

SERVICE MANUAL



MRH 601DS VIBRATION ROLLER

MAINTENANCE ○ DISASSEMBLY DIAGRAMS ○ TROUBLESHOOTING



CALIFORNIA

Proposition 65 Warning:



Engine exhaust and some of its constituents, and some dust created by power sanding, sawing, grinding, drilling and other construction activities contains chemicals known to the State of California to cause cancer, birth defects and other reproductive harm.

Some examples of these chemicals are:

- Lead and lead-based paint.
- Crystalline silica from bricks.
- Cement and other masonry products.
- Arsenic and chromium from chemically treated lumber.

Your risk from these exposures varies, depending on how often you do this type of work. To reduce your exposure to these chemicals: ALWAYS work in a well ventilated area, and work with approved safety equipment, such as dust mask that are specially designed to filter out microscopic particles.

1. PRECAUTIONS TO OBSERVE BEFORE SERVICING

- Proper maintenance must always be done on the vibration roller to ensure its safe operation. Improper maintenance could possibly lead to a serious accident. Therefore, always keep the machine in the best possible condition.
- Always stop engine before inspecting it and proceed with the inspection once the engine and parts are cooled down. Remove the radiator cap only after the engine has been cooled down.
- Do not service the machine under direct sunlight, and service it on a level surface that is free of dust.
- If there is some chance that the paint and components of the machine could be stained or damaged, cover them or provide them with some other form of protection.
If you dismantle or disassemble the machine, make sure you first know what the machine looks like in its assembled state.
- If you perform maintenance on the roller with it jacked up, always be sure apply its brakes and take other such safety precautions.
- If you hoist the roller with a crane, attach a wire to its designated lift point(s) and lift it from there. This will prevent other parts of the roller from being damaged.
- When you disassemble parts containing oil seals and O-rings, replace oil seals and o-rings with new ones every time.
- When you tighten bolts and nuts, apply screw lock glue (Loctite 243, 263) in accordance with the instructions, and tighten them at their designated torques (see the tightening torque list). When you apply the screw lock glue, wipe off the grease from the threads.
Loctite generally sets in 5-15 minutes at room temperature (20-25 °C), and reaches field use strength within 1-3 hours. Temporarily tighten the bolt/nut first, and then fully tighten it within 5 minutes.


**Caution: The screws used on this machine are right-handed threads, except the screws for the following.
The turnbuckle for the travel cable on the hydraulic pump side.**





- If you need to heat up the bolts when disassembling the roller, do not reuse them afterwards.
- When removing hydraulic pipes, always release pressure within the hydraulic piping circuit first. If you remove pipes while the pressure within the circuit is high, you could be hit by a hose still under hydraulic pressure and be injured.
- If you will push the roller by hand, see the unloader operations on page 13.

Caution: Never tow the roller with a vehicle. This could damage its hydraulic system.

- When you work on the electrical system, disconnect the negative terminal of the battery.
(negative ground on this machine).
- After you finish maintenance, check the installation of the safety components and check their safety. Check that you have left no bolts or nuts untightened.

2. WARNING LABELS

The  symbols in this manual and on the labels affixed on the roller are warning symbols. Be safe and always heed these labels.

	Denotes a bodily hazard
 DANGER	Indicates an extremely hazardous situation which, if not avoided, could result in death or serious injury.
 WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in moderate or minor injury.
CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage.

3. Safety precautions associated with the maintenance of this equipment

3.1 General precautions

WARNING

- Roller operation
To operate the roller you must meet the requirements stipulated in the Industrial Safety and Health Act.
- Do not operate the roller under the following conditions.
 - If you do not feel well due to overwork or physical illness.
 - If you are taking medication.
 - If you are under the influence of alcohol.
- Wearing protective gear
When servicing the roller, wear the proper clothing. Also, wearing oil stained work clothes is dangerous as they easily catch fire.
- Work area
 - You should perform maintenance on a solid, flat area.
 - You should always keep your work area organized and clean, and wipe away grease and oil off the floor. This will allow you to perform maintenance safely.



DANGER

- Fire prevention
 - Use non-flammable oils and greases to clean parts.
 - Open flame that poses an ignition risk is strictly prohibited. In particular, do not handle combustibles like fuel and paint near open flame.
 - Smoking during work is prohibited.
 - Have a fire extinguisher at the ready.
- Ventilation precautions
A poorly ventilated area poses a gas poisoning hazard. Provide adequate ventilation when handling fuel and types of paints, and especially to deal with the exhaust from the engine.
- High hydraulic pressure precautions
When you remove a hydraulic pipe, stop the engine. Then, loosen the cap for the oil tank and relieve any internal pressure.
- Battery
 - Battery gas poses an explosion risk. Do not have sparks or open flames near the battery.
 - Battery fluid is very toxic. Handle it with care. If you accidentally get battery fluid on your skin, into your eyes or on your clothing, rinse with lots of water and seek medical attention.

CAUTION

- Burn precautions
 - While the engine of the roller is running and directly after turning it off, the body of the engine and muffler are extremely hot. Do not touch them when they are hot.
 - Removing the radiator cap when the engine is hot is extremely dangerous. Remove the cap after you let the engine cool.

4. Specifications

Roller body

Model			MRH-601DS	
Chassis dimensions	Overall length (when being run)		89.17 in	2265 mm
	(when stowed)		52.36 in	1330 mm
	Overall height (when being run)		47.05 in	1195 mm
	(when stowed)		67.13 in	1705 mm
	Overall width		27.24 in	692 mm
Drum base	Drum diameter		13.98 in	355 mm
	Drum width		25.59 in	650 mm
Drum base			20.47 in	520 mm
Compaction width			25.59 in	650 mm
Machine weight			1181.67 lbs	536 kg
Travel speed			1.86 mph	0~3 km/h
Max. gradeability				35(20) % (deg.)
Vibration frequency				55(3300) Hz (V.P.M)
Centrifugal force			2428 lbs	10.8(1100) kN (kgf)
Front drum				34.9(3.6) N/cm
Rear drum				46.2(4.7) kgf/cm)
Front drum				118(12.0) N/cm
Rear drum				129(13.2) kgf/cm)
Water tank capacity			7.92 gallons	30 L
Oil tank capacity			5.8 gallons	22 L
Hydraulic oil(Idemitsu Daphne Super Hydro46A)				
Belt size & number used		No. of belts	A-36(Red)x1	

Engine

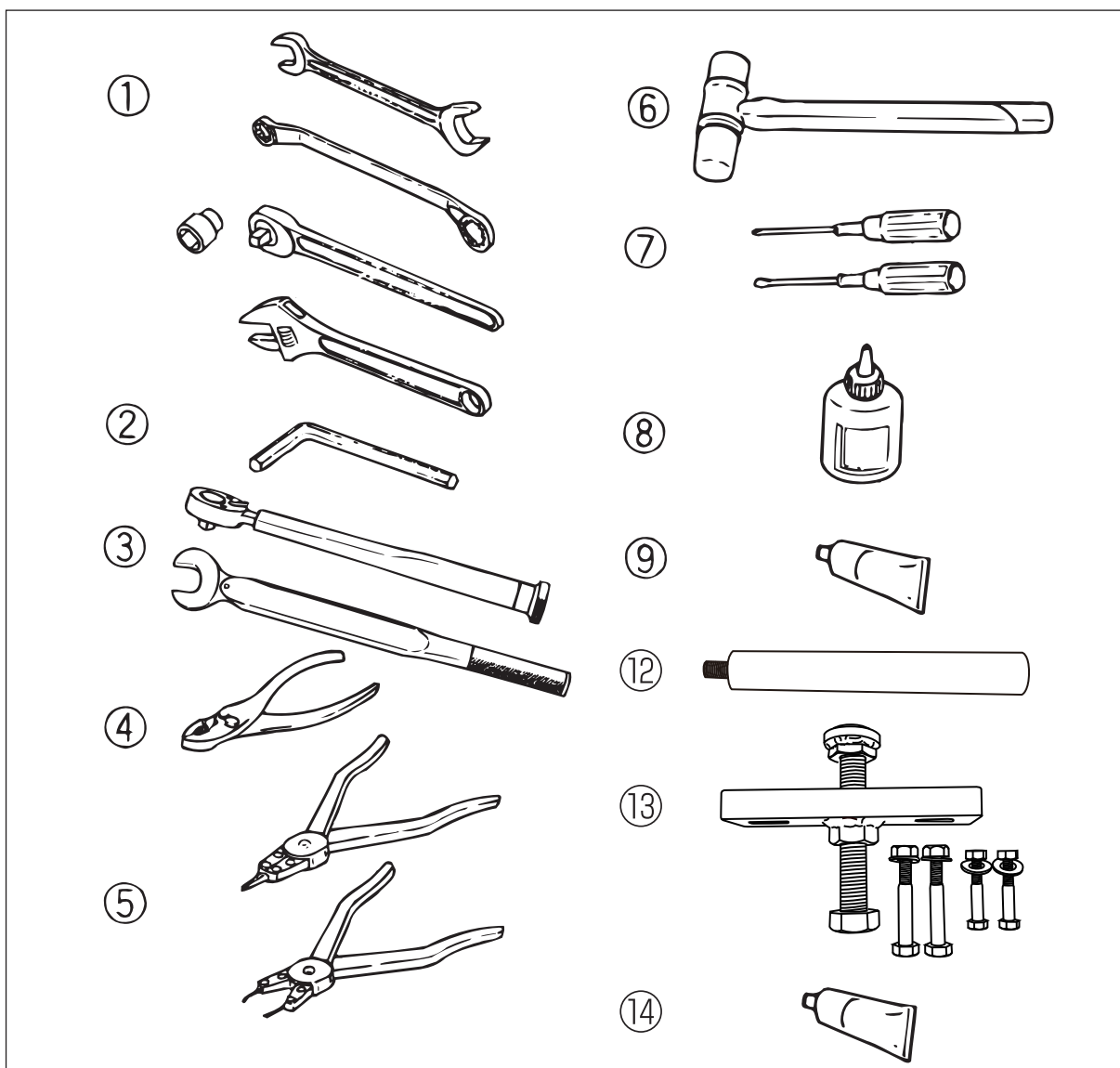
Name of manufacturer		Kubota	
Model		EA330-E3-NB3-HGMS-1	
Max. output	kw/min-1	4.6/2500 kw/min-1	
Starting system		Electric start	
Max. set rpm		2650 rpm	
Fuel tank capacity	5.06 Q	4.8 L	
Fuel consumption	1.8 Q/h	1.7 L/h	
Engine oil amount (Coolant amount)	1.7 Q (water 1.27 Q)	1.3 L (water 1.2 L)	

