SHOP MANUAL

KOMATSU

LW80-1

MACHINE MODEL SERIAL No.

LW80-1

H-shaped outrigger spec. 10001 and up

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- LW80-1 mount the S6D95L-1 engine;
  For details of the engine, see the 95 Series Engine Shop Manual.

Printed in Japan 10-93(02)00401

kgm

STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of "**Disassembly and Assembly**".

Thread diameter of bolt (mm)	Width across flat (mm)	(T)	(H)
		kgm	Nm
6	10	1.35±0.15	13.2±1.4
8	13	3.2±0.3	31.4±2.9
10	17	6.7±0.7	65.7±6.8
12	19	11.5±1.0	112±9.8
14	22	18.0±2.0	177±19
16	24	28.5±3	279±29
18	27	39±4	383±39
20	30	56±6	549±58
22	32	76±8	745±78
24	36	94.5±10	927±98
27	41	135±15	1320±140
30	46	175±20	1720±190
33	50	225±25	2210±240
36	55	280±30	2750±290
39	60	335±35	3280±340

This torque table does not apply to the bolts with which nylon packings or other non-ferrous metal washers are to be used, or which require tightening to otherwise specified torque.

★ **Nm (newton meter): 1Nm ≒ 0.1 kgm**

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7±0.7	65.7±6.8
12	17	11.5±1	112±9.8
16	22	28.5±3	279±29

SPECIFICATIONS

Machine model				LW80-1
Serial No.				10001 and up
Weight	Operating weight (excl. operator)		(kg)	11,650
	Gross weight (incl. one operator)		(kg)	11,705
Travel performance	Max. speed		(km/h)	49
	Traction		(N (kg))	54,880 (5,600)
	Gradeability (tan θ)		(%)	60
	Min. turning radius	• 2-wheel steering	(m)	7.0
		• 4-wheel steering	(m)	3.9
Operating performance	Operating performance		(t)	8.0
	Crane capacity: With outriggers fully extended total circumference		(t × m)	8.0 × 2.5 [4.5] 4.9 × 3.5 [7.8] 4.9 × 3.5 [11.1] 4.0 × 4.0 [14.4] 4.0 × 4.0 [17.7]
	Crane capacity: Over-front operations without outriggers		(t × m)	1.0 × 5.0 [4.5 — 7.8]
	Boom length		(m)	4.5 — 17.7
	Jib length		(m)	3.7
	Width with outriggers extended	(Front - Rear)	(mm)	4,670
		(Left - Right)	(mm)	4,450
	Max. lifting height	(Boom only)	(m)	18.9
		(with jib)	(m)	22.3
	Rope speed of main winch (High speed/Low speed)		(m/min)	111/56
	Hook speed of main winch (High speed/Low speed)		(m/min)	28/14
	Rope speed of auxiliary winch (High speed/Low speed)		(m/min)	104/52
	Hook speed of auxiliary winch (High speed/Low speed)		(m/min)	104/52
	Working range of boom		(deg.)	−9.5 — 83
	Booming lift speed		(sec.)	25
	Boom telescope speed (Boom length : 4.5 — 17.7m)		(sec.)	40
	Swing speed		(rpm)	2.5

Note : The value with [ ] are the values of boom length.

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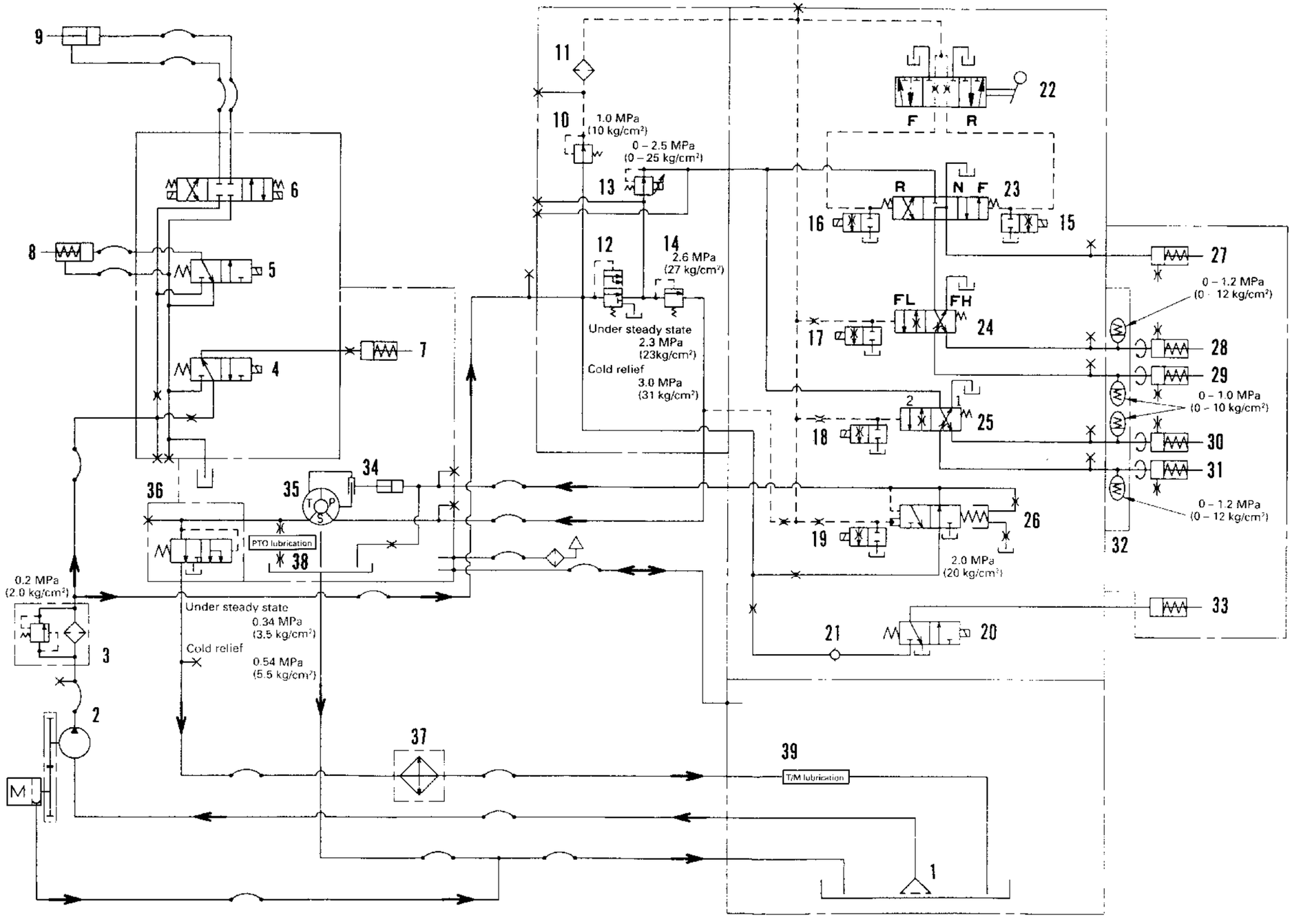
POWER TRAIN HYDRAULIC CIRCUIT DIAGRAM



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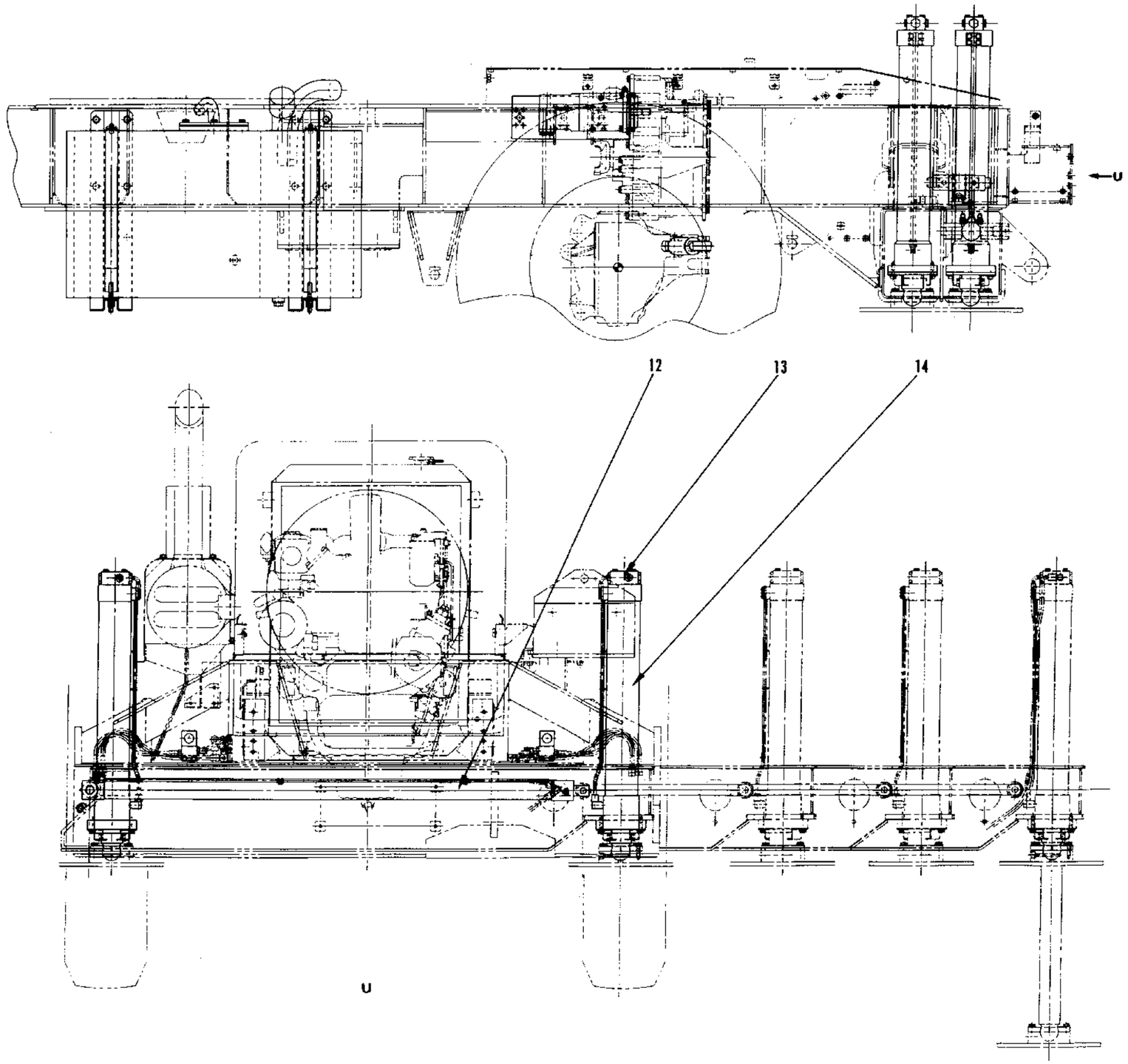

1. Steering mode selector valve
2. Solenoid selector valve for two rear wheel steering
3. Solenoid selector valve for reverse steering correction compensation
4. Solenoid selector valve for rear/four wheel drive
5. Flow priority valve
6. Hydraulic pump (SAL(1)-28+28)
7. Hydraulic pump (SAL(1)-25+6+22)
8. Steering cylinder
9. Outrigger individual valve
10. Hydraulic oil tank
11. Outrigger selector valve
12. Slide cylinder
13. Double pilot check valve
14. Jack cylinder

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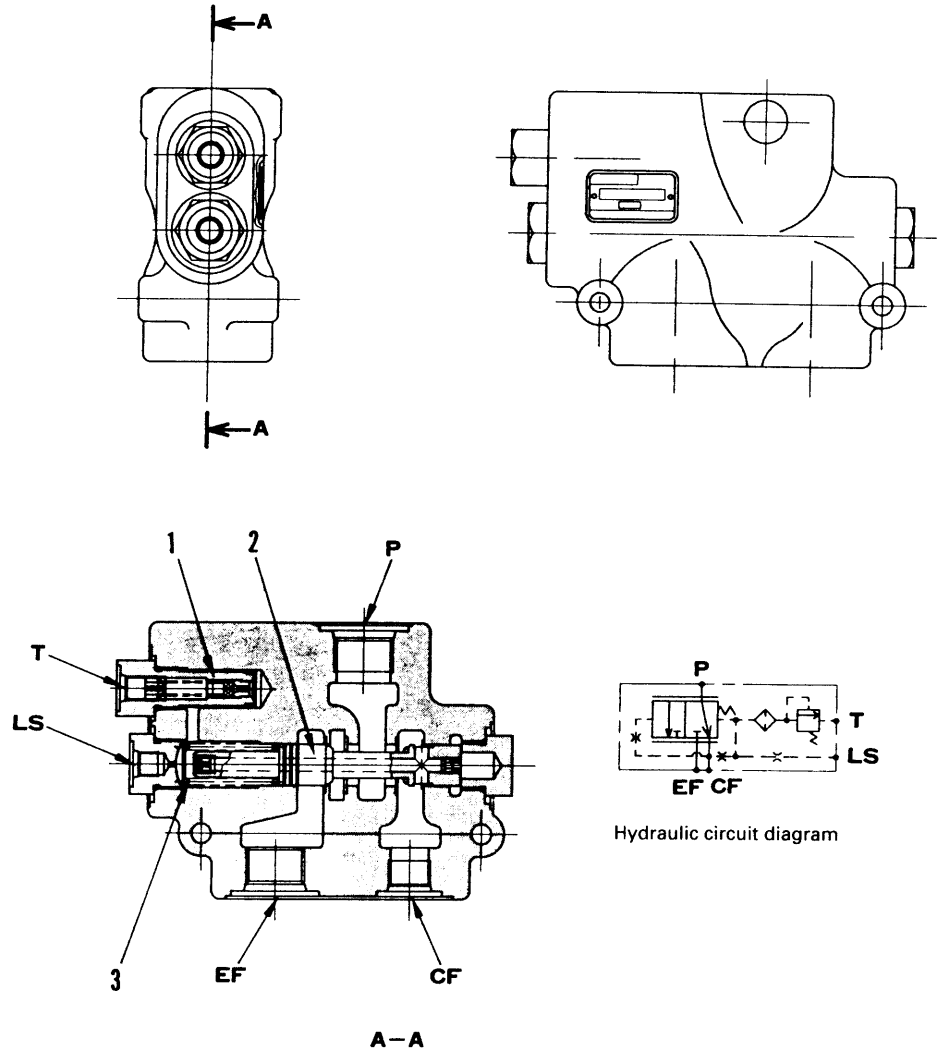
PRIORITY VALVE



Hydraulic circuit diagram

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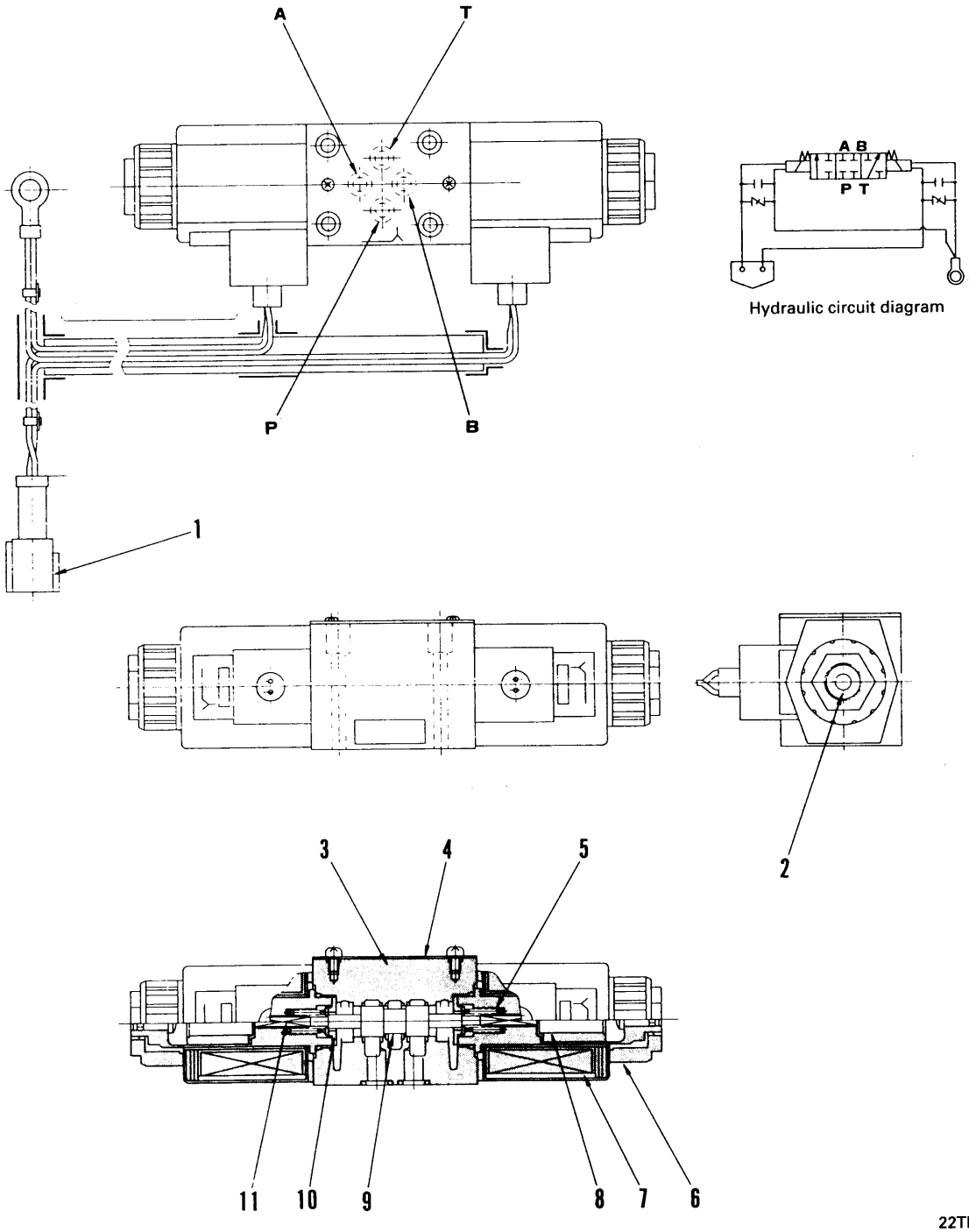
1. Relief valve assembly
2. Spool
3. Spring

T. T port (to tank)
CF. CF port (to steering valve)
EF. EF port (to cab cooler motor)
LS. LS port (to steering valve)

FUNCTION

- Oil supply to the steering circuit is given priority.
- When the steering valve is not operated, all oil from the pump flows into the cab cooler motor.
- Only the necessary amount of oil flows into the steering circuit according to the steering speed, irrespective of the engine speed.

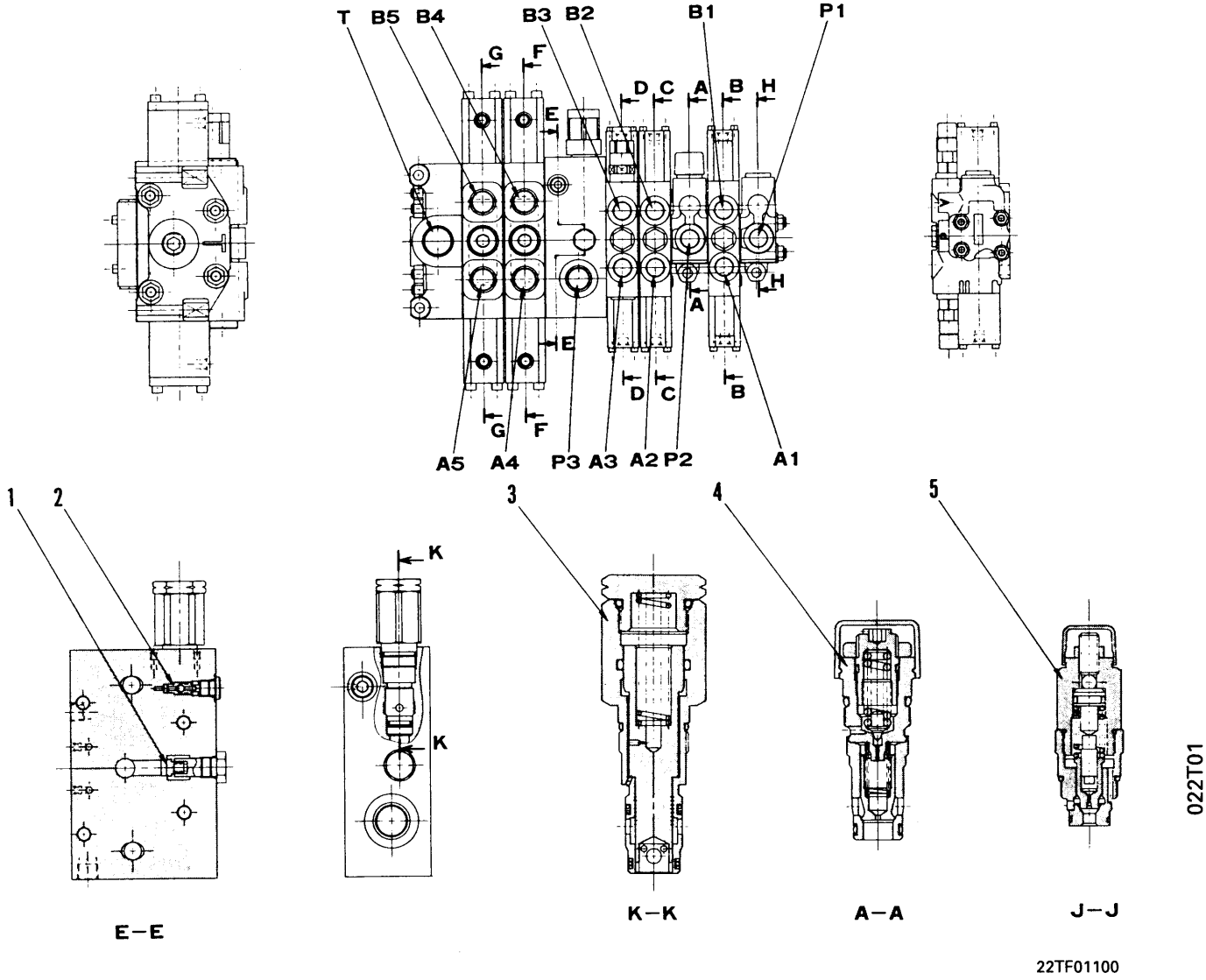
OUTRIGGER INDIVIDUAL VALVE



1. Connector
2. Manual push pin
3. Valve body
4. Cover
5. Spring
6. Nut
7. Coil assembly
8. Core assembly
9. Spool
10. Spacer
11. Push pin

A. A port (Cylinder port
B. B port (Cylinder port)
P. P port (Pump port)
T. T port (Tank port)

MAIN CONTROL VALVE



1. Plunger
2. Shuttle valve
3. Flow control assembly (for winch)
4. Relief valve assembly (for boom)
5. Port relief valve assembly (for boom raise)
6. Plunger
7. Spool (for swing)
8. Spool (for boom telescope)
9. Spool (for boom raise)
10. Spool (for auxiliary winch)
11. Shuttle valve
12. Spool (for main winch)
13. Shuttle valve

P1. Pump port (swing)
P2. Pump port (boom)
P3. Pump port (winch)
T. Tank port
A1. Cylinder port (for right swing)
B1. Cylinder port (for left swing)
A2. Cylinder port (for boom retract)
B2. Cylinder port (for boom extend)
A3. Cylinder port (for boom raise)
B3. Cylinder port (for boom lower)
A4. Cylinder port (for auxiliary winch wind out)
B4. Cylinder port (for auxiliary winch wind in)
A5. Cylinder port (for main winch wind out)
B5. Cylinder port (for main winch wind in)
a1. PPC port (for right swing)
b1. PPC port (for left swing)
a2. PPC port (for boom retract)
b2. PPC port (for boom extend)
a3. PPC port (for boom raise)
b3. PPC port (for boom lower)
a4. PPC port (for auxiliary winch wind out)
b4. PPC port (for auxiliary winch wind in)
a5. PPC port (for main winch wind out)
b5. PPC port (for main winch wind in)

BOOM

OUTLINE

- The boom is equipped with a Whole stage automatically telescoping hydraulic system (with built-in hydraulic hoses and gradually telescoping cylinders).
- A jib fitted inside the boom is automatically extended when the boom pin is reinserted while the boom is telescoped to the maximum.
- Slide pads are fitted on the respective booms to reduce sliding resistance during telescoping and to prevent backslash for smooth telescoping of the booms.
  Also, slide plates are used together with shims to adjust the gaps between the respective booms.
- The boom is also fitted with an automatic hook retracting system so that the main and auxiliary hooks can be retracted from the operator's seat.

SPECIFICATIONS

Main boom :

Box type, 5-stage, hydraulically activated, 2nd and 3rd, 4th and 5th jibs simultaneous telescoping type (Jib expansion/retraction type).

Jib :

Box type, 1-stage, hydraulically operated, fitted inside boom.

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OPERATION

- Piston side (Point **B'**) of boom 2nd cylinder (5) is fixed to the 3rd stage boom, and cylinder body (Point **F**) is fixed to 4th stage boom (6).
- Rope (11) for retracting the jib is set on pulley (Point **N**) at the rear end of the 5th stage boom, with each end fixed to rear end (Point **O**) of jib (10) and front end (Point **P**) of the 4th stage boom, respectively.
- Rope (12) for retracting the 5th stage boom is set on pulley (Point **Q**) at the rear end of the 4th stage boom, with each end fixed to rear end (Point **R**) of the 4th stage boom and front end (Point **S**) of the 3rd stage boom, respectively.
- When the boom telescoping lever is set to "Retract," pressurized oil enters the head of second cylinder (5) to retract the piston rod.
- As 2nd cylinder (5) retracts, 4th stage boom (6) is retracted into 3rd stage boom (3).
- At the same time as the 4th stage boom contracts, rope (12) for retracting the 5th stage boom becomes longer between front end (Point **S**) of the 3rd stage boom and pulley (Point **Q**) at the front end of the 4th stage boom. And since rope (12) for retracting the 5th stage boom is fixed to front end (Point **S**) of the 3rd stage boom, the 5th stage boom is retracted into the 4th stage boom (6).
- So, as the 5th stage boom retracts, jib (10) is also retracted into the 5th stage boom in the same way.

