

GW750

SHOP MANUAL

SAKAI®

Introduction

This manual provides important information to familiarize you with safe operating and maintenance procedures for your SAKAI roller. Even though you may be familiar with similar equipment you must read and understand this manual before operating or servicing this unit.

Safety is everyone's business and it is one of your primary concerns. Knowing the guidelines presented in this manual will help provide for your safety, for the safety of those around you and for the proper operation and maintenance of the machine. Improper operation is dangerous and can result in injury or death.

Sakai Heavy Industries cannot foresee all possible circumstances or varying conditions to which the operator, serviceman or machine may be exposed to that might lead to a potential hazard. Therefore, the warnings and cautions listed in this manual and those placed on the machine are not intended to be all inclusive and liability for personal injury or damage to equipment or property cannot be assumed.



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SAFETY

SAFETY


1. GENERAL SAFETY


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1. General Safety

1-1. Understanding the Safety Symbols and Signal Words

The words DANGER, WARNING, and CAUTION are used with the safety-alert symbol. DANGER identifies the most serious hazard. When the symbols DANGER, WARNING and CAUTION are displayed, become alert. Your safety or those around you may be involved. NOTICE is used to provide important information that is not hazard related.

 **DANGER:** Indicates an imminently hazardous situation or condition which if not avoided can result in serious personal injury or death.

 **WARNING:** Indicates a potentially hazardous situation or condition which if not avoided can result in serious personal injury or death.

 **CAUTION:** Indicates a potentially hazardous situation or condition which if not avoided may result in moderate personal injury or damage to the machine or personal property.

NOTICE: Indicates important information about operation or maintenance of the machine that may cause damage, breakdown, or shortened service life of the machine if you fail to observe.

 **★:** This signal means an important point to maintain of the technology and quality in maintenance works.

1-2. General

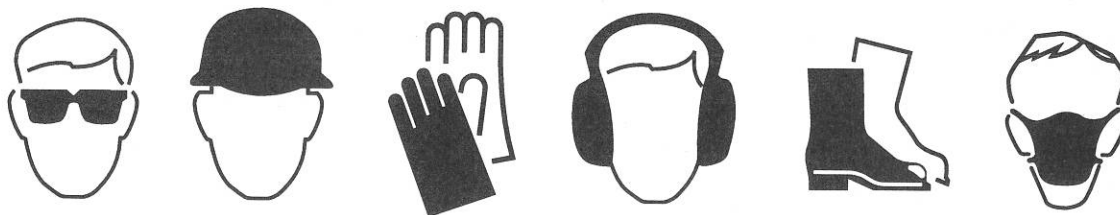
- Operators and maintenance personnel must be alert to recognize and avoid potential hazards. They should also have comprehensive training, the required skills and necessary tools to perform the job safely.
- The machine was built in accordance to the latest safety standards and recognized safety rules. Nevertheless, misuse of the machine may result in risk to life and limb of the user or nearby personnel and may cause damage to the machine or other property.
- The machine must only be used for its intended purpose as described in the Operator's Manual. It must be operated by safety-conscious persons who are fully aware of the risks involved when operating the machine. Any malfunctions especially those affecting the safety of the machine must be corrected immediately.
- The machine is designed specifically for the compaction of asphalt or soil road construction materials. Use of the machine for other purposes such as towing other equipment is considered contrary to the designated use. The manufacturer cannot be responsible or held liable for any damage resulting from such use. The risk for such use lies entirely with the user.
- Operating the machine within the limits of its designated use also involves compliance with the inspection and maintenance requirements contained in the Operation and Maintenance Manual.

1-3. Qualifications of Operators and Maintenance Personnel

- Work on the machine must be performed by qualified personnel only. Individual responsibilities of personnel regarding operation, maintenance, repair of the machine must be clearly stated.
- Define the operator's responsibilities; the operator should have authority to refuse instructions that are contrary to safety.
- Do not allow persons being trained to operate or perform maintenance on the machine without constant supervision by an experienced person.
- Work on the electrical system of the machine must be done only by an experienced person or under the guidance of a skilled electrician and according to electrical engineering rules and regulations.
- Work on the frame, brakes, hydraulic and steering systems must be performed by skilled personnel with special knowledge and training for such work.

1-4. Safety Practices and Policies

- Keep the manuals in the container provided on the machine. Manuals must always be available at the site where the machine is being used.
- The operator or user of the machine must be aware of all applicable or legal and mandatory regulations relevant to accident prevention and environmental protection. These regulations may also deal with handling of hazardous substances, the required proper personal safety and protective equipment and traffic or jobsite regulations.
- Machine operating instructions should also be supplemented with detailed instructions pertaining to the specific jobsite or work location.
- Always be sure the persons working on the machine have read the operating instructions and all safety precautions before beginning work. Reading safety instructions after work has already begun is too late.
- Wear close fitting garments and always tie back and secure long hair, also avoid wearing jewelry such as rings. Injury can result from loose clothing, hair or jewelry being caught up in the machinery or rotating parts.
- Use protective equipment as required by the circumstances or by law.



- Observe all safety instructions and warnings attached to the machine
- Make sure all safety instructions and warnings on the machine are complete and perfectly legible.
- Stop the machine immediately in the event of any malfunction. Report any malfunction immediately to the supervisor or other person of authority.
- Never perform service or maintenance on the machine unless the drum(s) or tires are adequately blocked, articulation lock bar and pin is in the locked position and the parking brake is applied.
- Never make any modifications to the machine which might affect safety without the manufacturer's approval.
- Always perform the recommended routine inspections and adjustments according to the prescribed intervals

1-5. Pre Start Inspection

- Inspect your machine daily. Ensure that the routine maintenance and lubrication are properly performed. Repair or replace any malfunctioning, broken or missing parts before using the machine. Refer to the maintenance schedule in the Operator's Manual.
- Check that all instructions and safety stickers are in place and readable.
- Never fill the fuel tank with the engine running or while near an open flame or while smoking.
- Always clean up any spilled fuel.
- Check for any warning tags placed on the machine, do not operate the machine until all repairs have been made and warning tags have been removed by authorized personnel.
- Check the seat belt for wear or damage; inspect the belt hardware and fabric. Replace if hardware is damaged or the belt is frayed or nicked or stitching is loose. Check that mounting hardware is tight.
- Clean the steps and operating platform of dirt and foreign matter to reduce danger of slipping.
- Know how to shut-down or stop the machine immediately in case of emergency.
- Know the capabilities and limitations of the machine such as speed, gradeability, steering and braking.
- Be aware of the dimensions of the machine such as height, weight especially for transporting.

1-6. Safety Instructions

- Take all necessary precautions to ensure that the machine is used only when in a safe and reliable condition.
- Avoid any operational mode that might compromise safety.
- Operate the machine only if all protective and safety devices are in place and fully functional.
- Always use the hand rails and steps to get on and off your machine maintaining 3-point contact (using both hands).

1-7. Starting

- Start the machine only from the driver's seat and always wear the seat belt.
- Watch that the warning lights and indicators during start-up and shutdown are working in accordance with operating instructions.
- Watch that no one is in danger before starting and when moving the machine.
- Check that braking, steering, signals and lights are fully functional before starting work or traveling with the machine.

1-8. Operating

- Always make sure that there are no obstructions or persons in your line of travel before starting the compactor in motion.
- Never climb on and off the machine while it is in motion.
- Always remain seated with the seat belt fastened when traveling, compacting or loading or unloading the machine.
- Use caution and be very observant when operating in close quarters and congested areas.
- Obey all traffic regulations when working on public roads and make sure machine is compatible with these regulations.
- Never carry passengers.
- Know and use the hand signals for particular jobs and who has the responsibility for signaling.

- Do not work close to edges or in the vicinity of overhanging banks or on grades that could cause the compactor to slide or roll over. Avoid any areas that may be a risk to machine stability.
- Avoid side hill travel. Always operate up and down the slope. Always keep the propulsion (travel control) lever in low speed range when climbing or descending hills or steep grades.
- Make sure there is sufficient clearance when crossing underpasses, bridges and tunnels or when passing under overhead power lines.
- Never allow anyone to stand in the articulation area of the machine when the engine is running.
- Always look in all directions before reversing the direction of travel.
- Always switch on the lighting system (if equipped) during poor visibility conditions and after dark.
- Do not attempt to control the compactor travel speed with the throttle control. Maintain engine speed at the full operating RPM.
- Do not run the engine in a closed building for an extended period of time. Exhaust fumes can kill.

1-9. Stopping

- Always park the machine in a safe area on solid and level ground. If this is not possible, always park at a right angle to the slope and block the drum(s) or tires.
- Do not leave the operator's platform with the engine running. Always move the travel lever to neutral position and apply the parking brake then turn the ignition switch to OFF.
- Lock all lockable compartments.
- Park behind a safe barrier, use proper flags, and warning devices, especially when parking in areas of heavy traffic.

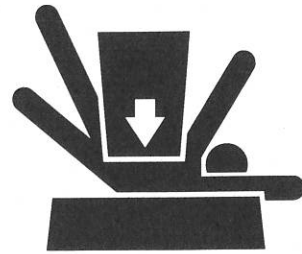
1-10. Maintenance

- In any performing any work concerning the operation, adjustment or modification of the machine or it's safety devices or any work related to maintenance, inspection or repair, always follow the start-up and shut-down procedures in the Operator's Manual and the Maintenance Manual.
- Ensure that the maintenance area is safe and secure.
- If the machine is shut down for maintenance or repair work it must be secured against inadvertent starting by removing the ignition key and attaching a warning sign to the ignition switch
- The machine must be parked on stable and level ground with the drum or tires blocked to prevent inadvertent movement.
- Immediately after the engine has stopped, the exhaust system, engine, radiator coolant, engine oil, hydraulic fluid and other lubricants and components will be very hot. Fluids can be under pressure, removing the radiator cap or draining oil or changing filters can cause serious burns. Wait until the machine has cooled down.



GENERAL SAFETY

- Use care when attaching and securing lifting tackle to individual parts and large assemblies being removed or repositioned for repair purposes to avoid the risk of accident. Use lifting devices that are in perfect condition and of sufficient lifting capacity. Never stand under suspended loads.



- Always use the proper tools and workshop equipment in good condition when performing maintenance or repairs on the machine.

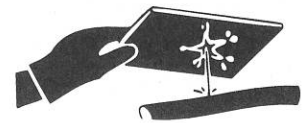


- Always use specially designed safety ladders and working platforms when working above floor level. Never use machine parts as a climbing aid.
- Keep all steps, handles, handrails, platforms and ladders free from mud, dirt, grease, ice or snow.
- Clean the machine, especially threaded connections of any traces of oil or fuel before carrying out any maintenance or repairs. Never use aggressive detergents. Use lint free cleaning rags.
- Examine all fuel, lubricant and hydraulic fluid lines and connectors for leaks, loose connections chafe marks or damage after cleaning.
- Repair or replace defective parts immediately.
- Whenever possible, avoid servicing or maintenance when the engine is running unless the drum and or tires are adequately blocked, the articulation lock bar is in the locked position and the parking brake is applied.
- Never fill the fuel tank with the engine running, while near an open flame or while smoking. Always clean up any spilled fuel.
- Ensure safe operation, optimum performance of the machine and its warranty by using only genuine SAKAI replacement parts.
- Use only the specified fluids and lubricants. Substitute only products known to be equivalent from reputable manufacturers.
- Disconnect the battery cables when working on the electrical system or when welding on the compactor.

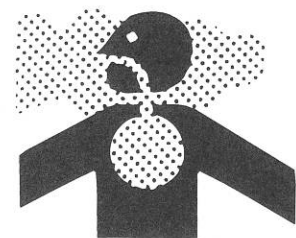


- Be sure the battery area is well ventilated (clear of fumes) should it be necessary to connect a jumper cable or battery charger. Fumes can ignite from a spark and may explode.
- Be sure battery charger is OFF when making connections if charging is required.
- Use only original fuses with the specified rating. Switch off the machine immediately if trouble occurs in the electrical system.
- Work on the electrical system may only be carried out by a qualified electrician or by a specially trained person according to electrical engineering principles.
- Inspect the electrical equipment of the machine at regular intervals. Defects such as loose connections or burnt or scorched wires must be repaired or replaced immediately.

- Do not weld, flame cut or perform grinding on the machine unless expressly authorized, as there may be a risk of fire or explosion. Disconnect the battery when welding on the machine.
- Clean the machine and its surrounding from dust or other flammable substances and make sure the area is adequately ventilated before beginning welding, flame cutting or grinding operations.
- Inspect hydraulic hoses at regular intervals and immediately replace if they show signs of chafing, cracking, brittleness, deformation, blistering, fitting separation, leakage, corrosion or other damage which may affect their function or strength.
- Do not work on hydraulic system while the engine is running and the system is under pressure. The hydraulic system remains pressurized even after the engine has stopped.
- Do not disconnect hydraulic hoses or fittings until the pressure has been properly relieved.
- Wait until the systems and fluid have cooled down before disconnecting.
- Never use your hands to check for leaks when inspecting a hydraulic system. Use a piece of cardboard and always wear gloves and safety glasses.



- Get immediate medical attention if fluid has been injected under your skin. Fluid penetration from a pin hole leak can cause severe injury or death.
- Ensure that hydraulic lines and hoses are routed and fitted properly. Ensure that no connections are interchanged. All fittings, lengths and specifications of hoses must comply with the technical requirements.
- Observe all product safety regulations when handling fuel, oils, grease engine coolant and other chemical substances. Be careful especially when these items are hot as there is a risk of burning or scalding.
- Operate internal combustion engines and fuel operated heating systems only in adequately ventilated premises. Before starting the engine in an enclosed area, make sure there is sufficient ventilation.



1-11. Transporting the Machine

- Use only suitable and approved trailers and haul vehicles and lifting equipment of sufficient capacity.
- Entrust to experienced personnel the fastening and lifting of loads and instructing of crane operators.
- Only experienced persons familiar with the operation of the machine may load and unload the machine.
- Use ramps or a loading dock when loading or unloading the machine. Ramps must be the proper strength, low angle and the proper height and width.

GENERAL SAFETY

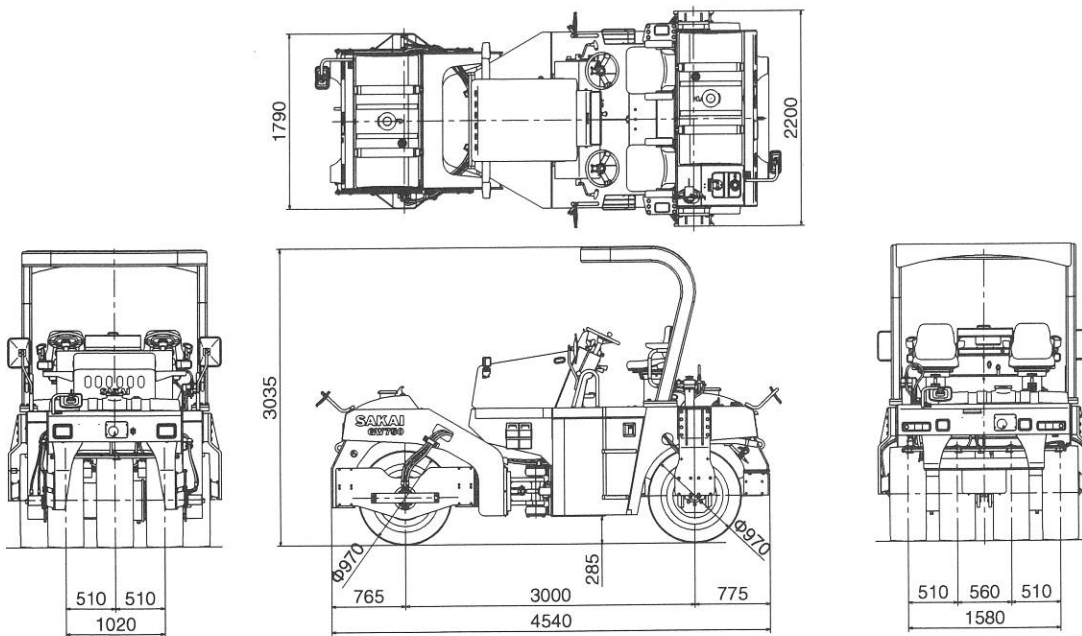
- Block the wheels (front and rear) of the hauling vehicle when loading and unloading the compactor. Ensure that the haul vehicle is on level ground and approach the loading ramps squarely to make sure that the compactor does not slide off the edge of the ramp.
- Keep the deck clear of mud, oil, ice or snow or other materials that can make the deck slippery.
- Position the compactor on the trailer or transport vehicle centered from side to side, and apply the brake. Shut off the engine and lock all lockable compartments.
- Block the drums and lock the articulation lock bar. Chain the machine down properly using the appropriate tackle.
- Know the overall height of the compactor and hauling vehicle. Observe height and weight regulations and be sure you can pass safely at overhead obstructions.
- Obey all traffic regulations and be sure that the proper clearance flags, lights and warning signs including "Slow Moving Vehicle" emblem are displayed when traveling on public roads.
- Know the approximate stopping distance at any given speed.
- Drive Safely. Never turn corners at excessive speeds.

SPECIFICATIONS

SPECIFICATIONS

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1. GENERAL



GW7502001

MODEL & TYPE		SAKAI "GW750withROPS"VIBRATING TIRED ROLLER	
MANUFACTURER		SAKAI HEVAY INDUSTRIES,LTD.	
WEIGHTS	Opreating weight	9,240 kg (20,370 lbs.)	
	Load on front axle	3,960 kg (8,730 lbs.)	
	Load on rear axle	5,280 kg (11,640 lbs.)	
	Shipping weight	8,640 kg (19,050 lbs.)	
	Load on front axle	3,660 kg (8,070 lbs.)	
	Load on rear axle	4,980 kg (10,980 lbs.)	
DIMENSIONS	Overall length	4,540 mm (179 in.)	
	Overall wight	2,200 mm (87 in.)	
	Overall height with ROPS	3,035 mm (119 in.)	
	Wheelbase	3,000 mm (118 in.)	
	Rolling width	1,950 mm (77 in.)	
	Ground clearance	265 mm (10.4 in.)	
TRAVEL SPPED(Forward & Reverse)	1 st	0 – 3 km/h (0 – 1.9 mph)	
	2 nd	0 – 5 km/h (0 – 3.1 mph)	
	3 rd	0 – 9 km/h (0 – 5.6 mph)	
VIBRATION	Frequency	1 st	40 Hz
		2 nd	40 Hz
		3 rd	40 Hz
		4 th	40 Hz
	Centrifugalforce	1 st	7.80 kN (1,764 lbs.)
		2 nd	24.50 kN (5,512 lbs.)
		3 rd	41.90 kN (9,414 lbs.)
		4 th	58.40 kN (13,139 lbs.)
	Amplitude	1 st	0.10 mm (0.004 in.)
		2 nd	0.31 mm (0.012 in.)
		3 rd	0.53 mm (0.021 in.)
		4 th	0.74 mm (0.029 in.)