Hydraulic pump

Name of manufacturer		Poclain	
Model		PMV0-09	

5. LIST OF DISASSEMBLY AND ASSEMBLY TOOLS

- | | | |
|------------------------------------|------|---|
| ① Open end wrench | 7 mm | ④ Pliers |
| Box end wrench | 10mm | ⑤ Stop ring pliers -external- |
| Socket wrench | 13mm | Stop ring pliers -internal- |
| Monkey wrench | 14mm | ⑥ Metal hammer, plastic hammer |
| | 17mm | ⑦ Screwdriver |
| | 19mm | ⑧ Thread locker (Loctite 243, 263) |
| | 22mm | ⑨ Liquid gasket (ThreeBond 1215) |
| | 24mm | ⑩ Lithium complex grease (Shell Stamina EP) |
| | 27mm | ⑪ Press |
| | 30mm | ⑫ Special tool (vibrator frame pulley not included) |
| | 46mm | ⑬ Special tool (drum bracket not included) |
| ② Hexagonal wrench | 3mm | ⑭ Liquid gasket (Loctite 575) |
| | 5mm | |
| | 6mm | |
| | 10mm | |
| ③ Box end torque wrench | | |
| Open end torque wrench (for pipes) | | |



6. LIST OF TIGHTENING TORQUES

6.1 Tightening torques for bolts and nuts

1. Standard tightening torques

Screw diameter		6mm (P1.0)	8mm (P1.25)	10mm (P1.5)	12mm (P1.75)	14mm (P2.0)	16mm (P2.0)
Tightening torque	Material strength class (10.7)	12.54 lb-ft	25.08 lb-ft	57.53 lb-ft	87.03 lb-ft	130.54 lb-ft	202.83 lb-ft
		17 N•m	34 N•m	78 N•m	118 N•m	177 N•m	275 N•m
	Material strength class (7.7)	8.85 lb-ft	18.44 lb-ft	36.14 lb-ft	36.14 lb-ft	93.67 lb-ft	—
		12 N•m	25 N•m	49 N•m	79 N•m	127 N•m	—

2. Anti-vibration rubber between the base and the side plate	Tightening torque	130.55 lb-ft (177 N•m)
3. Pendulum bolt for the vibrator frame	Tightening torque	57.53 lb-ft (78 N•m)
4. M10 bolt for the vibrator frame pulley	Tightening torque	36.14 lb-ft (49 N•m)
5. M4 mounting bolt for the micro switch protective cover	Tightening torque	1.11 lb-ft (1.5 N•m)

Caution: For all other bolts other than those for items 2-5, tighten with the standard torques found in item 1.

6.2 Tightening torque of hydraulic pipes

1. Metal joints for pipes

Size	Tightening torque	Tightening torque for lock nut on roller connection side
1/4 (pipe screw)	18.44 lb-ft (25 N•m)	28.76 lb-ft (39 N•m)
3/8 (pipe screw)	36.14 lb-ft (49 N•m)	36.14 lb-ft (49 N•m)
1/2 (pipe screw)	43.52 lb-ft (59 N•m)	43.52 lb-ft (59 N•m)

2. Interlocking metal joint

Size	Tightening torque	Tightening torque for lock nut on roller connection side
1/4 (pipe screw)	27.29 lb-ft (37 N•m)	28.76 lb-ft (39 N•m)
3/8 (pipe screw)	58.27 lb-ft (79 N•m)	36.14 lb-ft (49 N•m)
1/2 (pipe screw)	88.51 lb-ft (120 N•m)	43.52 lb-ft (59 N•m)

7. REMOVING AND INSTALLING THE DRIVE SYSTEM (DRUM, DRIVE MOTOR)

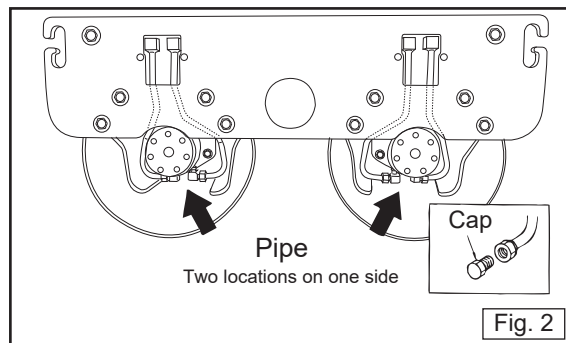
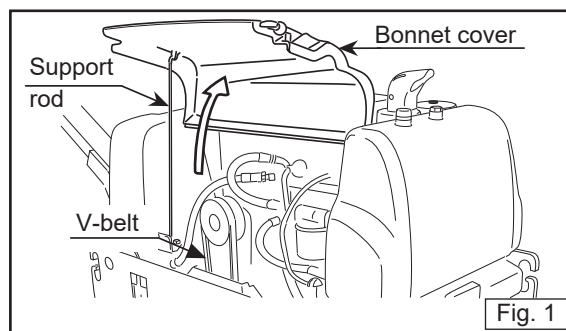
7.1 Disassembling

(1) Precautions to observe before disassembling

1. Make sure you do the following items to facilitate the safe disassembly of the roller.
 - a. Work on a level surface like on concrete pavement.
 - b. Check that no part of the roller swings up or down, or rattles at any of its four corners. If a part of the chassis moves up or down, mud or something else could possibly be on the drum(s), or the surface of the ground is possibly uneven. Remove the mud, or move the roller to another work area.
2. Secure the roller by placing chocks in the front and back of the drums.
3. Turn off the engine and then perform maintenance.

(2) Removing the drum

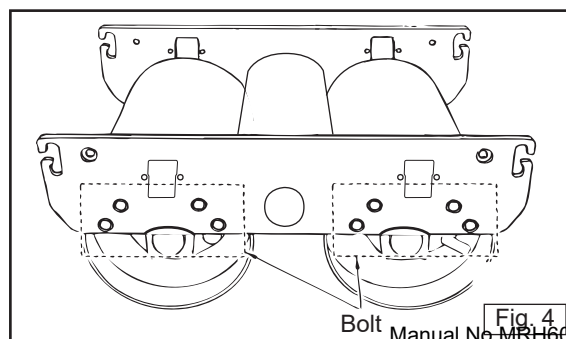
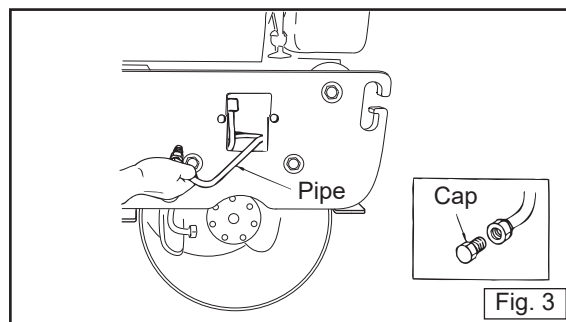
1. Open the bonnet cover and remove the V-belt. (Fig. 1)
MRH-601 V-belt A-36 x1
2. Remove the wire rope.
Remove the bolts 12x35 (x2) and remove the two wire ropes (both front and back).
3. Disconnect the pipes (both drums) and oil hose connecting with the inner side of the frame on the bonnet side (pipes coming from the oil motor). When doing this, be careful not to bend the pipes.



CAUTION

Clean the joints before removing the pipes.
Place a cap on the joint of the pipe that you removed to prevent oil from leaking out of it or debris from entering into it.

4. Remove the pipe guard (x2) and pipe holder (x2) and remove the 4 pipes sticking out from the oil motor. Pull out the pipes from the openings in the frame. When doing this, be careful not to bend the pipes. (Figs. 2, 3)
5. Use a crane to lift the vibration roller by its single point suspension hook to the point at which the drum nearly floats off the ground.
6. Remove the mounting bolts 14x30 (x16) for the frame and drum bracket. (Fig. 4)



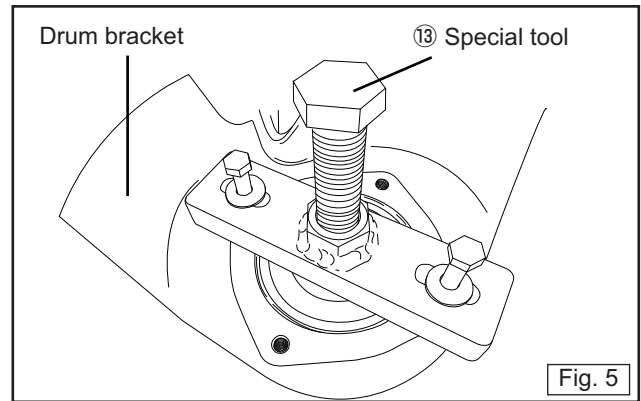
(3) Disassembling the drum

Drum disassembly is simple to perform if you stand the drum vertically.

