052</p>	 <p>1210mm (47.6 in.)</p> <p>B122F052</p>

[L2650, L2950, L3450, L3650]

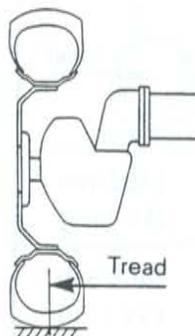
Models				
L2650 L2950 4.00-15 Farm 5.00-15 Farm	960 mm (37.8 in.)	1060 mm (41.7 in.)	1160 mm (45.7 in.)	1260 mm (49.6 in.)
L2650 L2950 23 x 8.50 - 12 Turf	1080 mm (42.5 in.)	1180 mm (46.5 in.)	1280 mm (50.4 in.)	1380 mm (54.3 in.)
L2650 L2950 23 x 8.50 - 14 Turf	1325 mm (52.2 in.)	1425 mm (56.1 in.)	1525 mm (60.0 in.)	1625 mm (64.0 in.)
L3450 5.00 - 15 Farm	1150 mm (45.3 in.)	1250 mm (49.2 in.)	1350 mm (53.1 in.)	1450 mm (57.1 in.)
L3450 L3650 25 x 8.50 - 14 Turf	1325 mm (52.2 in.)	1425 mm (56.1 in.)	1525 mm (60.0 in.)	1625 mm (64.0 in.)
L3650 6.00 - 16 Farm	1150 mm (45.3 in.)	1250 mm (49.2 in.)	1350 mm (53.1 in.)	1450 mm (57.1 in.)

■ IMPORTANT

- The front tread width for the front loader application on 2WD models should not be greater than 1060 mm (41.7 in.) for L2650 and L2950, 1150 mm (45.3 in.) for L3450 and L3650.

[4WD Type]

Front axle is not adjustable



Models	L2350			L2650, L2950	
Tires	6-14 Farm	7-16 Farm	24 x 8.50-14 Turf	7-16 Farm	25 x 8.50-14 Turf
Tread	1010 mm (39.8 in.)	1010 mm (39.8 in.)	1115 mm (43.9 in.)	1120 mm (44.1 in.)	1185 mm (46.7 in.)
Models	L2650, L2950		L3450		L3650
Tires	212/80-D15 Turf	7-16 Farm	8-16 Farm	212/80-D15 Turf	8-16 Farm
Tread	1170 mm (46.1 in.)	1120 mm (44.1 in.)	1170 mm (46.1 in.)	1215 mm (47.8 in.)	1170 mm (46.1 in.)
Models	L3650				
Tires	212/80-D15 Turf				
Tread	1215 mm (47.8 in.)				

0343F027

■ IMPORTANT

- Do not fill the front tires with liquid.

(2)-2 Rear Wheels

Rear tread can be adjusted in 6 steps depending on the model.

To change the tread

1. Lift the rear tires off the ground.
2. Follow the illustrations below to get the desired tread width.

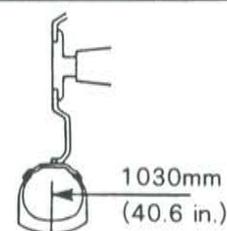
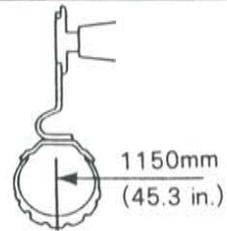
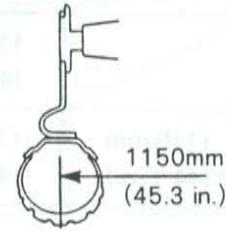
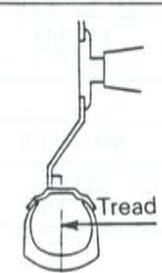
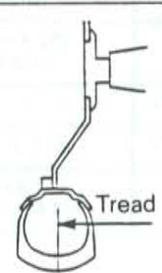
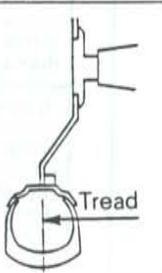
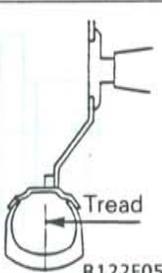
⚠ CAUTION

- When working on slopes or working with trailer, set the wheel tread as wide as practical for the job for maximum stability.

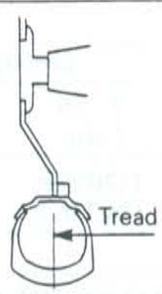
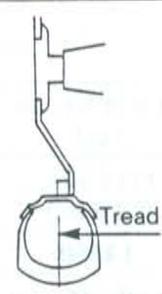
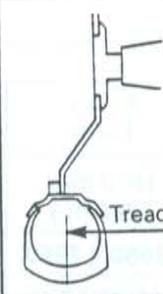
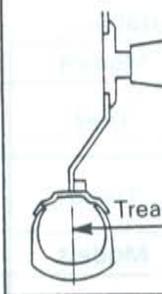
■ IMPORTANT

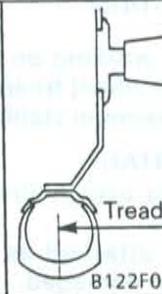
- Always attach tires as shown in the drawings below.
- If not attached as illustrated, transmission parts may be damaged.
- Do not use tires larger than specified.

[L2350]

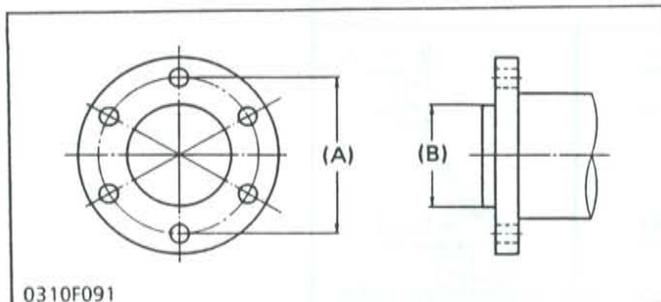
9.5-24 Farm	13.6-16 Turf	355/80-D20 Turf	
 <p>1030mm (40.6 in.)</p> <p>B122F057</p>	 <p>1150mm (45.3 in.)</p> <p>B122F058</p>	 <p>1150mm (45.3 in.)</p> <p>B122F058</p>	
11.2-24 Farm			
 <p>1025 mm (40.3 in.)</p>	 <p>1120 mm (44.0 in.)</p>	 <p>1200 mm (47.2 in.)</p>	 <p>1290 mm (50.8 in.)</p> <p>B122F059</p>

[L2650, L2950, L3450, L3650]

Models						
						B122F060
L2650 11.2 – 24 Farm		1030 mm (40.6 in.)	1125 mm (44.3 in.)	1220 mm (48.0 in.)	1305 mm (51.4 in.)	1400 mm (55.1 in.)
L2950 12.4 – 24 Farm		1030 mm (40.6 in.)	1125 mm (44.3 in.)	1220 mm (48.0 in.)	1305 mm (51.4 in.)	1400 mm (55.1 in.)
L3450 12.4 – 24 Farm	1050 mm (41.3 in.)	1150 mm (45.3 in.)	1240 mm (48.8 in.)	1335 mm (52.6 in.)	1420 mm (55.9 in.)	1515 mm (59.6 in.)
L3450 13.6 – 24 Farm		1155 mm (45.5 in.)	1225 mm (48.2 in.)	1325 mm (52.2 in.)	1350 mm (53.1 in.)	1450 mm (57.1 in.)
L3650 13.6 – 26 Farm		1155 mm (45.5 in.)	1225 mm (48.2 in.)	1325 mm (52.2 in.)	1350 mm (53.1 in.)	1450 mm (57.1 in.)

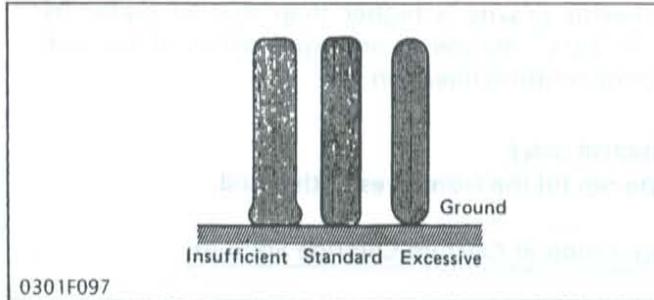
Models		
		B122F061
L2650, L2950 13.6 – 16 Turf		1145 mm (45.1 in.)
L2650, L2950 355/80 – D20 Turf		1150 mm (45.3 in.)
L3450, L3650 355/80 – D20 Turf	1120 mm (44.1 in.)	1265 mm (49.8 in.)

(3) Wheel Hub



	Front wheel hub	Rear wheel hub
Screw circle diameter (A)	152.4 mm (6 in.)	170 mm (6.7 in.)
Number of screws	6	6
Screw sizes	M14 × 1.5	M16 × 1.5
Hub pilot diameter (B)	117.4 mm (4.625 in.)	135 mm (5.315 in.)

(4) Tire Pressure



⚠ CAUTION

- Do not attempt to mount a tire. This should be done by a qualified person with the proper equipment. Qualified persons with the proper tire mounting equipment should recognize the following warning.

⚠ WARNING

- Never exceed 241 kPa (2.5 kgf/cm², 35 psi) when attempting to seat a bead. If beads have not been seated by the time the pressure reaches 241 kPa (2.5 kgf/cm², 35 psi), deflate the assembly, reposition the tire on the rim, relubricate and reinflate. After seating the bead, adjust inflation pressure as recommended in the inflation pressure chart.

Though the tire pressure is factory-set to the prescribed level, it naturally drops slowly in the course of time. Thus, check it everyday and inflate as necessary. To inflate the wheel tires, use an air compressor or hand pump.

- Recommended inflation pressure**
Maintain the pressure shown below.

	Tire sizes	Inflation Pressure
Rear	9.5 – 24, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	11.2 – 24, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	12.4 – 24, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	13.6 – 24, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	13.6 – 26, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	13.6 – 16, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
	355/80 – D20, 4PR	100 kPa (1.0 kgf/cm ² , 14 psi)
Front	4.00 – 15, 4PR	220 kPa (2.2 kgf/cm ² , 32 psi)
	5.00 – 15, 4PR	220 kPa (2.2 kgf/cm ² , 32 psi)
	5.50 – 16, 4PR	220 kPa (2.2 kgf/cm ² , 32 psi)
	6.00 – 16, 6PR	325 kPa (3.25 kgf/cm ² , 46 psi)
	6 – 14, 4PR	200 kPa (2.0 kgf/cm ² , 28 psi)
	7 – 16, 4PR	180 kPa (1.8 kgf/cm ² , 26 psi)
	8 – 16, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)
	23 × 8.50 – 12, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)
	24 × 8.50 – 14, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)
	25 × 8.50 – 14, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)
	27 × 8.50 – 15, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)
212/80 – D15, 4PR	160 kPa (1.6 kgf/cm ² , 23 psi)	

(5) Tire Liquid Injection

Auxiliary weights can be used to increase traction force for plowing in fields or clayey grounds.

Another way is to inject water or another liquid, such as a calcium chloride solution in the tires. Water must not be used in winter since it freezes at 0°C (32°F). The calcium chloride solution will not freeze and moreover, affords higher effect than water since

its specific gravity is higher than that of water by about 20%. Below is an explanation of calcium chloride solution injection.

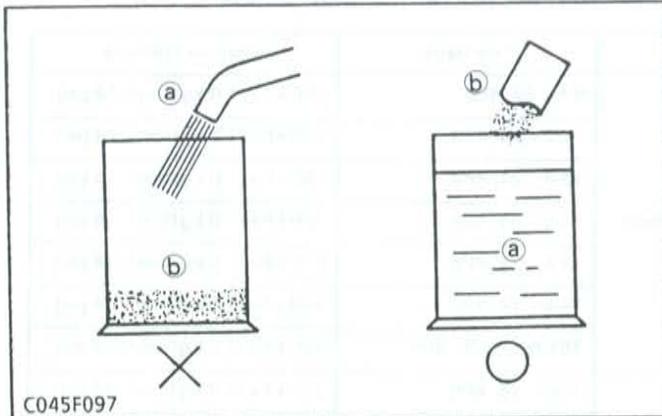
■ IMPORTANT

- Do not fill the front tires with liquid.

Preparation of Calcium Chloride Solution

⚠ CAUTION

- When making a calcium chloride solution, do not pour water over calcium chloride since this results in chemical reaction which will cause high temperature. Instead add a small amount of calcium chloride to the water at a time until the desired solution is achieved.



C045F097

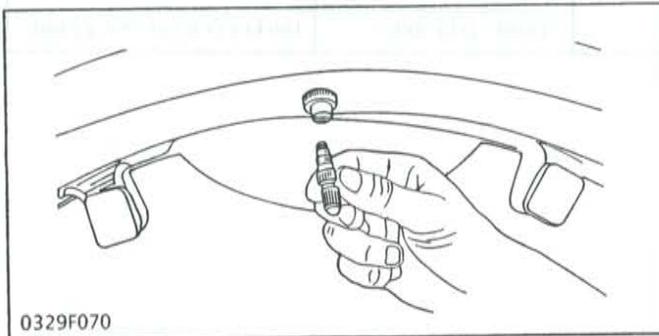
(a) Water

(b) CaCl₂ (Calcium Chloride)

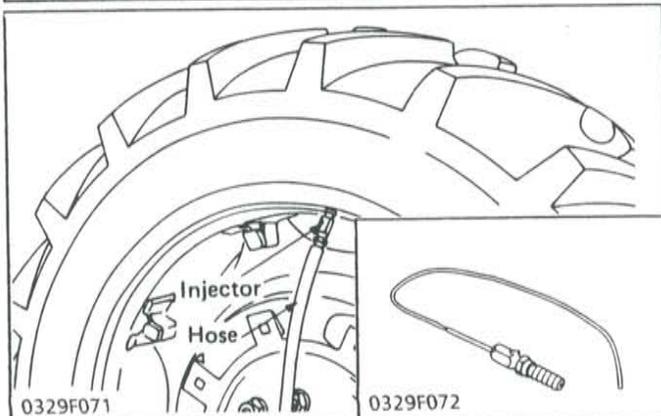
Freezing temp	Weight of CaCl ₂ to be dissolved in 100ℓ (26.5 US gals. 22.0 Imp. gals.) of water
-5°C (23°F)	12 kg (26.4 lbs)
-10°C (14°F)	21 kg (46.3 lbs)
-15°C (5°F)	28 kg (61.7 lbs)
-20°C (- 4°F)	34 kg (75.0 lbs)
-25°C (-13°F)	40 kg (88.2 lbs)
-30°C (-22°F)	44 kg (97.0 lbs)
-35°C (-31°F)	49 kg (108.0 lbs)
-40°C (-40°F)	52 kg (114.6 lbs)
-45°C (-49°F)	56 kg (123.5 lbs)
-50°C (-58°F)	61 kg (134.5 lbs)

Attaching the Injector

1. Lift the rear tires off the ground.
2. Turn the tire so that the air valve is at the top.
3. Remove the air valve, and attach the injector.
(Code No: 07916-52281)

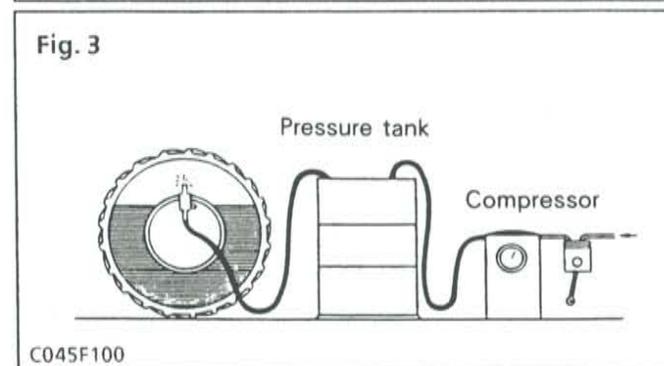
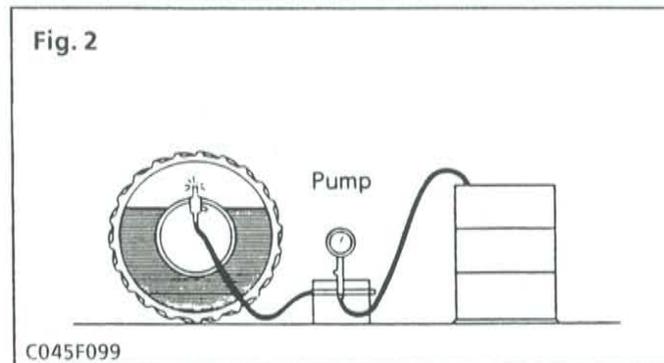
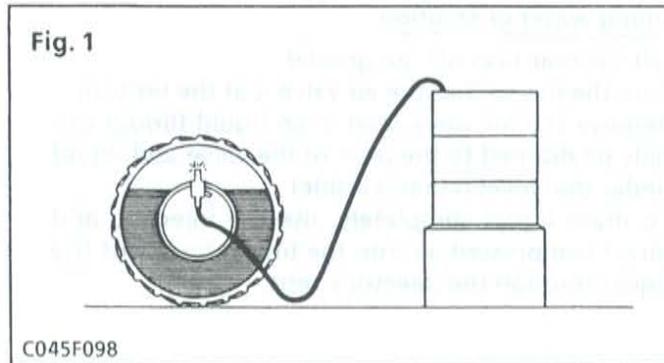


0329F070



0329F071

0329F072



Injection

CAUTION

- When a calcium chloride solution is used, cool it before pouring it into the tire.

The following four ways can be used to inject water or a calcium chloride solution into tires.

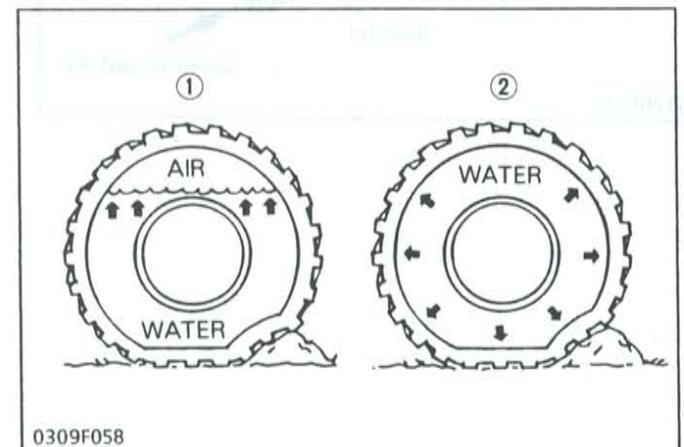
1. Gravity injection (Fig. 1)
2. Pump injection (Fig. 2)
3. Pressure tank injection (Fig. 3)
4. Injection directly from tap (only when water is being used).

NOTE

- Once injection is completed, reset the air valve, and pump air into the tire to the specified pressure.

CAUTION

- Do not fill tires with water or solution more than 75% of full capacity (to the valve stem level)

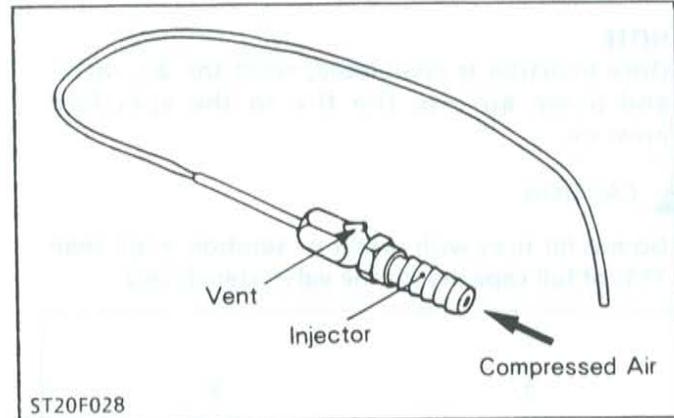
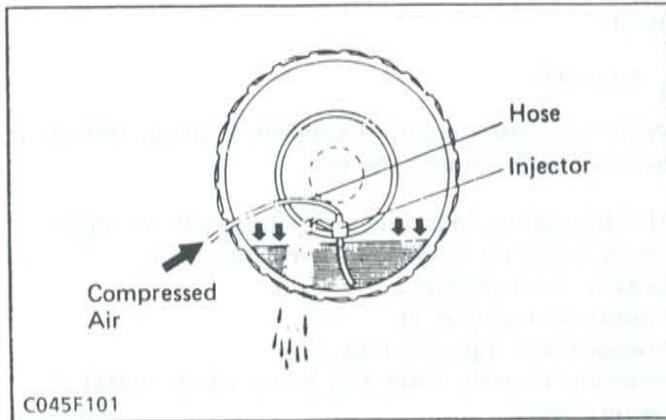


(1) Correct - 75% Air compresses like a cushion

(2) Incorrect - 100% Full Water can not be compressed

Weight of Calcium Chloride Solution Filling 75% of Full Capacity of a Tire.

Tire sizes	9.5-24	11.2-24	12.4-24	13.6-24	13.6-26
Slush free at -10°C (13°F) Solid at -30°C (-23°F) [Approx. 1 kg (2 lbs.) CaCl ₂ per 4 l (1 gal) of water]	75 kg (165 lbs)	103 kg (227 lbs)	117 kg (258 lbs)	153 kg (337 lbs)	172 kg (379 lbs)
Slush free at -24°C (-12°F) Solid at -47°C (-52°F) [Approx. 1.5 kg (3.5 lbs.) CaCl ₂ per 4 l (1 gal) of water]	81 kg (178 lbs)	108 kg (237 lbs)	125 kg (276 lbs)	160 kg (352 lbs)	181 kg (399 lbs)
Slush free at -47°C (-52°F) Solid at -52°C (-62°F) [Approx. 2.25 kg (5 lbs.) CaCl ₂ per 4 l (1 gal) of water]	85 kg (187 lbs)	115 kg (253 lbs)	133 kg (293 lbs)	170 kg (375 lbs)	192 kg (423 lbs)



Draining water or solution

1. Lift the rear tires off the ground.
2. Turn the tire so that the air valve is at the bottom.
3. Remove the air valve, and drain liquid (liquid can only be drained to the level of the valve and liquid under that level remains inside).
4. To drain liquid completely, use the injector, and direct compressed air into the tire to force out the liquid through the injector's vent.

[2] SPECIFICATIONS OF IMPLEMENT LIMITATIONS

The KUBOTA Tractor has been through tested for proper performance with implements sold or approved by KUBOTA. Use with implements which exceed maximum specifications listed below, or otherwise unfit for use with the KUBOTA Tractor

may result in malfunctions or failures of the tractor, damage to other property and injury to the operator or others. (Any malfunctions or failures of the tractor resulting from use with improper implements are not covered by the warranty.)

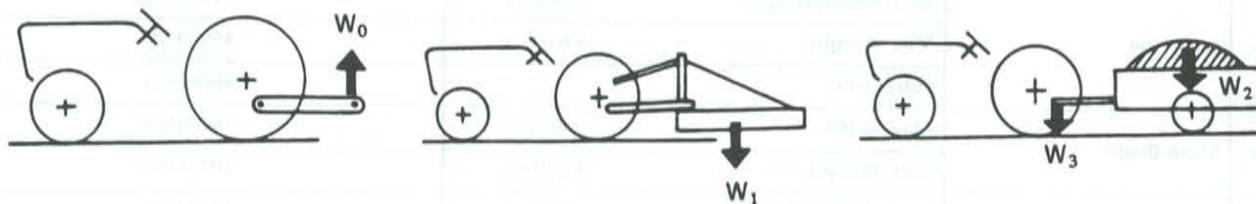
	Tread (max. width) with farm tires			Lift capacity lower link end W_0
	Front		Rear	
	2WD	4WD		
L2350	1010 mm (40 in.)	1010 mm (40 in.)	1030 mm (41 in.)	850 kg (1875 lbs.)
L2650	1260 mm (50 in.)	1120 mm (44 in.)	1400 mm (55 in.)	1200 kg (2645 lbs.)
L2950	1260 mm (50 in.)	1120 mm (44 in.)	1400 mm (55 in.)	1200 kg (2645 lbs.)
L3450	1450 mm (57 in.)	1120 mm (44 in.)	1515 mm (60 in.)	1200 kg (2645 lbs.)
L3650	1450 mm (57 in.)	1170 mm (46 in.)	1450 mm (57 in.)	1200 kg (2645 lbs.)

	Actual figures			
	Trailer loading weight W_2 Max. capacity		Max. Drawbar Load W_3 2WD, 4WD	Lift capacity 24 inch behind lower link end W_1
	2WD	4WD		
L2350	1000 kg (2200 lbs.)	1000 kg (2200 lbs.)	330 kg (730 lbs.)	650 kg (1435 lbs.)
L2650	1500 kg (3300 lbs.)	1500 kg (3300 lbs.)	500 kg (1100 lbs.)	900 kg (1985 lbs.)
L2950	1500 kg (3300 lbs.)	1500 kg (3300 lbs.)	500 kg (1100 lbs.)	900 kg (1985 lbs.)
L3450	2000 kg (4400 lbs.)	2000 kg (4400 lbs.)	650 kg (1430 lbs.)	930 kg (2050 lbs.)
L3650	2500 kg (5500 lbs.)	2500 kg (5500 lbs.)	650 kg (1430 lbs.)	930 kg (2050 lbs.)

Lower link end Max.lift capacity W_0

Implement weight The implement's weight which can be put on the links: W_1

Trailer loading weight The max. loading weight for trailer (without trailer's weight): W_2



No.	Implement		Remarks	L2350	
1	Trailer		Max. Load Capacity kg (lbs.)	1000 (2200)	
			Max. Drawbar Load kg (lbs.)	330 (730)	
2	Mid Mount		Max. Cutting Width mm (in.)	1829 (72)	
			Max. Weight kg (lbs.)	200 (440)	
		Rear Mount		Max. Cutting Width mm (in.)	1829 (72)
				Max. Weight kg (lbs.)	350 (770)
	Flail Mower		Max. Cutting Width mm (in.)	1270 (50)	
			Max. Weight kg (lbs.)	350 (770)	
	Sickle Bar		Max. Cutting Width mm (in.)	1829 (72)	
			Max. Weight kg (lbs.)	400 (880)	
3	Sprayer	Max. Tank capacity ℓ (gals.)	Rear mounted	300 (80)	
			Pull type	800 (210)	
4	Rotary Tiller		Max. Tilling Width mm (in.)	1370 (54)	
5	Bottom Plow		Max. Size	12 in. x 2, 16 in. x 1	
6	Disc-harrow (Pull type)		Max. Harrowing Width mm (in.)	1524 (60)	
			Max. Weight kg (lbs.)	300 (660)	
7	Chisel Plow		Max. Cutting Width mm (in.)	1829 (72)	
			Max. Weight kg (lbs.)	350 (770)	
8	Broad Caster		Max. Tank Capacity ℓ (gals.)	200 (53)	
			Max. Weight kg (lbs.)	100 (220)	
9	Manure Spreader		Max. Capacity kg (lbs.)	1000 (2200)	
10	Cultivator		Max. Width mm (in.)	1524 (60)	
			Number of Rows	1	
			Max. Weight kg (lbs.)	250 (550)	
11	Front Blade		Max. Cutting Width mm (in.)	1829 (72)	
			Max. Oil Pressure kgf/cm ² (psi.)	155 (2205)	
			Sub Frame	Necessary	
12	Rear Blade		Max. Cutting Width mm (in.)	1829 (72)	
			Max. Oil Pressure kgf/cm ² (psi.)	155 (2205)	
13	Front-end Loader		Max. Lifting Capacity kg (lbs.)	400 (880)	
			Max. Oil Pressure (Extra Hydro Kit)kgf/cm ² (psi.)	155 (2205)	
			Sub Frame	Necessary	
14	Box Blade		Max. Cutting Width mm (in.)	1321 (52)	
			Max. Weight kg (lbs.)	295 (650)	
15	Back Hoe		Max. Digging Depth mm (in.)	2288 (90)	
			Max. Weight kg (lbs.)	450 (990)	
			Sub Frame	Necessary	
16	Snow Blade		Max. Width mm (in.)	1524 (60)	
			Max. Weight kg (lbs.)	300 (660)	
17	Snow Blower		Max. Working Width mm (in.)	1524 (60)	
			Max. Weight kg (lbs.)	250 (550)	

No.	Implement		Remarks		L2650	L2950	L3450	L3650
1	Trailer		Max. Load Capacity	kg (lbs.)	1500 (3300)		2000 (4400)	2500 (5500)
			Max. Drawbar Load	kg (lbs.)	500 (1100)		650 (1430)	
2	Mower	Mid Mount	Max. Cutting Width	mm (in.)	1829 (72)			—
			Max. Weight	kg (lbs.)	200 (440)			—
		Rear Mount	Max. Cutting Width	mm (in.)	1829 (72)			—
			Max. Weight	kg (lbs.)	350 (770)		400 (880)	
	Flail Mower	Max. Cutting Width	mm (in.)	1524 (60)			—	
		Max. Weight	kg (lbs.)	400 (880)			—	
	Sickle Bar	Max. Cutting Width	mm (in.)	2133 (84)			—	
		Max. Weight	kg (lbs.)	500 (1100)			—	
3	Sprayer		Max. Tank capacity ℓ (gals.)	Rear mounted	300 (80)		400 (106)	
				Pull type	800 (210)		1000 (264)	1200 (317)
4	Rotary Tiller		Max. Tilling Width	mm (in.)	1520 (60)			
5	Bottom Plow		Max. Size		12 in. × 2, 16 in. × 1		14 in. × 2	
6	Disc-harrow (Pull type)		Max. Harrowing Width	mm (in.)	1829 (72)			
			Max. Weight	kg (lbs.)	350 (770)		400 (880)	
7	Chisel Plow		Max. Cutting Width	mm (in.)	1829 (72)			
			Max. Weight	kg (lbs.)	350 (770)			
8	Broad Caster		Max. Tank Capacity	ℓ (gals.)	200 (53)		250 (66)	300 (80)
			Max. Weight	kg (lbs.)	100 (220)			
9	Manure Spreader		Max. Capacity	kg (lbs.)	1500 (3300)		2000 (4400)	
10	Cultivator		Max. Width	mm (in.)	1829 (72)		2134 (84)	
			Number of Rows		1		2	
			Max. Weight	kg (lbs.)	300 (660)		350 (770)	400 (880)
11	Front Blade		Max. Cutting Width	mm (in.)	1829 (72)			
			Max. Oil Pressure	kgf/cm ² (psi.)	175 (2490)			
			Sub Frame		Necessary			
12	Rear Blade		Max. Cutting Width	mm (in.)	1829 (72)			
			Max. Oil Pressure	kgf/cm ² (psi.)	175 (2490)			
13	Front -end Loader		Max. Lifting Capacity	kg (lbs.)	450 (990)		650 (1430)	
			Max. Oil Pressure (Extra Hydro Kit)	kgf/cm ² (psi.)	175 (2490)			
			Sub Frame		Necessary			
14	Box Blade		Max. Cutting Width	mm (in.)	1321 (52)		1651 (65)	1670 (66)
			Max. Weight	kg (lbs.)	295 (650)		330 (730)	350 (770)
15	Back Hoe		Max. Digging Depth	mm (in.)	2288 (90)			
			Max. Weight	kg (lbs.)	450 (990)			
			Sub Frame		Necessary			
16	Snow Blade		Max. Width	mm (in.)	1524 (60)			1830 (72)
			Max. Weight	kg (lbs.)	300 (660)			350 (770)
17	Snow Blower		Max. Working Width	mm (in.)	1524 (60)		1676 (66)	
			Max. Weight	kg (lbs.)	250 (550)		280 (620)	

S SERVICING

- S.G** GENERAL
- S.S** SEPARATION
- S.1** ENGINE
- S.2** CLUTCH
- S.3** TRANSMISSION
- S.4** REAR AXLE
- S.5** BRAKES
- S.6** FRONT AXLE
- S.7** STEERING
- S.8** HYDRAULIC SYSTEM
- S.9** ELECTRICAL SYSTEM

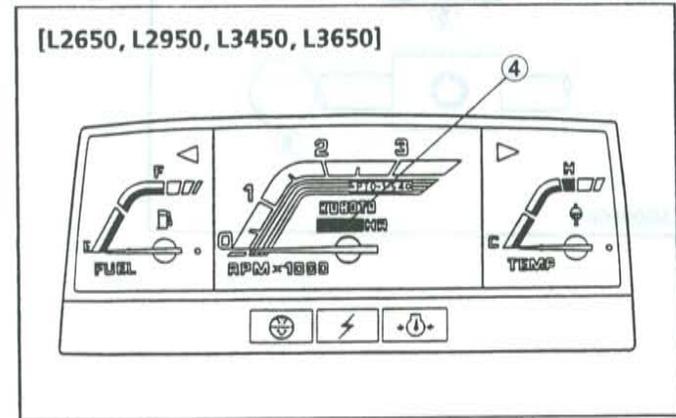
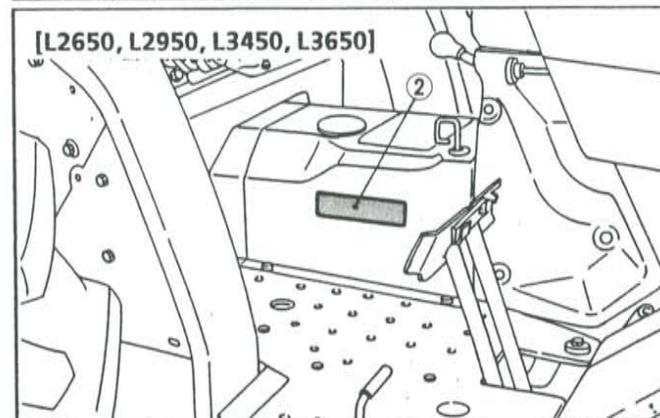
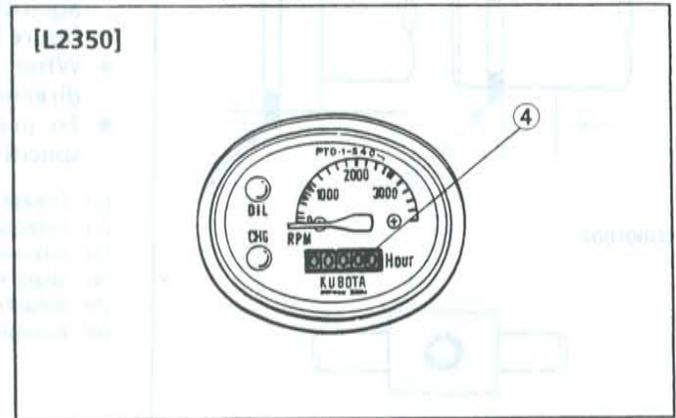
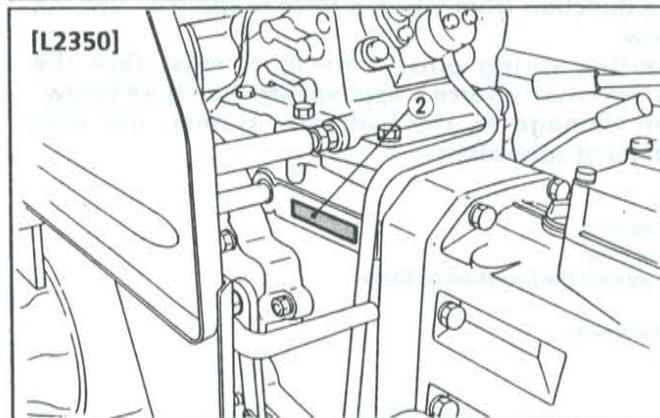
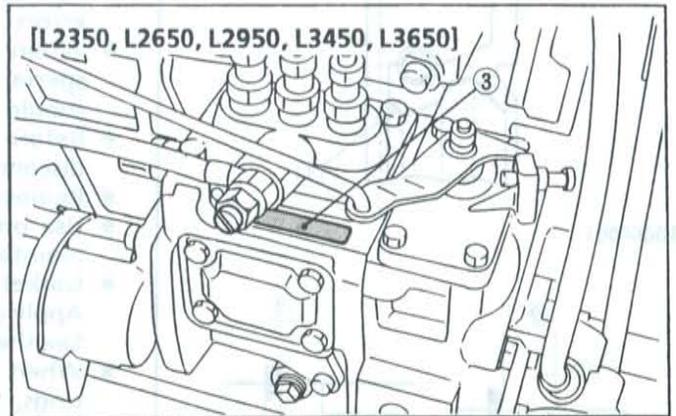
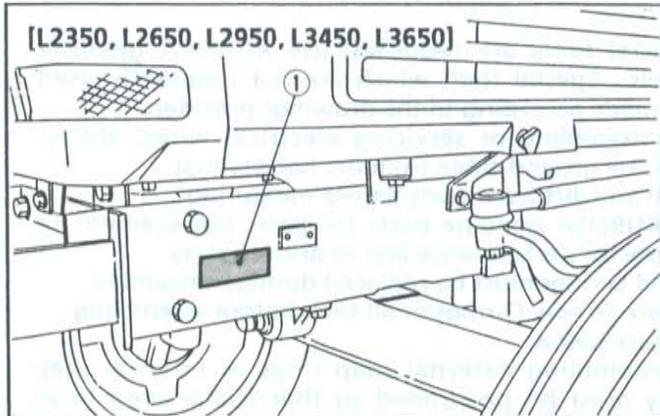
S.G GENERAL

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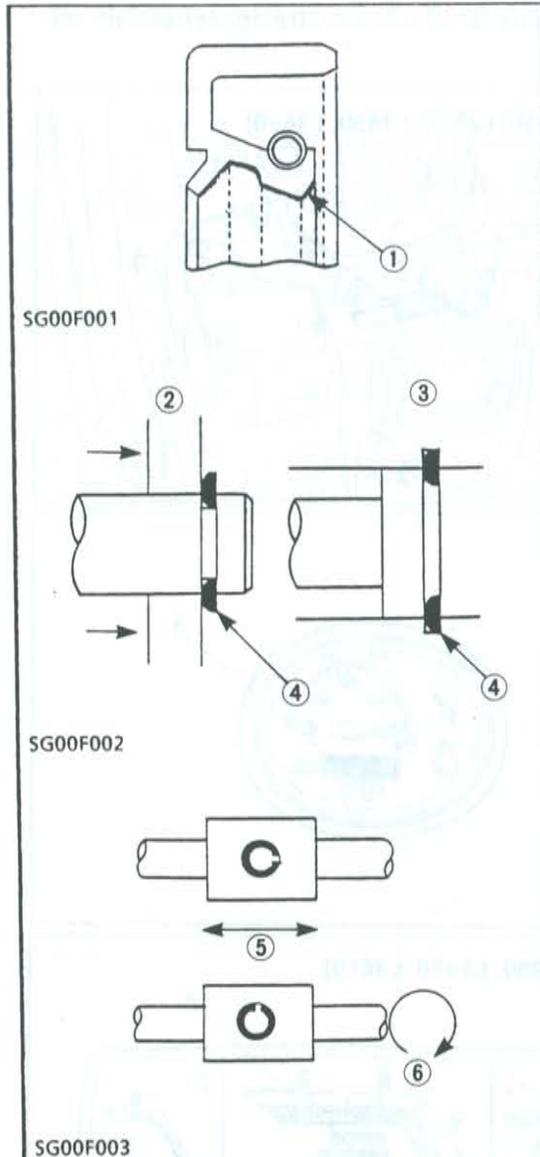
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[1] TRACTOR IDENTIFICATION

When contacting your local KUBOTA distributor, always specify engine serial number, tractor serial number and hourmeter reading.



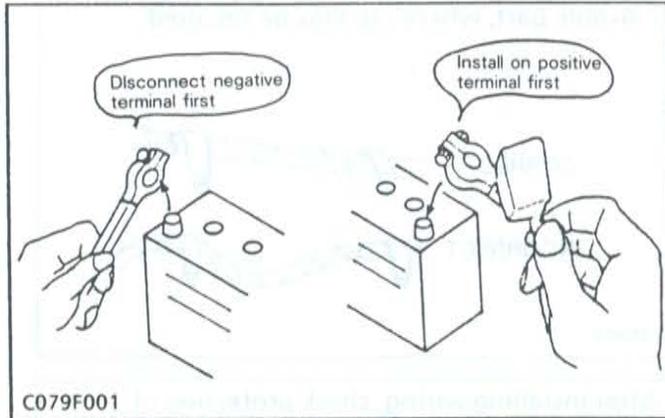
- (1) Identification plate
- (2) Tractor serial number
- (3) Engine serial number
- (4) Hour meter

[2] GENERAL PRECAUTIONS

- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Bolts and nuts should be installed in their original position to prevent reassembly errors.
- When special tools are required, use KUBOTA genuine special tools. Special tools which are not frequently used should be made according to the drawings provided.
- Before disassembling or servicing electrical wires, always disconnect the ground cable from the battery first.
- Remove oil and dirt from parts before measuring.
- Use only KUBOTA genuine parts for parts replacement to maintain tractor performance and to assure safety.
- Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling. See the figure below.
- When reassembling external snap rings or internal snap rings, they must be positioned so that sharp edge faces against the direction from which a force is applied. See the figure below.
- When inserting spring pins, their splits must face the direction from which a force is applied. See the figure below.
- To prevent damage to the hydraulic system, use only specified fluid or equivalent.

- (1) Grease
- (2) External Snap Ring
- (3) Internal Snap Ring
- (4) Sharp Edge against the Direction of Force
- (5) Axial Force
- (6) Rotating Movement

[3] HANDLING PRECAUTIONS FOR ELECTRICAL PARTS AND WIRING



C079F001

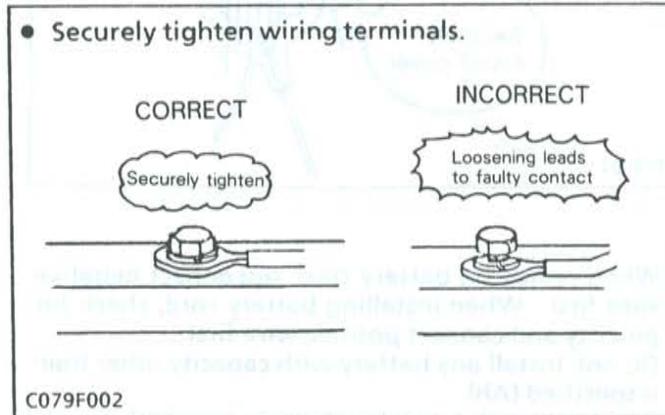
To ensure safety and prevent damage to the machine and surrounding equipment, heed the following precautions in handling electrical parts and wiring.

■ **IMPORTANT**

- Check electrical wiring for damage and loosened connection every year. To this end, educate the customer to do his or her own check and at the same time recommend the dealer to perform periodic check for a fee.
- Do not attempt to modify or remodel any electrical parts and wiring.
- When removing the battery cord, disconnect the negative wire first. When installing the battery cord, connect the positive wire first.

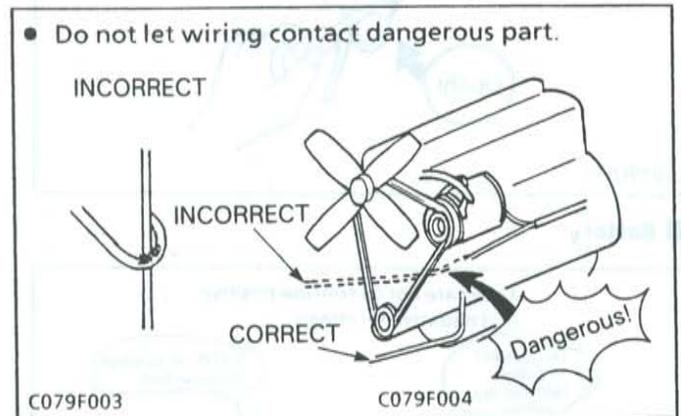
■ **Wiring**

- Securely tighten wiring terminals.



C079F002

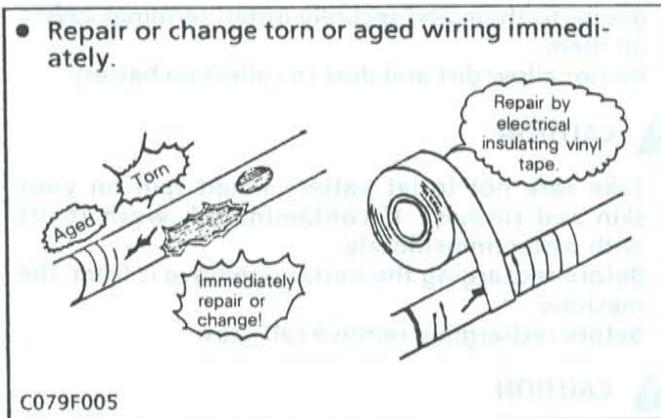
- Do not let wiring contact dangerous part.



C079F003

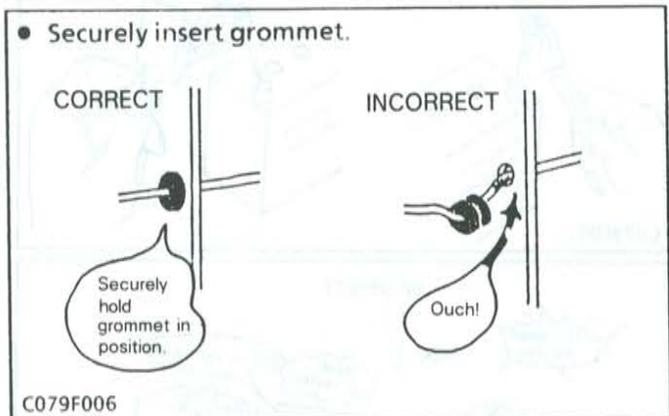
C079F004

- Repair or change torn or aged wiring immediately.



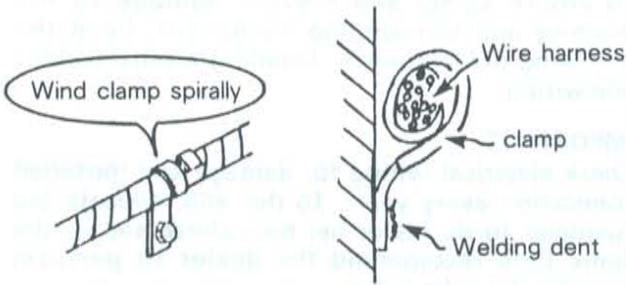
C079F005

- Securely insert grommet.



C079F006

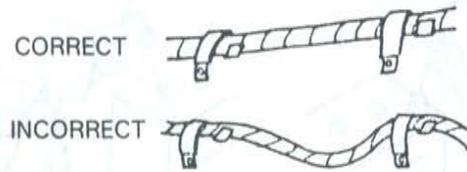
- Securely clamp, being careful not to damage wiring.



C079F007

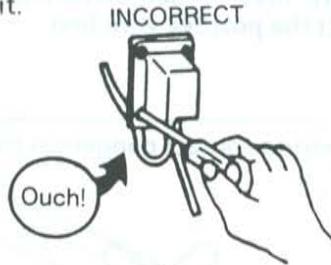
C079F008

- Clamp wiring so that there is no twist, unnecessary sag, or excessive tension, except for movable part, where sag may be required.



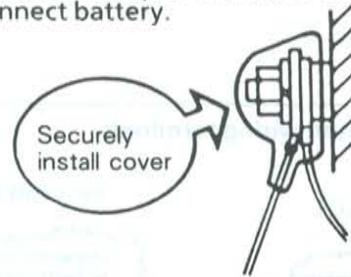
C079F009

- In installing a part, take care not to get wiring caught by it.



C079F010

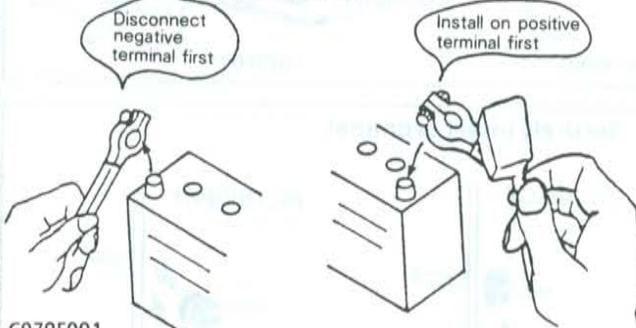
- After installing wiring, check protection of terminals and clamped condition of wiring, only then connect battery.



C079F011

■ Battery

Take care not to confuse positive and negative terminals



C079F001

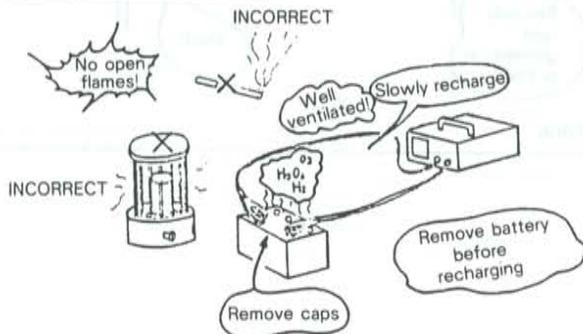
- When removing battery cord, disconnect negative wire first. When installing battery cord, check for polarity and connect positive wire first.
- Do not install any battery with capacity other than is specified (Ah).
- After connecting cord to battery terminals, apply grease to them and securely install terminal covers on them.
- Do not allow dirt and dust to collect on battery.

⚠ CAUTION

- Take care not to let battery liquid spill on your skin and clothes. If contaminated, wash it off with water immediately.
- Before recharging the battery, remove it from the machine.
- Before recharging, remove cell caps.

⚠ CAUTION

- Do recharging in a well-ventilated place where there is no open flame nearby, as hydrogen gas and oxygen are formed.



C079F013

■ Fuse

- Use fuses with specified capacity.
- Never use steel or copper wire in place of fuse.

Use the fuses with specified capacity

Neither too large or small capacity fuse is acceptable!

Do not substitute copper or steel wire!

C079F014

- Do not install working light, radio set, etc. on machine which is not provided with reserve power supply.
- Do not install accessories if fuse capacity of reserve power supply is exceeded.

Use reserve power supply for working light

It is dangerous to remodel as you please

C079F015

■ Connector

- For connector with lock, push lock to separate.

Unlock

Push lock to remove

C079F016

- In separating connectors, do not pull wire harnesses.

CORRECT

Hold connector bodies to separate

INCORRECT

Ouch!

Getting torn off

C079F017

- Use sandpaper to remove rust from terminals.
- Repair deformed terminal. Make certain there is no terminal being exposed or displaced.

Use sandpaper remove rust from terminals.

No bending!

No displaced or exposed terminal

C079F018

C079F019

- Make certain that there is no female connector being too open.

CORRECT

INCORRECT

C079F020

CORRECT

INCORRECT

C079F021

- Make certain plastic cover is large enough to cover whole connector.

CORRECT

INCORRECT

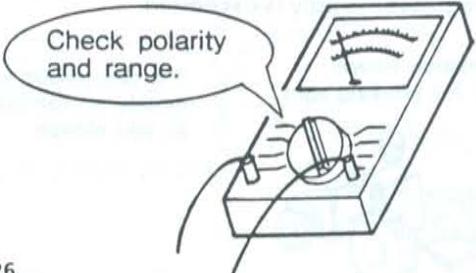
No coming off
No tear off

Plastic cover large enough to cover entire connector

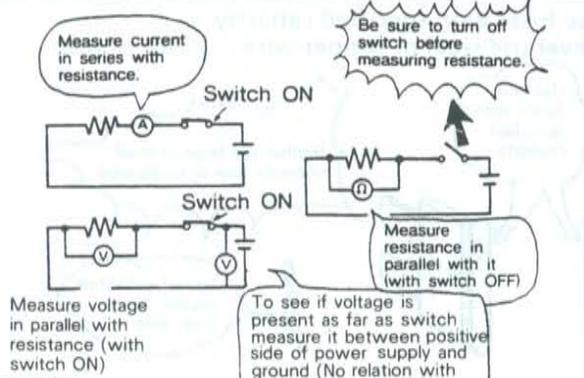
C079F028

■ Handling of circuit testers

- Use tester correctly following manual provided with tester.
- Check for polarity and range.



C079F026



Measure current in series with resistance.

Be sure to turn off switch before measuring resistance.

Measure resistance in parallel with it (with switch OFF)

Measure voltage in parallel with resistance (with switch ON)

To see if voltage is present as far as switch measure it between positive side of power supply and ground (No relation with switch ON or OFF)

C079F027

■ Handling of parts

- Do not throw or drop electrical parts and wire harnesses.



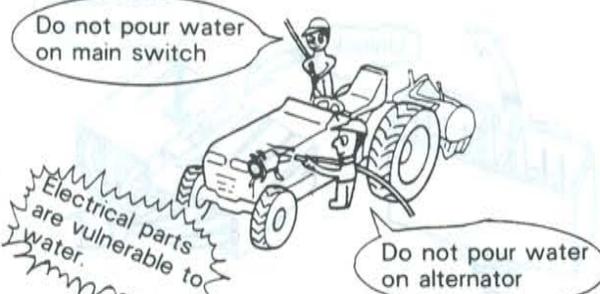
Do not drop.

Do not toss away

C079F023

■ Turnbuckle

- Do not pour water on electrical parts such as main switch and alternator.



Do not pour water on main switch

Do not pour water on alternator

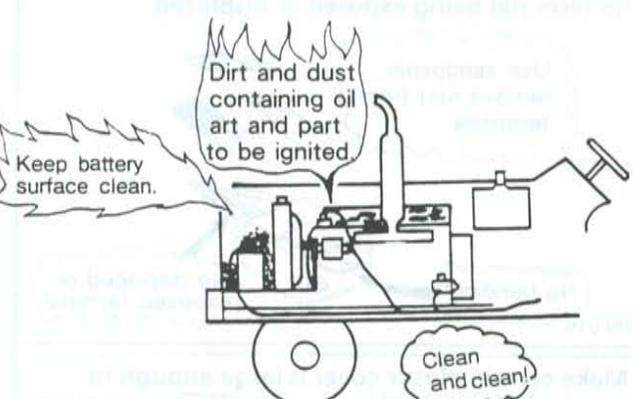
Electrical parts are vulnerable to water.

C079F025

■ Oil, dust and dirt

- If flammable material such as fuel, or lubricant spills, wipe it off with dry piece of cloth. Do not approach it with an open flame.
- Replace fuel pipe that is aged.
- Remove dirt and dust accumulated on heated part, wire harness, battery, etc.

C079F024



Keep battery surface clean.

Dirt and dust containing oil and part to be ignited

Clean and clean!

C079F024

[4] LUBRICANTS

Location	Capacity					Lubricant	
	L2350	L2650	L2950	L3450	L3650		
Fuel	29 ℓ 7.7 U.S.gals. 6.4 Imp. gals.					No.2-D diesel fuel No.1-D diesel fuel	
Coolant	6.0 ℓ 6.3 U.S.qts. 5.3 Imp. qts.	4.6 ℓ 4.9 U.S.qts. 4.0 Imp. qts.		5.6 ℓ 5.9 U.S.qts. 4.9 Imp. qts.		Fresh clean water with anti-freeze	
Engine crankcase	6.3 ℓ 6.7 U.S.qts. 5.5 Imp. qts.	5.7 ℓ 6.0 U.S.qts. 5.0 Imp. qts.		8.5 ℓ 8.9 U.S.qts. 7.5 Imp. qts.		<ul style="list-style-type: none"> Engine oil: API Service CC or CD Below 0°C (32°F) SAE 10W or 10W-30 0 to 25°C (32 to 77°F) SAE 20 or 10W-30 Above 25°C (77°F) SAE 30 or 10W-30 	
Transmission case	28 ℓ 7.4 U.S.gals. 6.2 Imp.gals.	[Except GST] [GST]	28.5 ℓ 7.7 U.S.gals 6.3 Imp. gals	27 ℓ 7.1 U.S.gals 5.9 Imp. gals		<ul style="list-style-type: none"> Multi-grade transmission fluid KUBOTA U D T Atlantic Richfield Arco Tractor Fluid Chevron Tractor Hydraulic Fluid Exxon Torque Fluid 56 Penzoil Hydra-Trans and Wet Br. Phillips H. T. Fluid Shell Donax TD, TT, TM Texaco T. D. H. Oil Union Hydraulic / Tractor Fluid Gulf Universal Fluid 425,350 Mobil Mobil Fluid 423,350 	
Steering gear case	—		0.1 ℓ 0.11 U.S.qt. 0.09 Imp. qt.			Gear Oil SAE 80 or SAE 90	
Steering gear box [Manual Steering]			0.21 ℓ 0.22 U.S.qt. 0.18 Imp. qt.				
Front axle case [4WD]	6 ℓ 6.3 U.S.qts. 5.3 Imp. qts.		6.5 ℓ 6.9 U.S.qts. 5.7 Imp. qts.				
Greasing							
Clutch pedal	Until grease overflows					1 point	Multipurpose type grease
Brake pedal						1 point	
Pedal shaft support						1 point	
Lift rod (right)						1 point	
Top link						1 or 2 points	
Top link bracket (with draft control)						2 points	
Knuckle shaft [2WD]						2 points	
Battery terminal	A small amount					2 points	Bearing grease
Front wheel hub [2WD]						2 points	
Shift Guide [GST]						1 point	

[5] TIGHTENING TORQUES (GENERAL USE SCREWS, BOLTS AND NUTS)

Screws, bolts and nuts whose tightening torques are not specified in this Workshop Manual should be tightened according to the table below.

Grade	*  No-grade or 4T SS41, S20C			*  7T S43C, S45C (Quenched and Tempered)			*  9T SCr435, SCM435 (Quenched and Tempered)				
	Nominal Diameter	Unit	N-m	kgf-m	ft-lbs	N-m	kgf-m	ft-lbs	N-m	kgf-m	ft-lbs
M 6 (6 mm, 0.24 in.)			7.84 to 9.31	0.80 to 0.95	5.79 to 6.87	9.80 to 11.2	1.00 to 1.15	7.24 to 8.32	12.3 to 14.2	1.25 to 1.45	9.05 to 10.5
M 8 (8 mm, 0.31 in.)			17.7 to 20.5	1.8 to 2.1	13.0 to 15.2	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
M10 (10 mm, 0.39 in.)			39.2 to 45.0	4.0 to 4.6	29.0 to 33.2	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	60.8 to 70.5	6.2 to 7.2	44.9 to 52.1
M12 (12 mm, 0.47 in.)			62.8 to 72.5	6.4 to 7.4	46.3 to 53.5	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5	103 to 117	10.5 to 12.0	76.0 to 86.8
M14 (14 mm, 0.55 in.)			108 to 125	11.0 to 12.8	79.6 to 92.5	124 to 147	12.6 to 15.0	91.2 to 108	167 to 196	17.0 to 20.0	123 to 144
M16 (16mm, 0.63 in.)			167 to 191	17.0 to 19.5	123 to 141	196 to 225	20.0 to 23.0	145 to 166	260 to 303	26.5 to 31.0	192 to 224
M18 (18 mm, 0.71 in.)			245 to 284	25.0 to 29.0	181 to 210	275 to 318	28.0 to 32.5	203 to 235	343 to 401	35.0 to 41.0	254 to 297
M20 (20mm, 0.79 in.)			334 to 392	34.0 to 40.0	246 to 289	368 to 431	37.5 to 44.0	272 to 318	490 to 568	50.0 to 58.0	362 to 420

* The figures on the table above are indicated on the top of screw or bolt.

[6] MAINTENANCE CHECK LIST**L2350**

No.	Check point	Indication on hour meter (Change or check every interval shown below)																After purchase		Reference page
		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	1 year	2 years	
1	Greasing	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○			S.G-17,18	
2	Clutch pedal play check		○		○		○		○		○		○		○				S.G-20	
3	Brake pedal play check		○		○		○		○		○		○		○				S.G-19	
4	Air cleaner element cleaning		○		○		○		○		○		○		○				S.G-21	
5	Engine oil change	○			○				○				○					○	S.G-13	
6	Hydraulic oil filter cleaning	○			○				○				○					○	S.G-16	
7	Battery electrolyte level check				○				○				○					○	S.G-21	
8	Radiator hose check				○				○				○					○	S.G-22	
9	Fan belt tension check				○				○				○					○	S.G-23	
10	Toe-in check				○				○				○					○	S.G-22	
11	Fuel line check				○				○				○					○	S.G-23	
12	Front wheel hub bearing greasing [2WD only]						○						○						S.G-24	
13	Engine oil filter cartridge replacement	○							○									○	S.G-14	
14	Transmission fluid change	○							○									○	S.G-14	
15	Front axle case oil change [4WD only]	○							○									○	S.G-17	
16	Front axle back-and-forth play check								○									○	S.G-24	
17	Fuel filter cartridge replacement								○									○	S.G-25	
17	Steering gear box oil check [Manual steering only]								○									○	S.G-26	
19	Radiator cleaning																	○	S.G-26	
20	Valve clearance check																	○	S.G-27	
21	Fuel injection nozzle injection pressure check																	○	S.G-28	
22	Air cleaner element replacement																	○*	S.G-28	
23	Fuel line replacement																		○**	S.G-29
24	Radiator hose replacement																		○**	S.G-30

Note: The jobs indicated by ○ must be done at 50 hours respectively.

* Every year or every 6 times of cleaning.

** Replace only if necessary.

L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)

No.	Check point	Indication on hour meter (Change or check every interval shown below)																After purchase		Reference page	
		25	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	1 year		2 years
1	Greasing		o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o			S.G-18
2	Fuel filter element cleaning			o		o		o		o		o		o		o		o			S.G-19
3	Clutch pedal play check			o		o		o		o		o		o		o		o			S.G-20
4	Brake pedal play check			o		o		o		o		o		o		o		o			S.G-19
5	Air cleaner element cleaning			o		o		o		o		o		o		o		o			S.G-20
6	Hydraulic oil paper filter cartridge replacement [GST only]	o				o				o				o				o			S.G-12
7	Hydraulic oil filter cartridge replacement [GST only]		o			o				o				o				o			S.G-16
8	Hydraulic oil filter cleaning [Except GST]		o			o				o				o				o			S.G-16
9	Engine oil change		o			o				o				o				o			S.G-13
10	Toe-in check					o				o				o				o			S.G-22
11	Battery electrolyte level check					o				o				o				o			S.G-21
12	Radiator hose check					o				o				o				o			S.G-22
13	Fan belt tension check					o				o				o				o			S.G-23
14	Fuel line check					o				o				o				o			S.G-23
15	Power steering rubber hose check					o				o				o				o			S.G-23
16	Front wheel hub bearing greasing [2WD only]							o						o							S.G-24
17	Magnetic plug cleaning [GST only]		o							o								o			S.G-16
18	Transmission fluid change		o							o								o			S.G-14, 15
19	Front axle case oil change [4WD only]		o							o								o			S.G-17
20	Engine oil filter cartridge replacement		o							o								o			S.G-14
21	Front axle back-and-forth play check									o								o			S.G-24
22	Fuel filter element replacement									o								o			S.G-25

No.	Check point	Indication on hour meter (Change or check every interval shown below)																After purchase		Reference page	
		25	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	1 year		2 years
23	Steering gear case oil check								○									○			S.G-25
24	Steering gear box oil check [Manual steering only]								○									○			S.G-26
25	Radiator cleaning																	○			S.G-26,27
26	Valve clearance check																	○			S.G-27
27	Fuel injection nozzle injection pressure check																	○			S.G-28
28	Air cleaner element replacement																	○	*		S.G-28
29	Power steering rubber hose replacement																		○	**	S.G-29
30	Fuel lines replacement																		○	**	S.G-29
31	Radiator hoses replacement																		○	**	S.G-30

Note: The jobs indicated by ○ must be done at initial 25 hours or initial 50 hours.

- * Every year or every 6 times of cleaning.
- ** Replace only if necessary.



[7] CHECK AND MAINTENANCE

(1) Daily Check

To prevent trouble from occurring, it is important to know the condition of the tractor. Check the following items before starting.

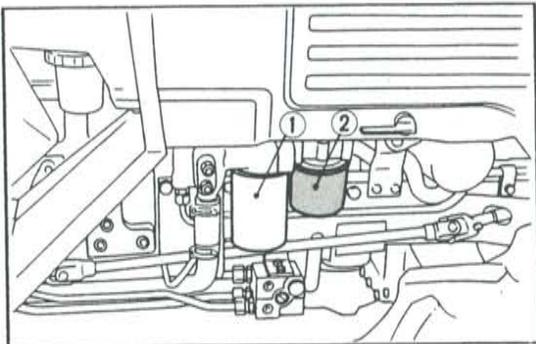
⚠ CAUTION

- Be sure to check and service the tractor on a flat place with engine shut off and the parking brake on.

Checking

- Check areas where previous trouble was experienced.
- Walk around the tractor.
 - 1) Check the tire pressure, and check for wear and damage.
 - 2) Check for oil and water leaks.
 - 3) Check the engine oil level.
 - 4) Check the amount of transmission oil.
 - 5) Check the coolant level.
 - 6) Check for dust in the air cleaner dust cup.
 - 7) Check and clean the radiator screen.
 - 8) Check the bolts and nuts of the tires are tight.
 - 9) Check the SMV emblem for damage and cleaner replace as necessary if equipped.
 - 10) Check the amount of front axle case oil.
 - 11) Clean around the exhaust manifold and the muffler of the engine.
- While sitting in the operator's seat.
 - 1) Check the throttle pedal, brake pedals and clutch pedal.
 - 2) Check the parking brake.
 - 3) Check the steering wheel.
- Turning the key switch.
 - 1) Check the performance of the easy checker lights.
 - 2) Check headlights, tail lights and hazard lights. Clean if necessary.
 - 3) Check the performance of the meters and gauges.
 - 4) Check the horn if equipped.
- Starting the engine.
 - 1) Check to see that the lights on the Easy Checker go off.
 - 2) Check the color of the exhaust.
 - 3) Check the brakes for proper operation.

(2) Check Point of the Initial 25 Hours



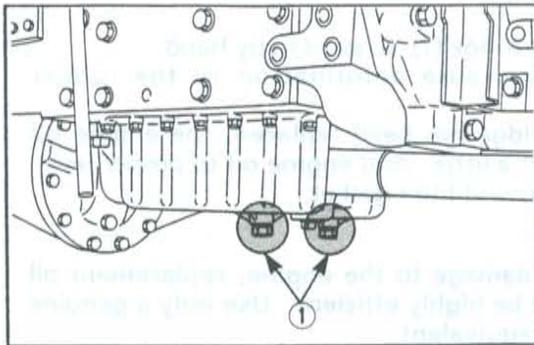
- (1) Hydraulic Oil Filter Cartridge
 (2) Hydraulic Oil Paper Filter Cartridge

Hydraulic Oil Paper Filter Cartridge Replacement (GST only)

1. Detach the oil filter cartridges (2).
2. Apply a slight coat of oil onto the cartridge gasket.
3. Fill up hydraulic oil to the new filter cartridges (2) to install the new cartridge, screw it in by hand. Over tightening may cause deformation of rubber gasket.

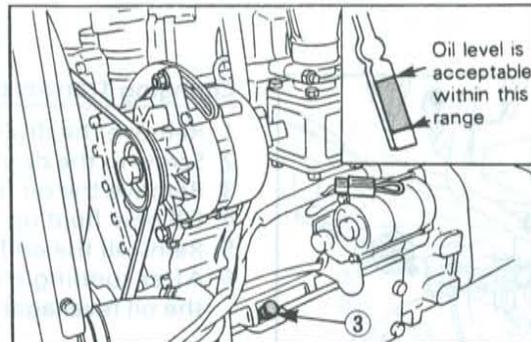
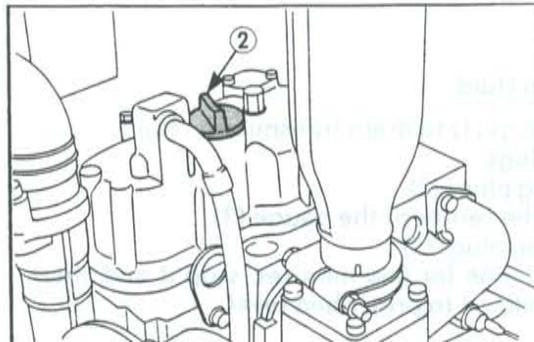
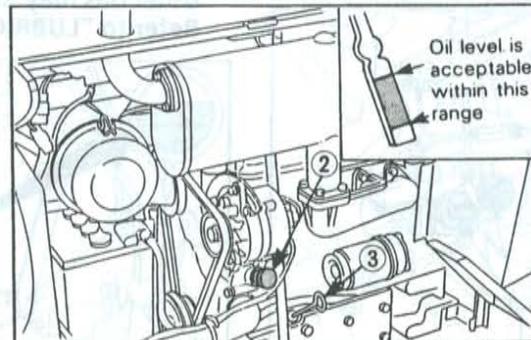
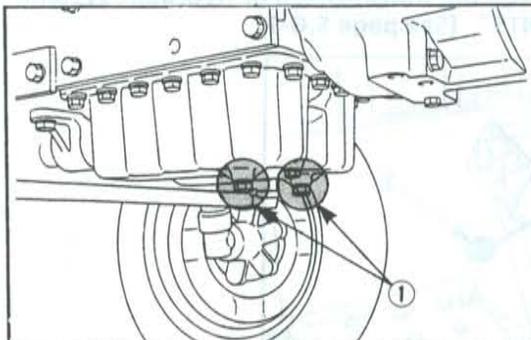
■ IMPORTANT

- To prevent serious damage to hydraulic system. Use only a KUBOTA genuine filter or its equivalent.

(3) Check Points of the Initial 50 Hours**[L2350]****Changing Engine Oil**

1. Start and warm up the engine for approx. 5 minutes.
2. Remove the drain plugs (1) to drain oil.
3. Screw in the drain plugs (1).
4. Fill new oil up to the upper line on the dipstick (3).
Refer to "LUBRICANTS". (See page S.G-7)

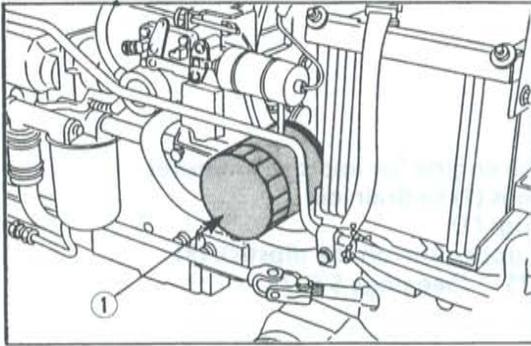
- (1) Drain Plugs
(2) Oil Inlet Plug
(3) Dipstick

**[L2650(GST), L2950(GST), L3450(GST), L3650(GST)]**

(1) Drain Plugs

(2) Oil Inlet Plug

(3) Dipstick



(1) Oil Filter Cartridge

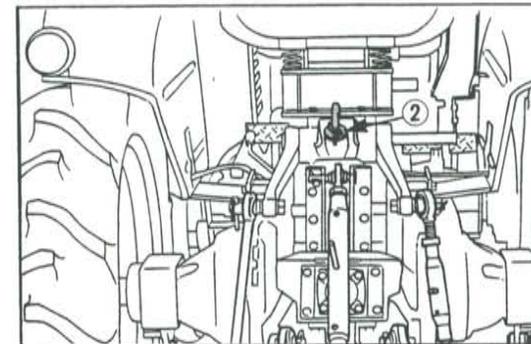
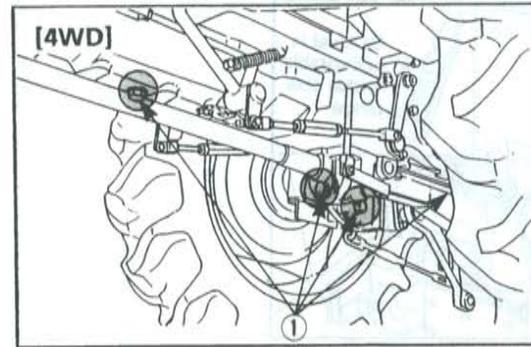
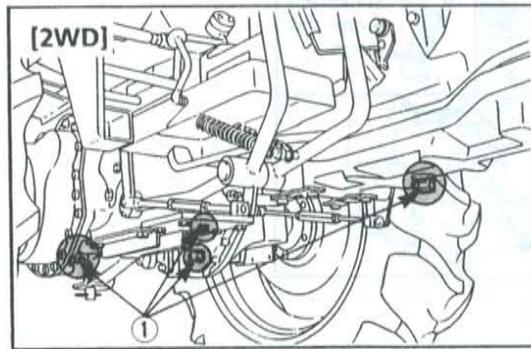
Engine Oil Filter Cartridge Replacement

1. Remove the engine oil filter cartridge (1).
2. When installing, apply the engine oil slightly to the rubber gasket.
3. To install the new cartridge (1), screw it in by hand. Overtightening may cause deformation of the rubber gasket.
4. After the new cartridge has been replaced, the engine oil level normally lowers a little. Add engine oil to proper level. Check for oil leaks around filter gasket.

■ IMPORTANT

- To prevent serious damage to the engine, replacement oil filter cartridge must be highly efficient. Use only a genuine KUBOTA filter or its equivalent.

[L2350]

(1) Drain Plugs
(2) Oil Filling Plug

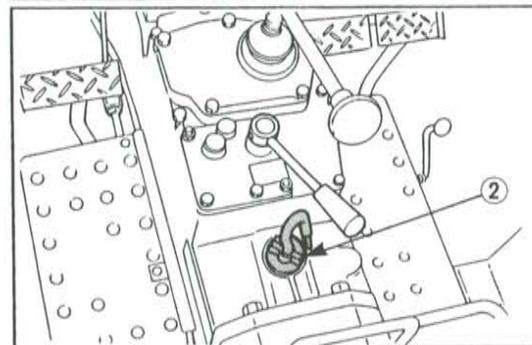
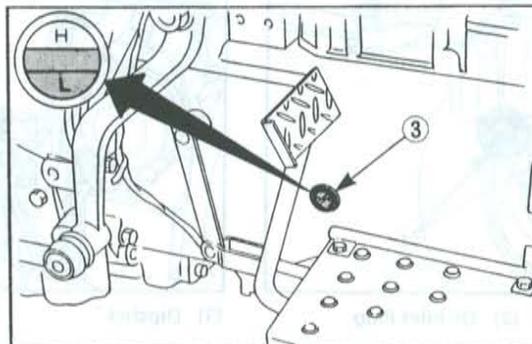
(3) Gauge

Changing Transmission Fluid

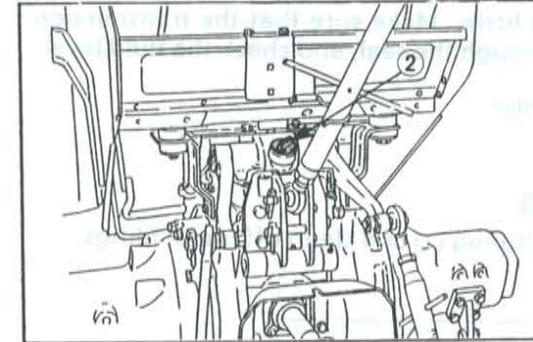
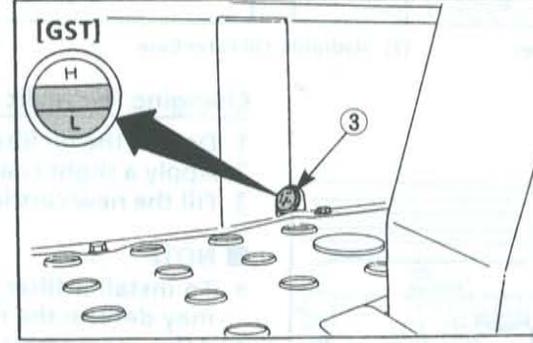
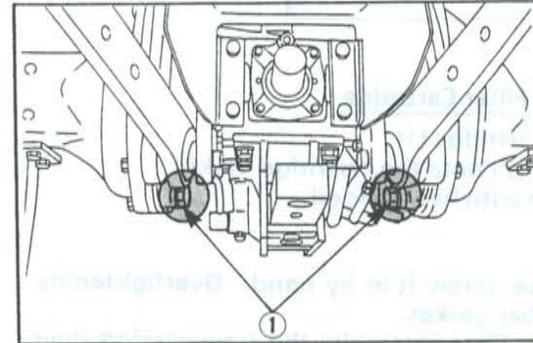
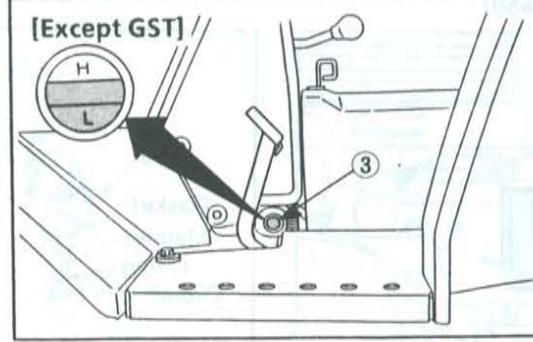
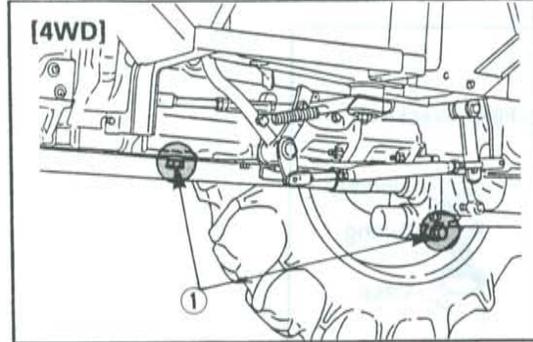
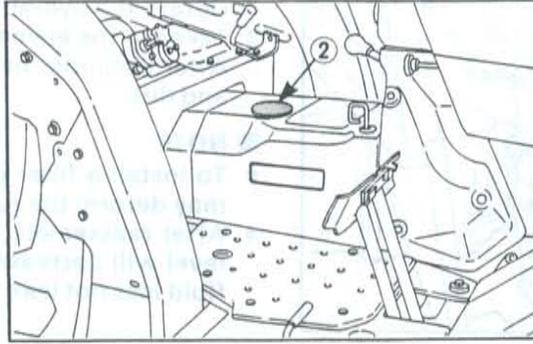
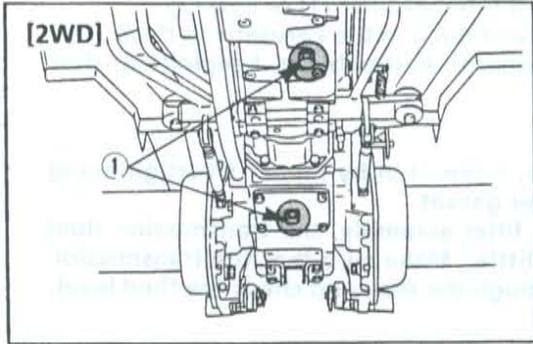
1. Remove the drain plugs (1) to drain transmission fluid.
2. Screw in the drain plugs.
3. Remove the oil filling plugs (2).
4. Fill new fluid up to the center of the gauge (3).
5. Reinstall the oil filling plugs (3).
6. After running the engine for few minutes, stop it and check the oil level again; add oil to prescribed level.

■ IMPORTANT

- Use only transmission fluid KUBOTA recommended. Use of other oils may damage the transmission or hydraulic system. Refer to "LUBRICANTS". (See page S.G-7)

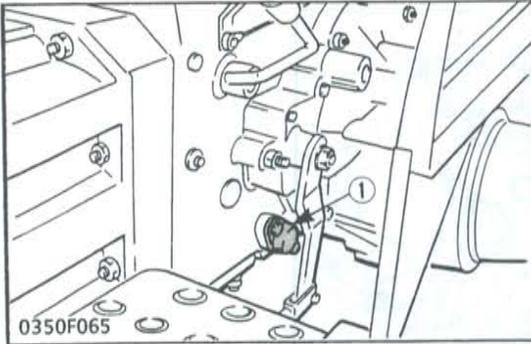


[L2650(GST), L2950(GST), L3450(GST), L3650(GST)]



- (1) Drain Plugs
- (2) Oil Filling Plug
- (3) Gauge

[L2350]



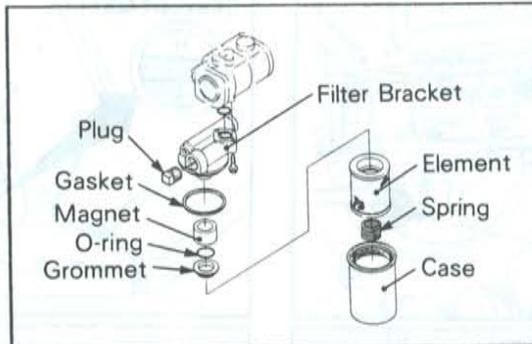
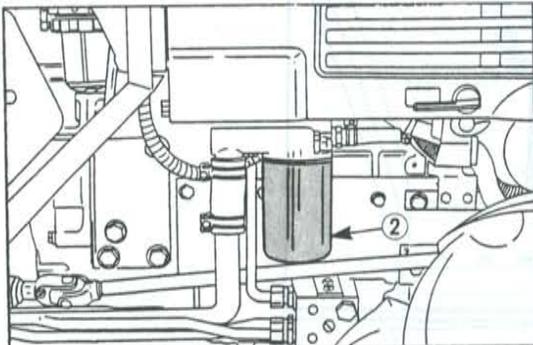
Hydraulic Oil Filter Cleaning

1. Detach the hydraulic oil filter retainer (1) or case (2).
2. Take cut the element, and dip it in the kerosene to rinse.
3. After cleaning the element, reassemble it, keeping out dust and dirt.

■ **NOTE**

- To install a filter case, screw it in by hand. Overtightening may deform the rubber gasket.
- After reassemble the filter assembly, the transmission fluid level will decrease a little. Make sure that the transmission fluid loss not leak through the seal, and check the fluid level.

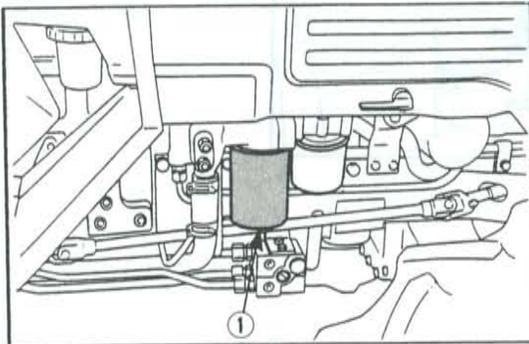
[L2650, L2950, L3450, L3650]



(1) Hydraulic Oil Filter Retainer

(2) Hydraulic Oil Filter Case

[L2650GST, L2950GST, L3450GST, L3650GST]



Changing Hydraulic Oil Filter Cartridge

1. Detach the oil filter cartridge (1).
2. Apply a slight coat of oil onto the cartridge gasket.
3. Fill the new cartridge with hydraulic oil.

■ **NOTE**

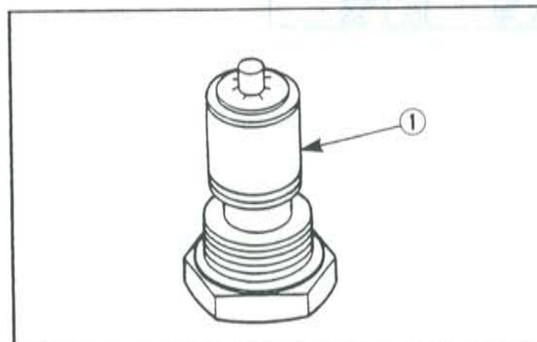
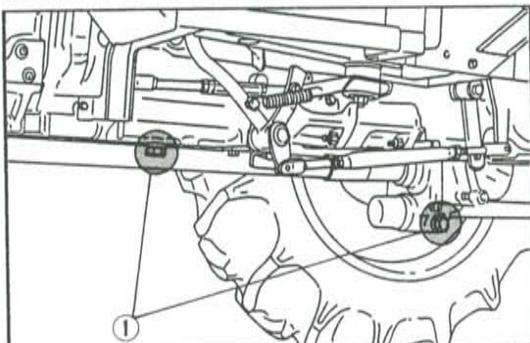
- To install a filter case, screw it in by hand. Overtightening may deform the rubber gasket.
- After reassemble the filter assembly, the transmission fluid level will decrease a little. Make sure that the transmission fluid loss not leak through the seal, and check the fluid level.

(1) Hydraulic Oil Filter Cartridge

Magnetic Plug Cleaning

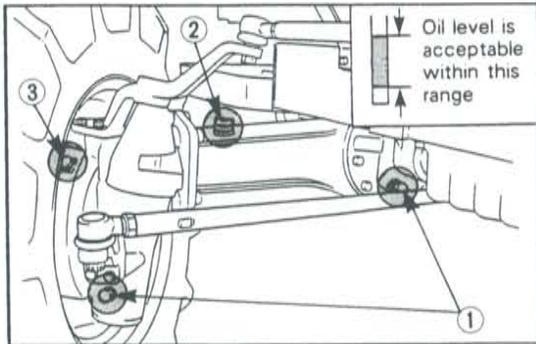
1. Remove the magnetic plug (1) and clean off metal filings.

[L2650GST, L2950GST, L3450GST, L3650GST]



(1) Magnetic Plugs

[L2350]

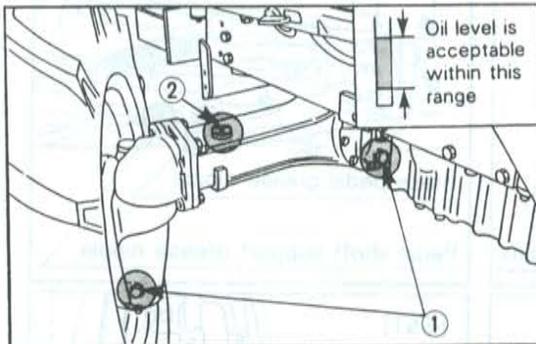


Changing Front Axle Case Oil [4WD TYPE]

1. Remove the drain plugs (1) and filling port plug (2) to drain the oil.
2. Screw in the drain plugs (1).
3. Remove the air vent plugs (3). (L2350 only)
4. Fill new oil up to the specified level. Refer to the "LUBRICANTS" (See page S.G-7).

- (1) Drain Plugs
- (2) Filling Port Plug
- (3) Air Vent Plug

[L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]

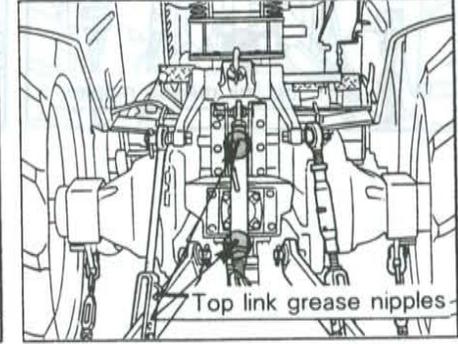
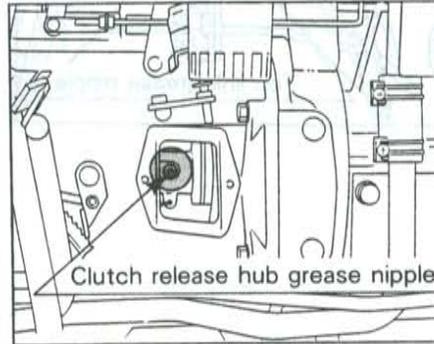
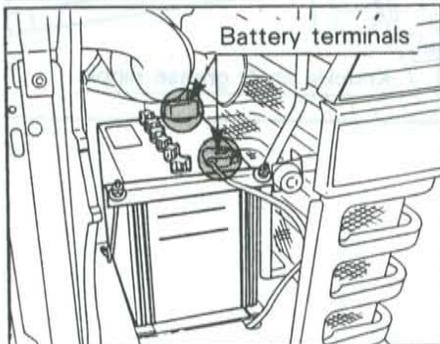
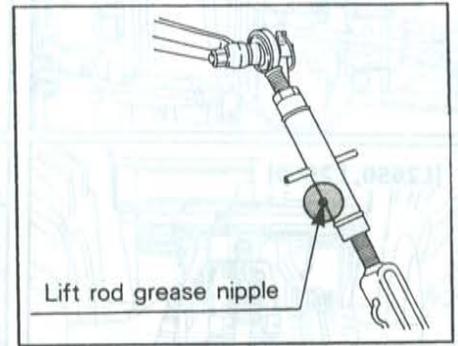
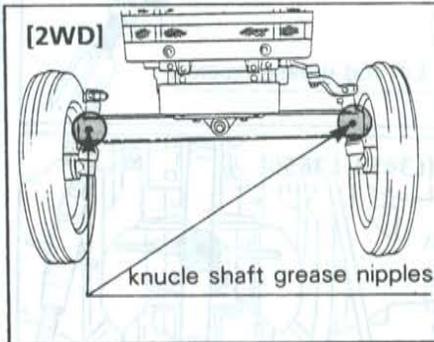
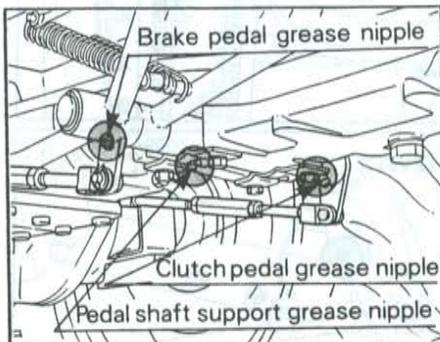


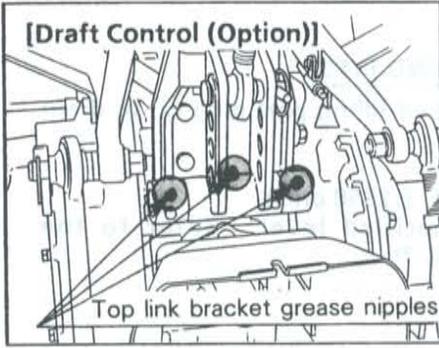
(4) Check Point of Every 50 Hours

Greasing

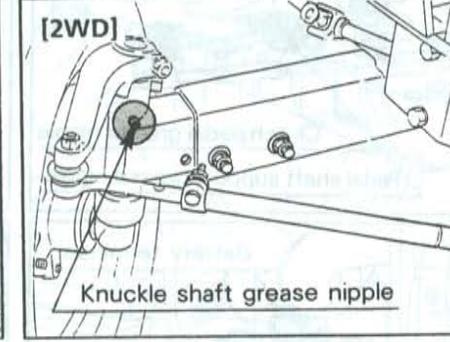
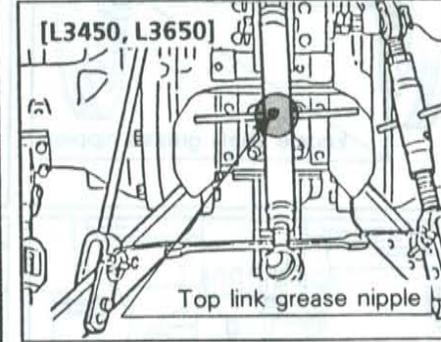
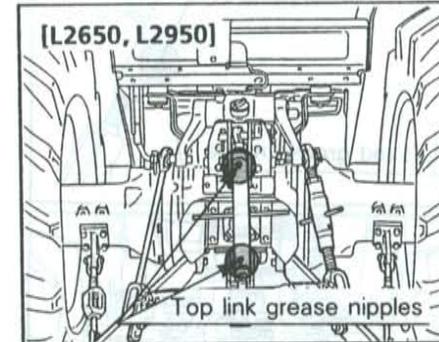
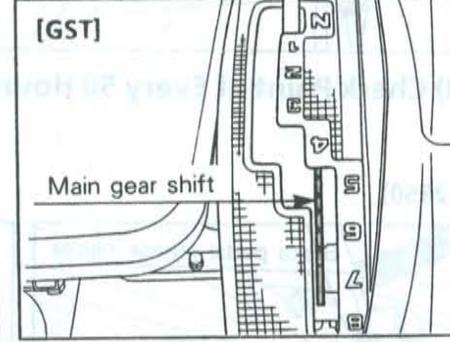
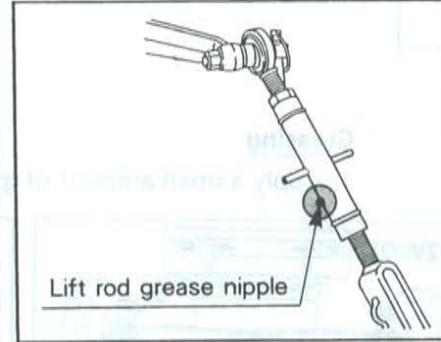
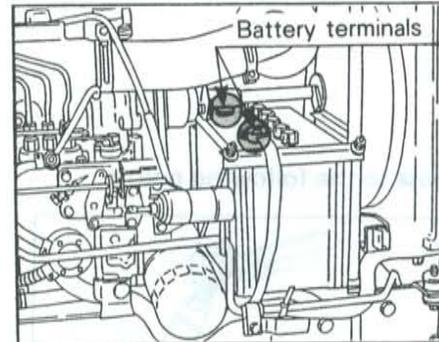
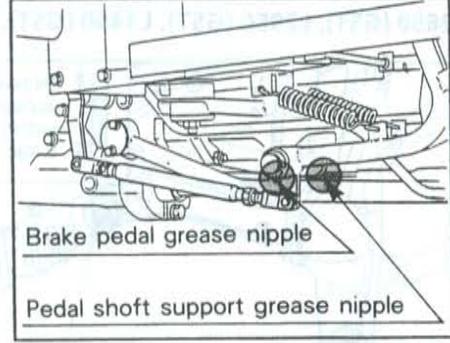
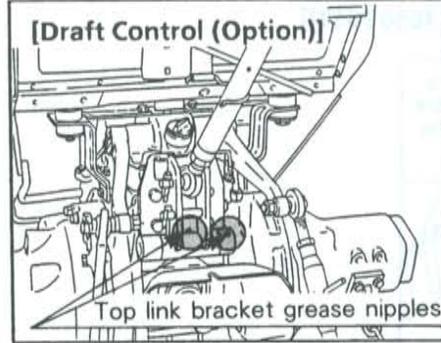
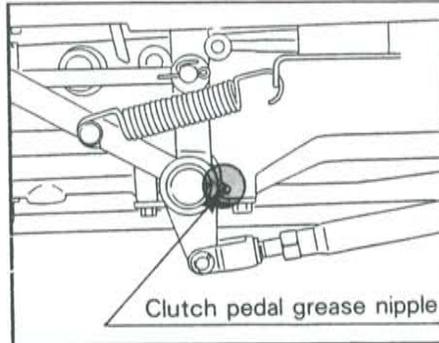
1. Apply a small amount of grease to the following points.

[L2350]



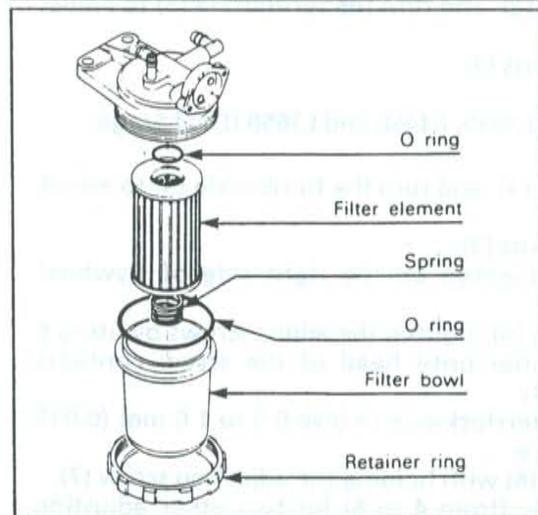
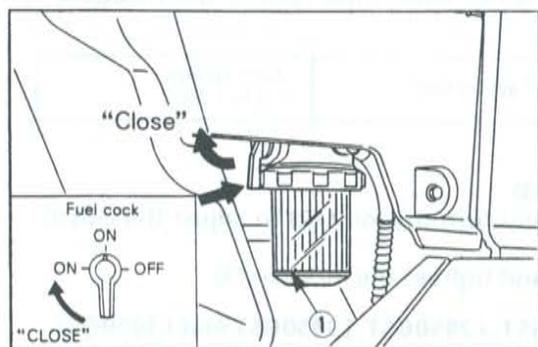


[L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]



(5) Check Points of Every 100 Hours

[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]



Fuel Filter Element and Fuel Filter Bowl Cleaning

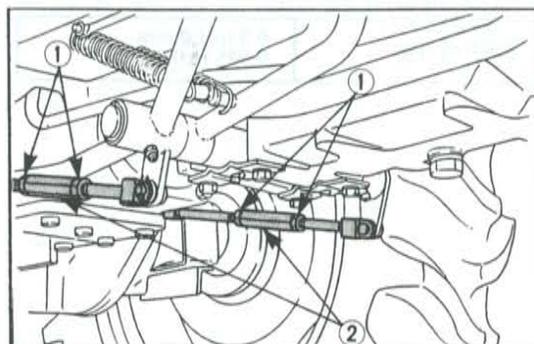
1. Close the fuel filter cock.
2. Unscrew the retainer ring and remove the filter bowl, and rinse the inside with kerosene.
3. Take out the element and dip it in the kerosene to rinse.
4. After cleaning, reassemble the fuel filter, keeping out dust and dirt.
5. Bleed the fuel system. (See page S.G-31)

■ IMPORTANT

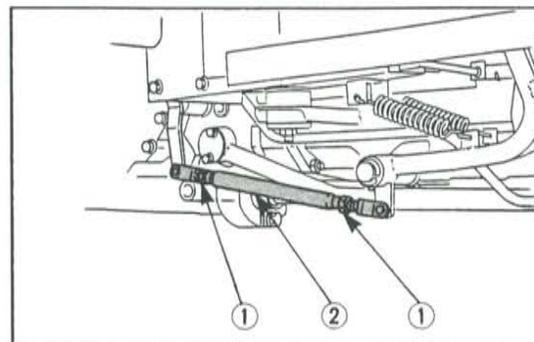
- This job should not be done in the field, but in a clean place.
- If dust and dirt enter the fuel, the fuel pump and injection nozzles are subject to quick wear. To prevent this, be sure to clean the fuel filter bowl periodically.

(1) Fuel Filter

[L2350]



[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]



Checking Brake Pedal Play

1. Depress the each brake pedal by hand, and measure the pedal play.
2. If the measurement is not within the factory specifications, adjust the play by turn buckle (2).

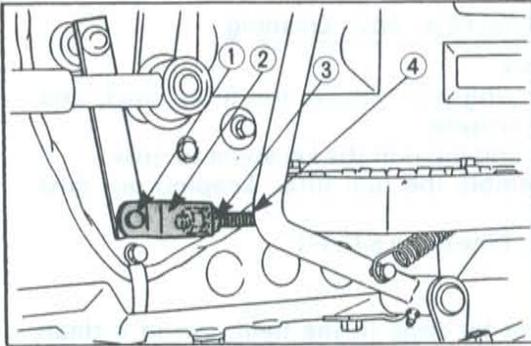
Brake pedal play	Factory spec.	20 to 30 mm 0.8 to 1.2 in.
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■ NOTE

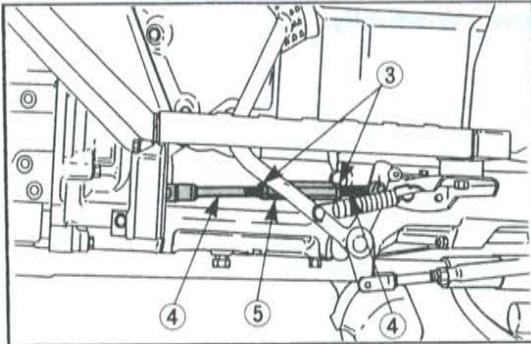
- Keep the pedal play in the right and left brake pedals equal.
- After adjustment, secure the turn buckle (2) with the lock nuts (1).

(1) Lock Nuts
(2) Turnbuckle

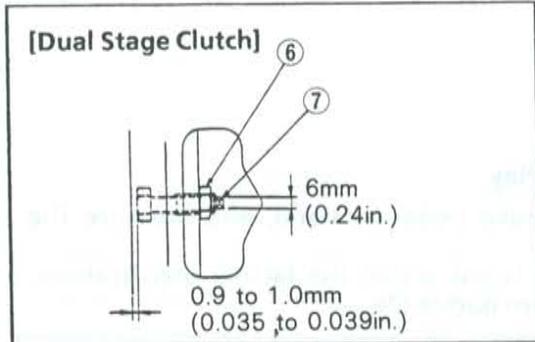
[L2350]



[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]



[L2650, L2950, L3450, L3650]



- (1) Pin
- (2) Joint
- (3) Lock Nuts
- (4) Clutch Rod
- (5) Turnbuckle
- (6) Lock Nut
- (7) Adjusting Screw

Checking Clutch Pedal Play

1. Press the clutch pedal by hand, and measure the movement of the pedal edge.
2. If the measurement is not within the factory specifications, adjust it.

Clutch pedal play	Factory spec.	20 to 30 mm 0.8 to 1.2 in.
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Adjustment For L2350

1. Loosen the lock nut (3).
2. Remove the pin (1) and turn the joint (2) to adjust the clutch rod length.
3. Reinstall the pin (1) and tighten the lock nut (3).

Adjustment For L2650GST, L2950GST, L3450GST and L3650GST

1. Loosen the lock nuts (3), and turn the turnbuckle (5) to adjust the rod length.
2. Retighten the lock nuts (3).

Adjustment For L2650, L2950, L3450 and L3650 (Dual Stage Clutch)

1. Loosen the lock nuts (3), and turn the turnbuckle (5) to adjust the rod length.
2. Retighten the lock nuts (3).
3. Remove the cover located on the right side of flywheel housing case.
4. Loosen the lock nuts (6), tighten the adjust screws by using 6 mm (0.24 in.) spanner until head of the screw contacts pressure plate slightly.
5. Make 3/4 turn counterclockwise to give 0.9 to 1.0 mm (0.035 to 0.039 in.) clearance.
6. Tighten the lock nut (6) with holding the adjusting screw (7).
7. Repeat the sameway (from 4 to 6) for two other adjusting screws (7).
8. Reinstall the cover on the right side of flywheel housing case.

Clearance of the adjusting screw (7)	Factory spec.	0.9 to 1.0 mm 0.035 to 0.039 in.
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Compressed air cleaning method



C047F050

Liquid cleaning method



C047F051

Cleaning Air Cleaner Element

1. To clean the element, use clean dry compressed air on the inside of the element. Air pressure at the nozzle must not exceed 205 kPa (2.1 kgf/cm², 30 psi). Maintain reasonable distance between the nozzle and the element.
2. To wash the element, use KUBOTA Filter of Donaldson ND-1500 Filter Cleaner which is especially effective on oily and soot-laden filters.
3. Follow instructions that are supplied with the filter cleaner.

(6) Check Points of Every 200 Hours

Hydraulic Oil Paper Filter Cartridge Replacement [GST TYPE]

- See page S.G-12

Hydraulic Oil Filter Cartridge Replacement [GST TYPE]

- See page S.G-16

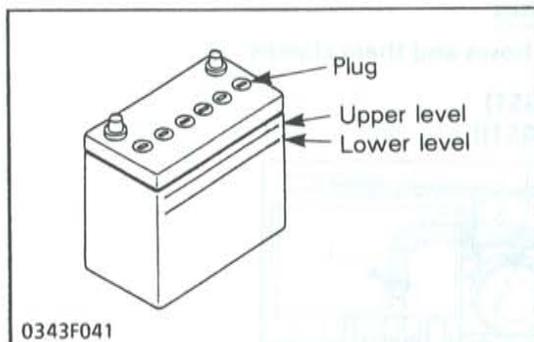
Hydraulic Oil Filter Cleaning [L2350, L2650, L2950, L3450, L3650]

- See page S.G-16

Hydraulic Oil Changing

- See page S.G-13

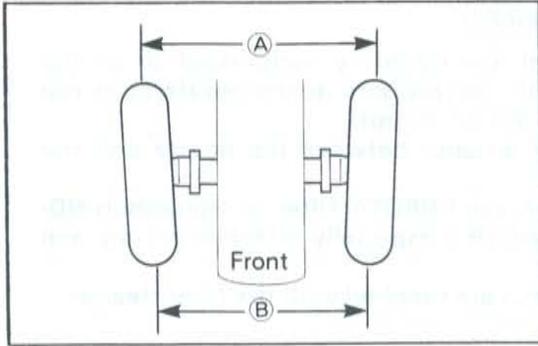
Checking Battery Electrolyte Level



0343F041

⚠ CAUTION

- Never remove the battery cap while the engine is running.
 - Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water.
1. Check that the battery electrolyte level is between the lower and upper levels.
 2. If insufficient, add distilled water.

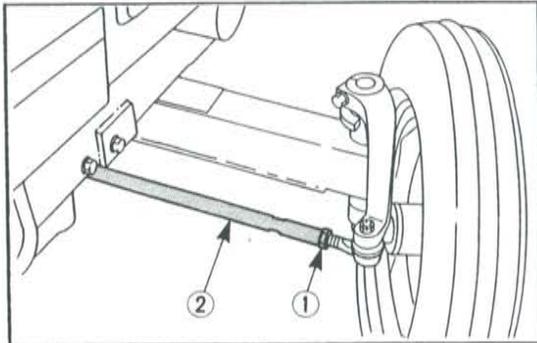


Checking Toe-in

1. Inflate the tires to the specified pressure.
2. Turn the front wheels straight ahead.
3. Measure the distance between the centers of front wheels at front and rear.
4. If the measurement exceeds the factory specification, adjust by changing the tie rod length.

Toe-in (A - B)	Factory spec.	2 to 8 mm 0.1 to 0.3 in.
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[L2350]



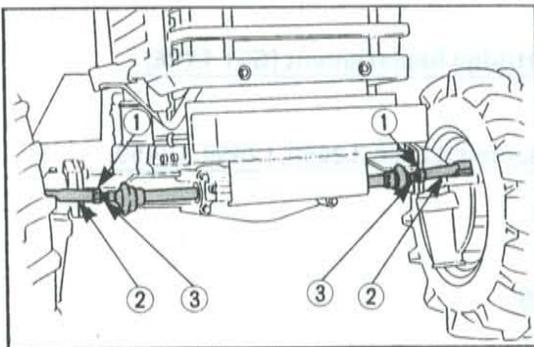
Adjustment

1. Loosen the lock nuts (1).
2. Turn the tie rod (2) or rods (3) to adjust the toe-in.
3. Tighten the lock nuts (1).

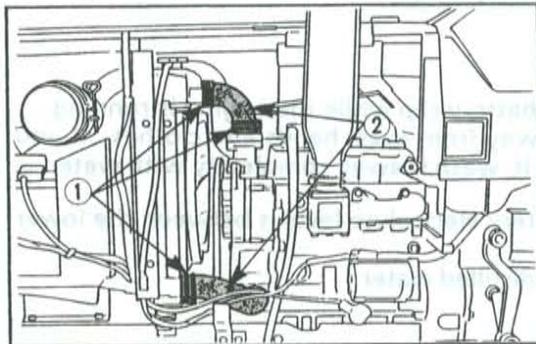
- (A) Heel
(B) Toe

- (1) Lock Nuts
(2) Tie Rod
(3) Rod

[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]



[L2350]



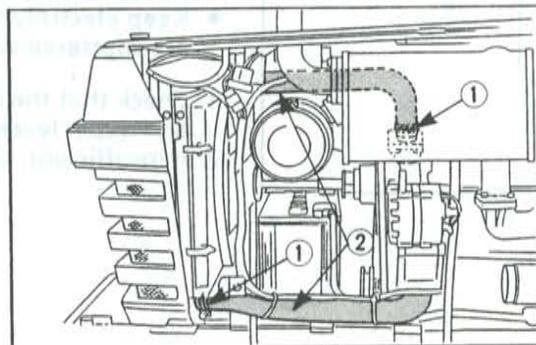
(1) Clamps

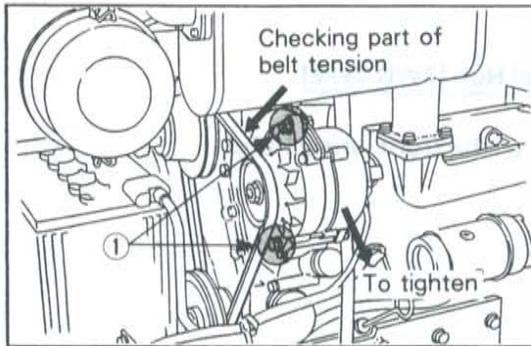
(2) Radiator Hoses

Checking Radiator Hoses

1. Check the radiator hoses and them clamps.

[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]





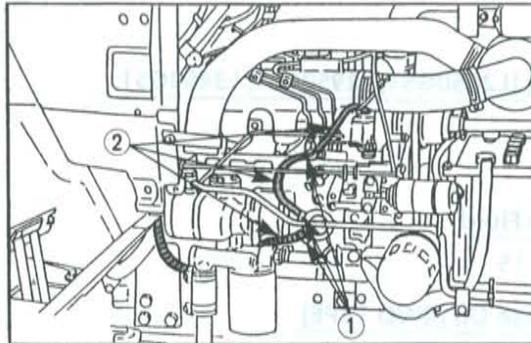
Checking Fan Belt Tension

1. Press the fan drive belt with a force of approx. 98N (10 kgf, 22 lbs.), and measure the deflection.
2. If the measurement is not the factory specification, adjust the fan drive belt tension.

Fan drive belt tension	Factory spec.	About 7 mm 0.3 in.
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(1) Nut

[L2350]

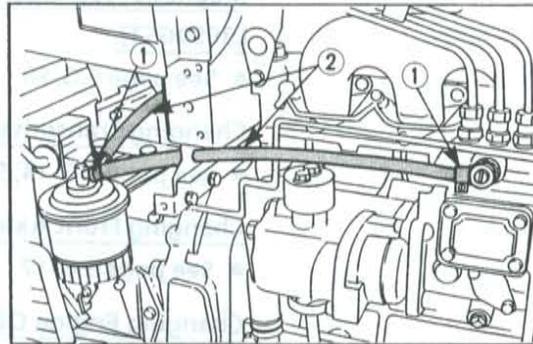


(1) Clamps (2) Fuel Lines

Fuel Lines Check

1. Check the fuel lines (2) and them clamps (1).

[L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]

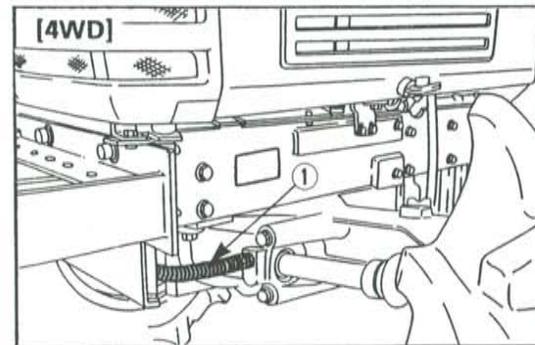
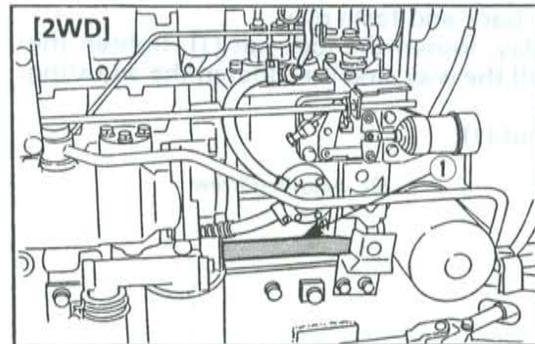


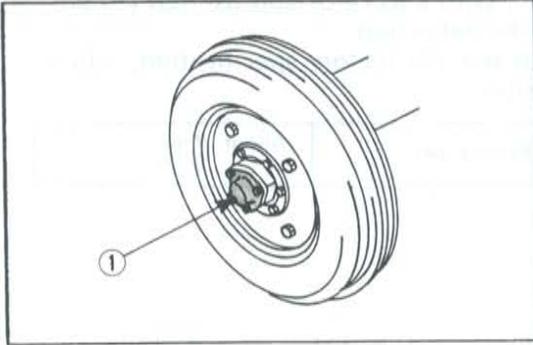
[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]

Power Steering Rubber Hose Check

1. Check the power steering rubber hose (1).

(1) Power Steering Rubber Hose



(7) Check Point of Every 300 Hours**Greasing for Front Wheel Hub [2WD TYPE]**

1. Detach the cover (1).
2. Apply bearing grease to the front wheel hubs.

(1) Front Wheel Hub Cover

(8) Check Points of Every 400 Hours**Magnetic Plug Cleaning [L2650GST, L2950GST, L3450GST, L3650GST]**

- See page S.G-16

Changing Transmission Fluid

- See page S.G-14, S.G-15

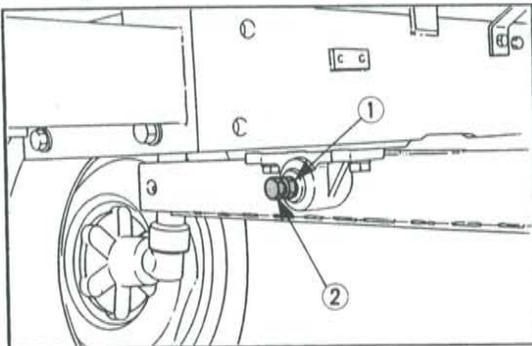
Changing Front Axle Case Oil [4WD TYPE]

- See page S.G-17

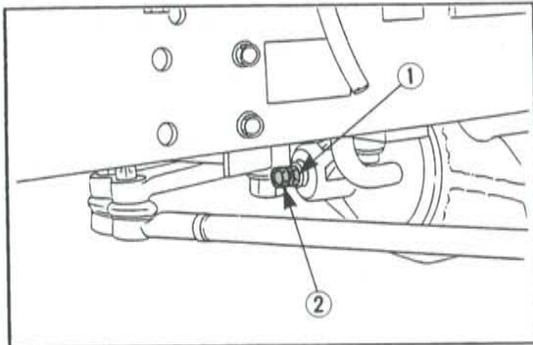
Changing Engine Oil Filter Cartridge

- See page S.G-14

[L2350]



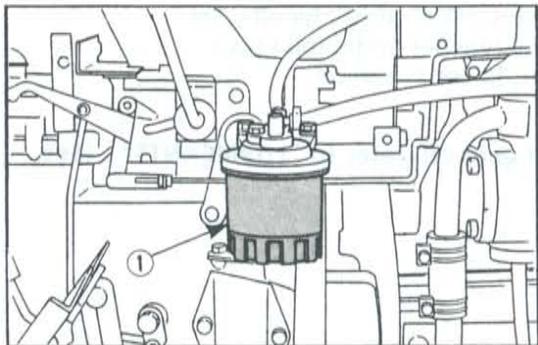
[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]

**Checking Front Axle Back-and-Forth Play**

1. Check the front axle back-and-forth play.
2. If it is not proper play, loosen the lock nut (1), tighten the adjusting screw (2) all the way, and then loosen the adjusting screw (2) by 1/6 turn.
3. Retighten the lock nut (1).

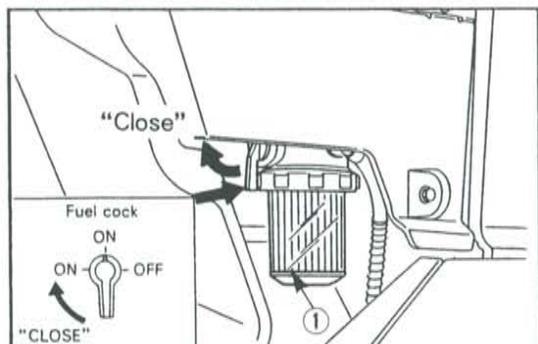
(1) Lock Nut

(2) Adjusting Screw

[L2350]**Fuel Filter Cartridge Replacement**

1. Empty the fuel out of a fuel tank.
2. Detach the filter (1) with the filter wrench.
3. Apply a slight coat of fuel to O-ring of the new filter (1).
4. Install it, and fully tighten it by hands.
5. Bleed the fuel system. (See page S.G-31)

(1) Fuel Filter

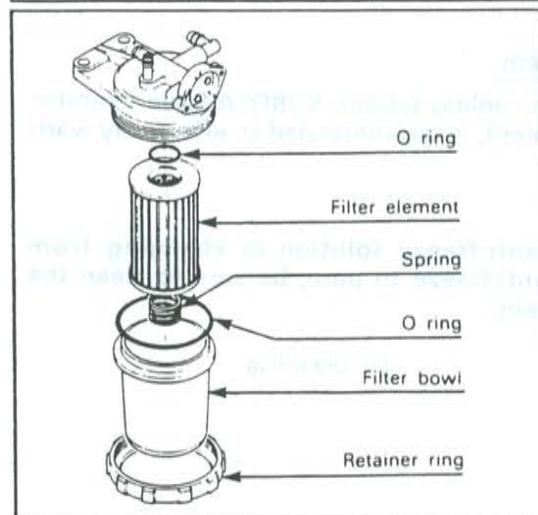
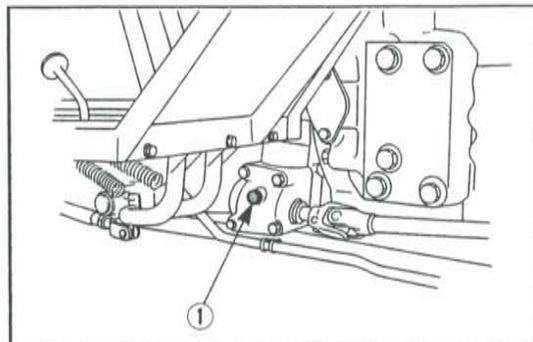
**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]****Fuel Filter Element Replacement**

1. Close the fuel cock.
2. Unscrew the retainer ring and remove the filter bowl and clean the inside with clean fuel.
3. Take out the filter element and reinstall the new one. Reassemble the fuel filter (1).
4. Bleed the fuel line. (See page S.G-31)

■ IMPORTANT

- If dust and dirt enter the fuel, the fuel pump and injection nozzles are subject to quick wear. To prevent this, be sure to clean the fuel filter bowl periodically.

(1) Fuel Filter

**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]****Checking Steering Gear Case Oil**

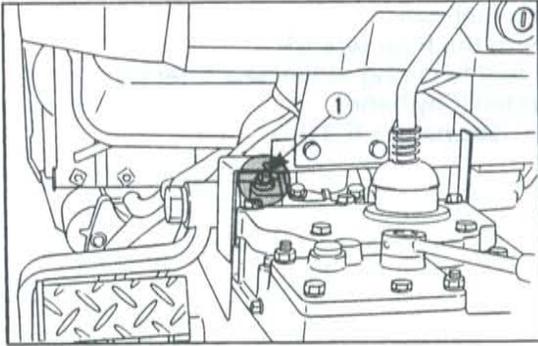
1. Remove the filling plug (1) to check the oil level. Check that the oil level reaches the rim of the filling port (1).
2. If the oil is insufficient, fill with new oil.

■ IMPORTANT

- Use only SAE weight gear oil, refer to "LUBRICANTS". (See page S.G-7)

(1) Filling Plug

[L2350]



Checking Steering Gear Box Oil

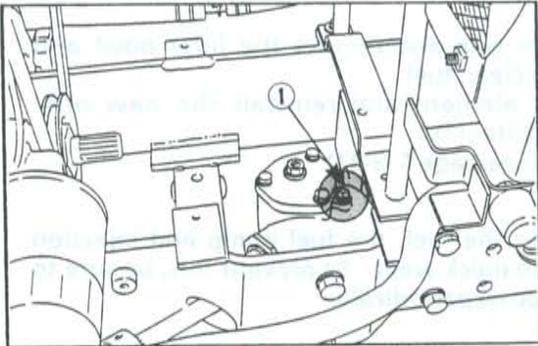
1. Remove the oil inlet plug (1) to check the oil level. Check that the oil level reaches under inlet port.
2. If the oil is insufficient, fill with new oil.

■ IMPORTANT

- Use only SAE weight gear oil, refer to "LUBRICANTS". (See page S.G-7)

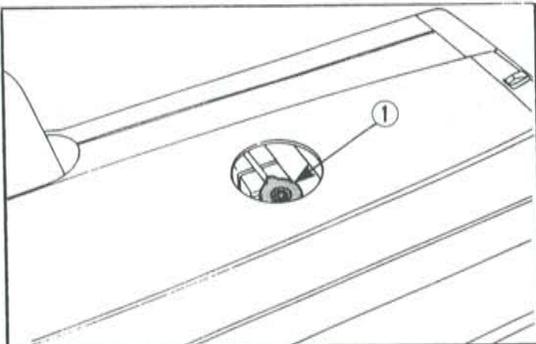
(1) Oil Inlet Plug

[L2650, L2950]



(9) Check Points of Every 800 Hours

[L2350]



Cleaning Cooling System

1. To clean the engine cooling system, KUBOTA Scale Inhibitor No. 20, or its equivalent, is recommended to effectively wash away scale build-up.

■ NOTE

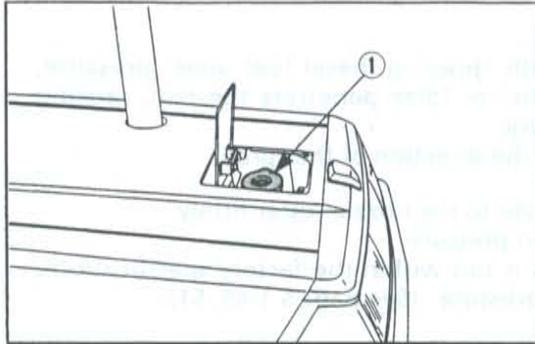
- When adding an anti-freeze solution or changing from water containing anti-freeze to pure, be sure to clean the engine cooling system.

(1) Radiator Cap

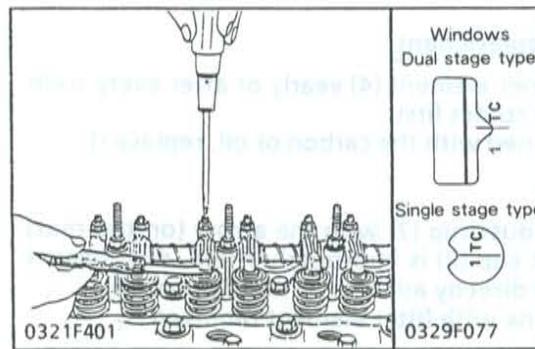
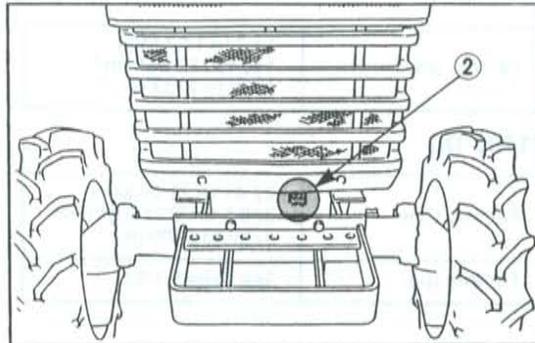
(2) Drain Plug



**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]**

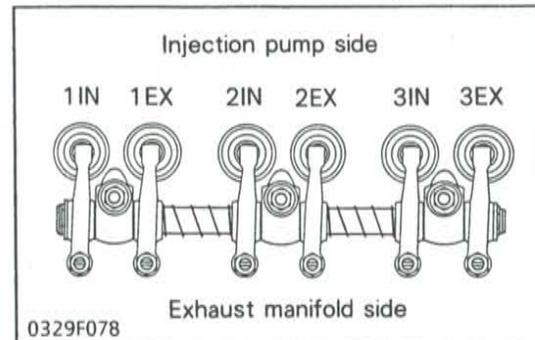


- (1) Radiator Cap
- (2) Drain Plug



Checking Valve Clearance

1. Remove the cylinder head cover and the timing window cover on the flywheel housing and all glow plugs.
2. Turn the flywheel and align the 1 TC mark with the timing mark of window on the flywheel housing to position the 1st cylinder valves at the **top dead center during compression**.
3. Measure the clearance at the valves marked with O in the table below with a feeler gauge.
4. Turn the flywheel just one turn to position the 1st cylinder valves at the **top dead center during overlap**.
5. Measure the clearance at the valves marked with ● in the table below with a feeler gauge.
6. If the clearance is not within the factory specifications, adjust.

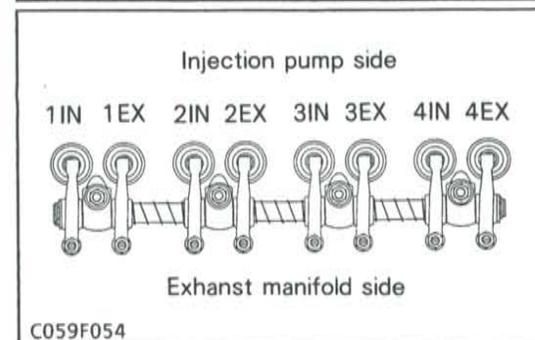


[D1102, D1402-DI, D1462-DI]

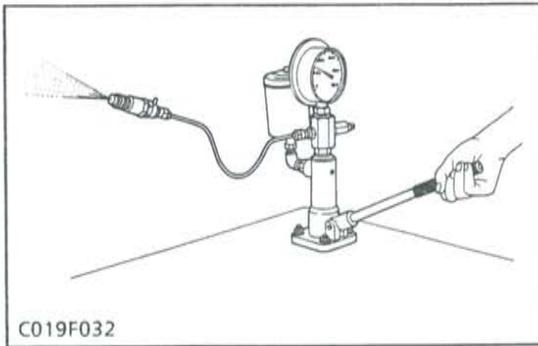
Cylinder No.	1		2		3	
Valve	IN.	EX.	IN.	EX.	IN.	EX.
Checking	○	○	●	○	○	●

[V1902-DI]

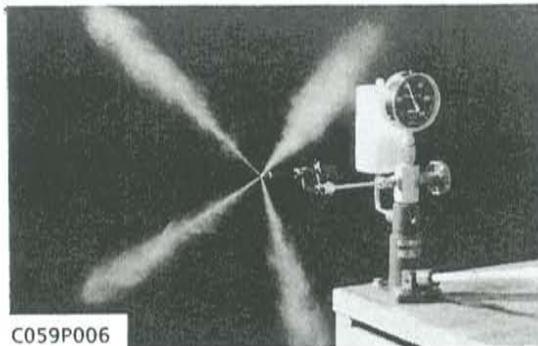
Cylinder No.	1		2		3		4	
Valve	IN.	EX.	IN.	EX.	IN.	EX.	IN.	EX.
Checking	○	○	○	●	●	○	●	●



Valve clearance IN. and EX.	Factory spec	0.18 to 0.22 mm 0.0071 to 0.0087 in.
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C019F032



C059P006

Checking Fuel Injection Nozzle Pressure

⚠ CAUTION

- Never to contact with spraying diesel fuel under pressure, which can have sufficient force penetrate the skin, causing serious personal injury.
- Be sure nobody is in the direction of the spray.

1. Set the injection nozzle to the nozzle tester firmly.
2. Measure the injection pressure.
3. If the measurement is not within the factory specifications, adjust the injection pressure. (See page S.1-45, 51)

[D1102]

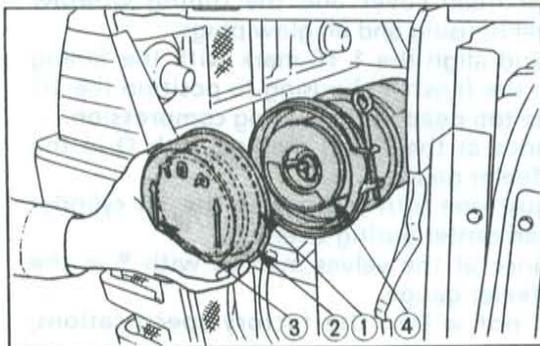
Injection pressure	Factory spec.	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1990 to 2133 psi
--------------------	---------------	--

[D1402-DI, D1462-DI, V1902-DI]

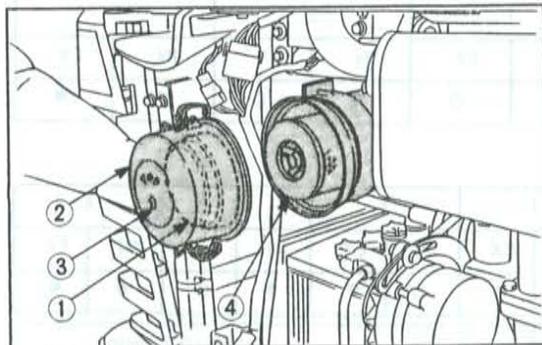
Injection pressure	Factory spec.	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi
Valve lift	Factory spec.	See page S.1-52

(10) Check Point of Every 1 Year

[L2350]



[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]



Air Cleaner Element Replacement

1. Replace the air cleaner element (4) yearly or after every sixth cleaning, whichever comes first.
2. If the element is stained with the carbon or oil, replace it.

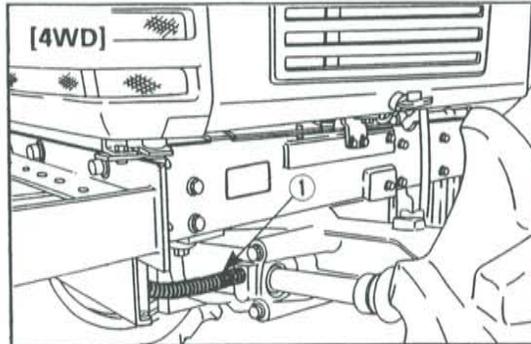
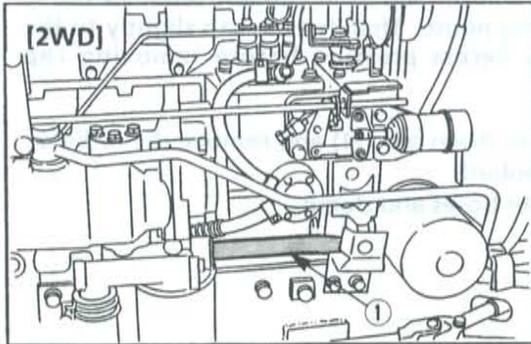
■ NOTE

- Be sure to refit the dust cup (2) with the arrow (on the rear) upright. If the dust cup (2) is improperly fitted, dust passes by the dust cup and directly adheres to the element (4).
- Do not run the engine with filter element removed.

- (1) Baffle
- (2) Dust Cup
- (3) Top Marks
- (4) Element

(11) Checking Points of Every 2 Years

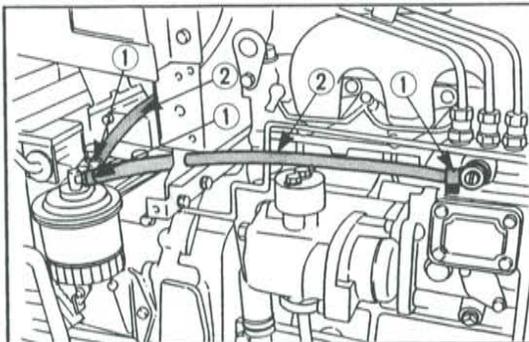
**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]**

**Power Steering Rubber Hose Replacement**

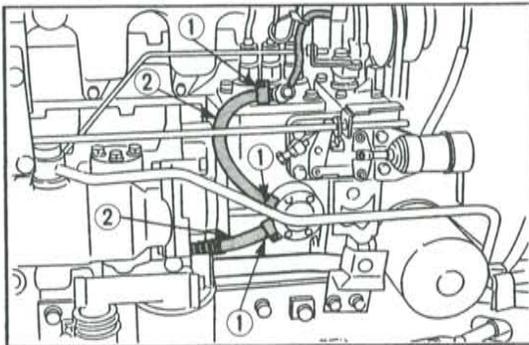
1. Remove the power steering hose.
2. Replace the hose and clamps.
3. After replacing, bleed air of the power steering system.
(See page S.7-38)

(1) Power Steering Rubber Hose

[L2350]

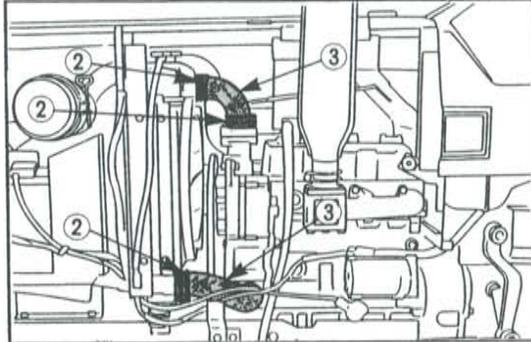
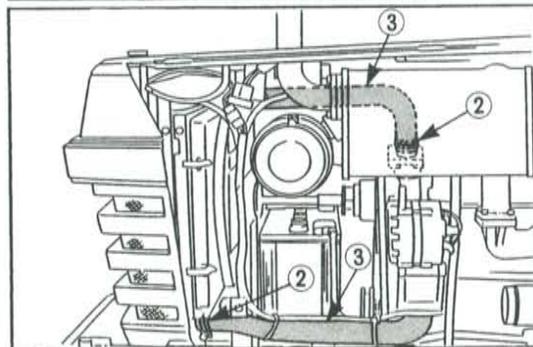
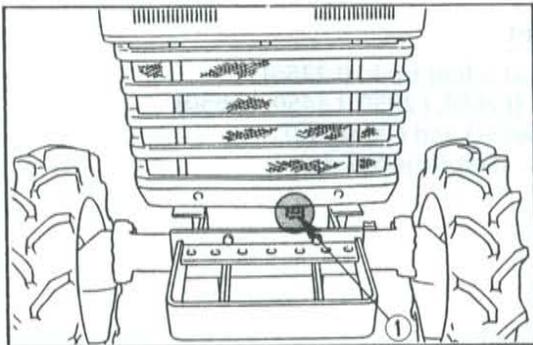


**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]**

**Fuel Lines Replacement**

1. Empty the fuel out of a fuel tank. (L2350)
Close the fuel cock. (L2650, L2950, L3450, L3650)
2. Replace the fuel lines (1) and clamps (2).
3. Bleed the fuel lines. (See page S.G-31)

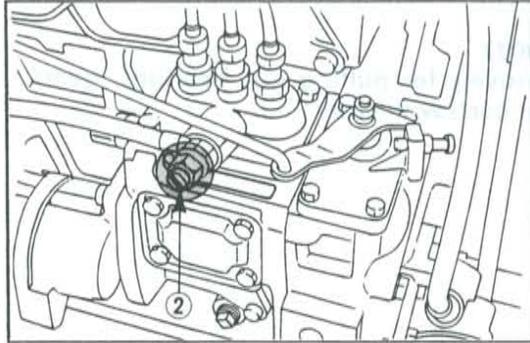
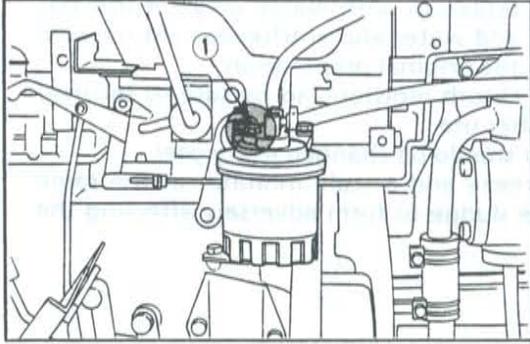
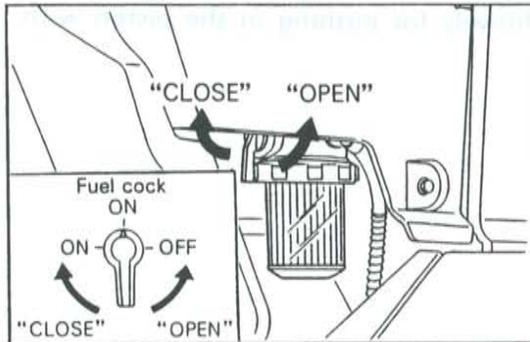
(1) Clamps
(2) Fuel Lines

[L2350]**[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]****Radiator Hoses Replacement****⚠ CAUTION**

- Never remove the radiator cap until coolant temperature is well below its boiling point. Then loosen cap slightly to the stop to relieve any excess pressure before removing cap completely.

1. Remove the radiator drain plug (1) and remove the radiator cap to drain the coolant.
2. Replace the radiator hoses and clamps.

- (1) Drain Plug
(2) Clamps
(3) Radiator Hoses

(12) Others**[L2350]****[L2650 (GST), L2950 (GST)
L3450 (GST), L3650 (GST)]****Fuel Line Bleeding****L2350****⚠ CAUTION**

- Do not bleed the fuel system when the engine is hot.

1. Fill the fuel to the tank.
2. Loosen the air vent plug (1) of the fuel filter two or three turns using a wrench.
3. When there are no more air bubbles in the fuel which flows out, tighten as before.
4. Loosen the air vent plug (2) of the injection pump and vent air in the same way.

■ IMPORTANT

- Always close the air vent plug except for bleeding fuel lines. Otherwise, engine runs irregularly or stalls frequently.

(1) Air Vent Plug

(2) Air Vent Plug

L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)

1. Fill the fuel to the tank.
2. Open the fuel cock (1).
3. Start the engine for about 1 minute, and then stop the engine.

(1) Fuel Cock

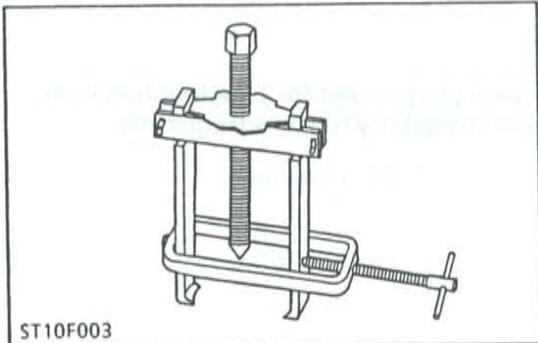
Antifreeze

If the cooling water freezes, the engine cylinder and radiator may crack. In cold weather before the temperature drops below 0°C (32°F), drain out the water or add a proper amount of antifreeze when the tractor is shut down.

- There are two types of antifreeze solutions, permanent type (PT) and semi-permanent type (SPT). For the Kubota Engine, be sure to use the permanent type.
- When antifreeze is used for the first time, fill and drain clean water two or three times so as to completely clean the inside of the radiator.

- Mix the antifreeze and the water, then pour the mixture into the radiator.
- When the cooling water mixed with antifreeze decreases due to evaporation, replenish with water only. If loss has been due to leaking, add water and antifreeze mixture with the same mix ratio as the original preparation.
- Antifreeze solutions absorb moisture, so be sure to securely close the container after use.
- Antifreeze and water should be changed every year.
- Do not use an antifreeze and a scale inhibitor at the same time. This may cause sludge to form adversely affecting the engine parts.

[8] SPECIAL TOOLS

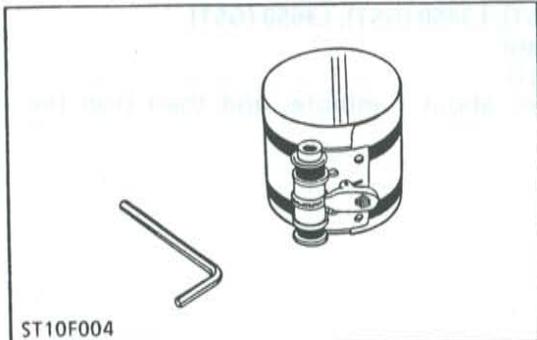


ST10F003

Special Use Puller Set

Code No: 07916-09032

Application: Use exclusively for pulling out bearings, gears and other parts with ease.

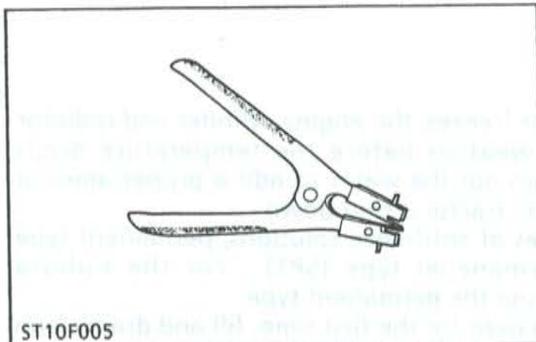


ST10F004

Piston Ring Compressor

Code No: 07909-32111

Application: Use exclusively for pushing in the piston with ease.

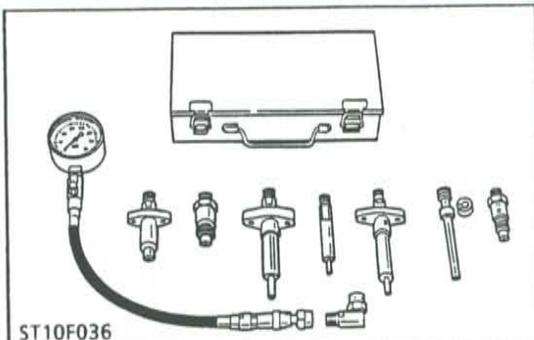


ST10F005

Piston Ring Tool

Code No: 07909-32121

Application: Use exclusively for removing or installing the piston ring with ease.



ST10F036

Diesel Engine Compression Tester (Including Adaptor G)

Code No: 07909-30206 (Assembly)

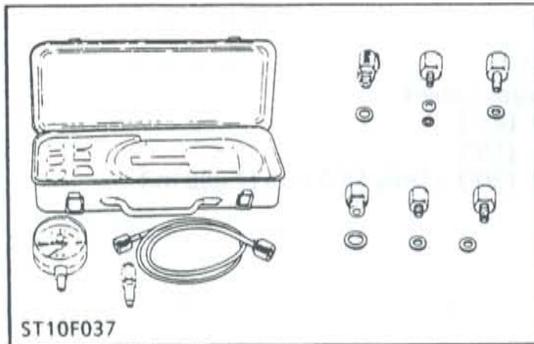
07909-30933 (A to F)

07909-31211 (E and F)

07909-31251 (G)

07909-31231 (H)

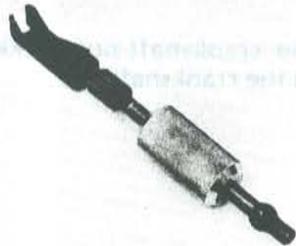
Application: Use for measuring diesel engine compression pressure.



Diesel Engine Oil Pressure Tester

Code No: 07916-32032
 Application: Use to measure lubricating, for all kinds of diesel engines.

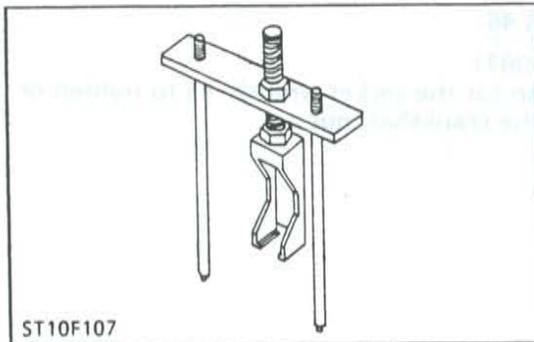
ST10F037



Nozzle Replacer

Code No: 07916-32721
 Application: Use exclusively for pulling out pencil nozzle with ease and without damaging nozzle.

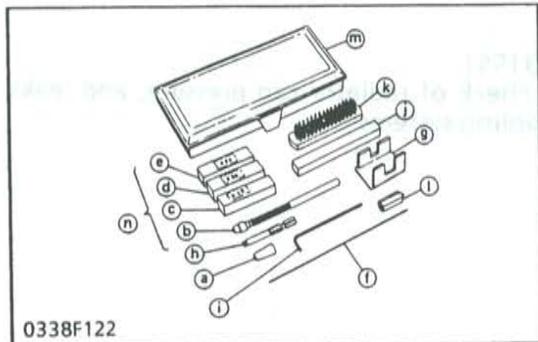
ST10P002



Nozzle Holder Puller

Code No: 07916-34061
 Application: Use exclusively for pulling out pencil nozzle on condition of engine installed to tractor.

ST10F107

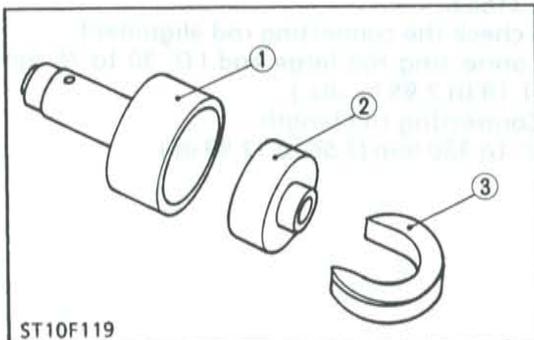


Nozzle Service Tool Kit

Code No: 07916-32881
 Application: Use exclusively for overhauling a pencil nozzle of a diesel engine.

- a. Carbon dam seal assembling tool (Part No. 07916-32741)
- n. Cleaning wire and pin vice set (Part No. 07916-32731)
- b. Pin vice
- c. Cleaning wire A (Ø 0.15)
- d. Cleaning wire B (Ø 0.20)
- e. Cleaning wire C (Ø 0.23)
- f. Tip scraper
- g. Fixture
- h. Needle valve retractor
- i. Hexagonal bar wrench
- j. Oil stone
- k. Nozzle cleaning brush
- l. Pressure adjusting wrench
- m. Housing (storage box)

0338F122

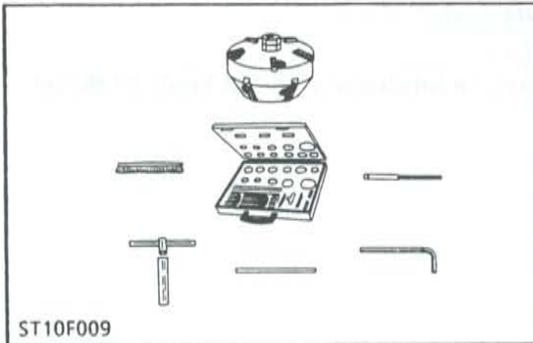


Auxiliary Socket For Fixing Crankshaft Sleeve

Code No: 07916-32091
 Application: Use to fix the crankshaft sleeve of the diesel engine.

- (1) Auxiliary Socket for Pushing
- (2) Sleeve Guide
- (3) Stopper

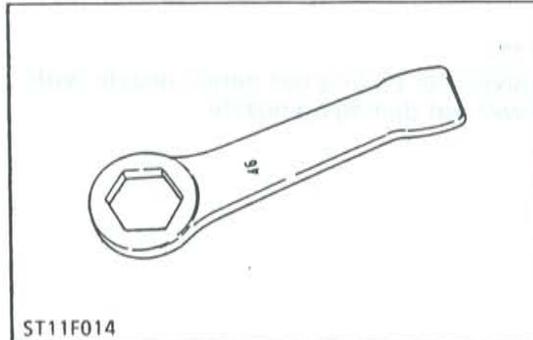
ST10F119



ST10F009

Valve Seat Cutter

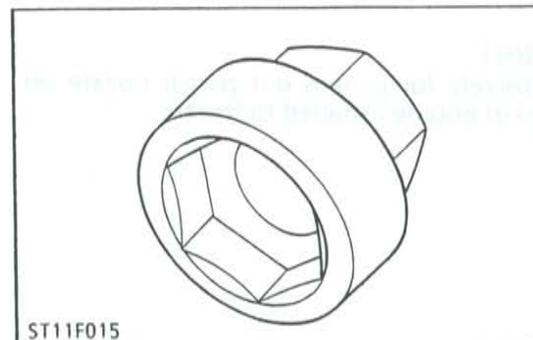
Code No: 07909-33102
 Application: Use to reseal valves.
 Angle: 0.785 rad. (45°)
 0.262 rad. (15°)
 0.523 rad. (30°) – Only 50.8 mm (2.000 in.)



ST11F014

Socket Wrench 46

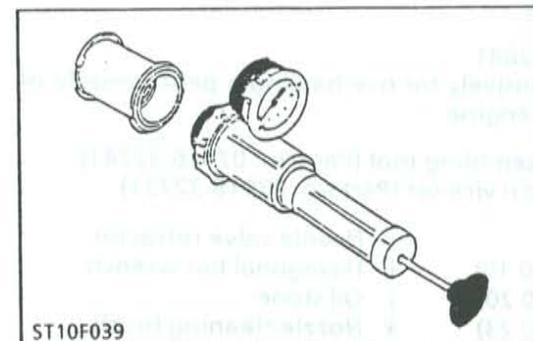
Code No: 07916-30901
 Application: Used also for the crankshaft-nut socket 46 to tighten or loosen the crankshaft nut.



ST11F015

Crankshaft-Nut Socket 46

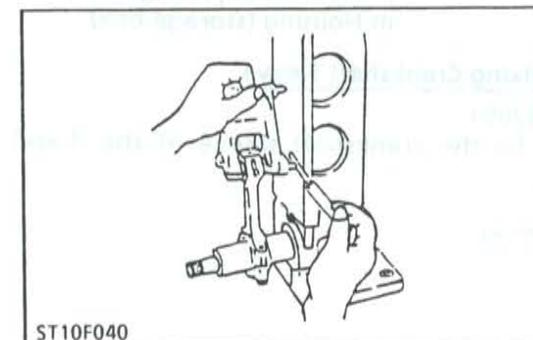
Code No: 07916-30821
 Application: Used also for the socket wrench 46 to tighten or loosen the crankshaft nut.



ST10F039

Radiator Tester

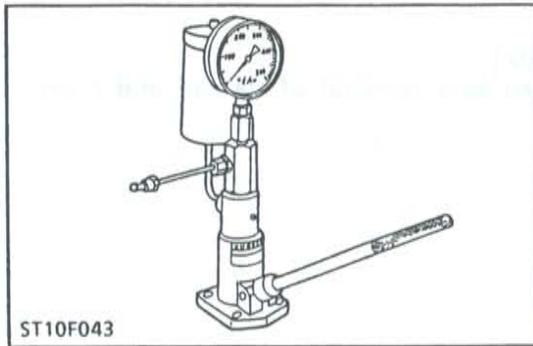
Code No: 07909-31551
 Application: Use to check of radiator cap pressure, and leaks from cooling systems.



ST10F040

Connecting Rod Alignment Tool

Code No: 07909-31661
 Application: Use to check the connecting rod alignment.
 Applicable range: Connecting rod large end I.D. 30 to 75 mm
 (1.18 to 2.95 in. dia.)
 Connecting rod length
 65 to 330 mm (2.56 to 12.99 in.)

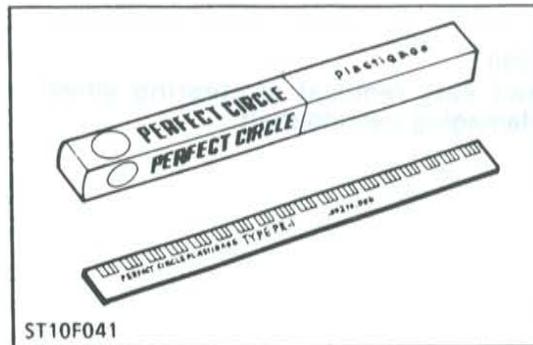


ST10F043

Nozzle Tester

Code No: 07909-31361

Application: Use to check the fuel injection pressure and spraying condition of nozzle.

Measuring range: 0 to 49 MPa (0 to 500 kgf/cm², 0 to 7112 psi)

ST10F041

Press Gauge

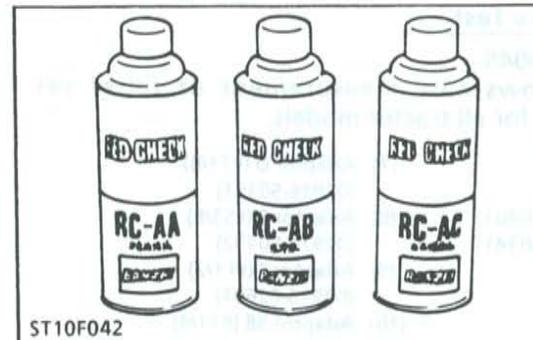
Code No: 07909-30241

Application: Use to check the oil clearance between crankshaft and bearing, etc.

Measuring range: Green - 0.025 to 0.076 mm
(0.001 to 0.003 in.)

Red - 0.051 to 0.152 mm
(0.002 to 0.006 in.)

Blue - 0.102 to 0.229 mm
(0.004 to 0.009 in.)

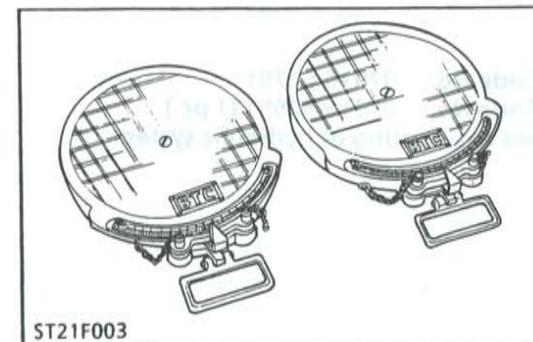


ST10F042

Red Check (Crack check liquid)

Code No: 07909-31371

Application: Use to check cracks on cylinder head, cylinder block, etc.

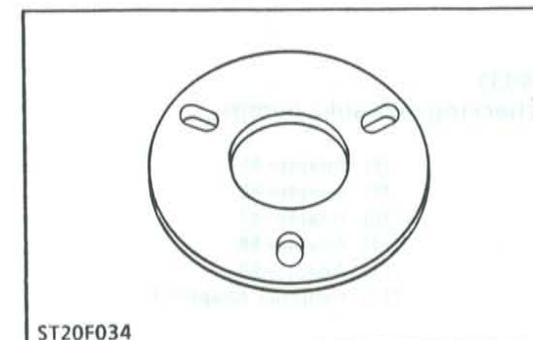


ST21F003

Turning Radius Gauge

Code No: 07909-31701

Application: This allows easy measurement of steering angle for all tractor models.

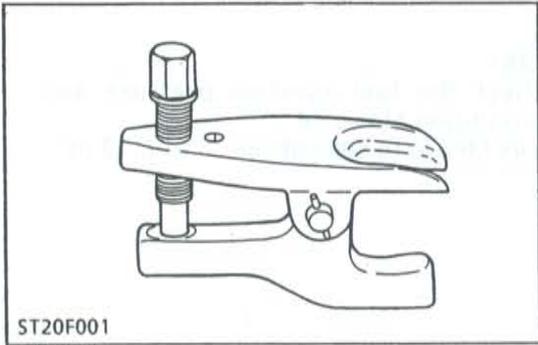


ST20F034

Power Steering Valve Holder

Code No: 07916-52891

Application: Use for disassembling and assembling the power steering valve.

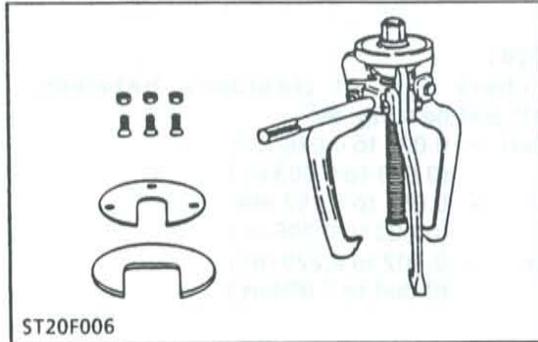


Tie Rod End Lifter

Code No: 07909-39021

Application: This allows easy removal of tie rod end from tractor.

ST20F001

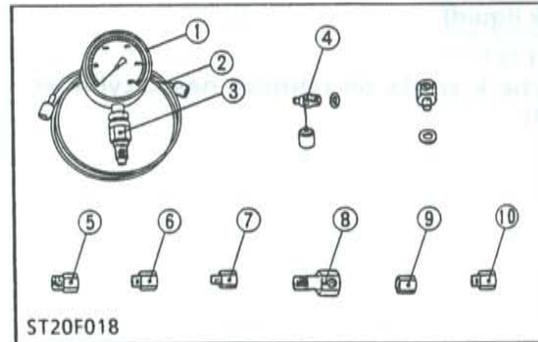


Steering Wheel Puller

Code No: 07916-51090

Application: This allows easy removal of steering wheel without damaging steering shaft.

ST20F006

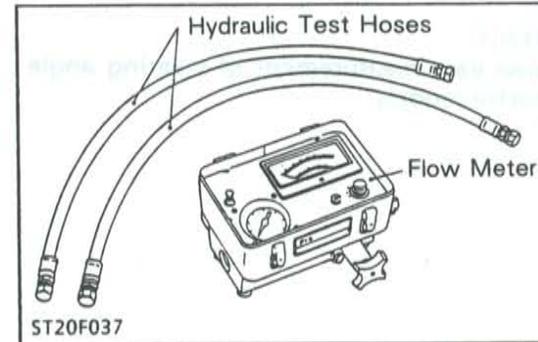


Relief Valve Set Pressure Test

Code No: 07916-50045

Application: This allows easy measurement of relief set pressure for all tractor models.

ST20F018



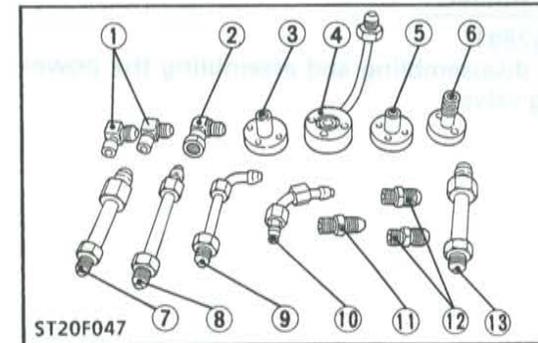
Flowmeter

Flowmeter Code No: 07916-52791

Hydraulic Test Hose Code No: 07916-52651 (1 pc.)

Application: This allows easy testing of hydraulic system.

ST20F037



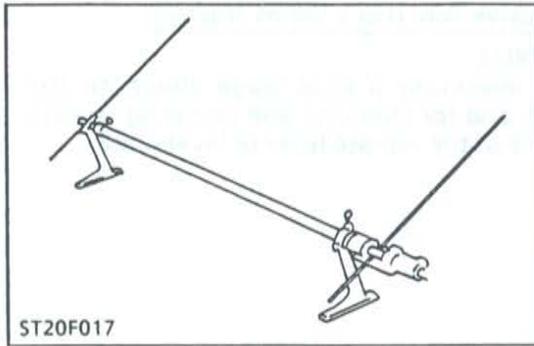
Adaptor Set

Code No: 07916-54031

Application: Use for checking hydraulic pumps.

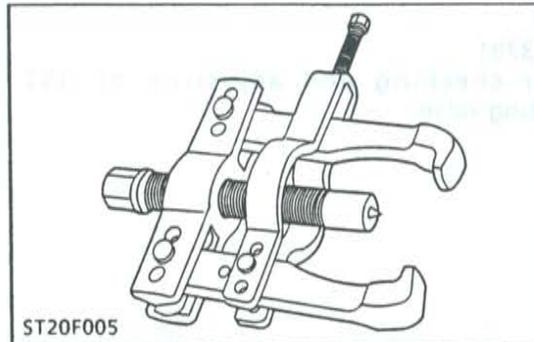
ST20F047

- | | |
|----------------|--------------------------|
| (1) Adaptor 52 | (8) Adaptor 65 |
| (2) Adaptor 53 | (9) Adaptor 66 |
| (3) Adaptor 54 | (10) Adaptor 67 |
| (4) Adaptor 61 | (11) Adaptor 68 |
| (5) Adaptor 62 | (12) Adaptor 69 |
| (6) Adaptor 63 | (13) Hydraulic Adaptor 1 |
| (7) Adaptor 64 | |

**Toe-in Gauge**

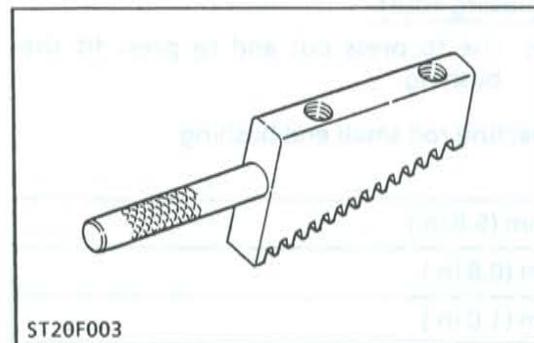
Code No: 07909-31681

Application: This allows easy measurement of toe-in for all tractor models.

**Pitman Arm Puller**

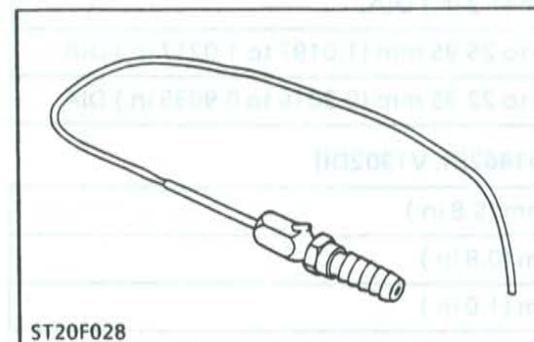
Code No: 07909-39011

Application: Use for pulling out pitman arm from steering.

**Pinion Locking Tool**

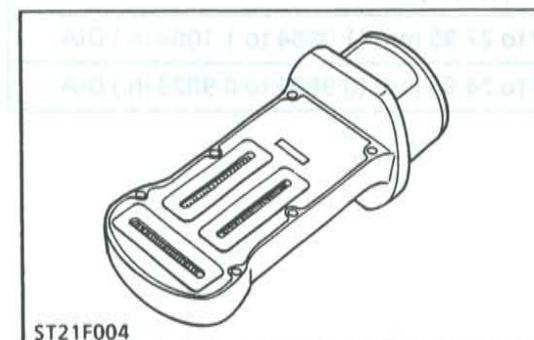
Code No: 07916-52311

Application: Use for preventing the shaft from turning when removing or tightening a spiral bevel pinion staking nut.

**Injector CH3**

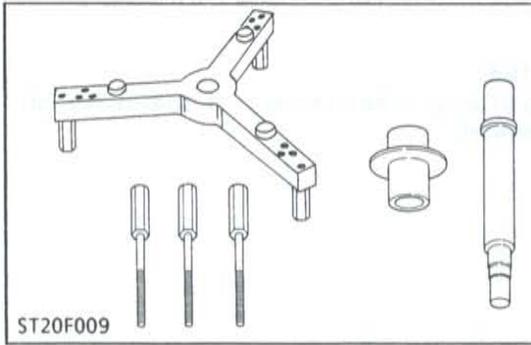
Code No: 07916-52501

Application: Use for injecting liquid (water or calcium chloride solution) into, and removing it from tires.

**Camber, Caster and King Pin Gauge**

Code No: 07909-31691

Application: This allows easy measurement of camber angle, caster angle and king pin inclination for all tractor models.

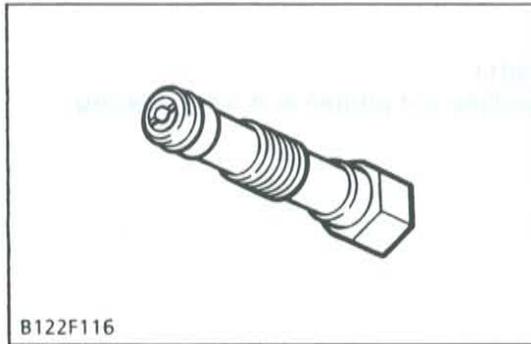


Dual Stage Clutch Exclusive Tool (For L Series Tractor)

Code No: 07916-90052

Application: Use for mounting a dual stage clutch to the flywheel, and for checking and adjusting relative difference of the release lever or lever plate.

ST20F009

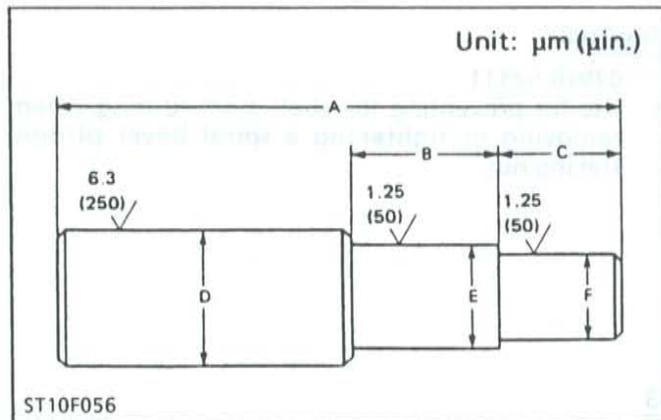


Adaptor 72

Code No: 07916-53791

Application: Use for checking and adjusting of GST modulating valve.

B122F116



ST10F056

Bushing Replacing Tools

Application: Use to press out and to press fit the bushing.

(1) For connecting rod small end bushing [D1102]

A	146 mm (5.8 in.)
B	20 mm (0.8 in.)
C	26 mm (1.0 in.)
D	30 mm (1.2 in.) DIA.
E	25.90 to 25.95 mm (1.0197 to 1.0217 in.) DIA.
F	22.90 to 22.95 mm (0.9016 to 0.9035 in.) DIA.

(2) For idle gear bushing [D1102]

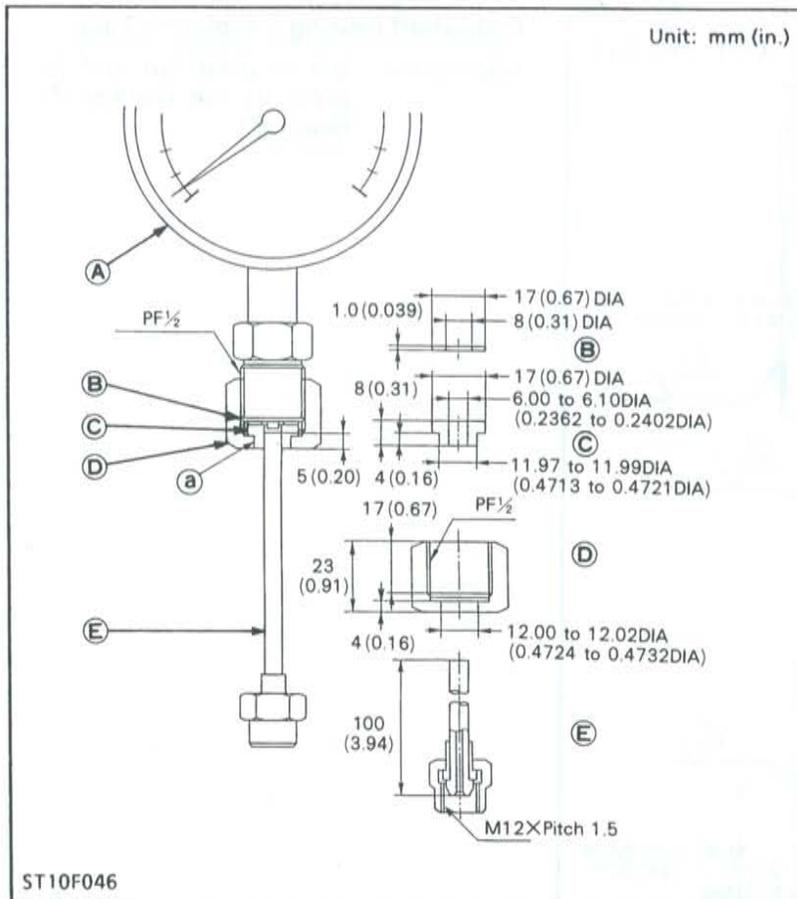
A	150 mm (5.9 in.)
B	30 mm (1.2 in.)
C	20 mm (0.8 in.)
D	25 mm (1.5 in.) DIA.
E	31.90 to 31.95 mm (1.256 to 1.258 in.) DIA.
F	27.80 to 27.95 mm (1.094 to 1.100 in.) DIA.

