



**ST318
ST321
ST324**

**WORKSHOP
MANUAL**



SHIBAUURA TRACTOR

Introduction

In order to refine the Shibaura tractor series furthermore, ST series tractors were developed this time.

These are economical tractors provided with practical functions and high power.

They meet users' needs according to efficient and economical specifications requiring no after-care.

This manual describes structure, functions, maintenance and service procedures for the ST tractors to obtain their functions fully and for safe operation.

Please read this carefully to promote sales and service, to improve the service techniques and guide users for proper operation of Shibaura tractors.

Figures or other conditions in this manual may be changed without notice in order to improve the performance or for other objects.

**Quality Assurance Department
Tractor Division
Ishikawajima-Shibaura Machinery Co., Ltd.**

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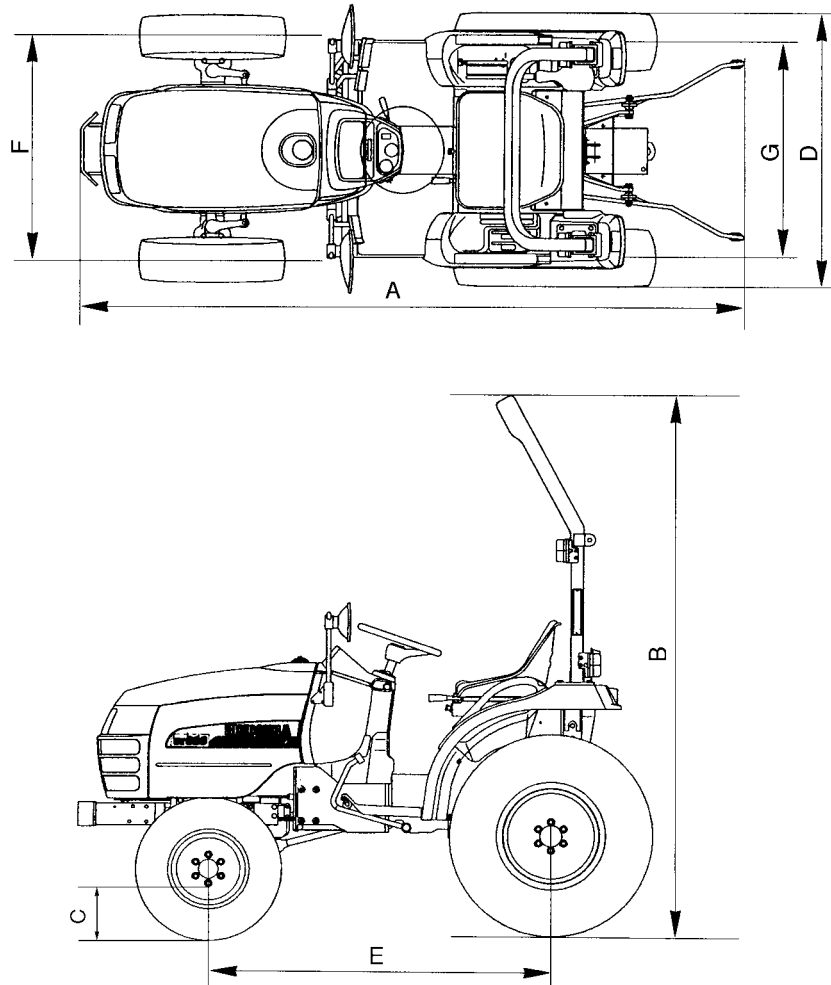
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Chapter 1. GENERAL

1-1 External Views

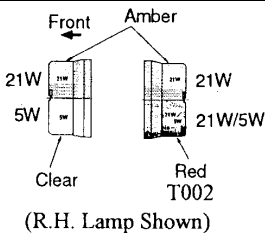


T001
unit : mm

Model	A	B	C	D	E	F	G
ST 318 (9 × 3)	2728	2262	245	1042	1405	822	851
ST 321 (9 × 3)	2728	2287	270	1138	1405	845	897
ST 318 (HST)	2728	2240	223	1188	1405	930	891
ST 321 (HST)	2728	2240	223	1188	1405	930	891
ST 324 (HST)	2728	2240	223	1188	1405	930	891

1-2 Specifications & Performances

Model			ST318	ST321	ST324	ST318	ST321
			HST			9 × 3	9 × 3
Main Body	Length (Lower Link horizontal)		2728 mm				
	Height	Top Steering Wheel	1233 mm			1265 mm	1290 mm
		Top ROPS	2240 mm			2262 mm	2287 mm
	Width		1088 mm		1042 mm	1138 mm	
	Wheel Base		1405 mm				
	Minimum Ground Clearance		223 mm		245 mm	270 mm	
	Minimum Turning Radius (with brake)		—		1870 mm	2070 mm	
	Weight (W/ROPS)		750 kg	748 kg	737 kg	754 kg	
	Front Wheel	Tire Size	20 × 8.00 – 10 (Turf)			5–12 (AG)	6–12 (AG)
		Inflation	See “Operator’s Manual”				
		Tread	930 mm			822 mm	845 mm
	Rear wheel	Tire Size	29 × 12.00 – 15 (Turf)			8-16 (AG)	9.5-16 (AG)
		Inflation	See “Operator’s Manual”				
		Tread	891~963 mm			851~999 mm	897~957 mm
	Clutch		Single Disc Dry Type				
	Speed Change method		Hydrostatic Transmission			Selective Sliding Shifter	
	Running Speed Changes		2 Steps Forward and 2 Steps Reverse			9 Speeds Forward and 3 Speeds Reverse	
	Differential		4 Pinion Spiral Bevel Drive Type with Diff. Lock				
	Brakes		Wet type Disc (R.H., L.H. Independently)				
	Steering		Full Hydraulic Power Steering				
	No. of PTO Speeds		1 Speed				
	PTO Shaft Size		35 mm in Diameter with 6 Square Splines				
	Three Point Linkage Size		Category 1				
	PTO Shaft Ground Clearance		Mid	261 mm		283 mm	308 mm
			Rear	419 mm		441 mm	466 mm
PTO Shaft Rotating Direction		Clockwise as seen from output end side					
Engine	Model		S753	S773	S773L	S753	S773
	Type		Water-Cooled 4-Cycle Vertical Diesel Engine				
	Number of Cylinders		3				
	Total Stroke Volume		954 cc	1005 cc	1131 cc	954 cc	1005 cc
	Continuous Rated Speed		2,600 rpm				
	Compression Ratio		23 : 1		22.5 : 1	23 : 1	
	Fuel		Diesel Fuel Oil				
	Starting Method		By Starting Motor				

The ground speeds are engine speed at 2600 rpm with 8-16 Rear Tires On Model ST318 Manual Transmission. The ground speeds are engine speed at 2600 rpm with 9.5-16 Rear Tires On Model ST321 Manual Transmission. The ground speeds are engine speed at 2600 rpm with 29x12.00-15 Rear Tires On Model ST318/321/324 HST Transmission.							
Ground Speeds	Forward (km/h)	L	1	1st	1.08	1.15	0 – 5.78
			2	2nd	1.79	1.91	
			3	3rd	2.40	2.56	
		M	1	4th	2.57	2.74	
			2	5th	4.26	4.54	
			3	6th	5.72	6.10	
		H	1	7th	6.72	7.16	0 – 14.86
			2	8th	11.15	11.89	
			3	9th	14.96	15.95	
	Reverse (Km/h)	L	R	R1	2.00	2.13	0 – 3.61
		M		R2	4.77	5.08	
		H		R3	12.47	13.29	0 – 9.29
No. of PTO Speeds				1	1	1	
PTO Speed (rpm) (at engine speed 2600 rpm)		Rear PTO		588	588	561	
		Mid PTO		2139	2139	2040	
Capacities	Fuel Tank	20 Liters					
	Engine oil	Less Filter 3.0 Liters, with Filter Change 3.3 Liters					
	Cooling Water	3.5 Liters					
	Transmission Oil	16 Liters					
	Hydraulics	Transmission Oil used in common					
	Front Axle Gear Case	1.8 Liters					
Electrical System	Grounding	Negative (—)					
	Battery	12 Volt, 36 amp.					
	Starting Motor	12 V — 1.0 kW					
	Glow Plug	11 V — 9.5 A					
	Alternator	12 V — 40 A					
	Regulator	13.8 V — 14.8 V (Adjusted voltage)					
	Head Light	65 W/55 W					
	Horn	12 V					
	Brake Lamp	21 W					
	Small Lamp	5 W					
	Tail Lamp	5 W					
	Flasher Lamp	21 W					
Each Warning Lamp	3.4 W						
High Beam Indicator	1.7 W						
Licence Lamp	5 W						

1-3 Precautions Before Servicing

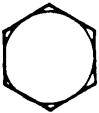
1. Have the tractor washed clean and have the oil, fuel, and cooling water drained out depending on the work required.
2. Service shop should always be kept clean to prevent dust from rising and should be well lit.
3. The disassembled parts should have the oil and grease washed off and arranged on a stand separated by groups.
4. Clothing, service tools and equipments should be checked to ensure safety at all times.

1-4 Basic Understanding on Servicing

1. Engine, transmission, and hydraulic components have been specially manufactured with a high degree of accuracy. Care should be exercised to maintain them in a clean state. Do not disassemble unnecessarily.
2. Defective parts due to wear and other causes shall be discarded and new parts ordered with the tractor make, serial No., code No., and part name clearly defined. (Keep the defective parts on hand to show to the customer.)
3. When assembling, it is essential to have oil applied to all moving parts so that they will be provided with initial oil film until normal lubrication takes place.
4. Unless specially instructed, bolts and nuts shall be tightened to the correct setting using a torque wrench.

METRIC BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Newton Meters	Kilo-gram Meters	Pitch (mm)	Newton-Meters	Kilo-gram Meters
M6	4T, 4.8	1.0	4.9-6.9	0.5-0.6	-----	-----	-----
	7T, 8T, 8.8		8.3-11.3	0.85-1.15			
	10T, 11T		11.7-15.7	1.2-1.6			
M8	4T, 4.8	1.25	12.7-16.7	1.3-1.7	1.0	15.2-20.1	1.55-2.05
	7T, 8T, 8.8		22.6-28.4	2.3-2.9		26.5-34.3	2.7-3.5
	10T, 11T		28.5-36.3	2.9-3.7		30.4-40.2	3.1-4.1
M10	4T, 4.8	1.5	25.5-33.3	2.6-3.4	1.25	28.4-36.2	2.9-3.7
	7T, 8T, 8.8		44.1-55.9	4.5-5.7		49.0-62.7	5.0-6.4
	10T, 11T		54.0-69.6	5.5-7.1		57.8-73.5	5.9-7.5
M12	4T, 4.8	1.75	37.3-47.0	3.8-4.8	1.25	43.1-54.9	4.4-5.6
	7T, 8T, 8.8		65.7-83.3	6.7-8.5		74.5-94.1	7.6-9.6
	10T, 11T		92.0-116	9.4-11.8		99.0-126	10.1-12.9
M14	4T, 4.8	2.0	62.8-80.4	6.4-8.2	1.5	69.6-87.2	7.1-8.9
	7T, 8T, 8.8		104-132	10.6-13.4		117-148	11.9-15.1
	10T, 11T		139-175	14.2-17.8		149-184	15.2-18.8
M16	4T, 4.8	2.0	86.1-110	8.8-11.2	1.5	91.1-114	9.3-11.7
	7T, 8T, 8.8		149-185	15.2-18.8		157-192	16.0-19.6
	10T, 11T		205-255	21-26		221-269	22.5-27.5
M18	4T, 4.8	2.0	113-141	11.6-14.4	1.5	132-162	13.4-16.6
	7T, 8T, 8.8		196-236	20-24		231-279	23.5-28.5
	10T, 11T		275-333	28-34		298-367	30.5-37.5
M20	4T, 4.8	2.5	144-180	14.7-18.3	1.5	172-210	17.5-21.5
	7T, 8T, 8.8		240-290	24.5-29.5		275-333	28.0-34.0
	10T, 11T		363-441	37-45		397-485	40.5-49.5

Bolt head identification mark	Strength grade	Example 4.8 Indicates yield point, 80% of tensile strength 32 kgf/mm² Tensile strength 40 kgf/mm²
 	4.8	
 	8.8	
   T003	10.9	

METRIC BOLT TORQUE SPECIFICATIONS

Bolt Size	Grade No.	Coarse Thread			Fine Thread		
		Pitch (mm)	Foot-Pounds	Newton Meters	Pitch (mm)	Foot-Pounds	Newton-Meters
M6	4T, 4.8	1.0	3.6-4.3	4.9-6.9	-----	-----	-----
	7T, 8T, 8.8		6.1-8.3	8.3-11.3			
	10T, 11T		8.7-11.5	11.7-15.7			
M8	4T, 4.8	1.25	9.4-12.3	12.7-16.7	1.0	11.2-14.8	15.2-20.1
	7T, 8T, 8.8		16.6-21.0	22.6-28.4		26.8-25.3	26.5-34.3
	10T, 11T		21-26.7	28.5-36.3		22.4-29.6	30.4-40.2
M10	4T, 4.8	1.5	18.8-24.6	25.5-33.3	1.25	21.0-26.7	28.4-36.2
	7T, 8T, 8.8		32.5-41.2	44.1-55.9		36.2-46.3	49.0-62.7
	10T, 11T		39.8-51.3	54.0-69.6		42.7-54.2	57.8-73.5
M12	4T, 4.8	1.75	27.4-34.7	37.3-47.0	1.25	31.8-40.5	43.1-54.9
	7T, 8T, 8.8		48.5-61.5	65.7-83.3		55.0-69.4	74.5-94.1
	10T, 11T		68.0-85.3	92.0-116		73.0-93.3	99.0-126
M14	4T, 4.8	2.0	46.3-59.3	62.8-80.4	1.5	51.4-64.3	69.6-87.2
	7T, 8T, 8.8		76.7-96.9	104-132		86.1-109	117-148
	10T, 11T		103-128	139-175		110-136	149-184
M16	4T, 4.8	2.0	64-81	96.1-110	1.5	67.3-84.6	91.1-114
	7T, 8T, 8.8		110-136	149-185		116-142	157-192
	10T, 11T		152-188	205-255		163-190	221-269
M18	4T, 4.8	2.0	84-104	113-141	1.5	97-120	132-162
	7T, 8T, 8.8		145-173	196-236		170-206	231-279
	10T, 11T		203-246	275-333		221-271	298-367
M20	4T, 4.8	2.5	107-132	144-180	1.5	127-155	172-210
	7T, 8T, 8.8		178-213	240-290		203-246	275-333
	10T, 11T		268-325	363-441		293-358	397-485

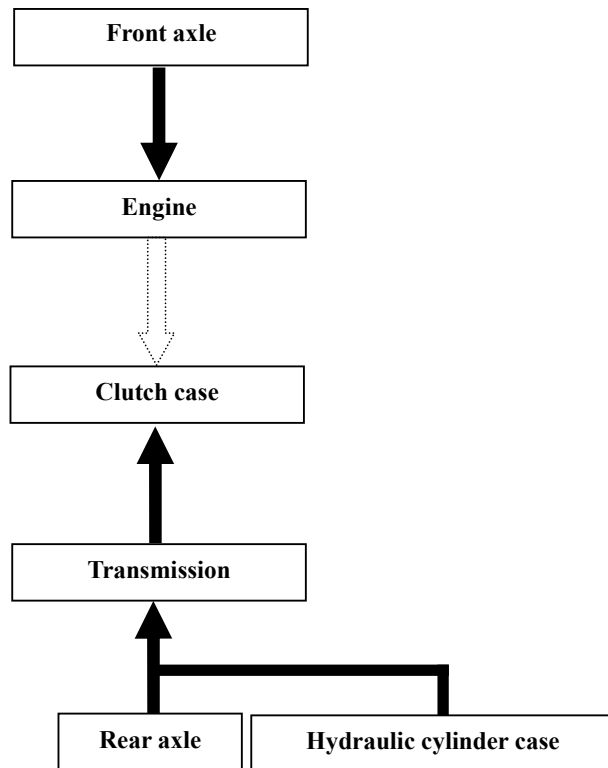
Bolt head identification mark	Strength grade	Example
	4.8	
	8.8	
	10.9	

T004

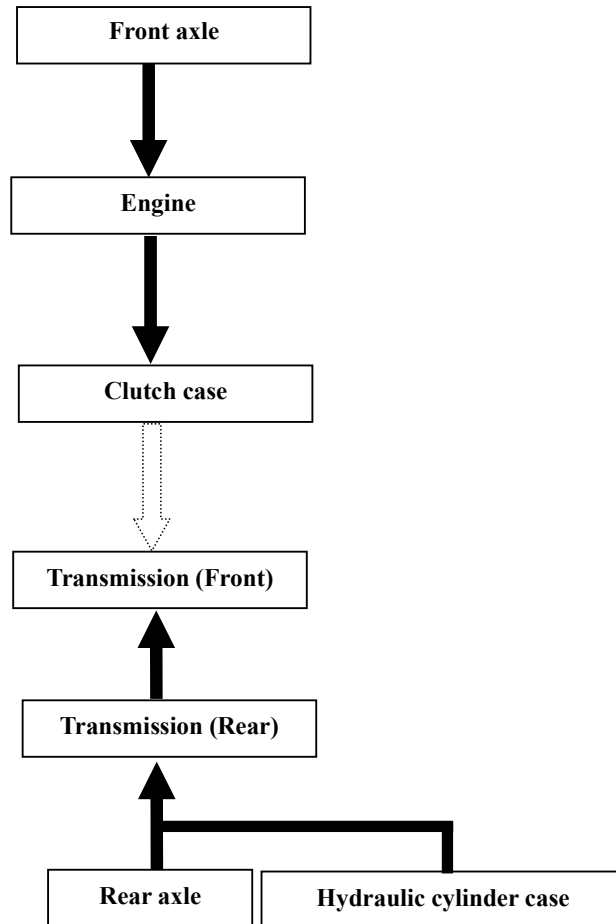
1-5 Sequence of Dismantling the Tractor

Flow chart

1. Manual Transmission Model



2. Hydrostatic Transmission Model



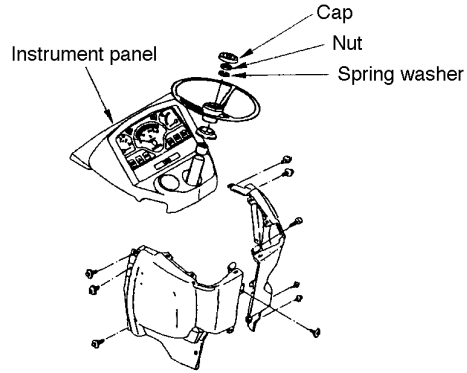
1. ENGINE and HST UNIT REMOVAL (9 × 3 and HST)

Disassembly

1. Steering wheel, instrument panel

- ① Remove the cap, retaining nut and spring washer.
- ② Pull the steering wheel.
- ③ Pull the instrument panel and disconnect the main wire harness and speed meter cable.
- ④ Remove the instrument panel.

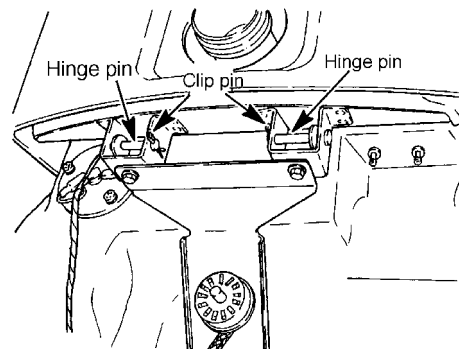
NOTE: Keep the glass face of the instrument panel up after removal. This will prevent the silicone oil in the fuel level and coolant temperature gauges from leaking out causing the gauges to give a false indication during operation.



T005

2. Bonnet (hood)

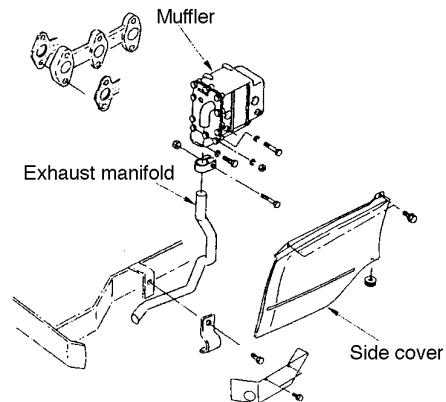
- ① Disconnect the negative terminal from the battery.
- ② Disconnect the connector for head lamps.
- ③ Remove the clip pin from the hood support plate, and gradually lower the hood.
- ④ Remove the clip pins from the hood hinge pins and remove the hinge pins.
- ⑤ Remove the hood from the tractor.



T006

3. Side cover, exhaust manifold

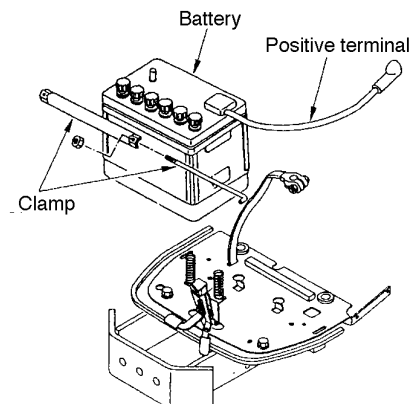
- ① Remove the right and left side covers.
- ② Remove the muffler cover, muffler and exhaust manifold from the engine.



T007

4. Battery

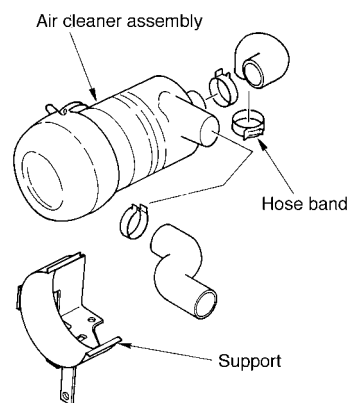
- ① Disconnect the positive terminal from the battery, and remove the clamp and battery.



T008

5. Air cleaner assembly

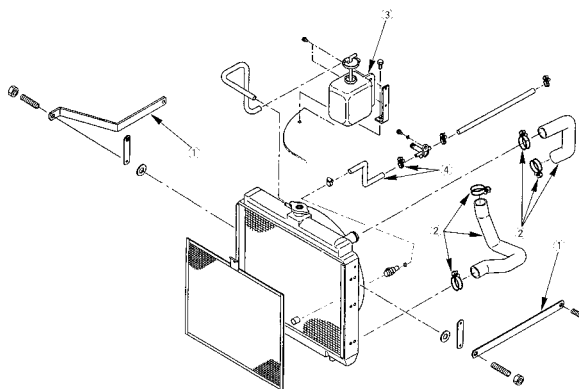
- ① Un tighten the hose band of the intake manifold.
- ② Remove the air cleaner assembly from the air cleaner support.



T009

6. Radiator assembly

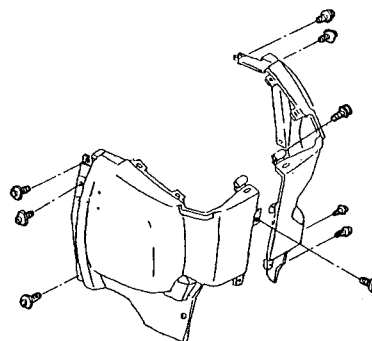
- ① Remove the radiator supports.
- ② Untighten the hose bands and disconnect the radiator hoses.
- ③ Remove the reserve tank from the tank support.
- ④ Disconnect the drain hoses from the drain cock.



T010

7. Dash board (shrouding)

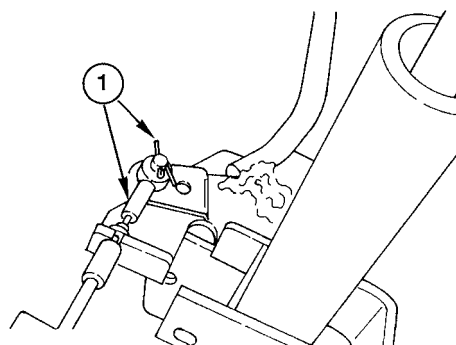
- ① Remove the screws securing the steering column center shrouding, disconnect the electrical connector from the ignition switch, and remove the shrouding.



T011

8. Throttle cable

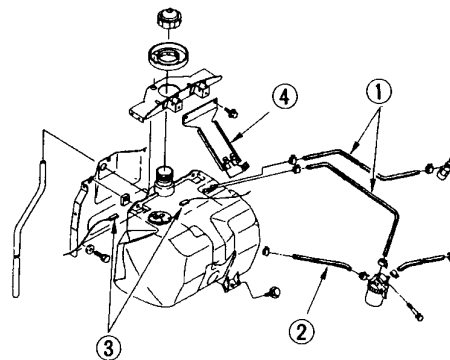
- ① Remove the cotter pin from the throttle lever and disconnect the throttle cable.
- ② Disconnect the electrical connector from the tractor rear main harness.



T012

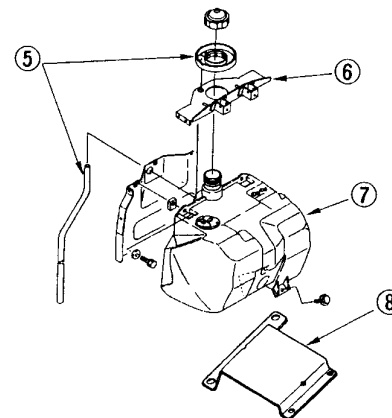
9. Fuel tank

- ① Disconnect the two fuel return hoses from the top of the fuel tank.
- ② Disconnect the fuel supply line from the fuel shut-off valve and drain the fuel from the tank into a clean container.
- ③ Disconnect the electrical connectors from the fuel level sender unit.
- ④ Remove the bracket form top of the fuel tank.



T013

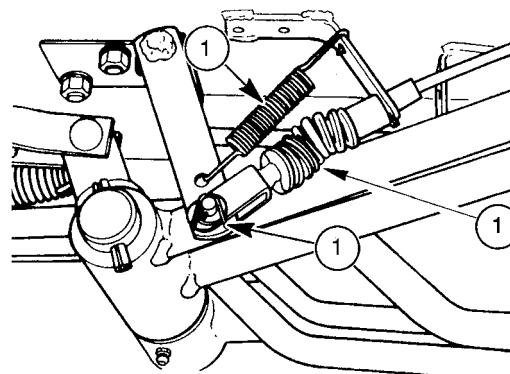
- ⑤ Remove the spillover collector from the fuel tank neck.
- ⑥ Remove the screws and hood hinge bracket form the firewall.
- ⑦ Remove the screws and tank from the tractor.
- ⑧ Remove the tank support.



T014

10. Side step

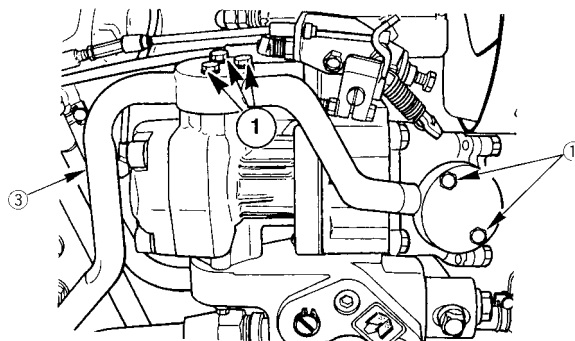
- ① Remove the foot throttle linkage return spring, remove cotter pin and disconnect the foot throttle linkage from underneath the right side step.
- ② Lift the side step floor mat, remove the bolts and side steps.



T015

11. Suction pipe

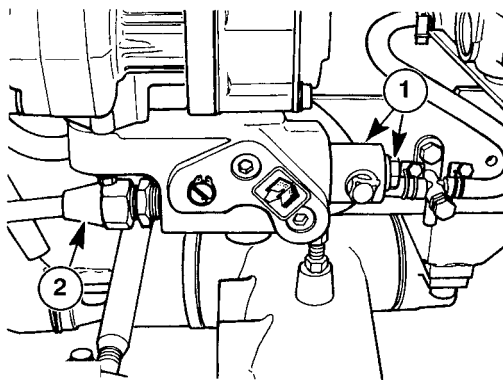
- ① Remove the bolts and lock washers and disconnect the hydraulic pump suction line from both oil pumps.
- ② Remove the hydraulic tubing support clamps from under the tractor.
- ③ Loosen the hose clamp and separate the suction line from the hose.



T016

12. Diverter valve

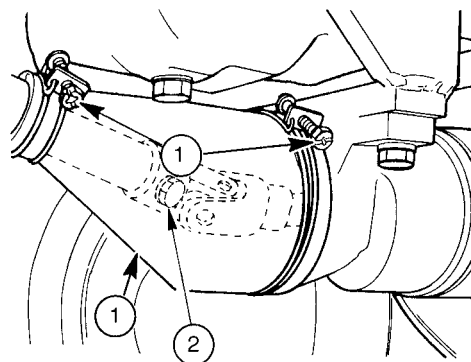
- ① Remove the banjo bolt and disconnect the sump return from the diverter valve disconnect the other end from the sump.
- ② Disconnect the system pressure line from the diverter valve and the lift cover.



T017

13. Rubber, drive shaft

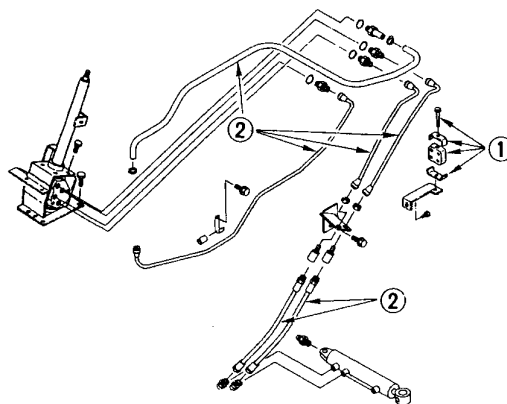
- ① Loosen the clamps on the front wheel drive shaft rubber boot and slide the boot rearward to gain access to the shaft universal joint.
- ② Remove the universal joint locking bolts from the front axle and transmission end universal joints and if necessary, remove the drive shaft.



T018

14. Power steering piping

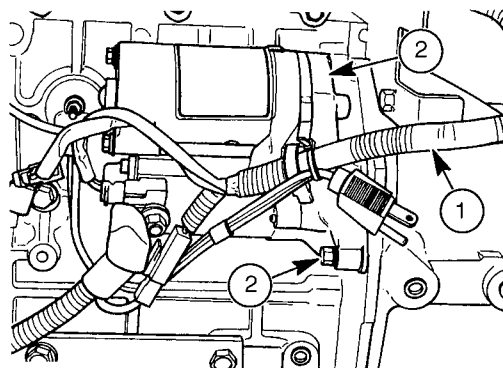
- ① Remove the clamps for power steering oil pipings.
- ② Disconnect the oil pipes and hoses and remove them.



T019

15. Wiring

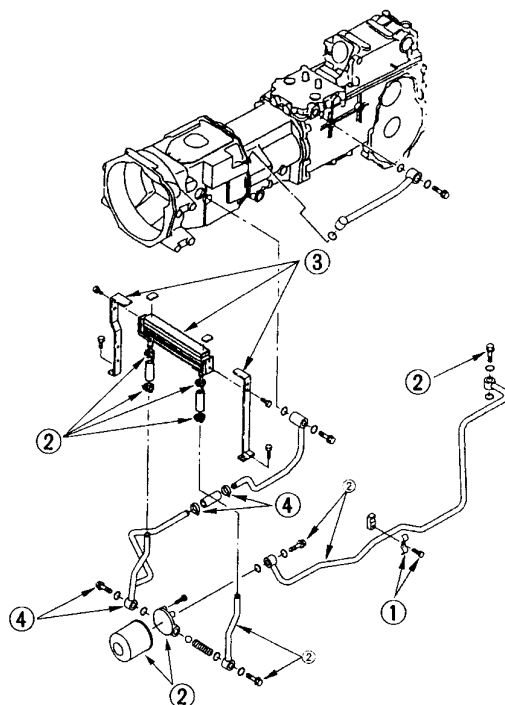
- ① Disconnect the wire harness from the starter, alternator, engine temperature switch, glow plug and engine oil pressure switch, and move the harness out of the way.
- ② Remove the starter mounting bolts and remove the starter.



T020

16. HST piping, oil cooler, oil filter with base (HST model)

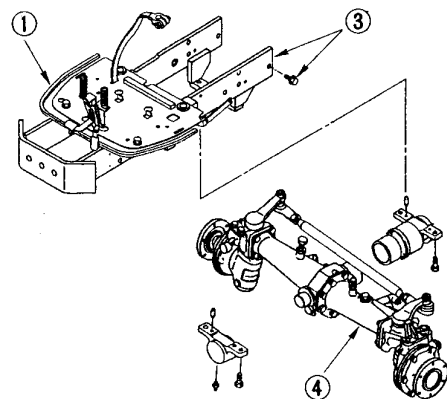
- ① Remove the clamps for HST piping.
- ② Release the hose bands and remove the banjo bolts, pipings and oil filter with base.
- ③ Remove the brackets and oil cooler form on the front axle support.
- ④ Release the hose band and remove the banjo bolt and suction pipe for HST.



T021

17. Battery base, front axle support

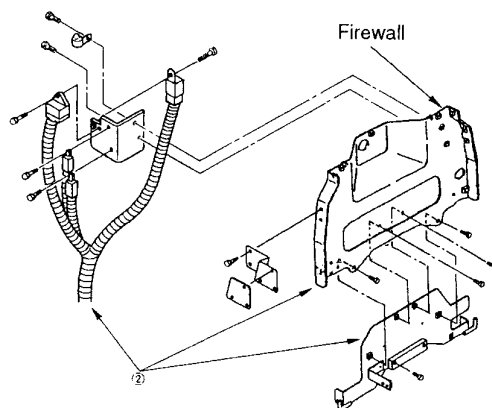
- ① Remove the bolts and battery base form on the front axle support.
- ② Lift the engine with the hoist and put the safety stand under the clutch housing.
- ③ Heat the front axle support attaching bolts head by burner, and remove the bolts and front axle support with front axle assembly.
- ④ Separate the front axle assembly from the support.



T022

18. Firewall

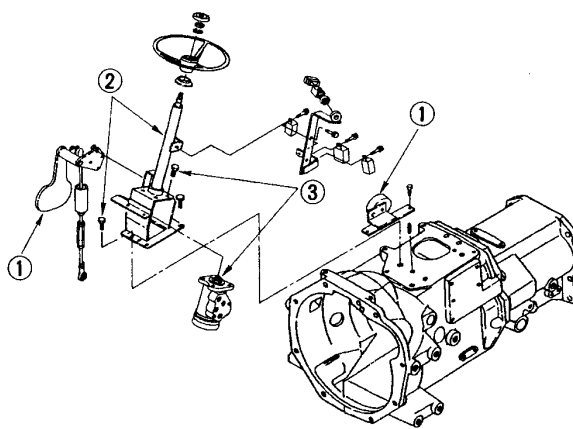
- ① Disconnect the electric wire connectors from the light switch and relay etc.
- ② Remove the firewall with electric wire harness.



T023

19. Power steering control valve, column

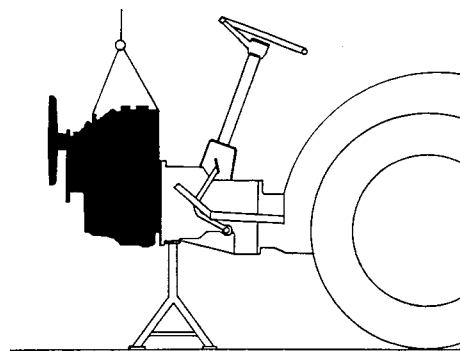
- ① Remove the cruise control assembly from the steering column on HST model.
- ② Remove the bolts and steering column from the clutch housing.
- ③ Remove the power steering control valve from the column.



T024

20. Engine

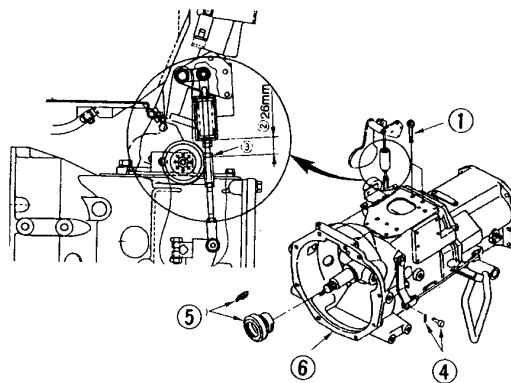
- ① Remove the engine attaching bolts and separate the engine from the clutch housing.



T025

21. Clutch housing (HST only)

- ① Remove the HST test port from top of clutch housing.
- ② Note the HST control rod length before removing for reassembly.
- ③ Untighten the lock nut on the turn buckle and remove the HST control assembly.
- ④ Remove the cotter pin and disconnect the clutch rod.
- ⑤ Remove the spring and release hub in the clutch housing.
- ⑥ Remove the clutch housing retaining bolts, and separate the clutch housing.

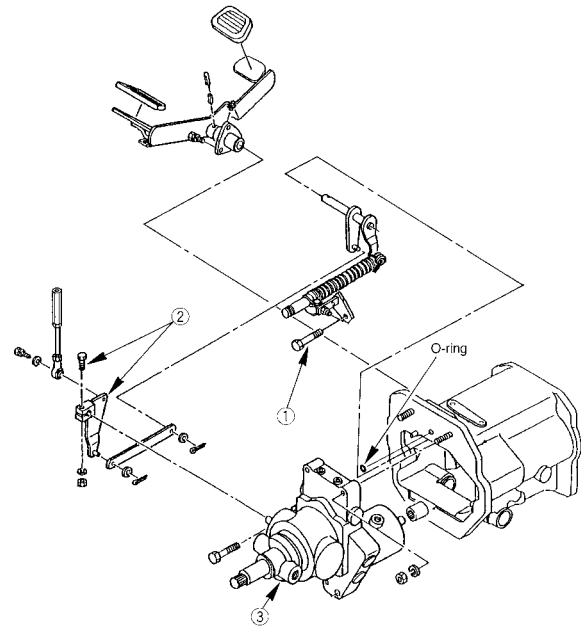


T026

22. HST unit

- ① Remove the damper bracket from front of the HST unit.
- ② Disconnect the shift link from the HST unit.
- ③ Remove the HST unit from the extension housing.

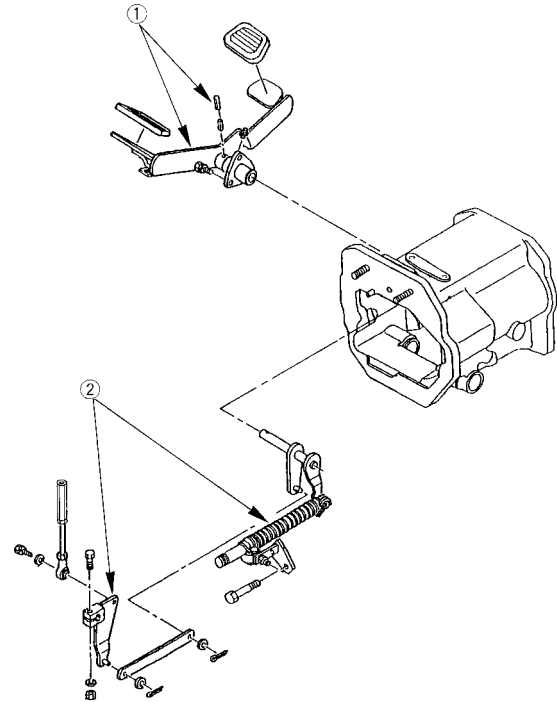
NOTE: Do not lose the O-ring when removing the unit from the extension housing.



T027

23. Damper, HST shift link assembly

- ① Drive out the roll pins and remove the HST control pedal.
- ② Remove the shift link and damper as an assembly.



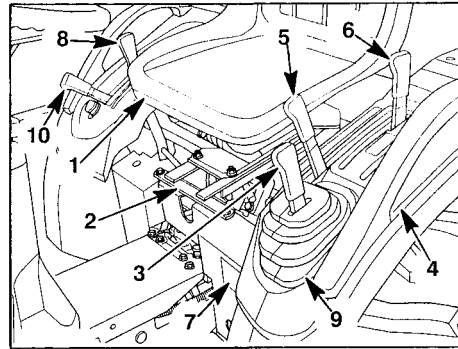
T028

2. TRANSMISSION REMOVAL (9 × 3)

Disassembly

1. Seat · seat track · grip · lever guide

- ① Remove the seat and seat track assembly.
- ② Remove the grips from the hydraulic control lever, FWD control lever, transmission speed range lever, and transmission speed main change lever.
- ③ Remove the lever guides, and rubber boot, from the fender.
- ④ Place a safety support jack under the rear of the clutch housing.



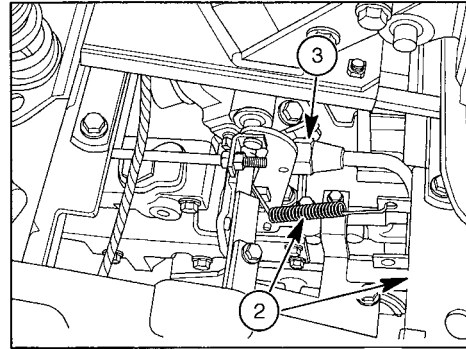
T029

- | | |
|------------------------|-----------------------|
| 1. Seat Assembly | 5. Range Lever |
| 2. Seat Track Assembly | 6. PTO Lever |
| 3. Main Lever | 7. Side Panel – Front |
| 4. Lever Guides | 8. FWD Lever |

- | |
|-----------------------------|
| 9. Rubber Boot |
| 10. Hydraulic Control Lever |

2. Front side cover

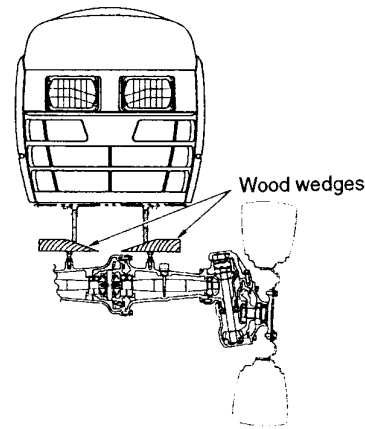
- ① On FWD models, disconnect the FWD shaft from the transmission, see ENGINE REMOVAL.
- ② Unhook the return spring, from the hydraulic control valve and remove the front side cover.
- ③ Disconnect the high-pressure inlet tube, from the top cover and plug the openings.



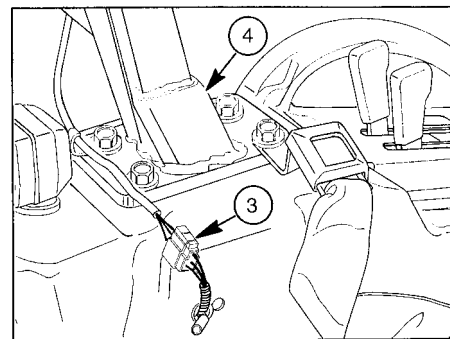
T030

3. ROPS · rear wheel

- ① If not separating the front axle and engine, place the wood wedges, between the front axle support and front axle to prevent the engine from tipping.
- ② Remove the hand brake assembly from the ROPS.
- ③ Disconnect the rear light wire connectors.
- ④ Remove the ROPS bar.
- ⑤ Using a moveable hoist and sling, support the rear transmission and center housing.
- ⑥ Remove the tractor rear wheels.



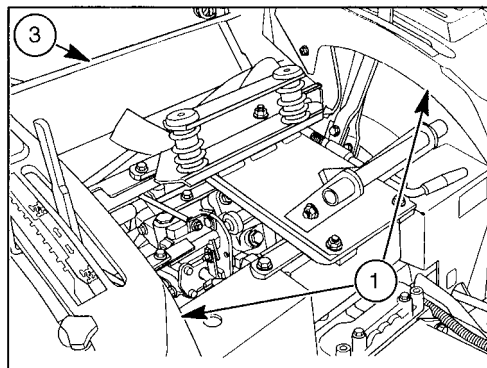
T031



T032

4. Fender, tool box, center frame

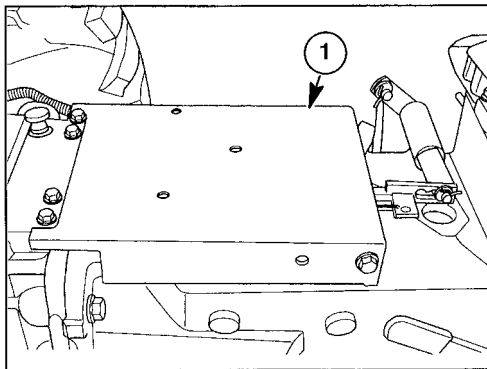
- ① Remove the fenders and frame:lower.
- ② Remove the clip pin and pin from the both brake levers to separate the hand brake wires.
- ③ Remove the tool box and center frame.



T033

5. Transmission cover plate

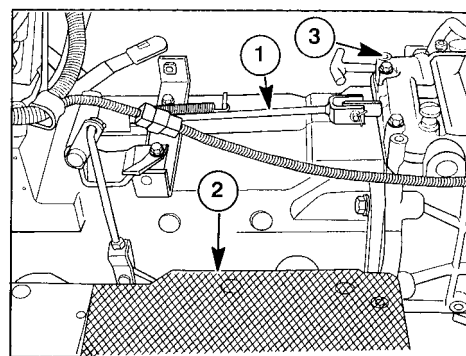
- ① Remove the transmission cover plate.



T034

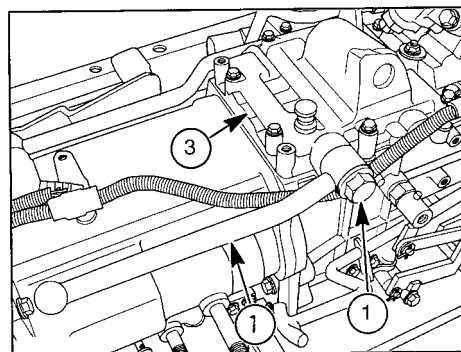
6. Shift cover assembly, brake rod

- ① Disconnect the shift link (9 × 3 only), from the shift cover assembly. Remove the banjo bolt and return pipe from the case cover (HST Model only).
- ② Remove the step plates, from both sides of the tractor, see ENGINE REMOVAL.
- ③ Remove the shift cover assembly (9 × 3) or case cover (HST).
- ④ Place blocking at the front and rear of both front wheels.
- ⑤ Disconnect the brake rods from the brake lever.



9 x 3 Trans shown

T035

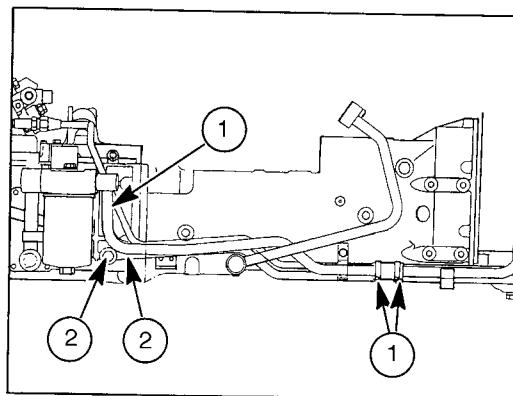


HST Shown

T036

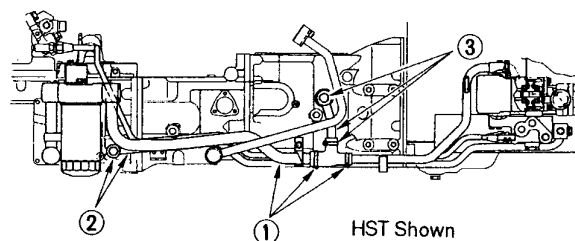
7. Suction, return tube

- ① Loosen the hose clamp, and remove the suction tube, from the filter.
- ② Remove the banjo bolt, with O-ring and remove the return tube.



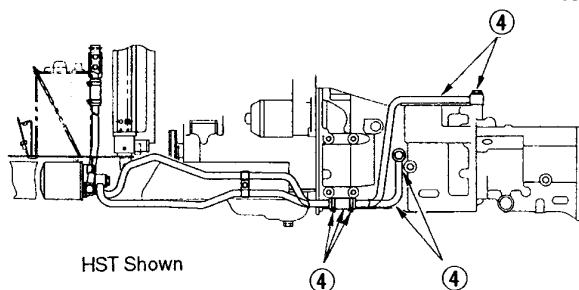
T037

- ③ Loosen the hose clamp and remove the banjo bolt and suction tube for HST.



T038

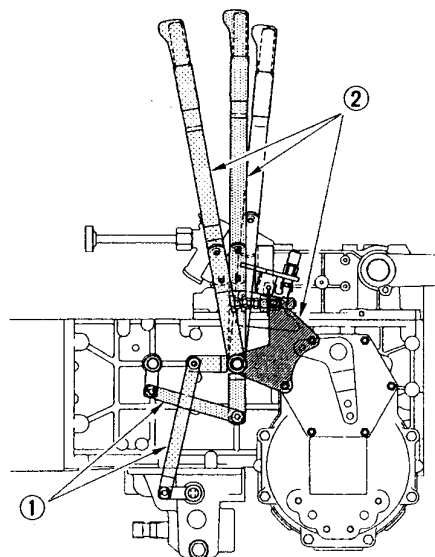
- ④ Remove the banjo bolts and piping for oil cooler and oil filter circuit.



T039

8. Mid PTO and rear PTO change lever assembly

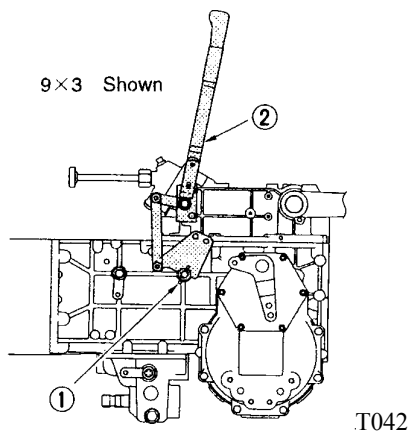
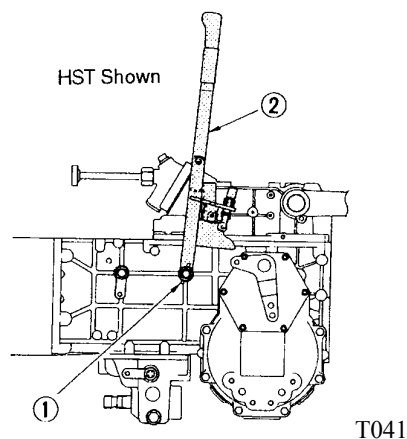
- ① Remove the split pins and separate the shift plates from the mid PTO and rear PTO change lever.
- ② Remove the mid PTO and rear as an assembly from the rear axle housing.



T040

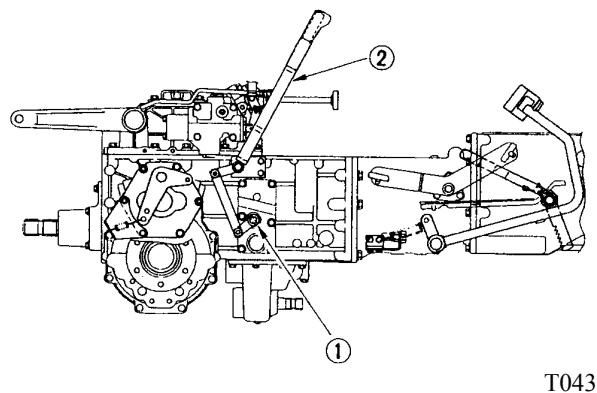
9. Range gear change lever

- ① Drive out the roll pin from the range change lever.
- ② Remove the range change lever assembly on HST Model, and remove the range change lever assembly from the hydraulic lift cylinder housing on 9×3 Model.



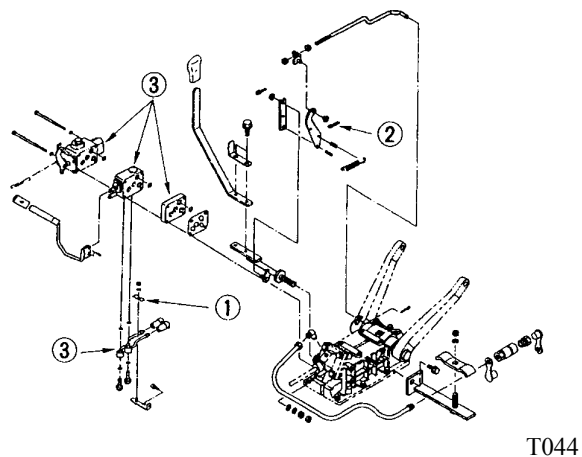
10. Fwd change lever

- ① Drive out the roll pin from the front drive change lever.
- ② Remove the front drive change lever assembly from the rear transmission housing.



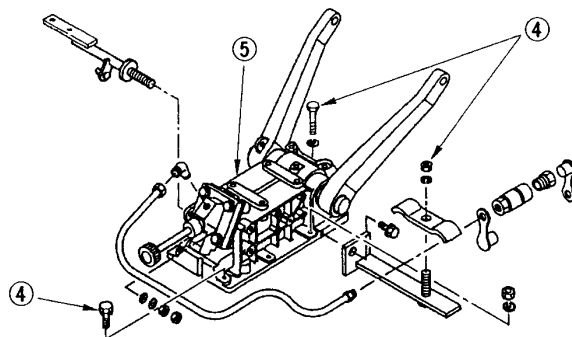
11. Lift cylinder housing

- ① Remove the clamps for the extension pipings.
- ② Remove the cotter pin from the lift arm feed back rod.
- ③ Remove the main control valve and sub-control valve with pipings.



- ④ Remove the retaining bolts and nuts securing the lift cover to the center housing.
- ⑤ Using a hoist, remove the lift cover.

NOTE: Use care when put the housing the range gears are installed bottom of the housing.



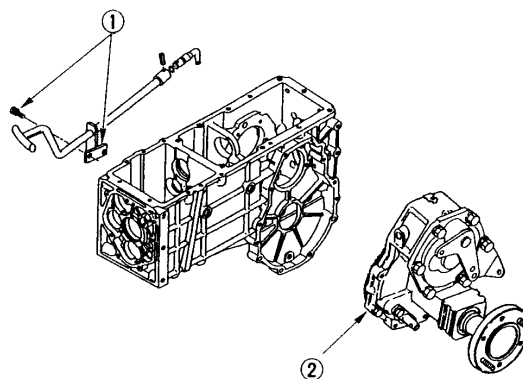
T045

12. Rear axle assembly

- ① Remove the clamp of the differential lock pedal.
- ② Remove the rear axle retaining bolts and nuts, and remove the rear axle assembly.

NOTE:

- 1 Take care so that units do not lose balance.
- 2 Care is also necessary since the differential lock fork and spring come out when the case is removed.
- 3 Differential lock pedal, fork and spring are installed on the R.H. housing of manual transmission and L.H. housing of HST model.



T046

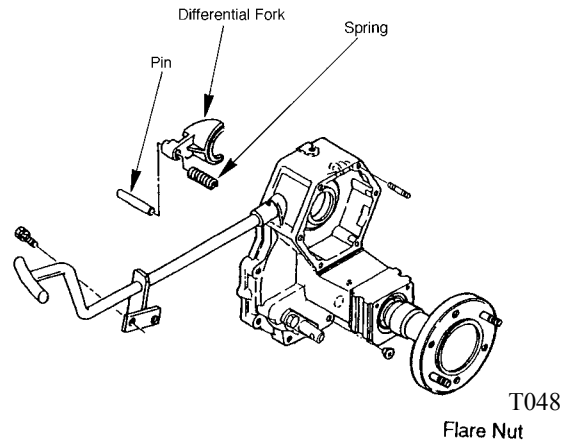
1-6 Installation and Trial Run

1 INSTALLATION

- 1) Liquid gasket and thread sealant (Loctite Safety Solvent)
 - ① We recommend the liquid gasket sealer is SHIBAURA Part Code No. 095109062 or Three Bond No. 1104.
 - ② Use care to not permit excess sealer to enter the inside of the housings or shift rod bores.
 - ③ We recommend the thread sealant is Three Bond No. 1305B and apply the thread sealant.
- 2) Installation generally follows the removal procedure in reverse and refer to mentioned below:

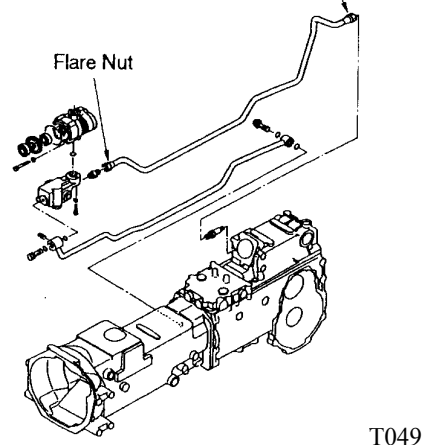
1. Return spring

- ① Apply the grease to the return spring for differential fork and install it on the pin when installing the rear axle assembly to the differential housing.



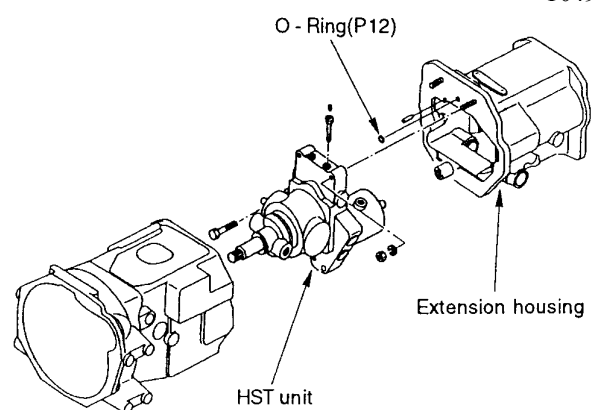
2. High pressure oil pipe

Flare nut of the high pressure oil pipe tighten to 58,8~78.4 N·m (6~8 kgf·m).



3. O-ring for HST

Install the O-ring between HST unit and extension housing.

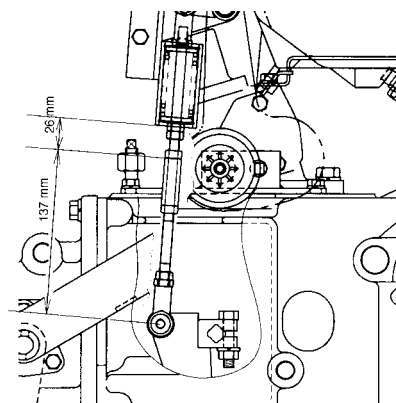


T050

4. HST cruise control rod

- ① Adjust the length of the cruise control rod as same as before disassembled length. If didn't measure length, adjust it as shown.

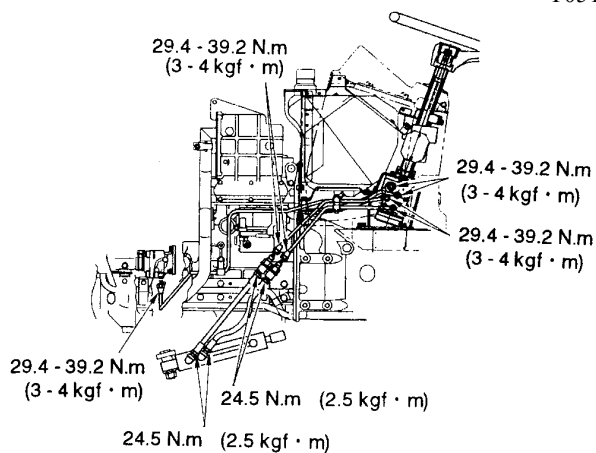
NOTE: If necessary, adjust the neutral position by tuenbackle.



T051

5. Power steering pipings

Power steering pipings tightening torque to follows as illustration.

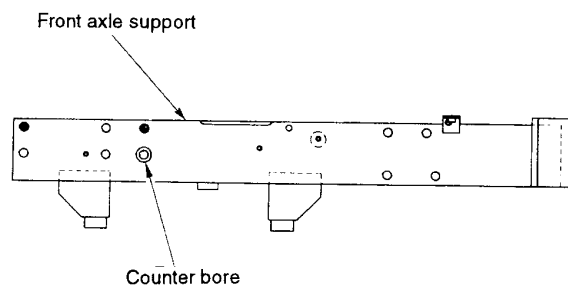


T052

6. Front axle support bolt

Apply the thread sealant on the bolts thread when install the front axle support and tighten to 49.0~62.7 N·m (5.0~6.4 kgf·m).

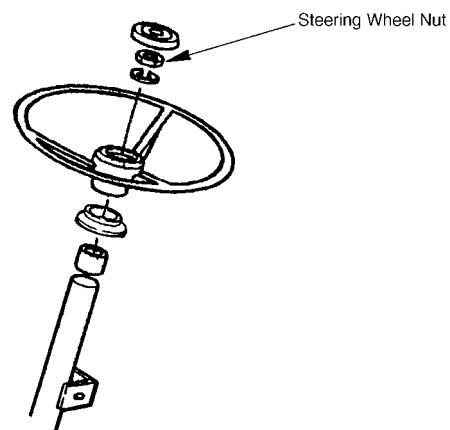
NOTE: The one short bolt (length is 25 mm) is installed to the counter bore on the R.H. front axle support.



T053

7. Steering wheel nut

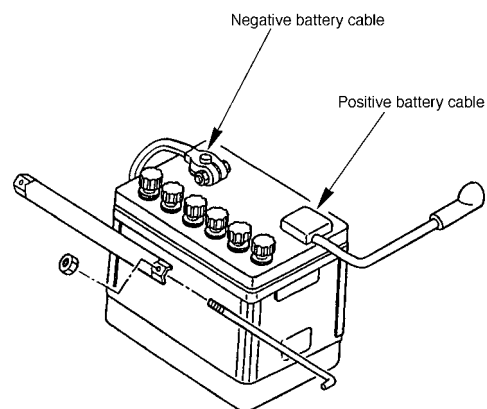
The nut for steering wheel is tightend to 3.0~3.4 N·m
(0.3~0.35 kgf·m)



T054

8. Battery cable

- ① Fit the positive battery cable first then the negative.



T055

2. TRIAL RUNNING

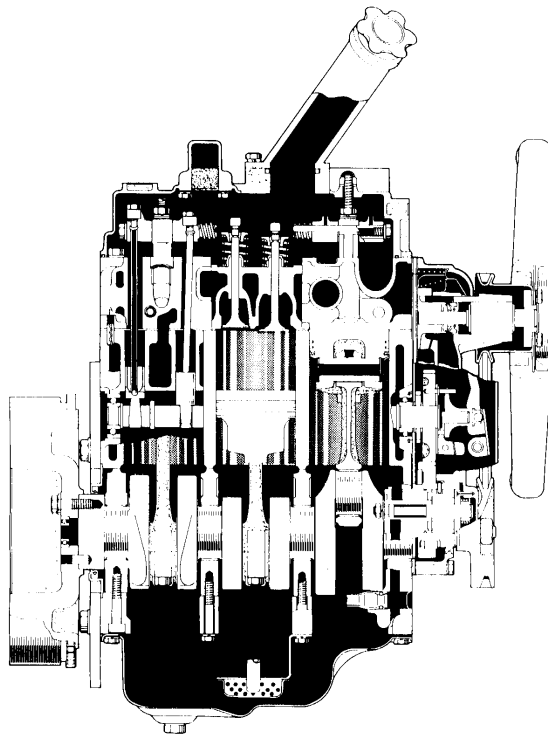
After overhaul engine it will need a trial run – Refer to the following

1. Check the quantity of the coolant, engine oil and fuel.
2. Disconnect the wiring harness connector as the engine stop solenoid.
3. Move the hand throttle lever to the low throttle position and foot throttle to the free position.
4. Turn the key switch to the “Start” position (rotate the starting motor) until the oil pressure lamp goes off. (about 20 – 30 seconds).
5. Turn the key switch to the “Off” position.
6. Connect the wiring harness connector at the engine stop solenoid.
7. Move the hand throttle lever to the half throttle position and start the engine.
8. Adjust the low speed engine running and warm up on at the same time as follows:
 - Check for abnormal sounds.
 - Check the coolant temperature.
 - Check the engine oil temperature.
 - Check the engine oil and coolant leaking.
 - Check the coloring of exhaust gas.

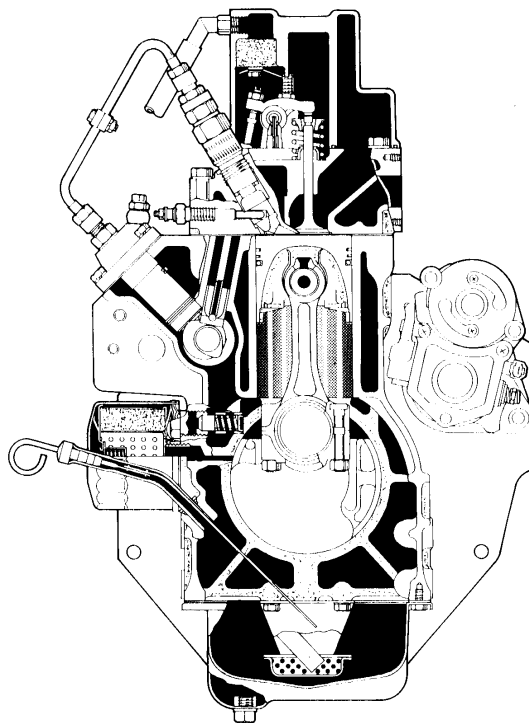
Chapter 2. ENGINE

Tractor Model	Engine Model
ST318	S753
ST321	S773
ST324	S773L

2-1 Engine Sectional View



T100



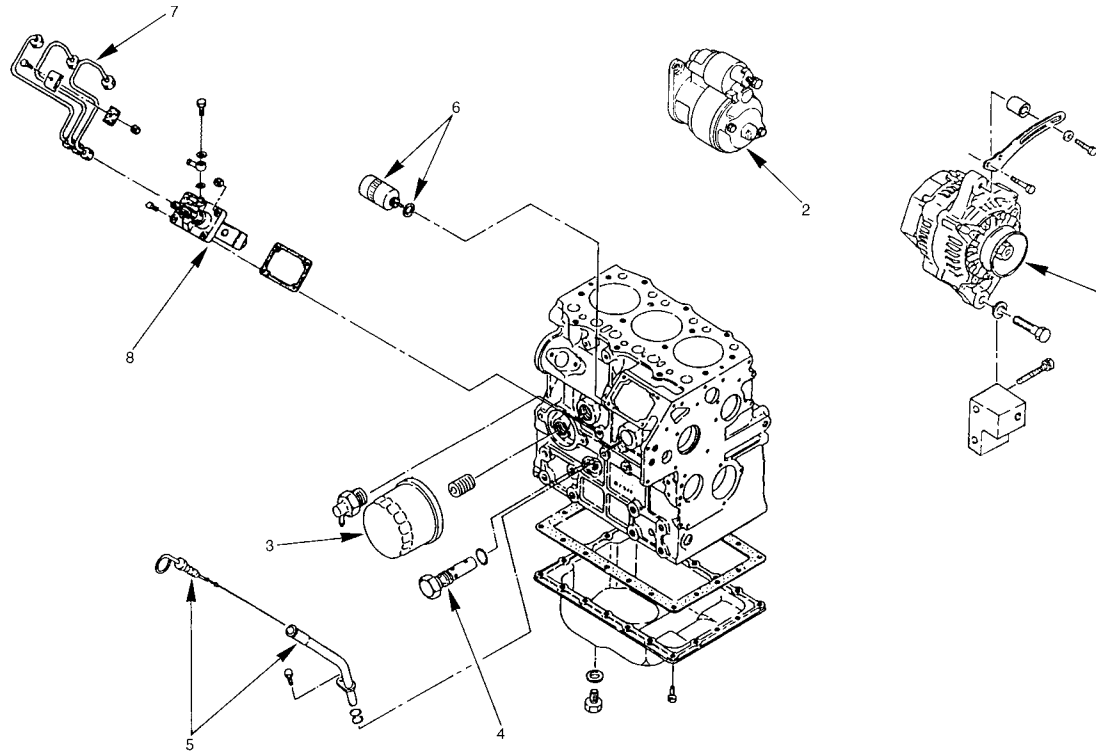
T101

2-2 Engine Specifications

Specifications	Model	ST318	ST321	ST324
		S753	S773	S773L
Type		4-cycle diesel engine		
Cylinder arrangement		Vertical in-line		
Combustion chamber type		Whirl-chamber type		
No. of cylinders		3		
Bore x stroke		75 mm × 72 mm	77 mm × 72 mm	77 mm × 82 mm
Total stroke volume		954 cc	1005 cc	1131 cc
Compression ratio		23 : 1	23 : 1	22.5 : 1
Performance				
Rated speed		2600 rpm	2600 rpm	2600 rpm
Fuel system				
Injection pump type		Bosch type		
Nozzle type		Throttle type		
Fuel		Diesel fuel oil		
Fuel consumption		200 g/PSH (0.46 lb/HP · Hr)		
Lubricating system				
Lubricating method		Trochoid pump forced pressure feeding		
Filtering method		Cartridge full-flow type		
Lubricating oil quantity (with filter change)		3.3 ℓ		3 ℓ
Cooling system				
Cooling method		Forced circulation water cooling type		
Cooling water volume		3.5 ℓ		
Air cleaner		Dry type (cyclone type)		
Electric system		12 V – 36 AH		
Battery capacity				
Alternator				
Starting motor				
Glow plug				

2-3 Disassembly, Inspection and Reassembly

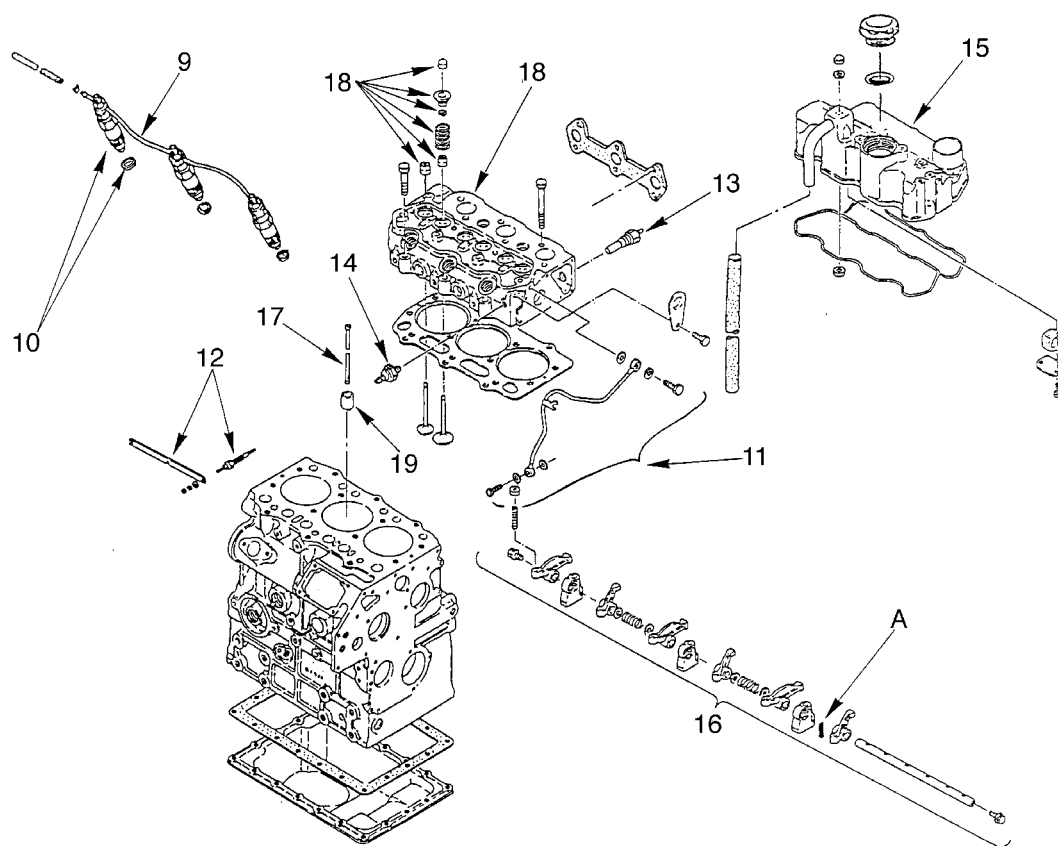
1. DISASSEMBLY



T102

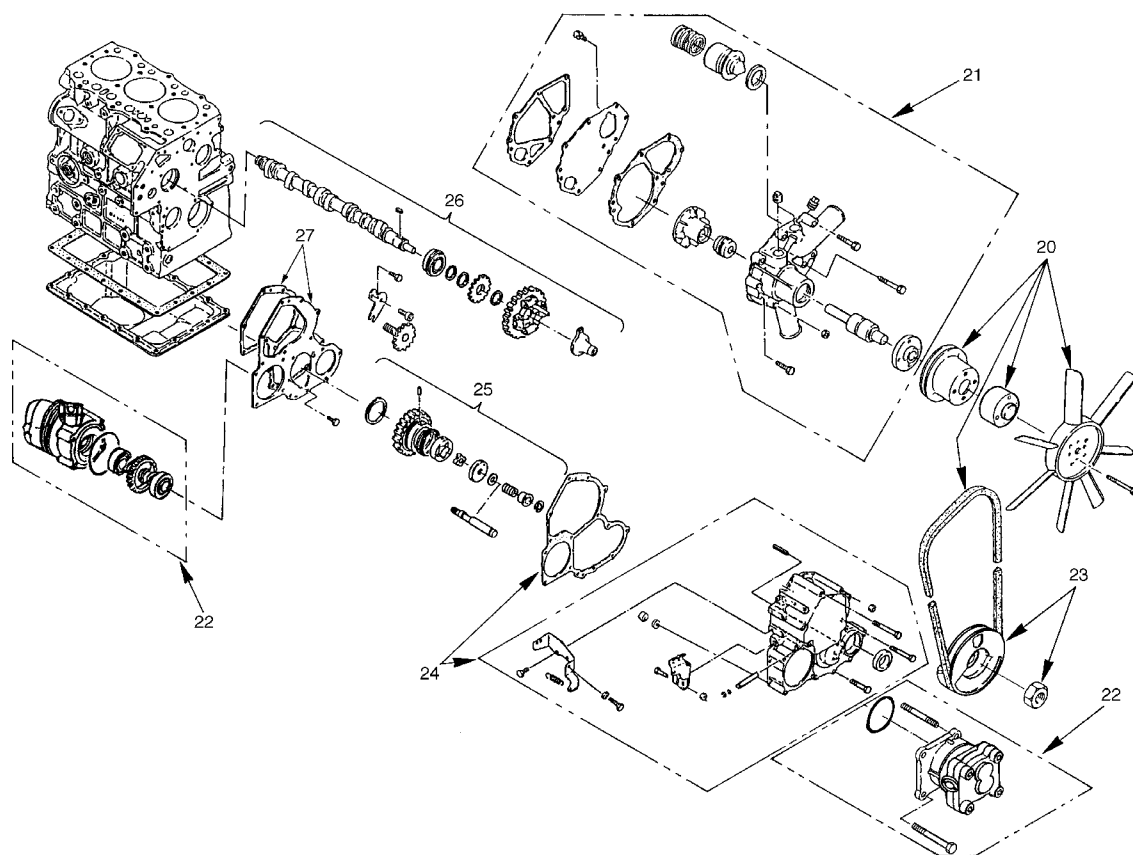
Disassembly

Order	Parts Name
1	Alternator
2	Starting motor
3	Oil filter
4	Relief valve
5	Oil level gauge · Gauge guide
6	Engine stop solenoid · Seal washer
7	Injection pipe
8	Injection pump NOTE: 1. Remove the injection pipes and engine stop solenoid before remove the injection pump. 2. Raise the injection pump and remove the governor link from the control rack. 3. Injection timing has been adjusted by the shims between injection pump and cylinder block. Take note of their thickness and number when removing the injection pump.



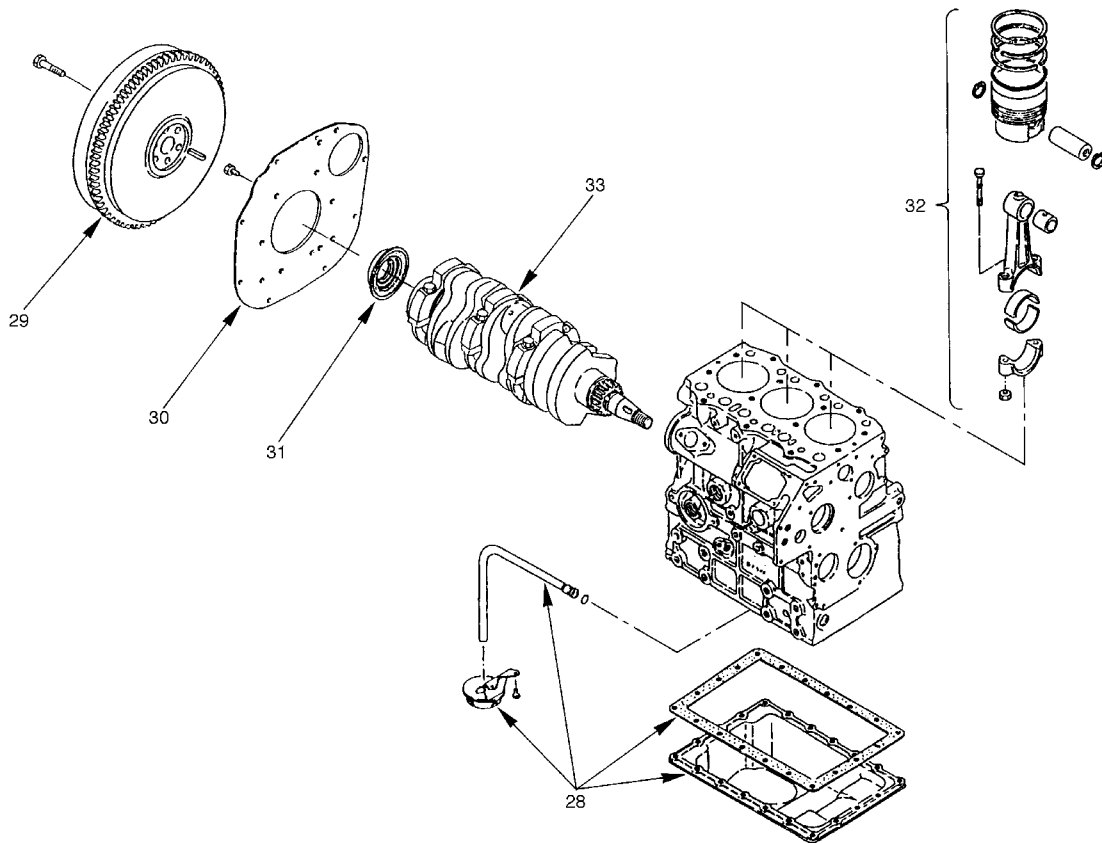
T103

Order	Parts Name
9	Return pipe
10	Injection nozzle · gasket
11	Oil pipe · Eye bolt · Seal washer
12	Glow plug · Connector
13	Thermo-sensor
14	Oil pressure switch
15	Head cover
16	Rocker arm assembly NOTE: Draw out the roll pin (A) from the No. 1 rocker arm bracket, and remove the rocker arm shaft.
17	Push rod
18	Cylinder head · Head gasket NOTE: 1. If necessary, remove the intake valves and exhaust valves with covered shop towel for prevent jump out the parts by spring.
19	Tappet NOTE: Store carefully to ensure they are refitted to the same place.



T104

Order	Parts Name
20	Fan holder · Fan pulley · V-belt · Cooling fan
21	Water pump assembly · Thermostat · Gasket
22	Hydraulic oil pump · Power steering oil pump
23	Crankshaft pulley
24	Timing gear case assembly NOTE: Remove the engine stop solenoid and injection pump assembly at first.
25	Idle gear · Oil pump assembly
26	Cam shaft assembly · Tachometer assembly NOTE: Remove the bolts and plate at first, and remove the cam shaft assembly and tachometer assembly.
27	Front plate · Gasket



T105

Order	Parts Name
28	Oil pan · Gasket · Suction filter · Suction pipe
29	Fly wheel
30	Rear plate
31	Oil seal
32	Piston and connecting rod assembly NOTE: 1. Before extracting piston, remove the carbon deposit from the TDC in the cylinder. 2. Place the connecting rod, cap and bearing removed in order of the cylinders.
33	Crank shaft and bearing holder assembly NOTE: Remove the four bolts, and draw out the crank shaft and bearing holder assembly as a set.