Refer to figure 7 below during disassembly.

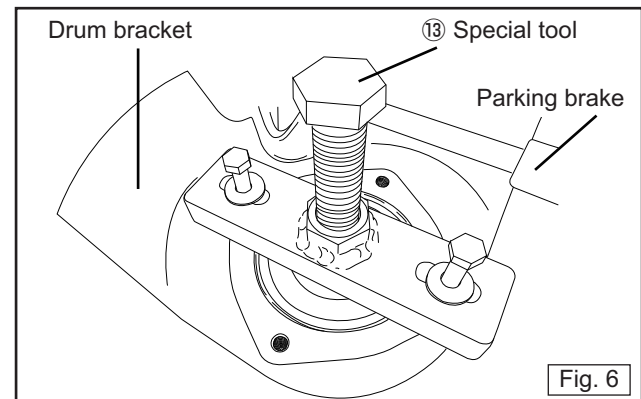
Disassembly on the drive motor side

1. Remove the drive motor.
(Mounting bolt (35) 10x35-4 boltsx2)
2. Remove the drum bracket from the flange (spline).
※ Use special tool ⑬ (Fig.5)
3. Remove the flange (spline) from the drum.
(Mounting bolt (18) 10x30-6 boltsx2)
4. Remove the bearing cover for the bearing bracket.
Remove the bearing and oil seal.
(Mounting bolt (23) 8x25-4 boltsx2)



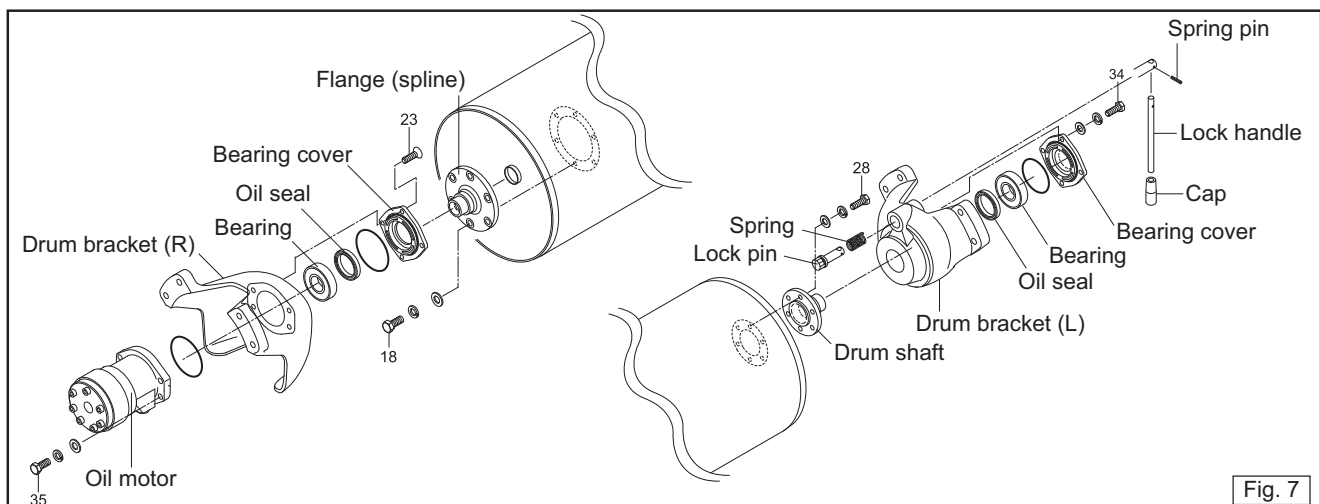
Disassembly of the drive motor free side

1. Remove the bearing cover.
(Mounting bolt (34) 8x25-4 boltsx2)
2. Remove the drum bracket from the drum.
※ Use special tool ⑬ (Fig.6)
3. Remove the drum shaft from the drum.
(Mounting bolt (28) 10x30-6 boltsx2)
4. Remove the bearing and the oil seal.



(4) Disassembling the parking brake

1. Pull out the spring pin from the lock pin and remove the lock handle.
2. Take out the lock pin and spring from the drum bracket.



7.2 Assembly

(1) Assembly

1. Assemble in the reverse order of the disassembly steps.
2. You should assemble the drums on a flat surface such as concrete pavement.
3. Thoroughly clean the disassembled parts and degrease their threads.
4. Degrease the bolts and nuts, and then apply Thread locker (Loctite 263) to them. Refer to the tightening torque list and tighten them at their prescribed torques.
5. Grease the bearings, lip surface of the oil seal, and the spring for the parking brake and then assemble them.

CAUTION

Make sure you install the oil seal in the correct direction as water, debris and other foreign matter may get past it.

Once disassembled replace the oil seals with new ones.

6. Clean off paint and debris sticking to the frame, and mounting surface of the drum bracket and scraper bracket before proceeding with assembly.
7. When installing the anti-vibration rubber to the frame, be careful not to twist and misalign it.
8. The oil pipes and hoses are assembled by the following procedure. If you forcibly assemble them without temporary attaching and positioning check for them, it might cause damage for them and oil leaks.
 - a. Attach the oil pipes (37, 38) to the each oil motors (33) temporarily. (Fig. 9)
 - b. Attach the oil pipe (44) and oil hoses (28, 29) from the variable pump (24) to the oil pipes (37, 38) in "a" temporarily. (Fig. 9)
 - c. Assemble the pipe holders (39) to the frame. (M8, Tightening torque: 25.08lb-ft 34N•m) (Fig. 10)
 - d. Assemble the pipe guards (41) to the each pipe holders (39) after checking parallelism of the oil pipes (37, 38). (M10, Tightening torque: 57.53lb-ft 78N•m) (Fig. 10)
 - e. Tighten the oil pipe (44) and oil hoses (28, 29) that attached temporarily in "b". (3/8 pipe screw, Tightening torque: 58.27lb-ft 79N•m) (Fig. 9)
 - f. Tighten the oil pipes (37, 38) that attached temporarily in "a". (3/8 pipe screw, Tightening torque: 36.14lb-ft 49N•m) (Fig. 9)

CAUTION

If you install (fully tighten) the oil pipes and oil hose before you mount (fully tighten) the pipe guards, the oil pipes and oil hose could be bent or damaged. Also, it will cause gaps to form in the pipes which will cause them to leak.

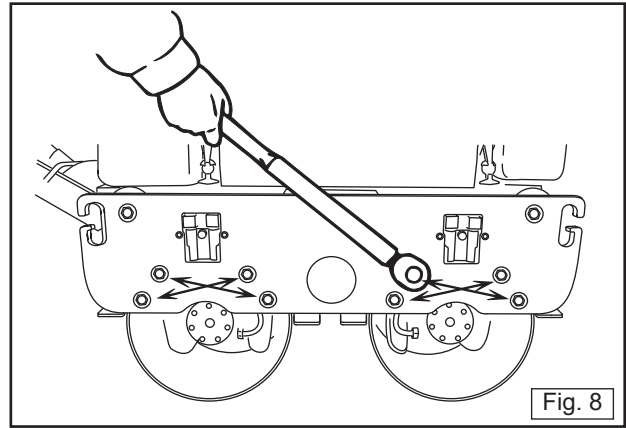


Fig. 8

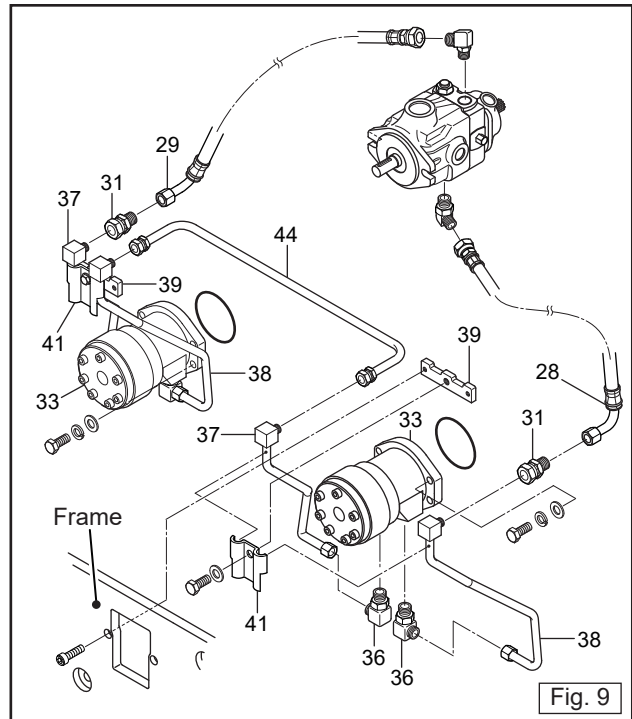
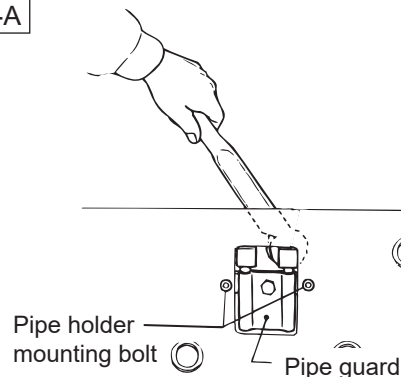