MIN.TURNING RADIUS(outer)		Approx. 5.4 m (213 in.)		
GRADABILITY		Approx. 38 % (21 °)		
ENGINE	Model	ISUZU"DD-4BG1T"Diesel Engine with turbo charger		
	Type	Water-cooled,4-cylinder in-line, vertical mounted, Overhead valve, direct injection type		
	Bore x Stroke	105mm x 125mm (4.134 in. x 4.921 in.)		
	Displacement	4.329 liters (264 cu.in.)		
	Performance	Rated speed	2,300 min ⁻¹ (2,300 rpm)	
		Rated output	78.8 kW (106 HP)	
		Max. torque	392 N•m (289 lb.·ft)	
			At 1,800 rpm	
	Governor	Mechanical all-speed type		
	Lubrication system	Pressure lubrication by gear pump		
	Oil filter	Full-flow: paper		
	Air cleaner	Dry type		
	Cooling system	Centrifugal forced feeding system(pressure type)		
	Cooling fan	Blower type		
Electrical system	Alternator	24 V 50 A		
	Starter	24 V 4.5 kW		
	Battery	12 V 100 Ah x 2 pcs. (24 V)		
POWER LINE	Pump Drive Gear Box	Spur gear type		
	Transmission	Type	0 – 5 km/h (0 – 3.1 mph)	
		Speed	0 – 9 km/h (0 – 5.6 mph)	
	Propulsion Pump Control	Switching the direction of flow delivered from the variable pump		
Final drive	Planetary gear			
VIBRATING SYSTEM	Transmission	Hydrostatic transmission		
	Vibrator	Eccentric shaft type		
BRAKE SYSTEM	Service brake	Hydrostatic and mechanical, multi-wet disc type		
	Parking brake	Mechanical, multi-wet disc type		
STEERING SYSTEM		Hydraulic type (Articulated type)		
WHEELS	Use	Front tires	Vibrate & Drive	
		Number of tires	3	
		Rear tires	Vibrate & Drive	
		Number of tires	4	
	Tire size	Front	14/70-20-12PR(OR),smooth tread	
		Rear	14/70-20-12PR(OR),smooth tread	
Suspension system	Front	Rubber damper type		
	Rear	Rubber damper type		
OTHERS	Rops	Steel frame		
	Instruments & lights	1 set		

2. SPECIFICATIONS AND SETTINGS

★ As for the condition when the numerical value shown in these lists was measured at $50 \pm 5^\circ\text{C}$ ($122 \pm 41^\circ\text{F}$) of hydraulic oil.

2-1. Engine

	Item	Standard value	Remarks
Engine	Model	DD-4BG1T	
	Rated output	79kW/2300 rpm (106hp/2300 rpm)	
	Max. rpm under no load	2600^{+0}_{-50} rpm	
	Min. rpm under no load	900 ± 25 rpm	
	Intake manifoldtightening torque	16 - 25 N•m (11.8 - 18.4 lb.·ft)	
	Exhaust manifoldtightening torque	16 - 25 N•m (11.8 - 18.4 lb.·ft)	
	Fan belt deflection	10 - 15 mm (0.39 - 0.59 in.)	Pressed by 10kg at mid. point between pulleys center distance
	Valve clearance (intake)	0.4 mm (0.016 in.)	When cold
	Valve clearance (exhaust)	0.4 mm (0.016 in.)	When cold
	Compression	3.0 MPa (435 psi)	At 200 rpm
	Injection pressure	18.1 MPa (2,625 psi)	
	Fuel consumption	253 g/kW•h (0.416 lb/hp•h)	At rated output
	Dry weight of engine	350 kg (772 lb.)	
	Intake pressure	-1.96 kPa (-0.28 psi)	
Exhaust pressure	9.4 kPa (1.36 psi)		

2-2. Propulsion

	Item		Standard value	Remarks
Propulsion	Speed	Forward	1 st	0 - 3.0 ± 0.5 km /h (0 - 1.9 ± 0.3 mph)
			2 nd	0 - 5.0 ± 0.5 km /h (0 - 3.1 ± 0.3 mph)
			3 rd	
		Reverse	1 st	900 ± 25 rpm
			2 nd	16 - 25 N•m (11.8 - 18.4 lb.·ft)
			3 rd	16 - 25 N•m (11.8 - 18.4 lb.·ft)
		Rear wheel/hub nut	265 N•m (195.4 lb.·ft)	
		Front wheel/hub nut	265 N•m (195.4 lb.·ft)	
		Tire inflation	441 kPa (63.96 psi)	

2-3. Hydraulic

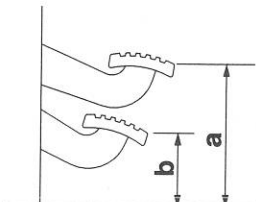
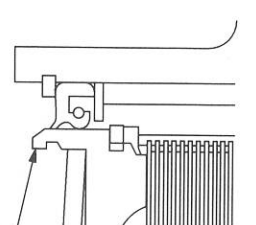
	Item		Standard value	Remarks
Hydraulic	Propulsion	Relief valve pressure setting	32.4 ± 1.0 MPa ($4,698 \pm 145$ psi)	Effective differential pressure
		Charge relief Pressure setting	2.4 ± 0.2 MPa (348 ± 29 psi)	
		Propulsion motor drain (front wheel)	Less than 5.4 l/min (Less than 1.43 gal/min)	Allowable max. value (at max. rotating speed)
		Propulsion motor drain (rear wheel)	Less than 5.4 l/min (Less than 1.43 gal/min)	Allowable max. value (at max. rotating speed)
		Front motor brake release pressure	1.4 - 3.0 MPa (203 - 435 psi)	
		Rear motor brake release pressure	1.4 - 3.0 MPa (203 - 435 psi)	

	Item	Standard value	Remarks	
Hydraulic	Vibration circuit	Relief pressure (front wheel)	17.2 ±1.0 MPa (2,495 ±145 psi)	
		Relief pressure (rear wheel)	17.2 ±1.0 MPa (2,495 ±145 psi)	
		Vibrator motor drain(front wheel)	Less than 5.7 l/min (Less than 1.5 gal/min)	Allowable max. value (at max. pressure androtating speed)
		Vibrator motor drain(rear wheel)	Less than 2.7 l/min (Less than 0.7 gal/min)	Allowable max. value (at max. pressure androtating speed)
	Steering circuit pressure (Orbitrol relief pressure+ charge relief pressure)	18.1 ±1.0 MPa (2,625 ±145 psi)		
	Propulsion pump control leverMax. stroke(forward travel)	28 ±1.0 mm (1.1 ±0.04 in.)		
	Propulsion pump control lever Max. stroke(reversing)	28 ±1.0 mm (1.1 ±0.04 in.)		

2-4. Steering

	Item	Standard value	Remarks
Steering	Steering wheel play	5 - 10 mm (0.2 - 0.4 in.)	Steering wheel periphery
		Less than 0.5 mm (Less than 0.02 in.)	Axial play

2-5. Brake

	Item	Standard value	Remarks
Brake	Brake pedal-floor clearance (when not depressed)	Distance 'a' 140 mm (5.5 in.)	
	Brake pedal-floor clearance (when depressed)	Distance 'b' 48 mm (1.9in.)	
	Brake stroke limit for front Brake renewal	Less than 0.9 mm (Less than 0.035 in.)	 <p>Brake piston stroke</p>
	Brake stroke limit for rear Brake renewal	Less than 0.9 mm (Less than 0.035 in.)	

SPECIFICATIONS AND SETTINGS

2-6. Water system

	Item	Standard value	Remarks
Water system	Water spray pump Delivery pressure (at 2.4 l/min)	0.18 ±0.05 MPa (26 ±7 psi)	
	Liquid spray pump delivery Pressure (at 1.3 l/min)	0.55 ±0.05 MPa (80 ±7 psi)	

2-7. Capacities

	Item	Standard value	Remarks
Capacities	Engine oil	13 litter (3.43 gal)	
	Coolant	16 litter (4.23 gal)	
	Vibrator case gear oil (front wheel)	3.2 litter (0.85 gal)	
	Vibrator case gear oil (rear wheel)	2.5 litter (0.66 gal)	2.5 litter (0.66gal) × 2
	Pump drive gear box case gear oil	1.6 litter (0.42 gal)	
	Hydraulic tank	65 litter (17.2 gal)	
	Fuel tank	130 litter (34.3 gal)	
	Water tank	600 litter (158.5 gal)	300 litter (79.25gal) × 2
	Liquid tank	19 litter (5 gal)	

3. FUEL AND LUBRICANTS SPECIFICATION

3-1. Rating

Lubricant	Service classification	Ambient temp. and applicable viscosity rating			Applicable Standards
		-15 - 30°C (5 - 86°F) Cold	0 - 40°C (32 - 104°F) Moderate	15 - 55°C (59 - 131°F) Tropical	
Engine oil	API grade CD	SAE 10W-30	SAE 30	SAE 40	MIL-L-2104D
Gear oil	API grade GL4	SAE 80W-90	SAE 90	SAE 140	MIL-L-2105
Hydraulic oil	Wear resistant	ISO-VG32 Over VI 140	ISO-VG46 Over VI 140	ISO-VG68 Over VI 110	ISO-3448
Grease	Lithium type extreme pressure				NLGI-2
Fuel	Diesel oil				ASTM D975-2D

3-2. Recommended lubricants

Lubricant Oil company	Engine oil API-CC	Gear oil API GL 40	Hydraulic VG 46	Grease (NLGI- II)
CALTEX	RPM DELO 300 oil	Universal Thuban 90	Rando Oil HD 46	Martifack EP-5
BP	BP Vanellus C3-30	BP Gear Oil EP 90	BP Energol HLP 46	BP Energrease LS-EP 2
ESSO	Esso Lube D3-330	Esso Gear Oil GP 90	Nuto H 46	Beacon EP-2
MOBIL	Mobil Delvac 1330	Mobil Prgasus	Nuto Oil 25	Beacon EP 25
SHELL	Shell Rotella CT Oil 30	Shell Spirax 90 EP	Shell Tellus Oil 48	Shell Alvania EP Grease 2
CASTROL	Castrol CRD 30	Castrol Hypoy 90	Hyspin AWS 46	Spherrol ELP 2

CAUTION : (1) Fill the fluid reservoirs with the filters installed.
(2) Use recommended fuels and lubricants only.

4. TIGHTENING TORQUE CHART

Unit : N•m (lb•ft)

	Nominal Dia.	Pitch	Strength Classification							
			6.8		8.8		10.9		12.9	
Metric coarse screw	5	0.8	4.9	(3.6)	5.9	(4.4)	7.8	(5.8)	7.8	(5.8)
	6	1.0	7.8	(5.8)	9.8	(7.2)	13	(9.6)	13	(9.6)
	8	1.25	17	(13)	23	(17)	31	(23)	31	(23)
	10	1.5	39	(29)	49	(36)	59	(44)	59	(44)
	12	1.75	69	(51)	78	(58)	108	(80)	108	(80)
	14	2.0	98	(72)	127	(94)	167	(123)	167	(123)
	16	2.0	157	(116)	196	(145)	265	(195)	265	(195)
	18	2.5	196	(145)	245	(181)	343	(253)	343	(253)
	20	2.5	294	(217)	392	(289)	539	(398)	539	(398)
	22	2.5	441	(325)	539	(398)	686	(506)	686	(506)
	24	3.0	539	(398)	637	(470)	883	(651)	883	(651)
	27	3.0	785	(579)	981	(724)	1324	(977)	1324	(977)
	30	3.5	1079	(796)	1324	(977)	1765	(1302)	1765	(1302)
Metric fine screw	10	1.25	39	(29)	49	(36)	69	(51)	69	(51)
	12	1.25	69	(51)	88	(65)	118	(87)	118	(87)
	14	1.5	108	(80)	137	(101)	186	(137)	186	(137)
	16	1.5	167	(123)	206	(152)	284	(209)	284	(209)
	18	1.5	245	(181)	294	(217)	392	(289)	392	(289)
	20	1.5	343	(253)	441	(325)	588	(434)	588	(343)
	22	1.5	490	(361)	588	(434)	785	(579)	785	(579)
	24	2.0	588	(434)	735	(542)	981	(724)	981	(724)
	27	2.0	834	(615)	1030	(760)	1422	(1049)	1422	(1049)
	30	2.0	1177	(868)	1422	(1049)	1961	(1446)	1961	(1446)

ENGINE AND CONTROLS

ENGINE AND CONTROLS

1. ENGINE

1-1. Engine mounting 3-002

2. CONTROL SYSTEM

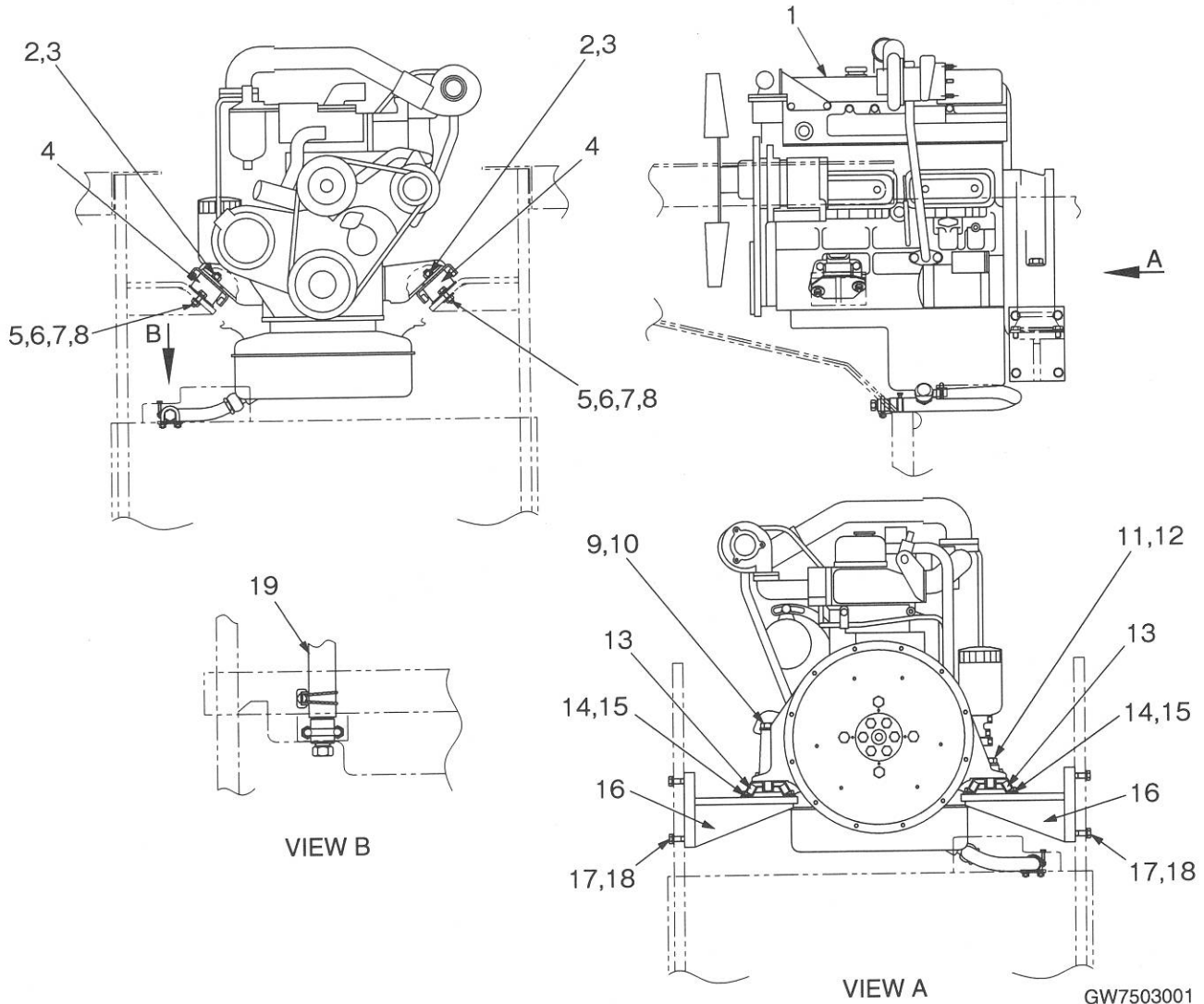
2-1. Throttle control 3-003
2-2. Forward/Reverse control 3-004

3. PUMP DRIVE GEAR BOX AND HYDRAULIC PUMPS

3-1. Pump Drive Gear Box 3-005
3-2. Removal and Installation of Pump Drive Gear Box/Hydraulic Pump Assembly 3-006
 3-2-1. Removal of pump drive gear box/hydraulic pump assembly 3-006
 3-2-2. Installation of pump drive gear box/hydraulic pump assembly 3-008
3-3. Disassembly and Reassembly of Pump Drive Gear Box 3-009
 3-3-1. Disassembly of pump drive gear box 3-009
 3-3-2. Reassembly of pump drive gear box 3-011

1. ENGINE SYSTEM

1-1. Engine system



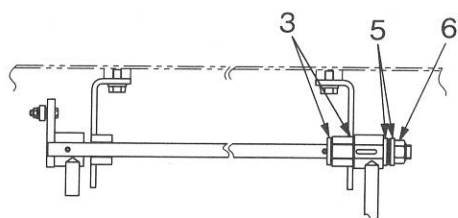
- 1. Engine
- 2. Nut (M12x1.25)
[Tightening torque:88N·m (64 lb·ft)]
- 3. Spring washer
- 4. Shockmounts
- 5. Bolt (M12x1.75)
- 6. Washer
- 7. Nut (M12x1.75)
[Tightening torque:78N·m (57 lb·ft)]
- 8. Washer
- 9. Bolt (M18x2.5)
[Tightening torque:343N·m (251 lb·ft)]
- 10. Washer

- 11. Bolt (M18x2.5)
[Tightening torque:343N·m (251 lb·ft)]
- 12. Washer
- 13. Damper
- 14. Bolt (M12x1.75)
[Tightening torque:108N·m (79 lb·ft)]
- 15. Washer
- 16. Bracket
- 17. Bolt (M12x1.75)
[Tightening torque:108N·m (79 lb·ft)]
- 18. Spring washer
- 19. Hose

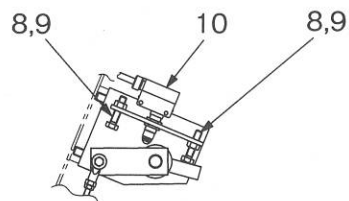
Dry weight of engine : 350 kg (772 lb.)
 Engine oil : 13 litter (3.43 gal.)