Schematic Drawing

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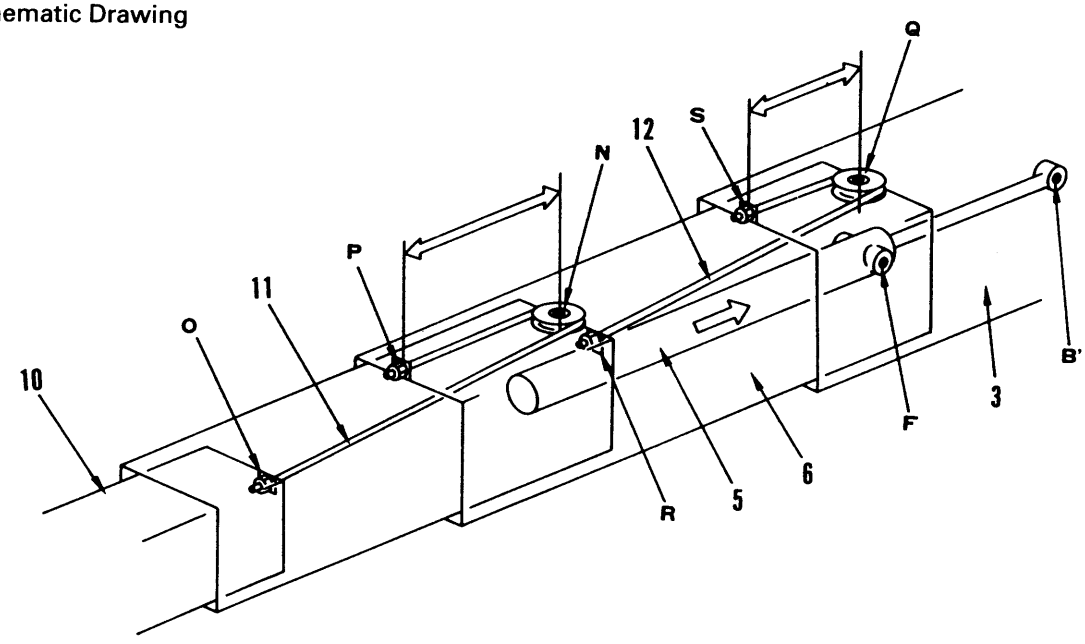

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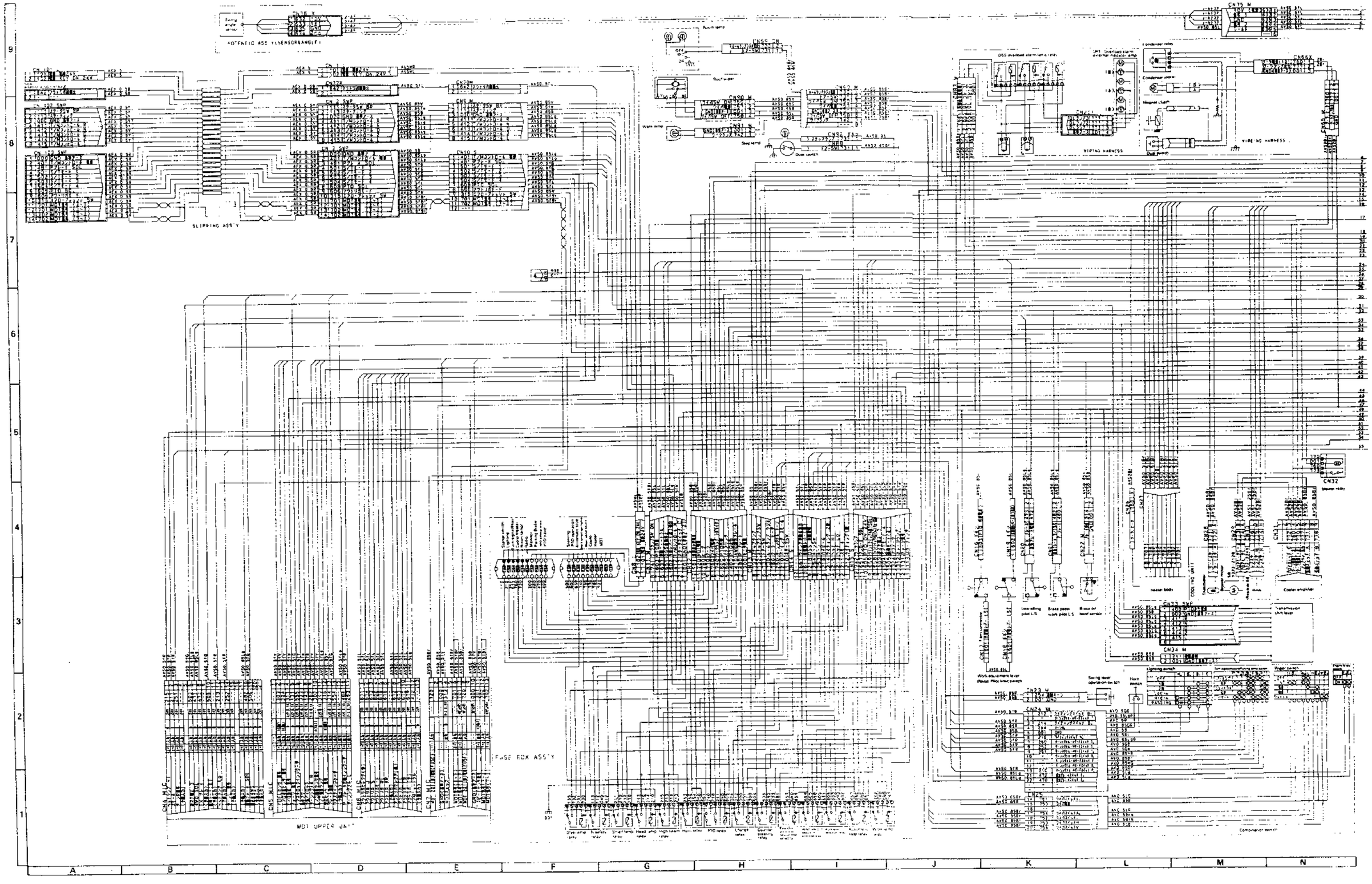
Electric Circuit Diagram (1/2)



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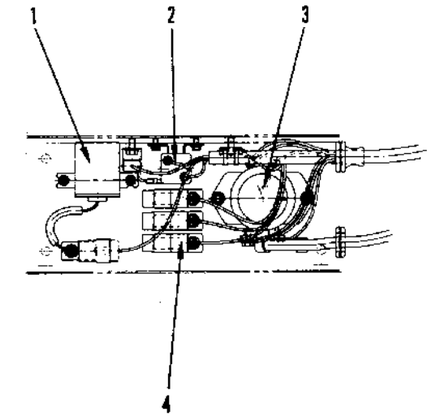
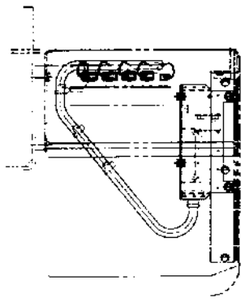
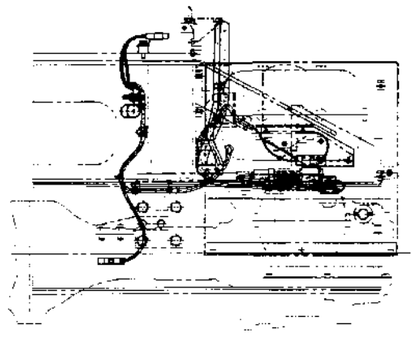
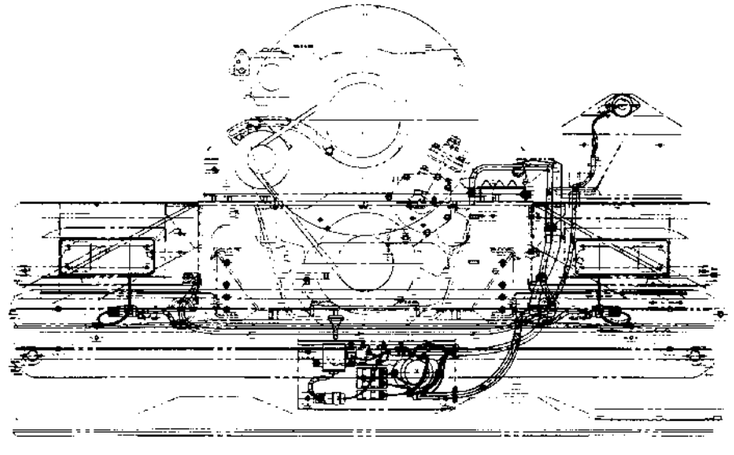
LOWER SECTION (2/2)









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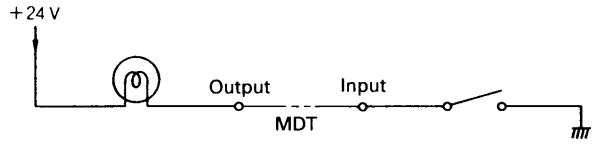
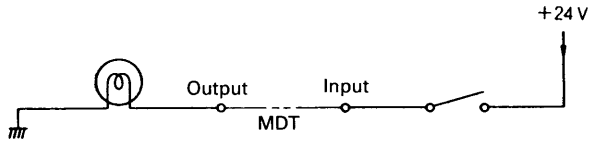
3. **"ON/OFF" signal from lower to upper unit**
The state of the switch connected to the lower unit is sent to the upper unit, and the output is turned on and off.
Types of signals available are "Earth type" and "24V type" as shown in the figure.
The MDT also has the following additional functions:
1) Charge
When the voltage at the input terminal is below 10V, the MDT assumes that the alternator is not generating power properly and turns on the charge lamp.
2) Rear steering lock display (Lock, free)
The MDT checks that the rear steering lock system limit switch corresponds to the rear steering lock system and steering mode commands shown in the table and controls its display.
★ Command signals are as shown in the table on the right.

★ ON/OFF signals from lower to upper unit and additional functions are as follows:

• Earth type



• 24V type



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• Command signal

Command signal	Name input terminal
Rear steering lock	CN105-6
Rear steering free	CN105-14
Interrupt 4WS	CN4-19
Front wheel mode	CN4-10

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Signal name	Input terminal (Lower unit)	Output terminal (Upper unit)	Signal type	Additional functions
Charge	CN105-5	CN5-5	Earth	Input signal of less than 10V is regarded as "switched on".
Engine oil pressure	CN105-4	CN5-4	Earth	——
Brake oil level	CN105-13	CN5-13	Earth	——
Turn pilot R	CN105-9	CN5-9	24 V	——
Turn pilot L	CN105-17	CN5-17	24 V	——
Rear steering lock	CN105-6	CN5-6	Earth	Lighting of the two lamps is controlled by the rear steering lock, rear steering free, interrupt 4WS and front wheel mode commands.
Rear steering free	CN105-14	CN5-14	Earth	

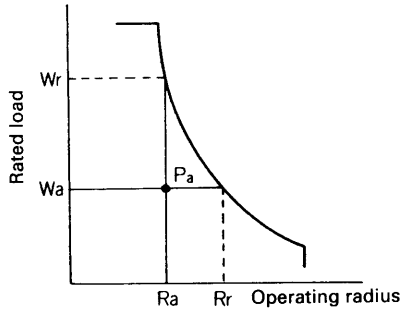
(3) Calculation of rated load
The CPU selects optimum constants for boom length and state of outrigger from the constant table and inputs them and the operating radius to the stored equation to calculate rated load.

(4) Calculation of maximum operating radius
When the hoisting load **"Wa"** agrees with the rated load when lowering the boom with the hoisting load, the maximum operating radius **"Rr"** is obtained and, if necessary, can be output to the digital display.

(5) Calculation of load factor (%)
The load factor can be calculated from hoisting load **"Wa"** calculated in Paragraph (2) and rated load **"Wr"** calculated in Paragraph (3) by using the following equation:

$$\text{Load factor (\%)} = \frac{Wa}{Wr} \times 100$$

(6) Measures against overload
According to the load factor calculated in Paragraph (5), signals are sent to the alarm lamp, alarm buzzer and automatic stop valve.
The automatic stop valve is designed to stop the boom automatically when it is turned off (no current is supplied). It is a fail-safe device against power disconnection and connection failure.



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Pa : Actual hoisting state
Ra : Actual operating radius
Wa : Hoisting load (including hook weight)
Rr : Maximum permissible radius with "Wa"
Wr : Rated load for "Ra"

Range of load factor	Alarm buzzer	Auto stop valve
Load factor $<$ 90	OFF	ON
90 $\leqq$ Load factor $<$ 100	Intermittent	ON
100 $\leqq$ Load factor	Continuous	OFF

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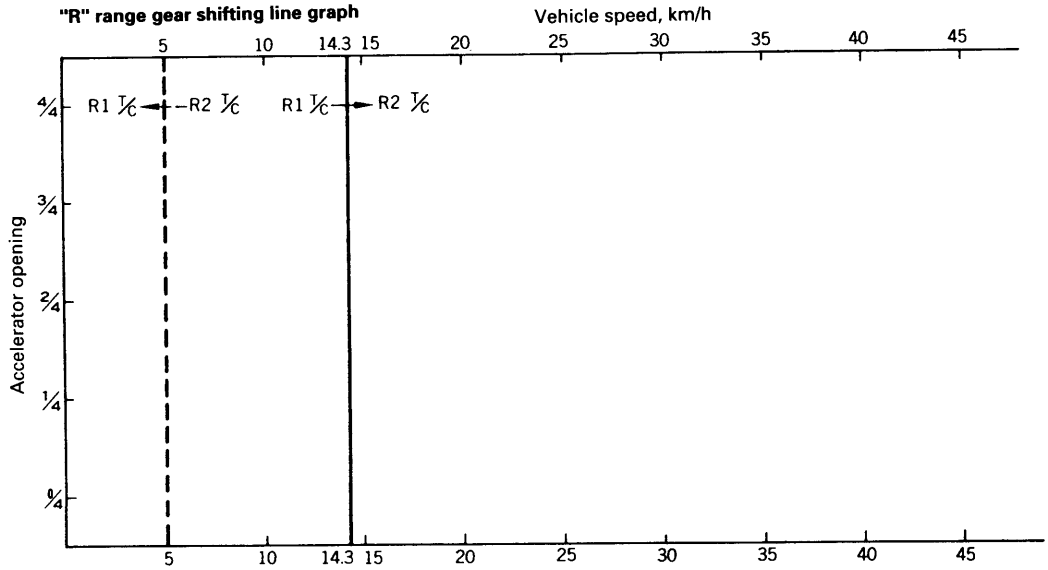
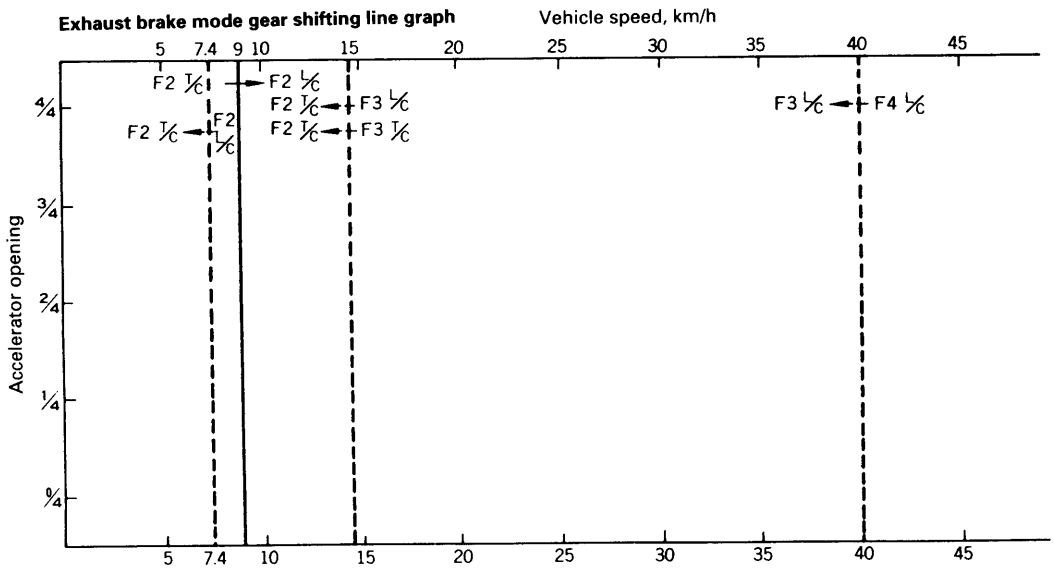
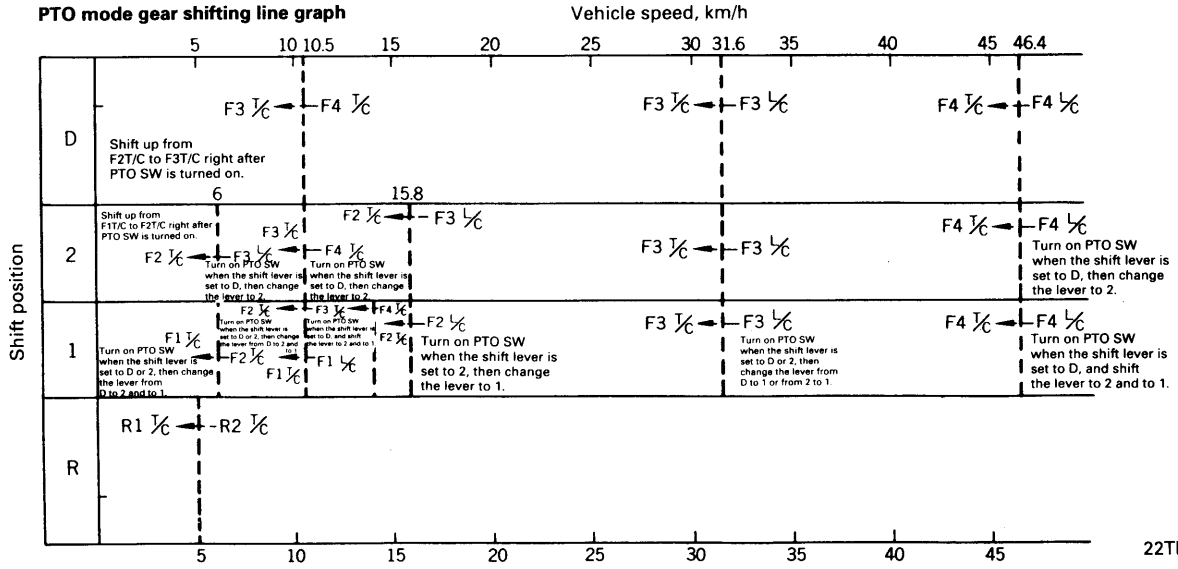
"R" range gear shifting line graph



Exhaust brake mode gear shifting line graph



PTO mode gear shifting line graph



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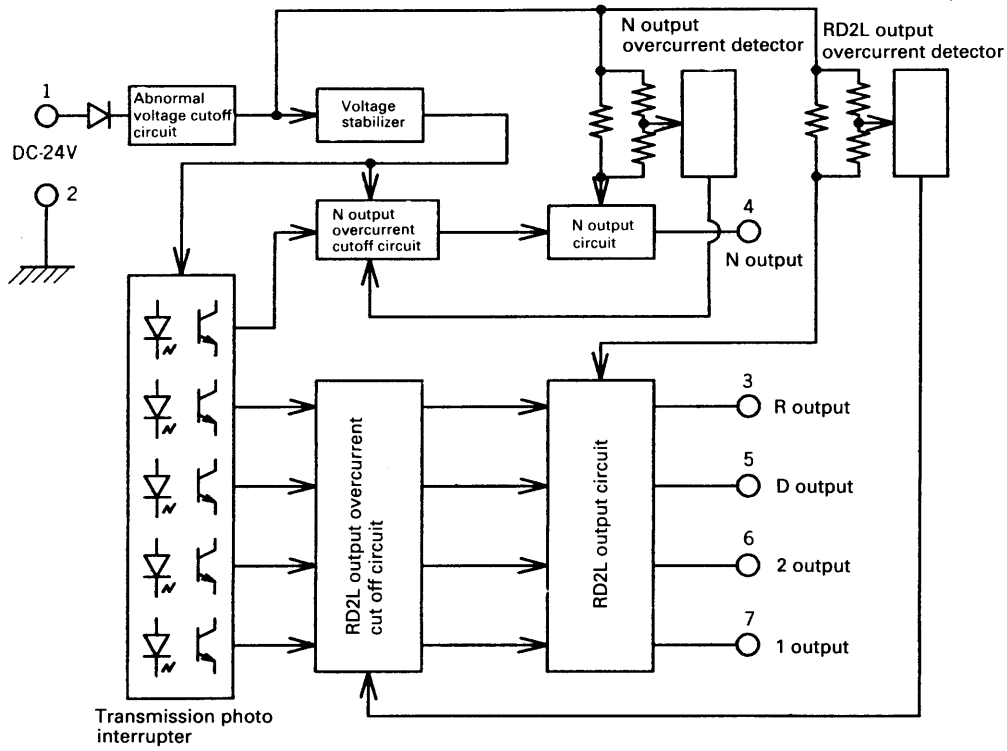
Circuit diagram



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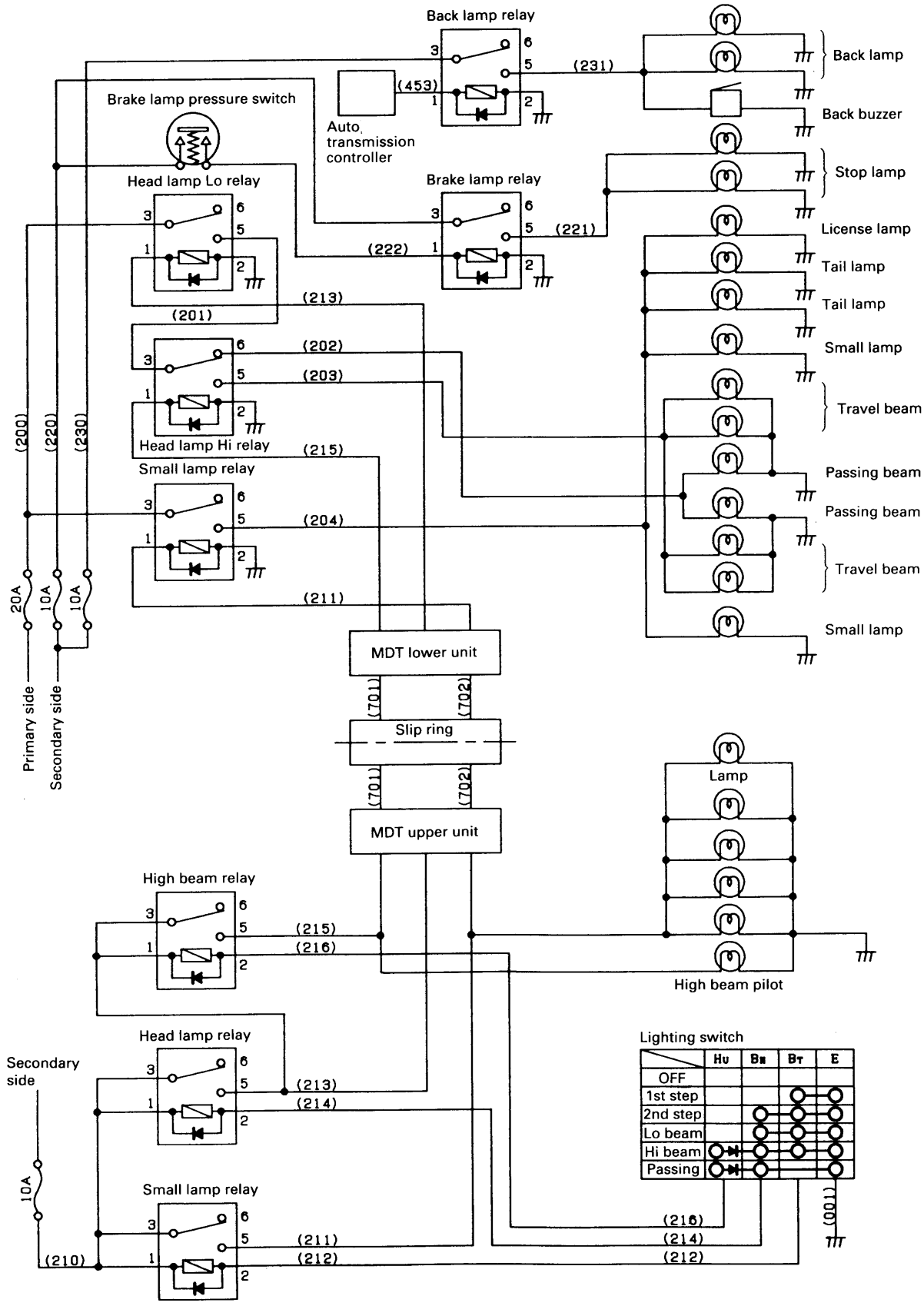
OUTLINE

- The gear shift lever is shifted to five positions such as R, N, D, 2 and L, and these positions are output to the automatic gear shift controller and the neutral safety relay through contactless electronic circuit.
- When the gear shift lever is set any of these five positions, light of the photo interrupter at the position will pass through the douser and be output as the signal of the position.
- Two systems of N (Neutral) and R, D, 2, L are set to the output circuit, overcurrent detector and overcurrent cut-off circuit, and the automatic gear shift is designed to normally operate at N (neutral) position even though R, D, 2 and L are short-circuited and outputs are cut off. And the automatic gear shift can secure minimum necessary signals for engine start and to automatic gear shift controller.
- Respective output signals from R, N, D, 2 and L are about 20V, about 4V lower than the input voltage of 24V. It takes about 1 second that the constant voltage circuit is turned on and is stabilized. When the ignition switch is set to OFF, ON and to START at a time, N is output, therefore operater can feel some time lug since about 1 second is taken until the starter starts turning.