2. DISASSEMBLY AND INSPECTION OF ENGINE MAIN PARTS

* Cautions before start

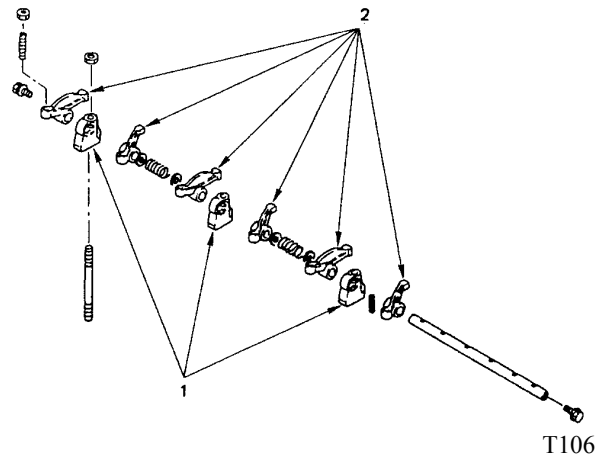
- 1) Check the cylinder block and cylinder head for wear, leakage and damage.
- 2) Remove deposit in oil holes of each part with air and check for clogging.
- 3) Wash each part well to remove dust, contaminated oil, carbon, and other foreign matter.
- 4) Remove carbon deposite on the piston, cylinder head, valves, etc. carefully not to damage parts. (Great care is necessary specifically for aluminum alloy parts.)
- 5) Valves, pistons, connecting rods, metals and other parts which are to be combined as specified should be attached match marks beforehand to prevent confusion.

1) Rocker arm ass'y

Disassembly

- (1) Remove the bolts at both ends of the rocker arm shaft and take out the rocker arm, rocker arm bracket, spring and shim.
- (2) Extract the spring pin which has been driven into the No. 1 cylinder rocker arm bracket and take out the rocker arm, spring and bracket.

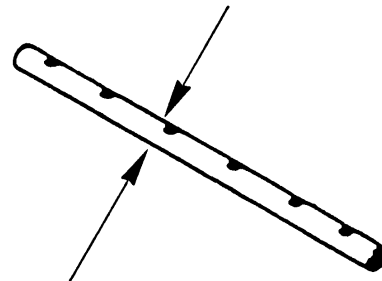
1. Rocker arm bracket
2. Rocker arm



Inspection and service

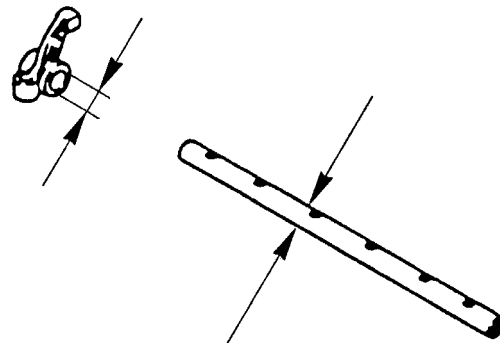
- (1) Using a micrometer, check outside diameter of the rocker arm shaft. If the shaft is worn exceeding service limit, replace it with new one.

Wear of rocker arm shaft $\varnothing$	
Standard assembling value	Service limit
11.65 – 11.668	Less than 11.57



- (2) Measure the inside diameter of the rocker arm. Calculate the clearance between the rocker arm and rocker arm shaft. If the clearance is excessive, replace the part.

Clearance between rocker arm and rocker arm shaft (mm)	
Standard assembling value	Service limit
0.032 – 0.068	More than 0.2

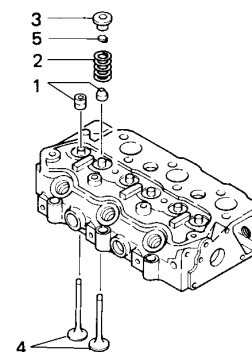


2) Cylinder head ass'y

Disassembly

- (1) Using a valve spring replacer, compress the valve spring to remove the valve cotter, retainer, spring and valve.
- (2) Remove the valve guide seal.

- | | |
|---------------------|-----------------|
| 1. Valve guide seal | 4. Valve |
| 2. Spring | 5. Valve cotter |
| 3. Retainer | |

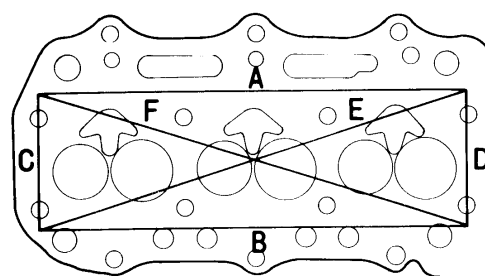


T109

Inspection and service

- (1) Distortion of cylinder head bottom surface Apply a straight edge to the bottom surface of the cylinder head, and insert a thickness gauge at 6 points from A to F in the right figure and measure distortion. If the distortion exceeds the repair value, correct with surface grinder or the like.

Distortion at cylinder head bottom surface (mm)	
Standard assembling value	Repair value
Less than 0.05	More than 0.12



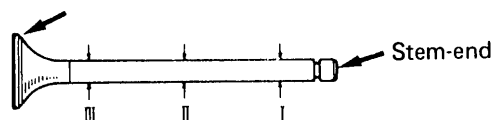
T110

- (2) Valve guide and valve stem

- ① Check the head and stem of each valve and replace if burnout, wear or deformation is remarkable.

Wear of valve stem (mm)			
Intake valve		Exhaust valve	
Standard assembling value	Service limit	Standard assembling value	Service limit
6.955 – 6.97	6.89	6.94 – 6.955	6.84

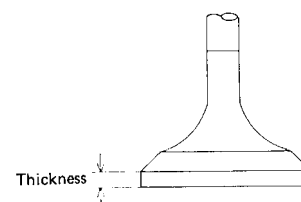
- ② Measure the outside diameter at the position I, II, and III on the valve stem with a micrometer and replace if the result is less than the service limit.



T111

- ③ Replace a valve if its head thickness is less than service limit.

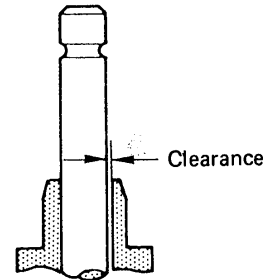
Valve head thickness (mm)	
Standard assembling value	Service limit
0.775 – 1.075	Less than 0.5



T112

- ④ Replace the valve if the clearance between the stem and guide exceeds the service limit.

Clearance between valve stem and valve guide (mm)			
Intake valve		Exhaust valve	
Standard assembling value	Service limit	Standard assembling value	Service limit
0.03 – 0.06	More than 0.2	0.045 – 0.075	More than 0.25



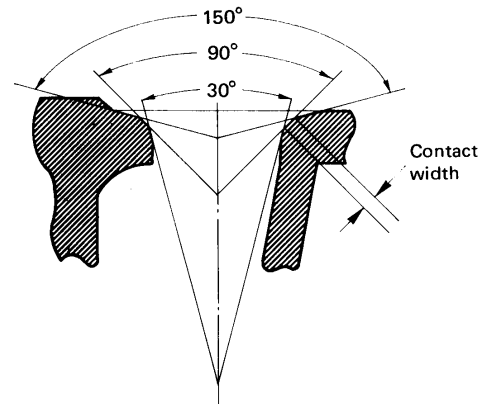
T113

(3) Valve seat

- ① Since the valve seat is corrected according to the valve guide, be sure to check the valve guide for wear condition first before correcting the seat.

Valve seat contact width (mm)	
Standard assembling value	Repair value
1.7 – 2.1	More than 2.5

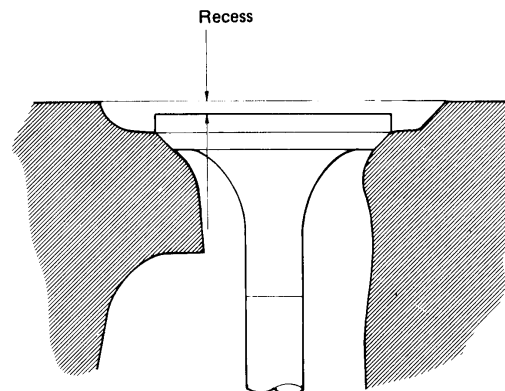
- ② Correct the seat to the standard assembling values of the contact width and recess using seat cutters of 15°, 45° and 75°.



T114

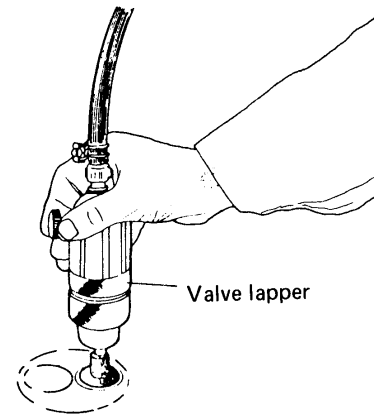
- ③ When the seat recess exceeds the service limit, replace the cylinder head.

Valve seat recess (mm)	
Standard assembling value	Service limit
0.85 – 1.15	More than 1.8



T115

- ④ Coat the valve seat surface with compound and lap the contact surface turning the valve.
- ⑤ Check that the valve contact surface is within the standard value and the contact position is even.
- ⑥ When the cylinder head is replaced with new one, adjust the seat contact width and seat recess to the specified values with a seat cutter before lapping.

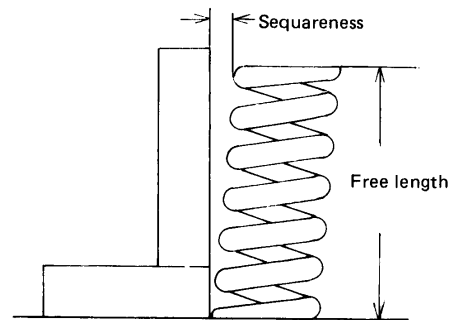


T116

(4) Valve spring

- ① Check the valve spring visually for damage.
- ② Measure the squareness of the spring using a square on a surface plate and replace if the service limit is exceeded.
- ③ Check the free length and spring force with a spring tester and replace if the service limit is exceeded.

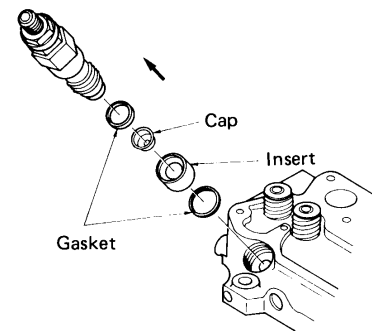
	Standard assembling value	Service limit
Squareness (mm)	1.2	More than 2
Free length (mm)	35	Less than 33.5
Spring force (when compressed to 30.4 mm)	72.9 N (8.1 kgf)	68.6 N (Less than 7 kgf)



T117

(5) Inner face of combustion chamber

Pull out the cap and insert from the cylinder head.
Check and clean the combustion chamber.



T118

NOTE:

1. Do not remove the insert.

Reassembly

Reassemble components in the reverse order to disassembly taking care to the following point.
When assembling the valve spring, retainer and cotter, take deep care not to damage the valve guide seal.

3) Cylinder block

Inspection and service

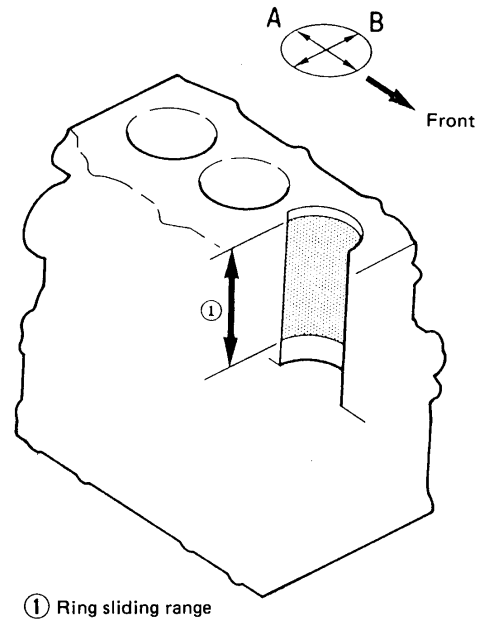
(1) Check for crack, damage and distortion on the top of the block in the same way as in the cylinder head.

(2) Measurement of cylinder bore

- ① There should be no scratch, rust, corrosion, etc. on the cylinder bore when checked visually.
- ② Measure the cylinder bore at the top, center and bottom respectively in the crankshaft direction (A) and the direction at right angle to it (B). If the repair value is exceeded, finish to an oversize by boring.
- ③ The above-described bore top corresponding to the top ring position at the piston TDC about **10 mm** below the cylinder block top surface, and the bottom corresponds to the oil ring position at the BDC about **100 mm** below the cylinder block top surface.
- ④ Use a cylinder gauge (inside dial gauge) for the measurement. Apply the gauge correctly at right angle to the bore wall surface.
- ⑤ Cylinder honing shall be conducted by boring according to the following specifications. Honing specifications (2-step honing according to Dia specifications)
 - Grinding stone: Tokyo Dia SD120/140
N100M (bronze type)
 - Finishing: GC600JB
 - Grinding stone size: 100L × 4W
 - Speed: 162 rpm
 - Axial feeding speed: 13 m/min
 - Gauge pressure: Rough finishing: 15kgf/cm²
Finishing: 5 kgf/cm²
 - Finishing stroke: 9
 - Honing allowance: 0.04 mm (diameter)
 - Cross hatch overall angle: 40°
 - Surface roughness: 2 – 4 μ

(Unit: mm)

Distortion on cylinder block top surface (mm)	
Standard assembling value	Repair value
Less than 0.05	More than 0.12



T119

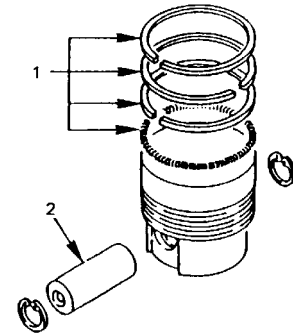
Model	Standard assembling value	Repair value		Standard assembling value	Repair value		Standard assembling value	Repair value
S753	ø75 - ø75.019	ø75.2	1st boring 0.5	ø75.5 - ø75.519	ø75.7	2nd boring 0.5	ø76 - ø76.019	More than ø76.2
S773 · S773L	ø77 - ø77.019	ø77.2	1st boring 0.5	ø77.5 - ø77.519	More than ø77.7		Replace the block.	

4) Piston and piston ring

Disassembly

- (1) Remove the piston ring using a piston ring tool.
- (2) Remove the snap ring and extract the piston pin.

1. Piston ring
2. Piston pin



T120

Inspection

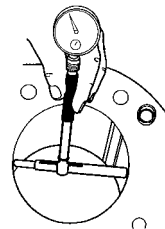
(1) Piston

- ① Check the piston for crack, streak and burnout on the outside surface and replace if remarkable.
- ② Measure the longer diameter at 10 mm above the lower end of the piston skirt and bore of the cylinder in the thrust direction, calculate the clearance, and replace if the repair value is exceeded.
- ③ When the cylinder is substituted with an oversize one, use a piston of an oversize.

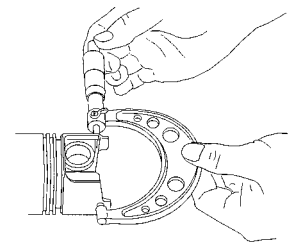
Model	Piston size	Part code No.	Skirt bottom longer dia.
S753	S.T.D	115317790	74.9325-74.9475
	O.S. 0.5	115317800	75.4325-75.4475
	O.S. 1.0	115317810	75.9325-75.9475
S773	S.T.D	115317630	76.9325-76.9475
	O.S. 0.5	115317640	77.4325-77.4475
S773L	S.T.D.	115317990	76.9325-76.9475
	O.S. 0.5	115317995	77.4325-77.4475

Clearance between cylinder and piston (mm)		
Model	Standard assembling value	Service limit
S753 S773 S773L	0.0425 – 0.0765	More than 0.25

Piston skirt bottom longer dia. (mm)		
Model	Standard assembling value	Service limit
S753	ø 74.9325-74.9475	Less than ø74.7
S773	ø76.9325-76.9475	Less than ø76.7
S773L	ø76.9325-76.9475	Less than ø76.7



T121



T122

- ④ Measure the piston pin hole diameter and piston pin outside diameter and replace if the clearance exceeds the service limit.

Clearance between piston pin hole and piston pin (mm)		
Model	Standard assembling value	Service limit
S753 S773 S773L	-0.004 ~ +0.004	More than 0.02

(2) Piston ring

- ① Replace worn out or damaged piston ring, if any.
- ② Insert a ring at a right angle to the least worn out skirt of a cylinder, measure the clearance of ring end gap with a thickness gauge and replace if the end gap exceeds the service limit.

Piston ring end gap (mm)		
S773	Standard assembling value	Service limit
Top ring	0.2 – 0.35	1.0
Second ring	0.15 – 0.20	1.0
Oil ring	0.15 – 0.35	1.0

Piston ring end gap (mm)		
S773L	Standard assembling value	Service limit
Top ring	0.2 – 0.35	1.0
Second ring	0.15 – 0.20	1.0
Oil ring	0.15 – 0.35	1.0

- ③ Measure the clearance between the piston ring grove and ring and replace if the service limit is exceeded.

- ④ When the cylinder is replaced with an over size one, use a piston ring set of over size accordingly. Piston kit composed of piston and piston rings are available.

Piston kit		
Model	Size	Part code No.
S753	STD.	115017140
	O.S. 0.5	115017150
	O.S. 1.0	115017160
S773	STD.	115016990
	O.S. 0.5	115016980
S773L	STD.	115017460
	O.S. 0.5	115017450

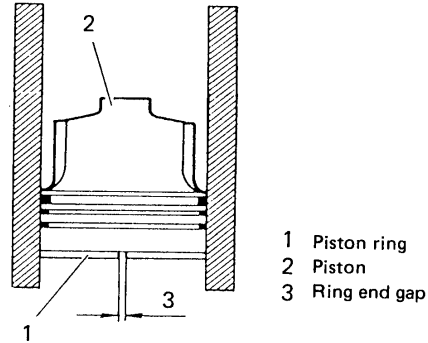
⑤ Piston ring installing procedure

Install the piston ring to the piston as shown in the right figure.

(3) Piston pin

Measure the outside diameter of the piston pin and replace if the service limit is exceeded.

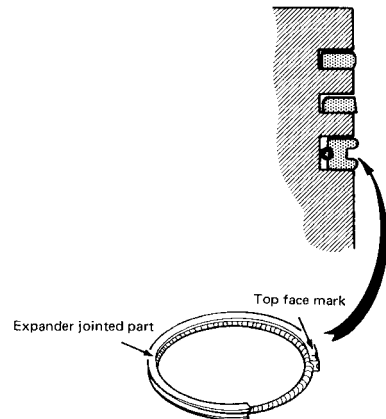
Piston ring end gap (mm)		
S753	Standard assembling value	Service limit
Top ring	0.2 – 0.35	1.0
Second ring	0.15 – 0.20	1.0
Oil ring	0.15 – 0.35	1.0



T123

Clearance between piston ring groove and ring (mm)		
	Standard assembling value	Service limit
Top ring	0.06 – 0.1	More than 0.25
Second ring	0.05 – 0.09	More than 0.25
Oil ring	0.02 – 0.06	More than 0.15

Model	Piston ring size	Part code No.
S753	STD.	115107201
	O.S. 0.5	115107204
	O.S. 1.0	115107206
S773-S773L	STD.	115107900
	O.S. 0.5	115107430



T124

Piston pin outside dia. (ø)	
Standard assembling value	Service limit
20.998 – 21.002	Less than 20.98

5) Connecting rod

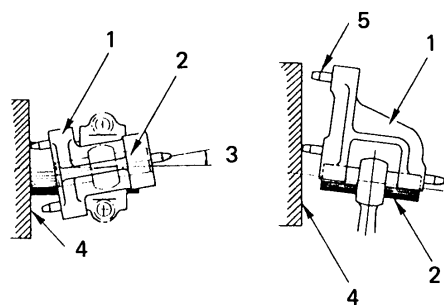
Inspection

- (1) Check for torsion, parallelism and damage.

Measure the torsion and parallelism using a connecting rod aligner and correct or replace if the repair value is exceeded.

1. Gauge
2. Piston pin
3. Torsion
4. Flat part of aligner
5. Pin

Torsion and parallelism of connecting rod (mm)		
	Standard assembling value	Repair value
Torsion (per 100 mm)	Less than 0.08	More than 0.2
Parallelism (per 100 mm)	Less than 0.05	More than 0.15



T125

- (2) Measure the bore of the connecting rod small end bush and replace if the clearance to the piston pin exceeds the service limit.

Clearance between bush and piston pin (mm)	
Standard assembling value	Service limit
0.008 – 0.023	More than 0.08

- (3) Install the connecting rod to the crankshaft, measure the axial play and replace the connecting rod if the service limit is exceeded.

Axial play of connecting rod and crank pin (mm)	
Standard assembling value	Service limit
0.1 – 0.3	More than 0.7

6) Connecting rod metal

Inspection

- (1) Check the metal and if peeling, melting, uneven wear, improper contact or other damage is noticed, replace the metal.
- (2) Measure the oil clearance of the crank pin and metal using plasti-gauge.
 - ① Remove oil dust or other foreign matter stuck to the metal and crank pin.
 - ② Cut plasti-gauge to the length same as the metal width and place it on the crank pin in parallel with the crankshaft avoiding the oil hole.
 - ③ Install the connecting rod metal and connecting rod cap and tighten with the specified tightening torque.

Tightening torque	29 – 34 N·m (3.0 – 3.5 kgf·m)
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NOTE: Never turn the connecting rod at this time.

- ④ Remove the connecting rod cap and measure the plasti-gauge width with the scale printed on the gauge envelope.

NOTE: Measure the widest part of the plasti-gauge.

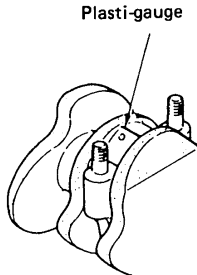
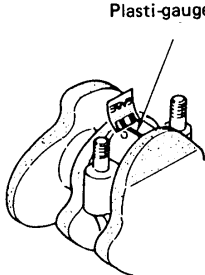
- (3) If the oil clearance exceeds the service limit according to the result of the measurement, replace the metal or grind the crank pin and replace with a metal of undersize.

NOTE:

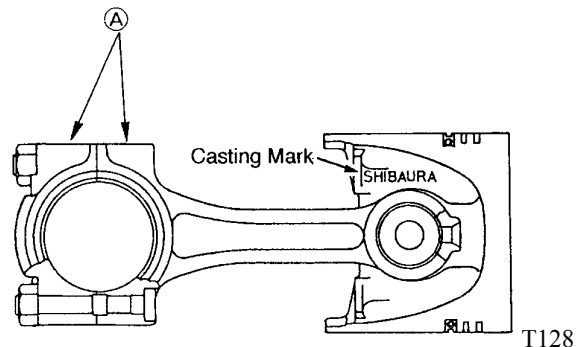
1. When the crank shaft pin outside is ground, check the oil clearance before installing it.
2. Grind the crank pin precisely referring to the paragraph of the crank shaft about the finishing accuracy and oil holes.

Reassembly (piston and connecting rod)

- (1) Heat the piston to about 100°C with a piston heater or the like and install it aligning the SHIBAURA mark in the piston and match mark at (A) of the connecting rod.
- (2) Care should be taken to the figure match mark at (A) of the connecting rod.
- (3) Install the piston ring to the piston facing the stamp at the end surface of the ring end gap upward.
- (4) When the connecting rod or piston and piston pin are replaced, weight variation among cylinders with the rod, piston and piston ring installed should be within 10 g.

Clearance between crank pin and connecting rod metal (oil clearance) (mm)	
Standard assembling value	Service limit
0.035 – 0.083	More than 0.2
Set a plasti-gauge.  T126	Measure the oil clearance.  T127

Metal size	Metal code No.	Crankshaft pin outside dia. Finishing dimension (φ)
S.T.D.	198517130	38.964 – 38.975
U.S. 0.25	198517134	38.714 – 38.725
U.S. 0.50	198517137	38.464 – 38.475



7) Disassembly, inspection and reassembly of bearing holder

Disassembly and inspection

Center bearing

- (1) Remove the bearing holder, and replace the metal if peeling, melting, uneven wear, or improper contact is noticed.
- (2) Measure the oil clearance of the crankshaft center journal and metal using a plasti-gauge.
- (3) If the oil clearance exceeds the service limit according to the result of the measurement, replace the metal or grind the crankshaft center journal according to paragraph 9) and replace with a metal of undersize.

Clearance between crankshaft center journal and metal (oil clearance) (mm)		
Model	Standard assembling value	Service limit
S753 · S773 · S773L	0.039 – 0.092	More than 0.2

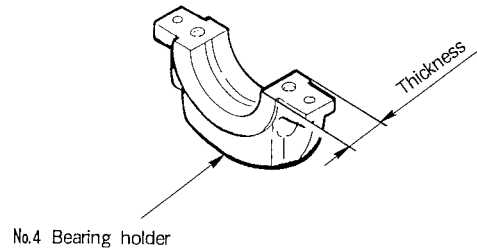
Rear bearing holder

Check the bearing holder and replace if wear, improper contact, seizure, or other damage is noticed, or thickness exceeds the service limit.

Rear bearing holder thickness (mm)		
Model	Standard assembling value	Service limit
S753 · S773 · S773L	21.85 – 21.95	21.55

Model S753· S773		
Metal size	Metal code No.	Crankshaft center journal finishing dimension (φ)
STD.	198517101 (upper) 198517110 (lower)	45.964 – 45.975
U.S. 0.25	198517105 (upper) 198517114 (lower)	45.714 – 45.725
U.S. 0.50	198517108 (upper) 198517117 (lower)	45.464 – 45.475

Model S773L		
Metal size	Metal code No.	Crankshaft center journal finishing dimension (φ)
STD.	198517570 (upper) 198517580 (lower)	47.975 – 47.964
U.S. 0.25	198517574 (upper) 198517584 (lower)	47.725 – 47.714
U.S. 0.50	198517577 (upper) 198517587 (lower)	47.475 – 47.464



No.4 Bearing holder

T129

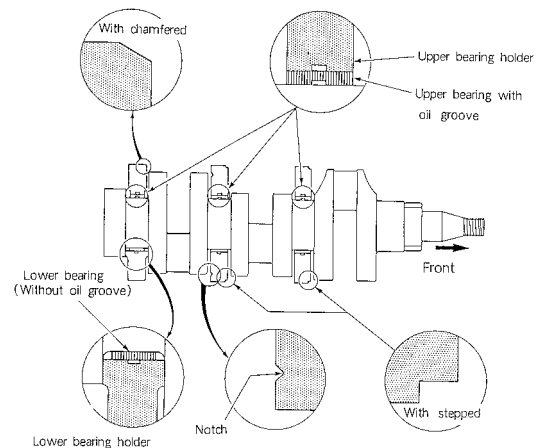
Reassembly (bearing holder, center bearing, thrust washer)

- (1) Install the bearing holder with identification cutting mark at the center and the bearing holder with thrust washer to the flywheel side, facing the chamfered side frontward.
- (2) Install the thrust washer facing the oil groove to the crankshaft thrust surface.

Bearing holder tightening torque (Made of aluminium die cast only)	20 – 25 N·m (2.0 – 2.5 kgf·m)
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- (3) Install the metal with oil groove to the upper side and the one without oil groove to the lower side.

NOTE: Be sure to confirm that the oil holes of the bearing holder and block are aligned.

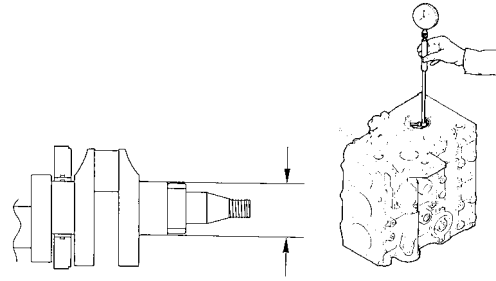


T130

8) Crankshaft bearing (bush)

Inspection

- (1) Check the bearing (bush) and replace if peeling, melting, uneven wear, improper contact, or other damage is notice.
- (2) Measure the oil clearance of the bearing (bush) and crankshaft journal using a cylinder gauge and micrometer.
- (3) If the oil clearance exceeds the service limit according to the result of measurement, replace the bearing (bush) or grind the crankshaft journal according to paragraph 9) and replace with a bearing (bush) of undersize.



T131

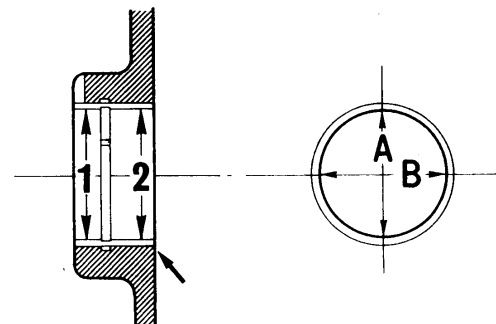
T132

Clearance between crankshaft journal and bearing (bush) (oil clearance) (mm)		
Model	Standard assembling value	Service limit
S753 S773 S773L	0.039 – 0.106	More than 0.2

Model	Bush size	Bush code No.	Crankshaft journal outside dia. Finishing dimension (ø)
S753 S773	STD.	198517080	45.964 – 45.975
	U.S. 0.25	198517084	45.714 – 45.725
	U.S. 0.50	198517087	45.464 – 45.475
S773L	STD.	198517590	47.975 – 47.964
	U.S. 0.25	198517594	47.725 – 47.714
	U.S. 0.50	198517597	47.475 – 47.464

NOTE:

1. Measure the dimensions in the A and B directions at the position 1 and 2 in the right figure avoiding the oil hole of the bearing (bush) and calculate difference from the maximum value of the crankshaft journal (oil clearance).
2. When replacing the bush, push it up using a press or the like. At this time, align the oil holes and push it up until the bush end surface becomes level with the outside machined surface of the cylinder block (see the arrow mark in the right figure).
3. When the crankshaft journal is ground, confirm the oil clearance before reinstalling it.



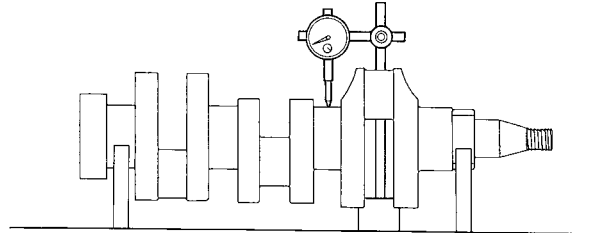
T133

9) Crankshaft

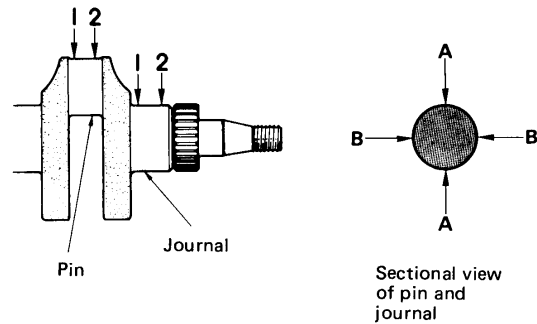
Inspection

- (1) To measure run-out of the crankshaft, support the crankshaft using a V block as shown in the right figure, apply a dial gauge to the crankshaft center journal, read the indication on the dial gauge rotating the shaft one turn gently. If the service limit is exceeded, correct or replace.
- (2) Check the crankshaft oil seal for damage or wear on the contact surface and oil hole clogging.
- (3) Check the crankshaft journal and pin for damage, irregular wear (ellipticity, conicalness), and shaft diameter and grind the journal and pin if the service limit or repair value is exceeded and replace the bearing (bush) and connecting rod metal respectively with one of undersize. Measure the dimensions of the journal and pin in the AA and BB directions at the position 1 and 2 avoiding the oil holes.

Crankshaft run-out (mm)	
Standard assembling value	Service limit
Less than 0.03	More than 0.06



T134

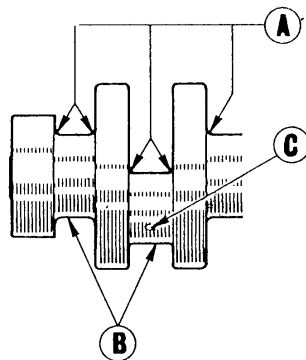


T135

NOTE: Finishing accuracy when grinding the crankshaft to undersize shall be as follows.

- Ⓐ R at pin and journal: **3R ± 0.2**
- Ⓑ Finishing accuracy: **1.6 Z(▽▽▽)**
- Ⓒ R around oil hole
 - At max. part: **2R**
 - At min. part: **0.5R**

Finish using #400 sand paper.



T136

Irregular wear limit of crankshaft journal and pin (mm)		
More than 0.05		
Shaft dia. At crankshaft journal		
	Outside dia. Finishing dimension	Repair value
STD.	45.964 – 45.975	Less than 45.9
U.S. 0.25	45.714 – 45.725	Less than 45.65
U.S. 0.50	45.464 – 45.475	Less than 45.40
Shaft dia. At crankshaft pin (φ)		
	Outside dia. Finishing dimension	Repair value
STD.	38.964 – 38.975	Less than 38.90
U.S. 0.25	38.714 – 38.725	Less than 38.65
U.S. 0.50	38.464 – 38.475	Less than 38.40

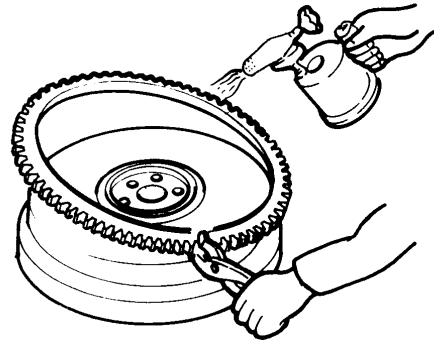
* Replace the crankshaft if U.S. 0.50 is exceeded.

10) Flywheel and ring gear

Inspection

Check the ring gear and replace if damage or remarkable wear is noticed.

When the wear is limited to a small area, remove the ring gear, turn it about 90 degrees and shrinkage-fit to reuse it. To shrinkage-fit the ring gear, heat it to 120 – 150°C to allow it to expand.



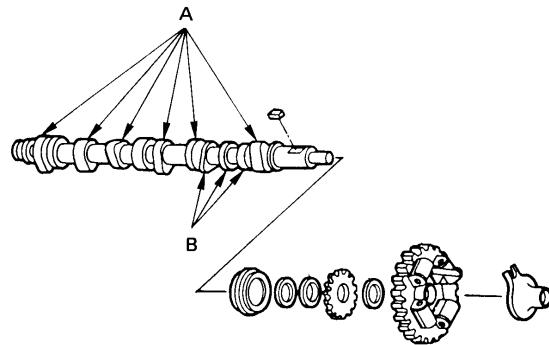
T137

11) Cam shaft ass'y

Inspection

- (1) Check the journal and cam for wear and damage and replace if the service limit is exceeded.
- (2) Correct insignificant uneven wear or scars on the cam surface using oil stone or the like.

A. Height of intake/exhaust valve cams (mm)	
Standard assembling value	Service limit
26.56 – 26.63	Less than 26.1
B. Height of injection pump cams (mm)	
Standard assembling value	Service limit
33.94 – 34.06	Less than 33.8



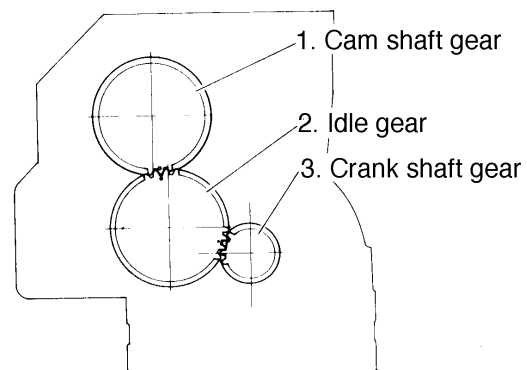
T138

12) Timing gear

Inspection

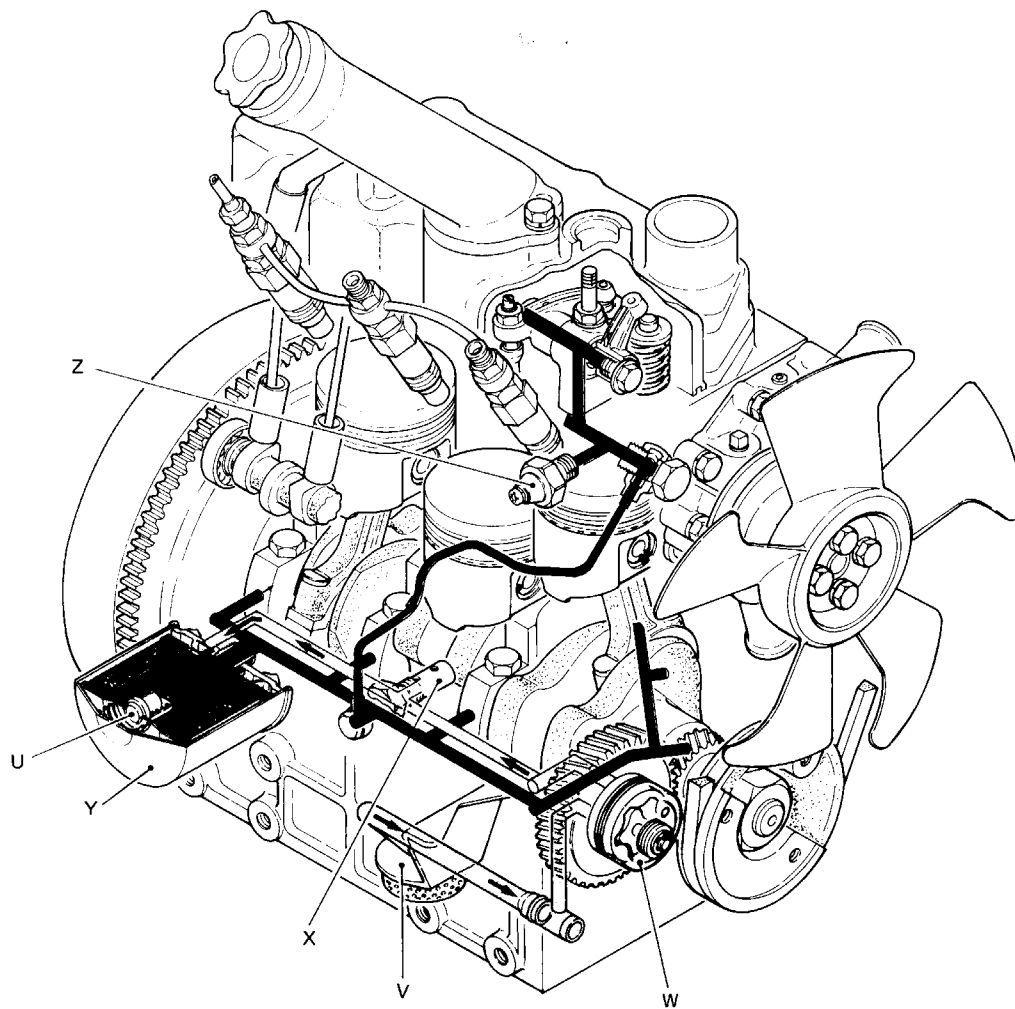
- (1) If pitting or remarkable wear is observed on the tooth face of gears, replace the gear.
- (2) Measure the backlash of gears and replace if the service limit is exceeded.

Timing gear backlash (mm)	
Standard assembling value	Service limit
0.08	More than 0.25



T139

13) Oil flow



- U: Safety valve
- V: Suction filter
- W: Oil pump
- X: Relief valve
- Y: Oil filter
- Z: Oil pressure switch

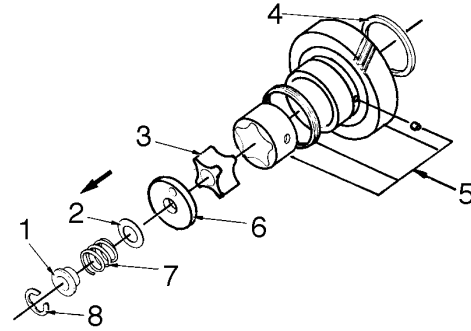
T140

14) Oil pump

Disassembly

Removal from engine

- (1) Remove the snap ring.
- (2) Take out the colar, spring and shim.
- (3) Take out the idle gear, vane, and oil pump cover together.
- (4) Extract the rotor and thrust washer.
- (5) Extract the oil pump cover from the idle gear.

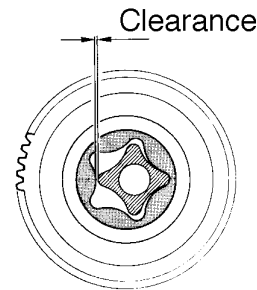


T141

- | | |
|------------------|--------------------|
| 1. Colar | 5. Idle gear ass'y |
| 2. Shim | 6. Oil pump cover |
| 3. Rotor | 7. Spring |
| 4. Thrust washer | 8. Snap ring |

Inspection and reassembly

- (1) Check the oil pump cover, rotor and vane and replace if worn out or damaged remarkably.
- (2) Check the clearance between the rotor and vane and replace if the service limit (0.25 mm) is exceeded.
- (3) Reassemble in the order reverse to disassembly.
 - ① Install the crankshaft gear and idle gear aligning the match mark.
 - ② Adjust the side clearance of the rotor and vane to **0.1 – 0.15 mm**. (See the assembling order 12, T162.)

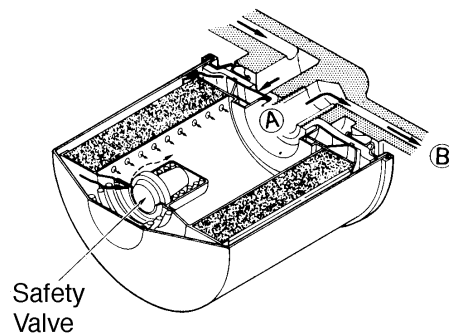


T142

15) Oil filter

Structure and Functions

- (1) The cartridge type oil filter is excellent in filtering performance.
 - (2) Since it is of the full-flow type, when the filter is clogged, the safety valve is opened to allow the oil to flow, preventing seizure or other troubles.
 - (3) The oil fed under pressure with the oil pump enters ① is filtered by the element, and supplied to each part from ②.
- When the element is clogged, the oil is supplied to each part without passing through the element.



T143

Replacement

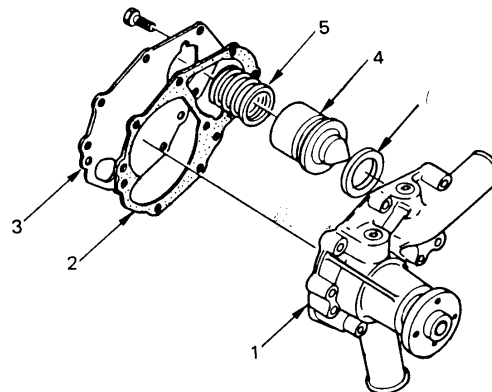
- (1) Replace the oil filter every 200 hours of operation.
- (2) Coat the filter mounting surface with oil and tighten the filter by hand.
- (3) Do not reuse the filter if it is removed once.

16) Water pump assembly and thermostat

Disassembly

- (1) Remove the set plate gasket.
- (2) Remove the thermostat spring.
 1. Water pump ass'y
 2. Gasket
 3. Set plate
 4. Thermostat
 5. Spring
 6. Gasket

NOTE: The pump main body is aluminum die cast and should be replaced as ass'y if subjected to water leakage or other troubles.



T144

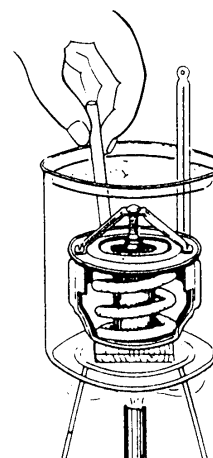
Specification and inspection

Thermostat

- (1) Replace if the valve is opened even only slightly at normal temperature.
- (2) Immerse the thermostat in water, increase the water temperature gradually and check the valve opening temperature and valve lift.

NOTE: 3 to 5 minutes are required until the valve is operated.

Model	S753, S773	S773L
Type	Wax pellet	
Opening temperature	80° - 84°C	73° - 77°C
Full-opening temperature	95°C	87°C
Valve lift (at water temperature 82°C)	8.0 mm	6.0 mm



T145

Reassembly

Reassemble the components in the reverse order to disassembly.

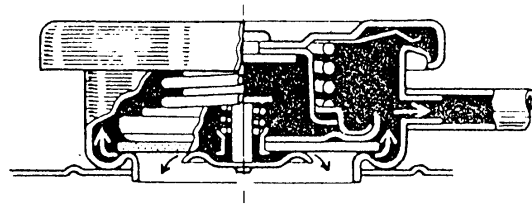
17) Radiator

Specifications and structure

Structure

- (1) The radiator is provided with the plate fin having superior anti-vibration characteristics.
- (2) The radiator cap is of the pressure type (sealing type) for higher cooling efficiency.
When the cooling water is heated to high temperature (high pressure), the pressure valve is pushed and opened to release excessive pressure from the overflow pipe (shown by white arrow mark).
When the cooling water temperature reduces and the inside pressure becomes lower than the atmospheric pressure, the negative pressure valve is opened to protect the radiator from being crushed under the atmospheric pressure (shown by black arrow mark).

Specifications	
Fin type	Corrugated
Cooling water volume	3.5 ℓ
Pressure valve starting pressure	68.6 – 88.2 kPa (0.7 – 0.9 kgf/cm ²)
Negative pressure valve starting pressure	– 4.9 kPa (0.04 – 0.05 kgf/cm ²)
Heat radiation volume	15,000 kcal/h



T146

Inspection

- (1) Check the radiator pipe for water leakage and repair or replace if unsatisfactory.
- (2) Check the radiator fin and remove dust, mud, or other foreign matter clogging in the air passage, if any.
- (3) Check the pressure valve and negative pressure valve of the radiator cap for valve opening pressure and sealing condition. Replace of defective.
- (4) Check the radiator hose and replace if damaged or aged.
- (5) If the net is clogged, remove and clean.

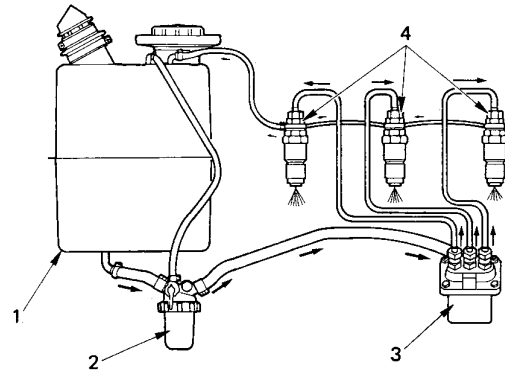
18) Fuel filter

Fuel passage

Fuel passage

The fuel flows as shown in the figure from the tank, pressurized by the injection pump to high pressure, and fed to the nozzle and injected to the combustion chamber. The fuel after lubricating the nozzle needle is returned to the tank through the overflow pipe.

- | | |
|----------------|----------------------|
| 1. Tank | 3. Injection pump |
| 2. Fuel filter | 4. Nozzle and holder |



T147

Inspection

If water, dust, or other foreign matter is observed in the transparent plastic case, clean and replace the filter if necessary.

Disassembly and reassembly

- (1) Remove the filter turning the filter ring nut counterclockwise.

NOTE: Take care to the O-ring fitted between the ring nut and main body, coat with grease before tightening.

- (2) Coat the area of the element to be mounted to the main body with grease and install the element by hand.

19) Governor

Structure and functions

- (1) Governor

This governor is a mechanical all-speed governor. It is installed in the gear case. The fly weight ass'y is installed to the cam shaft and its movement is transmitted to the control rack of the injection pump through the slider control lever link. The spring which controls the movement of the fly weight is hitched to the arm COMPL and tension lever. The spring tension is changed by changing the governor lever so as to control the engine speed.

- (2) Maximum speed set bolt

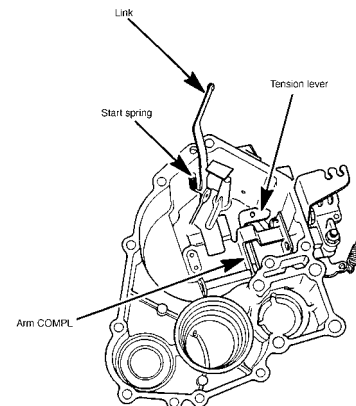
A bolt is mounted on the cylinder block. This bolt limits the movement of the arm COMPL (unloaded maximum rpm). This bolt has been adjusted and sealed at the factory.

- (3) Smoke set, start spring

These are built into the cylinder block, to regulate fuel injection amount at high speed range. Regulation of fuel injection amount at middle speed range is made

with torque control spring to realize bigger torque.

A start spring is placed between the gear case and link. This spring automatically functions to increase injection amount of fuel at the time of engine start. The smoke set had been adjusted at the factory.



T148

20) Injection pump

Specification

Engine Model	Part Code No.	Manufacturer and Injection Pump Type
S753	131017310	094500 – 3730
S773	131017710	094500 – 7410
S773L	131017640	094500 – 6340

Disassembly, Inspection and Reassembly

- (1) Disassembly, inspection, and reassembly of injection pump. If the trouble has been verified to be in the injection pump, do not disassemble other than at shop specializing in this operation.

21) Nozzle and holder

Specifications

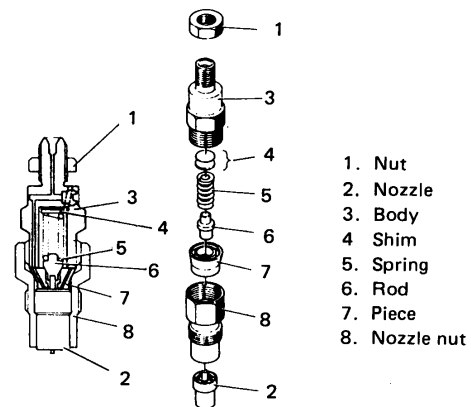
Part code	131406330	Nozzle type	Throttle type
Ass'y No.	093500 – 3320	Needle valve dia.	ø6
		Pintle dia.	ø1
		Valve opening pressure	11.27 – 12.25 MPa (115 – 125 kg/cm²)
Nozzle holder	093100 – 3320 (ND-KCA46SD332)	Adjustment pressure	12.25 – 12.74 MPa (125 – 130 kg/cm²)
Nozzle	093400 1460 (ND-DN4SDND146)	Injection angle	4°

Structure and functions

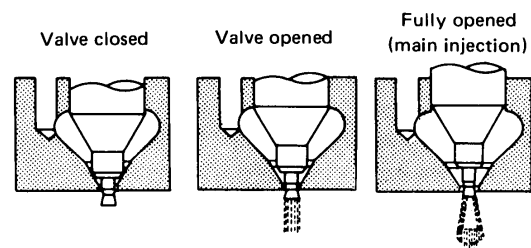
The nozzle is finished super-precisely to inject the fuel which is fed from the injection pump under pressure to the combustion room in good condition. Components as shown in the right figure are incorporated.

The fuel is fed under pressure from the oil hole of the nozzle holder main body to the nozzle body. When the pressure exceeds the specified value, it pushes the spring, injected from the nozzle, and at the same time lubricates and cools the nozzle and nozzle body.

The oil leaking at this time is returned to the tank by the return pipe.



T149



T150

Disassembly and inspection

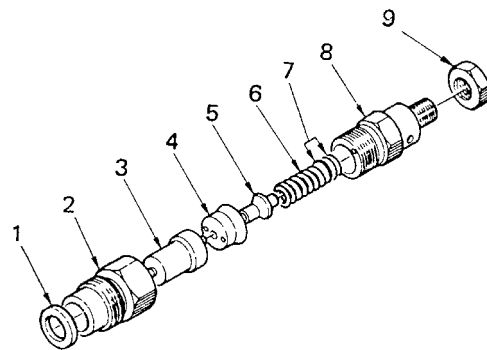
- (1) Place the nozzle holder (body) in a vice and disassemble turning the nozzle nut.

NOTE: Take care not to allow the needle valve to drop when removing the nozzle.

- (2) Wash the nozzle and needle valve and check for seizure and sticking of the nozzle and fuel leakage on the seat surface. Correct fuel leakage of the seat by lapping.
- (3) Check the distance piece upper and lower contact areas and correct to be stucked closely.
- (4) Check the push rod for wear on the nozzle needle valve contact surface and check the spring seat for crack.

Reassembly and adjustment

- (1) When assembling a new nozzle ass'y, heat light oil to 50 - 60°C and remove the rust preventive oil in it. Slide the body and needle valve to ensure that they slide lightly.
- (2) Invert the body, place the shim, spring, rod, piece and nozzle on it in this order, cover the nozzle nut and tighten.
- (3) After assembly, check for the nozzle injection pressure.
 1. Adjust by the adjusting washer (shim) so that the injection is started at 11.76 MPa (120 kgf/cm²) using a nozzle tester.
 2. The pressure increases or decreases about 0.98 MPa (10 kgf/cm²) by a washer of 0.1 mm.



1. Gasket
2. Nozzle nut
Tightening torque: 29.4 - 49 N·m (3 - 5 kgf·m)
3. Nozzle
4. Piece
5. Rod
6. Spring
7. Shim
8. Body
9. Nut
Tightening torque: 29.4 - 39.2 N·m (3 - 4 kgf·m)

- (4) Injection condition
 1. Small drops should not be mixed in the spray.
 2. The oil should be injected describing a cone by straight lines toward the center line of the nozzle.
 3. Place white paper at about 30 cm from the nozzle and confirm that the spray is approximately circular when injected.
 4. Keep the oil pressure lower by 1.96 MPa (20 kgf/cm²) than the specified value 11.76 MPa (120 kgf/cm²) and check that the test oil does not drop form the nozzle end.

T151

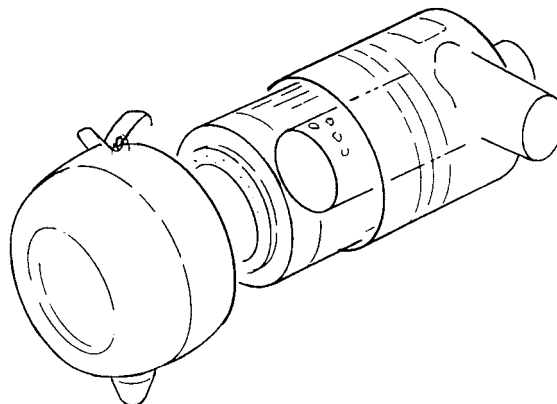
22) Air Cleaner

Structure and functions

- (1) The air cleaner is connected to the cylinder with the air cleaner hose.
- (2) The air cleaner is of the cyclone type incorporating filter element and removes dust from the intake air.

Inspection and replacement

- (1) Take out the element every 100 – 200 hours and blow compressed air (less than 0.686 MPa, 7 kg/cm²) from the inside and clean. (Clean the dust deposit on the dust pan also.)
- (2) If soot or oil has stuck to the element, immerse it in neutral detergent for about 15 minutes and then wash by shaking several times. Rinse in clean water sufficiently and dry naturally.
- (3) When the air cleaner is used in dusty place, clean it earlier.
- (4) After cleaning 6 times or once every year, replace the element with new one.
- (5) After completion of cleaning, apply light from the inside of the element and it should be replaced with new one if breakage, pin hole, and especially thinner part is observed or if the gasket is broken.
- (6) Do not use the element before drying completely.



T152

3. ENGINE REASSEMBLY

★ Cautions before assembly

1. Wash parts to be installed. (Especially wash oil passage bearing, piston and cylinder bore carefully.)
2. Coat the sliding and rotating parts of the cylinder bore, piston, bearing and other parts with new oil before installing.
3. Replace the gaskets with new ones. If necessary, use liquid packing to prevent oil leakage.
4. Do not tighten bolts and nuts for aluminum alloy parts excessively. Tighten them with specified torque.

Reassembly

1. Relief valve assembly with O-ring.

Relief valve tightening torque
59 – 69 N·m (6 – 7 kgf·m)

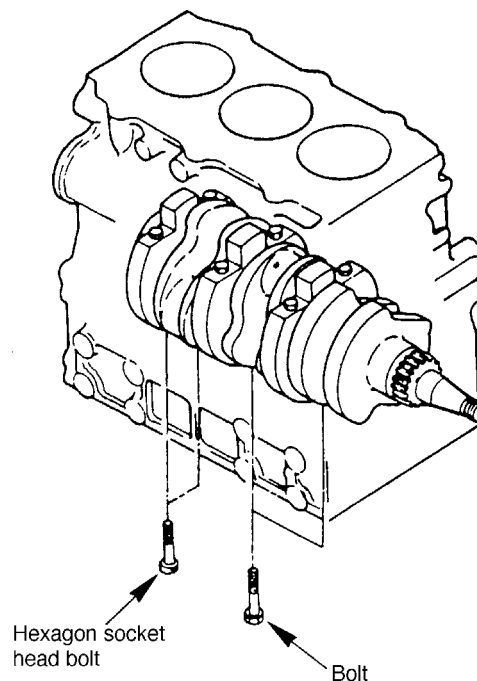
2. Crank shaft and bearing holder assembly.

Cylinder block to bearing holder tightening torque
25 – 29 N·m (2.5 – 3.0 kgf·m)

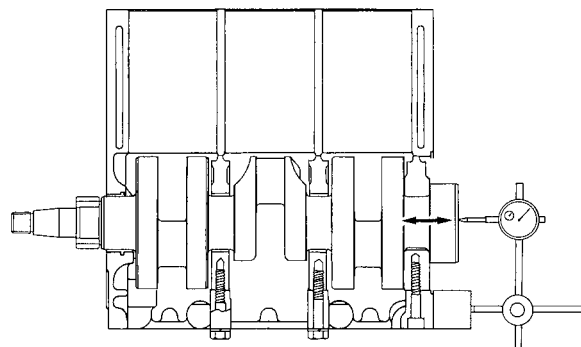
NOTE:

1. Take care not to damage the bush in the cylinder block by the crank shaft gear when install the crank shaft and bearing holder assembly
2. Install the two hexagon socket head bolts for the fly wheel side bearing holder.
3. Measure the end play of crank shaft.

Crankshaft end play	
Standard value	0.05 ~ 0.3 mm
Service limit	0.5 mm



T153



T154

3. Oil seal

4. Rear plate

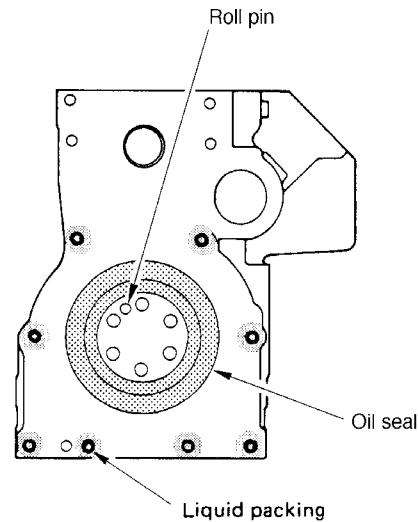
NOTE: Apply the liquid gasket to around the M 10 screw holes for rear plate.

Rear plate tightening torque:
46 ~ 54 N·m (4.7 ~ 55 kgf·m)

5. Fly wheel

Align the hole to the roll pin on the crankshaft.

Fly wheel tightening torque
69 ~ 78 N·m (7.0 ~ 8.0 kgf·m)



T155

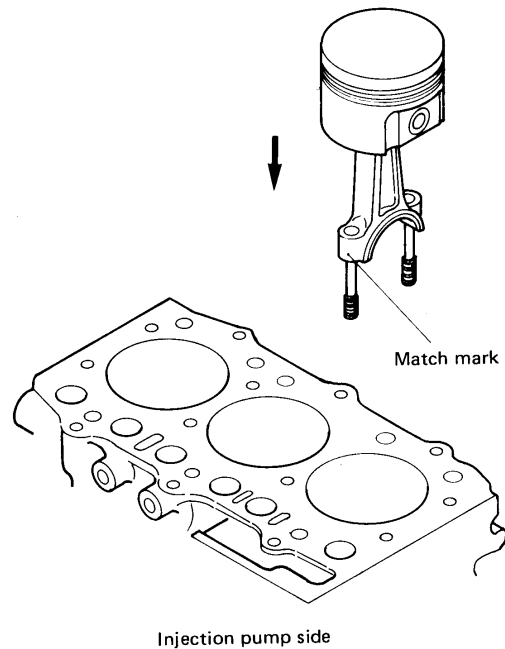
6. Piston and connecting rod assembly

- ① Coat the metal surface, piston and piston ring with engine oil.
- ② Turn the ring to allow the oil to ensure the ring groove sufficiently, and set the ring end gaps at 120° respectively avoiding piston pin direction and the direction at a right angle to the piston pin.
- ③ Insert the ring facing the connecting rod figure match mark toward the injection pump side, using ring pliers.

NOTE: Place the smallest connecting rod figure match mark to the front side so that the figures increase gradually.

- ④ Tighten the connecting rod cap with the specified torque and check for the axial play.

Connecting rod tightening torque
29 ~ 34 N·m (3.0 ~ 3.5 kgf·m)



T156

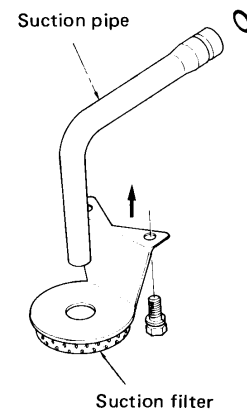
NOTE:

1. After tightening, confirm that the crankshaft moves lightly.
2. The connecting rod should move 0.1 – 0.3 mm in the axial direction.

7. Suction pipe and Suction filter

- ① Fit an O-ring to the suction pipe and insert the suction pipe to the cylinder block.
- ② Place the suction pipe end into the suction filter and fix the suction filter.

Suction filter tightening torque
9 ~ 3 N·m (0.9 ~ 1.3 kgf·m)

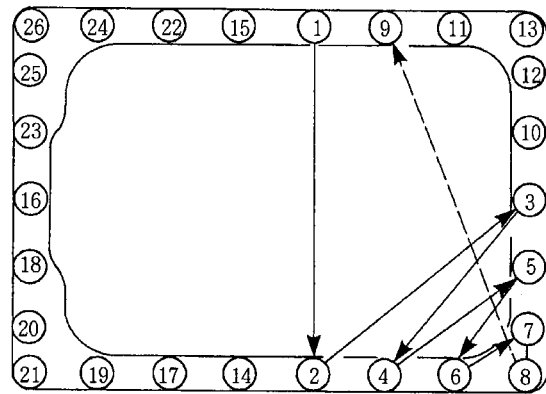


T157

8 Oil pan

Start tightening the bolts of the oil pan from the center, then tighten the opposing bolt on opposite side on the diagonal and specified torque.

Oil pan tightening torque
10 – 12.7 N·m (1.0 – 1.3 kgf·m)



Tightening Order

9 Oil level gauge and Gauge guide

Install the oil level gauge and gauge guide using 2 O-rings.

T158

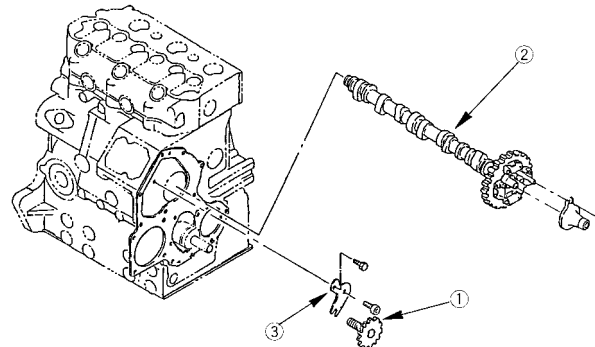
10 Front plate

Install the front plate together with the gasket.

11 Cam shaft ass'y · Tachometer shaft · Plate

- ① Install the tachometer shaft.
- ② Install the cam shaft ass'y (taking care to the bearing).
- ③ Fix the tachometer shaft and cam shaft ass'y with the plate.

Plate tightening torque
9 ~ 13 N·m (0.9 ~ 1.3 kgf·m)

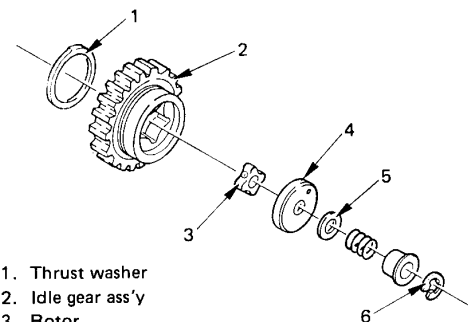


T159

NOTE: Install the timing gear case taking care so that the slider is not dislocated from the guide pin.

12 Idle gear · Oil pump ass'y

- ① Install a thrust washer to the idle gear shaft.
- ② Install the idle gear ass'y.
- ③ Align the match marks of the idle gear, crankshaft gear and cam shaft gear and install idle gear ass'y to the idle gear shaft.
- ④ Install the rotor.
- ⑤ Install the oil pump cover, shim, spring and collar and fix with a E shape clip.

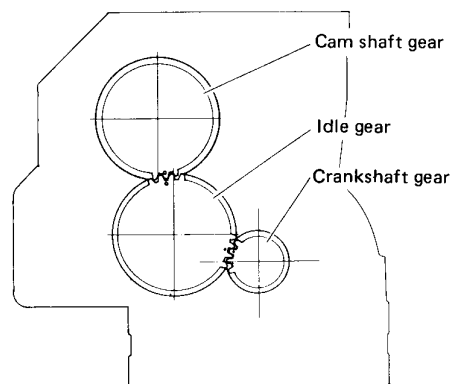


1. Thrust washer
2. Idle gear ass'y
3. Rotor
4. Oil pump cover
5. Shim
6. E shape clip

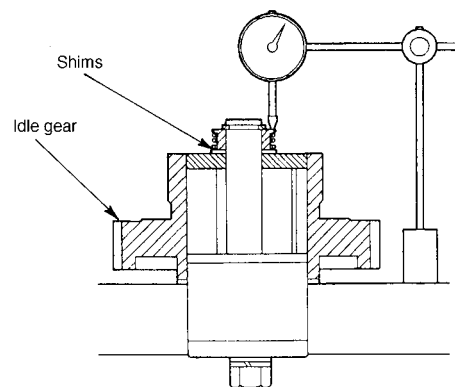
T160

NOTE:

1. Coat the rotor and vane both sides with grease before installing them.
2. Never turn the crankshaft until the timing gear case is installed.
3. Turn the oil pump cover clockwise and counterclockwise, fix the hole at the center of the spring pin inserting hole moving distance, and then install the gear case.



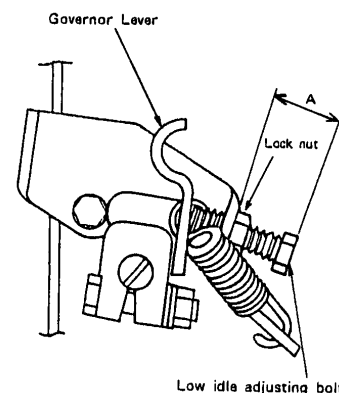
- ⑥ Adjust the shims so that the oil pump, rotor and vane side clearance is **0.1 – 0.15 mm**.



T161

13 Timing gear case

- ① Untighten the lock nut and remove the low idle set bolt.
- ② Install the start spring between the timing gear case and governor link.
- ③ Inserting the link into the cylinder block hole while turn the governor lever to clockwise and hold it, and then install the timing gear case.
- ④ Reinstall the low idle set bolt and secure the lock nut.



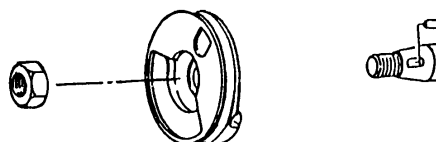
T162

T163

14 Crankshaft pulley

Install the key and assemble the crankshaft pulley and crankshaft.

Crankshaft pulley tightening torque
118 ~ 127 N·m (12 ~ 13 kgf·m)

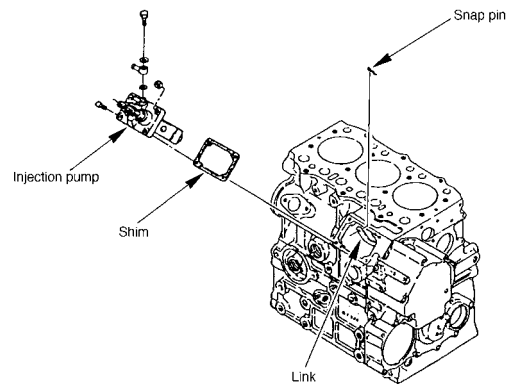


T164

15 Injection pump assembly

- ① Fit the shim which has been removed at the time of disassembly, connect the control rack of the injection pump and link, and fix with the snap pin.
- ② Tighten the injection pump with bolts and nut.

Injection pump tightening torque
5 ~ 7 N·m (0.5 ~ 0.7 kgf·m)



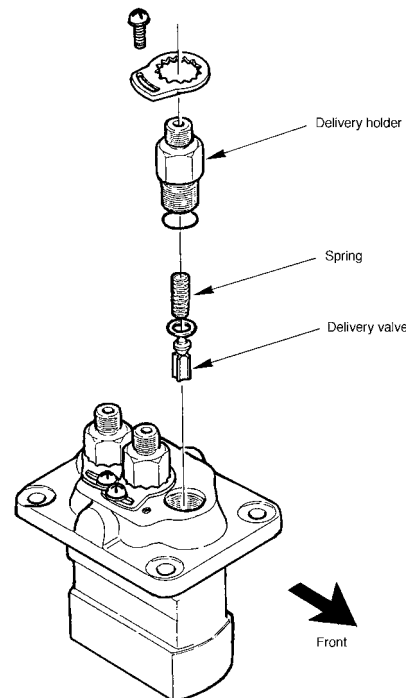
T165

16 Injection timing adjustment

Usually the injection timing is adjusted properly by the step of the order 15.

When the injection pump, cam shaft assembly or cylinder block is replaced, adjust the injection timing in the following procedure.

- ① Install the injection pump inserting a shim of 0.5 mm in thickness according to the procedure of order 15.
- ② Remove the delivery valve holder on the injection pump front side (radiator side).
- ③ Extract the delivery valve and spring and reinstall the delivery valve holder.
- ④ Move the governor lever in the fuel increasing direction and flow the fuel near 25° before compression TDC of the No. 1 piston (front side) and then the fuel flows out of the delivery valve holder.
- ⑤ Turn the crankshaft gently clockwise from the condition of above (4), and then the fuel flowing out of the delivery holder stops. Read the piston position before TDC at this time. If it is late more than 22° on models S753 and S773, and 23° on model S773L decrease the shim thickness and if earlier more than 24° on models S753 and S773, and 25° on model S773L increase the shim thickness.



T166

Engine Model	S753· S773
Injection timing (before TDC)	22 ~ 24°
Piston displacement (before TDC)	3.44 ~ 4.08 mm

Engine Model	S773L
Injection timing (before TDC)	23 ~ 25°
Piston displacement (before TDC)	4.217 ~ 4.96 mm

Engine Model S753 and S773			
Piston displacement to crankshaft angle (before TDC)			
(°)	Displacement	(°)	Displacement
20	2.850	25	4.411
21	3.137	26	4.761
22	3.436	27	5.132
23	3.749	28	5.496
24	4.074		

Engine Model S773L			
Piston displacement to crankshaft angle (before TDC)			
(°)	Displacement	(°)	Displacement
20	3.206	25	4.963
21	3.529	26	5.356
22	3.866	27	5.763
23	4.217	28	6.184
24	4.583		

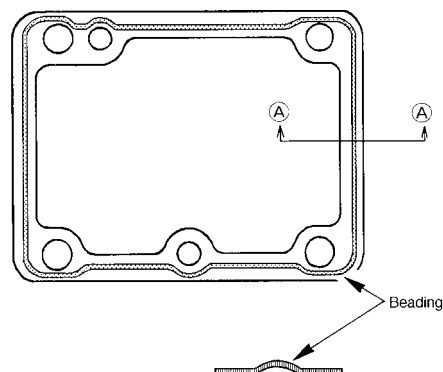
NOTE:

1. When shim is not required, coat required packing before installing.
2. The injection timing varies about 2° with 0.3 mm of shims.
3. Mix assemble a shim (0.5 mm) without beading when you need adjusting shims more than 1.0 mm.
4. Thickness is stamped on the shims.

- ⑥ Install the delivery valve and spring in the injection pump.

Delivery holder tightening torque
39 ~ 44 N·m (4.0 ~ 4.5 kgf·m)

Injection timing adjusting shim	
Thickness (mm)	Part code
0.2	131437310
0.3	131437320
0.4	131437330
0.5	131437340
*0.5	*131437630 (* without beading)



T167

17 Oil filter

Coat the mounting surface with a small quantity of oil and tighten by hand.

18 Engine stop solenoid

Tighten the engine stop solenoid lightly by pliers.

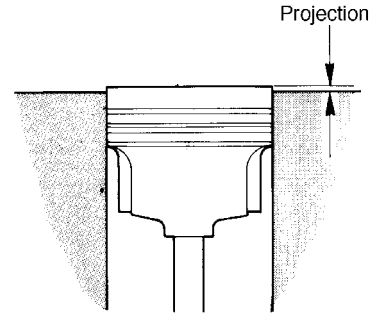
19 Tappet

Coat the oil to tappets and install.

20 Cylinder head <Models S753 and S773L>

- ① Position each of the pistons at top dead center and, using a dial indicator, determine the distance each piston projection above the face of the block.

NOTE: Measure each of the pistons while holding a slight down pressure on the piston. Use the dimension taken from the cylinder which has the greatest projection and select a head gasket as indicated in the following chart.



Models S753 and S773L

T168

NOTE: The variation in the amount of protrusion among all pistons must be within 0.1 mm.

Measured value (mm)	Head gasket part code No.		Tightened Thickness
	S753	S773L	
More than 0.45 – under 0.55	111147260		t = 1.1
More than 0.55 – under 0.65	111147270	111147560	t = 1.2
More than 0.65 – less than 0.75	111147280	111147570	t = 1.3

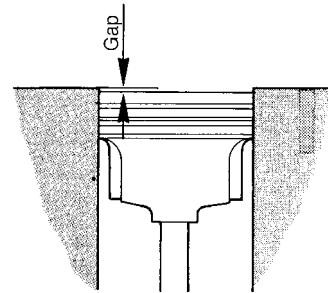
NOTE: Lowest for digits of code numbers are stamped on the head gasket. Install head gasket with code numbers at top.

<Model S773>

- ① Position each of the pistons at top dead center and, using a dial indicator, determine the distance each piston top to the face of the block.

NOTE: Measure each of the pistons while holding a slight down pressure on the piston.

NOTE: The variation in the amount of gap among all pistons must be within 0.1 mm.



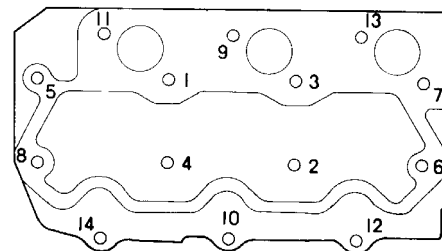
Model S773

T169

Model	Measured value (mm)	Head gasket part code No.	Thickness when tightened
S773	More than 0.3 – under 0.4	111147370	t = 0.4

- ② Tighten the cylinder head in several steps in the order as shown in the right figure and tighten with the specified torque finally.

Cylinder head tightening torque
49 ~ 52 N·m (5.0 ~ 5.3 kgf·m)



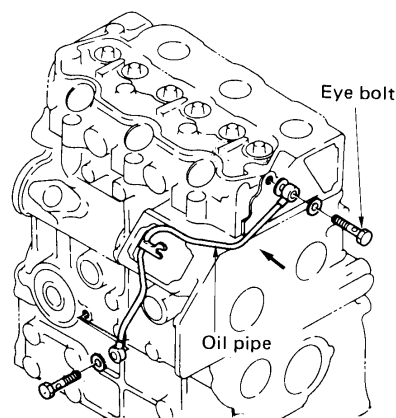
T170

NOTE:

1. Take care to the spring pin which positions the cylinder head ass'y.
2. Coat the thread with grease containing disulfide molybdenum.

21 Oil pipe

Eye bolt tightening torque
10 ~ 13 N·m (1.0 ~ 1.3 kgf·m)

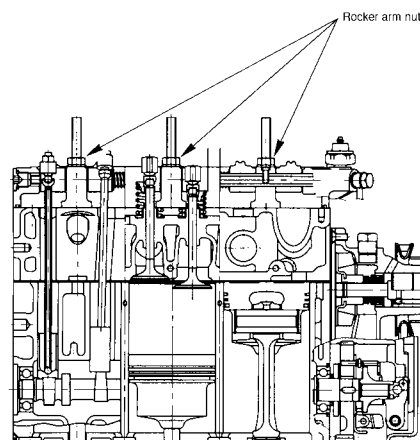


T171

22 Push rod Rocker arm ass'y

Install the push rod and rocker arm ass'y

Rocker arm ass'y tightening torque
20 ~ 25 N·m (2.0 ~ 2.5 kgf·m)



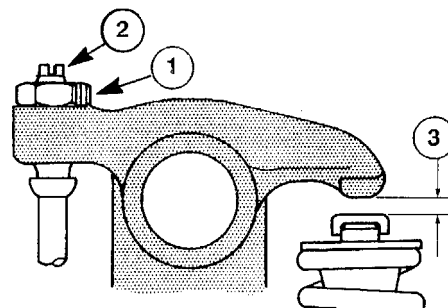
T172

23 Valve clearance adjustment

Untighten the nut of the intake and exhaust valves and adjust to 0.2 mm with adjust screw.

NOTE:

1. Adjust the valve clearance while cold.
2. Set the No. 1 cylinder at the compression TDC, adjust the valve clearance of the No. 1 intake and exhaust valves, and No. 2 exhaust valve, turn the crankshaft 240° counterclockwise when viewed from the front side, and adjust the No. 2 intake, and No. 3 intake and exhaust valves.



24 Head cover

Evenly tighten the cylinder head cover, taking care on the packing.

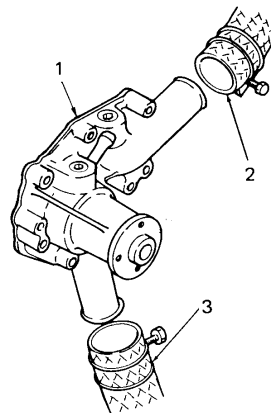
Head cover tightening torque
10 ~ 12 N·m (1.0 ~ 1.2 kgf·m)

1. Locknut
2. Adjusting Screw
3. Valve Clearance 0.2 mm

T173

25 Water pump ass'y · Radiator hose

1. Water pump ass'y
2. Radiator hose (upper)
3. Radiator hose (lower)



26 Glow plug · Connector

Model	Glow plug tightening torque
S753· S773	15 – 20 N·m (1.5 – 2.0 kgf·m)
S773L	8 – 15 N·m (0.8 – 1.5 kgf·m)

T174

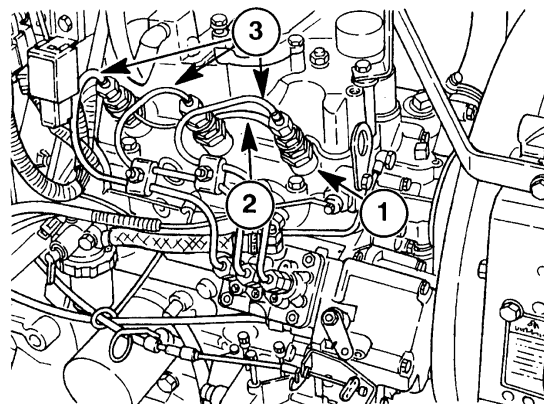
27 Oil pressure switch

Oil pressure switch tightening torque
15 ~ 20 N·m (1.5 ~ 2.0 kgf·m)

28 Nozzle and holder ass'y

Tighten the cap and gasket positively, tighten with specified torque using a nozzle holder socket, and install the return pipe.

Model	Nozzle and holder tightening torque
S753· S773	78 – 83 N·m (8.0 – 8.5 kgf·m)
S773L	59 – 68.6 N·m (6.0 – 7.0 kgf·m)



29 Return pipe COMPL · Injection pipe

Injection pipe

After installing the return pipe, install the injection pipe.

Injection pipe tightening torque
19.6 ~ 24.5 N·m (2.0 ~ 2.5 kgf·m)

1. Nozzle and holder
2. Return pipe
3. Injection pipe

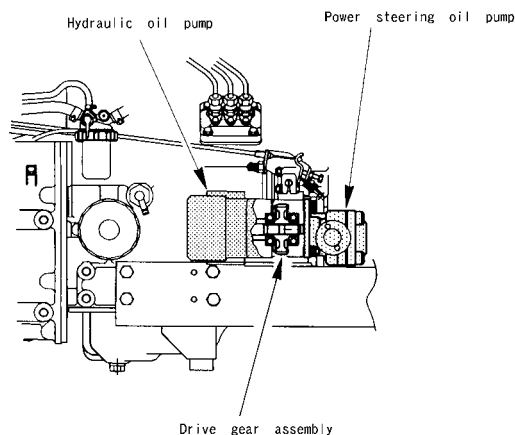
T176

30 Alternator ass'y

Install the alternator ass'y taking care to the direction of the adjusting plate.