Fig. 9

10-A



10-B

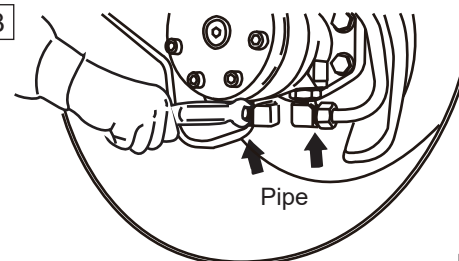


Fig. 10

8. DISASSEMBLING AND ASSEMBLING THE VIBRATOR FRAME SYSTEM

8.1 Disassembling the vibrator

1. Use the hammer to remove the seal cap (4) attached to the frame. (Fig. 11)

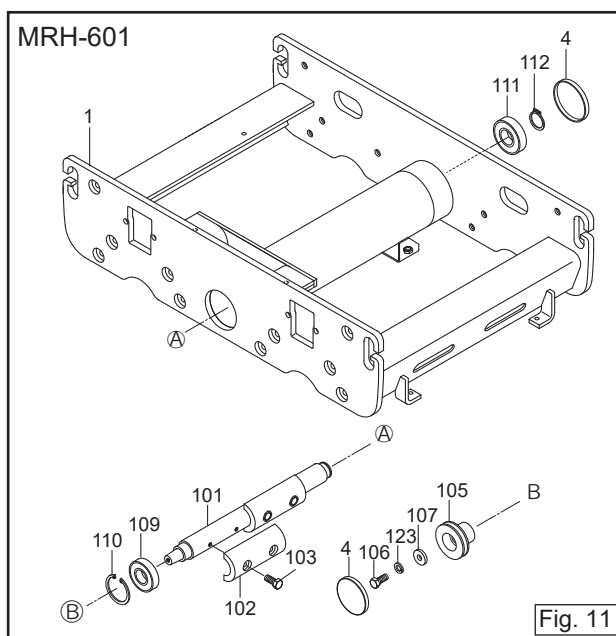
CAUTION

When taking off the seal cap, if it is bent or damaged, make sure that you replace it with a new one.

2. Remove the bolt (106) and remove the pulley (105) with the special tool ⑫. (Fig.11, 12)
3. Remove the stop ring (110) on the pulley side and pull out the rotary shaft (101) from the frame (1). (Fig. 11, 12)

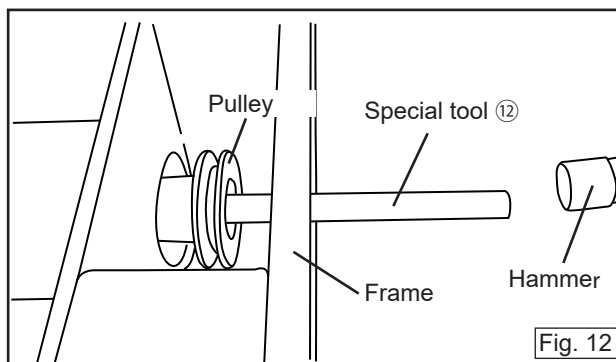
The rotary shaft (101) can be removed easily with the special tool ⑫ like removing the pulley (105).

4. Remove the Eccentric rotators (102), stop ring (112), and the bearings (109, 111) from the rotary shaft (101). (Fig. 11)



8.2 Assembling the vibrator

1. Assemble in the reverse order of the disassembly steps
2. Thoroughly clean the disassembled parts and make sure degrease to their threads. If the seal cap (4) is bent or damaged, replace it with a new one.
3. Grease the mating surfaces of the bearings (109, 111) and seal cap (4) and then assemble them.
4. Attach the Eccentric rotators (102) to the rotary shaft (101).
(Bolt (103) 10×30-2 bolts×2)
(Tightening torque 36.14lb-ft 79N•m)
5. When you assemble the seal cap (4), do not hit the seal cap (4) directly with a hammer.
Place an iron plate on it and hit the iron plate so that the seal cap assembles into place uniformly (frame and surface position).
6. When you assemble the pulley (105), degrease the bolts and nuts, and apply Thread locker (Loctite263) to them.
(Tightening torque 36.14lb-ft 79N•m)



9. REMOVING AND INSTALLING THE ENGINE AND THE VARIABLE PUMP

9.1 Precautions to observe before disassembly

1. Always perform maintenance after you turn off the engine.
2. Turn off the key switch and remove the negative terminal from the battery. (Fig. 13)
3. Do not lift the vibration roller with lifting hook equipped on the engine. It might cause an accident and damage of the roller and engine.

9.2 Removing the variable pump

1. If you replace the variable pump, remove the push – pull cable, then remove all of oil hoses that are connected to the variable pump.
2. Remove the electromagnetic clutch (101) that is attached to the hydraulic pump. (Fig. 15)
3. Remove the bolts (x4) for the pump bracket, and pull out the variable pump AY from the center flex (91) that is fixed to the engine drive shaft. (Fig. 14, 15)
4. Remove the mounting bolts (25) (x2) for the variable pump and the pump bracket, and then separate the variable pump and the pump bracket. (Fig. 15)
5. Loosen the bolt (37) for the PV lever (35) mounted to the trunnion shaft of the variable pump (24) and remove the PV lever (35) after removing the spring pin (36). (Fig. 15)

9.3 Removing the engine

1. Remove the engine guard (109) and water tank (22). (Fig. 14)
2. Open the bonnet cover (16) and remove the battery (11). (Fig. 14)
3. Remove the speed throttle wire (103) and all electrical cables connected to the engine. (Fig. 14)
4. Remove the engine flange (106). (Fig. 14)
5. Remove the engine mounting bolts (102) (x4) and remove the engine with lifting hook equipped on the engine from the roller.

9.4 Assembly

1. Assemble in the reverse order of the disassembly steps.
2. Thoroughly clean the disassembled parts and degrease their threads.
3. Degrease the bolt and apply screw lock glue to it. Then, tighten it to its prescribed torque. (See the tightening torque list in fig. 16)
4. Assemble the engine, variable pump and pump bracket after checking their position so that the center flex (91) will not deform.

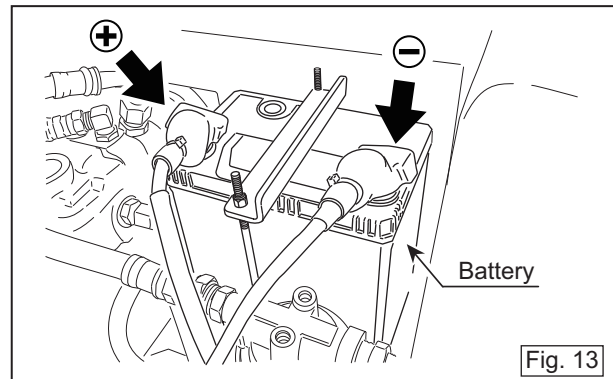


Fig. 13

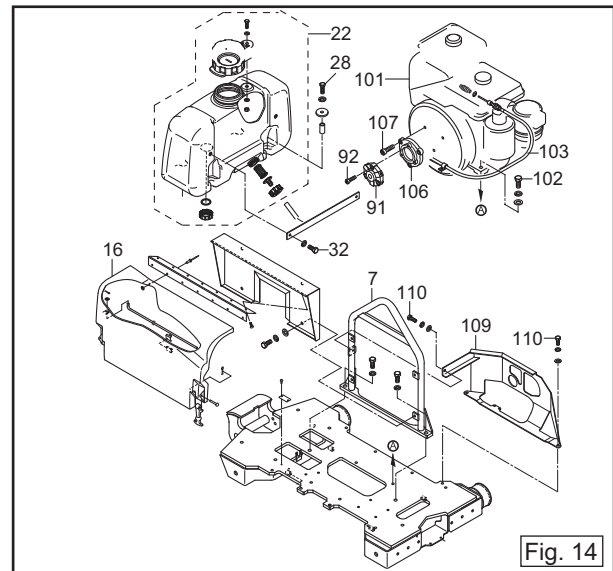


Fig. 14

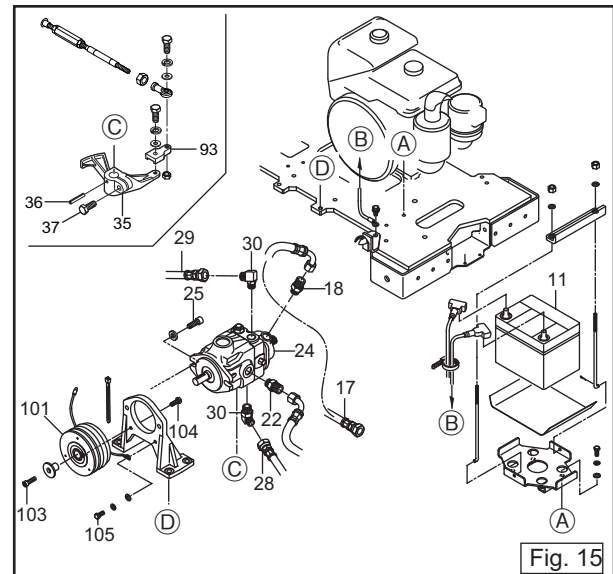


Fig. 15

Coupling flange attachment bolt.....	78 N•m
(apply Loctite 243)	
Mounting bolt to the bracket for the hydraulic pump.....	49 N•m
(apply Loctite 243)	
Engine mounting bolt	49 N•m
(apply Loctite 243)	
Pump bracket mounting bolt	49 N•m
(apply Loctite 243)	
Center flex	25 N•m