5. LIGHTING CIRCUIT



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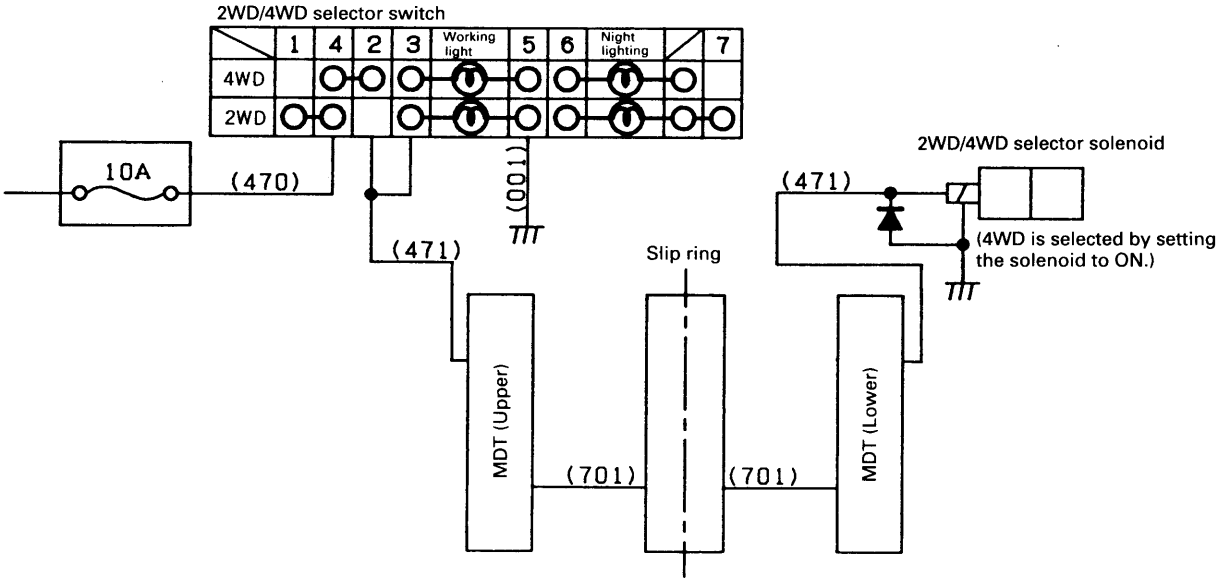
9. 2WD/4WD SELECT CIRCUIT



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OUTLINE

- The 2WD/4WD select circuit operates the solenoid valve by means of the 2WD/4WD selector switch, changes the shifter by selecting hydraulic circuit and also selects transmission outputs.
- Only when the drive selector switch is set to the **"4WD"** position, the 2WD/4WD solenoid valve is **EXCITED** and travels the vehicle by four-wheel driving.
  When the switch is set to the **"2WD"** position, the vehicle travels by two-wheel driving.

OPERATION

1. **When drive selector switch is set to "4WD"**
   When the drive selector switch is set to **"4WD"**, terminals 2 and 4 will be connected each other, and electricity of the upper fuse (for 4WD and exhaust brake) will flow from terminal 4 to terminal 2.
   Electricity from terminal 2 will partly flow to 4WD working lamp through terminal 3 to turn on the lamp.
   Also, the electricity will flow to the 4WD solenoid through the MDT unit to operate the valve and to operate the 4WD shifter for traveling the vehicle by 4WD when the hydraulic circuit is changed over.
2. **When drive selector switch is set to "2WD"**
   When the drive selector switch is set to **"2WD"**, terminals 1 and 4 will be connected each other, and he switch will not have any connection terminal for output.
   So, electricity does not flow to the 4WD solenoid, and valves change over their hydraulic circuits respectively to bring back the shifter for driving the vehicle by 2WD.

2. **When parking brake switch is set to "Parking,"**
When the switch is set to **"PARKING"** nothing will be output from the switch, and the power of line No. 481 will not flow, and the parking brake solenoid will be set to OFF. When it is set to OFF, air is discharged from the parking brake cylinder, and the spring force will work the parking brake. At the time, the air pressure switch detects an air pressure drop and contacts open, and the MDT detects that the parking brake has worked and turns on the parking brake lamp.

3. **When parking brake switch is set to "Auxiliary,"**
When the switch is set to **"AUXILIARY"** the power will flow from terminal 2 to terminal 3 and to the auxiliary brake solenoid through the MDT to turn on the auxiliary brake solenoid. When it is turned on, a constant air pressure (0.4MPa (4kg/cm^2)) will be sent to the power cluster for the service brake to control the front and rear brakes. At the same time, the power from the switch turns on the auxiliary brake lamp.
Also, this switch is not turned on with normal force being applied to the brake pedal, but if the brake pedal advances more than usual due to leakage of brake fluid or other cause, exactly same current as in case of auxiliary brake switch will flow, the auxiliary brake will operate and the auxiliary brake lamp will turn on.

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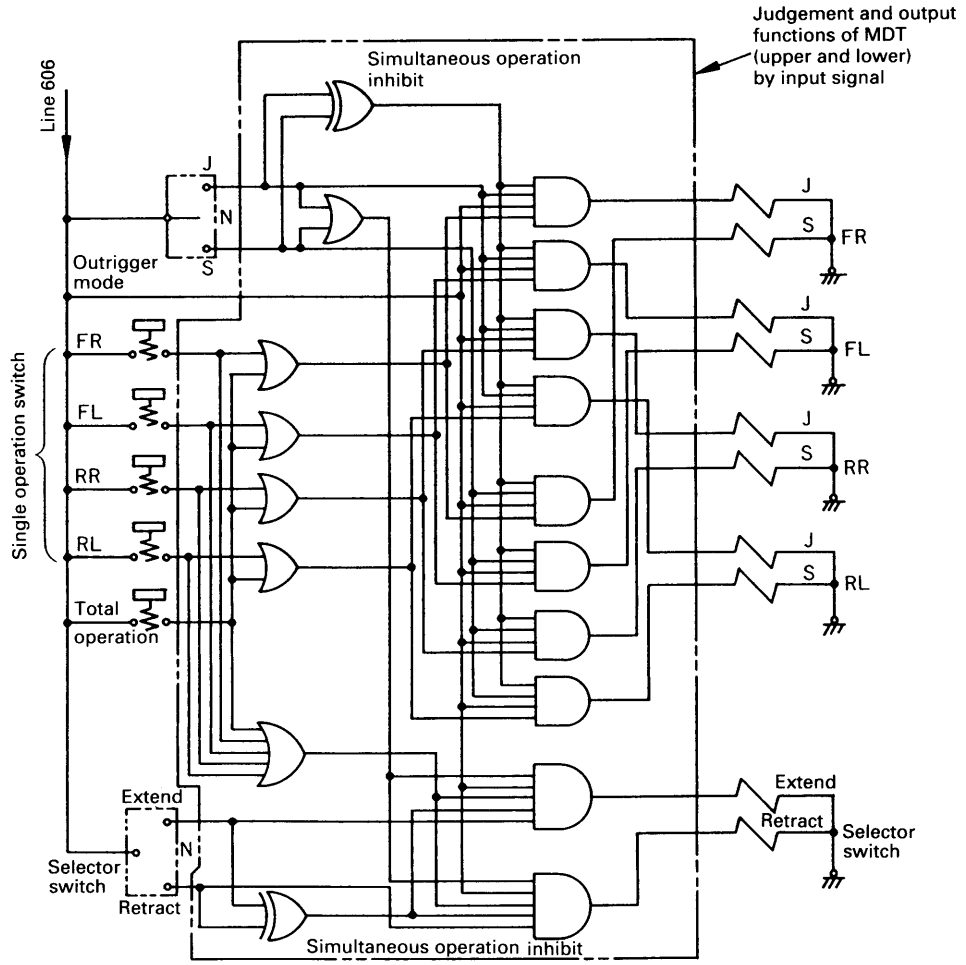
OPERATION

1. **When upper outrigger switch is used,**
   (1) After all the four signals below are input to the upper MDT by means of the upper outrigger switch, the lower MDT unit will output them to each solenoid:
   1 Outrigger mode signal (Line No. 606)
   2 Signals other than the neutral position of the extend/retract switch (Line No. 671 or 672)
   3 Signals other than the neutral position of the jack/slide switch (Line No. 673 or 674)
   4 Signal of total operation or single operation (Any one or more of line Nos. 675 to 679)

   Unless any one signal of the above is input, these signals are not output to the lower unit.

   These MDT functions can be illustrated as follows:



Legend

C : OR circuit :	Signal input to A or B is output to C.
E : AND circuit :	Only when signals are input to all of A,B, C and D, they are output to E.
C : Simultaneous input inhibit circuit :	Signal input separately to A and B is output to C. When signals are input to A and B at the same time, or when no signal is input to both A and B, no signal is output to C.

STANDARD VALUE TABLE FOR ENGINE

Engine				S6D95L	
Machine model				LW80	
Classification	Item	Measuring conditions	Unit	Standard value	Permissible value
Engine	Engine speed	High idling speed	rpm	3,450 ± 50	3,450 ± 50
		High idling speed (PTO-ON)		2,200 $^{+50}_{0}$	2,200 ± 50
		Low idling speed		750 $^{+50}_{0}$	750 ± 50
	Exhaust temperature	All speeds (20°C)	°C	Max. 650	700
	Exhaust gas color	At quick acceleration	Bosch	Max. 6.0	7.0
		At high idling		Max. 1.0	2.0
	Valve clearance	(Cold)	mm		
		Intake valve		0.35	0.35
		Exhaust valve		0.50	0.50
	Compression pressure	• SAE30 Oil • Oil temperature : 40 – 60°C • Engine speed 320 – 360 rpm	Mpa (kg/cm^2)	Max. 2.7 (28)	2.0 (20)
	Blow-by pressure	• SAE30 Oil • Water temperature operating range • At rated output	mmH_2O	Max. 85	150
	Oil pressure	(Water temperature operating range)	Mpa (kg/cm^2)		
		At high idling (SEA30)		0.34–0.69 (3.5–7.0)	0.25 (2.5)
		At low idling (SAE30)		Min. 0.1 (1.0)	0.07 (0.7)
		At high idling (SAE10W)		0.3–0.6 (3.0–6.0)	0.21 (2.1)
		Low idling (SAE10W)		Min. 0.8 (0.8)	0.07 (0.7)
	Oil temperature	All speed ranges (Oil in oil pan)	°C	90 – 110	120
	Fuel injection timing	Before compression top dead center	°	16 ± 1	16 ± 1
	Fan belt tension	Deflects when pushed with a force of about 58.8 N (6 kg)	mm	8	6 – 10

022T01

MEASURING HYDRAULIC PRESSURE

⚠ Extend the outrigger and set the machine securely.
★ Transmission oil temperature : 70 – 80°C

⚠ Be sure to remove plugs and the oil pressure gauge only after the engine has stopped completely.

⚠ Pay attention to the circumstances during the measurement, and set the parking brake to the parking position after the measurement.

1. Measuring oil pressure of torque converter lock-up clutch

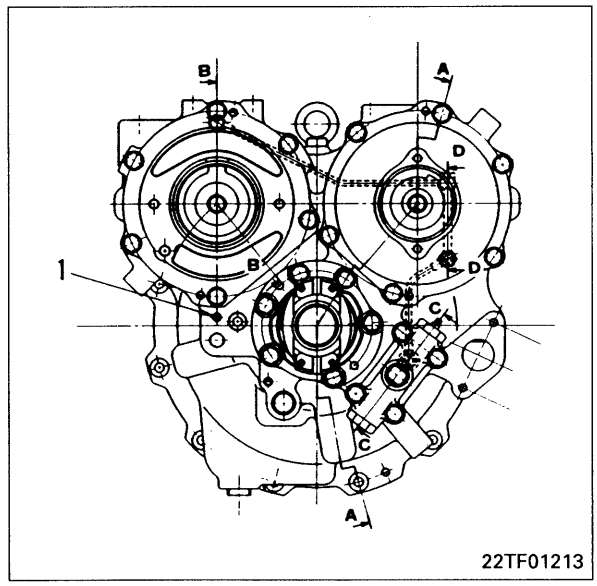
1) Remove the plug (1) from the hydraulic port of the torque converter lock-up clutch and fit a tool **C** (Gauge 2.5MPa (25 kg/cm^2)) there.

2) Start the engine and select proper gear shift range and vehicle speed from the table below:
★ Since the vehicle adopts the automatic lock-up system, its lock-up depends on vehicle speed and gear shift range.

	Gear shift range	Vehicle speed (km/h)
Lock-up	L	14
	2	43
	D	49

⚠ Before measurement, be sure to check that the outrigger has been set securely and the tires have been raised.
Then, pay attention to the circumstances.

3) Release the parking brake free and increase engine speed gradually up to the preset condition, then measure the clutch pressure.
★ Carefully note that hydraulic pressure cannot be measured if the vehicle speed is below the specified value.



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3. Adjusting lift cylinder oil pressure

1) Adjusting cylinder **"LOWER"** side oil pressure
   i) Remove the cap (7) of the relief valve on the boom **"LOWER"** side of the main control valve.
   ii) Loosen the locknut (8) and adjust the oil pressure by turning the adjust screw (9).
      ★ Turn it clockwise to increase the oil pressure, and turn it counterclockwise to lower the oil pressure.
      ★ The oil pressure will be increased or lowered 4.8 MPa (49 kg/cm²) by every turn of the adjust screw.
   iii) After the adjust, tighten the locknut (8) and fit the cap (7).
      ★ After tightening the locknut, check the oil pressure.

2) Adjusting cylinder **"RAISE"** side oil pressure and oil pressure for swing
   i) Remove the cap (10) of the relief valve on the boom **"RAISE"** side of the main control valve and for swing.
   ii) Loosen the locknut (11) and adjust the oil pressure by turning the adjust screw (12).
      ★ Turn it clockwise to increase the oil pressure, and turn it counterclockwise to lower the oil pressure.
      ★ The oil pressure will be increased or lowered 13.3 MPa (136 kg/cm²) by every turn of the adjust screw.
   iii) After the adjust, tighten the locknut (11) and fit the cap (10) to the boom lower side relief valve.
      ★ After tightening the locknut, check the oil pressure.

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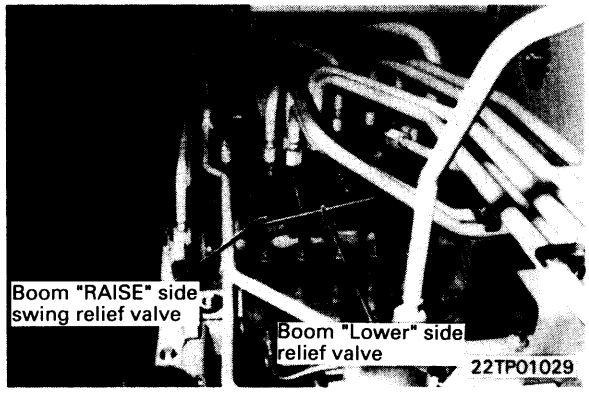
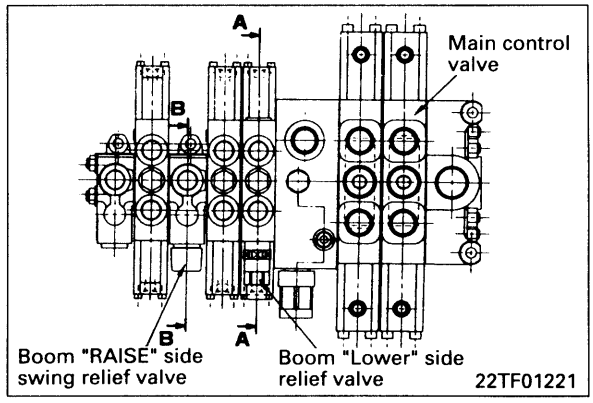
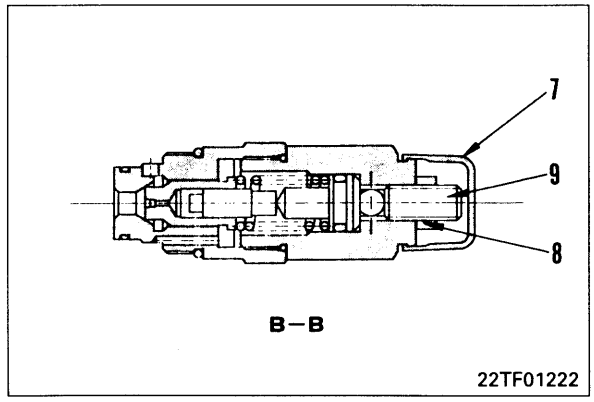
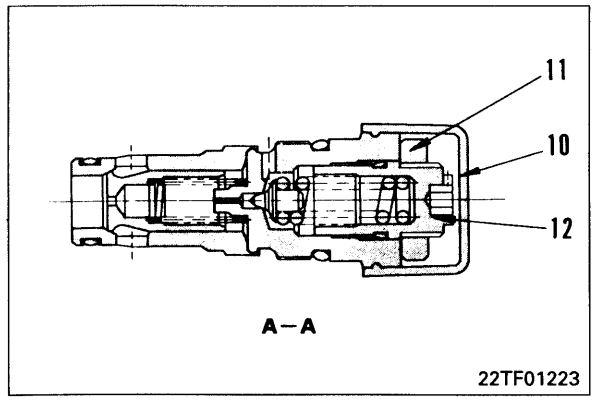


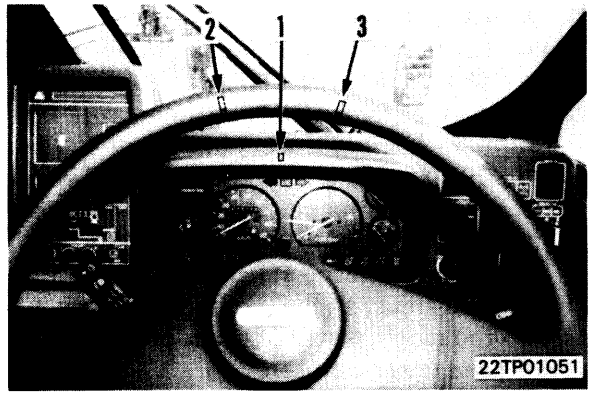






MEASURING PLAY OF STEERING WHEEL

★ Measuring conditions
- Engine speed : Low idling
- Vehicle posture : Straight forward travel

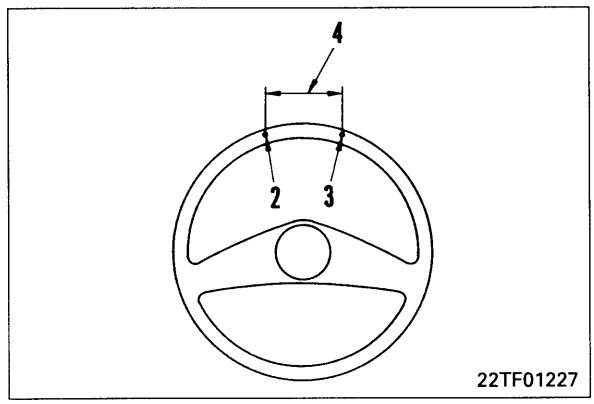


Measuring method

1. Move the steeling wheel left and right lightly two or three times to check the neutral position of the steering mechanism, and put a mark (1) on the vehicle monitor outer frame.

2. Turn the steering wheel right, bring the position where the tire starts moving to the marking (1), then put a mark (2) on the steering wheel.

3. Turn the steering wheel left or to the reverse direction of the one in Paragraph 2, bring the position where the steering force starts increasing to the marking (1), then put a mark (3) on the steering wheel. Measure the travel distance (4) between the both markings.



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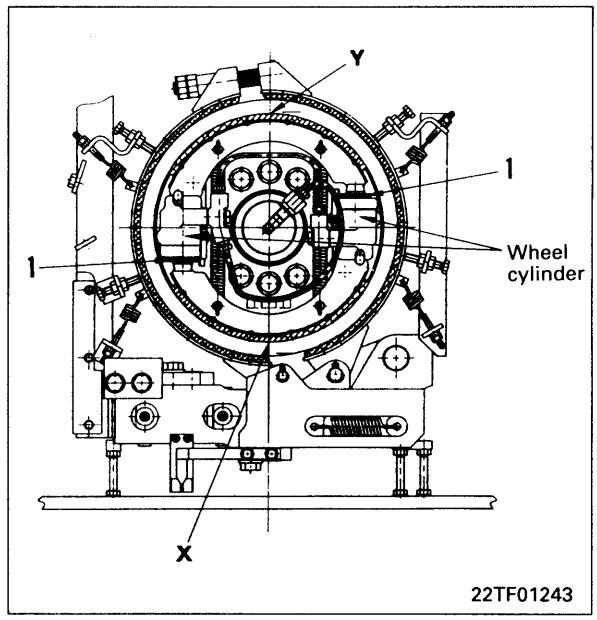
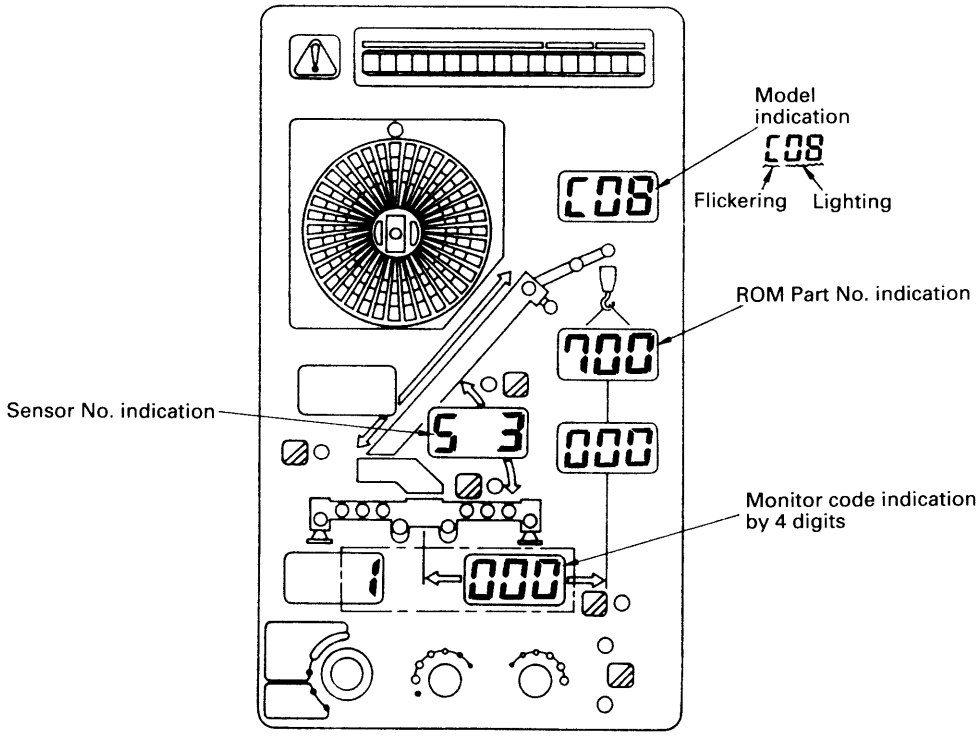
2. Adjusting main and auxiliary winch clutch

1) Set the main and auxiliary winch clutch levers to the **"OFF"** position, bring the drum to a free fall condition and ground the hook.
   ★ Be careful that the wire rope is not wound irregularly.
2) Rotate the adjusting wheel (1) of the clutch wheel cylinder until the lining touches the drum lightly.
   ★ Rotate the adjusting wheel clockwise from the wheel side, and the clutch shoe will expand.
3) Under the condition, check that the clearance between the lining and the drum is 0.7 to 0.9 mm (at X and Y points in the lining width).
4) After the adjustment, engage and disengage the clutch three times or so.
5) Fall a hook freely to check its smooth fall.



022T01

- **Monitor code display**



022T01

22TF01253

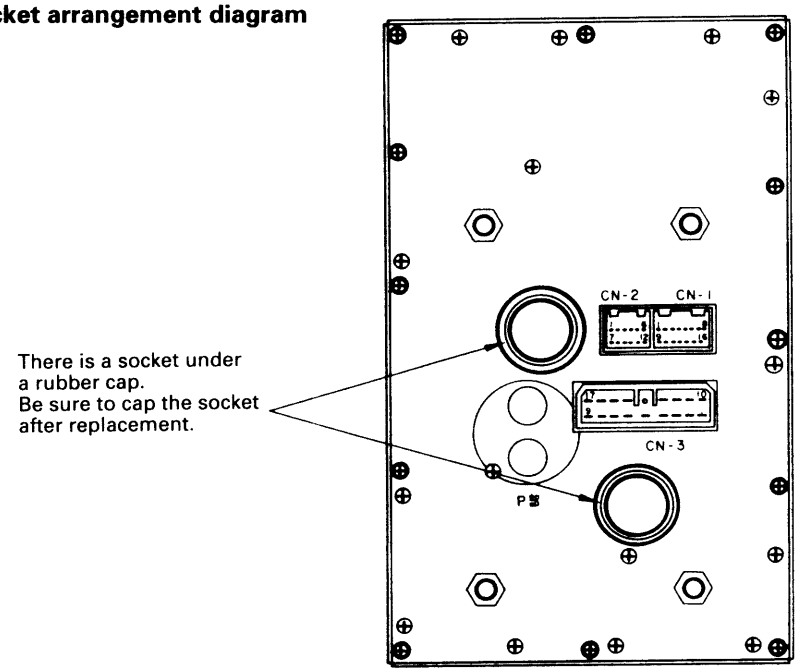
⚠ While monitor codes are displayed, the automatic stop function is not available. Conduct testing very carefully.

Returning method to normal display

- To return the displays to normal one after testing, set the outrigger setting switch (left) to a position other than **"CHECK"**.
  It is also possible to return to normal displays by turning **"OFF"** the power and turning it on again.