31 Drive gear assembly, Hydraulic oil pump and power steering oil pump

- ① Install the drive gear assembly to the hydraulic pump and then install them to the gear case.
- ② Install the power steering oil pump to front of the gear case.

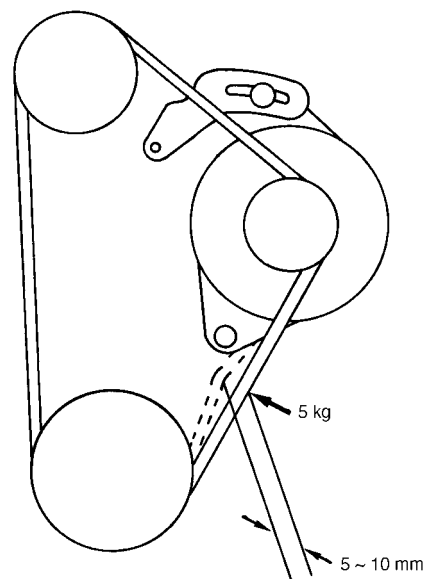


T177

32 V belt · Fan pulley · Cooling fan

- ① Install the fan pulley and cooling fan and then V belt.
- ② Adjust the belt tension with the alternator so that it is deflected 5~10 mm at the middle point between the crankshaft pulley and alternator pulley when depressed by a finger (about 5 kgf) and tighten.

Cooling fan tightening torque
8.8 ~ 12.7 N·m (0.9 ~ 1.3 kgf·m)



T178

33 Exhaust manifold (Muffler assembly)

34 Pressure plate · Clutch disk

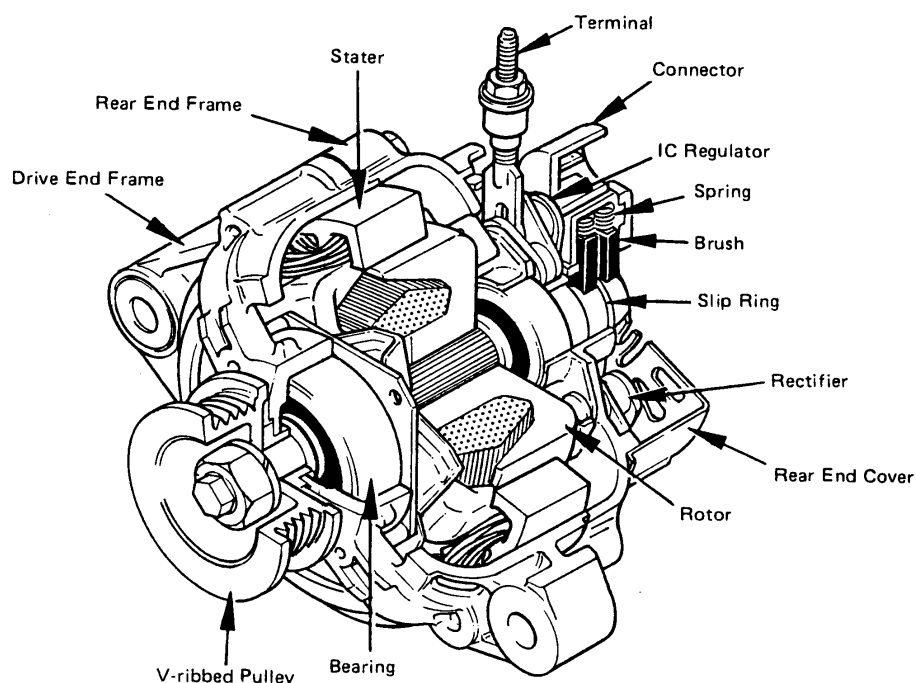
Install the pressure plate and clutch disk referring to paragraph 3-2, Clutch.

2-4 Electrical Units

1. ALTERNATOR

1) Specifications and construction

Rotating direction	Clockwise (when viewed from pulley side)
13.5 V speed	Less than 1350 rpm
Output current	More than 10A (at 14V, 2500 rpm) More than 40A (at 14V, 5000 rpm)



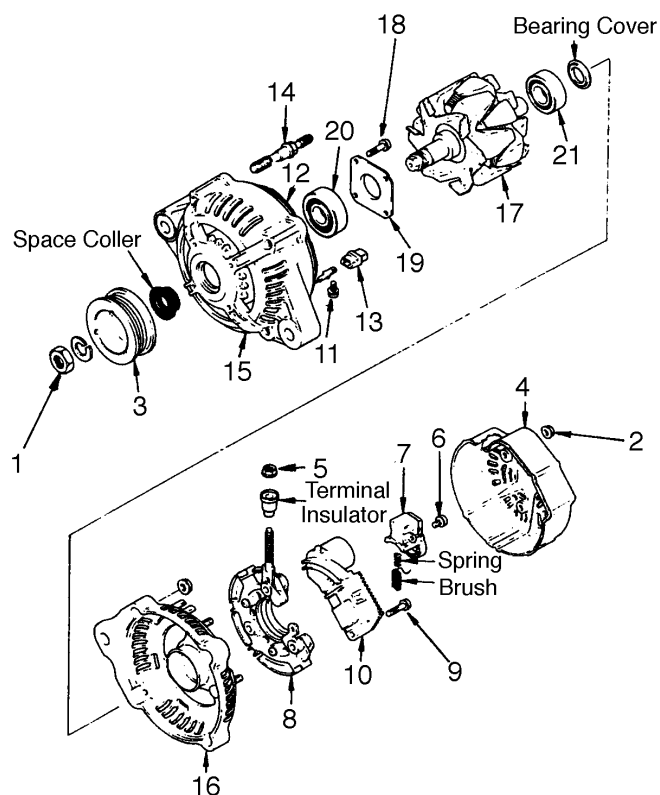
T179

2) Cautions for handling

Care should be taken to the following points when handling the alternator.

- (1) Reverse connection of the battery should be absolutely avoided.
- (2) Each terminal should be connected correctly.
- (3) When electricity is charged from the outside, the terminal B of the alternator and the battery terminal should be removed.
- (4) Test should not be conducted using a high voltage insulation resistance meter.
- (5) Do not disconnect the battery terminals and "B" terminal of alternator while rotating the alternator.

3) Disassembly



T180

Reference Figure 180T.

(1) Pulley

Loosen and remove the pulley nut (1) with a box wrench while the hexagonal section of the pulley shaft is held firmly with STT. (STT stands for Service Tester & Tool.)

(2) Rear end cover

Remove 3 nuts (2) holding the rear end cover (4) and a nut (5) at B terminal and remove rear end cover (4).

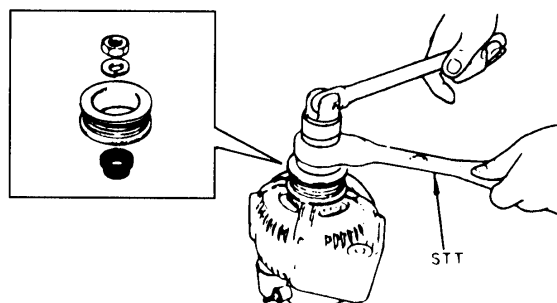
(3) Brush Holder

Remove 2 screws (6) fastening brush holder (7) to rectifier (8) and remove holder (7).

(4) IC regulator

Remove three screws (9) holding IC regulator (10) and remove regulator (10).

NOTE: The lengths of screws are different and they must be stored properly. If the wrong screw is used, it will touch the rear end frame, allow the regulator to run out of control, and cause a major breakdown of the system such as battery overcharging.



T181

(5) Rectifier

Remove four screws (11) holding rectifier (8) and lead wire from stator (12).

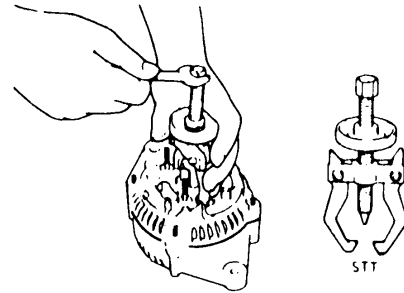
(6) Bushing

Remove bushing (13) and 4 bolts (14) which are holding the drive end frame (15) and rear end frame together.

NOTE: Do not stretch the stator wire when the bushing (13) is removed.

(7) Rear end cover

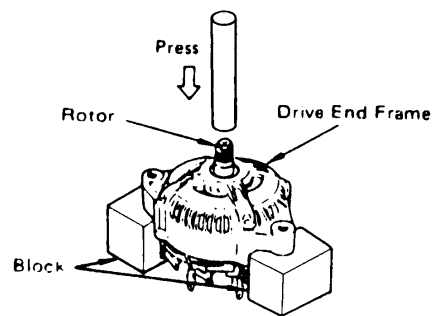
As shown in Figure T182, remove rear end cover (16) using STT.



T182

(8) Rotor

As shown in Figure T183, support drive end frame horizontally using 2 blocks and remove the rotor with a press.



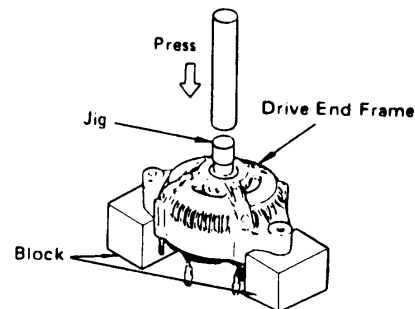
T183

(9) Retainer plate

Remove 4 screws (18) holding retainer plate (19) and remove the plate (19).

(10) Bearing (Drive end side)

As shown in Figure T184, support drive end frame horizontally with 2 blocks, put a jig on the bearing (20) and remove the bearing (20) with a press.



T184

(11) Bearing (Slip ring side)

Remove bearing (21) using puller.

4) INSPECTION AND REPAIR FOR EACH COMPONENT

(1) Pulley

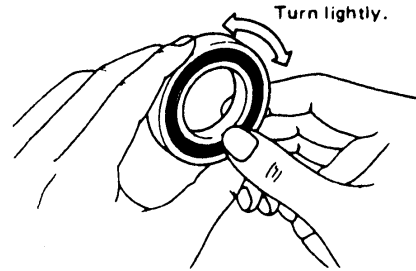
Check for fan belt slippage.

(2) Fan

Check for deformation.

(3) Ball Bearing

Rotate it by hand and check for resistance or noise in movement.



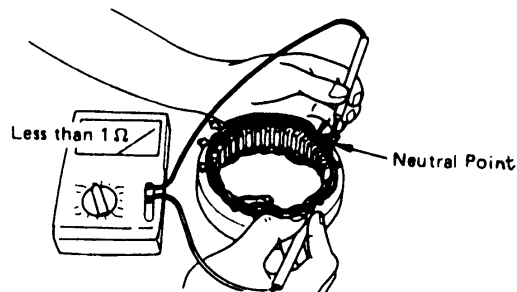
Ball Bearing Inspection

T185

(4) Stator

- Resistance between each phase (between each end of the lead wire and neutral point) shall be less than 1Ω .
- Insulation resistance between the core and coil shall be more than $0.1\text{ M}\Omega$ when measured with a 500 V megger.

NOTE: When there is no continuity, check the lead wire connection since stator coil disconnection is not likely.

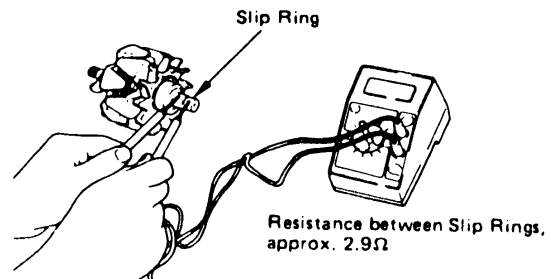


T186

(5) Rotor

- Resistance between slip rings.

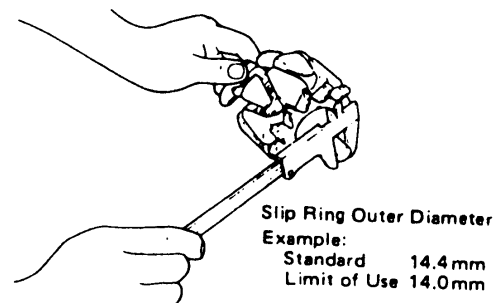
Example: approx. 2.9Ω



T187

Resistance between Slip Rings

- Check for stains or roughness of the surface. Fine sand-paper (#300 to #500) should be used to remove these. A slip ring is usable until its outer diameter wear reaches 0.4 mm.



T188

- Insulation resistance between slip ring and core pole.

More than 0.1 MΩ when measured with a 500 V megger.

- Slip Ring Outer Diameter
Example: Standard 14.4 mm
Limit of use 14.0 mm

(6) Rectifier

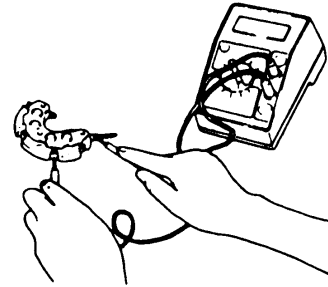
The circuit diagram of the rectifier is shown in Figure T190. Use the KΩ range of the circuit tester and check for continuity.

The rectifier is good if continuity is measured in one direction through the diode but not in the other.

NOTE: The condition of the rectifier cannot be determined by measurement of resistance in the right direction. Diode characteristics bring forth a great difference in current in the right direction, according to the source voltage and, therefore, measurement is different depending on the type of tester and its range of resistance.

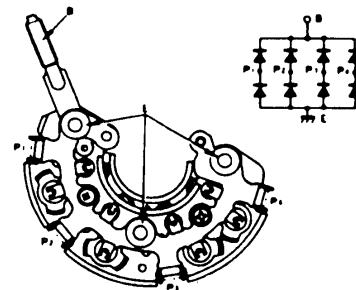
This is the reason why the rectifier is judged good when the difference in resistances measured in the right and in the reverse directions is big.

Do not use a 500 V megger for measuring because it will destroy the rectifier.



T189

Rectifier Check



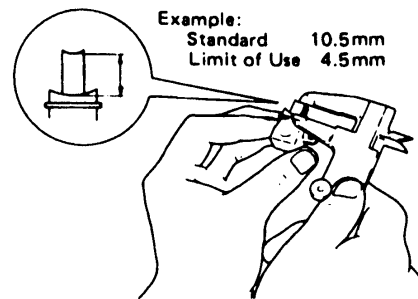
T190

Rectifier Terminal

(7) Brush

Measure length of brush protruding from the brush holder.

- Example: Standard 10.5 mm
Limit of use 4.5 mm



T191

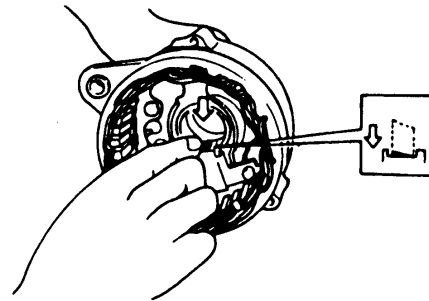
Check Length of Protruded Brush

5) ASSEMBLY

Assembly is the reverse of the disassembly procedure. Be care ful of the following points.

(1) Brush

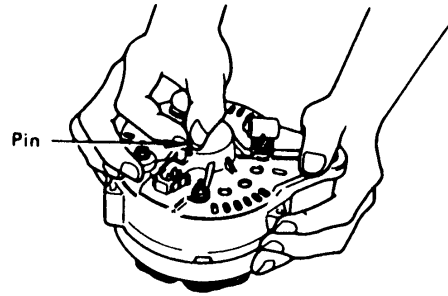
When a new brush is installed, it should protrude from brush holder by 1.5 mm.



T192

(2) Rotor

Before the rotor is installed, the brush should be pushed into the brush holder. (See Figure T192). The rotor cannot be placed in position unless the brush is pushed in. Failure to insert the brush will lead to its becoming damaged.



T193

Brush Installation

Brush Supporting

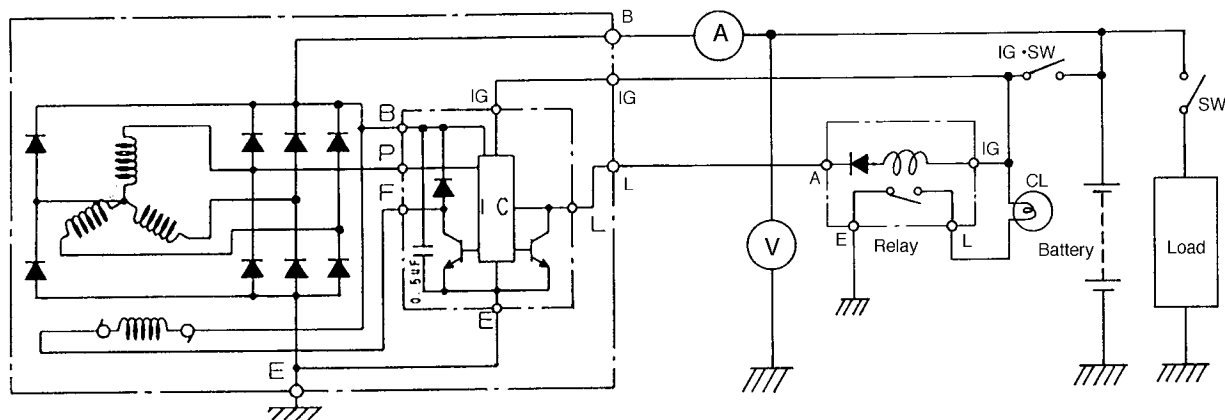
6) MEASUREMENT ON VEHICLE

(1) Regulated voltage check (IC regulator)

1. Connect the voltmeter and ammeter in the manner shown in Figure T194, and turn on the ignition switch. Check that the charge lamp is turned on.
2. Check if charge lamp is turned off when the engine starts.
3. Maintain an engine speed of 2000 rpm, and check battery voltage with an output current of 10A. (Check for regulator voltage)

Example: Standard 14.2 V to 14.8 V (A type IC regulator)

Caution: The standard temperature for an IC regulator is 25°C and, therefore, the voltage reading should be taken quickly. The maintenance standard for each type, therefore, should be followed.



T194

Check of Regulator Voltage

(2) Check for alternator output current

Turn headlight high-beam on (to put a load on the alternator) and take the output current reading while maintaining a speed of 2000 rpm. If the current reading is greater than the standard, the alternator is in good condition.

7) Trouble Shooting.

(1) FAILURE IN CHARGING SYSTEM

The following are considered failures in the charging system.

1. Excessive battery discharging : Starter does not run (or runs slow) and headlamps are dim.
2. Overcharging : Battery electrolyte diminishes sooner than normal.
3. Charge lamp failure : Does not light, is not turned off, or is lit dimly during vehicle operation.
4. Noise : Drumming, hissing, heavy groaning, or radio noises.

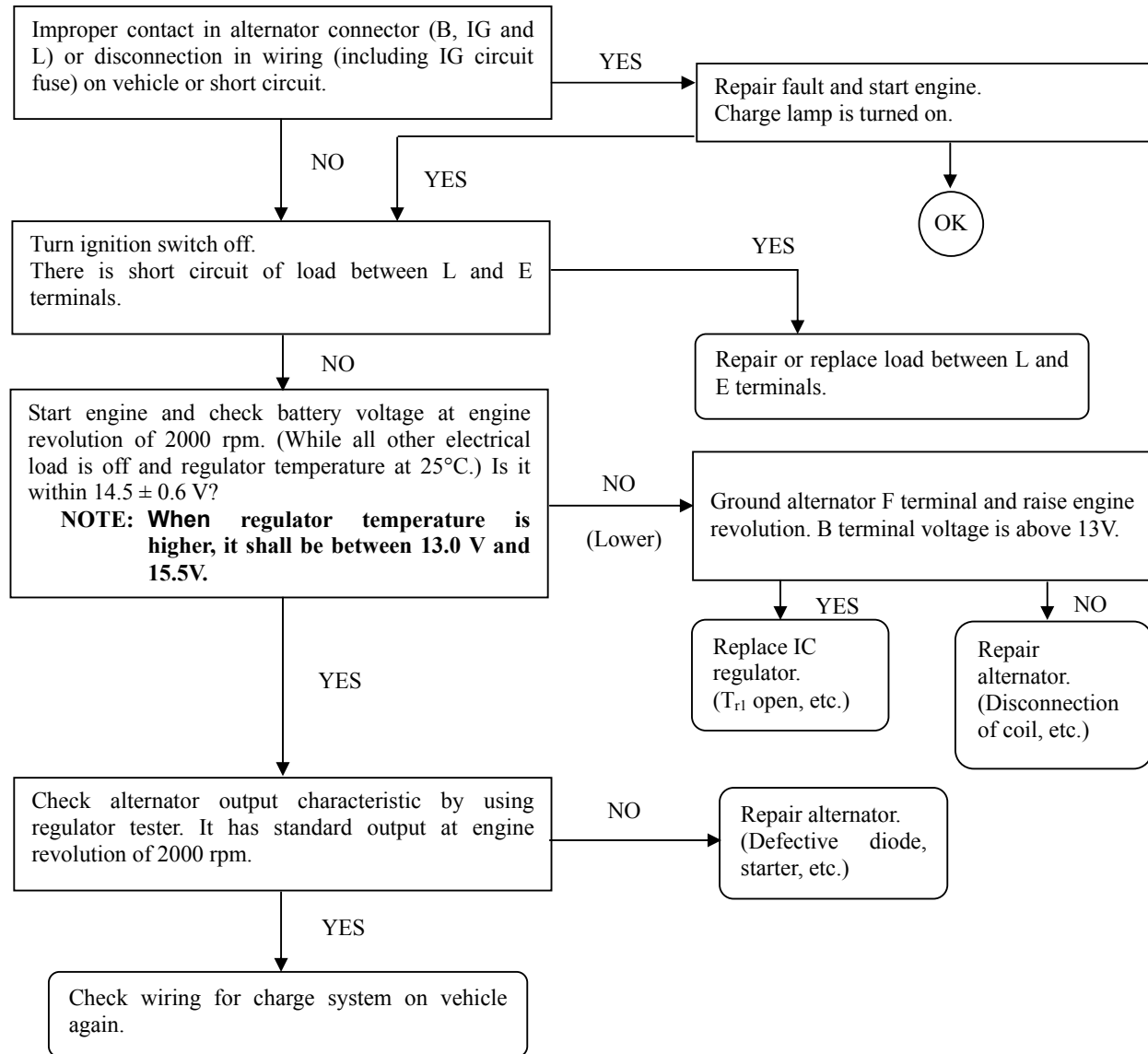
The cause of the noise should be narrowed down to the battery, wiring, alternator, regulator, or vehicle running condition.

(2) PRELIMINARY CHECK

Before starting this check, the following should be checked.

1. Confirmation of faulty condition.
2. Fan belt check: Check it for slippage due to cuts, dislocation, and slack. Belt tension is to be shown in Engine Assembly.
3. Wiring placement: Check if the wiring for the alternator and battery is properly placed.
4. Contact of connectors.
5. Installation of alternator: Check for proper belt alignment and securing of installation bolt.
6. Battery check: The battery sometimes discharges due to current leakage through corrosion and stains in the vicinity of its terminals. Check for electrolyte shortage, deformation of electropole plates, and changes in its color to white. Lost electrolyte should be replaced with distilled water.

(3) Troubleshooting when charge lamp is turned on while the engine is running.



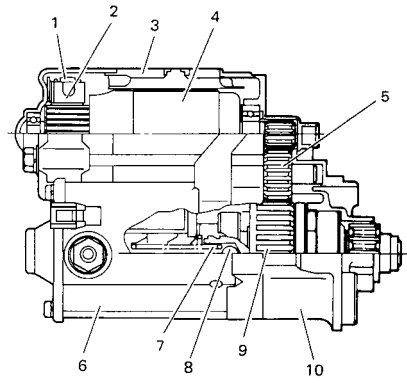
8) Care in Handling Charging System.

- (1) Pay attention to battery polarity and absolutely refrain from making a wrong connection. If it is wrongly connected, the battery will be short-circuited by the diode where it admits and enormously large current which will destroy the diode and regulator and burn the wiring harness out.
- (2) Do not ground the alternator B terminal as it is charged with a battery voltage at all times.
- (3) Do not run the engine at high speed while the B terminals of alternator is open.
This will raise the generated voltage of the alternator to nearly 200 V and cause the regulator coil to burn lead to diode destruction and is dangerous.
- (4) When the battery on the vehicle is charged quickly with a quick charger, the battery terminal should be disconnected.
Semiconductor equipment (tachometer, emission control computer, etc.) can be destroyed by abnormal pulse voltage and, therefore, this should be done by removing the battery from the vehicle, or disengaging the cable from the battery.
- (5) The alternator and regulator should be properly grounded.
Improper grounding causes overcharging, light flickering, unstable movement of the ammeter needle, etc.
- (6) Belt shall be set at the proper tension at all times.
Adjust it to the proper value as suggested by the manufacturer using a belt tension gauge.
As a guide, the proper tension is established when the belt is deflected 10 to 15 mm with a light push of the finger.
A slackened belt can cause lack of charging and excessive tension can cause the belt to prematurely snap, or lead to partial wear of the bearing.
- (7) Keep the water from getting on the alternator and other electrical equipment when the vehicle is washed.
- (8) Since the potential of the IC regulator case is ground, it should be securely bolted to the alternator and its potential should be rechecked.

2. STARTING MOTOR (TYPE 128000-0101 NIPPON DENSO)

1) Specifications

Continuous operation	30 seconds (max)
Output	1.0 kW
Weight	3.85 kg
Rotating direction (viewed from pinion)	Clockwise
Clutch type	Overrunning
Engaging type	Magnetic shift
Pinion ejecting voltage	8 volts



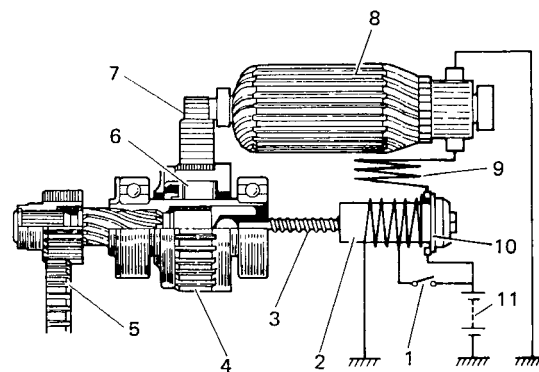
- | | |
|-------------------|--------------------|
| 1. Brush spring | 6. Magnetic switch |
| 2. Brush holder | 7. Spring |
| 3. Yoke | 8. Steel ball |
| 4. Armature ass'y | 9. Clutch |
| 5. Idle gear | 10. Housing |

T195

2) Operation and function

Operation and function

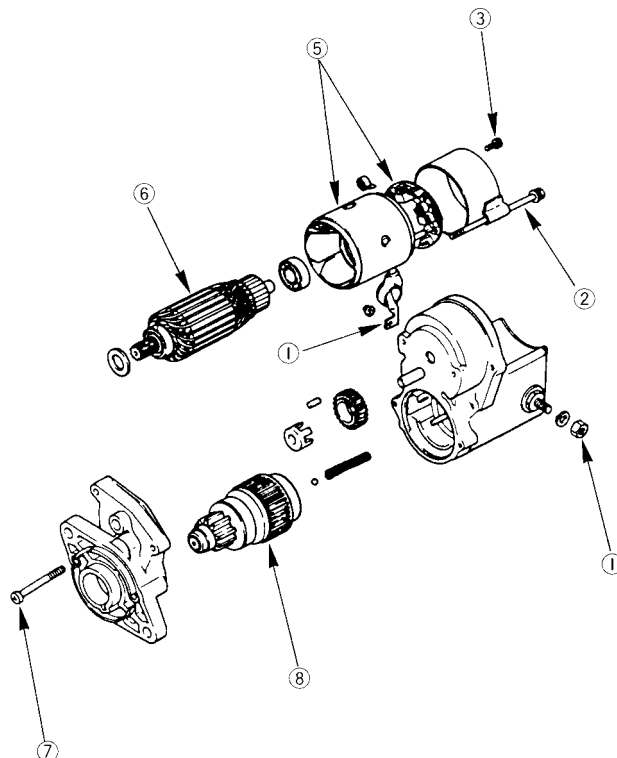
- (1) The key switch turns on.
- (2) Current flows to the pull-in coil and holding coil.
This draws the plunger to push out the pinion gear.
- (3) Pinion engages with the ring gear.
- (4) The contact plate of the plunger contacts to the main contact point. Then, full current is sent to the field coil and armature coil to crank the engine by direct connection with battery.
As the pull-in coil is shortcircuited in this case, the plunger is held only by the holding coil.
- (5) When the engine has been started, the armature is driven by the ring gear, so the clutch idles to prevent the motor from being driven at high speed by the engine.
- (6) When turning off the key switch, the current to the holding coil is shut off. Then, the plunger is returned to the OFF position by the force of return spring. Then, the main contact point opens to shut off the current to the armature.



- | | |
|------------------|-------------------|
| 1. Key switch | 7. Gear |
| 2. Plunger | 8. Armature |
| 3. Return spring | 9. Field coil |
| 4. Clutch | 10. Contact plate |
| 5. Ring gear | 11. Battery |
| 6. Rotor | |

T196

3) Disassembly, inspection and reassembly

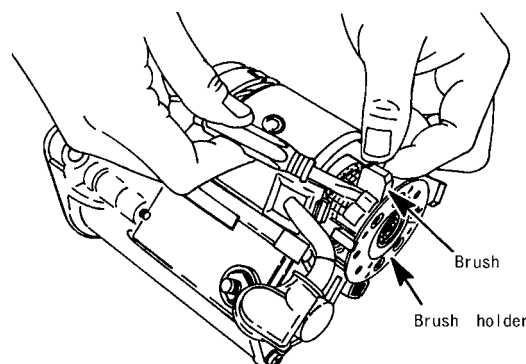


T197

- ① Remove the connecting lead which connects the magnetic switch and the yoke.
- ② Remove two thru bolts, which tighten the yoke to the housing, from the end frame side.
- ③ Remove two screws (end frame-to-brush holder) to remove the end frame.
- ④ Remove the two (+) side brushes from the brush holder.
- ⑤ Remove the brush and remove the yoke from the housing.
NOTE: Do not damage nor put oil on the brush and commutator.
- ⑥ Remove the armature from the housing.
- ⑦ Remove two screws (magnetic switch-to-housing) to remove the housing.
- ⑧ Remove the clutch from the housing.

NOTE:

1. Do not damage the clutch bearing.
2. Never disassemble the magnetic switch. (If the switch is found to be defective, replace as a magnetic switch assembly.)
3. Never loosen the nut at the magnetic switch contact bolt (terminal bolt).

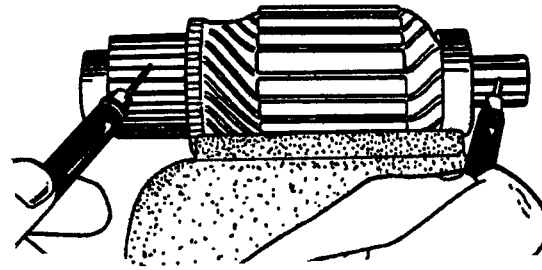


T198

Inspection

(1) Armature

- ① Check the insulation between the commutator and the armature with 500 V megger. The armature is normal if there is resistance of more than 0.1 mega ohm.
- ② Layer insulation test (short-circuit test)
Setting the armature on the growler tester, check the layer insulation.
If no vibration is resulted when placing an iron rod on the armature core, the layer insulation is favorable.



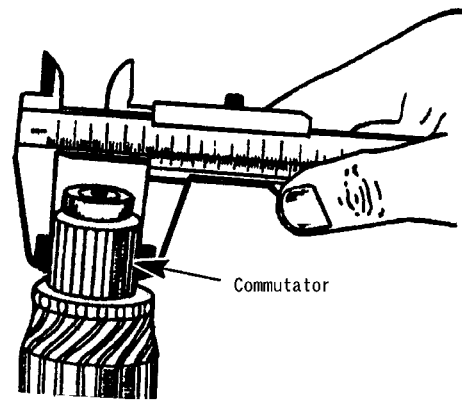
T199

NOTE: Before inspection, remove foreign matters between commutator and segments.

(2) Commutator

- ① Check for roughness and burning damage. If the surface is not smooth, correct with sand paper (No. 500 or 600).
- ② Check outside diameter of the commutator.

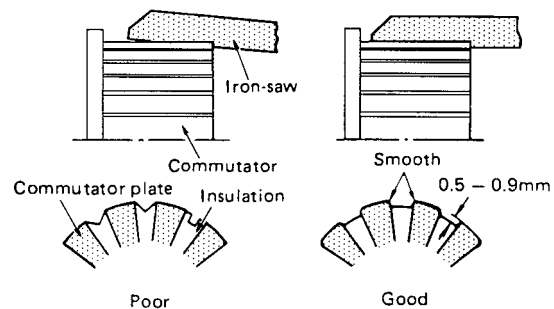
Standard assembling value	Service limit
30 mm	29 mm



T200

- ③ Depth of insulator (mica) between segments.

Standard depth	Service limit
0.5 – 0.9 mm	0.2 mm



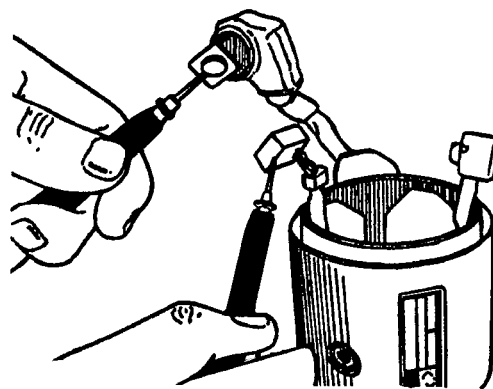
T201

(3) Field coil

① Continuity test

Using a circuit tester ($\times 1$ ohm range), check continuity among the C terminal, field coil and brush.

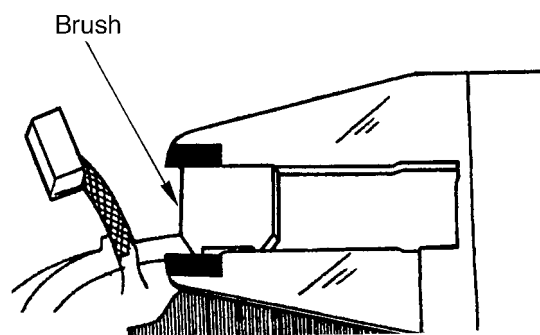
If there is continuity, the field coil is in satisfactory condition.



T202

② Insulation test

With a 500 V megger, check insulation between the field coil brush and yoke. There should be resistance of more than 0.1 mega ohm.



T203

(4) Brush and brush holder

① Roughness on the brush face

If the face is rough, correct it by wrapping the commutator with a sand paper (No. 300).

② Brush length (service limit)

Standard length 13.5 mm

Service limit 9 mm

③ Force of brush spring

With a spring scale, check the spring force.

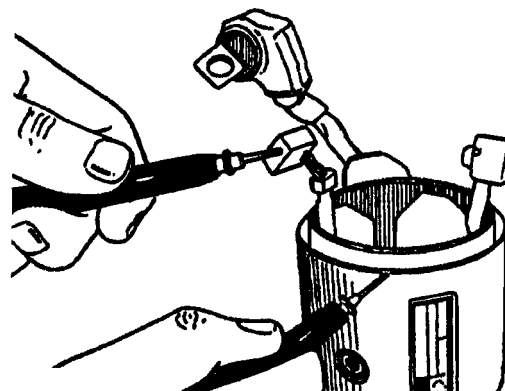
Standard force 1.7 kg

Service limit Less than 1.2 kg

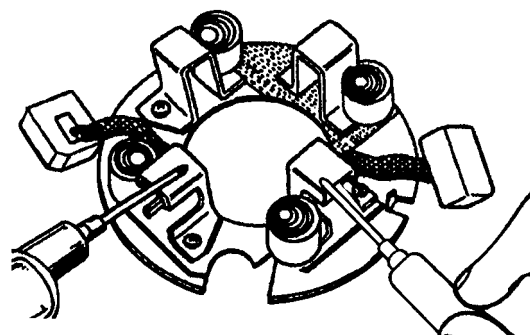
④ Insulation of brush holder

With a 500 V megger, check insulation between (+) and (-) sides of the brush holder.

If the resistance of more than 0.1 mega ohm is checked, the brush holder insulation is satisfactory.



T204



T205

NOTE: Carry out the insulation test after cleaning the brush holder with gasoline, to prevent checking error due to foreign matters.

(5) Clutch

- A. If the gear is excessively worn or damaged, replace it with new.
- B. Clutch operation
 - ① The clutch should lock the gear when turning it to the normal revolving direction. And, it should allow the gear to turn freely when turning the gear in reverse direction.
 - ② If the clutch fails to control the gear as explained above, replace it with new one.

(6) Bearing

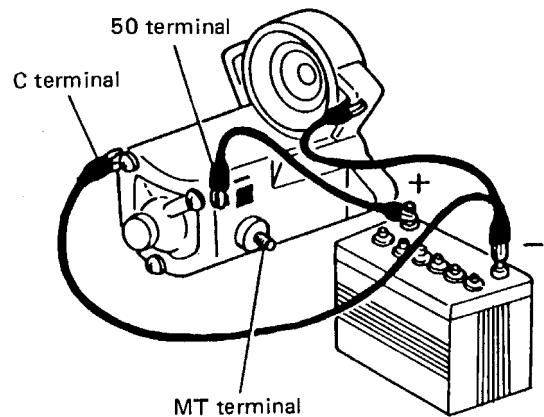
Rotate the bearing to check its catching or noise. If it is caught or generates noise, replace it with new.

(7) Magnetic switch

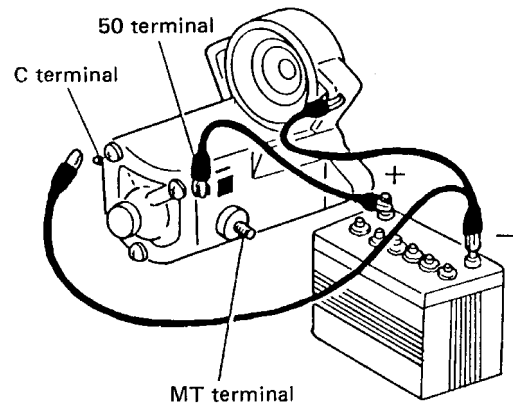
NOTE:

- 1. **Do not continue the following tests for more than 5 seconds.**
- 2. **Perform the test with 1/2 of the rated voltage.**

- ① Check of pull-in coil
Check that the pinion gear comes out when the (-) terminal of the battery is connected to the magnet switch body and C terminal and then the (+) terminal of the battery to the 50 terminal.
- ② Check of holding coil, holding condition
When removing the wire from the 'C' terminal, the pinion gear should be kept on coming out.
If the gear is returned, the holding coil is defective.



T206



T207

Reassembly

Perform reassembly of the starting motor in the reverse order of its disassembly. Before assembling the felt washer, retainer and steel ball, coat them with clean grease.

4) Troubleshooting

(1) The pinion does not move when the key switch is set to start position.

Trouble	Case	Remedy
Wiring	Disconnection, loosened terminals of the battery or switch	Repair and retighten.
Key Switch	Insufficient contact. No current flows.	Repair the contact area or replace
Starting motor	Pinion shaft helical spline is stucked and the pinion does not move.	Replace or repair
Magnetic switch	Irregular movement of the magnetic switch plunger, disconnection or short circuit of the coil.	Repair or replace

(2) Pinion is engaged, motor rotates, but the engine does not crank.

Trouble	Case	Remedy
Starting motor	Faulty clutch Damaged reduction gear	Replace Replace

(3) Pinion is engaged with the ring gear but starting motor does not run.

Trouble	Case	Remedy
Wiring	Disconnection or breakage of the wire connecting the battery and magnetic switch or improper grounding . Insufficient tightening of wiring connecting the magnetic switch and motor terminal.	Replace, retighten or correct the wire
Starting motor	Locked ball bearing Improper installation of the starting motor Dirty commutator Worn out brush, faulty contact of the brush spring Faulty armature and field coil Insufficient connection of the field coil and brush	Replace. Reinstall. Correct. Replace Repair or replace. Retighten
Magnetic switch	Insufficient contact of the contactor Rough contact surface of the contactor Broken holding coil	Replace Replace Replace
Battery	Discharged	Recharge

(4) The motor rotates at full speed before the pinion engages with the ring gear.

Trouble	Case	Remedy
Starting motor	Improper sliding of the pinion shaft Worn pinion gear end Improper coming out direction of pinion	Replace Correct Replace
Engine	Worn ring gear	Replace
Magnetic switch	Defective switch	Replace

(5) After the engine starts, the motor does not stop when the key switch is released.

Trouble	Case	Remedy
Key switch	Faulty switch	Replace
Magnetic switch	Faulty magnetic switch	Replace

3. GLOW PLUG

Ultra high speed heating type, IQS purpose glow plugs are used in this engine. For IQS system, refer to (Section 3-8 Electrical equipment and accessory).

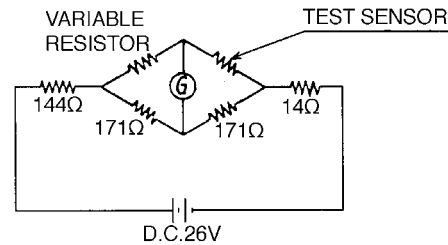
1) Specifications

Model	Part No.	NGK Part No.	Resistance	Insulator color
S753 · S773	185366190	Y701RS	1 Ω	B;ie
S773L	185366220	YE01	1 Ω	-

4. THERMO SENSOR

1) Specifications

Part No.	385720010
Temperature	Resistance
35°C	670 $\pm$ 80 Ω
80°C	118 $\pm$ 6 Ω
105°C	54.5 $\pm$ 2.7 Ω
115°C	42 $\pm$ 2.5 Ω
The resistance rating is measure on the special circuit.	



Special circuit
G: Galvanometer

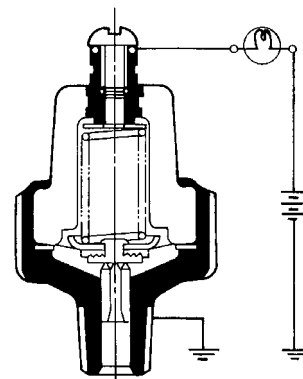
5. OIL PRESSURE SWITCH

Construction

The oil pressure switch is a warning device to inform low engine lubricating oil pressure. When oil pressure becomes less than specified one, this switch lights up the oil pressure warning lamp.

This pressure switch houses a diaphragm and a contact points as shown.

Oil pressure switch	
Operating range	0.0196 – 0.0392 MPa (Max. 0.2 – 0.4 kgf/cm ²)



T208

T209

6. BATTERY

1) Specifications

Type	12 V	Specific gravity of electrolyte	1.28/20°C when fully charged
Capacity	36 AH	Charging current	6.5 ampere (normal charging)

2) Specific gravity of electrolyte and charging condition

The specific gravity of electrolyte decreases approximately linearly in proportion to the discharged electricity of battery. By measuring the specific gravity of the electrolyte using a hydrometer, residual capacity of the battery can be known.

The specific gravity value measured by the hydrometer should be compensated with respect to temperature. The specific gravity of battery electrolyte is based on the temperature of 20°C. As the temperature varies 1°C, the specific gravity value increases or decreases 0.0007. Therefore measured values can be compensated by the following equation.

$$S_{20} = S_t + 0.0007 (t - 20)$$

S_{20} — Specific gravity converted to the value at 20°C
 S_t — Measured specific gravity
 t — Electrolyte temperature in measured value

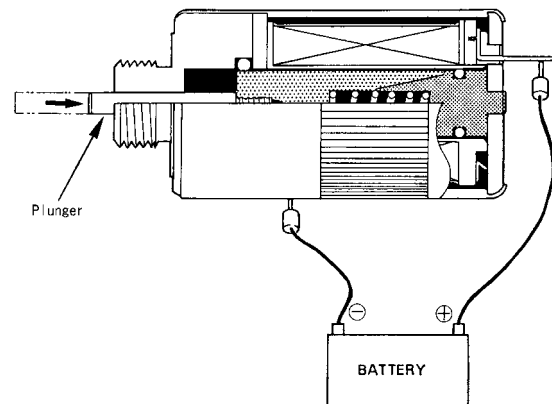
Specific gravity (20°C)	Discharged electricity (%)	Residual capacity (%)
1.280	0	100
1.230	25	75
1.180	50	50
1.130	75	25
1.080	100	0

The table indicates relation between the specific gravity values and battery residual capacity.

7. ENGINE STOP SOLENOID

Inspection

Connect the positive (+) side of the battery to the terminal of the engine stop solenoid and the negative (–) side to the main body. If the plunger is sucked into the main body, the engine stop solenoid is normal.



T210

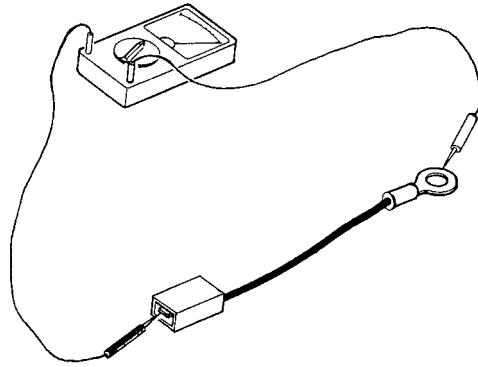
8. FUSIBLE LINK

Inspection

The fusible link is installed between the battery and alternator and key switch to prevent burning of electrical units and wiring harness to which large current flows instantaneously.

NOTE:

1. When the fusible link burns after replacement, short circuit of wiring, etc. are considered. Check the wiring harness in such a case.
2. Never use a substitute wire or the like at the time of burning.



T211

9. WIRING HARNESS (WIRING)

Inspection and service

- (1) Disconnect the negative cable of the battery at the time of inspection and service.
- (2) At the time of inspection or service, be sure to check each wiring for damaged sheath due to vibration, etc., or loosened connections. If any defective points are noticed, repair the insulation or replace the wiring harness. (Be sure to replace the band since it becomes fragile after used for long time.)
- (3) After completion of service for the tractor, etc., protect wiring inserting points with vinyl tube and check that the clamping fixture is protected with vinyl sheath and not in direct contact with the wiring. (Replace wiring if the fixture is not sheathed.)
Check especially carefully where the wiring is apt to be caught by something.
- (4) Check such points especially carefully to which plus current flows constantly to confirm the sheathing is not subjected to abnormalities.
 - 1) Starting motor
 - 2) Alternator
 - 3) Key switch
- (5) After completion of inspection, protect the wiring with corrugated tube, or the like.

2-5 Trouble Shooting

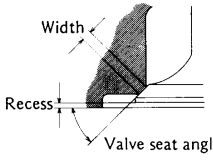
Trouble	Cause	Remedy
Engine does not start.	Defective key switch Insufficient charging or completely discharged battery. No fuel. Air mixed in the fuel system. Clogged fuel filter. Irregular of improper fuel supply. Defective glow plug. Improper viscosity of lubricating oil. Clogged air cleaner. Not compression. Defective engine stop solenoid. Trouble of IOS system.	Connect or correct contact points propely. Charge. Replenish the fuel. Correct points allowing the air to enter the fuel. Replace the fuel filter. Trouble of injection pump. Have corrected in work specified by Nippon Denso. Replace to disconnected wire of glow plug. Check and change. Clean the air cleaner. Check an correct each part. Check or replace wiring. Refer to 3-8 Electric Units and Accessories.
Irregular engine speed	Air mixed in the fuel system. Uneven fuel injection. Clogged fuel filter. Trouble of speed governor. Improper function of engine main body.	Discharge air from the fuel. Trouble of injection pump. Have corrected or replaced in a work specified by Nippon Denso. Replace the fuel filter. Check and adjust. Overhaul, check and correct each part.
Engine stops during operation	No fuel in fuel tank. Clogged fuel filter. Air mixed in the fuel system. Improper functions of engine main body.	Replenish fuel. Replace the filter. Correct points to allow the air to enter the fuel system. Check and correct each part.
Engine overheat	Insufficient cooling water. Loosened or slipping fan belt. Failure of fan belt. Clogged radiator. Clogged radiator fin. Cooling water passage clogged with dust, fur, etc. Improper function of thermostat. Insufficient lubricating oil. Overload.	Replenish the cooling water, and check and repair water leaking points. Clean oil dust, etc. and retighten. Replace. Clean the radiator. Clean. Wash. Check and replace Replenish. Decrease the load.

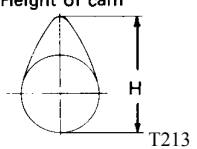
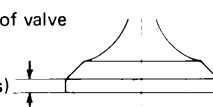
Trouble	Cause	Remedy
Improper color of engine exhaust (white or blue)	Too much engine oil. Too low viscosity of engine oil. Improper injection timing.	Check and adjust the quantity. Check and change. Too late. Correct.
Improper engine exhaust (black or dark gray)	Improper fuel. Excessive fuel injection. Damaged engine block. Overload. Clogged air cleaner.	Check and change. Check and adjust. Check and correct each part. Reduce the load. Clean the element.
Improper charging.	Loosened fan belt. Trouble in wiring of each part. Defective battery. Defective alternator.	Correct belt tension. Check and repair. Replace. Replace.
Starter does not operate.	Loosened or disconnected wiring of each part. Dropped battery voltage. Defective safety switch. Trouble in starter.	Check and install or tighten. Charge the battery. Replace. Check and correct the starter.
Oil pressure lamp does not go out.	Insufficient engine oil. Trouble in pressure switch. Oil leakage from lubricating system. Clogged oil filter. Short circuit between oil pressure lamp and oil pressure switch.	Replenish to specified gauge level. Replace the switch. Check and retighten. Replace with new one. Repair.
Oil pressure lamp does not light up with the key switch turned ON. (While engine stops.)	Burnt out lamp. Disconnected wire between battery and oil pressure lamp.	Replace the lamp. Repair.

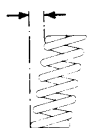
2-6 Engine Maintenance Standards Table

S753 ENGINE (ST318)

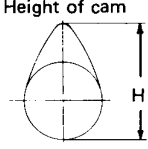
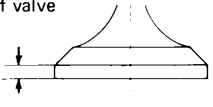
* Unit for values without unit in the column of inspection item is mm.

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
ENGINE	CYLINDER HEAD	Compression pressure of cylinder MPa (kgf/cm ²)		More than 2.94 (More than 30)	Less than 2.45 (Less than 25)		Engine 200 rpm
		Distortion of face of cylinder head		Less than 0.05	More than 0.12		
		Valve seat (Intake/exhaust) 		0.85 – 1.15	1.8		Valve seat angle 45°
		Width of valve seat (intake/exhaust)		1.7 – 2.1	More than 2.5		
		Tightening torque of cylinder head N·m (kgf·m)		49 ~ 52 (5.0 – 5.3)			Coat threads with molybdenum bisulfide based grease.
	CYLINDER BLOCK						
		Bore	Ø75	Ø75 – 75.019	Ø75.2	Ø76.2	Over size (0.5, 1.0)
		Distortion of upper face of cylinder block		Less than 0.05	0.12		
	PISTON	Skirt diameter (longer diameter)	Ø75	Ø74.9325 – 74.9475		Ø74.7	Over size (0.5, 1.0)
		Clearance to cylinder		Ø0.0525 – 0.0865		0.25	At 20°C
		Inside diameter of piston pin hole	Ø21	Ø20.998 – 21.002		21.016	
		Piston pin hole-to-pin clearance		-0.004 - +0.004		0.02	
	PISTON PIN	Outer diameter of pin	Ø21	Ø20.998 – 21.002		Ø20.98	
		Small end bush-to-pin clearance		0.008 – 0.023		0.08	Oil clearance
	PISTON RING	Piston ring gap:	No.1 ring	0.2 – 0.35		1.0	
			No.2 ring	0.15 – 0.20			
			Oil ring	0.15 – 0.35			
		Piston ring groove-to-ring clearance	No.1 ring	0.06 – 0.1		0.25	
			No.2 ring	0.05 – 0.09			
			Oil ring	0.02 – 0.06		0.15	
		Ring width	No.1 ring	2	1.97 – 1.99		Over size (0.5, 1.0)
			No.2 ring	1.5	1.47 – 1.49		
			Oil ring	4	3.97 – 3.99		

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
MAIN MOVING SYSTEM	CONNECTING ROD	Twist between small and large end holes (per 100 mm)		Less than 0.08	More than 0.2		
		Straightness at 100 mm between small and large end hole		Less than 0.05	More than 0.15		
		Front-to-rear clearance between connecting rod and crank pin		0.1 – 0.3		0.7	
		Connecting rod metal-to-crank pin clearance		0.035 – 0.083		0.2	Oil clearance
		Connecting rod bearing (inner diameter × width)	Ø37 × 17.5				
		Connecting rod bolt torque N·m (kgf·m)		29 ~ 34 (3.0 – 3.5)			
		Weight difference with piston (g)		Less than 10			
		Crush height of small end bush		0.034 – 0.079			
	CRANKSHAFT	Diameter of journal	Ø46	Ø45.964 – 45.975		Ø45.9	Under size (0.25, 0.5)
		Diameter of crank pin	Ø39	Ø38.964 – 38.975		Ø38.9	Same to above
		Roughness, main journal and crank pin	1.6Z				
		Crankshaft deflection		Less than 0.03	More than 0.06		
		Axial play of crankshaft		0.05 – 0.3		0.5	
		Thickness of thrust washer	2.0	1.95 – 2.0		1.8	
		O.D. × I.D. of bush (journal metal)	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft and journal metal (bush)		0.039 – 0.106		0.2	Oil clearance
		I.D. × O.D. of center bearing	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft journal and center bearing		0.039 – 0.092		0.2	Oil clearance Upper No. 2 and 3.
				0.029 – 0.082		0.2	Oil clearance Lower No.4
VALVE SYSTEM	CAMSHAFT		For intake/exhaust	26.565 – 26.62		26.1	
			For injection pump	33.94 – 34.06		33.8	
	VALVE	Backlash of cam gear		0.08		0.25	
		Diameter of intake valve stem		6.955 – 6.97		6.89	
		Diameter of exhaust valve stem		6.94 – 6.955		6.84	
		Clearance between valve stem and valve guide	Inlet	0.03 – 0.06		More than 0.2	
			Exhaust	0.045 – 0.075		More than 0.25	
		Thickness of valve  (thickness)	T214	1.0	0.775 – 1.075	0.5	

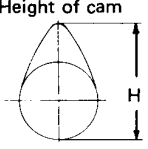
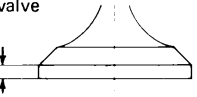
Unit	Part	Inspection Items		Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
VALVE SYSTEM	VALVE	Valve clearance (Intake/exhaust)			0.2	0.5		When cooling temperature
		Valve spring	Spring strength (kgf)		8.1		Less than 7	At 30.4 mm compressed length
			Free height		35		33.5	
			Squareness  T215		Less than 1.2		2.0	
		Inlet valve timing	Open-Before T.D.C	13°				
			Close-After B.D.C.	43°				
		Exhaust valve timing	Open-Before B.D.C.	43°				
			Close-After T.D.C.	13°				
	PUSH ROD	Overall length		157	156.8 – 157.2			
		Outer diameter		Ø6.3				
	ROCKER ARM	Wear, rocker arm shaft		Ø11.66	Ø11.65 – 11.668		Ø11.57	
		Clearance between rocker arm and shaft			0.032 – 0.068		0.2	Oil clearance
LUBRICATION SYSTEM	OIL PUMP							
		Oil pressure switch operating pressure kPa (kgf/cm ²)		29.4 (0.3)	19.6 – 39.2 (0.2 – 0.4)			
		Relief pressure kPa (kgf/cm ²)			245 – 343 (2.5 – 3.5)			
		Lubrication oil capacity (ℓ)		3.0				With filter change 3.3 ℓ
		Tip clearance (rotor-to-vane)			0.1 – 0.15		0.25	
		Side clearance (rotor-to-cover)			0.1 – 0.15		0.2	
FUEL SYSTEM	INJECTION PUMP	Type		094500-3730				DENSO
		Injection timing	Before T.D.C.		22 - 24°			
			Piston movement before T.D.C.		3.44 – 4.08			

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
	INJECTION NOZZLE	Type	093500 – 3320				DENSO
		Injection pressure MPa (kgf/cm ²)	11.76 (120)	11.27 – 12.25 (115 – 125)			
		Angle of injection direction	4°				
COOLING SYSTEM	COOLING	Cooling method	Water colded, forced circulation				
		Coolant capacity (ℓ)	3.5				
		Thermostat open temperature (°C)	82	80 – 84			
		Thermostat full-open temperature (°C)	95				
		V belt	M30				
ELECTRICAL SYSTEM	STARTER MOTOR	Type	128000 – 0101				DENSO
		No. of teeth of pinion gear	9				
		Shifting method of pinion	Magnetic shift type				
		Wear of commutator diameter	30			29	
		Stepped wear of commutator		0.05		0.2	
		Bending allowance of armature shaft		0.05	More than 0.08		
		Length of brush	13.5			9	
		Spring force of brush N (kgf)	16.7 (1.7)			Less than 11.76 (1.2)	
	ALTER MATOR	Type	10021 – 1680				DENSO
		Outside diameter of slip ring		14.4		14.0	
		Length of brush		10.5		4.5	
		Pulley tightening torque N·m (kgf·m)		58.3 – 78.8 (5.95 – 8.05)			

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
MAIN MOVING SYSTEM	CONNECTING ROD	Twist between small and large end holes (per 100 mm)		Less than 0.08	More than 0.2		
		Straightness at 100 mm between small and large end hole		Less than 0.05	More than 0.15		
		Front-to-rear clearance between connecting rod and crank pin		0.1 – 0.3		0.7	
		Connecting rod metal-to-crank pin clearance		0.035 – 0.083		0.2	Oil clearance
		Connecting rod bearing (inner diameter × width)	Ø37 × 17.5				
		Connecting rod bolt torque N·m (kgf·m)		29 ~ 34 (3.0 – 3.5)			
		Weight difference with piston (g)		Less than 10			
		Crush height of small end bush		0.034 – 0.079			
	CRANKSHAFT	Diameter of journal	Ø46	Ø45.964 – 45.975		Ø45.9	Under size (0.25, 0.5)
		Diameter of crank pin	Ø39	Ø38.964 – 38.975		Ø38.9	Same to above
		Roughness, main journal and crank pin	1.6Z				
		Crankshaft deflection		Less than 0.03	More than 0.06		
		Axial play of crankshaft		0.05 – 0.3		0.5	
		Thickness of thrust washer	2.0	1.95 – 2.0		1.8	
		O.D. × I.D. of bush (journal metal)	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft and journal metal (bush)		0.039 – 0.106		0.2	Oil clearance
		I.D. × O.D. of center bearing	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft journal and center bearing		0.039 – 0.092		0.2	Oil clearance Upper No. 2 and 3.
				0.029 – 0.082		0.2	Oil clearance Lower No.4
VALVE SYSTEM	CAMSHAFT	 Height of cam T217	For intake/exhaust	26.565 – 26.62		26.1	
			For injection pump	33.94 – 34.06		33.8	
	VALVE	Backlash of cam gear		0.08		0.25	
		Diameter of intake valve stem		6.955 – 6.97		6.89	
		Diameter of exhaust valve stem		6.94 – 6.955		6.84	
		Clearance between valve stem and valve guide	Inlet	0.03 – 0.06		More than 0.2	
			Exhaust	0.045 – 0.075		More than 0.25	
		 Thickness of valve (thickness) T218		1.0	0.775 – 1.075	0.5	

Unit	Part	Inspection Items		Standard Dimension	Standard Value		To be Repaired	Allowable Limit	Remarks
VALVE SYSTEM	VALVE	Valve clearance (Intake/exhaust)			0.2		0.5		When cooling temperature
		Valve spring	Spring strength (kgf)		8.1			Less than 7	At 30.4 mm compressed length
			Free height		35			33.5	
			Squareness  T219		Less than 1.2			2.0	
		Inlet valve timing	Open-Before T.D.C	13°					
			Close-After B.D.C.	43°					
		Exhaust valve timing	Open-Before B.D.C.	43°					
			Close-After T.D.C.	13°					
	PUSH ROD	Overall length		157	156.8 – 157.2				
		Outer diameter		Ø6.3					
	ROCKER ARM	Wear, rocker arm shaft		Ø11.66	Ø11.65 – 11.668			Ø11.57	
		Clearance between rocker arm and shaft			0.032 – 0.068			0.2	Oil clearance
LUBRICATION SYSTEM	OIL PUMP								
		Oil pressure switch operating pressure kPa (kgf/cm ²)		29.4 (0.3)	19.6 – 39.2 (0.2 – 0.4)				
		Relief pressure kPa (kgf/cm ²)			245 – 343 (2.5 – 3.5)				
		Lubrication oil capacity (ℓ)		3.0					With filter change 3.3 ℓ
		Tip clearance (rotor-to-vane)			0.1 – 0.15			0.25	
		Side clearance (rotor-to-cover)			0.1 – 0.15			0.2	
FUEL SYSTEM	INJECTION PUMP	Type		094500-7410					DENSO
		Injection timing	Before T.D.C.		22 - 24°				
			Piston movement before T.D.C.		3.44 – 4.08				

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
	INJECTION NOZZLE	Type	093500 – 3320				DENSO
		Injection pressure MPa (kgf/cm ²)	11.76 (120)	11.27 – 12.25 (115 – 125)			
		Angle of injection direction	4°				
COOLING SYSTEM	COOLING	Cooling method	Water colded, forced circulation				
		Coolant capacity (ℓ)	3.5				
		Thermostat open temperature (°C)	82	80 – 84			
		Thermostat full-open temperature (°C)	95				
		V belt	M30				
ELECTRICAL SYSTEM	STARTER MOTOR	Type	128000 – 0101				DENSO
		No. of teeth of pinion gear	9				
		Shifting method of pinion	Magnetic shift type				
		Wear of commutator diameter	30			29	
		Stepped wear of commutator		0.05		0.2	
		Bending allowance of armature shaft		0.05	More than 0.08		
		Length of brush	13.5			9	
		Spring force of brush N (kgf)	16.7 (1.7)			Less than 11.76 (1.2)	
	ALTER MATOR	Type	10021 – 1680				DENSO
		Outside diameter of slip ring		14.4		14.0	
		Length of brush		10.5		4.5	
		Pulley tightening torque N·m (kgf·m)		58.3 – 78.8 (5.95 – 8.05)			

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
MAIN MOVING SYSTEM	CONNECTING ROD	Twist between small and large end holes (per 100 mm)		Less than 0.08	More than 0.2		
		Straightness at 100 mm between small and large end hole		Less than 0.05	More than 0.15		
		Front-to-rear clearance between connecting rod and crank pin		0.1 – 0.3		0.7	
		Connecting rod metal-to-crank pin clearance		0.035 – 0.083		0.2	Oil clearance
		Connecting rod bearing (inner diameter × width)	Ø37 × 17.5				
		Connecting rod bolt torque N·m (kgf·m)		29 ~ 34 (3.0 – 3.5)			
		Weight difference with piston (g)		Less than 10			
		Crush height of small end bush		0.034 – 0.079			
	CRANKSHAFT	Diameter of journal	Ø46	Ø45.964 – 45.975		Ø45.9	Under size (0.25, 0.5)
		Diameter of crank pin	Ø39	Ø38.964 – 38.975		Ø38.9	Same to above
		Roughness, main journal and crank pin	1.6Z				
		Crankshaft deflection		Less than 0.03	More than 0.06		
		Axial play of crankshaft		0.05 – 0.3		0.5	
		No.4 bearing holder thickness		21.85 – 21.95		21.55	
		O.D. × I.D. of bush (journal metal)	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft and journal metal (bush)		0.039 – 0.106		0.2	Oil clearance
		I.D. × O.D. of center bearing	Ø46 × 50				Under size (0.25, 0.5)
		Clearance between crankshaft journal and center bearing		0.039 – 0.092		0.2	Oil clearance Upper No. 2 and 3.
				0.029 – 0.082		0.2	Oil clearance Lower No.4
VALVE SYSTEM	CAMSHAFT	 Height of cam T221	For intake/exhaust	26.565 – 26.62		26.2	
			For injection pump	33.94 – 34.06		33.8	
	VALVE	Backlash of cam gear		0.08		0.25	
		Diameter of intake valve stem		6.955 – 6.97		6.89	
		Diameter of exhaust valve stem		6.94 – 6.955		6.84	
		Clearance between valve stem and valve guide	Inlet	0.03 – 0.06		More than 0.2	
			Exhaust	0.045 – 0.075		More than 0.25	
		Thickness of valve  (thickness) T222		1.0	0.775 – 1.075	0.5	

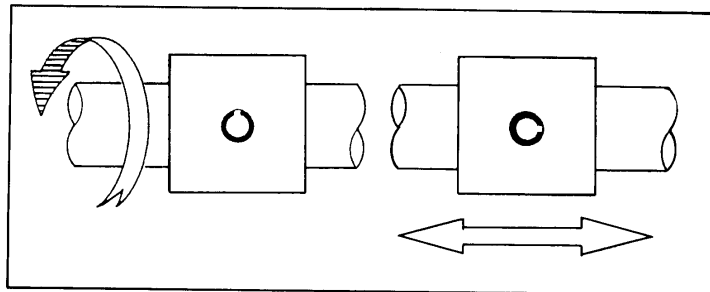
Unit	Part	Inspection Items		Standard Dimension	Standard Value		To be Repaired	Allowable Limit	Remarks
VALVE SYSTEM	VALVE	Valve clearance (Intake/exhaust)			0.2		0.5		When cooling temperature
		Valve spring	Spring strength (kgf)		8.1			Less than 7	At 30.4 mm compressed length
			Free height		35			33.5	
			Squareness  T223		Less than 1.2			2.0	
		Inlet valve timing	Open-Before T.D.C	13°					
			Close-After B.D.C.	43°					
		Exhaust valve timing	Open-Before B.D.C.	43°					
			Close-After T.D.C.	13°					
	PUSH ROD	Overall length		157	156.8 – 157.2				
		Outer diameter		Ø6.3					
	ROCKER ARM	Wear, rocker arm shaft		Ø11.66	Ø11.65 – 11.668			Ø11.57	
		Clearance between rocker arm and shaft			0.032 – 0.068			0.2	Oil clearance
LUBRICATION SYSTEM	OIL PUMP								
		Oil pressure switch operating pressure kPa (kgf/cm ²)		29.4 (0.3)	19.6 – 39.2 (0.2 – 0.4)				
		Relief pressure kPa (kgf/cm ²)			245 – 343 (2.5 – 3.5)				
		Lubrication oil capacity (ℓ)		3.0					With filter change 3.3 ℓ
		Tip clearance (rotor-to-vane)			0.1 – 0.15			0.25	
		Side clearance (rotor-to-cover)			0.1 – 0.15			0.2	
FUEL SYSTEM	INJECTION PUMP	Type		094500-6340					DENSO
		Injection timing	Before T.D.C.		23 - 25°				
Piston movement before T.D.C.			4.217 – 4.96						

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
	INJECTION NOZZLE	Type	093500 – 3320				DENSO
		Injection pressure MPa (kgf/cm ²)	11.76 (120)	11.27 – 12.25 (115 – 125)			
		Angle of injection direction	4°				
COOLING SYSTEM	COOLING	Cooling method kgf/cm ²	Water colded, forced circulation				
		Coolant capacity (ℓ)	3.5				
		Thermostat open temperature (°C)	82	80 – 84			
		Thermostat full-open temperature (°C)	95				
		V belt	M30				
ELECTRICAL SYSTEM	STARTER MOTOR	Type	128000 – 0101				DENSO
		No. of teeth of pinion gear	9				
		Shifting method of pinion	Magnetic shift type				
		Wear of commutator diameter	30			29	
		Stepped wear of commutator		0.05		0.2	
		Bending allowance of armature shaft		0.05	More than 0.08		
		Length of brush	13.5			9	
		Spring force of brush N (kgf)	16.7 (1.7)			Less than 11.76 (1.2)	
	ALTER MATOR	Type	100211 – 1680				DENSO
		Outside diameter of slip ring		14.4		14.0	
		Length of brush		10.5		4.5	
		Pulley tightening torque N·m (kgf·m)		58.3 – 78.8 (5.95 – 8.05)			

Chapter 3. TRACTOR MAIN BODY

NOTES: Precautions before start

- 1) Wash each part sufficiently and remove dust, liquid packing, gasket, etc.
- 2) Store bolts and O-rings in order not to be confused at the time of reassembly since their sizes vary depending on positions of use.
- 3) Handle gears carefully not to damage and store carefully so that they are not reassembled in incorrect direction.
- 4) Remove steel balls, springs and other small parts carefully not to miss when overhauling the transmission case and install them without fail at the time of reassembly.
- 5) When driving in a spring pin, apply the driving force and face the spring pin gap as shown in the figure below.
- 6) Replace the lock washers, wires and gaskets with new ones.
- 7) Be sure to coat liquid packing where liquid packing had been coated and leave it for 3 to 5 minutes before reassembly. (Use semi-dry, fluidity type liquid packing.)
- 8) Drain oil and water if required.

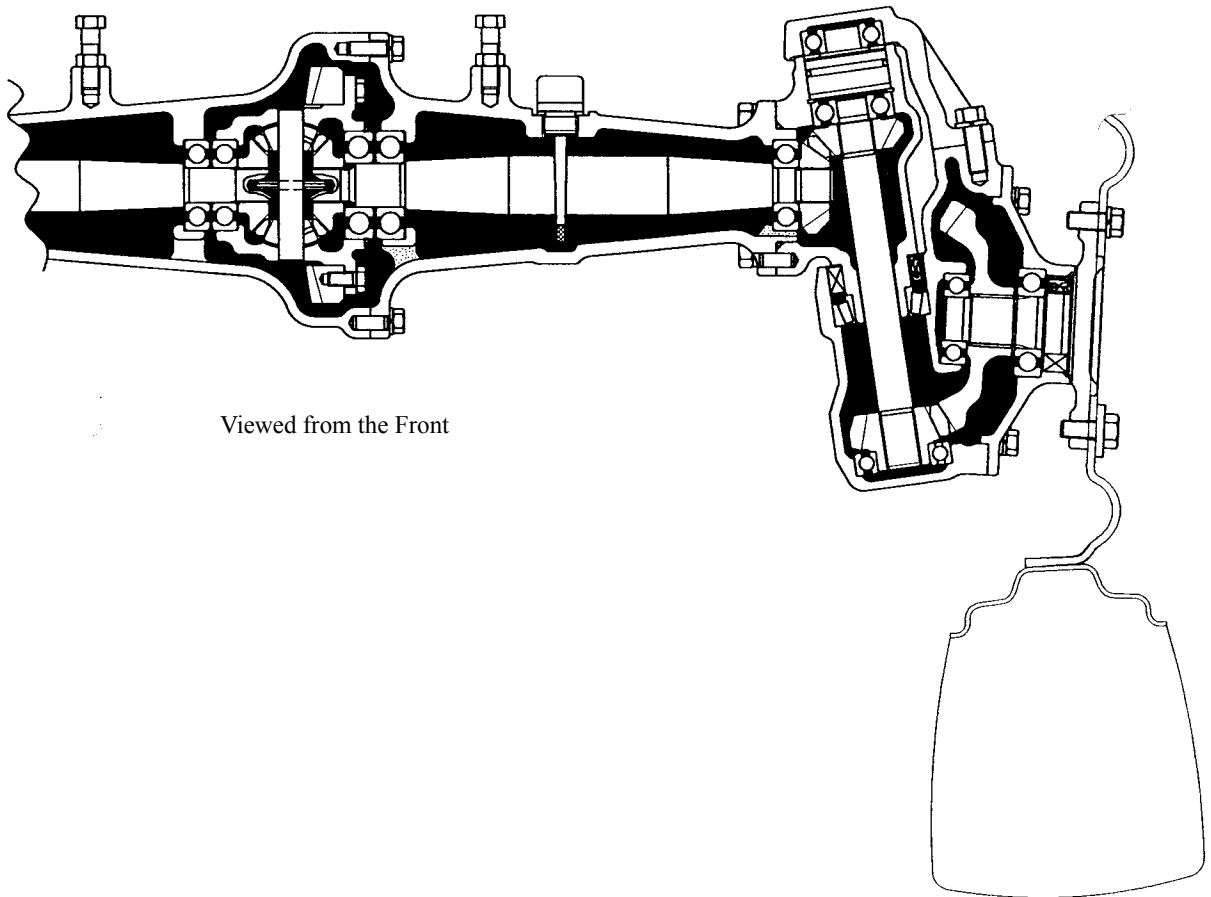


T400

3-1 Front Axle

1. SECTIONAL VIEWS

4 Wheel drive



T401

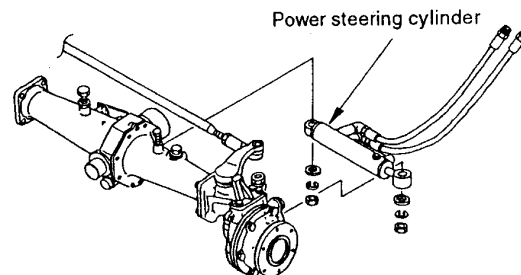
2. DISASSEMBLY, INSPECTION, REASSEMBLY OF FRONT AXLE

1) Power Steering Cylinder

Disassembling procedure

1 Power steering cylinder

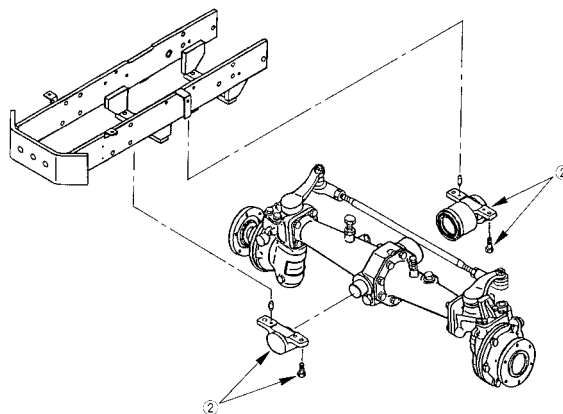
Remove the power steering cylinder with hoses from the front axle.



T402

2 Tire • Front wheel support

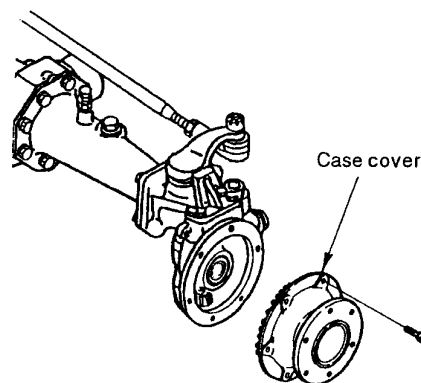
- ① Remove the right and left tires.
- ② Remove the front and rear bearing holders and separate the front axle ass'y and front wheel support.



T403

3 Case cover (final)

Remove the wheel shaft and final gear (bevel) together.

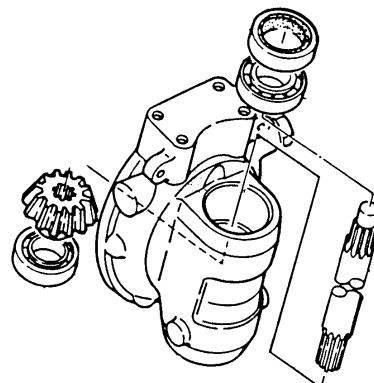


T404

4 Transmission case (final)

Remove the bolts of the arms (knuckle) and take out the right and left case (final) downwards.

NOTE: Be careful not to damage the oil seal.

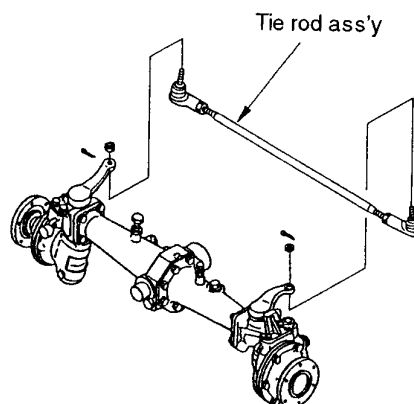


T405

5 Tie rod ass'y

Remove the split pins of the right and left arms (knuckle) and take away the nuts.

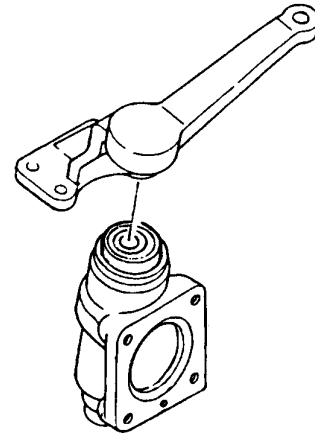
NOTE: Remove the tie rod ass'y when removing the arm. In the reassembling procedure (after the order 5), install it temporarily together with the arm.



T406

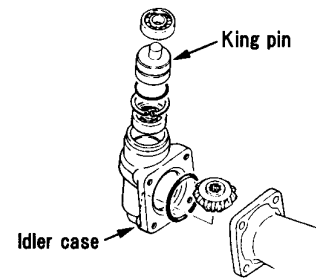
6 Arm (knuckle) king pin

Remove the right and left arms.



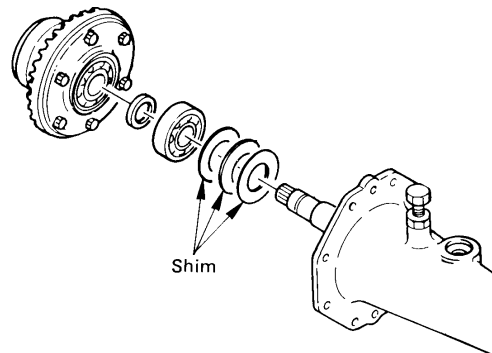
7 Transmission case (idler) · King pin

Remove the right and left transmission cases and king pin as a set.

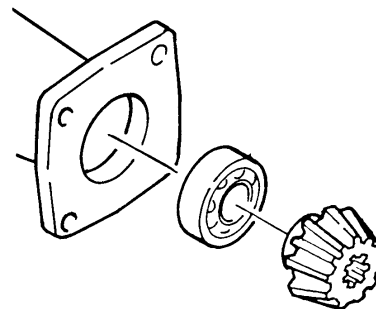


8 Wheel shaft case (left)

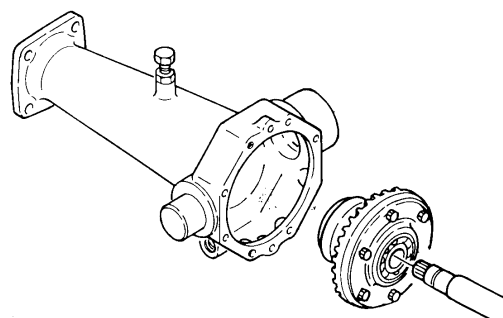
NOTE: When any shims have been installed between the case and bearing, note their thickness and quantity and take care not to miss them.



9 Final pinion (left) : Idler



10 Differential shaft (left) Differential ass'y

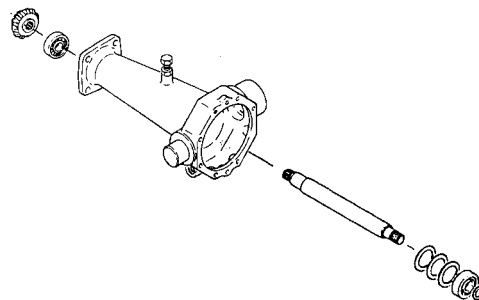


T411

11 Final pinion (right) Differential shaft (right)

Extract the final pinion (right), bearing and differential shaft (right).

NOTE: When any shims have been inserted between the case and bearing, note their thickness and quantity and take care not to miss them.



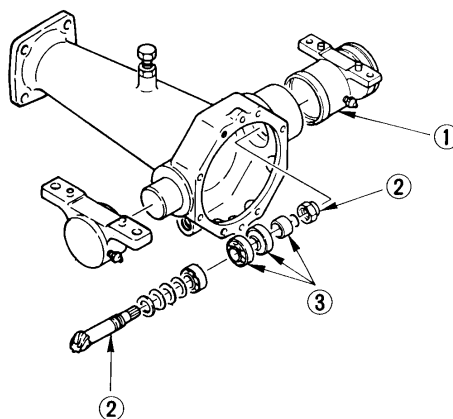
T412

12 Drive pinion

- ① Extract the bearing holder (rear) rearward.
- ② Remove the lock nut and extract the drive pinion to the inside of the case.

NOTE: Note the thickness and quantity of the shims.