Fig. 16

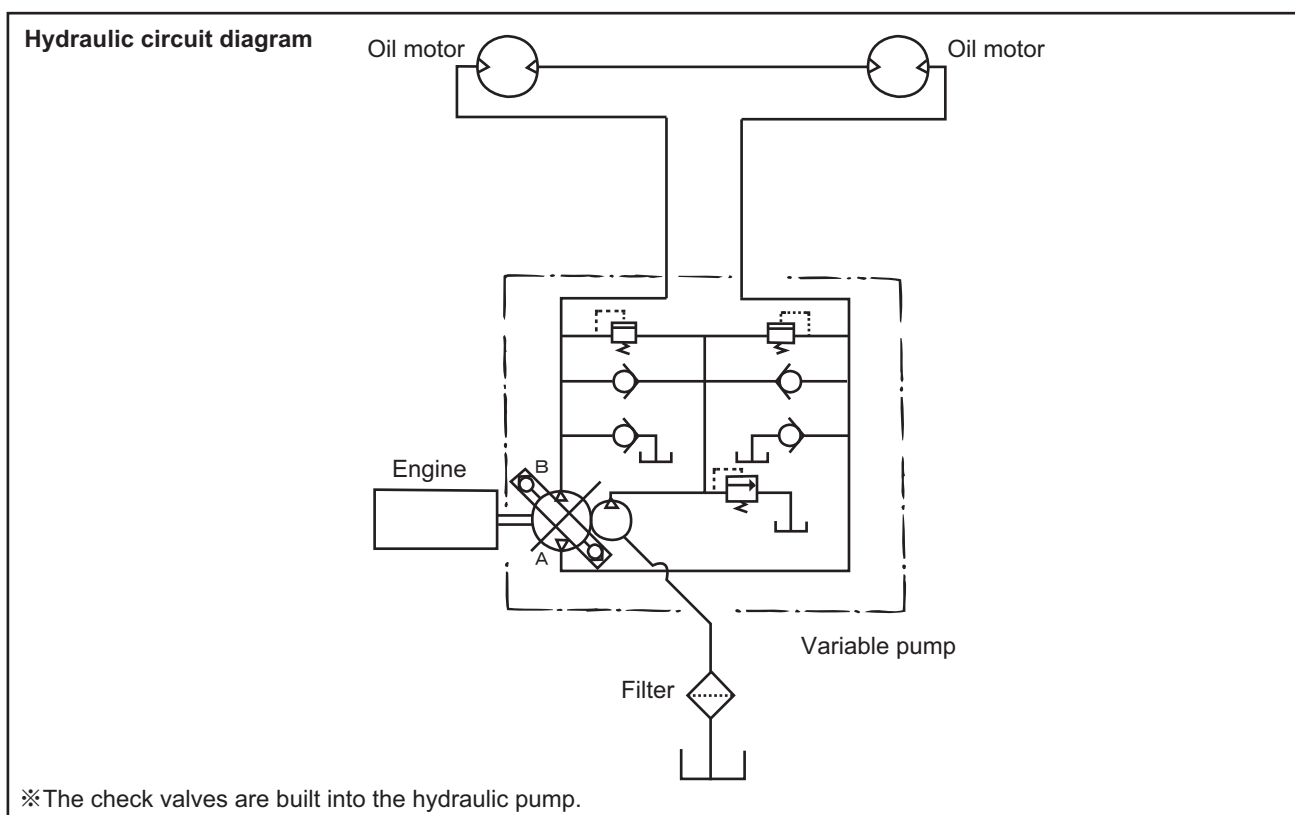
10. DISASSEMBLING AND ASSEMBLING THE HYDRAULIC DRIVE SYSTEM

10.1 Structure

The vibration roller has the variable pump and the oil motor for travel. The variable pump is assembled to the engine output shaft through the rubber coupling (center flex). The hydraulic pressure is generated by rotating the variable pump. Depending on the hydraulic pressure generated, the hydraulic oil is supplied to the oil motor built into the drum bracket and the oil motor rotate. The drum is rotated by rotating the oil motor and the vibration roller is driven.

With regard to forward and reverse travel and the travel speed of the vibration roller, when moving the travel lever on the handle to forward position, the swash plate in the variable pump tilt, and the hydraulic oil is supplied to the oil motor, and the vibration roller move forward. When moving the travel lever to forward position largely, the swash plate in the variable pump is tilted largely too, and the hydraulic oil is increased to supply to the oil motor, and the forward speed of the vibration roller is increased. In case of moving the travel lever to backward position, the swash plate in the variable pump is tilted to backward too, and the suction port and the discharge port are reversed, and the vibration roller is driven in reverse.

10.2 Hydraulic circuit diagram



10.3 Specifications

Hydraulic pump specifications (MRH-601 common specifications)

Pump model	Name of manufacturer	Max. discharge	Max. relief Set pressure	Charge pump Discharge	Charge relief setting pressure
PMV0-09	Poclain	9cc/rev	150 kgf/cm ²	3.2 cc/rev	8 kgf/cm ²
◎ Oil used: Uses ISO VG46					(1,800 rpm/h)

※ Contains Idemitsu Daphne Super Hydro A when shipped from the factory.

Hydraulic drive motor specifications

Model	Motor type	Name of manufacturer	Gerotor width (mm)	Displacement (cm ³ /rev)	MAX pressure ΔP(kgf/cm ²)
MRH-601	S-300	Eaton	38.5	299	126

10.4 Inspection and Maintenance of hydraulic system

(1) Inspection of the hydraulic system

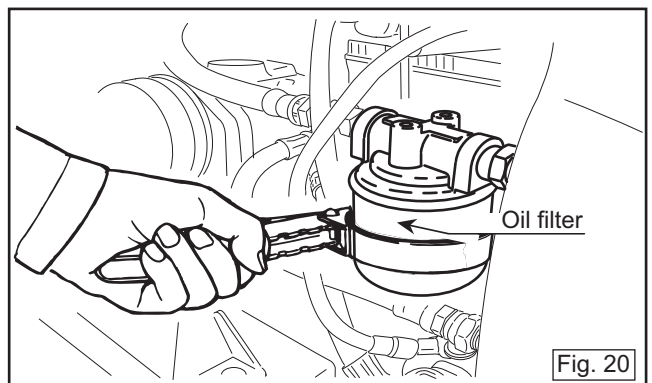
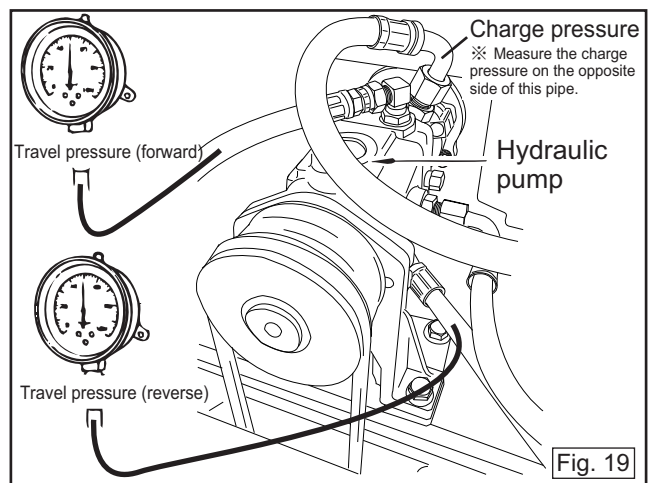
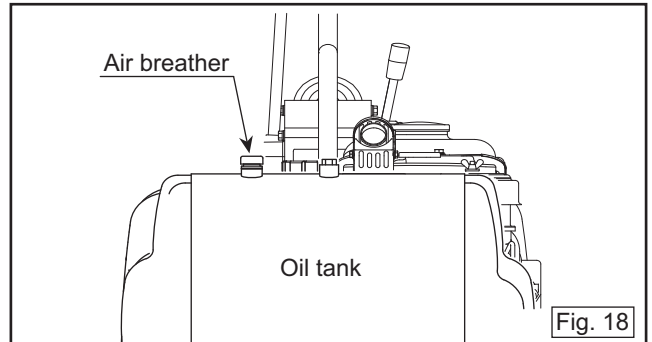
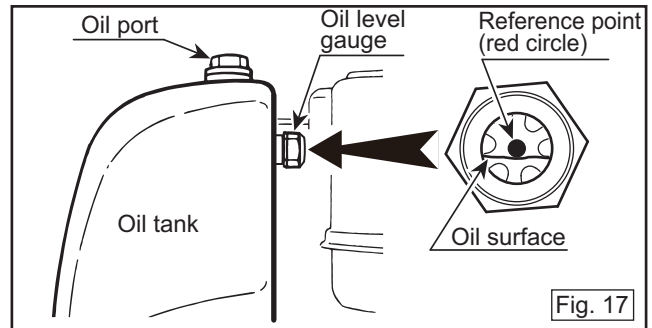
1. Inspect for any scratches or damage to the variable pump and oil motor.
2. Inspect for any loose or leaking oil hose and pipes.
3. Check that the hydraulic oil is the specified amount in the oil tank and its conditions (cloudy or emulsifying). If the hydraulic oil is cloudy, it is air entrainment in the variable pump. Therefore, retighten the pipes and add the hydraulic oil until the specified amount. If the hydraulic oil is emulsified, the water is mixed with the hydraulic oil. Therefore, replace it with new one. (Fig.17)
4. There is an air breather onto the oil tank and place a cover to prevent water entry into the oil tank. Make sure the cover does not fall off due to high pressure cleaning and other activity. (Fig. 18)
5. Inspect the oil filter to see whether the filter is dirty or damaged. The variable pump and oil motor may get damaged if the filter paper is damaged or if there are metal particles in it.
6. Pressure measurement (Fig. 19)
 - Traveling pressure measurement
Measurement procedure: full speed traveling in both forward and reverse
 - Port size 1/8 (JIS G 1/8)
(the engine has a maximum set rpm)
 Measurement reference value: 20-40bar (2-4Mpa)
(Temperature 20°C on concrete paved surface)
 - Charge pressure measurement (Temperature 20°C)
 - Port size 1/4 (JIS G 1/4)
 Measurement reference value: 8-10 bar (0.8-1Mpa)

(2) Maintenance of the hydraulic system

1. Replacing the oil filter (Fig. 20)
Around the first 50 hours
Replace the filter every 300 hours thereafter.

Caution: Oil filter - Use only genuine Mikasa filters (10 μ filter paper). In addition, when the suction resistance of the filter has exceeded 0.4 bar (hydraulic oil temperature 60°C) you should replace it with a new one.

