SW300 Series

SHOP MANUAL

SAKAI®

PREFACE

To make a machine working to maximum efficiency over a long period of time without any machine troubles, correct OPERATION, PREVENTIVE MAINTENANCE, TROUBLE-SHOOTING and REPAIR are of vital importance.

This shop manual provides instructions, for the most part, on GENERAL INFORMATION, STRUCTURE/FUNCTION, CHECKING/ADJUSTMENT, and TROUBLE-SHOOTING of the SAKAI SW300 Series Vibrating Rollers.

This manual is designed to serve as a guide for the operator and maintenance personnel to acquire correct information and repair procedure on these machines in order to give a correct decision on problems which the machines will confront, thus leading to quality repair. Fully understand the contents of the manual and make the best of it.

We will make utmost efforts to make this manual more useful for you through revisions.
Your opinions and advices will be particularly welcome and will be carefully considered.

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SPECIFICATIONS

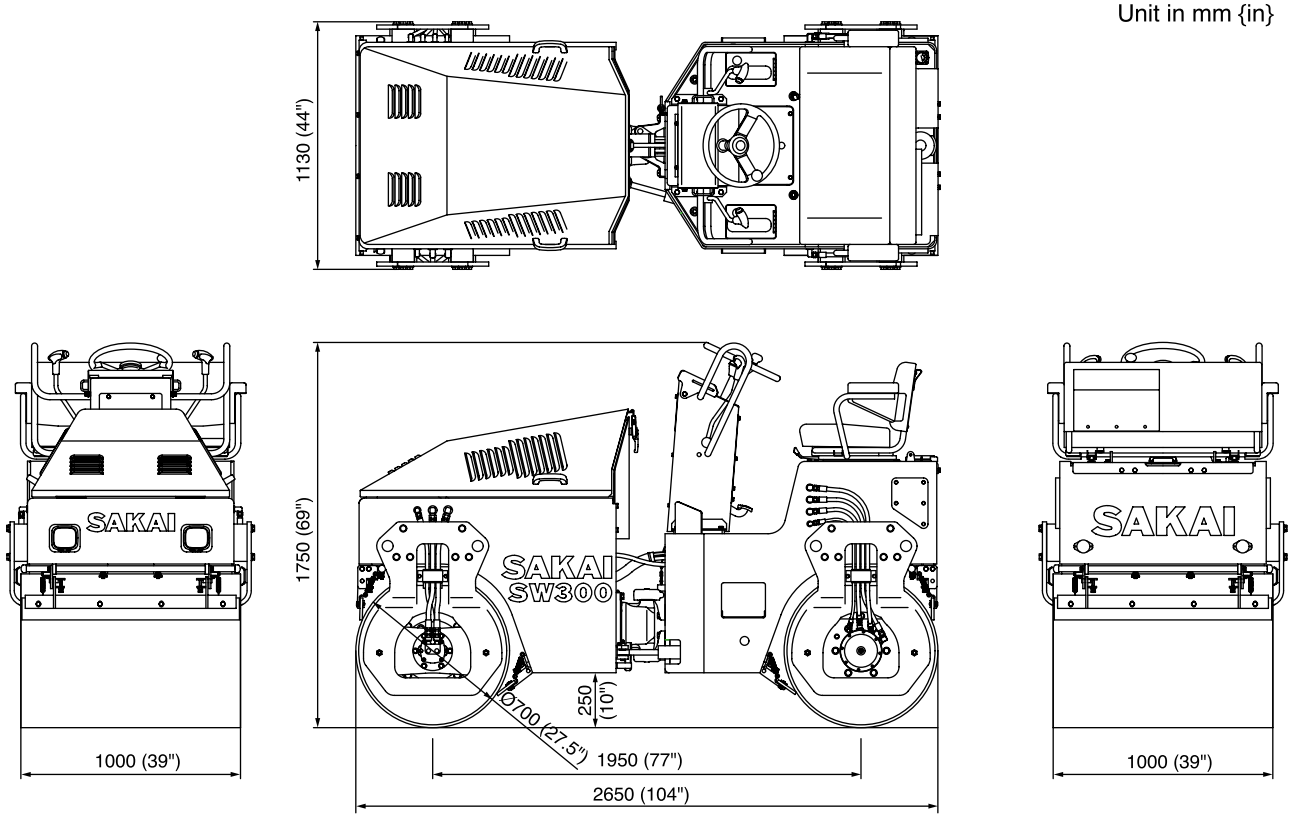
SPECIFICATIONS

1. External Views and Specifications

1. External Views and Specifications

1-1. SW300

Unit in mm {in}



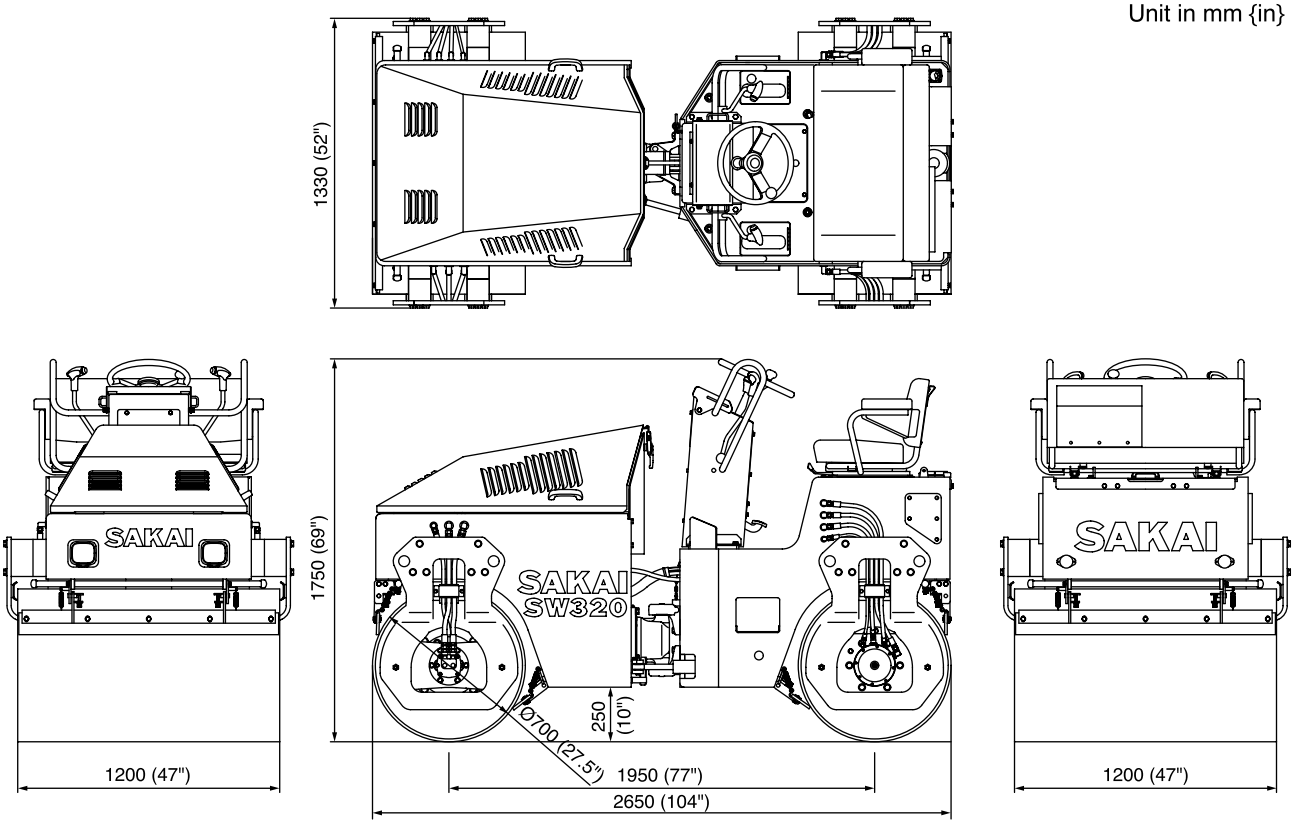
SW3001001

Model	SW300	Vibrating power:	
Weight:		Frequency	66.7 Hz {4,000 vpm}
Gross weight	2,700 kg {5,955 lbs}	Centrifugal force	27.5 kN (6,175 lbs) {2,800 kgf}
Empty weight	2,525 kg {5,570 lbs}		
Dimension:		**Engine:**	
Overall length	2,650 mm {104"}	Model	KUBOTA "D1703" Diesel Engine
Overall width	1,130 mm {44"}	Total displacement	1,647 cc {100.5 cu.in}
Overall height	1,750 mm {69"}	Rated output	25.4 kW/2,800 rpm (34.5 PS/2,800 rpm) {34.0 HP/2,800 rpm}
Wheelbase	1,950 mm {77"}		
Wheel			
Front	Roll (width x dia.) 1,000 x 700 mm {39" x 28"}	Max. torque	108 N•m/1,600 rpm (11.0 kgf•m/1,600 rpm) {79.6 lbf•ft/1,600 rpm}
Rear	Roll (width x dia.) 1,000 x 700 mm {39" x 28"}	**Tank capacity:**	
Performance:		Fuel tank	50 liters {13.2 gal}
Travel speed (forward/reverse)	0 ~ 12 km/h {0 ~ 7.5mile/h}	Hydraulic tank	42 liters {11.1 gal}
		Sprinkler tank	180 liters {48 gal}
Gradability	24 degrees		
Rolling width	1,000 mm {39"}		
Minimum turning radius	3.7 m {146"}		

NOTE: Gradability is the calculated value. It may vary with ground surface conditions.

1-2. SW320

Unit in mm {in}



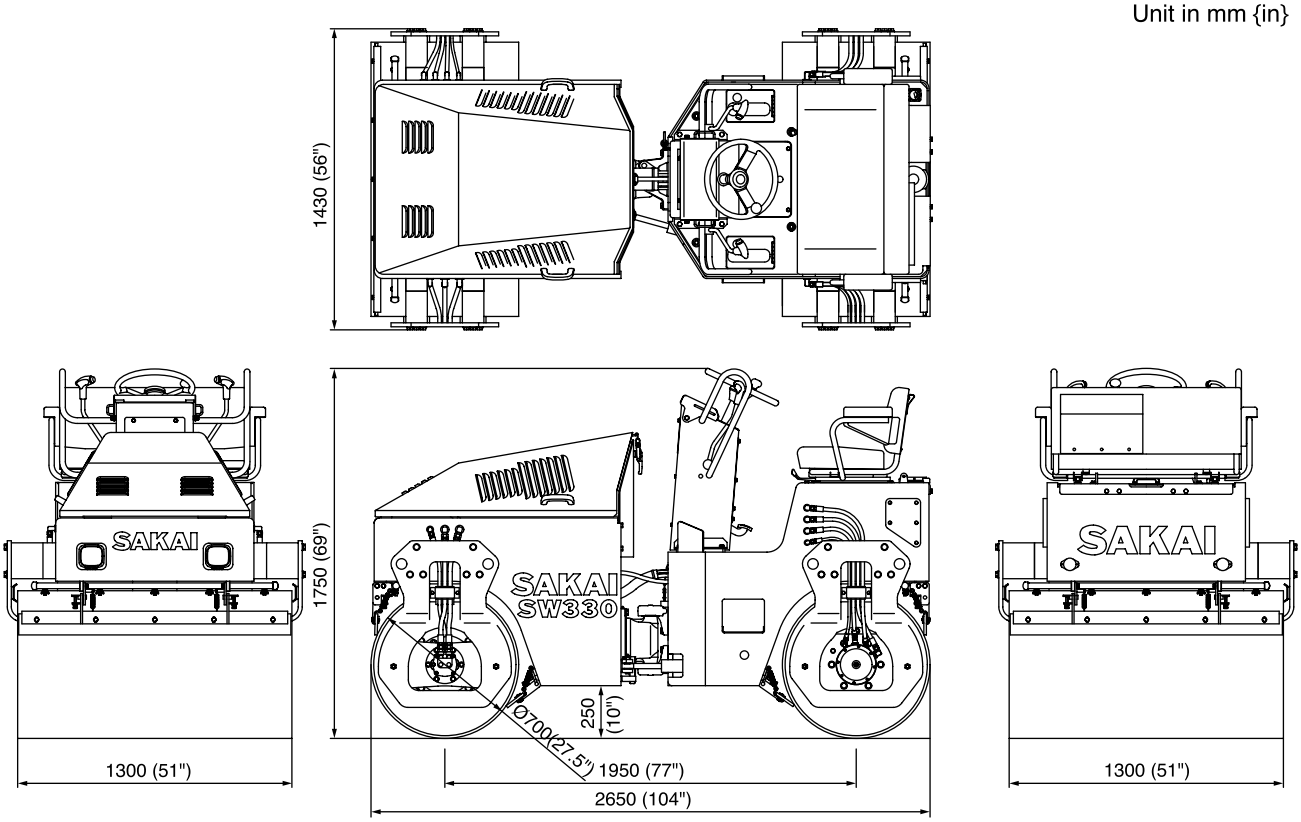
SW3001002

Model	SW320	Vibrating power:	
Weight:		Frequency	66.7 Hz {4,000 vpm}
Gross weight	2,865 kg {6,315 lbs}	Centrifugal force	31.4 kN (7,055 lbs) {3,200 kgf}
Empty weight	2,960 kg {5,930 lbs}		
Dimension:		**Engine:**	
Overall length	2,650 mm {104"}	Model	KUBOTA "D1703" Diesel Engine
Overall width	1,330 mm {52"}	Total displacement	1,647 cc {100.5 cu.in}
Overall height	1,750 mm {69"}	Rated output	25.4 kW/2,800 rpm (34.5 PS/2,800 rpm) {34.0 HP/2,800 rpm}
Wheelbase	1,950 mm {77"}		
Wheel			
Front	Roll (width x dia.) 1,200 x 700 mm {47" x 28"}	Max. torque	108 N•m/1,600 rpm (11.0 kgf•m/1,600 rpm) {79.6 lbf•ft/1,600 rpm}
Rear	Roll (width x dia.) 1,200 x 700 mm {47" x 28"}	**Tank capacity:**	
Performance:		Fuel tank	50 liters {13.2 gal}
Travel speed (forward/reverse)	0 ~ 12 km/h {0 ~ 7.5 mile/h}	Hydraulic tank	42 liters {11.1 gal}
		Sprinkler tank	180 liters {48 gal}
Gradability	22 degrees		
Rolling width	1,200 mm {47"}		
Minimum turning radius	3.8 m {150"}		

NOTE: Gradability is the calculated value. It may vary with ground surface conditions.

1-3. SW330

Unit in mm {in}



SW3001003

Model	SW330	Vibrating power:	
Weight:		Frequency	66.7 Hz {4,000 vpm}
Gross weight	2,945 kg {6,495 lbs}	Centrifugal force	31.4 kN (7,055 lbs) {3,200 kgf}
Empty weight	2,770 kg {6,110 lbs}		
Dimension:		**Engine:**	
Overall length	2,650 mm {104"}	Model	KUBOTA "D1703" Diesel Engine
Overall width	1,430 mm {56"}	Total displacement	1,647 cc {100.5 cu.in}
Overall height	1,750 mm {69"}	Rated output	25.4 kW/2,800 rpm (34.5 PS/2,800 rpm) {34.0 HP/2,800 rpm}
Wheelbase	1,950 mm {77"}		
Wheel			
Front	Roll (width x dia.) 1,300 x 700 mm {51" x 28"}	Max. torque	108 N•m/1,600 rpm (11.0 kgf•m/1,600 rpm) {79.6 lbf•ft/1,600 rpm}
Rear	Roll (width x dia.) 1,300 x 700 mm {51" x 28"}		
Performance:		**Tank capacity:**	
Travel speed (forward/reverse)	0 ~ 12 km/h {0 ~ 7.5 mile/h}	Fuel tank	50 liters {13.2 gal}
		Hydraulic tank	42 liters {11.1 gal}
		Sprinkler tank	180 liters {48 gal}
Gradability	21 degrees		
Rolling width	1,300 mm {51"}		
Minimum turning radius	3.8 m {150"}		

NOTE: Gradability is the calculated value. It may vary with ground surface conditions.

STRUCTURE & OPERATION

STRUCTURE & OPERATION

1. Location of Engine-related Key Units

2. Description and Operation of Hydraulic System

2-1. Description and operation of hydraulic pump and motor

2-2. Propulsion line

2-3. Vibrating system

2-4. Steering system

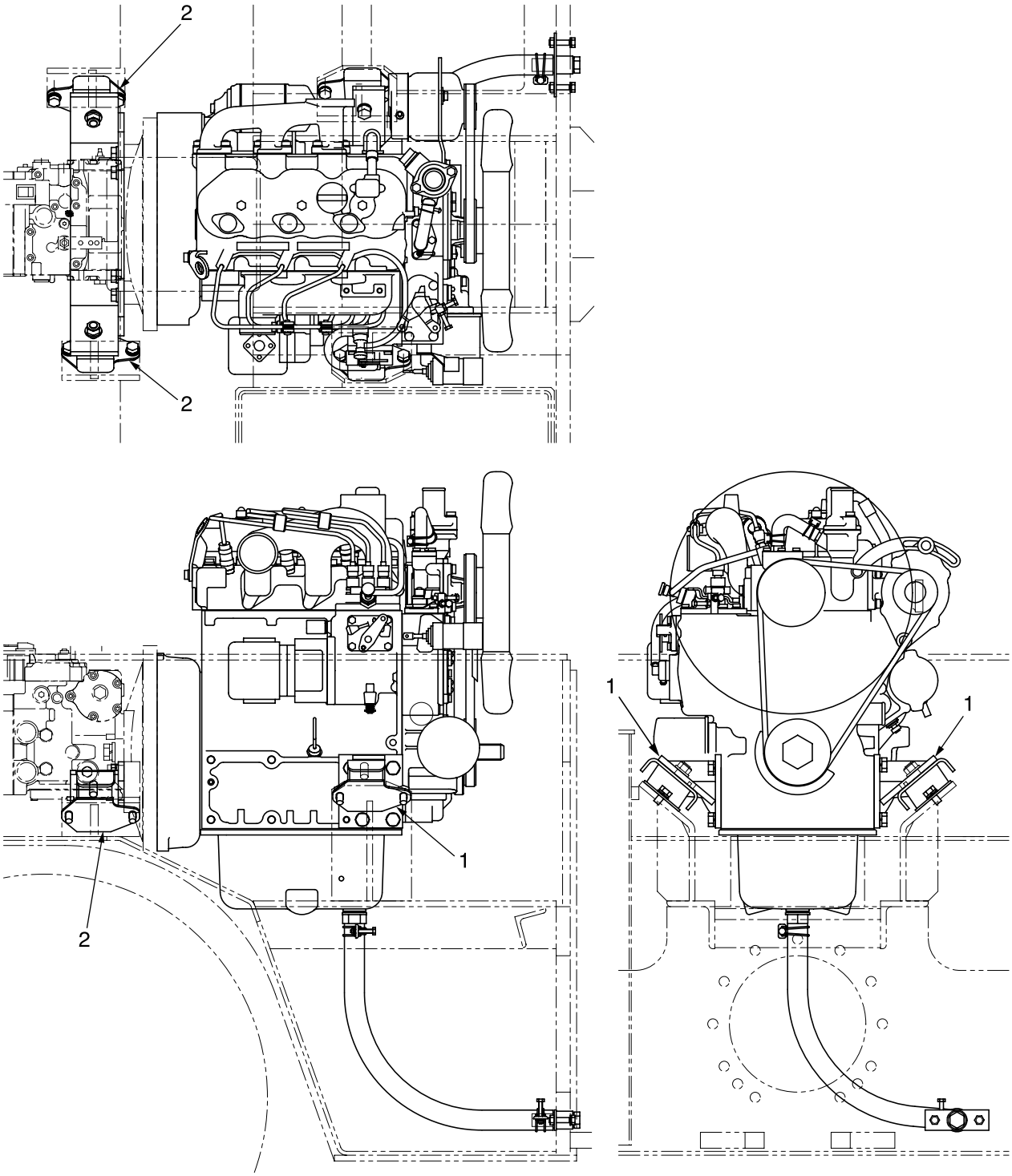
3. Brake System

4. Sprinkler & Scraper

5.Electric System

1.Location of Engine-related Key Units

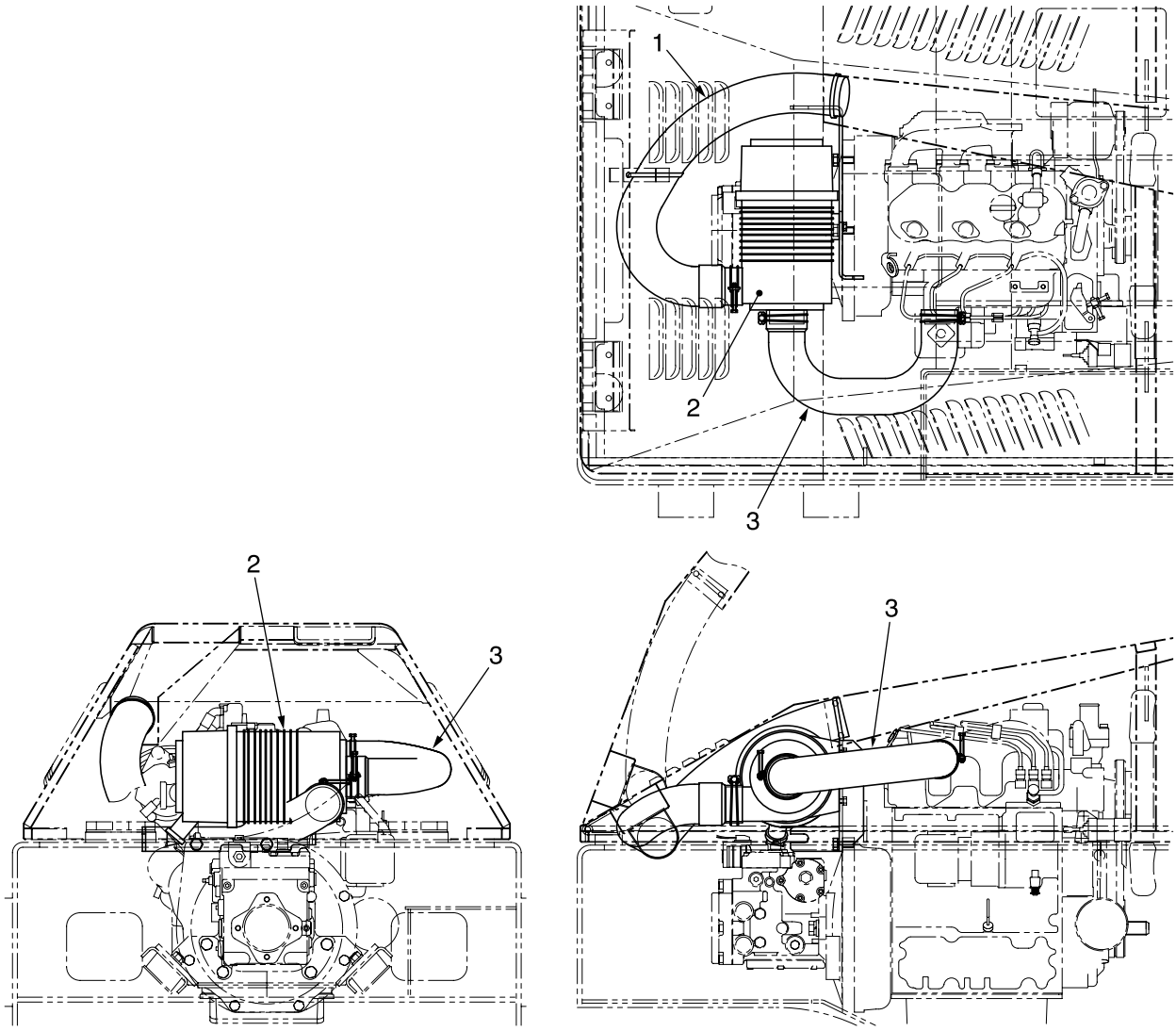
1-1. Engine mount



SW3002001

1. Engine mount (front)
2. Engine mount (rear)

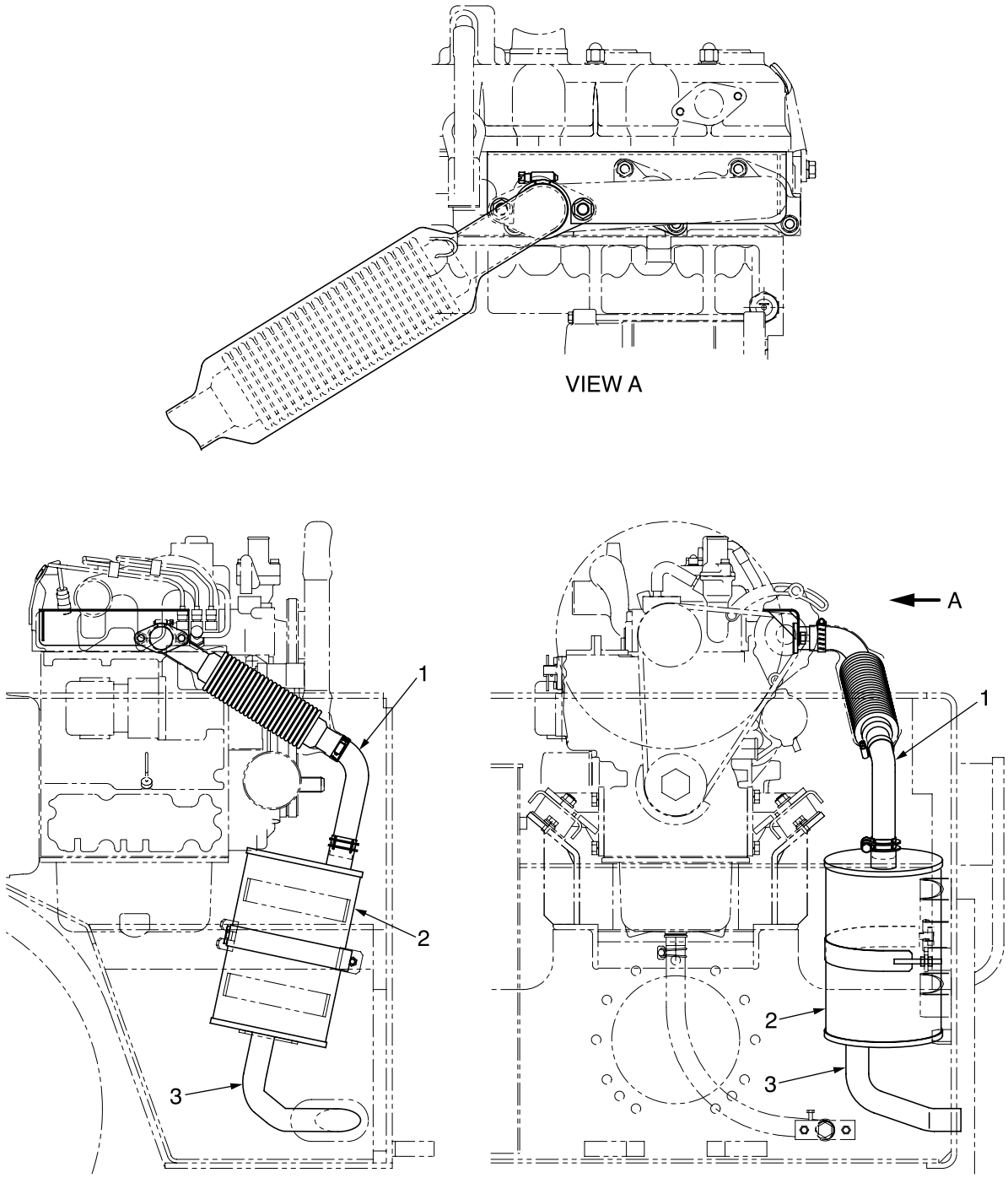
1-2. Intake system



SW3002002

1. Duct hose
2. Air cleaner
3. Intake hose

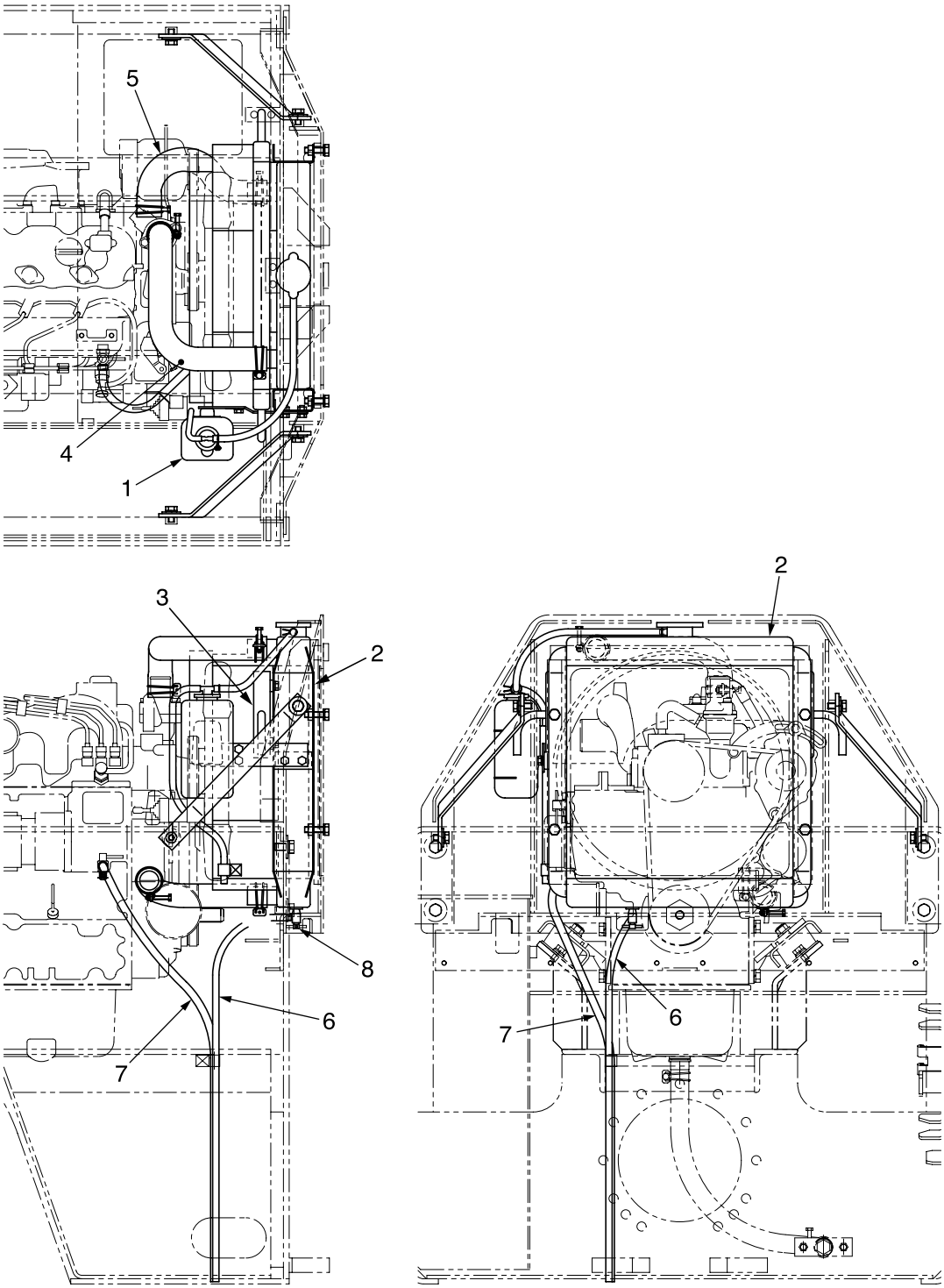
1-3. Exhaust system



SW3002003

1. Exhaust pipe
2. Muffler
3. Exhaust pipe

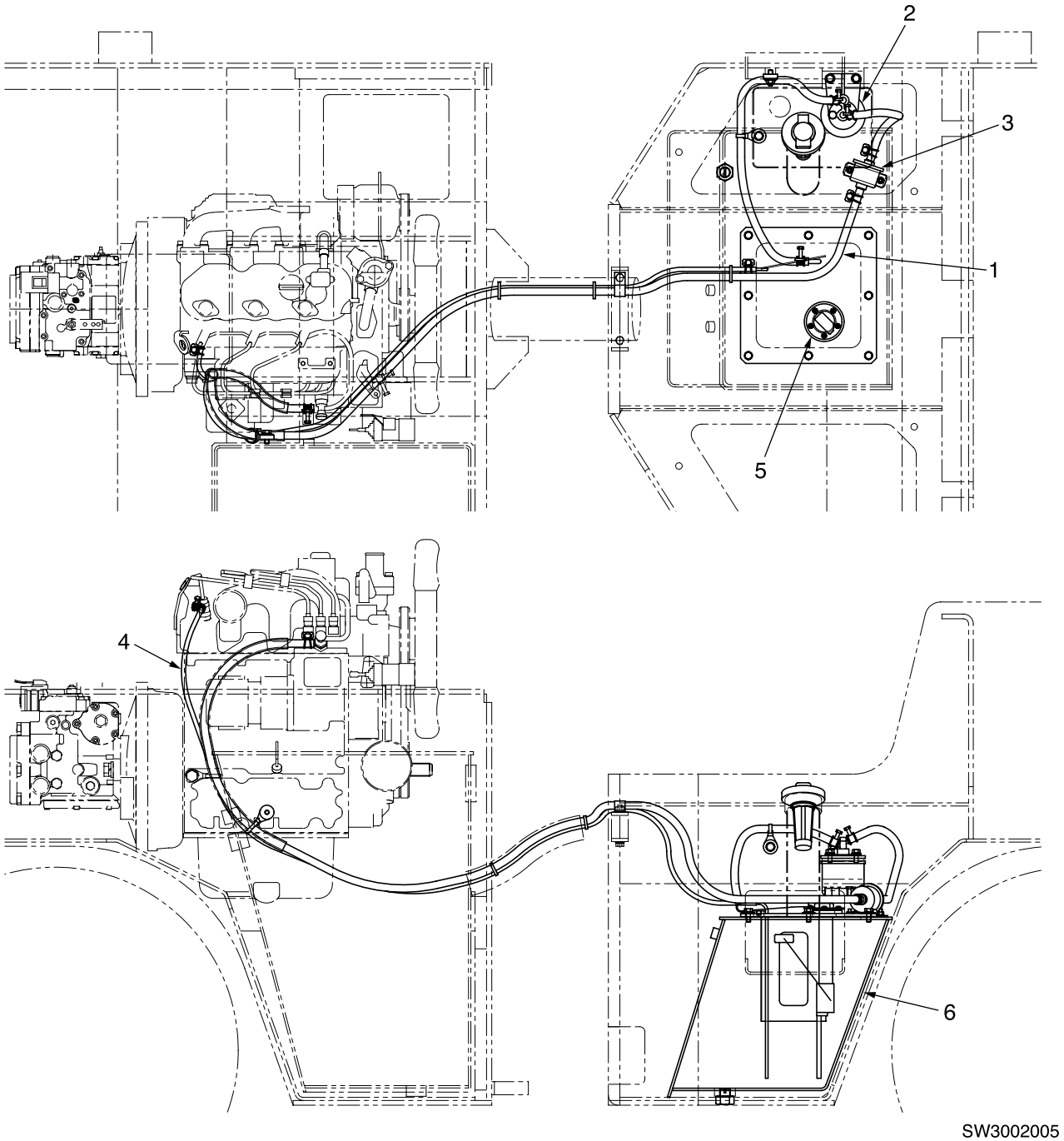
1-4. Cooling piping & radiator



SW3002004

1. Reservoir
2. Radiator
3. Oil cooler
4. Radiator inlet hose
5. Radiator outlet hose
6. Drain hose (radiator)
7. Drain hose (cylinder block)
8. Drain cock