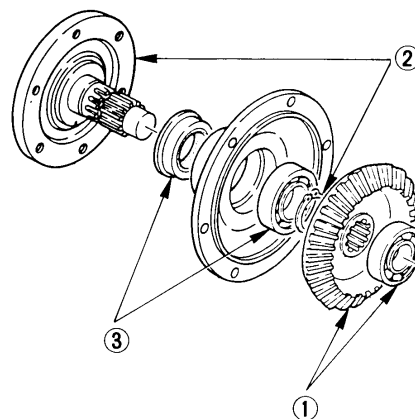
- ③ Remove the oil seal, collar, and bearing if necessary.



T413

13 Case cover ass'y

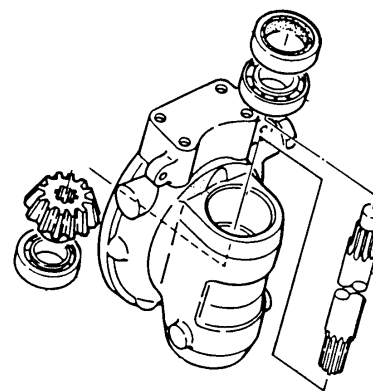
- ① Remove the final gear (bevel).
- ② Remove the snap ring and extract the wheel shaft.
- ③ Drive out the bearing from the cover. Remove the oil seal if necessary.



T414

14 Transmission case ass'y (final)

- ① Take out the final pinion, bearing, and drive shaft.
- ② Remove the oil seal and taper bearing.

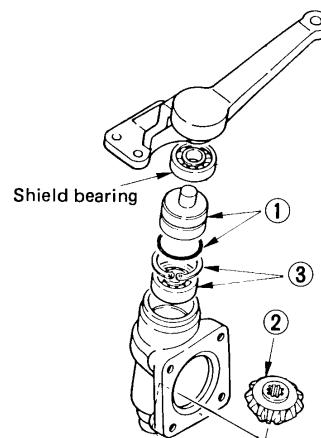


T415

15 Transmission case ass'y (idler)

- ① Remove the king pin and O-ring
- ② Remove the final pinion (idler).
- ③ Remove the snap ring and bearing if necessary.

NOTE: Confirm the direction of the bearing at the top of the king pin before removing it. (The shield should be positioned lower.)



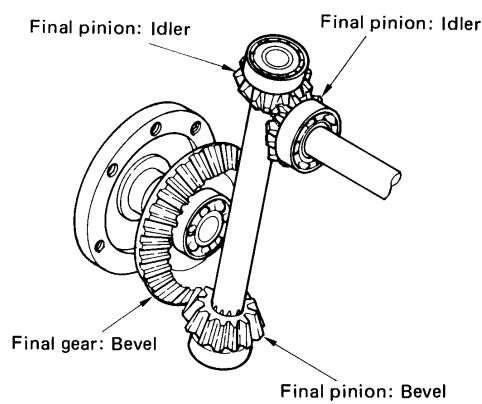
T416

Inspection and service

1. Final gear and final pinion

- (1) Rotate the bearing and replace if play or other trouble is noticed.
- (2) Replace the final gear and final pinion if the backlash exceeds the service limit.

Backlash of final gear and final pinion (mm)	
Assembling standard	Service limit
0.10 – 0.25	0.4



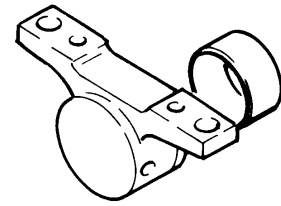
T417

2. Casing

Replace the bush if the play of the pivot shaft exceeds the repair value.

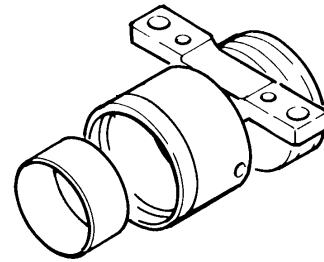
	Clearance between pivot shaft and bush (mm)	
	Standard assembling value	Repair value
Front side	0.02 – 0.2	0.35
Rear side	0.02 – 0.16	0.35

Front side



T418

Rear side

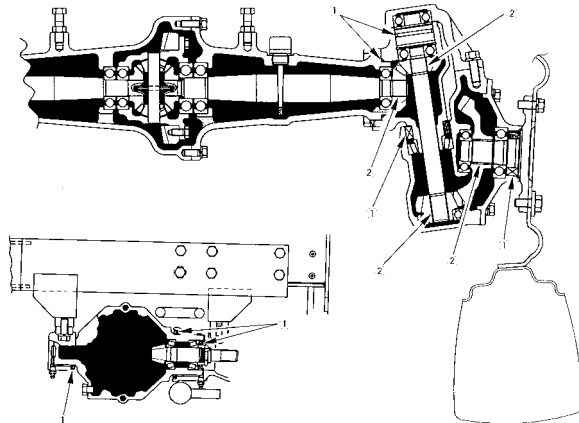


T419

3. Oil seal · O-ring · Shaft spline

- (1) Replace the oil seal and O-ring of oil leaks to the outside.
- (2) When the service limit is exceeded, replace the shaft or gear and pinion.

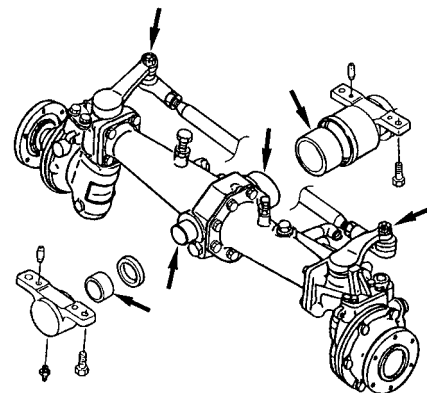
Play of spline in rotating direction (mm)	
Standard assembling value	Service limit
0 – 0.1	0.25



T420

4. Runout of front wheel

Check the bearing and shaft for wear and link mechanism for play. Correct if necessary.



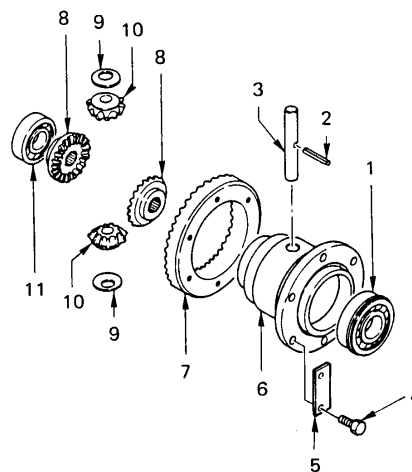
T421

6. Differential ass'y

Refer to paragraph of transmission (rear differential).

Components

1. Bearing (6305NR)
2. Spring pin
3. Pinion shaft
4. Bolt
5. Lock washer
6. Differential cage
7. Ring gear
8. Differential gear
9. Thrust washer
10. Differential pinion
11. Bearing (6304)



T422

NOTE: Coating bolts are used to tighten the ring gear in the factory (without lock washer). Bolts and lock washers are available as service parts to be used for reassembly. Use them and tighten with the specified torque. When reusing the bolts, remove oil and stain and tighten using lock washer without fail.

Ring gear tightening torque N·m (kgf·m)	22.6 – 28.4 (2.3 – 2.9)
--	--

- (1) Replace the thrust washer of the differential pinion if the service limit is exceeded.

Thrust washer thickness (mm)	
Standard dimension	Service limit
1.0	Less than 0.7

- (2) Replace the pinion shaft bush and differential pinion if their clearance exceeds the service limit.

Clearance between pinion shaft and differential pinion (mm)	
Standard dimension	Service limit
0.03 – 0.1	More than 0.5

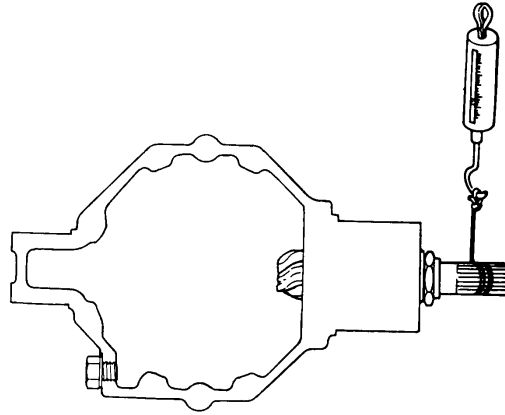
Reassembly

1. Reassembly of drive pinion

- (1) Be careful about the direction of the oil seal.
(Position the seal lip to the oil side and fit under pressure 2 mm inward from the case end.)
- (2) Tighten the nut and measure the starting load (preload).

Bearing preload	98 – 137 N (10 – 14 kgf)
-----------------	-----------------------------

NOTE: Measure the bearing starting load at the spline. Lock the nut at the time of measurement.



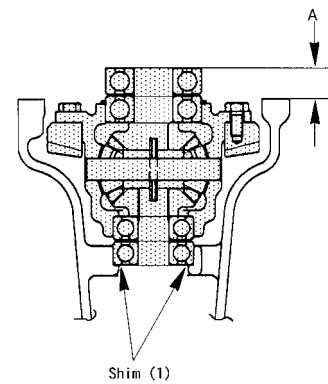
T423

2. Backlash of bevel gear (differential)

After assembling the drive pinion, adjust the backlash of the bevel gear in the following procedure.

- (1) Place the differential ass'y into the case and adjust the backlash to 0 (zero) with shims (1).

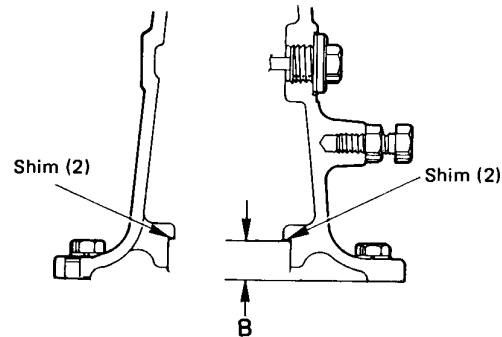
NOTE: When backlash is 0 (zero), the bevel gear of the differential may be stucked closely to the drive shaft, leaving gap between the bearing and case. Adjust in such a case increasing the shims.



T424

- (2) Take out the differential ass'y from the case again, fit a shim (1) so as to obtain the specified backlash, and install the differential ass'y.

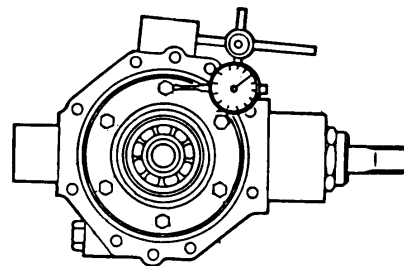
- (3) Adjust the shims (2) to obtain $A - B = 0$ mm



T425

- (4) Measure the backlash with a dial gauge.

Backlash of bevel gear (mm)	
Standard assembling value	Repair value
0.1 – 0.15	More than 0.3



T426

NOTE: Refer to the paragraph of the transmission for the gear contact pattern of the pinion and ring gear when adjusting.

3. WHEEL ALIGNMENT

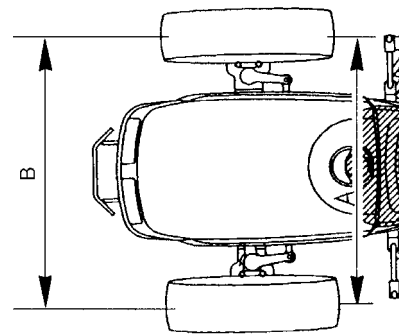
Inspection and service

1. Toe-in

When the steering link system is disassembled, perform the wheel alignment by adjusting the length of the tie rod.

Standard value (A – B)	-5 ~ +5 mm
------------------------	------------

(Inclination angle of king pin, caster and camber fixed)

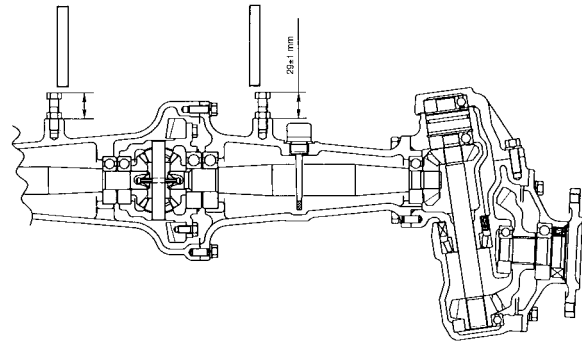


T427

2. Swing angle

(1) Check for the dimension from the wheel shaft case and bolt end surface to be as follows;

Bolt length	Swing angle
29±1mm	4°30'



T428

(2) If stopper bolt top surface has worn out unevenly, replace the bolt.

4. FRONT WHEEL

1) Specifications

	ST318		ST321·ST324	
	Tire size	Rim size	Tire size	Rim size
Agriculture	5 – 12	3.00D – 12	6 – 12	4JA × 12WDC
Turf	20 × 8.00 – 10	6.00I × 10	20 × 8.00 – 10	6.00I × 10

2) Inspection of Tire

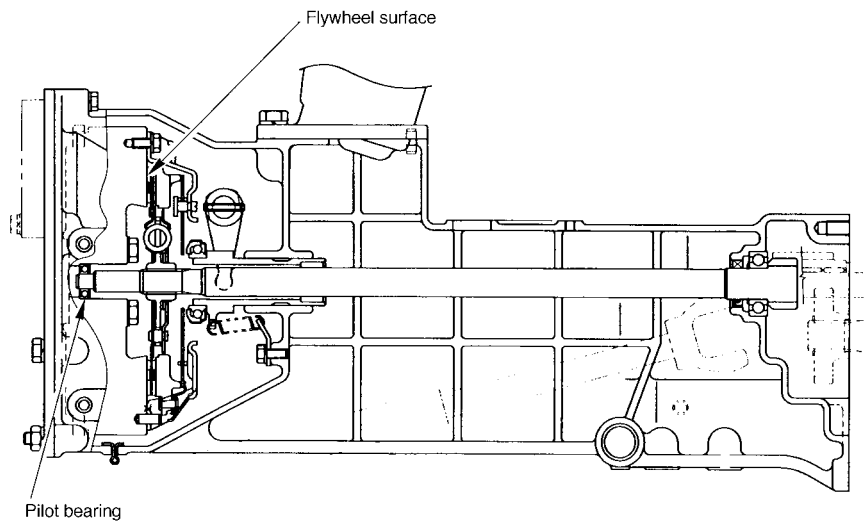
Tire size	5 – 12	6 – 12	20 × 8.00 - 10
1. Wear of tire (mm)			
· Lag height when new	25	28	7
· Lag height in service limit	14	14	4
2. Tightening Torque of Disk N·m (kgf·m)	58.8 – 74.5 (6.0 – 7.6)		
3. Rim run-out (mm)	Service limits within 5		
4. Air pressure of tire	See Operator's manual		

3-2 Clutch

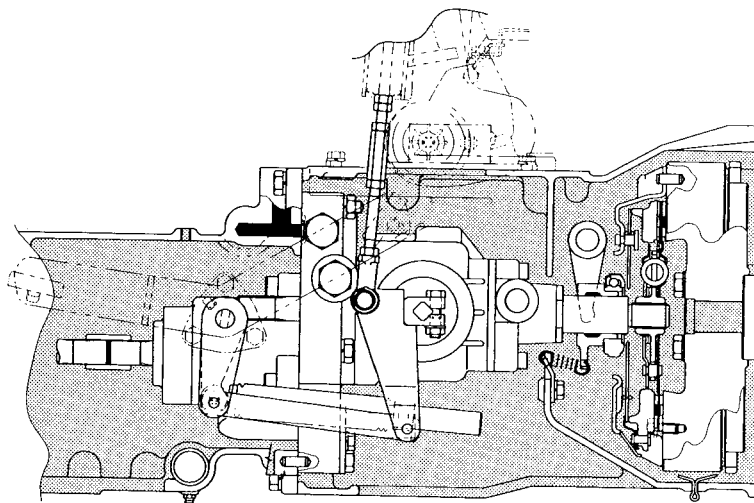
1. SINGLE CLUTCH

1) Specifications and sectional view

Type	Dry, single-plate foot-stepping type	Rivet recess	1.2 mm
No. of clutch plates	1 (facing; 2)	Operating method	Mechanical
Disk (O.D. × Bore × Thickness)	$\varnothing 184 \times \varnothing 127 \times 8.1 \pm 0.3 \text{ mm}$ (7.3 ± 0.3/330 kg) () shows the thickness when compress.	Release lever height (above flywheel surface)	30 ± 0.5mm



T429



T430

2) Disassembly, inspection and reassembly of clutch (Refer 1-5, Removal of outside, for the clutch case separating method.)

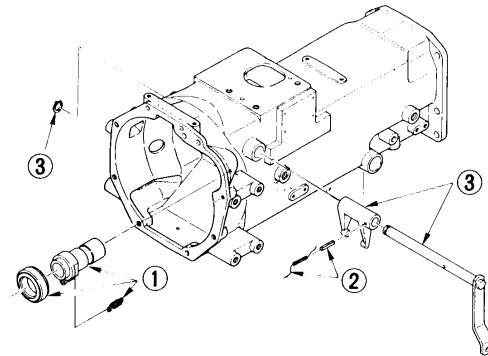
Disassembling procedure

1 Release bearing

Release hub
Clutch shaft
Clutch fork

For manual transmission

- ① Remove the return spring and extract the release hub and bearing together frontward.
- ② Remove the wire and drive out the spring pin.
- ③ Remove the snap ring, extract the clutch shaft leftwards, and take out the clutch fork from the case.

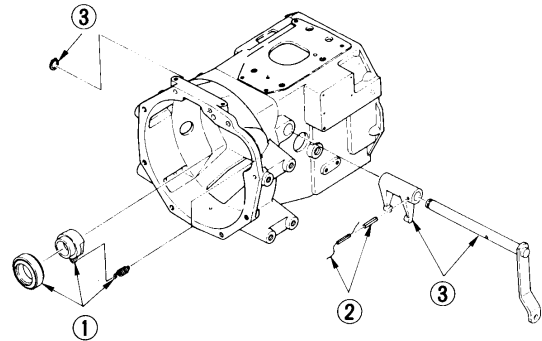


T431

For hydrostatic transmission

Remove the release bearing, release hub, clutch shaft and clutch fork in the same procedure as those for the manual transmission as described above.

* Inspection and service are also the same as in the manual transmission.



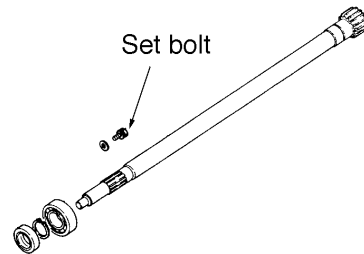
T432

2 Drive shaft

For manual transmission

If required, remove the set bolt and extract the drive shaft with bearing rearwards of the clutch case.

NOTE: Take care not to damage the oil seal.

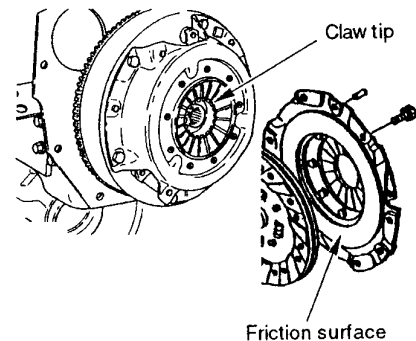


T433

Inspection and service

1. Pressure plate ass'y

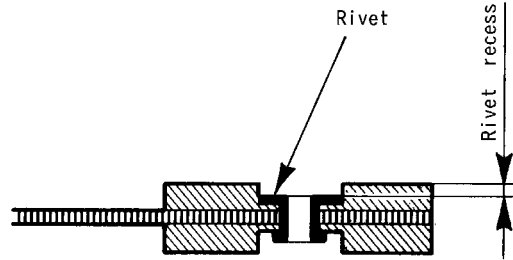
- (1) Wear at the claw tip (in contact with release bearing)
- (2) If the friction surface is distorted, scratched, or worn out unevenly, correct with sand paper or replace.



T435

2. Clutch disk COMPL

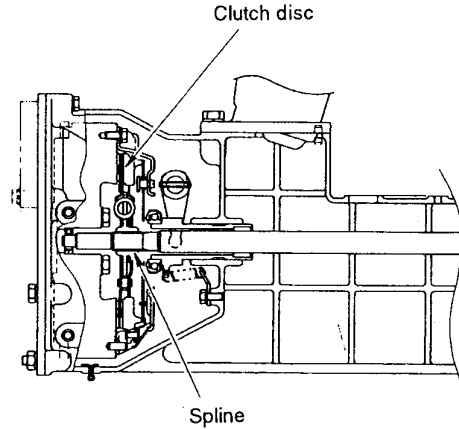
- (1) Measure the wear of the facing (rivet recess).
Replace if the rivet recess is less than 0.3 mm.
- (2) Replace the clutch disk compl if the facing is hardened or deflected due to seizure.
- (3) Wash in gasoline if oil is stuck.



T436

- (4) Replace the clutch disk compl if the spline is worn out or disk run-out is observed.

	Service limit
Disk run-out	1.0 mm



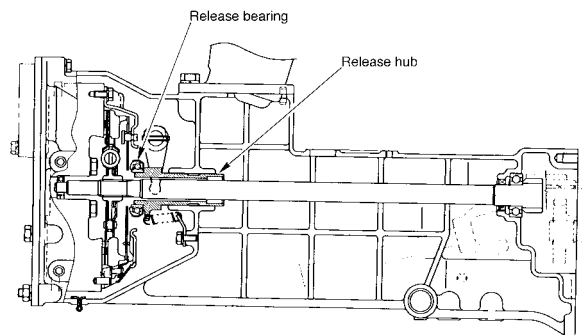
T437

3. Release bearing

- (1) If the fork claws or release hub sliding area are worn out unevenly, replace.
- (2) Coat the release hub sliding area with sufficient grease.

NOTE:

1. Do not wash the bearing since it is of non oil replenishing type.
2. Take care of bearing direction when installing.

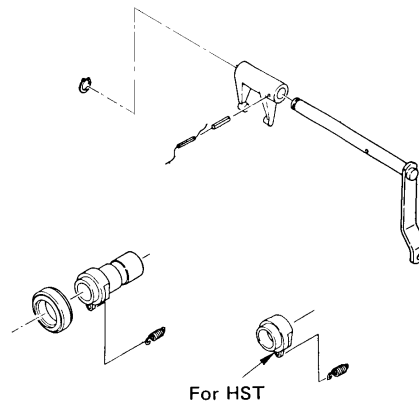


T438

4. Release hub and clutch fork

- (1) If the fork claws or release hub sliding area are worn out unevenly, replace.
- (2) Coat the release hub sliding area with sufficient grease.

NOTE: When installing the clutch fork, drive in a spring pin and lock with wire.

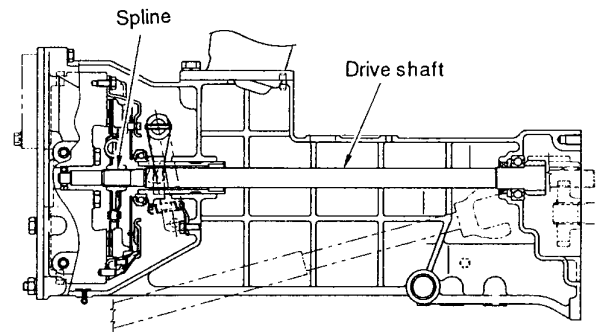


T439

5. Drive shaft

If the spline area is worn out unevenly or damaged, replace the drive shaft. (Refer to Disassembly of Transmission 1)

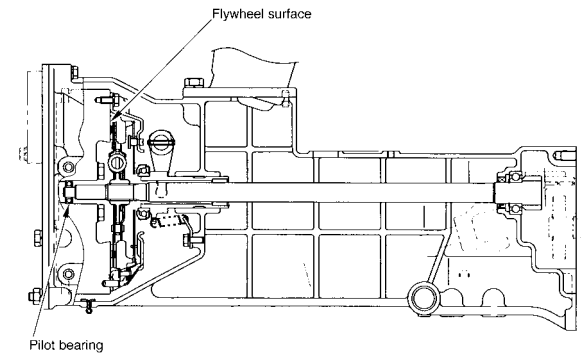
NOTE: Check the clutch disk spline area at the same time.



T440

6. Flywheel

- (1) Check for cracks and uneven wear and correct the clutch disc contacting surface if the damage is insignificant.
- (2) Check the pilot bearing for satisfactory condition, on model manual transmission.



T441

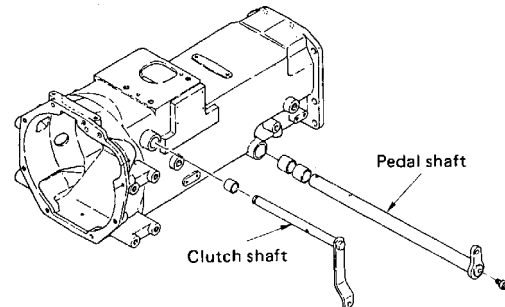
7. Clutch shaft and pedal shaft

- (1) Check for the shafts for smooth movement.
- (2) If the play of the shaft to case is excessive, replace the bush.

Clutch shaft bush bore (ø)	
Standard dimension	Service limit
18	18.5

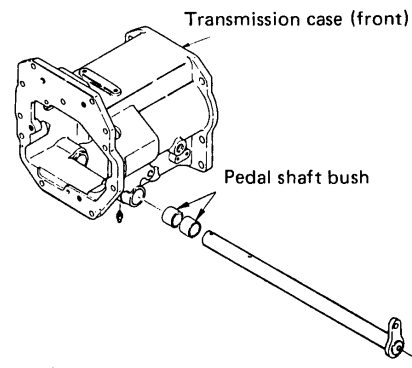
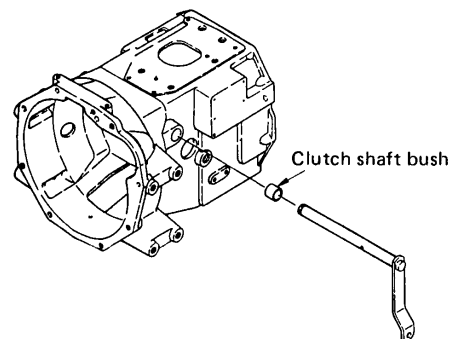
Pedal shaft bush bore (ø)	
Standard dimension	Service limit
25	26

For manual transmissions



T442

For HST

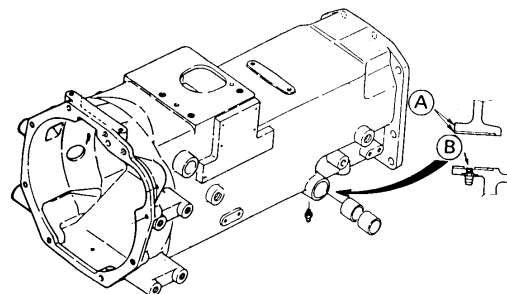


T443

NOTE:

1. Drive in the bush so that it becomes level with the boss end surface ①
2. Align the bush hole and grease nipple, hole (arrow mark ② in the right figure).

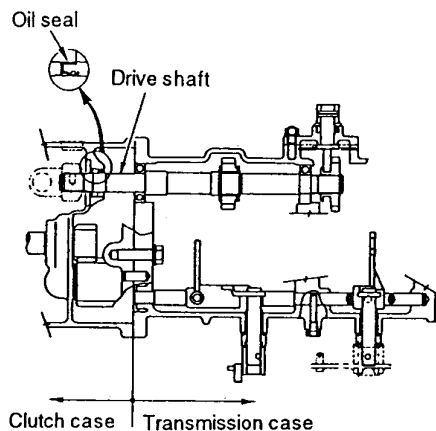
For manual transmission



T444

8. Oil seal for drive shaft (reverse gear shaft)

When replacing the oil seal, press in oil seal facing to the clutch case shown in the right figure.

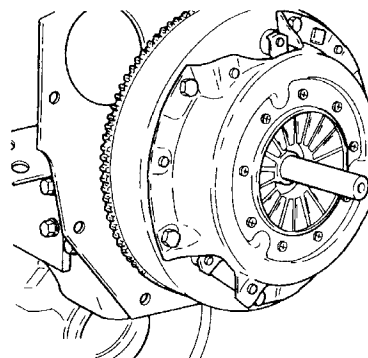


T444-1

Reassembly and adjustment

1. Pressure plate and clutch disk

Align the pressure plate and clutch disk using the special service tool and tighten to the flywheel evenly.



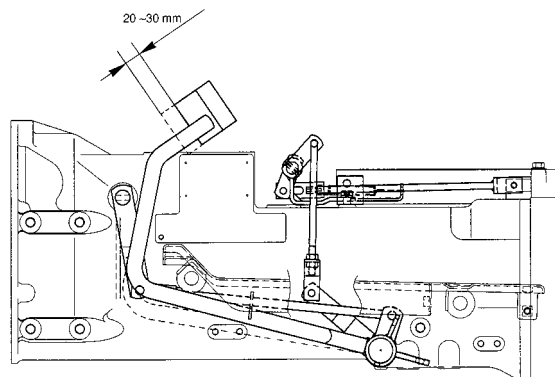
T445

2. Installation to main body

Install units to the main body in the reverse order to disassembly.

3. Adjustment of clutch pedal free-play

Adjust the free-play of the clutch pedal by turning the fork joint so that 20 – 30 mm of free-play can be obtained.



T446

2. TROUBLESHOOTING OF CLUTCH

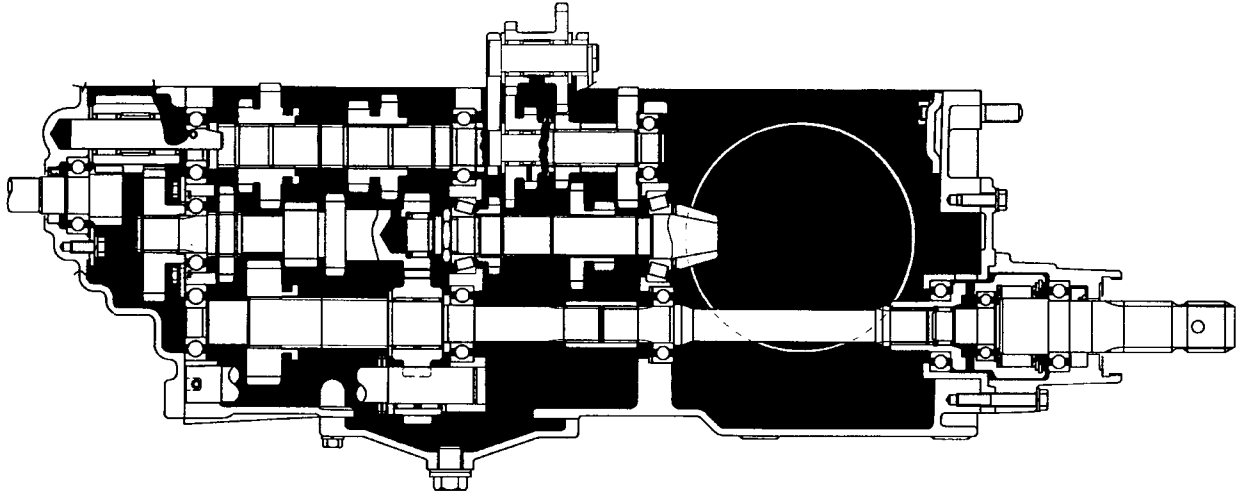
Condition	Cause	Remedy
1. Slippery clutch		
(1) Does not speed up. (2) Does not accelerate rapidly. (3) Smell of burning facing.	(1) No play in the clutch pedal. (2) Oil or grease stuck to the facing. (3)-1 Broken wire ring. (3)-2 Unevenly worn out and seized pressure plate or flywheel.	(1) Adjust the free-play to 20 – 30 mm on the pedal tread. (2) Remove and clean or replace. Correct so that no oil leaks also. (3)-1 Replace the pressure plate ass'y. (3)-2 Correct or replace.
2. Clutch is not engaged smoothly.		
(1) Sound of transmission gears. (2) Vehicle body moves even though the clutch is depressed.	(1) Excessive play of clutch pedal. (2)-1 Excessive wear of various parts of clutch. (2)-2 Deflection of disk ass'y. (2)-3 Play due to wear of pilot bearing. (2)-4 Uneven wear of disk hub and drive shaft.	(1) Adjust the free-play. (2)-1 Disassembly, check, and correct or replace if abnormality is noticed. (2)-2 Replace the disk ass'y. (2)-3 Replace the pilot bearing. (2)-4 Replace the disk ass'y and drive shaft.
3. Abnormal sound and vibration of clutch		
(1) Abnormal sound and vibration of clutch	(1) Fatigued damper spring. (2) Loosened rivet of clutch facing. (3) Wear or damage of release bearing. (4) Wear or damage of pilot bearing. (5) Loosened bolt tightening each part of clutch.	(1) Check and replace (disk ass'y). (2) Check and replace (disk ass'y). (3) Replace the release bearing. (4) Replace the pilot bearing. (5) Retighten the bolt.

3-3 Transmission

1. 9 × 3 MANUAL TRANSMISSION

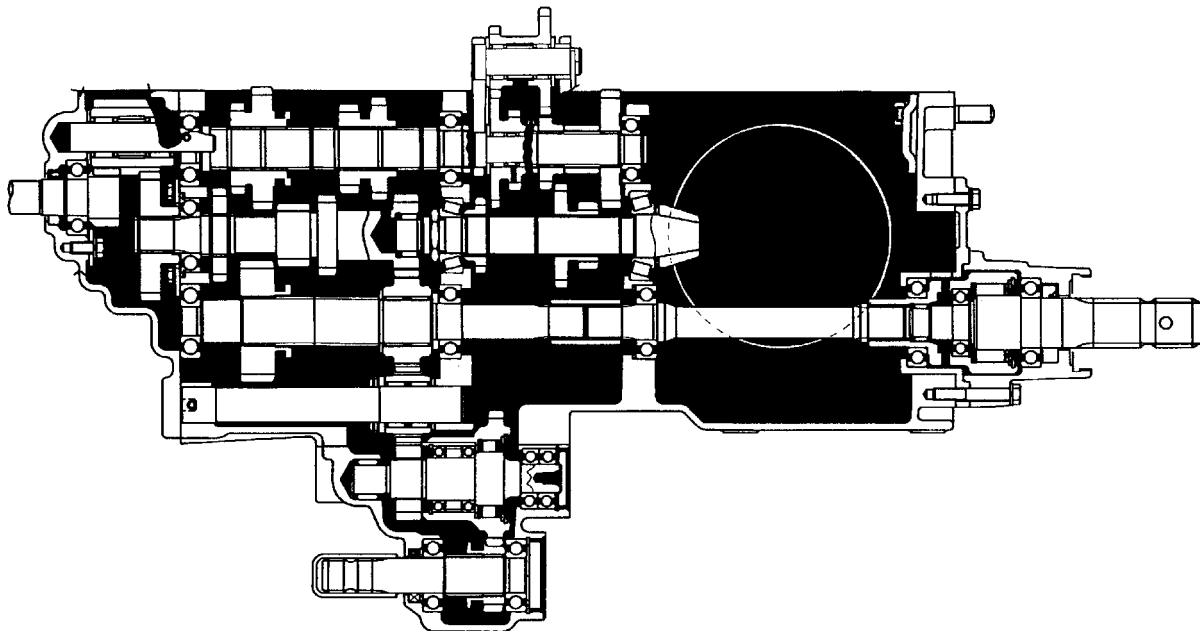
1) Sectional view

- Without Mid PTO



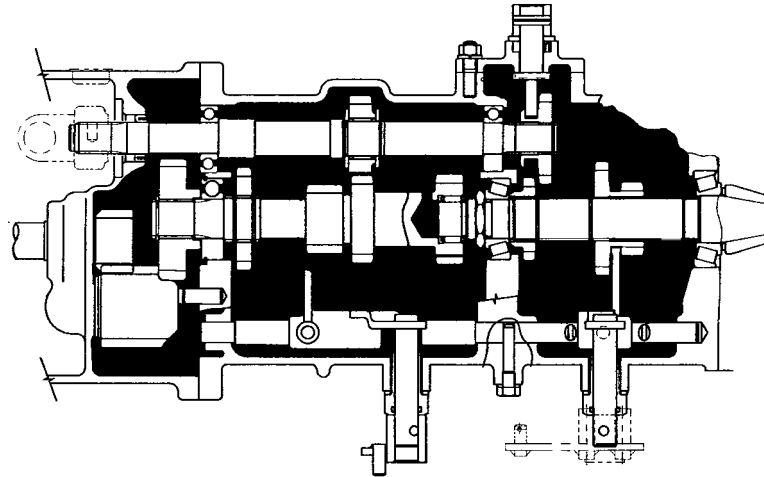
T447

- With Mid PTO



T447

Top View



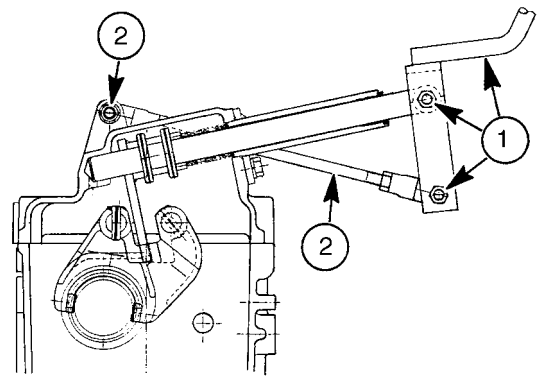
T448

2) Disassembly, Inspection and Reassembly of Transmission

Disassembling procedure

1 Change lever (Main shift)

- ① Remove the two nuts and change lever.
- ② Remove the nut and rod from the change lever case.

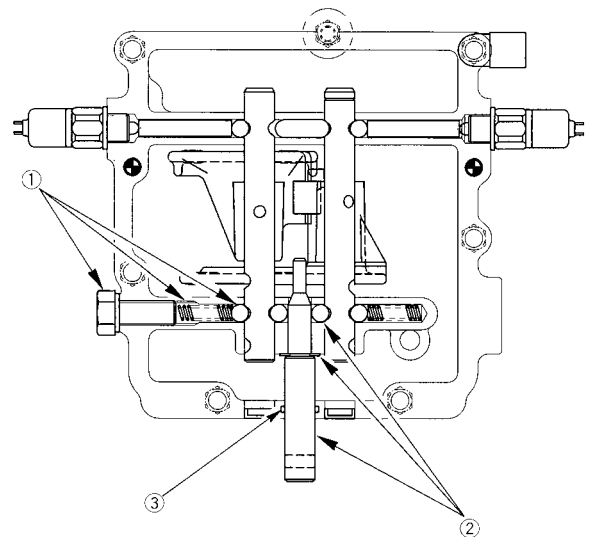


T449

2 Change lever case

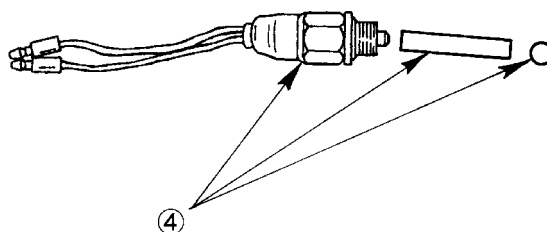
Shifter rods
Shifter forks
Shift arm

- ① Remove the bolt and draw out the spring and steel ball.
- ② Remove the snap ring from the shaft and slide the shaft and two steel balls out of the cover.
- ③ If required remove the O-ring from the cover.



T450

- ④ Remove the switches from each side and slide the pins and steel balls out of the cover.

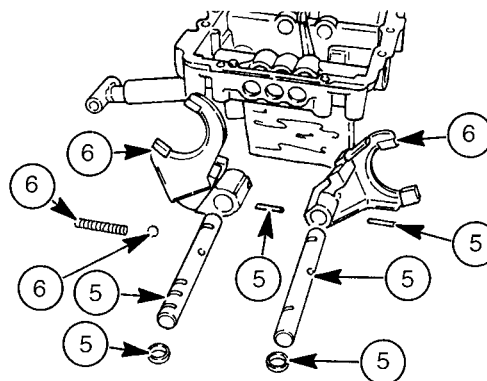


T451

- ⑤ Drive out the spring pins from the shifter forks and slide the shifter rods forward out of the cover driving the plugs out at the same time.

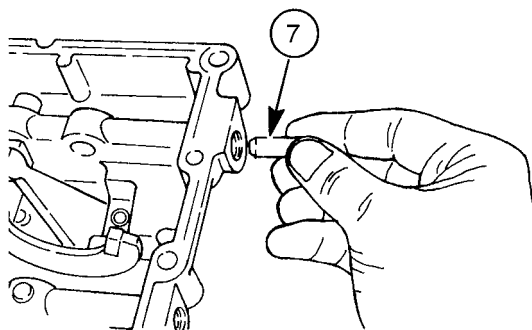
- ⑥ Remove the shifter forks, steel ball and spring from the cover.

NOTE: Hold shop towel over the top of the cover to restrain the detent ball and spring when the shifter rod is removed from the cover. The detent ball will be expelled with considerable force when it is released.



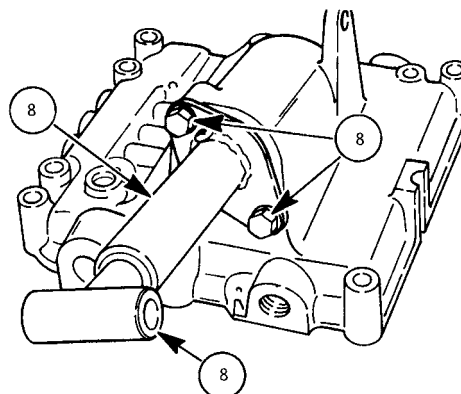
T452

- ⑦ Remove the balk pin from the switch bore of the cover.



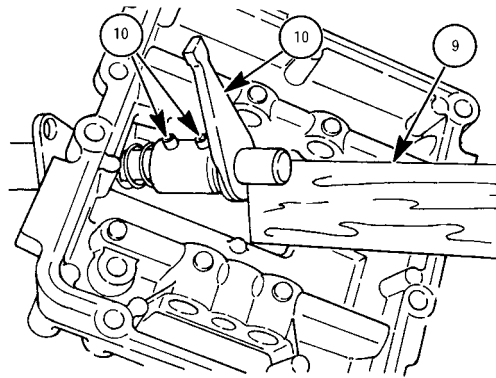
T453

- ⑧ Remove the bolts to free the shift arm and guide assembly.



T454

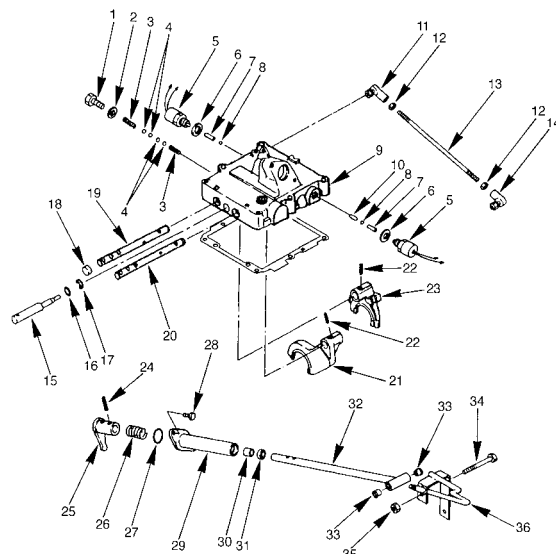
- ⑨ Place a wooden block between the shift arm and the cover.
- ⑩ Drive the spring pins from the shift arms and withdraw the shift arm, guide form the cover.



T455

Components

- | | | |
|-----------------|------------------|------------------|
| 1. Bolt | 15. Shaft | 30. Bush |
| 2. Seal washer | 16. O-ring | 31. Oil seal |
| 3. Spring | 17. Snap ring | 32. Shift arm |
| 4. Steel ball | 18. Plug | 33. Bush |
| 5. Switch | 19. Shifter rod | 34. Bolt |
| 6. Seal washer | 20. Shifter rod | 35. Nut |
| 7. Pin | 21. Shifter fork | 36. Change lever |
| 8. Steel ball | 22. Spring pin | |
| 9. Change lever | 23. Shifter fork | |
| Case | 24. Spring pin | |
| 10. Balk pin | 25. Shift arm | |
| 11. Rod end: R | 26. Spring | |
| 12. Nut | 27. O-ring | |
| 13. Rod | 28. Bolt | |
| 14. Rod end: L | 29. Shift guide | |



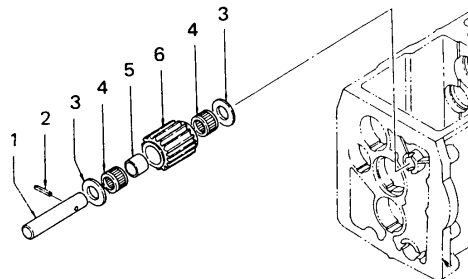
T456

3 Counter gear

Remove the counter gear, shaft, thrust washer and needle bearing together.

Components

1. Shaft
2. Spring pin
3. Thrust washer
4. Needle bearing
5. Collar
6. Counter gear



T457

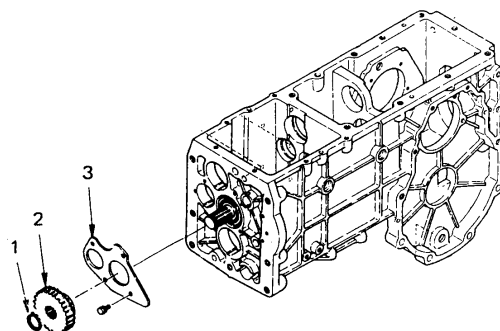
4 Fixed gear

Bearing retaining plate

- ① Remove the snap ring at the counter shaft end and take out the fixed gear.
- ② Remove the bearing retaining plate from the case.

Components

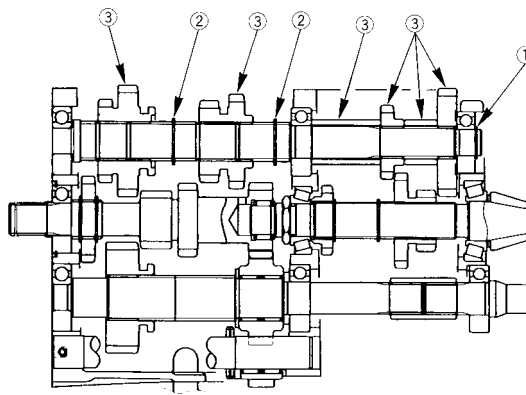
1. Snap ring (ø25)
2. Fixed gear
3. Bearing retaining plate



T458

5 Main shaft

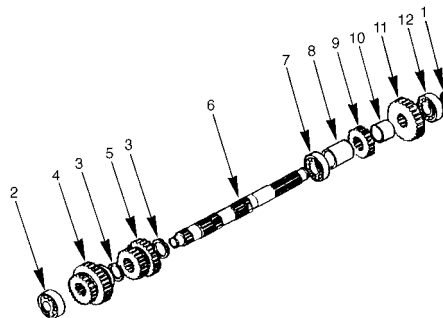
- ① Remove the snap ring at the shaft rear end.
- ② While sliding the main shaft frontwards, remove the snap ring on the shaft rearwards from the groove.
- ③ Extract the shaft frontwards and take out the fixed gear, collar, and slide gear.



T459

Component parts

1. Snap ring (ø20)
2. Bearing (6304)
3. Snap ring (ø30)
4. Sliding gear (3-1)
5. Sliding gear (R-2)
6. Main shaft
7. Bearing (6205)
8. Collar
9. Fixed gear
10. Collar
11. Fixed gear
12. Bearing (6204)

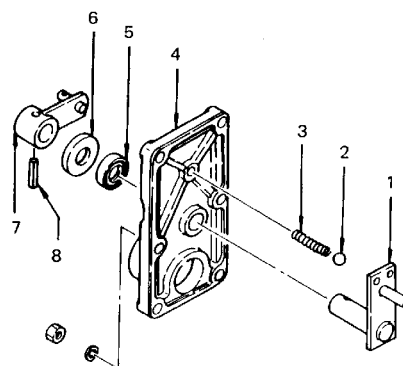


T460

6 Case cover (Related 4WD shifter)

- ① Remove the case cover as an ass'y
- ② If necessary, drive out the spring pin and separate the shift arm and lever.

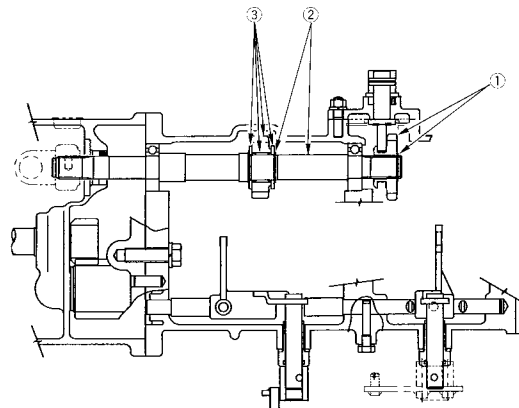
1. Shift arm
2. Steel ball
3. Spring
4. Case cover
5. Oil seal
6. Spacer
7. Shift lever
8. Spring pin



T461

7 4WD drive shaft (Reverse gear shaft)

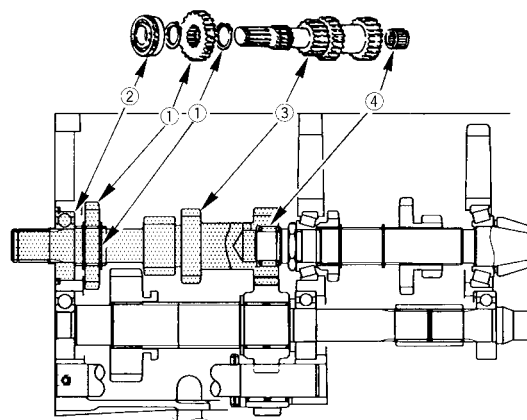
- ① Remove the snap ring at the rear end of the shaft and take out the 4WD slide gear.
- ② Remove the snap ring at the rear of the counter gear from the groove and extract the shaft frontwards.
- ③ Take out the counter gear, needle bearing and thrust washer.



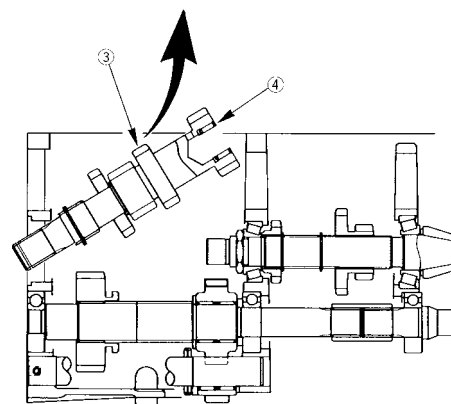
T462

8 Counter shaft

- ① Remove the snap ring on the shaft rearwards and move the fixed gear fully rearwards.
- ② Move the shaft together with the bearing frontwards and take out the bearing from the shaft.
- ③ Move the shaft furthermore frontwards. When it comes out of the drive pinion at the rear, take out the shaft from above the case.
- ④ If necessary, remove the needle bearing at the shaft rear end.



T463



T464

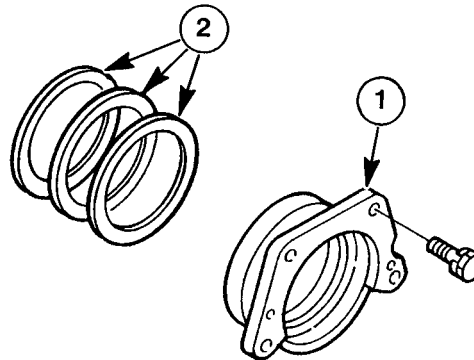
9 Bearing carrier (Differential)

Remove the right and left bearing carriers.

1. Bearing carrier
2. Shims

NOTE:

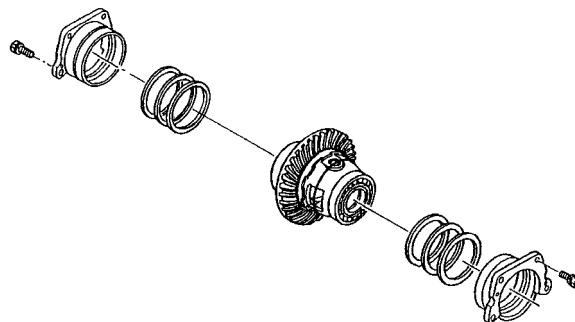
1. The bearing carries can be removed easily by tightening the 2 tap bolts evenly.
2. Check for the number and thickness of the shims and distinguish right and left ones.



T465

10 Differential ass'y

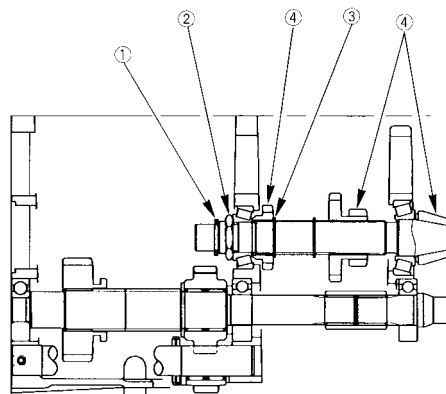
Take out the differential ass'y



T466

11 Drive pinion

- ① Remove the snap ring.
- ② Straighten the bent claws of the lock nut, and remove the nut.
- ③ Remove the snap ring at the rear of the 4WD fixed gear from the groove.
- ④ Extract the drive pinion rearwards and take out the fixed gear and slide gear (Range shift).



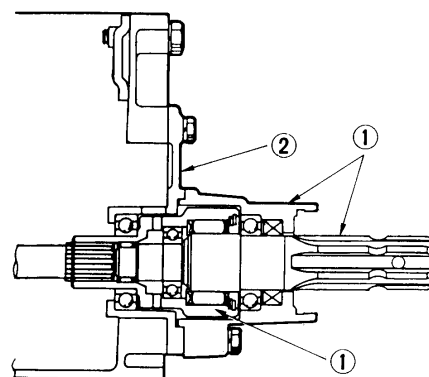
T467

12 PTO shaft

– 1-speed PTO –

- ① Remove the PTO shaft together with the seal cover and one-way clutch ass'y rearwards.
- ② Remove the bearing holder from the case.
- ③ If necessary, separate the seal cover and shaft and take out the one-way clutch.

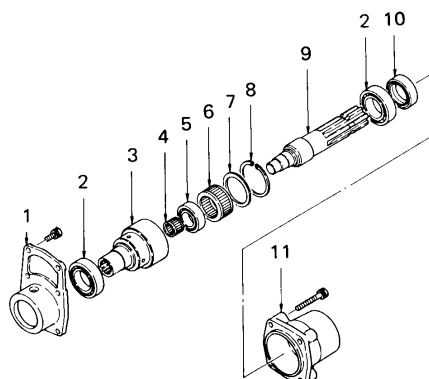
NOTE: Take care to the one-way clutch installing direction when assemble the one way clutch.



T468

Components

1. Bearing holder
2. Bearing (6007)
3. Counter shaft (outer race)
4. Needle bearing
5. Bearing (6005)
6. One way clutch
7. Spacer
8. Snap ring (ø60)
9. PTO shaft (inner race)
10. Oil seal
11. Seal cover

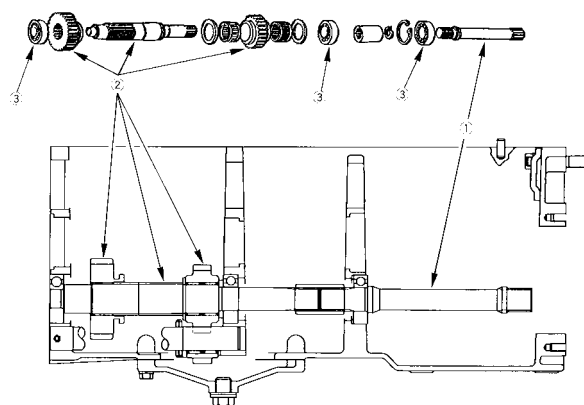


T469

13 PTO counter shaft

– 1-speed PTO –

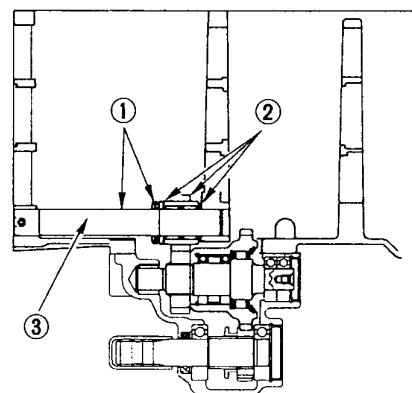
- ① Extract the counter shaft (rear) rearwards.
- ② Extract the counter shaft (front) front wards and take out the slide gear, thrust washer, needle bearings and counter gear.
- ③ If necessary, remove the bearing from the shaft and case.



T470

14 Mid PTO counter shaft (Portugal model is not installed)

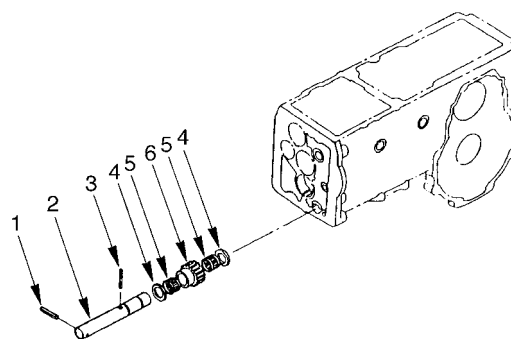
- ① Drive out the roll pin and slide the shaft frontwards.
- ② Remove the thrust washers, counter gear and needle bearings from the shaft.
- ③ Extract the shaft frontwards.



T471

Components

1. Spring pin
2. Counter shaft
3. Spring pin
4. Thrust washer
5. Needle bearing
6. Counter gear
7. Thrust washer

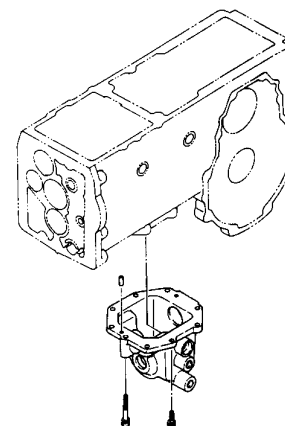


T472

15 Gear case (Mid PTO) (Option)

- ① Remove the mid PTO gear case from the below of the transmission case.

NOTE: Take care not to damage the transmission case and gear case mating surfaces.



T473

16 Shifter rod

Shifter forks

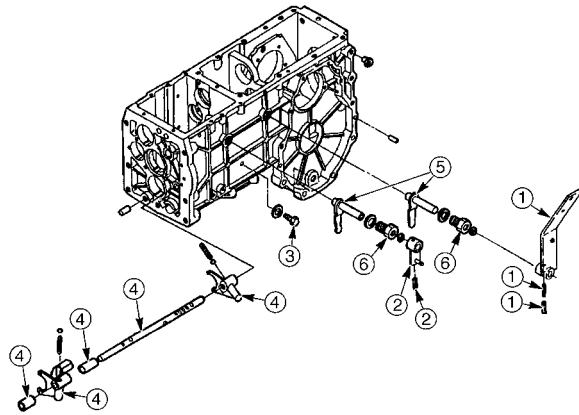
Shifter arms

(PTO and Range shift)

- ① Drive out the spring pins and take out the range change lever.
- ② Drive out the spring pin and take out the PTO change lever.
- ③ Remove the set bolt.
- ④ Extract the shifter rod frontwards and take out the shifter forks and collars. (PTO, range)

NOTE: The detained ball and spring come out at this time and therefore care should be taken not to miss them.

- ⑤ Extract the shift arms (PTO, range) inwards.
- ⑥ If necessary, take out the shift guide from the case.



T474

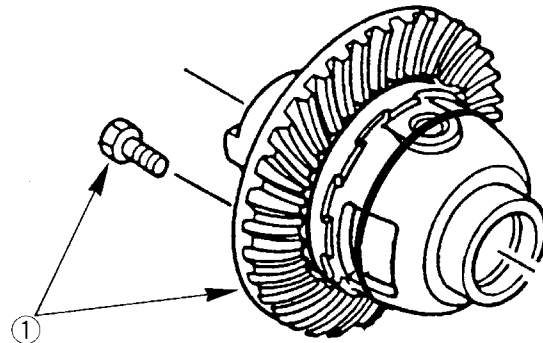
17 Differential ass'y

- ① Remove the ring gear bolts and separate the ring gear from the differential cage.
- ② Remove the clip and take out the gears and shafts in the differential cage.

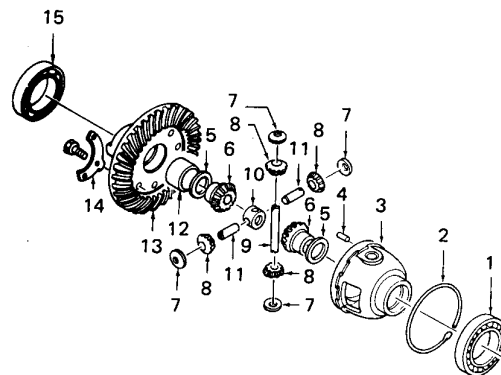
NOTE: Coating bolts used tighten the ring gear in the factory. Bolts and lock washers are available as service parts to be used for reassembly.

Components

1. Bearing (6911)
2. Clip
3. Differential cage
4. Knock pin
5. Thrust washer
6. Differential gear
7. Thrust washer
8. Differential pinion
9. Pinion shaft
10. Joint
11. Pinion shaft
12. Bush
13. Ring gear
14. Lock washer
15. Bearing (6010)



T475



T476

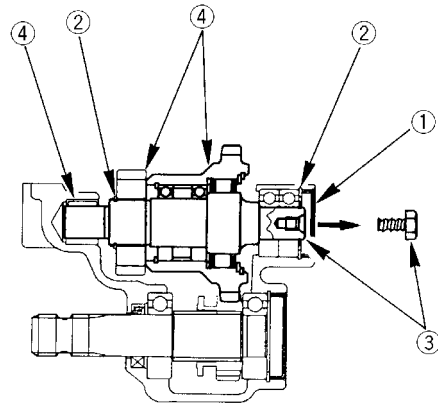
18 Mid PTO counter shaft (Option)

- ① Pry the sealing plug out from the rear end of the case.
- ② Remove the snap ring at the rear of the case and remove the snap ring in the front of the shaft from the groove.
- ③ Install a bolt (M8) to the rear end of the shaft and extract the shaft rearwards making use of the bolt.
- ④ Take out the needle bearing fixed gear, snap ring and counter gear with one way clutch assembly.

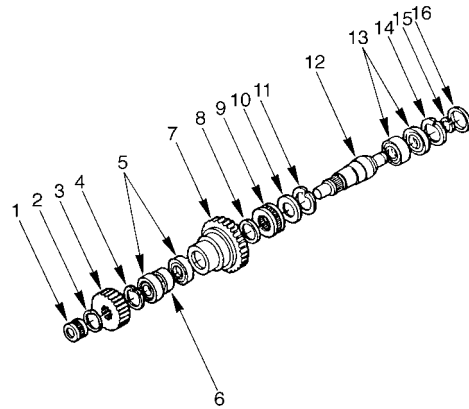
NOTE: Take care to the one-way clutch installing direction when assemble the one way clutch.

Components

1. Needle bearing
2. Snap ring (ø28)
3. Fixed gear
4. Snap ring (ø47)
5. Ball bearing (6906)
6. Collar
7. Counter gear
8. Thrust washer
9. One way clutch
10. Thrust washer
11. Snap ring (ø60)
12. Counter shaft
13. Ball bearing (6004)
14. Snap ring (ø42)
15. Snap ring (ø42)
16. Sealing plug



T477

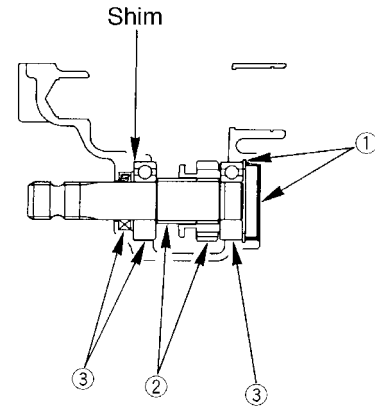


T478

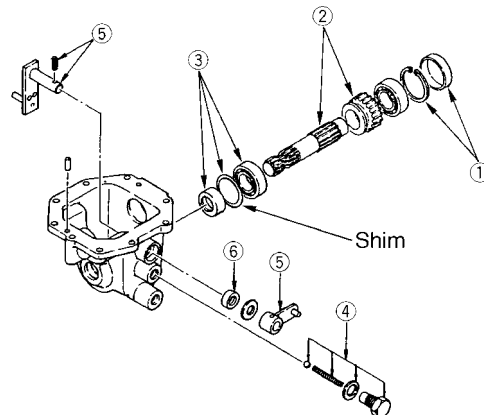
19 Mid PTO shaft Mid PTO shifter

- ① Pry the sealing plug out and remove the snap ring from the rear end of the case.
- ② Drive out the shaft rearwards and take out the slide gear.
- ③ If necessary, remove the bearing and oil seal from the shaft or case.
- ④ Remove the plug on the side of the case and take out the detained ball and spring.
- ⑤ Drive out the spring pin, remove the change lever, and extract the shift arm to the inside.
- ⑥ Remove the oil seal, if necessary.

NOTE: Inspect the end play of the Mid PTO shaft before disassembly.
If end play is more than 0.5 mm adjust the end play by shims when reassembly.



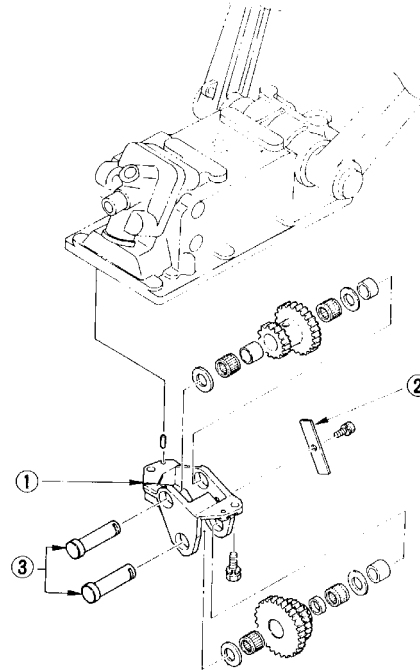
T479



T480

20 Transmission for range shift

- ① Remove the transmission ass'y from below the hydraulic cylinder case.
- ② Remove the plate at the rear of the transmission case.
- ③ Extract the counter shaft frontwards and take out the counter gear, needle bearing, collar, and thrust washer.



Inspection

T481

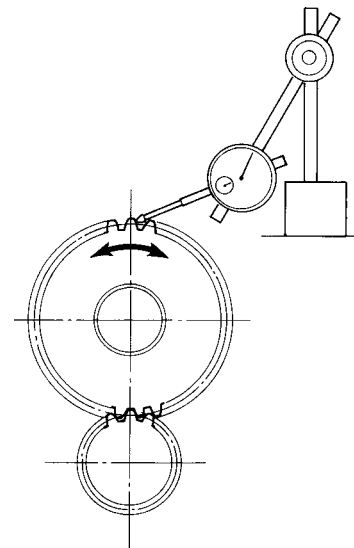
1. Bearing

Replace if excessive play or other abnormalities are noticed.

2. Gear backlash

Replace the gear if the service limit is exceeded.

Gear backlash (mm)	
Assembling standard value	Service limit
0.04 – 0.2	0.6

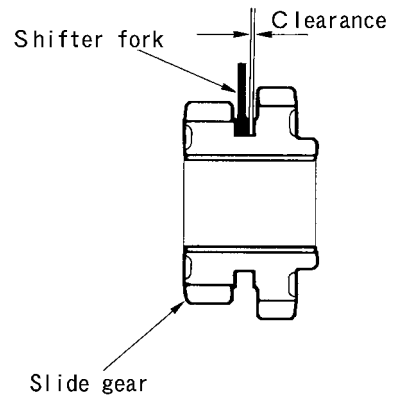


T482

3. Clearance between shifter fork and slide gear

Replace shifter fork and slide gear if the service limit is exceeded.

Clearance between shifter fork and slide gear (mm)	
Assembling standard value	Service limit
0.1 – 0.3	1.0

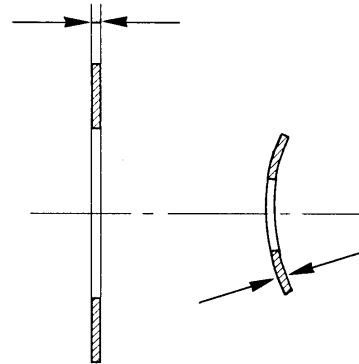


T483

4. Differential

- (1) Check each gear and replace it if damage is significant.
- (2) Replace the thrust washers of the differential gear and differential pinion if the service limit is exceeded.

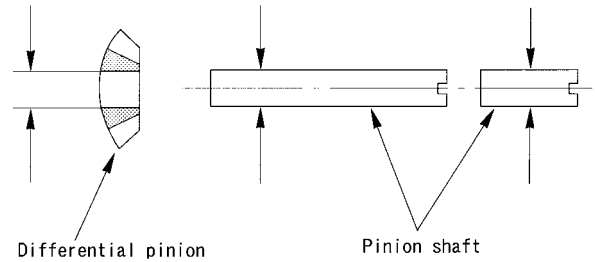
	Thrust washer thickness (mm)	
	Standard dimension	Service limit
Differential gear side	1.2	0.9
Differential pinion side	1.2	0.9



T484

- (3) Replace them if the clearance between the pinion shaft and differential pinion exceeds the service limit.

Clearance between pinion shaft and differential pinion (mm)	
Standard dimension	Service limit
0.03 – 0.1	0.5

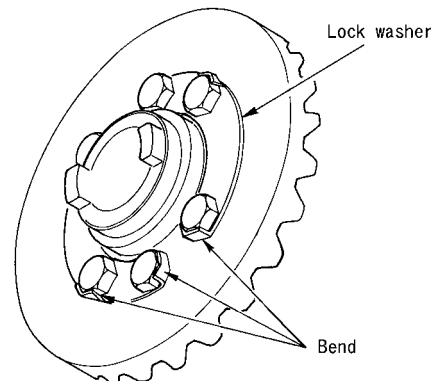


T485

- (4) Tighten the ring gear and differential cage with the specified tightening torque.

Tightening torque	25.5 – 28.4 N·m (2.6 – 2.9 kgf·m)
-------------------	--------------------------------------

NOTE: Be sure to use a lock washer at the time of reassembly of the ring gear as in the front wheel differential.



T486

(5) Backlash of differential gear and differential pinion

- ① Insert 2 fuses at opposing positions between the differential gear and differential pinion and turn the differential gear.
- ② Take out the fuses and measure the thickness with a micrometer.
- ③ Total thickness of 2 fuses $\div 2$ = backlash (mm)

Replace if the service limit is exceeded.

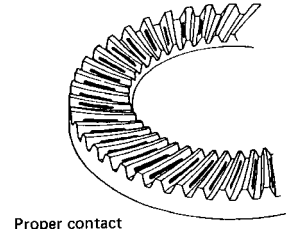
Backlash of differential gear and differential pinion (mm)	
Assembling standard value	Service limit
0.1 – 0.3	0.5

5. Tooth contact of drive pinion and ring gear

When visual inspection is difficult, coat 6 or 7 teeth of the ring gear with a very small quantity of red lead diluted with oil before disassembly, turn the drive pinion and judge the propriety of the tooth contact from the red lead condition attached to the ring gear teeth.

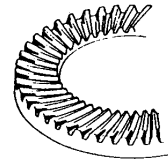
(1) Heel contact

Select shims so that the drive pinion is brought near the ring gear.



Proper contact

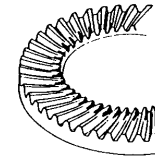
T488



T489

(2) Toe contact

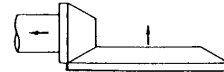
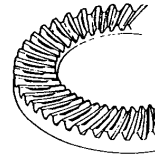
Select shims so that the drive pinion is put farther from the ring gear.



T490

(3) Face contact

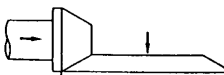
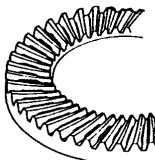
Select shims so that the ring gear is brought near the drive pinion.



T491

(4) Flank contact

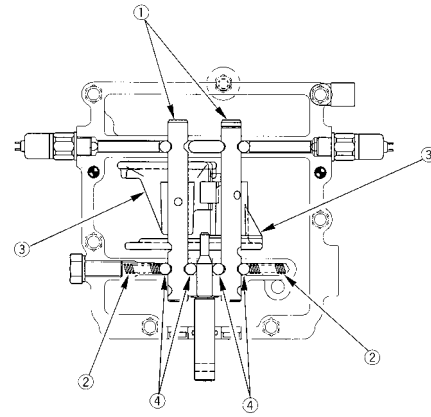
Select shims so that the ring gear is put farther from the drive pinion.



T492

6. Shifter

- ① Wear and damage of shifter rod groove
- ② Tension and breakage of detained spring
- ③ Wear of each shifter fork
- ④ Wear and damage of steel ball



T493

7. Oil seals, O-rings, and gaskets.

Replace the oil seals, O-rings and gaskets with new ones.

8. Drive pinion ass'y (drive pinion and ring gear)

- (1) When replacing with new one, adjust in the following procedure:

Increase or decrease the shims at the back of the drive pinion by the difference from the error value marked at the drive pinion end (value obtained by detecting the error value of the new one from former one).

For example:

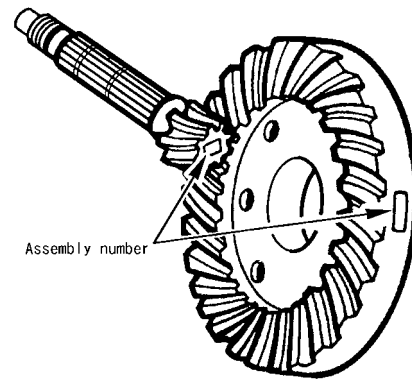
Error value of defective drive pinion: -0.2

Error value of new drive pinion: ± 0

$-0.2 - (\pm 0) = -0.2$

Decrease the shims by **0.2 mm** in this case.

*When no error value is noted, calculate assuming the error value to be ± 0 .



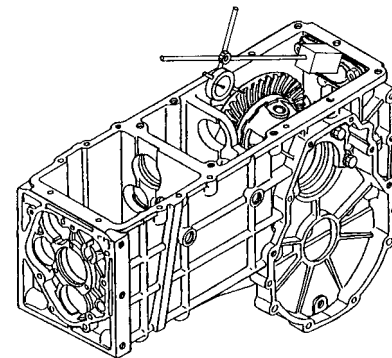
T494

- (2) Measure the backlash and adjust properly.

Backlash of drive pinion and ring gear (mm)	
Assembling standard value	Repair value
0.1 - 0.2	0.5

NOTE:

1. Replace the drive pinion and ring gear as an ass'y.
2. Refer to the paragraph of inspection of tooth contact for the backlash.



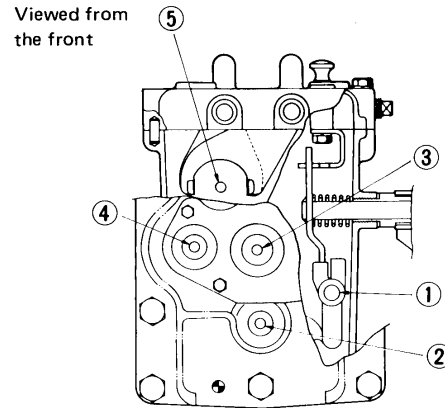
T495

Assemble

Assemble units in the reverse order to disassembly, taking care to the assembling procedure below.

Assemble the shafts in the order of ① shifter rod, ② PTO shaft, ③ drive pinion, counter shaft, ④ drive shaft (reverse gear shaft), and ⑤ main shaft.

NOTE: Install the shift guides and shift arms at first in the housing.



Reassembling procedure

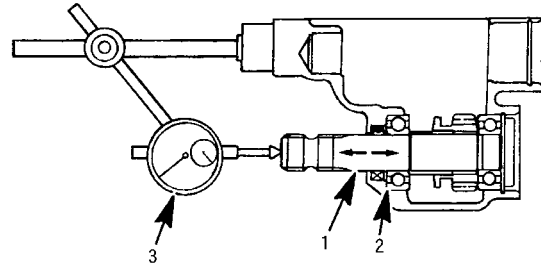
T496

1 Mid PTO case

- ① Check shaft end play using a dial indicator.
If end play is more than 0.5 mm, adjust the end play by shims.

1. Mid PTO shaft
2. Shim(s)
3. Dial indicator

- ② Install new seals and sealing plugs on reassembly.

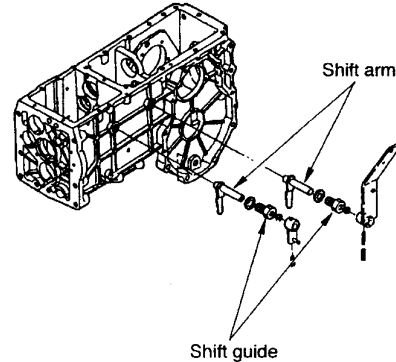


T497

2 Shift arm· Shift guide (PTO and range shift)

Be sure to tighten the shift guide with the specified torque when installing it.

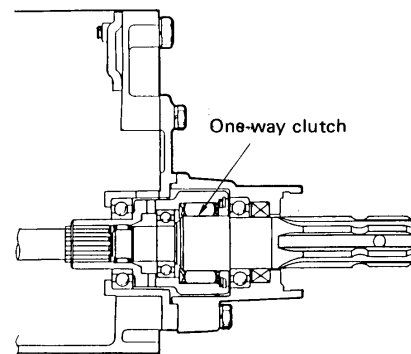
Shift guide tightening torque
24.5 – 29.4 N·m (2.5 – 3.0 kgf·m)



T498

3 PTO shaft One-way clutch

On assembly of the one-way clutch, be sure the one-way clutch locks up when the PTO shaft is rotated counterclockwise (as viewed from the rear) and will rotate freely when rotated clockwise.



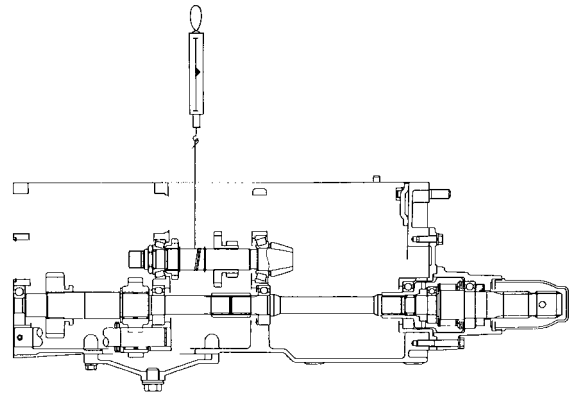
T499

4 Drive pinion

- ① Adjust the preload of the drive pinion at the specified value by tightening a new lock nut.

Preload (on the outer periphery of spline)
68.6 – 88.2 N (7 – 9 kgf)

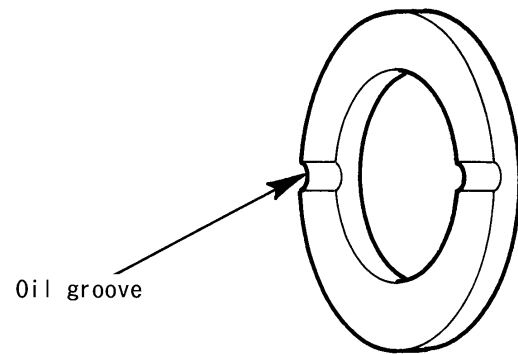
- ② Drive in the lock for the lock nut positively.



T500

5 Thrust washer

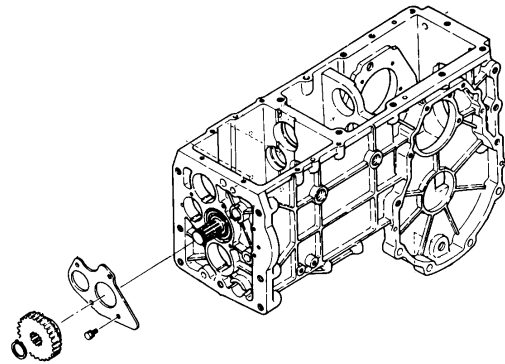
Install the thrust washer facing the oil groove toward the gear.



T501

6 Bearing retaining plate

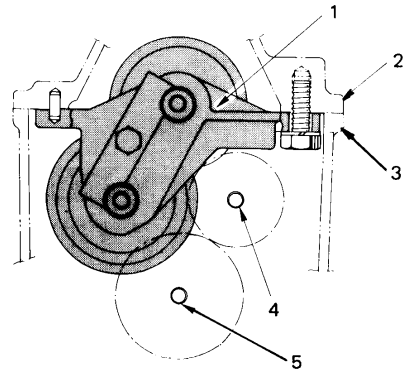
Tighten the bolt of bearing retaining plate with coating screw adhesives (thread sealant).