REPLACING PROCEDURES OF OVERLOAD SEFETY SYSTEM DISPLAY PANEL LAMP

- **Bulb and socket arrangement diagram**



22TF01261

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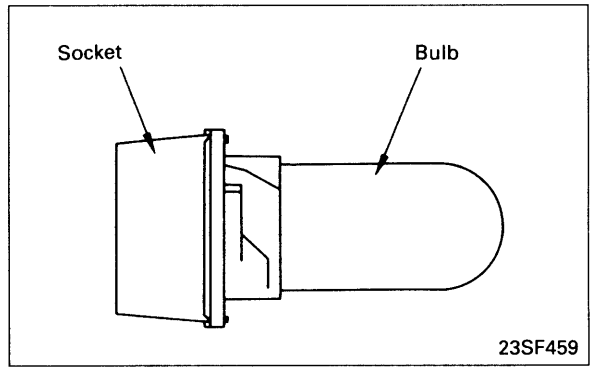
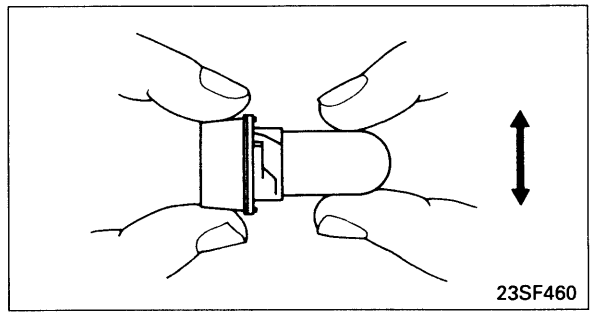
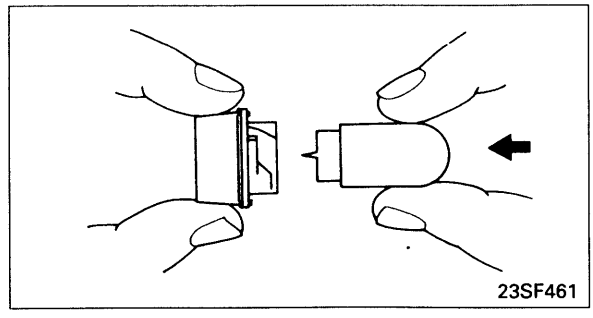
1. **Replacement of bulb and socket**
   Burnt and dark bulbs on the display panel should be replaced together with socket, if necessary, as follows referring to the above arrangement diagram:
   1) Turn the socket knob counterclockwise about 45°, check that the socket is not caught and remove it.
   2) Pull the defective bulb in the arrow direction shaking it slightly as shown in the right figure.
      ★ Do not pull it forcibly.
   3) Insert a bulb slowly into the socket as shown in the right figure.
      ★ Handle the bulb carefully.
   4) Set the protrusion on the socket into the hole on the panel side completely, then turn the socket clockwise about 45°. Check that the socket is not be pulled out.



23SF459



23SF460



23SF461

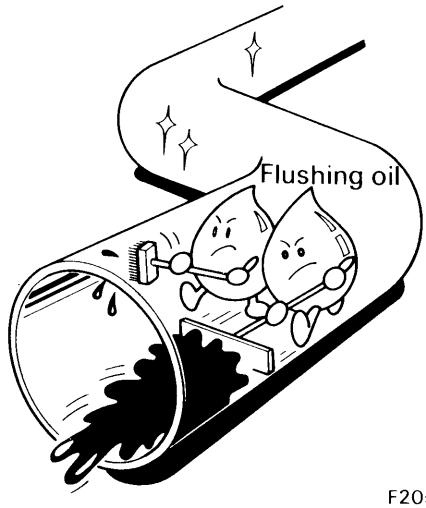
5) Change hydraulic oil when the temperature is high.

When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Do not drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6) Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.

Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



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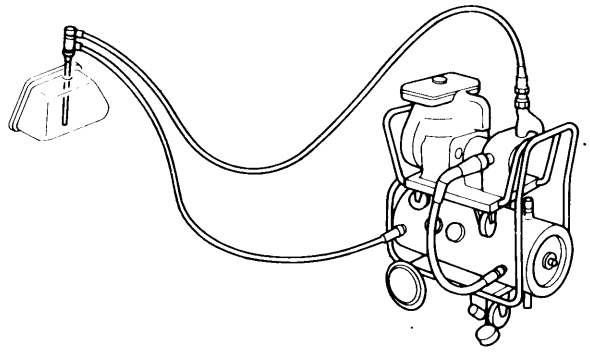
7) Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.

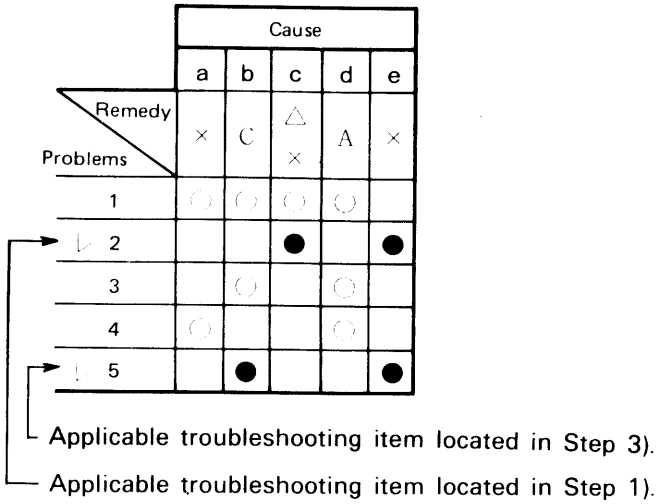
The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



F20505221

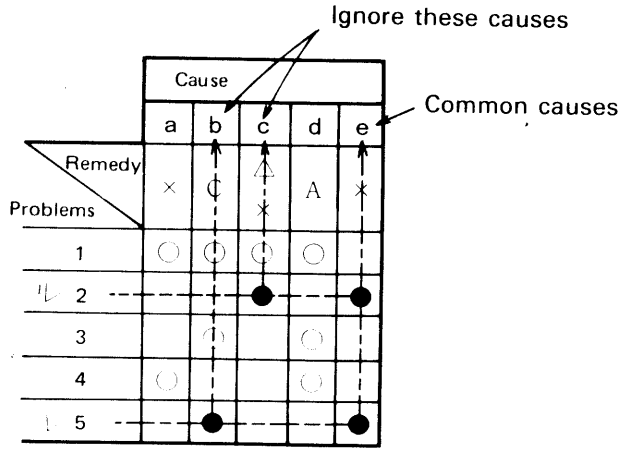
3) Operate the machine and check the troubleshooting items other than those in 1) .
Operate the machine and check the items in the same way as in 1), and if the symptom appears, mark that item. (In the chart on the right, the symptom appears again for item 5).

4) Find the appropriate cause from the cause column. In the same way as in Step 2), if the symptom appears, the ○ marks on that line indicate the possible causes. (For item No.5 in the table on the right, the possible causes are **b** or **e**.)



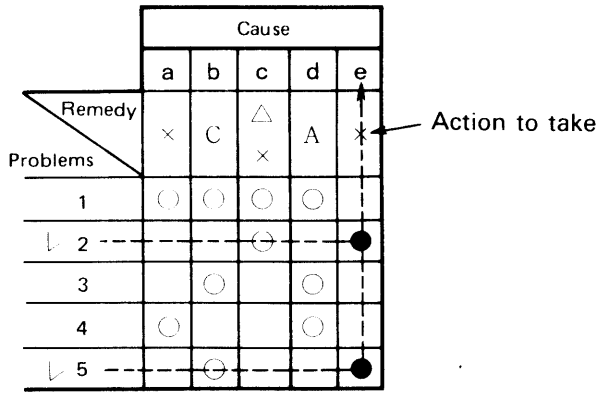
5) Narrow down the possible causes.
There is one common cause among the causes located in Steps 2) and 4). (One cause marked ○ appears on the line for both items.) This cause is common to both the symptoms in troubleshooting Steps 1) and 3).

★ The causes which are not common to both troubleshooting items (items which are not marked ○ for both symptoms) are unlikely causes, so ignore them.
(In the example given on the right, the causes for Troubleshooting Item 2 are **c** or **e**, and the causes for Troubleshooting Item 5 are **b** or **e**, so cause **e** is common to both.)



6) Repeat the operations in Steps 3), 4) and 5) until one cause (one common cause) remains.

★ If the causes cannot be narrowed down to one cause, narrow the causes down as far as possible.



7) Remedy
If the causes are narrowed down to one common cause, take the action given in the remedy column.
The symbols given in the remedy column indicate the following:
X: Replace, Δ: Repair, A: Adjust, C: Clean

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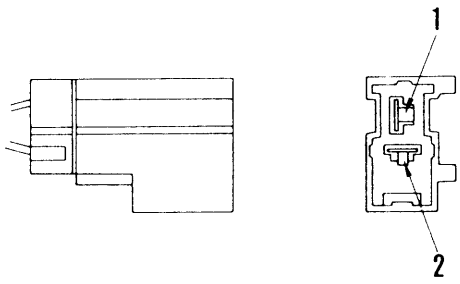
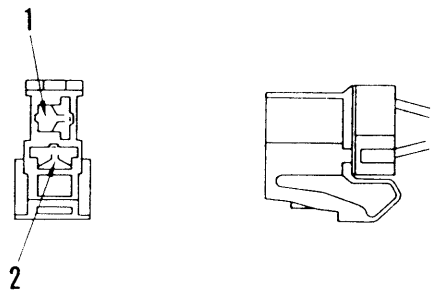
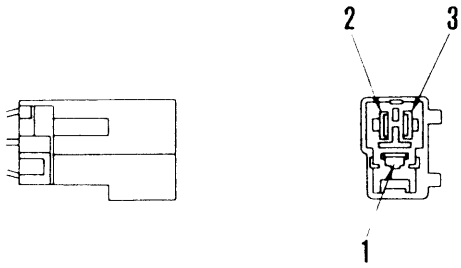
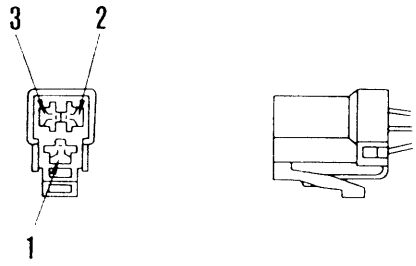
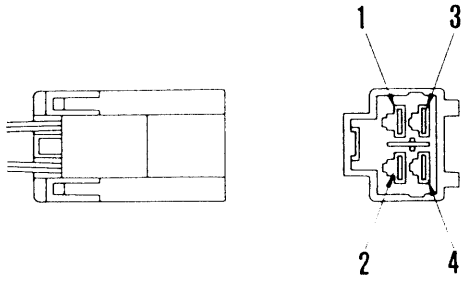
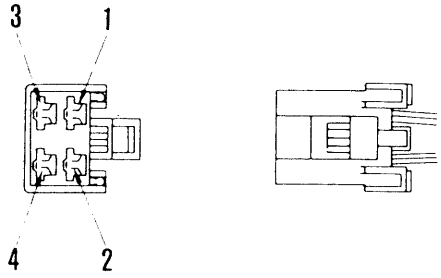
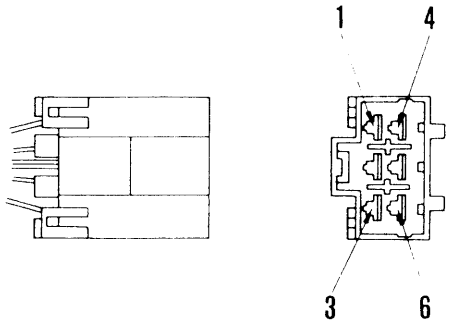
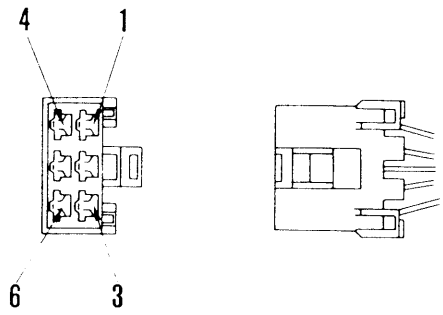
No. of pins	M type connecotr	
	Male (female housing)	Female (male housing)
2	 205F05319	 205F05320
3	 205F05321	 205F05322
4	 205F05323	 205F05324
6	 205F05325	 205F05326

③ Exhaust gas comes out but engine does not start (Fuel is being injected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

		Causes												
		Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Worm piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged fuel tank air breather hole	Improper fuel used	Defective quick glow system controller
Questions	Confirm recent repair history												
	Degree of use / Operated for long period			△	△	△				△			
	Suddenly failed to start	◎	◎										
	When engine is cranked, abnormal noise is heard from around head	◎											
	Engine oil must be added more frequently			◎									
	Non-specified fuel has been used		○							○			
	Replacement of filters has not been carried out according to operation manual				◎	◎	◎						
	Rust is found when fuel is drained				◎	◎							
	Air cleaner clogging lamp lights up						◎						
	Preheating indicator lamp does not light up												◎
Check items	Starting motor cranks engine slowly							◎					
	Mud is stuck to fuel tank cap										○		
	When fuel lever is placed at FULL position, it does not contact stopper		○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎										
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎						○	
	There is leakage from fuel piping								◎				
	When exhaust monifold is touched immediately after starting engine, temperature of some cylinder is low									◎			
	When fuel filter is drained, no fuel comes out											◎	
Troubleshooting	Remove head cover and check directly	●											
	When control rack is pushed, it is found to be heavy or does not return		●										
	When compression pressure is measured, it is found to be low			●									
	When fuel filter, strainer are inspected directly, they are found to be clogged				●							●	
	When feed pump strainer is inspected directly, it is found to be clogged					●							
	When air element is inspected directly, it is found to be clogged						●						
	Glow plug mount does not become warm												
	Either specific gravity of electrolyte or voltage of battery is low							●					
	When feed pump is operated, there is no response or pump is heavy								●				
	When nozzle holder is directly inspected, it is found to be clogged									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Replace	Repair	Clean	Clean	Replace	—

Refer to "Engine cannot be preheated or the preheating pilot lamp does not light".

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D-12 Oil pressure lamp lights up (drop in oil pressure)

General causes why oil pressure lamp lights up
- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Use of improper oil (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for engine oil selection

Type of fuel	Selection of oil SAE number according to ambient temperature
	−20 −10 0 10 20 30°C
Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40

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			Causes													
			Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Insufficient oil level in oil pan	Defective regulator valve	Defective relief valve	Leaking, crushed hydraulic piping	Defective oil level sensor	Defective oil pressure sensor	water, fuel in oil
Questions	Confirm recent repair history														
	Degree of use	Operated for long period	△	△				△							
	Replacement of filters has not been carried out according to operation manual		◎												
	Caution lamp lights up		◎								○				
	Non-specified fuel has been used		○	○											
Check items	Oil pressure lamp condition	Lights up at low idling		◎							○				
		Lights up at low or high idling			◎	◎	◎	◎	○	○	○				
		Lights up on a slope							◎						
		Lights up sometimes								◎	◎		○	○	
	There is clogging, leakage from hydraulic piping (external)											◎			
	Oil level sensor lamp lights up								◎				◎		
	When oil level in oil pan is inspected, it is found to be low								◎						
	Metal particles are found when oil is drained			◎											
	Metal particles are stuck to oil filter element			◎				○							
	Oil is cloudy white or smells of diesel oil														◎
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●											
	When oil pan is directly inspected after it is removed, it is found to be defective				●	●	●								
	Oil pump rotation is heavy, there is play							●							
	There is catching of relief valve, regulator valve, spring, valve guide is broken									●	●				
	After oil level sensor is replaced, oil pressure sensor lamp goes out												●		
	When oil pressure is measured, it is found to be within standard value													●	
	Remedy		Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace	—

Carry out troubleshooting for "Oil level rises".

Cause	Remedy
• Worn brake pad or defective operation • Defective wheel cylinder operation	Correct or replace.
Defective air master cylinder	Correct or replace.
Defective air regulator	Correct or replace.
Defective brake valve operation	Correct or replace.
Defective master cylinder	Correct or replace.
Improper brake adjustment	Adjust.

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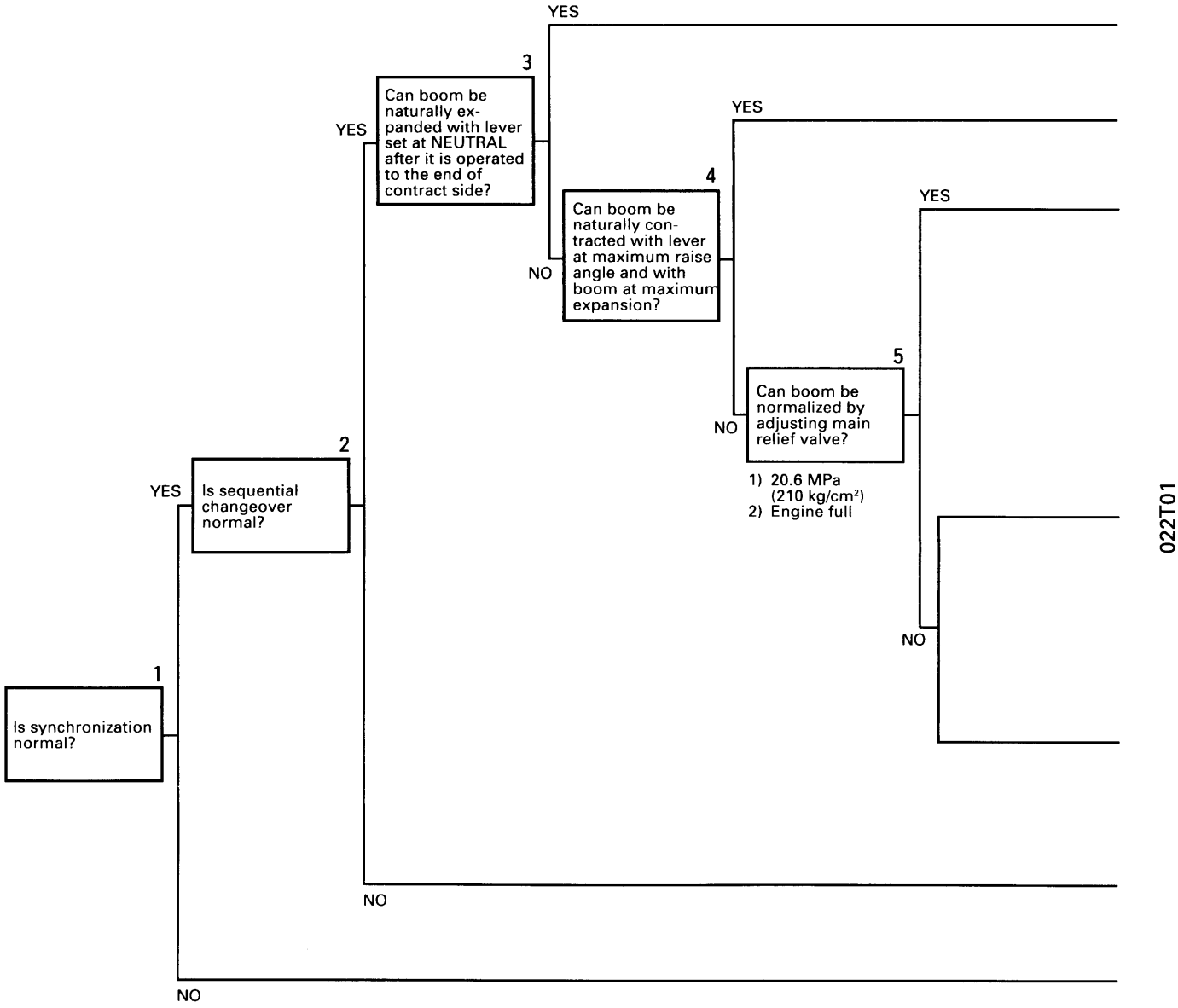
Cause	Remedy
Defective master cylinder return	Correct or replace.
Defective brake valve return	Correct or replace.
Defective air master cylinder return	Correct or replace.
• Defective brake shoe return • Defective wheel cylinder return	Correct or replace.
Defective brake pedal return	Correct.
Improper adjustment of brakes	Adjust.

H-11 Boom telescoping is impossible or slow.

★ When pilot circuit pressure is normal
★ When electrical system is normal



H-102 Acceleration or deceleration is impossible.

★ When any error is displayed on the controller

a) Acceleration is impossible.

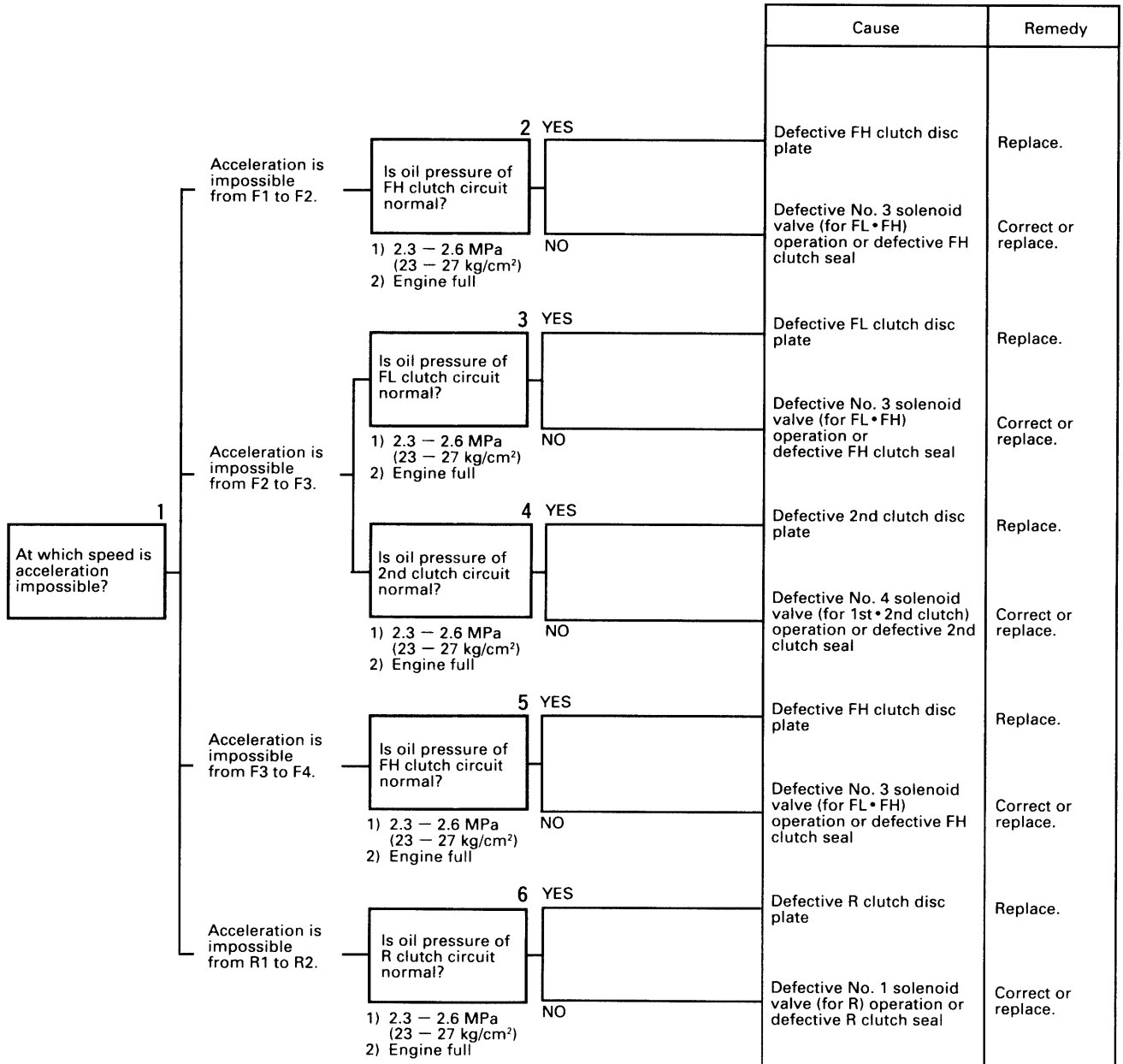


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Table of speed step-clutch combination

Clutch		R	FL	FH	1	2
Speed step	R1	○			○	
	R2	○				○
	F1		○		○	
	F2			○	○	
	F3		○			○
	F4			○		○

OPERATIONS BEFORE TROUBLESHOOTING OF STEERING SYSTEM

1. The rear steering is automatically locked when the front 2 wheels are driven, and automatically unlocked when the other wheels are driven.
2. When the front 2 wheels are driven, all the steering mode solenoids are "OFF". Any mode other than the front 2 wheels is not released when the front 2 wheels are not driven. Accordingly, perform troubleshooting by the item where the corresponding mode is NOT RELEASED.