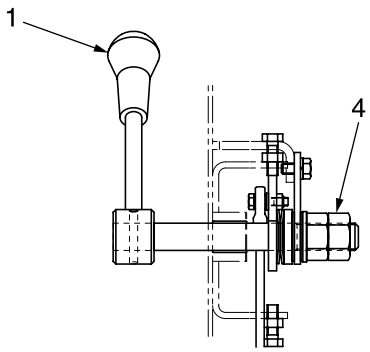
1-5. Fuel piping & fuel tank



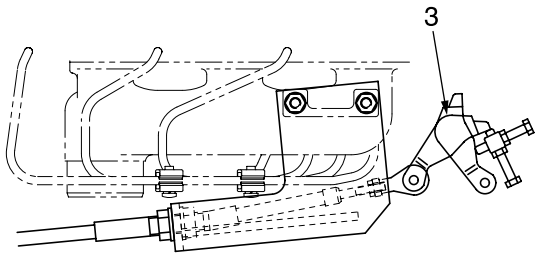
SW3002005

1. Suction hose
2. Filter
3. Fuel pump
4. Return hose
5. Fuel gauge unit
6. Fuel tank

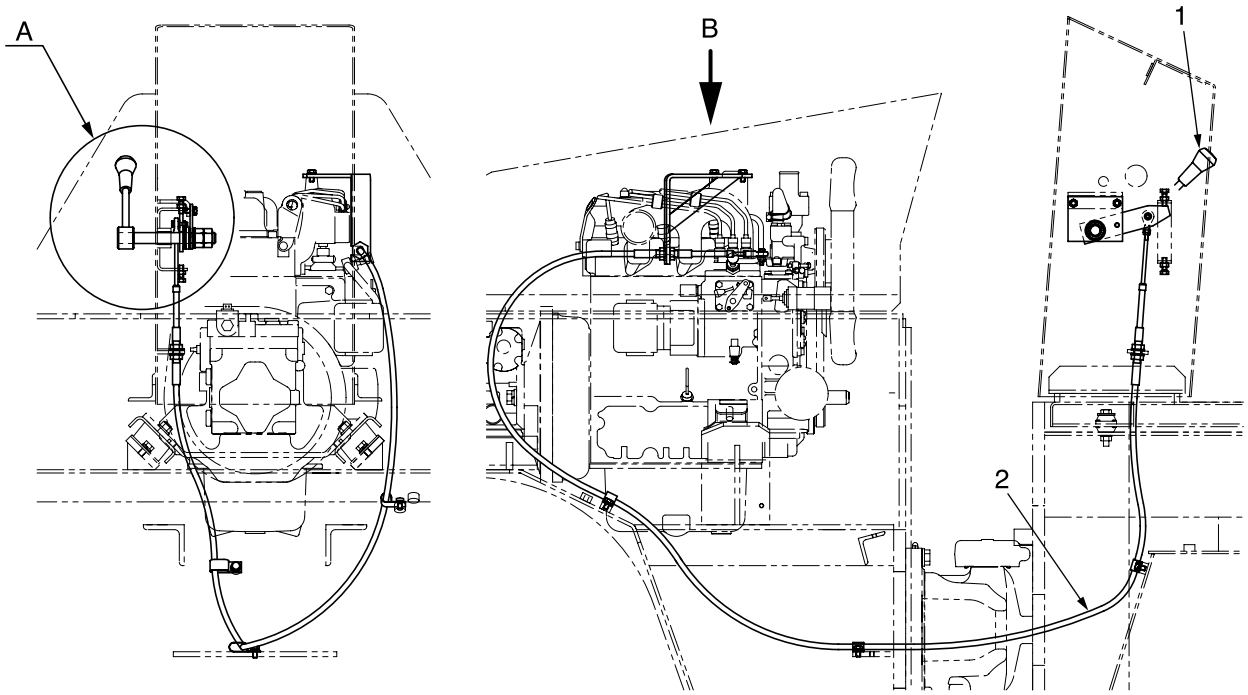
1-6. Fuel controls



DETAIL A



VIEW B



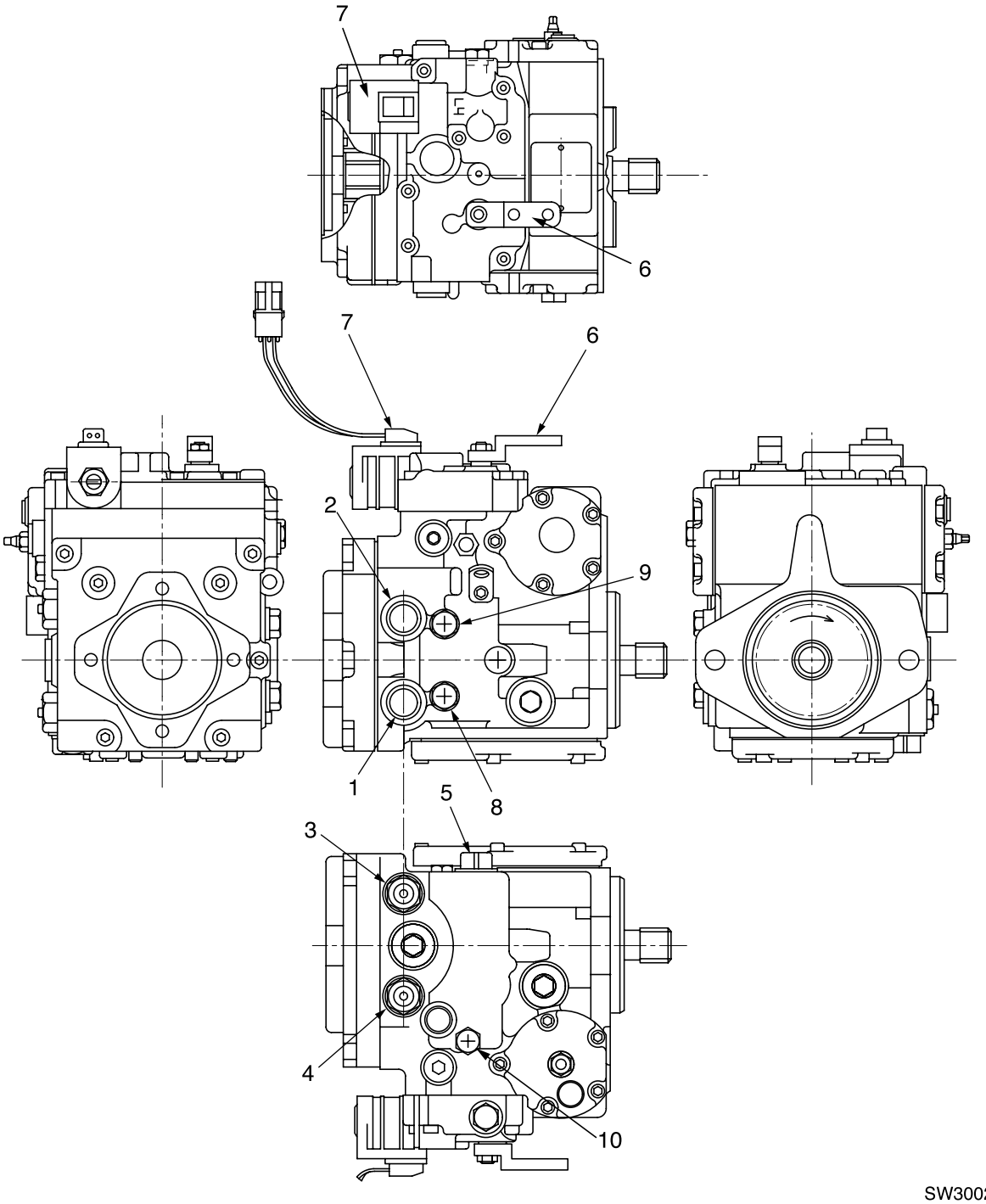
SW3002006

1. Throttle lever
2. Control cable
3. Control lever (fuel injection pump)
4. Operating force adjusting nut

2. Description and Operation of Hydraulic System

2-1. Description and operation of hydraulic pump and motor

2-1-1. Propulsion pump ass'y

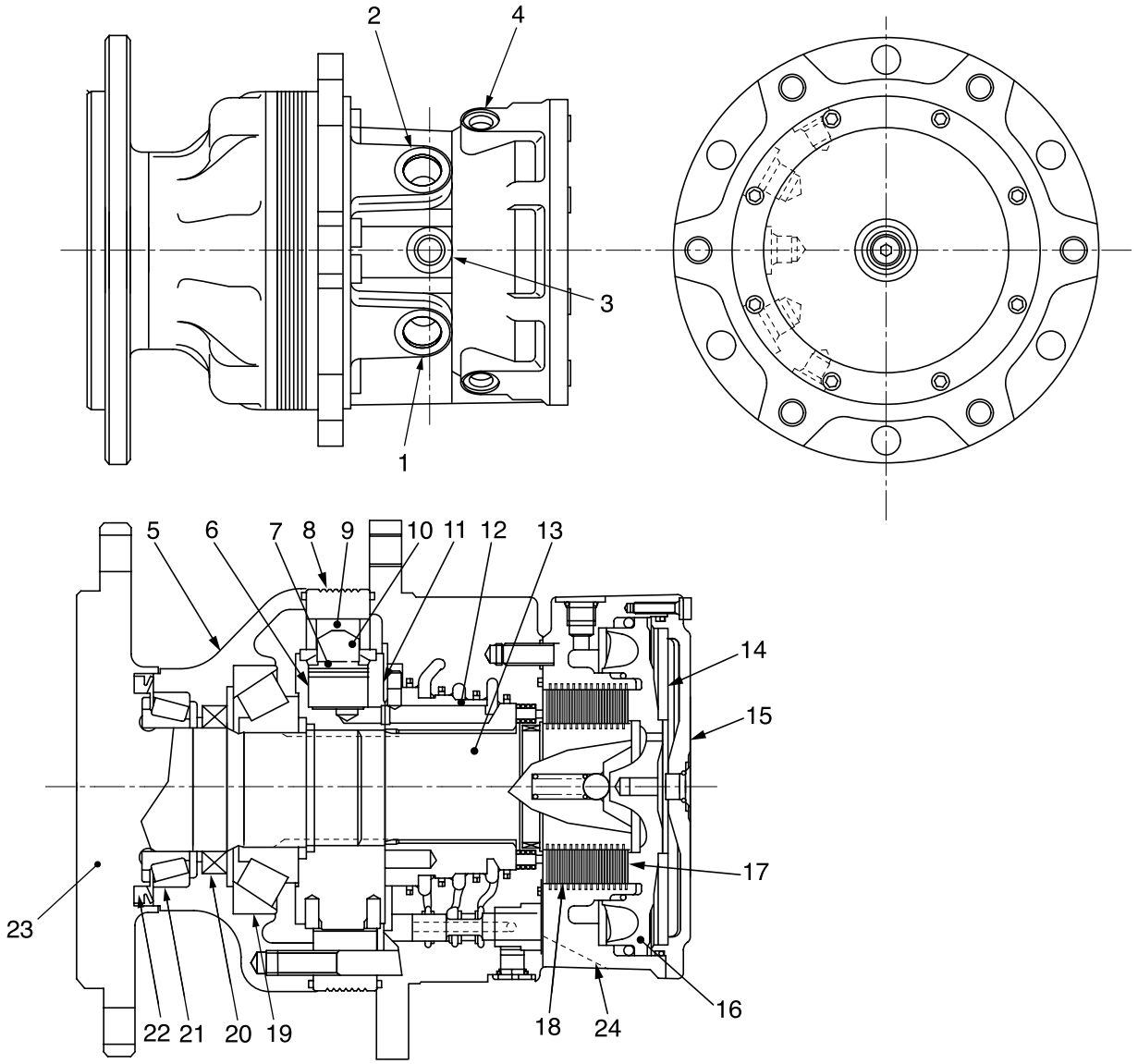


SW3002007

1. Port A (forward travel)
2. Port B (reversing)
3. High pressure relief valve (forward travel)
4. High pressure relief valve (reversing)
5. Charge relief valve
6. Control lever
7. Brake release solenoid valve
8. Circuit pressure gauge port (forward travel)
9. Circuit pressure gauge port (reversing)
10. Charge pressure gauge port

Specifications
- Model : DVN28-504
- Displacement : 28cm³/rev
- Relief valve setting
  : 34.5MPa (5000psi) {350kgf/cm²}
- Charge circuit pressure setting
  : 1.9MPa (280psi) {20kgf/cm²}

2-1-2. Propulsion motor



SW3002008

1. Port A
2. Port B
3. Drain port
4. Brake release pressure gauge port
5. Large flange
6. Piston ring
7. Journal bearing
8. Cam ring
9. Roller
10. Piston
11. Cylinder block
12. Distributor
13. Brake shaft
14. Brake spring
15. Brake cover
16. Brake piston
17. Friction plate
18. Separate plate
19. Roller bearing
20. Oil seal
21. Roller bearing
22. Dust seal
23. Output shaft
24. Brake housing

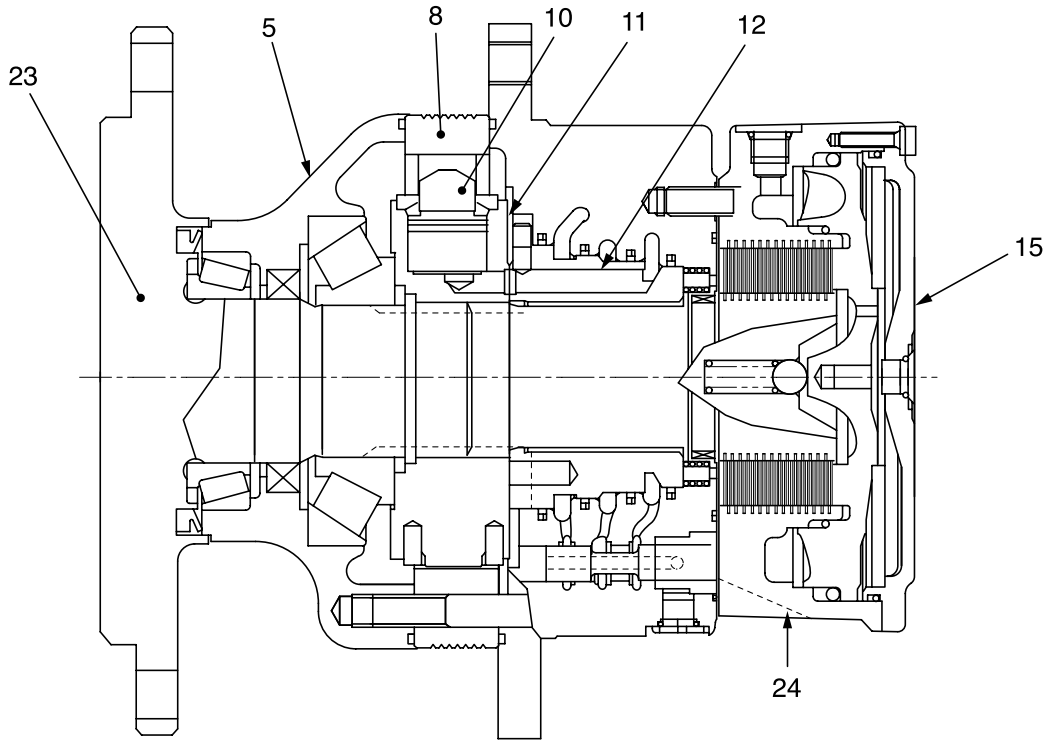
Specifications

- Model : DCM0280-517
- Displacement : 417cm^3/rev
- Circuit pressure setting : 34.5MPa (5000psi) {350kgf/cm^2}
  To be set on propulsion pump side

2-1-3. Description and operation of cam motor

Construction of cam motor

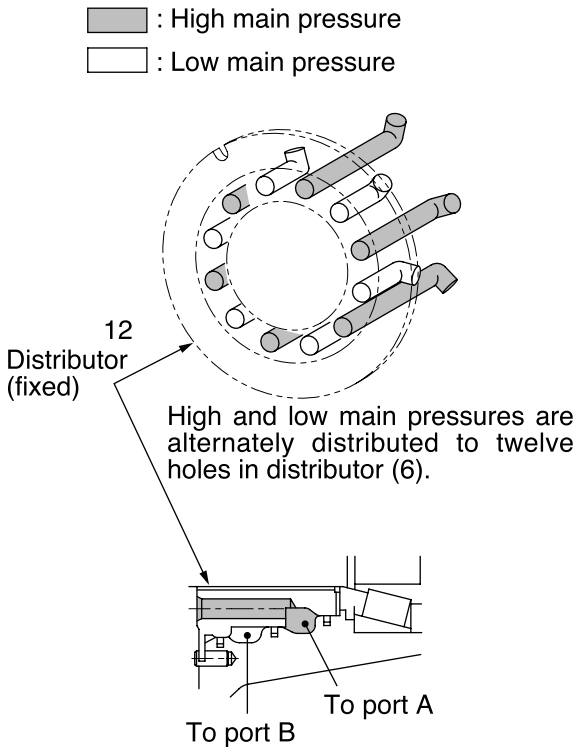
- Made up of brake cover (15), brake housing (24), cam ring (8), large flange (5), cylinder block (11), distributor (12) and output shaft (23).
- Eight sets of pistons (10) are assembled into cylinder block (11), while brake housing (24) houses spring-applied hydraulically released brake.
- Brake cover (15), brake housing (24), cam ring (8) and large flange (5) form one body fixed with fixing bolts.
- Cylinder block (11) is spline fitted to output shaft (23) and rotates when under hydraulic pressure. Cylinder block (11) has twelve oil holes to align with the holes in distributor (12).
- Distributor (12) fitted to large flange (5) with dowel pin feeds oil, which is supplied from port A or port B in large flange (5), to cylinder block (11) and also displaces oil from cylinder block (11). For this purpose, there are twelve oil holes in distributor (12). Six holes lead to port B in large flange (5) and other six holes to port A respectively. (See page 2-012)
- Inside surface of cam ring (8) are six cam profiles (see Fig.SW3002011 on page 2-012) along which the pistons move to provide rotary motion.
- Cylinder block (11) is located with eight sets of pistons inside cam ring (8).

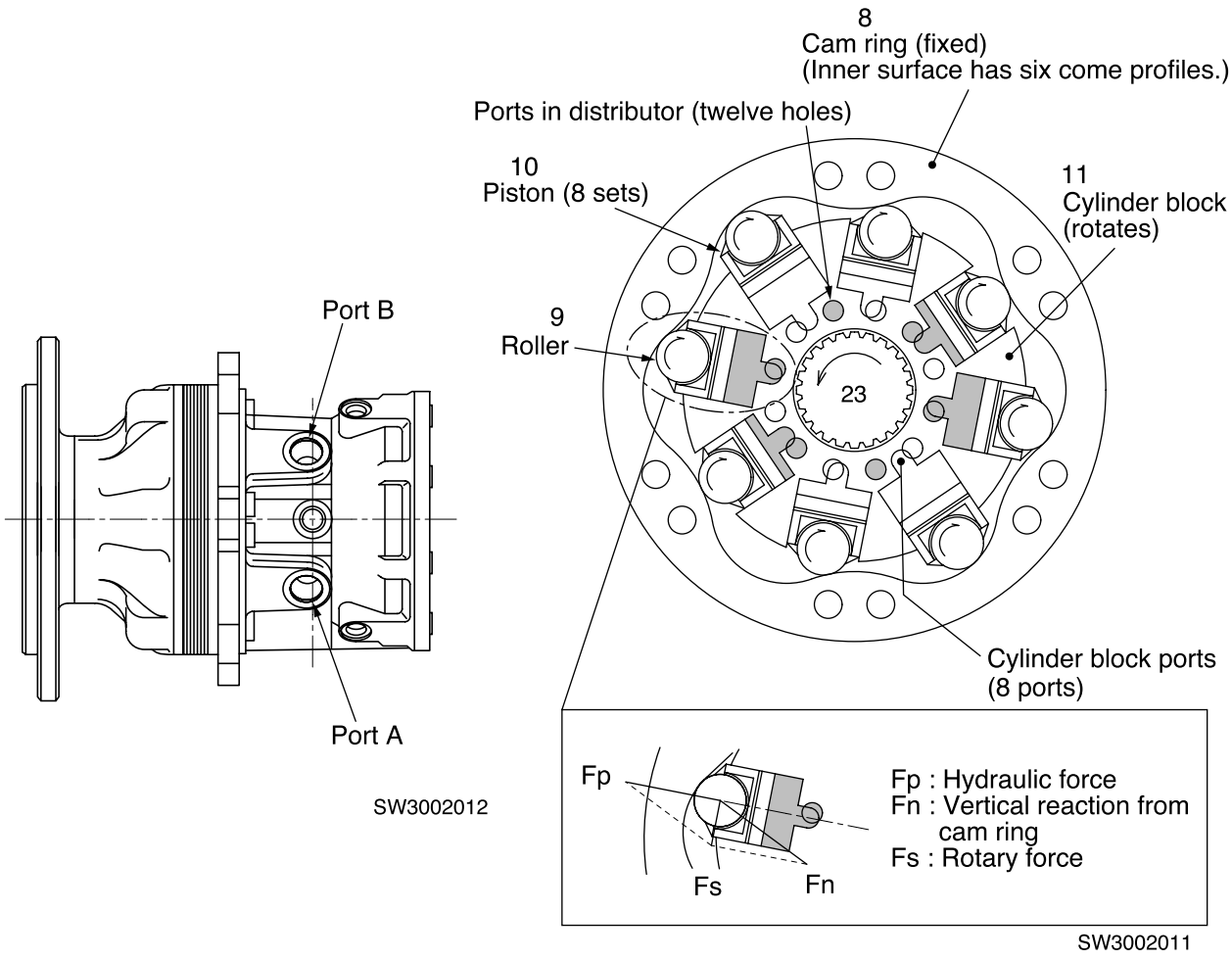


SW3002009

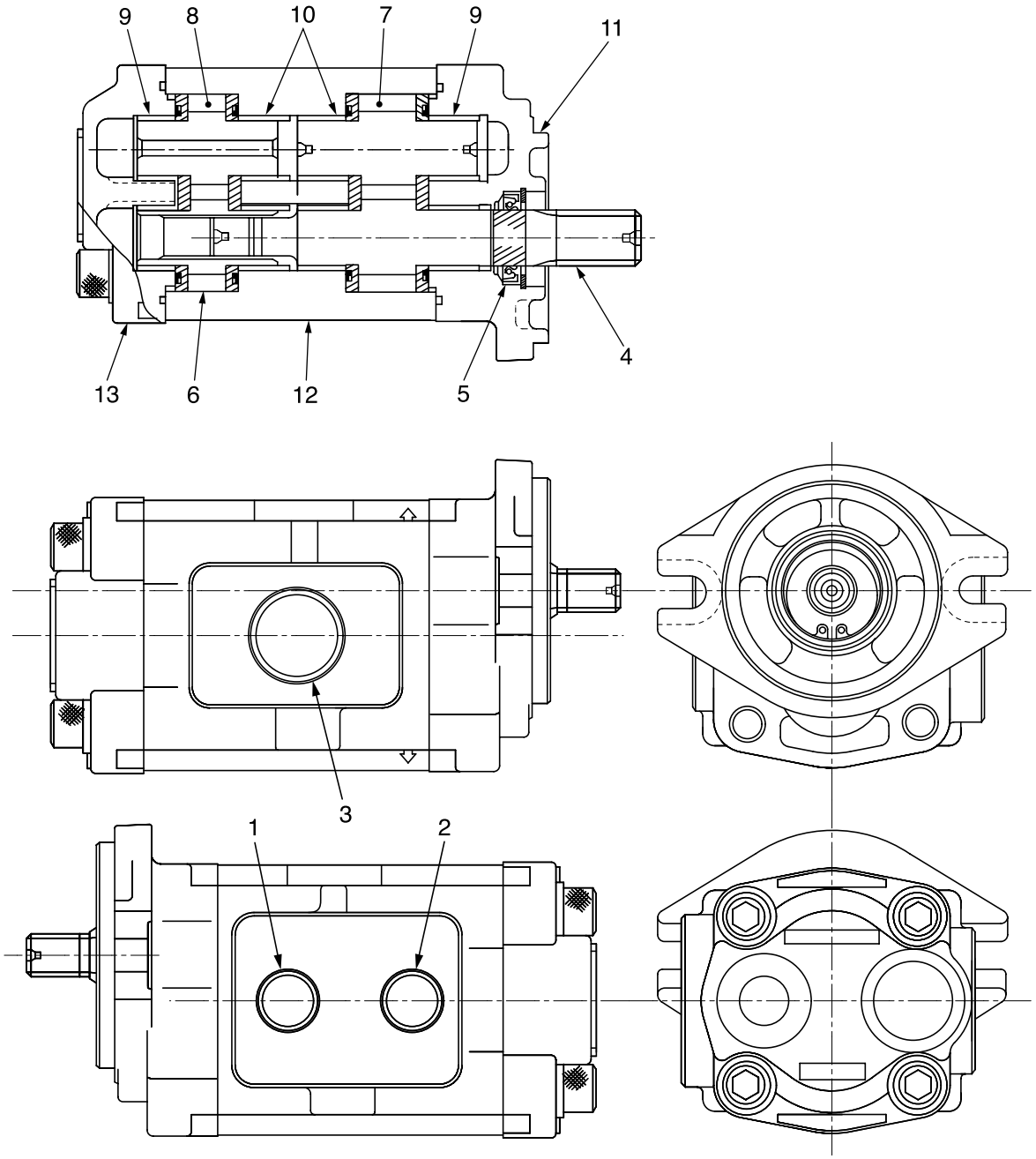
Operation (It is assumed that oil is fed into port B.)

- Pump flow to port B in large flange (5) is distributed into six holes in distributor (12) which lead to port B.
  * Oil is displaced from the remaining six holes.
- When the six holes in cylinder block (11) align with the six holes in distributor (12), pressurized oil lifts pistons (10).
- Movement of pistons (10) which move along the cam profiles with rollers (9) in contact with the profiles creates rotary force in cylinder block (11). This force rotates output shaft (23) spline fitted to cylinder block (11).
- Simultaneously, pistons (10) which are leading to port A (discharge port) also move along the cam formation to retract, displacing oil from port A.
  * If pump flow is fed into port A, the output shaft rotation is reversed.





2-1-4. Vibrator pump



SW3002013

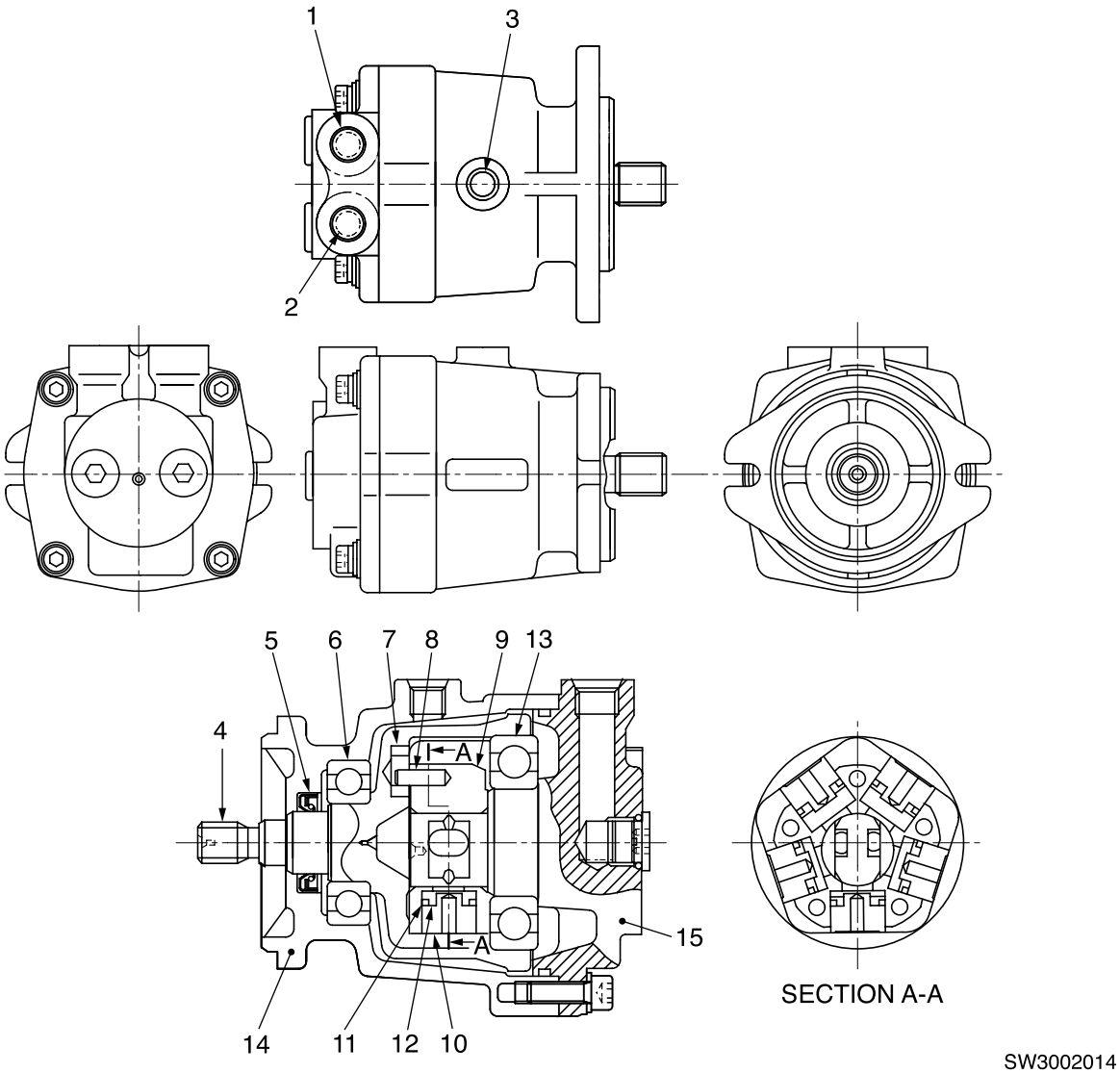
1. Outlet port (Pump No.1)
2. Outlet port (Pump No.2)
3. Suction port
4. Drive gear (pump No.1)
5. Oil seal
6. Drive gear (pump No.2)
7. Driven gear (pump No.1)
8. Driven gear (pump No.2)
9. Bush
10. Bush
11. Front cover
12. Body
13. Rear cover

Specifications

- Model : DIA14•14R270
- Displacement : 13.7+13.7cm^3/rev
- Pressure setting : 12.7MPa (1840psi) {130kgf/cm^2}

  To be set by valve

2-1-5. Vibrator motor



SW3002014

1. Suction port (port A)
2. Outlet port (port B)
3. Drain port
4. Drive shaft
5. Oil seal
6. Ball bearing
7. Timing ring
8. Timing pin
9. Cylinder block
10. Piston
11. Piston ring
12. Piston retainer
13. Ball bearing
14. Casing
15. Pintle

Specifications

- Model : SHM1
- Displacement : 9cm^3/rev
- Pressure setting : 12.7MPa (1840psi) {130kgf/cm^2}
  To be set by valve

2-1-6. Description and operation of vibrator motor

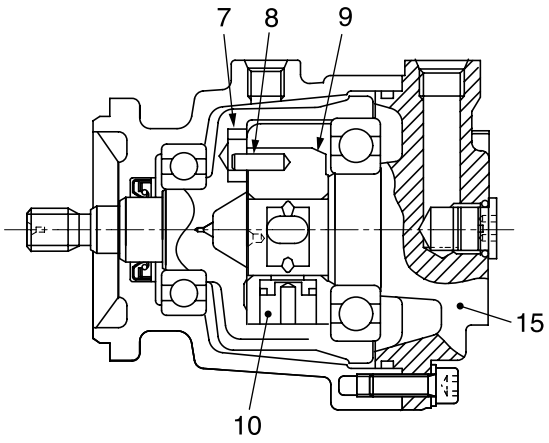
* See figures on page 2-014 for construction.

- Pressurized oil fed from a port provided at rear of pintle (15) flows through the low-high pressure selecting section and radiated oil ways of cylinder block (9) into one end of the pistons.

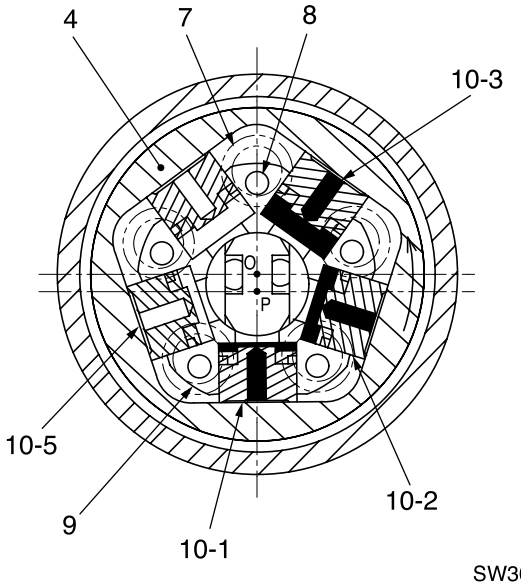
* In the center drawing, oil is occupying spaces shown black in pistons 10-1, 10-2 and 10-3.

- Point O is the rotating center of drive shaft (4), and point P shows the center of pintle (15). The center line of all pistons point to point P. Resultant forces F1, F2 and F3 generated by pistons 10-1, 10-2 and 10-3 (center and bottom drawings) act on point P and create a torque due to eccentric E. Because pintle (15) is fixed, drive shaft (4) which has a pentagon-shaped inner surface spins.
- Drive shaft (4) and cylinder block (9) rotate with their respective pentagon remaining parallel with each other because of timing pins (8) provided in cylinder block (9) and timing ring (7) in drive shaft (4).
- The low-high pressure selecting section of pintle (15) is made up of two flat faces of the eccentric cylinder and radiated portion (five holes into which the pistons are inserted) of cylinder block (9). One of the two flat faces of the eccentric cylinder leads to high pressure inlet port, while the other face corresponds to the low pressure outlet port. With the rotation of cylinder block (9) which spins together with drive shaft (4), pressurized oil is fed into the pistons when the radiated portion of cylinder block (9) leads to the high pressure side of eccentric cylinder. On the other hand, oil is exhausted from the pistons if the radiated portion is open to the low pressure side.

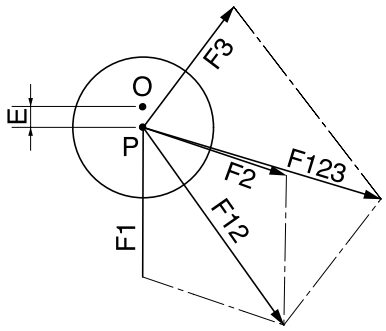
  In this way, torque is created continuously through flow in and flow out processes of oil. The motor runs continuously.



SW3002015



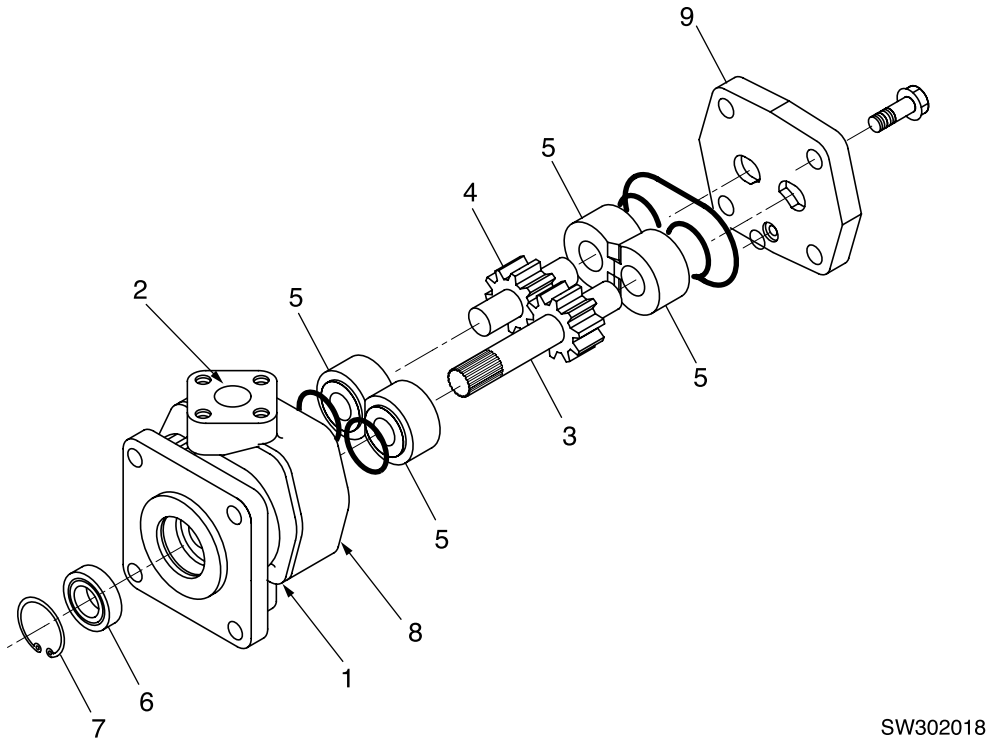
SW3002016



(C) Moment created by hydraulic pressure

SW3002017

2-1-7. Steering pump



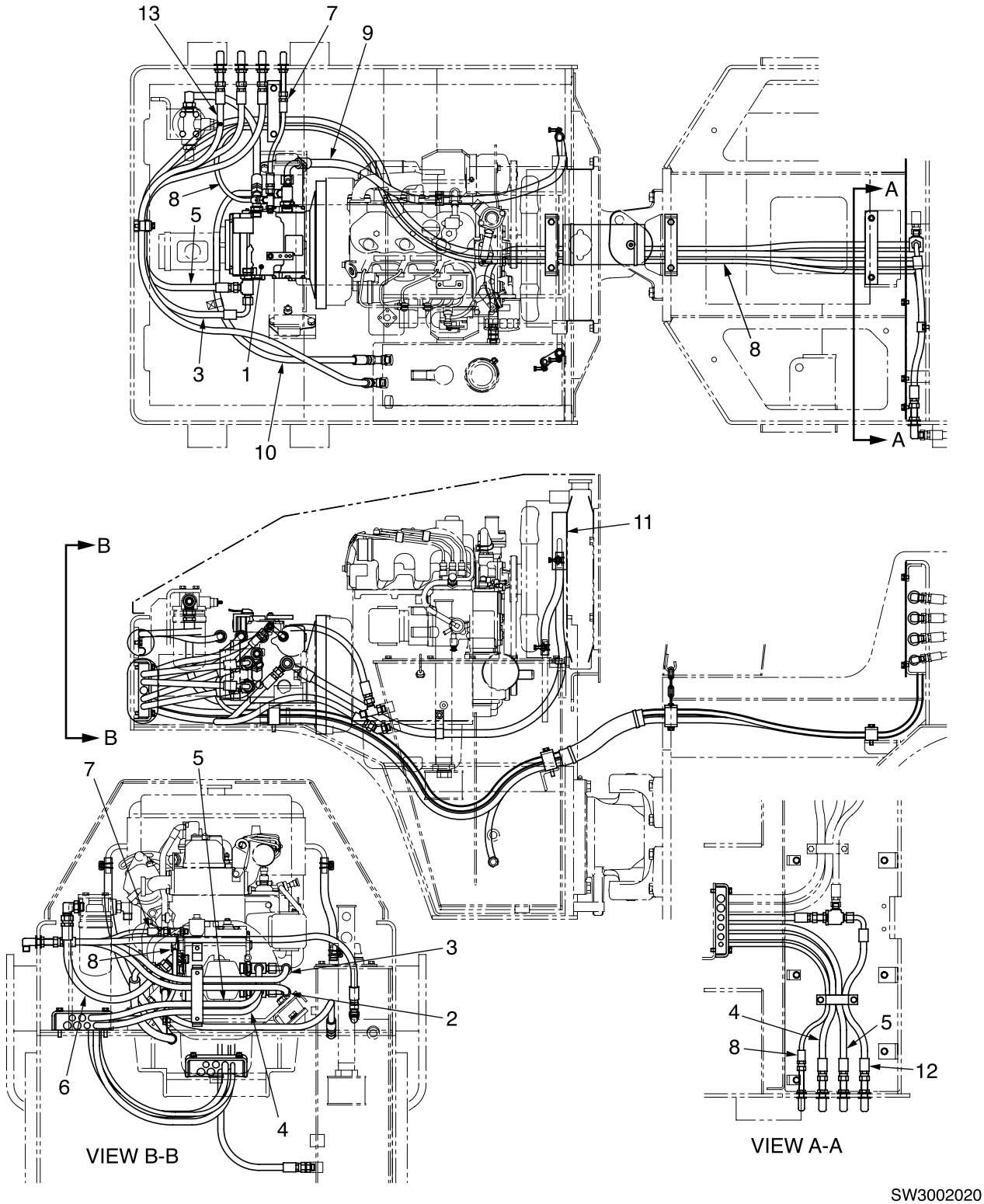
1. Outlet port
2. Suction port
3. Drive gear
4. Driven gear
5. Bush
6. Oil seal
7. Ring
8. Body
9. Rear cover

Specifications
- Displacement : 8.85cm^3/rev
- Pressure setting : 13MPa (1890psi) {133kgf/cm^2}
  To be set on Orbitrol side

2-1-8. Hydraulic circuit

2-2. Propulsion line

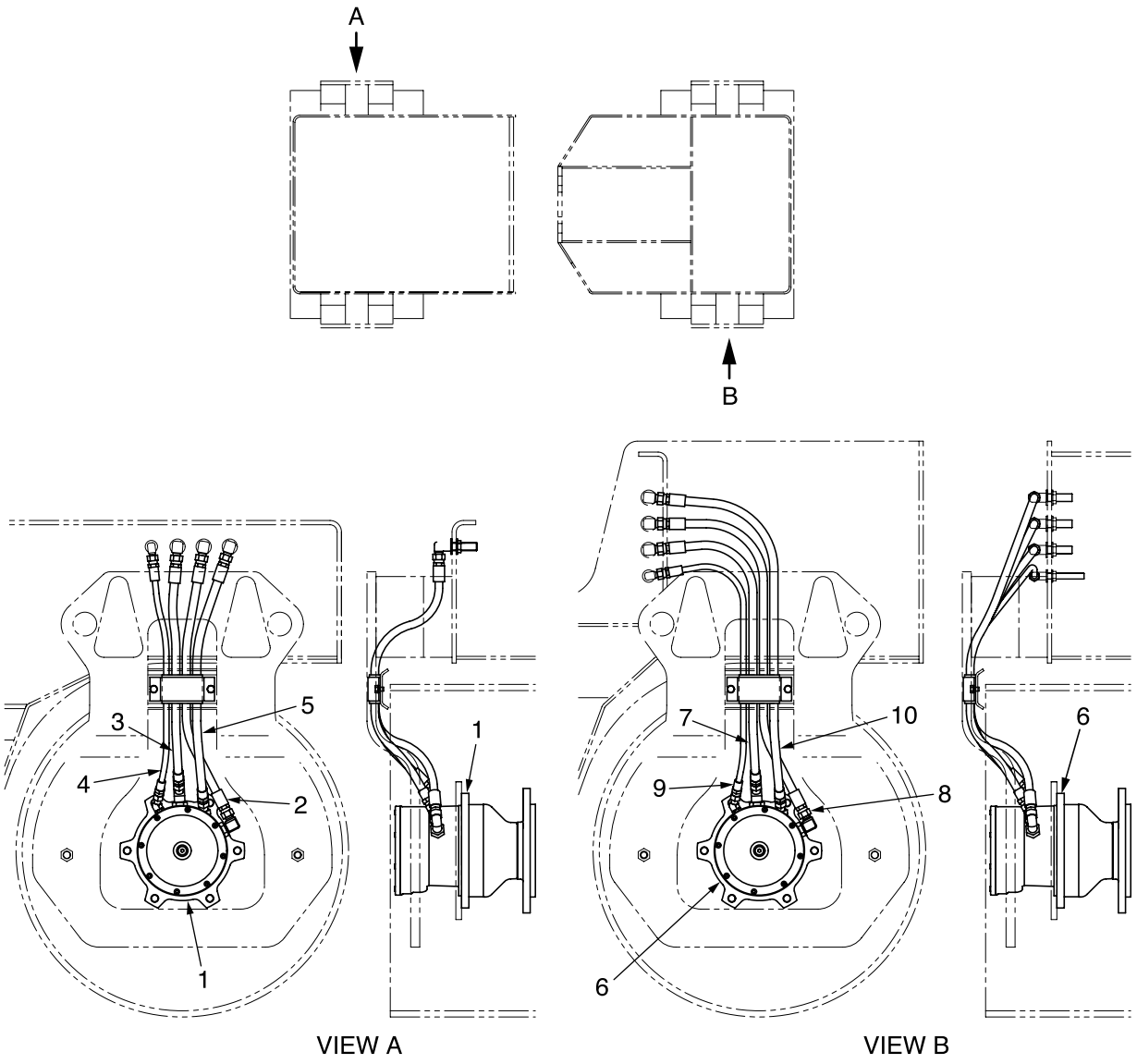
2-2-1. Hydraulic piping [1]