T502

7 Transmission for range shift

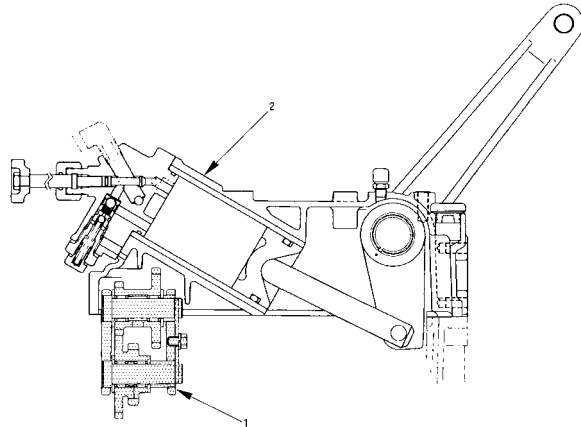
Use care to gearing of each gear when install the cylinder case Ass'y.



T503

Components

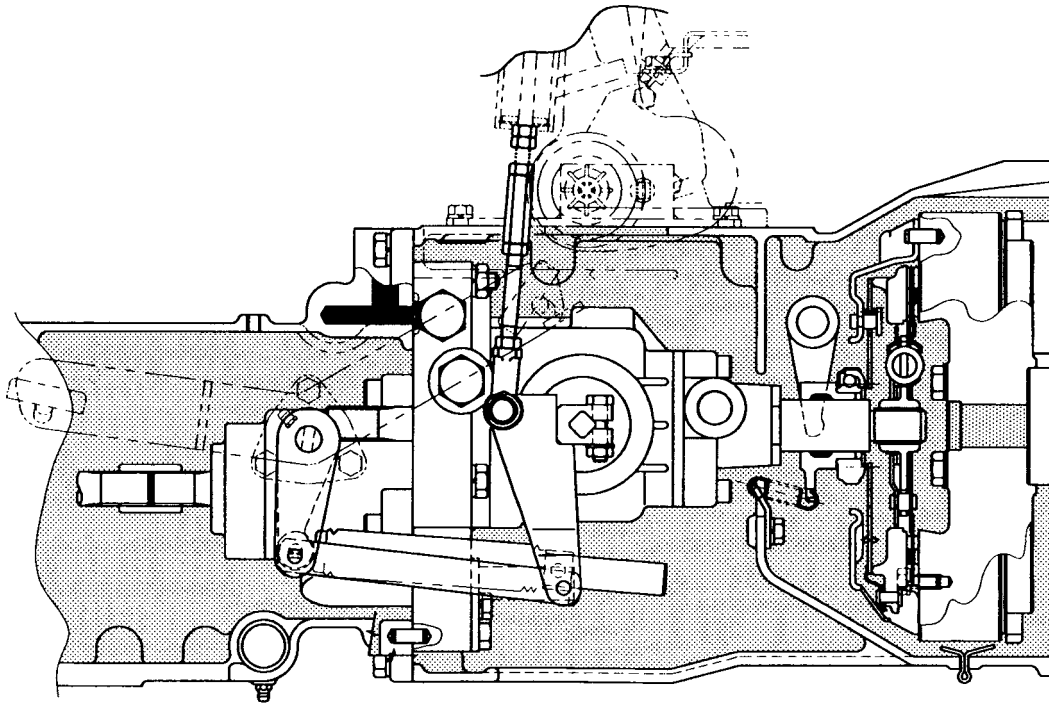
1. Transmission ass'y (Range shift)
2. Hydraulic cylinder case



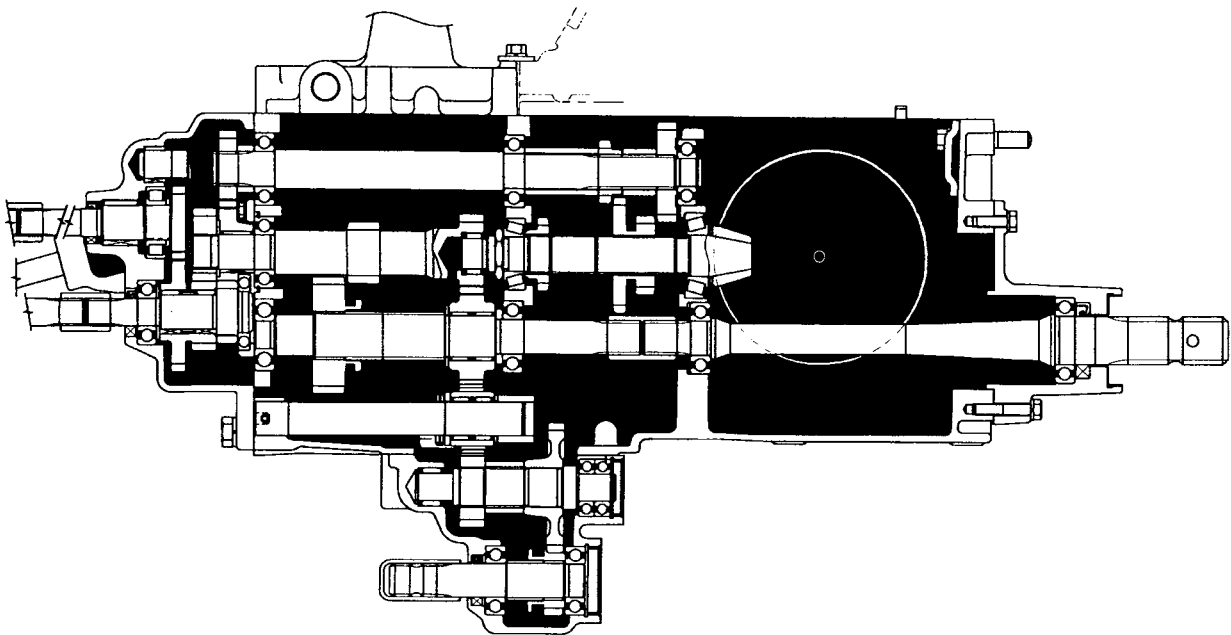
T504

2. HYDROSTATIC TRANSMISSION (1-SPEED PTO, MID PTO)

1) Sectional view



T505



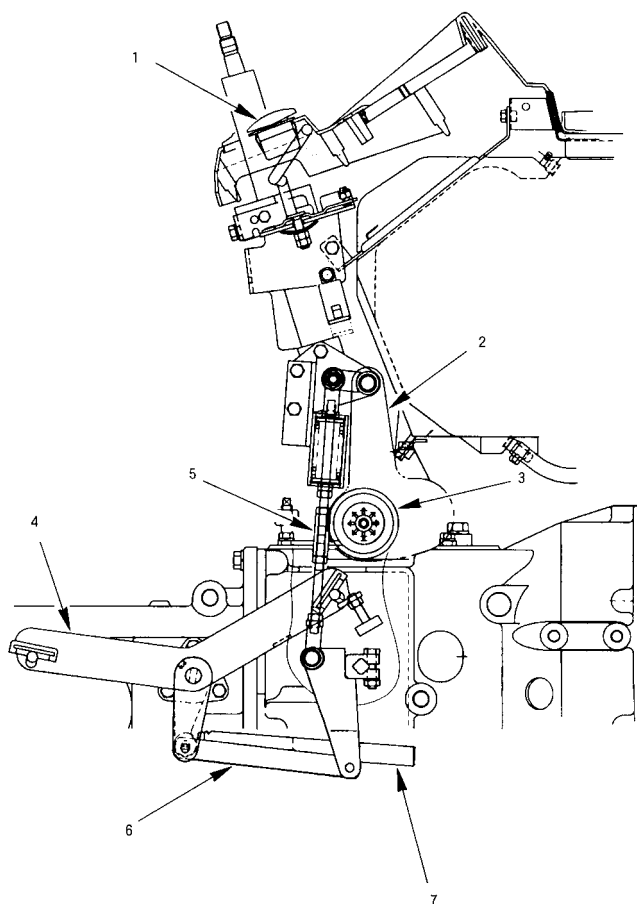
T506

2) Specifications

Name	Biaxle type HST
Model	HVFD16F-R28-P-LT
Max. input speed	2800 rpm
Output speed	0 – 2950 rpm (at 9.8 MPa (100 kgf/cm ²))
Pump swash plate tilting angle	0° - ±16°
Max. working pressure	27.4 MPa (280 kgf/cm ²)(Relief set pressure)
Charge circuit pressure	0.42 – 0.56 MPa (4.3 – 5.7 kgf/cm ²) at Eng. 2500 rpm
In-case pressure	0.098 MPa Less than (1 kgf/cm ²)
Pump capacity (variable type)	0 –16.4 cc/rev.
Motor capacity (fixed type)	16.4 cc/rev.
Charge pump capacity	4.1 cc/rev.

3) Name of components

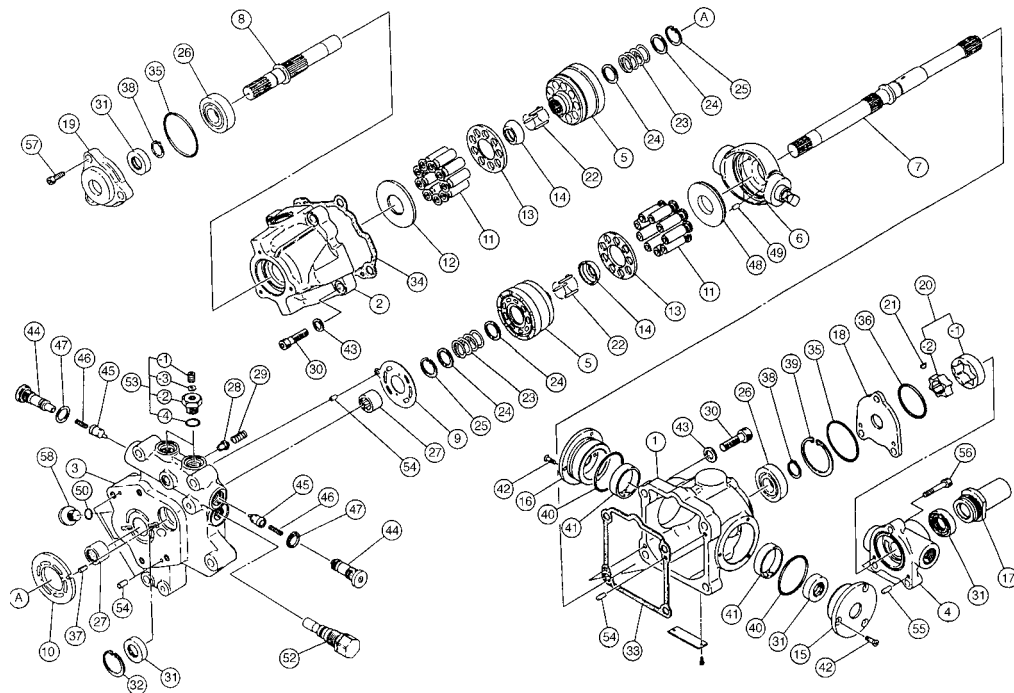
(1) Controls



- | | |
|------------------------------|------------------------------|
| 1. HST cruise control switch | 5. Neutral control linkage |
| 2. Shift arm | 6. Hydrostatic control plate |
| 3. Cruise control magnet | 7. Damper |
| 4. Foot pedal ass'y | |

T507

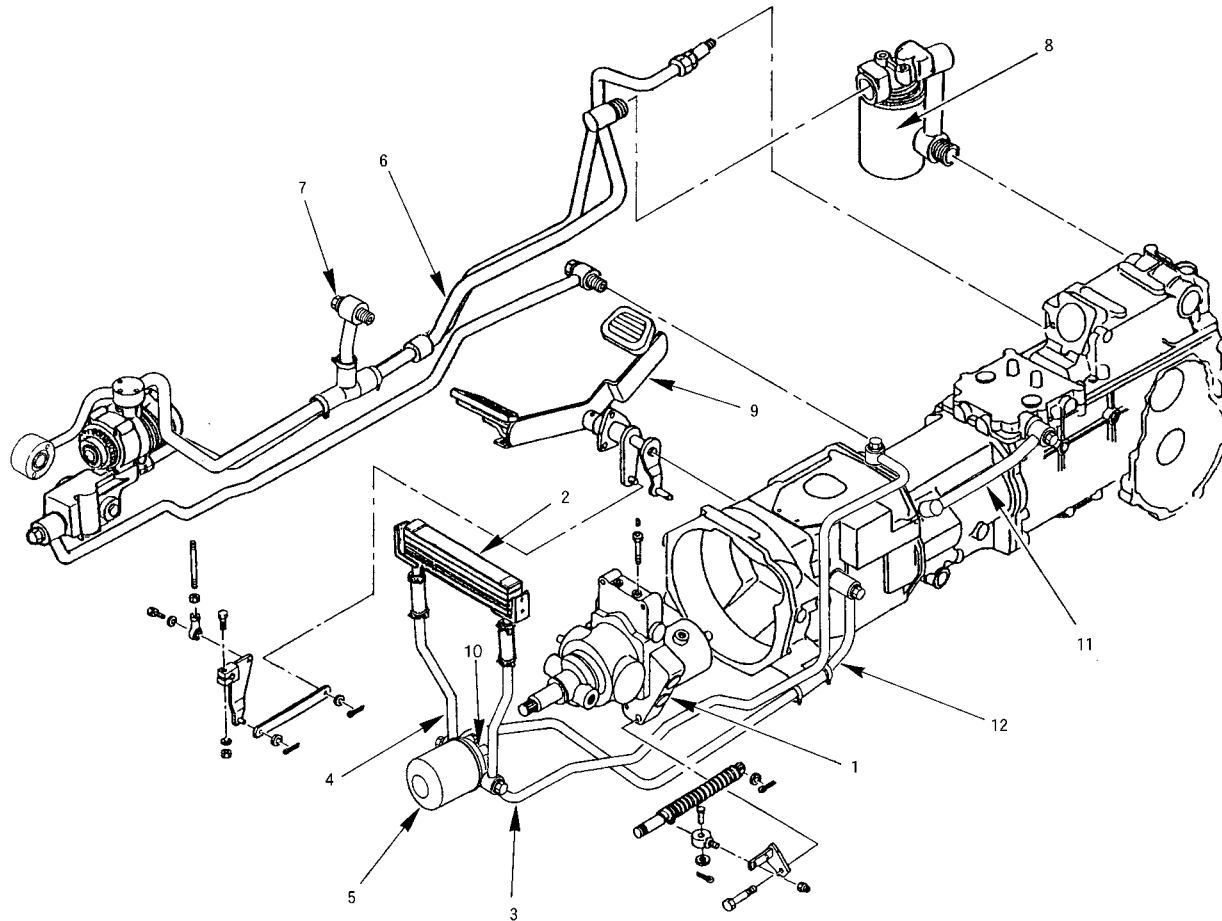
(2) HST main body



T508

- | | | | |
|---------------------|-------------------------------|------------------|--------------------------------|
| 1. Pump Case | 17. Holder | 33. Gasket | 49. Pin |
| 2. Motor Case | 18. Plate | 34. Gasket | 50. O-Ring |
| 3. Port Block | 19. Cover | 35. O-Ring | 51. Backup Ring |
| 4. Charge Pump Case | 20. Trochoid Rotor S/A | 36. O-Ring | 52. High Pressure Relief Valve |
| 5. Cylinder Block | 21. Key | 37. Pin | 53. Plug |
| 6. Swash Plate | 22. Pin | 38. Snap Ring | 54. Pin |
| 7. Input Shaft | 23. Spring | 39. Snap Ring | 55. Pin |
| 8. Output Shaft | 24. Washer | 40. O-Ring | 56. Socket Head Bolt |
| 9. Valve Plate | 25. Snap Ring | 41. Bush | 57. Socket Head Bolt |
| 10. Valve Plate | 26. Ball Bearing | 42. Screw | 58. Plug |
| 11. Piston S/A | 27. Needle Bearing | 43. Washer | |
| 12. Thrust Plate | 28. Low Pressure Relief Valve | 44. Plug | |
| 13. Retainer Plate | 29. Spring | 45. Poppet | |
| 14. Retainer Holder | 30. Socket Head Bolt | 46. Spring | |
| 15. Cover | 31. Oil Seal | 47. Bonded Seal | |
| 16. Cover | 32. Snap Ring | 48. Thrust Plate | |

(3) Hydraulic circuit

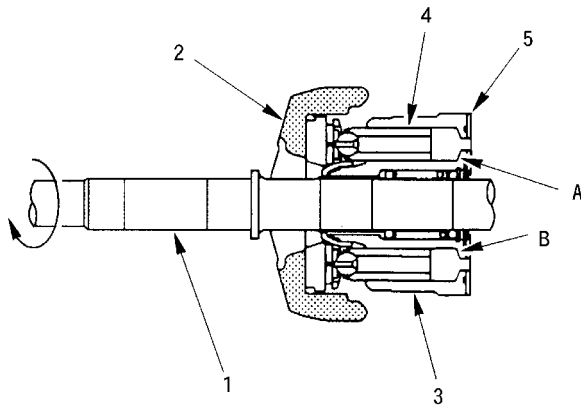


T509

- | | |
|---------------------------------------|-------------------------------------|
| 1. HST unit | 7. Oil pipe (to HST unit) |
| 2. Oil cooler | 8. Suction filter |
| 3. Oil pipe (to cooler from HST unit) | 9. Foot pedal |
| 4. Oil pipe (from cooler) | 10. Oil pipe; check valve |
| 5. Line filter | 11. Oil pipe; return |
| 6. Oil pipe; suction | 12. Oil pipe (from HST change pump) |

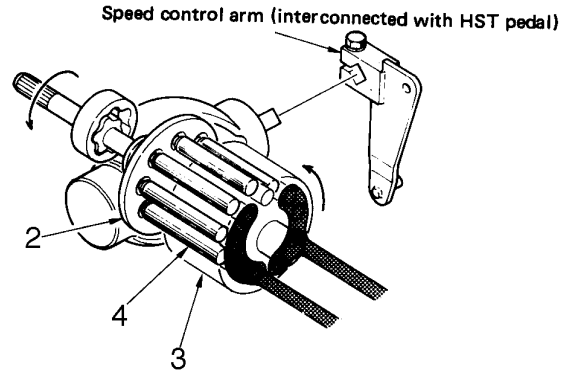
4) Operation

(1) Variable type pump



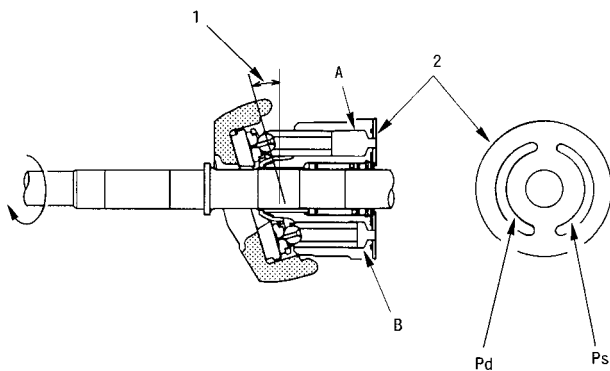
1. Shaft (input)
2. Swash plate
3. Cylinder block
4. Piston
5. Valve port plate

T510



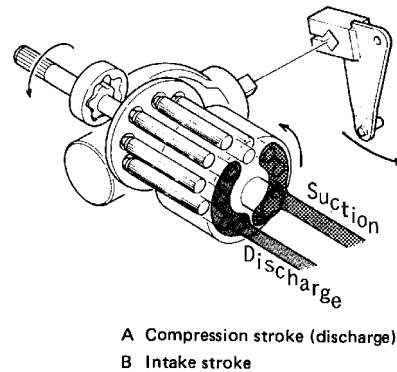
T511

Above figure shows the rotary parts of a swash plate type axial piston pump. Nine pistons are incorporated in the cylinder block. The shaft is interconnected with the engine and when the shaft rotates, the cylinder block rotates at the same time (the swash plate does not rotate). When the HST pedal is at the neutral position, the shaft axis and the swash plate are perpendicularly positioned. At this time, nothing is sucked or discharged because the blank A and B of the cylinder of the cylinder block have the same volume and therefore pumping action is not taken place.



1. Swash plate inclination angle
2. Valve port plate

T512

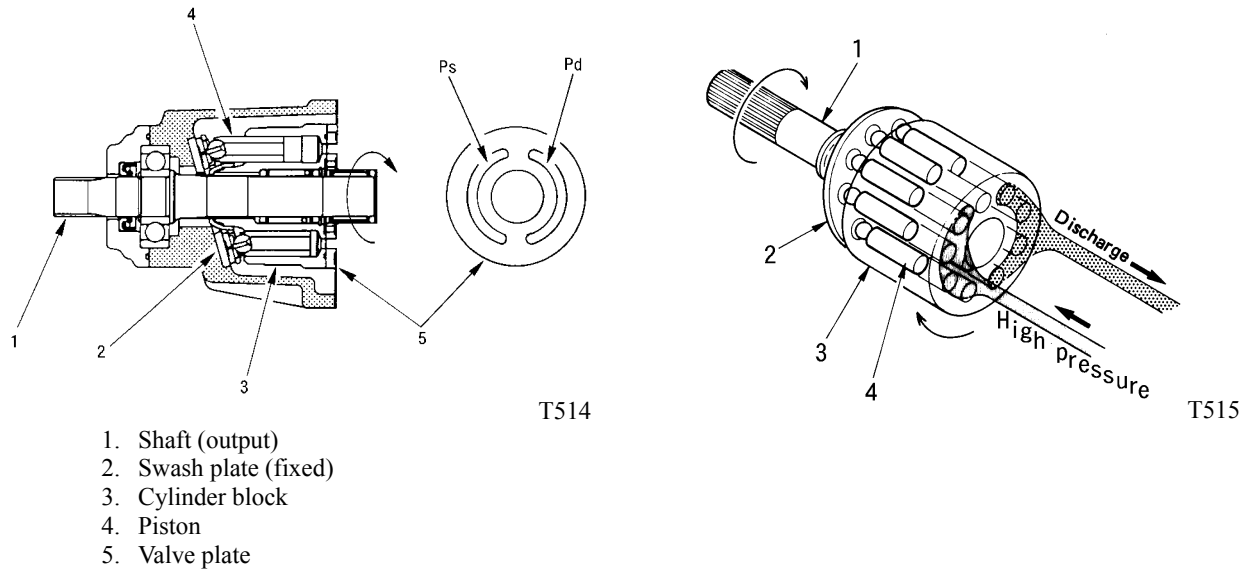


T513

When the HST pedal is depressed in the forward direction, the swash plate is inclined and proportion of the volume of A and B is changed to $A > B$. When the shaft is rotated at this condition in the arrow mark direction, the piston moves from A to B for discharge action in the angle 180° . When the piston moves from B to A, suction step takes place through the angle of 180° . Therefore, the crescent-shaped port Ps of the valve port plate is the suction port and another crescent-shaped port Pd is the discharge port.

With the increase of the depressing distance of the HST pedal (swash plate inclination angle), discharge volume and speed increase. By stepping the pedal in the opposing direction, the port Ps becomes the discharge port and Pd the suction port.

(2) Fixed type motor



Above figure shows the rotary parts of the axial piston motor. Nine pistons are incorporated in the cylinder block. The valve plate having 2 crescent-shaped passages Ps and Pd is in contact with one end of the cylinder block. The 2 crescent-shaped passages are connected with the feeding-in tube and discharging tube respectively.

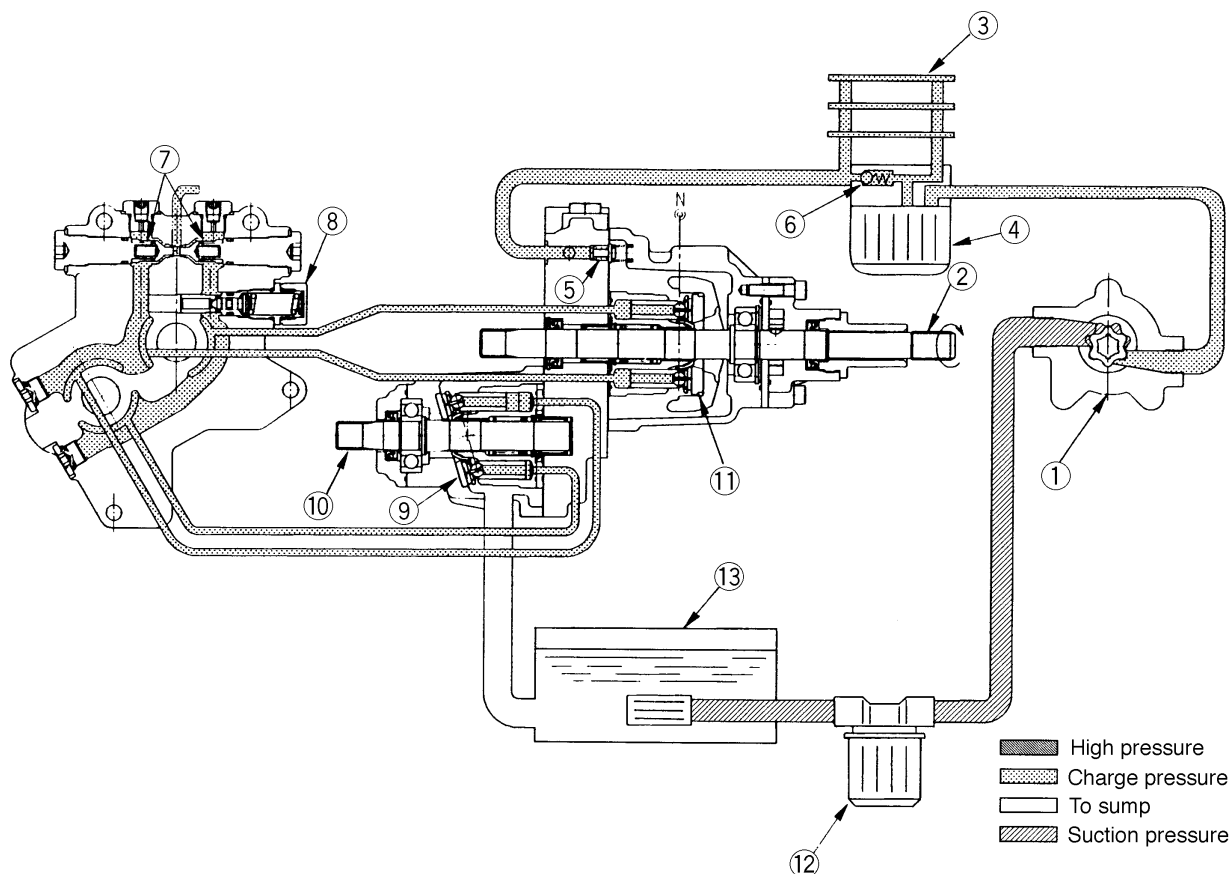
When high pressure oil from the variable pump is fed to the port Ps, the piston is pushed and force acts to push the swash plate. A component of this force in the rotating direction rotates the cylinder block, generates torque in the arrow mark direction in the shaft through the spline of the cylinder block, and actuates the motor. Hydraulic oil is discharged from the port Pd at this time. When high pressure oil is fed from the port Pd adversely, the above procedure is reversed.

5) Oil flow

(1) Neutral

Even when the input shaft from the engine is rotated, the variable displacement pump does not start the pumping operation. Therefore, no oil is supplied to the motor from the pump and the output shaft on the transmission side does not rotate.

The oil discharged from the charge pump is supplied to the pump and motor through a check valve. Excessive oil passes through a low pressure relief valve, cools the pump and motor in the case and then returns to the tank.



T516

Oil flow – Neutral position

- | | |
|------------------------------|--------------------------------|
| 1. Charge pump | 8. High pressure relief valve |
| 2. Input shaft | 9. Fixed displacement motor |
| 3. Oil cooler | 10. Output shaft |
| 4. Filter | 11. Variable displacement pump |
| 5. Low Pressure relief valve | 12. Hydraulic filter |
| 6. Safety valve | 13. Oil tank (Transmission) |
| 7. Check valve | |

(2) Forward

By depressing the HST pedal to the forward side, the variable displacement pump starts the pumping operation and discharges the oil.

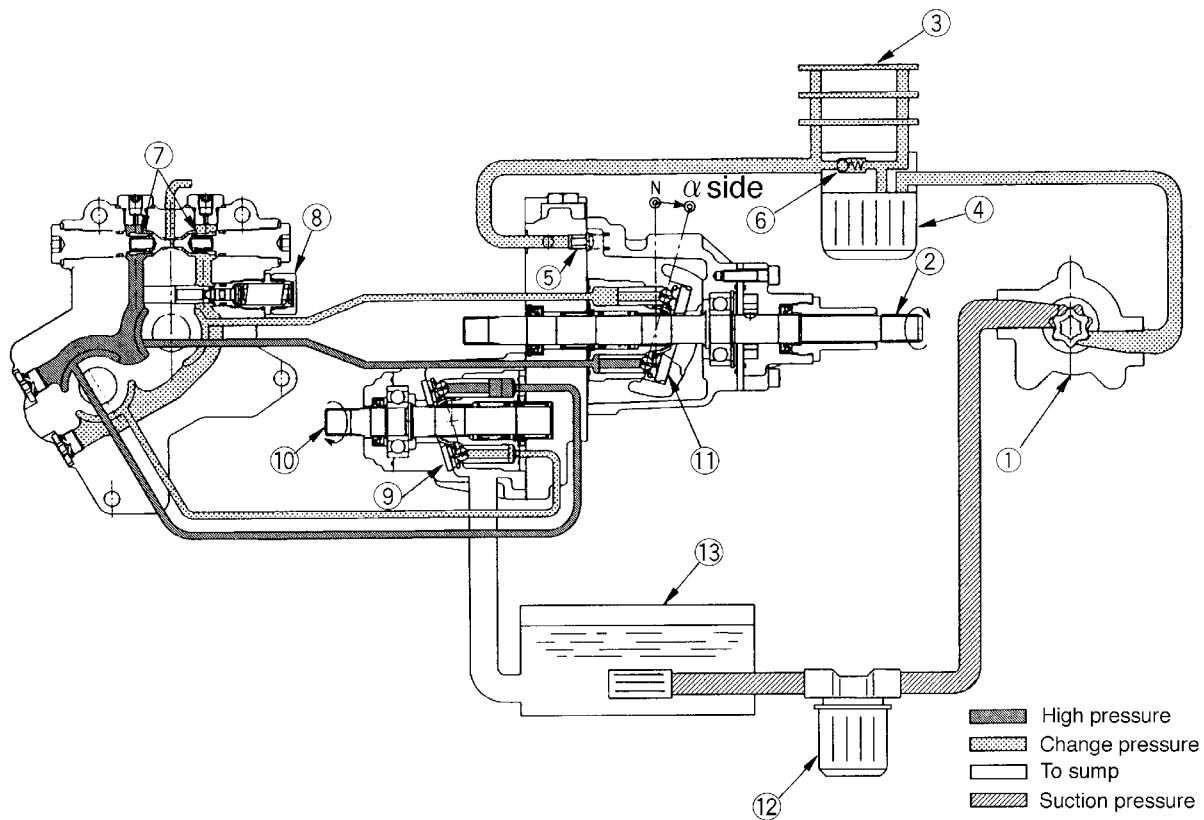
The discharged oil is supplied to the fixed displacement motor and output shaft is rotated.

The high pressure side check valve is closed under the pressure of the oil and the low pressure relief valve is opened under the charge pressure.

The check valve is opened at the neutral position but the high pressure side valve port is gradually closed with the increase of the circuit pressure action as a cushion at the time of acceleration enduring smooth acceleration.

When the pedal is returned to the neutral position, the valve returns to the neutral condition quickly by the charge pump pressure.

The high pressure relief valve is closed usually. But when excessive load acts on the motor output and the pressure in the HST circuit exceeds 27.4 MPa (280 kgf/cm²) the relief valve is actuated to prevent damage of various parts. The oil flows into the low pressure side circuit after passing through the relief valve.



T517

Oil flow – Forward position

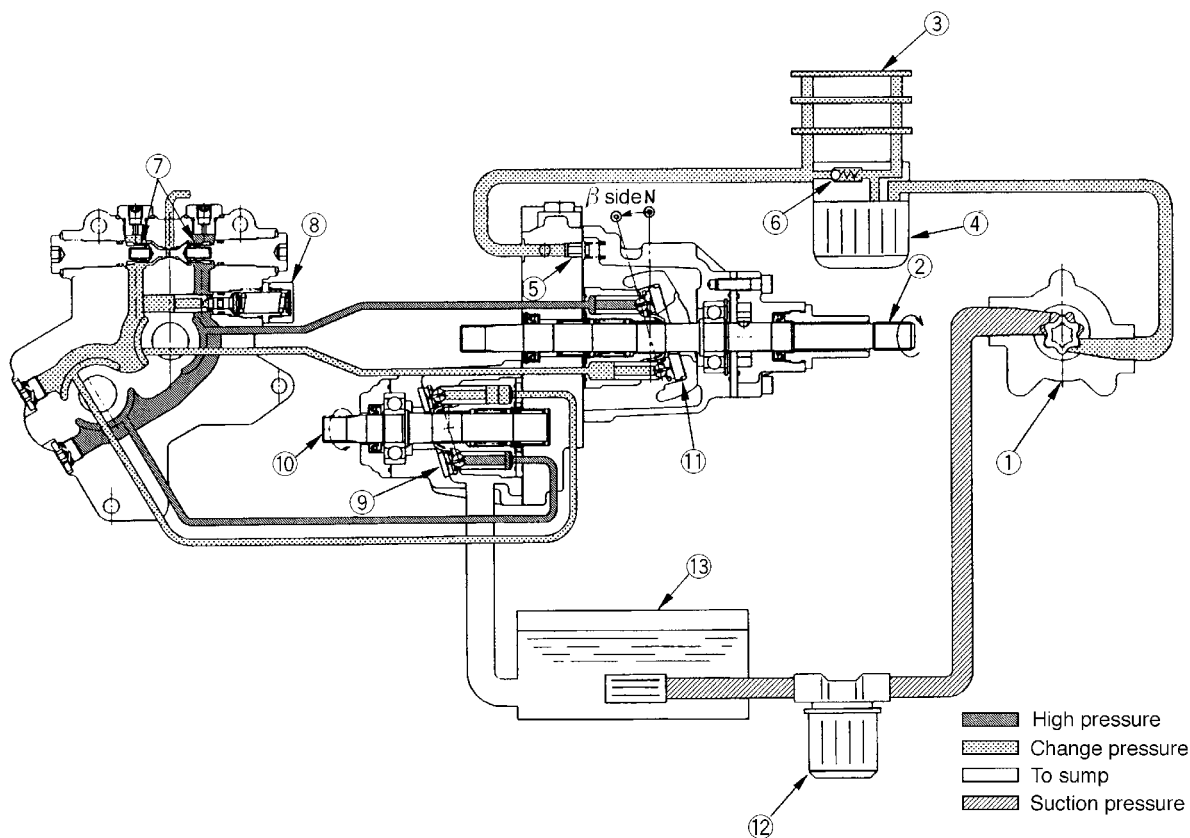
- | | |
|------------------------------|--------------------------------|
| 1. Charge pump | 8. High pressure relief valve |
| 2. Input shaft | 9. Fixed displacement motor |
| 3. Oil cooler | 10. Output shaft |
| 4. Filter | 11. Variable displacement pump |
| 5. Low pressure relief valve | 12. Hydraulic filter |
| 6. Safety valve | 13. Oil tank (Transmission) |
| 7. Check valve | |

(3) Reverse

By stepping the HST pedal to the reverse side, the variable displacement pump starts pumping operation and discharges oil.

The discharged oil is supplied to the fixed displacement motor and the output shaft rotates reversely to the forward operation.

The oil flow is also reverse to that for the forward side but the check valve and relief valve work in the same way as on the forward side.



T518

Oil flow – Reverse position

- | | |
|------------------------------|--------------------------------|
| 1. Charge pump | 8. High pressure relief valve |
| 2. Input shaft | 9. Fixed displacement motor |
| 3. Oil cooler | 10. Output shaft |
| 4. Filter | 11. Variable displacement pump |
| 5. Low pressure relief valve | 12. Hydraulic filter |
| 6. Safety valve | 13. Oil tank (Transmission) |
| 7. Check valve | |

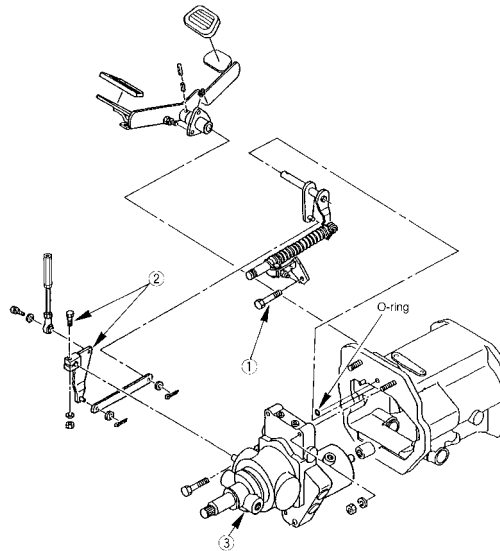
6) Disassembly, inspection and reassembly

(1) Disassembly of hydrostatic transmission

Disassembling procedure

1 HST unit HST pedal Shift link

- ① Remove the control lever from the HST unit (trunnion shaft) and separate the damper from below of the unit.
- ② Remove the HST unit from the front of the transmission case (front).
- ③ Remove the coupling with snap ring of the drive shaft.
- ④ If necessary, drive out the spring pin of the pedal and remove the pedal, pedal support and shift link. (Extract the shift link together with the shift plate and damper to the inside of the case.)

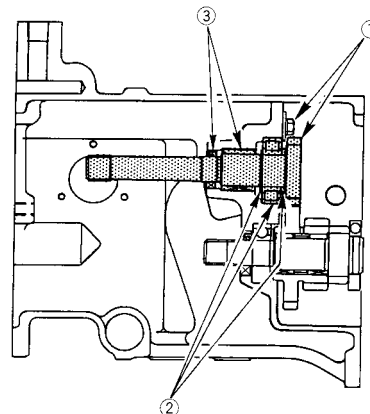


T519

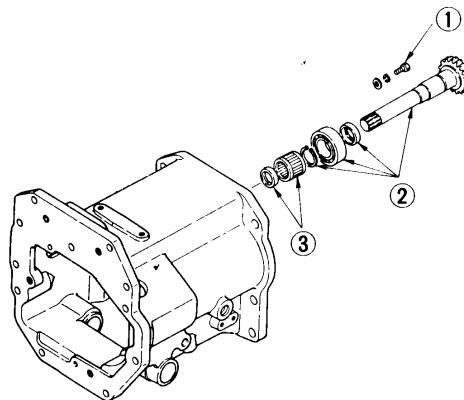
2 Drive shaft (PTO)

- ① Remove the bearing retaining bolt at the rear of the transmission case (front) and extract the shaft, roller bearing and collar together rearwards from the case.
- ② If necessary, remove the snap ring and take out the roller bearing and collar from the shaft.
- ③ Remove the oil seal and needle bearing from the case.

NOTE: Take care to the needle bearing and oil seal when extracting the shaft.



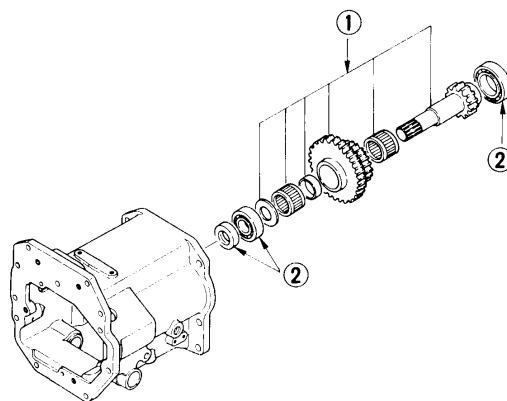
T520



T521

3 Drive shaft (traveling)

- ① Extract the shaft rearwards from the transmission case (front) and take out the counter gear, needle bearing, collar and thrust washer.
- ② If necessary, remove the bearing at the rear end of the shaft and bearing and oil seal in the case.

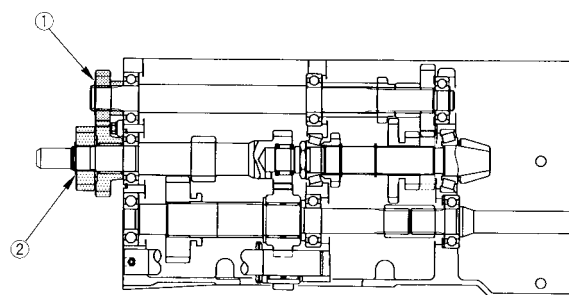


4 Bearing holder

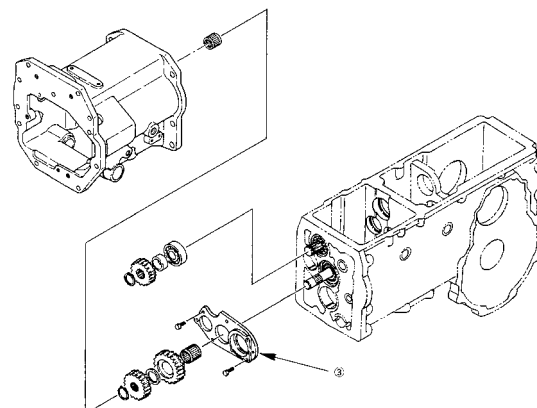
- ① Remove the snap ring at the end of the main shaft and take out the fixed gear and collar.
- ② Remove the snap ring on the front of the counter shaft and take out the fixed gear, thrust washer, counter gear and needle bearing.

NOTE: Remove the needle bearing at the end of the counter shaft, if any. If no needle bearing is installed here, one is installed in the transmission case (front). Confirm it.

- ③ Remove the bearing holder from the front of the transmission case (rear).



T522

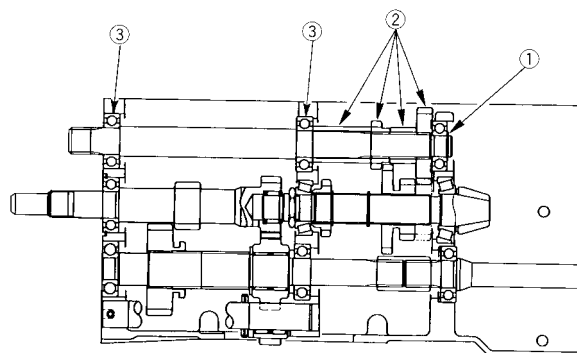


T523

T524

5 Main shaft

- ① Remove the snap ring at the rear end of the main shaft.
- ② Extract the shaft frontwards and take out the fixed gears and collars.
- ③ If necessary, remove the bearing from the shaft or case.

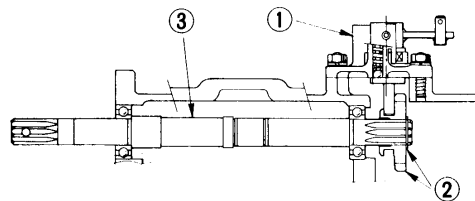


T525

6 4WD drive shaft

- ① Remove the 4WD shifting system case cover from the side of the transmission case. (See the paragraph of 9 × 3 manual transmission.)
- ② Remove the snap ring at the rear end of the shaft and take out the slide gear.
- ③ Extract the drive shaft frontwards.

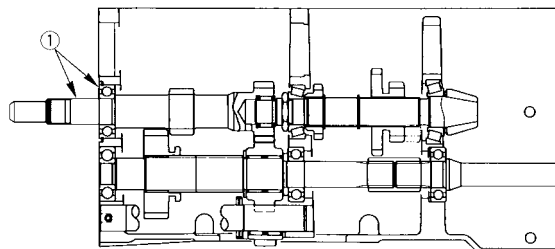
NOTE: If required, remove the oil seal from the transmission case (front).



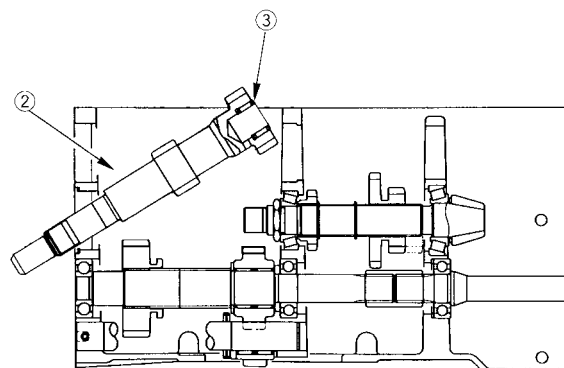
T526

7 Counter shaft

- ① Extract the shaft frontwards and take out the bearing on the front from the shaft.
- ② Move the shaft frontwards until it comes out of the drive pinion and take it out from above the case.
- ③ If necessary, take out the needle bearing at the rear end of shaft.



T527

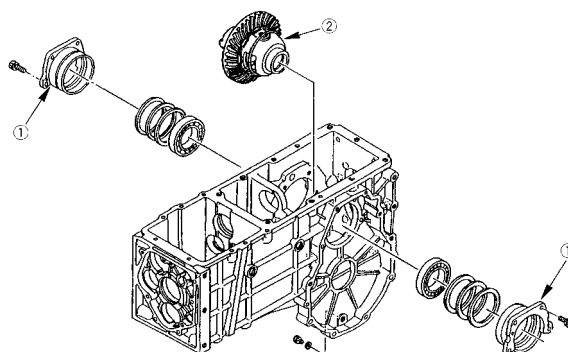


T528

8 Differential ass'y

- ① Remove the right and left bearing carriers.
- ② Take out the differential ass'y.

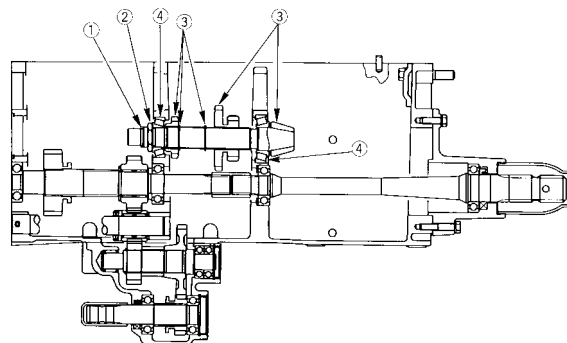
* Refer to the paragraph 9 × 3 manual transmission for details.



T529

9 Drive pinion

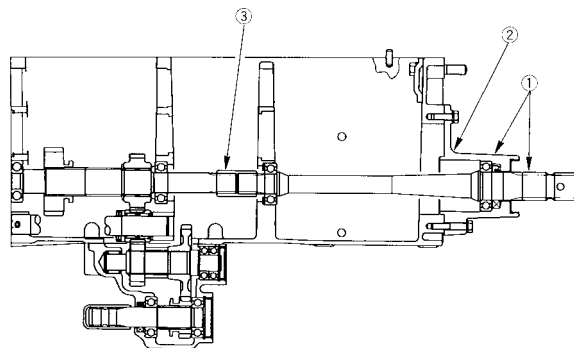
- ① Remove the snap ring.
- ② Straighten the bent claws of the lock nut and remove the nut.
- ③ Extract the drive pinion rearwards and take out the fixed gear, snap rings and slide gear (range gear).
- ④ Take out the taper roller bearings from the housing.



T530

10 PTO shaft

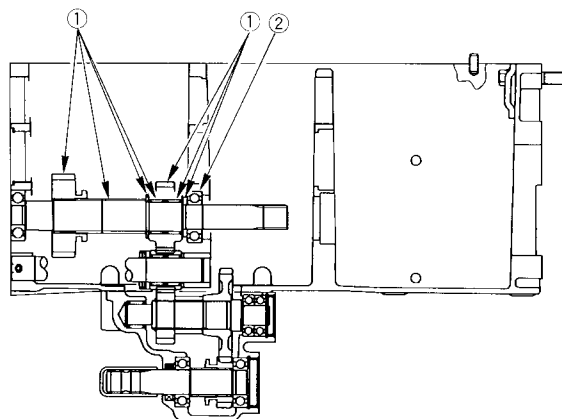
- ① Remove the PTO shaft rearwards together with the bearing holder.
- ② If necessary, separate the bearing holder from the shaft.
- ③ Remove the coupling and snap ring in the front of the output shaft (at the rear of the counter shaft).



T531

11 PTO countershaft

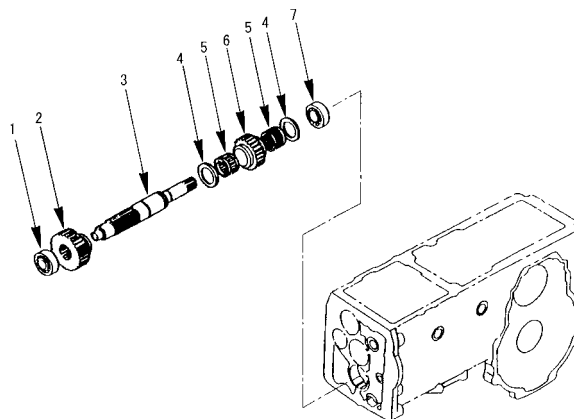
- ① Extracting the shaft frontwards, remove the slide gear, thrust washers, counter gear, and needle bearings.
- ② If necessary, remove the bearing from the housing.



T532

Components

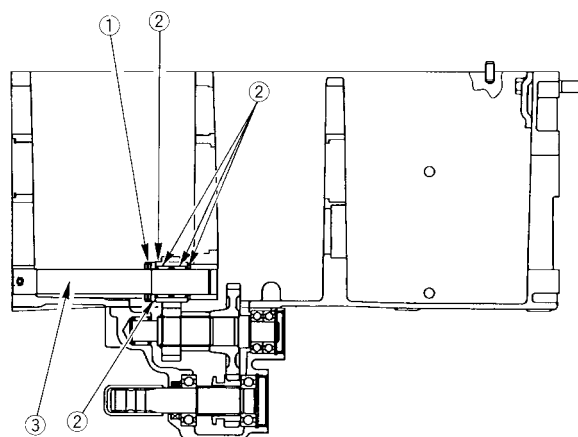
1. Bearing (6304)
2. Slide gear
3. Counter shaft
4. Thrust washer
5. Needle bearing
6. Counter gear
7. Bearing (6205)



T533

12 Mid PTO counter shaft

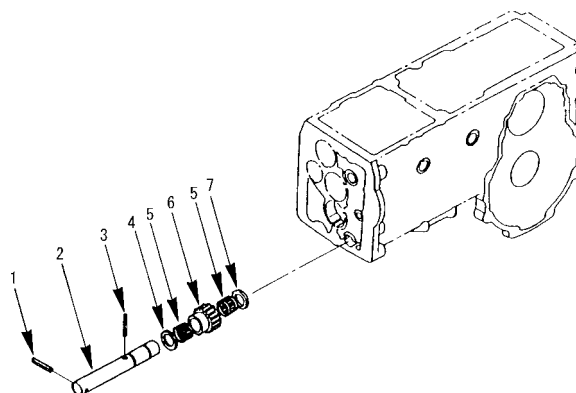
- ① Drive out the spring pin from the counter shaft.
- ② Slide the shaft frontwards and remove the thrust washers, counter gear and needle bearings from the shaft.
- ③ Extract the shaft frontwards.



T534

Components

1. Spring pin
2. Counter shaft
3. Spring pin
4. Thrust washer (large)
5. Needle bearing
6. Counter gear
7. Thrust washer (Small)



T535

13 Shifter rod

Shifter forks

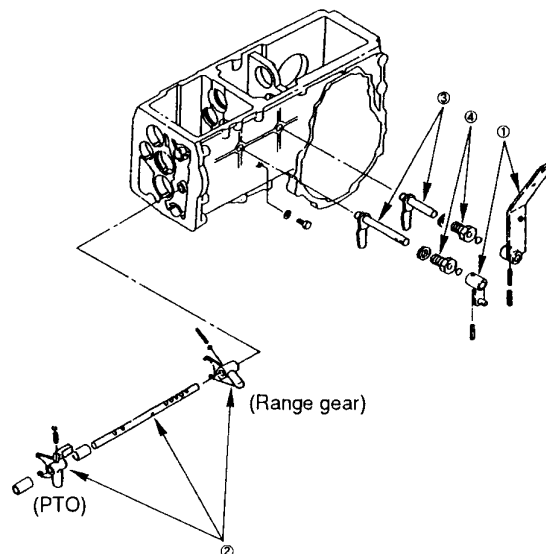
Shift arms

(PTO and range shift)

- ① Drive out the spring pin and remove the change lever (Range gear – PTO).
- ② Drive out the shifter rod frontwards and take out the shifter fork (PTO – auxiliary transmission).

NOTE: Take care at this time since the detained ball and spring come out.

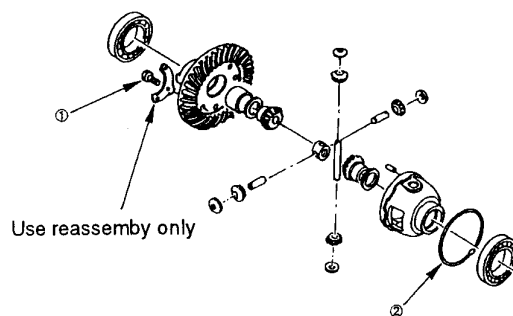
- ③ Extract the shift arm (PTO – auxiliary transmission) to the inside of the case.
- ④ If necessary, take out the shift guide from the case.



T536

14 Differential ass'y

- ① Heat the bolts head by burner and remove the bolts, and separate the ring gear and differential cage.
- ② Remove the clip and take out the gear and shaft in the differential cage.
(See the paragraph of 9 × 3 manual transmission disassembly.)

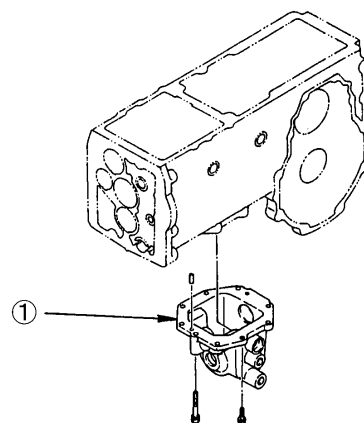


T537

15 Gear case (Mid PTO)

- ① Remove the mid PTO gear case from the below of the transmission case.

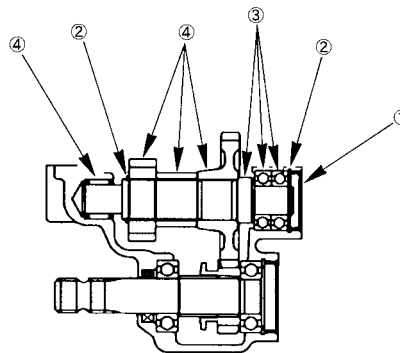
NOTE: Take care not to damage the transmission case and gear case mating surfaces.



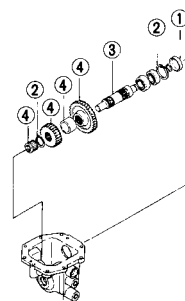
T538

16 Mid PTO counter shaft

- ① Pry the sealing plug out from the rear end of the case.
- ② Remove the snap ring at the rear of the case and remove the snap ring in the front of the shaft from the groove.
- ③ Drive out the shaft rearwards.
- ④ Take out the needle bearing, fixed gear, snap ring, and collar.



T539

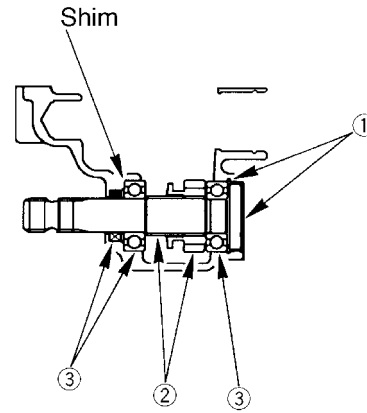


T540

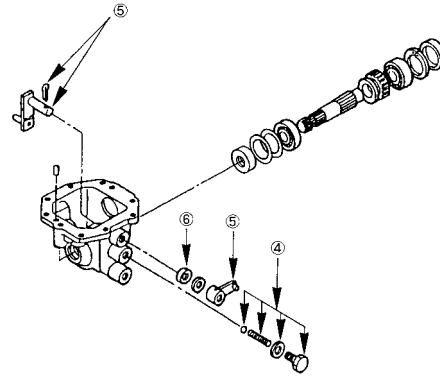
17 Mid PTO shaft Mid PTO shifter

- ① Pry the sealing plug out and remove the snap ring from the rear end of the case.
- ② Drive out the shaft rearwards and take out the slide gear.
- ③ If necessary, remove the bearing and oil seal from the shaft or case.
- ④ Remove the plug on the side of the case and take out the detained ball and spring.
- ⑤ Drive out the spring pin, remove the change lever, and extract the shift arm to the inside.
- ⑥ Remove the oil seal, if necessary.

NOTE: Inspect the end play of the Mid PTO shaft before disassembly. If end play is more than 0.5 mm adjust the end play by shims when reassembly.



T541



T542

(2) Inspection and reassembly of hydrostatic transmission

Inspection

Refer to the paragraph of inspection of 9 × 3 manual transmission.

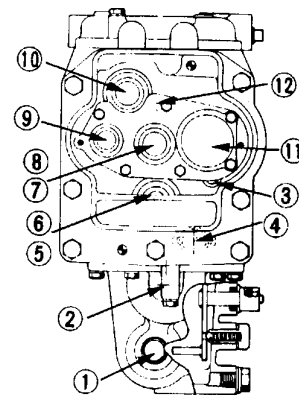
Reassembly

Reassemble units in the reverse order to disassembly, taking care to the following reassembling procedure.

Assemble the shafts in the following order: ① mid PTO shaft, ② mid PTO counter shaft, ③ PTO & range shifter rod, ④ mid PTO counter shaft, ⑤ PTO counter shaft, ⑥ PTO shaft, ⑦ drive pinion, ⑧ counter shaft, ⑨ 4WD drive shaft, ⑩ main shaft, ⑪ drive shaft (traveling), and ⑫ drive shaft (PTO).

* The right figure shows layout of the shafts when viewed from the front side of the transmission case.

Viewed from the front



T543

Refer to the paragraph of assembly of 9 × 3 manual transmission.

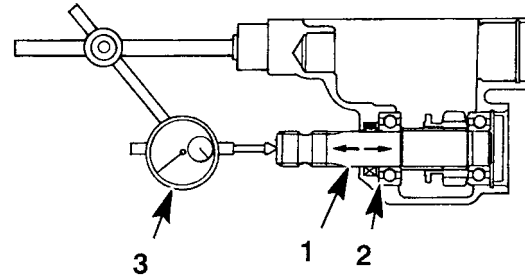
1. Shift guide (PTO & range shifter) tightening torque
2. Drive pinion preload
3. Thrust washer installing direction

Assembling procedure

1 Mid PTO case

- ① Check shaft end play using a dial indicator.
If end play is more than 0.5 mm, adjust the end play by shims.

1. Mid PTO shaft
2. Shim(s)
3. Dial indicator

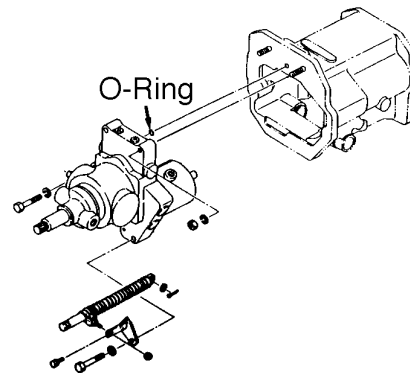


T544

- ② Install new seals and sealing plugs on reassembly.

2 HST unit

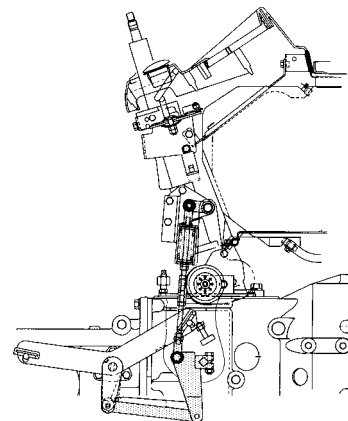
- ① Install the HST unit to the transmission case taking care to be O-ring (P12) at the back.



T545

3 HST control link

Refer to paragraph 7), Adjustment.



T546

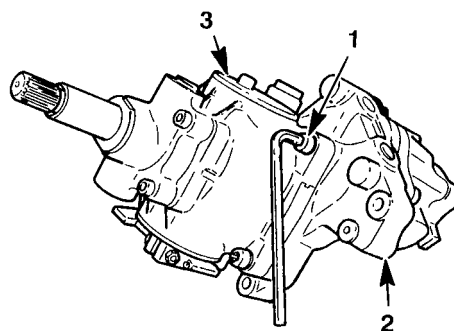
(3) Disassembly of HST unit

Disassembling procedure

1 Pump

- ① Remove the socket head bolts (4 pcs), and remove the pump case spring, valve and gasket from the port block.

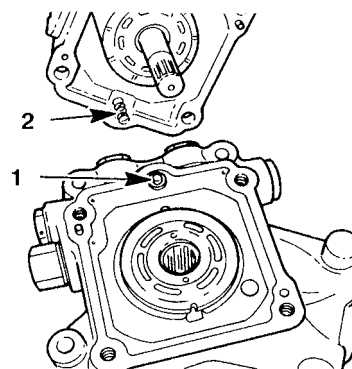
1. Socket head bolt
2. Port block
3. Pump case



T547

NOTE: Once the pump ass'y is separated from the port block the charge pump relief valve tappet and spring may fall out.

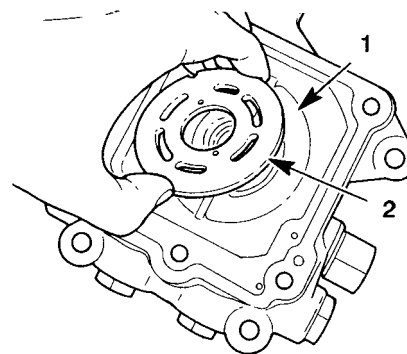
1. Relief valve tappet
2. Spring



T548

- ② Remove the valve plate from the port block. (Usually the valve plate is installed to the port block side. If it is installed to the cylinder block side, it should be removed.)

1. Port block
2. Valve plate



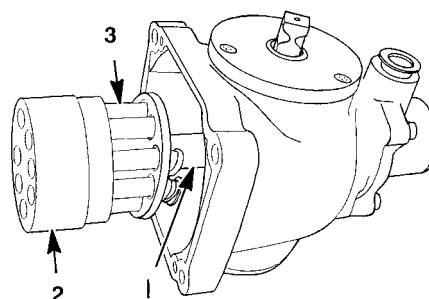
T549

NOTE:

1. Take care not to drop the valve plate.
2. The valve plate can be removed easily by raising its one side.

- ③ Slide the cylinder block and piston ass'y from the pump of the shaft.

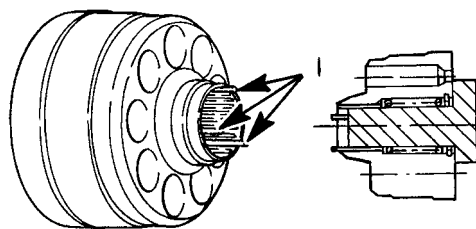
1. Shaft
2. Cylinder block
3. Piston ass'y



T550

NOTE: Use care not to lose the three pins when removing the cylinder block and piston ass'y.

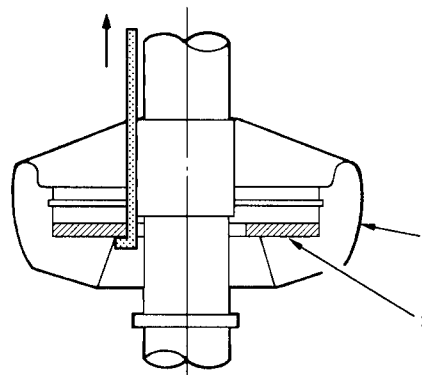
1. Pin



T551

- ④ Remove the thrust plate from the swash plate.
(When it is difficult to remove, raise the thrust plate using a L-shaped rod.)

1. Swash plate
2. Thrust plate



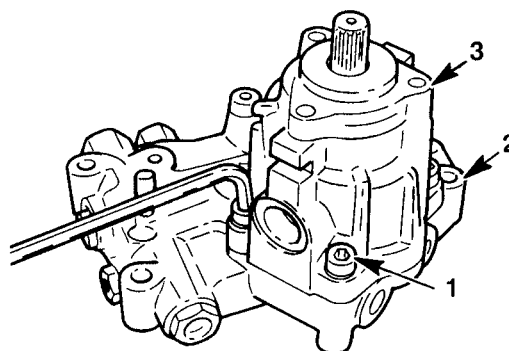
T552

2 Motor

- ① Remove socket head bolts (4pcs) and tap the port block with a soft hammer to loosen assembly.

1. Socket head bolt
2. Port block
3. Motor case

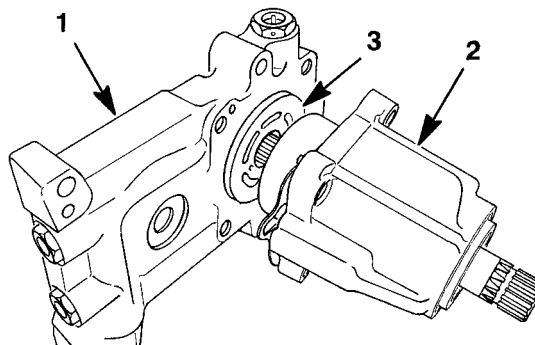
- ② Remove the motor case from the port block.



T553

- ③ Remove the valve plate from the port block.
(Usually the valve plate is installed to the cylinder block side. If it is installed to the port block side, it should be removed.)

1. Port block
2. Motor case
3. Valve plate

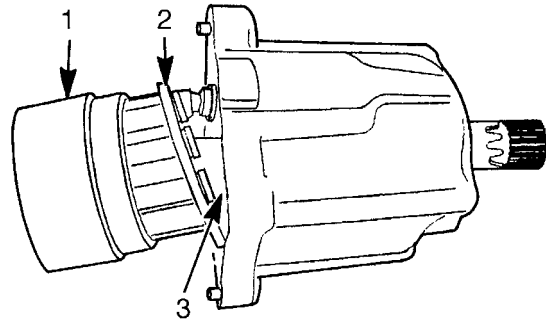


T554

NOTE: Take care not to drop the valve plate.

- ④ Slide the cylinder block and piston ass'y from the motor of the shaft.

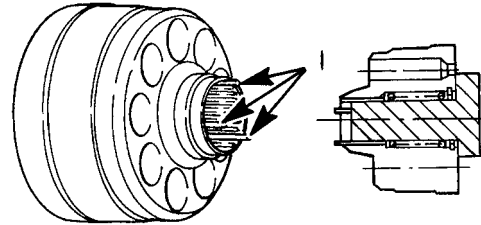
1. Cylinder block
2. Piston ass'y
3. Shaft



T555

NOTE: Use care not to lose the three pins when removing the cylinder block and piston ass'y.

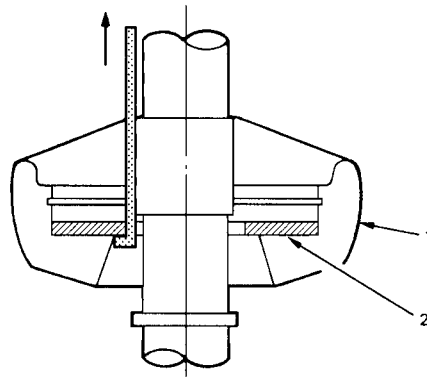
1. Pin



T556

- ⑤ Remove the thrust plate from the swash plate.
(When it is difficult to remove, raise the thrust plate using a L-shaped rod.)

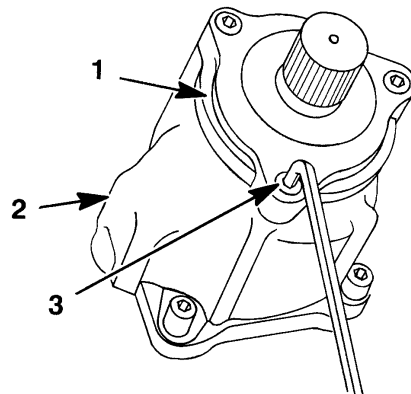
1. Swash plate
2. Thrust plate



T557

- ⑥ Remove the socket head bolts (3 pcs) and take out the cover and O-ring from the case.

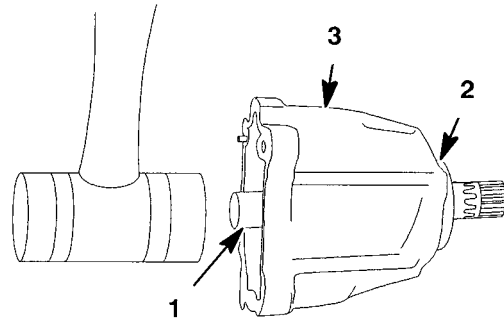
1. Cover
2. Case
3. Socked head bolt



T558

- ⑦ Tap the shaft from the front side and remove it together with the bearing and snap ring from the case.

1. Shaft
2. Bearing
3. Case

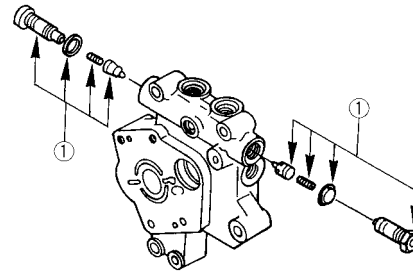


T559

3 Port block

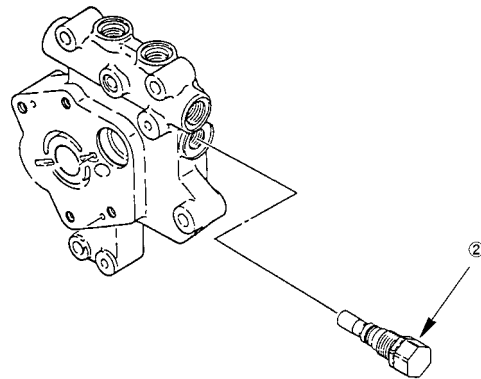
- ① Remove the right and left plugs and take out the check valve (poppet, spring) from the port block.

NOTE: Be careful not to damage the end surface of the port block at the time of disassembly.



T560

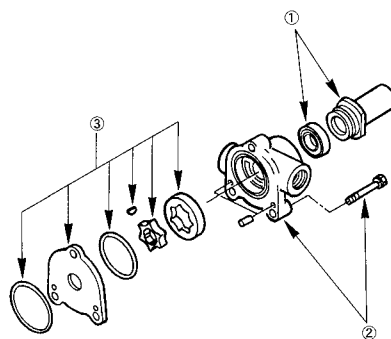
- ② Remove the relief valve (high pressure side) as an ass'y.



T561

4 Charge pump

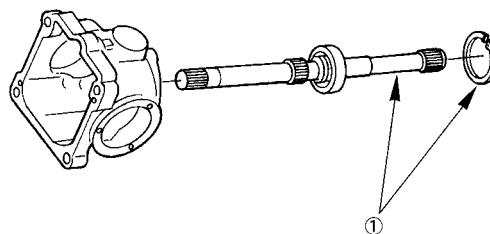
- ① If necessary, unscrew the holder and remove the oil seal.
- ② Remove the socket head bolts (3 pcs) and take out the pump case.
- ③ Remove the trochoid rotor, key, O-rings and plate from the shaft.



T562

5 Pump shaft

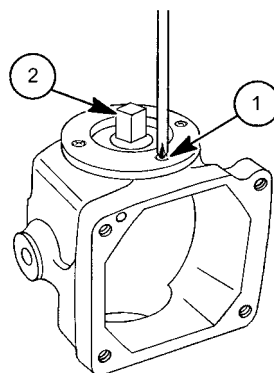
- ① Remove the snap ring (Ø52) from the case and tap the shaft to remove from the case together with the bearing.



T563

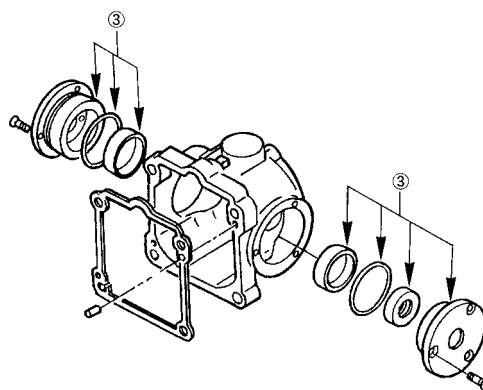
6 Swash plate (Trunnion plate)

- ① Remove screws (3 each) fixing the right and left covers.
- ② Tap the trunnion shaft of the swash plate to provide clearance between the cover and case.



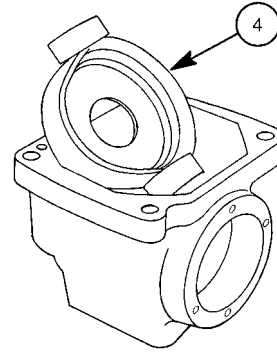
T564

- ③ Remove the cover from the case, tap the swash plate over the case to lift up the cover on the opposite side from the case and remove the cover ass'y in the same way.



T565

- ④ Take out the swash plate from the case.



T566

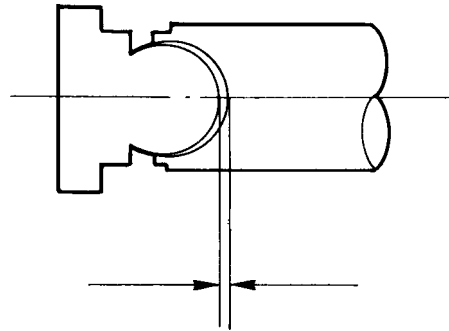
(4) Inspection and reassembly of HST unit

Inspection

1 Piston ass'y

- ① Replace if the play at the piston and shoe caulking area exceeds the service limit.

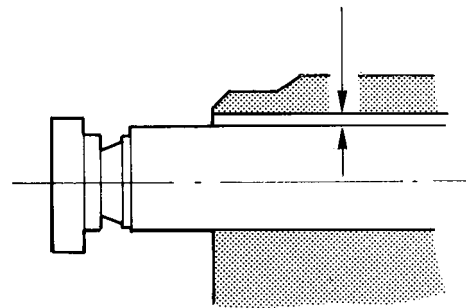
Assembling standard value	Service limit
0.03 mm	More than 0.2 mm



T567

- ② Replace if the diameter clearance between the piston and cylinder block exceeds the service limit.

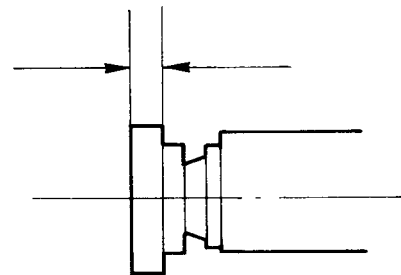
Assembling standard value	Service limit
0.02 mm	More than 0.04 mm



T568

- ③ Shoe thickness

Assembling standard value	Service limit
3.0 mm	Less than 2.9 mm

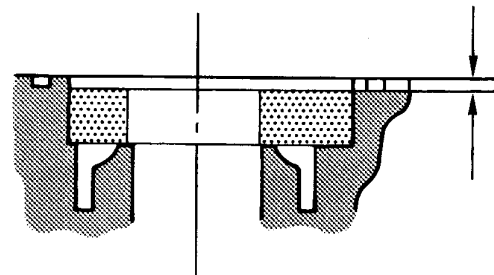


T569

2. Charge pump ass'y

Measure the side clearance of the trocoid rotor subass'y and replace if the service limit is exceeded.

Assembling standard value	Service limit
0.02 – 0.045 mm	More than 0.050 mm

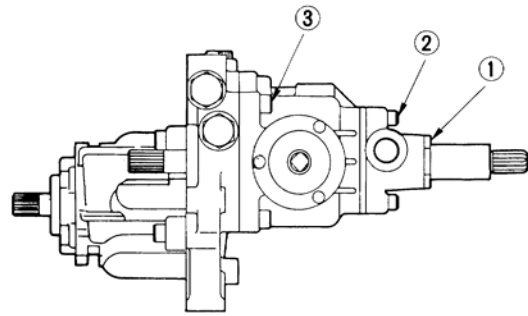


T570

Reassembly

Reassembly units in the reverse order to disassembly taking care of the following points.

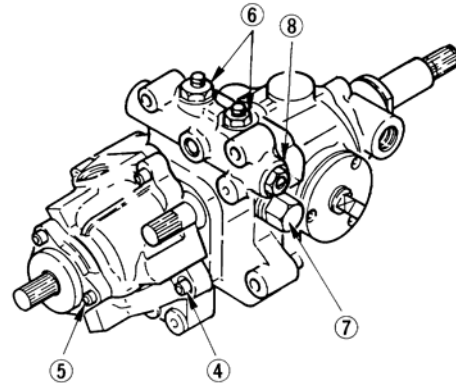
After completion of reassembly, rotate the input, output, and trunnion shafts respectively to check for smooth operation.



T571

1. Tightening torque at each part

Part	Tightening torque N·m (kgf·m)
① Holder	35.3 – 43.1 (3.6 – 4.4)
② Charge pump case	15.9 – 19.5 (1.6 – 2.0)
③ Pump case	35.2 – 43.2 (3.6 – 4.4)
④ Motor case	35.2 – 43.2 (3.6 – 4.4)
⑤ Motor case cover	7.1 – 8.7 (0.72 – 0.88)
⑥ Pressure detection plug	48.5 – 59.3 (4.9 – 6.0)
⑦ High pressure relief valve	33.1 – 40.5 (3.4 – 4.1)
⑧ Check valve	33.1 – 40.5 (3.4 – 4.1)

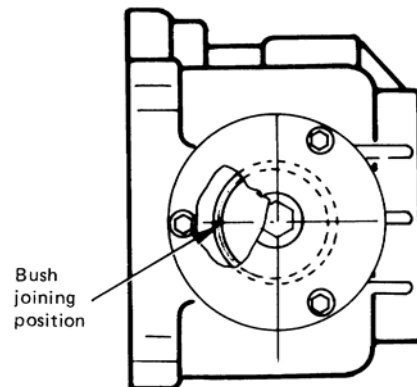


T572

2. Install the right and left covers to the pump case taking care to the bush joining position in the cover.

NOTE: The bush joining direction to against the port block when installing.

Tightening torque	2.0 – 2.6 N·m (0.20 – 0.26 kgf·m)
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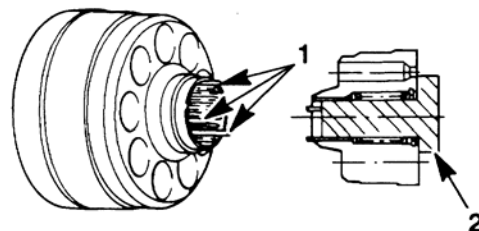


T573

3. Install assembling jigs to the subassembled cylinder block (with washer, spring and snap ring installed), and install 3 pins to the cylinder block spline groove. Then install the retainer holder, retainer plate, and piston sub-assembly.

(Reassemble motor cylinder block in the same way.)

1. Pin
2. Assembling jig



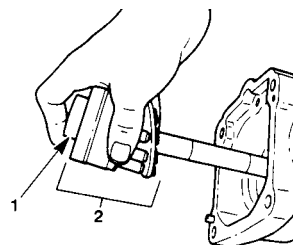
T574

4. Install the cylinder block ass'y to the shaft holding the assembling jig by fingers.

1. Assembling jig
2. Cylinder block ass'y

NOTE:

1. If the assembling jig is not held by fingers, the pin may drop off.
2. After installing the cylinder block ass'y, confirm that there is no pin on the shaft, assembling jig surface or in the case (since the pin condition cannot be directly confirmed).



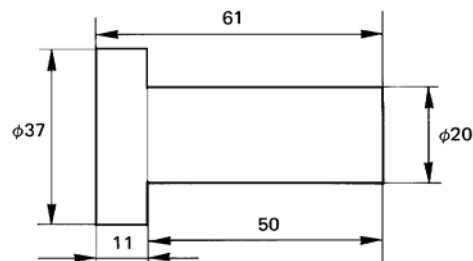
T575

- * Assemble the motor cylinder block in the same way.

Assembling jigs

Material: Synthetic resin

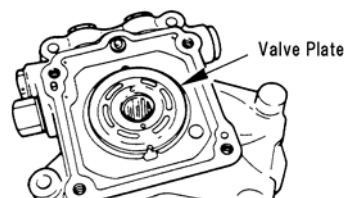
Shape: As shown in the right figure. (Unit: mm)



T576

5. When installing the valve plate to the port block, coat the installing surfaces with lithium grease and confirm that there is no play or gap between them after installation. Align the pin with hole of the valve plate and bronze color surface toward the cylinder block.

- * Install and check in the same way on the pump side and motor side.



T577

7) Adjustment

(1) Pressure

Check procedure

1. Pressure adjustment of high pressure relief valve

- ① Set the range transmission lever at "H" (after starting the engine).
- ② To prevent the tractor rushes out at the time of measurement, raise the rear wheels using stable bases (it is more recommendable to remove the rear wheels).
- ③ Remove the plug (PT1/8) on the clutch case.