2. CONTROLS

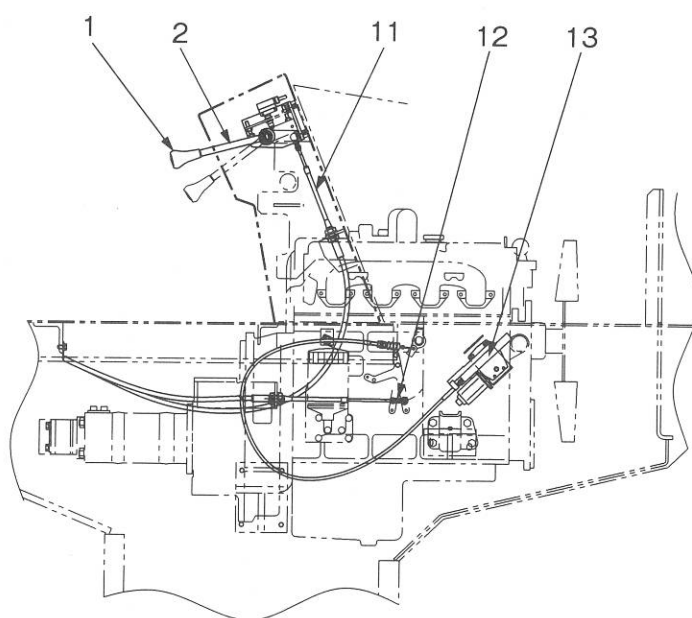
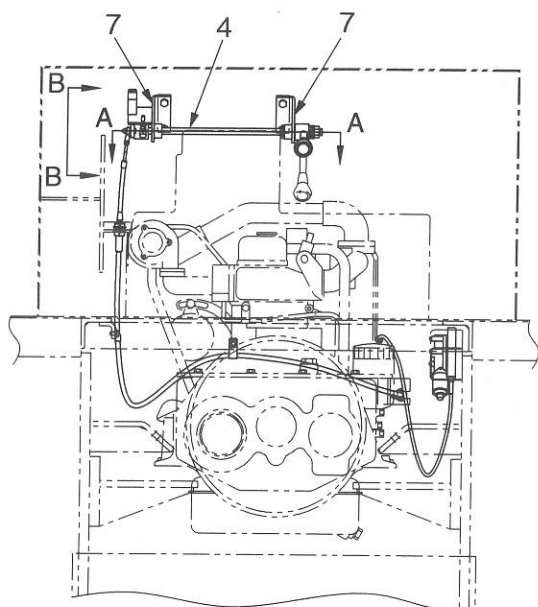
2-1. Throttle Control



SECTION A-A



VIEW B-B

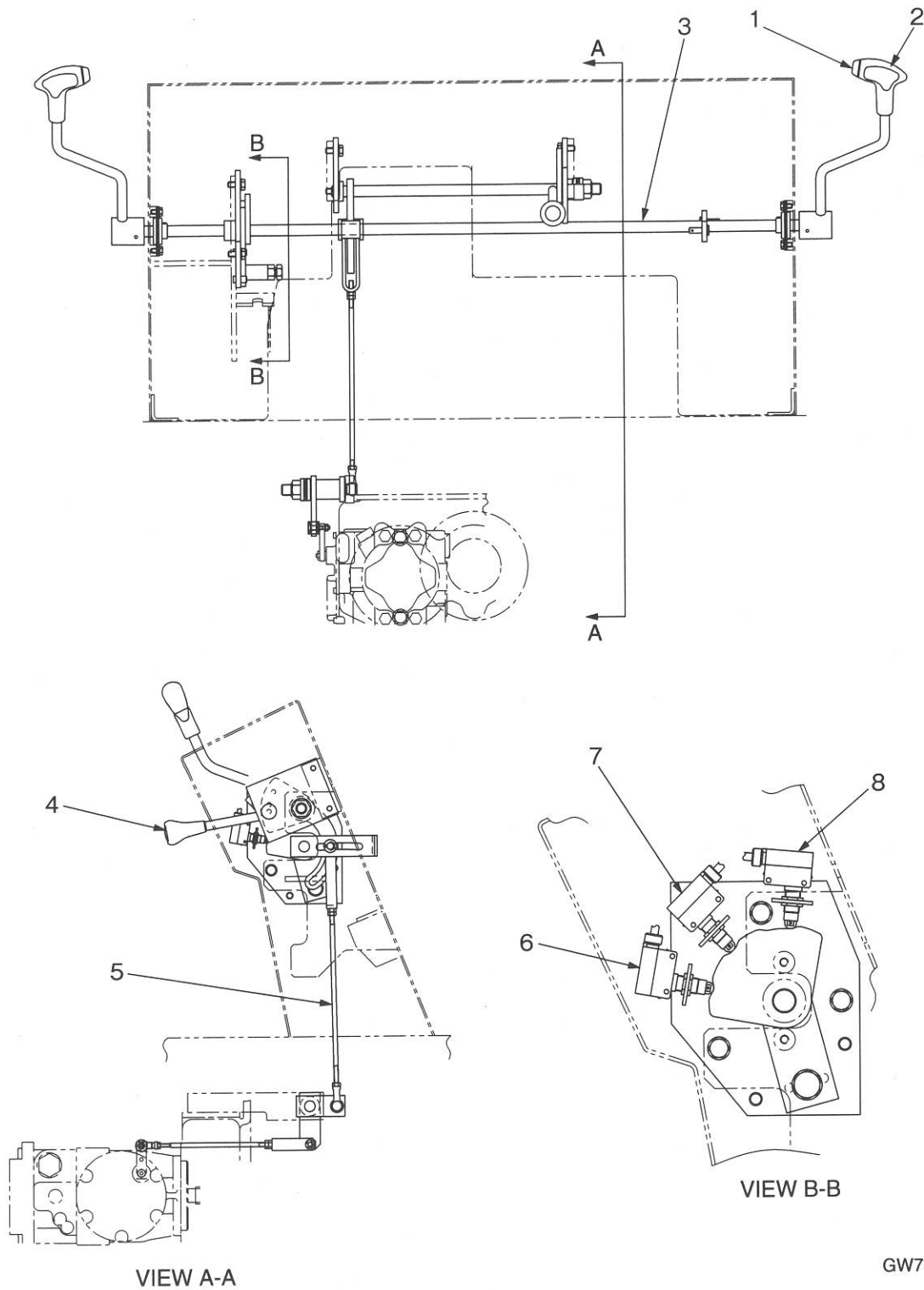


GW7503002

- 1. Knob
- 2. Lever
- 3. Washer
- 4. Shaft
- 5. Washer
- 6. Nut (M16x2.0)
- 7. Bracket

- 8. Bolt (M8x1.25)
- 9. Rock nut
- 10. Throttle switch
- 11. Control cable
- 12. Rod end
- 13. Motor stopper assembly

2-2. Forward/Reverse control



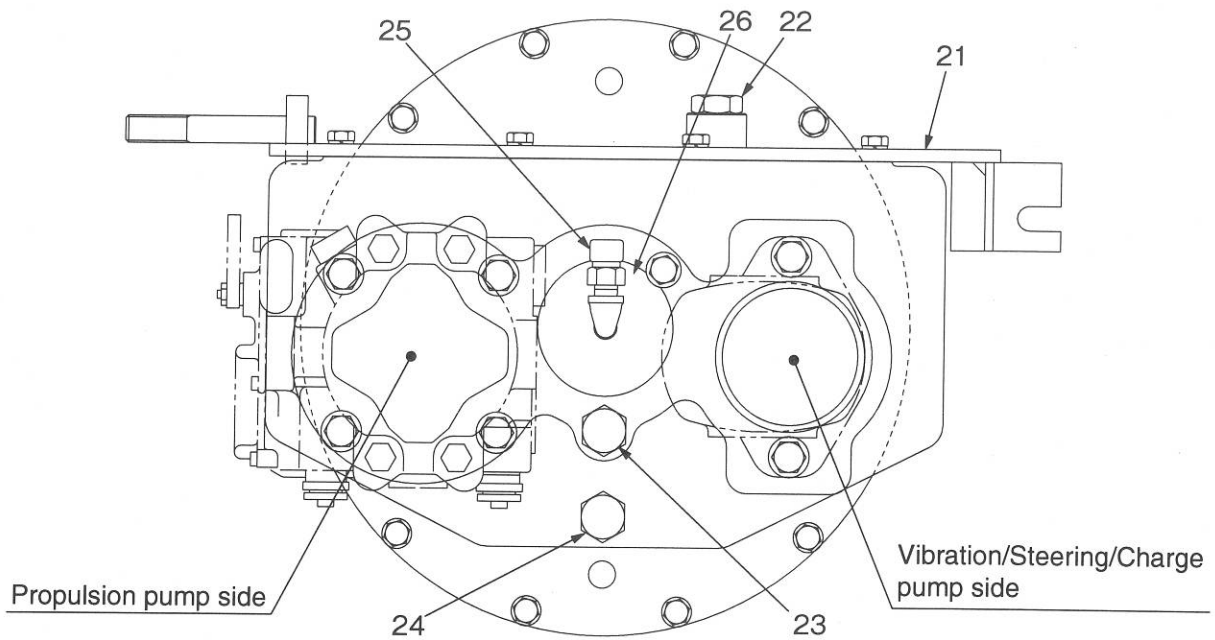
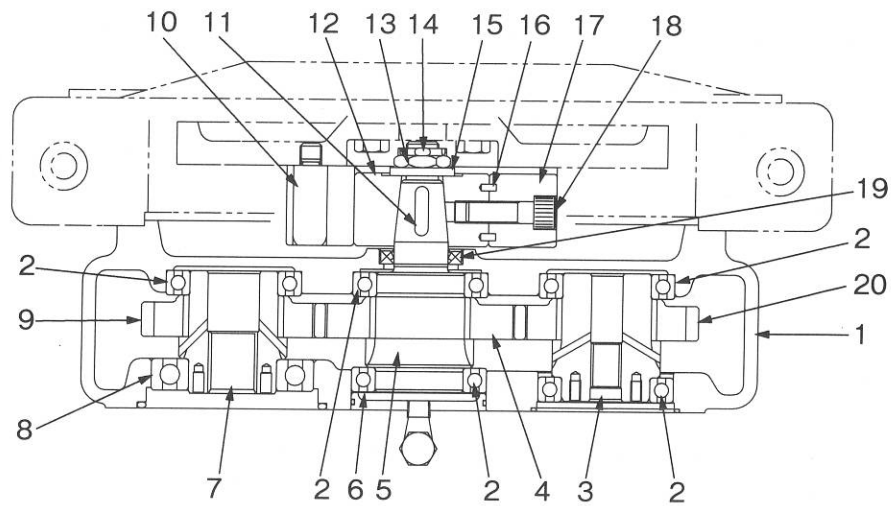
- 1. F-R lever vibrator switch
- 2. F-R lever
- 3. Shaft
- 4. Throttle control lever

- 5. Rod
- 6. F-R lever interlock switch
- 7. Vibration auto switch
- 8. Back up switch

GW7503003

3. PUMP DRIVE GEAR BOX AND HYDRAULIC PUMPS

3-1. Pump drive gear box



GW7503004

- | | | | |
|-----------------|-----------------|----------------|------------------|
| 1. Casing | 8. Ball bearing | 15. Washer | 22. Plug (fill) |
| 2. Ball bearing | 9. Gear | 16. Spring pin | 23. Plug (level) |
| 3. Shaft | 10. Bolt | 17. Coupling | 24. Plug (drain) |
| 4. Gear | 11. Key | 18. Bolt | 25. Air breather |
| 5. Shaft | 12. Hub | 19. Oil seal | 26. Cover |
| 6. Shim | 13. Nut | 20. Gear | |
| 7. Shaft | 14. Cotter pin | 21. Cover | |

3-2. Removal and Installation of Pump Drive Gear Box/Hydraulic Pump Assembly

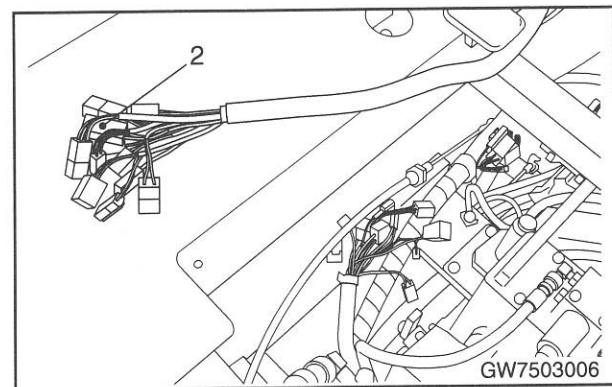
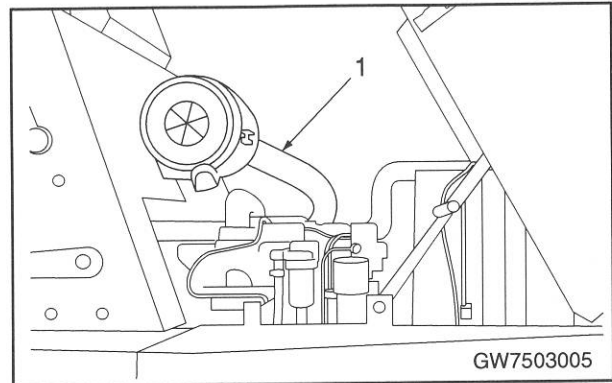
3-2-1. Removal of pump drive gear box/hydraulic pump assembly

★ For access to pump drive gear box and hydraulic pumps, you must remove the floor frame/instrument assembly using the following steps.

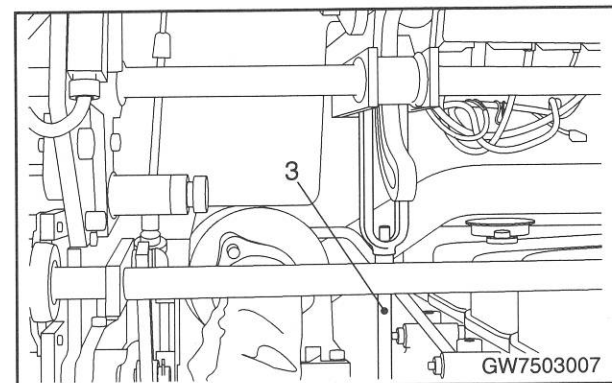
★ Disconnect the negative (-) cable from the battery.

1. Floor frame/instrument panel assembly

- (1) Open the engine hood.
- (2) Disconnect suction hose (1) from the air cleaner.
 - ★ Cap and plug the open end of the hoses and fittings to prevent ingress of foreign matter.
- (3) Remove the floor plate from the driver's station.
- (4) Disconnect electrical connectors (2) and other connectors from the joints, and the ground wire.

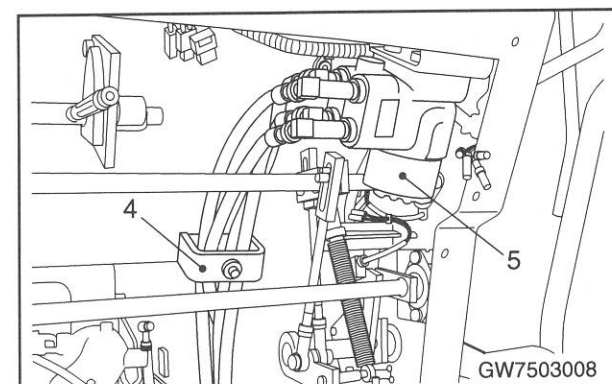


- (5) Disconnect propulsion pump control lever.
- (6) Disconnect forward-reverse rod (3) on the ball joint side. [*3]
- (7) Disconnect the throttle cable from the throttle lever. Also disconnect from the bracket by loosening the lock nuts.



(8) Orbitrol (steering valve)

- 1) Remove the turn signal switch and hose clamp (4).
- 2) Disconnect four hoses from Orbitrol (5).
- ★ Cover the openings of hoses and Orbitrol.
- 3) Remove the column shaft nut and remove both the steering wheels.




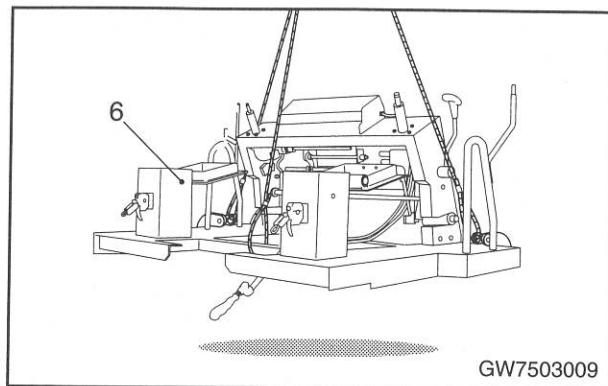
(9) Floor frame/instrument panel assembly

CAUTION

Use a lifting device of good condition and with sufficient capacity for lifting components being serviced or repaired.

- 1) Remove four mounting bolts and disconnect deck ground wire. Using a hoist, lift off floor frame/instrument panel assembly (6).

 Floor frame/instrument panel assembly (6): 250 kg (551.2 lb.)



2. Hydraulic pump hoses

CAUTION

After your machine has operated for some time, hydraulic fluid will be hot and there may be residual pressure in the hoses. Disconnecting the hoses in this condition can burn you. Perform this work after the machine has cooled off.

- (1) Disconnect eight propulsion pump hydraulic hoses; three hoses from block (7), one from the return filter and one from the line filter and remaining three from the solenoid valve.

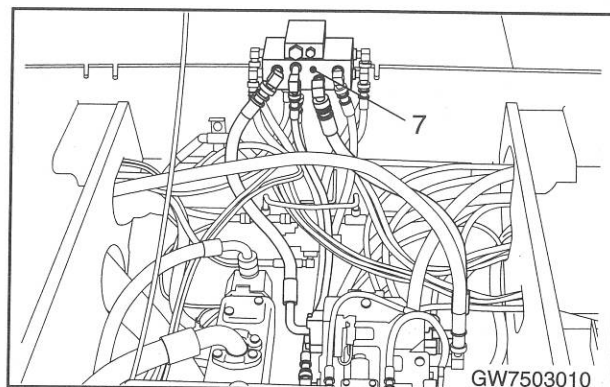
★ **Cap and plug the openings of the hoses, block, return filter, line filter and solenoid valve.**

- (2) Disconnect three vibrator hydraulic hoses; one from the hydraulic tank and two from the vibrator solenoid valve.

★ **Cap and plug the openings of the hoses, hydraulic tank and vibrator solenoid valve.**

- (3) Disconnect two the steering/charge pump hydraulic hoses from the hydraulic tank and from the steering valve.


★ **Cap and plug the openings of the hoses and hydraulic tank and steering valve.**



3. Pump drive gear box/hydraulic pump assembly

(1) Temporarily lift the pump drive gear box/hydraulic pump assembly (8), and remove eight flywheel securing bolts (9).

(2) Using a hoist, lift off the pump drive gear box/hydraulic pump assembly.

 Pump drive gear box/Hydraulic pump:
kg 140 kg (308.6 lb.)

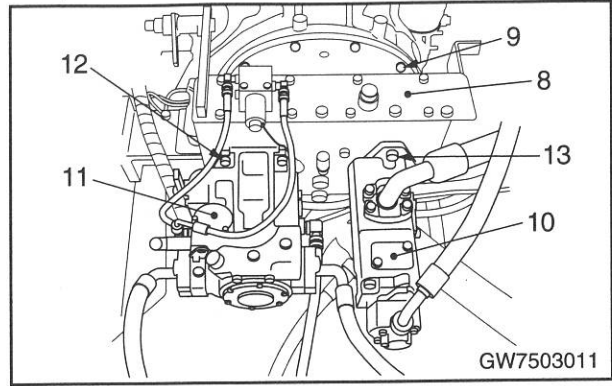
(3) Drain the pump drive gear box case by removing the drain plug.

(4) Remove the mounting bolts and separate the gear pump assembly (vibration/steering/charge pump assembly) (10) from the pump drive gear box. [*2]

 Gear pump assembly (10): 15 kg (33 lb.)

(5) Disconnect the control rod from the control lever of the propulsion pump assembly (11), and remove propulsion pump assembly from the pump drive gear box. [*1] [*2]

 Propulsion pump: 45 kg (99.2 lb.)