SW3002020

1. Propulsion pump
2. High pressure hose (front, forward travel)
3. High pressure hose (front, reversing)
4. High pressure hose (rear, forward travel)
5. High pressure hose (rear, reversing)
6. Charge hose
7. Brake release hose (front)
8. Brake release hose (rear)
9. Drain hose (pump to oil cooler)
10. Drain hose (pump to hydraulic tank)
11. Oil cooler
12. Drain hose (rear motor to hydraulic tank)
13. Drain hose (front motor to hydraulic tank)

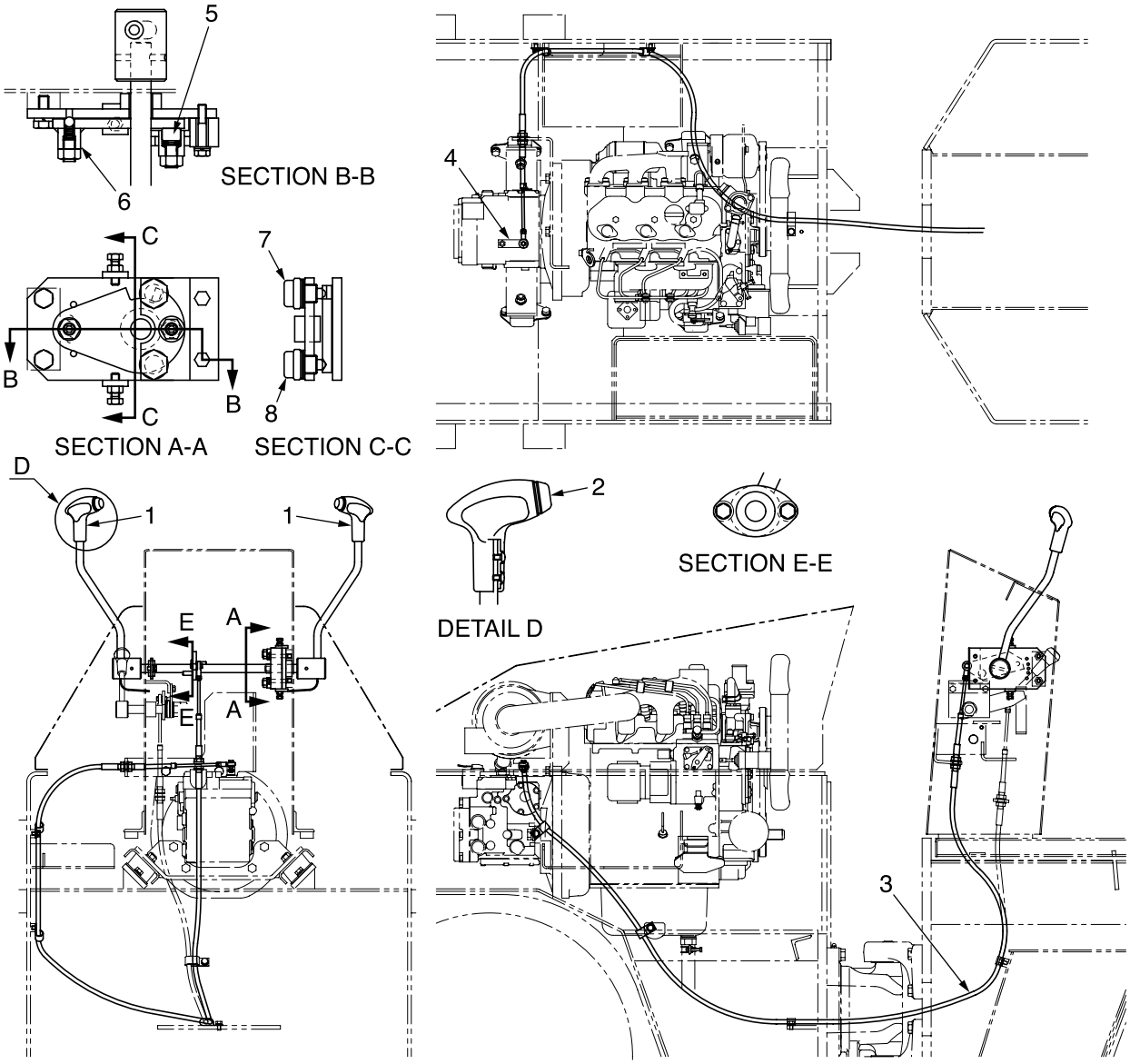
2-2-2. Hydraulic piping [2]



SW3002021

1. Propulsion motor
2. High pressure hose (forward travel)
3. High pressure hose (reversing)
4. Brake release hose
5. Drain hose
6. Propulsion motor (rear)
7. High pressure hose (forward travel)
8. High pressure hose (reversing)
9. Brake release hose
10. Drain hose

2-2-3. Propulsion controls

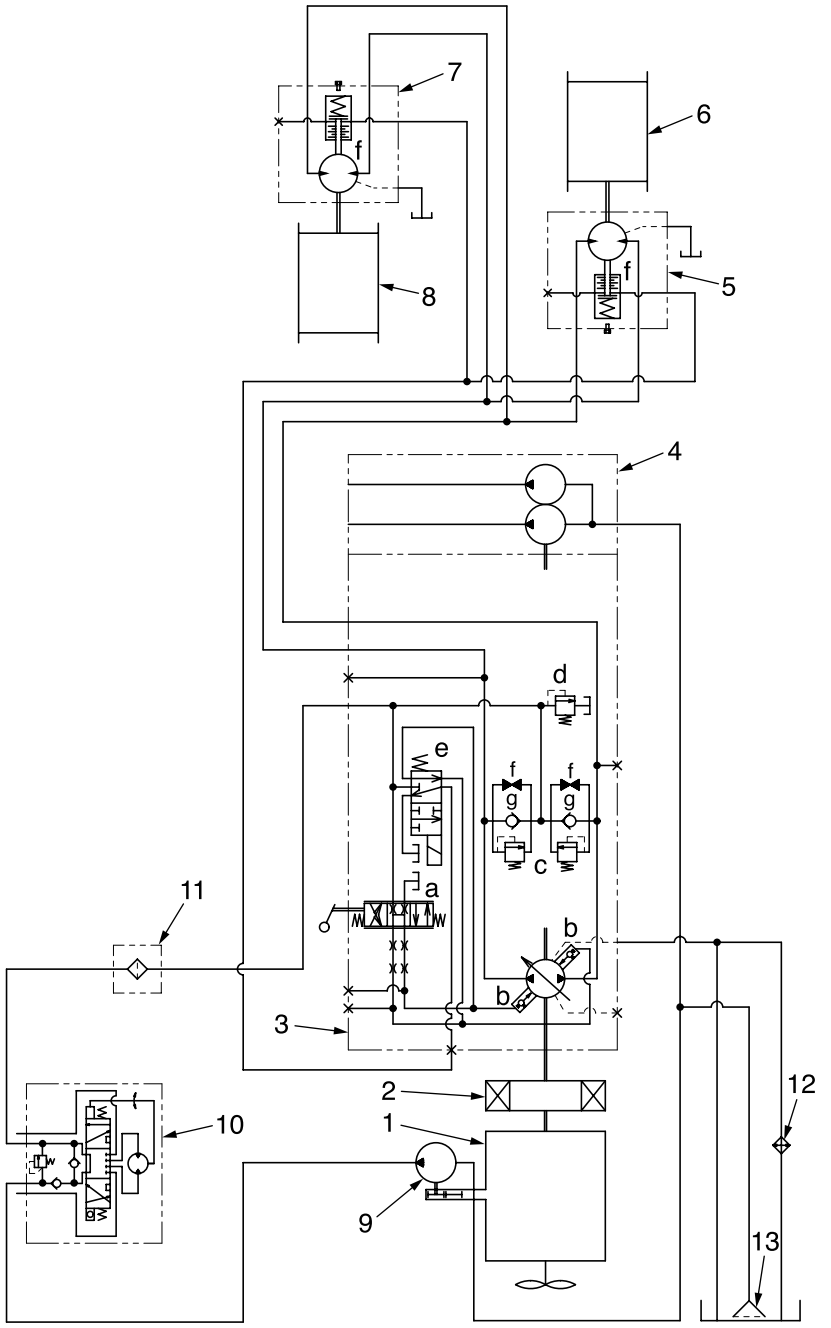


SW3002022

1. F-R lever
2. Vibrator switch
3. Control cable
4. Pump control lever
5. Holder
6. Detent
7. Reverse alarm switch
8. Interlock switch

2-2-4. Propulsion circuit

1. Engine
2. Coupling
3. Propulsion pump
   a. Control valve
   b. Servo piston
   c. High pressure relief valve
   d. Charge relief valve
   e. Brake release solenoid valve
   f. Bypass valve
   g. Check valve
4. Vibrator pump
5. Rear propulsion motor
6. Rear drum
7. Front propulsion motor
8. Front drum
9. Steering pump
10. Steering valve (Orbitrol)
11. Line filter
12. Oil cooler
13. Suction filter



SW3002023

2-2-5. Description and operation of propulsion system

♦ See the hydraulic circuit on pages 2-022.

Description of propulsion system

• Made up of propulsion pump (3), front propulsion motor (4), front drum (8), rear propulsion motor (5) and rear drum (6). Brake release solenoid (e) is built into the propulsion pump.

Basic function of propulsion pump and propulsion motor

• Propulsion pump
A piston pump is used which selects forward travel, neutral and backing by varying the swashplate inclination, and thus varying the piston stroke.

• Propulsion motor
A piston motor is used in which the displacement is fixed.

Operation (It is assumed that the machine travels forward.)

★The spring-applied hydraulically released brake is supposed to have been released.

♦ Assemblies such as pump ass'y and motor ass'y are indicated by numbers such as (1) and (2), while component parts of assemblies are shown by small letters such as (a) and (b).

• The circuit of the front motor and that of the rear motor connect in parallel with each other.
• When the forward-reverse lever (F-R lever) is moved forward, control valve (a) functions to tilt the pump swashplate in the forward travel direction.
• Propulsion pump (3) feeds oil from its port A into the forward travel circuit, then the oil flow branches into two lines; one line connecting to forward travel port B of front motor (7) and the other line connecting to port A of rear motor (5).
• The oil fed to the forward travel ports of the motors drives the motors, flowing out from the opposite side ports and joins again to flow into suction port B in propulsion pump (3).

NOTE: Because the propulsion circuit is a closed loop circuit, the relationship between the suction port and discharge port is reversed when the travel direction is reversed. (The direction of oil flow is reversed.)

Releasing of spring-applied hydraulically released brake

• When brake release solenoid valve (e) is energized, it functions to feed oil from the charge circuit into brake release ports in the propulsion motors.
• Oil then flows into the cylinder built in brake unit (h). The piston inside the cylinder of the brake unit releases brake against the spring compression.

Circuit protection against high pressure:

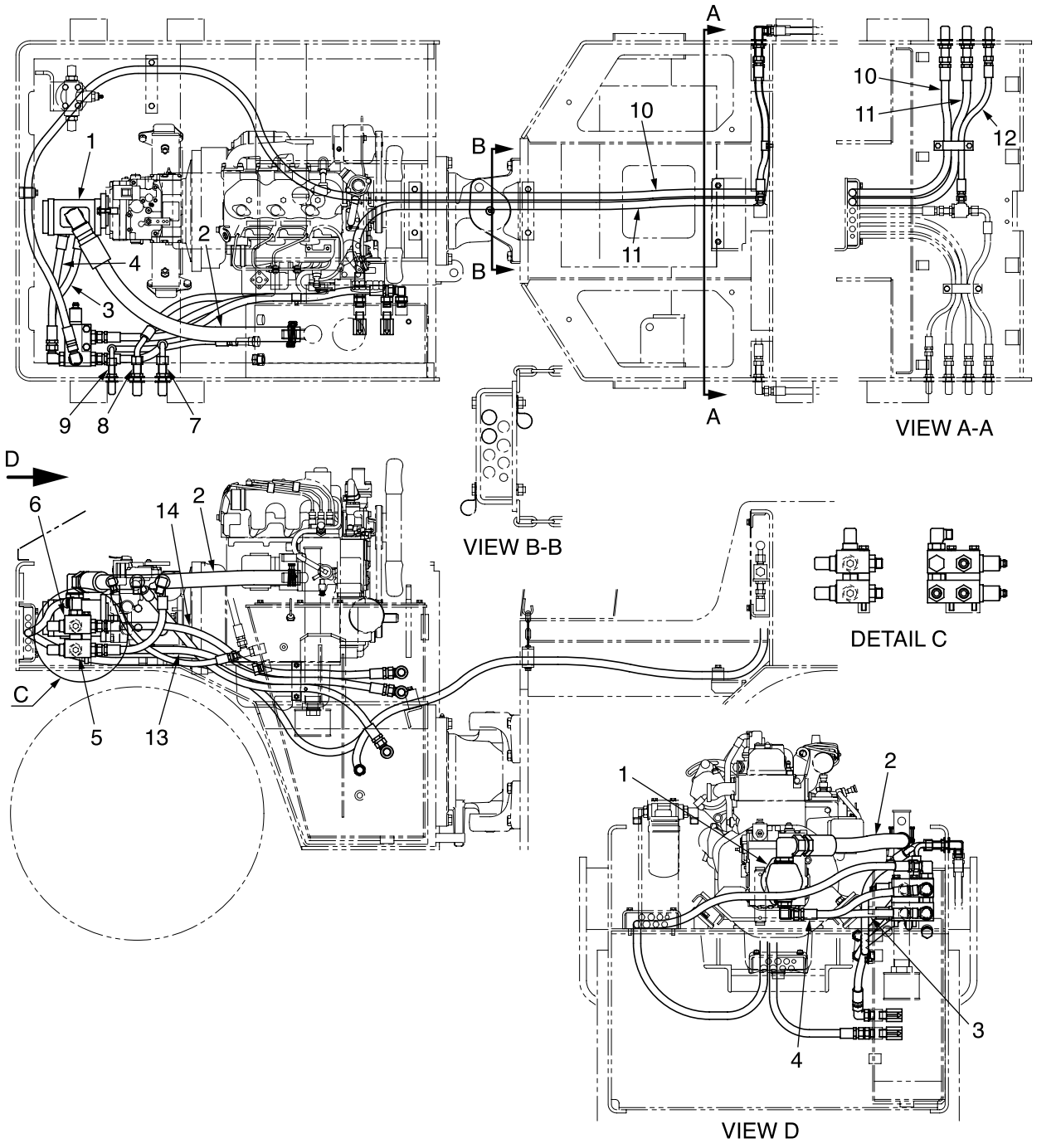
• Multi-function valve (c) fitted in the propulsion pump relieves pressure if the circuit pressure exceeds the setting of the valve, thus protecting the circuit.

Charge circuit

• The propulsion circuit is of a closed circuit, which needs feeding of oil into it for making up deficiency, cooling off or for other purposes.
• In the charge circuit, oil from steering pump (9) flows into steering valve (10) (Orbitrol), then the whole oil goes to propulsion pump (3) via filter (11) irrespective of the steering wheel operation.
• The pressure adjustment is achieved by charge relief valve (d) built in the propulsion pump (3).

2-3. Vibrating system

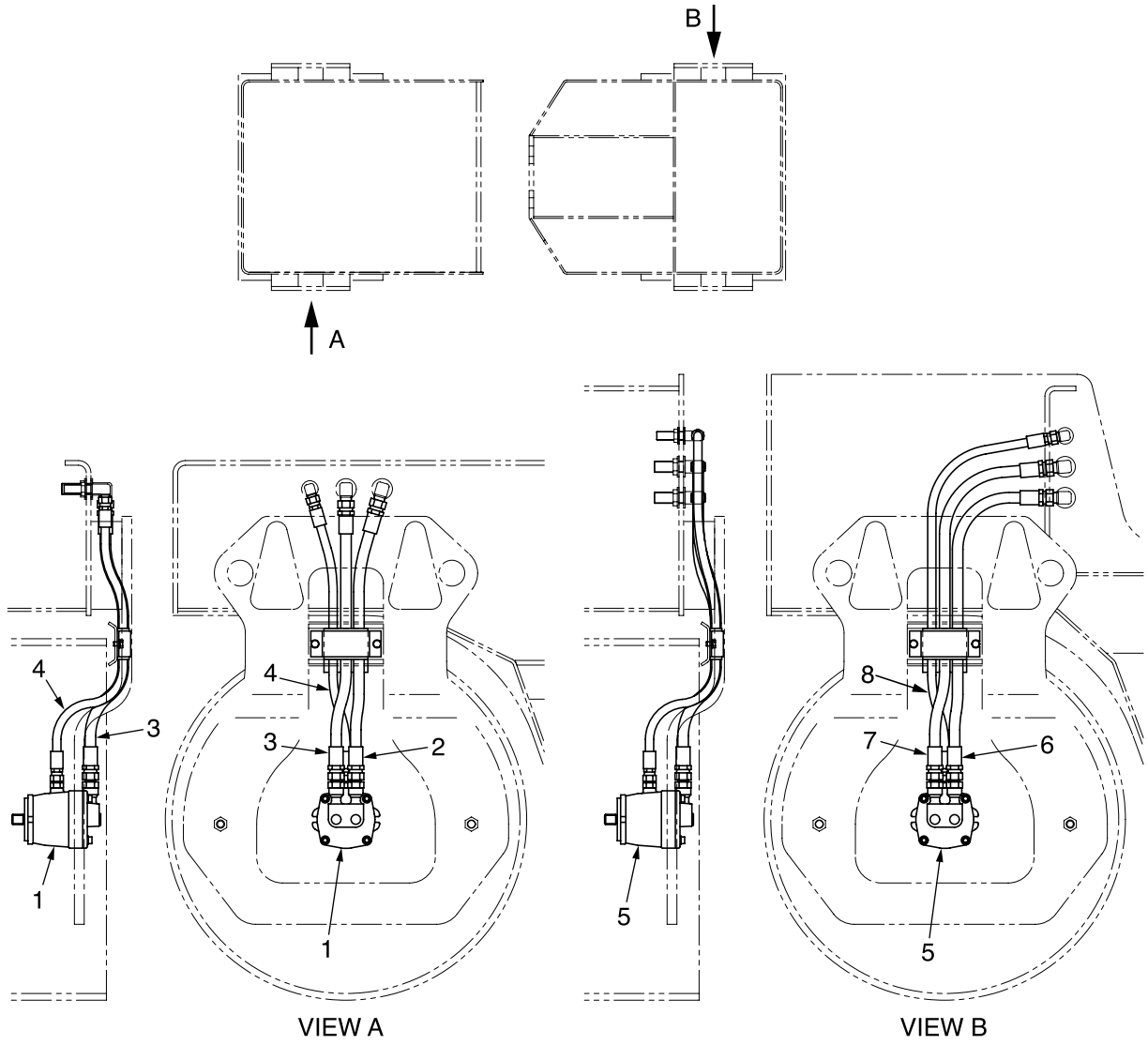
2-3-1. Hydraulic piping [1]



SW3002024

1. Vibrator pump
2. Suction hose
3. Outlet hose (pump No.1)
4. Outlet hose (pump No.2)
5. Vibration mode selector solenoid valve (front)
6. Vibration mode selector solenoid valve (rear)
7. High pressure hose (front motor rotating side)
8. Return hose (front motor to hydraulic tank)
9. Drain hose (front motor to hydraulic tank)
10. High pressure hose (rear motor rotating side)
11. Return hose (rear motor to hydraulic tank)
12. Drain hose (rear motor to hydraulic tank)
13. Return hose (front solenoid valve to hydraulic tank)
14. Return hose (rear solenoid valve to hydraulic tank)

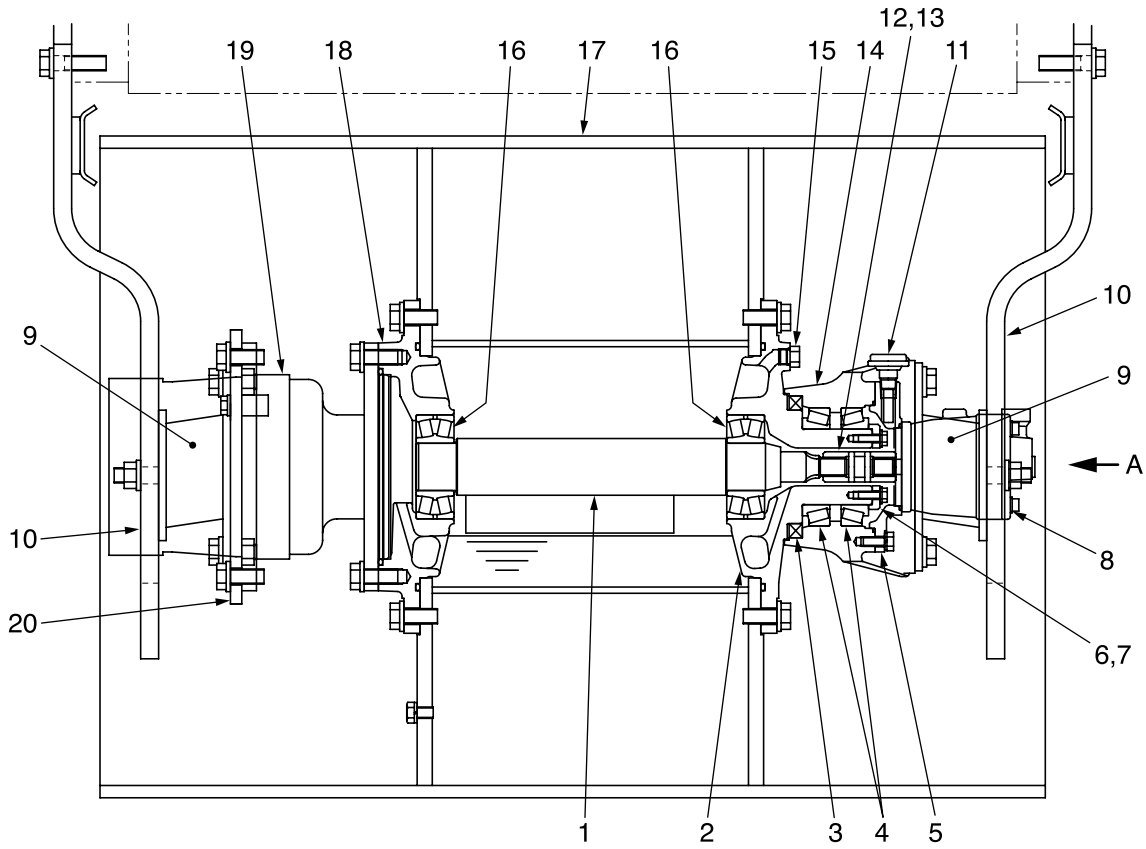
2-3-2. Hydraulic piping [2]

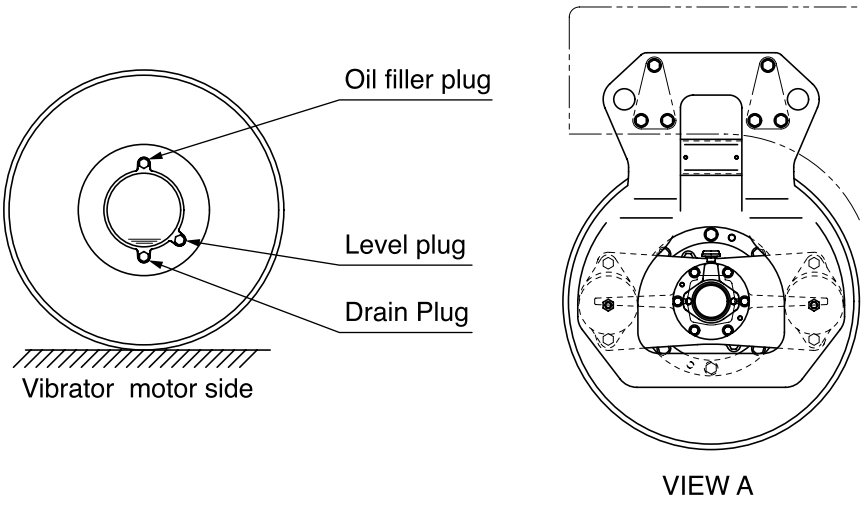


SW3002025

1. Vibrator motor (front)
2. High pressure hose [B] (high pressure side)
3. Return hose (motor to hydraulic tank)
4. Drain hose (motor to hydraulic tank)
5. Vibrator motor (rear)
6. High pressure hose [B] (high pressure side)
7. Return hose (motor to hydraulic tank)
8. Drain hose (motor to hydraulic tank)

2-3-3. Vibrating system (SW300)

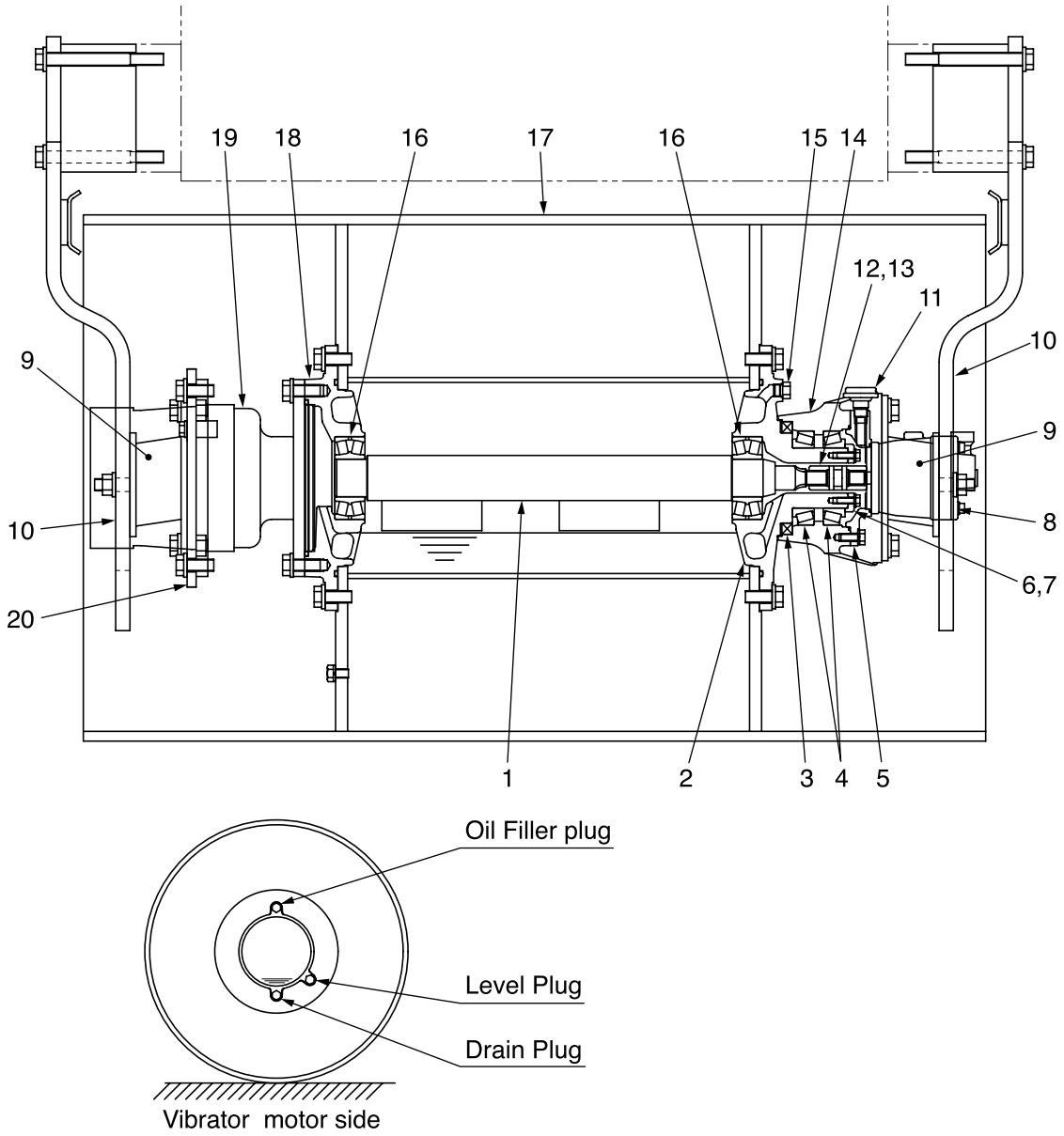




SW3002026

1. Vibrator shaft
2. Boss
3. Oil seal
4. Taper roller bearing
5. Cover
6. Cover
7. Shim
8. Vibrator motor
9. Damper
10. Plate
11. Breather
12. Sleeve
13. Spring pin
14. Disc
15. Plug
16. Roller bearing
17. Drum
18. Holder
19. Propulsion motor
20. Disc

2-3-4. Vibrating system (SW320,SW330)

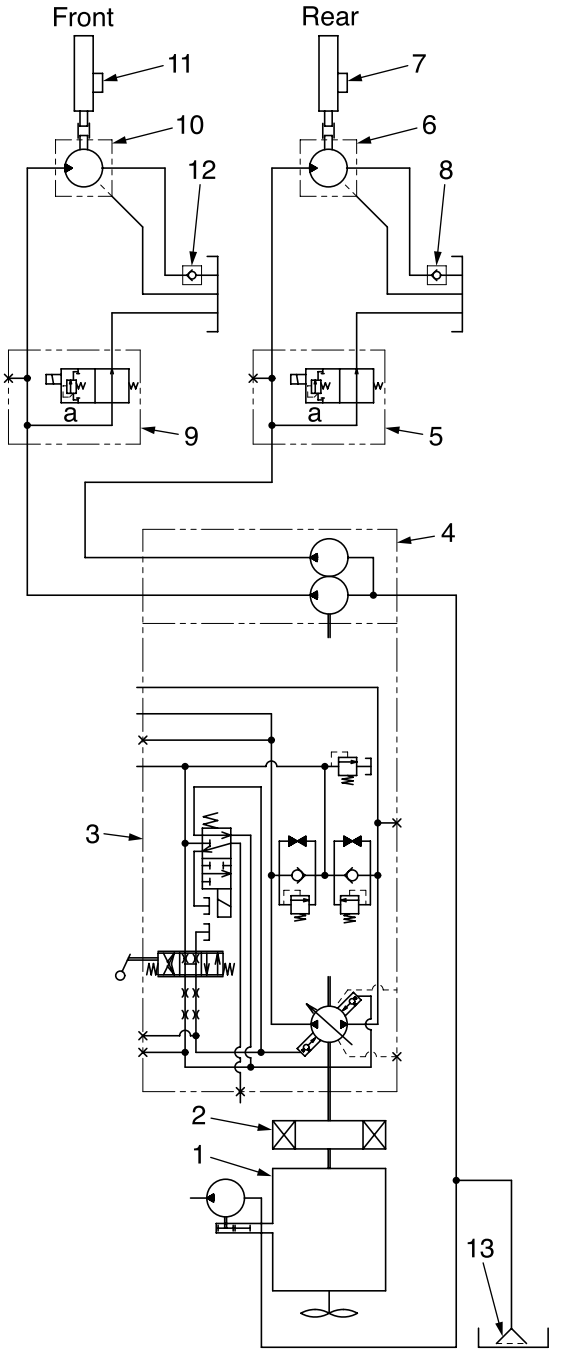


SW3002027

1. Vibrator shaft
2. Boss
3. Oil seal
4. Taper roller bearing
5. Cover
6. Cover
7. Shim
8. Vibrator motor
9. Damper
10. Plate
11. Breather
12. Sleeve
13. Spring pin
14. Disc
15. Plug
16. Roller bearing
17. Drum
18. Holder
19. Propulsion motor
20. Disc

2-3-5. Vibrator circuit

1. Engine
2. Coupling
3. Propulsion pump
4. Vibrator pump
5. Vibrator solenoid valve (rear)
   a. Pressure relief valve
6. Vibrator motor (rear)
7. Vibrator shaft (rear)
8. Check valve
9. Vibrator solenoid valve (front)
   a. Pressure relief valve
10. Vibrator motor (front)
11. Vibrator shaft (front)
12. Check valve
13. Suction filter



SW3002028

2-3-6. Description and operation of vibrating system

Description of vibrator circuit

• Made up of vibrator pump (4), front vibrator solenoid valve (9), front vibrator motor (10), front vibrator shaft (11), rear vibrator solenoid valve (5), rear vibrator motor (6) and rear vibrator shaft (7).

Basic function of vibrator pump and motor:

• Vibrator pump
A gear pump is in use. With a gear pump, its displacement is not variable.

• Vibrator motor
A radial piston motor is used.

Operation

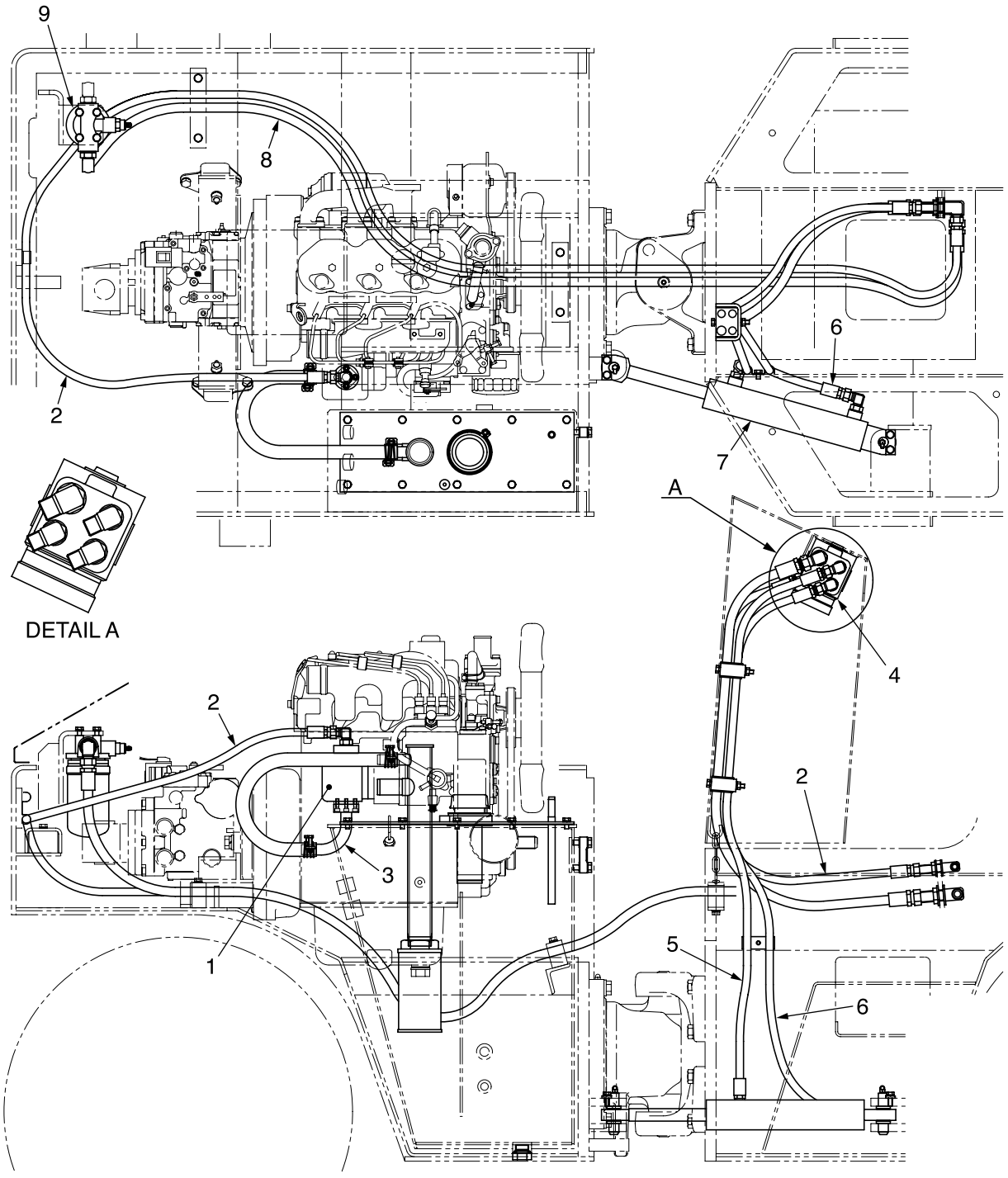
• The vibrator pump discharges oil as long as it is driven, as it is of a gear type. When the vibrator is not in use, the pump is put under no load by vibrator solenoid valves (5) and (9).
• With the vibrator switch ON, valves (5) and (9) close the unload circuit, making the vibrator operative. Vibrator motors (6) and (10) are driven. Oil displaced from the motors is dumped to the tank via check valves (8) and (12).

Circuit protection against high pressure

• Pressure relief valve (a) built in vibrator solenoid valves (5) and (9) opens to relieve the pressure if the system pressure exceeds the setting of valve (a).