[D1402DI, D1462DI, V1902DI]

A	146 mm (5.8 in.)
B	20 mm (0.8 in.)
C	26 mm (1.0 in.)
D	30 mm (1.2 in.) DIA.
E	27.90 to 27.95 mm (1.0984 to 1.1004 in.) DIA.
F	24.90 to 24.95 mm (0.9803 to 0.9823 in.) DIA.

[D1402DI, D1462DI, V1902DI]

A	150 mm (5.9 in.)
B	30 mm (1.2 in.)
C	20 mm (0.8 in.)
D	38 mm (1.5 in.) DIA.
E	35.80 to 35.90 mm (1.409 to 1.413 in.) DIA.
F	31.80 to 31.90 mm (1.252 to 1.256 in.) DIA.

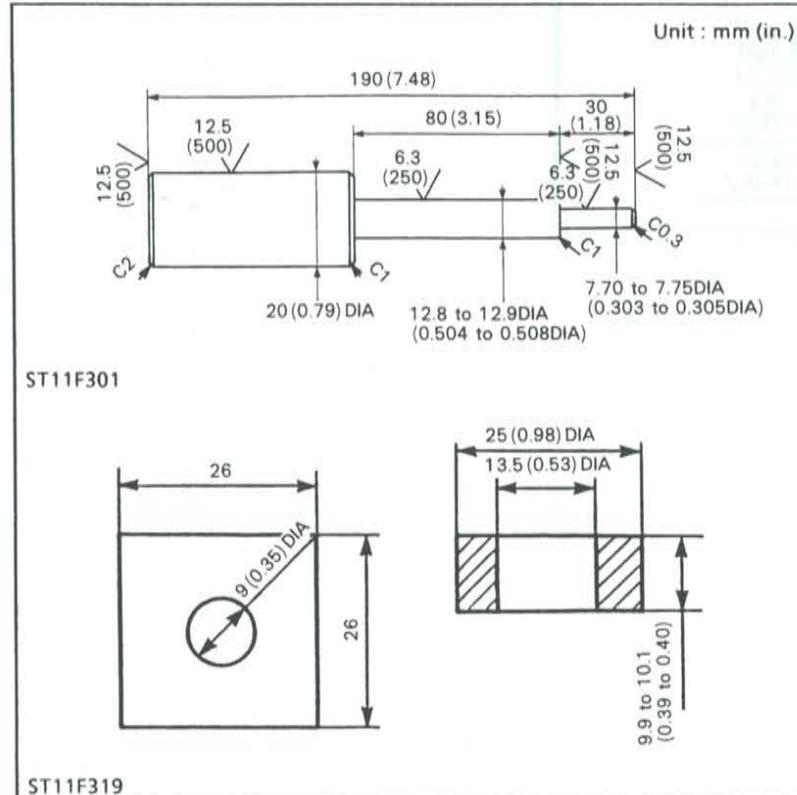


Injection Pump Pressure Tester

Application: Use to check fuel tightness of injection pumps.

(A)	Pressure gauge full scale more than 25 MPa (250 kgf/cm ² , 3500psi) and 50 MPa (500 kgf/cm ² , 7100 psi)
(B)	Gasket (copper)
(C)	Flange (steel)
(D)	Hex. nut with across the flat 25 mm (1.06 in.)
(E)	Injection pipe

(a) Apply adhesive



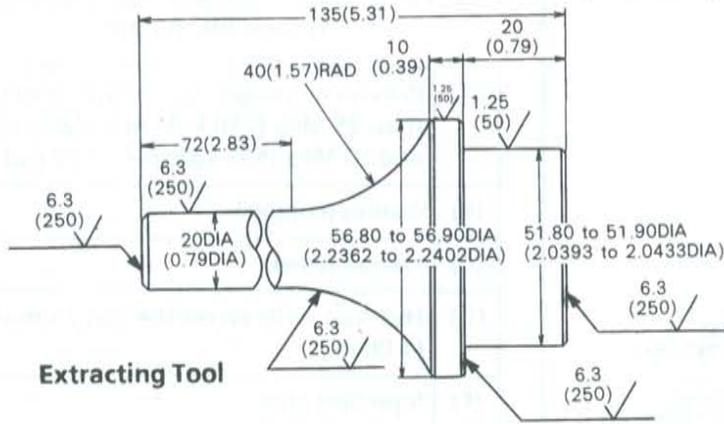
Valve Guide Replacing Tool

Application: Use to press out and press fit the valve guide.

Unit: mm (in.)

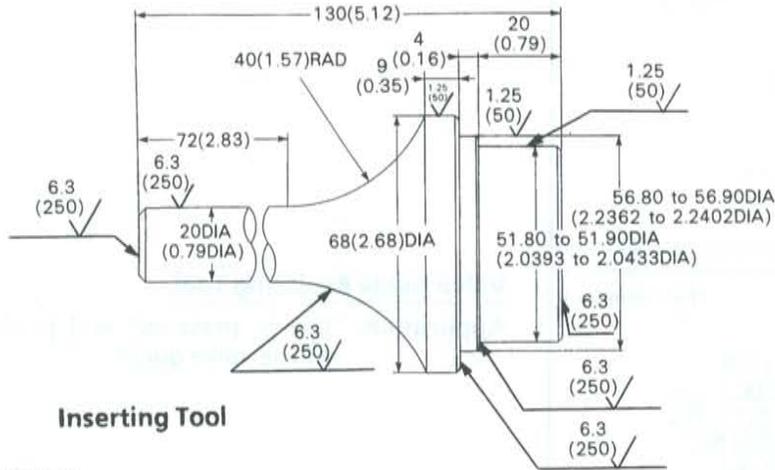
Crankshaft Bearing 1 Replacing Tool

Application: Use to press out and to press fit the crankshaft bearing 1.



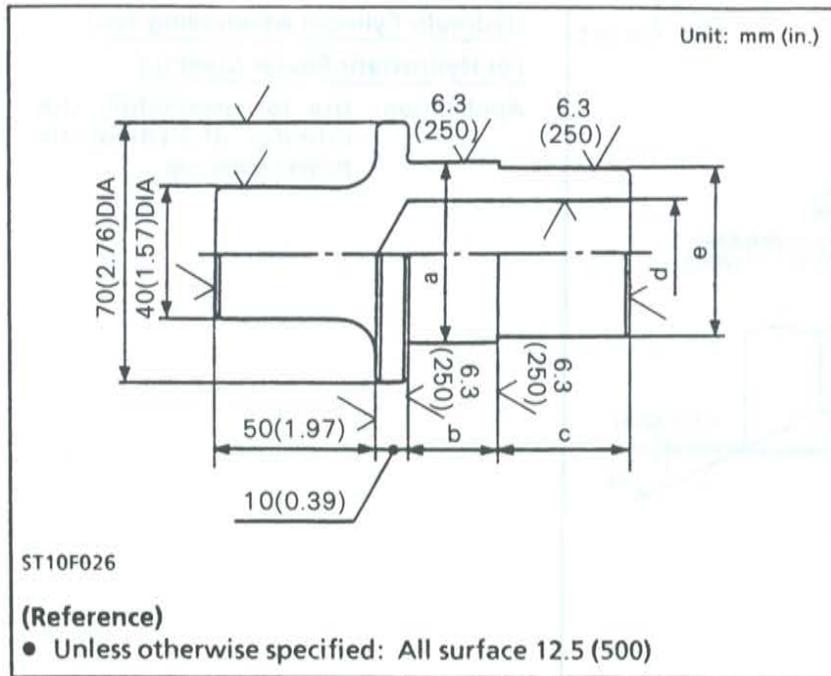
Extracting Tool

ST10F053



Inserting Tool

ST10F054

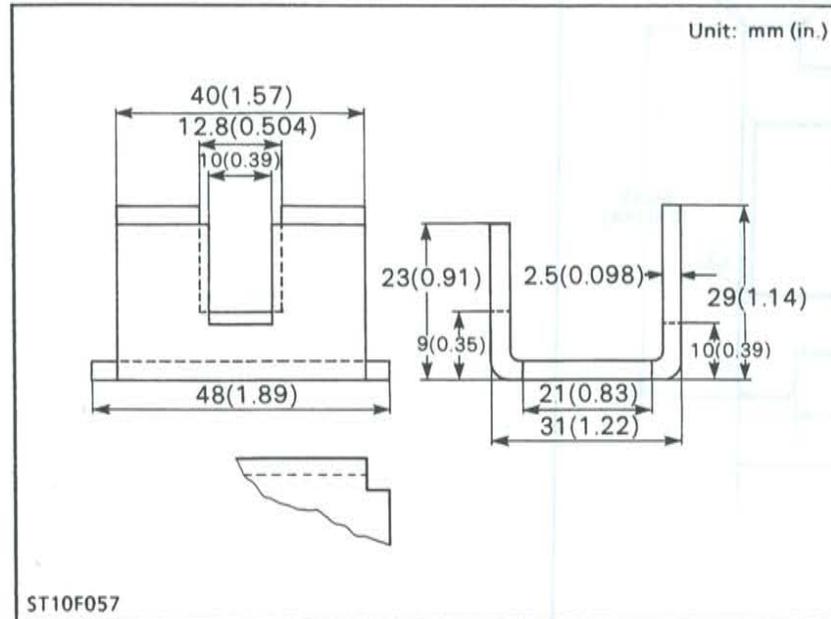


Hydraulic Arm Shaft Bushing Press-Fitting Tool

Application: Use for replacing the hydraulic arm shaft bushings in the hydraulic cylinder body.

Dimensions of hydraulic arm shaft bushing press-fitting tool.

	Right	Left
a	49.7 to 49.9 mm 1.9567 to 1.9646 in.	43.7 to 43.9 mm 1.7205 to 1.7283 in.
b	26.50 to 27.50 mm 1.0433 to 1.0827 in.	21.75 to 22.75 mm 0.8563 to 0.8957 in.
c	40 mm 1.57 in.	40 mm 1.57 in.
d	32 mm 1.26 in.	30 mm 1.18 in.
e	44.7 to 44.9 mm 1.7598 to 1.7677 in.	39.7 to 39.9 mm 1.5630 to 1.5709 in.

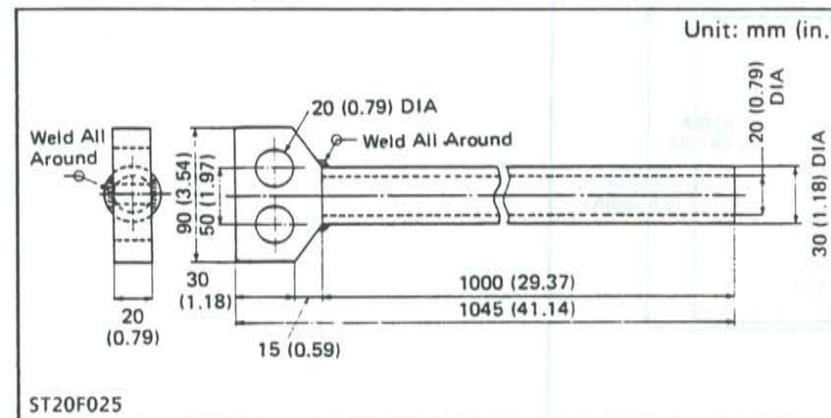


Nozzle Fixture

Application: Use to hold nozzle in it and to secure in the vise.

(Reference)

- Fixture is available from STANADYNE INC.

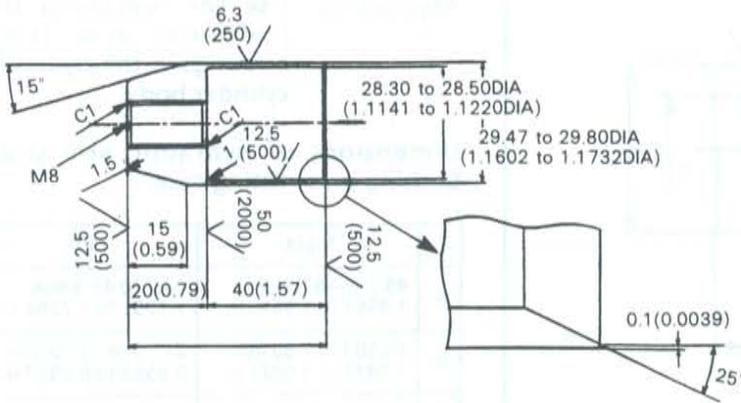


Test Bar

Application: Use for checking the lift range and floating range of hydraulic draft control. (See page S.8-16)

Oil Seal Guide

Unit: mm (in.)



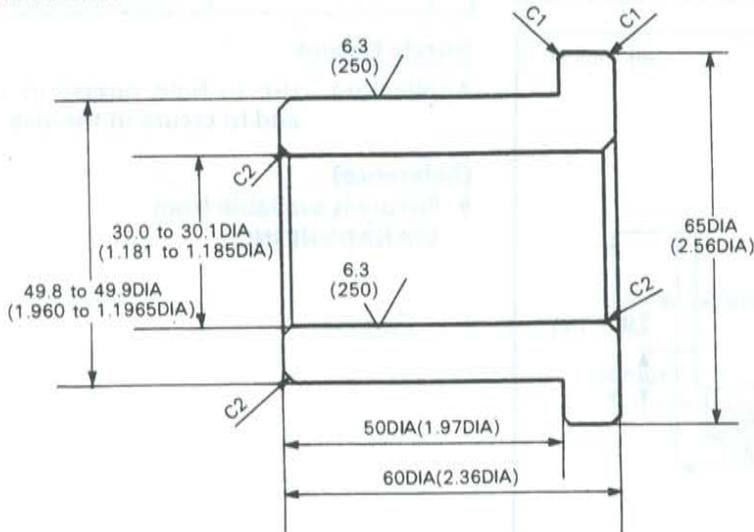
Hydraulic Cylinder Assembling Tool

For Hydrostatic Power Steering

Application: Use for assembling the cylinder of hydrostatic power steering.

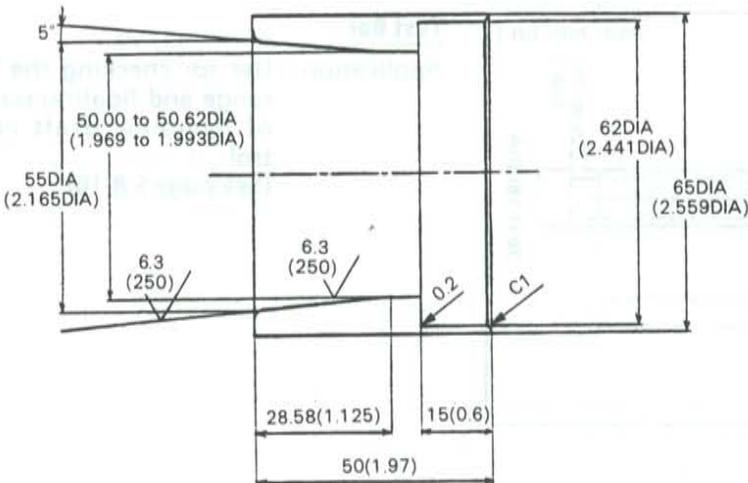
B122F144

Rod Guide



B122F145

Cylinder Tube Guide



B122F146

S.S SEPARATION

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TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: See page S.G-8)

[L2350]

Section	Item	N·m	kgf·m	ft·lbs
Front Axle	Front wheel mounting screw and nut	124 to 147	12.6 to 15.0	91.2 to 108.0
	Shaft bracket 1 (front) mounting screw	124 to 147	12.6 to 15.0	91.2 to 108.0
	Shaft bracket 2 (rear) mounting screw	103 to 117	10.5 to 12.0	76.0 to 86.8
	Front axle frame mounting screw to engine (Thread size: 10 mm, 0.39 in. DIA.)	60.8 to 70.5	6.2 to 7.2	44.9 to 52.1
	(Thread size: 12 mm, 0.47 in. DIA.)	103 to 117	10.5 to 12.0	76.0 to 86.8
Engine	Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Clutch Housing	Clutch housing mounting nut to transmission case	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2
Rear Axle, Brake	Rear wheel mounting screw and nut	197 to 225	20 to 23	145 to 166
	Rear axle case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
	Brake case mounting screw and nut	77.5 to 90.2	7.9 to 9.2	57.2 to 66.5
Steering	Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
	Tie rod end nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6

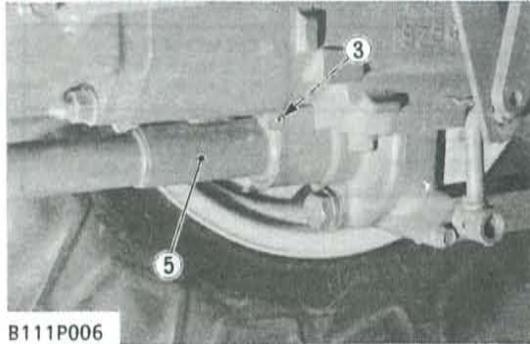
[L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]

Section	Item	N·m	kgf·m	ft·lbs
Front Axle	Front wheel mounting screw and nut	124 to 147	12.6 to 15.0	91.2 to 108.0
	Shaft bracket 1 (front) mounting screw	124 to 147	12.6 to 15.0	91.2 to 108.0
	Shaft bracket 2 (rear) mounting screw	103 to 117	10.5 to 12.0	76.0 to 86.8
	Front axle frame mounting screw to engine (Thread size: 10 mm, 0.39 in. DIA.) (Thread size: 12 mm, 0.47 in. DIA.)	60.8 to 70.5 103 to 117	6.2 to 7.2 10.5 to 12.0	44.9 to 52.1 76.0 to 86.8
Engine	Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Clutch Housing	Clutch housing mounting nut to mid case	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
Mid Case	Mid case mounting nut to transmission case	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
Rear Axle, Brake	Rear wheel mounting screw and nut	197 to 226	20 to 23	145 to 166
	Rear axle case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
	Rear axle case mounting nut	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
	Brake case mounting screw and nut 7T screw (Marked 7 on it's head)	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
	9T screw (marked 9 on it's head) Nut	103 to 117 77.5 to 90.1	10.5 to 12.0 7.9 to 9.2	76.0 to 86.8 57.2 to 66.5
Rear Hitch	Drawbar frame mounting screw (Thread size: 12 mm, 0.47 in. DIA.)	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
	(Thread size: 14 mm, 0.55 in. DIA.)	124 to 147	12.6 to 15.0	91.2 to 108.0
Steering	Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
	Tie rod end nut [2WD TYPE]	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
	Steering joint shaft 3 lock screw	29.4 to 34.3	3.0 to 3.5	21.7 to 25.3
	Steering gear box mounting screw	124 to 147	12.6 to 15.0	91.2 to 108.0
	Power steering delivery pipe end eye joint screw (At steering gear box)	49.0 to 58.8	5.0 to 6.0	36.2 to 43.4
	Steering controller mounting nut	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
	Power steering hydraulic flared pipe	34.3 to 39.2	3.5 to 4.0	25.3 to 28.9
	Tie rod end nut [4WD TYPE]	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
	Tie rod screw of cylinder rod side	98.1 to 117.7	10.0 to 12.0	72.3 to 86.8
	Steering cylinder mounting screw	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
	Power steering hydraulic hose	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Side Cover (GST TYPE)	Side cover mounting screw	42.2	4.3	31.1
	Hi-Lo shift spool valve mounting screw	17.7	1.8	13.0
	Gate valve mounting screw	17.7	1.8	13.0

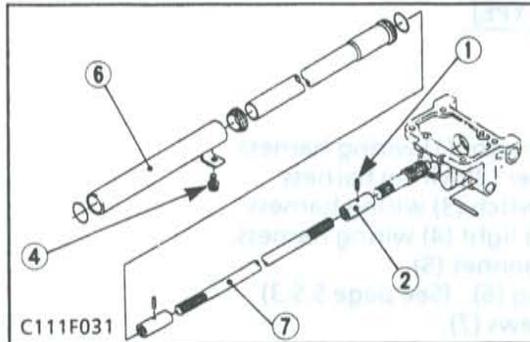
DISASSEMBLING AND ASSEMBLING

[1] L2350

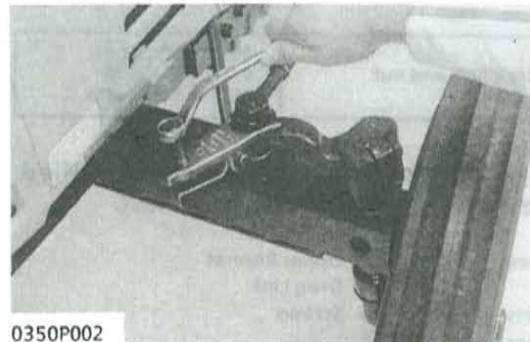
[1]-1 SEPARATING FRONT AXLE



B111P006



C111F031



0350P002



0301F129

Front Axle Case Oil [4WD TYPE]

1. Draining the front axle case oil. (See page S.G-17)

Propeller Shaft [4WD TYPE]

1. Remove the screw (4) then tap out the spring pin (3).
2. Slide the propeller shaft cover (5) to the front.
3. Tap out the spring pin (1) and slide the coupling (2) to the front.

(When reassembling)

- For assembling, slide the front coupling, too.

- | | |
|----------------|-----------------------------|
| (1) Spring Pin | (5) Propeller Shaft Cover 1 |
| (2) Coupling | (6) Propeller Shaft Cover 2 |
| (3) Spring Pin | (7) Propeller Shaft |
| (4) Screw | |

Drag Link

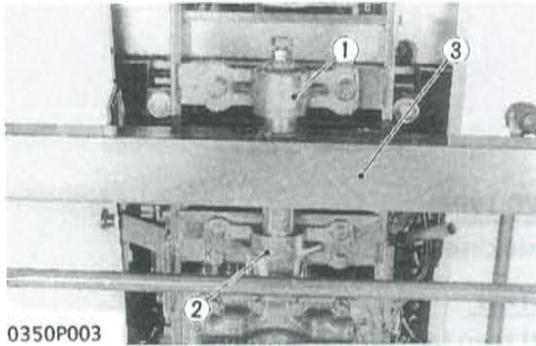
1. Remove the drag link end nut.
2. Remove the drag link end with the tie rod end lifter (Code No. 07909-39021).
3. Remove the drag link.

(When reassembling)

Tightening torque	Drag link end nut	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.2 to 50.6 ft·lbs

■ IMPORTANT

- After tightening the drag link end nut to the specified torque, install a cotter pin as shown in the figure left.



0350P003

Front Axle

1. Remove the front wheels.
2. Remove the shaft bracket 1 (1) mounting screws and shaft bracket 2 (2) mounting screws.
3. Take off the front axle assembly (3).

(When reassembling)

Tightening torque	Front wheel mounting screws and nuts	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft-lbs
	Shaft bracket 1 mounting screws	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft-lbs
	Shaft bracket 2 mounting screws	103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft-lbs

- (1) Shaft Bracket 1
(2) Shaft Bracket 2

- (3) Front Axle

[1]-2 SEPARATING ENGINE FROM CLUTCH HOUSING

Propeller Shaft [4WD TYPE]

(See page S.5-3)

Preparation 1

1. Disconnect the alternator (1) wiring harness.
2. Disconnect the starter (2) wiring harness.
3. Disconnect the oil switch (3) wiring harness.
4. Disconnect the head light (4) wiring harness.
5. Remove the upper bonnet (5).
6. Remove the drag link (6). (See page S.5-3)
7. Remove the two screws (7).

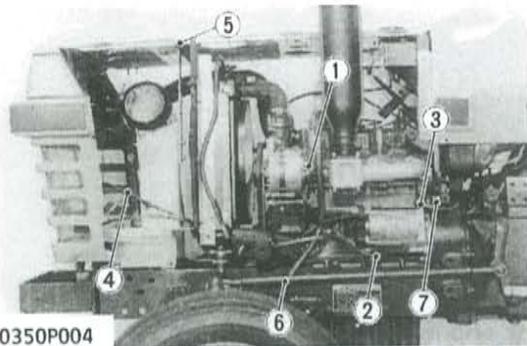
(When reassembling)

Tightening torque	Drag link end nut	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.2 to 50.6 ft-lbs
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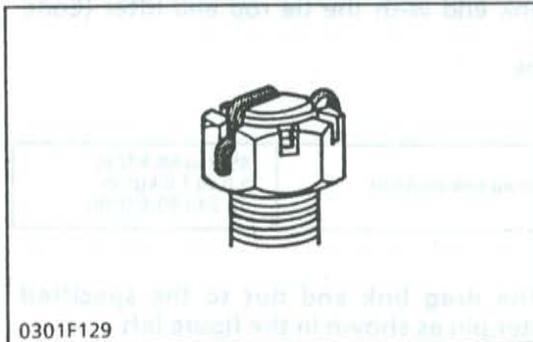
■ IMPORTANT

- After tightening the drag link end nut to the specified torque, install a cotter pin as shown in the figure left.

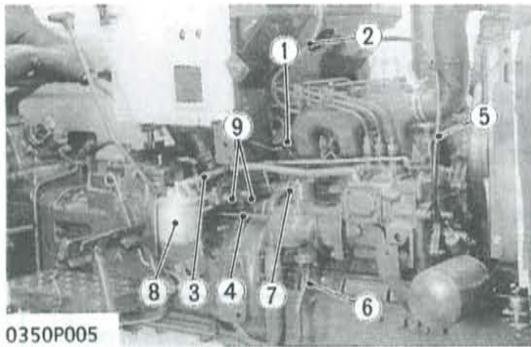
- | | |
|-------------------------------|------------------|
| (1) Alternator Wiring Harness | (5) Upper Bonnet |
| (2) Starter Wiring Harness | (6) Drag Link |
| (3) Oil Switch Wiring Harness | (7) Screws |
| (4) Head Light Wiring Harness | |



0350P004



0301F129



0350P005

Preparation 2

1. Disconnect the glow plug (1) wiring harness.
2. Disconnect the return fuel pipe (2).
3. Disconnect the fuel pipe (3).
4. Remove the fuel filter (8).
5. Remove the accelerator rod (4).
6. Disconnect the flexible cable (5).
7. Remove the delivery pipe (6).
8. Remove the inlet pipe (7).
9. Remove the two screws (9).

(When reassembling)

- Be sure to install delivery pipe (6), inlet pipe (7) and the O-rings.

- | | |
|------------------------------|-------------------|
| (1) Wiring Harness Glow Plug | (6) Delivery Pipe |
| (2) Return Fuel Pipe | (7) Inlet Pipe |
| (3) Fuel Pipe | (8) Fuel Filter |
| (4) Accelerator Rod | (9) Screws |
| (5) Flexible Cable | |



0350P006

Separating Engine from Clutch Housing

1. Remove the engine mounting screws to clutch housing.
2. Separate the engine from clutch housing.

Tightening torque	Engine mounting screws and nuts to clutch housing	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft-lbs
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[1]-3 SEPARATING ENGINE

Coolant

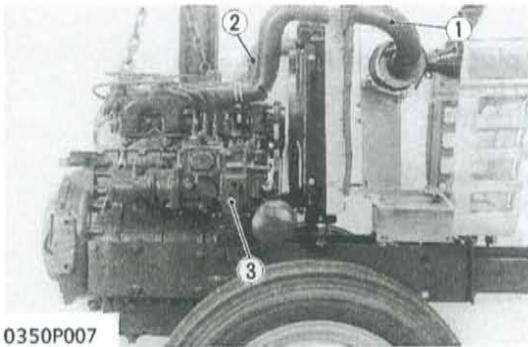
1. Draining the coolant. (See page S.G-26)

Propeller Shaft [4WD TYPE]

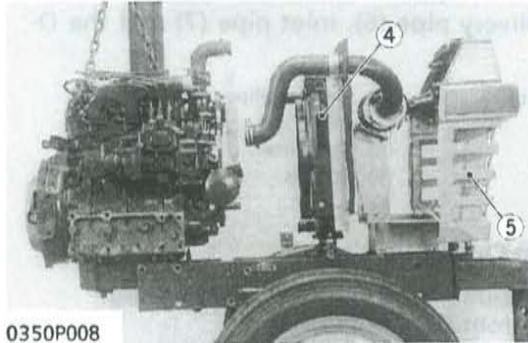
(See page S.S-3)

Separating Engine from Clutch Housing

Refer to [1]-2 SEPARATING ENGINE FROM CLUTCH HOUSING.
(See page S.S-4)



0350P007



0350P008

Front Axle Frame

1. Disconnect the air cleaner pipe (1).
2. Disconnect the radiator pipe upper (2).
3. Remove the support (3).
4. Disconnect the lower radiator pipe.
5. Remove the dipstick.
6. Remove the front axle frame mounting screws.
7. Separate the front axle frame with radiator (4) and front grille (5).

Tightening torques	Front axle frame mounting screws to engine	(Thread size: 10 mm, 0.39 in.DIA) 60.8 to 70.5 N·m 6.2 to 7.2 kgf·m 44.9 to 52.1 ft·ls
		(Thread size: 10 mm, 0.39 in.DIA) 60.8 to 70.5 N·m 6.2 to 7.2 kgf·m 44.9 to 52.1 ft·ls

- | | |
|-------------------------|------------------|
| (1) Air Cleaner Pipe | (4) Radiator |
| (2) Upper Radiator Pipe | (5) Front Grille |
| (3) Support | |

[1]-4 SEPARATING CLUTCH HOUSING

Transmission Fluid

1. Draining the transmission fluid. (See page S.G-14)

Propeller Shaft [4WD TYPE]

(See page S.5-3)

Preparation 1

1. Remove the panel (2) mounting screws.
2. Remove the switch board (3) mounting screws.
3. Disconnect the wiring harness for the hazard lights.
4. Remove the wiring harness retainer on the left step.
5. Remove the panel (2) and switch board (3) together.
6. Remove the steering wheel (1).

(When reassembling)

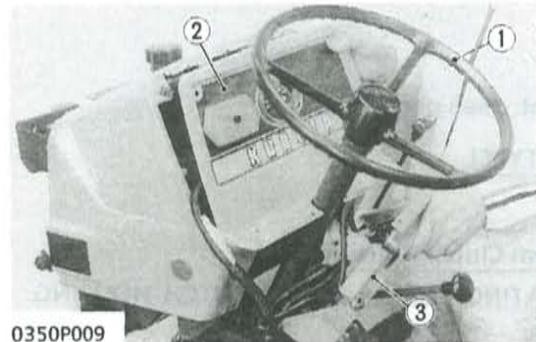
Tightening torque	Steering wheel mounting nut	29.9 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft·lbs
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- | | |
|--------------------|------------------|
| (1) Steering Wheel | (3) Switch Board |
| (2) Panel | |

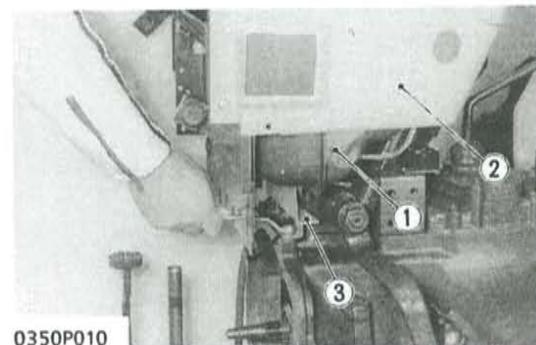
Preparation 2

1. Remove the fuel tank support (3) mounting screws.
2. Remove the fuel tank (1) with panel cover (2).

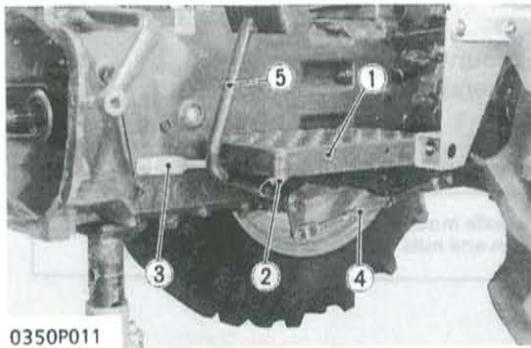
- | | |
|-----------------|------------------|
| (1) Fuel Tank | (3) Tank Support |
| (2) Panel Cover | |



0350P009



0350P010

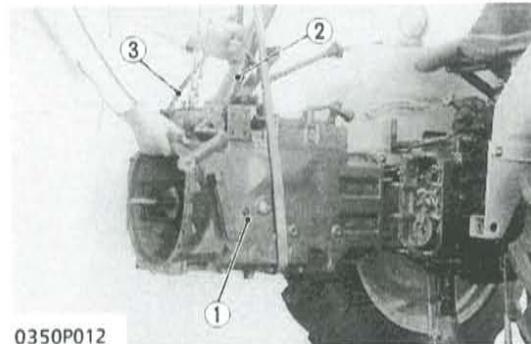


0350P011

Preparation 3:

1. Disconnect the brake rods (4) (right and left).
2. Disconnect the clutch rod (3).
3. Remove the springs (2) (right and left).
4. Remove the pedal assembly.
5. Remove the steps (1) (right and left).

- | | |
|----------------|------------------|
| (1) Step | (4) Brake Rod |
| (2) Spring | (5) Clutch Pedal |
| (3) Clutch Rod | |



0350P012

Dismounting Clutch Housing

1. Remove the hand accelerator lever assembly (3).
2. Remove the steering assembly (2).
3. Remove the power steering hydraulic pipes. [POWER STEERING TYPE]
4. Remove the clutch housing mounting nuts from the transmission case.
5. Separate the clutch housing (1) from the transmission case.

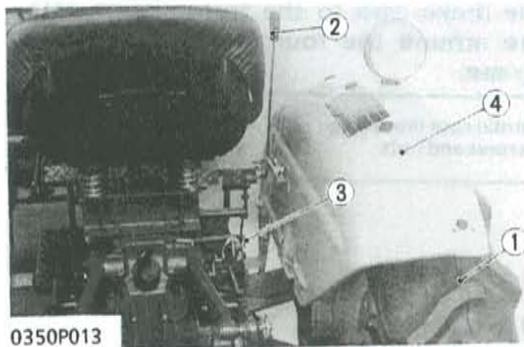
Tightening torques	Clutch housing mounting nut to transmission case	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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- | | |
|-----------------------|-------------------------------------|
| (1) Clutch Housing | (3) Hand Accelerator Lever Assembly |
| (2) Steering Assembly | |

[1]-5 SEPARATING REAR AXLE CASE AND BRAKE CASE

Transmission Fluid

1. Draining the transmission fluid. (See page S.G-14)



0350P013

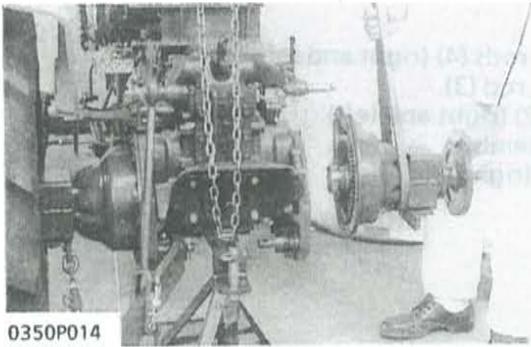
Preparation

1. Remove the rear wheel (1).
2. Remove the position control lever (2).
3. Disconnect the wiring harness for the hazard lights.
4. Remove the rear fenders (4) (right and left).
5. Remove the differential lock pedal (3).
6. Remove the lower links.

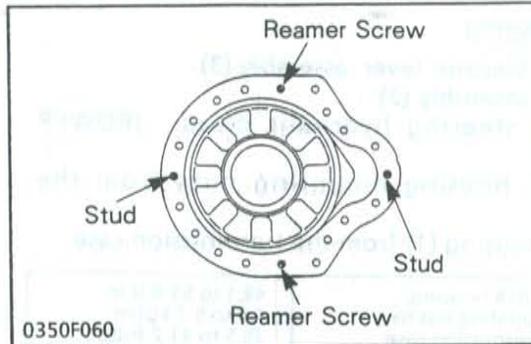
(When reassembling)

Tightening torque	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft·lbs
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- | | |
|----------------------------|-----------------------------|
| (1) Rear Wheel | (3) Differential Lock Pedal |
| (2) Position Control Lever | (4) Rear Fender |



0350P014



0350F060

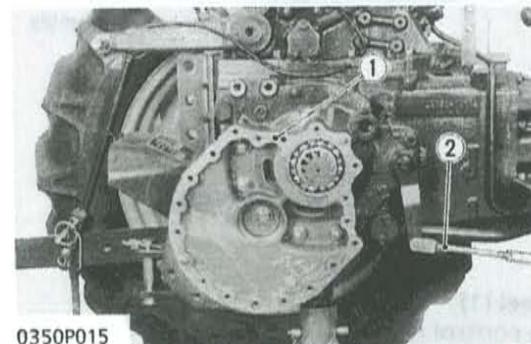
Rear Axle Case

1. Remove the rear axle mounting screws and nuts.
2. Remove the rear axle assembly.

(When reassembling)

- Tighten the reamer screws first.

Tightening torque	Rear axle mounting screws and nuts	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft·lbs
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0350P015

(1) Brake Case

(2) Brake Rod

Brake Case

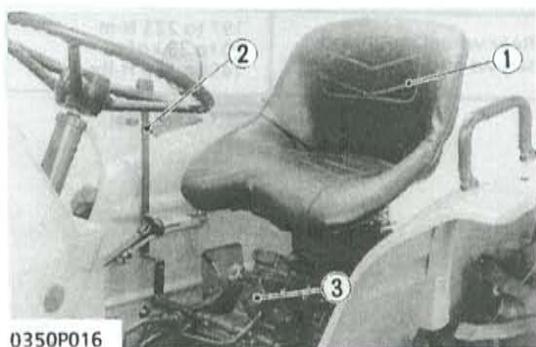
1. Disconnect the brake rod (2).
2. Remove the brake case mounting screws and nuts.
3. Remove the brake case (1).

(When reassembling)

- Apply grease to the brake ball seat. (Do not grease excessively)
- Before installing the brake case to the transmission case, install the camplate around the four protrusions on the differential bearing case.

Tightening torque	Brake case mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
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[1]-6 SEPARATING HYDRAULIC CYLINDER



0350P016

(1) Seat

(2) Position Control Lever

(3) Delivery Pipe

Preparation

1. Remove the seat (1) as a single unit.
2. Remove the position control lever (2).
3. Disconnect the delivery pipe (3).
4. Remove the lower link.
5. Disconnect the wiring harness on the hydraulic cylinder.
6. Remove the power steering hydraulic pipes. [POWER STEERING TYPE]



0350P017

Hydraulic Cylinder

1. Remove the hydraulic cylinder mounting screws and nuts.
2. Separate the hydraulic cylinder.

(When reassembling)

Tightening torque	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
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[1]-7 SEPARATING TRANSMISSION CASE

Transmission Fluid

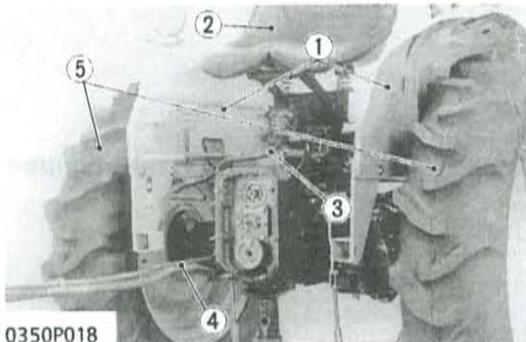
1. Draining the transmission fluid. (See page S.G-14)

Separating Clutch Housing

Refer to [1]-4 SEPARATING CLUTCH HOUSING (See page S.5-6)

Preparation

1. Remove the rear fenders (1).
2. Remove the seat (2).
3. Remove the delivery pipe (3).
4. Remove the inlet pipe (4).
5. Remove the rear wheels (5).



0350P018

- | | |
|-------------------|-----------------|
| (1) Rear Fenders | (4) Inlet Pipe |
| (2) Seat | (5) Rear Wheels |
| (3) Delivery Pipe | |

(When reassembling)

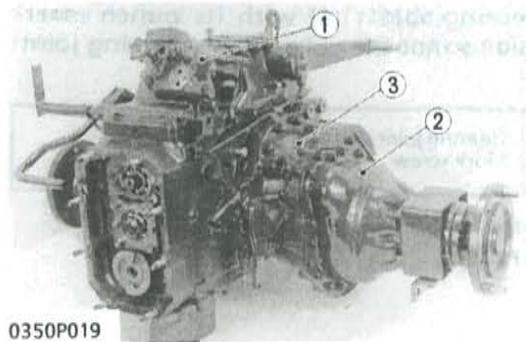
Tightening torque	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft·lbs
-------------------	-------------------------------------	---

Dismounting Transmission Case

1. Remove the hydraulic cylinder (1).
2. Remove the rear axles (2).
3. Remove the brake cases (3).

(When reassembling)

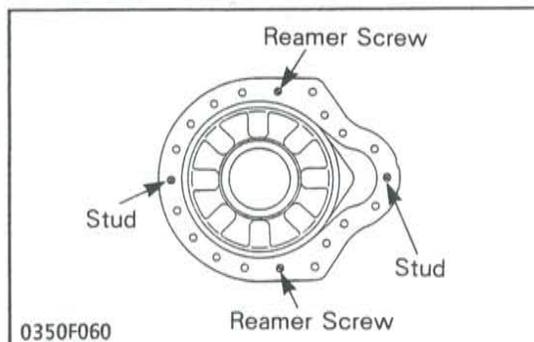
- Apply grease to the brake ball seat. (Do not over grease)
- Before installing the brake case to the transmission case, install the camplate around the four protrusions on the differential bearing case.
- Tighten the reamer screws first to install the rear axles.



0350P019

- | | |
|------------------------|----------------|
| (1) Hydraulic Cylinder | (3) Brake Case |
| (2) Rear Axle | |

Tightening torques	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
	Rear axle mounting screws and nuts	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft·lbs
	Brake case mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs



0350F060

[2] L2650, L2950, L3450, L3650

[2]-1 REMOVING STEERING GEAR BOX [2WD TYPE]



0329P015



0301F129

Bumper and Tie Rods

1. Remove the bumper.
2. Remove the tie rods with the tie rod end lifter (Code No: 07909-39021).

In this case, take special care not to damage the tie rod end nut (slotted nut). (It is preferable to replace it with an unrequired nut.)

(When reassembling)

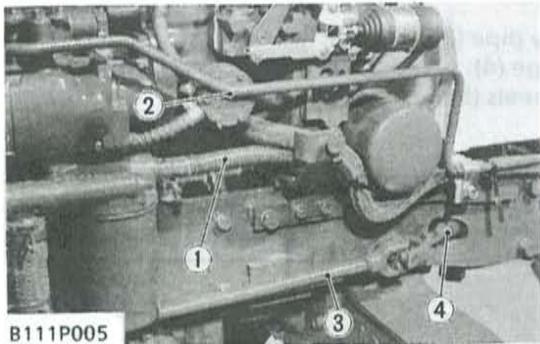
Tightening torque	Tie rod end nut	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
-------------------	-----------------	---

■ IMPORTANT

- After tightening the tie rod end nut to the specified torque, install a cotter pin as shown in the figure left.

Preparation

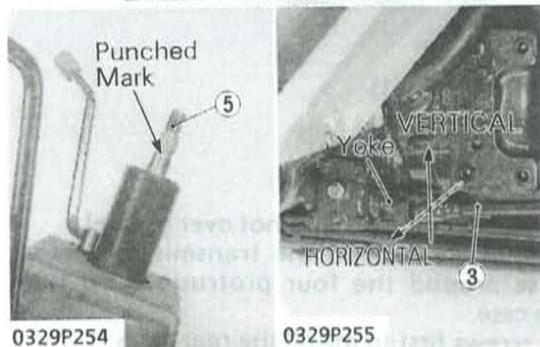
1. Remove the steering joint shaft 3 (3), 4 (4).
2. Remove the power steering delivery pipe (2) and return pipe (1).



B111P005

(When reassembling)

- Reassemble the steering shaft 1 (5) with its punch mark positioned on the side so that the yoke of the steering joint shaft 3 (3) is vertical.

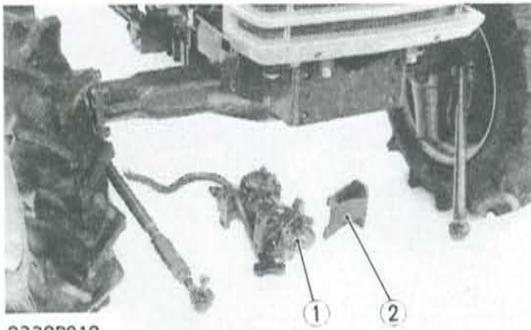


0329P254

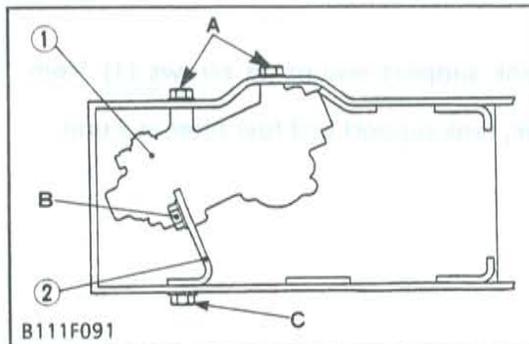
0329P255

Tightening torque	Steering joint shaft 3 lock screw	29.4 to 34.3 N·m 3.0 to 3.5 kgf·m 21.7 to 25.3 ft-lbs
-------------------	-----------------------------------	---

- | | |
|----------------------------------|----------------------------|
| (1) Power Steering Return Pipe | (4) Steering Joint Shaft 4 |
| (2) Power Steering Delivery Pipe | (5) Steering Shaft 1 |
| (3) Steering Joint Shaft 3 | |



0329P019



B111F091

Steering Gear Box

1. Remove the steering support (2).
2. Remove the steering gear box (1).

(When reassembling)

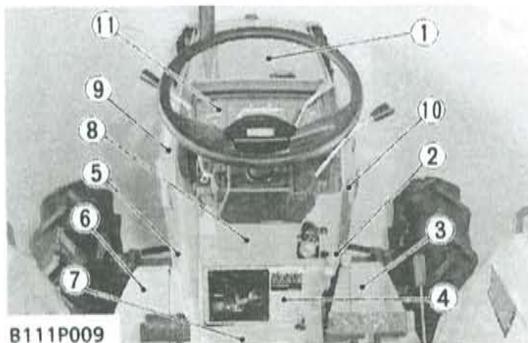
- After installing the steering gear box (1) and steering support (2) temporarily, tighten the steering gear box mounting screws to the specified torque in the order of A, C and B as illustrated on the left figure.

Tightening torque	Steering gear box mounting screws	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft-lbs
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(1) Steering Gear Box

(2) Steering Support

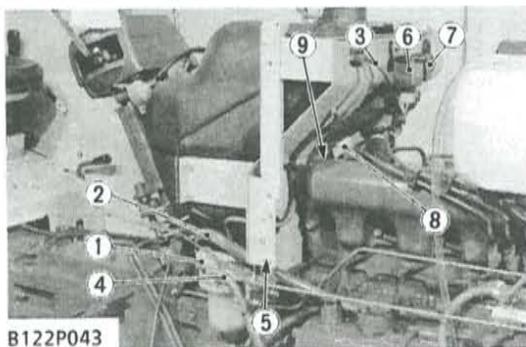
[2]-2 REMOVING STEERING CONTROLLER [4WD TYPE]



B111P009

Covers

1. Remove the side cover both side.
2. Remove the other covers (1), (2), (3), (4), (5), (6), (7), (8), (9), (10) and panel board (11).

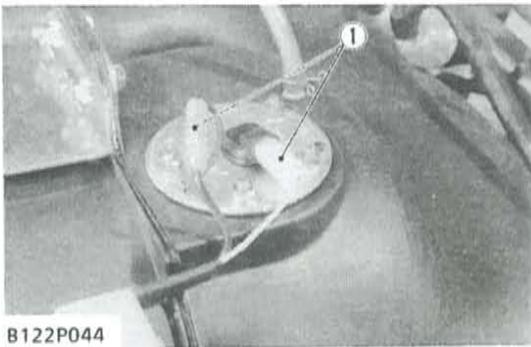


B122P043

Right Side

1. Close the fuel cock (1) on the fuel filter bracket.
2. Disconnect the fuel pipes (3), (4) from the fuel tank and the fuel filter bracket.
3. Disconnect the power steering hydraulic return hose (2) from the steering controller side.
4. Remove the engine stop rod guide mounting screw (5).
5. Disconnect the connectors from the engine key stop timer relay (6), starter relay (7), glow plug (8) and coolant temperature sensor (9).

- | | |
|--|---------------------------------|
| (1) Fuel Cock | (5) Screw |
| (2) Power Steering Hydraulic Return Hose | (6) Engine Key Stop Timer Relay |
| (3) Fuel Pipe | (7) Starter Relay |
| (4) Fuel Pipe | (8) Glow Plug |
| | (9) Coolant Temperature Sensor |

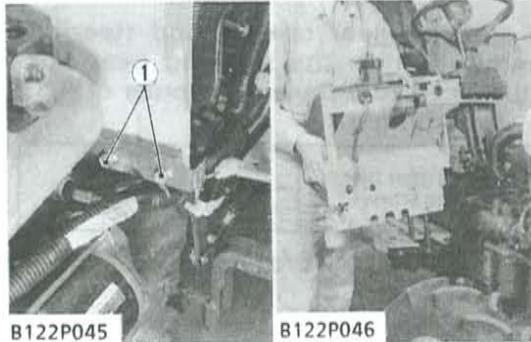


B122P044

Left Side

1. Disconnect the connectors (1) from fuel level sensor.

(1) Connectors



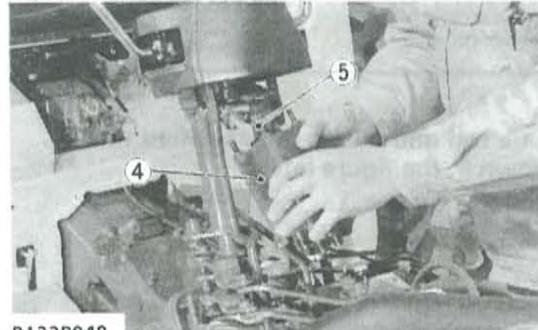
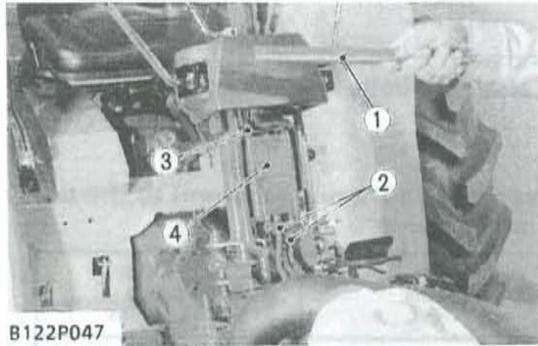
B122P045

B122P046

Fuel Tank

1. Remove the four tank support mounting screws (1) from both sides of tractor.
2. Remove the fuel tank, tank support and fuel filter as a unit.

(1) Screws



Steering Controller Assembly

1. Remove the bonnet support (1).
2. Disconnect the four power steering hydraulic flared pipes (2) from the steering controller assembly.
3. Remove the three steering controller mounting nuts (3), then remove the steering controller assembly (4) and joint shaft (5) as a unit.

(When reassembling)

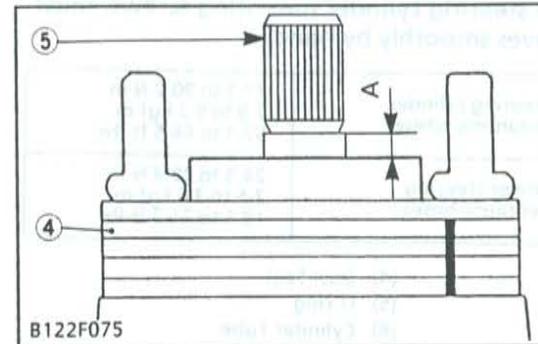
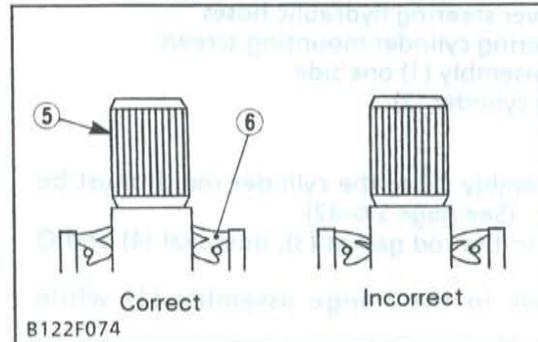
- Apply clean grease to the joint shaft (5).
- After install the joint shaft (5) to the steering controller (4), check the dust seal (6). (See figure)

■ IMPORTANT

- After install the joint shaft (5) to the steering controller (4), distance "A" is approx. 2 mm (0.08 in.). (See figure)

Tightening torques	Steering controller mounting nuts	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
	Power steering hydraulic flared pipes	34.3 to 39.2 N·m 3.5 to 4.0 kgf·m 25.3 to 28.9 ft-lbs

- (1) Bonnet Support
- (2) Power Steering Hydraulic Flared Pipes
- (3) Nuts
- (4) Steering Controller
- (5) Joint Shaft
- (6) Dust Seal



[2]-3 REMOVING STEERING CYLINDER [4WD TYPE]



Front Wheels

1. Place the jack under the front bumper.
2. Remove the front wheels.

(When reassembling)

Tightening torque	Front wheel mounting screws and nuts	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft-lbs
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B122P050

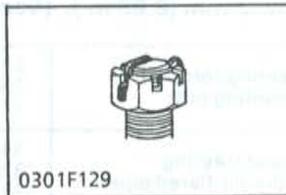
Tie Rod

1. Remove the tie rod end both sides.
2. Remove the tie rod assembly both sides from the cylinder rod.

(When reassembling)

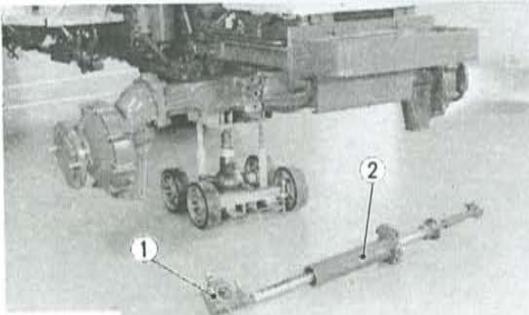
- Apply liquid lock (Three Bond 1372 or equivalent) to the tie rod screws of the cylinder rod side.

Tightening torques	Tie rod end nuts	39.2 to 45.1 N·m 4.0 to 4.6 kgf·m 28.9 to 33.3 ft-lbs
	Tie rod screws of the cylinder rod side	98.1 to 117.7 N·m 10.0 to 12.0 kgf·m 72.3 to 86.8 ft-lbs



■ IMPORTANT

- After tightening the tie rod end nut to the specified torque, install a cotter pin shown in the figure left.



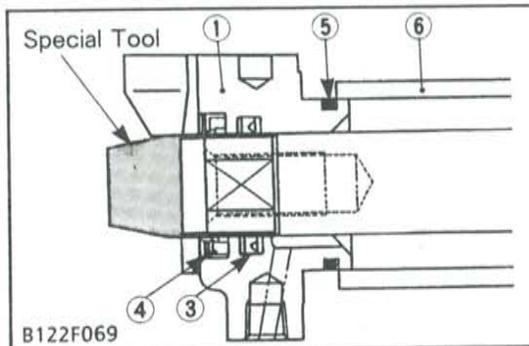
B122P051

Steering Cylinder

1. Remove the two power steering hydraulic hoses.
2. Remove the four steering cylinder mounting screws.
3. Remove the flange assembly (1) one side.
4. Remove the steering cylinder (2).

(When reassembling)

- Insert the flange assembly (1) to the cylinder rod, it must be used the special tool. (See page S.G-42)
- Apply clean grease to the rod gasket (3), dust seal (4) and O ring (5).
- Do not spin or drive in the flange assembly (1) while installing.
- After tightening the steering cylinder mounting screws, must be check the rod moves smoothly by hand.



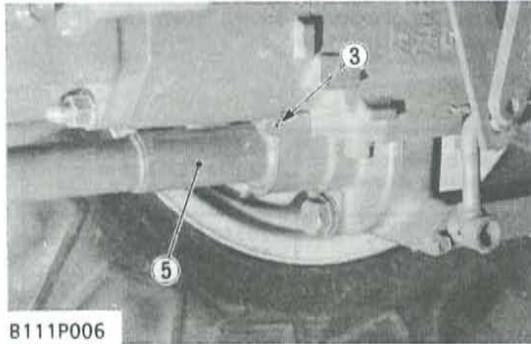
B122F069

Tightening torques	Steering cylinder mounting screws	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
	Power steering hydraulic hoses	24.5 to 29.4 N·m 2.5 to 3.0 kgf·m 18.1 to 21.7 ft-lbs

- (1) Flange Assembly
- (2) Steering Cylinder
- (3) Rod Gasket
- (4) Dust Seal
- (5) O-ring
- (6) Cylinder Tube

[2]-4 SEPARATING FRONT AXLE**Front Axle Case Oil**

1. Draining the front axle case oil. (See page S.G-17)



B111P006

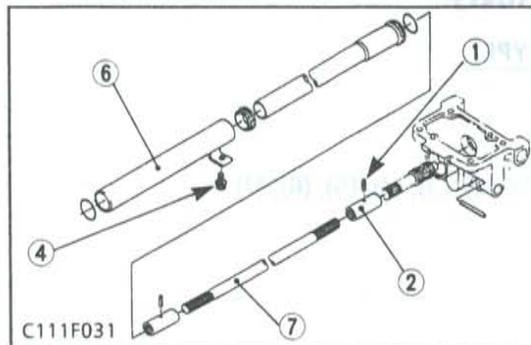
Propeller Shaft [4WD type]

1. Remove the screws (4) then tap out the spring pin (3).
2. Slide the propeller shaft cover (5) to the front.
3. Tap out the spring pin (1) and slide the coupling (2) to the front.

(When reassembling)

- For assembling, slide the front coupling, too.

- | | |
|----------------|-----------------------------|
| (1) Spring Pin | (5) Propeller Shaft Cover 1 |
| (2) Coupling | (6) Propeller Shaft Cover 2 |
| (3) Spring Pin | (7) Propeller Shaft |
| (4) Screw | |



C111F031

Bumper and Tie Rods [2WD TYPE]

1. Remove the bumper and tie rods. (See page S.S-10)

Bumper and Power Steering Hydraulic Hoses [4WD TYPE]

1. Remove the bumper and power steering hydraulic hoses. (See page S.S-14)



B111P007

Front Wheels

1. Place disassembly stand under the front axle, and support it with a jack.
2. Remove the front wheels.

(When reassembling)

Tightening torque	Front wheel mounting screws and nuts	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft·lbs
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Front Axle

1. Place disassembly stand under the clutch housing, and support it with a jack.
2. Remove the shaft bracket 1 mounting screws and shaft bracket 2 mounting screws.
3. Separate the front axle with propeller shaft from the front axle frame.

(When reassembling)

Tightening torques	Shaft bracket 1 mounting screws	124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108.0 ft-lbs
	Shaft bracket 2 mounting screws	103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft-lbs

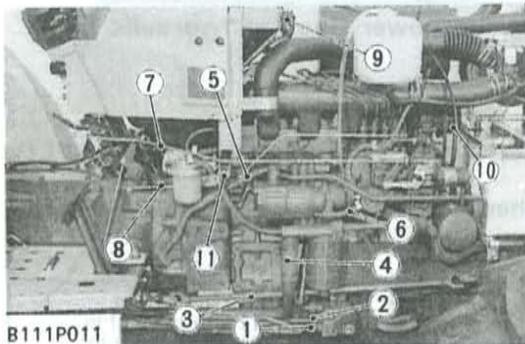
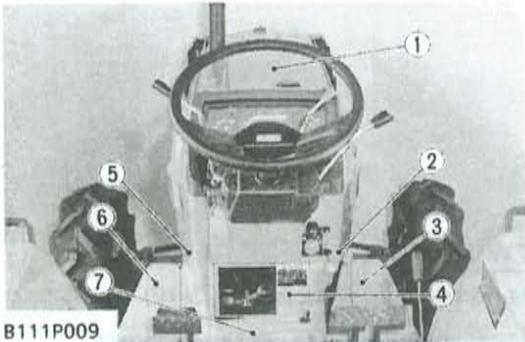
[2]-5 SEPARATING ENGINE FROM CLUTCH HOUSING

Propeller Shaft [4WD TYPE]

(See page S.5-15)

Covers

1. Remove the covers (1), (2), (3), (4), (5), (6), (7).



Right Side [2WD TYPE]

Remove the following parts.

- | | |
|-------------------|---------------------|
| (1) Delivery Pipe | (7) Stop Rod |
| (2) Return Pipe | (8) Accelerator Rod |
| (3) Joint Shaft | (9) Pipe |
| (4) Rubber Pipe | (10) Flexible Cable |
| (5) Pipe | (11) Screws |
| (6) Fuel Pipe | |

(When reassembling)

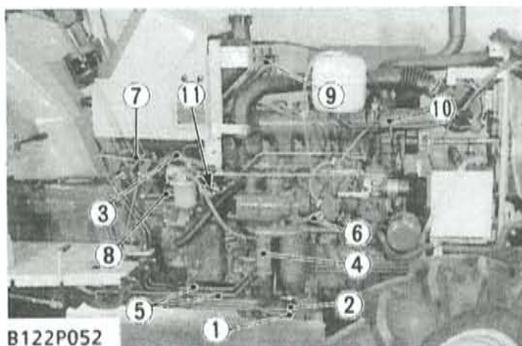
- Pay attention to steering joint arrangement. (See page S.5-10)

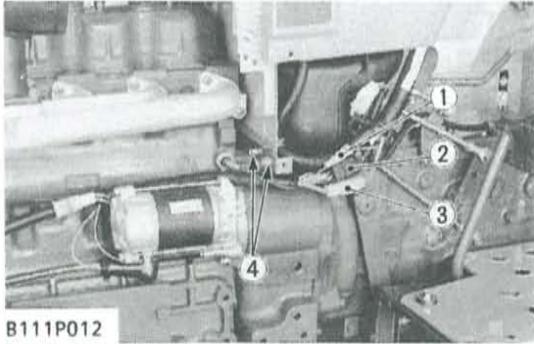
Tightening torque	Steering joint shaft 3 lock screw	29.4 to 34.3 N·m 3.0 to 3.5 kgf·m 21.7 to 25.3 ft-lbs
-------------------	--------------------------------------	---

Right Side [4WD TYPE]

Remove the following parts.

- | | |
|------------------------------------|---------------------|
| (1) Delivery Pipe | (7) Stop Rod |
| (2) Return Pipe | (8) Accelerator Rod |
| (3) Power Steering Return Hose | (9) Pipe |
| (4) Rubber Pipe | (10) Flexible Cable |
| (5) Power Steering Hydraulic Pipes | (11) Screws |
| (6) Fuel Pipe | |



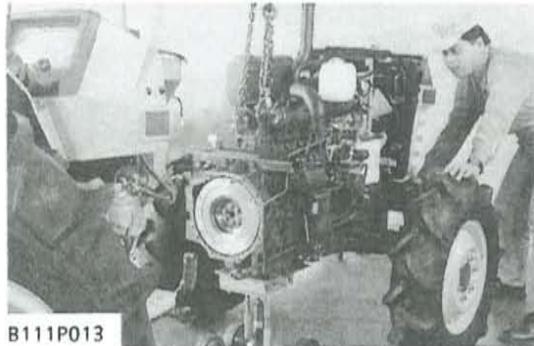


B111P012

Left Side

Remove the following parts.

- (1) 1P Connector
- (2) 2P Connector
- (3) 16P Connector
- (4) Screws



B111P013

Separating Engine

1. Place disassembly stand under the engine and clutch housing, and support them with jacks.
2. Remove the engine mounting screws and nuts.
3. Separate the engine from the clutch housing.

(When reassembling)

- Apply grease to splines.
- Apply liquid gasket (Three Bond 1104 or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine mounting screws and nuts to clutch housing	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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[2]-6 SEPARATING ENGINE

Coolant

1. Draining the coolant. (See page S.G-27)

Propeller Shaft [4WD TYPE]

(See page S.S-15)

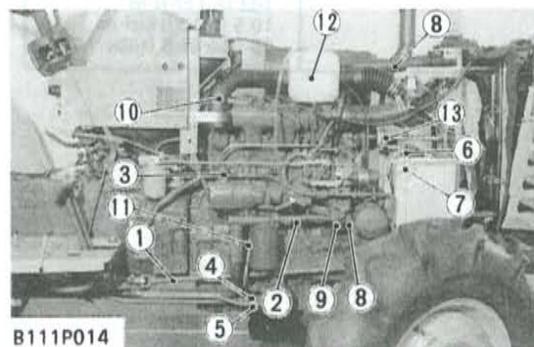
Covers

(See page S.S-16)

Right Side [2WD TYPE]

Remove the following parts.

- (1) Joint Shaft
- (2) P.S. Return Pipe
- (3) P.S. Delivery Pipe
- (4) Return Pipe
- (5) Delivery Pipe
- (6) Negative Terminal
- (7) 1P Connector
- (8) Radiator Hoses
- (9) Stay
- (10) Pipe
- (11) Pipe
- (12) Reserve Tank
- (13) Fan Joint

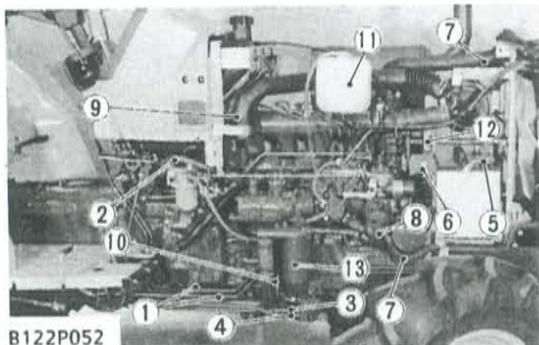


B111P014

(When reassembling)

- Pay attention to steering joint arrangement. (See page S.S-10)

Tightening torque	Steering joint shaft 3 lock screw	29.4 to 34.3 N·m 3.0 to 3.5 kgf·m 21.7 to 25.3 ft·lbs
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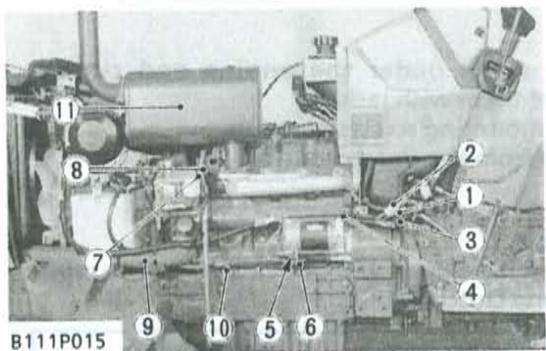


Right Side [4WD TYPE]

Remove the following parts.

- (1) Power Steering Hydraulic Pipes
- (2) Power Steering Return Hose
- (3) Return Pipe
- (4) Delivery Pipe
- (5) Negative Terminal
- (6) 1P Connector
- (7) Radiator Hoses
- (8) Stay
- (9) Pipe
- (10) Pipe
- (11) Reserve Tank
- (12) Fan Joint
- (13) Hydraulic Filter

B122P052

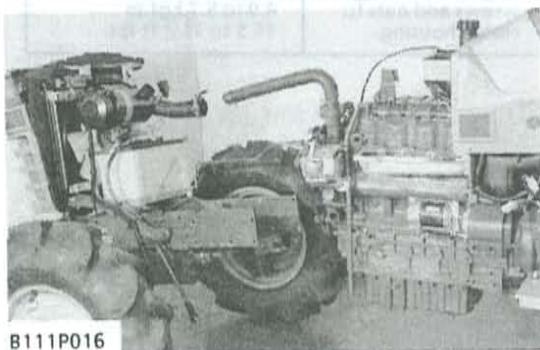


Left Side

Remove the following parts.

- (1) 1P Connector
- (2) 2P Connector
- (3) 16P Connector
- (4) Jumper Lead
- (5) S.Terminal
- (6) B Terminal
- (7) 2P Connector
- (8) B Terminal
- (9) Radiator Hose
- (10) Level Gauge
- (11) Muffler

B111P015

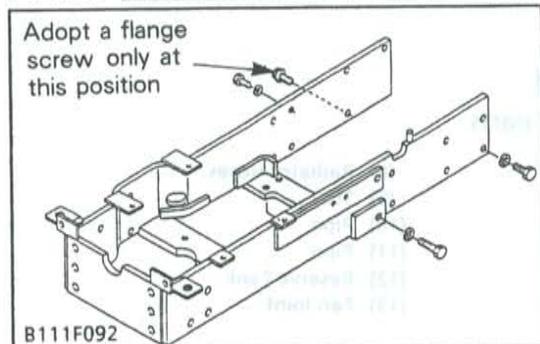


Front Axle Flame

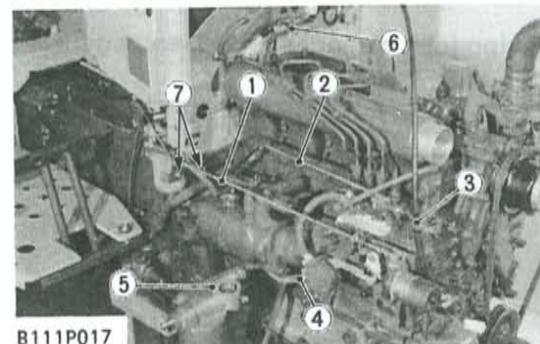
1. Place disassembly stand under the clutch housing, and support it with jack.
2. Remove the front axle frame mounting screws.
3. Separate the front axle frame from engine.

(When reassembling)

Tightening torques	Front axle frame mounting screws to engine	(Thread size: 10 mm, 0.39 in. DIA.) 60.8 to 70.5 N·m 6.2 to 7.2 kgf·m 44.9 to 52.1 ft·lbs
		(Thread size: 12 mm, 0.47 in. DIA.) 103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft·lbs



B111F092

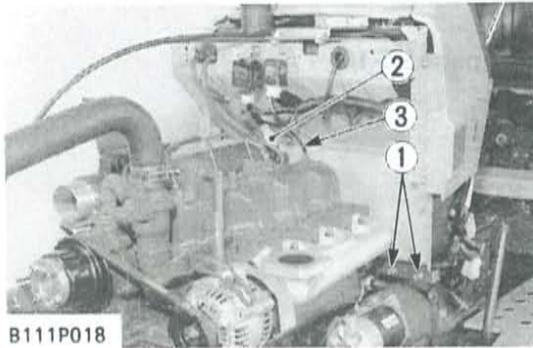


Right Side

Remove the following parts.

- (1) Stop Rod
- (2) Accelerator Rod
- (3) Flexible Cable
- (4) Fuel Pipe
- (5) Filter Bracket
- (6) Pipe
- (7) Screws

B111P017

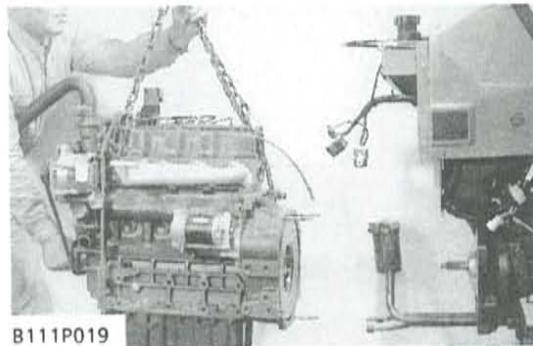


B111P018

Left Side

Remove the following parts.

- (1) Screws
(2) 1P Connector
(3) Jumper Lead



B111P019

Engine

1. Connect the lift chain to the engine hooks, and hoist the engine.
2. Remove the engine mounting screws and nuts.
3. Separate the engine from the clutch housing.

(When reassembling)

- Apply grease to splines.
- Apply liquid gasket (Three bond 1104 or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine mounting screws and nuts	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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[2]-7 SEPARATING CLUTCH HOUSING AND MID CASE**Transmission Fluid**

1. Draining the transmission fluid. (See page S.G-15)

Propeller Shaft [4WD TYPE]

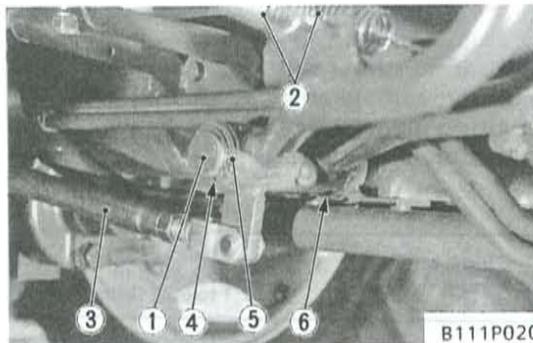
(See page S.S-15)

Brake Pedals and Clutch Pedal

1. Remove the clevis pins at the end of brake rods (3), and the clevis pin at the end of clutch rod.
2. Remove the brake pedal return springs (2) and clutch pedal return spring.
3. Tap out the spring pin (6) in the brake pedal LH.
4. Remove the external snap ring (4) and collar (5).
5. Draw out the brake pedal shaft (1) to the left side of tractor to remove the brake pedals and clutch pedal.

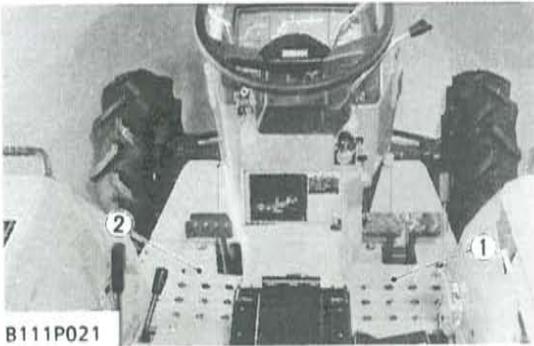
(When reassembling)

- After reassembling the pedals, inject grease and adjust the brake pedal play and clutch pedal play. (See page S.G-19. 20).



B111P020

- (1) Brake Pedal Shaft
(2) Return Spring
(3) Brake Rod
(4) External Snap Ring
(5) Collar
(6) Spring Pin
(7) Clevis Pin



B111P021

(1) Step RH

(2) Step LH

Covers and Steps

1. Remove the covers. (See page S.S-16)
2. Remove the steps.

Right Side

(See page S.S-16)

Left Side

(See page S.S-17)

Separating Engine

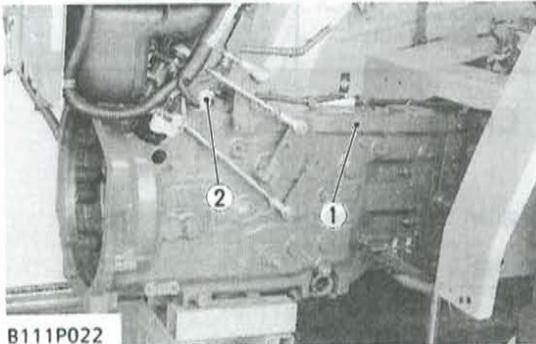
(See page S.S-17)

Shuttle Rod and Wire Harness

1. Remove the shuttle rod.
2. Remove the 4P connector.

(1) Shuttle Rod

(2) 4P Connector



B111P022

Clutch Housing

1. Place a jack under the transmission case.
2. Support the clutch housing with nylon lift straps and hoist.
3. Remove the clutch housing mounting nuts.
4. Separate the clutch housing from mid case.

(When reassembling)

Tightening torque	Clutch housing mounting nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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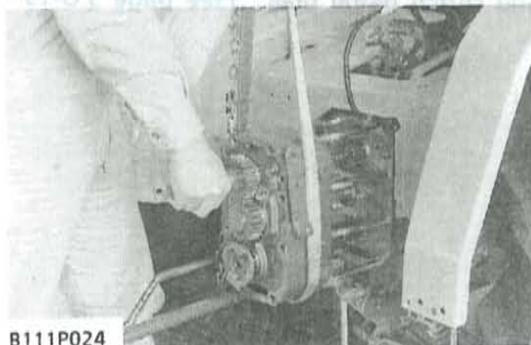
B111P023

Mid Case

1. Support the mid case with nylon lift strap and hoist.
2. Remove the mid case mounting nuts. (L2650, L2950)
3. Separate the mid case from transmission case.

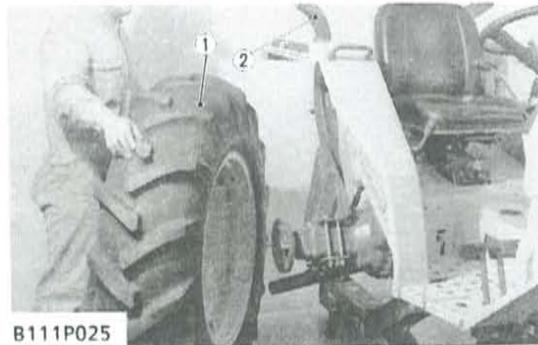
(When reassembling)

Tightening torque	Mid case mounting nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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B111P024

[2]-8 SEPARATING REAR AXLE CASE AND BRAKE CASE



B111P025

(1) Rear Wheel (2) ROPS



B111P026



B111P027

(1) Brake Cam Lever (2) Clevis Pin (3) Fender Support

Transmission Fluid

1. Draining the transmission fluid. (See page S.G-15)

Rear Wheel and ROPS

1. Place the jack under the transmission case.
2. Remove the rear wheel (1) mounting screws and nuts.
3. Remove the rear wheel.
4. Remove the ROPS (2) mounting bolts and nuts.
5. Remove the ROPS.

(When reassembling)

Tightening torque	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft·lbs
-------------------	-------------------------------------	---

Rear Axle Case

1. Support the rear axle case with nylon lift strap and hoist.
2. Remove the rear axle case mounting screws and nut.
3. Separate the rear axle case.

(When reassembling)

- Apply liquid gasket (Three bond 1104 or equivalent) to the rear axle case gasket.

Tightening torques	Rear axle case mounting screws	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
	Rear axle case mounting nut	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs

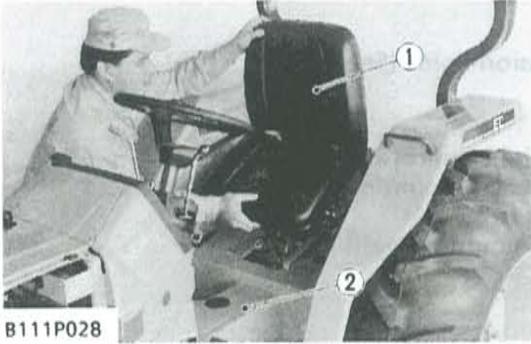
Brake Case

1. Remove the fender support (3).
2. Remove the clevis pin (2) at the end of brake rod.
3. Remove the brake case mounting screws and nuts.
4. Remove the brake case, tapping the brake cam lever (1) lightly.

(When reassembling)

- Apply grease to the brake ball seats. (Do not grease excessively.)
- Apply liquid gasket (Three bond 1104 or equivalent) to the brake case gasket.
- Before installing the brake case to the transmission case, install the cam plate around the four protrusions of the differential bearing case.
- Adopt a 9T screw (marked 9 on it's head) only at A position in the photograph.

Tightening torques	Brake case mounting 7T screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
	Brake case mounting 9T screw (At A position)	103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft·lbs

[2]-9 SEPARATING HYDRAULIC CYLINDER

B111P028

(1) Seat

(2) Floor Cover

Seat and Floor Cover

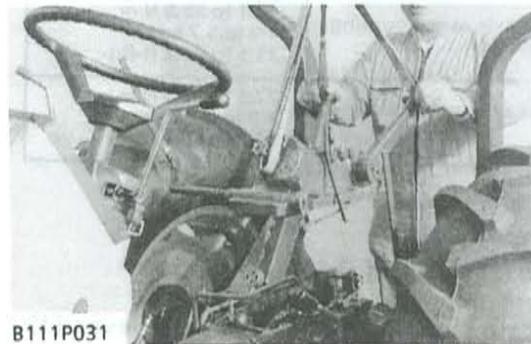
1. Remove the seat.
2. Remove the floor cover.



B111P030

Fender

1. Remove the fender mounting screws.
2. Support the fender with nylon lift strap and hoist.
3. Remove the fender.



B111P031

Hydraulic Cylinder

1. Remove the two screws to disconnect the delivery pipe from hydraulic cylinder, and loosen the delivery pipe nut at the front end of pipe.
2. Disconnect the draft control rod. (If equipped)
3. Remove the fender support both sides.
4. Remove the hydraulic cylinder mounting screws and nuts.
5. Separate the hydraulic cylinder.

(When reassembling)

Tightening torque	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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[2]-10 SEPARATING TRANSMISSION CASE**Transmission Fluid**

1. Draining the transmission fluid. (See page S.G-15)

Propeller Shaft [4WD TYPE]

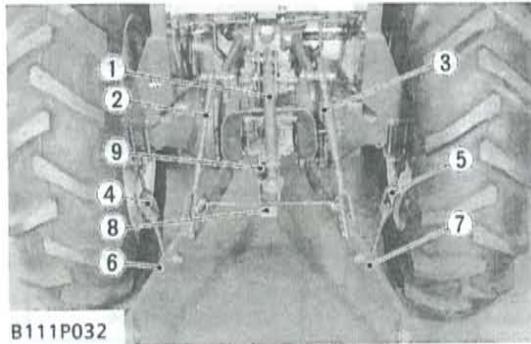
(See page S.S-15)

Seat and Floor Cover

(See page S.S-22)

Fender

(See page S.S-22)



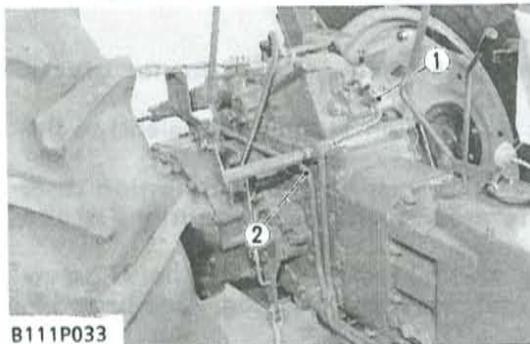
Three Point Hitch and Drawbar

Remove the following parts.

- | | |
|--------------------|-------------------|
| (1) Top Link | (6) Lower Link LH |
| (2) Lift Rod LH | (7) Lower Link RH |
| (3) Lift Rod RH | (8) Drawbar |
| (4) Check Chain LH | (9) Drawbar Frame |
| (5) Check Chain RH | |

(When reassembling)

Tightening torques	Drawbar frame mounting screws	(Thread size: 12 mm, 0.47 in. DIA.) 77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
		(Thread size: 14 mm, 0.55 in. DIA.) 124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108 ft·lbs



Preparation

Remove the following parts.

- | | |
|-------------------|-----------------|
| (1) Delivery Pipe | (2) Return Pipe |
|-------------------|-----------------|



Rear Wheels and ROPS

1. Place a jack under the transmission case.
2. Support the clutch housing with nylon lift strap and hoist.
3. Remove the rear wheel mounting screws and nuts.
4. Remove the rear wheels.
5. Remove the ROPS.

Tightening torque	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft·lbs
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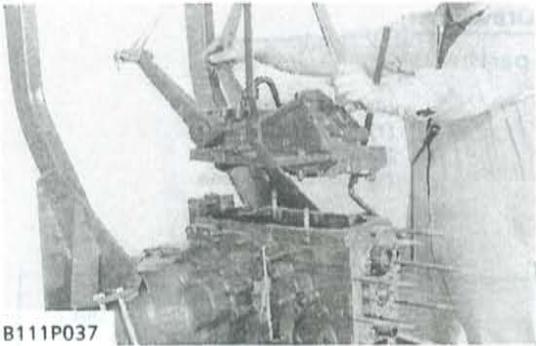


Clutch Housing and Mid Case

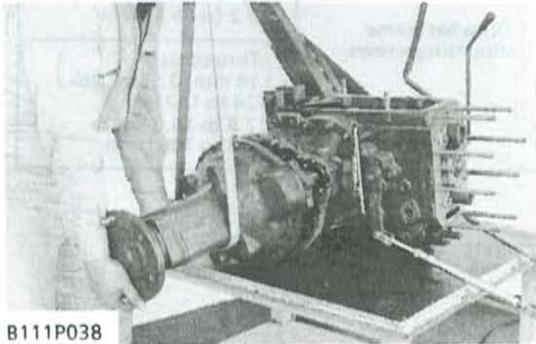
1. Place disassembly stand under the clutch housing and support the transmission case with nylon lift straps and hoist.
2. Remove the clutch housing mounting nuts. (L3450, L3650)
3. Remove the mid case mounting nuts. (L2650, L2950)
4. Separate the clutch housing and mid case.

(When reassembling)

Tightening torque	Clutch housing mounting nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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B111P037



B111P038

Hydraulic Cylinder

1. Disconnect the draft control rod from draft control valve. (If equipped).
2. Remove the fender support both sides.
3. Remove the hydraulic cylinder mounting screws and nuts.
4. Separate the hydraulic cylinder.

(When reassembling)

Tightening torque	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
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Rear Axle Case and Brake Case

1. Support the rear axle case with nylon lift strap and hoist.
2. Remove the rear axle case mounting screws and nuts, and separate the rear axle case.
3. Remove the brake case mounting screws and nuts, and remove the brake case, tapping the brake cam lever lightly.

(When reassembling)

- Apply grease to the brake ball seats. (Do not grease excessively.)
- Apply liquid gasket (Three bond 1104 or equivalent) to the brake case gasket and rear axle case gasket.
- Before installing the brake case to the transmission case, install the cam plate around the four protrusions of the differential bearing case.
- When reassembling the brake case, tighten the 9T screw (marked 9 on it's head), noting it's position. (See page S.S-21)

Tightening torques	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft-lbs
	Rear axle case mounting screws	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft-lbs
	Rear axle case mounting nut	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
	Brake case mounting 7T screws and nuts	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
	Brake case mounting 9T screw	103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft-lbs

[3] L2650GST, L2950GST, L3450GST, L3650GST**[3]-1 REMOVING STEERING CONTROLLER**

Refer to [2]-2 REMOVING STEERING CONTROLLER (See page S.S-11).

[3]-2 REMOVING STEERING CYLINDER

Refer to [2]-3 REMOVING STEERING CYLINDER (See page S.S-13).

[3]-3 SEPARATING FRONT AXLE

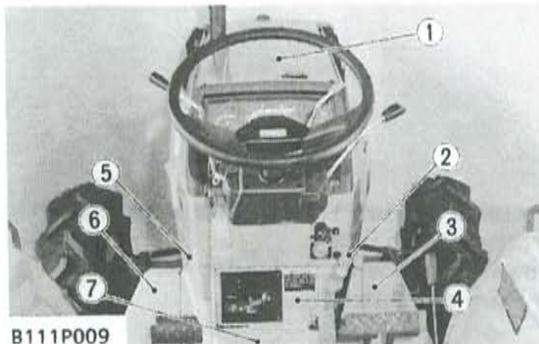
Refer to [2]-4 SEPARATING FRONT AXLE (See page S.S-15).

[3]-4 SEPARATING ENGINE FROM CLUTCH HOUSING**Propeller Shaft**

(See page S.S-15)

Covers

1. Remove the covers (1), (2), (3), (4), (5), (6), (7).

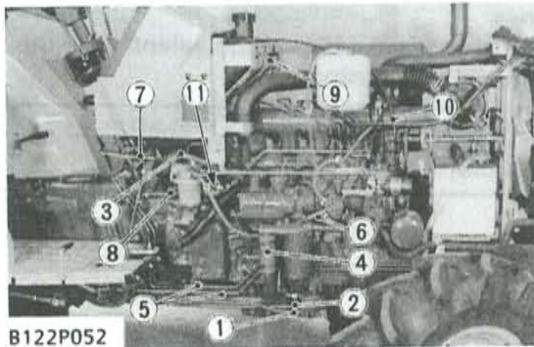


B111P009

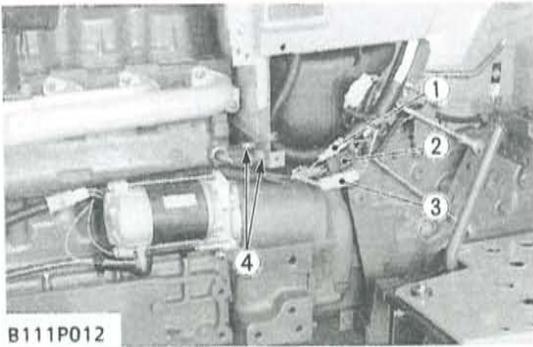
Right Side

Remove the following parts.

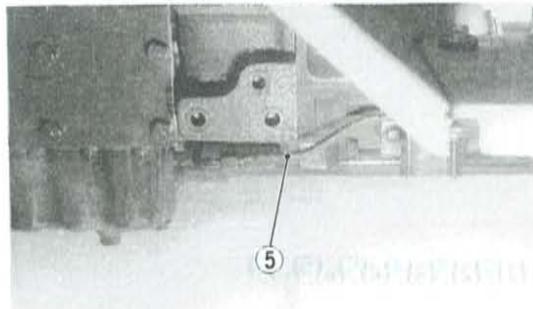
- | | |
|------------------------------------|---------------------|
| (1) Delivery Pipe | (7) Stop Rod |
| (2) Return Pipe | (8) Accelerator Rod |
| (3) Power Steering Return Hose | (9) Pipe |
| (4) Rubber Pipe | (10) Flexible Cable |
| (5) Power Steering Hydraulic Pipes | (11) Screws |
| (6) Fuel Pipe | |



B122P052



B111P012



0329P253



B111P013

Left Side

1. Disconnect the connectors (1), (2) and (3).
2. Disconnect the GST system hydraulic pipe (5).
3. Remove the screws (4).

- (1) 1P Connector
- (2) 2P Connector
- (3) 16P Connector
- (4) Screws
- (5) GST System Hydraulic Pipe

Separating Engine

1. Place disassembly stand under the engine and clutch housing, and support them with jacks.
2. Remove the engine mounting screws and nuts.
3. Separate the engine from the clutch housing.

(When reassembling)

- Apply grease to splines.
- Apply liquid gasket (Three Bond 1104 or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine mounting screws and nuts to clutch housing	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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[3]-5 SEPARATING ENGINE

Coolant

1. Draining the coolant. (See page S.G-27)

Propeller Shaft

(See page S.S-15)

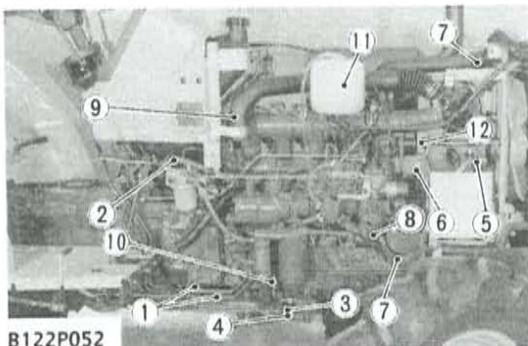
Covers

(See page S.S-25)

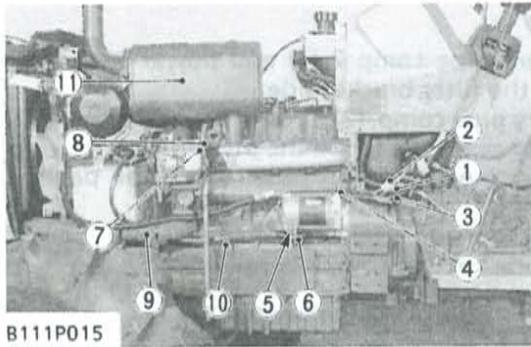
Right Side

Remove the following parts.

- (1) Power Steering Hydraulic Pipes
- (2) Power Steering Return Hose
- (3) Return Pipe
- (4) Delivery Pipe
- (5) Negative Terminal
- (6) 1P Connector
- (7) Radiator Hoses
- (8) Stay
- (9) Pipe
- (10) Pipe
- (11) Reserve Tank
- (12) Fan Joint



B122P052

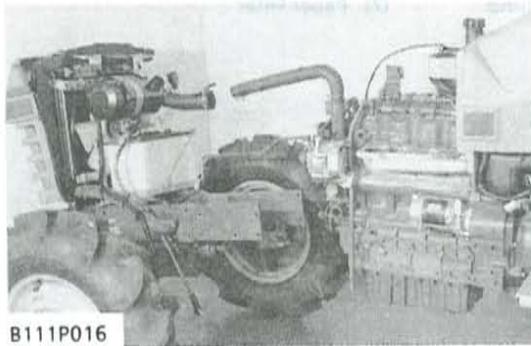


B111P015

Left Side

Remove the following parts.

- (1) 1P Connector
- (2) 2P Connector
- (3) 16P Connector
- (4) Jumper Lead
- (5) S.Terminal
- (6) B Terminal
- (7) 2P Connector
- (8) B Terminal
- (9) Radiator Hose
- (10) Level Gauge
- (11) Muffler



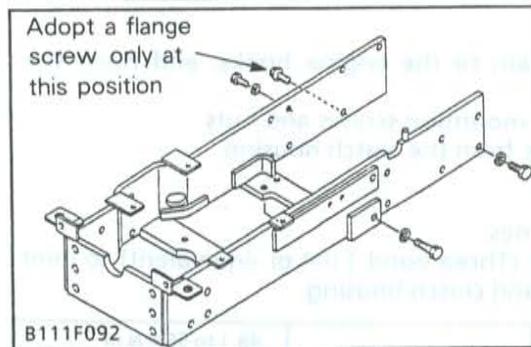
B111P016

Front Axle Frame

1. Place disassembly stand under the clutch housing, and support it with jack.
2. Remove the front axle frame mounting screws.
3. Separate the front axle frame from engine.

(When reassembling)

Tightening torques	Front axle frame mounting screws to engine	(Thread size: 10 mm, 0.39 in. DIA.) 60.8 to 70.5 N·m 6.2 to 7.2 kgf·m 44.9 to 52.1 ft-lbs
		(Thread size: 12 mm, 0.47 in. DIA.) 103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft-lbs



B111F092

Adopt a flange screw only at this position

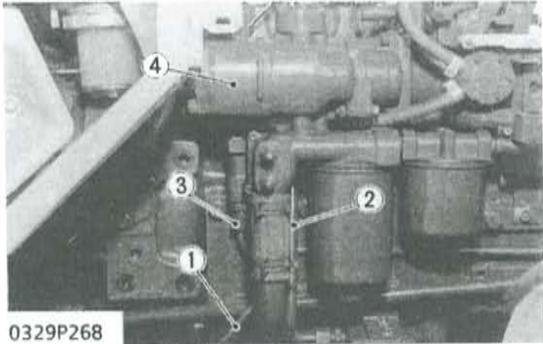


B111P017

Right Side

Remove the following parts.

- (1) Stop Rod
- (2) Accelerator Rod
- (3) Flexible Cable
- (4) Fuel Pipe
- (5) Pipe
- (6) Screws

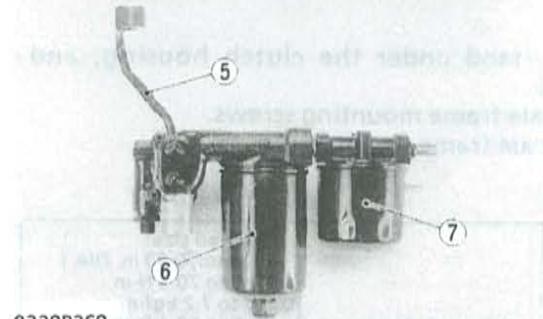


0329P268

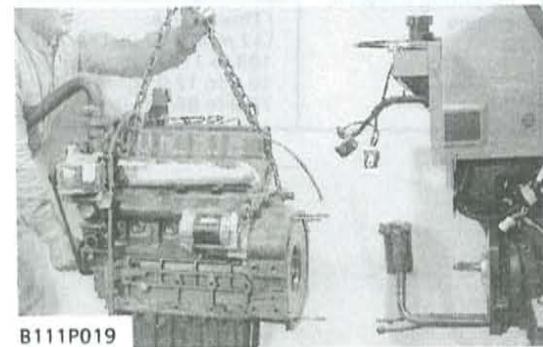
Filter Bracket Assembly

1. Remove the delivery pipe comp 2 (1) and power steering pipe 1 comp (3) on the filter bracket side.
2. Remove the delivery pipe comp. (2).
3. Remove the delivery pipe P-RE (5) on the pump side.
4. Remove the power steering return pipe before the paper filter.
5. Remove the oil pressure pump (4) as a complete unit.
6. Remove the filter bracket as a complete unit.

- | | |
|---------------------------------|------------------------|
| (1) Delivery Pipe Comp 2 | (5) Delivery Pipe P-RE |
| (2) Delivery Pipe Comp | (6) Filter Cartridge |
| (3) Power Steering Pipe 1 Comp. | (7) Paper Filter |
| (4) Oil Pressure Pump | |



0329P269



B111P019

Engine

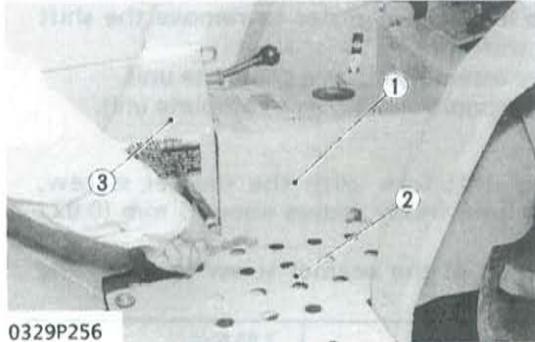
1. Connect the lift chain to the engine hooks, and hoist the engine.
2. Remove the engine mounting screws and nuts.
3. Separate the engine from the clutch housing.

(When reassembling)

- Apply grease to splines.
- Apply liquid gasket (Three bond 1104 or equivalent) to joint face of the engine and clutch housing.

Tightening torque	Engine mounting screws and nuts	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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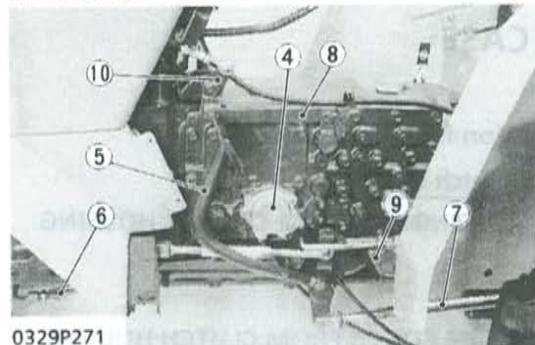
[3]-6 REMOVING SIDE COVER FROM CLUTCH HOUSING



0329P256

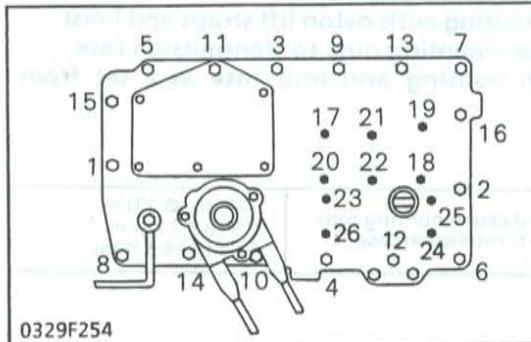
(1) Left Foot Cover
(2) Left Step

(3) Side Cover



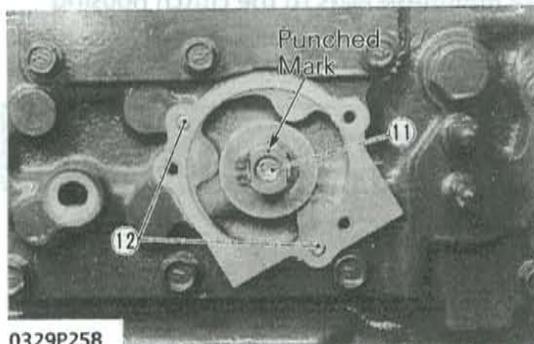
0329P271

(4) Shift Cable
(5) Clutch Pedal
(6) Delivery Pipe Comp. 1
(7) Brake Rod
(8) Shuttle Rod
(9) Left Rear Support
(10) Connecting Arm



0329F254

17 to 22 denote gate valve mounting screws
23 to 26 denote Hi-Lo spool valve mounting screws
1 to 16 denote side cover mounting screws



0329P258

Transmission Fluid

1. Draining the transmission fluid (See page S.G-15).

Side Cover Assembly

1. Start the engine, set all shift levers to neutral positions and stop the engine.
2. Remove the steps (right and left), foot covers (right and left), and side cover.
3. Remove the clutch rod and brake rod (7) and pull out the brake pedal shaft.
4. Remove the shift cable (4).
5. Remove the delivery pipe comp. 1 (6).
6. Remove the shuttle rod (8).
7. Remove the left step rear support (9).
8. Set the connecting arm (10) free.
9. Remove the Hi-Lo shift spool valve and the gate valve mounting screws.
10. Remove the side cover mounting screws and take off the side cover. (Leave the Hi-Lo shift spool valve and the gate valve.)

(When reassembling)

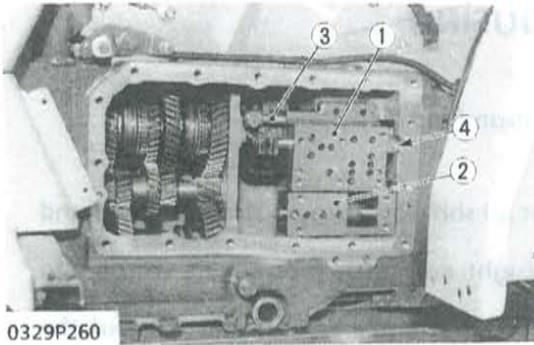
- To facilitate the side cover reassembly, install a stud or guide bar at the upper left (position 15) and upper right (position 7) of the housing case. The stud or guide bar is used as the guide.
- Set the shift lever to neutral position, point the punch mark of the rotary valve shaft (11) upwards, align the punch mark with the straight pin (12), and assemble.
- After assembly, adjust the shift cable. (For adjustment, refer to page S.3-54)
- Hand tighten the side cover mounting screws and tighten them regularly in order from screw 1 to screw 16.
- Before mounting the Hi-Lo shift spool valve and gate valve on the side cover, install an 8 mm stud or guide bar on the valve. This stud or guide bar is used as the guide to facilitate the assembly.
- Tighten mounting screws of the Hi-Lo shift spool valve and gate valve in the order 17 to 22 and 23 to 26.

NOTE

- Note the angle of the shuttle arm and securely fit it into the groove of the shift fitting.
- Hand tighten the Hi-Lo shift spool valve and the gate valve and securely tighten them with a wrench.
- If not tightened straight, the knock pin is scraped resulting in possible oil leakage. If excessively tightened, the valve will not operate properly.

Tightening torques	Side cover mounting screws	42.2 N·m 4.3 kgf·m 31.1 ft-lbs
	Mounting screws of Hi-Lo shift spool valve and gate valve	17.7 N·m 1.8 kgf·m 13.0 ft-lbs

- (11) Rotary Valve Shaft
(12) Straight Pin



0329P260
 (1) Gate Valve (2) Hi-Lo Shift Spool Valve
 (3) Pipe (4) Reamer Screw

Gate Valve, Hi-Lo Shift Spool Valve

1. Move the snap ring of the pipe for gate valve assembly (1) and move the pipe (3) toward the gate valve assembly side.
2. Remove the reamer screw securing the shuttle shift spool and the shift fork after loosen the lock washer, and move the shuttle shift spool to left side in order to remove the shift fork from the shuttle shift spool.
3. Remove the gate valve assembly (1) as a complete unit.
4. Remove the Hi-Lo shift spool valve (2) as a complete unit.

(When reassembling)

- After tightening the shift fork with the reamer screw, confirm that the shift fork freely moves about 5 mm (0.021 in.).
- Confirm the lock washer of the reamer screw for replacing and lock up.

Tightening torque	Shuttle shift fork mounting reamer screw	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
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[3]-7 SEPARATING CLUTCH HOUSING AND MID CASE

Transmission Fluid

1. Draining the Transmission fluid (See page S.G-15).

Separating Engine From Clutch Housing

Refer to [3]-4 SEPARATING ENGINE FROM CLUTCH HOUSING. (See page S.S-25)

Side Cover Assembly

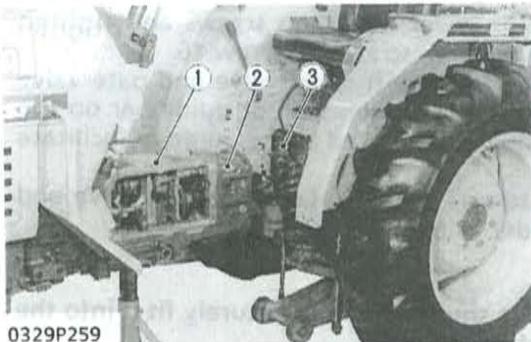
Refer to [3]-6 REMOVING SIDE COVER FROM CLUTCH HOUSING. (See page S.S-29)

Clutch Housing and Mid Case

1. Place a jack under the transmission case.
2. Support the clutch housing with nylon lift straps and hoist.
3. Remove the mid case mounting nuts to transmission case.
4. Separate the clutch housing and mid case as a set from transmission case.

(When reassembling)

Tightening torque	Mid case mounting nuts to transmission case	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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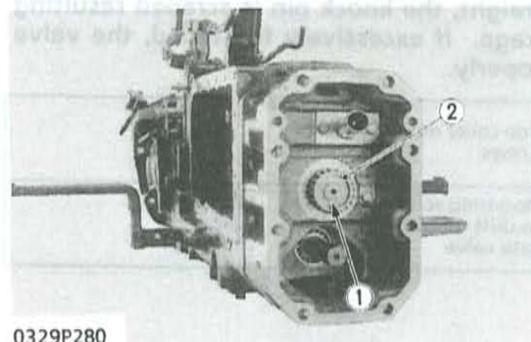
0329P259
 (1) Clutch Housing (2) Mid Case (3) Transmission Case

Mid Case

1. Remove the external snap ring (1) and the spline boss (2).
2. Remove the mid case mounting nuts to the clutch housing.
3. Divide the mid case.

(When reassembling)

Tightening torque	Mid case mounting nuts to clutch housing	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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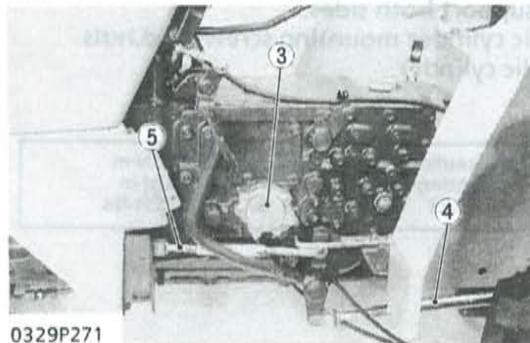
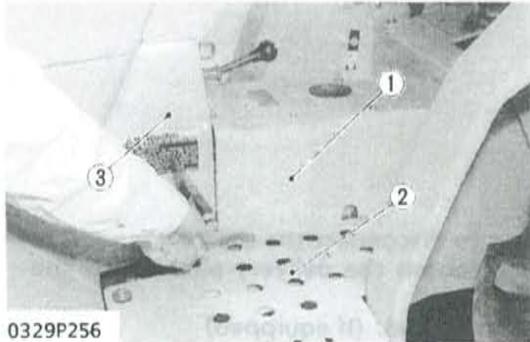


0329P280
 (1) Snap Ring (2) Spline Boss

[3]-8 SEPARATING REAR AXLE CASE AND BRAKE CASE

Refer to [2]-8 SEPARATING REAR AXLE CASE AND BRAKE CASE. (See page S.S-21)

[3]-9 SEPARATING HYDRAULIC CYLINDER

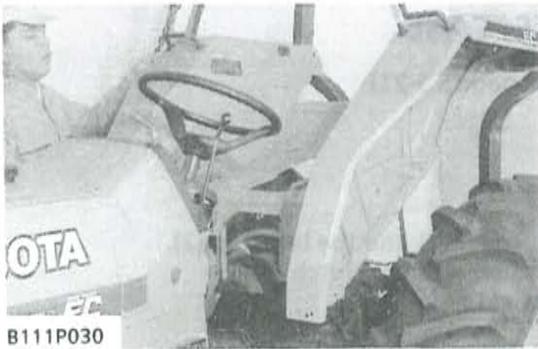


Shift Cable

1. Remove the left foot cover (1) and the left step (2).
2. Remove the brake rod (4) and the clutch rod (5).
3. Remove the shift cable (3).
4. Remove the seat.
5. Remove the rear step (7).
6. Remove the shift guide fixing nut and the shift guide cover (6).
7. Remove the shift guide assembly (8) with the shift cable fitted.

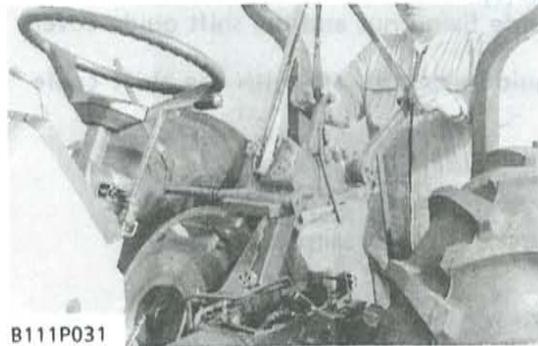
- (1) Left Foot Cover
 (2) Left Step
 (3) Shift Cable
 (4) Brake Rod

- (5) Clutch Rod
 (6) Shift Guide Cover
 (7) Rear Step
 (8) Shift Guide Assembly



Fender

1. Remove the fender mounting screws.
2. Support the fender with nylon lift strap and hoist.
3. Remove the fender.



Hydraulic Cylinder

1. Remove the two screws to disconnect the delivery pipe from hydraulic cylinder, and loosen the delivery pipe nut at the front end of pipe.
2. Disconnect the draft control rod. (If equipped)
3. Remove the fender support both sides.
4. Remove the hydraulic cylinder mounting screws and nuts.
5. Separate the hydraulic cylinder.

(When reassembling)

Tightening torque	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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[3]-10 SEPARATING TRANSMISSION CASE

Transmission Fluid

1. Draining the transmission fluid. (See page S.G-15)

Propeller Shaft [4WD TYPE]

(See page S.S-15)

Shift Cable

(See page S.S-31)

Fender

(See page S.S-32)

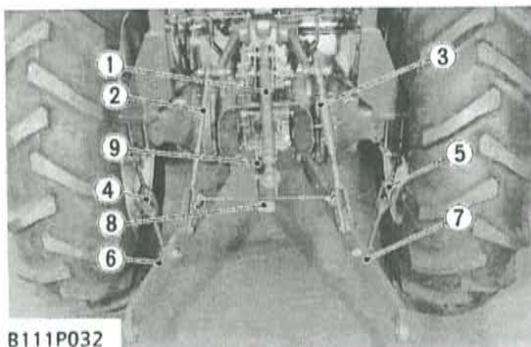
Three Point Hitch and Drawbar

Remove the following parts.

- | | |
|--------------------|-------------------|
| (1) Top Link | (6) Lower Link LH |
| (2) Lift Rod LH | (7) Lower Link RH |
| (3) Lift Rod RH | (8) Drawbar |
| (4) Check Chain LH | (9) Drawbar Frame |
| (5) Check Chain RH | |

(When reassembling)

Tightening torques	Drawbar frame mounting screws	(Thread size: 12 mm, 0.47 in. DIA.) 77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
		(Thread size: 14 mm, 0.55 in. DIA.) 124 to 147 N·m 12.6 to 15.0 kgf·m 91.2 to 108 ft·lbs



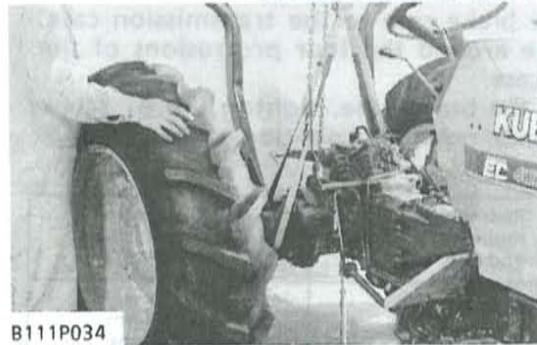


B111P033

Preparation

Remove the following parts.

- (1) Delivery Pipe
- (2) Return Pipe



B111P034

Rear Wheels and ROPS

1. Place a jack under the transmission case.
2. Support the clutch housing with nylon lift strap and hoist.
3. Remove the rear wheel mounting screws and nuts.
4. Remove the rear wheels.
5. Remove the ROPS.

Tightening torque	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft·lbs
-------------------	-------------------------------------	---



B111P035

Clutch Housing and Mid Case

1. Place disassembly stand under the clutch housing and support the transmission case with nylon lift straps and hoist.
2. Remove the mid case mounting nuts to the transmission case.
3. Separate the clutch housing and mid case.

(When reassembling)

Tightening torque	Mid case mounting nuts to transmission case	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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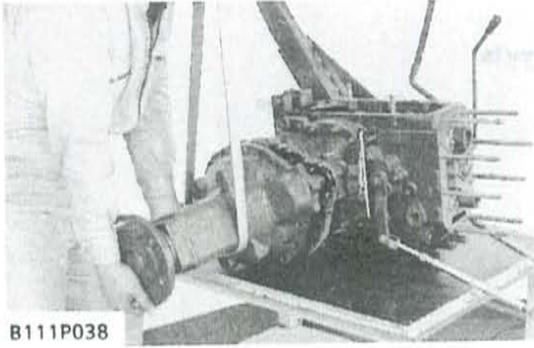
B111P037

Hydraulic Cylinder

1. Disconnect the draft control rod from draft control valve. (If equipped).
2. Remove the fender support both sides.
3. Remove the hydraulic cylinder mounting screws and nuts.
4. Separate the hydraulic cylinder.

(When reassembling)

Tightening torque	Hydraulic cylinder mounting screws and nuts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft·lbs
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B111P038

Rear Axle Case and Brake Case

1. Support the rear axle case with nylon lift strap and hoist.
2. Remove the rear axle case mounting screws and nuts, and separate the rear axle case.
3. Remove the brake case mounting screws and nuts, and remove the brake case, tapping the brake cam lever lightly.

(When reassembling)

- Apply grease to the brake ball seats. (Do not grease excessively.)
- Apply liquid gasket (Three bond 1104 or equivalent) to the brake case gasket and rear axle case gasket.
- Before installing the brake case to the transmission case, install the cam plate around the four protrusions of the differential bearing case.
- When reassembling the brake case, tighten the 9T screw (marked 9 on it's head), noting it's position. (See page S.S-22)

Tightening torques	Rear wheel mounting screws and nuts	197 to 225 N·m 20 to 23 kgf·m 145 to 166 ft-lbs
	Rear axle case mounting screws	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft-lbs
	Rear axle case mounting nut	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
	Brake case mounting 7T screws and nuts	77.5 to 90.1 N·m 7.9 to 9.2 kgf·m 57.2 to 66.5 ft-lbs
	Brake case mounting 9T screw	103 to 117 N·m 10.5 to 12.0 kgf·m 76.0 to 86.8 ft-lbs

S.1 ENGINE

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TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble, and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Engine oil	S.G-13
2	Coolant	S.G-26, 27
3	Fan belt	S.G-23
4	Air cleaner	S.G-21, 28
5	Fuel	-
6	Fuel filter	S.G-19
7	Fuel pipes	S.G-29
8	Air bleed from fuel line	-
9	Battery and terminals	S.9-6
10	Wiring connectors	M.10-1, 2, 3
11	Idling speed	-
12	Maximum speed	-
13	Valve clearance	S.1-14

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	● Incorrect injection timing	Adjust	S.1-47, 54
	● Fuel camshaft worn	Replace	S.1-28
	● Injection nozzle plugged	Clean	S.1-45, 51
	● Fuel transfer pump malfunctioning	Repair or replace	S.1-28
	● Seizure of crankshaft, camshaft, piston, cylinder liner or bearing	Repair or replace	-
	● Compression leak from cylinder	Check compression pressure	S.1-13
	● Improper valve seat alignment, valve spring broken, valve seized	Repair or replace	S.1-21, 22, 23
	● Improper valve timing	Correct or replace timing gear	S.1-27
	● Piston ring and liner worn	Replace	S.1-33, 35, 43, 44
	● Injection pump malfunctioning	Repair or replace	S.1-25, 46, 47, 54, 55
(Starter Does Not Run)	● Starter malfunctioning	Repair or replace	S.9-13
	● Starter switch malfunctioning	Replace	S.9-10
	● Safety switch malfunctioning [L2350]	Replace	S.9-11
	● Shuttle limit switch, P.T.O. limit switch malfunctioning [Except L2350]	Replace	S.9-11
	● Starter relay malfunctioning [Except L2350]	Replace	S.9-12

Symptom	Probable Cause	Solution	Reference Page
Engine Revolution Is Not Smooth	<ul style="list-style-type: none"> ● Injection pump malfunctioning ● Incorrect nozzle opening pressure ● Injection nozzle stuck or plugged ● Governor malfunctioning 	Repair or replace Adjust Replace Repair	S.1-25,46, 47, 54, 55 S.1-45,48, 51, 52 S.1-45,48, 51, 58 S.1-26, 28
Either White or Blue Exhaust Gas Is Observed	<ul style="list-style-type: none"> ● Piston ring and liner worn or stuck ● Incorrect injection timing ● Deficient compression 	Repair or replace Adjust Check compression pressure	S.1-33,35, 43, 44 S.1-47,54 S.1-13
Either Black or Dark Gray Exhaust Gas Is Observed	<ul style="list-style-type: none"> ● Overload 	Lessen the load	–
Deficient Output	<ul style="list-style-type: none"> ● Incorrect injection timing ● Engine's moving parts seem to be seizing ● Uneven fuel injection ● Deficient nozzle injection ● Compression leak 	Adjust Repair or replace Repair or replace injection pump Repair or replace nozzle Check compression pressure	S.1-47,54 – S.1-25,46, 47, 54, 55 S.1-45,48, 51, 52 S.1-13
Excessive Lubricant Oil Consumption	<ul style="list-style-type: none"> ● Piston ring's gap facing the same direction ● Oil ring worn or stuck ● Piston ring groove worn ● Valve stem and guide worn ● Crankshaft bearing, and crank pin bearing worn 	Shift ring gap direction Replace Replace piston Replace Replace	S.1-33 S.1-37 S.1-37 S.1-21 S.1-39,40, 41, 42
Fuel Mixed into Lubricant Oil	<ul style="list-style-type: none"> ● Injection pump's plunger worn ● Fuel transfer pump broken [Except L2350] 	Replace pump element or pump Replace	S.1-25 S.1-28
Water Mixed into Lubricant Oil	<ul style="list-style-type: none"> ● Head gasket defective ● Cylinder block or cylinder head flawed 	Replace Replace or repair	S.1-19 S.1-20
Low Oil Pressure	<ul style="list-style-type: none"> ● Oil strainer clogged ● Oil filter cartridge clogged ● Relief valve stuck with dirt ● Relief valve spring weaken or broken ● Excessive oil clearance of crankshaft bearing ● Excessive oil clearance of crank pin bearing ● Excessive oil clearance of rocker arm bush ● Oil passage clogged ● Oil pump defective 	Clean Replace Clean Replace Replace Replace Replace Clean Repair or replace	S.1-32 S.G-14 – – S.1-39,40, 41 S.1-42 S.1-23 – S.1-28,63
High Oil Pressure	<ul style="list-style-type: none"> ● Relief valve defective 	Replace	–

Symptom	Probable Cause	Solution	Reference Page
Engine Overheated	● Radiator net and radiator fin clogged with dust	Clean	–
	● Inside of radiator corroded	Clean or replace	S.G-26,27
	● Cooling water flow route corroded	Clean or replace	S.G-26,27,30
	● Radiator cap defective	Replace	S.1-60
	● Radiator hose damaged	Replace	S.G-30
	● Overload running	Loosen the load	–
	● Head gasket defective	Replace	S.1-19
	● Incorrect injection timing	Adjust	S.1-47,54
	● Thermostat defective	Replace	S.1-61,62
	● Water pump defective	Replace	S.1-61
● Mechanical seal defective	Replace	S.1-61	

SERVICING SPECIFICATIONS

[1] ENGINE BODY

CYLINDER HEAD

Item		Factory Specification	Allowable Limit
Cylinder Head Surface	Flatness	–	0.05 mm 0.0020 in.
Top Clearance	[D1102]	0.7 to 0.9 mm 0.0276 to 0.0354 in.	–
	[D1402-DI] [D1462-DI] [V1902-DI]	0.6 to 0.7 mm 0.0236 to 0.0276 in.	–
Cylinder Head Gasket	Thickness [D1102]	Free 1.30 to 1.60 mm 0.0512 to 0.0630 in.	–
	[D1402-DI] [D1462-DI] [V1902-DI]	1.25 to 1.45 mm 0.0492 to 0.0571 in.	–
Compression Pressure	[D1102]	2.84 to 3.24 MPa 29 to 33 kgf/cm ² 412 to 469 psi	2.26 MPa 23 kgf/cm ² 320 psi
	[D1402-DI] [D1462-DI] [V1902-DI]	2.75 to 3.04 MPa 28 to 31 kgf/cm ² 398 to 441 psi	2.16 MPa 22 kgf/cm ² 313 psi

VALVES

Item		Factory Specification	Allowable Limit
Valve Clearance (Cold)		0.18 to 0.22 mm 0.0071 to 0.0087 in.	—
Valve Seat	Width	IN, EX. 2.1 mm IN, EX. 0.083 in.	—
	Angle	IN, EX. 0.783 to 0.787 rad. IN, EX. 44°55' to 45°05'	—
Valve Face	Angle	IN, EX. 0.792 to 0.796 rad. IN, EX. 45°23' to 45°37'	—
Valve Recessing	[D1102]	1.1 to 1.3 mm 0.043 to 0.051 in.	1.6 mm 0.063 in.
	[D1402-DI] [D1462-DI] [V1902-DI]	0.65 to 0.85 mm 0.026 to 0.033 in.	1.15 mm 0.045 in.
Valve Stem to Valve Guide	Clearance	0.04 to 0.07 mm 0.0016 to 0.0028 in.	0.1 mm 0.0039 in.
	Valve Stem O.D.	7.960 to 7.975 mm 0.3134 to 0.3140 in.	—
	Valve Guide I.D.	8.015 to 8.030 mm 0.3156 to 0.3161 in.	—
Valve Guide	Protrusion	9.8 to 10.2 mm 0.39 to 0.40 in.	—

VALVE TIMING

Inlet Valve	Open	[D1102]	0.35 rad., 20° before T.D.C.	—
		[D1402-DI] [D1462-DI] [V1902-DI]	0.14 rad., 8° before T.D.C.	—
	Close	[D1102]	0.79 rad., 45° after B.D.C.	—
		[D1402-DI] [D1462-DI] [V1902-DI]	0.35 rad., 20° after B.D.C.	—
Exhaust Valve	Open	[D1102]	0.87 rad., 50° before B.D.C.	—
		[D1402-DI] [D1462-DI] [V1902-DI]	0.63 rad., 60° before B.D.C.	—
	Close	[D1102]	0.26 rad., 15° after T.D.C.	—
		[D1402-DI] [D1462-DI] [V1902-DI]	0.21 rad., 12° after T.D.C.	—

VALVE SPRING

Item	Factory Specification	Allowable Limit
Free Length	41.7 to 42.2 mm 1.6417 to 1.6614 in.	41.2 mm 1.6220 in.
Setting Load / Setting Length	117.7 N/35.15 mm 12 kgf/35.15 mm 26.5 lbs/1.38 in.	100.0 N/35.15 mm 10.2 kgf/35.15 mm 22.5 lbs/1.38 in.
Tilt	—	1.0 mm 0.039 in.

ROCKER ARM

Rocker Arm Shaft to Rocker Arm	Clearance	0.018 to 0.070 mm 0.0007 to 0.0028 in.	0.15 mm 0.0059 in.
Rocker Arm Shaft	O.D.	13.973 to 13.984 mm 0.5501 to 0.5506 in.	—
Rocker Arm Bore	I.D.	14.002 to 14.043 mm 0.5513 to 0.5529 in.	—

TIMING GEAR

Timing Gear	Backlash	0.04 to 0.11 mm 0.0016 to 0.0043 in.	0.15 mm 0.0059 in.
Idle Gear	Side Clearance	0.20 to 0.51 mm 0.0079 to 0.0201 in.	0.90 mm 0.0354 in.
Idle Gear Shaft to Idle Gear Bushing	Clearance	0.020 to 0.054 mm 0.0008 to 0.0021 in.	0.10 mm 0.0039 in.
Idle Gear Shaft	O.D. [D1102]	27.967 to 27.980 mm 1.10106 to 1.10158 in.	—
	D1402-DI	31.959 to 31.975 mm	—
	D1462-DI	1.2582 to 1.2589 in.	—
	V1902-DI		—
Idle Gear Bushing	I.D. [D1102]	28.000 to 28.021 mm 1.10236 to 1.10319 in.	—
	D1402-DI	32.000 to 32.025 mm	—
	D1462-DI	1.2598 to 1.2608 in.	—
	V1902-DI		—
(Service Parts Dimension) Idle Gear Shaft to Idle Gear Bushing	Clearance	0.020 to 0.084 mm 0.0008 to 0.0033 in.	0.10 mm 0.0039 in.
Idle Gear Shaft	O.D. [D1102]	27.967 to 27.980 mm 1.10106 to 1.10158 in.	—
	D1402-DI	31.967 to 31.980 mm	—
	D1462-DI	1.25854 to 1.25906 in.	—
	V1902-DI		—
Idle Gear Bushing	I.D. [D1102]	28.000 to 28.046 mm 1.10236 to 1.10417 in.	—
	D1402-DI	32.000 to 32.046 mm	—
	D1462-DI	1.25984 to 1.26165 in.	—
	V1902-DI		—

TAPPET AND PUSH ROD

Item		Factory Specification	Allowable Limit
Tappet to Guide	Clearance	0.020 to 0.062 mm 0.0008 to 0.0024 in.	0.07 mm 0.0028 in.
Tappet	O.D.	23.959 to 23.980 mm 0.94327 to 0.94410 in.	-
Tappet Guide	I.D.	24.000 to 24.021 mm 0.94488 to 0.94571 in.	-
Push Rod	Alignment	-	0.25 mm 0.0098 in.

CAMSHAFT

Camshaft	Side Clearance	0.07 to 0.22 mm 0.0028 to 0.0087 in.	0.3 mm 0.0118 in.
Camshaft	Alignment	-	0.05 mm 0.020 in.
Cam	Height (IN., EX.) [D1102]	33.36 mm 1.3134 in.	33.31 mm 1.3114 in.
	[D1402-DI] [D1462-DI] [V1902-DI]	33.463 to 33.483 mm 1.3174 to 1.3182 in.	33.42 mm 1.3157 in.
Camshaft	Oil Clearance	0.050 to 0.091 mm 0.0020 to 0.0036 in.	0.15 mm 0.0059 in.
Camshaft Journal	O.D.	39.934 to 39.950 mm 1.5722 to 1.5728 in.	-
Camshaft Bearing	I.D.	40.000 to 40.025 mm 1.5748 to 1.5758 in.	-

PISTON AND PISTON RING

Piston Pin-bore	I.D. [D1102] [D1402-DI] [D1462-DI] [V1902-DI]	23.000 to 23.013 mm 0.9055 to 0.9060 in. 25.000 to 25.013 mm 0.9843 to 0.9848 in.	23.053 mm 0.9076 in. 25.05 mm 0.9862 in.
Compression Ring 2 to Ring Groove	Clearance	0.093 to 0.120 mm 0.0037 to 0.0047 in.	0.2 mm 0.008 in.
Piston Ring Groove	Width	2.055 to 2.070 mm 0.08091 to 0.08150 in.	-
Compression Ring 2	Width	1.950 to 1.962 mm 0.07677 to 0.07734 in.	-
Oil Ring to Ring Groove	Clearance	0.020 to 0.052 mm 0.00079 to 0.00205 in.	0.15 mm 0.0059 in.
Piston Ring Groove	Width	5.010 to 5.030 mm 0.19724 to 0.19803 in.	-
Oil Ring	Width	4.978 to 4.990 mm 0.19598 to 0.19646 in.	-

PISTON AND PISTON RING (Continued)

Item		Factory Specification	Allowable Limit
Compression Ring 1	Ring Gap	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
Compression Ring 2	Ring Gap	0.30 to 0.45 mm 0.0118 to 0.0177 in.	1.25 mm 0.0492 in.
Oil Ring	Ring Gap	0.25 to 0.45 mm 0.0098 to 0.0177 in.	1.25 mm 0.0492 in.
Piston and Piston Ring	Oversize	+ 0.5 mm + 0.020 in.	—

CONNECTING ROD

Connecting Rod	Alignment	0.02 mm 0.0008 in.	0.05 mm 0.0020 in.
Piston Pin to Small End Bushing	Clearance	0.014 to 0.038 mm 0.0006 to 0.0015 in.	0.15 mm 0.0059 in.
Piston Pin	O.D.		
Small End Bushing	[D1102]	23.002 to 23.011 mm 0.9056 to 0.9059 in.	—
	[D1402-DI] [D1462-DI] [V1902-DI]	25.002 to 25.011 mm 0.9843 to 0.9847 in.	—
	I.D.		
	[D1102]	23.025 to 23.040 mm 0.9065 to 0.9071 in.	—
	[D1402-DI] [D1462-DI] [V1902-DI]	25.025 to 25.040 mm 0.9852 to 0.9858 in.	—
(Service Parts Dimension) Piston Pin to Small End Bushing	Clearance	0.015 to 0.067 mm 0.0006 to 0.0026 in.	0.15 mm 0.0059 in.
Piston Pin	O.D.		
	[D1102]	23.002 to 23.011 mm 0.9056 to 0.9059 in.	—
	[D1402-DI] [D1462-DI] [V1902-DI]	25.002 to 25.011 mm 0.9843 to 0.9847 in.	—
Small End Bushing	I.D.		
	[D1102]	23.026 to 23.069 mm 0.9065 to 0.9082 in.	—
	[D1402-DI] [D1462-DI] [V1902-DI]	25.026 to 25.069 mm 0.9853 to 0.9870 in.	—

CRANKSHAFT

Item		Factory Specification	Allowable Limit
Crankshaft	Alignment	0.02 mm 0.0008 in.	0.08 mm 0.0031 in.
Crankshaft to Crankshaft Bearing 1	Oil Clearance	0.040 to 0.118 mm 0.00157 to 0.00465 in.	0.20 mm 0.0079 in.
Crankshaft	O.D.	51.921 to 51.940 mm 2.04414 to 2.04489 in.	-
Crankshaft Bearing 1	I.D.	51.980 to 52.039 mm 2.04646 to 2.04878 in.	-
Crankshaft to Crankshaft Bearing 2	Oil Clearance	0.040 to 0.104 mm 0.00157 to 0.00409 in.	0.20 mm 0.0079 in.
Crankshaft	O.D.	51.921 to 51.940 mm 2.04414 to 2.04489 in.	-
Crankshaft Bearing 2	I.D.	51.980 to 52.025 mm 2.04646 to 2.04823 in.	-
Crank Pin to Crank Pin Bearing	Oil Clearance [D1102]	0.035 to 0.093 mm 0.0014 to 0.0037 in.	0.20 mm 0.0079 in.
Crank Pin	[D1402-DI] [D1462-DI] [V1902-DI]	0.025 to 0.087 mm 0.0010 to 0.0034 in.	0.20 mm 0.0079 in.
	O.D. [D1102]	43.959 to 43.975 mm 1.7307 to 1.7313 in.	-
Crank Pin Bearing	[D1402-DI] [D1462-DI] [V1902-DI]	46.959 to 46.975 mm 1.8488 to 1.8494 in.	-
	I.D. [D1102]	44.010 to 44.052 mm 1.7327 to 1.7343 in.	-
	[D1402-DI] [D1462-DI] [V1902-DI]	47.000 to 47.046 mm 1.8504 to 1.8522 in.	-
Crankshaft	Side Clearance	0.15 to 0.31 mm 0.0059 to 0.0122 in.	0.50 mm 0.0197 in.
Crankshaft Sleeve	Wear	-	0.10 mm 0.004 in.

FLYWHEEL

Flywheel	Flatness	-	1.00 mm 0.039 in.
	Sway	-	0.05 mm 0.0020 in.

CYLINDER

Item		Factory Specification	Allowable Limit
Cylinder	I.D. [D1102]	76.000 to 76.019 mm 2.9921 to 2.9929 in.	76.169 mm 2.9988 in.
	[D1402-DI,V1902-DI]	85.000 to 85.022 mm 3.3465 to 3.3473 in.	85.170 mm 3.3531 in.
	[D1462-DI]	87.000 to 87.022 mm 3.4252 to 3.4261 in.	87.170 mm 3.4319 in.
Oversized Cylinder	I.D. [D1102]	76.500 to 76.519 mm 3.0118 to 3.0126 in. in.	76.669 mm 3.0185 in.
	[D1402-DI,V1902-DI]	85.500 to 85.522 mm 3.3661 to 3.3670 in.	85.670 mm 3.3728 in.
	[D1462-DI]	87.500 to 87.522 mm 3.4449 to 3.4457 in.	87.670 mm 3.4516 in.

[2] LUBRICATING SYSTEM**OIL PUMP**

Engine Oil Pressure	At Idle Speed	98 kPa 1.0 kgf/cm ² 14 psi	—
	At Rated Speed	294 to 441 kPa 3.0 to 4.5 kgf/cm ² 43 to 64 psi	245 kPa 2.5 kgf/cm ² 36 psi
Inner Rotor to Outer Rotor	Clearance	0.10 to 0.16 mm 0.0039 to 0.0063 in.	0.20 mm 0.0079 in.
Outer Rotor to Pump Body	Clearance	0.11 to 0.19 mm 0.0043 to 0.0075 in.	0.25 mm 0.0098 in.
Inner Rotor to Cover	End Clearance	0.105 to 0.150 mm 0.0041 to 0.0059 in.	0.20 mm 0.0079 in.

[3] COOLING SYSTEM**RADIATOR**

Item		Factory Specification	Allowable Limit
Radiator	Water Tightness	Water tightness at specified pressure 137 kPa, 1.4 kgf/cm ² , 20 psi	—
Radiator Cap	Opening Pressure	10 seconds or more 88 → 59 kPa 0.9 → 0.6 kgf/cm ² , 13 → 9 psi	—
Fan Belt Tension	Deflection	7 mm/98N, 10 kgf 0.28 in./22 lbs.	—

THERMOSTAT

Valve Opening Temperature	At Beginning	80.5° to 83.5°C 176.9° to 182.3°F	—
	Opened Completely 8 mm, 0.315 in.	95°C 203°F	—

[4] FUEL SYSTEM**INJECTION PUMP**

Injection Order	[D1102 D1402-DI D1462-DI]	1-2-3	—
	[V1902-DI]	1-3-4-2	—
Injection Timing	[D1102]	0.401 to 0.436 rad. 23° to 25° before T.D.C.	—
	[D1402-DI D1462-DI V1902-DI]	0.298 to 0.3316 rad. 17° to 19° before T.D.C.	—
Pump Element Fuel Tightness	[D1102]	—	14.77 MPa 150 kgf/cm ² 2133 psi
	[D1402-DI D1462-DI V1902-DI]	60 seconds or more 39.23 MPa → 34.32 MPa 400 kgf/cm ² → 350 kgf/cm ² 5689 psi → 4978 psi	30 seconds 39.23 MPa → 34.32 MPa 400 kgf/cm ² → 350 kgf/cm ² 5689 psi → 4978 psi

INJECTION PUMP (Continued)

Item		Factory Specification	Allowable Limit
Delivery Valve Fuel Tightness	[D1102]	—	5 seconds 9.81 MPa → 9.32 MPa 100 kgf/cm ² → 95 kgf/cm ² 1422 psi → 1351 psi
	[D1402-DI] [D1462-DI] [V1902-DI]	10 seconds or more 18.63 MPa → 17.65 MPa 190 kgf/cm ² → 180 kgf/cm ² 2702 psi → 2560 psi	5 seconds 18.63 MPa → 17.65 MPa 190 kgf/cm ² → 180 kgf/cm ² 2702 psi → 2560 psi

INJECTION NOZZLE

Injection Nozzle Fuel Injection Pressure	[D1102]	13.73 to 14.71 MPa 140 to 150 kgf/cm ² 1991 to 2133 psi	—
	[D1402-DI] [D1462-DI] [V1902-DI]	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi	—
Nozzle Valve Seat Fuel Tightness	[D1102]	When the pressure is 12.75 MPa (130 kgf/cm ² , 1849 psi) the valve seat must be fuel tightness	—
	[D1402-DI] [D1462-DI] [V1902-DI]	No fuel leak for 5 seconds at pressure 18.96 to 20.00 MPa 193.3 to 203.9 kgf/cm ² 2750 to 2900 psi	—

TIGHTENING TORQUES

Screws, bolts and nuts must be tightened to the specified torque using a torque wrench. Several screws, and nuts such as those used on the cylinder head must be tightened in proper sequence and at the proper torque.

(For general use screws and nuts: See page S.G-8)

Item	Size x Pitch	N·m	kgf·m	ft-lbs
* Cylinder head cover cap nuts	M8 x 1.25	6.9 to 8.8	0.7 to 0.9	5.1 to 6.5
* Cylinder head screws	M10 x 1.25	83.4 to 88.3	8.5 to 9.0	61.5 to 65.1
* Bearing case screws 1	M8 x 1.25	36.3 to 41.2	3.7 to 4.2	26.8 to 30.4
* Bearing case screws 2	M10 x 1.25	68.6 to 73.5	7.0 to 7.5	50.6 to 54.2
* Flywheel screws	M12 x 1.25	98.1 to 107.9	10.0 to 11.0	72.3 to 79.6
* Connecting rod screws	M8 x 1.0	44.1 to 49.0	4.5 to 5.0	32.5 to 36.2
* Rocker arm bracket nuts	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
* Crankshaft nut	M30 x 1.5	137.3 to 156.9	14.0 to 16.0	101.3 to 115.7
Glow plugs	M10 x 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Drain plug	M12 x 1.25	32.4 to 37.3	3.3 to 3.8	23.9 to 27.5
Oil switch	PT1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Nozzle holder assembly [D1102]		39.2 to 49.0	4.0 to 5.0	28.9 to 36.2
Nozzle holder body retaining nut [D1102]		58.8 to 78.4	6.0 to 8.0	43.4 to 57.9
Nozzle locating screws [Except D1102]	M8 x 1.25	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Injection pipe retaining nuts	M12 x 1.5 M14 x 1.5	14.7 to 24.5 24.5 to 29.4	1.5 to 2.5 2.5 to 3.0	10.8 to 18.1 18.1 to 21.7

NOTE

- For * marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.
- The letter "M" in Size x Pitch means that the screw, bolt or nut dimension stands for metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.

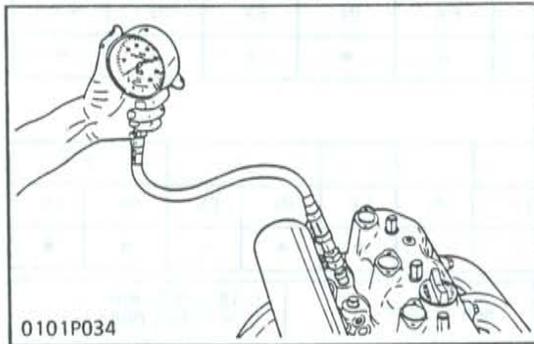
CHECKING, DISASSEMBLING AND SERVICING

[1] CYLINDER HEAD

CHECKING AND ADJUSTING



0101P034



0101P034

Compression Pressure

1. Warm up the engine.
2. Remove the air cleaner and the nozzle holders from all the cylinders.
3. Set a compression tester to the cylinder to be measured.
4. Run the engine with the starter at 200 to 300 rpm and read constant maximum on the tester. Execute the test at least twice. (Run the engine for 5 to 10 seconds for each test.)

NOTE

- For the test, use a fully charged battery and the specified valve clearance.
- If the compression pressure is below the given allowable limit, pour a small amount of oil through the nozzle holder hole and test again.
- If the pressure recovers to the standard level, inadequate pressure may be caused by wear or adhesion of the piston rings. Check the related points.
- If the pressure does not recover, cylinder head or valve problems may be the cause. Check the related points.
- If the compression differs more than 10% among the cylinders, trace the cause of pressure variation and take corrective measures.

TEST EQUIPMENT

Compression tester (Code No: 07909-30204)

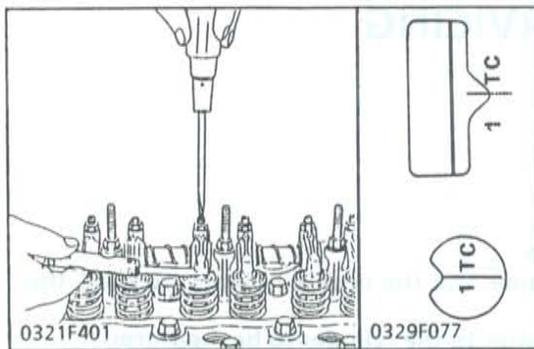
[D1102]

Reference compression pressure	Factory spec.	2.84 to 3.24 MPa 29 to 33 kgf/cm ² 412 to 469 psi
Compression pressure allowable limit should be more than 75% of reference compression pressure	Factory spec.	2.26 MPa 23 kgf/cm ² 320 psi

[D1402-DI, D1462-DI, V1902-DI]

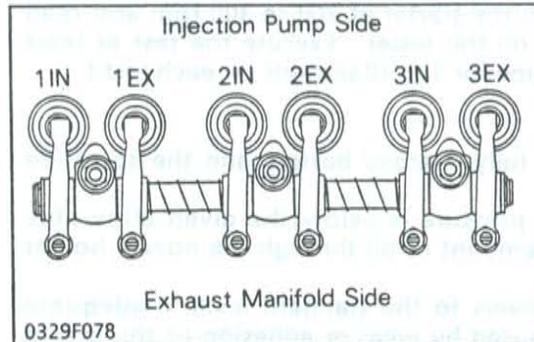
Reference compression pressure	Factory spec.	2.75 to 3.04 MPa 28 to 31 kgf/cm ² 398 to 441 psi
Compression pressure allowable limit should be more than 75% of reference compression pressure	Factory spec.	2.16 MPa 22 kgf/cm ² 313 psi

- Difference in compression pressure among cylinders should be within 10%.



Valve Clearance

1. Remove the cylinder head cover and the timing window cover on the flywheel housing and all glow plugs.
2. Turn the flywheel and align the 1 TC mark with the timing mark of window on the flywheel housing to position the 1st cylinder valves at the top dead center during compression.
3. Measure the clearance at the valves marked with ○ in the table below with a feeler gauge.
4. Turn the flywheel just one turn to position the 1st cylinder valves at the top dead center during overlap.
5. Measure the clearance at the valves marked with ● in the table below with a feeler gauge.
6. If the clearance is not within the factory specifications adjust.

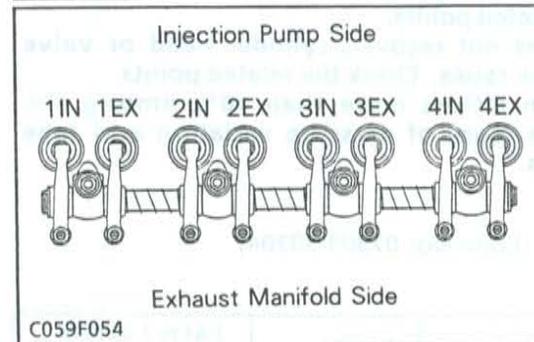


[D1102, D1402-DI, D1462-DI]

Cylinder No.	1		2		3	
Valve	IN.	EX.	IN.	EX.	IN.	EX.
Checking	○	○	●	○	○	●

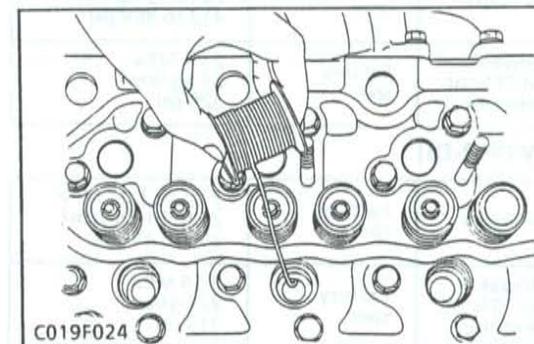
[V1902-DI]

Cylinder No.	1		2		3		4	
Valve	IN.	EX.	IN.	EX.	IN.	EX.	IN.	EX.
Checking	○	○	○	●	●	○	●	●
Valve clearance IN. and EX.	Factory spec.					0.18 to 0.22 mm 0.0071 to 0.0087 in.		

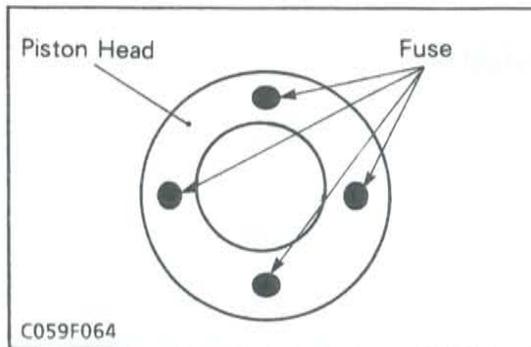


Top Clearance [D1102]

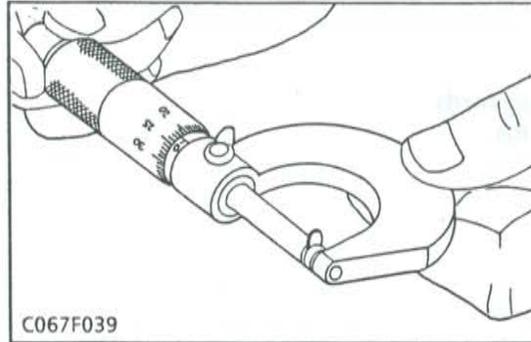
1. Remove the nozzle holder.
2. Lower the piston in the cylinder to be measured.
3. Insert a high-quality fuse from the nozzle holder hole. Be careful not to let the fuse touch the valve surface.
4. Rotate the engine with your hand.
5. Take the fuse out carefully.
6. Measure the place where the fuse was crushed with vernier calipers.
7. If the clearance is not within the factory specification, adjust by inserting a shim between the cylinder head and the gasket.



Top clearance	Factory spec.	0.7 to 0.9mm 0.0276 to 0.0354 in.
Thickness of gasket shim	Factory spec.	0.20 mm 0.0079 in.



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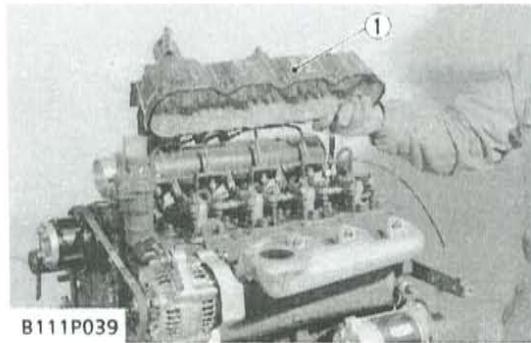
C067F039

Top Clearance [D1402-DI, D1462-DI, V1902-DI]

1. Remove the cylinder head.
2. Move the piston up and stick a strip of fuse on the piston head at four position with grease.
3. Lower the piston and install the cylinder head. (Use a new cylinder head gasket and tighten with a specified tightening torque.)
4. Turn the flywheel until the piston passes through the TDC.
5. Remove the cylinder head and measure the thickness of the fuses.
6. If the measurement is not within the factory specifications, insert or remove the gasket shim. If the measurement exceeds the factory specification on the engine without the shim, check the oil clearances between the crankpin and bearing and between the piston pin and bush.

Top clearance	Factory spec.	0.6 to 0.7 mm 0.024 to 0.035 in.
Thickness of gasket shim	Factory spec.	0.20 mm 0.0079 in.

DISASSEMBLING AND ASSEMBLING



B111P039

(1) Cylinder Head Cover

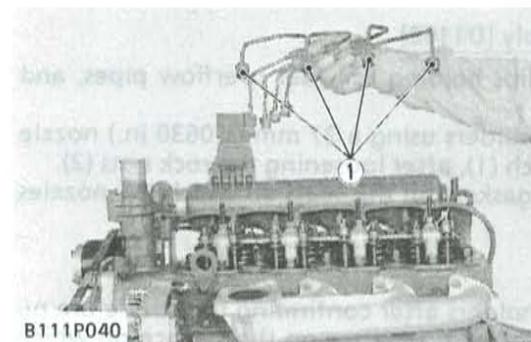
Cylinder Head Cover

1. Remove the head cover nuts.
2. Remove the head cover.

(When reassembling)

- Check to see if the head cover gasket is not defective.
- To prevent valve stem seizure, apply enough engine oil to the valve guide and valve stem.

Tightening torque	Cylinder head cover cap nuts	6.9 to 8.8 N·m 0.7 to 0.9 kgf·m 5.1 to 6.5 ft-lbs
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B111P040

(1) Injection Pipes

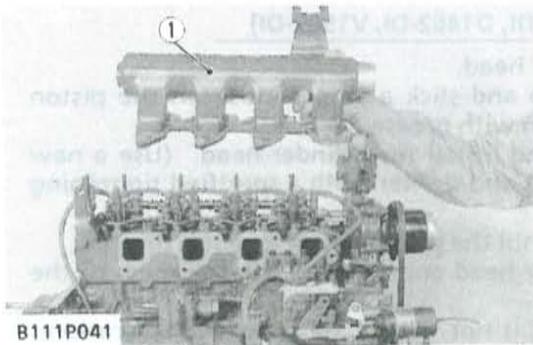
Injection Pipes

1. Loosen the screws on the pipe clamps.
2. Detach the injection pipes.

(When reassembling)

- Send compressed air into the pipes to blow out dust. Then, reassemble the pipes in the reverse order.

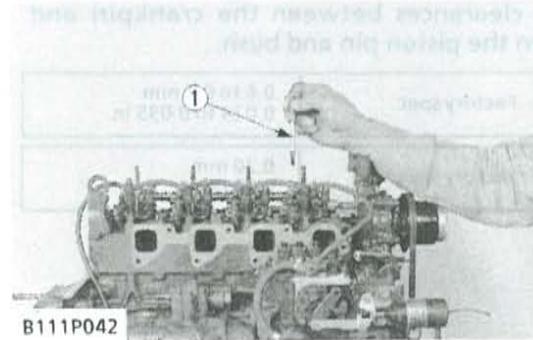
Tightening torque	Retaining nuts (M12 × 1.5)	15 to 25 N·m 1.5 to 2.5 kgf·m 11 to 18 ft-lbs
	Retaining nuts (M14 × 1.5)	25 to 29 N·m 2.5 to 3.0 kgf·m 18 to 22 ft-lbs



(1) Inlet Manifold

Inlet Manifold

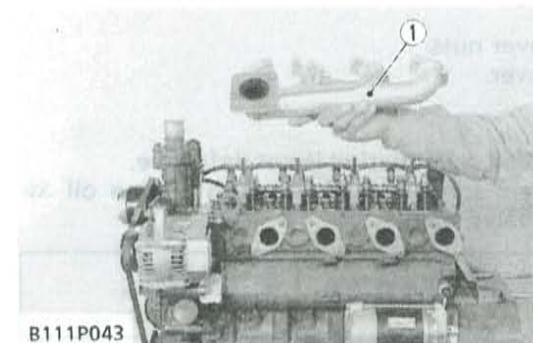
1. Remove the inlet manifold.



(1) Glow Plug

Glow Plugs

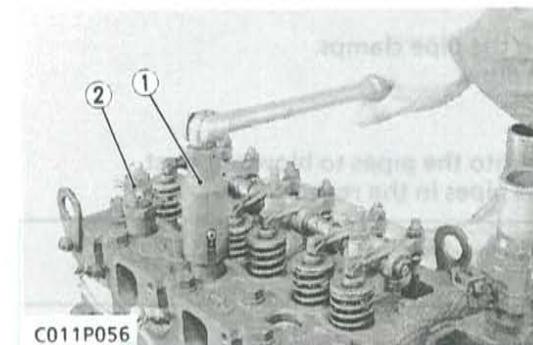
1. Remove the glow plug cords.
2. Remove the glow plugs.



(1) Exhaust Manifold

Exhaust Manifold

1. Remove the exhaust manifold.



(1) Nozzle Holder Socket Wrench

(2) Rock Nut

Nozzle Holder Assembly [D1102]

1. Remove the pipe clips holding the fuel overflow pipes, and detach the pipes.
2. Detach the nozzle holders using a 27 mm (1.0630 in.) nozzle holder socket wrench (1), after loosening the rock nuts (2).
3. Detach the copper gaskets on the seats on which the nozzles are to be installed.

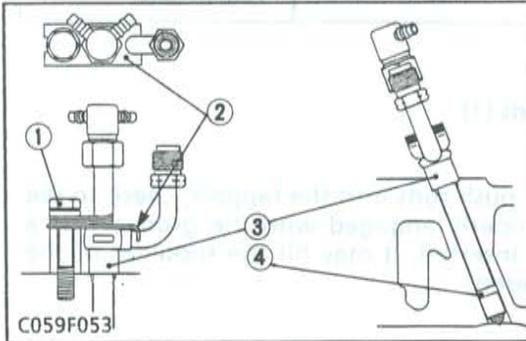
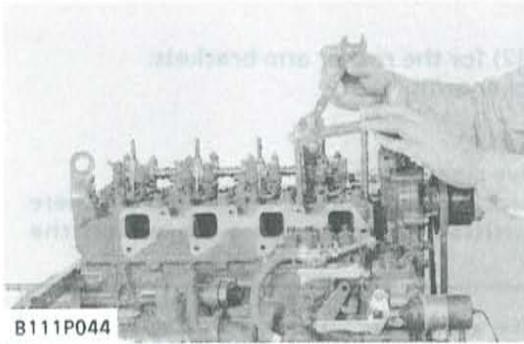
(When reassembling)

- Return the nozzle holders after confirming that there are no metallic particles or foreign matter on the surface on which the nozzles are to be installed.

Tightening torque	Nozzles	39 to 49 N·m 4.0 to 5.0 kgf·m 29 to 36 ft·lbs
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SPECIAL TOOL:

Nozzle holder socket wrench (Code No: 07916-30841)



- (1) Locating Screw (3) Compression Seal
 (2) Locating Plate (4) Carbon Dam Seal

Injection Nozzle Assembly [D1402-DI, D1462-DI, V1902-DI]

1. Remove the locating screws (1) and the locating plates (2).
2. Draw out the injection screws nozzles assembly using the nozzle replacer (Code No: 07916-32721, See page S.G-33).

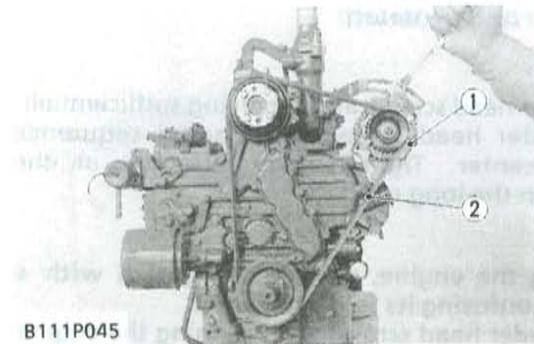
■ IMPORTANT

- Never draw out the nozzle by prying with screw-drivers or other similar tools. This can deform the nozzle body.
- Do not interchange nozzles among cylinders. Mark the cylinder number on the nozzle to prevent interchanging.
- Cap the nozzle inlet and tip to prevent damage in handling.
- Cover the nozzle bores on cylinder head to prevent entrance of foreign materials.

(When reassembling)

- Replace the scored compression seal (3).
- Replace the carbon dam seal (4), whenever the nozzle is removed from the engine, using the replacing tool (Code No: 07916-32741).
- Wipe out oil on the nozzle body and use no lubricants on the nozzle body.
- Insert nozzle with a rocking and twisting motion to prevent damage to the carbon dam seal (4).
- Place the clamp spacer and the locating plate in their proper position and tighten the bolts, noting not to damage them. They control tip protrusion and direction.

Tightening torque	Locating screws	24.5 to 29.4 N·m 2.5 to 3.0 kgf·m 18.1 to 21.7 ft-lbs
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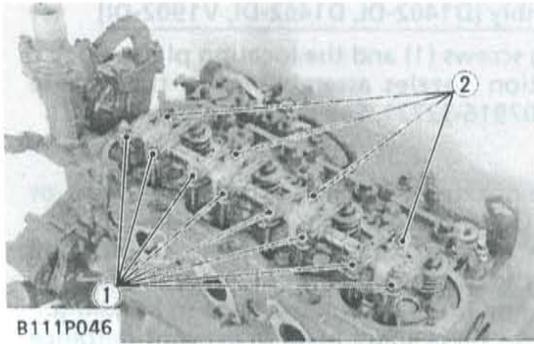
- (1) Alternator (2) Fan Belt

Alternator and Fan Belt

1. Loosen the nut and tension screw.
2. Detach the fan belt (2) and alternator (1).

(When reassembling)

- Check to see if the fan belt is placed in a correct position (where letters on the belt can be read from your side), and there is no oil or grease on the belt.
- Fan belt tension:
The belt should deflect approx. 7 mm (0.3 in.) when the center of the belt is depressed with a finger pressure of 98 N (10 kgf, 22 lbs.).



(1) Rocker Arms (2) Set Nuts

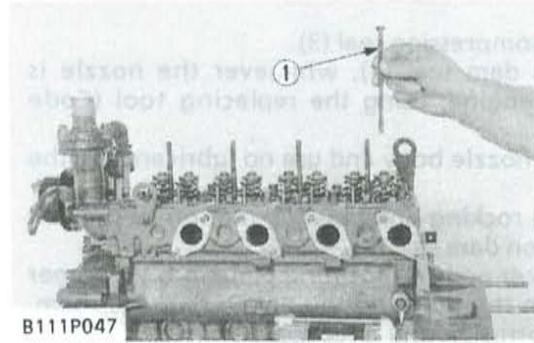
Rocker Arm

1. Remove the set nuts (2) for the rocker arm brackets.
2. Detach the whole rocker arms (1).

(When reassembling)

- Always adjust the valve clearance.
- Before installing the rocker arm bracket, check to see if there are any metallic particles on the surface on which the assembly is mounted.

Tightening torque	Rocker arm set nuts	24 to 28 N·m 2.4 to 2.8 kgf·m 17 to 20 ft·lbs
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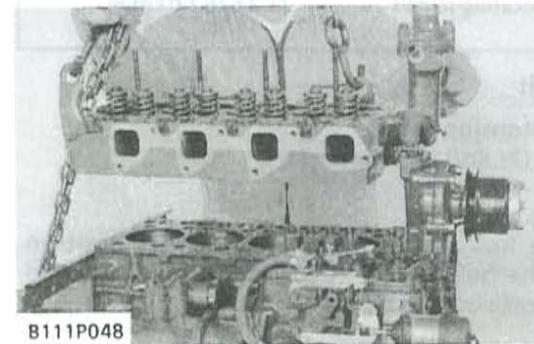
(1) Push-rods

Push-rods

1. Remove the push-rods (1).

(When reassembling)

- Before inserting the push rods into the tappets, check to see if their ends are properly engaged with the grooves. If a push rod is roughly inserted, it may hit the shoulder of the tappet and be damaged.



B111P048

Cylinder Head

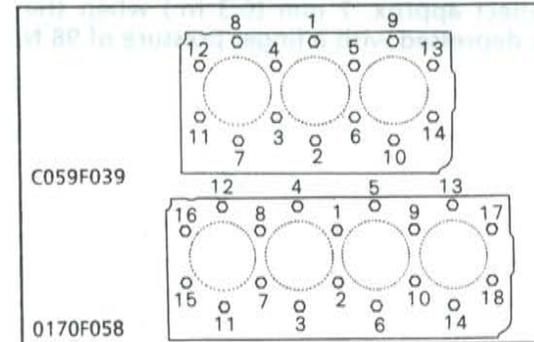
1. Remove the cylinder head screws.
2. Lift up the cylinder head to detach.

(When reassembling)

- Tighten the cylinder head screws after applying sufficient oil.
- Tighten the cylinder head screws in diagonal sequence starting from the center. Tighten them uniformly, or the head may deform in the long run.

■ IMPORTANT

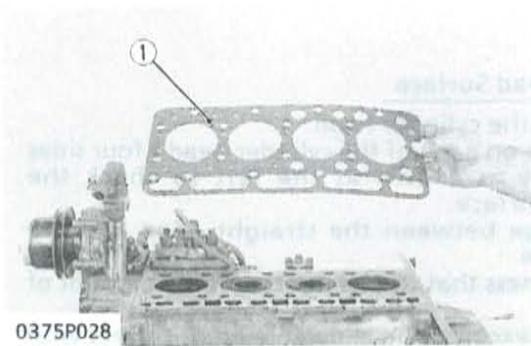
- When overhauling the engine, replace the gasket with a new one without confusing its front and back. Retighten the cylinder head screws after running the engine for 30 minutes.



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Tightening torque	Cylinder head screws	83.4 to 88.3 N·m 8.5 to 9.0 kgf·m 61.5 to 65.1 ft·lbs
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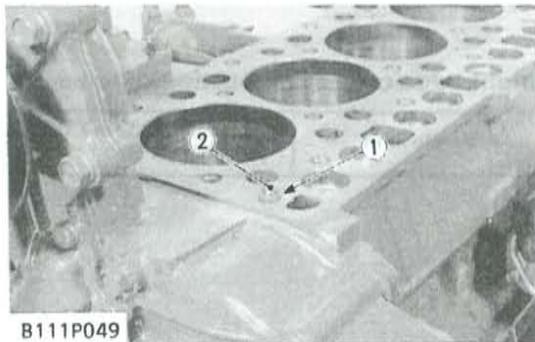
Cylinder Head Gasket

1. Detach the cylinder head gasket, being careful not to scratch it.

(When reassembling)

- Before installing the gasket, check to see there is no foreign matter on the cylinder head and the cylinder.

(1) Cylinder Head Gasket

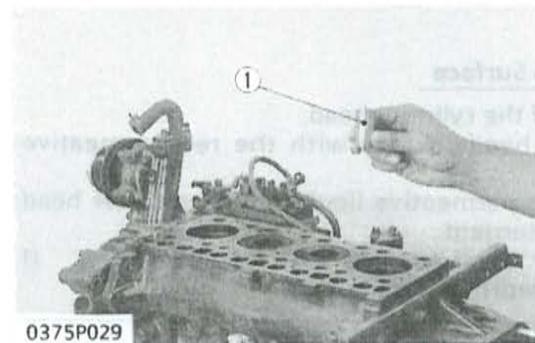


O-ring

1. Remove the O-ring from the periphery of the oil pipe on the crankcase.

(1) O-ring

(2) Pipe Pin



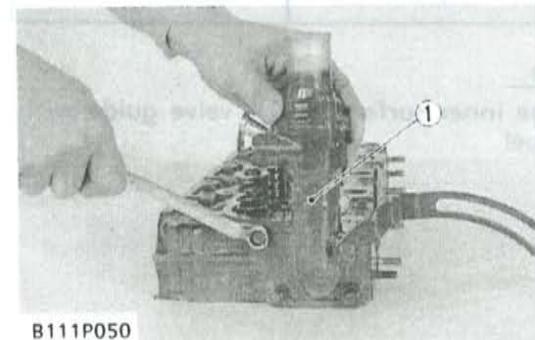
Tappets

1. Remove the tappets from the crankcase.

(When reassembling)

- Visually check the contact between tappets and cams for proper rotation. If a defect is found, replace tappets.
- Before installing the tappets, apply engine oil thinly around them.

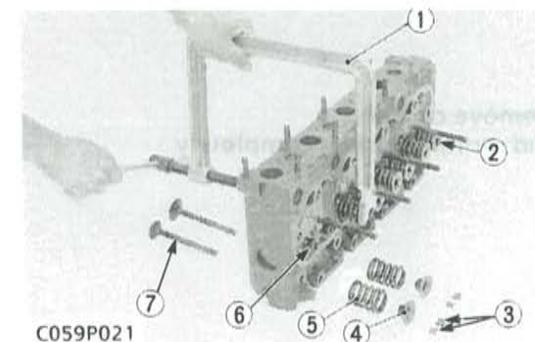
(1) Tappets



Water Flange

1. Remove the water flange from the cylinder head.

(1) Water Flange



Valves

1. Remove the valve caps (2).
2. Remove the valve spring collet (3), pushing the valve spring retainer (4) by valve spring replacer (1).
3. Remove the valve spring retainer (4), valve spring (5) and valve stem seal (6).
4. Remove the valve (7).

■ IMPORTANT

- Do not change the combination of valve and valve guide.