3-2-2. Installation of pump drive gear box/hydraulic pump assembly

★ **For installation, reverse the removal steps.**

[*1] Install the assembly with bolt holes (14) of the pump drive gear box coupling aligned with bolt holes (15) of the flywheel.

- (size of bolt: M16 x 2.0)
- Tightening torque : 245 N·m (180.7 lb.-ft)

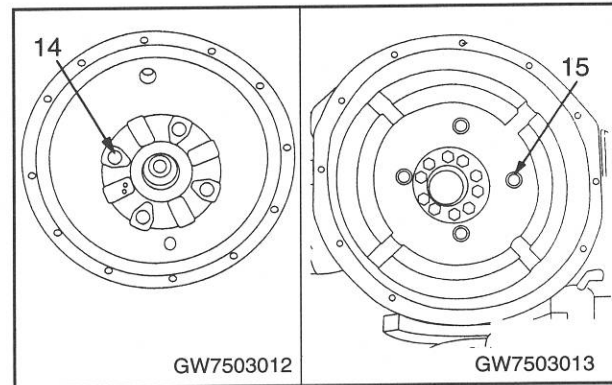
[*2] Install the assembly with bolt of the propulsion pump assembly and the gear pump assembly

- (size of bolt: M14 x 2.0)
- Tightening torque : 147 N·m (108.4 lb.-ft)

[*3]
★ **Adjust the linkage as in “F-R lever linkage adjustment”, INSPECTION, ADJUSTMENT section.**

★ **Add oil to the tank to compensate a leak during removal.**

★ **Start the engine. Allow oil to circulate through the hoses, and recheck the oil level.**



3-3. Disassembly and Reassembly of Pump Drive Gear Box


3-3-1. Disassembly of pump drive gear box

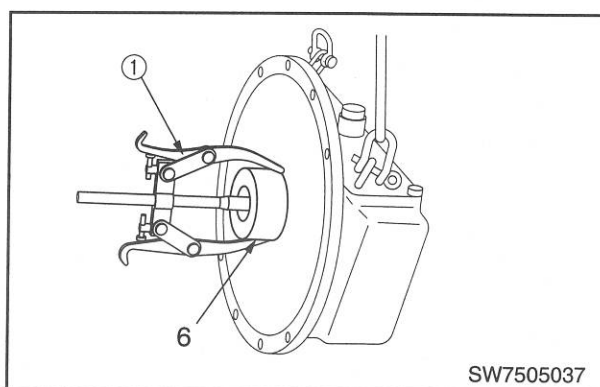
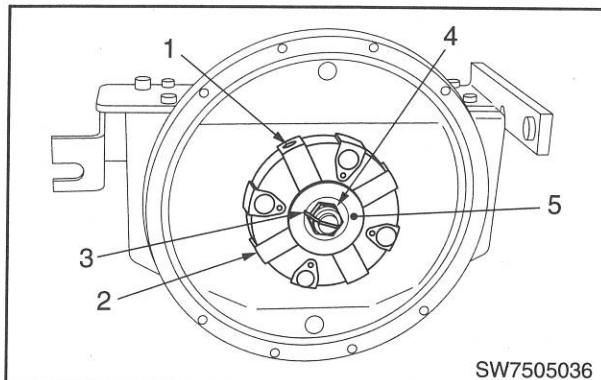
Preparation

Remove the pump drive gear box referring to "Removal of pump drive gear box/ hydraulic pump assembly" in this section.

1. Coupling and hub

- (1) Remove four bolts (1) and remove Coupling (2).
- (2) Remove cotter pin (3) and remove nut (4) and washer (5).
- (3) Using puller, pull off hub (6).
- (4) Remove the key from the shaft.

 Pump drive gear box assembly: 80 kg (176.4 lb.)

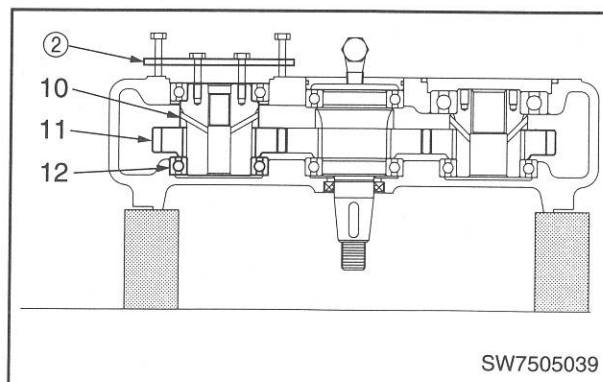
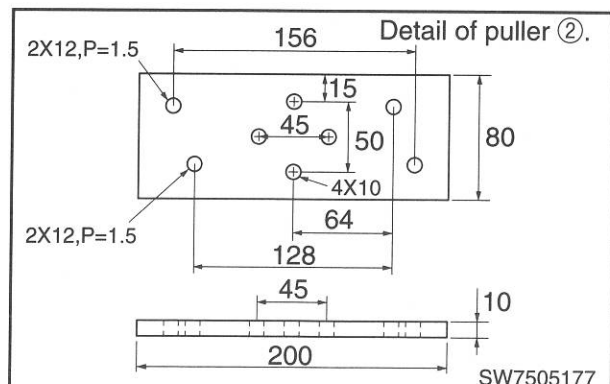
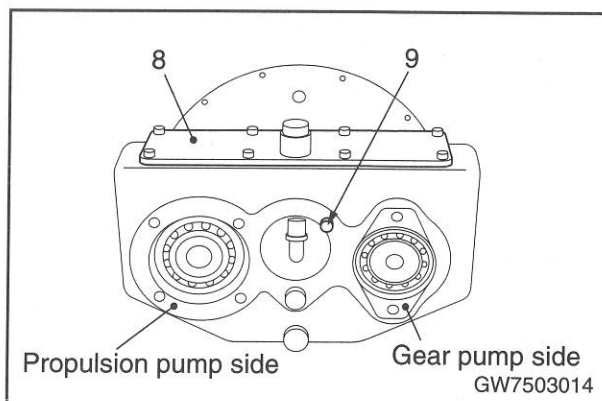


2. Cover and bolt

- (1) Remove cover (8).
- (2) Remove bolt (9) which secures the drive shaft bearing cover.

3. Pump drive gear and shaft

- (1) Using puller ②, pull off shaft (10).
- ★ Gear (11) and bearing (12) are slid off from the shaft and will be left inside the case.
- (2) Remove gear (11) and bearing (12).

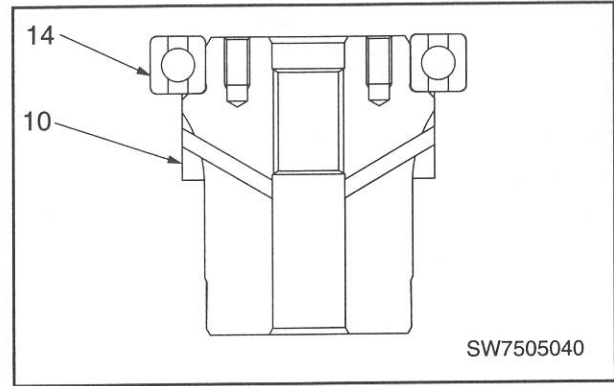


PUMP DRIVE GEAR BOX AND HYDRAULIC PUMPS

(3) Remove bearing (14) from shaft (10).

★ **Disassemble the gear/shaft assembly on the propulsion pump side and vibration/steering pump side using the same procedure.**

★ **The outer bearing of propulsion pump side differs in size with the outer bearing of the vibration/steering pump side.**



4. Drive gear and shaft

(1) Place spacer (3) between gear case (16) and gear (15) to allow the gear to contact evenly with case (16).

(2) With the threaded portion of drive shaft (17) up, tap end of the drive shaft with a soft-faced hammer and drive off the shaft.

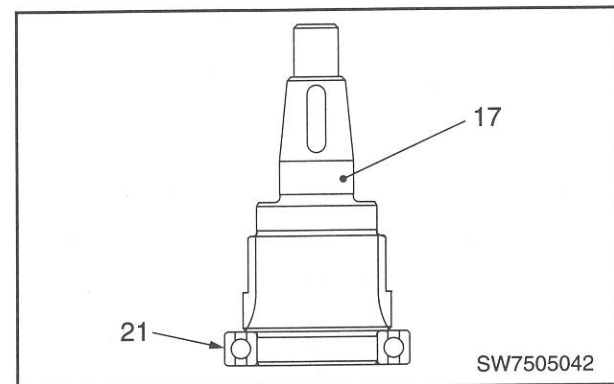
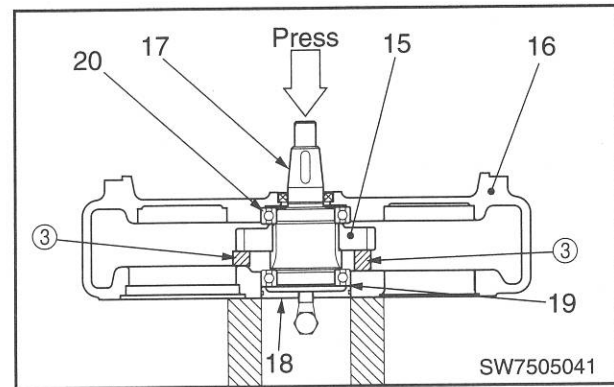
(3) Pressed by the shaft, cover (18) and shim (19) will fall free.

★ **Record the shim thickness and number and retain the shims for reuse.**

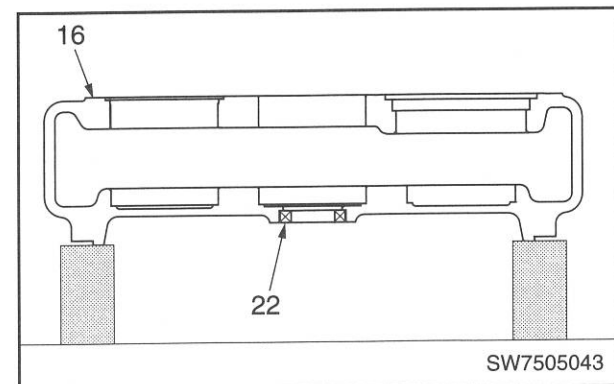
★ **Gear (15) and bearing (20) will slide off the shaft and remain inside the case.**

(4) Pull off gear (15) and bearing (20).

(5) Pull off bearing (21) from drive shaft (17).



(6) Remove oil seal (22) from case (16).



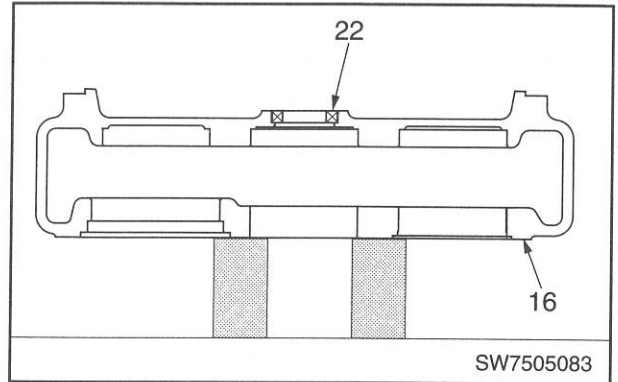
3-3-2. Reassembly of pump drive gear box

★ Thoroughly clean the parts and remove burrs etc if noticeable.

1. Drive gear and shaft

(1) Fit oil seal (22) to case (16).

★ Pack the oil seal lips with Grease.

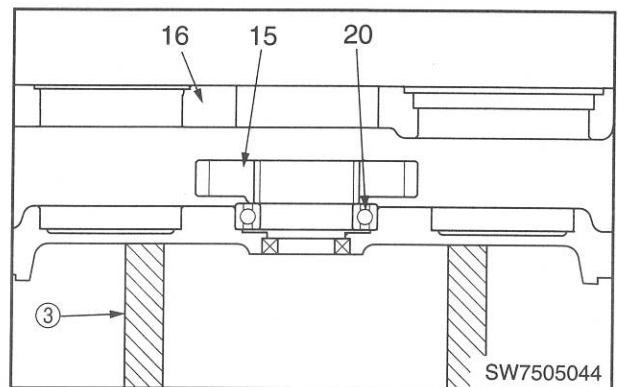


(2) Place case (16) on block (3) with the pump mounting side up.

(3) Mount bearing (20) in case (16).

(4) Position gear (15) on bearing (20).

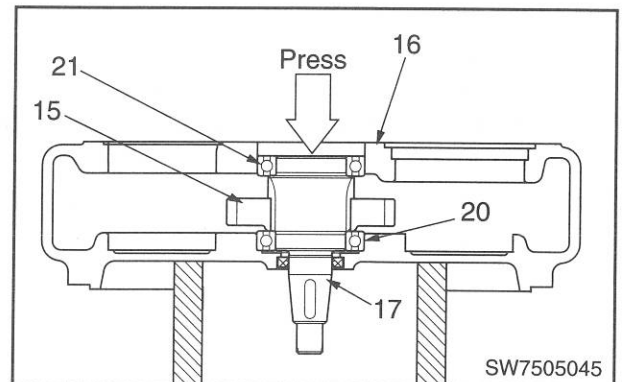
★ Place the flat machined surface (pump mounting side) up.



(5) Press shaft (17) into bearing (20) by allowing the shaft splines to correctly mesh with the splines of gear (15).

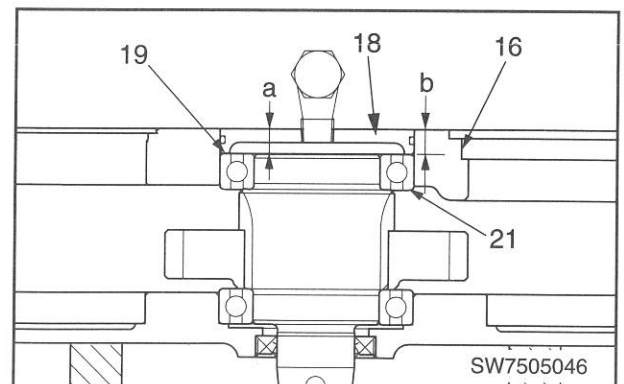
(6) Install bearing (21) making sure it is fully seated on shaft (17) and the bore of case (16).

★ Press fit the bearing inner race and outer race simultaneously.



(7) Measure height 'a' of cover (18) and dimension 'b' between upper surface of case (16) and bearing (21) as indicated in the bottom illustration. Assemble the cover into the case bore with shims (19) that provide a clearance of 0.2 to 0.3 mm between the cover and bearing.

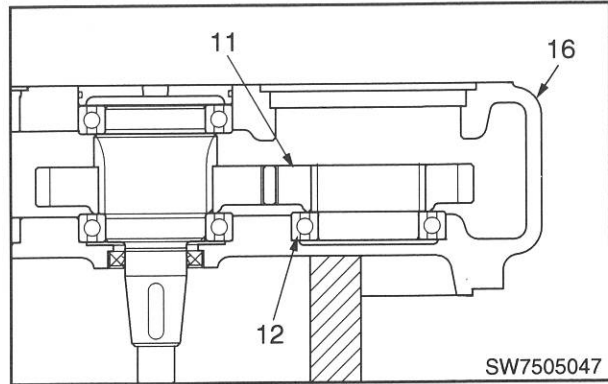
(8) Install cover (18).



2. Pump drive gear and shaft

- (1) Mount bearing (12) into case (16).
- (2) Position gear (11) on bearing (12).

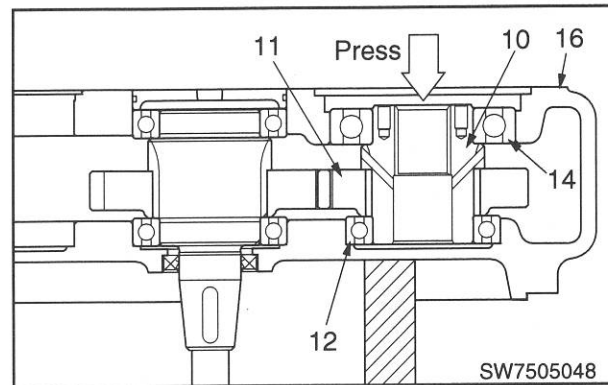
★ Place the flat machined surface (pump mounting side) up.



- (3) Press-fit shaft (10) into bearing (12) with the splined portion of the shaft correctly fitting in the splined portion of gear (11).
- (4) Press-fit bearing (14) into the bore of case (16) and onto shaft (10) making sure that the bearing fits in the case and shaft.

★ Assemble the gear/shaft assembly on the propulsion pump side and vibration/steering pump side using the same procedure.

★ The outer bearing of propulsion pump side differs in size with the outer bearing of the vibration/steering pump side.

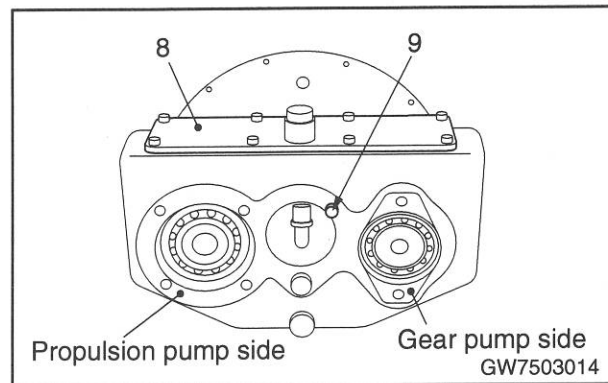


3. Cover

- (1) Install cover (8) with the packing.

★ Apply liquid sealant to the mounting surfaces.

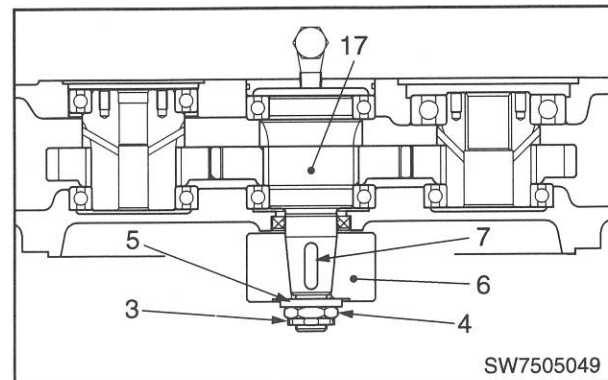
- (2) Fit bolt (9) which retains the drive shaft bearing cover.



4. Coupling and hub

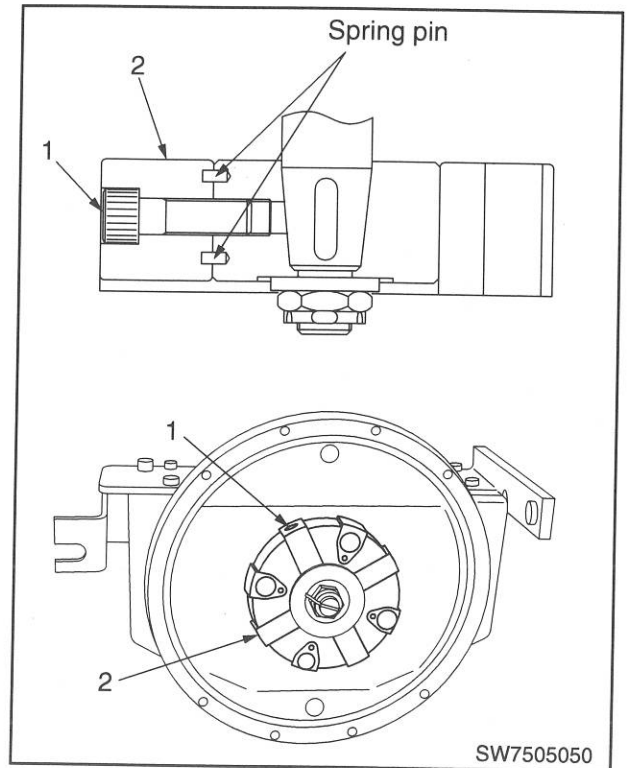
- (1) Fit key (7) on drive shaft (17).
- (2) Fit hub (6) onto the shaft with the key way aligned with key (7).
- (3) Fit nut (4) with washer (5) and tighten the nut. Fit cotter pin (3).