2. Replace every 1000-1500 hours depending on the replacement load of the hydraulic oil. Remove the drain plug and hose connection for the oil tank. Drain the old oil and refill with the prescribed amount (22L) of recommended hydraulic oil. When you change the oil make sure not to contain debris and moisture into the oil.



Recommended hydraulic oil : wear resistant hydraulic oil
 Viscosity: ISOVG32 or equivalent (for cold climates)
 ISOVG 46, 56 or equivalent (generally for warm climates)
 (Contains Idemitsu Daphne Super Hydro 46A when shipped from the factory.)

(3) Precautions to observe when assembling the oil pipes

1. When you assemble the pipes, make extra sure that no debris, etc. enters inside the piping circuit.
2. Tightening torque of the pipes / places to apply the liquid gasket (Fig. 21)

- ①.....36.14 lb-ft (49 N•m)
- ②.....43.52 lb-ft (59 N•m)
- ③.....57.53 lb-ft (78 N•m)
- ④.....Liquid gasket (Loctite 575)

- 1...When you install the Elbow 90° plug, check the position of lock nut, whether and O-rings for it are correct or not. Clean the screw, O-ring and the surface of O-ring port for the Elbow 90°plug. Grease the O-ring and screw of the Elbow 90°plug and screw it until contacting of its washer and O-ring port lightly. From this position, adjust the direction of the Elbow 90°plug in the loosening direction and tighten the lock nut. (Tightening torque 43.52lb-ft 59N•m) (Fig.22)

- 2....How to connect the interlocking joints

1. Use a torque wrench to connect the joint. (pre-tighten) (Tightening torque 57.53lb-ft 78N•m)
2. Loosen the sleeve once and check its condition.
If it is undamaged, connect the interlocking joint using a torque wrench. (fully tighten)
(Tightening torque 57.53lb-ft 78N•m)

CAUTION

Reusing a disassembled interlocking joint is acceptable if you did not find any deterioration, cuts or damage on its sleeve.

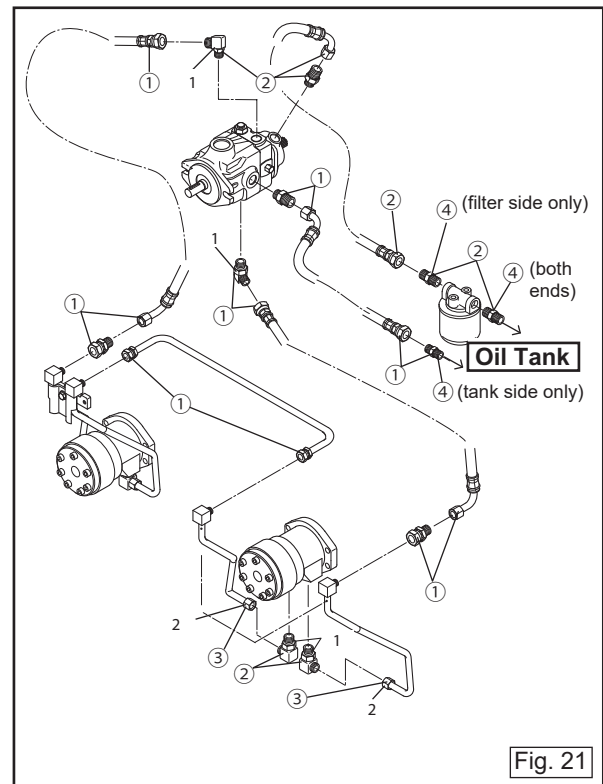


Fig. 21

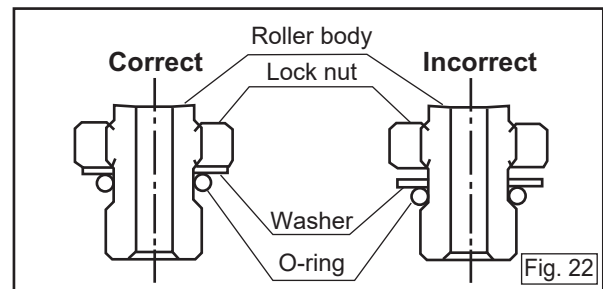


Fig. 22

(4) Operating the unloader (Fig. 23)

CAUTION

Operating the unloader is extremely dangerous. Only operate it in an emergency.

1. When you move the roller by hand after you stop its engine, loosen the bypass valve bolt for the hydraulic pump and you will be able to easily move the unloader.
2. Always re-tighten the bolt after you move the roller. (Tightening torque 62±5.7lb-in 7±0.7N•m)

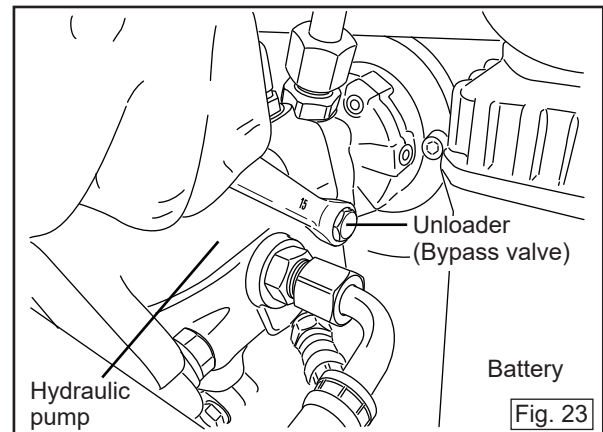


Fig. 23

CAUTION

If you over-tighten the bolt, it could damage the unloader valve tip (inside the pump).

CAUTION

This roller should never be used for towing an automobile or other similar vehicle. This could damage its hydraulic system.

WARNING

Never operate the unloader on a slope. If the parking brake or drum chock are defective, the roller could run away under its own weight.

(5) Faults and their countermeasures

1. The roller does not travel.

- a. Check whether the hydraulic pump shaft is spinning.
- b. Check whether there is hydraulic oil in the oil tank.
 - Add oil if it is low.
 - Check whether the hydraulic oil is cloudy (air is co-mingling) or not.
- c. Check whether the control shaft for the hydraulic pump is operating or not.
 - Inspect the link mechanism, from the travel lever on the handle to the PV lever on the hydraulic pump.
- d. Check whether the charge pressure rises to the measurement reference value.
 - Inspect the charge relief valve.
 - Inspect whether it meets fully and moves smoothly.
 - Measure the charge pressure.
- e. Inspect the check and high pressure relief valves.
 - Inspect whether it meets fully and moves smoothly.
- f. Inspect the hydraulic pump and oil motor.
 - Inspect whether the drive pressure is at the measurement reference value.
- g. Check whether the parking brake disengages.

2. The roller travels in only one direction.

- a. Check whether the control shaft for the hydraulic pump moves in both directions.
 - Inspect the link mechanism, from the travel lever on the handle to the PV lever on the hydraulic pump.
- b. Inspect the check and high pressure relief valves.
 - If it sticks, replace the relief valve to remove the cause of the problem
 - Replace the left and right relief valves, and replace the relief valve on one side if the “non-operated side” moves.
(See Hydraulic pump specifications on P.11)

3. The oil has reached an abnormally high temperature.

- a. Check for hydraulic oil in the oil tank.
 - Add oil if it is low.
 - Check whether the the hydraulic oil is cloudy (air is co-mingling) or not.
- b. The oil filter is clogged.
 - Replace the oil filter.
- c. Inspect the check and high pressure relief valves.
- d. The functionality of the hydraulic pump and oil motor has dropped.
 - If the travel speed of the roller has decreased, the hydraulic pump and oil motor are worn out or damaged.
 - Measure the charge pressure. If it is below the reference value, the hydraulic pump and oil motor are worn out or damaged.

4. The roller produces abnormal sounds.

- a. Check if there is hydraulic oil in the oil tank.
 - Add oil if it is low.
 - Check whether the the hydraulic oil is cloudy (air is co-mingling) or not.
- b. Check that the oil hose and tube assemblies do not vibrate.

11. DISASSEMBLING AND ASSEMBLING THE ELECTRICAL SYSTEM

11.1 Battery

11.1 Battery

CAUTION

When you inspect the battery no source of ignition should be present. The battery produces flammable gas which could explode.