(1) Valve Spring Replacer

(2) Valve Cap

(3) Valve Spring Collet

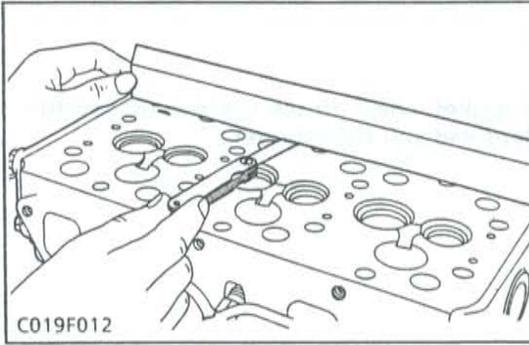
(4) Valve Spring Retainer

(5) Valve Spring

(6) Valve Stem Seal

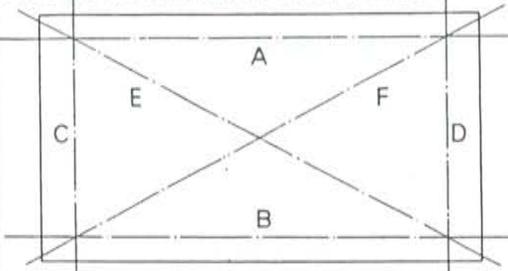
(7) Valve

SERVICING



C019F012

How to check cylinder head surface



C019F013

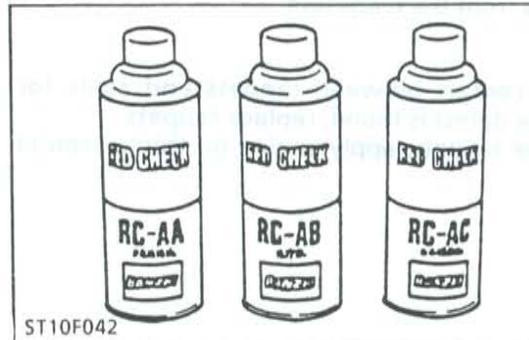
Flatness of Cylinder Head Surface

1. Clean the surface of the cylinder head.
2. Place a straight edge on each of the cylinder head's four sides and two diagonally as shown at the left to check the straightness of the surface.
3. Insert a feeler gauge between the straight edge and the cylinder head surface.
4. The maximum thickness that can be inserted is the amount of flatness.
5. If the measurement exceeds the allowable limit, correct with a surface grinder.

NOTE

- Do not place the straight edge on the combustion chamber.

Cylinder head surface length	Allowable limit	0.05 mm (0.002 in.) per 100 mm (4 in.)
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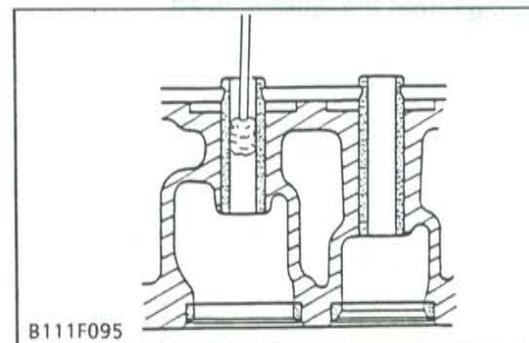


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Flaw of Cylinder Head Surface

1. Clean the surface of the cylinder head.
2. Spray the cylinder head surface with the red permeative liquid.
3. Wash away the red permeative liquid on the cylinder head surface with the detergent.
4. Spray the cylinder head surface with the developer. If flawed, it can be identified as red marks.

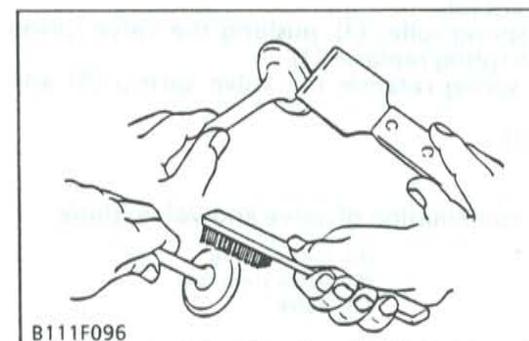
Flaw of cylinder head surface	Factory spec.	Should be no flaw
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Clean the Valve Guide

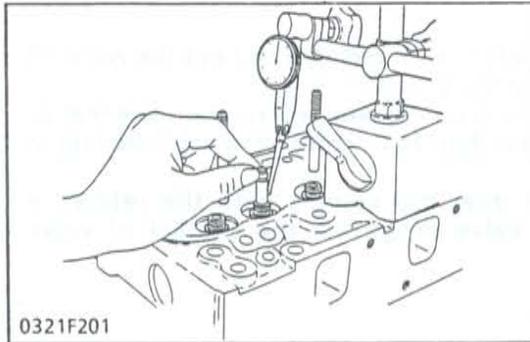
1. Wash and clean the inner surface of the valve guide with kerosene or diesel fuel.



B111F096

Clean the Valve

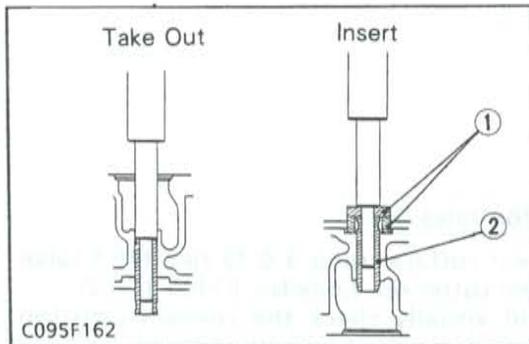
1. Use a scraper and remove carbon.
2. Use a wire brush and remove carbon completely.



Guide Clearance

1. Remove carbon from the valve guide.
2. After making sure that the valve stem is straight, insert the valve into the valve guide.
3. Measure the stem guide clearance with a dial gauge.
4. If the measurement exceeds the allowable limit, replace the stem guide and the valve.

Valve stem clearance	Factory spec.	0.040 to 0.070 mm 0.00157 to 0.00276 in.
	Allowable limit	0.1 mm 0.004 in.
Valve guide bore I.D.	Factory spec.	8.015 to 8.030 mm 0.31555 to 0.31614 in.
Valve stem O.D.	Factory spec.	7.960 to 7.975 mm 0.31339 to 0.31398 in.



(1) Spacer

(2) Valve Guide

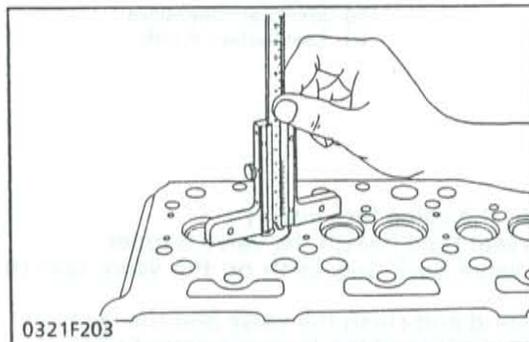
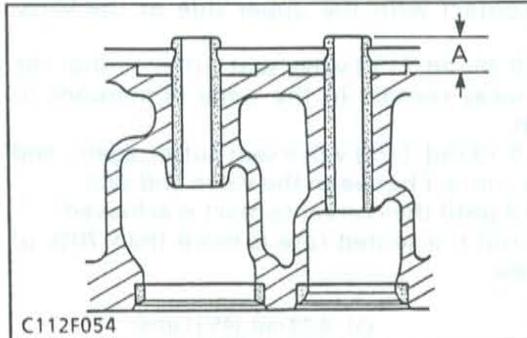
Replace the Valve Guide

1. Remove the spacer (1).
2. Press out the used valve guide from the cylinder head's lower end.
3. Before pressing in, apply oil on the outer surface of the valve guide, place a spacer of the specified protrusion allowance (A) on the cylinder head, and press in the spacer from above.
4. After press-fitting, finish the valve guide by means of reamer machining to specified dimension.

NOTE

- Be careful not to strike valve guides with a hammer, etc. during replacement.

Valve guide bore I.D.	Factory spec.	8.015 to 8.030 mm 0.31555 to 0.31614 in.
Valve guide protrusion	Factory spec.	9.8 to 10.2 mm 0.39 to 0.40 in.



Valve Recessing

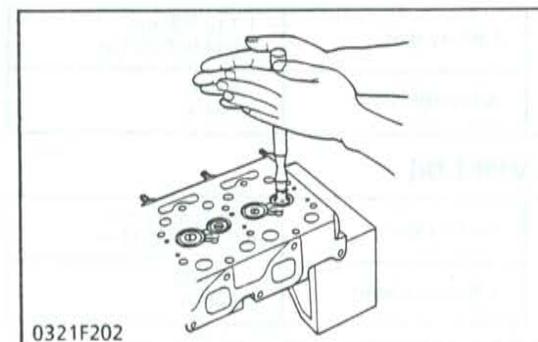
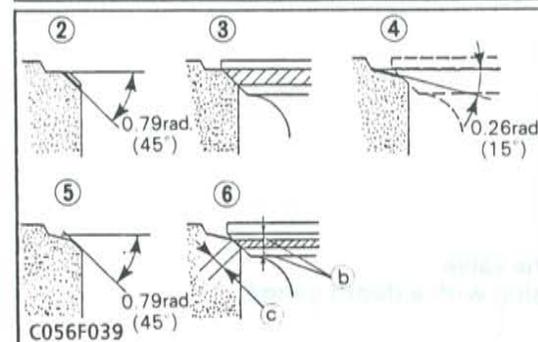
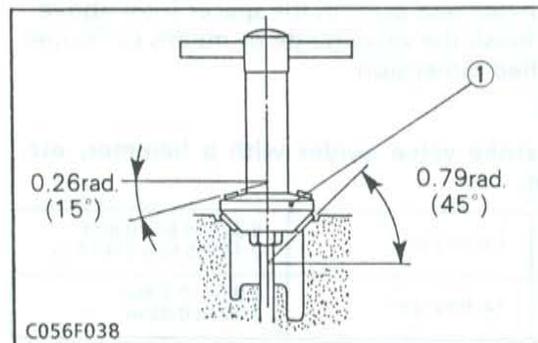
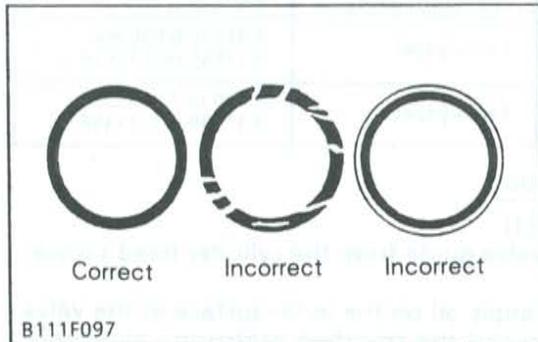
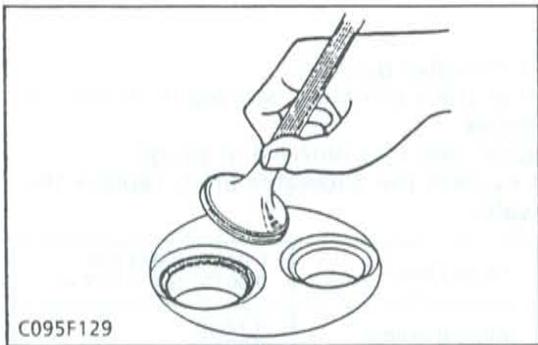
1. Clean the face of the valve.
2. Measure the recessing with a depth gauge.

[D1102]

Valve recessing	Factory spec.	1.1 to 1.3 mm 0.043 to 0.051 in.
	Allowable limit	1.6 mm 0.063 in.

[D1402-DI, D1462-DI, V1902-DI]

Valve recessing	Factory spec.	0.65 to 0.85 mm 0.026 to 0.033 in.
	Allowable limit	1.15 mm 0.045 in.



Valve Seating

1. Coat the valve face lightly with red lead and put the valve on its seat to check the contact.
2. If the valve does not seat all the way around the valve seat or the valve contact is less than 70%, correct the valve seating as follows.
3. If the valve contact does not comply with the reference value, replace the valve or correct the contact of valve seating.

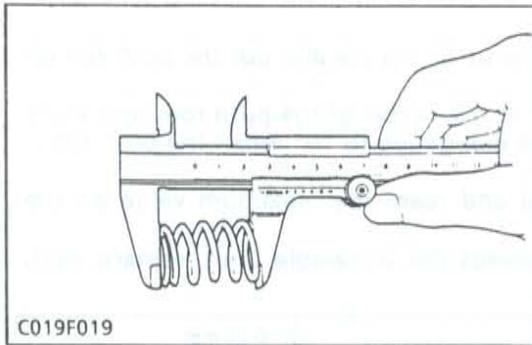
Correcting Procedure for Valve Seat

1. Correct the valve seat surface using a 0.79 rad. (45°) valve seat cutter (Valve seat cutter set: Code No. 07909-33102).
2. Place the valve and visually check the contact position between the valve face and valve seat with red lead.
(If the valve has been used for a long period of time, the seat tends to come in contact with the upper side of the valve face.)
3. Cut the seat with a 0.26 rad. (15°) valve seat cutter so that the valve seat width makes contact in the same dimensions to the valve face width.
4. Cut the seat with a 0.79 rad. (45°) valve seat cutter again, and visually recheck the contact between the valve and seat.
5. Repeat steps 3, and 4 until the correct contact is achieved.
6. Continue lapping until the seated rate is more than 70% of the total contact area.

- | | |
|----------------------------|----------------------------|
| (1) Valve Seat Cutter | (5) 0.79 rad. (45°) Cutter |
| (2) 0.79 rad. (45°) Cutter | (6) Contact Check |
| (3) Contact Check | (b) Identical Dimensions |
| (4) 0.26 rad. (15°) Cutter | (c) Seat Surface Width |

Valve Lapping

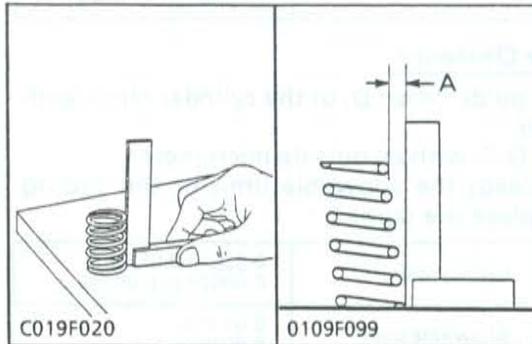
1. Apply compound on the valve face evenly.
2. Put the valve on its seat hold it with the valve flapper.
3. Turn and flap the valve back and forth on the valve seat to lap.
4. Remove the compound and clean the valve and the seat.
5. Apply oil on the valve face and finish to complete fitting.
6. Repeat lapping until the valve seats correctly, checking the seating.



Valve Spring Free Length

1. Measure the spring with a set of vernier calipers.
2. If the measurement exceeds the allowable limit, replace.

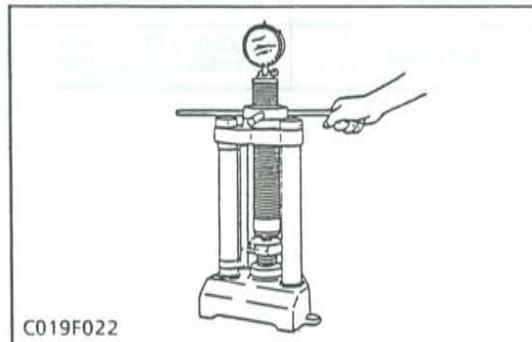
Valve spring free length	Factory spec.	41.7 to 42.2 mm 1.64 to 1.66 in.
	Allowable limit	41.2 mm 1.622 in.



Valve Spring Squareness

1. Put the spring on a surface plate, place a square on the side of the spring, and check to see if the entire side is in contact with the square.
2. Rotate the spring and measure the maximum B. (See the illustration at left.)
3. If the measurement exceeds the allowable limit, replace. The flat surface at the end of the spring coil must exceed the full circumference by two-thirds. Check the entire surface of the spring for scratches.

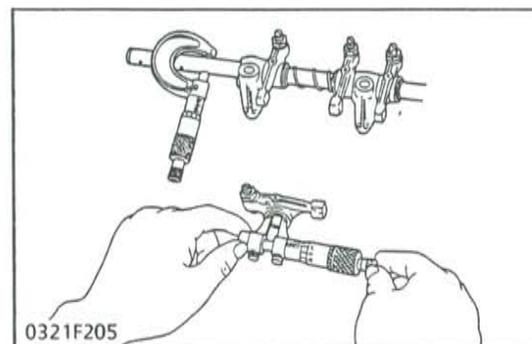
Valve spring squareness	Allowable limit	1.0 mm 0.039 in.
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Valve Spring Tension

1. Place the spring on a tester and compress it to the same degree that it is actually compressed in the engine. (31 mm, 1.2 in.)
2. Read the compression load on the gauge.
3. If the measurement exceeds the allowable limit, replace.

Valve spring tension	Factory spec.	117 N/35.15 mm 12.0 kgf/35.15 mm 26.5 lbs./1.38 in.
	Allowable limit	100 N/35.15 mm 10.2 kgf/35.15 mm 22.5 lbs./1.38 in.



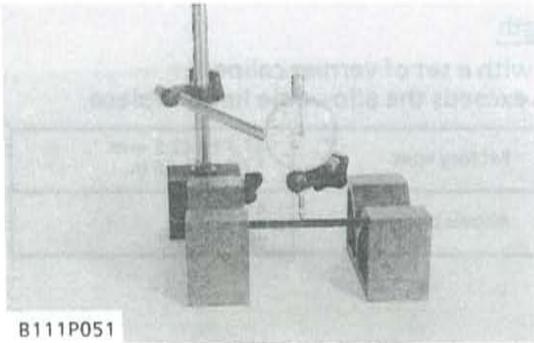
Oil Clearance between Rocker Arm Shaft and Rocker Arm

1. Measure the rocker arm bore I.D.
2. Measure the rocker arm shaft O.D.
3. If the clearance exceeds the allowable limit, replace.

Oil clearance between rocker arm shaft and rocker arm	Factory spec.	0.018 to 0.070 mm 0.00071 to 0.00276 in.
	Allowable limit	0.15 mm 0.0059 in.

Rocker arm shaft O.D.	Factory spec.	13.973 to 13.984 mm 0.55012 to 0.55055 in.
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Rocker arm bore I.D.	Factory spec.	14.002 to 14.043 mm 0.55126 to 0.55287 in.
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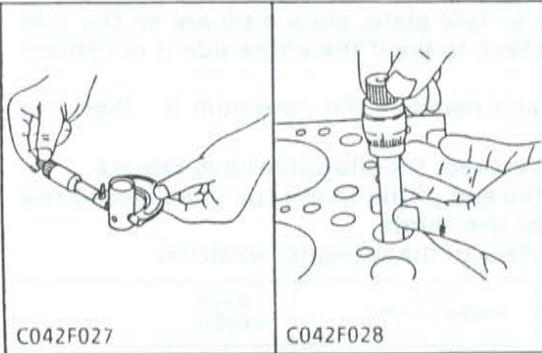


B111P051

Bend of Push Rod

1. Place a V block on the surface plate and put the push rod on the V block.
2. Place the dial gauge at the center of the push rod, rotate the push rod, and set the dial gauge to "0" when the push rod is at its lowest position.
3. Rotate the push rod and read the maximum value on the dial gauge.
4. If the alignment exceeds the allowable limit, replace push rod.

Push rod alignment	Allowable limit	0.25 mm 0.0098 in.
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C042F027

C042F028

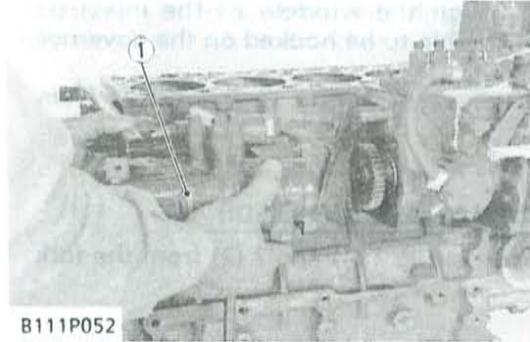
Tappet and Guide Bore Clearance

1. Measure the tappet guide bore I.D. of the cylinder block with an inside micrometer.
2. Measure the tappet O.D. with an outside micrometer.
3. If the clearance exceeds the allowable limit or the sliding surface is scored, replace the tappet.

Clearance between tappet and guide bore	Factory spec.	0.020 to 0.062 mm 0.00079 to 0.00244 in.
	Allowable limit	0.07 mm 0.0028 in.
Tappet O.D.	Factory spec.	23.959 to 23.980 mm 0.94327 to 0.94410 in.
	Factory spec.	24.000 to 24.021 mm 0.94488 to 0.94571 in.

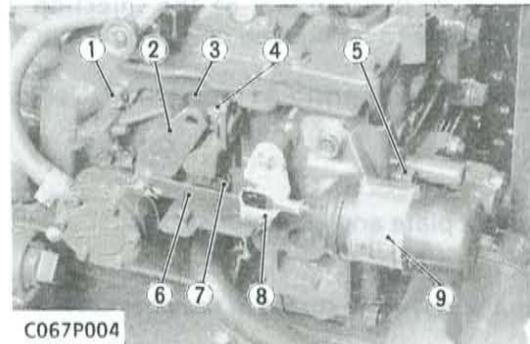
[2] TIMING GEARS

DISASSEMBLING AND ASSEMBLING



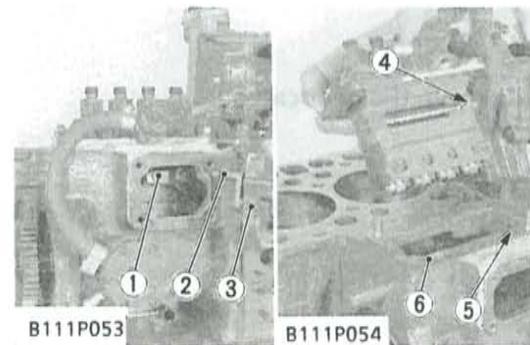
B111P052

(1) Hydraulic Pump



C067P004

- | | |
|-----------------------|------------------|
| (1) Screw | (6) Stop Lever 1 |
| (2) Engine Stop Lever | (7) Screw |
| (3) Leaf Spring | (8) Stop Lever 2 |
| (4) Stop Rod | (9) Solenoid |
| (5) Screw | |



B111P053

- | |
|--------------------------|
| (1) Fork Lever 1 |
| (2) Engine Stop Lever |
| (3) Injection Pump Cover |



B111P054

- | |
|----------------------|
| (4) Control Rack Pin |
| (5) Groove |
| (6) Shims |

Cylinder Head Assembly

1. Remove the cylinder head assembly. (See page S.1-15)

Hydraulic Pump

1. Remove the hydraulic pump mounting screws.
2. Detach the hydraulic pump (1).

Solenoid [D1402-DI, D1462-DI, V1902-DI]

1. Disconnect the stop lever 1 (6) from the engine stop lever (2).
2. Remove the screws (1), (5) and (7).
3. Remove the solenoid (9) with its support.

(When reassembling)

- Loosen the solenoid mounting screws.
- Install the support and complete the linkage between the solenoid and the engine stop lever.
- Pushing the solenoid plunger to the bottom, pull the stop lever 2 (8) with it until the engine stop lever (2) is turned to the end, then tighten the screws.

■ NOTE

- Be sure to install the leaf spring (3) in its position.

Injection Pump

1. Remove the injection pump cover (3) with the engine stop lever (2).
2. Remove the injection pump.

(When reassembling)

- Apply liquid gasket (Three Bond 1215, 1104 or equivalent) to the both sides of injection pump cover gasket and shim (6) and install them.
- Install the injection pump so that its control rack pin (4) engages with the groove (5) of fork lever 1.
- Install the injection pump cover with the arm of engine stop lever (2) at the right of the arm of fork lever 1 (1). [Except D1102]

[5] GEAR CASE, TIMING GEAR, CAMSHAFT, OIL PUMP

C011P068

Governor Spring [D1102]

1. Disconnect the governor spring from governor fork lever 2.

(When reassembling)

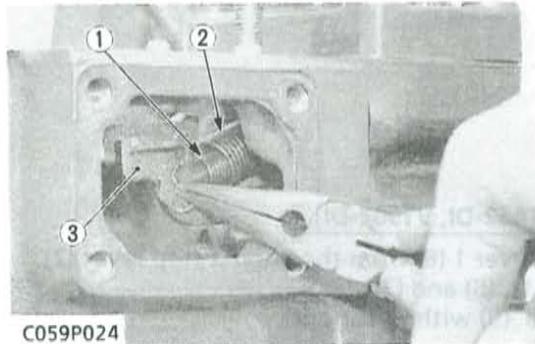
- Fix the governor spring to the speed control lever, and pull the spring or wire through the window of the injection pump, and spring will be able to be hooked on the governor fork with ease.
Bend the end of the governor spring to prevent it from falling off.

Governor Spring [D1402-DI, D1462-DI, V1902-DI]

1. Disconnect the governor spring 1 (1) and 2 (2) from the fork lever 2 (3).

(When reassembling)

- Fix the governor spring to the speed control lever, and pull the spring or wire through the window of the injection pump, and spring will be able to be hooked on the governor fork with ease.
Bend the end of the governor spring to prevent it from falling off.



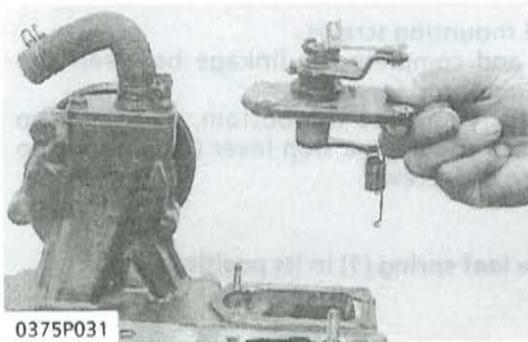
C059P024

Speed Control Plate

1. Remove the speed control plate and governor spring.

(When reassembling)

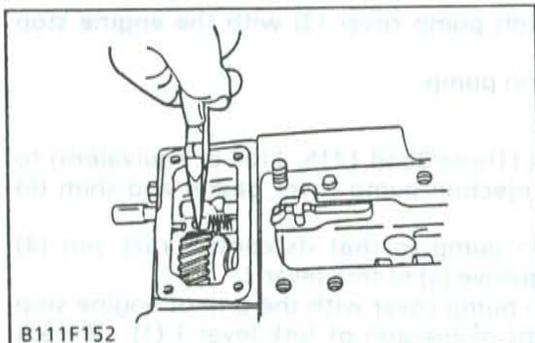
- Be careful not to drop the governor spring in the gear case.



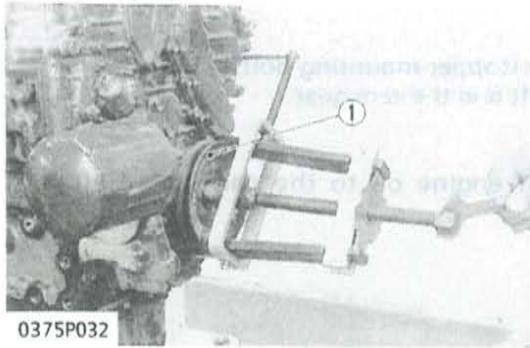
0375P031

Start Spring

1. Remove the start spring from the gear case.



B111F152



0375P032

(1) Fan Drive Pulley

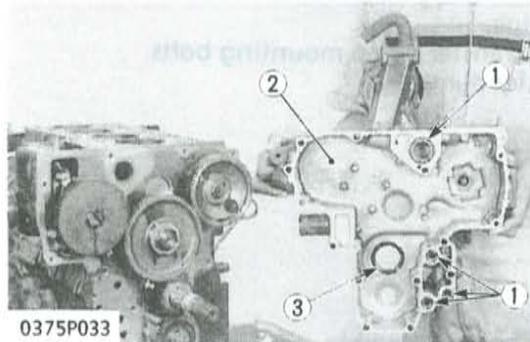
Fan Drive Pulley

1. Loosen and remove the crankshaft nut.
2. Draw out the pulley with a puller.

(When reassembling)

- Do not tighten the nut excessively, it may damage the oil slinger, causing oil leakage.

Tightening torque	Crankshaft nut	137.3 to 156.9 N·m 14.0 to 16.0 kgf·m 101.3 to 115.7 ft·lbs
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0375P033

(1) O-rings
(2) Gear Case
(3) Oil Seal

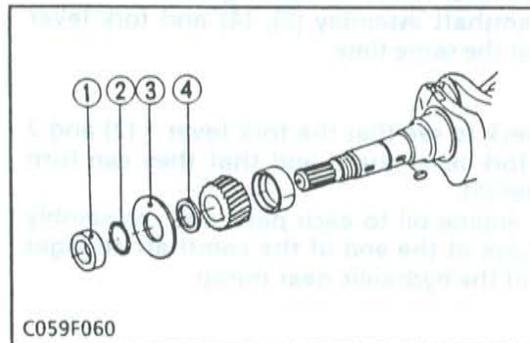
Gear Case

1. Remove the oil filter assembly.
2. Remove the gear case (2).
3. Remove the O-rings (1).

- Check to see if there are four O-rings (1) inside the gear case (2).

(When reassembling)

- Apply a thin film of engine oil to the oil seal (3), and install it, noting the lip come off.
- Before installing the gear case gasket, apply a non-drying adhesive.

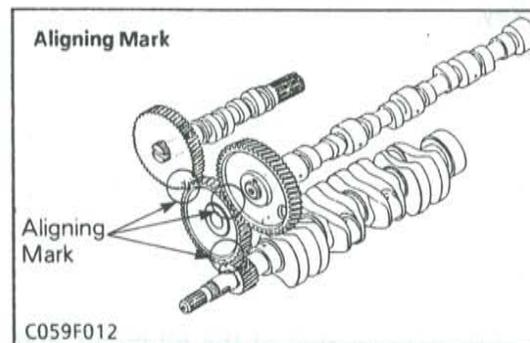


C059F060

(1) Crankshaft Collar
(2) O-ring
(3) Crankshaft Oil Slinger
(4) Crank Gear Collar

Crankshaft Oil Slinger

1. Remove the feather key.
2. Remove the crankshaft collar (1).
3. Remove the O-ring (2).
4. Detach the crankshaft oil slinger (3).



C059F012

Aligning Mark

Aligning Mark

Idle Gear

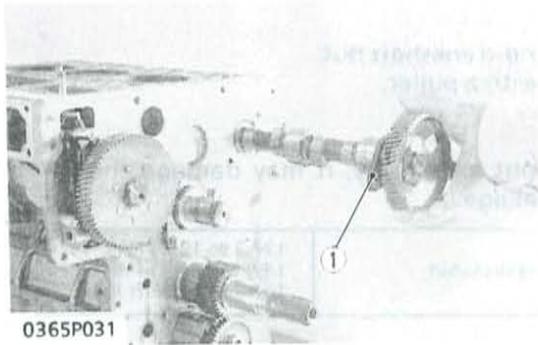
1. Remove the external snap ring.
2. Detach the idle gear collar 2.
3. Detach the idle gear.
4. Detach the idle gear collar 1.

(When reassembling)

- Check to see each gear is aligned with its aligning mark:
 - Idle gear and crank gear
 - Idle gear and camshaft gear
 - Idle gear and injection pump gear

Tappets

(See page S.1-19)



0365P031

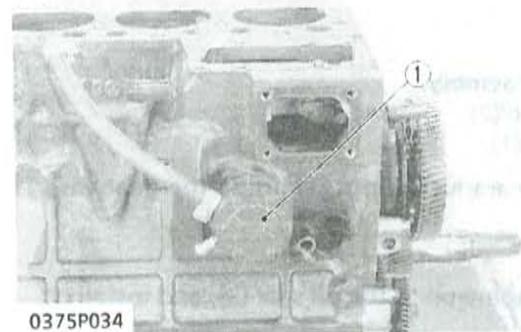
Gear and Camshaft

1. Remove the camshaft stopper mounting bolts.
2. Draw out the camshaft and the cam gear.

(When reassembling)

- Apply a thin film of engine oil to the camshaft before installation.

(1) Camshaft Stopper

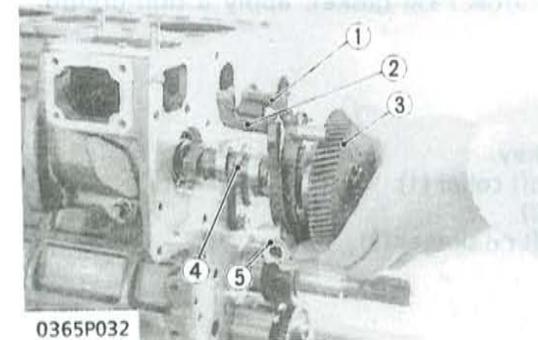


0375P034

Fuel Transfer Pump [D1402-DI, D1462-DI, V1902-DI]

1. Disconnect the fuel pipe.
2. Remove the two fuel transfer pump mounting bolts. Detach the fuel transfer pump.

(1) Fuel Transfer Pump



0365P032

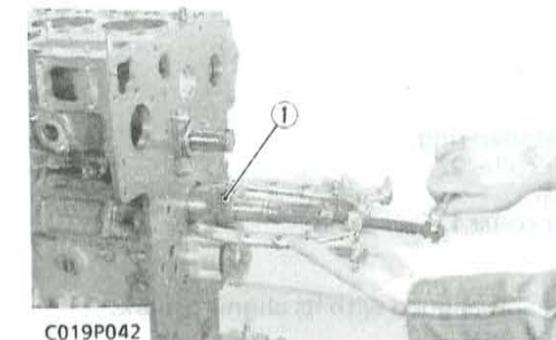
- | | |
|------------------------|-----------------------|
| (1) Fork Lever 2 | (4) Fuel Camshaft |
| (2) Fork Lever 1 | (5) Fork Lever Holder |
| (3) Fuel Camshaft Gear | |

Fuel Camshaft and Fork Lever Assembly

1. Detach the fuel camshaft cover.
2. Remove the three fork lever holder mounting bolts.
3. Draw out the fuel camshaft assembly (3), (4) and fork lever assembly (1), (2), (5) at the same time.

(When reassembling)

- After installation, check to see that the fork lever 1 (2) and 2 (1) are fixed to the fork lever shaft, and that they can turn smoothly in the holder (5).
- Apply a thin film of engine oil to each part, and reassembly so that the drive groove at the end of the camshaft engages with the drive shaft of the hydraulic gear pump.

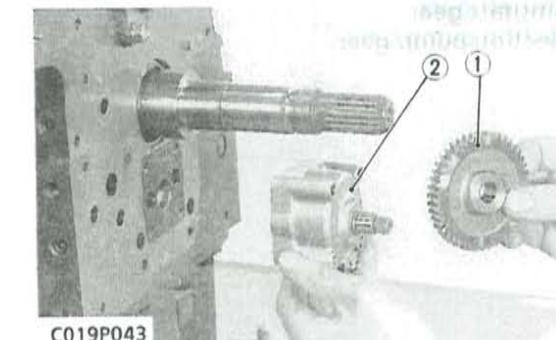


C019P042

Crank Gear

1. Draw out the crank gear (1) with a puller.
2. Remove the feather key.

(1) Crank Gear



C019P043

Oil Pump

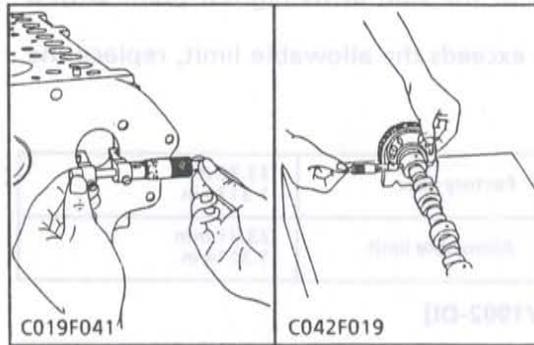
1. Straighten the claw of the claw washer of the oil pump, and remove the nut.
2. Draw out the oil pump drive gear (1) with gear puller.
3. Remove the four oil pump mounting bolts. Detach the oil pump (2).

(When reassembling)

- Be sure to bend the claw of claw washer.

(1) Pump Drive Gear (2) Oil Pump

SERVICING

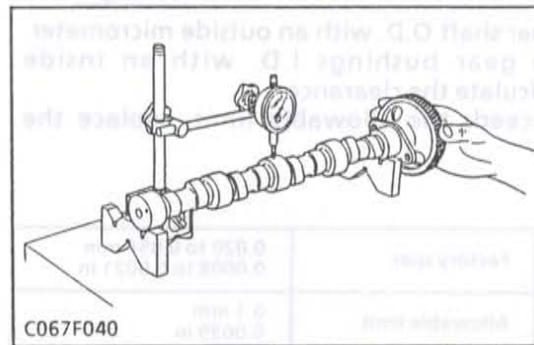


Oil Clearance of Camshaft

1. Measure the camshaft bearing in the crankcase with an inside micrometer.
2. Measure the camshaft journal with an outside micrometer. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the camshaft.

Oil clearance of camshaft	Factory spec.	0.050 to 0.091 mm 0.0020 to 0.0036 in.
	Allowable limit	0.15 mm 0.0059 in.

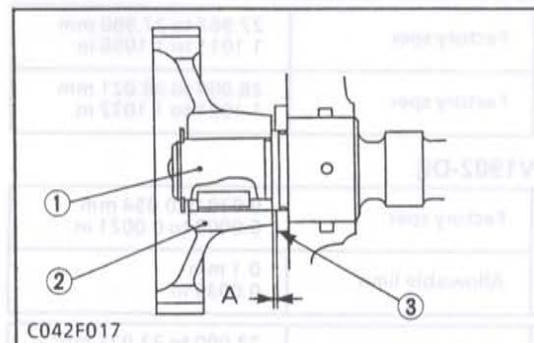
Camshaft bearing journal O.D.	Factory spec.	39.934 to 39.950 mm 1.57221 to 1.57284 in.
Camshaft bearing I.D.	Factory spec.	40.000 to 40.025 mm 1.57480 to 1.57579 in.



Camshaft Alignment

1. Gently put the camshaft on V blocks.
2. Set a dial gauge to the journal.
3. While slowly rotating the camshaft, read the dial gauge. The camshaft flexure is half of the reading.
4. If the measurement exceeds the allowable limit, replace the camshaft.

Camshaft alignment	Allowable limit	0.05 mm 0.0020 in.
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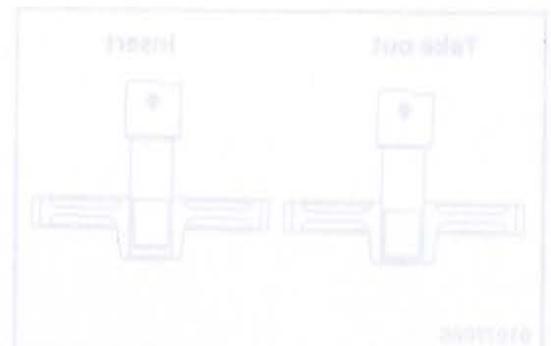


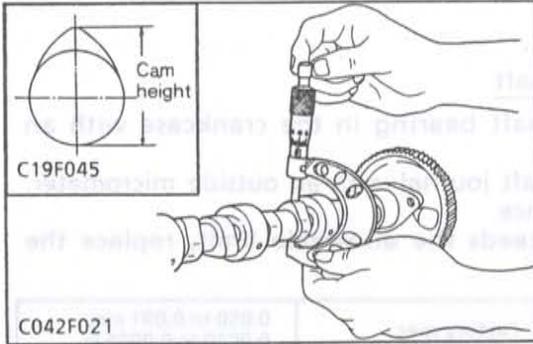
Cam Gear Side Clearance

1. Pull the cam gear (2) with the camshaft (1) to its end.
2. Measure the clearance A between the cam gear (2) and the camshaft stopper (3).
3. If the clearance exceeds the allowable limit, replace the camshaft stopper (3).

Side clearance	Factory spec.	0.07 to 0.22 mm 0.028 to 0.087 in.
	Allowable limit	0.3 mm 0.0118 in.

- (1) Camshaft (2) Cam Gear (3) Stopper





Cam Heights of Intake and Exhaust

1. Measure the height of the cam at its highest point with a micrometer.
2. If the measurement exceeds the allowable limit, replace the camshaft.

[D1102]

Cam heights of intake and exhaust	Factory spec.	33.36 mm 1.3134 in.
	Allowable limit	33.31 mm 1.3114 in.

[D1402-DI, D1462-DI, V1902-DI]

Cam heights of intake and exhaust	Factory spec.	33.463 to 33.483 mm 1.3174 to 1.3182 in.
	Allowable limit	33.42 mm 1.3157 in.

Clearance between Idle Gear Shaft and Idle Gear Bushings

1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the bushings.

[D1102]

Clearance between idle gear shaft and idle gear bushings	Factory spec.	0.020 to 0.054 mm 0.0008 to 0.0021 in.
	Allowable limit	0.1 mm 0.0039 in.

Idle gear shaft O.D.	Factory spec.	27.967 to 27.980 mm 1.1011 to 1.1056 in.
Idle gear bushing I.D.	Factory spec.	28.000 to 28.021 mm 1.1024 to 1.1032 in.

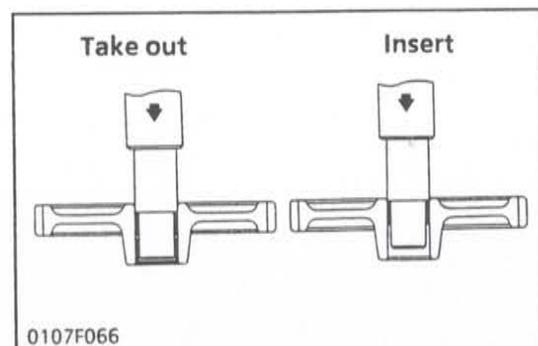
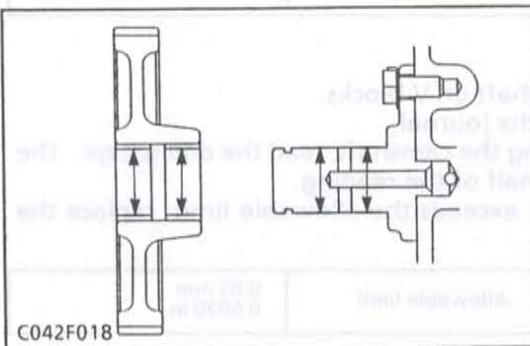
[D1402-DI, D1462-DI, V1902-DI]

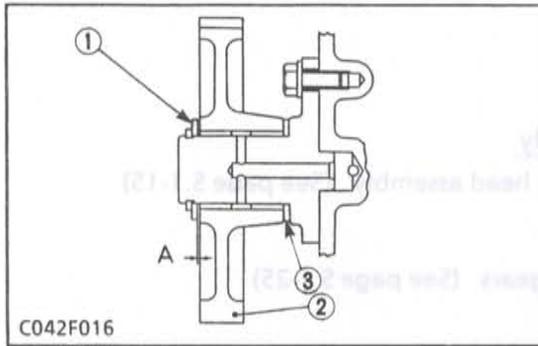
Clearance between idle gear shaft and idle gear bushings	Factory spec.	0.020 to 0.054 mm 0.0008 to 0.0021 in.
	Allowable limit	0.1 mm 0.0039 in.

Idle gear shaft O.D.	Factory spec.	32.000 to 32.025 mm 1.2598 to 1.2608 in.
Idle gear bushing I.D.	Factory spec.	31.959 to 31.975 mm 1.2582 to 1.2589 in.

Replace the Idle Gear Bushings

1. Prepare the necessary tool. (See page S.G-38)
2. Press out the used bushes and press a new part in, using this tool.
3. After pressing in the bushing, finish with a reamer to the specified factory specification.



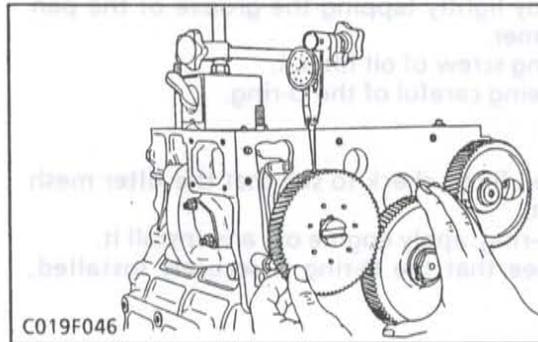


(1) Idle Gear Collar 2 (3) Idle Gear Collar 1
 (2) Idle Gear

Idle Gear Side Clearance

1. Pull the idle gear collar 2 (1) and push the idle gear (2) to each end.
2. Measure the clearance A between the idle gear and the idle gear collar 2 with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the idle gear collar 1 (3)

Side clearance	Factory spec.	0.20 to 0.51 mm 0.0079 to 0.0201 in.
	Allowable limit	0.9 mm 0.035 in.



C019F046

Gear Backlash

1. Install a lever-type indicator between the gear teeth.
2. Clamp one gear, rotate the other and measure the backlash.
3. If the backlash exceeds the allowable limit, replace the gear.

Gear backlash	Factory spec.	0.04 to 0.11 mm 0.0016 to 0.0043 in.
	Allowable limit	0.15 mm 0.0059 in.

[3] CRANKCASE

DISASSEMBLING AND ASSEMBLING

Cylinder Head Assembly

1. Remove the cylinder head assembly. (See page S.1-15)

Timing Gears

1. Remove the timing gears. (See page S.1-25)

Oil Pan and Oil Filter 1

1. Lay the engine on the engine cradle on its side.
2. Remove the oil pan mounting screws.
3. Detach the oil pan by lightly tapping the groove of the pan with a wooden hammer.
4. Remove the mounting screw of oil filter 1.
5. Detach oil filter 1, being careful of the O-ring.

(When reassembling)

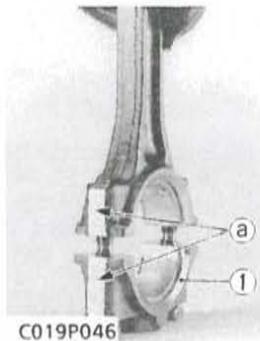
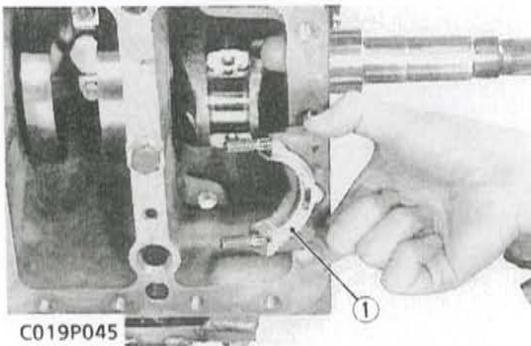
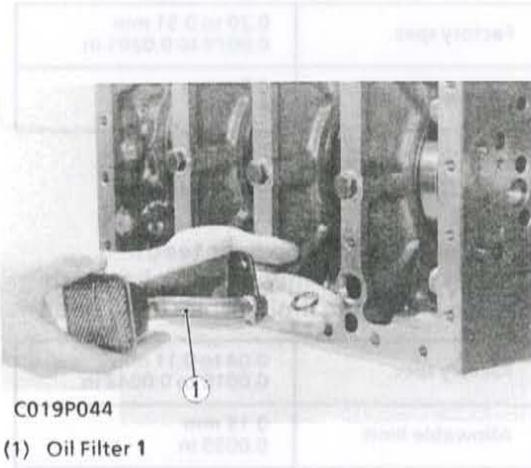
- After cleaning the oil filter, check to see that the filter mesh is clean, and install it.
- Visually check the O-ring, apply engine oil, and install it.
- After checking to see that the O-ring is securely installed, attach the oil filter.

Connecting Rod Cap

1. Remove the connecting rod screws from connecting rod cap.
2. Detach the connecting rod caps.

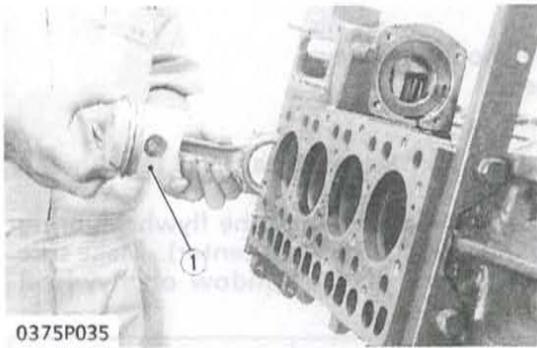
■ IMPORTANT

- Apply engine oil to the connecting rod screws and tighten them to 44.1 to 49.0 N·m (4.5 to 5.0 kgf·m, 32.5 to 36.2 ft·lbs).



(1) Connecting Rod Cap

- (a) Align the marks with each other.
(Face the marks toward the injection pump)



0375P035

Pistons

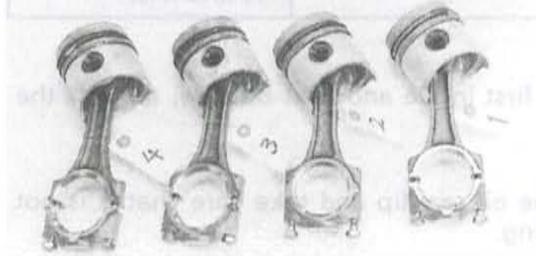
1. Turn the crankshaft by 3.14 rad (180°) and bring the piston to top dead center.
2. Draw out the piston upward by lightly tapping it from the bottom of the crankcase with the grip of a hammer.
3. Draw out the other piston in the same method as above.

(When reassembling)

- Before inserting the pistons into the cylinders, apply enough engine oil to the pistons.

■ IMPORTANT

- Install the piston rings with their gaps making an angle of 2.09 rad (120°) or 3.14 rad (180°) to each other. (Place the top ring with their gaps on the opposite side of the combustion chamber.)
- Attach a ring to the pistons securely with a piston ring compressor, and set them to the cylinder, being careful about the cylinder number and the position of the connecting rod (Connecting rods must be installed with their ends bearing the number toward the fuel injection pump).
- Carefully insert the pistons. Otherwise, their chrome-plated section may be scratched, causing trouble inside the liner.



0375P036

(1) Piston

Piston Ring and Piston Pin

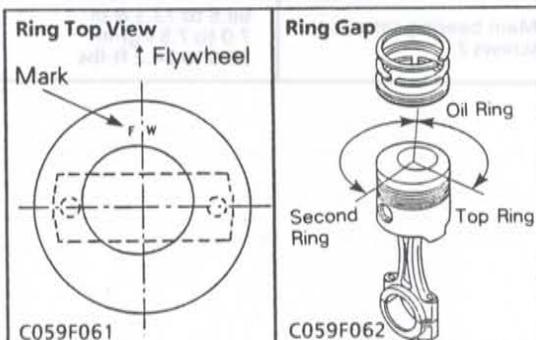
1. Remove the piston rings with a piston ring replacing tool (Code No : 07909-32121).
2. Remove the piston pin.

(When reassembling)

- Clean all the parts before assembling.
- Heat the piston in approx. 80°C (176°F) of oil for 10 to 15 minutes, when inserting the piston pin into the piston.
- Install the piston and connecting rod with the mark **FW** on the piston to the flywheel and the mark on the connecting rod to the injection pump. [Except D1102]
- Install the piston rings with their manufacturer's mark to the top of piston.
- Install the expander in the oil ring with its gap opposite to the gap of oil ring.
- Install the top ring with its gap at 1.57 rad (90°) from piston pin to the exhaust port.
- Install the second ring and oil ring with their gap at every 2.09 rad (120°).

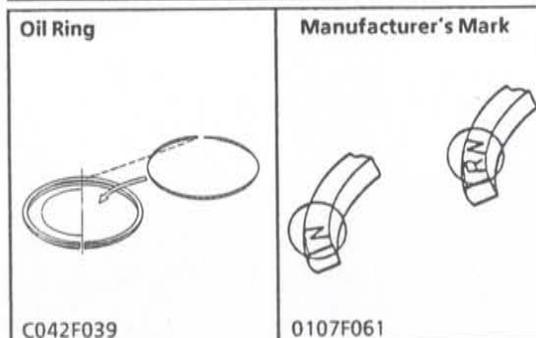


C059P037



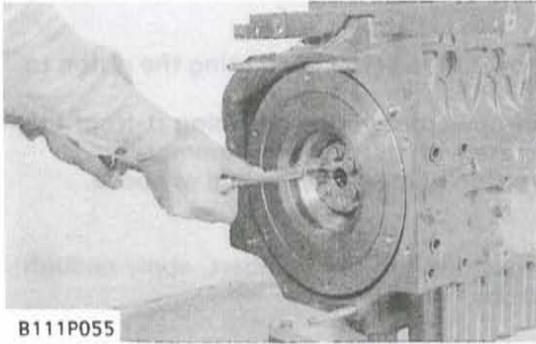
C059F061

C059F062



C042F039

0107F061



B111P055

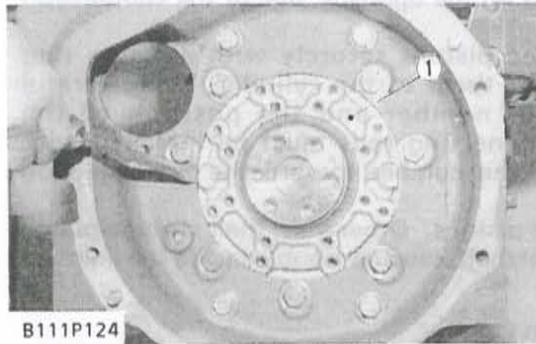
Flywheel

1. Remove the flywheel mounting screws.
2. Remove the flywheel.

(When reassembling)

- Check to see that there are no metal particles left on the flywheel mounting surface.
- To ease alignment of the crankshaft and the flywheel, bring the crank of No. 1 cylinder to TC (top dead center). Make sure of the flywheel 1 TC, align it in the window on flywheel housing.

Tightening torque	Flywheel mounting screws	98 to 108 N·m 10 to 11 kgf·m 72 to 80 ft-lbs
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B111P124

Bearing Case Cover

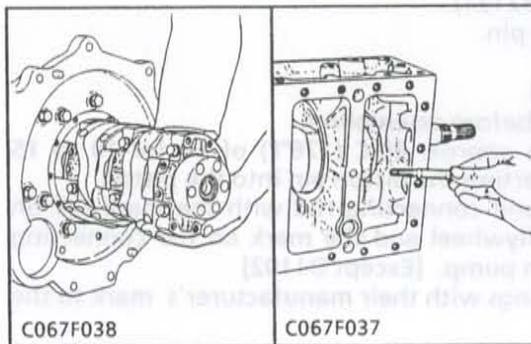
1. Loosen the screws first inside and next outside, and lift the cover (1).

(When reassembling)

- Apply grease to the oil seal lip and take care that it is not rolled when installing.

Tightening torque	Bearing case cover screws	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
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(1) Bearing Case Cover



C067F038

C067F037

Crankshaft

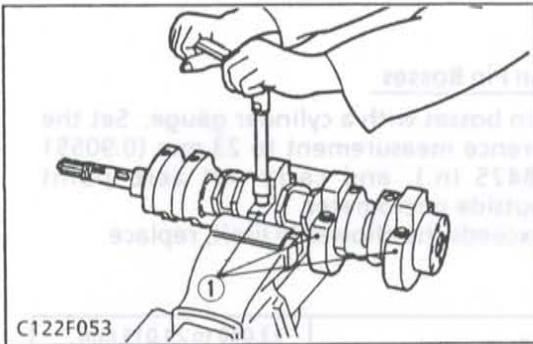
1. Remove the main bearing case screws 2.
2. Pull out the crankshaft, taking care not to damage the crankshaft bearing 1.

(When reassembling)

- Apply oil to the main bearing case screws 2.
- Clean the oil passage of the crankshaft with compressed air.

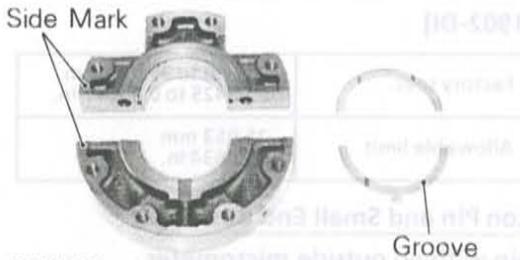
Tightening torque	Main bearing case screws 2	68.6 to 73.5 N·m 7.0 to 7.5 kgf·m 50.6 to 54.2 ft-lbs
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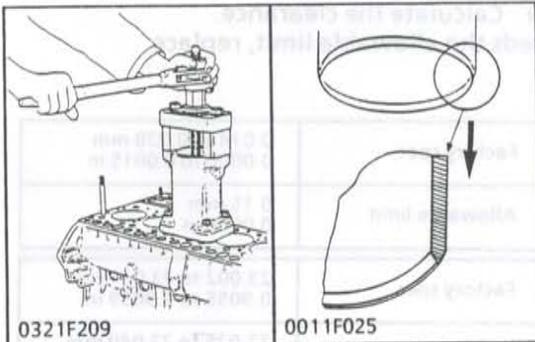


C122F053

(1) Main Bearing Case



C019P055



0321F209

0011F025

Main Bearing Case

1. Remove the main bearing case screws 1 and remove the main bearing cases (1).
2. Remove the thrust bearing from the flywheel end bearing case.
3. Detach the other bearing case in the same method. Be careful not to mix them up.

IMPORTANT

- Mark the location number to the bearing case, to prevent interchanging.

(When reassembling)

- Clean the oil holes in the main bearing cases.
- Install the main bearing cases with their side marks toward the gear case.
- Place the thrust bearings on the bearing case with their oil grooves outside.
- Apply engine oil to the main bearing case mounting screws.

Tightening torque	Main bearing case screws 1	36.3 to 41.2 N·m 3.7 to 4.2 kgf·m 26.8 to 30.4 ft·lbs
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Cylinder Liner [D1102]

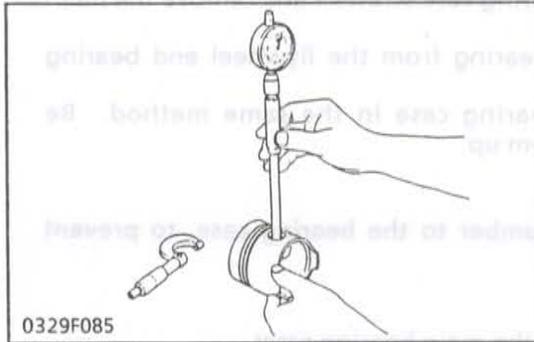
1. Install the dry liner changer (Code No: 07916-30043) on the cylinder block and replace the cylinder liner with new one.
2. Bore and hone to the specified dimension (See the table in Cylinder Liner)

IMPORTANT

- Clean the cylinder liner and the bore, and apply oil to them.
- Insert the liner with its chamfered end downward (See figure).

mm 0.014 to 0.038 in 0.0005 to 0.0015	Factory limit	Clearance between piston pin and small end bushing
mm 0.27 in 0.0106	Allowable limit	
mm 52.005 to 52.017 in 2.0493 to 2.0497	Factory limit	Piston pin O.D.
mm 52.025 to 52.040 in 2.0498 to 2.0478	Factory spec.	Small end bushing I.D.

SERVICING

**Inside Diameter of Piston Pin Bosses**

1. Measure the piston pin bosses with a cylinder gauge. Set the cylinder gauge's reference measurement to 23 mm (0.90551 in.) or 25 mm (0.98425 in.), and carry out zero point adjustment with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace.

[D1102]

Inside diameter of piston pin bosses	Factory spec.	23.000 to 23.013 mm 0.90551 to 0.78898 in.
	Allowable limit	25.053 mm 0.90759 in.

[D1402-DI, D1462-DI, V1902-DI]

Inside diameter of piston pin bosses	Factory spec.	25.000 to 25.013 mm 0.98425 to 0.98477 in.
	Allowable limit	25.053 mm 0.98634 in.

Clearance between Piston Pin and Small End Bushing

1. Measure the piston pin with an outside micrometer.
2. Measure the I.D. of connecting rod small end bushing with an inside micrometer. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

[D1102]

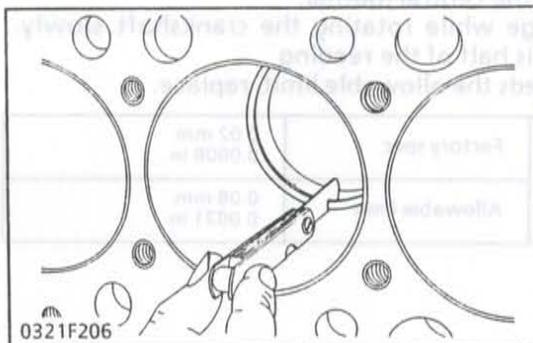
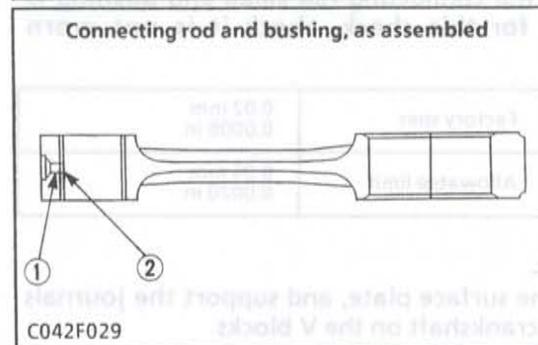
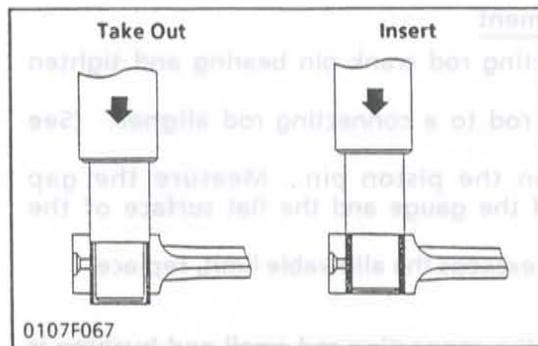
Clearance between piston pin and small end bushing	Factory spec.	0.014 to 0.038 mm 0.0006 to 0.0015 in.
	Allowable limit	0.15 mm 0.0059 in.

Piston pin O.D.	Factory spec.	23.002 to 23.011 mm 0.9056 to 0.9059 in.
Small end bushing I.D.	Factory spec.	23.025 to 23.040 mm 0.9065 to 0.9071 in.

[D1402-DI, D1462-DI, V1902-DI]

Clearance between piston pin and small end bushing	Factory spec.	0.014 to 0.038 mm 0.0006 to 0.0015 in.
	Allowable limit	0.15 mm 0.0059 in.

Piston pin O.D.	Factory spec.	25.002 to 25.011 mm 0.9843 to 0.9847 in.
Small end bushing I.D.	Factory spec.	25.025 to 25.040 mm 0.9852 to 0.9858 in.



Replace the Small End Bushing

1. Prepare the necessary tool. (See page S.G-38)
2. Press out the used bushing and, using this tool, press a new bushing in, taking due care to see that the connecting rod hole matches the bushing hole.
3. After pressing in the bushing, finish with a reamer to the specified factory specification.

[D1102]

Small end bushing I.D.	Factory spec.	23.025 to 23.040 mm 0.9065 to 0.9071 in.
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[D1402-DI, D1462-DI, V1902-DI]

Small end bushing I.D.	Factory spec.	25.025 to 25.040 mm 0.9852 to 0.9858 in.
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- (1) Connecting Rod Hole (2) Bushing Hole

Piston Ring Gap

1. Put the piston ring in the cylinder.
2. Turn the piston upside down and push the ring into the cylinder with the piston head.
3. Insert a feeler gauge into the piston ring gap.
4. If the clearance exceeds the allowable limit, replace.

■ IMPORTANT

- Measure the piston ring gap at the point of the minimum inside diameter of the cylinder liner.

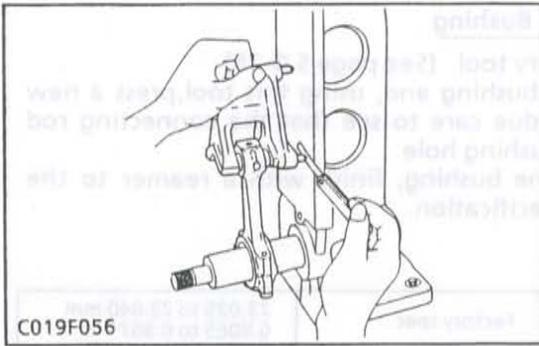
Top ring Second ring	Factory spec.	0.30 to 0.45 mm 0.0118 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

Oil ring	Factory spec.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

Piston Ring Clearance

1. Clean the rings and the ring grooves.
2. Measure the clearance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston rings.
4. If the clearance still exceeds the allowable limit with new ring, replace the piston.

Piston ring clearance	Second ring	Factory spec.	0.093 to 0.120 mm 0.00366 to 0.00472 in.
		Allowable limit	0.20 mm 0.0079 in.
	Oil ring	Factory spec.	0.020 to 0.052 mm 0.00079 to 0.00205 in.
		Allowable limit	0.15 mm 0.0059 in.



C019F056

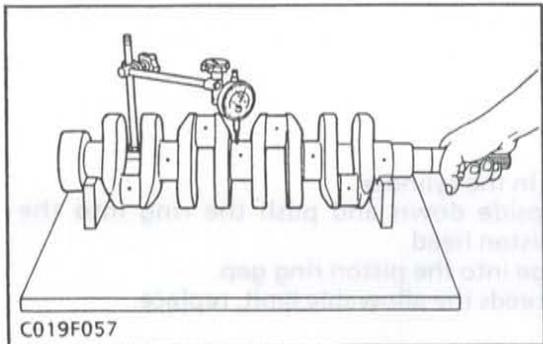
Connecting Rod Alignment

1. Remove the connecting rod crank pin bearing and tighten the rod screws.
2. Set the connecting rod to a connecting rod aligner. (See page S.G-34)
3. Place the gauge on the piston pin. Measure the gap between the pin of the gauge and the flat surface of the aligner.
4. If the measurement exceeds the allowable limit, replace.

IMPORTANT

- Because the I.D. of the connecting rod small end bushing is used as the basis for this check, check it is not worn beforehand.

Connecting rod alignment	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.0020 in.



C019F057

Crankshaft Alignment

1. Place V blocks on the surface plate, and support the journals at both ends of the crankshaft on the V blocks.
2. Set a dial gauge to the central journal.
3. Read the dial gauge while rotating the crankshaft slowly. Crankshaft flexure is half of the reading.
4. If the reading exceeds the allowable limit, replace.

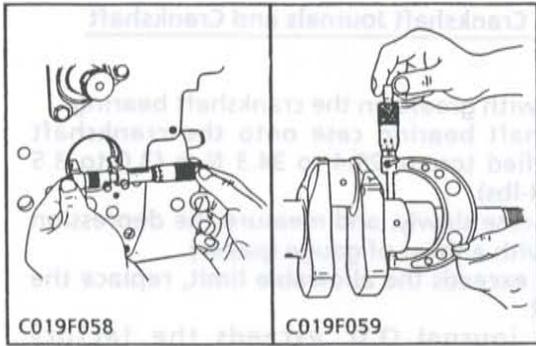
Crankshaft alignment	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.08 mm 0.0031 in.

Oil ring	Factory spec.	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	1.25 mm 0.0492 in.

Piston Ring Clearance

1. Clean the rings and the ring grooves.
2. Measure the distance between the ring and the groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston rings.
4. If the clearance still exceeds the allowable limit with new ring, replace the piston.

Piston ring clearance	Oil ring	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in.
	Oil ring	Allowable limit	0.50 mm 0.0197 in.
Piston ring clearance	Scrub ring	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in.
	Scrub ring	Allowable limit	0.50 mm 0.0197 in.



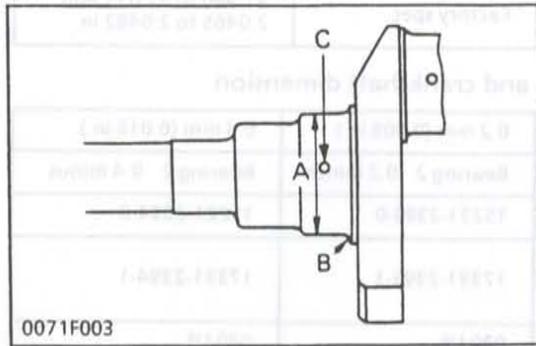
Oil Clearance between Crankshaft Journal and Crankshaft

Bearing 1

1. Measure the crankshaft journal (on the side of the crankshaft bearing 1) with an outside micrometer.
2. Measure the crankshaft bearing 1 with an inside micrometer. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the crankshaft bearing 1.
4. If the crankshaft journal O.D. exceeds the factory specification, machine the crankshaft journal, and use an undersize crankshaft bearing 1.

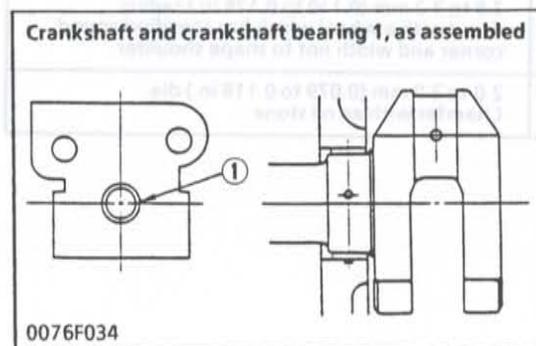
Oil clearance between crankshaft journal and crankshaft bearing 1	Factory spec.	0.040 to 0.118 mm 0.0016 to 0.0047 in.
	Allowable limit	0.2 mm 0.0079in.
Crankshaft journal O.D.	Factory spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 1 I.D.	Factory spec.	51.980 to 52.039 mm 2.0465 to 2.0488 in.

0.040 to 0.118 mm 0.0016 to 0.0047 in.	Factory spec.
0.2 mm 0.0079 in.	Allowable limit
51.921 to 51.940 mm 2.0441 to 2.0449 in.	Factory spec.
51.980 to 52.039 mm 2.0465 to 2.0488 in.	Factory spec.



• Undersize bearing 1 and crankshaft dimension

Undersize	0.2 mm (0.008 in.)	0.4 mm (0.016 in.)
Bearing	Bearing 1 0.2 minus	Bearing 1 0.4 minus
Code Number	17331-2391-1	17331-2392-1
Marking	020 US	040 US
A	51.721 to 51.740 mm 2.03626 to 2.03701 in.	51.521 to 51.540 mm 2.02839 to 2.02914 in.
B	2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.	
C	2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.	

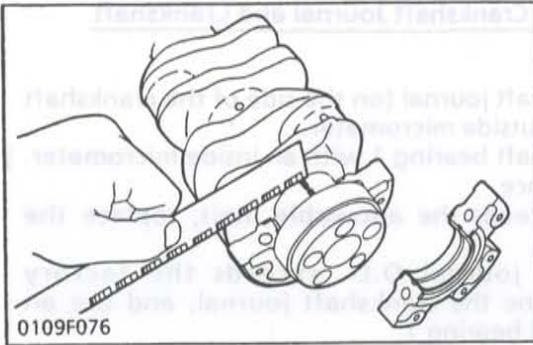


Replace the Crankshaft Bearing 1

1. Prepare the necessary tool. (See page S.G-40)
2. Press out the bearing 1, using the extracting tool.
3. Insert a new bearing 1, using the inserting tool, taking due care to see that the seam of bearing 1 faces the exhaust manifold side.

0076F034

(1) Seam



0109F076

Oil Clearance between Crankshaft Journals and Crankshaft Bearings 2

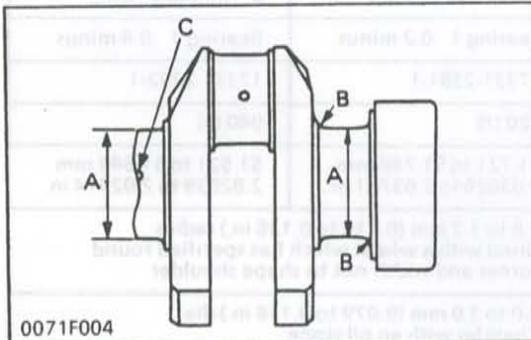
1. Paste a press gauge with grease on the crankshaft bearing.
2. Tighten the crankshaft bearing case onto the crankshaft journal to the specified torque 29.4 to 34.3 N·m (3.0 to 3.5 kgf·m, 21.7 to 25.3 ft-lbs).
3. Detach the bearing case slowly, and measure the depression of the press gauge with a sheet of gauge (paper).
4. If the measurement exceeds the allowable limit, replace the crankshaft bearing 2.
5. If the crankshaft journal O.D. exceeds the factory specification, machine the crankshaft journal, and use an undersize crankshaft bearing 2.

Oil clearance between crankshaft journal and crankshaft bearing 2	Factory spec.	0.040 to 0.104 mm 0.0016 to 0.0041 in.
	Allowable limit	0.20 mm 0.0079 in.

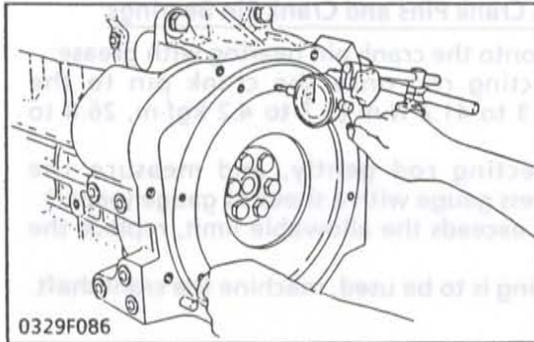
Crankshaft journal O.D.	Factory spec.	51.921 to 51.940 mm 2.0441 to 2.0449 in.
Crankshaft bearing 2 I.D.	Factory spec.	51.980 to 52.025 mm 2.0465 to 2.0482 in.

• Undersize bearing 2 and crankshaft dimension

Undersize	0.2 mm (0.008 in.)	0.4 mm (0.016 in.)	
Bearing	Bearing 2 0.2 minus	Bearing 2 0.4 minus	
Code Number	D1102	15221-2393-0	15221-2394-0
	D1402-DI D1462-DI V1902-DI	17331-2393-1	17331-2394-1
	Marking	020 US	040 US
A	51.721 to 51.740 mm 2.03626 to 2.03701 in.	51.521 to 51.540 mm 2.02839 to 2.02914 in.	
B	2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.		
C	2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.		

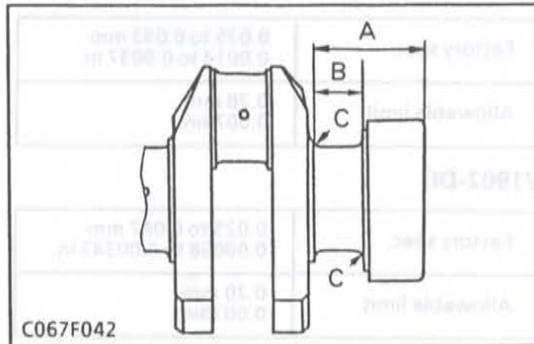


0071F004



Flywheel Sway and Crankshaft Side Clearance

1. Set a dial indicator with its tip on the rear friction face of the flywheel near the edge.
2. Turn the flywheel and measure the sway.
3. If the measurement exceeds the allowable limit, remove the flywheel and check the contact faces of the crankshaft and flywheel.
4. Move the crankshaft with flywheel back and forth to each end and measure the side clearance.
5. If the side clearance exceeds the allowable limit, replace the side bearing.
6. If an oversize bearing is to be used, machine the crankshaft.

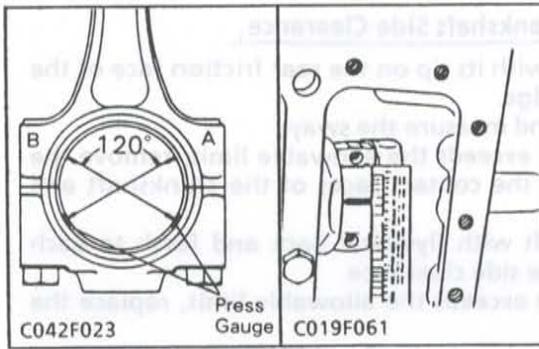


Sway	Allowable limit	0.05 mm 0.0020 in.
Side clearance	Factory spec.	0.15 to 0.31 mm 0.0059 to 0.0122 in.
	Allowable limit	0.5 mm 0.020 in.

● Oversize bearing and crankshaft dimension

Undersize	0.2 mm (0.008 in.)		0.4 mm (0.016 in.)	
Bearing	Side bearing 1 0.2 plus	Side bearing 2 0.2 plus	Side bearing 1 0.4 plus	Side bearing 2 0.4 plus
Code Number	D1102	15521-2395-0	15521-2396-0	19202-2398-1
	D1402-DI D1462-DI V1902-DI	15221-2395-1	19202-2397-1	
Marking	020 OS		040 OS	
A	54.6 to 54.8 mm 2.150 to 2.157 in.		54.8 to 55.0 mm 2.157 to 2.165 in.	
B	26.40 to 26.45 mm 1.0394 to 1.0413 in.		26.80 to 26.85 mm 1.0551 to 1.0571 in.	
C	2.8 to 3.2 mm (0.110 to 0.126 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.			





Oil Clearance between Crank Pins and Crank Pin Bearings

1. Paste a press gauge onto the crank pin bearing with grease.
2. Tighten the connecting rod onto the crank pin to the specified torque 36.3 to 41.2 N·m (3.7 to 4.2 kgf·m, 26.8 to 30.4 ft-lbs).
3. Remove the connecting rod gently, and measure the depression of the press gauge with a sheet of gauge (paper).
4. If the measurement exceeds the allowable limit, replace the crankpin bearing.
5. If an undersize bearing is to be used, machine the crankshaft.

[D1102]

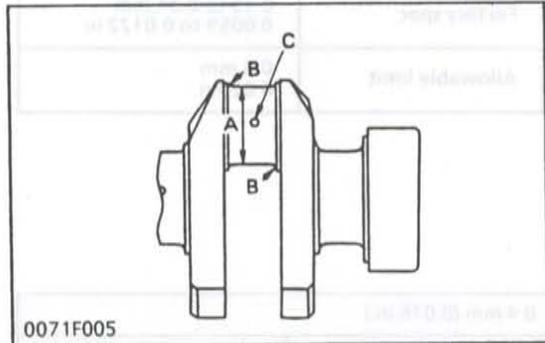
Oil clearance between crank pins and crank pin bearings	Factory spec.	0.035 to 0.093 mm 0.0014 to 0.0037 in.
	Allowable limit	0.20 mm 0.0079 in.

[D1402-DI, D1462-DI, V1902-DI]

Oil clearance between crank pins and crank pin bearings	Factory spec.	0.025 to 0.087 mm 0.00098 to 0.00343 in.
	Allowable limit	0.20 mm 0.0079 in.

● Undersize bearing and crankshaft dimension

Undersize	0.2 mm (0.008 in.)	0.4 mm (0.016 in.)	
Bearing	Connecting rod bearing 0.2 minus	Connecting rod bearing 0.4 minus	
Code Number	D1102	15471-2297-0	15471-2298-0
	D1402-DI D1462-DI V1902-DI	17331-2297-1	17331-2298-1
	Marking	020 US	040 US
A	D1102	43.759 to 43.775 mm 1.72280 to 1.72343 in.	43.559 to 43.575 mm 1.71492 to 1.71555 in.
	D1402-DI D1462-DI V1902-DI	46.759 to 46.775 mm 1.84091 to 1.84154 in.	46.559 to 46.575 mm 1.83303 to 1.83366 in.
B	3.3 to 3.7 mm (0.130 to 0.146 in.) radius Grind with a wheel which has specified round corner and width not to shape shoulder.		
C	2.0 to 3.0 mm (0.079 to 0.118 in.) dia. Chamfer with an oil stone.		



Crankshaft Sleeve Wear

1. Measure the wear of the crankshaft sleeve with a surface roughness tester.
2. If the wear exceeds the allowable limit, replace the crankshaft sleeve.

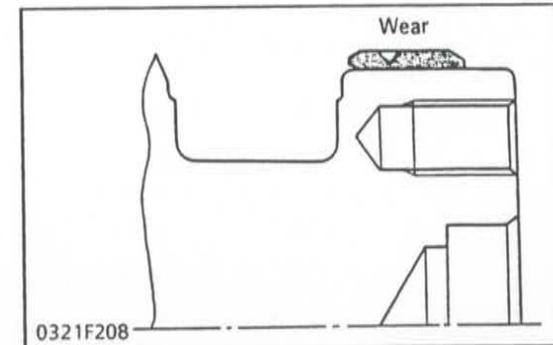
Wear	Allowable limit	0.1 mm 0.0039 in.
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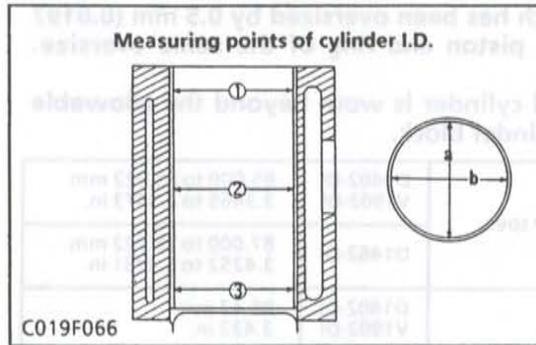
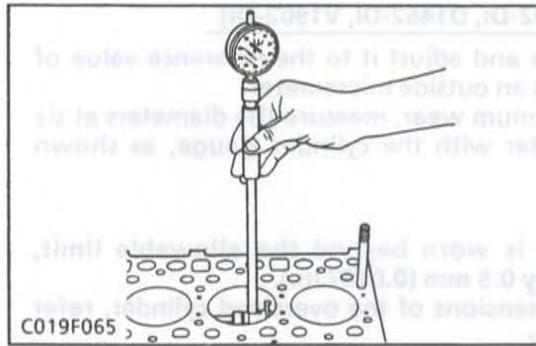
(When removing)

- Pull out the crankshaft sleeve with a special-use puller set (Code No: 07916-09032)

(When installing)

- Heat a new sleeve to a temperature between 150 to 200°C (302 to 392°F), and fix the sleeve to the crankshaft.
- Press fit the crankshaft sleeve using an auxiliary socket (Code No: 07916-32091)





- (1) Top
- (2) Middle
- (3) Bottom (Skirt)
- (a) Right-angle to the Piston Pin
- (b) Parallel to the Piston Pin

Wear of Cylinder Liner [D1102]

1. Set a cylinder gauge and adjust it to the reference value of the cylinder liner with an outside micrometer.
2. To find out the maximum wear, measure the diameters at six points on the cylinder liner with the cylinder gauge, as shown below.

NOTE

- When the cylinder liner is worn beyond the allowable limit, rebore and hone it by 0.5 mm (0.0197 in.).
- For the finish dimensions of the cylinder liners, refer to the table below.
- The cylinder liner which has been oversized by 0.5 mm (0.0197 in.) should use a piston and ring of the same oversize. (See the Table 2)
- When the oversized cylinder liner is worn beyond the allowable limit, replace the cylinder liner, and rebore and hone it.

Cylinder I.D.	Factory spec.	76.000 to 76.019 mm 2.9921 to 2.9929 in.
	Allowable limit	76.169 mm 2.9988 in.

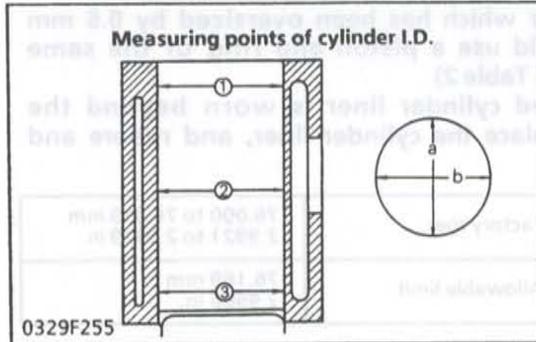
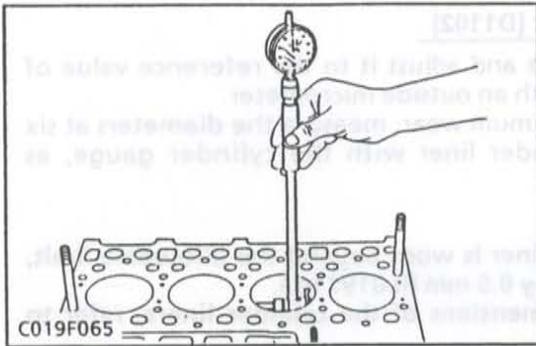
Table 1

Oversized Cylinder I.D.	Finishing
76.500 to 76.519 mm 3.0118 to 3.0126 in.	Hone to 1.2 to 2.0 μR max.

Table 2

Oversize	Part name	Code number	Mark
0.5 mm 0.0197 in.	Piston 05	15221-2191-1	050S
	Piston ring 05 assembly	15501-2109-0	

Model	Cylinder number	Model	Part name	Oversize
2000	7-101-5-101-1	D1403-D1	Piston 05	0.5 mm 0.0197 in.
	7-101-5-101-1	D1403-D1		
	7-101-5-101-1	D1403-D1		
2000	7-101-5-101-1	D1403-D1	Piston ring 05 assembly	0.5 mm 0.0197 in.
	7-101-5-101-1	D1403-D1		
	7-101-5-101-1	D1403-D1		



- (a) Right-angle to the Piston Pin (1) Top
 (b) Parallel to the Piston Pin (2) Middle
 (3) Bottom (Skirt)

Wear of Cylinder [D1402-DI, D1462-DI, V1902-DI]

1. Set a cylinder gauge and adjust it to the reference value of the cylinder I.D. with an outside micrometer.
2. To find out the maximum wear, measure the diameters at six points on the cylinder with the cylinder gauge, as shown below.

■ **NOTE**

- When the cylinder is worn beyond the allowable limit, rebore and hone it by 0.5 mm (0.0197 in.).
- For the finish dimensions of the oversized cylinder, refer to the table below.
- The cylinder which has been oversized by 0.5 mm (0.0197 in.) should use a piston and ring of the same oversize. (See the Table 2)
- When the oversized cylinder is worn beyond the allowable limit, replace the cylinder block.

Cylinder I.D.	Factory spec.	D1402-DI V1902-DI	85.000 to 85.022 mm 3.3465 to 3.3473 in.
		D1462-DI	87.000 to 87.022 mm 3.4252 to 3.4261 in.
	Allowable limit	D1402-DI V1902-DI	85.17 mm 3.432 in.
		D1462-DI	87.67 mm 3.452 in.

Table 1

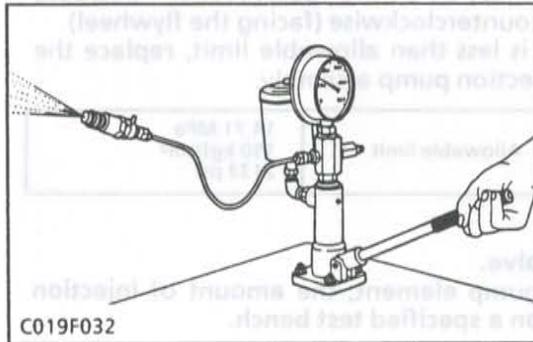
	Oversized Cylinder I.D.	Finishing
D1402-DI V1902-DI	85.500 to 85.522 mm 3.3661 to 3.3670 in.	Hone to 1.2 to 2.0 μR max.
D1462-DI	87.500 to 87.522 mm 3.4449 to 3.4457 in.	

Table 2

Oversize	Part name	Model	Code number	Mark
0.5 mm 0.0197 in.	Piston 05	D1402-DI	19821-2191-1	050S
		D1462-DI	17367-2191-1	
		V1902-DI	17365-2192-1	
	Piston ring 05 assembly	D1402-DI V1902-DI	15521-2109-2	
D1462-DI		17331-2109-1		

[4] FUEL SYSTEM (D1102)

CHECKING AND ADJUSTING



Fuel Injection Pressure

1. Set a nozzle to a nozzle tester.
2. Move the tester handle up and down to prime fuel. Measure the pressure of fuel jetting from the nozzle tip.
3. If the measurement is not within the factory specification, adjust with the adjustment washer inside the nozzle holder. (See page S.1-48) Each extra 0.1 mm (0.0039 in.) of washer thickness causes an approximate 980.6 kPa (10 kgf/cm², 142.2 psi) increase in fuel injection pressure.

CAUTION

- Be careful not to come into direct contact with the injected fumes. The fumes destroy any cells they may touch. They may also cause blood poisoning.

Opening pressure of nozzle	Factory spec.	13.7 to 14.7 MPa 140 to 150 kgf/cm ² 1990 to 2133 psi
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Fuel Tightness of Nozzle Valve Seat

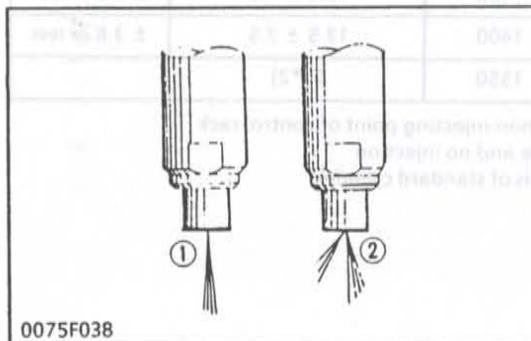
1. Set a nozzle to a nozzle tester.
2. Apply a pressure 12.7 MPa (130 kgf/cm², 1848.6 psi).
3. After keeping the nozzle under this pressure for 10 seconds, check to see if fuel leaks from the nozzle valve seat.
4. If fuel should leak, replace the nozzle piece.

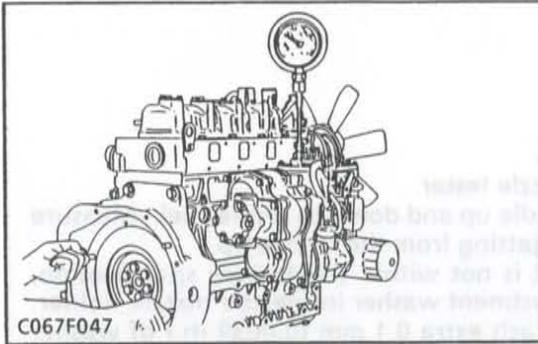
Factory spec.
When the pressure is 12.7 MPa (130 kgf/cm ² , 1848.6 psi), in the valve seat must be oil-tight.

Shape of Fumes Across Nozzle Tip

1. Set the nozzle to a nozzle tester and shoot it in the air. Check the shape of the fumes.
2. If the shape is defective, replace the nozzle piece.

- (1) Good
(2) Bad





Fuel Tightness of Pump Element

1. Remove the injection pipes, glow plug and the inlet manifold, and install the pressure tester (See page S.G-39)
2. Speed control lever must be at the fuel injection position, turn the crankshaft counterclockwise (facing the flywheel).
3. If the measurement is less than allowable limit, replace the pump element or injection pump assembly.

Fuel tightness of pump element	Allowable limit	14.71 MPa 150 kgf/cm ² 2133 psi
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■ IMPORTANT

- Use good delivery valve.
- After replace only pump element, the amount of injection should be adjusted on a specified test bench.

[Test Conditions]

Nozzle	DN125D12
Opening pressure	13.73 MPa (140 kgf/cm ² , 1991 psi)
Injection pipe	6mm dia. x 2 mm dia. x 600 mm long 0.24 in. dia x 0.08 in. dia. x 23.62 in. long
Fuel feed pressure	20 kPa (0.2 kgf/cm ² , 3 psi)
Test fuel	Diesel fuel No. 2-D
Pre-stroke	2.15 to 2.25 mm, 0.0846 to 0.0886 in.
Cam profile	See figure

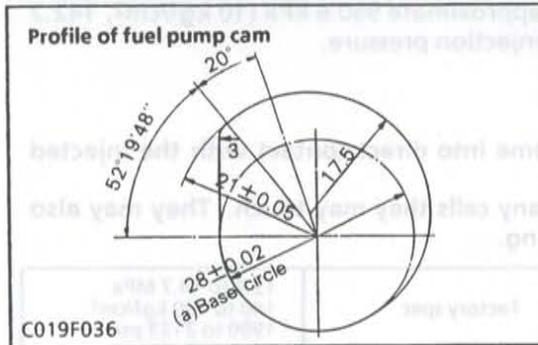
[Adjustment Reference Data]

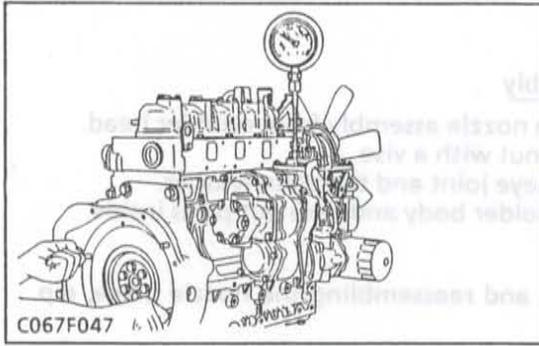
Control rack position (*1)	Speed (rpm)	Amount of injection (mm ³ /st)	Allowance (mm ³) (*3)
9	1400	23 ± 1.5	± 1.5 or less
8	1400	18.5 ± 7.5	± 3.8 or less
7	1400	13.5 ± 7.5	± 3.8 or less
0 to 3.5	1550	0 (*2)	

*1: Travel distance from non-injecting point of control rack

*2: Zero opening pressure and no injection

*3: Allowance on the basis of standard cylinder

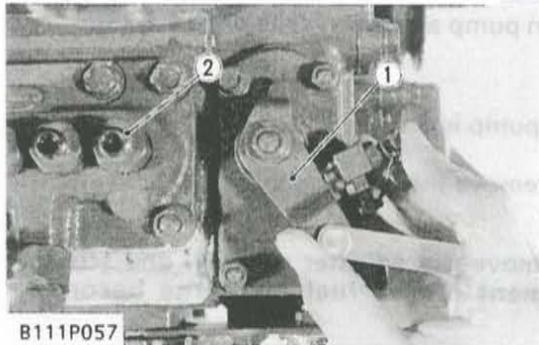




Fuel Tightness of Delivery Valve of Fuel Injection Pump

1. Remove the injection pipes, glow plugs and the inlet manifold, and install the pressure tester (See page S.G-39).
2. With the speed control lever at the fuel injection position, turn the crankshaft counterclockwise (facing the flywheel) until the pressure build up to 9.8 MPa (100kgf/cm², 1422 psi).
3. Release the pressure in the delivery chamber by moving down the plunger to bottom dead center (turn the crankshaft clockwise approx. 1.57 rad (90°) from the FI timing).
4. Measure the time needed to decrease the initial pressure from 9.81 to 9.32 MPa (100 to 95 kgf/cm², 1422 to 1351 psi).
5. If measurement is less than allowable limit, replace the delivery valve.
6. If the pressure does not build up, replace the pump element with new one and test again.

Fuel tightness of delivery valve of fuel injection pump	Allowable limit	5 seconds
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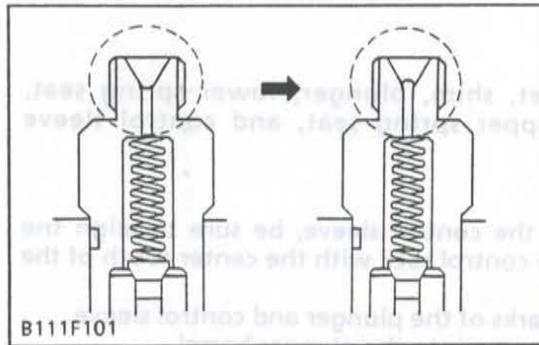


(1) Speed Control Lever (2) Delivery Valve Holder

Injection Timing

1. Disconnect the injection pipes from the injection pump.
2. Position the speed control lever (1) at maximum speed.
3. Rotate the flywheel counterclockwise to verify that the fuel flows from the delivery valve holder (2) of the injection pump.
4. Rotate the flywheel clockwise by about 0.7 rad. (40°).
5. Slowly rotate the flywheel counterclockwise again, find out an instance when the fuel level rises from the delivery valve holder (2), and stop flywheel rotation immediately.
6. Read the injection timing of the window on the flywheel housing.
7. The fuel injection timing lines are issued each 0.09 rad. (5°) from the TC mark on the flywheel. Therefore, reading of the fuel injection timings are roughly.
8. If the timing is out of adjustment, readjust with shim.

Injection timing	Factory spec.	0.401 to 0.436 rad (23° to 25°) before T.D.C.
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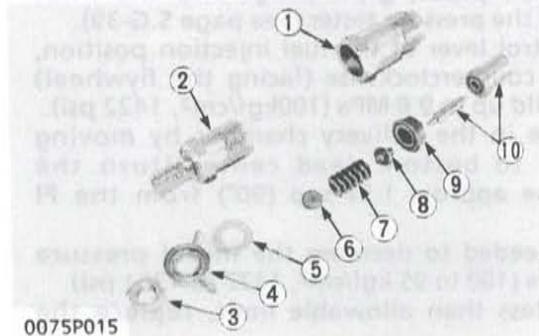
Timing Window



(Reference)

- The timing advances by removing 0.15 mm (0.006 in.) of shim and retard by adding one, approx. 0.26 rad (1.5°) of crank angle.
- Approx. 3.6 mm (0.142 in.) of turn at outer rim of flywheel equals 0.26 rad (1.5°) of crank angle.
- Thickness of adjusting shims:
 0.15 mm (0.0059 in.) [Code No. 15321-52113]
 0.30 mm (0.0118 in.) [Code No. 15521-52111]
 0.45 mm (0.0177 in.) [Code No. 15511-52111]

DISASSEMBLING AND ASSEMBLING



0075P015

- | | |
|------------------------|----------------------|
| (1) Retaining Nut | (6) Adjusting Washer |
| (2) Nozzle Holder Body | (7) Nozzle Spring |
| (3) Nut | (8) Push Rod |
| (4) Eye Joint | (9) Distance Piece |
| (5) Plain Washer | (10) Nozzle Piece |

Injection Nozzle Assembly

1. Remove the injection nozzle assembly from cylinder head.
2. Secure the retaining nut with a vise.
3. Remove the nut, the eye joint and the plain washer.
4. Remove the nozzle holder body and take out parts inside.

(When reassembling)

- When disassembling and reassembling the nozzle piece, dip it in clean fuel.
- Install the push rod, don't refit it upside down.
- Do not tighten it too much, or the needle valve will not slide easily and the injection performance will be decreased.

Tightening torque	Nozzle holder body to retaining nut	58.8 to 78.4N·m 6.0 to 8.0 kgf·m 43.4 to 57.9 ft·lbs
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Injection Pump Assembly

1. Remove the injection pump assembly. (See page S.1-25)

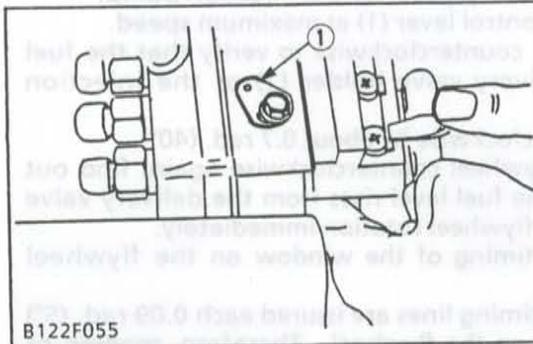
Tappet Guide Pin

1. Clamp the injection pump in a vice.
2. Flatten the plate.
3. Push in the tappet, remove the tappet guide pin.

■ IMPORTANT

- Never loosen or remove the adjuster plate (1) and screws unless the adjustment of the fuel discharge becomes necessary.

- (1) Adjuster Plate



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Tappet, Other Parts

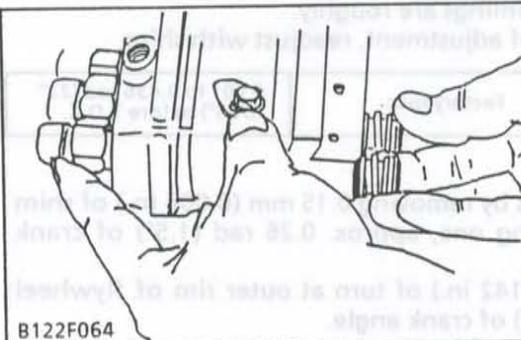
1. Remove the tappet, shim, plunger, lower spring seat, plunger spring, upper spring seat, and control sleeve together.

(When reassembling)

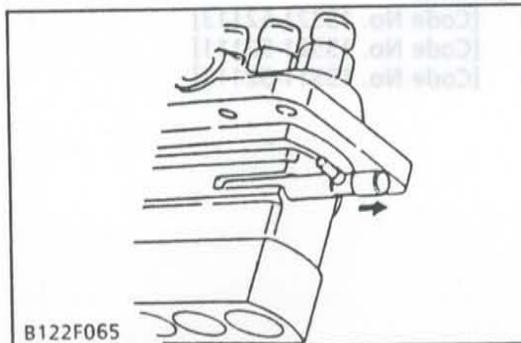
- Before assembling the control sleeve, be sure to align the stamped line of the control rack with the center tooth of the control sleeve.
- Set the assembly marks of the plunger and control sleeve.
- Do not force the plunger into the plunger barrel.

Control Rack

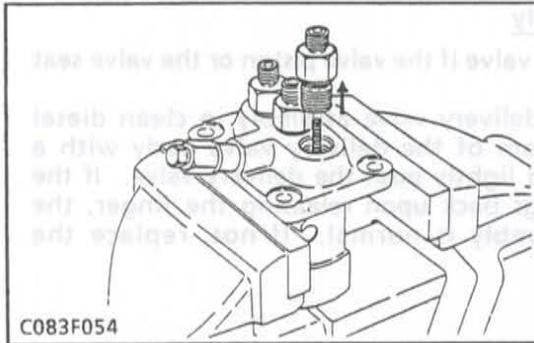
1. Remove the control rack.



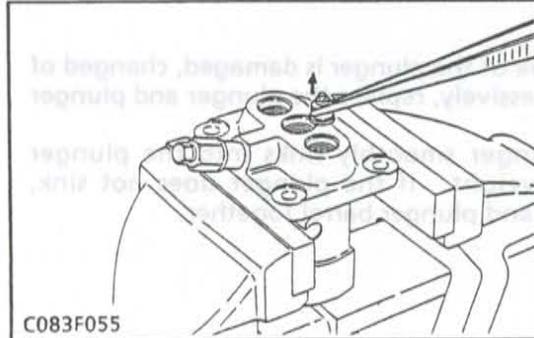
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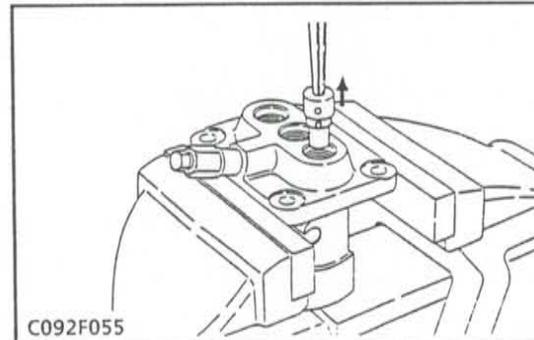
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Delivery Valve, Plunger Barrel

1. Loosen and remove the delivery valve holder.
2. Remove the delivery valve spring, delivery valve assembly and gasket.
3. Remove the plunger barrel.

(When reassembling)

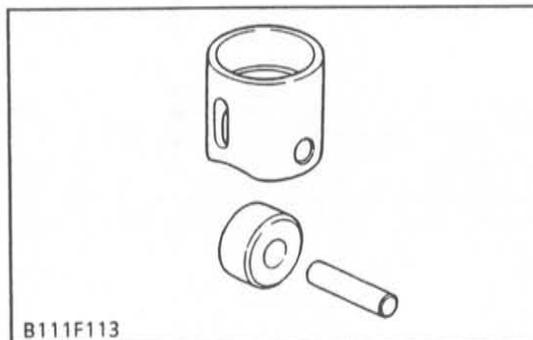
- Install the plunger barrel so that its locator groove fits the eccentric pin.

Tightening torque	Delivery valve holder	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft-lbs

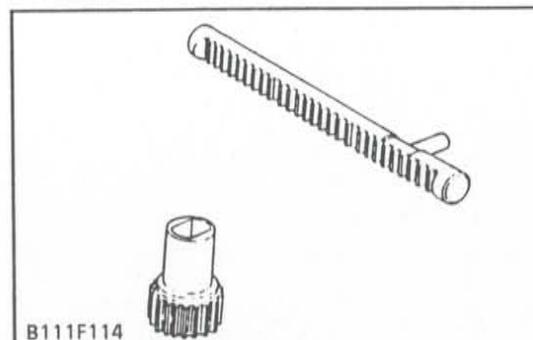
■ IMPORTANT

- Always disassemble and assemble the delivery valve and plunger barrel in clean diesel fuel.
- Attach tags to all removed parts for proper matching in reassembling and enter notes on installation, place and sequences of assembling.

SERVICING



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Tappet Assembly

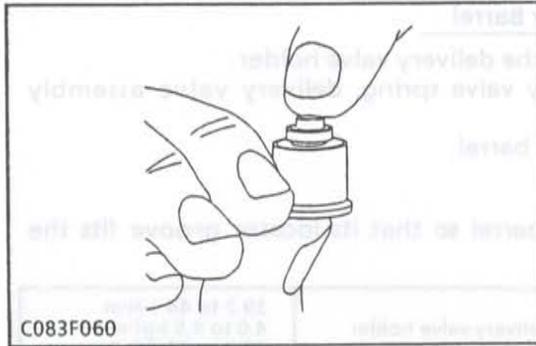
1. Replace the tappet assembly if the outer circumference of the tappet, roller and roller pin are damaged or excessively worn.

Control Rack

1. Replace the control rack if it is bent, damaged or the tooth is excessively worn.

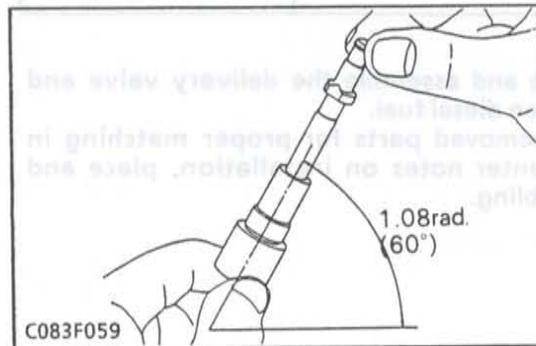
Control Sleeve

1. Replace the control sleeve if the teeth or groove of the control sleeve is excessive worn.



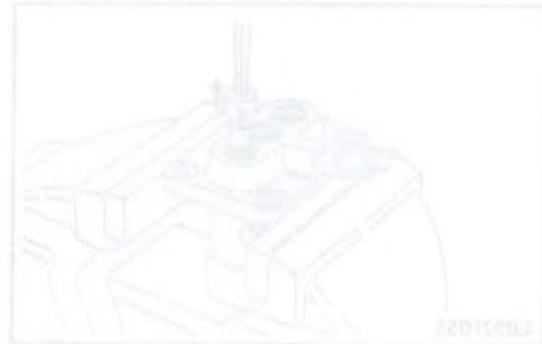
Delivery Valve Assembly

1. Replace the delivery valve if the valve piston or the valve seat is damaged or worn.
2. After washing the delivery valve assembly in clean diesel fuel, close the bottom of the delivery valve body with a finger as shown and lightly push the delivery valve. If the delivery valve springs back upon releasing the finger, the delivery valve assembly is normal. If not, replace the assembly.



Pump Element

1. If the notch or groove of the plunger is damaged, changed of its color or worn excessively, replace the plunger and plunger barrel together.
2. Verify that the plunger smoothly sinks into the plunger barrel by its own weight. If the plunger does not sink, replace the plunger and plunger barrel together.

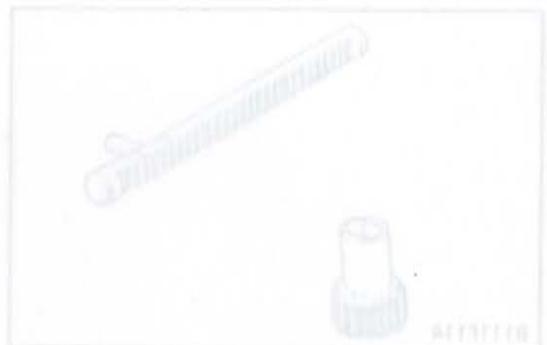


SERVICING



Roller Assembly

Replace the roller assembly if the outer circumference of the roller and roller pin are damaged or excessively worn.



Control Rack

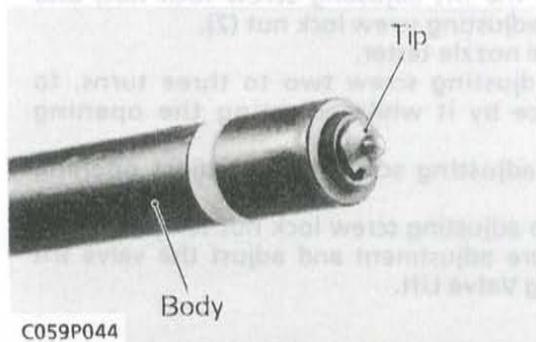
Replace the control rack if it is bent, damaged or the teeth is excessively worn.

Control Sleeve

Replace the control sleeve if the teeth or groove of the control sleeve is excessive worn.

[5] FUEL SYSTEM (D1402-DI, D1462-DI, V1902-DI)

CHECKING AND ADJUSTING

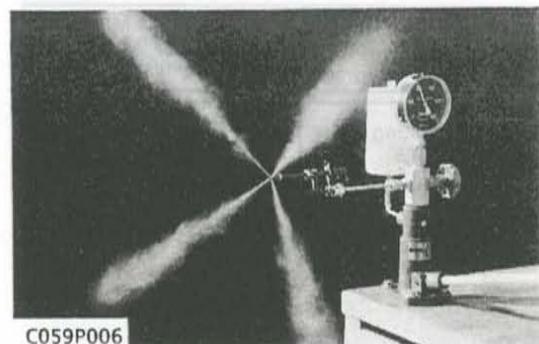


Injection Nozzle

1. Remove the injection nozzle assembly. (See page S.1-17)

Nozzle Body and Tip

1. Check the nozzle body and tip.
2. If the body is deformed, replace the nozzle.
3. If any orifices are chipped at the edges or eroded to an extent that the spray pattern is affected, replace the nozzle.



Fuel Injection Pressure

1. Set the injection nozzle to the nozzle tester.
2. Measure the injection pressure.
3. If the measurement is not within the factory specification, adjust the opening pressure and the valve lift referring to **Adjusting Opening Pressure and Adjusting Valve Lift**, (See page S.1-52).

Fuel injection pressure	Factory spec.	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi
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⚠ CAUTION

- Never contact with spraying diesel fuel under pressure, which can have sufficient force to penetrate the skin, causing serious personal injury.
- Be sure nobody is in the direction of the spray.

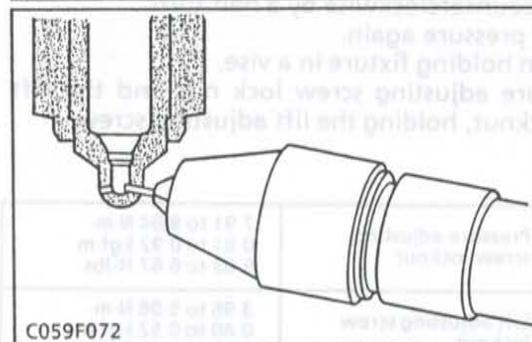
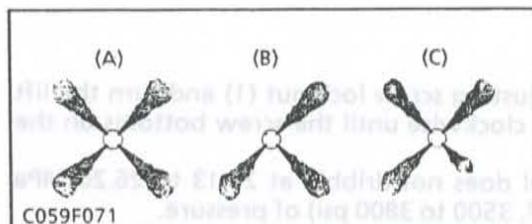
Spray Pattern

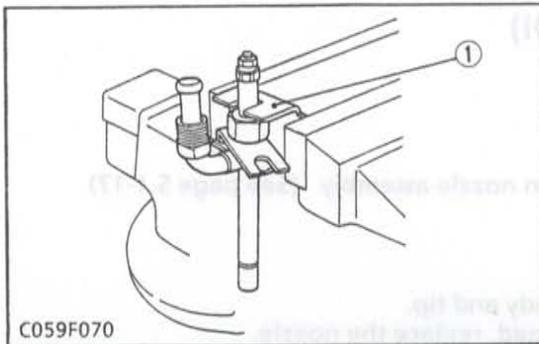
1. After checking the opening pressure, operate the tester at 30 downward strokes per minute and observe spray pattern.
2. If the spray pattern is affected by the chipped or eroded edge of orifices, replace the nozzle.
3. If the spray pattern is not **Typical**, clean the orifices as follows or replace the nozzle.
4. At first, secure the 0.19 mm (0.008 in.) DIA. of wire in the cleaning fixture (Code No: 07916-32731) in pin vise with the end protruding approx. 1.0 mm (0.04 in.).
5. Insert the cleaning wire into each orifice and rotate it until free and progress to the 0.22 mm (0.009 in.) wire and repeat the process.
6. Finally clean the orifices with the 0.24 mm (0.01 in.) and wipe off and inspect the tip.

■ NOTE

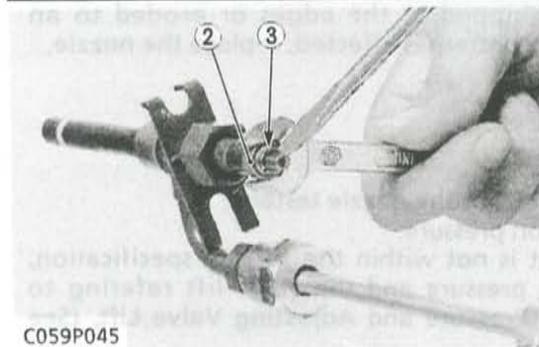
- Clean orifice only after it is disassembled.

- (A) Typical Spray Pattern
(B) One Orifice is Plugged
(C) One Edge of Orifice is Chipped or Eroded

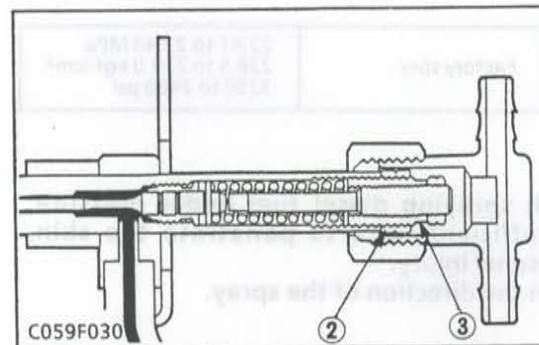




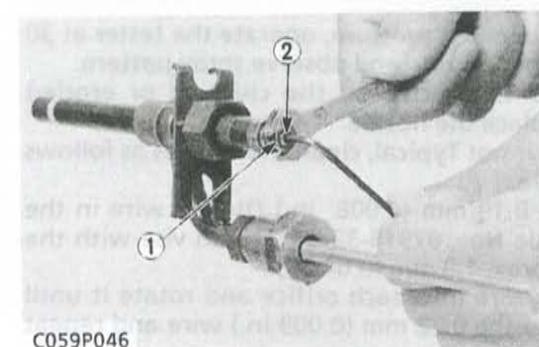
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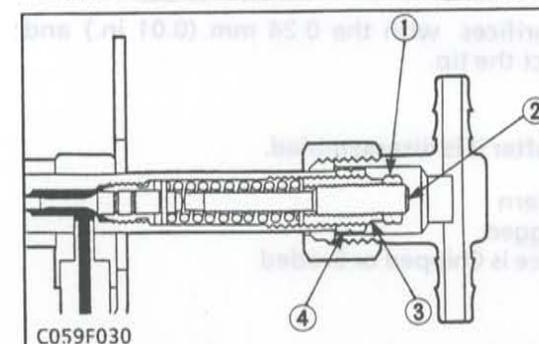
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C059P046



C059F030

Adjusting Valve Opening Pressure

1. Secure the nozzle in holding fixture (1) (See page S.G-41) in a vise and remove the leak-off cap.
2. Loosen and remove the lift adjusting screw lock nut, and loosen the pressure adjusting screw lock nut (2).
3. Set the nozzle to the nozzle tester.
4. Back out the lift adjusting screw two to three turns, to prevent interference by it while adjusting the opening pressure.
5. Turn the pressure adjusting screw (3) to adjust opening pressure.
6. Tighten the pressure adjusting screw lock nut temporarily to maintain the pressure adjustment and adjust the valve lift referring to **Adjusting Valve Lift**.

(Reference)

Opening pressure	Factory spec.	22.41 to 23.44 MPa 228.5 to 239.0 kgf/cm ² 3250 to 3400 psi
Tightening torque	Pressure adjusting screw lock nut	7.91 to 9.04 N-m 0.81 to 0.92 kgf-m 5.83 to 6.67 ft-lbs

- (1) Holding Fixture
(2) Pressure Adjusting Screw Locknut

- (3) Pressure Adjusting Screw

Adjusting Valve Lift

1. Remove the lift adjusting screw lock nut (1) and turn the lift adjusting screw (2) clockwise until the screw bottoms on the valve.
2. Check that the fuel does not dribble at 24.13 to 26.20 MPa (246 to 267 kgf/cm², 3500 to 3800 psi) of pressure.
3. Turn the lift screw counterclockwise by a half turn.
4. Check the opening pressure again.
5. Secure the nozzle in holding fixture in a vise.
6. Tighten the pressure adjusting screw lock nut and the lift adjusting screw locknut, holding the lift adjusting screw.

(Reference)

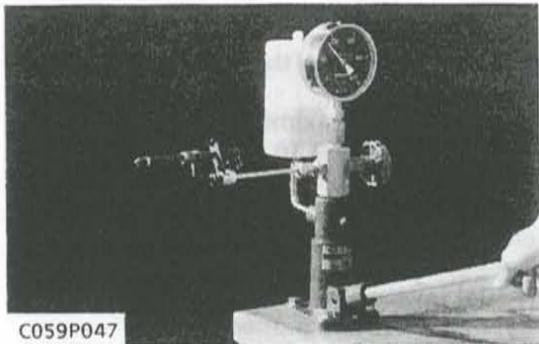
Tightening torque	Pressure adjusting screw locknut	7.91 to 9.04 N-m 0.81 to 0.92 kgf-m 5.83 to 6.67 ft-lbs
	Lift adjusting screw locknut	3.96 to 5.08 N-m 0.40 to 0.52 kgf-m 2.92 to 3.75 ft-lbs

■ IMPORTANT

- Do not turn the lift adjusting screw excessively, as bending of the valve may result.

- (1) Lift Adjusting Screw Lock nut
(2) Lift Adjusting Screw

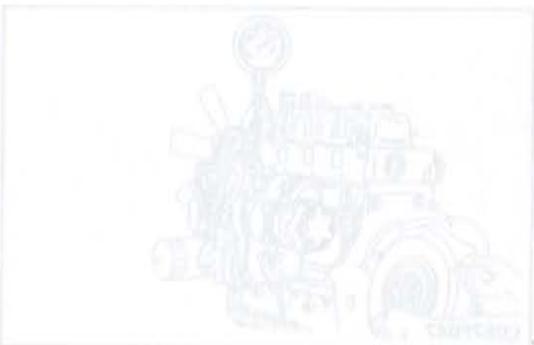
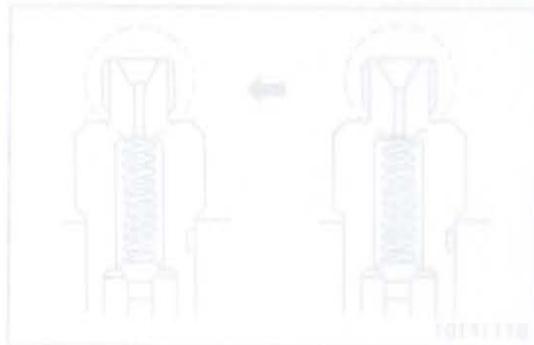
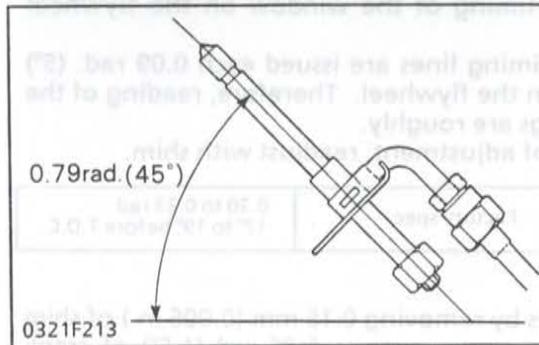
- (3) Pressure Adjusting Screw
(4) Pressure Adjusting Screw Locknut



Valve Seat Tightness

1. Set the nozzle to the nozzle tester with the tip highest at approx. 0.79 rad. (45°) as shown in the figure.
2. Dry the nozzle tip and raise the pressure to 18.96 to 20.00 Mpa (193.3 to 203.9 kgf/cm², 2750 to 2900 psi).
3. If the fuel dribbles from the tip within 5 seconds, replace the nozzle.

Valve seat tightness	Factory spec.	No leaks for 5 seconds at 18.96 to 20.00 MPa (193.3 to 203.9 kgf/cm ² , 2750 to 2900 psi)
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Thickness of adjusting shim:

0.12 mm (0.008 in.)	[Code No. 15321-22113]
0.30 mm (0.018 in.)	[Code No. 15321-22111]
0.45 mm (0.0173 in.)	[Code No. 15211-22111]

for 3 cylinders.

0.12 mm (0.008 in.)	[Code No. 15401-22113]
0.30 mm (0.018 in.)	[Code No. 15421-22111]
0.45 mm (0.0173 in.)	[Code No. 15481-22111]

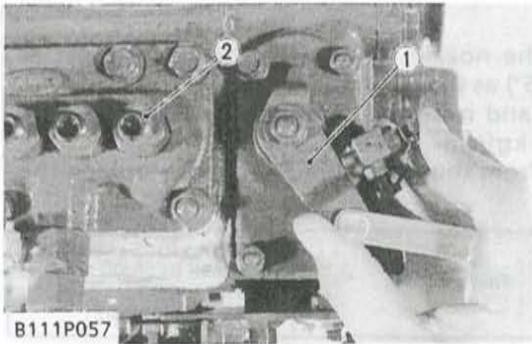
for 4 cylinders.

Delivery Valve Fuel Tightness

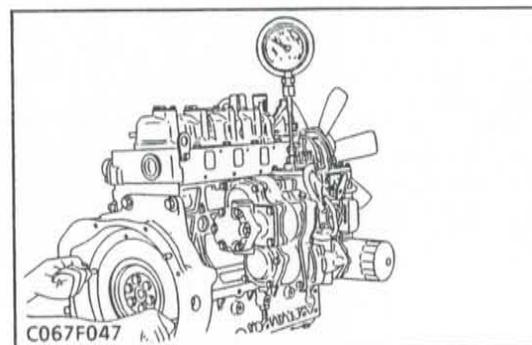
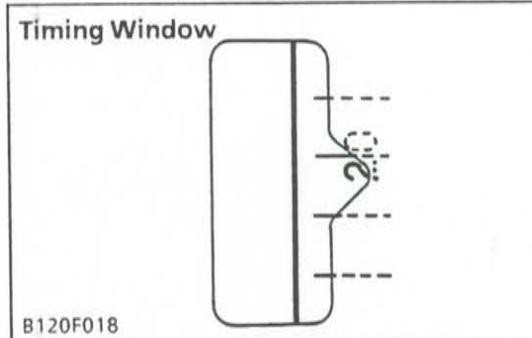
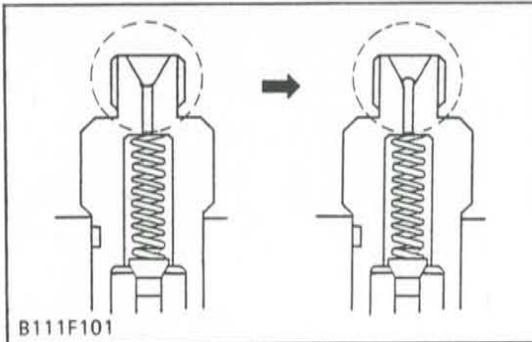
1. Remove the injection pipe, inlet manifold and glow plug, and install a pressure tester on the delivery valve holder of the injection pump. (See page 2-6-39)
2. Position the speed control lever at the maximum speed.
3. Rotate the flywheel counterclockwise until the pressure tester indicates 18.63 MPa (190 kgf/cm², 2750 psi).
4. When the pressure has reached 18.63 MPa (190 kgf/cm², 2750 psi), immediately stop rotating the flywheel and measure the time required for the pressure to lower down to 17.62 MPa (180 kgf/cm², 2580 psi).

2. Measure all delivery valves. If the fuel tightness is below the allowable limit, replace the applicable delivery valve assembly or replace the injection pump assembly.

10 seconds or more 18.63—17.62 MPa 190—180 kgf/cm ² 2750—2580 psi	Factory spec.	Fuel tightness of delivery valve
2 seconds 18.63—17.62 MPa 190—180 kgf/cm ² 2750—2580 psi	Allowable limit	



(1) Speed Control Lever (2) Delivery Valve Holder



Injection Timing

1. Remove the injection pipe and remove the timing inspection hole of the flywheel housing.
2. Position the speed control lever at maximum speed.
3. Rotate the flywheel counterclockwise to verify that the fuel flows from the delivery valve holder (2) of the injection pump.
4. Rotate the flywheel clockwise by about 0.7 rad. (40°).
5. Slowly rotate the flywheel counterclockwise again, find out an instance when the fuel level rises from the delivery valve holder (2), and stop flywheel rotation immediately.
6. Read the injection timing of the window on the flywheel housing.
7. The fuel injection timing lines are issued each 0.09 rad. (5°) from the TC mark on the flywheel. Therefore, reading of the fuel injection timings are roughly.
8. If the timing is out of adjustment, readjust with shim.

Injection timing	Factory spec.	0.30 to 0.33 rad 17° to 19° before T.D.C.
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(Reference)

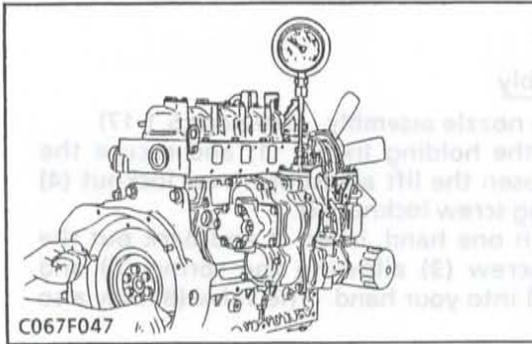
- The timing advances by removing 0.15 mm (0.006 in.) of shim and retard by adding one, approx. 0.26 rad (1.5°) of crank angle.
- Approx. 3.6 mm (0.142 in.) of turn at outer rim of flywheel equals 0.26 rad (1.5°) of crank angle.
- Thickness of adjusting shims:
 0.15 mm (0.0059 in.) [Code No. 15321-52113]
 0.30 mm (0.0118 in.) [Code No. 15521-52111]
 0.45 mm (0.0177 in.) [Code No. 15511-52111]
 for 3 cylinders.

 0.15 mm (0.0059 in.) [Code No. 15401-52112]
 0.30 mm (0.0118 in.) [Code No. 15471-52111]
 0.45 mm (0.0177 in.) [Code No. 15461-52111]
 for 4 cylinders.

Delivery Valve Fuel Tightness

1. Remove the injection pipe, inlet manifold and glow plugs, and install a pressure tester on the delivery valve holder of the injection pump. (See page S.G-39)
2. Position the speed control lever at the maximum speed.
3. Rotate the flywheel counterclockwise until the pressure tester indicates 18.63 MPa (190 kgf/cm², 2702 psi).
4. When the pressure has reached 18.63 MPa (190 kgf/cm², 2702 psi), immediately stop rotating the flywheel and measure the time required for the pressure to lower down to 17.65 MPa (180 kgf/cm², 2560 psi).
5. Measure all delivery valves. If the fuel tightness is below the allowable limit, replace the applicable delivery valve assembly or replace the injection pump assembly.

Fuel tightness of delivery valve	Factory spec.	10 seconds or more 18.63 → 17.65 MPa 190 → 180 kgf./cm ² 2702 → 2560 psi
	Allowable limit	5 seconds 18.63 → 17.65 kPa 190 → 180 kgf./cm ² 2702 → 2560 psi



Pump Element Fuel Tightness

1. Remove the injection pipe, inlet manifold and glow plugs, and install a pressure tester on the delivery valve holder of the injection pump.
2. Position the speed control lever at the maximum speed.
3. Rotate the flywheel counterclockwise until the pressure tester indicates 39.23 MPa (400 kgf/cm², 5689 psi).
4. As soon as the pressure has reached 39.23 MPa (400 kgf/cm², 5689 psi), stop rotating the flywheel and measure the time required for the pressure to lower down to 34.32 MPa (350 kgf/cm², 4978 psi).
5. Measure all pump elements. If the fuel tightness is below the allowable limit, replace the applicable pump element assembly or replace the injection pump assembly.

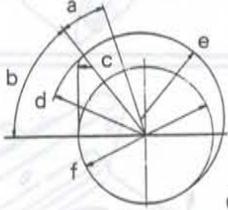
Fuel tightness of pump element	Factory spec.	60 seconds or more 39.23 → 34.32 MPa 400 → 350 kgf/cm ² 5689 → 4978 psi
	Allowable limit	30 seconds 39.23 → 34.32 kPa 400 → 350 kgf/cm ² 5689 → 4978 psi

■ IMPORTANT

- After replacing only pump element, the amount of injection should be adjusted on a specified test bench.

(Reference)

- Test condition

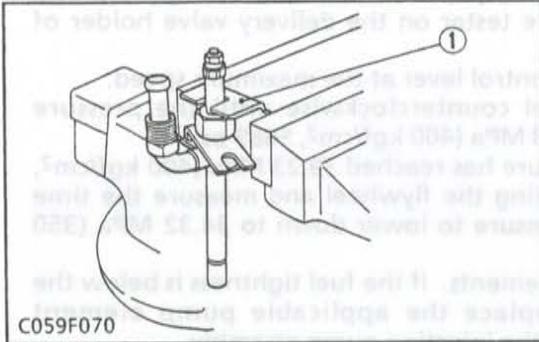
Nozzle	Stanadyne Pencil Nozzle
Opening pressure	22.41 to 23.44 MPa (228.5 to 239.0 kgf/cm ² , 3250 to 3400 psi)
Injection pipe	6 mm (0.24 in.) dia. x 1.4 mm (0.055 in.) / 1.2 mm (0.047 in.) dia. x 410 (16.14 in.) long
Fuel feed pressure	20 kPa (0.2 kgf/cm ² , 3 psi)
Fuel	Diesel fuel No.2-D
Pre-stroke	2.94 mm (0.1157 in.)
Cam profile	
	a. 0.35 rad. (20°) b. 0.9133 rad. (52.33°) c. 3 mm (0.12 in.) d. 20.95 to 21.05 mm (0.8248 to 0.8287 in.) e. 17.5 mm (0.689 in.) f. 27.98 to 28.02 mm (1.1016 to 1.1032 in.)

- Fuel discharge

Control rack position (mm)	Camshaft speed (rpm)	Fuel discharge (cc/100 stroke)	Difference between two units (%)
A + 1	1300	-	less than ± 5
*A	1300	2.425 to 2.575	less than ± 2
A - 2	1300	-	less than ± 8
A - 2	350	-	less than ± 15

- * A is the rack position where the fuel is discharged by the reference amount in one temporary unit, and should be 8 to 10 mm (0.31 to 0.39 in.) of rack travel from no injection.

DISASSEMBLING AND ASSEMBLING



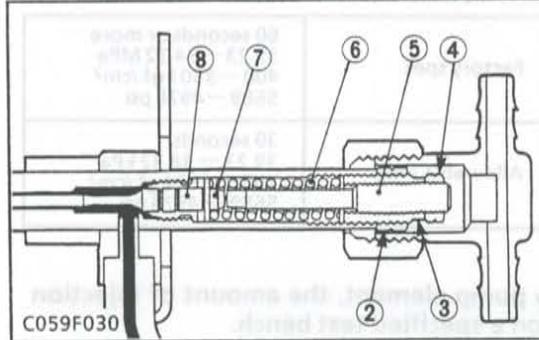
Injection Nozzle Assembly

1. Remove the injection nozzle assembly. (See page S.1-17)
2. Place the nozzle in the holding fixture (1) and secure the fixture in a vise. Loosen the lift adjusting screw locknut (4) and pressure adjusting screw locknut (2).
3. Holding the nozzle in one hand, invert it and back out the pressure adjusting screw (3) allowing the spring (6) and spring seats (7) to fall into your hand. The valve (8) may also slide out.

■ IMPORTANT

- Handle parts and components with due care.
- Always disassemble and assemble the injection nozzle assembly in clean diesel fuel.

- | | |
|--------------------------------------|--------------------------|
| (1) Holding Fixture | (5) Lift Adjusting Screw |
| (2) Pressure Adjusting Screw Locknut | (6) Spring |
| (3) Pressure Adjusting Screw | (7) Spring Seat |
| (4) Lift Adjusting Screw Locknut | (8) Valve |



Injection Pump Assembly

1. Remove the injection pump assembly. (See page S.1-25)

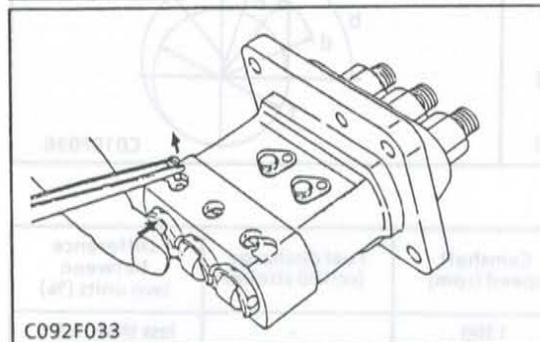
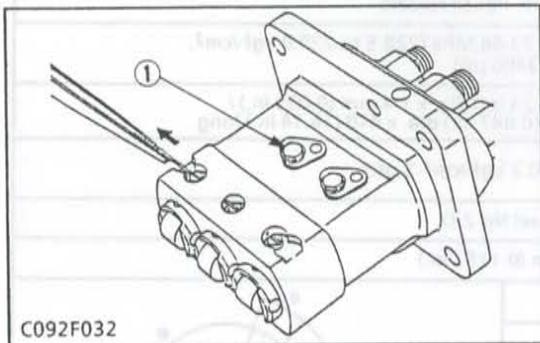
Tappet Pin

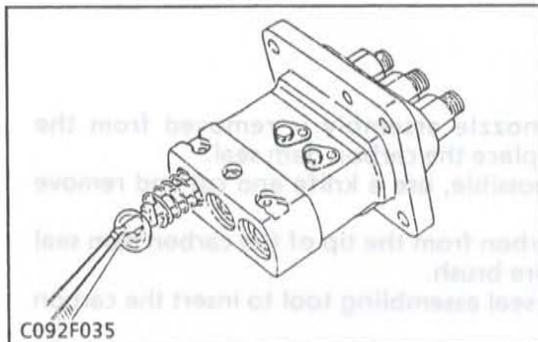
1. Clamp the injection pump in a vise.
2. Pull out the crank pin.
3. Push in the tappet, remove the tappet guide pin.

■ IMPORTANT

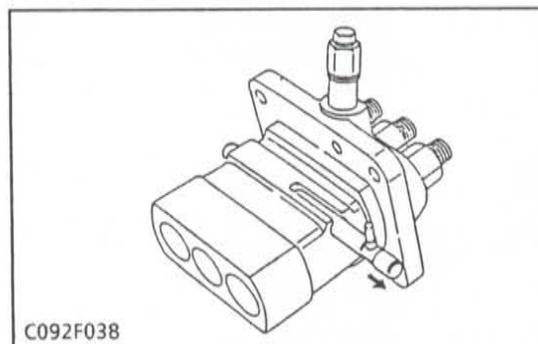
- Never loosen or remove the adjuster plate (1) and screws unless the adjustment of the fuel discharge becomes necessary.

- (1) Adjuster Plate

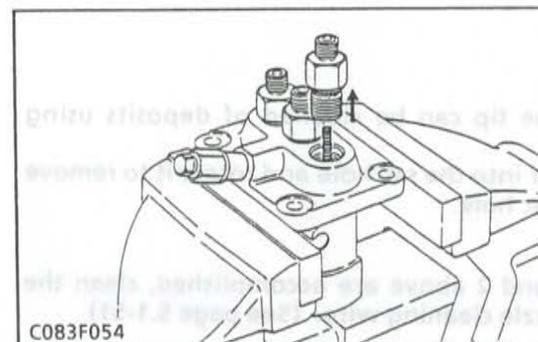




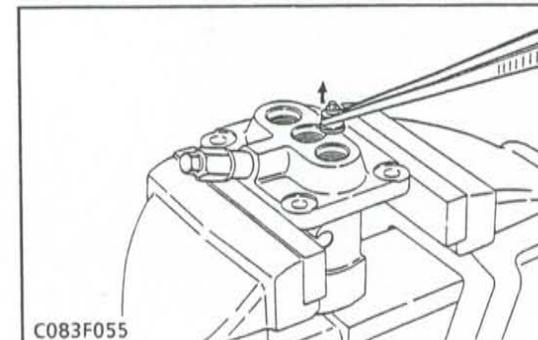
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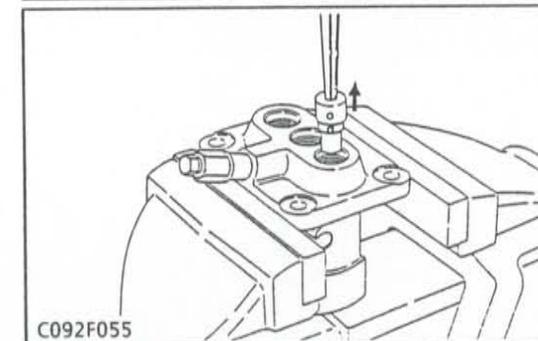
C092F038



C083F054



C083F055



C092F055

Tappet, Other Parts

1. Remove the tappet, shim, plunger, lower spring seat, plunger spring, upper spring seat, and control sleeve together.

(When reassembling)

- Before assembling the control sleeve, be sure to align the stamped line of the control rack with the center tooth of the control sleeve.
- Set the assembly marks of the plunger and control sleeve.
- Do not force the plunger into the plunger barrel.

Control Rack

1. Remove the control rack.

Delivery Valve, Plunger Barrel

1. Loosen and remove the delivery valve holder.
2. Remove the delivery valve spring, delivery valve assembly and gasket.
3. Remove the plunger barrel.

(When reassembling)

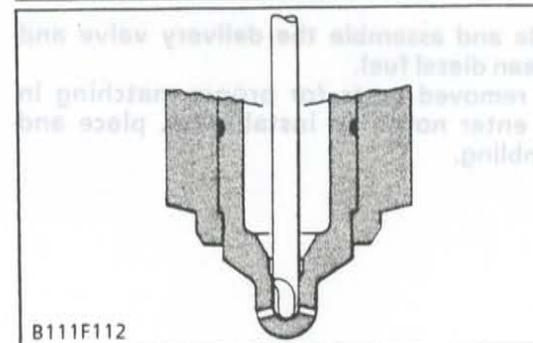
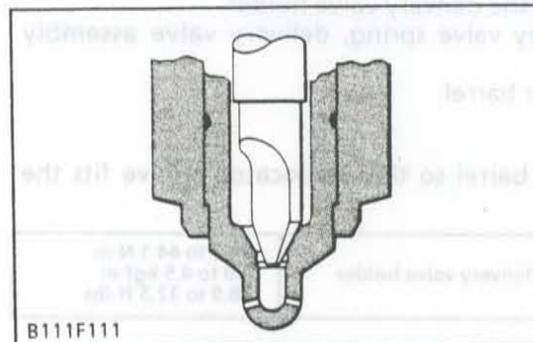
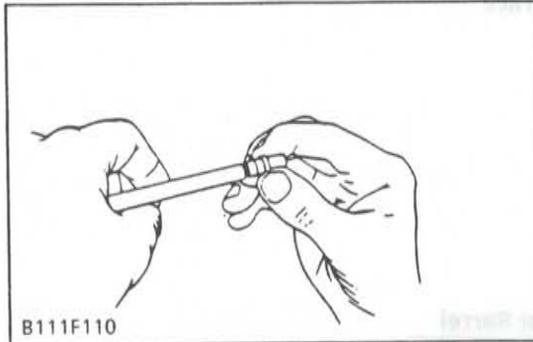
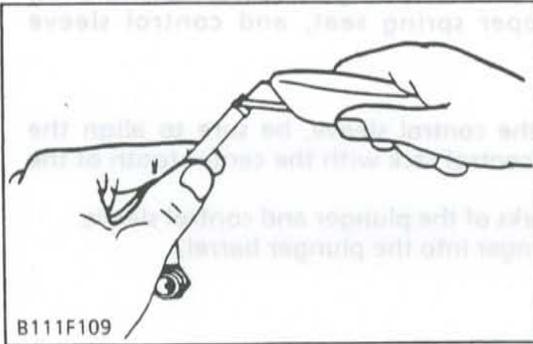
- Install the plunger barrel so that its locator groove fits the eccentric pin.

Tightening torque	Delivery valve holder	39.2 to 44.1 N·m 4.0 to 4.5 kgf·m 28.9 to 32.5 ft·lbs

■ IMPORTANT

- Always disassemble and assemble the delivery valve and plunger barrel in clean diesel fuel.
- Attach tags to all removed parts for proper matching in reassembling and enter notes on installation, place and sequences of assembling.

SERVICING

**Carbon Dam Seal**

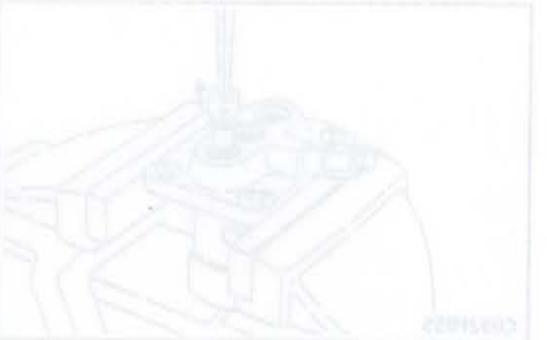
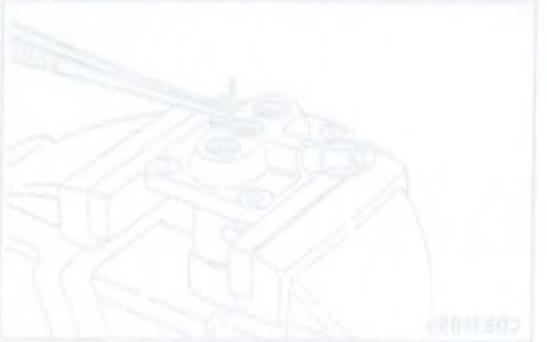
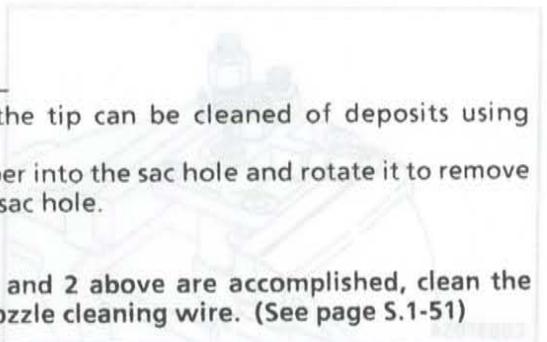
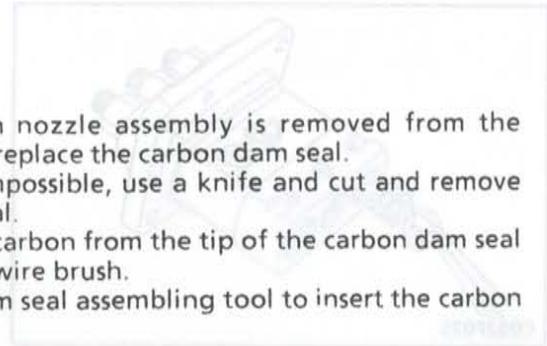
1. After the injection nozzle assembly is removed from the engine, be sure to replace the carbon dam seal.
2. Since removal is impossible, use a knife and cut and remove the carbon dam seal.
3. Remove the loose carbon from the tip of the carbon dam seal groove with brass wire brush.
4. Use the carbon dam seal assembling tool to insert the carbon dam seal.

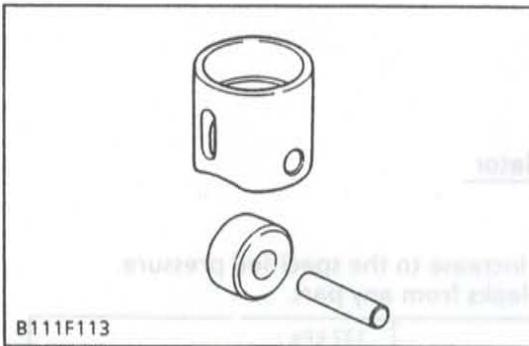
Valve Seat Cleaning

1. The seat area in the tip can be cleaned of deposits using scraper.
2. Insert the tip scraper into the sac hole and rotate it to remove deposits from the sac hole.

■ **IMPORTANT**

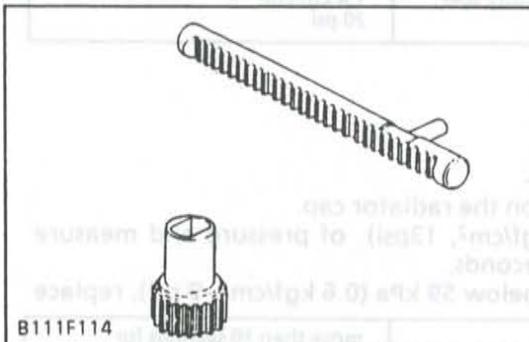
- After the items 1 and 2 above are accomplished, clean the nozzle with the nozzle cleaning wire. (See page S.1-51)





Tappet Assembly

1. Replace the tappet assembly if the outer circumference of the tappet, roller and roller pin are damaged or excessively worn.



Control Rack

1. Replace the control rack if it is bent, damaged or the tooth is excessively worn.

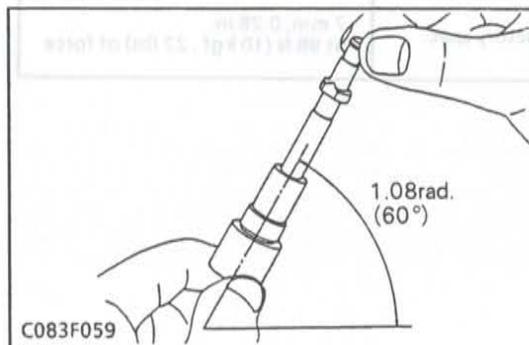
Control Sleeve

1. Replace the control sleeve if the teeth or groove of the control sleeve is excessive worn.



Delivery Valve Assembly

1. Replace the delivery valve if the valve piston or the valve seat is damaged or worn.
2. After washing the delivery valve assembly in clean diesel fuel, close the bottom of the delivery valve body with a finger as shown and lightly push the delivery valve. If the delivery valve springs back upon releasing the finger, the delivery valve assembly is normal. If not, replace the assembly.

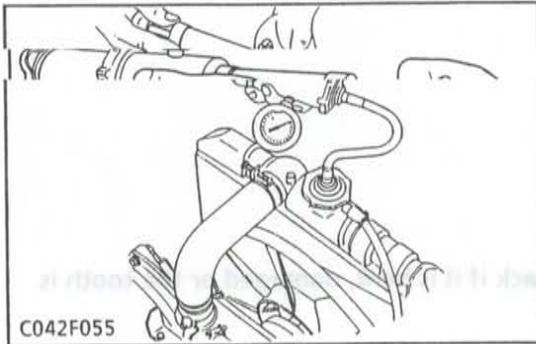


Pump Element

1. If the notch or groove of the plunger is damaged, changed of its color or worn excessively, replace the plunger and plunger barrel together.
2. Verify that the plunger smoothly sinks into the plunger barrel by its own weight. If the plunger does not sink, replace the plunger and plunger barrel together.

[6] COOLING SYSTEM

CHECKING AND ADJUSTING

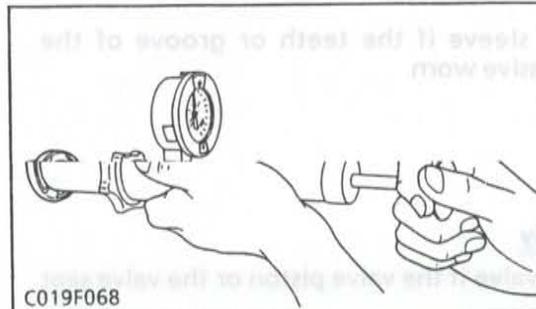


C042F055

Water Tightness of Radiator

- the radiator cap.
- Warm up the engine.
- Set a radiator tester. Increase to the specified pressure.
- Check to see if water leaks from any part.

Water tight at the specified pressure	Factory spec.	137 kPa 1.4 kgf/cm ² 20 psi
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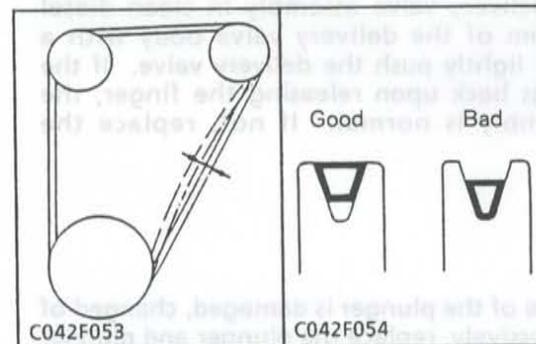


C019F068

Radiator Cap Tightness

- Set a radiator tester on the radiator cap.
- Apply 88 kPa (0.9 kgf/cm², 13psi) of pressure and measure the pressure for 10 seconds.
- If the pressure falls below 59 kPa (0.6 kgf/cm², 9 psi), replace

Radiator cap tightness	Factory spec.	more than 10 seconds for pressure fall from 88 to 59 kPa (0.9 to 0.6 kgf/cm ² , 13 to 9 psi)
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C042F053

C042F054

Fan Belt Tension

- Measure the deflection, depressing the belt halfway between the fan drive pulley and the alternator pulley at 98 N (10 kgf, 22 lbs) of force.
- If the deflection is not between the factory specifications, loosen the bolts, and relocate the alternator to adjust.
- If the belt is damaged or worn (See figure), replace the belt.

Belt tension (deflection)	Factory spec.	7 mm, 0.28 in. at 98 N (10 kgf, 22 lbs) of force
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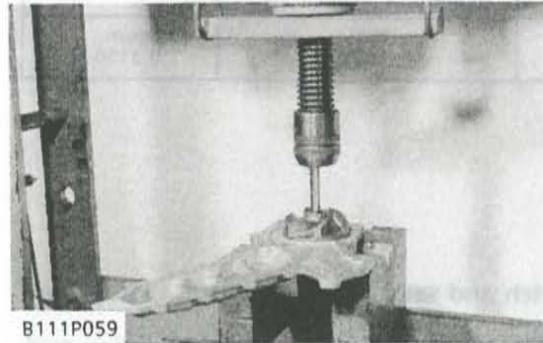
DISASSEMBLING AND ASSEMBLING



Water Pump Assembly

1. Loosen the alternator mounting bolts and remove the fan belt.
2. Remove the fan pulley.
3. Remove the water pump assembly mounting screws and remove the water pump assembly.

(1) Water Pump Assembly



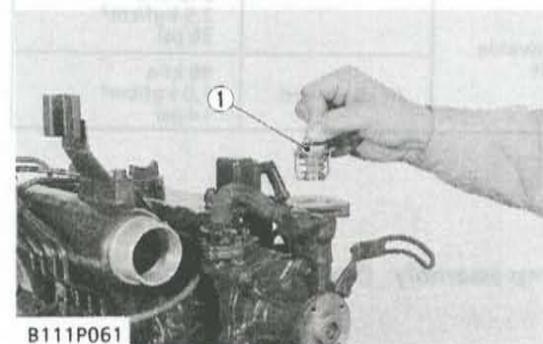
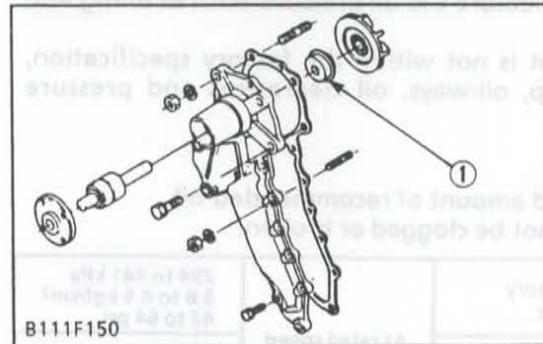
Mechanical Seal Assembly

1. Use a press and press out the water pump shaft from the water pump impeller side.
2. Remove the mechanical seal assembly from the water pump body.

■ IMPORTANT

- Do not disassemble the mechanical seal assembly.

(1) Mechanical Seal Assembly



Thermostat Assembly

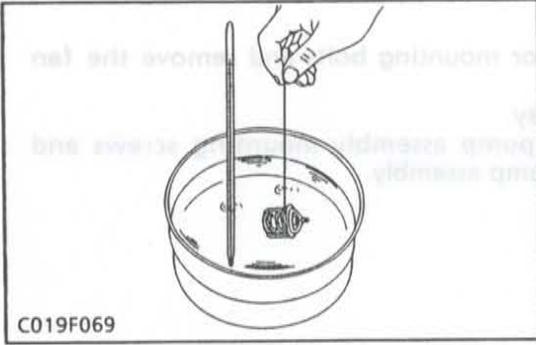
1. Remove the thermostat cover mounting bolts and remove the thermostat cover.
2. Remove the thermostat assembly.

(When reassembling)

- Put the rib of the thermostat assembly in place in the recess of the water flange.

(1) Thermostat Assembly

SERVICING



C019F069

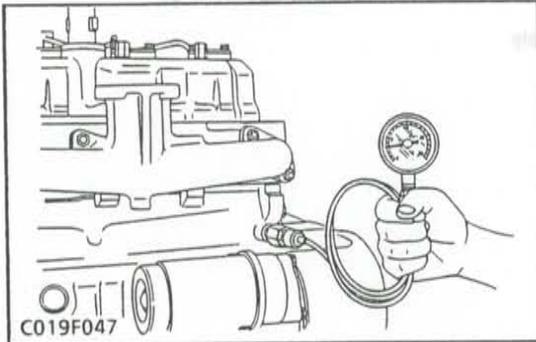
Operating Temperature of Thermostat

1. Place a thermostat and a thermometer in water and heat the water.
2. Check to see if the thermostat begins to open at 80.5 to 83.5°C (176.9 to 182.3°F).
3. Check to see if the thermostat opens fully around 95°C (203°F).
4. If the measurement is defective, replace the thermostat.

Reference value		
Temperature at which thermostat should start to open	Temperature at which thermostat completely opens	Distance of lift
80.5 to 83.5°C 176.9 to 182.3°F	95°C 203°F	8 mm 0.3150 in.

[7] LUBRICATING SYSTEM

CHECKING AND ADJUSTING



C019F047

Oil Pressure

1. Remove the oil switch and set a pressure gauge. (See page S.G-33)
2. Start the engine. Measure the oil pressure both at idling and at the rated speed.
3. If the measurement is not within the factory specification, check the oil pump, oil-ways, oil clearances and pressure regulating valve.

(When reassembling)

- Supply the specified amount of recommended oil.
- The oil filter must not be clogged or broken.

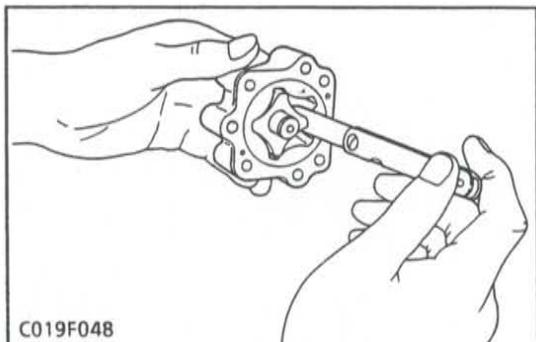
Oil pressure	Factory spec.	At rated speed	294 to 441 kPa 3.0 to 4.5 kgf/cm ² 43 to 64 psi
	Allowable limit		245 kPa 2.5 kgf/cm ² 36 psi
			At idle speed

DISASSEMBLING AND ASSEMBLING

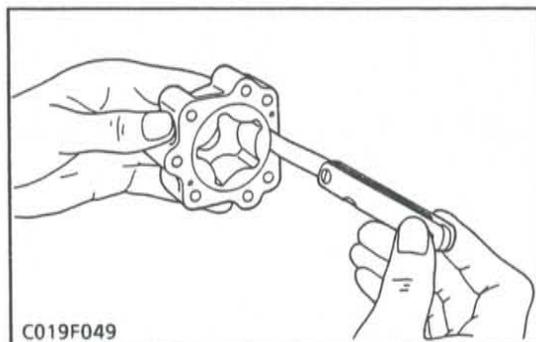
Oil Pump Assembly

1. Remove the oil pump assembly. (See page S.1-28)

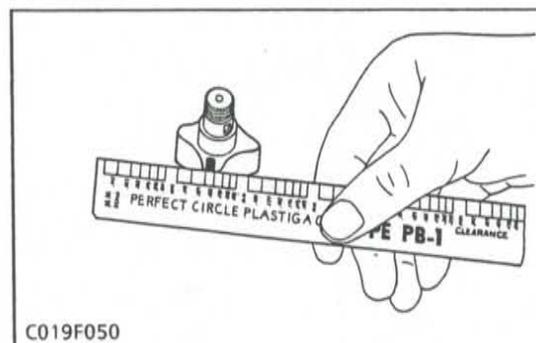
SERVICING



C019F048



C019F049



C019F050

Oil Pump (Rotor type)**1) Checking Rotor Lobe Clearance**

1. Insert a feeler gauge into the gap between the inner and outer rotors and measure the clearance.
2. If the clearance exceeds the allowable limit, replace the pump.

Outer and inner rotor clearance	Factory spec.	0.10 to 0.16 mm 0.0039 to 0.0063 in.
	Allowable limit	0.20 mm 0.0079 in.

2) Radial Clearance between Outer Rotor and Pump Body

1. Insert a feeler gauge into the gap between the oil pump body and the outer rotor and measure the clearance.
2. If the measurement exceeds the allowable limit, replace the pump.

Radial clearance between outer rotor and pump body	Factory spec.	0.11 to 0.19 mm 0.0043 to 0.0075 in.
	Allowable limit	0.25 mm 0.0098 in.

3) End Clearance between Rotor and Cover

1. Paste a press gauge to the surface of the gear with grease.
2. Attach the cover.
3. Gently remove the cover. Measure the clearance by placing the gauge (paper) on the press gauge where it is crushed.
4. If the measurement is not within the factory specification, replace the pump.

End clearance between rotor and cover	Factory spec.	0.105 to 0.150 mm 0.0041 to 0.0059 in.
	Allowable limit	0.20 mm 0.0079 in.

S.2 CLUTCH

CONTENTS

TROUBLESHOOTING	S.2-1
SERVICING SPECIFICATIONS	S.2-3
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CHECKING, DISASSEMBLING AND SERVICING	S.2-6
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CHECKING AND ADJUSTING	S.2-6
DISASSEMBLING AND ASSEMBLING	S.2-7
SERVICING	S.2-7
[2] DRY TYPE, DUAL STAGE CLUTCH	S.2-10
CHECKING AND ADJUSTING	S.2-10
DISASSEMBLING AND ASSEMBLING	S.2-10
SERVICING	S.2-12

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and inspect the affected sections.

(1) Basic Inspection

No.	Contents	Reference Page
1	Clutch pedal free play	S.G-20

(2) Troubleshooting

[DRY TYPE, SINGLE STAGE CLUTCH]

Symptom	Probable Cause	Solution	Reference Page
Clutch Drags	● Clutch disc boss spline sticking or rusted	Replace or remove rust	S.2-7
	● Dust on clutch disc generated from clutch disc facing	Remove rust	-
	● Release fork broken	Replace	S.2-7
	● Grease or oil on clutch disc facing	Replace	S.2-7
	● Clutch disc or pressure plate warped	Replace	S.2-9
	● Wire ring worn or broken (pressure plate side)	Replace (Pressure plate assembly)	S.2-7
	● Pilot bearing sticking or worn	Replace	S.2-8
Clutch Slips	● Clutch disc excessively worn	Replace	S.2-8
	● Grease or oil on clutch disc facing	Replace	S.2-7
	● Clutch disc or pressure plate warped	Replace	S.2-9
	● Diaphragm spring weaken or broken	Replace	S.2-8
	● Wire ring worn or broken (clutch cover side)	Replace (Pressure plate assembly)	S.2-7
Chattering	● Grease or oil on clutch disc facing	Replace	S.2-7
	● Clutch disc or pressure plate warped	Replace	S.2-8
	● Clutch disc boss spline worn or rusted	Replace or remove rust	S.2-7
	● Main shaft bent	Replace	S.3-19, 67
	● Pressure plate or flywheel face cracked or scored	Replace	S.2-8
	● Clutch disc boss spline and main shaft spline worn	Replace	S.2-7
	● Diaphragm spring strength uneven or diaphragm spring broken	Replace	S.2-8
Rattle During Running	● Clutch disc boss spline worn	Replace	S.2-7
	● Thrust ball bearing worn or sticking	Replace	S.2-8
	● Pilot bearing worn or sticking	Replace	S.2-8
Clutch Squeaks	● Thrust ball bearing sticking or dry	Replace or lubricate	S.2-8
	● Pilot bearing worn or sticking	Replace	S.2-8
	● Clutch disc excessively worn	Replace	S.2-8
Vibration	● Main shaft bent	Replace	S.3-19, 67
	● Clutch disc rivet worn or broken	Replace	S.2-8
	● Clutch parts broken	Replace	-

[DRY TYPE, DUAL STAGE CLUTCH]

Symptom	Probable Cause	Solution	Reference Page
Clutch Drags	<ul style="list-style-type: none"> Release lever improperly adjusted Clutch disc boss spline sticking or rusted 	Adjust Replace or remove rust Remove dust	S.2-13 S.2-10, 11 -
	<ul style="list-style-type: none"> Dust on clutch disc generated from clutch disc facing Grease or oil on clutch disc facing Clutch disc or pressure plate warped Pilot bearing sticking or worn 	Replace Replace Replace	S.2-11 S.2-14 S.2-12
Clutch Slips	<ul style="list-style-type: none"> Release lever improperly adjusted Clutch disc excessively worn Grease or oil on clutch disc facing Clutch disc or pressure plate warped Belleville spring weaken or broken 	Adjust Replace Replace Replace Replace	S.2-13 S.2-12 S.2-11 S.2-14 S.2-14
Chattering	<ul style="list-style-type: none"> Grease or oil on clutch disc facing Clutch disc or pressure plate warped Clutch disc boss spline worn, sticking or rusted Main shaft and gear shaft bented Pressure plate or flywheel face cracked or scored 	Replace Replace Replace or remove rust Replace Replace	S.2-11 S.2-14 S.2-10, 11, 12 S.3-32 S.2-14
	<ul style="list-style-type: none"> Clutch disc boss spline and main shaft spline worn Belleville spring strength uneven or broken 	Replace Replace	S.2-12 S.2-14
Rattle During Running	<ul style="list-style-type: none"> Thrust ball bearing worn or sticking Pilot bearing worn or sticking 	Replace Replace	S.2-12 S.2-12
Clutch Squeaks	<ul style="list-style-type: none"> Thrust ball bearing sticking or dry Pilot bearing worn or sticking Clutch disc excessively worn 	Replace or lubricate Replace Replace	S.2-12 S.2-12 S.2-12
Vibration	<ul style="list-style-type: none"> Main shaft and gear shaft bented Clutch disc rivet worn or broken Clutch parts broken 	Replace Replace Replace	S.3-32 - -

SERVICING SPECIFICATIONS**[DRY TYPE, SINGLE STAGE CLUTCH]**

Item		Factory Specification	Allowable Limit
Clutch Pedal	Free play	20 to 30 mm 0.79 to 1.20 in.	-
Safety Switch to Clutch Lever [L2350]	Clearance	0 to 1.0 mm 0 to 0.039 in.	-
Clutch Disc	Disc Facing Surfaces to Rivet Top (Depth)	-	0.3 mm 0.012 in.
Clutch Disc Spline Boss to Main Shaft	Backlash (Displacement around disc edge)	-	2.00 mm 0.0787 in.
Pressure Plate	Flatness	-	0.2 mm 0.008 in.
Brake Pedal Shaft to Clutch Pedal Bushing	Clearance	0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D.	24.9 to 25.0 mm 0.980 to 0.984 in.	-
Clutch Pedal Bushing	I.D.	25.05 to 25.10 mm 0.9862 to 0.9882 in.	-
Clutch Lever	Wear	14.967 to 15.000 mm 0.5893 to 0.5906 in.	14.30 mm 0.5630 in.