★ If the cotter pin holes of the nut and shaft do not line up, turn the nut in the tightening direction.



(4) Position coupling (2) on the hub and tighten the four bolts (1).

★ When tightening bolts (1), ensure that the spring pins fit securely into the holes of the coupling and hub.



HYDRAULIC SYSTEMS

HYDRAULIC SYSTEMS

Graphical Symbols For Hydraulic 4-002

1. SYSTEM CIRCUIT DIAGRAM

1-1. Hydraulic circuit diagram 4-004

2. PROPULSION SYSTEM

2-1. Hose diagram (1) 4-005

2-2. Hose diagram (2) 4-006

2-3. Component specifications 4-007

2-3-1. Propulsion pump assembly 4-007

2-3-2. Propulsion motor assembly (front and rear) 4-008

2-3-3. Internal structure of propulsion motor assembly 4-009

3. VIBRATORY SYSTEM

3-1. Hose diagram (1) Vib. pump and motors 4-010

3-2. Hose diagram (2) Vib. amplitude cylinder 4-011

3-3. Component specification 4-012

3-3-1. Front vibrator motor assembly 4-012

3-3-2. Rear vibrator motor assembly 4-013

3-3-3. Amplitude control cylinder (Front) 4-014

3-3-4. Amplitude control cylinder (Rear) 4-015

3-3-5. Vibration/steering/charge pump assembly 4-016

4. STEERING SYSTEM

4-1. Hose diagram 4-017

4-2. Frame(Center pin) 4-018

4-3. Component specifications 4-019

4-3-1. Steering valve (Orbitrol) 4-019

4-3-2. Steering cylinder 4-020

Graphical Symbols For Hydraulic

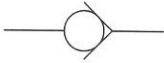

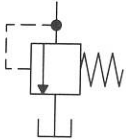

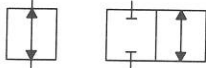
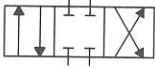

Basic Symbols

DESCRIPTION	SYMBOL
Lines: Main Working	
Pilot Control Drain or Bleed	
Lines, joining	
Not Connected	
Component Outline	
Arrow indicates direction of flow.	
Line with fixed restriction (orifice).	
Test port, pressure measurement.	
Temperature measurement gauge	
Pressure measurement gauge	
Reservoir (vented)	
Filter or Strainer	
Heat exchanger, lines indicate flow of coolant.	
Quick Disconnect: Connected with mechanically opened checks.	
Disconnected.	
Sloping arrow through a symbol at 45° indicates that a component can be adjusted or varied.	

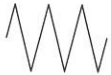
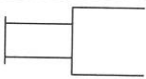

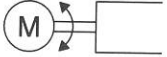
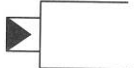

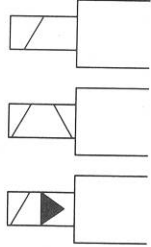
Pump, Motors and Cylinders

DESCRIPTION	SYMBOL
Hydraulic Pumps:	
Fixed Displacement Unidirectional	
Bidirectional	
Variable Displacement Unidirectional	
Bidirectional	
Variable Displacement Pressure Compensated Unidirectional	
Hydraulic Motor:	
Unidirectional	
Bidirectional	
Double acting hydraulic cylinder	
Differential cylinder	
Electric Motor	

Valves

DESCRIPTION	SYMBOL
Check Valve	
Manual Shut Off (On-Off)	
Pressure Relief	
Flow control, adjustable	
Valve Symbols: The basic valve symbol one or more squares with lines representing flow paths and flow conditions between ports.	
Multiple squares indicate a valve with as many distinct positions there are squares providing various flow path options for the fluid. The multiple square moves to represent how flow paths change when the valving element is shifted within the component.	
Valves with infinite positioning between certain limits are symbolized with lines parallel to the squares.	

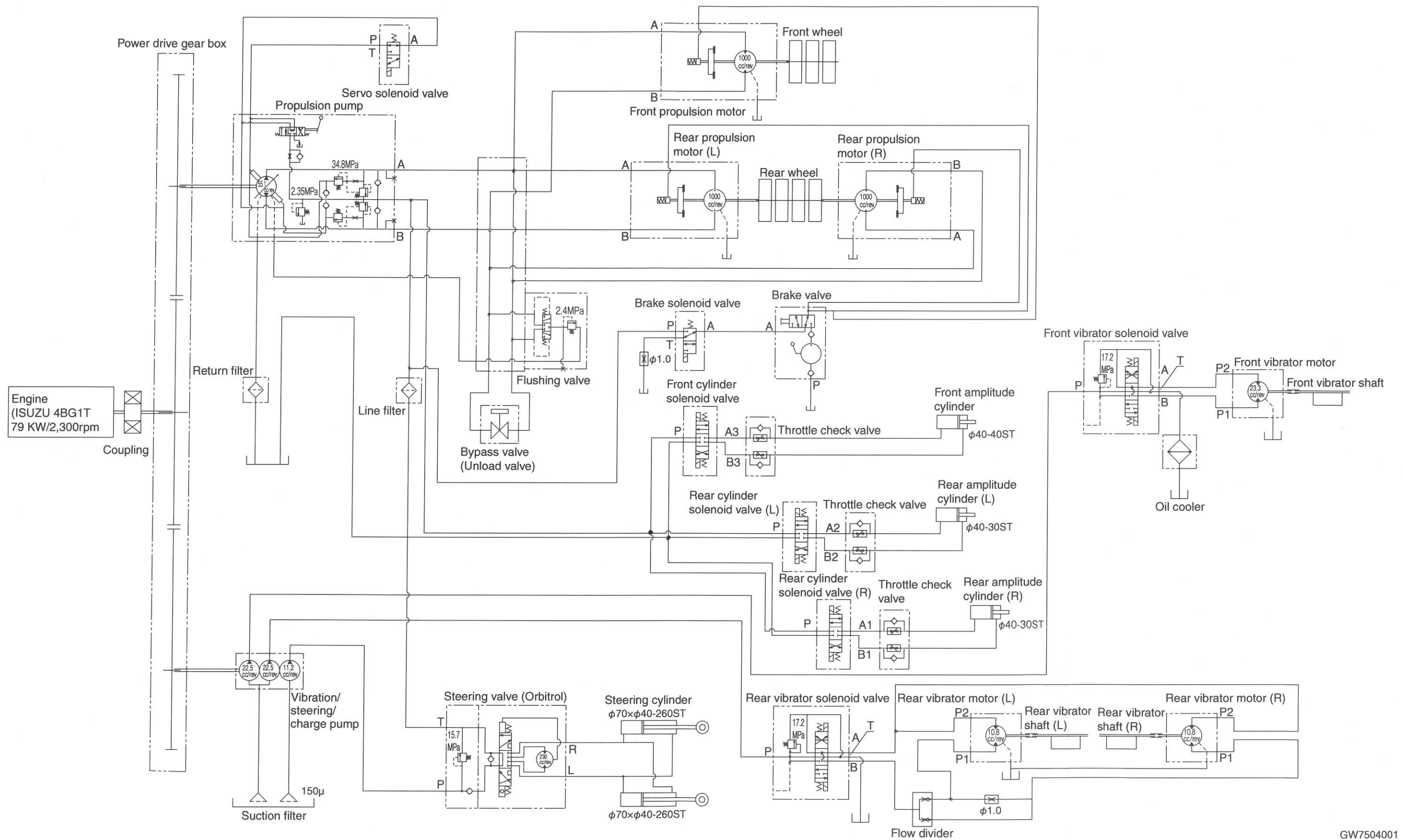
Methods of Operation

DESCRIPTION	SYMBOL
Spring	
Manual	
Pressure Compensated	
Reversing Motor	
Pilot Pressure: Internal Supply	
Remote Supply	
Solenoid: Single winding Two windings operating in opposite directions. Pilot directional valve is actuated by the solenoid.	



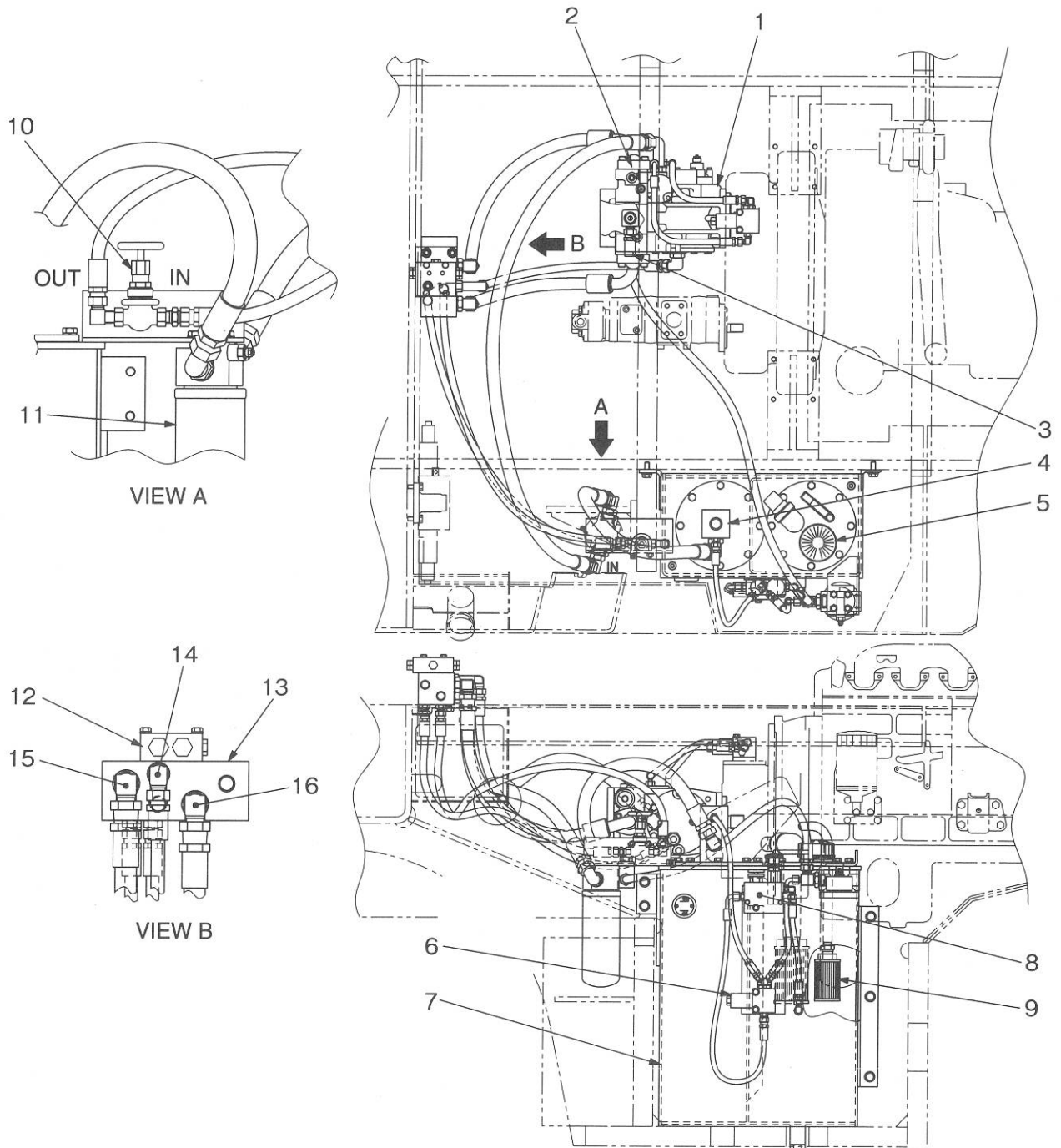
1. SYSTEM CIRCUIT DIAGRAM

1-1. Hydraulic circuit diagram



2. PROPULSION SYSTEM

2-1. Hose diagram (1)

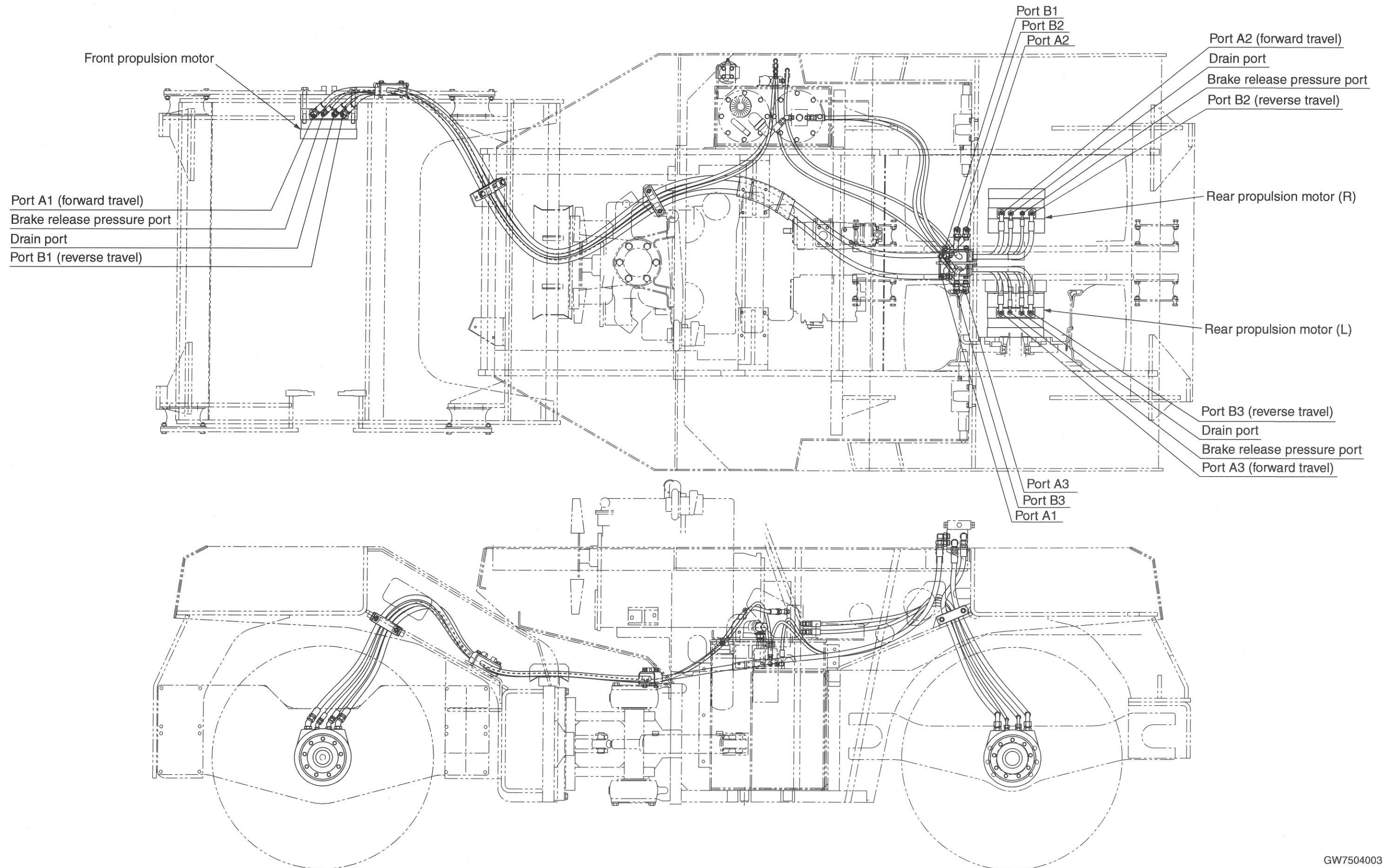


GW7504002

- | | |
|---|--------------------|
| 1. Propulsion pump | 9. Suction filter |
| 2. B port (propulsion pump) | 10. Unload valve |
| 3. A port (propulsion pump) | 11. Return filter |
| 4. Return block | 12. Flushing valve |
| 5. Filler cap | 13. Block |
| 6. Brake solenoid valve | 14. Port T (block) |
| 7. Hydraulic tank | 15. Port A (block) |
| 8. Brake valve
(parking brake release hand pump + manual selector valve) | 16. Port B (block) |

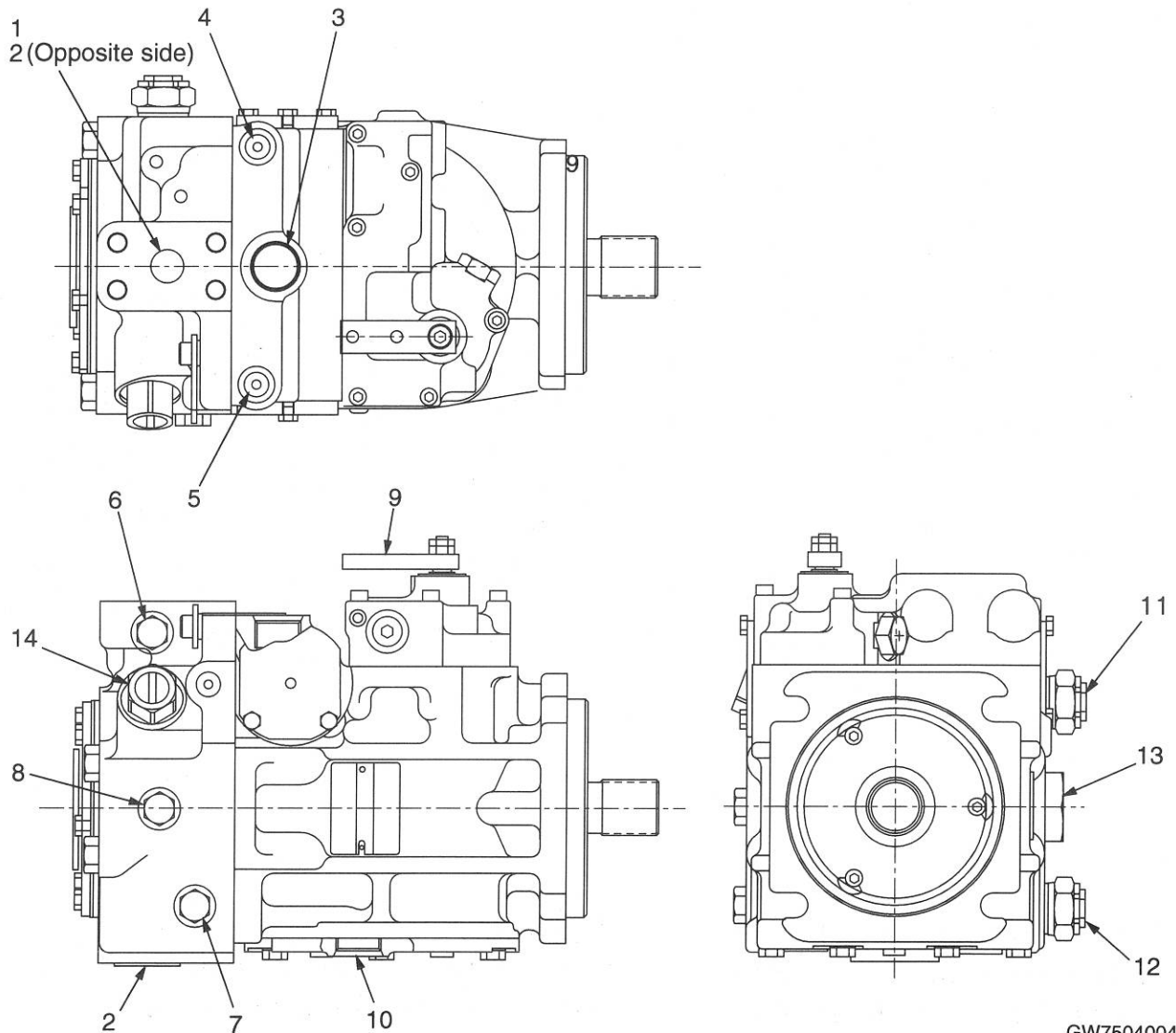


2-2. Hose diagram (2)