2-4. Steering system

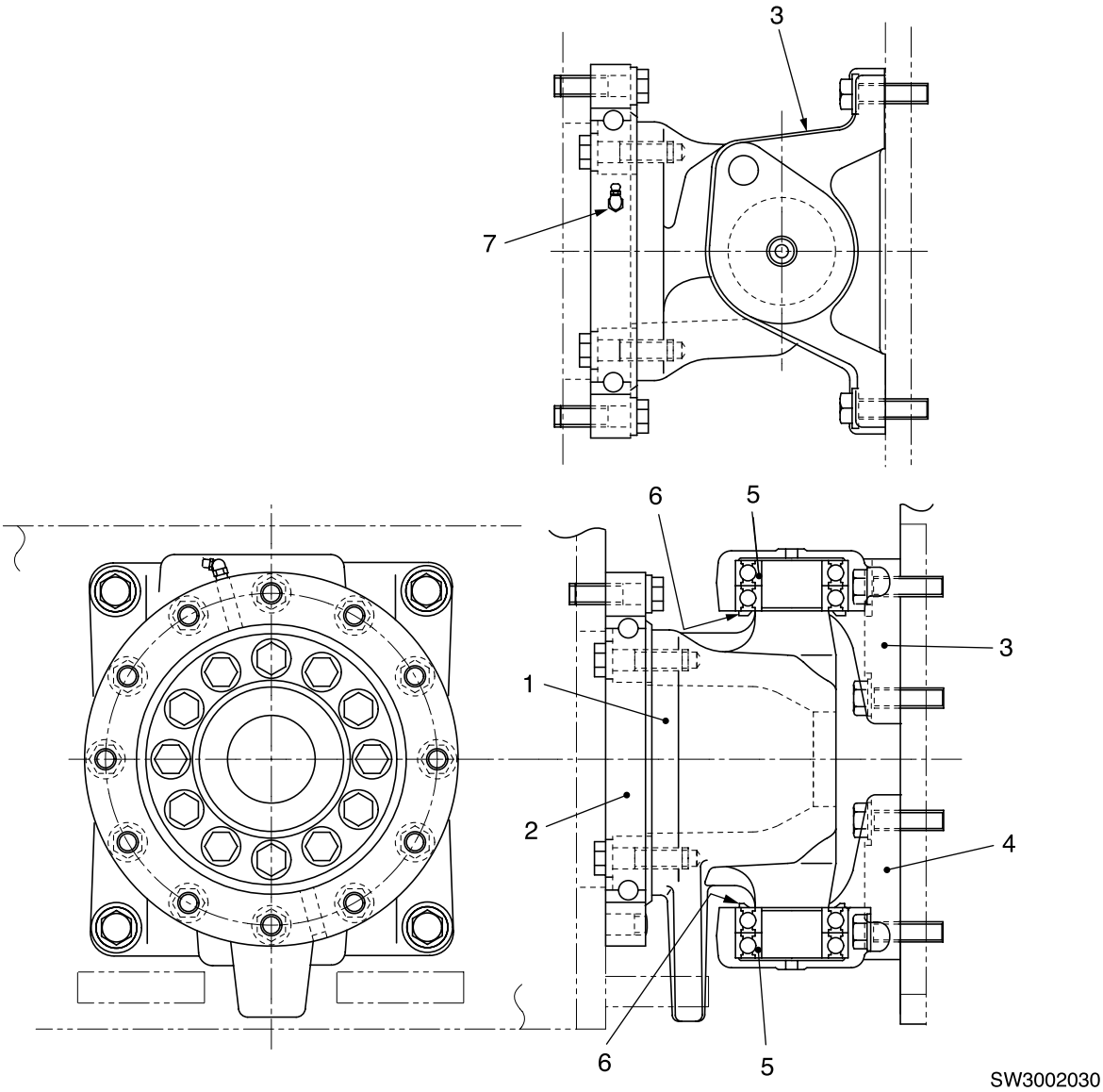
2-4-1. Hydraulic piping



SW3002029

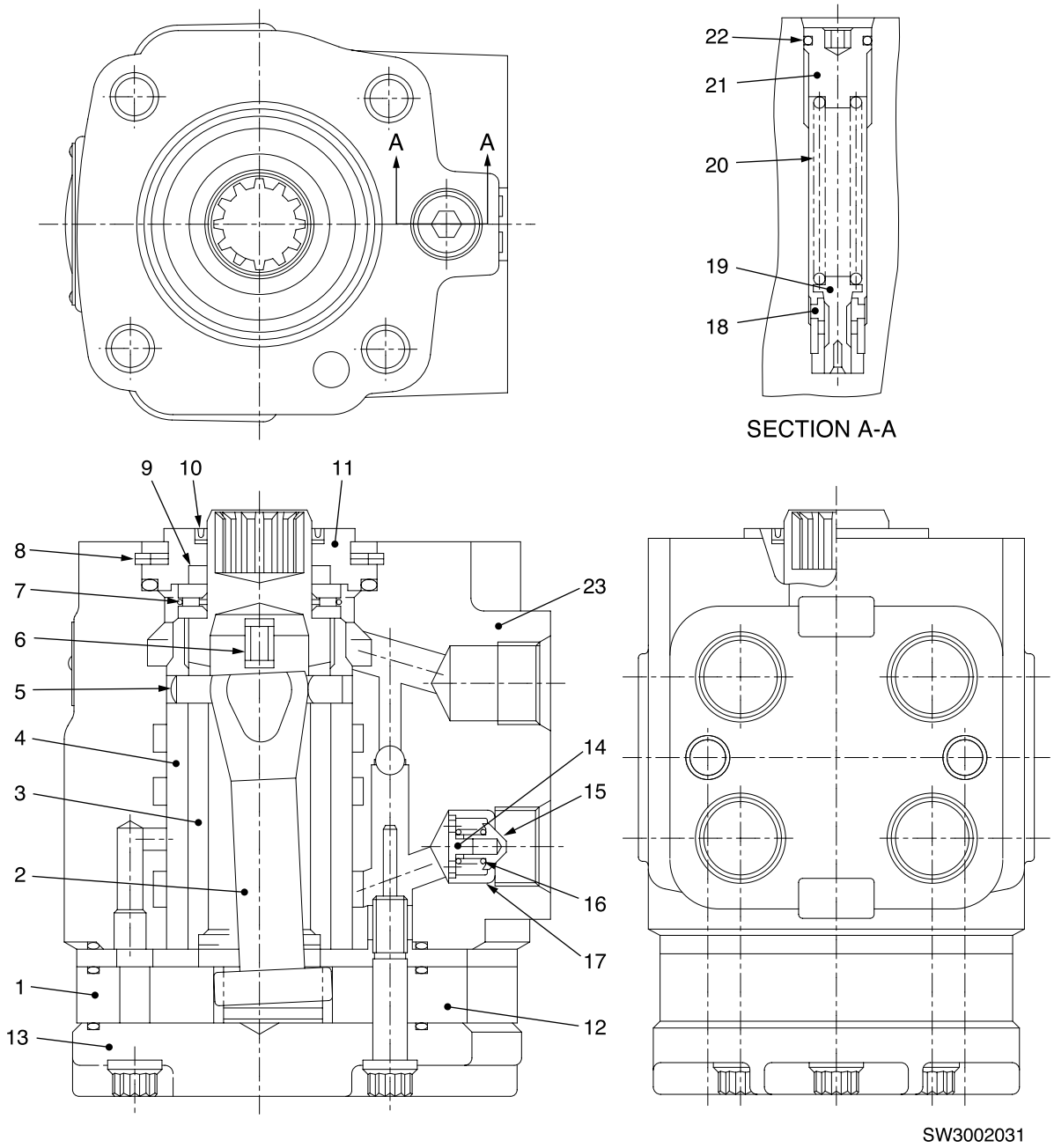
1. Steering pump
2. Outlet hose
3. Suction hose
4. Steering valve (Orbitrol)
5. High pressure hose (left turn)
6. High pressure hose (right turn)
7. Steering cylinder
8. Charge circuit hose
9. Line filter

2-4-2. King pin



1. Yoke
2. Bearing ass'y
3. Bracket (upper)
4. Bracket (lower)
5. Ball bearing
6. Cover
7. Grease fitting

2-4-3. Steering valve (Orbitrol)



1. Stator
2. Drive
3. Spool
4. Sleeve
5. Cross pin
6. Centering spring
7. Thrust needle
8. Retaining ring
9. Oil seal
10. Dust seal
11. Seal gland bush
12. Rotor
13. End cap
14. Guide
15. Poppet
16. Spring
17. Body
18. Valve seal
19. Poppet
20. Spring
21. Plug
22. O-ring
23. Housing

Specifications

- Valve system : Open center non-load reaction
- Displacement : 96.0cc/rev
- Relief valve setting : 13MPa (1890psi) {133kgf/cm^2}

2-4-4. Description and operation of Orbitrol

The steering valve (Orbitrol) is of a load-sensing type which allows the steering pump to feed an amount of oil into the valve corresponding to the speed at which the steering wheel is rotated.

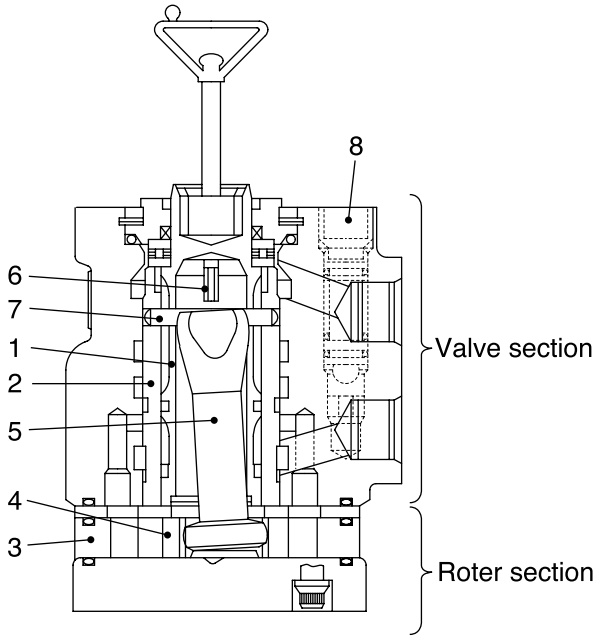
Description

*** Valve section**

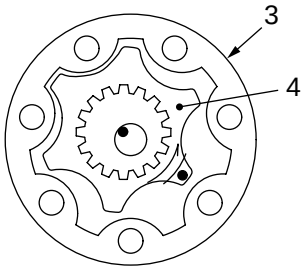
- The valve section makes itself a rotary type direction control valve consisting of spool (1) and sleeve (2) as main components. The steering wheel is spline-connected to spool (1).
- When the steering wheel is not operated, spool (1) and sleeve (2) stay in the neutral position with each other due to centering springs (6) with the oil grooves in spool (1) and oil holes in sleeve (2) not aligned. This blocks oil flow to the steering cylinder.
- When the steering wheel is turned, the oil grooves in spool (1) and oil holes in sleeve (2) are aligned to feed oil to the cylinder.

*** Rotor section**

- The rotor is an external gear which meshes with the internal gear of stator (3). When the valve section (spool-sleeve ass'y) opens, the rotor-stator ass'y acts as a hydraulic motor.
- The rotation of rotor (4) is conveyed to the valve section through drive shaft (5) spline-connected to rotor (4). An extent to which the valve opens is controlled by the speed at which the steering wheel is rotated.

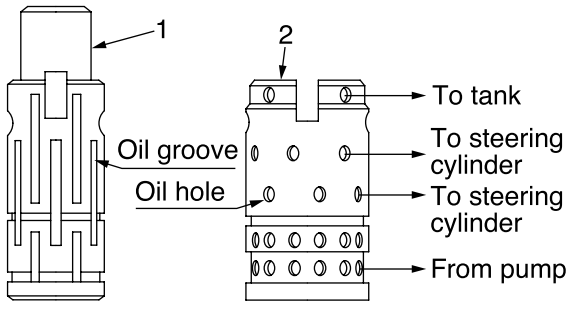


SV4002042



SV4002043

1. Spool
2. Sleeve
3. Stator
4. Rotor
5. Drive shaft
6. Centering spring
7. Cross pin
8. Check valve



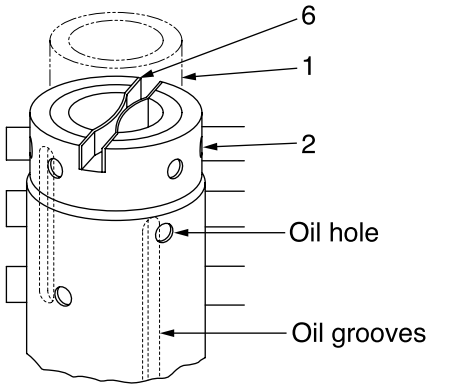
SV4002044

Operation

*** Neutral state (Steering wheel not operated)**

- Centering springs (6) (flat springs) are located in spring notches provided at end of spool (1) and sleeve (2).
- With the steering wheel not operated, centering springs (6) make the spool-sleeve ass'y stay in neutral.

***** This steering valve (Orbitrol) is of a load-sensing, non-load reaction, normal close type. In the neutral position, the oil grooves and oil holes are not aligned, blocking oil flow to the steering cylinder.

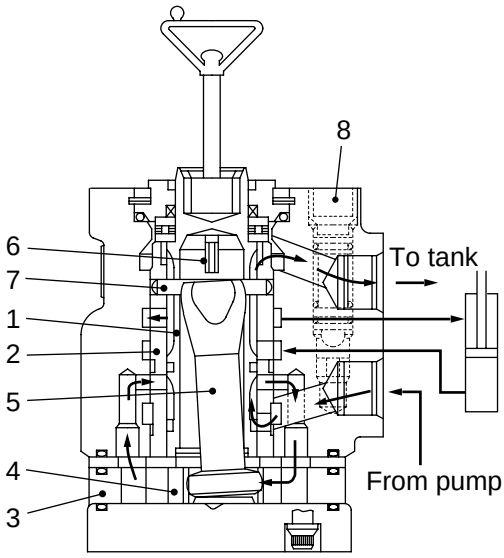


SV4002045

*** Turning (Steering wheel operated)**

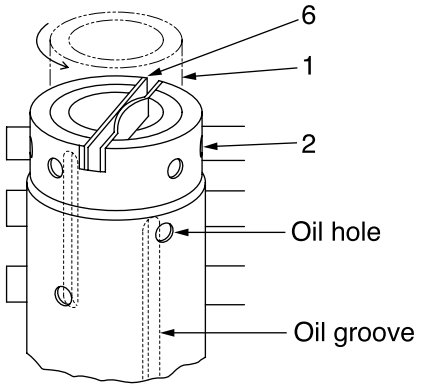
* In neutral, all the valve holes stay closed and oil remains trapped in the space between rotor (4) and stator (3). Rotor (4) is in a fixed state, being unable to rotate in any direction. Sleeve (2) is also unable to rotate, as it is connected to rotor (4) through cross pin (7) and drive shaft (5).

- When the steering wheel is spined, the rotating force is conveyed to spool (1). Spool (1) compresses centering springs (6). Then, there is a relative movement between spool (1) and sleeve (2). This aligns the oil grooves with oil holes.
- As a result, the whole ports (pump port, tank port and cylinder ports) open, allowing oil flow to related components. Rotor (4) spins.



SV4002046

1. Spool
2. Sleeve
3. Stator
4. Rotor
5. Drive shaft
6. Centering spring
7. Cross pin
8. Check valve

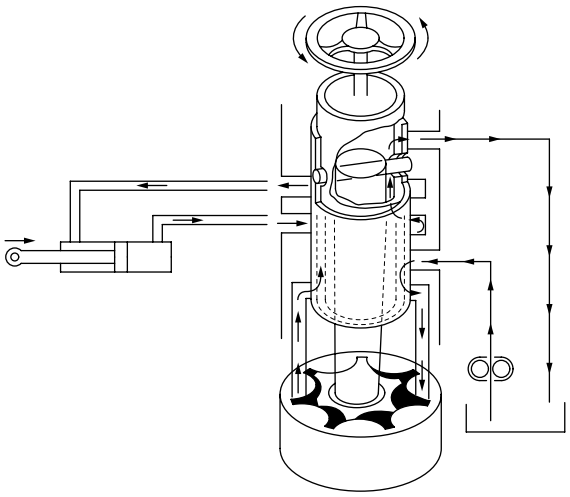


SV4002047

Operation of feed back mechanism

- Operation of the steering wheel creates an angular divergence in circumferential directions between spool (1) and sleeve (2) due to centering springs (6). This makes the oil grooves align with oil holes, allowing pump flow into the steering valve (Orbitrol). Rotor (4) spins and feeds oil into the steering cylinder.
- As a result, sleeve (2) rotates trailing spool (1) with an angular divergence maintained between the two components. This enables spool (1) to spin continuously with the rotation of the steering wheel. The machine makes a turn continuously.
- Stopping the steering wheel operation brings spool (1) rotation to an instant halt. However, the spool-sleeve ass'y does not get back to the neutral condition instantly. Oil continues to flow into Orbitrol, allowing rotor (4) to continue to rotate. This rotating motion lets sleeve (2) catch up to spool (1), blocking the hydraulic circuit to stop oil flowing.

  Finally, centering springs (6) restore the spool-sleeve ass'y to the neutral position, stopping the oil flow completely.



SV4002048

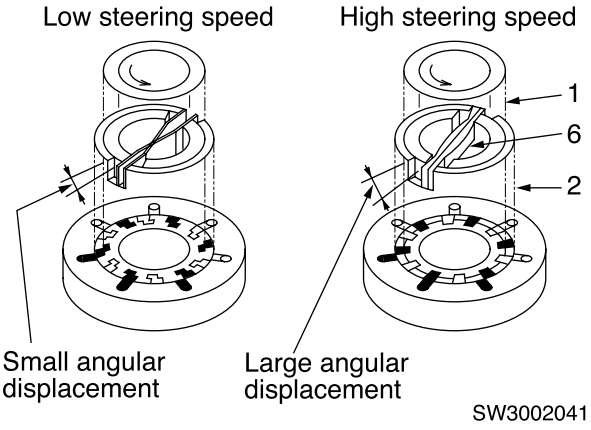
Steering wheel rotating speed and controlling the flow

***** In the steering mechanism, it is essential to increase or decrease oil flow into the steering cylinder according to the rotating speed of the steering wheel.

- The steering valve (Orbitrol) controls the oil flow by varying the angular displacement between spool (1) and sleeve (2) as stated below:
  With the steering wheel rotated, sleeve (2) runs after spool (1) attempting to block the hydraulic circuit.
- The angular displacement between spool (1) and sleeve (2) increases with increasing rotating speed of the steering wheel. The oil flow increases.

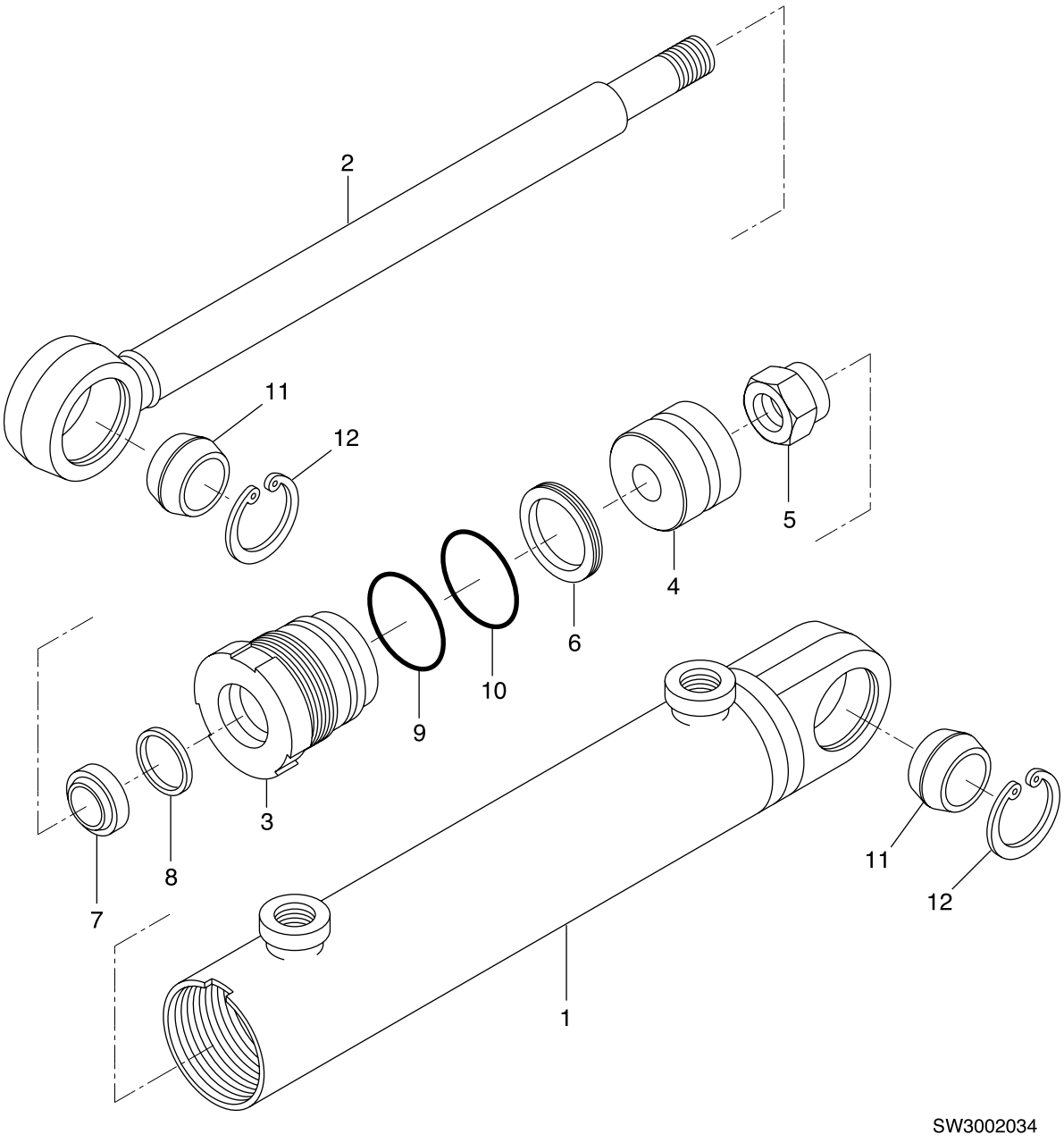
Pump flow and force required to rotate steering wheel

- When the pump allows sufficient oil flow, the force to rotate the steering wheel equals the sliding resistance offered by sleeve (2) and rotor (4), etc. The steering wheel is light to rotate.
- If pump flow is insufficient, the angular displacement between spool (1) and sleeve (2) stays maximum. The amount of oil fed to rotor (4) from the pump is small. Rotor (4) spins slowly.
- For this reason, spool (1) rotates faster than rotor (4), making the angular displacement maximum. Spool (1) drives rotor (4) through cross pin (7) and drive shaft (5). Then, rotor (4) acts as a hydraulic pump. A heavy steering wheel results.



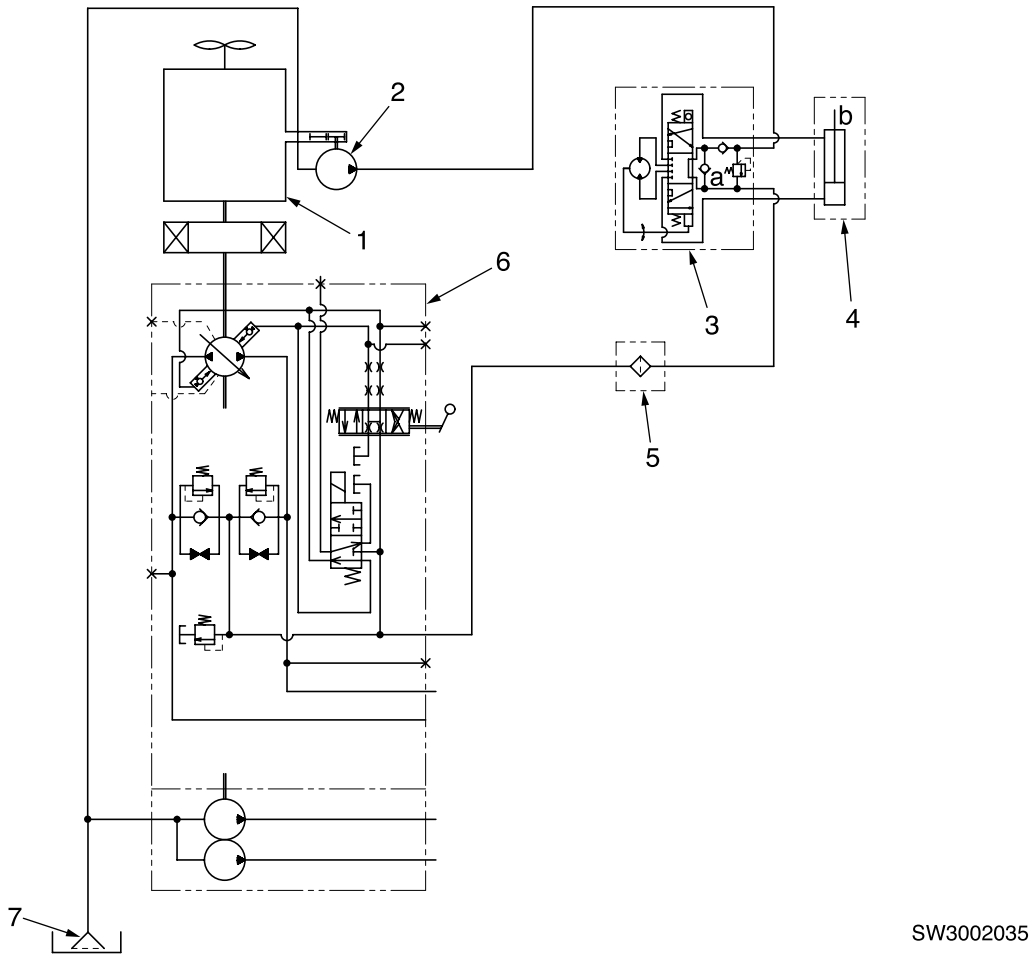
1. Spool
2. Sleeve
6. Centering spring

2-4-5. Steering cylinder ass'y



1. Cylinder
2. Piston rod
3. Bush
4. Piston
5. Nut
6. Piston seal
7. Dust seal
8. Packing
9. O-ring
10. O-ring
11. Spherical bearing
12. Lock ring

2-4-6. Steering circuit



1. Engine
2. Steering pump
3. Steering valve (Orbitrol)
   a. Pressure relief valve
4. Steering cylinder
   b. Piston rod
5. Line filter
6. Propulsion pump
7. Suction filter

Description:

• The steering system is made up of steering pump (2), steering valve (3) (Orbitrol), steering cylinder (4) and line filter (5).

Operation

• Oil from gear pump (2) enters steering valve (3). The valve feeds an amount of oil to steering cylinder (4). The amount of oil handled varies with the direction in which the steering wheel is rotated and with the speed at which the steering wheel is turned.

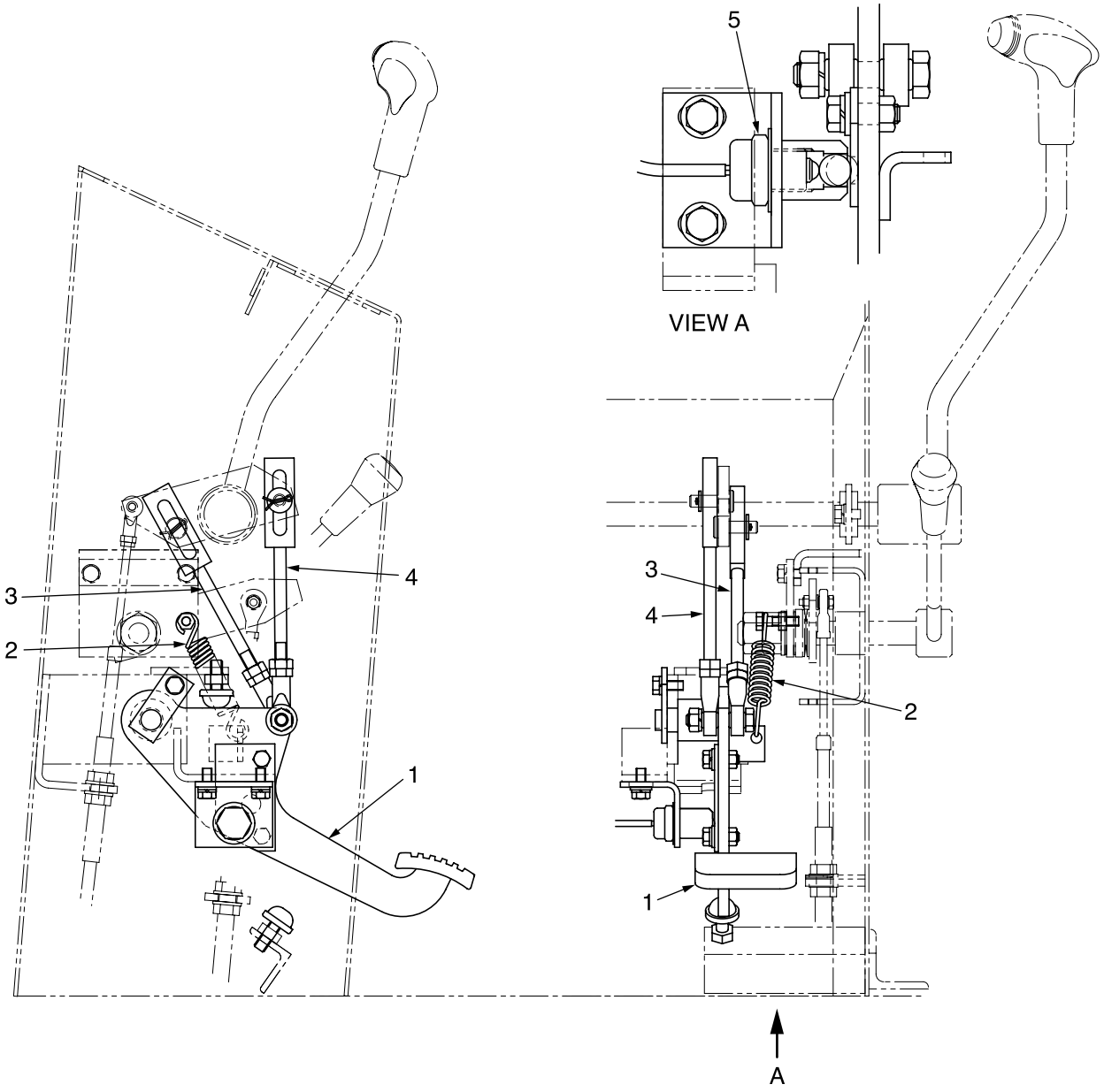
• The fluid fed into steering cylinder (4) moves the piston rod (b) to achieve steering. The oil displaced from the opposite side of the piston flows, through steering valve (3) and line filter (5), to the charge circuit for propulsion.

★ Refer to "Charge circuit" under "Description and operation of propulsion system".

• Relief valve (a) built in steering valve (3) opens to relieve the pressure if the system pressure exceeds the setting of the relief valve, thus protecting the circuit.

3. Brake System

3-1. Brake pedal



SW3002036

1. Brake pedal
2. Return spring
3. Rod (for neutral position of F-R lever)
4. Rod (for neutral position of F-R lever)
5. Foot brake switch

3-2. Description and operation of brake circuit

Description:

- Consists of brake pedal (1), foot brake switch (brake release switch) (5), F-R levers (6), return-to-neutral rods (3), (4), parking brake switch (7), brake release solenoid (8) and parking brakes (negative brakes) (9), (10).

Operation:

Parking brake switch set to position PARKING:

- The contacts in parking brake switch (7) open the brake release solenoid (8) circuit and close the indicator lamp (on Combination meter) circuit.
- The indicator lamp comes on. The parking brakes (9) and (10) are applied.

  ★ The parking brake solenoid is deenergized.

Parking brake switch set to position RELEASE:

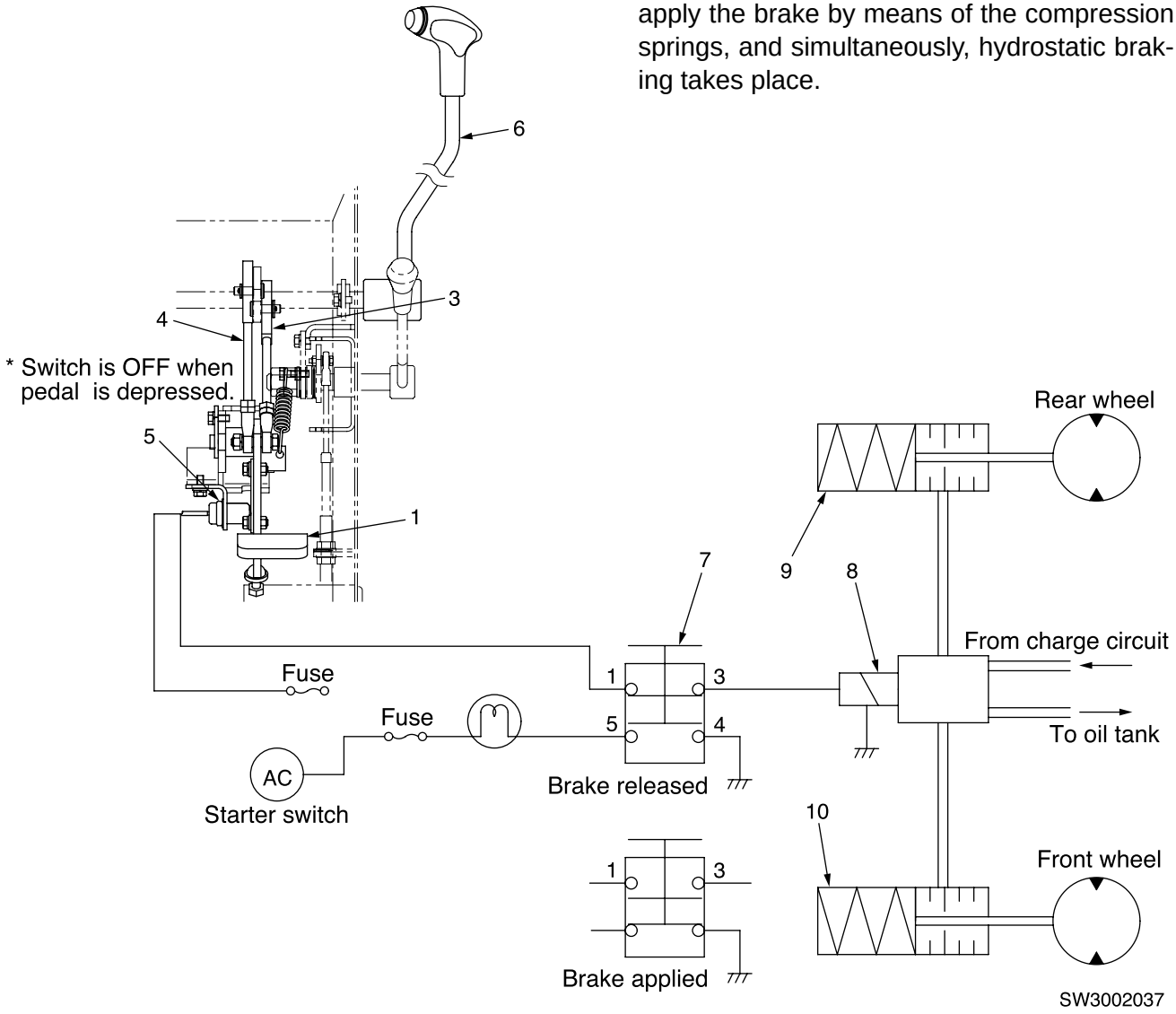
- The contacts in parking brake switch (7) close the circuit of brake release solenoid (8) and open the indicator lamp circuit.
- The indicator lamp comes off. The parking brakes (9) and (10) are disengaged.

  ★ The parking brake solenoid is energized.

Braking in an emergency:

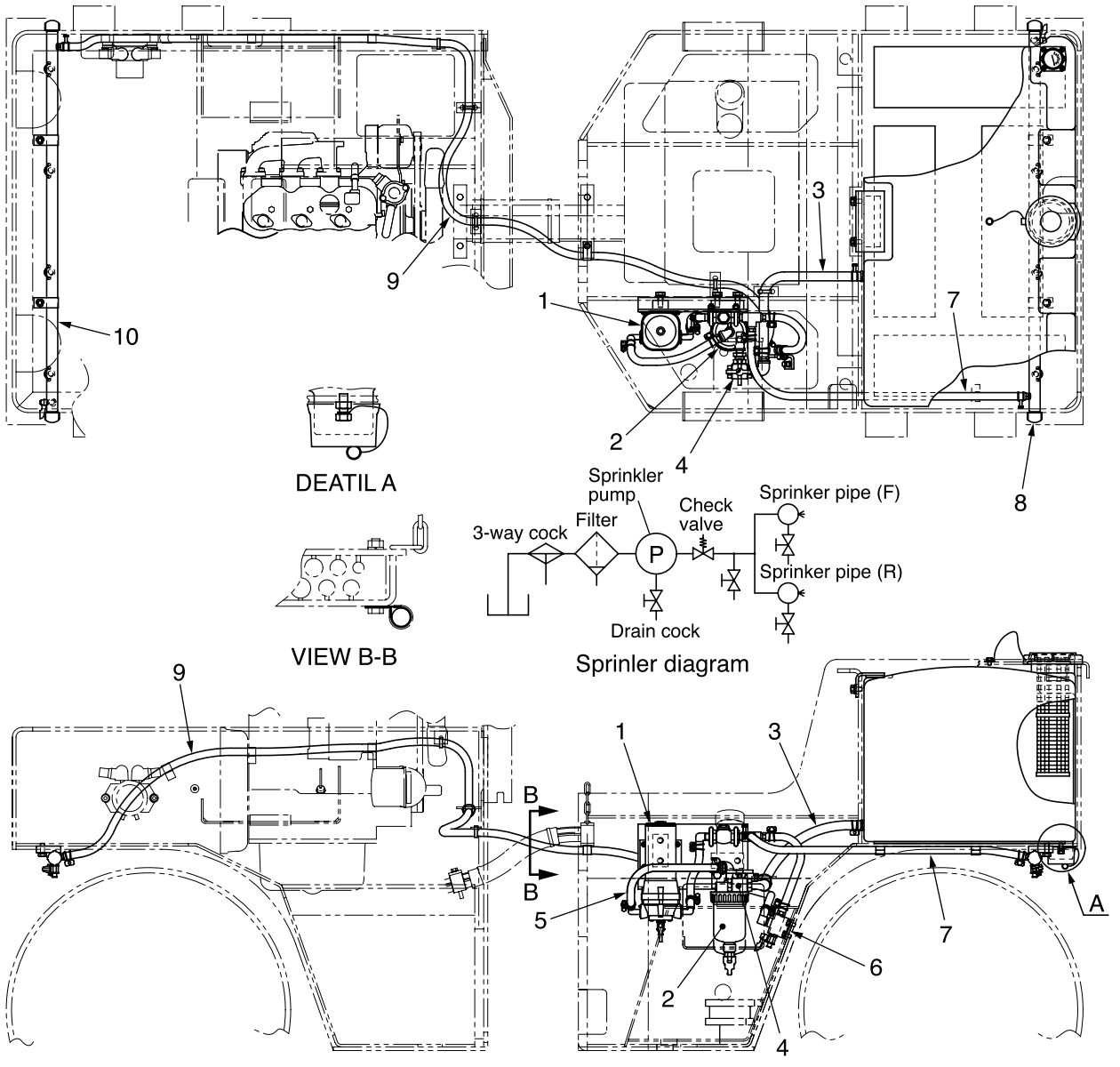
- Pushing down on the brake pedal (1) as far as it will go breaks the contact in foot brake switch (brake release switch) (5), opening the parking brake solenoid circuit. At the same time, the pedal movement moves either of rods (3), (4) to bring F-R levers (6) to the neutral position.

  The parking brake solenoid is deenergized to apply the brake by means of the compression springs, and simultaneously, hydrostatic braking takes place.