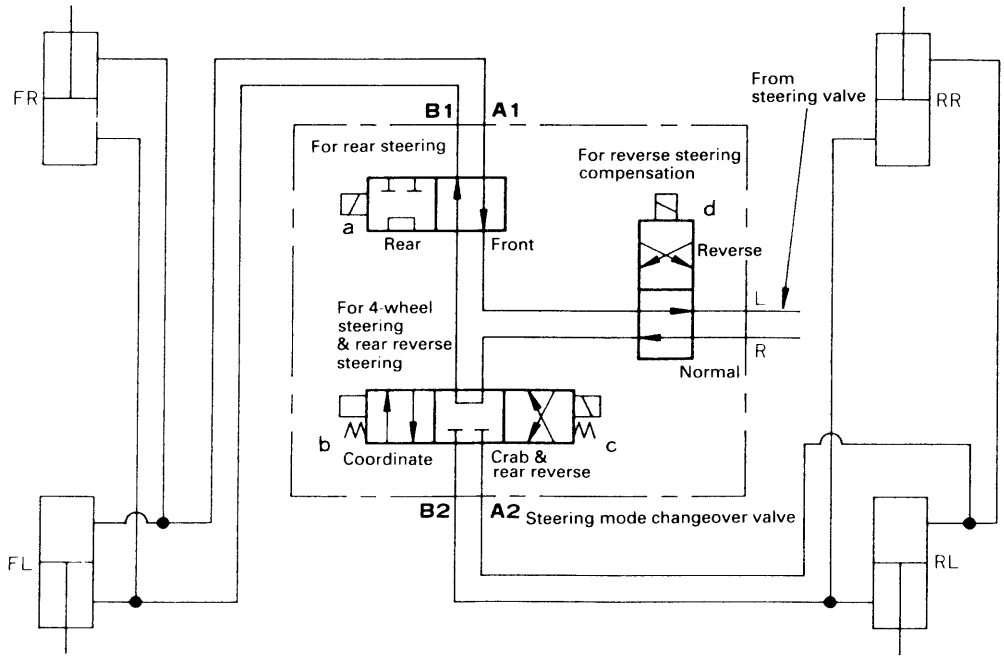
		Rear steering lock solenoid		Indicator		Steering mode solenoid			
		Lock	Unlock	Lock	Unlock	a	b	c	d
Steering mode	Front 2 wheels	○		○					
	Rear 2 wheels		○		○	○	○		
	4-wheel coordinate		○		○		○		
	4-wheel crab		○		○			○	
	Reverse front 2 wheels		○		○				○
	Reverse rear 2 wheels		○		○	○		○	
	Reverse 4-wheel coordinate		○		○		○		○

Table 1
Steering modes and solenoid operating status and steering lock solenoid operating status

The mark ○ shows an energized solenoid status.

022T01

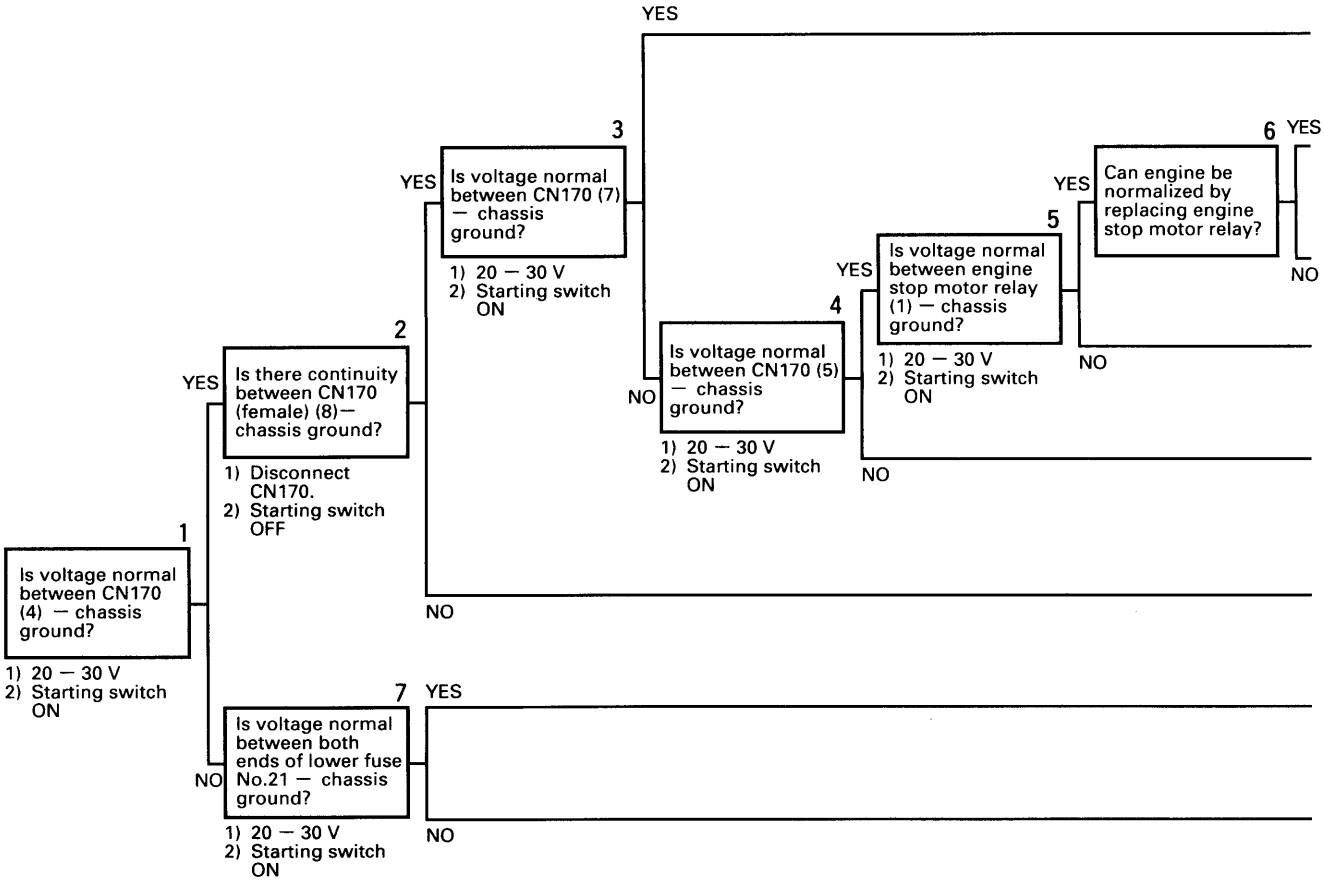
Fig. 1 Steering mode changeover valve/steering cylinder connection diagram

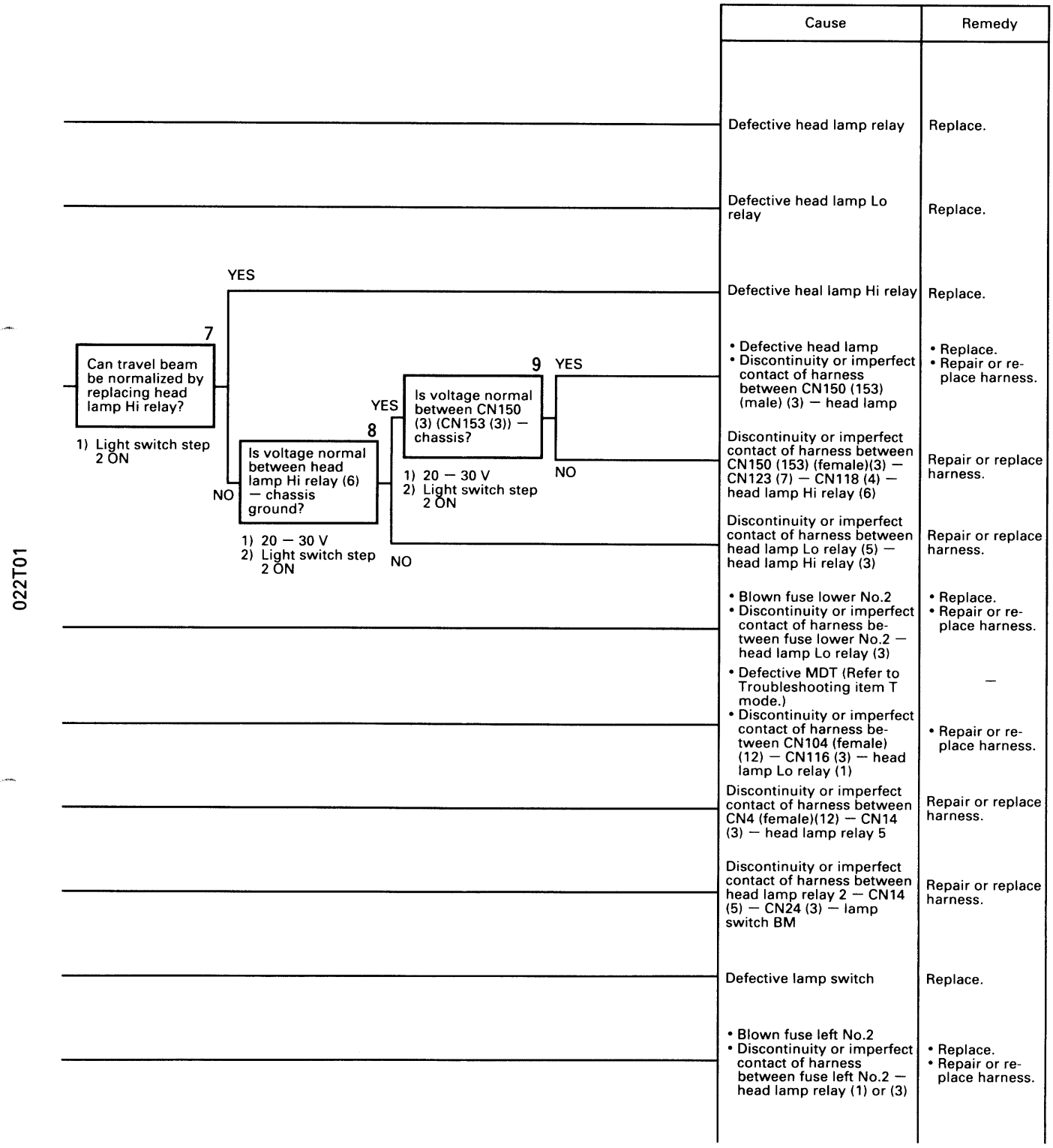


22TF01271

E-4 Starting motor can rotate but engine cannot start.

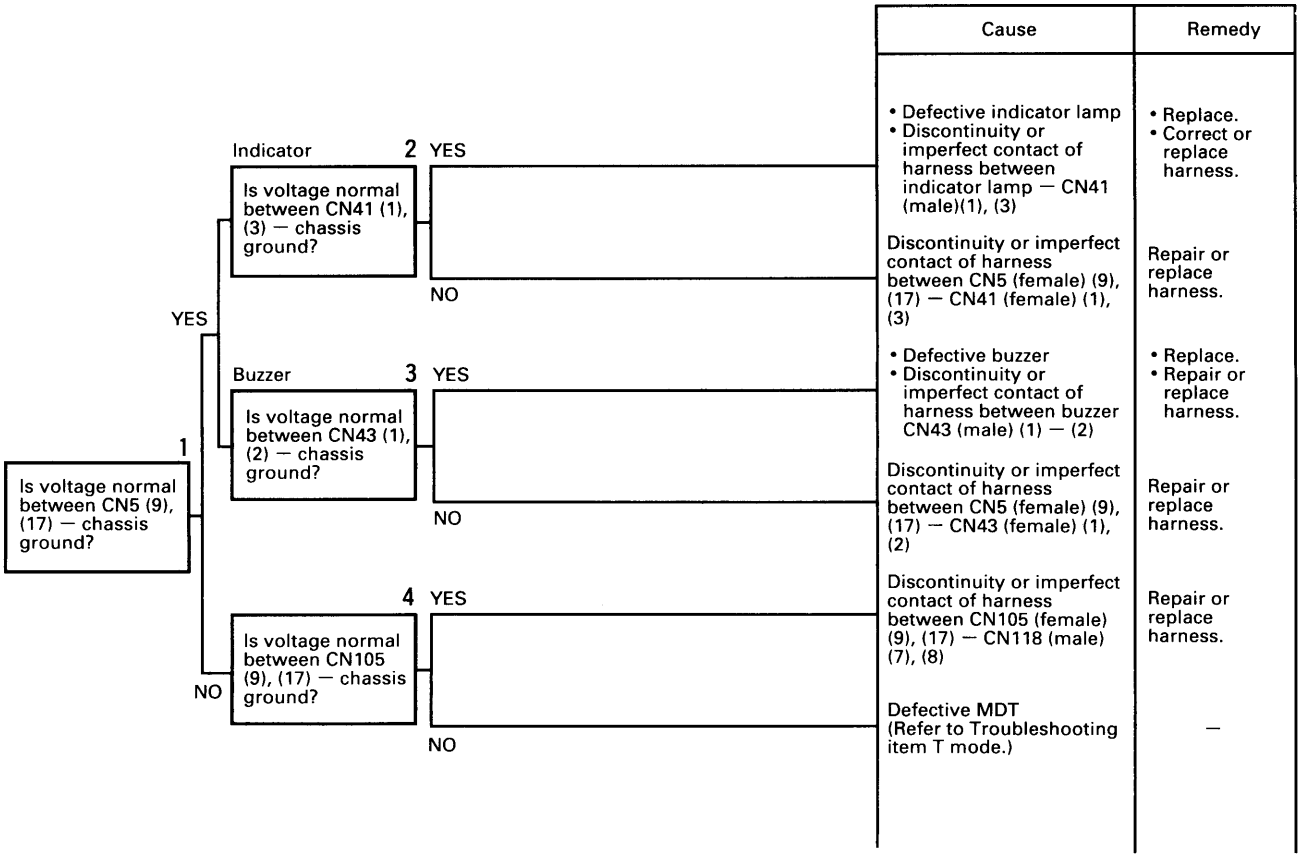
★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.





Cause	Remedy
Defective head lamp relay	Replace.
Defective head lamp Lo relay	Replace.
Defective heal lamp Hi relay	Replace.
• Defective head lamp • Discontinuity or imperfect contact of harness between CN150 (153) (male) (3) — head lamp	• Replace. • Repair or replace harness.
Discontinuity or imperfect contact of harness between CN150 (153) (female)(3) — CN123 (7) — CN118 (4) — head lamp Hi relay (6)	Repair or replace harness.
Discontinuity or imperfect contact of harness between head lamp Lo relay (5) — head lamp Hi relay (3)	Repair or replace harness.
• Blown fuse lower No.2 • Discontinuity or imperfect contact of harness between fuse lower No.2 — head lamp Lo relay (3)	• Replace. • Repair or replace harness.
• Defective MDT (Refer to Troubleshooting item T mode.)	—
• Discontinuity or imperfect contact of harness between CN104 (female) (12) — CN116 (3) — head lamp Lo relay (1)	• Repair or replace harness.
Discontinuity or imperfect contact of harness between CN4 (female)(12) — CN14 (3) — head lamp relay 5	Repair or replace harness.
Discontinuity or imperfect contact of harness between head lamp relay 2 — CN14 (5) — CN24 (3) — lamp switch BM	Repair or replace harness.
Defective lamp switch	Replace.
• Blown fuse left No.2 • Discontinuity or imperfect contact of harness between fuse left No.2 — head lamp relay (1) or (3)	• Replace. • Repair or replace harness.

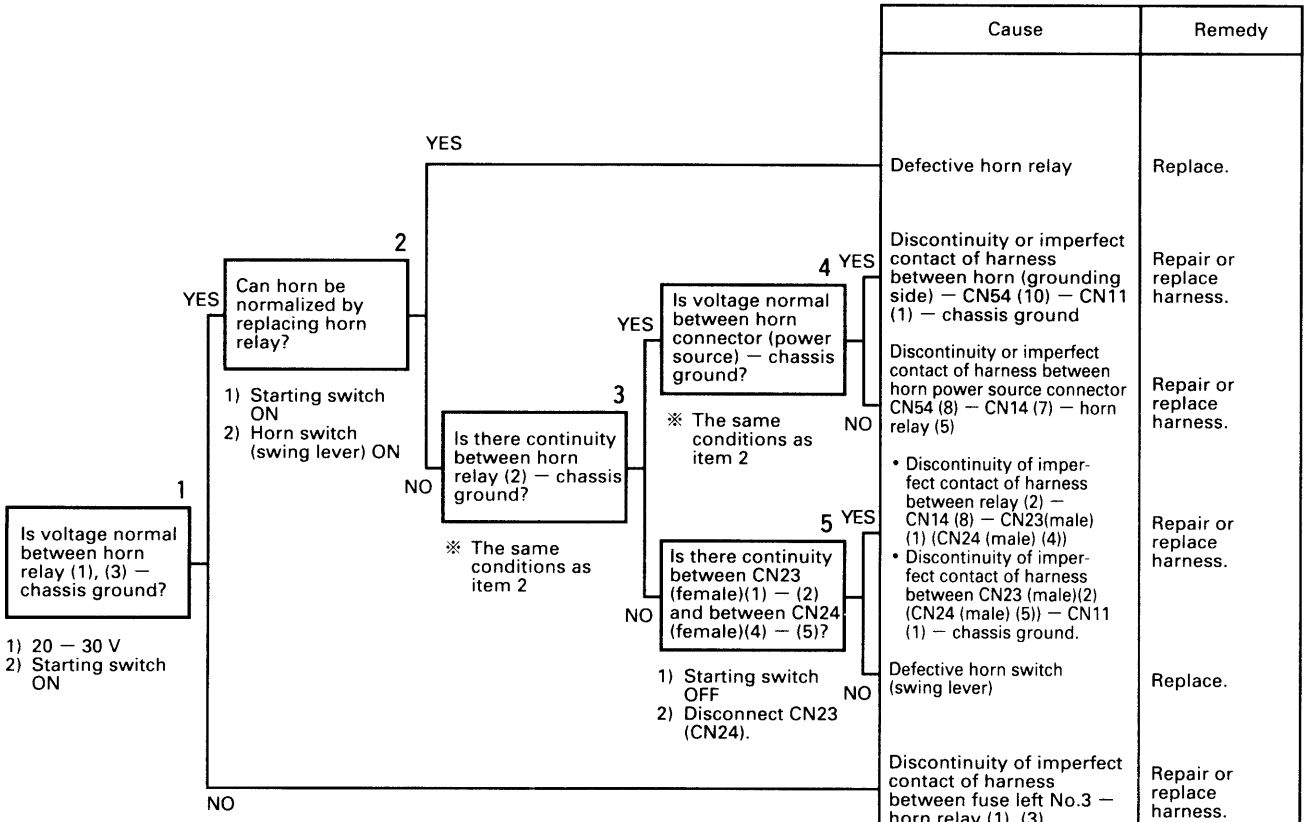
c) When signal indicator does not flickers (and buzzer does not sound, either)



022T01

E-21 Horn does not sound. (Horn does not sound by pressing the horn switch of swing lever in the middle of steering wheel.)

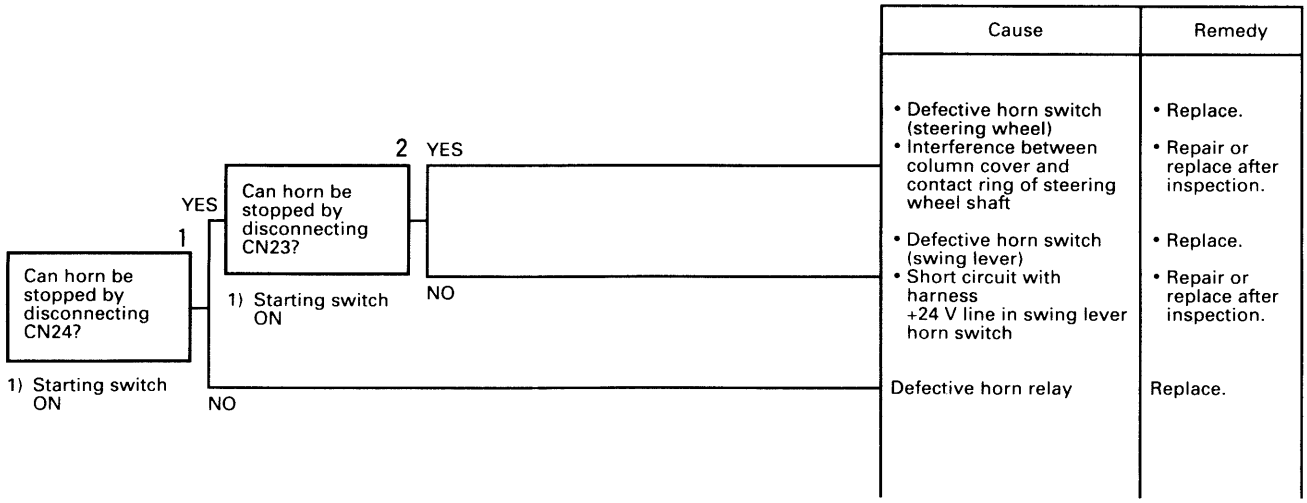
★ Check that fuse is not burnt out.
★ Before starting troubleshooting, check if there is defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



022T01

E-22 Horn cannot be stopped.

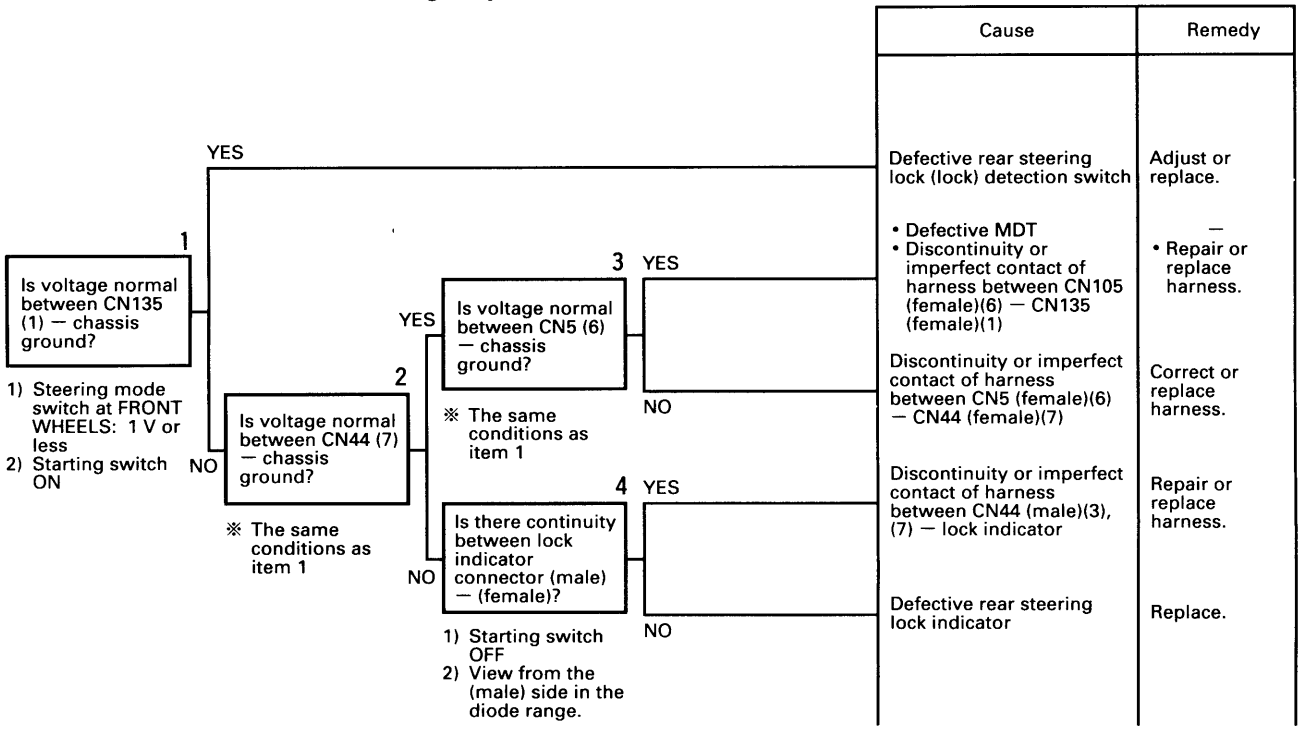
★ Before starting troubleshooting, check if there is defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



E-28 Rear steering (lock/release) indicator lamp ON error

★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.

a) When lock indicator does not light up with front 2 wheels



Cause	Remedy
Defective rear steering lock (lock) detection switch	Adjust or replace.
• Defective MDT • Discontinuity or imperfect contact of harness between CN105 (female)(6) — CN135 (female)(1)	— • Repair or replace harness.
Discontinuity or imperfect contact of harness between CN5 (female)(6) — CN44 (female)(7)	Correct or replace harness.
Discontinuity or imperfect contact of harness between CN44 (male)(3), (7) — lock indicator	Repair or replace harness.
Defective rear steering lock indicator	Replace.

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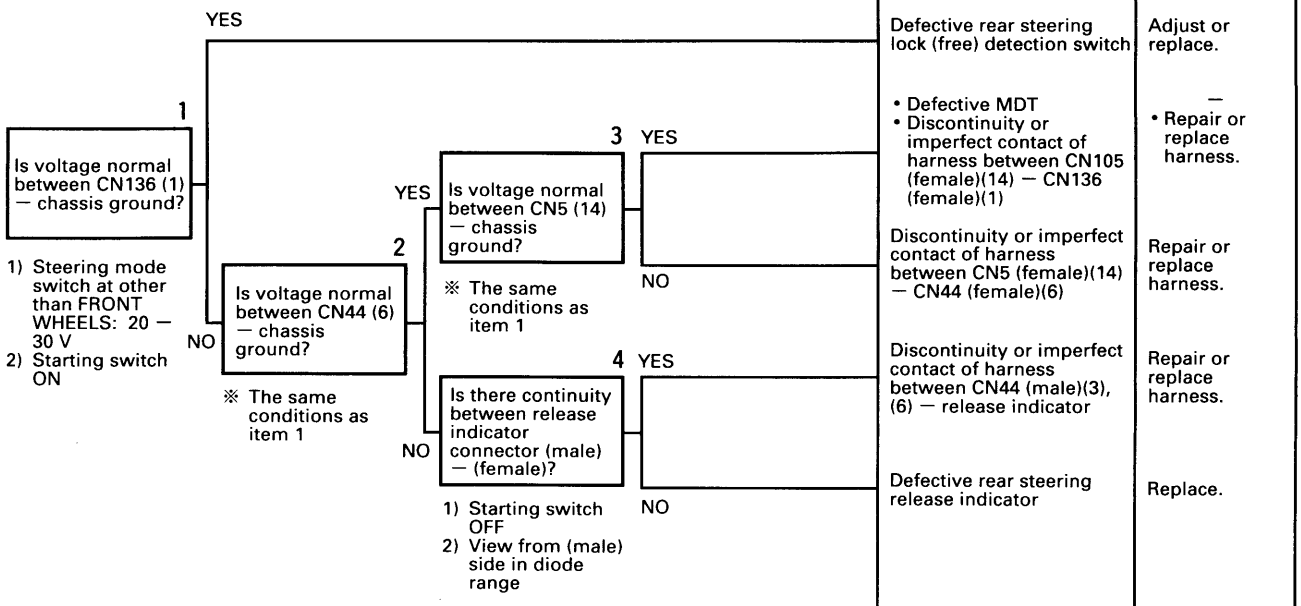
b) When release indicator does not light up at other than 2 wheels.