[DRY TYPE, DUAL STAGE CLUTCH]

Clutch Pedal	Free play	20 to 30 mm 0.79 to 1.20 in.	-
Release Lever	Height	Less than 0.3 mm 0.012	-
	Mutual Difference	Less than 0.2 mm 0.008 in.	-

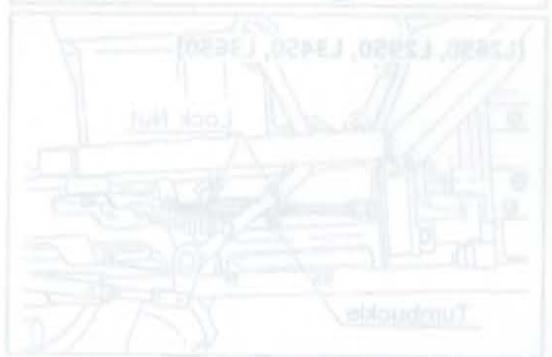
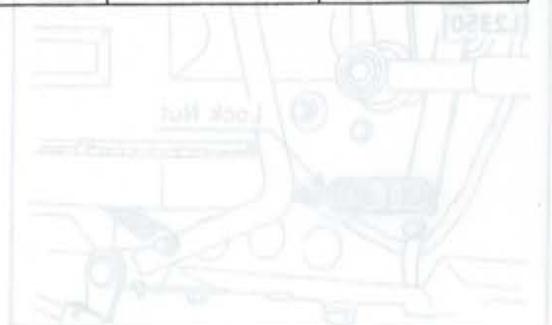
[DRY TYPE, DUAL STAGE CLUTCH (Continued)]

Item		Factory Specification	Allowable Limit
Travelling Clutch Disc	Disc Facing Surface to Rivet Top (Depth)	-	0.3 mm 0.012 in.
Travelling Belleville Spring	Free Height [L2650]	7.24 mm 0.2850 in.	6.76 mm 0.2661 in.
	[L2950, L3450] [L3650]	7.72 mm 0.3039 in.	7.22 mm 0.2843 in.
Travelling Clutch Disc Spline Boss to Main Shaft	Backlash (Displacement around disc edge)		2.0 mm 0.079 in.
PTO Clutch Disc	Disc Facing Surfaces to Rivet Top (Depth)	-	0.3 mm 0.012 in.
PTO Belleville Spring	Free Height [L2650]	7.24 mm 0.2850 in.	6.76 mm 0.2661 in.
	[L2950, L3450] [L3650]	7.72 mm 0.3039 in.	7.22 mm 0.2843 in.
PTO Clutch Disc Spline Boss to Gear Shaft 16T Gear Shaft [L2650, L2950] 17T Gear Shaft [L3450, L3650]	Backlash (Displacement around disc edge)	-	2.0 mm 0.079 in.
Pressure Plate 2 (PTO) to Adjusting Screw	Clearance	0.9 to 1.0 mm 0.035 to 0.039 in.	-
Pressure Plate	Flatness		0.2 mm 0.008 in.
Brake Pedal Shaft to Clutch Pedal Bushing	Clearance	0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D.	24.9 to 25.0 mm 0.980 to 0.984 in.	-
Clutch Pedal Bushing	I.D.	25.05 to 25.10 mm 0.9862 to 0.9882 in.	-
Clutch Lever	Wear	14.967 to 15.000 mm 0.5893 to 0.5906 in.	14.30 mm 0.5630 in.

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
 (For general use screws and nuts: See page S.G-8)

Screws and Nuts	N·m	kgf·m	ft-lbs
[Single Stage Clutch]			
Clutch mounting screws and reamer screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Release fork setting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch rod lock nut	39.2 to 49.0	4.0 to 5.0	28.9 to 36.2
[Dual Stage Clutch]			
Clutch mounting screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Release fork setting screws	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch rod lock nut	39.2 to 49.0	4.0 to 5.0	28.9 to 36.2
Release lever adjusting screw lock nut	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Pressure plate adjusting screw lock nut	15.7 to 21.6	1.6 to 2.2	11.6 to 15.9



Clearance between Safety Switch and Clutch Lever (L3350)
 1 Measure the clearance between safety switch and clutch lever with a feeler gauge.
 2 If the measurement is not within the factory specification, adjust the adjuster.

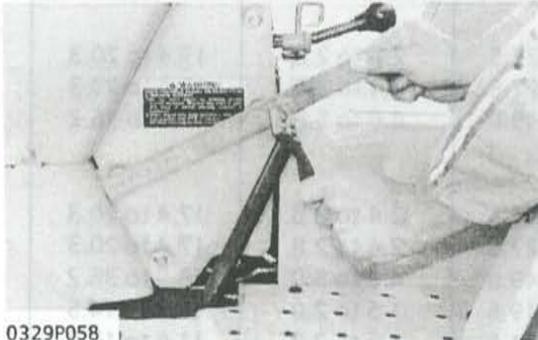
Clearance between safety switch and clutch lever	Factory spec	0 to 1.0 mm 0 to 0.039 in
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IMPORTANT
 After adjustment, check that the starter runs when clutch pedal is depressed to the stroke end and turn the main switch to start position.

CHECKING, DISASSEMBLING AND SERVICING

[1] DRY TYPE, SINGLE STAGE CLUTCH

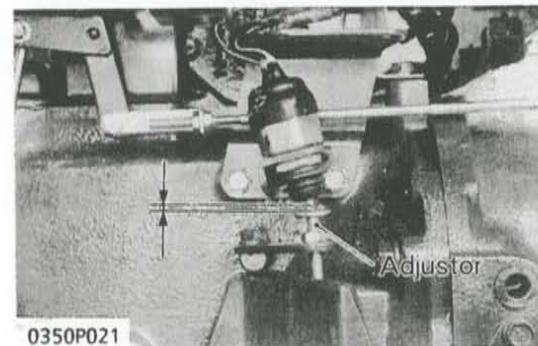
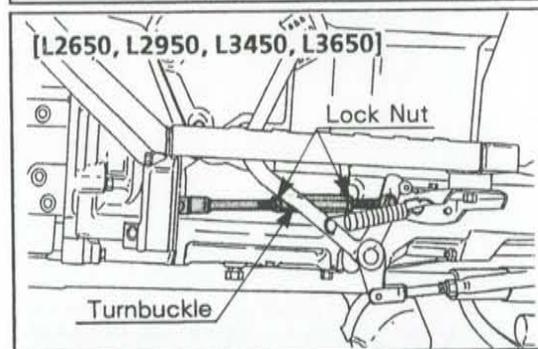
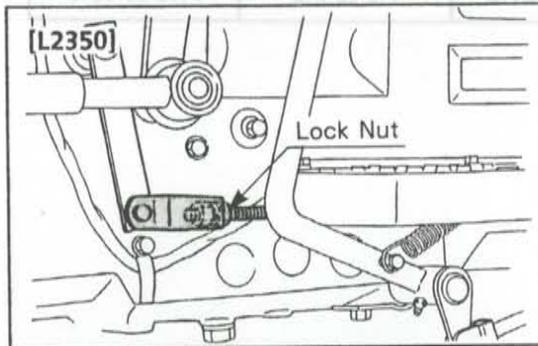
CHECKING AND ADJUSTING



Clutch Pedal Free Play

1. Measure the free play by depressing the clutch pedal.
2. If the measurement is not within the factory specifications, adjust the play by changing the length of clutch rod.
3. After adjustment, tighten the lock nut on the turnbuckle firmly.

Clutch pedal free play	Factory spec.	20 to 30 mm 0.79 to 1.20 in.
Tightening torque	Lock nut	39.2 to 49.0 N·m 4.0 to 5.0 kgf·m 28.9 to 36.2 ft·lbs



Clearance between Safety Switch and Clutch Lever [L2350]

1. Measure the clearance between safety switch and clutch lever with a feeler gauge.
2. If the measurement is not within the factory specifications, adjust the adjuster.

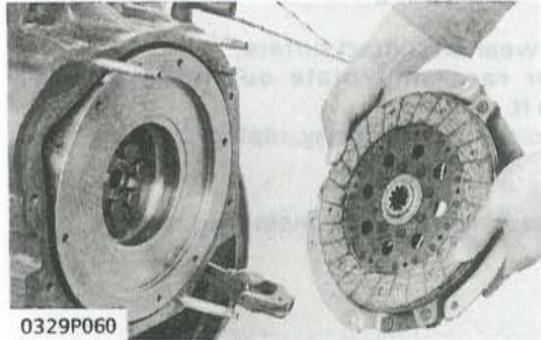
(Reference)

Clearance between safety switch and clutch lever	Factory spec.	0 to 1.0 mm 0 to 0.039 in.
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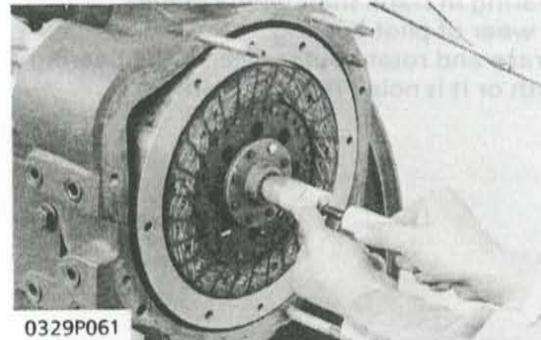
■ IMPORTANT

- After adjustment, check that the starter runs when clutch pedal is depressed to the stroke end and turn the main switch to start position.

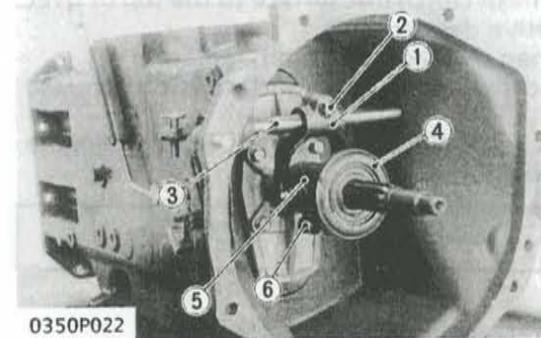
DISASSEMBLING AND ASSEMBLING



0329P060



0329P061



0350P022

- | | |
|------------------|-------------------------|
| (1) Release Fork | (4) Thrust Ball Bearing |
| (2) Screw | (5) Release Hub |
| (3) Clutch lever | (6) Hub Return Spring |

Removing Clutch

1. Remove the clutch from the flywheel.

(When reassembling)

■ IMPORTANT

- Be sure to align the center of disc and flywheel by inserting the clutch center tool (Code No. 07916-51051).
- Direct the shorter end of the clutch disc boss toward the flywheel.
- Apply molybdenum disulphide (Three Bond 1901 or equivalent) to the splines of clutch disc boss.
- Install the pressure plate, noting the position of reamer screws.

■ NOTE

- Do not allow grease and oil on the clutch disc facing.

Tightening torque	Clutch mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
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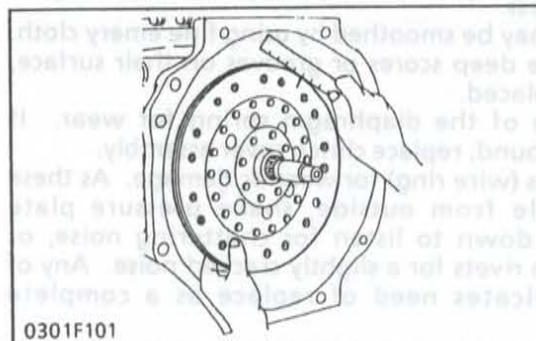
Release Hub and Clutch Lever

1. Remove the release fork (1) mounting screw (2).
2. Draw out the clutch lever (3) to remove the release fork (1).
3. Remove the hub return spring (6).
4. Remove the thrust ball bearing (4) and release hub (5) as a unit.

(When reassembling)

- Make sure the direction of the release fork (1) is correct.
- Inject grease to the release hub (5).
- Be sure to set the hub return spring (6).

SERVICING

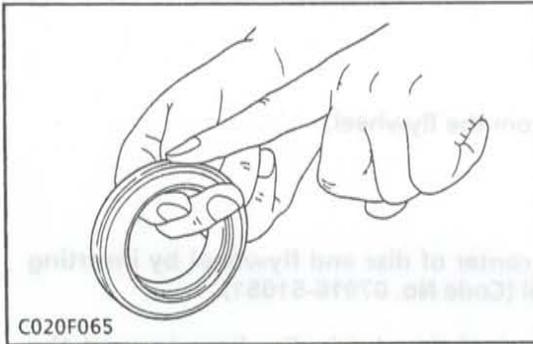


0301F101

Backlash between Clutch Disc Boss and Main Shaft

1. Mount the clutch disc to the main shaft.
2. Hold the main shaft so that it may not turn.
3. Rotate disc lightly and measure the displacement around the disc edge.
4. If the measurement exceeds the allowable limit, replace disc.

Displacement around disc edge	Allowable limit	2.0 mm 0.079 in.
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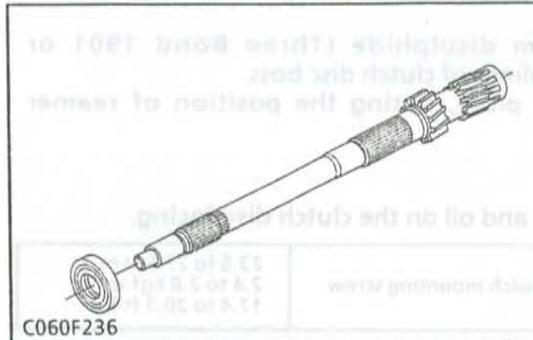


Thrust Ball Bearing

1. Remove the thrust ball bearing from release hub with a puller.
2. Check for abnormal wear on contact surface.
3. Hold bearing inner race and rotate outer race, while applying pressure to it.
4. If the bearing rotation is rough or noisy, replace bearing.

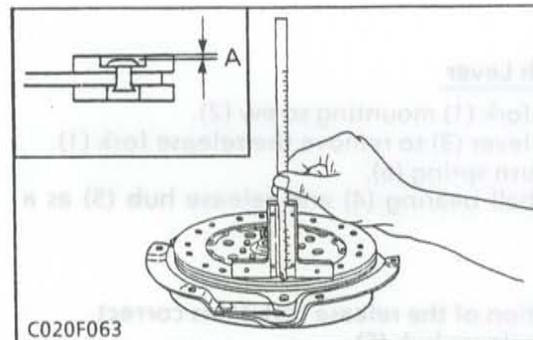
NOTE

- Do not depress outer race, when installing thrust ball bearing.



Pilot Bearing

1. Remove the pilot bearing in crank shaft with a puller.
2. Check for abnormal wear of pilot bearing.
3. Hold bearing inner race and rotate outer race. If the bearing rotation is not smooth or it is noisy, replace bearing.

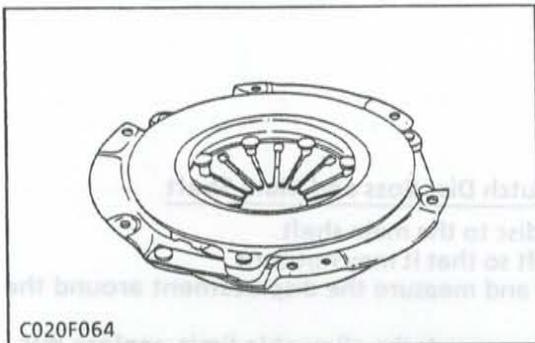


Clutch Disc Wear

1. Measure the depth from clutch disc surface to the top of rivet at least 10 points with a depth gauge.
2. If the depth is less than the allowable limit, replace.
3. If oil is sticking to clutch disc, or disc surface is carbonized, replace.
In this case, inspect transmission main shaft oil seal, engine rear oil seal and other points for oil leakage.

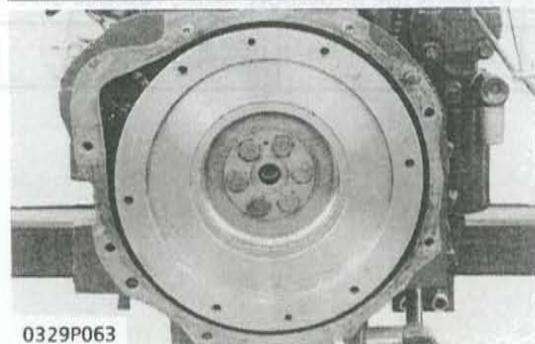
Depth to rivet top	Allowable limit	0.3 mm 0.012 in.

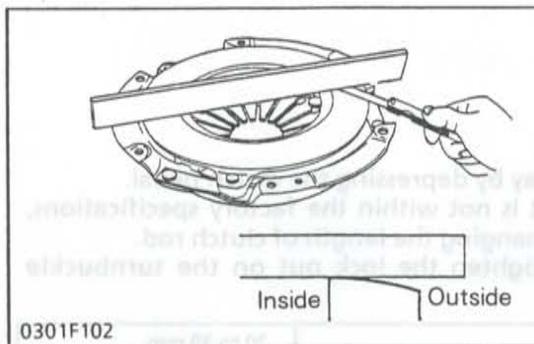
A: More than 0.3 mm (0.012 in.)



Checking Pressure Plate Assembly and Flywheel

1. Wash the disassembling parts except clutch disc with a suitable cleaning solvent to remove dirt and grease before making inspection and adjustment.
2. Check friction surface of pressure plate and flywheel for scoring or roughness.
 - Slight roughness may be smoothed by using fine emery cloth.
 - If these parts have deep scores or grooves on their surface, they should be replaced.
3. Check the surface of the diaphragm spring for wear. If excessive wear is found, replace clutch cover assembly.
4. Inspect thrust rings (wire ring) for wear or damage. As these parts are invisible from outside, shake pressure plate assembly up and down to listen for chattering noise, or lightly hammer on rivets for a slightly cracked noise. Any of these noises indicates need of replace as a complete assembly.



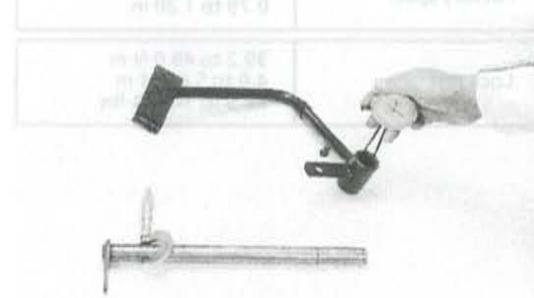


0301F102

Pressure Plate Flatness

1. Place a straightedge on the pressure plate and measure clearance with a feeler gauge at several points.
2. If the clearance exceeds the allowable limit, replace.
3. When the pressure plate is worn around its outside and its inside surface only is in contact with the straightedge, replace even if the clearance is within the allowable limit.

Clearance between pressure plate and straightedge	Allowable limit	0.2 mm 0.008 in.
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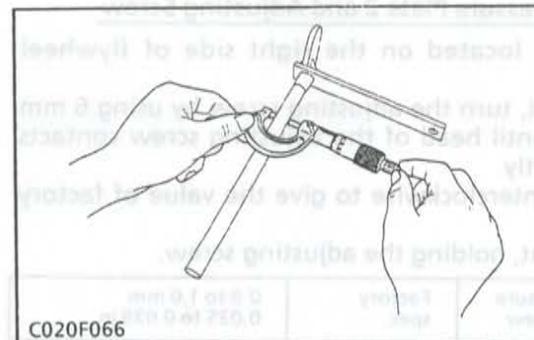


0350P023

Clearance between Brake Pedal Shaft and Clutch Pedal Bushing

1. Measure the bearing portion O.D. of the brake pedal shaft with an outside micrometer.
2. Measure the clutch pedal bushing I.D. with a caliper gauge.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between brake pedal shaft and clutch pedal bushing	Factory spec.	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec.	24.9 to 25.0 mm 0.980 to 0.984 in.
Clutch pedal bushing I.D.	Factory spec.	25.05 to 25.10 mm 0.9862 to 0.9882 in.



C020F066

Clutch Lever Wear

1. Measure the bearing portion O.D. of the clutch lever with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace.

Clutch lever O.D.	Factory spec.	14.967 to 15.000 mm 0.5893 to 0.5906 in.
	Allowable limit	14.130 mm 0.5630 in.

DISASSEMBLING AND ASSEMBLING

Removing Clutch

1. Insert the clutch center tool (Code No. 07916-90025).
2. Remove the clutch assembly.

(When reassembling)

IMPORTANT

- Be sure to align the center of disc (travelling) and flywheel by inserting the clutch center tool (Code No. 07916-90025).

Tightening torque	Clutch mounting screw	11.4 to 20.7 N·m 8.4 to 15.4 ft-lb
Tightening torque	Clutch mounting screw	23.2 to 27.2 N·m 1.7 to 2.0 kgf-m

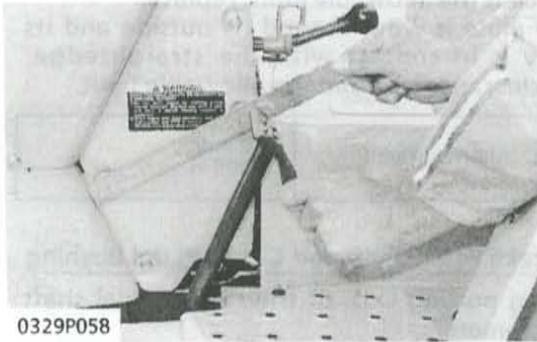


NOTE

- Do not allow grease and oil on the clutch disc facing.

[2] DRY TYPE, DUAL STAGE CLUTCH

CHECKING AND ADJUSTING

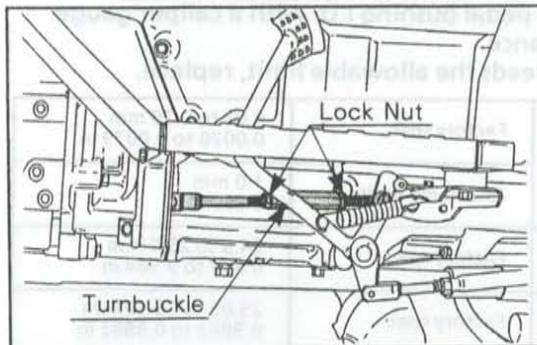


0329P058

Clutch Pedal Free Play

1. Measure the free play by depressing the clutch pedal.
2. If the measurement is not within the factory specifications, adjust the play by changing the length of clutch rod.
3. After adjustment, tighten the lock nut on the turnbuckle firmly.

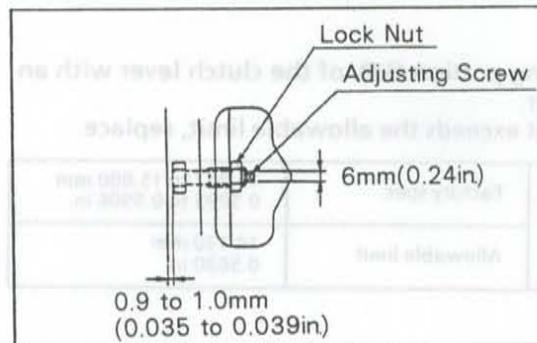
Clutch pedal free play	Factory spec.	20 to 30 mm 0.79 to 1.20 in.
Tightening torque	Lock nut	39.2 to 49.0 N·m 4.0 to 5.0 kgf·m 28.9 to 36.2 ft·lbs



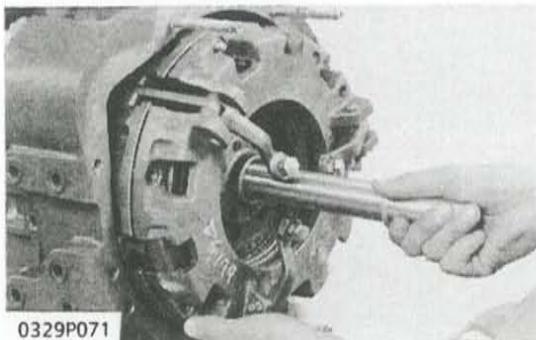
Clearance between Pressure Plate 2 and Adjusting Screw

1. Remove the cover located on the right side of flywheel housing case.
2. Loosen the lock nut, turn the adjusting screw by using 6 mm (0.24 in.) wrench until head of the adjusting screw contacts pressure plate slightly. Make 3/4 turn counterclockwise to give the value of factory specification.
3. Tighten the lock nut, holding the adjusting screw.

Clearance between pressure plate 2 and adjusting screw	Factory spec.	0.9 to 1.0 mm 0.035 to 0.039 in.
Tightening torque	Lock nut	15.7 to 21.6 N·m 1.6 to 2.2 kgf·m 11.6 to 15.9 ft·lbs



DISASSEMBLING AND ASSEMBLING



0329P071

Removing Clutch

1. Insert the clutch center tool (Code No: 07916-90052).
2. Remove the clutch assembly.

(When reassembling)

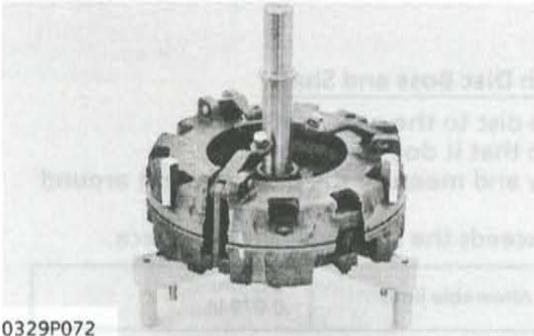
■ IMPORTANT

- Be sure to align the center of disc (Travelling) and flywheel by inserting the clutch center tool (Code No. 07916-90052).

Tightening torque	Clutch mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
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■ NOTE

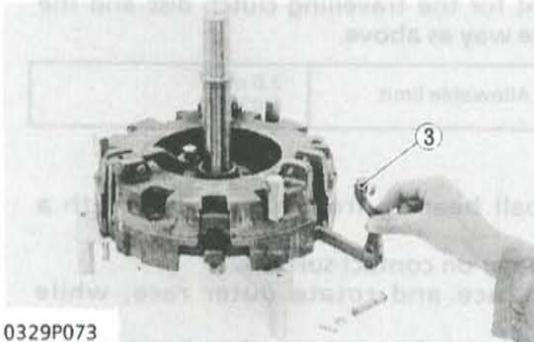
- Do not allow grease and oil on the clutch disc facing.



0329P072

Mounting to Main Colutch Assembling Tool

1. Put parting marks on clutch cover and pressure plate.
2. Mount clutch on dual stage clutch exclusive tool (Code No: 07916-90052).



0329P073

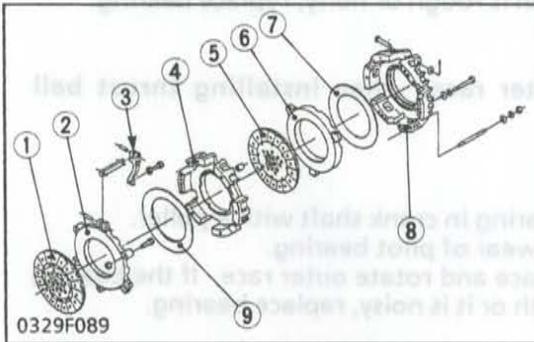
Disassembling Clutch Assembly

1. Draw out the clevis pins and remove the release levers (3).
2. Loosen the three mounting screws evenly and remove them.
3. Remove the clutch cover 2 (8), belleville spring (7), pressure plate 2 (PTO) (6), and clutch disc (PTO) (5) in order.
4. Remove the clutch cover 1 (4), belleville spring (9), and pressure plate 1 (Travelling) (2) in order.

(When reassembling)

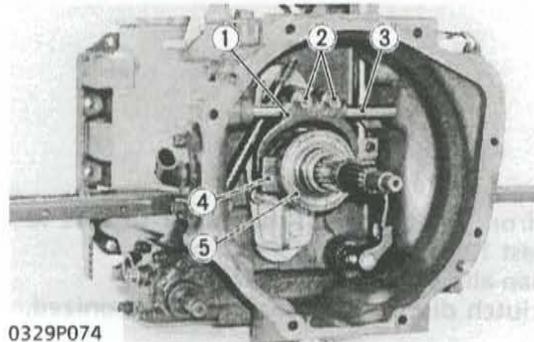
■ IMPORTANT

- When assembling the clutch covers and pressure plates, be sure to align the parting marks to insure proper dynamic balance.



0329F089

- | | |
|-----------------------------------|----------------------------|
| (1) Clutch Disc (Travelling) | (6) Pressure Plate 2 (PTO) |
| (2) Pressure Plate 1 (Travelling) | (7) Belleville Spring |
| (3) Release Lever | (8) Clutch Cover 2 |
| (4) Clutch Cover 1 | (9) Belleville Spring |
| (5) Clutch Disc (PTO) | |



0329P074

Release Hub and Clutch Lever

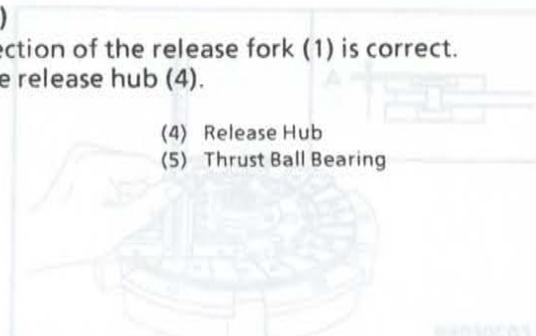
1. Remove the release fork (1) mounting screws (2).
2. Draw out the clutch lever (3) to remove the release fork (1).
3. Remove the thrust ball bearing (5) and release hub as a unit.

(When reassembling)

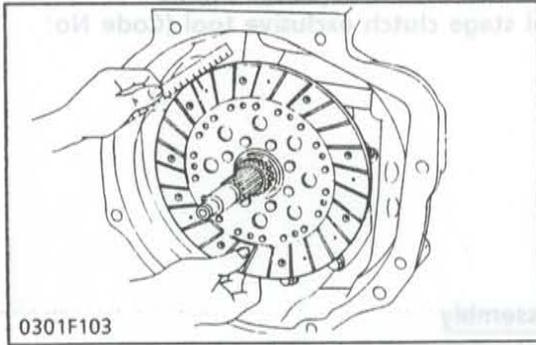
- Make sure the direction of the release fork (1) is correct. Inject grease to the release hub (4).

- | | |
|------------------|-------------------------|
| (1) Release Fork | (4) Release Hub |
| (2) Screws | (5) Thrust Ball Bearing |
| (3) Clutch Lever | |

0.3 mm 0.012 in	Allowable limit	Depth to rest top travelling clutch disc and PTO clutch disc
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SERVICING



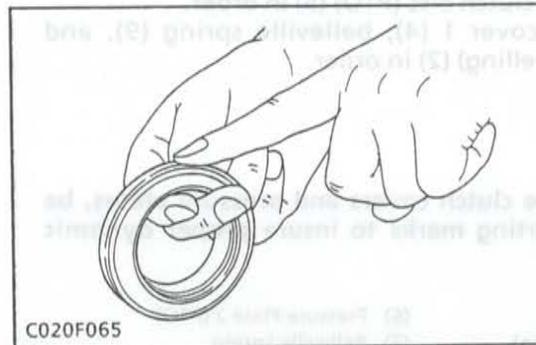
Backlash between Clutch Disc Boss and Shaft

1. Mount the PTO clutch disc to the gear shaft.
2. Hold the gear shaft so that it does not turn.
3. Rotate the disc lightly and measure the displacement around the disc edge.
4. If the displacement exceeds the allowable limit, replace.

Displacement around disc edge (PTO)	Allowable limit	2.0 mm 0.079 in.
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5. Perform measurement for the travelling clutch disc and the main shaft in the same way as above.

Displacement around disc edge (travelling)	Allowable limit	2.0 mm 0.079 in.
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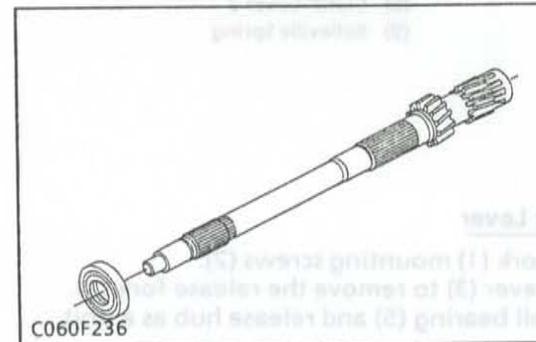


Thrust Ball Bearing

1. Remove the thrust ball bearing from release hub with a puller.
2. Check for abnormal wear on contact surface.
3. Hold bearing inner race and rotate outer race, while applying pressure to it.
4. If the bearing rotation is rough or noisy, replace bearing.

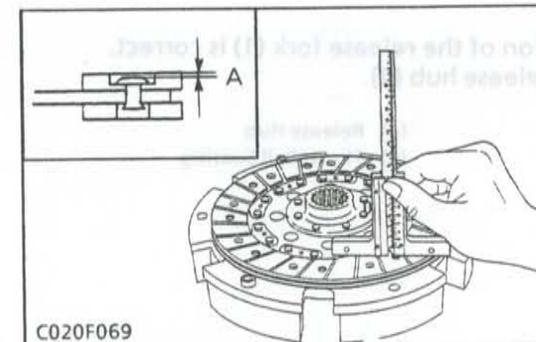
NOTE

- Do not depress outer race, when installing thrust ball bearing.



Pilot Bearing

1. Remove the pilot bearing in crank shaft with a puller.
2. Check for abnormal wear of pilot bearing.
3. Hold bearing inner race and rotate outer race. If the bearing rotation is not smooth or it is noisy, replace bearing.



Clutch Disc Wear

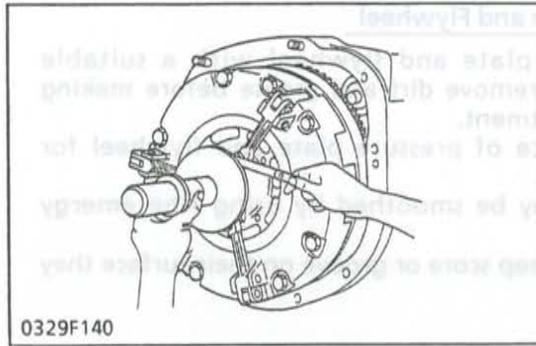
1. Measure the depth from the travelling clutch disc surface to the top of rivet at least 10 points with a depth gauge.
2. If the depth is less than allowable limit, replace.
3. If oil is sticking to clutch disc, or disc surface is carbonized, replace.

In this case, inspect transmission main shaft oil seal, engine rear oil seal and other points for oil leakage.

4. Check the same at the PTO clutch disc as travelling clutch disc.

Depth to rivet top (travelling clutch disc and PTO clutch disc)	Allowable limit	0.3 mm 0.012 in.
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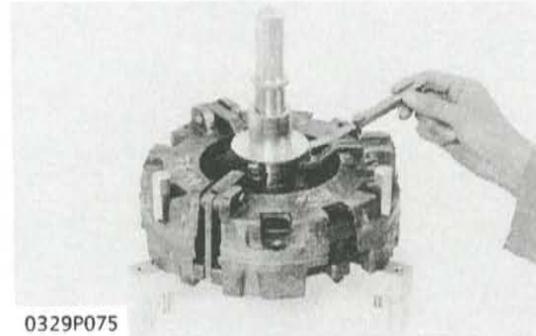
A: More than 0.3 mm (0.012 in.)



Mutual Difference of Release Lever

1. Insert the dual stage clutch exclusive tool (Code No: 07916-90052).
2. Measure the clearance between gauge ring and the top of adjusting screws with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Mutual difference of release lever	Factory spec.	0.0 to 0.2 mm 0.000 to 0.008 in.
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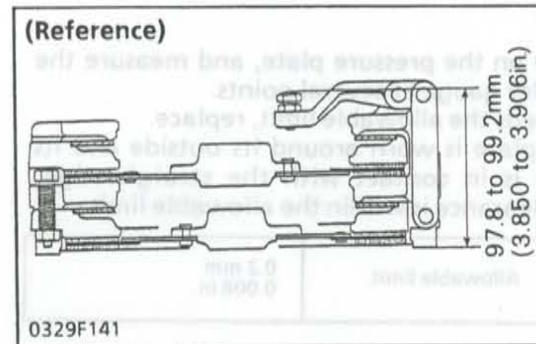


Release Lever Hight

1. Mount the dual stage clutch exclusive tool (Code No: 07916-90052).
2. Measure the clearance between gauge ring and the top of adjusting screws with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Clearance between gauge ring and the top of adjusting screws	Factory spec.	0.0 to 0.7 mm 0.000 to 0.028 in.
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0329P075



Tightening torque	Adjusting screw lock nut	14.7 to 19.6 N·m 1.5 to 2.0 kgf·m 10.8 to 14.5 ft·lbs
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0329F141

IMPORTANT

- Be sure to adjust the mutual difference of release lever to within the factory specifications.

NOTE

- Apply adhesive (Camedine No. 110 by Cemedine Industry Co., Ltd. or equivalent) to the adjusting screws, replace lever and lock nuts.



Clearance between Pressure Plate 2 and Adjusting Screws

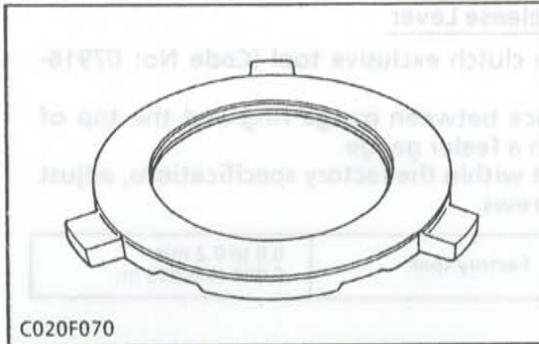
1. Measure the clearance between pressure plate 2 and the top of adjusting screws with a feeler gauge.
2. If the clearance is not within the factory specifications, adjust with the adjusting screws.

Clearance between pressure plate 2 and adjusting screws	Factory spec.	0.95 to 1.00 mm 0.0374 to 0.0394 in.
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0329P076

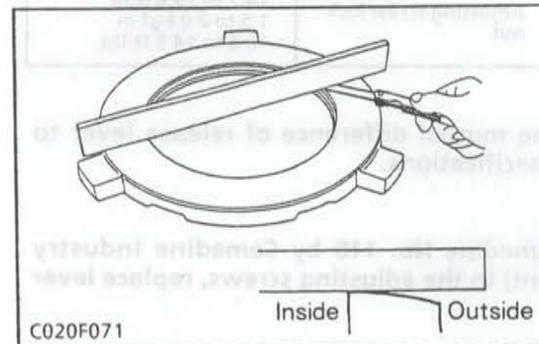
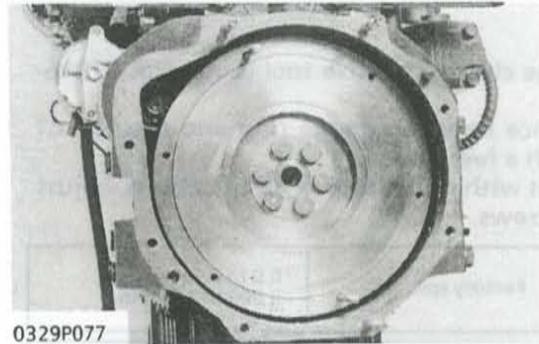
Tightening torque	Pressure plate 2 height adjusting screw lock nut	15.7 to 21.6 N·m 1.6 to 2.2 kgf·m 11.6 to 15.9 ft·lbs
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Factory spec.	allowable limit	height
0.95 to 1.00 mm	0.95 to 1.00 mm	
0.0374 to 0.0394 in.	0.0374 to 0.0394 in.	



Checking Pressure Plate and Flywheel

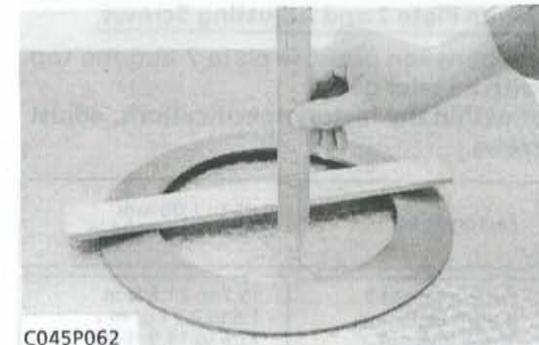
1. Wash the pressure plate and flywheel with a suitable cleaning solvent to remove dirt and grease before making inspection and adjustment.
2. Check friction surface of pressure plate and flywheel for scoring or roughness.
 - Slight roughness may be smoothed by using fine emery cloth.
3. If these parts have deep score or groove on their surface they should be replaced.



Pressure Plate Flatness

1. Place a straightedge on the pressure plate, and measure the clearance with a feeler gauge at several points.
2. If the clearance exceeds the allowable limit, replace.
3. When the pressure plate is worn around its outside and its inside surface only is in contact with the straightedge, replace even if the clearance is within the allowable limit.

Clearance between pressure plate and straightedge	Allowable limit	0.2 mm 0.008 in.
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Belleville Spring Free Height

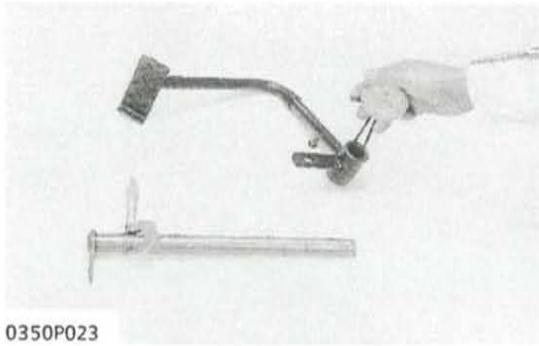
1. Put the belleville spring on the surface plate.
2. Place a straightedge on the belleville spring and measure the free height.
3. If the measurement is less than the allowable limit, replace.
4. Check for cracks, if defects are found, replace.

[L2650]

Belleville spring free height	Factory spec.	7.24 mm 0.2850 in.
	Allowable limit	6.76 mm 0.2661 in.

[L2950, L3450, L3650]

Belleville spring free height	Factory spec.	7.72 mm 0.3039 in.
	Allowable limit	7.22 mm 0.2843 in.

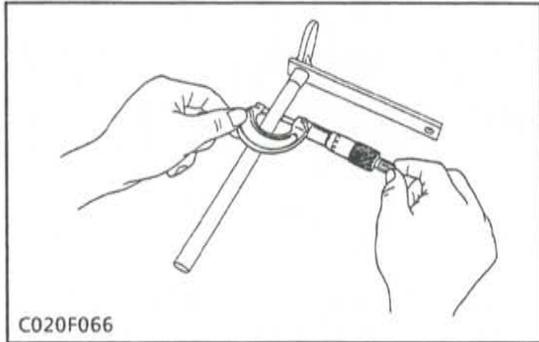


0350P023

Clearance between Brake Pedal Shaft and Clutch Pedal Bushing

1. Measure the bearing portion O.D. of the brake pedal shaft with an outside micrometer.
2. Measure the clutch pedal bushing I.D. with a caliper gauge.
3. Calculate the clearance.
4. If the clearance exceeds allowable limit, replace.

Clearance between brake pedal shaft and clutch pedal bushing	Factory spec.	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec.	24.9 to 25.0 mm 0.980 to 0.984 in.
Clutch pedal bushing I.D.	Factory spec.	25.05 to 25.10 mm 0.9862 to 0.9882 in.



C020F066

Clutch Lever Wear

1. Measure the bearing portion O.D. of the clutch lever with an outside micrometer.
2. If the measurement exceeds the allowable limit, replace.

Clutch lever O.D.	Factory spec.	14.967 to 15.000 mm 0.5893 to 0.5906 in.
	Allowable limit	14.30 mm 0.5630 in.

S.3 TRANSMISSION

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TROUBLESHOOTING**[L2350, L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)]**

Symptom	Probable Cause	Solution	Reference Page
Excessive Transmission Noise	<ul style="list-style-type: none"> Transmission fluid insufficient Gear worn or backlash improper Improper backlash between spiral bevel pinion and bevel gear Improper backlash between differential pinion and side gear Improper clearance between gear and spline boss on counter shaft 1 [L2650, L2950, L3450, L3650] 	Replenish Replace Adjust Adjust Adjust	S.G-7, 14, 15 S.3-20,35, 69 S.3-23,42, 76 S.4-8, 10 S.3-34
	<ul style="list-style-type: none"> Bearings worn Counter shaft 2 lock nut and spiral bevel pinion lock nut improperly tightened [L2650, L2950, L3450, L3650] Spiral bevel pinion lock nut improperly tightened [L2350] Counter shaft lock nut (22 nut) and spiral bevel pinion lock nut improperly tightened [L2650GST, L2950GST, L3450GST, L3650GST] 	Replace Tighten Tighten Tighten	- S.3-38 S.3-24 S.3-67,78
	<ul style="list-style-type: none"> Shift linkages maladjusted Improper clearance between gear and spline boss on counter shaft 1 [L2650, L2950, L3450, L3650] Shifter or shift fork worn or damaged Shift fork interlock ball spring weaken or damaged [L2350, L2650, L2950, L3450, L3650] Interlock ball fallen Synchronizer unit damaged [Synchromesh Type, GST] 	Adjust Adjust Replace Replace Resemble Repair or replace	- S.3-34 S.3-21,35, 69 - - S.3-36,37, 70
Hard Shifting	<ul style="list-style-type: none"> Shifter or shift fork worn or damaged Shift fork bent Synchronizer unit damaged [Synchromesh Type, GST] Shift linkage maladjusted or rusted [L2650, L2950, L3450, L3650] Shaft part of shift arms rusted. 	Replace Replace Repair or replace Adjust or repair Repair	S.3-21,35, 69 - S.3-36,37, 70 - -
Gears Clash When Shifting	<ul style="list-style-type: none"> Clutch does not release Synchronizer unit defective [Synchromesh Type, GST] 	Adjust or repair Repair or replace	S.2-6, 9 S.3-36,37, 70

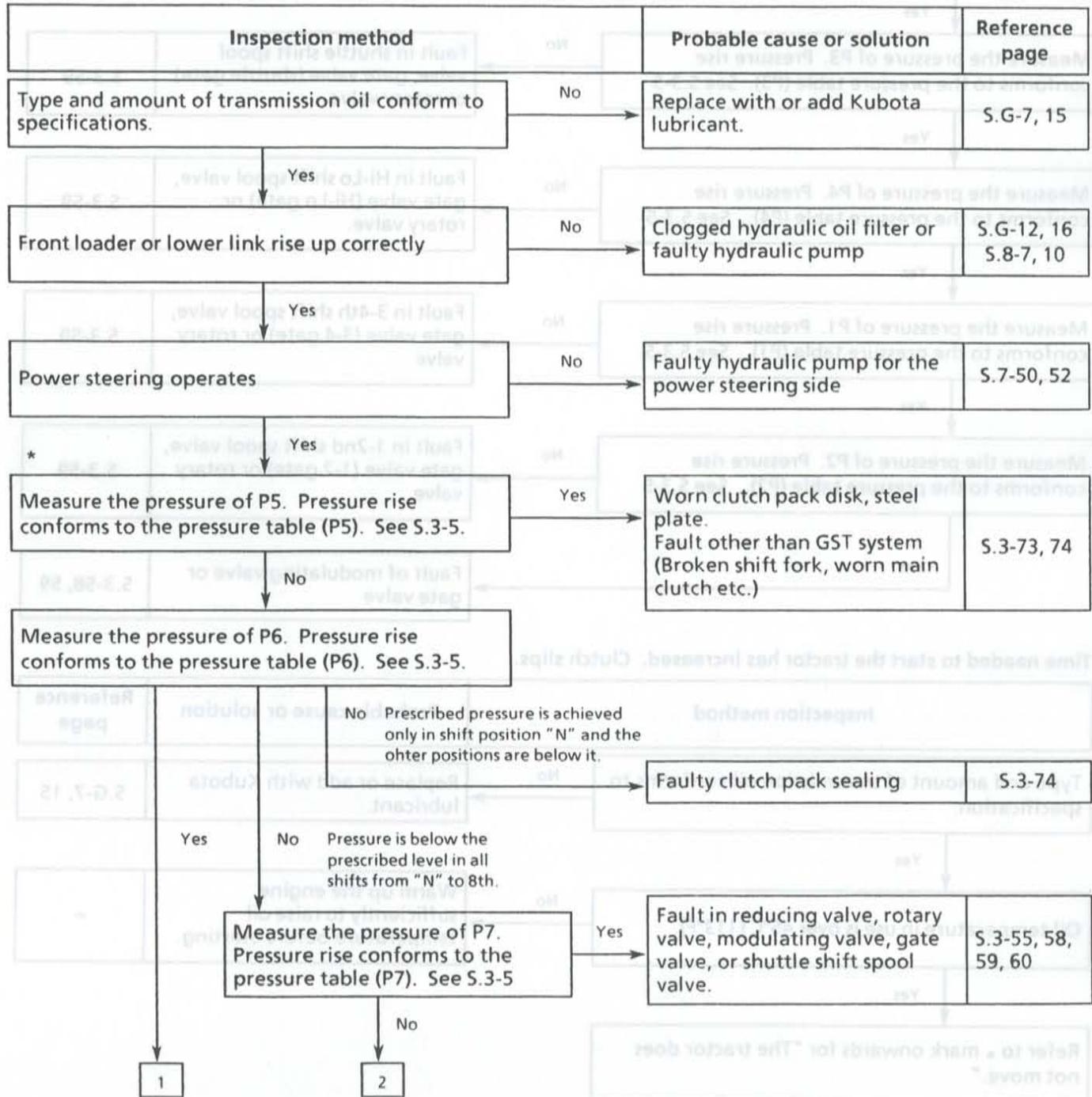
Symptom	Probable Cause	Solution	Reference Page
Differential Lock Can Not Be Set	<ul style="list-style-type: none"> Differential lock shift fork damaged 	Replace	S.3-24,43, 77
	<ul style="list-style-type: none"> Differential lock shift fork mounting clevis pin damaged [L2650 (GST), L2950 (GST), L3450 (GST), L3650 (GST)] 	Replace	S.3-43,77
	<ul style="list-style-type: none"> Differential lock shifter pin bent or damaged 	Replace	S.4-6, 8
	<ul style="list-style-type: none"> Differential lock fork shaft bent or damaged 	Replace	S.3-24,43, 77
Differential Lock Pedal Does Not Return	<ul style="list-style-type: none"> Differential lock pedal return spring weaken or damaged 	Replace	-
	<ul style="list-style-type: none"> Differential shifter pin bent or damaged 	Replace	S.4-6, 8
	<ul style="list-style-type: none"> Differential lock fork shaft bent 	Replace	S.3-24,43, 77

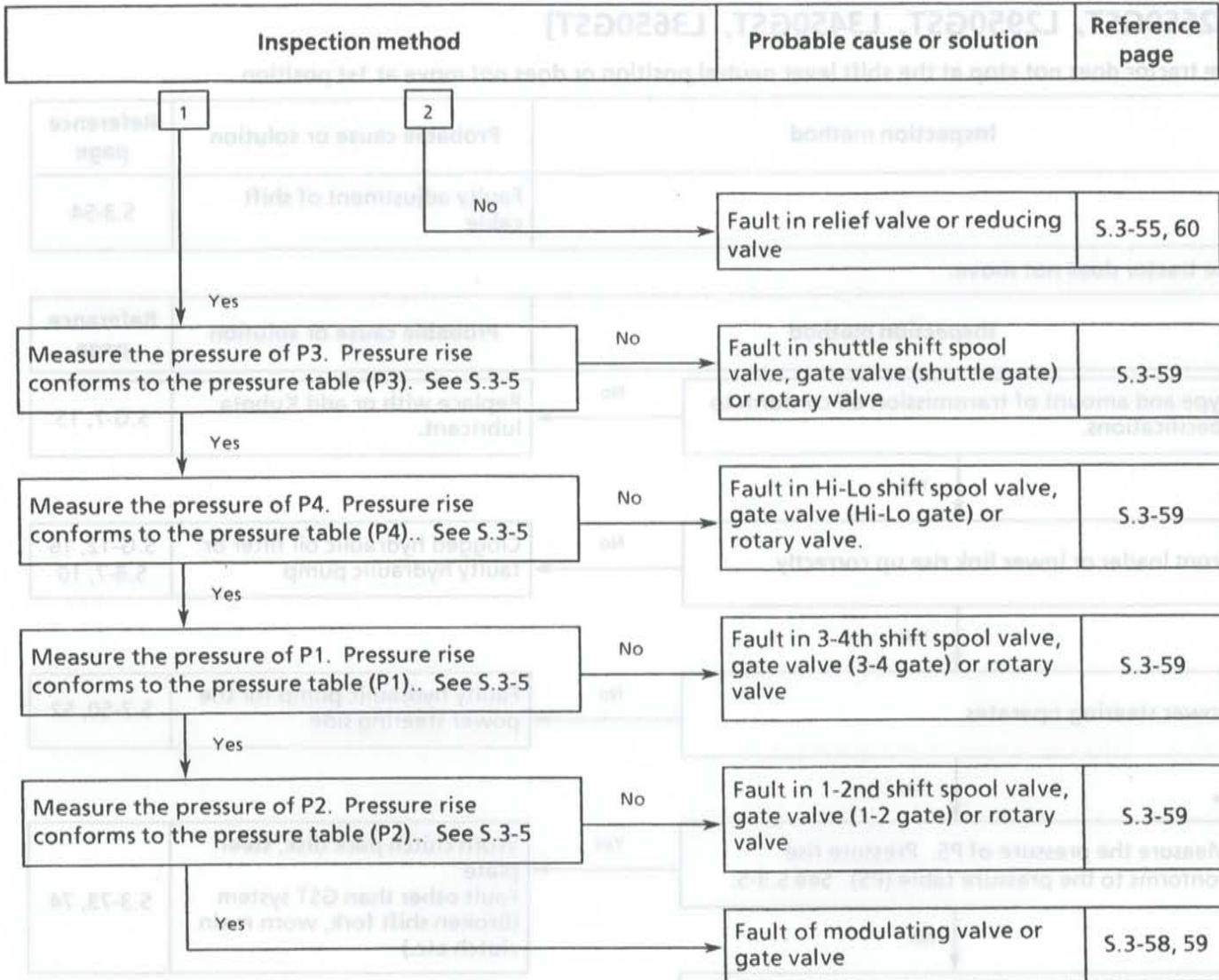
[L2650GST, L2950GST, L3450GST, L3650GST]

The tractor does not stop at the shift lever neutral position or does not move at 1st position.

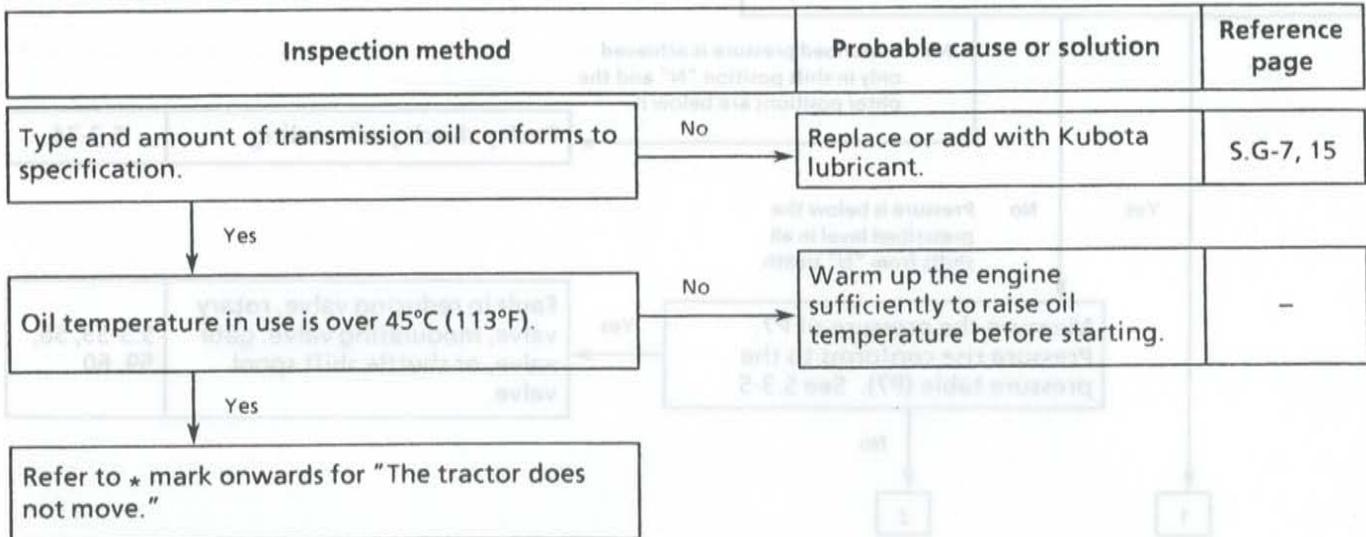
Inspection method	Probable cause or solution	Reference page
	Faulty adjustment of shift cable	S.3-54

The tractor does not move.





Time needed to start the tractor has increased. Clutch slips.

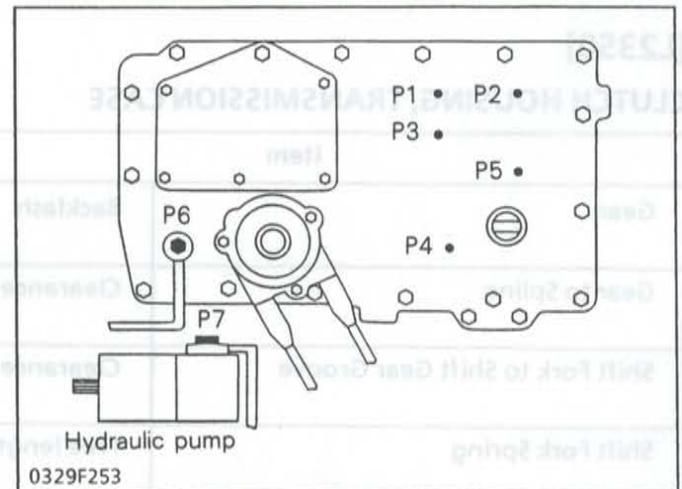


■ Pressure Table

○----- Pressure is 2.4 MPa (24 kgf/cm², 341 psi)
 ◎----- Pressure is 3.1 MPa (32 kgf/cm², 455 psi)

Shift Position	P1	P2	P3	P4	P5	P6	P7
Neutral			○			○	◎
1st Shift		○	○	○	○	○	◎
2nd Shift		○	○	○	○	○	◎
3rd Shift	○		○	○	○	○	◎
4th Shift	○		○	○	○	○	◎
5th Shift		○	○	○	○	○	◎
6th Shift		○	○	○	○	○	◎
7th Shift	○		○	○	○	○	◎
8th Shift	○		○	○	○	○	◎

■ Pressure discharging port diagram



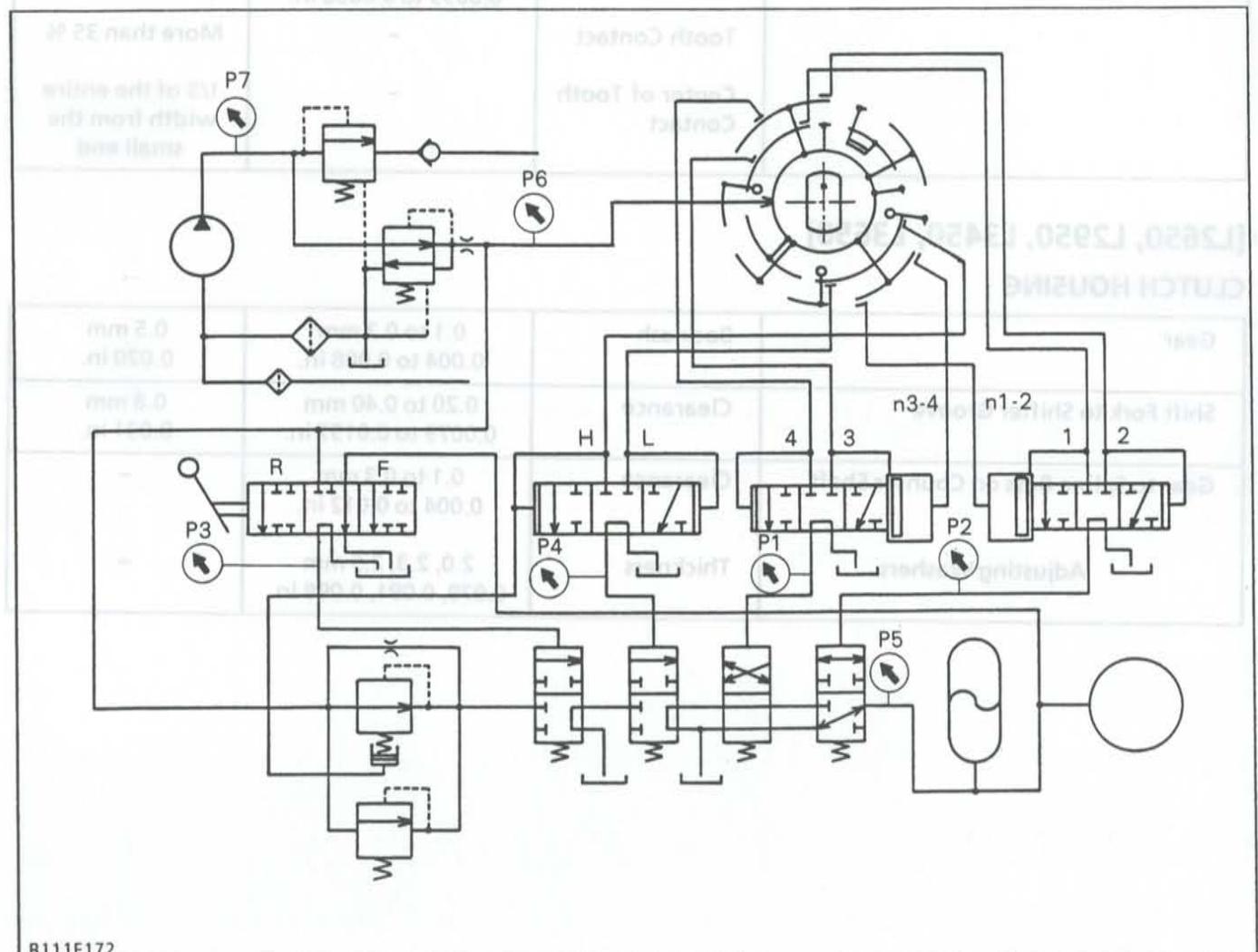
■ IMPORTANT

- Shuttle lever must be at "Forward" or "Reverse" position when checking the pressure.

⚠ CAUTION

- Depress the clutch pedal when checking the pressure.

■ GST Hydraulic System Circuit Diagram and Positions of Pressure Gauges



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SERVICING SPECIFICATIONS

[L2350]

CLUTCH HOUSING, TRANSMISSION CASE

Item		Factory Specification	Allowable Limit
Gear	Backlash	0.1 to 0.3 mm 0.004 to 0.012 in.	0.4 mm 0.0157 in.
Gear to Spline	Clearance	0.030 to 0.078 mm 0.0012 to 0.0031 in.	0.2 mm 0.0079 in.
Shift Fork to Shift Gear Groove	Clearance	0.15 to 0.40 mm 0.0059 to 0.0157 in.	0.6 mm 0.0236 in.
Shift Fork Spring	Free length	22 mm 0.8661 in.	20 mm 0.7874 in.
Reverse Gear Bushing to Reverse Shaft	Clearance	0.020 to 0.054 mm 0.0008 to 0.0021 in.	0.3 mm 0.0118 in.
Spiral Bevel Pinion and Differential Assembly	Combined Turning Torque	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 0.3 to 0.7 ft-lbs	-
Spiral Bevel Pinion to Bevel Gear	Backlash	0.15 to 0.25 mm 0.0059 to 0.0098 in.	-
	Tooth Contact	-	More than 35 %
	Center of Tooth Contact	-	1/3 of the entire width from the small end

[L2650, L2950, L3450, L3650]

CLUTCH HOUSING

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.20 to 0.40 mm 0.0079 to 0.0157 in.	0.8 mm 0.031 in.
Gear to Spline Boss on Counter Shaft	Clearance	0.1 to 0.3 mm 0.004 to 0.012 in.	-
Adjusting Washers	Thickness	2.0, 2.3, 2.5 mm 0.079, 0.091, 0.098 in.	-

CLUTCH HOUSING (Continued)

Item	Factory Specification	Factory Specification	Allowable Limit
45T Gear to Counter Shaft	Clearance	0.020 to 0.055 mm 0.00079 to 0.00217 in.	0.1 mm 0.004 in.
45T Gear	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	-
Counter Shaft	O.D.	31.995 to 32.005 mm 1.25965 to 1.26004 in.	-
Gear to Inner Races on Counter Shaft	Clearance	0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
Gears on Counter Shaft	I.D.	32.025 to 32.050 mm 1.26083 to 1.26181 in.	-
Inner Races	O.D.	31.992 to 32.008 mm 1.25953 to 1.26016 in.	-
Synchronizer Ring to Gear [Synchromesh Type]	Side Clearance	-	More than 0.35 mm 0.0138 in.
	Contact Condition on Taper Portion	-	More than 80 %
Bushing to PTO Counter Shaft	Clearance	0.012 to 0.078 mm 0.00047 to 0.00307 in.	0.2 mm 0.0079 in.
Bushing	I.D.	14.021 to 14.060 mm 0.55165 to 0.55354 in.	-
PTO Counter Shaft End	O.D.	13.982 to 14.000 mm 0.55047 to 0.55118 in.	-
16T or 17T Gear Shaft to Main Shaft	Clearance	0.016 to 0.057 mm 0.00063 to 0.00224 in.	0.1 mm 0.004 in.
16T or 17T Gear Shaft	I.D.	31.009 to 31.025 mm 1.22083 to 1.22146 in.	-
Main Shaft	O.D.	24.980 to 24.993 mm 0.98347 to 0.98398 in.	-
Needle	O.D.	2.994 to 3.000 mm 0.11787 to 0.11811 in.	-

MID CASE

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.20 to 0.40 mm 0.0079 to 0.0157 in.	0.8 mm 0.031 in.
Gear to Spline	Clearance	0.030 to 0.078 mm 0.00118 to 0.00307 in.	0.2 mm 0.0079 in.

MID CASE (Continued)

Item	Factory Specification	Factory Specification	Allowable Limit
23T Gear to Inner Race on Counter Shaft 2	Clearance 0.003 to 0.042 mm 0.00012 to 0.00165 in.		0.1 mm 0.004 in.
23T Gear	I.D. 39.009 to 39.025 mm 1.53578 to 1.53641 in.		-
Inner Race	O.D. 31.995 to 32.006 mm 1.25964 to 1.26008 in.		-
Needle	O.D. 3.494 to 3.500 mm 0.13756 to 0.13780 in.		-
Reverse Shaft 2 to 15T Gear	Clearance 0.002 to 0.036 mm 0.00008 to 0.00142 in.		0.1 mm 0.004 in.
15T Gear	I.D. 26.007 to 26.020 mm 1.02390 to 1.02441 in.		-
Reverse Shaft 2	O.D. 19.996 to 20.005 mm 0.78724 to 0.78760 in.		-
Needle	O.D. 2.994 to 3.000 mm 0.11787 to 0.11811 in.		-

TRANSMISSION CASE

Shift Fork to Shifter Groove [Hi-Lo Shift]	Clearance 0.2 to 0.4 mm 0.008 to 0.016 in.		0.8 mm 0.031 in.
Gear or Spline Boss to Spline	Clearance 0.030 to 0.078 mm 0.00118 to 0.00307 in.		0.2 mm 0.0079 in.
Gears to Inner Races on 8T Spiral Bevel Pinion	Clearance 0.055 to 0.090 mm 0.00217 to 0.00354 in.		0.2 mm 0.0079 in.
Gears	I.D. 36.025 to 36.050 mm 1.41831 to 1.41929 in.		-
Inner Races	O.D. 35.960 to 35.970 mm 1.41575 to 1.41614 in.		-
8T Spiral Bevel Pinion and Differential Assembly	Turning Torque Combined 4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs		-
Adjusting Shims (Differential Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.		-

TRANSMISSION CASE (Continued)

Item		Factory Specification	Allowable Limit
8T Spiral Bevel Pinion to Bevel Gear	Backlash	0.15 to 0.25 mm 0.0059 to 0.0098 in.	-
	Tooth Contact	-	More than 35%
	Center of Tooth Contact	-	1/3 of the entire width from the small end
	Adjusting Shims (Differential Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	-
(Pinion Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	-	
8T Spiral Bevel Pinion Only	Turning Torque	2.0 to 2.9 N·m 0.2 to 0.3 kgf·m 1.4 to 2.2 ft-lbs	-
20T Gear to PTO Drive Shaft [L2650-L2950-L3450] 20T Gear	Clearance	0.015 to 0.046 mm 0.00059 to 0.00181 in.	0.1 mm 0.004 in.
	I.D.	30.020 to 30.041 mm 1.18189 to 1.18272 in.	-
	PTO Drive Shaft	O.D. 29.995 to 30.005 mm 1.18091 to 1.18130 in.	-
19-34T Gear to Inner Race on PTO Drive Shaft [L2650 4WD, L2950 4WD] 19-34T Gear	Clearance	0.004 to 0.043 mm 0.00016 to 0.00169 in.	0.1 mm 0.004 in.
	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	-
	Inner Race	O.D. 29.996 to 30.005 mm 1.18095 to 1.18130 in.	-
	Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13780 in.	-
19-32T Gear to PTO Drive Shaft [L3450 4WD, L3650 4WD] 19-32T Gear	Clearance	0.009 to 0.052 mm 0.00035 to 0.00205 in.	0.1 mm 0.004 in.
	I.D.	37.009 to 37.025 mm 1.45705 to 1.45768 in.	-
	PTO Drive Shaft	O.D. 29.987 to 30.000 mm 1.18059 to 1.18110 in.	-
	Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13780 in.	-

[L2650GST, L2950GST, L3450GST, L3650GST]**GST SYSTEM**

Item		Factory Specification	Allowable Limit
GST System Pressures Condition ● Engine Speed Maximum rpm ● Oil Temperature 45 to 55 °C 113 to 131 °F	Relief Valve	3.14 to 3.23 MPa 32.0 to 33.0 kgf/cm ² 455 to 469 psi	-
	System Pressure	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi	-
	Modulating Valve	1.37 to 1.42 MPa 14.0 to 14.5 kgf/cm ² 199 to 206 psi	-
Clutch Park	Clutch Disk	Thickness 2.2 to 2.3 mm 0.0866 to 0.0906 in.	1.9 mm 0.0748 in.
	Steel Plate 1.2	Thickness 1.10 to 1.20 mm 0.0433 to 0.0472 in.	0.90 mm 0.0354 in.
	Steel Plate 4.0	Thickness 3.89 to 4.05 mm 0.1531 to 0.1594 in.	3.70 mm 0.1457 in.
	Piston	Flatness -	0.15 mm 0.0059 in.
	Steel Plate 1.2, 4.0	Flatness -	0.30 mm 0.0118 in.
	Spring	Length 20.3 to 20.7 mm 0.799 to 0.815 in.	17.4 mm 0.685 in.
	Seal Ring	Thickness 2.45 to 2.50 mm 0.0965 to 0.0984 in.	20.00 mm 0.0787 in.

CLUTCH HOUSING

Gear	Backlash	0.1 to 0.2 mm 0.004 to 0.008 in.	0.5 mm 0.020 in.
Shift Fork to Shifter Groove	Clearance	0.25 to 0.45 mm 0.0098 to 0.0177 in.	0.8 mm 0.031 in.
Gear to Spline Boss on PTO Counter Shaft [L2650GST, L2950GST, L3450GST] Adjusting Washers	Clearance	0.1 to 0.3 mm 0.004 to 0.012 in.	0.1 mm 0.004 in.
	Thickness	2.0, 2.3, 2.5 mm 0.079, 0.091, 0.098 in.	-
46T Gear to Counter Shaft	Clearance	0.020 to 0.055 mm 0.0008 to 0.0022 in.	0.1 mm 0.004 in.
46T Gear	I.D.	32.025 to 32.050 mm 1.2608 to 1.2618 in.	-
Counter Shaft	O.D.	31.995 to 32.005 mm 1.2597 to 1.2600 in.	-

CLUTCH HOUSING (Continued)

Item	Factory Specification	Allowable Limit
Gear to Inner Races on Counter Shaft	Clearance 0.017 to 0.058 mm 0.0007 to 0.0023 in.	0.1 mm 0.004 in.
Gears on Counter Shaft	I.D. 32.025 to 32.050 mm 1.2608 to 1.2618 in.	-
Inner Races	O.D. 31.992 to 32.008 mm 1.2596 to 1.2602 in.	-
Synchronizer Ring to Gear	Side Clearance -	More than 0.35 mm 0.0138 in.
	Contact Condition on Taper Portion -	More than 80 %
Gear to Inner Races on PTO Counter Shaft	Clearance 0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
Gears on PTO Counter Shaft	I.D. 32.025 to 32.050 mm 1.26083 to 1.26181 in.	-
Inner Races	O.D. 31.992 to 32.008 mm 1.25953 to 1.26016 in.	-
27T Gear to Inner Race on Shuttle Shaft	Clearance 0.017 to 0.052 mm 0.00067 to 0.00205 in.	0.1 mm 0.004 in.
27T Gear	I.D. 37.025 to 37.034 mm 1.45768 to 1.45803 in.	-
Inner Race	O.D. 31.992 to 32.008 mm 1.25953 to 1.26016 in.	-
Needle	O.D. 2.495 to 2.500 mm 0.09823 to 0.09843 in.	-
17-32T or 17-33T Gear to Shuttle Shaft	Clearance 0.0005 to 0.038 mm 0.00002 to 0.00150 in.	0.1 mm 0.004 in.
17-32T or 17-33T Gear	I.D. 29.007 to 29.020 mm 1.14200 to 1.14252 in.	-
Shuttle Shaft	O.D. 24.994 to 25.0065 mm 0.98402 to 0.98452 in.	-
Needle	O.D. 1.994 to 2.000 mm 0.07850 to 0.07874 in.	-

CLUTCH HOUSING (Continued)

Item	Factory Specification	Allowable Limit
Hi-Lo Shaft to 17-17T or 18-17T Gear	Clearance 0.002 to 0.041 m,m 0.00008 to 0.00161 in.	0.1 mm 0.004 in.
17-17T or 18-17T Gear	I.D. 33.009 to 33.025 mm 1.29957 to 1.30020 in.	-
Hi-Lo Shaft	O.D. 27.994 to 28.007 mm 1.10213 to 1.10264 in.	-
Needle	O.D. 2.495 to 2.500 mm 0.09823 to 0.09843 in.	-
42T Gear to Inner Race on Hi-Lo Shaft	Clearance 0.017 to 0.058 mm 0.00067 to 0.00228 in.	0.1 mm 0.004 in.
42T Gear	I.D. 32.025 to 32.050 mm 1.26083 to 1.26181 in.	-
Inner Race	O.D. 31.992 to 32.008 mm 1.25953 to 1.26016 in.	-

MID CASE

Reverse Shaft to Reverse Gear	Clearance 0.015 to 0.044 mm 0.00059 to 0.00173 in.	0.1 mm 0.004 in.
Reverse Gear	I.D. 26.020 to 26.028 mm 1.02441 to 1.02472 in.	-
Reverse Shaft	O.D. 19.996 to 20.005 mm 0.78724 to 0.78760 in.	-
Needle	O.D. 2.994 to 3.000 mm 0.11787 to 0.11811 in.	-

TRANSMISSION CASE

Gear to 6T Spiral Bevel Pinion	Clearance 0.030 to 0.078 mm 0.00118 to 0.00307 in.	0.2 mm 0.0079 in.
20T Gear to PTO Drive Shaft [L2650GST, L2950GST, L3450GST]	Clearance 0.015 to 0.046 mm 0.00059 to 0.00181 in.	0.1 mm 0.004 in.
20T Gear	I.D. 30.020 to 30.041 mm. 1.18189 to 1.18272 in.	-
PTO Drive Shaft	O.D. 29.995 to 30.005 mm 1.18091 to 1.18130 in.	-

TRANSMISSION CASE (Continued)

Item	Factory Specification	Allowable Limit
21-34T Gear to Inner Race on PTO Drive Shaft [L2650GST, L2950GST]	Clearance 0.004 to 0.043 mm 0.00016 to 0.00169 in.	0.1 mm 0.004 in.
21-34T Gear	I.D. 37.009 to 37.025 mm 1.45705 to 1.45768 in.	-
Inner Race	O.D. 29.996 to 30.005 mm 1.18095 to 1.18130 in.	-
Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13780 in.	-
21-32T or 19-32T Gear to PTO Drive Shaft [L3450GST, L3650GST]	Clearance 0.009 to 0.052 mm 0.00035 to 0.00205 in.	0.1 mm 0.004 in.
21-32T or 19-32T Gear	I.D. 37.009 to 37.025 mm 1.45705 to 1.45768 in.	-
PTO Drive Shaft	O.D. 29.987 to 30.000 mm 1.18059 to 1.18110 in.	-
Needle	O.D. 3.493 to 3.500 mm 0.13752 to 0.13778 in.	-
6T Spiral Bevel Pinion and Differential Assembly	Turning Torque Combined 4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft-lbs	-
Adjusting Shims (Differential Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	-
6T Spiral Bevel Pinion to Bevel Gear	Backlash 0.15 to 0.25 mm 0.0059 to 0.0098 in.	-
	Tooth Contact -	More than 35%
	Center of Tooth Contact -	1/3 of the entire width from the small end
Adjusting Shims (Differential Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	-
(Pinion Bearing Case)	Thickness 0.1, 0.2, 0.5 mm 0.004, 0.008, 0.020 in.	-
6T Spiral Bevel Pinion Only	Turning Torque 2.0 to 2.9 N·m 0.2 to 0.3 kgf·m 1.4 to 2.2 ft-lbs	-

TIGHTENING TORQUES

Tightening torques of screws, bolts and nuts on the table below are especially specified.
(For general use screws, bolts and nuts: See page S.G-8)

[L2350]

Item	N·m	kgf·m	ft-lbs
Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Main shaft case mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch housing mounting nut to transmission case	48.1 to 55.9	4.9 to 5.7	35.5 to 41.2
Spiral bevel pinion lock nut	147 to 196	15 to 20	108 to 145
Pinion bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Differential bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2

[L2650, L2950, L3450, L3650]

Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Main shaft case mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Clutch housing mounting nut to mid case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Mid case mounting nut to transmission case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Counter shaft 2 lock nut	39.2 to 58.8	4.0 to 6.0	28.9 to 43.4
Spiral bevel pinion lock nut	147 to 196	15 to 20	108 to 145
Pinion bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Differential bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
PTO shaft lock nut	147 to 196	15 to 20	108 to 145
PTO shift fork setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
PTO shifter setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32

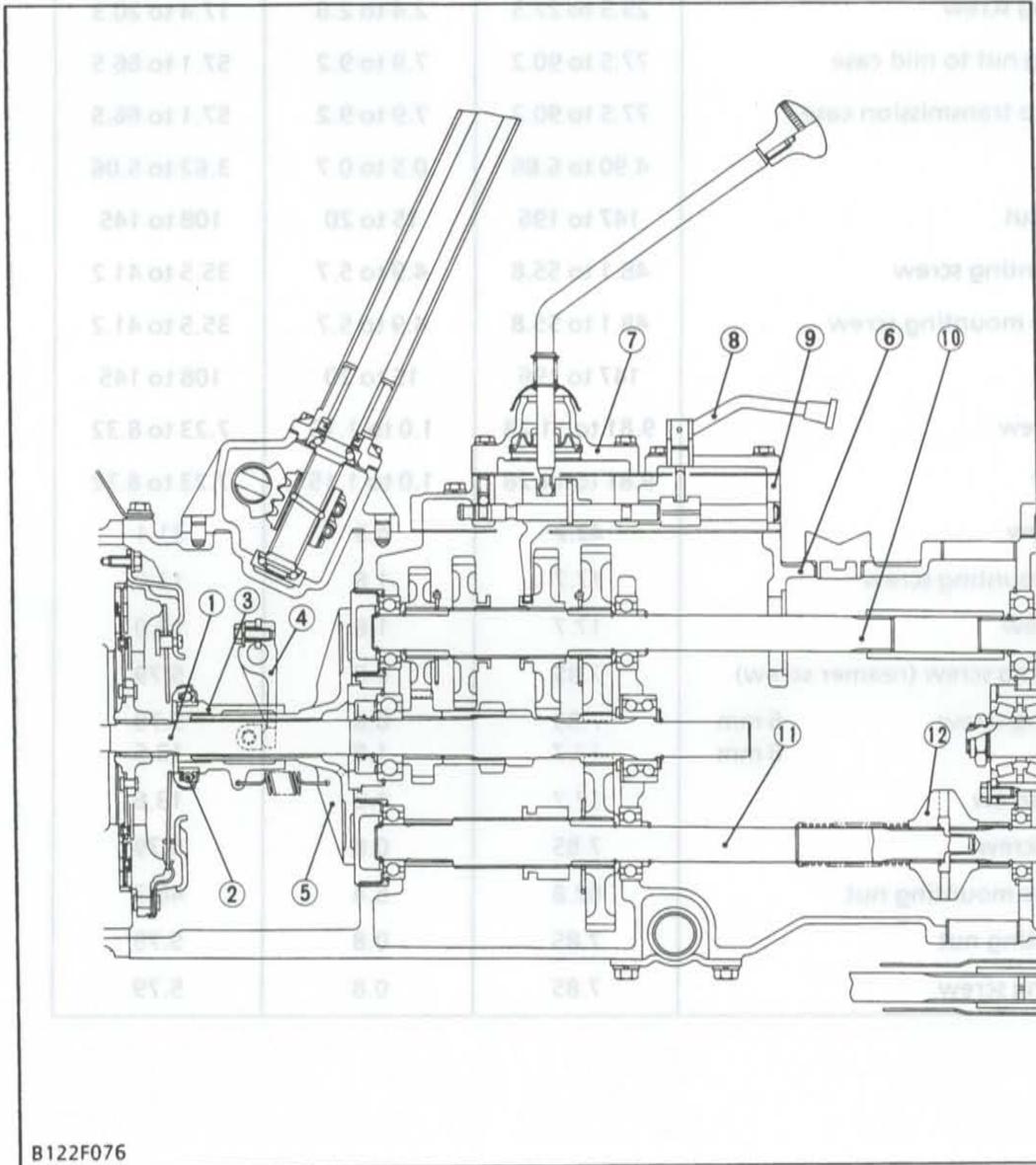
[L2650GST, L2950GST, L3450GST, L3650GST]

Item	N·m	kgf·m	ft-lbs	
Engine mounting screw and nut to clutch housing	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	
Main shaft case mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3	
Clutch housing mounting nut to mid case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5	
Mid case mounting nut to transmission case	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5	
Counter shaft 22 nut	4.90 to 6.86	0.5 to 0.7	3.62 to 5.06	
Spiral bevel pinion lock nut	147 to 196	15 to 20	108 to 145	
Pinion bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	
Differential bearing case mounting screw	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2	
PTO shaft lock nut	147 to 196	15 to 20	108 to 145	
PTO shift fork setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32	
PTO shifter setting screw	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32	
Side cover mounting screw	42.2	4.3	31.1	
Hi-Lo shift spool valve mounting screw	17.7	1.8	13.0	
Gate valve mounting screw	17.7	1.8	13.0	
Shuttle shift fork mounting screw (reamer screw)	7.85	0.8	5.79	
Main shift valve mounting screw	6 mm 8 mm	7.85 17.7	0.8 1.8	5.79 13.6
Accumulator mounting screw	17.7	1.8	13.6	
Rotary valve mounting screw	7.85	0.8	5.79	
Rotary valve detent plate mounting nut	62.8	6.4	46.3	
Modulating valve mounting nut	7.85	0.8	5.79	
Reducing valve case fixing screw	7.85	0.8	5.79	

CHECKING, DISASSEMBLING AND SERVICING

[1] L2350

[1]-1 CLUTCH HOUSING



- (1) Main Shaft
- (2) Thrust Ball Bearing
- (3) Release Hub
- (4) Release Fork
- (5) Main Shaft Case
- (6) Clutch Housing
- (7) Shift Base
- (8) PTO Shift Lever
- (9) Shift Cover
- (10) Counter Shaft
- (11) PTO Counter Shaft
- (12) One-way Clutch (Slant Cam)

B122F076

DISASSEMBLING AND ASSEMBLING

Separating Clutch Housing

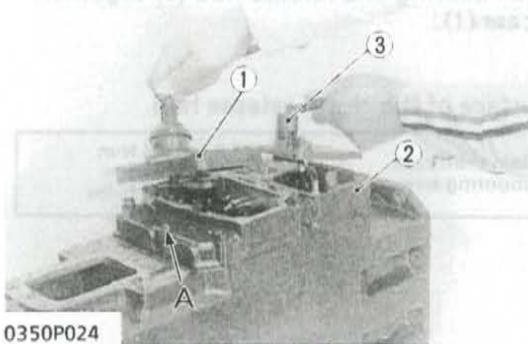
(See page S.5-6)

Shift Base and Cover

1. Detach shift base (1) and PTO shift base (3) from shift cover (2).
2. Remove shift cover (2).

(When reassembling)

- Take care not to drop springs and balls in the transmission.
- Use a seal washer at the single specified point "A".

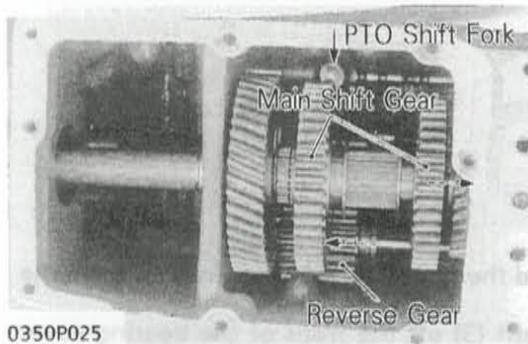


0350P024

- (1) Shift Base
- (2) Shift Cover
- (3) PTO Shift Base

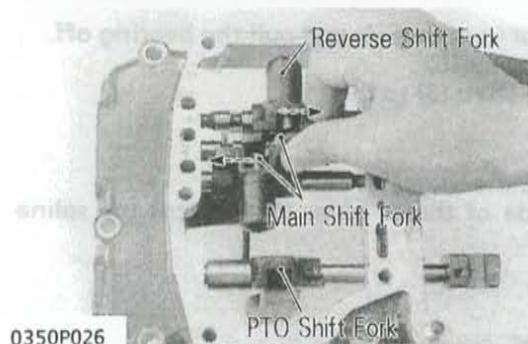
Tightening torque	Bolt with seal washer	11.8 to 20.6 N·m 1.2 to 2.1 kgf·m 8.7 to 14.5 ft-lbs
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- The shift forks should be fitted onto the gear fork grooves as follows.



0350P025

1. Shift the PTO shift forks to neutral.
2. Shift the main shift gear to F4 (F8).
3. Retreat the reverse gear until it touches the 48T gear.



0350P026

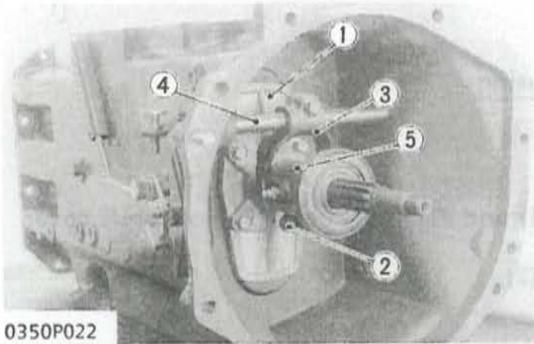
4. Shift the main shift fork to F4 (F8).
5. Retreat the reverse shift fork approx. 6 mm (0.24 in.).
6. Shift the PTO shift forks to neutral.



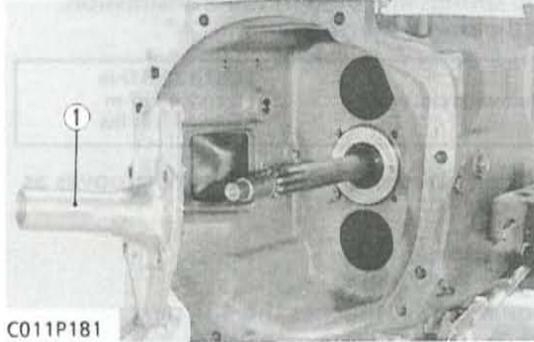
0350P027

7. Hold the three main shift forks with fingers to prevent the neutral piece from coming off.
8. Securely fit the three main shift forks into the gear shift fork grooves.
9. Fit the PTO levers onto the shift fork pins by slightly lifting the left side of the speed change cover.

Tightening torque	Speed change cover mounting screw	24 to 28 N·m 2.4 to 2.8 kgf·m 174.0 to 202.8 ft-lbs
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C0350P022



C011P181

- (1) Main Shaft Case
- (2) Hub Return Spring
- (3) Release Fork
- (4) Clutch Lever
- (5) Release Hub

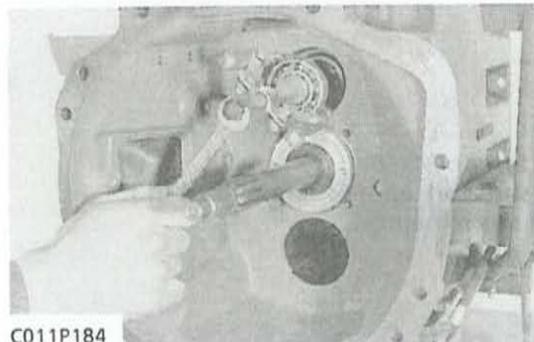
Main Shaft Case

1. Remove the release fork (3) mounting screws.
2. Draw out clutch lever (4) to remove release fork (3).
3. Remove hub return spring (2).
4. Remove the thrust ball bearing and release hub (5) together.
5. Remove main shaft case (1).

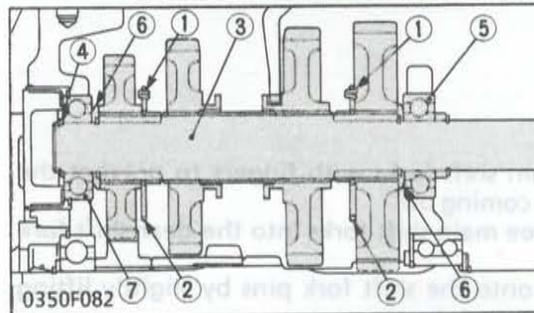
(When reassembling)

- Grease the sliding surface of the clutch release hub.

Tightening torque	Main shaft case mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
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C011P184



O350F082

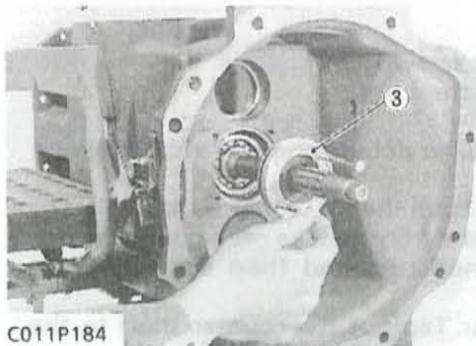
- (1) Wire
- (2) Snap Ring
- (3) Counter Shaft
- (4) Snap Ring
- (5) Bearing
- (6) Thrust Collar
- (7) Bearing Cover

Counter Shaft

1. Remove wire (1) and the two external snap rings (2) from the counter shaft (3).
2. Tap the counter shaft (3) off the front of the bearing cover (8).
3. Remove the external snap ring (4) and pull the bearing off.
4. Remove the thrust collar (6).
5. Tap out the counter shaft (3) to the rear.

(When reassembling)

- Bind the wires (1) to the rings (2).
- Point oil groove side of thrust collar (6) towards the spline boss.



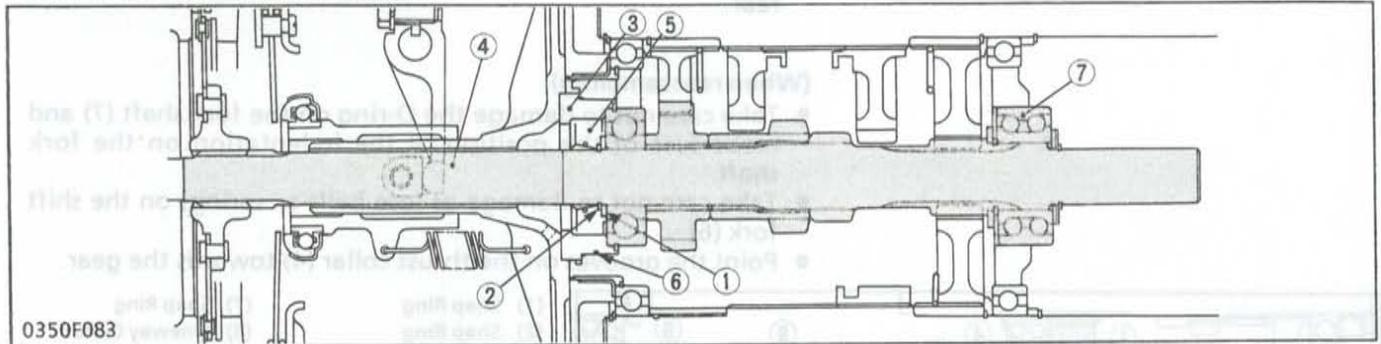
C011P184

Main Shaft

1. Screw the two screws into the spacer (3) and pull it out.
2. Remove the external snap ring (2).
3. Remove the collar (1).
4. Tap out the main shaft (4) to the rear.

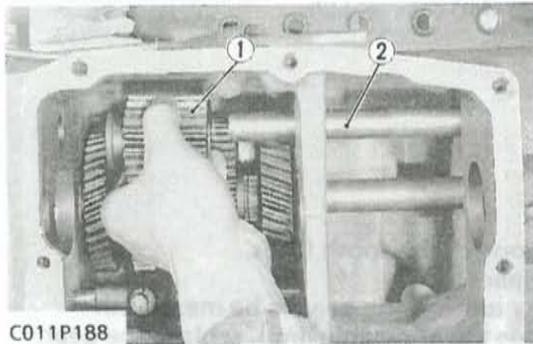
(When reassembling)

- Apply grease to oil seal (5).
- Point the outer raceway of bearing (7) towards the differential gear.



0350F083

- | | | | |
|------------------------|----------------|--------------|------------------|
| (1) Washer | (3) Spacer | (5) Oil Seal | (7) Ball Bearing |
| (2) External Snap Ring | (4) Main Shaft | (6) O-ring | |



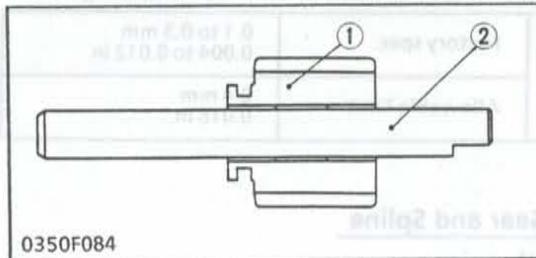
C011P188

Reverse Shaft

1. Remove the set screw on the reverse shaft.
2. Draw out the reverse shaft and remove the gear.

(When reassembling)

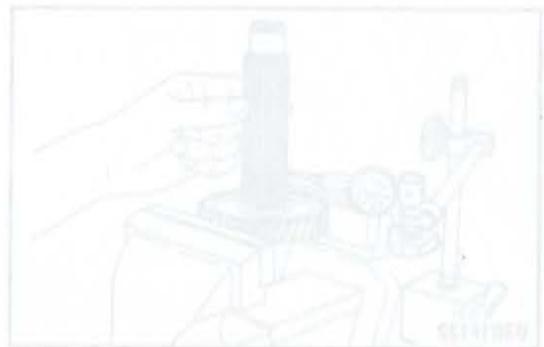
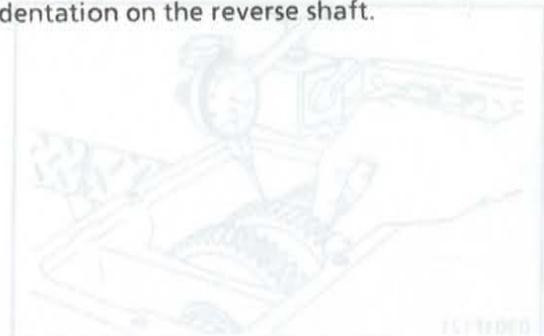
- Make sure of the direction of the reverse shaft and of the position of the indentation on the reverse shaft.

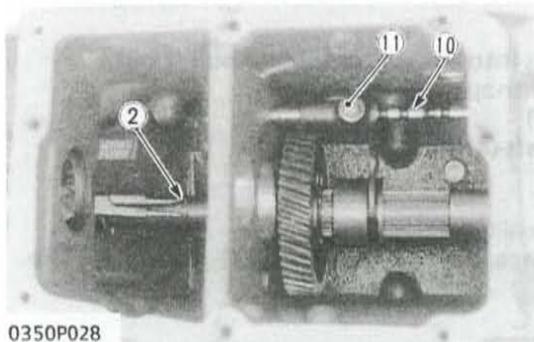


0350F084

- | | |
|------------------|-------------------|
| (1) Reverse Gear | (2) Reverse Shaft |
|------------------|-------------------|

0.020 to 0.025 mm	Factory spec.	Clearance between gear and spline
0.015 to 0.021 mm		
0.5 mm	Allowable limit	
0.029 mm		





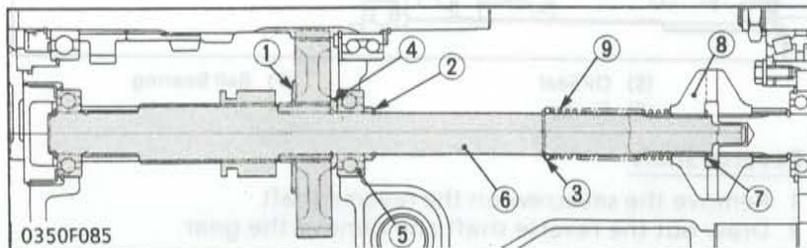
0350P028

PTO Counter Shaft

1. Remove the fork shaft set screw.
2. Tap out fork shaft (10) to the front.
3. Remove shift fork (11).
4. Remove snap rings (7), (3) to detach one way clutch (8) and spring (9).
5. Remove the snap ring (1) from the PTO counter shaft (6).
6. Tap the counter shaft to the front to take off bearing cover.
7. Remove the external snap ring and then draw out the bearing.
8. Detach the thrust collar. Tap out the counter shaft to the rear.

(When reassembling)

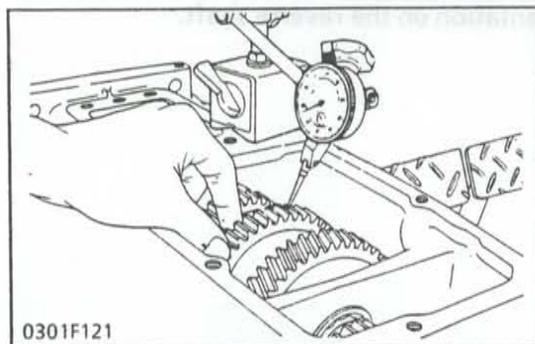
- Take care not to damage the O-ring on the fork shaft (7) and make sure of the position of the indentation on the fork shaft.
- Take care not to damage or lose balls or springs on the shift fork (6).
- Point the grooves on the thrust collar (4) towards the gear.



0350F085

- | | |
|-----------------------|-------------------|
| (1) Snap Ring | (7) Snap Ring |
| (2) Snap Ring | (8) Oneway Clutch |
| (3) Snap Ring | (9) Spring |
| (4) Thrust Collar | (10) Fork Shaft |
| (5) Bearing | (11) Shift Fork |
| (6) PTO Counter-shaft | |

SERVICING

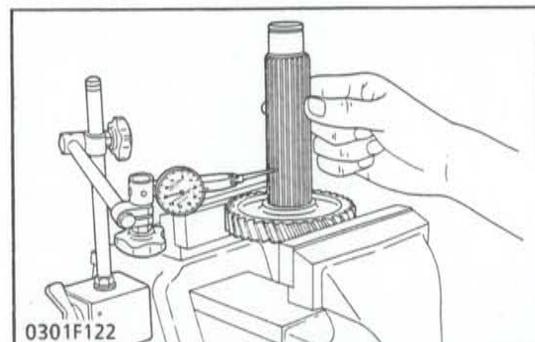


0301F121

Gear Backlash

1. Set a dial gauge on one of the tooth faces.
2. Clamp the mating gear.
3. Measure backlash by turning the gear to be measured.
4. If the reading exceeds the allowable limit, replace the gear.

Gear backlash	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
	Allowable limit	0.4 mm 0.016 in.

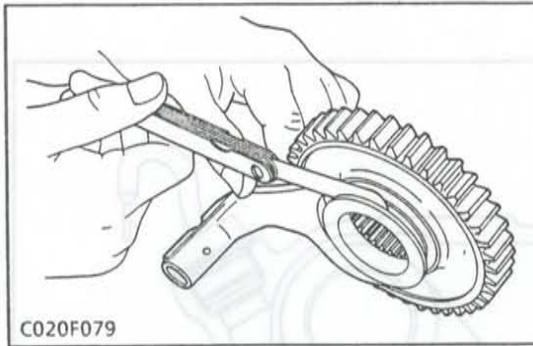


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Clearance between Gear and Spline

1. Secure the gear with a vise.
2. Set the dial indicator (lever type) with its finger on the spline.
3. Move the shaft to measure clearance.
4. If the clearance exceeds allowable limit, replace.

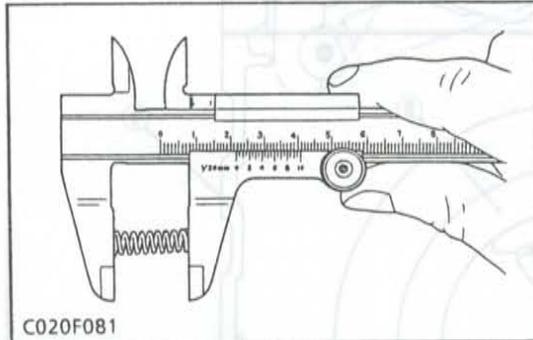
Clearance between gear and spline	Factory spec.	0.030 to 0.078 mm 0.0012 to 0.0031 in.
	Allowable limit	0.2 mm 0.0079 in.



Clearance between Shift Fork and Shift Gear Groove or Shifter Groove

1. Place for in the groove to check clearance with feeler gauge.
2. If the clearance exceeds allowable limit, replace.

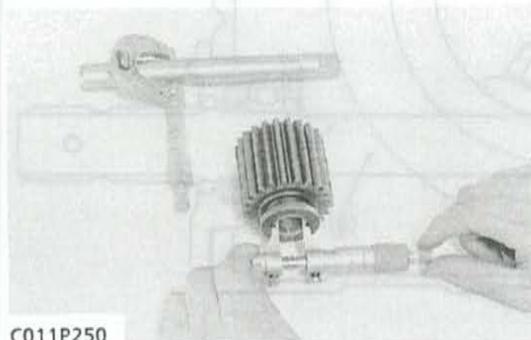
Clearance between shift fork and shift gear groove	Factory spec.	0.15 to 0.40 mm 0.006 to 0.016 in.
	Allowable limit	0.6 mm 0.024 in.
Clearance between shift fork and shifter groove	Factory spec.	0.20 to 0.40 mm 0.008 to 0.016 in.
	Allowable limit	0.6 mm 0.024 in.



Free Length of the Shift Fork Spring

1. Measure free length of spring with vernier caliper.
2. If the free length is less than the allowable limit, replace.

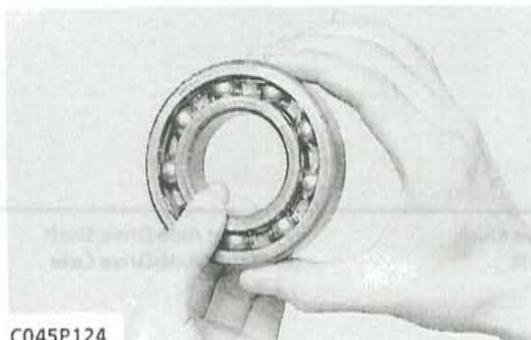
Free length of the shift fork spring	Factory spec.	22 mm 0.866 in.
	Allowable limit	20 mm 0.787 in.



Clearance between Reverse Gear Bushing and Reverse Shaft

1. Measure the outside diameter of the reverse shaft.
2. Measure the inside diameter of the reverse gear bushing and take the difference for the clearance.
3. If the clearance exceeds the allowable limit, replace.

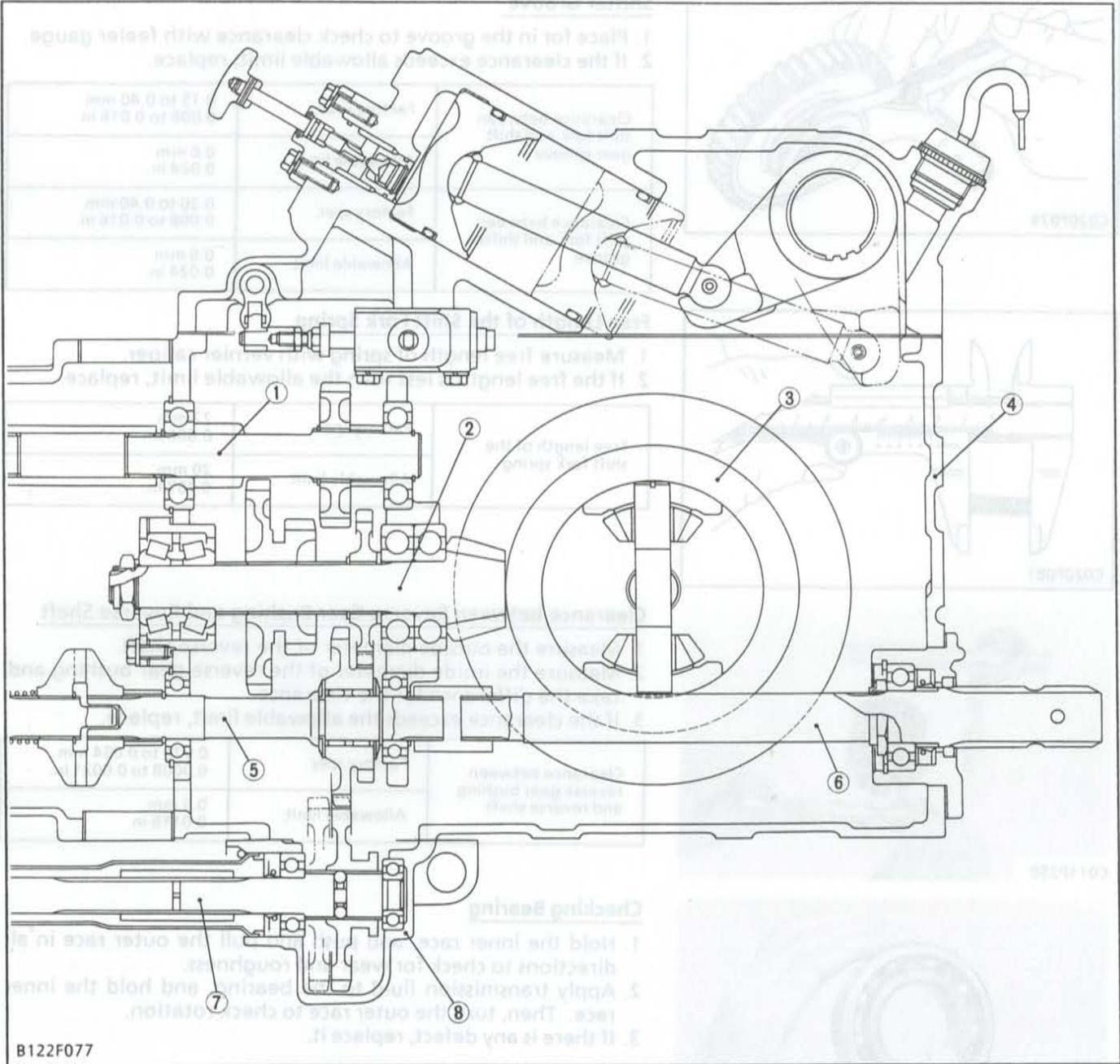
Clearance between reverse gear bushing and reverse shaft	Factory spec.	0.020 to 0.054 mm 0.0008 to 0.0021 in.
	Allowable limit	0.3 mm 0.0118 in.



Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

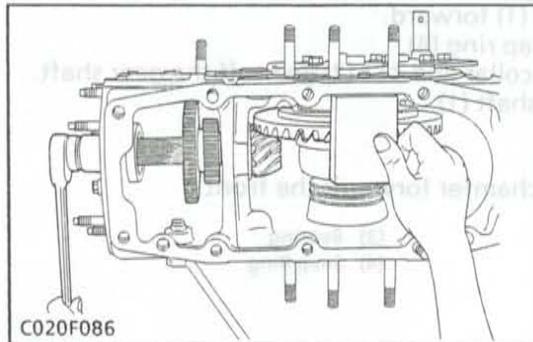
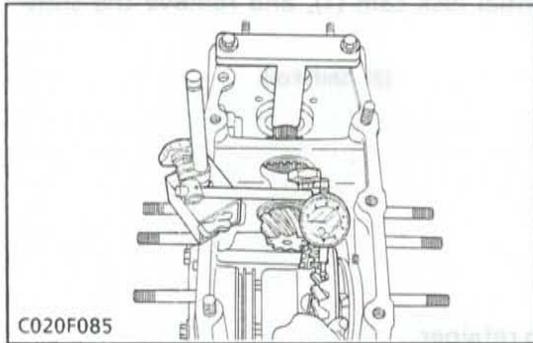
[1]-2 TRANSMISSION CASE



B122F077

- | | | | |
|-------------------------|-----------------------|---------------------|----------------------------|
| (1) 12T Gear Shaft | (3) Differential Gear | (5) PTO Drive Shaft | (7) Front Axle Drive Shaft |
| (2) Spiral Bevel Pinion | (4) Transmission Case | (6) PTO Shaft | (8) Front Axle Drive Case |

CHECKING AND ADJUSTING



Separating Transmission Case

(See page S.5-9.)

Backlash and Tooth Contact between Bevel Gear and 8T Spiral Bevel Pinion

1. Set a dial gauge with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 8T spiral bevel pinion and moving bevel gear by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims at right bearing case (right) and insert the removed shims to the left bearing case (left). If the backlash is less than the factory specification, decrease the number of shims at left bearing case (left) and insert the removed shims to the right bearing case (right).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between bevel gear and 8T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in.
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5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear.
6. Turn the 8T spiral bevel pinion while pressing a wooden piece against the periphery of the bevel gear.
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

- Thickness of differential side shims:
 - 0.1 mm (0.004 in.) [Code No. 37150-26171]
 - 0.2 mm (0.008 in.) [Code No. 37150-26161]
 - 0.5 mm (0.020 in.) [Code No. 37150-26181]
- Thickness of spiral bevel pinion shims:
 - 0.1 mm (0.004 in.) [Code No. 34150-22631]
 - 0.2 mm (0.008 in.) [Code No. 34150-22621]
 - 0.5 mm (0.020 in.) [Code No. 34150-22611]

• Proper Contact



More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

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• Heel Contact



• Tip Contact



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Replace adjusting shim with thinner one to move the bevel pinion shaft backward. And place the left side shim to the right to move the bevel gear rightward. Repeat above until the proper tooth contact and backlash are achieved.

• Toe Contact



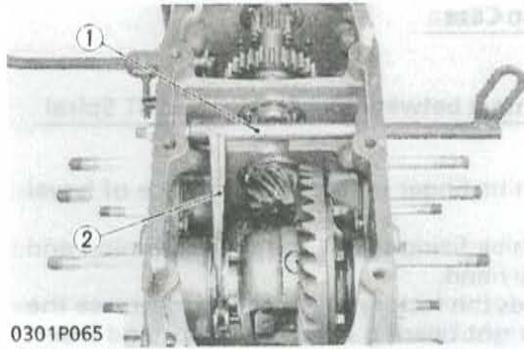
• Base Contact



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Replace adjusting shim with thicker one to move the bevel pinion shaft forward. And place the right side shim to the left to move the bevel gear leftward. Repeat above until the proper tooth contact and backlash are achieved.

DISASSEMBLING AND ASSEMBLING



Differential Lock

1. Drive out the spring pin.
2. Pull out the differential lock cam (1), and remove the shift fork (2).

(1) Differential Lock Cam

(2) Shift Fork



12T Gear Shaft

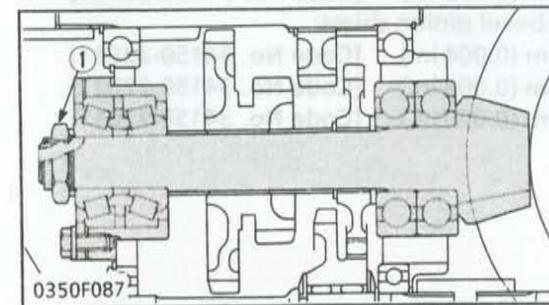
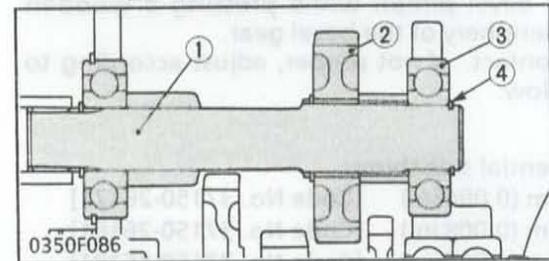
1. Remove the bearing retainer.
2. Shift 12T gear shaft (1) forward.
3. Remove external snap ring (4).
4. Pull the bearing (3) collar and 31T (2) gear off the gear shaft.
5. Draw out 12T gear shaft (1).

(When reassembling)

- Point the 31T gear chamfer forwards the front.

(1) 12T Gear Shaft
(2) 31T Gear

(3) Bearing
(4) Snap Ring



Differential Gear Assembly

1. Unlock and remove the lock nut (1).
2. Remove the differential bearing case (2) mounting screws.
3. Detach the case by screwing two M8 screws.

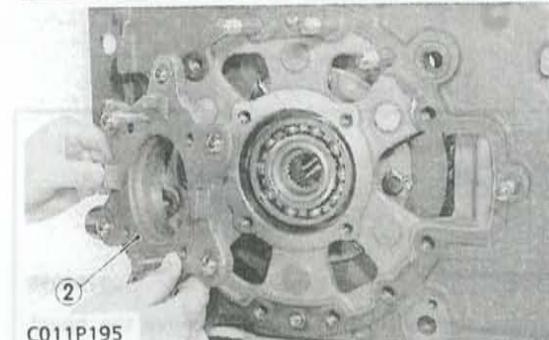
(When reassembling)

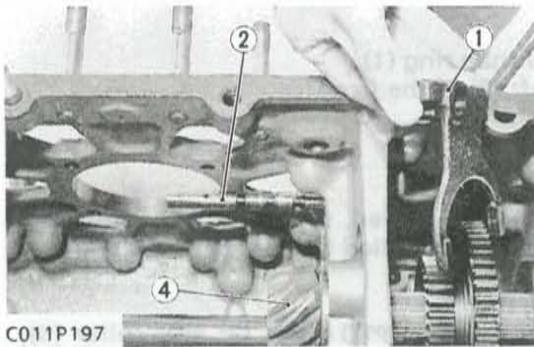
- Use same number of shims as before disassembling.
- Replace the left and right bearing cases on the same sides as before.
- Apply grease to ball and ball seats.

Tightening torque	Lock Nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft·lbs
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(1) Lock Nut

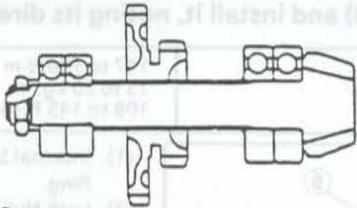
(2) Bearing Case



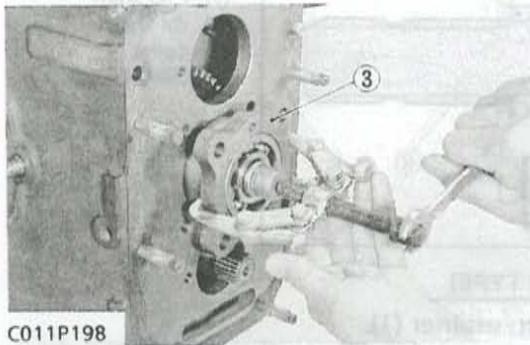


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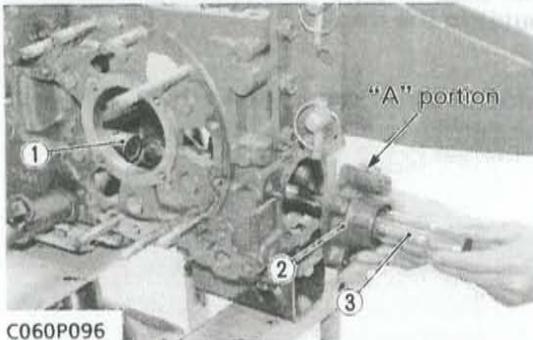
[2WD]



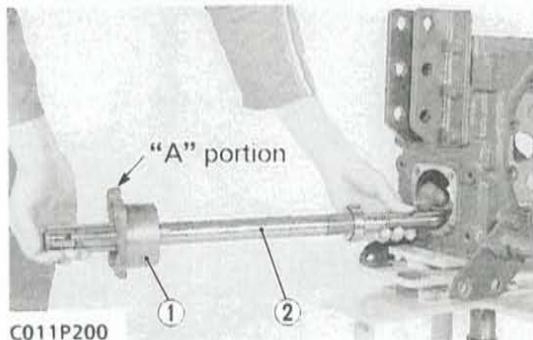
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C011P200

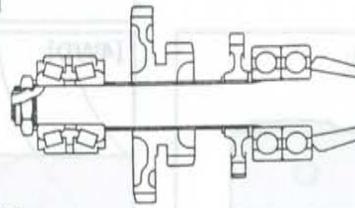
Spiral Bevel Pinion Shaft

1. Remove the fork shaft set screw.
2. Remove the fork shaft snap pin.
3. Pull the fork shaft (2) off the rear.
4. Remove the shift fork (1).
5. Remove the bearing cover (3).
6. Remove the bearing case mounting screws.
7. Pull out the bearing case (3) with a gear puller.
8. Pull the spiral bevel pinion shaft (4) off the rear.
9. Pull out the 29-48T gears.

(When reassembling)

- Take gear case not to lose or damage the balls and spring in fork (1) in refitting fork shaft (2) to fork (1).
- Make sure of the number of shims in the bearing case.

[4WD]



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- (1) Shift Fork
- (2) Fork Shaft

- (3) Bearing Case
- (4) Spiral Bevel Pinion Shaft

PTO Bearing Case [4WD TYPE]

1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1).

(When reassembling)

- Direct the boss "A" portion on bearing case (2) upward.

- (1) Coupling
- (2) Bearing Case

- (3) PTO Shaft

PTO Shaft [2WD TYPE]

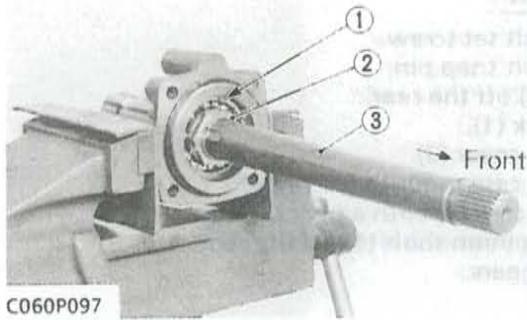
1. Remove the bearing case (1) mounting screws.
2. Pull PTO shaft (2) and bearing base (1) off the rear.

(When reassembling)

- Direct the boss "A" portion on bearing case (1) upward.

- (1) Bearing Case

- (2) PTO Shaft



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PTO Shaft

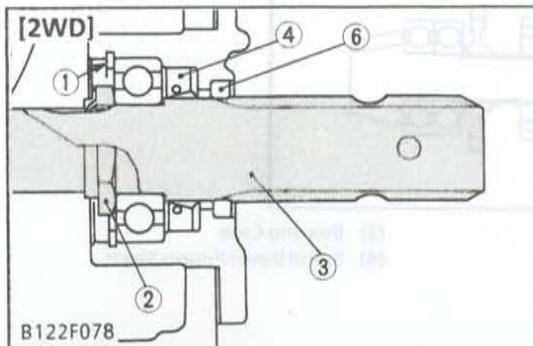
1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (3) to the front.

(When reassembling)

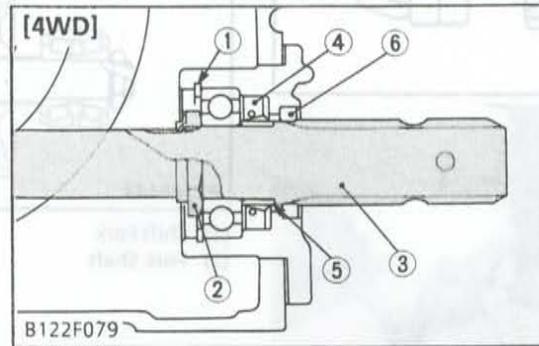
NOTE

- In the lock nut (2) was removed, replace a new one, and after tightening it to the specified torque, be sure to lock it firmly.
- Install the slinger (6) firmly.
- After applying grease to the PTO shaft (3) and collar (5), insert the collar to PTO shaft. [4WD TYPE]
- Apply grease to oil seal (4) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft-lbs
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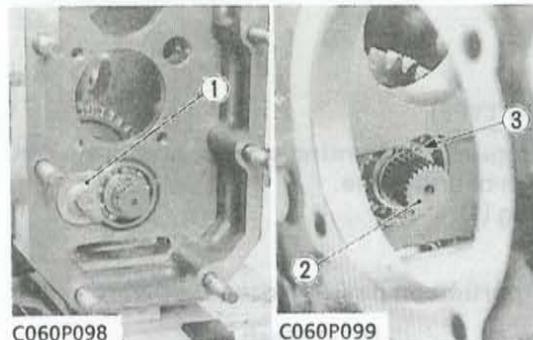


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B122F079

- (1) Internal Snap Ring
- (2) Lock Nut
- (3) PTO Shaft
- (4) Oil Seal
- (5) Collar
- (6) Slinger



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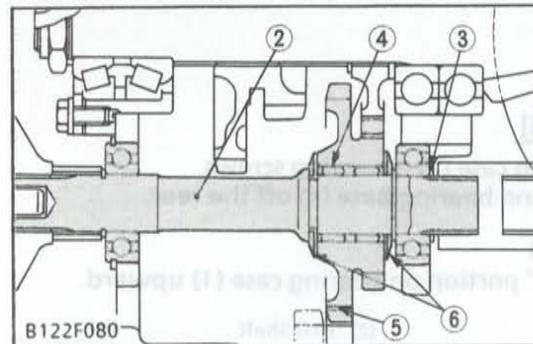
PTO Drive Shaft [4WD TYPE]

1. Remove the bearing retainer (1).
2. Remove the external snap ring (3) on the rear of PTO drive shaft (2), and tap out it to the front.

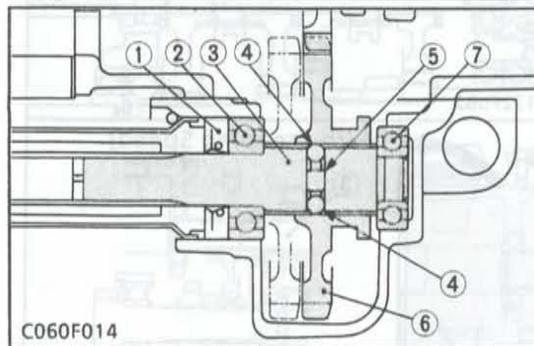
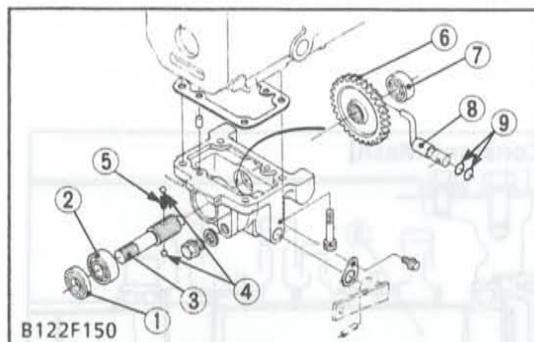
(When reassembling)

- Direct the groove side of thrust collars (6) to the 19-34T gear side.

- (1) Bearing Retainer
- (2) PTO Drive Shaft
- (3) External Snap Ring
- (4) Needle Bearing
- (5) 19-34T Gear
- (6) Thrust Collars



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Front Drive Case

1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting screws	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-ring |
| (5) Spring | (10) Change Lever |

SERVICING

Checking Bearing

(See page S.3-21)

Gear Backlash

(See page S.3-20)

Clearance between Gear and Spline

(See page S.3-20)

Clearance between Shift Fork and Shifter Groove

(See page S.3-21)

Differential Gear Rotating Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the rotating torque.
2. Adjust the torque by altering the differential bearing case shim thickness.

Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)

Differential gear rotating torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft·lbs
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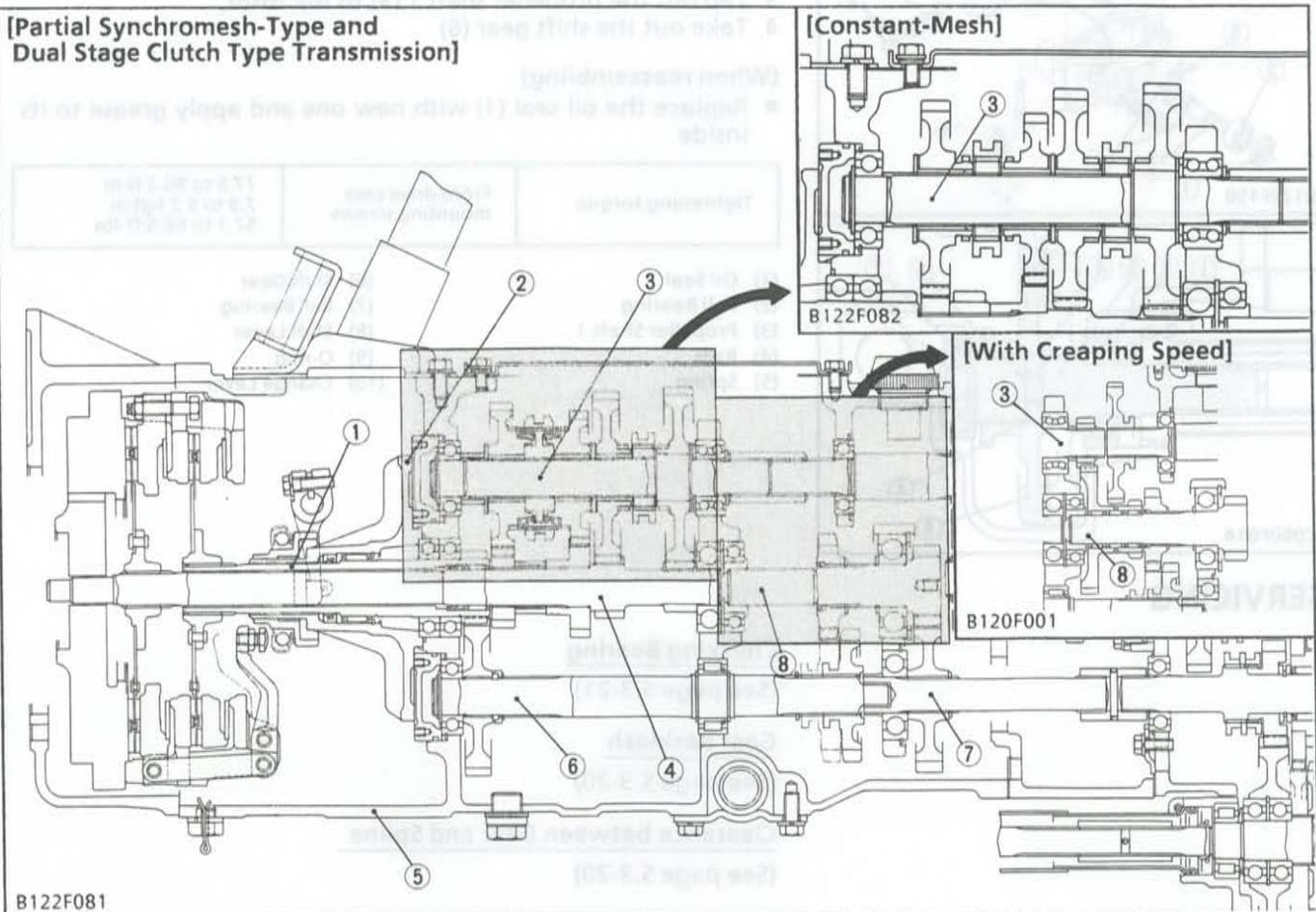
[2] L2650, L2950, L3450, L3650

[2]-1 CLUTCH HOUSING

[Partial Synchromesh-Type and Dual Stage Clutch Type Transmission]

[Constant-Mesh]

[With Creeping Speed]

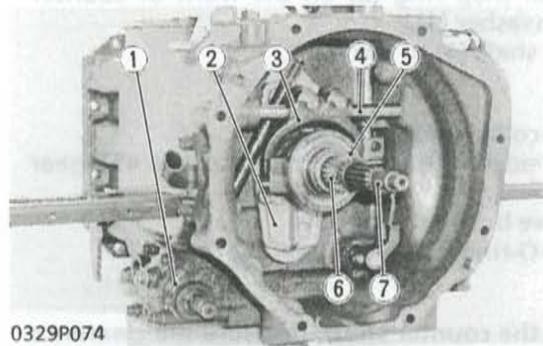


- (1) Gear Shaft
- (2) Main Shaft Case
- (3) Counter Shaft
- (4) Main Shaft
- (5) Clutch Housing
- (6) PTO Counter Shaft 1
- (7) PTO Counter Shaft 2
- (8) PTO Gear Shaft

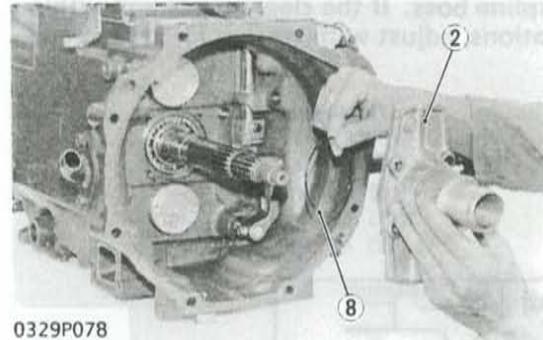
DISASSEMBLING AND ASSEMBLING

Separating Clutch Housing

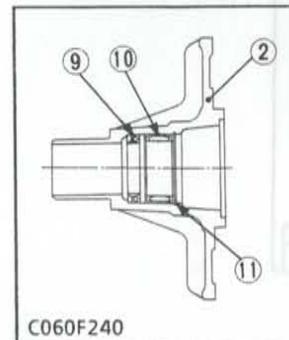
(See page S.5-20.)



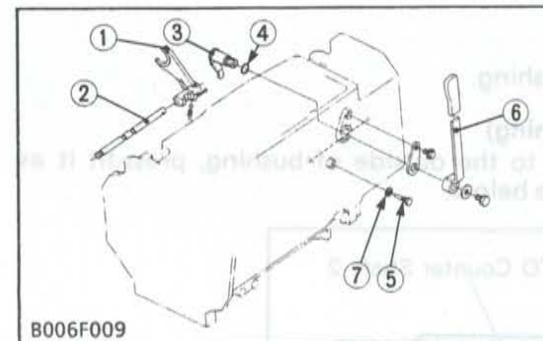
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Main Shaft Case

1. Remove the steering gear case (1).
2. Remove the release fork (3) mounting screws.
3. Draw out the clutch lever (4) to remove the release fork (3).
4. Remove the thrust ball bearing and release hub (5) as a unit.
5. Remove the main shaft case (2).
6. Remove the O-ring (8).

(When reassembling)

- Apply grease to O-ring (8) and install it to the clutch housing.
- Apply grease to the oil seal and needle bearing in the main shaft case (2).
- After reassembling the main shaft case, check that gear shaft (6) and main shaft (7) rotate respectively and that they have a little axial play.

Tightening torque	Main shaft case mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
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(When replacing Bearing and Oil Seal in Main Shaft Case)

- Install the oil seal (9) as shown in the figure, noting its direction.
- Apply grease to needle bearing (10) and press-fit it up to the groove of internal snap ring (11).

- (1) Steering Gear Case
(2) Main Shaft Case
(3) Release Fork
(4) Clutch Lever
(5) Release Hub
(6) Gear Shaft

- (7) Main Shaft
(8) O-ring
(9) Oil Seal
(10) Needle Bearing
(11) Internal Snap Ring

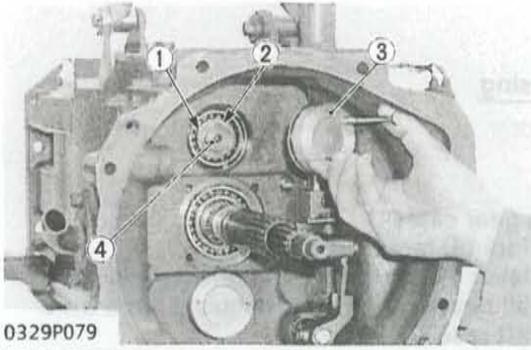
Shift Fork and Shift Lever [Only with creeping Speed]

1. Remove the shift rod setting screw (5).
2. Screw in the M6 screw (6 mm, 0.236 in. DIA.) to the rear end of fork rod (2) and pull out it.
3. Remove the shift fork (1) and 42T gear.
4. Remove the shift lever (6) and shift arm (3) with O-ring (4).

(When reassembling)

- Apply grease to O-ring (4) on shift arm (3).
- Set the sealing washer (7) to fork rod setting screw (5), and insert it to groove on fork rod (2).
- Be sure to align the alignment marks on the shift arm (3) and shift lever (6).

- (1) Shift Fork
(2) Shift Rod
(3) Shift Arm
(4) O-ring
(5) Shift Rod Setting Screw
(6) Shift Lever
(7) Sealing Washer



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Counter Shaft

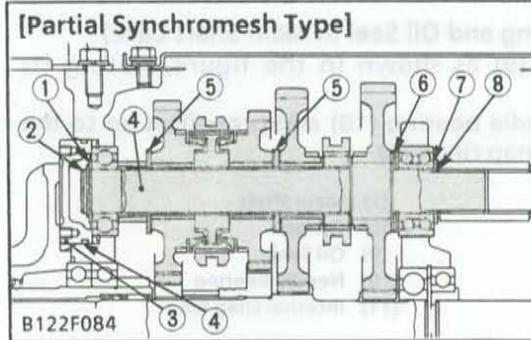
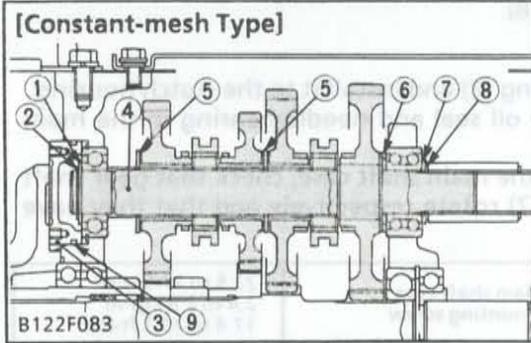
1. Remove the speed change cover.
2. Remove the bearing cover (3) using screws (6 mm, 0.236 in. DIA.).
3. Remove the external snap ring (2) on the front of counter shaft. Take out the washer (1).
4. Tap out the counter shaft (4) to the rear.

(When reassembling)

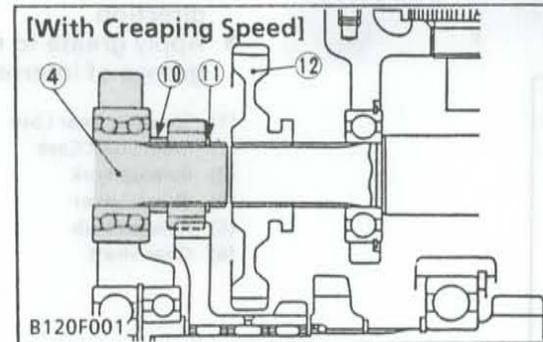
- Apply grease to the collars and inner races.
- Direct the grooved side of thrust collars (6) to the 45T gear side.
- Apply grease to the O-ring (9) on the bearing cover (3).

■ IMPORTANT

- After reassembling the counter shaft, measure the clearance between gear and spline boss. If the clearance is not within the factory specifications, adjust with washer (1). (See page S.3-34)



- | | |
|------------------------|-------------------------|
| (1) Washer | (7) Washer |
| (2) External Snap Ring | (8) External Snap Ring |
| (3) Bearing Cover | (9) O-ring |
| (4) Counter Shaft | (10) Collar |
| (5) Thrust Collar | (11) External Snap Ring |
| (6) Thrust Collar | (12) 42T Gear |



PTO Counter Shaft 2

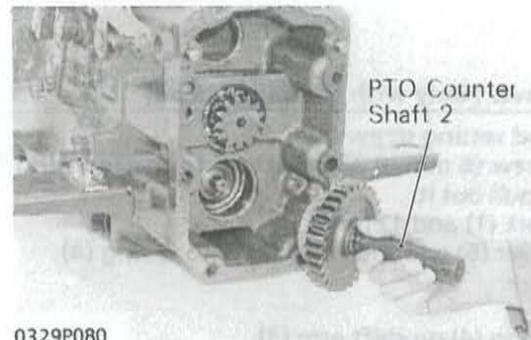
1. Draw out the PTO counter shaft 2.

(When reassembling)

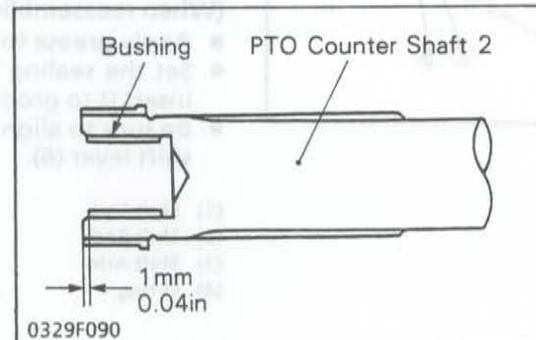
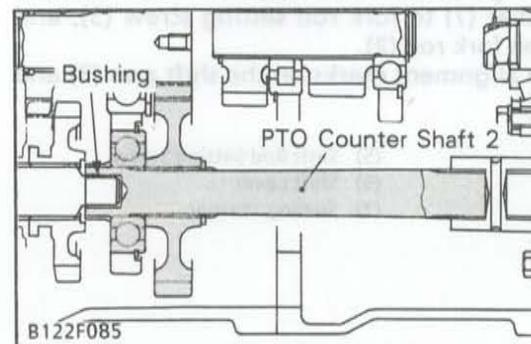
- Apply grease to bushing.

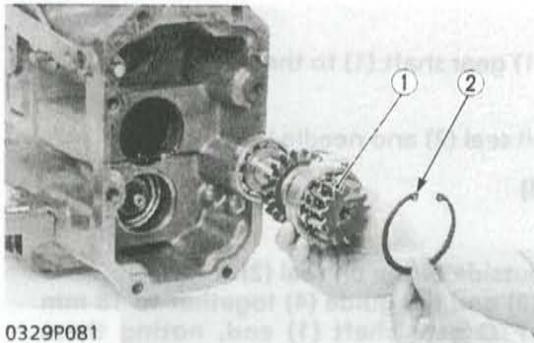
(When replacing bushing)

- After applying oil to the outside of bushing, press-fit it as shown in the figure below.



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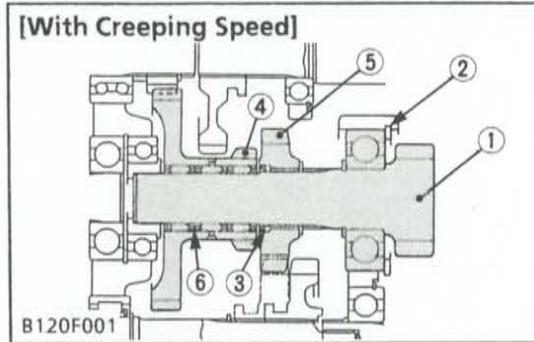
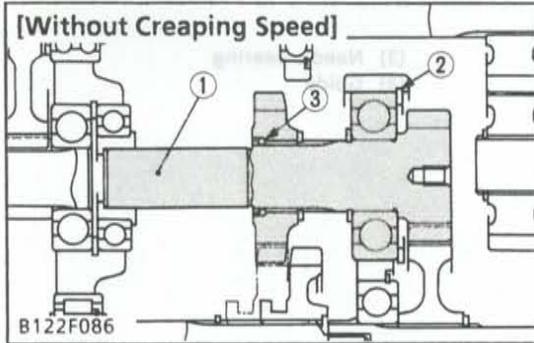
PTO Gear Shaft

1. Remove the internal snap ring (2).
2. Draw out the PTO gear shaft (1) to the rear.
3. Pick the 17-45T gear (4) up. [Only with creeping speed.]

(When reassembling)

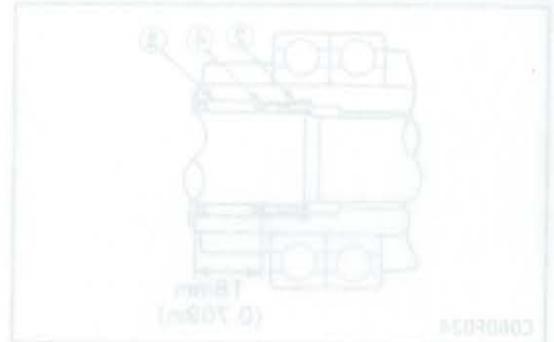
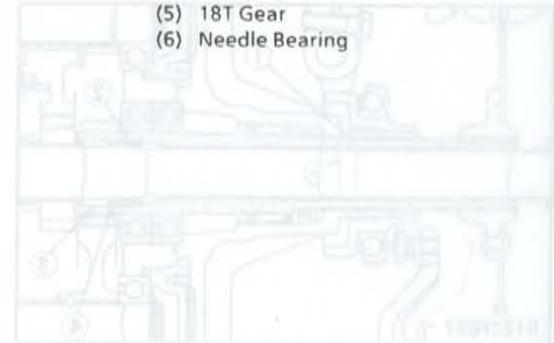
- Install the stopper (3) to the inside of 18T gear (5), and direct the longer boss side of 18T gear (5) to the rear.
- Apply grease to the needle bearings (6) on PTO gear shaft (1) for 17-45T gear (4). [Only with creeping speed.]

0329P081



- (1) PTO Gear Shaft
- (2) Internal Snap Ring
- (3) Stopper

- (4) 17-45T Gear
- (5) 18T Gear
- (6) Needle Bearing

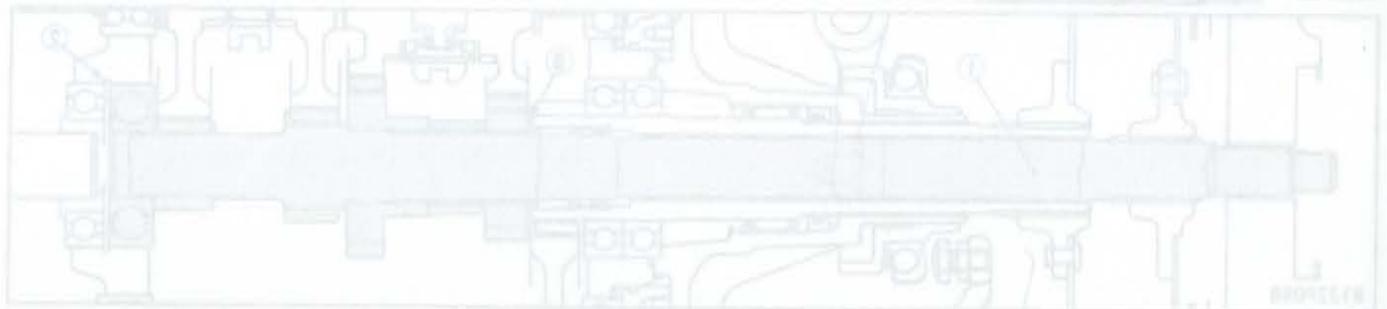


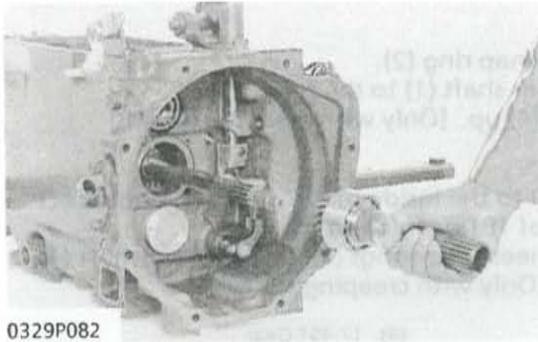
Main Shaft

1. Remove the internal snap ring (2).
 2. Tap out the main shaft (1) to the rear.
- (When reassembling)
- Install the copper washer (3) to the front of 18T gear.

(3) Copper Washer

(1) Main Shaft
(2) Internal Snap Ring





0329P082

16T (17T) Gear Shaft

1. Draw out the 16T (17T) gear shaft (1) to the front.

(When reassembling)

- Apply grease to the oil seal (2) and needle bearing (3).

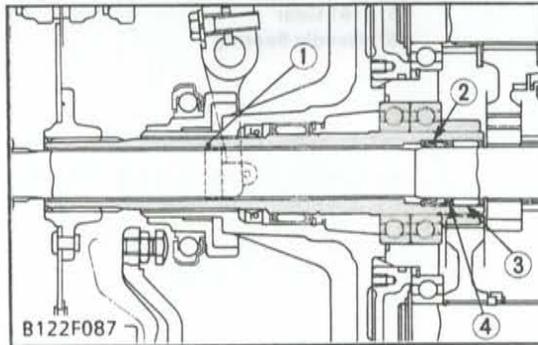
(When replacing oil seal)

■ **IMPORTANT**

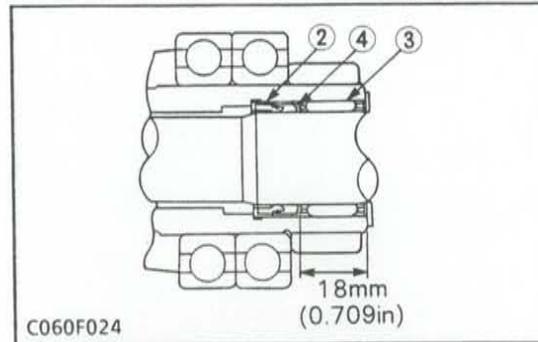
- Apply grease to the outside of the oil seal (2).
- Press-fit the oil seal (2) and the guide (4) together to 18 mm (0.709 in.) inside of PTO gear shaft (1) end, noting their direction.

- (1) PTO Gear Shaft
- (2) Oil Seal

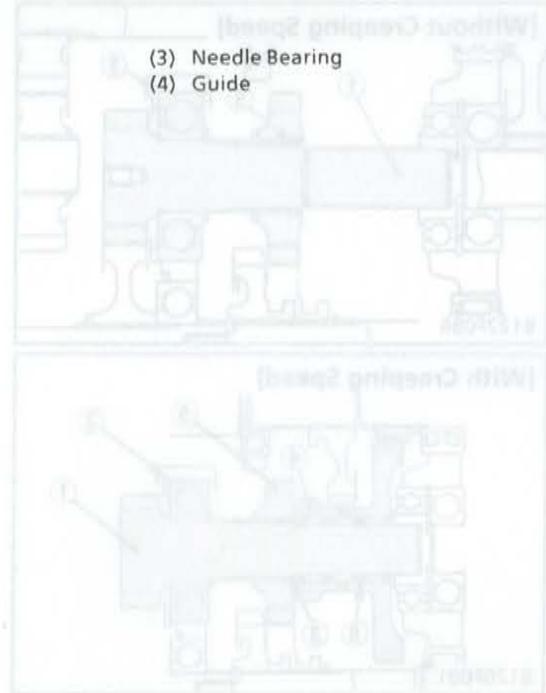
- (3) Needle Bearing
- (4) Guide



B122F087



C060F024



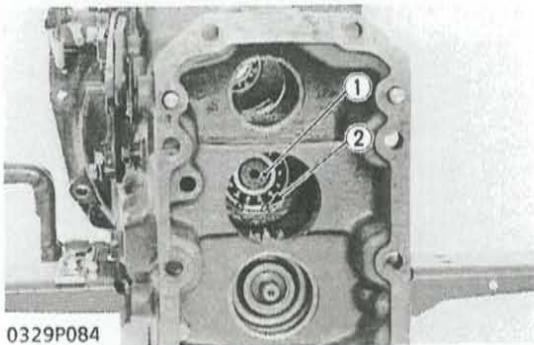
Main Shaft

1. Remove the internal snap ring (2).
2. Tap out the main shaft (1) to the rear.

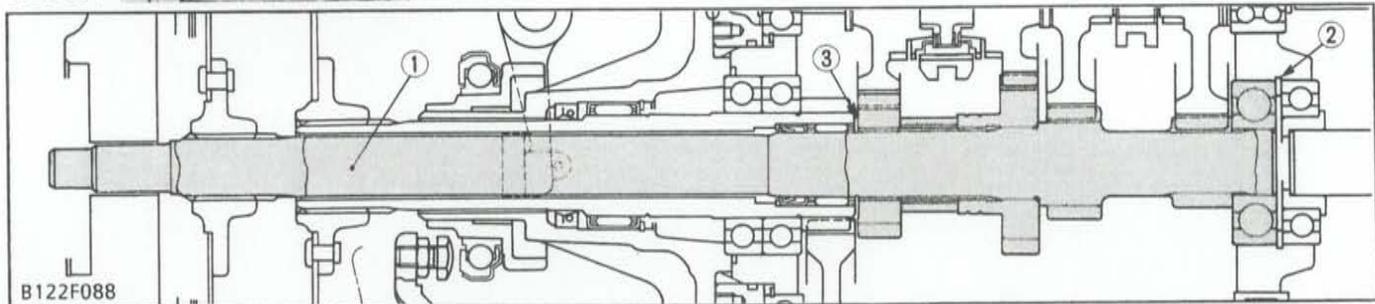
(When reassembling)

- Install the copper washer (3) to the front of 18T gear.

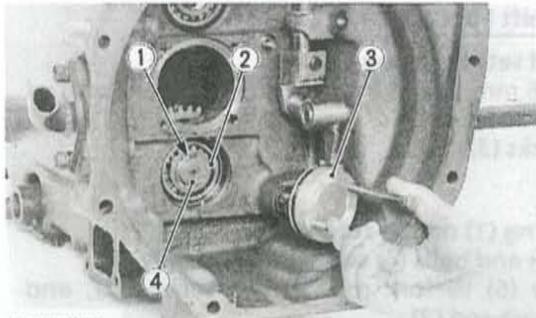
- (1) Main Shaft
- (2) Internal Snap Ring
- (3) Copper Washer



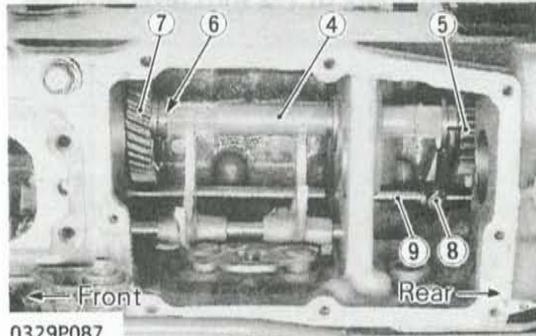
0329P084



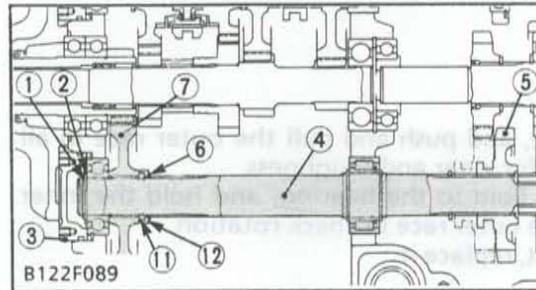
B122F088



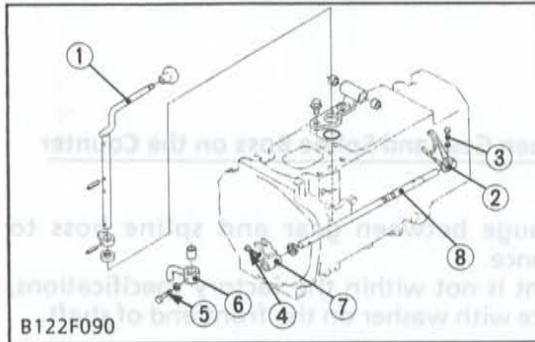
0329P086



0329P087



B122F089



B122F090

PTO Counter Shaft 1

1. Remove the bearing cover (3) using screws (6 mm, 0.236 in. DIA.), and remove the external snap ring (1) and washer (2).
2. Slide the external snap ring (6) on the rear of 39T (37T) gear (7) to the rear. Take out the set collar (11).
3. Tap the PTO counter shaft 1 (4) to the front to remove the 23T gear (5).
4. Tap out the PTO counter shaft 1 (4) to the rear.

(When reassembling)

- Install the collar cover (12) so as to prevent the set collar (11) from falling off.
- When tap the PTO counter shaft 1 (4) to the front, use the soft hammer to prevent damage of the PTO counter shaft 1 (4).

- | | |
|-------------------------|---------------------|
| (1) External Snap Ring | (7) 39T or 37T Gear |
| (2) Washer | (8) PTO Shift Fork |
| (3) Bearing Cover | (9) PTO Fork Rod |
| (4) PTO Counter Shaft 1 | (10) Shifter |
| (5) 23T Gear | (11) Set Collar |
| (6) External Snap Ring | (12) Collar Cover |

PTO Shift fork and Lever

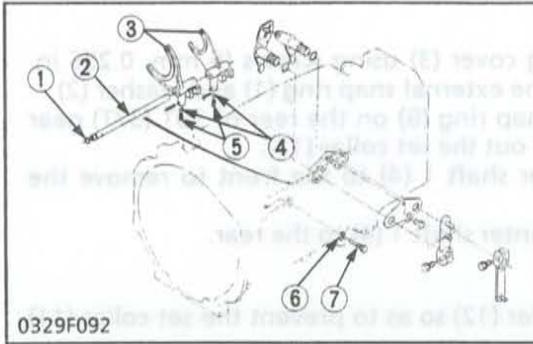
1. Remove the mounting screws (3), (4), (5) of the arm (6), shifter (7) and shift fork (2).
2. Pull out the PTO shift lever (1).
3. Tap out the PTO fork rod (8) to the front and take out the PTO shift fork (2).

(When reassembling)

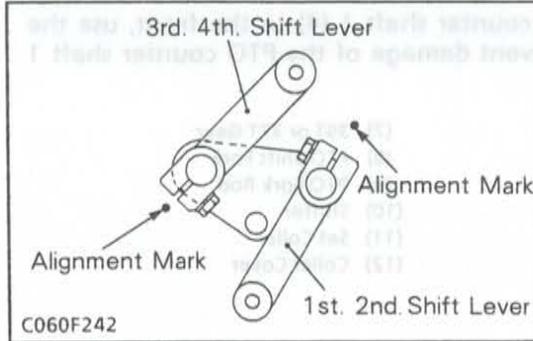
Tightening torque	Shift fork and shifter mounting screw	9.81 to 11.28 N·m 1.00 to 1.15 kgf·m 7.23 to 8.32 ft·lbs
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- | | |
|---------------------|--------------|
| (1) PTO Shift Lever | (5) Screw |
| (2) Shift Fork | (6) Arm |
| (3) Screw | (7) Shifter |
| (4) Screw | (8) Fork Rod |

0.1 to 0.3 mm 0.004 to 0.012 in.	Factory spec	Size clearance between gear and pinion teeth
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0329F092



C060F242

Main Speed Change Shift Fork

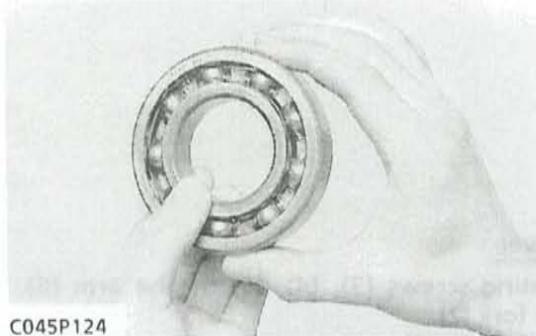
1. Remove the fork rod setting screw (7).
2. Screw a M6 screw (6 mm, 0.236 in. DIA.) to the front end of fork rod (2) and pull out it.
3. Remove the shift forks (3).

(When reassembling)

- Apply grease to O-ring (1) on the fork rod (2).
- Install the springs (5) and balls (4) to shift fork firmly.
- Set the seal washer (6) to fork rod setting screw (7), and insert it to hole on fork rod (2).
- Be sure to align the alignment mark of 1-2 shift lever and 3-4 shift lever.

- | | |
|----------------|-------------------|
| (1) O-ring | (5) Spring |
| (2) Fork Rod | (6) Seal Washer |
| (3) Shift Fork | (7) Setting Screw |
| (4) Ball | |

SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.



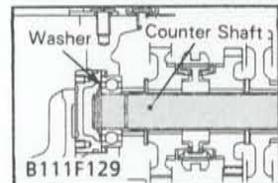
B111P089

Side Clearance between Gear and Spline Boss on the Counter Shaft

1. Insert a feeler gauge between gear and spline boss to measure the clearance.
2. If the measurement is not within the factory specifications, adjust the clearance with washer on the front end of shaft.

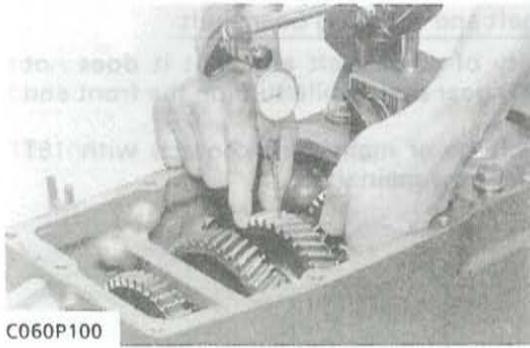
(Reference)

- Thickness of washers:
 - 2.0 mm (0.079 in.) [Code No. 34150-21561]
 - 2.3 mm (0.091 in.) [Code No. 38450-23781]
 - 2.5 mm (0.098 in.) [Code No. 38450-23791]



B111F129

Side clearance between gear and spline boss	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
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C060P100

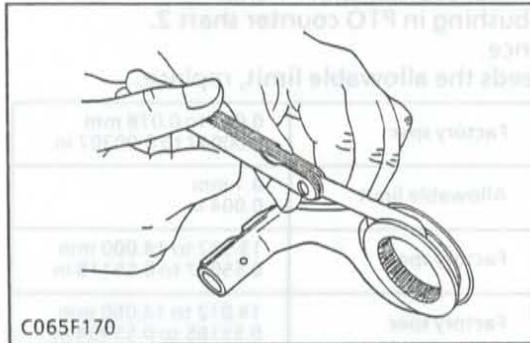
Gear Backlash

1. Set a dial gauge (lever type) with its finger on the gear tooth surface.
2. Move the gear to measure the backlash.
3. If the measurement exceeds the allowable limit, replace.

IMPORTANT

- Measure the backlash at three equally spaced positions on the gear, and obtain the average.

Gear backlash	Factory spec.	0.1 to 0.2 mm 0.004 to 0.008 in.
	Allowable limit	0.5 mm 0.020 in.

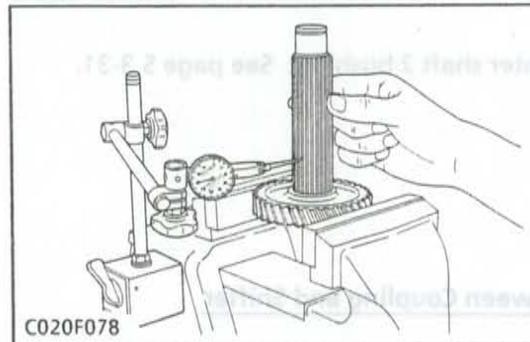


C065F170

Clearance between Shift Fork and Shifter Groove

1. Place the shift fork in the shifter groove to measure the clearance.
2. If the measurement exceeds the allowable limit, replace them.

Clearance between shift fork and shifter groove	Factory spec.	0.20 to 0.40 mm 0.008 to 0.016 in.
	Allowable limit	0.8 mm 0.031 in.

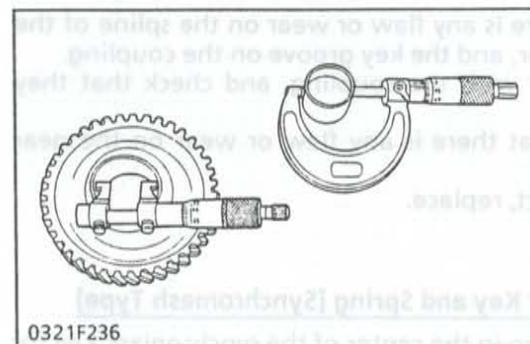


C020F078

Clearance between Gear and Spline

1. Secure the gear in a vise.
2. Set a dial gauge (lever type) with its finger on the spline.
3. Move the shaft to measure the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between gear and spline	Factory spec.	0.030 to 0.078 mm 0.0012 to 0.0031 in.
	Allowable limit	0.2 mm 0.008 in.



0321F236

Clearance between Gear and Inner Race (or Shaft)

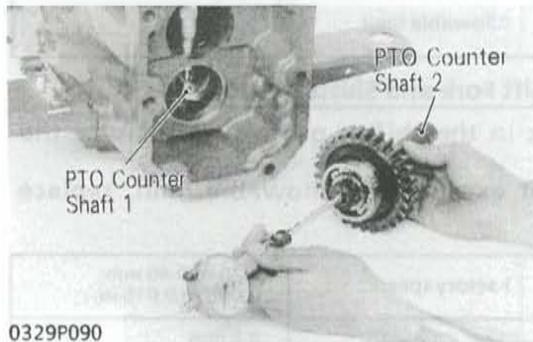
1. Measure the gear I.D. and inner race (or shaft) O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between gear and counter shaft	Factory spec.	0.020 to 0.055 mm 0.0008 to 0.0022 in.
	Allowable limit	0.1 mm 0.004 in.
45T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Counter shaft O.D.	Factory spec.	31.995 to 32.005 mm 1.2597 to 1.2600 in.
Clearance between gears and inner races on counter shaft or PTO counter shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
Gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner Race O.D.	Factory spec.	31.992 to 32.008 mm 1.2597 to 1.2601 in.



Eccentricity of Main Shaft and 16T (17T) Gear Shaft

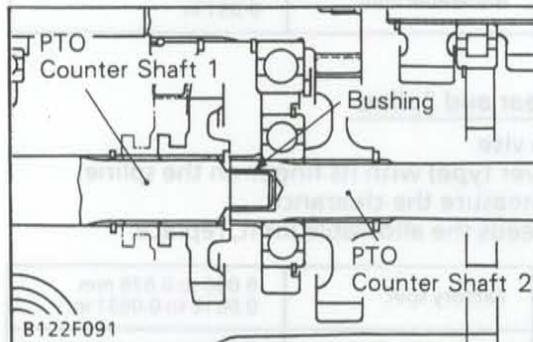
1. Check the eccentricity of main shaft and that it does not contact with 16T (17T) gear shaft while turning the front end of main shaft.
2. If the eccentricity is large or main shaft contacts with 16T (17T) gear shaft, replace the main shaft.



Clearance between PTO Counter Shaft 1 and Bushing

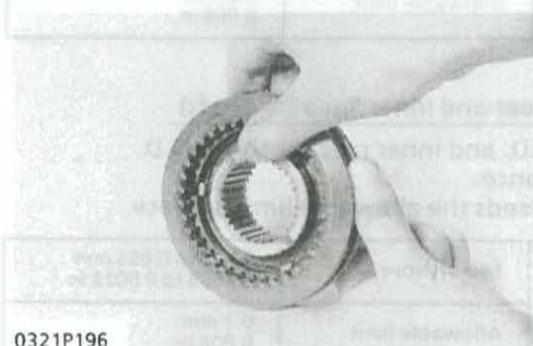
1. Measure the O.D. of PTO counter shaft 1 end.
2. Measure the I.D. of bushing in PTO counter shaft 2.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between bushing and shaft end	Factory spec.	0.012 to 0.078 mm 0.00047 to 0.00307 in.
	Allowable limit	0.1 mm 0.004 in.
Shaft end O.D.	Factory spec.	13.982 to 14.000 mm 0.55047 to 0.55118 in.
Bushing I.D.	Factory spec.	14.012 to 14.060 mm 0.55165 to 0.55354 in.



(Reference)

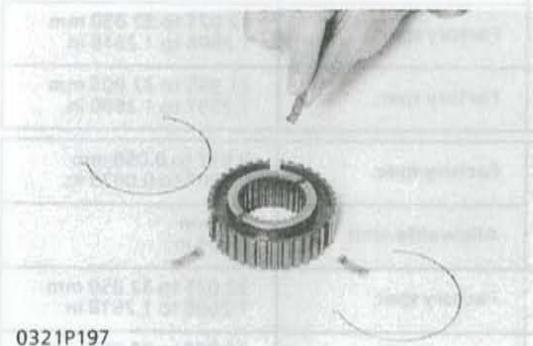
- Replacing PTO counter shaft 2 bushing: See page S.3-31.



Checking Contact between Coupling and Shifter

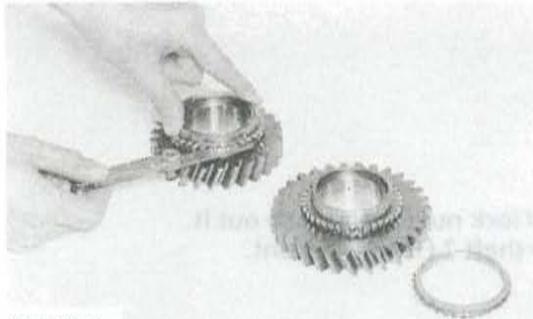
[Synchronesh Type]

1. Check to see if there is any flaw or wear on the spline of the coupling and shifter, and the key groove on the coupling.
2. Engage the shifter with the coupling, and check that they slide smoothly.
3. Similarly, check that there is any flaw or wear on the gear splines.
4. If there is any defect, replace.



Flaw on Synchronizer Key and Spring [Synchronesh Type]

1. Check the projection in the center of the synchronizer key for wear.
2. Check the spring for fatigue or wear on the area where the spring contacts with the keys.
3. If there is any defect, replace.