- Servicing the battery
Loose or corroded terminals can cause poor contact. Whenever there is white powder on the terminals, clean it off with warm water and then grease the terminals. Also, whenever the terminals are markedly corroded, clean them with a wire brush or sandpaper. Grease and firmly attach them so that they are not loose.
- Removing and installing the battery (Fig. 24)
Remove the battery by detaching the negative terminal first. Install the battery by first attaching the positive terminal and then the negative terminal.

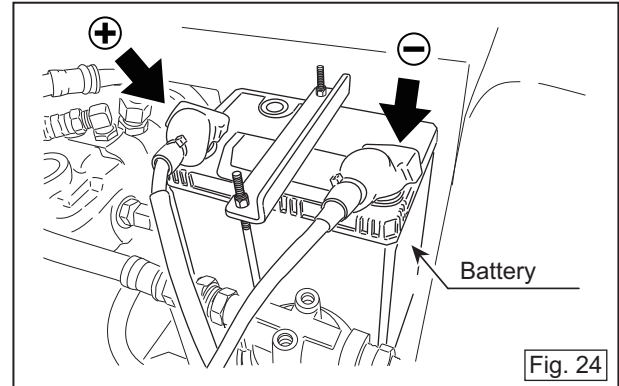


Fig. 24

CAUTION

When connecting the cables, make sure to never short the positive and negative terminals. Also, be careful that if you connect the positive and negative terminals in reverse, you will damage the electrical components.

- Servicing the battery (Check only the exterior for a maintenance-free type battery)
Make sure that the battery is undamaged and has no cracks. If white marks appear on the inside of the battery (sulfation), and if pasty material collects at the base of the battery, replace the battery with a new one.

Specific gravity	Use a hydrometer to measure the specific gravity of the battery fluid. If the specific gravity of the battery fluid is 1.230 or less, charge the battery.
	Full charge: 1.270-1.290
	Partial charge: 1.260 or less

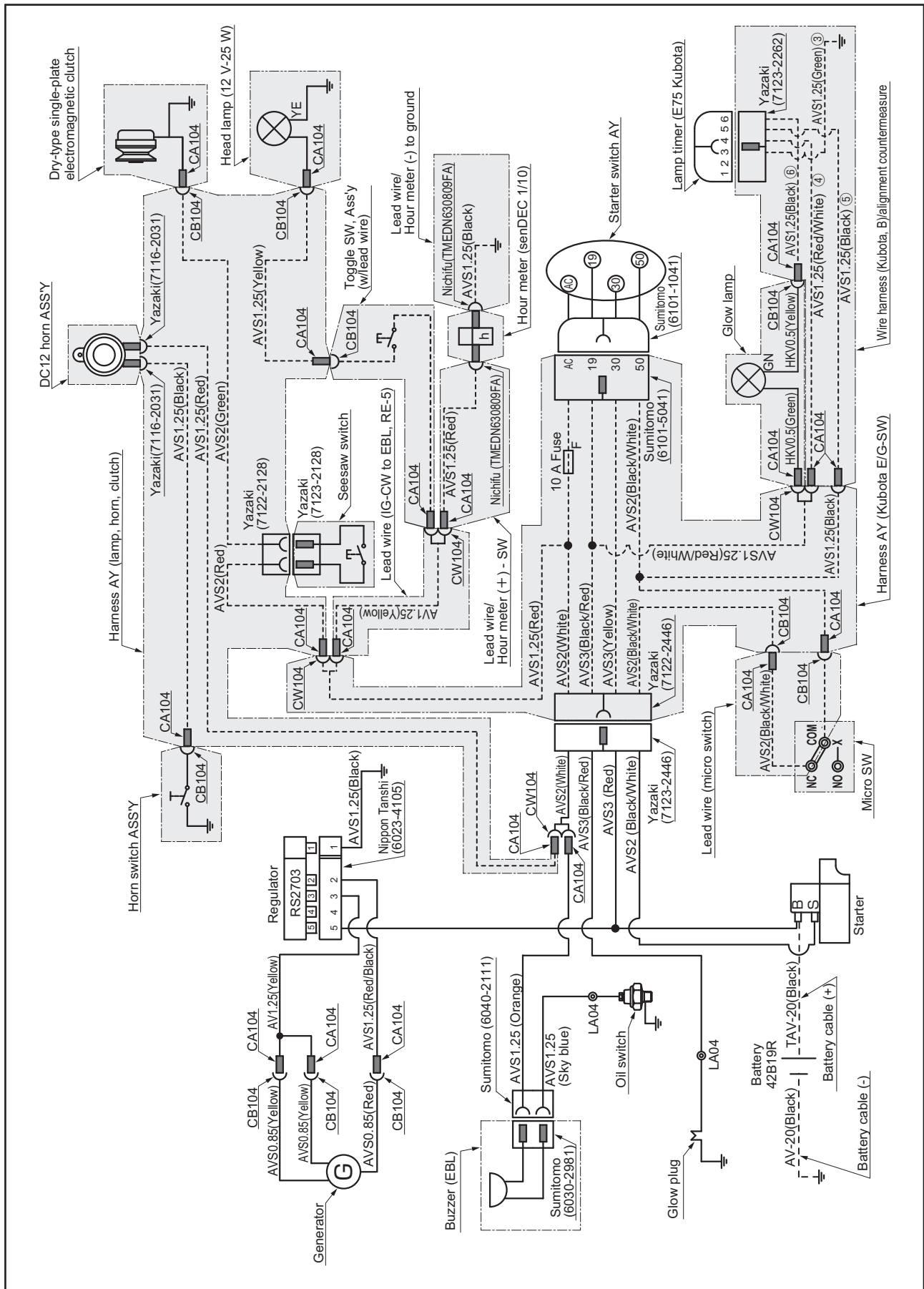
CAUTION

Battery fluid is very toxic. Handle it with care. If you accidentally get battery fluid on your skin, into your eyes or on your clothing, rinse with lots of water and seek medical attention.

(2) Electrical wiring diagram

1. When you replace the battery, use one with the specified capacity.
2. When you remove a wire, attach a tag with a code written on it to the wire that identifies which wire it is so that you do not mix up wires when you reinstall them.
3. Firmly attach the connector so that it does not become loose.

12. WIRING DIAGRAM



13. ASSEMBLING AND DISASSEMBLING, AND ADJUSTING THE OPERATIONAL SYSTEMS

13.1 Assembling and disassembling the handle

(1) Disassembly (Fig. 25)

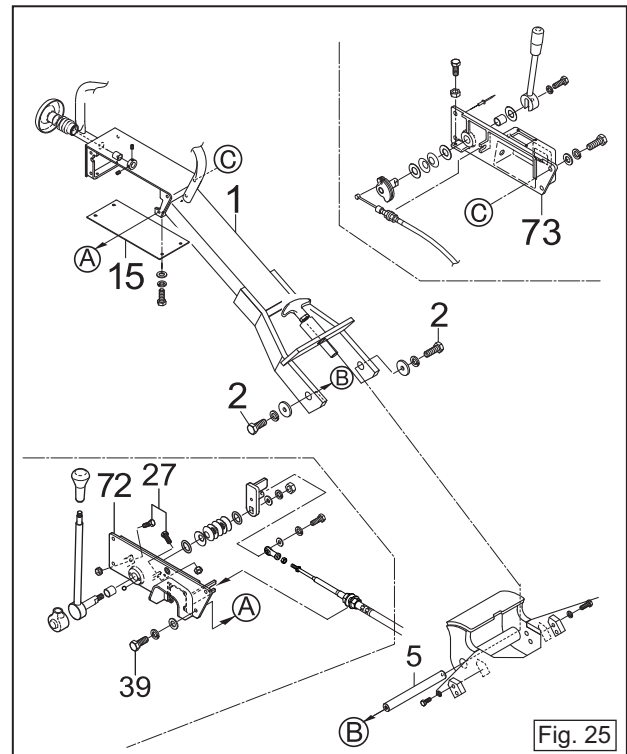
1. Remove all of wires and cables from the body and engine.
2. Cut all cable clamps.
3. Remove all corrugated tubes.
4. Pull out all wires and cables on the outside of the frame.
5. Remove the bolt (2) for shaft (5) and slightly lift the handle (1). (to the point at which the drum nearly floats off the ground.)
6. Bring an adequately-sized iron bar ($\phi 15-24$ mm) to the shaft (5) on the side from which you removed the bolt and tap the bar out the opposite side.

Caution: When you tap the shaft (5), be careful not to smash the screw hole. If you strike the special tool ⑫ into the threaded screw hole for the bolt (2) that you removed, the shaft comes out easily. If you have difficulty removing the shaft, heat the threaded screw hole with a torch and apply lubricant to the shaft (5). When you are doing this step, be careful not to burn the wiring.

7. Remove the handle cover (15), the travel lever bracket (72) and throttle bracket (73). Remove all of the cables and wires from the handle (1).

(2) Assembly (Fig. 25)

1. Assemble in the reverse order of the disassembly steps.
2. Lift the handle (1) and line up the position of the holes for the frame and handle shaft.
3. Grease the shaft holes for the frame and handle, and the shaft (5). Fix the shaft with the mounting bolt (2).
4. Install all of cables and wires to the handle (1) and connect all of the components.