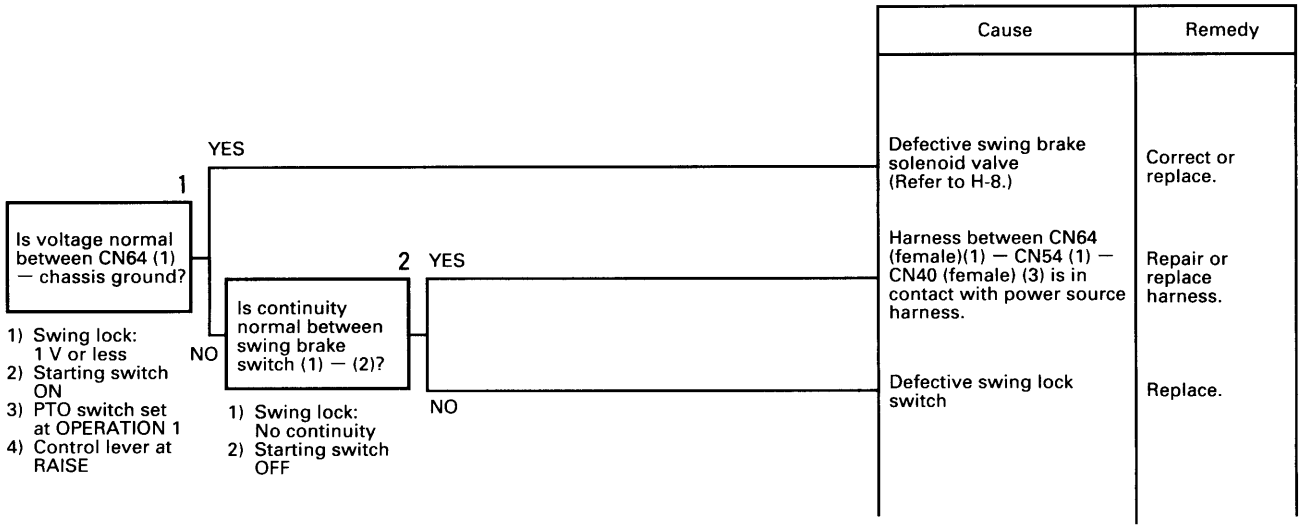
Cause	Remedy
Defective rear steering lock (free) detection switch	Adjust or replace.
• Defective MDT • Discontinuity or imperfect contact of harness between CN105 (female)(14) — CN136 (female)(1)	— • Repair or replace harness.
Discontinuity or imperfect contact of harness between CN5 (female)(14) — CN44 (female)(6)	Repair or replace harness.
Discontinuity or imperfect contact of harness between CN44 (male)(3), (6) — release indicator	Repair or replace harness.
Defective rear steering release indicator	Replace.

c) When both lock and release indicators flicker.

Cause	Remedy
Rear steering lock pin stops halfway.	Correct pin or hole.

E-35 Swing cannot be locked. (Swing remains free.)

★ When work equipment can be normally operated
★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



E-36 Swing cannot be set free.

★ When work equipment can be normally operated
★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.

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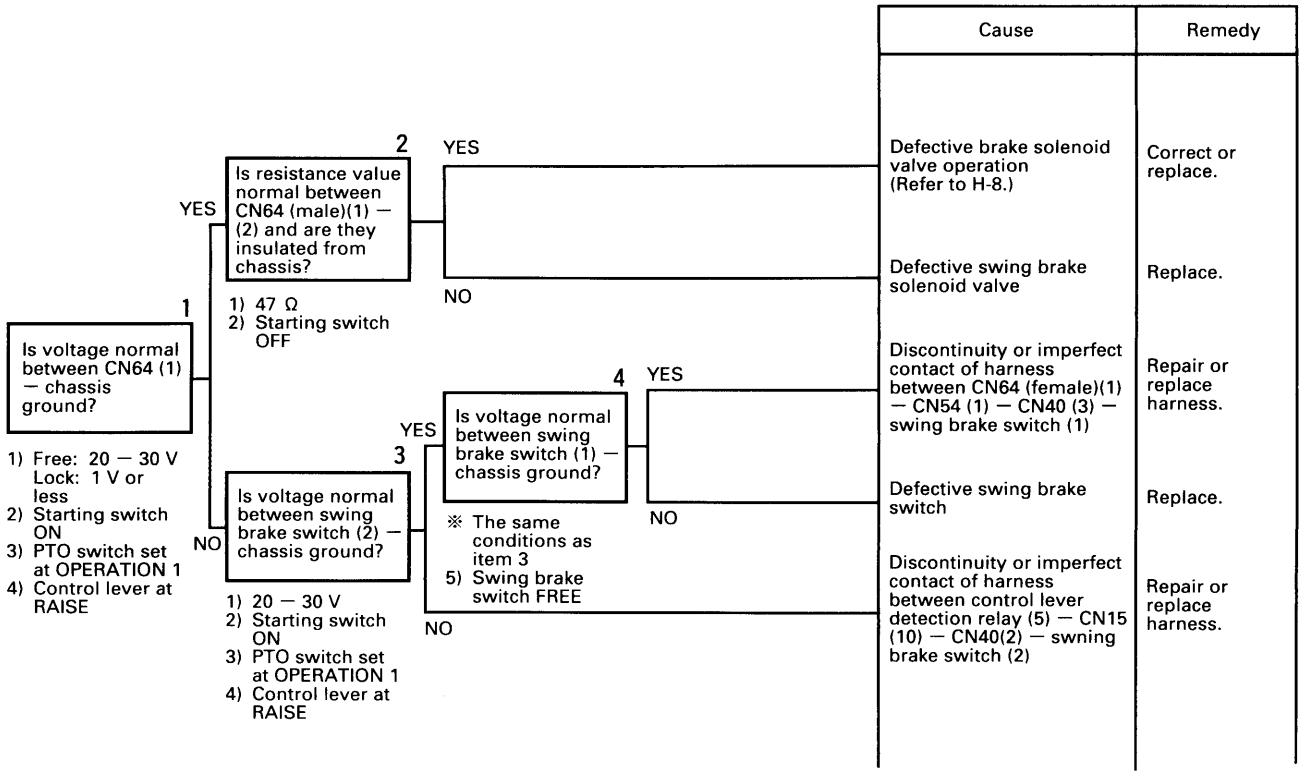

d) Any one of outrigger individual operations is impossible. (The remaining 3 operations are possible.)

★ If any outrigger operation fails at all operations, execute troubleshooting according to this item.

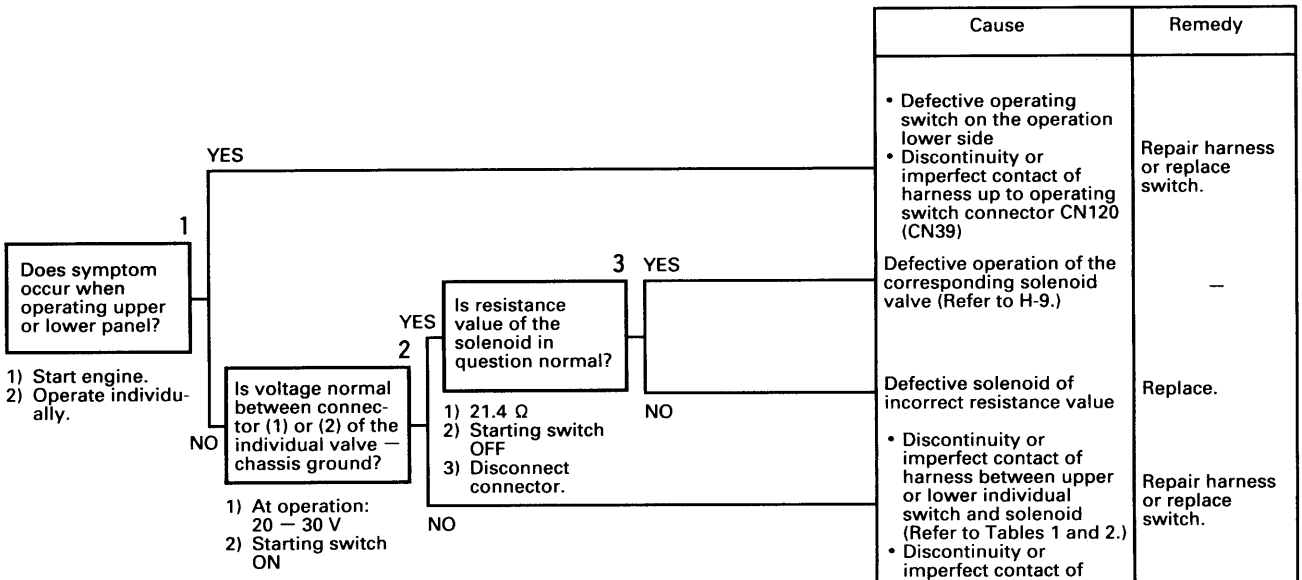

Table 1 Connections between lower switches and connectors

Slide/jack changeover switch					Individual switch					Intermediate connector		Individual connector				Operating direction of slide/jack cylinder
					RL	RR	FR	FL	All	CN 120	CN 123	CN 155	CN 156	CN 157	CN 158	
SW4	12	○								⑥	—			①		RL slide
	11	○	○	○	●				●							
	10			○						⑤	—			②		RL jack
SW6	9	○								②	—				①	RR slide
	8	○	○	○		●			●							
	7			○						①	—				②	RR jack
SW3	6	○									⑧	④	①			FR slide
	5	○	○	○			●		●							
	4			○						⑦	③	②				FR jack
SW5	3	○								④	②		①			FL slide
	2	○	○	○				●	●							
	1			○						②	①		②			FL jack
SW1		Slide	Neutral	Jack												

※ The mark ● shows an input from a individual switch to a slide/jack changeover switch.

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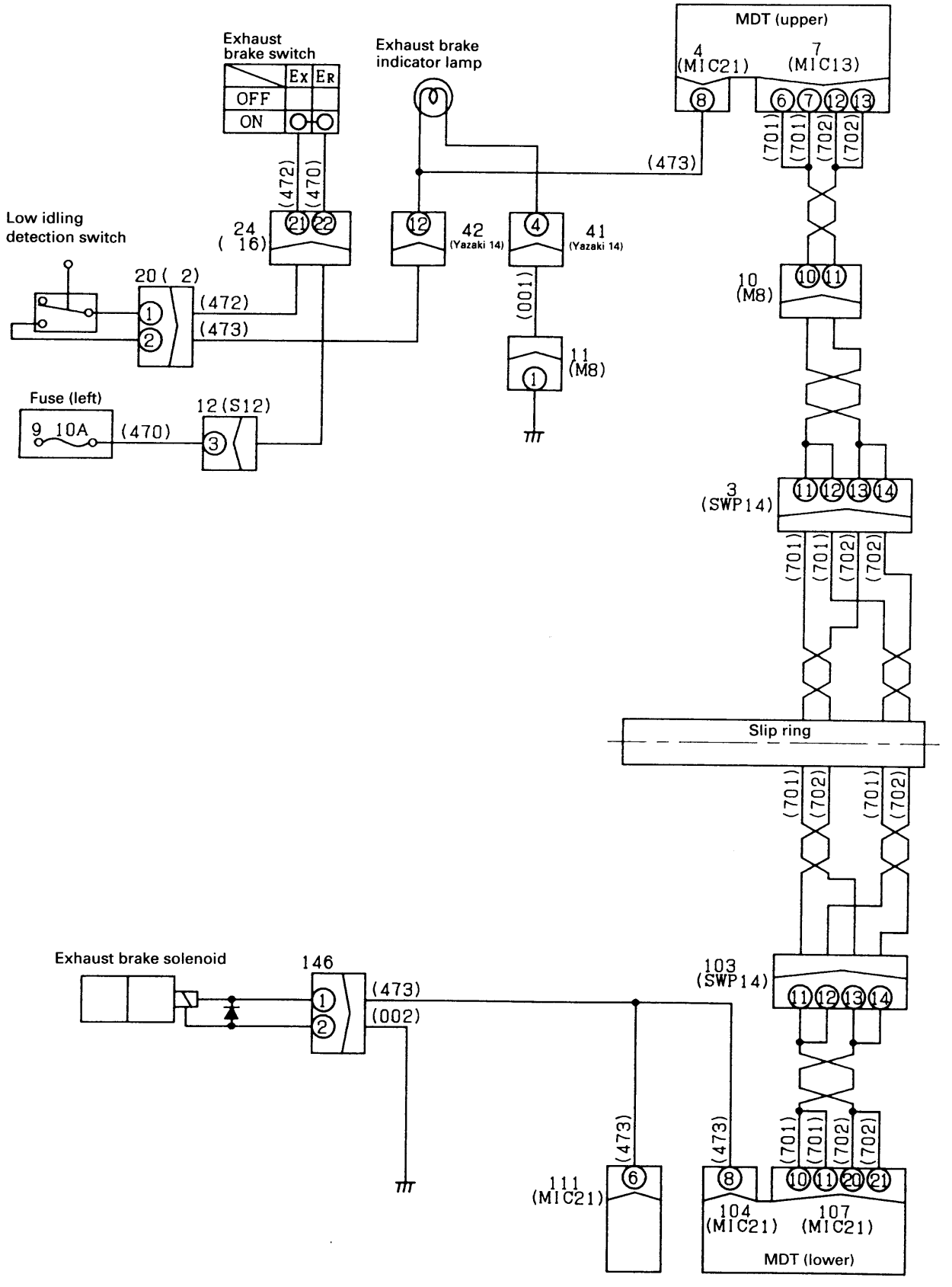
Table 2 Connections between upper individual switches and connectors

Individual switch		Connector pin No.	
		CN39	CN6
3	RL	⑩	⑤
4	FL	⑨	⑨
5	RR	⑧	⑥
6	FR	⑦	⑩

※ When operated from an upper switch, the individual switch signal and slide/jack changeover switch are compounded in MDT. (Refer to the circuit diagram.)

Exhaust brake system (related to E-23)

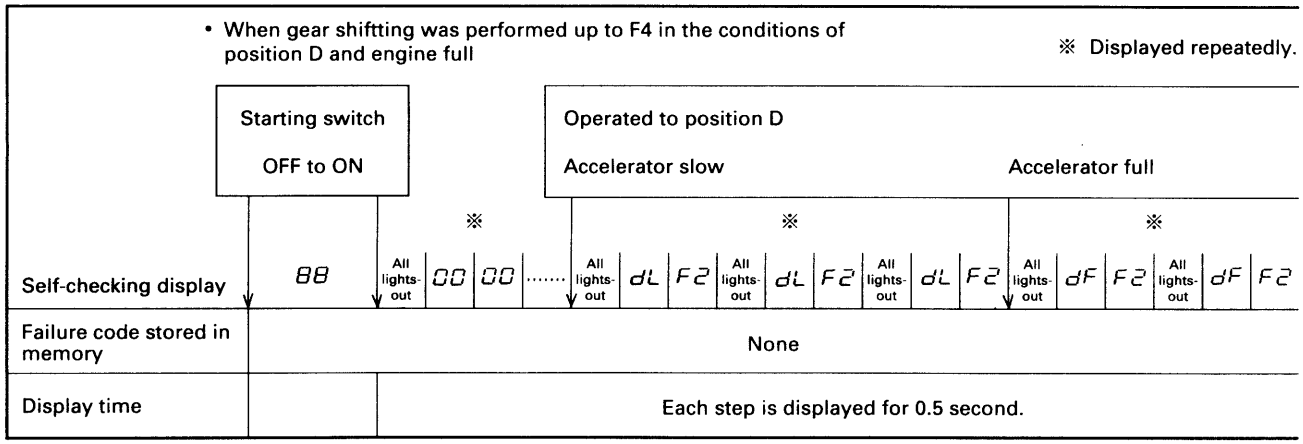


3. Display method

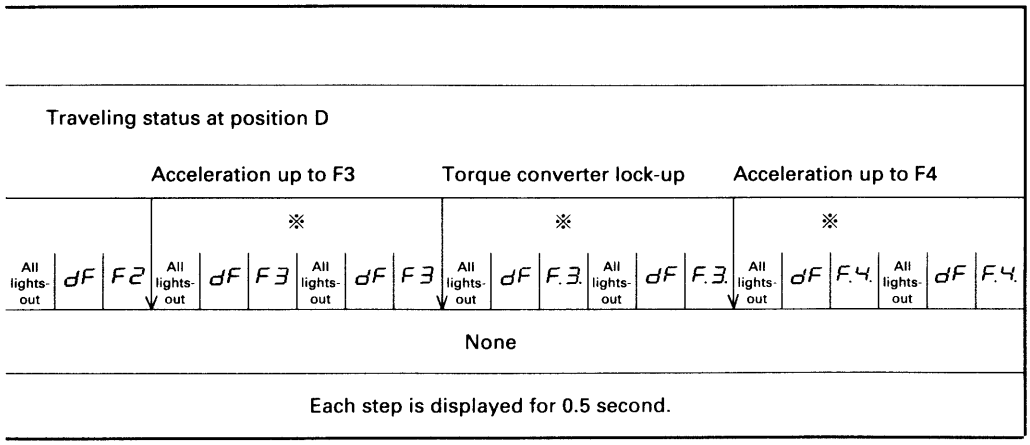
1) When the starting switch is turned on, a display is started and its contents change in the following order.
   Each step is displayed for 0.5 second.
   ① All lights-out: Indicates a start of display.
   ② Transmission gear shift mode: Indicates the current transmission gear shift mode.
   ③ Gear shift step: Indicates the current outputting gear shift step.
   ④ E—: Indicates the error that is currently occurring.
   ⑤ Number: Indicates the type of error.
   ⑥ C—: Indicates the error that occurred in the past and are stored in memory.
   ⑦ Number: Indicates the type of error.

2) Real display
   ① Display that is not made currently and yet not stored in memory (Table 6)

Table 6



022T01



A-5 [14] [Discontinuity in throttle sensor system] is displayed.

★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.

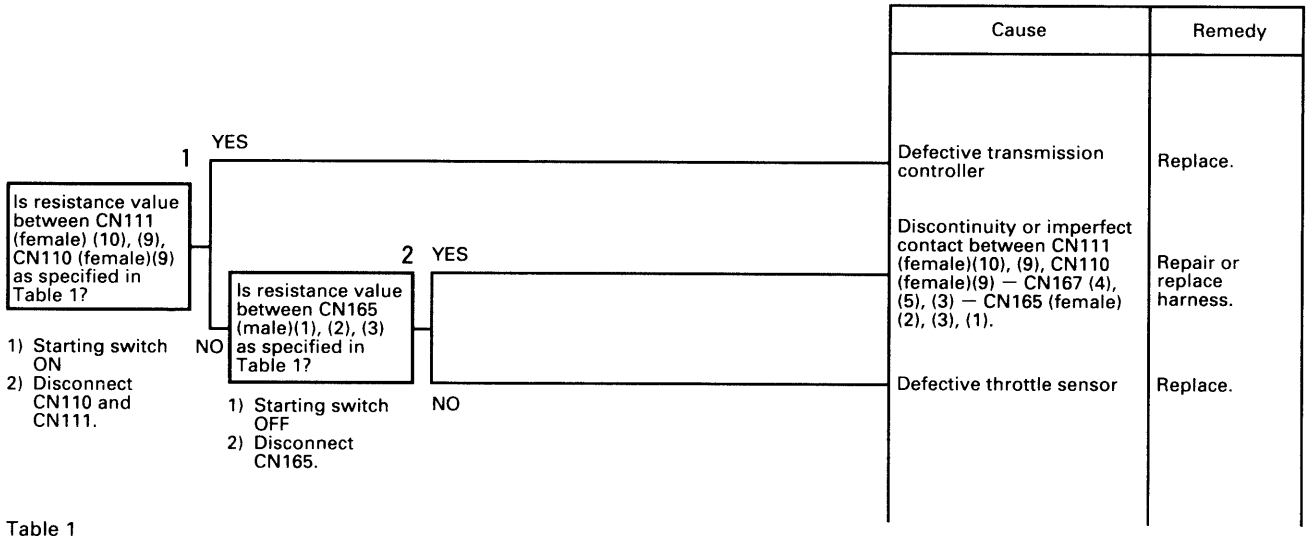


Table 1

CN165 (male)	CN110, CN111 (female)	Resistance value
(2) — (3)	CN111 (10) — (9)	5kΩ ±20%
(1) — (3)	CN110 (9) — CN111 (9)	3.4(Lo) — 1.3(Hi)kΩ
(1) — (2)	CN110 (9) — CN111 (9)	1.6(Lo) — 3.7(Hi)kΩ

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A-6 [15] [Discontinuity in torque converter oil temperature sensor system] is displayed.

★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.

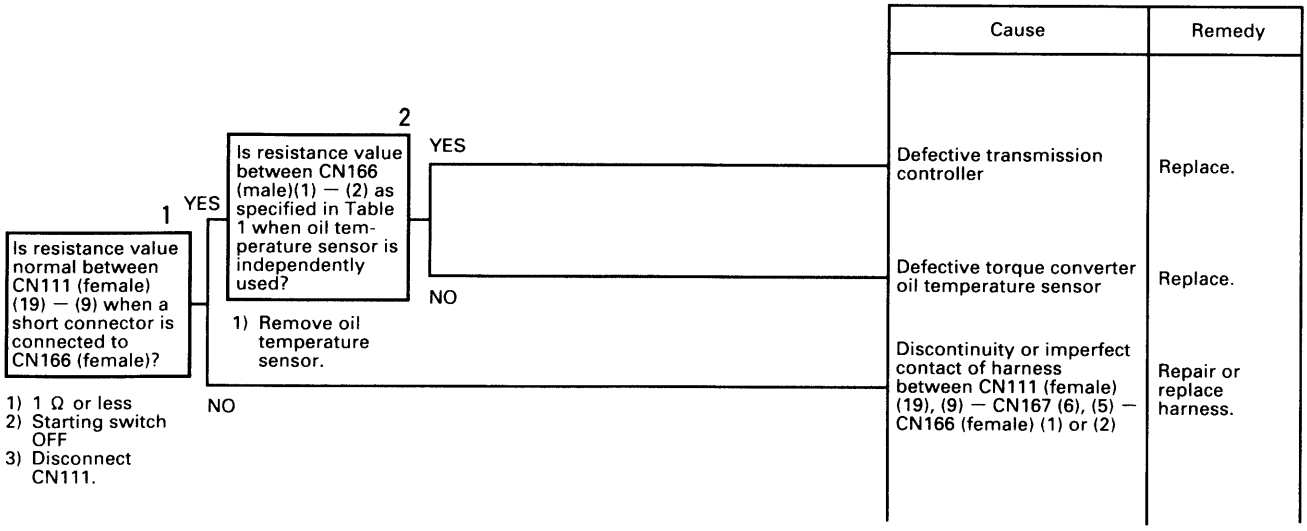
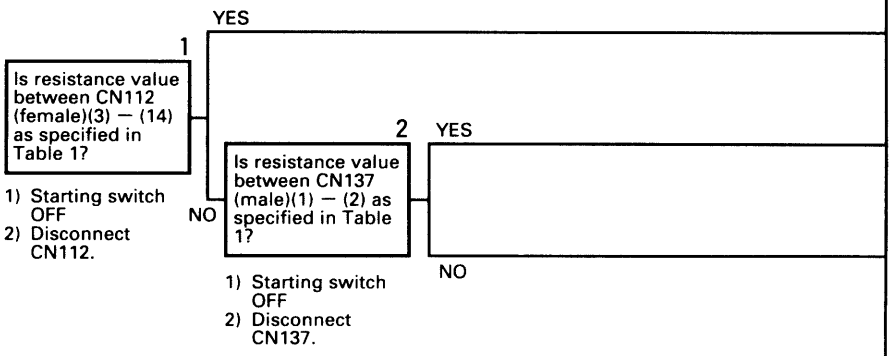


Table 1

Temperature	Resistance value	Reference resistance value
Normal temperature (25°C)	38.18 — 47.77kΩ	42.7 kΩ
100°C	3.604 — 3.903kΩ	3.750 kΩ

A-17 [12] [Discontinuity in torque converter lock-up solenoid system] is displayed.

★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



Cause	Remedy
Defective transmission controller	Replace.
Discontinuity or imperfect contact of wiring harness between CN112 (female) (3), (14) — CN137 (female) (1), (2)	Repair or replace wiring harness.
Defective torque converter lock-up solenoid	Replace.

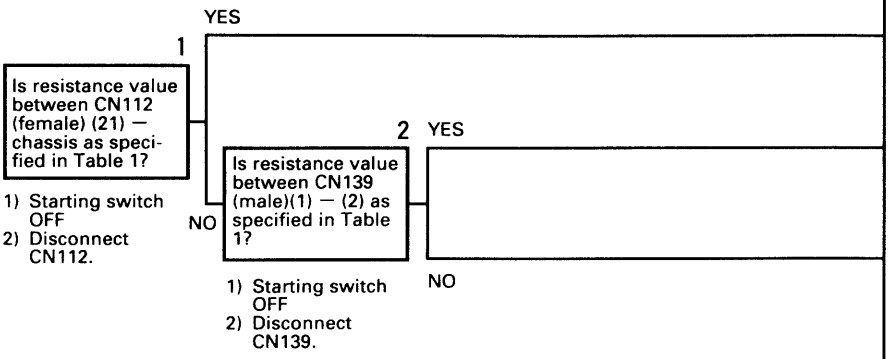
Table 1

CN112 (female)	CN130 (male)	Resistance value
(3) — (14)	(1) — (2)	52Ω ±7% (20°C)

022T01

A-18 [13] [Discontinuity in transmission solenoid (2) system] is displayed.

