

SHIBAURA TRACTOR

MODEL

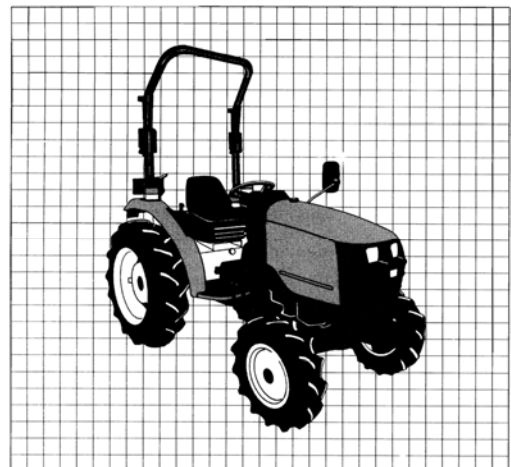
ST330/ST333

**WORKSHOP
MANUAL**

NOTE:

**This WORKSHOP MANUAL for
the Tier 3 ENGINE of ST330 and
ST333 Tractor.**

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SHIBAURA TRACTOR

MODEL

ST330/ST333

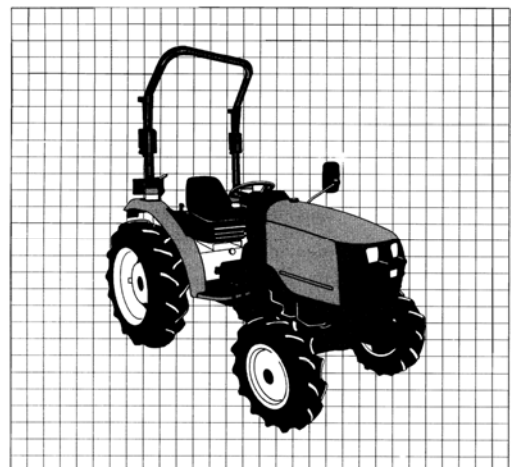
**WORKSHOP
MANUAL**

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- 1 — 2 Specification & Performances
- 1 — 3 Precautions Before Servicing
- 1 — 4 Basic Understanding on Servicing
- 1 — 5 Sequence of Dismantling the Tractor
- 1 — 6 Installation and Trial Run

NOTE:

This WORKSHOP MANUAL for the Tier 3 ENGINE of ST330 and ST333 Tractor.



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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.

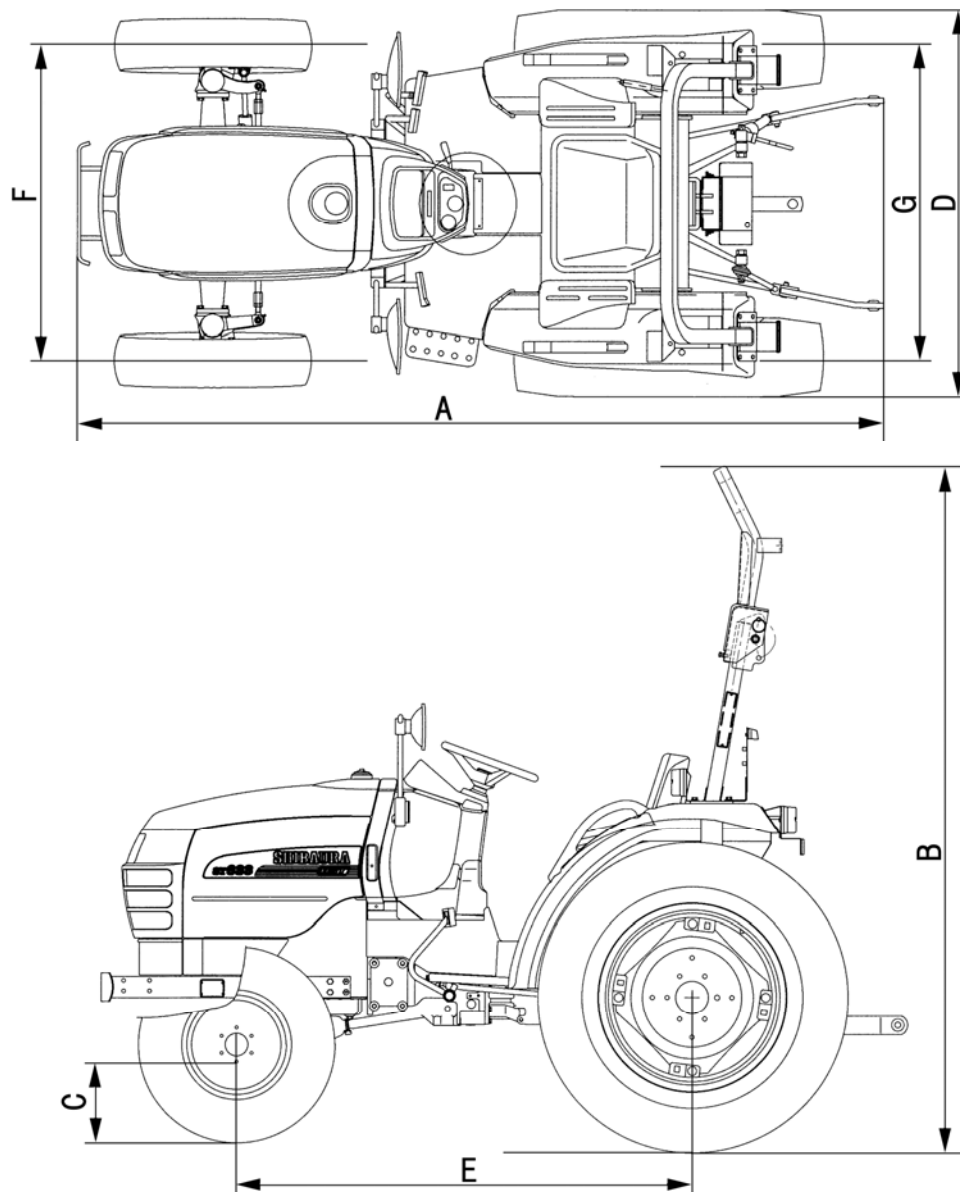
They meet users' needs according to efficient and economical specifications requiring no after-care.

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

IHI-Shibaura Machinery Co., Ltd.
Tractor and Turf Care Machinery Division
Tractor Quality Assurance Group

Chapter 1. GENERAL

1-1 External Views



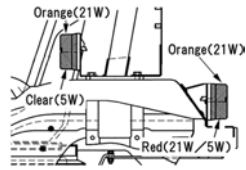
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Unit: mm

Model	A	B	C	D	E	F	G
ST 330 (9 × 3) ST 333 (9 × 3)	2825	2490	300	1390	1600	1150	1115 (953~1345)
ST 330 (HST) ST 333 (HST)	2825	2425	240	1500	1600	1100	1155

1-2 Specifications & Performances

Model			ST330	ST333	ST330	ST333
			HST		9 × 3	
Main Body	Length (Lower Link at horizontal)		2825			
	Height	Top Steering Wheel	1373 mm		1432 mm	
		Top ROPS	2425mm		2490 mm	
	Width		1470 mm		1345 mm	
	Wheel Base		1600 mm			
	Minimum Ground Clearance		240 mm		285 mm	
	Minimum Turning Radius (with brake)		2760 mm			
	Weight (W/ROPS)		1090kg	1090kg	1115kg	1115kg
	Front Wheel	Tire Size	25 × 8.50 – 14 (Turf)		7–14 (AG) 6–14 (AG)-Option	
		Inflation	See “Operator’s Manual”			
		Tread	1150 mm		1100 mm	
	Rear wheel	Tire Size	13.6 – 16 (Turf)		11.2-24 (AG) 9.5-24 (AG)-Option	
		Inflation	See “Operator’s Manual”			
		Tread	1120 mm		1070 (953~1345) mm	
	Clutch		Single Disc Dry Type			
	Speed Change method		Hydrostatic Transmission		Selective Sliding Shifter	
	Running Speed Changes		3 Steps Forward and 3 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		1-Speed or 2-Speed	
	PTO Shaft Size		35 mm in Diameter with 6 Square Splines			
Three Point Linkage Size		Category 1				
PTO Shaft Ground Clearance		Mid	296 mm			
		Rear	499 mm		555 mm	
PTO Shaft Rotating Direction		Clockwise as seen from output end side				
Engine	Model		N843 (ST330)		N843 (ST333)	
	Type		Water-Cooled 4-Cycle Vertical Diesel Engine			
	Number of Cylinders		3			
	Total Stroke Volume		N843 - 1496cc			
	Continuous Rated Speed		2,800 rpm			
	Compression Ratio		22.2 : 1			
	Fuel		Diesel Fuel Oil			
	Starting Method		By Starting Motor			

The ground speeds are engine speed at 2800 rpm with 11.2-24 Rear Tires On Manual Transmission. The ground speeds are engine speed at 2800 rpm with 13.6-16 Rear Tires On Model HST Transmission.								
		Range	Main	Gear Position	Manual Transmission		Hydrostatic Transmission	
					AG Tire	Turf Tire	AG Tire	Turf Tire
Ground Speeds	Forward (km/h)	L	1	1st	1.30	1.17	0 – 5.59	0 – 5.63
			2	2nd	1.94	1.73		
			3	3rd	2.78	2.49		
		M	1	4th	4.14	3.70	0 – 13.07	0 – 11.69
			2	5th	6.11	5.46		
			3	6th	8.79	8.24		
		H	1	7th	10.58	9.47	0 – 25.18	23.84
			2	8th	15.65	14.00		
			3	9th	23.04	20.07		
	Reverse (km/h)	L	R	R1	1.94	1.73	0 – 3.92	0 – 3.94
		M		R2	6.11	5.46	0 – 9.15	0 – 8.18
		H		R3	15.65	14.00	0 – 17.63	0 – 16.69
No. of PTO Speeds					1 or 2		1	
1-speed PTO Model	Engine speed for 540rpm Rear PTO (rpm)				2455		2500	
	Engine speed for 2000rpm Mid PTO (rpm)						2420	
2-speeds PTO Model	Engine speed for 540rpm Rear PTO (rpm)				2485		—	
	PTO speed at engine speed 2800 rpm (rpm)				608		—	
					893		—	
Capacities	Fuel Tank		30 Liters					
	Engine oil		Less Filter 4.0 Liters, with Filter Change 4.5 Liters					
	Cooling Water		5 Liters					
	Transmission Oil		32.5 Liters (HST) , 30.5 Liters (9 × 3)					
	Hydraulics		Transmission Oil used in common					
	Front Axle Gear Case		3.1 Liters (Front differential gear case 1.5 litters and final reduction gear case 0.8 Liters×2)					
Electrical System	Grounding		Negative (—)					
	Battery		12 Volt, 55 amps. (HST), 12 Volt, 64 amp. (9×3)					
	Starting Motor		12 V — 1.7 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					
License 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 model, 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.

1. 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

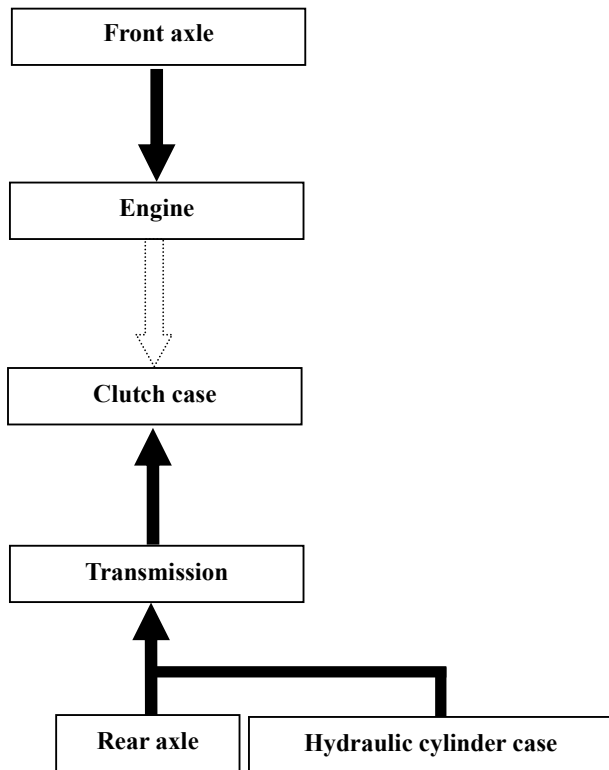
Bolt head identification mark	Strength grade	Example
	4.8	
	8.8	
	10.9	

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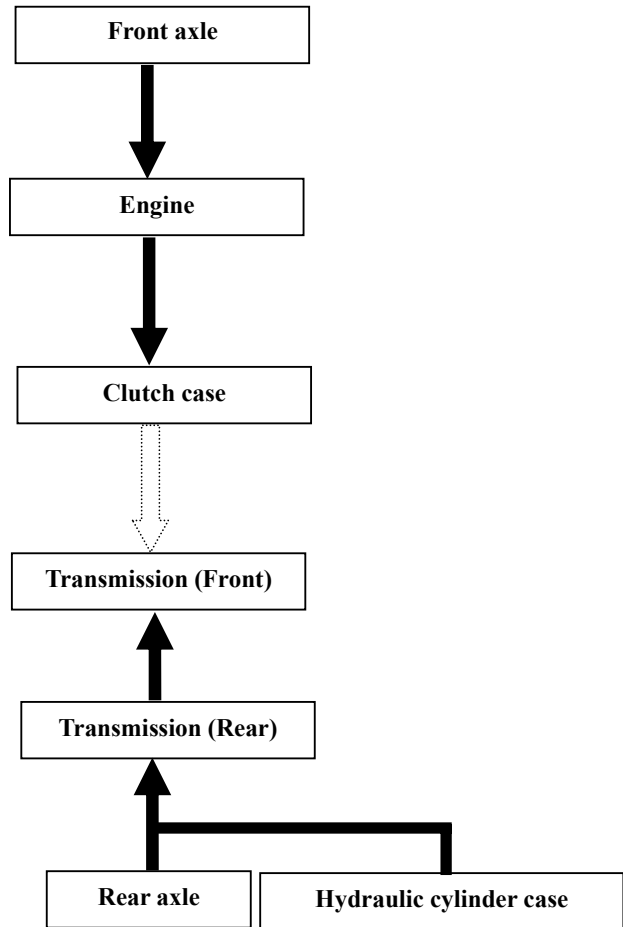
1-5 Sequence of Dismantling the Tractor

1. FLOW CHART

1) Manual Transmission Model



2) Hydrostatic Transmission Model



2. ENGINE AND HST UNIT REMOVAL (9 × 3 and HST)

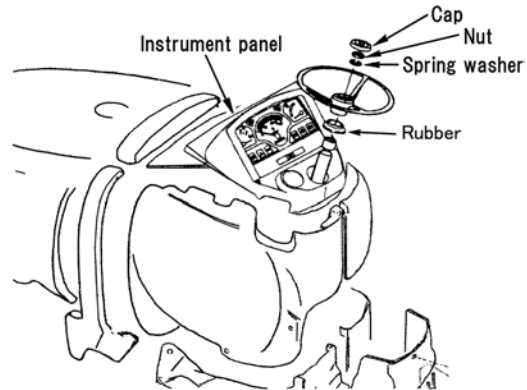
DISASSEMBLY

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, speed meter cable and combination switch connector.
- ④ Remove the rubber and instrument panel.

NOTE:

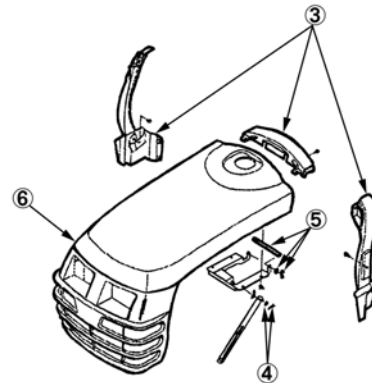
Keep the glass face of the instrument panel up after removal. This will prevent the silicone oil in the fuel level gauge and coolant temperature gauge from leaking out causing the gauges to give a false indication during operation.



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2) BONNET (HOOD)

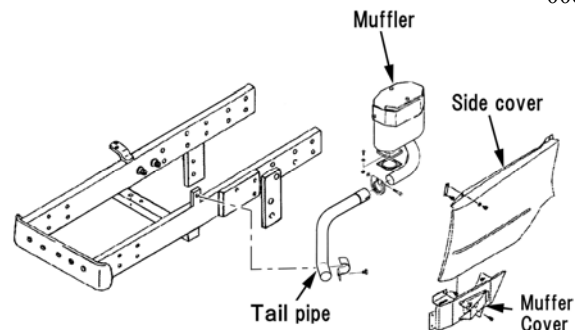
- ① Disconnect the negative terminal from the battery.
- ② Disconnect the connector for head lamps.
- ③ Remove the cover from rear of hood.
- ④ Remove the clip pin and washer from the hood support plate, and gradually lower the hood.
- ⑤ Remove the clip pins from the hood hinge pin and remove the hinge pin.
- ⑥ Remove the hood from the tractor.



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3) SIDE COVER, EXHAUST MANIFOLD

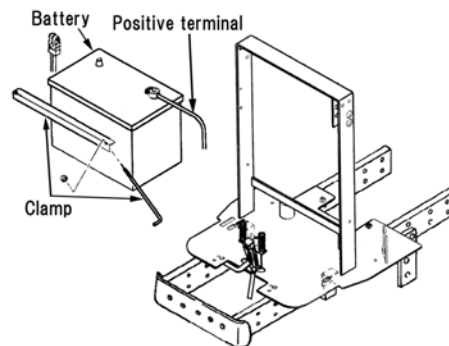
- ① Remove the right and left side covers.
- ② Remove the muffler cover, muffler and tail pipe from the engine.



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4) BATTERY

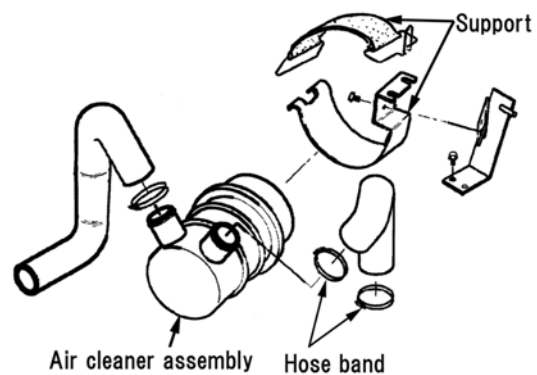
- ① Disconnect the positive terminal from the battery, and remove the clamp and battery.



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5) AIR CLEANER ASSEMBLY

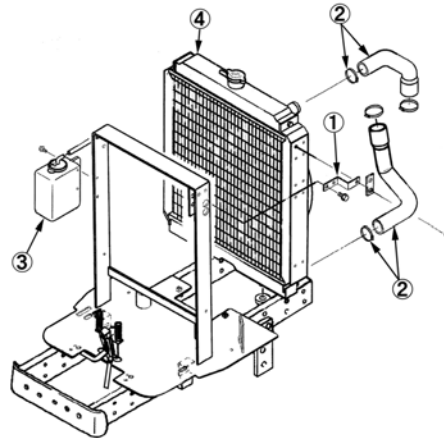
- ① Un tighten the hose band of the intake manifold.
- ② Remove the air cleaner assembly from the air cleaner support.



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6) RADIATOR ASSEMBLY

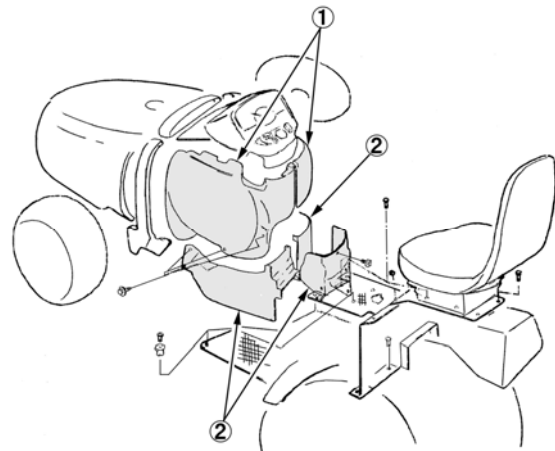
- ① Remove the radiator supports.
- ② Untighten the hose bands and disconnect the radiator hoses.
- ③ Remove the reserve tank from the battery support.
- ④ Remove the radiator assembly.



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7) DASH BOARD (SHROUDING)

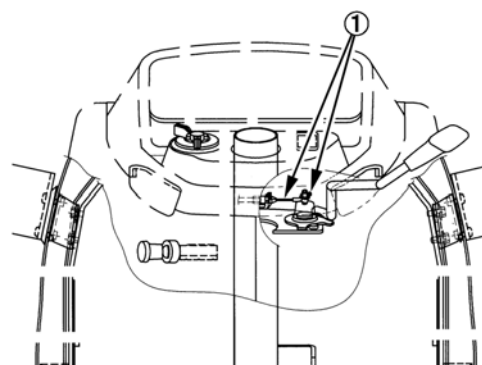
- ① Remove the cover (R.H. and L.H.) and dash board (Rear) .
- ② Remove the screws securing the steering column center shrouding, disconnect the electrical connectors from the ignition switch and light switch, and remove the shrouding.



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8) THROTTLE CABLE

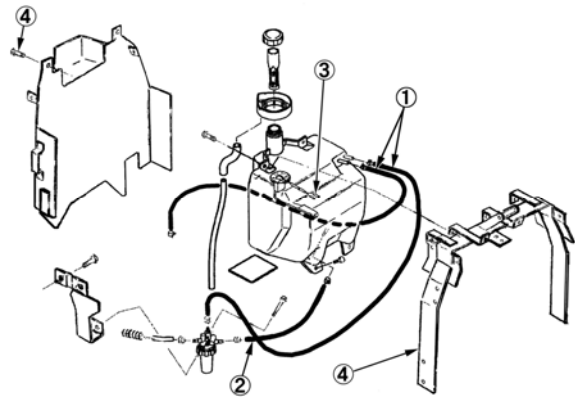
- ① Remove the cotter pin from the throttle lever and disconnect the throttle cable.
- ② Disconnect the electrical connector from the tractor rear main harness.



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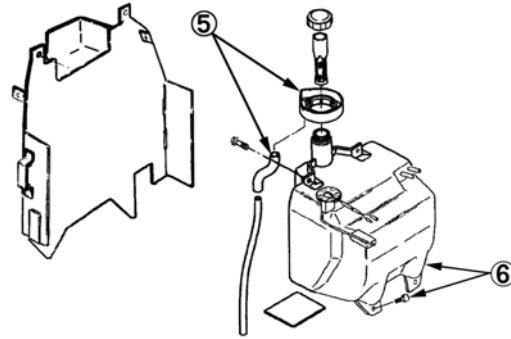
9) FUEL TANK

- 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 from top of the fuel tank.



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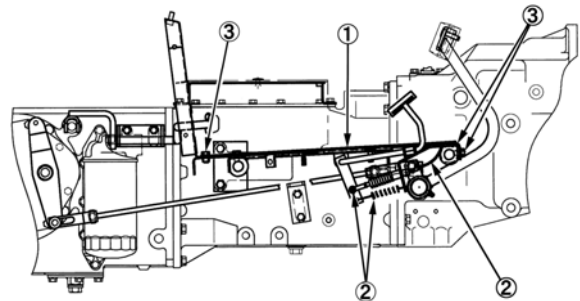
- ⑤ Remove the spillover collector from the fuel tank neck.
- ⑥ Remove the screws and tank from the tractor.



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10) SIDE STEP

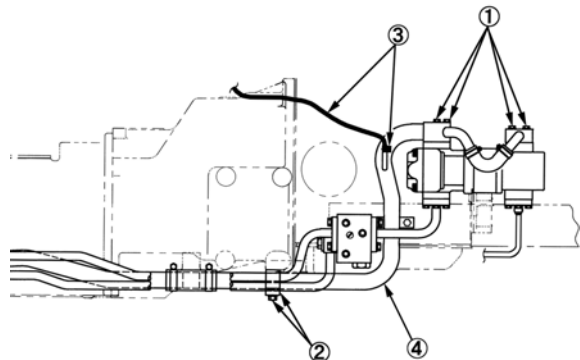
- ① Remove the floor mat and sponge.
- ② Remove the foot throttle linkage return spring, remove cotter pin and disconnect the foot throttle linkage from underneath the right side step. (9×3 Model only)
- ③ Remove the bolts and side steps.



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11) SUCTION PIPE

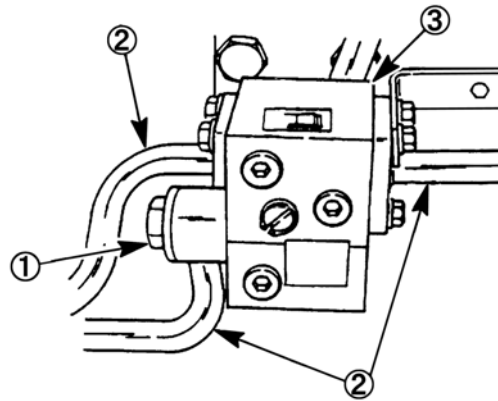
- ① Remove the bolts and lock washers and disconnect the hydraulic pump suction line from both oil pumps.
- ② Remove the hydraulic tubing support clamps from under the tractor.
- ③ Remove the hose band and power steering oil return hose from the suction pipe.
- ④ Loosen the hose clamp and separate the suction line from the hose.



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12) DIVERTER VALVE

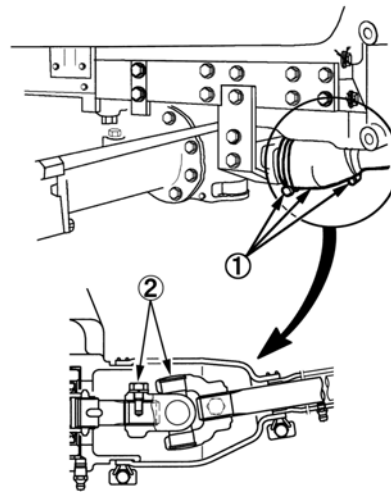
- ① Remove the banjo bolts and disconnect the sump return from the diverter valve disconnect the other end from the sump.
- ② Disconnect the system pressure line from the diverter valve and the lift cover.
- ③ Remove the diverter valve.



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13) RUBBER AND DRIVE SHAFT

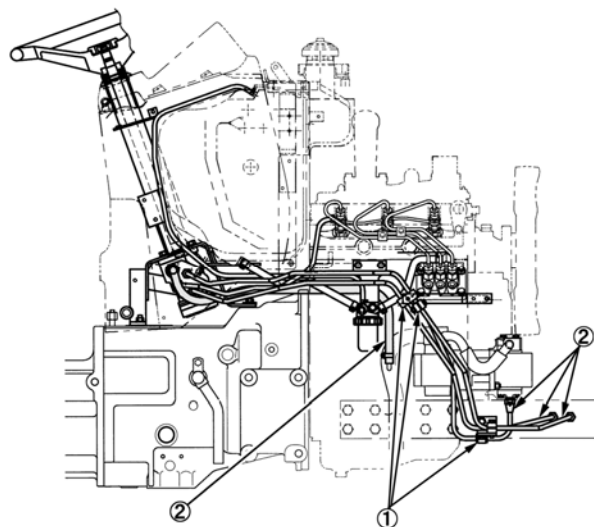
- ① Loosen the clamps on the front wheel drive shaft rubber boot and slide the boot rearward to gain access to the shaft universal joint.
- ② Remove the universal joint locking bolts from the front axle and transmission end universal joints and if necessary, remove the drive shaft.



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14) POWER STEERING PIPING

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



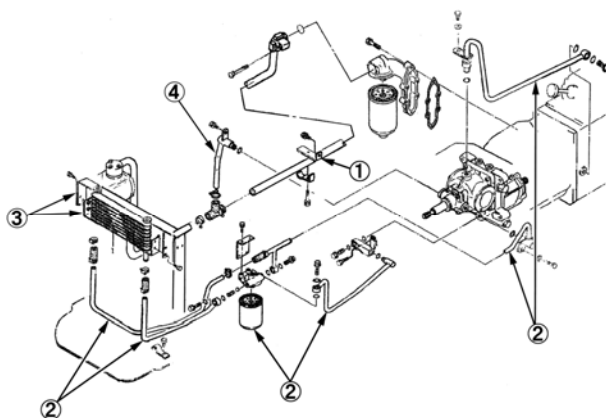
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15) WIRING

- 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.

16) HST PIPING, OIL COOLER, OIL FILTER WITH BASE (HST MODEL)

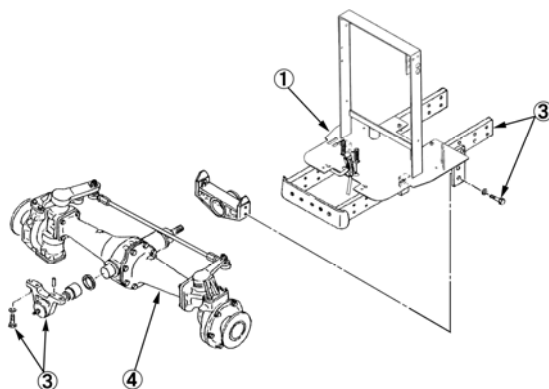
- ① Remove the clamps for HST piping.
- ② Release the hose bands and remove the banjo bolts, pipings and oil filter with base.
- ③ Remove the brackets and oil cooler from on the radiator.
- ④ Release the hose band and remove the banjo bolt and suction pipe for HST.



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17) BATTERY BASE, FRONT AXLE SUPPORT

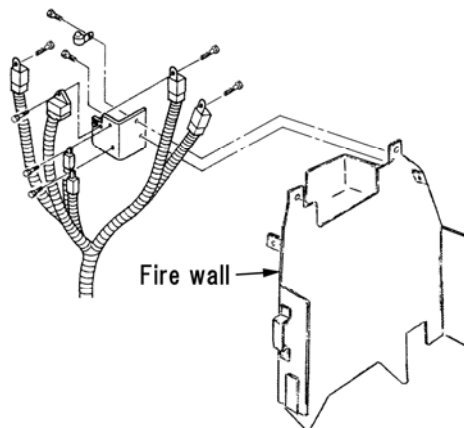
- ① Remove the bolts and battery base from on the front axle support.
- ② Lift the engine with the hoist and put the safety stand under the clutch housing.
- ③ Heat the front axle support attaching bolts head by burner, and remove the bolts and front axle support with front axle assembly.
- ④ Separate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



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18) FIREWALL

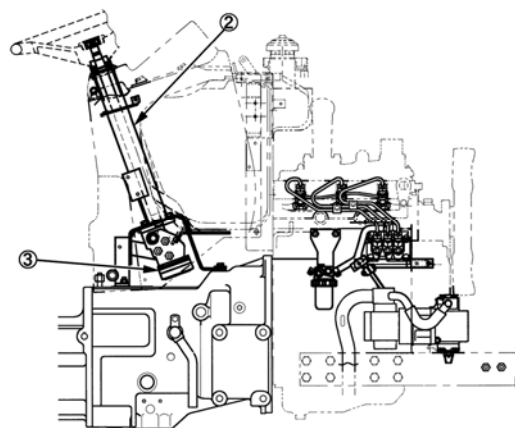
- ① Disconnect the electric wire connectors from the light switch and relay etc.
- ② Remove the firewall with electric wire harness.



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19) POWER STEERING CONTROL VALVE, COLUMN

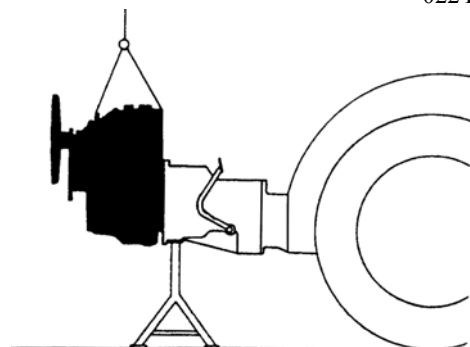
- ① Remove the cruise control assembly from the steering column on HST model.
- ② Remove the bolts and steering column from the clutch housing.
- ③ Remove the power steering control valve from the column.



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20) ENGINE

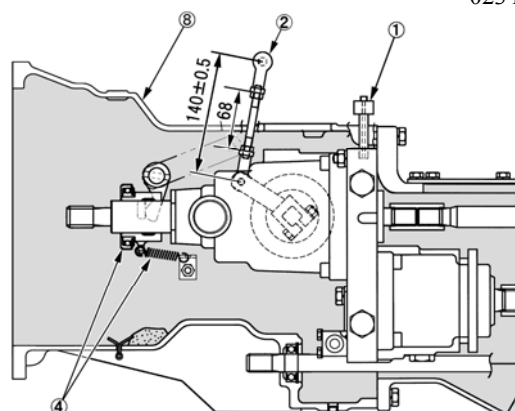
- ① Remove the engine attaching bolts and separate the engine from the clutch housing.



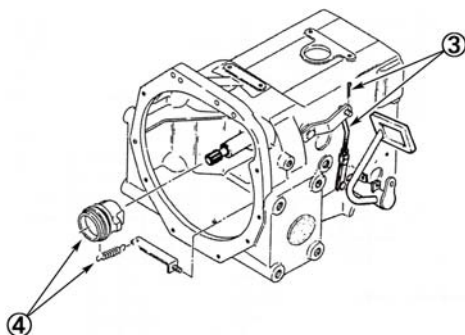
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21) CLUTCH HOUSING (HST ONLY)

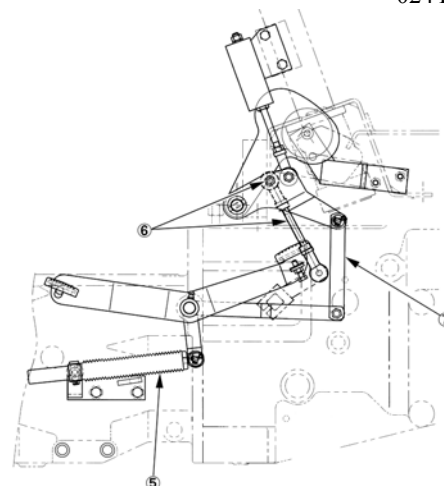
- ① Remove the HST test port from top of clutch housing.
- ② Note the HST control rod length before removing for reassembly.
- ③ Remove the cotter pin and disconnect the clutch rod.
- ④ Remove the spring and release bearing from front of HST.
- ⑤ Remove the damper from R.H. side of the transmission housing.
- ⑥ Remove the nut and disconnect the turn buckle from the shift link.
- ⑦ Remove the shift link.
- ⑧ Remove the clutch housing retaining bolts, and separate the clutch housing.



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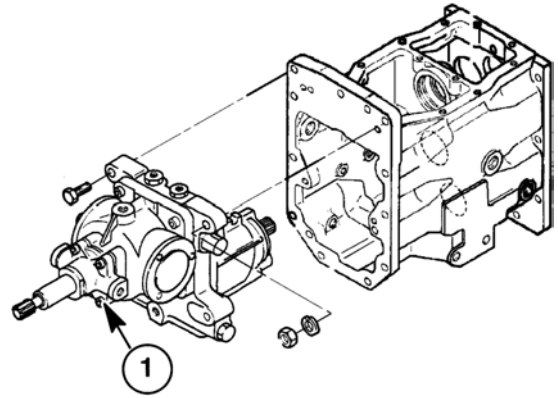
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22) HST UNIT

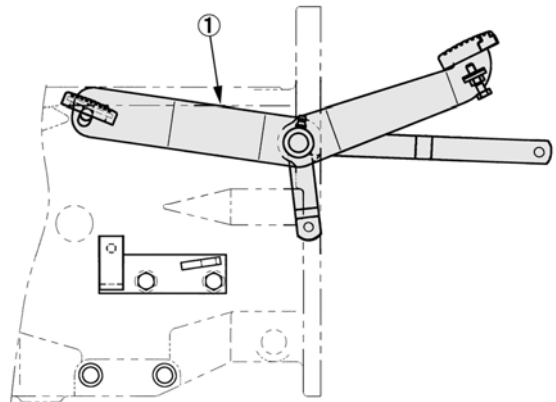
- ① Remove the HST unit from the extension housing.



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23) HST SHIFT LINK ASSEMBLY

- ① Remove the E-clip and remove the HST control pedal.



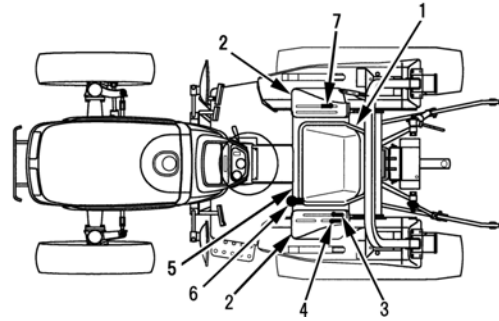
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3. TRANSMISSION REMOVAL (9 × 3 and HST)

1) DISASSEMBLY

(1) SEAT · SEAT TRACK · GRIP · LEVER GUIDE

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

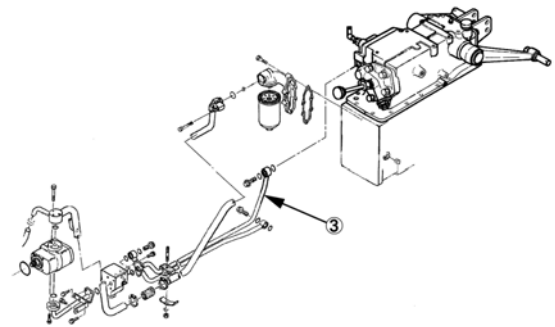


027Y

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

(2) FRONT SIDE COVER HIGH-PRESSURE INLET TUBE

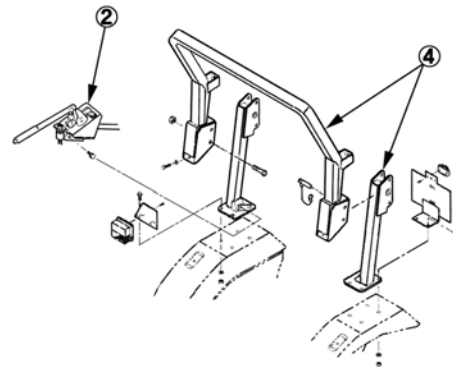
- ① Disconnect the FWD shaft from the transmission, see ENGINE REMOVAL.
- ② Open the hood and remove the front side cover.
- ③ Disconnect the high-pressure inlet tube, from the valve cover and plug the openings.



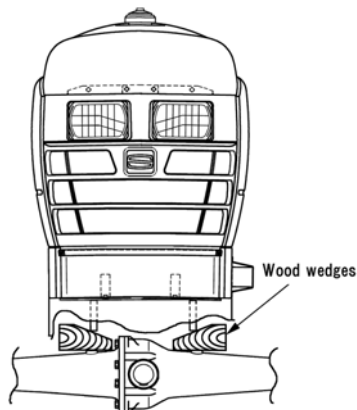
028Y

(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.



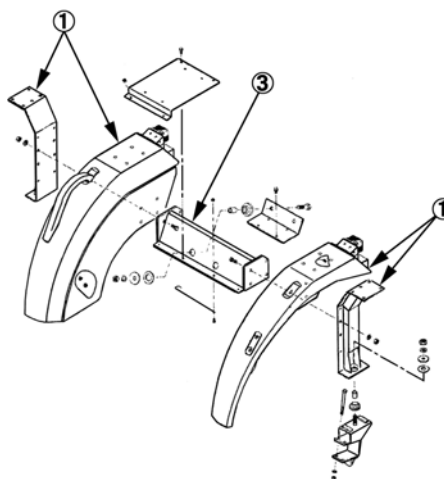
030Y



029Y

(4) FENDERS, TOOLBOX, CENTER FRAME

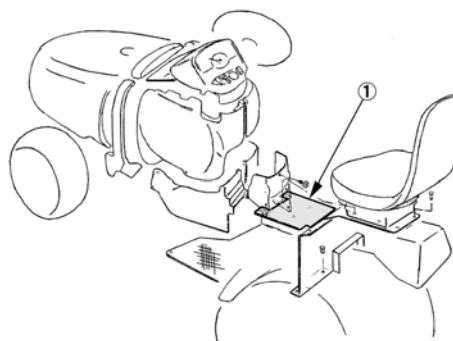
- ① Remove the fenders and ROPS. frame: lower.
- ② Remove the clip pin and pin from the both brake levers to separate the hand brake wires.
- ③ Remove the center frame.



031Y

(5) TRANSMISSION COVER PLATE

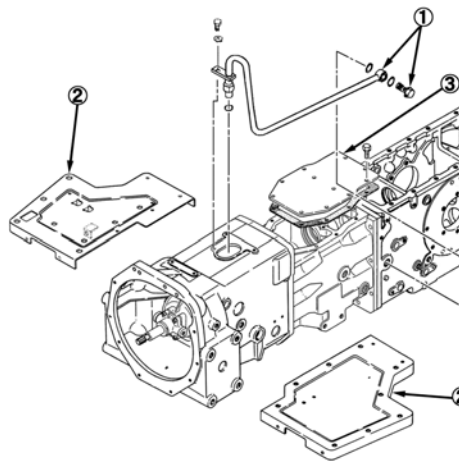
- ① Remove the transmission cover : Flower.



032Y

(6) CASE COVER BRAKE ROD

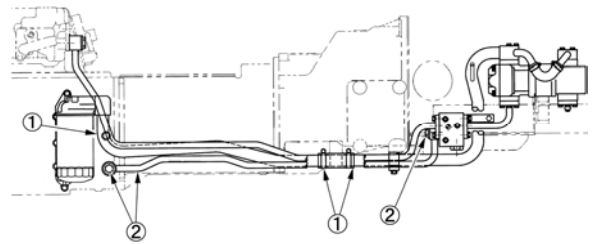
- ① Remove the bolt, banjo bolt and return pipe from the clutch housing. transmission housing (HST Model only).
- ② Remove the step plates, from both sides of the tractor, see ENGINE REMOVAL.
- ③ Remove the case cover.
- ④ Place blocking at the front and rear of both front wheels.
- ⑤ Disconnect the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



033Y

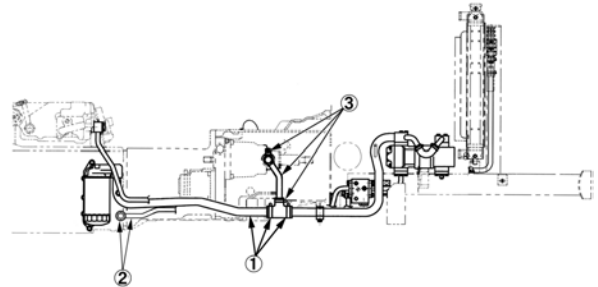
(7) SUCTION TUBE, RETURN TUBE

- 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.



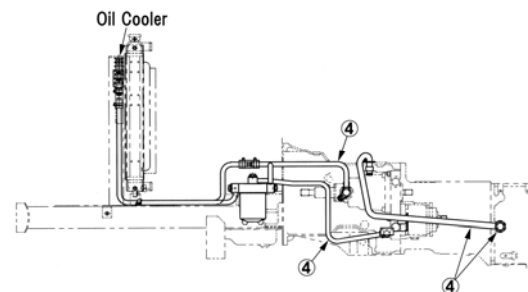
9×3 Shown
035Y

- ③ Loosen the hose clamp and remove the bolt, and suction tube.



HST Shown
036Y

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



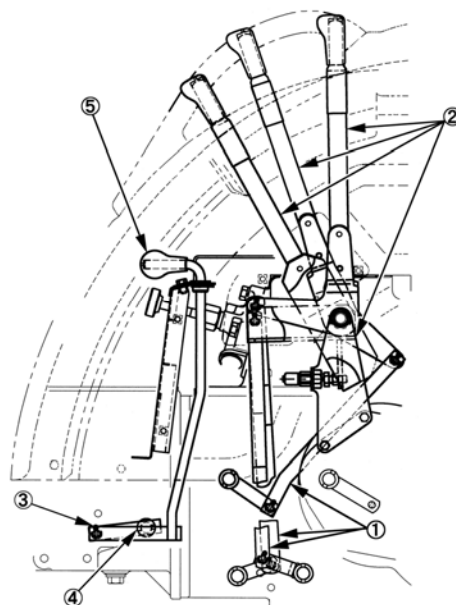
HST Shown
037Y

(8) MID PTO, REAR PTO AND RANGE GEAR CHANGE LEVER ASSEMBLY

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

(9) FRONT WHEEL DRIVE CHANGE LEVER

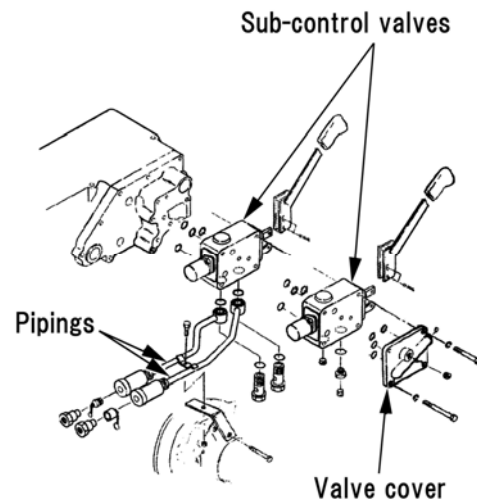
- ③ Remove the sprit pin.
- ④ Drive out the roll pin from the front drive change lever.
- ⑤ Remove the front drive change lever assembly from the transmission housing.



038Y

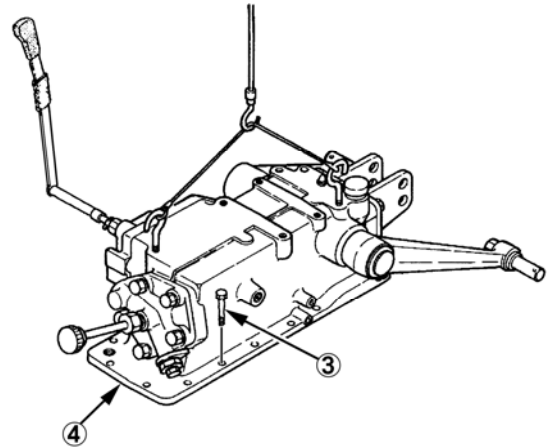
(10) LIFT CYLINDER HOUSING

- ① Remove the clamps for the extension pipings.
- ② Remove the valve cover and sub-control valve assembly with pipings.



042Y

- ③ Remove the retaining bolts and nuts securing the lift cover to the center housing.
- ④ Using a hoist, remove the lift cover.



043Y

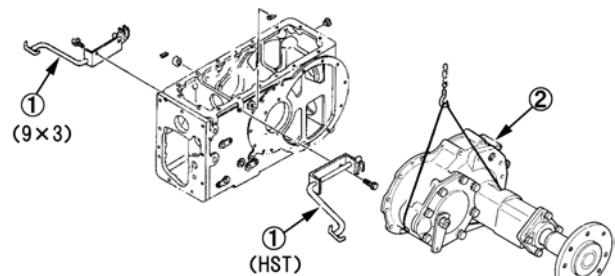
(11).REAR AXLE ASSEMBLY

- 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:

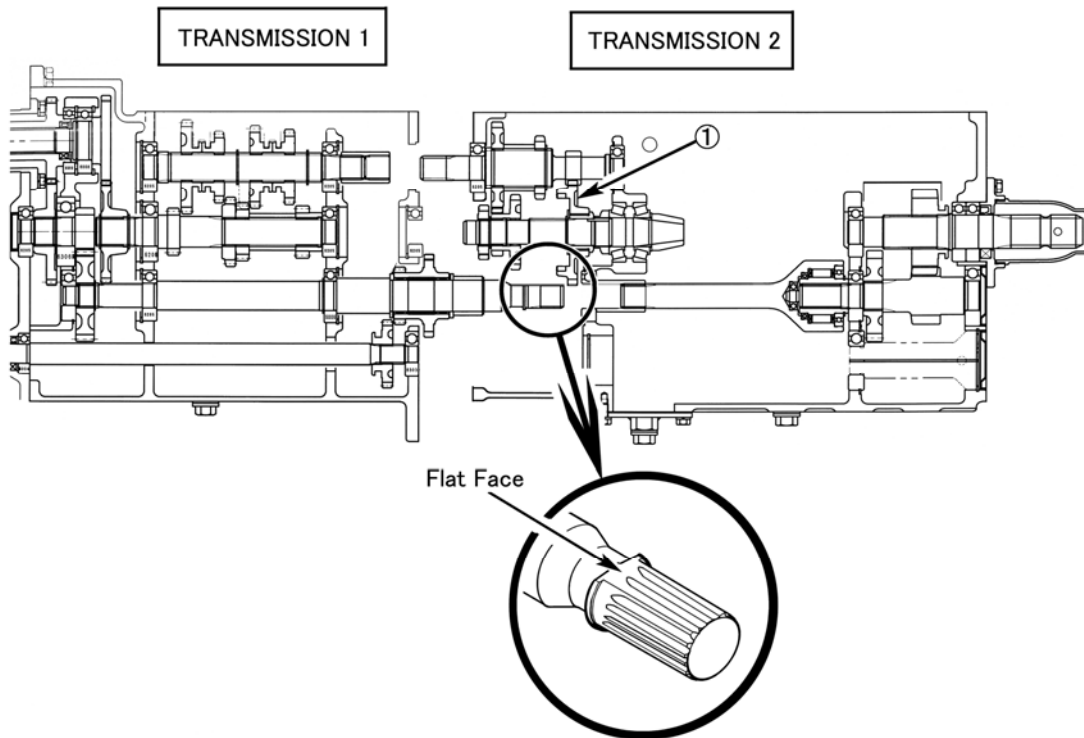
1 Take care so that units do not lose balance.

2 Differential lock pedal is installed on the R.H. housing of manual transmission and L.H. housing of HST model.



044Y

NOTE: Turn the flat face of the PTO countershaft toward the range counter gear, 1, on the drive pinion shaft to avoid the interferences when separate the transmission 2 from the transmission 1, refer to SECTION 3-3, TRANSMISSION 1 for 9X3 and SECTION 3-5, TRANSMISSION 2 for 9X3 in this MANUAL



044-1Y

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 refers to mentioned below:

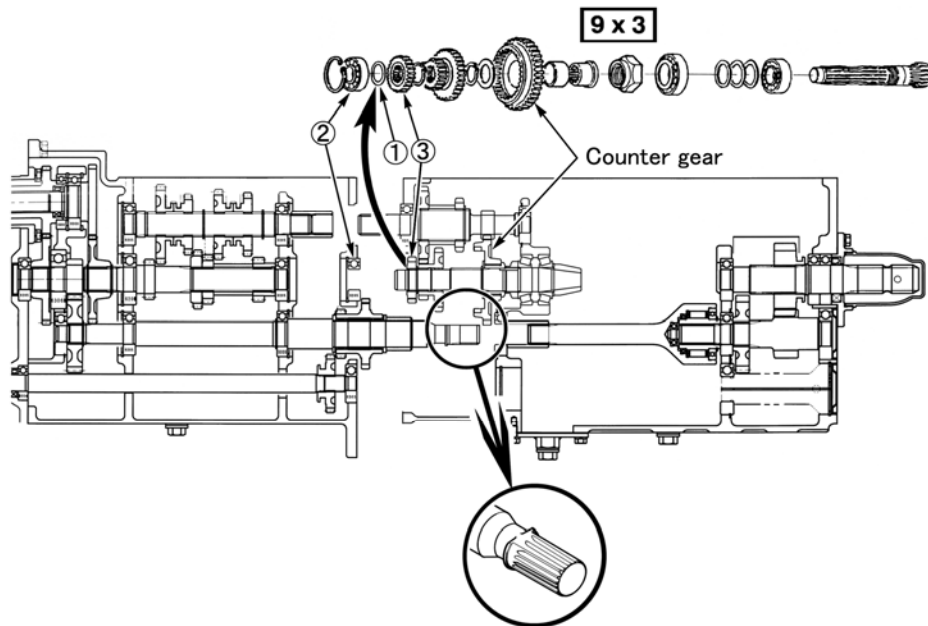
(1) JOIN THE TRANSMISSION 1 AND TRANSMISSION 2

When install the transmission 1 and transmission 2, take care as follows on Model 9×3 manual transmission.

Align the flat face on the PTO counter shaft of transmission 1 and counter gear on the drive pinion of transmission 2 when install the transmission 1 and transmission 2.

(For prevent the interference counter gear and PTO counter shaft.)

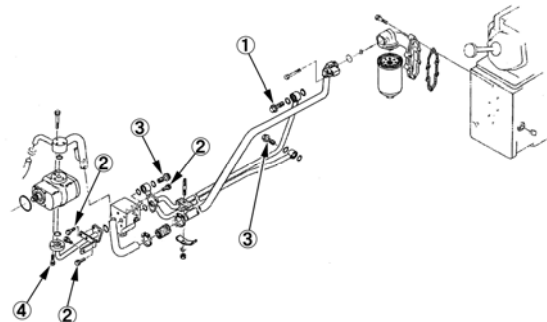
NOTE: Install the same thickness shim, 1, between the bearing, 2, and 4WD fixed gear, 3, before install the TRANSMISSION 1 and TRANSMISSION 2 on the 9x3 and HST models.



045Y

(2) Tightening torque for piping

- ① PF1/2 65.7~78.4 N·m {6.7~8.0 kgf·m}
- ② M8 22.6~28.4 N·m {2.3~2.9 kgf·m}
- ③ PF3/8 39.2~49.0 N·m {4.0~5.0 kgf·m}
- ④ M6 8.3~11.2 N·m {0.85~1.15 kgf·m}



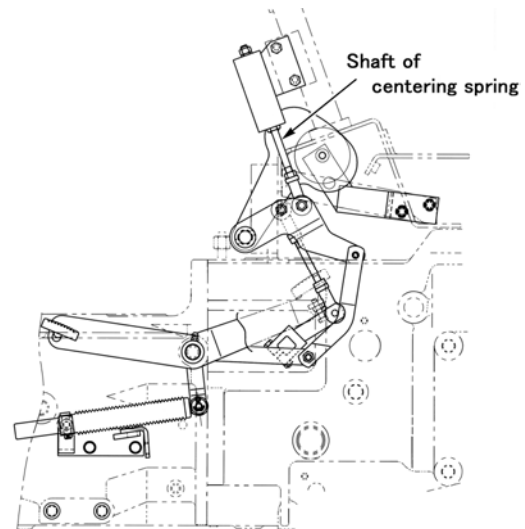
046Y

(3) 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 :

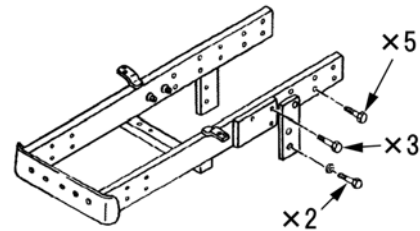
If necessary, adjust the neutral position by turn the shaft of the centering spring.



(4) FRONT AXLE SUPPORT BOLT

Apply the thread sealant on the bolts thread when install the front axle support and tighten to 117~148 N·m (11.9~15.1 kgf·m).

047Y

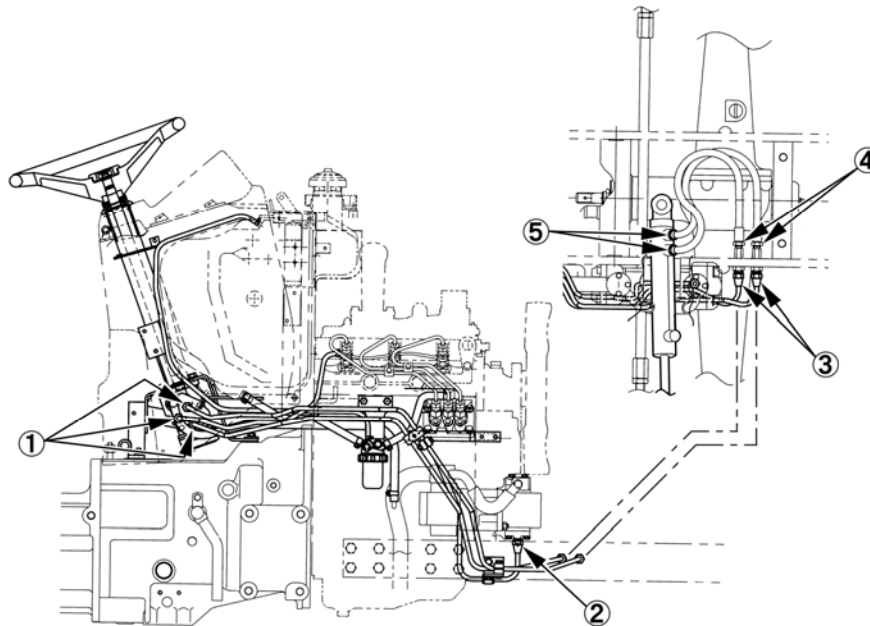


049Y

(5) POWER STEERING PIPING

Power steering pipings tightening torque to follows :

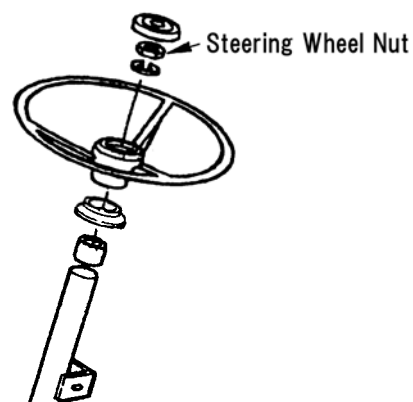
	Tightening torque	
①	29.4~39.2 N·m	{3.0~4.0 kgf·m}
②	29.4~39.2 N·m	{3.0~4.0 kgf·m}
③	29.4~39.2 N·m	{3.0~4.0 kgf·m}
④	35.3 N·m	{3.6 kgf·m}
⑤	35.3 N·m	{3.6 kgf·m}



048Y

(6) STEERING WHEEL NUT

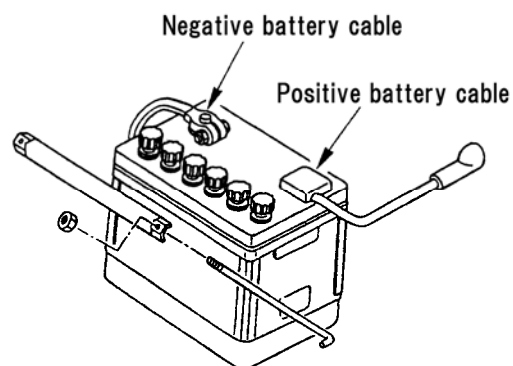
The nut for steering wheel is tightened to 25.5~33.3 N·m
(2.6~3.4 kgf·m)



050Y

(7) BATTERY CABLE

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



051Y

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 at 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.

INDEX

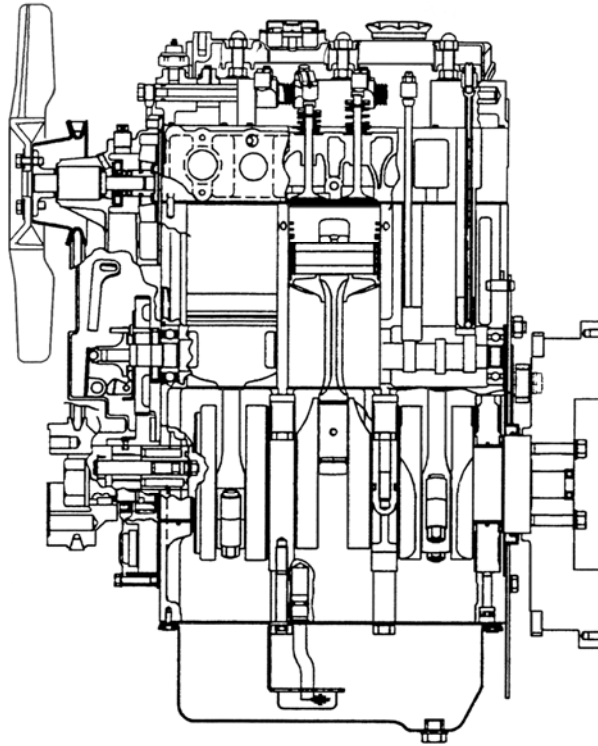
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Chapter 2. ENGINE

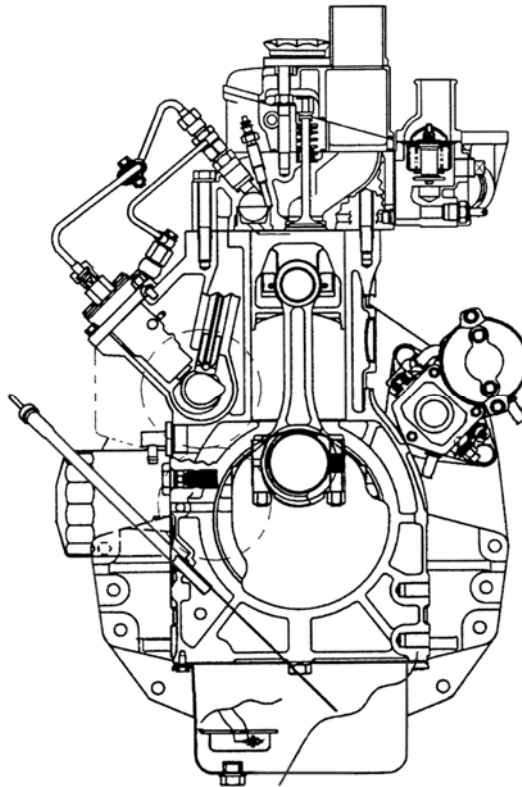
Tractor Model	Engine Model
ST330	N843 (Tire 3)
ST333	N843 (Tire 3)

Due to Pollutant Regulations, some of parts relating to Engine exhaust are not available for spares as an individual part.

2-1 Engine Sectional View



100Y



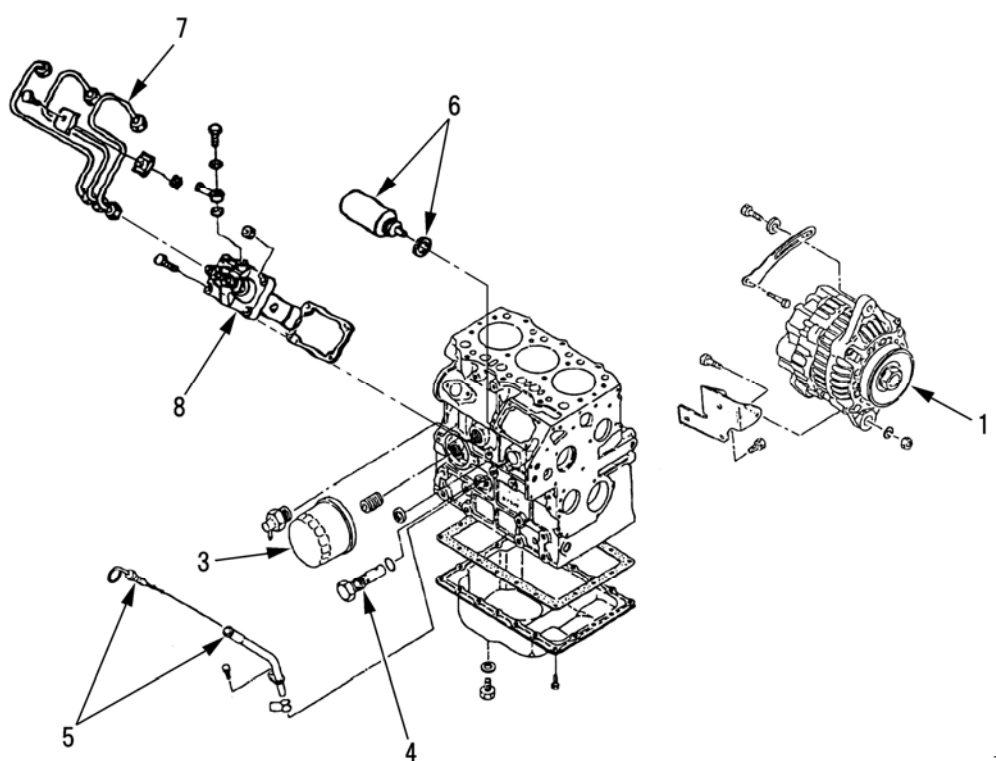
101Y

2-2 Engine Specifications

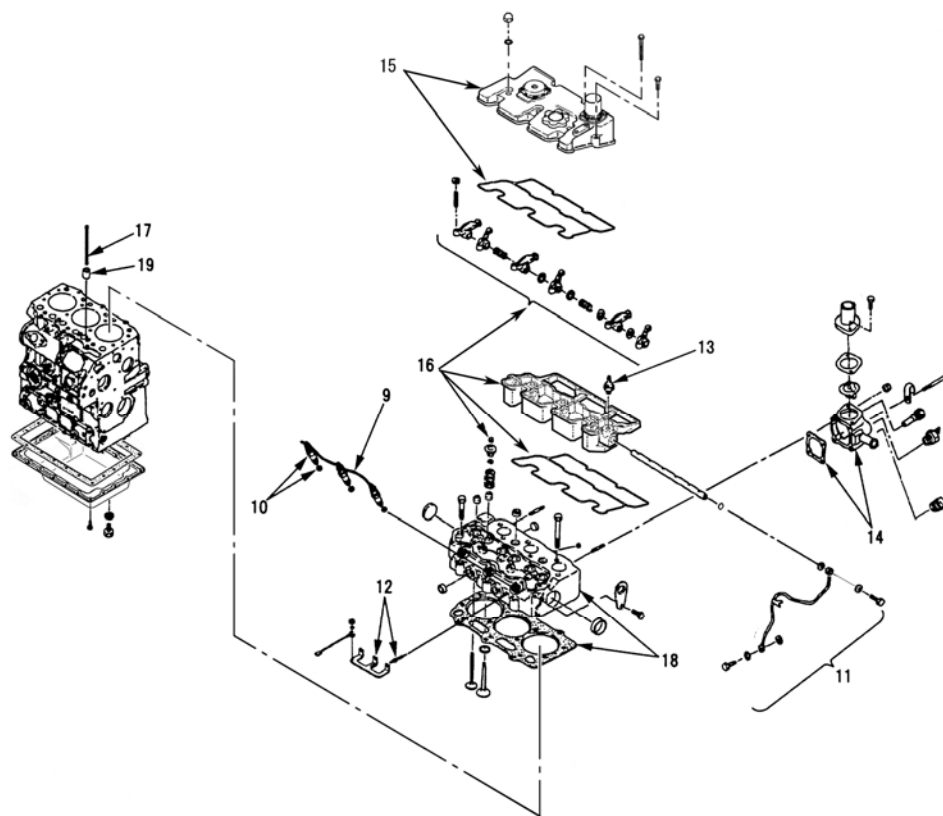
Specifications	Model	ST330	ST333
		N843	N843
Type	4-cycle diesel engine		
Cylinder arrangement	Vertical in-line		
Combustion chamber type	Swirl-chamber type		
No. of cylinders	3		
Bore x stroke		84 mm × 90 mm	84 mm × 90 mm
Total stroke volume		1496 cc	1496 cc
Compression ratio		22.2 : 1	22.2 : 1
Performance Rated speed		2800 rpm	2800 rpm
Fuel system Injection pump type Nozzle type Fuel Fuel consumption	Bosch type Throttle type Diesel fuel oil 200 g/PSH (0.46 lb/HP · Hr)		
Lubricating system Lubricating method Filtering method Lubricating oil quantity (with filter change)	Trochoid pump forced pressure feeding Cartridge full-flow type 5ℓ		
Cooling system Cooling method Cooling water volume	Forced circulation water cooling type 5.0ℓ		
Air cleaner	Dry type (cyclone type)		
Electric system Battery capacity Alternator Starting motor Glow plug	12 V – 55 amps. (HST), 12V – 64 amps. (9 × 3) 12 V – 40 A 12 V – 1.7 kW 11 V – 9.5 A (900°C)		

2-3 Disassembly, Inspection and Reassembly

1. Disassembly

Disassembly	
	
102Y	
Order	Disassemble Parts Name
1	Alternator
2	Not available
3	Oil filter
4	Relief valve
5	Oil level gauge • Gauge guide
6	Engine stop solenoid • Seal washer
7	Injection pipe
8	Injection pump assembly
	Note : 1. Remove the injection pipes and engine stop solenoid before remove the injection pump. 2. Raise the injection pump and disconnect the governor link from the control rack by remove the snap pin. 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.

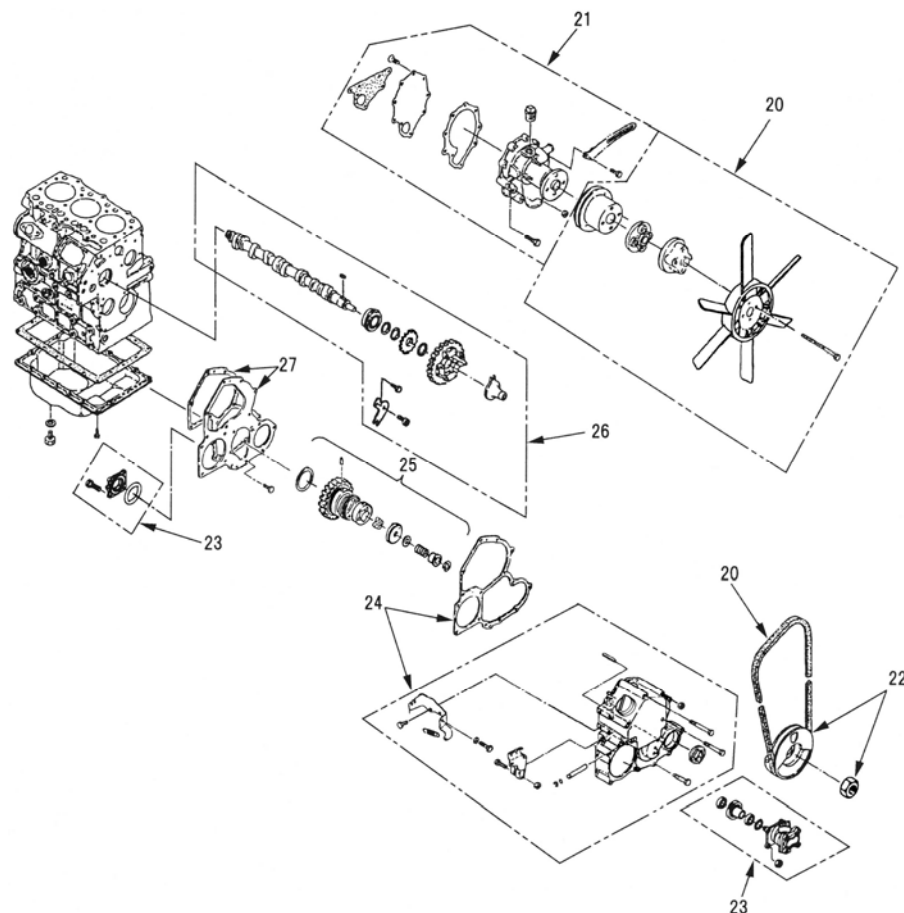
Disassembly



103Y

Order	Disassemble Parts Name
9	Return pipe
10	Injection nozzle • Gasket
11	Oil transfer pipe • Eye bolt • Seal washer
12	Connector • Glow plug
13	Oil pressure switch
14	Thermostat case • Gasket
15	Head cover • O-ring
16	Rocker arm and support bracket assembly • O-ring • Cap NOTE : Remove the caps from each intake valves and exhaust valves.
17	Push rod
18	Cylinder head assembly • Head gasket (discard) NOTE : 1. Untighten the cylinder head bolts in several steps and remove the cylinder head assembly.
19	Tappet

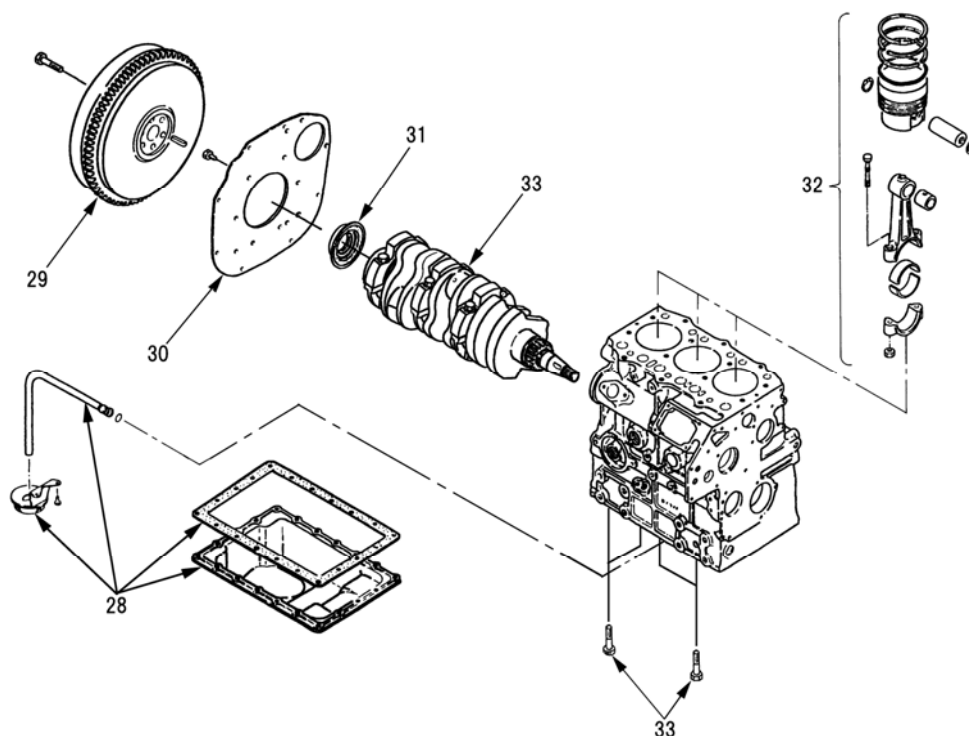
Disassembly



104Y

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

Disassembly



105Y

Order	Disassemble 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 crankshaft and bearing holder assembly as a set.

2. DISASSEMBLY AND INSPECTION OF ENGINE MAIN PARTS

* Cautions before start

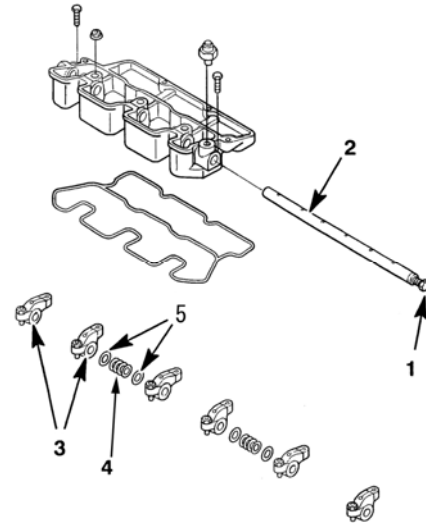
- 1) Check the cylinder block and cylinder head for wear, leakage and damage.
- 2) Remove deposit in oil holes of each part with air and check for clogging.
- 3) Wash each part well to remove dust, contaminated oil, carbon, and other foreign matter.
- 4) Remove carbon deposited on the piston, cylinder 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) Thread an 8 mm bolt into the front and of the rocker shaft and slowly withdraw rocker shaft while at the same time removing the rocker arms, springs and shims.

1. M8 bolt
2. Rocker arm shaft
3. Rocker arm
4. Spring
5. Shim

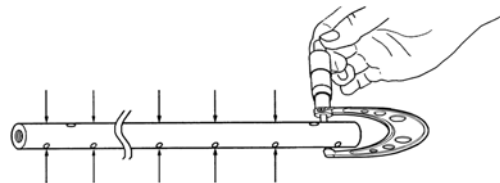


106Y

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.

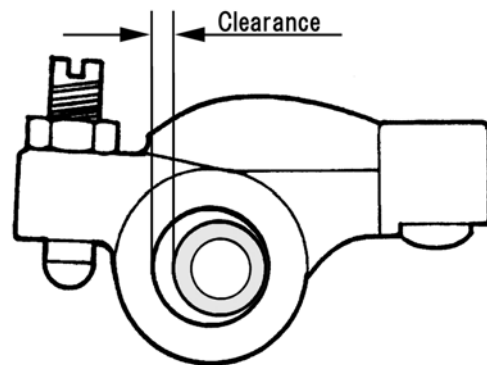
Wear of rocker arm shaft (ø)		
	Standard assembling value	Service limit
N843	14.95—14.97	14.87



107Y

- (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



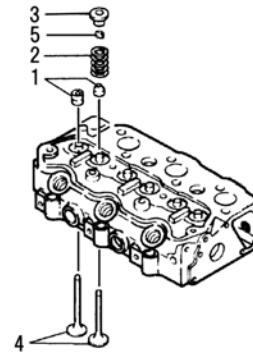
108Y

- (3) Check the valve cap-contact surface for uneven wear and streaks. Correct curved surface with an oilstone or grinder correctly if insignificant.

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.