13.2 Installing the travel cables

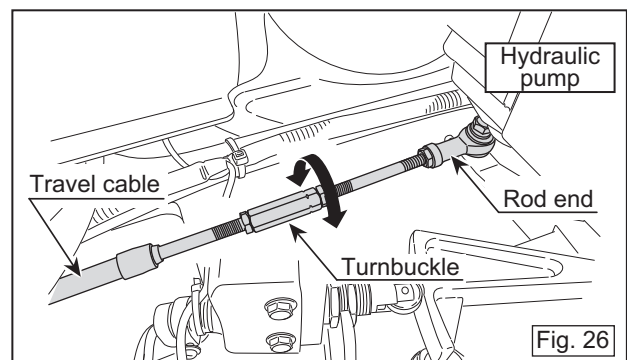


Stop the engine before you start installation work.

1. Connect the travel cable to the PV lever on the hydraulic pump side. If the opening for the rod end at the end of the travel cable and the mounting hole for the PV lever don't line up, twist the rod end to line them up, or align them with the turnbuckle. (Fig. 26)
2. Start the engine.



To prevent any danger when installing the travel cable, first lift the roller by its single point suspension hook and suspend the drum off the ground.



- While you move the travel lever, adjust the hydraulic pump and PV lever with the turnbuckle so that they are in the neutral position.

CAUTION

**Fix the rod end and turnbuckle with the nut.
(The nut on the hydraulic pump side is a left-handed thread.)**

- Stop the engine and lower the roller.
- Push the pressed fitting for the deadman and place the travel lever in the "stop" position (neutral). (Fig. 27)
When you replace the travel cable, screw the rod end approx. 10 mm at both ends into the cable. (Fig. 26)

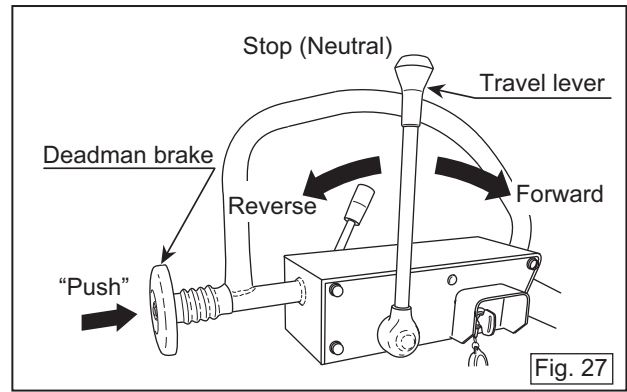
13.3 Adjusting the neutral positioning

If the travel lever misaligns with the stop position (neutral), you can fine adjust its neutral positioning.

Drive the roller first before checking and adjusting the neutral position of the travel lever. Regardless of what position the travel lever is in, stop the engine of the roller in the stop position (neutral).

The travel lever lightly locks when it is in neutral.

Adjust the turnbuckle for the travel cable on the hydraulic pump side until the travel lever goes to neutral. (Fig. 26)



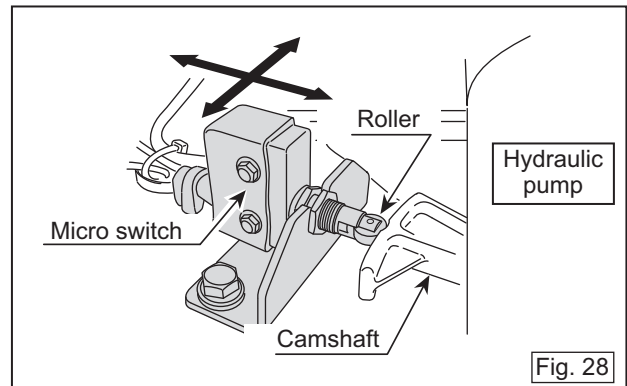
13.4 Adjusting the micro switch

This machine comes with a micro switch as standard that allows you to start the engine only when travel lever is in neutral.

This prevents the machine from running away when it is started up.

The micro-switch is in a neutral state when the roller on the end of the micro switch touches against the depression in Camshaft of PV lever. (Fig. 28)

Once you finish adjusting the micro switch, apply a thin layer of grease on the roller bearing of the micro switch.



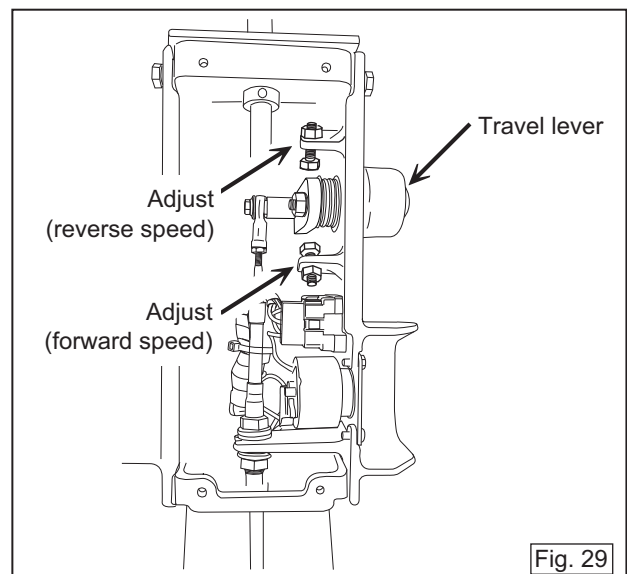
13.5. Adjusting the travel speed

- To adjust the travel speed, remove the back cover of the box on the handle and adjust the positions of the stopper bolts for the travel lever. (Fig. 29)
- Adjust the travel speed in accordance with the table below.

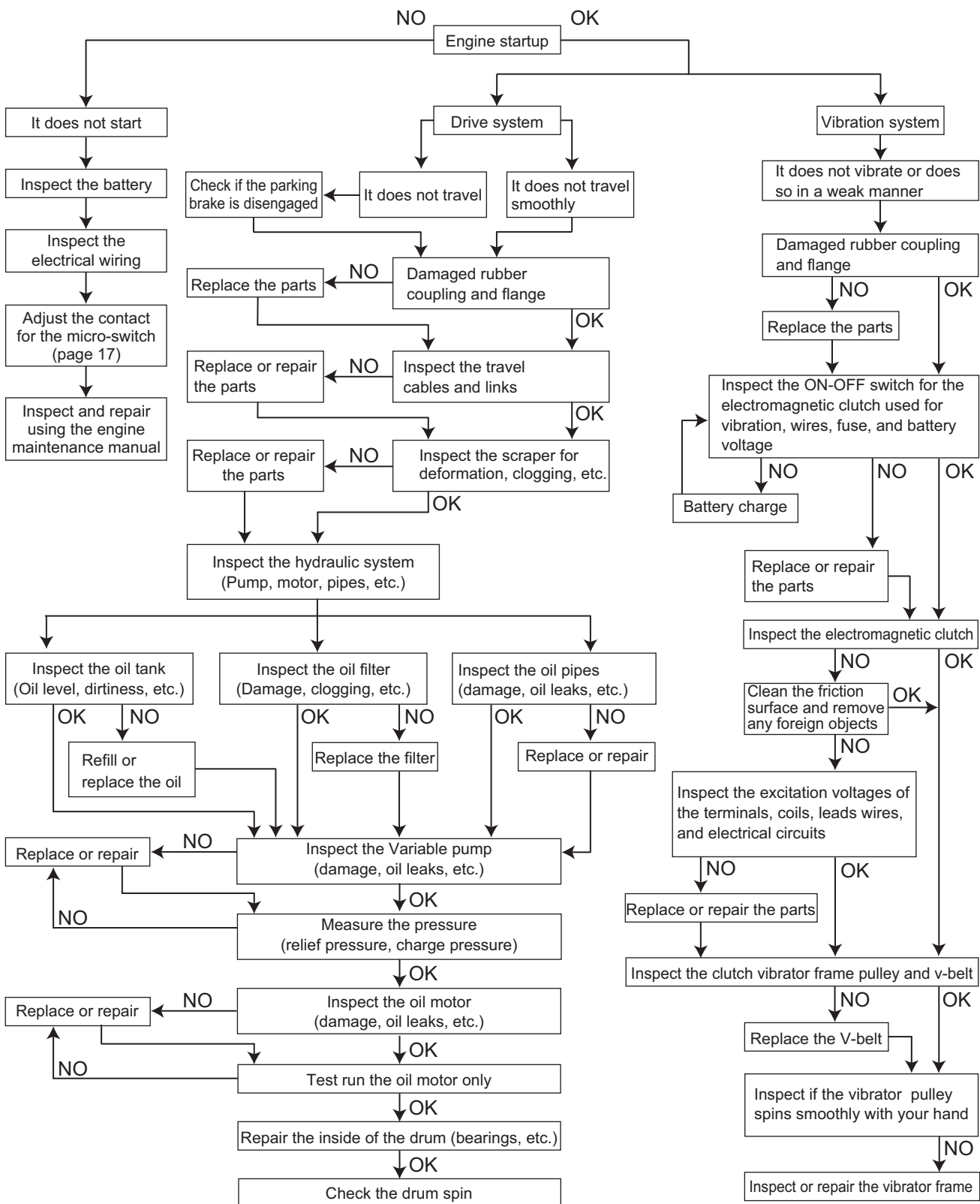
Model	Travel speed	Drum rpm
MRH-601	Forward 3.0 km/h (Speed: 50 m/min)	45±1 r.p.m
	Reverse 2.5 km/h (Speed: 41.7 m/min)	37±1 r.p.m

CAUTION

If you adjust the speed higher than the one shown in the table above, the engine may be a loss of output power when traveling with vibrating.



14. TROUBLESHOOTING





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