2-3. Component specifications

2-3-1. Propulsion pump assembly



GW7504004

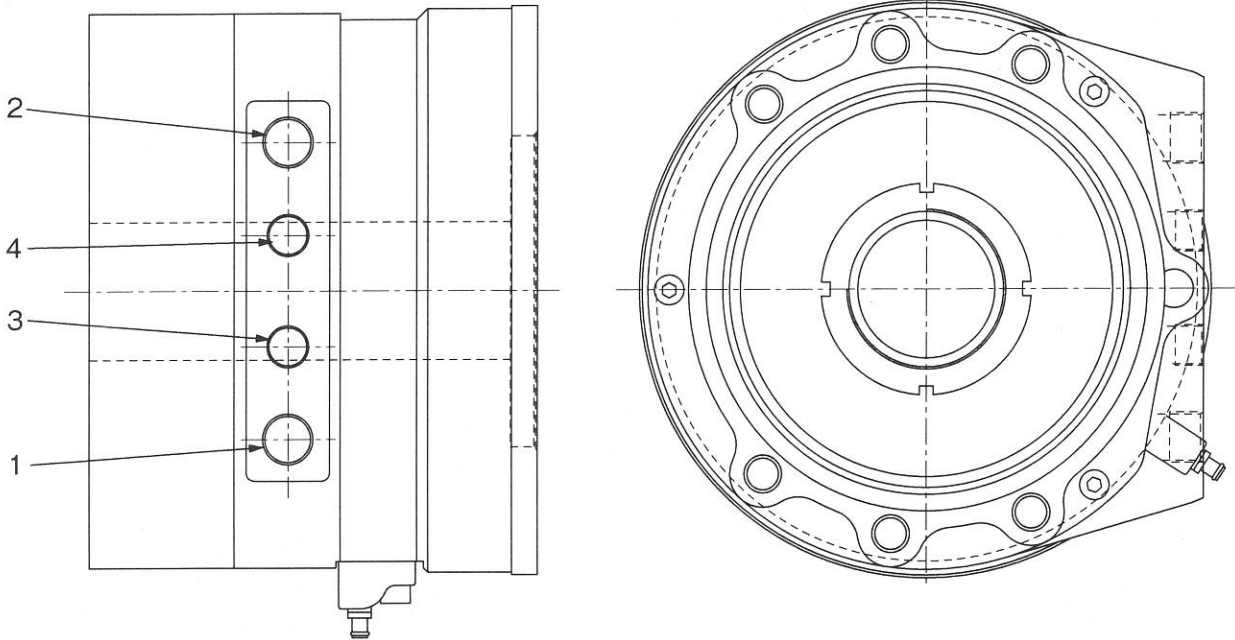
- | | |
|---|--|
| 1. Port B (reverse travel)
(SAE 1) | 8. Suction gauge port
(9/16-18UNF) |
| 2. Port A (forward travel)
(SAE 1) | 9. Control lever |
| 3. Case drain port
(1 1/16-20 UNF) | 10. Case drain port
(1 1/16-20 UNF) |
| 4. Servo press. gauge port
(7/16-20 UNF) | 11. Multi-function valve
(port B) |
| 5. Servo press. gauge port
(7/16-20 UNF) | 12. Multi-function valve
(port A) |
| 6. High press. gauge port
(port B) (9/16-18 UNF) | 13. Charge press. gauge
port
(9/16-18 UNF) |
| 7. High press. gauge port
(port A) (9/16-18 UNF) | 14. Charge relief valve |

Specification

- Model PV055-621
- Displacement: 55.1 cm³/rev
(3.36 cu.in./rev)
- Pressure setting: 34.8 MPa (5047 psi)
- Charge pressure: 2.4 MPa at 20.1 l/min
(348 psi at 5.3 gal/min)

PROPULSION SYSTEM

2-3-2. Propulsion motor assembly (front and rear)



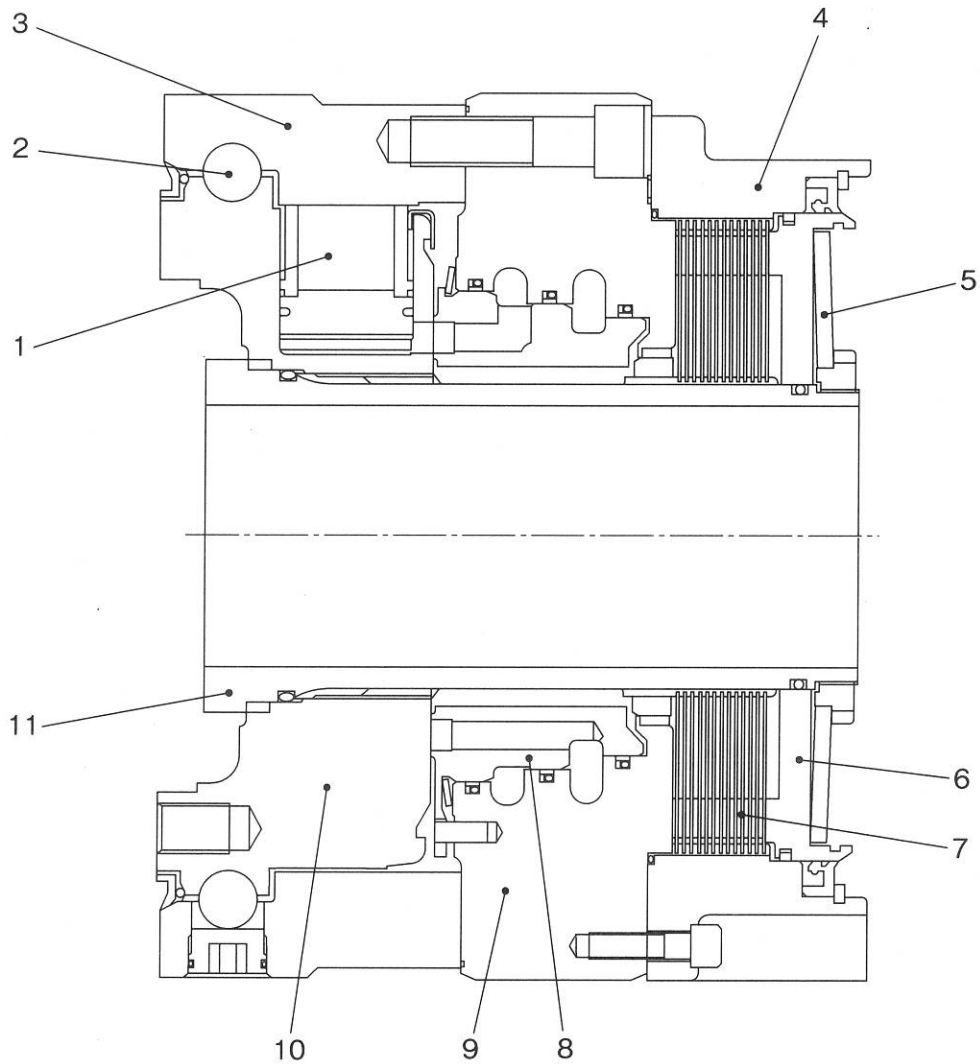
GW7504005

1. Port A (forward travel) (7/8-14 UNF)
2. Port B (reverse travel) (7/8-14 UNF)
3. Brake release port (9/16-18 UNF)
4. Drain port (3/4-18 UNF)

Specification

- Model : MK08-2-12A-F08-1340-A000
- Displacement : 1,000 cc/rev (61 cu.in./rev)
- Max. working pressure : 40.0 MPa (580 psi)
- Brake release pressure: 1.4 to 3.0 MPa (203 to 435 psi)

2-3-3. Internal structure of propulsion motor assembly



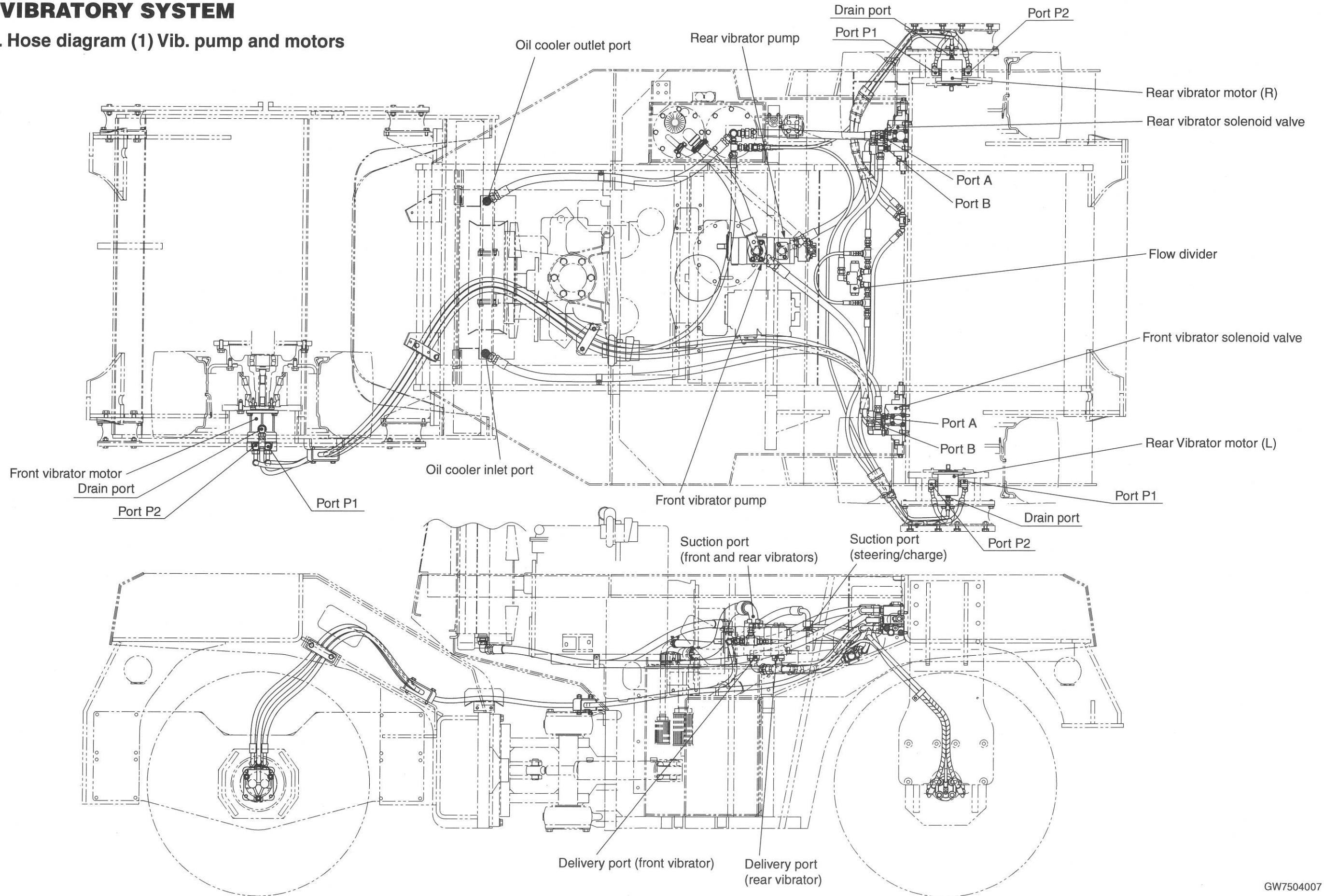
GW7504006

- | | | |
|------------------|-------------------|--------------------|
| 1. Piston | 5. Brake spring | 9. Cover |
| 2. Bearing | 6. Brake piston | 10. Cylinder block |
| 3. Cam ring | 7. Disc brake kit | 11. Shaft |
| 4. Brake housing | 8. Distributor | |

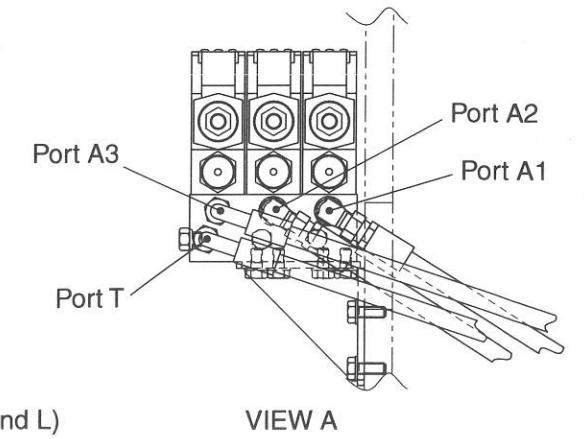
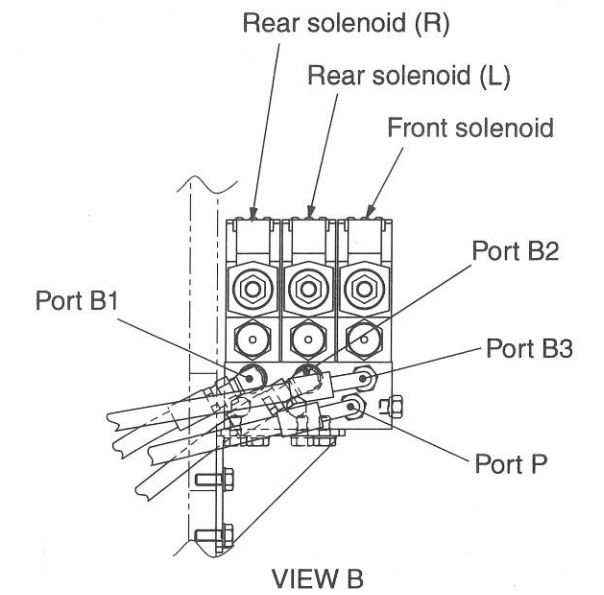
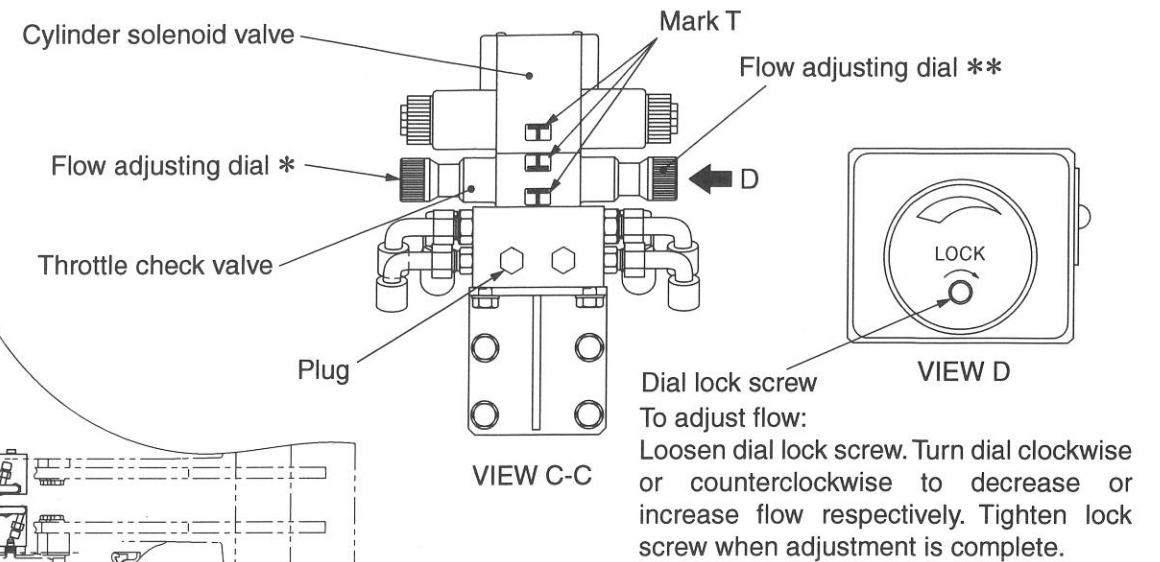
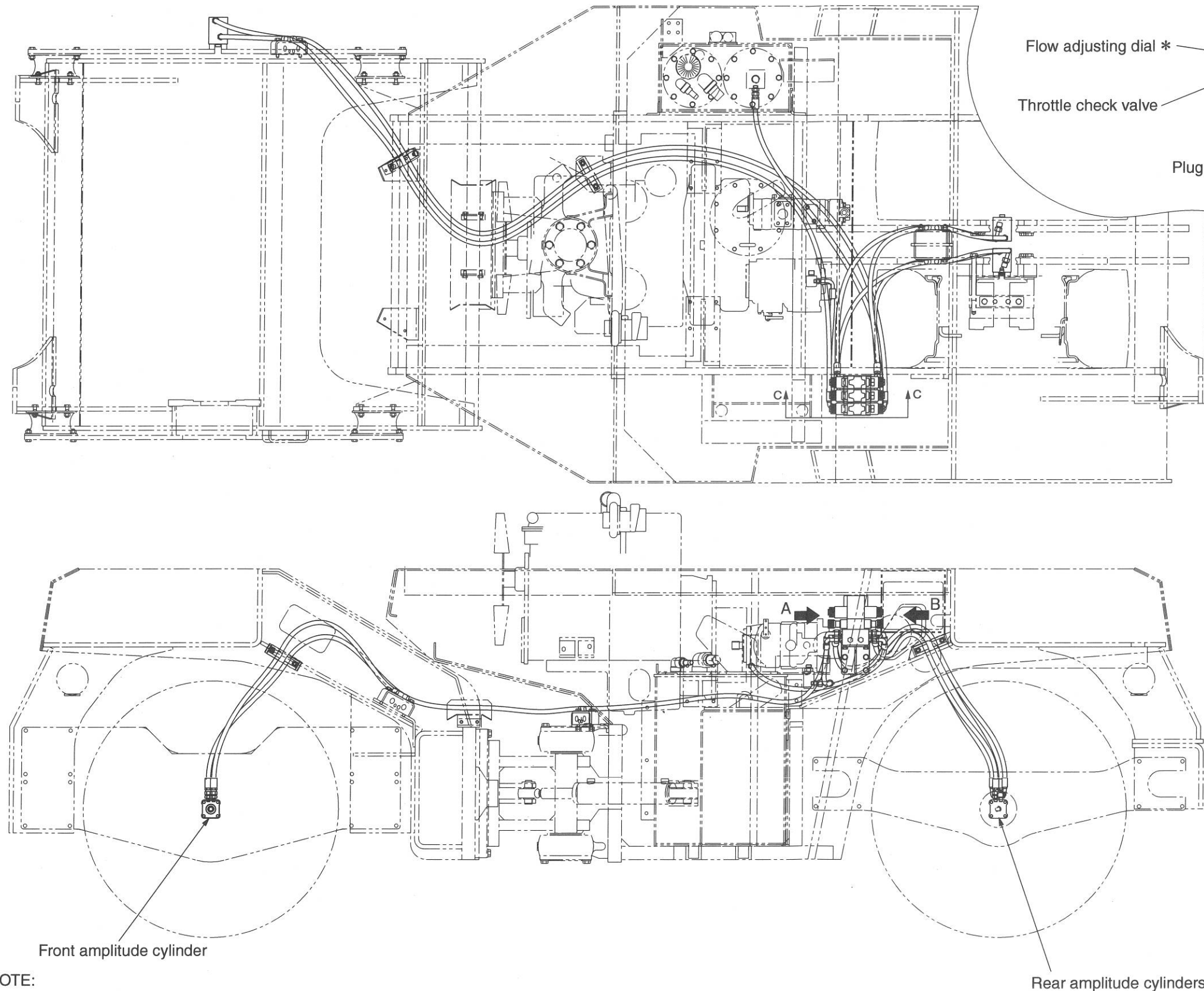