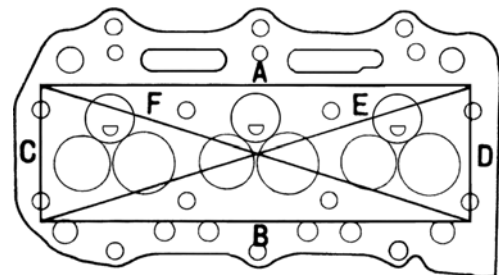
- | | |
|---------------------|-----------------|
| 1. Valve guide seal | 4. Valve |
| 2. Spring | 5. Valve cotter |
| 3. Retainer | |

109Y

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, **replace with new one.**

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



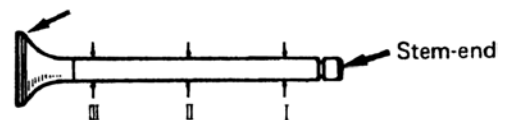
110Y

- (2) Valve guide and valve stem

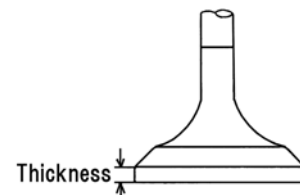
- ① Check the head and stem of each valve and replace if burnout, wear or deformation is remarkable.
- ② Measure the outside diameter at the position I, II, and III on the valve stem with a micrometer and replace if the result is less than the service limit.
- ③ Replace a valve if its head thickness is less than service limit.

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

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 – 6.95	6.84



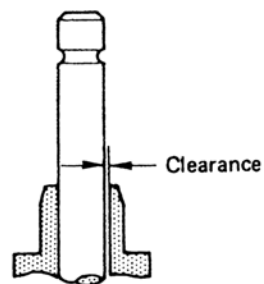
111Y



112Y

- 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

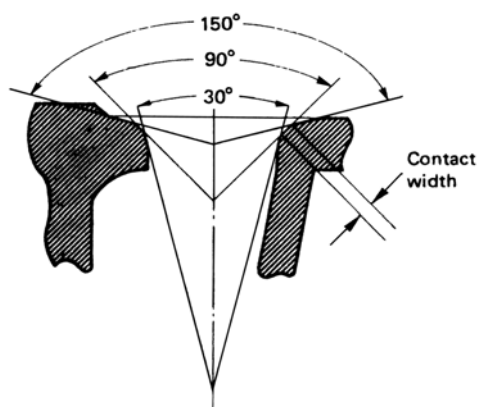


113Y

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

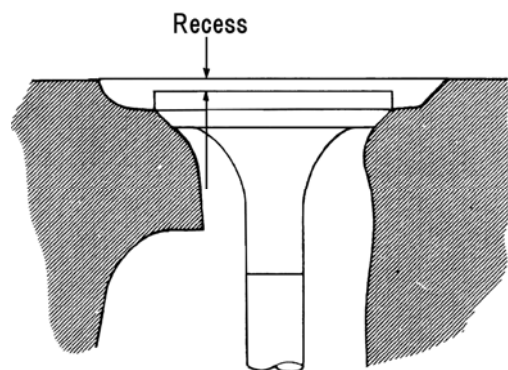
Valve seat contact width (mm)		
	Standard assembling value	Repair value
Intake	1.66 – 1.87	2.5
Exhaust	1.66 – 1.73	2.5



114Y

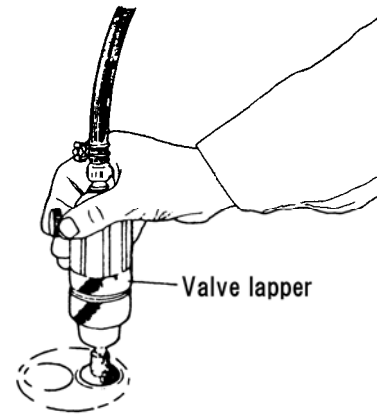
- ③ When the seat recess exceeds the service limit, replace the cylinder head.

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



115Y

- 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.

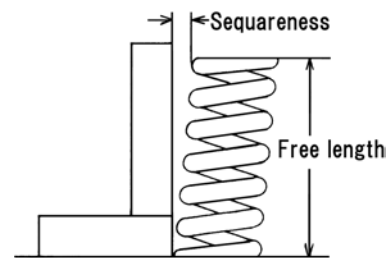


116Y

(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.

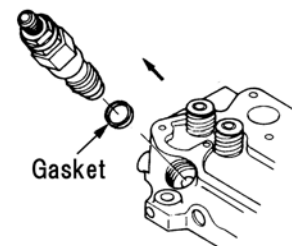
	Standard assembling value	Service limit
Squareness (mm)	1.2	2
Free length (mm)	35	33.5
Spring force (when compressed to 30.4 mm)	72.9 N {8.1 kgf}	68.6 N {7 kgf}



117Y

(5) Inner face of combustion chamber

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



NOTE:

1. Do not remove the insert from the cylinder head.

118Y

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.

Tighten the glow plug with the tightening torque to 14.7—19.6 N·m {1.5~2.0 kgf·m} .

3) Cylinder block

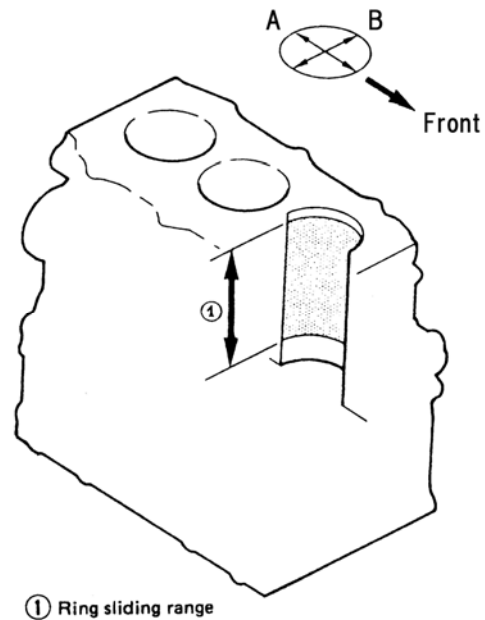
Inspection and service

(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, replace engine long block.

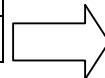
Distortion on cylinder block top surface (mm)	
Standard assembling value	Repair value
Less than 0.05	More than 0.12



119Y

(Unit: mm)

Model	Standard assembling value	Repair value
N843	ø84 — ø84.019	ø84.2

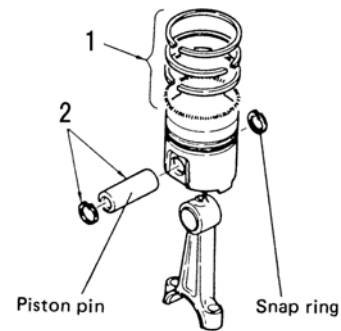


Replace with long block assembly

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.



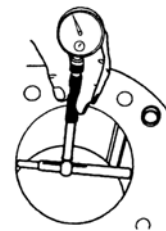
120Y

Inspection

(1) Piston

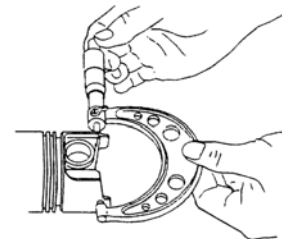
- ① Check the piston for crack, streak and burnout on the outside surface and replace if remarkable.
- ② Measure the longer diameter at 10 mm above the lower end of the piston skirt and bore of the cylinder in the thrust direction, calculate the clearance, and replace if the repair value is exceeded.

Clearance between cylinder and piston (mm)		
Model	Standard assembling value	Service limit
N843	0.0375 – 0.0715	0.25



121Y

Piston skirt bottom longer dia. (mm)		
Model	Standard assembling value	Service limit
N843	∅ 83.948 – 83.96	∅83.7



122Y

- ③ 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
N843	-0.001 ~ +0.007	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.

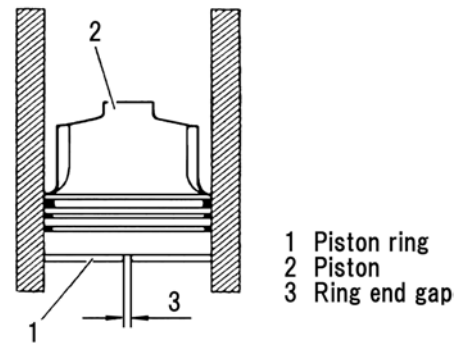
Piston ring end gap (mm)		
N843	Standard assembling value	Service limit
Top ring	0.2 – 0.35	1.0
Second ring	0.2 – 0.4	1.0
Oil ring	0.2 – 0.8	1.2

- ③ Measure the clearance between the piston ring grove and ring and replace if the service limit is exceeded.
- ④ Piston kit composed of piston and piston rings are available.

Piston kit		
Model	Size	Part code No.
N843	STD	115017541

⑤ Piston ring installing procedure

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



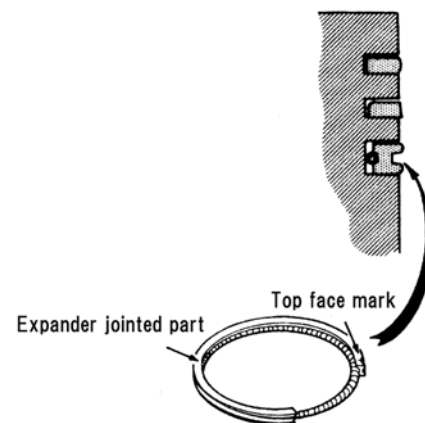
123Y

Clearance between piston ring groove and ring (mm)		
N843	Standard assembling value	Service limit
Top ring	0.07 – 0.11	0.25
Second ring	0.04 – 0.08	0.25
Oil ring	0.03 – 0.13	0.25

Model	Piston ring size	Part code No.
N843	STD.	115107970

(3) Piston pin

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



124Y

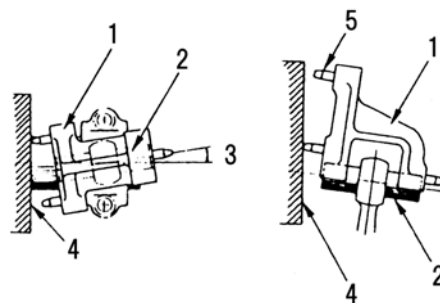
Piston pin outside dia. (ø)		
Standard assembling value		Service limit
N843	27.994 – 28.0	27.97

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.

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



125Y

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

- (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	49.0 – 53.9 N·m {5.0 – 5.5 kgf·m}
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NOTE: Never turn the connecting rod at this time.

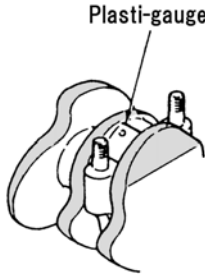
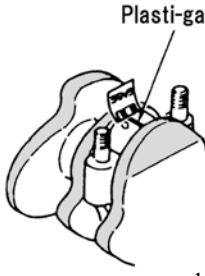
- ④ Remove the connecting rod cap and measure the plasti-gauge width with the scale printed on the gauge envelope.

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

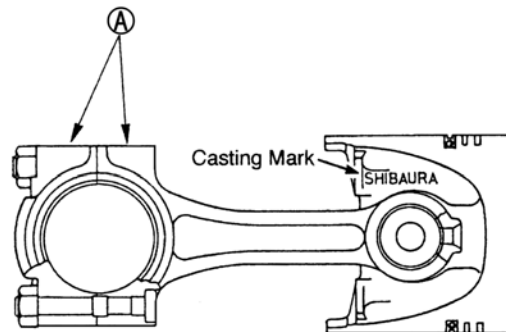
- (3) If the oil clearance exceeds the service limit according to the result of the measurement, replace the metal.

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	0.2
Set a plasti-gauge  126Y	Measure the oil clearance  127Y

Metal size	Metal code No.	Crankshaft pin outside dia. Finishing dimension (φ)
N843	198517252	51.964 – 51.975



128Y

7) Disassembly, inspection and reassembly of bearing holder

Disassembly and inspection

Center bearing

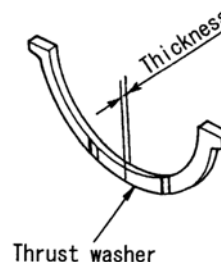
- (1) Remove the bearing holder, and replace the metal if peeling, melting, uneven wear, or improper contact is noticed.
- (2) Measure the oil clearance of the crankshaft center journal and metal using a plasti-gauge.
- (3) If the oil clearance exceeds the service limit according to the result of the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

Model N843		
Metal size	Metal code No.	Crankshaft center journal finishing dimension (ø)
STD.	198517232 (upper) 198517242 (lower)	67.957 – 67.970

Clearance between crankshaft center journal and metal (oil clearance) (mm)		
Model	Standard assembling value	Service limit
N843	0.044—0.102	0.2

Thrust washer

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



129Y

Rear bearing holder thickness (mm)		
Model	Standard assembling value	Service limit
N843	2.95—3.00	2.8

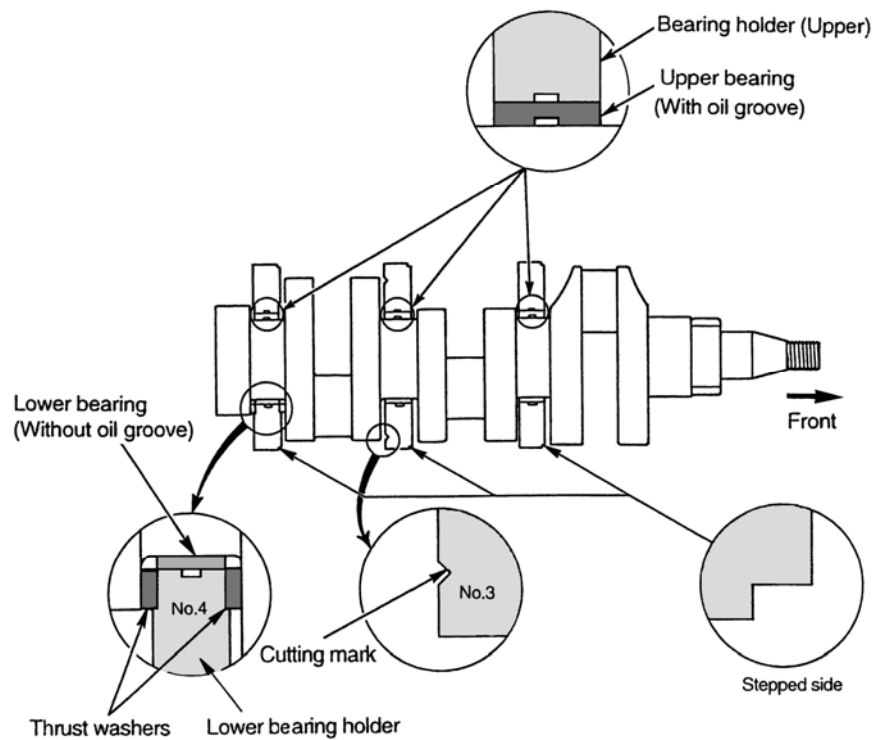
Reassembly (bearing holder, center bearing, thrust washer)

- (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	49.0 – 53.9 N·m { 5.0 – 5.5 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 cylinder block are aligned.



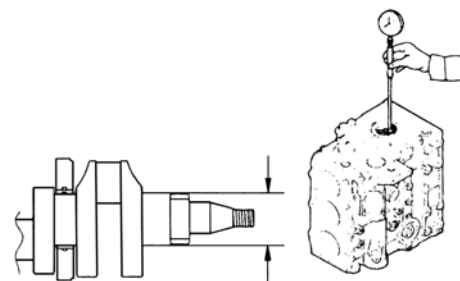
130Y

8) Crankshaft bearing (bush)

Inspection

- (1) Check the bearing (bush) and replace if peeling, melting, uneven wears, 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) and/or crankshaft.

Clearance between crankshaft journal and bearing (bush) (oil clearance) (mm)		
Model	Standard assembling value	Service limit
N843	0.044—0.116	0.2

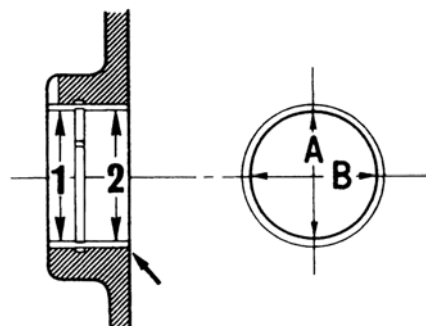


131Y

Model	Bush size	Bush code No.	Crankshaft journal outside dia. Finishing dimension (ø)
N843	STD.	198517222	67.957—67.970

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.



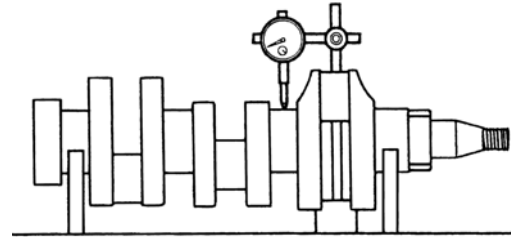
132Y

9) Crankshaft

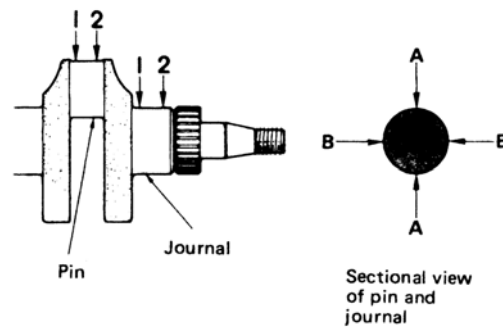
Inspection

- (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. If service limit is exceeded replace the bearing (bush) and/or crankshaft. 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



133Y



134Y

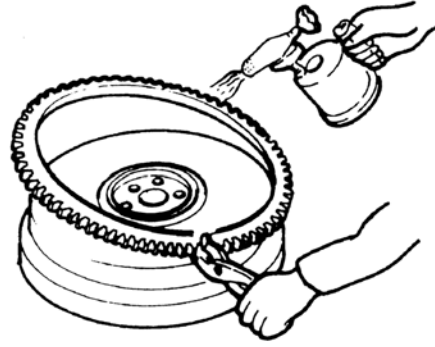
Irregular wear limit of crankshaft journal and pin (mm)			
More than 0.05			
Shaft dia. At crankshaft journal			
Model		Outside dia. Finishing dimension	Repair value
N843	STD.	67.957—67.970	67.9
Shaft dia. At crankshaft pin (∅)			
Model		Outside dia. Finishing dimension	Repair value
N843	STD.	51.964—51.975	51.90

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.



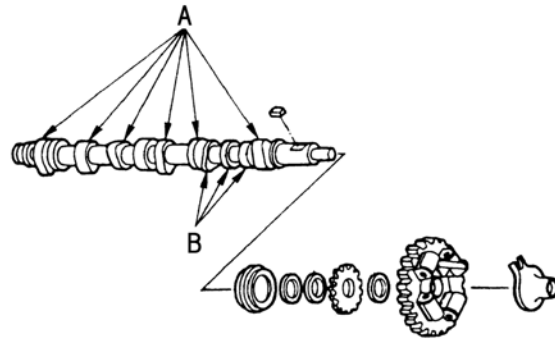
135Y

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
34.441—34.508	34.1
B. Height of injection pump cams (mm)	
Standard assembling value	Service limit
42.99—43.01	42.8



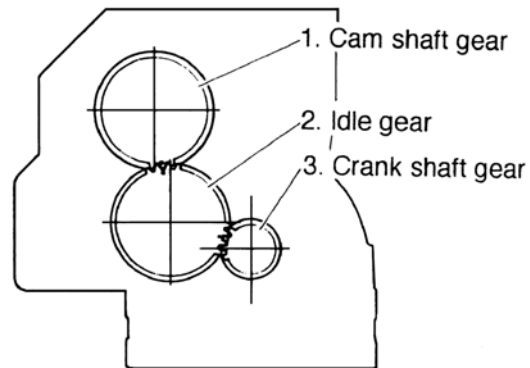
136Y

12) Timing gear

Inspection

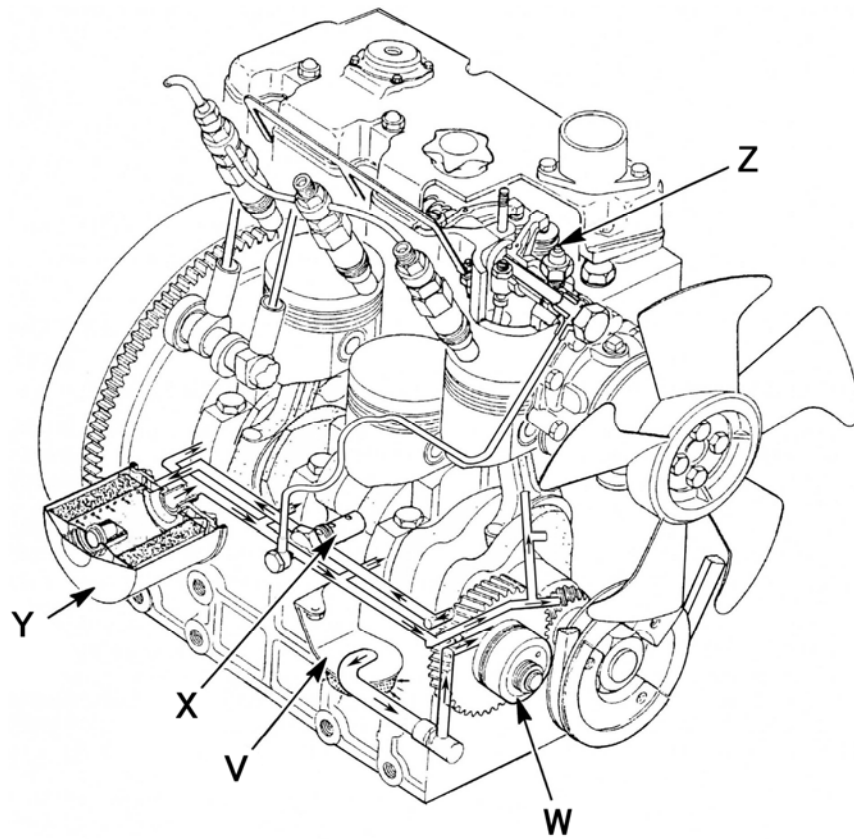
- (1) If pitting or remarkable wear is observed on the tooth face of gears, replace the gear.
- (2) Measure the backlash of gears and replace if the service limit is exceeded.

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



137Y

13) Oil flow



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

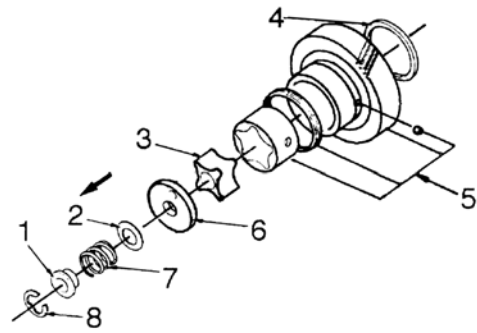
138Y

14) Oil pump

Disassembly

Removal from engine

- (1) Remove the snap ring.
- (2) Take out the collar, 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.

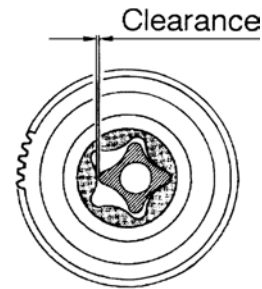


139Y

- | | |
|------------------|--------------------|
| 1. Collar | 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 [13](#), 164Y.)

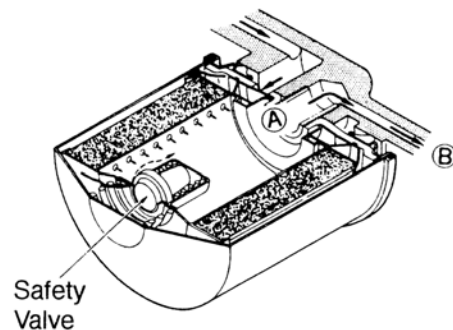


140Y

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.



141Y

Replacement

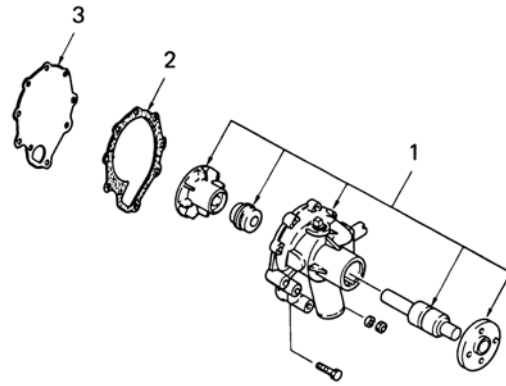
- (1) Replace the oil filter every 200 hours of operation.
- (2) Coat the filter mounting surface with oil and tighten the filter by hand.
- (3) Do not reuse the filter if it is removed once.

16) Water pump assembly and thermostat

Disassembly

- (1) Remove the set plate gasket.
- (2) Remove the thermostat spring.

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



142Y

1. Water pump ass'y
2. Gasket
3. Set plate

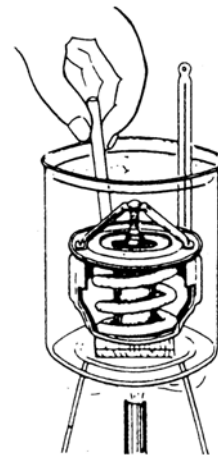
Specification and inspection

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	N843
Type	Wax pellet
Opening temperature	71°C
Full-opening temperature	82°C
Valve lift	8.0 mm



143Y

Reassembly

Reassemble the components in the reverse order to disassembly.

17) Radiator

Specifications and structure

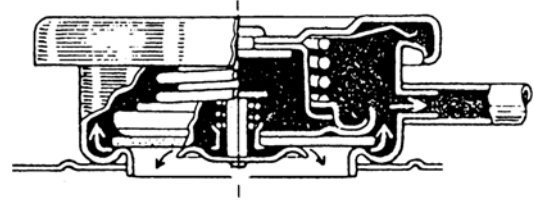
Structure

- (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).

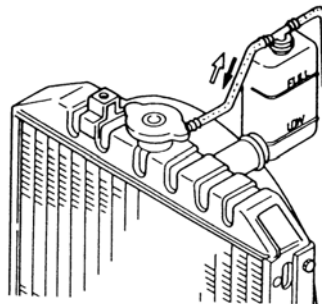
Specifications	
Fin type	Corrugated
Cooling water volume	5.0ℓ
Pressure valve starting pressure	73.5 – 103 kPa {0.75 – 1.05 kgf/cm ² }
Negative pressure valve starting pressure	– 4.9 kPa {0.04 – 0.05 kgf/cm ² }



144Y

Inspection

- a. Check the radiator, pipe, and reserve tank for water leakage and repair or correct if any.
- b. Check the radiator fin and remove dust, mud, or other foreign matter clogging in the air passage, if any.
- c. Check the pressure valve and negative pressure valve of the radiator cap for valve opening pressure and sealing condition. Replace if defective.
- d. Check the radiator hose and replace if damaged or aged.
- e. If the net is clogged, remove and clean.
- f. The cooling water level in the reserve tank should be always between FULL and LOW.

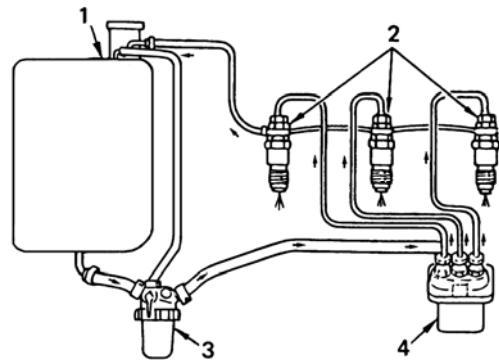


145Y

18) Fuel filter

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.



146Y

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

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 flyweight ass'y is installed to the camshaft 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 flyweight 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.

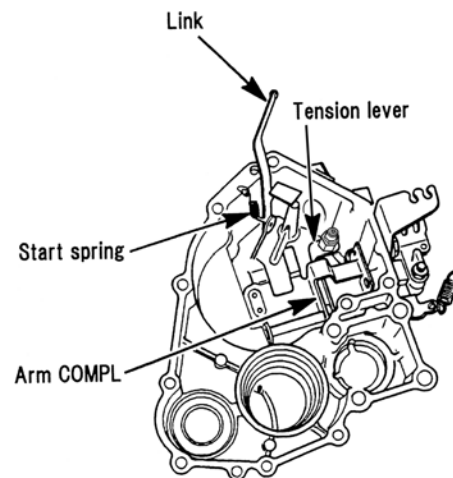
- (2) Maximum speed set bolt

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.



147Y

20) Injection pump

Specification

Engine Model	Part Code No.	Manufacturer and Injection Pump Type
N843	131017811	BOSCH AUTOMOTIVE SYSTEM CORPORATION 104135 – 3061

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 **where specialized and authorized this operation specializing in this operation.**

Trouble-shooting

Trouble	Possible Cause	Check or Remedy
1. Engine does not start.	(1) Fuel Shortage or air mixed in. (2) Defective engine stop solenoid.	(1) Replenish fuel, check air entering part, bleed air (2) Check and replace the electric system
2. Engine starts but will not stop at once.	(1) Filter or pipes clogged. (2) Air mixed in. (3) Fuel tank filter cap air breath clogged. (4) Short-circuit or disconnected wire of electric system of engine stops solenoid.	(1) Replace or clean out. (2) Check fuel pipe and connections. (3) Wash (4) Inspect and repair.
3. Engine output unstable	(1) Air mixed in. (2) Water mixed in fuel.	(1) Check fuel pipe and connections. (2) Replace fuel, replace filter.
NOTE: Due to possibilities of other troubles, refer to 2 – 3 Trouble Shooting		

21) Nozzle and holder

Specifications

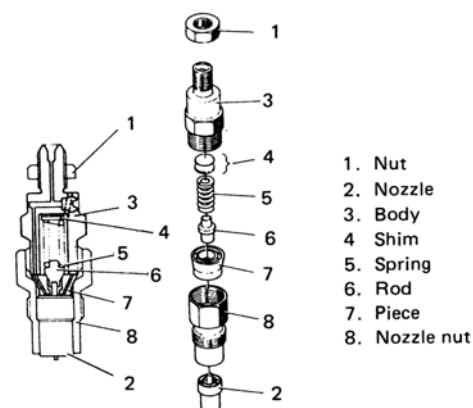
Model	N843 (ST330/333)	Model	N843 (ST330/333)
Part code No.	131406360	Needle valve dia.	φ 4
Ass'y No.	105148 - 1170	Pintle dia.	φ 1
		Valve opening	14.7 MPa {150 kgf/cm²}
Nozzle holder	105078 - 0100	Injection angle	4°
Nozzle	105007 – 1170 (NP-DN4PDN117)	Nozzle type	Throttle type

Structure and functions

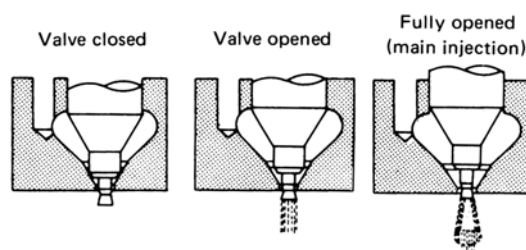
The nozzle is finished super-precisely to inject the fuel, which is fed from the injection pump under pressure to the combustion room in good condition. Components as shown in the right figure are incorporated.

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.



148Y



149Y

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.



151Y

Inspection and replacement

- (1) Take out the element every **100 – 200 hours** and blow compressed air (less than **7kgf/cm²**) from the inside and clean. (Clean the dust deposit on the dustpan 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 dust 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. It should be replaced with new one if puncture, pinhole, and especially thinner part is observed or if the gasket is broken.
- (6) Do not use the element before drying completely.

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.

1) Reassembly

(1) Relief valve assembly with O-Ring.

Relief valve tightening torque to:

Relief valve tightening torque	
	49 – 59 N·m {5.0 – 6.0 kgf·m}

(2) Crank shaft and bearing holder assembly

Cylinder block to bearing holder tightening torque

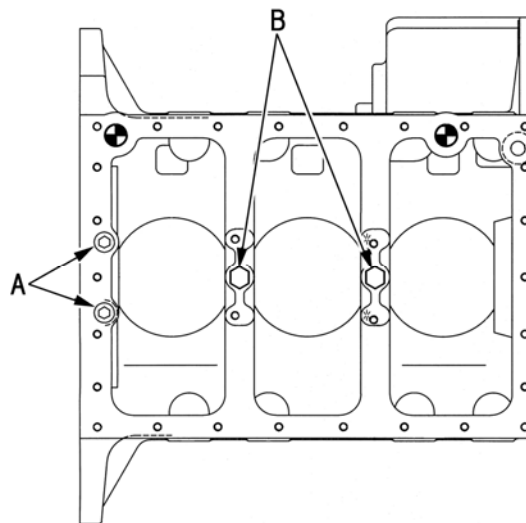
Bolts fixing bearing holder		
A	Hexagon socket head bolt	25 – 29 N·m {2.5 – 3.0 kgf·m}
B	Hexagon bolt	49 – 54 N·m {5.0 – 5.5 kgf·m}

NOTE:

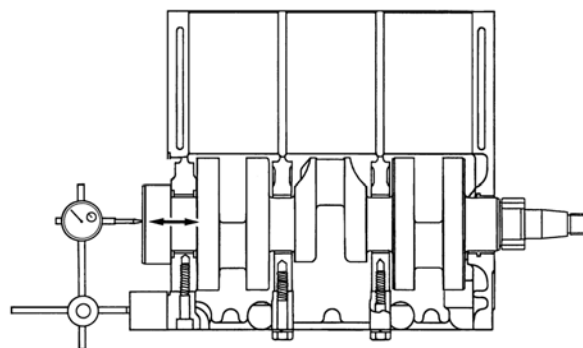
1. Take care not to damage the bush in the cylinder block by the crankshaft gear when install the crankshaft and bearing holder assembly.
2. Install the two hexagon socket head bolts for the flywheel side bearing holder.

(3) Measure the endplay of crankshaft

Crankshaft end play	
Standard value	0.1 – 0.4 mm
Service limit	0.5 mm

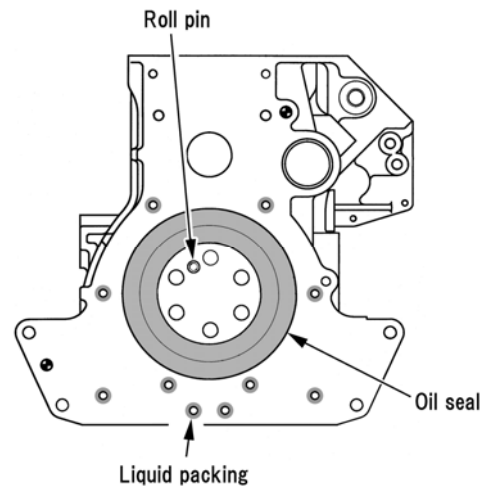


152Y



153Y

(4) Oil seal



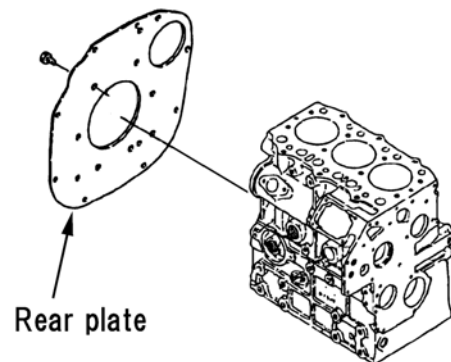
154Y

(5) Rear plate

NOTE:

Apply the liquid gasket to around the M8 screw holes for rear plate

Rear plate tightening torque:
22.6 – 28.4 N·m {2.3 – 2.9 kgf·m}

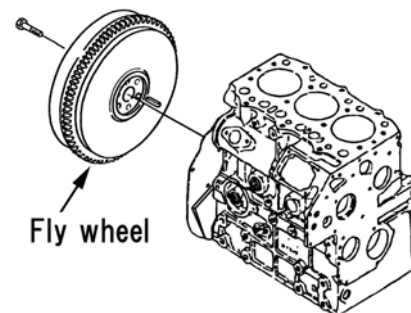


155Y

(6) Flywheel

Align the hole to the roll pin on the crankshaft.

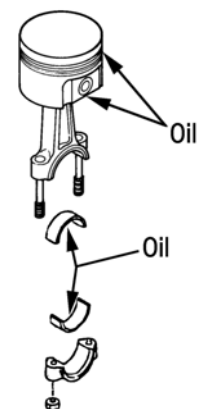
Fly wheel tightening torque
73 – 78 N·m {7.4 – 8.0 kgf·m}



156Y

(7) Piston and connecting rod assembly

- ① Coat the metal surface, piston and piston ring with engine oil.



157Y

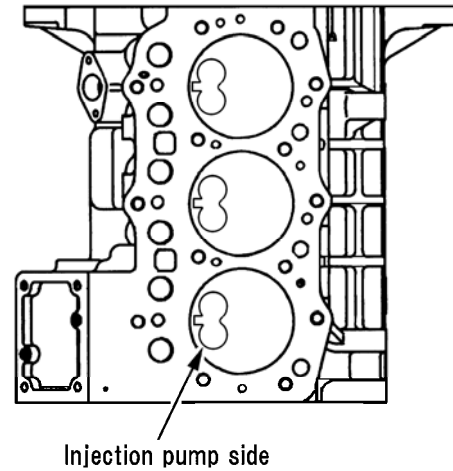
- ② Turn the ring to allow the oil to ensure the ring groove sufficiently, and set the ring end gaps at 90° respectively avoiding piston pin direction and the direction at a right angle to the piston pin.
- ③ Insert the ring facing the connecting rod figure match mark toward the injection pump side, 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
49 – 54 N·m {5.0 – 5.5 kgf·m}



158Y

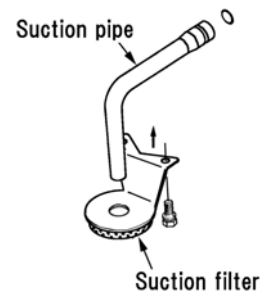
NOTE:

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

(8) Suction pipe · 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 – 13 N·m {0.9 – 1.3 kgf·m}

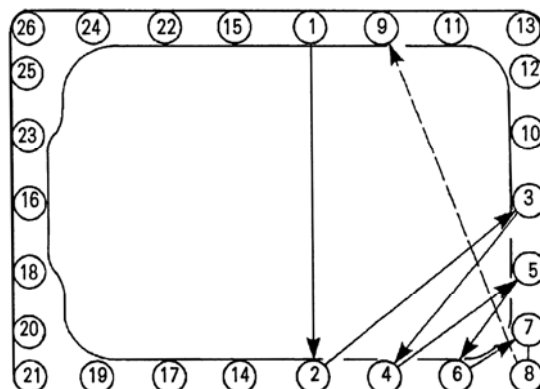


159Y

(9) 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.

Bolt tightening torque
10 – 12.7 N·m {1.0 – 1.3 kgf·m}



Tightening Order

160Y

(10) Oil level gauge · Gauge guide

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

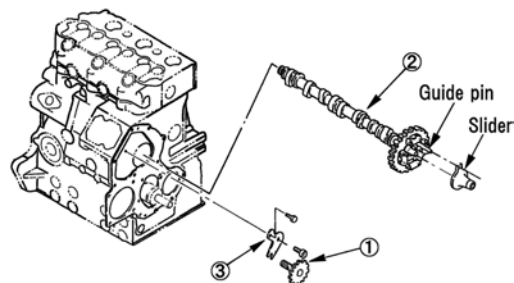
(11) Front plate

Install the front plate together with the gasket.

(12) Camshaft 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}



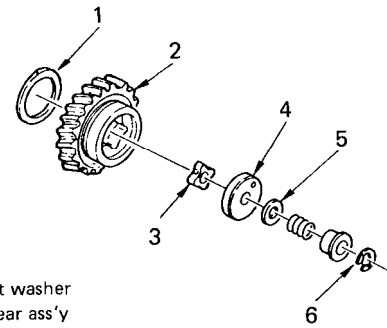
161Y

NOTE:

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

(13) 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 camshaft gear and install it to the idle gear shaft.
- ④ Install the rotor.
- ⑤ Install the oil pump cover, shim, spring and collar and fix with a snap ring.

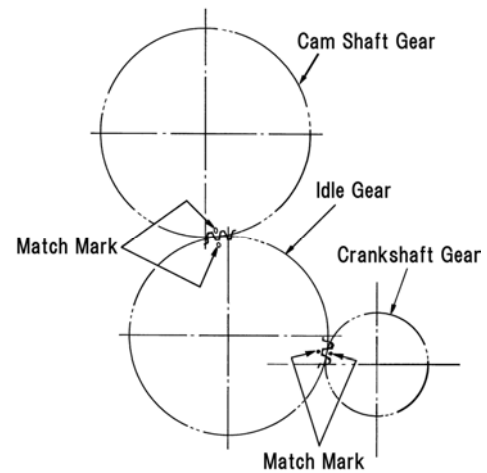


1. Thrust washer
2. Idle gear ass'y
3. Rotor
4. Oil pump cover
5. Shim
6. Snap ring

NOTE:

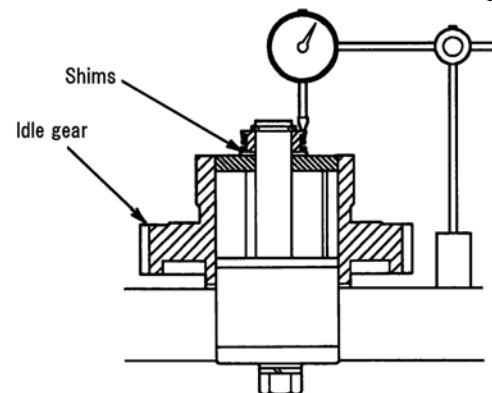
1. Coat the rotor and vane both sides with grease before installing them.
2. Never turn the crankshaft until the timing gear case is installed.
3. Turn the oil pump cover clockwise and counterclockwise, fix the hole at the center of the spring pin inserting hole moving distance, and then install the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

162Y



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

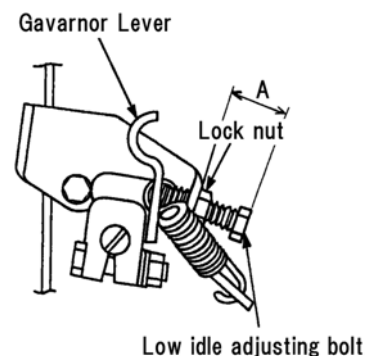
163Y



164Y

(14) Timing gear case · Cover

- 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.
- ⑤ Install the covers.



165Y

(15) Crankshaft pulley

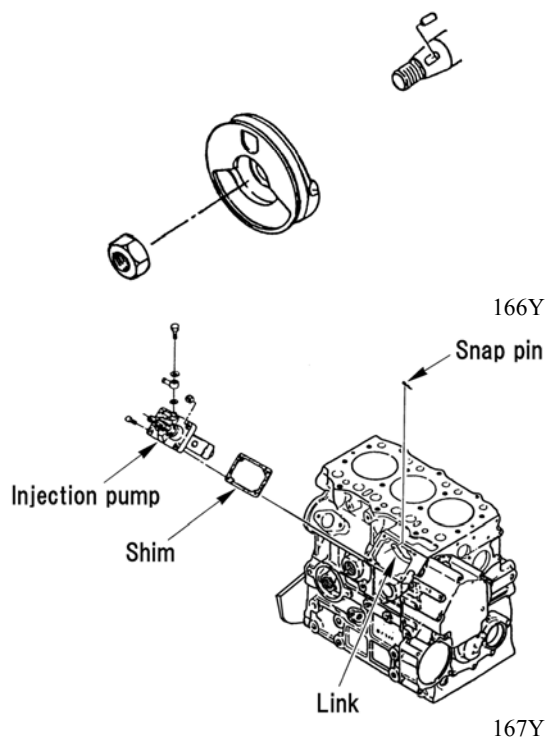
Fit the key to the crankshaft, and install the crankshaft pulley and tighten with the nut.

Crankshaft pulley tightening torque
274 – 333 N·m {28 – 34 kgf·m}

(16) 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
13 – 17 N·m {1.3 – 1.7 kgf·m}



(17) Injection timing adjustment

IMPORTANT : This Tier 3 type engine cannot inspect and adjust spill-timing.
If injection pump is replaced with new one, install same thickness shims with original pump.

(18) Drive gear ass'y (for hydraulic pump) · Hydraulic pump ass'y

Install the drive gear ass'y to the hydraulic pump and then install it to the gear case.

(19) Oil filter

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

(20) Engine stop solenoid

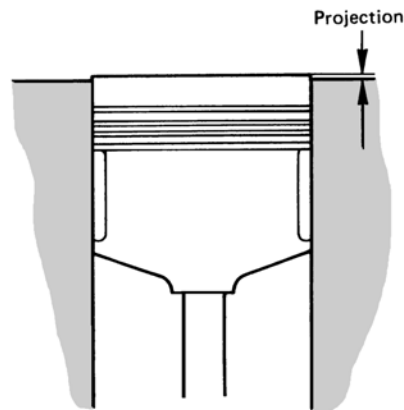
Tighten the engine stop solenoid lightly with pliers.

(21) Cylinder head ass'y

- ① Set the piston at the TDC and measure the injection beyond the cylinder block with a depth gauge or dial gauge.

NOTE:

1. Measure holding the piston lightly by hand.
 2. Use the cylinder with the largest projection distance among the 3 cylinders as the reference. The variation of the projection should be within 0.1 mm.
- ② Select a head gasket according to the measured value.



171Y

Measured value (mm)	Head gasket part code No.	Thickness when tightened
More than 0.6 – under 0.7	111147490	t = 1.3
More than 0.7 – less than 0.8	111147500	t = 1.4

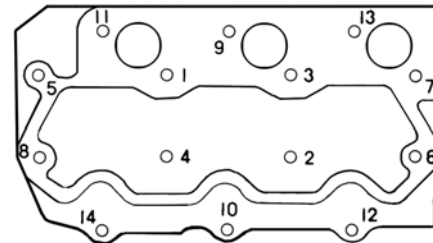
NOTE: Four smallest digits of the part code No. are stamped on the top surface of the head gasket.

- ③ 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
98 – 103 N·m {10 – 10.5 kgf·m}

NOTE:

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

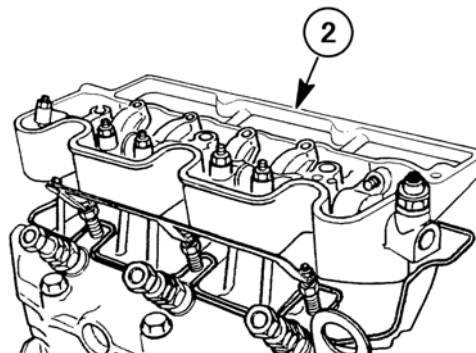


172Y

(22) Cap · Pushrod · Rocker arm ass'y

- ① Install the cap to the valve steam end.
- ② Install the push rod and rocker arm ass'y.

Rocker arm ass'y tightening torque	
N843	27 – 39 N·m {2.8 – 4.0 kgf·m}



173Y

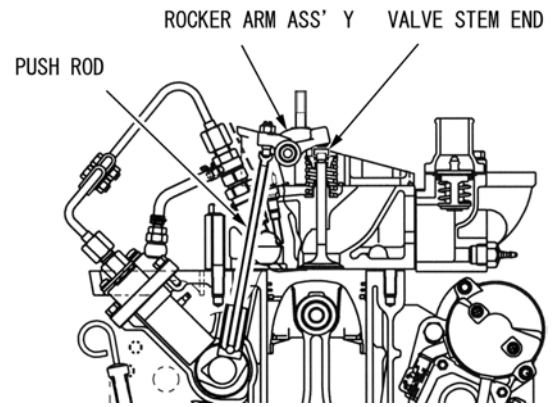
(23) Valve clearance adjustment

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

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.

Lock nut tightening torque
11.8 – 15.7 N·m {1.2 – 1.6 kgf·m}

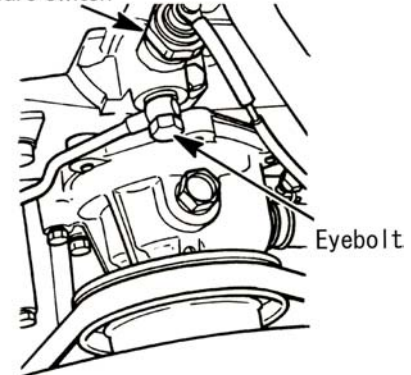


174Y

(24) Oil pressure switch

Oil pressure switch tightening torque
15 – 20 N·m {1.5 – 2.0 kgf·m}

Oil pressure switch



175Y

(25) Oil pipe

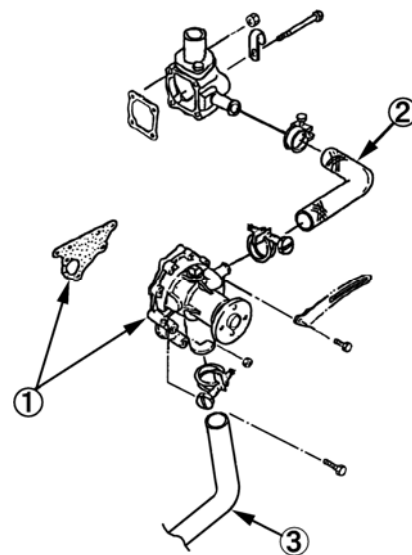
Eye bolt tightening torque
M8 10 – 13 N·m {1.0 – 1.3 kgf·m}

(26) Water pump ass'y · Bypass hose

- ① Install and tighten the gasket and water pump ass'y.
- ② Connect the thermostat case and water pump case with bypass hose.
- ③ Install the radiator hose.

(27) Connector

Install the connector to the glow plugs. (Reference Figure 103Y)



176Y

(28) Head cover **with intake manifold**

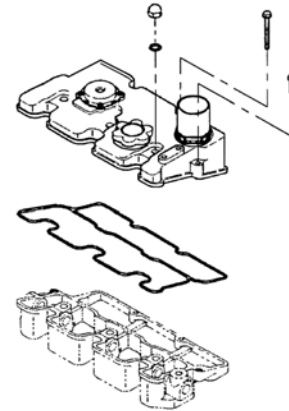
Tighten the head cover with gasket.

Head cover tightening torque	
N843	12 – 16 N·m {1.2 – 1.6 kgf·m}

(29) Nozzle and holder ass'y

Tighten the nozzle and holder ass'y with specified torque using a nozzle holder socket.

Nozzle and holder tightening torque	
	59 – 69 N·m {6 – 7 kgf·m}

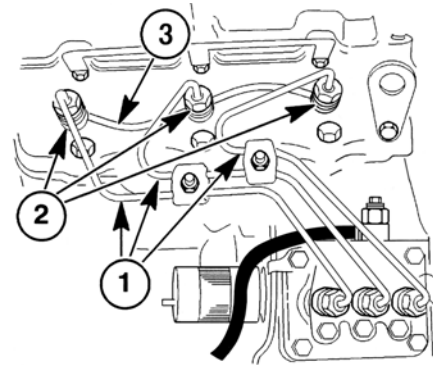


176-1Y

(30) Return pipe COMPL · Injection pipe

Install the return pipe and then injection pipe.

Injection pipe tightening torque	
	15 – 25 N·m {1.5 – 2.5 kgf·m}

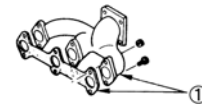


1. Injection pipe
2. Nozzle and holder
3. Return pipe

177Y

(31) Exhaust manifold

- ① Install the exhaust manifold with gasket.



178Y

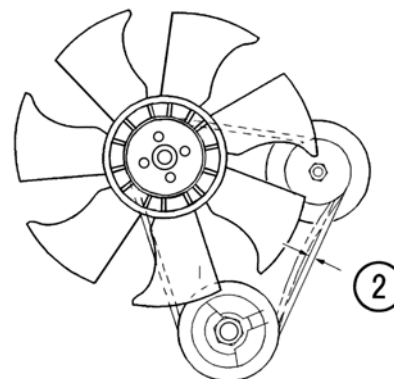
(32) Alternator

Install the alternator taking care to the direction of the adjusting plate.

(33) 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	
	9 – 13 N·m {0.9 – 1.3 kgf·m}



179Y

2—4 Trouble Shooting

Condition	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 compressed. Defective engine stop solenoid.	Connect or correct contact points properly. 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 BASC. Replace. Check and change. Clean the air cleaner. Check and correct each part. Check or replace wiring.
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 BASC. 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.

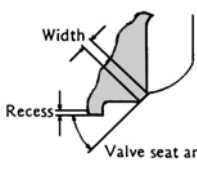
* BASC : BOSCH AUTOMOTIVE SYSTEMS CORPORATION

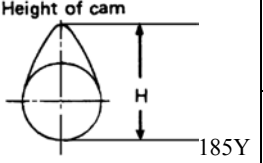
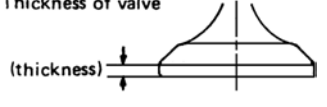
Condition	Cause	Remedy
Improper color of engine exhaust	Too much engine oil. Too low viscosity of engine oil. Improper injection timing.	Check and adjust the quantity. Check and change. Too late. Correct.
Improper engine exhaust (black or dark gray)	Improper fuel. Excessive fuel injection. Improper function of engine main body. Overload. Clogged air cleaner.	Check and change. Check and adjust. Check a 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.
Starting motor does not operate.	Loosened or disconnected wiring of each part. Dropped battery voltage. Defective safety switch. Trouble in starting motor. Disconnected wire of fusible link.	Check and install or tighten. Charge the battery. Replace. Check and correct the starting motor. Replace.
Oil pressure lamp does not go out.	Insufficient engine oil. Trouble in oil pressure switch. Oil leakage from lubricating system. Clogged oil filter. Short circuit wiring 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.

2-5 Engine Maintenance Standards Table

N843 ENGINE

* 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
		Cylinder head tightening torque N·m {kgf·m}		98—103 {10.0—10.5}			Coat threads with engine oil.
		Distortion of face of cylinder head		Less than 0.05	0.12		
		Valve seat (Intake/exhaust) 		0.85—1.15	1.8		Valve sheet angle 45°
		Width of valve seat	Intake	1.66—1.87	2.5		
			Exhaust	1.66—1.73	2.5		
	CYLINDER BLOCK						
		Bore	Ø84	Ø84—84.019		Ø84.2	
		Distortion of upper face of cylinder block		Less than 0.05	0.12		
	PISTON	Skirt diameter (longer diameter)	Ø83.955	Ø83.948—83.963		Ø83.7	
		Clearance to cylinder		0.038—0.072		0.25	At 20°C
		Clearance between piston pin hole and pin		-0.001—+0.007		0.02	
	PISTON	Outer diameter of pin		Ø27.996—28.0		Ø27.98	
		Small end bush-to-pin clearance		0.010—0.025		0.08	Oil clearance
	PISTON RING	Piston ring gap:	No.1 ring	0.20—0.35		1.0	
			No.2 ring	0.20—0.40			
			Oil ring	0.20—0.8			
		Piston ring groove-to-ring clearance	No.1 ring	0.07—0.11		0.25	
			No.2 ring	0.04—0.08			
			Oil ring	0.02—0.06			
		Ring width	No.1 ring	2			
			No.2 ring	1.5			
			Oil ring	4			

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 – 0.085		0.2	Oil clearance
		Connecting rod tightening torque N·m {kgf·m}			49.0—54.0 {5.0 – 5.5}			
		Weight difference with piston (g)			Less than 10			
	CRANKSHAFT	Diameter of journal		Ø68	Ø67.957 – 67.970	Ø67.9		
		Diameter of crank pin		Ø52	Ø51.964 – 51.975	Ø51.9		
		Roughness, main journal and crank pin		1.6Z				
		Crankshaft deflection			Less than 0.03	More than 0.06		
		Axial play of crankshaft			0.1 – 0.4		0.5	
		Thickness of thrust washer		3.0	2.95 – 3.00		2.8	
		O.D. × I.D. of bush (journal metal)		Ø68 × 72				
		Clearance between crankshaft and journal metal (bush)			0.044– 0.116		0.2	Oil clearance
		I.D. × O.D. of center bearing		Ø68 × 72				
		Clearance between crankshaft journal and center bearing			0.044 – 0.102		0.2	
VALVE SYSTEM	CAMSHAFT		For intake/exhaust		34.441 – 34.5076		34.1	
			For injection pump		42.99 – 43.01		42.8	
		Cam shaft run out			Less than 0.03	More than 0.1		
		Cam gear backlash			0.08		0.25	
	VALVE	Diameter of intake valve stem		6.97	6.955 – 6.97		6.89	
		Diameter of exhaust valve stem		6.95	6.94 – 6.955		6.84	
		Clearance between valve stem and valve guide	Inlet		0.03 – 0.06		More than 0.2	
			Exhaust		0.05 – 0.075		More than 0.25	
		Thickness of valve 		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		
		Valve spring	Spring strength N {kgf}		79.4 {8.1}		68.6 {7}	
			Free height		35		33.5	
			Squareness  187Y		Less than 1.2		2.0	
	PUSH ROD	Overall length		177.8	177.6 – 178.0			
		Outer diameter		Ø6.3				
	ROCKER ARM	Wear, rocker arm shaft		Ø14.96	Ø14.95 – 14.97		Ø14.87	
		Clearance between rocker arm and shaft			0.032 – 0.068		0.2	Oil clearance
	LUBRICATION SYSTEM	OIL PUMP	Discharge rate : Engine speed 2500rpm Discharge pressure 294 – 490 kPa {3 – 5 kgf/c m ² } Oil temperature 50°C – 80°C(SAE30)			16.2		
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)			4.5				With filter change 5.0 ℓ	
Tip clearance (rotor-to-vane)				00.1 – 0.15		0.25		
Side clearance (rotor-to-cover)				0.1 – 0.15		0.2		
FUEL SYSTEM	INJECTION PUMP	Type		104135 – 3050				※BASC.
		Injection timing	Before T.D.C.		20 – 22°			
			Piston movement before T.D.C.		3.539 – 4.267			

※ BASC. is BOSCH AUTOMOTIVE SYSTEM CORPORATION

Unit	Part	Inspection Items	Standard Dimension	Standard Value	To be Repaired	Allowable Limit	Remarks
	INJECTION NOZZLE	Type	(Nozzle) 105007—1170 (NP DN4PDN117)				※BASC.
		Injection pressure MPa {kgf/cm ² }	14.7{150}	14.2—15.2 {145—155}			
		Angle of injection direction	4°				
		Nozzle and holder tightening torque N·m {kgf·m}		58.8—68.6 {6—7}			With cylinder head installed
COOLING SYSTEM	COOLING CONDITIONS	Cooling method	Forced circulation water cooling				
		Coolant capacity (ℓ)	5.0				Reserve tank 0.6ℓ
		Thermostat open temperature (°C)	82				
		Thermostat full-open temperature (°C)	95				
		V belt (fan) looseness (load at center 5kg)		5-10			
		Operation start pressure of radiator cap negative pressure valve kPa {kgf/c m ² }	73.5 {0.75}	88.2 {0.9}			
		Operation start pressure of radiator cap pressure valve kPa {kgf/c m ² }		Less than 4.9 {0.05}			
ELECTRICAL SYSTEM	STARTER MOTOR	Type	M001T66081				
		No. of teeth of pinion gear	11				
		Shifting method of pinion	Magnetic shifting				
		Wear of commutator diameter	Ø29.4		Ø28.8		
		Stepped wear of commutator		0.05		0.2	
		Bending allowance of armature shaft		0.05	More than 0.08		
		Length of brush	17.5			9	
		Spring force of brush N {kgf}		22.5—32.5 {2.3—3.3}		Less than 8.8 {0.9}	
	ALTERNATOR	Type	A007T03877				12V—40A
		Outside diameter of slip ring		22.7		22.1	
		Length of brush		18.5		5.0	
		Pulley tightening torque N·m {kgf·m}		58.3—78.8 {5.95—8.05}			

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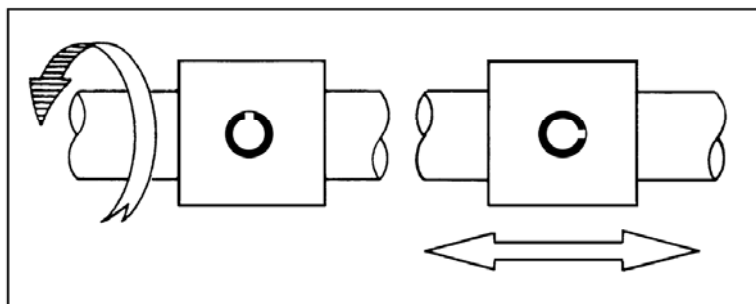
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Chapter 3. TRACTOR MAIN BODY

⚠ NOTES: Precautions before start

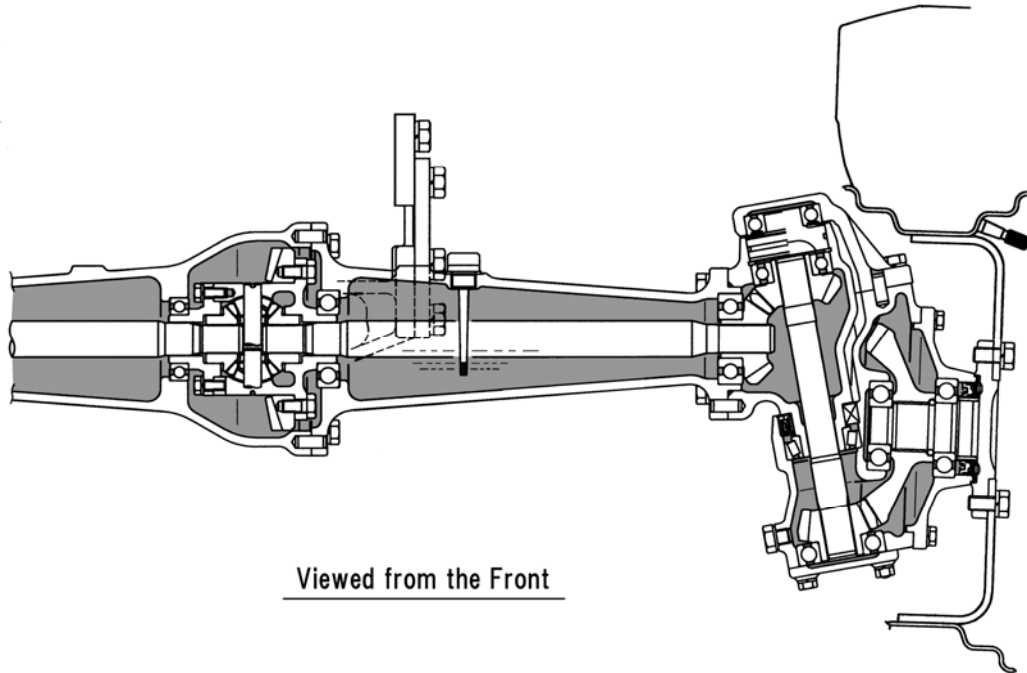
- 1) Wash each part sufficiently and remove dust, liquid packing, gasket, etc.
- 2) Store bolts and O-rings in order not to be confused at the time of reassembly since their sizes vary depending on positions of use.
- 3) Handle gears carefully not to damage and store carefully so that they are not reassembled 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 type liquid packing.)
- 8) Drain oil and water if required.



300Y

3-1 Front Axle

1. SECTIONAL VIEWS



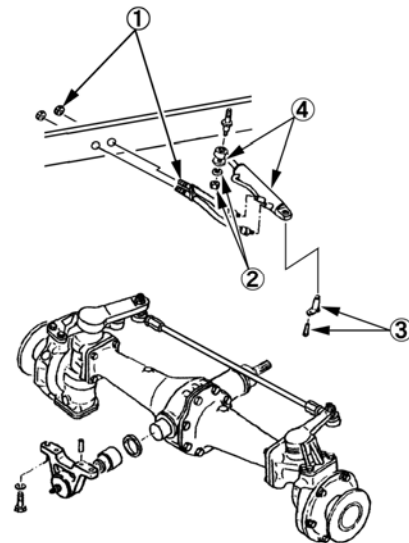
300-1Y

2. DISASSEMBLY

Disassembling procedure

1. Cylinder (for power steering)

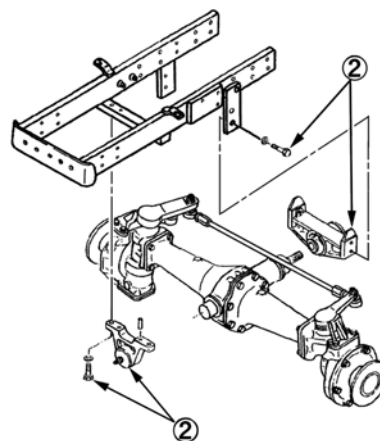
- ① Remove the nuts and adapters for power steering from front axle support.
- ② Remove the nut (M16) of the arm (right) and take out the spring washer and spacer.
- ③ Remove the bolt (M8 × 12) of the wheel shaft case(right) and take out the pin.
- ④ Remove the cylinder and spacer.



301Y

2. Tire ·Front axle 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 axle support.



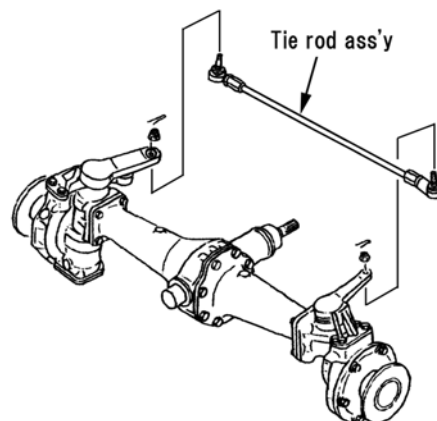
302Y

3 Tie rod ass'y

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

NOTE:

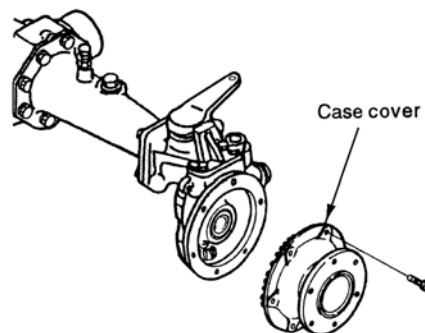
Remove the tie rod ass'y when removing the arm. In the reassembling procedure (after the order 5), install it temporarily together with the arm.



303Y

4. Case cover (final)

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



304Y

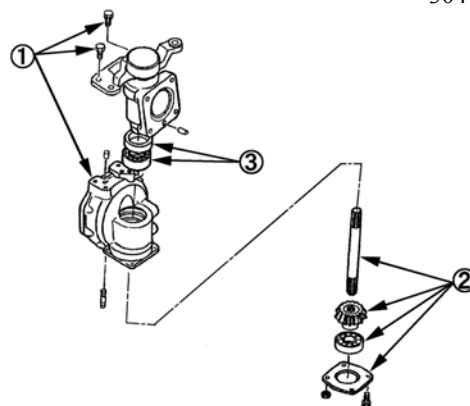
5. Transmission case (final)

- ① 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.

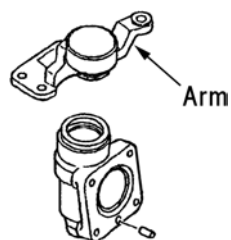
- ② Remove the case cover, bearing, final pinion and drive shaft from the case.
- ③ Remove the oil seal and bearing.



305Y

6. Arm (knuckle)

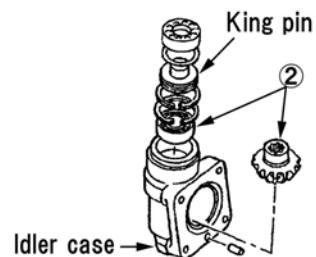
Remove the right and left arms **from the idler case**.



306Y

7. Transmission case (idler) · King pin

- ① Remove the right and left transmission cases, O-ring and king pin as a set.
- ② Remove the final pinion and bearing from in the idler case.
- ③ Remove the bearing, king pin, O-ring and snap ring from idler case.

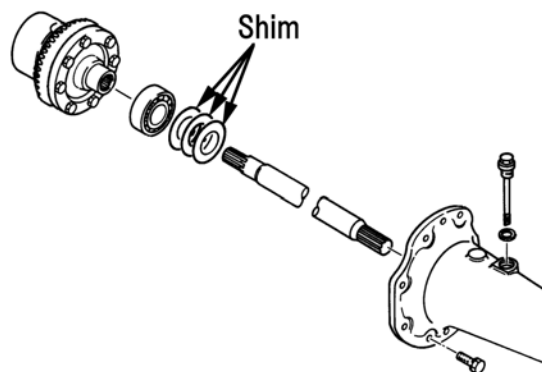


307Y

8. Wheel shaft case (left)

NOTE:

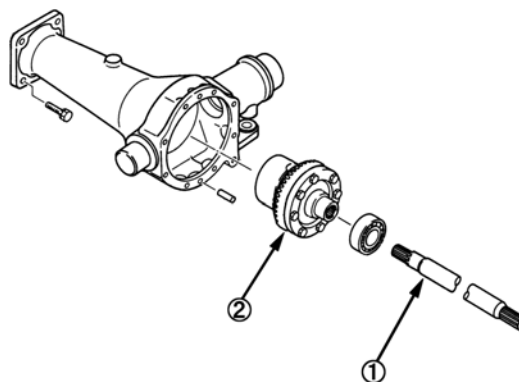
When any shims have been installed between the case and bearing, note their thickness and quantity and take care not to miss them.



308Y

9. Differential shaft (left) · Differential ass'y

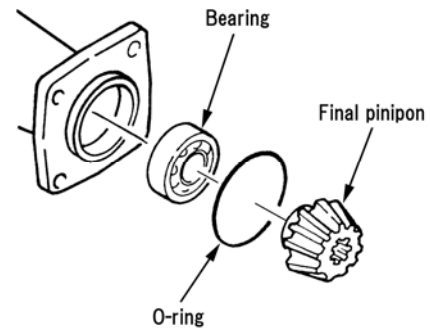
1. Differential shaft (left)
2. Differential ass'y



309Y

10. Final pinion (left): Idler

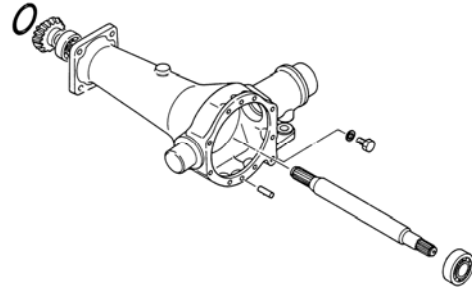
Remove the final pinion, bearing and O-ring.



310Y

11. Final pinion (right) Differential shaft (right)

Extract the wheel shaft (right), final pinion (right) and bearing together, from the wheel shaft case (right).



311Y

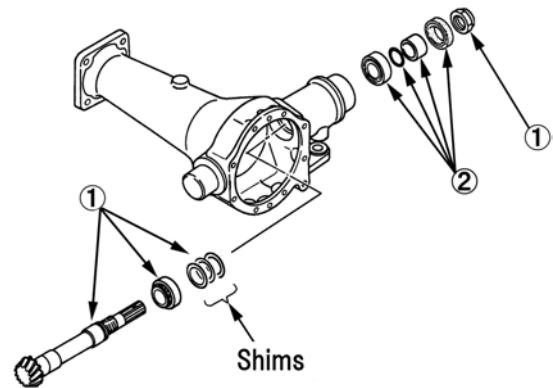
12. Drive pinion

- ① Remove the lock nut and extract the drive pinion, **front bearing** and shim to the inside of the case.

NOTE:

Confirm the thickness and number of the shims.

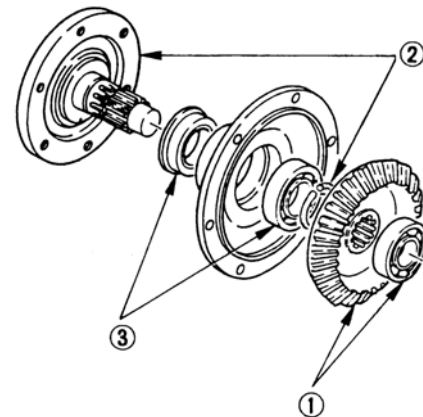
- ② Remove the oil seal, collar, and **bearing** if necessary.



312Y

13. Case cover ass'y

- ① Remove the final gear (bevel), and bearing.
- ② Remove the crips and extract the wheel shaft.
- ③ Drive out the bearing and oil seal from the cover.



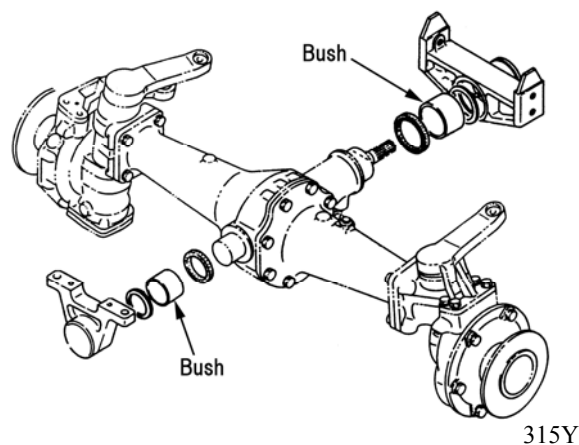
313Y

3. INSPECTION AND SERVICE

1) Casing

- ① Replace the bush if the play of the pivot shaft exceeds the repair value.

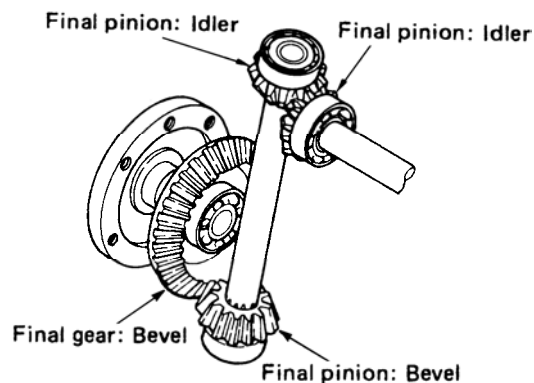
	Clearance between pivot shaft and bush (mm)	
	Standard assembling value	Repair value
Front side	0.02 – 0.2	0.35
Rear side	0.02 – 0.16	0.35



2) 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
0.2 – 0.4	0.5



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

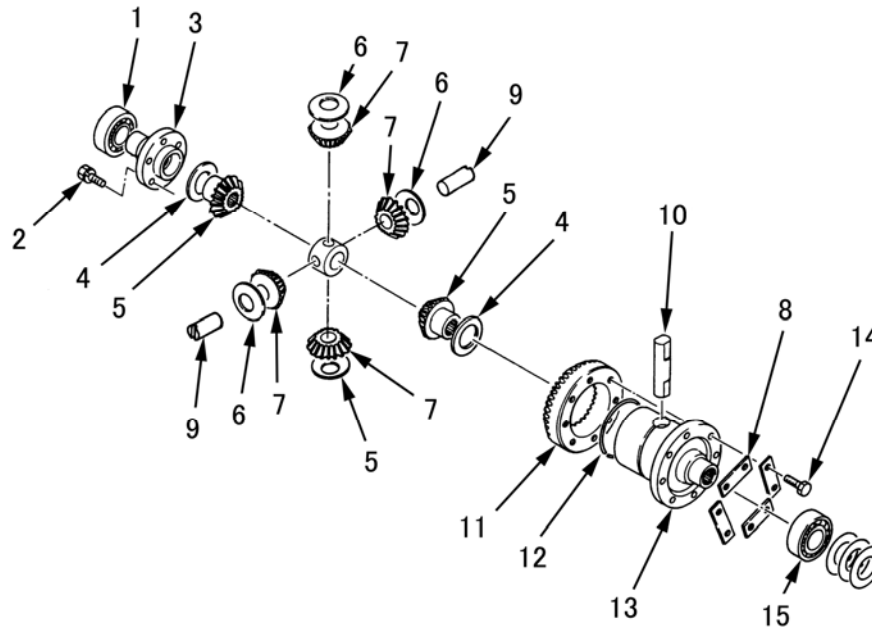
4) Run-out of front wheel

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

5) Differential ass'y

Refer to paragraph of transmission (rear differential).

Components



- | | | |
|------------------------------|------------------|-----------------------------------|
| 1. Bearing (6008) | 6. Thrust washer | 11. Bevel gear |
| 2. Bolt | 7. Gear ass'y | 12. Clip |
| 3. Differential cage (cover) | 8. Lock washer | 13. Differential cage (main body) |
| 4. Thrust washer | 9. Pinion shaft | 14. Bolt |
| 5. Differential gear | 10. Pinion shaft | 15. Bearing (6208) |

318Y

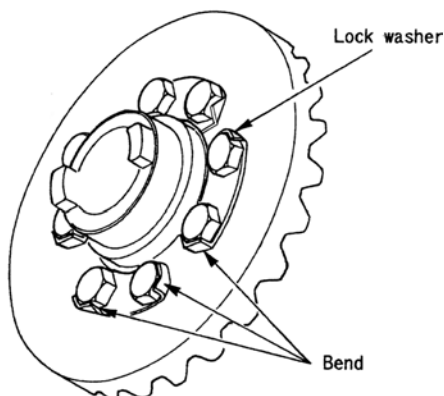
NOTE:

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.

- (1) Replace the thrust washer of the differential pinion if the service limit is exceeded.
- (2) Replace the **pinion shaft and differential pinion** if their clearance exceeds the service limit.

Ring gear tightening torque N·m {kgf·m}	49—62.7 {5.0—6.4}
--	----------------------

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



318-1Y

4. 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 **adjust** the starting loads (preload).

Bearing preload	128~166 N {13~17 kgf}
-----------------	--------------------------

NOTE:

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

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.