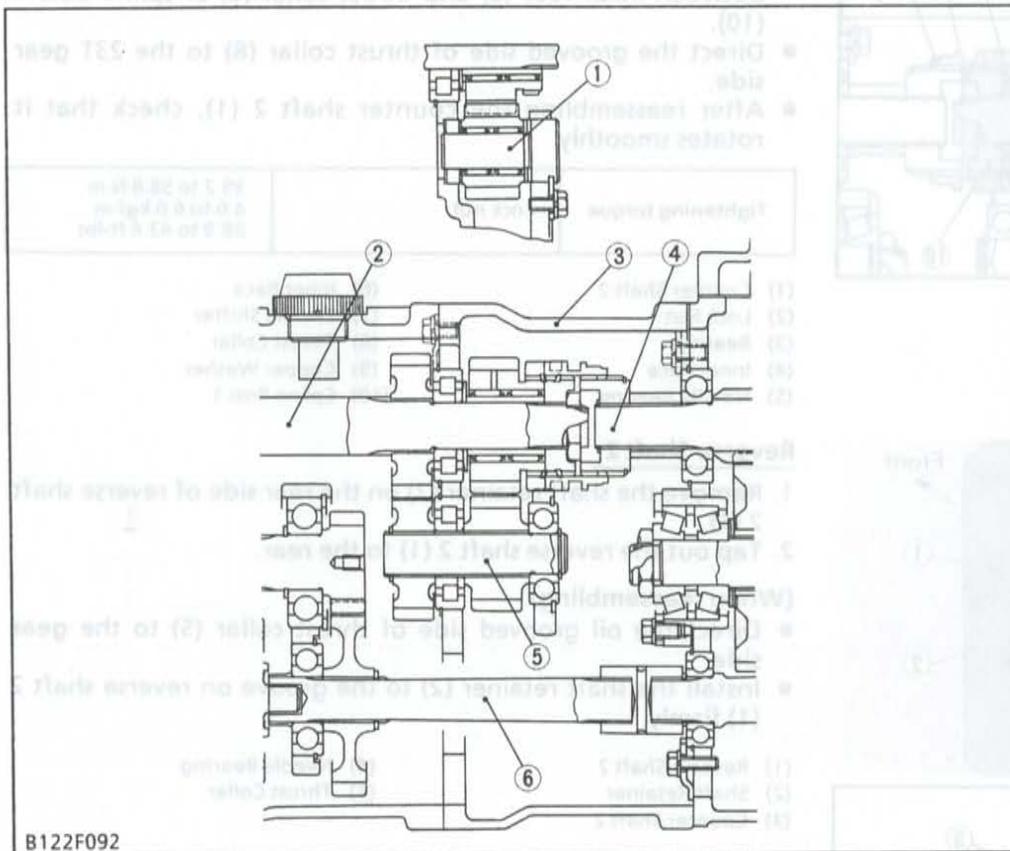
0321P198

**Side Clearance between Synchronizer Ring and Gear
(in Contact) [Synchromesh Type]**

1. Press the synchronizer ring against the tapered portion of the gear, and measure the side clearance.
2. Apply a thin film of red lead to the tapered portion, press the ring against it by hand, rub them together a few times, and check the contact.
3. Check the tooth surface and key grooves of the ring for wear.
4. If the side clearance exceeds the allowable limit or if there is any defect, replace the synchronizer ring.

Side clearance	Allowable limit	0.35 mm 0.0138 in.
Contact condition on tapered portion	Allowable limit	More than 80 %

[2]-2 MID CASE



B122F092

- (1) Reverse Shaft
- (2) Counter Shaft 2
- (3) Mid Case
- (4) 13T Gear Shaft
- (5) Reverse Shaft 1
- (6) PTO Counter Shaft 2

DISASSEMBLING AND ASSEMBLING

Separating Mid Case

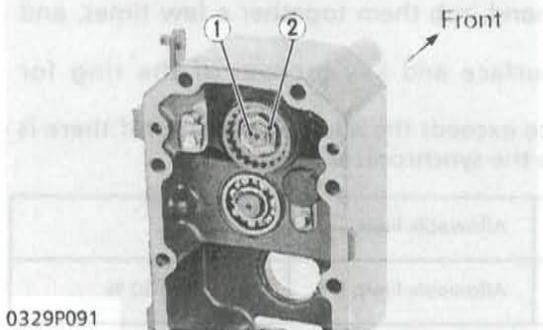
(See page S.5-19.)

Counter Shaft 2

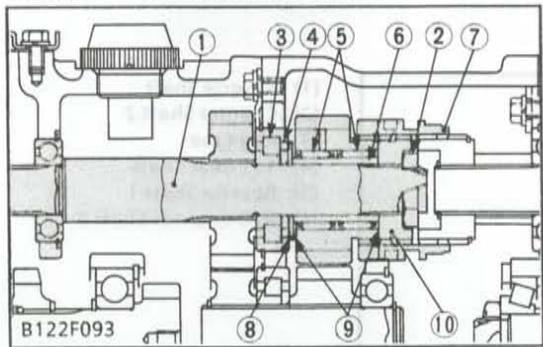
1. Remove the stake of lock nut (2) and take out it.
2. Tap out the counter shaft 2 (1) to the front.

(When reassembling)

- Be sure to direct the chamfered side of shuttle shifter (7) to the 23T gear side.
- Be sure to install the inner race (4) of bearing (3).
- Two types of needle bearings (5) are used for 23T gear. Assemble the shorter one to the bearing (3) side.
- Install the bearing (3) so that snap ring thereon may face outward as shown in the figure.
- Install the copper washers (9) so that they may not fall between inner race (6) and thrust collar (8) or spline boss 1 (10).
- Direct the grooved side of thrust collar (8) to the 23T gear side.
- After reassembling the counter shaft 2 (1), check that it rotates smoothly.



0329P091



B122F093

Tightening torque	Lock nut	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft·lbs
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- (1) Counter Shaft 2
- (2) Lock Nut
- (3) Bearing
- (4) Inner Race
- (5) Needle Bearing
- (6) Inner Race
- (7) Shuttle Shifter
- (8) Thrust Collar
- (9) Copper Washer
- (10) Spline Boss 1

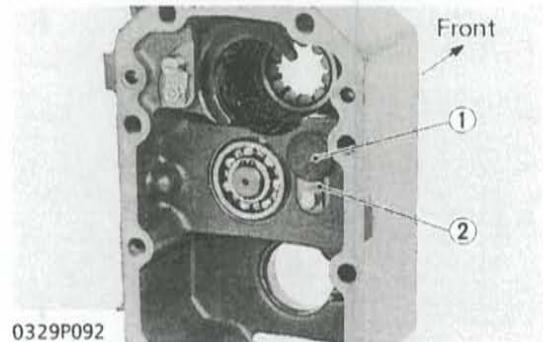
Reverse Shaft 2

1. Remove the shaft retainer (2) on the rear side of reverse shaft 2 (1).
2. Tap out the reverse shaft 2 (1) to the rear.

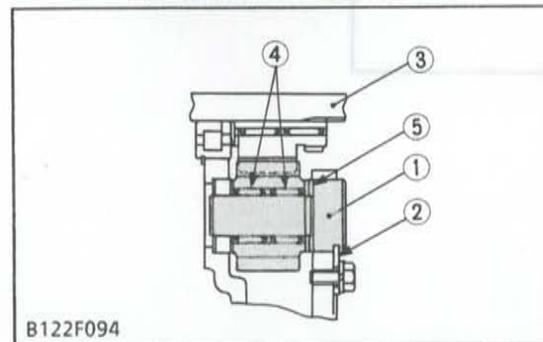
(When reassembling)

- Direct the oil grooved side of thrust collar (5) to the gear side.
- Install the shaft retainer (2) to the groove on reverse shaft 2 (1) firmly.

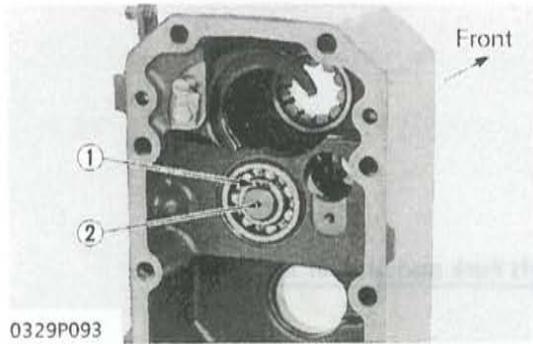
- (1) Reverse Shaft 2
- (2) Shaft Retainer
- (3) Counter Shaft 2
- (4) Needle Bearing
- (5) Thrust Collar



0329P092



B122F094



0329P093

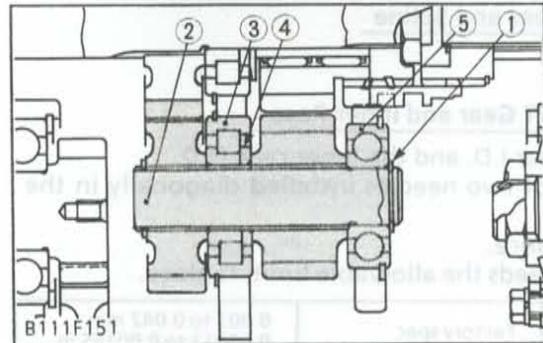
Reverse Shaft 1

1. Remove the external snap ring (1) on the rear side of reverse shaft 1 (2).
2. Tap out the reverse shaft 1 (2) to the front.

(When reassembling)

- Be sure to install the inner race (4) of bearing (3).
- Install the bearings (3), (5) so that the snap ring on them may direct to outside as shown in figure.

- | | |
|------------------------|----------------|
| (1) External Snap Ring | (4) Inner Race |
| (2) Reverse Shaft 1 | (5) Bearing |
| (3) Bearing | |



B111F151

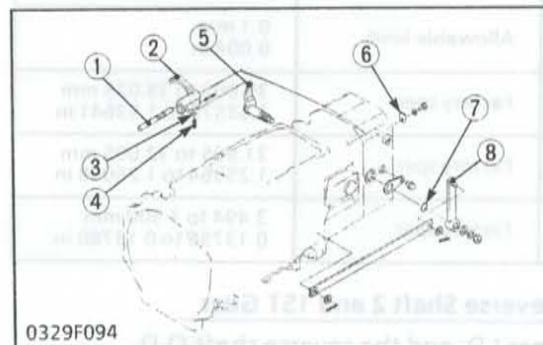
Shuttle Shift Fork

1. Remove the shuttle fork rod setting plate (6).
2. Tap out the shuttle fork rod (1) to the front.
3. Remove the shuttle arm mounting screw and take out the shuttle arm (5).

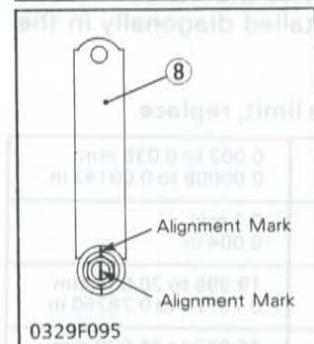
(When reassembling)

- Apply grease to O-ring (7) on shuttle arm (5).
- Be sure to align the alignment marks on the shuttle arm (5) and shuttle lever (8).
- Install the spring (4) and ball (3) to shift fork firmly.

- | | |
|------------------------|-------------------|
| (1) Shuttle Fork Rod | (5) Shuttle Arm |
| (2) Shuttle Shift Fork | (6) Setting Plate |
| (3) Ball | (7) O ring |
| (4) Spring | (8) Shuttle Lever |



0329F094



0329F095

SERVICING

Checking Bearing

(See page S.3-34.)

Gear Backlash

(See page S.3-35.)

Clearance between Shift Fork and Shifter Groove

(See page S.3-35.)

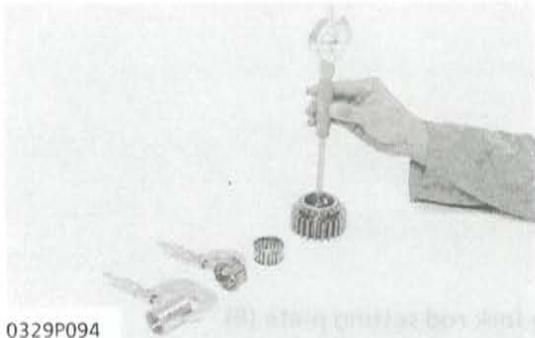
Clearance between Gear and Spline

(See page S.3-35.)

Clearance between 23T Gear and Inner Race

1. Measure the 23T gear I.D. and the inner race O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 23T gear and inner race	Factory spec.	0.003 to 0.042 mm 0.00012 to 0.00165 in.
	Allowable limit	0.1 mm 0.004 in.
23T gear I.D.	Factory spec.	39.009 to 39.025 mm 1.53578 to 1.53641 in.
Inner race O.D.	Factory spec.	31.995 to 32.005 mm 1.25964 to 1.26008 in.
Needle O.D.	Factory spec.	3.494 to 3.500 mm 0.13756 to 0.13780 in.

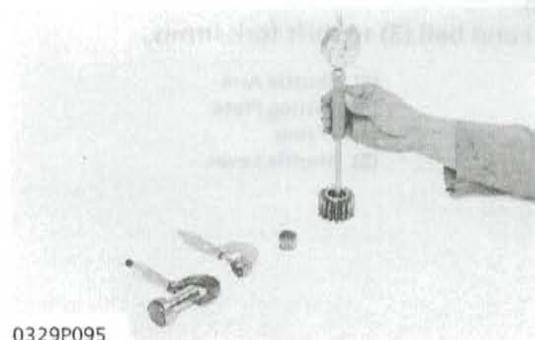


0329P094

Clearance between Reverse Shaft 2 and 15T Gear

1. Measure the 15T gear I.D. and the reverse shaft O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

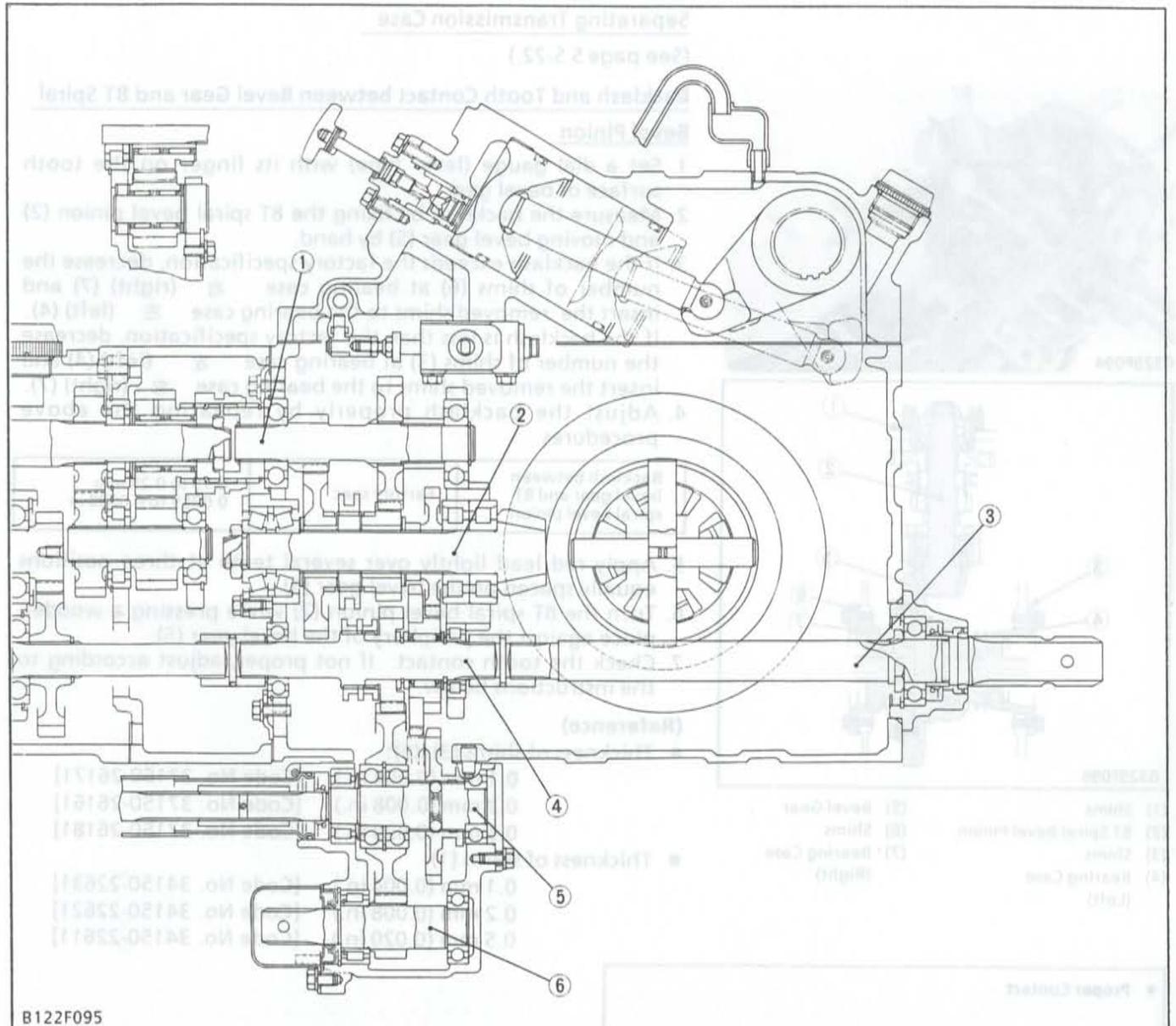
Clearance between reverse shaft 2 and 15T gear	Factory spec.	0.002 to 0.036 mm 0.00008 to 0.00142 in.
	Allowable limit	0.1 mm 0.004 in.
Reverse shaft 2 O.D.	Factory spec.	19.996 to 20.005 mm 0.78724 to 0.78760 in.
15T gear I.D.	Factory spec.	26.007 to 26.020 mm 1.02390 to 1.02441 in.
Needle O.D.	Factory spec.	2.994 to 3.000 mm 0.11787 to 0.11811 in.



0329P095

[2]-3 TRANSMISSION CASE

CHECKING AND ADJUSTING



B122F095

(1) 13T Gear Shaft
(2) Spiral Bevel Pinion

(3) PTO Shaft
(4) PTO Drive Shaft

(5) Front Drive Shaft

(6) Mid PTO Shaft

Replace adjusting shim (1) with thicker one to move the bevel pinion shaft forward.
And place the right side shim (2) to the left to move the bevel gear leftward.
Repeat above until the proper tooth contact and backlash are achieved.

* For Contact

* Base Contact

Replace adjusting shim (1) with thinner one to move the bevel pinion shaft backward.
And place the left side shim (2) to the right to move the bevel gear rightward.
Repeat above until the proper tooth contact and backlash are achieved.

* Tip Contact

* Best Contact

CHECKING AND ADJUSTING

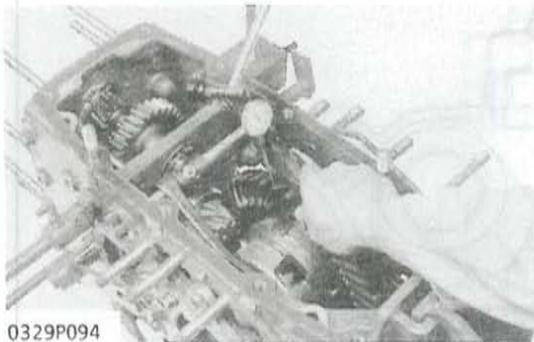
Separating Transmission Case

(See page S.5-22.)

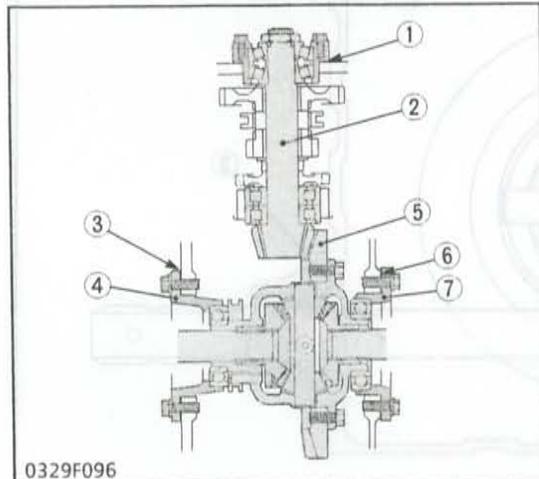
Backlash and Tooth Contact between Bevel Gear and 8T Spiral Bevel Pinion

Bevel Pinion

1. Set a dial gauge (lever type) with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 8T spiral bevel pinion (2) and moving bevel gear (5) by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims (6) at bearing case 右 (right) (7) and insert the removed shims to the bearing case 左 (left) (4). If the backlash is less than the factory specification, decrease the number of shims (3) at bearing case 左 (left) (4) and insert the removed shims to the bearing case 右 (right) (7).
4. Adjust the backlash properly by repeating the above procedures.



0329P094



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- (1) Shims
- (2) 8T Spiral Bevel Pinion
- (3) Shims
- (4) Bearing Case (Left)
- (5) Bevel Gear
- (6) Shims
- (7) Bearing Case (Right)

Backlash between bevel gear and 8T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in.
--	---------------	---

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear (5).
6. Turn the 8T spiral bevel pinion (2) while pressing a wooden piece against the periphery of the bevel gear (5).
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

- Thickness of shims (3), (6):
 - 0.1 mm (0.004 in.) [Code No. 37150-26171]
 - 0.2 mm (0.008 in.) [Code No. 37150-26161]
 - 0.5 mm (0.020 in.) [Code No. 37150-26181]
- Thickness of shims (1):
 - 0.1 mm (0.004 in.) [Code No. 34150-22631]
 - 0.2 mm (0.008 in.) [Code No. 34150-22621]
 - 0.5 mm (0.020 in.) [Code No. 34150-22611]

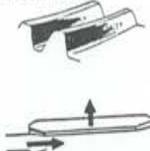
● Proper Contact



More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

C065F198

● Heel Contact



Replace adjusting shim (1) with thinner one to move the bevel pinion shaft backward. And place the left side shim (3) to the right to move the bevel gear rightward. Repeat above until the proper tooth contact and backlash are achieved.

● Tip Contact



0329F097

● Toe Contact



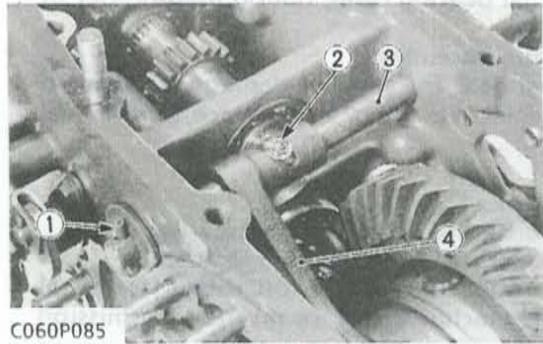
Replace adjusting shim (1) with thicker one to move the bevel pinion shaft forward. And place the right side shim (6) to the left to move the bevel gear leftward. Repeat above until the proper tooth contact and backlash are achieved.

● Base Contact



0329F098

DISASSEMBLING AND ASSEMBLING

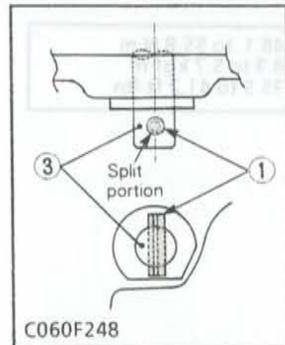


Differential Lock Shift Fork

1. Tap out the spring pin (1).
2. Remove the cotter pin and take out the clevis pin (2).
3. Draw out the differential lock fork shaft (3) and take out the differential lock shift fork (4).

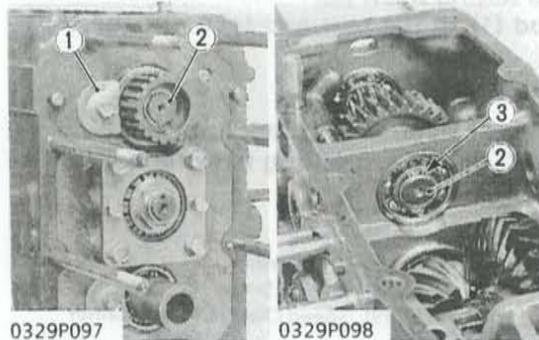
(When reassembling)

- Apply grease to the left and right oil seals on the transmission case.
- Insert the clevis pin (2) from under and install the washer and cotter pin.
- Tap in the spring pin (1) so that its split portion may face outward as shown in the figure.



- (1) Spring Pin
(2) Clevis Pin

- (3) Differential Lock Fork Shaft
(4) Differential Lock Shift Fork

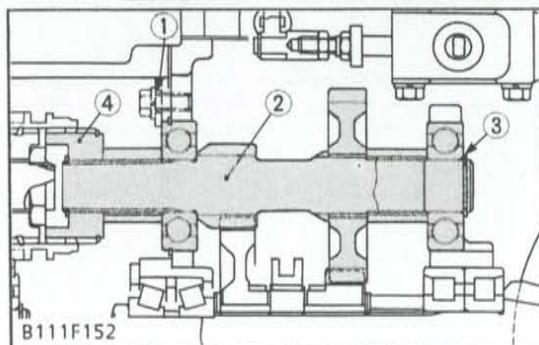


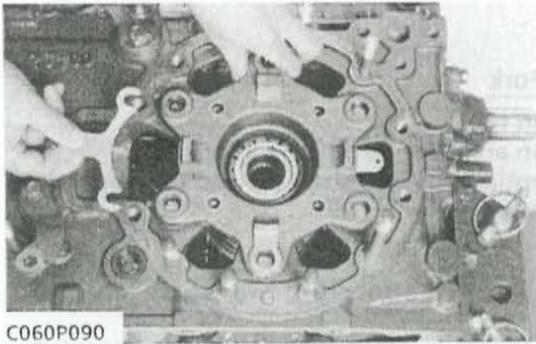
13T Gear Shaft

1. Remove the bearing retainer (1) on the front of 13T gear shaft (2).
2. Remove the external snap ring (3) on the rear of 13T gear shaft (2).
3. Tap out the 13T gear shaft to the front.

- (1) Bearing Retainer
(2) 13T Gear Shaft

- (3) External Snap Ring
(4) Spline Boss 2



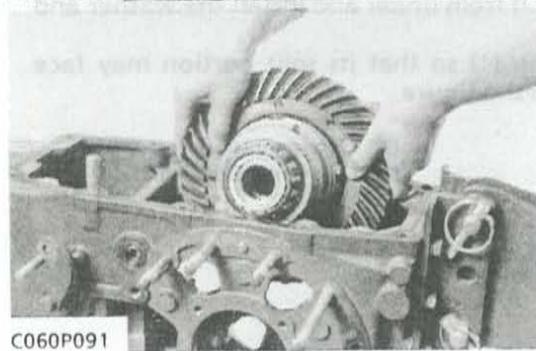


Differential Gear Assembly

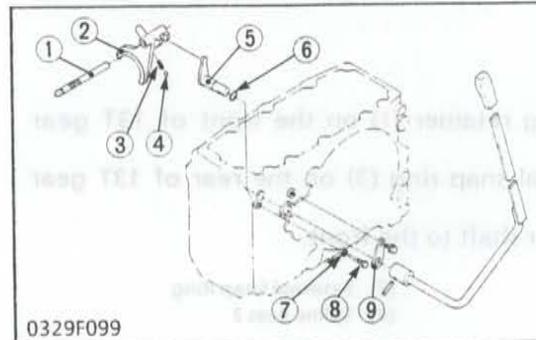
1. Remove the differential bearing cases, noting the number of left and right shims.
2. Take out the differential assembly.
3. Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace spiral bevel pinion.

(When reassembling)

- Be sure to install the differential bearing case marked 右 in the right side, and marked 左 in the left side.
- Be sure to align the ball hole portion on the differential bearing case with the machined surface on the transmission case.



Tightening torque	Differential bearing case mounting bolts	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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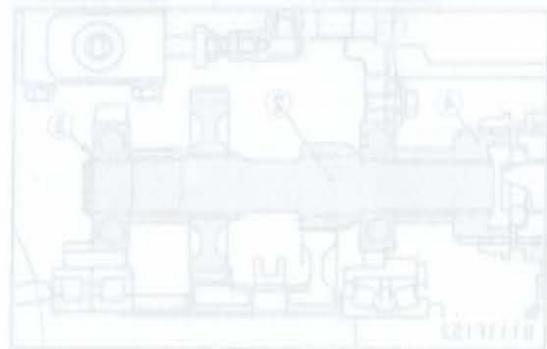
Hi-Lo Range Shift Fork

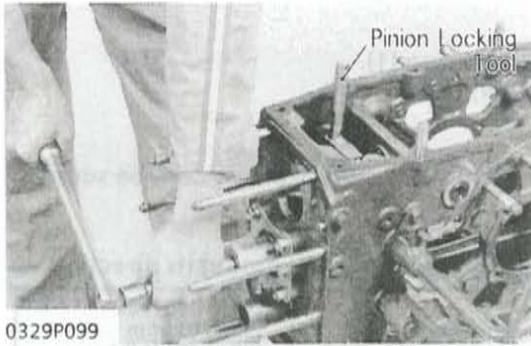
1. Remove the fork rod setting screw (8).
2. Tap out the fork rod (1) to the rear and take out the shift fork (2).

(When reassembling)

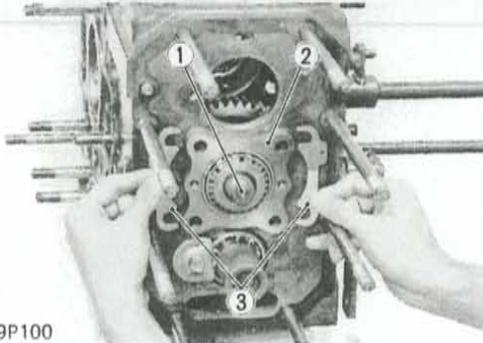
- Install the spring (3) and ball (4) to shift fork firmly.
- Set the seal washer (7) to fork rod setting screw and insert it to hole on fork rod.

- | | |
|--------------------------|-------------------------------|
| (1) Hi-Lo Range Fork Rod | (6) O-ring |
| (2) Shift Fork | (7) Seal Washer |
| (3) Spring | (8) Setting Screw |
| (4) Ball | (9) Speed Change Arm Retainer |
| (5) Hi-Lo Range Arm | |





0329P099



0329P100

Spiral Bevel Pinion

1. Remove the stake of lock nut (4).
2. Set the pinion locking tool (Code No. 07916-52311), and remove the lock nut.
3. Remove the pinion bearing retainer (7).
4. Tap the spiral bevel pinion (1) to the front.
5. Take the pinion bearing case shims (3), noting the number of them.
6. Remove the pinion bearing case (2) with a puller.
7. Take out the distance collar (5).
8. Hammer out the spiral bevel pinion (1) to the rear.

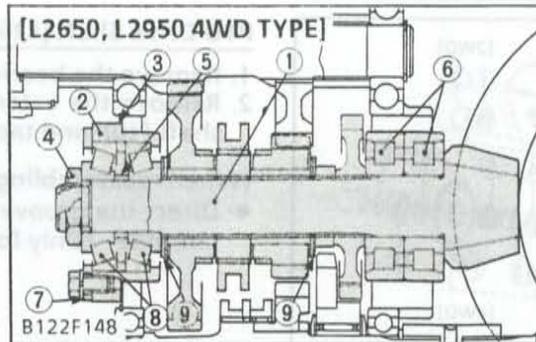
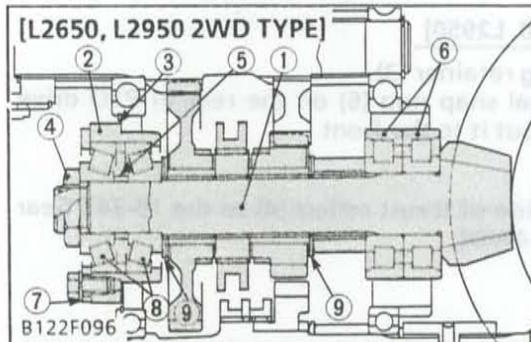
Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft·lbs
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※

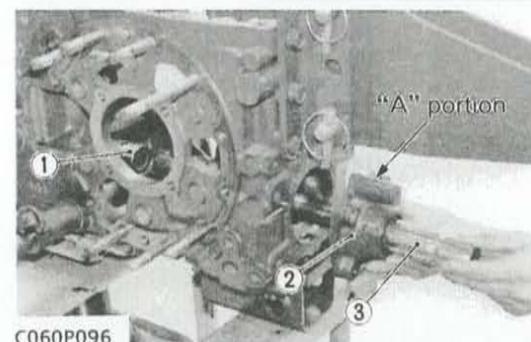
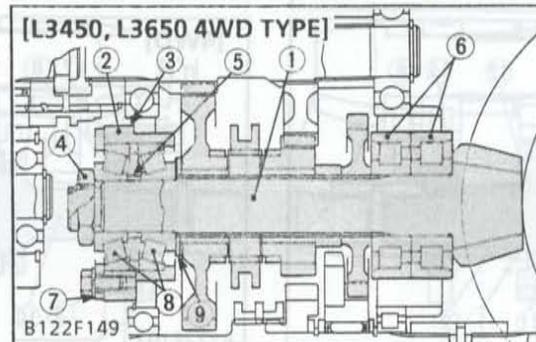
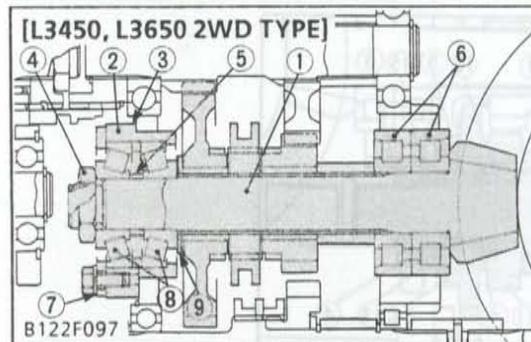
NOTE

- The ball bearings are used for the following tractor serial No.

L2650 (2WD) : 19999 and below
L2650 (4WD) : 50001 to 59999



- (1) Spiral Bevel Pinion
- (2) Pinion Bearing Case
- (3) Shims
- (4) Lock Nut
- (5) Distance Collar
- (6) Bearings ※
- (7) Pinion Bearing Retainer
- (8) Bearings
- (9) Thrust Washers



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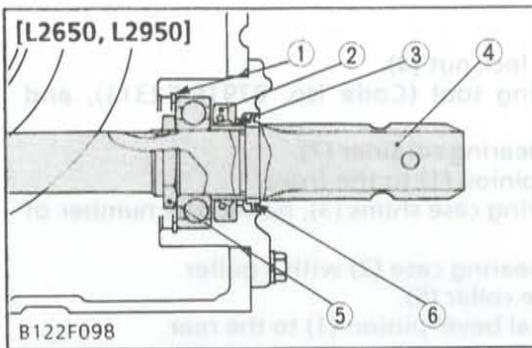
PTO Bearing Case

1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1)

(When reassembling)

- Direct the boss A portion on bearing case (2) upward.

- (1) Coupling
- (2) Bearing Case
- (3) PTO Shaft



PTO Shaft

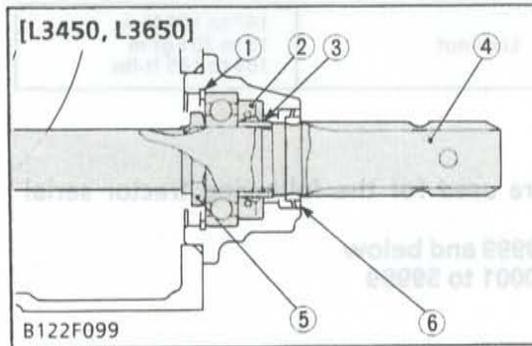
1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (4) to the front.

(When reassembling)

- If the lock nut (5) was removed, replace a new one, be sure to stake it firmly.
- Install the slinger (6) firmly.
- Apply grease to oil seal (2) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft·lbs
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- | | |
|------------------------|---------------|
| (1) Internal Snap Ring | (4) PTO Shaft |
| (2) Oil Seal | (5) Lock Nut |
| (3) Collar | (6) Slinger |

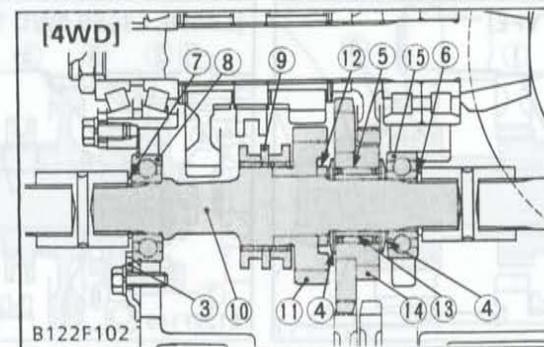
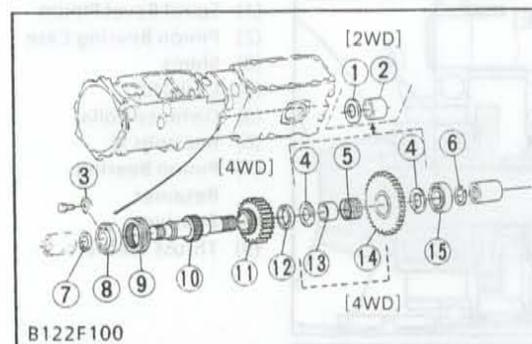


PTO Drive Shaft [L2650, L2950]

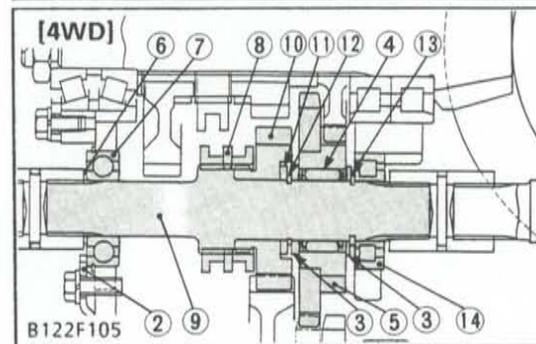
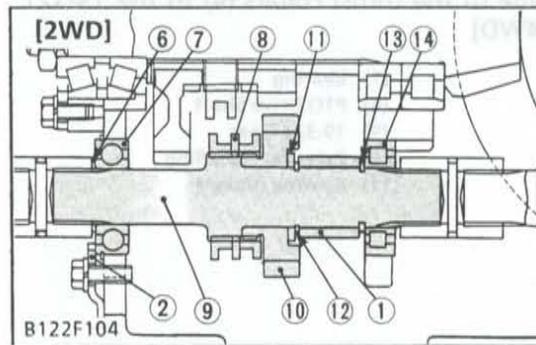
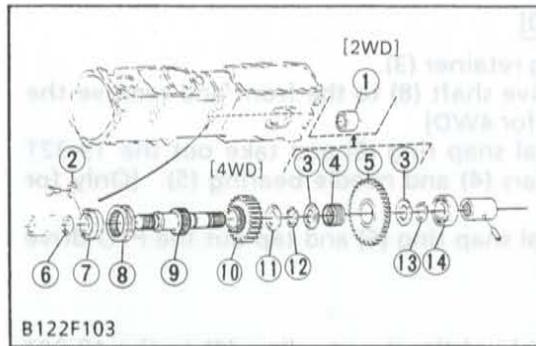
1. Remove the bearing retainer (3).
2. Remove the external snap ring (6) on the rear of PTO drive shaft (10), and tap out it to the front.

(When reassembling)

- Direct the groove side of thrust collars (4) to the 19-34T Gear (14) side. [Only for 4WD]



- | | |
|------------------------|----------------------|
| (1) Washer | (9) Shifter |
| (2) Collar | (10) PTO Drive Shaft |
| (3) Bearing Retainer | (11) 20T Gear |
| (4) Thrust Collars | (12) Collar |
| (5) Needle Bearing | (13) Inner Ring |
| (6) External Snap Ring | (14) 19-34T Gear |
| (7) External Snap Ring | (15) Bearing |
| (8) Bearing | |



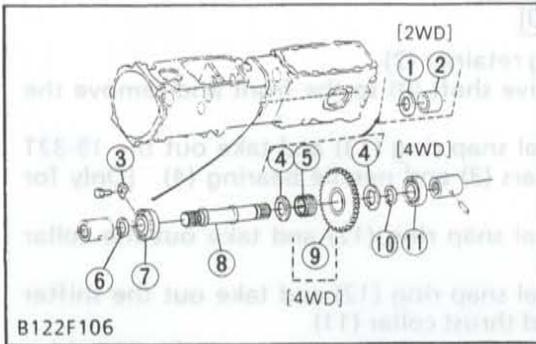
PTO Drive Shaft [L3450]

1. Remove the bearing retainer (2).
2. Tap out the PTO drive shaft (9) to the front and remove the bearing (14).
3. Remove the external snap ring (13) and take out the 19-32T gear (5), thrust collars (3) and needle bearing (4). [Only for 4WD]
4. Remove the external snap ring (12) and take out the collar (1). [Only for 2WD]
5. Remove the external snap ring (12) and take out the shifter (8), 20T gear (10) and thrust collar (11).
6. Remove the external snap ring (6) and tap out the PTO drive shaft (9) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (3) to the 19-32T gear (5) side. [Only for 4WD]
- Direct the groove side of the thrust collar (11) to the 20T gear side.

- | | |
|------------------------|-------------------------|
| (1) Collar | (9) PTO Drive Shaft |
| (2) Bearing Retainer | (10) 20T Gear |
| (3) Thrust Collars | (11) Thrust Collar |
| (4) Needle Bearing | (12) External Snap Ring |
| (5) 19-32T gear | (13) External Snap Ring |
| (6) External Snap Ring | (14) Bearing (Roller) |
| (7) Bearing | |
| (8) Shifter | |



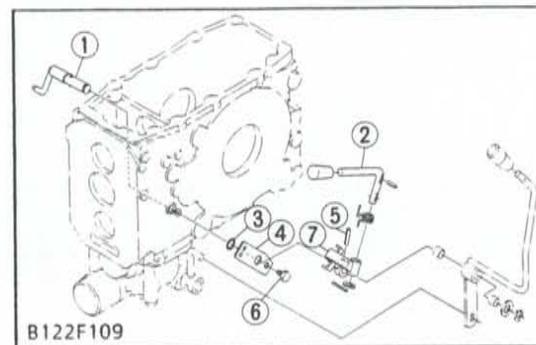
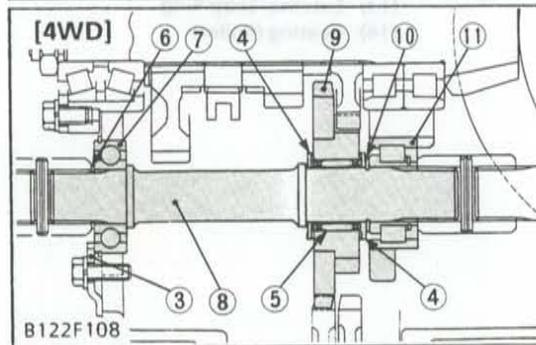
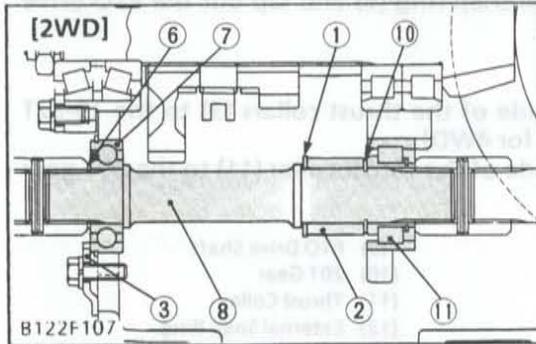
PTO Drive Shaft [L3650]

1. Remove the bearing retainer (3).
2. Tap out the PTO drive shaft (8) to the front and remove the bearing (11). [Only for 4WD]
3. Remove the external snap ring (6) and take out the 19-32T gear (9), thrust collars (4) and needle bearing (5). [Only for 4WD]
4. Remove the external snap ring (6) and tap out the PTO drive shaft (8) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (4) to the 19-32T gear (9). [Only for 4WD]

- | | |
|------------------------|-------------------------|
| (1) Washer | (7) Bearing |
| (2) Collar | (8) PTO Drive Shaft |
| (3) Bearing Retainer | (9) 19-32T Gear |
| (4) Thrust Collars | (10) External Snap Ring |
| (5) Needle Bearing | (11) Bearing (Roller) |
| (6) External Snap Ring | |



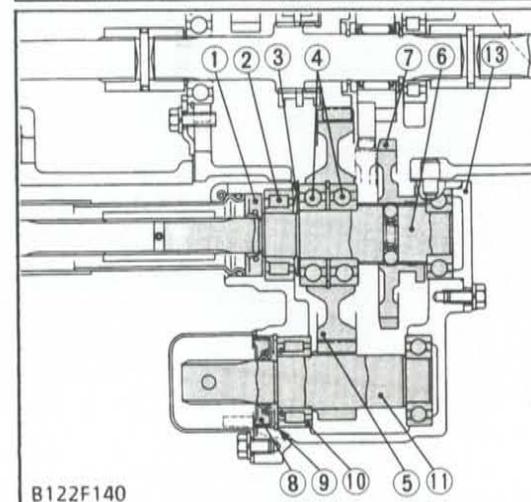
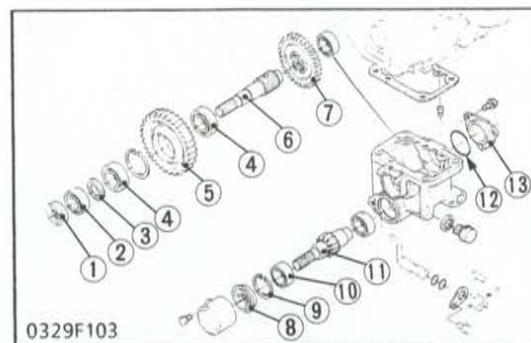
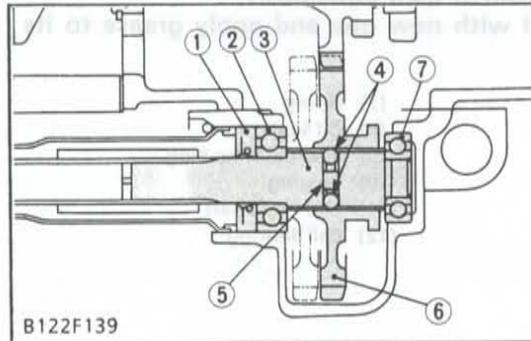
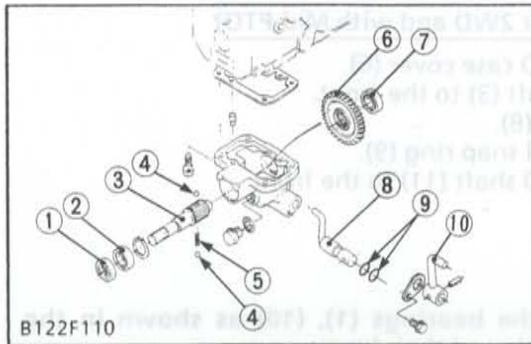
Mid PTO Shift Lever [L2650, L2950, L3450]

1. Remove the shift levers (2), (7) and guide (4).
2. Take out the shift lever 3 (1).

(When reassembling)

- Tighten the screw (6) of the guide (4) after installing the spring pin (5).

- | | |
|-------------------|-------------------|
| (1) Shift Lever 3 | (5) Spring Pin |
| (2) Shift Lever 1 | (6) Screw |
| (3) O-ring | (7) Shift Lever 2 |
| (4) Guide | (8) Holder |



Front Drive Case [Only for 4WD and without Mid-PTO]

1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting bolts	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft-lbs
-------------------	---------------------------------	---

- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-rings |
| (5) Spring | (10) Change Lever |

Front Drive Case [Only for 4WD and with Mid-PTO]

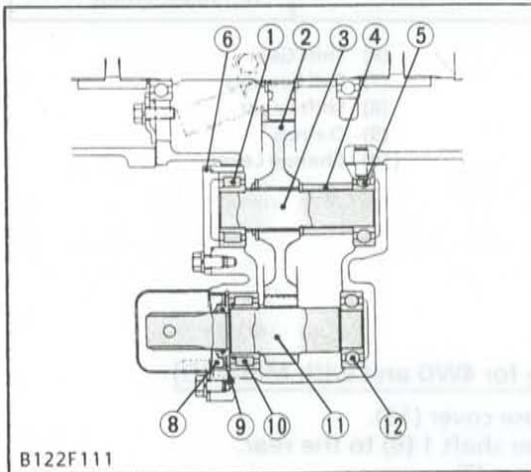
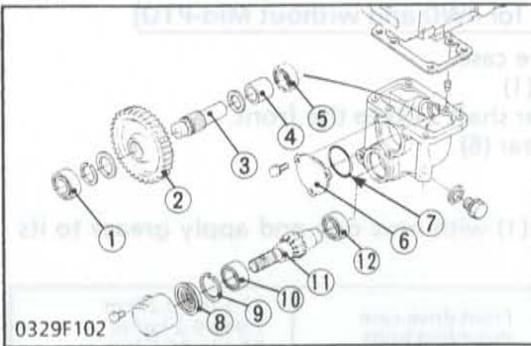
1. Remove the drive case cover (13).
2. Tap out the propeller shaft 1 (6) to the rear.
3. Take out the shift gear (7).
4. Remove the oil seal (8).
5. Remove the internal snap ring (9).
6. Tap out the mid PTO shaft (11) to the front.

(When reassembling)

■ IMPORTANT

- Be sure to install the bearings (2), (10) as shown in the figure, noting direction of their inner races.
- Direct the longer boss side of the 37T gear (5) to the front.
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Replace the oil seal with new one and apply grease to its inside.

- | | |
|-----------------------|------------------------|
| (1) Oil Seal | (8) Oil Seal |
| (2) Ball Bearing | (9) Internal Snap Ring |
| (3) Thrust Collar | (10) Bearing |
| (4) Ball Bearing | (11) Mid PTO Shaft |
| (5) 37T Gear | (12) O-ring |
| (6) Propeller Shaft 1 | (13) Drive Case Cover |
| (7) Shift Gear | |



Mid PTO Case [Only for 2WD and with Mid-PTO]

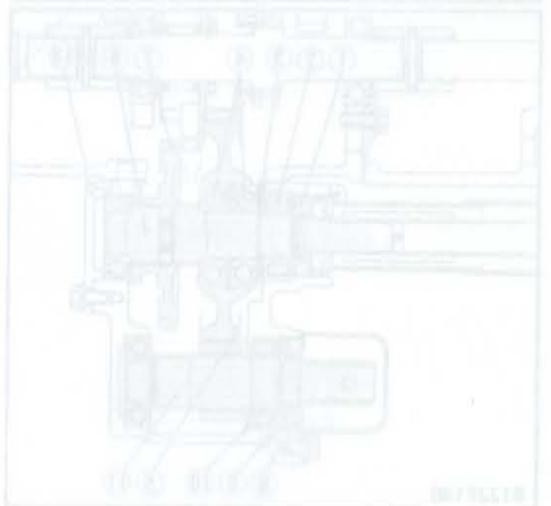
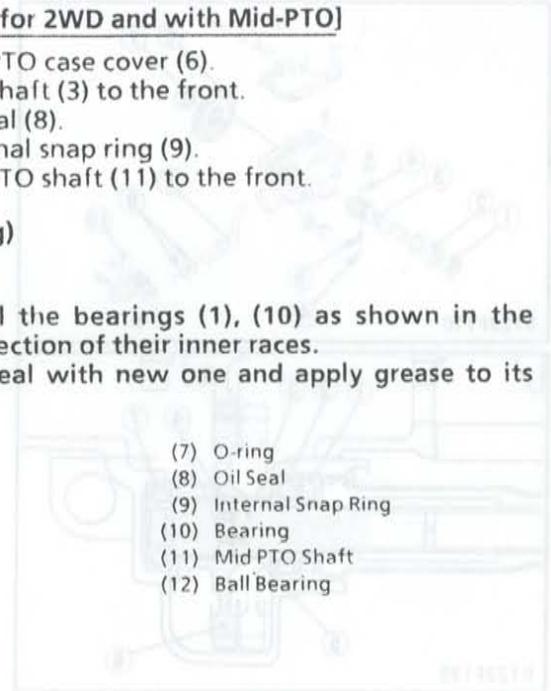
1. Remove the mid PTO case cover (6).
2. Tap out the idle shaft (3) to the front.
3. Remove the oil seal (8).
4. Remove the internal snap ring (9).
5. Tap out the mid PTO shaft (11) to the front.

(When reassembling)

■ IMPORTANT

- Be sure to install the bearings (1), (10) as shown in the figure, noting direction of their inner races.
- Replace the oil seal with new one and apply grease to its inside.

- | | |
|------------------------|------------------------|
| (1) Bearing | (7) O-ring |
| (2) 37T Gear | (8) Oil Seal |
| (3) Idle Shaft | (9) Internal Snap Ring |
| (4) Spacer | (10) Bearing |
| (5) Ball Bearing | (11) Mid PTO Shaft |
| (6) Mid PTO Case Cover | (12) Ball Bearing |



SERVICING

Checking Bearing

(See page S.3-34.)

Gear Backlash

(See page S.3-35.)

Clearance between Gear and Spline

(See page S.3-35.)

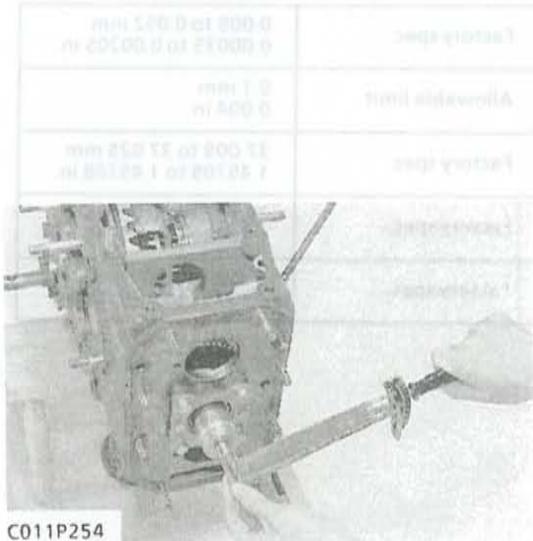
Clearance between Shift Fork and Shifter Groove

(See page S.3-35.)

Differential Gear Turning Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the turning torque.
2. Adjust the torque by altering the differential bearing case shim thickness.
Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)

Differential gear turning torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft·lbs
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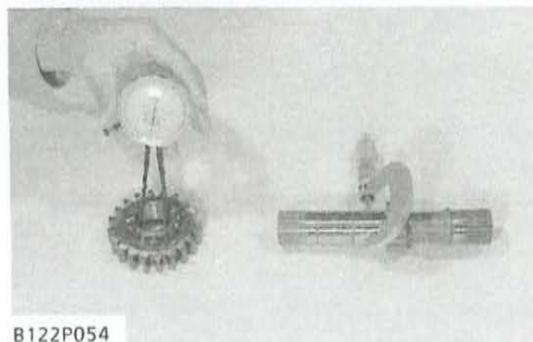
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Clearance between 20T Gear and PTO Drive Shaft

[L2650, L2950, L3450]

1. Measure the 20T gear I.D. and the PTO drive shaft O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 20T gear and PTO drive shaft	Factory spec.	0.015 to 0.046 mm 0.00059 to 0.00181 in.
	Allowable limit	0.1 mm 0.004 in.
20T gear I.D.	Factory spec.	30.020 to 30.041 mm 1.18189 to 1.18272 in.
PTO drive shaft O.D.	Factory spec.	29.995 to 30.005 mm 1.18091 to 1.18130 in.

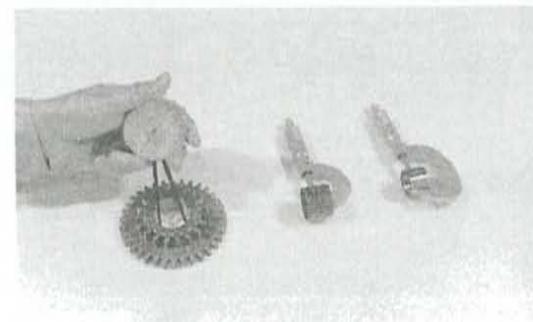


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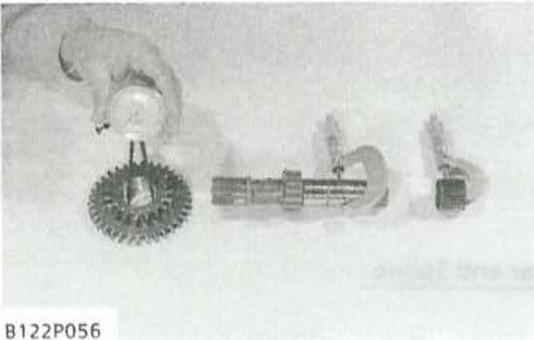
Clearance between 19-34T Gear and Inner Race on PTO Drive Shaft [L2650 4WD, L2950 4WD]

1. Measure the 19-34T gear I.D. and the inner race O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 19-34T gear and inner race	Factory spec.	0.004 to 0.043 mm 0.00016 to 0.00169 in.
	Allowable limit	0.1 mm 0.004 in.
19-34T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
Inner race O.D.	Factory spec.	29.995 to 30.005 mm 1.18095 to 1.18130 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.



B122P055



B122P056

Clearance between 19-32T Gear and PTO Drive Shaft

[L3450 4WD, L3650 4WD]

1. Measure the 19-32T gear I.D. and the PTO drive shaft O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 19-32T gear and PTO drive shaft	Factory spec.	0.009 to 0.052 mm 0.00035 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
19-32T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
PTO drive shaft O.D.	Factory spec.	29.987 to 30.000 mm 1.18059 to 1.18110 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.

Differential gear turning torque (combined)	Factory spec.	0.21 to 0.22 N·m 0.15 to 0.16 lbf·ft 1.5 to 1.6 ft·lb
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Clearance between 30T Gear and PTO Drive Shaft
[L2350, L2650, L2950]

1. Measure the 30T gear I.D. and the PTO drive shaft O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 30T gear and PTO drive shaft	Factory spec.	0.012 to 0.025 mm 0.0005 to 0.001 in.
	Allowable limit	0.1 mm 0.004 in.
30T gear I.D.	Factory spec.	30.020 to 30.027 mm 1.18169 to 1.18225 in.
PTO drive shaft O.D.	Factory spec.	29.992 to 30.002 mm 1.1809 to 1.18110 in.

Clearance between 19-32T Gear and Inner Race on PTO Drive Shaft [L2650 4WD, L2950 4WD]

1. Measure the 19-32T gear I.D. and the inner race O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 19-32T gear and inner race	Factory spec.	0.016 to 0.043 mm 0.0006 to 0.0017 in.
	Allowable limit	0.1 mm 0.004 in.
19-32T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
Inner race O.D.	Factory spec.	29.992 to 30.002 mm 1.1809 to 1.18110 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.

[3] L2650GST, L2950GST, L3450GST, L3650GST

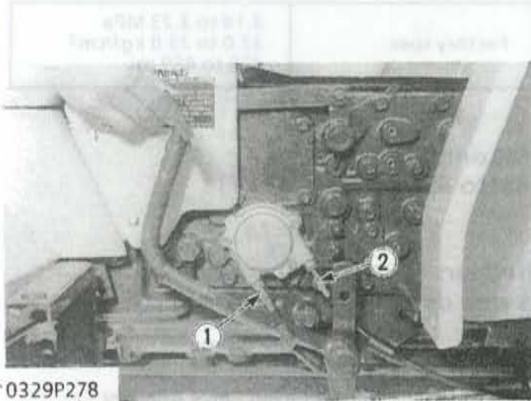
[3]-1 SHIFT CABLE, SIDE COVER AND FILTER BRACKET
CHECKING AND ADJUSTING

Checking of main Shift Lever Position

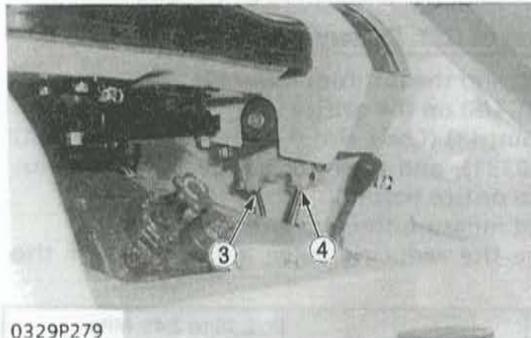
1. Check the shift position of the main shift lever. If the tractor moves with the main shift lever is "Neutral" position, adjust the shift cable.

Adjusting of Shift Cable

1. Set the main gear shift lever to "Neutral" and the shuttle shift lever to F or R position.
2. Adjust the adjustor A (1) and the adjustor B (2) so that the tractor does not move with the shift lever is "NEUTRAL" position but moves when the shift lever is 1st position.
3. After the adjustment, confirm that part C (3) and part D (4) sections are free from play and tighten the lock nuts of the cable adjustors A (1) and B (2).
4. Confirm that the tractor can be started by setting the main gear shift lever to all speed positions.



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- | | |
|----------------------|------------|
| (1) Cable Adjustor A | (3) Part C |
| (2) Cable Adjustor B | (4) Part D |

(Reference)

- Extend the cable adjustor B and shorten the cable adjustor A.



When the tractor starts with the main gear shift lever at "Neutral" position.

- Shorten the cable adjustor B and extend the cable adjustor A.

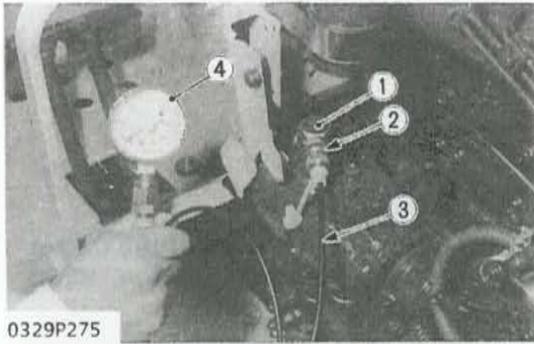


When the tractor does not start with the main gear shift lever at 1st speed position.

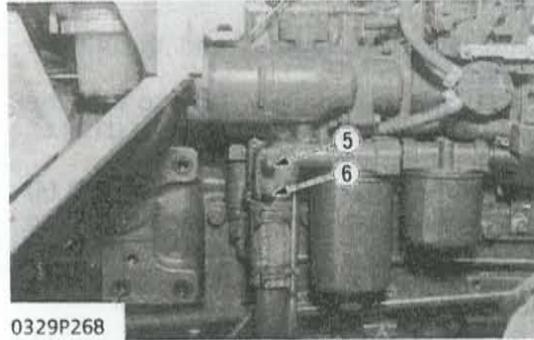
⚠ CAUTION

- Do not adjust with main clutch engaged to avoid personal injury.

Adjust the this adjustment with disengaged the main clutch, after that engage it to confirm the adjustment.



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Checking and Adjusting of Relief Valve Pressure (P7)

1. Replace the delivery pipe mounting joint for power steering pump with the adaptor E (1) (Code No: 07191-50392).
2. Set the threaded joint (2) (Code No: 07191-50392) and the cable (3) (Code No: 07916-50331), and pressure gauge (4) (Code No: 07916-52961) on the adaptor E.
3. Start the engine and measure the pressure.
4. For adjustment, use the relief valve adjustor (5) of the filter bracket.

Relief valve set pressure	Factory spec.	3.14 to 3.23 MPa 32.0 to 33.0 kgf/cm ² 455 to 469 psi
---------------------------	---------------	--

Condition

- Engine speed Maximum rpm.
- Oil temperature 45° to 55°C (113° to 131°F)

(Reference)

- Turn to clockwise direction → Pressure increase.
- Turn to counterclockwise direction ← Pressure decrease.

- | | |
|--------------------|-----------------------------|
| (1) Adaptor E | (4) Pressure Gauge |
| (2) Threaded Joint | (5) Relief Valve Adjustor |
| (3) Cable | (6) Reducing Valve Adjustor |

Checking and Adjusting of GST System Pressure (P6)

1. Remove the left step and the left foot cover (1).
2. Remove the plug (PT 1/8) on the orifice bolt.
3. Set the threaded joint (3) (Code No: 07191-50392), cable (4) (Code No: 07916-50331), and pressure gauge (2) (Code No: 07916-52961) on the orifice bolt (1).
4. Start the engine and measure the pressure.
5. For adjustment, use the reducing valve adjustor (6) of the filter bracket.

GST system pressure	Factory spec	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi
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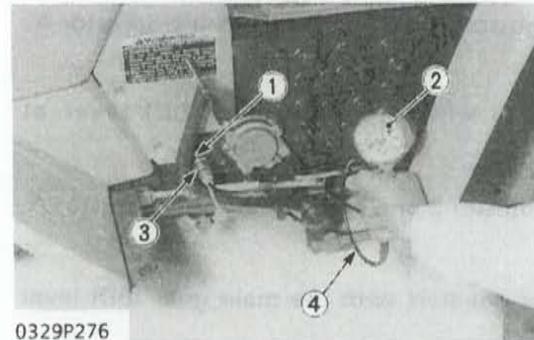
Condition

- Engine speed Maximum rpm.
- Oil temperature 45° to 55°C (113° to 131°F)

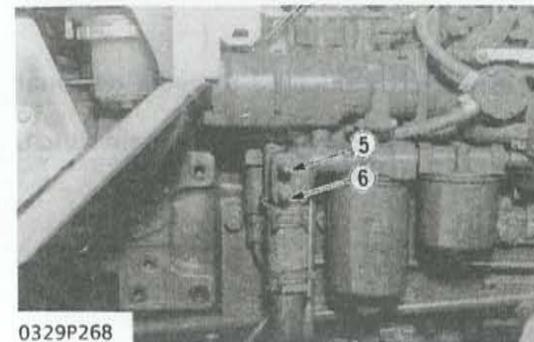
(Reference)

- Turn to clockwise direction → Pressure increase.
- Turn to counterclockwise direction ← Pressure decrease
- Pressure change per half rotation of the adjustor.
Approx: 0.196 MPa
2.0 kgf/cm²
28 psi

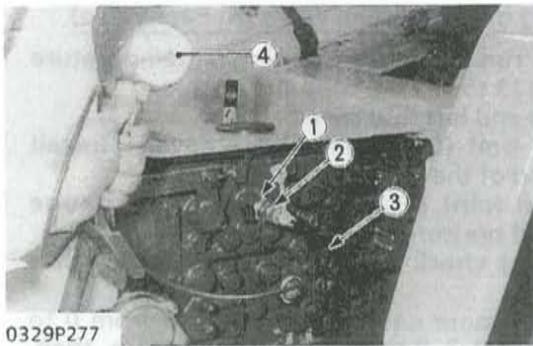
- | | |
|--------------------|-----------------------------|
| (1) Orifice Bolt | (4) Cable |
| (2) Pressure Gauge | (5) Relief Valve Adjustor |
| (3) Threaded Joint | (6) Reducing Valve Adjustor |



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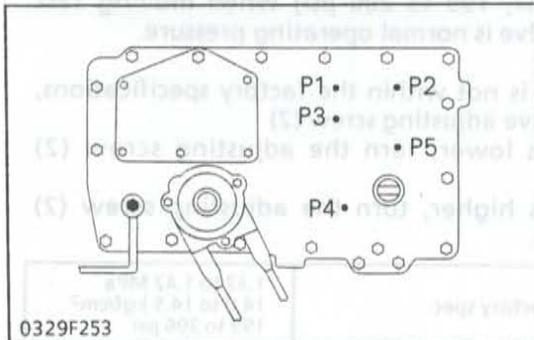
0329P277

Checking and Adjusting of GST System Pressure (P1 to P5)

1. Remove the left step and the left foot cover.
2. Remove the each plugs of P1 to P5 and set the adaptor D (1) (Code No: 07916-50381), threaded joint (2) (Code No: 07916-50392), cable (3) (Code No: 07916-50331), and pressure gauge (4) (Code No: 07916-52961).
3. Start the engine and measure the pressure of each port and each main shift lever position as the pressure table.

GST system pressure	Factory spec.	2.35 to 2.45 MPa 24.0 to 25.0 kgf/cm ² 341 to 356 psi
---------------------	---------------	--

Pressure disahrging port diagram



0329F253

- (1) Adaptor D
- (2) Threaded Joint
- (3) Cable
- (4) Pressure Gauge

Condition

- Engine speed Maximum rpm.
- Oil temperature 45 to 55°C (113 to 131°F)

Pressure Table

○ Pressure is 24 kgf/cm² (341 psi)

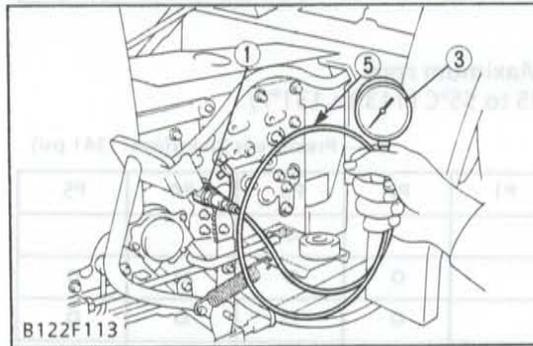
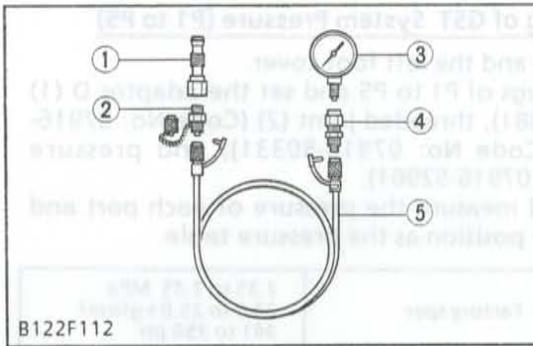
Shift Position	P1	P2	P3	P4	P5
Neutral			○		
1st Shift		○	○	○	○
2nd Shift		○	○	○	○
3rd Shift	○		○	○	○
4th Shift	○		○	○	○
5th Shift		○	○	○	○
6th Shift		○	○	○	○
7th Shift	○		○	○	○
8th Shift	○		○	○	○

NOTE

- Shuttle shift lever must be at "Forward" or "Reverse" position when checking the pressure.
- Measure the pressure according to P1 to P5 and use the results of measurement to locate causes of trouble when performing trouble-shooting. (Refer to page S.3-3, 4, 5)
- This pressure adjustment can be made by the reducing valve adjustor but individual and separate pressure change is not possible.

CAUTION

- Disengage the main clutch when checking the pressure.

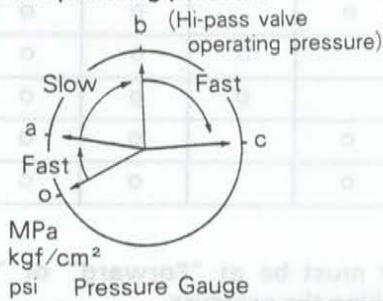


Checking and Adjusting of Modulating Valve (Hi-Pass Valve)

1. Start the engine and run it until transmission oil temperature reaches 45 to 55 °C (113 to 131 °F). Stop the engine.
2. Remove the left step and left foot cover.
3. Remove the orifice bolt (6) from the side cover. Install adaptor 72 (1) instead of the orifice bolt (6).
4. Install the threaded joint (2), cable (5), pressure gauge threaded joint (4) and pressure gauge (3) to adaptor 72 (1).
5. Start the engine and check the hi-pass valve operating pressure.
6. The pointer of the pressure gauge (3) moves fast from 0 to 0.22 MPa (0 to 2.2 kgf/cm², 0 to 31.3 psi), slows down, then speeds up again. If the pointer indicates 1.37 to 1.42 MPa (14.0 to 14.5 kgf/cm², 199 to 206 psi) when moving fast again, the Hi-pass valve is normal operating pressure.
7. Stop the engine.
8. If the measurement is not within the factory specifications, adjust the hi-pass valve adjusting screw (2)
 - If the pressure is lower, turn the adjusting screw (2) clockwise.
 - If the pressure is higher, turn the adjusting screw (2) counter clockwise.

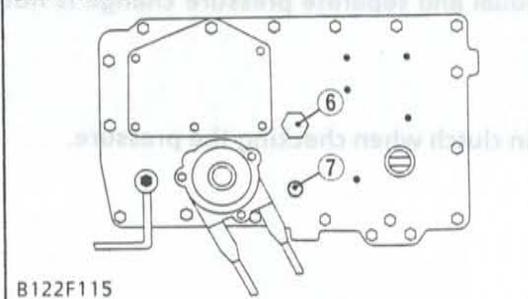
Modulating valve (Hi-pass valve) operating pressure	Factory spec.	1.37 to 1.42 MPa 14.0 to 14.5 kgf/cm ² 199 to 206 psi
---	---------------	--

Hi-pass valve operating pressure



- (a) 0.22 MPa (2.2 kgf/cm², 31.3 psi)
 (b) 1.37 MPa (14.0 kgf/cm², 199 psi)
 (c) 2.35 MPa (24.0 kgf/cm², 341 psi)

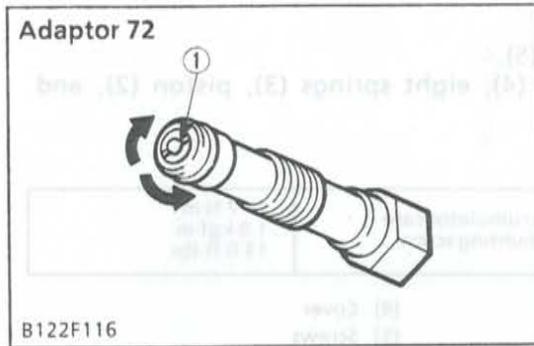
Side cover



- (1) Adaptor 72 07916-53791
 (2) Threaded Joint 07916-50341
 (3) Pressure Gauge 50 07916-52961
 (4) Pressure Gauge 07916-50401
 Threaded Joint
 (5) Cable 07916-50331
 (6) Orifice Bolt
 (7) Hi-pass Valve Adjusting Screw

Condition

- Engine speed Maximum rpm
- Oil temperature 45 to 55 °C (113 to 131 °F)



(1) Adjusting Screw

NOTE

If the pointer of the pressure gauge moves too fast or too slow, adjust with the adjusting screw of adaptor 72 until the gauge is read more easily.

- If the pointer moves too fast. → "Clockwise"
- If the pointer moves too slow. → "Counterclockwise"

CAUTION

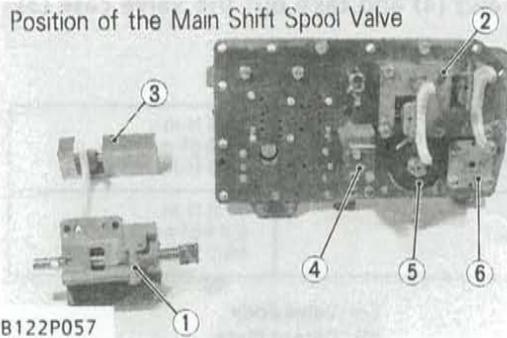
- Shift the shift levers to "Neutral" position when checking the pressure.

DISASSEMBLING AND ASSEMBLING

Side Cover Assembly, Gate Valve and Hi-Lo Shift Spool Valve

(See page S.3-29)

Position of the Main Shift Spool Valve



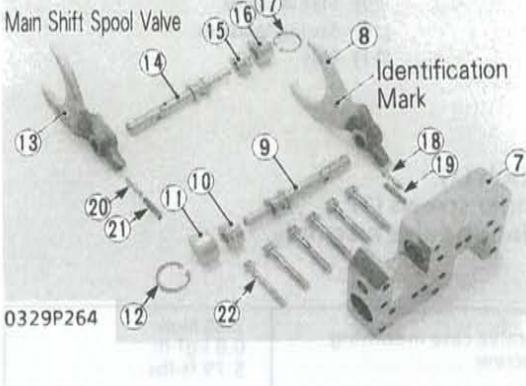
Main Shift Spool Valve

1. Remove the six screws (22).
2. Take out the main shift spool valve (2).

(When reassembling)

Tightening torques	Main shift spool valve mounting screw	6 mm (0.24 in.)	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
		8 mm (0.31 in.)	17.7 N·m 1.8 kgf·m 13.0 ft·lbs

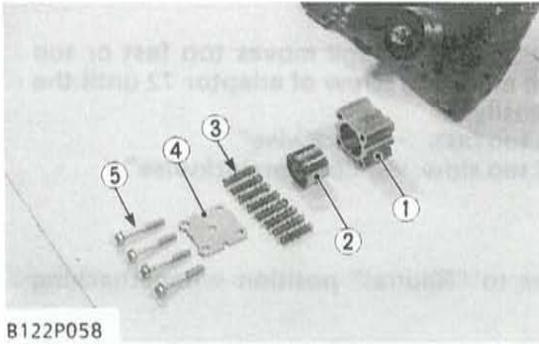
Main Shift Spool Valve



IMPORTANT

- Do not disassemble inside of the main shift spool valve (2).

- | | |
|--|-------------------------|
| (1) Gate Valve (Shuttle Shift Spool Valve) | (12) Snap Ring |
| (2) Main Shift Spool Valve | (13) 3-4th Shift Fork |
| (3) Hi-Lo Shift Spool Valve | (14) Spool Valve |
| (4) Modulating Valve | (15) Neutral Piston |
| (5) Rotary Valve | (16) Shift Piston Cover |
| (6) Accumulator | (17) Snap Ring |
| (7) Main Shift Valve Case | (18) Pin |
| (8) 1-2nd Shift Fork | (19) Spring Pin |
| (9) Spool Valve | (20) Pin |
| (10) Neutral Piston | (21) Spring Pin |
| (11) Shift Piston Cover | (22) Screws |



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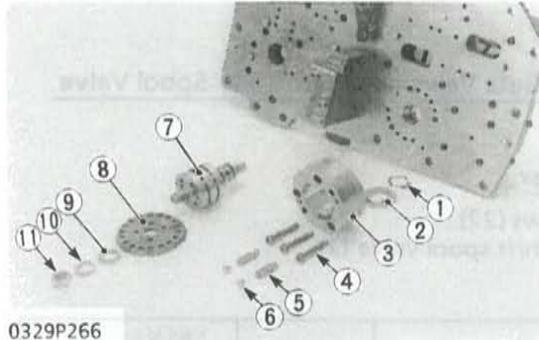
Accumulator

1. Remove four screws (5).
2. Take out the cover (4), eight springs (3), piston (2), and accumulator case (1).

(When reassembling)

Tightening torque	Accumulator case mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft·lbs
-------------------	---------------------------------	--------------------------------------

- | | |
|----------------------|------------|
| (1) Accumulator Case | (4) Cover |
| (2) Piston | (5) Screws |
| (3) Springs | |



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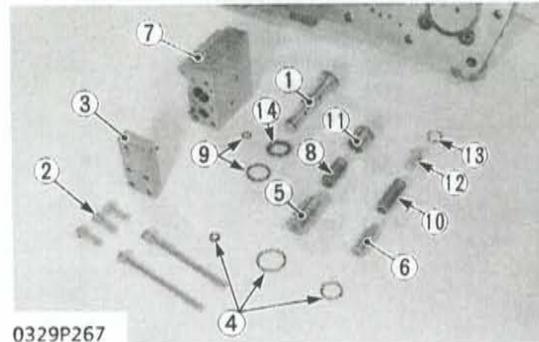
Rotary Valve Assembly

1. Remove the snap ring and take out the rotary valve assembly from the side cover.
2. Remove the nut (11) and take out the detent plate (8) from the valve body (7).
3. Remove the three screws (4) and take out the valve case (3) from the side cover.

(When reassembling)

Tightening torques	Valve case mounting screw	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
	Nut	62.8 N·m 6.4 kgf·m 46.3 ft·lbs

- | | |
|----------------|--------------------|
| (1) Snap Ring | (7) Valve Body |
| (2) Collar | (8) Detent Plate |
| (3) Valve Case | (9) Flat Washer |
| (4) Screws | (10) Spring Washer |
| (5) Springs | (11) Nut |
| (6) Balls | |



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Modulating Valve

1. Remove the orifice bolt (1).
2. Remove the two longer screws (2).
3. Take out the modulating valve assembly.

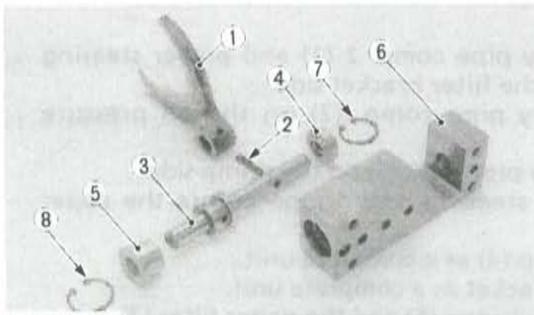
(When reassembling)

Tightening torque	Valve case mounting screw	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
-------------------	---------------------------	--------------------------------------

■ IMPORTANT

- Do not disassemble inside of the modulating valve.
- Do not remove the hi-pass valve adjusting screw, if removed it, adjust it correctly. (See page S.3-56, 57)

- | | |
|---------------------------|------------------------------|
| (1) Orifice Bolt | (8) Spring |
| (2) Screws | (9) O-rings (2 pieces) |
| (3) Valve Cover | (10) Spring |
| (4) O-rings (3 pieces) | (11) Lo-pass Piston |
| (5) Lo-pass Valve | (12) Hi-pass Spring Retainer |
| (6) Hi-pass Valve | (13) Snap Ring |
| (7) Modulating Valve Case | (14) Seal Washer |



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- (1) Shift Fork
- (2) Spring Pin
- (3) Hi-Lo Shift Spool
- (4) Shift Piston Cover R
- (5) Shift Piston Cover F
- (6) Hi-Lo Shift Case
- (7) Snap Ring
- (8) Snap Ring

Hi-Lo Shift Spool Valve

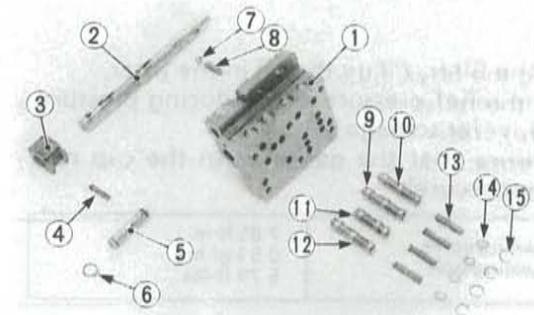
(When reassembling)

- Take care to mount the Hi-Lo shift spool valve assembly. (See page S.5-29, 30)

Tightening torque	Hi Lo shift spool valve mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft·lbs
-------------------	--	--------------------------------------

■ **IMPORTANT**

- Do not disassemble inside of the Hi-Lo shift spool valve assembly.



0329P262

- (1) Gate Valve Case
- (2) Shuttle Shift Spool
- (3) Shift Fitting
- (4) Spring Pin
- (5) Pipe
- (6) Snap ring
- (7) Ball
- (8) spring
- (9) Pilot Valve (3-4 gate)
- (10) Pilot Valve (1-2 gate)
- (11) Pilot Valve (Hi-Lo gate)
- (12) Pilot Valve (Shuttle gate)
- (13) Spring
- (14) Washer
- (15) Snap Ring

Gate Valve (Shuttle Shift Spool Valve)

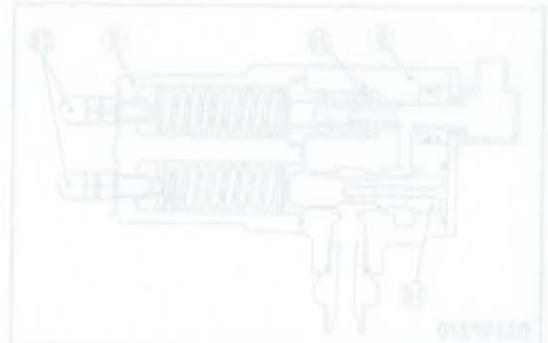
(When reassembling)

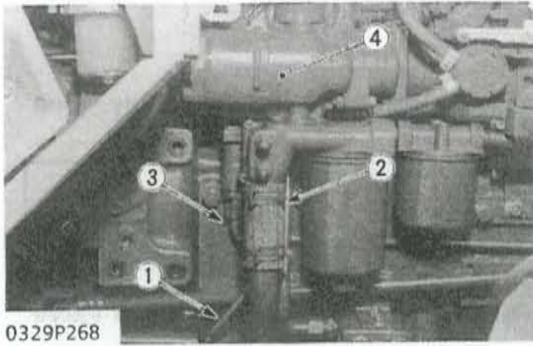
- Take care to mount the gate valve assembly. (See page S.5-29, 30)

Tightening torque	Gate valve mounting screw	17.7 N·m 1.8 kgf·m 13.0 ft·lbs
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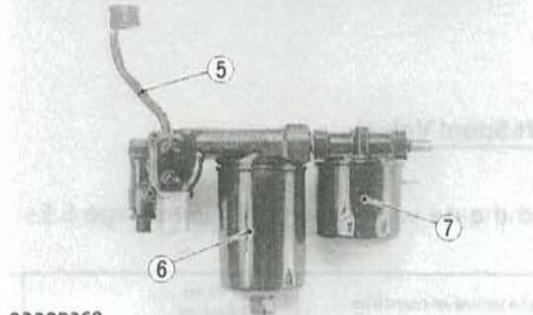
■ **IMPORTANT**

- Do not disassemble inside of the gate valve assembly.





0329P268



0329P269

- (1) Delivery Pipe Comp. 2
- (2) Delivery Pipe Comp.
- (3) Power Steering Pipe 1 Comp.
- (4) Oil Pump
- (5) Delivery Pipe P-RE
- (6) Filter Cartridge
- (7) Paper Filter

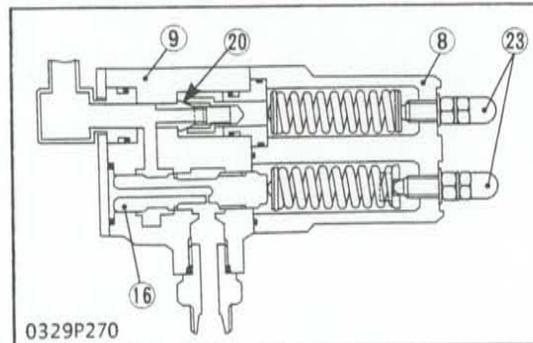
Filter Bracket Assembly

1. Remove the delivery pipe comp. 2 (1) and power steering pipe 1 comp. (3) on the filter bracket side.
2. Remove the delivery pipe comp. (2) on the oil pressure block side.
3. Remove the delivery pipe P-RE (5) on the pump side.
4. Remove the power steering return pipe before the paper filter.
5. Remove the oil pump (4) as a complete unit.
6. Remove the filter bracket as a complete unit.
7. Remove the filter cartridge (6) and the paper filter (7).
8. Remove bolts (11), (21) and remove the reducing valve (16), relief poppet (20) etc.
9. Confirm the protruding allowance of the adjusting bolt (22) and disassemble.
10. Remove the nipple (14) and the poppet (13).

(When reassembling)

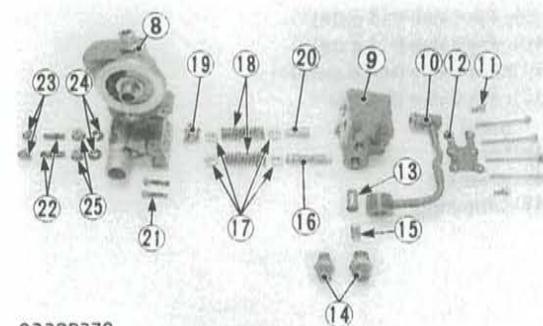
- Before reassembling the filter, fill up the oil in the filter.
- For adjustments of the relief pressure and reducing pressure (GST system pressure), refer to page 5.3-54.
- After adjustment, ensure that the gasket is in the cap nut and tighten the cap nut securely.

Tightening torque	Reducing valve mounting bolt	7.85 N·m 0.8 kgf·m 5.79 ft·lbs
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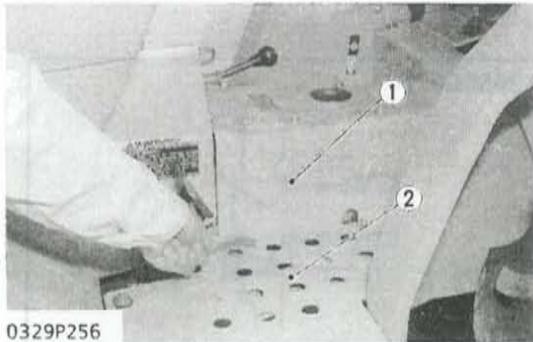
0329P270

- (8) Filter Bracket
- (9) Reducing Valve Case
- (10) Delivery Pipe P-RE
- (11) Screw
- (12) Reducing Valve Cover
- (13) Poppet
- (14) Nipples
- (15) Spring
- (16) Reducing Valve
- (17) Spring Retainers
- (18) Springs
- (19) Relief Bushing
- (20) Relief Poppet
- (21) Screw
- (22) Adjusting Screw
- (23) Cap Nut



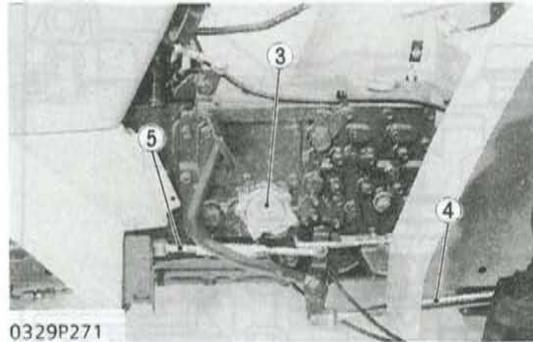
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- (24) Seal Washers
- (25) Nuts



0329P256

(1) Left Foot Cover (2) Left Step



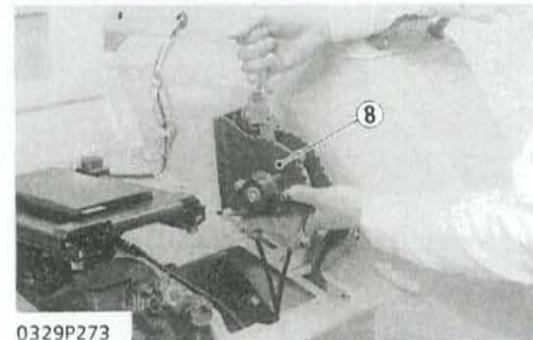
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(3) Shift Cable (4) Brake Rod (5) Clutch Rod



0329P272

(6) Shift Guide Cover (7) Rear Step

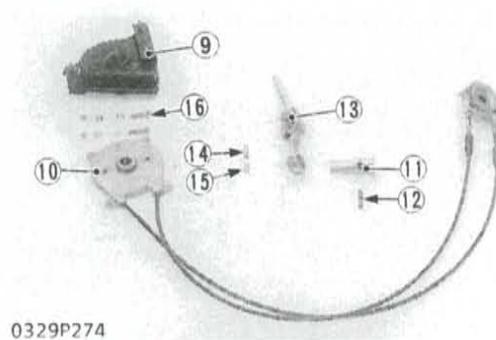
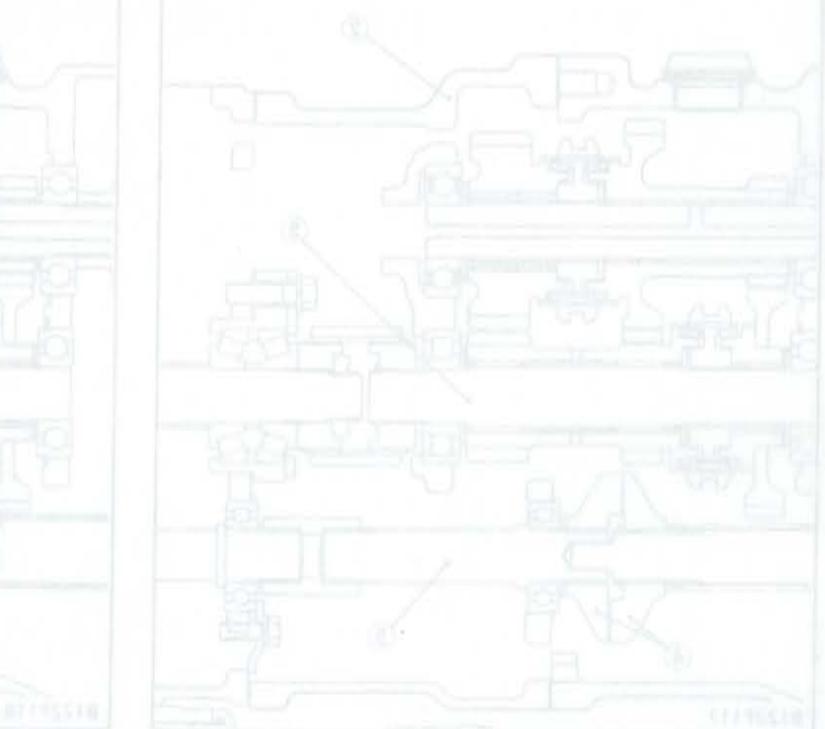


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(8) Shift Guide Assembly

Shift Cable

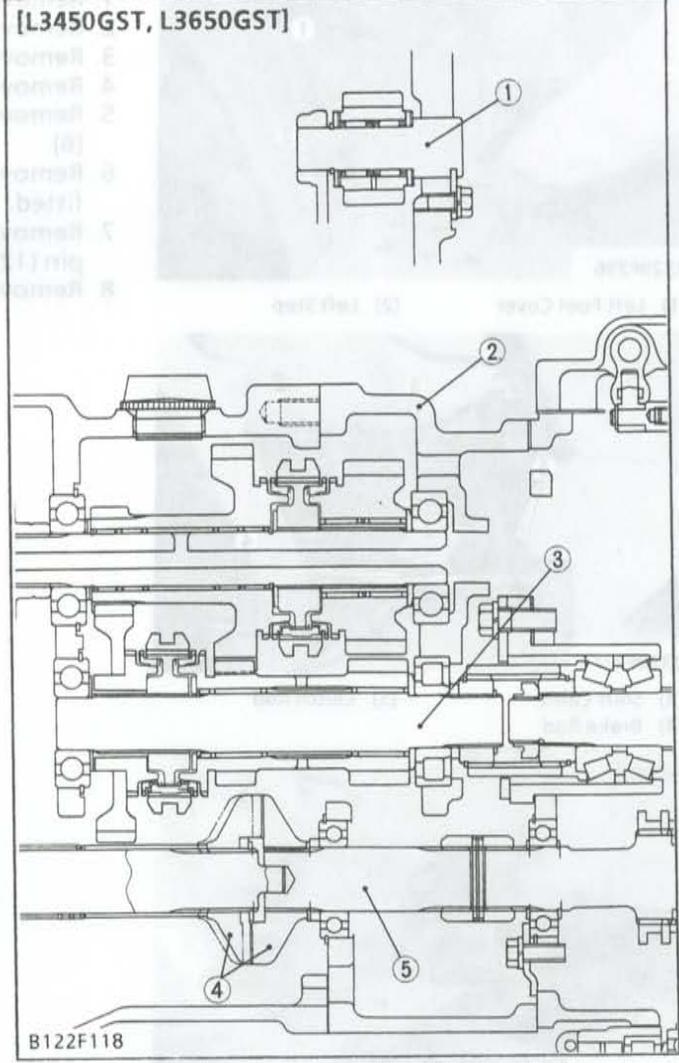
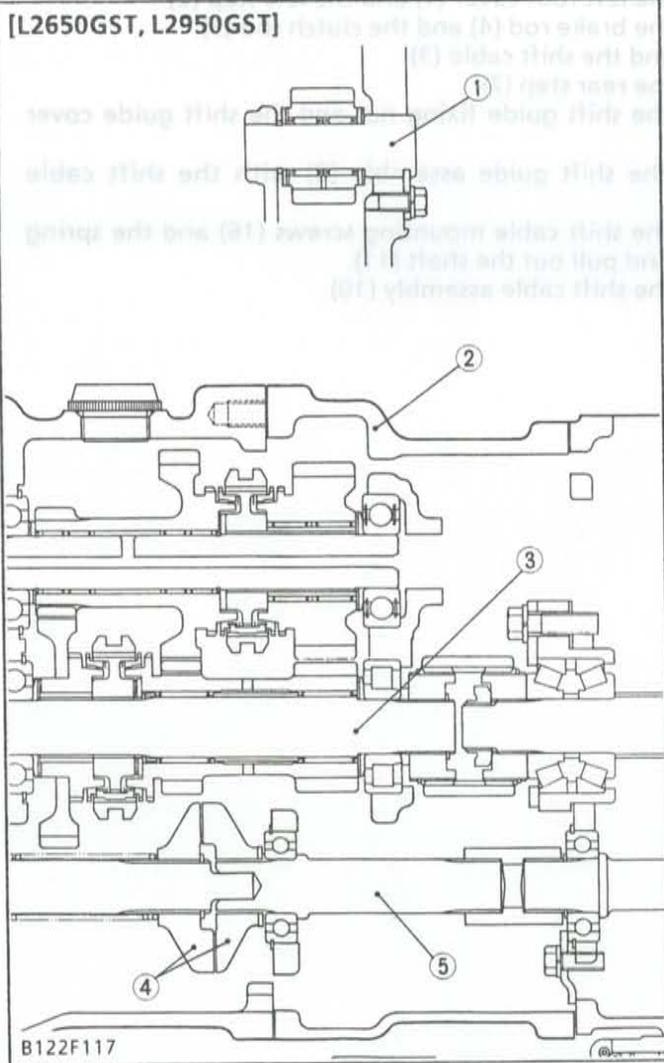
1. Remove the left foot cover (1) and the left step (2).
2. Remove the brake rod (4) and the clutch rod (5).
3. Remove and the shift cable (3).
4. Remove the rear step (7).
5. Remove the shift guide fixing nut and the shift guide cover (6).
6. Remove the shift guide assembly (8) with the shift cable fitted.
7. Remove the shift cable mounting screws (16) and the spring pin (12), and pull out the shaft (11).
8. Remove the shift cable assembly (10).



0329P274

(9) Shift Guide (10) Speed Change Cable Assembly (11) Shaft (12) Spring Pin (13) Lever (14) Spring (15) Detent (16) Mounting Bolts

[3]-2 MID CASE



(1) Reverse Shaft
(2) Mid Case

(3) Hi-Lo Shaft

(4) One-way Clutch

(5) PTO Drive Shaft

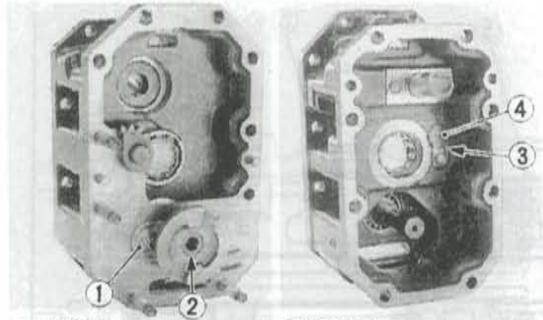


DISASSEMBLING AND ASSEMBLING

[B]-3 CLUTCH HOUSING

Separating Mid Case

(See page S.S-30.)



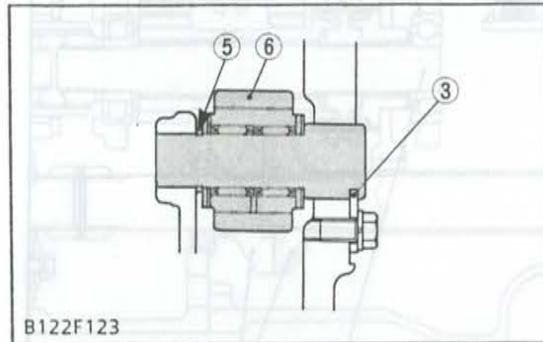
0329P281

0329P282

Reverse Shaft and PTO Drive Shaft

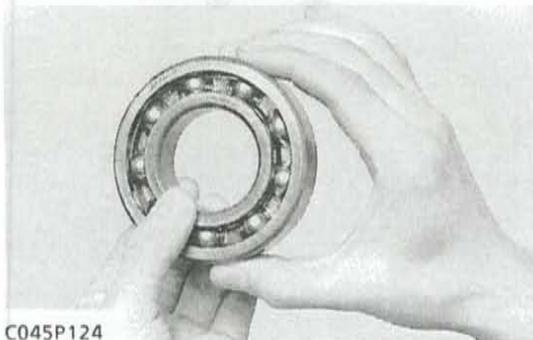
1. Remove the reverse shaft holder (3).
2. Remove the snap ring (5) on the reverse shaft.
3. Remove the reverse gear (6) of the reverse shaft.
4. Remove the bearing retainer (1) and pull out the PTO drive shaft (2).

- (1) PTO Bearing Retainer
- (2) PTO Drive Shaft
- (3) Reverse Shaft Holder
- (4) Reverse Shaft
- (5) Snap Ring
- (6) Reverse Gear



B122F123

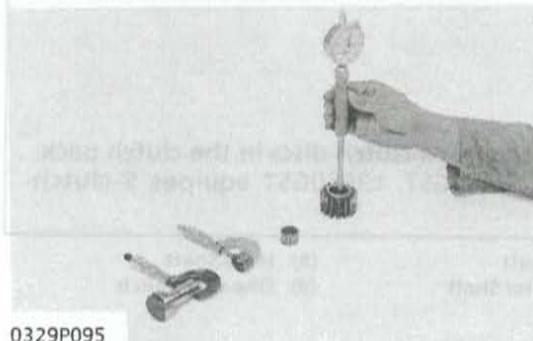
SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.



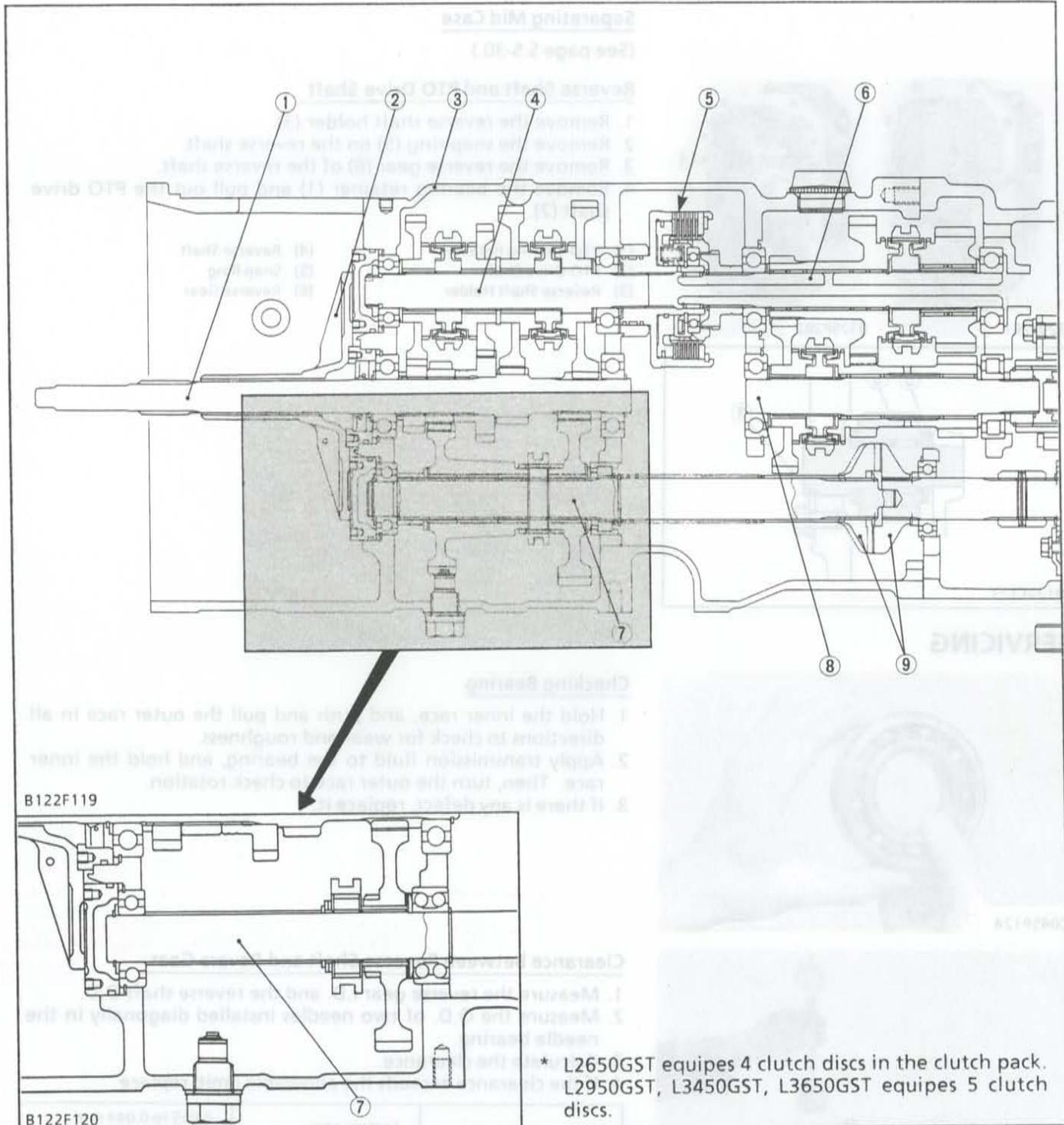
0329P095

Clearance between Reverse Shaft and Revers Gear

1. Measure the reverse gear I.D. and the reverse shaft O.D.
2. Measure the O.D. of two needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between reverse shaft and 15T gear	Factory spec.	0.015 to 0.044 mm 0.00059 to 0.00173 in.
	Allowable limit	0.1 mm 0.004 in.
Reverse shaft O.D	Factory spec.	19.996 to 20.005 mm 0.78724 to 0.78760 in.
Reverse gear I.D.	Factory spec.	26.020 to 26.028 mm 1.02441 to 1.02472 in.
Needle O.D.	Factory spec.	2.994 to 3.000 mm 0.11787 to 0.11811 in.

[3]-3 CLUTCH HOUSING



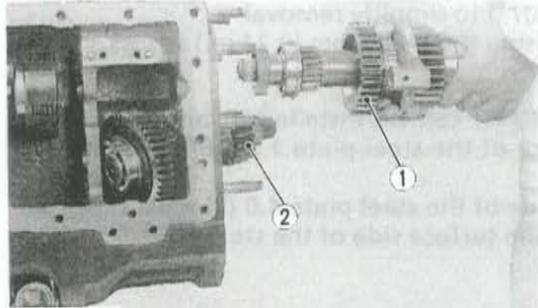
* L2650GST equipes 4 clutch discs in the clutch pack.
L2950GST, L3450GST, L3650GST equipes 5 clutch discs.

- | | | | |
|---------------------|-------------------|-----------------------|--------------------|
| (1) Main Shaft | (4) Counter Shaft | (6) Shuttle Shaft | (8) Hi-Lo Shaft |
| (2) Main Shaft Case | (5) Clutch Pack | (7) PTO Counter Shaft | (9) One-way Clutch |
| (3) Clutch Housing | | | |

DISASSEMBLING AND ASSEMBLING

Separating Clutch Housing

(See page S.5-30.)



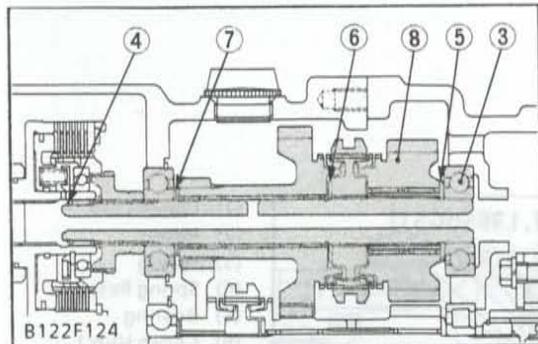
0329P283

Shuttle Shaft

1. Remove the Hi-Lo shaft (2) as a complete unit and drop it as a unit.
2. Remove the complete shuttle shaft (1) as a unit.
3. Remove the bearing (3) and the snap ring (4), and remove the gears.

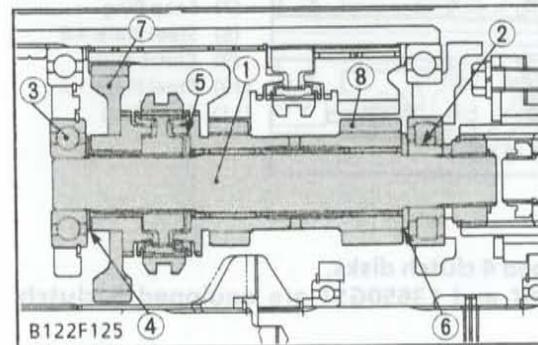
(When reassembling)

- Apply grease to the collar and the inner race.
- Thrust collars (6), (7) can be installed in any direction.
- The groove of the thrust collar (5) must face the 27T gear (8).



B122F124

- | | |
|----------------------------|-------------------|
| (1) Complete Shuttle Shaft | (5) Thrust Collar |
| (2) Complete Hi-Lo Shaft | (6) Thrust Collar |
| (3) Bearing | (7) Thrust Collar |
| (4) Snap Ring | (8) 27T Gear |



B122F125

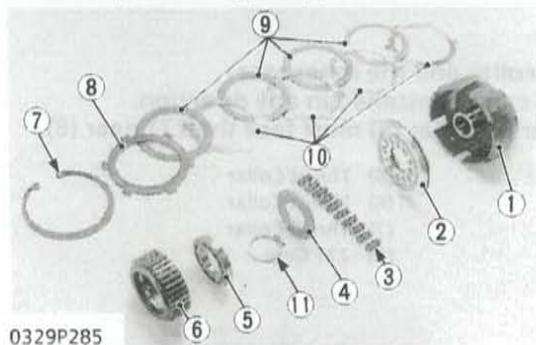
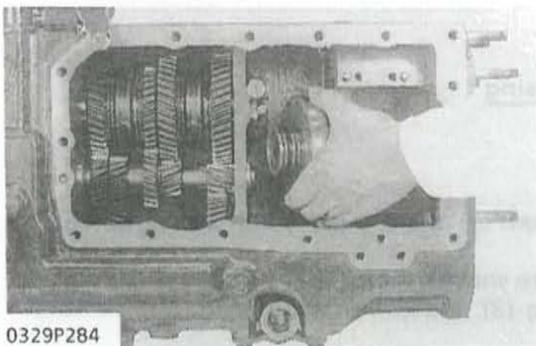
Hi-Lo Shaft

1. Remove the Hi-Lo shaft (1) as a complete unit.
2. Remove the bearing (3) and the inner race (2), and pull out the gears.

(When reassembling)

- Apply grease to the collars and the inner races.
- Thrust collar (5) can be fit in any direction.
- The groove of the thrust collar (4) must face the 42T gear (7).
- The groove of the thrust collar (6) must face the 17-17T gear or the 17-18T gear (8).

- | | |
|-------------------|----------------------------|
| (1) Hi-Lo Shaft | (6) Thrust Collar |
| (2) Inner Race | (7) 42T Gear |
| (3) Bearing | (8) 17-17T Gear (L2650GST) |
| (4) Thrust Collar | 17-18T Gear (L2950GST, |
| (5) Thrust Collar | L3450GST, L3650GST) |

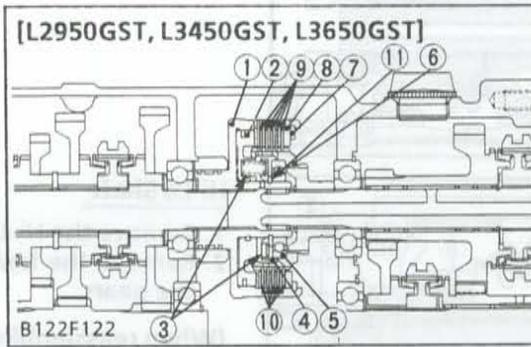
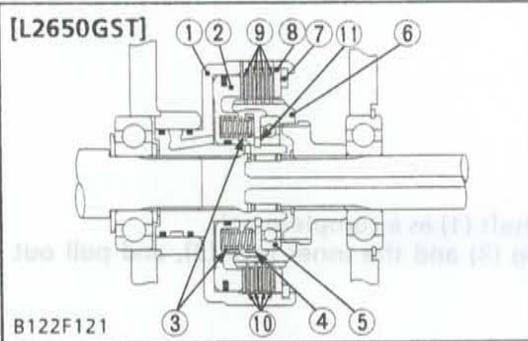


Clutch Pack

1. Remove the clutch pack as a complete set.
2. Remove the clutch hub 1 (6), steel plate (8), (9), and disk (10).
3. Remove the snap ring (11), spring retainer (4) and spring (3) in that order. Use the Clutch Pack Disassembly special tool (Code No: 07916-52071) to simplify removal.
4. Pull out the piston using the two 6 mm (0.24 in.) screws.

(When reassembling)

- The steel plates 1.2 (10) can be installed in any direction, because both surface of the steel plate 1.2 (10) are polished up.
- Mark "O" surface side of the steel plate 4.0 (8) must face the rear, because only one surface side of the steel plate 4.0 (8) is polished up.



- (1) Clutch Case
- (2) Piston
- (3) Spring
- (4) Spring Retainer
- (5) Bearing
- (6) Clutch Hub 1
- (7) Snap Ring
- (8) Steel Plate 4.0
- (9) Clutch Disk
- (10) Steel Plate 1.2
- (11) Snap Ring

CAUTION

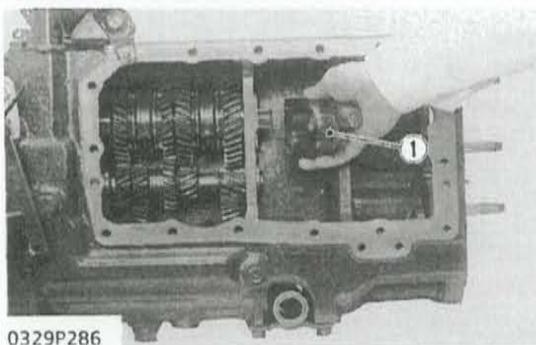
- L2650GST is equipped 4 clutch disks.
- L2950GST, L3450GST and L3650GST are equipped 5 clutch disks.

Clutch Pack Support

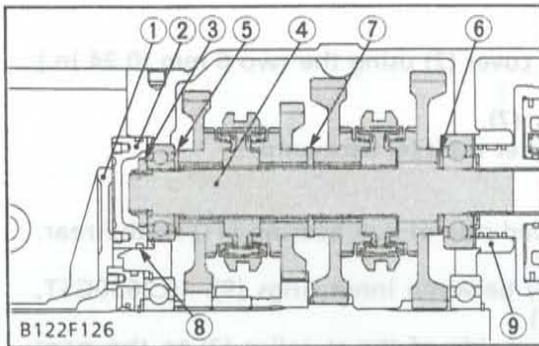
1. Remove screws. Note that one of the three screws is the reamer screw for positioning.
2. Remove the clutch pack support (1).

(When reassembling)

- Check that the inner surface is free from scratches and burrs before reassembling.



(1) Clutch Pack Support



- (1) Main Shaft Case
- (2) Bearing Cover
- (3) Nut 22
- (4) Counter Shaft
- (5) Thrust Collar
- (6) Thrust Collar
- (7) Thrust Collar
- (8) O-ring
- (9) Support

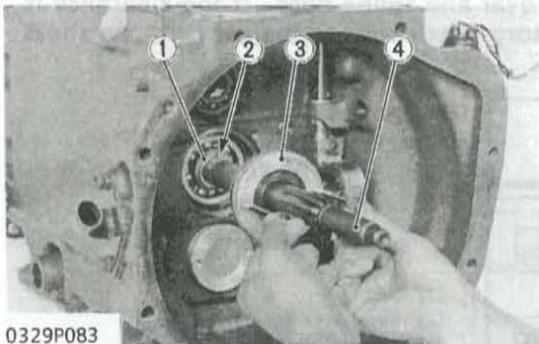
Counter Shaft

1. Remove the main shaft case (1).
2. Remove the bearing cover (2) using the two 6 mm (0.24 in.) screws.
3. Release the caulking of the nut 22 (3) and remove it.
4. Tap out the counter shaft (4) backward.
5. Remove the gears.

(When reassembling)

- Apply grease to the collar and inner race.
- The groove of the thrust collars (5), (6) must face inside.
- The thrust collar (7) can be fitted in any direction.
- Apply grease to the O-ring (8) of the bearing cover (2) before reassembling.

Tightening torque	22 Nut	4.90 to 6.86 N·m 0.5 to 0.7 kgf·m 3.62 to 5.06 ft·lbs
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0329P083

Main Shaft

1. Remove the spacer (3) using the two 6 mm (0.24 in.) screws.
2. Remove the snap ring (2) on the main shaft and remove the washer (1).
3. Tap out the main shaft backward.

(When reassembling)

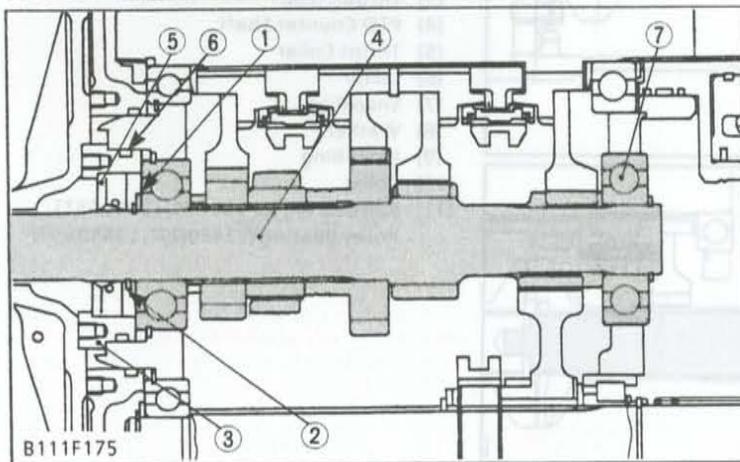
- Apply grease to the O-ring (6) and oil seal (5).

■ IMPORTANT

- After reassembling the main shaft, check the clearance between bearing and washer. If the clearance is too much, adjust with washers (1).

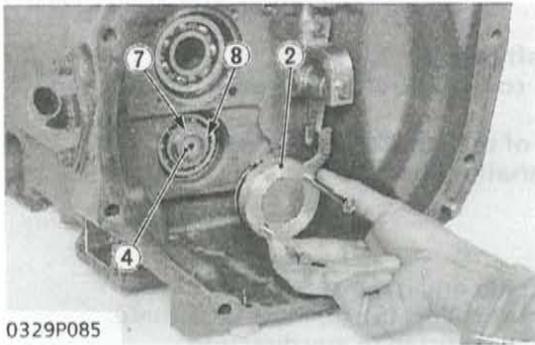
(Reference)

- Thickness of washers (1):
2.0 mm (0.079 in.)
2.3 mm (0.090 in.)
2.5 mm (0.098 in.)



B111F175

- (1) Washer
- (2) Snap Ring
- (3) Spacer
- (4) Main Shaft
- (5) Oil Seal
- (6) O-ring
- (7) Bearing



0329P085

PTO Counter Shaft

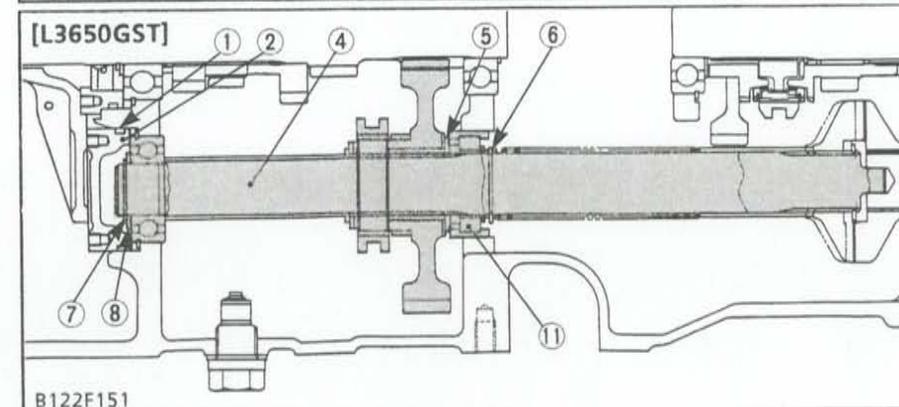
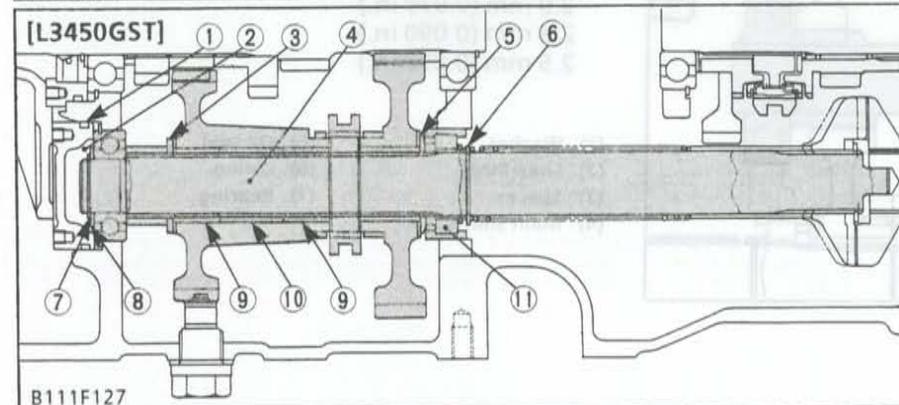
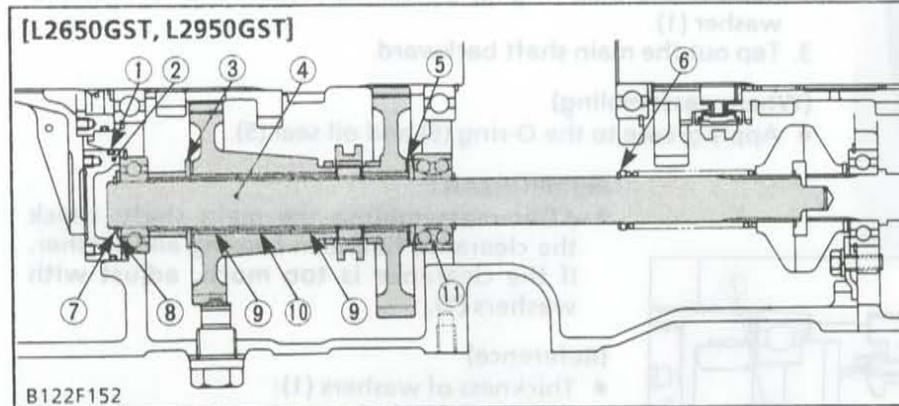
1. Remove the bearing cover (2) using the two 6 mm (0.24 in.) screws.
2. Remove the snap ring (7).
3. Tap out the PTO counter shaft (4) backward.

(When reassembling)

- Direct the ball grooved side of ball bearing (11) to the rear. (L2650GST, L2950GST)
- Install the collar (10) between inner rings (9). (L2650GST, L2950GST, L3450GST)
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Install the collar (6) of one-way clutch certainly.
- Apply grease to O-ring (1) on the bearing cover.

■ IMPORTANT

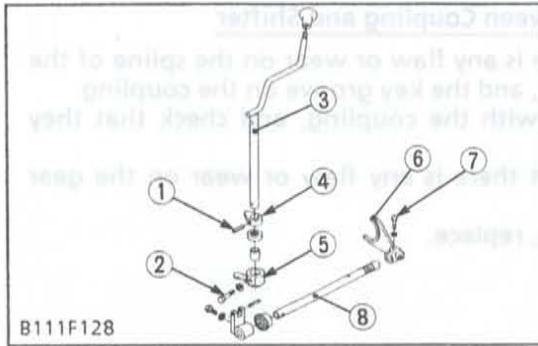
- After reassembling the PTO counter shaft, measure the clearance between gear and spline boss. If the clearance is not within the factory specifications, adjust with washers (8).



(Reference)

- Thickness of washers (8):
 2.0 mm (0.079 in.)
 2.3 mm (0.090 in.)
 2.5 mm (0.098 in.)

- (1) O-ring
- (2) Bearing Cover
- (3) Thrust Collar
- (4) PTO Counter Shaft
- (5) Thrust Collar
- (6) Collar
- (7) Snap Ring
- (8) Washer
- (9) Inner Ring
- (10) Collar
- (11) Ball Bearing [L2650GST, L2950GST]
 Roller Bearing [L3450GST, L3650GST]



B111F128

PTO Shift Fork and Lever

1. Remove the PTO shift fork mounting screw (2).
2. Pull out the PTO shift rod (8) and take out the PTO shift fork (1).
3. Remove the speed change arm mounting screw (2).
4. Tap out the spring pin (1).
5. Pull out the PTO shift lever (3).

- | | |
|------------------------|----------------------|
| (1) Spring Pin | (5) Speed Change Arm |
| (2) Screw | (6) PTO Shift Fork |
| (3) PTO Shift Lever | (7) Screw |
| (4) Neutral Switch Cam | (8) PTO Shift Rod |

SERVICING

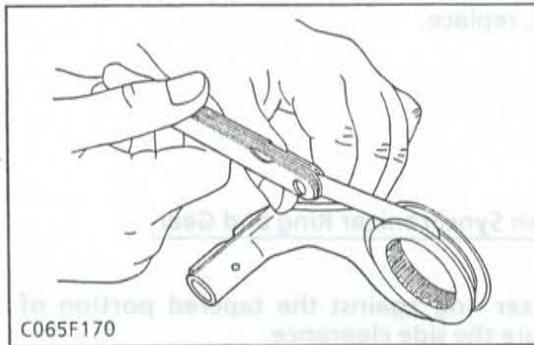
Checking Bearing

(See page S.3-62.)

Clearance between Shift Fork and Shifter Groove

1. Place the shift fork in the shifter groove to measure the clearance.
2. If the measurement exceeds the allowable limit, replace them.

Clearance between shift fork and shifter groove	Factory spec	0.25 to 0.45 mm 0.0098 to 0.0177 in.
	Allowable limit	0.8 mm 0.031 in.



C065F170

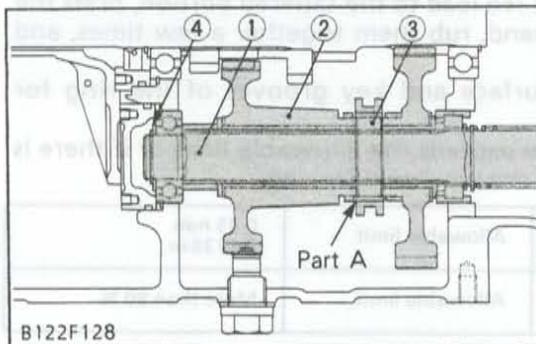
Side Clearance between Gear and Spline Boss on the PTO Counter Shaft [L2650GST, L2950GST, L3450GST]

1. Insert a feeler gauge between gear and spline boss (Part A) to measure the clearance.
2. If the measurement is not within the factory specifications, adjust the clearance with washer (4) on the front end of shaft.

(Reference)

- Thickness of washers:
 - 2.0 mm (0.079 in.) [Code No. 34150-21561]
 - 2.3 mm (0.091 in.) [Code No. 38450-23781]
 - 2.5 mm (0.098 in.) [Code No. 38450-23791]

Side clearance between gear and spline boss	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
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B122F128

- | | |
|-----------------------|-------------------|
| (1) PTO Counter Shaft | (3) Spline Boss |
| (2) 39T Gear | (4) Adjust Washer |

Gear Backlash

1. Set a dial gauge (lever type) with its finger on the gear tooth surface.
2. Move the gear to measure the backlash.
3. If the measurement exceeds the allowable limit, replace.

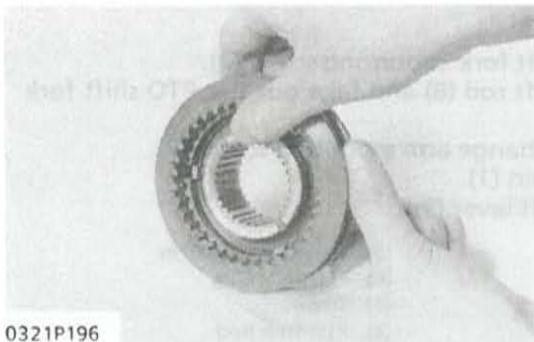
■ IMPORTANT

- Measure the backlash at three equally spaced positions on the gear, and obtain the average.

Gear backlash	Factory spec	0.1 to 0.2 mm 0.004 to 0.008 in.
	Allowable limit	0.5 mm 0.020 in.



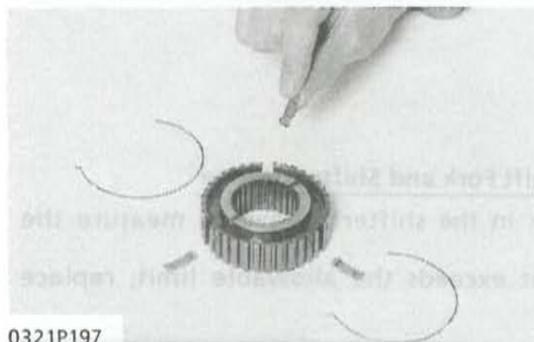
C060P100



0321P196

Checking Contact between Coupling and Shifter

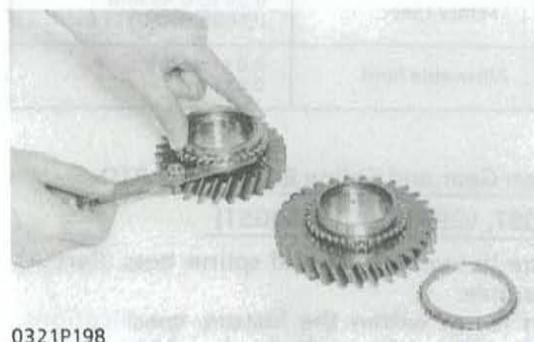
1. Check to see if there is any flaw or wear on the spline of the coupling and shifter, and the key groove on the coupling.
2. Engage the shifter with the coupling, and check that they slide smoothly.
3. Similarly, check that there is any flaw or wear on the gear splines.
4. If there is any defect, replace.



0321P197

Flaw on Synchronizer Key and Spring

1. Check the projection in the center of the synchronizer key for wear.
2. Check the spring for fatigue or wear on the area where the spring contacts with the keys.
3. If there is any defect, replace.



0321P198

Side Clearance between Synchronizer Ring and Gear (in Contact)

1. Press the synchronizer ring against the tapered portion of the gear, and measure the side clearance.
2. Apply a thin film of red lead to the tapered portion, press the ring against it by hand, rub them together a few times, and check the contact.
3. Check the tooth surface and key grooves of the ring for wear.
4. If the side clearance exceeds the allowable limit or if there is any defect, replace the synchronizer ring.

Side clearance	Allowable limit	0.35 mm 0.0138 in.
Contact condition on tapered portion	Allowable limit	More than 80 %

Side clearance between gear and tapered part	Factor: gear	0.1 to 0.3 mm 0.004 to 0.012 in.
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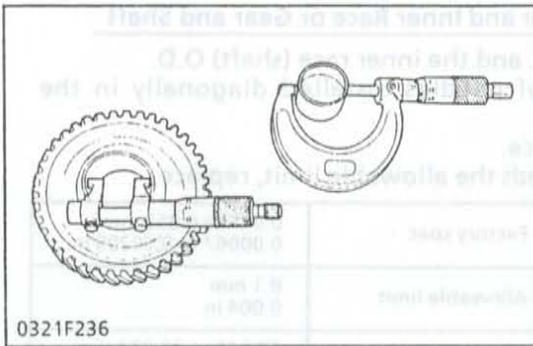
Gear Backlash

1. Set a dial gauge (level type) with its finger on the gear tooth surface.
2. Move the gear to measure the backlash.
3. If the measurement exceeds the allowable limit, replace.

IMPORTANT

Measure the backlash at three equally spaced positions on the gear, and obtain the average.

Gear backlash	Factory spec	0.04 to 0.08 mm 0.0015 to 0.003 in.
	Allowable limit	0.2 mm 0.020 in.



Clearance between Gear and Inner Race (or Shaft)

1. Measure the gear I.D. and inner race (or shaft) O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between 46T gear and counter shaft	Factory spec.	0.020 to 0.055 mm 0.0008 to 0.0022 in.
	Allowable limit	0.1 mm 0.004 in.
46T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Counter shaft O.D.	Factory spec.	31.995 to 32.005 mm 1.2597 to 1.2600 in.

Clearance between gears and inner races on counter shaft or PTO counter shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
Gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.2596 to 1.2602 in.

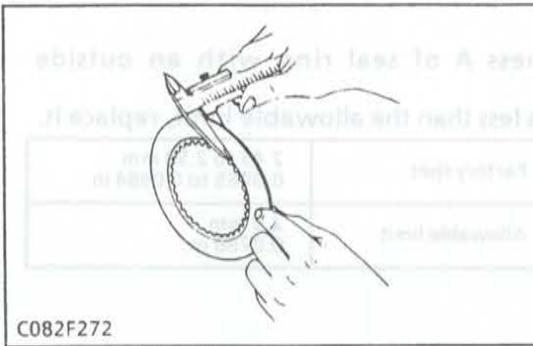
Clearance between 42T gear and inner race on Hi-Lo shaft	Factory spec.	0.017 to 0.058 mm 0.0007 to 0.0023 in.
	Allowable limit	0.1 mm 0.004 in.
42T gear I.D.	Factory spec.	32.025 to 32.050 mm 1.2608 to 1.2618 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.2596 to 1.2602 in.

Clearance between Gear and Inner Race or Gear and Shaft

1. Measure the gear I.D. and the inner race (shaft) O.D.
2. Measure the O.D. of needles installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

0329P094

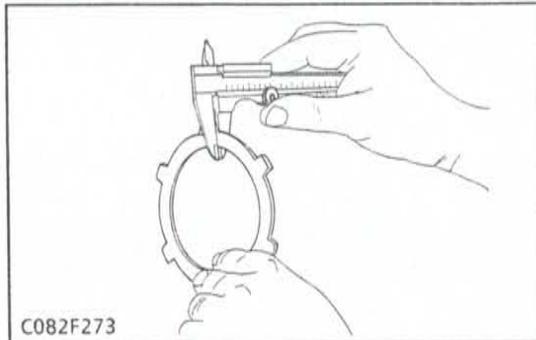
Clearance between 27T gear and inner race	Factory spec.	0.017 to 0.052 mm 0.00067 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
27T gear I.D.	Factory spec.	37.025 to 37.034 mm 1.45768 to 1.45803 in.
Inner race O.D.	Factory spec.	31.992 to 32.008 mm 1.25953 to 1.26016 in.
Needle O.D.	Factory spec.	2.459 to 2.500 mm 0.09823 to 0.09843 in.
Clearance between 17-32T or 17-33T gear and shuttle shaft	Factory spec.	0.005 to 0.038 mm 0.00002 to 0.002150 in.
	Allowable limit	0.1 mm 0.004 in.
17-32T or 17-33T gear I.D.	Factory spec.	29.007 to 29.020 mm 1.14200 to 1.14252 in.
Shuttle shaft O.D.	Factory spec.	24.9940 to 25.0065 mm 0.98402 to 0.98452 in.
Needle O.D.	Factory spec.	1.994 to 2.000 mm 0.07850 to 0.07874 in.
Clearance between 17-17T or 18-17T gear and Hi-Lo shaft	Factory spec.	0.002 to 0.041 mm 0.00008 to 0.00161 in.
	Allowable limit	0.1 mm 0.004 in.
17-17T or 18-17T gear I.D.	Factory spec.	33.009 to 33.025 mm 1.29957 to 1.30020 in.
Hi-Lo shaft O.D.	Factory spec.	27.994 to 28.007 mm 1.10213 to 1.10264 in.
Needle O.D.	Factory spec.	2.495 to 2.500 mm 0.09823 to 0.09843 in.



Clutch Disc Wear

1. Measure the thickness of the clutch disc with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

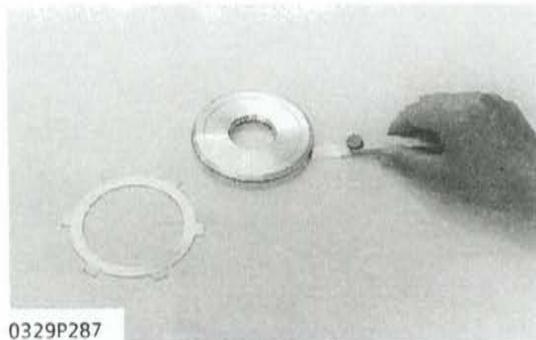
Thickness of clutch disk	Factory spec.	2.2 to 2.3 mm 0.0866 to 0.0906 in.
	Allowable limit	1.9 mm 0.0748 in.



Steel Plate Wear

1. Measure the thickness of the steel plate with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

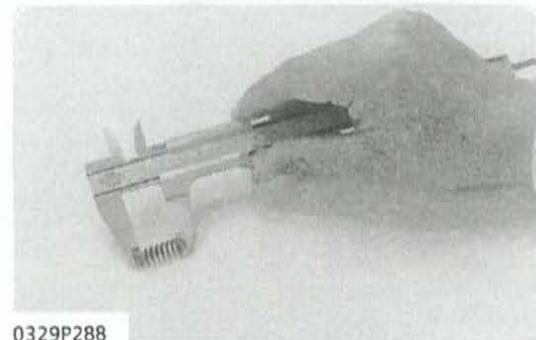
Thickness of steel plate 1.2	Factory spec.	1.10 to 1.20 mm 0.0433 to 0.0472 in.
	Allowable limit	0.90 mm 0.0354 in.
Thickness of plate 4.0	Factory spec.	3.89 to 4.05 mm 0.1531 to 0.1594 in.
	Allowable limit	3.70 mm 0.1457 in.



Flatness of Piston Plate 1.2 and Plate 4.0

1. Place the part on a surface plate and check it unable to insert a feeler gauge (allowable limit size) underneath it at opposite locations at least four points.
2. If the gauge can be inserted, grind the plate with sandpaper using a circular motion or replace.

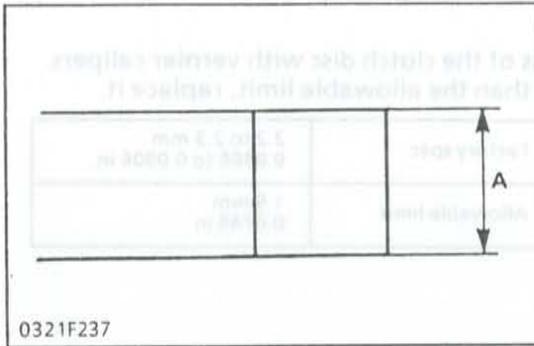
Flatness of piston	Allowable limit	0.15 mm 0.0059 in.
Flatness of plate 1.2 and plate 4.0	Allowable limit	0.30 mm 0.0118 in.



Piston Return Spring Free Length

1. Measure the piston return spring using calipers.
2. If the measurement is smaller than the using limit, replace the piston return spring.

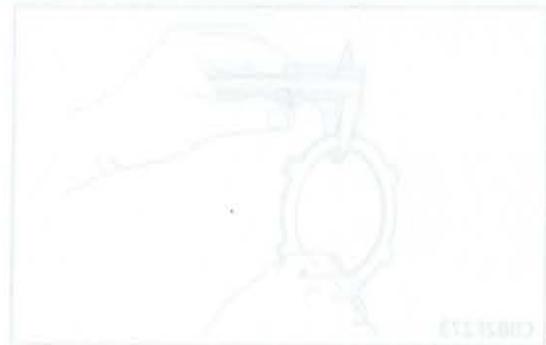
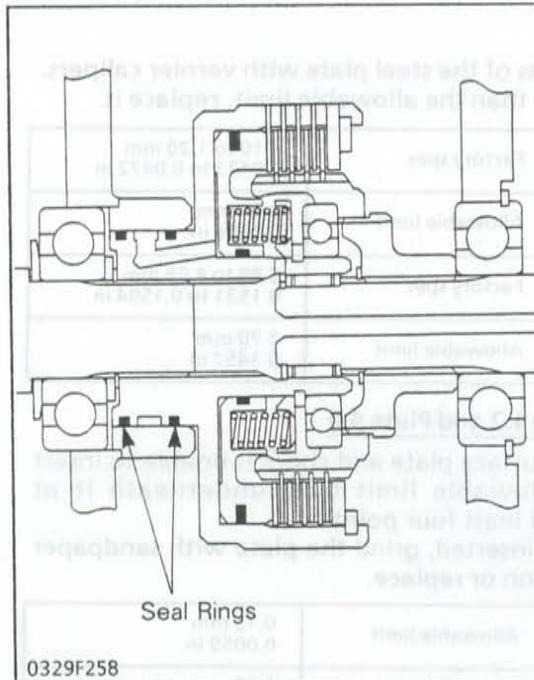
Free length	Factory spec.	20.3 to 20.7 mm 0.799 to 0.815 in.
	Allowable limit	17.4 mm 0.685 in.



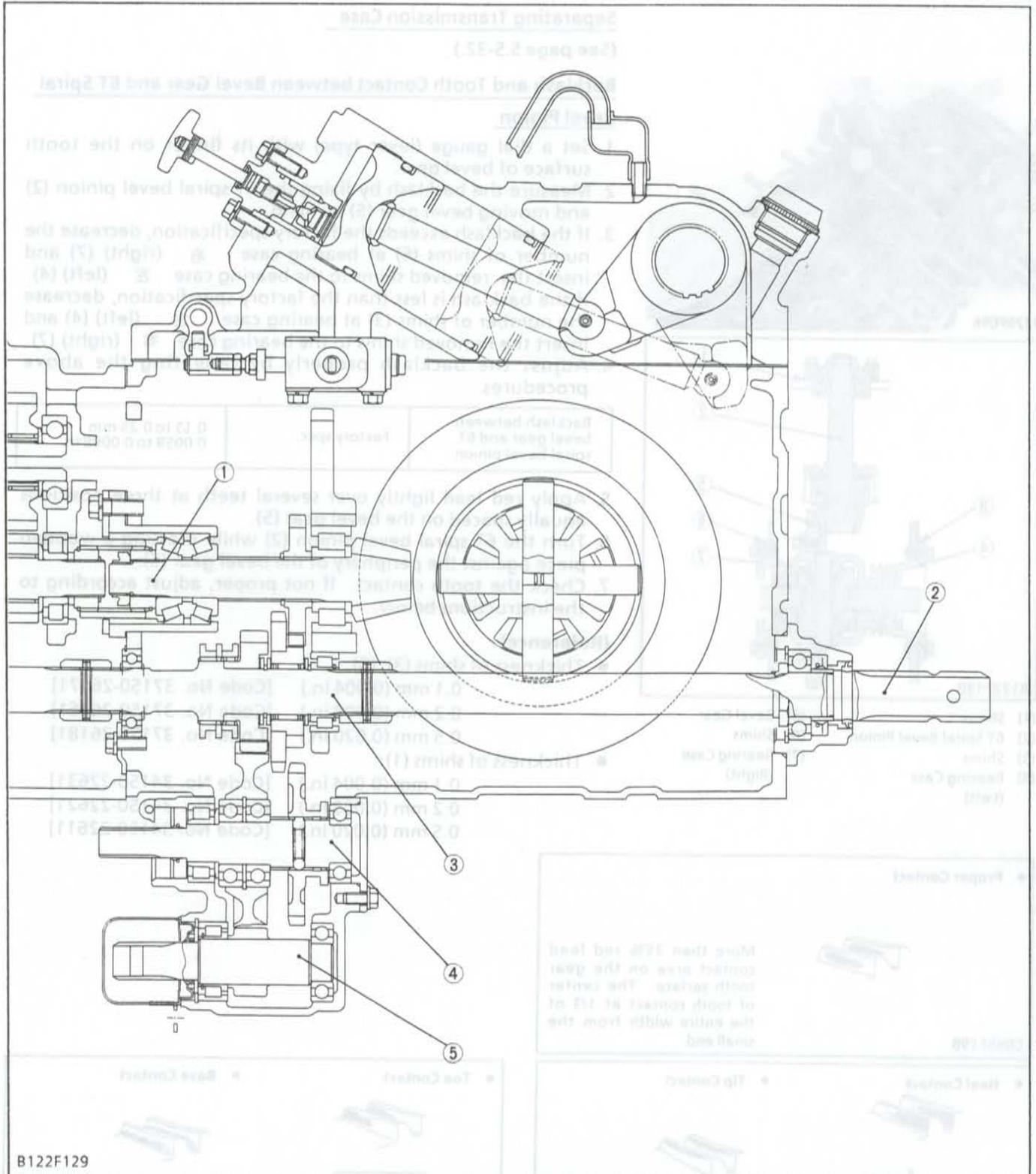
Thickness of Seal Ring

1. Measure the thickness A of seal ring with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it.

Thickness of seal ring	Factory spec.	2.45 to 2.50 mm 0.0965 to 0.0984 in.
	Allowable limit	2.0 mm 0.0788 in.

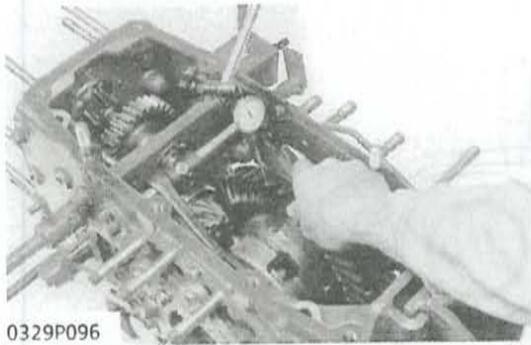


[3]-4 TRANSMISSION CASE

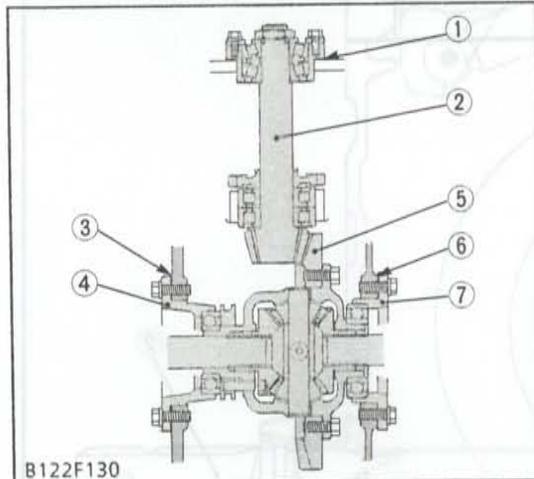


- | | | | |
|-----------------------------------|----------------------------|------------------------------|--------------------------|
| <p>(1) 6T Spiral Bevel Pinion</p> | <p>(3) PTO Drive Shaft</p> | <p>(4) Front Drive Shaft</p> | <p>(5) Mid PTO Shaft</p> |
| <p>(2) PTO Shaft</p> | | | |

CHECKING AND ADJUSTING



0329P096



B122F130

- (1) Shims
- (2) 6T Spiral Bevel Pinion
- (3) Shims
- (4) Bearing Case (Left)
- (5) Bevel Gear
- (6) Shims
- (7) Bearing Case (Right)

Separating Transmission Case

(See page S.5-32.)

Backlash and Tooth Contact between Bevel Gear and 6T Spiral Bevel Pinion

Bevel Pinion

1. Set a dial gauge (lever type) with its finger on the tooth surface of bevel gear.
2. Measure the backlash by fixing the 6T spiral bevel pinion (2) and moving bevel gear (5) by hand.
3. If the backlash exceeds the factory specification, decrease the number of shims (6) at bearing case 右 (right) (7) and insert the removed shims to the bearing case 左 (left) (4). If the backlash is less than the factory specification, decrease the number of shims (3) at bearing case 左 (left) (4) and insert the removed shims to the bearing case 右 (right) (7).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between bevel gear and 6T spiral bevel pinion	Factory spec.	0.15 to 0.25 mm 0.0059 to 0.0098 in
--	---------------	--

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear (5).
6. Turn the 6T spiral bevel pinion (2) while pressing a wooden piece against the periphery of the bevel gear (5).
7. Check the tooth contact. If not proper, adjust according to the instructions below.

(Reference)

- Thickness of shims (3), (6):
 - 0.1 mm (0.004 in.) [Code No. 37150-26171]
 - 0.2 mm (0.008 in.) [Code No. 37150-26161]
 - 0.5 mm (0.020 in.) [Code No. 37150-26181]
- Thickness of shims (1):
 - 0.1 mm (0.004 in.) [Code No. 34150-22631]
 - 0.2 mm (0.008 in.) [Code No. 34150-22621]
 - 0.5 mm (0.020 in.) [Code No. 34150-22611]

● Proper Contact



More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

C065F198

● Heel Contact



● Tip Contact



0329F097

Replace adjusting shim (1) with thinner one to move the bevel pinion shaft backward. And place the left side shim (3) to the right to move the bevel gear rightward. Repeat above until the proper tooth contact and backlash are achieved.

● Toe Contact



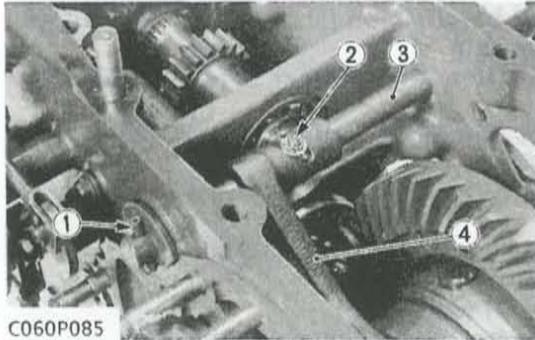
● Base Contact



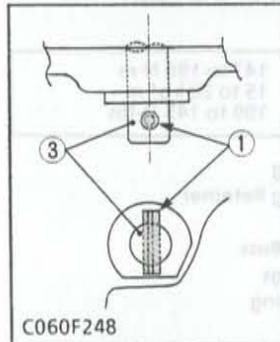
0329F098

Replace adjusting shim (1) with thicker one to move the bevel pinion shaft forward. And place the right side shim (6) to the left to move the bevel gear leftward. Repeat above until the proper tooth contact and backlash are achieved.

DISASSEMBLING AND ASSEMBLING



C060P085



C060F248

Differential Lock Shift Fork

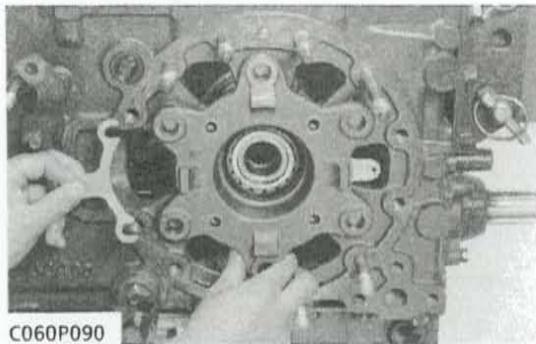
1. Tap out the spring pin (1).
2. Remove the cotter pin and take out the clevis pin (2).
3. Draw out the differential lock fork shaft (3) and take out the differential lock shift fork (4).

(When reassembling)

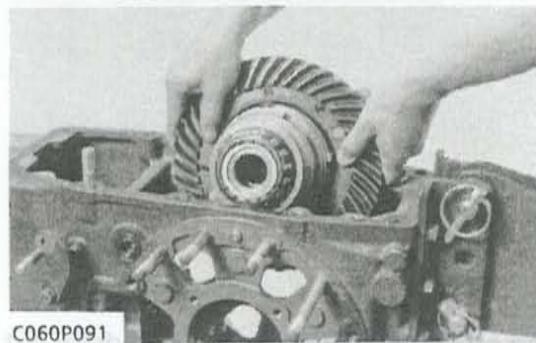
- Apply grease to the left and right oil seals on the transmission case.
- Insert the clevis pin (2) from under and install the washer and cotter pin.
- Tap in the spring pin (1) so that its split portion may face outward as shown in the figure.

- (1) Spring Pin
- (2) Clevis Pin

- (3) Differential Lock Fork Shaft
- (4) Differential Lock Shift Fork



C060P090



C060P091

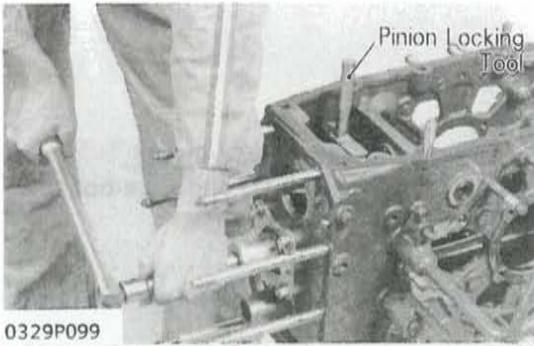
Differential Gear Assembly

1. Remove the differential bearing cases, noting the number of left and right shims.
2. Take out the differential assembly.
3. Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace spiral bevel pinion.

(When reassembling)

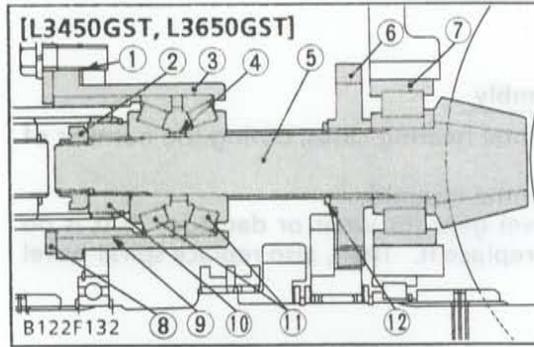
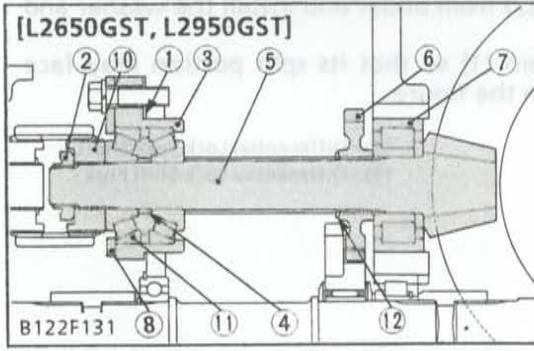
- Be sure to install the differential bearing case marked 右 in the right side, and marked 左 in the left side.
- Be sure to align the ball hole portion on the differential bearing case with the machined surface on the transmission case.

Tightening torque	Differential bearing case mounting screw	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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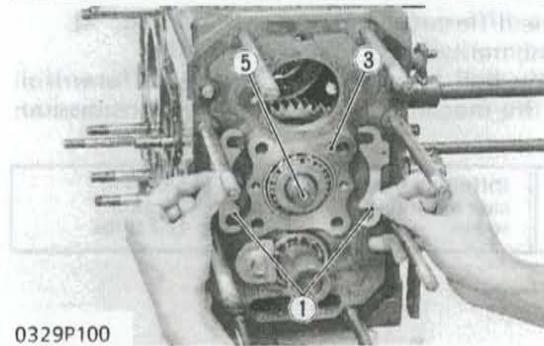
6T Spiral Bevel Pinion

1. Remove the stake of lock nut (2).
2. Lock up the 6T spiral bevel pinion (5), and remove the lock nut (2) and spline boss (10).
3. Remove the pinion bearing retainer (8). [L2650GST, L2950GST]
Remove the pinion bearing retainer (8) and collar (9). [L3450GST, L3650GST]
4. Take the pinion bearing case shims (1), noting the number of them.
5. Remove the pinion bearing case (3) with a puller.
6. Take out the distance collar (4).
7. Move the snap ring (12) to the front.
8. Hammer out the 6T spiral bevel pinion (5) to the rear.
9. Take out the 21T gear (6).



Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 109 to 145 ft·lbs
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- | | |
|----------------------------|----------------------|
| (1) Shims | (7) Bearing |
| (2) Lock Nut | (8) Bearing Retainer |
| (3) Bearing Case | (9) Collar |
| (4) Distance Collar | (10) Spline Boss |
| (5) 6T Spiral Bevel Pinion | (11) Bearings |
| (6) 21T Gear | (12) Snap Ring |



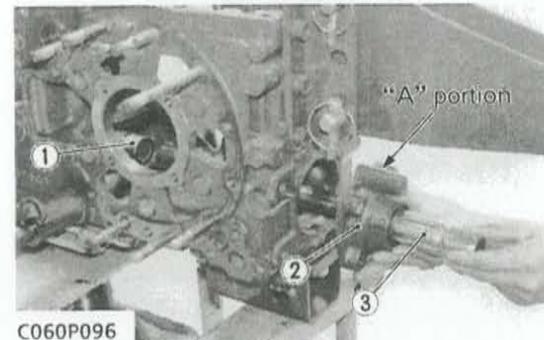
PTO Bearing Case

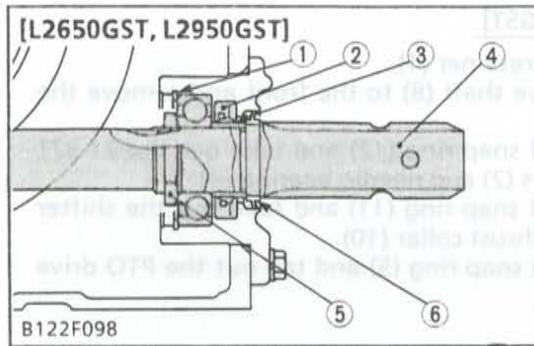
1. Remove the bearing case (2) mounting screws, and draw out the PTO shaft (3) with bearing case.
2. Take out the coupling (1).

(When reassembling)

- Direct the boss A portion on bearing case (2) upward.

- | | |
|------------------|---------------|
| (1) Coupling | (3) PTO Shaft |
| (2) Bearing Case | |





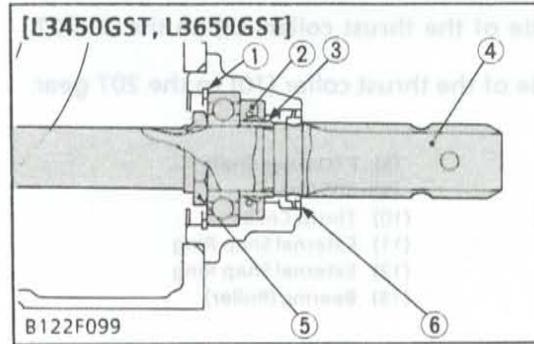
PTO Shaft

1. Remove the internal snap ring (1).
2. Tap out the PTO shaft (4) to the front.

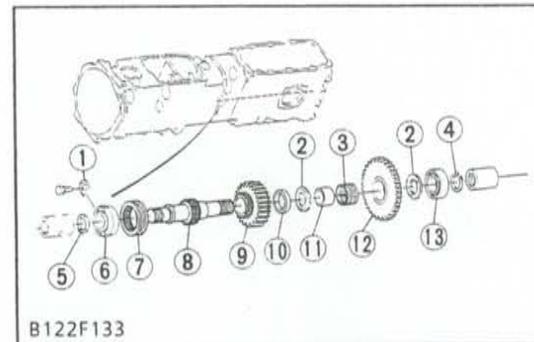
(When reassembling)

- If the lock nut (5) was removed, replace a new one, be sure to stake it firmly.
- Install the slinger (6) firmly.
- Apply grease to oil seal (2) and install it, noting its direction.

Tightening torque	Lock nut	147 to 196 N·m 15 to 20 kgf·m 108 to 145 ft-lbs
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- | | |
|------------------------|---------------|
| (1) Internal Snap Ring | (4) PTO Shaft |
| (2) Oil Seal | (5) Lock Nut |
| (3) Collar | (6) Slinger |



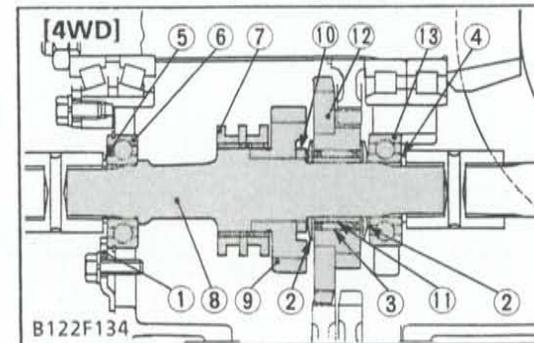
PTO Drive Shaft [L2650GST, L2950GST]

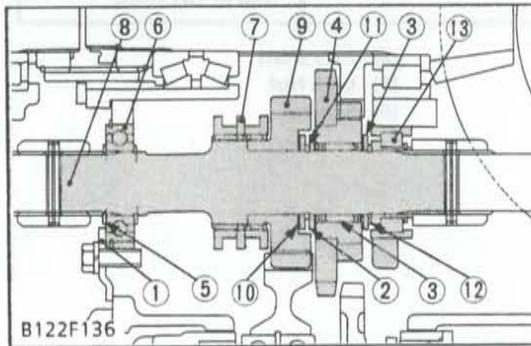
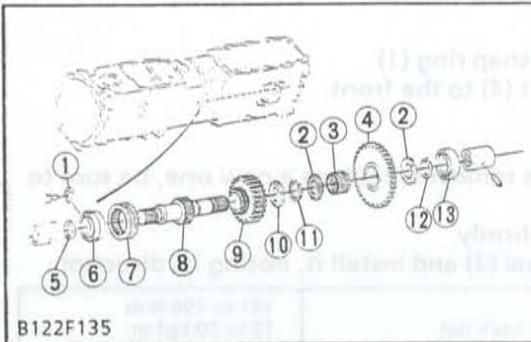
1. Remove the bearing retainer (1).
2. Remove the external snap ring (4) on the rear of PTO drive shaft (8), and tap out it to the front.

(When reassembling)

- Direct the groove side of thrust collars (2) to the 21-34T Gear (12) side.

- | | |
|----------------------|---------------------|
| (1) Bearing Retainer | (8) PTO Drive Shaft |
| (2) Thrust Collars | (9) 20T Gear |
| (3) Needle Bearing | (10) Collar |
| (4) Snap Ring | (11) Inner Ring |
| (5) Snap Ring | (12) 21-34T |
| (6) Bearing | (13) Bearing |
| (7) Shifter | |





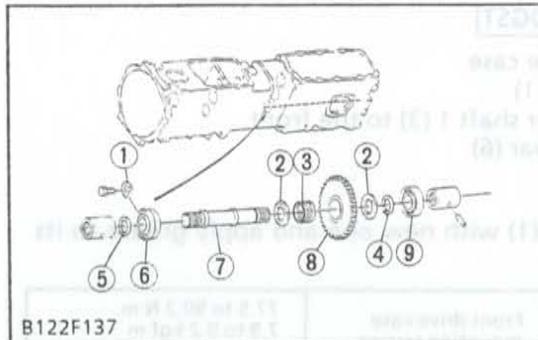
PTO Drive Shaft [L3450GST]

1. Remove the bearing retainer (1).
2. Tap out the PTO drive shaft (8) to the front and remove the bearing (13).
3. Remove the external snap ring (12) and take out the 21-32T gear (4), thrust collars (2) and needle bearing (3).
4. Remove the external snap ring (11) and take out the shifter (7), 20T gear (9) and thrust collar (10).
5. Remove the external snap ring (5) and tap out the PTO drive shaft (8) to the rear.

(When reassembling)

- Direct the groove side of the thrust collars (2) to the 21-32T gear (4) side.
- Direct the groove side of the thrust collar (10) to the 20T gear side.

- | | |
|------------------------|-------------------------|
| (1) Bearing Retainer | (8) PTO Drive Shaft |
| (2) Thrust Collars | (9) 20T Gear |
| (3) Needle Bearing | (10) Thrust Collar |
| (4) 21-32T gear | (11) External Snap Ring |
| (5) External Snap Ring | (12) External Snap Ring |
| (6) Bearing | (13) Bearing (Roller) |
| (7) Shifter | |

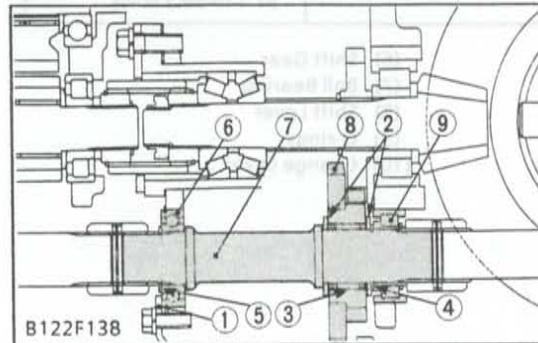


PTO Drive Shaft [L3650GST]

1. Remove the bearing retainer (1).
2. Tap out the PTO drive shaft (7) to the front and remove the bearing (9).
3. Remove the external snap ring (4) and take out the 21-32T gear (8), thrust collars (2) and needle bearing (3).
4. Remove the external snap ring (5) and tap out the PTO drive shaft (7) to the rear.

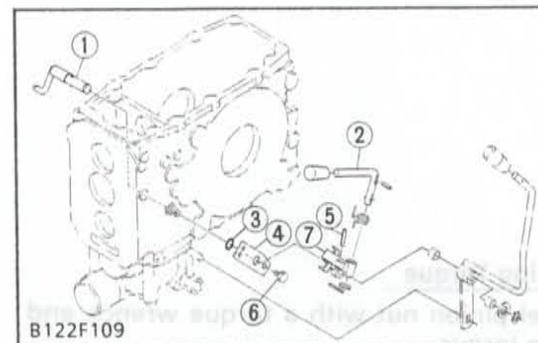
(When reassembling)

- Direct the groove side of the thrust collars (2) to the 21-32T gear (8).



- (1) Bearing Retainer
- (2) Thrust Collars
- (3) Needle Bearing
- (4) External Snap Ring
- (5) External Snap Ring

- (6) Bearing
- (7) PTO Drive Shaft
- (8) 21-32T Gear
- (9) Bearing (Roller)



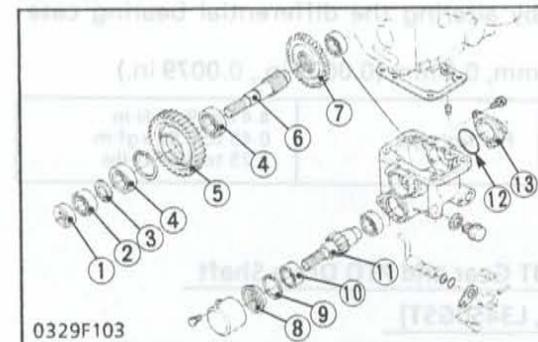
Mid PTO Shift Lever [L2650GST, L2950GST, L3450GST]

1. Remove the shift levers (2), (7) and guide (4).
2. Take out the shift lever 3 (1).

(When reassembling)

- Tighten the screw (6) of the guide (4) after installing the spring pin (5).