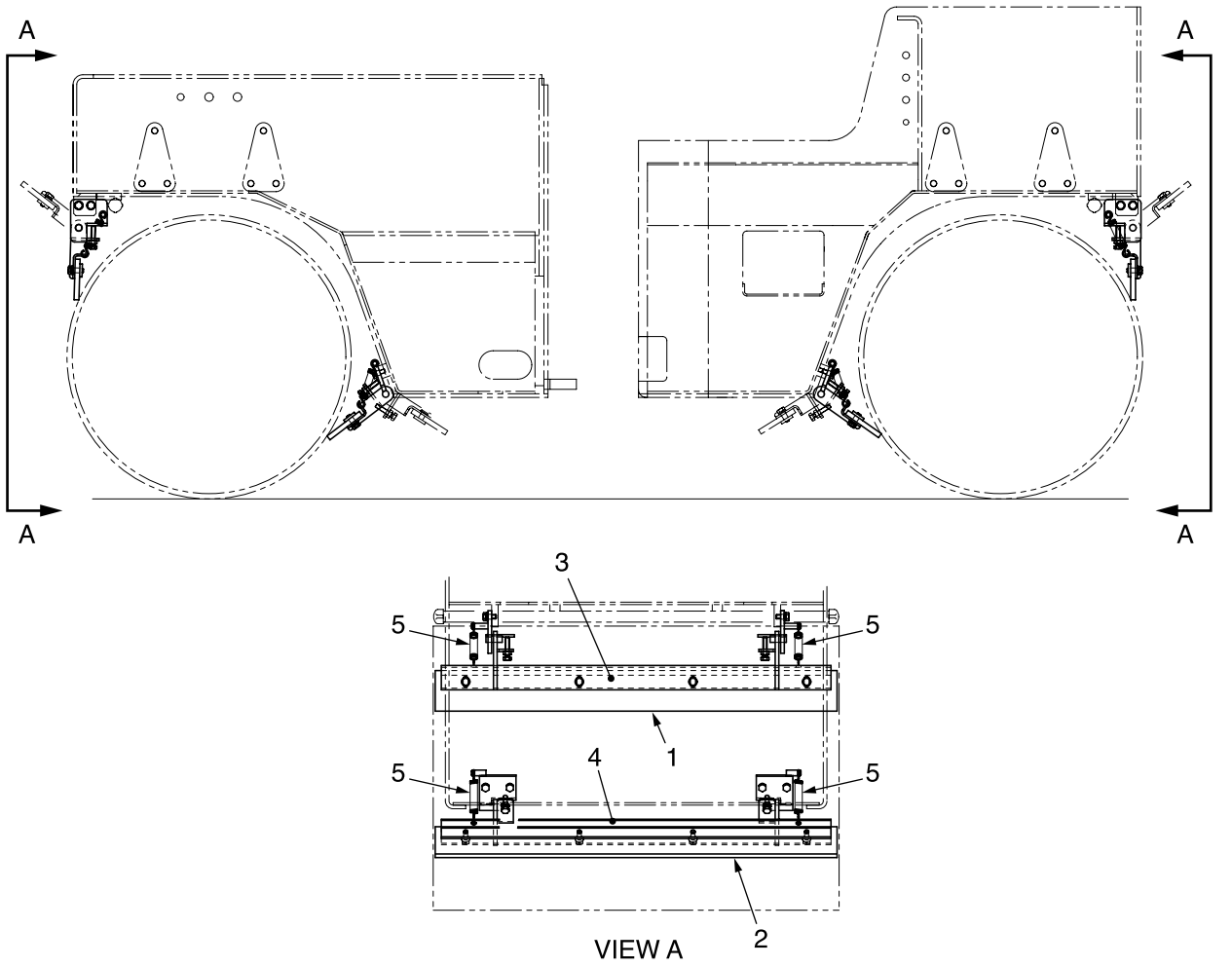
4. Sprinkler and Scraper

4-1. Sprinkler piping



1. Sprinkler pump
2. Filter
3. Sprinkler hose (tank to 3-way cock)
4. 3-way cock
5. Hose (filter to pump)
6. Drain cock
7. Hose (pump to rear sprinkler pipe)
8. Rear sprinkler pipe
9. Hose (pump to front sprinkler pipe)
10. Front sprinkler pipe

4-2. Scraper

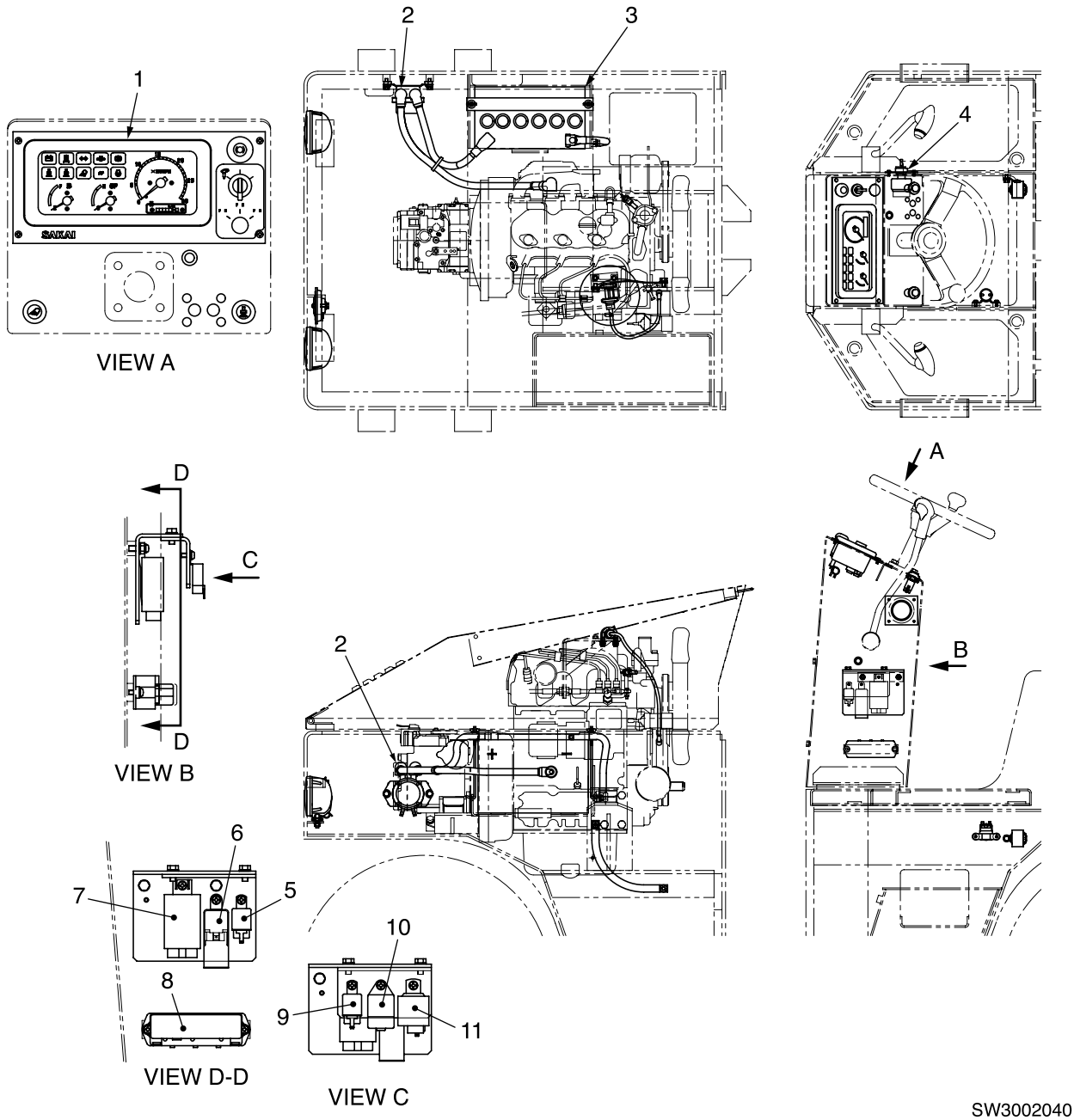


SW3002039

1. Blade (upper)
2. Blade (lower)
3. Bracket (upper)
4. Bracket (lower)
5. Spring

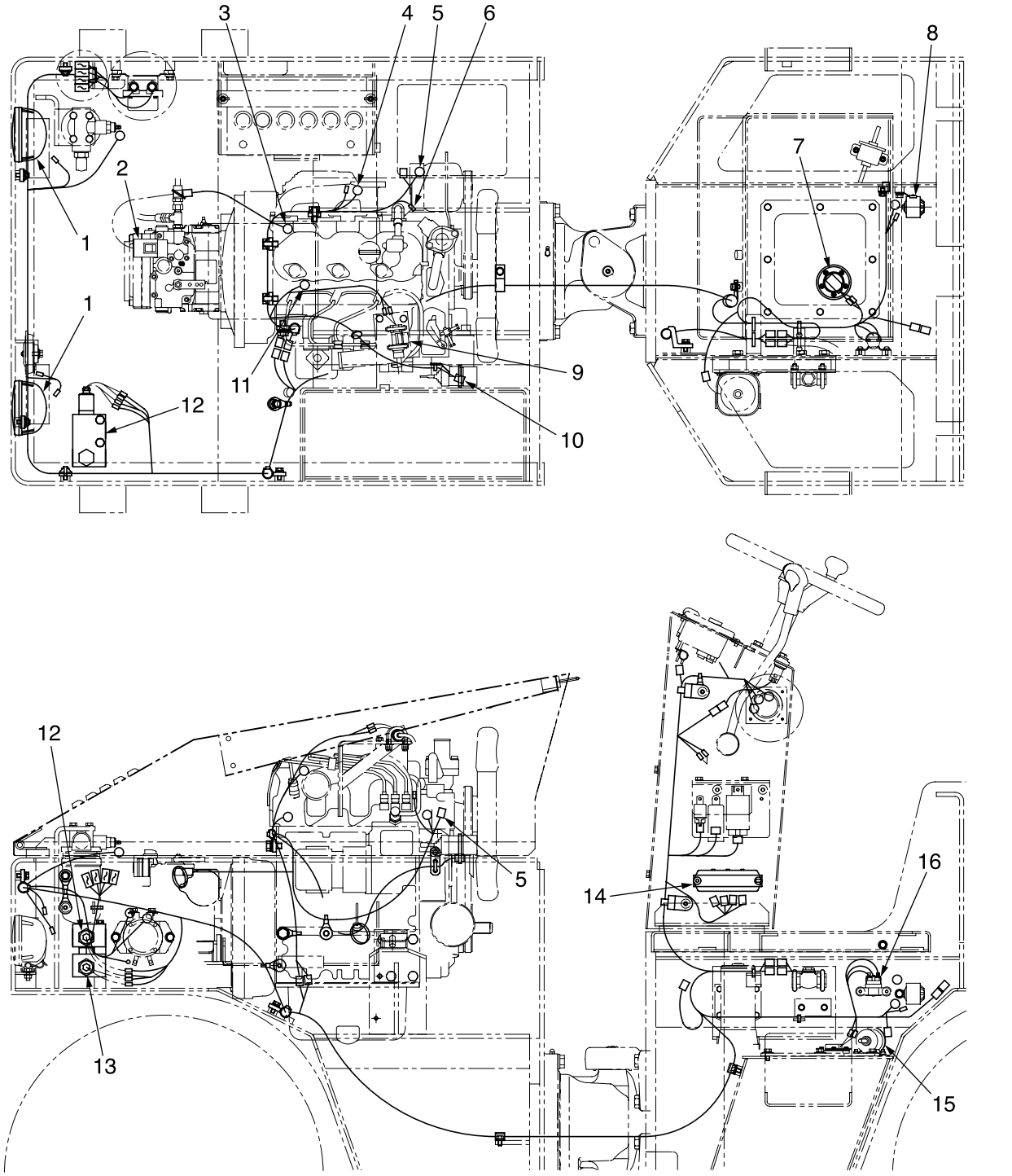
5. Electric System

5-1. Location of instrument panel and relays



1. Combination meter
2. Battery relay
3. Battery
4. Starter switch
5. Horn relay
6. Interlock relay
7. Vibrator relay
8. Fuse box
9. Vibrator indicator lamp relay
10. Glow lamp timer
11. Engine stop timer

5-2. Location of electric components



SW3002032

1. Headlamp
2. Brake release solenoid valve
3. Engine oil pressure switch
4. Starter
5. Alternator
6. Thermo sensor
7. Fuel gauge unit
8. Reverse alarm
9. Engine revolution sensor
10. Engine stop solenoid
11. Glow plug
12. Vibrator solenoid valve (rear)
13. Vibrator solenoid valve (front)
14. Fuse box
15. Fuel pump
16. Sprinkler pump relay

5-3. Electric wiring diagram

INSPECTION & ADJUSTMENT

INSPECTION & ADJUSTMENT

★Precautions for Use of Standard Value Chart

1) Values in the chart are based upon ones when the machine leaves the factory. They should be used for estimation of wear after extended operation and for guidance when the machine is repaired.
2) Values in the chart are ones based on various test results etc. They should be used as a guide to fault finding practice in due consideration of the past repair frequency and operating record of the machine.
3) Values in the chart should not be used for the standard for claim application.

★Precautions for Checking, Adjustment and Fault Finding

⚠ **For checking, adjustment and fault finding practices, park the machine on level ground and block with the safety pins or chocks.**

⚠ **When working with other workers, use hand signals positively and keep people not concerned away from the work area.**

⚠ **Cool off the coolant or hydraulic fluid when removing the radiator cap or the hydraulic tank filler cap. Hot fluids can burn you.**

⚠ **Do not put your hands close to parts in motion such as fan belts.**

1. Standard Value Chart

1-1. Standard value chart for roller body

Item			Measuring conditions	Unit	Standard value for new machine	Permissible range
Engine	Speed	Low idle	• Coolant temp. : Green zone on gauge • Hydraulic oil temperature : 50 ± 5°C (122 ± 41°C)	min^{-1} (rpm)	1000±50	———
		High idle			2800±50	———
		Rated speed			2800	———
Travel speed	Forward		• Engine at full throttle • Coolant temp. : Green zone on gauge • Hydraulic oil temperature : 50 ± 5°C (122 ± 41°C)	km/h (mile/h)	0~12 (0~7.5)	←
	Reverse				0~12 (0~7.5)	←
Oil pressure	Propulsion	Main circuit pressure	• Engine at full throttle • Hydraulic oil temperature : 50 ± 5°C (122 ± 41°C)	MPa (psi) {kgf/cm^2}	34.5±1.0 (5000±140) {352±10}	31.7 (4600) {324}
		Charge circuit pressure			1.9±0.19 (270±27) {19±1.9}	1.7 (240) {17}
	Vibrator Circuit pressure				12.7±0.5 (1840±70) {130±5}	11 (1580) {113}
	Steering circuit pressure				13.8±0.5 (2000±70) {141±5}	11.9 (1720) {121}
	Brake release circuit pressure				1.9±0.19 (270±27) {19±1.9}	1.7 (240 {17}

2. Inspection & Adjustment

2-1. Measurement and adjustment of pressure in propulsion main circuit

1. Measurement

★ Hydraulic oil temperature: 50±5°C (122±41°F)

⚠ Park on level ground. Stop the engine. Block the wheels.

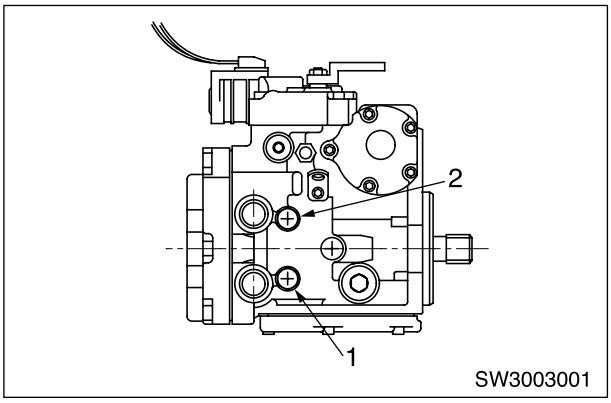
★ Make certain that the parking brake functions correctly.

1) Remove plugs from gauge points (1) and (2) in the propulsion pump and attach adapter ①. Fit a 0 - 60 MPa (0 - 8700 psi) {0 - 600 kgf/cm^2} pressure gauge to adapter ①.
   - Gauge port: 9/16-18UNF
   - Port (1): for forward travel
   - Port (2): for reversing

2) Start the engine. With the throttle lever operated slowly, bring the engine to full speed.

3) Ensuring that the parking brake is ON, operate the F-R lever slowly till the engine reaches the rated speed. Take the gauge reading.

4) When the measurement is complete, bring the F-R lever to the neutral position immediately.



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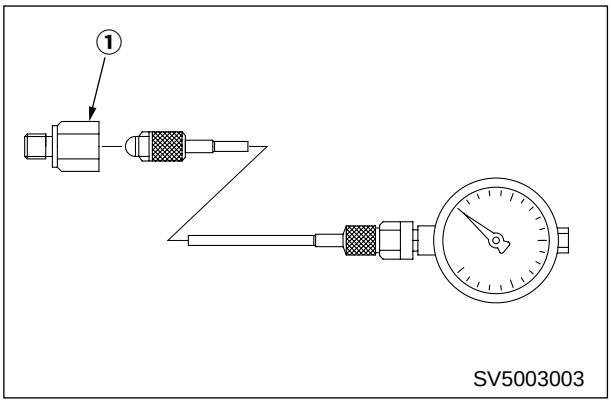


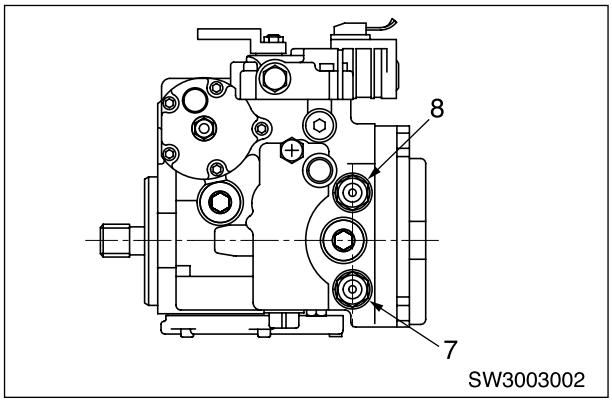
SV5003003

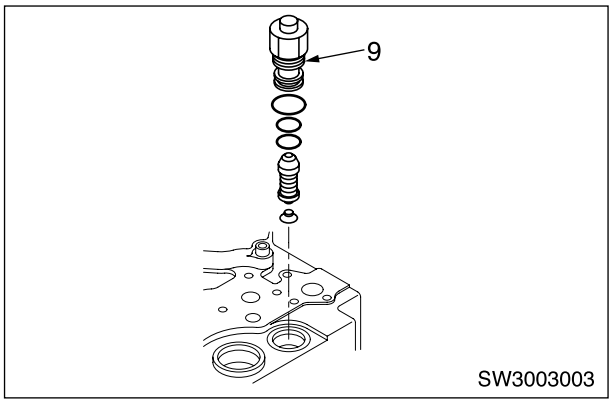
2. Adjustment

If the measured value falls outside the permissible range, clean or renew pressure relief valves (7) (forward travel) and (8) (reversing).

- Tightening torque for valve seat plug (9):
  40 - 95 N•m (30 - 70 lbf•in) {300 kgf•cm}

★ **Carefully perform disassembly and reassembly taking necessary measures to prevent ingress of foreign matter.**





2-2. Measurement of propulsion charge circuit pressure

1. Measurement

★ Hydraulic oil temperature: 50±5°C (122±41°F)

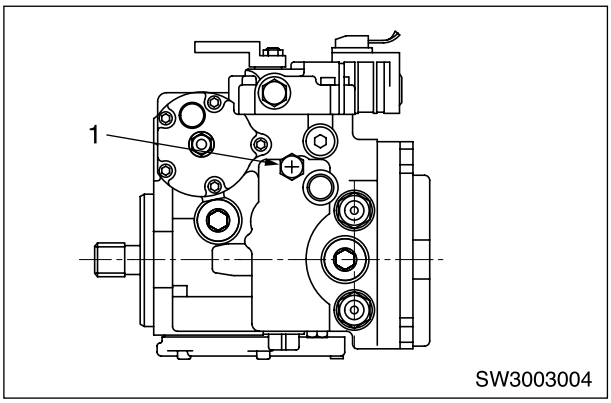
⚠ Park the machine on level ground. Stop the engine and block the wheels.

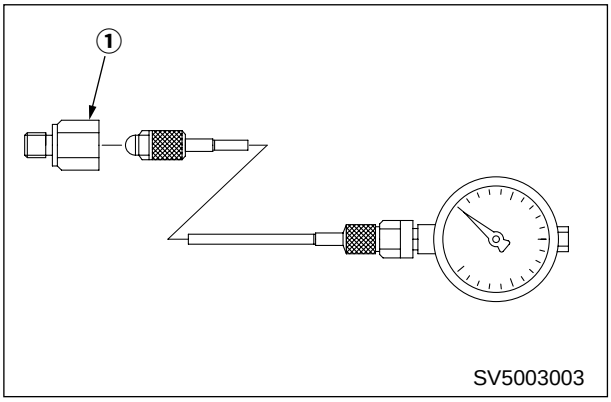
★ Make sure, before the test, that the parking brake works correctly.

1) Remove the plug from propulsion pump gauge port (1) (9/16-18UNF) and mount adapter ①. Attach a 0 - 6.0 MPa (0 - 870 psi) {0 - 60 kgf/cm²} pressure gauge to adapter ①.

2) Start the engine. Slowly operate the throttle lever to run the engine at maximum speed.

3) Ensuring that F-R lever is in the neutral position, take the reading of the pressure gauge.





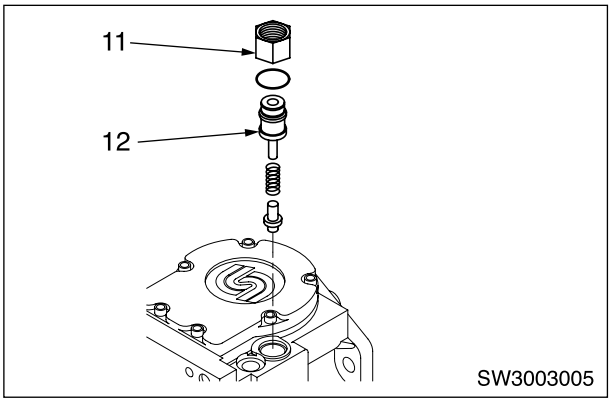
2. Adjustment

If the measured value is not within the permissible range, adjust as follows:

1) Loosen locknut (11) on the charge relief valve. Adjust by rotating screw (12).
   - Clockwise rotation raises the pressure. When turned counterclockwise, the pressure decreases.
   - A quarter turns (90 degrees) of the screw increases or decreases the pressure by 0.27 MPa (39 psi) {2.8 kgf/cm²}.
   - Tightening torque for locknut: 47 - 57 N•m (34 - 42 lbf•in) {48 - 58 kgf•cm}

2) When adjustment is complete, check for correct setting.

3) If the valve is beyond adjustment, disassemble and clean or renew the pressure relief valve assembly.
   ★ Carefully perform disassembly and reassembly taking necessary means to prevent ingress of foreign matter.



2-3. Measurement of brake release pressure

1. Measurement

★ Hydraulic oil temperature: 50±5°C (122±41°F)

⚠ Park the machine on level ground. Stop the engine and block the wheels.

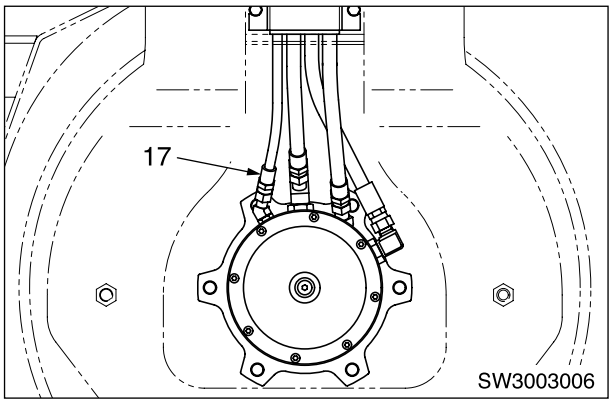
★ Because oil is supplied from steering circuit, make sure, before the test, that the steering system works correctly.

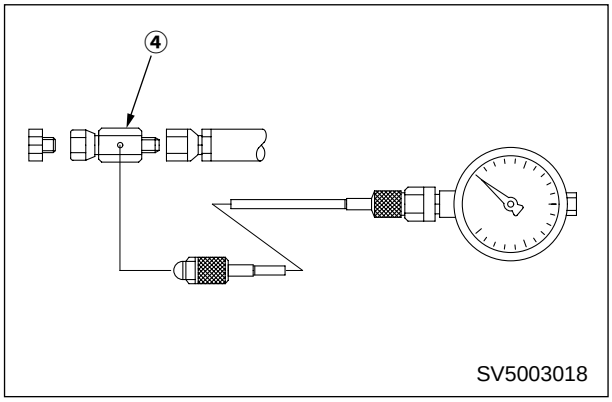
1) Disconnect brake release hose (17) from the propulsion motor and install adapter ④.
   ★ Plug the open ports of the motor.

2) Install a 0 - 6.0 MPa (0 - 870 psi) {0 - 60 kgf/cm²} pressure gauge to adapter ④.

3) Start the engine. Ensuring that the F-R lever is in the neutral position, slowly move the throttle lever to full throttle.

4) Set the parking brake switch to the RELEASE position and take the gauge reading.





2-4. Measurement of vibrator circuit pressure

1. Measurement

★ Hydraulic oil temperature: 50±5°C (122±41°F)

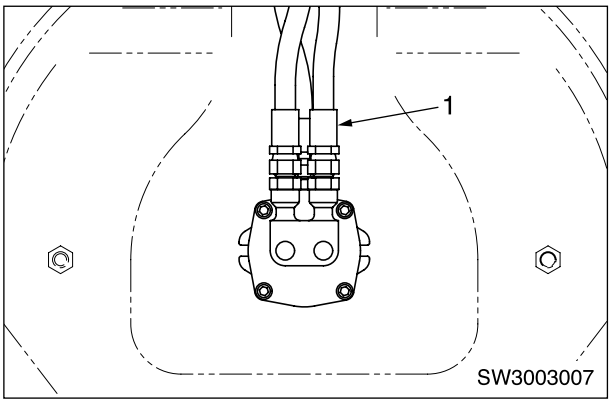
⚠ Park the machine on level ground. Stop the engine and block the wheels.

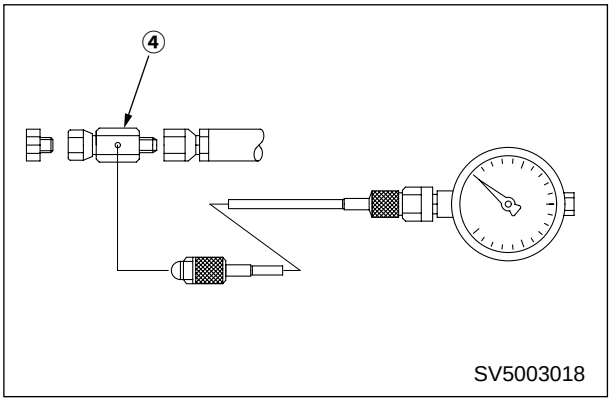
1) Disconnect high pressure inlet hose (1) from the vibrator motor and mount adapter ④.
   ★Plug the open ports of the motor.

2) Install a 0 - 25 MPa (0 - 3600 psi) {0 - 250 kgf/cm²} pressure gauge to adapter ④.

3) Start the engine. Slowly operate the throttle lever to run the engine at maximum speed.

4) Shift the vibration mode selector switch from OFF to CONT. Switch ON the vibrator switch on top of the F-R lever and take the gauge reading.





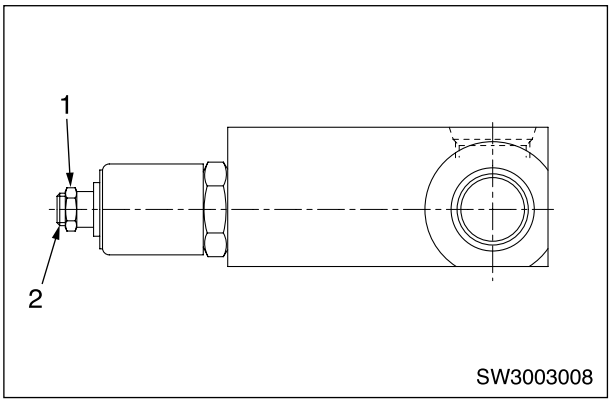
2. Adjustment

If the measured value is not within the permissible range, adjust as follows:

1) Loosen lock nut (1) on the relief valve and turn adjusting screw (2). Clockwise rotation raises the pressure. The pressure lowers if turned counter-clockwise.

2) When adjustment is complete, check for correct setting.

3) If the valve is beyond adjustment, disassemble and clean or renew the pressure relief valve assembly.
   ★ Carefully perform disassembly and reassembly taking necessary means to prevent ingress of foreign matter.



2-5. Measurement of steering circuit pressure

1. Measurement

★ Hydraulic oil temperature: 50±5°C (122±41°F)

⚠ Park on level ground. Stop the engine.

★ Because the return line of the steering circuit feeds the charge line in the propulsion circuit, check to see if the charge pressure in the propulsion circuit is as specified.

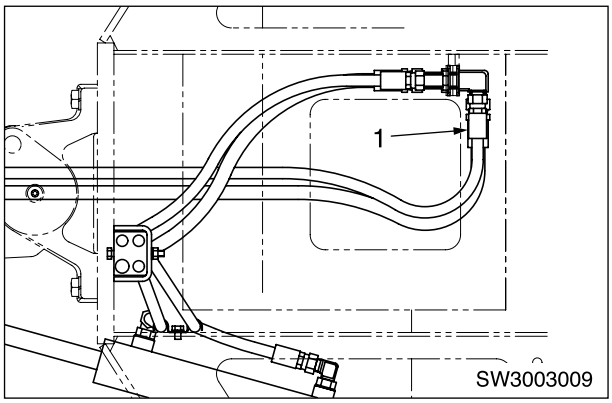
1) Disconnect outlet hose (1) from steering pump. Reconnect after installing adapter ⑤.

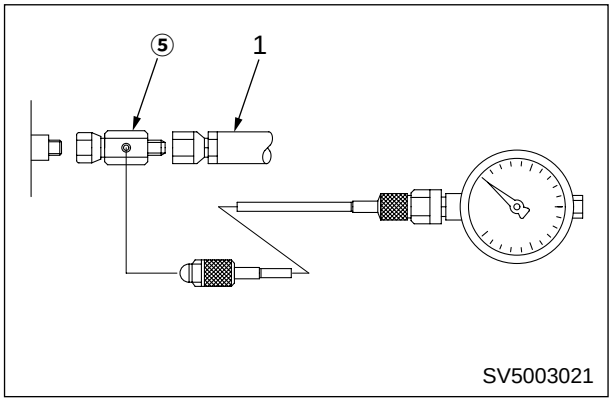
2) Install a 0 - 25 MPa (0 - 3600 psi) {0 - 250 kgf/cm²} pressure gauge to adapter ⑤.

3) Start the engine. Ensuring that the F-R lever is in the neutral position, slowly move the throttle lever to full throttle.

4) Turn the steering wheel counter-clockwise to full lock. Take the gauge reading.

⚠ When rotating the steering wheel, do not allow anyone to enter the pinch area of the articulated frame.





2. Adjustment

If the measured value is not within the permissible range, disassemble and clean or renew the relief valve assembly built in Orbitrol. The valve is not adjustable.

★ Carefully perform disassembly and reassembly taking necessary means to avoid ingress of foreign matter.

2-6. Throttle linkage adjustment

★ **When the throttle linkage has been renewed (or reconnected) or if the high idle or low idle rpm is not to specification, adjust as follows:**

1. Adjustment

★ **Coolant temperature: Green area on gauge.**

1) Set throttle lever (1) to the LOW IDLE position.

2) Connect throttle cable (2) to fuel injection pump governor lever (3).

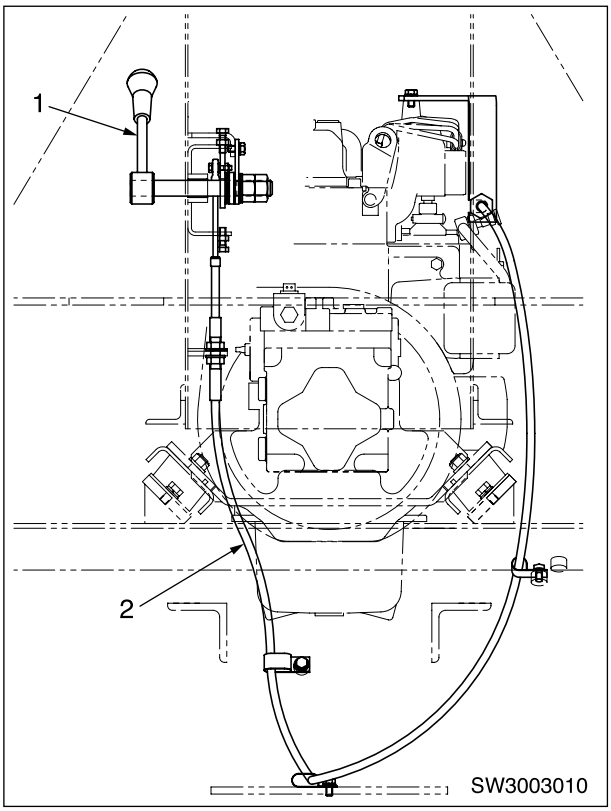
3) Start the engine. Slacken lock nut (4) and adjust stop bolt (5) until correct low idle revolution is reached.
★ **Low idle: 1000±50min^{-1} (rpm)**

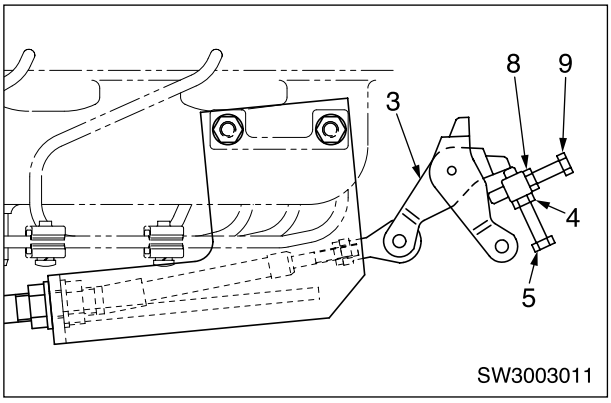
4) Screw in stop bolt (6) so that it makes contact with throttle lever (1). Then screw out by 1/4 to 1/2 turns and fix with lock nut (7).

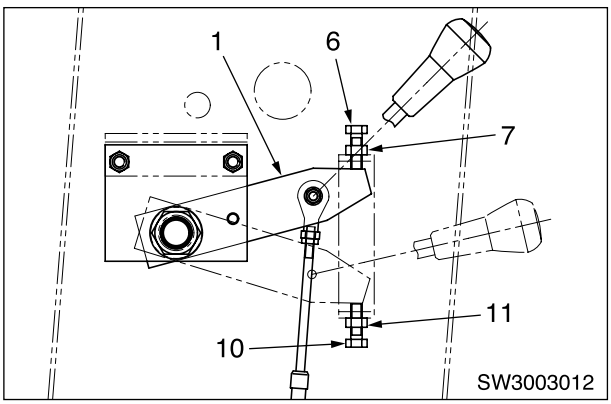
5) Move throttle lever (1) to full throttle side. Loosen lock nut (8) and adjust stop bolt (9) to set the high idle speed to specification.

6) Start the engine and check that the high idle rpm is to specification.
★**High idle: 2850±50min^{-1} (rpm)**

7) Screw in stop bolt (10) until it makes contact with throttle lever (1). Then screw out by 1/4 to 1/2 turns and fix with lock nut (11).







2-7. Adjustment of F-R lever linkage

★ When the F-R lever linkage has been renewed (or reconnected) or if the F-R levers fail to move smoothly, adjust as described below:

1. Adjustment

★ Hydraulic oil temperature: 50±5°C (122±41°F)

★ Inspect the stroke of pump control lever as described below. Positions of F-R levers are positively determined by notch balls.

★Check that the F-R lever operates smoothly.

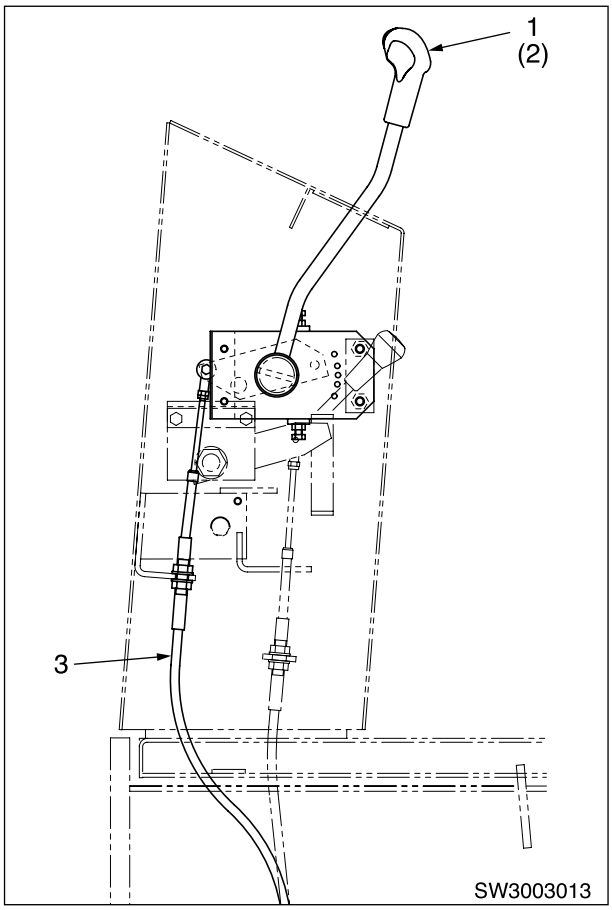
1) With F-R levers (1), (2) in the neutral position, connect control cable (3) to F-R lever (1) or (2).

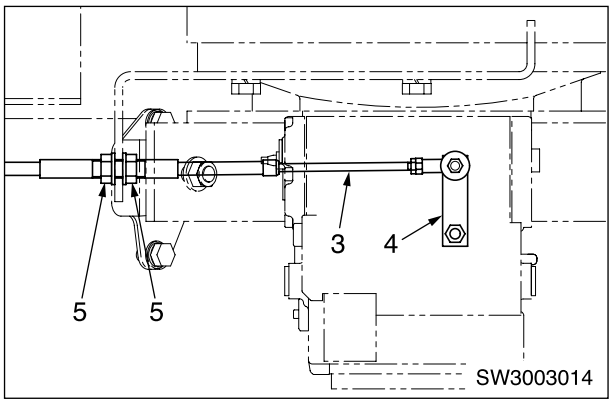
2) Connect cable (3) to propulsion pump control lever (4).

3) Move F-R lever (1) or (2) to each detent position and ensure pump control lever (4) follows in F-R lever positively.

4) To adjust the neutral position, rotate fixing nuts (5) of cable (3), while moving the F-R lever (neutral → forward → neutral → backward → neutral), so that the F-R lever travel from the neutral position to the position in which the machine starts traveling is equal for both forward and backward traveling.

★Perform this adjustment on level and flat concrete pavement while varying the engine revolution in several steps ranging from low to high idles.