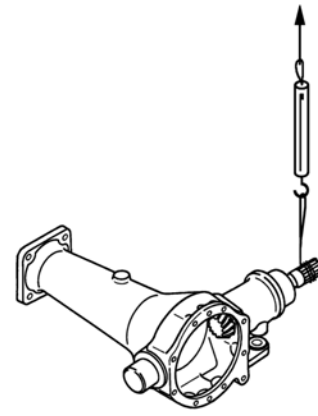
NOTE:

When backlash is 0 (zero), the bevel gear of the differential may be stuck closely to the drive shaft.

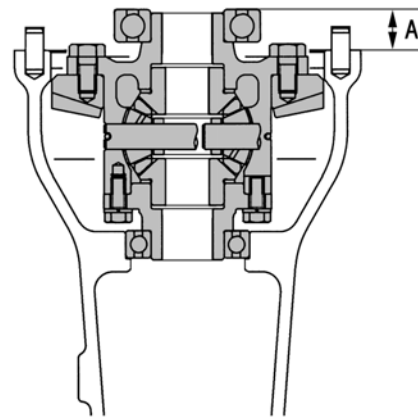
- (2) Adjust the shims (2) to obtain $B - A = 0.15 \text{ mm}$

NOTE:

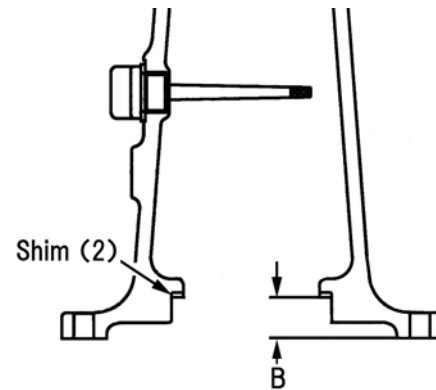
Refer to the paragraph of the transmission for the gear contact pattern of the pinion and ring gear when adjusting.



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320Y



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5. 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 assembling value
$A - B = -5 \sim +5 \text{ mm}$

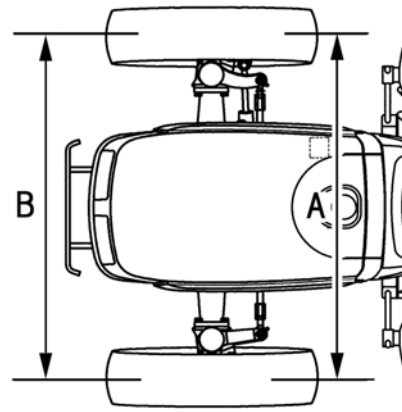
(Inclination angle of king pin, caster and camber fixed)

NOTE: Tighten torque of the lock nut of the tie rod is $125 \text{ N} \cdot \text{m}$ ($13 \text{ kgf} \cdot \text{m}$).

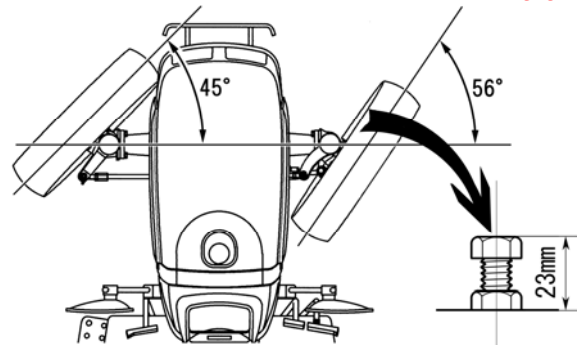
2. Steering angle

Standard assembling value	$54 - 56^\circ$ (inside) (outside 45°)
---------------------------	---

NOTE : To ensure correct steering operation the stopbolt should protrude a minimum of 23 mm from the casing.



323Y



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6. FRONT WHEEL

1) Specifications

	ST330 • ST333	
	Tire size	Rim size
(AG) — Option	6-14	5J-14
(AG) — Standard	7-14	5J-14
(TURF) — Standard	25×8.50-14	7JA-14

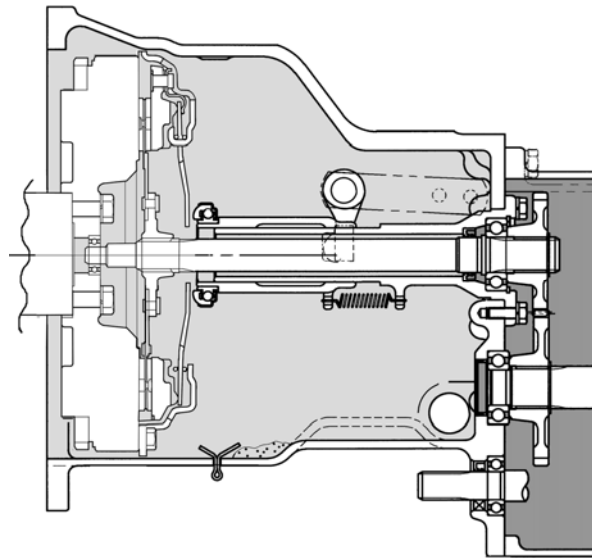
2) Inspection of Tire

		4WD		
Tire size		6-14	7-14	25×8.5-14
1. Wear of tire (mm)	● Lag height when new	28	28	8.5
	● Lag height in service limit	14	14	4
2. Tightening Torque of Disk	N·m {kgf·m}	75-95 {7.7-9.6}		
3. Rim run-out (mm)		Service limit within 5		
4. Air pressure of tire		See Operator's Manual		

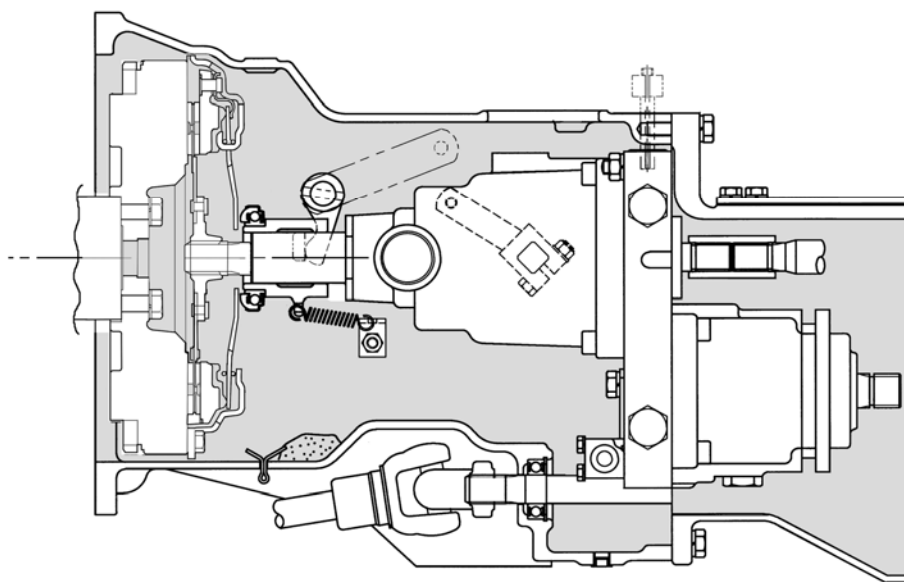
3 - 2 Clutch

1. SPECIFICATIONS AND SECTIONAL VIEW

Type	Dry, single-plate foot-stepping type	
No. of clutch plates	1 (facing ; 2)	
Disk (O.D×Bore×Thickness)	ST330/333	$\phi 224 \times \phi 150 \times 8.65$ (t=8.0 at 550 kgf compressed)
Release lever height (Above flywheel surface)	ST330/333	36.1 ± 1 mm



For 9×3 Manual Mission



For HST Mission

325Y

2. DISASSEMBLY, INSPECTION AND REASSEMBLY OF CLUTCH

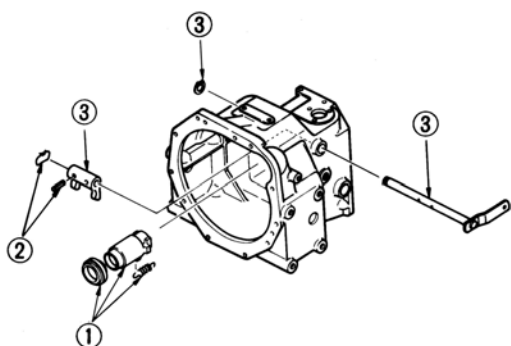
(Refer to 1 - 5, Removal of outside, for the clutch case separating method.)

1) Disassembling procedure

(1) Release bearing• Release hub• Clutch shaft• Clutch fork

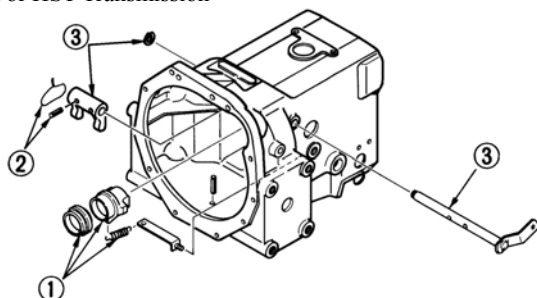
- ① Remove the return spring and extract the release hub and bearing together frontward.
- ② Disconnect the wire and drive out the spring pin.
- ③ Remove the snap ring, extract the clutch shaft leftwards, and take out the clutch fork from the case.

For Manual Transmission



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For HST Transmission

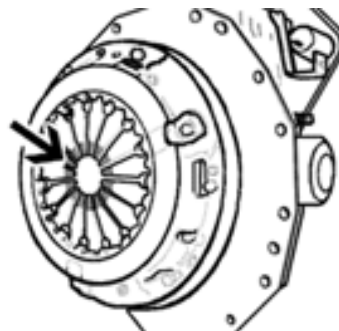


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2) Inspection and service

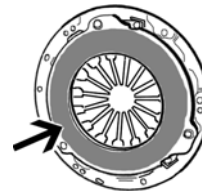
(1) Pressure plate ass'y

- ① Wear of lever (fork end) to be in contact with the release bearing.



329Y

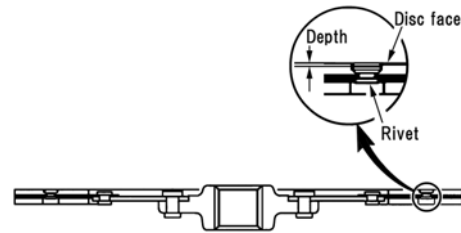
- ② If the friction surface is deflected, scratched or worn out unevenly, correct with sand paper or replace.



330Y

(2) Clutch disk COMPL

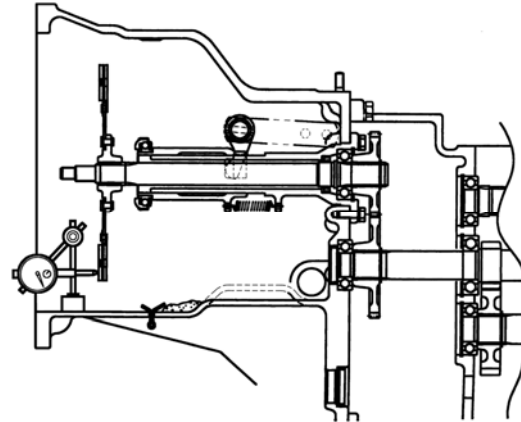
- ① Measure the wear of the facing (rivet recess).
Replace if the rivet recess is less than 0.3 mm.
- ② Replace the facing if hardened, or deflected due to seizure.
- ③ Wash in **oil solvent** if oil is stuck.



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- ④ Replace the spline if it is worn out or disk run-out is observed.

	Service limit
Disk run-out	1.0mm



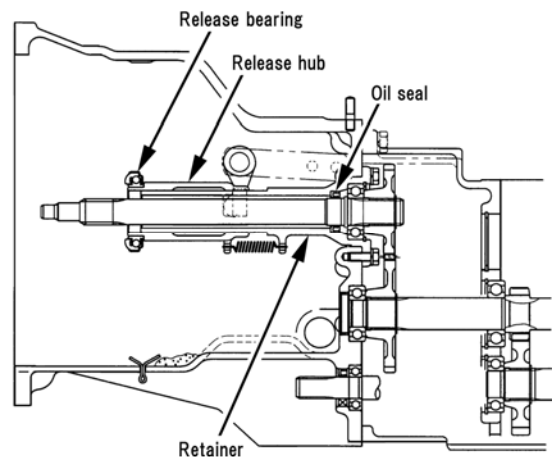
332Y

(3) Release bearing

1. Rotate the bearing by hand and observe the following conditions:
 - a. Abnormal noise
 - b. Uneven rotation
 - c. Excessive free-play
 - d. Scoring on inner race surface.

NOTE :

Do not wash the bearing since it is of non oil replenishing type.



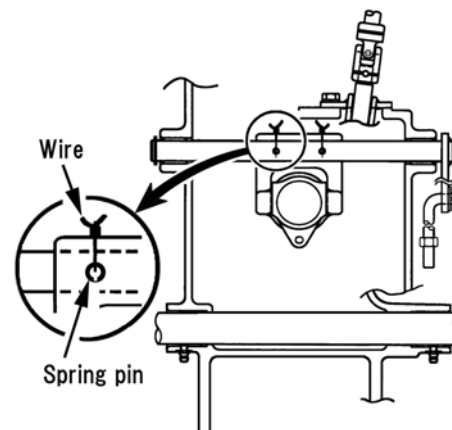
333Y

(4) Release hub and clutch fork

- ① Replace the release hub and clutch fork if the fork claw or release hub sliding part are worn out unevenly.
- ② When oil leakage is noticed from the inside of the retainer, replace the oil seal. (Refer to the paragraph of disassembly of transmission 1.)
- ③ Coat the sliding parts of the retainer and release hub sufficiently with grease.

NOTE :

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



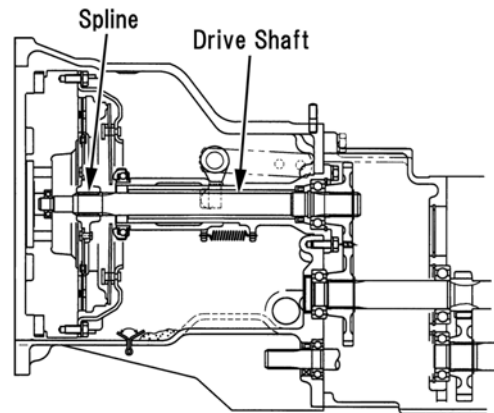
334Y

(5) Drive shaft

Replace the drive shaft if the spline is worn out unevenly or damaged.

NOTE :

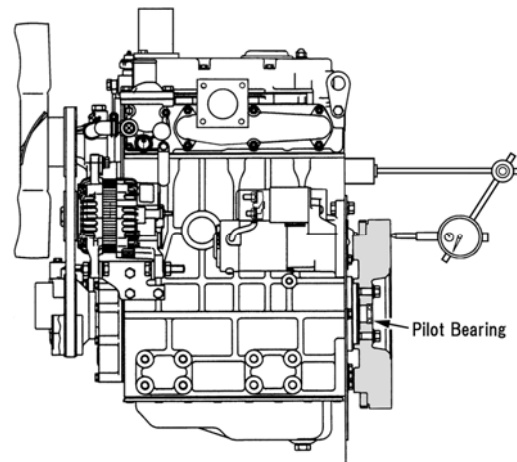
Check the spline of the clutch disc at the same time.



335Y

(6) Flywheel

- ① Check for cracks and one-sided wear and correct the mounting surface if the damage is insignificant.
- ② Check the **pilot bearing** for satisfactory condition.
(9×3 model only installed)

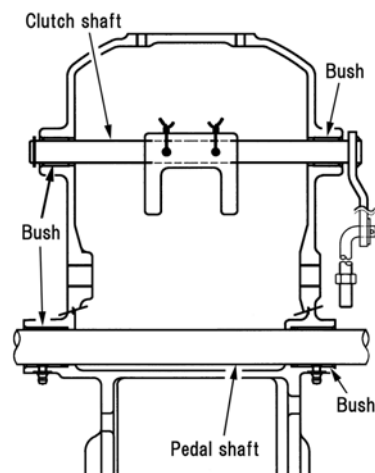


336Y

(7) Clutch shaft

- ① Check the clutch shaft for smooth operation.
- ② If the play of the clutch shaft and clutch case is excessive, replace the bush.

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



337Y

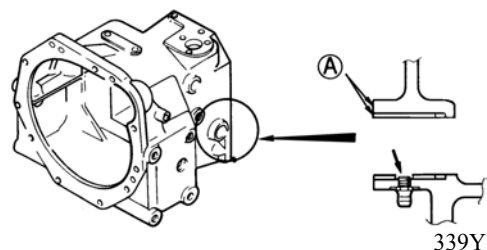
(8) Pedal shaft

- ① Check the pedal shaft for smooth operation.
- ② If the play of the pedal shaft and clutch case is excessive, replace the bush.

Pedal shaft bush bore (ϕ)	
Standard dimension	Service limit
28	29

NOTE :

1. Drive in the bush until it becomes level with the pedal shaft end surface. (A)
2. Align the bush hole and grease *fitting* hole.



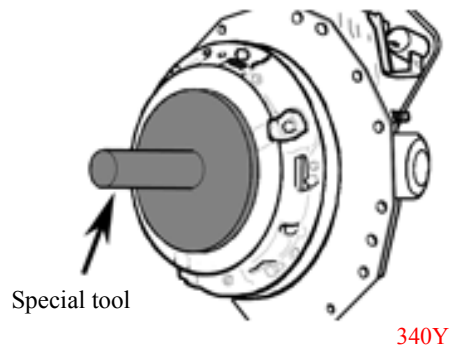
3) Reassembly and adjustment

(1) Pressure plate and clutch disk

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

NOTE:

On Model ST 329, since the clutch ass'y fixing bolts are different in length (2 types), care should be taken about combination with the bolt holes (bolt hole depth is also different.)

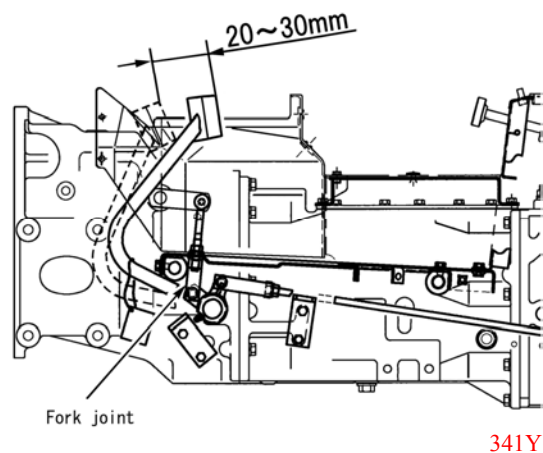


(2) Assembly to main body

Reassembly shall be in the reverse order to disassembly.

(3) Adjustment of clutch pedal play

Adjust the clutch pedal play to 20 - 30 mm at the pedal tread turning the fork joint.



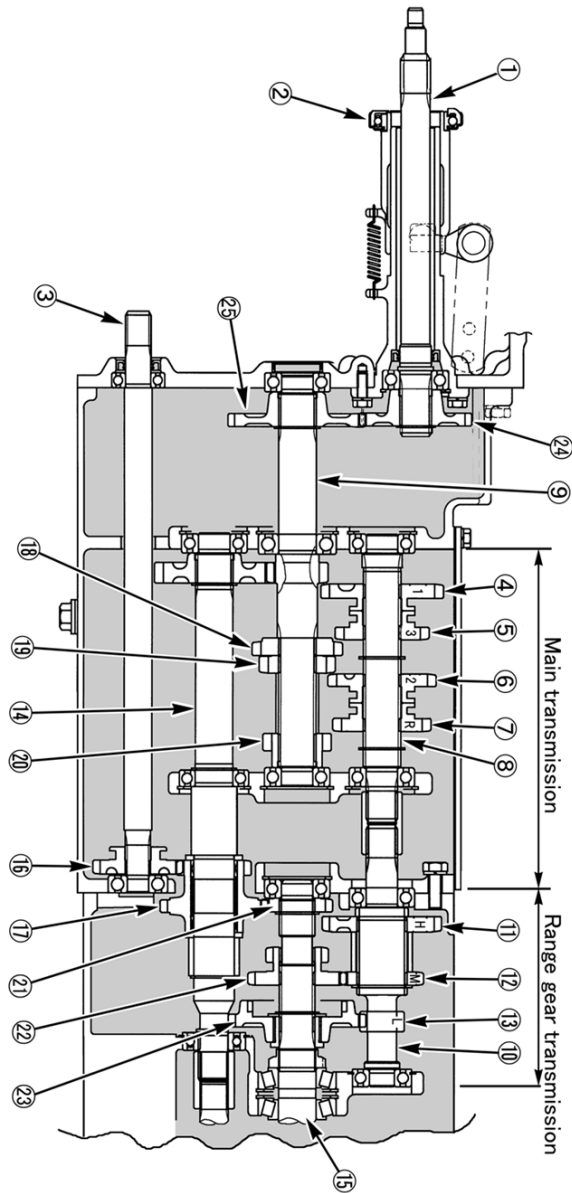
3. TROUBLESHOOTING

Condition	Cause	Remedy
1. Slippery clutch		
(1) Does not speed up.	(1) No clutch pedal play.	(1) Adjust the play to 20—30 mm on pedal tread.
(2) Does not accelerate.	(2) Oil or grease stacked to the facing.	(2) Remove and clean or replace. Correct oil leakage at the same time.
(3) Smell of burning facing.	(3)—1 Broken wiring.	(3)—1 Replace the pressure plate ass'y.
	(3)—2 Uneven wear or seizure of pressure plate or flywheel.	(3)—2 Correct or replace.
2. Improper disengagement of clutch		
(1) Sound of transmission gears.	(1) Excessive play of clutch pedal.	(1) Adjust the play.
(2) Tractor body moves even when the clutch is depressed.	(2)—1 Excessive wear of clutch components.	(2)—1 Disassemble, check and correct or replace if trouble is noticed.
	(2)—2 Distortion of disk ass'y.	(2)—2 Replace the disk ass'y.
	(2)—3 Play generated due to wear of pilot bearing.	(2)—3 Replace the pilot bearing.
	(2)—4 Uneven wear of disk hub and drive.	(2)—4 Replace the disc ass'y or drive shaft.
3. Noise and vibration of clutch		
(1) Noise and vibration of clutch.	(1) Fatigued damper spring.	(1) Check and replace (disk ass'y).
	(2) Loosened rivet of clutch facing.	(2) Check and replace (disk ass'y).
	(3) Wear or damage of release bearing.	(3) Replace the release bearing.
	(4) Wear or damage of pilot bearing.	(4) Replace the pilot bearing.
	(5) Loosened bolts tightening each part of clutch.	(5) Retighten the bolt.

3—3 Transmission 1 for 9×3

1. SECTIONAL VIEW

- | | | | |
|--------------------------------------|-----------------------|---------------------------------|----------------------|
| ① Input shaft | ⑧ Counter shaft | ⑮ Drive pinion | ⑳ 4WD Fixed gear |
| ② Clutch release bearing | ⑨ Main counter shaft | ⑯ 4WD slide gear | ㉑ Range sliding gear |
| ③ 4WD Drive shaft | ⑩ Range main shaft | ⑰ 4WD counter gear | ㉒ Range counter gear |
| ④ Main slide gear (1 st) | ⑪ Range gear (High) | ⑱ Fixed gear (3 rd) | ㉓ Fixed gear |
| ⑤ Main slide gear (3 rd) | ⑫ Range gear (Middle) | ⑲ Fixed gear (2 nd) | ㉔ Fixed gear |
| ⑥ Main slide gear (2 nd) | ⑬ Range gear (Low) | ㉚ Fixed gear (Reverse) | |
| ⑦ Main slide gear (Reverse) | ⑭ PTO counter shaft | | |

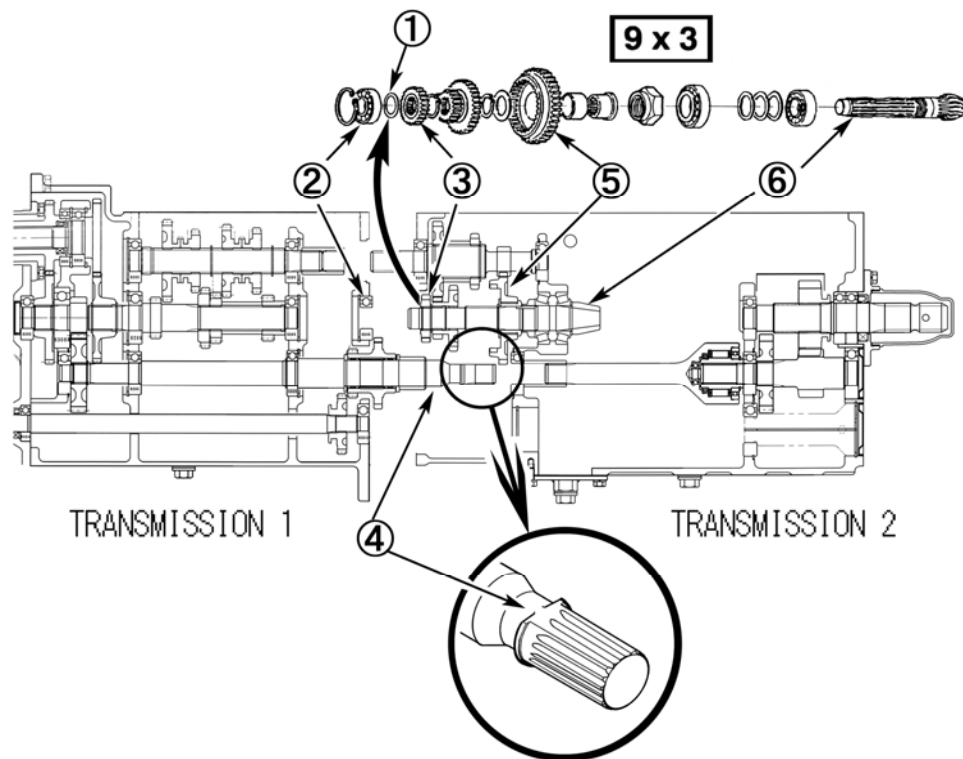


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NOTE:

1. *Keep the shims, 1, between the bearing, 2, and 4WD fixed gear, 3, when separating the transmission 1 and transmission 2*
2. *Turn the flat face of the PTO countershaft, 4, toward the range counter gear, 5, on the drive pinion shaft, 6, to avoid the interferences when separate the transmission 2 from the transmission 1.*

Inspect the each gears backlash refer to “2) Inspection” in this section before disassemble the transmission 2.



342-1Y

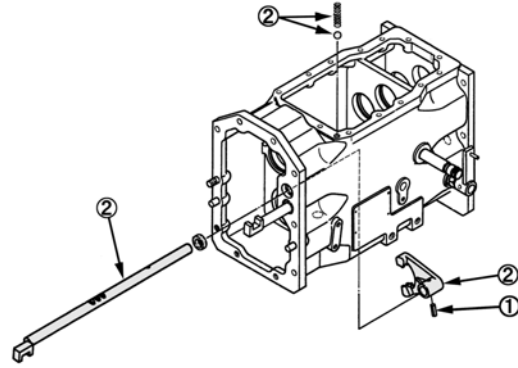
2. DISASSEMBLING

1) Shifter rod • Shifter fork (main : 2 - R)

- ① Drive out the spring pin from the 2—R shifter fork.
- ② Drive out the shifter rod front-wards and remove the shifter fork.

NOTE :

1. Set the shifter rod on the 1—3 side (lower side) at the neutral position.
2. When the rod is pulled out, a steel ball drops into the inside of the case. Take care not to miss it.



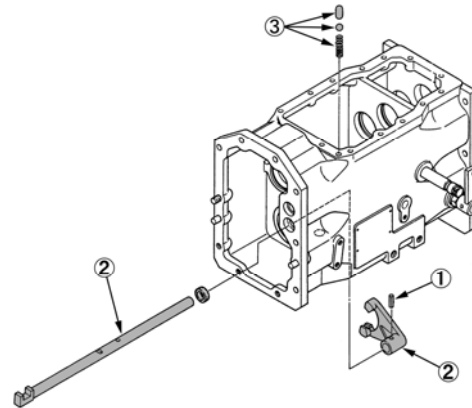
343Y

2) Shifter rod • Shifter fork (main : 1 - 3)

- ① Drive out the spring pin from the shifter fork.
- ② Drive out the shifter rod front-wards and remove the shifter fork
- ③ Take out the pin, steel ball and spring from the housing.

NOTE :

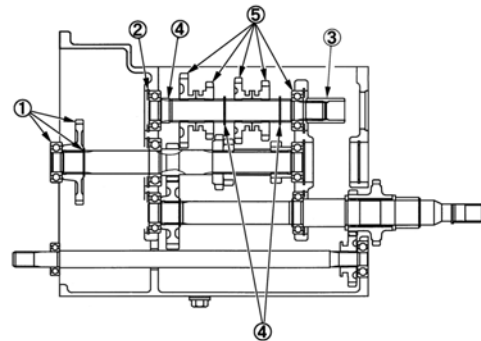
1. When the rod is pulled out, a balk pin and steel ball come out. Take care not to miss them.
2. Remove the spring installed below the steel balls.



344Y

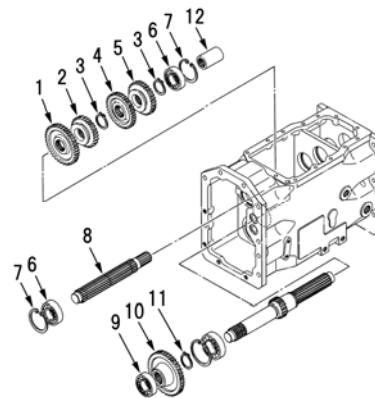
3) Counter shaft : main

- ① Remove the bearing, fixed gear and snap ring from the front of counter shaft.
- ② Remove the snap ring ($\phi 52$) from front in the housing.
- ③ Remove the coupler from rear of counter shaft.
- ④ Pull out the counter shaft front-wards moving the snap rings ($\phi 30$) on the counter shaft to rear-wards.
- ⑤ Take out the slide gears, snap rings and bearing from housing.



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1. Slide gear A (main : 1)
2. Slide gear A (main : 3)
3. Snap ring ($\phi 30$)
4. Slide gear A (main : 2)
5. Slide gear A (R)
6. Bearing (6205)
7. Snap ring ($\phi 52$)
8. Counter shaft : main
9. Bearing
10. Fixed gear
11. Snap ring
12. Coupler

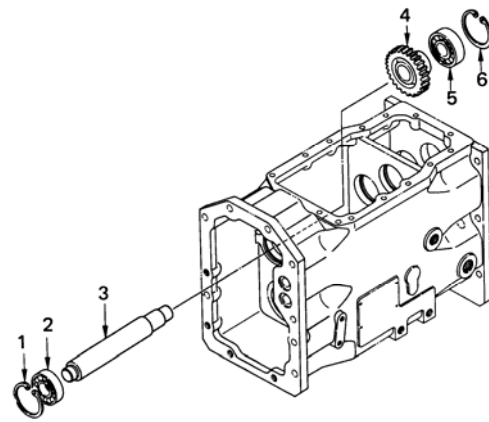


346Y

4) Reverse gear shaft

- ① Remove the snap ring (ϕ 47) from in the housing.
- ② Drive out the reverse gear shaft together with the bearing on the front side **to front-wards while** holding the counter gear A.
- ③ Remove the bearing from the shaft if necessary.
Remove the bearing and snap ring (ϕ 52) from the case.

1. Snap ring (ϕ 47)
2. Bearing (6204)
3. Reverse gear shaft
4. Counter gear A (reverse idler)
5. Bearing (6304)
6. Snap ring (ϕ 52)

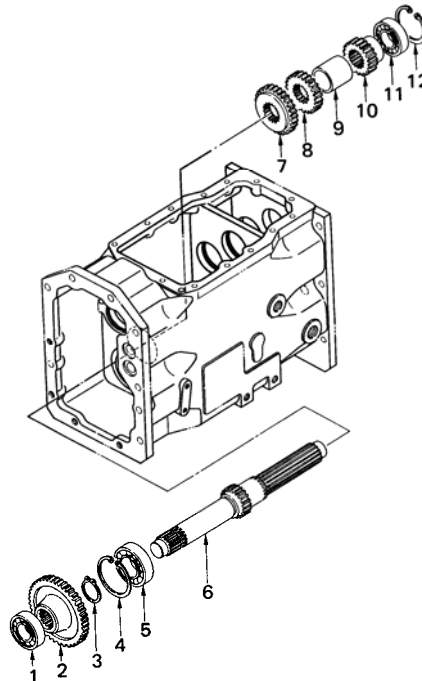


347Y

5) Counter shaft

- ① Remove the snap ring (ϕ 62) from in the housing.
- ② Drive out the counter shaft front-wards and remove the fixed gears (3 pcs), collar (1 pc.) and bearing.

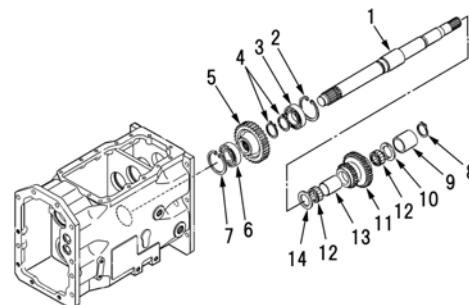
- | | |
|---------------------------|----------------------------|
| 1. Bearing | 7. Fixed gear A (main: 3) |
| 2. Fixed gear A | 8. Fixed gear A (main: 2) |
| 3. Snap ring (ϕ 30) | 9. Collar |
| 4. Snap ring (ϕ 62) | 10. Fixed gear A (R) |
| 5. Bearing (6206) | 11. Bearing (6205) |
| 6. Counter shaft | 12. Snap ring (ϕ 52) |



6) PTO counter shaft

- ① **Remove the snap ring (ϕ 32), collars, thrust washers, 4WD counter gear and needle bearings from PTO counter shaft.**
- ② Remove the snap ring (ϕ 55) fixing the bearing (6006) in the middle of the housing.
- ③ Driving out the shaft rearwards, remove the bearing (6205) and counter gear at the shaft end.
- ④ Remove 2 snap rings (ϕ 30) and bearing (6006) from the shaft if necessary.

- | | |
|---------------------------|---------------------------|
| 1. PTO counter shaft | 8. Snap ring (ϕ 32) |
| 2. Snap ring (ϕ 55) | 9. Collar |
| 3. Bearing (6006) | 10. Thrust washer |
| 4. Snap ring (ϕ 30) | 11. 4WD counter gear |
| 5. Fixed gear | 12. Needle bearings |
| 6. Bearing (6205) | 13. Collar |
| 7. Snap ring (ϕ 52) | 14. Thrust washer |



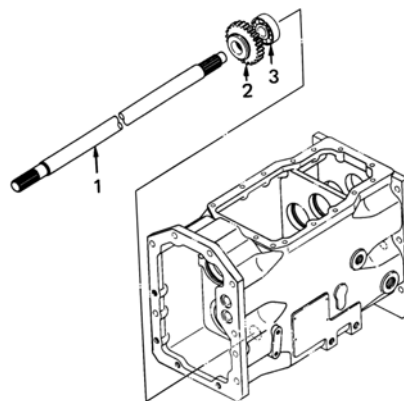
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349Y

7) Drive shaft (4WD)

Drive out the drive shaft (4WD) front-wards and remove the slide gear.

1. Drive shaft
2. Slide gear
3. Bearing (6303)



350Y

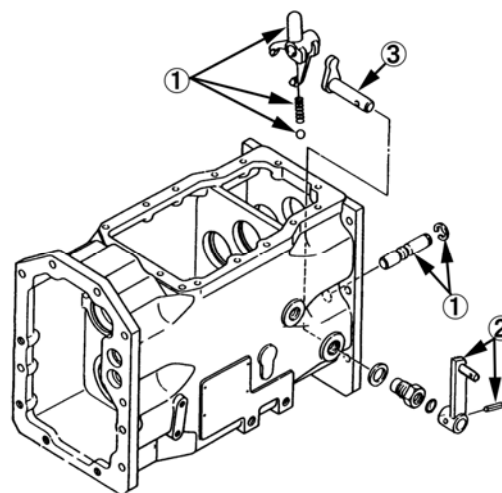
8) Shifter rod • Shifter fork (4WD)

- ① Drive out the shifter rod rear-wards and remove the shifter fork.

NOTE :

*When the shifter rod pulled out, a steel ball and spring come out from in the shifter fork.
Be careful not to miss them.*

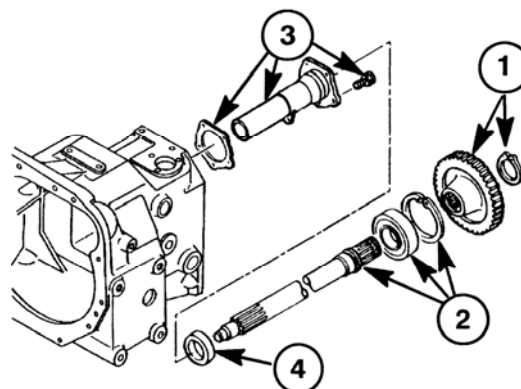
- ② Drive out the spring pin and remove the change lever.
- ③ Remove the shift arm from the inside of the housing.



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9) Drive Shaft • Retainer • Oil seal (Remove it from clutch housing)

- ① Remove the snap ring (ϕ 30) and take out the fixed gear from drive shaft.
- ② Remove the snap ring (ϕ 52) from in the retainer and drive out the drive shaft and bearing to rear-ward.
- ③ Remove bolts and retainer from rear of clutch housing.
- ④ If necessary remove the oil seal from in the retainer and clutch housing.



352Y

3. INSPECTION AND SERVICE

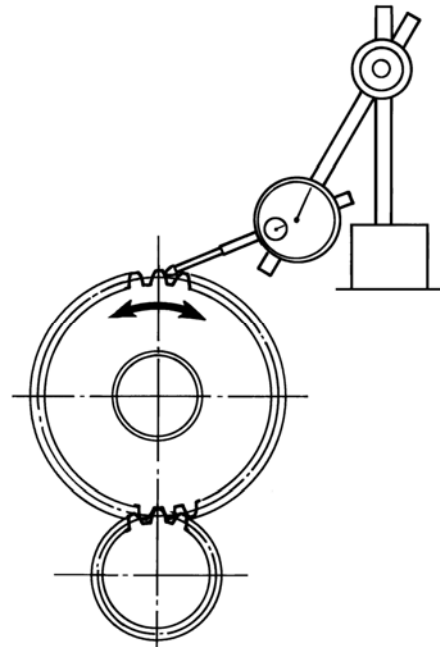
1) Bearing

Replace if excessive play, discoloration, unsmooth rotation, noise, etc. are noticed.

2) Backlash of gear

Replace if the service limit is exceeded.

Backlash of gear (mm)	
Standard assembling Value	Service limit
0.04—0.16	0.6

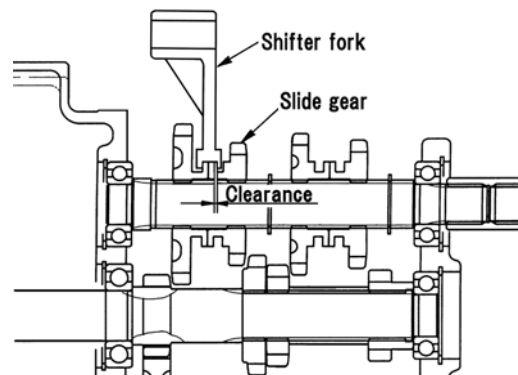


354Y

3) Shifter fork and slide gear

Replace if the service limit is exceeded.

Clearance between shifter fork and slide gear (mm)	
Standard assembling value	Service limit
0.1—0.3	1.0



355Y

4) Oil seal and O-ring

Replace with new ones.

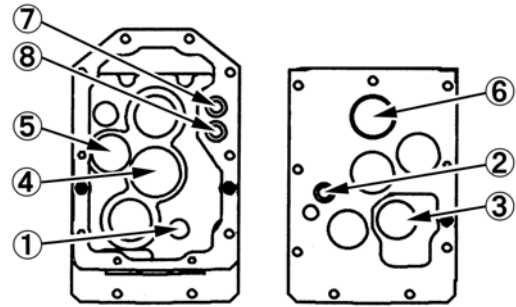
4. REASSEMBLY

NOTE:

Reassemble units generally in the reverse order to disassembly. Assemble the main units in the following procedure.

Assemble shafts and shifters in the order as shown in the right figure.

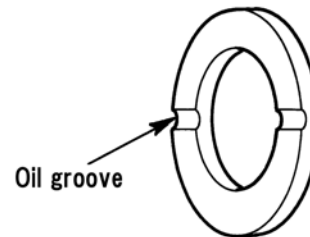
- | | |
|----------------------|-----------------------|
| 1. Drive shaft (4WD) | 5. Back gear shaft |
| 2. Shifter (4WD) | 6. Main shaft |
| 3. PTO counter shaft | 7. Main shifter (1-R) |
| 4. Counter shaft | 8. Main shifter (3-2) |



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1. Thrust washer

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



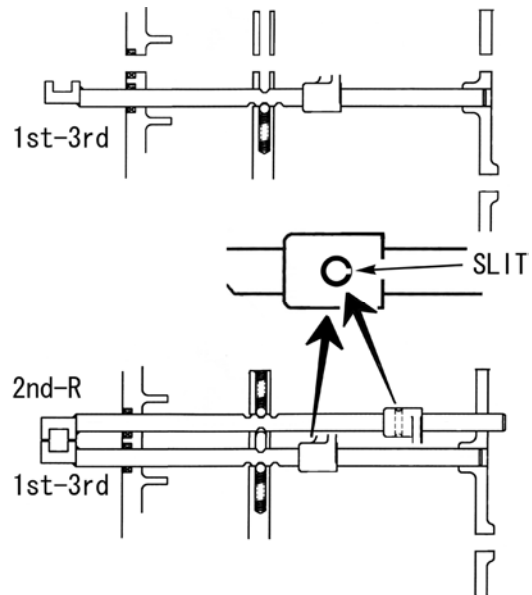
357Y

2. Main shifter rod and fork

- ① Place the spring and steel ball into the transmission case and install the shifter rod (1st-3rd) and fork.

NOTES :

1. Install the shifter rod (1st-3rd) with a fork setting hole at the center.
2. Spring for the main transmission is shorter one and the longer one is for 4WD.
3. Install the fork after confirming that the steel ball has been positively installed.

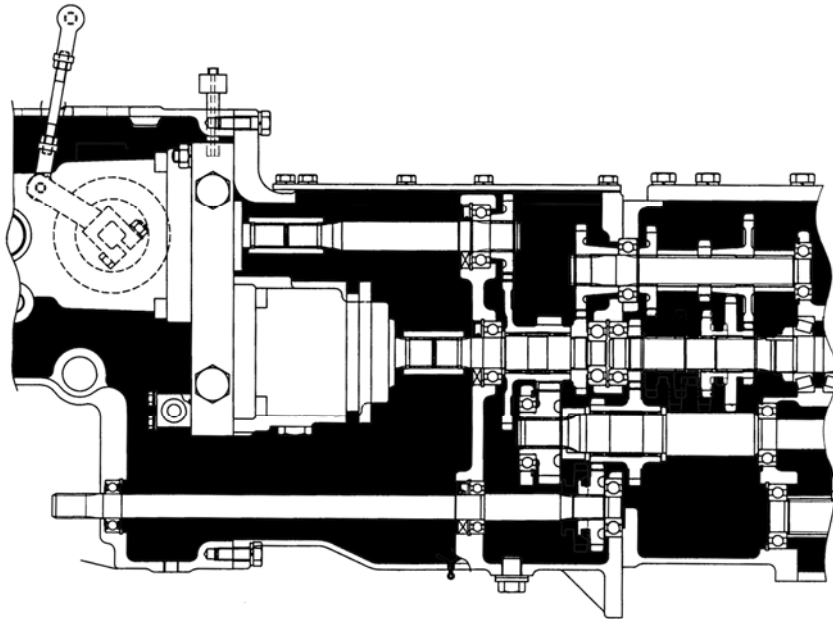


358Y

- ② Set the shifter rod (1st-3rd) at the neutral position and install the balt pin to the case.
- ③ Place the shifter rod (2nd-R) into the transmission case and install the fork.
- ④ Install the steel ball and spring to the transmission case when installing the change lever case.
- ⑤ Drive the spring pins into the main shifter fork and take care the slit direction of the spring pin to the front or rear.

3 - 4 Transmission 1 for HST

1. SECTIONAL VIEW



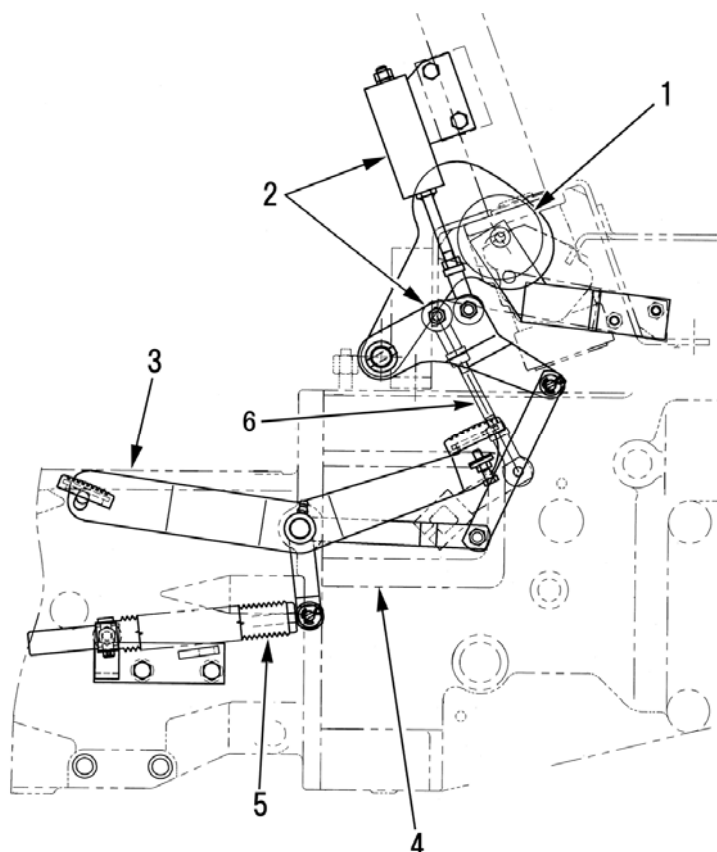
360Y

2. SPECIFICATIONS

Name	Two—axle type HST
Model	HVFD23F —R28 —P —LT
Max. input speed	3000 rpm
Output speed	0—2800 rpm
Pump swash plate inclination angle	0—±18°
Max. working pressure	27.5MPa [280 kg/c m²] (Relief set pressure)
Charging circuit pressure	0.4-0.6 MPa[4.1—6.1 kg/c m²] at engine 2800 rpm.
Case internal pressure	Less than 0.098 MPa [1 kg/c m²]
Pump capacity (variable displacement type)	0—23.4 cc/rev.
Motor capacity (fixed displacement type)	23.4 cc/rev.
Charge pump capacity	6.2 cc/rev.

3. NAME OF UNITS

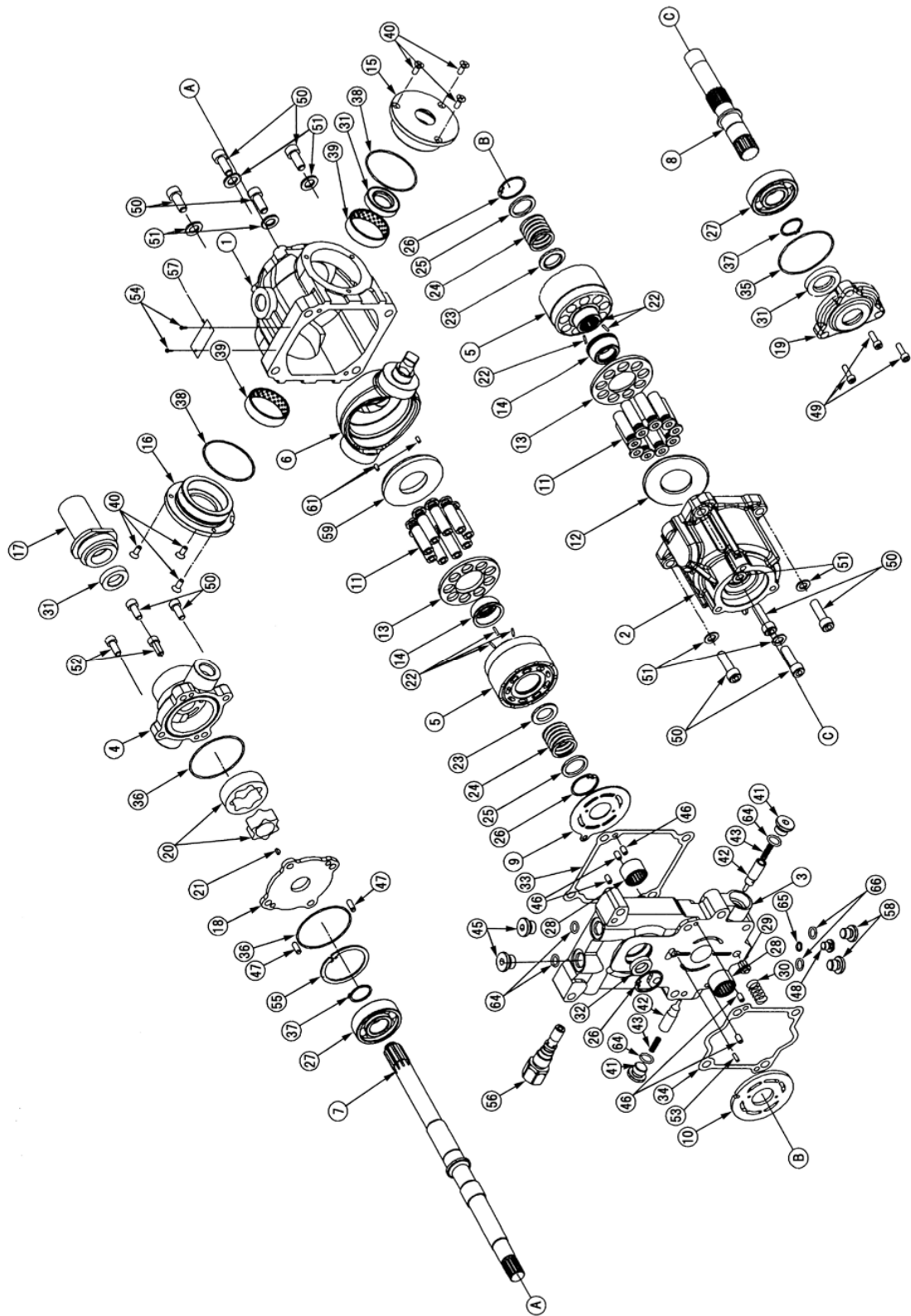
1) Control unit



1. Cruise control magnet
2. Neutral control linkage
3. Foot pedal
4. HST unit
5. Damper
6. HST control rod

361Y

2) HST unit



362Y

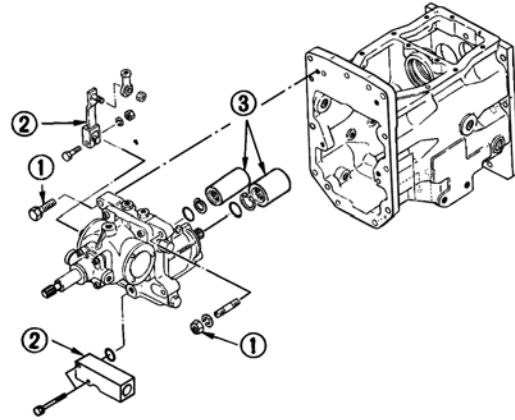
- | | | |
|--------------------------|--------------------|------------------------------------|
| Pump case | 20. Key | 39. Plug |
| 1. Motor case | 21. Pin | 40. Poppet |
| 2. Port block | 22. Spring holder | 41. Spring |
| 3. Charge pump caser | 23. Spring | 45. Plug |
| 4. Cylinder block | 24. Spring holder | 46. Pin |
| 5. Swash plate | 25. Snap ring | 47. Pin |
| 6. Input shaft | 26. Ball bearing | 48. Plug |
| 7. Output shaft | 27. Needle bearing | 49. Socket head bolt |
| 8. Valve plate for pump | 28. Valve | 50. Socket head bolt |
| 9. Valve plate for motor | 29. Spring | 51. Washer |
| 10. Piston | 30. Oil seal | 52. Socket head bolt |
| 11. Thrust plate | 31. Oil seal | 53. Pin |
| 12. Retainer plate | 32. Gasket | 55. Snap ring |
| 13. Retainer holder | 33. Gasket | 56. Valve Ass'y |
| 14. Cover A | 34. O-ring | 58. Plug |
| 15. Cover B | 35. O-ring | 59. Thrust plate |
| 16. Holder | 36. Snap ring | 61. Pin |
| 17. Plate | 37. O-ring | 62. Cylinder block ass'y for pimp |
| 18. Cover | 38. Bush | 63. Cylinder block ass'y for motor |
| 19. Trochoid rotor | 40. Screw | 64. O-ring |
| | | 65. O-ring |
| | | 66. O-ring |

4. TRANSMISSION 1

1) Disassembling

(1) HST unit

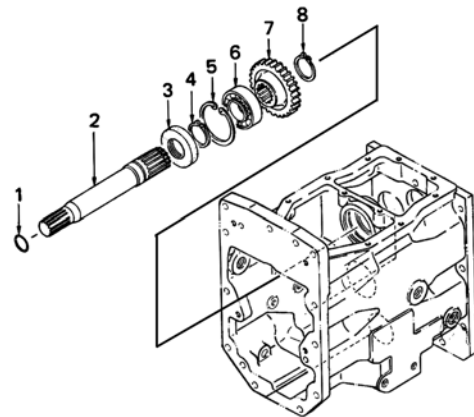
- ① Remove the HST unit from the front of the transmission case (2 bolts and 2 nuts.).
- ② Remove the control lever and adaptor from the HST unit.
- ③ Remove the joint, snap ring and O-ring from the drive shaft.



(2) Drive shaft (PTO)

- ① Remove the snap ring ($\phi 25$) at the rear of the drive shaft and take out the fixed gear A.
- ② Break and remove the oil seal and remove the snap ring ($\phi 52$).
- ③ Drive out the shaft front-wards together with the bearing.

- | | |
|----------------------------|----------------------------|
| 1. O-ring (P16) | 5. Snap ring ($\phi 52$) |
| 2. Drive shaft | 6. Bearing (6205) |
| 3. Oil seal | 7. Fixed gear A |
| 4. Snap ring ($\phi 25$) | 8. Snap ring ($\phi 25$) |



363Y

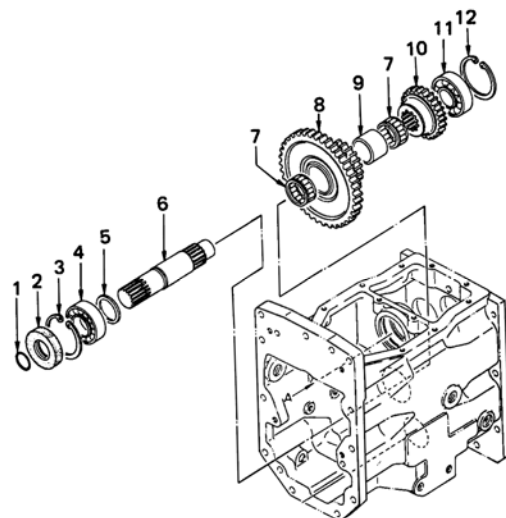
(3) Drive shaft (for traveling)

- ① Break and remove the oil seal and remove the snap ring ($\phi 52$) .
- ② Drive out the shaft front-wards together with the bearing (6205) and thrust washer and take out the counter gear B with needle bearings, collar and fixed gear A.

NOTE :

Take care for needle bearing and collar in the counter gear.

- | | |
|----------------------------|-----------------------------|
| 1. O-ring ($\phi 21$) | 7. Needle bearing |
| 2. Oil seal | 8. Counter gear B |
| 3. Snap ring ($\phi 52$) | 9. Collar |
| 4. Bearing (6205) | 10. Fixed gear A |
| 5. Thrust washer | 11. Bearing (6304) |
| 6. Drive shaft | 12. Snap ring ($\phi 52$) |

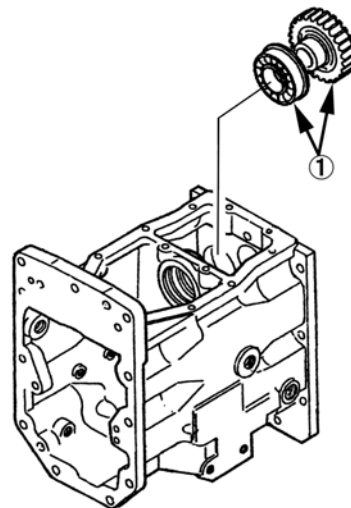


364Y

365Y

(4) Fixed gear A

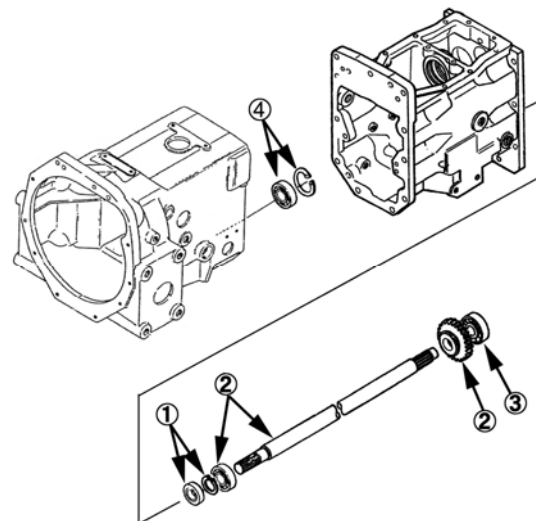
- ① Drive out the fixed gear A rear-wards together with the bearing.



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(5) Drive shaft (4WD)

- ① Break and remove the oil seal and remove the snap ring ($\phi 42$) .
- ② Slide out the shaft front-wards together with the bearing (6004) and take out the slide gear.
- ③ Remove the bearing (6303) from rear of housing.
- ④ If necessary, remove the snap ring ($\phi 42$) and bearing (6004 uu) from bottom of clutch housing.



367Y

(6) Shifter rod• Shifter fork (4WD)

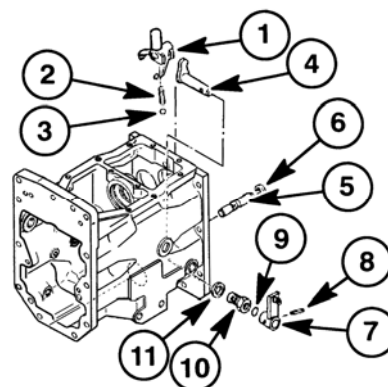
- ① Extract the shifter rod rear-wards and remove the shifter fork.

NOTE :

When extracting the rod, steel ball and spring come out of the fork. Take care for them not to miss.

- ② Drive out the spring pin and remove the change lever.
- ③ Remove the shift arm from the inside of the case.

- | | |
|-------------------------|-----------------|
| 1. Shifter fork | 7. Change lever |
| 2. Spring | 8. Spring pin |
| 3. Steel ball | 9. O-ring |
| 4. Shift arm | 10. Shift guide |
| 5. Shift rod | 11. Seal washer |
| 6. Snap ring (E-shaped) | |



368Y

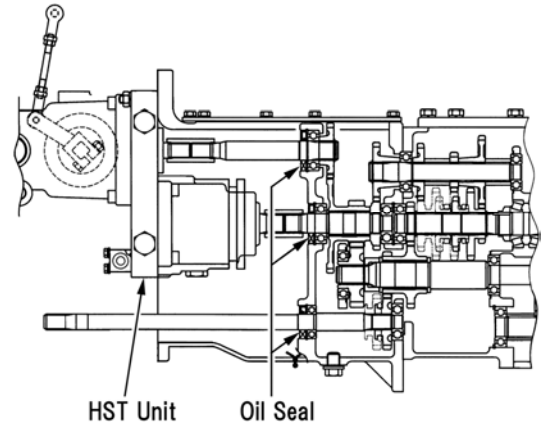
2) Inspection

Refer to the description of manual 9×3 transmission for inspections.

3) Reassembly

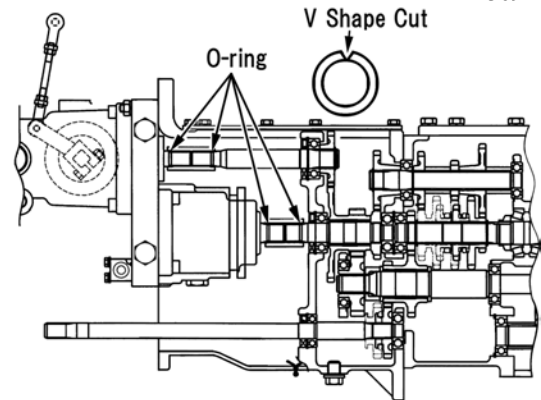
Reassemble units in the reverse order to disassembly taking care for the following points.

1. Because the oil seals of the drive shafts (PTO, Traveling, 4WD) break when disassembling, the new oil seals are installed.



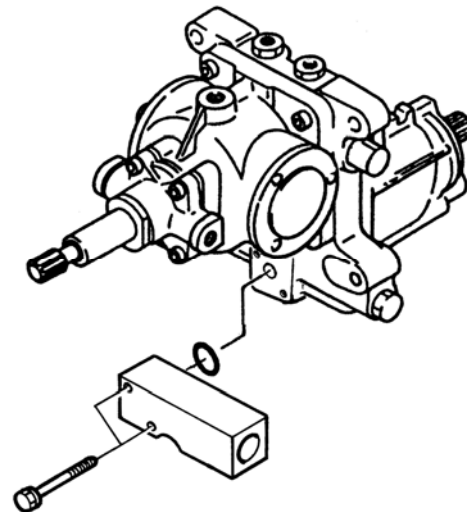
369Y

2. Pack the drive shaft (PTO, for traveling) and joint inside with grease. Cut a part of O-ring in V shape.



370Y

3. Complete the adaptor-related installation before installing the HST unit to the transmission case.



371Y

5. HST UNIT

1) Disassembling

Reference Figure 372Y.

(1) Pump Removal

- ① Remove the socket head bolts (50) (4 pcs) and take out the pump case assembly (1) and gasket (33) from the port block.
- ② Remove the valve plate (9) from the port block (3).
(The valve plate (9) is usually installed to the cylinder block (5) but may be installed to the port block side in some cases.)

NOTE:

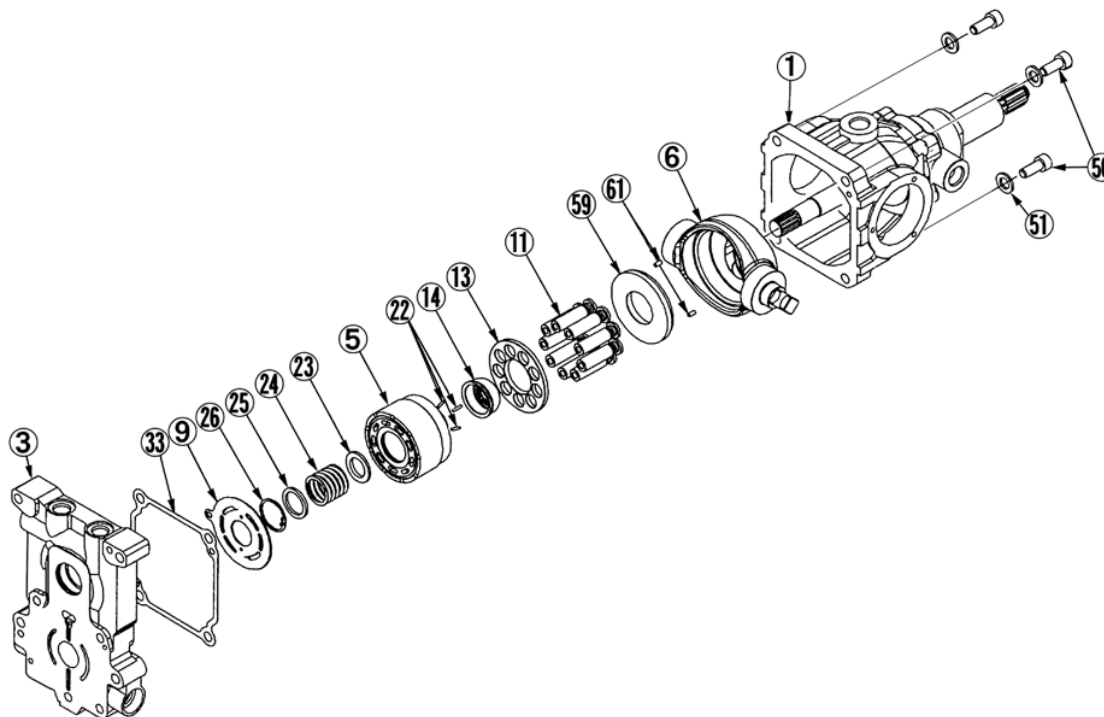
1. Be careful not to drop the valve plate(9).
2. Raising one side of the valve plate (9) will facilitate its removal.

- ③ Remove the cylinder block assembly from the pump case (1).

NOTE :

Take care do not lost three pins (22) when removed cylinder block assembly.

- ④ Remove the thrust plate (59) from the swash plate (6).
(If the thrust plate is difficult to remove, pulling it up with an L-shaped bar will facilitate its removal.)



372Y

(2) Motor Removal - Reference Figure 373Y

- ① Remove the socket head bolts (50) (4 pcs) and take out the motor case assembly from the port block (3).
- ② Remove the valve plate (10) from the cylinder block.

NOTE:

Be careful not to drop the valve plate (10).

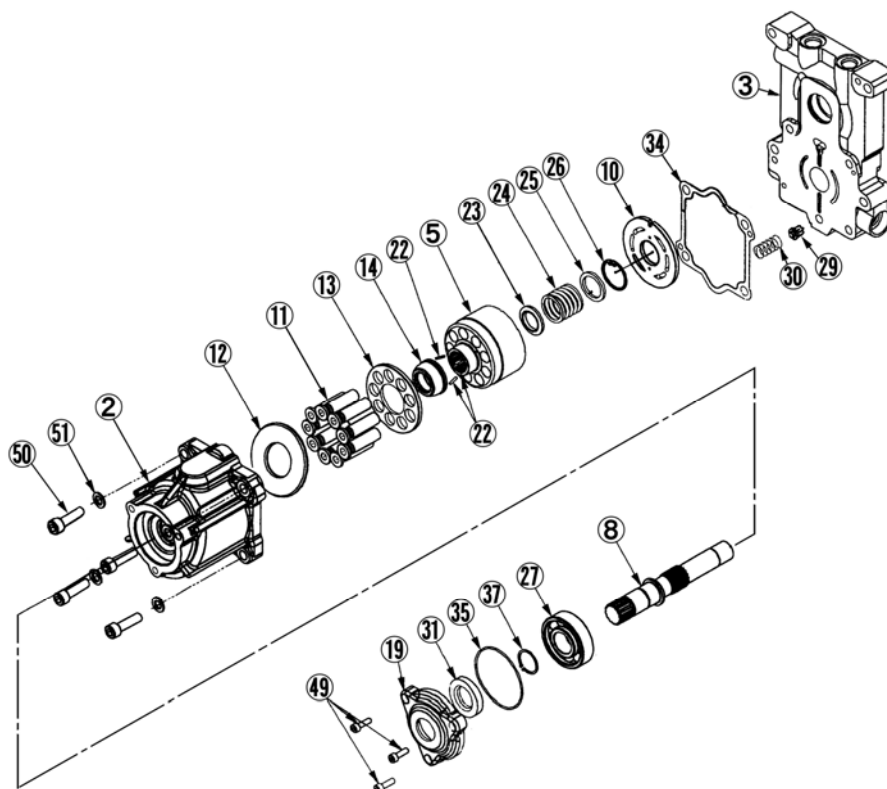
- ③ Remove gasket (34), valve (29) and spring (30), from port block (3).
- ④ Remove the cylinder block ass'y from the shaft (8).
- ⑤ Remove the thrust plate (12) from the case.
(If it is difficult to remove, pull it with an L-shaped bar when removing.)

NOTE:

Take care not lost the three pins (22) when remove the cylinder block assembly.

(3) Shaft Removal

- ① Remove the socket head bolt (49) and remove the cover (19) and O-ring (35) from the case (2).
- ② Remove the shaft (8) together with the bearing (27) and snap ring (37) tapping the shaft lightly from the front side.
- ③ Remove the oil seal (31) from the cover (19).



373Y

(4) Port block Removal Reference Figure 374Y.

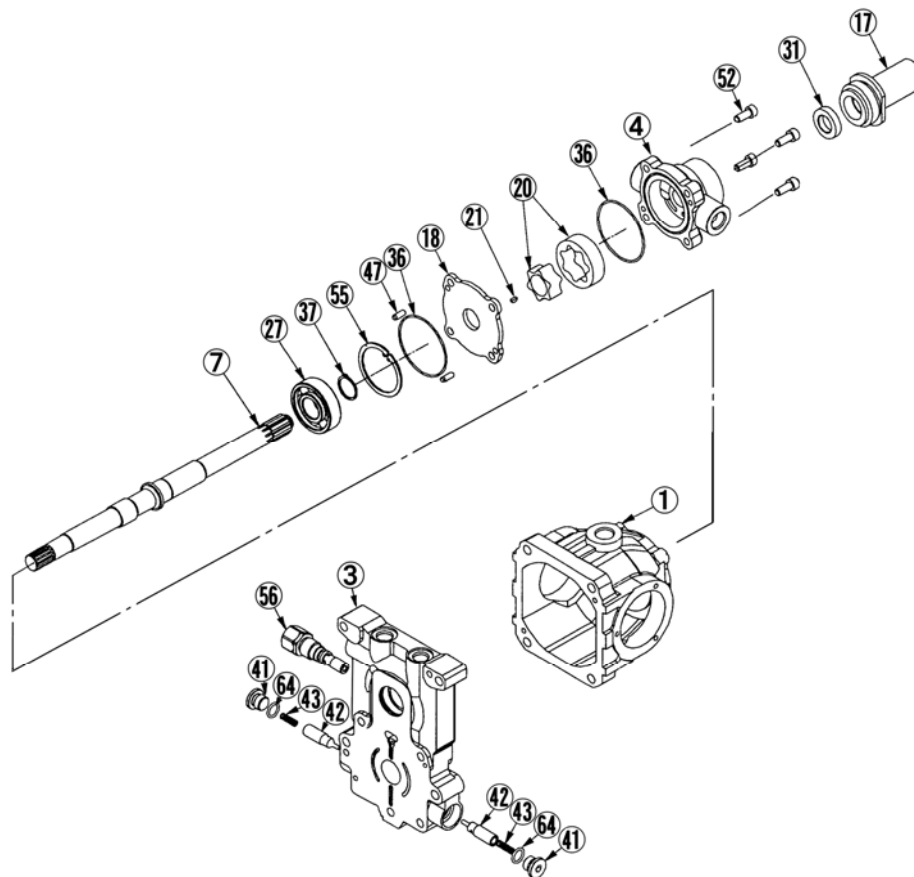
- ① Remove the right and left plugs (41) and take out the neutral valve (popet (42) and spring (43)) from the port block (3).
- ② Remove the relief valve ass'y (56).

(5) Charge pump Removal

- ① Remove the socket head bolts (52) (4 pcs) and take out the pump case (4).
- ② Remove the trochoid rotor (20), key (21), O-ring (36) (2 pcs) and plate (18) from the shaft (7).

(6) Pump shaft Removal

- ① Remove the snap ring (55) from the case (1) and remove the shaft (7) together with the bearing (27) and snap ring (37) tapping the shaft lightly.



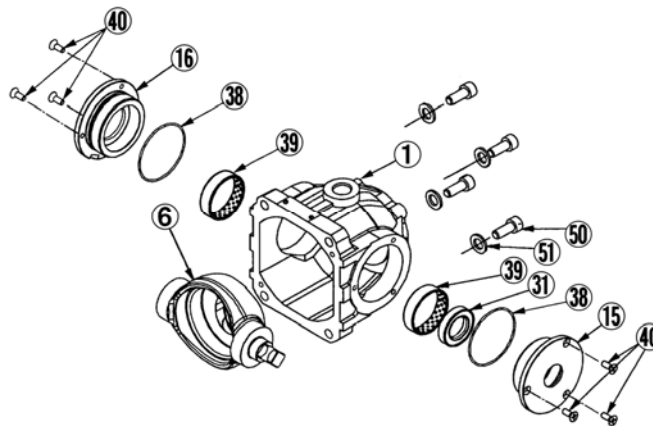
374Y

(7) Swash plate (trunnion plate) Removal

NOTE :

Make the scribe mark on the covers (15 and 16) and case (1) before disassemble them.

- ① Remove the three each screws (40) fixing the right and left covers.
- ② Tap the trunnion shaft of the swash plate (6) lightly to provide gap between the cover (16) and case (1).
- ③ Insert drivers (2 pcs) into the gap, remove the cover (16) from the case (1), tap the swash plate to separate the cover on the opposite side from the case and remove the cover (15) in the same way.
- ④ Remove the swash plate (6) from the case (1).
- ⑤ Remove the bush (39) and O-ring (38) from the cover (16).
- ⑥ Remove bush (39), oil seal (31) and O-ring (38) from the cover (15).



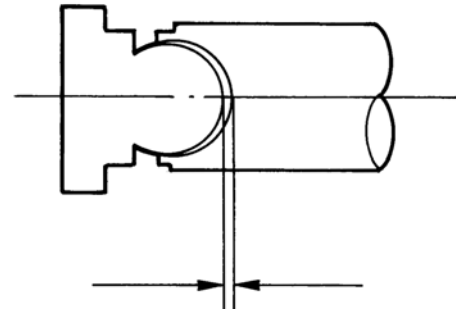
375Y

2) Inspection

(1) Piston ass'y

- ① Replace if the play of the piston and chamfered part of the shoe exceeds the service limit.

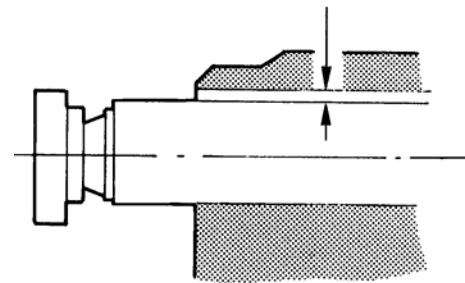
Standard assembling value	Service limit
0.01—0.1 mm	More than 0.2 mm



376Y

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

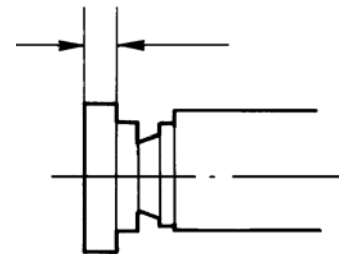
Standard assembling value	Service limit
0.02 mm	More than 0.04 mm



377Y

- ③ Shoe thickness.

Standard assembling value	Service limit
3.0 mm	Less than 2.9 mm

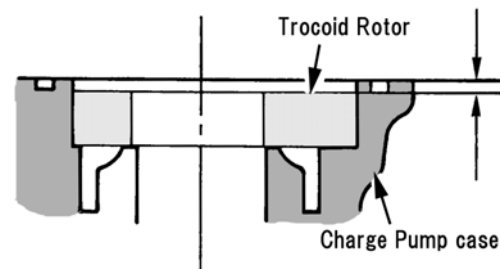


378Y

(2) Charge pump ass'y

Measure the side clearance of the trochoid rotor sub-ass'y and replace if the service limit is exceeded.

Standard assembling value	Service limit
0.030~0.058 mm	0.063 mm



379Y

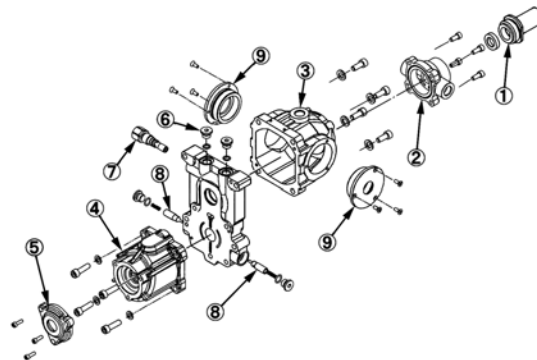
3) Reassembly

(1) Reassemble units in the reverse order to removal taking care to the following points.

- Wash and clean each parts and blow with compressed air.
- Check each parts not to damage and worn out before installing.
- Replace the seals and O-rings with new one.
- Tighten the bolts and screws to specified torque.
- Apply the lithium grease to oil seals lip and O-rings before installing.
- After completion of reassembly, turn the input, output and trunnion shafts to check for smooth operation.