3. VIBRATORY SYSTEM

3-1. Hose diagram (1) Vib. pump and motors



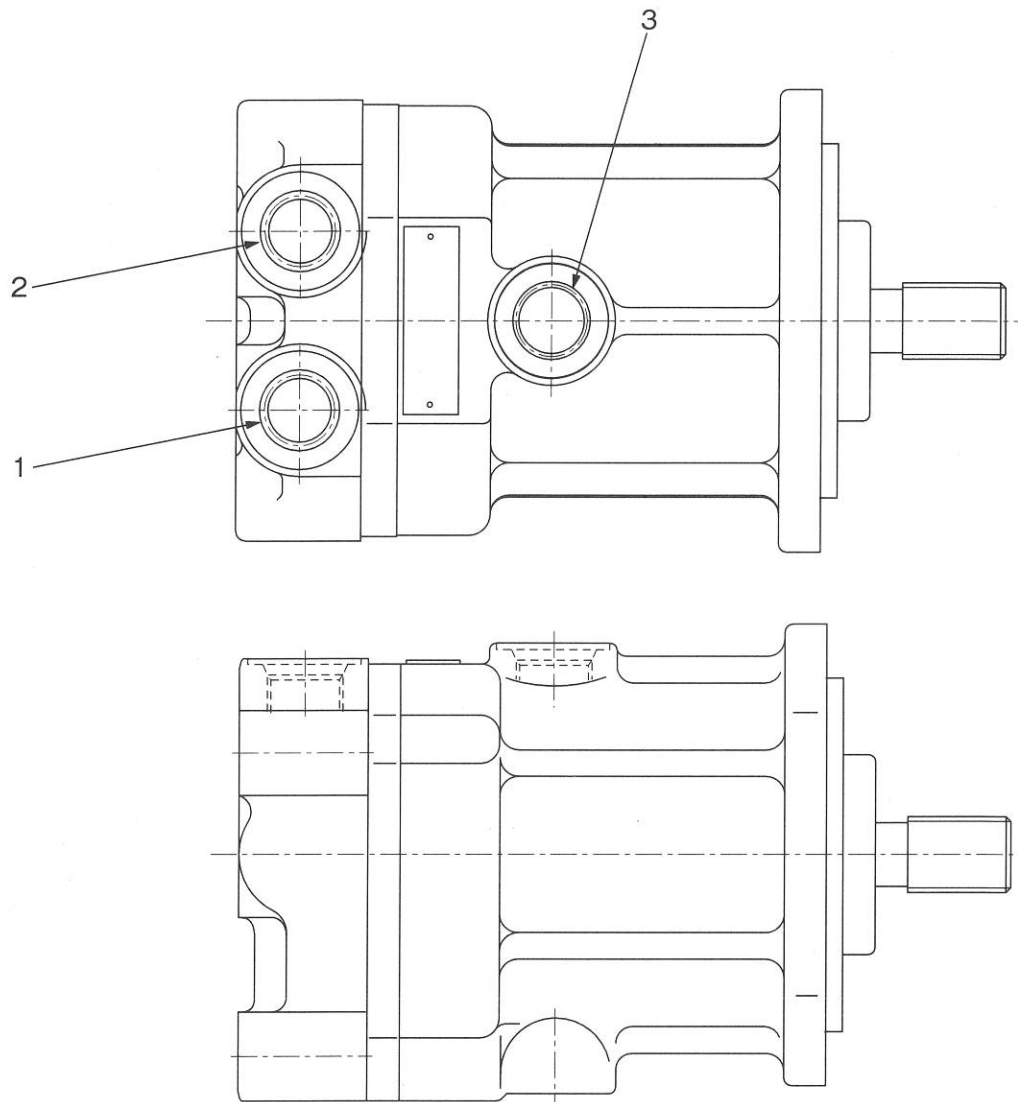
3-2. Hose diagram (2) Vib. amplitude cylinder



- NOTE:
- Fit the cylinder solenoid valve with marks T on the plug side as View C-C.
 - Adjust restrictor with mark * so that it takes about 1.5 seconds for amplitude to change after operating the amplitude selector switch.
 - Because it does not matter however fast the amplitude may be changed to neutral, do not attempt to restrict flow by means of flow adjusting dial with mark **.

3-3. Component specification

3-3-1. Front vibrator motor assembly



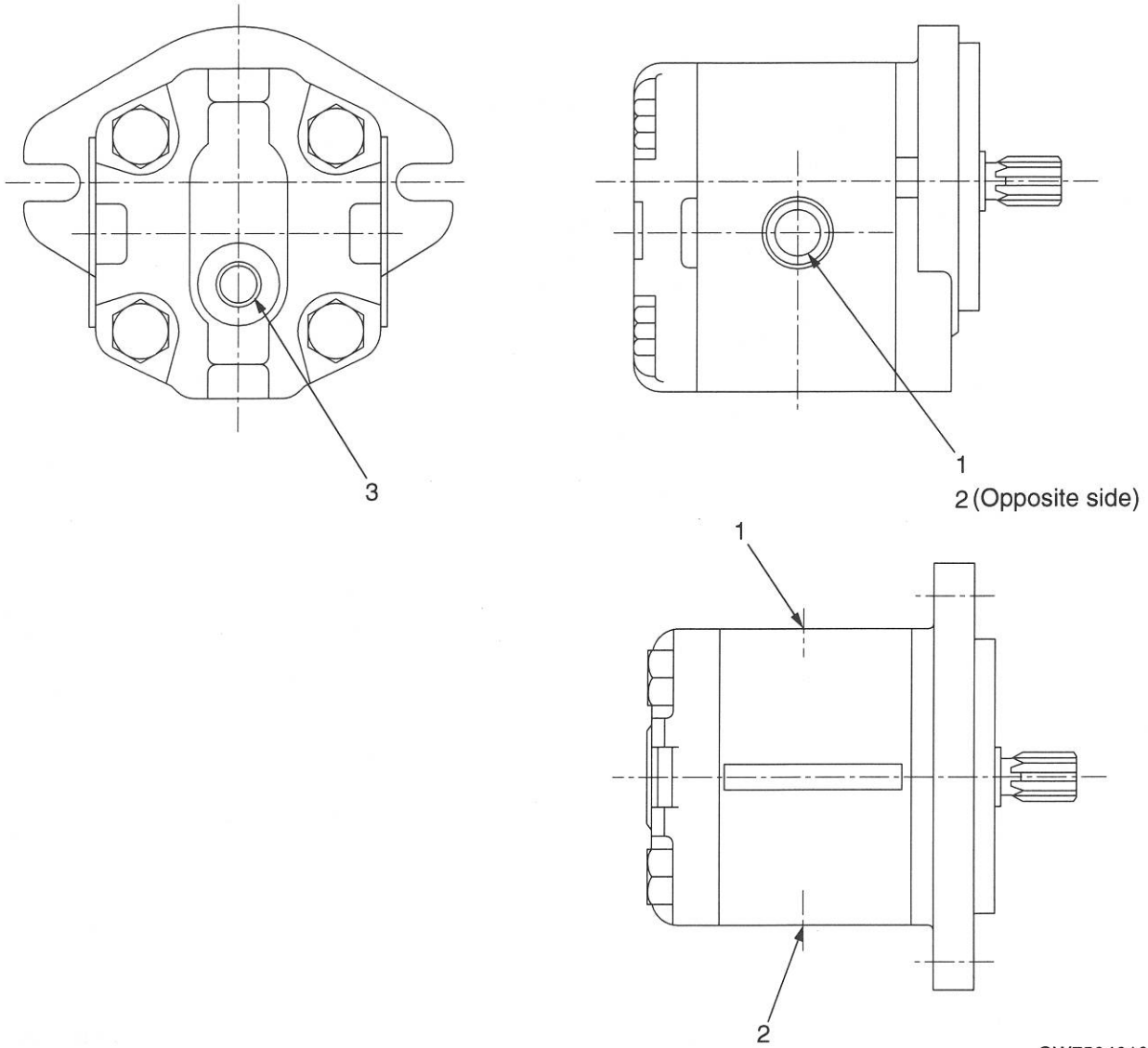
GW7504009

1. Port P1 (G1/2)
2. Port P2 (G1/2)
3. Drain port (G1/2)

Specification

- Model : MSK-23N-F
- Displacement : 23.3 cm³/rev (1.42 cu.in./rev)

3-3-2. Rear vibrator motor assembly



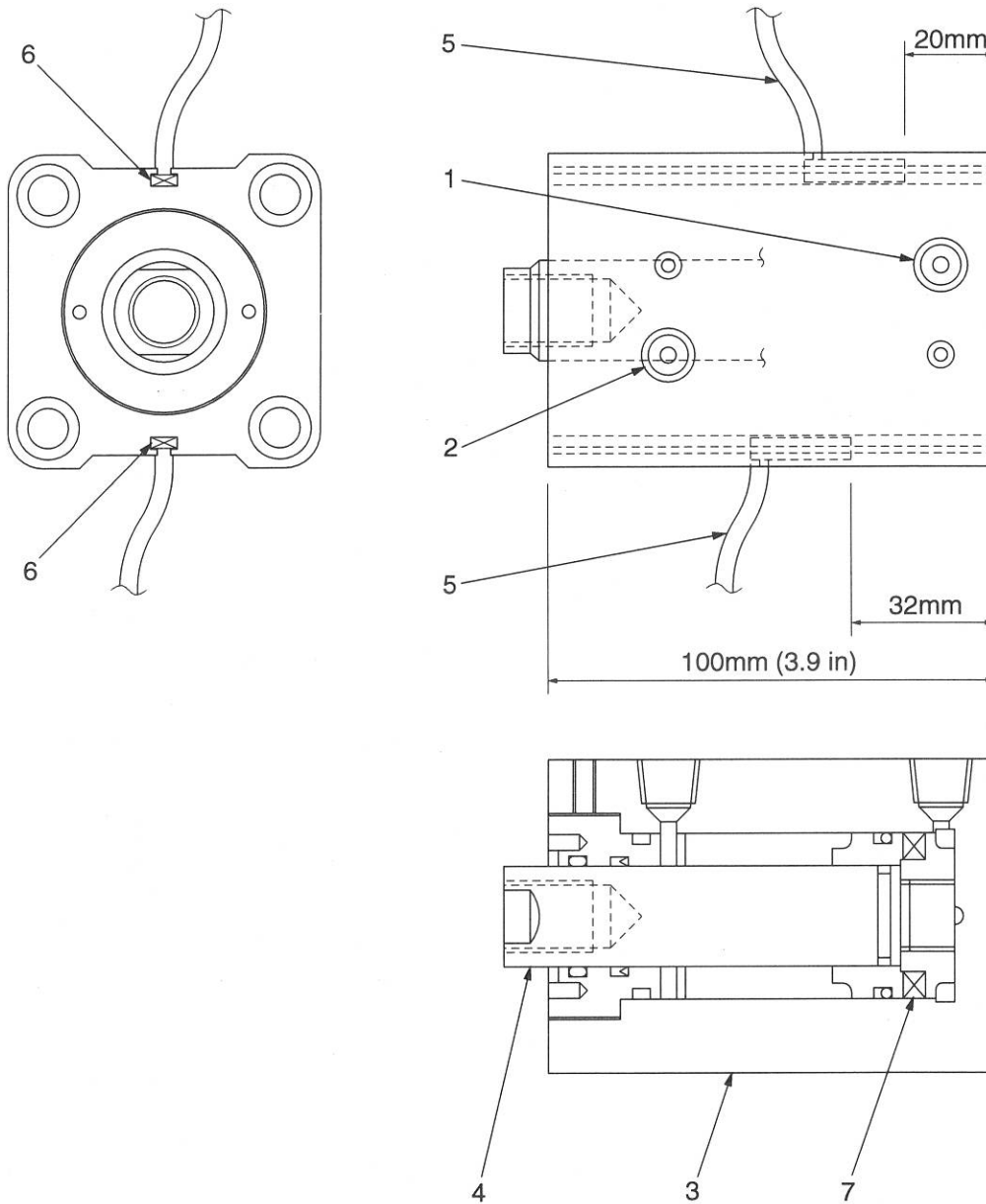
- 1. Port P1 (7/8-14 UNF)
- 2. Port P2 (7/8-14 UNF)
- 3. Drain port (9/16-18 UNF)

Specification

- Model : SNM2/11
- Displacement : 10.8 cm³/rev (0.66 cu.in/rev)

GW7504010

3-3-3. Amplitude control cylinder assembly (Front)



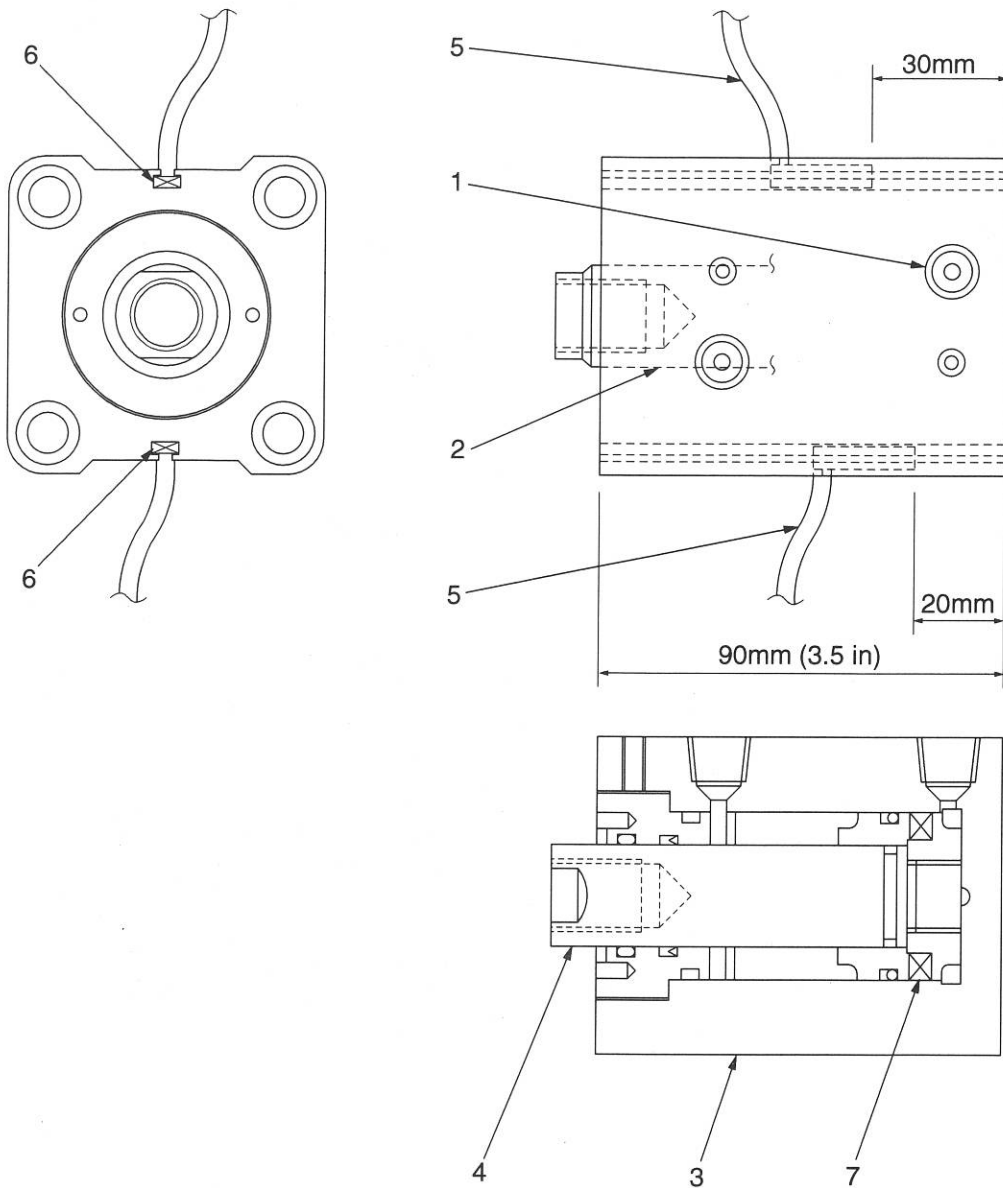
GW7504011

- 1. Port (Rc1/4))
- 2. Port (Rc1/4)
- 3. Cylinder tube
- 4. Cylinder rod
- 5. Cord
- 6. Lead switch
- 7. Magnet ring

Specification

- Model : C6R-SA-ISA40B140N40-2CK
- Inner dia. x stroke : 40mm x 40mm (1.6 in. x 1.6 in.)
- Max. working pressure : 14 MPa (2030 psi)

3-3-4. Amplitude control cylinder assembly (Rear)