- (1) Shift Lever 3
- (2) Shift Lever 1
- (3) O-ring
- (4) Guide
- (5) Spring Pin
- (6) Screw
- (7) Shift Lever 2
- (8) Holder



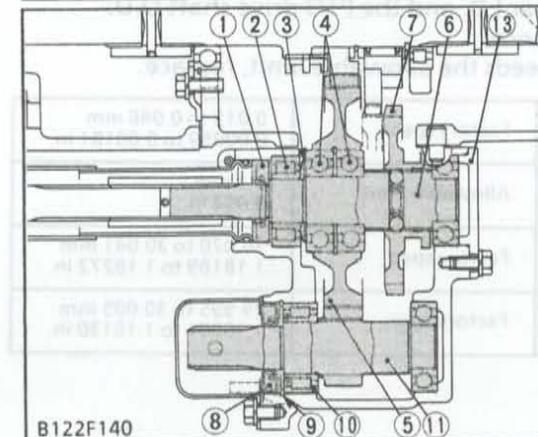
Front Drive Case [L2650GST, L2950GST, L3450GST]

1. Remove the front drive case cover (13).
2. Tap out the propeller shaft 1 (6) to the rear.
3. Take out the shift gear (7).
4. Remove the oil seal (8).
5. Remove the internal snap ring (9).
6. Tap out the mid PTO shaft (11) to the front.

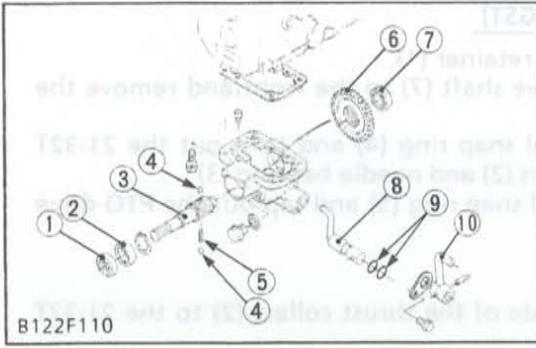
(When reassembling)

■ IMPORTANT

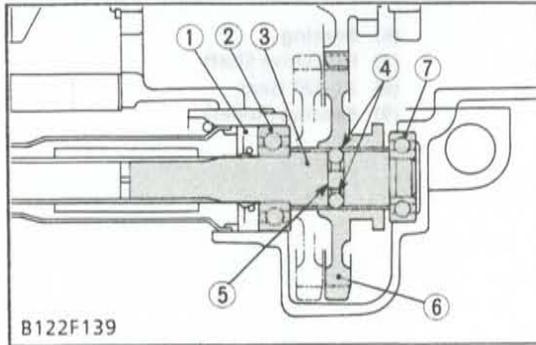
- Be sure to install the bearings (2), (10) as shown in the figure, noting direction of their inner races.
- Direct the longer boss side of the 37T gear (5) to the front.
- Direct the oil grooved side of thrust collar (3) to the gear side.
- Replace the oil seal with new one and apply grease to its inside.



- (1) Oil Seal
- (2) Bearing
- (3) Thrust Collar
- (4) Ball Bearing
- (5) 37T Gear
- (6) Propeller Shaft 1
- (7) Shift Gear
- (8) Oil Seal
- (9) Internal Snap Ring
- (10) Bearing
- (11) Mid PTO Shaft
- (12) O-ring
- (13) Drive Case Cover



B122F110



B122F139

Front Drive Case [L3650GST]

1. Removing front drive case.
2. Remove the oil seal (1).
3. Tap out the propeller shaft 1 (3) to the front.
4. Take out the shift gear (6).

(When reassembling)

- Replace the oil seal (1) with new one and apply grease to its inside.

Tightening torque	Front drive case mounting screws	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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- | | |
|-----------------------|-------------------|
| (1) Oil Seal | (6) Shift Gear |
| (2) Ball Bearing | (7) Ball Bearing |
| (3) Propeller Shaft 1 | (8) Shift Lever |
| (4) Balls | (9) O-rings |
| (5) Spring | (10) Change Lever |

SERVICING

Checking Bearing

(See page S.3-62.)

Gear Backlash

(See page S.3-68.)

Differential Gear Turning Torque

1. Grip the spiral bevel pinion nut with a torque wrench and measure the turning torque.
2. Adjust the torque by altering the differential bearing case shim thickness.
Shim thickness: 0.1 mm, 0.2 mm (0.0039 in., 0.0079 in.)



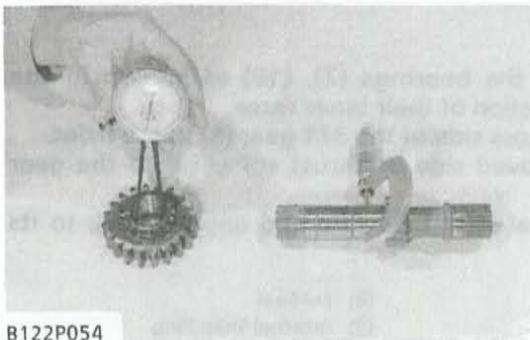
C011P254

Differential gear turning torque (Combined)	Factory spec.	4.41 to 9.32 N·m 0.45 to 0.95 kgf·m 3.25 to 6.87 ft·lbs
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Clearance between 20T Gear and PTO Drive Shaft

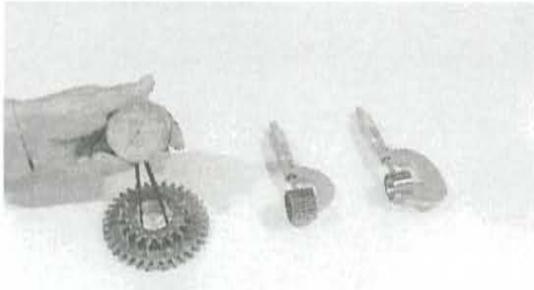
[L2650GST, L2950GST, L3450GST]

1. Measure the 20T gear I.D. and the PTO drive shaft O.D.
2. Calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.



B122P054

Clearance between 20T gear and PTO drive shaft	Factory spec.	0.015 to 0.046 mm 0.00059 to 0.00181 in.
	Allowable limit	0.1 mm 0.004 in.
20T gear I.D.	Factory spec.	30.020 to 30.041 mm 1.18189 to 1.18272 in.
PTO drive shaft O.D.	Factory spec.	29.995 to 30.005 mm 1.18091 to 1.18130 in.

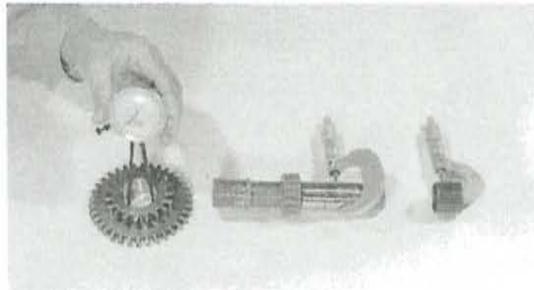


B122P055

Clearance between 21-34T Gear and Inner Race on PTO Drive Shaft [L2650GST, L2950GST]

1. Measure the 21-34T gear I.D. and the inner race O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 21-34T gear and inner race	Factory spec.	0.004 to 0.043 mm 0.00016 to 0.00169 in.
	Allowable limit	0.1 mm 0.004 in.
21-34T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
Inner race O.D.	Factory spec.	29.995 to 30.005 mm 1.18095 to 1.18130 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.



B122P056

Clearance between 21-32T Gear and PTO Drive Shaft [L3450GST, L3650GST]

1. Measure the 21-32T gear I.D. and the PTO drive shaft O.D.
2. Measure the O.D. of needle installed diagonally in the needle bearing.
3. Calculate the clearance.
4. If the clearance exceeds the allowable limit, replace.

Clearance between 21-32T gear and PTO drive shaft	Factory spec.	0.009 to 0.052 mm 0.00035 to 0.00205 in.
	Allowable limit	0.1 mm 0.004 in.
21-32T gear I.D.	Factory spec.	37.009 to 37.025 mm 1.45705 to 1.45768 in.
PTO drive shaft O.D.	Factory spec.	29.987 to 30.000 mm 1.18059 to 1.18110 in.
Needle O.D.	Factory spec.	3.493 to 3.500 mm 0.13752 to 0.13780 in.

S.4 REAR AXLE

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TIGHTENING TORQUES	S.4-3
CHECKING, DISASSEMBLING AND SERVICING	S.4-4
[1] REAR AXLE (L2350)	S.4-4
DISASSEMBLING AND ASSEMBLING	S.4-4
SERVICING	S.4-5
[2] REAR AXLE (L2650, L2950, L3450, L3650)	S.4-5
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SERVICING	S.4-6
[3] DIFFERENTIAL GEAR (L2350, L2650)	S.4-6
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SERVICING	S.4-7
[4] DIFFERENTIAL GEAR (L2650, L2950, L3450, L3650)	S.4-8
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SERVICING	S.4-10

TROUBLESHOOTING

Before troubleshooting, confirm symptoms and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Inflation pressure of tire	M.11-5
2	Tightening torque Front wheels screws and nuts Rear wheels screws and nuts Rim bolts and nuts	S.S-1, 2
3	Transmission fluid	S.G-14, 15

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Excessive or Unusual Noise At All Time	<ul style="list-style-type: none"> Improper backlash between 8T spiral bevel pinion and bevel gear 	Adjust	S.3-23, 42, 76
	<ul style="list-style-type: none"> Improper backlash between differential pinion and differential side gear 	Adjust	S.4-8, 10
	<ul style="list-style-type: none"> Bearings worn 	Replace	-
Noise While Turning	<ul style="list-style-type: none"> Differential pinions or differential side gears worn or damaged 	Replace	S.4-6, 8
	<ul style="list-style-type: none"> Differential lock binding (does not disengage) 	Replace	-
	<ul style="list-style-type: none"> Bearings worn 	Replace	-
Differential Lock Can Not Be Set	<ul style="list-style-type: none"> Differential lock shift fork damaged 	Replace	S.3-24, 43, 77
	<ul style="list-style-type: none"> Differential lock shift fork mounting pin damaged 	Replace	S.3-24, 43, 77
	<ul style="list-style-type: none"> Differential lock shifter pin damaged 	Replace	S.3-24, 43, 77
Differential Lock Pedal Does Not Return	<ul style="list-style-type: none"> Differential lock pedal return spring weaken or damaged 	Replace	-
	<ul style="list-style-type: none"> Differential lock shifter pin damaged 	Replace	-

SERVICING SPECIFICATIONS

DIFFERENTIAL GEAR

Item		Factory Specification		Allowable Limit	
Differential Case Bore to Differential Side Gear Boss		Clearance		0.050 to 0.151 mm 0.00197 to 0.00594 in.	0.35 mm 0.0138 in.
Differential Case Bore	I.D.	L2350 L2650*1	38.000 to 38.062 mm 1.49606 to 1.49850 in.	-	
		L2650*2 L2950 L3450 L3650	40.500 to 40.562 mm 1.59449 to 1.59693 in.	-	
Differential Side Gear Boss	O.D.	L2350 L2650*1	37.911 to 37.950 mm 1.49256 to 1.49410 in.	-	
		L2650*2 L2950 L3450 L3650	40.411 to 40.450 mm 1.59099 to 1.59252 in.	-	
Differential Pinion Shaft to Differential Pinion	Clearance	L2350 L2650*1	0.100 to 0.142 mm 0.00394 to 0.00559 in.	0.30 mm 0.0118 in.	
		L2650*2 L2950 L3450 L3650	0.060 to 0.102 mm 0.00236 to 0.00402 in.	0.25 mm 0.0098 in.	
Differential Pinion Shaft	O.D.	L2350 L2650*1	19.939 to 19.960 mm 0.78500 to 0.78583 in.	-	
		L2650*2 L2950 L3450 L3650	19.959 to 19.980 mm 0.78579 to 0.78661 in.	-	
Differential Pinion	I.D.	L2350 L2650*1	20.060 to 20.081 mm 0.78976 to 0.79059 in.	-	
		L2650*2 L2950 L3450 L3650	20.040 to 20.061 mm 0.78898 to 0.78980 in.	-	
Differential Pinion to Differential Side Gear	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.		-	
Differential Side Gear Washer 1	Thickness	1.5 (1.46 to 1.54) mm 0.059 (0.0575 to 0.0606) in.		-	
Differential Side Gear Washer 2	Thickness	1.6 (1.56 to 1.64) mm 0.063 (0.0614 to 0.0646) in.		-	
Differential Side Gear Washer 3	Thickness	1.7 (1.66 to 1.74) mm 0.067 (0.0654 to 0.0685) in.		-	

NOTE

- The tractor serial No. affected to L2650 is as follows.
 L2650*1 : L2650 (2WD) ; 10001 to 19999, L2650 (4WD) ; 50001 to 59999
 L2650*2 : L2650 (2WD) ; 20001 and above, L2650 (4WD) ; 60001 and above

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
 (For general use screws and nuts: See page S.G-8)

REAR AXLE CASE

Item	N·m	kgf·m	ft-lbs
Rear axle case mounting screws and nuts [L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Rear axle case mounting screws [Except L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2
Rear axle case mounting nut [Except L2350]	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
Rear axle lock nut	196 to 245	20 to 25	145 to 181

DIFFERENTIAL GEAR

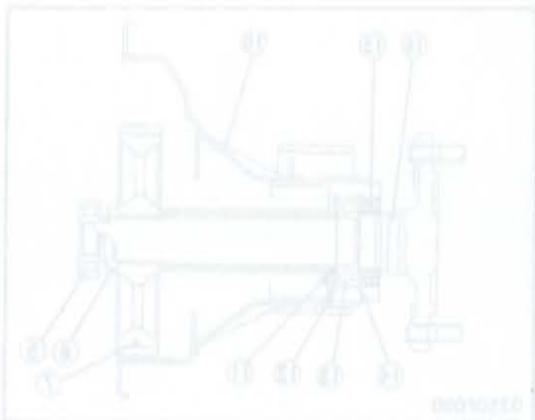
Spiral bevel gear mounting screws	68.6 to 88.3	7.0 to 9.0	50.6 to 65.1
Differential case cover mounting screws [Except L2350]	48.1 to 55.8	4.9 to 5.7	35.5 to 41.2



Separating Rear Axle
 (See page S-7)

Rear Axle

- 1 Remove ball bearing (3) with a puller
 - 2 Remove pin from lock nut (8)
 - 3 Hold rear axle (18) in a vise and remove lock nut (8)
 - 4 Take out 23T gear (7), spacer (8) and thrust washer (11)
 - 5 Tap out rear axle (18)
 - 6 Remove internal snap ring (12) and ball bearing (13)
 - 7 Remove internal snap ring (14) and oil seal (15)
- (When reassembling)
- Apply grease to oil seal (15)
 - Place thrust washer (11) between spacer (8) and ball bearing (13)
 - Replace the lock nut with new one, and after tightening it to specified torque, pin it securely.

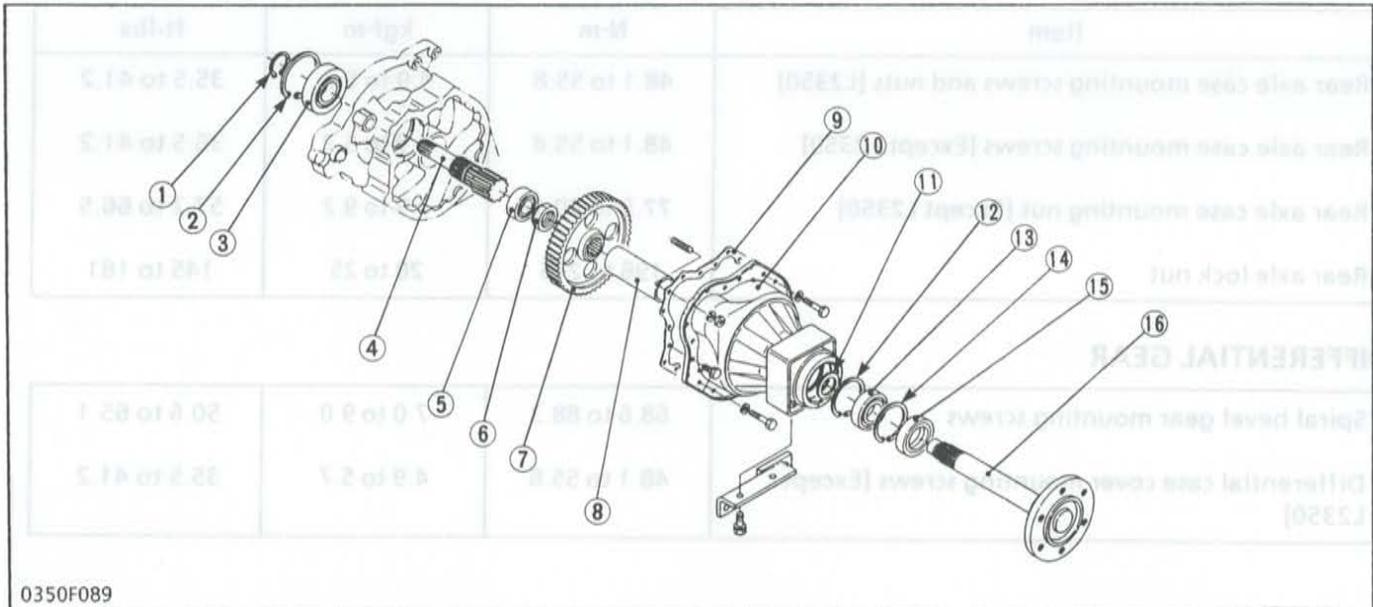


Tightening torque	Lock nut
196 to 245 N·m 20 to 25 kgf·m 145 to 181 ft·lbf	

CHECKING, DISASSEMBLING AND SERVICING

[1] REAR AXLE (L2350)

DISASSEMBLING AND ASSEMBLING

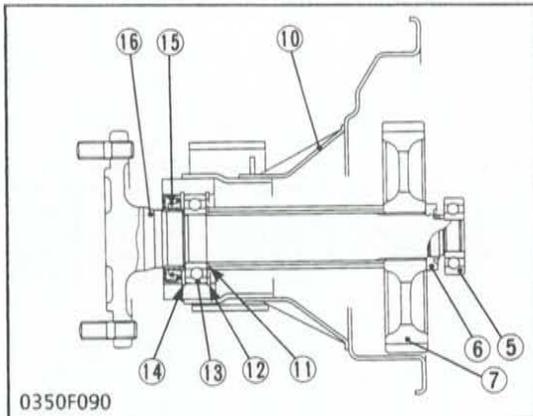


0350F089

- | | | | |
|-----------------------------|------------------|-------------------------|-------------------------|
| (1) External Snap Ring | (5) Ball Bearing | (9) Gasket | (13) Ball Bearing |
| (2) Internal Snap Ring | (6) Lock Nut | (10) Rear Axle Case | (14) Internal Snap Ring |
| (3) Ball Bearing | (7) 53T Gear | (11) Thrust Washer | (15) Oil Seal |
| (4) Differential Gear Shaft | (8) Spacer | (12) Internal Snap Ring | (16) Rear Axle |

Separating Rear Axle

(See page S.5-7)



0350F090

Rear Axle

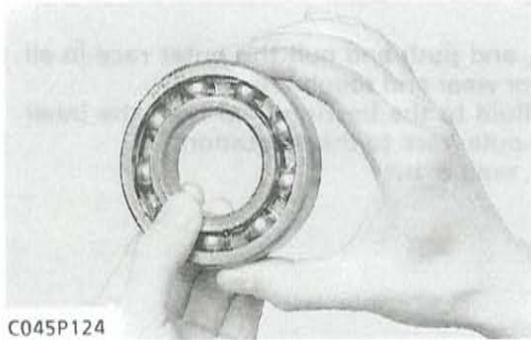
1. Remove ball bearing (3) with a puller.
2. Remove pin from lock nut (6).
3. Hold rear axle (16) in a vise and remove lock nut (6).
4. Take out 53T gear (7), spacer (8) and thrust washer (11).
5. Tap out rear axle (16).
6. Remove internal snap ring (12) and ball bearing (13).
7. Remove internal snap ring (14) and oil seal (15).

(When reassembling)

- Apply grease to oil seal (15).
- Place thrust washer (11) between spacer (8) and ball bearing (13).
- Replace the lock nut with new one, and after tightening it to specified torque, pin it securely.

Tightening torque	Lock nut	196 to 245 N·m 20 to 25 kgf·m 145 to 181 ft·lbs
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SERVICING



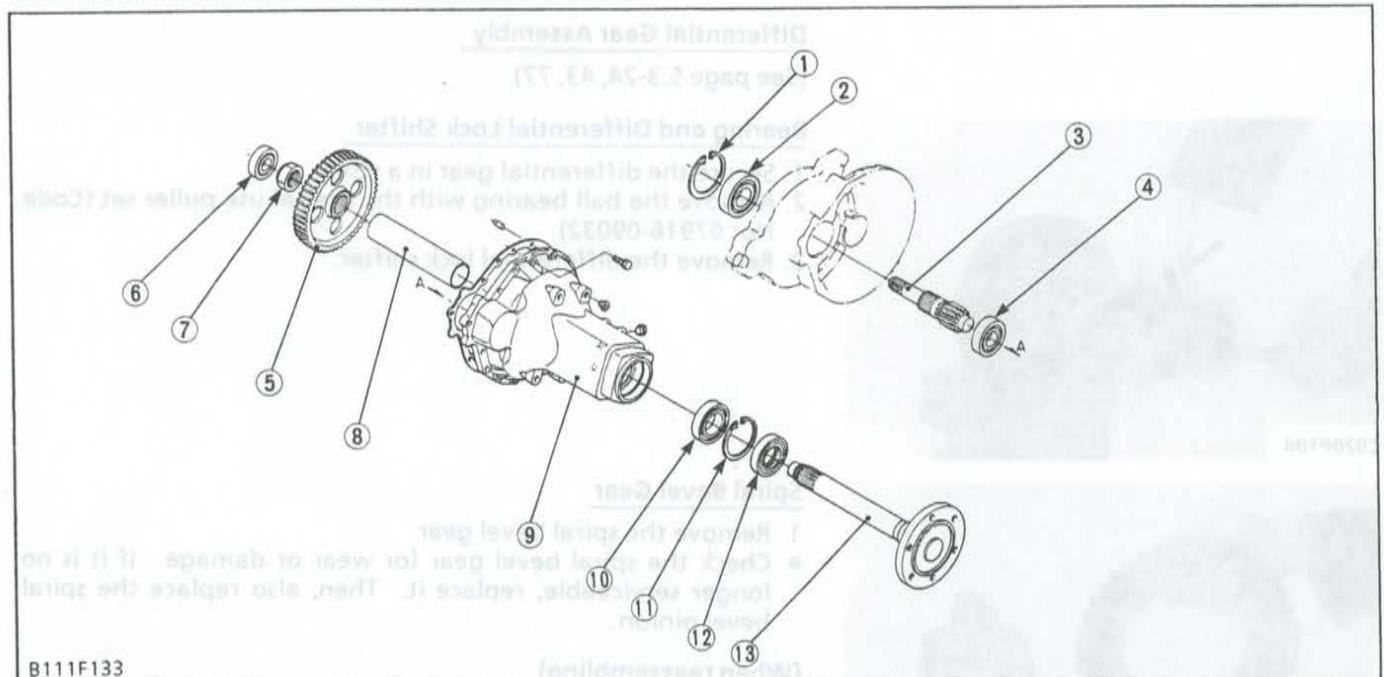
C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

[2] REAR AXLE (L2650, L2950, L3450, L3650)

DISASSEMBLING AND ASSEMBLING



B111F133

- | | | | |
|-----------------------------|------------------|--------------------|-------------------------|
| (1) Internal Snap Ring | (5) 53T Gear | (8) Spacer | (11) Internal Snap Ring |
| (2) Ball Bearing | (6) Ball Bearing | (9) Rear Axle Case | (12) Oil Seal |
| (3) Differential Gear Shaft | (7) Lock Nut | (10) Ball Bearing | (13) Rear Axle |
| (4) Ball Bearing | | | |

Separating Rear Axle

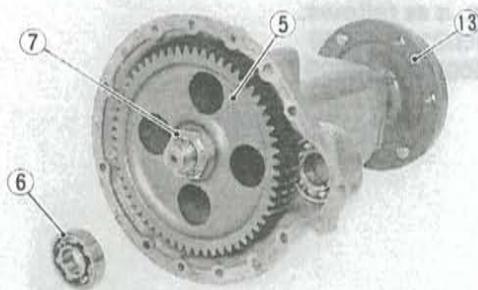
(See page S.5-21)

Rear Axle

1. Remove the ball bearing (6) with a puller.
2. Remove the stake of lock nut (7).
3. Secure the rear axle (13) in a vise and remove the lock nut.
4. Take out the 53T gear (5) and spacer (8).
5. Tap out the rear axle (3).

(When reassembling)

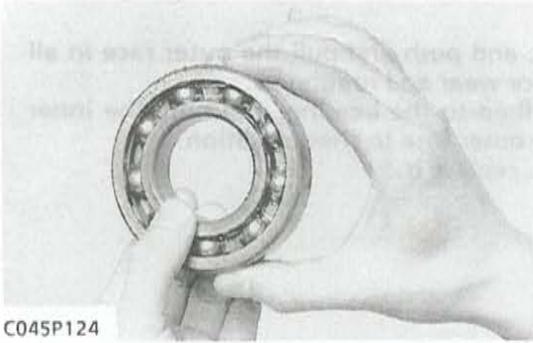
- Apply grease to the oil seal (12) and install it.
- Replace the lock nut with new one, and after tightening it to specified torque, stake it firmly.



0329P104

Tightening torque	Lock nut	196 to 245 N·m 20 to 25 kgf·m 145 to 181 ft·lbs
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SERVICING



C045P124

Checking Bearing

1. Hold the inner race, and push and pull the outer race in all directions to check for wear and roughness.
2. Apply transmission fluid to the bearing, and hold the inner race. Then, turn the outer race to check rotation.
3. If there is any defect, replace it.

[3] DIFFERENTIAL GEAR (L2350, L2650※)

DISASSEMBLING AND ASSEMBLING



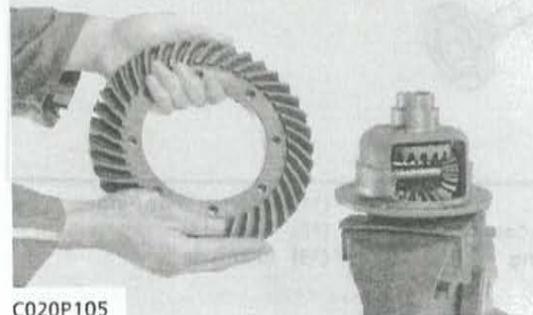
C020P104

Differential Gear Assembly

(See page S.3-24, 43, 77)

Bearing and Differential Lock Shifter

1. Secure the differential gear in a vise.
2. Remove the ball bearing with the special use puller set (Code No: 07916-09032).
3. Remove the differential lock shifter.



C020P105

Spiral Bevel Gear

1. Remove the spiral bevel gear.
 - Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace the spiral bevel pinion.

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the spiral bevel gear mounting screws.

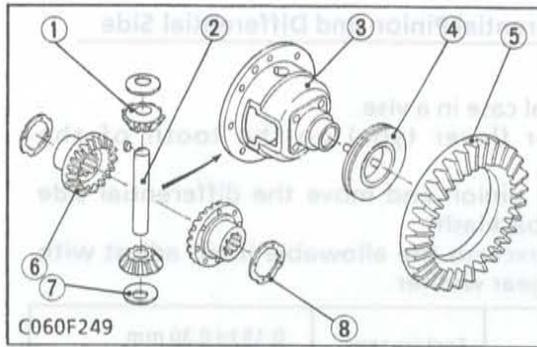
Tightening torque	Spiral bevel gear mounting screws	68.6 to 88.3 N·m 7.0 to 9.0 kgf·m 50.6 to 65.1 ft·lbs
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■ NOTE

- The tractor serial No. is as follows.
L2650 (2WD) : 10001 to 19999
L2650 (4WD) : 50001 to 59999

100 to 120 N·m 10 to 12 kgf·m 70 to 85 ft·lb	Lock nut	Tightening torque
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- (1) Differential Pinion
 (2) Differential Pinion Shaft
 (3) Differential Case
 (4) Differential Lock Shifter
 (5) Spiral Bevel Gear
 (6) Differential Side Gear
 (7) Differential Pinion Washer
 (8) Differential Side Gear Washer

Differential Pinion and Differential Side Gear

1. Draw out the differential pinion shaft (2).
2. Take out the differential pinions (1) and the differential side gears (6).

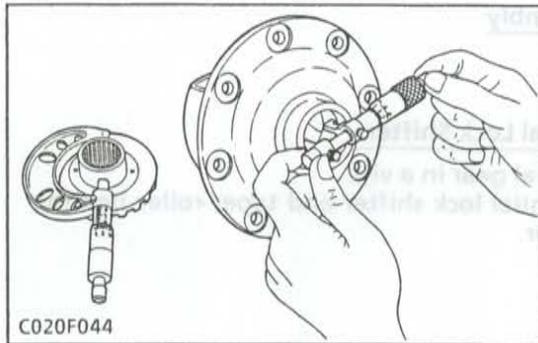
NOTE

- Arrange the parts to know their original position.

(When reassembling)

- Examine the thrust and bearing surface of both differential side gears (6). If they are worn or damaged, bores in the differential case may also be damaged.
- Check the differential pinions (1) and pinion shaft (2) for excessive wear. If these parts are damaged or excessively worn, also replace parts they are in mesh with, or they are sliding on.
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions.
- Install the parts to their original position.

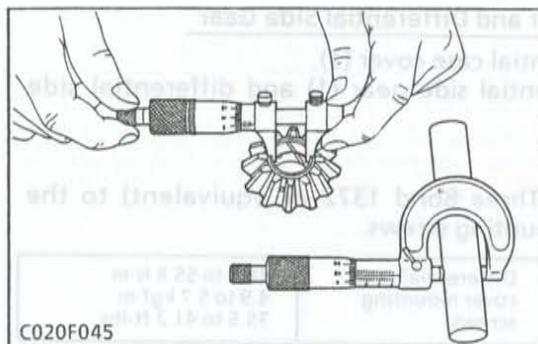
SERVICING



Clearance between Differential Case Bore and Differential Side Gear Boss

1. Measure the bore I.D. of the differential case.
2. Measure the boss O.D. of the differential side gear and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

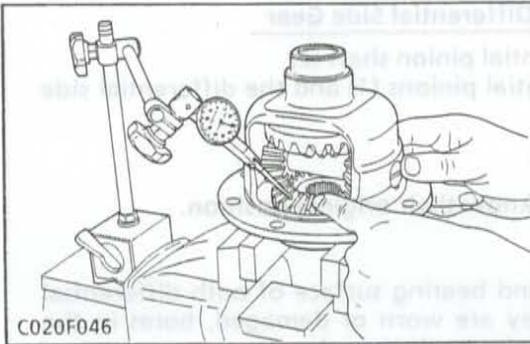
Clearance between differential case bore and differential side gear boss	Factory spec.	0.050 to 0.151 mm 0.00197 to 0.00594 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D.	Factory spec.	38.000 to 38.062 mm 1.49606 to 1.49850 in.
Differential side gear boss O.D.	Factory spec.	37.911 to 37.950 mm 1.49256 to 1.49410 in.



Clearance between Differential Pinion Shaft and Differential Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential pinion shaft and pinion	Factory spec.	0.100 to 0.142 mm 0.00394 to 0.00559 in.
	Allowable limit	0.30 mm 0.0118 in.
Differential pinion shaft O.D.	Factory spec.	19.939 to 19.960 mm 0.78500 to 0.78583 in.
Differential pinion boss I.D.	Factory spec.	20.060 to 20.081 mm 0.78976 to 0.79059 in.



C020F046

Backlash between Differential Pinion and Differential Side Gear

Gear

1. Secure the differential case in a vise.
2. Set a dial indicator (lever type) on the tooth of the differential side gear.
3. Hold the differential pinion and move the differential side gear to measure the backlash.
4. If the measurement exceeds the allowable limit, adjust with the differential side gear washer.

Backlash between differential pinion and differential side gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
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(Reference)

- Thickness of differential side gear washers :
 - 1.5 mm (0.059 in.) [Code No. 31331-26471]
 - 1.6 mm (0.063 in.) [Code No. 31331-26481]
 - 1.7 mm (0.067 in.) [Code No. 31331-26491]

[4] DIFFERENTIAL GEAR (L2650*, L2950, L3450, L3650)

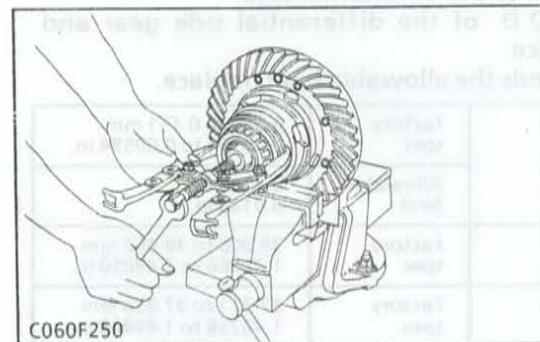
DISASSEMBLING AND ASSEMBLING

Differential Gear Assembly

(See page S.3-43, 77)

Bearing and Differential Lock Shifter

1. Secure the differential gear in a vise.
2. Remove the differential lock shifter and taper roller bearing as a unit with a puller.



C060F250

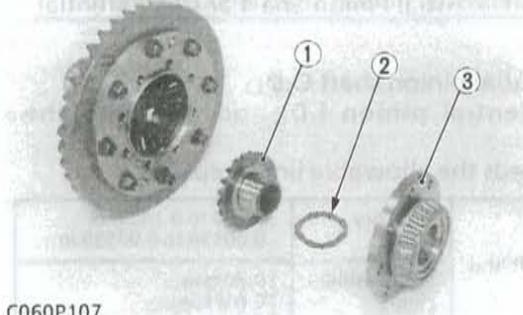
Differential Case Cover and Differential Side Gear

1. Remove the differential case cover (3).
2. Remove the differential side gear (1) and differential side gear washer (2)

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the differential case mounting screws.

Tightening torque	Differential case cover mounting screws	48.1 to 55.8 N·m 4.9 to 5.7 kgf·m 35.5 to 41.2 ft·lbs
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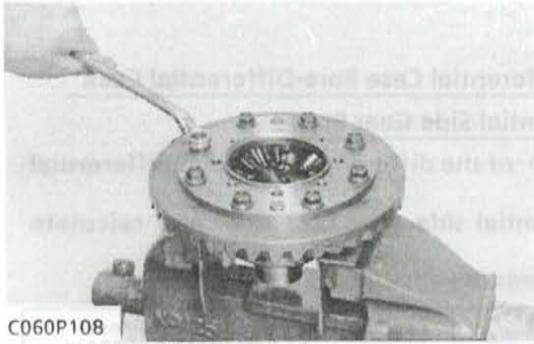
C060P107

- (1) Differential Side Gear
- (2) Differential Side Gear Washer
- (3) Differential Case Cover

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NOTE

- The tractor serial No. is as follows.
 L2650 (2WD) : 20001 and above
 L2650 (4WD) : 60001 and above



C060P108

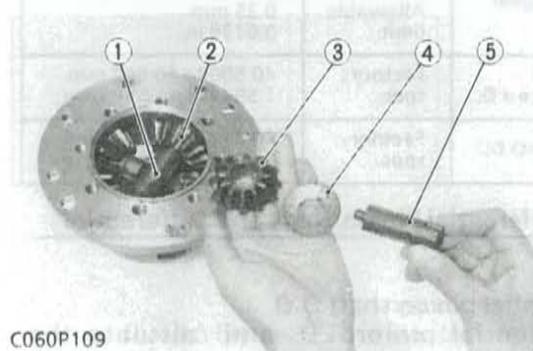
Spiral Bevel Gear

1. Remove the spiral bevel gear.
 - Check the spiral bevel gear for wear or damage. If it is no longer serviceable, replace it. Then, also replace the spiral bevel pinion.

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the spiral bevel gear UBS screws.

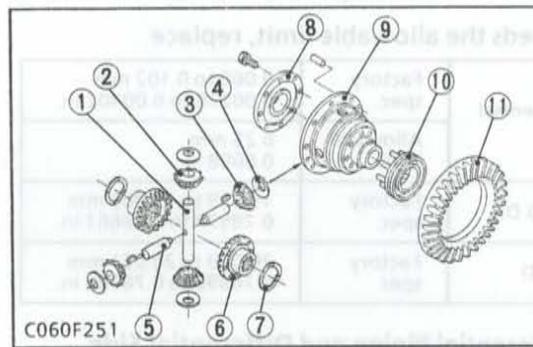
Tightening torque	Spiral bevel gear UBS screws	68.6 to 88.3 N·m 7.0 to 9.0 kgf·m 50.6 to 65.1 ft·lbs
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C060P109

Differential Pinion Shaft and Differential Pinion

1. Draw out the differential pinion shaft 2 (5), and take out the differential pinion (3) and differential pinion washer (4).
 2. Draw out the differential pinion shaft (1) and take out the differential pinion (2) and differential pinion washer.
- Check the differential pinions (2), (3) and pinion shaft (1), (5) for excessive wear. If these parts are damaged or excessively worn, also replace parts they are in mesh with, or they sliding on.



C060F251

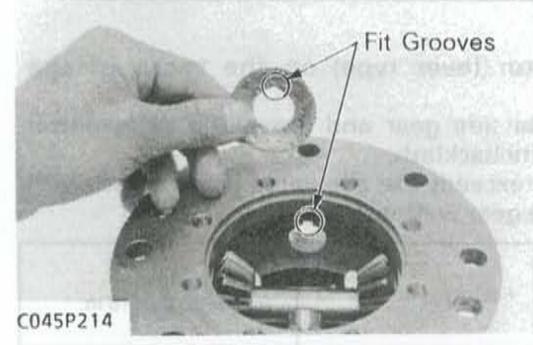
- (1) Differential Pinion Shaft
- (2) Differential Pinion
- (3) Differential Pinion
- (4) Differential Pinion Washer
- (5) Differential Pinion Shaft 2
- (6) Differential Side Gear
- (7) Differential Side Gear Washer
- (8) Differential Case Cover
- (9) Differential Case
- (10) Differential Lock Shifter
- (11) Spiral Bevel Gear

NOTE

- Arrange the parts to know their original position.

(When reassembling)

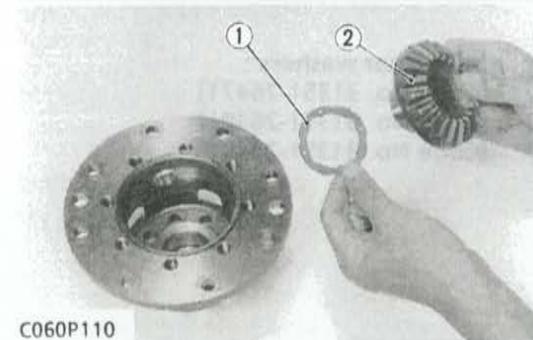
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions.
- Install the parts to their original position.
- Install the differential pinion washer (4), noting its groove position.



C045P214

Differential Side Gear

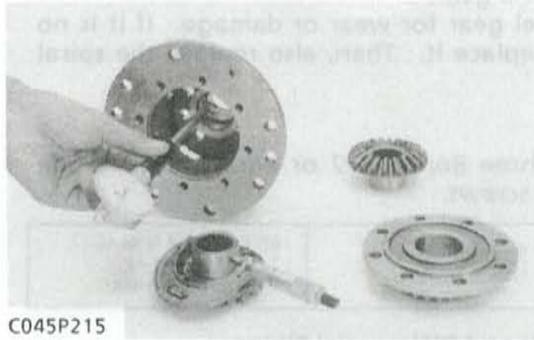
1. Take out the differential side gear (2) and differential side gear washer (1).
- Examine the thrust and bearing surface of both differential side gears (2). If they are worn or damaged, bores in the differential case may also be damaged.



C060P110

- (1) Differential Side Gear Washer
- (2) Differential Side Gear

SERVICING

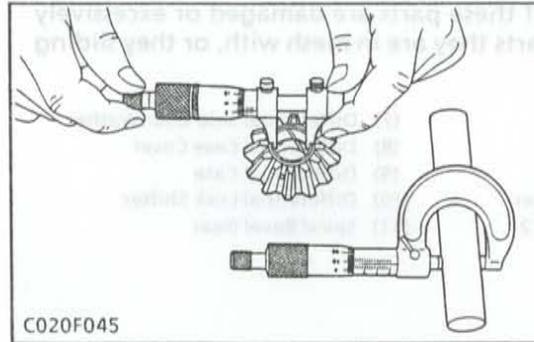


C045P215

Clearance between Differential Case Bore-Differential Case Cover Bore and Differential Side Gear Boss

1. Measure the bore I.D. of the differential case and differential case cover
2. Measure the differential side gear boss O.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential case bore differential case cover bore and differential side gear boss	Factory spec.	0.050 to 0.151 mm 0.00197 to 0.00594 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D., Differential case cover bore I.D.	Factory spec.	40.500 to 40.562 mm 1.59449 to 1.59693 in.
Differential side gear boss O.D.	Factory spec.	40.411 to 40.450 mm 1.59099 to 1.59252 in.



C020F045

Clearance between Differential Pinion Shaft and Differential Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

Clearance between differential pinion shaft and pinion	Factory spec.	0.060 to 0.102 mm 0.00236 to 0.00402 in.
	Allowable limit	0.25 mm 0.0098 in.
Differential pinion shaft O.D.	Factory spec.	19.959 to 19.980 mm 0.78579 to 0.78661 in.
Differential pinion boss I.D.	Factory spec.	20.040 to 20.061 mm 0.78898 to 0.78980 in.



C045P217

Backlash between Differential Pinion and Differential Side Gear

1. Set a dial indicator (lever type) on the tooth of the differential pinion.
2. Hold the differential side gear and move the differential pinion to measure the backlash.
3. If the measurement exceeds the allowable limit, adjust with the differential side gear washer.

Backlash between differential pinion and differential side gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
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(Reference)

- Thickness of differential side gear washers :
 - 1.5 mm (0.059 in.) [Code No. 31351-26471]
 - 1.6 mm (0.063 in.) [Code No. 31351-26481]
 - 1.7 mm (0.067 in.) [Code No. 31351-26491]

S.5 BRAKES

CONTENTS

TROUBLESHOOTING	S.5-1
SERVICING SPECIFICATIONS	S.5-2
TIGHTENING TORQUES	S.5-2
CHECKING, DISASSEMBLING AND SERVICING	S.5-3
[1] BRAKE PEDAL	S.5-3
CHECKING AND ADJUSTING	S.5-3
DISASSEMBLING AND ASSEMBLING	S.5-4
SERVICING	S.5-4
[2] BRAKE CASE	S.5-5
DISASSEMBLING AND ASSEMBLING	S.5-5
SERVICING	S.5-6

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

Because the trouble in the brake system is directly related to the human life, utmost care and attention must be used in inspection and maintenance. To accomplish careful works, it is important to make it a rule to reconfirm the work after the work is done.

(1) Basic Inspection

No.	Contents	Reference Page
1	Play of brake pedal	S.5-3
2	Brake linkage	S.5-3
3	Transmission fluid	S.G-14, 15

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Uneven Braking Force	● One side brake disc worn away	Replace	S.5-4
	● Cam plate warped	Replace	S.5-3
Brake Drags	● Ball holes of cam plate for uneven wear	Replace	S.5-4
	● Brake pedal return spring weaken or broken	Replace	-
	● Brake cam rusted	Repair	S.5-3
Poor Braking Force	● Brake disc worn	Replace	S.5-4
	● Cam plate warped	Replace	S.5-3
	● Brake cam or lever damaged	Replace	S.5-2

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: see page 2-8)

Item	N·m	kgf·m	ft·lbf
Nut	77.2 to 90.1	7.9 to 9.2	57.3 to 66.2
ST screw (Marked 9 on its head) (except L320)	103 to 117	10.5 to 12.0	76.0 to 86.8
T7 screw (Marked 7 on its head)	77.2 to 90.1	7.9 to 9.2	57.3 to 66.2
Brake case mounting screw and nut	77.2 to 90.1	7.9 to 9.2	57.3 to 66.2

SERVICING SPECIFICATIONS

Item	Factory Specification	Allowable Limit
Brake Pedal	Free Play 20 to 30 mm 0.8 to 1.2 in.	-
Right and Left	Difference Less than 5 mm 0.20 in.	-
Brake Pedal Shaft to Bushing	Clearance 0.020 to 0.153 mm 0.00079 to 0.00602 in.	1.0 mm 0.039 in.
Brake Pedal Shaft	O.D. 24.9 to 25.0 mm 0.980 to 0.984 in.	-
Brake Pedal Bushing	I.D. 25.020 to 25.053 mm 0.98504 to 0.98634 in.	-
Brake Pedal Shaft to Support Bushing	Clearance 0.05 to 0.20 mm 0.0020 to 0.0079 in.	1.0 mm 0.039 in.
Support Bushing	I.D. 25.05 to 25.10 mm 0.9862 to 0.9882 in.	-
Cam Plate	Flatness -	0.3 mm 0.012 in.
Cam Plate and Ball	Height 20.09 to 20.10 mm 0.7909 to 0.7913 in.	20.06 mm 0.7898 in.
Brake Disc	Thickness 4.6 to 4.8 mm 0.181 to 0.189 in.	4.2 mm 0.165 in.

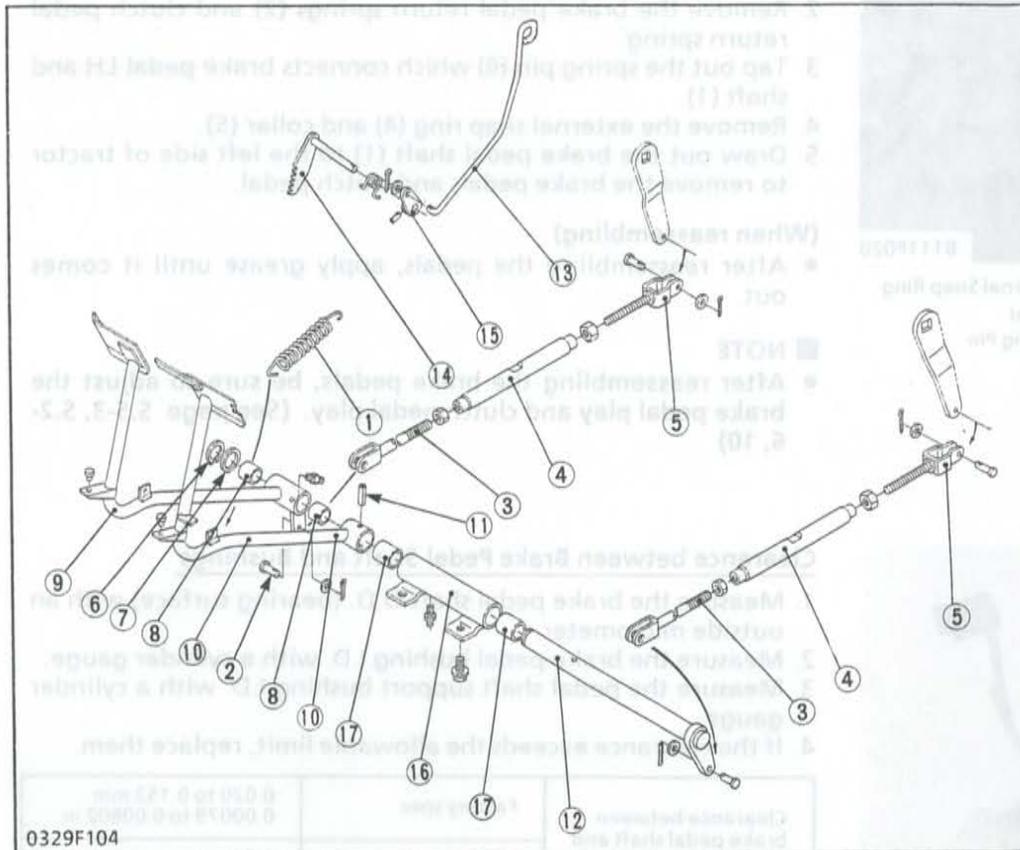
TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below are especially specified.
(For general use screws and nuts: See page S.G-8)

Item	N·m	kgf·m	ft-lbs
Brake case mounting screw and nut			
7T screw (Marked 7 on its head)	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5
9T screw (Marked 9 on its head) [Except L2350]	103 to 117	10.5 to 12.0	76.0 to 86.8
Nut	77.5 to 90.1	7.9 to 9.2	57.2 to 66.5

CHECKING, DISASSEMBLING AND SERVICING

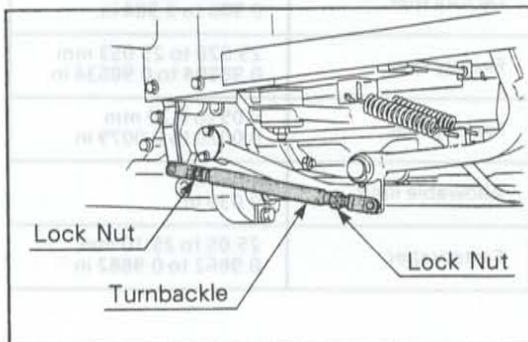
[1] BRAKE PEDAL



- (1) Return Spring
- (2) Clevis Pin
- (3) Brake Rod 1
- (4) Turnbuckle
- (5) Brake Rod 2
- (6) External Snap Ring
- (7) Collar
- (8) Bushing
- (9) Brake Pedal RH
- (10) Brake Pedal LH
- (11) Spring Pin
- (12) Brake Pedal Shaft
- (13) Parking Rod
- (14) Brake Lock
- (15) Parking Lever
- (16) Pedal Shaft Support
- (17) Bushing

0329F104

CHECKING AND ADJUSTING



Brake Pedal Free Play

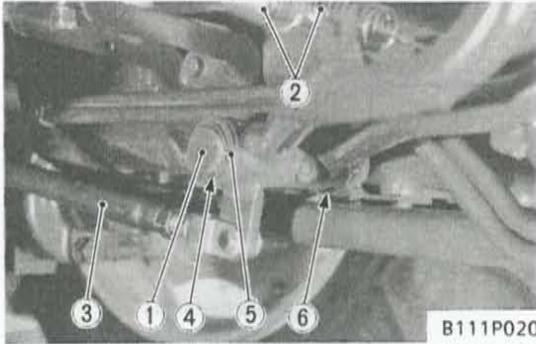
1. Press the center of the pedal with a force of approx. 39 to 59 N (4 to 6 kgf, 9 to 13 lbs.), and measure the free play of the brake pedal as shown in Fig.
2. If the measurement is not within the factory specifications, turn the turnbuckle of brake rod to adjust.
3. After adjustment, tighten the turnbuckle lock nut firmly.

Brake pedal free play	Factory spec.	20 to 30 mm 0.8 to 1.2 in.
-----------------------	---------------	-------------------------------

NOTE

- The difference between the right and left pedal plays must be less than 5 mm (0.20 in.).
- After checking brake pedal free play, be sure to engage the parking brake lock fully and check to see that the brake pedals are securely locked.

DISASSEMBLING AND ASSEMBLING



B111P020

- (1) Brake Pedal Shaft
- (2) Return Spring
- (3) Brake Rod
- (4) External Snap Ring
- (5) Collar
- (6) Spring Pin

Brake Pedals and Clutch Pedal

1. Remove the clevis pins of brake rods (3) and clutch rod.
2. Remove the brake pedal return springs (2) and clutch pedal return spring.
3. Tap out the spring pin (6) which connects brake pedal LH and shaft (1).
4. Remove the external snap ring (4) and collar (5).
5. Draw out the brake pedal shaft (1) to the left side of tractor to remove the brake pedals and clutch pedal.

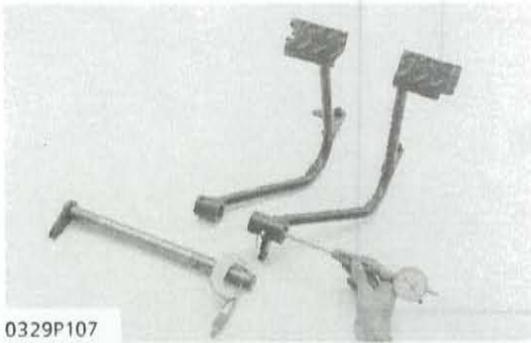
(When reassembling)

- After reassembling the pedals, apply grease until it comes out.

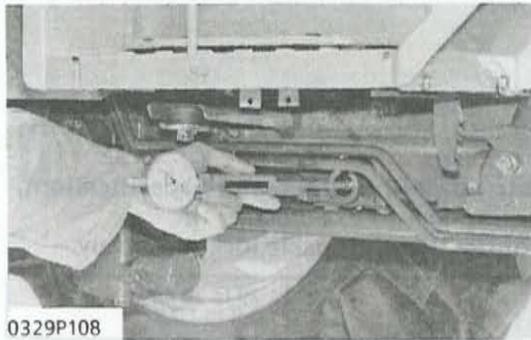
NOTE

- After reassembling the brake pedals, be sure to adjust the brake pedal play and clutch pedal play. (See page S.5-3, S.2-6, 10)

SERVICING



0329P107



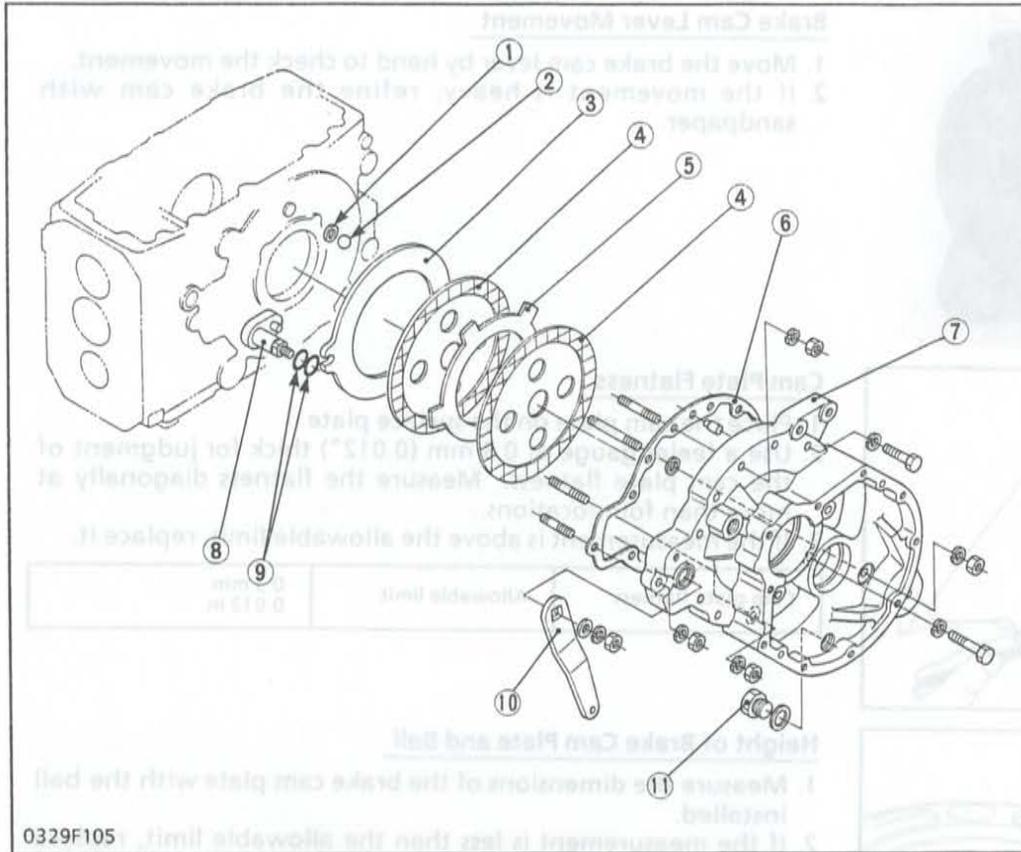
0329P108

Clearance between Brake Pedal Shaft and Bushings

1. Measure the brake pedal shaft O.D. (bearing surface) with an outside micrometer.
2. Measure the brake pedal bushing I.D. with a cylinder gauge.
3. Measure the pedal shaft support bushing I.D. with a cylinder gauge.
4. If the clearance exceeds the allowable limit, replace them.

Clearance between brake pedal shaft and brake pedal bushing	Factory spec	0.020 to 0.153 mm 0.00079 to 0.00602 in.
	Allowable limit	1.0 mm 0.039 in.
Brake pedal shaft O.D.	Factory spec.	24.9 to 25.0 mm 0.980 to 0.984 in.
Brake pedal bushing I.D.	Factory spec	25.020 to 25.053 mm 0.98504 to 0.98634 in.
Clearance between brake pedal shaft and pedal shaft support bushing	Factory spec	0.05 to 0.20 mm 0.0020 to 0.0079 in.
	Allowable limit	1.0 mm 0.039 in.
Pedal shaft support bushing I.D.	Factory spec	25.05 to 25.10 mm 0.9862 to 0.9882 in.

[2] BRAKE CASE



- (1) Ball Seat
- (2) Ball
- (3) Cam Plate
- (4) Brake Disc
- (5) Plate
- (6) Gasket
- (7) Brake Case
- (8) Brake Cam
- (9) O-ring
- (10) Brake Cam Lever
- (11) Drain Plug

DISASSEMBLING AND ASSEMBLING

Rear Axle Case

(See page S.5-7, 21)

Brake Case

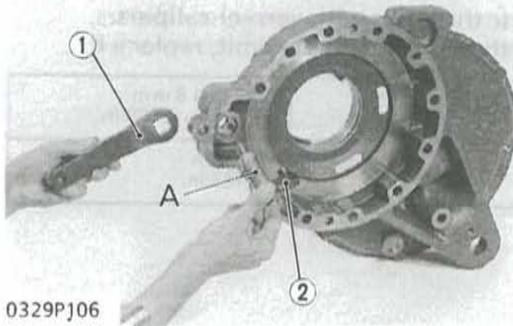
(See page S.5-7, 21)

Brake Cam

1. Remove the nut on the brake cam.
2. Remove the brake cam (2) and brake cam lever (1).

(When reassembling)

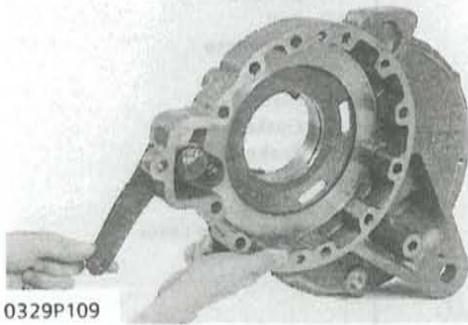
- Apply grease to the O-ring and the care not to damage it.
- Apply small amount of grease to the journal A to prevent rust problem that leads to lock up.



(1) Brake Cam Lever (2) Brake Cam

SERVICING

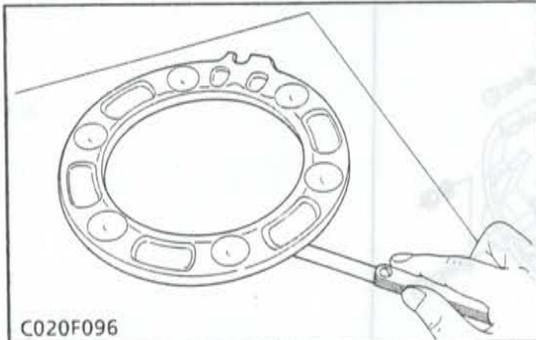
[5] BRAKE CASE



0329P109

Brake Cam Lever Movement

1. Move the brake cam lever by hand to check the movement.
2. If the movement is heavy, refine the brake cam with sandpaper.

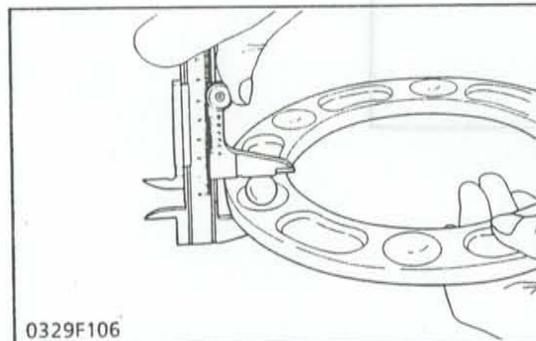


C020F096

Cam Plate Flatness

1. Place the cam plate on the surface plate.
2. Use a feeler gauge of 0.3 mm (0.012") thick for judgment of the cam plate flatness. Measure the flatness diagonally at more than four locations.
3. If the measurement is above the allowable limit, replace it.

Cam plate flatness	Allowable limit	0.3 mm 0.012 in.
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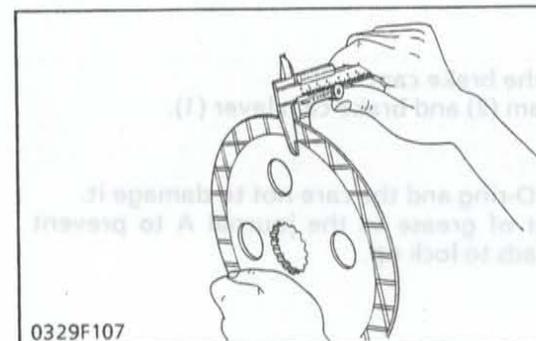


0329F106

Height of Brake Cam Plate and Ball

1. Measure the dimensions of the brake cam plate with the ball installed.
2. If the measurement is less than the allowable limit, replace the cam plate and balls.
3. Inspect the ball holes of cam plate for uneven wear. If the uneven wear is found, replace it.

Height of brake cam plate and ball	Factory spec.	20.09 to 20.10 mm 0.7909 to 0.7913 in.
	Allowable limit	20.06 mm 0.7898 in.

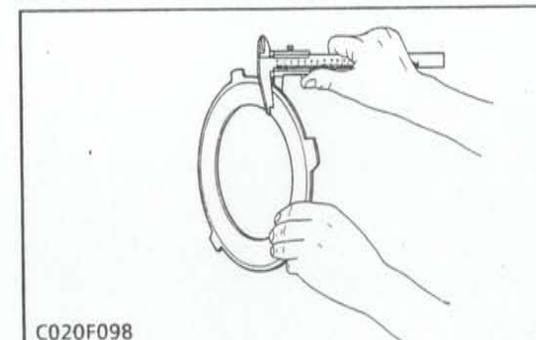


0329F107

Brake Disc Wear

1. Measure the brake disc thickness with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

Brake disc thickness	Factory spec.	4.6 to 4.8 mm 0.181 to 0.189 in.
	Allowable limit	4.2 mm 0.165 in.



C020F098

Plate Wear

1. Measure the plate thickness with vernier calipers.
2. If the thickness is less than the allowable limit, replace it.

Plate thickness	Factory spec.	2.54 to 2.66 mm 0.1000 to 0.1047 in.
	Allowable limit	2.10 mm 0.0827 in.

S.6 FRONT AXLE

CONTENTS

TROUBLESHOOTING	S.6-1
SERVICING SPECIFICATIONS	S.6-2
TIGHTENING TORQUES	S.6-5
CHECKING, DISASSEMBLING AND SERVICING	S.6-6
CHECKING AND ADJUSTING	S.6-6
DISASSEMBLING AND ASSEMBLING	S.6-7
[2WD TYPE]	S.6-7
[4WD TYPE]	S.6-8
SERVICING	S.6-13
[2WD TYPE]	S.6-13
[4WD TYPE]	S.6-14

TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Toe-in	S.6-6
2	Inflation pressure of tire	M.11-5
3	Front axle case fluid [4WD TYPE]	S.G-17
4	Transmission fluid	S.G-14, 15
5	Steering wheel free play	S.7-10, 22, 25

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Front Wheels Wander to Right or Left	<ul style="list-style-type: none"> Excessive clearance between front axle center pivot and front axle bracket's bushing Small rocking force of front axle Excessive sway of front wheel Air sucked in power steering circuit Knuckle shaft bushings worn [2WD TYPE] Tie-rod end loose 	Replace Adjust Replace Bleed air Replace Tighten	S.6-13, 18, 19 S.6-7 S.6-6 S.7-28, 38 S.6-13 -
Shimmy	<ul style="list-style-type: none"> Air sucked in power steering circuit Incorrect backlash between sector gear shaft and ball nut 	Bleed air Adjust	S.7-28, 38 -
Front Wheels Can Not be Driven [4WD TYPE]	<ul style="list-style-type: none"> Propeller shaft broken Front wheel drive gears broken Front differential gear broken Shift fork broken Slipped off coupling 	Replace Replace Replace Replace Replace	- S.3-27, 49, 82 S.6-8, 9, 10, 11, 12 S.6-11 S.3-27, 49, 82 S.5-3, 15
Noise [4WD TYPE]	<ul style="list-style-type: none"> Excessive backlash of gear Incorrect turning torque of differential gear Bearings damaged or broken Gears damaged or broken 	Adjust Adjust Replace Replace	S.6-14, 15, 16, 17 S.6-15 - -

SERVICING SPECIFICATIONS

[2WD TYPE]

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	2 to 8 mm 0.08 to 0.32 in.	-
	Camber Angle	0.026 to 0.044 rad. 1.5 to 2.5°	-
	Caster Angle	0.017 to 0.035 rad. 1.0 to 2.0°	-
	King Pin Angle	0.166 to 0.183 rad. 9.5 to 10.5°	-
Front Wheel	Axial Sway	Less than 2 mm 0.08 in.	-
	Radial Sway	Less than 4 mm 0.16 in.	-
Front Axle	Rocking Force	49.0 to 117.7 N 5.0 to 12.0 kgf 11.0 to 26.5 lbs	-
Knuckle Shaft to Bushing	Clearance	0.000 to 0.285 mm 0.0000 to 0.0112 in.	0.4 mm 0.016 in.
	Knuckle Shaft O.D.	27.880 to 27.900 mm 1.0976 to 1.0984 in.	-
	Bushing I.D.	27.900 to 28.165 mm 1.0984 to 1.1087 in.	-
Front Axle Middle Boss to Front Axle Bracket Bushing	Clearance	0.000 to 0.177 mm 0.0000 to 0.0070 in.	0.3 mm 0.012 in.
	Front Axle Middle Boss O.D.	39.938 to 40.000 mm 1.5724 to 1.5748 in.	-
	Bushing I.D.	40.000 to 40.115 mm 1.5748 to 1.5793 in.	-
		<ul style="list-style-type: none"> Front differential gear broken Shift fork broken Slipped off coupling Excessive backlash of gear Incorrect timing torque of differential gear Bearing damaged or broken Gear damaged or broken 	

[4WD TYPE]

Item		Factory Specification	Allowable Limit
Front Wheel Alignment	Toe-in	2 to 8 mm 0.08 to 0.32 in.	-
	Camber Angle	0.026 to 0.044 rad. 1.5 to 2.5°	-
	Caster Angle	0.017 to 0.035 rad. 1.0 to 2.0°	-
	King Pin Angle	0.166 to 0.183 rad. 9.5 to 10.5°	-
Front Wheel	Axial Sway	Less than 2 mm 0.08 in.	-
	Radial Sway	Less than 4 mm 0.16 in.	-
Front Axle	Rocking Force	49.0 to 117.7 N 5.0 to 12.0 kgf 11.0 to 26.5 lbs	-
Differential Case to Differential Side Gear	Clearance	0.050 to 0.151 mm 0.0020 to 0.0059 in.	0.35 mm 0.0138 in.
	Differential Case I.D.	32.000 to 32.062 mm 1.2598 to 1.2623 in.	-
	Differential Side Gear O.D.	31.911 to 31.950 mm 1.2563 to 1.2579 in.	-
Spiral Bevel Gear to Differential Side Gear	Clearance	0.050 to 0.114 mm 0.0020 to 0.0045 in.	0.35 mm 0.0138 in.
	Spiral Bevel Gear I.D.	32.000 to 32.025 mm 1.2598 to 1.2608 in.	-
	Differential Side Gear O.D.	31.911 to 31.950 mm 1.2563 to 1.2579 in.	-
Differential Pinion Shaft to Differential Pinion Gear	Clearance	0.064 to 0.100 mm 0.0025 to 0.0039 in.	0.25 mm 0.0098 in.
	Differential Pinion Shaft O.D.	13.950 to 13.968 mm 0.5492 to 0.5499 in.	-
	Differential Pinion Gear I.D.	14.032 to 14.050 mm 0.5524 to 0.5532 in.	-
Differential Pinion to Differential Side Gear	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.
	Shim Thickness	0.4 mm 0.016 in.	-
		0.6 mm 0.024 in.	-
		0.8 mm 0.031 in.	-
		1.0 mm 0.039 in.	-
		1.2 mm 0.047 in.	-

Item		Factory Specification	Allowable Limit	
Differential Bevel Pinion Shaft to Bevel Gear	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.	
	Shim	Thickness	0.4 mm 0.016 in.	-
			0.6 mm 0.024 in.	-
			0.8 mm 0.031 in.	-
			1.0 mm 0.039 in.	-
			1.2 mm 0.047 in.	-
Bevel Gears in Bevel Gear Case (13T Bevel Gear to 15T Bevel Gear)	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.	
	Shim	Thickness	0.4 mm 0.016 in.	-
			0.6 mm 0.024 in.	-
			0.8 mm 0.031 in.	-
			1.0 mm 0.039 in.	-
			1.2 mm 0.047 in.	-
Bevel Gears in Front Axle Case	Backlash	0.15 to 0.30 mm 0.0059 to 0.0118 in.	0.40 mm 0.016 in.	
	Shim	Thickness	0.8 mm 0.031 in.	-
			1.2 mm 0.047 in.	-
			1.6 mm 0.063 in.	-
			1.8 mm 0.071 in.	-
			2.0 mm 0.079 in.	-
			2.3 mm 0.091 in.	-
			2.6 mm 0.102 in.	-
		Turning Torque	1.118 to 1.373 N·m 0.114 to 0.140 kgf·m 0.825 to 1.013 ft-lbs	-
		Pinion Bearing Case to Front Axle Bracket Bushing (Rear)	Clearance	0.060 to 0.220 mm 0.0024 to 0.0087 in.
Pinion Bearing Case	O.D.		64.970 to 65.000 mm 1.3755 to 1.3780 in.	-
Bushing	I.D.		65.060 to 65.190 mm 2.5614 to 2.5665 in.	-

Item		Factory Specification	Allowable Limit
Front Axle Case Center Pivot to Front Axle Bracket Bushing (Front)	Clearance [L2350]	0.000 to 0.147 mm 0.0000 to 0.0058 in.	0.3 mm 0.012 in.
	L2650, L2950 L3450, L3650	0.000 to 0.177 mm 0.0000 to 0.0060 in.	0.3 mm 0.012 in.
Front Axle Case Center Pivot	O.D. [L2350]	34.938 to 35.000 mm 1.3755 to 1.3780 in.	-
	L2650, L2950 L3450, L3650	39.938 to 40.000 mm 1.5724 to 1.5748 in.	-
Bushings	I.D. [L2350]	35.000 to 35.085 mm 1.3780 to 1.3813 in.	-
	L2650, L2950 L3450, L3650	40.000 to 40.115 mm 1.5748 to 1.5793 in.	-

TIGHTENING TORQUES

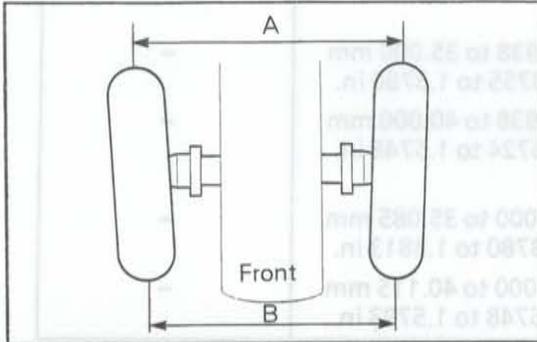
Tightening torques of especially screws, bolts and nuts.
(For general use screws, bolts and nuts: See page S.G-8)

Item	N·m	kgf·m	ft-lbs
Front axle bracket mounting screws			
Front (Thread size: 14 mm, 0.55 in. DIA.)	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Rear (Thread size: 12 mm, 0.47 in. DIA.)	103.0 to 117.7	10.5 to 12.0	75.9 to 86.8
Slotted nuts of tie rod end	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Slotted nuts of tie rod end [Full hydrostatic power steering type]	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Front wheel mounting screws and nuts	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Bevel gear case mounting screws [4WD Type]	166.7 to 196.1	17.0 to 20.0	123.0 to 144.7
Pinion bearing case mounting screws and nuts [4WD Type]	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Differential adjusting screw [4WD Type]	9.8 to 29.4	1.0 to 3.0	7.2 to 21.7
Differential supports mounting screws [4WD Type]	48.1 to 55.9	4.9 to 5.7	35.4 to 41.2
Spiral bevel gear mounting screws [4WD Type]			
9T	122.6 to 130.4	12.5 to 13.3	90.4 to 96.2
10T	127.5 to 142.2	13.0 to 14.5	94.0 to 104.8
Knuckle arm mounting screw and nut [2WD Type]	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Front wheel hub slotted nut [2WD Type]	78.5 to 117.7	8.0 to 12.0	57.9 to 86.8

CHECKING, DISASSEMBLING AND SERVICING

CHECKING AND ADJUSTING

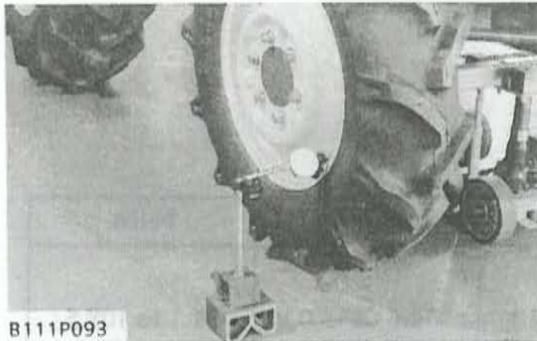
Park the tractor on a flat place, apply the hand brake and verify that the brake has been applied securely. Stop the engine and set the wheel stoppers before starting work.



Toe-in

1. Inflate the tires to the specified pressure.
2. Turn the front wheels straight ahead.
3. Measure the toe-in.
4. If the measurement is not within the factory specifications, adjust the tie rod length.

Toe-in	Factory spec.	2 to 8 mm 0.08 to 0.32 in.

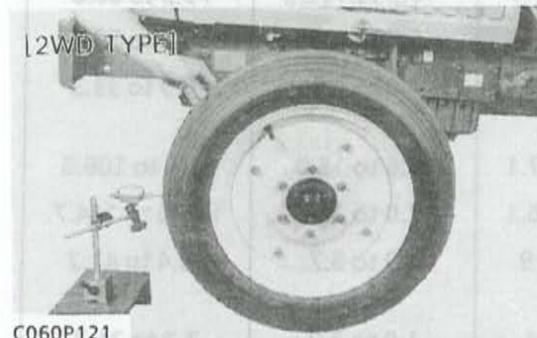


B111P093

Axial Sway of Front Wheel

1. Jack up the front side of tractor.
2. Set a dial gauge on the outside of rim.
3. Turn the wheel slowly and read the runout of rim.
4. If the runout exceeds the specified limit, check the bearing, rim, and front wheel hub.

Axial sway	Factory spec.	Less than 2.0 mm 0.08 in.



[2WD TYPE]

C060P121

Radial Sway of Front Wheel

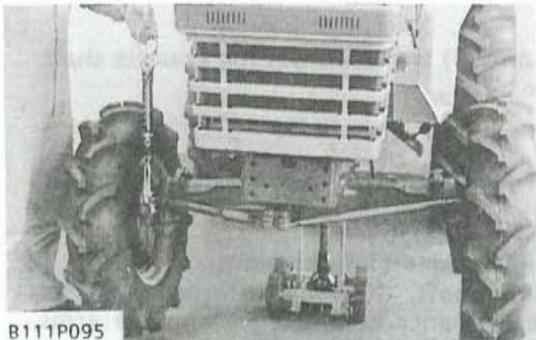
1. Jack up the front side of tractor.
2. Set a dial gauge on the tire tread. [2WD TYPE]
Set a dial gauge on the wheel. [4WD TYPE]
3. Turn the wheel slowly and read the dial gauge.
4. If the runout exceeds the specified limit, check the bearing, rim, and front wheel hub.

Radial sway	Factory spec.	Less than 4.0 mm 0.16 in.



[4WD TYPE]

B111P094



B111P095

Front Axle Rocking Force

1. Jack up the front side of tractor.
2. Set a spring balance to the tie rod end.
3. Measure the front axle rocking force.
4. If the measurement is not within the factory specifications, adjust with the adjusting screw.
5. Tight the lock nut firmly.

Front axle rocking force	Factory spec.	49.0 to 117.7 N·m 5.0 to 12.0 kgf·m 11.0 to 26.5 ft·lbs
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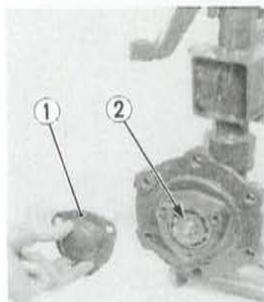


C060P122

Adjusting Screw

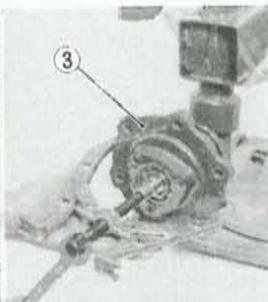
DISASSEMBLING AND ASSEMBLING

[2WD TYPE]



C060P126

- (1) Front Wheel Cap
- (2) Slotted Nut



C060P127

- (3) Front Wheel Hub

Front Wheel Hub

1. Remove the front wheel cap (1).
2. Draw out the cotter pin.
3. Remove the slotted nut (2).
4. Remove the collar.
5. Remove the front wheel hub (3) with a puller.

(When reassembling)

- Replace cotter pin with a new one.
- Apply grease to the oil seal in the front wheel hub.

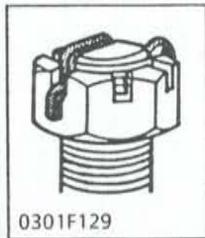
■ IMPORTANT

- After tightening the slotted nut to the specified torque, insert a cotter pin and bend it as shown in the figure.
- Pack in the grease to the bearing in the front wheel hub.



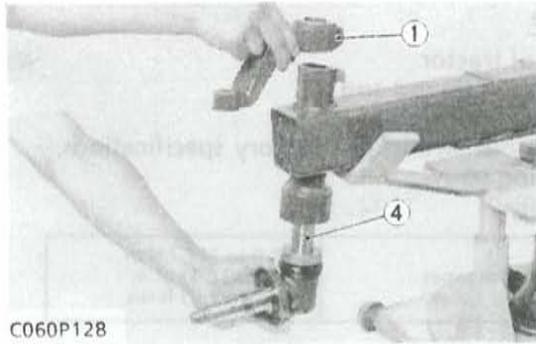
Grease Oil Seal

C060F263



0301F129

Tightening torque	Front wheel hub slotted nut	78.5 to 117.7 N·m 8.0 to 12.0 kgf·m 57.9 to 86.8 ft·lbs
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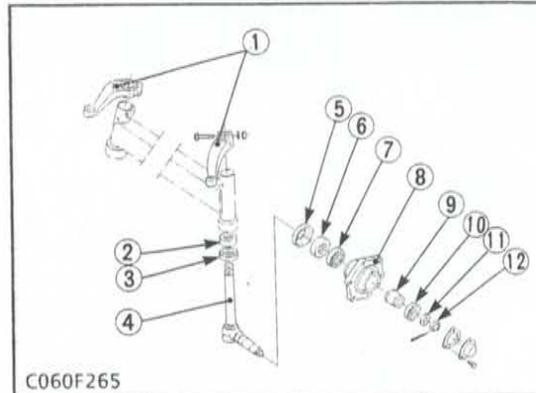
Knuckle Shaft

1. Remove the knuckle arm (1) and draw out the knuckle shaft (4) from the front axle.

(When reassembling)

- Install the thrust ball bearing (2) and oil seal (3), noting its direction.
- Apply grease to the oil seals (3), (6).
- Do not interchange right and left knuckle arms.
- When lift the knuckle shaft, the knuckle arms must be mounted so that the clearance between the knuckle arms and front axle is 0.3 to 1.0 mm (0.012 to 0.039 in.).

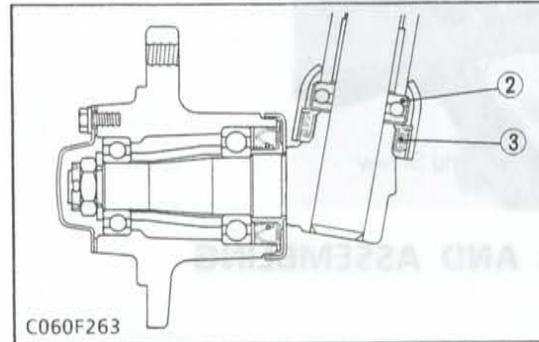
C060P128



C060F265

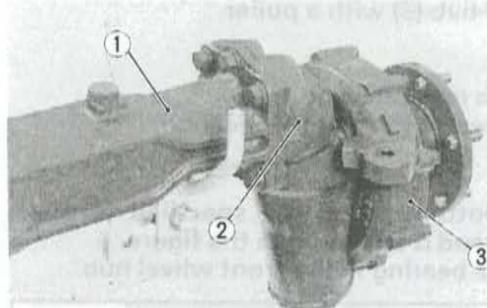
- | | |
|-------------------------|---------------------|
| (1) Knuckle Arm | (7) Ball Bearing |
| (2) Thrust Ball Bearing | (8) Front Wheel Hub |
| (3) Oil Seal | (9) Spacer |
| (4) Knuckle Arm Shaft | (10) Ball Bearing |
| (5) Dust Cover | (11) Washer |
| (6) Oil Seal | (12) Slotted Nut |

Tightening torque	Knuckle arm mounting bolt and nut	77.5 to 90.2 N·m 7.9 to 9.2 kgf·m 57.1 to 66.5 ft·lbs
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C060F263

[4WD TYPE]



0329P112

- | | |
|---------------------|---------------|
| (1) Front Axle Case | (3) Axle Case |
| (2) Bevel Gear Case | |

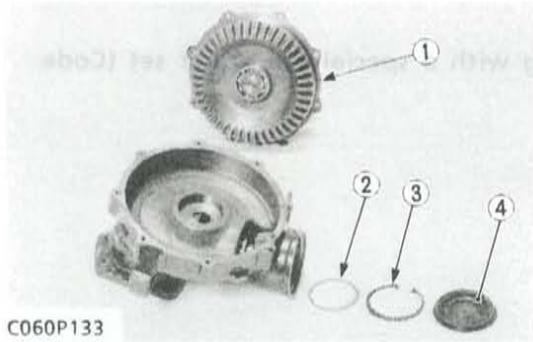
Axle Case and Bevel Gear Case

1. Remove the axle case (3) and bevel gear case (2) as a unit from the front axle case (1).

(When reassembling)

- When installing the O-rings, apply grease to them.
- Do not interchange right and left bevel gear case assemblies and axle case assemblies.

Tightening torque	Bevel gear case mounting screws	166.7 to 196.1 N·m 17.0 to 20.0 kgf·m 123.0 to 144.7 ft·lbs
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C060P133

- (1) Axle Flange
- (2) Shim
- (3) Internal Snap Ring
- (4) Plug

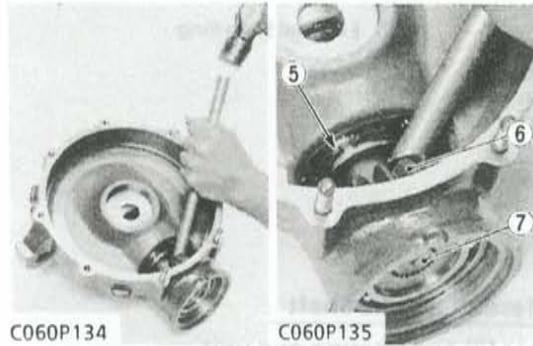
Bevel Gear Case, Axle Flange and Axle Case

1. Remove the plug (4).
2. Remove the internal snap ring (3) and shim (2).
3. Remove the axle flange (1).

(When reassembling)

- Apply grease to the O-rings of axle flange (1).
- Tighten the axle flange mounting screws and nuts diagonally in several steps.

Tightening torque	Axle flange mounting screws and nuts	23.6 to 27.4 N·m 2.4 to 2.8 kgf·m 17.4 to 20.2 ft-lbs
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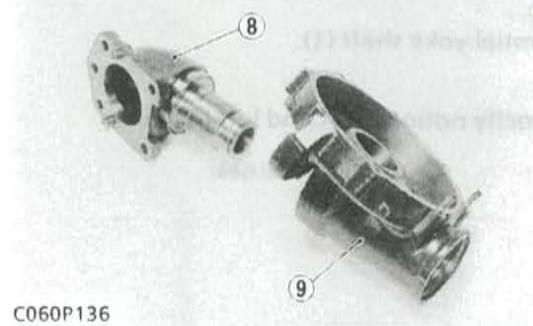
C060P134

C060P135

4. Tap out the bevel gear (6) and ball bearing.
5. Draw out the bevel gear shaft (7).
6. Remove the external snap ring (5).

- (5) External Snap Ring
- (6) 12T Bevel Gear

(7) Bevel Gear Shaft

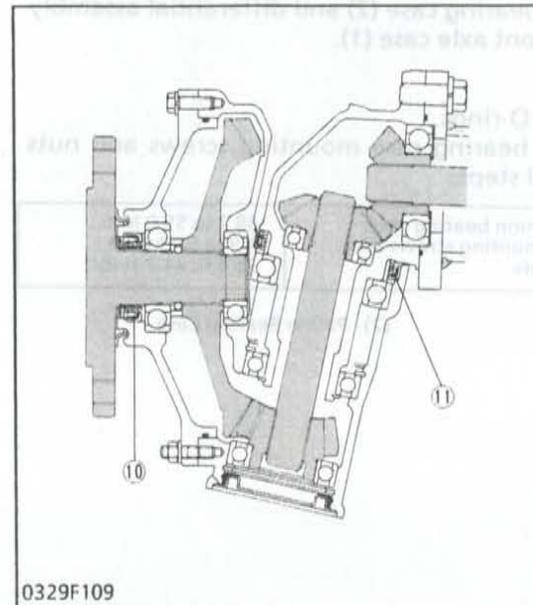


C060P136

7. Tap the bevel gear case (8), and separate it from the axle case (9).

(8) Bevel Gear Case

(9) Axle Case



0329F109

(When reassembling)

- Install the oil seals (10), (11) of bevel gear case and axle case, noting their direction as shown in the figure.

(10) Oil Seal

(11) Oil Seal

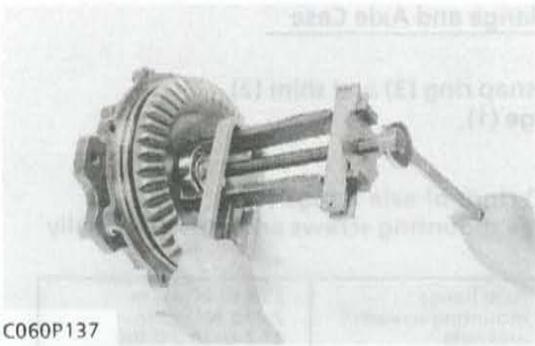
Bevel Gear

1. Remove the bearing with a special use puller set (Code No:07916-09032).

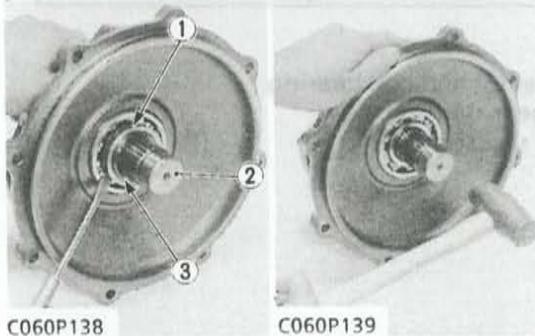
2. Remove the collar (1), external snap ring (3) and thrust collar.
3. Tap out the axle (2).

- (1) Collar
- (2) Axle

- (3) External Snap Ring

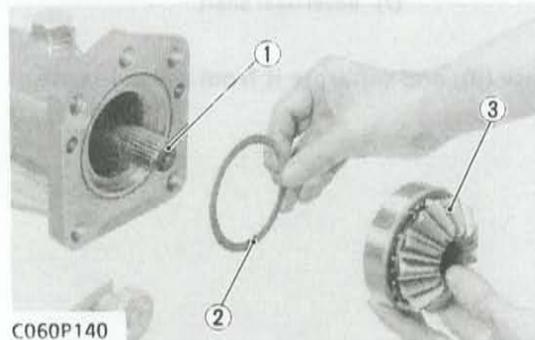


C060P137



C060P138

C060P139



C060P140

13T Bevel Gear and Differential Yoke Shaft

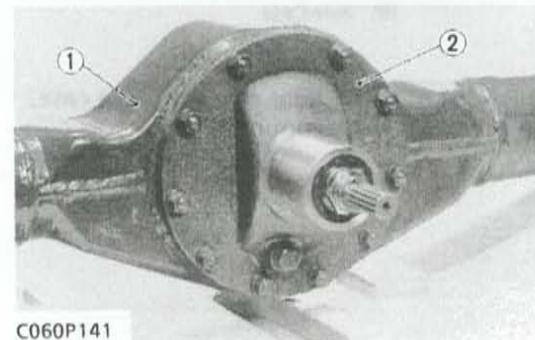
1. Remove the bevel gear (3) and bearing as a unit.
2. Remove the shims (2).
3. Draw out the differential yoke shaft (1).

(When reassembling)

- Install the shims correctly noting right and left location.

- (1) Differential Yoke Shaft
- (2) Shims

- (3) 13T Bevel Gear



C060P141

Pinion Bearing Case

1. Remove the pinion bearing case (2) and differential assembly as a unit from the front axle case (1).

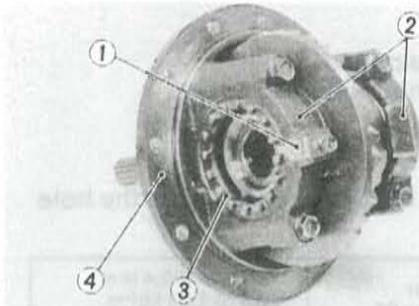
(When reassembling)

- Apply grease to the O-rings.
- Tighten the pinion bearing case mounting screws and nuts diagonally in several steps.

Tightening torque	Pinion bearing case mounting screws and nuts	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.4 to 41.2 ft·lbs
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- (1) Front Axle Case

- (2) Pinion Bearing Case



C060P142

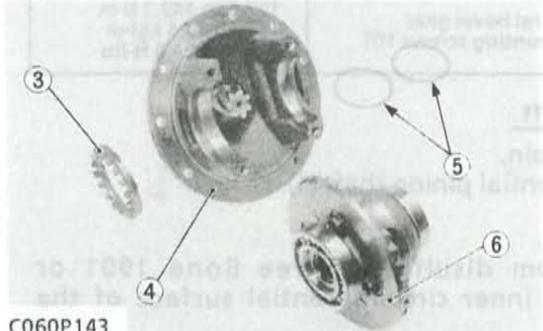
Differential Assembly

1. Remove the lock plate (1) and the adjusting screw (3).
2. Remove the differential supports (2).
3. Remove the differential assembly (6) and the shims (5) from the pinion bearing case (4).

- (1) Lock Plate
- (2) Differential Supports
- (3) Adjusting Screw
- (4) Pinion Bearing Case
- (5) Shims
- (6) Differential Assembly

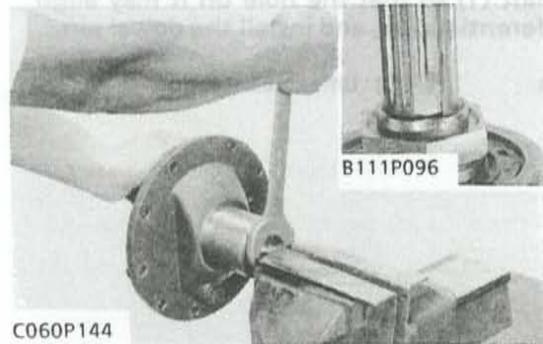
(When reassembling)

- Tighten the adjusting screw (3) by hand, and lock it with the lock plate (1) firmly.
- Do not change the combination of pinion bearing case (4) and differential supports (2), because both parts are proceeded as a unit.



C060P143

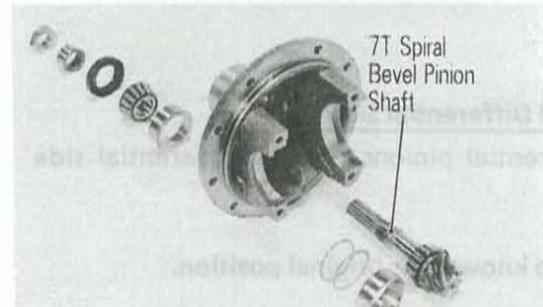
Tightening torque	Differential adjusting screw	9.8 to 29.4 N·m 1.0 to 3.0 kgf·m 7.2 to 21.7 ft·lbs
	Differential support (left-right) mounting screws	48.1 to 55.9 N·m 4.9 to 5.7 kgf·m 35.0 to 41.2 ft·lbs



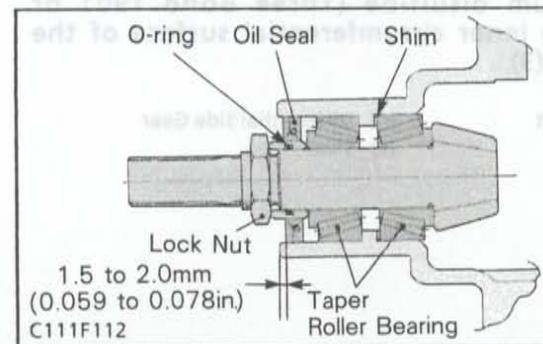
C060P144

7T Spiral Bevel Pinion Shaft

1. Secure the 7T spiral bevel pinion shaft in a vise.
2. Remove the stake of lock nut and then remove the lock nut.

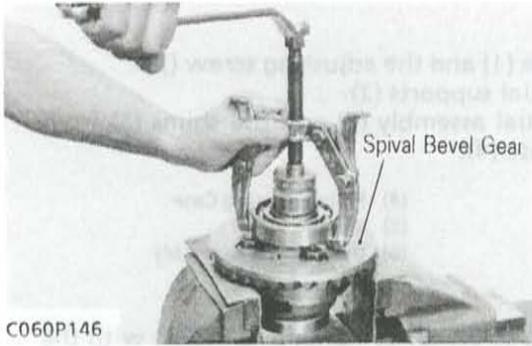


C060P145



(When reassembling)

- Apply grease to the O-ring and oil seal.
- Install the same shims as before they are removed.
- Install the taper roller bearing correctly, noting their direction, and apply gear oil to them.
- When press-fitting a oil seal, observe the dimension described in the figure.
- Replace the lock nuts with a new one.
- Install the 7T spiral bevel pinion shaft and tighten the lock nut.
- Stake the lock nut.



C060P146

Spiral Bevel Gear

1. Remove the ball bearing with a puller.
2. Remove the spiral bevel gear mounting UBS screws.
3. Remove the spiral bevel gear.

(When reassembling)

- Apply liquid lock (Three Bond 1372 or equivalent) to the hole and tighten the screws.

Tightening torque	Spiral bevel gear mounting screws 9T	122.6 to 130.4 N·m 12.5 to 13.3 kgf·m 90.4 to 96.2 ft·lbs
	Spiral bevel gear mounting screws 10T	127.5 to 142.2 N·m 13.0 to 14.5 kgf·m 94.0 to 104.8 ft·lbs

Differential Pinion Shaft

1. Take out the dowel pin.
2. Draw out the differential pinion shaft (1).

(When reassembling)

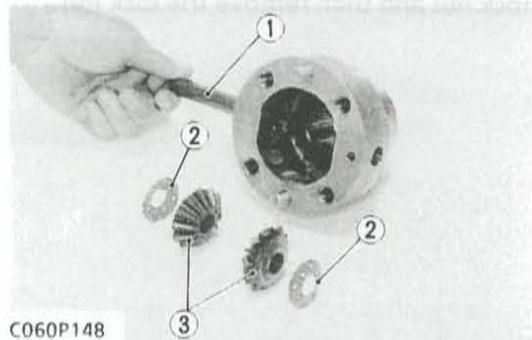
- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential case.
- Install the pinion shaft (1) so that the hole on it may align with the hole on differential case, and install the dowel pin.

- (1) Differential Pinion Shaft
(2) Pinion Thrust Collars

- (3) Differential Pinions



C060P147



C060P148

Differential Pinion and Differential Side Gear

1. Take out the differential pinions (3) and differential side gears (4).

NOTE

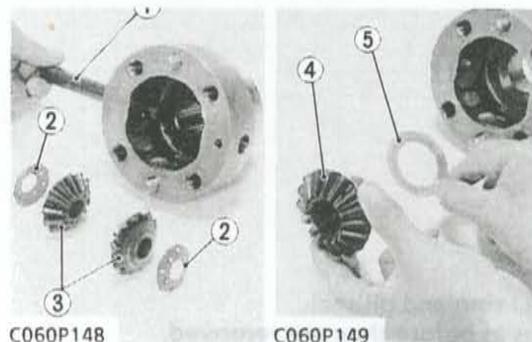
- Arrange the parts to know their original position.

(When reassembling)

- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the inner circumferential surface of the differential pinions (3).

- (1) Differential Pinion Shaft
(2) Pinion Thrust Collars
(3) Differential Pinions

- (4) Differential Side Gear
(5) Shim



C060P148

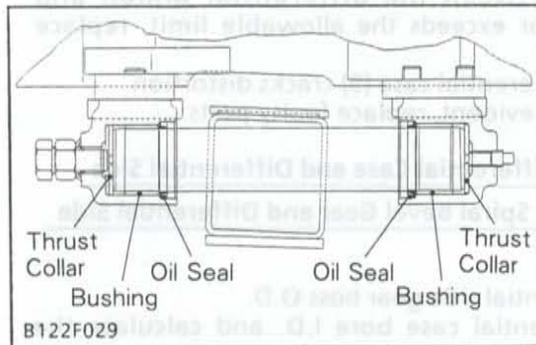
C060P149

SERVICING

[2WD TYPE]



C060P129



B122F029

Clearance between Front Axle Middle Boss and Bracket

Bushing

1. Measure the front axle middle boss O.D. at several points where it contacts with the bushing.
2. Measure the front axle bracket 1 bushing I.D. and bracket 2 bushing I.D. in the same method, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

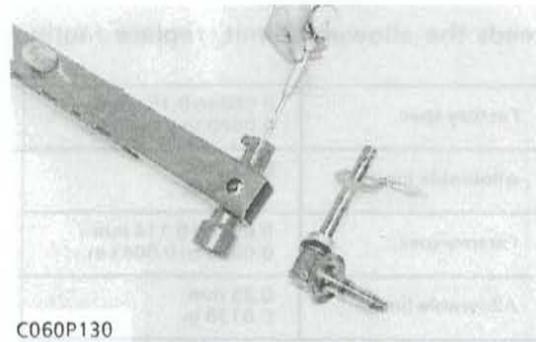
(When reassembling)

- Before press-fitting the bushing, install the new thrust collar.
- Install the oil seals, noting their direction.

■ IMPORTANT

- After replacing the bush, be sure to adjust the front axle rocking force.

Clearance between front axle middle boss and bushing	Factory spec.	0.000 to 0.177 mm 0.0000 to 0.0070 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle middle boss O.D.	Factory spec.	39.938 to 40.000 mm 1.5724 to 1.5748 in.
	Factory spec.	40.000 to 40.115 mm 1.5748 to 1.5793 in.



C060P130

Clearance between Knuckle Shaft (King pin) and Bushing

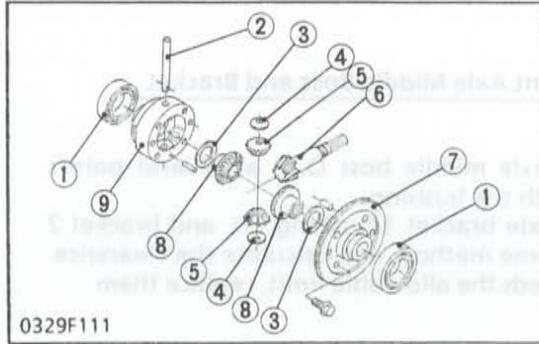
1. Measure the shaft O.D. at several points where it contacts with the bushings.
2. Measure the bushing I.D. in the same method, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace.

(When reassembling)

- Remove the bushing with a bushing puller set (Code No: 07916-51031).

Clearance between front axle middle boss and bushing	Factory spec.	0.000 to 0.285 mm 0.0000 to 0.0112 in.
	Allowable limit	0.4 mm 0.016 in.
Front axle middle boss O.D.	Factory spec.	27.880 to 27.900 mm 1.0976 to 1.0984 in.
	Factory spec.	27.900 to 28.165 mm 1.0984 to 1.1087 in.

[4WD TYPE]



- (1) Ball Bearing
- (2) Pinion Shaft
- (3) Shims
- (4) Pinion Thrust Collars
- (5) Differential Pinions
- (6) 7T Spiral Bevel Pinion Shaft
- (7) Spiral Bevel Gear
- (8) Differential Side Gears
- (9) Differential Case

Inspection

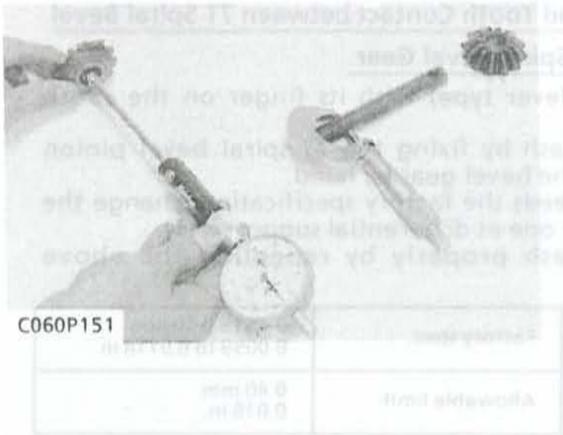
1. Thoroughly clean all disassembled parts.
2. Check gear teeth for scoring, cracking or chipping, and make sure that tooth contact pattern indicates meshing depth. If any fault is evident, replace parts as required.
3. Check pinion shaft (2) and differential pinions (5) scores and signs of wear, and replace as required. Follow the same procedure for differential side gears (8) and their seats on differential case.
4. Inspect ball bearings (1) races and rollers for scoring, chipping or evidence of excessive wear.
5. Inspect pinion thrust collars (4) surface. Small faults can be corrected with a sandpaper. If the backlash between the differential pinion and differential side gear exceeds the allowable limit, replace pinion thrust collars.
6. Inspect gear and differential case (9) cracks distortion. If either condition is evident, replace faulty parts.

Clearances between Differential Case and Differential Side Gear and between 34T Spiral Bevel Gear and Differential Side Gear

1. Measure the differential side gear boss O.D.
2. Measure the differential case bore I.D. and calculate the clearance.
3. Measure the 34T spiral bevel gear I.D. and calculate the clearance.
4. If the clearance exceeds the allowable limit, replace faulty parts.



Clearance between differential case and differential side gear	Factory spec.	0.050 to 0.151 mm 0.0020 to 0.0059 in.
	Allowable limit	0.35 mm 0.0138 in.
Clearance between 34T spiral bevel gear and differential side gear	Factory spec.	0.050 to 0.114 mm 0.0020 to 0.0045 in.
	Allowable limit	0.35 mm 0.0138 in.
Differential case bore I.D.	Factory spec.	32.000 to 32.062 mm 1.2598 to 1.2623 in.
Spiral bevel gear bore I.D.	Factory spec.	32.000 to 32.025 mm 1.2598 to 1.2608 in.
Differential side gear O.D.	Factory spec.	31.911 to 31.950 mm 1.2563 to 1.2579 in.

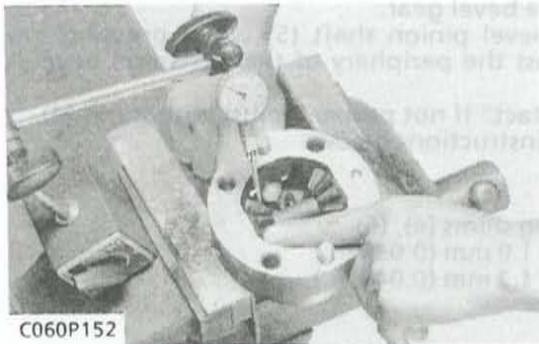


C060P151

Clearance between Differential Pinion Shaft and Pinion

1. Measure the differential pinion shaft O.D.
2. Measure the differential pinion I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace faulty parts.

Clearance between differential pinion shaft and pinion	Factory spec.	0.064 to 0.100 mm 0.0025 to 0.0039 in.
	Allowable limit	0.25 mm 0.0096 in.
Differential pinion shaft O.D.	Factory spec	13.950 to 13.968 mm 0.5492 to 0.5499 in.
Differential pinion I.D.	Factory spec	14.032 to 14.050 mm 0.5524 to 0.5532 in.



C060P152

Backlash between Differential Pinion and Differential Side Gear

1. Set a dial gauge (lever type) on a tooth of the differential pinion.
2. Fix the differential side gear and move the differential pinion to measure the backlash.
3. If the measurement exceeds the allowable limit, adjust with the differential side gears shims.

Backlash between differential pinion and differential side gear	Factory spec	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

(Reference)

- Thickness of adjusting shims

0.4 mm (0.016 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.8 mm (0.031 in.)	

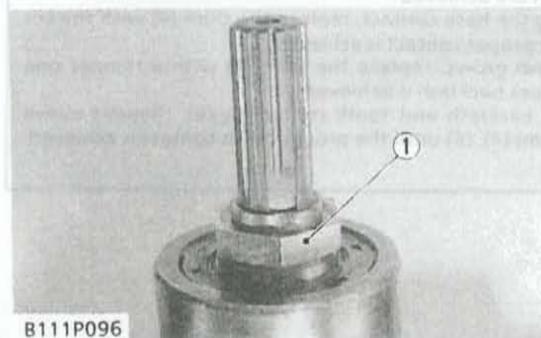
Turning Torque of Bevel Pinion Shaft

1. Secure the spacer with a vise.
2. Wind a string around the bevel pinion shaft and attach spring balance to the tip of the string.
3. Slowly pull the spring balance in a direction at right angle to the bevel pinion shaft to measure the turning force.
4. If the turning torque is not within the factory specifications, adjust with the lock nut.



C060P153

Turning force	Factory spec	111.8 to 137.3 N 11.4 to 14.0 kgf 82.5 to 101.3 lbs
Turning torque	Factory spec.	1.118 to 1.373 N m 0.114 to 0.140 kgf m 0.825 to 1.013 ft-lbs



B111P096

NOTE

- The turning torque is figured by multiplying the radius (distance from the center of the bevel pinion shaft to a point on the circumference from which the string is pulled) by the reading on the spring balance.
- After turning torque adjustment, be sure to stake the lock nut (1).

(1) Lock Nut

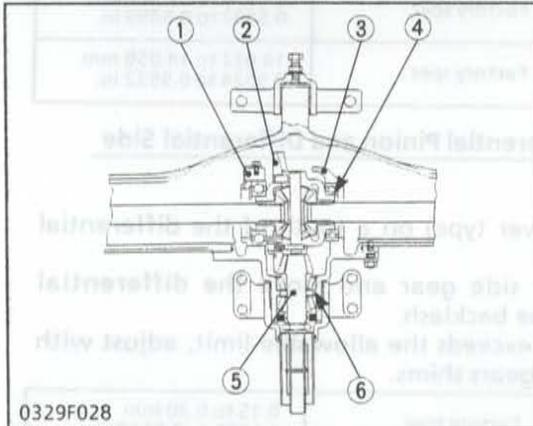
Adjusting Backlash and Tooth Contact between 7T Spiral Bevel Pinion Shaft and 34T Spiral Bevel Gear



C060P154

1. Set a dial gauge (lever type) with its finger on the tooth surface.
2. Measure the backlash by fixing the 7T spiral bevel pinion shaft and moving the bevel gear by hand.
3. If the backlash exceeds the factory specification, change the shim (4) for thinner one at differential support R (3).
4. Adjust the backlash properly by repeating the above procedures.

Backlash between 34T spiral bevel gear and 7T bevel pinion shaft	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.



0329F028

5. Apply red lead lightly over several teeth at three positions equally spaced on the bevel gear.
6. Turn the 7T spiral bevel pinion shaft (5) while pressing a wooden piece against the periphery of the 34T spiral bevel gear (2).
7. Check the tooth contact. If not proper, adjust with shims (4), (6) according to the instructions below:

(Reference)

- Thickness of adjusting shims (4), (6)
 0.4 mm (0.016 in.) 1.0 mm (0.039 in.)
 0.6 mm (0.024 in.) 1.2 mm (0.047 in.)
 0.8 mm (0.031 in.)

NOTE

- Be careful the 7T spiral bevel pinion shaft (5) may not contact with differential case by adjusting the tooth contact with shims (4), (6).

- (1) Differential Support (Left)
- (2) 34T Spiral Bevel Gear
- (3) Differential Support (Right)
- (4) Shim
- (5) 7T Spiral Bevel Pinion Shaft
- (6) Shim

• **Proper Contact**

More than 35% red lead contact area on the gear tooth surface. The center of tooth contact at 1/3 of the entire width from the small end.

C065F198

• **Heel Contact** • **Tip Contact**

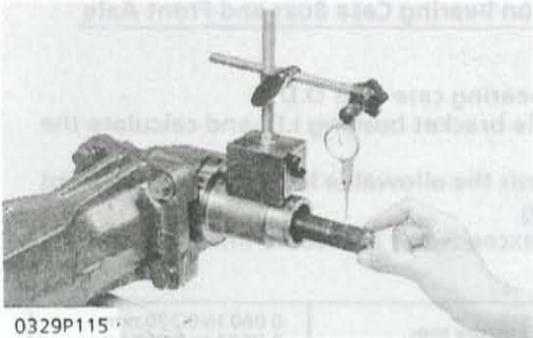
Replace the shim (6) with a thinner one to move the bevel pinion shaft toward inside (toward the pinion bearing case), and repeat above until the proper backlash and tooth contact are achieved. For adjusting the tip contact, replace the shim (4) with a thinner one and repeat this procedure until the proper tip contact is achieved. If the backlash is small, replace the shim (4) with a thicker one and repeat this procedure until the proper backlash is achieved. Confirm the backlash and tooth contact again. Repeat above until the proper backlash and tooth contact are achieved.

0329F097

• **Toe Contact** • **Base Contact**

Replace the shim (6) with a thinner one to move the bevel pinion shaft backward. Repeat above until the proper backlash and tooth contact are achieved. For adjusting the base contact, replace the shim (4) with thicker one until the proper contact is achieved. If the backlash grows, replace the shim (4) with a thinner one until the proper backlash is achieved. Confirm the backlash and tooth contact again. Repeat above using the shims (4), (6) until the proper tooth contact is achieved.

0329F098



0329P115

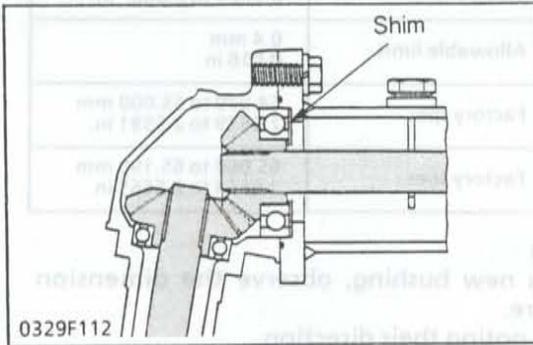
Backlash between 13T Bevel Gear and 15T Bevel Gear

1. Set a dial gauge (lever type) on the bevel gear shaft.
2. Move the bevel gear shaft by hand to measure the circumferential play of the bevel gear shaft.
3. Calculate the backlash from the ratio of the shaft diameter to the gear diameter.

Backlash	Play x 2.18
----------	-------------

4. If the backlash exceeds the allowable limit, adjust with shims.

Backlash between 13T bevel gear and 15T bevel gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.

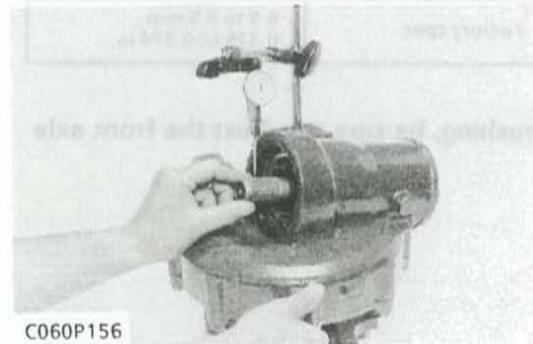


0329F112

(Reference)

- Thickness of adjusting shims

0.4 mm (0.016 in.)	1.0 mm (0.039 in.)
0.6 mm (0.024 in.)	1.2 mm (0.047 in.)
0.8 mm (0.031 in.)	



C060P156

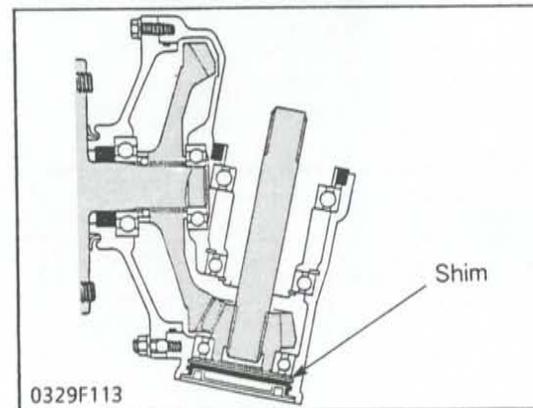
Backlash between 12T Bevel Gear and 40T (42T) Bevel Gear

1. Fix the front axle case and front axle shaft (1).
2. Set a dial gauge (lever type) on a spline tooth of the bevel gear shaft (2).
3. Move the bevel gear shaft (2) by hand, and measure the circumferential play of the bevel gear shaft (2).
4. Calculate the backlash from the ratio of the shaft diameter to the gear diameter.

Backlash	Play x 1.92
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5. If the backlash exceeds the allowable limit, adjust with shims (3).

Backlash between 12T bevel gear and 40T (42T) bevel gear	Factory spec.	0.15 to 0.30 mm 0.0059 to 0.0118 in.
	Allowable limit	0.40 mm 0.016 in.



0329F113

(Reference)

- Thickness of adjusting shims:

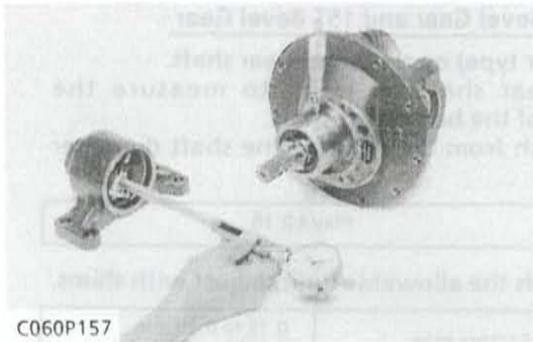
0.8 mm (0.031 in.)	2.0 mm (0.079 in.)
1.2 mm (0.047 in.)	2.3 mm (0.091 in.)
1.6 mm (0.063 in.)	2.6 mm (0.102 in.)
1.8 mm (0.071 in.)	

- | | |
|----------------------|-----------|
| (1) Front Axle Shaft | (3) Shims |
| (2) Bevel Gear Shaft | |

Clearance between Pinion Bearing Case Boss and Front Axle

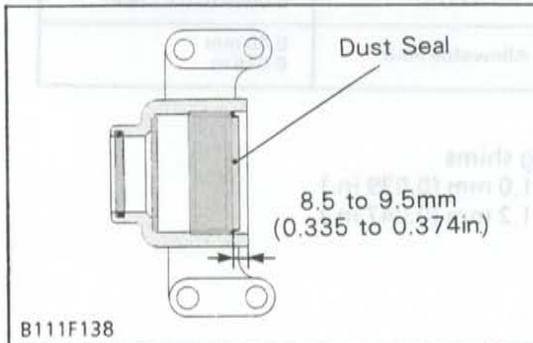
Bracket (Rear) Bushing

1. Measure the pinion bearing case boss O.D.
2. Measure the front axle bracket bushing I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the front axle bracket's bushing.
4. If the clearance still exceeds the allowable limit, replace the pinion bearing case.



C060P157

Clearance between pinion bearing case boss and front axle bracket bushing	Factory spec.	0.060 to 0.220 mm 0.0024 to 0.0087 in.
	Allowable limit	0.4 mm 0.016 in.
Pinion bearing case boss O.D.	Factory spec.	64.970 to 65.000 mm 2.5579 to 2.5591 in.
Bushing I.D.	Factory spec.	65.060 to 65.190 mm 2.5614 to 2.5665 in.



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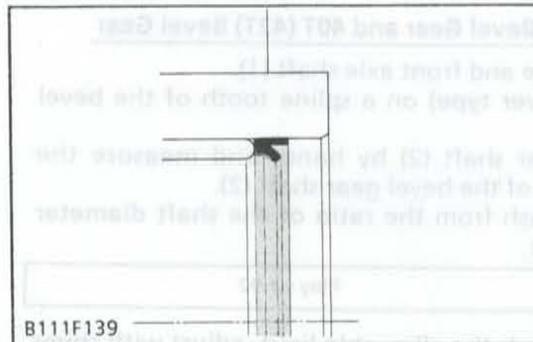
■ **Press-fitting Bushing**

- When press-fitting a new bushing, observe the dimension described in the figure.
- Install the dust seals, noting their direction.

Press-fit depth of bushing	Factory spec.	8.5 to 9.5 mm 0.335 to 0.374 in.
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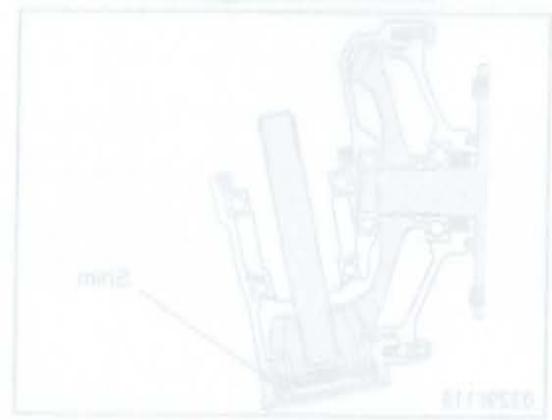
■ **NOTE**

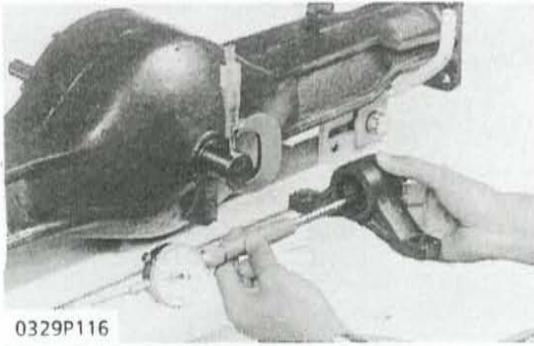
- After replacing the bushing, be sure to adjust the front axle rocking force.



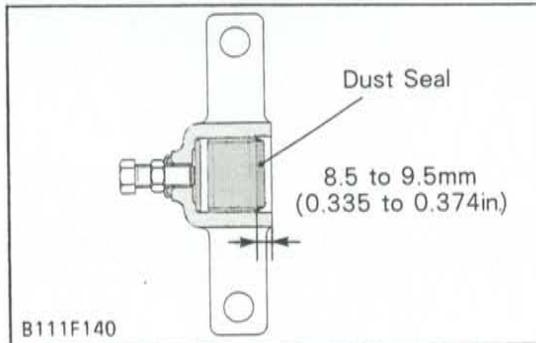
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Pinion bearing case boss O.D.	Factory spec.	64.970 to 65.000 mm 2.5579 to 2.5591 in.
Bushing I.D.	Factory spec.	65.060 to 65.190 mm 2.5614 to 2.5665 in.

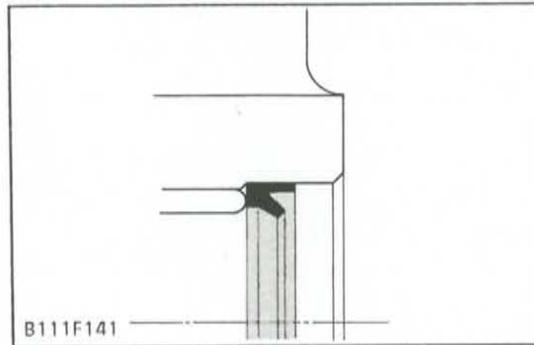




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Clearance between Front Axle Center Pivot and Front Axle Bracket (Front) Bushing

1. Measure the front axle center pivot O.D.
2. Measure the front axle bracket bushing I.D. and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the front axle bracket (front) bushing.
4. If the clearance still exceeds the allowable limit, replace the front axle case.

[L2350]

Clearance between front axle center pivot and front axle bracket bushing	Factory spec.	0.000 to 0.147 mm 0.0000 to 0.0058 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle center pivot O.D.	Factory spec.	34.938 to 35.000 mm 1.3755 to 1.3780 in.
Bushing I.D.	Factory spec.	35.000 to 35.085 mm 1.3780 to 1.3813 in.

[L2650, L2950, L3450, L3650]

Clearance between front axle center pivot and front axle bracket bushing	Factory spec.	0.000 to 0.177 mm 0.0000 to 0.0060 in.
	Allowable limit	0.3 mm 0.012 in.
Front axle center pivot O.D.	Factory spec.	39.938 to 40.000 mm 1.5724 to 1.5748 in.
Bushing I.D.	Factory spec.	40.000 to 40.115 mm 1.5748 to 1.5793 in.

■ Press-fitting Bushing

- When press-fitting a new bushing, observe the dimension described in the figure.
- Install the dust seals, noting their direction.

Press-fit depth of bushing	Factory spec.	8.5 to 9.5 mm 0.335 to 0.374 in.
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■ NOTE

- After replacing the bushing, be sure to adjust the front axle rocking force.

S.7 STEERING

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TROUBLESHOOTING

MANUAL STEERING TYPE

Symptom	Probable Cause	Solution	Reference Page
Excessive Steering Wheel Play	● Back lash between sector gear shaft and ball nut too large	Adjust	S.7-10, 22
	● Steering linkage worn ● Sector gear shaft worn	Replace Replace	- S.7-11, 24
Steering Wheel Does not Return to Neutral Position	● Ball nut malfunctioning ● Bevel gear, bearing sticking or damaged [L2650 2WD, L2950 2WD]	Replace Repair or replace	S.7-11, 24 S.7-21
Hard Steering	● Steering wheel play too small ● Improper front wheel alignment ● Insufficient tire pressure ● Thrust ball bearing damaged ● Insufficient steering gear case oil ● Bevel gear, bearing sticking or damaged [L2650 2WD, L2950 2WD]	Adjust Adjust Inflate Replace Refill Replace	S.7-10, 22 S.6-6 M.11-5 S.7-11, 24 S.G-7 S.7-21
	● Insufficient steering gear box oil	Refill	S.G-7
Tractor Pulls to Right or Left	● Tire pressure uneven ● Steering wheel play too small ● Improper toe-in adjustment ● Front wheel hub ball bearing worn or damaged ● Brake pedal play unevenly adjusted	Adjust Adjust Adjust Replace Adjust	- S.7-10, 22 S.6-6 S.6-7 S.5-3
	● Steering linkage worn ● Improper toe-in adjustment ● Knuckle shaft bushing worn ● Clearance between front axle middle and bushing excessive	Replace Adjust Replace Replace	- S.6-6 S.6-13 S.6-13

INTERGRAL POWER STEERING TYPE

Excessive Steering Wheel Play	● Back lash between sector gear shaft and ball nut too excessive	Adjust	S.7-10, 27
	● Steering linkage worn ● Sector gear shaft worn ● Centering spring weaken or broken	Replace Replace Replace	- S.7-14, 31 S.7-15, 30
Tractor Pulls to Right or Left	● Tire pressure uneven ● Steering wheel play too small ● Improper toe-in adjustment ● Front wheel hub ball bearing worn or damaged ● Brake pedal play unevenly adjusted	Adjust Adjust Adjust Replace Adjust	- S.7-10, 25 S.6-6 S.6-7 S.5-3

INTEGRAL POWER STEERING TYPE (Continued)

Symptom	Probable Cause	Solution	Reference Page
Front Wheels Vibrate	<ul style="list-style-type: none"> Steering linkage worn Improper toe-in adjustment Knuckle shaft bushing worn Clearance between front axle middle boss and bushing excessive 	Replace Adjust Replace Replace	– S.6-6 S.6-13 S.6-13
Hard Steering	<ul style="list-style-type: none"> Transmission fluid improper or insufficient Oil leak from pipe joint Hydraulic pump malfunctioning Relief valve malfunctioning Control valve malfunctioning Seals in the steering gear box damaged Back lash between sector gear shaft and ball nut too small Air in the hydraulic pipes Low operating pressure 	Change Retighten Replace Adjust or replace Replace Replace Adjust Bleed Refer to next item	S.G-7 S.7-35 S.7-12, 26 S.7-15, 30 S.7-16, 17, 32, 33 S.7-10, 27 S.7-28 –
Low Operating Pressure	<ul style="list-style-type: none"> Hydraulic pump malfunctioning Improper relief valve adjustment Control valve malfunctioning Seals in the steering gear box damaged Ball nut malfunctioning Oil leak from pipe or pipe broken 	Replace Adjust Replace Replace Replace ball nut assembly Replace	S.7-35 S.7-12, 27 S.7-15, 30 S.7-16, 17, 32, 33 S.7-14, 32 –
Steering Wheel Does Not Return to Neutral Position	<ul style="list-style-type: none"> Control valve malfunctioning Valve spool and valve housing jammed Centering spring weaken or broken 	Replace Repair or replace Replace	S.7-15, 30 S.7-15, 30 S.7-15, 30
Steering Force Fluctuates	<ul style="list-style-type: none"> Insufficient oil Insufficient bleeding Control valve malfunctioning 	Replenish Bleed Replace	S.G-7 S.7-28 S.7-15, 30
Noise	<ul style="list-style-type: none"> Insufficient oil Air sucked in pump from suction circuit Pipe deformed 	Replenish Repair Replace	S.G-7 – –

FULL HYDROSTATIC POWER STEERING TYPE

Symptom	Probable Cause	Solution	Reference Page
Tractor Can Not Be Steered	<ul style="list-style-type: none"> Hydraulic pump malfunctioning Valve plate malfunctioning 	Replace Replace	S.7-50 S.7-40
Front Wheels Vibrate	<ul style="list-style-type: none"> Centering spring weaken or broken Improper toe-in adjustment Air in the hydraulic system Improperly mounted wheels Tie rod end loose or worn Front wheel hub bearings worn Clearance between center pivot and bushing, front wheel differential gear case and bushing excessive 	Replace Adjust Bleed Retighten Retighten or replace Replace Replace	S.7-40, 41 S.6-6 S.7-38 - S.5-14 S.6-10 S.6-18, 19
Hard Steering	<ul style="list-style-type: none"> Hydraulic pump malfunctioning Overload Transmission fluid improper or insufficient Oil leak from pipe joint Insufficient tire pressure Valve plate malfunctioning Relief valve malfunctioning 	Replace - Change Retighten Inflate Replace Replace	S.7-50 - S.G-7 - M.11-5 S.7-40 S.7-38
Steering Force Fluctuates	<ul style="list-style-type: none"> Air sucked in pump due to leaking or missing of oil Air sucked in pump from suction circuit 	Replenish Repair	S.G-7 -
Front Wheels Wander to Right and Left	<ul style="list-style-type: none"> Centering spring weaken or broken Air sucked in pump due to leak of oil Air sucked in pump from suction circuit Tire pressure uneven Insufficient bleeding Improper toe-in adjustment Clearance between center pivot and bushing, front wheel differential gear case and bushing excessive Tie rod end loose or worn 	Replace Replenish Repair Inflate Bleed Adjust Replace Retighten or replace	S.7-40, 41 S.G-7 - M.11-5 S.7-38 S.6-6 S.6-18, 19 S.5-14
Wheels Are turned to a Direction Opposite to Steering Direction	<ul style="list-style-type: none"> Piping connected in reverse 	Repair	-
Noise	<ul style="list-style-type: none"> Air sucked in pump due to lack of oil Air sucked in pump from suction circuit Pipe deformed 	Replenish Repair Replace	S.G-7 - -

SERVICING SPECIFICATIONS

MANUAL STEERING [L2350]

Item		Factory Specification	Allowable Limit
Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	-
Drag Link End and Tie-rod	Play	-	0.3 mm 0.0118 in.
Steering Shaft	Initial turning torque	Less than 1.72 N·m Less than 0.175 kgf·m Less than 1.26 ft-lbs	-
Steering Shaft (Without bushing and seal)	Turning torque	0.25 to 0.44 N·m 0.025 to 0.045 kgf·m 0.181 to 0.326 ft-lbs	-

POWER STEERING [L2350]

Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.	-
Relief Valve Condition <ul style="list-style-type: none"> ● Engine Speed Approx. 2800 rpm ● Oil Temperature 45 to 55°C 113 to 131°F 	Setting Pressure	10.0 to 10.6 MPa 102 to 108 kgf/cm ² 1451 to 1536 psi	-
Steering Gear Box and Ball Nut	Clearance	0.030 to 0.079 mm 0.0012 to 0.0031 in.	0.079 mm 0.0031 in.
Ball Nut Assembly	Axial Play	0.02 mm 0.0008 in.	0.12 mm 0.0047 in.
Worm Shaft	O.D.	28.562 to 28.575 mm 1.1245 to 1.1250 in.	28.475 mm 1.1211 in.
Valve Housing and Spool	Clearance	0.008 to 0.015 mm 0.0003 to 0.0006 in.	0.025 mm 0.0010 in.
Sector Shaft	O.D.	38.059 to 38.075 mm 1.4984 to 1.4990 in.	38.025 mm 1.4970 in.
Sector Gear and Ball Nut	Backlash	0 to 0.4 mm 0 to 0.016 in.	-
Sector Shaft	Initial Turning torque	1.177 or less 0.12 kgf·m or less 0.87 ft-lbs or less	-

STEERING GEAR CASE [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Item	Factory Specification	Allowable Limit
Bevel Gears in Steering Gear Case (14T Bevel Gears) Adjusting Shim	Backlash	0.1 to 0.3 mm 0.004 to 0.012 in.
	Thickness	0.8 mm (0.031 in.) 1.0 mm (0.039 in.) 1.2 mm (0.047 in.)
		0.4 mm 0.016 in. -

MANUAL STEERING [L2650 2WD, L2950 2WD]

Item	Factory Specification	Allowable Limit
Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.
Sector Gear Shaft to Ball Nut	Backlash	0 to 0.33 mm 0 to 0.013 in.
Worm Shaft	Turning Torque	Less than 0.98 N·m 0.10 kgf·m 0.72 ft-lbs

POWER STEERING [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Item	Factory Specification	Allowable Limit
Steering Wheel	Play	20 to 50 mm 0.79 to 1.97 in.
Relief Valve Condition <ul style="list-style-type: none"> ● Engine Speed Max. rpm ● Oil Temperature 45 to 55°C 113 to 131°F 	Setting Pressure	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi
Steering Gear Box to Ball Nut	Clearance	0.030 to 0.079 mm 0.00118 to 0.00311 in.
Gear Box bore	I.D.	61.000 to 61.030 mm 2.40158 to 2.40276 in.
Ball Nut	O.D.	60.951 to 60.970 mm 2.39965 to 2.40040 in.
Ball Nut Assembly	Axial Play	Less than 0.020 mm 0.00079 in.

POWER STEERING [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD] (Continued)

Item	Factory Specification	Allowable Limit
Worm Shaft	O.D. 24.996 to 25.009 mm 0.98410 to 0.98461 in.	—
Valve Housing to Spool	Clearance 0.008 to 0.015 mm 0.0031 to 0.0059 in.	0.025 mm 0.00098 in.
Sector Gear Shaft Steering Gear Box Side	O.D. 31.987 to 32.000 mm 1.25933 to 1.25984 in.	31.900 mm 1.25591 in.
Side Cover Side	O.D. 27.987 to 28.000 mm 1.10185 to 1.10236 in.	27.900 mm 1.09843 in.
Sector Gear Shaft to Ball Nut	Backlash 0 to 0.30 mm 0 to 0.0130 in.	—
Warm Shaft	Turning Torque Less than 1.18 N·m 0.12 kgf·m 0.87 ft-lbs	—

POWER STEERING [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Relief Valve Condition	Setting Pressure	10.30 to 11.28 MPa 105 to 115 kgf/cm ² 1493 to 1636 psi	—
<ul style="list-style-type: none"> ● Engine Speed Max. rpm ● Oil Temperature 45 to 55°C 113 to 131°F 			
Rotor Set	Clearance	—	0.08 mm 0.003 in.

STEERING CYLINDER [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Cylinder Tube	I.D.	50.000 to 50.062 mm 1.9685 to 1.9709 in.	50.100 mm 1.9724 in.
Rod to flange	Clearance	0.020 to 0.062 mm 0.0008 to 0.0024 in.	—
Rod	O.D.	29.959 to 29.980 mm 1.1795 to 1.1803 in.	—
Flange	I.D.	30.000 to 30.021 mm 1.1811 to 1.1819 in.	—

POWER STEERING HYDRAULIC PUMP [L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

Item	Factory Specification	Factory Specification	Allowable Limit
<p>Hydraulic Pump Condition</p> <ul style="list-style-type: none"> ● Engine Speed L2650, L2950, L3650 2600 rpm L3450 2500 rpm ● Rated Pressure 11.28 to 11.77 MPa 115 to 120 kgf/cm² 1636 to 1707 psi ● Oil Temperature 45 to 55°C 113 to 131°F 	<p>Delivery at No Pressure [L2650, L2950]</p> <p>[L3450]</p> <p>[L3650]</p> <p>Delivery at Rated Pressure [L2650, L2950]</p> <p>[L3450]</p> <p>[L3650]</p>	<p>Above 10.5 ℓ/min 2.77 U.S.gal/min 2.31 Imp.gal/min</p> <p>Above 11.7 ℓ/min 3.09 U.S.gal/min 2.57 Imp.gal/min</p> <p>Above 12.1 ℓ/min 3.20 U.S.gal/min 2.66 Imp.gal/min</p> <p>Above 10.2 ℓ/min 2.69 U.S.gal/min 2.24 Imp.gal/min</p> <p>Above 11.3 ℓ/min 2.99 U.S.gal/min 2.49 Imp.gal/min</p> <p>Above 11.7 ℓ/min 3.09 U.S.gal/min 2.57 Imp.gal/min</p>	<p>-</p> <p>-</p> <p>-</p> <p>9.1 ℓ/min 2.40 U.S.gal/min 2.00 Imp.gal/min</p> <p>10.2 ℓ/min 2.69 U.S.gal/min 2.24 Imp.gal/min</p> <p>10.5 ℓ/min 2.77 U.S.gal/min 2.31 Imp.gal/min</p>
<p>Housing</p>	<p>-</p>	<p>Depth of Scratch</p> <p>-</p>	<p>0.09 mm 0.0035 in.</p>
<p>Bushing to Gear Shaft</p>	<p>-</p>	<p>Clearance</p> <p>-</p>	<p>0.15 mm 0.0059 in.</p>
<p>Bushing</p>	<p>-</p>	<p>Length</p> <p>16.99 to 17.00 mm 0.6689 to 0.6693 in.</p>	<p>16.80 mm 0.6614 in.</p>

POWER STEERING HYDRAULIC PUMP [L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

Item	Factory Specification	Factory Specification	Allowable Limit
<p>Hydraulic Pump Condition</p> <ul style="list-style-type: none"> ● Engine Speed L2650, L2950, L3650 2600 rpm L3450 2500 rpm ● Rated Pressure 10.30 to 11.28 MPa 105 to 115 kgf/cm² 1493 to 1636 psi ● Oil Temperature 45 to 55°C 113 to 131°F 	<p>Delivery at No Pressure [L2650, L2950]</p> <p>[L3450]</p> <p>[L3650]</p> <p>Delivery at Rated Pressure [L2650, L2950]</p> <p>[L3450]</p> <p>[L3650]</p>	<p>Above 17.1 l/min 4.52 U.S.gal/min 3.76 Imp.gal/min</p> <p>Above 14.7 l/min 3.88 U.S.gal/min 3.23 Imp.gal/min</p> <p>Above 15.3 l/min 4.04 U.S.gal/min 3.37 Imp.gal/min</p> <p>Above 16.6 l/min 4.39 U.S.gal/min 3.65 Imp.gal/min</p> <p>Above 14.3 l/min 3.78 U.S.gal/min 3.15 Imp.gal/min</p> <p>Above 14.8 l/min 3.91 U.S.gal/min 3.26 Imp.gal/min</p>	<p>-</p> <p>-</p> <p>-</p> <p>14.9 l/min 3.94 U.S.gal/min 3.28 Imp.gal/min</p> <p>12.8 l/min 3.38 U.S.gal/min 2.82 Imp.gal/min</p> <p>13.3 l/min 3.51 U.S.gal/min 2.93 Imp.gal/min</p>
<p>Housing</p> <p>Bushing to Gear Shaft</p> <p>Bushing</p>	<p>Depth of Scratch</p> <p>Clearance</p> <p>Length</p>	<p>-</p> <p>-</p> <p>15.79 to 15.80 mm 0.6217 to 0.6220 in.</p>	<p>0.09 mm 0.0035 in.</p> <p>0.15 mm 0.0059 in.</p> <p>15.60 mm 0.6142 in.</p>

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below is especially specified.
(For general use screws and nuts: See page S.G-8)

[L2350]

Item	N·m	kgf·m	ft-lbs
Tie-rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	118 to 157	12.0 to 16.0	87.0 to 115.9
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Jam nut (Manual steering)	157 to 196	16.0 to 20.0	115.8 to 144.6
Column lock nut (Power steering)	98 to 127	10.0 to 13.0	72.3 to 94.0
Special nut (Power steering)	58.8 to 78.4	6.0 to 8.0	43.4 to 57.9

[L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD]

[Manual Steering Type]			
Steering shaft and joint shaft mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tie rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	117.7 to 156.9	12.0 to 16.0	86.8 to 115.7
Steering gear box mounting screw	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Side cover mounting screw	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
[Power Steering Type]			
Steering shaft and joint shaft mounting bolt	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Tie rod end mounting nut	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Pitman arm mounting nut	147.1 to 196.1	15.0 to 20.0	108.5 to 144.7
Power steering assembly mounting screw	123.6 to 147.1	12.6 to 15.0	91.1 to 108.5
Power steering delivery pipe end eye joint screw (at steering gear box)	49.0 to 58.8	5.0 to 6.0	36.2 to 43.4
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
End cover mounting screw	37.3 to 56.9	3.8 to 5.8	27.5 to 42.0
Relief valve lock nut	49.0 to 58.8	5.0 to 6.0	36.2 to 43.4
Side cover lock nut	19.6 to 29.4	2.0 to 3.0	14.5 to 21.7
Side cover mounting screw	34.3 to 54.9	3.5 to 5.6	25.3 to 40.5

[L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD]

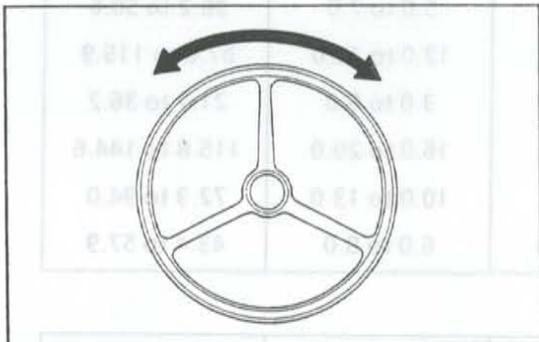
[Steering Controller]			
Steering controller mounting nuts	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
Flared pipes	34.3 to 39.2	3.5 to 4.0	25.3 to 28.9
Retaining nuts	27.0 to 33.0	2.8 to 3.4	20.0 to 24.0
Hex. socket head cap screws	1.24 to 1.47	0.13 to 0.15	0.94 to 1.08
Steering wheel mounting nut	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
[Steering Cylinder]			
Steering cylinder mounting screws	77.5 to 90.2	7.9 to 9.2	57.1 to 66.5
Tie rod end mounting nuts	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
Tie rod screws of rod side	98.1 to 117.7	10 to 12	72.3 to 86.8
Hydraulic hoses	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7

CHECKING, DISASSEMBLING AND SERVICING

[1] L2350

[1]-1 MANUAL STEERING

CHECKING AND ADJUSTING



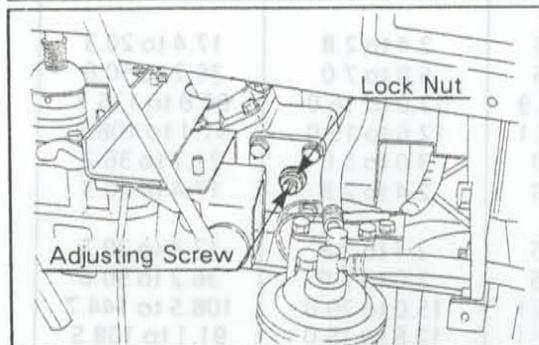
Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the play is not within the factory specifications, turn the adjusting screw to adjust.

Steering wheel play	Factory spec.	20 to 50 mm 0.79 to 1.97 in.
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(Adjusting)

1. Loosen the lock nut and turn the adjusting screw with a screwdriver to adjust the play. When the adjusting screw is turned clockwise, the play decreases.
2. After adjustment, while holding the adjusting screw, fix it with lock nut.



DISASSEMBLING AND ASSEMBLING



0301P107

Pitman Arm

1. Remove the pitman arm from the sector shaft with the pitman arm puller. (Code No: 07909-39011).

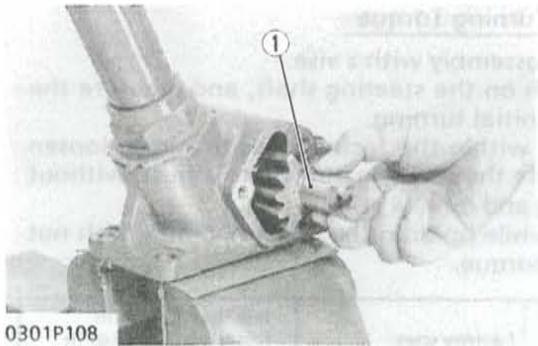
(When reassembling)

- Install the pitman arm to the sector shaft making sure that the marks are aligned.

Tightening torque	Pitman arm mounting nut	118 to 157 N·m 12.0 to 16.0 kgf·m 87.0 to 115.9 ft·lbs
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C020P053



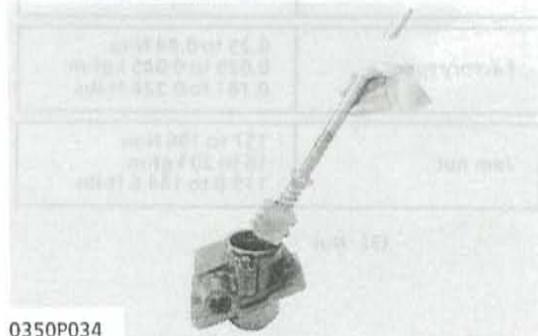
0301P108

Side Cover and Sector Gear Shaft

1. Drain the oil.
2. Remove the side cover mounting screws.
3. Remove the lock nut and cap nut at the center of the side cover.
4. Turn the adjusting screw to remove the side cover.
5. Tap out sector gear shaft (1) toward the side cover.

(When reassembling)

- Apply liquid gasket (Three Bond No.4 or equivalent) to the mounting surface of side cover gasket.



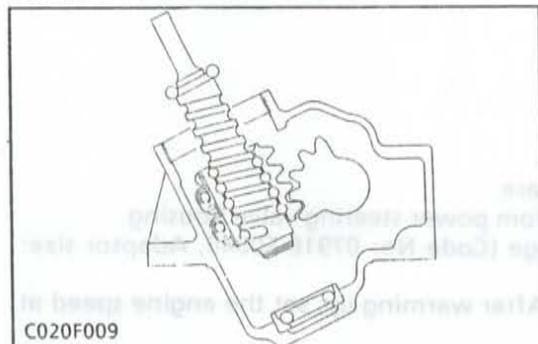
0350P034

Steering Column, Steering Shaft and Ball Nut Assembly

1. Remove the nut and steering column.
2. Remove the steering shaft and ball nut assembly.

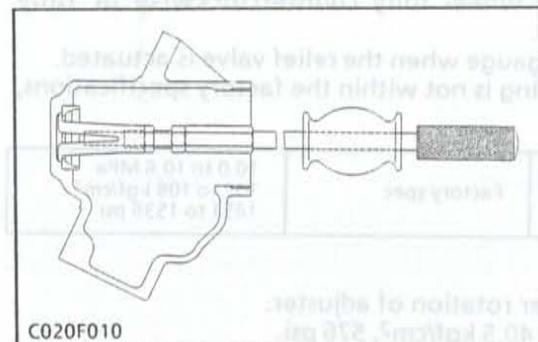
(When reassembling)

- Steering box assembly.
 - Install the sector gear shaft, and turn it clockwise fully.
 - Install the ball nut assembly and mesh it with the sector gear, making sure that the thrust bearing does not leave the outer race.
- Adjust the steering shaft initial turning torque.
(See page S.7-12)



C020F009

(1) Sector Gear Shaft

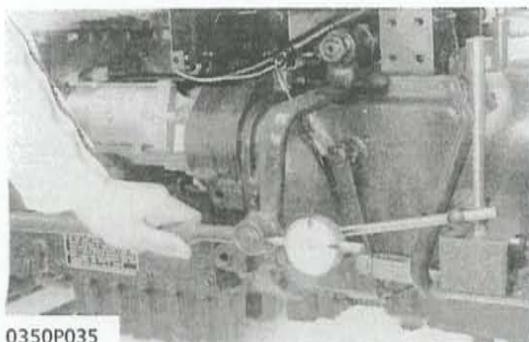


C020F010

Thrust Ball Bearing

1. Draw out the bearing outer with the bushing replacement tool. (Code No: 07916-51031).

SERVICING

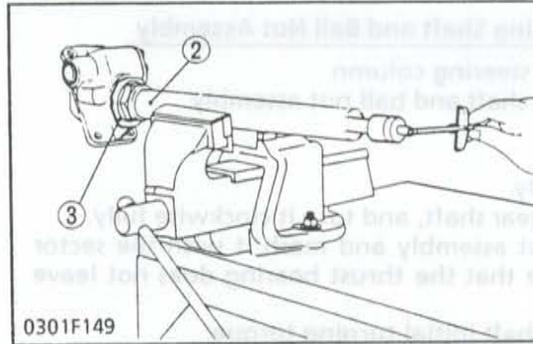
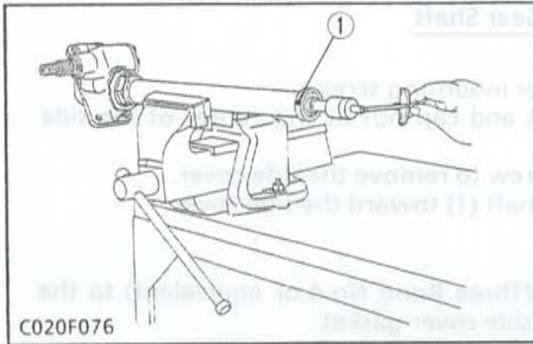


0350P035

Tie Rod End Play

1. Remove either one of the tie rod ends.
2. Set a dial indicator with its finger on the tie rod end.
3. Move the tie rod lightly and measure the play.
4. If the play exceeds the allowable limit, replace the tie rod end.

Play of tie rod end	Allowable limit	0.3 mm 0.012 in.



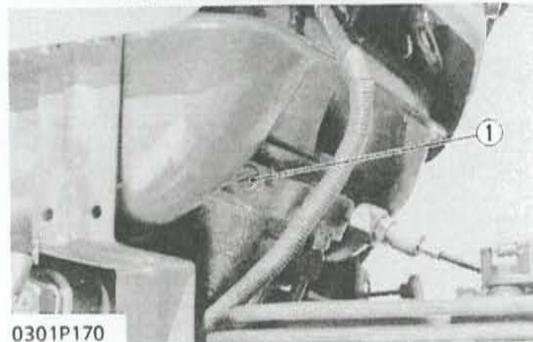
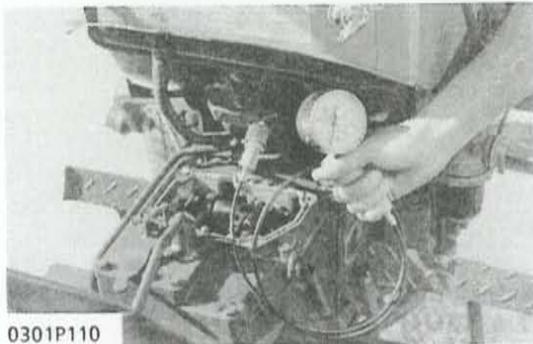
Steering Shaft Initial Turning Torque

1. Secure the steering assembly with a vise.
2. Set a torque wrench on the steering shaft, and measure the torque required to initial turning.
3. If the torque is not within the factory specifications, loosen the nut (3) and rotate the steering post (2) to adjust, without the column bushing and oil seal (1).
4. After adjustment, while holding the column, jam it with nut (3) to the specified torque.

Steering shaft initial turning torque	Factory spec.	less than 1.72 N-m less than 0.175 kgf-m less than 1.26 ft-lbs
Initial turning torque (without bushing and seal)	Factory spec.	0.25 to 0.44 N-m 0.025 to 0.045 kgf-m 0.181 to 0.326 ft-lbs
Tightening torque	Jam nut	157 to 196 N-m 16 to 20 kgf-m 115.8 to 144.6 ft-lbs

- (1) Oil Seal (3) Nut
(2) Steering Post

[1]-2 POWER STEERING CHECKING AND ADJUSTING



Relief Valve Pressure

1. Remove the shift base.
2. Remove the plug from power steering valve housing.
3. Set a pressure gauge (Code No: 07916-50040, Adaptor size: PT 1/8).
4. Start the engine. After warming up, set the engine speed at max. speed.
5. Turn the steering wheel fully counterclockwise or fully clockwise and hold.
6. Read the pressure gauge when the relief valve is actuated.
7. If the pressure setting is not within the factory specifications, adjust.

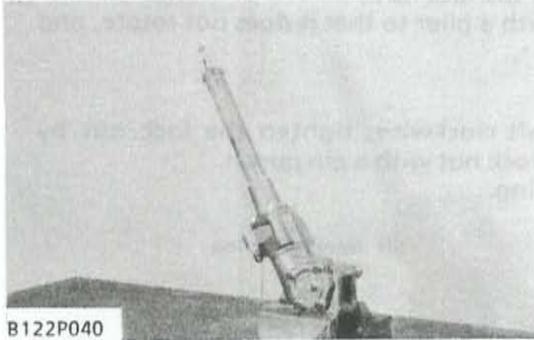
Relief valve setting pressure	Factory spec	10.0 to 10.6 MPa 102 to 108 kgf/cm ² 1451 to 1536 psi
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(Reference)

- Pressure change per rotation of adjuster.
Approx. 3.97 MPa, 40.5 kgf/cm², 576 psi.

- (1) Adjuster

DISASSEMBLING AND ASSEMBLING



B122P040

Power Steering Unit

1. Turn the steering shaft clockwise and counterclockwise several times to drain oil from the gear box.
2. Secure the power steering unit with a vise.



0301P112

Pitman Arm

1. Remove nut and spring washer.
2. Temporarily remount the nut.
3. Remove pitman arm with the pitman arm puller. (Code No: 07909-39011).

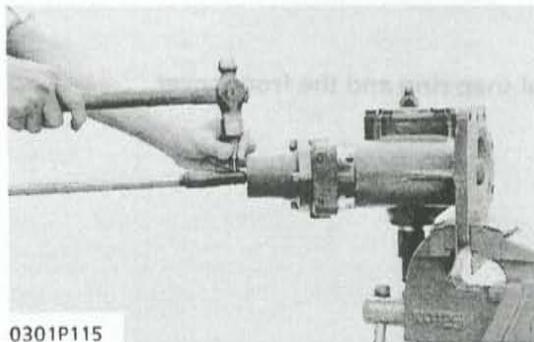
(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their aligning marks.

Tightening torque	Pitman arm mounting nut	118 to 157 N·m 12.0 to 16.0 kgf·m 87 to 116 ft-lbs
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0301P113



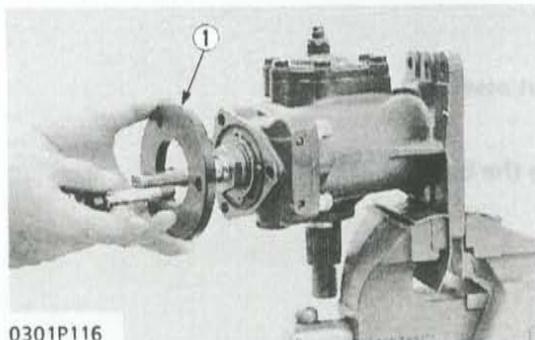
0301P115

Steering Shaft

1. Remove the column.
2. Draw out the rivet and drive out the spring pin.
3. Remove the steering shaft.

(When reassembling)

Tightening torque	Column lock nut	98 to 127 N·m 10 to 13 kgf·m 72.3 to 94.0 ft-lbs
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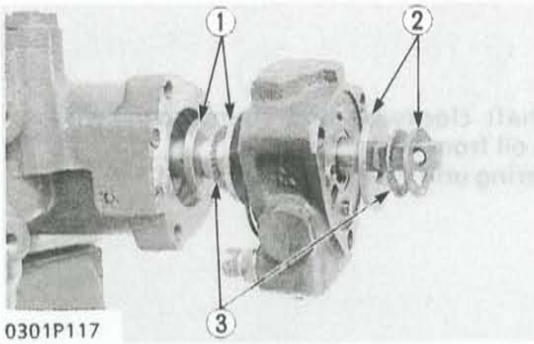


0301P116

(1) Special Mounting Plate

Rear Cover

1. Remove the rear cover.
2. Install the mounting plate (See page S.G-35) with three screws.



Valve Assembly

1. Flatten the staking of the lock nut.
2. Fix the worm shaft with a plier so that it does not rotate, and remove the lock nut.

(When reassembling)

- Screw the worm shaft clockwise, tighten the lock nut by hand, and stake the lock nut with a pin punch.
- Be sure to mount O-ring.

- (1) Thrust Race (3) Needle Bearing
 (2) Thrust Race



Side Cover

1. Remove the special nut and gasket from the adjuster section.
2. Remove the side cover mounting screws, turn the adjusting screw clockwise, and remove the side cover.

(When reassembling)

Tightening torque	Special nut	58.8 to 78.4 N·m 6.0 to 8.0 kgf·m 43.4 to 57.9 ft-lbs
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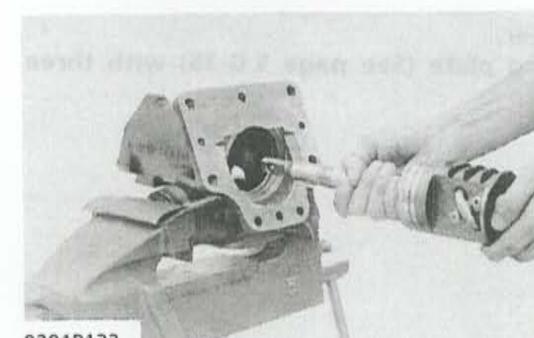
Sector Gear Shaft

1. Remove the sector gear shaft from the side cover.



Front Cover

1. Remove the internal snap ring and the front cover.

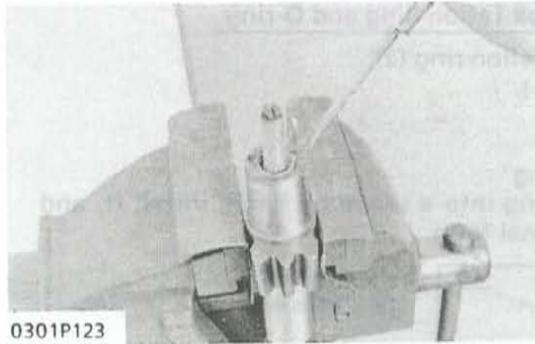


Ball Nut

1. Pull out the ball nut assembly.

NOTE

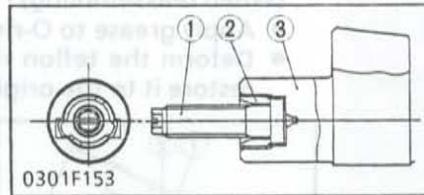
- Never disassemble the ball nut assembly.



0301P123

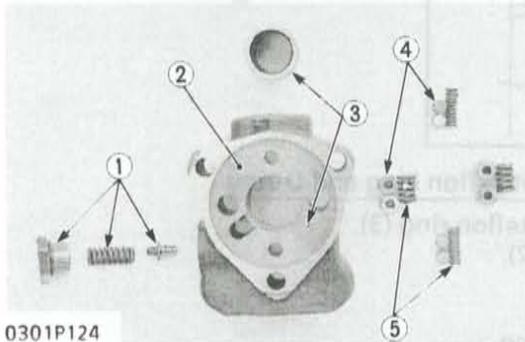
Adjustor

1. Remove the adjuster.



0301F153

- (1) Adjuster Screw
- (2) Adjuster
- (3) Sector Shaft



0301P124

Control Valve

1. Remove the relief valve (1).
2. Remove the spool, reaction pistons (4) and springs (5).

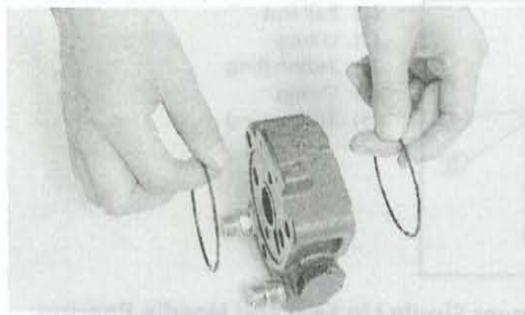
(When reassembling)

- Align P marks on the sleeve and spool to assemble.
- Apply grease to O-ring.
- After assembling, adjust the power steering relief pressure. (See page S.7-12)

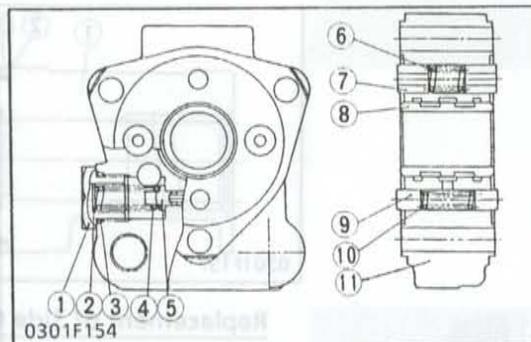
NOTE

- Replace the spool and valve housing as an assembly.

- (1) Relief Valve
- (2) Valve Housing
- (3) P Mark
- (4) Reaction Piston
- (5) Coil Spring



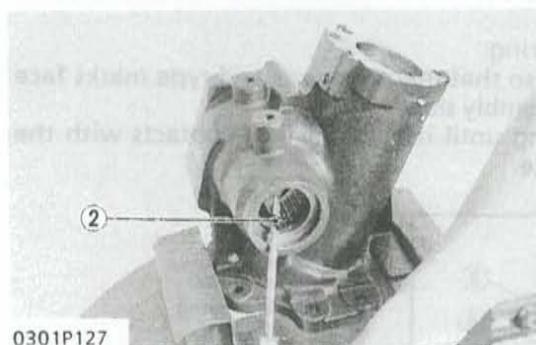
0301P125



0301F154

- (1) Adjuster
- (2) Jam Nut
- (3) O-ring
- (4) Coil Spring
- (5) Poppet
- (6) Coil Spring
- (7) Reaction Piston
- (8) Spool
- (9) Reaction Piston
- (10) Coil Spring
- (11) Valve Housing

SERVICING



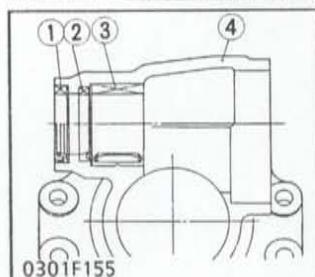
0301P127

Replacement of Seals and Bearing

1. Remove the oil seal (1) with screwdriver.
2. Remove the single lip seal (2) with screwdriver.
3. Remove the needle bearing (3) from the gear box with the puller.

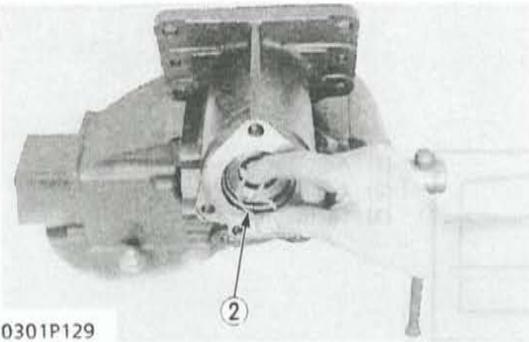
(When reassembling)

- Apply grease to oil seal and single lip seal, and insert them.
- Install the bearing so that manufacturer marks and type marks face to the inside of the gear box.
- Press fit the bearing until its race surface contacts with the housing end surface.



0301F155

- (1) Oil Seal
- (2) Single Lip Seal
- (3) Needle Bearing
- (4) Gear Box



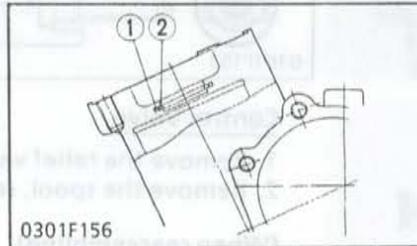
0301P129
(2) Teflon Ring

Replacement of Gear Box Teflon Ring and O-ring

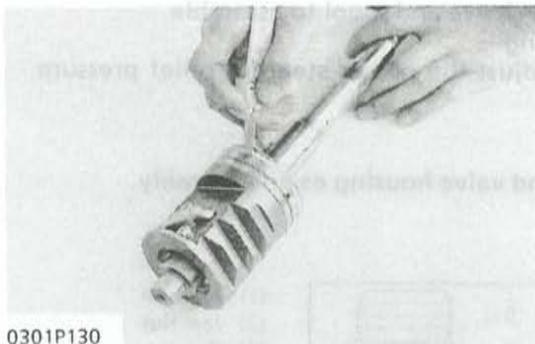
1. Cut and remove the teflon ring (2).
2. Remove the O-ring (1).

(When reassembling)

- Apply grease to O-ring.
- Deform the teflon ring into a shape by hand, install it, and restore it to the original form.



(1) O-ring
(2) Teflon Ring



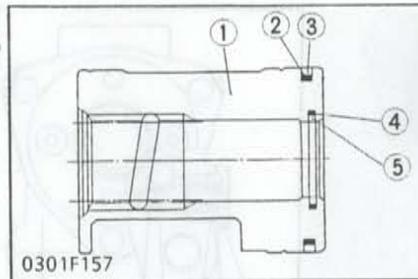
0301P130

Replacement of Ball Nut Teflon Ring and O-ring

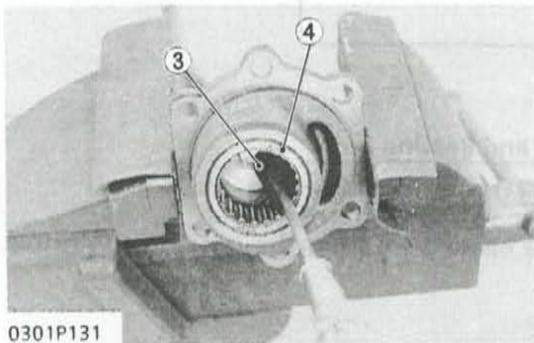
1. Cut and remove the teflon ring (3).
2. Remove the O-ring (2).

(When reassembling)

- Apply grease to O-ring
- Stretch the teflon ring by hand, install it on the ball nut, and press it so that it is restored to its original form.



(1) Ball Nut
(2) O-ring
(3) Teflon Ring
(4) O-ring
(5) Teflon Ring



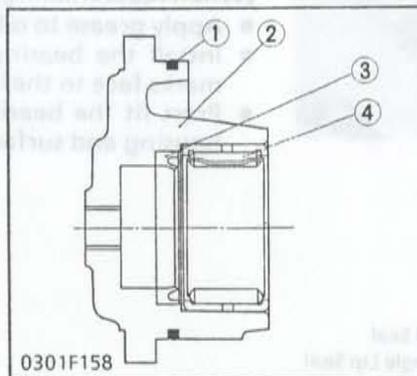
0301P131
(3) Single Lip Seal
(4) Needle Bearing

Replacement of Side Cover Single Lip Seal and Needle Bearing

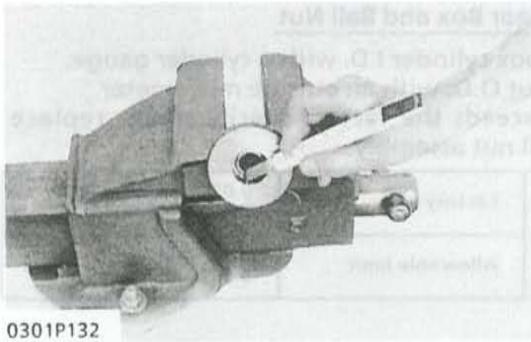
1. Remove the single lip seal (3) with a screwdriver.
2. Pull out the needle bearing (4) with a puller.

(When reassembling)

- Apply grease to O-ring.
- Install the bearing so that manufacturer and type marks face to the gear box assembly side.
- Press fit the bearing until its race surface contacts with the housing end surface.



(1) O-ring
(2) Side Cover
(3) Single Lip Seal
(4) Needle Bearing



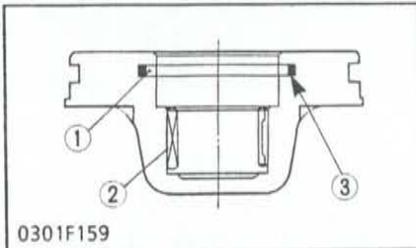
0301P132

Replacement of Front Cover Teflon Ring and Needle Bearing

1. Cut and remove the teflon ring (1).
2. Pull out the needle bearing (2) with a puller.
3. Remove the O-ring (3).

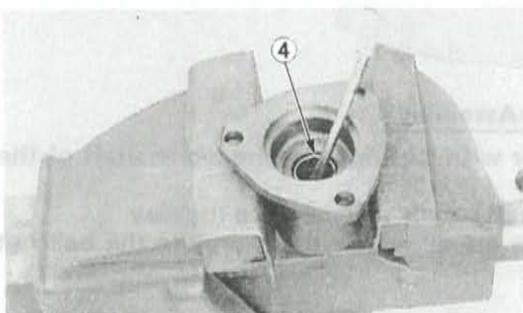
(When reassembling)

- Apply grease to O-ring.
- Deform the teflon ring into a shape by hand, install it, and restore it to its original form.
- Install the bearing so that manufacturer and type marks face forward.
- Press fit bearing until its race surface contacts with the housing end surface.