(2) Tightening torque of parts

No.	Item	Tightening torque N · m (kgf · m)
1	Holder	58.8{6.0}
2	Charge pump case	17.7{1.8}
3	Pump case	39.2{3.5}
4	Motor case	39.2{3.5}
5	Motor case cover	4.9{0.5}
6	Pressure detection plug	51.0{5.5}
7	High pressure relief valve	36.8{2.7}
8	Neutral valve	51.0{3.75}
9	Cover	3.9{0.4}



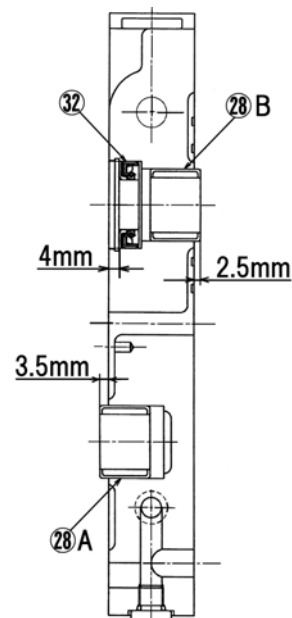
380Y

(3) Port block assembly

When the needle bearing is removed from the port block, be careful about the push-up depth.
The needle bearing (28A) of the motor should be projected **3.5mm** over the port block surface.

The needle bearing (28B) of the pump should be projected **2.5mm** over the port block surface.
The stamped surface of the needle bearings are toward the out side.

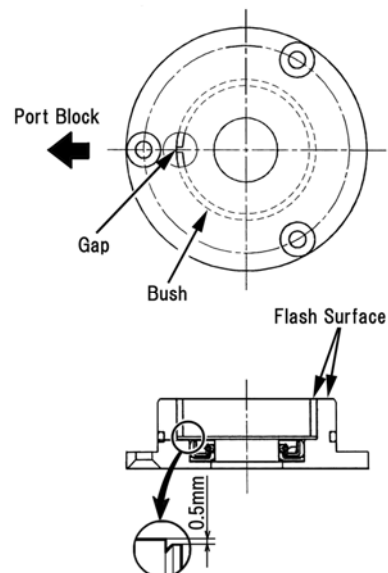
Press the oil seal (32) to 4mm in depth from surface to the port block and secure with snap ring.



381Y

(4) Trunnion cover assembly

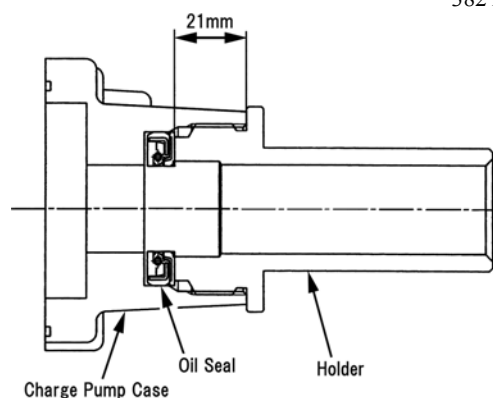
- ① Press the oil seal to 0.5 mm in depth from counter bore of the trunnion cover.
- ② Install the bush in the cover and take care bush's gap direction toward the port block.
- ③ Press the bush flush with trunnion the port block.



382Y

(5) Charge pump case assembly

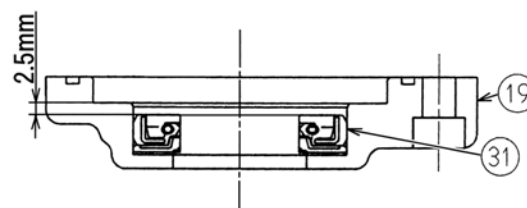
- Install the oil seal to **21mm** in depth from charge pump case surface.
- Install the holder (17) on the charge pump case and tighten to 58.8 N·m (6 kgf·m).



383Y

(6) Cover assembly

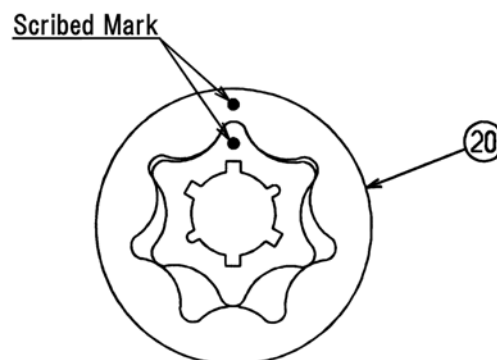
Install the oil seal (31) to **2.5 mm** in depth from counter bore surface.



384Y

(7) Trochoid pump assembly

Align the scribed mark on the inner and outer of trochoid pump, and the scribed mark toward the plate (18), figure 389Y.



385Y

(8) Cylinder block assembly

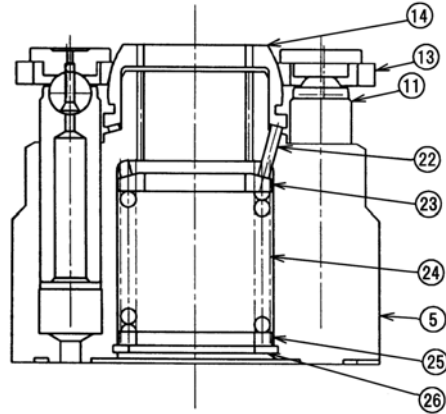
Install the cylinder block assembly shown as an illustration.

When removing the retainer plate (13) and piston sub ass'y from the cylinder block ass'y (5 and 11), confirm that 3 pins (22) are installed.

When removing the retainer holder (14) adjust the direction of the spline to the cylinder block.

When installing the valve plate to the port block, coat the installing surface (gray color surface) with lithium grease.

- ① Install the spring holder (23), spring (24) and spring holder (25) with secure snap ring (26).



NOTE :

Take care the spring holder (23) direction.

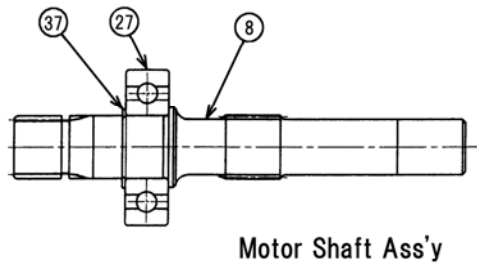
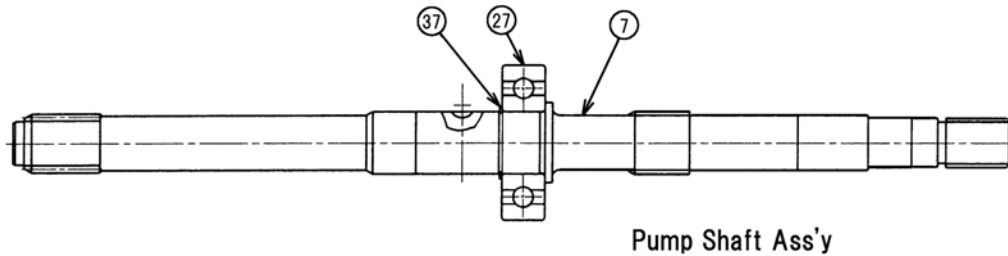
- ② Install the three pins (22) in the cylinder block.
- ③ Install the retainer holder (14) on the cylinder block.
- ④ Install the 9 pistons in the cylinder block.

(9) Pump Shaft assembly

Install bearing (27) and secure with snap ring (37) on the pump shaft (7).

(10) Motor shaft assembly

Install the bearing (27) and secure with snap ring (37) on the motor shaft (8).



386Y

387Y

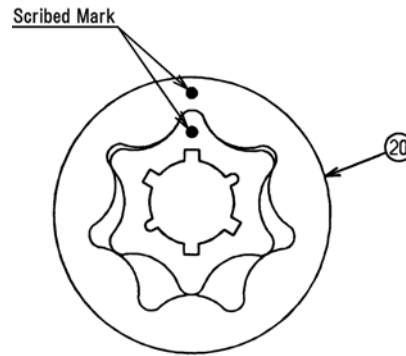
(11) Pump case and motor case assemble

Reference Figure 389Y, 390Y and 391Y.

1. Install the swash plate (6) in the case (1).
2. Install caver assemblies (15 and 16) to the case.

NOTE :

1. Aline the scribe mark on the cover and case when marked at disassemble.
2. Recheck the gap of bush is at the port block side.
3. Install the pump shaft (7) assembly in the cases (1) and secure with snap ring (55).
4. Install pins (47), O-ring (36) and plate (18) on the case (1).
5. Install the key (21) and trochoid rotor assembly (20) on the pump shaft (7)



388Y

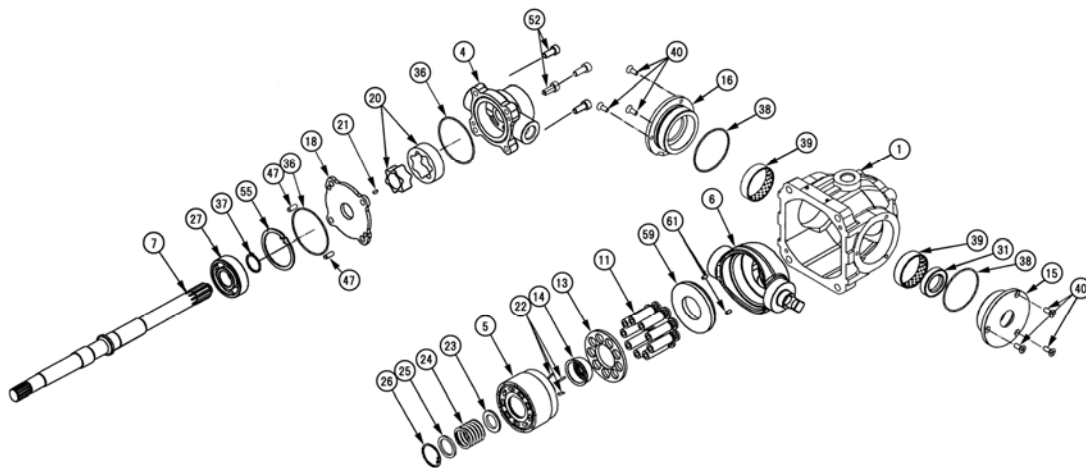
NOTE :

The scribed mark on the trochoid rotor assembly toward the plate (18).

6. Install the charge pump case (4) assembly with O-ring (36) on the case (1) and tighten the socket head bolts (52) to $15.9 \sim 19.5 \text{ N} \cdot \text{m}$ $\{1.6 \sim 2.0 \text{ kgf} \cdot \text{m}\}$
7. Install the cylinder block assembly on the pump shaft (7).

NOTE :

Take care the pin (61) and hole of thrust plate (59) are aligned and check the pins (22) are not remained in the case (1).

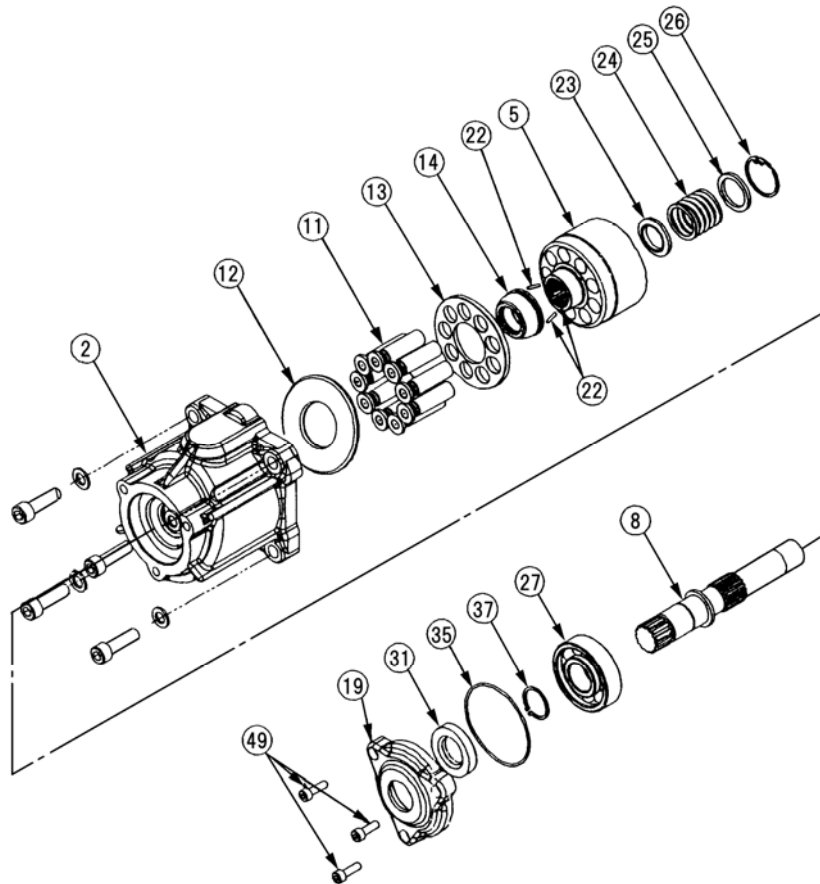


389Y

8. Install the motor shaft (8) assembly and cover assembly (19) on the case (2) and tighten the socket head bolts (49) to $4.4 \sim 5.4 \text{ N} \cdot \text{m}$ $\{0.45 \sim 0.55 \text{ kgf} \cdot \text{m}\}$.
9. Install the thrust plate (12) and cylinder block assembly in the case (2).

NOTE :

Check the pins (22) are not remained in case (2).



390Y

10. Install the pump case assembly to valve plate as follows:

- Install the pins (46) on the case.
- Apply the grease thinly on the gasket (33) and put it on the case (1)
- Apply the grease thinly on the gray color surface of the valve plate (9) and put it on the port block assembly.

NOTE :

Install the gray color surface (grease applied surface) of the valve plate toward the port block assembly.

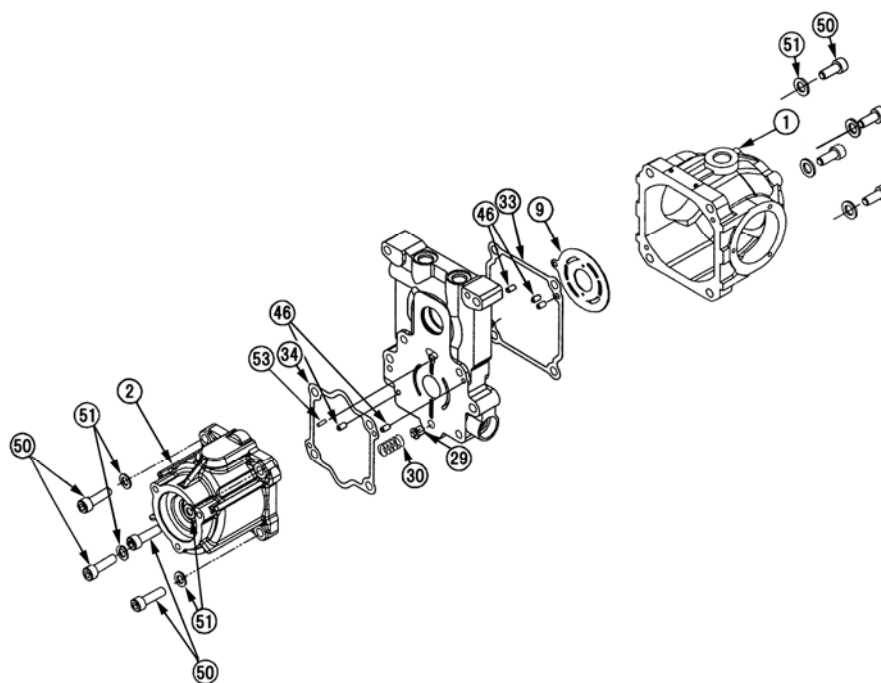
- Install the pump case assembly on the port block assembly and tighten with washers and socket head bolts (50).
- Tightening torque to 35.2~43.2 N·m {3.6~4.4 kgf·m}

11. Install the motor case assembly to port block assembly as follows :

- Install the pins (46) on the case (2).
- Apply the grease thinly on the gasket (34) and put it on the case (2).
- Apply the grease thinly on the spring (30) end and put it in the case (2).
- Apply the grease thinly on the low pressure relief valve (29) and put it in the port block assembly.
- Apply the grease thinly on the gray color surface of the valve plate and put it on the port block assembly.

NOTE :

1. Install the gray color surface (grease applied surface) of the valve plate (10) toward the port block assembly.
2. Align the pin (53) of the port block assembly and notch of the valve plate when install the motor case assembly.
3. Align the spring (30) and valve (29) when install the motor case assembly.
4. Install the motor case assembly and tighten with washer (51) and socket head bolt (50).
Tightening torque to 35.2~43.2 N·m {3.6~4.4 kgf·m}



391Y

6. INSPECTION AND ADJUSTMENT

1) High pressure relief valve inspection

- ① Jack up the front and rear wheels off of the ground and jack stands under the axles.
Make sure all four wheels are clear of the ground.
- ② Set the auxiliary speed change lever at H position (after starting the engine).
- ③ Remove the plug (PT 1/8) on the clutch case.

NOTE :

Either one of the 2 plugs may be removed but the HST pedal depressing direction at the time of measurement varies depending on the plug.

When pressure gauge is set on the tractor left side HST pedal depressed front-wards.

When pressure gauge is set on the tractor right side, HST pedal depressed rearwards.

- ④ Install a pressure gauge 0~50 MPa (0—500 kg/c m²) to test port.
- ⑤ Securely lock the parking brake
- ⑥ Disengage the clutch and start the engine. Set throttle speed to 2800 rpm.
- ⑦ Be sure the **HST** foot pedal is in neutral position and then release the clutch.
- ⑧ Slowly move the foot pedal in the forward position to obtain a reading on the pressure gauge. Read the maximum pressure on the gauge. Pressure reading should be 27.5MPa {280 kgf/c m²}.

NOTE: Read pressure in minimum time to prevent overheating and possible damage to the **HST**.

NOTE: If low hydrostatic power is a concern, test **HST** pressure when oil is cold. Then test pressure at operating temperature. If pressure is within specification when cold and low when at operating temperature, suspect internal wear of pump or motor rotating group or valve plates.

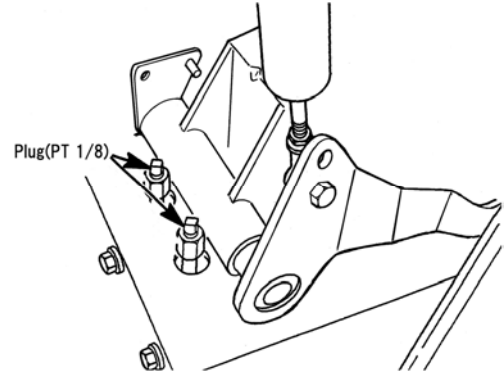
Relief set pressure	27.5 MPa {280 kg/c m ² }
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NOTE :

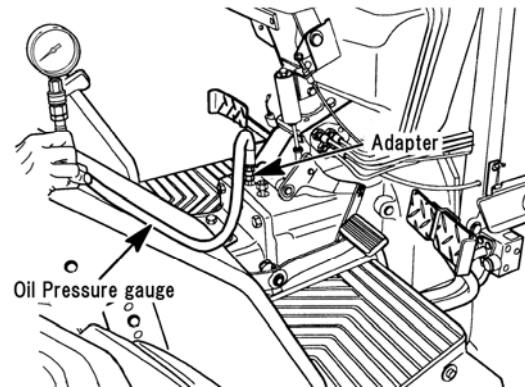
Measure the relief pressure within 2—3 seconds.

The relief valve is non adjustable type, then replace the relief valve as an ass'y, if necessary.

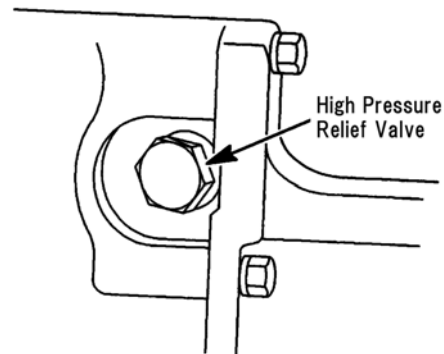
- ⑨ Continued to low pressure relief valve test as follows.



392Y



393Y

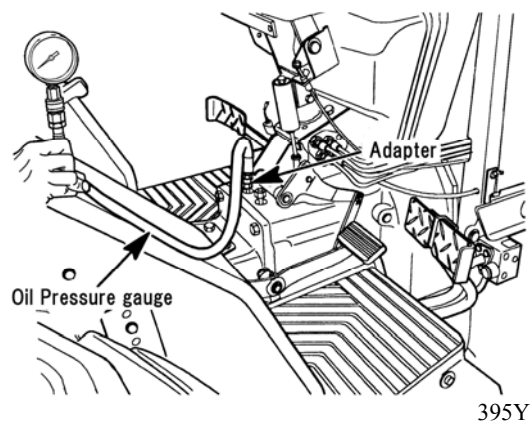


394Y

2) Low-pressure relief valve inspection (Continued above high pressure relief testing)

- ① Set the HST pedal and range gear change lever at the neutral position.
- ② Read the pressure on the gauge. Pressure reading should be 0.42-0.56 MPa {4.3-5.7 kgf/c m²}.
- ③ If the pressure gauge is too large range, stop the engine and replace to small range oil pressure gauge.
- ④ Start the engine, and set throttle speed to 2800rpm.

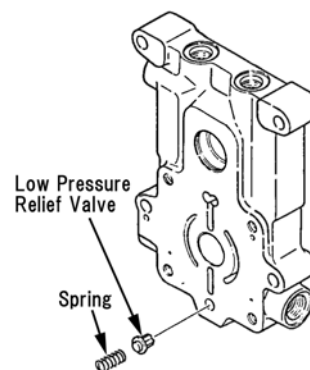
Set pressure	0.4~0.6 MPa {4.1—6.1 kgf/c m²}
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NOTE:

Never move the HST pedal to forward or reverse, for prevent the oil pressure gauge from damage.

- ⑤ Read the pressure on the gauge. Pressure reading should be 0.4-0.6 MPa {4.1-6.1 kgf/c m²}.
- ⑥ If the set value is not satisfied, replace the spring of low pressure relief valve.



3) Centering Spring and Rod Assembly

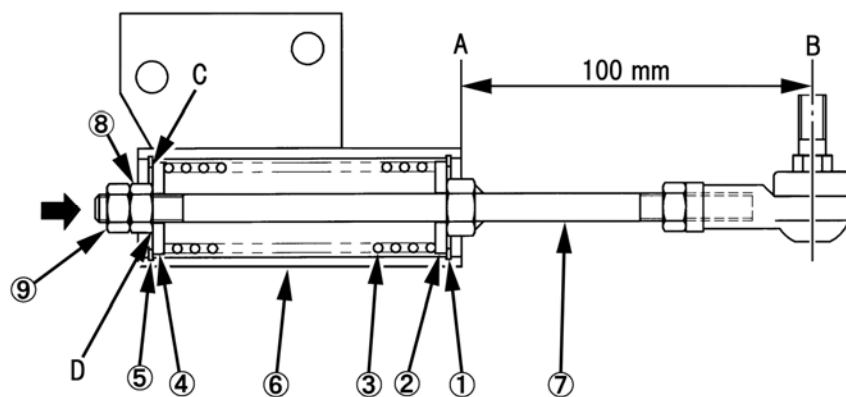
If disassembled the centering spring from the rod, install as follows:

1. Install the snap ring, 1, washer, 2, spring, 3, washer, 4, and snap ring, 5, in the spring holder, 6.
2. Install the rod, 7, through the washers, 2 and 4, and spring, 3, in the spring holder, 6, with finger tight the two nuts, 8 and 9.
3. Initial length of 100mm from spring holder bottom surface "A" to center of rod end "B" is a starting point.

NOTE: Additional adjustment may be needed after installed to tractor.

Adjustment

1. Inspect the clearance : C between snap ring, 5, and washer, 4, is less than 0.3mm while slightly push (did not compressed the spring) the rod to arrow mark direction.
2. Inspect the clearance : D between nut, 8, and washer, 4, is nothing clearance while slightly push (did not compressed the spring) the rod to opposite arrow mark direction



397-1Y

- | | |
|--------------|------------------|
| 1. Snap ring | 5. Snap ring |
| 2. Washer | 6. Spring holder |
| 3. Spring | 7. Rod |
| 4. Washer | 8. Nut |
| | 9. Nut |

4) Link adjustment

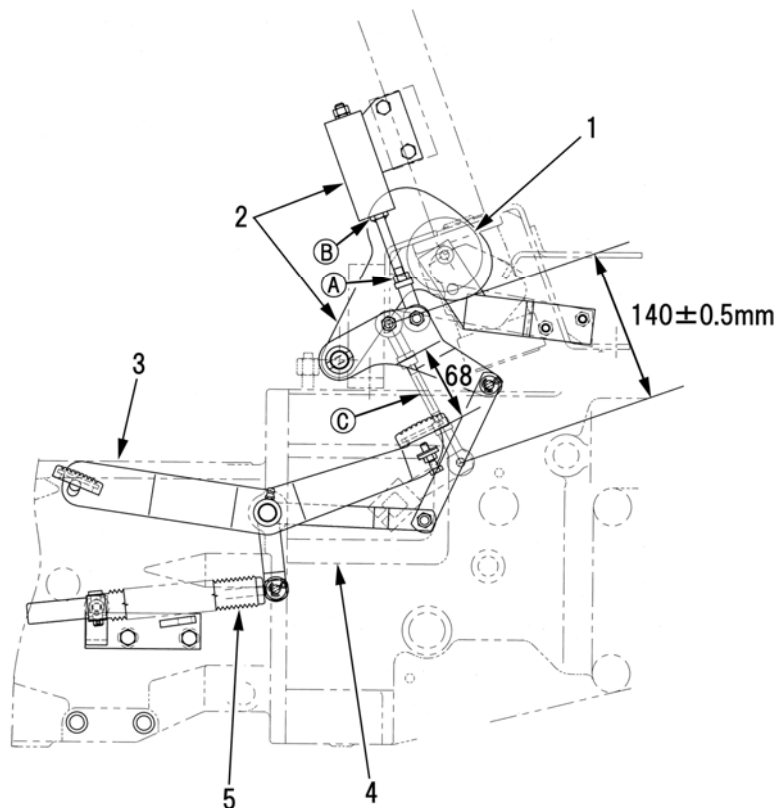
(1) Neutral position adjustment

1. Jack up the front and rear wheels off the ground and jack stands under the axles.
Make sure all four wheels are clear of the ground.
2. Apply the master brake pedal and start the engine, release the brake pedal.
3. Set the throttle at low speed and place the range shift lever in the low range position.
4. If the wheels rotate at this time, loosen the lock nut (A) and rotate the rod (B) until the wheels stop and tighten the lock nut, Figure 398Y.

NOTE :

Turning the rod (B) clockwise will cause wheels to rotate in reverse and turning counter clockwise the wheels will rotate in the forward direction.

5. Stop the engine and remove the jack stands.
Lower the wheels to the ground.
6. While seated in the operators seat, start the engine with the range lever in low range, and increase the engine speed to full throttle. The tractor should not move in either direction.



398Y

- | | |
|----------------------------|-------------|
| 1. Cruise control magnet | 4. HST unit |
| 2. Neutral control linkage | 5. Damper |
| 3. Foot pedal | |

NOTE :

If necessary, inspect the rod (C) length to $140 \pm 0.5\text{mm}$, and take care the bottom end's thread is left handed screw.

5) HST CRUISE CONTROL SYSTEM

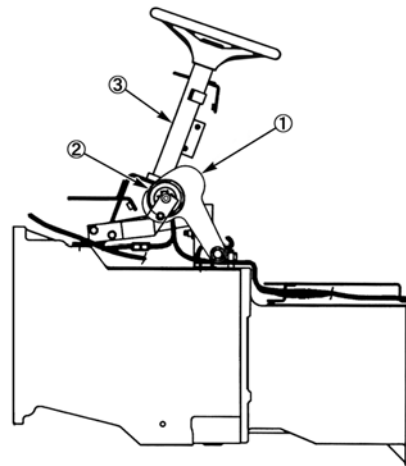
The cruise control system consists with shift arm, electric magnet, switch, relays and diode.

SHIFT ARM AND MAGNET

Shift arm and electric magnet are located under the instrument panel on the left side of the steering column, 3.

The shift arm, 1, is linked with HST pedal, and holds it by electric magnet, 2.

The electrical magnet is energized with the cruise control switch to push the “SET” position to “ON” position.

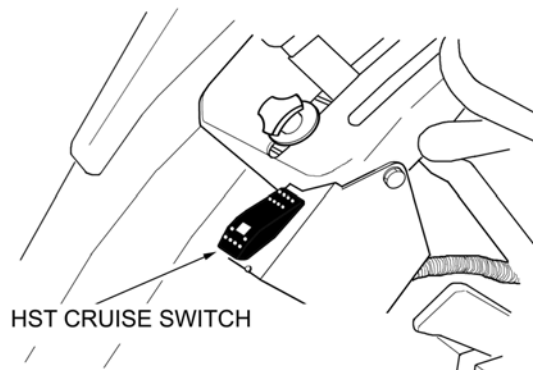


399YA

CRUISE LATCH SWITCH

The cruise switch is located on the right fender near the HPL control lever.

The switch has three positions, which are “SET” position, “ON” position and “OFF” position.



399YB

CRUISE LATCH RELAY (385230300)

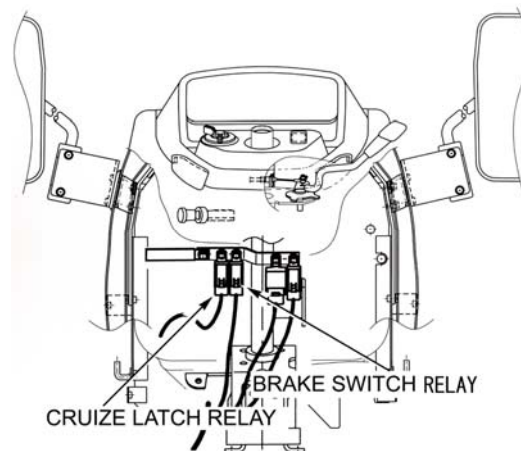
The cruise latch relay is located under the instrument panel on the steering column with black color connector.

The relay controls current flowing to cruise latch magnet when the cruise switch is “ON” position after push to “SET “ position.

BRAKE SWITCH RELAY (385230290)

The brake switch relay is located under the instrument panel on the steering column with blue color connector.

The relay controls current flowing from the cruise latch relay to stop ground circuit when the brake pedals are depressed.



399YC

DIODE

The diode attached with tape on the HST wire harness near the cruise latch relay.

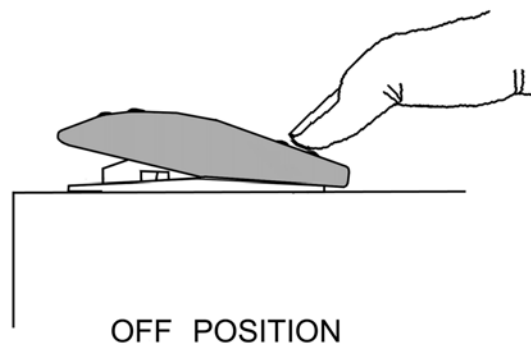
The diode current flows one way to cruise latch relay when the cruise latch switch is "ON" position after "SET" position.

CANCELS HST CRUISE CONTROL

Drive the tractor and depress the HST pedal to suitable position, and then push the HST cruise control switch to "SET" position and "ON" position.

Tractor is driven to constant speed on the ground.

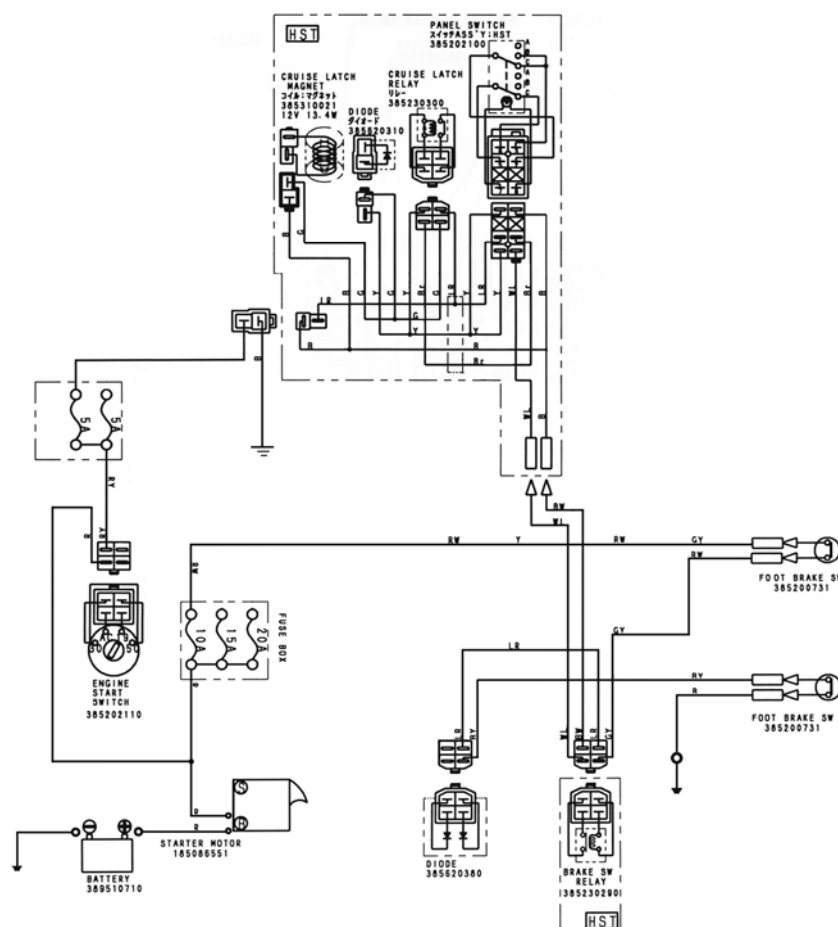
HST cruise control is canceled to depress the both brake pedals or push the HST cruise control switch to "OFF" position.



399YD

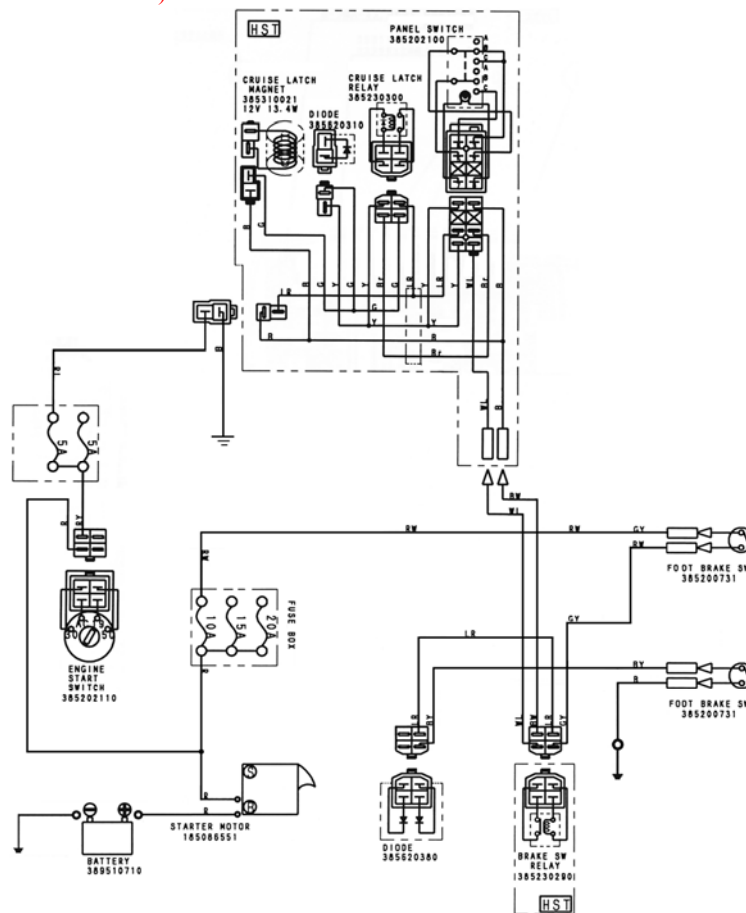
HST WIRINGS

1. SET Position



399YE

2. ON Position (From SET Position)

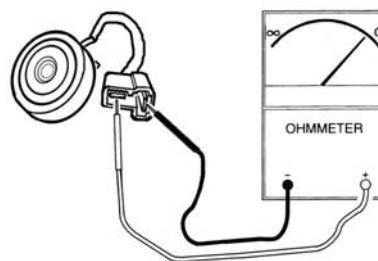


399YF

INSPECTION

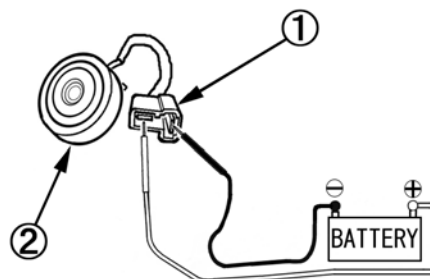
1. Electrical magnet

- 1) Using an ohmmeter, connect test leads to each terminal on the electrical magnet connector.
- 2) Observe the ohmmeter. The ohmmeter should indicate a resistance of 11-12 ohms. If the resistance of the magnet is not as specified, the magnet is defective and needs replaced.



399YG

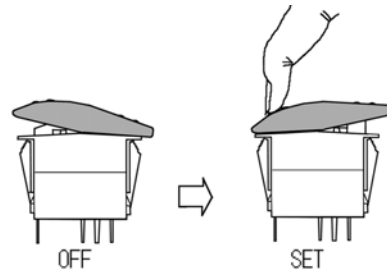
- 3) Use jumper wires to connect a 12-volt power supply to the terminals on the cruise control magnet connector, 1.
- 4) The cruise control magnet, 2, should become magnetic and attract any ferrous objects, the magnet is defective and needs replaced.



399YH

2. Cruise control switch

- 1) Press the cruise control switch from the "OFF" position and hold the switch to the "SET" position. Observe the ohmmeter.

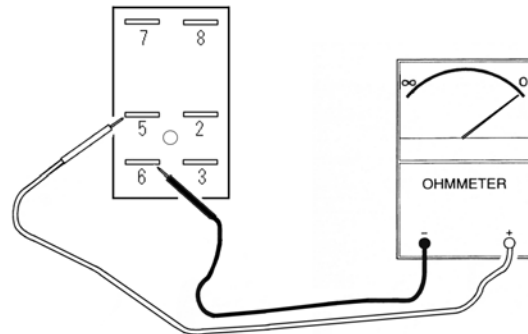


399YI

- 2) Using an ohmmeter, touch one ohmmeter test probe to terminal 5 of the cruise control switch. Touch the other ohmmeter probe to terminal 6.

- 3) The ohmmeter should show little or no resistance indicating continuity.

- 4) If there is no continuity, the switch is defective and needs replaced.

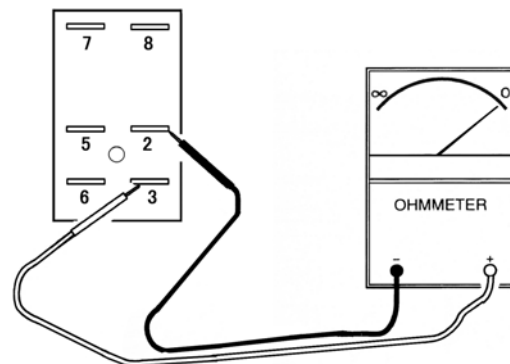


399YJ

- 5) Touch one ohmmeter test probe to terminal 2 and the other probe to terminal 3.

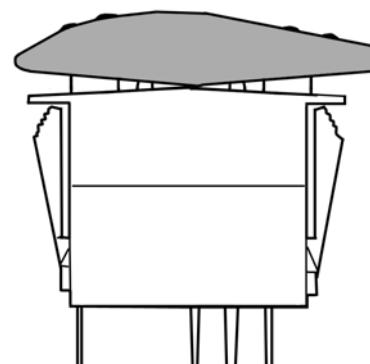
- 6) The ohmmeter should show little or no resistance indicating continuity.

- 7) If there is no continuity, the switch is defective and needs replaced.



399YK

- 8) Continue to hold ohmmeter test probes to terminal 2 and 3 of the switch and let the switch rocker from the "SET" position to the "ON" position. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating continuity. If there is no continuity, the switch is defective and needs replaced.

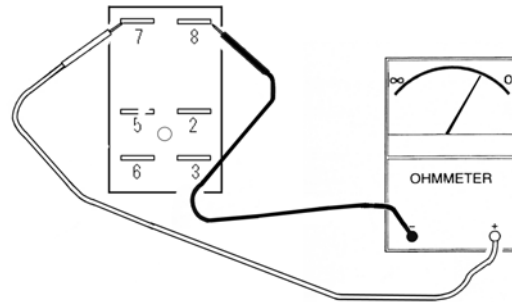


ON POSITION

399YL

NOTE: The cruise control switch indicator light is not serviceable and cannot be replaced. If the light is defective, the cruise control switch must be replaced.

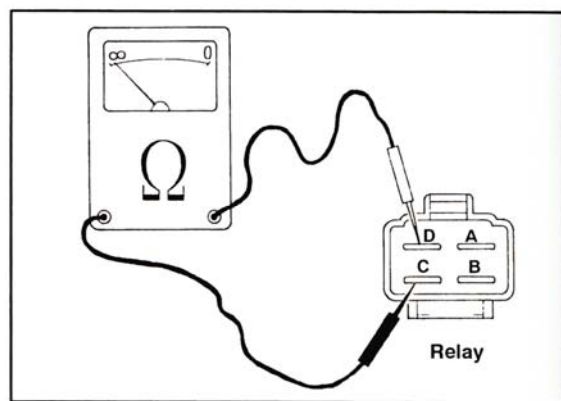
- 9) To test the internal light bulb for the switch, touch an ohmmeter test probe to terminal 7 and the other ohmmeter test probe to terminal 8 of the cruise control switch. Observe the ohmmeter. The ohmmeter should show between 18 and 22 ohms of resistance. If resistance is not within specifications, the switch light is defective and the switch needs replaced.



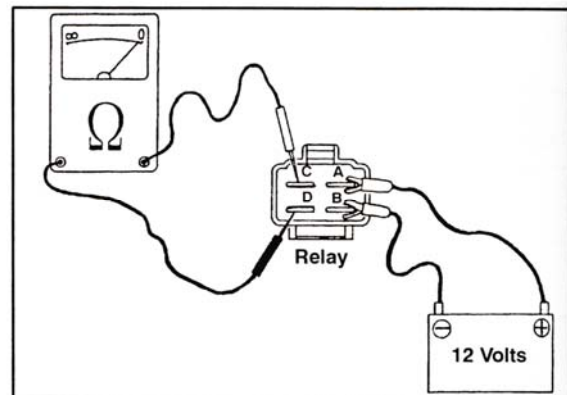
399YM

CRUISE LATCH RELAY (385230300)

- 1) Using an ohmmeter, connect test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
- 2) There should be high resistance between terminals "C" and "D", indicating no continuity and that the relay is functioning properly when non-energized. If there is continuity, the relay is defective and needs replaced.
- 3) To test the relay when energized, use jumper wires to connect a 12-volt power supply to terminals "A" and "B" on the relay.
- 4) Touch ohmmeter test probes to the terminals "C" and "D" on the relay and observe the ohmmeter. Little or no resistance between the terminals indicates that there is continuity and that the relay is functioning properly. If there is no continuity, between the terminals, the relay is defective and needs replaced.



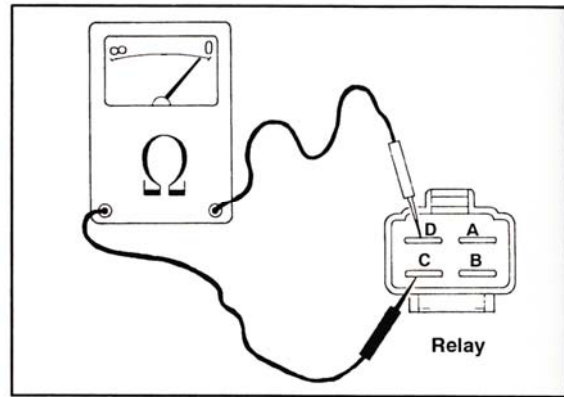
399YN



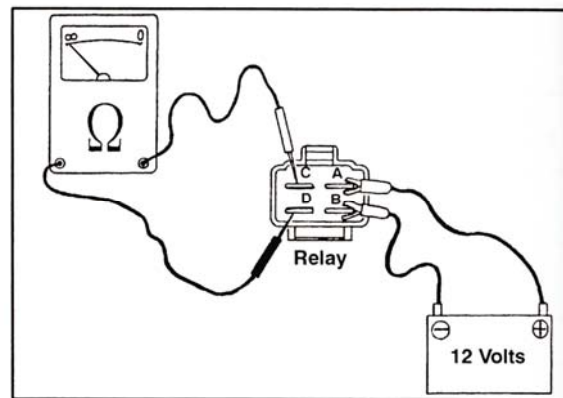
399YO

BRAKE SWITCH RELAY (385230290)

1. Using an ohmmeter, connect test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
2. There should be little or no resistance between the terminals indicates that there is continuity and that the relay is functioning properly when non-energized. If there is no continuity, the relay is defective and needs replaced.
3. To test the relay when energized, use jumper wires to connect a 12-volt power supply to terminals "A" and "B" on the relay.
4. Touch ohmmeter test probes to the terminals "C" and "D" on the relay and observe the ohmmeter. There is no continuity between the terminals indicates that the relay is functioning properly. If there is continuity, between the terminals, the relay is defective and needs replaced.



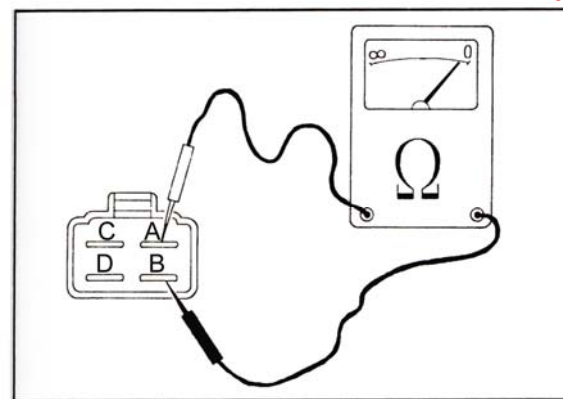
399YP



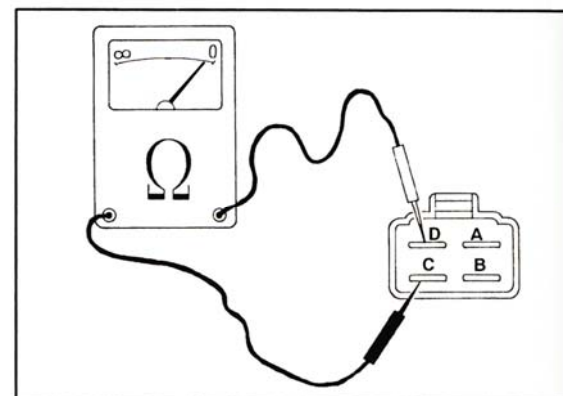
399YQ

DIODE

1. Using an ohmmeter, connect positive test probe to terminal "B" and connect the other test probe to terminal "A" on the diode. Observe the ohmmeter reading.
2. There should be little or no resistance between the terminals indicates that there is continuity and that the diode is functioning properly. If there is no continuity, the diode is defective and needs replaced.
3. Using an ohmmeter, connect positive test probe to terminal "D" and connect the other test probe to terminal "C" on the diode. Observe the ohmmeter reading.
4. There should be little or no resistance between the terminals indicates that there is continuity and that the diode is functioning properly. If there is no continuity, the diode is defective and needs replaced.



399YR



399YS

7. Troubleshooting

(1) HST Troubleshooting

Usually replace the HST main body as an ass'y when it is defective.

Condition	Possible cause	Remedy
1. The output shaft does not rotate even though the HST pedal is depressed in forward or reverse direction.	1. Improper operation of HST pump or motor.	Check the trunnion shaft for operation and replace the ass'y.
	2. Damaged charge pump.	Measure the charge pressure and replace the ass'y.
	3. Dropped set pressure of low-pressure relief valve.	Measure the pressure of the low-pressure circuit and replace parts.
	4. Dropped set pressure of high-pressure relief valve.	Measure the pressure of high-pressure circuit and replace the parts.
	5. Defective HST check valve seat.	Replace parts.
	6. Air is mixed in the HST oil.	Inspect the suction line and oil level of transmission. (need air breeze from in the HST)
2. Output shaft does not stop rotating even though the HST pedal is set at the neutral position.	1. Improper operation of HST link system or defective return spring.	Disassemble, link system and reassemble.
	2. Defective thrust plate of pump side.	Replace part.
3. Too low speed of HST output shaft.	1. Leak of high-pressure oil due to worn out sliding part of HST pump or motor.	Replace the HST ass'y. Replace the mission oil and filter.
	2. Air is mixed in the HST oil.	Inspect the suction line and oil level of transmission. (need air breeze from in the HST).
	3. Lack of HST oil of HST system.	Check the oil level and replace the oil filter and strainer.
	4. Lack of charge pump discharge quantity by abnormal HST oil temperature.	At too cold : Warming up At too hot : Stop engine and restart after cold.
4. Oil leakage at shaft and seal	Oil leakage due to broken oil seal or O-ring.	Replace the broken oil seal or O-ring with new one. At this time, be careful not to damage the lip of the oil seal.
	Drain piping is clogged with foreign matter or the like and oil seal is broken and oil leaks. (Oil seal pressure withstand : Normally 0.098MPa {1 kgf/c m ² })	Remove the clogging of the drain piping to avoid pressure exceeding the normal 0.098MPa 1kgf/c m ² and replace the oil seal with new one. At this time, be careful sufficiently not to damage the lip when inserting the oil seal.

Condition	Possible cause	Remedy
5. Too slow of HST pedal return speed	1. Damaged bush of swash plate	Replace bush.
	2. Damaged shaft of swash plate or place the foreign matter.	Replace swash plate or cleaning.
6. Abnormal sound from HST	1. Air is mixed in the HST oil.	Inspect the suction line and oil level of transmission (need air breeze form in the HST)
	2. Lack of HST oil for clogged oil filter or strainer..	Replace oil filter or strainer.
	3. Lack of discharge oil from charge pump by abnormal oil temperature.	At too cold : warming up At too hot : stop engine and restart after cold.
	4. Control link system is unscrewed or abrasion.	Adjust or repair the link system.
	5. Damaged internal main parts of HST or coupling of input shaft or out put shaft.	Replace all transmission oil and change to new HST assembly.

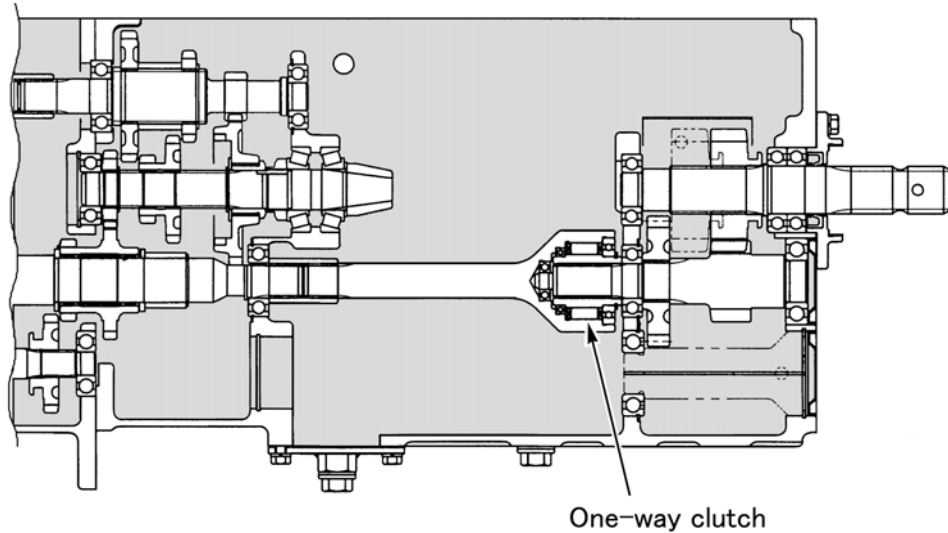
(2) HST cruise control system troubleshooting

Condition	Possible cause	Remedy
Does not work HST cruise control	1. Defective the cruise control switch	Replace the switch
	2. Defective cruise control magnet	Replace the magnet
	3. Defective cruise latch relay	Replace the cruise latch relay
	4. Defective brake switch relay	Replace the brake switch relay
	5. Defective the brake switches	Replace the brake switches
	6. Defective the diode	Replace the diode
	7. Depressed both brake pedals	The brake pedals return to free position
	8. Defective 5-amp fuse	Replace the fuse
	9. Opened or shorted the cruise control wiring	Repair the wiring
Could not off the HST cruise control	1. Defective the cruise control switch	Replace the switch
	2. Defective cruise latch relay	Replace the cruise latch relay
	3. Defective brake switch relay	Replace the brake switch relay
	4. Defective the brake switches	Replace the brake switches
	5. Defective mechanical system for HST speed control	Repair the mechanical system for HST speed control

3-5 Transmission 2 (Rear Transmission)

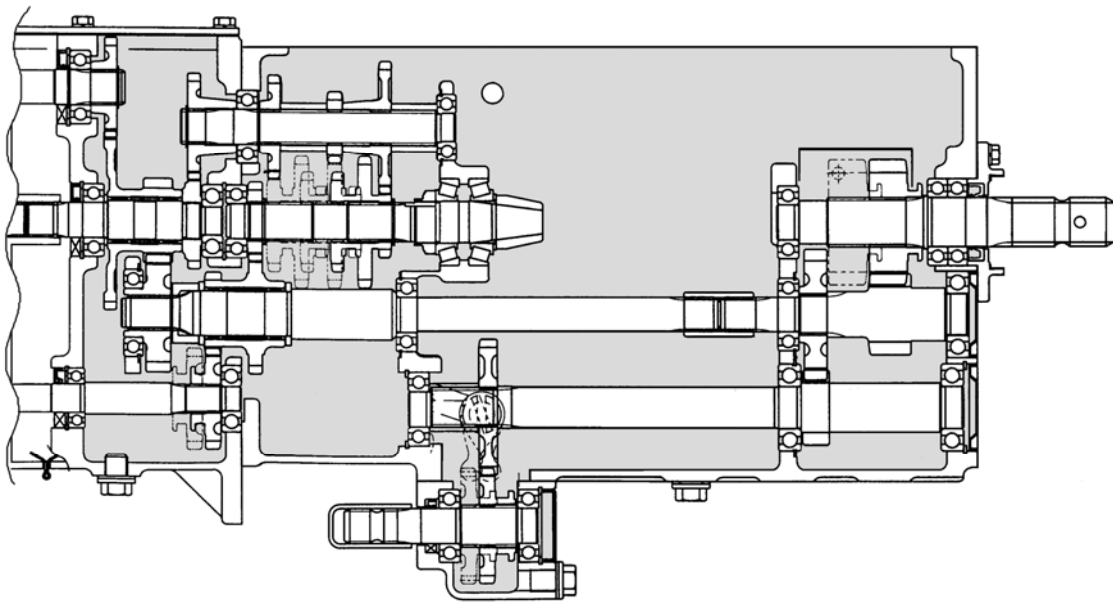
1. SECTIONAL VIEW

1) One Speed PTO Model



9×3 Single clutch, 1-speed PTO

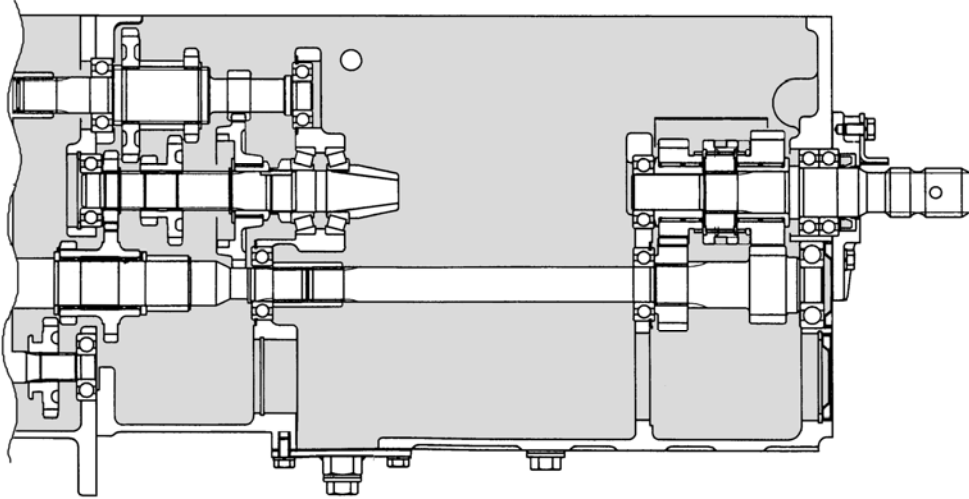
400Y



HST with Mid PTO and 1-speed PTO

401Y

2) Two Speed PTO Model



9×3 Transmission Without one way clutch – 2 Speed PTO

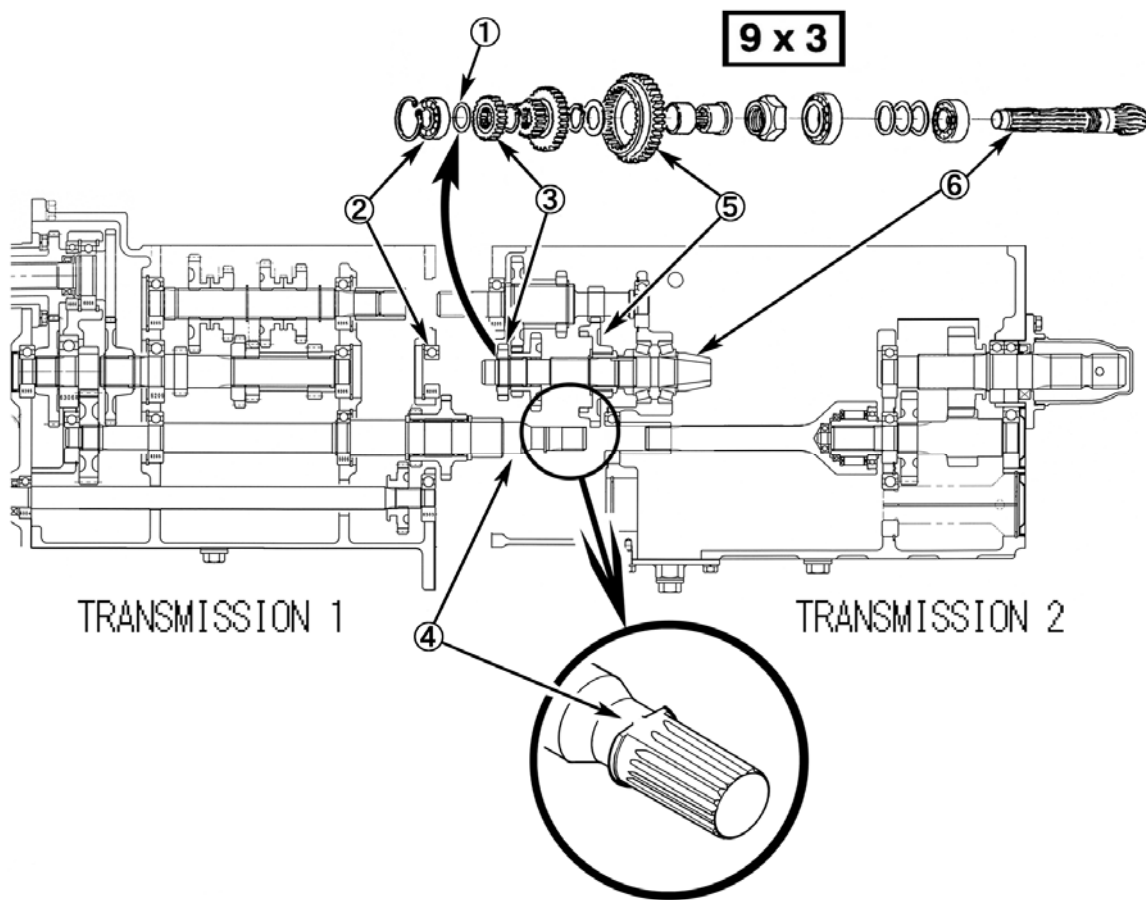
403Y

2. TRANSMISSION 2 FOR 9×3 MODEL

(Refer to “1—5 Removal of outside” for the transmission 2 separating method)

NOTE:

1. Keep the shims, 1, between the bearing, 2, and 4WD fixed gear, 3, when separating the transmission 1 and transmission 2
2. Turn the flat face of the PTO countershaft, 4, toward the range counter gear, 5, on the drive pinion shaft, 6, to avoid the interferences when separate the transmission 2 from the transmission 1.
3. Inspect the each gears backlash refer to “2) Inspection” in this section before disassemble the transmission 2.



403-1Y

1) DISASSEMBLY

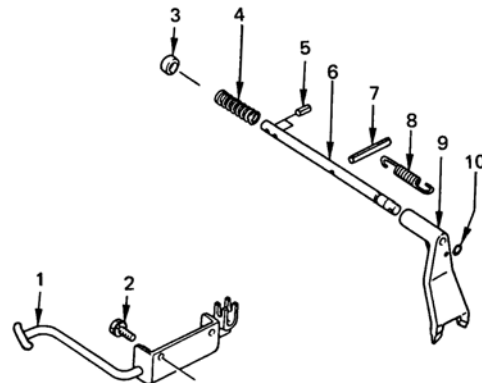
(Manual transmission of one-speed PTO and two-speed PTO Model)

(1) Differential lock pedal • Differential shaft • Differential fork

- ① Remove the differential lock pedal, 1.
- ② Remove the spring, 8, and drive out the spring pin.
- ③ Extract the differential lock shaft, 6, rightwards and take out the spring, 4, and differential fork, 10.

NOTE:

Remove the O-ring, 10, at the end of the shaft before extracting the shaft.



404Y

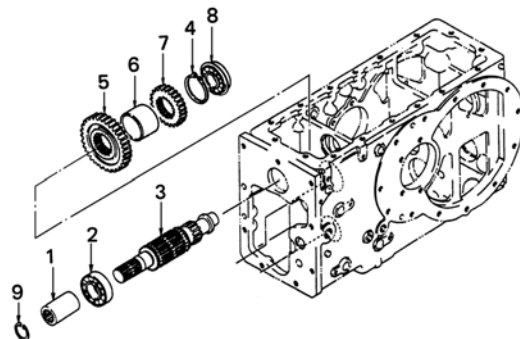
- | | |
|----------------------------|----------------------------|
| 1. Differential lock pedal | 6. Differential lock shaft |
| 2. Bolt | 7. Spring pin |
| 3. Oil seal | 8. Spring |
| 4. Spring | 9. Differential lock fork |
| 5. Spring pin | 10. O-ring (P11) |

(2) Main shaft ; Range gear

- ① Remove the snap ring (ϕ 40) at the rear side of the fixed gear (range ; M), 7, and move the gear rearwards.
- ② Driving out the main shaft, 3, frontwards, remove the fixed gears (range ; H), 5, (range ; M), 7, and collar, 6.

NOTE:

Take care for the snap ring, 9, which is in the joint, 1, at the end of the shaft.



405Y

- | | |
|-----------------------------|-----------------------------|
| 1. Joint | 6. Collar |
| 2. Bearing (6205) | 7. Fixed gear A (range ; M) |
| 3. Main shaft | 8. Bearing (6204) |
| 4. Snap ring (ϕ 40) | 9. Snap ring (ϕ 22) |
| 5. Fixed gear A (range ; H) | |

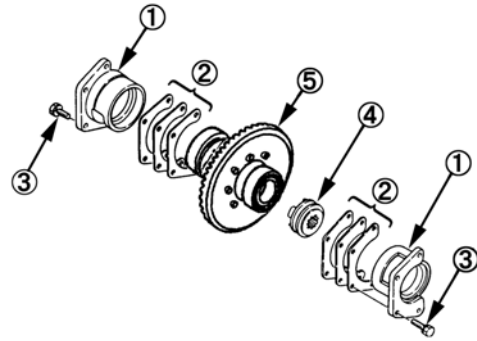
(3) Differential support • Differential ass'y

- ① Remove the right and left differential supports, 1.

NOTE:

1. Though the right and left differential supports are the **same**, number and thickness of shims are different. Keep them independently.
2. Remove the differential lock clutch, 4, on the left side.

- ② Remove the differential ass'y, 5.



406Y

1. Differential support
2. Shim : 0.1 t
 : 0.3 t
 : 0.5 t
3. Bolt
4. Differential lock clutch (left only)
5. Differential ass'y

(4) Shifter rod • Shifter fork

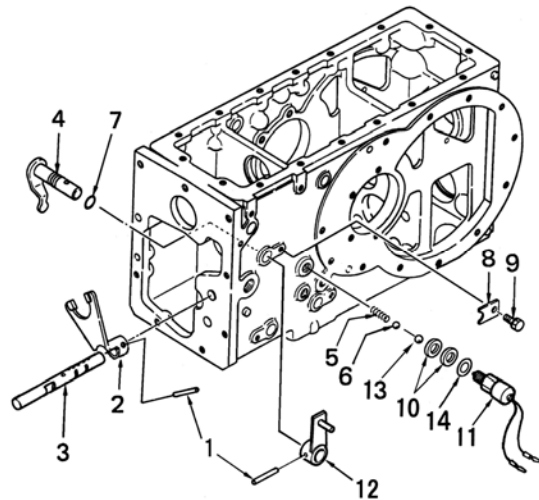
(For range gear transmission)

- ① Remove the safety switch, 11, seal washers, 10, shim, 14, and steel ball, 13, from the housing.
- ② Drive out the roll pins, 1, from shifter fork.
- ③ Extract the shifter rod, 3, front-wards

NOTE :

- Steel balls, 6, come out from housing when remove the shifter rod, 3. Take care not to miss it.
- The steel balls, 6 and 13, are different size which small size ball, 13, is installed to the safety switch, 11, side.

- ④ Remove the shifter fork, 2.
- ⑤ Remove the shift arm, 4, (after removing the drive pinion.)
- ⑥ Remove spring, 5, from the housing.



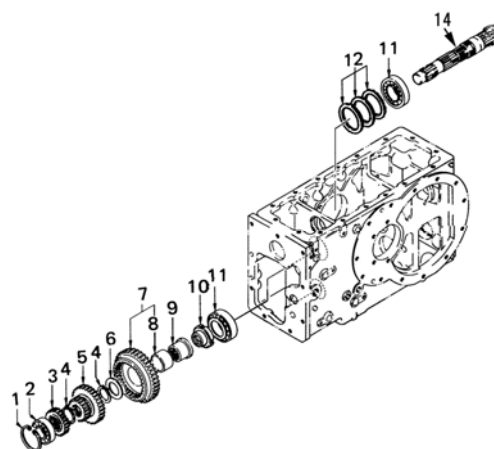
407Y

1. Roll pin
2. Shifter-fork
3. Shifter rod; range
4. Shift arm ; range
5. Spring
6. Steel ball (ϕ 8.73)
7. O-ring (P14)
8. Plate
9. Bolt (M3 $\times$ 16)
10. Seal washer
11. Safety switch
12. Change lever
13. Steel ball (ϕ 7.94)
14. Shims (t=0.5mm)

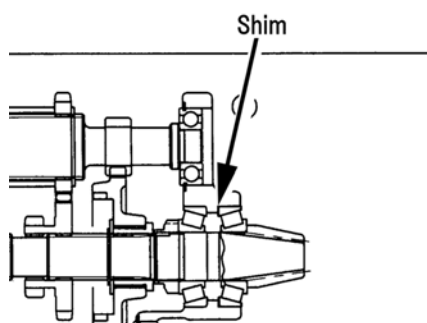
(5) Drive pinion

- ① Remove the snap ring (ϕ 28), 4, from the ditch on the drive pinion at the front of the counter gear, 7, (Range gear ; L) and move the thrust washer, 6, gear, 7, and joint, 9, front-wards.
- ② Straighten the flange of the lock nut, 10, and untighten lock nut.
- ③ Extracting the drive pinion, 14, rear wards, remove the fixed gear (4WD), 3, snap rings (ϕ 28), 4, slide gear, 5, thrust washer, 6, joint, 9, counter gear, 7, lock nut, 10, and taper roller bearing, 11.
- ④ Take out the rear bearing and shims, 12.

- | | |
|---|--------------------------------|
| 1. Snap ring (ϕ 52) | 8. Bush |
| 2. Bearing (6205) | 9. Joint |
| 3. Fixed gear | 10. Lock nut |
| 4. Snap ring (ϕ 28) | 11. Taper roller bearing |
| 5. Slide gear
(range transmission) | 12. Shim (0.1 t, 0.2 t, 0.5 t) |
| 6. Thrust washer | 14. Drive pinion |
| 7. Gear ass'y
(counter gear)
(Range gear ; L) | |



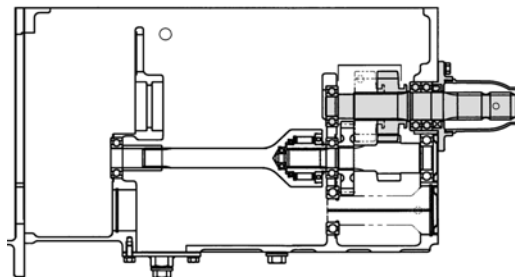
410Y



411Y

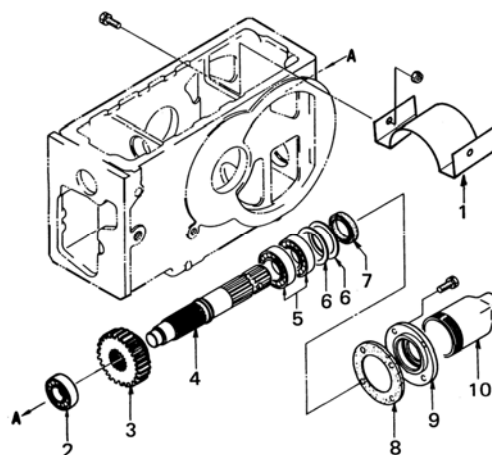
(6) PTO shaft : One-speed PTO Model

- ① Remove the bracket.
- ② Remove the seal cover, 9, and extract the PTO shaft, 4, rearwards together with 2 bearings, 5.
- ③ Remove the slide gear, 3.



412Y

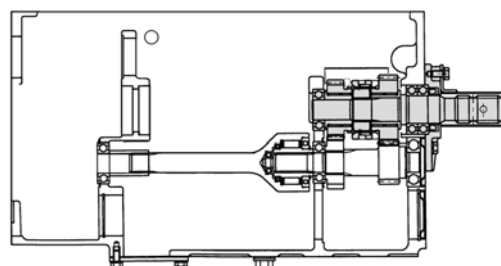
- | | |
|---------------------|------------------------|
| 1. Bracket | 6. Shim (0.2 t, 0.5 t) |
| 2. Bearing (6205) | 7. Oil seal |
| 3. Fixed gear (PTO) | 8. Gasket |
| 4. PTO shaft | 9. Seal cover |
| 5. Bearing (6007) | 10. Guard |



413Y

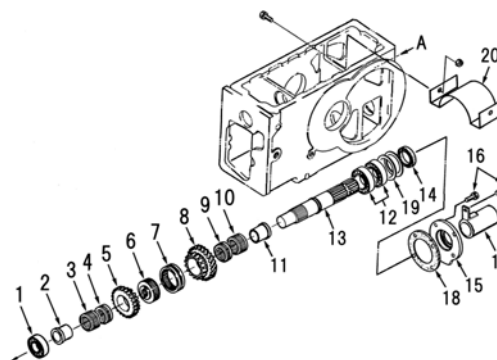
(6) PTO shaft : Two-speed PTO Model

- ① Remove the bracket, 20.
- ② Remove the seal cover, 15, and extract the PTO shaft, 13, rearwards together with 2 bearings, 12.
- ③ Remove the couplings, 2 and 11, needle bearings, 3, 4, 9 and 10, counter gears, 5 and 8, synchronize hub, 6, sleeve, 7, and bearing, 1, from in the housing.



414Y

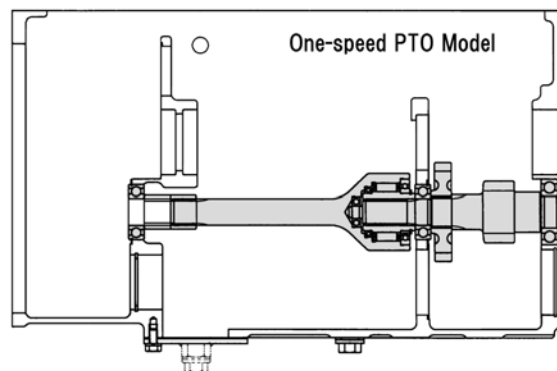
- | | |
|--------------------|--------------------|
| 1. Bearing | 9. Needle bearing |
| 2. Coupling | 10. Needle bearing |
| 3. Needle bearing | 11. Coupling |
| 4. Needle bearing | 12. Bearing |
| 5. Counter gear | 13. PTO shaft |
| 6. Synchronize hub | 14. Oil seal |
| 7. Sleeve | 15. PTO seal cover |
| 8. Counter gear | 16. Bolt |
| | 17. PTO Guard |
| | 18. Gasket |
| | 19. Shim |
| | 20. Bracket |



415Y

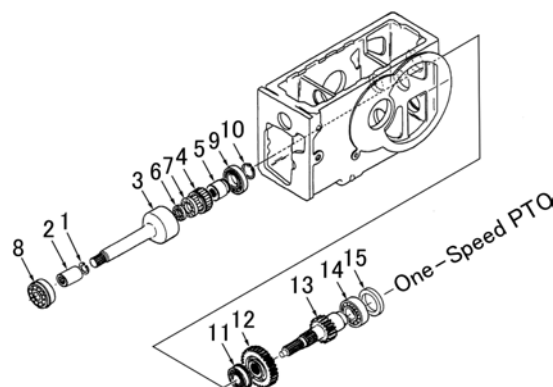
(7) PTO counter shaft : 9×3 with one – speed PTO Model

- ① Remove the bearing (6205 NR).
- ② Remove the middle PTO counter shaft (together with one-way bearing, joint, bearing, and snap ring.)
- ③ Drive out the rear PTO counter shaft rearwards together with the seal cover and bearing.
- ④ Remove the bearings and fixed gear remaining in the case if necessary.



417Y

- | | |
|----------------------|-----------------------|
| 1. Snap ring (φ 20) | 10. Snap ring (φ 35) |
| 2. Joint | 11. Bearing (6205NR) |
| 3. PTO counter shaft | 12. Fixed gear |
| 4. One-way bearing | 13. PTO counter shaft |
| 5. Joint | 14. Bearing (6206) |
| 6. Bearing (6001) | 15. Seal cover |
| 7. Bearing (6807) | |
| 8. Bearing (6505NR) | |
| 9. Bearing (16007) | |

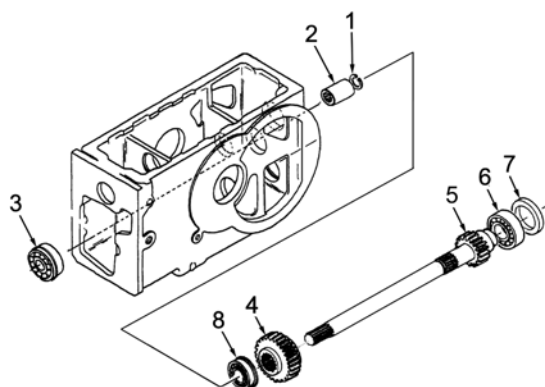


416Y

(7) PTO counter shaft : 9×3 with two – speed PTO Model

- ① Remove the bearing (6205 NR), 3.
- ② Tap the PTO counter shaft to rear-ward and remove the seal cover, 7, bearing, 6, PTO counter shaft, 5, to rear-ward.
- ③ Take out the fixed gear, 4, and bearing, 8, from the housing.

- | | |
|----------------------|----------------------|
| 1. Snap ring (φ 20) | 7. Seal cover |
| 2. Joint | 8. Bearing (6205RNR) |
| 3. Bearing (6505NR) | |
| 4. Fixed gear | |
| 5. PTO counter shaft | |
| 6. Bearing (6305R) | |



419Y

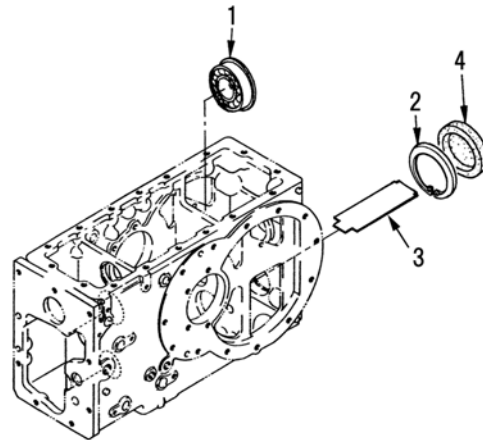
(8) Bearing support : 9×3One speed PTO only

- ① Remove the seal cover, 4, bearing support, 3, snap ring, 2, and bearing (6206NR), 1, from housing.

NOTE :

Since the bearing support is installed horizontally with snap ring and therefore should be taken at the time of reassembly.

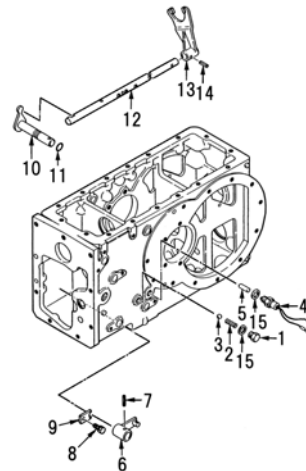
1. Bearing (6206NR)
2. Snap ring (φ 62)
3. Bearing support
4. Seal cover



420Y

(9) PTO Shifter rod.