★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



Cause	Remedy
Defective transmission controller	Replace.
Discontinuity or imperfect contact of wiring harness between CN112 (female) (21) — CN139 (male)(1) or between CN139(female)(2) — chassis ground	Repair or replace wiring harness.
Defective transmission solenoid (2) (for F)	Replace.

Table 1

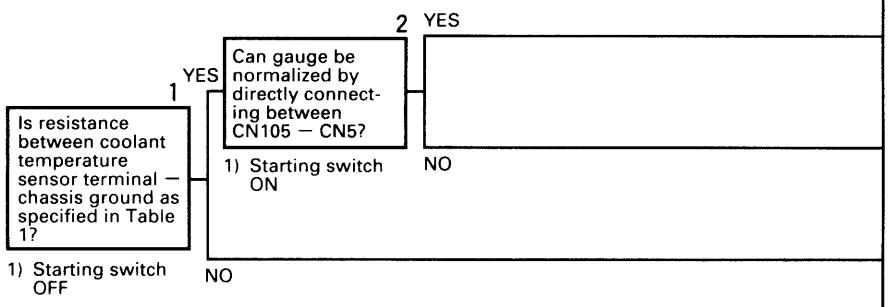
CN112 (female)	CN139 (male)	Resistance value
(21) — chassis	(1) — (2)	52Ω ±7% (20°C)

TROUBLESHOOTING OF MACHINE MONITOR SYSTEM

(M MODE)

022T01

c) When the value indicated on coolant temperature gauge does not agree with Coolant temperature



Cause	Remedy
Defective MDT (Refer to Troubleshooting item T mode.)	–
• Discontinuity or imperfect contact of wiring harness in gauge cluster • Defective coolant temperature gauge	Replace gauge assembly.
Defective coolant temperature sensor	Replace.

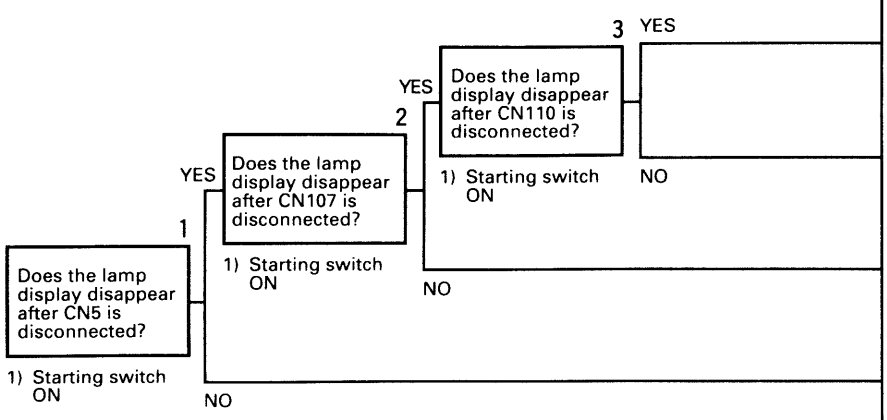
Table 1 (Reference values)

Temperature (°C)	50	100
Resistance (Ω)	102	19.8

022T01

M-7 Torque converter oil temperature alarm error (when torque converter oil temperature is normal)

★ Check that no error is displayed on the transmission controller.
(If any error is displayed, perform Troubleshooting item A mode in advance.)
★ Before starting troubleshooting, check if there is any defective fitness in related connectors.
★ Before proceeding to the next step, be sure to return disconnected connectors to their original status.



Cause	Remedy
Refer to "TROUBLESHOOTING OF TRANSMISSION CONTROLLER SYSTEM".	–
Wiring harness between CN107 (female) (18) – CN110 (female) (16) is in contact with (+) wiring harness.	Replace gauge assembly.
Defective MDT (Refer to Troubleshooting item T mode.)	–
Ground-fault of wiring harness between CN5 (female) (11) – CN42 (male) (10), or contact with (–) wiring harness.	Repair or replace wiring harness.

TROUBLESHOOTING OF MULTIPLE DATA TRANSMISSION (MDT)

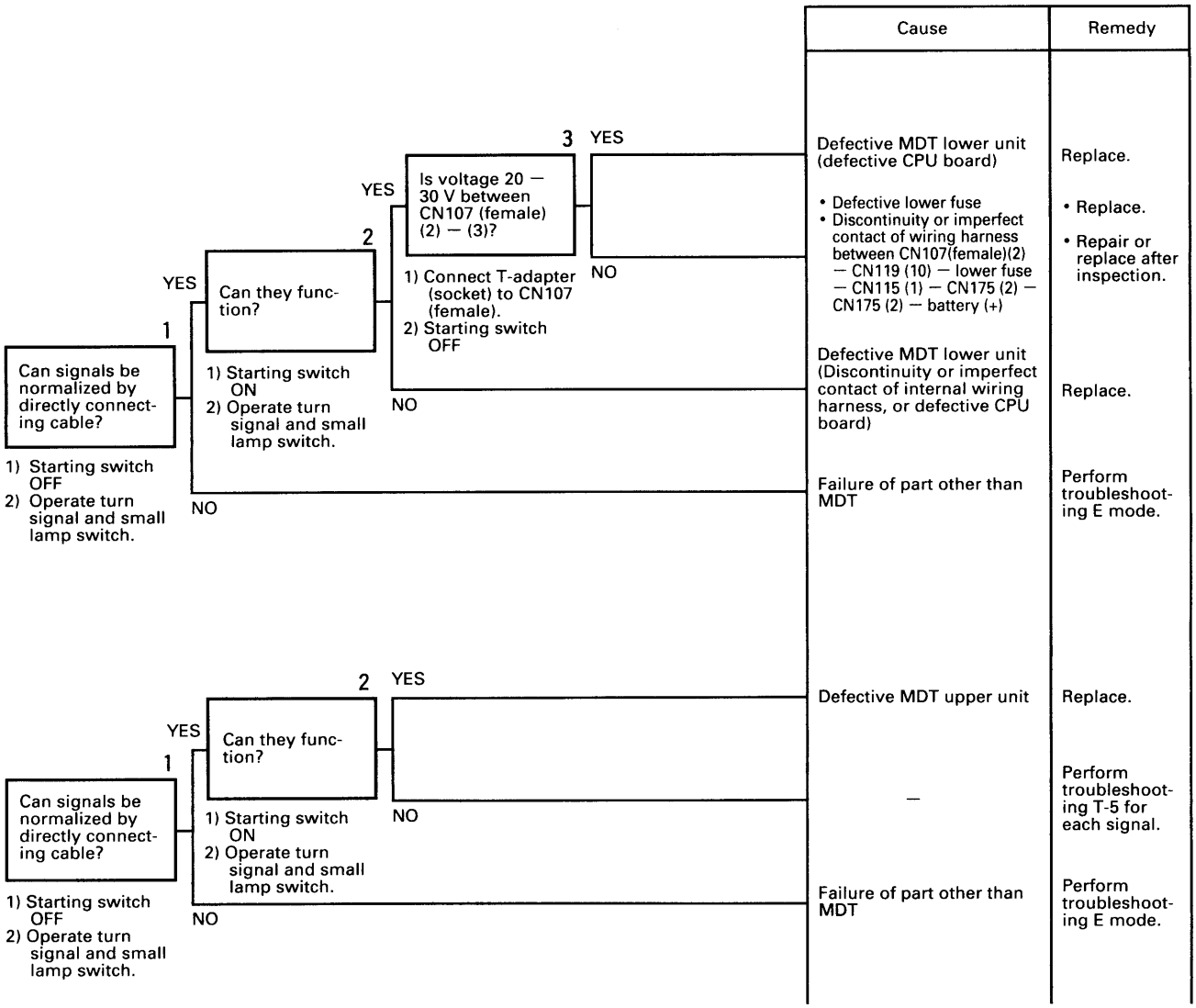
(T MODE)

022T01

T-7 Some signals do no function with starting switch "OFF". (Left/right turn signal lamp, small lamp)

★ Before connecting T-adapter (or socket) and disconnecting connectors, turn off starting switch.
★ Connect T-adapter to each of male and female and connect socket to the portion specified in parentheses.
★ After completion of inspection, connect disconnected connectors at once.
★ For direct cable connection, refer to "TESTING AND ADJUSTING".

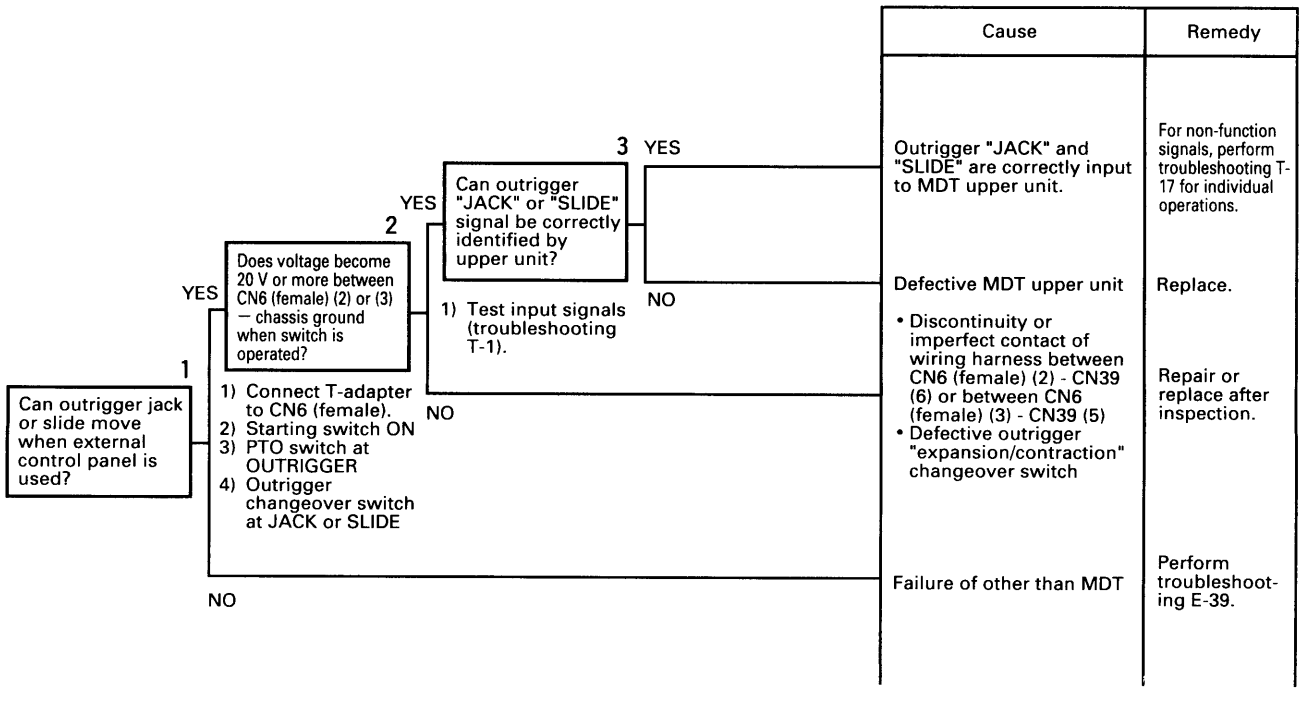
a) When all signals do not function with starting switch "OFF"



022T01

T-16 Outrigger jack or slide does not move.

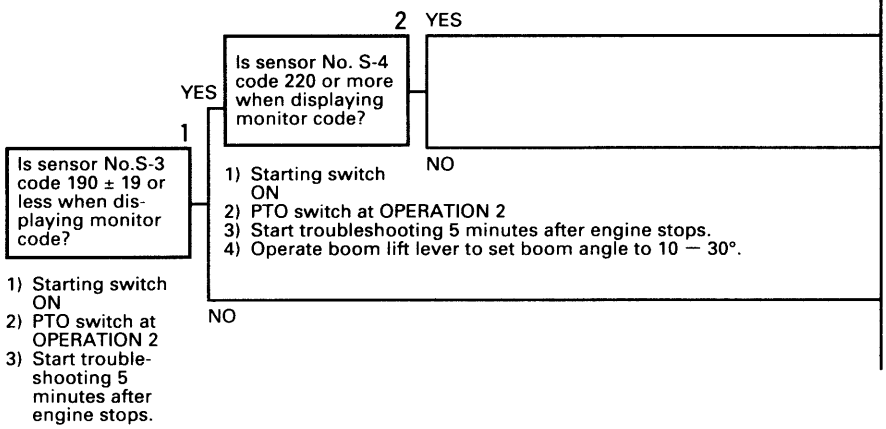
★ Before connecting T-adapter (or socket) or disconnecting socket, turn off starting switch.
★ Connect T-adapter to each of male and female and connect socket to the portion specified in parentheses.
★ After completion of inspection, connect disconnected connectors at once.



022T01

S-1 Digital display [E 38] is made. (Error system: Boom cylinder pressure signal)

★ For monitor code display, refer to "TESTING AND ADJUSTING".
★ When the rod shaft force of boom cylinder becomes tensile force, this error occurs but does not mean a failure.
Example 1: When boom is pushed down like ground auger
Example 2: When boom is brought down to the maximum angle of inclination and brought down further
★ When connecting pressure sensor wiring harnesses, this error occurs if one for bottom and the other for head are connected reversely.
★ In cases except the above, perform the following troubleshooting.

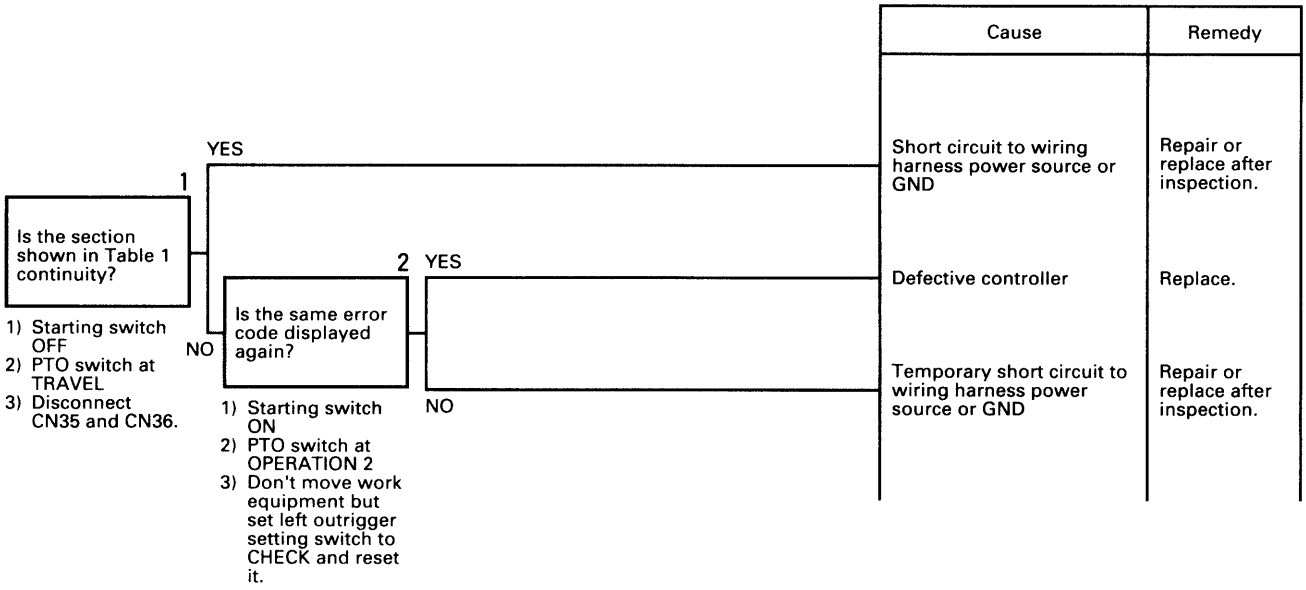


Cause	Remedy
Defective control panel	Replace.
Pressure signal error on boom cylinder bottom side	Perform troubleshooting S-4.
Pressure signal error on boom cylinder head side	Perform troubleshooting S-5.

022T01

S-7 Digital display E 50 E 53 E 54 E 55 E 57 E 58 E 59 is made. (Error system: Short circuit of output signal system)

★ Before connecting T-adapter (or socket) and disconnecting connectors, turn OFF starting switch.
★ Connect T-adapter to each of male and female and connect socket to the portion specified in parentheses.
★ After completion of inspection, connect disconnected connectors at once.
★ Once an error code is displayed, this display does not disappear even if discontinuity has been corrected at energizing time. Accordingly, after repairing, turn OFF the power source, then turn it ON.



022T01

Table 1 Continuity check sections

Error code	Check section (Note)	Remarks
E50	CN36 (female)(1) — CN35 (female)(3)	You may check between CN57 (1) — (2) instead.
E53	CN36 (female)(4) — CN35 (female)(1)	You may check between CN15 (10) — (8) instead.
E54	CN83 (1) - (3)	Connect T-adapter to CN83.
E55	CN83 (1) - (2)	
E57	CN36 (female)(8) — CN35 (female)(1)	
E58	CN36 (female)(9) — CN35 (female)(1)	
E59	CN36 (female)(7) — CN35 (female)(1)	

Note: If a continuity status is found even when tester measuring terminals are swapped, this is regarded as continuity.

2. Precautions for installation operations

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 — 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with antifriction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run at low idling.
2. Operate the work equipment control lever to operate the hydraulic cylinder 4 — 5 times, stopping 100 mm from the end of its stroke.
3. Next, operate the hydraulic cylinder 3 — 4 times to the end of its stroke.
4. After doing this, run the engine at normal speed.
   ★ When using the machine for the first time after repair or long storage, follow the same procedure.

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3. Precautions when completing the operations

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
  ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

DISASSEMBLY OF PPC VALVE ASSEMBLY

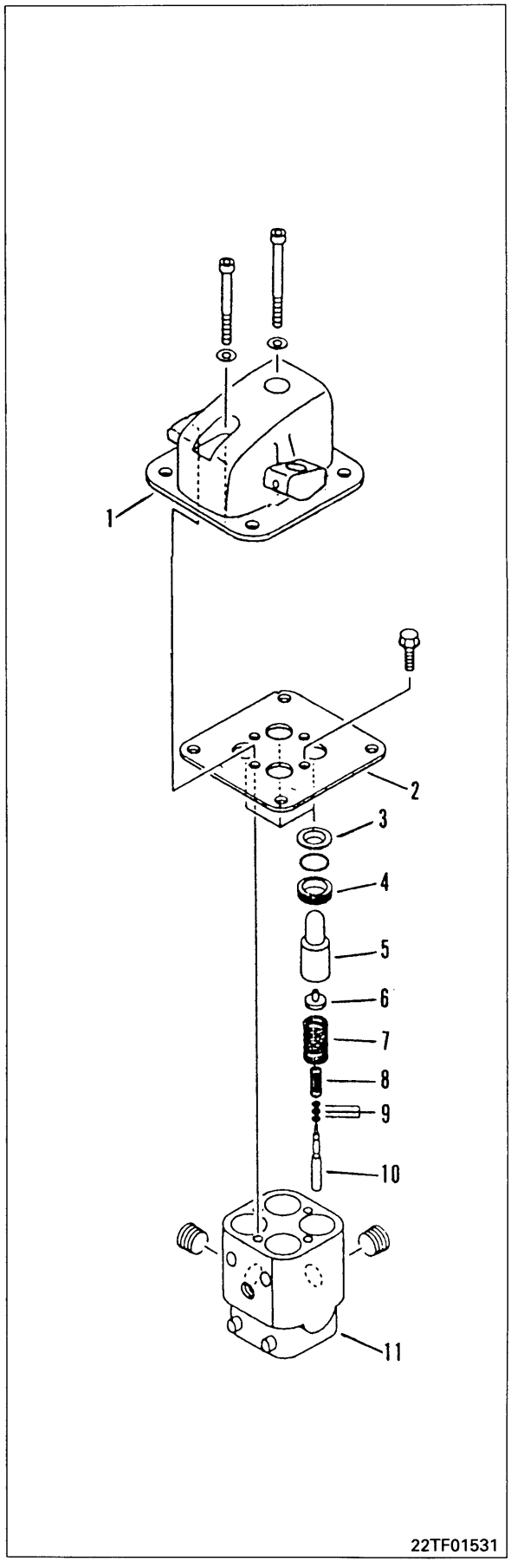
FOR THE LEVER STAND (702-16-01140)

1. Remove the cover, cam assembly (1).
2. Remove the plate (2).
3. Remove the seal (3) and collar (4).
4. Pull out the piston (5) and remove the retainer (6), spring (7) and shims (9).
   ★ Check thickness and used quantity of shims (9) at each location and keep them with care not to mix or lose.
5. Pull out the valve (10) from the body (11).

ASSEMBLY OF PPC VALVE ASSEMBLY

FOR THE LEVER STAND (702-16-01140)

1. Install the valve (10) into the body (11).
2. Set shims (9) and the spring (8) to the valve (10).
   ★ Set the shims (9) back to their positions checking their thickness and used quantity found out when disassembling the PPC valve assembly.
   Standard shim thickness: 0.9mm
   ★ The spring (8) is vertically unsymmetirical and direct the smaller end coil diameter (bore) side toward the shims when mounting it.
3. Insert the spring (7), retainer (6) and piston (5).
   Peripheral surface of the piston and the body hole: Grease (G2-LI)
4. Set the collar (4) with the O-ring into the body (11) and put the seal (3) over them.
5. Put the plate (2).
   kgm Mounting bolts: 13.7 ± 1.9Nm (1.4 ± 0.2 kgm)
6. Mount and clamp the cover, cam assembly(1).
   kgm Mounting bolts: 13.7 ± 1.9Nm (1.4 ± 0.2 kgm)



022T01

REMOVAL OF THE OUTRIGGER JACK CYLINDER ASSEMBLY

⚠ Extend the outrigger to grab the ground securely.

1. Sliing the outrigger inner frame (3) and insert rectangular lumber pieces **A** (350mm high) underneath the floats (2) of the outrigger jack cylinders (1) to lift up the vehicle.
   ★ Insert the same lumber pieces beneath all the 4 floats of the outriggers.

2. Extend the jack cylinders fully and insert rectangular lumber pieces B (900mm high or more) to support the vehicle.
   ★ Insert the same lumber pieces beneath all the 4 outrigger inner frames.

3. Remove the plate (6) and bolt (7) mounting the jack cylinder rod (4) and float (2).

4. Retract the jack cylinder rod (4) fully.

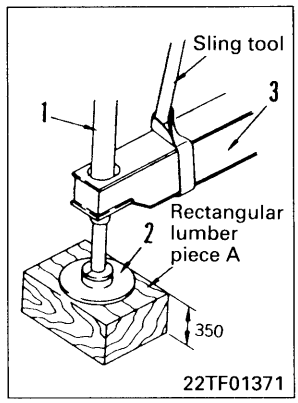
5. Separate 2 check valve hoses (8) of the jack cylinder (1).

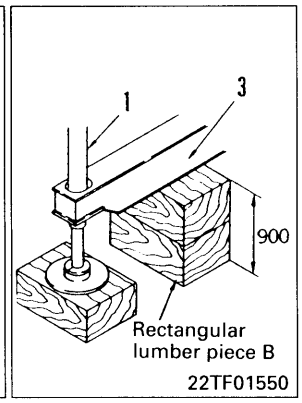
6. Temporarily suspend the jack cylinder to remove 4 pieces of jack cylinder mounting bolts (9).

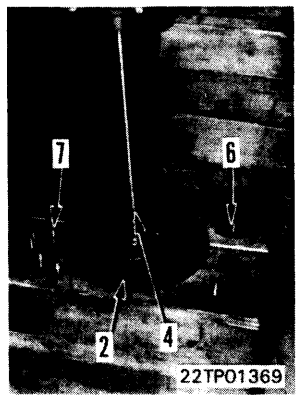
7. Apply another hanger around the flange of the jack cylinder head to sling it.
   ★ Remove the hanger used for temporary suspension.

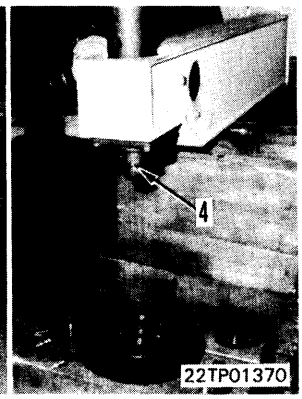
8. Cover the check valve (10) by a plastic sheet and remove 2 bolts (11) to take off the valve.
   ⚠ When removing the check valve, always cover it by a plastic sheet or the sort as pressure remains inside the valve.
   ★ Seal the cylinder mounting face of the check valve thus removed to prevent entrance of foreign matters into the valve.

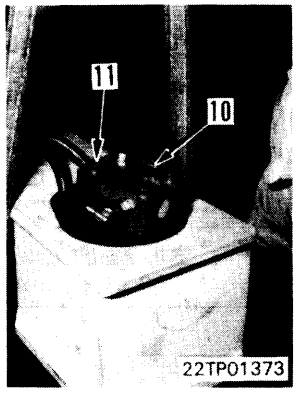
9. Remove the jack cylinder (1) from the inner frame (3).
   kg Jack cylinder : 50.5 kg









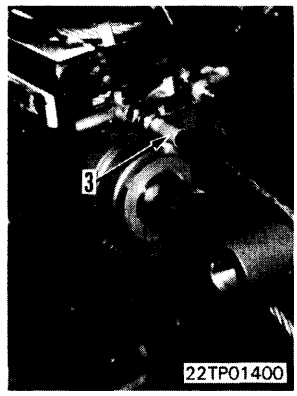


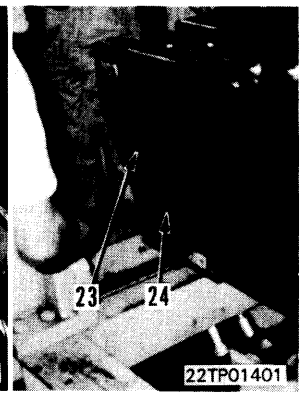
022T01

4. Removal of 4th boom

1) Disconnect the telescope cylinder hose (3) from the cylinder.
   ★ Plug the separated hose to prevent foreign matters from entering into it.