NOTE: Either one of the 2 plugs may be removed. However, HST pedal stepping direction varies at the time of measurement depending on the plug.

Pressure gauge set on the left side of the tractor: Pedal stepped frontwards

Pressure gauge set on the right side of the tractor: Pedal stepped rearwards

- ④ Install a pressure gauge (0-39.2 MPa (0-400 kgf/cm²))
- ⑤ Depress the HST pedal, fixed there, and increase the engine speed to 2600 rpm.

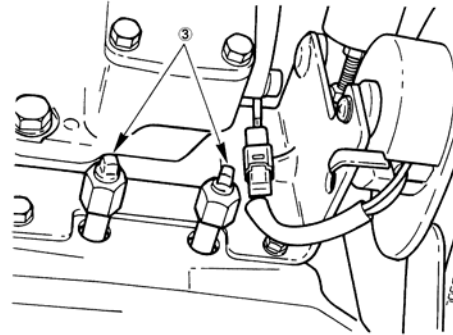
Relief set pressure	27.4 MPa (280 kgf/cm ²)
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NOTE:

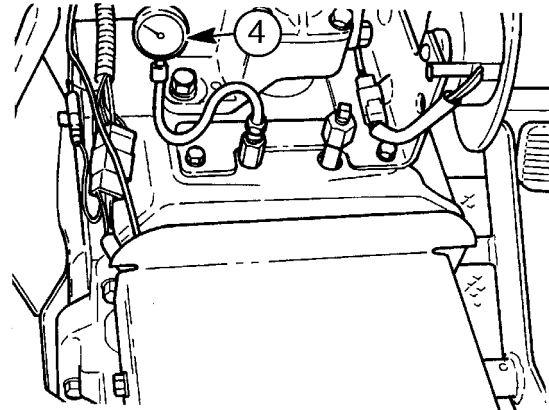
1. Take measurement in 2 – 3 seconds.

- ⑥ If necessary, replace the relief valve as an assembly as follows:

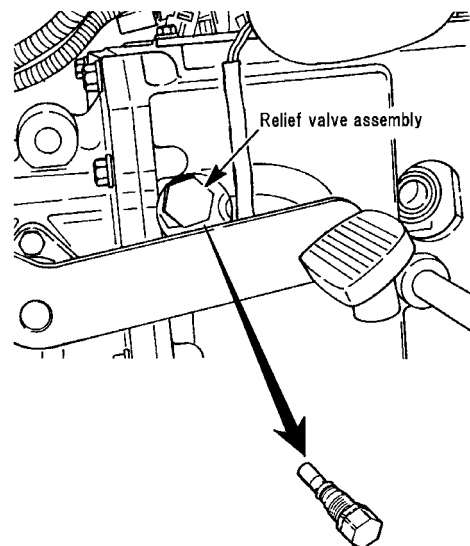
- Remove the rear cover.
- Press the HST pedal to rearward.
- Replace the relief valve assembly as a set.



T578



T579

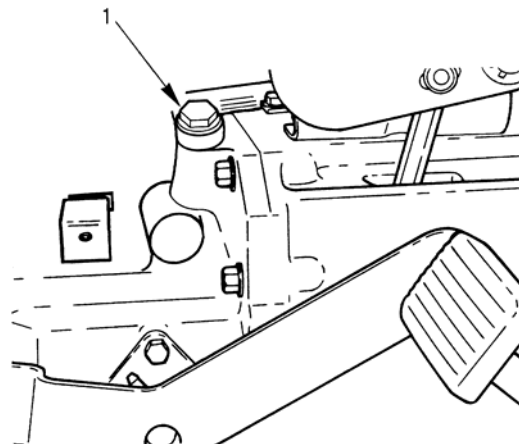


T580

2. Check of pressure of low pressure relief valve. (charge pump pressure)

- ① Set the range transmission and HST pedal at the neutral position.
- ② Remove the top cover of the transmission case and remove the eye bolt of the right side oil pipe.

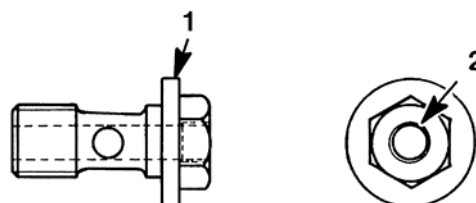
1. Eye bolt



T582

- ③ Drill and tap a eye bolt (part No. 388480240) for pressure testing as shown. Install the special eye bolt for pressure check.

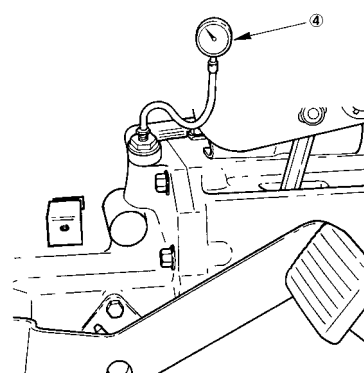
1. Eye bolt (for Pressure test)
2. Drill and tap PT1/8.



T583

- ④ Install an eye bolt for pressure measurement and install a pressure gauge : 0 – 2.5 MPa (0 – 25kgf/cm²) to eye bolt.
- ⑤ Increase the engine speed to 2500rpm and read the indication on the pressure gauge.

Set pressure	0.4 – 0.6 MPa (4.3 – 5.7 kgf/cm²)
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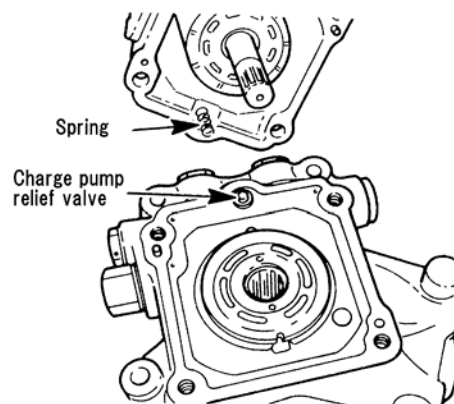
T584

- ⑥ If the pressure reading is low, check the following:

- a. Restricted suction filters
- b. Check or replace the charge pump relief valve
- c. Check and repair the charge pump

- ⑦ If the pressure reading is high, check the following:

- a. Stuck or restricted charge pump relief valve



T584-1

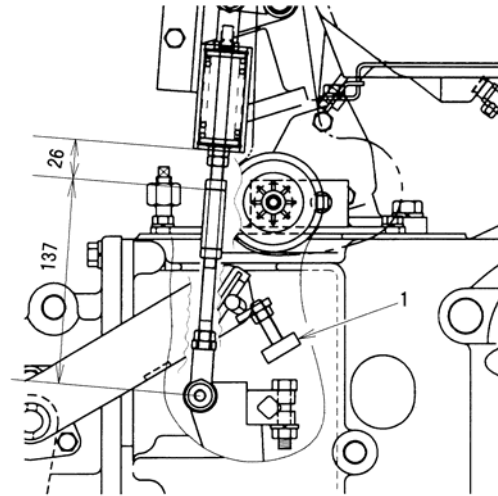
(2) Link system

Check procedure

1. Adjustment of control rod and pedal stop

- ① Adjust the length of the control rod, from the turnbuckle top end to the bottom rod end center, to 137 mm.
- ② Adjust the length from the top of the turnbuckle to the bottom of the spring holder to 26 mm.
- ③ Adjust the pedal forward side stop bolt by stepping the pedal fully, turning the bolt by 1 turn from that position (to lengthen), and lock with nut.

1. Pedal stop bolt

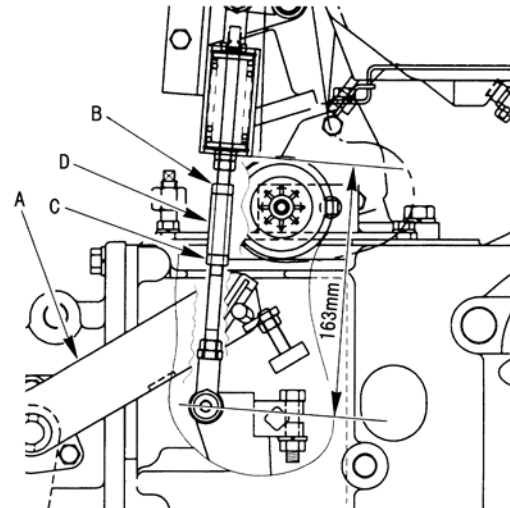


T585

2. Adjustment of HST neutral

- ① Raise the tractor rear and front axles so the rear and front wheels are off the ground and place safety stands under the axles.
Start the engine and place the HST pedal, A, in the NEUTRAL position. The rear wheels should not rotate in either direction.
- ② For fine adjustments of the NEUTRAL position, loosen lock nuts, B and C and turn the turnbuckle, D, 1/4 turn at a time, clockwise for reverse wheel rotation or counter clockwise for forward wheel rotation, until the rear wheels are at a complete stop.

NOTE: This procedure is based on the assumption that the HST spring housing and HST linkage has been pre-set at 163mm.



T586

8) Trouble Shooting

Replace the HST main body, if defective, as an ass'y as a rule.

Condition	Possible cause	Remedy
1. Output shaft fails to rotate when the HST pedal is set at forward or reverse position.	1. Improper operation of HST pump or motor.	Check the trunnion shaft movement and replace the ass'y.
	2. Damaged charge pump.	Measure the charge pressure and replace the ass'y.
	3. Too low set pressure of low pressure relief valve.	Measure the low circuit pressure and replace part.
	4. Too low set pressure of high pressure relief valve.	Measure the high pressure circuit pressure and replace parts.
	5. Defective seat of HST check valve.	Replace the part.
2. Output shaft fails to stop rotating with the HST pedal at neutral position.	1. Improper operation of check valve.	Disassemble, wash, and then reassemble (correction of valve).
	2. Defective seat of check and high pressure relief valve assembly.	Repair or replace the check and high pressure relief valve assembly.
3. Insufficient speed of HST output shaft or abnormal sound in the HST unit.	1. High pressure oil leaking due to wear at sliding part of HST pump or motor.	Clean in the oil circuit and replace HST unit.
	2. Lack of oil by clogging oil filters.	Replace oil filters.
	3. The air is mixture in the HST oil circuit.	Inspect the suction line of the charge pump or lack of the oil in the sump.
	4. Lack of discharge oil quantity by abnormal oil temperature.	When low temperature: Warm up the tractor. When high temperature: Stop the engine and restart the engine after cooled.
4. Oil leaks at shaft and seal.	Oil leakage due to damaged oil seal or O-ring.	Replace damaged oil seal or O-ring with new one. In this case, take sufficient care not to damage the lip when inserting the oil seal.

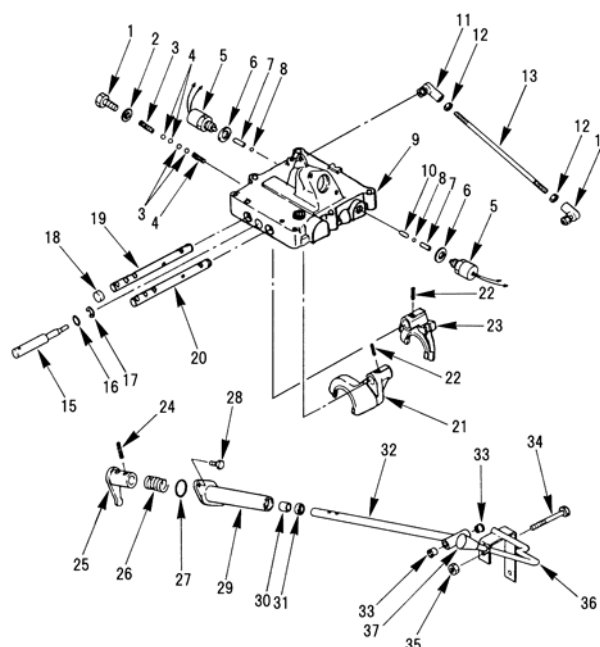
3-4 Change Lever Linkage

1. MAIN SHIFT CHANGE LEVER, RANGE SHIFT CHANGE LEVER, REAR PTO CHANGE LEVER, MID PTO CHANGE LEVER AND 4WD CHANGE LEVER

Remove the grips, rubber boot, lever guide, seat, seat track to refer to “1-5, sequence of Dismantling the tractor “in Chapter 1.

1) Main shift change lever

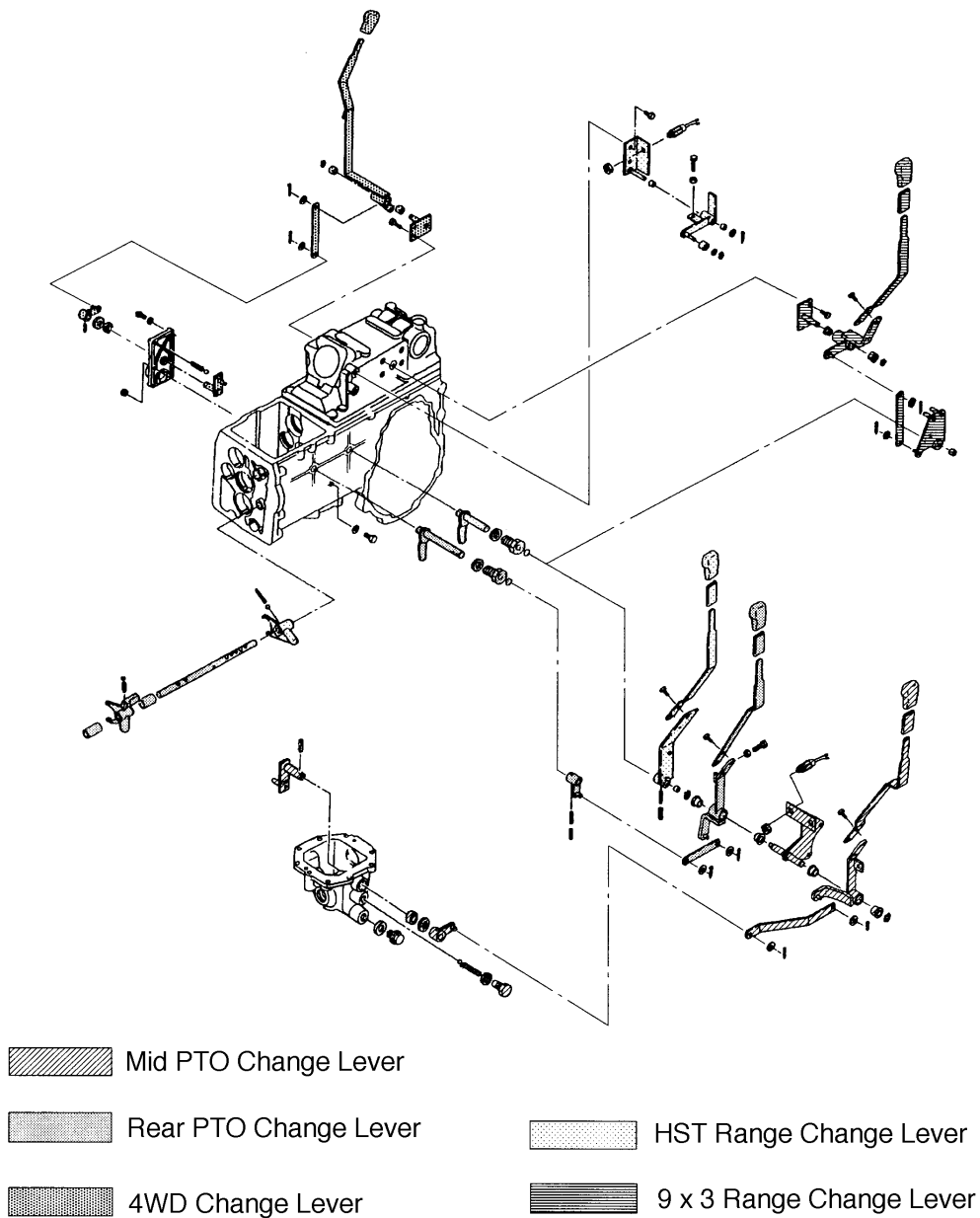
The main shift change system’s disassembly and reassembly to refer to “3-3, Transmission.” in chapter 3.



T587

- | | | | |
|----------------------|-----------------|------------------|------------------|
| 1. Bolt | 10. Balk pin | 20. Shifter rod | 30. Bush |
| 2. Seal washer | 11. Rod end: R | 21. Shifter fork | 31. Oil seal |
| 3. Spring | 12. Nut | 22. Spring pin | 32. Shift arm |
| 4. Steel ball | 13. Rod | 23. Shifter fork | 33. Bush |
| 5. Switch | 14. Rod end: L | 24. Spring pin | 34. Bolt |
| 6. Seal washer | 15. Shaft | 25. Shift arm | 35. Nut |
| 7. Pin | 16. O-ring | 26. Spring | 36. Change lever |
| 8. Steel ball | 17. Snap ring | 27. O-ring | 37. Grip |
| 9. Change lever case | 18. Plug | 28. Bolt | |
| | 19. Shifter rod | 29. Shift guide | |

2) Range shift change lever, Rear PTO change lever, Mid PTO change lever and 4WD change lever

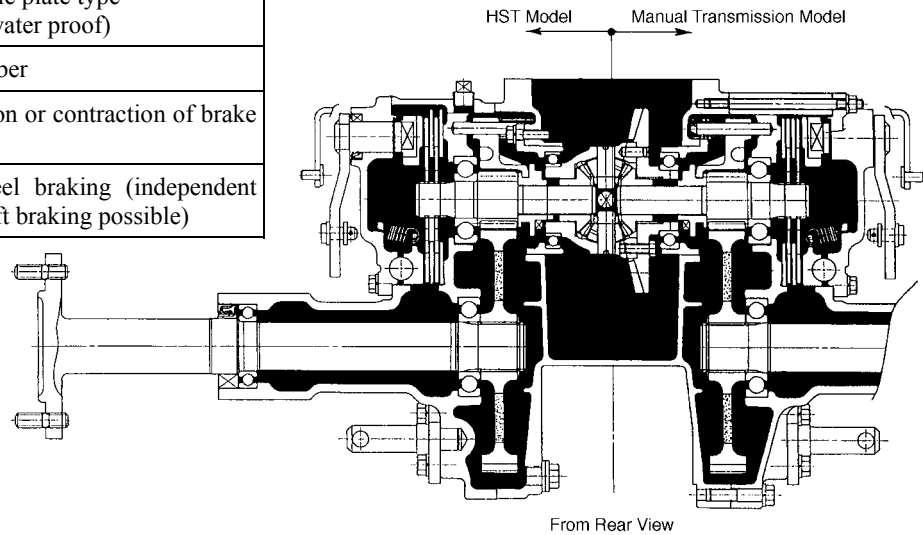


T588

3-5 Real Axle and Brake

1. SPECIFICATIONS AND SECTIONAL VIEW

Style	Internal sliding mechanical style
Type	Wet, multiple plate type (complete water proof)
Lining	Cellulose fiber
Brake adjustment	By expansion or contraction of brake rod
Operation	2 rear wheel braking (independent right and left braking possible)



T589

2. DISASSEMBLY, INSPECTION AND REASSEMBLY OF BRAKE ASS'Y

NOTE:

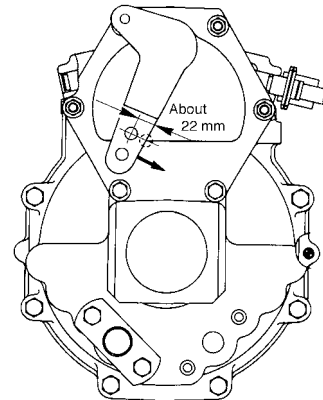
- (1) Do not disassembly the brake ass'y except when any trouble occurs.
- (2) The stator disk is easily damaged and should be handled carefully not to allow dust, etc. to stick.

Dimension measurement from outside

When checking the degree of wear of the lining (not trouble), check from the outside first to judge whether disassembly and inspection is required or not.

Move the lever in the operating direction by hand to measure the moving distance. When it moves more than 50 mm in the pin mounting hole, disassemble and check.

When tractor is new	About 22
---------------------	-----------------



T590

Disassembling procedure

1 Differential lock clutch

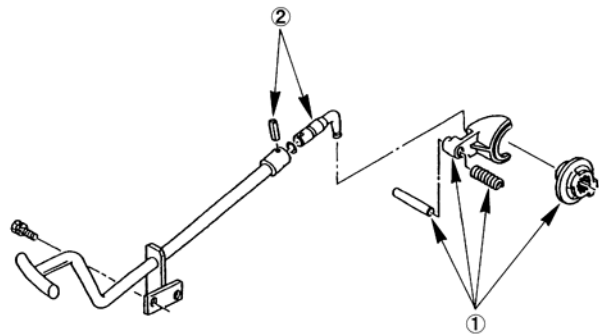
Differential lock fork

Differential lock pedal

Shift arm

- ① Extract the differential lock clutch and fork from the differential shaft. Remove the spring from the pin.
- ② Drive out the spring pin, separate the differential pedal and shift arm and take them out of the case respectively.

NOTE: In case of 9×3 manual transmission, above parts are installed to the right side of the wheel shaft case. In case of HST, they are installed to the left side.



T592

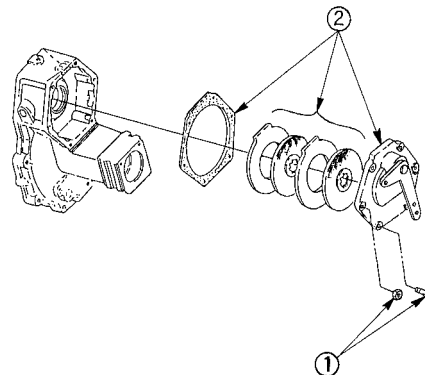
2 Brake cover

Stator

Disk (Lining)

- ① Remove the brake cover fixing bolt and nut

Cover tightening torque
22.6 – 28.4 N·m (2.3 – 2.9 kgf·m)



T593

- ② Remove the brake cover and stator disk.

NOTE: Since the stator disk is easy to be damaged, handle it carefully not to allow dust, etc. to stick.

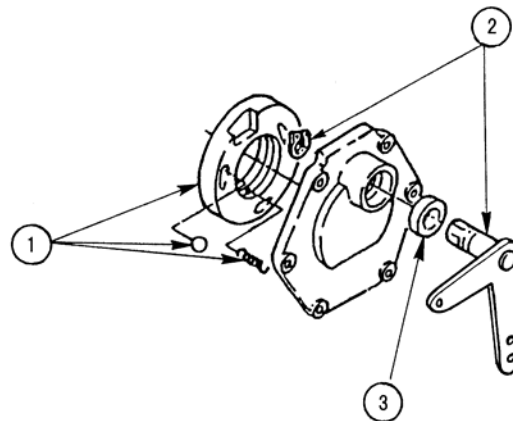
3 Spring

Steel ball

Lever

Oil seal

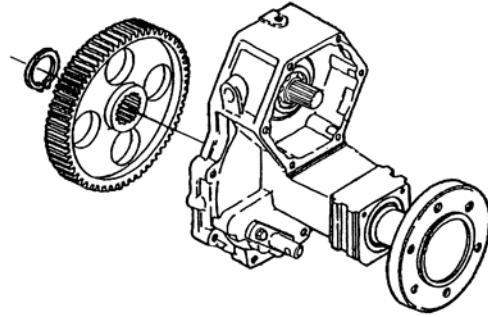
- ① Remove the spring and take out the steel ball and pressure plate.
- ② Remove the snap ring and extract the lever with cam.
- ③ If necessary remove the oil seal.



T594

4 Final gear

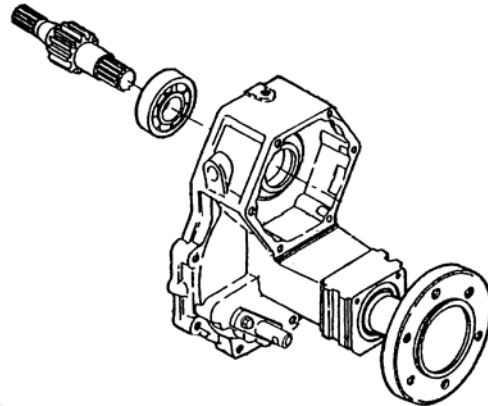
Remove the snap ring (Ø40) of the wheel shaft and take out the final gear from the shaft.



T595

5 Differential shaft

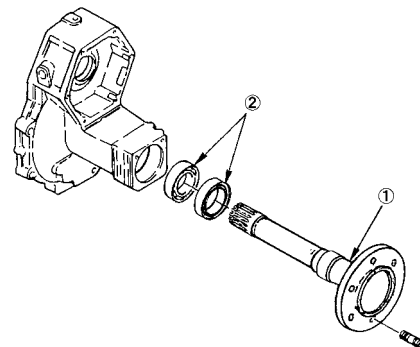
- ① Remove the differential shaft from the case.
- ② If necessary, remove the bearing (6306) and oil seal.



T596

6 Wheel shaft

- ① Drive out the wheel shaft outwards.
- ② If necessary, remove the bearing and oil seal.



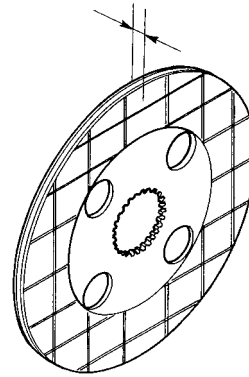
T597

Inspection and service

① Disk

Measure the lining thickness and replace if the measurement is below the service limit.

Standard dimension	Service limit
4.0 mm	3.7 mm

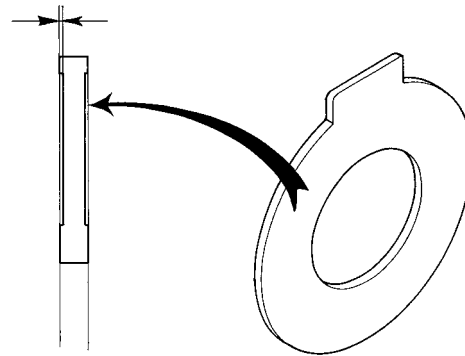


T598

② Stator

Replace the stator if the lining-contact surface is roughened or the difference of level height is more than 0.1 mm.

Level height difference of contact surface	
Service limit	0.1 mm



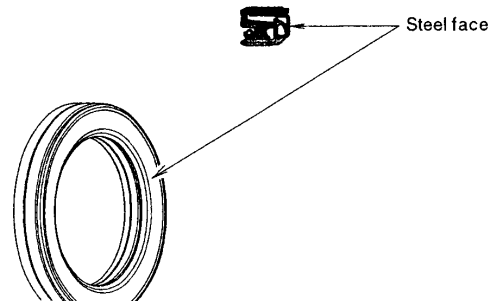
T599

③ Check the brake cover, steel ball, brake cam, and spring and replace defective ones.

④ Check each bearing, gear and shaft and replace if damage or wear is significant.

⑤ Replace oil seals if oil leakage is noticed.

NOTE: Install oil seals steel face to outwards.

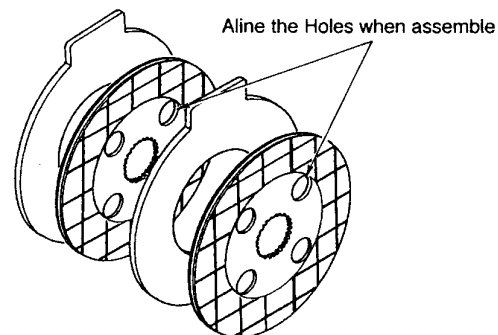


T600

Reassembly

Reassemble units in the reverse order taking care to the following points.

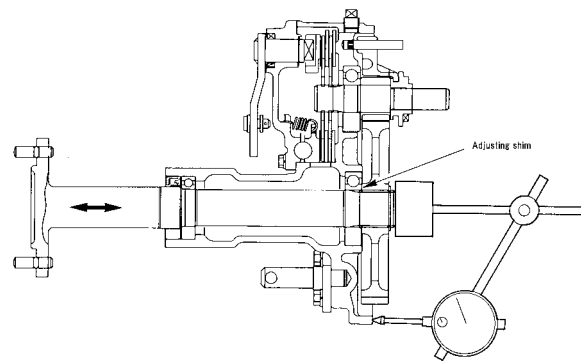
- Installation of disk
Align the holes of the disk as far as possible (for better oil lubrication).
- Coat the stator and disk with oil sufficiently.



T601

- Adjust the wheel shaft end play to less than 0.5 mm by shims.

Shim part number	
t = 0.2 mm	199280760
t = 0.5 mm	199280770

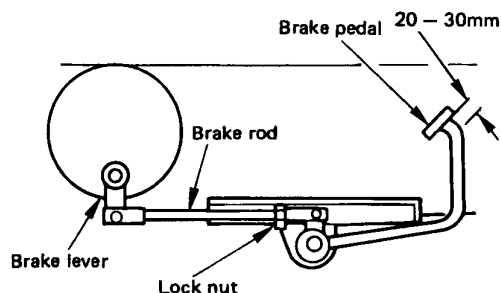


T602

3. BRAKE ADJUSTMENT

Confirm that the right and left pedals work sufficiently and adjust the play to the standard value by means of the right and left brake rods.

Brake pedal free-play	
Standard value (on tread)	Service limit
20 – 30 mm	40 mm



T603

4. REAR WHEEL

1) Specifications

Tire size	8 – 16	9.5 × 16	29 × 12.00 - 15
Rim size	5JA-16	W8 × 16	10LB × 15
Tire type	Nylon bias structure with tube		

2) Inspection of tire

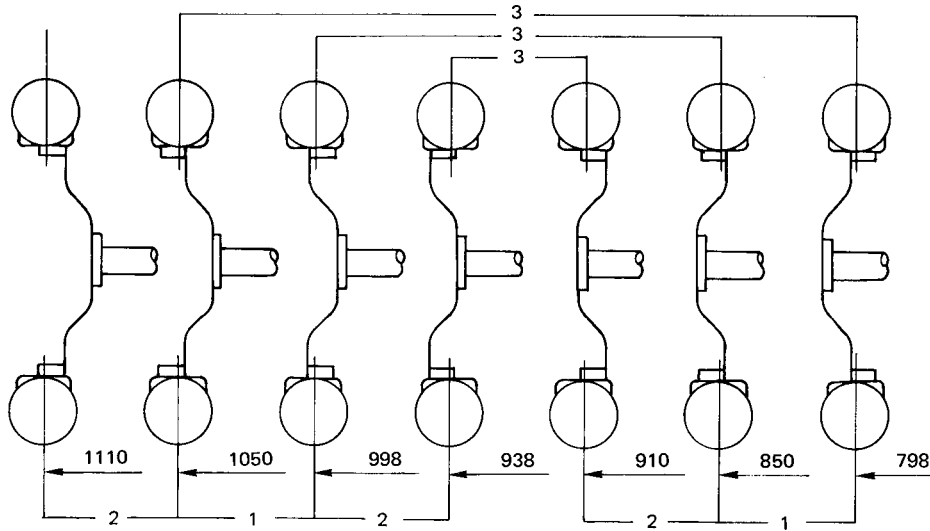
Tire size	8 – 16	9.5 × 16	29 × 12.00 - 15
Tire rug height (when new)	31	33	9
Tire rug height (service limit)	15	15	4
Axle-disk tightening torque	71 – 84 N·m (7.2 – 8.6 kgf·m)		
Rim-disk tightening torque (Option)	71 – 84 N·m (7.2 – 8.6 kgf·m)		
Rim run-out (mm)	Service limit 5		
Air pressure	See Operator's Manual		

3) Adjustment of wheel track (Option)

The wheel track can be adjusted in 7 stages by changing the rim positions and interchanging the tires.

NOTE: Bolts are apt to be loosened here. Tighten each bolt positively.

Unit: mm



1. Reposition rim on disc
2. Rim repositioned on opposite disc

3. Inter-changing rear wheel assemblies give these combinations

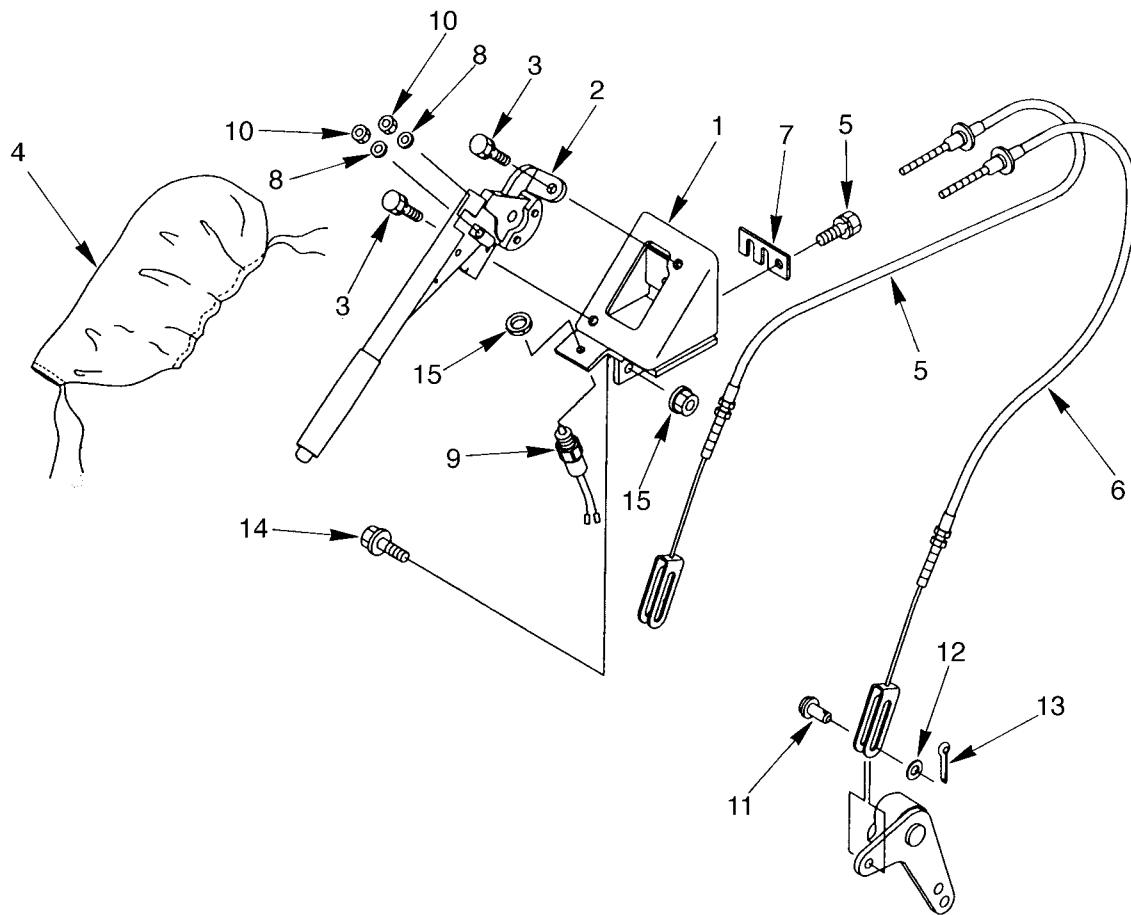
T604

5. TROUBLESHOOTING

Condition	Cause	Remedy
1) Insufficient return of the brake pedal	- Rusted brake cam - Rusted brake pedal	- Correct with sand paper and grease up. - Correct with sand paper and grease up.
2) Poor braking effect	- Insufficient adjustment of the brake pedal - Worn or burnt lining	- Adjust the play. - Replace the brake shoe.
3) One side braking	- Insufficient adjustment - Trouble in one brake system.	- Adjust the play of both right and left pedals to the same value. - Inspect and correct.
4) Noise in the brake system	- Water is mixture in the transmission oil. - Transmission oil is different.	- Replace the transmission oil. - Replace the transmission oil.

6. HAND BRAKE

1) Components



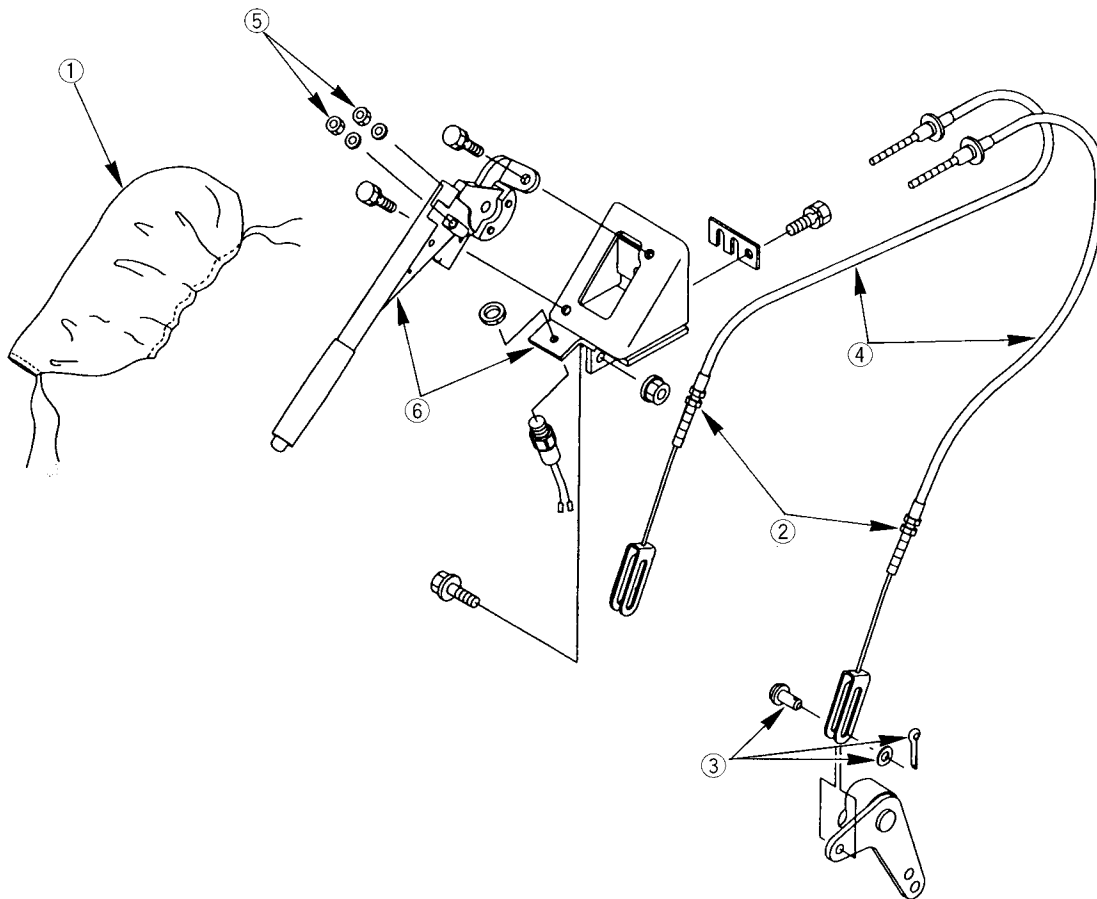
- | | |
|----------------|-----------------|
| 1. Bracket | 9. Brake Switch |
| 2. Hand brake | 10. Nut |
| 3. Bolt | 11. Pin |
| 4. Cover | 12. Washer |
| 5. Wire | 13. Split Pin |
| 6. Wire | 14. Bolt |
| 7. Wire Holder | 15. Nut |
| 8. Washer | |

T605

2) Disassembly, inspection and reassembly

Disassembly

- ① Remove the cover.
- ② Untighten the lock nut of each wire.
- ③ Remove the split pin and flat head pin.
- ④ Remove the wire ass'y, L.H., and R.H.
- ⑤ Remove the U nut and disconnect the wire ass'y from the hand brake.
- ⑥ If necessary, remove the brake lever, hand brake and bracket from the tractor.



T606

Inspection

- (1) Check the inner wire for corrosion, unwinding, or torsion. The wire ass'y cannot be repaired. Replace the ass'y if necessary. Confirm that the wire is lubricated with high grade grease.

Reassembly

Reassemble components in the reverse order to disassembly.

3) Adjustment

Adjustment procedure

NOTE:

① Be sure to adjust the hand brake ass'y after reassembly.

② After adjusting the play of the foot brake, adjust the hand brake.

① Confirm that the hand brake lever, 1, is at the lowermost position.

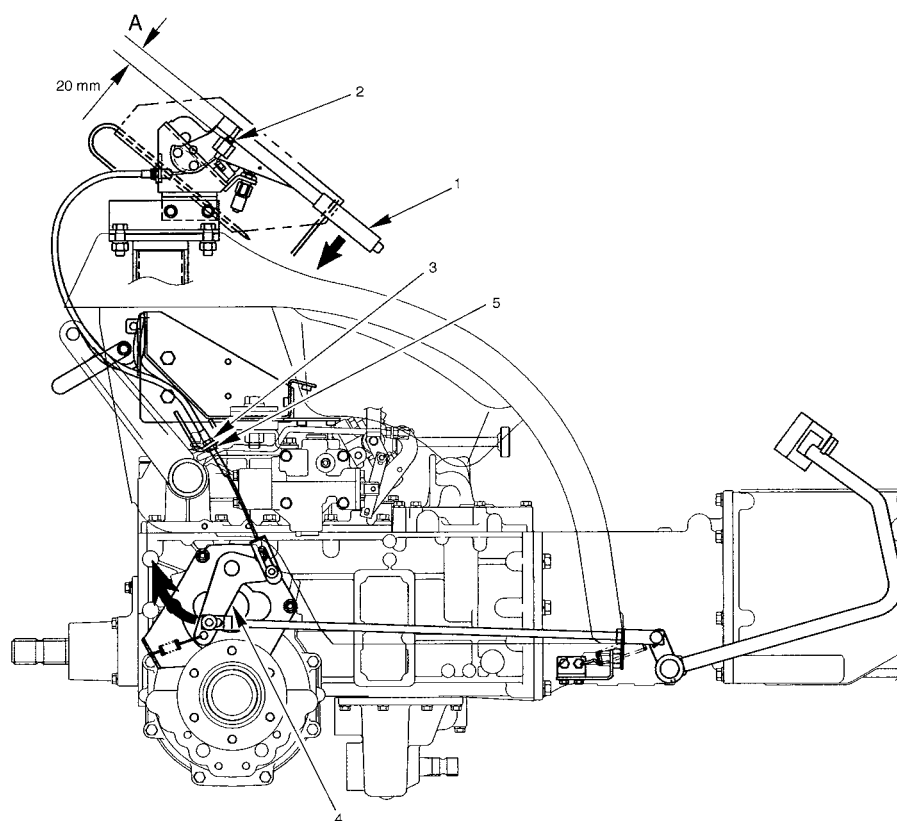
② Tighten the U-nuts, 2, as dimension A to 20 mm.

③ Tighten the adjusting nuts, 3, to the both wires are stretched slightly while push the each brake lever, 4, to arrow mark direction (brake does not work direction).

Tighten the both lock nuts, 5.

The tension of both wires should be equal.

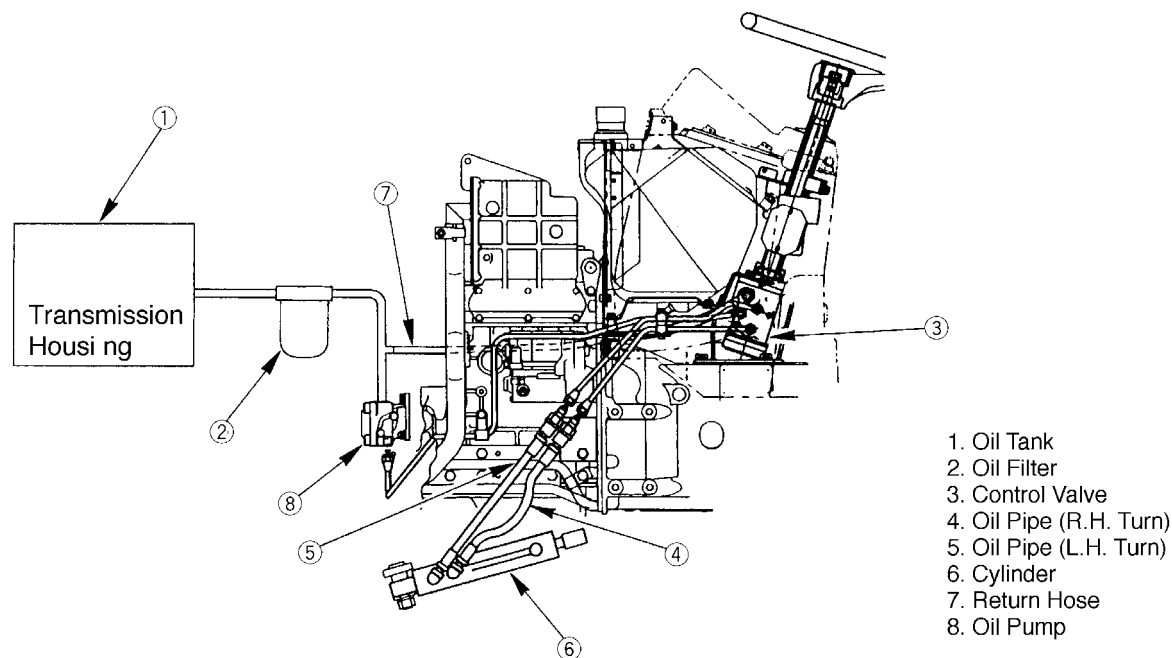
④ Adjust the wires play by U-nuts, 2, so that the right and left rear wheels are locked at the 1st or 2nd notch of the hand brake ratchet.



T607

3-6 Steering and Linkage

1. EXTERNAL VIEW



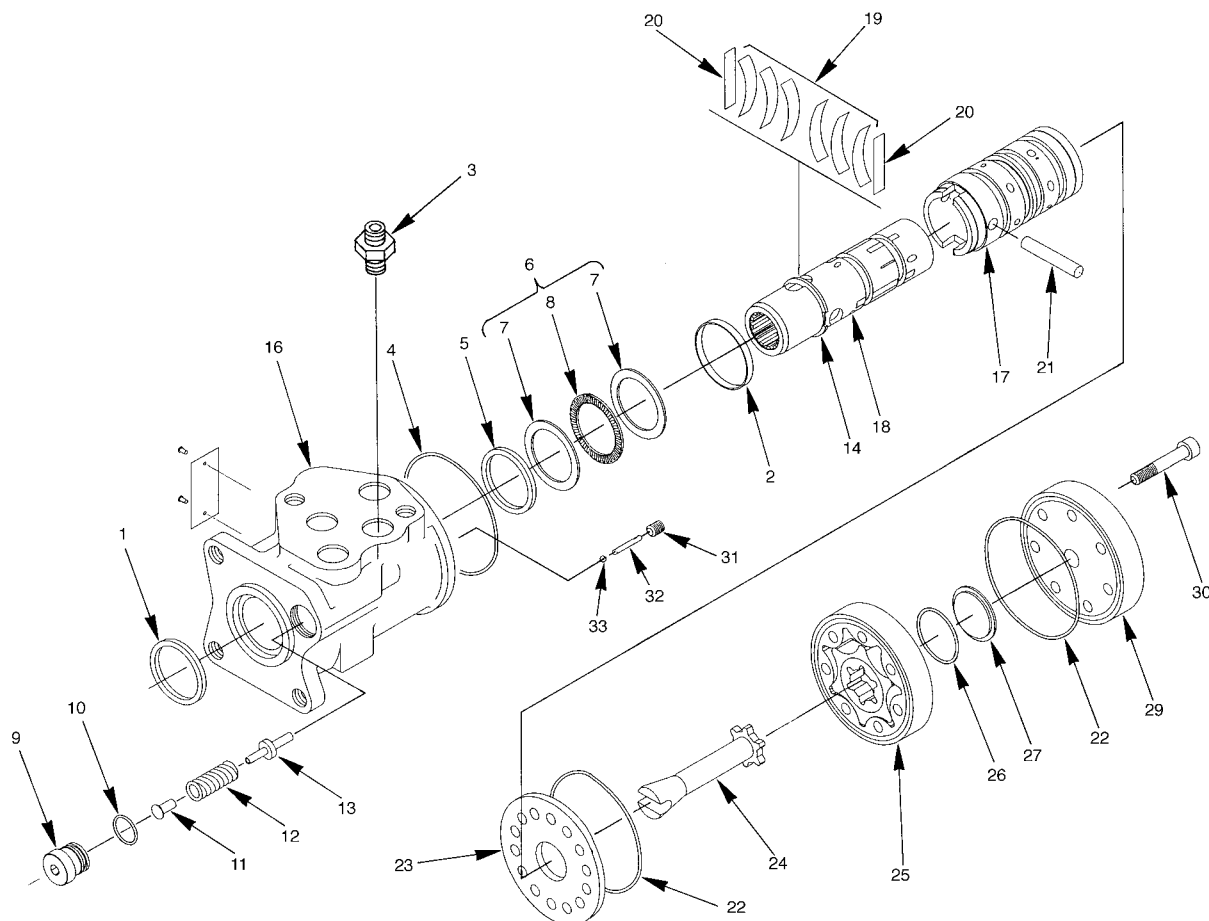
T608

2. SPECIFICATIONS

1. Oil pump	Discharge quantity (cc/rev)	6.0
	Rotating direction	Counterclockwise viewed from shaft side
2. Steering	Type	Full hydraulic type (non load reaction type)
3. Steering cylinder	Stroke (mm)	166
	Bore (ø)	35
4. Relief valve	Adjusted flow rate (ℓ/min)	8
	Adjusted pressure	5.9 – 6.6 MPa (60 – 67 kgf/cm ²) at 8ℓ/min
5. Oil	Oil quantity (ℓ)	16
	Oil type	SAE 80 ... 9 × 3 Manual Transmission ISO VG 46 ... HST Transmission

3. POWER STEERING CONTORL VALVE

1) Each parts list



T609

- | | |
|---------------------------|--------------------|
| 1. Dust seal | 19. Flat spring |
| 2. Spring retaining ring | 20. Pin |
| 3. P port check connector | 21. O-ring |
| 4. O-ring | 22. Spacer plate |
| 5. Oil seal | 23. Drive |
| 6. Needle bearing kit | 24. Gerotor |
| 7. Lace bearing | 25. O-ring |
| 8. Thrust needle | 26. O-ring |
| 9. Adjust plug | 27. Plate |
| 10. O-ring | 29. End cap |
| 11. Damper collar | 30. Screw |
| 12. Spring | 31. Retainer screw |
| 13. Poppet | 32. Retainer pin |
| 14. Retaining ring | 33. Ball |
| 15. Housing | |
| 16. Sleeve | |
| 17. Spool | |
| 18. Centering spring | |

Relief valve

Check valve

2) Structure and function of each part

1. Spool and sleeve

- ① The spool and sleeve are rotary valves to change the direction or combination of the oil passage. Three combinations are possible (neutral, right steering and left steering) by handle operation.
- ② The spool and sleeve are mechanically linked to the B and C section as shown in the figure below.
 - A: The spool and sleeve are linked by leaf spring.
When the handle is released or not moved in either side, the spool and sleeve are kept at the neutral position by the force of the leaf spring.
 - B: Spool and sleeve are linked by the pin.
The sleeve and drive are linked with the pin positively leaving no play.
The spool hole is oval to allow the spool to move laterally with respect to the pin (see the figure below), for the purpose of composing oil passage for the right and left turn by deviating the spool laterally to the sleeve.

2. Drive

Movement of the gear pump (Gerotor) is transmitted to the sleeve. When the engine or oil pump fails, power of the operator is transmitted to the internal gear of the gear pump through the spool and pin.

3. Gear pump (Gerotor)

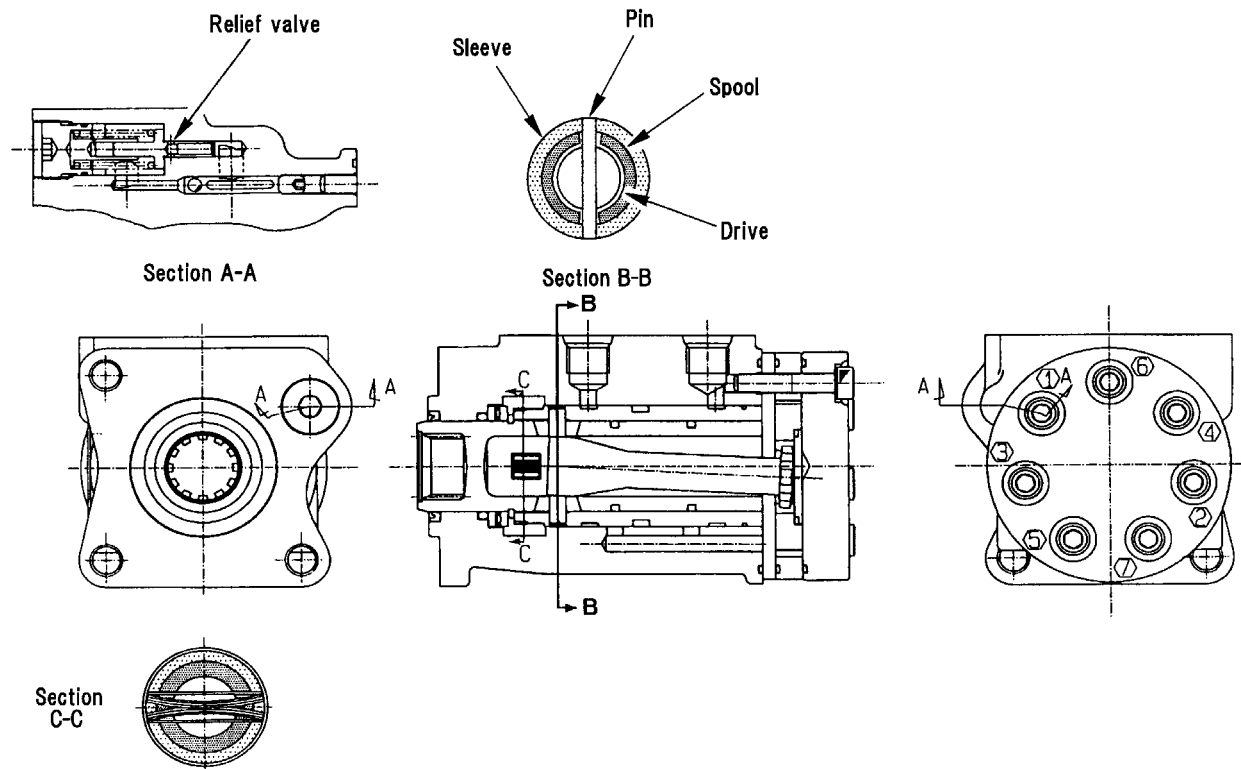
When engine or oil pump is subjected to trouble, the gear pump is driven by the operator and serves as an emergency auxiliary pump.

4. Check valve

When oil is fed under pressure from the oil pump, the check valve prevents flow of oil from IN to OUT and when the engine or oil pump fails, the valve is opened to allow the oil to be sucked from the oil tank to the IN side.

5. Relief valve

When the steering wheel is turned fully clockwise or counterclockwise, the relief valve protects the pump and hydraulic circuit.



T610

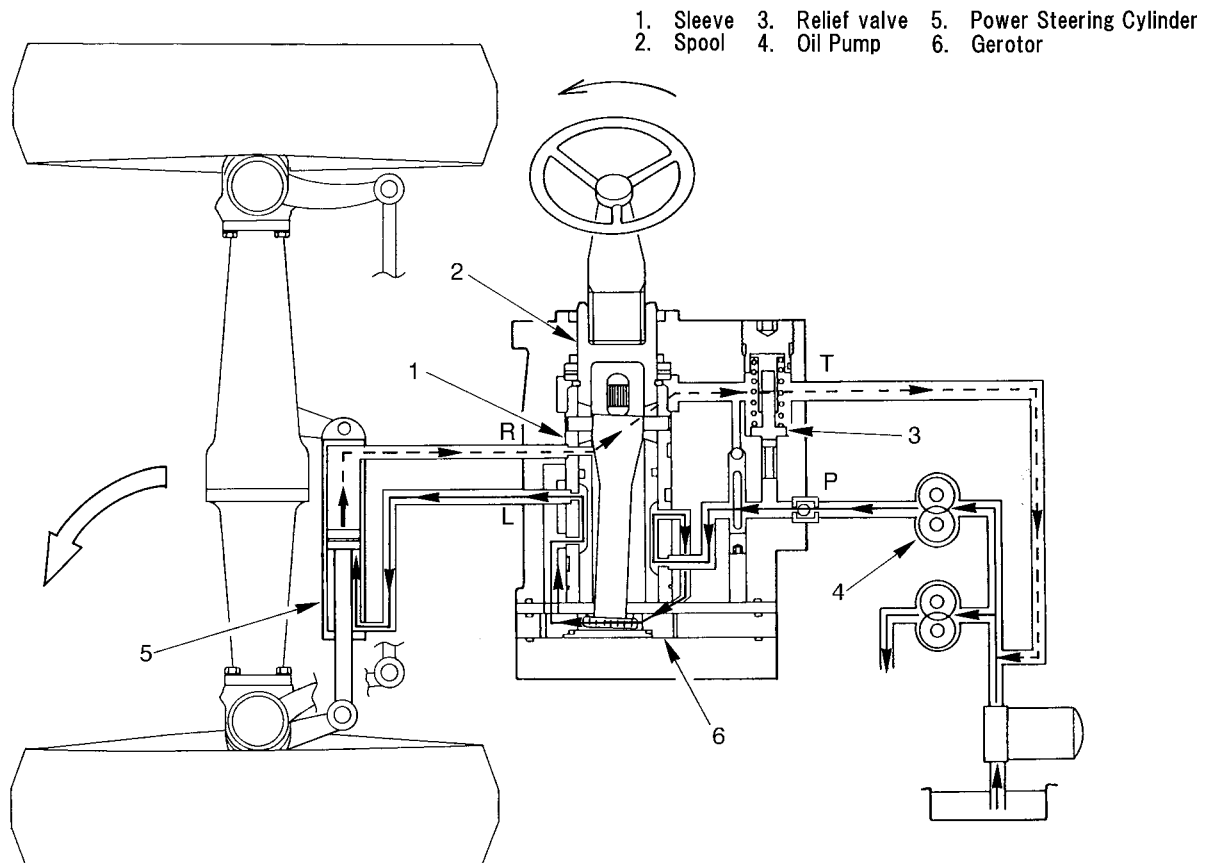
2. Left turn

When the steering wheel is turned counterclockwise from the neutral position, the spool groove is turned counterclockwise and deviated from the hole and groove of the sleeve.

At this condition, the oil passes through the spool groove and spool hole, and is supplied to gerotor.

The gerotor is rotated counterclockwise, the oil is discharged through the sleeve hole and spool groove, fed to the cylinder from the port L, and the wheels are turned to the left. The oil from the port R is returned to suction pipe through the holes and grooves of the sleeve and spool.

When the steering wheel is turned still more after the wheels are turned fully to the left, the relief valve is actuated and the oil is returned to the suction pipe. (Right turn operation is the same as in the left turn.)



T612

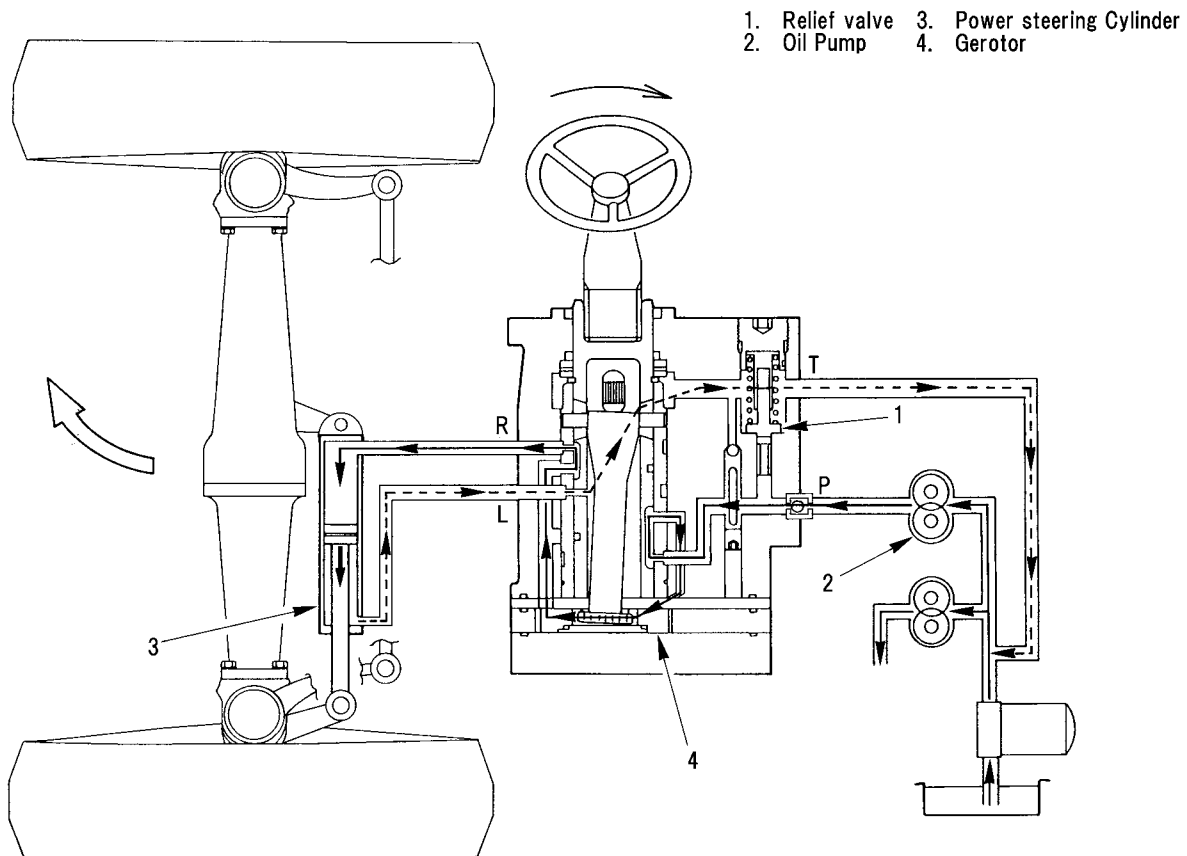
3. Right turn

When the steering wheel is turned clockwise from the neutral condition, the spool is deviated rightwards from the sleeve. The oil passes through the holes and grooves of the sleeve and spool and is supplied to gerotor.

The Gerotor is turned clockwise and oil is discharged through the holes and grooves of the sleeve and spool, and fed under pressure to the cylinder from the port R.

The oil from the port L passes through holes and grooves of the sleeve and spool and is returned to the suction pipe.

NOTE: Since the steering cylinder is fixed, the piston rod moves. The extension and contraction of the piston rod is transmitted to the tie rod to operate the wheels.

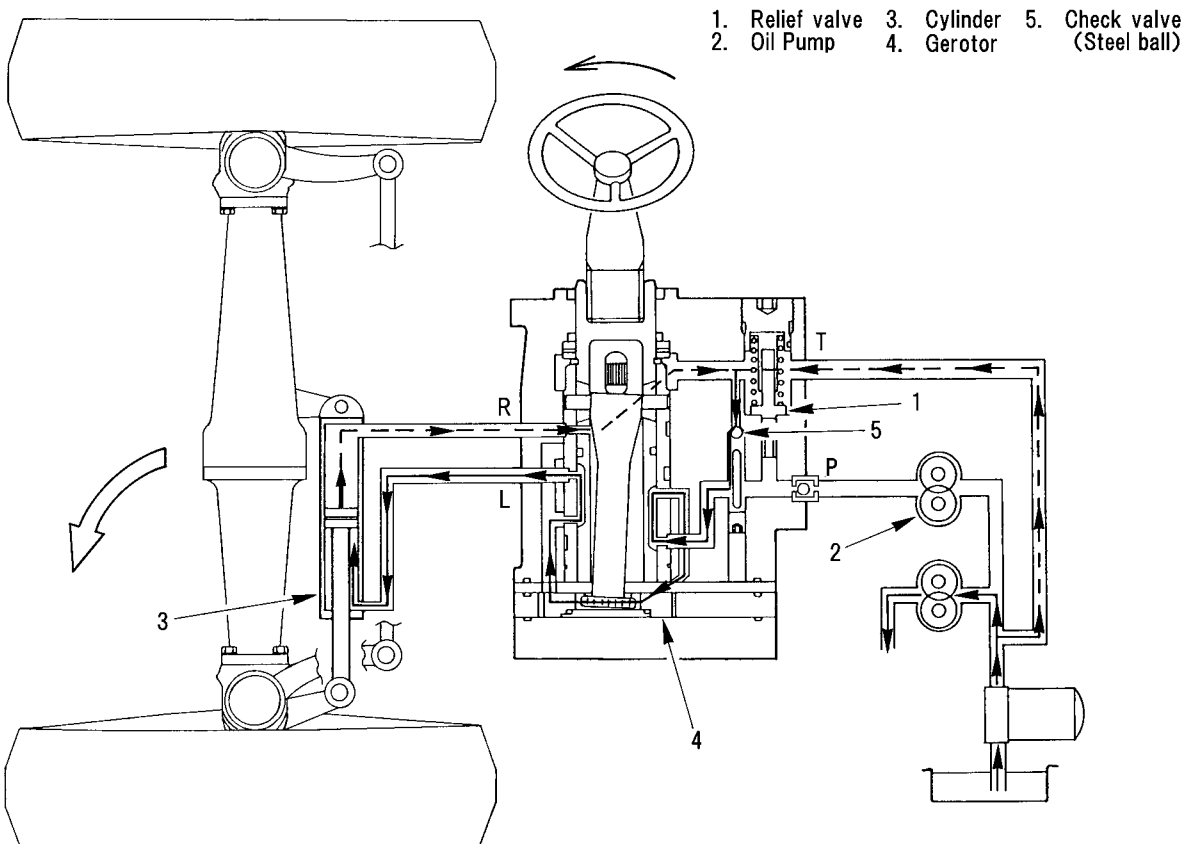


T613

4. At emergency (engine stop)

No oil is supplied from the oil pump at emergency. If the steering wheel is turned counterclockwise at this condition, the Gerotor is rotated by the force of the operator. Resultantly the passage inside becomes negative pressure, and the oil from the oil tank moves the check valve bottom and is supplied. The oil supplied flows the same passage as in the normal left turn.

The oil returned from the port R does not return to the tank but flows to the check valve. Therefore the flow of the oil pumped up from the tank stops at this time.



T614

4) Disassembly and Reassembly of control Valve

(1) Disassembly

Disassembly

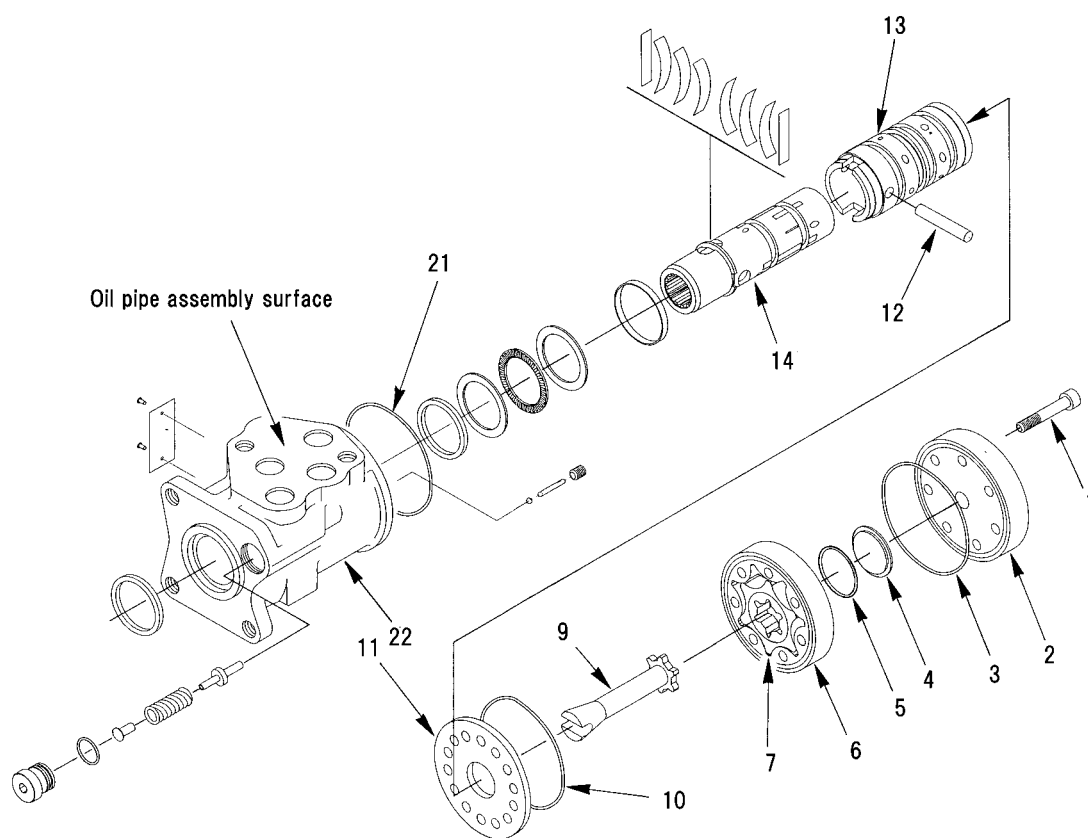
1. Place the end cap to a vice facing the gerotor upward, inserting a copper plate or the like.

NOTE: Do not tighten strongly since the internal clearance is small and apt to be deformed.

2. Remove the seven screws (1), end cap (2) and O-ring (3).
3. Remove the plate (4) and O-ring (5).
4. Remove the gerotor (6 and 7), take care do not fall down rotor (7).
5. Remove the O-ring (10) from the gerotor.

6. Pull out the drive (9).
7. Remove the spacer plate (11) and O-ring (21).
8. Remove the housing (22) from the vice and put it on the clean cloth to the oil pipe attaching surface to bottom ward.
9. Rotate the spool (14) and sleeve (13) until the pin (12) to horizontal position.
10. Push the spool (14) from the spline side, and pull out the spool and sleeve assembly.

NOTE: Take care not to bite in the housing by spool and sleeve assembly.



T615

11. Remove the retaining ring (15) and pin (12) from the spool and sleeve assembly.
12. Slide out the spool (14) a little from the sleeve (13) and remove the centering springs (16) and flat springs (17) from the spool.
13. Remove the sleeve (13) from the spool while rotate is slowly.

NOTE: Never remove the retaining ring (32) from the spool.

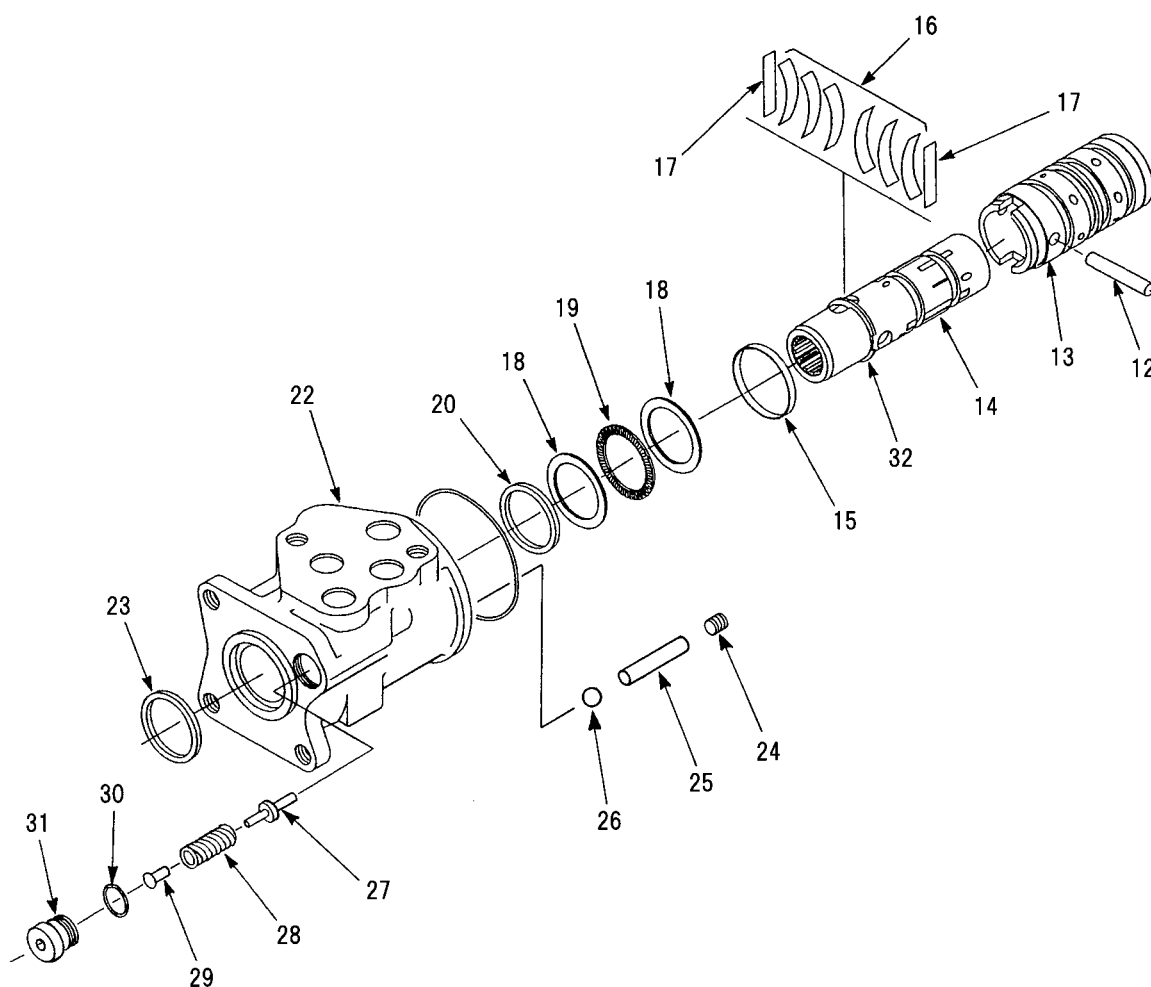
14. Remove the bearing laces (18), thrust needle bearing (19), oil seal (20) and dust seal (23) from the housing (22).

15. Remove the retainer screw (24), retainer pin (25) and steel ball (26) from the housing.
16. Measure the depth of the relief adjust plug (31) from the housing surface before remove it.

NOTE:

- Do not remove the relief valve from the housing unnecessary.
- If removed, need adjust the relief pressure after installed to the tractor.

17. Remove the relief adjust plug (31) and remove the O-ring (30) from the plug.
18. Remove the damper collar (29), spring (28) and poppet (27).



T616

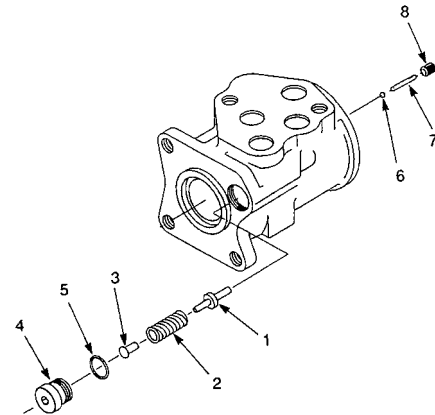
(2) ASSEMBLY

Reassembly

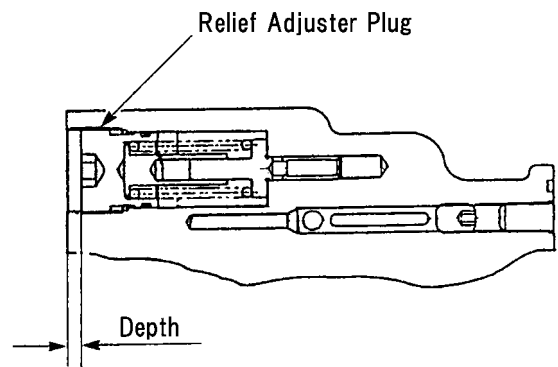
1. Inspect the spool and sleeve for evidence of sticking, scuff marks, and any other damage before reassembly. If found defective, replace the control valve assembly.
2. Wash the material parts by clean solvent and air dry. Never use the cloth or paper for prevent the trouble by waste threads.
3. O-ring and seals are installed with new one and apply the thin grease to O-ring when reassembly.
4. Install the poppet (1), spring (2), damper collar (3) and relief adjuster plug (4) in the housing.
5. Adjust the relief adjuster plug's depth before disassembly measured dimension. At this time will get same relief pressure before disassemble ordinary.

NOTE: The relief adjuster plug is changed 1.47 MPa (15 kgf/cm²) by one turn.

6. Install the ball (6), retainer pin (7) and retainer screw (8) and tighten to 12.8 N·m (1.3 kgf·m).

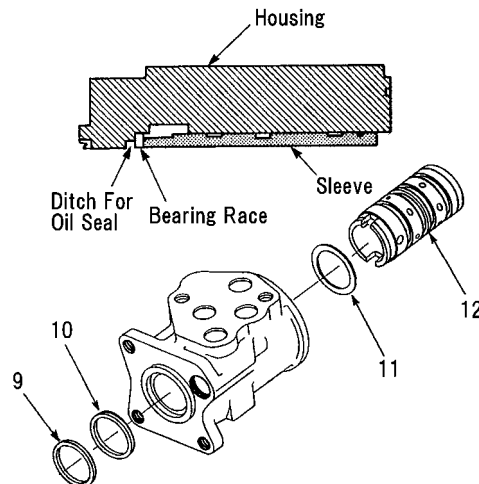


T617



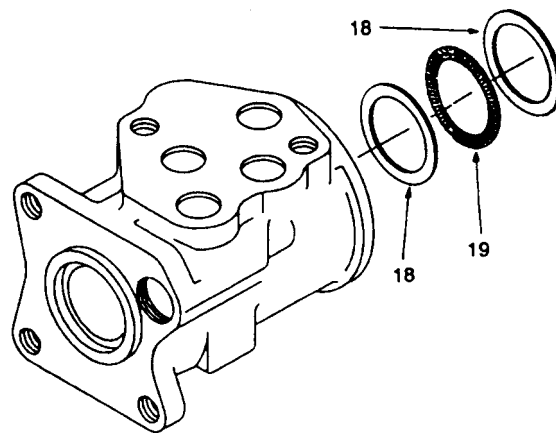
T618

7. Install the dust seal (9) in the housing.
8. Install the oil seal (10) as follows:
 - ① Makeshift install one bearing race (11) and sleeve (12) in the housing and concentric and keep them.
 - ② Install the oil seal (10) to the ditch between the housing and bearing race.
 - ③ Remove the sleeve and bearing race from the housing.



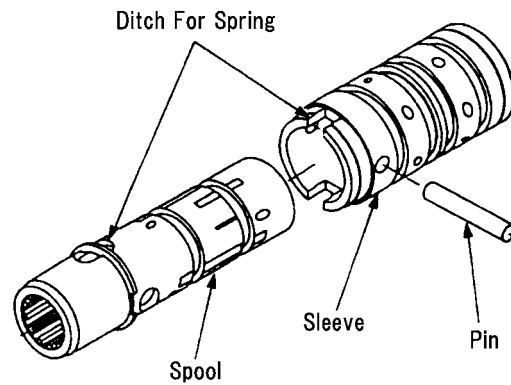
T619

9. Install the bearing race (18), needle bearing (19) and bearing race (18) in the housing.

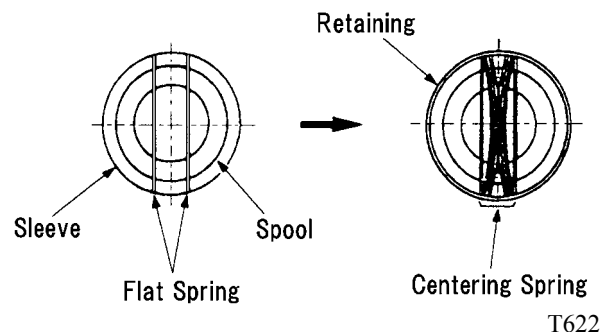


T620

10. Insert the spool in the sleeve and align the spring's ditch.
11. Install two flat spring (17) in the spring's ditch end.
12. Install the centering springs between flat springs at the one time.
13. Install the retaining ring (15) on the centering springs.
14. Apply the grease between the retaining ring and sleeve for prevent fall down.
15. Install the pin in the sleeve.