- ① Drive out the roll pin, 14, from the PTO shifter fork.
- ② Remove the bolt, 1, spring, 2, and steel ball, 3, from the left side of the housing.
- ③ Remove the PTO safety switch, 4, and pin, 5, from the left of the housing.
- ④ Drive out the roll pin, 7, from the change lever, 6, and remove the change lever, 6.
- ⑤ Remove the bolt, 8, and plate, 9.
- ⑥ Remove the shift arm, 10, inward from housing.
- ⑦ Remove the shifter rod, 12, from housing.



(10) Bracket• Filter

- ① Remove the filters and bracket from housing.

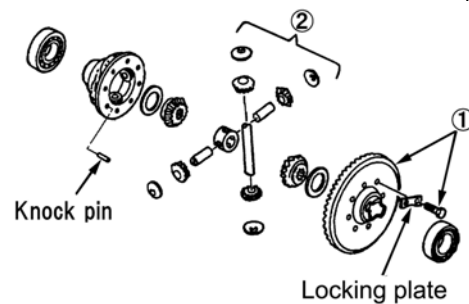
421Y

(11) Differential ass'y

- ① Remove 8 bolts tightening the bevel gear and separate the differential cage.
- ② Remove the knock pin and take out the gears, thrust washers and shafts in the differential cage.

NOTE :

The factory installed ring gear bolts are coated with a thread sealant on assembly and should not be reused. On installation, use new bolts with locking plates.



422Y

2) Inspection

Refer to the description of "Transmission 2 for HST" for inspections.

3) Reassemble

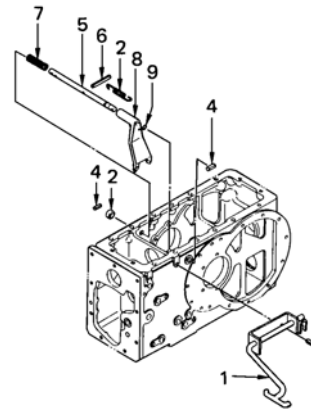
Refer to the description of "Transmission 2 for HST" for reassembly.

3. TRANSMISSION 2 FOR HST MODEL (1-speed PTO with mid PTO)

1) Disassembly

(1) Differential lock pedal • Differential shaft • Differential lock fork

- ① Remove the differential lock pedal, **1**, and drive out the spring pin, **4**, on the left side of the shaft, **5**.
- ② Remove the spring, **2**, and drive out the spring pin, **6**.
- ③ Pull out the differential lock shaft, **5**, rightwards and take out the spring, **7**, and differential lock-fork, **8**.



423Y

NOTE :

Remove the O-ring, **9**, at the shaft end before extracting the shaft, **5**.

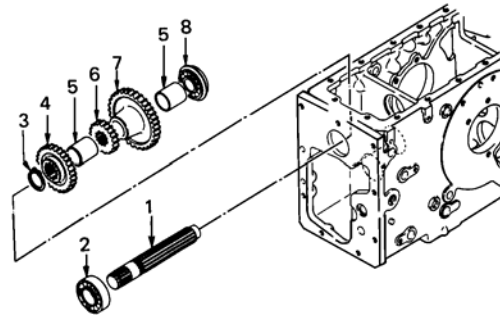
- | | |
|----------------------------|---------------------------|
| 1. Differential lock pedal | 6. Spring pin |
| 2. Oil seal | 7. Spring |
| 3. Spring | 8. Differential lock fork |
| 4. Spring pin | 9. O-ring (P11) |
| 5. Differential lock shaft | |

(2) Main shaft

- ① Driving out the main shaft, **1**, front-wards together with the bearing, **2**, and snap ring, **3**, on the front side, remove the fixed gears (**range** ; H,L,M) and collars (2 pcs), **5**.

② Remove the bearing, **8**, from the housing.

- | | |
|-----------------------------|-----------------------------|
| 1. Main shaft | 5. Collar |
| 2. Bearing (6205) | 6. Fixed gear A (Range ; L) |
| 3. Snap ring (φ 25) | 7. Fixed gear A (Range ; H) |
| 4. Fixed gear A (Range ; M) | 8. Bearing (6204) |



424Y

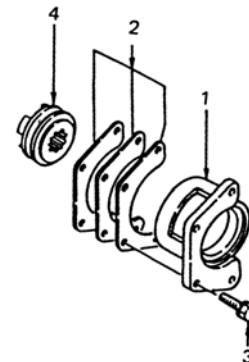
(3) Differential support • Differential ass'y

- ① Remove the right and left differential supports.

NOTE :

1. Though the right and left differential supports are the same, number and thickness of shims are different and should be keep separately.
2. Remove the differential lock clutch on the left side.

- ② Remove the differential assembly.



425Y

- | |
|-------------------------------|
| 1. Differential support |
| 2. Shim : 0.1 t, 0.3 t, 0.5 t |
| 3. Bolt |
| 4. Differential lock clutch |

(4) Shifter rod • Shifter fork

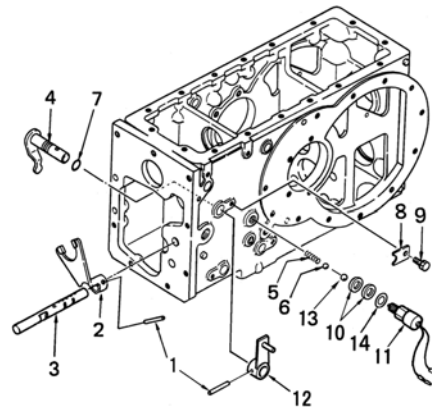
(Range transmission)

- ① Drive out the roll pins, 1, from shifter fork, 2, shifter rod, 3, and change lever, 12.
- ② Pull out the shifter rod, 3, front-wards.

NOTE :

Two steel balls, 6, come out from the housing. Be careful not to miss them.

- ③ Remove the shifter fork, 2.
- ④ Remove the plate, 8, and extract the shift arm, 4, inwardly (after remove the drive pinion).
- ⑤ Remove the switch ass'y, 11, shim, 14, seal washers, 10, and spring, 5, from the housing.



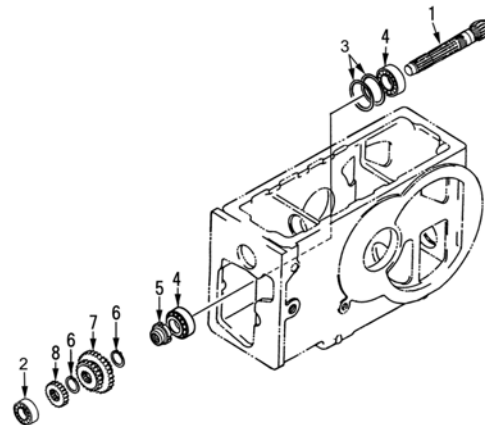
426Y

- | | |
|-----------------|--------------------------------|
| 1. Roll pin | 6. Steel balls (ϕ 8.73) |
| 2. Shifter fork | 7. O-ring (P14) |
| 3. Shifter rod | 8. Plate |
| 4. Shift arm | 9. Bolt |
| 5. Spring | 10. Seal washers |
| | 11. Switch |
| | 12. Change lever |
| | 13. Steel ball (ϕ 7.94) |
| | 14. Shim (t=0.5mm) |

(5) Drive pinion

- ① Straighten the flange of the lock nut, 5, and untighten lock nut.
- ② Pulling out the drive pinion, 1, rearwards, remove the fixed gear (4WD), 8, snap rings (2 pcs), 6, and slide gear, 7, (Range transmission).
- ③ Pulling out the lock nut, 5, taper roller bearings, 4, and shims, 3.

- | | |
|-------------------------|----------------------------|
| 1. Drive pinion | 5. Lock nut |
| 2. Bearing (6205) | 6. Snap ring (ϕ 28) |
| 3. Shim (t=0.1, 0.2) | 7. Slide gear |
| 4. Taper roller bearing | (Range transmission) |
| | 8. Fixed gear (4WD) |

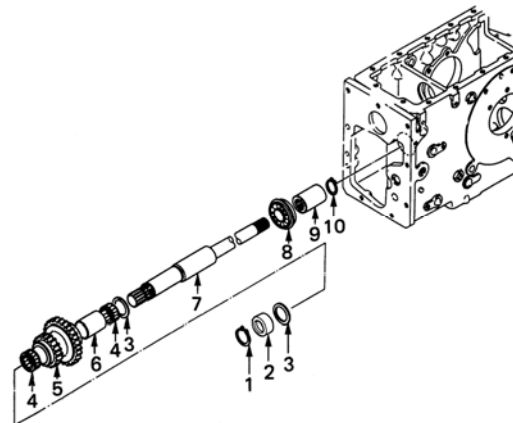


427Y

(6) PTO counter shaft

- ① Remove the snap ring (ϕ 25), 1, from the shaft, 7, and remove the collar, 2, thrust washers, 3, counter gear, 5, (4WD), needle bearings (2 pcs), 4, and collar, 6.
- ② Drive out the shaft, 7, and bearing, 8, front-wards together and remove the joint, 9, and snap ring, 10, on the rear side.

- | | |
|----------------------------|-----------------------------|
| 1. Snap ring (ϕ 25) | 6. Collar |
| 2. Collar | 7. PTO counter shaft |
| 3. Thrust washer | 8. Bearing |
| 4. Needle bearing | 9. Coupling |
| 5. Counter gear (4WD) | 10. Snap ring (ϕ 22) |

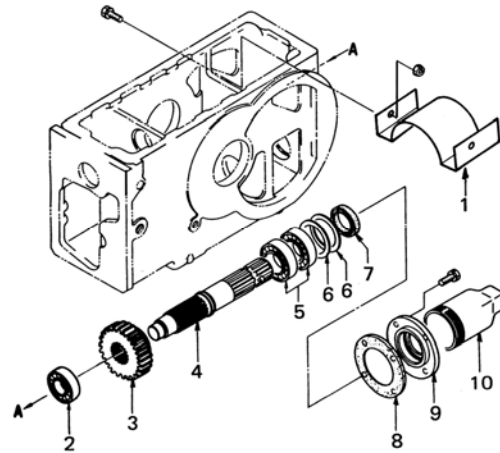


428Y

(7) PTO shaft

- ① Remove the bracket, 1
- ② Remove the seal cover, 9, and extract the PTO shaft, 4, rearwards together with 2 bearings, 5.
- ③ Remove the slide gear, 3.
- ④ Remove the bearing, 2, from the housing.

- | | |
|---------------------|------------------------|
| 1. Bracket | 6. Shim (0.2 t, 0.5 t) |
| 2. Bearing (6205) | 7. Oil seal |
| 3. Slide gear (PTO) | 8. Gasket |
| 4. PTO shaft | 9. Seal cover |
| 5. Bearing (6007) | 10. Guard |

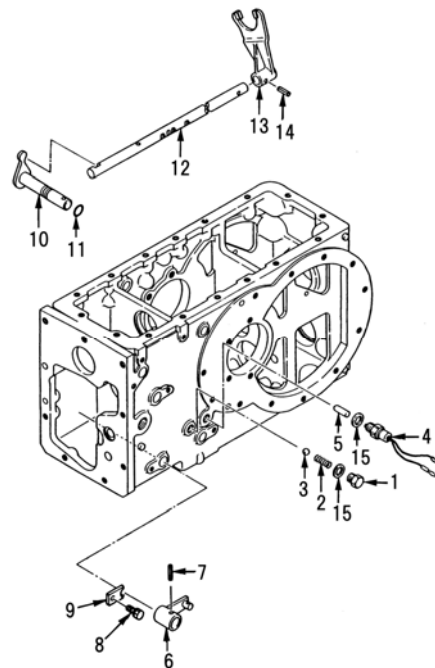


429Y

(8) PTO shifter rod • Sifter fork

- ① Drive out the spring pin, 7, and remove the change lever, 6.
- ② Remove the plate, 9, and extract and remove the shift arm, 10, inwards.
- ③ Remove the bolt, 1, and seal washer, 15, and take out the steel ball, 3, and spring, 2.
- ④ Remove the safety switch, 4, and seal washer, 15, and take out the baulk pin.
- ⑤ Drive out the spring pin and remove the and shifter-fork, 13.
- ⑥ Extract the shifter rod, 12, front-wards.

- | | |
|----------------------|------------------|
| 1. Bolt | 8. Bolt |
| 2. Spring | 9. Plate |
| 3. Steel ball | 10. Shift arm |
| 4. PTO safety switch | 11. O-ring |
| 5. Pin | 12. Shifter rod |
| 6. Change lever | 13. Shifter fork |
| 7. Roll pin | 14. Roll pin |
| | 15. Seal washer |

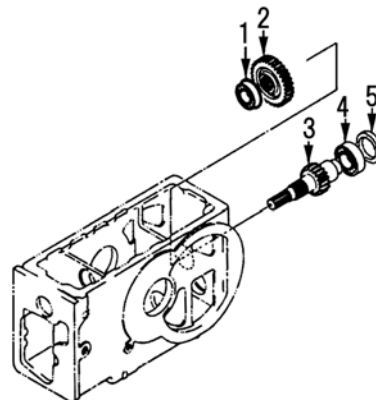


430Y

(9) PTO counter shaft

- ① Drive out the shaft, 3, together with the seal cover, 5, and bearing, 4.
- ② Take out the fixed gear (mid PTO), 2.

1. Bearing (6205NR)
2. Fixed gear (mid PTO)
3. PTO counter shaft
4. Bearing (6206)
5. Seal cover

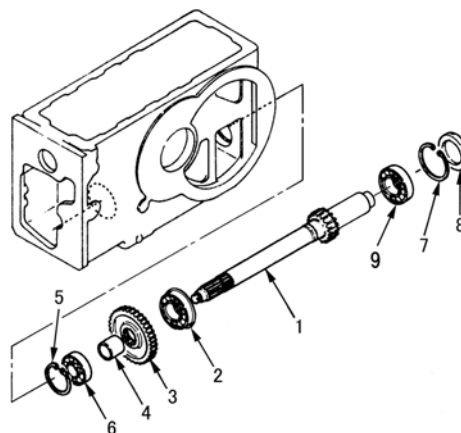


431Y

(10) Mid PTO counter shaft

- ① Drive in the screwdriver to the seal cover, 8, and remove seal cover and discard it.
- ② Drive out the counter shaft, 1, to rearward.
- ③ Remove bearing, 9, from the counter shaft, 1,.
- ④ Take out the collar, 4, and fixed gear, 3.
- ⑤ Remove the bearing, 6, and snap ring, 5, in the housing.
- ⑥ Remove the bearing, 2, from the housing.

- | | |
|--------------------------|---------------------------|
| 1. MID PTO Counter shaft | 5. Snap ring (ϕ 52) |
| 2. Bearing (6026:NR) | 6. Bearing (6205) |
| 3. Fixed gear | 7. Snap ring (ϕ 62) |
| 4. Collar | 8. Seal cover |
| | 9. Bearing (6206) |

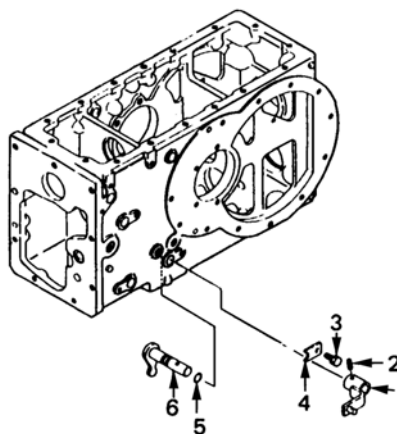


432Y

(11) Shift arm

- ① Drive out the spring pin, 2, and remove the change lever, 1.
- ② Remove the plate, 4, and remove the shift arm, 6, from the inside of the case.

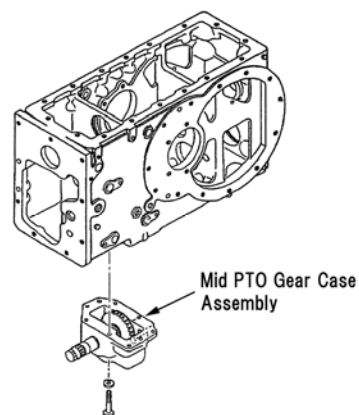
- | | |
|-----------------|----------------------|
| 1. Change lever | 4. Plate |
| 2. Spring pin | 5. O-ring (P14) |
| 3. Bolt | 6. Mid PTO shift arm |



433Y

(12) Mid PTO gear case

- ① Remove the gear box fixing bolt and remove the mid PTO gear case assembly.



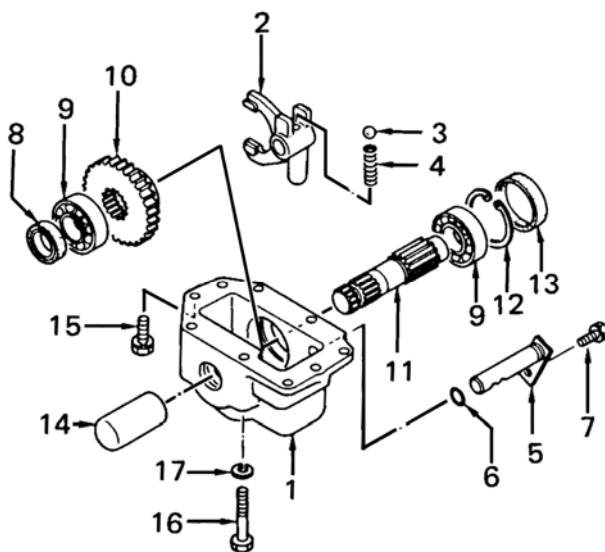
434Y

- ② Remove the shifter rod fixing bolt, 7, and drive out the rod, 5, rear-wards.

NOTE :

Be careful since a steel ball, 3, comes out from the shifter fork, 2.

- ③ Take out the shifter fork, 2.
 ④ Take out the seal cover, 13, at the rear side of the case and remove the snap ring (ϕ 52), 12.
 ⑤ Drive out the shaft, 11, rearwards together with the bearing, 9, and take out the slide gear, 10.
 ⑥ Takeout the bearing, 9, and oil seal, 8, from the case if necessary.

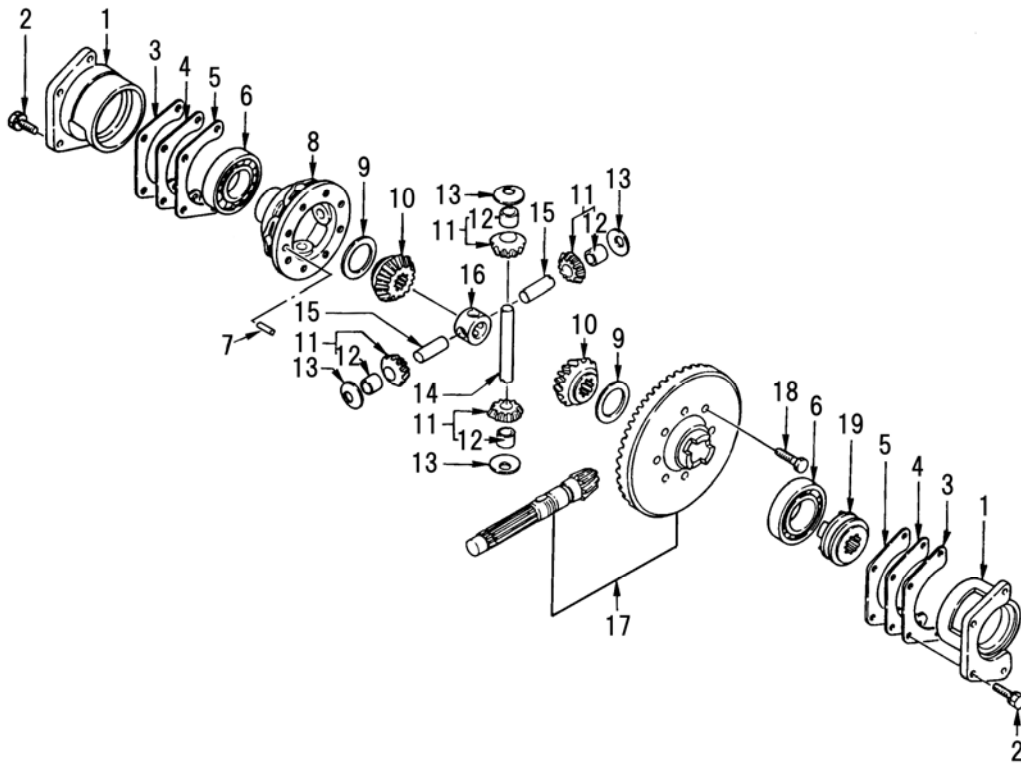


- | | |
|----------------------|----------------------------|
| 1. Mid PTO gear case | 10. Slide gear |
| 2. Shifter fork | 11. PTO shaft |
| 3. Steel ball | 12. Snap ring (ϕ 52) |
| 4. Spring | 13. Seal cover |
| 5. Shifter rod | 14. Cover ; cap |
| 6. O-ring (P11) | 15. Bolt |
| 7. Bolt | 16. Bolt |
| 8. Oil seal | 17. Spring washer |
| 9. Bearing (6205) | |

436Y

(13) Differential ass'y

- ① Remove 8 bolts, 18, tightening the bevel gear, 17, and separate the differential cage, 8.
- ② Remove the pin, 7, and remove the gears, 10 and 11, thrust washer , 9 and 13, shafts, 14 and 15, and joint, 16, in the differential cage, 8.



437Y

- | | |
|-------------------------------|---|
| 1. Differential support | 11. Differential pinion ass'y |
| 2. Bolt | 12. Bush |
| 3. Shim (0.1 t, 0.3 t, 0.5 t) | 13. Thrust washer |
| 4. Shim (0.1 t, 0.3 t, 0.5 t) | 14. Pinion shaft |
| 5. Shim (0.1 t, 0.3 t, 0.5 t) | 15. Pinion shaft |
| 6. Bearing (6010.) | 16. Joint |
| 7. Pin | 17. Ring gear ass'y |
| 8. Differential cage | 18. Special bolt (which coat the chemicals) |
| 9. Thrust washer | 19. Differential lock clutch |
| 10. Differential gear | |

2) Inspection

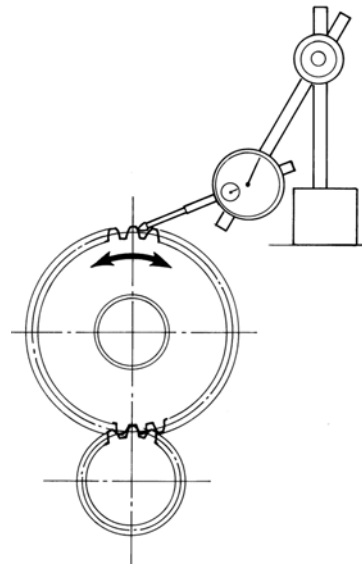
(1) Bearing

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

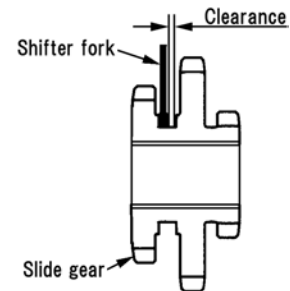


437-1Y

(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

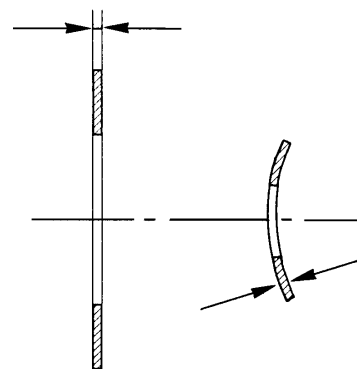


437-2Y

(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.

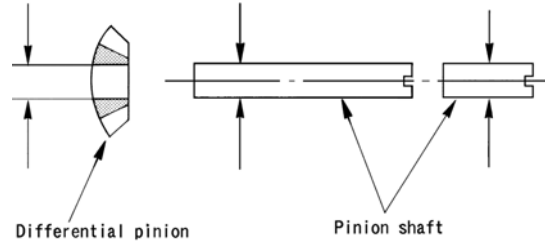
Thrust washer thickness (mm)		
	Standard dimension	Service limit
Differential gear side	1.2	0.9
Differential pinion side		



437-3Y

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



437-4Y

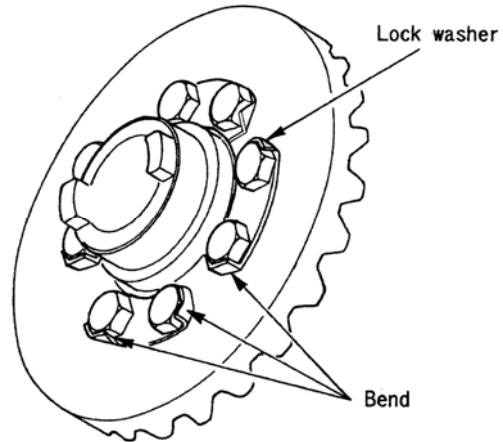
4. Tighten the ring gear and differential cage with the specified tightening torque.

Tightening torque	46.1 – 55.9 N.m (4.5 – 5.7 kgf.m)
-------------------	--

NOTE:

Be sure to use four lock washers at the time of reassembly of the ring gear as in the front wheel differential.

The lock washer parts No. is 399310330.



437-5Y

(5) 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 bearing** 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).

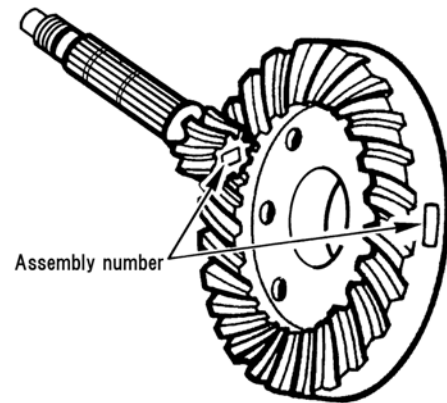
For example:

Error value of defective drive pinion: -0.2

Error value of new drive pinion: ± 0

$-0.2 - (4-0) = -0.2$

Decrease the shims by 0.2 mm in this case.



437-6Y

NOTE:

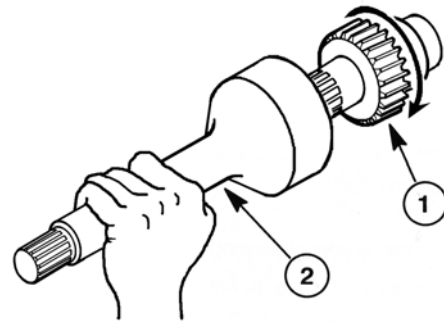
When no error value is noted, calculate assuming the error value to be ± 0 .

3) Reassembly

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

1. One way clutch (9x3 1speed PTO model only)

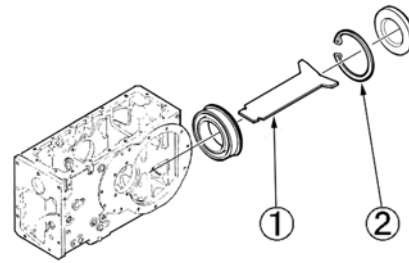
If the rear PTO countershaft, 1, is rotates counterclockwise, as viewed from the rear; the assembly is correct. If the rear PTO countershaft, 1, is unable to rotate counterclockwise, as viewed from the rear when hold the PTO counter shaft, 2, the assembly is incorrect. The one-way bearing needs to be reversed.



437-6AY

2. Bearing support (9x3 1speed PTO model only)

Install the bearing support, 1, to horizontally with it hold by rear snap ring, 2.



437-6BY

3. Drive pinion

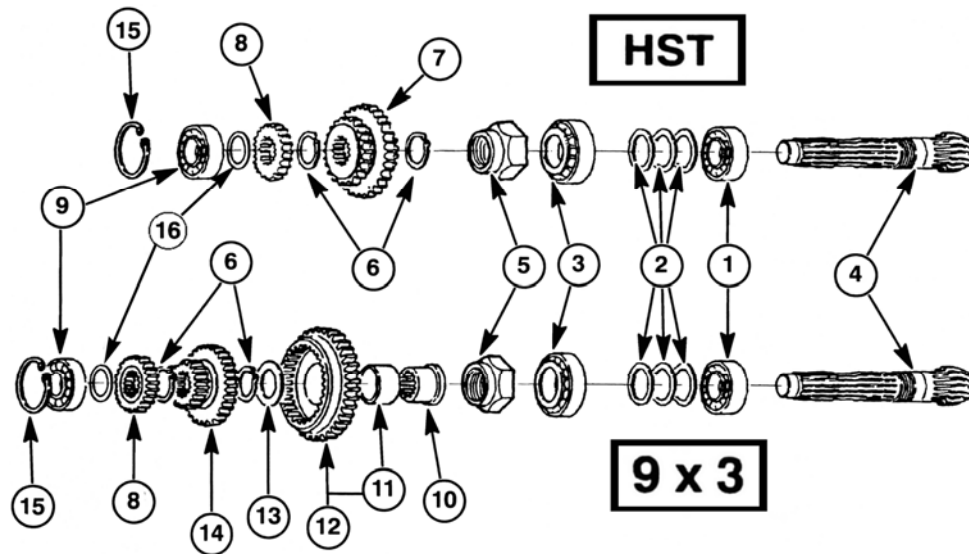
- ① Install the same thickness and quantity shims , 2,between the transmission housing and rear taper roller bearing, 1, on the drive pinion, 4.
- ② Install the front taper roller bearing, 3, in the housing.

[On model 9×3]

- ③ Position the lock nut, 5, coupling, counter gear, thrust washer, snap ring, slide gear, snap ring and 4WD fixed gear in the housing and install the drive pinion, 4, from rear of housing.

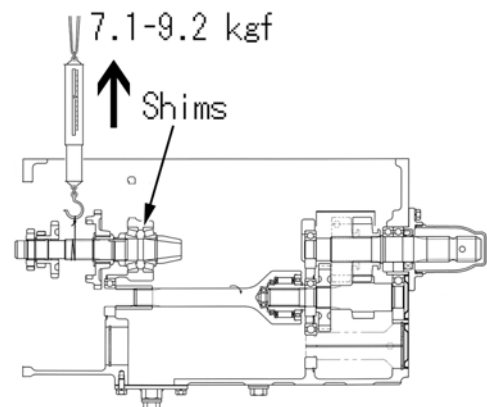
[On model HST]

- ④ Position the lock nut, 5, snap rings, 6, slide gear, 7, fixed gear, 8, and install the drive pinion, 4, from rear of housing.



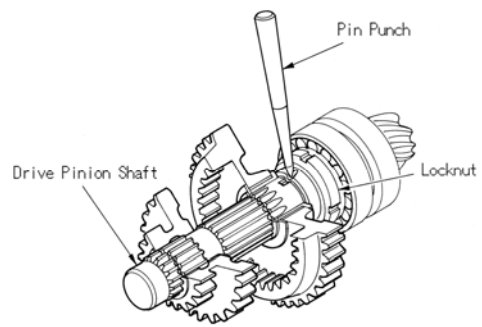
437-6CY

- | | |
|-------------------------------|----------------------------|
| 1. Rear taper roller bearing | 10. Coupling |
| 2. Shims | 11. Bush |
| 3. Front taper roller bearing | 12. Low range counter gear |
| 4. Drive pinion shaft | 13. Thrust washer |
| 5. Locknut | 14. 9x3 range sliding gear |
| 6. Snap ring | 15. Snap ring |
| 7. HST Range sliding gear | 16. Shim |
| 8. FWD fixed gear | |
| 9. Ball bearing | |
- ④ Tighten the lock nut and adjust the pinion bearing pre-load using a strong cord wrapped around the pinion shaft and pull scale. Tighten the pinion lock nut to obtain the specified preload of constant pull to rotate the pinion assembly. Preload for bearings at a constant load should be 7.1-9.2 kgf.



437-6DY

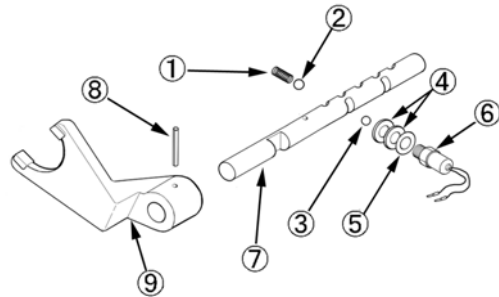
Bend the collar of the lock nut at the drive pinion shaft groove with a punch after adjusted the pre-load.



437-6EY

4. Steel ball

The small size steel ball(ϕ 7.94), 3, is installed at the range gear safety switch side and large size steel ball(ϕ 8.73), 2, is installed at the detent ball.



437-6FY

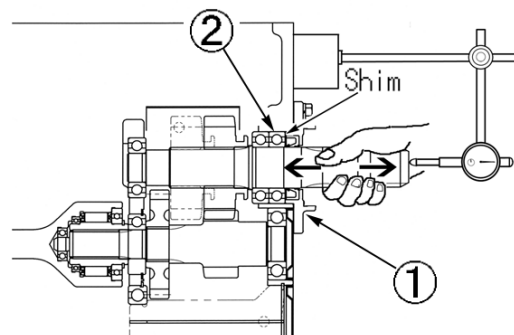
- | | |
|-----------------------|-----------------|
| 1. Spring | 7. Shifter rod |
| 2. Steel ball(8.73mm) | 8. Spring pin |
| 3. Steel ball(7.94mm) | 9. Shifter fork |
| 4. Seal washer | |
| 5. Shim | |

5. Rear PTO shaft endplay

Inspect the rear PTO shaft endplay with a dial gauge after installed PTO seal cover, 1.

PTO shaft endplay is less than 0.3 mm.

If the endplay is larger than 0.3 mm, adjust with the shims between the rear bearing, 2, and seal cover, 1.

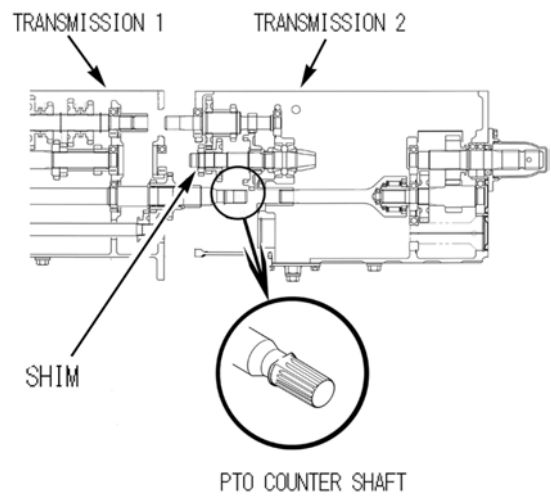


437-6GY

6. Transmission 1 and Transmission 2

On models with 9x3 transmission, the PTO counter shaft must be turned before installation transmission 1 and transmission 2. The flat face of the PTO counter shaft must face the counter gear avoiding any interference.

On models with both (HST and 9x3) transmissions, the shim is installed between 4WD fixed gear and bearing before installation transmission 1 and transmission 2



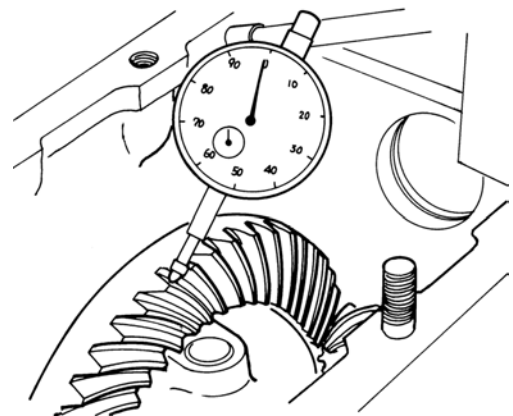
437-6HY

2. Measure the backlash and adjust properly.

Backlash of drive pinion and ring gear (mm)	
Assembling standard value	0.08 – 0.13
Repair value	0.3

NOTE:

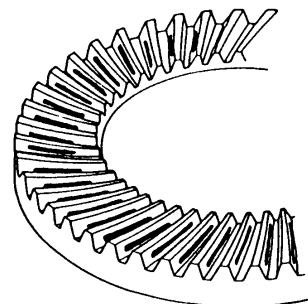
1. Replace the drive pinion and ring gear as an ass'y.
 2. Refer to the paragraph of inspection of tooth contact for the backlash.
 3. Backlash of differential gear and differential pinion.
 - a. Insert 2 fuses at opposing positions between the differential gear and differential pinion and turn the differential gear.
 - b. Take out the fuses and measure the thickness with a micrometer.
 - c. Total thickness of 2 fuses $\div$ 2 = backlash (mm)
- Replace if the service limit is exceeded.



437-7Y

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

- (7) **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.

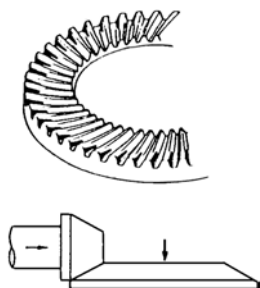


Proper contact

437-8Y

a. Heel contact

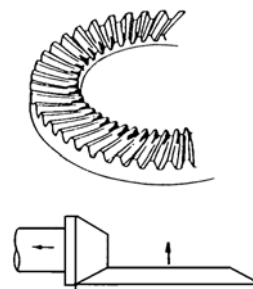
Select shims so that the drive pinion is brought near the ring gear.



437-9Y

b. Toe contact

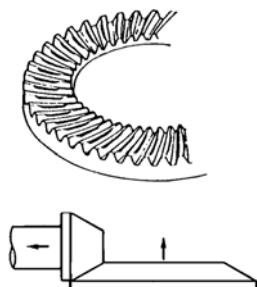
Select shims so that the drive pinion is put farther from the ring gear.



437-10Y

c. Face contact

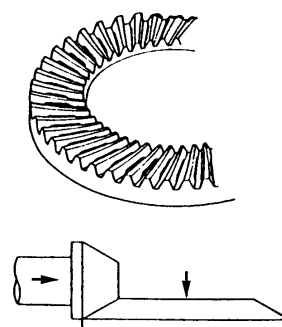
Select shims so that the ring gear is brought near the drive pinion.



437-11Y

d. Flank contact

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



437-12Y

3—6 Change Lever Linkage

NOTE:

Remove the dashboard, cover, and meter ass'y referring to 1-5, Removal of outside.

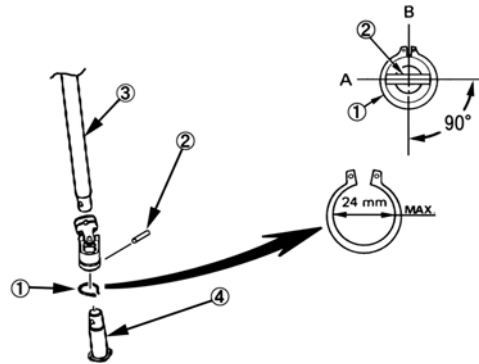
1. MAIN CHANGE LEVER ASS'Y

1) Disassembly

- a. Remove the snap rings ① and drive out the pin, ② and separate the main change lever ass'y ③ from the shift arm ④.

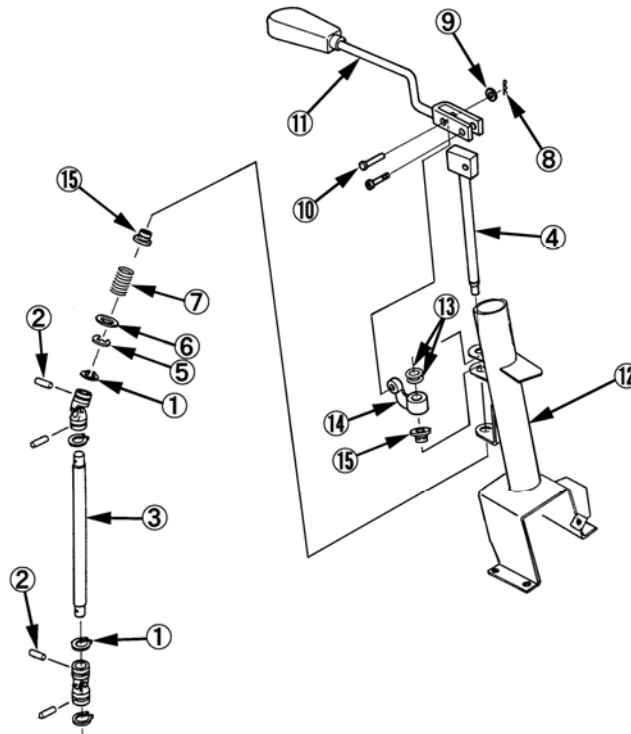
NOTE :

When removing the snap ring, do not expand it to more than $\phi 24$ in bore since the tightening force decreases.



438Y

- b. Remove the snap ring ⑤, washer ⑥, and spring ⑦, from the shift arm ④.
- c. Remove the snap pin ⑧, washer ⑨, and pin ⑩, from the change lever, ⑪.
- d. Draw out the change lever ⑪, and shift arm ④, from the steering column ⑫.
5. Remove the shims ⑬ shift arm ⑭, and bushes ⑮ from the steering column.

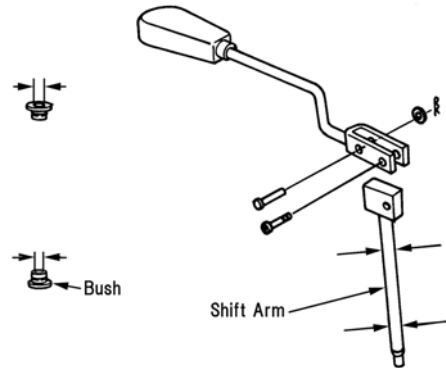


439Y

2) Inspection

1. Check the clearance between the shift arm and bush and replace if the service limit is exceeded.

Clearance between shift arm and bush	
Standard assembling value	Service limit
0.19—0.24 mm	0.5 mm

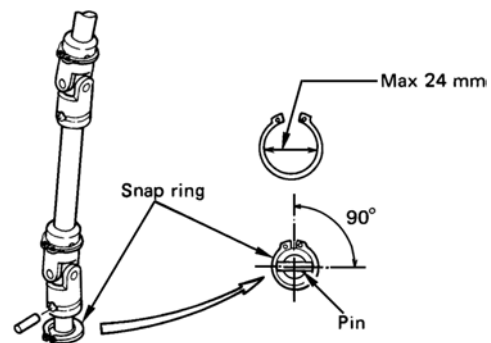


440Y

3) Reassembling

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

1. When connecting the shift arm and link ass'y, the pin should be at the right angle to the snap ring end gap. The snap ring should not be expanded to more $\phi 24$ in bore at the time of installation.



441Y

2. Apply the grease to contact surface of change lever and shift arms.

2. RANGE SHIFT, PTO AND 4WD CHANGE LEVER (Remove the covers referring to 1-5, Removal of outside.)

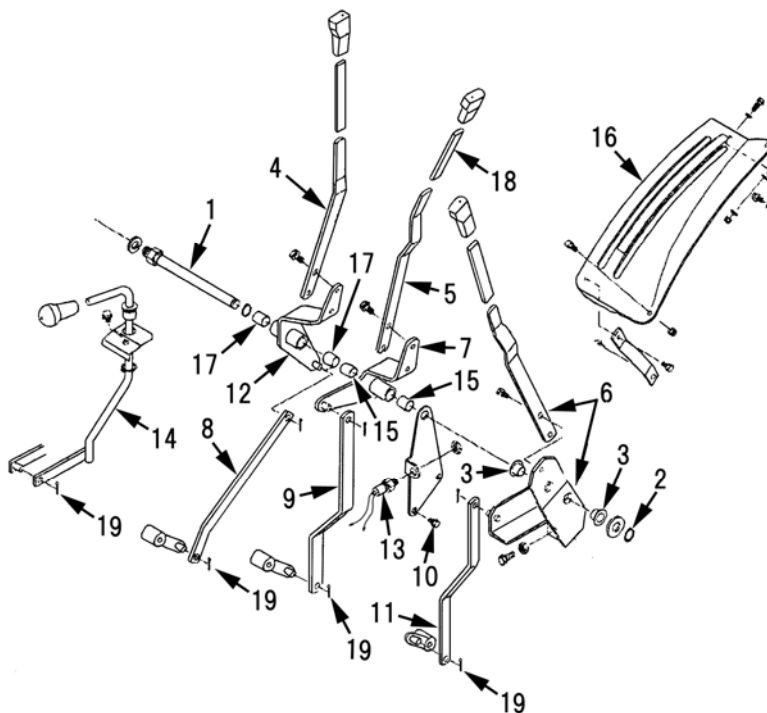
1) Disassembly and reassembly

(1) Range shift and PTO change lever

- ① Remove the split pins, 19, from each change lever, and separate the shift plates, 8, 9 and 11.
- ② Remove two bolts, 10, for the bracket.
- ③ Remove the change lever assembly as a set by turn the shaft, 1.

(2) 4WD change lever

- ① Remove the split pin, 19, and remove the 4WD change lever, 14, from the shift arm.



1. Shaft; shift guide
2. Snap ring
3. Bushing
4. Change lever ; range shift
5. Change lever ; PTO
6. Change lever ; mid PTO
7. Change lever ; rear PTO
8. Shift plate ; range shift
9. Shift plate ; PTO (one speed)

10. Bracket
11. Shift plate ; mid PTO
12. Change lever : range
13. Safety switch (mid PTO - only)
14. Change lever ; 4WD
15. Bush
16. **Lever Guide**
17. Bush
18. Change lever ; PTO
19. **Split pin**

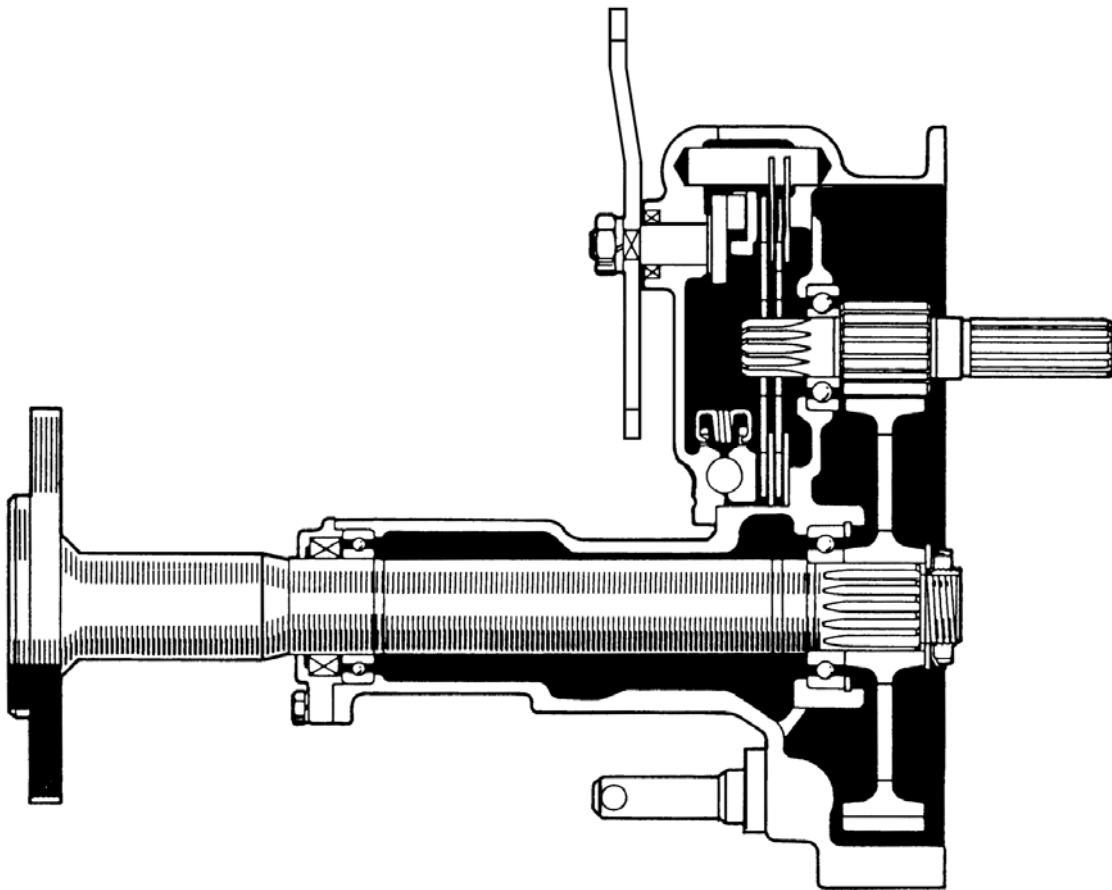
NOTE : Reassemble units in the reverse order to disassembly

442Y

3—7 Real Axle and Brake

1. SPECIFICATIONS AND SECTIONAL VIEW

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



443Y

2. BRAKE ASS'Y

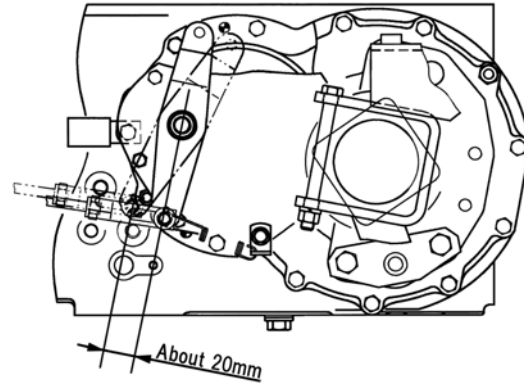
NOTE :

- (1) Do not disassemble 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 20 mm
---------------------	-------------



1) Disassembly

1. Brake cover • Stator • Disk (Lining)

- ① Remove the brake cover fixing bolt

Bolt tightening torque
44.1—55.9 N·m {4.5~5.7 kgf·m}

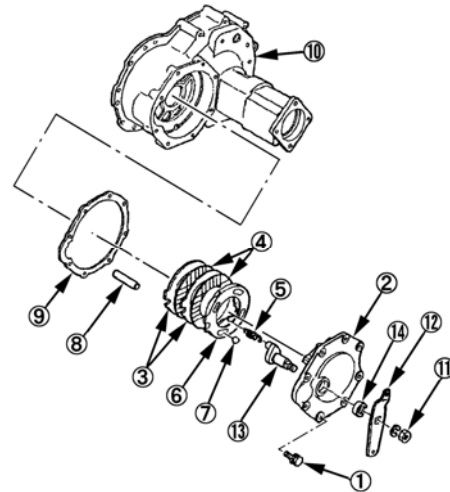
- ② Remove the brake cover ②, gasket ⑨, stators ③ and disks ④.

NOTE:

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

2. Spring • Steel ball • Plate.

- ① Remove the springs ⑤ and take out the plate ⑥ and steel balls ⑦.
- ② Extract the anchor pin ⑧ of the case ⑩ if necessary.



3 Lever • Brake cam • Oil seal

- ① Remove the nut ⑪ and extract the lever ⑫.

Lever tightening torque (M20)
24.0~29.0 N·m {24.5~29.5 kgf·m}

- ② Extract the cam ⑬.
- ③ Remove the oil seal ⑭, if necessary.

444Y

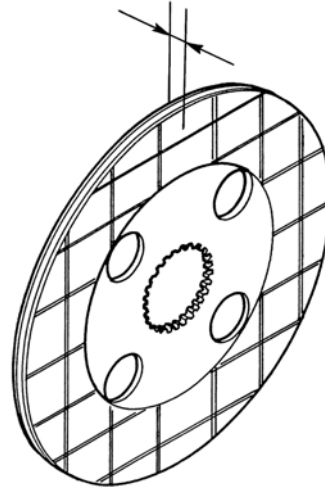
445Y

2) 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

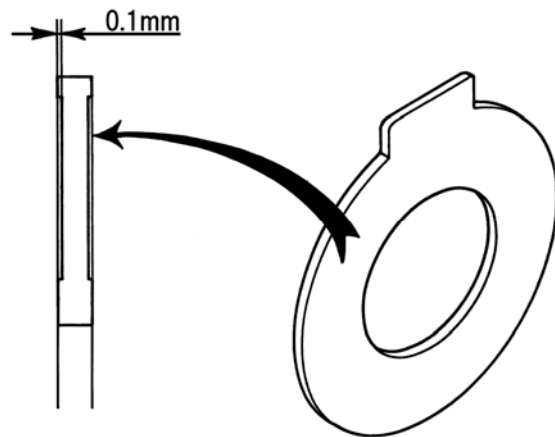


446Y

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



447Y

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

3) 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.

3. REAR AXLE ASS'Y

1) Disassembling

(1) Brake ass'y

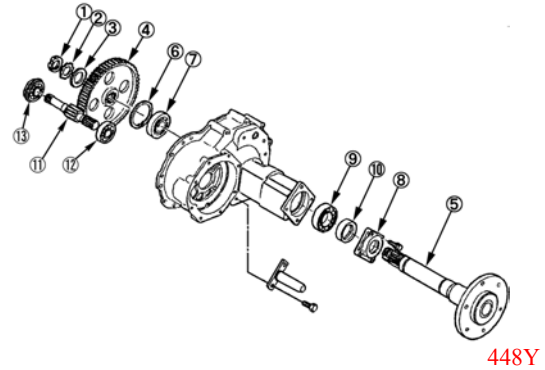
Refer to the previous paragraph, Brake ass'y.

(2) Differential shaft

Drive out the differential shaft, 11, and bearing (62/32NR), 13, together.

(3) Final gear • Wheel shaft • Wheel shaft case • Cover

- a Raise the lock washer and remove the lock nut ① and lock washer ②.
- b Extract the spacer ③ and final gear ④.
- c Drive out the wheel shaft ⑤ outwards.
- d Remove the snap ring ⑥ and extract the bearing ⑦.
- e Remove the wheel shaft case cover ⑧ and extract the bearing ⑨.
- f Remove the oil seal ⑩ from the wheel shaft case cover ⑧ if necessary.
- g Remove the bearing (62/32), 12, from the housing.

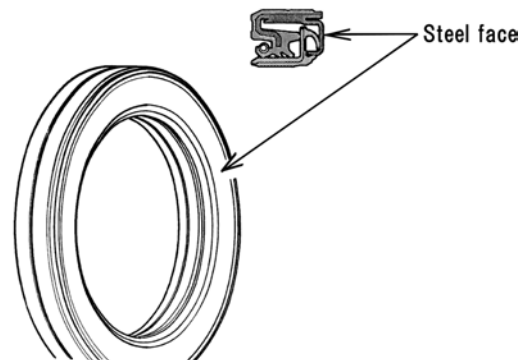


2) Inspection and reassembly

- (1) Check each bearing, gear and shaft and replace if damage and wear is significant.
- (2) If oil leakage from oil seal is noticed, replace the oil seal.

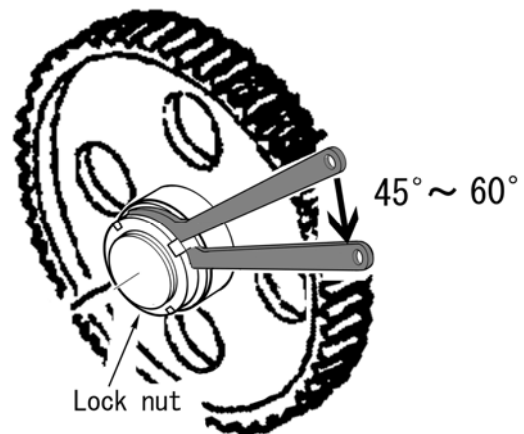
NOTE :

Install the oil seal steel surface to the outwards.



- (3) The lock nut, ①, Fig. 448Y, is more tightened to $45^{\circ} \sim 60^{\circ}$ from the hard (heavy) tightening position and bend the lock washer tab at the ditch of the lock nut.

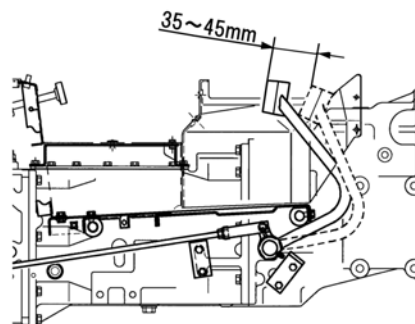
- (4) Reassemble units in the reverse order to disassembly.



4. BRAKE ADJUSTMENT

Check the right and left pedals for sufficient operation and adjust the play to the standard value with the right and left brake rod.

Brake pedal free play	
Standard value (on tread)	35—45 mm



NOTE :

When the brake is disassembled, adjust it after stepping the pedal 4 - 5 times so that it seats in well.

450Y

5. REAR WHEEL

1) Specifications

Tire size	9.5x24 4PR (AG)	11.2x24 4PR (AG)	13.6-16 4PR (Turf)
Rim size	W7 x 24	W10-24	W11-16
Tire type	Nylon bias structure tube used		

2) Check of tire

Tire size	9.5 x 24	11.2 x 24	13.6 - 16
Tire rug height (when new)	35 mm	35 mm	19 mm
Tire rug height (service limit)	18 mm	18 mm	9 mm
Axle-disk tightening torque	157~192 N·m {16 - 19.6 kgf·m}		
Rim-disk tightening torque	157~192 N·m {16 - 19.6 kgf·m}		
Rim run-out (mm)	Service limit 5		
Air pressure	See Operator's Manual		

3) Adjustment of tread (Rear tire only)

The track tread can be adjusted at 7 stages depending on combination of rim position exchange, and exchange of right and left tires.

NOTE :

Bolts at this points are easily loosened. Tighten them positively.

NOTE :

Tread settings are measured from center of tire to center of tire.

Front Wheel Settings

Front Tire Type	Tread Setting	Note
Agricultural 6-14	1100 mm	Not Adjustable
Agricultural 7-14	1100 mm	Not Adjustable
Turf 25×8.50-14	1150 mm	Not Adjustable

IMPORTANT : Never attempt to widen the tread setting by reversing front wheels on a four-wheel drive system.

NOTE :

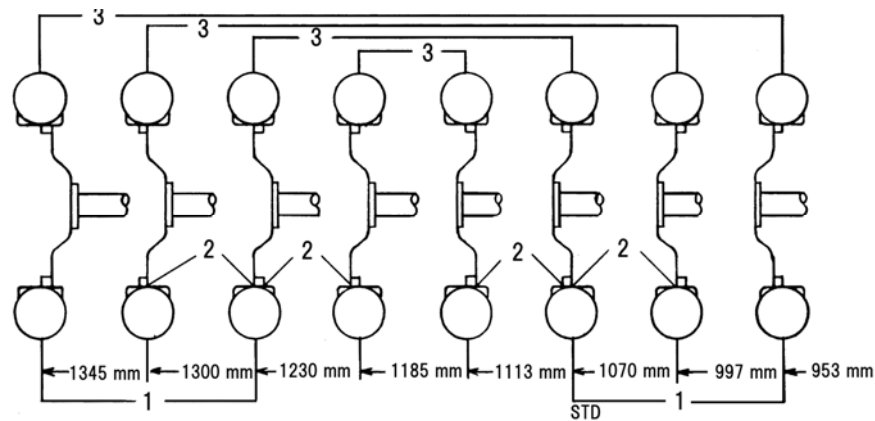
Torque front wheel bolts ; M12 to 75-95 N·m

Rear Wheel Settings

Rear Tire Type	Tread Setting	Note
Agricultural 11.2-24	1115 mm	Adjustable by switching Disc in or disc out
Agricultural 9.5-24	1115 mm	Adjustable by switching Disc in or disc out
Turf 13.6-16	1155 mm	Not Adjustable

NOTE :

Torque rear wheel bolts ; M16 to 157-192 N·m



Rear Wheel Tread Settings (Tire ; AG11.2-24 or 9.5-24)

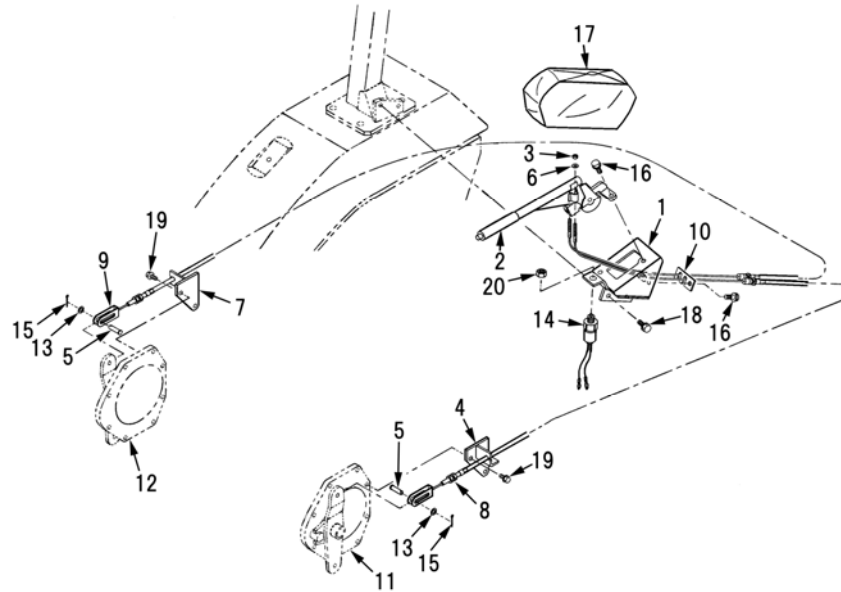
1. Reposition Rim On Disc
2. Rim Repositioned On Opposite Disc
3. Inter-Changing Rear Wheel Assemblies

Give These Combinations

451Y

6. HAND BRAKE

1) components



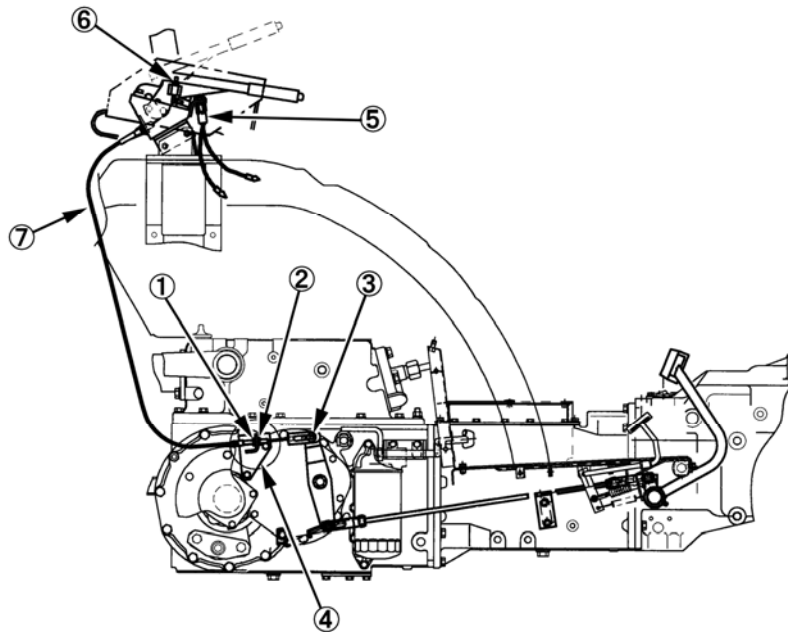
452Y

- | | |
|-----------------------|-------------------------------|
| 1. Bracket | 11. Brake assembly—L.H. |
| 2. Hand brake lever | 12. Brake assembly—R.H. |
| 3. U-nut | 13. Washer |
| 4. Bracket—L.H. | 14. Hand brake warning switch |
| 5. Flat head pin | 15. Split pin |
| 6. Washer | 16. Bolt |
| 7. Bracket—R.H. | 17. Cover |
| 8. Wire assembly—L.H. | 18. Bolt |
| 9. Wire assembly—R.H. | 19. Bolt |
| 10. Holder—wire | 20. Nut |

2) Disassembly, inspection and disassembly

Disassembly

- a. Pull down the hand brake lever.
- b. Untighten lock nuts ①, and ② of each wire.
- c. Remove the split pin and flat head pin ③.
- d. Remove the brackets L and R ④ from the cover, if necessary.
- e. Disconnect the connector from brake switch ⑤.
- f. Remove the hand brake assembly from the tractor.
- g. If necessary, untighten the U-nut ⑥ and remove the wire assembly ⑦ from hand brake.



453Y

Inspection

- ① Check the inner wire for corrosion, unstranding, or twisting. Confirm that the wire is lubricated by high-grade grease.
- ② The wire ass'y cannot be repaired and should be replaced as ass'y.

Reassembly

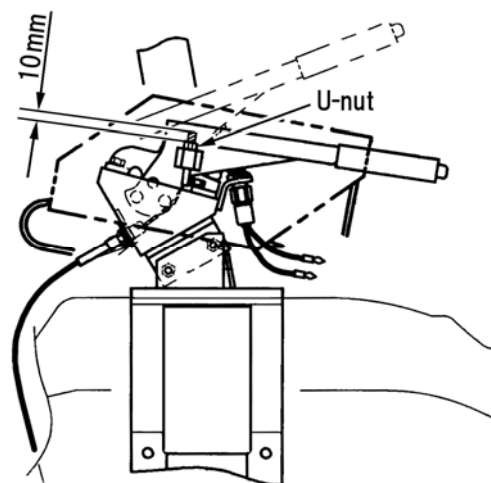
Reassemble units in the reverse order to disassembly.

3) Adjustment

NOTE :

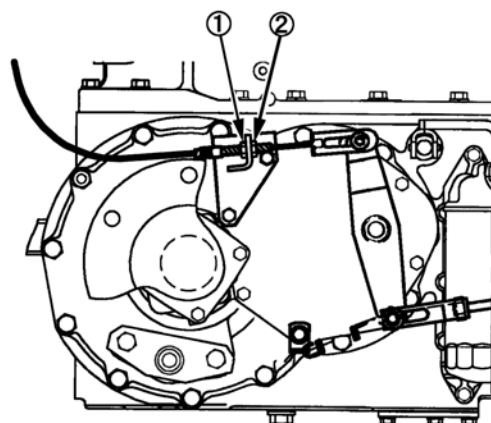
1. Be sure to adjust the hand brake ass'y after reassembly
2. After adjusting the play of the foot brake, adjust the hand brake.
3. *Off the both rear wheels from the ground with a garage jack, and range gear is neutral position.*

- a. Confirm that the hand brake is at the lowermost position.
- b. Tighten the U-nut until the screw of the wire assembly is projected about 10mm from the U-nut top face.

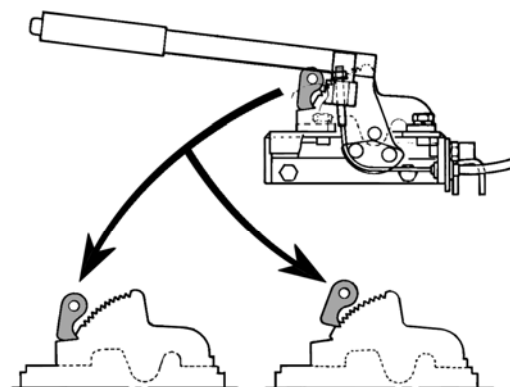


454Y

- c. Repeats depress the brake pedals several times.
- d. Repeats pull-up and pull-down hand brake lever several time.
- e. Adjust the wire assemblies by nuts ① and ② at the bracket to stretching the right and left wires equally.
- f. Confirm that the hand brake works start from the first notch of the hand brake ratchet and the right and left rear wheels are locked at the third or fourth notch, adjust at the lock nuts ① and ②.
- g. Confirm that the rear wheels rotate freely when the hand brake is released. (If the brake drags, readjust.)



455Y



Brake at free condition Brake starts working

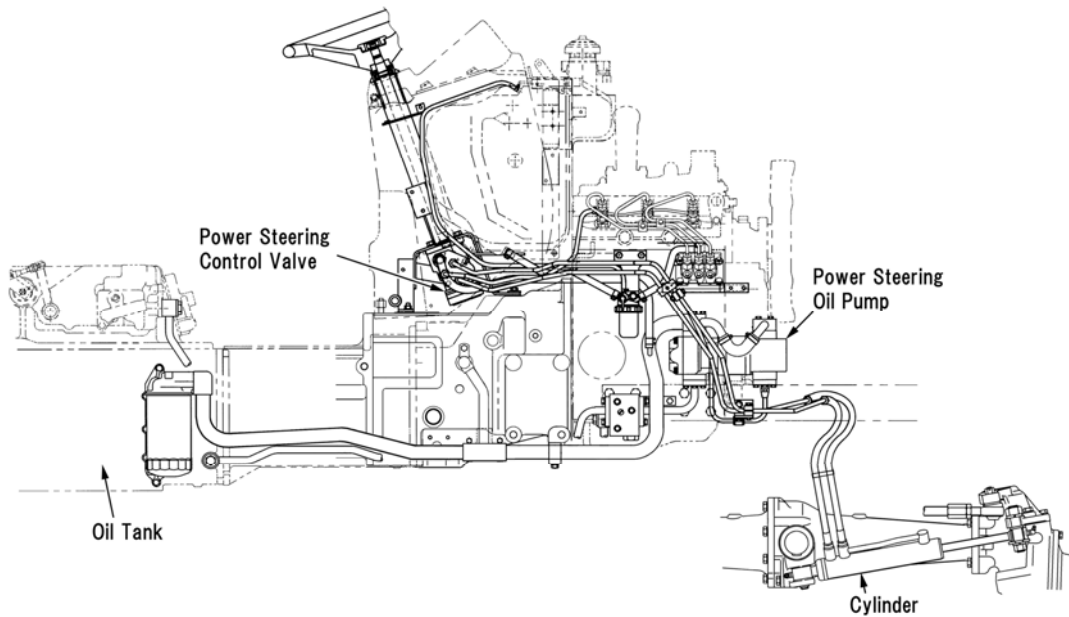
456Y

7. TROUBLE SHOOTING

Condition	Cause	Remedy
1. Brake pedal does not return smoothly.	(1) Broken return spring. (2) Brake pedal fastened with rust.	(1) Replace. (2) Correct with sand paper and supply grease.
2. Brake does not work satisfactorily.	(1) Improper adjustment of brake pedal. (2) Wear of lining. (3) Reversed installed brake ass'y on the right and left sides.	(1) Adjust the play of the right and left pedals. (2) Adjust the brake ass'y. (3) Install the brake ass'y properly on the right and left sides.
3. Brake working unevenly	(1) Improper brake adjustment. (2) Either side of the brake does not work.	(1) Adjust the play of the right and left pedals. (2) Check or adjust.
4. Noise of brake	(1) Water mixed in transmission oil or not used genuine oil.	(1) Change to genuine transmission oil. (Manual transmission : equivalent to SAE80 HST : equivalent to ISO VG46)

3—8 Steering and Linkage

1. EXTERNAL VIEW



457Y

2. SPECIFICATIONS

1. Oil pump (340450970)	Discharge quantity (cc/rev)	6
	Rotating direction	Counterclockwise viewed from shaft side
2. Steering control valve (334011330)	Type	Full hydraulic type (non load reaction type)
3. Steering cylinder (344952570)	Stroke (mm)	185
	Bore (φ)	35
4. Relief valve	Adjusted flow rate (L/min)	8
	Adjusted pressure (MPa {kgf/cm ² })	9.45 {105} at 8 L/min.
5. Tank	Oil quantity (L)	About 31
	Oil used	Common use transmission oil

3. POWER STEERING CONTROL VALVE

The power steering control valve internal parts are not supplied, and then usually replace the power steering control valve as an assembly when it is defective.

1) Adjustment

• Inspection and adjustment of relief valve

1. With the tractor engine stopped, disconnect one of the hydraulic lines that run to the steering cylinder.
2. Connect a fitting, 3, and a 0—20 MPa (200kgf/c m²) pressure gauge, 4, to the end of the line ,1, from the steering motor and cap the line leading to the steering cylinder, 2.
3. Start the tractor engine, and allow it to idle.
Observe the pressure gauge, it should indicate 0 MPa
4. Turn the steering wheel so that the line which the gauge is connected to receives steering pump fluid pressure intended for the steering cylinder. For example, if the gauge is connected to the left side of the cylinder, as viewed from the operator's seat, turn the wheel to the left.
Observe the gauge and the following :

Test Results

If the pressure gauge reading rises before the steering wheel is turned, it indicates that the steering motor will defective.

If the pressure gauge reading to the relief valve setting of 10.3 MPa (105 kgf/c m²), when the steering wheel is turned, the steering pump relief valve is working properly.

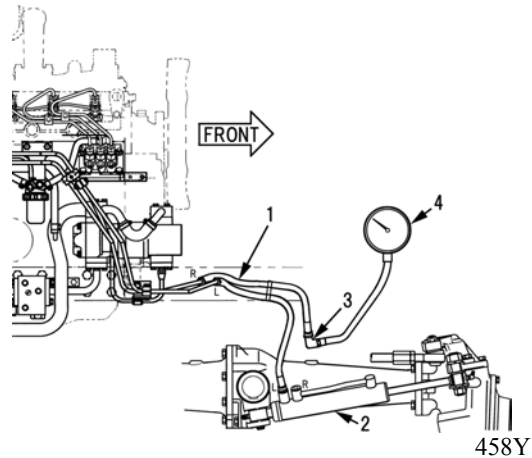
If the pressure gauge reading is below the relief valve setting, it may indicate that the relief valve is not working properly, or the pump parts are worn.

5. Stop the tractor engine.
6. Remove the power steering control valve from the steering column to adjust the relief valve pressure.

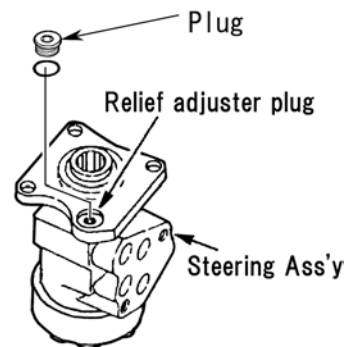
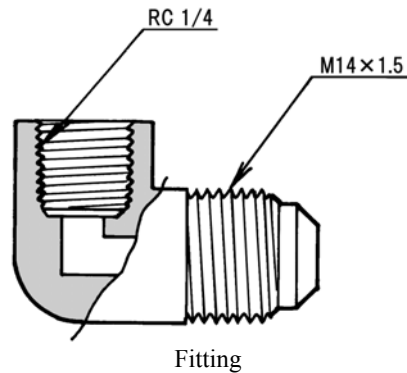
NOTE:

The steering system relief valve is located on the top side of the steering motor. Rotate the relief valve adjuster plug clockwise to increase the pressure and counterclockwise to decrease the pressure, Figure 460Y.

The relief pressure changed about 1.0~1.3 MPa (10~13 kgf/c m²) with one turn of the relief valve adjuster plug.



1. Steering Motor to Steering Cylinder Line
2. Steering cylinder
3. Fitting (Part No.340671510)
4. 0—20MPa(200kgf/c m²) Pressure Gauge



4. POWER STEERING PIPING

1) Disassembling, inspection and assembling

- ① Replace the oil hose (8 and 9 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.

PT 1/4 tightening torque	N · m {kgf·m}	35.3 {3.6}
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NOTE :

- When winding seal tape on the pipe, be careful not to allow the **tape** flow into the hydraulic piping.
- Right and left oil hoses are different in length. L=500mm, R=400mm.

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

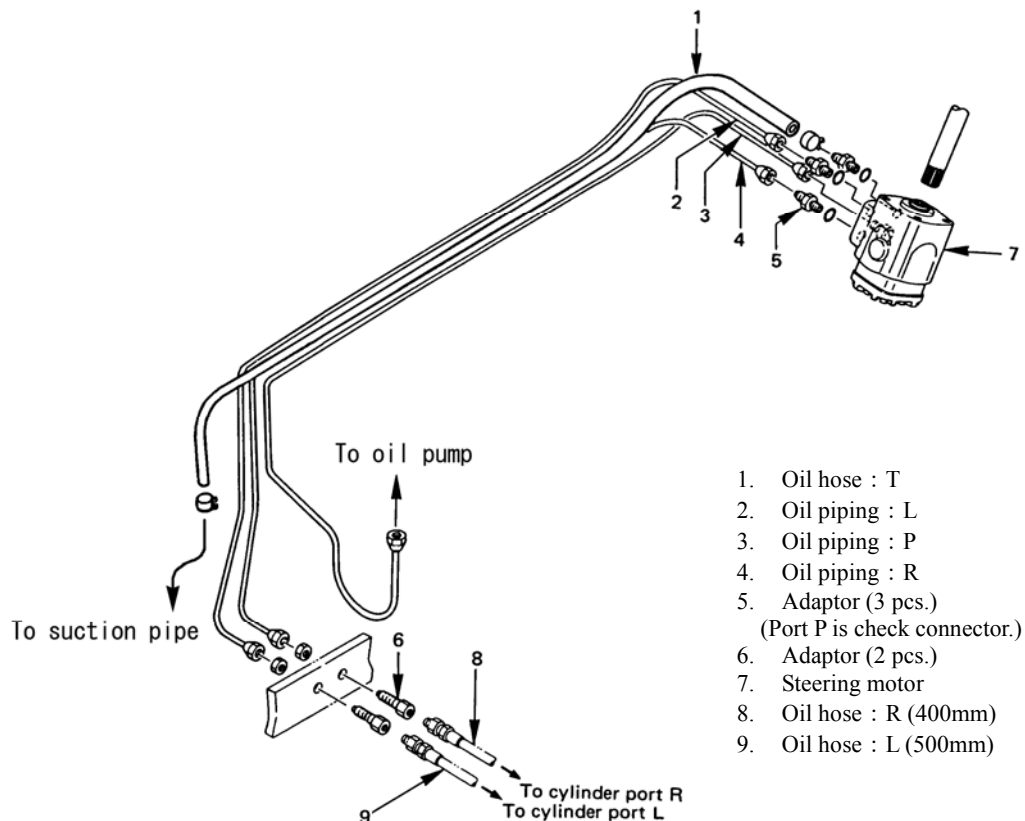
PF3/8 tightening torque	N · m {kgf·m}	44.1~53.9 {4.5~5.5}
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- ③ Tighten the oil pipe (2—4 in the figure below) and port P check connector with specified torque.