TROUBLESHOOTING

TROUBLESHOOTING

1. Precautions for Troubleshooting

⚠ **Park the machine on level ground. Make sure that the safety pins are engaged, wheels chocked and parking brake applied.**

⚠ **When working with other workers, use hand signals authorized, and keep people not concerned away from the work area.**

⚠ **If the radiator cap is carelessly removed from a hot engine, hot coolant will gush out to cause a burn. Remove the cap only when the engine has been cooled off.**

⚠ **Exercise care not to touch hot parts or not to be caught in rotating parts.**

⚠ **When disconnecting electric wires, disconnect the battery negative (-) cable.**

⚠ **When taking off plugs or caps from units which are under pressure such as hydraulic, water and air pressures, do the works after removing residual pressure. If gauges are to be connected, attach them surely.**

- Troubleshooting is to determine the root cause of troubles, repair faulty parts as quickly as practicable, and prevent recurrence of the troubles.
- Important when conducting troubleshooting practice is of course to well understand the structure and function of machines to be handled. For effective troubleshooting, however, it is of prime importance to have a clear picture of the trouble concerned by contacting the operator.

1. When a trouble has occurred, do not attempt to disassemble blindly.

Disassembling in a hurry will invite disadvantageous situations as described below:

- Parts which need not be disassembled may be disassembled.
- Tracing the cause of trouble will become more difficult.

These will cause increased service costs because of wasteful service hours, spare parts or expendables like oil or grease. To make matters worse, such a careless practice will invite operators' (customers') distrust. For these reasons, sufficient advance investigations and diagnosis in accordance with troubleshooting procedures specified are essential for efficient fault finding practices.

2. Questions to be addressed to the operator (customer) .

1) Are there any trouble other than the one in question?
2) Was there any abnormal condition with the machine before the trouble occurs?
3) Did the trouble occur suddenly without signs of abnormal conditions in advance?
4) In what occasion did the trouble occur?
5) Has the machine been repaired before the trouble occurs? If so, when has it been repaired?
6) Did similar trouble occur in the past?

3. Before-diagnosis inspection

1) Perform daily inspections.
2) Perform other inspections required for diagnosis.

4. Confirmation of trouble

Know the degree of the trouble. Determine whether it is a trouble caused by improper design etc. or the trouble was caused by incorrect handling.

★ **When making the trouble recur to trace the cause of the trouble by putting the machine in motion, use care not to cause more damages to the machine.**

5. Troubleshooting

From the results of items 2 to 4 above, narrow down the cause of the trouble, and pinpoint the source of the trouble by utilizing the diagnosis flow chart.

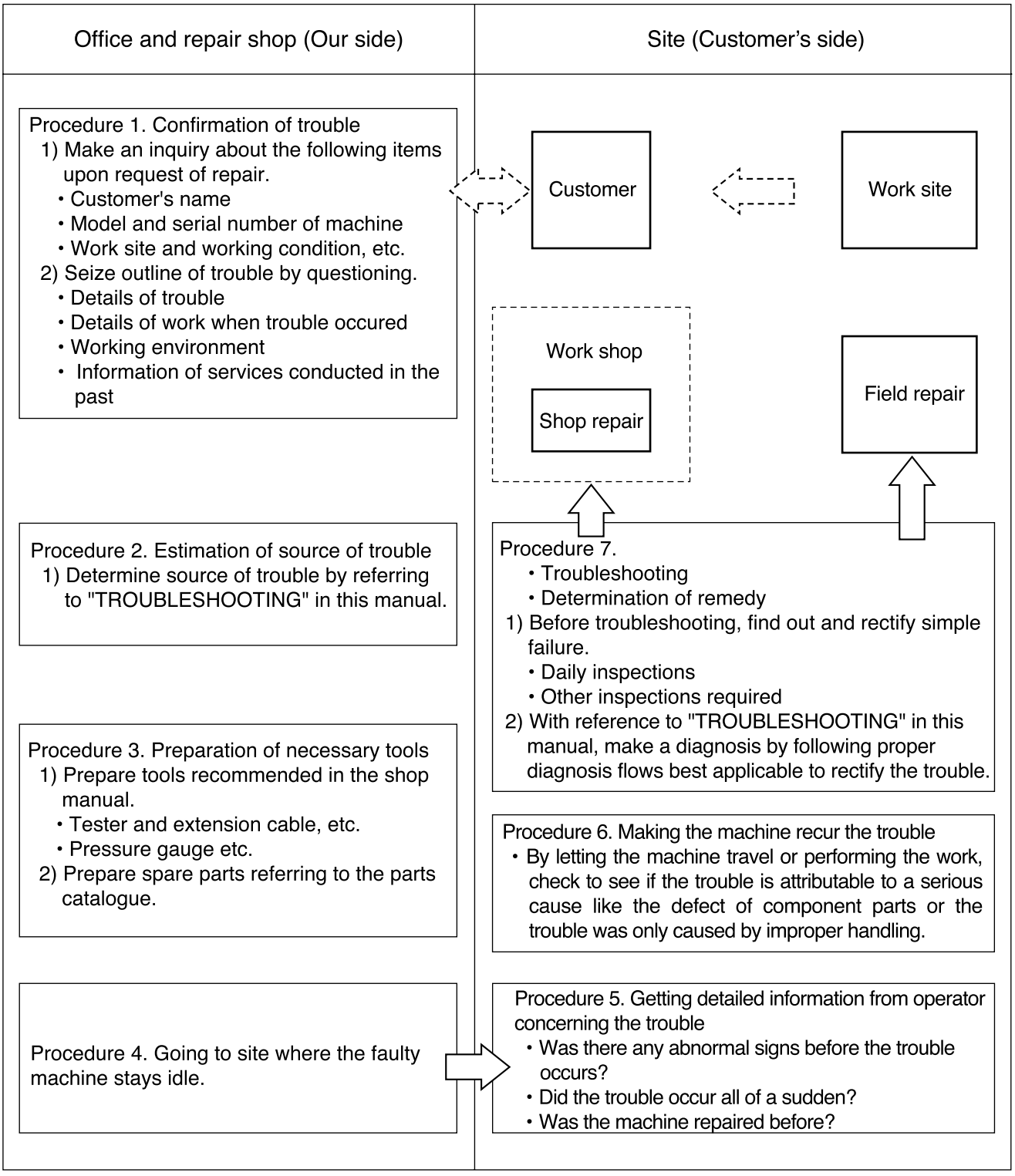
★ **The basic points of the diagnosis are:**

1) Start from the portion simple.
2) Start from the portion having a high probability to solve the problem.
3) Investigate related matters.

6. Basic remedy for the trouble

Even if a trouble has been rectified, it will develop again if its cause is not determined. It is of prime importance to trace the very cause of the trouble.

2. How to Diagnose the Machine



3. How to Use the Troubleshooting Flow

1. Troubleshooting codes

1) Electric system: E-01 to E-14
2) Hydraulic and mechanical systems: H-01 to H-11

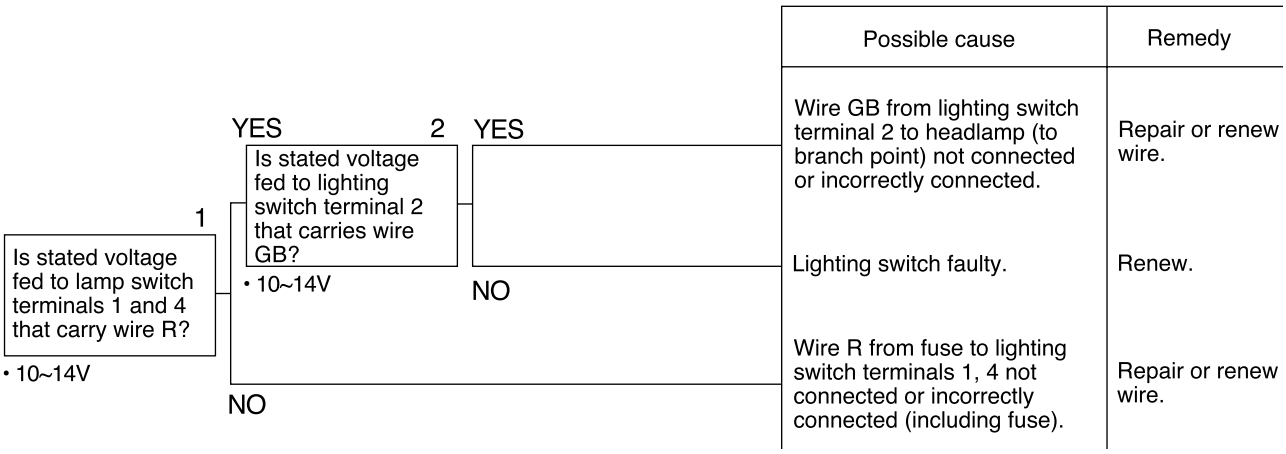
2. How to follow the troubleshooting flow

① E-08 Headlamps do not light (Example)

② **★Measure the voltage with the starter switch ON.**

③ a) Both headlamps do not come on.

④



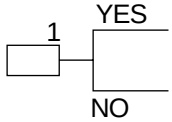
①Troubleshooting code No. and fault symptom
On top of the flow chart are code No. and fault symptom.

②General precautions
Under the code No. and fault symptom are precautions (marked ★) for the whole items in the flow chart. Though these precautions are not indicated inside each box (☐) which contains checking instructions, pay attention to the precautions when making inspections described in the box (☐).

③Sub classification
To make diagnosis easier or for simplified flow chart, fault symptom is subclassified. Ex. a) Starter does not run

④How to forward the diagnosis
- Each box (☐) contains diagnosis procedure. Depending upon the results of inspection or measurement, proceed to YES or NO line.
- Normally, if the result is YES then proceed to upper line. If NO then go to the lower line.

NOTE: The number above each box (☐) is a reference number. It does not mean a diagnosis order.



- As a result of diagnosis, if YES line or NO line directly goes to the description in POSSIBLE CAUSE column, take necessary action as indicated in REMEDY column.
- Under each box (□) are normal values and conditions necessary for inspection and adjustment. If the result gives an affirmative answer to the question in the box (□) or agrees to the normal value indicated under the box, go to YES line. Otherwise, go to NO line.
- The normal values were taken from the standard value list.
- For locations of component parts such as relay mentioned in the flow chart, see "Location of key units". Line colors mentioned in the flow charts are indicated in the electric wiring diagram shown under the flow charts. In the machine, each harness is identified by color.

4. Precautions for Diagnosis of Electric Circuit

1. When disconnecting or connecting connectors or harnesses, cut the power supply.

2. Before making a diagnosis, check the connectors or harnesses for poor connection.
   ★ **If a connector is at fault, check it by repeating connection and disconnection several times.**

3. Before proceeding to the next step, reconnect removed connectors or harnesses in place.
   ★ **Care must be used for the controller circuit. If the power source is switched on with the connector disconnected, this can cause an incorrect measurement.**

4. When making a diagnosis of circuits (measurement of voltage, resistance, current, test for continuity, etc.), check to see if tester readings vary by shaking connectors or harnesses.
   ★ **If readings vary, a possible cause is a poor connection of the circuit.**

5. For voltage measurement, turn the starter switch ON. For resistance checking, let the switch stay in the Off position.
   ★ **If necessary to take a measurement of resistance by energizing relays or other units with the starter switch ON, necessary instructions are given in the flow charts.**

5. Troubleshooting for Electric System (Mode E)

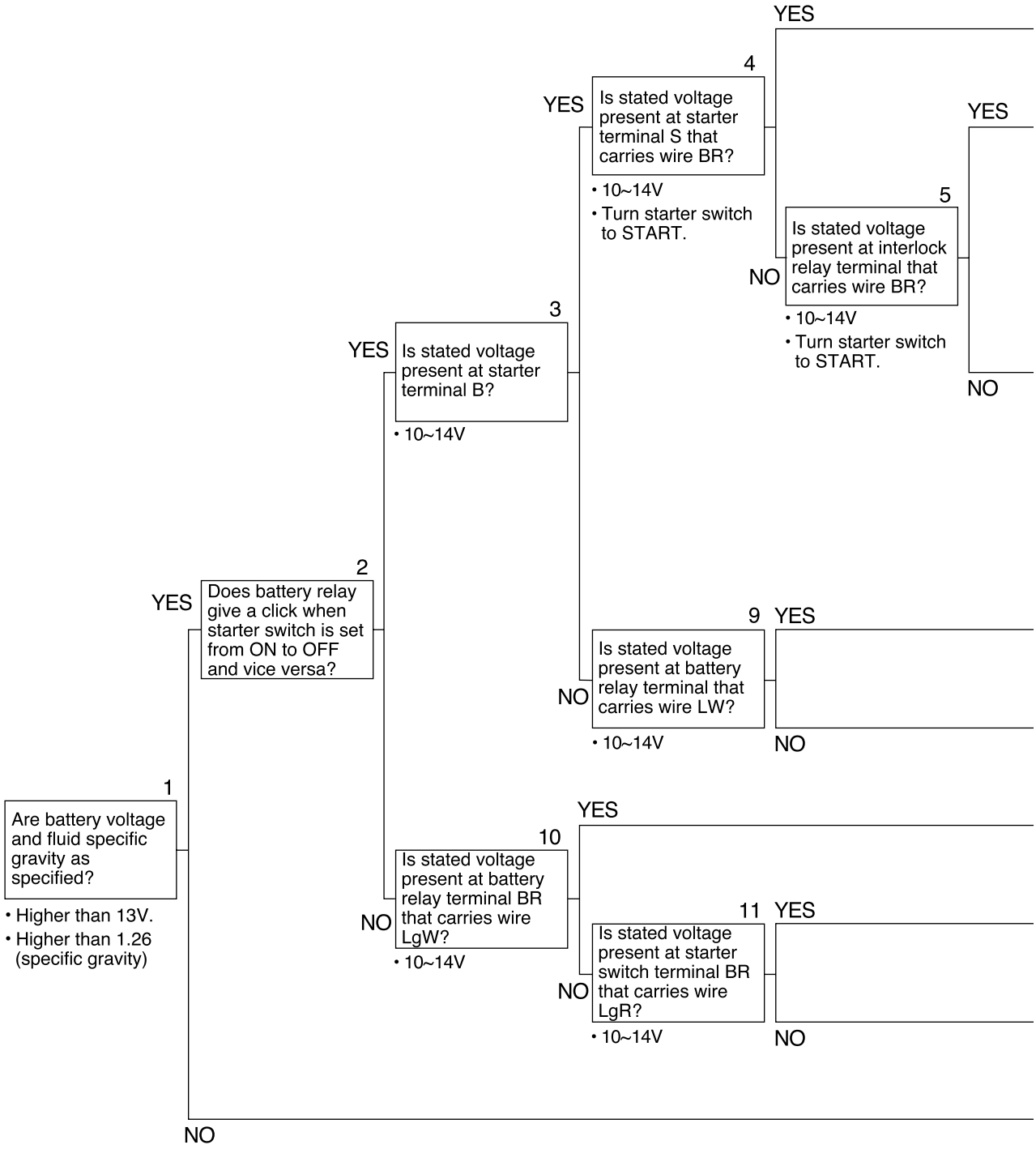
Wire color code

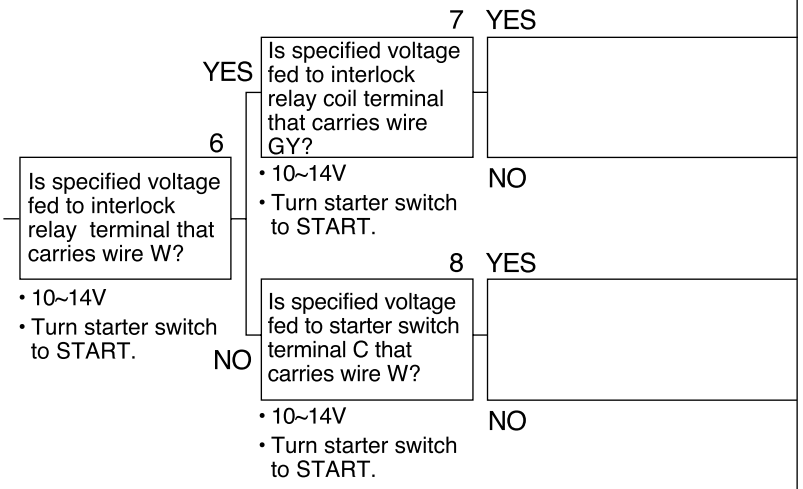
B	Black	BrY	Brown/ Yellow stripe	L	Blue	LgY	Light green/ Yellow stripe	W	White	YL	Yellow/ Blue stripe
BR	Black/ Red stripe	G	Green	LR	Blue/ Red stripe	R	Red	WB	White/ Black stripe	YR	Yellow/ Red stripe
BW	Black/ White stripe	GB	Green Black stripe	LW	Blue/ White stripe	RB	Red/ Black stripe	WL	White/ Blue stripe	YW	Yellow/ White stripe
BY	Black/ Yellow stripe	GL	Green Blue stripe	LY	Blue/ Yellow stripe	RG	Red/ Green stripe	WR	White/ Red stripe	Gy	Gray
Br	Brown	GR	Green Red stripe	Lg	Light green	RL	Red/ Blue stripe	WY	White/ Yellow stripe	O	Orange
BrB	Brown/ Black stripe	GW	Green White stripe	LgB	Light green/ Black stripe	RW	Red/ White stripe	Y	Yellow	Sb	Sky blue
BrR	Brown/ Red stripe	GY	Green Yellow stripe	LgR	Light green/ Red stripe	RY	Red/ Yellow stripe	YB	Yellow/ Black stripe	P	Pink
BrW	Brown/ White stripe			LgW	Light green/ White stripe			YG	Yellow/ Green stripe		

E-01 Engine does not start

★Set the F-R lever to the neutral position.
★For voltage measurement, turn the starter switch ON.

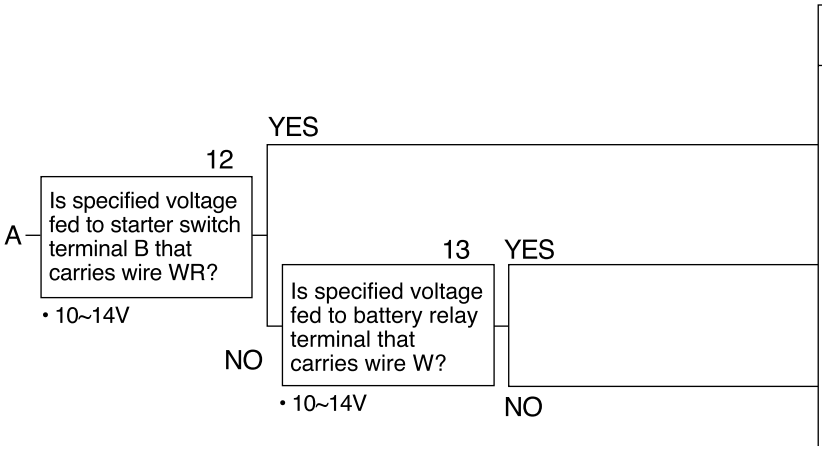
a) Starter motor does not operate. (1/2)





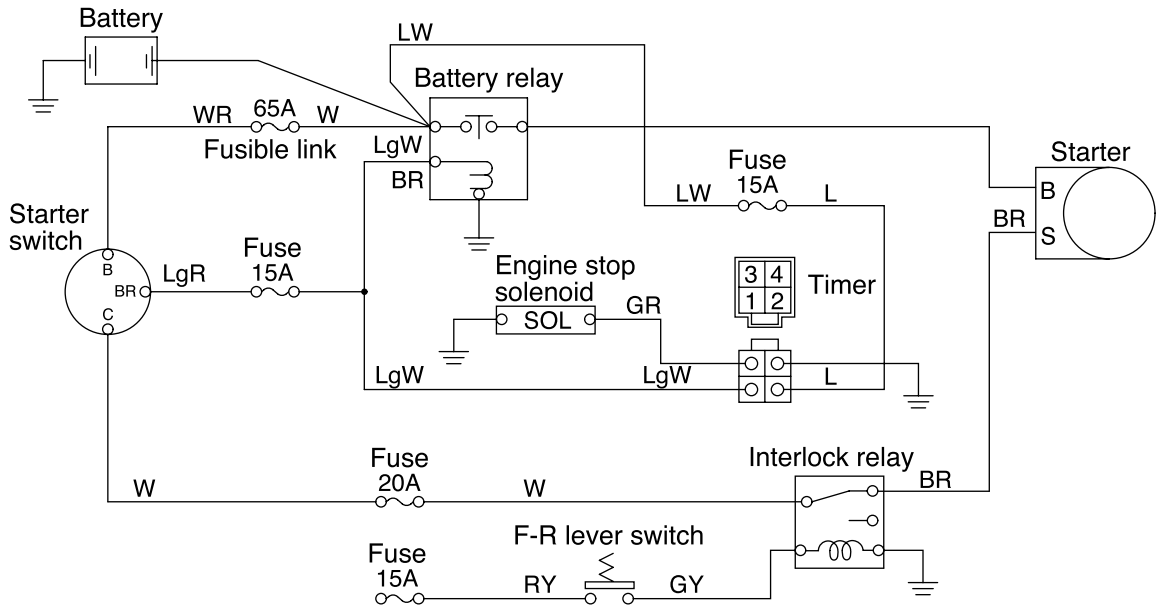
Possible cause	Remedy
Starter faulty.	Renew.
Wire BR from interlock relay terminal to starter terminal S not connected or incorrectly connected.	Repair or renew wire.
Safety switch on F-R lever defective.	Renew.
Interlock relay faulty.	Renew.
Wire W(W) from starter terminal C to interlock relay not connected or incorrectly connected.	Repair or renew wire.
Starter switch defective (between B and C)	Renew.
Wire from battery relay to starter not connected or incorrectly connected.	Repair or renew wire.
Battery relay contact faulty.	Renew.
Battery relay coil faulty.	Renew.
Wire LgR (LgW) from starter switch terminal BR to battery relay terminal BR not connected or incorrectly connected (including fuse).	Repair or renew wire.
To A on page 4-204.	
Battery capacity lowered.	Charge or renew battery.

a) Starter motor does not operate. (2/2)



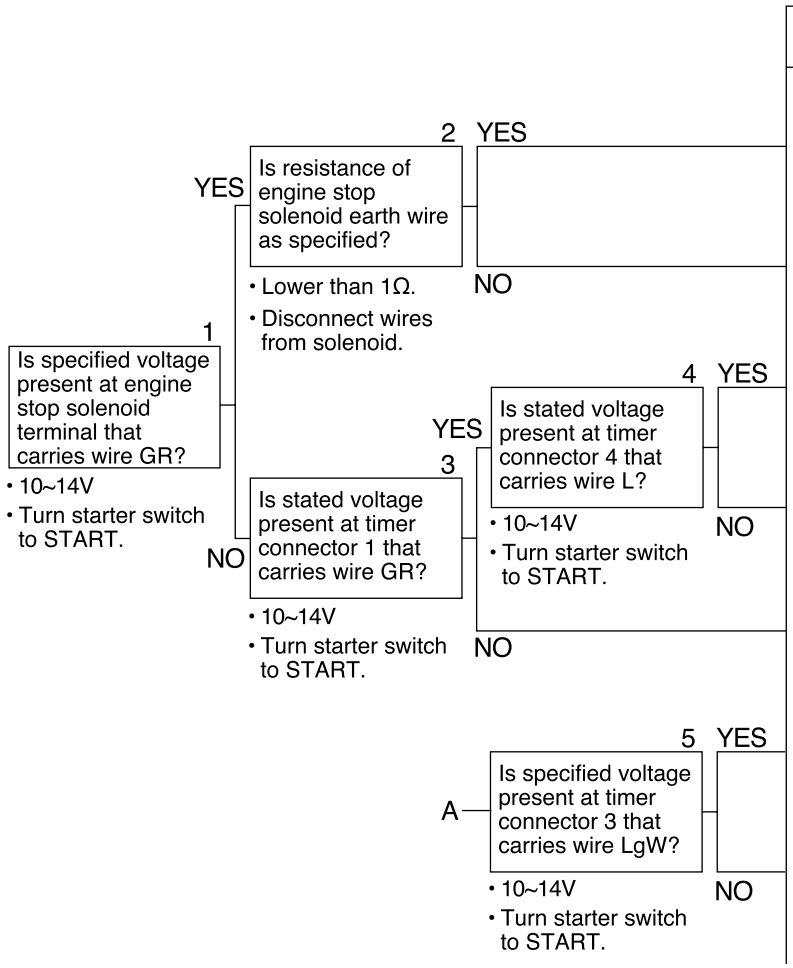
Possible cause	Remedy
Starter switch faulty (between B and BR).	Renew.
Wire WR(W) from battery relay terminal BR to starter switch tereminal B not connected or incorrectly connected (including fuse).	Repair or renew wire. Renew fuse.
Wire from battery to battery relay not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for modes E-01 and E-02



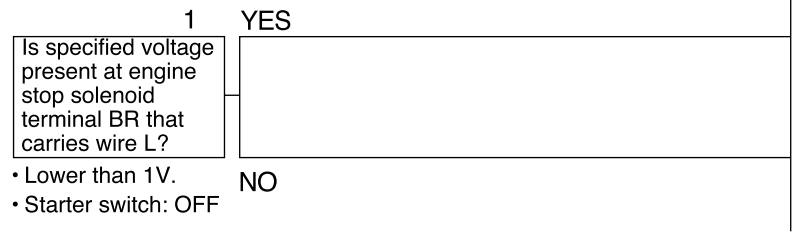
SW3004001

b）Engine stop solenoid inoperative (starter motor operative)



Possible cause	Remedy
Engine stop solenoid faulty.	Renew.
Engine stop solenoid earth wire not connected or incorrectly connected.	Repair or renew wire.
To “A” on this page.	
Wire LgR (LgW) from starter switch terminal BR to timer connector 3 not connected or incorrectly connected (including fuse).	Repair of renew wire. Renew fuse.
Timer faulty or earth wire not connected or incorrectly connected.	Repair or renew.
Wire LW (L) from battery relay to timer connector 4 not connected or incorrectly connected (including fuse).	Repair of renew wire. Renew fuse.
Wire GR from solenoid to timer connector 1 not connected or incorrectly connected (including fuse).	Repair of renew wire. Renew fuse.

E-02 Engine does not stop



Possible cause	Remedy
Engine stop solenoid faulty.	Renew.
Battery relay defective.	Renew.

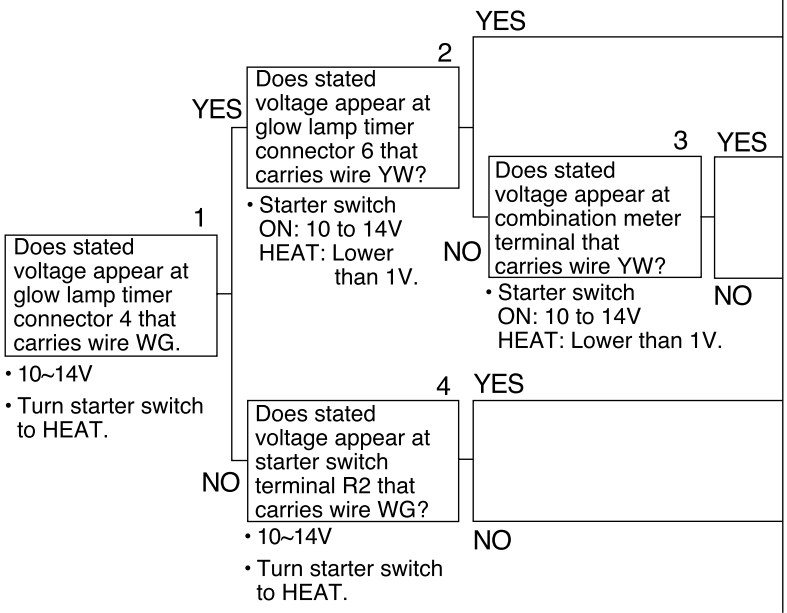
E-03 Glow plugs do not become red-hot (difficult starting)

★It is assumed that the starter is normal.

★Measure the voltage with the starter switch ON.

a) Glow lamp does not become bright. (Other lamps light up.)

★The glow indicator should become bright when the starter switch is turned to the HEAT position, and come off when preheating is complete.

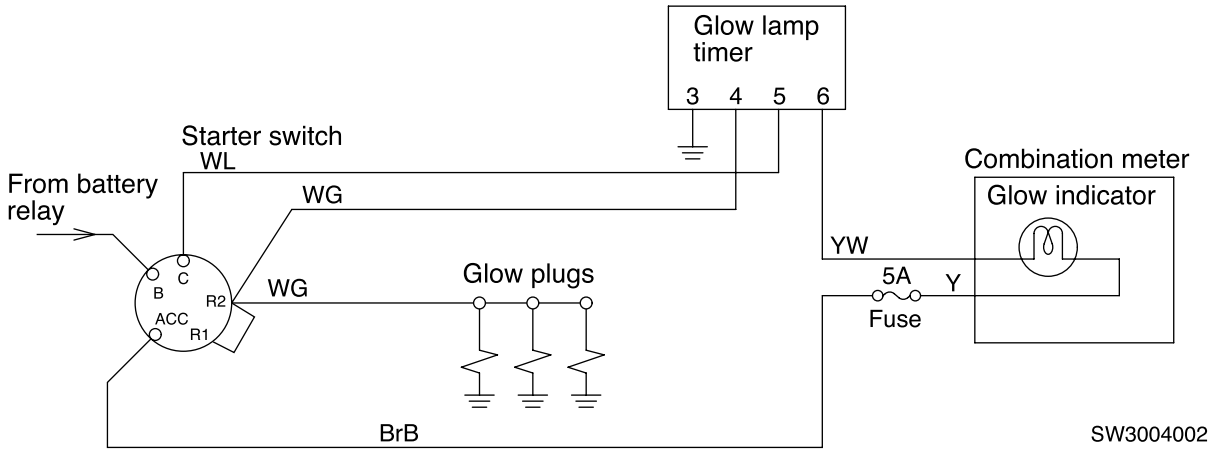


Possible cause	Remedy
Glow lamp relay faulty.	Renew.
Wire YW from combination meter to glow lamp timer connector 6 not connected or incorrectly connected.	Repair or renew wire.
Glow indicator faulty.	Renew.
Wire WG from starter switch terminal R2 to glow plug not connected or incorrectly connected.	Repair or renew wire.
Starter switch faulty (between B and R2).	Renew.

b) Glow indicator becomes bright but hard starting

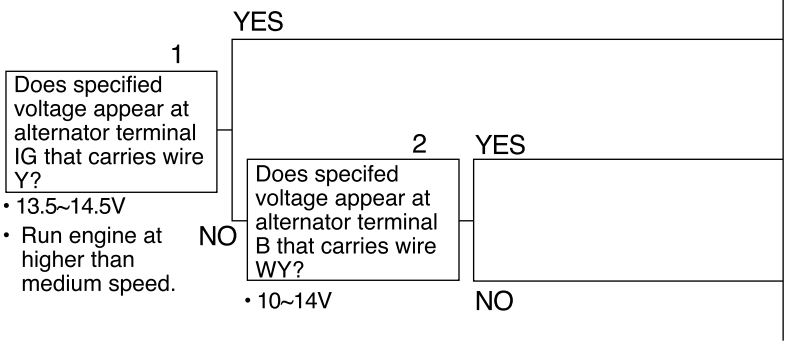
Possible cause	Remedy
Glow plug faulty.	Renew.
Wire WG from starter switch terminal R2 to glow plug not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for mode E-03



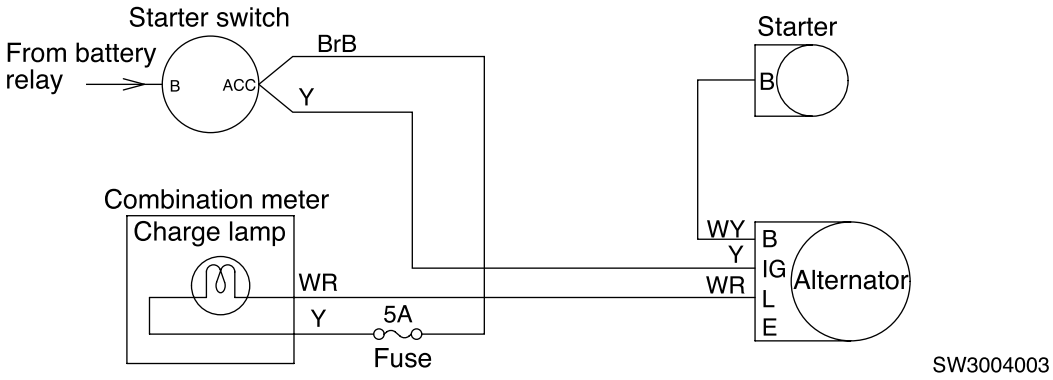
E-04 No charging (charge lamp stays bright.)

★Measure the voltage with the starter switch ON.



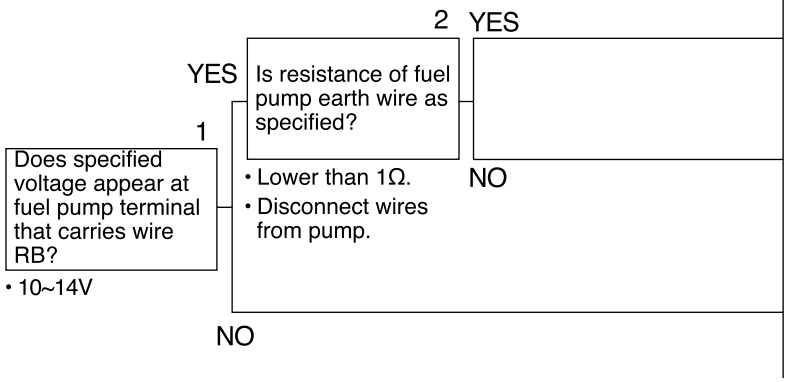
Possible cause	Remedy
Regulator faulty.	Renew.
Alternator faulty.	Renew.
Wire WY from alternator terminal B to starter terminal B not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for mode E-04



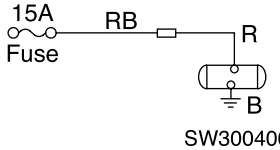
E-05 Fuel pump does not work

★Measure the voltage with the starter switch ON.



Possible cause	Remedy
Fuel pump faulty.	Renew.
Fuel pump earth wire not connected or incorrectly connected.	Repair or renew wire.
Wire RB from fuse to fuel pump not connected or incorrectly connected.	Repair or renew wire.

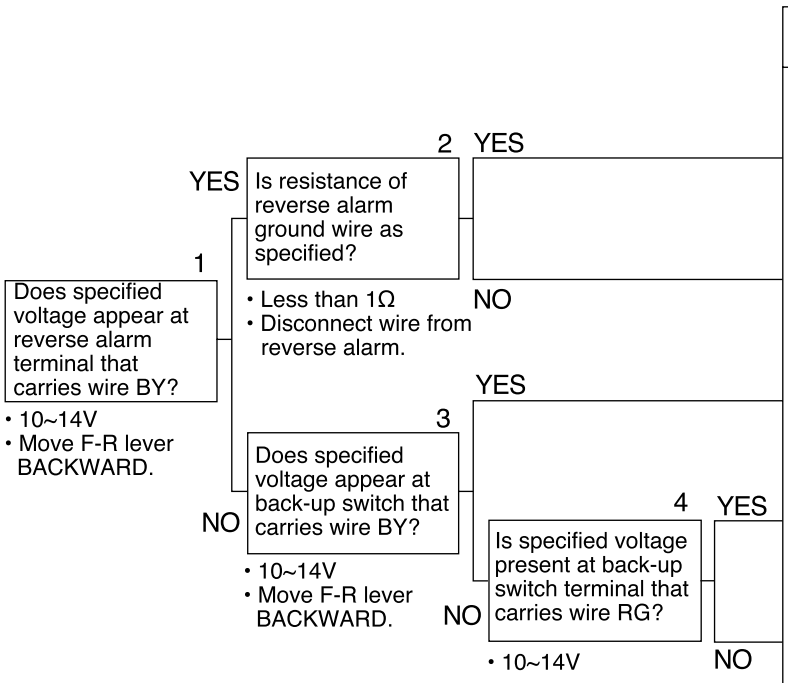
Electric wiring diagram for mode E-05



E-06 Reverse alarm does not sound

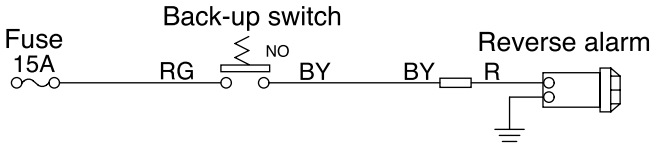
★First, check that the fuse is not blown.

★The voltage measurement should be taken with the starter switch ON.



Possible cause	Remedy
Reverse alarm faulty.	Renew.
Reverse alarm earth wire not connected or incorrectly connected.	Repair or renew wire.
Wire BY from back-up switch to reverse alarm not connected or incorrectly connected.	Repair or renew wire.
Back-up switch faulty.	Renew.
Wire RG from back-up switch to fuse not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for mode E-06

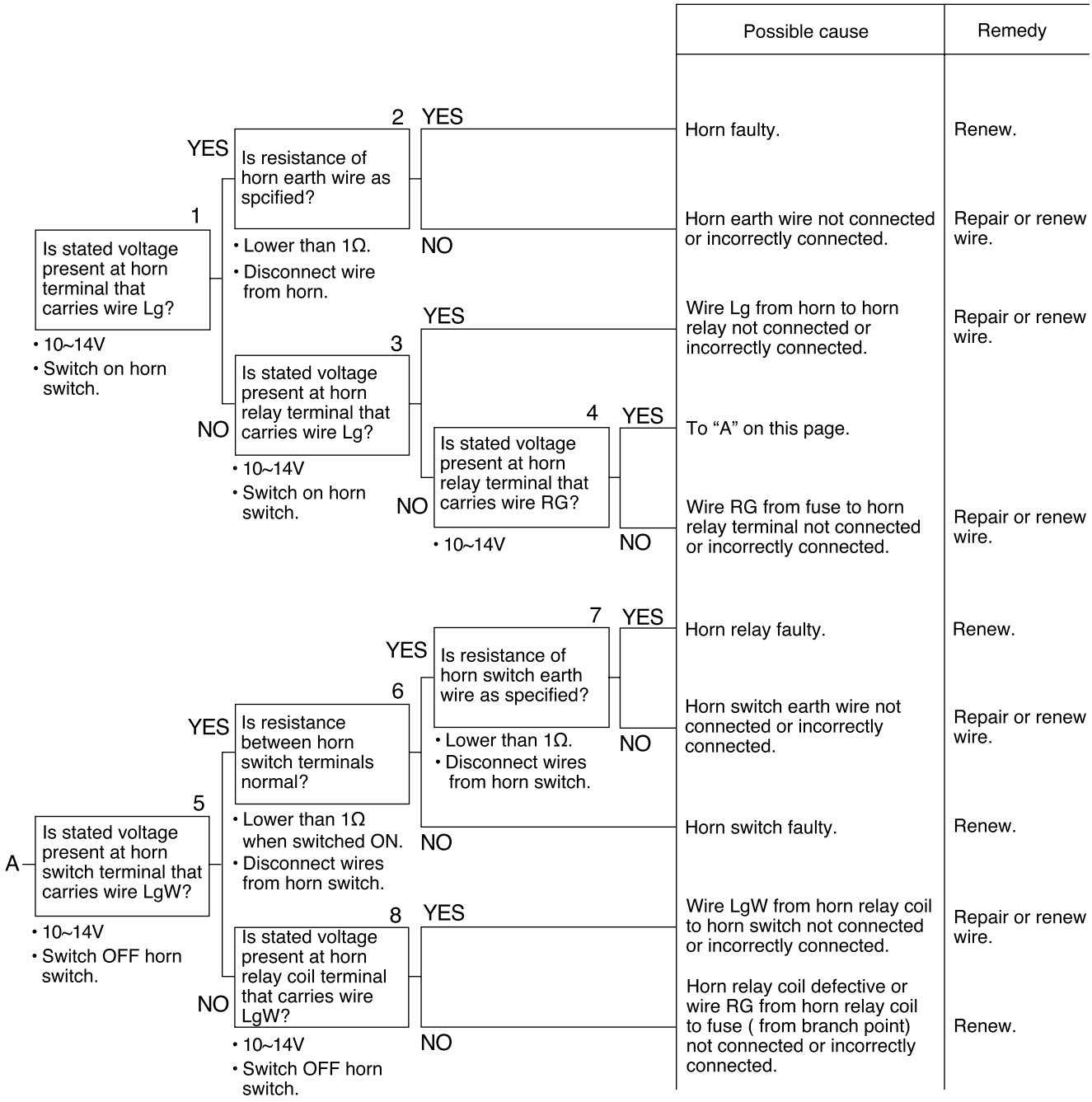


SW3004005

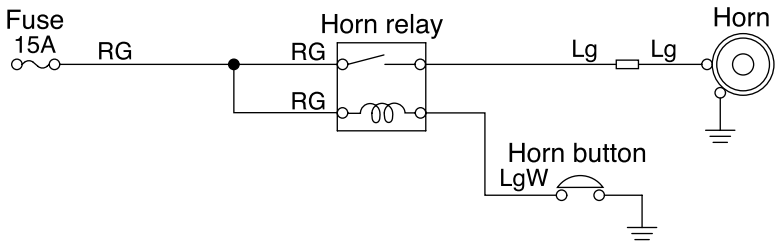
E-07 Horn does not sound

★First, check that fuse is not blown.