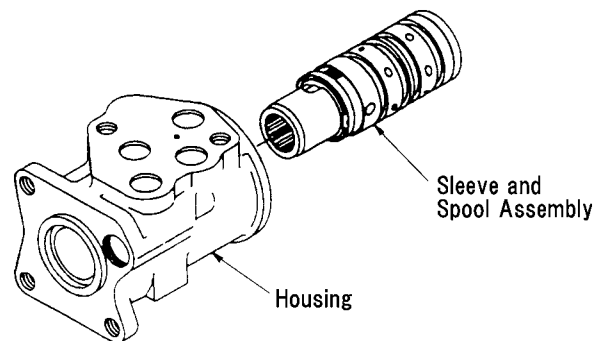
T621



T622

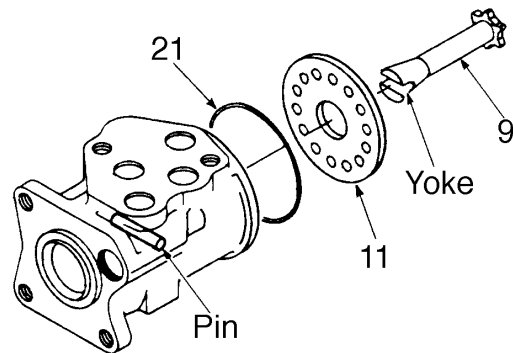
16. Install the sleeve and spool assembly in the housing and as follows:

- ① Keep the housing to vertical when install the spool and sleeve assembly.
- ② Keep the sleeve center parallel to housing center when installing. If not parallel them will be bite in the housing.
- ③ Keep the pin to horizontally and insert them while a little bit rotate clockwise and counterclockwise.
- ④ Inspect the sleeve and spool assembly is rotate in the housing at align the housing end with sleeve and spool end.



T623

17. Install the O-ring (21) on the housing.
18. Put the spacer plate (11) on the housing and align the bolt holes and oil holes.
19. Insert the drive (9) in the housing, and install the yoke on the drive to the pin.

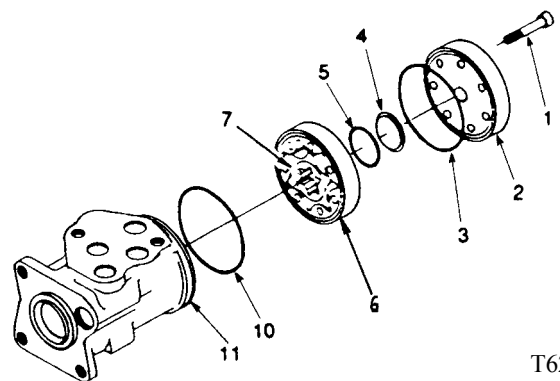


T624

20. Install the O-ring (10) on the gerotor (6), and install them on the spacer plate (11) while matching the spline of the drive and gerotor's star, and align for bolt holes.

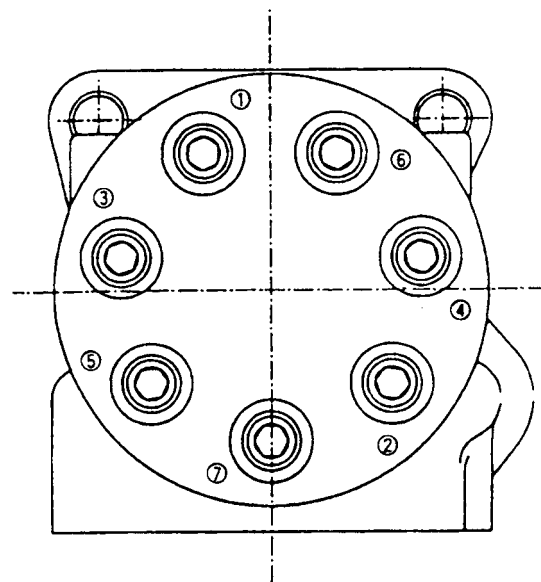
NOTE: O-ring installed surface against the housing.

21. Install the O-ring (5) on the plate (4) and install them to the gerotor.
22. Install the O-ring (3) on the end cap (2), and install them on the gerotor while aligning the bolt holes.



T625

23. Apply the oil to the thread of all screws, and install the screws and tighten to 4.9 N·m (0.5 kgf·m) at first, and tightening order (1) ~ (7) as illustrations.
24. Retighten screws to 9.8 N·m (1.0 kgf·m) as same tightening order.
25. Install the control valve assembly to the tractor and inspect the spool is rotate.



Screw Tightening Order

T626

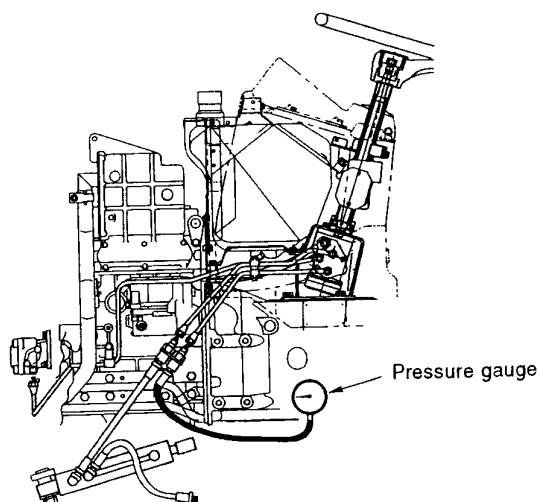
(3) Adjustment

1. Inspection and adjustment of relief valve

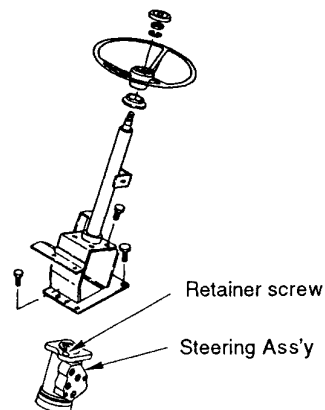
- ① After installed power steering parts to tractor, inspect the relief pressure as follows.
- ② Disconnect the oil hose from the adapter or power steering cylinder.
- ③ Connect a 15 MPa (150 kgf/cm²) oil pressure gauge to end of the pressure line from the steering control valve.
- ④ Start the engine and warm up the transmission oil more than 50°C.
- ⑤ Keep the engine to high idle speed and slowly turn the steering wheel, and observe the gauge immediately.

Relief valve adjusting pressure
5.9 – 6.6 MPa (60 – 67 kgf/cm ²)

NOTE: The relief adjuster plug is changed 1.47 MPa (15 kgf/cm²) by one turn.

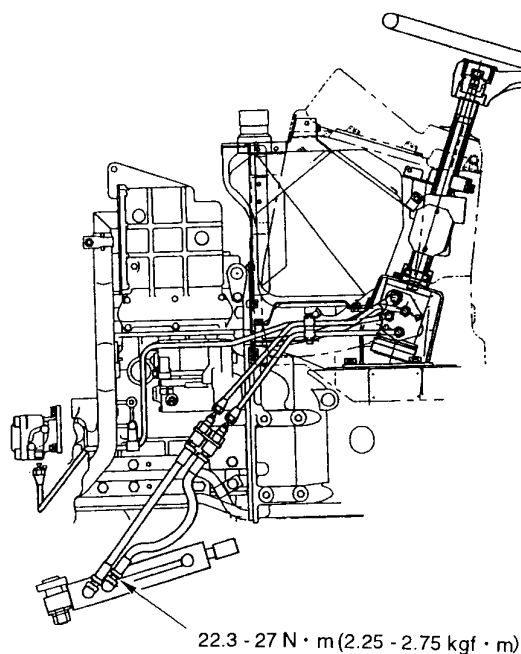


T627



T628

- ⑥ Install the oil hose to the adapter and tighten to 22.3 ~ 27 N·m (2.25 ~ 2.75 kgf·m).
- ⑦ Remove the air in the steering piping by turn the steering wheel counterclockwise and clockwise several times while raise the front wheel.



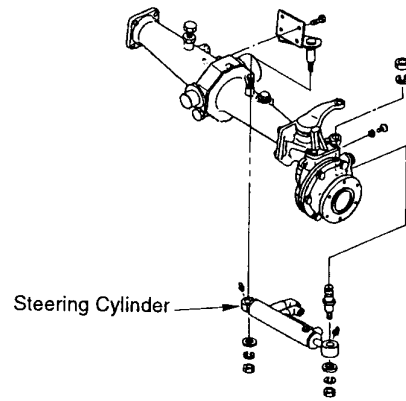
T629

4. POWER STEERING CYLINDER

1) Disassembly, inspection and reassembly

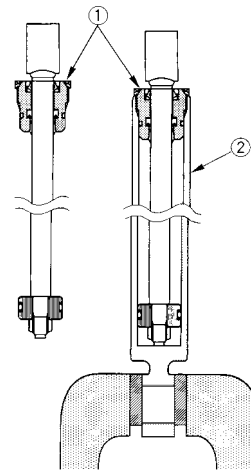
Disassembly

1. Disconnect the oil hoses from the steering cylinder.
2. Remove the steering cylinder from axle housing.



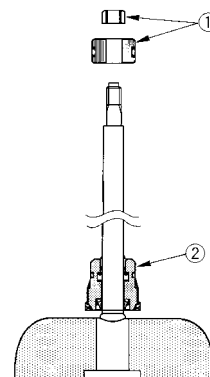
T630

3. Place the cylinder barrel end in a vise and unscrew the head (1) from the cylinder barrel (2).
4. Remove the cylinder rod, head and piston from the barrel.



T631

5. Place the cylinder rod end in a vise, and remove the nut and piston (1) and head (2) from the rod.

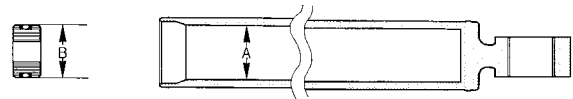


T632

Inspection and adjustment

1. Cylinder tube and piston

- ① Replace if the cylinder inside is worn out or damaged.
- ② Measure the clearance between the cylinder bore and piston and replace if the service limit is exceeded.



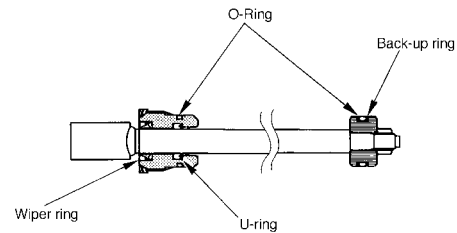
T633

Clearance (A – B in right figure) mm
Service limit
0.7

2. Seal components

Check components of the piston and cylinder head and replace if worn out or damaged.

NOTE: Never reuse each seal components if removed.

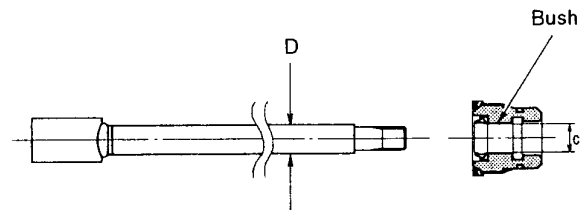


T634

3. Cylinder head and piston rod

Measure the clearance between the bush of the cylinder head and piston rod. Replace the bush or piston rod if the service limit is exceeded.

Clearance (C – D in the right figure) mm
Service limit
0.3

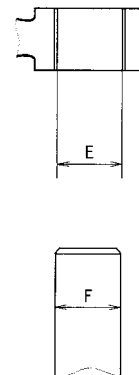


T635

NOTE: Use the press with jig when remove the bush.

4. Piston rod, pin (arm), cylinder tube, pin (differential case) Measure the clearance between each bush and pin and replace the bush or pin if the service limit is exceeded.

Clearance (E – F in right figure) mm
Service limit
0.5



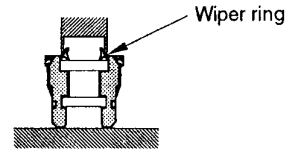
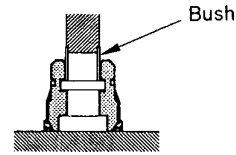
T636

Assembly

Reassemble units in the reverse order to disassembly taking care to the following points.

1. Cylinder head and piston

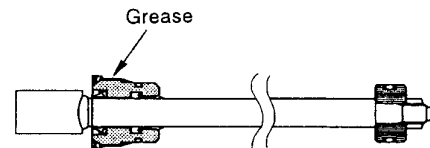
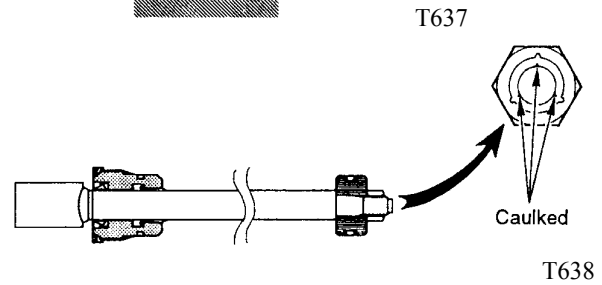
- ① When replacing O-ring or seals, check grooves for dust, damage, etc. and coat new ones with grease before installing.
Use jigs to install wiper rings and bushes.



- ② When installing the cylinder head and piston to the piston rod, take care not to damage seal components.

- ③ Tighten the nut with specified torque, then caulk the rod end at 3 points to lock as shown in the right figure.

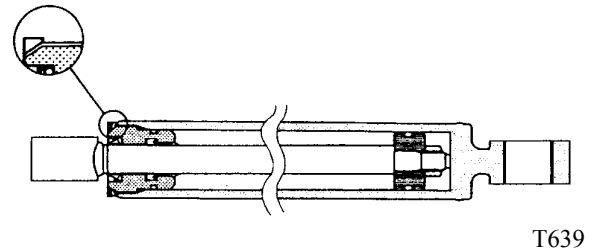
Tightening torque	35.3 N·m (3.6 kgf·m)
-------------------	---------------------------------------



2. Cylinder head and cylinder tube

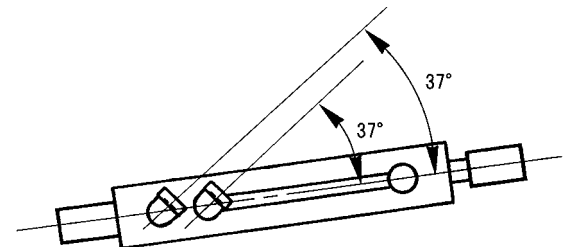
- ① Insert the assembly of the cylinder head, piston and piston rod, which was assembled in the previous paragraph, to the cylinder tube.
At this time, coat the cylinder head thread with grease and tighten with specified torque.

Tightening torque	127.4 N·m (13 kgf·m)
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- ② After tightening the cylinder head, bend the end of the cylinder tube.

- ③ If remove adapter form the cylinder, install the adapter on the 37 degrees from cylinder center.



T640

5. Steering piping

Disassembling, inspection and assembling

- ① Replace the oil hose (9 and 10 in the figure below) if cracks, oil leakage, or other damages are noticed. When replacing, wind new one with seal tape and tighten with specified torque.

PT1/4 tightening torque	22.3 - 27 N·m (2.25 - 2.75 kgf·m)
-------------------------	--------------------------------------

NOTE:

1. When winding seal tape on the pipe, be careful not to allow the tap to flow into the hydraulic piping.

- ② Tighten the adaptor (5 and 6 in the figure below) with specified torque.

PF3/8 tightening torque	58.8 - 78.4 N·m (6 - 8 kgf·m)
-------------------------	----------------------------------

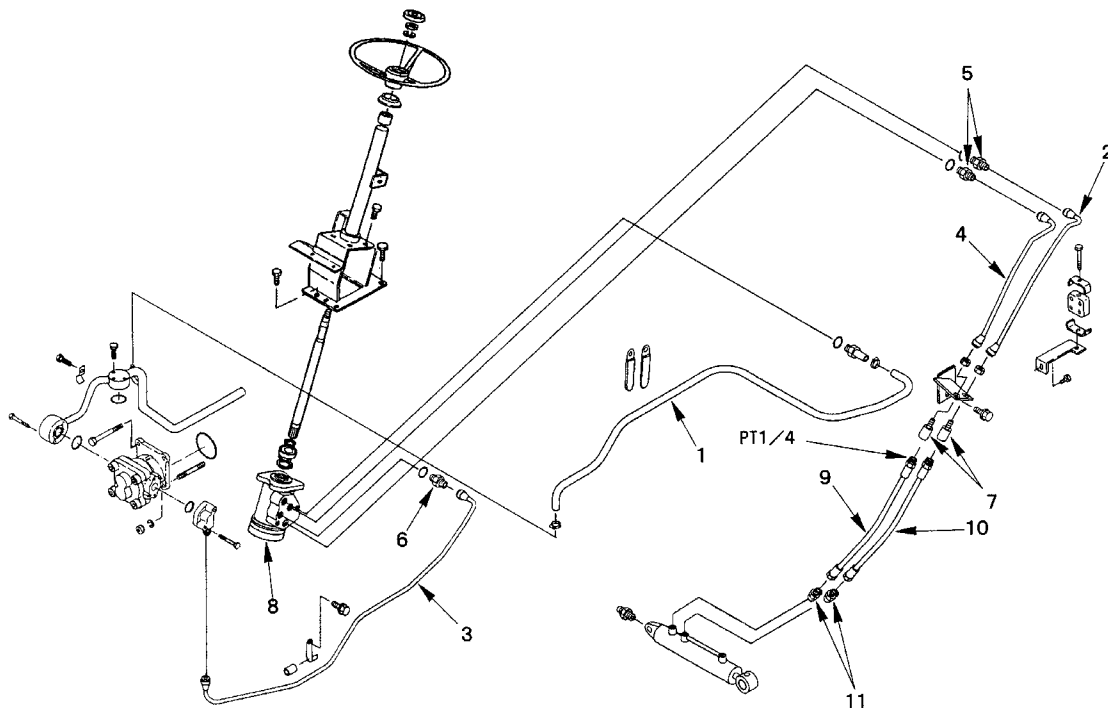
- ③ Tighten the oil pipe (2,3 and 4 in the figure below) with the specified torque.

M14 tightening torque	29.4 - 39.2 N·m (3 - 4 kgf·m)
-----------------------	----------------------------------

- ④ Tighten the adaptor (11 in the figure below) with seal tape and specified torque.

NOTE: Be careful to keep oil hoses and oil pipes off other part. Fix clamps securely.

PT1/4 tightening torque	35.3 N·m (3.6 kgf·m)
-------------------------	-------------------------



- | | |
|---------------------|---------------------|
| 1. Oil hose: T | 7. Adaptor (2 pcs.) |
| 2. Oil piping: L | 8. Steering case |
| 3. Oil piping: P | 9. Oil hose: R |
| 4. Oil piping: R | 10. Oil hose: L |
| 5. adaptor (2 pcs.) | 11. Adaptor |
| 6. Check connector | |

T641

6. Steering pump

Inspection and adjustment

- ① If the oil pump is defective, replace the ass'y.
- ② After completion of service, start the engine, turn the steering wheel in both directions at idling speed (several times) to discharge the air, stop the engine and check the hydraulic oil in the oil tank (transmission).

NOTE: Turn the steering wheel fully at this time not to allow the relief valve to work. It is recommendable to lift the front wheels.

7. Troubleshooting (steering control unit)

Condition	Cause	Remedy
Steering wheel too heavy.	- Steering control unit - Misalignment without column - Seizure of spool/sleeve ass'y due to dust entry. - Excessive tightening torque of 7 end cap bolts (at the time of disassembly and reassembly). - Pump - Does not work. - Wear, failure - Improper rating - Relief valve - Failure (improper operation) - Too low set pressure	Correct (if the steering wheel becomes lighter by untightening the bolt tightening the steering column control unit, the cause is misalignment with the column.) Repalce. Tighten evenly with the specified torque. Repair. Replace. Reselect pressure and flow rate. Replace. Reset.
Steering wheel turns freely.	- Steering control unit. - Seizure of spool or sleeve due to dust entry. - Misalignment with column.	Replace. Correct.
Cylinder does not follow up sufficiently or at all the rotations of the steering handle.	- Steering control unit. - Air mixed at the time of installation, replacement (reassembly), or since unused for a long time into Gerotor. - Cylinder - Air mixed - Broken piston seal	Discharge the air.. Discharge the air. Replace.
Steering wheel turns reversely (handle kick).	- Steering control unit - Improper valve timing setting (at the time of disassembly and reassembly). - Tubing - Improper tubing to 4 ports.	Correct. Correct.
Oil leakage 1. Shaft (spool, periphery of inner spline) 2. Joint (Between housing, spacer plate, generator, and end cap)	Wear of oil seal - Contaminated hydraulic oil. Damaged O-ring. - Caught somewhere at the time of disassembly or reassembly.	Change the hydraulic oil. Repalce.

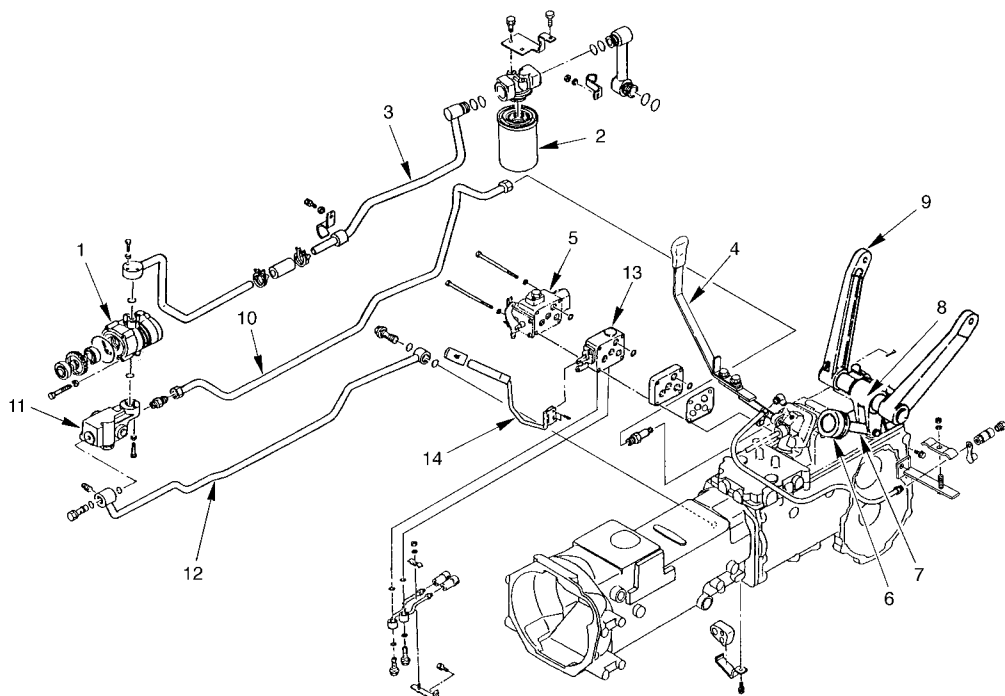
Condition	Cause	Remedy
Oil pressure is too low.	(1) Defective power steering oil pump 1. Worn or damaged internal parts. (2) Defective power steering control valve. 1. Worn, seizure or damaged internal parts. (3) damaged at the sealing. (4) Damaged at the piping and oil leaking. (5) Defective relief valve. 1. Misadjust relief valve. 2. Defected or damaged relief valve spring. 3. Damaged relief valve poppet or valve seat. (6) Defective piston seal of cylinder	(1) Replace oil pump (2) Repair or replace control valve (3) Replace seal (4) Tighten or replace piping. (5)-1 Readjust the relief valve (5)-2 Replace control valve assembly (5)-3 Replace control valve assembly (6) Replace the piston seal or cylinder assembly
Steering wheel too heavy	(1) Rack of transmission oil (2) Mixture or sucked air in the oil (3) Too low air pressure of front tire. (4) Too low oil pressure (5) Worn, seizure or damaged internal parts of control valve.	(1) Fill the oil. (2) Discharge air or tighten the piping. (3) Charge air to the tire. (4) Refer to above "Oil pressure is too low". (5) Repair or replace control valve.
Hard to return steering wheel	(1) Worn, seizure or damaged internal parts of control valve.	(1) Repair or replace control valve.
Abnormal sound at the power steering oil circuit.	(1) Lack of oil quantity. (2) Air mixture or suck the air in the piping. (3) Gear sound by suction resistance. 1. Clogged oil filter. 2. Dented the oil pipe. (4) Oil temperature is too low.	(1) Fill the oil. (2) Discharge air or tighten the piping. (3)-1 Replace oil filter. (3)-2 Replace oil pipe (4) Warm up the transmission oil.
Cylinder does not follow up or free rotate steering wheel.	(1) Defective piston seal of cylinder. (2) Air is in the cylinder.	(1) Replace the piston seal or cylinder assembly. (2) Discharge air in the cylinder.

3-7 Hydraulic System

1. SPECIFICATIONS

Oil pump	Type		Gear pump
	Discharge	ST318	15.3 ℓ/min (at 2600 rpm)
		ST321-ST324	18.4 ℓ/min (at 2600 rpm)
	Rotating direction		Clockwise when viewed from shaft side
Control valve	Relief valve working pressure		12.7 MPa (130 kgf/cm ²)
Hydraulic cylinder	Type	Single acting	
	Bore	Ø65	
Max. lift (at the lower link end)			6.57kN (670kgf)
Hydraulic oil	Manual transmission model		SAE 80
	HST Model		ISO VG 46

2. NAME OF COMPONENTS (HYDRAULIC CIRCUIT)



T642

- | | | |
|-------------------------|----------------------------------|----------------------------|
| 1. Hydraulic pump | 7. Piston rod | 13. Remote control valve |
| 2. Inlet filter | 8. Hydraulic arm | 14. Control lever (Remote) |
| 3. Suction pipe | 9. Lift arm | |
| 4. Control lever (Main) | 10. High pressure pipe | |
| 5. Control valve | 11. System relief-diverter valve | |
| 6. Piston | 12. Return pipe | |

Model 9 × 3 shown

3. DISASSEMBLY, INSPECTION AND REASSEMBLY OF CYLINDER CASE ASS'Y

1) Disassembly

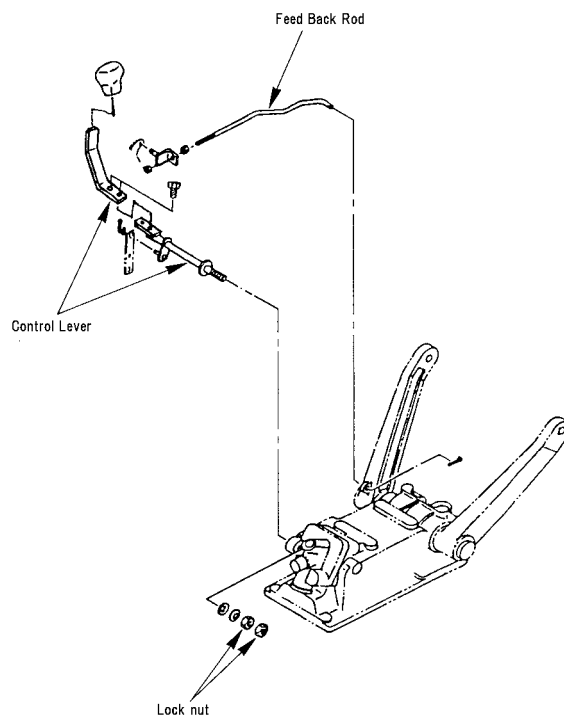
Disassembling procedure

1 Rod (for feedback)

Remove the rod at the lift arm. If necessary, remove it at the control lever side and take out the rod.

2 Control lever

Remove the lock nut and take out control lever.



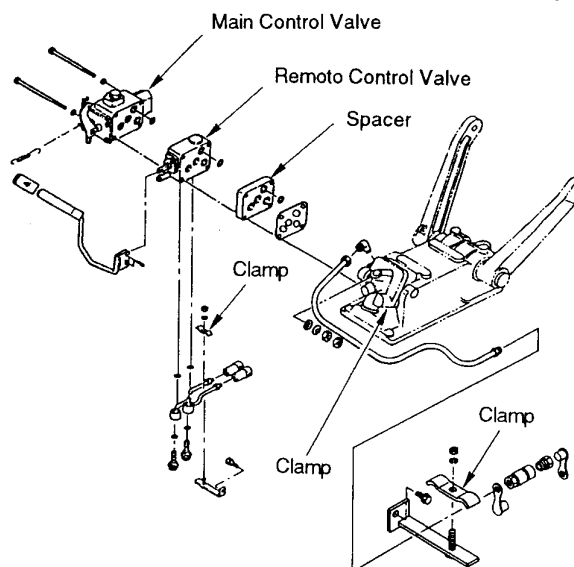
T644

3 Control valve ass'y (Main Control valve) (Remote control valve)

① Remove the clamp for the remote control oil pipes.

NOTE: Be careful not to miss the O-ring on the installing surface.

② Remove the main control valve and remote control valve and spacer.



T645

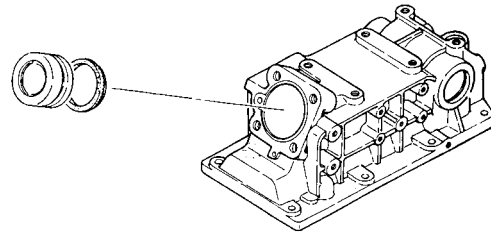
4 Cylinder head

① Remove the clamp for the oil pipe.

② Remove the cylinder head.

5 Piston

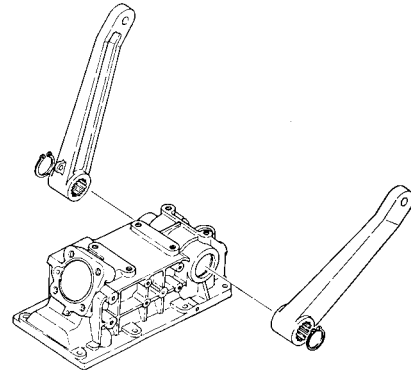
Drive out the piston using handle of as hammer, etc. to the head side.



T647

6 Lift arm

Remove the snap ring at both ends and extract the lift arm.

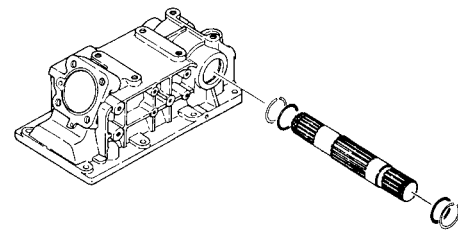


T648

7 Hydraulic arm shaft Hydraulic arm

Extract the hydraulic arm shaft leftwards and take out the hydraulic arm.

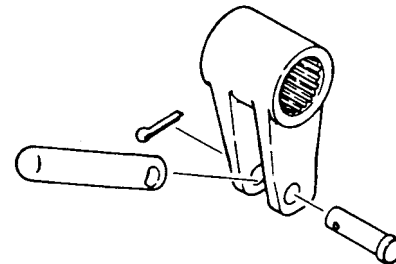
NOTE: Be careful not to miss the O-rings and springs.



T649

8 Piston rod

Remove the piston rod from the hydraulic arm.

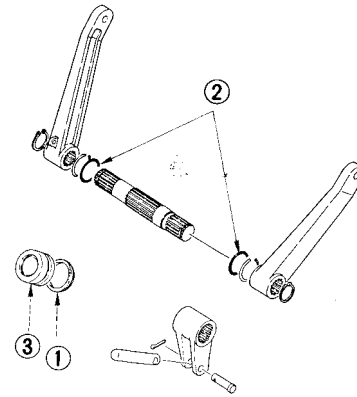


T650

2) Inspection

Inspection and correction

- ① Piston O-ring and backup ring
Replace if worn out or damaged.
- ② O-ring
Replace if damaged.
- ③ Piston and cylinder
Replace if worn out, scratched or damaged otherwise.



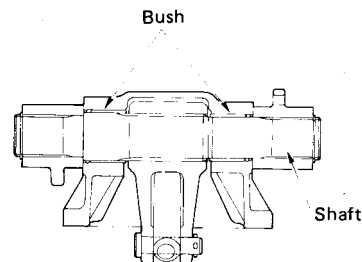
T651

- ④ Cylinder case bush
Measure the clearance between the shaft and bush and replace if the service limit is exceeded.

Clearance between shaft and bush (mm)	
Assembling standard value	Service limit
0.02 – 0.15	0.3

NOTE: When replacing the bush, drive it is so that an O-ring and spring can be installed.

Driving in depth from cylinder case end surface	Left side 6.0 mm
	Right side 6.0 mm



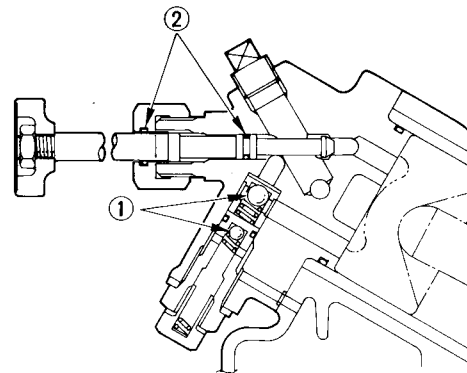
T652

1. Cylinder head

- ① When oil in the hydraulic cylinder leaks, check the steel ball and guide for wear and replace if defective.

NOTE: Replace the control valve ass'y (safety valve) as an ass'y.

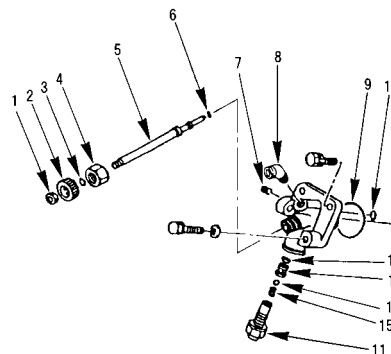
Tightening torque	49 – 58.8 N·m (5.0 – 6.0 kgf·m)
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T653

- ② Replace the O-ring of the implement lowering speed adjust valve if worn out or cut.

- | | |
|-----------------|------------------|
| 1. Nut | 9. O-ring (G60) |
| 2. Grip | 10. O-ring (P12) |
| 3. O-ring (P12) | 11. Valve ass'y |
| 4. Guide | 12. Gasket |
| 5. Valve | 13. Guide |
| 6. O-ring (P7) | 14. Steel Ball |
| 7. Plug | 15. Spring |
| 8. Plug | |



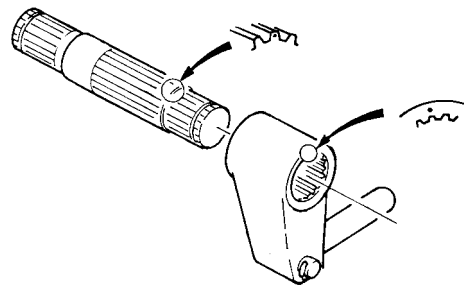
T654

3) Reassembly

Reassembly

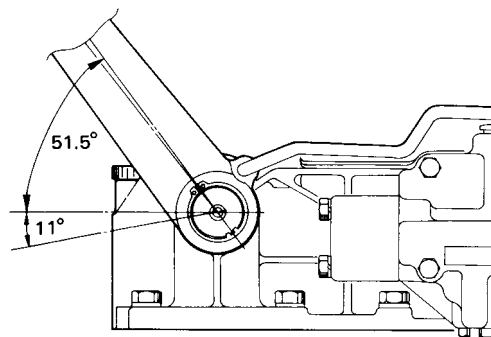
Reassemble units in the reverse order to disassembly, taking care to the following points.

- (1) Align the match marks on the hydraulic arm and hydraulic arm shaft when installing.



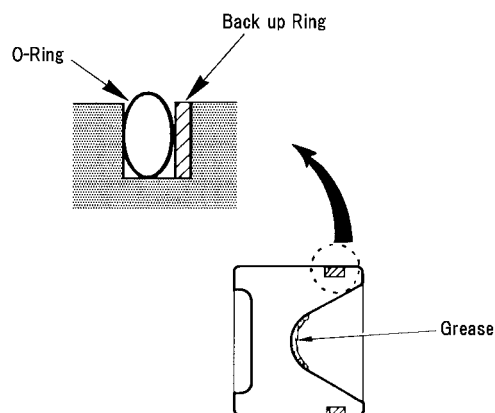
T655

- (2) Install the lift arm at the angles of elevation and depression as shown in the right figure.



T656

- (3) Coat an O-ring with sufficient oil and install. (Do not use grease.)
- (4) Install an O-ring and backup ring taking care to the installing position.
- (5) Coat at the piston – piston rod contact areas with grease slightly and insert the piston from the cylinder head side.

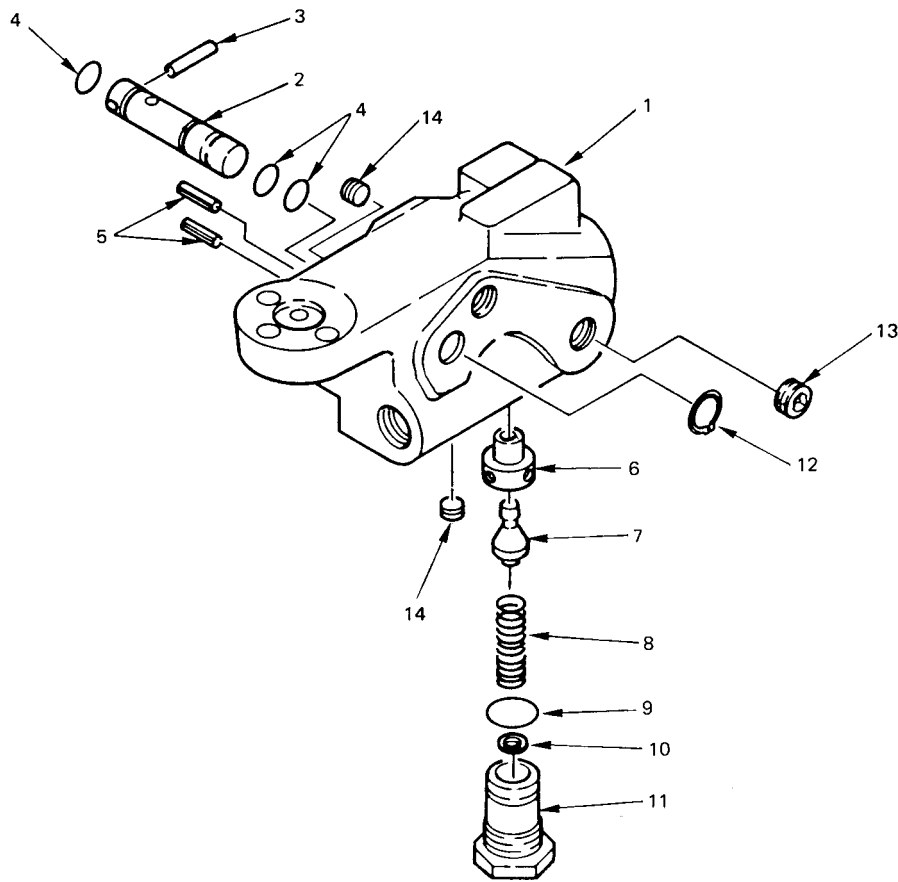


T657

4. CONTROL VALVE

1) Control valve (relief valve) 340013400

(1) Name of components



- | | |
|-------------------------|-----------------------------|
| 1. Valve body | 8. Spring |
| 2. Diverter valve spool | 9. O-ring (P18) |
| 3. Spring pin | 10. Shim |
| 4. O-ring (P10) | 11. Plug |
| 5. Spring pin | 12. Snap ring ($\phi 13$) |
| 6. Relief housing | 13. Plug |
| 7. Poppet | 14. Plug |

T658

(2) Operation (flow of oil)

The oil in the transmission case passes through the filter, is fed under pressure by the oil pump, and enters the Port P_1 of the control valve.

[When valve is at "O" position]

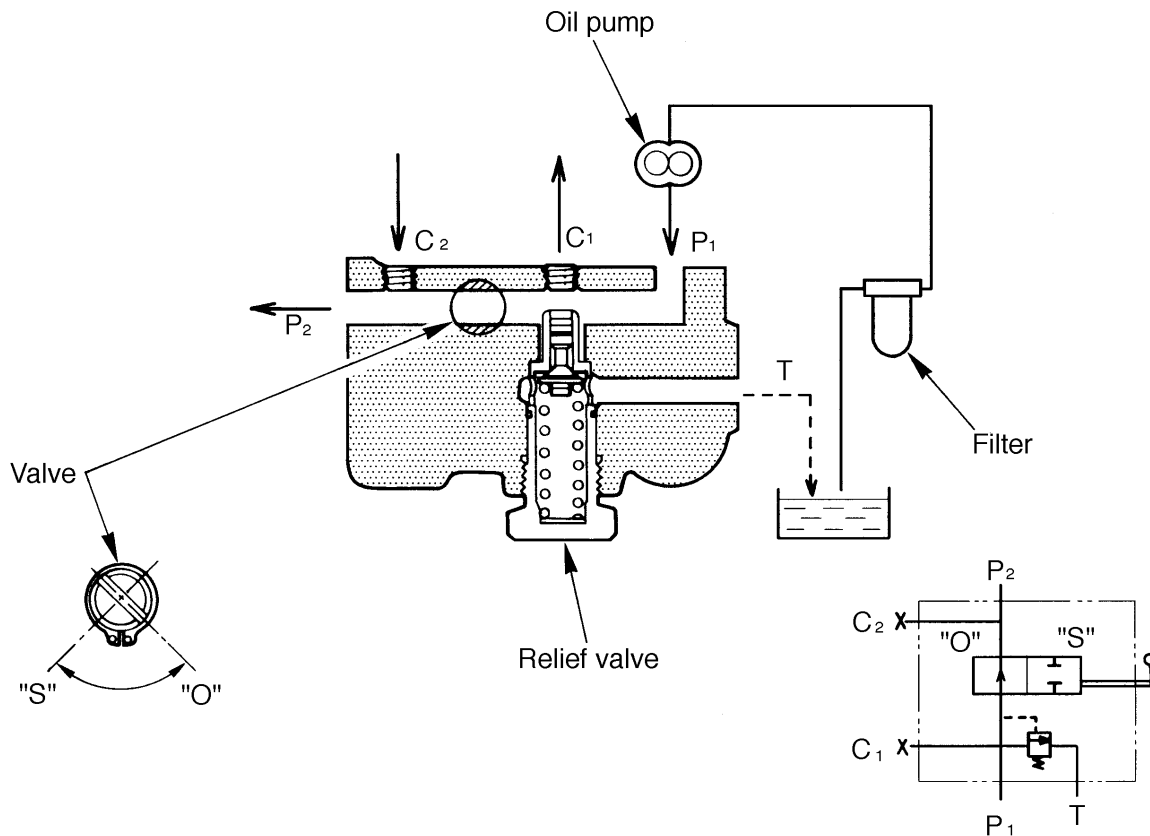
When the oil pressure is not taken out, adjust the valve to the "O" position. The oil after entering P_1 passes through P_2 and is fed under pressure to the control valve for lifting/lowering the implement.

[When valve is at "S" position]

When the oil pressure is taken out (for front loader, etc.), connect hydraulic piping for an external implement to the ports C_1 and C_2 and set the valve at the "S" position.

Oil entering P_1 passes through the port C_1 , returns to the port C_2 through the valve on the implement side, and is sent from the port P_2 as in the above case.

The relief valve is mounted to protect the hydraulic system. When the pressure exceeds a certain value, the valve is opened to relieve the oil from the port. T to the transmission case. Set valve for the relief valve is 12.74 MPa (130 ± 5 kgf/cm²).



T659

Disassembly, inspection and reassembly of control valve

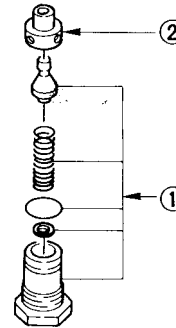
*NOTE:

- (1) Never disassemble the control valve during the claim warranty term (1 year or 600 hours). If disassembled, claim will not be accepted.
- (2) If it should be unavoidably disassembled, handle it very carefully since it is finished precisely.

Disassembling procedure

1 Relief valve

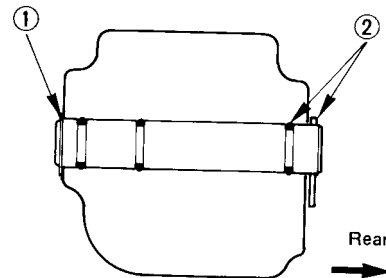
- ① Remove the plug and take out the shims, spring and poppet.
- ② Remove the relief housing kit.



2 Spool

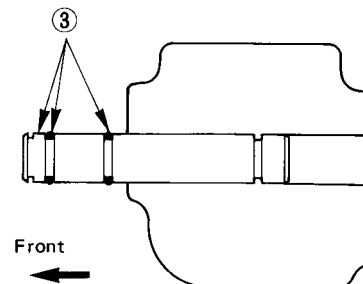
- ① Remove the snap ring
- ② Drive out the spring pin, extract the spool rearwards until the O-ring on the rear side of the valve can be removed, and remove the O-ring.

T660



- ③ Extract the spool forwards of the valve body and remove 2 O-rings.

T661



NOTE: If extracting in either one direction, the O-ring is broken.
For reassembly, install 2 O-rings on the front side, push the spool rearwards, install the O-ring on the rear side and return frontwards, in the reverse order.

Inspection and reassembly

- ① Relief valve ass'y
Replace the seat if the surface is worn out.

T662

Plug tightening torque	34.3 – 39.2 N·m (3.5 – 4.5 kgf·m)
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- ② Spool and O-ring
Replace the spool and O-rings if oil leaks.

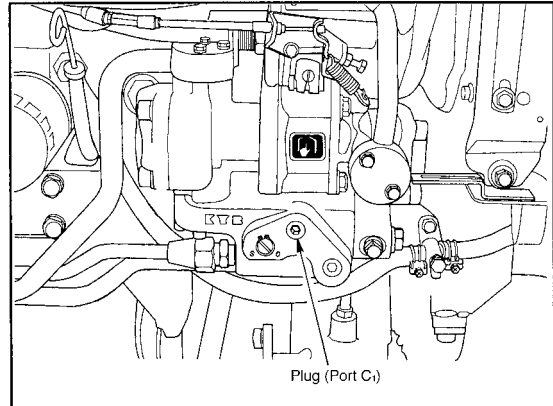
- ③ When connecting the oil pressure take-out piping, wind seal tape on it before tightening.

PT3/8 tightening torque	29.4 – 49 N·m (3 – 5 kgf·m)
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(4) Pressure adjustment of relief valve

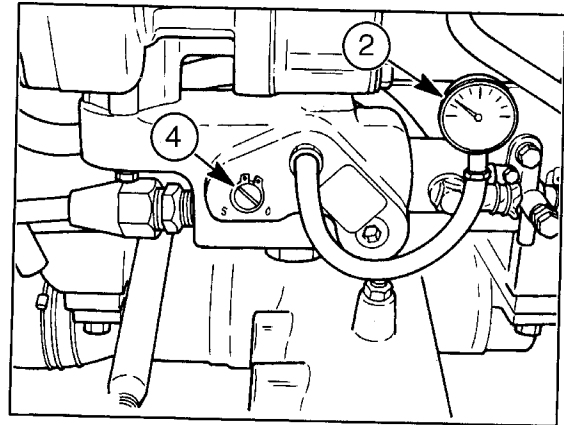
Reassembly and adjustment

- ① Remove the oil pressure take-out plug (3/8 NPTF) from the port C1 (see the right figure).



T663

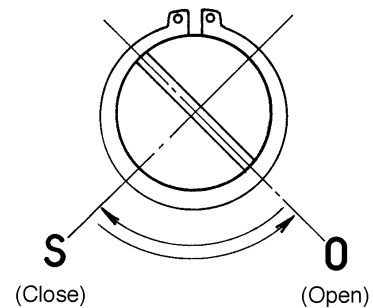
- ② Install a pressure gauge (0 – 200 kgf/cm²) to the port C1.
- ③ Start the engine and keep the engine speed at 2500 rpm.



T664

- ④ Set the valve at the S (closed) position and read the indication on the pressure gauge. (Complete in a short time.)

Relief set pressure	12.7 – 13.2 MPa (130 – 135 kgf/cm²)
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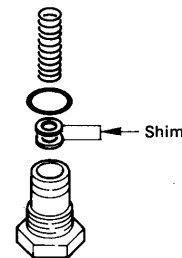
T665

- ⑤ Adjust the set pressure by increase or decrease the number of shims as shown in the right figure. The pressure varies about 0.265 MPa (2.7 kgf/cm²) by 0.1 mm of shims.

NOTE:

1. A kit contains 3 shims of 0.1 mm and 0.35 mm in thickness respectively (6 in total).
2. Remove the pressure gauge, wind seal tape on the plug and install taking care not to allow the seal tape to enter the hydraulic piping.

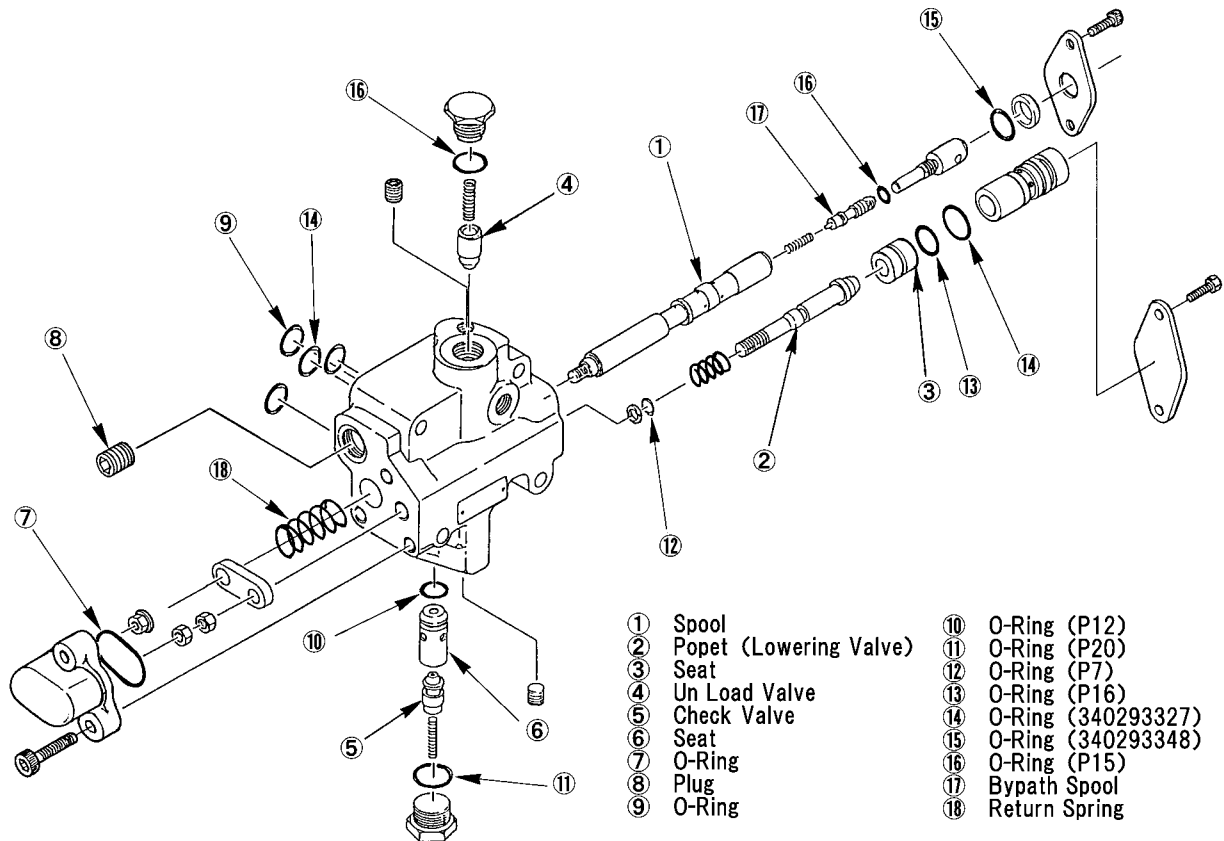
- ⑥ Return the valve secretly to “O” position after inspection.



T666

2) Control valve (for lifting/lowering implement) 340016110

(1) Name of components



T667

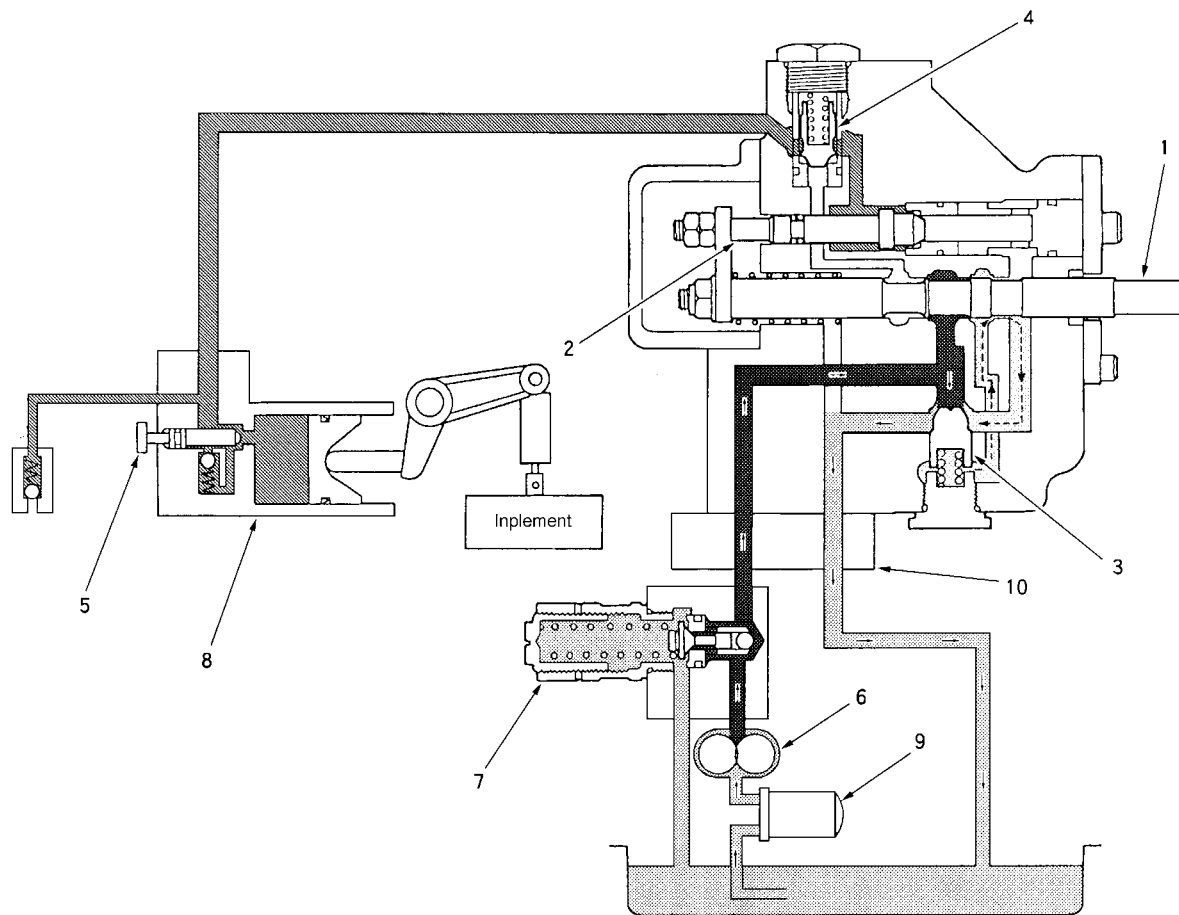
(2) Operation (flow of oil)

① Neutral position

Oil fed under pressure by the oil pump pushes and opens the unload valve of the control valve and is returned again to the transmission case.

On the other hand, the oil in the hydraulic cylinder tries to flow to the control valve side by the weight of the implement but the oil works in the direction to close the valve from the back of the check valve. The poppet is closed and shuts off the oil and therefore the oil is kept in the hydraulic cylinder the implement is kept at a constant height.

While the control valve (implement lowering speed adjust valve) is closed, the oil is shut off here.



1. Pilot spool
2. Poppet; lowering valve
3. Poppet; unload
4. Valve; check
5. Valve; flow control

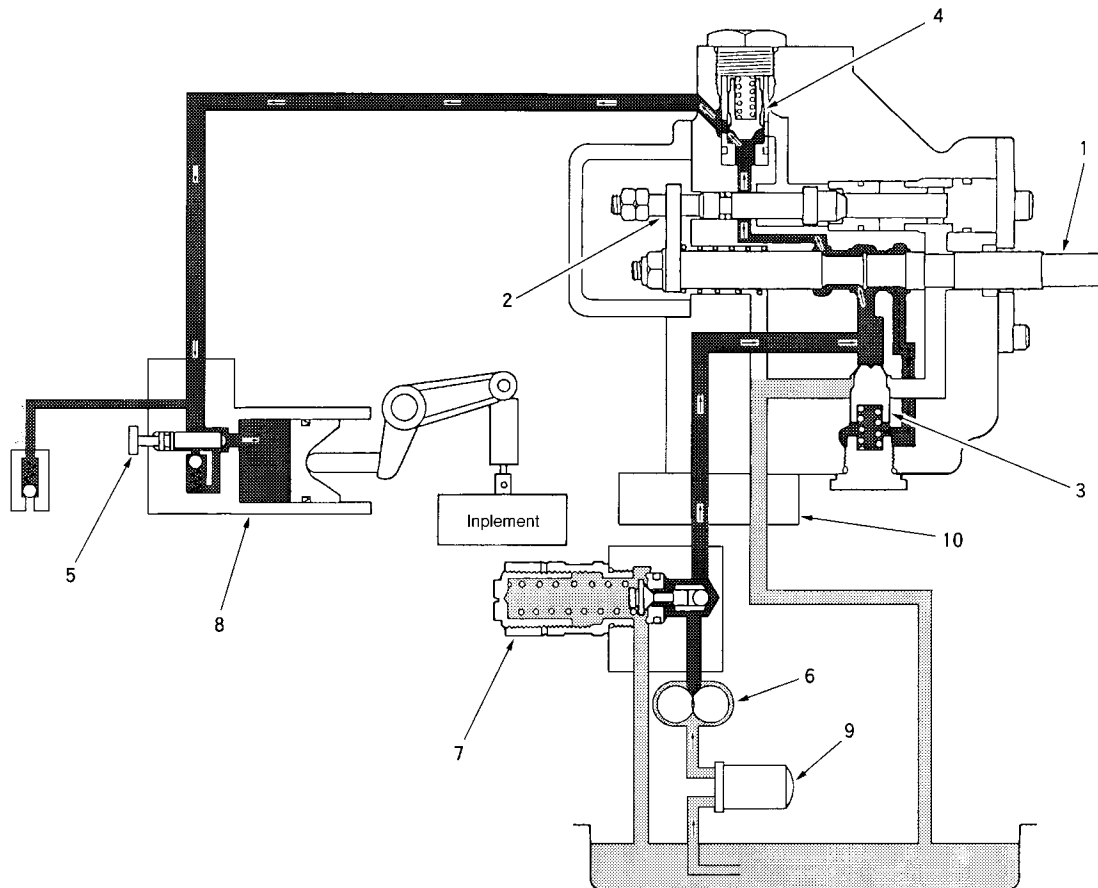
6. Hydraulic pump
7. Valve; relief
8. Hydraulic cylinder
9. Filter
10. Remote control valve

T668

② Lifting position

When the control lever is set at the lifting direction, the spool moves rightwards, the oil fed under pressure by the oil pump passes through the recessed part of the spool, flows to the back of the unload valve and close off the unload valve. Therefore the oil passes through the outer periphery of the spool, open the check valve, is fed under pressure to the hydraulic cylinder and the implement ascends.

At this time, when the oil pressure exceeds 12.7 MPa (130 kgf/cm²), the relief valve is opened and the oil is returned to the transmission case.



- | | |
|--------------------------|--------------------------|
| 1. Pilots spool | 6. Hydraulic pump |
| 2. Popet; lowering valve | 7. Valve; relief |
| 3. Valve; unload | 8. Hydraulic cylinder |
| 4. Valve; check | 9. Filter |
| 5. Valve; flow control | 10. Remote Control Valve |

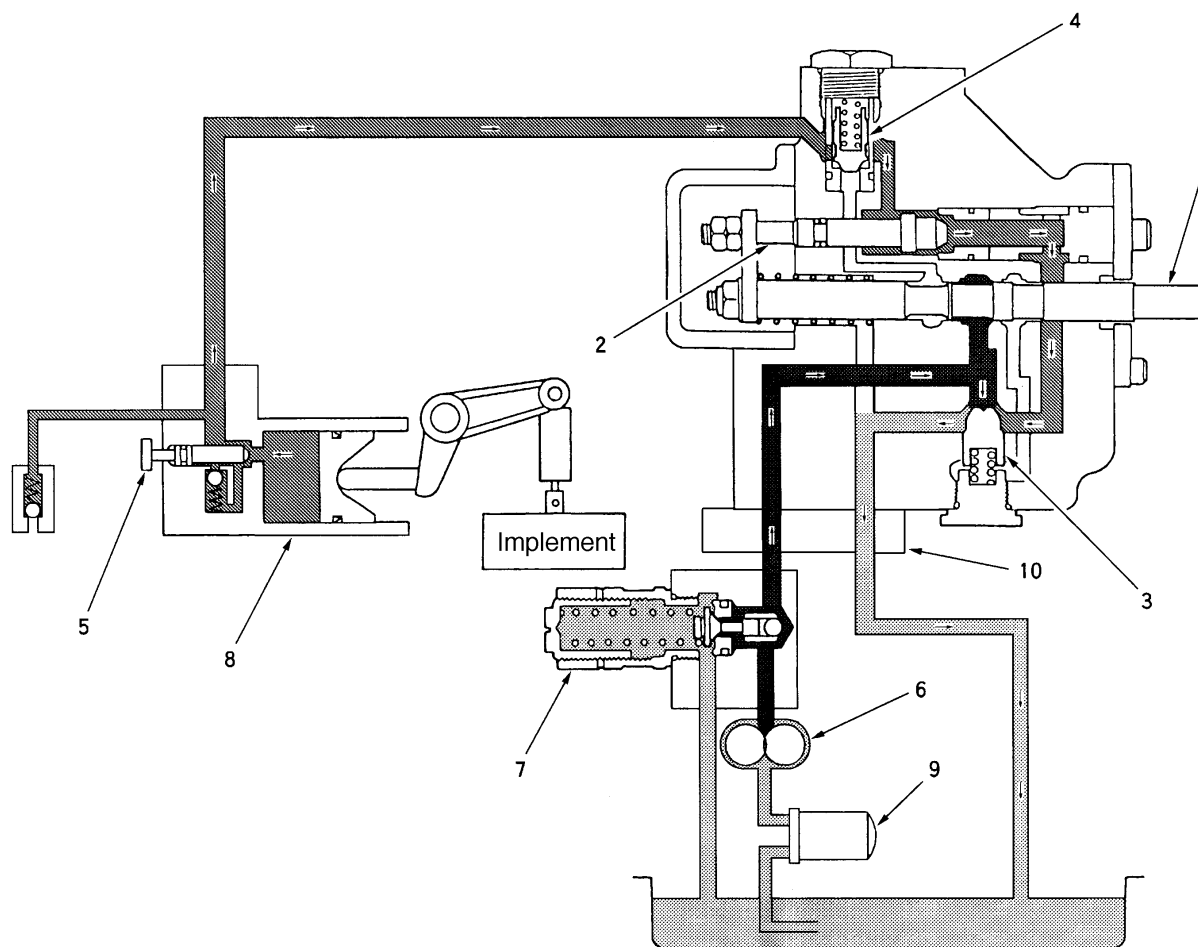
T669

③ Lowering position

When the control lever is set at the lowering direction, the spool moves leftwards, the poppet is opened at the rear end of the spool, and the oil in the hydraulic cylinder is pushed out to the transmission case.

At this time, the implement lowering speed is adjusted by adjusting the flow rate by the flow control valve of the hydraulic cylinder case head. (The implement does not lower when the valve is closed.)

On the other hand, the oil fed under pressure from the oil pump opens the unload valve as in the neutral position and is returned to the transmission case.



1. Pilot spool
2. Poppet; lowering valve
3. Valve; unload
4. Valve; check
5. Valve; flow control

6. Hydraulic pump
7. Valve; relief
8. Hydraulic cylinder
9. Filter
10. Remote control valve

T670

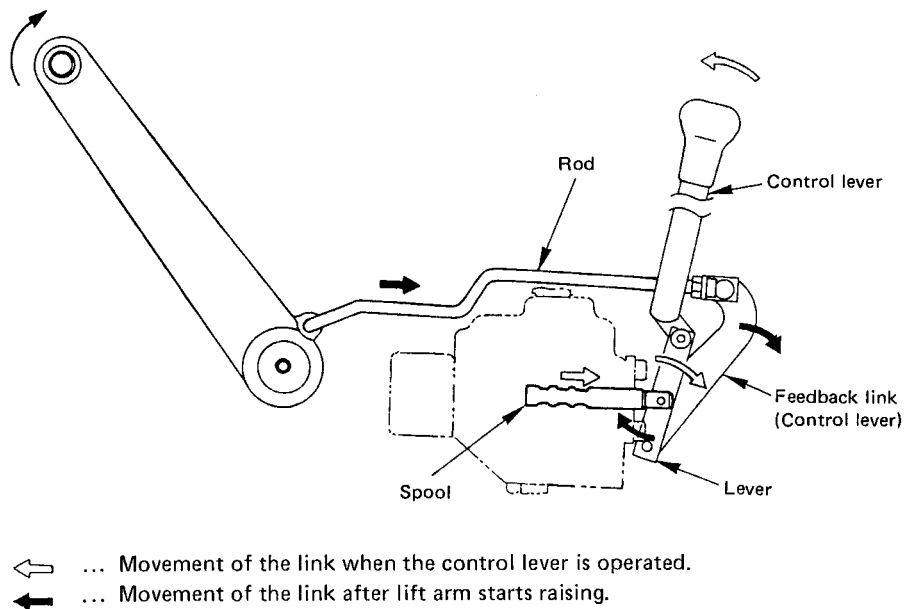
(3) Linkage

① “RAISE” position

When the control lever is shifted to “RAISE” position, the lever turns clockwise making the lower pin as the fulcrum. This moves the spool to the right, as it is connected to the lever center pin which is moved to the right. Then, the control valve is set to be “Raise” position.

When the oil enters the hydraulic cylinder, the lift arm is raised and the rod is pushed to the right. This pushes down the center part of the feedback link (control lever) clockwise.

As the bottom part of the feedback link is connected with the lever, it turns to left making its upper pin as the fulcrum. Then, the spool pinned to the middle part of the lever is gradually returned to and stops at the “NEUTRAL” position.



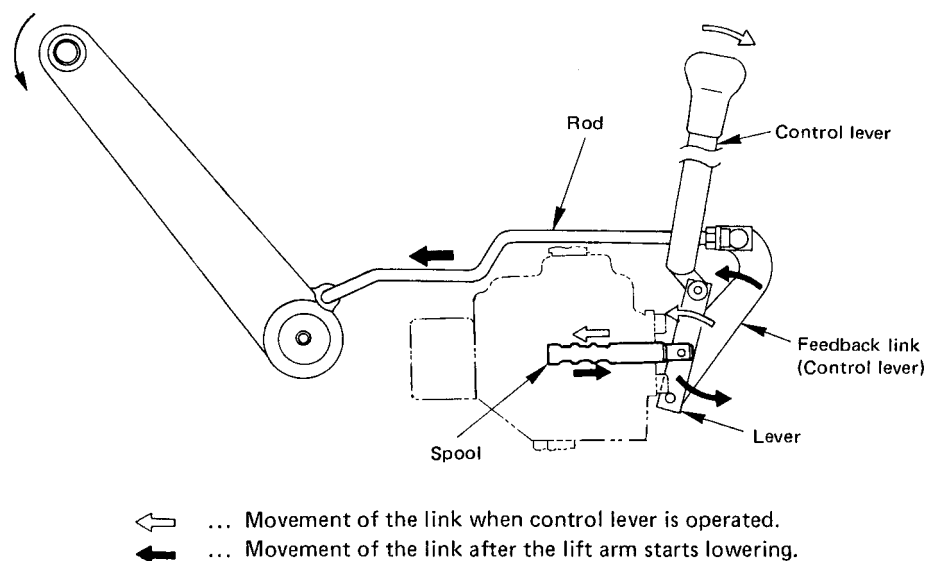
T671

② “LOWER” position

When the control lever is shifted to “LOWER” position, the lever which is connected to the spool moves to the left side with the lower pin being the fulcrum, which accordingly pushed the spool to the left side establishing the “LOWER” circuit.

Then, the oil in the hydraulic cylinder is returned to the transmission case and the lift arm is lowered. Accordingly, the rod is pulled to the left side and rotated counterclockwise with the center of the feedback link (control lever) being the fulcrum.

As the lower part of the feedback link is pinned to the lever, it moves to the right with the upper pin of the lever as fulcrum, and the spool pinned to the center of the lever is gradually returned to and stops at the “NEUTRAL” position.



T672

(4) Disassembly, inspection and reassembly of control valve

NOTE:

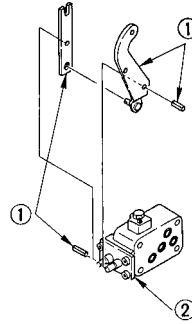
- (1) Never disassemble the control valve during the claim warranty term (1 year or 600 hours). If it is disassembled, claim will not be accepted.
- (2) When it should be unavoidably disassembled, handle it carefully since it is finished precisely.

Disassembly procedure

1. Lever, Control Lever, Bracket

- ① Drive out the spring pin from the spool and bracket and remove the lever and control lever respectively.
- ② Remove the bracket from the valve body.

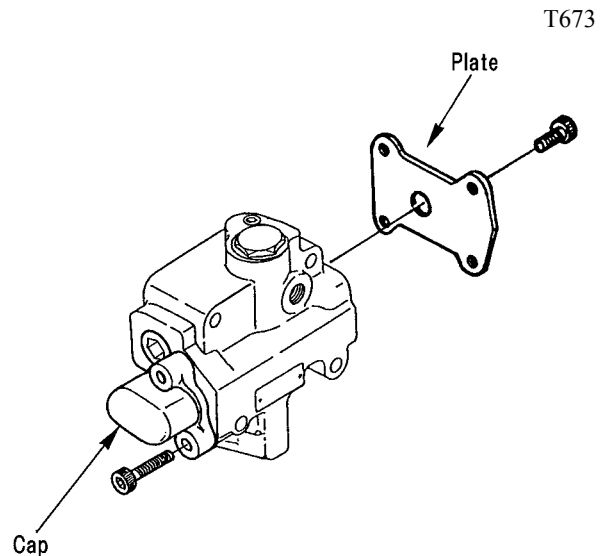
Tightening torque	5.9 – 7.8 N·m (0.6 – 0.8 kgf·m)
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2. Cap, Plate

Remove the cap and plates from the valve body.

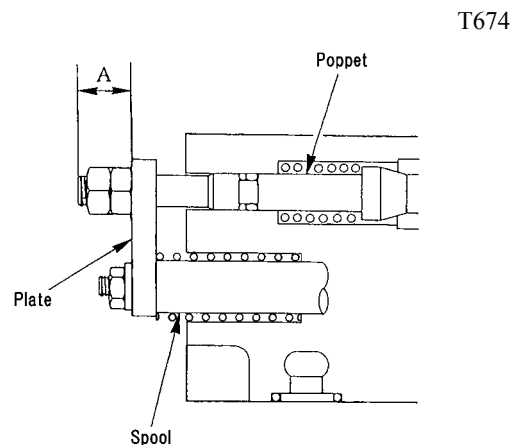
Tightening torque	19.6 – 24.5 N·m (2 – 2.5 kgf·m)
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3. Poppet (Lowering Valve)

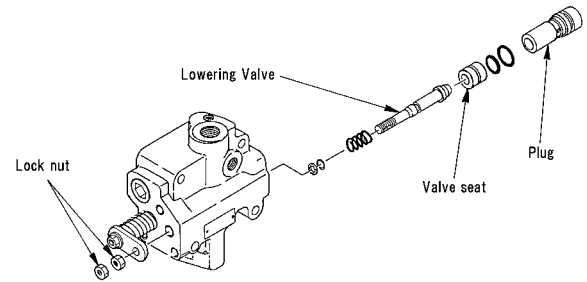
- ① Measure the poppet installing position (since the dead zone varies).

NOTE: Measure the point ① in the right figure, which has been set at about 15 mm.



T675

- ② Untighten the lock nuts and remove the plug, valve seat, poppet and spring from the body.

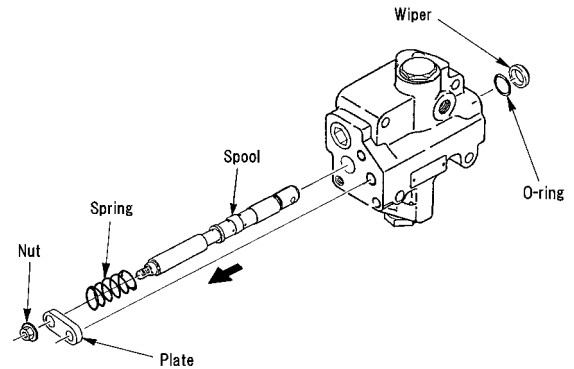


T676

4. Pilot Spool

- ① Pull out the spool, plate and spring as a set to the arrow mark.
- ② Remove the O-ring and wiper from the body.
- ③ If necessary, remove the nut, plate and spring.

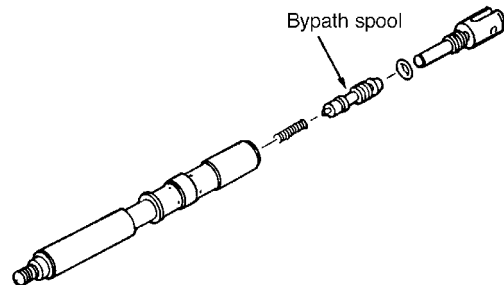
Nut tightening torque	
	18 – 22 N·m (1.8 – 2.2 kgf·m)



T677

- ④ If necessary, remove the spool head, bypath spool and spring from the spool.

Spool Head tightening torque	
	9.8 – 14.7 N·m (1 – 1.5 kgf·m)

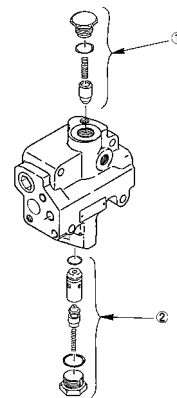


T678

5. Unload Valve, Check Valve

- ① Remove the plug and take out the spring and unload valve.
- ② Remove the plug and take out the spring, check valve and valve seat.

Plug tightening torque	
Unload valve	98 – 120 N·m (10 – 12 kgf·m)
Check valve	59 – 69 N·m (6 – 7 kgf·m)



T679

Inspection

(1) Spool

- ① Check the spool surface and sliding part of the body for nicks and burrs.
- ② Check if the spool falls down by its own weight.

Check ① or ②, if defective, replace control valve ass'y.

(2) Check valve

Check its seat for uneven wear.

(3) Unload valve

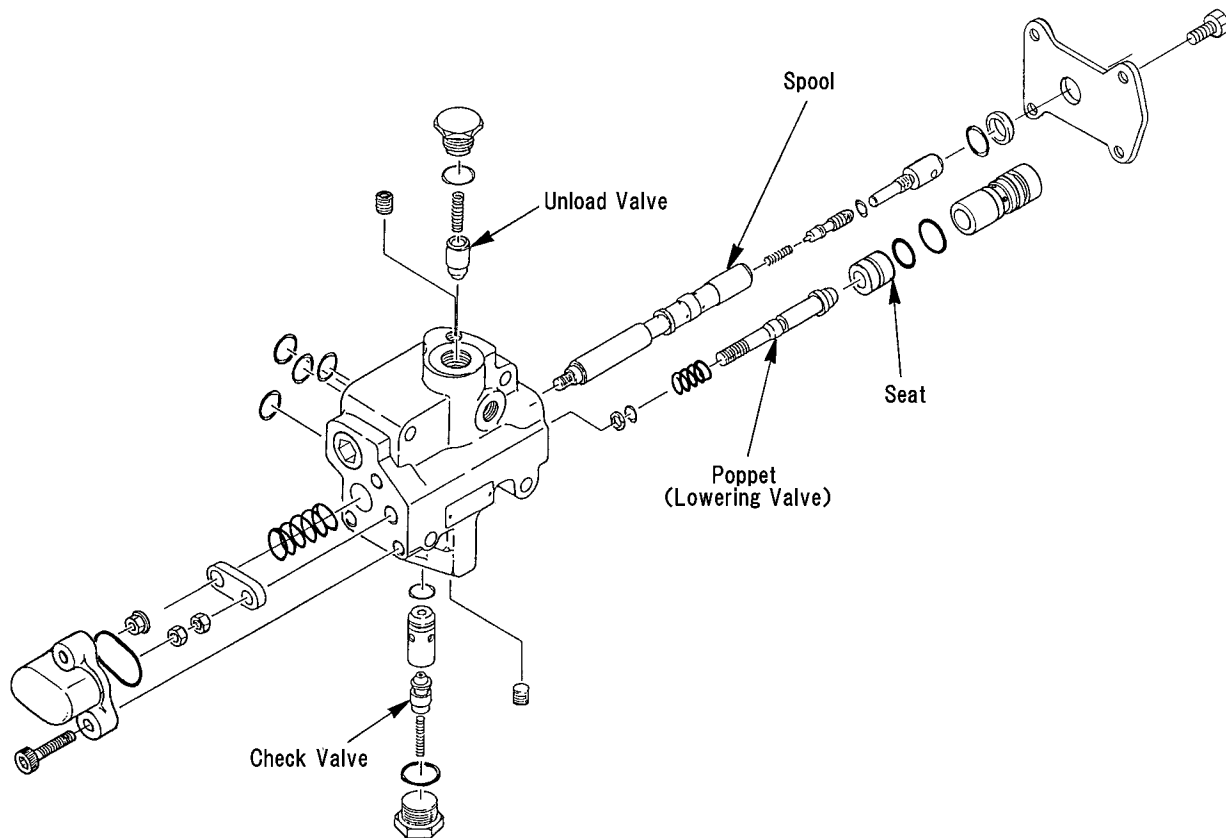
- ① Check the seat for stepped wear.
- ② Check the sliding part for nicks and burrs.

(4) Lowering valve (poppet)

- ① Check the seat for stepped wear.
- ② Check the sliding part for nicks and burrs.

(5) O-ring, back-up ring, wiper

Check for wear or crack.



T680

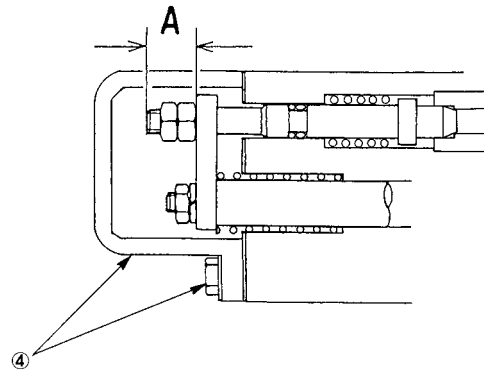
Reassembly and adjustment

Reassemble the units in the reverse order to disassembly taking sufficient care to oil leakage.

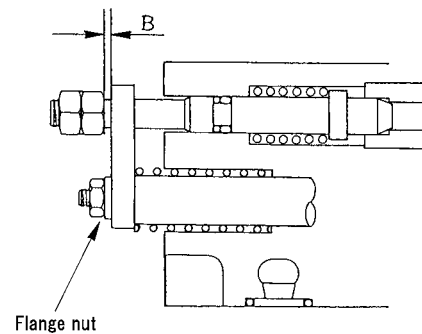
1. Installation of poppet (lowering valve)

(1) When either of the poppet, valve seat or valve body is replaced:

- ① Set the dimension A in the right figure to about 15 mm and tighten with a lock nut, install the control valve properly.
- ② Install the control valve to the tractor and install the link system.
Start the engine and set the control lever to rising direction.
- ③ Stop the engine, set the control lever to lowering direction and stop at any point.
The lift arm lowers and stop. (Valve neutral position).
- ④ At this condition (do not move the spool), remove the cap.
- ⑤ Measure the dimension B in the right figure, adjust to 0.6 mm by the nut and tighten with the lock nut.



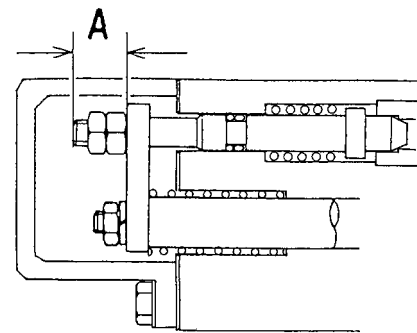
T681



T682

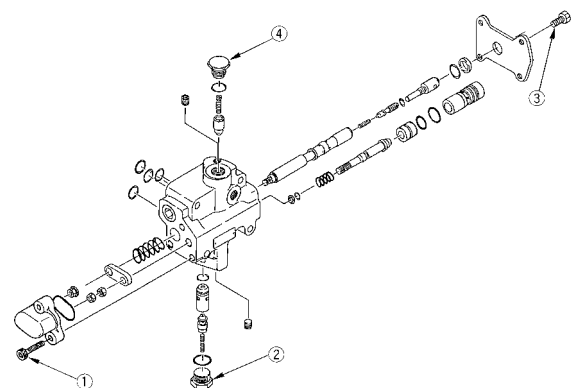
(2) When above components are not replaced:

- ① Adjust the dimension A Figure, to the value measured at the time of disassembly by the nut and tighten with the lock nut.