M14 tightening torque	N · m {kgf·m}	29.4~39.2 {3~4}
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NOTE :

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



461Y

5. POWER STEERING PUMP

1) Inspection and adjustment

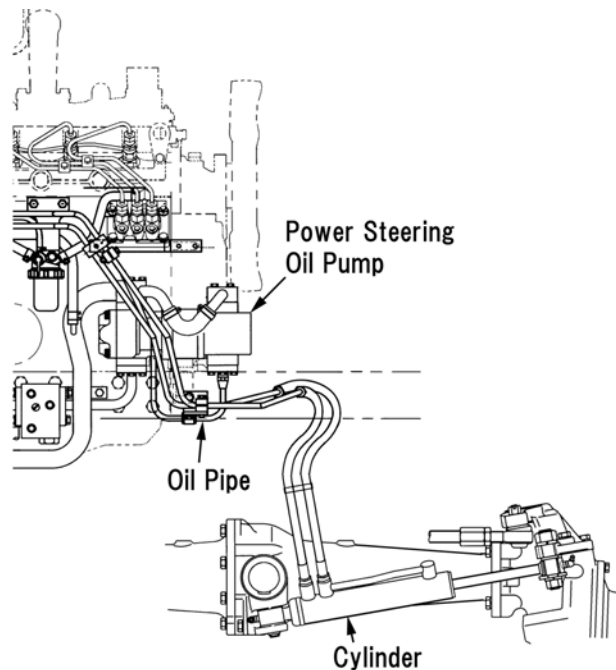
- ① If the oil pump is defective, replace the ass'y.
- ② After completion of service, start the engine, turn the steering wheel in both directions at idling speed (several times) to discharge the air, stop the engine and check the **transmission** oil.

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.

- ④ Tighten the oil pipe to the bottom of the pump with following torque.

Oil pipe tightening torque	N·m {kgf·m}	29.4~39.2 {3-4}
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462Y

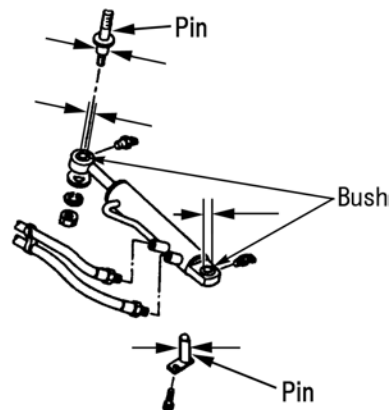
6. POWER STEERING CYLINDER

1) Removal

Refer to "3-1 Front Axle" for removal of power steering cylinder from the front axle.

2) Inspection

- a. Oil leakage is evident from the cylinder, replace the cylinder with new one.
- b. Measure the clearance between each bush and pin, if the service limit is exceeded replace the bush and pin.



463Y

7. TROUBLESHOOTING (STEERING CONTROL UNIT)

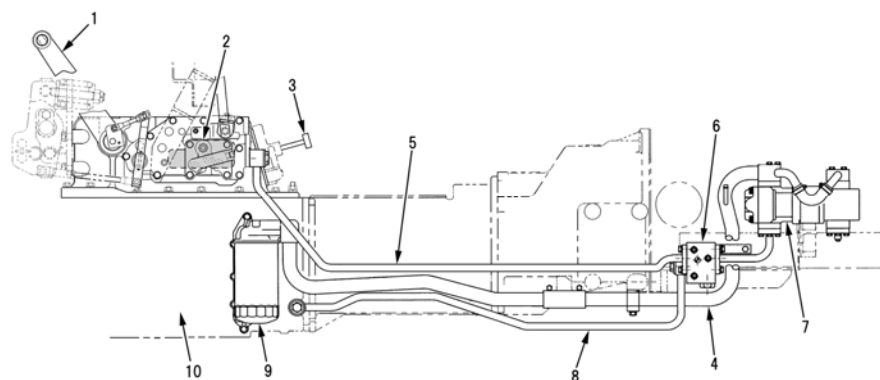
Condition	Cause	Remedy
Steering wheel too heavy.	- Steering control unit - Misalignment with column - Seizure of spool/sleeve ass'y due to dust entry. - Excessive tightening torque of 7 end cap bolts (at the time of disassembly and reassembly). - Pump - Dose not work. - Wear, failure - Improper rating - 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.) Replace. 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.	Replace.
Cylinder dose not follow up sufficiently or at all the rotations of the steering wheel .	- 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 - Shaft (spool, periphery of inner spline) - Joint (Between housing, spacer plate, gerotor, and end cap)	Wear of oil seal (X ring) - Contaminated hydraulic oil. Damaged O-ring - Caught somewhere at the time of disassembly or reassembly.	Change the hydraulic oil. Replace.

3—9 Hydraulic System

1. SPECIFICATIONS

Oil pump	Type	Gear pump
	Discharge rate	29.1 l/min. (12.3 cc/rev.)
	Speed	2369 rpm
	Rotating direction	Clockwise viewed from the shaft end
Control valve	Relief valve working pressure	14.7MPa {150 kgf/c m ² }
Hydraulic cylinder	Type	Single-acting
	Bore	φ 70
Max. lift	1520 kg (Rear hole at the lowerlink end)	
Hydraulic oil	SAE 80 gear oil (manual transmission) ISO VG 46 gear oil (HST)	

2. HYDRAULIC CIRCUIT



464Y

- | | |
|-----------------------------|---|
| 1. Lift arm | 6. Control valve (with relief valve) |
| 2. Control valve | (Oil pressure take-out, pressure control) |
| 3. Implement lowering speed | 7. Oil pump |
| adjusting valve | 8. Return pipe |
| 4. Suction pipe | 9. Oil filter |
| 5. Delivery pipe | 10. Transmission (oil tank) |

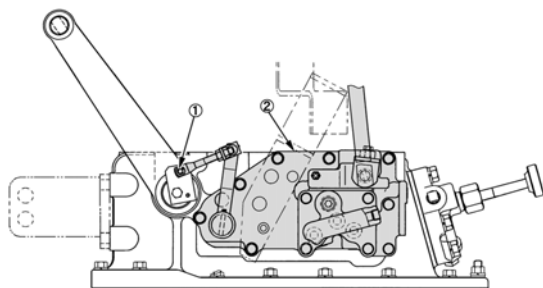
3. CYLINDER CASE ASS'Y

(Refer to 1-5, Removal of outside, for separation of hydraulic cylinder case from tractor main body.)

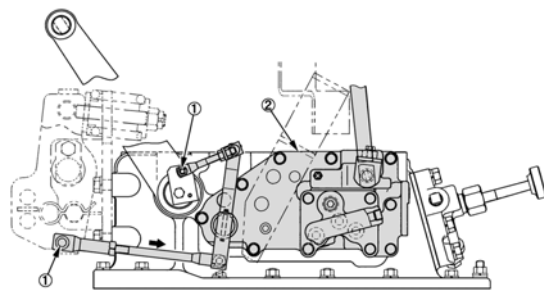
1) Disassembling

(1) Valve cover ass'y • Control valve ass'y

- ① Remove the split pin (s) of the feedback link (s).
- ② Remove the valve cover and control valve together.



Position control type

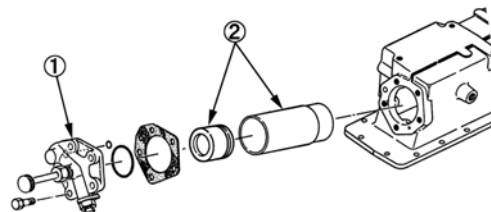


Draft control type

465Y

(2) Cylinder head • Piston • Cylinder

- ① Remove the cylinder head.
- ② Remove the cylinder liner and piston together to the cylinder head side.



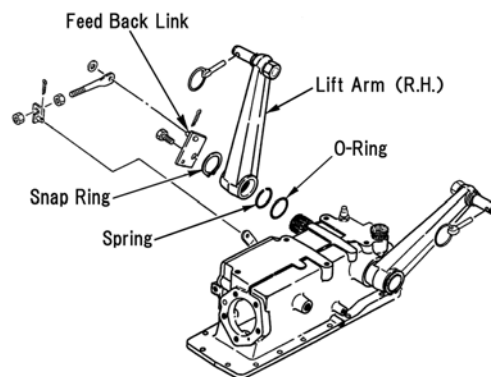
466Y

NOTE :

Install or remove the piston from the cylinder head side.

(3) Lift arm (right)

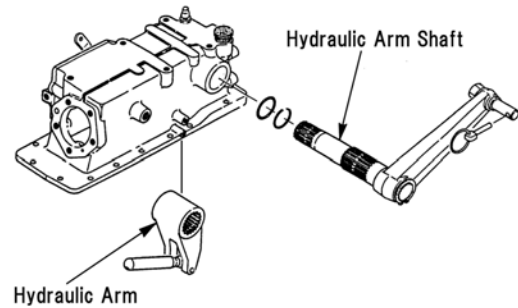
- ① Remove the feedback link interconnecting rod at the right end of the hydraulic arm shaft.
- ② Remove the snap ring and take out the lift arm (right), spring and O-ring.



467Y

(4) Lift arm (left) • Hydraulic arm shaft • Hydraulic arm

- ① Extract the lift arm (left) and hydraulic arm shaft together
- ② Remove the spring, O-ring and hydraulic arm.



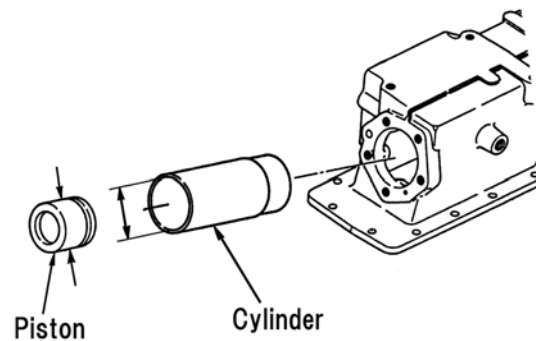
468Y

2) Inspection

(1) Piston and cylinder

Check the outside surface of the piston and cylinder bore. Replace if worn out or damaged.

Clearance between hydraulic cylinder and piston		
Standard assembling value	(mm)	0.03-0.15
Service limit	(mm)	0.5



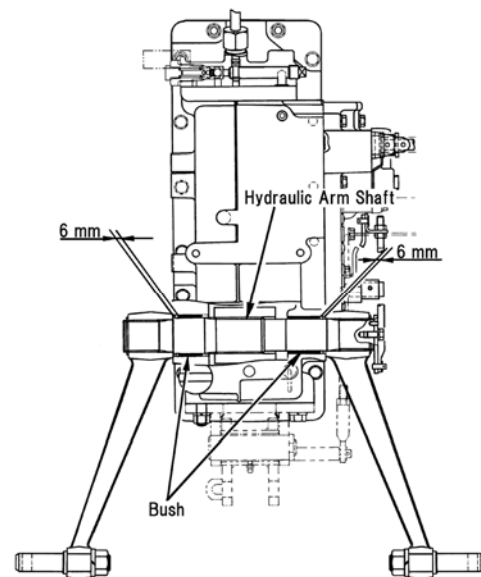
469Y

(2) O-ring

Check each O-ring and replace worn out or damaged ones, if any.

(3) Hydraulic arm shaft and bush

- ① Measure the clearance between the hydraulic arm shaft and bush and replace if the service limit is exceeded.
- ② When replacing the bush, drive in a new one up to **6 mm** in depth below the cylinder case end surface.



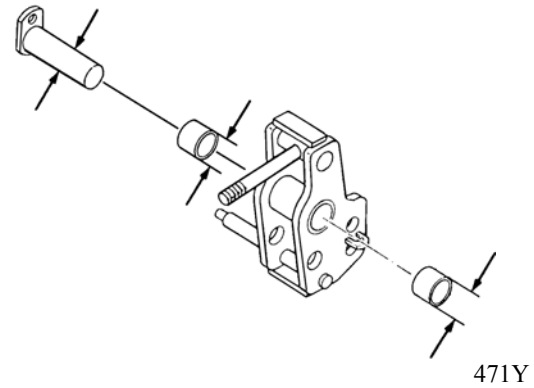
470Y

(4) Top link bracket (Draft control only)

- ① Measure the clearance between the bush and pin.
If the service limit is exceeded, replace the bush.

Clearance between bracket bush and pin (mm)	
Standard assembling value	Service limit
0.09-0.25	0.5

- ② Adjust the spring installing length to the dimension shown in the figure with the castle nut. After the adjustment, fix with the split pin.



(5) Cylinder head

- ① If oil in the hydraulic cylinder leaks, check the steel ball guide for wear and replace if defective.

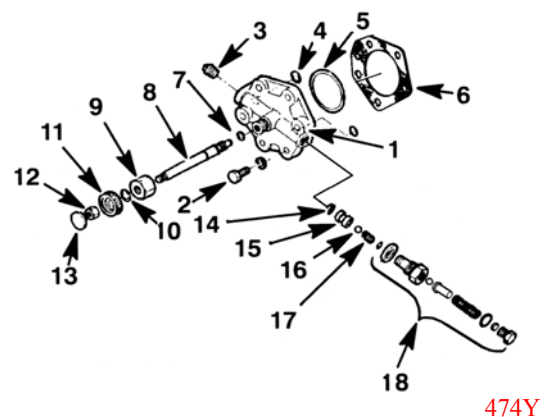
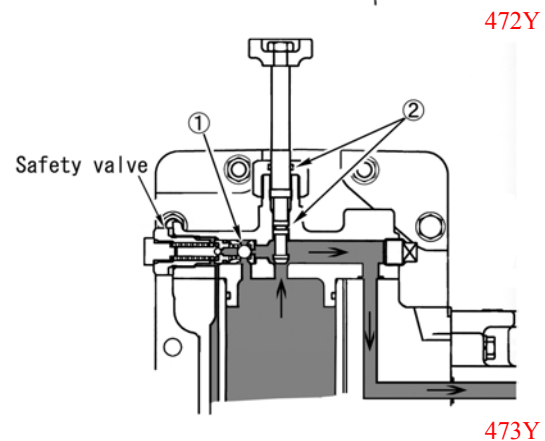
NOTE:

Replace the control valve ass'y (safety valve) as an ass'y.

Tightening torque	49~58.8 N·m {500 - 600 kgf·m}
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- ② Replace the O-rings of the improvement lowering speed adjusting valve if any.

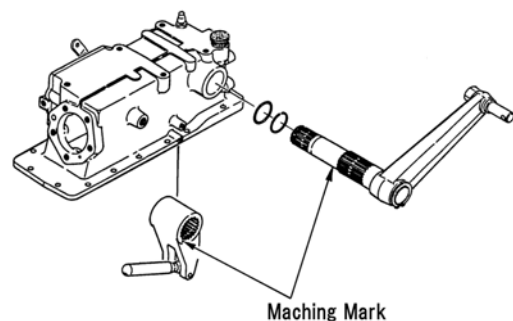
- | | |
|------------------|------------------------|
| 1. Cylinder head | 10. O-ring |
| 2. Bolt | 11. Grip |
| 3. Plug | 12. Nut |
| 4. O-ring | 13. Nameplate |
| 5. O-ring ; P65 | 14. Gasket |
| 6. Gasket | 15. Guide |
| 7. O-ring ; P7 | 16. Steel ball |
| 8. Valve | 17. Spring |
| 9. Guide | 18. Safety valve ass'y |



3) Reassembly

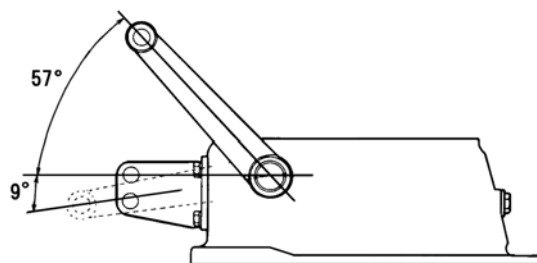
Reassemble units in the reverse order to disassembly, taking care to the following points.

- (1) Align the match marks on the hydraulic arm and hydraulic arm shaft when installing.



475Y

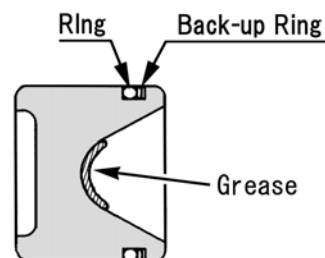
- (2) Install the lift arm at the angles of elevation and depression as shown in the right figure.



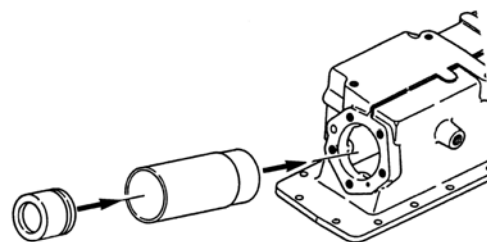
476Y

- (3) Coat an O-ring with sufficient oil and install.
(Do not use grease.)
- (4) Install a packing care to the installing order.
- (5) Coat the piston-piston rod contact areas with grease and insert them from the cylinder head side.

NOTE : Confirm that the piston rod is in the cylinder when install the cylinder into the cylinder housing.



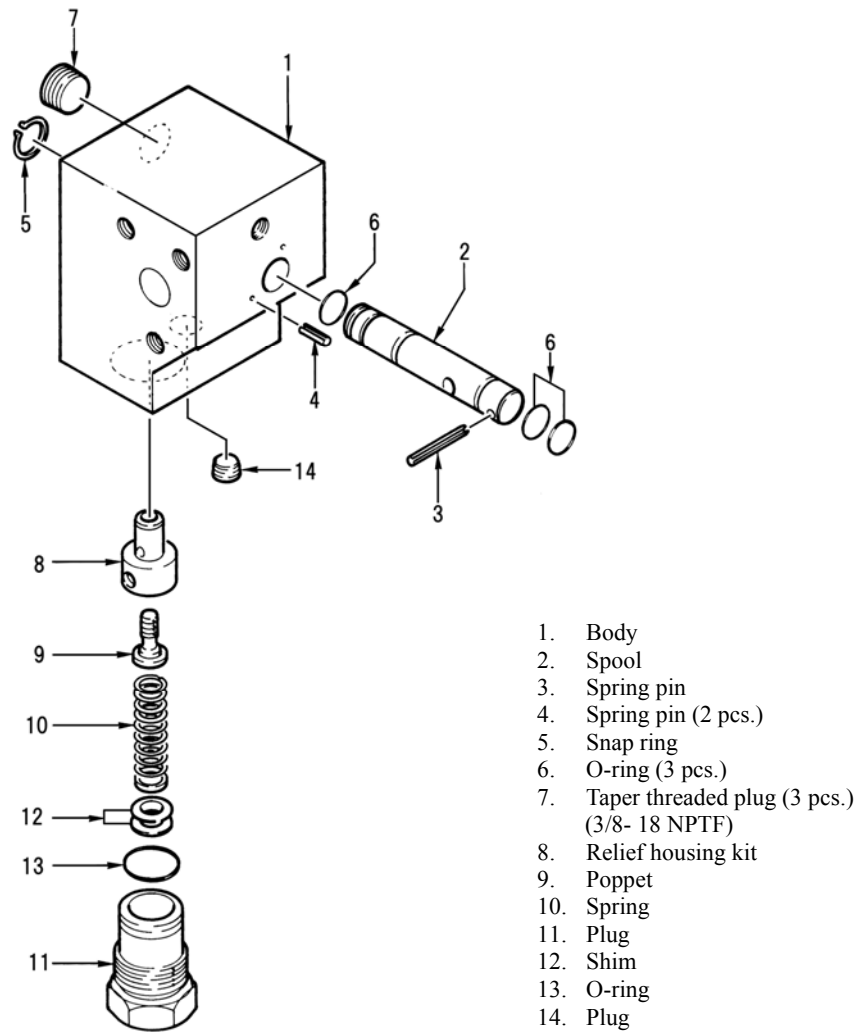
477Y



478Y

4. CONTROL VALVE ASSEMBLY (RELIEF VALVE) : No. 340016660

1) Name of components



479Y

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 P1 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 P1 passes through P2 and is fed under pressure to the control valve for lifting/lowering the implement.

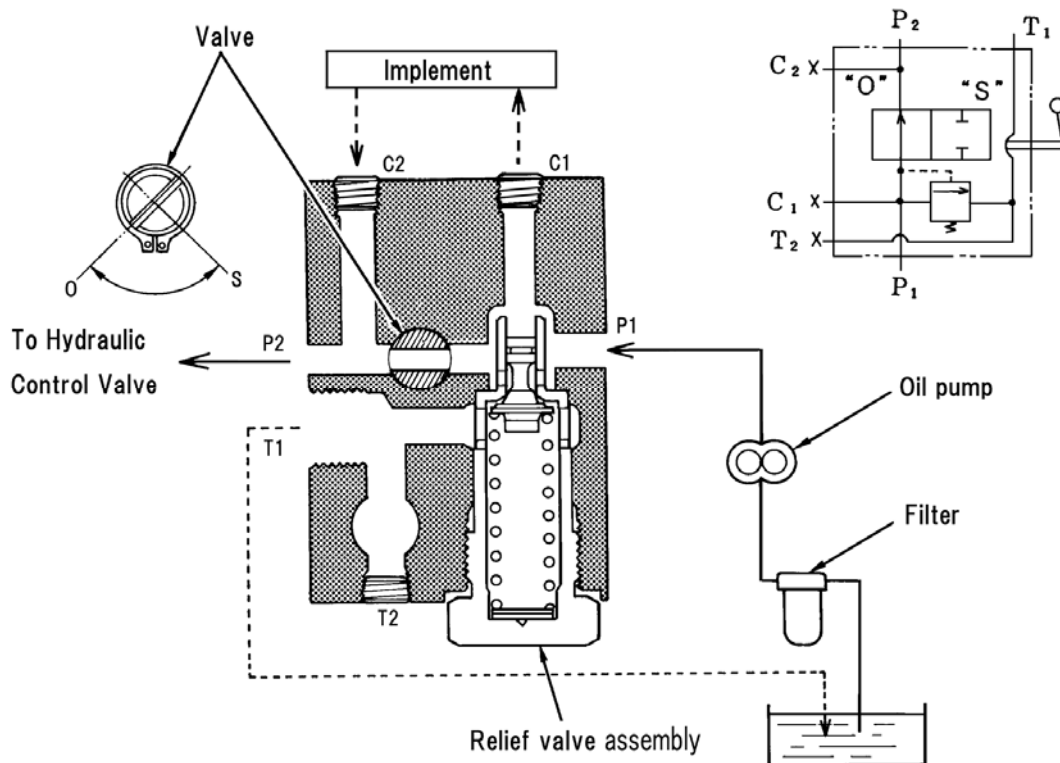
[When valve is at "S" position]

When the oil pressure is taken out (for front loader, etc.), connect hydraulic piping for an external implement to the ports C1 and C2 (and the port T2 depending on the implement), and set the valve at the "S" position.

Oil entering P1 passes through the port C1, returns to the port C2 through the valve on the implement side, and is sent from the port P2 as in the above case.

The port T2 is a passage to return the oil directly to the transmission case from the external implement and is connected when required.

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 value for the relief valve **ST330/333** is 150 - 155 kgf/cm².



480Y

3) Disassembling

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.

(1) Relief valve

- a. Remove the plug and take out the shims, spring and poppet.
- b. Remove the relief housing kit.

(2) Change over valve

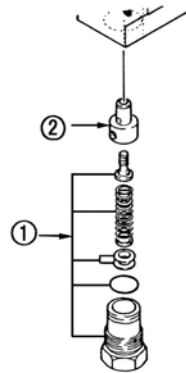
- a. Remove the snap ring ①.
- b. Drive out the spring pin, ② extract the spool ③ rearwards until the O-ring ④ on the rear side of the valve can be removed, and remove the O-ring ④.

- c. Extract the spool forwards of the valve and remove 2 O-rings ⑤.

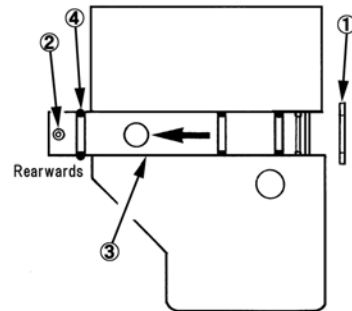
NOTE :

If extracting in either one direction, the O-ring is broken.

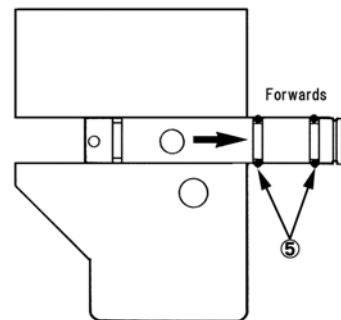
For reassembly, install 2 O-rings on the front side, push the spool rearwards, install the O-ring on the rear side and return front-wards, in the reverse order.



481Y



482Y



483Y

4) Inspection and reassembly

(1) Relief valve ass'y

Replace the **valve assembly** if the **seat** surface is worn out.

Plug tightening torque	34.3—44 N·m {3.5—4.5 kgf·m}
------------------------	--------------------------------

(2) Valve and O-ring

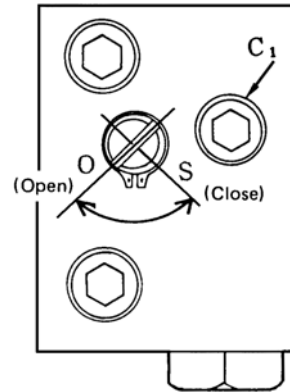
Replace the valves and O-rings if oil leaks.

- (3) When connecting the oil pressure take-out piping, wind seal tape on it before tightening.

PT 3/8 plug tightening torque	29.4~49.0 N·m {3—5 kgf·m}
-------------------------------	------------------------------

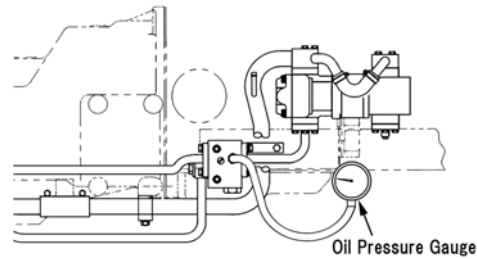
(4) Pressure adjustment of relief valve

- ① Remove the oil pressure take-out plug (3/8 NPTF) from the port C1 (see the right figure).



484Y

- ② Install a pressure gauge 19.6 MPa {0 - 200 kgf/c m²} to the port C1.
- ③ Start the engine and increase the speed.



485Y

- ④ Set the **change over** valve at the S (closed) position and read the indication on the pressure gauge. (Complete in a short time.)

Relief set pressure	14.7—15.2 MPa {150—155 kgf/c m ² }
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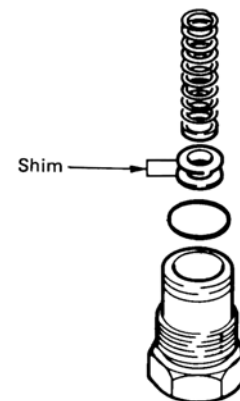


486Y

- ⑤ Adjust the set pressure by increase or decrease the number of shims as shown in the right figure. The pressure varies about **0.26MPa {2.7 kgf/c m²}**: by **0.1 mm** of shims.

NOTE:

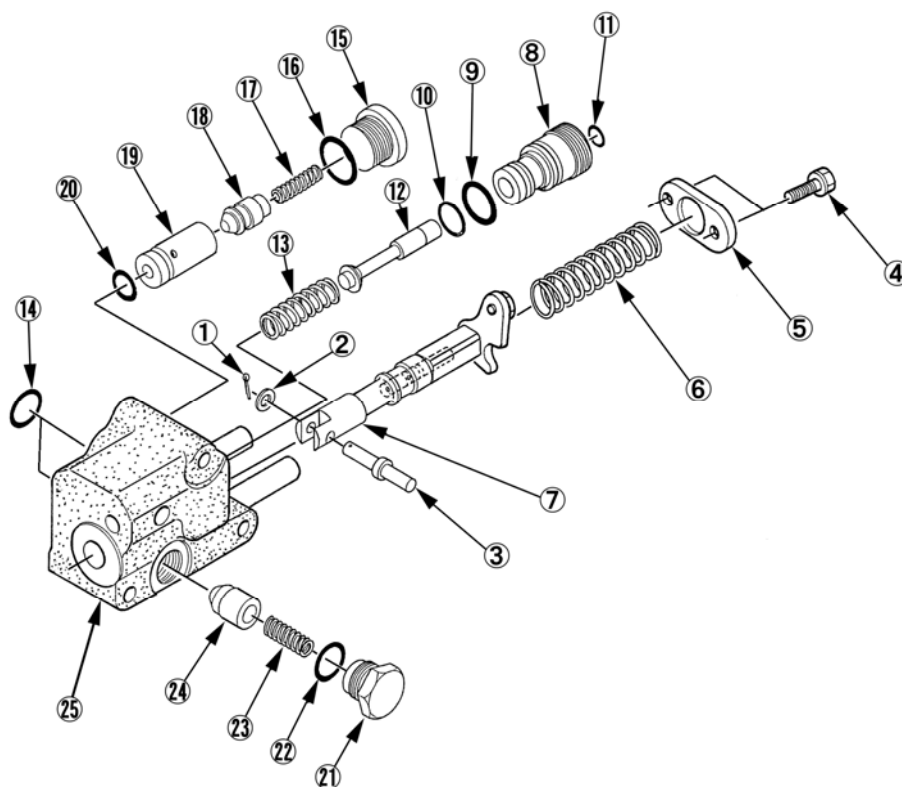
1. A kit (No. 340293230) contains 3 shims of **0.1 mm × 2** and **0.15 mm × 1** in thickness respectively (3 in total).
2. Remove the pressure gauge, wind seal tape on the plug and install taking care not to allow the seal tape to enter the hydraulic piping.



487Y

5. CONTROL VALVE ASSEMBLY (for lifting/lowering implement) : No. 340016350

1) Name of components.



488Y

NOTE:

Any parts will not be provided as a piece of part, please refer to the PARTS LIST.

- | | | |
|---------------|--------------------|--------------------|
| 1. Split pin | 12. Lowering valve | 23. Spring |
| 2. Washer | 13. Spring | 24. Shut-off spool |
| 3. Pin | 14. O-ring | 25. Valve body |
| 4. Bolt | 15. Plug | |
| 5. Cap | 16. O-ring | |
| 6. Spring | 17. Spring | |
| 7. Spool | 18. Check valve | |
| 8. Valve seat | 19. Valve seat | |
| 9. O-ring | 20. O-ring | |
| 10. O-ring | 21. Plug | |
| 11. O-ring | 22. O-ring | |

2) Operation (Oil flow)

(1) Neutral position.

In the neutral position the control valve spool (4) is centered in the valve body.

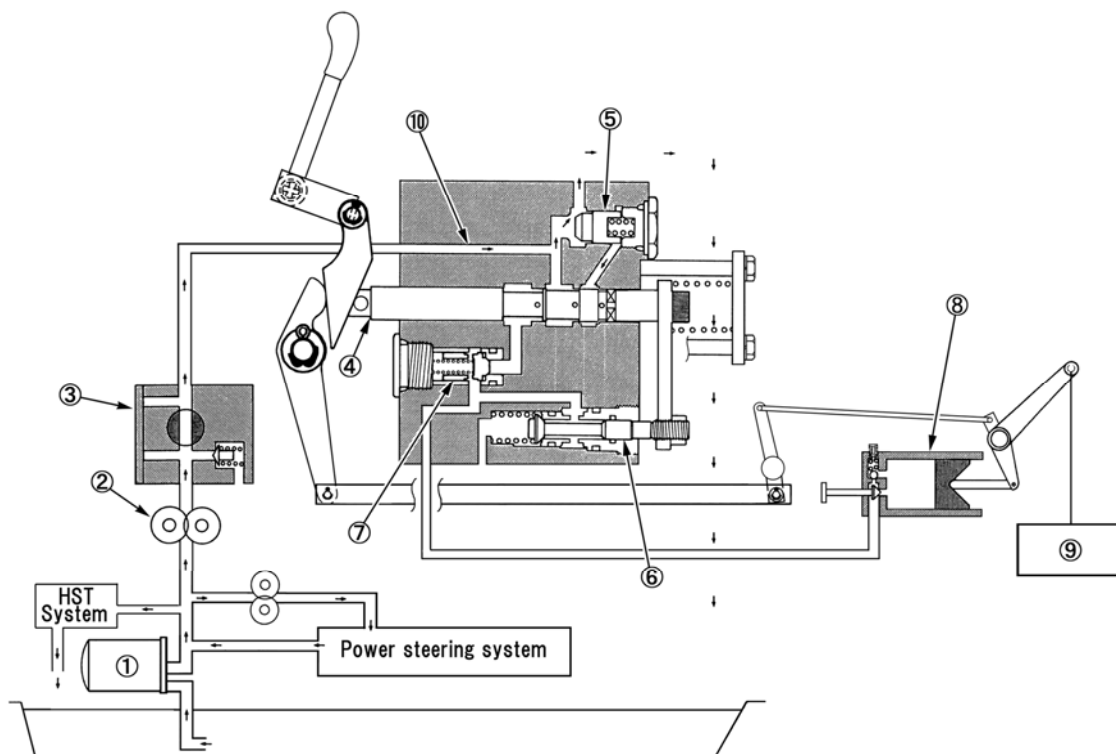
Oil from the hydraulic pump is directed flows to the valve body.

The oil pressure moves the shut-off valve (5) and compressing the spring and opens the passage to the sump.

Oil flows from the pump through the passage (10) and returns to sump.

Oil trapped in the lift cylinder, under pressure caused by the weight of the implement on the lift arms, exerts pressure on the cylinder side of the check valve (7) holding it in a closed position.

The lowering valve spool (6), positioned by the spring, retains the oil in the lift cylinder and maintains the implement in a fixed position.



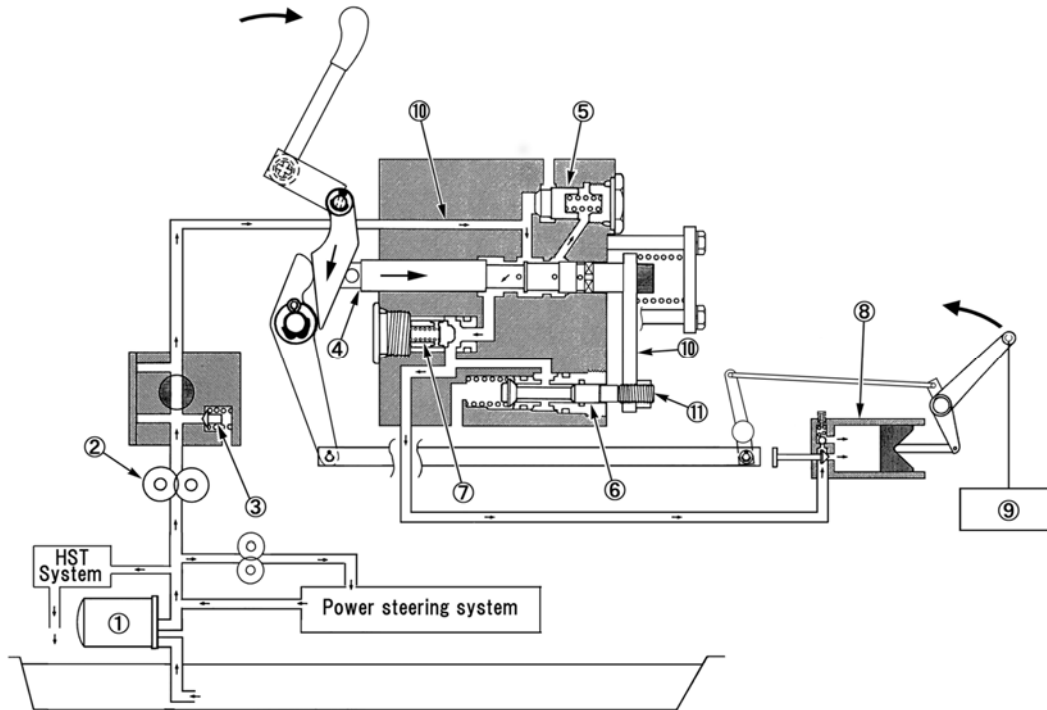
489Y

Oil flow — Neutral position.

- | | |
|---|-------------------|
| 1. Oil filter | 6. Lowering valve |
| 2. Oil pump | 7. Check valve |
| 3. Diverter valve Ass'y
(Relief valve Ass'y) | 8. Lift cylinder |
| 4. Valve spool | 9. Implement |
| 5. Shut-off valve | 10. Oil passage |

(2) Raising position.

When the position control lever is moved to the raise position, the control valve spool (4) is moved inward. The oil passages of the control valve spool are opened and oil flows through passage (10), to the check valve (7). The oil pressure against the check valve overcomes the check valve spring and lift cylinder oil static pressure on the check valve, raising the check valve off its seat and allowing oil to flow to the lift cylinder to raise the implement. When the oil pressure in the system exceeds 14.7 MPa (150 kgf/cm²) (2133 psi.), the relief valve (3) opens and oil is returned to sump.



490Y

Oil flow — Raising position.

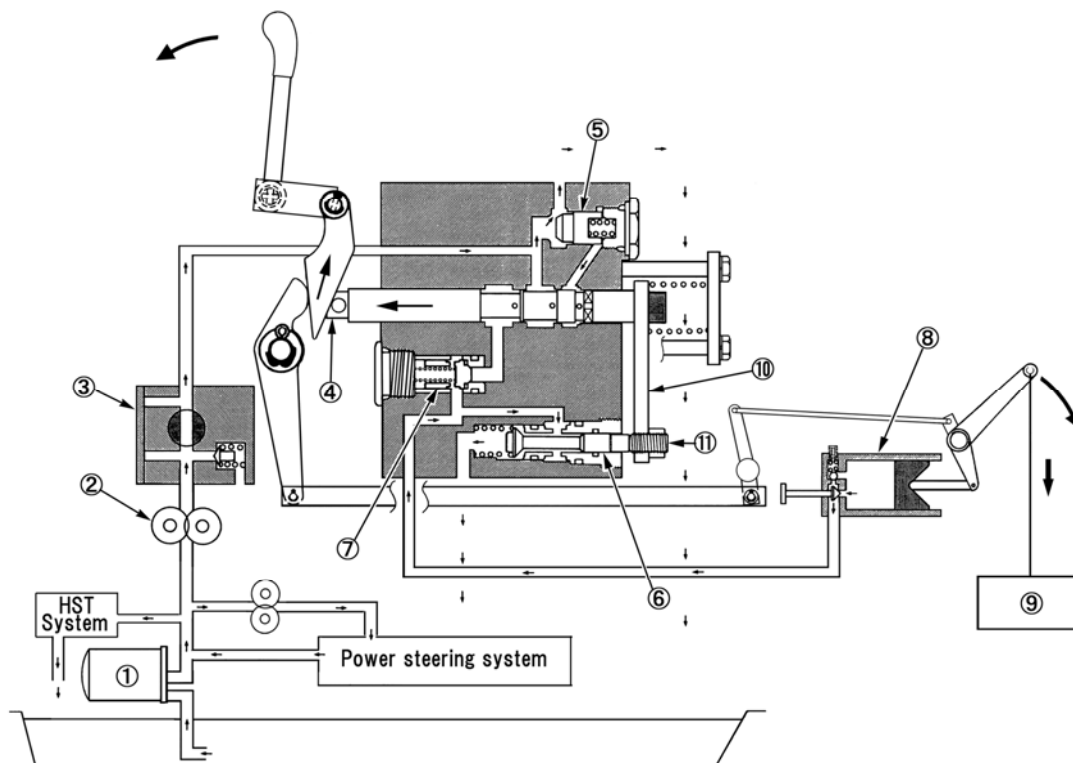
- | | |
|-----------------------|-------------------|
| 1. Oil filter | 6. Lowering valve |
| 2. Oil pump | 7. Check valve |
| 3. Relief valve Ass'y | 8. Lift cylinder |
| 4. Valve spool | 9. Implement |
| 5. Shut-off valve | 10. Oil passage |

(3) Lowering position.

When the position control lever is moved to lowering position, the control valve spool (4) is moved forward. The plate (10) and adjusting bolt (11) attached to the control valve spool, also moves forward and contacts the lowering valve spool (6), pushing it off its seat.

The oil from the pump flows through the passage and opens the shut-off valve and return to sump as in the neutral position.

The oil in the lift cylinder (8) flows through passage past the check valve (7) to the lowering valve spool and seat and returns to sump permitting the implement to lower.



491Y

Oil flow — Lowering position.

- | | |
|---|-------------------|
| 1. Oil filter | 6. Lowering valve |
| 2. Oil pump | 7. Check valve |
| 3. Diverter valve Ass'y
(Relief valve Ass'y) | 8. Lift cylinder |
| 4. Valve spool | 9. Implement |
| 5. Shut-off valve | 10. Plate |
| | 11. Screw |

(4) Bypass spool.

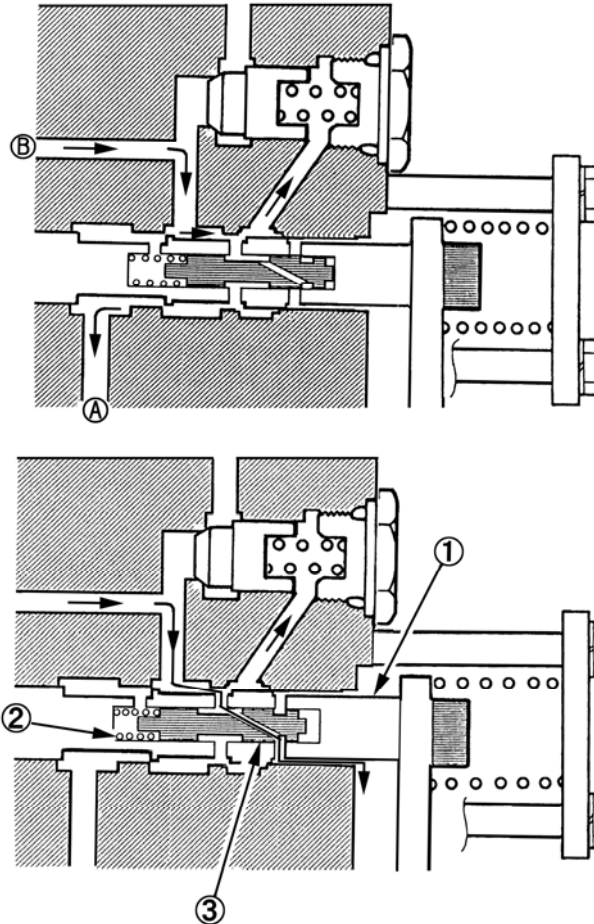
The bypass spool and spring are located in the control valve spool.

The bypass spool actions for prevent the shock to the hydraulic system when the much oil flows from the oil pump at a time.

The bypass spool is stayed the R.H. side by spring and the cylinder passage pressure (A) higher than the oil pump passage pressure (B).

When the control lever is moved to the raising position and the much oil flows from the oil pump, the cylinder passage pressure (A) lower than the oil pump passage pressure (B), and the bypass spool is moved to the L.H. side then the bypass circuit is opened, and remained oil flows via the bypass spool to the sump.

When the cylinder passage pressure (A) and oil pump passage pressure (B) are became equal, the bypass spool returns to the R.H. side then close the bypass passage.



492Y

Bypass spool-oil flow

1. Control valve spool
2. Spring
3. Bypass spool
- A. Cylinder passage pressure
- B. Oil pump passage pressure

3) Disassembly.

IMPORTANT:

1. Never disassemble the control valve during the claim warranty term (1 year or 600 hours). If disassembled, claim will not be accepted.
2. When it should be unavoidably disassembled, handle it carefully since it is finished precisely.

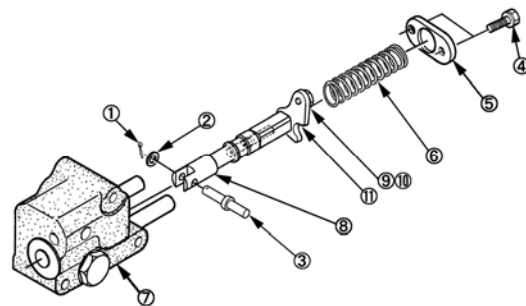
(1) Control valve spool.

- ① Remove the sprit pin, 1, washer, 2, and pin, 3, from the spool, 8.
- ② Slide out the spool, 8, from the valve body, 7, after remove the bolt, 4, cap, 5, and spring, 6.

NOTE :

Don't remove the plate(11), nut(10) and screw(9) from the spool(8).

- | | | |
|--------------|---------------|-----------|
| 1. Sprit pin | 5. Cap | 9. Screw |
| 2. Washer | 6. Spring | 10. Nut |
| 3. Pin | 7. Valve body | 11. Plate |
| 4. Bolt | 8. Spool | |

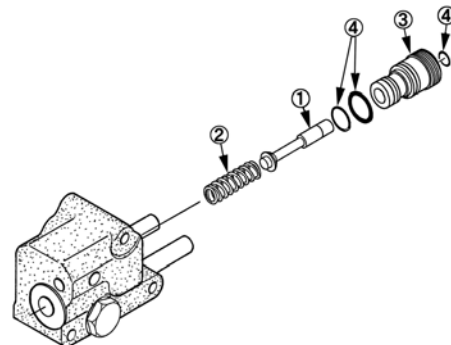


493Y

(2) Lowering valve

- ① Remove the valve seat, 3, by special tool.
- ② Remove the lowering valve spool, 1 and spring, 2, from the valve body.

- | |
|-------------------------|
| 1. Lowering valve spool |
| 2. Spring |
| 3. Valve seat |
| 4. O-ring |

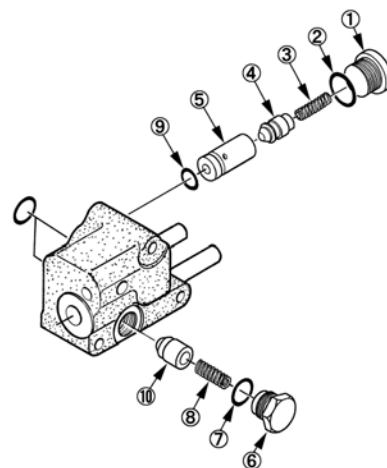


494Y

(3) Check valve• Shut-off valve.

- ① Remove the plug, 1, spring, 3, check valve, 4, and valve seat, 5, from the valve body.
- ② Remove the plug, 6, spring, 8, and shut-off valve, 10, from the valve body.

- | | | |
|-----------|----------------|--------------------|
| 1. Plug | 4. Check valve | 7. O-ring |
| 2. O-ring | 5. Valve seat | 8. Spring |
| 3. Spring | 6. Plug | 9. O-ring |
| | | 10. Shut-off valve |



495Y

4) Inspection

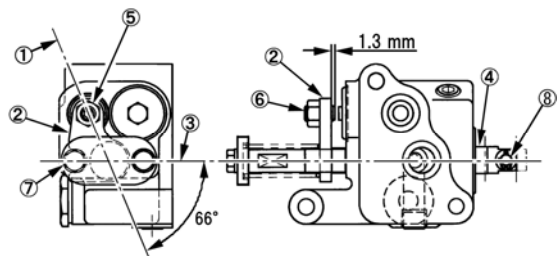
1) Spool, Check valve, Lowering valve and Shut-off valve.

- ① Clean all components in a suitable solvent and air dry
- ② Inspect the valve spool and bore for excess wear, scratches or other damage.
The valve spool and valve body must be replaced as a matched set only.
- ③ Inspect the check valve's seat, lowering valve's seat and valve seat area for uneven wear or other damage.
Replace the valve and valve seat as a set if required.
- ④ Inspect the shut-off valve and valve seat area for uneven wear or other damage.
Replace the valve and valve seat as a set if required.
- ⑤ Inspect all O-ring grooves for nicks or burrs.

5) Reassembly

Reassemble the control valve in the reverse order to disassembly and observe the followings :

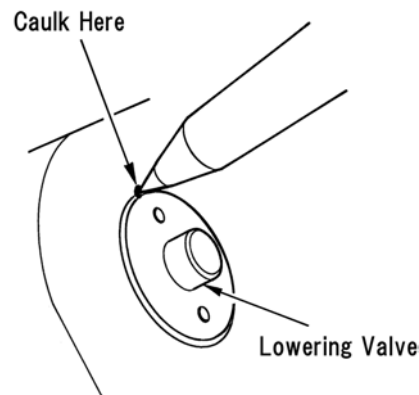
- (1) Replace all O-ring with new one.
- (2) If removed the plate, 2, from the spool, 4, install the plate has 66 degrees from the pin center, 3.
- (3) If remove nut and screw from the plate, 2, install the screw projects 1.3 mm from the plate, 2.



496Y

- | | |
|-----------------------|----------|
| 1. Plate center | 5. Nut |
| 2. Plate | 6. Screw |
| 3. Center of pin hole | 7. Bolt |
| 4. Spool | 8. Pin |

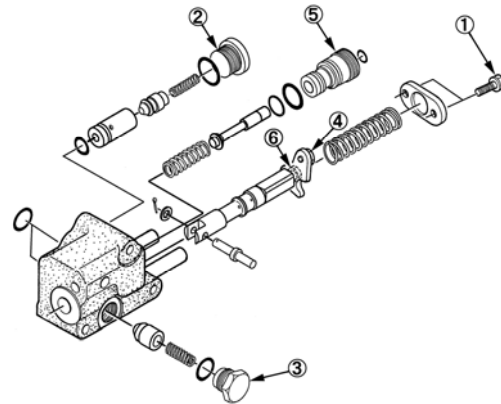
- (4) Install the lowering valve spool components and tighten the valve seat by special tool and a caulk by center punch.



497Y

(5) Tightening torque of each parts.

Name	Tightening torque	
	N·m	kg f·m
① Bolt (Cap)	7.3~10.0	0.74~1.02
② Plug (Check valve)	58.8~68.6	6~7
③ Plug (Shut-off valve)	98~118	10~12
④ Lock nut	18.0~21.5	1.8~2.2
⑤ Lowering valve seat	29.0	3.0
⑥ Bolt (Plate)	10~15	1~1.5



498Y

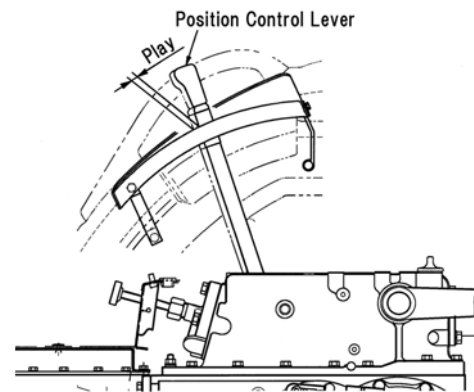
NOTE :

Remove the oil from the spool thread and bolt thread :
⑥, and apply the thread sealant to them before tighten.

6) Adjustment of sensitivity.

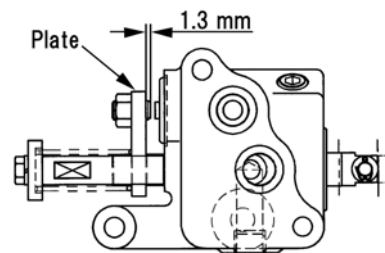
- Rotate the engine at 1000~1500 rpm and inspect the play of the lever (insensible area) that the position control lever is at the position as shown below on the lever guide.

Play of control lever	
Continuous lifting	About 5mm
Continuous lowering	
Lifting to lowering change over	About 10mm
Lowering to lifting change over	



499Y

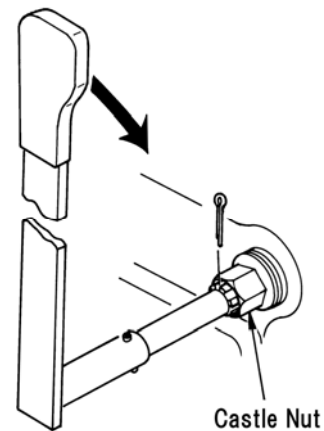
- When the play of the lever does not meet the above values, adjust properly with the screw projects from the plate. If the screw projects from the plate is greater that the lift arms will be cycle up and down, and if it is smaller that the control lever play will be greater.



500Y

(3) Adjust the lever operating force.

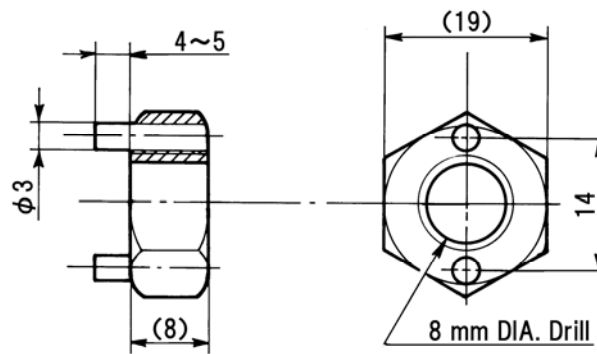
Remove the split pin and adjust with the castle nut so that the operating force for the control lever(s) is 19.6 ~ 29.4 N (2 ~ 3 kgf) at the lowering direction.



501Y

7) Special tool

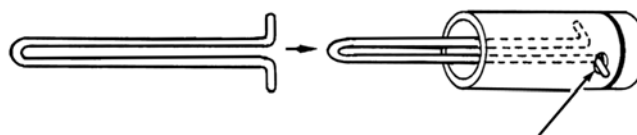
Please make this special tool for removal and reassemble the lowering valve seat (3), Figure 494Y.



Dimension Shown in mm.

502Y

Please make this special tool for removal the check valve seat (5), Figure 495Y made by 2~3 mm diameter wire with proper shape.



The special tool hooks to this hole

503Y

4) Link System

(1) Position control

- **Movement from neutral to lifting position**

By setting the position control lever at the lifting position, the cam (A) is pushed down between the cam (B) and pilot spool. At this time, the cam (B) is interconnected with the lift arm, and the implement is held. The pilot spool is changed over to the lifting position, oil is fed to the hydraulic cylinder, and the implement is raised by lift arm.

- **Movement from lifting to neutral position**

When the lift arms rise, the rod (feedback link) is pushed to front, and the connecting rod is moved to rearward, and cam (B) is turned dotted arrow direction.

The cam (A) is pushed by the spring at the back of the pilot spool, the pilot spool is gradually returned to the neutral position.

Pump oil pressured flow is redirected to sump and lift arms stop rising.

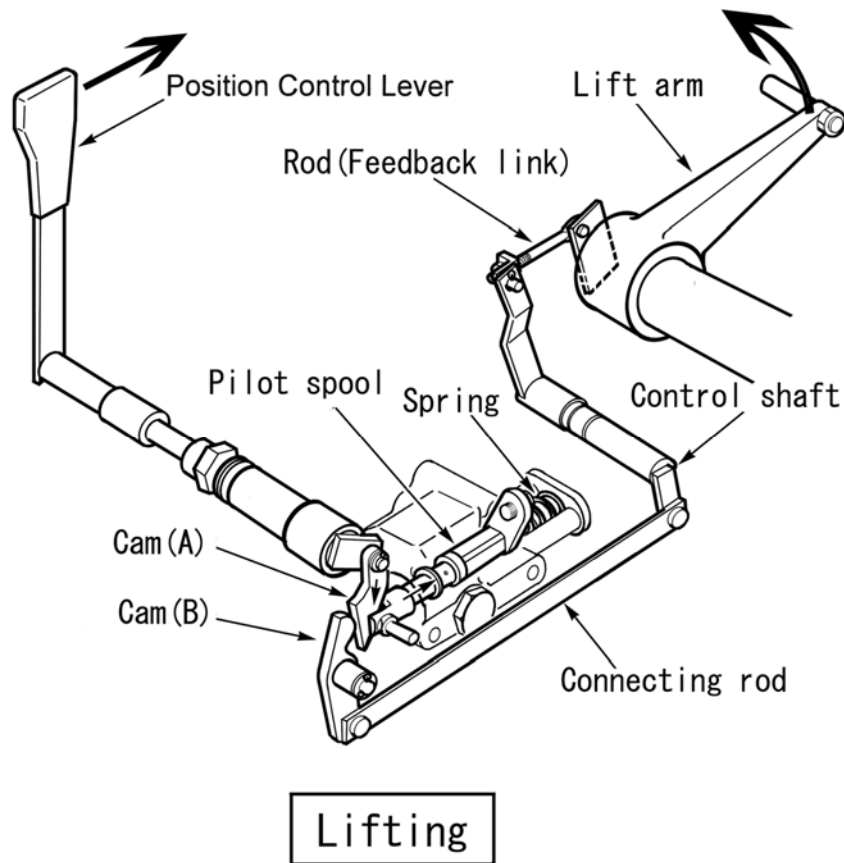
NOTE: The rod (feedback link) and control shaft are fixed by a spring pin.

- **Movement from neutral position to lowering position**

When the lever is set at lowering position, the cam (A) is raised, the pilot spool is moved to the lowering position (come out) by the force of the spring, and the oil in the cylinder flows to sump via the control valve.

When the lever is moved in the lowermost position, movement from the lift arm is not feedback to the pilot spool even though the rod detects it, since the cam (A) has been pulled up.

(The implement moves according to the ground surface by stabilizing wheel, etc. installed to it. This position is called floating range.)



504Y

(2) Draft control(Option)

- **Increase of compression force from top link**

When the lever is set at any position and strong compressive force (responsive spring is compressed) acts on the top link, the rod and the interconnecting rod are moved in the solid line direction in the figure. The cam (B) pushes the pilot spool through the cam (A), the oil is fed to the hydraulic cylinder and the implement rises.

- **Reduction of compressive force from top link**

When the traction resistance of the tractor decreases, the compressive force of the top link decreases (returned by the force of the responsive spring), the rod and interconnecting rod are stretched, **to the rear and cam (B) is turned to counterclock-wise** the pilot spool is changed over to the lowering position by the force of the spring at the back, and the implement lowers.

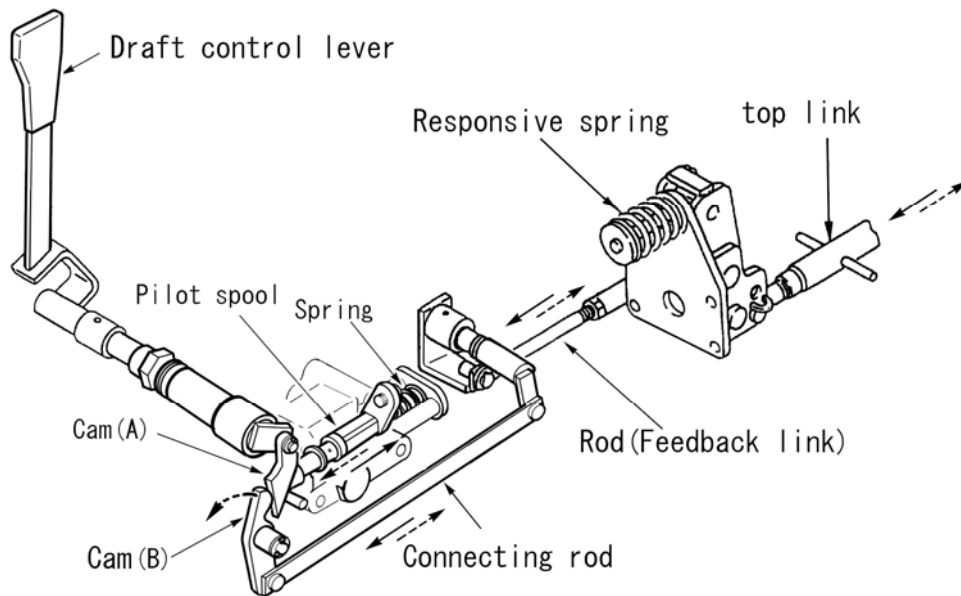
In this way, lifting and lowering are repeated according to variation of the compressive force, controlling the traction resistance of the tractor.

- **Setting of resistance sensitivity**

Signal from the top link is transmitted to the cam (B). When the cam (A) is at lower position, that is, when the lever is at the "+" (sensitive) position, the direction can be changed over to lifting even though the signal is small from the cam (B).

When the lever is near the "-" (**insensible**) position, the cam (A) gets far from the pilot spool (upwards), and the direction cannot be changed to rising if the signal is not large of the cam (B).

In this way, by adjusting the lever (resistance sensitivity), traction resistance can be changed according to working conditions.

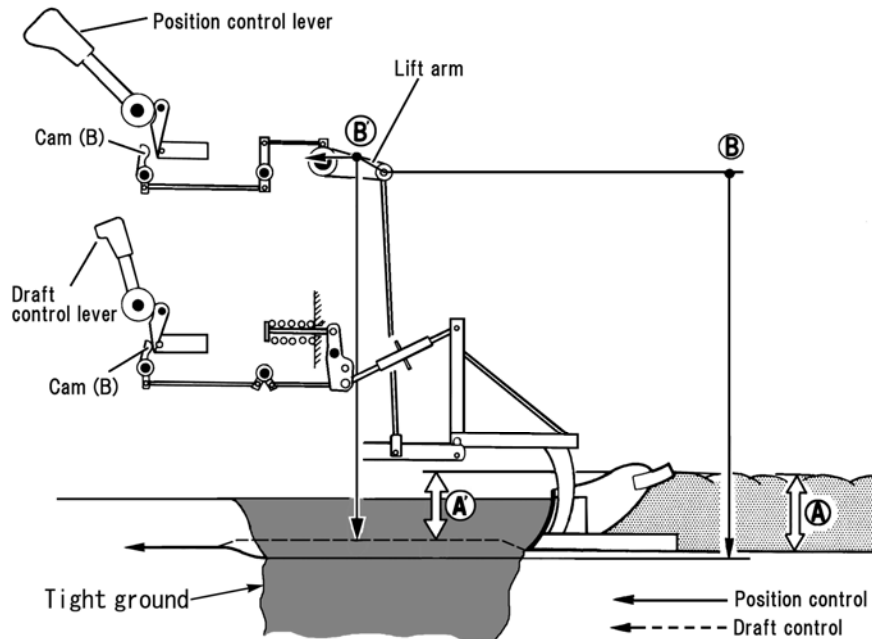


505Y

(3) Joint use of position control and draft control

Joint use of position control and draft control is described below taking an example of plow operation. Set the traction resistance (plowing depth) of (A) by the draft control lever as shown in the figure below and set the maximum lowering position of the plow to the tractor (B) with the position control lever (control of maximum plowing depth).

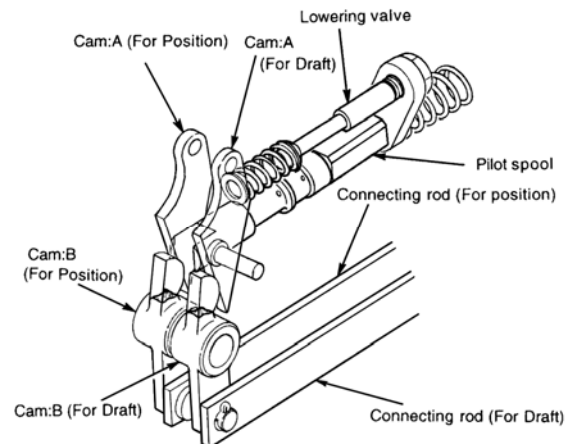
When the soil conditions are the same as those at the point (A), the plowing depth is kept constant. However, in hard ground, the draft control attempts the depth of (A') to keep the traction resistance constant. However, though the lift arm raises to the position (B') by the draft traction resistance, when the tractor tries to go across (B'), the pilot spool becomes at neutral position the plowing depth should be controlled with the plow lifted by the tractor.



506-2Y

NOTE :

For the link of the position and draft, as described in the above figure, relative position to the pilot spool is interconnected with the pilot spool (1 pc.), and movement caused to both links of the position draft is combined to operate the pilot spool.

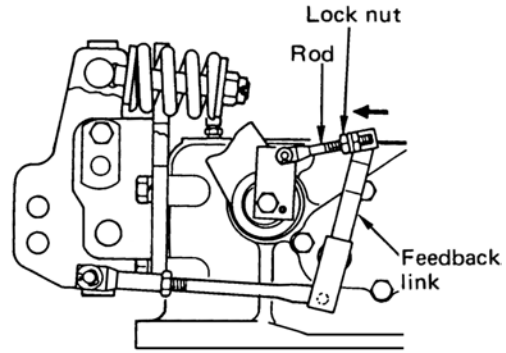


507Y

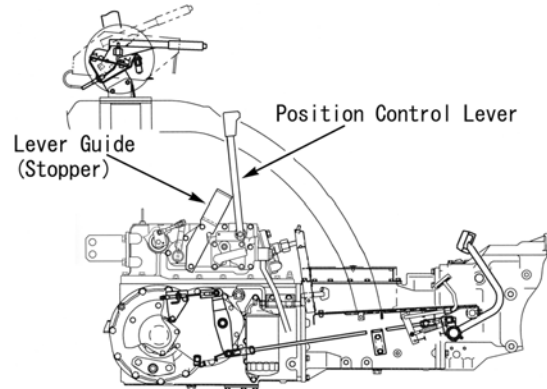
(4) Adjustment of Link

1. Position control

- ① Untighten the lock nut of the rod.
- ② Start the engine and set the speed at 1000 - 1500 rpm.
- ③ Set the position control lever at the highest position of the lever guide.
- ④ Move the feedback link back and forth to find the relief valve operating position (engine sound changes at this position). Move the lock nut front-wards about 3 turns and fix. Move the position control lever up and down several times. Then, confirm that the play at the lift arm end is 9mm when the position control lever is set at the uppermost lifting position.



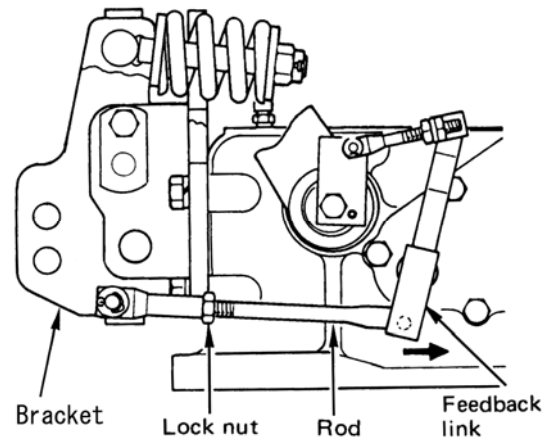
508Y



508YA

2. Draft control

- ① Untighten the lock nut of the rod.
- ② Remove the rod at the bracket side.
- ③ Set the position control lever at any lifting position, and set the draft control lever at "-" (forward) position.
- ④ Start the engine, and set at 1000-1500 rpm.
- ⑤ Move the feedback link in the arrow mark direction (front of tractor), and adjust the rod to the bracket mounting length immediately before the lift arm starts lifting. Turn the rod once from this length (to cause it to be shortened), install to the bracket, and fix with lock nut.
- ⑥ Set the position control lever at the uppermost lifting position and the draft control lever at "+" (rearward) position, set the position control lever at the lowermost lowering position and confirm that the lift arm lowers.



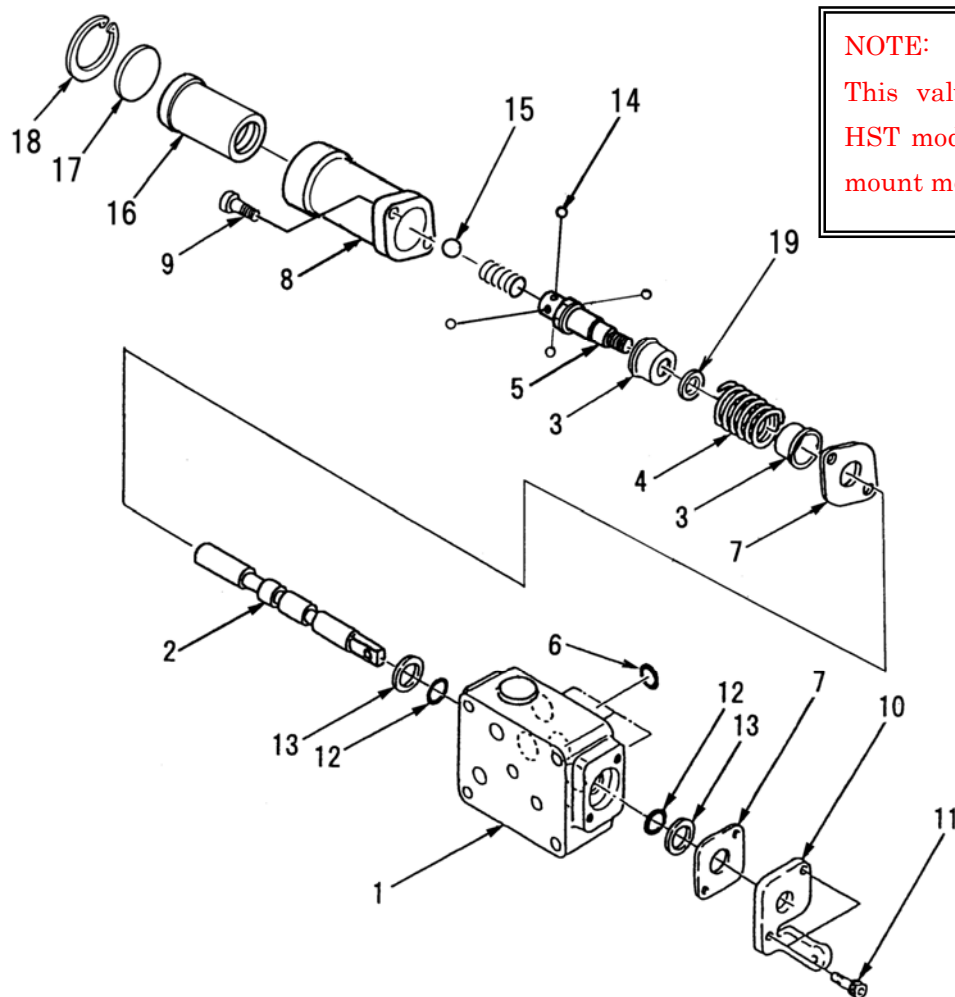
509Y

NOTE :

1. Adjust the position control first before adjusting the draft control.
2. Set the implement lowering speed adjusting valve at the highest speed position. (Full opened position.)
3. If the lift arm does not lower when checked, or the lowering speed is slow, turn the rod once to be shortened and check again.

6. REMOTE CONTROL VALVE

1) Single acting control valve (with detent position) (No. 340015270)



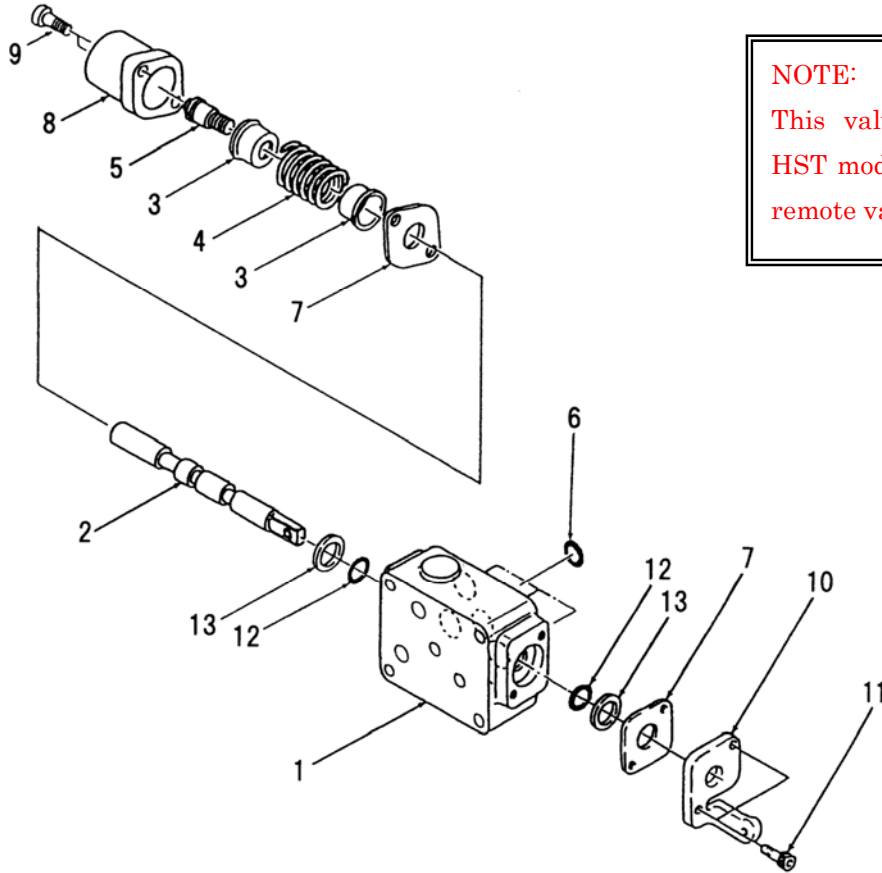
NOTE:

This valve is located on the HST model tractor for the mid mount mower lifting.

- | | |
|----------------|----------------|
| 1. Valve body | 8. Cap |
| 2. Spool | 9. Bolt |
| 3. Spring seat | 10. Bracket |
| 4. Spring | 11. Seal plate |
| 5. Bolt | 12. O-ring |
| 6. O-ring | 13. Wiper ring |
| 7. Seal plate | 14. Steel ball |
| | 15. Steel ball |
| | 16. Sleeve |
| | 17. Spacer |
| | 18. Snap ring |

510Y

2) Double acting control valve (340015230)



NOTE:

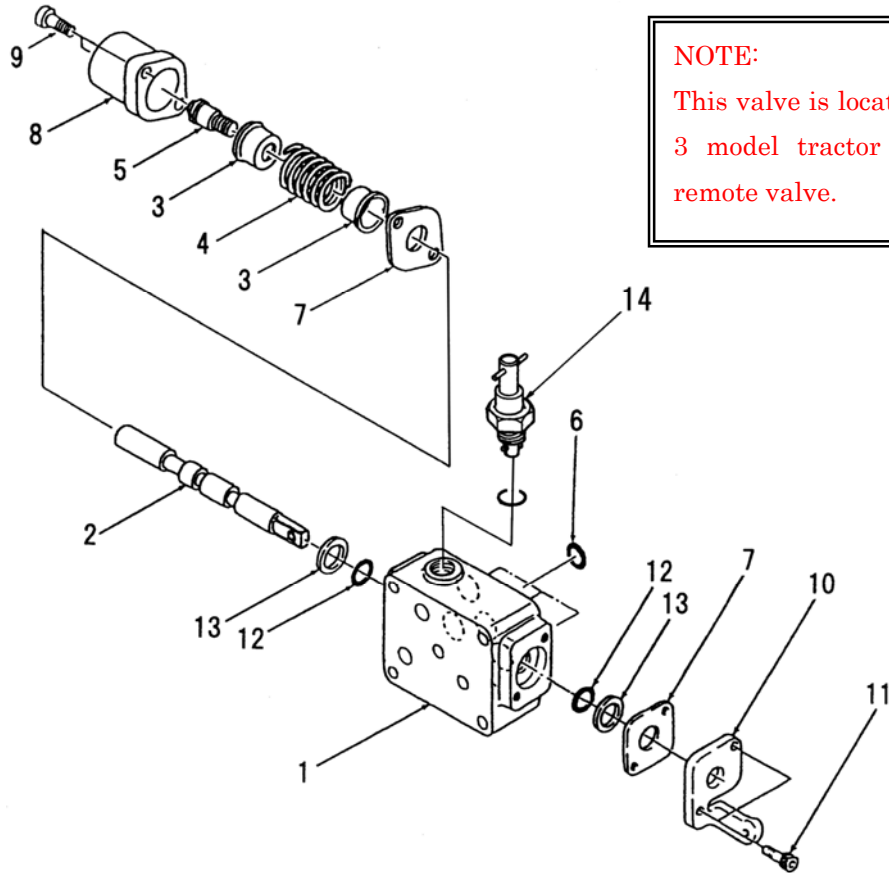
This valve is located on the HST model tractor for the rear remote valve.

- 1. Valve body
- 2. Spool
- 3. Spring seat
- 4. Spring
- 5. Bolt
- 6. O-ring
- 7. Seal plate

- 8. Cap
- 9. Bolt
- 10. Bracket
- 11. Bolt
- 12. O-ring
- 13. Wiper ring

511Y

3) Single acting or double acting change over control valve (340015250)



NOTE:

This valve is located on the 9×
3 model tractor for the rear
remote valve.

1. Valve body
2. Spool
3. Spring seat
4. Spring
5. Bolt
6. O-ring
7. Seal plate

8. Cap
9. Bolt
10. Bracket
11. Bolt
12. O-ring
13. Wiper ring
14. Shut off valve

512Y

4) Disassembly

IMPORTANT :

If it should be unavoidably disassembled, handle it carefully since it is finished precisely.