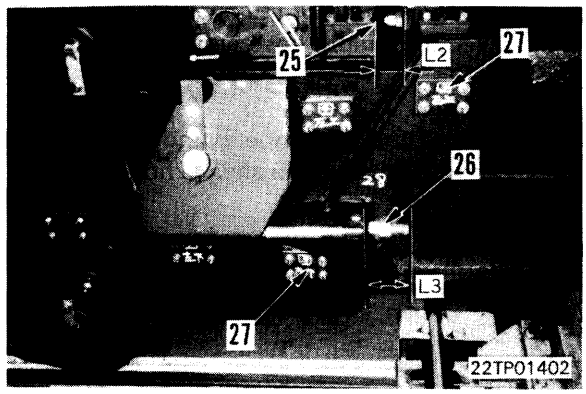
2) Remove the snap rings of the telescope cylinder mounting pins (23) and (24) and take both pins out using a forcing screw.





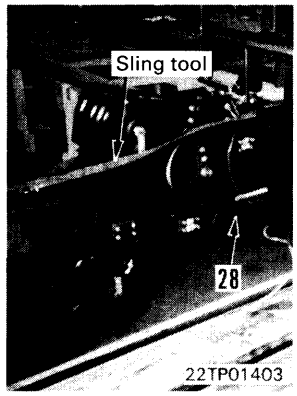
3) Remove the retracting rope end bracket (25) and the extending rope end (26) located at the front part of the 3rd boom.
   ★ Keep record of the length of the retracting rope end and extending rope end (**L2**, **L3**) before disassembling them.

4) Remove left and right side pads (27) at the upper and lower part of the top end of the 3rd boom.
   ★ Keep record of the location of the side pads and used quantity of shims.

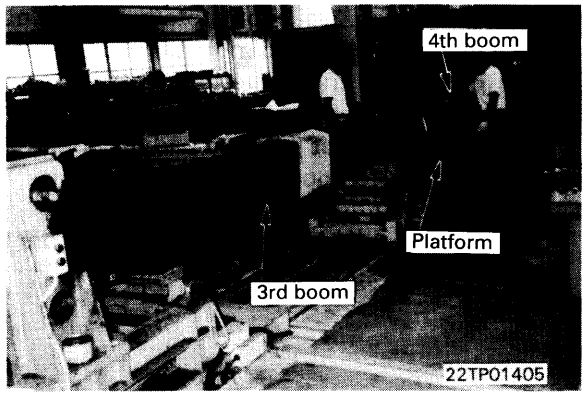


5) Lay a sling tool around the sheave guide portion at the top end of the 4th boom (28) to pull it out horizontally.
   ★ Be sure to sling the top end of the 4th boom to pull it, and when it comes out to some extent, shift the sling position.

6) Before the 4th boom comes out totally, remove the slide pad (2) and grease nipple located at the lower part of the 3rd boom.
   ★ Removing the slide pad becomes easier if the 4th boom is lifted up.



7) Pull out the 4th boom totally from the 3rd boom and place it level on the platform.



022T01

REMOVAL OF WINCH BRAKE CYLINDER ASSEMBLY

⚠ Extend the outriggers and grab the ground securely. Then, retract the boom fully and lower it until it lands.

1. Remove the winch cover (1).

2. **Hoses**

   1) Disconnect the auxiliary winch motor hose (2).

   2) Disconnect the winch clutch hose (3).

   3) Disconnect the winch brake hose (4) from the revolving frame block.

   4) Disconnect the winch brake air vent hoses (5) and (6) from the breather.
      ★ Mark separated hoses using tags or the sort.
      ★ Plug separated hosed to prevent foreign matters from entering into them.

3. Remove the swivel joint cover (8) of the winch assembly to take off the swivel joint (7) and O-ring (7-1).

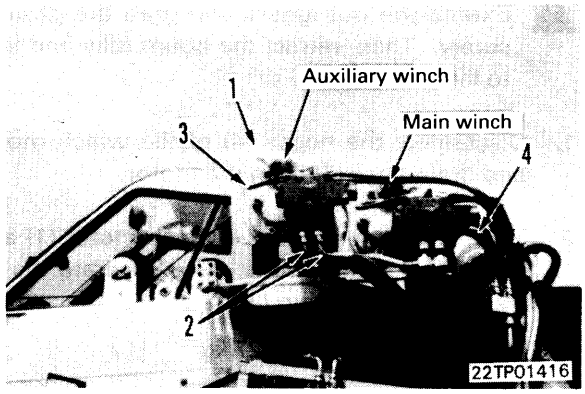
4. Insert a rectangular lumber piece so that the drum of the winch assembly and the winch mounting frame run parallel.

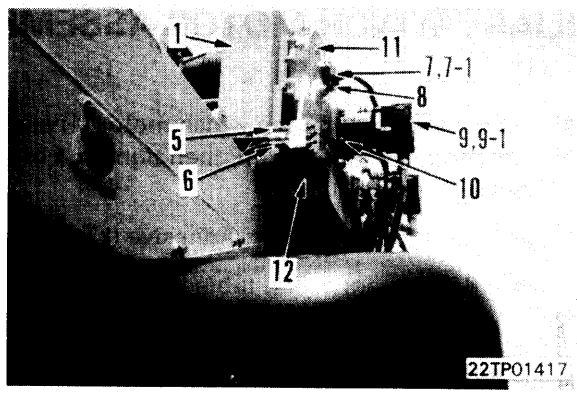
5. Temporarily suspend the winch motor (9) and remove 4 mounting bolts (10) to separate the winch motor (9) and O-ring (9-1).

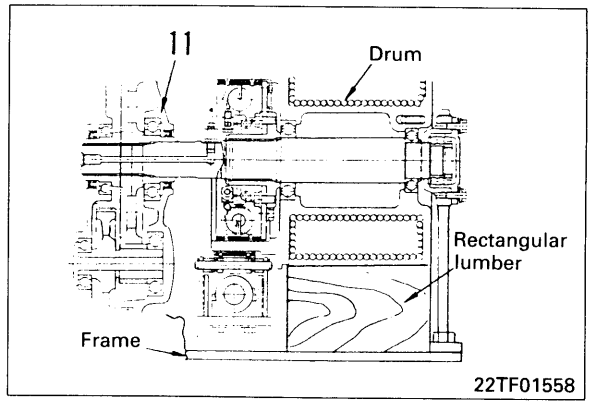
   kg Winch motor: 27 kg

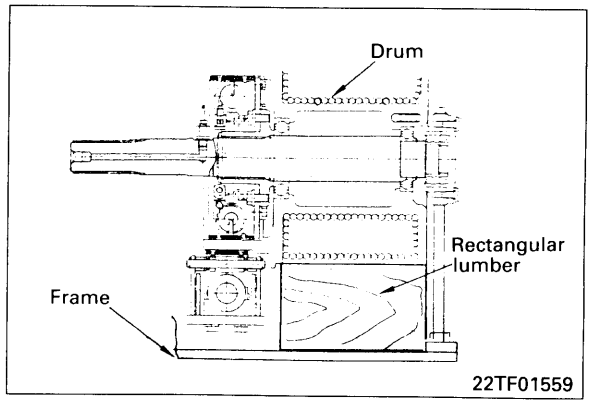
6. Install eyebolts (sling tool) into the swivel joint cover tapped holes (Thread dia : 10mm, Pitch : 1.5mm) in the winch gear case (11) and suspend the winch gear case temporarily to remove 5 mounting bolts (12) to pull out the gear case (11) from the drum shaft.

   kg Winch gear case: 45 kg









022T01

REMOVAL OF WINCH ASSEMBLY

⚠ Extend the outriggers and seat the ground securely. Then, retract the boom as far as it go and lower it to land the hook.

⚠ Always wear thick leather gloves when disconnecting wire ropes.

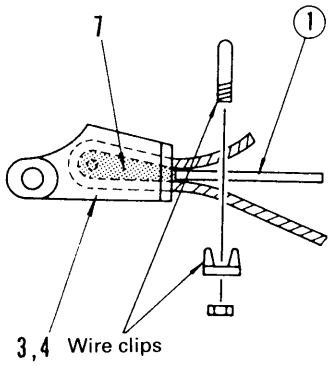
1. Wire socket

1) Disconnect the wire harness connectors (1) and (2) from the hangers of the over-wind prevention devices.

2) Remove the main winch side wire socket mounting pin (5) and the auxiliary winch side wire socket mounting pin (6).

3) Separate the wire clips and hammer out the rope wedge (7) using a round bar ① (10 - 14mm dia).

4) Remove the sockets (3), (4) and the over-wind prevention device deadweights (8), (9) from the wire rope.



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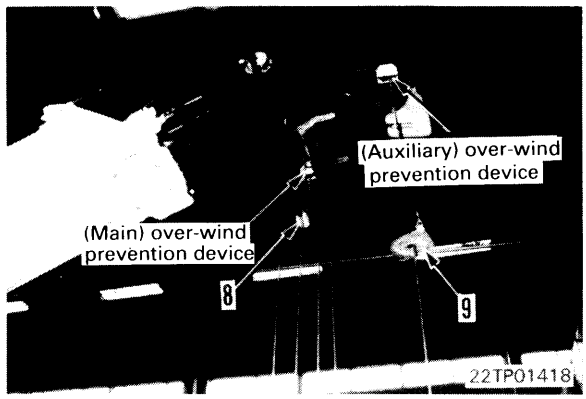
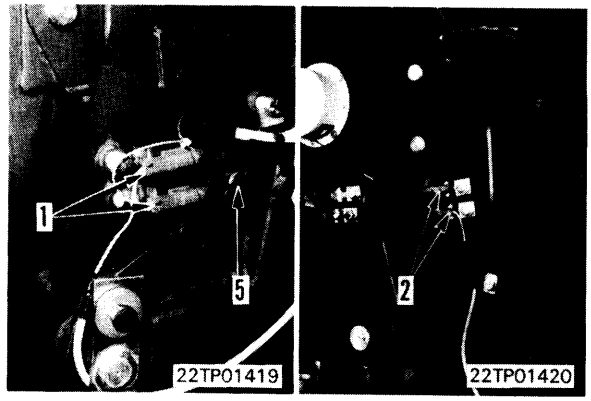
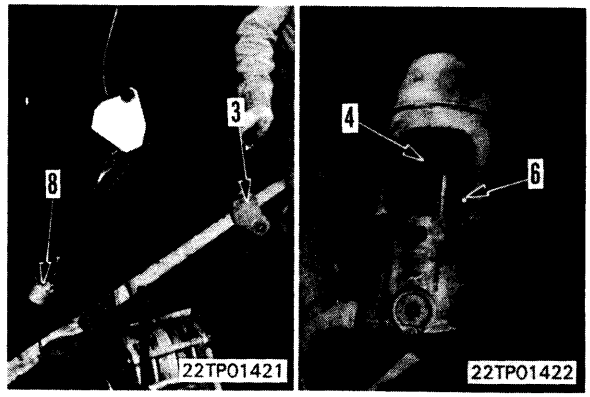


Main winch side Auxiliary winch side



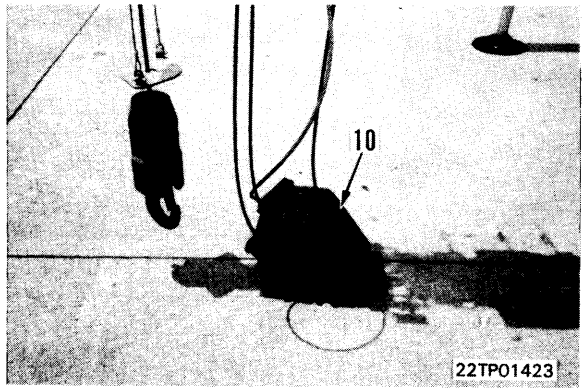
Main winch side Auxiliary winch side



022T01

2. Hook

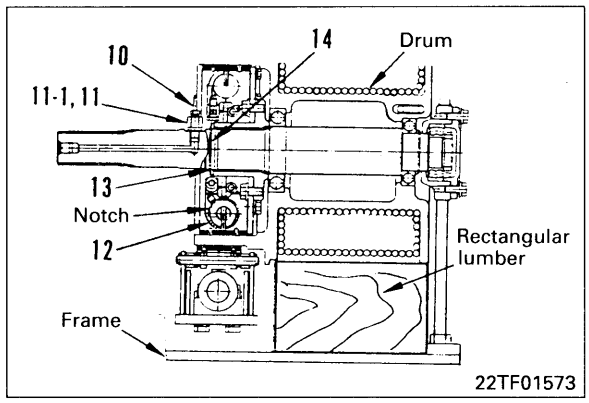
Disconnect the wire rope from the main winch hook (10).



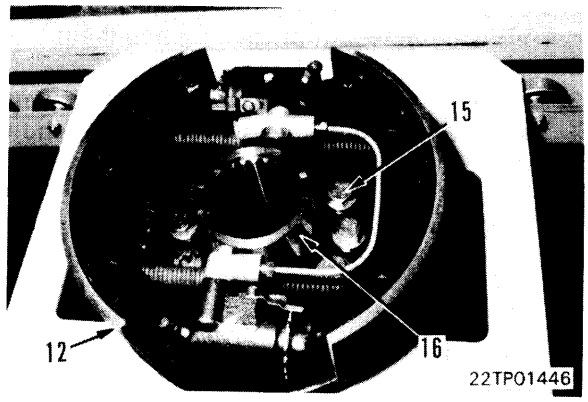
7. Clutch assembly

1) Disconnect the hydraulic tube (10), connector (11) and gasket (11-1) from the winch clutch.

2) Loosen the notch of the clutch assembly and remove the snap ring (13) and spacer (14) to separate the clutch assembly (12).

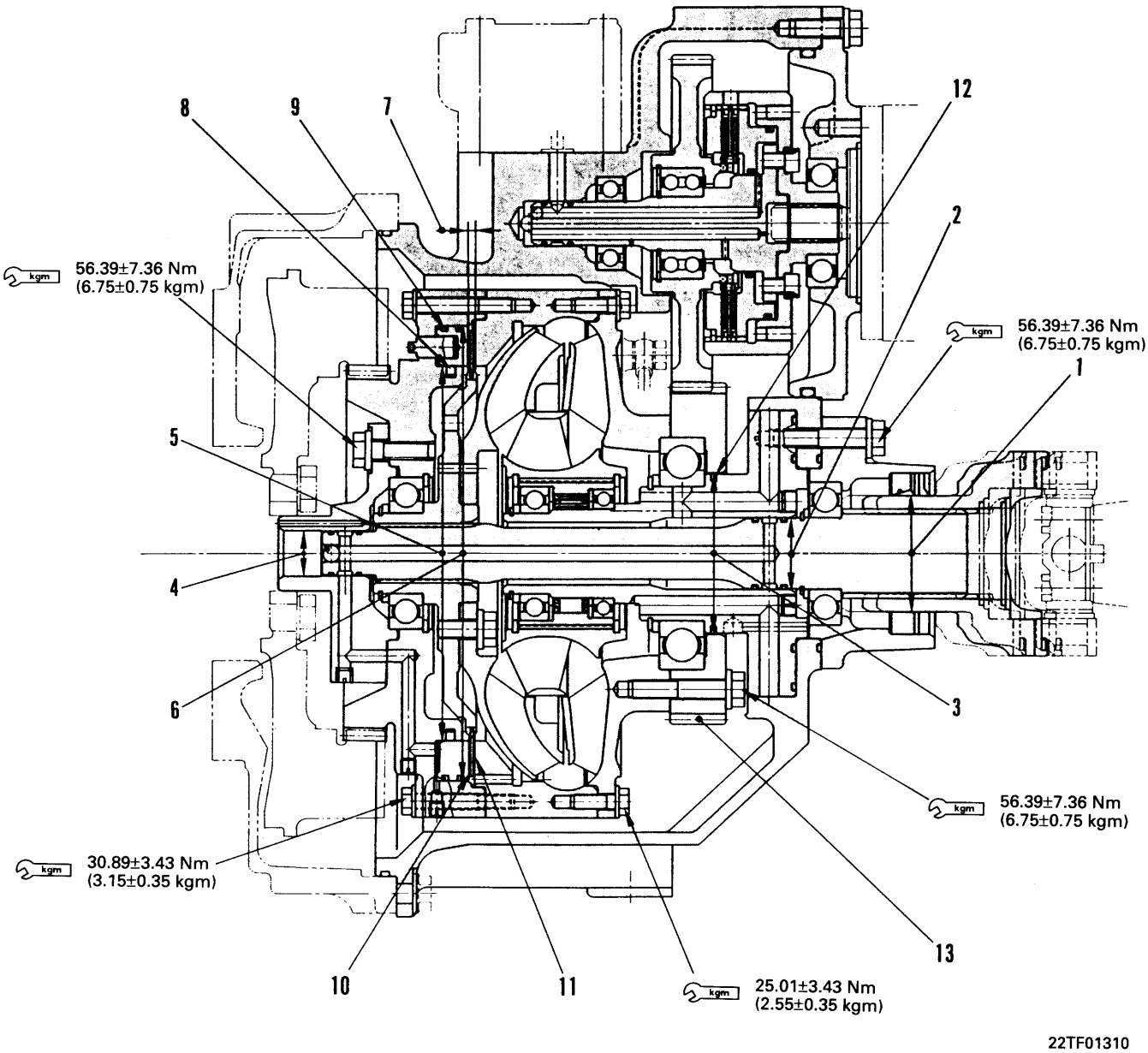


8. Remove the flange mounting bolt (15) from the clutch assembly (12) to take off the flange (16).

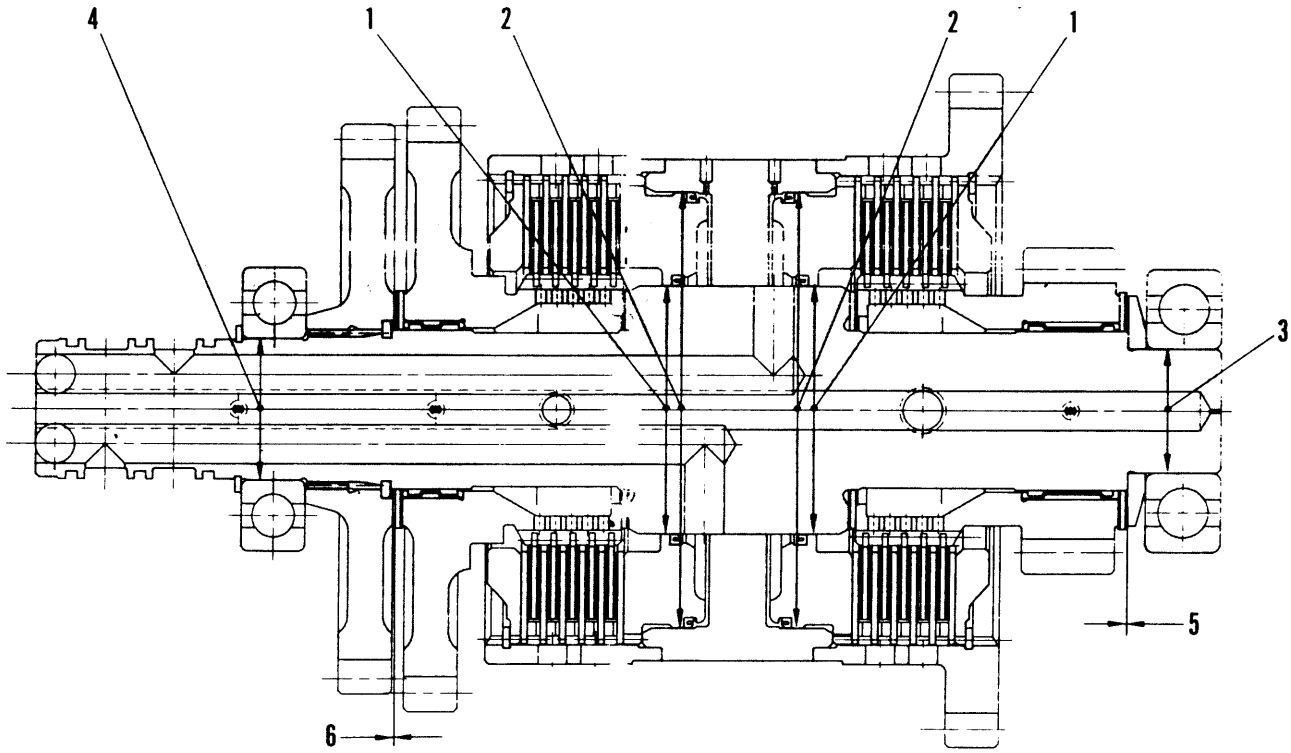


022T01

TORQUE CONVERTER



1ST AND 2ND CLUTCHES



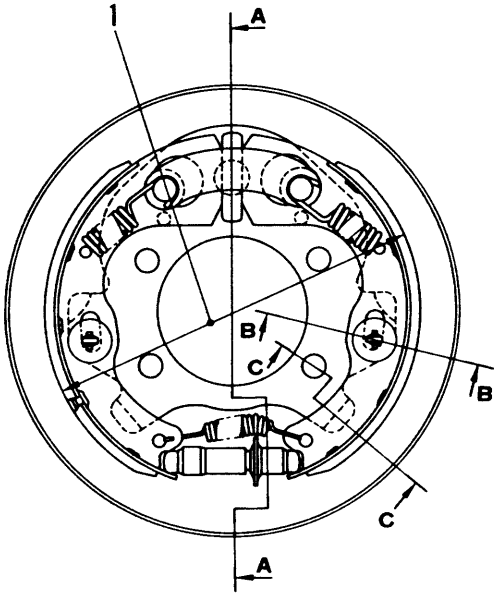
022T01

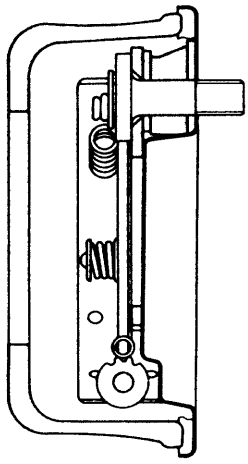
22TF01315

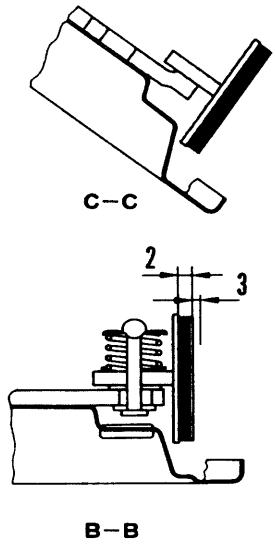
Unit : mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance (Inside diameter) between piston and cylinder	70	−0 −0.013	+0.23 +0.10	0.10—0.24	—	Replace
2	Clearance (Outside diameter) between piston and cylinder	123	−0.27 −0.32	+0.06 −0.07	0.20—0.38	—	
3	Clearance (1) at 1st and 2nd clutch shaft bearing press-fitting section outside diameter	35	+0.025 +0.009	0 −0.012	−0.037 −0.009	—	
4	Clearance (2) at 1st and 2nd clutch shaft bearing press-fitting section outside diameter	40	+0.025 +0.009	0 −0.012	−0.037 −0.009	—	
5	1st gear end play	0.05—1.2					
6	2nd gear end play	0.05—1.15					

PARKING BRAKE







22TF01325

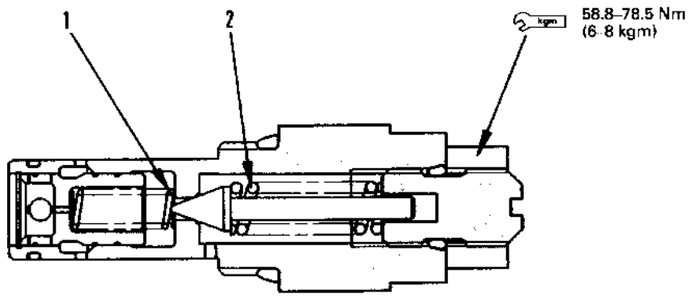
022T01

Unit : mm

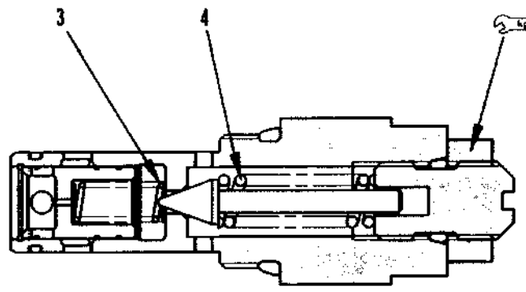
No.	Check item	Criteria		Remedy
1	Inside diameter of brake drum	Standard size	Repair limit	Replace
		216	220	
2	Brake lining thickness	5.5	3.3 (0.5mm from rivet head)	
3	Clearance between brake drum inside diameter and brake shoe	0.16 (Loosen the adjust screw 7 clicks after having fully turned the adjust screw to stick the shoe to the drum.)		Adjust

RELIEF VALVE

RELIEF VALVE FOR PPC PILOT CIRCUIT
RELIEF VALVE FOR CABIN COOLER MOTOR
RELIEF VALVE FOR OIL COOLER MOTOR



RELIEF VALVE FOR RETRACTING WINCH HOOK



022T01

22TF01337

Unit : mm

No.	Check item	Criteria				Remedy
		Standard size			Limit load	
		Free length × O.D.	Installed length	Installed load		
1	Main valve spring	23.3 × 7.2	19	19.6 N (2 kg)	15.7 N (1.6 kg)	Replace
2	Poppet spring	29.6 × 9.5	27.3	104.9 N (10.7 kg)	84.3 N (8.6 kg)	
3	Main valve spring	20.9 × 7.2	17	19.6 N (2 kg)	15.7 N (1.6 kg)	
4	Poppet spring	31 × 8.4	28.1	49 N (5 kg)	39.2 N (4 kg)	