0301F159

- (1) Teflon Ring
- (2) Needle Bearing
- (3) O-ring



0301P135

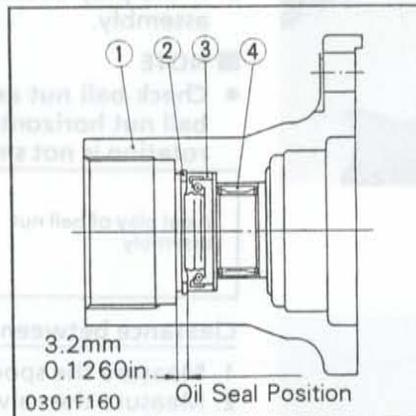
(4) Needle Bearing

Replacement of Rear Cover Oil Seal and Needle Bearing

1. Remove the internal snap ring.
2. Remove the oil seal (3).
3. Draw out the needle bearing (4).

(When reassembling)

- Install the bearing so that manufacturer and type marks face to the column side.



0301F160

- (1) Rear Cover
- (2) Snap Ring
- (3) Oil Seal
- (4) Needle Bearing

0.01 mm 0.000 in	Tolerance limit
0.13 mm 0.005 in	Allowable limit

Replacement of Column Oil Seal

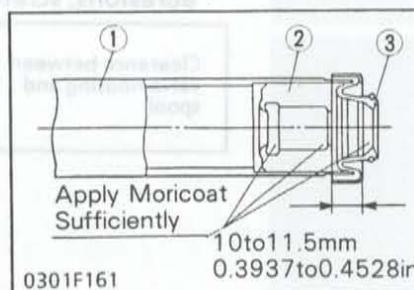
1. Remove the oil seal and column cap (seal cap) as an assembly.

(When reassembling)

- Apply molybdenum disulfide (Three Bond 1901 or equivalent) to the column bushing.



0301P136



0301F161

- (1) Steering Post
- (2) Column Bushing
- (3) Oil Seal

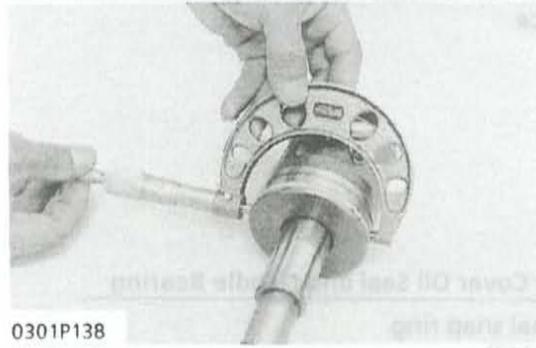


0301P137

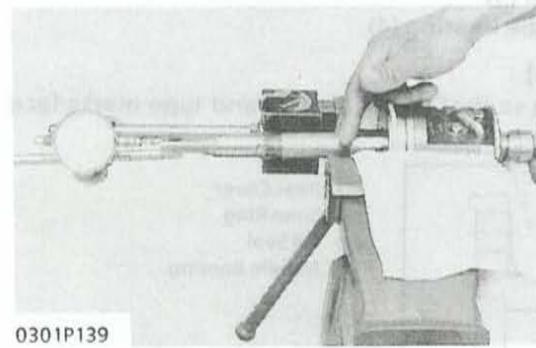
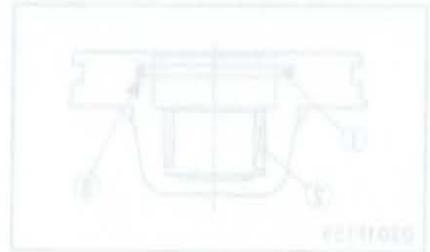
Clearance between Gear Box and Ball Nut

1. Measure the gear box cylinder I.D. with a cylinder gauge.
2. Measure the ball nut O.D. with an outside micrometer.
3. If the clearance exceeds the factory specifications, replace the gear box or ball nut assembly.

Clearance between gear box and ball nut	Factory spec.	0.030 to 0.079 mm 0.0012 to 0.0031 in.
	Allowable limit	0.079 mm 0.0031 in.



0301P138



0301P139

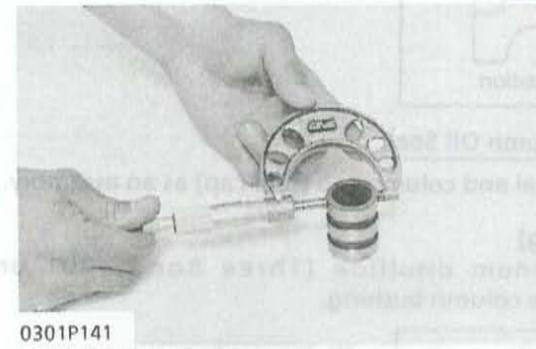
Axial Play of Ball Nut Assembly

1. Set a dial indicator with its finger on the worm shaft of the ball nut assembly.
2. Move the worm shaft axially and measure the play.
3. If the play exceeds the allowable limit, replace the ball nut assembly.

NOTE

- Check ball nut assembly for smooth rotation by holding the ball nut horizontally, and slowly rotating the worm shaft. If rotation is not smooth, replace the ball nut assembly.

Axial play of ball nut assembly	Factory spec.	0.02 mm 0.0008 in.
	Allowable limit	0.12 mm 0.0047 in.



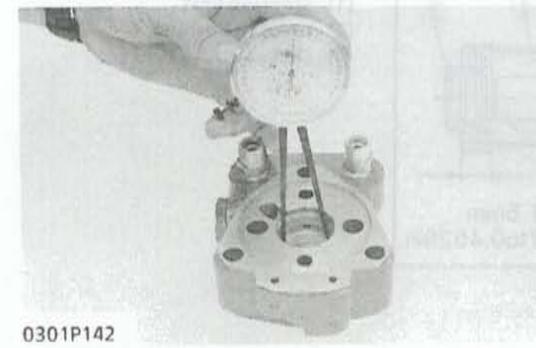
0301P141

Clearance between Valve Housing and Spool

1. Measure the spool O.D. with an outside micrometer.
2. Measure the valve housing I.D. with a caliper gauge.
3. If the clearance exceeds the allowable limit, replace the valve housing and spool as an assembly.

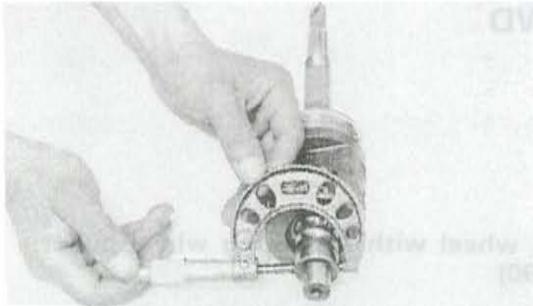
NOTE

- Check that the spool slides smoothly and rotates in the sleeve.
- Check that the spool and sleeve edges are free from abrasions, scratches, etc.



0301P142

Clearance between valve housing and spool	Factory spec.	0.008 to 0.015 mm 0.0003 to 0.0006 in.
	Allowable limit	0.025 mm 0.0010 in.

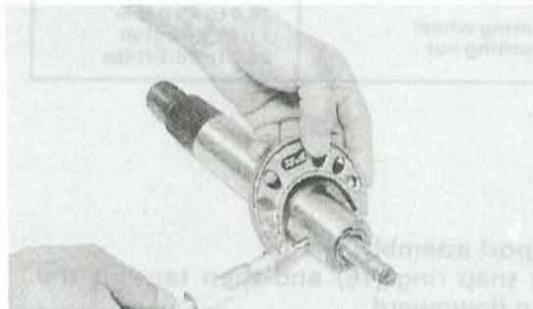


0301P140

Worm Shaft Wear

1. Measure the worm shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the ball nut assembly.

Worm shaft O.D.	Factory spec	28 562 to 28 575 mm 1 1245 to 1.1250 in.
	Allowable limit	28 475 mm 1.1211 in.

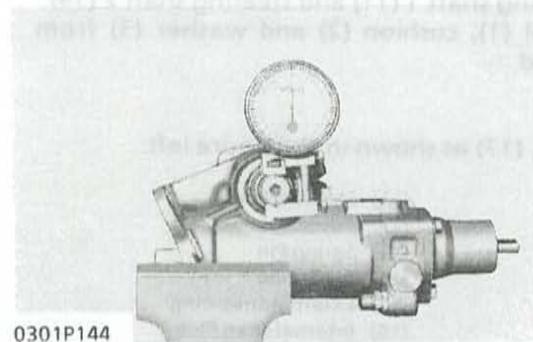


0301P143

Sector Gear Shaft Wear

1. Measure the sector gear shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace.

Sector gear shaft O.D.	Factory spec.	38 059 to 38 075 mm 1 4984 to 1.4990 in.
	Allowable limit	38 025 mm 1.4970 in.



0301P144

Sector Shaft Working Angle

1. Set an angle gauge on the sector shaft.
2. Measure the angle over the rotation range of the steering shaft.
3. If the measurement is less than the factory specifications, overhaul.

Sector shaft working angle	Factory spec	(32° to 35°) x 2
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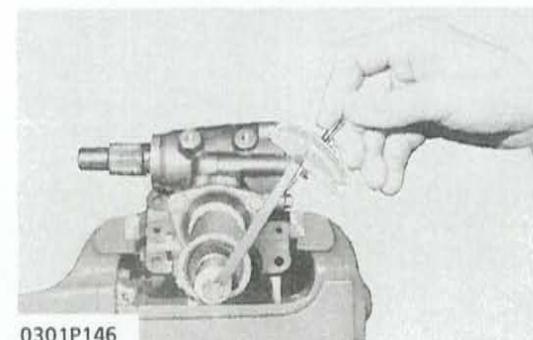


0301P145

Backlash between Sector Gear and Ball Nut

1. Set a dial indicator with its finger on the pitman arm.
2. Move the pitman arm lightly, and measure the pitman arm deflection.
3. If the measurement is not within the factory specifications, adjust the backlash with the adjusting screw.

Backlash between sector gear and ball nut	Factory spec.	0 to 0.4 mm 0 to 0.016 in.
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0301P146

Steering Shaft Initial Turning Torque

1. Secure the steering assembly with a vise.
2. Set a torque wrench on the steering shaft and measure the torque required to initial turning.
3. If the measurement exceeds the factory specifications, overhaul.

Steering shaft initial turning torque	Factory spec.	1 177 N·m or less 0 12 kgf·m or less 0 87 ft·lbs or less
	Allowable limit	1 961 N·m 0 2 kgf·m 1 477 ft·lbs

[2] L2650 2WD, L2950 2WD, L3450 2WD, L3650 2WD

[2]-1 STEERING POST AND STEERING GEAR
DISASSEMBLING AND ASSEMBLING



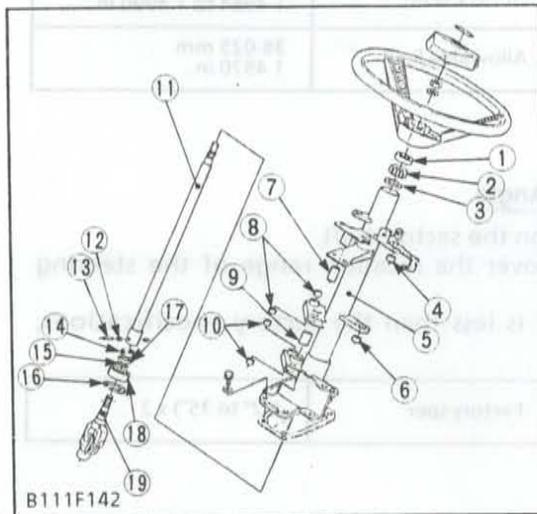
B111P097

Steering Wheel

1. Remove the steering wheel with a steering wheel puller (Code No: 07916-51090).

(When reassembling)

Tightening torque	Steering wheel mounting nut	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft·lbs
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B111F142

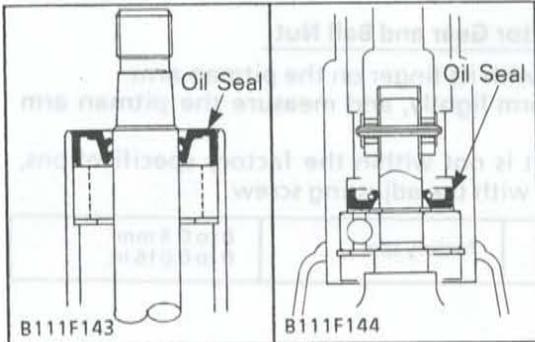
Steering Post

1. Remove the steering post assembly.
2. Remove the internal snap ring (16) and then tap out the steering shaft 1 (11) to downward.
3. Remove the set spring (14), spring pin (13), and cushions (12) to separate the steering shaft 1 (11) and steering shaft 2 (19). Push out the oil seal (1), cushion (2) and washer (3) from downward to upward.

(When reassembling)

- Install the oil seal (1), (17) as shown in the figure left.

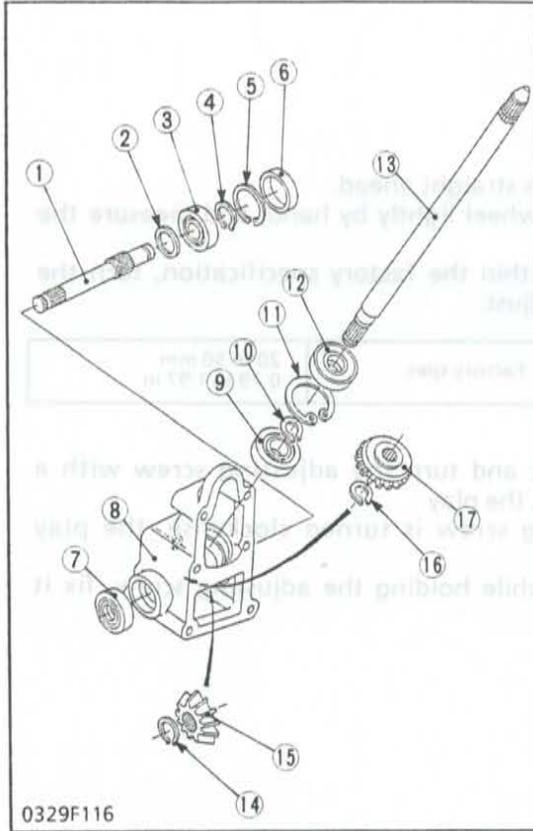
- | | |
|-------------------|-------------------------|
| (1) Oil Seal | (11) Steering Shaft |
| (2) Cushion | (12) Cushion |
| (3) Washer | (13) Spring Pin |
| (4) Bushing | (14) Set Spring |
| (5) Steering Post | (15) External Snap Ring |
| (6) Bushing | (16) Internal Snap Ring |
| (7) Bushing | (17) Oil Seal |
| (8) Bushing | (18) Ball Bearing |
| (9) Bushing | (19) Steering Shaft |
| (10) Bushing | |



B111F143

B111F144

Steering shaft initial turning torque	Factory spec	1.13 to 1.27 N·m 0.12 to 0.13 kgf·m 0.83 to 0.92 ft·lb
allowable limit		1.0 to 1.4 N·m 0.1 to 0.14 kgf·m 0.74 to 1.03 ft·lb



0329F116

Steering Gear case

1. Remove the steering gear case from the clutch housing.
2. Remove the plug (6).
3. Remove the internal snap ring (5) and external snap ring (14).
4. Tap out the joint shaft 2 (1).
5. Remove the external snap ring (4), and pull out the ball bearing (3), shim (2) on the joint shaft 2 (1).
6. Take out the bevel gear (15) and remove the oil seal (12).
7. Remove the internal snap ring (11), external snap ring (16), and the joint shaft 1 (13).
8. Remove the external snap ring (10).
9. Remove the ball bearing (9).
10. Take out the bevel gear (17) from the steering gear case.
11. Remove the oil seal (7).

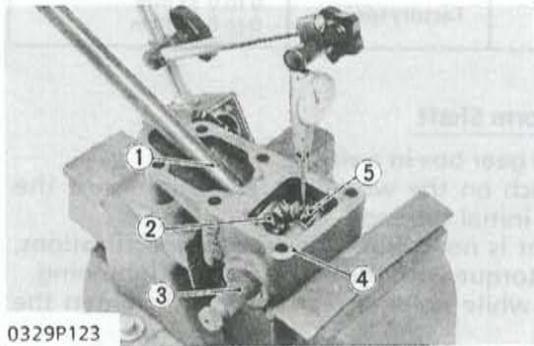
(When reassembling)

- Replace the oil seal, plug and snap ring with new ones.
- When installing the oil seals (7), (12), direct the lip of them to the inside.
- After installing steering gear case (8), fill transmission fluid up to the level of oil filling plug.

Tightening torque	Steering gear case mounting bolt	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft·lbs
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- | | |
|------------------------|-------------------------|
| (1) Joint Shaft 2 | (10) External Snap Ring |
| (2) Shim | (11) Internal Snap Ring |
| (3) Ball Bearing | (12) Oil Seal |
| (4) External Snap Ring | (13) Joint Shaft 1 |
| (5) Internal Snap Ring | (14) External Snap Ring |
| (6) Plug | (15) Bevel Gear |
| (7) Oil Seal | (16) External Snap Ring |
| (8) Steering Gear Case | (17) Bevel Gear |
| (9) Ball Bearing | |

SERVICING



0329P123

Backlash between 14T Bevel Gears

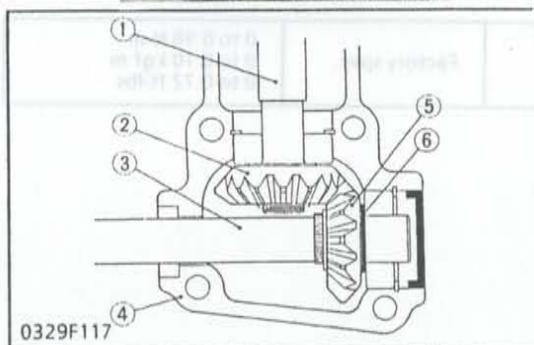
1. Secure the steering gear case (4) in a vise.
2. Set a dial indicator (lever type) on the tooth of the 14T bevel gear (2).
3. Push the 14T bevel gear (2) on joint shaft 1 (1) to upward and fix it, move the 14T bevel gear (5) to measure the backlash.
4. If the backlash exceeds the allowable limit, adjust it by shims (6).

(Reference)

- Thickness of shims: 0.8 mm (0.031 in.)
1.0 mm (0.039 in.)
1.2 mm (0.047 in.)

Backlash between 14T bevel gears	Factory spec.	0.1 to 0.3 mm 0.004 to 0.012 in.
	Allowable limit	0.4 mm 0.016 in.

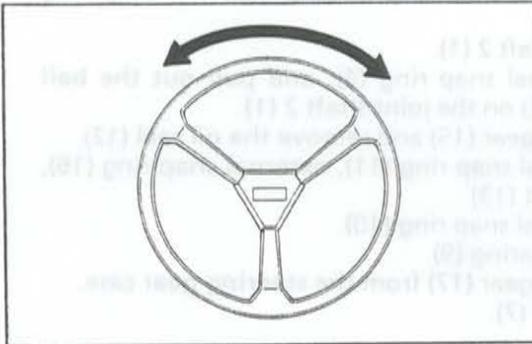
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|--------------------|------------------------|
| (1) Joint Shaft 1 | (4) Steering Gear Case |
| (2) 14T Bevel Gear | (5) 14T Bevel Gear |
| (3) Joint Shaft 2 | (6) Shim |



0329F117

[2]-2 MANUAL STEERING

CHECKING AND ADJUSTING



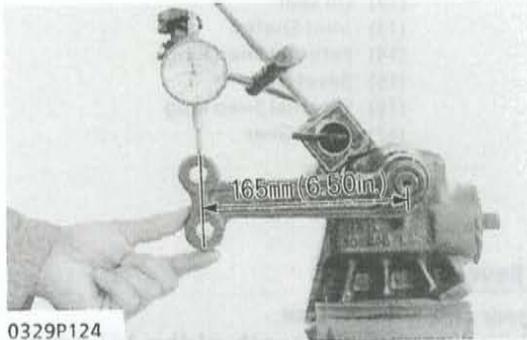
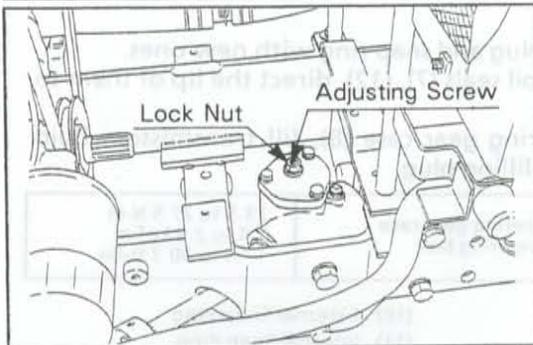
Steering Wheel Play

1. Turn the front wheels straight ahead.
2. Rotate the steering wheel lightly by hand, and measure the play.
3. If the play is not within the factory specification, turn the adjusting screw to adjust.

Steering wheel play	Factory spec	20 to 50 mm 0.79 to 1.97 in.
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(Adjusting)

1. Loosen the lock nut and turn the adjusting screw with a screwdriver to adjust the play.
When the adjusting screw is turned clockwise, the play decreases.
2. After adjustment, while holding the adjusting screw, fix it with lock nut.



0329P124

Backlash between Sector Gear Shaft and Ball Nut

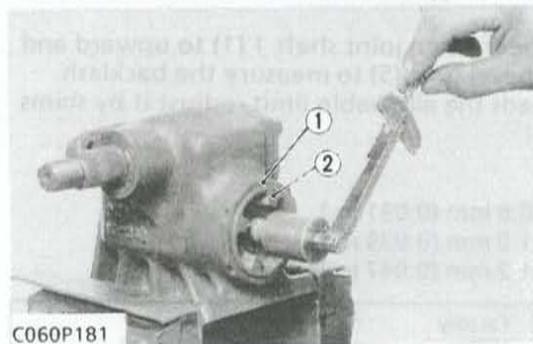
1. Secure the steering gear box in a vise.
2. Set a dial indicator with its finger on the pitman arm.
3. Move the pitman arm lightly, and measure the pitman arm deflection.
4. If the backlash is not within the factory specifications, adjust the backlash with the adjusting screw.

Backlash between sector gear shaft and ball nut	Factory spec.	0 to 0.33 mm 0 to 0.0130 in.
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Turning Torque of Worm Shaft

1. Secure the steering gear box in a vise.
2. Set a torque wrench on the worm shaft and measure the torque required to initial turning.
3. If the measurement is not within the factory specifications, adjust the turning torque with the rear cover (2) tightening.
4. After adjustment, while holding rear cover (2), tighten the lock nut (1).

Turning torque of worm shaft	Factory spec.	0 to 0.98 N·m 0 to 0.10 kgf·m 0 to 0.72 ft·lbs
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C060P181

(1) Lock Nut

(2) Rear Cover

DISASSEMBLING AND ASSEMBLING



C060P173

Draining Oil

1. Secure the steering gear box in a vise.
2. Remove the drain plug and drain the used oil from the gear box.

Steering gear box oil	Lubricant	Gear oil SAE 80 or SAE 90
	Capacity	0.2ℓ 0.21 U.S.qts. 0.18 Imp.qts.



C060P174

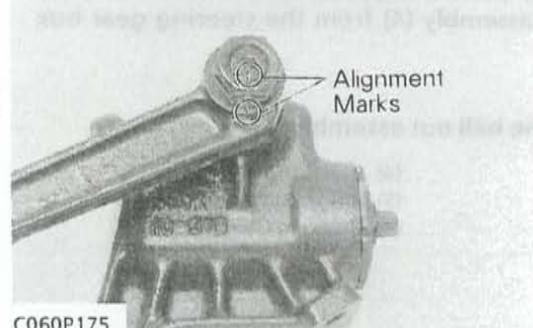
Pitman Arm

1. Loosen the pitman arm mounting nut to the sector gear shaft end.
2. Remove the pitman arm with the pitman arm puller (Code No: 07909-39011).

(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their alignment marks.

Tightening torque	Pitman arm mounting nut	117.7 to 156.9 N·m 12 to 16 kgf·m 86.8 to 115.7 ft-lbs
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C060P175



C060P176

Side Cover

1. Remove the side cover mounting screws and remove the adjusting lock nut.
2. Turn the adjusting screw clockwise to remove the side cover.

(When reassembling)

- Apply grease to the O-ring.
- Apply liquid gasket (Three bond 1211 or equivalent) to the seam of the side cover gasket.
- Take care not to damage the O-ring.
- After reassembling the side cover, be sure to adjust the backlash.

Tightening torque	Side cover mounting screw	23.5 to 27.5 N·m 2.4 to 2.8 kgf·m 17.4 to 20.3 ft-lbs
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C060P178

Sector Gear Shaft

1. Tap out the sector gear shaft toward the side cover.

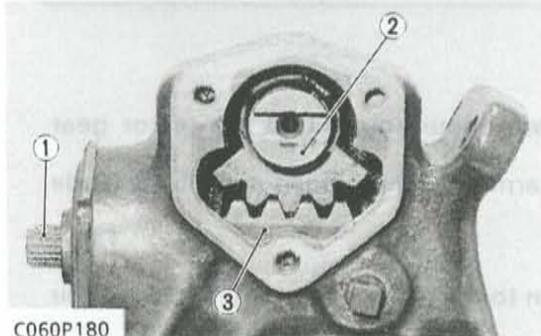
(When reassembling)

- Apply grease to the oil seal which is installed the inside of steering gear box.

NOTE

- Turn the worm shaft (1) so that the ball nut (3) is centered in its travel. Then, install the sector gear shaft (2) so that center tooth of it engages the center of the ball nut (3).
- Adjust the turning torque of worm shaft (1) to the factory specification and tighten the lock nut.

- | | |
|-----------------------|--------------|
| (1) Worm Shaft | (3) Ball Nut |
| (2) Sector Gear Shaft | |



C060P180

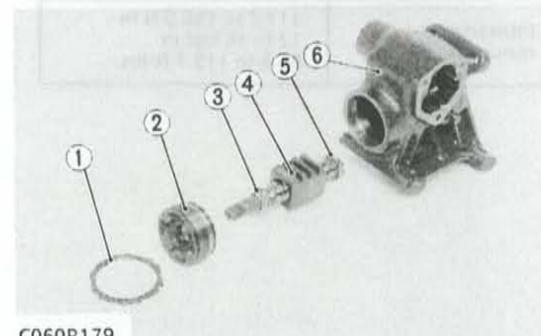
Rear Cover and Ball Nut Assembly

1. Remove the lock nut (1) and then, remove the rear cover (2).
2. Pull out the ball nut assembly (4) from the steering gear box (6).

IMPORTANT

- Never disassemble the ball nut assembly (4).

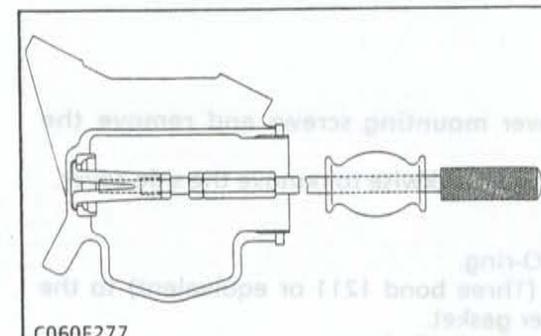
- | | |
|-------------------------|-------------------------|
| (1) Lock Nut | (4) Ball Nut Assembly |
| (2) Rear Cover | (5) Thrust Ball Bearing |
| (3) Thrust Ball Bearing | (6) Steering Gear Box |



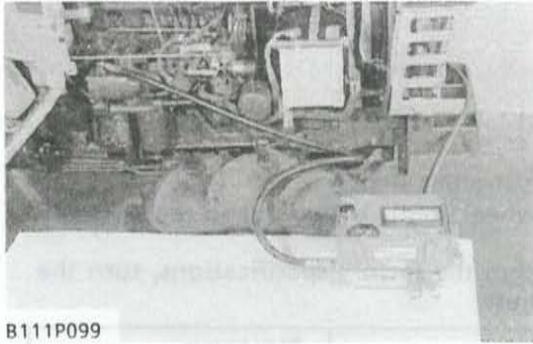
C060P179

Thrust Bearing

1. Remove the thrust bearing with the bushing puller set (code No: 07916-51031).



C060F277



B111P099

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

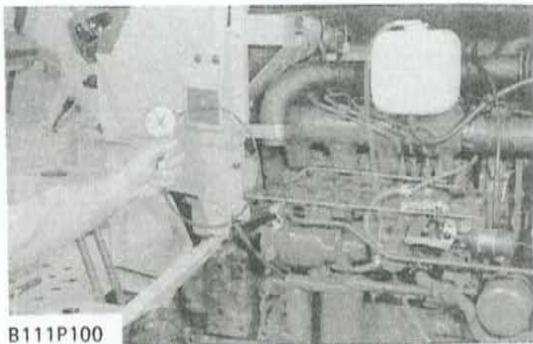
Relief Valve Setting Pressure Test Using Flowmeter

■ IMPORTANT

- When using a flowmeter other than KUBOTA specified flowmeter (Code No: 07916-52791), be sure to use the instructions with that flowmeter.
- Do not close the flowmeter loading valve completely, before testing, because it has no relief valve.

1. Disconnect the delivery pipe which is connected from hydraulic pump to power steering.
2. Install the two adaptor 52 (Code No: 07916-52841) to pump and power steering inlet port.
3. Connect the hydraulic test hose (Code No.: 07916-52651) to the adaptor 52 (pump side) and flowmeter inlet port. Connect the other hydraulic test hose to flowmeter outlet port and the adaptor 52 (power steering side).
4. Open the flowmeter loading valve completely. (Turn counterclockwise)
5. Start the engine and set the engine speed at max. speed.
6. Slowly close the loading valve to generate pressure approx. 11.77 MPa (120 kgf/cm², 1707 psi). Hold in this condition until oil temperature reaches 45 to 55°C (113 to 131°F).
7. Open the flowmeter loading valve completely. (Turn counterclockwise)
8. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
9. Stop the engine.
10. If the pressure is not within the factory specifications, check the pump delivery line, adjust the relief valve setting pressure (See the next page) or repair the power steering.

Relief valve setting pressure	Factory spec.	11.28 to 11.77 N·m 115 to 120 kgf·m 1636 to 1707 ft·lbs
Tightening torque	Power steering delivery pipe end joint bolt (at steering gear box)	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36.2 to 43.4 ft·lbs



B111P100

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Relief Valve Setting Pressure Test Using Pressure Tester

1. Disconnect the delivery pipe joint which connects delivery pipe and power steering pump.
2. Install the adaptor E (Code No: 07916-50392) of relief valve setting pressure tester (Code No: 07916-50040) to hydraulic pump, and then set a pressure gauge (Code no: 07916-50321), cable (Code No: 07916-50331) and thread joint (Code No: 07916-50341).
3. Start the engine and set the engine speed at max. speed.
4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.
6. If the pressure is not within the factory specifications, check the pump delivery line, adjust the relief valve setting pressure (See the next item) or repair the power steering.

Power steering relief valve setting pressure	Factory spec.	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi
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0329P121

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Adjusting Relief Valve Setting Pressure

1. Loose the lock nut of adjusting screw.
2. Adjust the relief pressure by turning the adjusting screw, while the relief valve is operating. When the adjusting screw is turned clockwise, the relief pressure increases.
3. After adjustment, fix the adjusting screw with lock nut, while holding it.

Relief valve setting pressure	Factory spec	11.28 to 11.77 MPa 115 to 120 kgf/cm ² 1636 to 1707 psi
Tightening torque	Lock nut	49.0 to 58.8 N-m 5.0 to 6.0 kgf-m 36.2 to 43.4 ft-lbs

(Reference)

- Pressure change per 1/4 turn of adjusting screw.
Approx. 1.27 MPa
13.0 kgf/cm²
185 psi



C060P210

Backlash between Sector Gear Shaft and Ball Nut

1. Found and set the steering wheel center position.
2. Set a dial indicator with its finger on the pitman arm.
3. Move the pitman arm lightly, and measure the pitman arm deflection.
4. If the backlash is not within the factory specifications, adjust the backlash with the adjusting screw. (See page S.7-25)

Backlash between sector gear shaft and ball nut	Factory spec.	0 to 0.33 mm 0 to 0.0130 in.
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C060P211

Turning Torque of Worm Shaft

1. Secure the steering gear box in a vise.
2. Set a torque wrench on the worm shaft and measure the torque required to initial turning.
3. If the measurement is not within the factory specifications, disassemble the steering gear box to check inside.

Turning torque of worm shaft	Factory spec.	0 to 1.18 N-m 0 to 0.12 kgf-m 0 to 0.87 ft-lbs
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(17) Needle bearing	(22) Needle bearing	(27) Oil seal	(32) Oil seal	(37) Oil seal	(42) Oil seal	(47) Oil seal	(52) Oil seal	(57) Oil seal	(62) Oil seal	(67) Oil seal	(72) Oil seal	(77) Oil seal	(82) Oil seal	(87) Oil seal	(92) Oil seal	(97) Oil seal	(102) Oil seal	(107) Oil seal	(112) Oil seal	(117) Oil seal	(122) Oil seal	(127) Oil seal	(132) Oil seal	(137) Oil seal	(142) Oil seal	(147) Oil seal	(152) Oil seal	(157) Oil seal	(162) Oil seal	(167) Oil seal	(172) Oil seal	(177) Oil seal	(182) Oil seal	(187) Oil seal	(192) Oil seal	(197) Oil seal	(202) Oil seal	(207) Oil seal	(212) Oil seal	(217) Oil seal	(222) Oil seal	(227) Oil seal	(232) Oil seal	(237) Oil seal	(242) Oil seal	(247) Oil seal	(252) Oil seal	(257) Oil seal	(262) Oil seal	(267) Oil seal	(272) Oil seal	(277) Oil seal	(282) Oil seal	(287) Oil seal	(292) Oil seal	(297) Oil seal	(302) Oil seal	(307) Oil seal	(312) Oil seal	(317) Oil seal	(322) Oil seal	(327) Oil seal	(332) Oil seal	(337) Oil seal	(342) Oil seal	(347) Oil seal	(352) Oil seal	(357) Oil seal	(362) Oil seal	(367) Oil seal	(372) Oil seal	(377) Oil seal	(382) Oil seal	(387) Oil seal	(392) Oil seal	(397) Oil seal	(402) Oil seal	(407) Oil seal	(412) Oil seal	(417) Oil seal	(422) Oil seal	(427) Oil seal	(432) Oil seal	(437) Oil seal	(442) Oil seal	(447) Oil seal	(452) Oil seal	(457) Oil seal	(462) Oil seal	(467) Oil seal	(472) Oil seal	(477) Oil seal	(482) Oil seal	(487) Oil seal	(492) Oil seal	(497) Oil seal	(502) Oil seal	(507) Oil seal	(512) Oil seal	(517) Oil seal	(522) Oil seal	(527) Oil seal	(532) Oil seal	(537) Oil seal	(542) Oil seal	(547) Oil seal	(552) Oil seal	(557) Oil seal	(562) Oil seal	(567) Oil seal	(572) Oil seal	(577) Oil seal	(582) Oil seal	(587) Oil seal	(592) Oil seal	(597) Oil seal	(602) Oil seal	(607) Oil seal	(612) Oil seal	(617) Oil seal	(622) Oil seal	(627) Oil seal	(632) Oil seal	(637) Oil seal	(642) Oil seal	(647) Oil seal	(652) Oil seal	(657) Oil seal	(662) Oil seal	(667) Oil seal	(672) Oil seal	(677) Oil seal	(682) Oil seal	(687) Oil seal	(692) Oil seal	(697) Oil seal	(702) Oil seal	(707) Oil seal	(712) Oil seal	(717) Oil seal	(722) Oil seal	(727) Oil seal	(732) Oil seal	(737) Oil seal	(742) Oil seal	(747) Oil seal	(752) Oil seal	(757) Oil seal	(762) Oil seal	(767) Oil seal	(772) Oil seal	(777) Oil seal	(782) Oil seal	(787) Oil seal	(792) Oil seal	(797) Oil seal	(802) Oil seal	(807) Oil seal	(812) Oil seal	(817) Oil seal	(822) Oil seal	(827) Oil seal	(832) Oil seal	(837) Oil seal	(842) Oil seal	(847) Oil seal	(852) Oil seal	(857) Oil seal	(862) Oil seal	(867) Oil seal	(872) Oil seal	(877) Oil seal	(882) Oil seal	(887) Oil seal	(892) Oil seal	(897) Oil seal	(902) Oil seal	(907) Oil seal	(912) Oil seal	(917) Oil seal	(922) Oil seal	(927) Oil seal	(932) Oil seal	(937) Oil seal	(942) Oil seal	(947) Oil seal	(952) Oil seal	(957) Oil seal	(962) Oil seal	(967) Oil seal	(972) Oil seal	(977) Oil seal	(982) Oil seal	(987) Oil seal	(992) Oil seal	(997) Oil seal	(1002) Oil seal	(1007) Oil seal
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DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

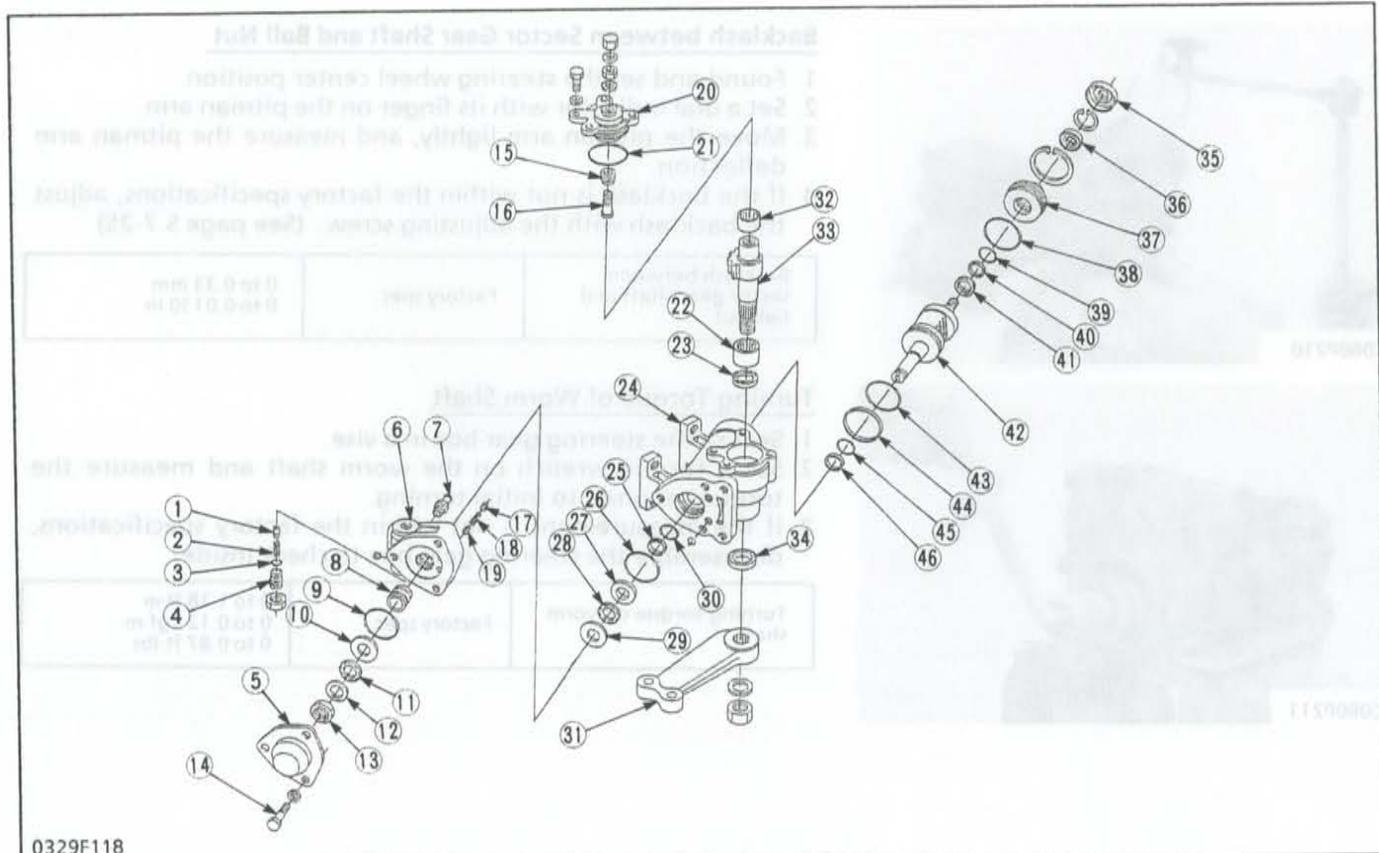
- Use only the transmission fluid (See page S.G-7), in no case use mixture of oils of different brands.
- Before disassembling the power steering system hydraulic components, check the performance of hydraulic pump and power steering using a flowmeter (Code No: 07916-52791). Do not disassemble the power steering needlessly.
- After removing or disassembling the power steering hydraulic components, be sure to bleed air.

- If disassembly of power steering is needed, perform disassembly carefully following the instructions given below.

1. Since the sliding surfaces of those parts have been precisely finished, do not brush or grind with sandpaper. Use transmission fluid for cleaning and compressed air for blowing off.
2. When reassembling, inspect each part for wear and damage. If seriously damaged, replace parts as sub-assembly or assembly. It is desirable to replace O-rings and seals with new ones.

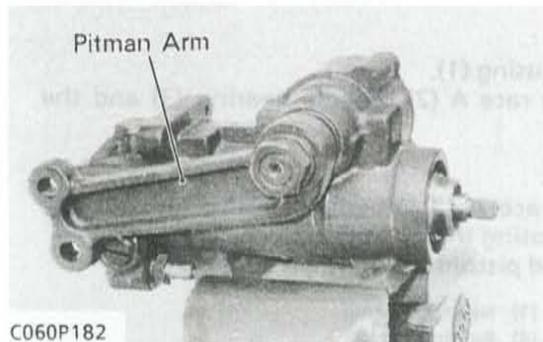
[Bleeding]

1. Start the engine.
2. Turn the steering wheel slowly in both directions all the way alternately several times, and stop the engine.



0329F118

- | | | | |
|---------------------|---------------------|------------------------|---------------------|
| (1) Poppet | (13) Lock Nut | (25) Seal Ring | (37) Top Cover |
| (2) Spring | (14) Flange Bolt | (26) O-ring | (38) O-ring |
| (3) O-ring | (15) Adjuster | (27) Bearing Race D | (39) O-ring |
| (4) Adjusting Screw | (16) Adjust Screw | (28) Needle Bearing | (40) Seal Ring |
| (5) End Cover | (17) Piston | (29) Bearing Race A | (41) Needle Bearing |
| (6) Valve Housing | (18) Spring | (30) O-ring | (42) Ball Nut |
| (7) Joint Pipe | (19) Piston | (31) Pitman Arm | (43) Seal Ring |
| (8) Spool | (20) Side Cover | (32) Needle Bearing | (45) O-ring |
| (9) O-ring | (21) O-ring | (33) Sector Gear Shaft | (46) Seal Ring |
| (10) Bearing Race A | (22) Needle Bearing | (34) Oil Seal | |
| (11) Needle Bearing | (22) Oil Seal | (35) Dust Seal | |
| (12) Bearing Race D | (24) Gear Box | (46) Seal Ring | |



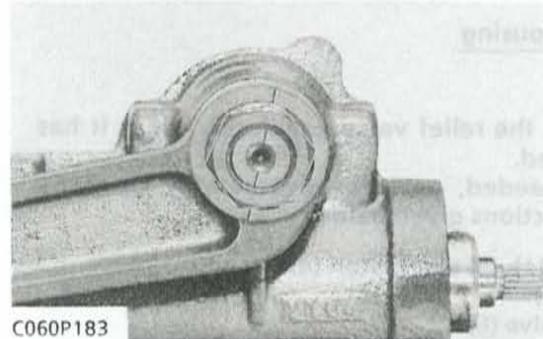
C060P182

Pitman Arm

1. Secure the steering gear box in a vise.
2. Swing the pitman arm several times to drain oil from the gear box.
3. Loosen the pitman arm mounting nut to the sector gear shaft end.
4. Remove the pitman arm with the pitman arm puller (Code No:07909-39011).

NOTE

- When secure the gear box in a vise, not grasp cylinder of gear box.

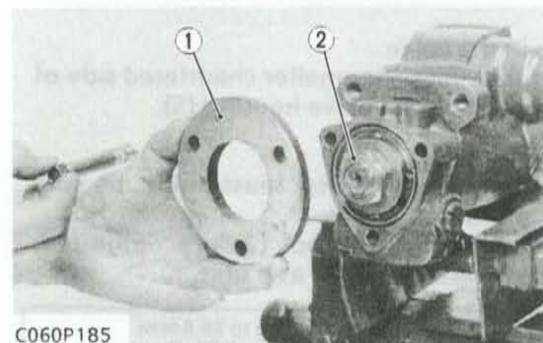


C060P183

(When reassembling)

- Install the pitman arm to the sector gear shaft, aligning their alignment marks.

Tightening torque	Pitman arm mounting nut	147.1 to 196.1 N·m 15 to 20 kgf·m 108.5 to 144.7ft·lbs
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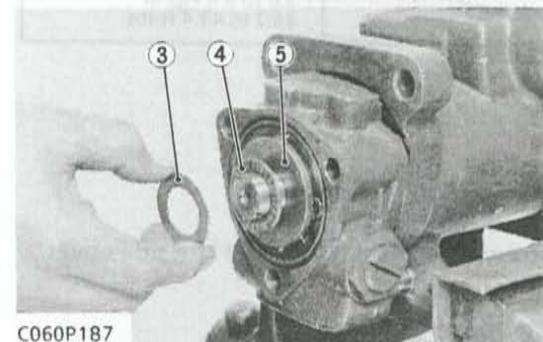
C060P185

End Cover and 22 Nut

1. Remove the end cover and mount the power steering valve holder (Code No: 07916-52891).
2. Remove the stake of 22 nut (2).
3. Remove the power steering valve holder (1), bearing race D (3), needle bearing (4) and bearing race A (5).

(When reassembling)

- Assembling 22 nut (2).
1. Install the power steering valve holder (1).
 2. Protect the sedation of input shaft by a socket or cloth.
 3. While turning the input shaft to counterclockwise fully, tighten the 22 nut (2) by hand. Do not use a wrench.
 4. Install the bearing race D (3), needle bearing (4) and the bearing race A (5), noting its direction.



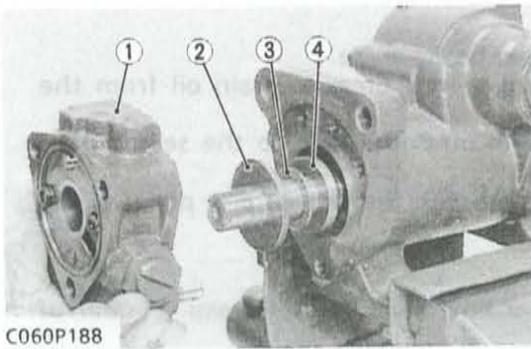
C060P187

Tightening torque	End cover mounting screws	34.3 to 56.9 N·m 3.5 to 5.8 kgf·m 25.3 to 42.0ft·lbs
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- (1) Power Steering Valve Holder
- (2) 22 Nut
- (3) Bearing Race D
- (4) Needle Bearing
- (5) Bearing Race A



C060P186



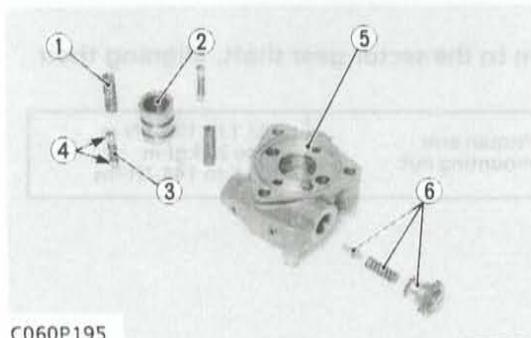
Valve Housing

1. Remove the valve housing (1).
2. Remove the bearing race A (2), needle bearing (3) and the bearing race D (4).

(When reassembling)

- Install the bearing race A (2), needle bearing (3) and the bearing race D (4), noting their position.
- Install the springs and pistons in the valve housing.

- | | |
|--------------------|--------------------|
| (1) Valve Housing | (3) Needle Bearing |
| (2) Bearing Race A | (4) Bearing Race D |



Disassembling Valve Housing

■ IMPORTANT

- Do not disassemble the relief valve needlessly, since it has been factory-adjusted. If disassembly is needed, perform disassembly carefully following the instructions given below.

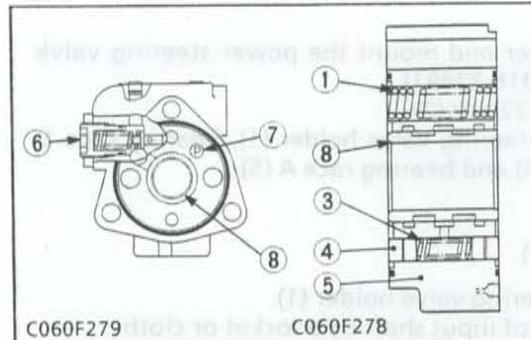
1. Remove the springs (1), (3) and piston (4).
2. Remove the spool (2).
3. Remove the relief valve (6).

(When reassembling)

- Apply grease to seals in the valve.
- When installing the spool, face the smaller chamfered side of the spool to the mark P (7) on the valve housing (5).

■ IMPORTANT

- If disassemble the relief valve (6), after reassembly, be sure to adjust the setting pressure.
- When the valve housing (5) or spool (2) are damaged, replace valve housing (5) and spool (2) as a unit.



- | | |
|------------|-------------------|
| (1) Spring | (5) Valve Housing |
| (2) Spool | (6) Relief Valve |
| (3) Spring | (7) Mark P |
| (4) Piston | (8) Chamfer |

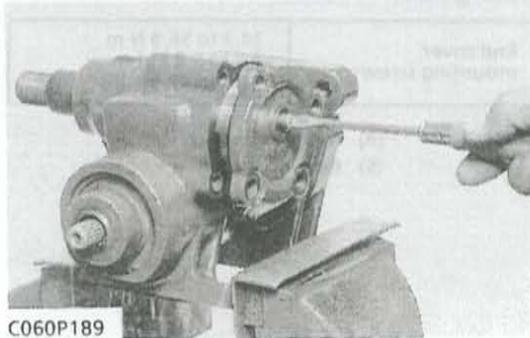
Tightening torque	Relief valve lock nut	49.0 to 58.8 N·m 5.0 to 6.0 kgf·m 36.2 to 43.4 ft-lbs
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Side Cover

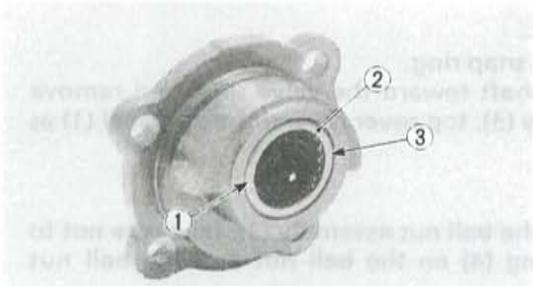
1. Remove the adjusting nut and O-ring.
2. Remove the side cover mounting screws.
3. Turn the adjusting screw clockwise to remove the side cover.

(When reassembling)

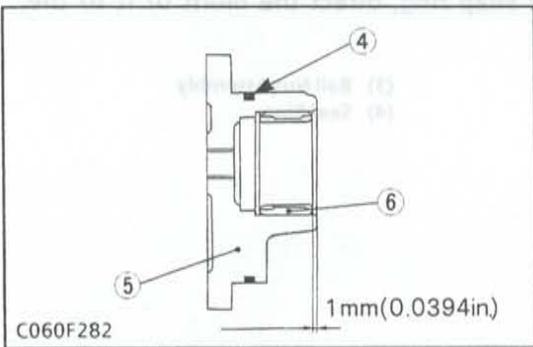
- Apply grease to the O-ring.



Tightening torque	Lock nut	19.6 to 29.4 N·m 2.0 to 3.0 kgf·m 14.5 to 21.7 ft-lbs
	Side cover mounting screws	35.3 to 54.9 N·m 3.6 to 5.6 kgf·m 26.0 to 40.5 ft-lbs



C060P189



C060F282

Needle Bearing on Side Cover

1. Remove the needle bearing.

IMPORTANT

- Do not remove the needle bearing except that it is replaced.

(When reassembling)

- Manufacturer's mark and type mark face must be to the gear box side to install the needle bearing.
- When press-fitting the needle bearing, observe the dimensions described in the figure.

- | | |
|-------------------------|--------------------|
| (1) Type Mark | (4) O-ring |
| (2) Needle Bearing | (5) Side Cover |
| (3) Manufacturer's Mark | (6) Needle Bearing |



C060P190

Sector Gear Shaft

1. Tap out the sector gear shaft (2) toward the side cover.

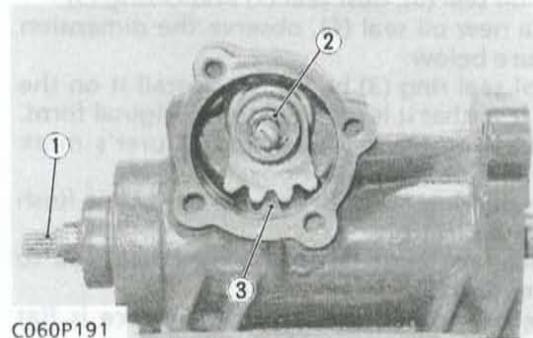
(When reassembling)

- Turn the worm shaft (1) so that the ball nut (3) is centered in its travel. Then, install the sector gear shaft (2) so that center tooth of it engages the center of the ball nut (3).

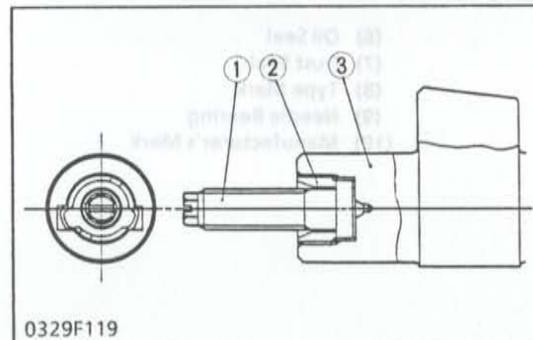
NOTE

- When setting the sector gear shaft (2), take care not to damage the oil seal and U-seal.

- | | |
|-----------------------|--------------|
| (1) Worm Shaft | (3) Ball Nut |
| (2) Sector Gear Shaft | |



C060P191

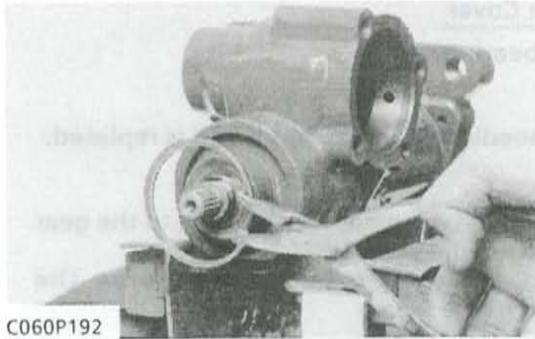


0329F119

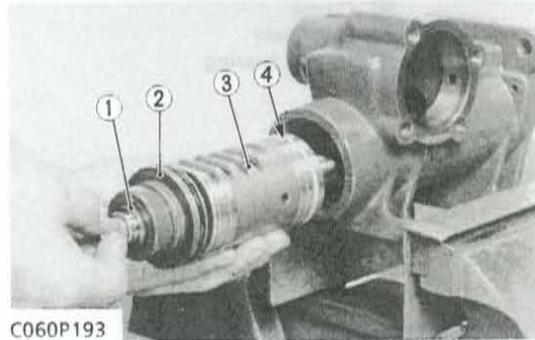
Adjuster of Sector Gear Shaft

1. Remove the adjuster with screw driver. After that take out the adjusting screw.

- | | |
|------------------|-----------------------|
| (1) Adjust Screw | (3) Sector Gear Shaft |
| (2) Adjuster | |



C060P192



C060P193

Top Cover and Ball Nut

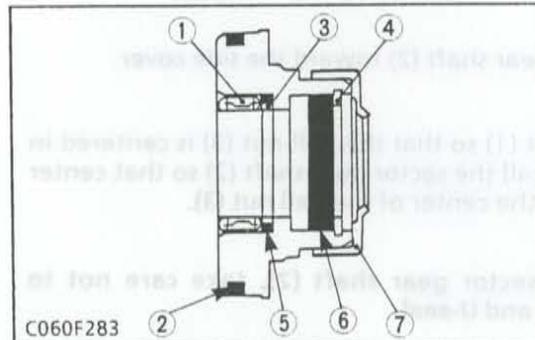
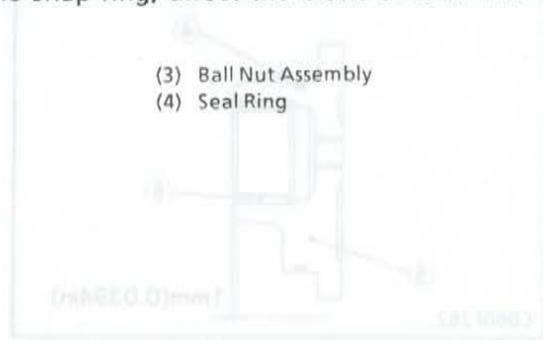
1. Remove the internal snap ring.
2. Tap out the worm shaft toward the valve side, and remove the ball nut assembly (3), top cover (2) and the dust seal (1) as a unit.

NOTE

- When drawing out the ball nut assembly (3), take care not to damage the seal ring (4) on the ball nut and the ball nut circuit face.
- Never disassemble the ball nut assembly (3).
- When installing the snap ring, direct the blunt of it to the top cover side.

- (1) Dust Seal
(2) Top Cover

- (3) Ball Nut Assembly
(4) Seal Ring



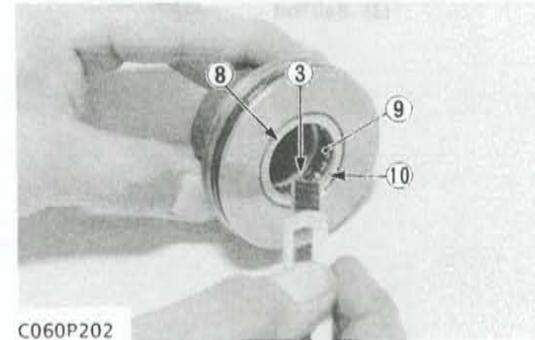
C060F283

Disassembling of Top Cover

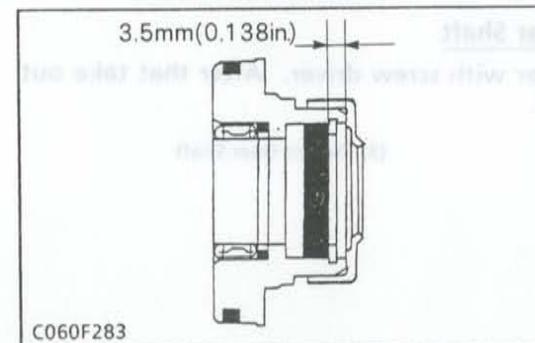
1. Remove the dust seal (7).
2. Remove the snap ring (4).
3. Draw out the oil seal (6).
4. Cut the seal ring (3) with a knife and remove it.
5. Remove the needle bearing (1).
6. Remove the O-ring (5).

(When reassembling)

- Replace the dust seal (7), oil seal (6), needle bearing (1), O-ring (2) and seal ring (3) with new ones.
- Apply grease to the oil seal (6), dust seal (7) and O-ring (5).
- When press-fitting a new oil seal (6), observe the dimension described in the figure below.
- Change the shape of seal ring (3) by fingers, install it on the gear box, and press it so that it is restored to its original form.
- Install the needle bearing (9) so that manufacturer's mark (10) and type mark (8) face to the gear box.
- Press fit the needle bearing (1) until its race surface is flush with the top cover end surface.
- Manufacturer's mark face must be to the gear box side to install the needle bearing (1).
- Press fit the needle bearing (1) until its race surface is flat with the top cover end surface.



C060P202



C060F283

- (1) Needle Bearing
(2) O-ring
(3) Seal Ring
(4) Snap Ring
(5) O-ring

- (6) Oil Seal
(7) Dust Seal
(8) Type Mark
(9) Needle Bearing
(10) Manufacturer's Mark





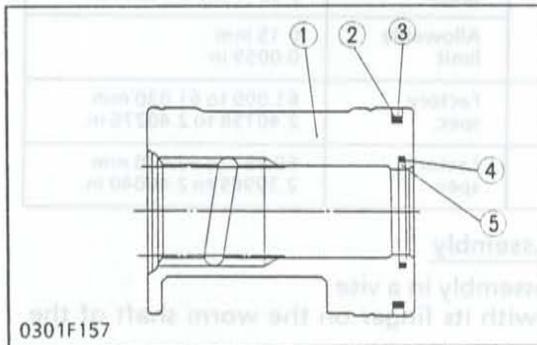
Seal Ring on Ball Nut

1. Cut the seal ring (3) with a knife and remove it.
2. Remove the O-ring (2).

(When reassembling)

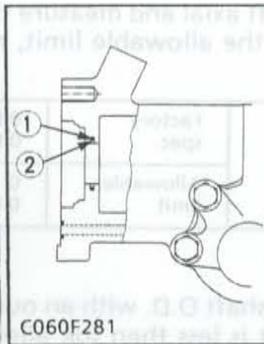
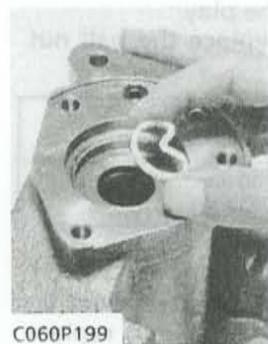
- Apply grease to the ring groove.
- Replace the seal rings with new ones.
- Stretch the seal ring by hand, install it on the ball nut (1), and press it so that it is restored to its original form.

C060P200



- | | |
|---------------|---------------|
| (1) Ball Nut | (4) O-ring |
| (2) O-ring | (5) Seal Ring |
| (3) Seal Ring | |

0301F157



Seal Ring and O-ring on Gear Box

1. Cut the seal ring (2) with a knife and remove it.
2. Remove the O-ring (1).

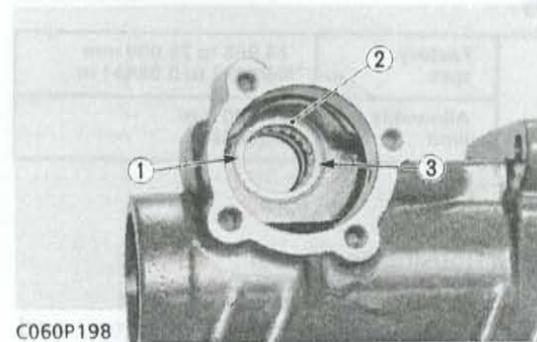
(When reassembling)

- Apply grease to the ring groove.
- Replace the seal ring (2) and O-ring (1) with new ones.
- Change the shape of seal ring (2) by fingers, install it on the gear box, and press it so that it is restored to its original form.

- | | |
|------------|---------------|
| (1) O-ring | (2) Seal Ring |
|------------|---------------|

C060P199

C060F281



Needle Bearing on Gear Box

1. Remove the needle bearing (2).

■ IMPORTANT

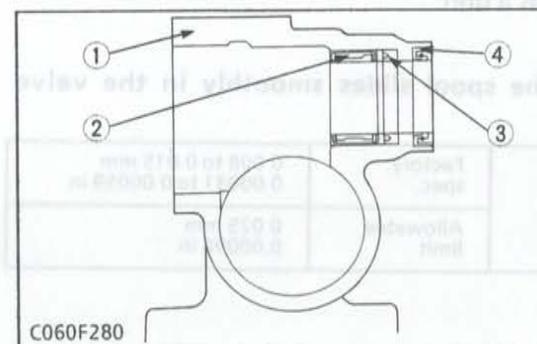
- Do not remove the needle bearing (2) except that it is replaced.

(When reassembling)

- Manufacturer's mark face must be to the gear box side to install the needle bearing (1).
- Press fit the needle bearing until its race surface is flat with inside surface.

C060P198

- | | |
|--------------------|-------------------------|
| (1) Type Mark | (3) Manufacturer's Mark |
| (2) Needle Bearing | |



Oil Seal and U-Seal on Gear Box

1. Remove the oil seal (4).
2. Remove the U-seal (3) with a sharp tool.

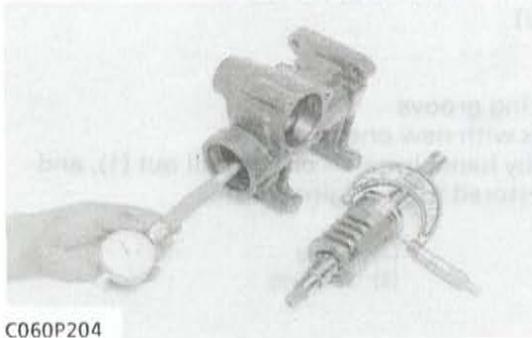
(When reassembling)

- When installing the oil seal (4), direct the lip to outside.
- Replace oil seal (4) and U-seal (3) with new ones.

- | | |
|--------------------|--------------|
| (1) Gear Box | (3) U-Seal |
| (2) Needle Bearing | (4) Oil Seal |

C060F280

SERVICING

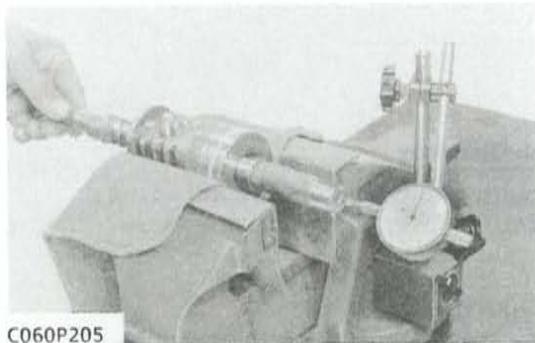


C060P204

Clearance between Steering Gear Box and Ball Nut

1. Measure the steering gear box cylinder I.D. with a cylinder gauge.
2. Measure the ball nut O.D. with an outside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the steering gear box or ball nut assembly.

Clearance between steering gear box and ball nut	Factory spec.	0.030 to 0.079 mm 0.00118 to 0.00311 in.
	Allowable limit	0.15 mm 0.0059 in.
Gear box bore I.D.	Factory spec.	61.000 to 61.030 mm 2.40158 to 2.40276 in.
Ball nut O.D.	Factory spec.	60.951 to 60.970 mm 2.39965 to 2.40040 in.



C060P205

Axial Play of Ball Nut Assembly

1. Secure the ball nut assembly in a vise.
2. Set a dial indicator with its finger on the worm shaft of the ball nut assembly.
3. Move the worm shaft axial and measure the play.
4. If the play exceeds the allowable limit, replace the ball nut assembly.

Axial play of ball nut assembly	Factory spec.	0 to 0.020 mm 0 to 0.00079 in.
	Allowable limit	0.100 mm 0.00394 in.



C060P206

Worm Shaft Wear

1. Measure the worm shaft O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the ball nut assembly.

Worm shaft O.D.	Factory spec.	24.966 to 25.009 mm 0.98291 to 0.98461 in.
	Allowable limit	24.900 mm 0.98032 in.



C060P207

Clearance between Valve Housing and Spool

1. Measure the valve housing I.D. with a cylinder gauge.
2. Measure the spool O.D. with an outside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the spool and valve housing as a unit.

IMPORTANT

- Check to see if the spool slides smoothly in the valve housing.

Clearance between valve housing and spool	Factory spec.	0.008 to 0.015 mm 0.00031 to 0.00059 in.
	Allowable limit	0.025 mm 0.00098 in.

DISASSEMBLING AND ASSEMBLING

IMPORTANT

- The hydraulic pump is precision machined and assembled: if disassembled once, it may be unable to maintain its original performance. Therefore, when the hydraulic pump fails, replacement should be carried out with the hydraulic pump assembled except when emergency repair is unavoidable.
- When repair is required, follow the disassembly

and servicing procedures shown below with utmost care.

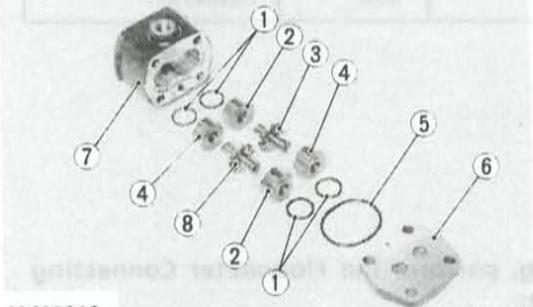
- Be sure to test the hydraulic pump with a flowmeter before disassembling.
- After reassembly, be sure to perform break-in operation and ensure that there is nothing abnormal with the hydraulic pump.

Disassembling Pump

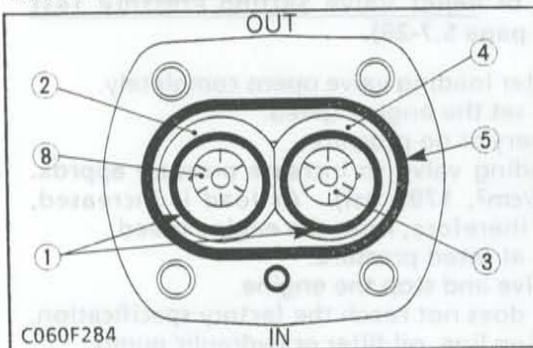
1. Remove the pump cover.
2. Remove the O-ring (5) and seal ring (1).
3. Remove the bushings (2), (4) of cover (6) side as a unit.
4. Take out the drive gear (8) and driven gear (3).
5. Take out the bushings (2), (4) in back of pump housing (7) as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4) be sure to reassemble them to the each original position.
- Take care not to damage the seal rings and O-rings.
- After reassembling the power steering hydraulic pump, mount an arm approx. 100 mm (3.93 in.) long to the drive gear to check for smooth rotation.



C060P212



C060F284

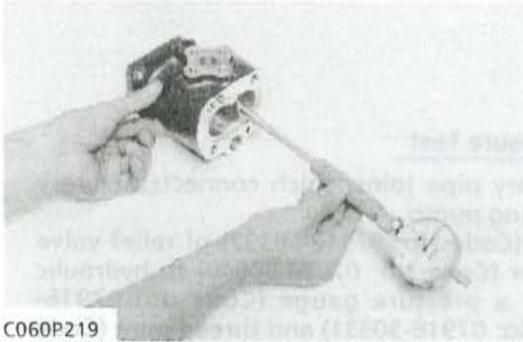
- | | |
|-----------------|------------------|
| (1) Seal Ring | (5) O-ring |
| (2) Bushing | (6) Cover |
| (3) Driven Gear | (7) Pump Housing |
| (4) Bushing | (8) Drive Gear |

Hydraulic Pump Running-In

After reassembly, perform break-in operation in the following manner, and check the pump for abnormality before use. If the pump temperature should rise noticeably during running-in, recheck should be performed.

1. Install the hydraulic pump to the tractor, and mount the suction pipe and delivery pipe securely.
2. Set the engine speed at 1300 to 1500 rpm, and operate the hydraulic pump at no load for about 10 minutes.
3. Set the engine speed at 2000 to 2200 rpm, and with the hydraulic pump applied with 2.94 MPa (30 kgf/cm², 427 psi) to 4.90 MPa (50 kgf/cm², 711 psi) pressure, operate it for approx. 15 minutes.
4. With the engine set to maximum speed, fully turn the steering wheel to the left or right, then actuate the relief valve five times for 25 seconds (one time 5 seconds).

SERVICING



C060P219

Housing Bore (Depth of scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
------------------	-----------------	-----------------------



C045P249

Clearance between Bushing and Gear Shaft

1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear shaft and the bushings as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.15 mm 0.0059 in.
--	-----------------	-----------------------



C021P015

Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the bushings and gears as a unit.

Bushing length	Factory spec.	16.99 to 17.00 mm 0.6689 to 0.6693 in.
	Allowable limit	16.80 mm 0.6614 in.

If disassembly of power steering is needed, perform disassembly carefully following the instructions given below.

1. Since the sliding surfaces of those parts have been precisely finished, do not push or grind with sandpaper. Use transmission fluid for cleaning and compressed air for blowing off.

2. When reassembling, inspect each part for wear and damage. If seriously damaged, replace parts as sub-assembly or assembly.

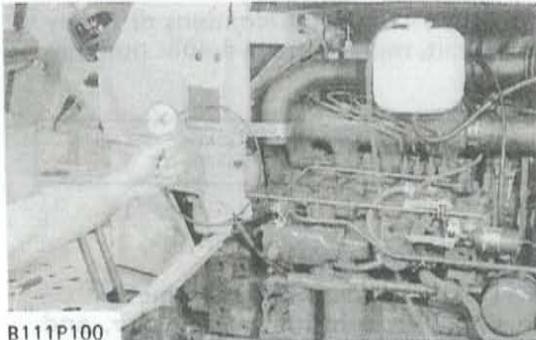
It is desirable to replace O-rings and seals with new ones.

IMPORTANT

- Use only the transmission fluid (see page 2.6-7).
- In no case use mixture of oils of different brands.
- Before disassembling the power steering system hydraulic component, check the performance of hydraulic pump and power steering using a flowmeter (Code No. 02516-62391).
- Do not disassemble the power steering needlessly.
- After removing or disassembling the power steering hydraulic component, be sure to bleed air.

[bleeding]

1. Start the engine.
2. Turn the steering wheel slowly in both directions all the way alternately several times, and stop the engine.

[3] L2650 4WD, L2950 4WD, L3450 4WD, L3650 4WD**[3]-1 POWER STEERING****CHECKING AND ADJUSTING**

B111P100

Condition

- Engine speed Max. rpm
- Oil temperature..... 45 to 55°C
113 to 131°F

Relief Valve Setting Pressure Test

1. Disconnect the delivery pipe joint which connects delivery pipe and power steering pump.
2. Install the adaptor E (Code No: 07916-50392) of relief valve setting pressure tester (Code No: 07916-50040) to hydraulic pump, and then set a pressure gauge (Code no: 07916-50321), cable (Code No: 07916-50331) and thread joint (Code No: 07916-50341).
3. Start the engine and set the engine speed at max. speed.
4. Fully turn the steering wheel to the left or right and read the pressure when the relief valve functions.
5. Stop the engine.
6. If the pressure is not within the factory specifications, check the pump delivery line, replace the relief valve assembly or repair the power steering.

Power steering relief
valve setting pressure

Factory spec.

10.30 to 11.28 MPa
105 to 115 kgf/cm²
1493 to 1636 psi

B122P038

Removing Relief Valve Assembly

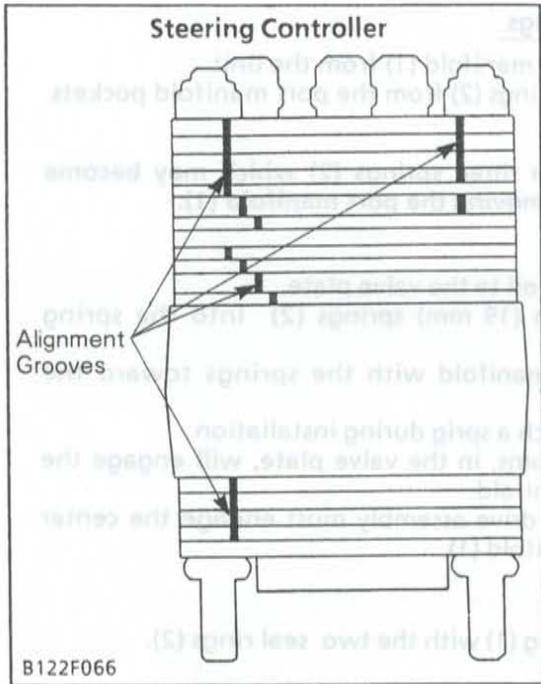
1. Remove the covers (See page S.5-11) and pull out the shuttle rod.
2. Remove the relief valve plug and relief valve assembly.

DISASSEMBLING AND ASSEMBLING**■ IMPORTANT**

- Use only the transmission fluid (See page S.G-7), in no case use mixture of oils of different brands.
 - Before disassembling the power steering system hydraulic components, check the performance of hydraulic pump and power steering using a flowmeter (Code No: 07916-52791). Do not disassemble the power steering needlessly.
 - After removing or disassembling the power steering hydraulic components, be sure to bleed air.
- If disassembly of power steering is needed, perform disassembly carefully following the instructions given below.
1. Since the sliding surfaces of those parts have been precisely finished, do not brush or grind with sandpaper. Use transmission fluid for cleaning and compressed air for blowing off.
 2. When reassembling, inspect each part for wear and damage. If seriously damaged, replace parts as sub-assembly or assembly. It is desirable to replace O-rings and seals with new ones.

[Bleeding]

1. Start the engine.
2. Turn the steering wheel slowly in both directions all the way alternately several times, and stop the engine.



IMPORTANT

- Components of the steering controller with alignment grooves must be assembled so that their alignment grooves are positioned as figured for the unit to function.

Steering Controller Assembly

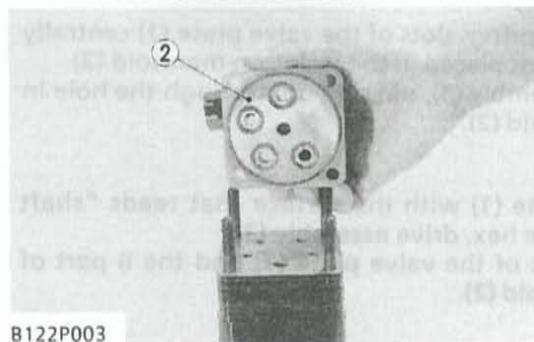
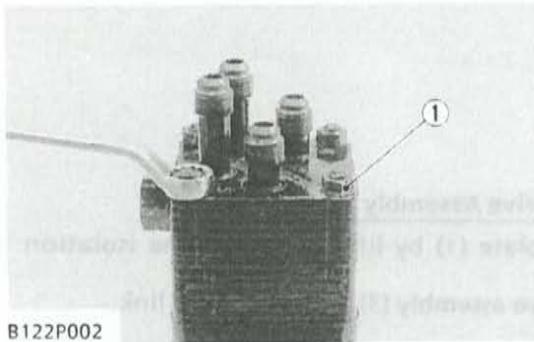
1. Remove the steering controller assembly. (See page S.5-11)

Port Cover Assembly

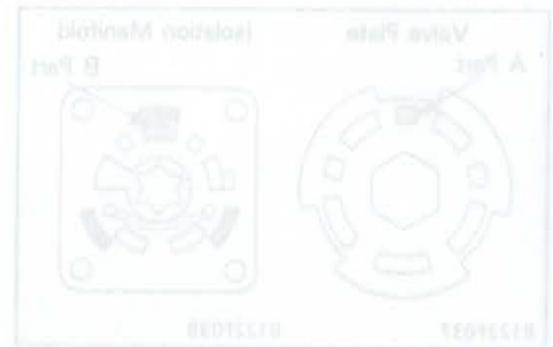
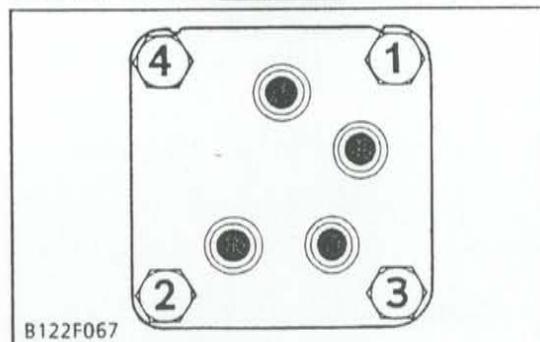
1. Slightly hold the steering controller assembly with a vise.
2. Remove the four retaining nuts (1) from the port cover assembly (2).
3. Remove the port cover assembly (2).

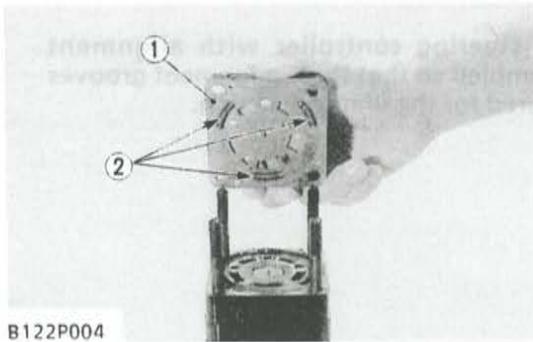
(When reassembling)

- The retaining nut (1) are a special self-locking type. Do not substitute any other. Use only genuine parts.
- Apply clean grease to the four O-rings and seal ring.
- Install self-locking nuts onto bolts. Tighten each one gradually until resistance is felt.



Tightening torque	Retaining nuts	27 to 33 N·m 2.8 to 3.4 kgf·m 20 to 24 ft·lbs
	(1) Retaining Nut	
	(2) Port Cover Assembly	





B122P004
 (1) Port Manifold (2) Springs

Port Manifold and Springs

1. Carefully lift the port manifold (1) from the unit.
2. Remove the three springs (2) from the port manifold pockets.

NOTE

- Be prepared to catch three springs (2) which may become disengaged when removing the port manifold (1).

(When reassembling)

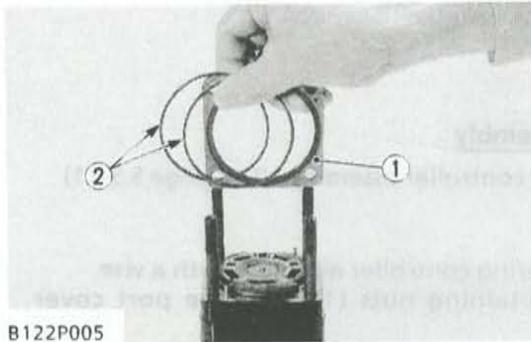
- Apply a few drops of oil to the valve plate.
- Install three 3/4 inch (19 mm) springs (2) into the spring pockets.
- Assemble the port manifold with the springs toward the valve plate.
- Be careful not to pinch a spring during installation.
- The two alignment pins, in the valve plate, will engage the holes in the port manifold.
- The pin on the hex. drive assembly must engage the center hole in the port manifold (1).

Valve Ring

1. Remove the valve ring (1) with the two seal rings (2).

(When reassembling)

- Apply clean grease to the seal rings (2).
- Install the valve ring (1) over the bolts and alignment pins with seal ring facing the isolation manifold.



B122P005
 (1) Valve Ring (2) Seal Rings

Valve Plate and Hex. Drive Assembly

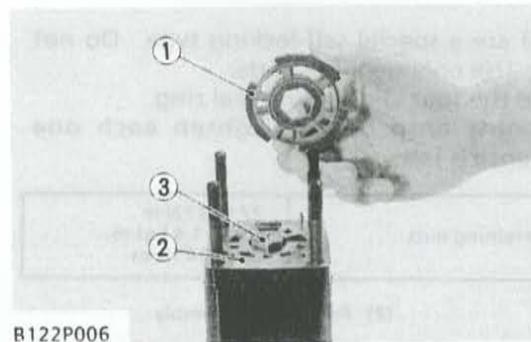
1. Remove the valve plate (1) by lifting it from the isolation manifold (2).
2. Pull out the hex. drive assembly (3) from the drive link.

(When reassembling)

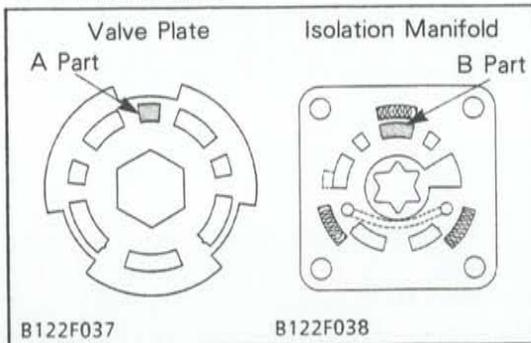
- Aligning the three springs slots of the valve plate (1) centrally over the three springs placed in the isolation manifold (2).
- Place hex. drive assembly (3), pin side up, through the hole in the isolation manifold (2).

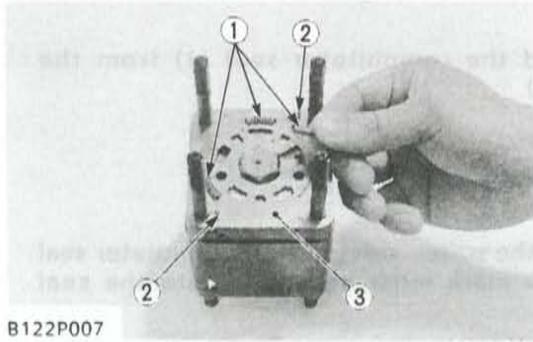
IMPORTANT

- Place the valve plate (1) with the surface that reads "shaft side" down over the hex. drive assembly (3).
- Aligning the A part of the valve plate (1) and the B part of the isolation manifold (2).



B122P006
 (1) Valve Plate (2) Isolation Manifold (3) Hex. Drive Assembly





B122P007

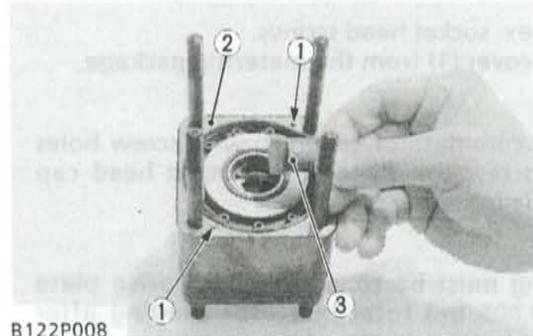
- (1) Springs
(2) Alignment Pins
(3) Isolation Manifold

Springs and Isolation Manifold

1. Remove the three springs (1) from the isolation manifold pockets.
2. Remove the two alignment pins (2).
3. Remove the isolation manifold (3).

(When reassembling)

- Install three 1/2 inch (13 mm) springs (1) into the spring pockets.



B122P008

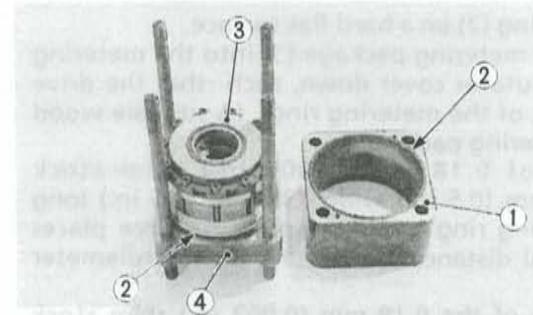
- (1) Alignment Pins
(2) Metering Ring
(3) Drive Link

Alignment Pins and Drive Link

1. Remove the two alignment pins (1) from the metering ring (2).
2. Remove the drive link (3) from the metering package.

(When reassembling)

- Insert large tang of the drive link (3) into the slot in the rotor.



B122P009

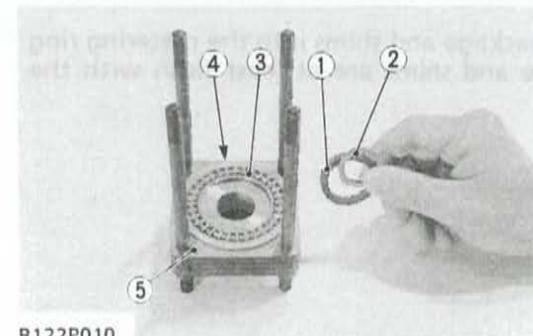
- (1) Metering Ring
(2) Seal Ring
(3) Metering Package
(4) Upper Cover Plate

Metering Ring and Metering Package

1. Remove the metering ring (1) and discard the two seal rings (2).
2. Lift the metering package (3) from the upper cover plate (4).

(When reassembling)

- Apply clean grease to the metering seal rings (2).
- Apply a small amount of clean grease on the drive plate.



B122P010

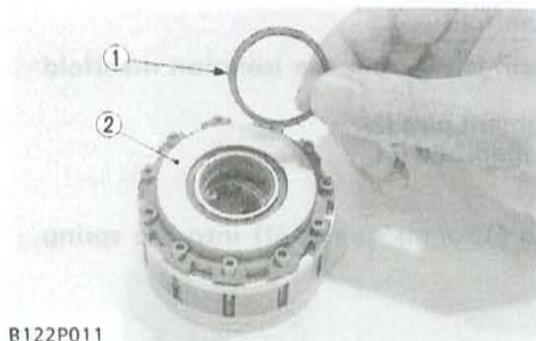
- (1) Face Seal
(2) Face Seal Spacer
(3) Thrust Bearing
(4) Bearing Spacer
(5) Upper Cover Plate

Face Seal, Face Seal Spacer, Thrust Bearing and Bearing Spacer

1. Remove the face seal (1), face seal spacer (2), thrust bearing (3) and bearing spacer (4) from the upper cover plate (5).

(When reassembling)

- Apply clean grease to the thrust bearing (3).



B122P011

(1) Commutator Seal (2) Commutator Cover

Commutator Seal

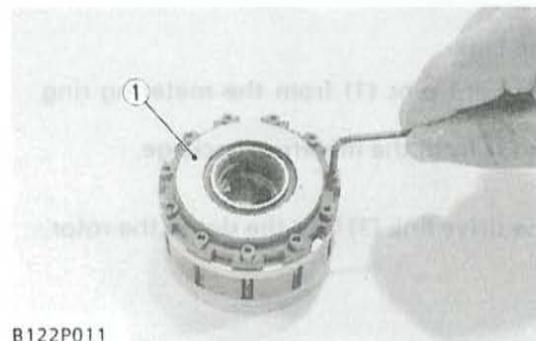
1. Remove and discard the commutator seal (1) from the commutator cover (2).

(When reassembling)

- Apply clean grease to the commutator seal (1).

■ IMPORTANT

- The rubber portion (the softer side) of the commutator seal (1) with the yellow mark must be placed into the seal groove.



B122P011

(1) Commutator Cover

Commutator Cover

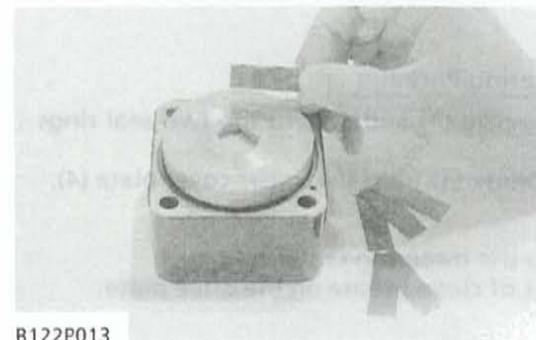
1. Remove the eleven hex. socket head screws.
2. Lift the commutator cover (1) from the metering package.

(When reassembling)

- Align screw holes in commutator cover(1), with screw holes in drive plate then screw the eleven hex. socket head cap screws loosely into the metering package.

■ IMPORTANT

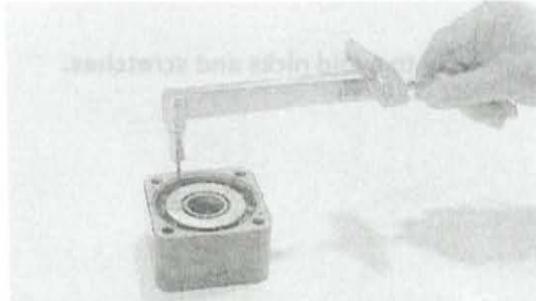
- The Commutator ring must be concentric with drive plate within 0.127 mm (0.005 in.) total indicator reading after tightening the eleven hex. socket head cap screws.
- The next procedures are a method of achieving the concentricity.



B122P013

1. Place the metering ring (2) on a hard flat surface.
2. Place the assembled metering package (3) into the metering ring with the commutator cover down, such that the drive plate is partially out of the metering ring. (A suitable wood block under the metering package.)
3. Place one piece of 0.18 mm (0.007 in.) shim stock approximately 13 mm (0.5 in.) wide x 38 mm (1.5 in.) long between the metering ring and drive plate in three places approximately equal distance around the outside diameter of the drive plate.
4. Place another piece of the 0.18 mm (0.007 in.) shim stock between the drive plate and each of the three pieces of shim stock already in place.
5. Lift the metering ring and metering package and remove the wood block.
6. Push the metering package and shims into the metering ring until the drive plate and shims are at least flush with the metering ring.

7. Reverse the metering ring and metering package as a unit on the flat surface.
8. Push down on the metering package until the drive plate is on the flat surface.
9. Be sure the cap screws are loose enough to allow the commutator ring and drive plate to align themselves concentrically in the metering ring bore.
10. Gradually tighten the eleven cap screws, following the sequence shown in figure.
11. Remove the metering package and shims from the metering ring.

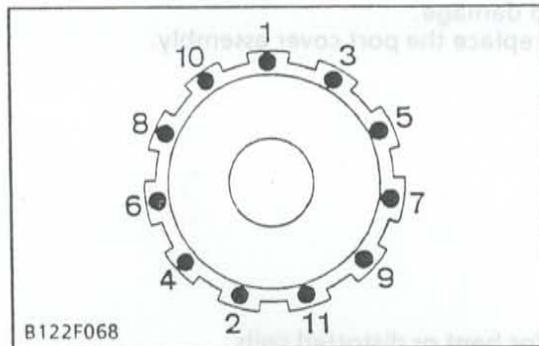


B122P014

Tightening torque	Hex. socket head cap screw	1.24 to 1.47 N·m 0.13 to 0.15 kgf·m 0.94 to 1.08 ft-lbs
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CAUTION

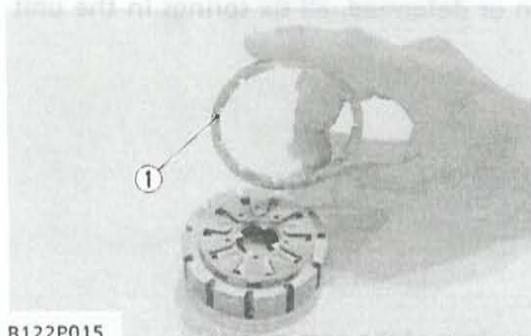
- Use care and eye protection while adding and removing shims from metering ring as the shims will be under spring tension and could fly into the air causing injury.



B122F068

Commutator Ring

1. Remove the commutator ring (1).

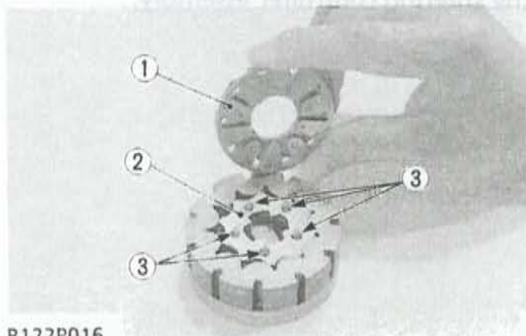


B122P015

(1) Commutator Ring

Commutator and Alignment Pins

1. Remove the commutator (1) from the rotor (2).
2. Pull out the five alignment pins (3).

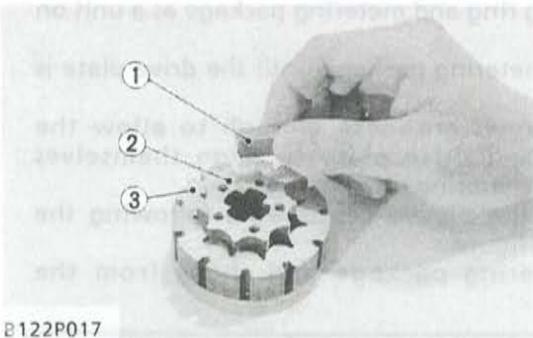


B122P016

(1) Commutator (2) Rotor (3) Alignment Pins

(When reassembling)

- Make sure the five alignment pins (3) are pressed below the surface of the commutator (1).
- Place a few drops of oil into each recess in the commutator (1).



Drive Link Spacer and Rotor Set

1. Remove the drive link spacer (1).
2. Remove the rotor (2) and the stator (3) as a unit.

(When reassembling)

- Apply small amount of clean grease to drive link spacer (1) and insert it into the drive slot in the rotor (2).

■ IMPORTANT

- Handle the rotor set carefully to avoid nicks and scratches.

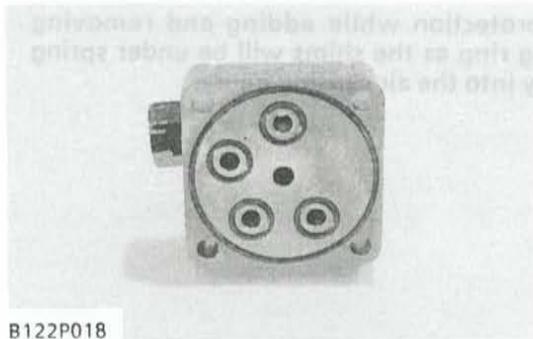
B122P017

(1) Drive Link Spacer

(3) Stator

(2) Rotor

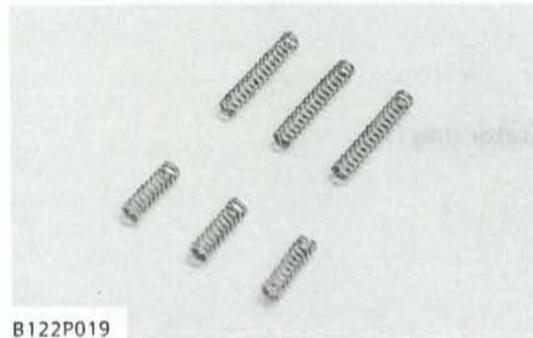
SERVICING



B122P018

Port Cover

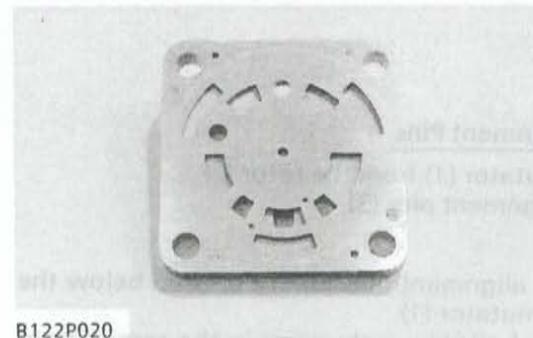
1. Inspect the port cover for port fitting sealing surface scratches and thread damage.
2. If these conditions, replace the port cover assembly.



B122P019

Springs

1. Inspect the springs for bent or distorted coils.
2. If a spring is broken or deformed, all six springs in the unit should be replaced.



B122P020

Port manifold

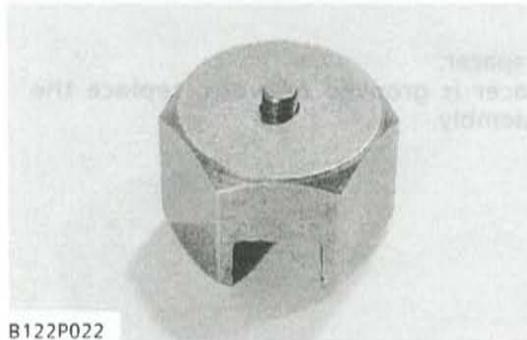
1. Inspect the ground surface of the port manifold.
2. If the port manifold shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P021

Valve Plate

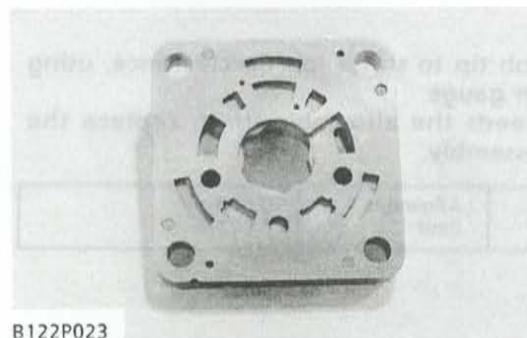
1. Inspect the slot edges and ground surface.
2. If the valve plate shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P022

Hex. Drive Assembly

1. The pin in the hex. drive assembly should not show wear and must be firmly pressed in place.
2. The sides of the hex. and the slot should not have grooves or scoring.
3. If the hex. drive assembly shows signs of this type of wear, replace the steering controller assembly.



B122P023

Isolation Manifold

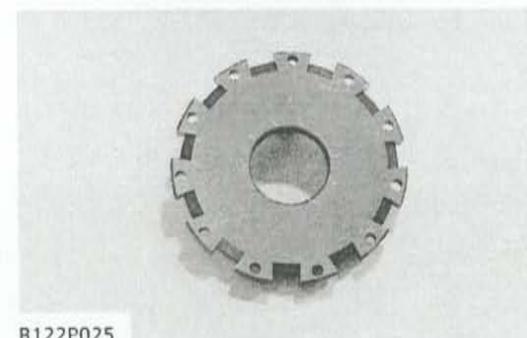
1. Inspect the ground surface of the isolation manifold.
2. If the isolation manifold shows nicks or scoring or the edges are not sharp, replace the steering controller assembly.



B122P024

Drive Link

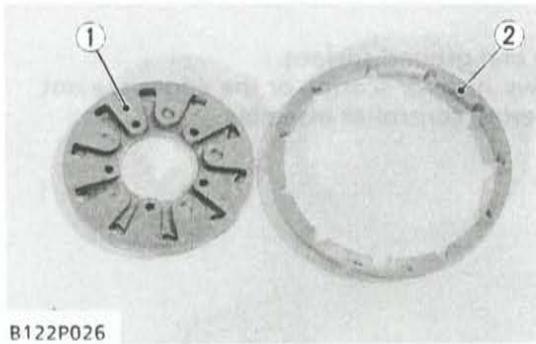
1. Inspect each end of the drive link.
2. If the drive link shows wear or scoring, replace the steering controller assembly.



B122P025

Commutator Cover

1. Inspect the ground surfaces of the commutator cover.
2. If the commutator cover has nicks, burrs or scoring, replace the steering controller assembly.

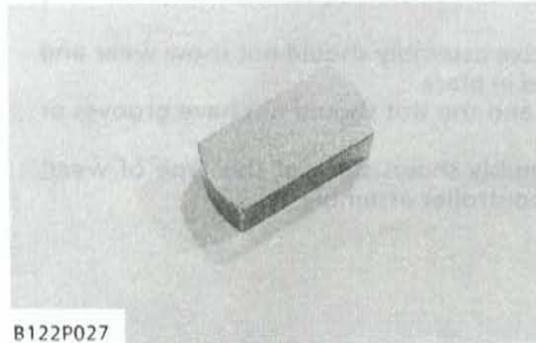


Commutator Ring and Commutator

1. Inspect the ground surfaces of the commutator (1) and inside surfaces of the commutator ring (2).
2. If either is worn or damaged, replace the steering controller assembly.

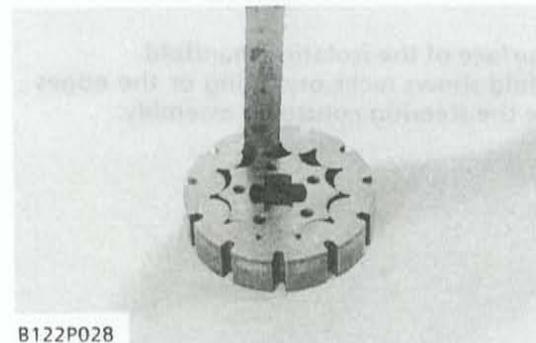
(1) Commutator

(2) Commutator Ring



Drive Link Spacer

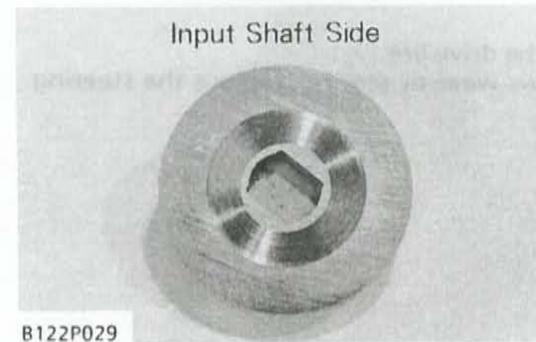
1. Inspect the drive link spacer.
2. If the drive link spacer is grooved or worn, replace the steering controller assembly.



Rotor Set

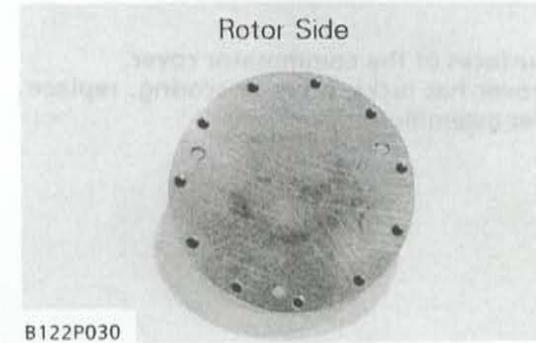
1. Measure the rotor lobe tip to stator lobe tip clearance, using the appropriate feller gauge.
2. If the clearance exceeds the allowable limit, replace the steering controller assembly.

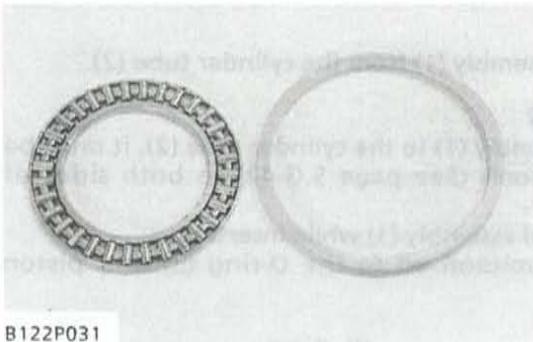
Clearance between rotor lobe tip and stator lobe tip	Allowable limit	0.08 mm 0.003 in.
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Drive Plate

1. The rotor side of the drive plate should show the "normal" spiral pattern due to rotor movement.
2. Inspect the thrust bearing side of the plate for brinelling (dents) or spalling (flaking).
3. The flat sides of the input shaft engagement hole should not be grooved or worn.
4. If any of these conditions are present, replace the steering controller assembly.





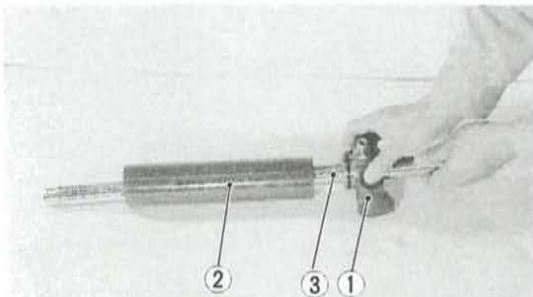
B122P031

Bearing and Spacers

1. Inspect the thrust bearing for brinelling (dents) or spalling (flaking).
2. If either exists, or if one or more of the rolls are lost or broken, replace the steering controller assembly.
3. If the seal spacer or bearing spacer are worn or broken, replace the steering controller assembly.

[3]-2 STEERING CYLINDER

DISASSEMBLING AND ASSEMBLING



B122P032

Steering Cylinder Assembly

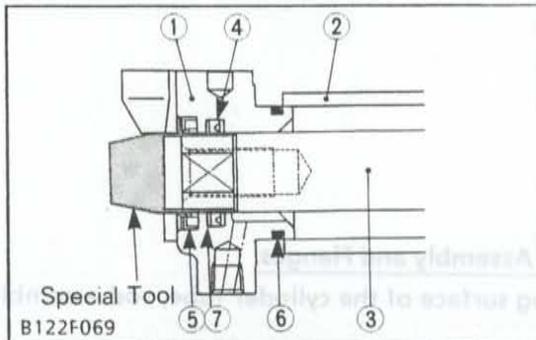
1. Remove the steering cylinder assembly. (See page S.5-13)

Flange Assembly

1. Pull out the flange assembly (1) from the cylinder tube (2).

(When reassembling)

- Insert the rod assembly (3) to the flange assembly (1), it must be used the special tool (See page S.G-42).
- Do not spin or drive in the rod assembly (3) while installing.
- Apply clean grease to the rod gasket (4), dust seal (5) and O-ring (6).
- Change the shape of rod gasket (4) as shown in the figure left, install it to the flange.
- Install the back up gasket (7) as shown in the figure below.

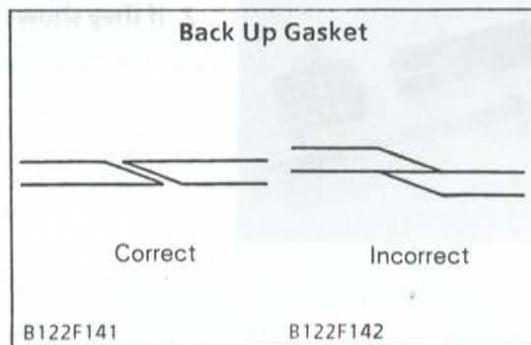


- (1) Flange Assembly
- (2) Cylinder Tube
- (3) Rod Assembly
- (4) Rod Gasket

- (5) Dust Seal
- (6) O-ring
- (7) Back Up Gasket

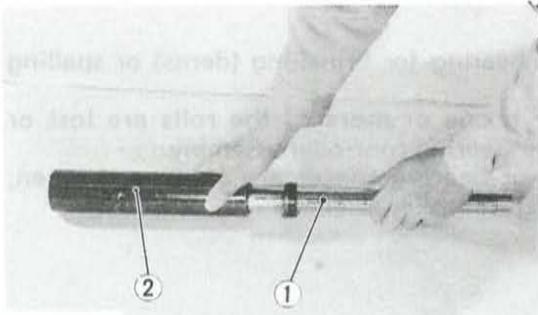


B122P039



B122F141

B122F142



B122P033

Rod Assembly

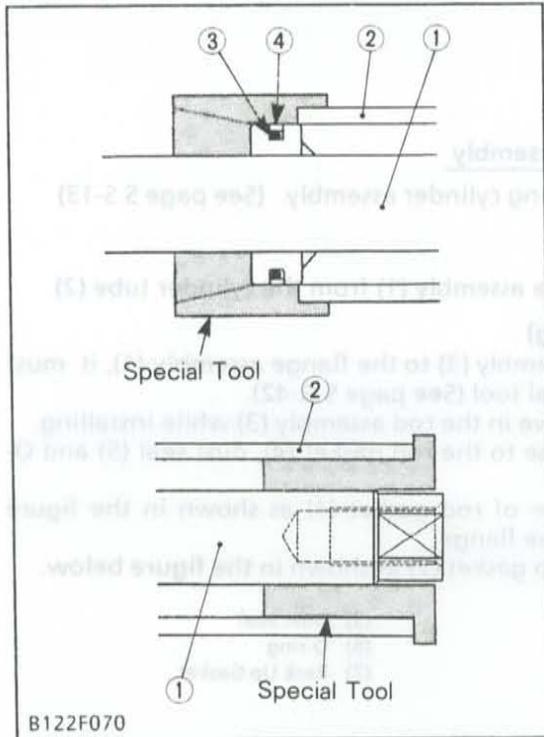
1. Pull out the rod assembly (1) from the cylinder tube (2).

(When reassembling)

- Insert the rod assembly (1) to the cylinder tube (2), it must be used the special tools (See page S.G-42) to both sides of cylinder tube (2).
- Do not spin the rod assembly (1) while inserting.
- Apply clean transmission oil to the O-ring (3) and piston gasket (4).

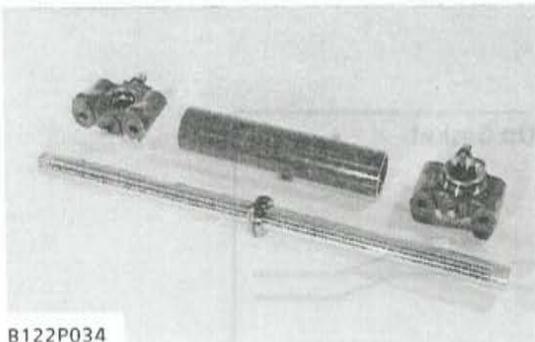
- (1) Rod Assembly
- (2) Cylinder Tube

- (3) O-ring
- (4) Piston Gasket



B122F070

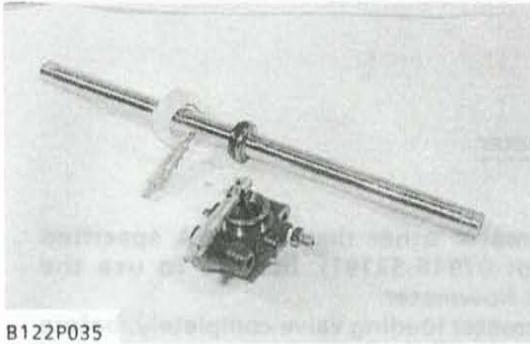
SERVICING



B122P034

Cylinder Tube, Rod Assembly and Flanges

1. Inspect the sliding surface of the cylinder tube, rod assembly and flanges.
2. If they shows nicks or scoring, they must be replaced.



B122P035

Clearance between Rod and Flange

1. Measure the rod O.D. with an outside micrometer.
2. Measure the flange I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the rod assembly or flange.

Clearance between rod and flange	Factory spec.	0.020 to 0.062 mm 0.0008 to 0.0024 in.
	Allowable limit	0.1 mm 0.0039 in.
Flange I.D.	Factory spec.	30.000 to 30.021 mm 1.1811 to 1.1819 in.
	Factory spec.	29.959 to 29.980 mm 1.1795 to 1.1803 in.



B122P036

Cylinder Tube Wear

1. Measure the cylinder tube I.D. with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace the cylinder tube.

Cylinder tube I.D.	Factory spec	50.000 to 50.062 mm 1.9685 to 1.9709 in.
	Allowable limit	50.100 mm 1.9724 in.

Hydraulic pump delivery at no pressure	L2350	Above 1.55 U.S. gallon 1.75 imp. gallon
	L2450	Above 1.66 U.S. gallon 1.93 imp. gallon
Hydraulic pump delivery at rated pressure	L2650	Above 1.04 U.S. gallon 1.23 imp. gallon
	L2850	Above 1.19 U.S. gallon 1.42 imp. gallon
Hydraulic pump delivery at rated pressure	L2950	Above 1.27 U.S. gallon 1.52 imp. gallon
	L3450	Above 1.70 U.S. gallon 1.93 imp. gallon
Hydraulic pump delivery at rated pressure	L3650	Above 1.91 U.S. gallon 2.28 imp. gallon
	L3850	Above 2.04 U.S. gallon 2.46 imp. gallon
Hydraulic pump delivery at rated pressure	L3950	Above 2.18 U.S. gallon 2.61 imp. gallon
	L4250	Above 2.38 U.S. gallon 2.85 imp. gallon
Hydraulic pump delivery at rated pressure	L4450	Above 2.57 U.S. gallon 3.08 imp. gallon
	L4650	Above 2.77 U.S. gallon 3.31 imp. gallon

[3]-3 POWER STEERING HYDRAULIC PUMP CHECKING AND ADJUSTING



B122P037

Condition

- Engine speed
(L2650-L2950-L3650) Approx. 2600 rpm
(L3450) Approx. 2500 rpm
- Rated pressure..... 11.28MPa
115 kgf/cm²
1636 psi
- Oil temperature..... 45 to 55°C
113 to 131°F

Pump Test Using Flowmeter

■ **IMPORTANT**

- When using a flowmeter other than KUBOTA specified flowmeter (Code No: 07916-52791), be sure to use the instructions with that flowmeter.
- Do not close the flowmeter loading valve completely, before testing, because it has no relief valve.

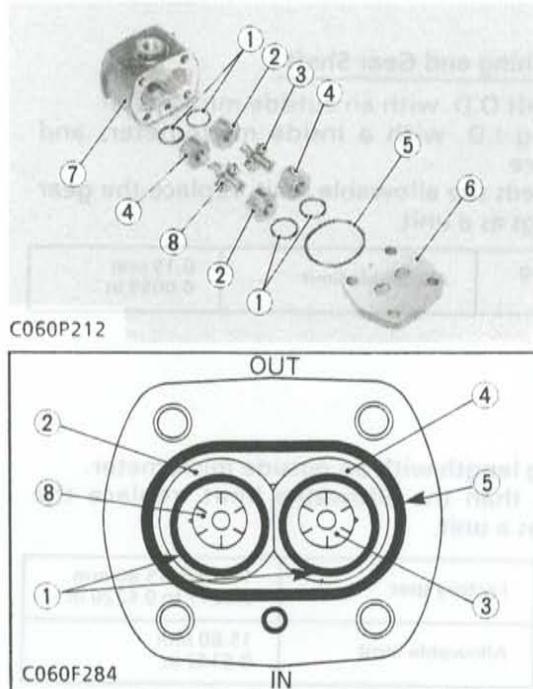
1. Disconnect the delivery pipe which is connected from hydraulic pump to power steering.
2. Install the adaptor 52 (Code No: 07916-52841) to pump.
3. Connect the hydraulic test hose (Code No.: 07916-52651) to the adaptor 52 (pump side) and flowmeter inlet port. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case filling plug hole.
4. Open the flowmeter loading valve completely. (Turn counterclockwise)
5. Start the engine and set the engine speed at max. speed.
6. Slowly close the loading valve to generate pressure approx. **11.28 MPa (115 kgf/cm², 1636 psi)**. Hold in this condition until oil temperature reaches **45 to 55°C (113 to 131°F)**.
7. Open the flowmeter loading valve completely. (Turn counterclockwise)
8. Set the engine speed at rated revolution.
9. Read the pump delivery at no pressure.
10. Slowly close the loading valve to increase pressure approx. **11.28 MPa (115 kgf/cm², 1636 psi)**. As load is increased, engine speed drops, therefore, reset the engine speed.
11. Read the pump flow at rated pressure.
12. Open the loading valve and stop the engine.
13. If the pump delivery does not reach the factory specification, check the pump suction line, oil filter or hydraulic pump.

Hydraulic pump delivery at no pressure	Factory spec.	L2650 L2950	Above 17.1 ℓ/min 4.52 U.S.gal/min. 3.76 Imp.gal/min.
		L3450	Above 14.7 ℓ/min 3.88 U.S.gal/min. 3.23 Imp.gal/min.
		L3650	Above 15.3 ℓ/min 4.04 U.S.gal/min. 3.37 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2650 L2950	Above 16.6 ℓ/min 4.39 U.S.gal/min. 3.65 Imp.gal/min.
		L3450	Above 14.3 ℓ/min 3.78 U.S.gal/min. 3.15 Imp.gal/min.
		L3650	Above 14.8 ℓ/min 3.91 U.S.gal/min. 3.26 Imp.gal/min.
	Allowable limit	L2650 L2950	14.9 ℓ/min 3.94 U.S.gal/min. 3.28 Imp.gal/min.
		L3450	12.8 ℓ/min 3.38 U.S.gal/min. 2.82 Imp.gal/min.
		L3650	13.3 ℓ/min 3.51 U.S.gal/min. 2.93 Imp.gal/min.

DISASSEMBLING AND ASSEMBLING

■ IMPORTANT

- The hydraulic pump is precision machined and assembled; if disassembled once, it may be unable to maintain its original performance. Therefore, when the hydraulic pump fails, replacement should be carried out with the hydraulic pump assembled except when emergency repair is unavoidable.
- When repair is required, follow the disassembly and servicing procedures shown below with utmost care.
- Be sure to test the hydraulic pump with a flowmeter before disassembling.
- After reassembly, be sure to perform break-in operation and ensure that there is nothing abnormal with the hydraulic pump.



Disassembling Pump

1. Remove the pump cover.
2. Remove the O-ring (5) and seal ring (1).
3. Remove the bushings (2), (4) of cover (6) side as a unit.
4. Take out the drive gear (8) and driven gear (3).
5. Take out the bushings (2), (4) in back of pump housing (7) as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4) be sure to reassemble them to the each original position.
- Take care not to damage the seal rings and O-rings.
- After reassembling the power steering hydraulic pump, mount an arm approx. 100 mm (3.39 in.) long to the drive gear to check for smooth rotation.

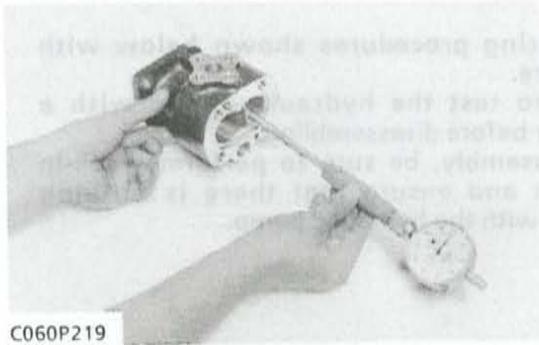
- | | |
|-----------------|------------------|
| (1) Seal Ring | (5) O-ring |
| (2) Bushing | (6) Cover |
| (3) Driven Gear | (7) Pump Housing |
| (4) Bushing | (8) Drive Gear |

Hydraulic Pump Running-In

After reassembly, perform break-in operation in the following manner, and check the pump for abnormality before use. If the pump temperature should rise noticeably during running-in, recheck should be performed.

1. Install the hydraulic pump to the tractor, and mount the suction pipe and delivery pipe securely.
2. Set the engine speed at 1300 to 1500 rpm, and operate the hydraulic pump at no load for about 10 minutes.
3. Set the engine speed at 2000 to 2200 rpm, and with the hydraulic pump applied with 2.94 MPa (30 kgf/cm², 427 psi) to 4.90 MPa (50 kgf/cm², 711 psi) pressure, operate it for approx. 15 minutes.
4. With the engine set to maximum speed, fully turn the steering wheel to the left or right, then actuate the relief valve five times for 25 seconds (one time 5 seconds).

SERVICING



C060P219

Housing Bore (Depth of scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
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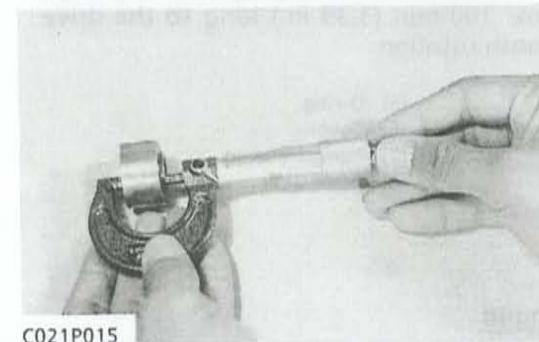


C045P249

Clearance between Bushing and Gear Shaft

1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear shaft and the bushings as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.15 mm 0.0059 in.
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C021P015

Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the bushings and gears as a unit.

Bushing length	Factory spec.	15.79 to 15.80 mm 0.6217 to 0.6220 in.
	Allowable limit	15.60 mm 0.6142 in.

S.8 HYDRAULIC SYSTEM

CONTENTS

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TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Transmission fluid	S.G-14, 15
2	Hydraulic oil filter	S.G-16
3	Suction pipe	-
4	Delivery pipe	-
5	Top link length	-
6	Lifting rod holes	-
7	Weight of implement	M.11-10, 11
8	Lever guide stopper position	S.8-11
9	Relief valve function	S.8-18, 19
10	Lowering speed adjusting valve	-

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Implement Does Not Rise (Not Noise)	<ul style="list-style-type: none"> Control linkage improperly adjusted Control linkage improperly assembled or damaged Position control valve malfunctioning (unload poppet, spool, poppet 1, 2, 3) Relief valve spring weaken or broken 	Adjust Repair or replace Repair or replace	S.8-11 S.8-11 S.8-12,13, 14
	<ul style="list-style-type: none"> Hydraulic piston O-ring, cylinder damaged Relief valve setting pressure too low Hydraulic pump malfunctioning 	Replace Adjust Repair or replace	S.8-18,19, 20 S.8-20 S.8-18, 19 S.8-7,8,9
Implement Does Not Reach Maximum Height	<ul style="list-style-type: none"> Position control rod improperly adjusted Position control valve spool joint 1 improperly adjusted Hydraulic arm shaft, hydraulic arm, lift arm improperly assembled 	Adjust Adjust Adjust	S.8-11 S.8-15 S.8-21
Implement Does Not Lower	<ul style="list-style-type: none"> Control valve malfunctioning <ul style="list-style-type: none"> Spool damaged 	Replace	S.8-12,13, 14
	<ul style="list-style-type: none"> Poppet valve adjusting nut improperly adjusted 	Adjust	S.8-15

Symptom	Probable Cause	Solution	Reference Page
Implement Drops by Weight	<ul style="list-style-type: none"> Hydraulic cylinder worn or damaged Hydraulic piston and O-ring worn or damaged 	Replace Replace	S.8-20 S.8-20
	<ul style="list-style-type: none"> Position control valve malfunctioning <ul style="list-style-type: none"> Poppet 1 seat surface damaged 	Replace	S.8-12,13,14
	<ul style="list-style-type: none"> Poppet 1 O-ring damaged 	Replace	S.8-12,13,14
	<ul style="list-style-type: none"> Poppet 2 seat surface damaged 	Replace	S.8-12,13,14
	<ul style="list-style-type: none"> Poppet 2 O-ring damaged 	Replace	S.8-12,13,14
	<ul style="list-style-type: none"> Poppet 3 seat surface damaged Poppet 3 O-ring damaged 	Replace Replace	S.8-13 S.8-13
Implement Hunts (Moves Up and Down)	<ul style="list-style-type: none"> Poppet 1, poppet 2, poppet 3 seat surface damaged Control valve O-rings worn or damaged 	Replace Replace	S.8-12,13,14 S.8-12,13,14
	<ul style="list-style-type: none"> Poppet 2 adjusting nut improperly adjusted 	Adjust	S.8-15
Draft Control Malfunctioning	<ul style="list-style-type: none"> Draft control valve malfunctioning Draft control linkage improperly adjusted Torsion bar weaken or broken 	Replace Adjust Replace	S.8-16, 17 S.8-16 -
Oil Temperature Increases Rapidly	<ul style="list-style-type: none"> Relief valve operating Hydraulic pump leak or damaged Oil leaks from valves Gear or bearing damaged in the transmission case 	Adjust Replace or repair Replace or repair Replace	S.8-18,19 S.8-6,7,8,9 - -

SERVICING SPECIFICATIONS

HYDRAULIC PUMP

Item	Factory Specification	Allowable Limit	
Hydraulic Pump Condition <ul style="list-style-type: none"> ● Engine Speed <ul style="list-style-type: none"> [L2350] <ul style="list-style-type: none"> Approx. 2800 rpm [L2650, L2950, L3650] <ul style="list-style-type: none"> Approx. 2600 rpm [L3450] <ul style="list-style-type: none"> Approx. 2500 rpm ● Oil Temperature <ul style="list-style-type: none"> 45 to 55°C 113 to 131°F 	Delivery at No Pressure [L2350 2WD]	Above 17.3 l/min. 4.57 U.S. gal/min. 3.81 Imp.gal/min.	-
	[L2350 4WD]	Above 27.2 l/min. 7.19 U.S. gal/min. 5.98 Imp.gal/min.	-
	[L2650, L2950]	Above 25.4 l/min. 6.71 U.S. gal/min. 5.59 Imp.gal/min.	-
	[L3450]	Above 28.4 l/min. 7.50 U.S. gal/min. 6.25 Imp.gal/min.	-
	[L3650]	Above 29.5 l/min. 7.79 U.S. gal/min. 6.49 Imp.gal/min.	-
Hydraulic Pump Condition <ul style="list-style-type: none"> ● Engine Speed <ul style="list-style-type: none"> [L2350] <ul style="list-style-type: none"> Approx. 2800 rpm [L2650, L2950, L3650] <ul style="list-style-type: none"> Approx. 2600 rpm [L3450] <ul style="list-style-type: none"> Approx. 2500 rpm ● Rated pressure <ul style="list-style-type: none"> [L2350] <ul style="list-style-type: none"> 15.19 MPa 155 kgf/cm² 2204 psi [L2650, L2950, L3450, L3650] <ul style="list-style-type: none"> 17.16 MPa 175 kgf/cm² 2489 psi ● Oil Temperature <ul style="list-style-type: none"> 45 to 55°C 113 to 131°F 	Delivery at Rated Pressure [L2350 2WD]	Above 16.8 l/min. 4.44 U.S. gal/min. 3.70 Imp.gal/min.	15.1 l/min. 3.99 U.S. gal/min. 3.32 Imp.gal/min.
	[L2350 4WD]	Above 26.4 l/min. 6.97 U.S. gal/min. 5.81 Imp.gal/min.	23.7 l/min. 6.26 U.S. gal/min. 5.21 Imp.gal/min.
	[L2650, L2950]	Above 24.6 l/min. 6.50 U.S. gal/min. 5.41 Imp.gal/min.	22.1 l/min. 5.84 U.S. gal/min. 4.86 Imp.gal/min.
	[L3450]	Above 27.5 l/min. 7.26 U.S. gal/min. 6.05 Imp.gal/min.	24.7 l/min. 6.53 U.S. gal/min. 5.43 Imp.gal/min.
	[L3650]	Above 28.6 l/min. 7.56 U.S. gal/min. 6.29 Imp.gal/min.	25.7 l/min. 6.79 U.S. gal/min. 5.65 Imp.gal/min.

HYDRAULIC PUMP

Item		Factory Specification	Allowable Limit	
Gear (Drive, Driven)	O.D.	33.47 to 33.48 mm 1.3177 to 1.3181 in.		
Housing	Depth of Scratch	-	0.09 mm 0.0035 in.	
Bushing to Gear Shaft	Clearance	-	0.12 mm 0.0043 in.	
Bushing	Length [L2350 2WD]	18.99 to 19.00 mm 0.7476 to 0.7480 in.	18.80 mm 0.7402 in.	
		[L2350 4WD, L2650, L2950]	22.99 to 23.00 mm 0.9051 to 0.9055 in.	22.80 mm 0.8976 in.
		[L3450, L3650]	20.49 to 20.50 mm 0.8067 to 0.8071 in.	20.30 mm 0.7992 in.

RELIEF VALVE

Relief Valve Condition	Setting Pressure [L2350]	14.70 to 15.19 MPa 150 to 155 kgf/cm ² 2133 to 2204 psi	-
	[L2650, L2950] [L3450, L3650]	16.67 to 17.16 MPa 170 to 175 kgf/cm ² 2418 to 2489 psi	-
<ul style="list-style-type: none"> ● Engine Speed Maximum ● Oil Temperature 45 to 55°C 113 to 131°F 			

HYDRAULIC CYLINDER

Cylinder Bore	I.D. [L2350]	75.000 to 75.050 mm 2.9528 to 2.9547 in.	75.150 mm 2.9587 in.
Hydraulic Piston	[L2650, L2950] [L3450, L3650]	85.000 to 85.050 mm 3.3465 to 3.3484 in.	85.150 mm 3.3524 in.
	Stroke	90 mm 3.54 in.	-
Hydraulic Arm Shaft to Bushing	Clearance	(Right)	0.125 to 0.230 mm 0.0049 to 0.0091 in.
		(Left)	0.125 to 0.220 mm 0.0049 to 0.0087 in.
Hydraulic Arm Shaft	O.D.	(Right)	44.920 to 44.950 mm 1.7685 to 1.7697 in.
		(Left)	39.920 to 39.950 mm 1.5717 to 1.5728 in.
Bushing	I.D.	(Right)	45.075 to 45.150 mm 1.7746 to 1.7776 in.
		(Left)	40.075 to 40.140 mm 1.5778 to 1.5803 in.

CONTROL LINKAGE

Item		Factory Specification	Allowable Limit
Lift Arm Stroke Angle (Angle of Lift Arm) (Upward)	Angle	0.767 to 0.802 rad. 44 to 46°	-
	Angle	0.384 to 0.419 rad. 22 to 24°	-
Position Control Lever and Draft Control Lever		14.7 to 34.3 N 1.5 to 3.5 kgf 3.3 to 7.7 lbs	-

TIGHTENING TORQUES

Tightening torques of screws and nuts on the table below is especially specified.
(For general use screws and nuts: See page S.G-8)

Item	N·m	kgf·m	ft-lbs
Relief valve plug	49.0 to 68.6	5.0 to 7.0	36.2 to 50.6
Position control valve lock nut	13.7 to 19.6	1.4 to 2.0	10.1 to 14.5
Position control valve plug	39.2 to 58.8	4.0 to 6.0	28.9 to 43.4
Position control valve seat plug	29.4 to 49.0	3.0 to 5.0	21.7 to 36.2
Position control valve mounting screws	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2
Draft control valve mounting screws	23.6 to 27.4	2.4 to 2.8	17.4 to 20.2
Draft control valve plug	58.8 to 68.6	6.0 to 7.0	43.4 to 50.6

IMPORTANT
 * In this hook-up, there is no relief valve. Therefore, while testing, do not close the flow meter loading valve completely.

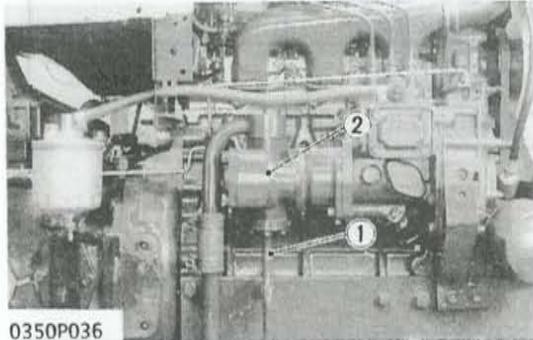
Item	Factory Spec.	Allowable Limit
Hydraulic pump delivery at rated pressure	L2350 2WD Above 17.1 gpm 4.57 U.S. gal/min 3.81 imp. gal/min	L2350 2WD Above 17.1 gpm 4.57 U.S. gal/min 3.81 imp. gal/min
Hydraulic pump delivery at rated pressure	L2350 2WD Above 16.8 gpm 4.44 U.S. gal/min 3.70 imp. gal/min	L2350 2WD Above 16.8 gpm 4.44 U.S. gal/min 3.70 imp. gal/min
	L2350 4WD Above 16.4 gpm 4.37 U.S. gal/min 3.61 imp. gal/min	L2350 4WD Above 16.4 gpm 4.37 U.S. gal/min 3.61 imp. gal/min
Hydraulic pump delivery at rated pressure	L2350 2WD Above 15.1 gpm 4.03 U.S. gal/min 3.35 imp. gal/min	L2350 2WD Above 15.1 gpm 4.03 U.S. gal/min 3.35 imp. gal/min
	L2350 4WD Above 14.7 gpm 3.94 U.S. gal/min 3.27 imp. gal/min	L2350 4WD Above 14.7 gpm 3.94 U.S. gal/min 3.27 imp. gal/min

CHECKING, DISASSEMBLING AND SERVICING

[1] HYDRAULIC PUMP

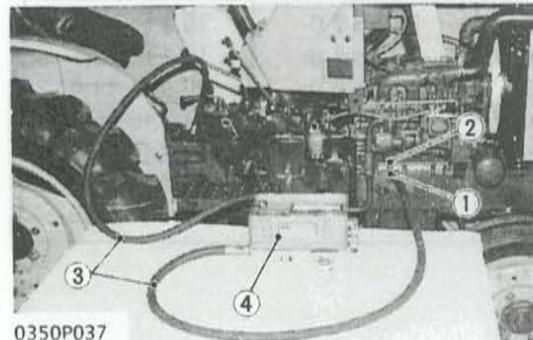
CHECKING AND ADJUSTING

[L2350]



0350P036

(1) Delivery Pipe (2) Hydraulic Pump



0350P037

(1) Adaptor 53 (2) Adaptor 54 (3) Hydraulic Test Hose (4) Flowmeter

Hydraulic Flow Test

1. Disconnect the delivery pipe which is connected from hydraulic pump to hydraulic cylinder.
2. Install the adaptor 54 (Code No: 07916-52861) and adaptor 53 (Code No: 07916-52851) to the pump discharge port.
3. Connect the hydraulic test hose (Code No: 07916-52651) to the adaptor 53 and flowmeter (Code No: 07916-52791) inlet port.
4. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case oil filling plug hole.
5. Open the flowmeter loading valve completely. (Turn counterclockwise)
6. Start the engine and set the engine speed at 2000 to 2200 rpm.
7. Slowly close the loading valve to generate pressure approx. 14.7 MPa (150 kgf/cm², 2133 psi). Hold in this condition until oil temperature reaches approx. 45°C (113°F).
8. Open the loading valve completely.
9. Set the engine speed at approx. 2800 rpm.
10. Read and note the pump delivery at no pressure.
11. Slowly close the loading valve to increase pressure approx. 15.19 MPa (155 kgf/cm², 2204 psi). As the load is increased, engine speed drops, therefore, reset the engine speed.
12. Read and note the pump flow at rated pressure.
13. Open the loading valve and stop the engine.
14. If the pump delivery does not reach the allowable limit, check the pump suction line, oil filter or hydraulic pump.

Condition

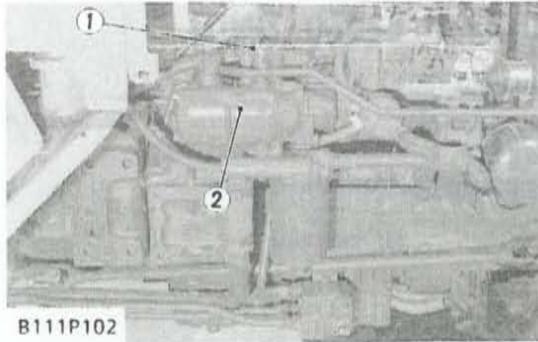
- Engine speed..... approx.2800 rpm
- Rated pressure..... 15.19 MPa
155 kgf/cm²
2204 psi
- Oil temperature..... 45 to 55 °C
113 to 131 °F

■ IMPORTANT

- In this hook-up, there is no relief valve. Therefore, while testing, do not close the flow meter loading valve completely.

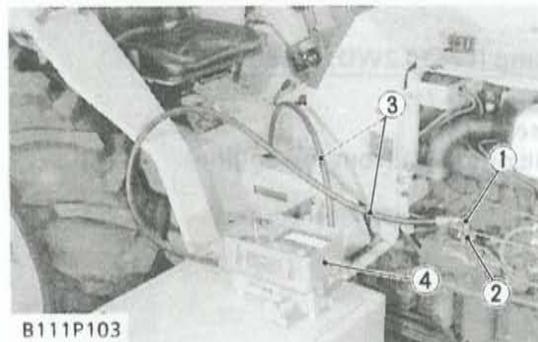
Hydraulic pump delivery at no pressure	Factory spec.	L2350 2WD	Above 17.3 ℓ/min 4.57 U.S.gal/min. 3.81 Imp.gal/min.
		L2350 4WD	Above 27.2 ℓ/min 7.19 U.S.gal/min. 5.98 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2350 2WD	Above 16.8 ℓ/min 4.44 U.S.gal/min. 3.70 Imp.gal/min.
		L2350 4WD	Above 26.4 ℓ/min 6.97 U.S.gal/min. 5.81 Imp.gal/min.
	Allowable limit	L2350 2WD	15.1 ℓ/min 3.99 U.S.gal/min. 3.32 Imp.gal/min.
		L2350 4WD	23.7 ℓ/min 6.26 U.S.gal/min. 5.21 Imp.gal/min.

[L2650, L2950, L3450, L3650]



B111P102

(1) Delivery Pipe (2) Hydraulic Pump



B111P103

(1) Adaptor 53 (2) Adaptor 54 (3) Hydraulic Test Hose (4) Flowmeter

Hydraulic Flow Test

1. Disconnect the delivery pipe which is connected from hydraulic pump to hydraulic block.
2. Install the adaptor 54 (Code No: 07916-52861) and adaptor 53 (Code No: 07916-52851) to the pump discharge port.
3. Connect the hydraulic test hose (Code No: 07916-52651) to the adaptor 53 and flowmeter (Code No: 07916-52791) inlet port.
4. Connect the other hydraulic test hose to flowmeter outlet port and to transmission case oil filling plug hole.
5. Open the flowmeter loading valve completely. (Turn counterclockwise)
6. Start the engine and set the engine speed at 2000 to 2200 rpm.
7. Slowly close the loading valve to generate pressure approx. 17.16 MPa (175 kgf/cm², 2489 psi). Hold in this condition until oil temperature reaches approx. 45°C (113°F).
8. Open the loading valve completely.
9. Set the engine speed at approx. 2600 rpm. (L3450, 2500 rpm)
10. Read and note the pump delivery at no pressure.
11. Slowly close the loading valve to increase pressure approx. 17.16 MPa (175 kgf/cm², 2489 psi). As the load is increased, engine speed drops, therefore, reset the engine speed.
12. Read and note the pump flow at rated pressure.
13. Open the loading valve and stop the engine.
14. If the pump delivery does not reach the allowable limit, check the pump suction line, oil filter or hydraulic pump.

Condition

- Engine speed [L2650,L2950,L3650] approx.2600 rpm [L3450] approx.2500 rpm
- Rated pressure..... 17.16 MPa 175 kgf/cm² 2489 psi
- Oil temperature..... 45 to 55°C 113 to 131°F

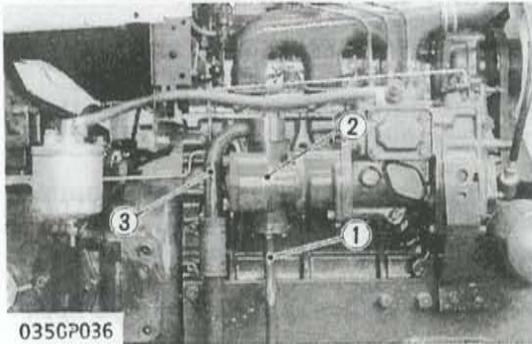
IMPORTANT

- In this hook-up, there is no relief valve. Therefore, while testing, do not close the flow meter loading valve completely.

Hydraulic pump delivery at no pressure	Factory spec.	L2650 L2950	Above 25.4 ℓ/min 6.71 U.S.gal/min. 5.59 Imp.gal/min.
		L3450	Above 28.4 ℓ/min 7.50 U.S.gal/min. 6.25 Imp.gal/min.
		L3650	Above 29.5 ℓ/min 7.79 U.S.gal/min. 6.49 Imp.gal/min.
Hydraulic pump delivery at rated pressure	Factory spec.	L2650 L2950	Above 24.6 ℓ/min 6.50 U.S.gal/min. 5.41 Imp.gal/min.
		L3450	Above 27.5 ℓ/min 7.26 U.S.gal/min. 6.05 Imp.gal/min.
		L3650	Above 28.6 ℓ/min 7.56 U.S.gal/min. 6.29 Imp.gal/min.
Allowable limit		L2650 L2950	22.1 ℓ/min 5.84 U.S.gal/min. 4.86 Imp.gal/min.
		L3450	24.7 ℓ/min 6.53 U.S.gal/min. 5.43 Imp.gal/min.
		L3650	25.7 ℓ/min 6.79 U.S.gal/min. 5.65 Imp.gal/min.

DISASSEMBLING AND ASSEMBLING

[L2350, MANUAL STEERING TYPE OF L2650 2WD AND L2950 2WD]



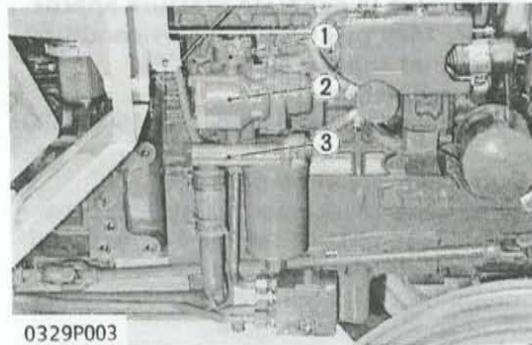
0350P036

Removing Hydraulic Pump [L2350]

1. Disconnect the delivery pipe (1).
2. Remove the inlet pipe (3).
3. Remove the hydraulic pump (2) from the engine.

(1) Delivery Pipe
(2) Hydraulic Pump

(3) Inlet Pipe



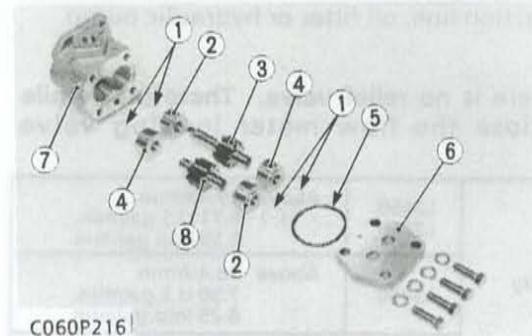
0329P003

Removing Hydraulic Pump [L2650 2WD, L2950 2WD]

1. Disconnect the delivery pipe (1).
2. Remove the filter bracket (3).
3. Remove the hydraulic pump (2) from the engine.

(1) Delivery Pipe
(2) Hydraulic Pump

(3) Filter Bracket



C060P216

Disassembling Hydraulic Pump

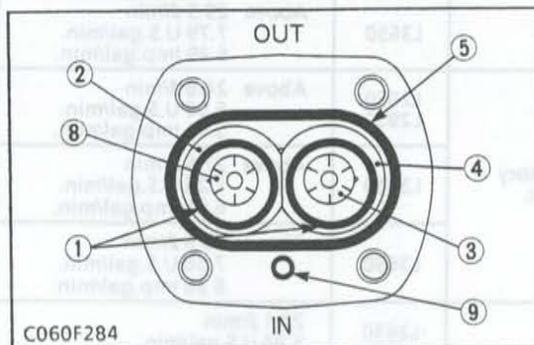
1. Remove the pump cover (6).
2. Remove the seal rings (1) and O-ring (5).
3. Remove the bushings (2), (4) of cover side as a unit.
4. Take out the drive gear (3) and driven gear (8).
5. Take out the bushings (2), (4) in back of the pump body (7) as a unit.

(When reassembling)

- Install the driven gear (8), noting its original direction.
- When installing the bushings (2), (4), be sure to reassemble them to the each original position.
- Take care not to damage the seal rings (1) and O-ring (5).
- After reassembly, mount an arm approx. 100 mm (4 in.) long, etc. to the drive gear to check for smooth rotation.

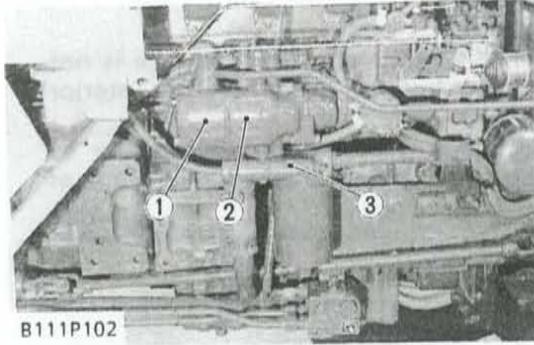
(1) Seal Ring
(2) Bushing
(3) Drive Gear
(4) Bushing
(5) O-ring

(6) Cover
(7) Pump Body
(8) Driven Gear
(9) O-ring



C060F284

[POWER STEERING TYPE OF L2650, L2950, L3450 AND L3650]

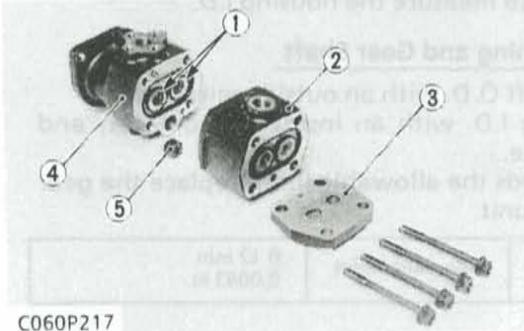


B111P102

Removing Three Point Hydraulic Pump and Power Steering Hydraulic Pump

1. Disconnect the delivery pipes from the three point hydraulic pump and power steering pump.
2. Remove the filter bracket (3).
3. Remove the power steering hydraulic pump (1) and three point hydraulic pump (2) as a unit from the engine.

- | | |
|-----------------------------------|--------------------|
| (1) Power Steering Hydraulic Pump | (3) Filter Bracket |
| (2) Three Point Hydraulic Pump | |



C060P217

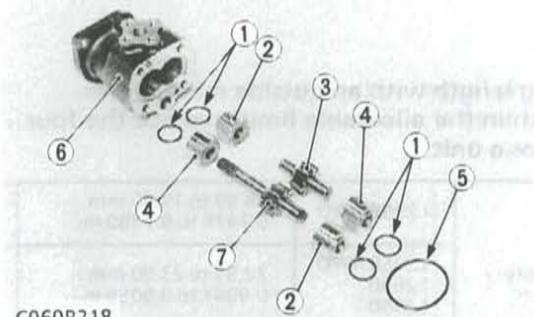
Separating Three Point Hydraulic Pump

1. Remove four screws from the power steering hydraulic pump (2), and separate it from the three point hydraulic pump (4).

(When reassembling)

- Install the cover (3), noting the position of oil port.
- Take care not to damage the O-rings.

- | | |
|-------------------------|--------------------------------|
| (1) Seal Ring | (4) Three Point Hydraulic Pump |
| (2) Power Steering Pump | (5) Coupling |
| (3) Cover | |



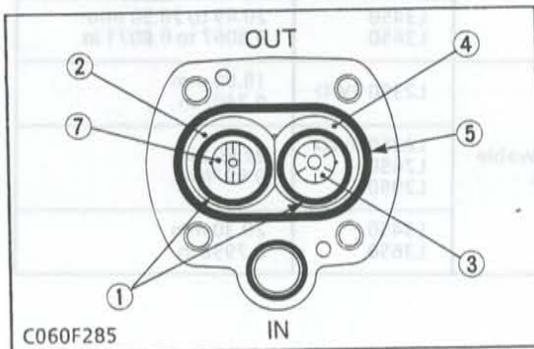
C060P218

Disassembling Three Point Hydraulic Pump

1. Remove the seal rings (1) and O-ring (5).
2. Remove the bushings (2), (4) of cover side as a unit.
3. Take out the drive gear (7) and driven gear (3).
4. Take out the bushings (2), (4) in back of the pump body as a unit.

(When reassembling)

- Install the driven gear (3), noting its original direction.
- When installing the bushings (2), (4), be sure to reassemble them to the each original position.
- Take care not to damage the seal rings (1) and O-ring (5).



C060F285

- | | |
|-----------------|----------------|
| (1) Seal Ring | (5) O-ring |
| (2) Bushing | (6) Pump Body |
| (3) Driven Gear | (7) Drive Gear |
| (4) Bushing | |

SERVICING

Housing Bore (Depth of Scratch)

1. Measure the housing I.D. where the interior surface is not scratched, and measure the housing I.D. where the interior surface is scratched.
2. If the values obtained in the two determinations differ by more than the allowable limit, replace the hydraulic pump as a unit.

Depth of scratch	Allowable limit	0.09 mm 0.0035 in.
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(Reference)

- Use a cylinder gauge to measure the housing I.D.

Clearance between Bushing and Gear Shaft

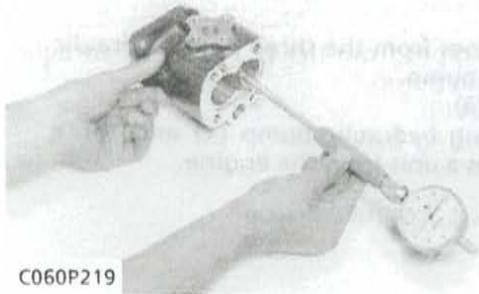
1. Measure the gear shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with an inside micrometer, and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace the gear and the bushing as a unit.

Clearance between bushing and gear shaft	Allowable limit	0.12 mm 0.0043 in.
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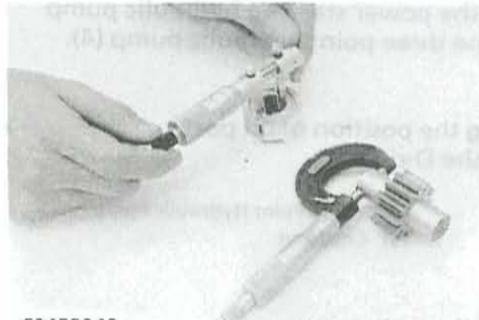
Bushing Length

1. Measure the bushing length with an outside micrometer.
2. If the length is less than the allowable limit, replace the four bushings and gears as a unit.

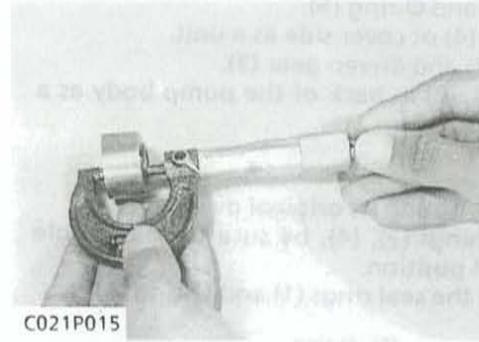
Bushing length	Factory spec.	L2350 2WD	18.99 to 19.00 mm 0.7476 to 0.7480 in.
		L2350 4WD L2650 L2950	22.99 to 23.00 mm 0.9051 to 0.9055 in.
		L3450 L3650	20.49 to 20.50 mm 0.8067 to 0.8071 in.
	Allowable limit	L2350 2WD	18.80 mm 0.7402 in.
		L2350 4WD L2650 L2950	22.80 mm 0.8976 in.
		L3450 L3650	20.30 mm 0.7992 in.



C060P219

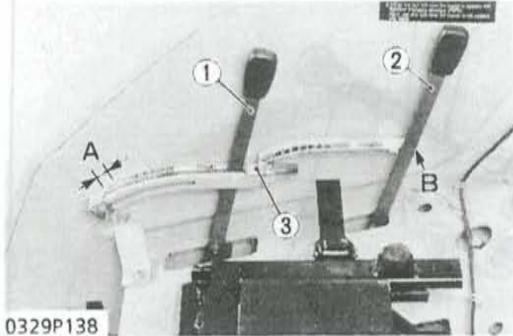


C045P249



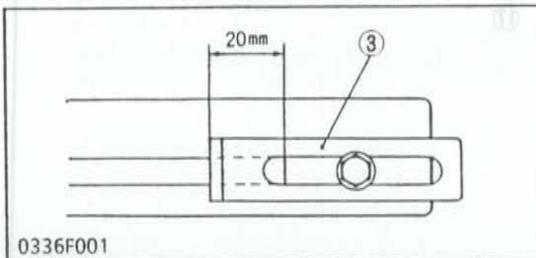
C021P015

[2] POSITION CONTROL VALVE CHECKING AND ADJUSTING

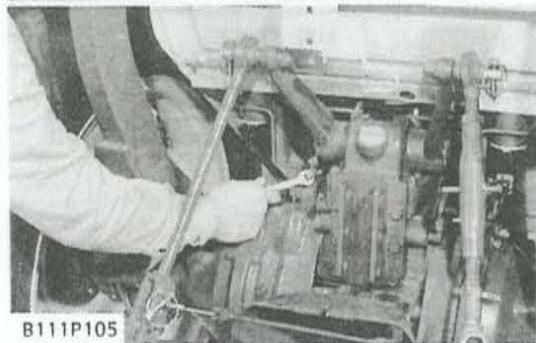


0329P138

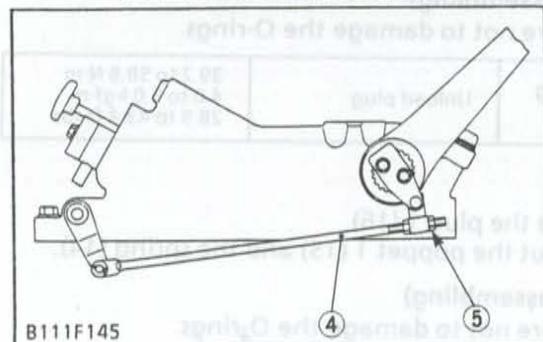
- (1) Position Control Lever
- (2) Draft Control Lever
- (3) Lever Stopper



0336F001



B111P105



- (4) Position Control Rod
- (5) Adjusting Nut

Adjusting Position Control Rod

1. Set the position control lever (1) to the floating position A.
2. Start the engine, and after warming-up, set the engine speed at the maximum.
3. Move the draft control lever (2) to the Lock position B. (If equipped)
4. Set the lever stopper (3) as shown in the figure. And move the position control lever (1) until it contacts the lever guide stopper.
5. Turn the adjusting nuts (5) until the relief valve begins to be operated.
6. From the position obtained in above 5, turn the adjusting nut (5) clockwise by 1-1/4 turn.
7. After adjustment, move the position control lever to the lowest position to check that the floating range can be obtained.
8. Tighten the adjusting nut firmly.

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly (See page 2-8)

2. Remove the position control valve assembly

IMPORTANT

• Measure the distance between the spool edge and spool joint 2 edge before disassembling

Spool

1. Remove the spool joint 1 (2) and the spool joint 2 (1)

2. Remove the plate (4)

3. Remove the spool (10)

(When reassembling)

13.5 to 18.8 N·m 1.0 to 2.0 kgf·m 10 to 14.2 ft-lb	Lock Nut	Tightening torque
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Point 2

1. Draw out the push rod (7)

2. Remove the plug (8) and draw out the poppet (10) and the spring (11)

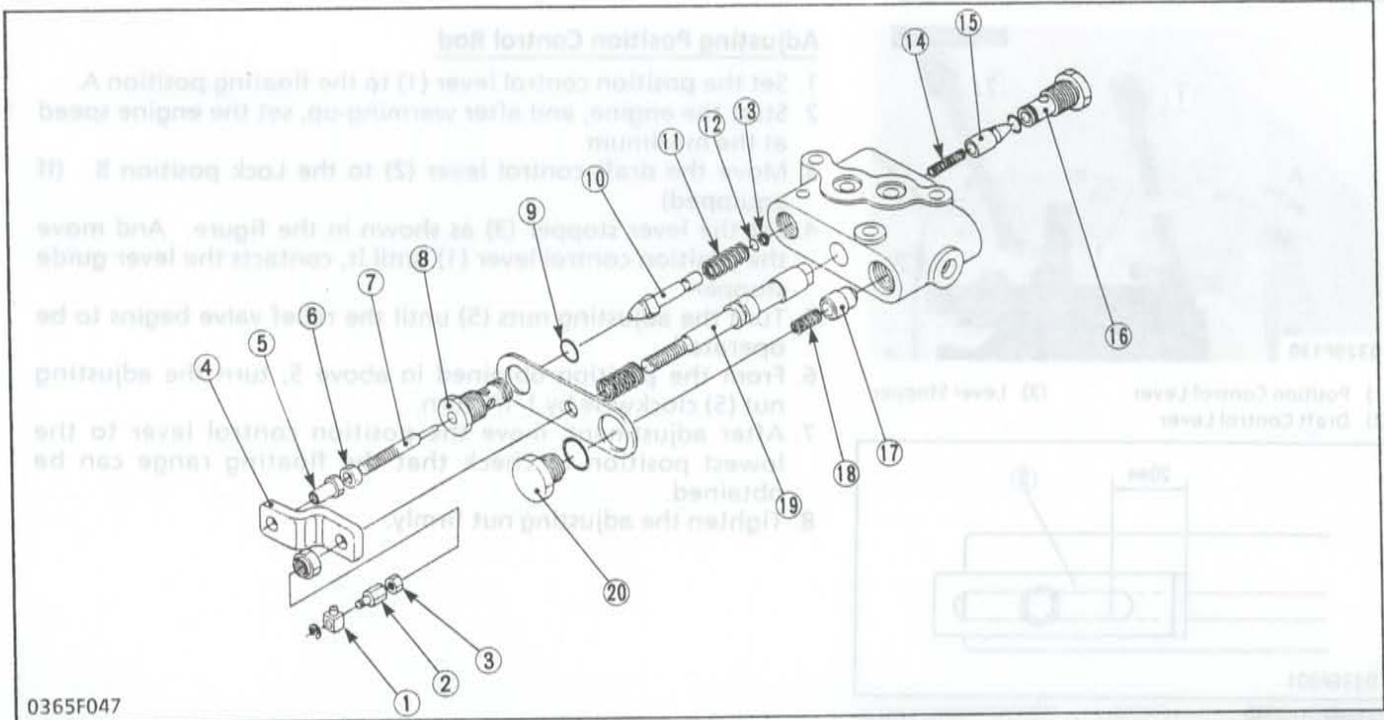
(When reassembling)

• Take care not to damage the O-ring

29.8 to 39.0 N·m 2.0 to 2.9 kgf·m 21.7 to 28.2 ft-lb	Plug	Tightening torque
--	------	-------------------

DISASSEMBLING AND ASSEMBLING

[L2350]



0365F047

- | | | | |
|-------------------|---------------|------------------|--------------------|
| (1) Spool Joint 2 | (6) Lock Nut | (11) Spring 2 | (16) Plug 1 |
| (2) Spool Joint 1 | (7) Push Rod | (12) O-ring | (17) Unload Poppet |
| (3) Lock Nut | (8) Plug 2 | (13) Backup Ring | (18) Spring |
| (4) Plate | (9) O-ring | (14) Spring | (19) Spool |
| (5) Adjusting Nut | (10) Poppet 2 | (15) Poppet 1 | (20) Unload Plug |

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page S.5-8)
2. Remove the position control valve assembly.

IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and the spool joint 2 (1).
2. Remove the plate (4).
3. Remove the spool (19).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft·lbs
-------------------	----------	---

Poppet 2

1. Draw out the push rod (7).
2. Remove the plug 2 (8) and draw out the poppet 2 (10) and the spring 2 (11).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft·lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (20).
2. Draw out the unload poppet (17) and the spring (18).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft·lbs
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Poppet 1

1. Remove the plug 1 (16).
2. Draw out the poppet 1 (15) and the spring (14).

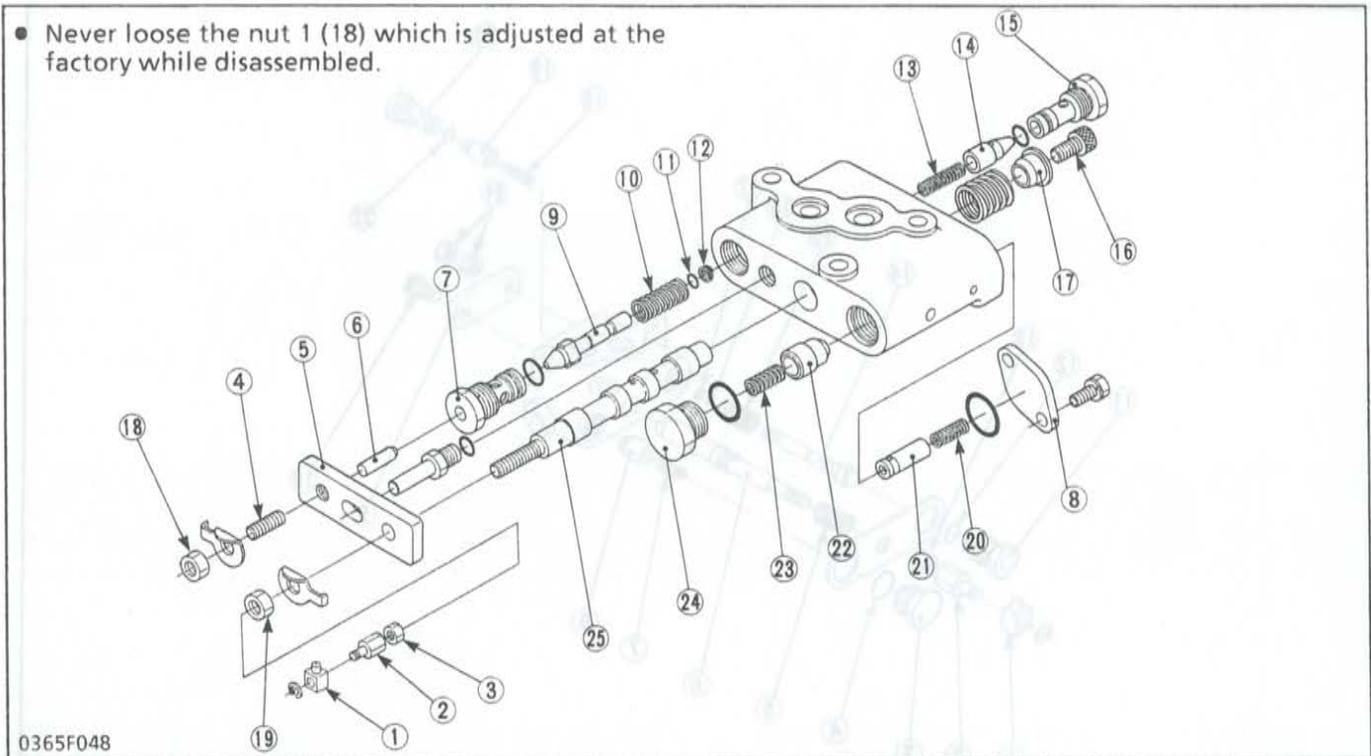
(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft·lbs
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[L2350 WITH DRAFT CONTROL (if equipped)]

- Never loose the nut 1 (18) which is adjusted at the factory while disassembled.



0365F048

- | | | | | |
|-------------------|---------------|------------------|--------------------|--------------------|
| (1) Spool Joint 2 | (6) Push Rod | (11) O-ring | (16) Screw | (21) Poppet 3 |
| (2) Spool Joint 1 | (7) Plug 2 | (12) Backup Ring | (17) Spring Holder | (22) Unload Poppet |
| (3) Lock Nut | (8) Plate 2 | (13) Spring | (18) Nut 1 | (23) Spring |
| (4) Set Screw | (9) Poppet 2 | (14) Poppet 1 | (19) Nut 2 | (24) Unload Plug |
| (5) Plate 1 | (10) Spring 2 | (15) Plug 1 | (20) Spring | (25) Spool |

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page 5.5-8)
2. Remove the position control valve assembly.

IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and the spool joint 2 (1).
2. Remove the nut 2 (19).
3. Remove the spool (25) and spring (5).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs
-------------------	----------	---

Poppet 2

1. Draw out the push rod (6).
2. Remove plug 2 (7) and draw out the poppet 2 (9) and spring 2 (10).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (24).
2. Draw out the unload poppet (22) and the spring (23).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft-lbs
-------------------	-------------	---

Poppet 3

1. Remove the plate 2 (8).
2. Draw out the spring (20) and the poppet 3 (21).

(When reassembling)

- Take care not to damage the O-rings.

Poppet 1

1. Remove the plug 1 (15).
2. Draw out the poppet 1 (14) and the spring (13).

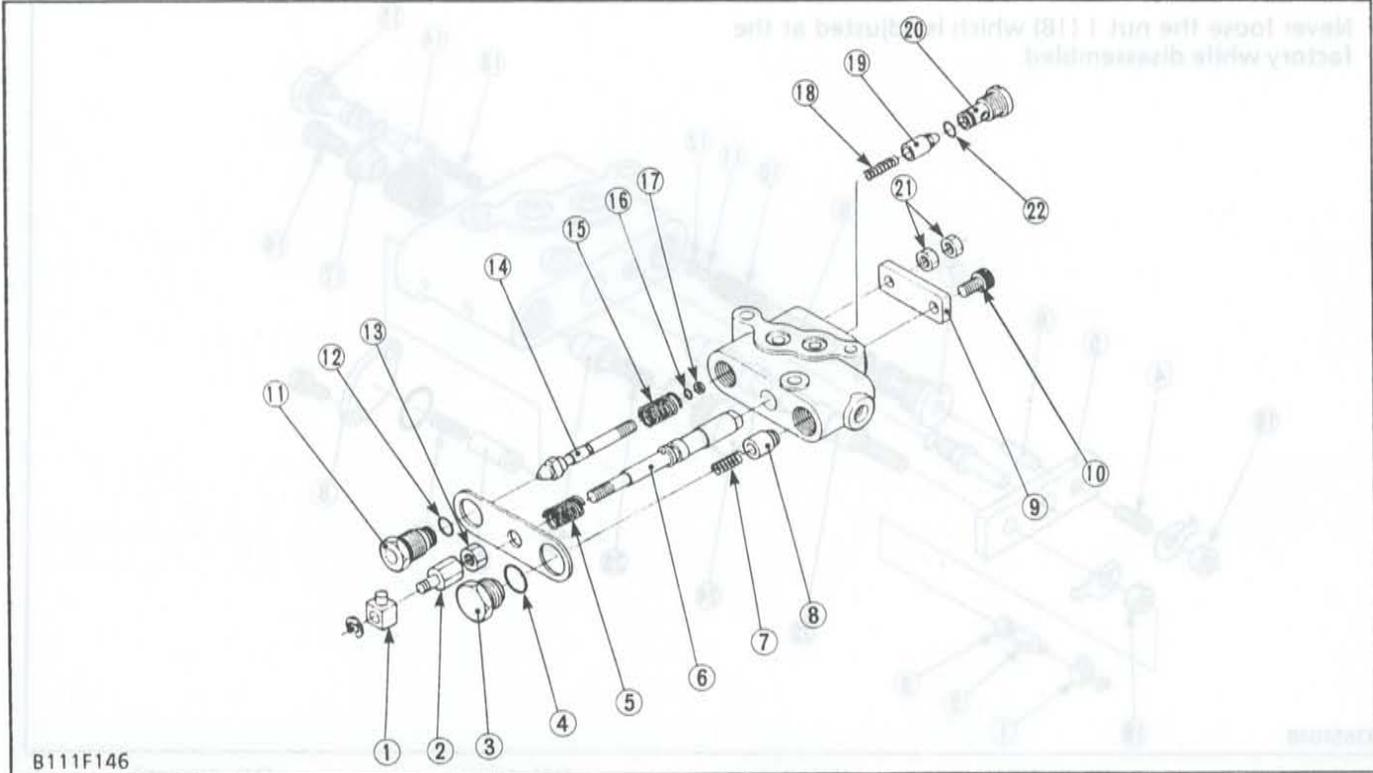
(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

[L2650, L2950, L3450, L3650]

(L2350 WITH DRAFT CONTROL (if equipped))



B111F146

- | | | | | |
|-------------------|-------------------|---------------|-------------------|---------------|
| (1) Spool Joint 2 | (6) Spool | (11) Plug 2 | (15) Spring | (19) Poppet 1 |
| (2) Spool Joint 1 | (7) Spring | (12) O-ring | (16) O-ring | (20) Plug 1 |
| (3) Unload Plug | (8) Unload Poppet | (13) Lock Nut | (17) Back Up Ring | (21) Nuts |
| (4) O-ring | (9) Plate | (14) Poppet 2 | (18) Spring | (22) O-ring |
| (5) Spool Spring | (10) Screw | | | |

Position Control Valve Assembly

1. Separate the hydraulic cylinder assembly. (See page S.5-22, 31)
2. Remove the position control valve assembly.

IMPORTANT

- Measure the distance between the spool edge and spool joint 2 edge before disassembling.

Spool

1. Remove the spool joint 1 (2) and spool joint 2 (1).
2. Remove the screw (10).
3. Pull out the spool (6) and spring (5).

(When reassembling)

Tightening torque	Lock nut	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs
-------------------	----------	---

Poppet 1

1. Remove the screw (10).
2. Remove the plug 1 (20) then pull out the poppet 1 (19) and the spring (18).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Plug 2	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

Unload Poppet

1. Remove the unload plug (3).
2. Draw out the spring (7) and unload poppet (8).

(When reassembling)

- Take care not to damage the O-rings.

Tightening torque	Unload plug	39.2 to 58.8 N·m 4.0 to 6.0 kgf·m 28.9 to 43.4 ft-lbs
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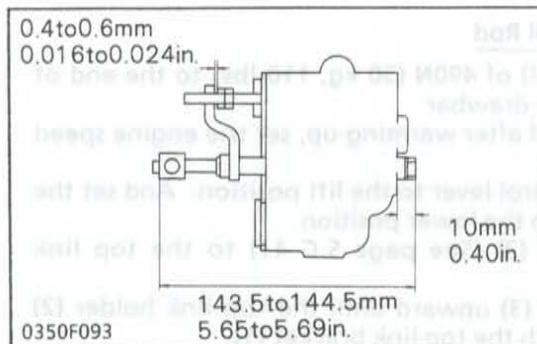
Poppet 2

1. Remove the plug 2 (11) and nuts (21).
2. Pull out the poppet 2 (14) and the spring (15).

(When reassembling)

- Take care not to damage the O-rings.

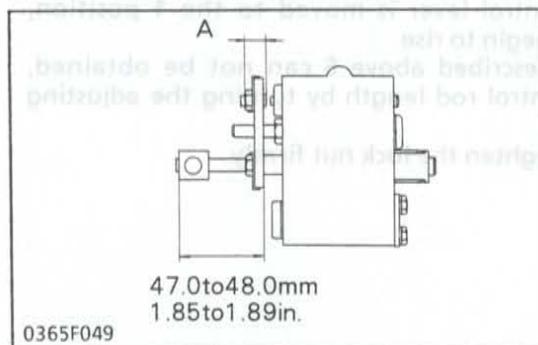
Tightening torque	Plug 1	29.4 to 49.0 N·m 3.0 to 5.0 kgf·m 21.7 to 36.2 ft-lbs
-------------------	--------	---

SERVICING**[L2350]****Clearance between Plate and Adjusting Nut**

1. Put the control valve on the block (height 10 mm, 0.40 in.)
2. Hold the control valve and measure the clearance between plate and adjusting nut with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting nut.

Spool Joint 2

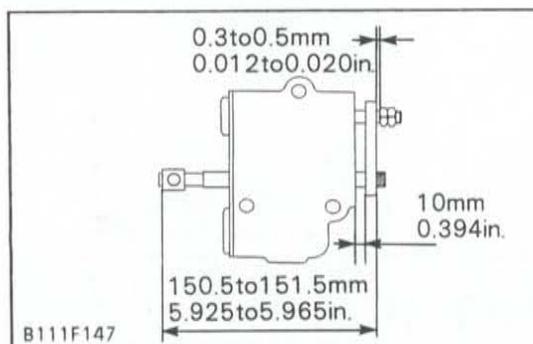
1. Measure the length of the spool from end to end. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.

[L2350 WITH DRAFT CONTROL (if equipped)]**Spool Joint 2**

1. Measure the length of the spool from end to plate. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.

NOTE

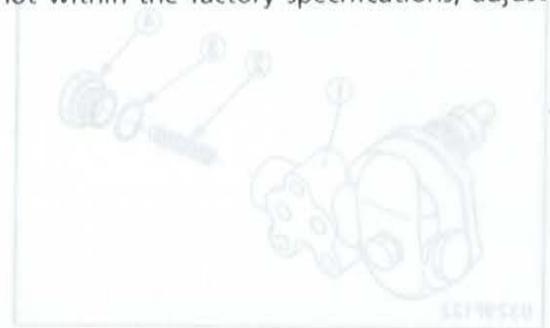
- Measure and record the distance "A" before to disassembling.
- Distance "A" is approx. 17 mm (0.67 in.).

[L2650, L2950, L3450, L3650]**Clearance between Plate and Adjusting Nut**

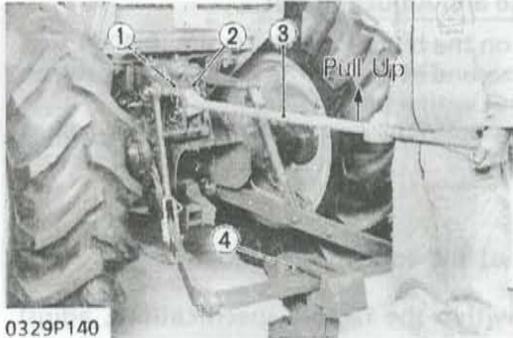
1. Hold 10 mm (0.40 in.) clearance between the valve body and the plate with using the 10 mm (0.40 in.) block gauge.
2. Hold the control valve and measure the clearance between plate and adjusting nut with a feeler gauge.
3. If the clearance is not within the factory specifications, adjust with the adjusting nut.

Spool Joint 2

1. Measure the length of the spool from end to end. (See diagram)
2. If the length is not within the factory specifications, adjust spool joint 2.

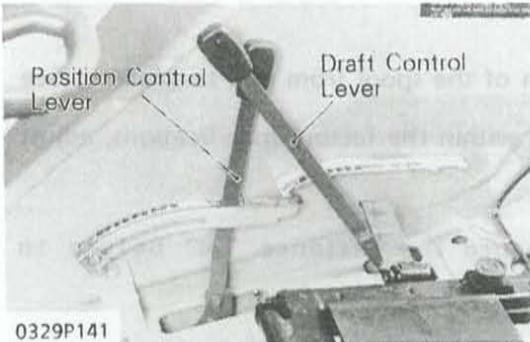


[3] DRAFT CONTROL VALVE CHECKING AND ADJUSTING

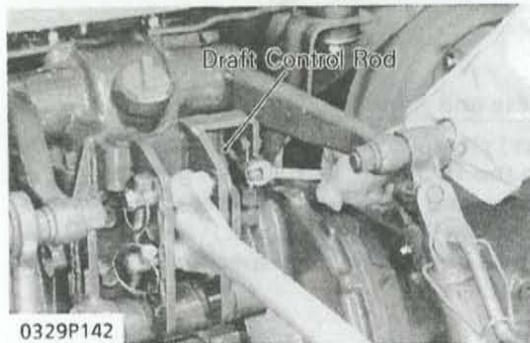


0329P140

- (1) Top Link Bracket
- (2) Top Link Holder
- (3) Test Bar
- (4) Weight



0329P141

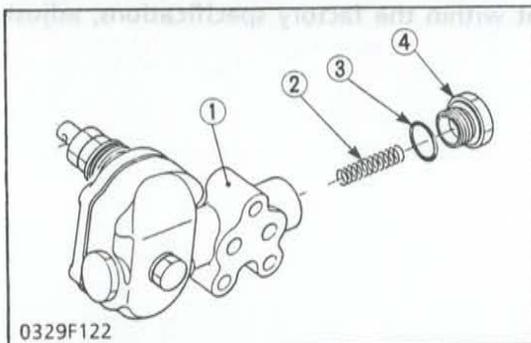


0329P142

Adjusting Draft Control Rod

1. Attach the weight (4) of 490N (50 kg, 110 lbs) to the end of lower link or linkage drawbar.
2. Start the engine, and after warming-up, set the engine speed at approx. 2000 rpm.
3. Set the position control lever to the lift position. And set the draft control lever to the lower position.
4. Attach the test bar (3) (See page S.G-41) to the top link holder (2).
5. Pull up the test bar (3) upward until the top link holder (2) comes in contact with the top link bracket (1).
6. In this condition, check the followings.
 - When the draft control lever is set to the DEEP position on the lever guide label, lower links should not rise.
 - When the draft control lever is moved to the 1 position, lower links should begin to rise.
7. If the operations described above 6 can not be obtained, adjust the draft control rod length by turning the adjusting nut.
8. After adjustment, tighten the lock nut firmly.

DISASSEMBLING AND ASSEMBLING



0329F122

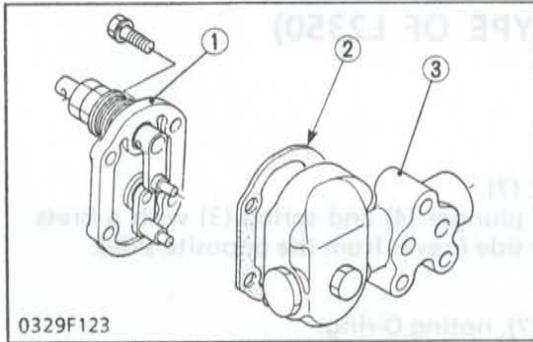
- (1) Valve Body
- (2) Spring
- (3) O-ring
- (4) Plug

Spool Return Spring

1. Remove the plug (4).
2. Remove the spool return spring (2).

(When reassembling)

- Install the plug (4), noting O-ring (3).



0329F123

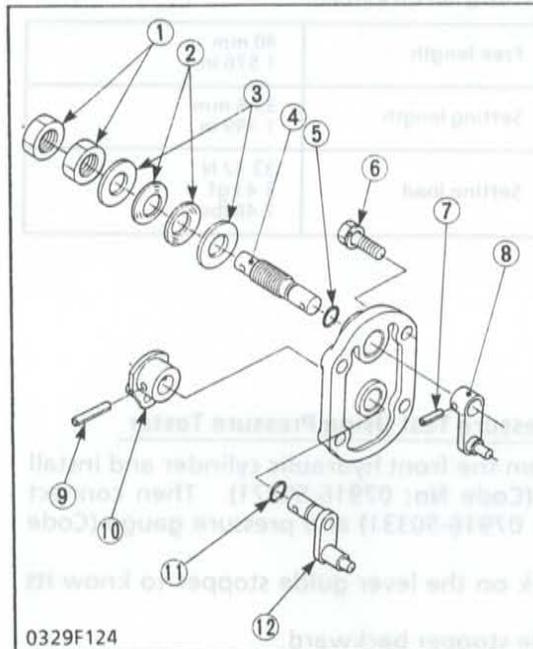
Valve Cover

1. Remove four screws, and separate the valve cover (1) from valve body (3).

(When reassembling)

- Install the plug (4), noting O-ring (3).

- | | |
|-----------------|----------------|
| (1) Valve Cover | (3) Valve Body |
| (2) Gasket | |



0329F124

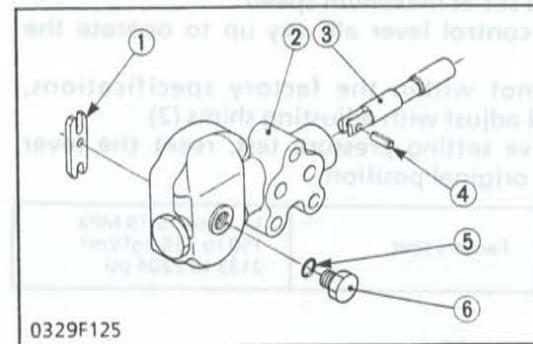
Control Lever Shaft and Feedback Lever Shaft

1. Tap out the spring pin (7).
2. Remove the draft control lever (8) and take out draft control lever shaft (4).
3. Tap out the spring pin (9).
4. Remove the feedback lever (10), and draw out the feedback lever shaft (12).

(When reassembling)

- Take care not to damage the O-rings.

- | | |
|-------------------------|---------------------------|
| (1) Nuts | (7) Spring Pin |
| (2) Disc Springs | (8) Draft Control Lever |
| (3) Washers | (9) Spring Pin |
| (4) Control Lever Shaft | (10) Feedback Lever |
| (5) O-ring | (11) O-ring |
| (6) Screws | (12) Feedback Lever Shaft |



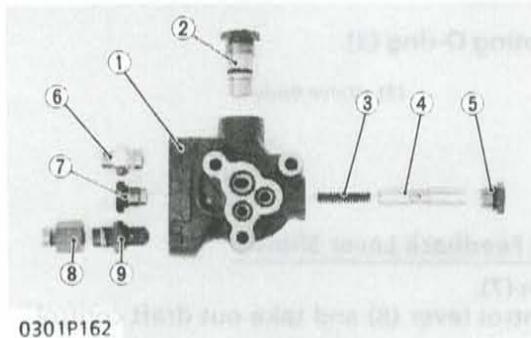
0329F125

Spool and Spool Drive Lever

1. Remove the plug (6).
2. Remove the spring pin (4).
3. Draw out the spool (3).
4. Remove the spool drive lever (1).

- | | |
|-----------------------|----------------|
| (1) Spool Drive Lever | (4) Spring Pin |
| (2) Valve Body | (5) O-ring |
| (3) Spool | (6) Plug |

[4] FLOW PRIORITY VALVE (POWER STEERING TYPE OF L2350) DISASSEMBLING AND ASSEMBLING



0301P162

- (1) Valve Body
- (2) Plug
- (3) Spring
- (4) Plunger
- (5) Plug
- (6) Connector
- (7) Plug
- (8) Connector
- (9) Connector

Flow Priority Valve

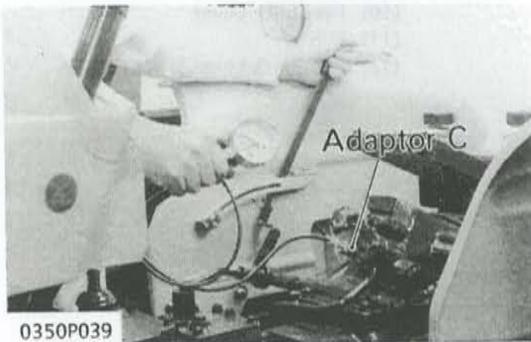
1. Remove the plugs (5), (7).
2. Lightly push out the plunger (4) and spring (3) with a brass rod from the plug (7) side (never from the opposite side).

(When reassembling)

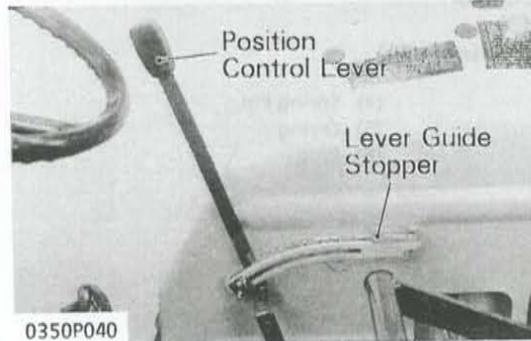
- Install the plugs (5), (7), noting O-ring.
- Install the plunger, noting its direction.

Spring specification	Free length	40 mm 1.576 in.
	Setting length	35.5 mm 1.399 in.
	Setting load	33.32 N 3.4 kgf 7.48 lbs

[5] RELIEF VALVE (L2350) CHECKING AND ADJUSTING



0350P039



0350P040

Relief Valve Setting Pressure Test Using Pressure Tester

1. Remove the plug from the front hydraulic cylinder and install the threaded joint (Code No: 07916-50371). Then connect the cable (Code No: 07916-50331) and pressure gauge (Code No: 07916-50322).
2. Put the parting mark on the lever guide stopper to know its original position.
3. Move the lever guide stopper backward.
4. Start the engine and set at maximum speed.
5. Move the position control lever all way up to operate the relief valve.
6. If the pressure is not within the factory specifications, remove plug (3) and adjust with adjusting shims (2).
7. After the relief valve setting pressure test, reset the lever guide stopper to its original position.

Relief valve setting pressure	Factory spec.	14.70 to 15.19 MPa 150 to 155 kgf/cm ² 2133 to 2204 psi
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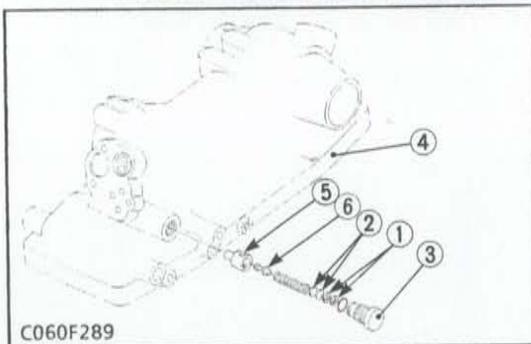
Condition

- Engine speed Maximum
- Oil temperature 45 to 55°C
113 to 131°F

(Reference)

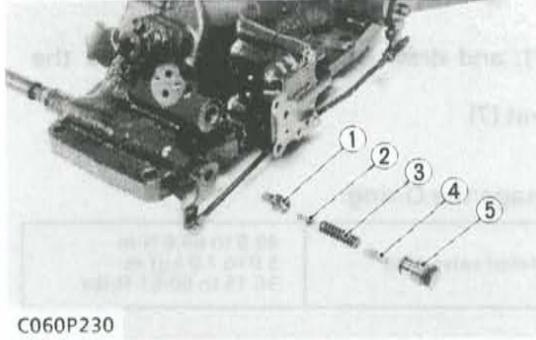
- Thickness of shim (2): 0.1 mm (0.0039 in.)
0.2 mm (0.0078 in.)
0.4 mm (0.0157 in.)
- Pressure change per 0.1 mm (0.0039 in.) shim
Approx. 264.8 kPa
2.7 kgf/cm²
38.4 psi

- (1) Washer
- (2) Shim
- (3) Plug
- (4) Hydraulic Cylinder
- (5) Seat
- (6) Poppet



C060F289

DISASSEMBLING AND ASSEMBLING



C060P230

Relief Valve Assembly

1. Remove the plug (5) and take out the other parts.

(When reassembling)

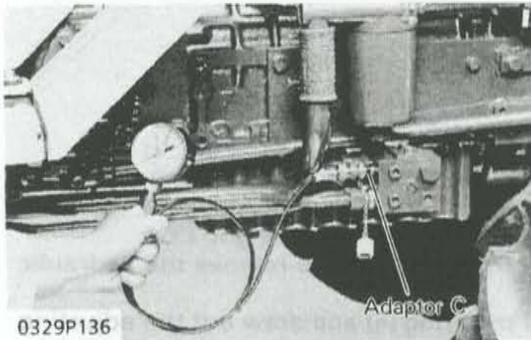
Tightening torque	Plug	49 to 69 N·m 5.0 to 7.0 kgf/cm ² 36 to 51 ft-lbs
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- (1) Seat
- (2) Poppet
- (3) Spring

- (4) Shim
- (5) Plug

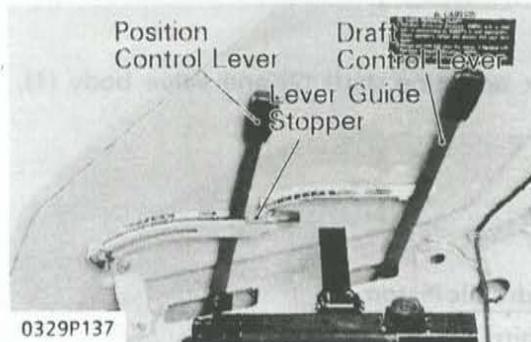
[6] RELIEF VALVE (L2650, L2950, L3450, L3650)

CHECKING AND ADJUSTING

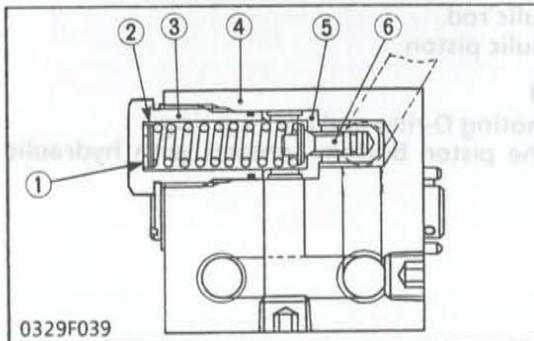


0329P136

Adaptor C



0329P137



0329F039

- (1) Washer
- (2) Adjusting Shims
- (3) Relief Valve Plug
- (4) Front Hydraulic Block
- (5) Seat
- (6) Poppet

Relief Valve Setting Pressure Test Using Pressure Tester

1. Remove the plug from the front hydraulic block and install the hydraulic adaptor C (screw size: PT 1/4) (Code No: 07916-50371). Then connect the cable (Code No: 07916-50331) and pressure gauge (Code No: 07916-50332) to adaptor C.
2. Mark on the lever guide stopper to know its original position.
3. Move the lever guide stopper backward.
4. Start the engine and set at maximum speed.
5. Set the draft control lever to the Lock position. (If equipped)
6. Move the position control lever all way up to operate the relief valve.
7. If the pressure is not within the factory specifications, remove the plug (3) and adjust with the adjusting shims (2).
8. After the relief valve setting pressure test, reset the lever guide stopper to its original position.

Relief valve setting pressure	Factory spec.	16.67 to 17.16 MPa 170 to 175 kgf/cm ² 2418 to 2489 psi
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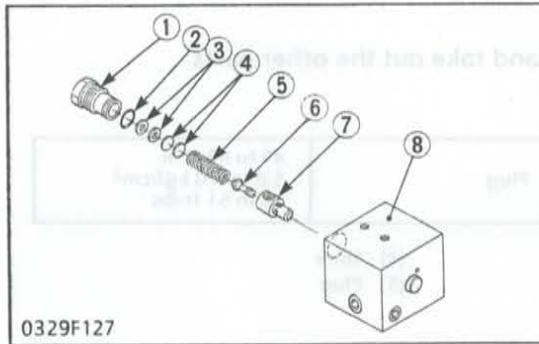
Condition

- Engine speed Maximum
- Oil temperature 45 to 55°C
113 to 131°F

(Reference)

- Thickness of shim (2) : 0.1 mm (0.0039 in.)
0.2 mm (0.0078 in.)
0.4 mm (0.0157 in.)
- Pressure change per 0.1 mm (0.0039 in.) shim:
Approx. 264.8 kPa
2.7 kgf/cm²
38.4 psi

DISASSEMBLING AND ASSEMBLING



Relief Valve

1. Remove the plug (1), and draw out the spring (5) and the poppet (6).
2. Take out the valve seat (7).

(When reassembling)

- Take care not to damage the O-ring.

Tightening torque	Relief valve plug	49.0 to 68.6 N·m 5.0 to 7.0 kgf·m 36.15 to 50.61 ft-lbs
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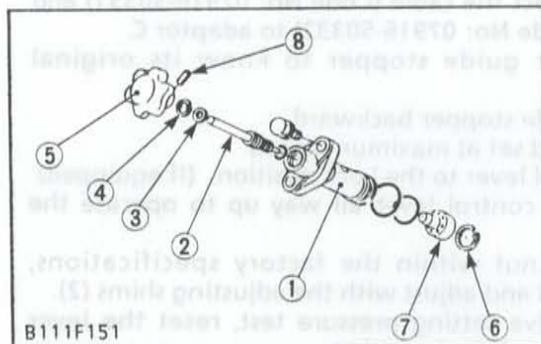
■ IMPORTANT

- After disassembling and assembling the relief valve, be sure to adjust the relief valve setting pressure. (See page S.8-19)

- 0329F127
- (1) Plug
 - (2) O-ring
 - (3) Washers
 - (4) Adjusting Shims
 - (5) Spring
 - (6) Poppet
 - (7) Valve Seat
 - (8) Front Hydraulic Block

[7] HYDRAULIC CYLINDER

DISASSEMBLING AND ASSEMBLING



Lowering Speed Adjusting Valve

1. Remove the lowering speed adjusting valve from hydraulic cylinder block.
2. Tap out the spring pin (8), and remove the grip (5).
3. Remove the internal snap ring (4), and remove the hydraulic adjusting shaft (2).
4. Remove the internal snap ring (6) and draw out the adjusting collar (7).

(When reassembling)

- Install the hydraulic adjusting shaft (2) and valve body (1), noting O-ring.

- B111F151
- (1) Valve Body
 - (2) Hydraulic Adjusting Shaft
 - (3) Washer
 - (4) Internal Snap Ring
 - (5) Grip
 - (6) Internal Snap Ring
 - (7) Adjusting Collar
 - (8) Spring Pin

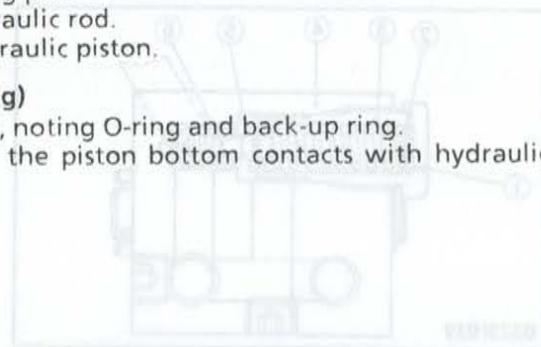


Hydraulic Rod and Hydraulic Piston

1. Tap out the spring pin.
2. Remove the hydraulic rod.
3. Push out the hydraulic piston.

(When reassembling)

- Install the piston, noting O-ring and back-up ring.
- Apply grease to the piston bottom contacts with hydraulic rod.





C060P235

C060P236

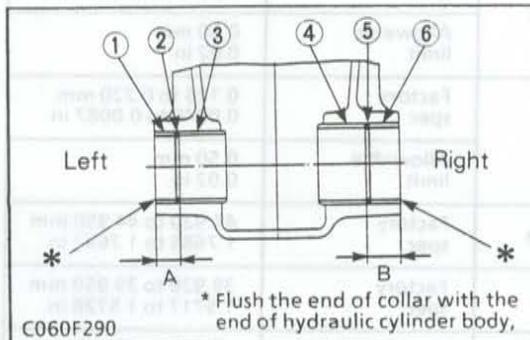
Lift Arm, Hydraulic Arm and Hydraulic Arm Shaft

1. Disconnect the feedback rod from feedback lever.
2. Remove the lift arm setting screws.
3. Draw out the hydraulic arm shaft (5) and right lift arm (6) as a unit.
4. Take out the hydraulic arm (1).
5. Remove the collar (3) and O-ring (2).

(When reassembling)

- Align the alignment marks of the hydraulic arm (1) and hydraulic arm shaft (5).
- Align the alignment marks of the lift arm and hydraulic arm shaft (5).
- Apply grease to the right and left bushes of hydraulic cylinder block and O-rings (2).
- Take care not to damage the O-rings (2).

- (1) Hydraulic Arm
- (2) O-rings
- (3) Collar
- (4) Lift Arm (Left)
- (5) Hydraulic Arm Shaft
- (6) Lift Arm (Right)
- (7) Alignment Mark (Hydraulic Arm Shaft and Hydraulic Arm)
- (8) Alignment Mark (Hydraulic Arm Shaft and Lift Arm)



C060F290

- (1) Collar (Left)
- (2) O-ring
- (3) Bushing (Left)
- (4) Bushing (Right)
- (5) O-ring
- (6) Collar (Right)

Bushings

1. Remove the bushings right (4) and left side (3).

(When reassembling)

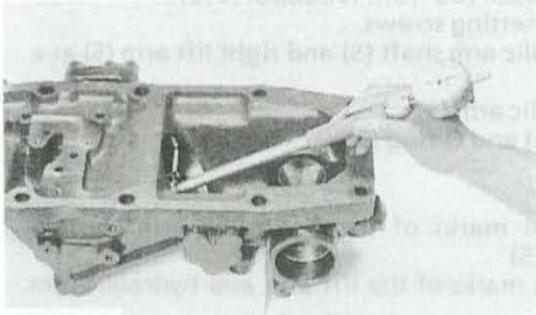
- When press-fitting new bushings (3), (4) with a press-fitting tool (See page S.G-41) observe the dimensions described in the figure.
- Apply transmission fluid to the hydraulic cylinder liner boss and bushing.
- Press-fit the bushing so that each seam face upward.

Press-fit location of bushings	Factory spec.	A	21.75 to 22.75 mm 0.856 to 0.895 in.
		B	26.50 to 27.50 mm 1.043 to 1.082 in.

SERVICING

Hydraulic Cylinder Bore

1. Check the cylinder internal surface for scoring or damage.
2. Measure the cylinder I.D. with a cylinder gauge.
3. If the measurement exceeds the allowable limit, replace.

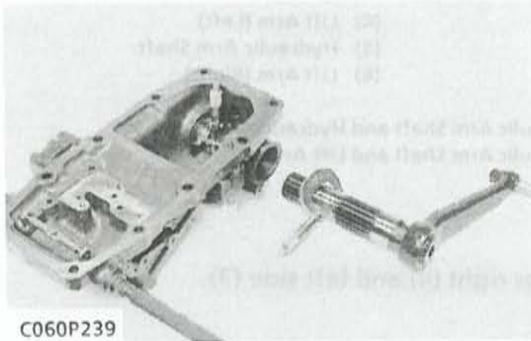


C060P238

Cylinder I.D.	Factory spec.	L2350	75.000 to 75.050 mm 2.9528 to 2.9547 in.
		L2650, L2950 L3450, L3650	85.000 to 85.050 mm 3.3465 to 3.3484 in.
	Allowable limit	L2350	75.150 mm 2.9587 in.
		L2650, L2950 L3450, L3650	85.150 mm 3.3524 in.

Clearance between Hydraulic Arm Shaft and Bushing

1. Measure the hydraulic arm shaft O.D. with an outside micrometer.
2. Measure the bushing I.D. with a cylinder gauge.
3. If the clearance exceeds the allowable limit, replace.



C060P239

Clearance between hydraulic arm shaft and bushing	Right	Factory spec.	0.125 to 0.230 mm 0.0049 to 0.0091 in.
		Allowable limit	0.50 mm 0.02 in.
	Left	Factory spec.	0.125 to 0.220 mm 0.0049 to 0.0087 in.
		Allowable limit	0.50 mm 0.02 in.
Hydraulic arm shaft O.D.	Right	Factory spec.	44.920 to 44.950 mm 1.7685 to 1.7697 in.
	Left	Factory spec.	39.920 to 39.950 mm 1.5717 to 1.5728 in.
Bushing I.D. (after press fitted)	Right	Factory spec.	45.075 to 45.150 mm 1.7746 to 1.7776 in.
	Left	Factory spec.	40.075 to 40.140 mm 1.5778 to 1.5803 in.

S.9 ELECTRICAL SYSTEM

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TROUBLESHOOTING

Before troubleshooting, confirm symptoms of trouble, and accomplish basic inspection.

(1) Basic Inspection

No.	Contents	Reference Page
1	Battery	S.9-6
2	Battery terminals	S.9-6
3	Slow blow fuse or fusible link	-
4	Fuses	-
5	Connectors	-

(2) Troubleshooting

Symptom	Probable Cause	Solution	Reference Page
Fuse Blown Frequently	<ul style="list-style-type: none"> Short-circuited 	Repair or replace	-

BATTERY

Battery Discharges Too Quickly	<ul style="list-style-type: none"> Alternator defective Regulator relay defective [L2350] Wiring harness disconnected or improperly connected (between battery positive terminal and alternator B terminal, between battery positive terminal and regulator relay B terminal [L2350]) Cooling fan belt slipping 	Repair or replace Replace Repair or replace	S.9-18,19,26 S.9-20,21,22 M.10-1,2,3
		Adjust tension	S.G-23

STARTING SYSTEM

Starter Motor Does Not Operate	<ul style="list-style-type: none"> Safety switch improperly adjusted or defective [L2350] 	Adjust or replace	S.9-11
	<ul style="list-style-type: none"> Starter relay defective [L2650, L2950, L3450, L3650] 	Replace	S.9-12
	<ul style="list-style-type: none"> Shuttle limit switch improperly adjusted or defective [L2650, L2950, L3450, L3650] 	Adjust or replace	S.9-11
	<ul style="list-style-type: none"> PTO limit switch improperly adjusted or defective [L2650, L2950, L3450, L3650] 	Adjust or replace	S.9-11
	<ul style="list-style-type: none"> Wiring harness disconnected or improperly connected [L2350] (between main switch ST terminal and safety switch, between safety switch and starter motor, between battery positive terminal and starter motor) 	Repair or replace	M.10-1, 2, 3

Symptom	Probable Cause	Solution	Reference Page
Starter Motor Does Not Operate (Continued)	[L2650, L2950, L3450, L3650] (between main switch ST terminal and shuttle limit switch, between shuttle limit switch and PTO limit switch, between PTO limit switch and starter relay, between starter relay and ground, between main switch B terminal and starter relay, between starter relay and starter motor S terminal, between battery positive terminal and starter motor B terminal) <ul style="list-style-type: none"> ● Starter motor defective ● Main switch defective 	Repair or replace Replace	M.10-3 S.9-13 S.9-10,11
Glow Plug Indicator Does Not Glow [L2350]	<ul style="list-style-type: none"> ● Wiring harness disconnected or improperly connected (between main switch G1 terminal and glow plug indicator, between glow plug indicator and glow plugs) ● Main switch defective ● Glow plug indicator defective 	Repair or replace Replace Replace	M.10-1, 2 S.9-10, 11 -

ENGINE KEY SWITCH SHUT-OFF SYSTEM [L2650, L2950, L3450, L3650]

Engine Does Not Stop When Main Switch is Turned OFF	<ul style="list-style-type: none"> ● Timer relay defective ● Wiring harness disconnected or improperly connected (between main switch AC terminal and timer relay 4 terminal, between timer relay 1 terminal and fuel cut off solenoid) ● Fuel cut off solenoid defective 	Replace Repair or replace Replace	S.9-16 M.10-3 S.9-17
Engine Does Not Start	<ul style="list-style-type: none"> ● Timer relay defective ● Fuel cut off solenoid defective 	Replace Replace	S.9-16 S.9-17

CHARGING SYSTEM

Charging Lamp Does Not Light When Main Switch is Turned ON	<ul style="list-style-type: none"> ● Wiring harness disconnected or improperly connected [L2350] (between main switch AC terminal and hour meter, between hour meter and regulator L terminal) ● [L2650, L2950, L3450, L3650] (between main switch AC terminal and panel board, between panel board and alternator L terminal) ● Regulator relay defective [L2350] ● IC regulator defective [L2650, L2950, L3450, L3650] 	Repair or replace Repair or replace Repair or replace	M.10-1,2,3 M.10-1,2 M.10-3 S.9-20,21,22 S.9-30
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CHARGING SYSTEM (Continued)

Symptom	Probable Cause	Solution	Reference Page
Charging Lamp Does Not Go OFF When Engine is Running	<ul style="list-style-type: none"> Wiring harness disconnected or improperly connected [L2350] (between alternator N terminal and regulator N terminal, between main switch B terminal and regulator B terminal, between hour meter and regulator L terminal) [L2650, L2950, L3450, L3650] (between panel board and alternator L terminal) 	Repair or replace	M.10-1,2,3 M.10-1,2 M.10-3

LIGHTING SYSTEM

Headlight Does Not Light	<ul style="list-style-type: none"> Bulb blown Wiring harness disconnected or improperly connected (between main switch AC terminal and combination switch B1 terminal, between combination switch 1 terminal and headlight, between combination switch 2 terminal and headlight) 	Replace Repair or replace	- M.10-1,2,3
Illumination Light Does Not Light	<ul style="list-style-type: none"> Bulb blown Wiring harness disconnected or improperly connected (between combination switch T terminal and panel board) 	Replace Repair or replace	- M.10-1,2,3
Tail Light Does Not Light	<ul style="list-style-type: none"> Bulb blown Wiring harness disconnected or improperly connected (between combination switch T terminal and tail light) 	Replace Repair or replace	- M.10-1,2,3
Hazard Light Does Not Light	<ul style="list-style-type: none"> Bulb blown Wiring harness disconnected or improperly connected (between main switch AC terminal and hazard unit, between hazard unit and combination switch B2 terminal, between combination switch R or L terminal and hazard lights) Hazard unit defective Combination switch defective 	Replace Repair or replace Replace Replace	- M.10-1,2,3 S.9-33 S.9-32
Hazard Indicator Lamp Does Not Light [L2650, L2950, L3450, L3650]	<ul style="list-style-type: none"> Bulb blown Wiring harness disconnected or improperly connected (between combination switch R or L terminal and panel board) 	Replace Repair or replace	- M.10-3
Hazard Light Does Not Go ON and OFF	<ul style="list-style-type: none"> Hazard unit defective 	Replace	S.9-33

WARNING LAMPS

Symptom	Probable Cause	Solution	Reference Page
Clogged Air Cleaner Lamp Lights Up [L2650, L2950 L3450, L3650]	<ul style="list-style-type: none"> ● Air cleaner clogged ● Air cleaner sensor defective ● Short circuit between air cleaner sensor lead and chassis ● Circuit in panel board defective 	Clean or replace Replace Repair or replace Replace	S.G-21, 28 S.9-35 M.10-3 -
Clogged Air Cleaner Lamp Does Not Light When Air Cleaner Clogged [L2650, L2950 L3450, L3650]	<ul style="list-style-type: none"> ● Bulb blown ● Air cleaner sensor defective ● Wiring harness disconnected or improperly connected (between panel board and air cleaner sensor, between air cleaner sensor and ground) 	Replace Replace Repair or replace	- S.9-35 M.10-3
Oil Pressure Lamp Lights Up When Engine is Running	<ul style="list-style-type: none"> ● Engine oil pressure too low ● Engine oil insufficient ● Oil pressure switch defective ● Short circuit between oil pressure switch lead and chassis ● Circuit in panel board defective 	Repair engine Replenish Replace Repair Replace	- S.G-13 S.9-34 M.10-3 -
Oil Pressure Lamp Does Not Light When Main Switch is turned ON and Engine is Not Running	<ul style="list-style-type: none"> ● Bulb blown ● Oil pressure switch defective ● Wiring harness disconnected or improperly connected (between panel board and oil pressure switch) ● Circuit in panel board defective 	Replace Replace Repair or replace Replace	- S.9-34 M.10-1,2,3 -

GAUGES

Fuel Gauge Does Not Function [L2350 4WD, L2650, L2950 L3450, L3650]	<ul style="list-style-type: none"> ● Fuel gauge defective ● Fuel level sensor (tank unit) defective ● Wiring harness disconnected or improperly connected (between panel board and fuel level sensor) ● Circuit in panel board defective 	Replace Replace Repair or replace Replace	S.9-36,38 S.9-35,37 M.10-2,3 -
Coolant Temperature Gauge Does Not Function [L2650, L2950 L3450, L3650]	<ul style="list-style-type: none"> ● Coolant temperature gauge defective ● Coolant temperature sensor defective ● Wiring harness disconnected or improperly connected (between panel board and coolant temperature sensor) ● Circuit in panel board defective 	Replace Replace Repair or replace Replace	S.9-36,38 S.9-36,37 M.10-3 -

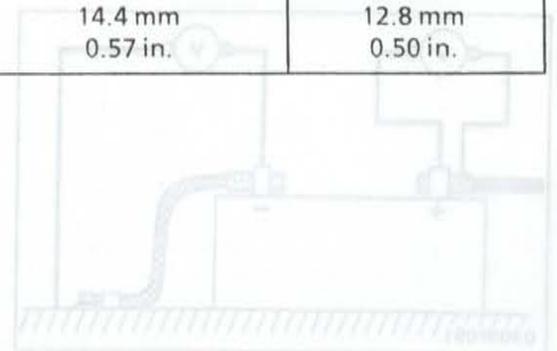
SERVICING SPECIFICATIONS

STARTER MOTOR

Item		Factory Specification	Allowable Limit
Commutator	O.D.	30.0 mm 1.181 in.	29.0 mm 1.142 in.
Mica	Undercut	0.50 to 0.80 mm 0.02 to 0.03 in.	0.2 mm 0.008 in.
Brush	Length [L2350]	13.0 mm 0.51 in.	11.3 mm 0.44 in.
	[L2650, L2950]	15.0 mm	11.0 mm
	[L3450, L3650]	0.59 in.	0.43 in.

ALTERNATOR

Brush	Length [L2350]	12.5 mm 0.49 in.	5.5 mm 0.22 in.
	[L2650, L2950]	10.5 mm	8.4 mm
	[L3450, L3650]	0.41 in.	0.33 in.
Slip Ring	O.D. [L2350]	32.5 mm 1.28 in.	32.1 mm 1.26 in.
	[L2650, L2950]	14.4 mm	12.8 mm
	[L3450, L3650]	0.57 in.	0.50 in.



Factory spec.	Less than 3 V
---------------	---------------

CHECKING, DISASSEMBLING AND SERVICING

■ IMPORTANT

- If the tractor is to be operated for a short time without battery (using a slave battery for starting), do not, under any circumstances, interrupt the circuit by switching off the key switch before stopping the engine by pulling engine stop knob. Use additional current (lights) while engine is running. Insulate terminal of battery. If this advice is disregarded, damage to alternator and regulator may result.

⚠ CAUTION

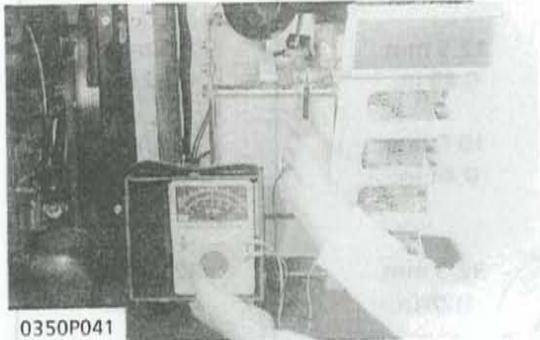
- To avoid accidental short circuit, be sure to attach the positive cable to the positive terminal before the ground cable is attached to the negative terminal.

■ NOTE

- In this section, when measuring resistance, voltage and amperage, leads of ohmmeter, voltmeter and ammeter are represented by — marks in figure.

[1] BATTERY

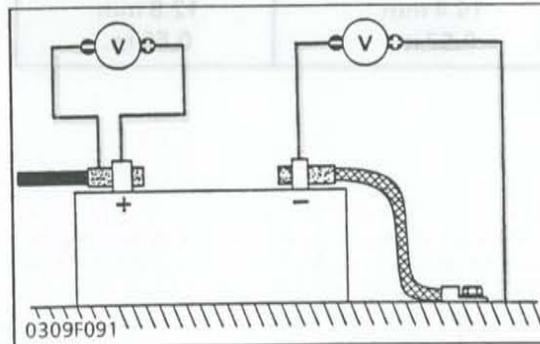
CHECKING



Battery Voltage

1. Stop the engine and turn the main switch off.
2. Connect the COM (-) lead of the voltmeter to the battery's negative terminal post and the (+) lead to the positive terminal post, and measure the battery voltage.
3. If the battery voltage is less than the factory specifications, check the battery condition. (See the next page.)

Battery voltage	Factory spec.	More than 12 V
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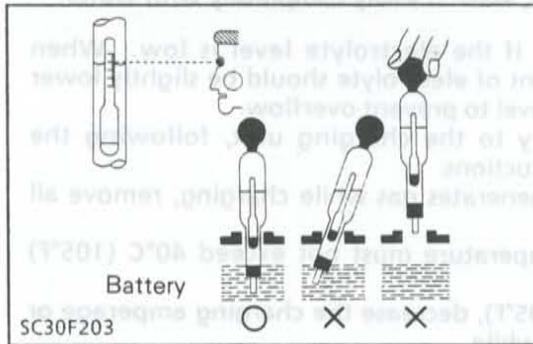
Battery Terminal Connection

1. Turn the main switch on, and turn on the headlight.
2. Measure the voltage with a voltmeter across the battery's positive terminal post and the cable terminal, and the voltage across the battery's negative terminal post and the chassis.
3. If the measurement exceeds the factory specifications, clean the battery terminal posts and cable clamps, and tighten them firmly.

Factory spec.	Less than 0.1 V
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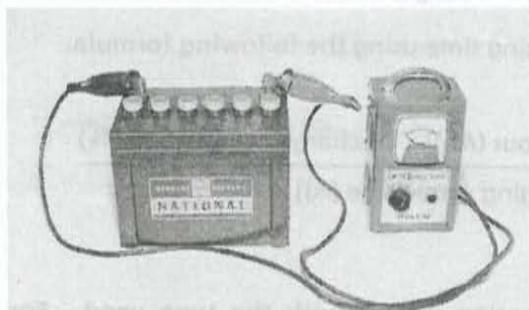
0321P303



SC30F203

Specific Gravity	State of Charge
1.260 Sp. Gr.	100% Charged
1.230 Sp. Gr.	75% Charged
1.200 Sp. Gr.	50% Charged
1.170 Sp. Gr.	25% Charged
1.140 Sp. Gr.	Very Little Useful Capacity
1.110 Sp. Gr.	Discharged

At an electrolyte temperature of 20°C (68°F)



CO12P081

Battery Specific Gravity

1. Check the specific gravity of the electrolyte in each cell with a hydrometer.
2. When the electrolyte temperature differs from that at which the hydrometer was calibrated, correct the specific gravity reading following the formula mentioned in (Reference) below.
3. If the specific gravity is less than 1.215 (after it is corrected for temperature), charge or replace the battery.
4. If the specific gravity differs between any two cells by more than 0.05, replace the battery.

NOTE

- Hold the hydrometer tube vertical without removing it from the electrolyte.
- Do not suck too much electrolyte into the tube.
- Allow the float to move freely and hold the hydrometer at eye level.
- The hydrometer reading must be taken at the highest electrolyte level.

CAUTION

- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water.

(Reference)

- Specific gravity slightly varies with temperature. To be exact, the specific gravity decreases by 0.0007 with an increase of 1°C (0.0004 with an increase of 1°F) in temperature, and increases by 0.0007 with a decrease of 1°C (0.0004 with a decrease of 1°F).

Therefore, using 20°C (68°F) as a reference, the specific gravity reading must be corrected by the following formula:

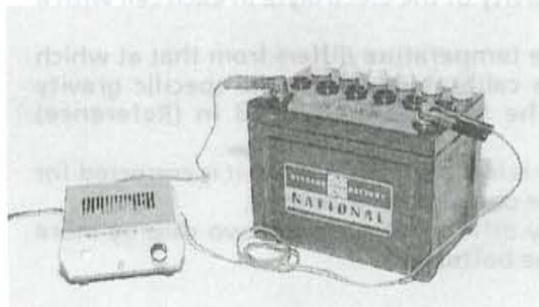
- Specific gravity at 20°C = Measured value + 0.0007 x (electrolyte temperature - 20°C)
- Specific gravity at 68°F = Measured value + 0.0004 x (electrolyte temperature - 68°F)

High-rate Discharge Test

1. Connect the battery tester to the battery, following the manufacturer's instructions.
2. Discharge the battery for the specified time under the fixed load, following the manufacturer's instructions.
3. Read the indication and follow the instructions.

Battery 20 ampere-hour rate	Factory spec.	75D26R(L)	65 Ah
		75D31R	70 Ah

SERVICING



C022P006

Recharging-Slow Charging

⚠ CAUTION

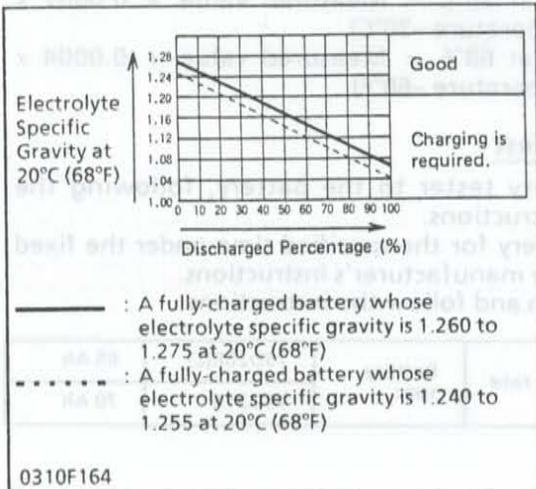
- After the battery is activated, hydrogen and oxygen gases in the battery are very explosive. Keep open sparks and flames away from the battery at all times, especially when charging the battery.
- Keep electrolyte away from eyes, hands and clothes. If you are splattered with it, wash it away completely with water.

1. Add distilled water if the electrolyte level is low. When charging, the amount of electrolyte should be slightly lower than the specified level to prevent overflow.
2. Connect the battery to the charging unit, following the manufacturer's instructions.
3. As the electrolyte generates gas while charging, remove all port caps.
4. The electrolyte temperature must not exceed 40°C (105°F) during charging. If it exceed 40°C (105°F), decrease the charging amperage or stop charging for a while.
5. When charging several batteries in series, charge at the rate of the smallest battery in the line.

(Reference)

- **Charging Amperage**
The charging amperage must be 1/20 to 1/10 of the battery ampere-hour rate.

Battery 20 ampere-hour rate	Factory spec.	75D26R(L)	65 Ah
		75D31R	70 Ah



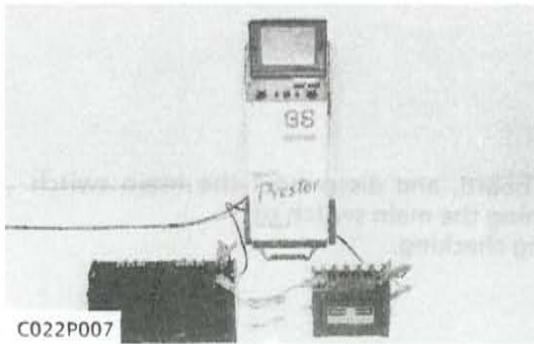
- **Discharged Percentage**
Measure the specific gravity of the electrolyte, and obtain the discharged percentage based on the electrolyte's specific gravity, referring to the diagram.
- **Charging Time**
Calculate the charging time using the following formula.

Charging time (H)

$$= \frac{[\text{Battery Ampere-hour (Ah)}] \times \text{Discharge percentage (\%)}}{[\text{Charging Amperage (A)}] \times 100} \times (1.2 \text{ to } 1.5)$$

■ NOTE

- Slow charger operation differs with the type used. For details, refer to the manufacturer's instructions.



Recharging-Quick Charging

1. Add distilled water if electrolyte is insufficient. The amount of electrolyte should be slightly lower than the specified level to prevent overflow while charging.
2. Connect the battery and the charging unit, following the manufacturer's instructions.
3. Determine the proper charging amperage and charging time using the tester provided with the quick charger, or following the manufacturer's instructions.
4. As the electrolyte generates gas while charging, remove all port caps.
5. The electrolyte temperature must not exceed 40°C (105°F) during charging. If it exceeds 40°C (105°F), decrease the charging amperage or stop charging for a while.
6. When charging several batteries in series, charge at the rate of the smallest battery in the line.

NOTE

- Quick charger operation differs with the type used. For details, refer to the manufacturer's instructions.

(Reference)

- Generally, the ratio of the charging amperage to the battery ampere-hour rate is 1:1. However, if the battery ampere-hour rate exceeds 50 Ah, the maximum charging amperage must be 50 Ah.

Battery 20 ampere-hour rate	Factory spec	75D26R(L)	65 Ah
		75D31P	70 Ah

Approx battery voltage	Connector Terminal - Charge
------------------------	-----------------------------

(Reference)

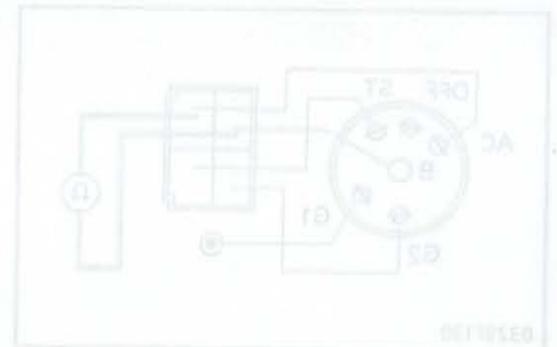
Self-discharge Rate

Temperature	Self-discharge rate
30°C (86°F)	Approx. 1.0% per day
20°C (68°F)	Approx. 0.5% per day
10°C (50°F)	Approx. 0.25% per day

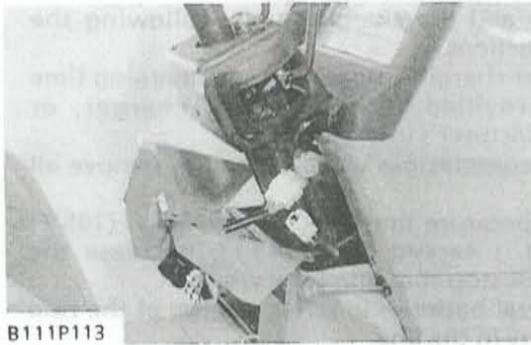
Directions for Storage

1. When shutting down the tractor for long periods of time, remove the battery from the tractor, adjust the electrolyte to the proper level, and after fully charging, store the battery in a well ventilated place where it is not exposed to direct sunlight.
2. Since the battery self-discharges by approx. 0.5% per day even in storage, it must be once every two months in cold season.
3. When storing the battery mounted on the tractor, disconnect the ground cable from the battery's negative terminal post.

Resistance	B-AC	0 ohm
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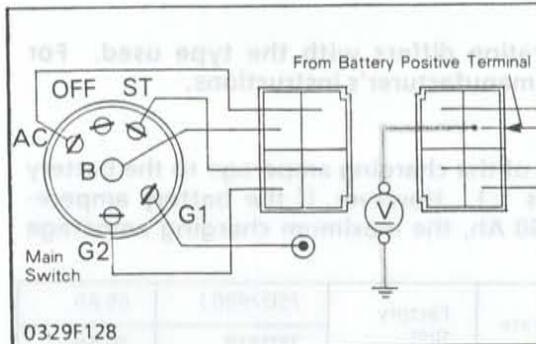
[2] STARTING SYSTEM CHECKING



B111P113

Main Switch

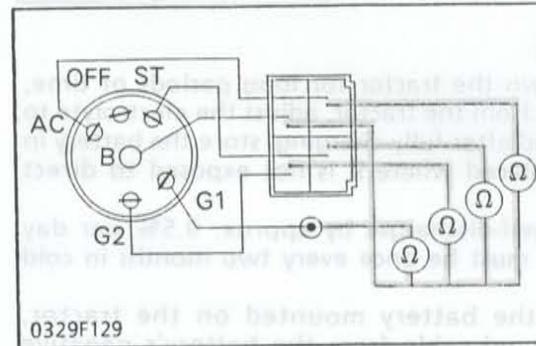
- Remove the switch board, and disconnect the main switch connectors after turning the main switch off. Perform the following checking.



Connector Voltage

- Measure the voltage with a voltmeter across the connector B terminal and chassis.
- If the voltage differs from the battery voltage (11 to 14 V), the wiring harness is faulty.

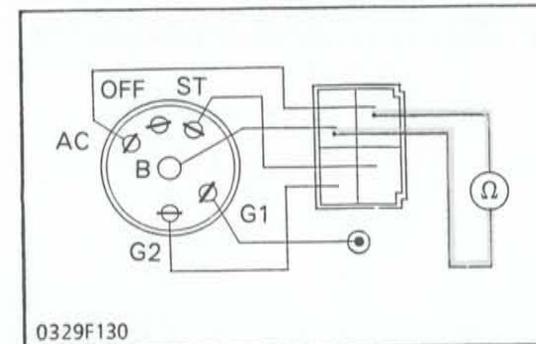
Voltage	Connector B terminal - Chassis	Approx. battery voltage
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Main Switch Key at OFF Position

- Turn the main switch off.
- Measure the resistances with an ohmmeter across the B terminal and the AC terminal, B terminal and ST terminal, B terminal and G2 terminal.
- If infinity is not indicated, the contacts of the main switch are faulty.

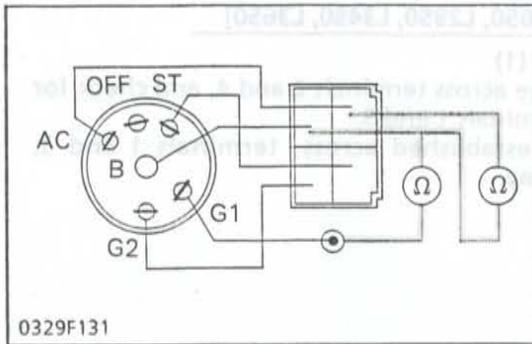
Resistance	B - AC	Infinity
	B - ST	Infinity
	B - G1	Infinity
	B - G2	Infinity



Main Switch Key at ON Position

- Turn the main switch on.
- Measure the resistances with an ohmmeter across the B terminal and the AC terminal.
- If 0 ohm is not indicated, the B - AC contacts of the main switch are faulty.

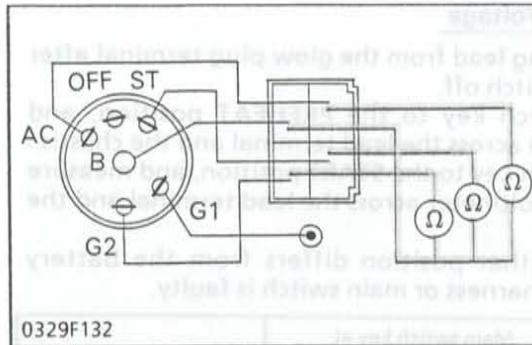
Resistance	B - AC	0 ohm
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Main Switch Key at PREHEAT Position

1. Turn and hold the main switch key at the **PREHEAT** position.
2. Measure the resistances with an ohmmeter across the **B** terminal and the **G1** terminal, and measure the resistance across the **B** terminal and the **AC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

Resistance	B – G1	0 ohm
	B – AC	



Main Switch Key at START Position

1. Turn and hold the main switch key at the **START** position.
2. Measure the resistances with an ohmmeter across the terminal and the **G2** terminal, and across the **B** terminal and the **AC** terminal.
3. If 0 ohm is not indicated, these contacts of the main switch are faulty.

Resistance	B – G2	0 ohm
	B – ST	
	B – AC	



Safety Starter Switch [L2350]

NOTE

- Be sure to measure the safety starter switch resistance after adjusting the clearance between the safety starter switch and clutch pedal.

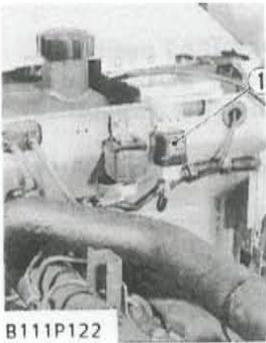
1. Disconnect the safety starter switch leads.
2. Connect the leads of an ohmmeter to the safety starter switch lead terminals.
3. Measure the resistance while pressing the clutch pedal.
4. If 0 ohm is not indicated, the safety starter switch is faulty or improperly mounted.
5. Measure the resistance while the clutch pedal is released.
6. If infinity is not indicated, the safety starter switch is faulty.

Resistance Across switch terminals	When switch push is pushed	0 ohm
	When switch push is released	Infinity

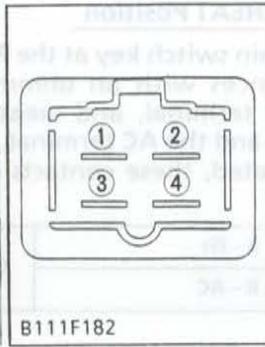


Check for Mismatching of the Shuttle and PTO Limit Switches [L2650, L2950, L3450, L3650]

1. Disconnect the leads from shuttle and PTO limit switches.
2. Measure the resistance with an ohmmeter across the limit switch wiring lead and lead.
3. If the ohmmeter reads 0 ohm when the shift lever is in neutral, and infinity when the lever is in other positions, it is an indication that the switch is normal.



B111P122

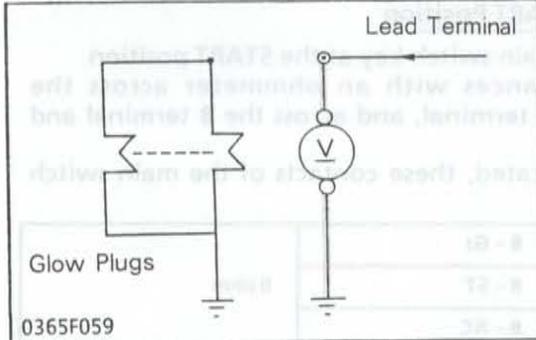


B111F182

Check Starter Relay [L2650, L2950, L3450, L3650]

1. Remove starter relay (1).
2. Apply battery voltage across terminals 2 and 4, and check for continuity across terminals 1 and 3.
3. If continuity is not established across terminals 1 and 3, renew the starter relay.

(1) Starter Relay



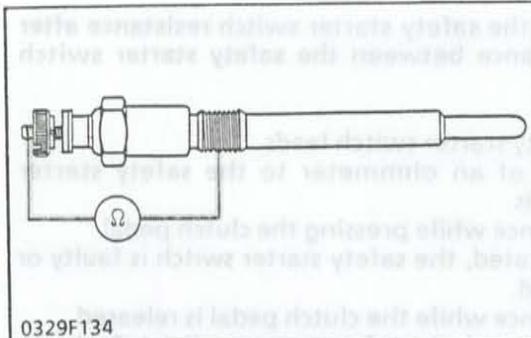
Glow Plugs

0365F059

Pre-heating Terminal Voltage

1. Disconnect the wiring lead from the glow plug terminal after turning the main switch off.
2. Turn the main switch key to the **PREHEAT** position, and measure the voltage across the lead terminal and the chassis.
3. Turn the main switch key to the **START** position, and measure the voltage with a voltmeter across the lead terminal and the chassis.
4. If the voltage at either position differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Main switch key at PREHEAT	Approx. battery voltage
	Main switch key at START	



0329F134

Glow Plug

1. Disconnect the leads from the glow plugs.
2. Measure the resistance with an ohmmeter across the glow plug terminal and the chassis.
3. If 0 ohm is indicated, the screw at the tip of the glow plug and the housing are short-circuited.
4. If the factory specifications is not indicated, the glow plug is faulty.

Glow plug resistance	Factory spec.	Approx. 1.5 ohms.
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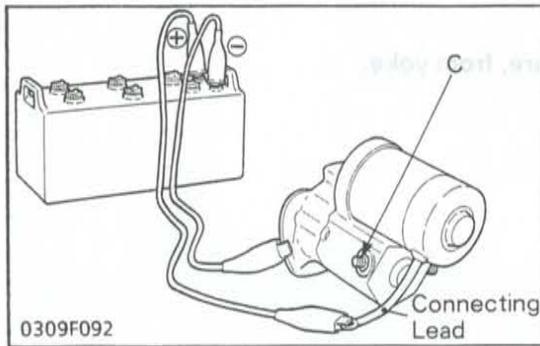


0329P148

Starter Motor B Terminal Voltage

1. Measure the voltage with a voltmeter across the **B** terminal and chassis.
2. If the voltage differs from the battery voltage, the battery's positive cable or the battery negative cable is faulty.

Voltage	B terminal-chassis	Approx. battery voltage
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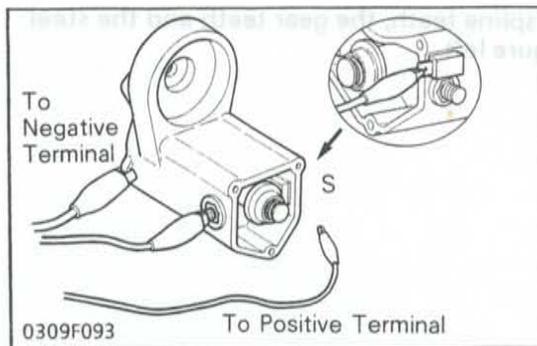


Motor Test

1. Disconnect the ground cable clamp from the battery negative terminal post.
2. Disconnect the battery positive cable and the leads from the starter.
3. Remove the starter motor from the engine.
4. Disconnect the connecting lead from the starter C terminal.
5. Connect a jumper lead from the connecting lead to the battery positive terminal post.
6. Connect a jumper lead momentarily between the starter motor housing and the battery negative terminal post.
7. If the motor does not run, check the motor.

⚠ CAUTION

- Secure the starter in a vise to prevent it from jumping up and down while testing the motor.



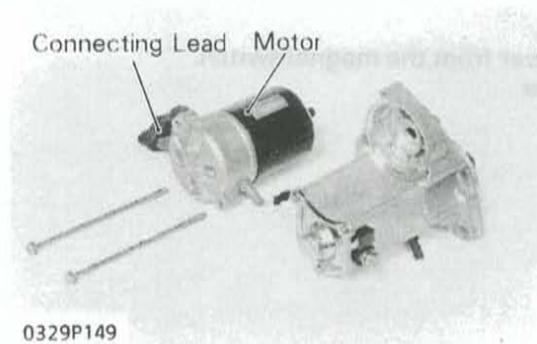
Magnet Switch Test (Pull-in, Holding Coils)

1. Remove the motor from the starter housing.
2. Prepare a 6 V battery for the test.
3. Connect jumper leads from the battery negative terminal to the housing and the starter C terminal.
4. The plunger should be attached and the pinion gear should pop out when a jumper lead is connected from the battery positive terminal to the S terminal. It's a correct.
5. Disconnect the jumper lead to the starter C terminal. Then the pinion gear should remain popped out. It's a correct.

⚠ CAUTION

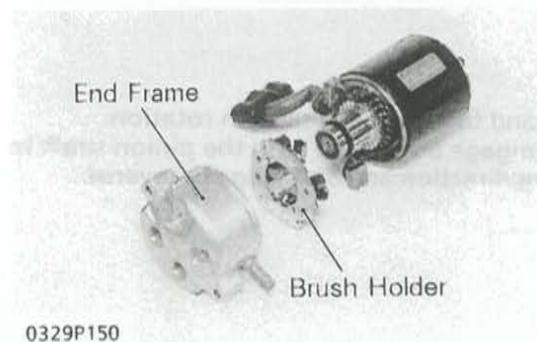
- Testing time must be 3 to 5 sec.

DISASSEMBLING AND ASSEMBLING



Motor

1. Disconnect the connecting lead.
2. Remove the through screws.
3. Remove the motor.

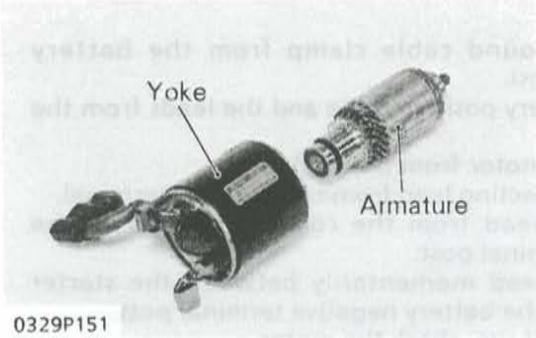


Brush Holder

1. Remove the end frame.
2. Draw out the brushes from each holder while lifting the spring up.
3. Remove the brush holder.

Armature

1. Draw out the armature, from yoke.



0329P151

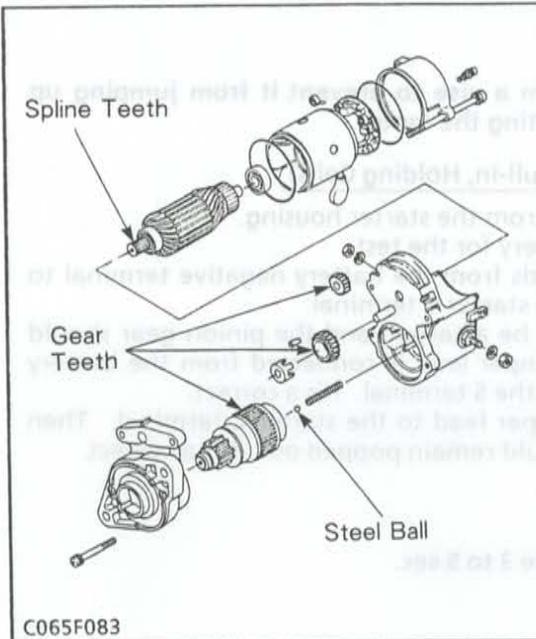


Drive End Frame

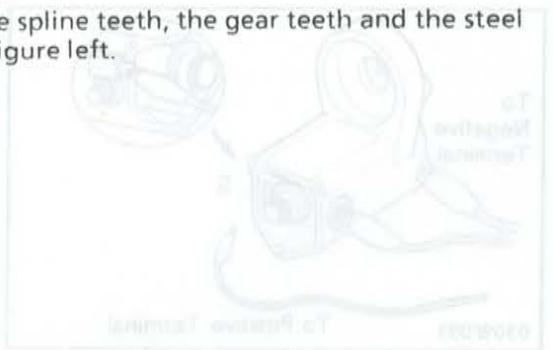
1. Separate the drive end frame and the magnet switch.
2. Remove the gears and clutch.

(When reassembling)

- Apply grease to the spline teeth, the gear teeth and the steel ball shown in the figure left.

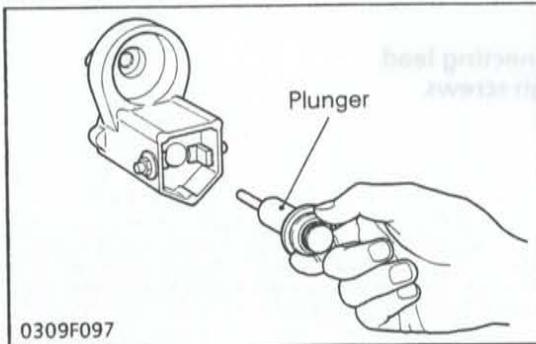


C065F083



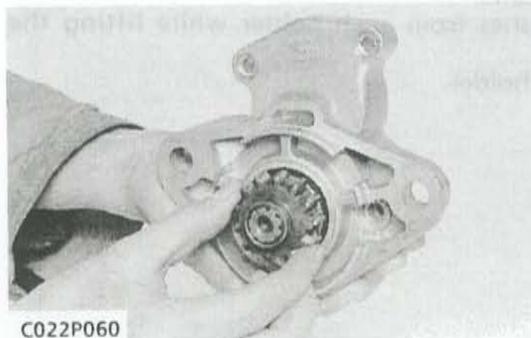
Plunger

1. Remove the end cover from the magnet switch.
2. Remove the plunger



0309F097

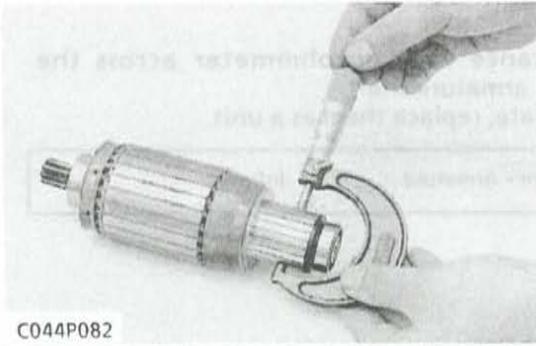
SERVICING



C022P060

Bearing and Clutch

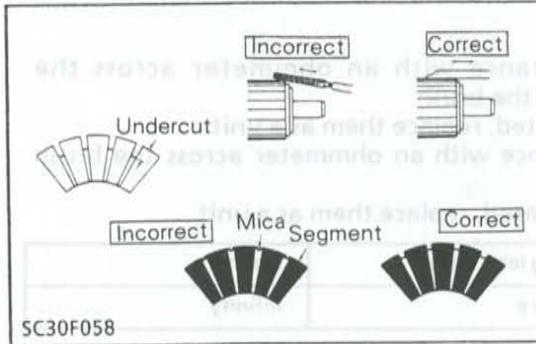
1. Check the bearing and the clutch for smooth rotation. The clutch should engage and rotate with the pinion shaft in the forward driving direction and disengage in reverse.



C044P082

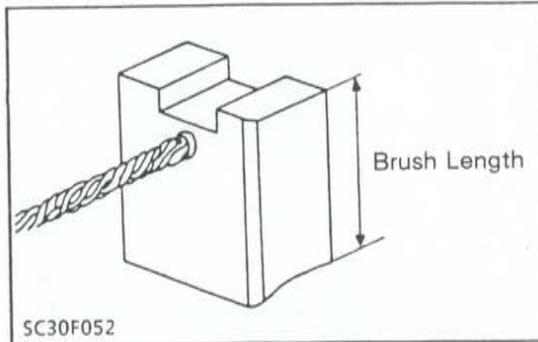
Commutator and Mica

1. If the commutator surface is dirty or dusty, clean it with sandpaper.
2. Measure the commutator O.D. with an outside micrometer at several points.
3. If the minimum O.D. is less than the allowable limit, replace the armature.
4. If the difference of the outer diameters exceeds the allowable limit, use a lathe to adjust the outer diameter to within the allowable limit.
5. Measure the mica undercut.
6. If the undercut is less than the allowable limit, correct it with a saw blade and chamfer the segment edges.



SC30F058

Commutator O.D.	Factory spec.	30.0 mm 0.181 in.
	Allowable limit	29.0 mm 1.142 in.
Difference of max. O.D. and min. O.D.	Factory spec.	Less than 0.02 mm 0.0008 in.
	Allowable limit	0.05 mm 0.0020 in.
Mica undercut	Factory spec.	0.50 to 0.80 mm 0.02 to 0.03 in.
	Allowable limit	0.2 mm 0.008 in.



SC30F052

Brush Wear

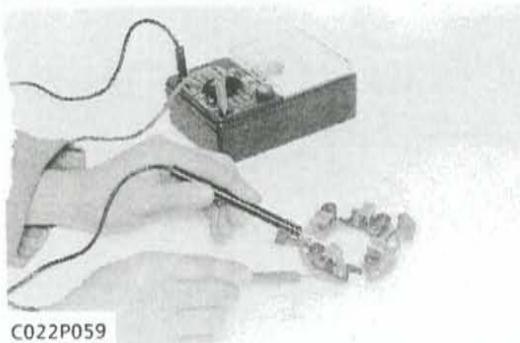
1. If the contact face of the brush is dirty or dusty, clean it with sandpaper.
2. Measure the brush length.
3. If the length is less than the allowable limit, replace it.

Brush length	Factory spec.	L2350	13.0 mm 0.51 in.
		L2650, L2950 L3450, L3650	15.0 mm 0.59 in.
	Allowable limit	L2350	11.3 mm 0.44 in.
		L2650, L2950 L3450, L3650	11.0 mm 0.43 in.

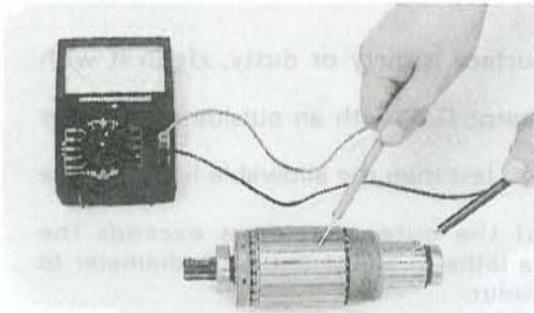
Brush Holder

1. Measure the resistance with an ohmmeter across the brush holder and the holder support.
2. If infinity is not indicated, replace them as a unit.

Resistance	Brush holder - Holder support	Infinity
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C022P059

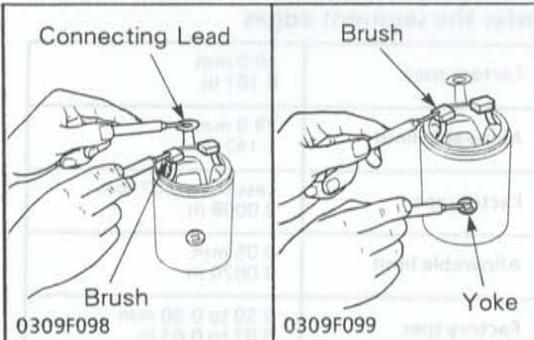


Armature Coil

1. Measure the resistance with an ohmmeter across the commutator and the armature shaft.
2. If infinity is not indicated, replace them as a unit.

Resistance	Commutator – Armature	Infinity
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C044P084



Field coil

1. Measure the resistance with an ohmmeter across the connecting lead and the brush.
2. If 0 ohm is not indicated, replace them as a unit.
3. Measure the resistance with an ohmmeter across the brush and the yoke.
4. If infinity is not indicated, replace them as a unit.

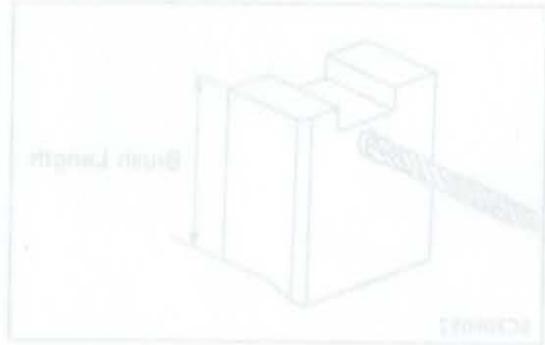
Resistance	Connecting lead – Brush	0 ohm
	Brush – Yoke	Infinity

0.5 mm 0.02 in	Allowable limit	
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Brush Wear

1. If the contact face of the brush is dirty or dusty, clean it with toothpaste.
2. Measure the brush length.
3. If the length is less than the allowable limit, replace it.

13.0 mm 0.51 in	L3350	Brush length	Allowable limit
12.0 mm 0.47 in	L3450-L3650		
11.5 mm 0.45 in	L3750	Allowable limit	L3850-L3950 L3950-L3950
11.0 mm 0.43 in	L3950-L3950		



Brush Holder

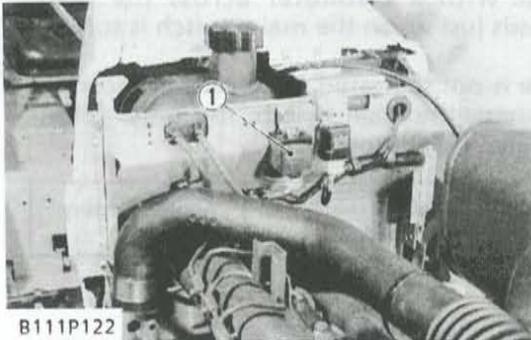
1. Measure the resistance with an ohmmeter across the brush holder and the holder support.
2. If infinity is not indicated, replace them as a unit.

Resistance	Brush holder – holder support	Infinity
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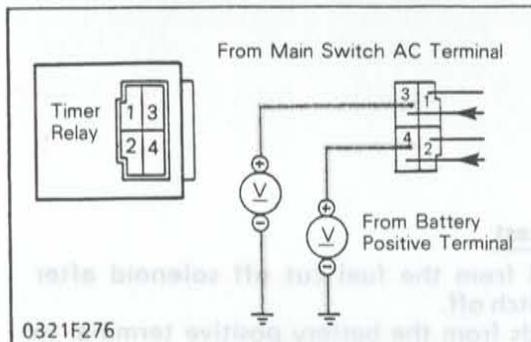


[3] ENGINE KEY SWITCH SHUT-OFF SYSTEM (L2650,L2950,L3450,L3650)

CHECKING



B111P122



0321F276

Timer Relay Connector Voltage

1. Disconnect the connector from the timer relay after turning the main switch off.
2. Measure the voltage with a voltmeter across the connector 4 terminal and chassis.
3. Turn the main switch on, and measure the voltage across the connector 3 terminal and chassis.
4. If these voltages differ from the battery voltage, the wiring harness or main switch is faulty.

Voltage	Connector 4 terminal – chassis	Approx. battery voltage
	Connector 3 terminal – chassis	

NOTE

- If the fuel cut off solenoid is burnt, replace it together with the timer relay (1).
- When installing the timer relay, it shall be installed upward. (See the upper left photo.) If it is mounted up-side-down or inclined sideways, water may intrude to lead to timer relay failure and solenoid burning.
- When washing the tractor, be very careful to prevent direct water from splashing onto the timer relay.

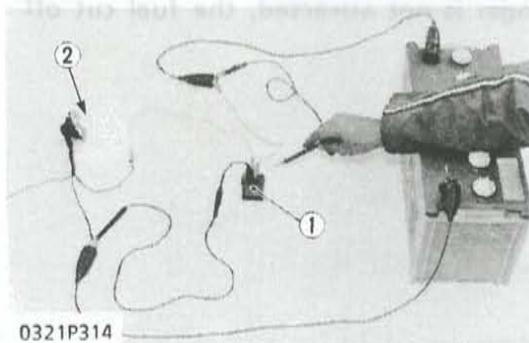
(1) Timer Relay

Test of Timer Relay

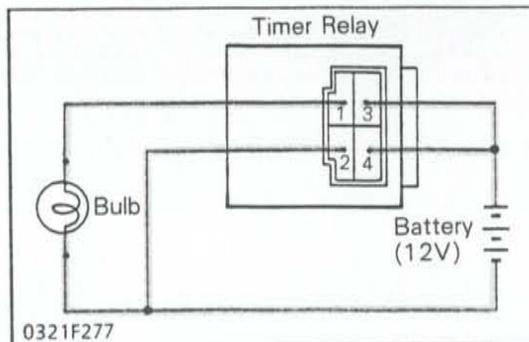
1. Remove the timer relay from the tractor.
2. Connect jumper leads across the battery positive terminal and the timer relay 3 terminal, and across the battery positive terminal and the timer relay 4 terminal.
3. Connect jumper leads across the battery negative terminal and the timer relay 2 terminal, and across the battery negative terminal and the bulb terminal.
4. Connect jumper lead across the timer relay 1 terminal and the bulb terminal.
5. The bulb lights up when disconnecting a jumper lead from the 3 terminal and goes off 6 to 13 seconds later, the timer relay is proper.

(1) Timer Relay

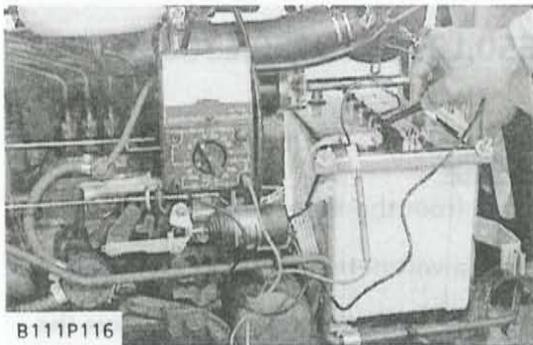
(2) Load (Lamp)



0321P314



0321F277

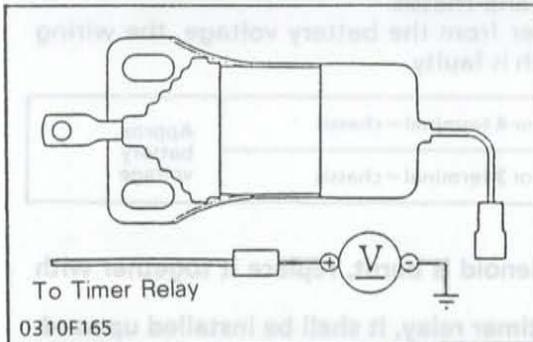


B111P116

Fuel Cut Off Solenoid Lead Terminal Voltage

1. Disconnect the lead from the fuel cut off solenoid after turning the main switch off.
2. Start the engine.
3. Measure the voltage with a voltmeter across the lead terminal and the chassis just when the main switch is turned off.
4. If the battery voltage is not indicated for a certain seconds, check the wiring harness, the main switch, the timer relay, the regulator, a fuse and the alternator.

Voltage	Across lead terminal and chassis when main switch turned off	Approx. battery voltage
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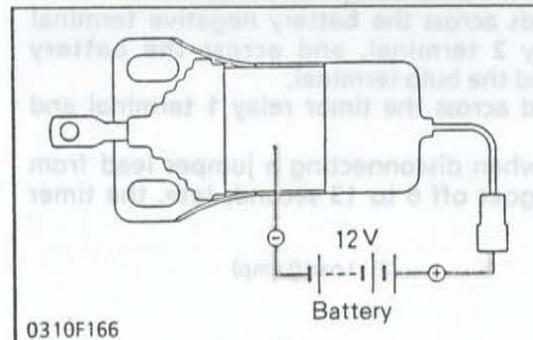
0310F165



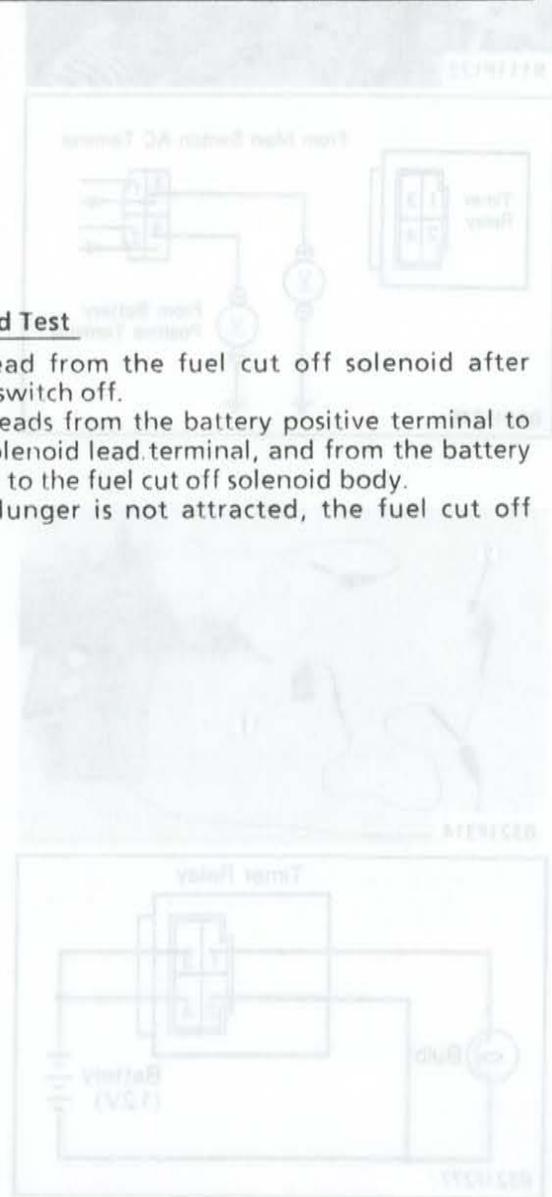
B111P117

Fuel Cut Off Solenoid Test

1. Disconnect the lead from the fuel cut off solenoid after turning the main switch off.
2. Connect jumper leads from the battery positive terminal to the fuel cut off solenoid lead terminal, and from the battery negative terminal to the fuel cut off solenoid body.
3. If the solenoid plunger is not attracted, the fuel cut off solenoid is faulty.

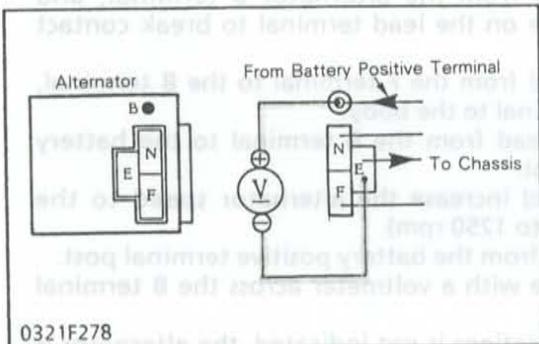


0310F166



[4] CHARGING SYSTEM (L2350)

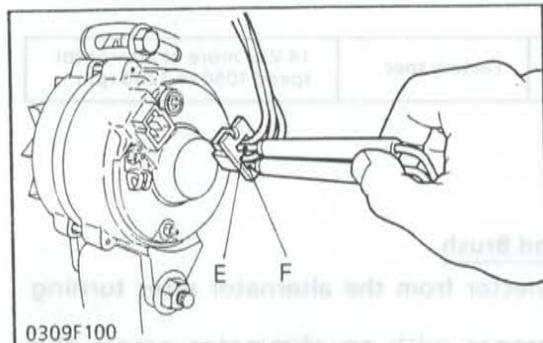
CHECKING



Alternator Terminal Voltage

1. Measure the voltage with a voltmeter across the lead **B** terminal and connector **E** terminal.
2. If the voltage differs from the battery voltage, the wiring harness is faulty.

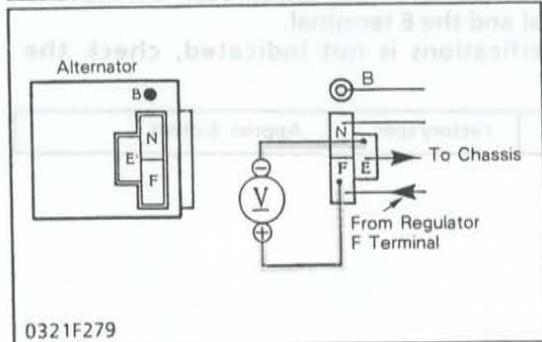
Voltage	Lead B terminal – Connector E terminal.	Approx. battery voltage
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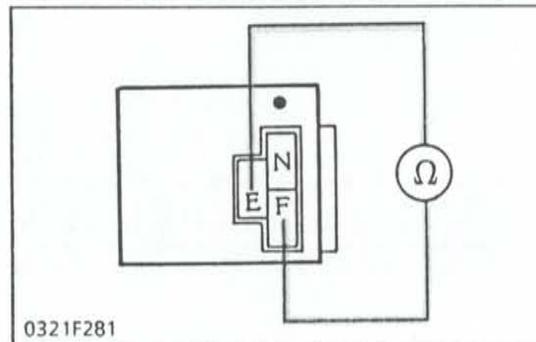
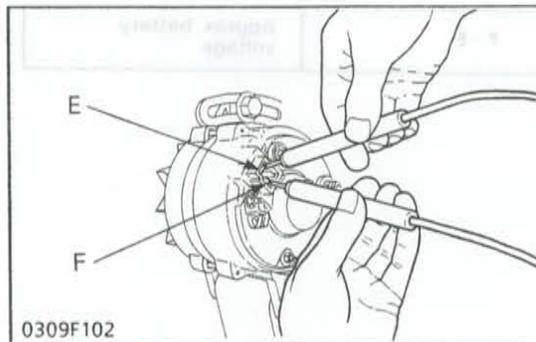
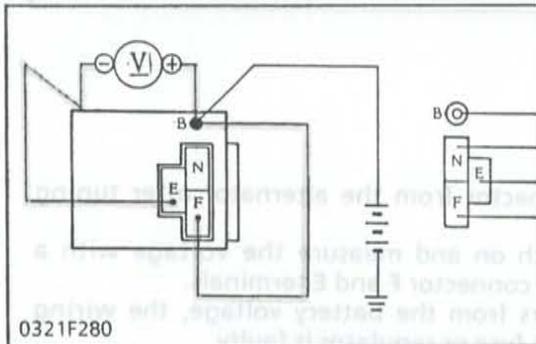
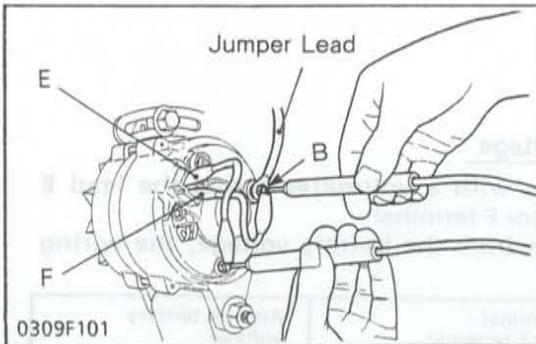


Connector Voltage

1. Disconnect the connector from the alternator after tuning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the connector **F** and **E** terminals.
3. If the voltage differs from the battery voltage, the wiring harness, main switch fuse or regulator is faulty.

Voltage	F – E	Approx. battery voltage
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No-Load Test

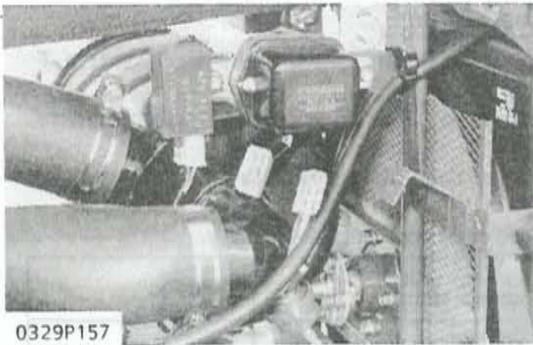
1. Disconnect the connector from the alternator after turning the main switch off.
2. Disconnect the lead from the alternator **B** terminal, and wind insulation tape on the lead terminal to break contact with the chassis.
3. Connect jumper lead from the **F** terminal to the **B** terminal, and from the **E** terminal to the body.
4. Connect a jumper lead from the **B** terminal to the battery positive terminal post.
5. Start the engine and increase the alternator speed to the specified rate (1050 to 1250 rpm).
6. Disconnect the lead from the battery positive terminal post.
7. Measure the voltage with a voltmeter across the **B** terminal and the body.
8. If the factory specifications is not indicated, the alternator is faulty.

Voltage	B terminal - Body	Factory spec.	14 V or more at alternator speed 1050 to 1250 rpm
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Rotor Coil, Slip Ring and Brush

1. Disconnect the connector from the alternator after turning the main switch off.
2. Measure the resistance with an ohmmeter across the alternator **F** terminal and the **E** terminal.
3. If the factory specifications is not indicated, check the alternator.

Resistance	F - E	Factory spec.	Approx. 6 ohms
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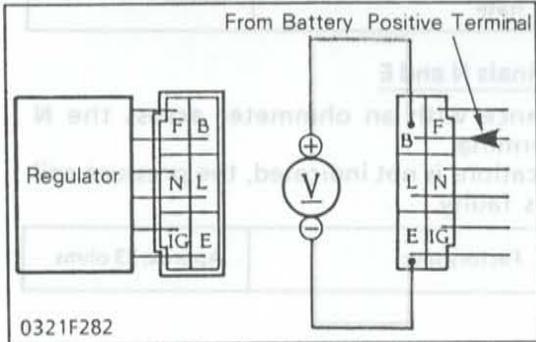


0329P157

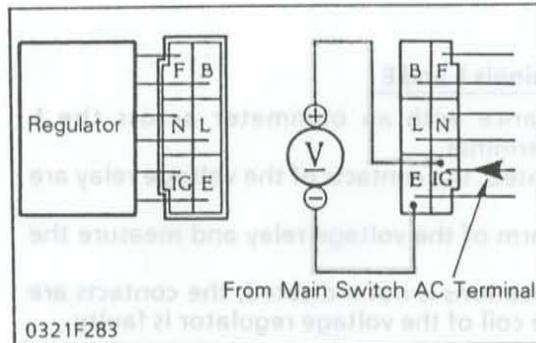
Regulator Relay Voltage across B and E

1. Disconnect the connector from the regulator after turning the main switch off.
2. Measure the voltage with a voltmeter across the connector B terminal and the E terminal.
3. If the voltage differs from the battery voltage, the wiring harness or the main switch is faulty.

Voltage	B - E	Approx. battery voltage
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0321F282

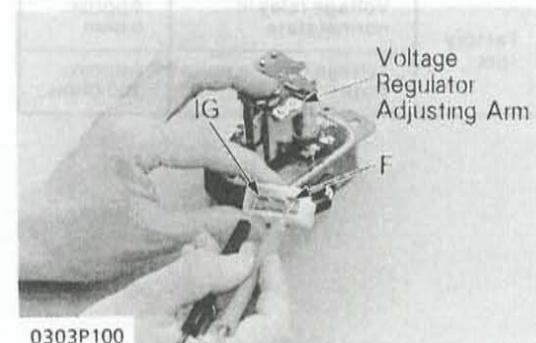


0321F283

Voltage across IG and E

1. Disconnect the connector from the regulator after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the connector IG terminal and the E terminal.
3. If the voltage differs from the battery voltage, the main switch, fuse or wiring harness is faulty.

Voltage	IG - E	Approx. battery voltage
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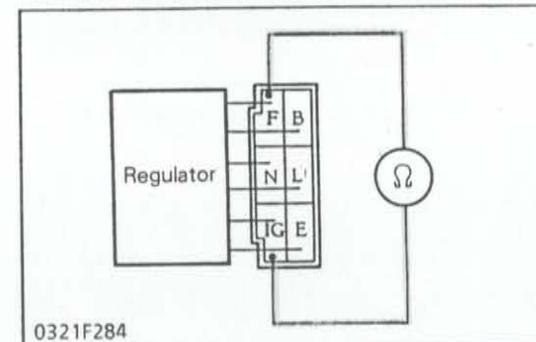


0303P100

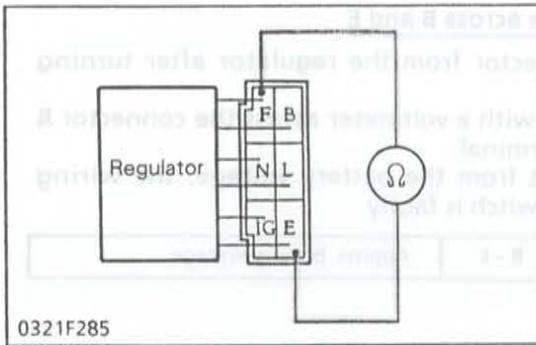
Resistance across Terminals IG and F

1. Measure the resistance with an ohmmeter across the IG terminal and the F terminal.
2. If 0 ohm is not indicated, the contacts of the voltage regulator are faulty.
3. Press the adjusting arm of the voltage regulator and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the control resistor is faulty.

Resistance	IG - F	Factory spec.	Voltage regulator in normal state	0 ohm
			voltage regulator in pull state	Approx. 11 ohms



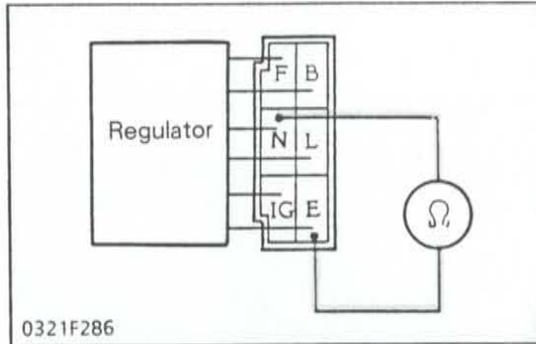
0321F284



Resistance across Terminals F and E

1. Measure the resistance with an ohmmeter across the F terminal and the E terminal.
2. If infinity is not indicated, the contacts of the voltage regulator are faulty.
3. Press the adjusting arm of the voltage regulator and measure the resistance.
4. If 0 ohm is not indicated, the contacts are faulty.

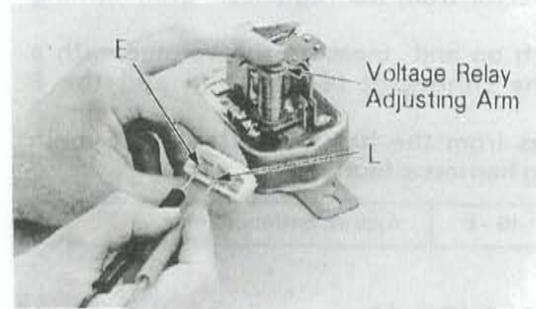
Resistance	F - E	Voltage regulator in normal state	Infinity
		voltage regulator in pull state	0 ohm



Resistance across Terminals N and E

1. Measure the resistance with an ohmmeter across the N terminal and the E terminal.
2. If the factory specifications is not indicated, the pressure coil of the voltage relay is faulty.

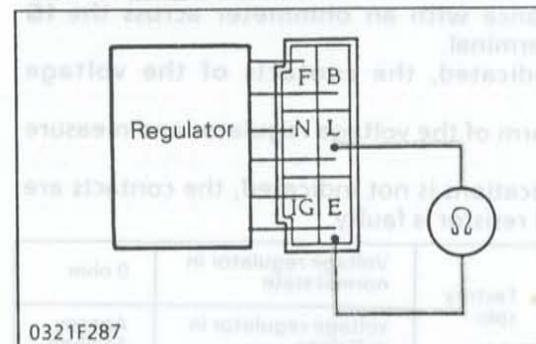
Resistance	N - E	Factory spec.	Approx. 23 ohms
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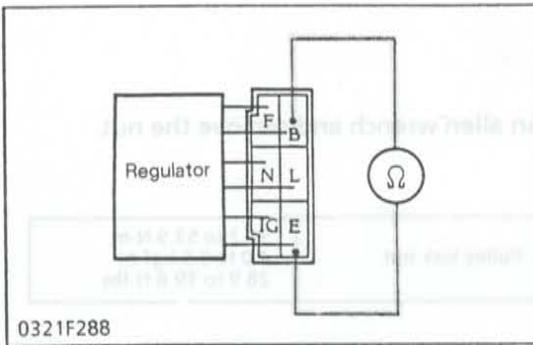


Resistance across Terminals L and E

1. Measure the resistance with an ohmmeter across the L terminal and the E terminal.
2. If 0 ohm is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the voltage coil of the voltage regulator is faulty.

Resistance	L - E	Factory spec.	Voltage relay in normal state	Approx. 0 ohm
			voltage relay in pull state	Approx. 100 ohms

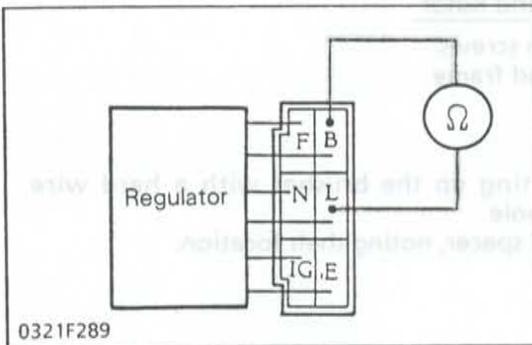




Resistance across Terminals B and E

1. Measure the resistance with an ohmmeter across the **B** terminal and the **E** terminal.
2. If infinity is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the factory specifications is not indicated, the contacts are faulty or the voltage coil of the voltage regulator is faulty.

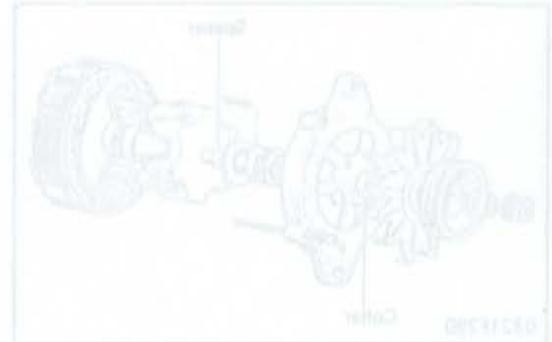
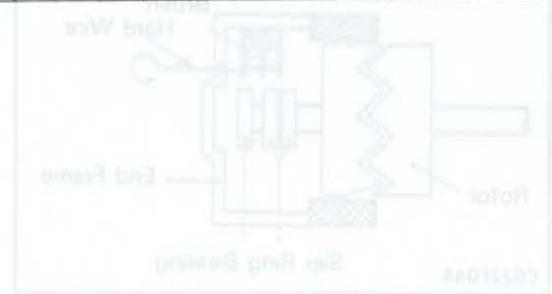
Resistance	B - E	Factory spec.	Voltage relay in normal state	Infinity
			voltage relay in pull state	Approx. 100 ohms



Resistance across Terminals B and L

1. Measure the resistance with an ohmmeter across the **B** terminal and the **L** terminal.
2. If infinity is not indicated, the contacts of the voltage relay are faulty.
3. Press the adjusting arm of the voltage relay and measure the resistance.
4. If the 0ohm is not indicated, the contacts are faulty.

Resistance	B - L	Factory spec.	Voltage relay in normal state	Infinity
			voltage relay in pull state	0 ohm



Rectifier

1. Remove the nut.
2. Remove the end frame.
3. Remove the rectifier.

(When reassembling)

- Be sure to install the insulation washers on the screws at the positive diode side.

0321F011

DISASSEMBLING AND ASSEMBLING

Pulley

1. Hold the shaft with an allen wrench and remove the nut.
2. Remove the pulley
3. Remove the fan.

Tightening torque	Pulley lock nut	39.2 to 53.9 N-m 4.0 to 5.5 kgf-m 28.9 to 39.8 ft-lbs
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C022P018

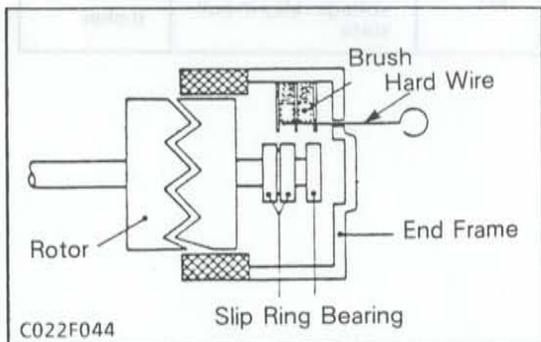
Drive Side End Frame and Rotor

1. Remove the through screws.
2. Remove the drive end frame.
3. Draw out the rotor.

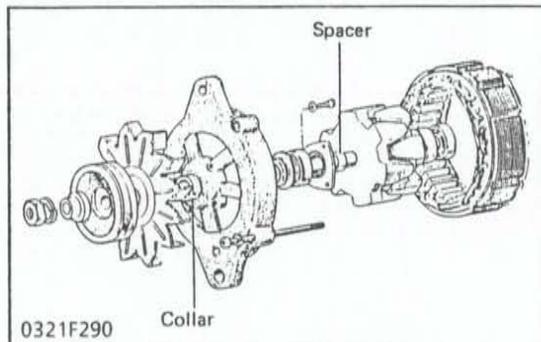
(When reassembling)

- Install the rotor, lifting up the brushes with a hard wire through the access hole.
Install the collar and spacer, noting their location.

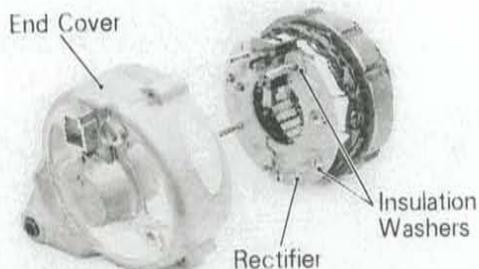
C022P019



C022F044



0321F290



C022P022

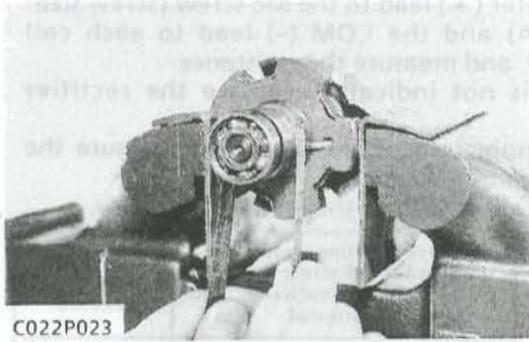
Rectifier

1. Remove the nuts.
2. Remove the end frame.
3. Remove the rectifier.

(When reassembling)

- Be sure to install the insulation washers on the screws at the positive diode side.

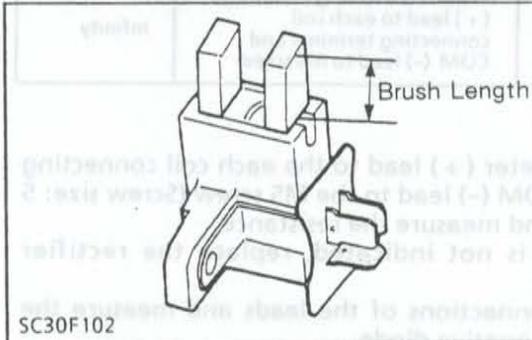
SERVICING



C022P023

Alternator Slip Ring

1. Check the slip ring for scoring.
2. If scored, correct with sandpaper or a lathe.

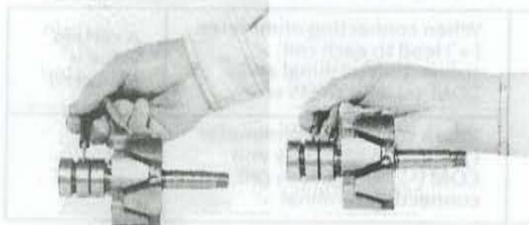


SC30F102

Brush Wear

1. Check the length of the brush. If the length is shorter than the allowable limit, replace it.
2. Make sure that the brush moves smoothly.
3. If the brush is defective, replace it.

Brush length	Factory spec.	12.5 mm 0.49 in.
	Allowable limit	5.5 mm 0.22 in.



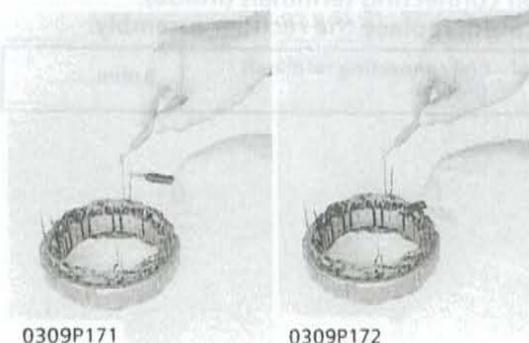
Rotor Coil

1. Measure the resistance with an ohmmeter across the slip ring and the core.
2. If infinity is not indicated, replace them as a unit.
3. Measure the resistance with an ohmmeter across the slip rings.
4. If the factory specifications is not indicated, replace them as a unit.

Resistance	Factory spec.	Slip ring-Core	Infinity
		Across slip ring	Approx. 4 ohms

C022P025

C022P024



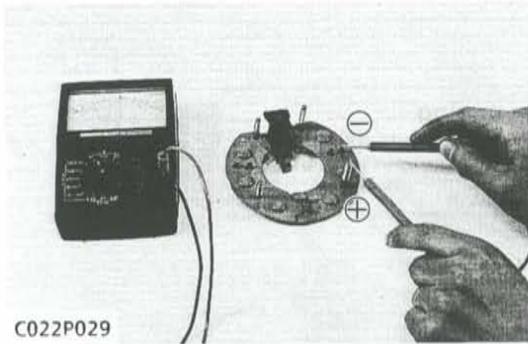
0309P171

0309P172

Stator Coil

1. Measure the resistance with an ohmmeter across each lead of the stator coil.
2. If 0 ohm is not indicated, replace the stator coil and core as a unit.
3. Measure the resistance with an ohmmeter across each stator coil lead and core.
4. If infinity is not indicated, replace them as a unit.

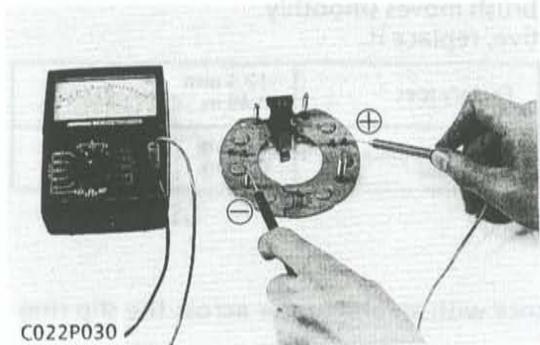
Resistance	Across stator coil leads	0 ohm
	Stator coil lead-Core	Infinity



Positive Diodes

1. Connect the ohmmeter (+) lead to the M6 screw (Screw size: 6 mm, 0.24 in. DIA) and the COM (-) lead to each coil connecting terminal, and measure the resistance.
2. If a certain value is not indicated, replace the rectifier assembly.
3. Interchange the connections of the leads and measure the resistance of each positive diode.
4. If infinity is not indicated, replace the rectifier assembly.

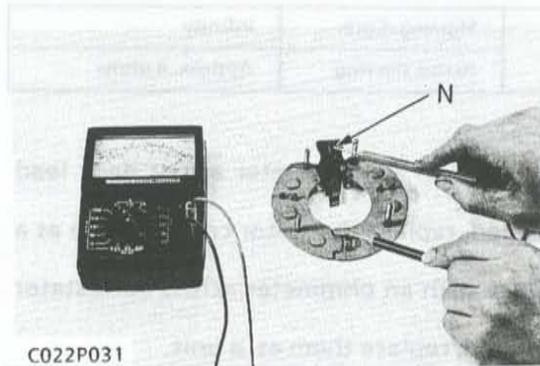
Resistance	Factory spec.	When connecting ohmmeter (+) lead to M6 screw and COM (-) lead to each coil connecting terminal	A certain value is indicated
		When connecting ohmmeter (+) lead to each coil connecting terminal and COM (-) lead to M6 screw	Infinity



Negative Diodes

1. Connect the ohmmeter (+) lead to the each coil connecting terminal and the COM (-) lead to the M5 screw (Screw size: 5 mm, 0.20 in. DIA) and measure the resistance.
2. If a certain value is not indicated, replace the rectifier assembly.
3. Interchange the connections of the leads and measure the resistance of each negative diode.
4. If infinity is not indicated, replace the rectifier assembly.

Resistance	Factory spec.	When connecting ohmmeter (+) lead to each coil connecting terminal and COM (-) lead to M5 screw	A certain value is indicated
		When connecting ohmmeter (+) lead to M5 screw and COM (-) lead to each coil connecting terminal	Infinity



N Terminal and Coil Connecting Terminal

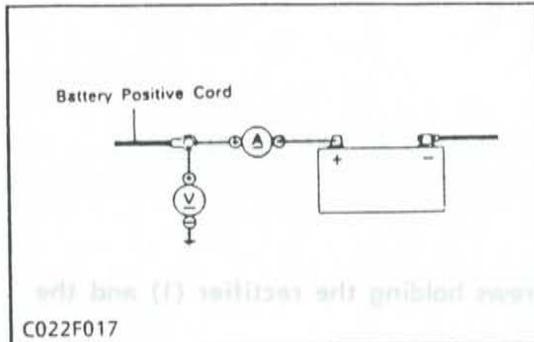
1. Measure the resistance with an ohmmeter across the N terminal and the coil connecting terminals (inside).
2. If 0 ohm is not indicated, replace the rectifier assembly.

Resistance	N terminal - Coil connecting terminals (inside)	0 ohm
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Resistance	Across rotor coil leads	Infinity
Resistance	Stator coil lead-COM	Infinity

[5] CHARGING SYSTEM (L2650, L2950, L3450, L3650)

CHECKING



Battery Charging Current

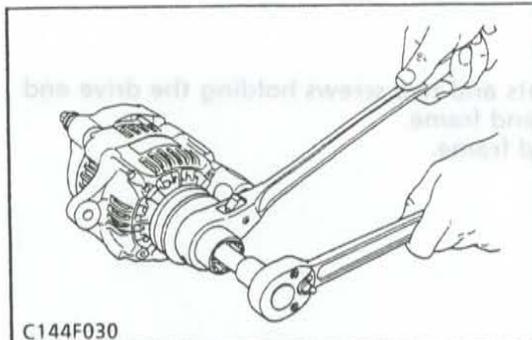
1. After starting the engine, disconnect the battery positive cord (+), and connect an ammeter and voltmeter. Then switch on all electrical loads (such as headlights) and measure the charging current.

NOTE

- Connect an ammeter only after starting the engine.
- When the electrical loads is considerably low or the battery is fully charged, the specified reading may not be obtained.

Factory spec.	Current	14 to 15A
	Voltage	14 to 15V
	Dynamo speed	5200 r.p.m

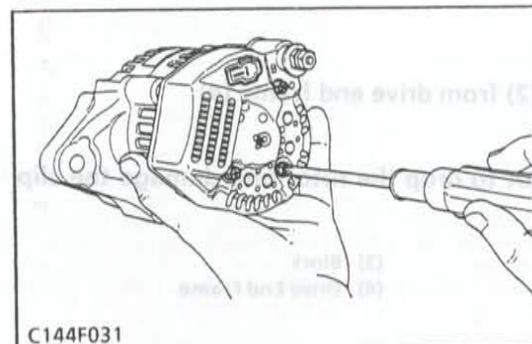
DISASSEMBLING AND ASSEMBLING



Pulley

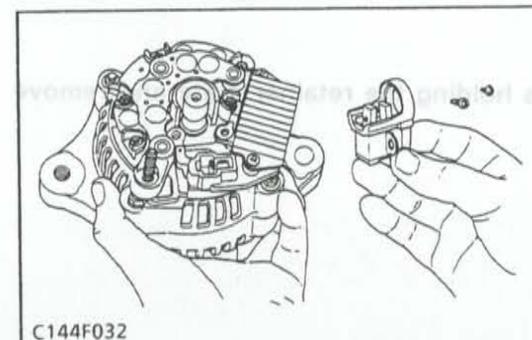
1. Secure the hexagonal end of the pulley shaft with a double-ended ratchet wrench as shown in the photo, loosen the nut with a socket wrench and remove it.

Tightening torque	Pulley lock nut	58.3 to 78.9 N·m 5.95 to 8.05 kgf·m 43.0 to 58.2 ft·lbs
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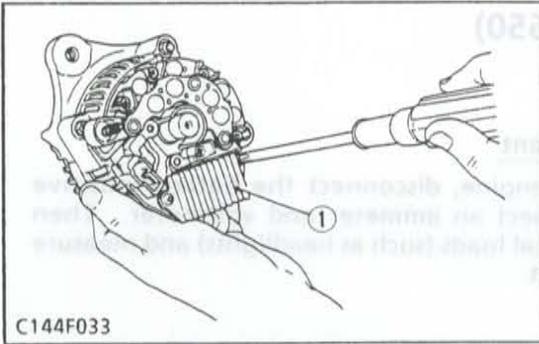
Rear End Cover

1. Unscrew the three rear end cover screws and the terminal B nut and remove the rear end cover.



Brush Holder

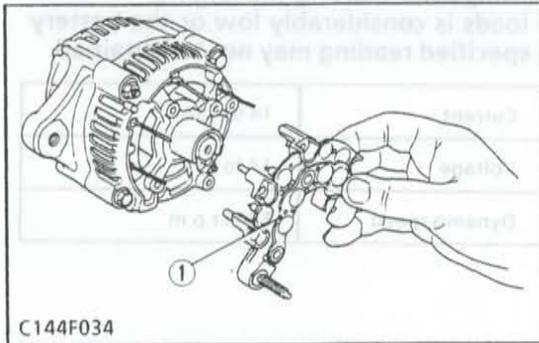
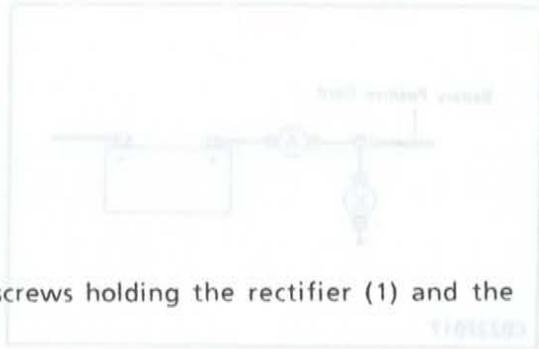
1. Unscrew the two screws holding the brush holder and remove the brush holder.



IC Regulator

1. Unscrew the three screws holding the IC regulator (1) and remove it.

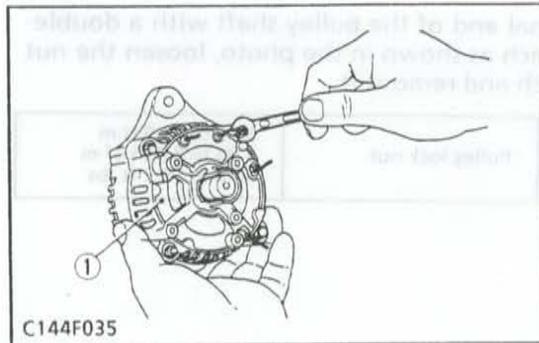
(1) IC Regulator



Rectifier

1. Remove the four screws holding the rectifier (1) and the stator lead wires.

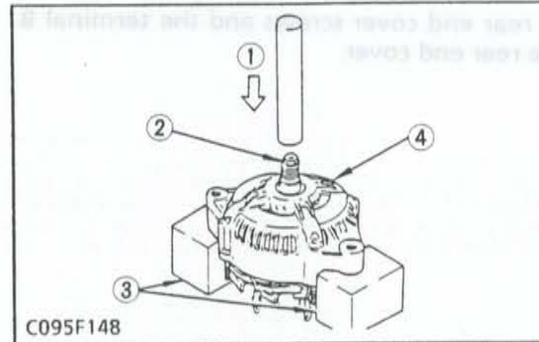
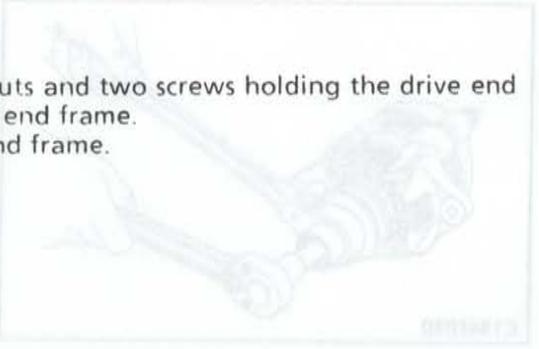
(1) Rectifier



Rear End Frame

1. Remove the two nuts and two screws holding the drive end frame and the rear end frame.
2. Remove the rear end frame.

(1) Rear End Frame



Rotor

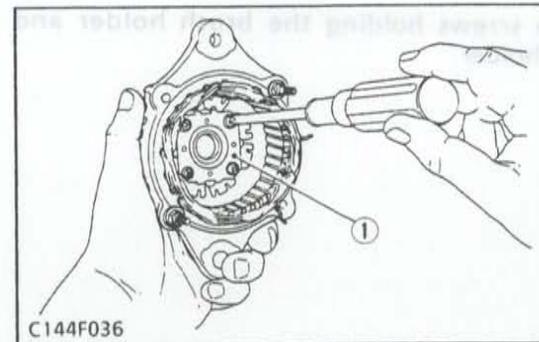
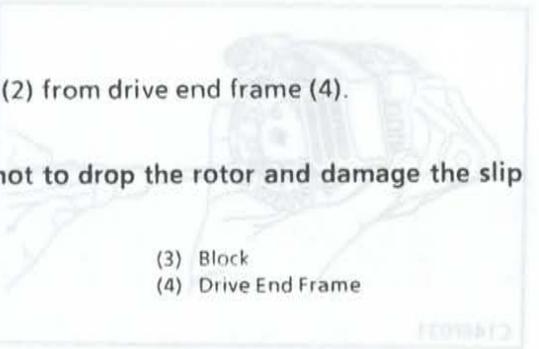
1. Press out the rotor (2) from drive end frame (4).

IMPORTANT

- Take special care not to drop the rotor and damage the slip ring or fan, etc.

(1) Press
(2) Rotor

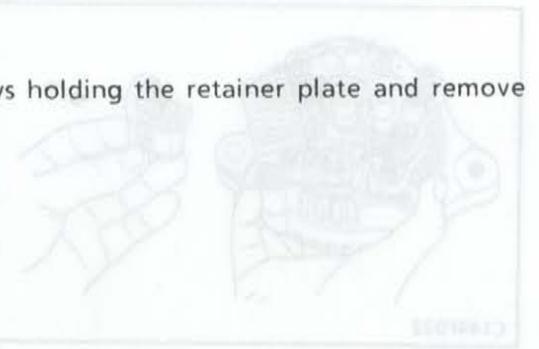
(3) Block
(4) Drive End Frame

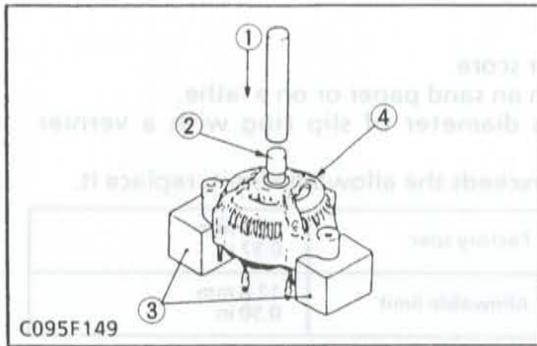


Retainer Plate

1. Remove the screws holding the retainer plate and remove the retainer plate.

(1) Retainer Plate



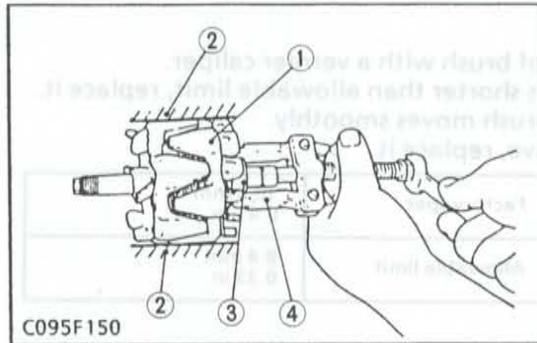


Bearing on the Drive End Side

1. Press out the bearing from drive end frame (4) using with press (1) and jig (2).

- (1) Press
- (2) Jig

- (3) Block
- (4) Drive End Frame



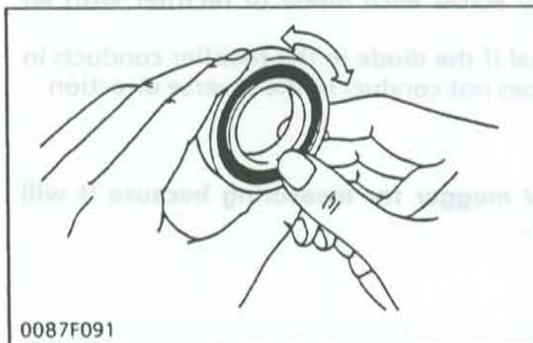
Bearing at the Slip Ring Side

1. Lightly secure the rotor (1) with a vise (2) to prevent damage and remove the bearing using with puller (4).

- (1) Rotor
- (2) Vise

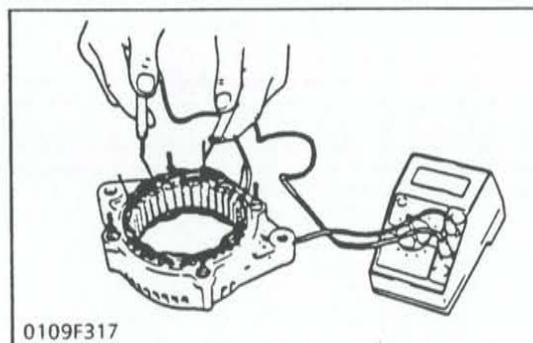
- (3) Bearing
- (4) Puller

SERVICING



Bearing

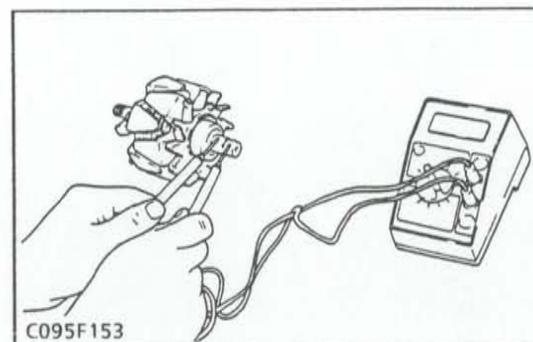
1. Check the bearing for smooth rotation.
2. If it does not rotate smoothly, replace it.



Stator

1. Measure the resistance with an ohmmeter across each lead of the stator coil.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

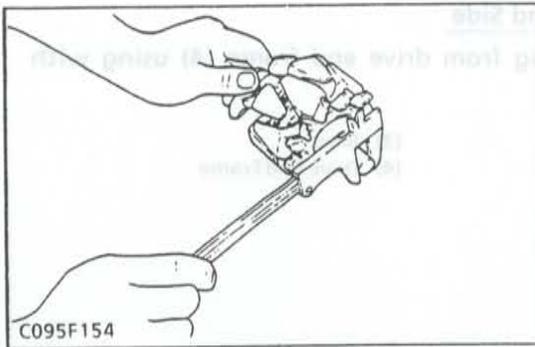
Resistance	Factory spec.	Less than 1.0 ohm
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Rotor

1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If infinity is not indicated, replace it.

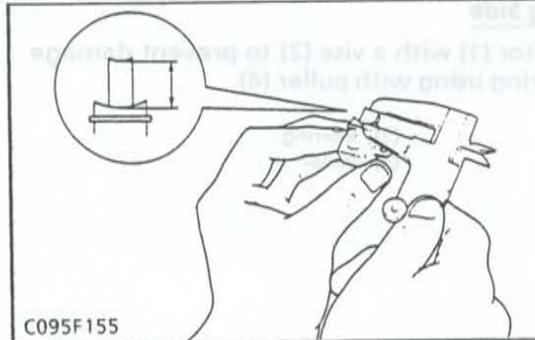
Resistance	Factory spec.	2.9 ohm
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Slip Ring

1. Check the slip ring for score.
2. If scored, correct with an sand paper or on a lathe.
3. Measure the outside diameter of slip ring with a vernier caliper.
4. If the measurement exceeds the allowable limit, replace it.

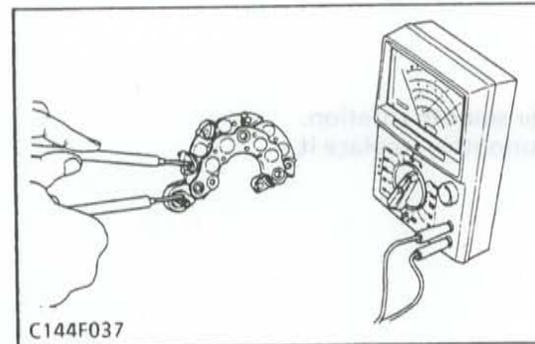
Slip ring O D	Factory spec.	14.4 mm 0.57 in.
	Allowable limit	12.8 mm 0.50 in.



Brush Wear

1. Measure the length of brush with a vernier caliper.
2. If the measurement is shorter than allowable limit, replace it.
3. Make sure that the brush moves smoothly.
4. If the brush is defective, replace it.

Brush length	Factory spec.	10.5 mm 0.41 in.
	Allowable limit	8.4 mm 0.33 in.



Rectifier

1. Check the continuity across each diode of rectifier with an ohmmeter.
2. The rectifier is normal if the diode in the rectifier conducts in one direction and does not conduct in the reverse direction.

CAUTION

- Do not use a 500 V megger for measuring because it will destroy the rectifier.

Stator

1. Measure the resistance with an ohmmeter across each lead of the stator coil.
2. If the measurement is not within factory specification, replace it.
3. Check the continuity across each stator coil lead and core with an ohmmeter.
4. If infinity is not indicated, replace it.

Resistance	Factory spec.	Less than 1.0 ohm
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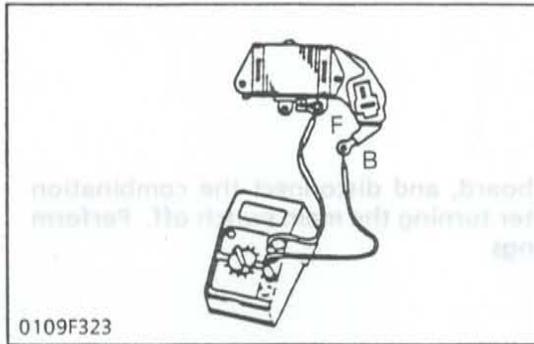


Rotor

1. Measure the resistance across the slip rings.
2. If the resistance is not the factory specification, replace it.
3. Check the continuity across the slip ring and core with an ohmmeter.
4. If infinity is not indicated, replace it.

Resistance	Factory spec.	3.0 ohm
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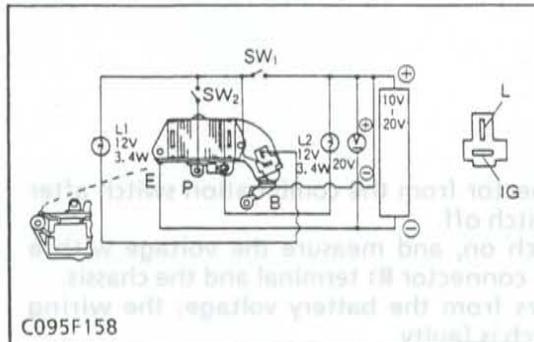


IC Regulator

1. Check the continuity across the **B** terminal and the **F** terminal of IC regulator with an ohmmeter.
2. The IC regulator is normal if the conducts in one direction and does not conduct in the reverse direction.

CAUTION

- Do not use a 500 V megger for measuring because it will destroy the rectifier.



IC Regulator Test

1. Connect the IC regulator unit, variable DC source, voltmeter, lamps and etc. so that they form a circuit as shown in the figure. (**SW1** and **SW2** shall be kept in the "OFF" position.)
2. Adjust the source voltage to 12 V.
3. Turn **SW1** "ON" check if **L1** (charge lamp substitution) is lit brilliantly and **L2** (rotor coil substitution) is dimly.
4. Then, turn **SW2** "ON" while **SW1** is still turned "ON". Check if **L1** is turns "OFF" and **L2** is lit brilliantly.
5. While keeping **SW1** and **SW2** in the "ON" position, raise the variable DC source voltage gradually from 12 V and check if the **L2** lamp is turned "OFF" at a voltage of 13.9 to 15.1 V at 25°C (45°F).

CAUTION

- A wrong connection in the IC regulator may destroy the regulator in a short time, therefore, inspection of the IC regulator is to be done only after the wiring diagram in the maintenance standard has been thoroughly studied.

Infinity	B1-T	Resistance (Switch knob at OFF position)
	B1-S	
	B1-T	

0 ohm	B1-S	Resistance (Switch knob at LOW-BEAM position)
	B1-T	

[6] LIGHTING SYSTEM CHECKING



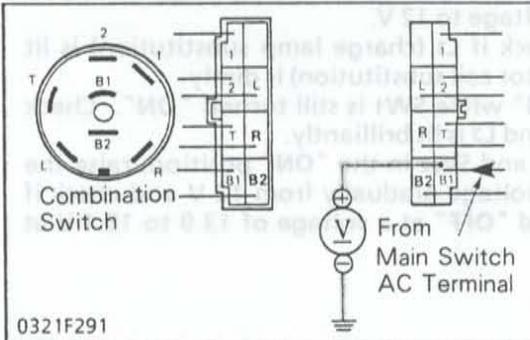
Combination Switch

- Remove the switch board, and disconnect the combination switch connectors after turning the main switch off. Perform the following checkings.

Connector Voltage

- Disconnect the connector from the combination switch after turning the main switch off.
- Turn the main switch on, and measure the voltage with a voltmeter across the connector B1 terminal and the chassis.
- If the voltage differs from the battery voltage, the wiring harness or main switch is faulty.

Voltage	B1 - Chassis	Approx. battery voltage
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Headlight Switch Continuity When Setting Switch Knob at OFF Position

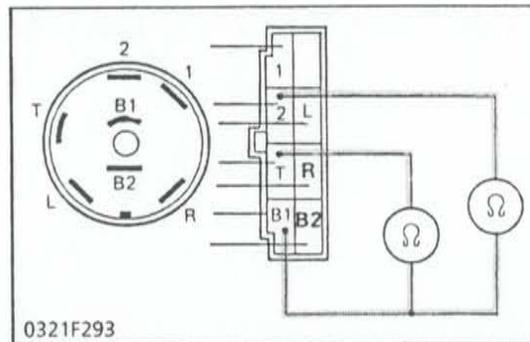
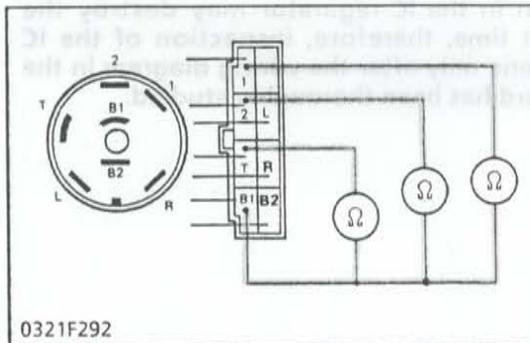
- Disconnect the connector from the combination switch after turning the main switch off.
- Set the light switch knob to the OFF position.
- Measure the resistances with an ohmmeter across the B1 terminal and 1 terminal, across the B1 terminal and 2 terminal, and across the B1 terminal and the T terminal.
- If infinity is not indicated, the combination switch is faulty.

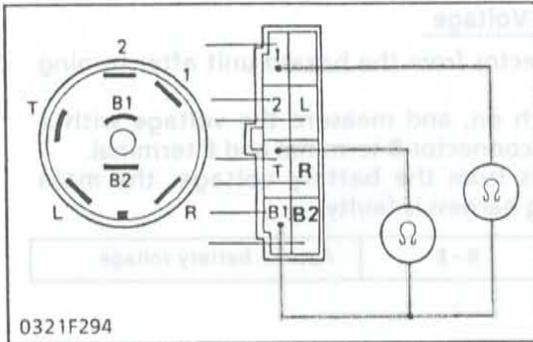
Resistance (Switch knob at OFF position)	B1 - 1	Infinity
	B1 - 2	
	B1 - T	

Headlight Switch Continuity When Setting Switch Knob at LOW-BEAM Position

- Measure the resistances with an ohmmeter across the B1 terminal and 2 terminal, and across the B1 terminal and T terminal.
- If 0 ohm is not indicated, the combination switch is faulty.

Resistance (Switch knob at LOW-BEAM position)	B1 - 2	0 ohm
	B1 - T	

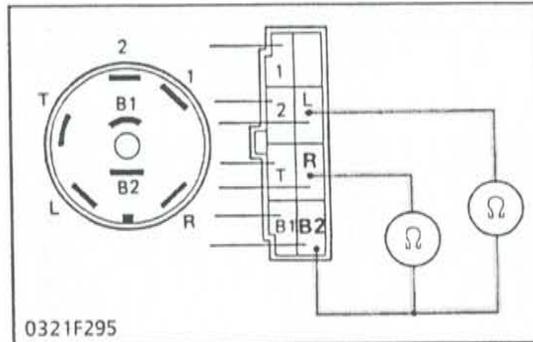




Headlight Switch Continuity When Setting Switch Knob at HI-BEAM Position

1. Measure the resistances with an ohmmeter across the B1 terminal and 1 terminal, and across the B1 terminal and T terminal.
2. If 0 ohm is not indicated, the combination switch is faulty.

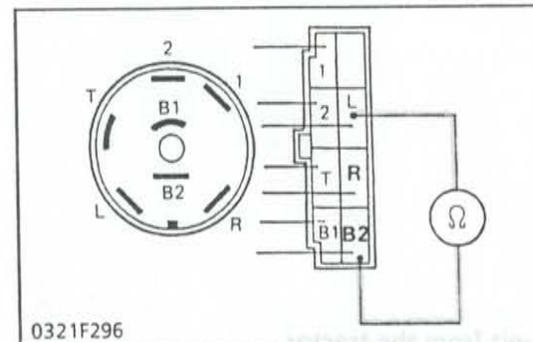
Resistance (Switch knob at HI-BEAM position)	B1 - 1	0 ohm
	B1 - T	



Hazard Switch Continuity When Setting Switch Knob at OFF Position

1. Disconnect the connector from the combination switch after turning the main switch off.
2. Set the hazard switch knob to the OFF position.
3. Measure the resistances with an ohmmeter across the B2 terminal and L terminal, and across the B2 terminal and R terminal.
4. If infinity is not indicated, the combination switch is faulty.

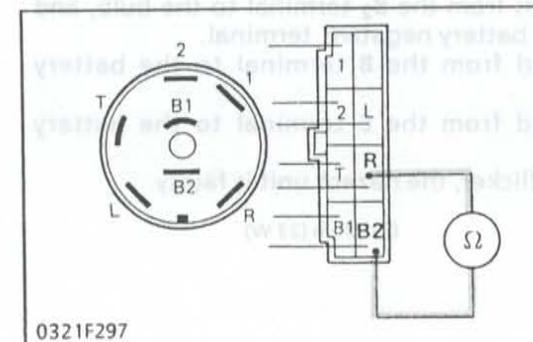
Resistance (Switch knob at OFF position)	B2 - L	Infinity
	B2 - R	



Hazard Switch Continuity When Setting Switch Knob at L Position

1. Set the hazard switch knob to the L position.
2. Measure the resistance with an ohmmeter across the B2 terminal and L terminal.
3. If 0 ohm is not indicated, the combination switch is faulty.

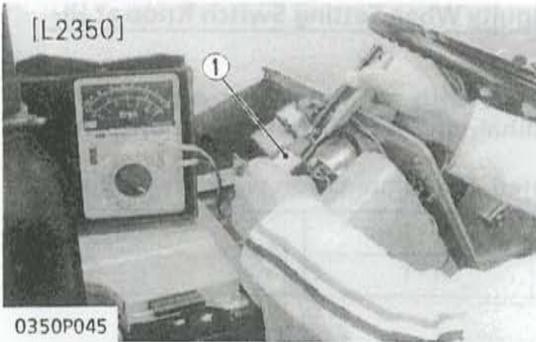
Resistance (Switch knob at L position)	B2 - L	0 ohm
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Hazard Switch Continuity When Setting Switch Knob at R Position

1. Set the hazard switch knob to the R position.
2. Measure the resistance with an ohmmeter across the B2 terminal and R terminal.
3. If 0 ohm is not indicated, the combination switch is faulty.

Resistance (Switch knob at R position)	B2 - R	0 ohm
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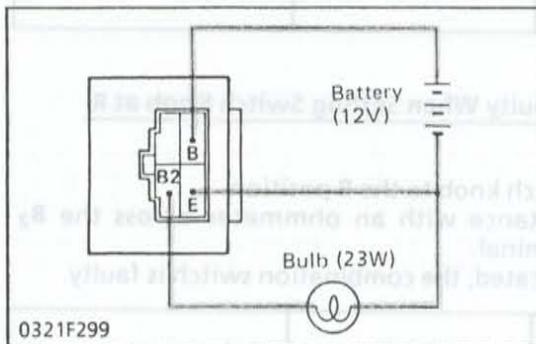
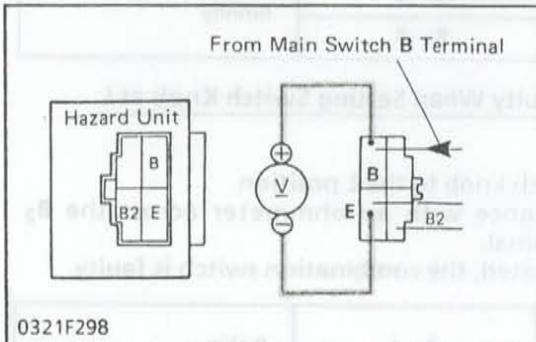


Hazard Unit Connector Voltage

1. Disconnect the connector from the hazard unit after turning the main switch off.
2. Turn the main switch on, and measure the voltage with a voltmeter across the connector B terminal and E terminal.
3. If the voltage differs from the battery voltage, the main switch, fuse or wiring harness is faulty.

Voltage	B - E	Approx. battery voltage
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(1) Hazard Unit



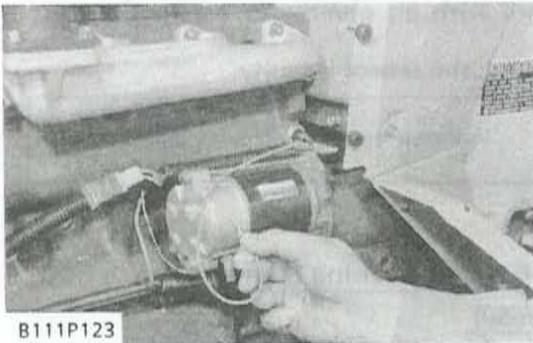
Hazard Unit Test

1. Remove the hazard unit from the tractor.
2. Connect jumper leads from the B₂ terminal to the bulb, and from the bulb to the battery negative terminal.
3. Connect jumper lead from the B terminal to the battery positive terminal.
4. Connect jumper lead from the E terminal to the battery negative terminal.
5. If the bulb does not flicker, the hazard unit is faulty.

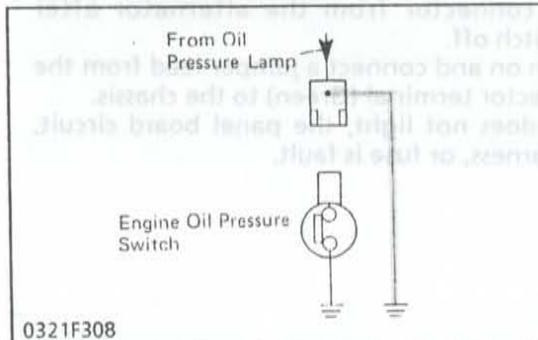
(1) Hazard Unit
(2) Battery (12 V)

(3) Bulb (23 W)

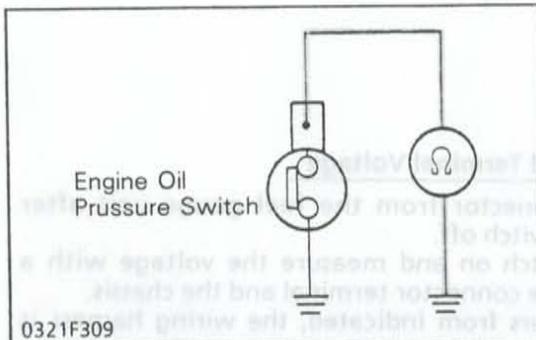
[7] WARNING LAMPS CHECKING



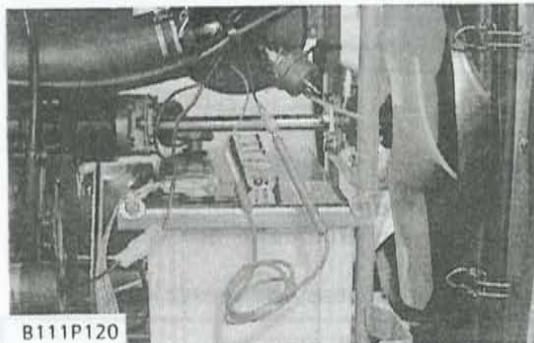
B111P123



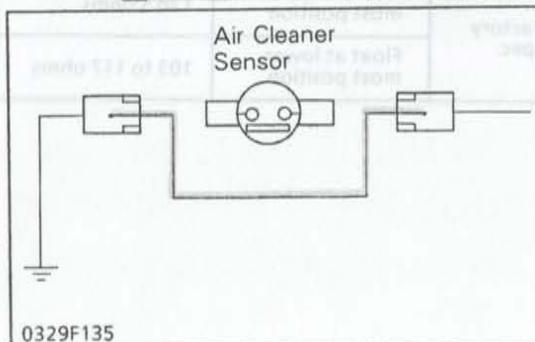
0321F308



0321F309



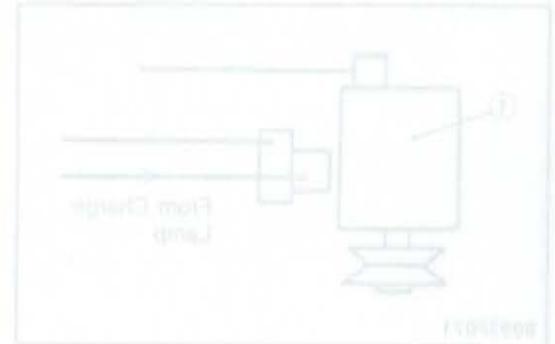
B111P120



0329F135

Engine Oil Pressure Switch Panel Board and Wiring Harness

1. Disconnect the lead from the engine oil pressure switch after turning the main switch off.
2. Turn the main switch on and connect a jumper lead from the lead terminal to the chassis.
3. If the engine oil pressure indicator lamp does not light, the panel board circuit or the wiring harness is faulty.



Engine Oil Pressure Switch Continuity

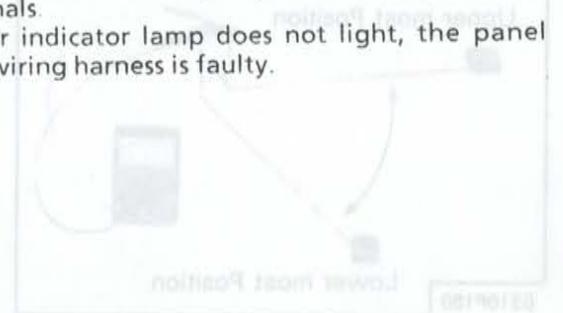
1. Measure the resistance with an ohmmeter across the switch terminal and the chassis.
2. If 0 ohm is not indicated in the normal state, the switch is faulty.
3. If infinity is not indicated at pressure over 4.9 kPa (0.5 kgf/cm², 7 psi), the switch is faulty.

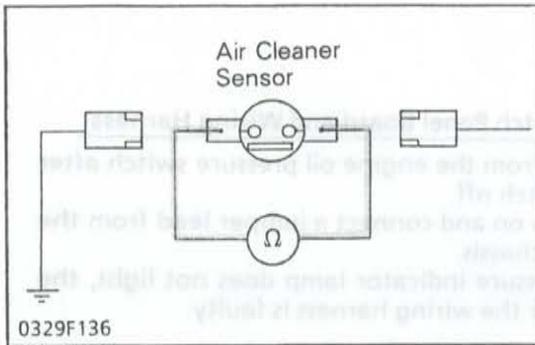
Resistance (Switch terminal) - Chassis	In normal state	0 ohm
	At pressure over approx. 4.9 kPa (0.5 kgf/cm ² , 7 psi)	Infinity

Air Cleaner Sensor Panel Board and Wiring Harness

[L2650, L2950, L3450, L3650]

1. Disconnect the connectors from the air cleaner sensor after turning the main switch off.
2. Start the engine and connect a jumper lead between the connector terminals.
3. If the air cleaner indicator lamp does not light, the panel board circuit or wiring harness is faulty.

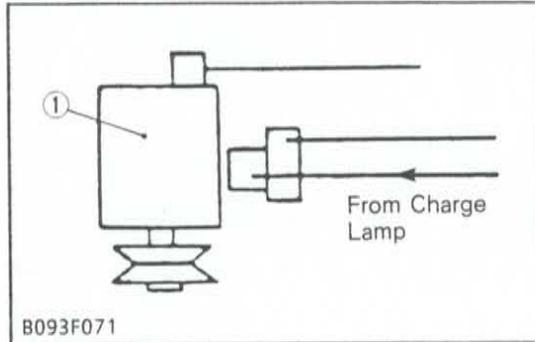




Air Cleaner Sensor Continuity [L2650, L2950, L3450, L3650]

1. Disconnect the two 1P connectors from the air cleaner sensor after turning the main switch off.
2. Measure the resistance with an ohmmeter across the two terminals.
3. If infinity is not indicated, the sensor is faulty.

Resistance (Across sensor terminals)	In normal state	Infinity
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Charging Circuit (Panel Board and Wiring Harness)

[L2650, L2950, L3450, L3650]

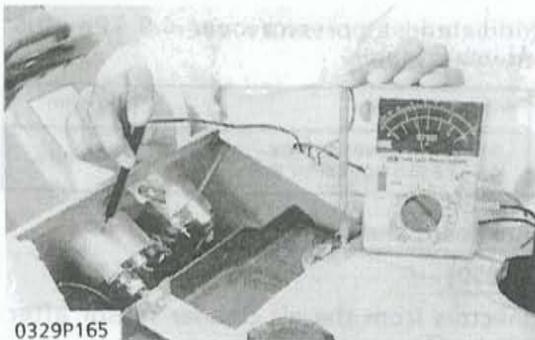
1. Disconnect the 2P connector from the alternator after turning the main switch off.
2. Turn the main switch on and connect a jumper lead from the wiring harness connector terminal (Green) to the chassis.
3. If the charge lamp does not light, the panel board circuit, alternator, wiring harness, or fuse is fault.

(1) Alternator

[8] GAUGE

CHECKING

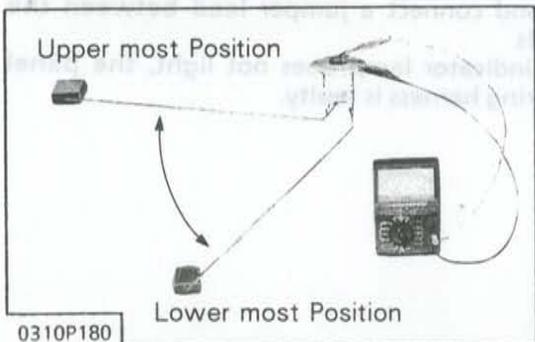
[L2350 4WD]



Fuel Level Sensor Lead Terminal Voltage

1. Disconnect the connector from the fuel gauge unit after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the connector terminal and the chassis.
3. If the voltage differs from indicated, the wiring harness is faulty.

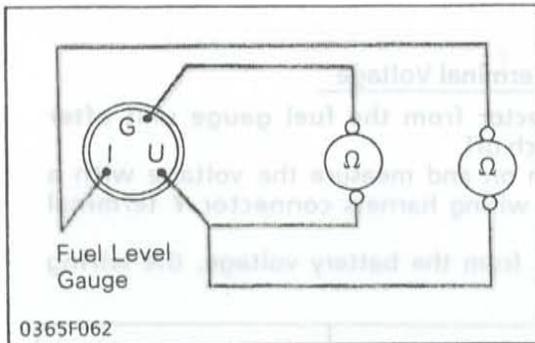
Voltage	Lead terminal - Chassis	4 to 7 voltage
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Fuel Level Sensor Continuity

1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the measurement are not indicated, the sensor is faulty.

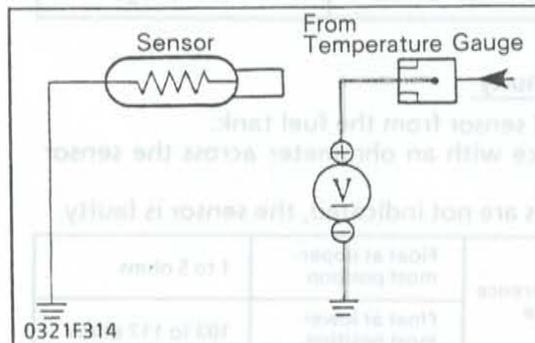
Resistance (Sensor terminal - its body)	Factory spec.	Float at upper-most position	1 to 5 ohms
		Float at lower-most position	103 to 117 ohms



Fuel Level Gauge

1. Remove the fuel level gauge.
2. Measure the resistance with an ohmmeter across the U terminal and I terminal, U terminal and G terminal.
3. If the measurements are not indicated, the gauge is faulty.

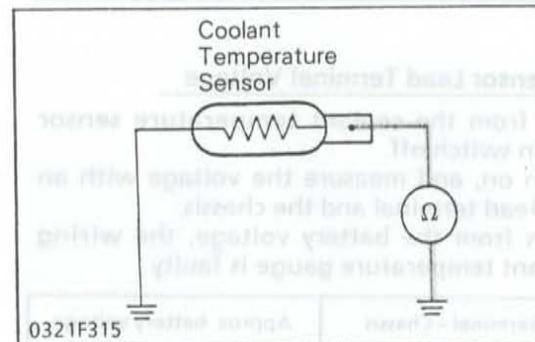
Resistance	U - I	70 to 100 ohms
	U - G	100 to 120 ohms



Coolant Temperature Sensor Lead Terminal Voltage

1. Disconnect the lead from the coolant temperature sensor after turning the main switch off.
2. Turn the main switch on, and measure the voltage with an voltmeter across the lead terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

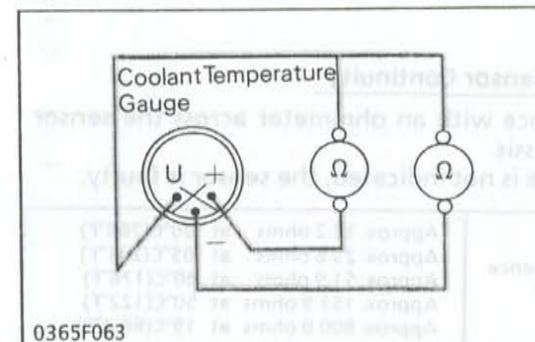
Voltage	Lead terminal - Chassis	Approx. battery voltage
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Coolant Temperature Sensor Continuity

1. Measure the resistance with an ohmmeter across the sensor terminal and the chassis.
2. If the measurement is not indicated, the sensor is faulty.

Resistance (Sensor terminal) - Chassis	Factory spec	Approx. 12.2 ohms at 130°C (266°F) Approx. 23.6 ohms at 105°C (221°F) Approx. 51.9 ohms at 80°C (176°F) Approx. 153.9 ohms at 50°C (122°F) Approx. 800.0 ohms at 19°C (66.2°F)
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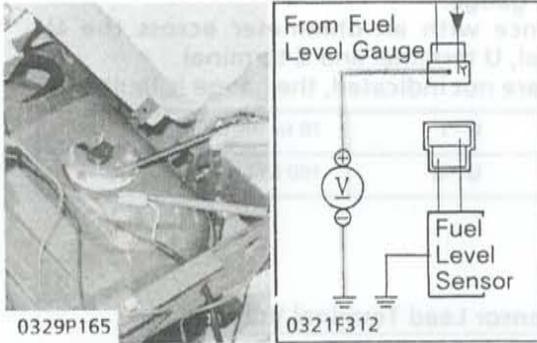


Coolant Temperature Gauge

1. Remove the coolant temperature gauge.
2. Measure the resistance with ohmmeter across the U terminal and + terminal, U terminal and - terminal.
3. If the measurement is not indicated, the gauge is faulty.

Resistance	U - +	100 to 120 ohms
	U - -	70 to 100 ohms

[L2650, L2950, L3450, L3650]



Fuel Level Sensor Lead Terminal Voltage

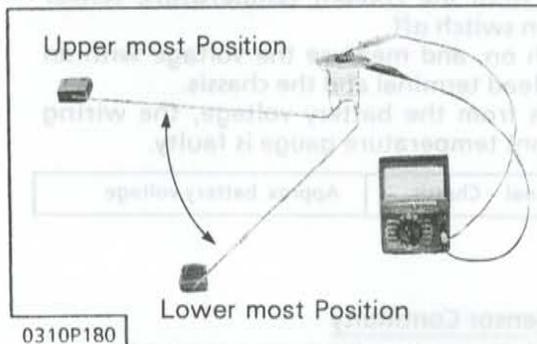
1. Disconnect the connector from the fuel gauge unit after turning the main switch off.
2. Turn the main switch on and measure the voltage with a voltmeter across the wiring harness connector Y terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness is faulty.

Voltage	Lead terminal - Chassis	4 to 7 voltage
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Fuel Level Sensor Continuity

1. Remove the fuel level sensor from the fuel tank.
2. Measure the resistance with an ohmmeter across the sensor terminal and its body.
3. If the reference values are not indicated, the sensor is faulty.

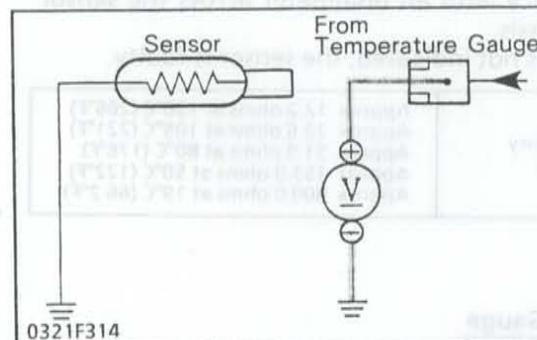
Resistance (Sensor terminal - its body)	Reference value	Float at upper-most position	1 to 5 ohms
		Float at lower-most position	103 to 117 ohms



Coolant Temperature Sensor Lead Terminal Voltage

1. Disconnect the lead from the coolant temperature sensor after turning the main switch off.
2. Turn the main switch on, and measure the voltage with an voltmeter across the lead terminal and the chassis.
3. If the voltage differs from the battery voltage, the wiring harness, fuse or coolant temperature gauge is faulty.

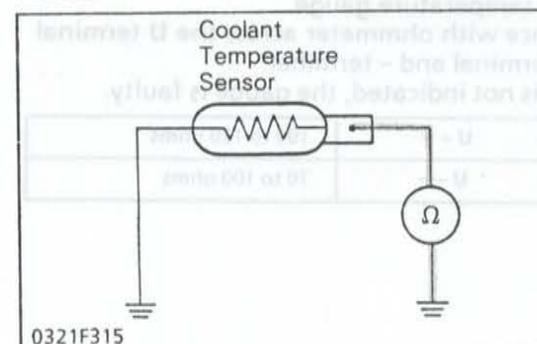
Voltage	Lead terminal - Chassis	Approx. battery voltage
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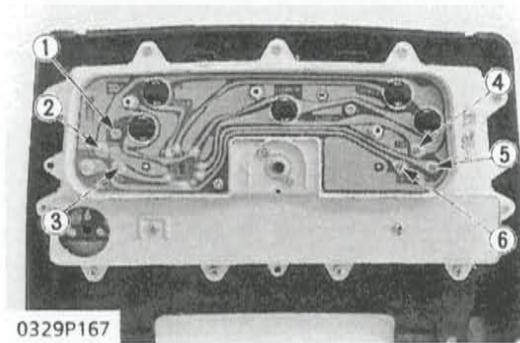


Coolant Temperature Sensor Continuity

1. Measure the resistance with an ohmmeter across the sensor terminal and the chassis.
2. If the reference value is not indicated, the sensor is faulty.

Resistance (Sensor terminal - Chassis)	Reference value	Approx. 12.2 ohms at 130°C(266°F)
		Approx. 23.6 ohms at 105°C(221°F)
		Approx. 51.9 ohms at 80°C(176°F)
		Approx. 153.9 ohms at 50°C(122°F)
		Approx. 800.0 ohms at 19°C(66.2°F)





- 0329P167
- (1) GND Terminal
 - (2) IG Terminal
 - (3) Tu Terminal

- (4) GND Terminal
- (5) Fu Terminal
- (6) IG Terminal

Fuel Gauge, Coolant Temperature Gauge

1. Remove the panel board from the tractor.
2. Measure the resistances with an ohmmeter across the FU terminal (5) and IG terminal (6) and across the FU terminal (5) and GND terminal (4).
3. If the reference values are not indicated, the fuel gauge is faulty.
4. Measure the resistances with an ohmmeter across the TU terminal (3) and IG terminal (2) and across the TU terminal (3) and GND terminal (1).
5. If the reference values are not indicated, the coolant temperature gauge is faulty.

Fuel Gauge			
Resistance	Reference value	FU – IG	60 to 68 Ω
		FU – GND	166.5 to 171.5 Ω

Coolant Temperature Gauge			
Resistance	Reference value	TU – IG	86 to 94 Ω
		TU – GND	155.3 to 160.3 Ω

(29°C, 84°F)



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