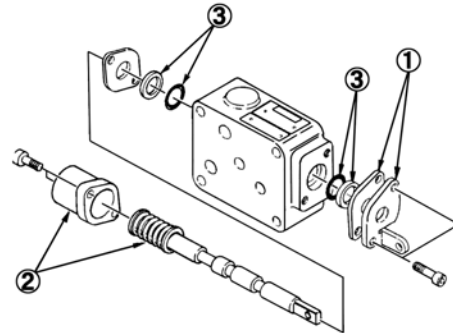
1. Spool

- ① Remove the bracket.
- ② Remove the bolt and cap, and extract the spool gently.

NOTE :

Be careful not to damage the O-ring when taking out the spool.

- ③ Remove the O-ring and wiper ring of the valve body. (Only when replacing)



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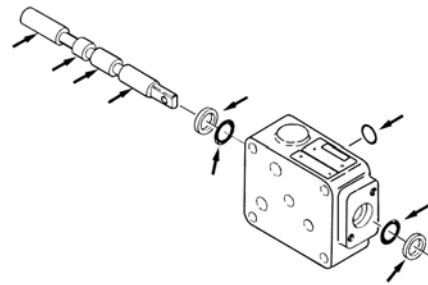
5) Inspection

1. Spool

If the sliding surface or seat surface have worn out or damaged, replace the valve ass'y.

2. O-ring and wiper ring

- ① Replace the O-ring and wiper ring if oil leaks or the O-ring is damaged.



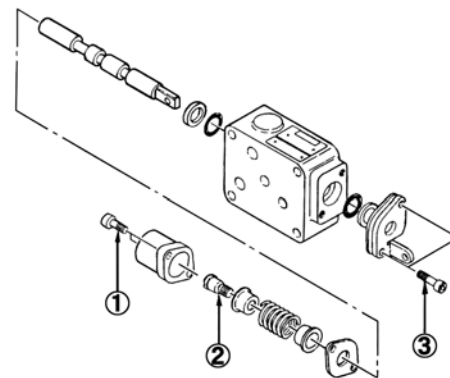
515Y

6) Reassembly

1. Reassemble the components in the reverse order to disassembly.

Bolt tightening torque

No.	Tightening torque	
	N·m	kg f·m
①	7.8~11.7	0.8~1.2
②	7.8~11.7	0.8~1.2
③	7.8~11.7	0.8~1.2



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7. Troubleshooting

Condition	Cause	Remedy
1. When the control lever is set at the lifting position, the implement does not raise.	(1) The implement is heavy. (2) The oil pump discharges no oil. (3) Dropped relief set pressure. (4) Shut-off spool is not closed.	(1) Check the implement. (2) Replace the oil pump. (3) Adjust the set pressure. (4) Check the spool for dust and scarring.
2. When the control lever is set at the neutral, the implement lowers at high speed. (Hunting is repeated.)	(1) Worn out housing and spool. (2) Leak in the cylinder. (3) Scar on the check valve seat surface. (4) Leak from lowering valve.	(1) Replace the valve ass'y. (2)-1 Replace the O-ring. (2)-2 Replace the liner and piston. (3) Replace the valve and bush. (4) Replace the lowering valve ass'y.
3. Implement rises more slowly than specified.	(1) Improper sliding of shut-off spool. (2) Leak in the cylinder. (3) Reduced oil pump volumetric efficiency. (4) Clogged oil filter. (5) Hydraulic oil.	(1) Correct or replace. (2) Inspect or replace the O-ring, liner and piston. (3) Replace the pump (in case of oil leak). (4) Replace the filter (check oil for contamination). (5) Use proper hydraulic oil (SAE80 or ISO VG46)
4. Rapid rise of oil temperature.	(1) Seizure of oil pump. (2) Reduced volumetric efficiency of oil pump. (3) Use with the relief valve working.	(1) Replace the pump (check the oil for contamination). (2) Replace the pump (check the oil for contamination). (3)-1 Check the changeover valve position. (3)-2 Dislocated feedback link.
5. Noise generated.	(1) Seizure of pump. (2) Insufficient suction of pump. (3) Air sucked. (4) Hydraulic oil.	(1) Replace the pump. (2) Replace the oil filter. (3)-1 Check or replace the O-ring of suction pipe, filter or other positions subjected to seizure. (3)-2 Check the suction pipe for air sucked. (3)-3 Check the oil pump oil seal for air sucked. (4) Use proper hydraulic oil (SAE80 or ISO VG46).
6. When the implement is held at a certain position and the engine is stopped, the implement lowers naturally too fast.	Take the same measures as for above 2.	

Condition	Cause	Remedy
7. Implement lowers naturally while traveling.	(1) Control lever moves naturally in the lowering direction due to vibration while traveling.	(1)-1 Adjust the washer (friction spring) with the castle nut not to allow the control lever to move. (It should be operated by the force of 19.6—29.4 (2—3 kgf). (1)-2 Adjust so that the lever cannot move in the lowering direction by the lever stopper.

3—10 Electric Unit and Accessories

1. INTRODUCTION

Reference Figure 517Y.

Component Location and Function

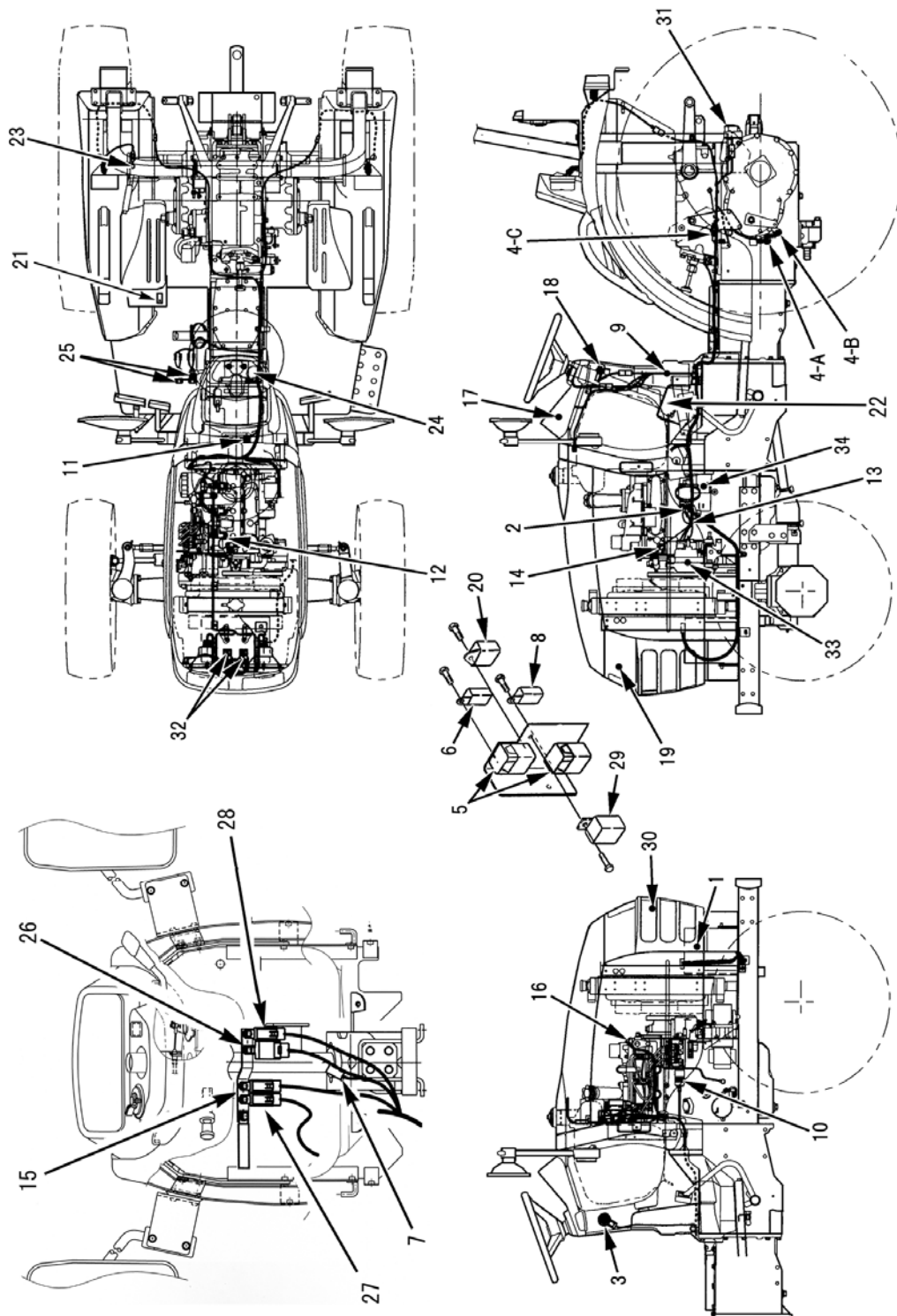
- 1) **Battery** — Located under the engine cover, on the front axle support.
- 2) **Fusible Link** — Located on the left side of the engine, near the starter. The fusible link protects the entire electrical system from damage due to excessive current flow.
- 3) **Key Switch** — Located on the right side of the dashboard. The key switch is used switch battery power on or off to the tractor's electronic circuits, supplies power to the engine glow plugs, or to start the tractor.
- 4) **Safety Start Switches** — The tractor utilizes two or three safety start switches. "A", is on the tractor rear transmission shifter system and prevents the tractor from starting when range change lever is "ON" position. "B" is located on the PTO control shifter system and prevents the tractor from starting if the PTO is engaged. "C" is located on the Mid PTO change lever linkage and prevents the tractor from starting if the Mid PTO is engaged.
- 5) **Fuse Blocks** — Located in the engine compartment, on the left side of the firewall and two additional fuse blocks are attached to near the head lamp inside the engine hood. The fuse blocks hold fuses that protect individual circuits from damage due to excessive current.
- 6) **Relay for Safety Start** — Located backside of the bottom fuse block, the relay utilized by individual circuit of the starting system.
- 7) **Diode for Brake Switch** — Located under the instrument panel, is attached to the tractor's main wiring harness.
- 8) **Relay for Glow Lamp** — Located backside of the top fuse block, the relay

alerting the operator of low oil pressure.

- 9) **Diode for HST Circuit**— Located in the dashboard, attached on the HST wiring harness.
- 10) **Fuel Shutoff Solenoid**— Located on the right of the engine, on the fuel injection pump, the fuel shutoff solenoid shuts off fuel flow to the injection pump to stop the engine.
- 11) **Fuel Level Sending Unit**— Located inside the fuel tank, the fuel level sending unit sends a signal indicating fuel level to the fuel level gauge located on the instrument panel.
- 12) **Engine Glow Plugs (3)**— Located on the right side of the engine cylinder head and near the fuel injectors. The glow plugs preheat the air in the pre-combustion chamber to aid in cold engine start-up.
- 13) **Diode for alternator**— Located adjacent to the alternator, attached on the wire harness.
- 14) **Coolant Temperature Sending Unit**— Located on the front left side of the engine cylinder head in the thermostat housing, the coolant temperature sending unit sends a signal indicating coolant temperature to the temperature gauge, located on the instrument panel.
- 15) **Relay for HST Brake Switch**— Located on the bottom of steering column and connected with blue connector. The relay utilized by individual HST cruise control system. The cruise magnet is un-energized when the both brake pedals are depressed.
- 16) **Engine Oil Pressure Switch**— Located on the front of the engine cylinder head. The engine oil pressure switch closes when engine oil pressure is less than 29.4 kPa (0.3 kgf/c m²). When the switch closes, an indicator on the instrument panel illuminates and

- 17) **Instrument Panel** — Located on the steering column, the instrument panel houses gauges and indicator lights that monitor tractor functions.
 - 18) **Headlight Switch** — Located below the instrument panel on the left dashboard, the headlight switch switches the headlight, side light, tail right and instrument panel lights on or off. It has four positions.
 - 19) **Headlight** — Located on the front of the tractor, the headlight illuminates the area in front of the tractor.
 - 20) **Glow Lamp Timer** — Located adjacent fuse blocks, the timer is illuminated at 4.5 seconds glow lamp indicator in the instrument panel.
 - 21) **Electric Cruise Control Switch (HST only)** — Located to the right of the instrument panel, the cruise control switch controls current to the cruise control magnet.
 - 22) **Cruise Control Magnet (HST only)** — Located on the hydrostatic transmission (HST) control linkage, the cruise control magnet locks the HST linkage in place to set a constant transmission speed.
 - 23) **Hand Brake Switch** — Located on the hand brake and switch is “ON “ when the lever is pulled up.
- NOTE :**
The hand brake switch lights the hand brake indicator light on the instrument panel when the hand brake is engaged.
- 24) **Combination Switch** — Located on the right of the instrument panel, the switch are controlled current to the horn, turn signal lamps and hazard lamps.
 - 25) **Brake Lamp Switches** — Located under the right footstep, the brake lamp switches close and the brake lamps illuminate with brake relay when depress the brake pedals.
 - 26) **Brake Switch Relay** — Located on the bottom steering column in the dash board. The brake switch relay energized, current flows to brake lamps.
 - 27) **HST Cruise Latch Relay (HST Model Only)** — Located on the bottom steering column and is connected with black connector. The relay utilized by individual circuit of the HST system.
 - 28) **Hazard Lamp Relay** — Located on the bottom of the steering column. Hazard lamp relay is illuminated to trailer turn indicator lamp while hazard switch is “ON” position.
 - 29) **Flasher Relay** — Located adjacent fuse blocks. The flasher relay illuminates the flasher lamps on the fender and pilot lamps, hazard pilot lamp and trailer turn indicator lamp in the instrument panel by flasher switch or hazard switch.
 - 30) **Horn** — Located in the engine cover adjacent head lamps. Horn alarms while the horn switch is pushed position in the combination switch.
 - 31) **Trailer Socket** — Located on the left side of rear wheel shaft housing.
 - 32) **Fuse Block for Head Lamp** — Located near the headlamps in the hood. The fuse blocks hold fuses that protect individual circuits from damage due to excessive current.
 - 33) **Alternator** — The alternator is located on the front left side of the engine and generates power to charge the battery.
 - 34) **Starter** — Located on the left side of the engine, opposite the alternator. The starter rotates the engine for starting.

2. COMPONENT LOCATION



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3. DESCRIPRION OR TESTING

WARNING :

Before working on any component of the electrical system, the negative (-) battery cable should be disconnected from the battery, as electrical shock or damage to system components may occur. Some testing requires 12-volt power; care should be taken in cases where power is needed.

1) BATTERY

Checking the Battery Electrolyte Level

NOTE: *Check the battery electrolyte level after every 50 hours of operation.*

WARNING:

Always check the battery electrolyte level with the tractor engine stopped, as an explosive gas is produced inside the battery when the alternator is charging the battery. Do not use an exposed flame and do not smoke when checking the battery electrolyte level.

2) FUSIBLE LINK

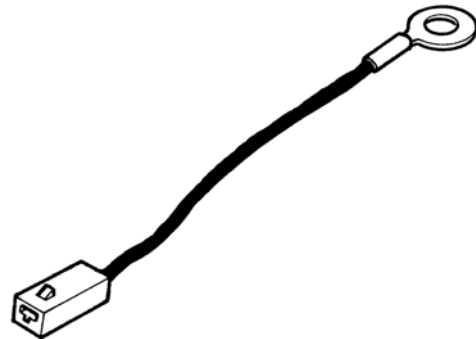
A fusible link wire is used to protect the entire tractor's electrical system. If too much current (amperage) passes through the fusible link, the fusible link will melt. When the fusible link melts, electrical current is no longer able to pass through the tractor's electrical system, protecting the system from damage.

The fusible link wire is a short red wire that is bolted to the positive (+) terminal of the starter, connecting to a connector that links into the main wiring harness.

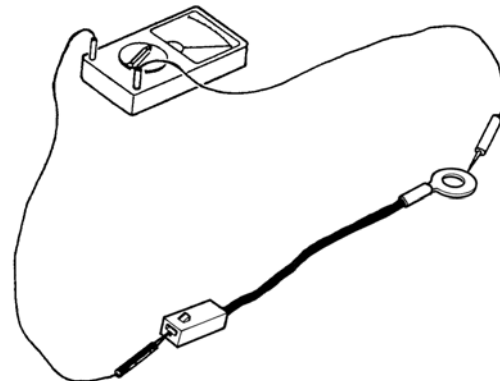
Fusible Link Rating
20 Amps at 20°C
15 Amps at 69°C

CAUTION:

Always replace the fusible link with one that is rated for the same amperage (Part #SBA385603370). DO NOT increase amperage rating.



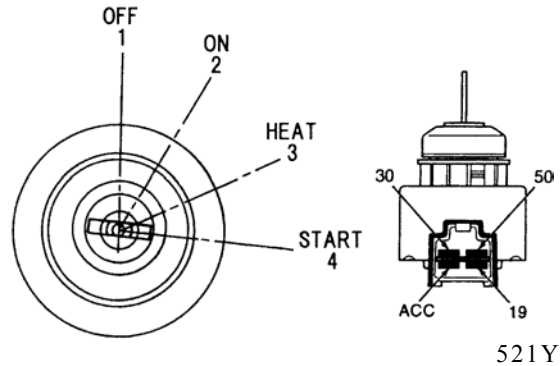
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3) KEY SWITCH

- ① Conduct continuity test between terminal [30] and other terminals at each position of the key switch. If no continuity is noticed between (○—○), replace the switch.



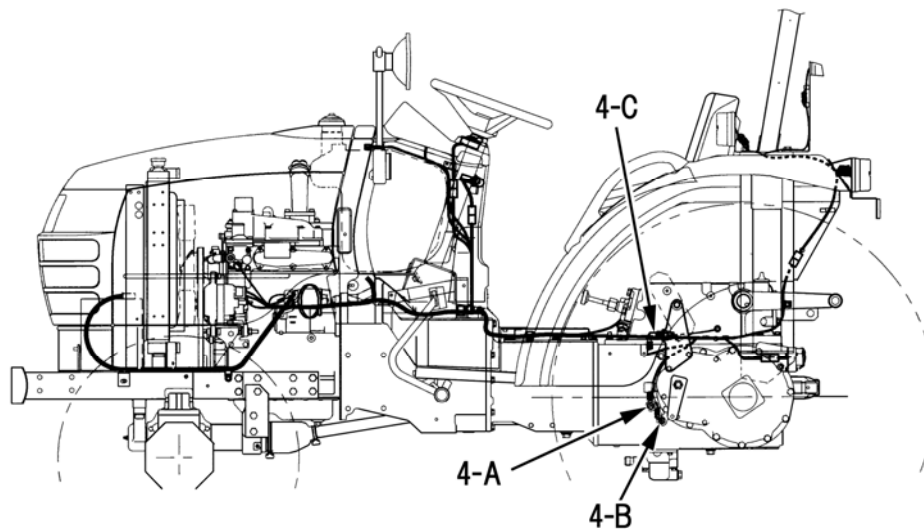
521Y

Key Position	Terminal			
	19	30	50	AC
OFF				
ON		○	○	○
HEAT	○	○	○	○
START	○	○	○	○

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4) SAFETY START SWITCHES

- Range gear safety start switch is a single pole, push bottom type switch located on the left side rear transmission housing. When the range change lever is engaged position, the contacts in the switch is open, not allowing tractor to start.
- The PTO (rear) safety start switch is a single pole, push button type switch located on the left side rear transmission housing. When the PTO change lever is engaged position, the contact in the switch is open, not allowing tractor to start.
- The Mid PTO safety start switch is a single pole, push button type switch located on the Mid PTO change lever link system. When the Mid PTO change lever is engaged position, the contact in the switch is open, not allowing tractor to start.



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5) FUSE BLOCK

Description

The fuse blocks are located on the right side of the firewall in the engine compartment.

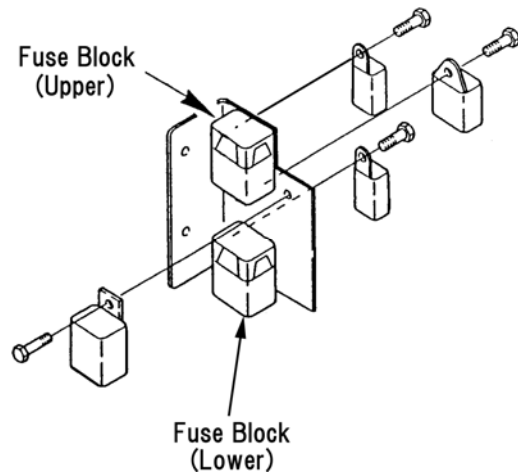
The fuse blocks hold fuses that protect individual circuits in the tractor's electrical system.

The fuse blocks hold a total of five fuses.

The fuse blocks contain the following fuses:

Upper Fuse Block		
	Fuse Size	Circuit Protected
①	20 amps.	Headlights, Parking lights Instrument panel lights
②	15 amps.	Indicators, Hazard lights
③	10 amps.	Brake lights, Horn

Lower Fuse Block		
	Fuse Size	Circuit Protected
④	5 amps.	Warning lights, Gauges, HST speed control
⑤	5 amps.	Engine fuel solenoid



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6) RELAY FOR SAFETY START

Description and Location

Relay is used to automatically complete (close) a circuit.

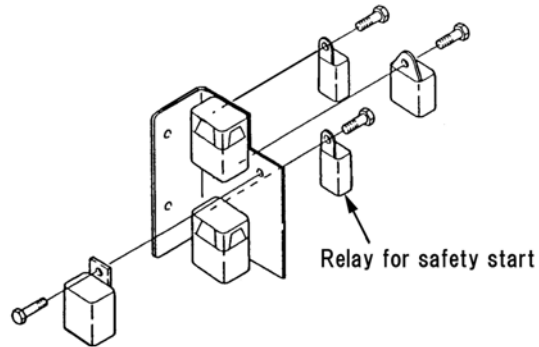
A relay contains two parts of a circuit. One part, the control circuit, uses current to energize a coil. The other part, the function circuit, is a switch. When energized, the coil of a relay becomes an electromagnet opening or closing a single circuit.

The safety relay utilizes single-pole, single-throw switch (SPST).

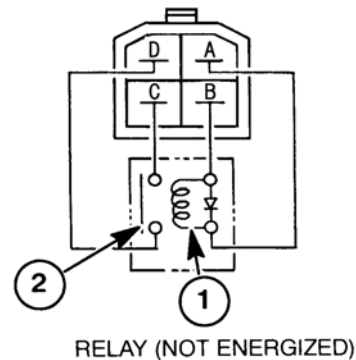
Relay employs a diode to direct current in the control circuit.

The function circuit, 2, is normally open when no current is being supplied to the coil, 1. If a circuit with an SPST relay is energized with current on the tractor, the switch becomes closed and the circuit is completed. The relay is then said to be latched.

The relays coil is energized when the range safety switch, PTO safety switch and mid PTO switch (if installed) are all closed.



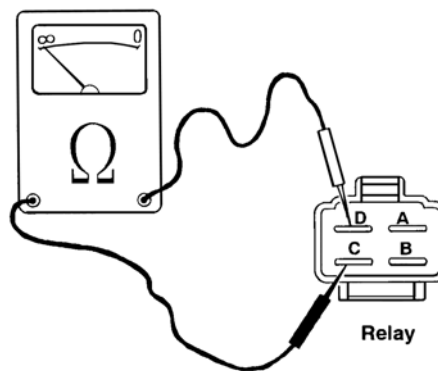
525Y



526Y

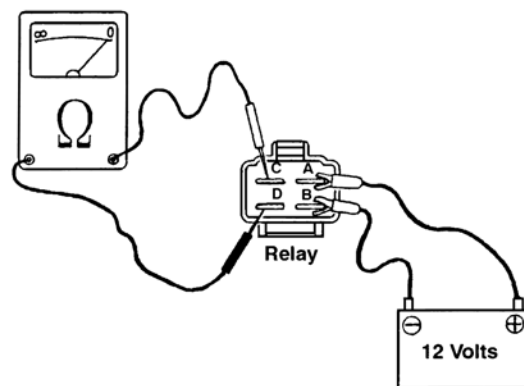
Relay Operation Testing

1. Disconnect the negative (—) battery cable from the battery.
2. Disconnect and remove the relay to be tested from the tractor.
3. Using an ohmmeter, connect test probes to terminals "C" and "D" on the relay observe the ohmmeter reading.
4. There should be high resistance between terminals "C" and "D", indicating no continuity and that the relay is functioning properly when non-energized. If there is continuity, the relay is defective and needs replaced.



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5. To test the relay when energized, use jumper wires to connect a 12-volt power supply to terminals "A" and "B" (brass terminals) on the relay.
6. Touch ohmmeter test probes to the "C" and "D" terminals on the relay and observe the ohmmeter. Little or no resistance between the terminals indicates that there is continuity and that the relay is functioning properly. If there is no continuity between the terminals, the relay is defective and needs replaced.



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7. Install the relay onto the tractor.
8. Connect the negative (—) battery cable to the battery.

7) DIODE FOR BRAKE SWITCH

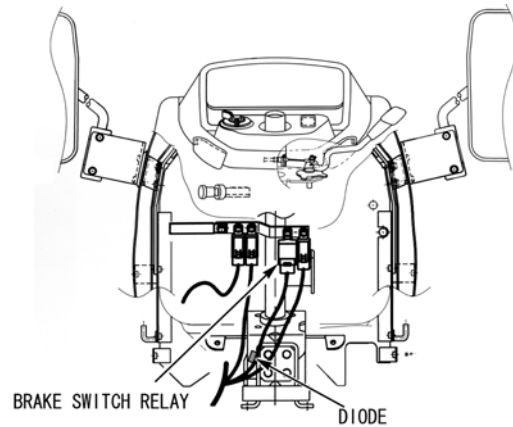
Description

The diode, 1, is in the dashboard of the tractor, attached to the tractor wiring harness.

Diode is electrical devices which current is allowed to pass in one direction, directing current within a circuit. Diodes allow the use of one wire within multiple circuits to control current flow to electrical components such as relays.

This diode is paired together in a single case.

The remaining diode is housed alone.



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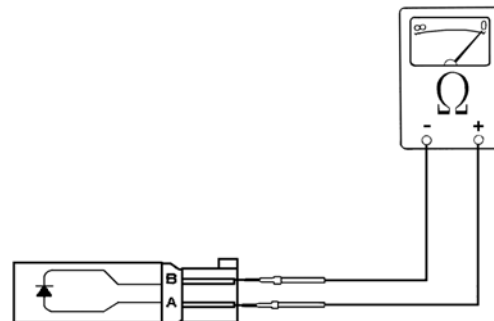
Diode Testing

1. Disconnect the negative (-) battery cable from the battery.
2. Remove the dashboards from the tractor.
3. Disconnect the diode from the wiring harness of the tractor.

NOTE:

For this test, an electrical multimeter with diode test capabilities may be used in place of an ohmmeter. If a multimeter with diode testing capabilities is unavailable, use an ohmmeter to test as described below.

4. Using an ohmmeter, touch the red, positive (+), test probe to diode terminal "A". Touch the black, negative (-), ohmmeter test probe to diode terminal "B". Observe the ohmmeter.
5. The ohmmeter should show high resistance, indicating no continuity and that current is not flowing through the diode in that direction. If there is continuity. Check to see that the test probes are on the correct terminals, and if they are, the diode is defective and needs replaced.
6. If the previous test indicated the diode was functioning properly, touch the red, positive (+), ohm meter test probe to terminal "B" of the diode and the black, negative (-), test probe to terminal "A" of the diode.
7. Observe the ohmmeter. The ohmmeter should show little or no resistance, indicating continuity in that direction. If the ohmmeter does not show continuity, the diode is defective and needs replaced.



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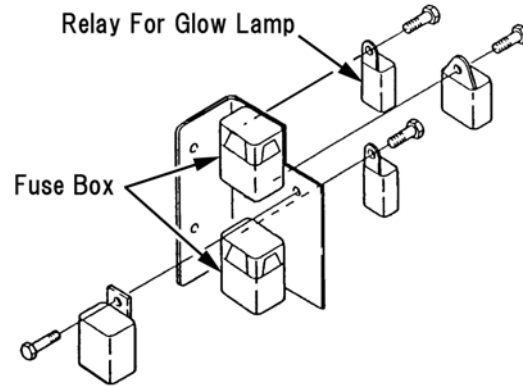
8) RELAY FOR GLOW LAMP

Description

Relay for glow lamps is installed backside of the fuse blocks and top side of the safety start relay.

Glow lamp relay is the same part with safety start relay and hazard lamp relay, and are interchangeable.

Relay testing is as same as safety start relay.



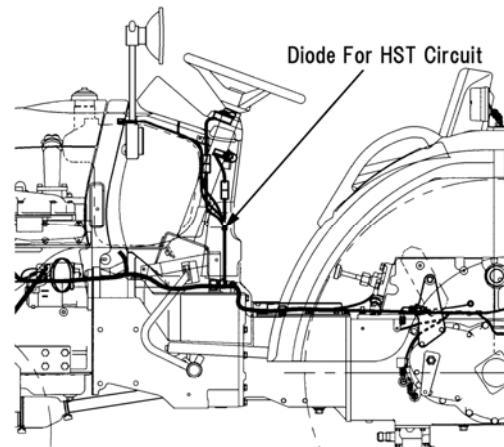
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9) DIODE FOR HST CIRCUIT

HST only

Description

Diode for HST circuit is installed left side of the steering column in the dash board. This is a single diode in the case, and the other descriptions and testings are referred to brake switch diode.

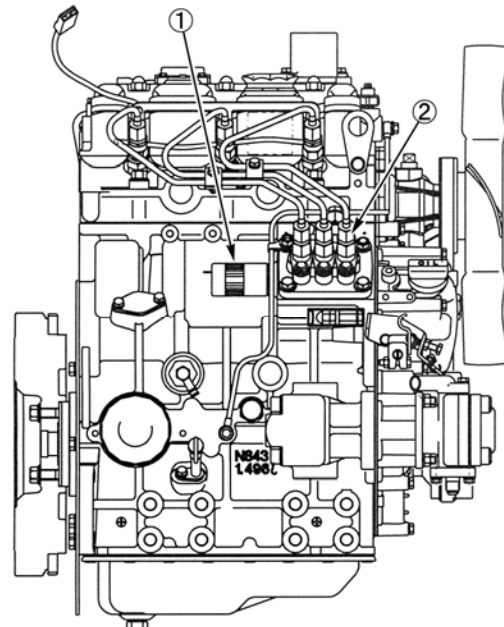


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10) FUEL SHUTOFF SOLENOID

Description and Location

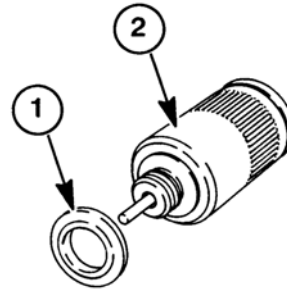
The fuel shutoff solenoid, 1, is located on the right side of the engine, threaded into the rear of the fuel injection pump, 2. The fuel shutoff solenoid contains a spring-loaded plunger that pushes the injection pump control rack to the closed (shut-off) position when the solenoid is not energized. When the key switch is turned to the "ON" or "START" position, the safety stop relay closes completing the circuit that energizes the solenoid. This retracts the plunger from the injection pump, and the injection pump control rack moves into the position that allows the engine to start.



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Removal

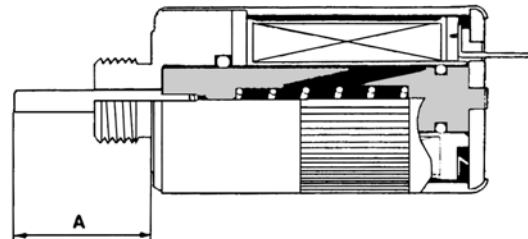
1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect the wiring harness lead, from the fuel shutoff solenoid.
3. Using a pair of pliers, carefully remove the fuel shutoff solenoid from the engine.
4. Remove and discard the sealing washer, 1, which seals the solenoid, 2, to the engine.



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Testing

1. Using a suitable measuring device, measure the protrusion distance, "A", on the solenoid. The distance should measure between 25.5 - 26.4 mm. If the distance is not within these specifications, the solenoid is defective and needs replaced.

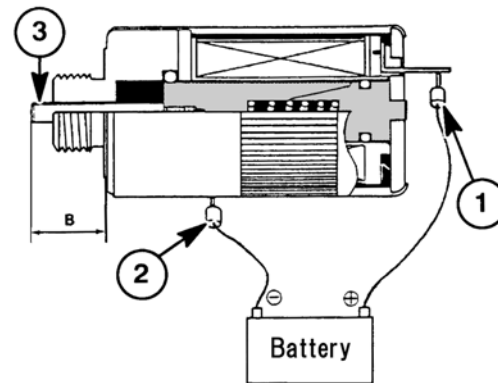


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NOTE:

When connecting the 12-volt power supply to the solenoid body, be sure paint is the removed from the body. Otherwise, the power will not be transferred to the solenoid.

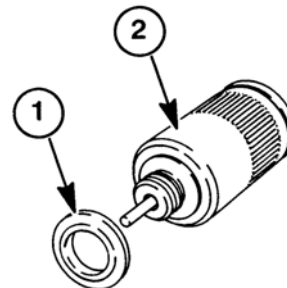
2. Use jumper wires to connect the positive (+) terminal of a 12-volt power supply to the solenoid lead, 1. Connect the negative terminal of the 12-volt power supply to the solenoid body, 2. The plunger, 3, should retract into the solenoid body.
3. Using a suitable measuring device, measure the protrusion distance, "B" on the solenoid. The distance should measure between 11.5 - 14.5 mm. If the distance is not within these specifications or the plunger does not retract, the solenoid is defective and needs replaced.



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Installation

Assembly of the engine stop solenoid generally follows the disassembly in reverse, and installs a new sealing washer, 1, on the solenoid, 2.

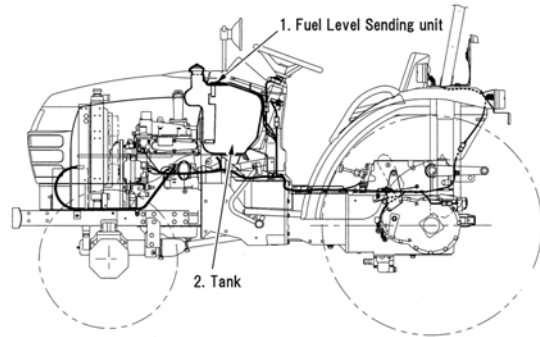


537Y

11) FUEL LEVEL SENDING UNIT

Description and Location

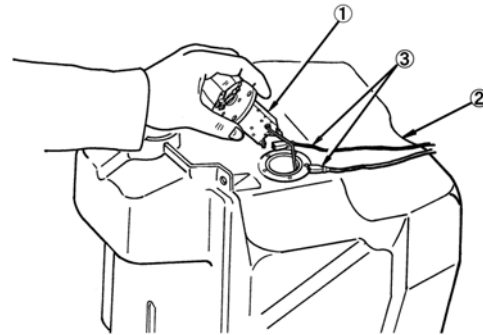
The fuel level sending unit, 1, is mounted on top of the fuel tank, 2, and extends into the tank. The sending unit utilizes a float that raises and lowers with the fuel level inside the tank. The float regulates a variable resistance to ground, which translates into movement of the fuel gauge on the instrument panel. As the float lowers (fuel being consumed) inside the tank, the ground resistance increases, indicating less fuel on the fuel gauge.



538Y

Removal

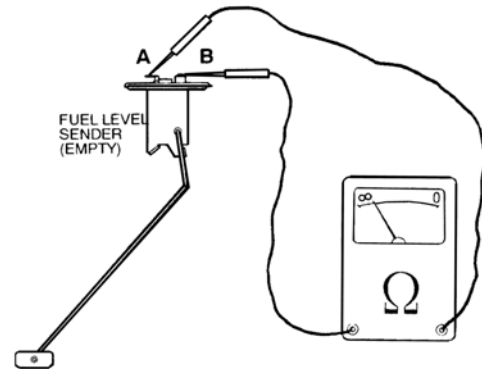
1. Disconnect the negative (–) battery cable from the battery.
2. Disconnect the two wiring harness leads, 3, attached to the terminals on the fuel level sending unit, 1. Be sure to make note of what terminal each lead is connected to for ease of installation.
3. Remove the five (5) retaining screws that secure the sending unit, 1, to the fuel tank, 2.
4. Carefully remove the sending unit, 1, from the fuel tank, 2.
5. Remove and discard the sealing gasket from the sending unit.



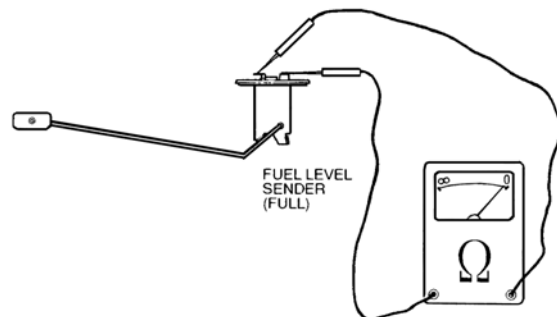
539Y

Fuel Level Sending Unit Testing

1. Using an ohmmeter, touch one test probe to terminal "A" of the sending unit, touch the other test probe to terminal "B" of the sending unit. Observe the reading on the ohmmeter.
2. With the sending unit float in the down position (tank empty), the ohmmeter should indicate between 103 and 117 ohms. If the ohmmeter reading is not within these specifications, the sending unit is defective and needs replaced.
3. With the sender in the up position (tank full), the ohmmeter should indicate between 0.8 and 5 ohms. If the ohmmeter reading is not within these specifications, the sending unit is defective and needs replaced.



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Installation

Assembly of the fuel level sending unit generally follows the disassembly in reverse.

NOTE:

When attaching the wiring harness leads to the fuel level sending unit, be sure the Yellow/white wire is connected to the insulated terminal (center) on the sending unit.

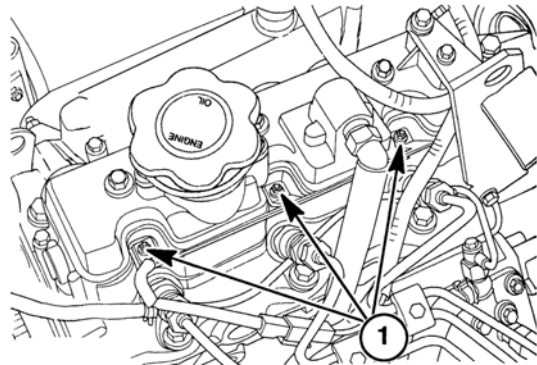
12) ENGINE GLOW PLUGS

(185366190)

Description

The engine glow plugs, 1, are located on the right side of the engine cylinder head, near the fuel injectors.

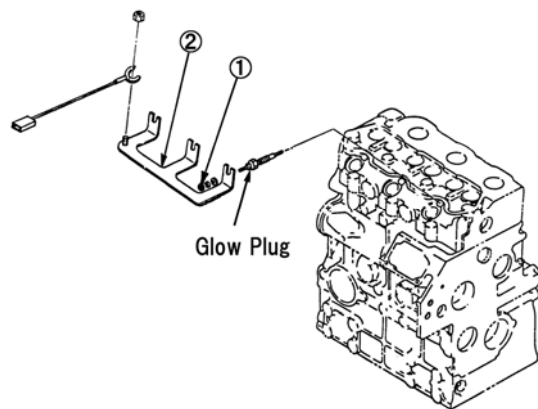
The glow plugs are used to preheat the air in the pre-combustion chamber. This aids in the starting of the engine when cold.



542Y

Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Remove the three (3) nuts, 1, and washers securing the electrode bar, 2, to the glow plugs.
3. Remove the glow plugs from the engine cylinder head.



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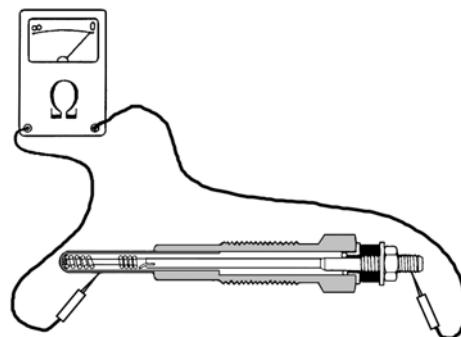
Engine Glow Plug Testing

1. Clean carbon from the sheath end of the glow plug.

NOTE:

Do not test resistance using the glow plug sheath.

2. Using an ohmmeter, touch one test probe to the glow plug electrode. Touch the other test probe to the glow plug body.
3. Observe the ohmmeter. A resistance reading of 1.0 ohms maximum is normal for the ST tractor, glow plug. If the resistance is too high, the glow plug is defective and needs replaced.



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Installation

1. Thread the glow plugs into the engine cylinder head. Torque each glow plug to 15-20 N·m {1.5~2.0 kgf·m}.
2. Install the electrode bar and the washers onto the glow plugs. Secure with the three (3) nuts.
3. Connect the negative (-) battery cable to the battery.

13) DIODE FOR ALTERNATOR

Description

This diode is as same as “9) DIODE OF HST CIRCUIT “ except installed position.
It is installed near alternator on the wiring harness.

14) ENGINE COOLANT

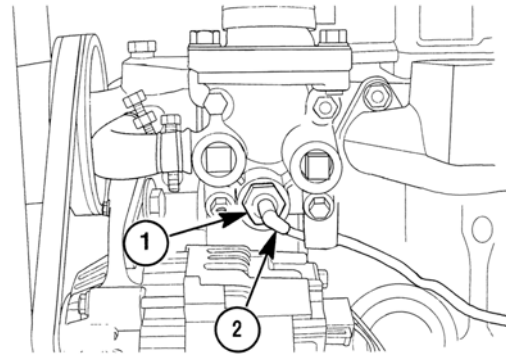
TEMPERATURE

SENDING UNIT (385720011)

Description

The engine coolant temperature sending unit, 1, is located on the left side of the thermostat housing.

The sending unit regulates a variable resistance to ground, which translates to movement of the temperature gauge on the instrument panel. The sending unit decreases ground resistance as coolant temperature rises, causing the temperature gauge to rise.



545Y

Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Drain the engine coolant from the radiator.
3. Disconnect the main wiring harness terminal, 2, from the coolant temperature sending unit, 1.
4. Remove the sending unit, 1, from the engine.

Testing

WARNING:

Do not perform sending unit test with tractor engine running, contact with moving parts will cause bodily injury.

NOTE:

- Engine paint must be removed from sending unit body or the ohmmeter will indicate a false reading when the ohmmeter test lead is touched to sending unit body.
- The resistance rating is measured on the special circuit for correctly.

1. Using an ohmmeter, touch one test lead to the sending unit terminal. Touch the other test lead to the sending unit body.
2. Observe the ohmmeter for resistance readings at different engine operating temperatures. If resistance is too high, the sending unit is defective and needs replaced.

Reference value

Coolant Temperature	Sending Unit Resistance
35°C	670.0 ± 80 ohms
80°C	118.0 ± 6 ohms
105°C	54.5 ± 2.7 ohms
115°C	42.0 ± 2.5 ohms

Installation

1. Install the sending unit, 1, into the engine.
2. Connect the main wiring harness terminal, 2, to the sending unit, 1.
3. Fill the radiator with the recommended coolant mixture.
4. Connect the negative (-) battery cable to the battery.

15) RELAY FOR HST BRAKE SWITCH

SWITCH

Description

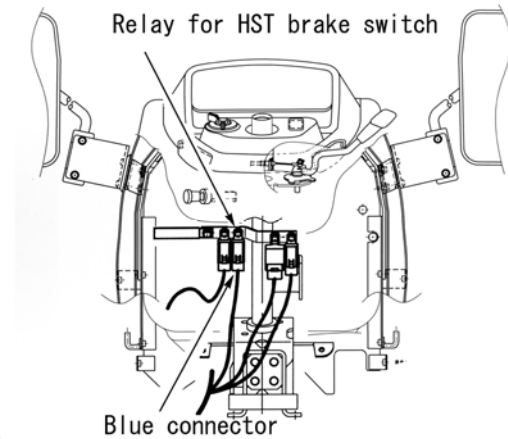
The relay for HST brake switch is located on the steering column in the dash board, and it is connected with blue color connector on the HST circuit wire harness.

Relay is used to automatically open a circuit. A relay contains two parts of a circuit. One part, the control circuit, uses current to energize a coil.

The other part, the function circuit, is a switch. When energized, the coil of a relay becomes an electromagnet opening or closing a single circuit.

The HST brake switch relay utilizes single-pole, single-throw switches (SPST).

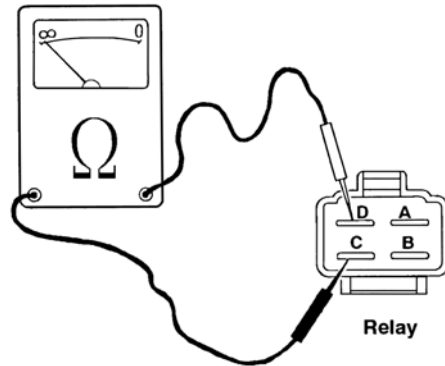
The function circuits are normally close when no current is being supplied to the coil. If a circuit with an SPST relay is energized with current, the switch becomes opened.



547Y

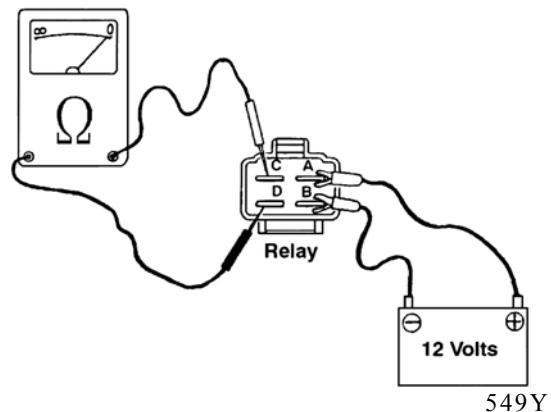
Relay Operation Testing

1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect and remove the relay to be tested from the tractor.
3. Using an ohmmeter, connect test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading.
4. There should be high resistance between terminals "C" and "D", indicating continuity and that the relay is functioning properly when non-energized. If there is no continuity, the relay is defective and needs replaced.



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5. To test the relay when energized, use jumper wires to connect a 12-volt power supply to terminals "A" and "B" (brass terminals) on the relay.
6. Touch ohmmeter test probes to the "C" and "D" terminals on the relay and observe the ohmmeter. High resistance between the terminals indicates that there is no continuity and that the relay is functioning properly. If there is continuity between the terminals, the relay is defective and needs replaced.
7. Install the relay onto the tractor.
8. Connect the negative (-) battery cable to the battery.



549Y

16) ENGINE OIL PRESSURE SWITCH

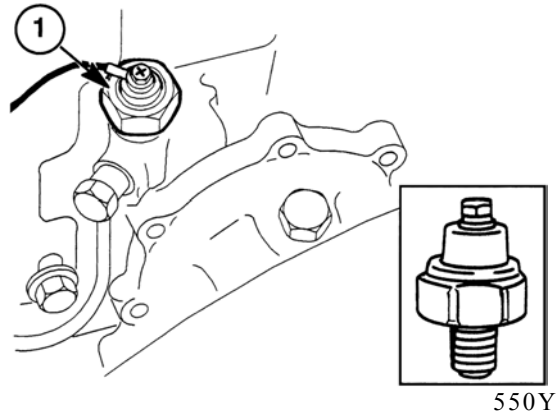
Description and Location

The engine oil pressure switch, 1, is located in the front of the engine cylinder head.

The oil pressure switch is located on top of the cylinder head. The engine oil pressure switch closes (circuit completed) when engine oil pressure is less than 29.4 kPa.

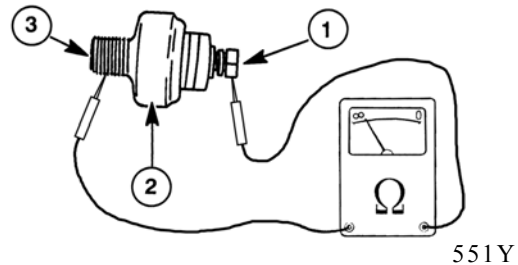
This illuminates an indicator light on the instrument panel lights.

The engine oil pressure switch is closed before the tractor engine is started, and is opened after the engine is started. If the indicator light fails to switch after the tractor is started, the oil level inside the engine may be low or there may be a problem with the oil pump or relief valve assembly.



Engine Oil Pressure Switch Testing

1. Using an ohmmeter, touch one test lead to the pressure switch terminal, 1, and the other test lead to the threads of the switch body, 2.
 2. Observe the ohmmeter. There should be little or no resistance, indicating continuity in the switch.
- If there is no continuity, the switch is defective and needs replaced.



CAUTION:

Do not use high pressure compressed air for the following test, otherwise damage may occur to the oil pressure switch.

NOTE:

The following test is not a calibrated test. The purpose of the test is to see if the switch contacts open at pressure.

3. While the test leads are connected to the switch, pressurize the switch oil pressure port, 3, with low pressure 69~138 kPa {0.7~1.4 kgf/cm²} compressed air.
4. Observe the ohmmeter. While air pressure is being supplied to the oil pressure port, the ohmmeter should indicate high resistance, or no continuity. If there is continuity, the switch is defective and needs replaced.

Installation

1. Install the oil pressure switch into the engine cylinder head and tighten to 14.7~19.6 N·m (1.5~2.0 kgf·m).
2. Install the ring terminal onto the oil pressure switch, and secure the terminal with the retaining screw, 1.

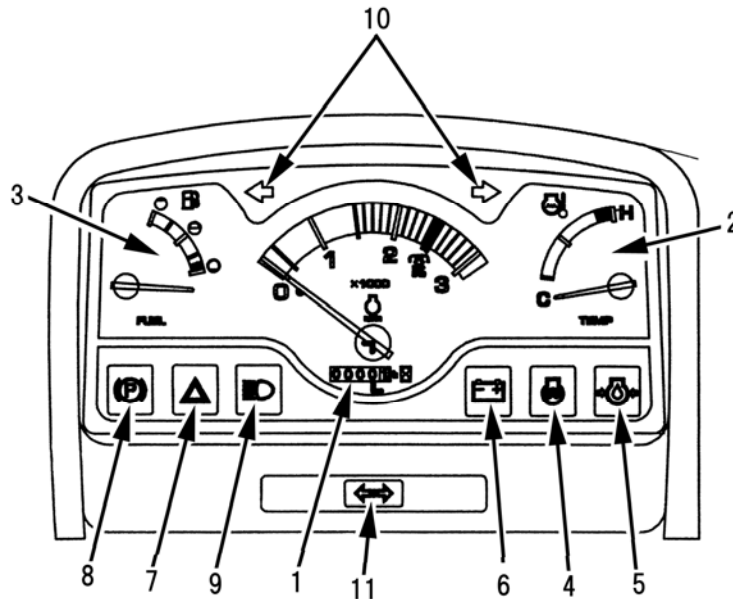
NOTE : *If the oil pressure switch is too much tightened, will be broken the support bracket.*

17) INSTRUMENT PANEL - COMPONENT OPERATION AND SERVICING

Description

The indicator and instrument light bulbs are the only serviceable components of the instrument panel.

If any other part of the instrument panel is found to be defective, the instrument panel must be replaced as a unit.



552Y

1. Proof Meter - The proof meter indicates hours of operation for the tractor engine. Units are expressed on the meter to tenths of an hour (6 minutes). The proof meter is used as a guide to determine hours of service and maintenance intervals.

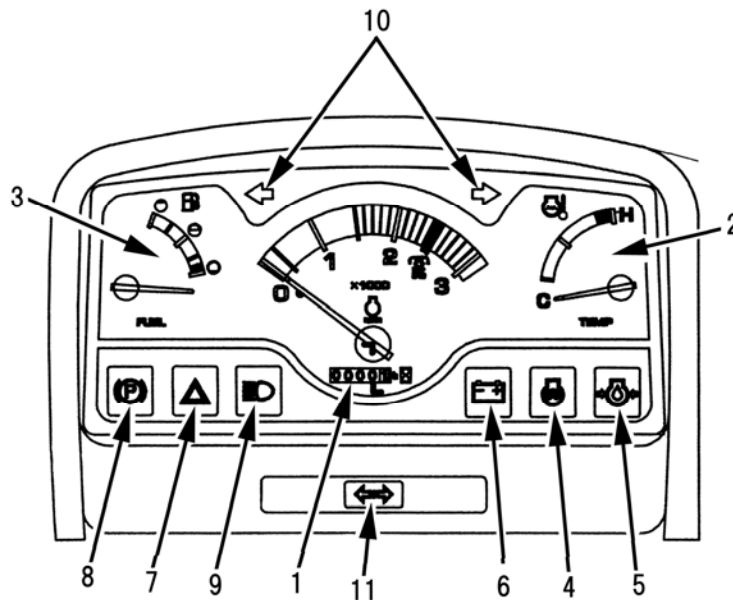
NOTE: *The proof meter is not serviceable and the instrument panel must be replaced if the meter is defective.*

2. Temperature Gauge - The temperature gauge indicates engine coolant temperature. The temperature gauge is activated when the key switch is turned to the "ON/HEAT/START" position, as battery current is being supplied to the gauge. Normal engine operating temperature is indicated as the white region of the gauge. The red portion of the gauge indicates an engine overheating condition. This is to alert the operator to stop the tractor engine and investigate a possible engine malfunction, should the gauge needle enter the red portion.

3. Fuel Gauge - The fuel gauge indicates the amount of diesel fuel in the tractor fuel tank. The fuel gauge is activated when the key switch is turned to the "ON/HEAT/START" position, as battery current is being supplied to the gauge.

The mark "○" of the gauge indicates a full tank of fuel and the mark "●" of the gauge indicates an empty fuel tank. The fuel gauge needle will move ○ to ● as the tractor engine consumes fuel.

4. Glow Plug Indicator Light - The glow plug indicator light will illuminate when the key switch is in the "HEAT" and "START" positions, indicating the engine glow plugs are energized and heating the tractor engine combustion chambers. The indicator light will stay illuminated for four (4) seconds when the key switch is in the "HEAT" position and remains illuminated when the key switch is turned to the "START" position.



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- 5. Engine Oil Pressure Warning Light** - The engine oil pressure warning light alerts the operator of low engine oil pressure. The warning light will illuminate oil pressure. The warning light will illuminate when the key switch is in the "ON/HEAT/START" position and the tractor engine is not running. The warning light will remain illuminated for a short period of time after the tractor engine is started, as engine oil pressure is being built up. If oil pressure should drop below-29.4 kPa while the tractor engine is running, the warning light will illuminate. This is to alert the operator to stop the tractor engine immediately and investigate the cause, as the low engine oil pressure will likely damage the engine.
- 6. Battery Charging System Warning Light** - The battery charging system warning light alerts the operator that the tractor's charging system is malfunctioning. The warning light will illuminate when the key switch is in the "ON/HEAT/START" position and the tractor engine is not running. The warning light will go out after the tractor engine is started. If the light remains on or illuminates while the tractor engine is running, the light is warning of a charging system malfunction. While the tractor may run for a period of time on battery reserve, the problem should be investigated as soon as possible.
- 7. Hazard Pilot Light**
The hazard pilot light illuminated when the hazard switch in the combination switch is "ON" position with key switch is any position.
- 8. Parking Brake Indicator Light** - The parking brake indicator light illuminates when the parking brake is engaged. The parking brake indicator light will illuminate when the key switch is in the as power is being supplied to the light.
- 9. High Beam Indicator Light**
The high beam indicator light illuminate when the headlamp switch is high beam position (4th position).
- 10. Turn Indicator Lights**
The turn indicator lights illuminate when the turn signal switch is right or left positions and/or hazard switch is "ON" position.
- 11. Trailer Turn Indicator Light**
The trailer turn indicator light is flashed when the hazard switch is "ON" position and trailer turn bulb is burnt out, trailer turn circuit is broken or trailer socket is not connected at the key switch is "ON/HEAT/START" position.

Instrument Panel Removal

1. Disconnect the negative battery cable from the battery.
2. Remove the steering wheel.
3. Grasp the instrument panel and pull up the instrument panel and disconnect the three connectors and flexible shaft from the instrument panel.
4. Remove the instrument panel.

NOTE:

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

Instrument Panel Light Replacement

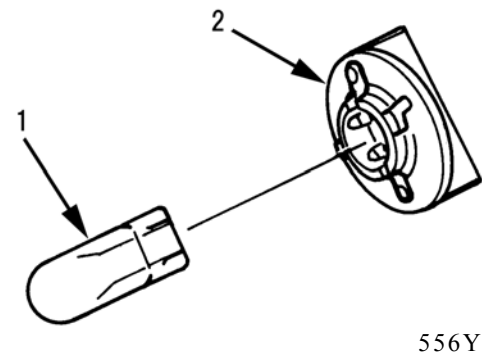
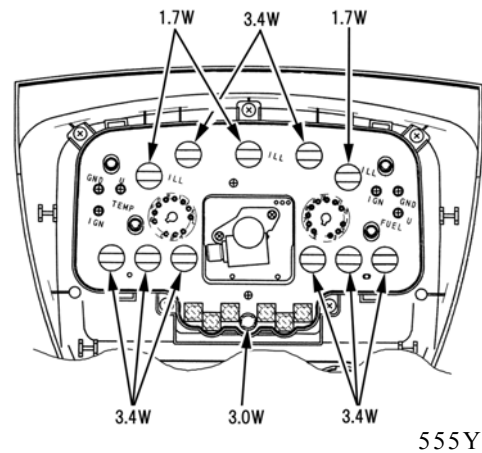
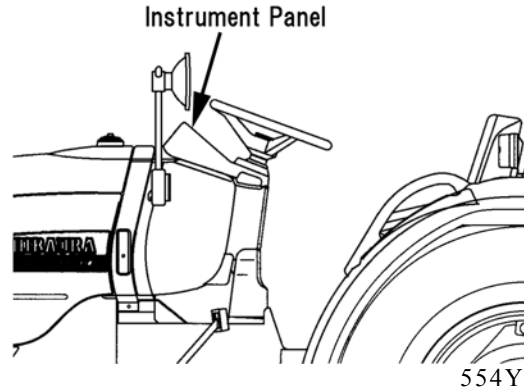
1. From the back of the instrument panel, rotate the bulb socket containing the faulty bulb and pull the socket from the instrument panel.

NOTE:

Illumination bulbs should not be inter-changed with indicator/warning bulbs.

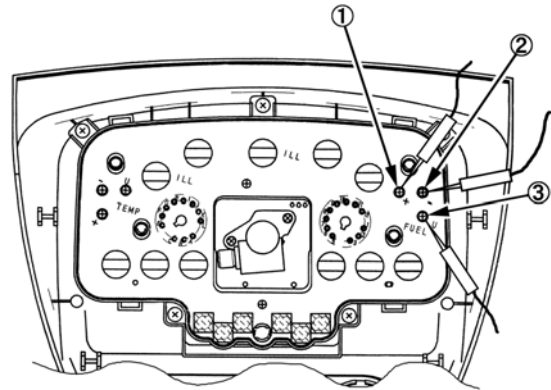
Instrument Panel Lighting		
	Designation	Bulb Rating
1	Illumination	1.7 watts
2	Indicator	3.4 watts
3	Warning	3.4 watts
4	Indicator	3 watts

2. Grasp the faulty bulb, 1, and pull the bulb from the socket, 2.
3. Push the replacement bulb into the socket and install the socket into the back of the instrument panel.



Fuel Gauge Testing

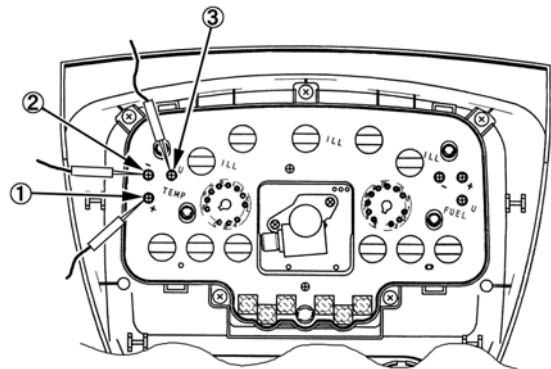
1. Disconnect the instrument panel connector from the main wiring harness.
2. Using an ohmmeter, touch one test probe to the "+" terminal, 1, of the fuel gauge and touch the other test probe to the "-" terminal, 2, of the fuel gauge.
3. Observe the ohmmeter. The measured resistance should be about 88 ohms. If resistance is not this specification, the gauge is defective and the instrument panel needs replaced.
4. Using an ohmmeter, touch one test probe to the "+" terminal of the fuel gauge and touch the other test probe to the "U" terminal of the fuel gauge.
5. Observe the ohmmeter. The measured resistance should be about 72 ohms. If resistance is not this specification, the gauge is defective and the instrument panel needs replaced.



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Temperature Gauge Testing

1. Disconnect the instrument panel connector from the main wiring harness.
2. Using an ohmmeter, touch one test probe to the "+" terminal, 1, of the temperature gauge and touch the other test probe to the "-" terminal, 2, of the temperature gauge.
3. Observe the ohmmeter. The measured resistance should be about 88 ohms. If resistance is not this specification, the gauge is defective and the instrument panel needs replaced.
4. Using an ohmmeter, touch one test probe to the "+" terminal, 3, of the temperature gauge and touch the other test probe to the "U" terminal, 3, of the temperature gauge.
5. Observe the ohmmeter. The measured resistance should be about 77 ohms. If resistance is not this specification, the gauge is defective and the instrument panel needs replaced.



558Y

Instrument Panel Installation

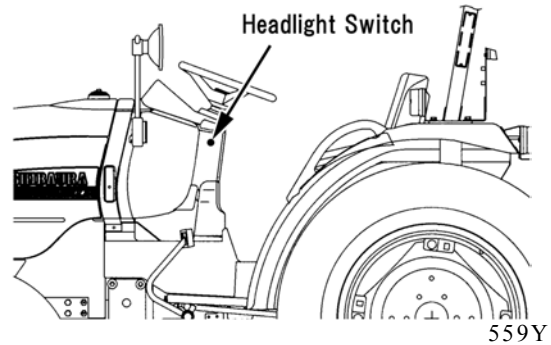
Install the instrument panel generally follows the disassembly procedure in reverse.

18) HEADLIGHT SWITCH

Description

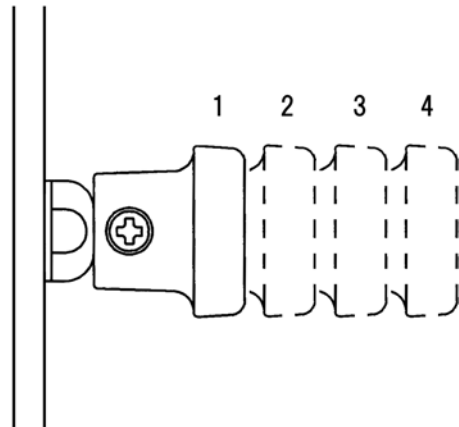
The headlight switch is located on the left dashboard. This switch is pull—push type switch with four positions as follows:

Switch position	Condition
1 st	Lights “OFF”
2 nd	Side and Tail Lights “ON”
3 rd	Side, Tail and Headlights “ON” (Low Beam)
4 th	Side, Tail and Headlights “ON” (High Beam)



Removal

1. Pull up the instrument panel.
2. Remove the left dashboard.
3. Disconnect the connector from the headlight switch.
4. Unscrew the screw from the grip and remove them.
5. Untighten the nut and remove nut, washer and switch from the dashboard.



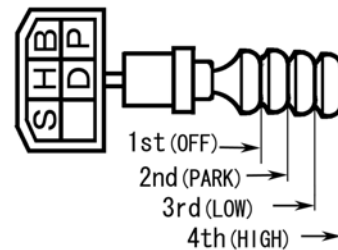
Inspection

Conduct continuity test between terminal “B” and the other terminals at each position of the switch.

If no continuity is noticed between “○—○”, replace the switch.

Installation

Assembly of headlight switch generally follows the disassembly in reverse.



LIGHT SWITCH CHART					
TERMINAL	B	D	P	H	S
1st (OFF)					
2nd (PARK)	○—○				
3rd (LOW)	○—○	○—○			
4th (HIGH)	○—○			○—○	

19) HEADLIGHT

Description

The headlights are located on the front of the engine hood.

The headlight assemblies contain a bulb each that may be replaced if the bulb burns out.

Removal

To remove the head light bulb as follows :

1. Disconnect the negative battery cable from the battery.
2. Disconnect the connector from the defective headlight assembly.
3. Remove the rubber.
4. Turn the bulb support and pull out the bulb.

Inspection

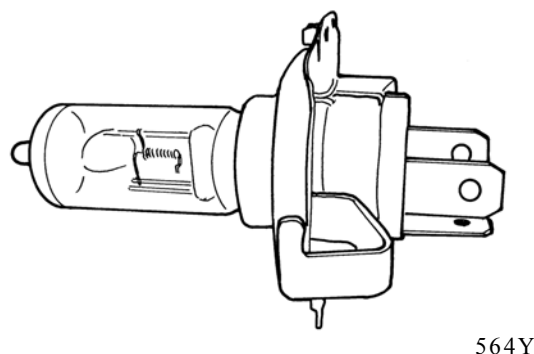
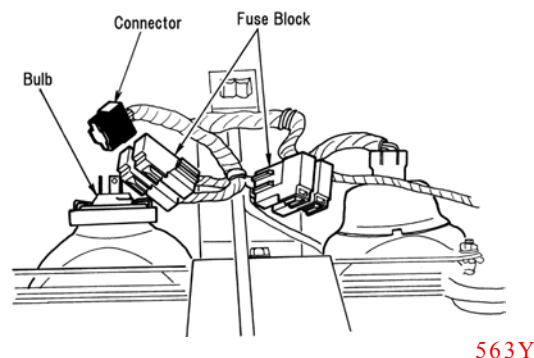
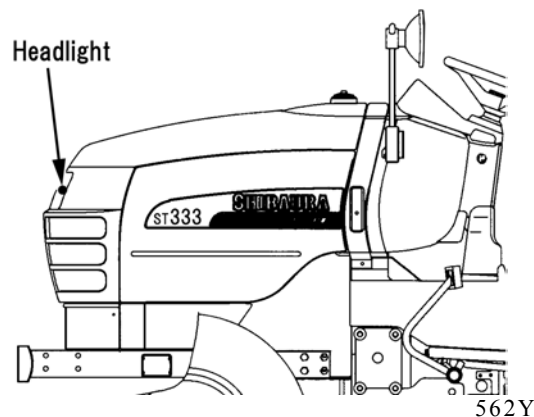
NOTE :

1. *Replace the headlight bulb with new bulb.*
2. *Do not touch naked fingers to the bulb glass.*

Inspect the bulb and filament for damage or corrosion. Replace as necessary.

Installation

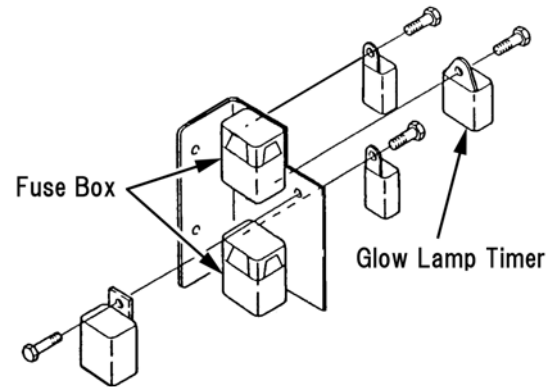
1. Place the headlight bulb in place and turn the bulb support to clockwise so that locks bulb into the headlight assembly.
2. Install the rubber on the headlight assembly.
3. Install the connector on the headlight terminal.
4. Install the negative terminal to the negative battery terminal.



20) GLOW LAMP TIMER

Description and Location

The glow plug indicator light timer is an electronic timer that is located under the engine cover on the right side of the tractor firewall. The timer controls how long the glow plug indicator light on the instrument panel remains illuminated when the key switch is in the "HEAT" position (approximately 4 ~ 5 seconds). The glow plug indicator light timer does not control current to the glow plugs, only current to the indicator light on the instrument panel. The timer turns the indicator light off by opening the circuit to the light on the instrument panel.



565Y

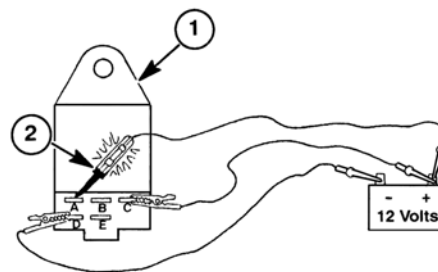
Glow Plug Indicator Light Timer Operation Testing

1. Disconnect the negative (-) battery cable from the battery.
2. Remove the bolt retaining the light timer to the tractor and disconnect the timer from the main wiring harness.

NOTE:

The terminals are not number or letter coded on the light timer.

3. Connect a jumper wire from terminal "C" on the timer, 1, to the positive (+) terminal of a 12-volt power supply.
4. Connect a test light, 2, from terminal "A" of the timer, 1, to the positive (+) terminal of a 12-volt power supply.
5. Connect a jumper wire from terminal "D" of the timer, 1, to the negative (-) terminal of the 12-volt power supply. Observe the test light, 2.
6. The test light should illuminate for approximately 4 ~ 5 seconds and then turn off. If the test light fails to illuminate or does not turn off after 4 ~ 5 seconds, the timer is defective and needs replaced.
7. Connect the negative (-) battery cable to the battery.



566Y

21) ELECTRIC CRUISE CONTROL SWITCH (HST Model only)

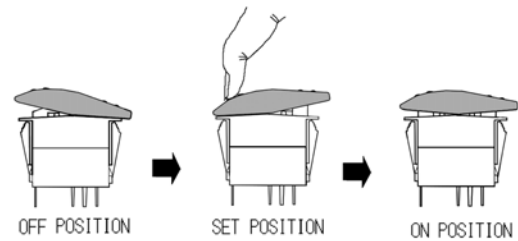
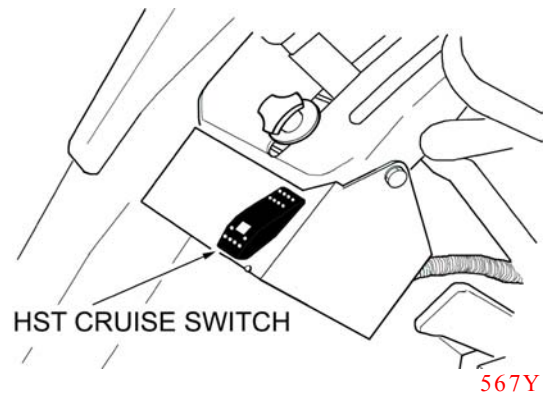
Description and Location

The electric cruise control switch, 1, is located to the right **fender**.

The cruise control switch controls current to cruise control magnet. Cruise control is used to maintain the tractor at a constant speed forward.

When the cruise control switch is pushed from the "off" position to the "set" position, the control circuit of the cruise control, relay is energized. This closes (completes) the function circuit of the relay, which supplies power to the cruise control magnet. When the cruise control switch is released from the "ON" position, the switch rockers to the "ON" position, which keeps the cruise control activated until the switch is pushed to the "OFF" position or the brake **pedals are depressed**. Current to the cruise control relay is interrupted when both brake switches **are** engaged, which deactivates the cruise control magnet.

The cruise control switch is equipped with an indicator light that will illuminate when the switch is moved to the "SET" and "ON" position, indicating the cruise control has been activated.



Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Disconnect the wiring harness connector from the cruise control switch.
3. Push the switch out of the **adapter**.

Cruise Control Switch Testing

NOTE:

Switch terminals are identified on the terminal end of the switch. Numbers 1 and 4 do not have terminals and are blank.

1. Using an ohmmeter touch one ohmmeter test probe to terminal 2 of the cruise control switch. Touch the other ohmmeter probe to terminal 3.
2. Press the cruise control switch from the "OFF" position and hold the switch to the "SET" position. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating continuity. If there is no continuity, the switch is defective and needs replaced.
3. Touch one ohmmeter test probe to terminals 5 and the other probe to terminal 6.
4. Press the cruise control switch from the "SET" position and hold the switch to the "SET" position. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating continuity.

If there is no continuity, the switch is defective and needs replaced.

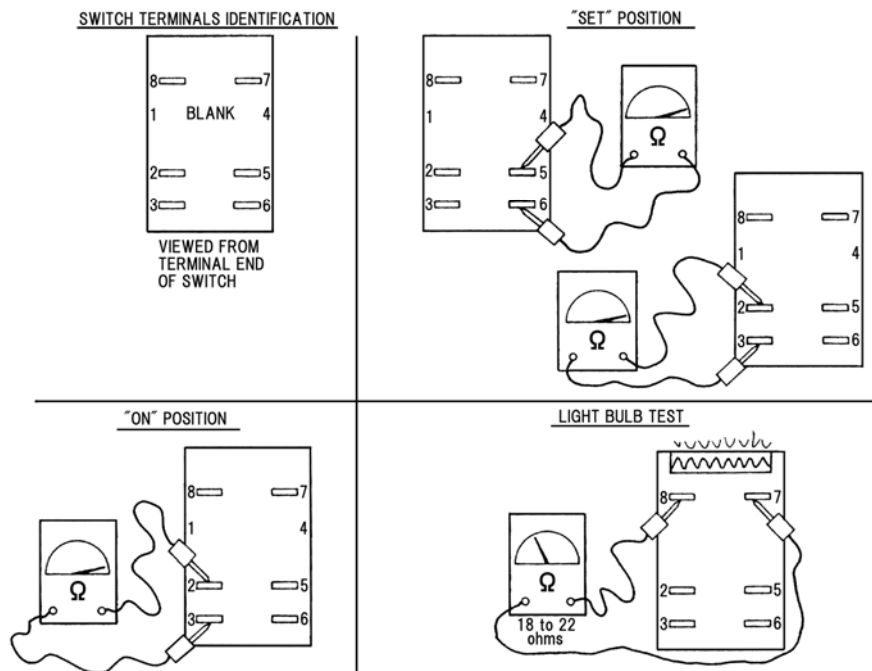
5. Continue to hold ohmmeter test probes to terminal 2 and 3 of the switch and let the switch rocker from the "SET" position to the "ON" position. Observe the ohmmeter. The ohmmeter should show little or no resistance indicating continuity. If there is no continuity, the switch is defective and needs replaced.

NOTE:

The cruise control switch indicator light is not serviceable and cannot be replaced. If the light is defective, the cruise control switch must be replaced.

6. To test the internal light bulb for the switch, touch an ohmmeter test probe to terminal 7 and the other ohmmeter test probe to terminal 8 of the cruise control switch. Observe the ohmmeter. The ohmmeter should show between 18 and 22 ohms of resistance. If the resistance is not within specifications, the switch light is defective and the switch needs replaced.

TESTING CRUISE CONTROL ROCKER SWITCH



569Y

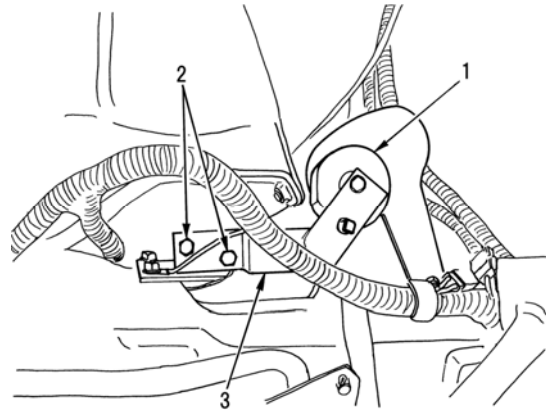
Installation

Assembly of the cruise control switch generally follows the disassembly in reverse.

22) CRUISE CONTROL MAGNET (HST Model only)

Description and Location

The cruise control magnet, 1, is located under the left tractor in the dash board and is attached to the hydrostatic transmission (HST) linkage. The cruise control magnet is a simple electromagnet. When the cruise control switch is activated, current is supplied to the cruise control magnet and the magnet locks the HST control linkage in place. This maintains a constant transmission speed, which translates to a constant tractor ground speed, forward.



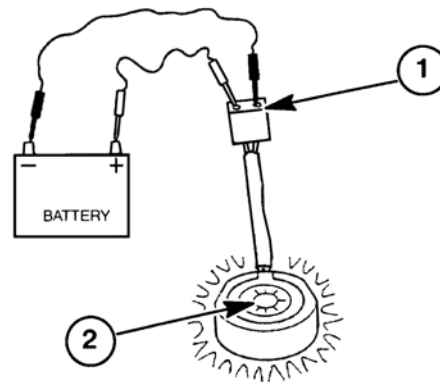
570Y

Removal

1. Disconnect the negative (-) battery cable from the battery.
2. Pull up instrument panel and remove the left dashboard.
3. Disconnect the main wiring harness connector, from the cruise control magnet.
4. Remove the two bolts, 2, which secures the cruise control magnet mounting bracket, 3, to the steering column. Remove the magnet from the tractor.

Cruise Control Magnet Testing

1. Using an ohmmeter, connect test leads to each terminal on the cruise control magnet connector, 1.
2. Observe the ohmmeter. The ohmmeter should indicate a resistance of 11 - 12 ohms. If the resistance of the magnet is not as specified, the magnet is defective and needs replaced.
3. Use jumper wires to connect a 12-volt power supply to the terminals on the cruise control magnet connector, 1.
4. The cruise control magnet, 2, should become magnetic and attract any ferrous object. If the cruise control magnet does not attract any ferrous objects, the magnet is defective and needs replaced.