T683

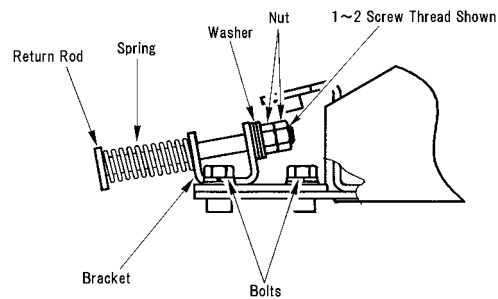
① Bolt for cap	$22.5 \pm 2.5 \text{ N} \cdot \text{m}$ ($2.25 \pm 0.25 \text{ kgf} \cdot \text{m}$)
② Plug for check valve	$64 \pm 5 \text{ N} \cdot \text{m}$ ($6.5 \pm 0.5 \text{ kgf} \cdot \text{m}$)
③ Bolt for bracket	$6.85 \pm 0.95 \text{ N} \cdot \text{m}$ ($0.7 \pm 0.1 \text{ kgf} \cdot \text{m}$)
④ Plug for unload valve	$109 \pm 11 \text{ N} \cdot \text{m}$ ($11 \pm 1 \text{ kgf} \cdot \text{m}$)



T684

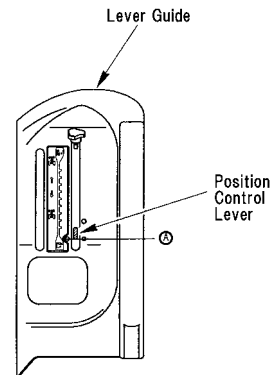
2. Control lever return rod adjustment

- ① Install the lever return rod with spring and three washers to the bracket, and tighten the lock nuts at one or two screw threads shown.
- ② Move the position control lever to the position: ①.



T685

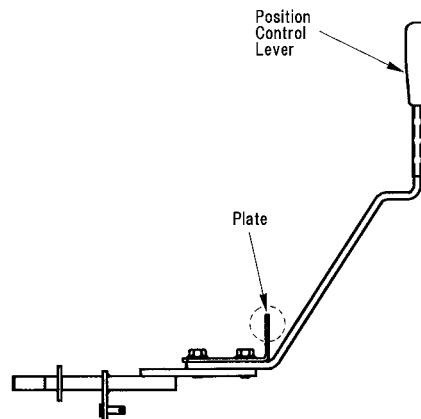
- ③ Slide the bracket and return rod assembly to contact the return rod and plate on the position control lever, and then tighten the two bolts, Figure T685.



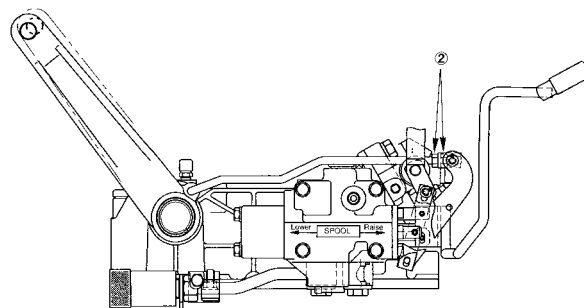
T686

3. Adjustment of feedback link

- ① Start the engine (800 – 1000 rpm), and set the control lever at the position ①, figure T686. (Confirm that the lift arm rises to the uppermost point.)
- ② Untighten the lock nut and drive in the nut rearwards. Then the lift arm rises. The lift arm lowers when the nut is untightened. Tighten the nut at the point where the relief is effected, return (untighten) the nut by 1.5 turns from that position, and fix with the lock nut.
- ③ After adjustment, confirm that the relief is not effected operating the control lever at the position (A), Figure T686 and it is returned position by return rod.



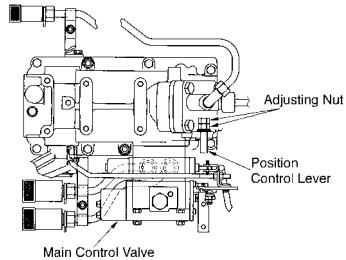
T687



T688

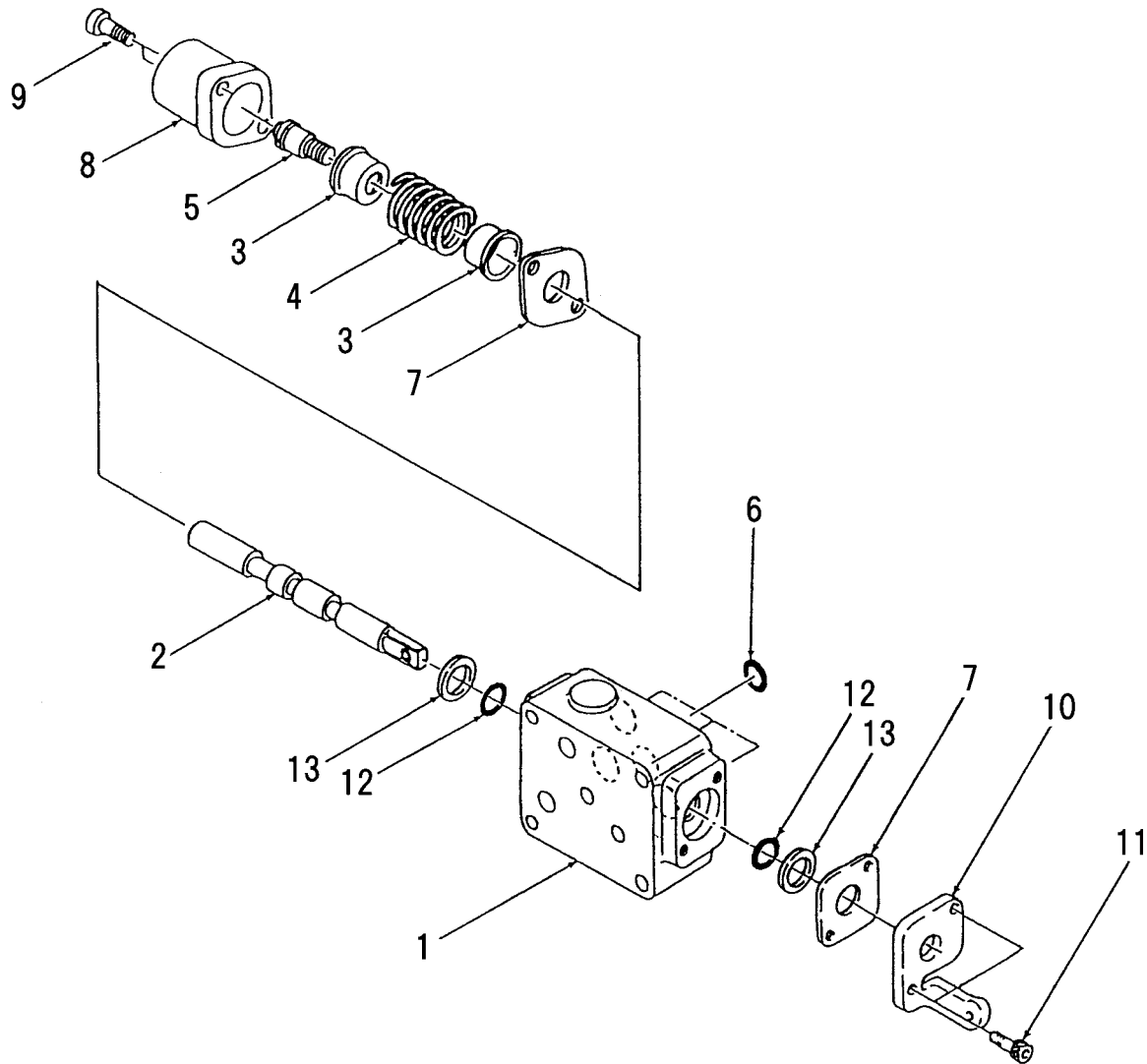
5. TROUBLE SHOOTING

Condition	Possible cause	Remedy
1. The implement does not raise even with the control lever shifted to the "RAISE" position.	(1) Too heavy implement. (2) Oil pump does not discharge oil. (3) Low relief pressure. (4) Unload valve does not close.	(1) Check the implement. (2) Replace the oil pump. (3) Readjust the pressure. (4)-1 Check if there is any dirt or sticking at the unload valve. (4)-2 If sticking, correct by lapping. (Check oil contamination)
2. The implement heavily hunts, with the valve at neutral. (moving up and down)	(1) Damaged seat surfaces of lowering valve and seat valve. (2) Lowering valve does not attach seat. (3) Damaged seat surface of the check valve. (4) Damaged O-ring. (Lowering valve, check valve seat.) (5) Leakage in the cylinder.	(1) Polish or replace lowering valve and seat valve. (2) Adjust unmoved condition. (3) Polish seat surface or replace the check valve seat. (4) Replace O-ring. (5) Check cylinder liner, piston oil seal and piston, or replace if needed.
3. Raising speed of the implement is slower than specified.	(1) Damaged seat surface of the unload valve. (2) Damaged seat surface of the relief valve. (3) Leakage in the cylinder. *the same with 2. (4) Damaged O-ring. *the same with 2. (5) Reduced volume efficiency. (6) Clogged line filter.	(1) Polish or replace the control valve assembly. (2) Replace valve seat. (3) Check cylinder liner, piston oil seal and piston. Replace if needed. (4) Replace O-ring. (5) Replace oil pump. (Check oil leakage.) (6) Wash and clean filter. (Check oil contamination.)
4. Unsmooth change-over by control lever.	(1) Dust between the body and spool, or damaged spool.. (2) Broken spring (for return).	(1)-1 Check the dust and remove it. (1)-2 If the spool is damaged, replace the body and spool. (2) Replace the return spring.
5. Abrupt rise of the oil temperature of the tank.	(1) Seizure of oil pump. (2) Decreased volume efficiency of oil pump. (3) Damaged seat surface of the unloading valve. (4) Damaged seat surface of the relief valve. (5) Excessive oil leakage in the cylinder. (6) Tractor is operated with the relief valve working.	(1) Replace the oil pump. (Check oil contamination) (2) – do – (3) Replace the body and unload valve in an assembly. (4) Replace relief valve and valve seat. (5)-1 Replace O-ring or oil seal. (5)-2 Replace piston and cylinder case. (6) Adjust the feedback link.

Condition	Possible cause	Remedy
6. Abnormal sound	(1) Seizure of oil pump. (2) Insufficient intake of pump. (3) Air trapped in the system. (4) Improper hydraulic oil.	(1) Replace oil pump. (2) Wash the filter. (3)-1 Inspect the O-ring at suction pipe on mounting part of the filter. Replace it or other parts if found to be defective. (3)-2 Check O-rings in suction line for looseness. (3)-3 Check oil seal on the oil pump. Replace it, if needed. (3) Use proper hydraulic oil. (Manual transmission; SAE80, HST: ISO VG46) (4) Use proper hydraulic oil. (Manual transmission: SAE 80, HST: ISO VG46)
7. Lowering speed of the implement is too fast, when the engine is stopped with the implement retained at raised position.	Possible cause and remedy are same as explained in “Condition – 2” above. (Same complaint may be brought up also when the adjustment of lock nut of the lowering valve is not proper during reassembly of the control valve.)	
8. Implement lowers by itself while tractor is traveling.	(1) Control lever is moving to lower direction by itself to lowerange, due to the vibration of machine.	(1)-1 Adjust the friction spring so that the control lever will not move. *Must be moved by 19.6 – 29.4 N (2 – 3 kgf) at lever grip part.  T689 (1)-2 Set the lever stopper to the full “RAISE” position, so that the lever can not move to “LOWER” range.

6. REMOTE CONTROL VALVE (SINGLE SPOOL)

1) Name of components



- 1. Valve body
- 2. Spool
- 3. Spring seat
- 4. Spring
- 5. Bolt
- 6. O-ring
- 7. Plate

- 8. Cap
- 9. Bolt
- 10. Bracket
- 11. Bolt
- 12. O-ring
- 13. Wiper ring

T690

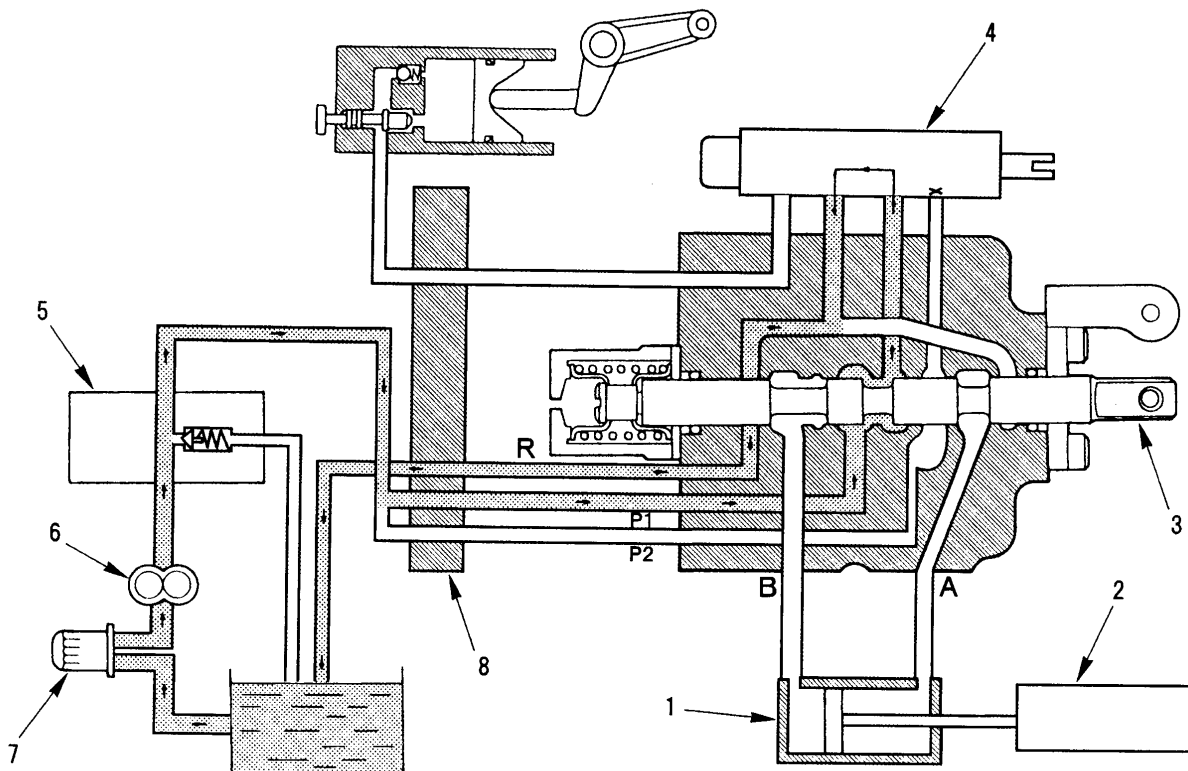
2) Operation (oil flow)

(1) Neutral position

The oil is fed under pressure by the oil pump through the ports P_1 and P_2 to the remote valve.

The oil from the port P_2 passes through the outer surface of the spool and is fed to the main control valve. It is blocked there are fed under pressure from the port P_1 side to the main control valve through the passage as illustrated below.

The oil from the remote cylinder is cut out by the spool so that the implement is held.



- | | |
|---|------------------------|
| 1. Remote Cylinder | 5. System Relief Valve |
| 2. Implement | 6. Oil Pump |
| 3. Remote Valve Spool | 7. Suction Filter |
| 4. Main Control Valve
(For Lifting/Lowering Implement) | 8. Spacer |

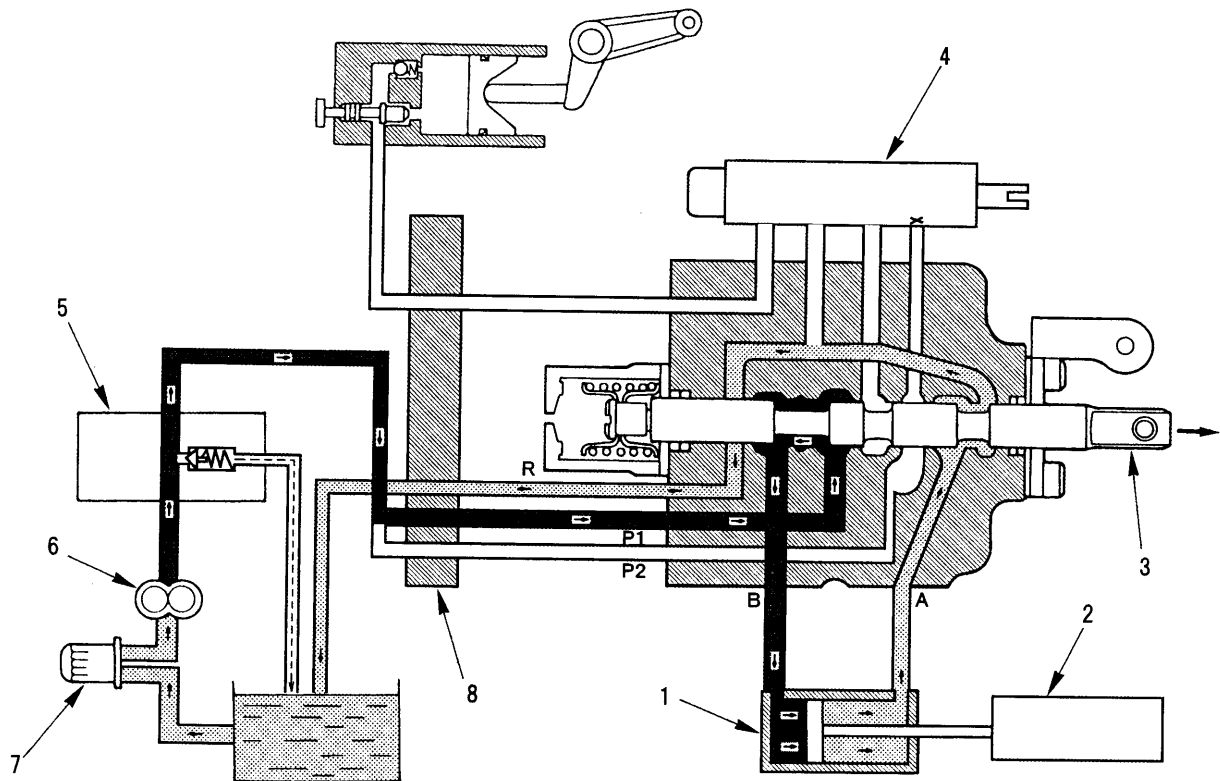
T691

(2) Extending position

By setting the control lever at the extending position, the spool can be pulled out. The oil from the port "P₂" is blocked as same as "neutral position" and is fed under pressure from the port "P₁" to the port "B" through the passage as illustrated below to allow the cylinder rod to be extended.

On the other hand, the oil from the cylinder passes through the port "R" from the port "A" and is returned to the transmission case.

At this time, when the oil pressure exceeds 12.74 MPa (130 kgf/cm²), the relief valve is opened and the oil is returned to the transmission case.



1. Remote Cylinder
2. Implement
3. Remote Valve Spool
4. Main Control Valve
(For Lifting/Lowering Implement

5. System Relief Valve
6. Oil Pump
7. Suction Filter
8. Spacer

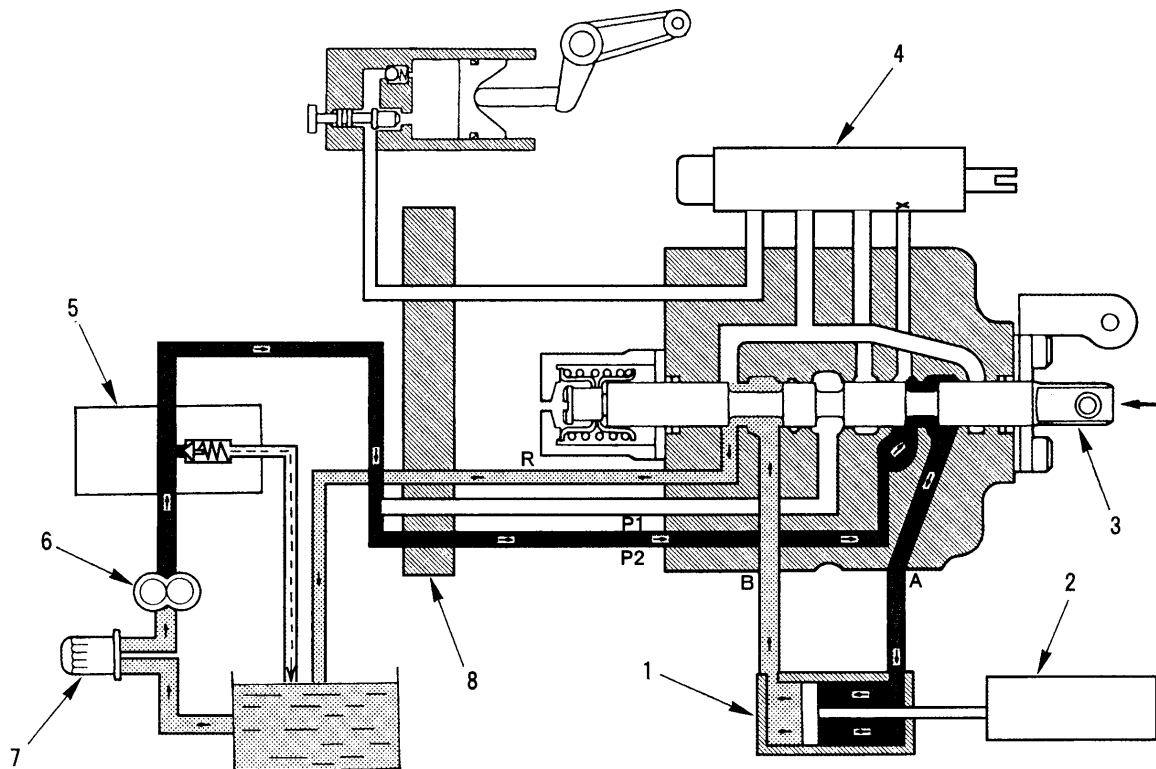
T692

(3) Retracting position

By setting the control lever at the retracting position, the spool can be pushed in. The oil from the port P_1 is blocked by the spool, fed under pressure from the port P_2 to the port A through the passage as illustrated below so that the cylinder rod is contracted.

On the other hand, the oil from the cylinder passes through the port B and port R and is returned to the transmission case.

At this time also, when the oil pressure exceeds 12.74 MPa (130 kgf/cm²), the relief valve is opened and the oil is returned to the transmission case.



- | | |
|----------------------------------|------------------------|
| 1. Remote Cylinder | 5. System Relief Valve |
| 2. Implement | 6. Oil Pump |
| 3. Remote Valve Spool | 7. Suction Filter |
| 4. Main Control Valve | 8. Spacer |
| (For Lifting/Lowering Implement) | |

T693

3) Disassembly, inspection and reassembly of control valve

NOTE:

1. Never disassemble during the claim warranty term (1 year or 600 hours). If it is disassembled, claim will not be accepted.
2. If it should be unavoidably disassembled, handle it carefully since it is finished precisely.

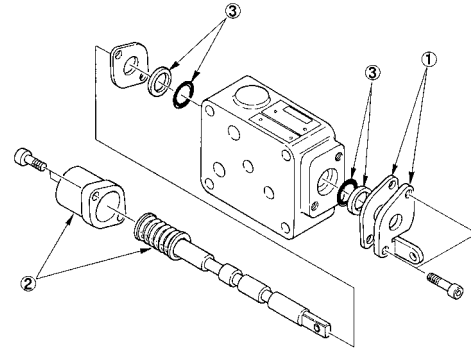
Disassembly

(1) Spool

- ① Remove the bracket and plate.
- ② Remove the cap nut and extract the spool gently.

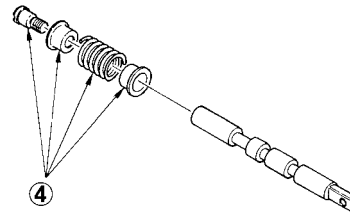
NOTE: Be careful not to damage the oil seal when taking out the spool.

- ③ Remove the wiper ring and O-ring of the valve body. (Only when replacing)



T694

- ④ Remove the bolt and take out the spring seats (2 pcs.) and spring.



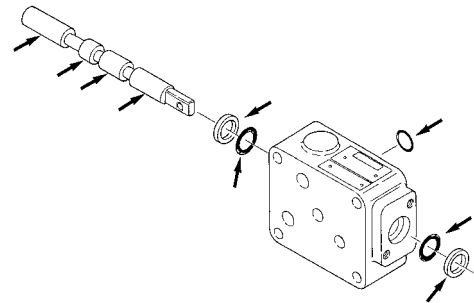
Inspection and service

(1) Spool

If the sliding surface or seat surface have worn out or damaged, replace the valve ass'y.

(2) Wiper ring and O-ring

- ① Replace the wiper ring if oil leaks or the O-ring is damaged.
- ② Replace the O-ring if worn out or damaged.



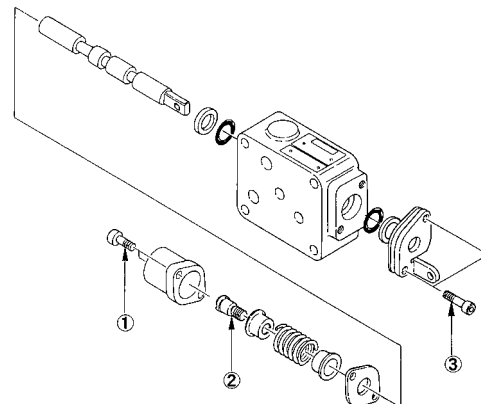
T695

Reassembly

- (1) Reassemble the components in the reverse order to disassembly.

Bolt tightening torque

No.	Tightening torque
①	7.9 – 11.8 N·m (0.8 – 1.2 kgf·m)
②	
③	



T697

3-8 Electric Units and Accessories

1. COMPONENT LOCATION

1. ALTERNATOR

Alternator is located L.H. front side of engine, and refer to CHAPTER 2-4 "Electric Units".

2. HEAD LAMPS

Head lamp is located on the front grill, it has two filaments (60W/55W) in one bulb.

3. HORN

Horn is located near head lamp in the grill.

4. FUEL LEVEL SENSOR

Fuel level sensor is located under the instrument panel and in the fuel tank.

5. ENGINE STOP SOLENOID

Engine stop solenoid is located R.H. of engine.

6. ENGINE OIL PRESSURE SENSOR UNIT

Engine oil pressure sensor unit is located on the R.H. of cylinder head.

7. ENGINE COOLANT THERMOMETER SENSOR

Water thermometer sensor is located on the L.H. cylinder head.

8. INSTRUMENT PANEL

Instrument panel is located under the steering wheel. It consists cold start indicator light, engine oil pressure warning light, battery charge warning light, proof meter, tachometer, high beam indicator light, parking indicator light, fuel gauge, turn indicator warning light, temperature gauge, hazard indicator warning light, hazard and flasher switch and cruise control switch (HST only).

9. CRUISE LATCH MAGNET (HST model)

Cruise latch magnet is located on the clutch housing in the R.H. dash board.

10. CRUISE LATCH RELAY (HST model)

Cruise latch relay is located R.H. on the steering column in the dash board.

11. HST CRUISE CONTROL SWITCH

HST cruise control switch is located on the instrument panel.

12. COMBINATION LAMP ASSEMBLY: FRONT

They are located on the front of the ROPS, and it consists of 5W position lamp and 21W turn signal lamp.

13. COMBINATION LAMP ASSEMBLY: REAR

They are located on the rear of the ROPS, and it consists of 5W tail lamp and 21W brake lamp in one bulb, and 21W turn signal lamp.

14. TRAILER COUPLER

Trailer coupler is located rear of the transmission housing for trailer combination lighting.

15. PARKING BRAKE SWITCH

Parking brake switch is located under the hand brake.

16 and 17. FOOT BRAKE SWITCH

One foot brake switch is located under the right platform and the other one is located under the left platform. Brake lamps go on when the two switches are actuated with brake relay. The HST cruise control is canceled by both brake switches are ON position.

18. SAFETY SWITCHES (HST model)

A. Range gear neutral switch

B. Rear PTO neutral switch

C. Mid PTO neutral switch

Safety switches are located between L.H. of the transmission housing and L.H. fender.

These switches are neutral position, engine can be started.

19. SAFETY SWITCHES (9 x 3 model)

A. Main gear neutral switches

B. Rear PTO neutral switch

C. Mid PTO neutral switch (option)

Safety switches are located between L.H. of the transmission housing and L.H. fender.

20. BRAKE SWITCH RELAY (HST model)

Brake switch relay is located rear R.H. of bottom of steering column.

21. BRAKE SWITCH RELAY

Brake switch relay is located rear center of bottom of steering column.

22. ENGINE START SWITCH

Engine start switch is located R.H. of dash board.

23. COMBINATION LIGHT SWITCH

Combination light switch is located L.H. top on the dash board.

24. LIGHT SWITCH

The light switch is located L.H. the upside on the dash board.

25. HAZARD LAMP RELAY

The hazard lamp relay is located rear left of bottom of steering column.

26. FLASHER RELAY

The flasher relay is located on the front R.H. of the fire wall.

27. GLOW LAMP TIMER

The glow lamp timer is located on the front R.H. of the fire wall.

28. GLOW LAMP RELAY

The glow lamp relay is located on the front R.H. of the fire wall.

29. SAFETY START RELAY

The safety start relay is located on the front R.H. of the fire wall.

30. STARTER MOTOR

The starter motor is located L.H. of the engine.

31. BATTERY

The battery is located front of the radiator.

32. FUSIBLE LINK

The fusible link is located between B terminal on the starter motor and main harness.

33. HEAD LAMP FUSE BOX

The fuse boxes for head lamp are located between head lamps in the grill.

34. GLOW PLUG

The glow plugs are located on the cylinder head.

35. FUSE BOX

The fuse box is located on the front R.H. of the fire wall. The top one is two fuses located.

36. FUSE BOX

The fuse box is located on the front R.H. of the fire wall. The bottom one is located three fuses located.

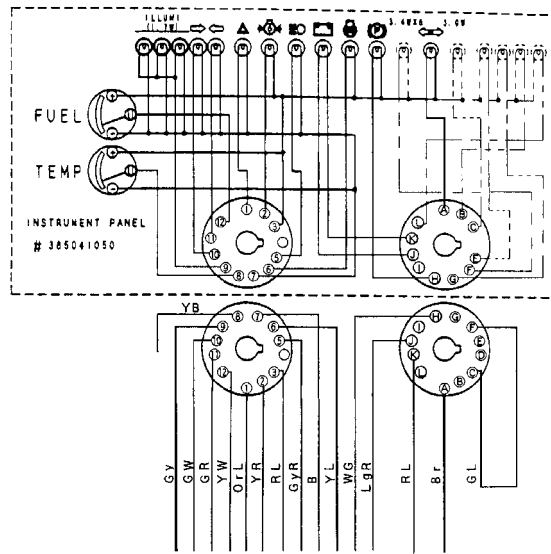
37. DIODE (HST)

The diode is located near the HST cruise control relay (10) on the steering column.

38. DIODE

The diode is located near the brake switch relay (21) on the steering column.

3. INSTRUMENT PANEL CIRCUIT



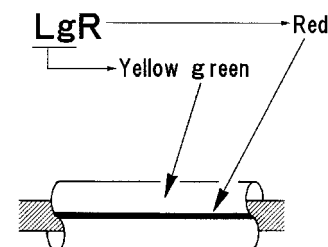
T700

1. Hazard lamp
2. Engine oil pressure warning lamp
3. From positive line
4. Empty
5. High beam indicator lamp
6. Glow lamp indicator lamp
7. To ground
8. Water temperature gauge
9. Illumination lamp
10. Turn signal lamp: left
11. Turn signal lamp: right
12. Fuel gauge

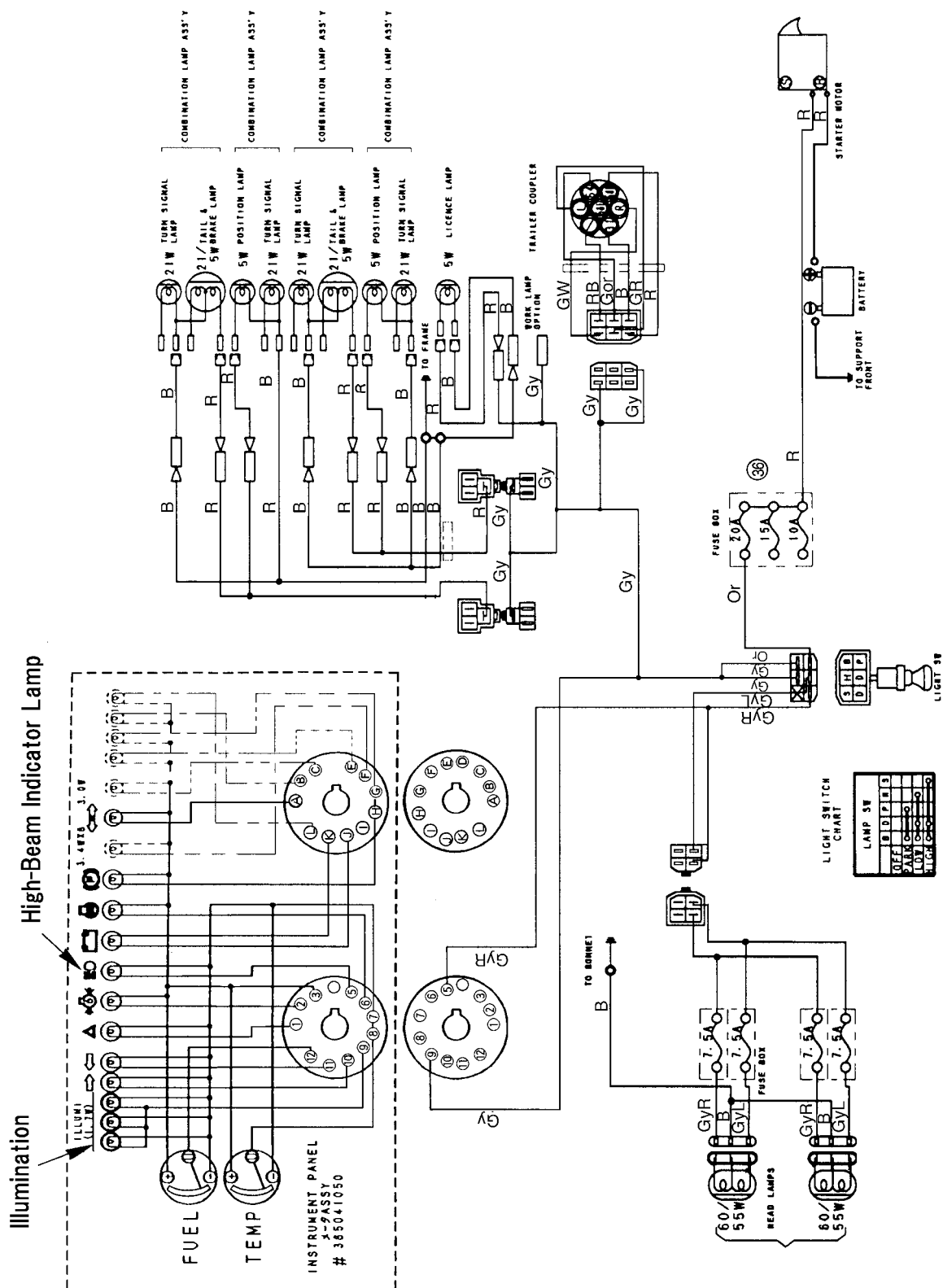
- A. Hazard indicator lamp
- B. Empty
- C. Empty
- D. Empty
- E. Empty
- F. Empty
- G. Empty
- H. Parking brake indicator lamp
- I. Empty
- J. Charge indicator lamp
- K. Charge indicator lamp
- L. Empty

Wiring color code	
Mark	Color
B	Black
R	Red
Y	Yellow
W	White
G	Green
L	Blue
Pu	Purple
Br	Brown
Or	Orange
Gy	Gray
Lg	Yellow green

For example

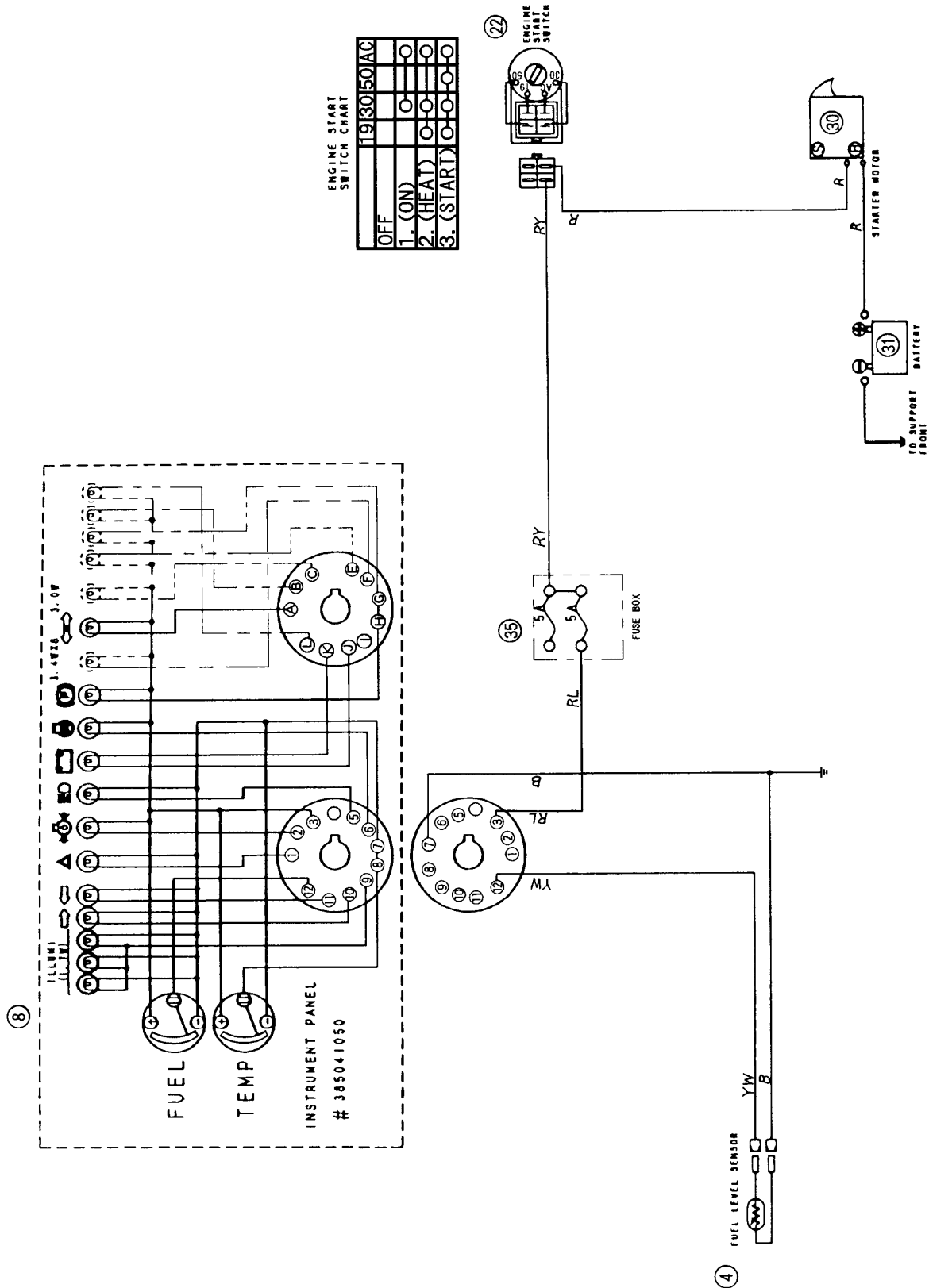


T701



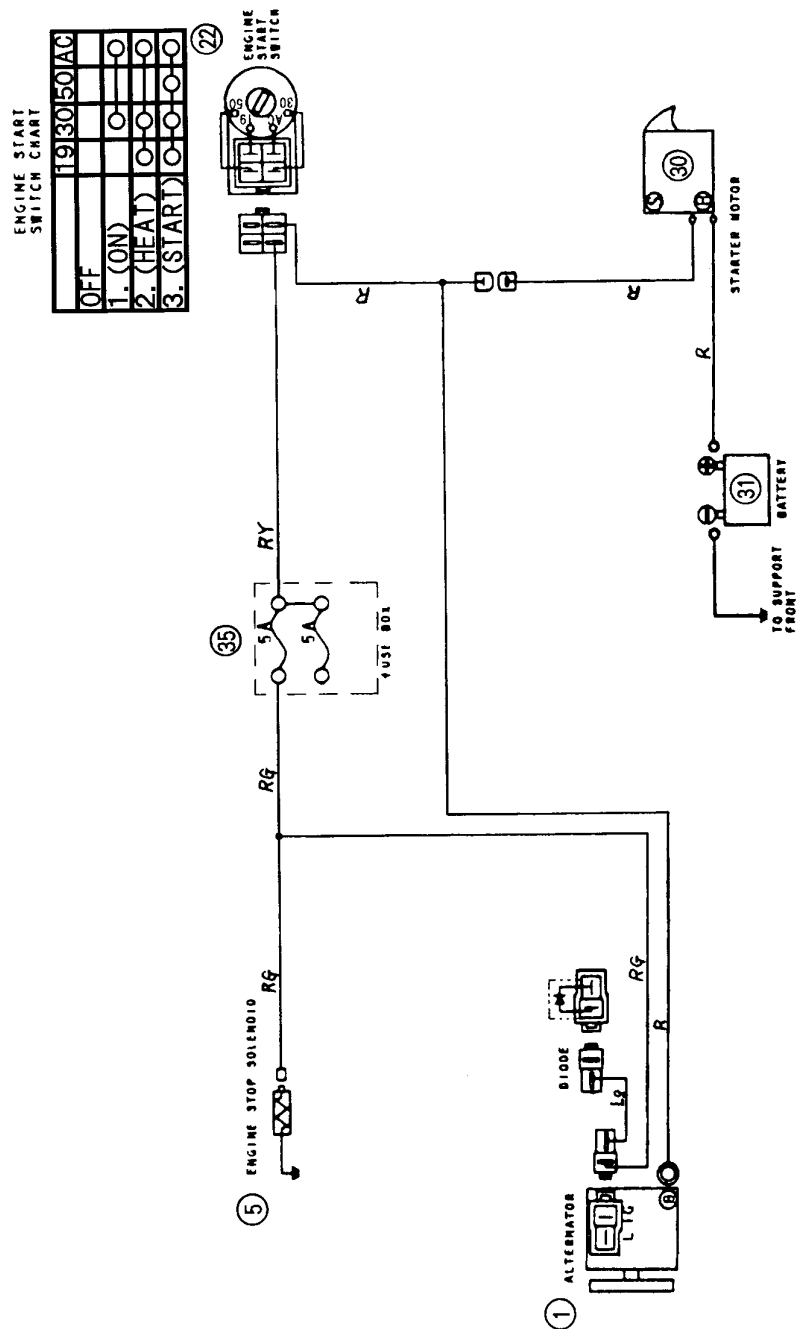
T702

6. FUEL LEVEL CIRCUIT



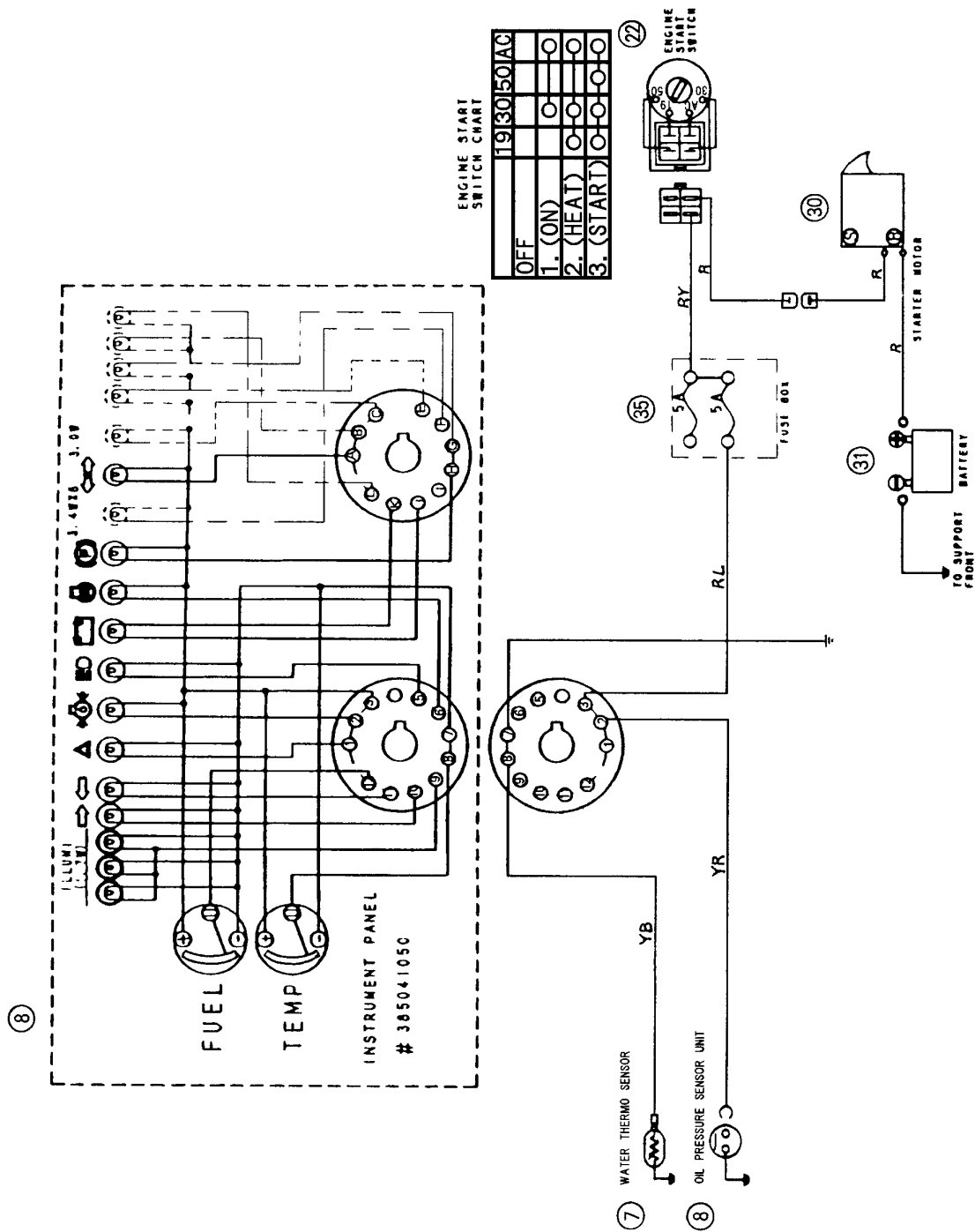
T704

7. ENGINE STOP SOLENOID CIRCUIT



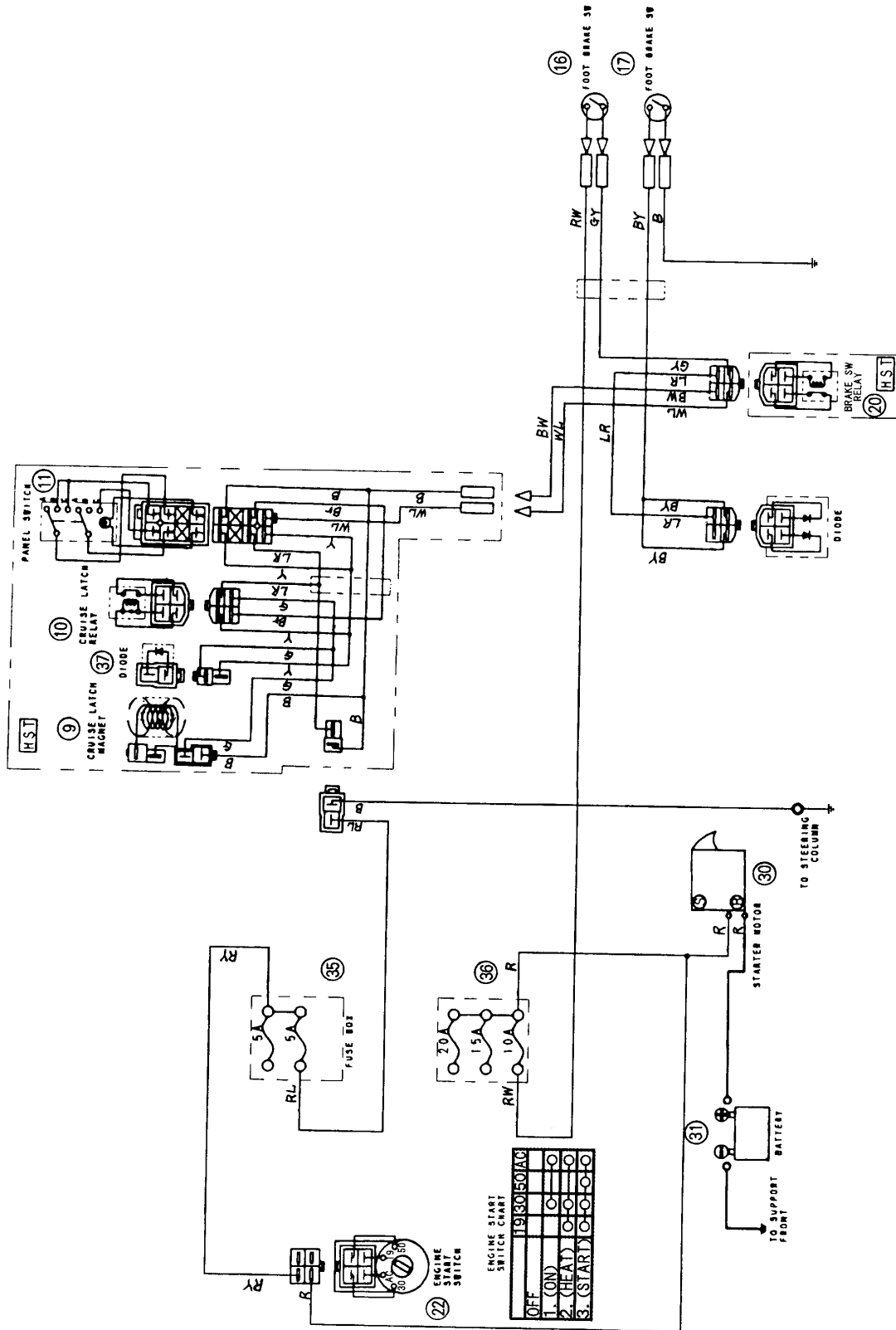
T705

8. ENGINE COOLANT TEMPERATURE CIRCUIT, ENGINE OIL PRESSURE WARNING CIRCUIT



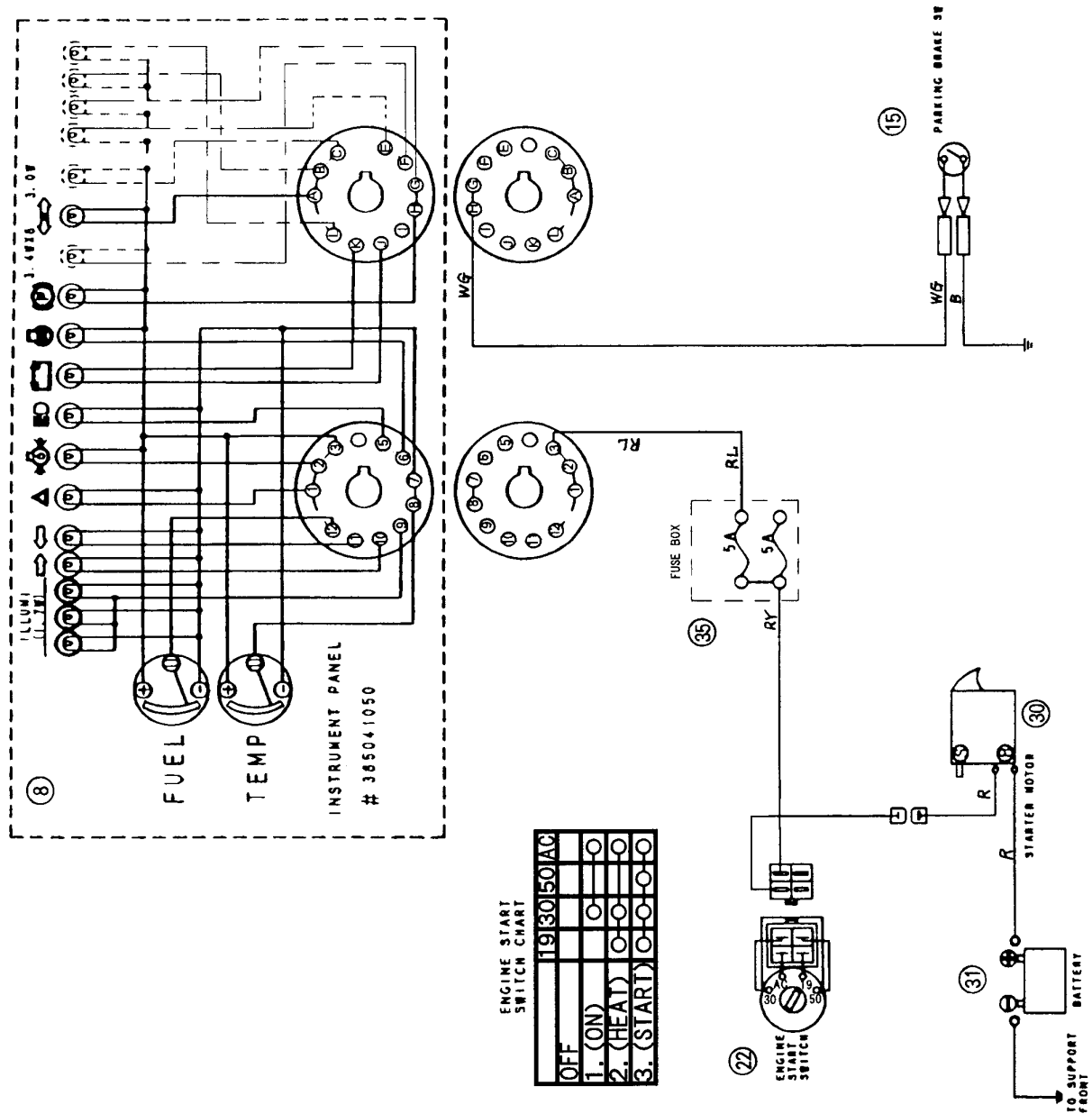
T706

9. HST CRUISE CONTROL CIRCUIT



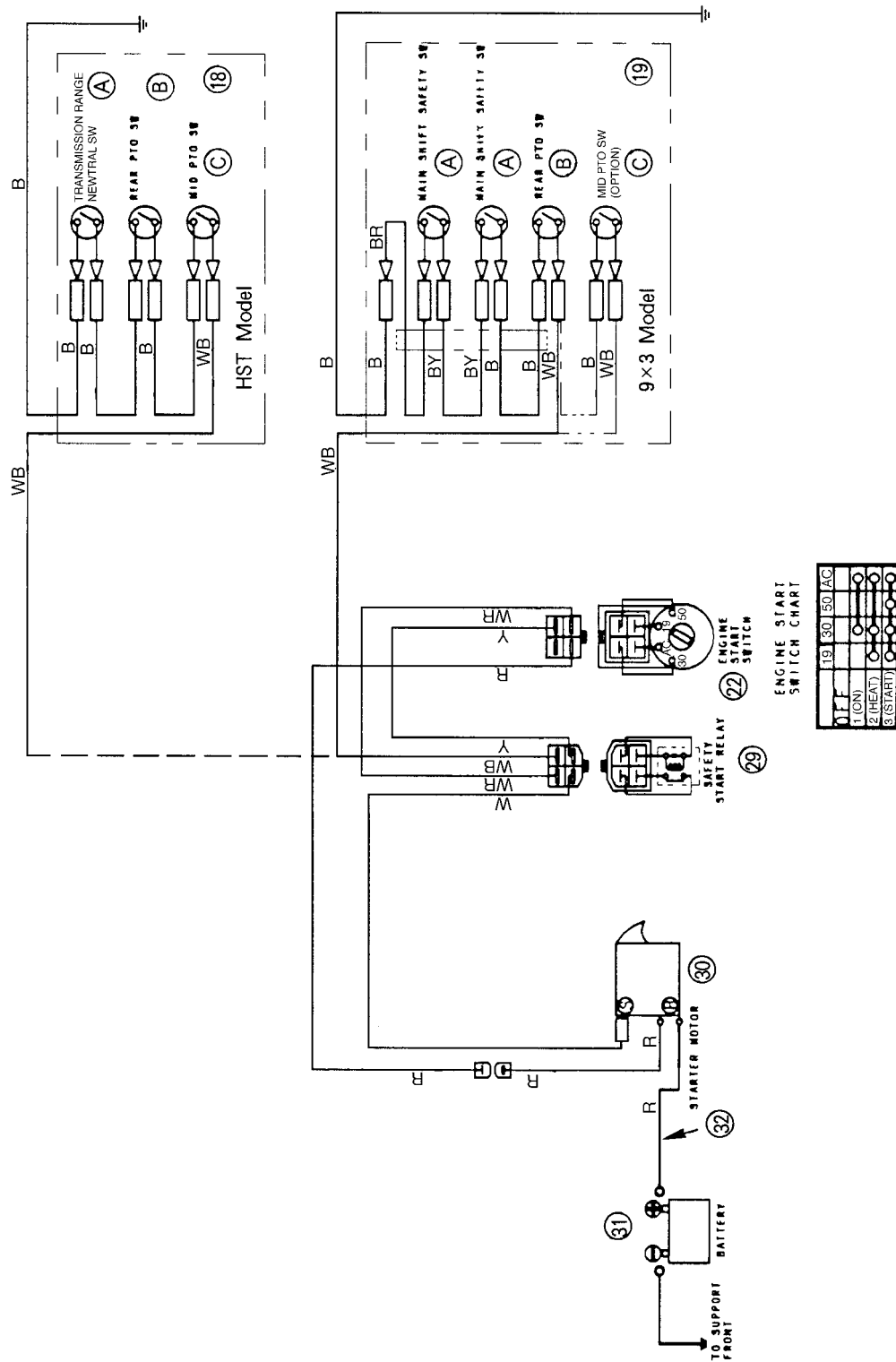
T707

10. PARKING BRAKE WARNING LIGHT CIRCUIT



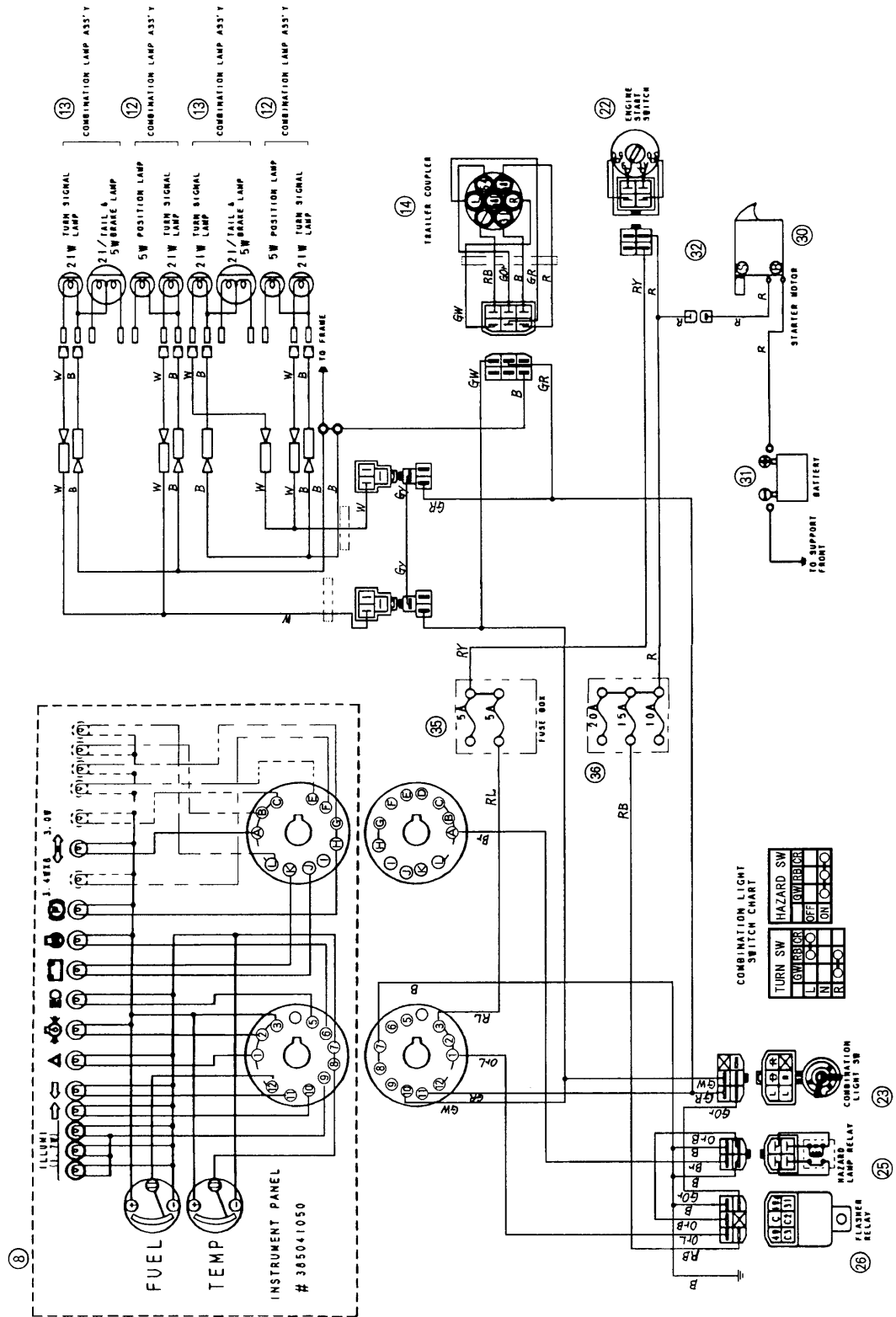
T708

12. SAFETY START CIRCUIT



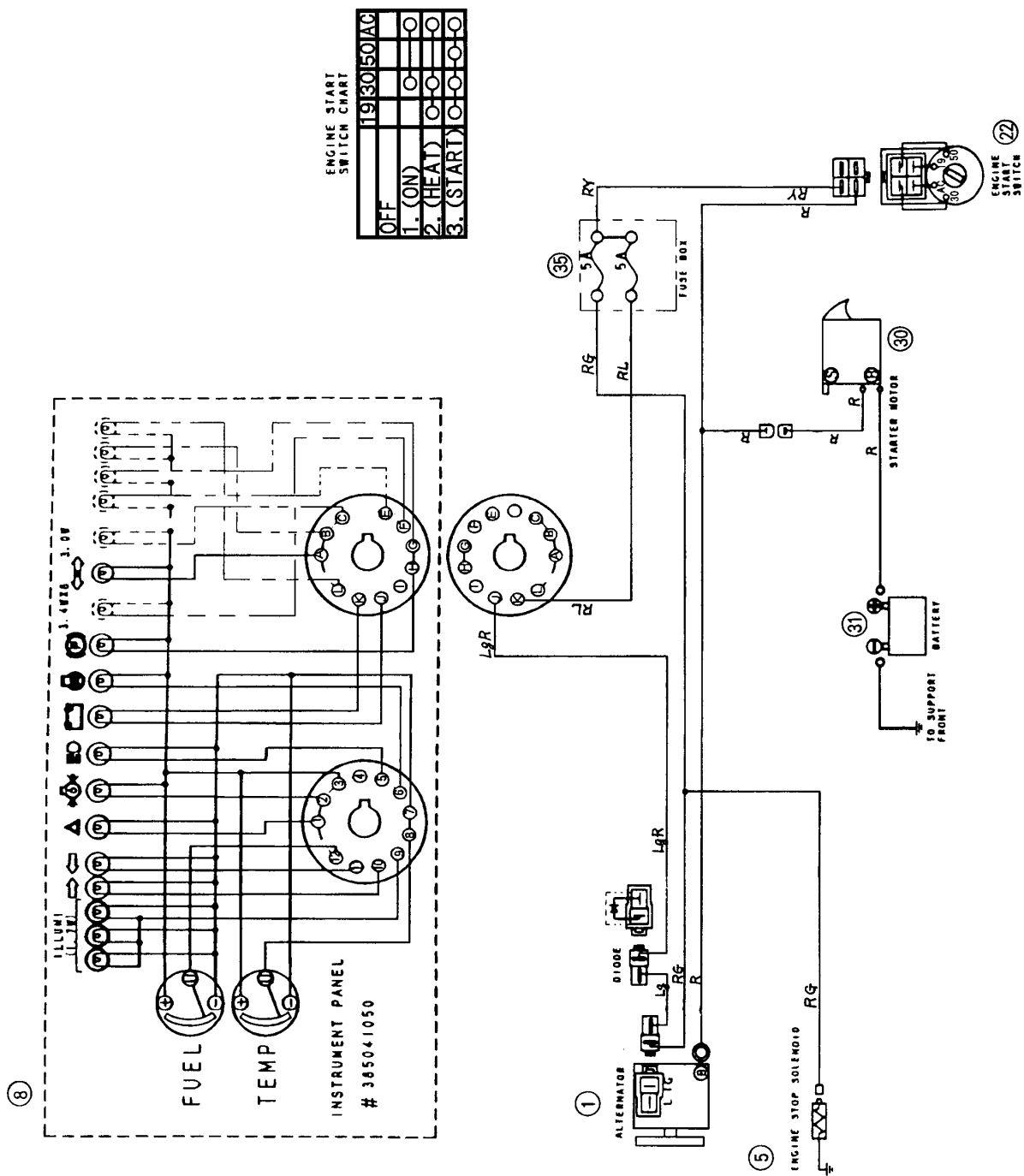
T710

13. FLASHER AND HAZARD LAMP CIRCUIT



T711

15. ALTERNATOR AND ENGINE STOP SOLENOID CIRCUIT



T713

16. TROUBLESHOOTING

Electric parts are operated with power supplied by the battery. Therefore, in case of trouble in electric parts, check the battery at first, conduct continuity test from the power source to the each part in success in using a circuit tester to determine whether the part or wiring is defective.

Condition	Cause	Remedy
Head lamp does not light	Burnt out bulb (2) Insufficient battery charge (31) Blown fusible link (22) Blown 20 amp fuse (36) Blown 7.5 amp fuse (33) for head lamp Malfunctioning light switch (24) Improper wiring connection Improper ground to bonnet	Replace Recharge Replace Replace Replace Replace Repair Repair
Horn does not sound	Malfunctioning horn (3) Defective horn switch (23) Blown 10 amp fuse (36) Blown fusible link (32) Improper wiring connection Improper ground to bonnet	Replace Replace Replace Replace Repair Repair
Fuel gauge level Pointer does not move	Defective fuel level sensor (4) Defective fuel meter (8) Blown out 5 amp fuse (35) Improper ground Insufficient battery charge (31) Blown fusible link (22) Defective key switch (22) Improper wiring connection	Replace Replace Replace Correct Recharge Replace Replace Repair
Inoperative engine stop solenoid	Defective key switch (22) Blown out 5 amp fuse (35) Defective engine stop solenoid (5) Defective key switch (22) Improper ground Improper wiring connection Insufficient battery charge (31) Blown fusible link (22)	Replace Replace Replace Replace Correct Repair Recharge Replace
Engine oil pressure lamp does not light at key switch ON position and engine no running	Defective key switch (22) Blown out bulb (8) Defective instrument panel wiring (8) Blown out 5 amp fuse (35) Improper ground Improper wiring connection Insufficient battery charge (31) Blown fusible link (22)	Replace Replace Replace Replace Correct Repair Recharge Replace

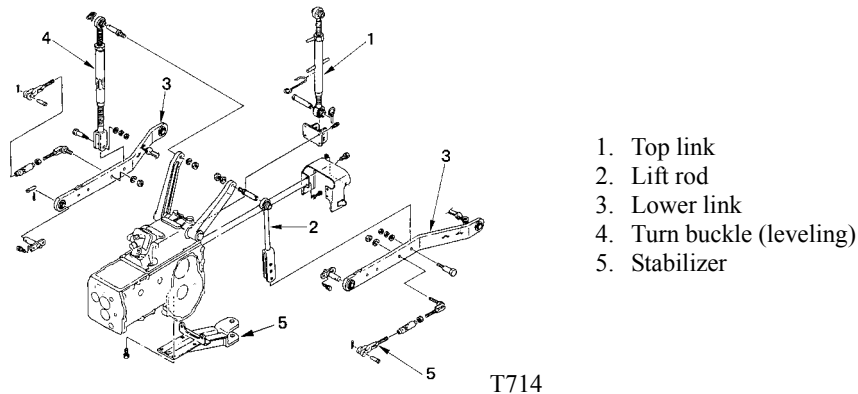
Condition	Cause	Remedy
Engine oil pressure lamp does not go off while engine running	Low oil pressure Short circuit between instrument panel and oil pressure sensor Insufficient battery charge (31) Blown fusible link (32) Blown 5 amp fuse (33) Malfunctioning key switch (22) Improper wiring connection Improper ground to bonnet	Check Correct Recharge Replace Replace Replace Repair Repair
Coolant temperature gauge pointer does not move	Defective thermometer sensor (7) Defective temperature gauge (8) Blown out 5 amp fuse (35) Defective instrument panel wiring (8) Insufficient battery charge (31) Blown fusible link (32) Malfunctioning key switch (22) Improper wiring connection Improper ground	Replace Replace Replace Replace Recharge Replace Replace Repair Repair
Cruise control does not work	Defective cruise control switch (11) Defective cruise latch relay (10) Defective diode (37) Defective latch magnet (9) Brake switches (16 and 17) are ON position Defective HST brake switch relay (20) Insufficient battery charge (31) Blown fusible link (32) Blown 5 amp fuse (35) Malfunctioning key switch (22) Improper wiring connection Improper ground	Replace Replace Replace Replace Adjust Replace Recharge Replace Replace Replace Repair Repair
Parking brake indicator lamp does not light when pulled up brake lever	Blown out 5 amp fuse (35) Defective parking brake switch (15) Defective instrument panel wiring (8) Insufficient battery charge (31) Blown fusible link (32) Malfunctioning key switch (22) Improper wiring connection Improper ground	Replace Replace Replace Recharge Replace Replace Repair Repair
Parking brake indicator lamp lighting when pulled down brake lever	Shorted wiring between instrument panel to switch Defective instrument panel wiring (8)	Correct Replace

Condition	Cause	Remedy
Brake lamps do not light when depress the brake pedal(s)	Blown out 10 amp fuse (36) Defective diode (38) Brake pedal switches adjustment are not correct Defective brake switch relay (21) Insufficient battery charge (31) Blown fusible link (32) Improper wiring connection Improper ground	Replace Replace Readjust Replace Recharge Replace Repair Repair
Starting motor will not energized	Insufficient battery charge (31) Blown fusible link (32) Malfunctioning key switch (22) Improper wiring connection Improper ground Defective safety start relay (29) Defective or unadjusted range safety switch (18-A) (HST model) Defective or unadjusted rear PTO switch (18-B) (HST model) Defective or unadjusted mid PTO Switch (18-C) (HST model) Defective or unadjusted main safety switch (19-A) (9×3 model) Defective or readjusted rear PTO switch (19-B) (9×3 model) Defective or unadjusted mid PTO switch (19-C) (9×3 model)	Recharge Replace Replace Repair Repair Replace Replace or correct Replace or correct Replace or correct Replace or correct Replace or correct Replace or correct
Flasher and hazard light not illuminated	Defective flasher relay (26) Defective ground Blown out bulb (12 and 13) Blown out 15 amp fuse (36) Insufficient battery charge (31) Blown fusible link (32) Improper wiring connection Improper ground	Replace Correct Replace Replace Recharge Replace Repair Repair
Glow plugs will not heat	Insufficient battery charge (31) Blown out fusible link wire (32) Defective glow plugs (34) Malfunctioning key switch (22) Improper wiring connection Improper ground	Recharge Replace Replace Replace Repair Repair
Cold starting indicator light will not illuminated	Defective glow lamp timer (27) Defective glow lamp relay (28) Defective ground Insufficient battery charge (31) Blown fusible link (32) Blown 5 amp fuse (35) Malfunctioning key switch (22) Improper wiring connection Improper ground Blown out bulb (8) Malfunctioning instrument panel wiring (8)	Replace Replace Correct Recharge Replace Replace Replace Repair Repair Replace Replace

3-9 Cultivating Implement Installing Device

1. THREE POINT LINK

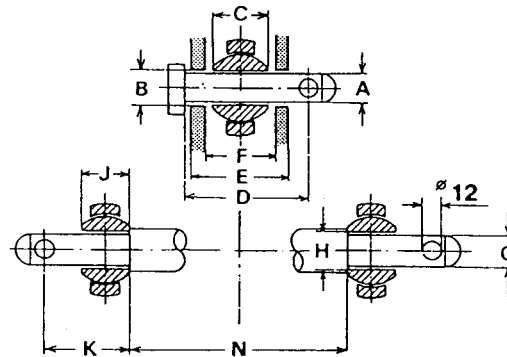
1) Name of major components of three-point link



2) Standard for three-point link

The hydraulic three-point link is of the 1 type in conformity with the international standard category. Any implements with mounting part in conformity with this standard may be mounted.

Type	A	B	C (Max.)	D (Min.)	E (Max.)	F (Min.)	G	H	J	K (Min.)	N
Category 1	$19 \begin{smallmatrix} 0 \\ -0.084 \end{smallmatrix}$	$19.5 \begin{smallmatrix} +0.21 \\ 0 \end{smallmatrix}$	44	76	69	44.5	$22 \begin{smallmatrix} 0 \\ -0.21 \end{smallmatrix}$	$22.4 \begin{smallmatrix} +0.33 \\ 0 \end{smallmatrix}$	$35 \begin{smallmatrix} 0 \\ -0.2 \end{smallmatrix}$	40 or 52	683 ± 1.5



T715

3) Service and cautions for handling of three-point link

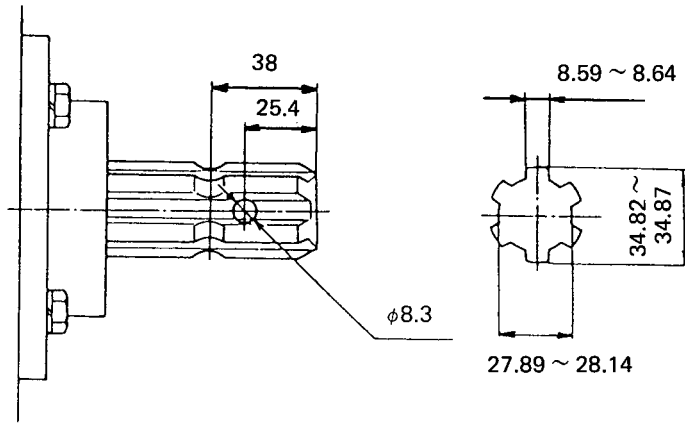
- (1) Understand the functions and the method of mounting the implement well before mounting it.
- (2) In case of rotor, etc. with which PTO is used together, determine the position and length of the top link giving consideration to the universal joint angle.

- (3) Each spherical joint of the three-point link is hard to wear when no grease or oil is used. However, coat it thinly with grease to prevent rust when storing.
- (4) Supply oil to the tread of the top link always to secure smooth operation.
- (5) Be sure to leave the pins of the three-point link on the side of the tractor when disconnecting the implement since they are apt to be lost.

2. PTO (POWER TAKE-OFF SHAFT)

Specifications

(1) Rear PTO

Model	Manual Transmission	Hydrostatic
Rotating direction	Clockwise facing the shaft	
PTO speed (at engine speed 2600 rpm) (rpm)	588	561
PTO ground clearance mm (mm)	441 (ST318)	419
	466 (ST321)	
PTO shaft dimension (mm)	φ35, 6-groove square spline shaft  Unit mm	

T716

(2) Mid mount PTO

Model	Manual Transmission		Hydrostatic Transmission
	ST318	ST321	ST318· 321· 324
Rotating direction	Clockwise facing shaft		
Speed (at engine speed 2600 rpm) (rpm)	2139	2139	2040
PTO shaft ground clearance (mm)	283	308	261

3-10 Maintenance Standards Table

* Values without unit in the column of inspection item are mm ones.

Main or auxiliary	Unit	Inspection item	Standard dimension	Assembling standard	Repair value	Service limit	Remarks
Main body	Clutch	Clearance between drive shaft and clutch disk spline		0.3 – 0.43		0.6	
		Clearance between clutch disk and drive shaft in rotating direction		0.025 – 0.1		0.25	
		Clearance between clutch case and release hub		0.025 – 0.075		0.5	
		Clutch disk thickness	8.1 ± 0.3			6.6	
		Recess of clutch disk ribbet	1.2			0.3	
		Pedal play		20 – 30	More than 40		
		Release lever height	29.5 – 30.5				
	Transmission	Gear backlash		0.04 – 0.2		0.6	
		Clearance of slide gear and shifter fork		0.1 – 0.3		1.0	
		Clearance between shifter rod and casing bearing		0.03 – 0.1		0.3	
	Differential/PTO	Clearance between differential pinion and pinion shaft		0.03 – 0.1		0.5	
		Differential pinion thrust washer thickness	1.2			0.9	
		Backlash of differential gear and differential pinion		0.1 – 0.3		0.5	
		Ring gear tightening torque N·m (kgf·m)		25.5 – 28.4 (2.6 – 2.9)			
		Drive pinion preload N(kgf)		68.6 – 88.2 (7 – 9)			Load when pulled with string wound
		Drive pinion ring gear backlash		0.1 – 0.2	0.5		
		PTO end run-out		Less than 0.1		0.3	
		Gear oil quantity (ℓ)	16				Manual Trans. SAE80
							HST. ISO VG46

Main or auxiliary	Unit	Inspection item	Standard dimension	Assembling standard	Repair value	Service limit	Remarks
Main body	Rear wheel	Rim run-out		3		5	
		Lug height	AG	28		14	
			Turf	7		4	
		Tire size	AG	9.5 – 164 ply (ST321)			
			Turf	29 × 12.00 – 15 (HST)			
	Brake	Brake lining thickness	4.0			3.7	
		Stator level height difference	0			0.1	
		Clearance between pedal shaft and bush		0.05 – 0.35		1.0	
		Pedal play		20 – 30		40	
	Hydraulic system	Relief valve working pressure kgf/cm ² MPa (kgf/cm ²)	12.74 (130)	12.25 – 13.23 (125 – 135)			
		Clearance between hydraulic arm shaft and bush		0.02 – 0.15		0.3	
		Natural drop of hydraulic system (at lower link end) (mm/min)		30/5		100/5	Engine stopped Load 350 kg Hydraulic system temp. 60 - 70° C
	4WD front axle	Clearance between differential pinion and pinion shaft		0.03 – 0.1		0.5	
		Differential pinion thrust washer thickness	1.0			0.7	
		Differential gear and differential pinion backlash		0.1 – 0.15	0.5		
		Ring gear tightening torque N·m (kgf·m)		26.5 – 28.4 (2.7 – 2.9)			
		Drive pinion preload N(kgf)		98 – 137 (10 – 14)			

Main or auxiliary	Unit	Inspection item		Standard dimension	Assembling standard	Repair value	Service limit	Remarks
Main body	4WD front axle	Drive pinion ring gear backlash			0.1 – 0.15	0.3		
		Clearance between pivot shaft and bush	Front		0.02 – 0.2		0.35	
			Rear		0.02 – 0.16		0.35	
		King pin inclination angle		8°				Fixed type
		Toe-in			-5 ~ +5	-10 ~ +10		
		Caster		0°				Fixed type
		Camber		3°				Fixed type
		Final gear backlash			0.1 – 0.25		0.4	
		Rim run-out			3.0		5.0	
		Wheel lug height	5 – 12	25			14	
			6 – 12	28			14	
			20 × 8.00-10	7			4	
		Tire size	AG	5 – 12				
				6 – 12				
			Turf	20 × 8.00 -10				
		Gear oil (ℓ)	Differential chamber	1.0				
			Gear chamber	One side 0.4				
		Idle gear backlash			0.1 – 0.25		0.4	