★The voltage measurement should be taken with the starter switch ON.



Electric wiring diagram for mode E-07

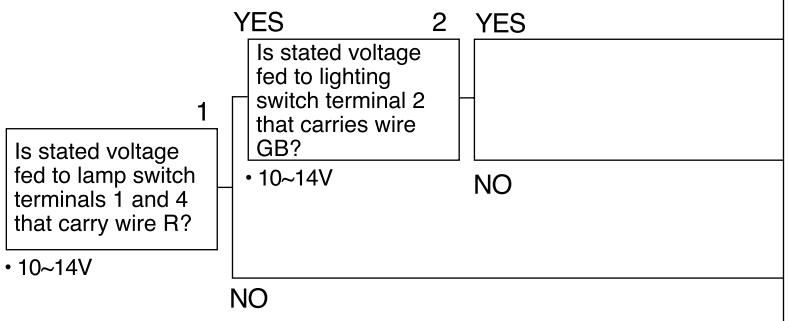


SW3004006

E-08 Headlamps do not light

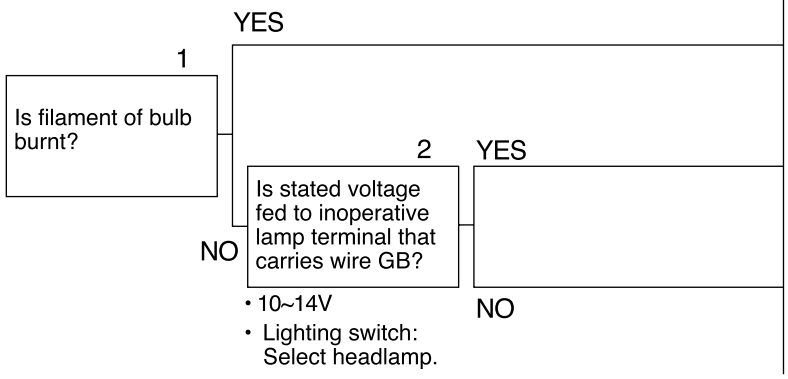
★Measure the voltage with the starter switch ON.

a) Both headlamps do not come on.



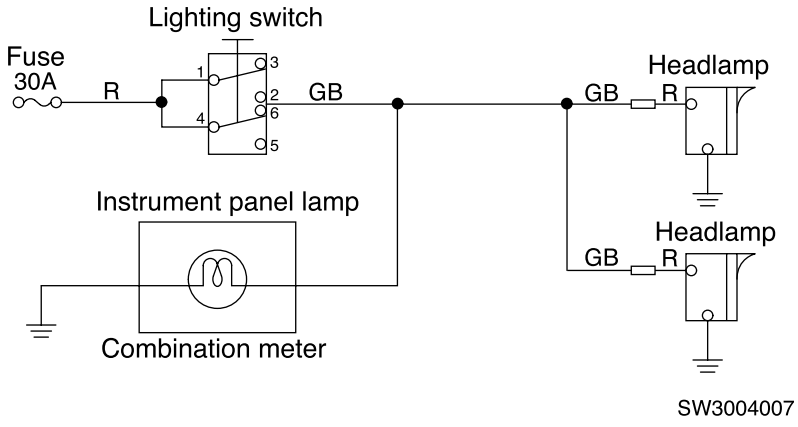
Possible cause	Remedy
Wire GB from lighting switch terminal 2 to headlamp (to branch point) not connected or incorrectly connected.	Repair or renew wire.
Lighting switch faulty.	Renew.
Wire R from fuse to lighting switch terminals 1, 4 not connected or incorrectly connected (including fuse).	Repair or renew wire.

b) Either left or right headlamp does not come on.



Possible cause	Remedy
Filament is burnt.	Renew.
Poor contact of bulb or earth wire not connected or incorrectly connected.	• Repair. • Repair or renew wire.
Wire GB from lighting switch terminal 2 to headlamps (from branch point) not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for mode E-08



SW3004007

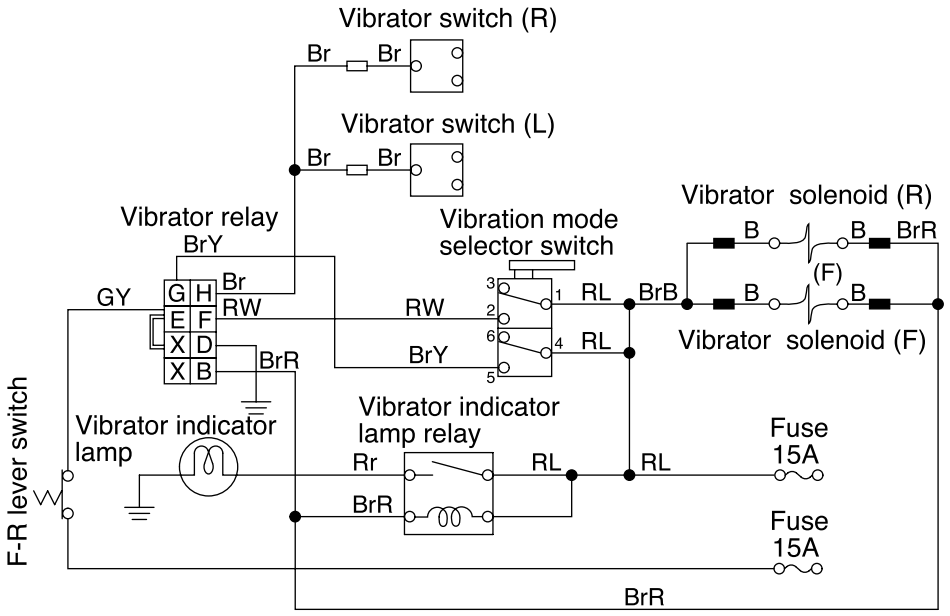
E-09 Vibrator does not operate

★Measure the voltage with the starter switch ON.

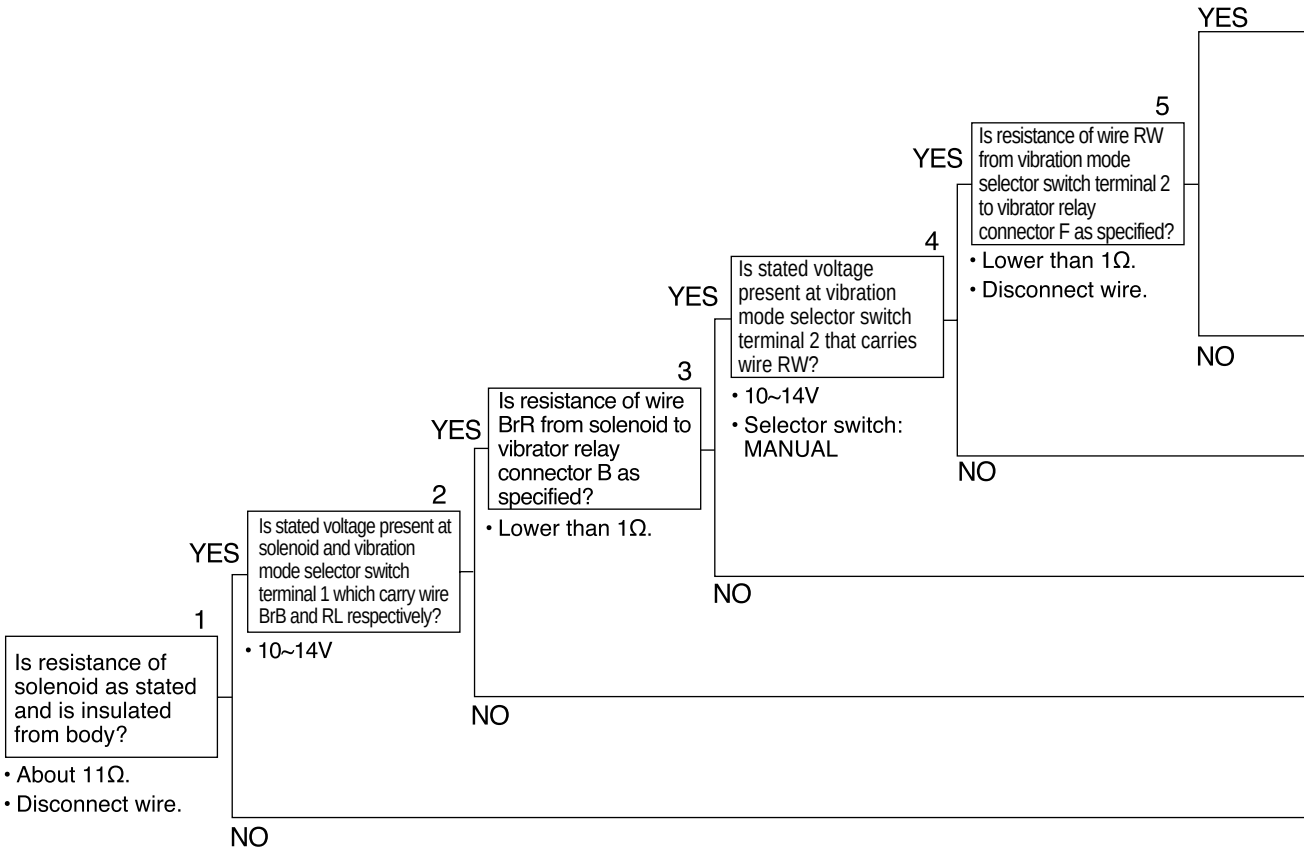
a) Inoperative in MANUAL mode.

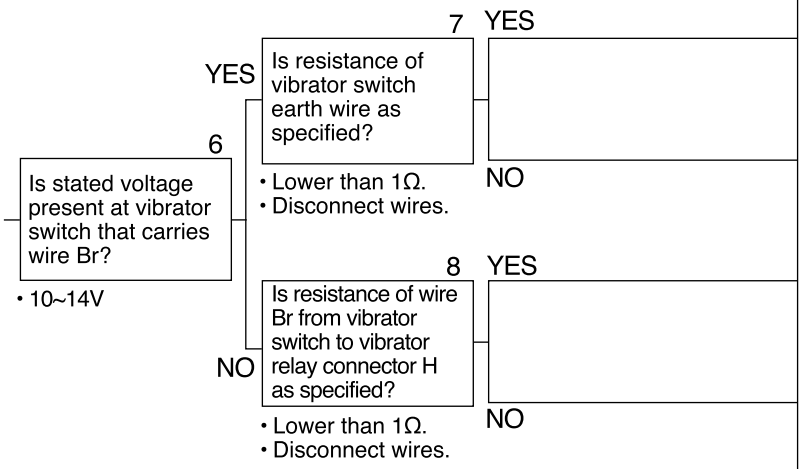
★Diagnose with vibration mode selector switch set to MANUAL.

Electric wiring diagram for mode E-09



SW3004008

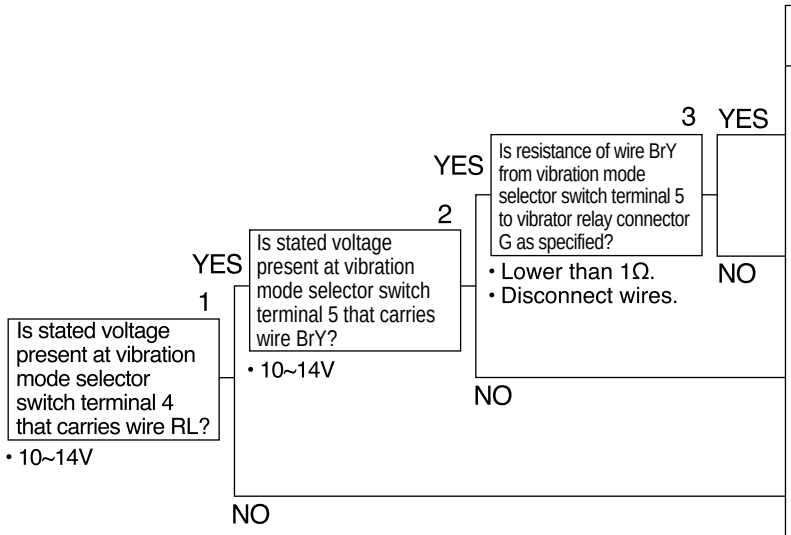

1
Is resistance of solenoid as stated and is insulated from body?
• About 11Ω.
• Disconnect wire.
NO
YES
2
Is stated voltage present at solenoid and vibration mode selector switch terminal 1 which carry wire BrB and RL respectively?
• 10~14V
NO
YES
3
Is resistance of wire BrR from solenoid to vibrator relay connector B as specified?
• Lower than 1Ω.
NO
YES
4
Is stated voltage present at vibration mode selector switch terminal 2 that carries wire RW?
• 10~14V
• Selector switch: MANUAL
NO
YES
5
Is resistance of wire RW from vibration mode selector switch terminal 2 to vibrator relay connector F as specified?
• Lower than 1Ω.
• Disconnect wire.
NO
YES



Possible cause	Remedy
Vibrator switch faulty.	Renew.
Vibrator switch earth wire not connected or incorrectly connected.	Repair or renew wire.
Vibrator relay faulty.	Renew.
Wire Br from vibrator switch to vibrator relay connector H not connected or incorrectly connected.	Repair or renew wire.
Wire RW from vibration mode selector switch to vibrator relay connector F not connected or incorrectly connected.	Repair or renew wire.
Vibration mode selector switch faulty.	Renew.
Wire BrR from vibrator solenoid to vibrator relay connector B not connected or incorrectly connected.	Repair or renew wire.
Wire RL (BrB) from vibration mode selector switch terminal 1 to fuse not connected or incorrectly connected.	Repair or renew wire.
Solenoid faulty.	Renew.

b) Inoperative in AUTO mode (Operative in MANUAL mode)

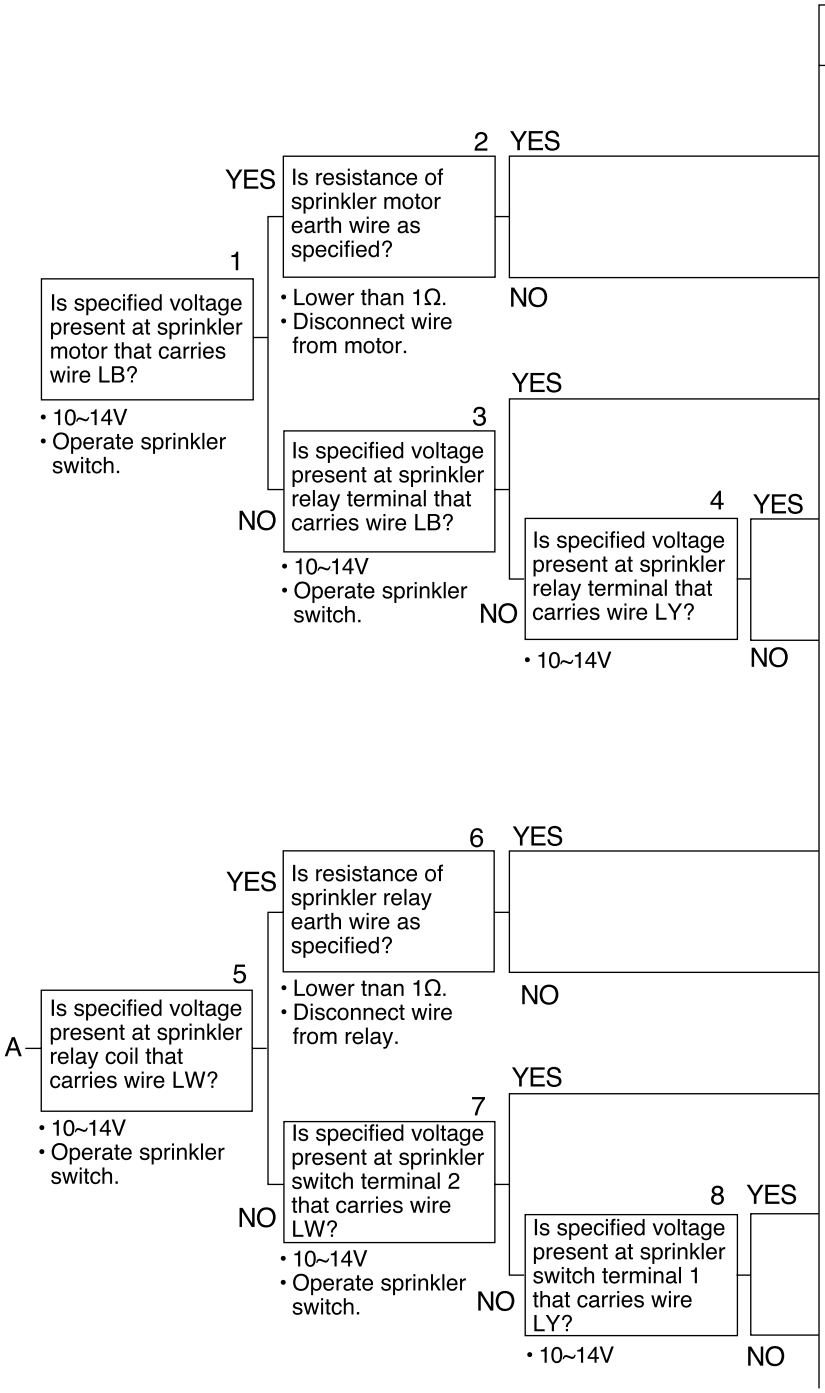
★Set vibration mode selector switch to AUTO.



Possible cause	Remedy
To "A" on this page.	
Wire BrY from vibrator relay connector G to selector switch not connected or incorrectly connected.	Repair or renew wire.
Vibration mode selector switch faulty.	Renew.
Wire RL from vibration mode selector switch termianl 4 to fuse not connected or incorrectly connected.	• Repair or renew wire. • Renew fuse.
Vibrator relay faulty.	Renew.
Wire GY from vibrator relay connector E to F-R lever switch not connected or incorrectly connected.	Repair or renew wire.

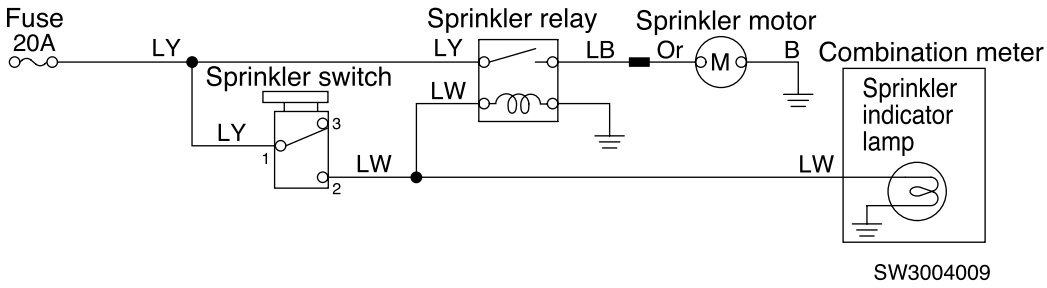
E-10 Sprinkler does not work

★Measure the voltage with the starter switch ON.



Possible cause	Remedy
Sprinkler motor faulty.	Renew.
Sprinkler motor earth wire not connected or incorrectly connected.	Repair or renew wire.
Wire LB from sprinkler relay to sprinkler motor not connected or incorrectly connected.	Repair or renew wire.
To “A” on this page.	
Wire LY from fuse to sprinkler relay not connected or incorrectly connected.	Repair or renew wire.
Sprinkler relay faulty.	Renew.
Sprinkler relay earth wire not connected or incorrectly connected.	Repair or renew wire.
Wire LW from sprinkler switch terminal 2 to sprinkler relay coil not connected or incorrectly connected.	Repair or renew wire.
Sprinkler switch faulty.	Renew.
Wire LY from fuse to sprinkler switch terminal 1 (from branch point) not connected or incorrectly connected.	Repair or renew wire.

Electric wiring diagram for mode E-10

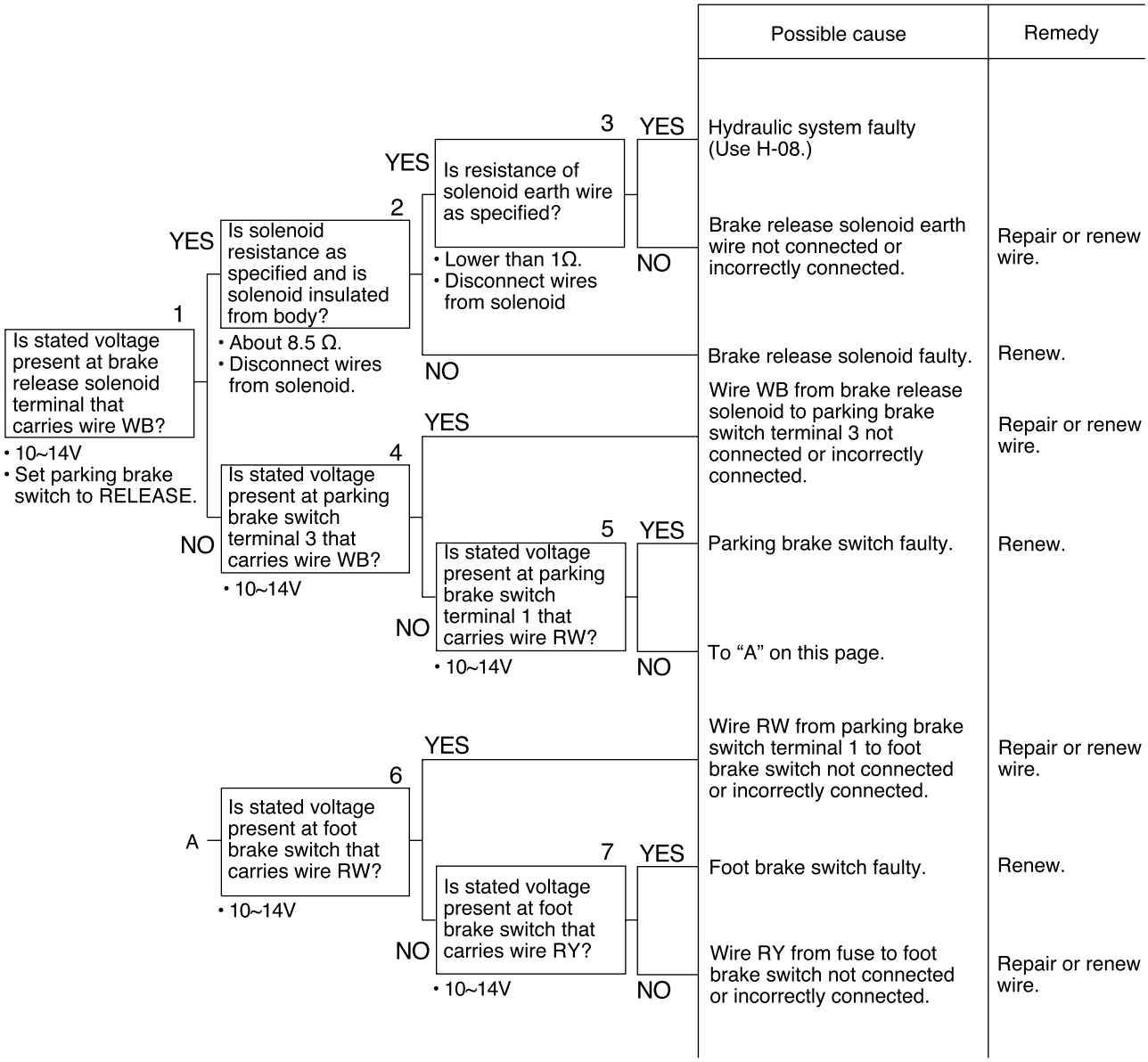


SW3004009

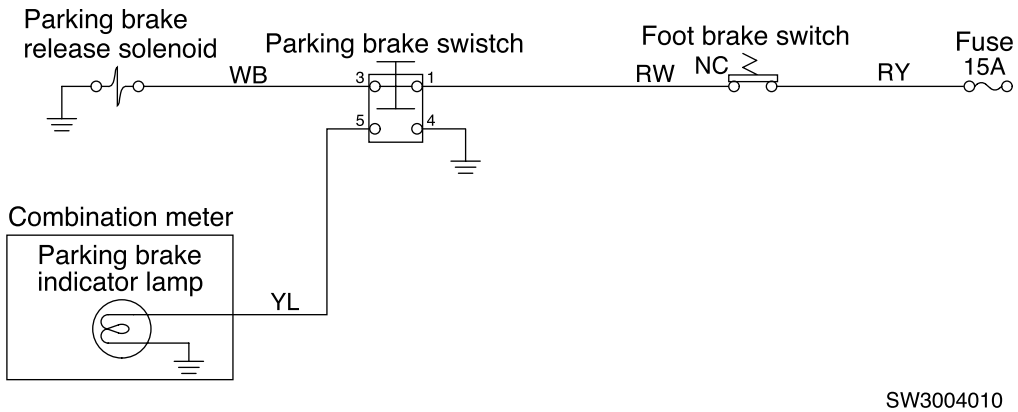
E-11 Parking brake not released

★Measure the voltage with the starter switch ON.

★Set the parking brake to DISENGAGE and keep the foot brake pedal not depressed.



Electric wiring diagram for modes E-11



E-12 Fuel gauge reads wrong

★Other gauges and lamps are normal.

★Measure the voltage with the starter switch ON.

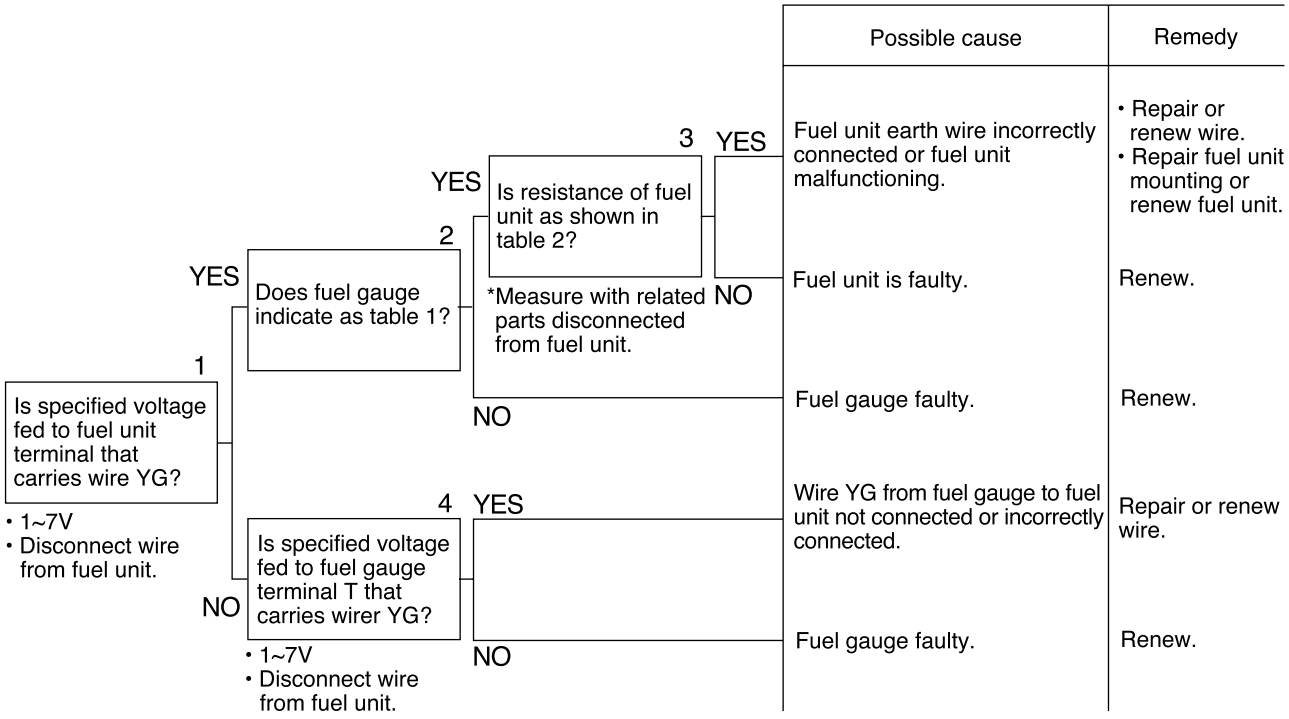


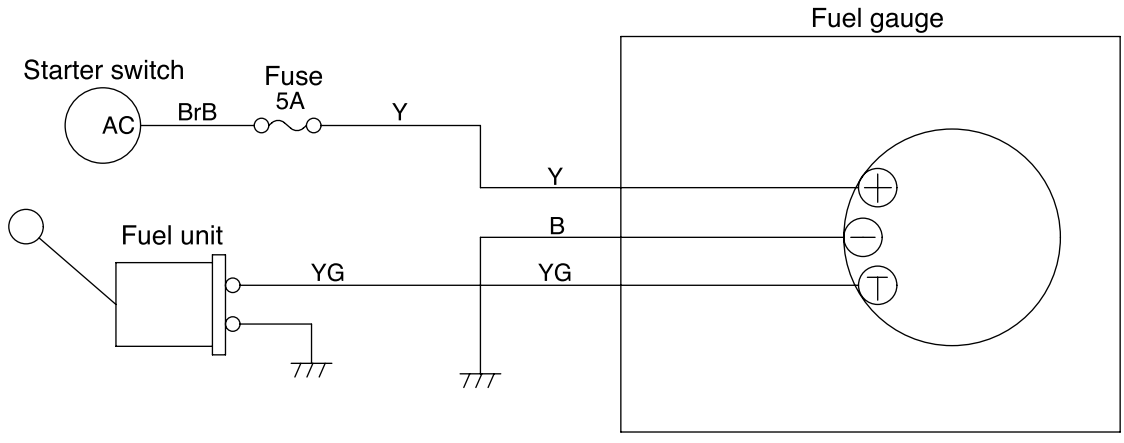
Table 1

Fuel unit wire YG	Gauge reading
Disconnected	Empty
Grounded	Full

Table 2

Fuel unit float	Resistance (Ω)
Full	10~17.5
Empty	82.5~90

Electric wiring diagram for mode E-12

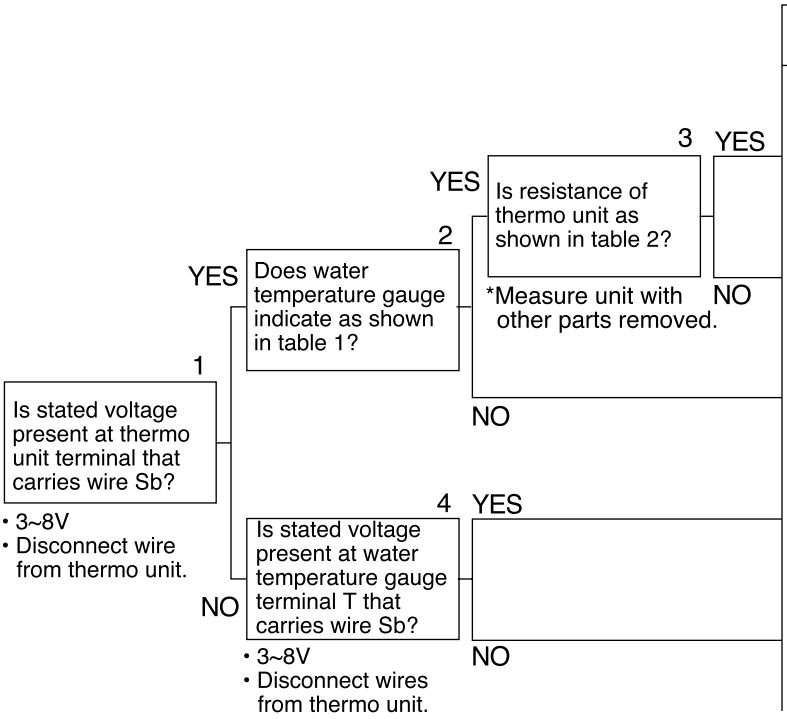


SW5004013

E-13 Water temperature gauge reads wrong

★Other gauges and lamps operate correctly.

★Measure the voltage with the starter switch ON.



Possible cause	Remedy
Thermo unit earth wire incorrectly connected or thermo unit faulty.	• Repair or renew wire. • Repair mounting or renew thermo unit.
Thermo unit faulty.	Renew.
Water temperature gauge faulty.	Renew.
Wire Sb from water temperature gauge to thermo unit not connected or incorrectly connected.	Repair or renew wire.
Water temperature gauge faulty.	Renew.

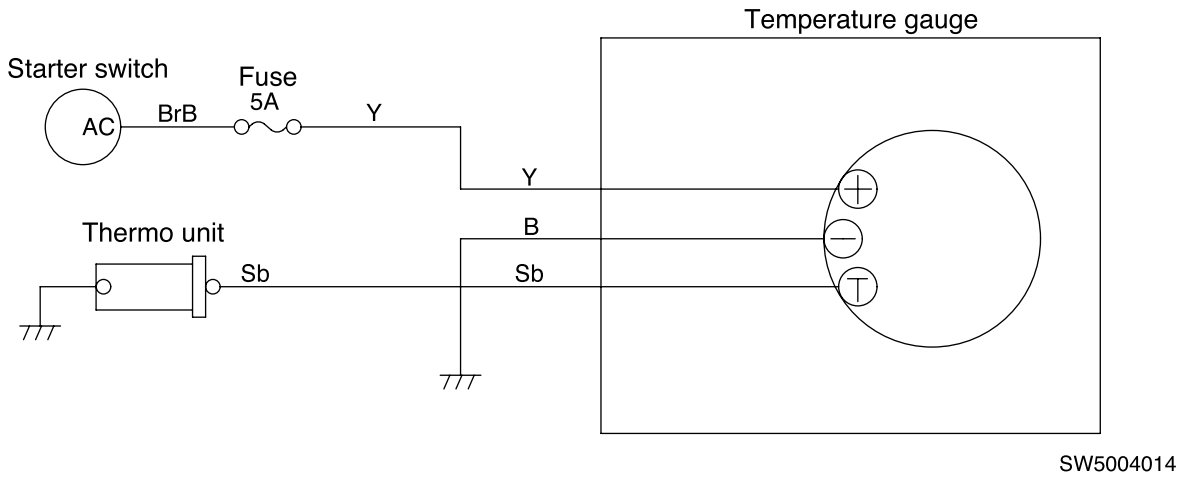
Table 1

Thermo unit terminal wire Sb	Gauge reading
Disconnected	Lowest
Grounded	Highest

Table 2

Thermo unit temperature	Resistance (Ω)
50°C	150~158
100°C	About 27.4

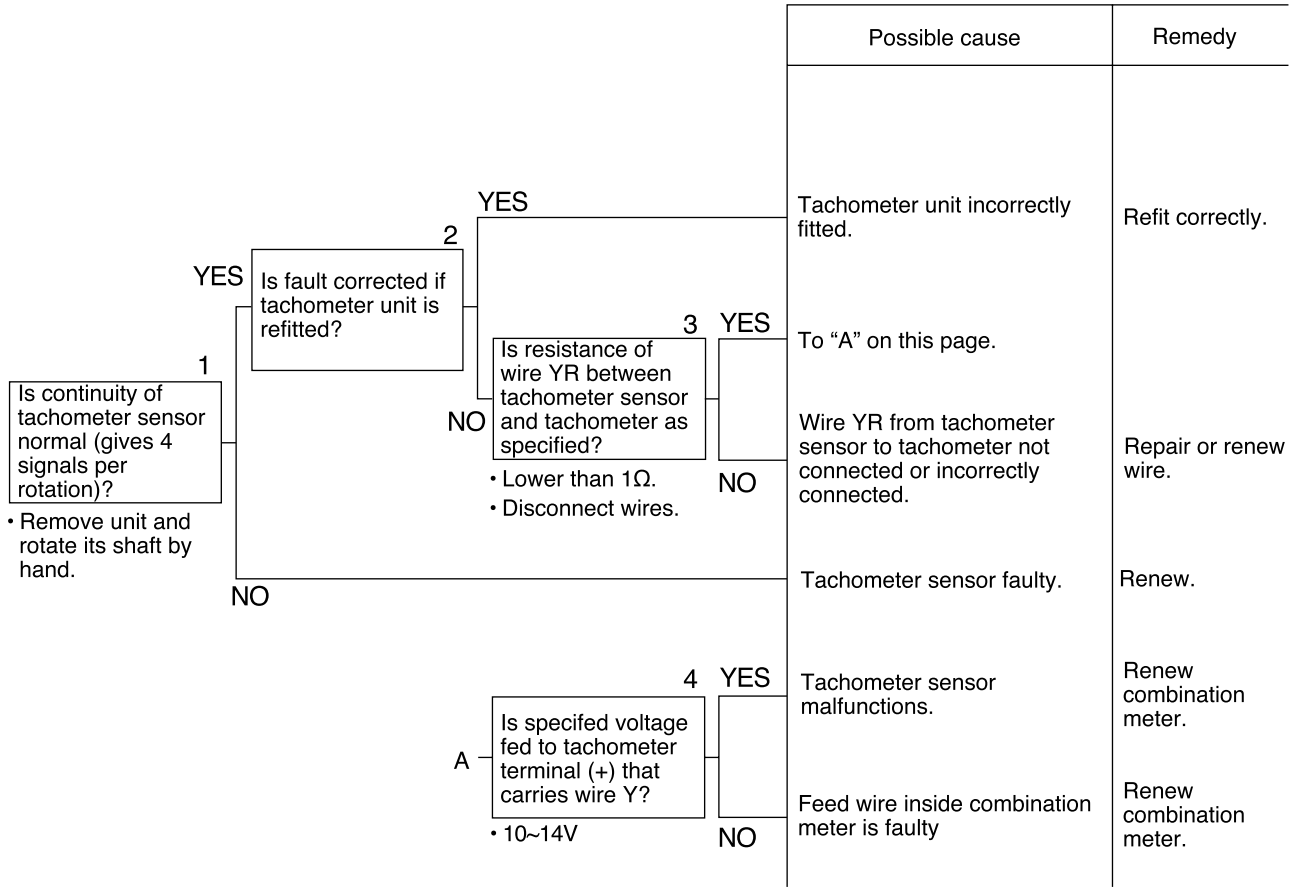
Electric wiring diagram for mode E-13



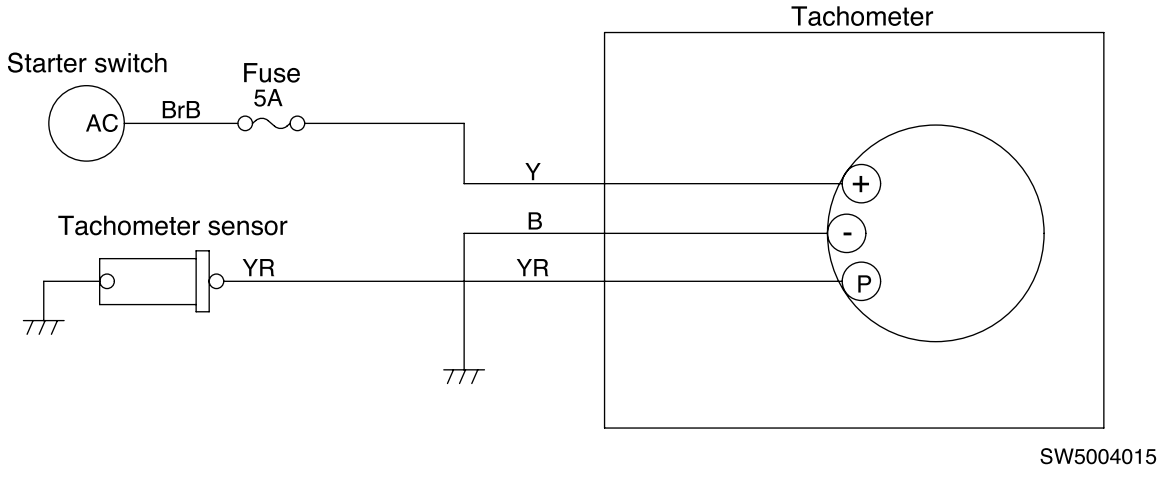
SW5004014

E-14 Tachometer reads wrong

★Other gauges and lamps operate correctly.
★Measure the voltage with the starter switch ON.