Installation

Assembly of the cruise control magnet generally follows the disassembly in reverse.

571Y

23) PARKING BRAKE SWITCH (385200731)

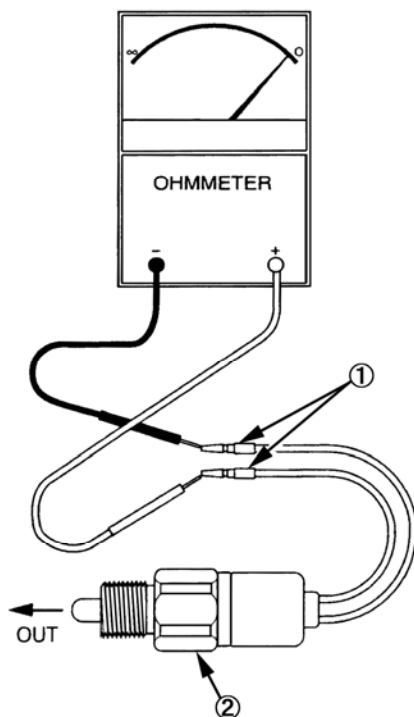
Description

The parking brake light switch is a single pole, push-button type switch. The parking brake light switch is located underneath the parking brake lever on the parking brake linkage, which is on the right side of the tractor. When the parking brake is pull up the contacts in the switch is closed. When the parking brake is pull down the contacts in the switch is open.

Removal

NOTE: The parking brake light switch may be tested for continuity without removing the switch from the tractor, but it is recommended that the switch be down removed for testing. To test the switch in the tractor, disconnect the two switch leads to switch and touch an ohmmeter probe to each lead. Engage and disengage the parking brake, using the continuity test to check the switch for proper operation.

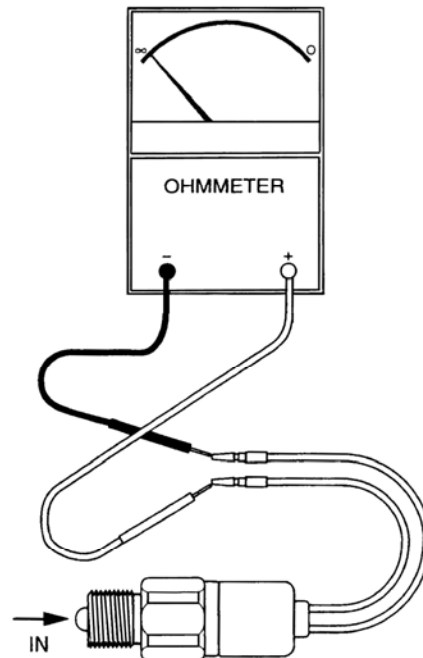
1. Disconnect the negative (-) battery cable from the battery.



Parking Brake Light Switch

Trouble-shooting - Continuity Test

1. Using an ohmmeter, connect test leads to each terminal, 1, on the safety switch, 2. Observe the ohmmeter reading.
2. With the switch button in the "OUT" (parking brake engaged) position, the switch contacts should be closed, and there will be little or no resistance indicating continuity in the switch. If there is no continuity, the switch is defective and needs replaced.
2. With the switch button in the "IN" (parking brake disengaged) position, the switch contacts should be open, and there will be high resistance, indicating no continuity in the switch. If there is continuity, the switch is defective and needs replaced.



572Y

Installation

1. Assemble of the parking brake safety switch generally follows the disassembly in reverse.

24) COMBINATION SWITCH

DESCRIPTION

Hazard Light Switch Description

The combination switch is located on the left-hand side of the dashboard. The combination switch consists of hazard light switch, flasher light switch and horn switch. The hazard and flasher switch, 1, are dial switch and horn switch is a push **button** switch. The two positions of the hazard light switch are ON and OFF. When the hazard light switch is in the "ON" position, the flasher/warning lights on the fenders will operate.

NOTE: The hazard lights can be activated with the key switch in the "OFF" position.

Flasher Light Switch Description

The three positions of the flasher light switch are OFF, Right turn and Left turn. When the flasher light switch is in the "Right" or "Left" turn position, the flasher lights on the fender and instrument panel will operate.

Horn Switch Description

The horn switch is pushed ON type switch. When the horn switch is pushed, horn circuit is complete and alarm the horn.

Combination Switch Removal

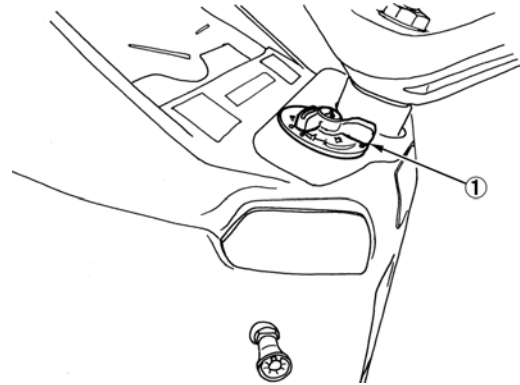
Remove the instrument panel to gain access to the combination switch. To remove the switch, unplug it from the harness, release the retaining tabs, and lift the switch out of the instrument panel from the top.

A. Hazard Light Switch Testing

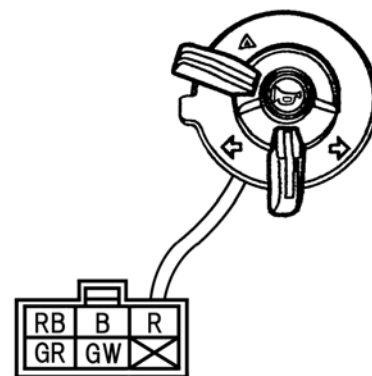
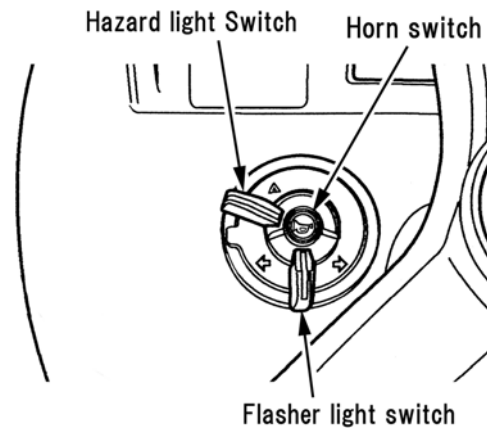
Use an ohmmeter to test the hazard light switch.

1. With the switch in the "OFF" position, there will not be continuity between any of the terminals.
2. With the switch in the "ON" position, there will be continuity between terminals GW, RB and GR.

If test results are not as outlined above, replace the combination switch.



573Y



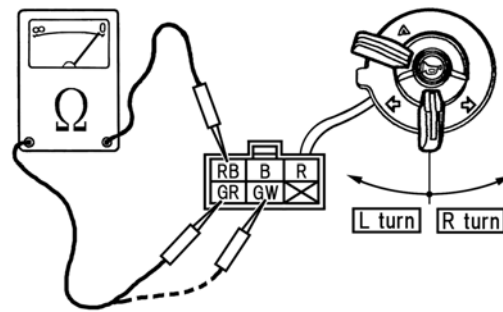
575Y

B. Flasher Light Switch Testing

Use an ohmmeter to test the flasher light switch.

1. With the switch in the "OFF" position, there will not be continuity between any of the terminals.
2. With the switch in the "R turn" position, there will be continuity between terminals RB and GW.
3. With the switch in the "L turn" position, there will be continuity between terminals RB and GR.

If test results are not as outlined above, replace the combination switch.



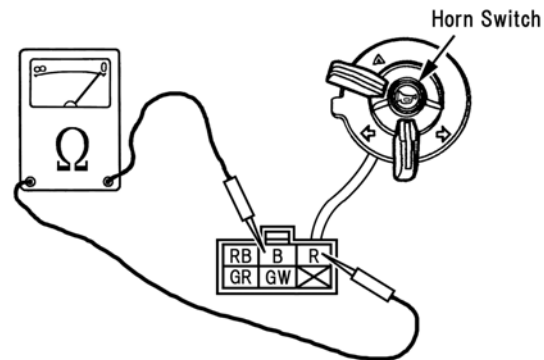
576Y

C. Horn Switch Testing

Use an ohmmeter to test the horn switch.

1. With the switch in the "OFF" position, there will not be continuity between any of the terminals.
2. With the switch at the "push" position, there will be continuity between terminals B and R.

If test results are not as outlined above, replace the combination switch.



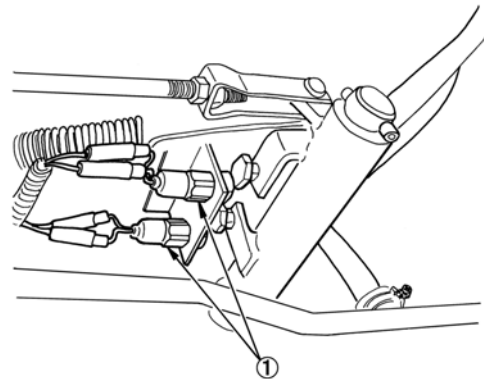
577Y

25) BRAKE LAMP SWITCH

Description and Location

The master brake switch, 1, is a single pole, pullout-plunger type switch. The switches are located under the right side of the operator's on the master brake linkage. The switch is closed when the brake pedal is depressed about 20mm.

When the brake pedal is not depressed, the switch contacts are open.

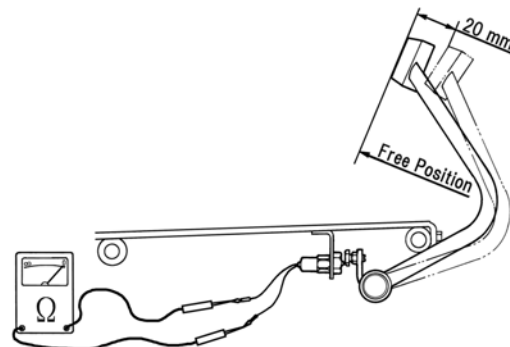


578Y

Adjustment

If the master brake switch is suspected of being defective, check the adjustment of the switch before replacing. The switch also needs adjusted if removed from the tractor. To adjust the switch use the following procedure:

1. Using an ohmmeter connect test leads to each terminals on the each switches and observe the ohmmeter.
2. Adjust the brake switch is closed position by bolt and lock nut when depress the brake pedal to 20mm.



579Y

26) BRAKE light RELAY (No.385230250)

The brake light relay is installed on the bottom of steering column in the dashboard, and it is connected with white connector of main wire harness.

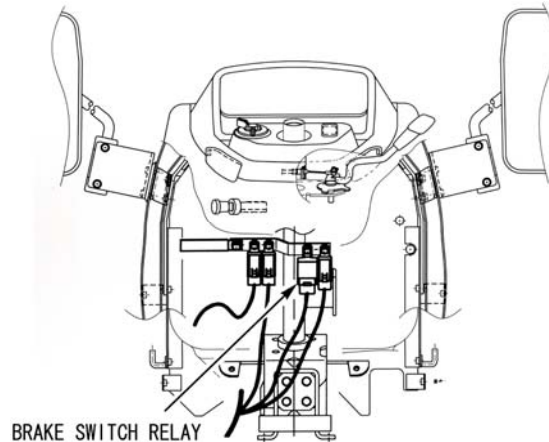
The relay is automatically complete (close) a circuit.

The brake light is a single-pole, single-throw switch (SPST) that contains three circuits.

One circuit is the control circuit, which controls the relay's coil. The other two are function circuits. The brake light relay switches from one function circuit to another when the coil is energized. One function circuit is always closed, which depends on if the relay's coil is energized. The brake light relay does not utilize an internal diode. The master brake switch when closed, will energize the brake light relay coil, which completes brake lamp circuit. This allows the brake lamps illuminate.

When the coil is not energized, the relay completes the circuit for brake lamps.

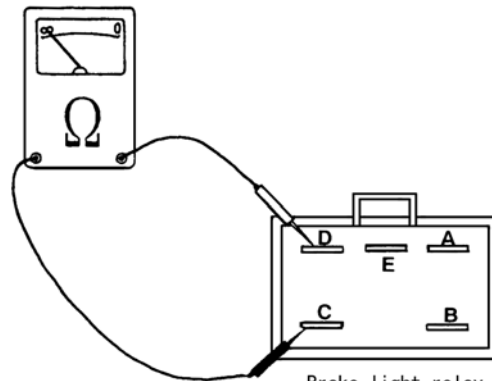
If the operator depresses the master brake pedal the relay's coil will energize, which also close brake lamps circuit.



581Y

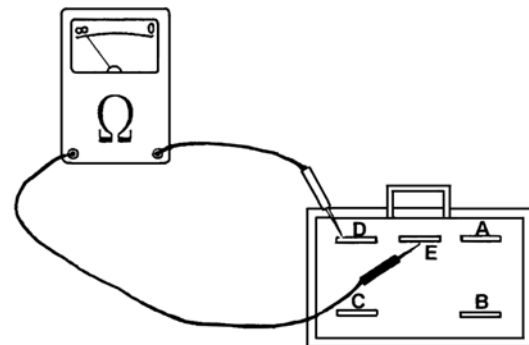
Brake light Relay Test

1. Disconnect the connector and remove the brake relay from the tractor.
2. Using an ohmmeter, connect test probes to terminals "C" and "D" on the relay. Observe the ohmmeter reading. Repeat for terminals "D" and "E".



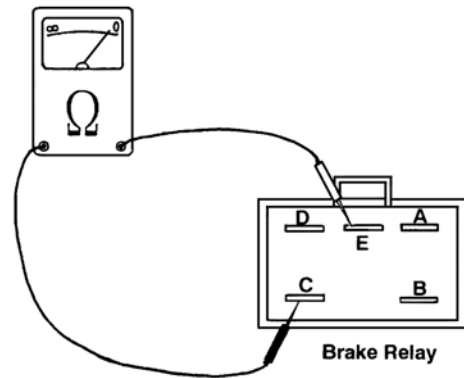
582Y

3. There should be high resistance between terminals "C" and "D" and terminals "D" and "E", indicating no continuity and that the relay is functioning properly when non-energized. If there is continuity, the relay is defective and needs replaced.



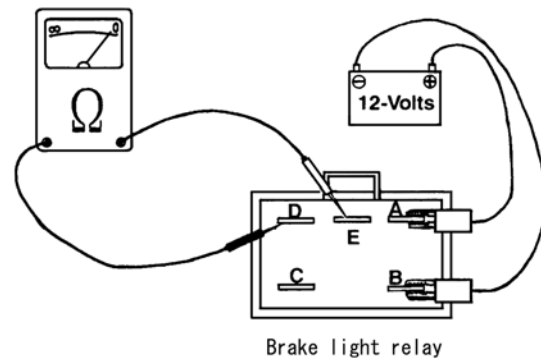
583Y

4. Using an ohmmeter, connect test probes to terminals "C" and "E" on the relay. Observe the ohmmeter reading.
5. There should be little or no resistance between terminals "C" and "E", indicating that there is continuity and that the relay is functioning properly. If there is no continuity between the terminals, the relay is defective and needs replaced.



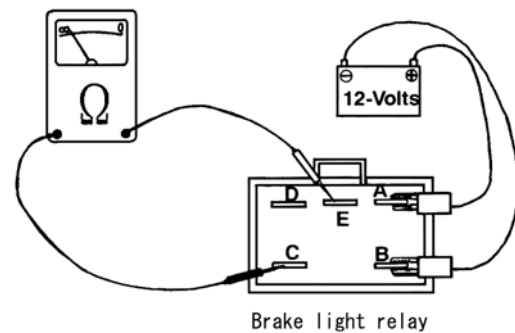
584Y

6. To test the relay when energized, connect a 12-volt power supply to terminals "A" and "B" (brass terminals) on the relay. Touch ohmmeter test probes to the "E" and "D" terminals on the relay and observe the ohmmeter. Little or no resistance between the terminals indicates that there is continuity and that the relay is functioning properly. If there is no continuity between the terminals, the relay is defective and needs replaced.



585Y

7. There should be high resistance between terminals "C" and "E", indicating that there is no continuity and that the relay is functioning properly. If there is continuity between the terminals, the relay is defective and needs replaced.



586Y

27) HST CRUISE LATCH RELEY

Description and Location

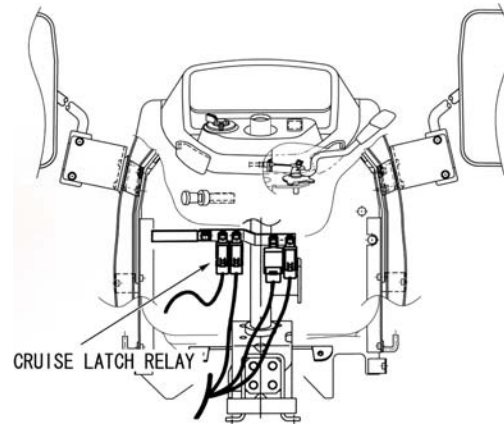
HST cruise latch relay is used to automatically complete (close) a circuit. The relay is located under the instrument panel in the dashboard.

It is connected with black color connector of main circuit.

The HST cruise relay is same part and interchangeable with safety start relay.

The relay description and test operation are referred to “6) RELAY FOR SAFETY START.”

The coil is energized when HST switch is “ON” position and current flows to HST cruise magnet.



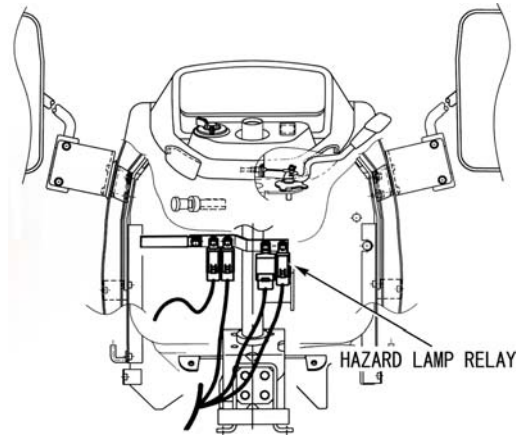
587Y

28) HAZARD LAMP RELAY

Description

Hazard lamp relay is installed in the dashboard. The hazard lamp relay is same part and interchangeable with safety start relay.

The relay description and test operation are referred to “6) RELAY FOR SAFETY START.”



588Y

29)FLASHER AND HAZARD RELAY

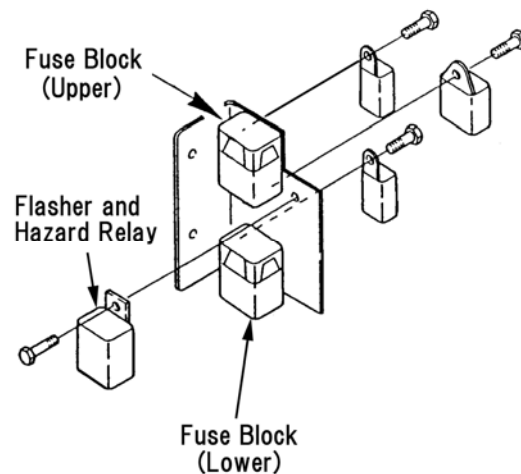
Description

Flasher and hazard relay is installed near fuse blocks.

The flasher and hazard relay controls the flashing of the turn light and/or hazard light, and pilot light in the instrument panel by the turn signal switch or hazard light switch.

NOTE :

Hazard relay is not working when the four turn signal lights are not connected.



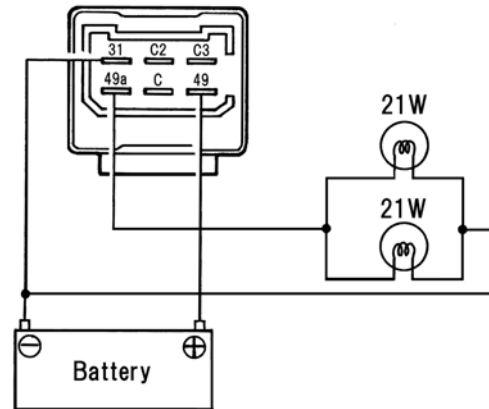
589Y

Flasher Light Relay Testing

A 12-volt battery and auxiliary light are needed to test the relay. The terminals are not marked on the relay itself.

1. Install the battery's positive (+) lead to terminal "49" of the relay.
2. Install both of the light's positive (+) leads to terminal "49a" of the relay.
3. Install the battery's negative (–) lead and the light's negative (–) leads to terminal "31" of the relay.
4. The lights will flash and the relay will make a clicking sound if the relay is functioning properly.
Replace the relay if test results do not match the above.

No. 385230150

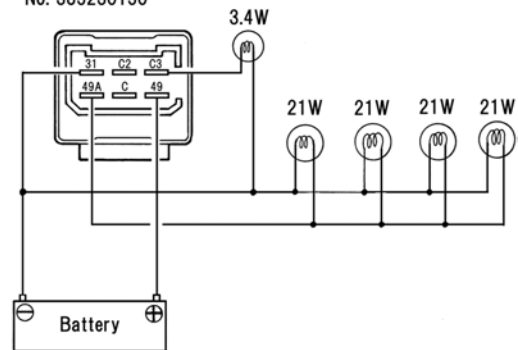


590Y

Hazard Light Relay Testing

1. Install the battery's positive (+) lead to terminal "49" of the relay.
2. Install four 21W of the light's positive (+) leads to terminal "49a" of the relay.
3. Install 3.4W of the light's positive (+) lead to terminal "C3" of the relay.
4. Install the battery's negative (–) lead and the light's negative (–) leads to terminal "31" of the relay.
5. The lights will flash and the relay will make a clicking sound if the relay is functioning properly. Replace the relay if test results do not match the above.

No. 385230150



591Y

30) HORN

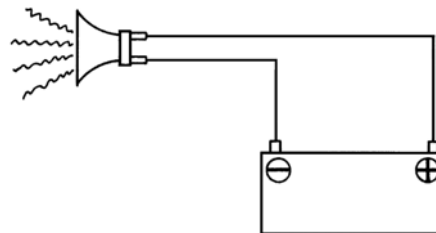
Description

The horn installs near the right headlamp in the engine cover.

The horn is energized and alarm when the horn button pushed.

Test

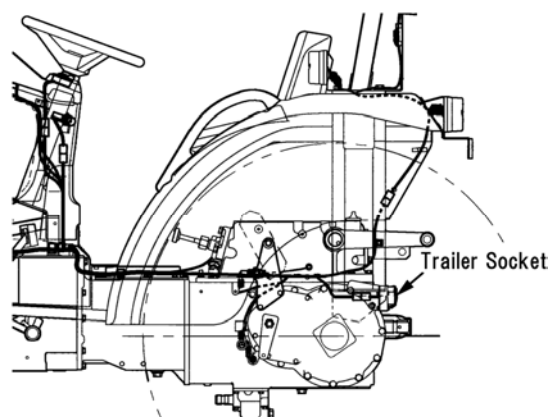
1. Connect the battery terminals to the horn terminal.
2. The horn alarms, the horn is properly.
Replace the horn if horn is not alarmed.



592Y

31) TRAILER SOCKET

The trailer socket is installed left side on the rear axle housing. This socket is a standard seven pin socket.

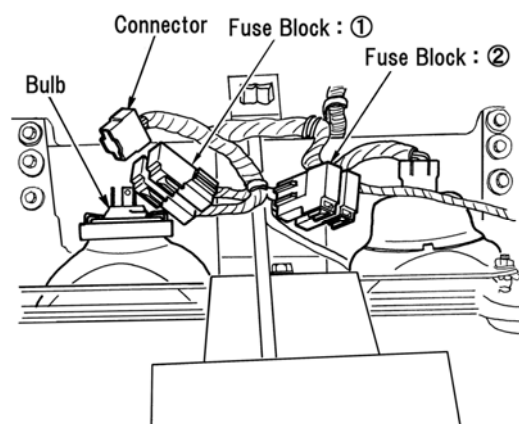


593Y

32) FUSE BLOCK FOR HEADLAMP

The fuse blocks for headlamps are located near the headlamp in the engine cover. The fuse blocks hold fuses that protect individual headlamps circuit.

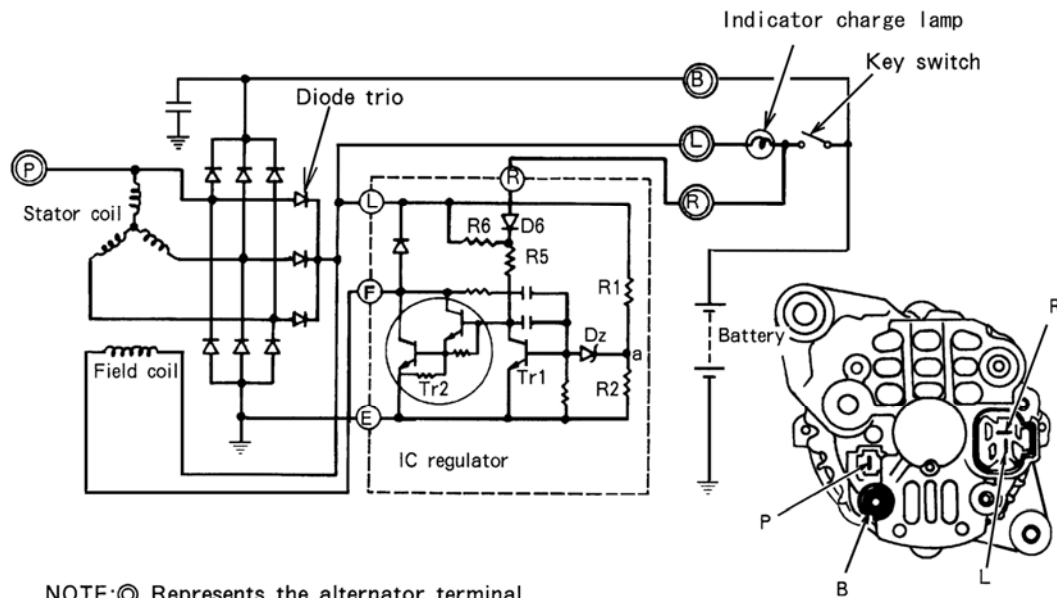
Headlight Fuse Block		
	Fuse Size	Circuit protected
①	7.5 amp	Headlight - Low Beam
②	7.5 amp	Headlight - High Beam



594Y

33) ALTERNATOR (40 amp version) (No. 185046320)

1. Charging circuit



595Y

2. Description

- A. The charging circuit and internal connection are shown in Fig. 595Y. The charging system consists of an I C regulator built in alternator, a battery and connecting wires. Because of the use of IC, the voltage regulator is very compact and is built into the alternator.
- B. The field current flows directly from the diode trio to the field coil with out passing through the external circuit. But to help the initial voltage built up when the engine is started, the field current is supplied through the indicator lamp from the battery.
- C. Since the frequency pulse output of 1/10 the alternator speed develops on P terminal, this terminal is used for speed detection.

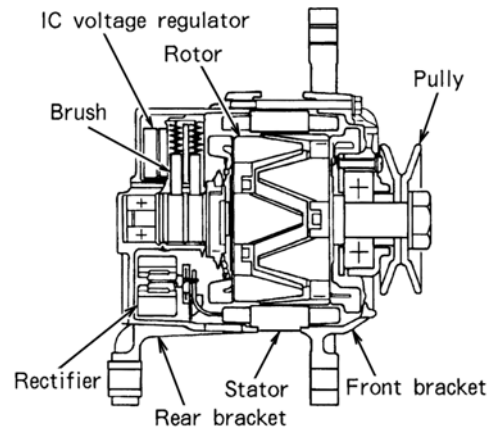
3. Construction

The principal components of the IC alternator are the stator, the rotor, the rectifier assembly, the IC voltage regulator, the front bracket, the rear bracket and the pulley.

The rectifier assembly consists of two heat sinks, one positive and one negative, and diode trio.

The diode trio is used as field supply diode and is connected to the field coil and the terminal L on the alternator.

The built-in IC regulator is a solid-state unit so that it can only be serviced as an assembly.

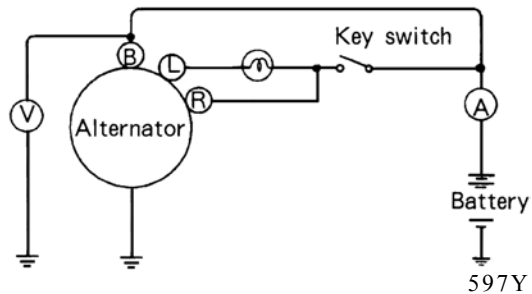


596Y

4. Check on the Equipment

A. Checking the regulator adjusting voltage.

- a. In the case of equipment without an ammeter, connect a test ammeter (50A capacity) at the position shown in Fig.597Y.



597Y

- b. Connect a voltmeter between the terminal B of the alternator and the ground. In this state, confirm that the reading on the voltmeter indicates the battery voltage.
If the voltmeter reading is zero, the wiring between the terminal B and the battery is faulty.
- c. With the test ammeter terminals short-circuited, start the engine.

CAUTION:

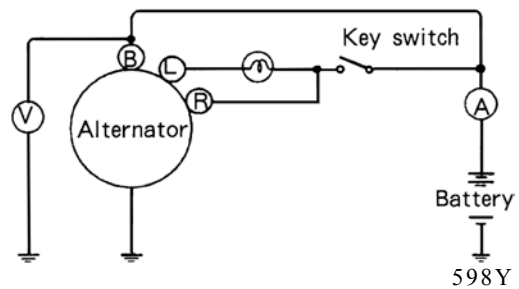
In the case of where the test ammeter is connected at the position shown in Fig.597Y, make sure that no starting current is applied to the ammeter when the engine is started.

- d. Remove the short circuit across the test ammeter terminals and increase the engine speed immediately to approx. 2000rpm. Take the ammeter reading.
- e. If the ammeter reading is 5A or less, take the voltmeter reading without changing the engine speed (approx. 2000rpm). The reading is the adjusting voltage.
- f. If the ammeter reading is more than 5A, continue to charge the battery until the reading falls to less than 5A or replace the battery with a fully charged one.
An alternative method is to limit the charging current by connecting a 1/4 Ω (25W) resistor in series with the battery.

B. Checking output

If the previous section "A" check is satisfactory, check the output as follows:

- After opening the battery switch, disconnect the terminal B of the alternator and connect an ammeter (50A capacity) at the position shown in Fig.598Y.
- Connect the voltmeter between the terminal B of the alternator and the ground. Confirm that the voltmeter indicates the battery voltage.
- Close the key switch.
- Start the engine and turn on all the lamps. Immediately accelerate the engine to 2000 rpm. Or more and measure the maximum value indicated on the ammeter.
- If this value is more than 70% of the nominal output (refer to Section on "Service Specifications"), the alternator can be considered as working almost at its factory.

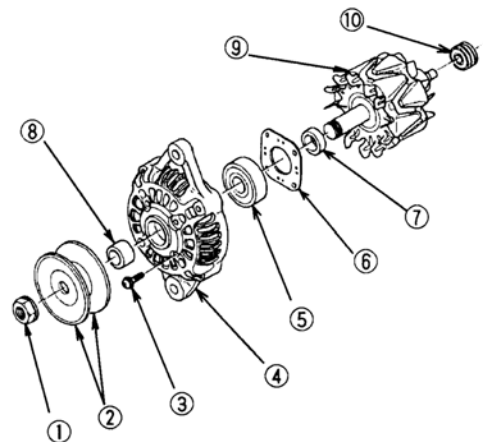


NOTE:

To make the above judgment more accurate, remove the alternator from the engine and check it on a test bench.

5. Disassembly

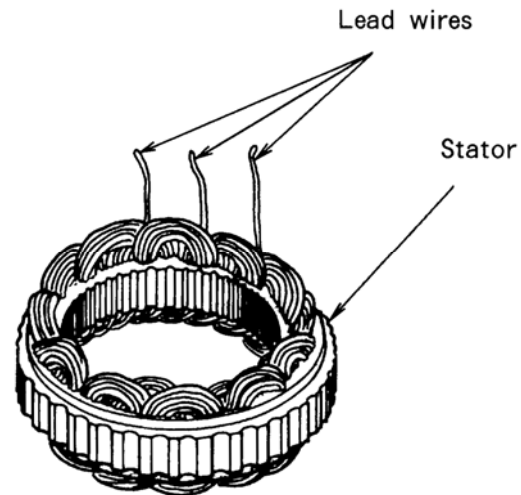
- Mark both brackets and the stator with a scribe mark for assembly.
- Remove the four through bolts. Pry between the stator and front bracket④ with blade of a screwdriver. Carefully separate the front bracket④, pulley② and rotor assembly⑨ away from the stator and rear bracket assembly.
- Place the rotor⑨ in a vice with soft jaws and remove the pulley nut①, washer, pulley spacer⑧ and front bracket④ from the rotor⑨.



- | | |
|-----------------|------------------|
| ① Pulley nut | ⑥ Bearing holder |
| ② Pulley | ⑦ Collar |
| ③ Screw | ⑧ Pulley spacer |
| ④ Front bracket | ⑨ Rotor |
| ⑤ Bearing | ⑩ Bearing |

599

- d. Unsolder three stator leads and remove the stator.
- e. Remove the voltage regulator assembly and rectifier assembly as a set.

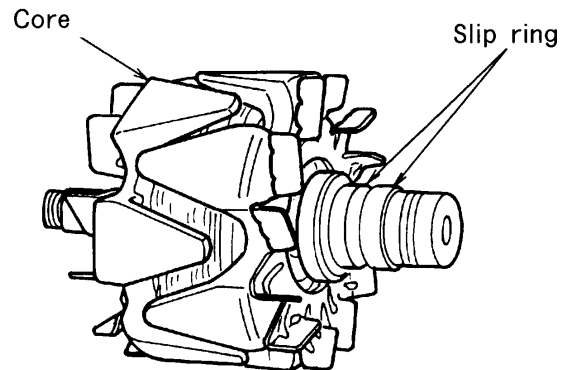


600Y

6. Inspection of parts

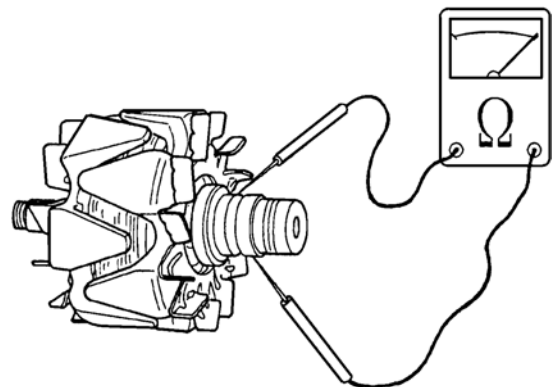
A. Rotor

- a. Inspection of slip ring surface.
Correct stain or scratches on the slip ring surface with a sand paper of about 400-600#
A badly roughened slip ring or a slip ring worn down beyond the service limit should be replaced.



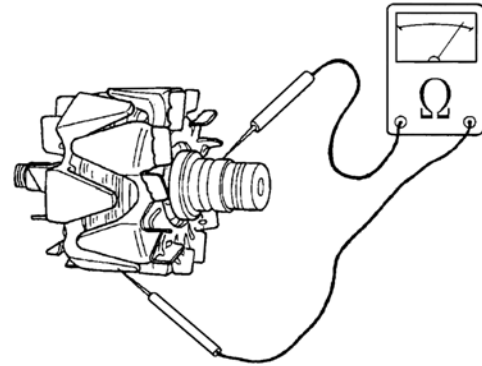
601Y

- b. Check for continuity between both the slip rings, Figure 602Y.
If there is no continuity, the field coil is defective.
Replace the rotor assembly.



602Y

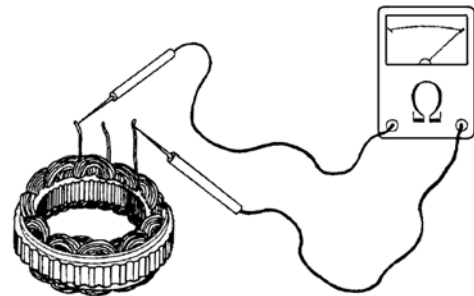
- c. Check for continuity between the slip ring and shaft (or core), Figure 603Y. If there is continuity, it means that the coil or slip ring is grounded. Replace the rotor assembly.



603Y

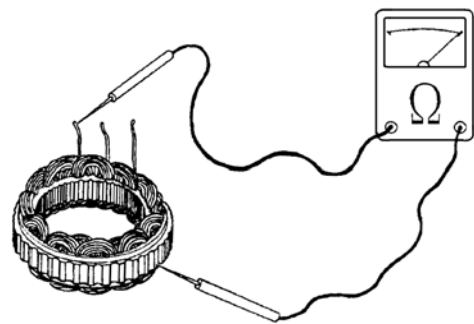
B. Stator

- a. Check for continuity between the leads of the stator coil, Figure 604Y. If there is no continuity, the stator coil is defective. Replace the stator assembly.



604Y

- b. Check for continuity between any stator lead and stator core, Figure 605Y. If there is continuity, it means that the coil is grounded. Replace the stator assembly.



605Y

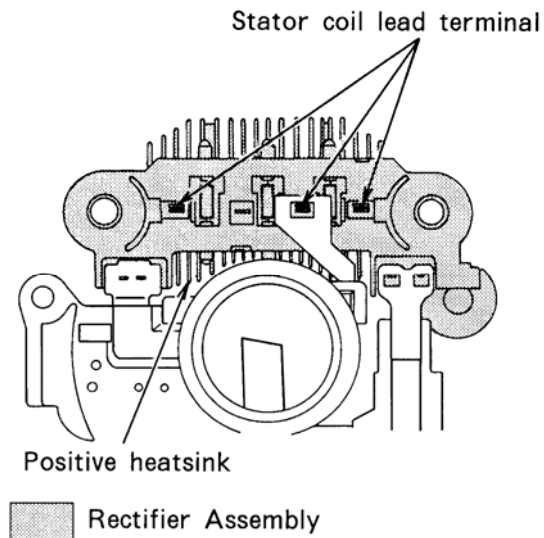
C. Rectifier Assembly

a. Positive Heat sink

Check for continuity between the positive (+) heat sink and stator coil lead connection terminal with a circuit tester.

If there is continuity in both directions, the diode is short-circuited.

Replace the rectifier assembly.



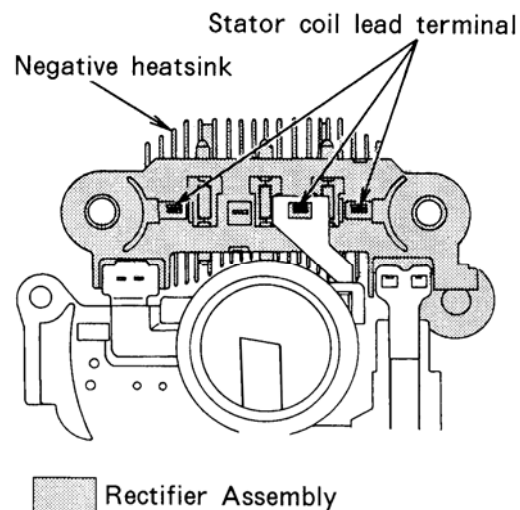
606Y

b. Negative Heat sink

Check for continuity between the negative (−) heat sink and stator coil lead connection terminal with a circuit tester.

If there is continuity in both directions, the diode is short-circuited.

Replace the rectifier assembly.



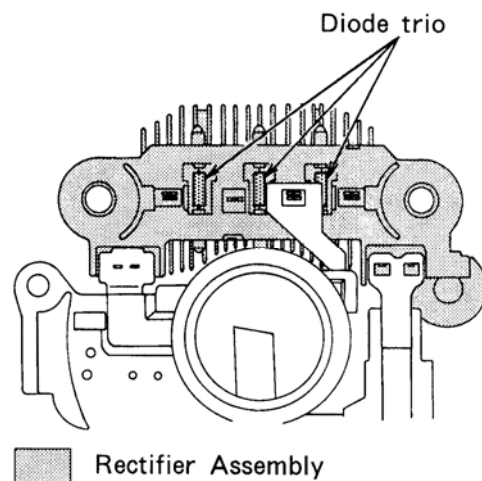
607Y

c. Diode Trio

Using a circuit tester, check the three small diodes for continuity in both directions.

If there is either continuity or an open circuit in both directions, the diode is defective.

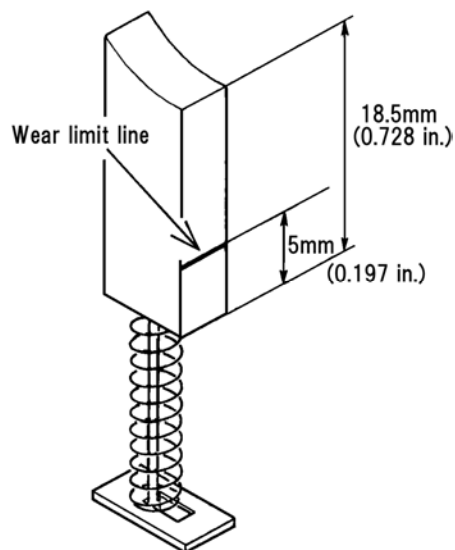
Replace the rectifier assembly.



608Y

d. Brush and Brush spring.

1. Check the length of the brush.
A brush worn down to the wear limit line should be replaced.
2. Check the brush spring pressure and make sure the brush moves smoothly in the brush holder.



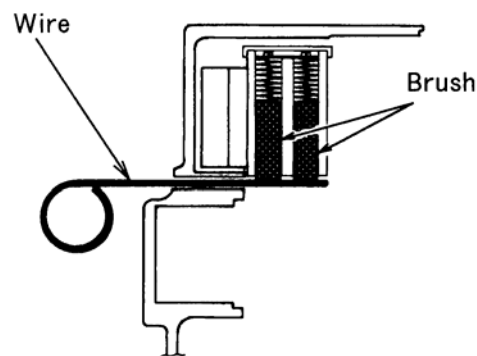
7. Reassembly

Reverse the disassembly procedure except for the following:

A. Installing rotor

Push brushes into brush holder, and insert a wire to hold them in raised position before install the rectifier and regulator assembly.

Install rotor and remove wire.



609Y

610Y

NOTE :

Since rear bearing and rear bracket fitting is tight, heat the bearing box in the rear bracket to 50 ~ 60 °C before installing rotor.

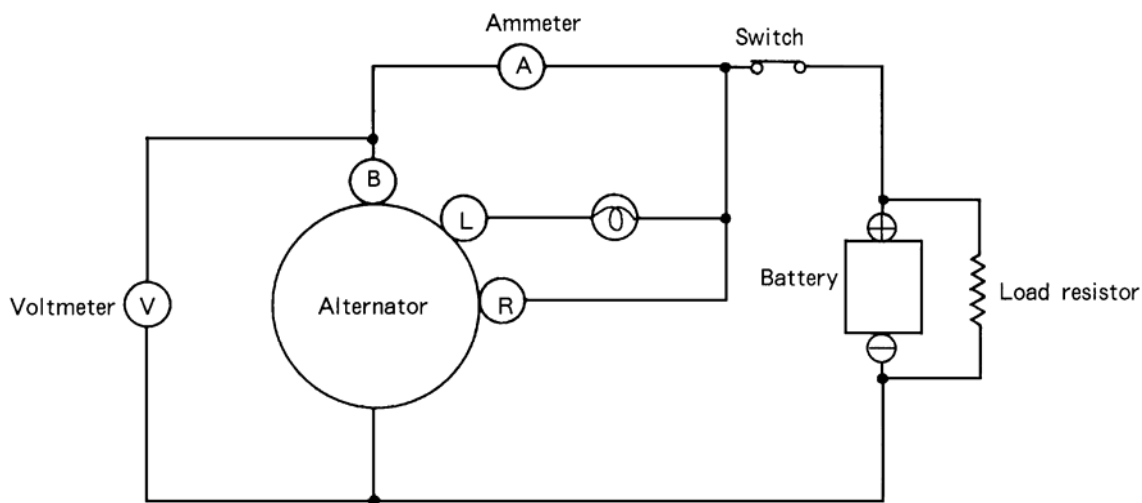
B. Lubrication to bearing box for bearing with resin band, grease should not be applied.

Remove oils completely if found on the bearing box in the rear bracket.

8. Bench Check

To check the alternator on a test bench, proceed as follows:

- Make connection as shown in the Figure 611Y, except leave the load resistor disconnected.
- Slowly increase the alternator speed and observe the voltage.
- If the voltage is uncontrolled with speed and increases above 15.5V, check the alternator.
- If voltage is below 15.5V, connect the load resistor as shown in the figure 611Y.
- Operate the alternator at 2500rpm and adjust the load resistor as required to obtain maximum output.
- Measure the output current. The output must be within the limits shown in the section on "Service Specifications".
If the output is less than specified value the alternator should be disassembled and checked.



611Y

9. Precautions

- Reversed battery connections will damage the alternator and/or wiring.
- When connecting a booster battery, make certain to connect negative battery terminals together and positive battery terminals together.
- When a fast charger is used to charge the battery, the equipment battery cables should be disconnected.
- Grounding of the alternator output terminal will damage the alternator and/or circuit.
- Do not connect a load of over 1A to the terminal "L".
- If the alternator is operated with the terminal L and B short-circuited, it may damage the diode trio.

10. Maintenance

Item Name		Model	A007T03877 (MITSUBISHI)
Nominal output		(V-A)	12-40
Polarity			Negative ground
Weight		(kg)	Approx.3.7 (8.2 lb)
Rotational direction (Viewed from the pulley)			Clockwise
Load characteristics (cold)	Terminal voltage	(V)	13.5
	Current	(A)	Min. 30
	Revolution number	(rpm)	2500
Brush length	Original	(mm)	18.5 (0.728")
	Limit	(mm)	5.0 (0.2")
Brush spring tension	Original	(g)	470~590 (1.036~1.300 lb)
	Limit	(g)	270 (0.60 lb)
Bearing	Rear side		ECSC8
	Front side		6303DDG
Slip ring diameter eccentric wear	To be repaired	(mm)	0.05 (.002")
	Allowable limit	(mm)	0.2 (0.08")
Slip rings surface condition			If dirty or damaged correct with emery clothe.
Rotor shaft bending	To be repaired	(mm)	0.07 (.0028")
Field coil resistance		(Ω/at 5000rpm)	2.8
Adjusting voltage		(V) (at 5000rpm)	14.4~15.0

11. Fault Finding

Trouble	Parts	Cause	Remedy
No charging	Wiring, ammeter	Disconnection, short circuit, loosened connection	Correct
	Alternator	Disconnection of coils, earth short circuit	Replace
		Defective rectifier	Replace
		Disconnection of RF resistor	Replace
	Regulator	Defective regulator	Replace
Insufficient charging	Wiring	Disconnection, short circuit, loosened connection	Correct
	Alternator	Loosened alternator belt	Correct
		Layer short of rotor coil	Replace
		Layer short of stator coil	Replace
		Defective rectifier	Replace
		Insufficient contact of brush, stained slip ring	Correct
	Regulator	Defective regulator	Replace
Over charge	Battery	Internal short circuit	Replace
	Regulator	Defective regulator	Replace
Unstable charging current	Wiring	Disconnection or breakage of wire	Replace
	Alternator	Slackened alternator drive belt	Replace
		Short of rotor coil, breakage of wire	Replace
		Shortage of stator coil, breakage of wire	Replace
		Insufficient contact of brush, stained brush and slip ring	Correct
		Broken brush and sprig	Replace
		Insufficient contact of terminals	Correct
	Regulator	Defective regulator	Replace
Abnormal noise of alternator	Alternator	Incorrect installation of alternator	Correct
		Defective bearing	Replace
		Rotor core and stator core in contact	Correct
		Defective diode	Replace
		Short of stator coil	Replace

34) STARTING MOTOR (M001T66081) (No. 185086551)

1. Description

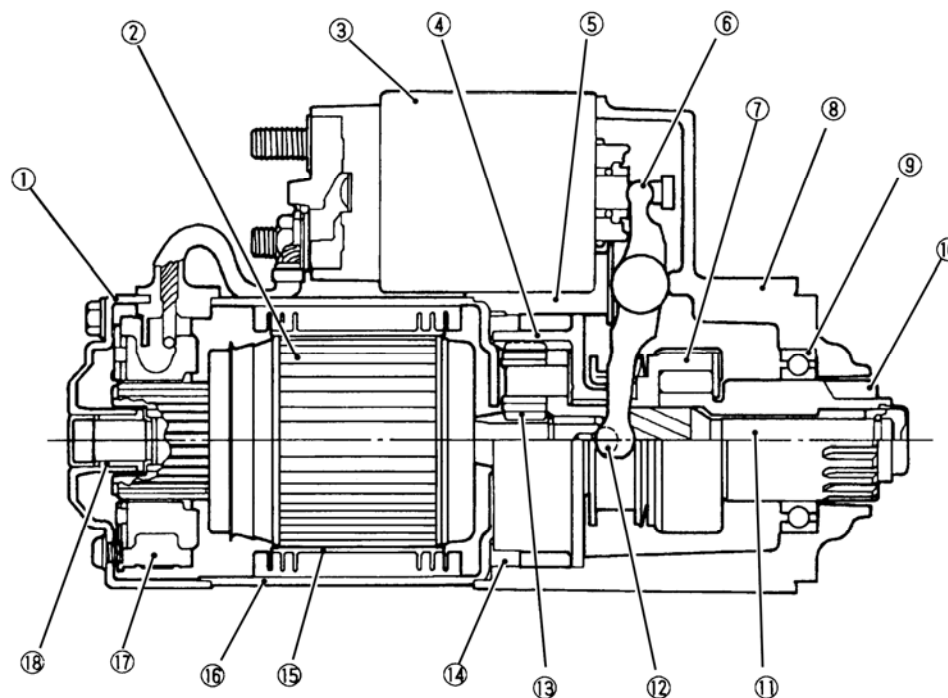
This starter features a reduction mechanism of planetary gearing system and permanent magnets for magnetic field induction.

Its reduction mechanism comprises internal gear, three planetary gears, gear shafts (with overrunning clutch fitted by spline) and armature shaft gear.

The structure is different from that of direct drive type, but the electrical wiring is the same between two types.

The magnetic field is produced by six permanent magnets. The magnets are mounted in the yoke and positioned according to polarity.

They are permanently attached to the yoke and, are not removable.



612Y

- | | | |
|-----------------|----------------------|-------------------|
| ① Rear Bracket | ⑦ Overrunning Clutch | ⑬ Planetary Gears |
| ② Armature | ⑧ Front Bracket | ⑭ Rubber Cover |
| ③ Switch | ⑨ Bearing | ⑮ Magnets |
| ④ Internal Gear | ⑩ Pinion | ⑯ Yoke |
| ⑤ Lever Packing | ⑪ Gear Shaft | ⑰ Brushes |
| ⑥ Lever | ⑫ Ball | ⑱ Sleeve Bearing |

2. Disassembly

Reference Figure 614Y.

NOTE :

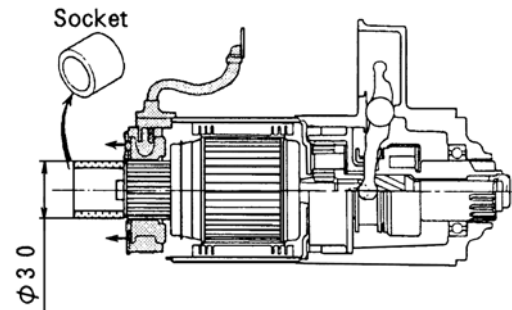
1. *Before disassembling starter, be sure to put match marks at two locations (switch and yoke) so that any possible mistake can be avoided.*
2. *Do not clamp yoke in a vise or strike it with a hammer during repair operations. Permanent magnets attached to yoke could be broken and yoke dented or deformed if mishandled.*

- (1) Remove switch terminal nut (1) and disconnect connecting wire (2). Remove screws (3) securing switch and remove switch and plunger (4).
- (2) Remove brush holder securing screws (5) and through bolts (6). Remove rear bracket (7) but do not remove brush holder (8).

- (3) Install a socket (outer diameter 30mm) on the armature commutator, see Figure 613Y.

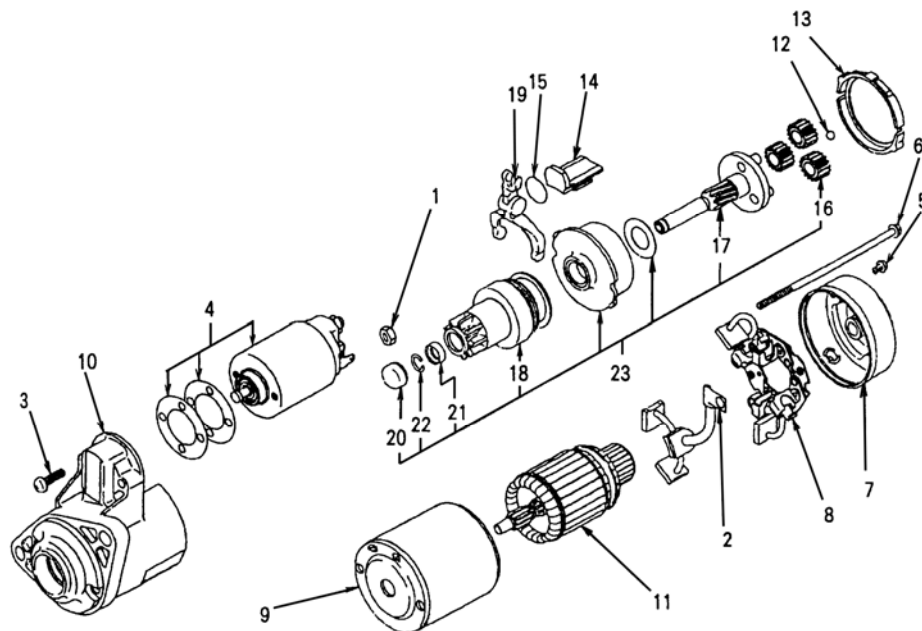
Then slide the brush holder (8) onto the socket.

Leave the socket in position in the brush holder for inspection and reassembly. Socket



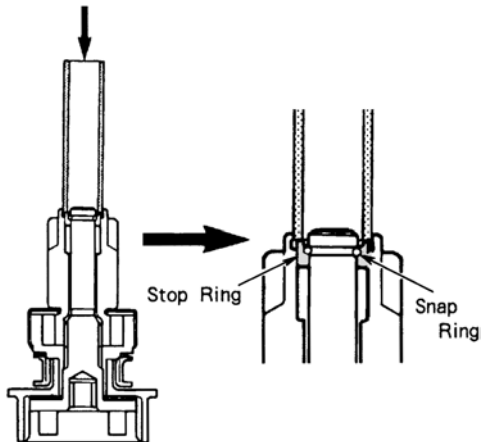
613Y

- (4) Slide yoke (9) away from front bracket (10).
- (5) Remove armature (11) and ball (12). Do not lose ball when removing the armature.



614Y

- (6) Remove rubber cover (13) from planetary gear assembly (23) and remove lever packing (14) and plate (15).
- (7) Remove planetary gears (16). Remove gear shaft/overrunning clutch assembly (18) and lever (19) as a unit from front bracket (10).
- (8) To remove overrunning clutch (18).
 - a. Remove plastic cap (20). If the cap is too badly distorted or cracked, it will be necessary to use a new one on reassembly.
 - b. Slide a piece of pipe of suitable size over shaft against stop ring (21). Then tap the pipe with a hammer to remove the stop ring and expose snap ring (22). Remove the pipe from the shaft.



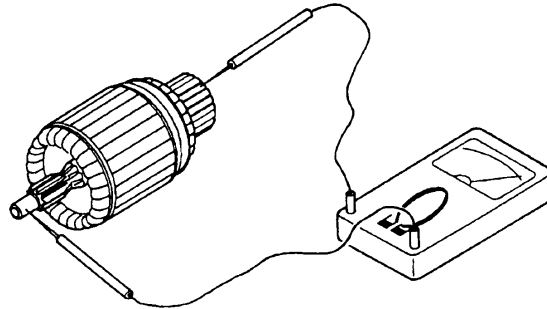
615Y

- c. Remove the snap ring and the stop ring and separate the over running clutch (18) from the gear shaft (17). If the snap ring is distorted, it will be necessary to use a new one on reassembly.

3. Inspections

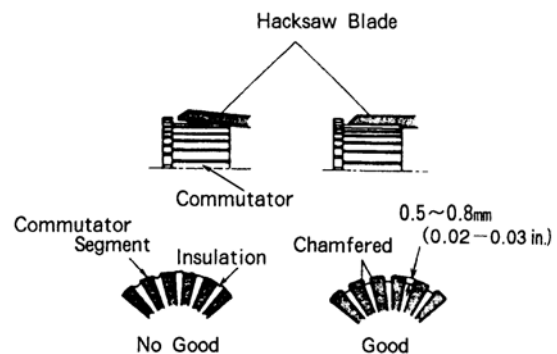
(1) Armature

- a. Inspect the armature coil for short-circuit with a growler tester. Replace armature if shorted.
- b. Inspect armature coil for ground with a circuit tester. Replace grounded armature.



616Y

- c. Inspect commutator for wear. If below the limit, replace armature.
- d. Inspect commutator for insulator depth. Correct if below the limit.
- e. Check gear teeth for wear or damage, and replace armature as necessary.



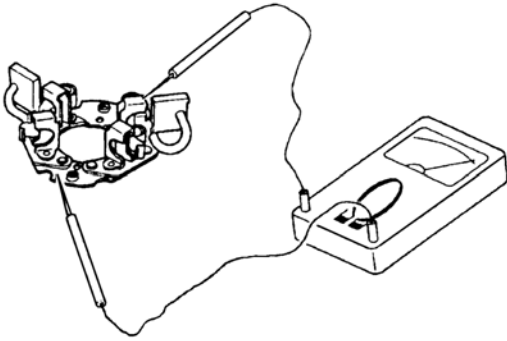
617Y

(2) Permanent magnets

Check permanent magnets for crack, damage and looseness, replace yoke assembly as necessary.

(3) Brushes

- a. Check brushes for wear. Replace brushes if below the limit.
- b. Check brush spring pressure to make sure brush moves smoothly in brush holder.
- c. To check brush holder assembly for grounds, touch one probe of a circuit tester to holder plate and the other probe to each of insulated holders. Replace brush holder assembly if any continuity is noted.



618Y

(4) Over running clutch and pinion gear.

While holding clutch housing, rotate pinion. Pinion should rotate smoothly in one direction (not necessarily easily), but should not rotate in opposite direction. If the clutch does not function properly, replace it. If pinion gear is worn or burred, replace it.

NOTE :

Overrunning clutch should not be cleaned with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism.

(5) Front bracket

Replace front bracket as an assembly including ball bearing if the bearing fails to rotate smoothly or it is noisy.

(6) Rear bracket

Replace rear bracket as an assembly including sleeve bearing if the bearing is badly worn.

(7) Internal gear and planetary gears

Replace the gears if their teeth are badly worn or damaged.

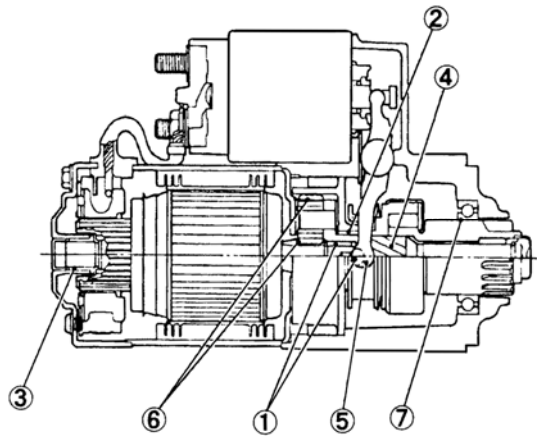
(8) Switch

Check continuity between M terminal and body (ground). Replace the switch if no continuity is noted.

4. Reassembly and adjustment

To reassemble the starter, follow the reverse of disassembling procedure, and observe the following precautions:

- (1) Apply grease to the following parts during assembly.
 - a. Sleeve bearing and ball.
 - b. Sleeve bearing in internal gear.
 - c. Sleeve bearing in rear bracket.
 - d. Gear shaft
 - e. Sliding surface of lever and overrunning clutch.
 - f. Armature shaft gear, internal gear and planetary gears.
 - g. Sliding surfaces of pinion and front bearing.



619Y

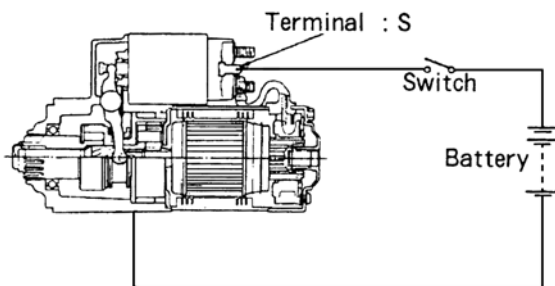
(2) Armature shaft endplay No adjustment.

(3) Pinion position adjustment.

After completing reassembly, check pinion position to be sure that it is between 0.5 and 2.0mm.

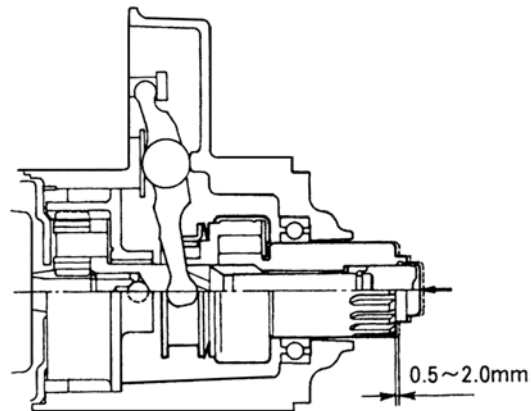
To adjust, proceed as follows :

- a. Connect the starter to a battery, as shown in Figure 620Y.
Close switch. This will shift pinion into **cranking** position.



620Y

- b. Push pinion back by hand and measure the amount of the pinion movement as shown in Figure 621Y.
If the amount does not fall within limit, adjust it by adding or removing shims which are located between switch and front bracket.
Adding shims decreases the amount of the movement.



621Y

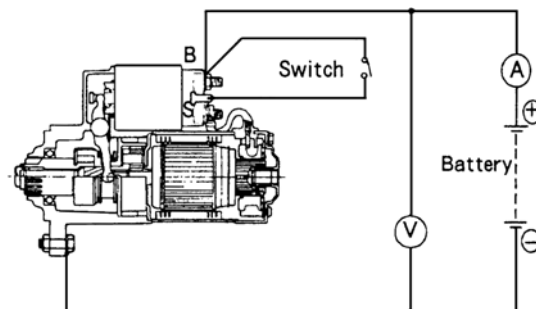
5. Non-load test

- (1) After adjusting pinion position, from a test circuit with a voltmeter and an ammeter, as shown in Figure 622Y.

NOTE :

Use wires as thick as possible and tighten each terminal fully.

- (2) Close the switch and compare the R.P.M. current and voltage readings with the Service Specifications.
- (3) If any abnormality is noted, check it according to the Inspections.



622Y

6. Maintenance

Item		Standard Value or Service Limit
No-load Characteristic	Volts	11
	Amps.	110 Max.
	R.P.M.	2400 Min.
Commutator	Outer Dia.	29.4 mm
	Service Limit	28.8 mm
Brush	Length	17.5 mm
	Service Limit	10 mm
Brush spring	Tension	22.5~32.5 N
	Service Limit	10 N
Pinion Movement (Pinion Gap)		0.5~2.0 mm

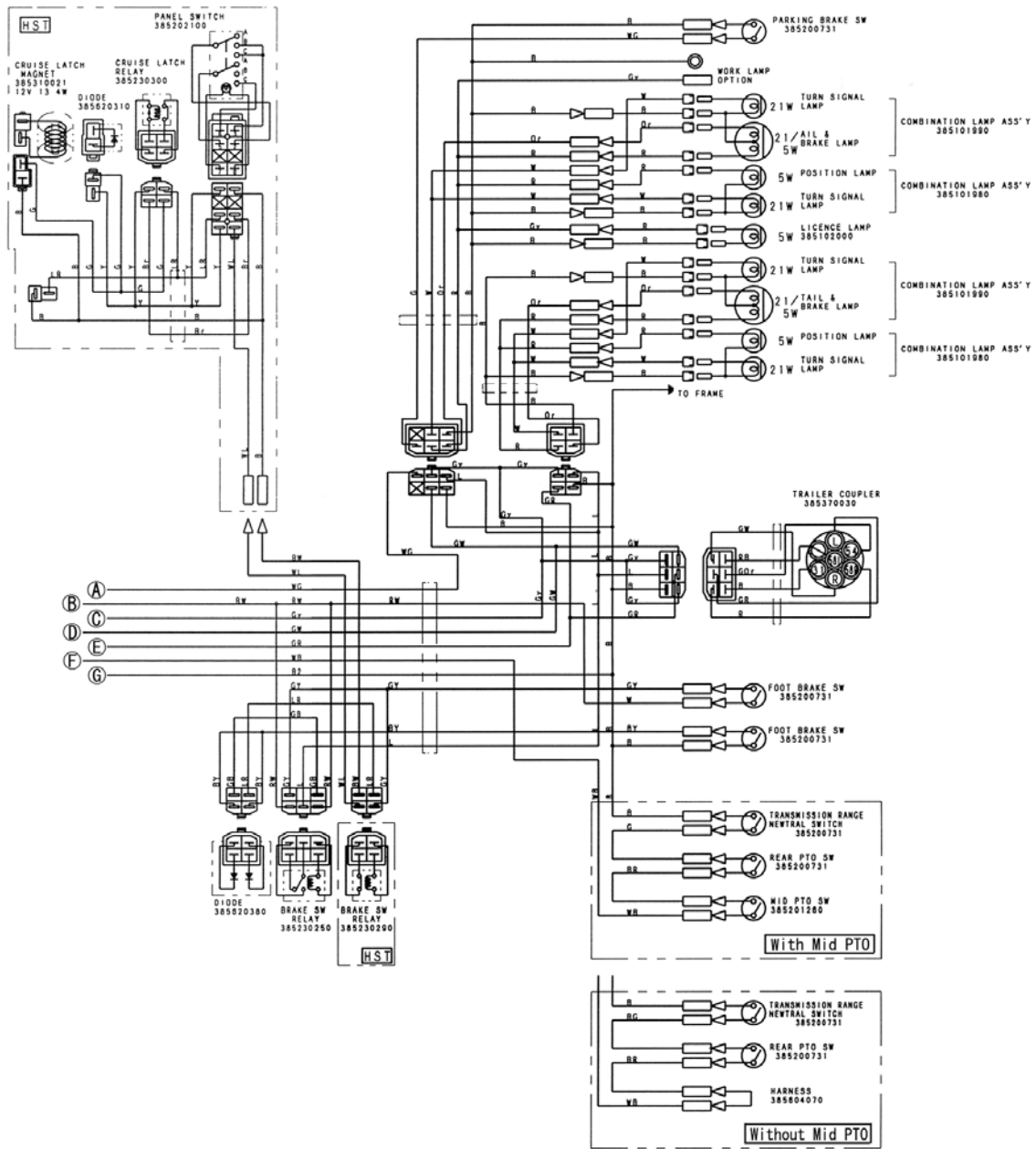
7. Troubleshooting

(1) Pinion dose not advance even though the key switch is turned ON.		
Unit	Cause	Remedy
Wiring	Disconnected wire, untightened battery and switch terminals, or improper contact of the inserting part.	Correct and retighten
Key switch	Improper contact preventing flow of current.	Correct or replace the contact part
Starting motor	Helical spline of the pinion shaft is scored and prevents the pinion from moving.	Replace or correct
Magnet switch	Improper movement of the plunger of the magnet switch or disconnected wire or short circuit of the coil.	Correct or replace

(2) Though the pinion is engaged and the motor rotates, the rotation is not transmitted to the engine.		
Unit	Cause	Remedy
Starting motor	Defective clutch. Broken reduction gear.	Replace Replace

(3) Though the pinion is engaged with the ring gear, the starting motor dose not start		
Unit	Cause	Remedy
Wiring	Disconnected wire connecting the battery and magnet switch. Insufficient tightening of the lead wire connecting the magnet switch and motor.	Repair, retightening, or replace the wire.
Starting motor	Locked bell bearing. Improper installation. Worn out brush, improper contact of brush spring. Stained commutator. Defective armature or field coil. Insufficient tightening of connections of the field coil and brush.	Replace Install properly Replace Correct Correct or replace Retighten
Magnet switch	Broken holding coil Improper contact of contact Roughened contact surface of contact	Replace Replace Replace
Battery	Discharged	Charge

(4) Motor stars rotating before the pinion is engaged with the ring gear		
Unit	Cause	Remedy
Starting motor	Improper sliding of pinion shaft Worn out pinion tooth top Improper pinion pushing position	Replace Correct Replace
Engine	Worn out ring gear	Replace
Magnet switch	Defective magnet switch	Replace

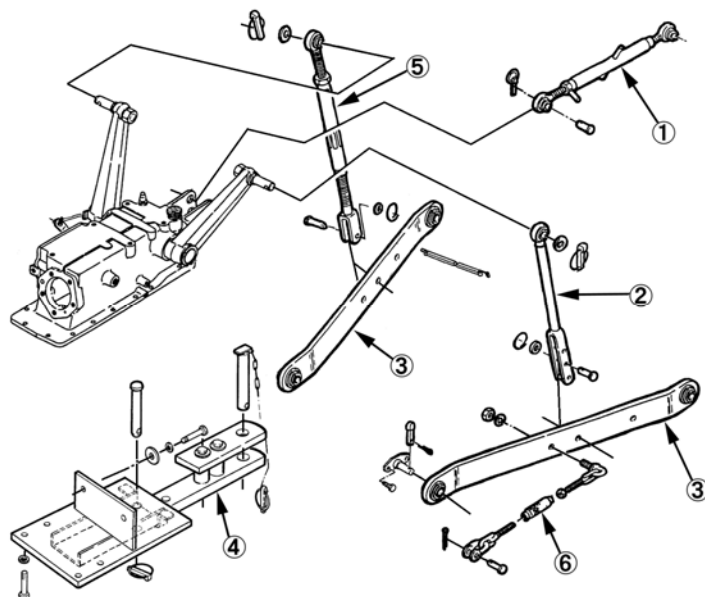


518bY

3-11 Cultivating Implement Installing Device

1. Three-point link

1) Name of major parts of three-point link



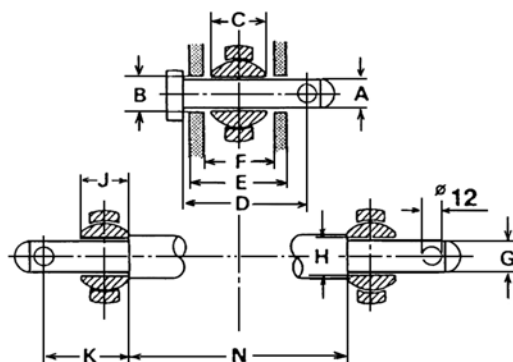
1. Top link
2. Lift rod
3. Lower link
4. Fixed hitch
5. Adjustable lift rod
6. Stabilizer

623Y

2) Standards 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 1Type	$19 \begin{smallmatrix} 0 \\ -0.084 \end{smallmatrix}$	$19.5 \begin{smallmatrix} +0.21 \\ 0 \end{smallmatrix}$	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



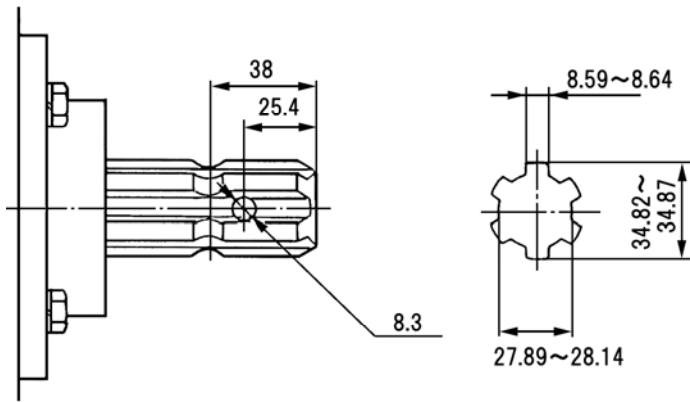
624Y

3) Service and cautions for handling of 3-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 oil is used. However, coat it thinly with grease to prevent rust when storing.
- (4) Supply oil to the thread 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-out shaft)

Specifications

Model		ST330/333	
Rotating direction		Clockwise facing the shaft	
Rear PTO Speed	1 — speed PTO	540rpm at engine speed 2455 rpm on Model 9×3	
		540 rpm at engine speed 2500 rpm on Model HST.	
	1 st	540 rpm at engine speed 2485 rpm 608 rpm at engine speed 2800 rpm	
	2 nd	893 rpm at engine speed 2800 rpm	
PTO ground clearance		555 mm (on 11.2-24 AG Tire)	
PTO shaft dimension		JIS $\phi 35$ 6-groove, square type spline shaft  Unit mm	

625Y

Mid Mount PTO	
Rotating direction	Clockwise facing shaft
Speed (at engine speed 2000 rpm)	2377 rpm on Model 9×3, 2420 rpm on Model HST
Mid PTO shaft ground clearance	296 mm (on 13.6-16 Turf Tire)

3—12 Maintenance Standard Table

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

Part	Inspection item		Standard dimension	Standard assembling value	Repair value	Service limit	Remarks
Clutch	Retainer-release hub clearance			0.025—0.1		0.8	
	Clutch shaft bush bore		18			18.5	
	Pedal shaft bush bore		28			29	
	Clutch disk thickness		8.6	8.9—8.3		6.8	Single clutch
	Clutch disk rivet recess		1.2			0.3	Single clutch
	Pressure plate claw height	Claw (above flywheel surface)	35.4	34.4—36.4			Single clutch
	Pedal play			20—30	More than 40		
Transmission	Gear backlash			0.04—0.16		0.5	
	Slide gear-shifter fork clearance			0.1—0.3		1.0	
	Shifter rod casing bearing clearance			0.03—0.1		0.3	
Differential/PTO	Differential pinion—pinion shaft clearance			0.02—0.1		0.5	
	Differential pinion thrust washer thickness		1.2	1.1—1.2		0.9	
	Differential gear thrust washer thickness		1.2	1.1—1.2		0.9	
	Differential gear/differential pinion backlash			0.2—0.4		0.6	
	Ring gear tightening torque N·m {kgf·m}			44.1—55.8 {4.5—5.7}			
	Drive pinion preload N {kgf}			68.6—88.2 {7—9}			
	Drive pinion/ring gear backlash			0.08—0.13	0.3		Load when pulled with string wound on spline
	PTO shaft end play			Less than 0.1		0.3	
	Gear oil quantity L		32.5 (9×3-1 speed PTO) 30.5 (HST)		31.0 (9×3-2 speed PTO)		
	Oil type : Manual transmission		SAE80				
	Oil type : HST		ISO VG56				
Rear wheel	Run-out			3		5	
	AG Tire rug height		47			20	
	Tire size		9.5×24 4ply (AG)				Optional
			11.2×24 4ply (AG)				
			13.6×16 4ply (Turf)				
Brake	Brake lining thickness		4.0			3.7	
	Level difference to stator (on lining contact surface)		0			0.1	
	Pedal shaft-bush clearance			0.05—0.1			
	Pedal play			35—45	More than 50		

	Inspection item		Standard dimension	Standard assembling value	Repair value	Service limit	Remarks	
Hydraulic	Relief valve working pressure MPa {kgf/c m ² }		14.7 {150}					
	Lift arm-bush clearance			0.025—0.1		0.5		
	Hydraulic oil natural settlement (lower link end) mm/min			30/5		100/5	Engine stop. Load 350 kg. Oil temperature 60—70℃	
	Hydraulic cylinder-piston clearance			0.15		0.5		
4WD front axle	Ring gear (bevel) backlash			0.13—0.18	0.3			
	Differential pinion-pinion shaft clearance			0.03—0.1		0.5		
	Ring gear tightening torque N·m {kgf·m}			49—62.7 {5—6.4}				
	Drive pinion preload N {kgf}			127.4—166.6 {13—17}	Load when pulled with string wound on spline			
	Transmission case (differential) — bush clearance	Front		0.02—0.15		0.35		
		Rear		0.02—0.15		0.35		
	King pin inclination angle		10°				Fixed	
	Toe in			-5~+5	-10~+10			
	Caster		0°				Fixed	
	Camber		2°				Fixed	
	Final gear backlash			0.13—0.3		0.4		
	Front wheel shaft end play			0.4		0.8		
	Rim run-out			3.0		5.0		
	Wheel rug height		28			15		
	King pin inclination (inside)	Inside		54—58°				
		Outside		46°				
	Tire size		6×14 4ply (AG)					Optional
			7×14 4ply (AG)					
			25×8.50—14 4ply (Turf)					
	Gear oil	Differential chamber		2				
		Gear chamber		0.6 on one side				
	Differential pinion thrust washer thickness		1.2			0.9		
	Differential gear/differential pinion backlash			0.2—0.3		0.5		
	Idle gear backlash			0.13—0.3		0.5		
Power steering	Relief valve working pressure MPa {kgf/c m ² }		10.3 {105}					
	Oil quantity						Common use transmission	
	Oil type		SAE 80 or ISO VG46					
	Steering wheel peripheral play			20—40		50		