Electric wiring diagram for mode E-14



MEMO

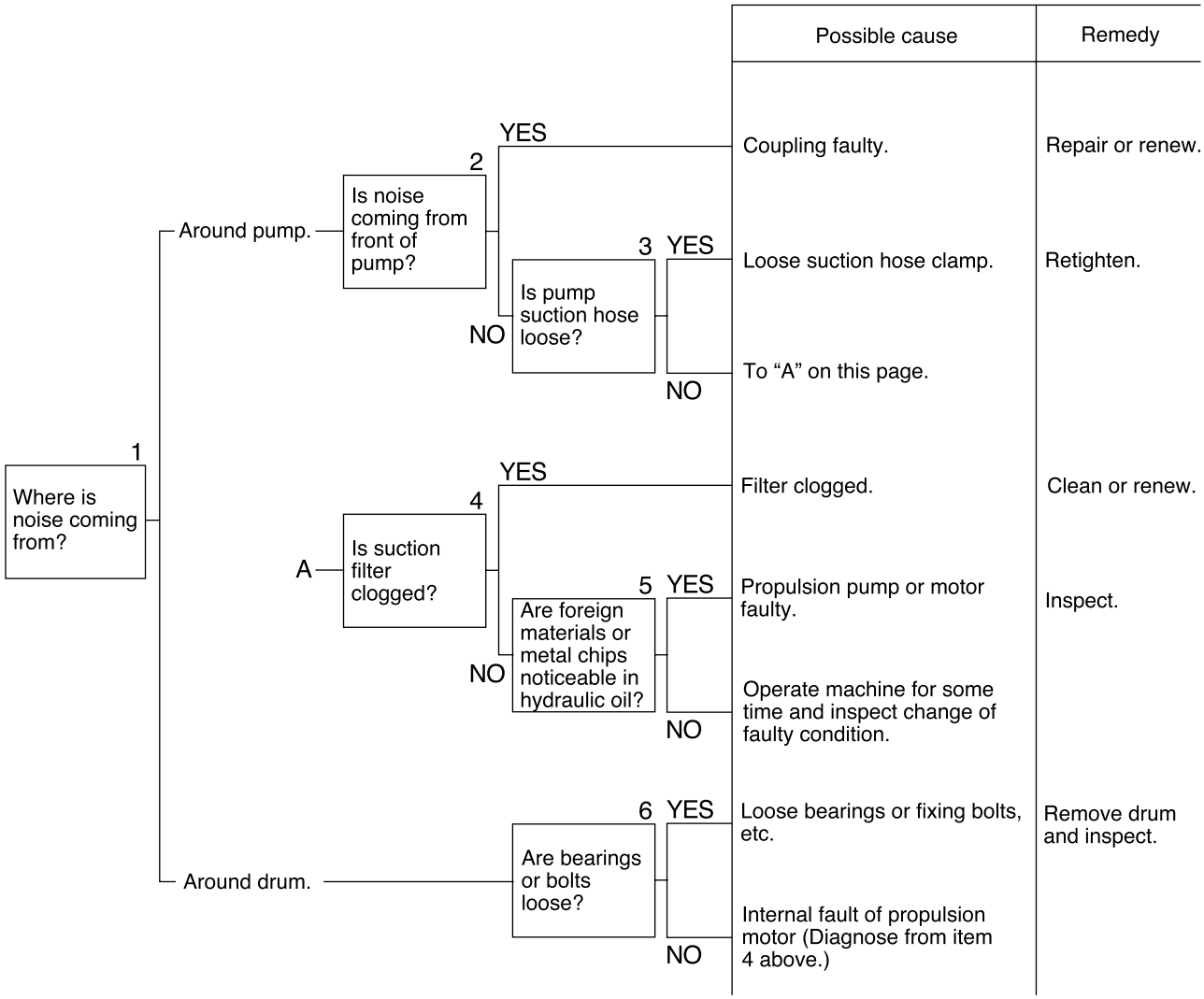
6. Fault Finding for Hydraulic and Mechanical Systems (Mode H)

Trouble modes for hydraulic and mechanic systems and sources of trouble

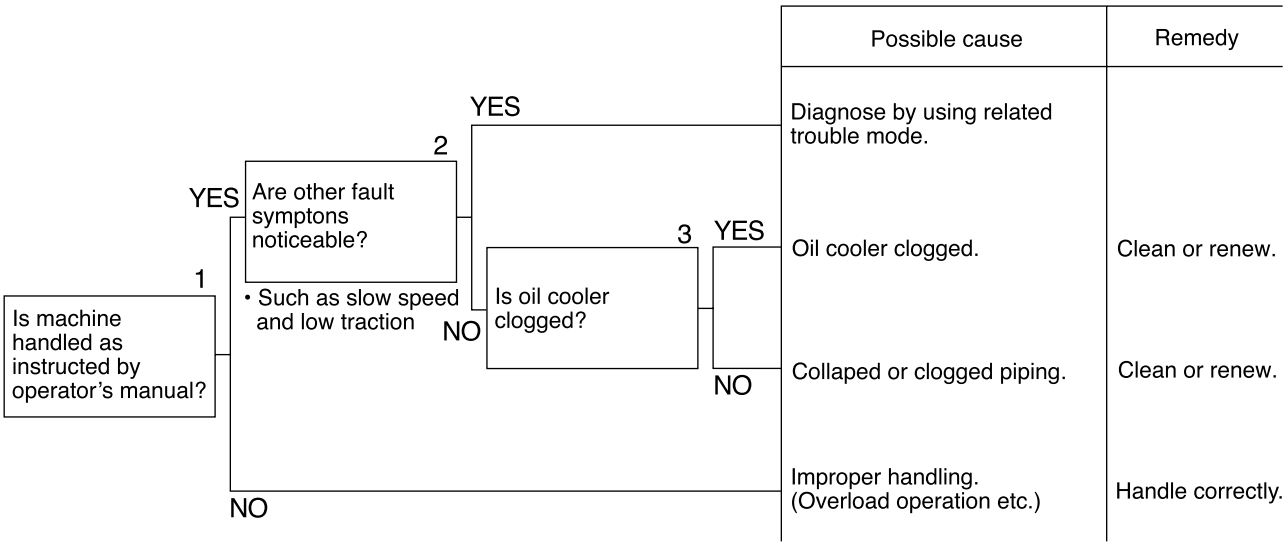
Source-of-trouble units \ Trouble mode			Unusual sounds	Hydraulic fluid too hot	Propulsion			
					Not propelled		Speed not gained or low traction	
					a) Forward and reverse	b) Either forward or reverse	a) Forward and reverse	b) Either forward or reverse
Propulsion	Pump	Propulsion pump	●		●		●	
		Charge pump (Steering pump)			●		●	
		Servo valve/servo linkage			●	●	●	●
		High pressure relief valve				●		●
		Charge relief valve			●		●	
	Front motor	Motor unit	●		●	●	●	●
		Negative brake (parking brake)			●		●	
		Drum	●					
	Rear motor	Motor unit	●		●	●	●	●
		Negative brake (parking brake)			●		●	
		Drum	●					
	Brake valve				●		●	
Vibrator	Rear	Pump						
		Motor unit						
		Vibrator						
		Vibrator solenoid valve (pressure relief valve)						
	Front	Pump						
		Motor unit						
		Vibrator						
		Vibrator solenoid valve (pressure relief valve)						
Steering	Steering pump							
	Steering valve (Orbitrol)							
	Pressure relief valve							
	Steering cylinder							
	Steering mechanism							
	Steering column							
Sprinkler	Sprinkler pump							
	Hose/Valve/Nozzle/Filter							
Others	F-R lever linkage				●	●	●	●
	Oil cooler			●				
	Coupling		●		●		●	
	Filter/piping, etc.		●	●				
Diagnosis code			H-01	H-02	H-03a	H-03b	H-04a	H-04b

Vibrator does not work	Week vibrating force	Steering		Parking brake is not applied sufficiently	Parking brake is not released	No sprinkling on tires
		Not performed	Heavy or slow			
				●	●	
				●	●	
				●	●	
●	●					
●	●					
●						
●	●					
●	●					
●	●					
●						
●	●					
		●	●			
		●				
		●	●			
			●			
		●	●			
			●			
						●
						●
H-05	H-06	H-07	H-08	H-09	H-10	H-11

H-01 Noisy (Unusual sounds)



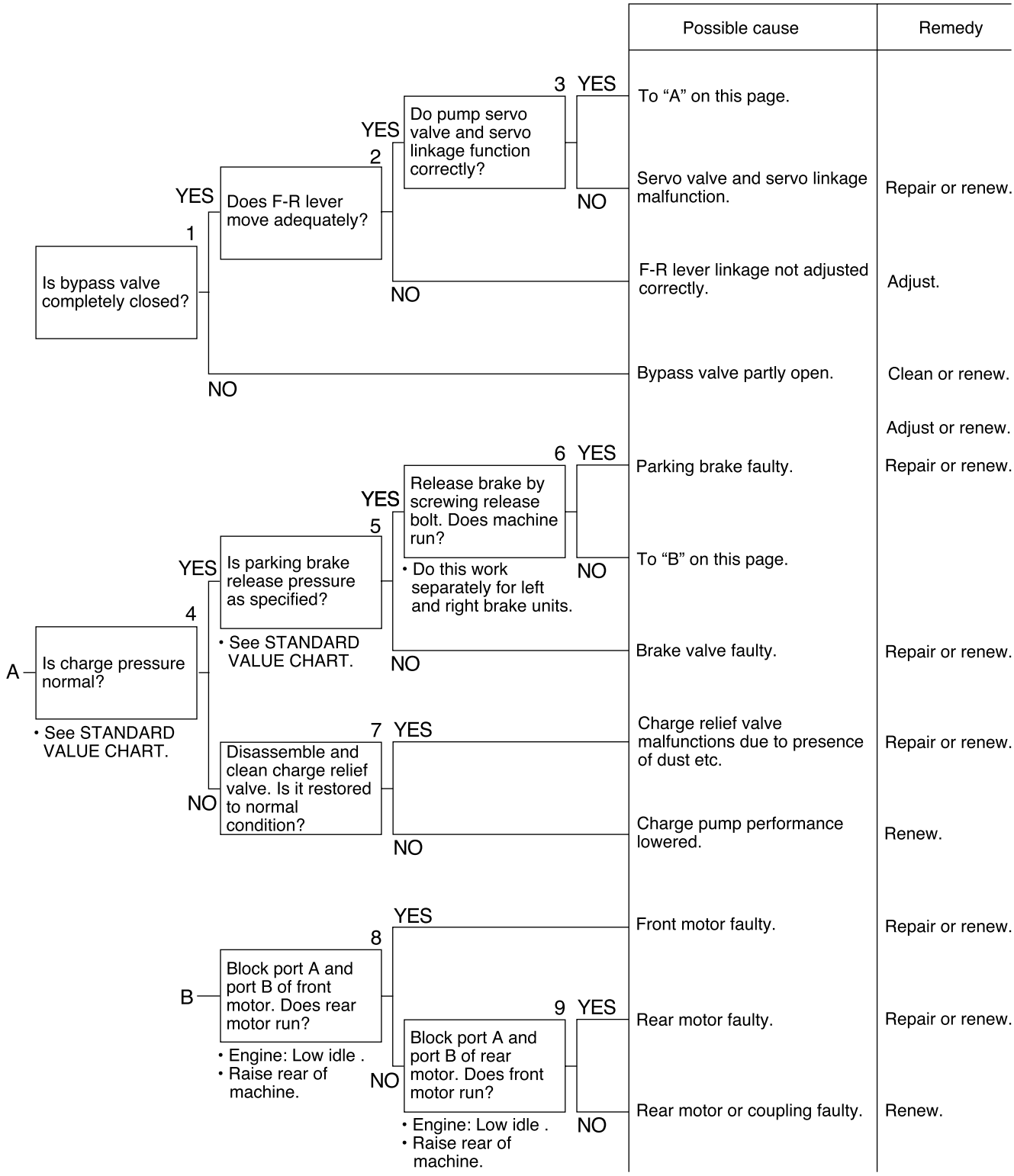
H-02 Hot hydraulic oil



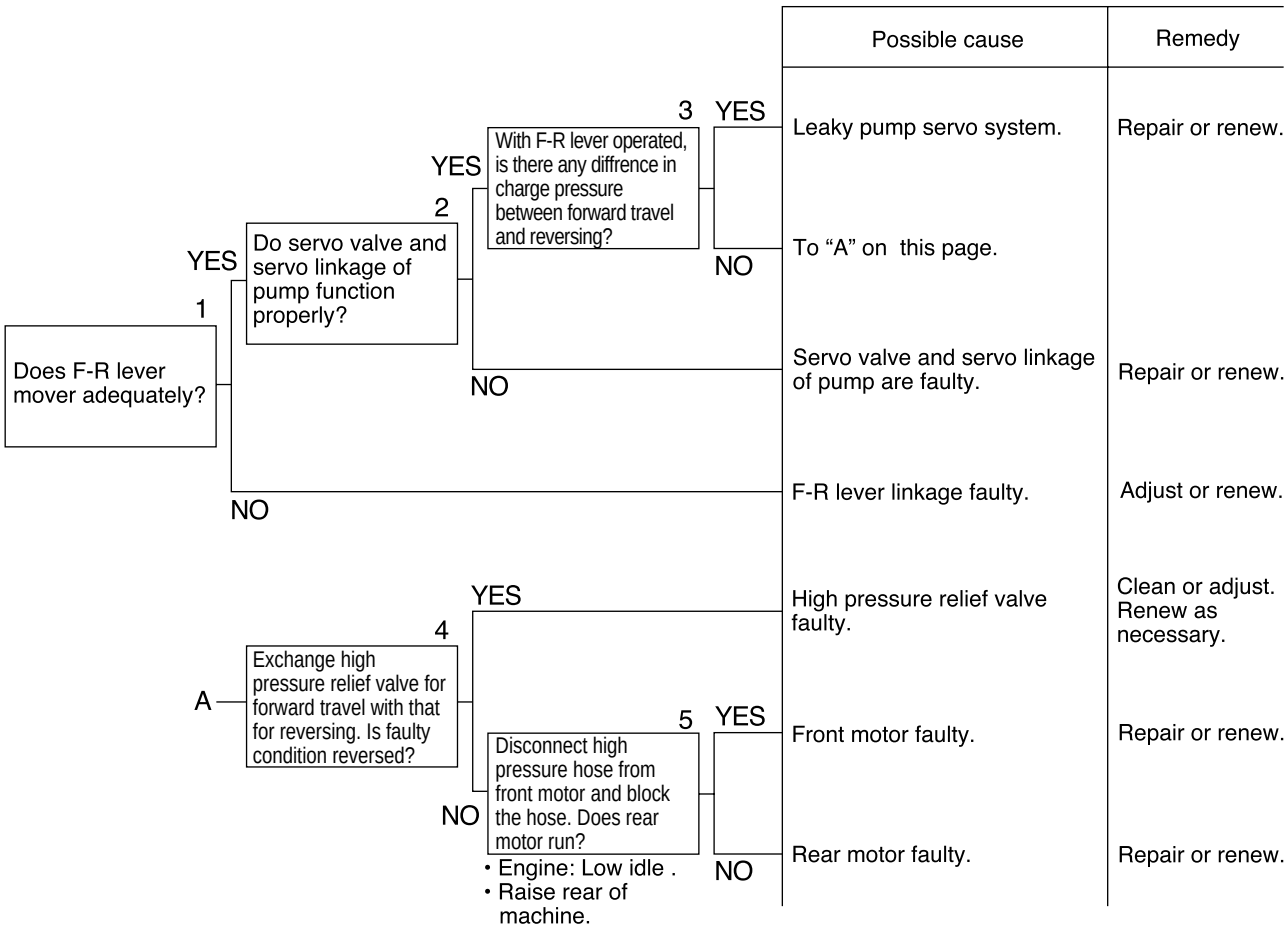
H-03 Not Propelled

★Diagnose electric systems first then proceed as follows.
★First, check the oil level of the hydraulic tank.

a) Not propelled in both directions.



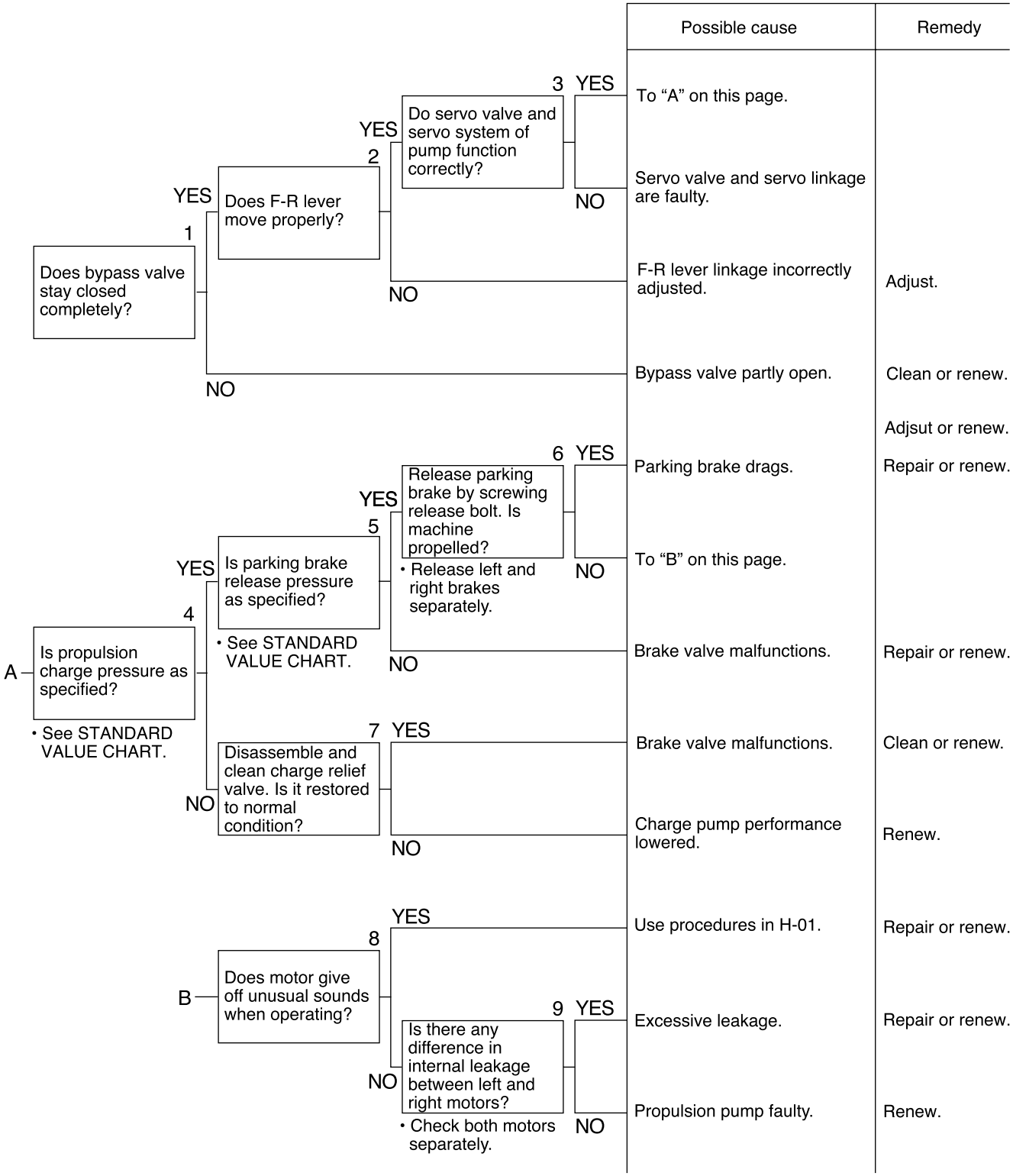
b) Machine travels in one direction only, either forward or in reverse.



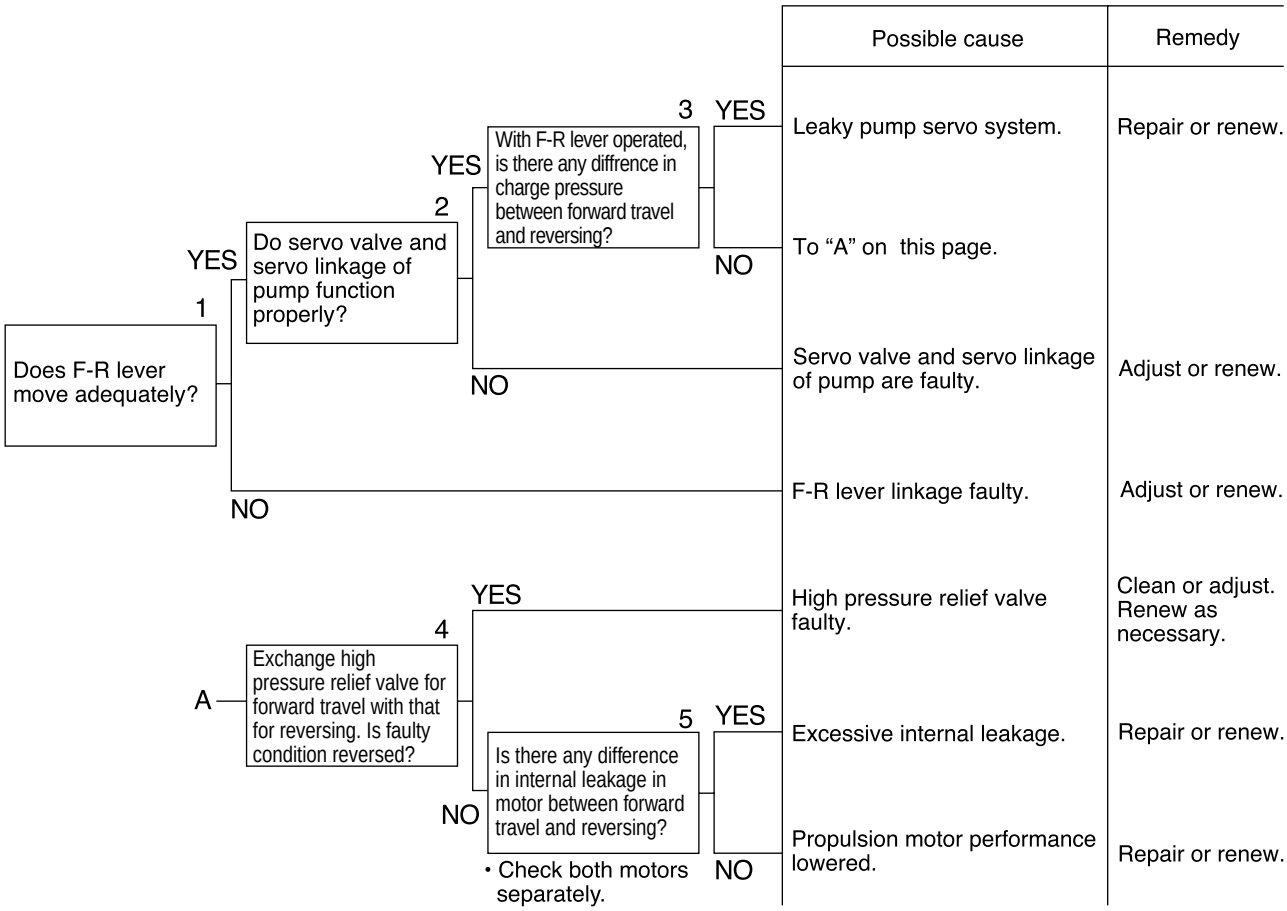
H-04 Speed not gained or low traction

★Diagnose electric systems first then use procedures as listed below.
★Check oil level in hydraulic tank in advance.

a) Speed not gained in both directions; forward and reverse.

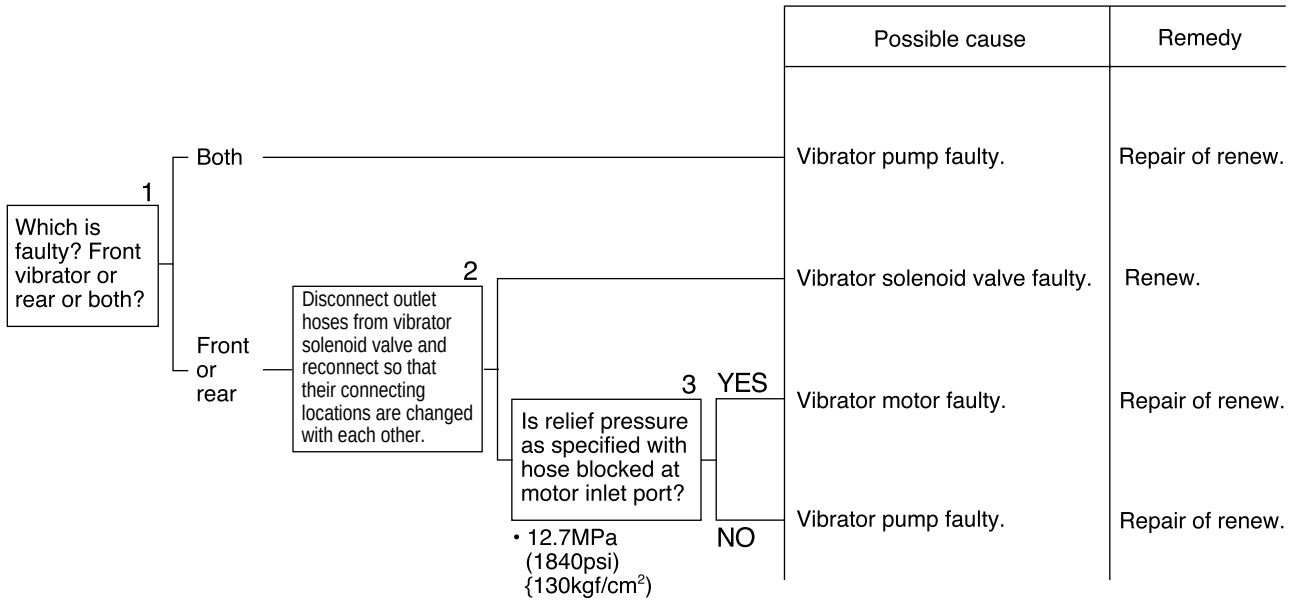


b) Faulty in one travel direction only.



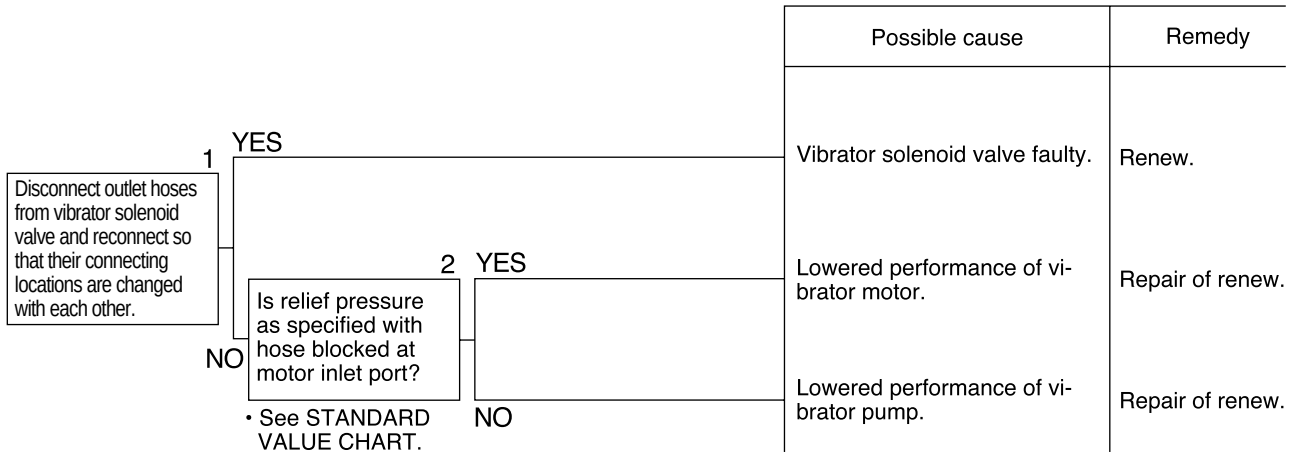
H-05 Vibrator does not work

★Diagnose electric systems first then use procedures as listed bellow.



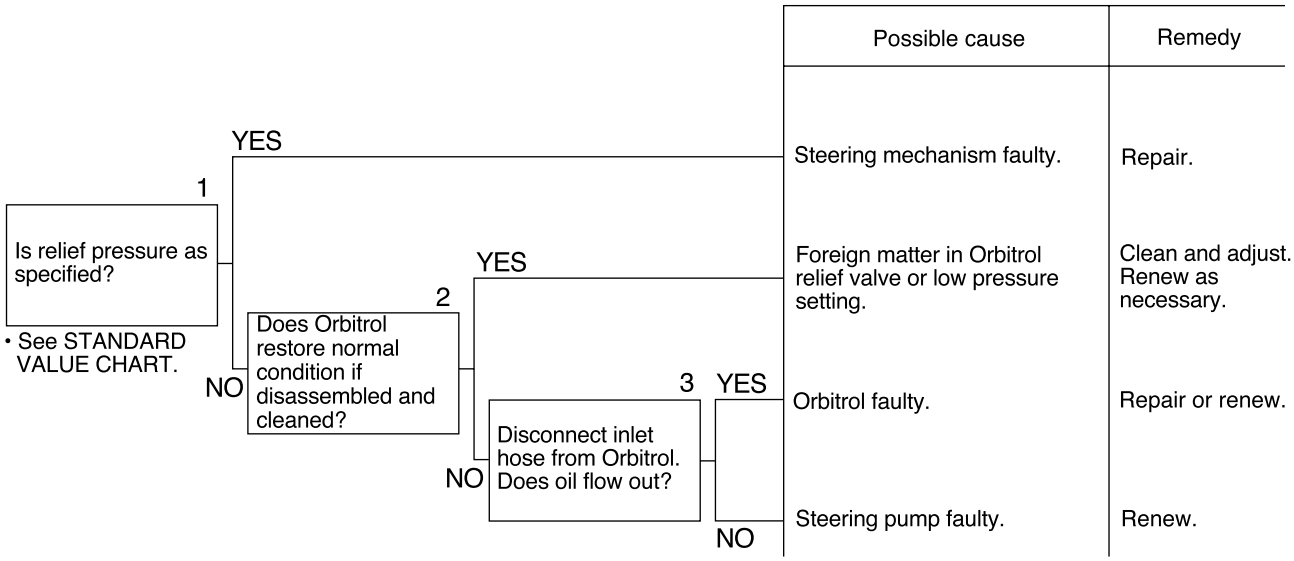
H-06 Weak vibratory force

★Diagnose electric systems first then use procedures as listed bellow.



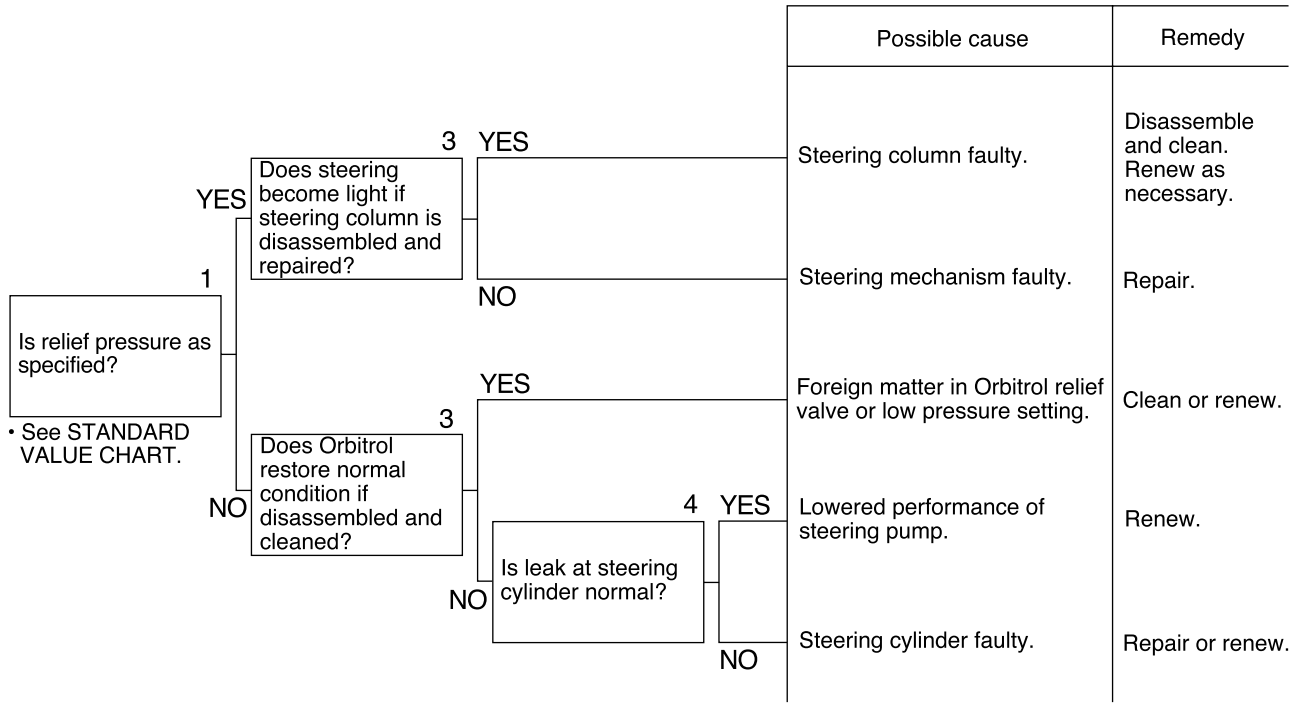
H-07 Steering not performed

★Check oil level in hydraulic tank first.



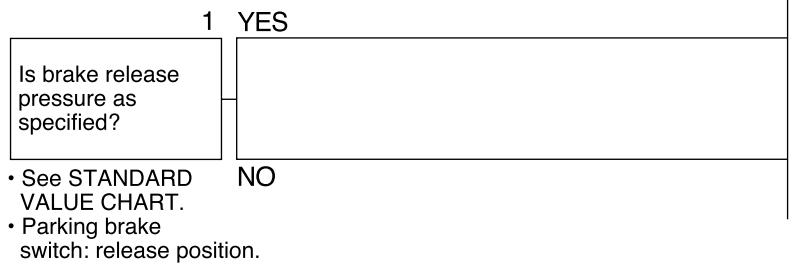
H-08 Heavy or slow steering

★Check oil level in hydraulic tank first.



H-09 Parking brake not applied sufficiently

★Diagnose electric systems first then use procedure as listed below.

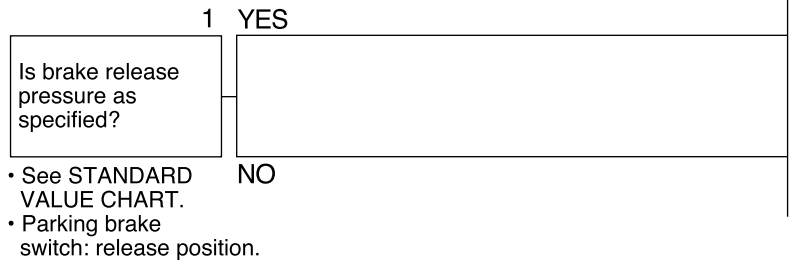


- See STANDARD VALUE CHART.
- Parking brake switch: release position.

Possible cause	Remedy
Worn inner parts of parking brake.	Repair or renew.
Parking brake release solenoid valve faulty.	Clean or renew.

H-10 Parking brake not released

★Diagnose electric systems first then use procedure as listed below.

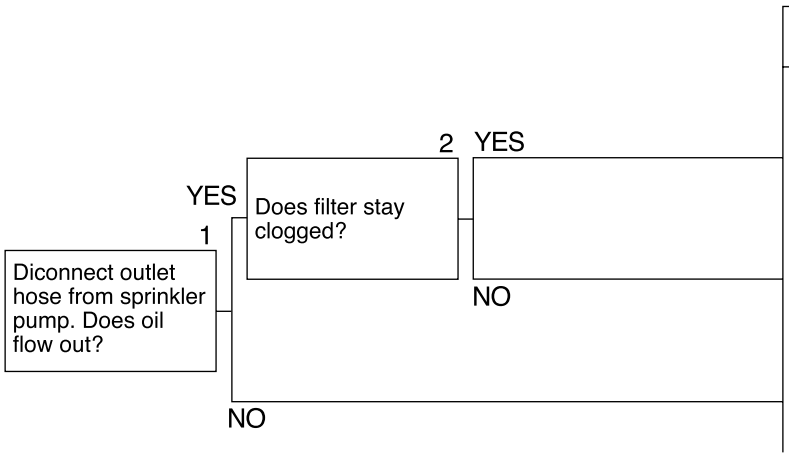


- See STANDARD VALUE CHART.
- Parking brake switch: release position.

Possible cause	Remedy
Parking brake piston seal faulty or warped discs or plates.	Renew motor.
Brake release solenoid valve faulty.	Clean and repair. Renew as necessary.

H-11 No sprinkling on tires

★Diagnose electric systems first then use procedure as listed below.



Possible cause	Remedy
Filter clogged.	Renew.
Hoses or nozzles clogged.	Clean or renew.
Sprinkler pump faulty.	Renew.

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