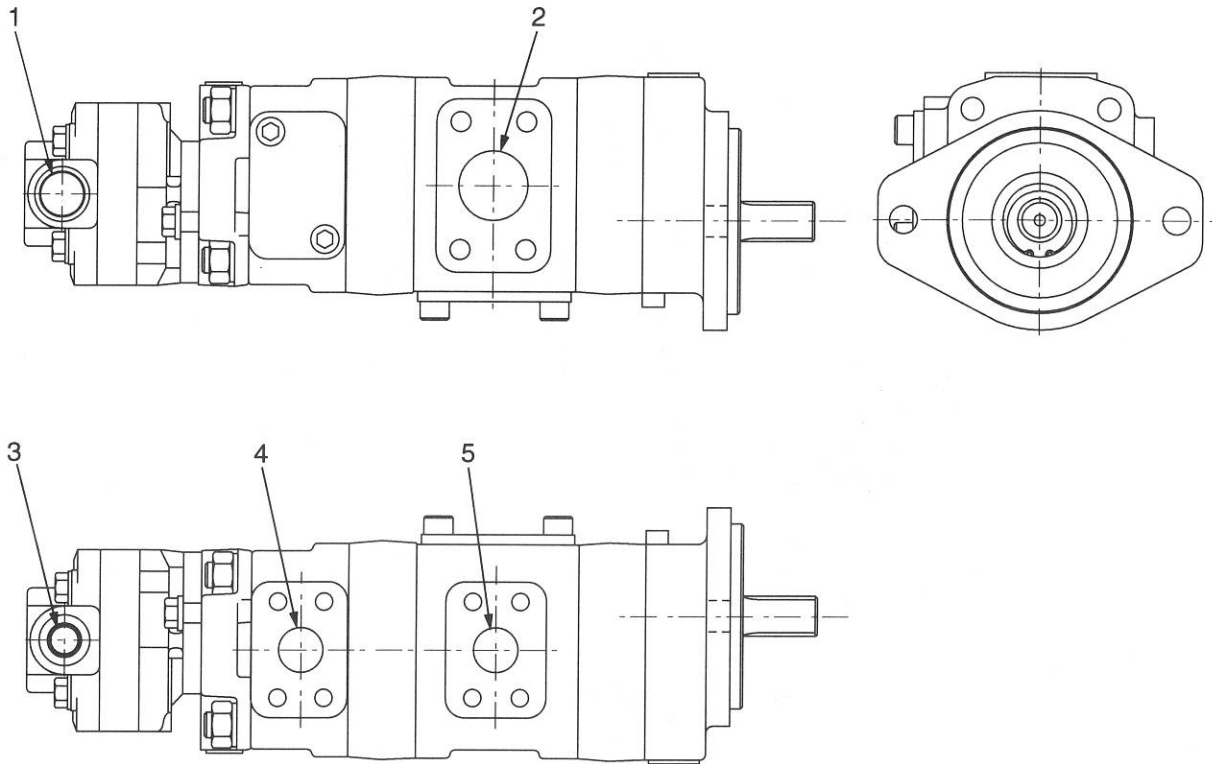
GW7504012

- 1. Port (Rc1/4)
- 2. Port (Rc1/4)
- 3. Cylinder tube
- 4. Cylinder rod
- 5. Cord
- 6. Lead switch
- 7. Magnet ring

Specification

- Model : C6R-SA-ISA40B140N40-2CK
- Inner dia. x stroke : 40mm x 30mm (1.6 in. x 1.2 in.)
- Max. working pressure : 14 MPa (2030 psi)

3-3-5. Vibration/steering/charge pump assembly



GW7504013

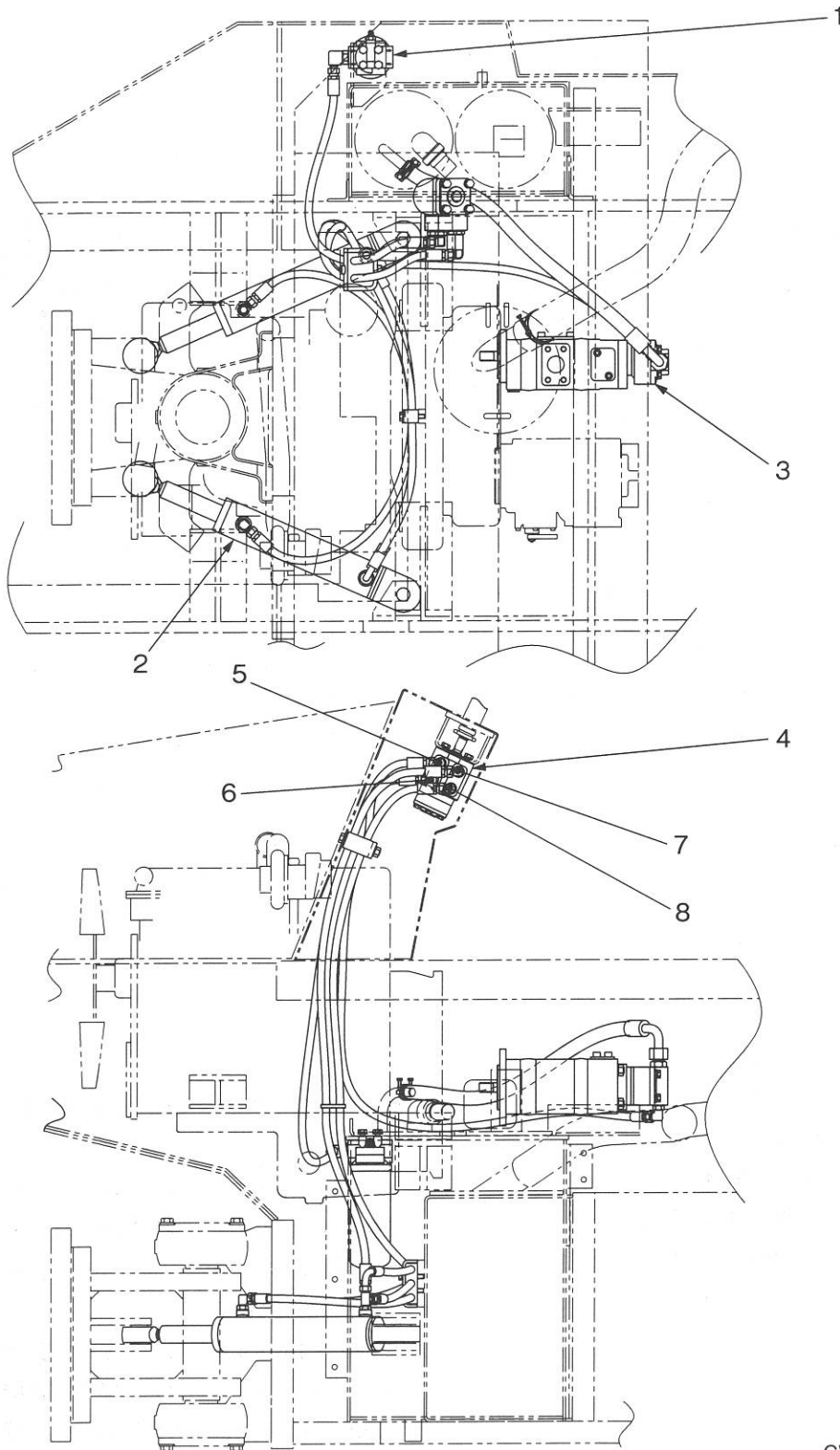
1. Suction port (G3/4) (steering/charge)
2. Suction port (SAE 1 1/2)
(front and rear vibrator pumps)
3. Delivery port (G3/8) (steering/charge)
4. Delivery port (rear vibrator) (SAE 1)
5. Delivery port (front vibrator) (SAE 1)

Specification

- Model KFP3223-23-KP1011AFX
- Displacement
 - Front vibrator : 22.5 cm³/rev (1.37 cu.in./rev)
 - Rear vibrator : 22.5 cm³/rev (1.37 cu.in./rev)
 - Steering/charge : 11.2 cm³/rev (0.68 cu.in./rev)
- Pressure setting
 - Front vibrator : 17.2 MPa (2495 psi)
 - Rear vibrator : 17.2 MPa (2495 psi)
 - Steering/charge : 15.7 MPa (2277 psi)

4. STEERING SYSTEM

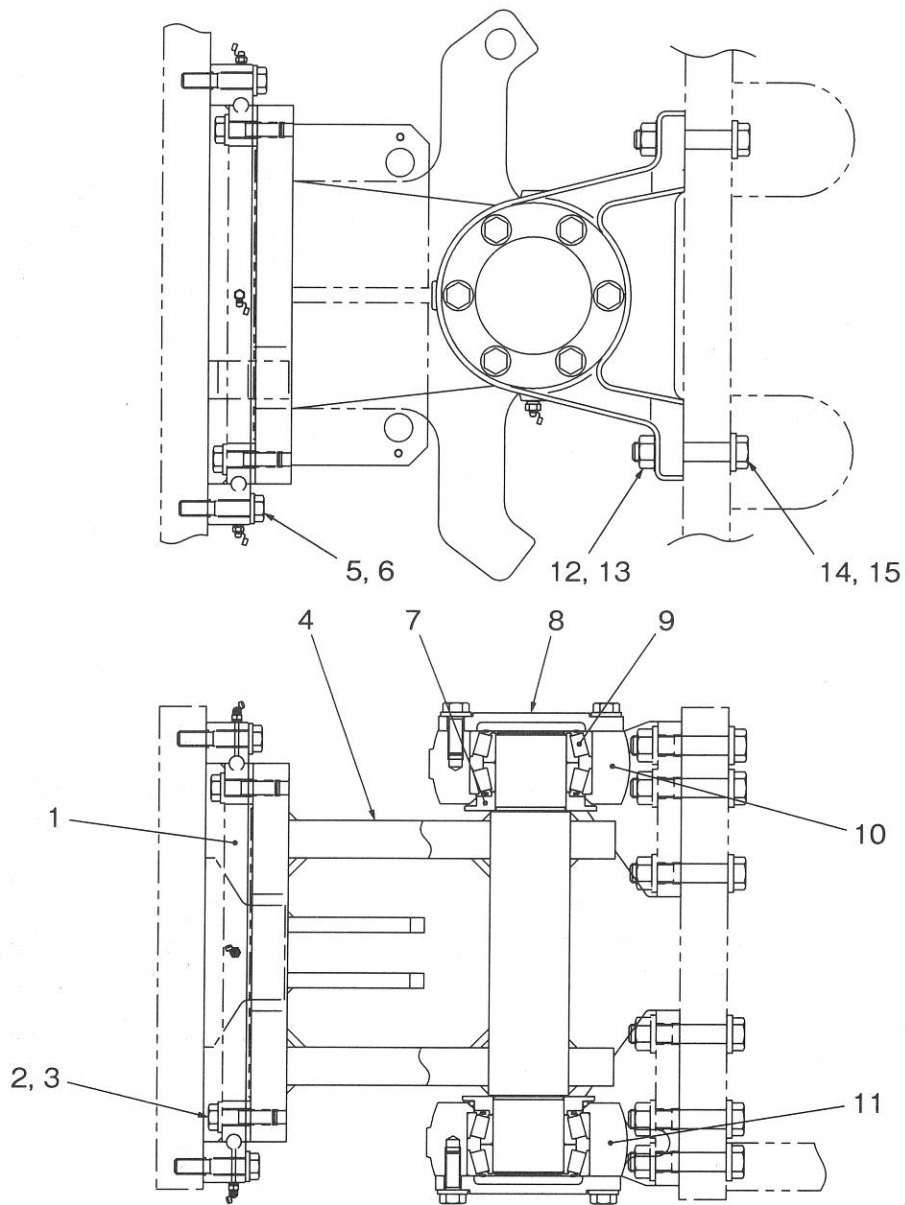
4-1. Hose diagram



GW7504014

- | | | |
|-------------------------|------------------------------|------------------------|
| 1. Line filter | 4. Steering valve (Orbitrol) | 7. Port L (3/4-16 UNF) |
| 2. Steering cylinder | 5. Port T (3/4-16 UNF) | 8. Port R (3/4-16 UNF) |
| 3. Steering/charge pump | 6. Port P (3/4-16 UNF) | |

4-2. Frame (Center pin)

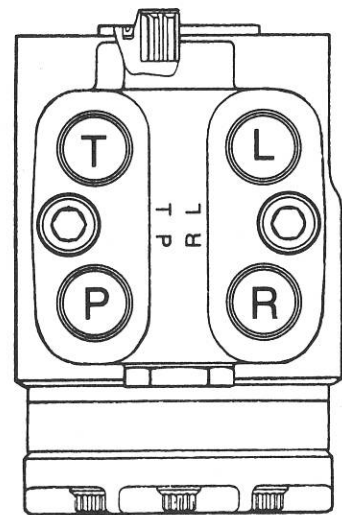
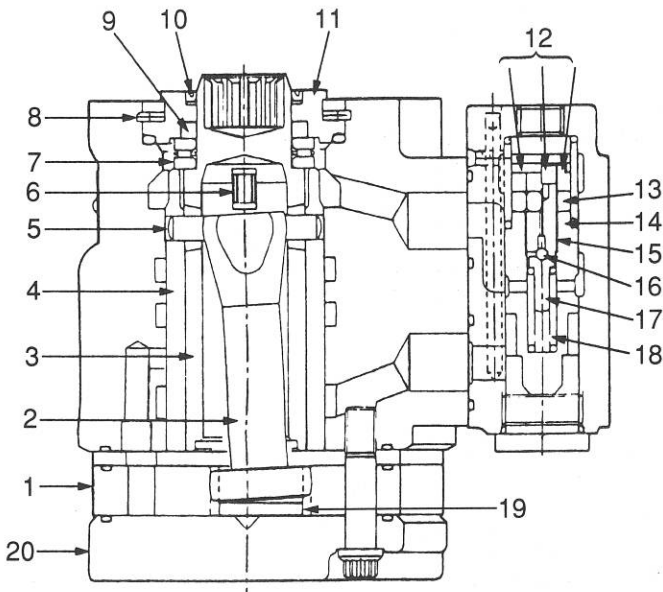
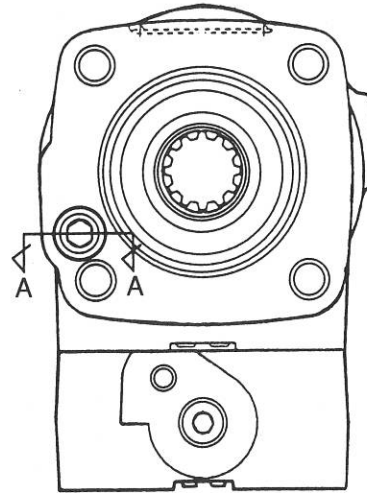
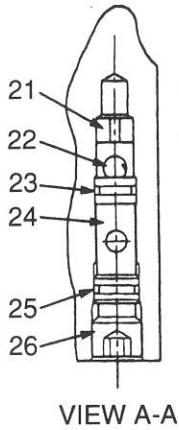


GW7504015

- | | |
|--|--|
| 1. Oscillation bearing | 8. Cover |
| 2. Bolt (M16x2.0)
[Tightening torque:265N•m (194 lb.·ft)] | 9. Roller bearing |
| 3. Washer | 10. Bracket (upper) |
| 4. Yoke | 11. Bracket (lower) |
| 5. Bolt (M16x2.0)
[Tightening torque:265N•m (194 lb.·ft)] | 12. Nut (M16x2.0)
[Tightening torque:265N•m (194 lb.·ft)] |
| 6. Washer | 13. Washer |
| 7. Collar | 14. Bolt (M16x2.0) |
| | 15. Washer |

4-3. Component specifications

4-3-2. Steering valve (Orbitrol)



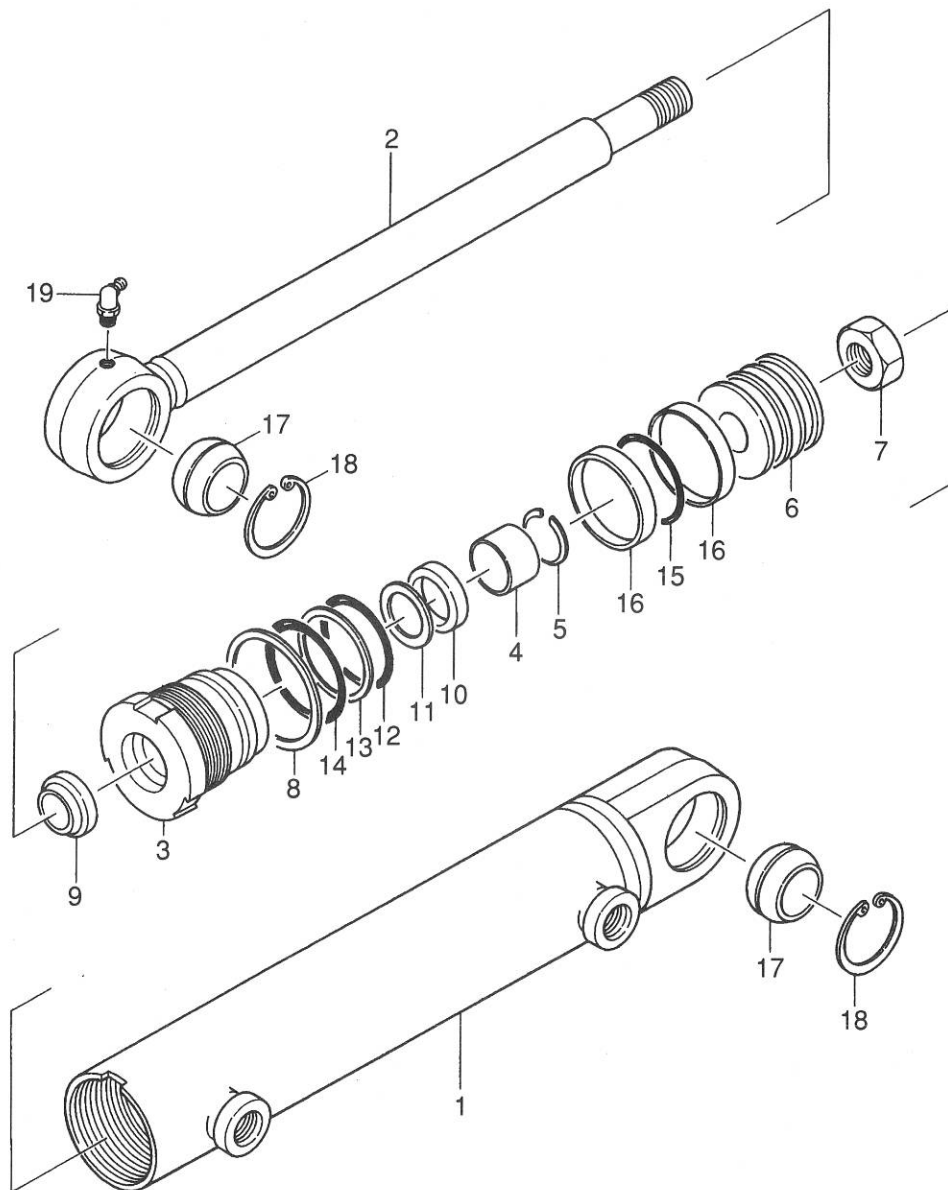
SV5002031

- | | |
|------------------------|-------------------------|
| 1. Geroler | 14. Spool |
| 2. Drive | 15. Valve seat |
| 3. Spool | 16. Ball |
| 4. Sleeve | 17. Ball guide |
| 5. Pin | 18. Inner valve spring |
| 6. Centering spring | 19. Spacer |
| 7. Thrust needle | 20. End cap |
| 8. Retaining ring | 21. Retainer check ball |
| 9. Oil seal | 22. Ball |
| 10. Dust seal | 23. O-ring |
| 11. Seal gland bushing | 24. Check seat |
| 12. Filter subassembly | 25. O-ring |
| 13. Lock nut | 26. Set screw |

Specifications

- Valve system : Open center non-load reaction
- Displacement: 230 cm³/rev (14 cu.in./rev)
- Relief valve pressure setting:
15.7 MPa (2277 psi)

4-3-2. Steering cylinder

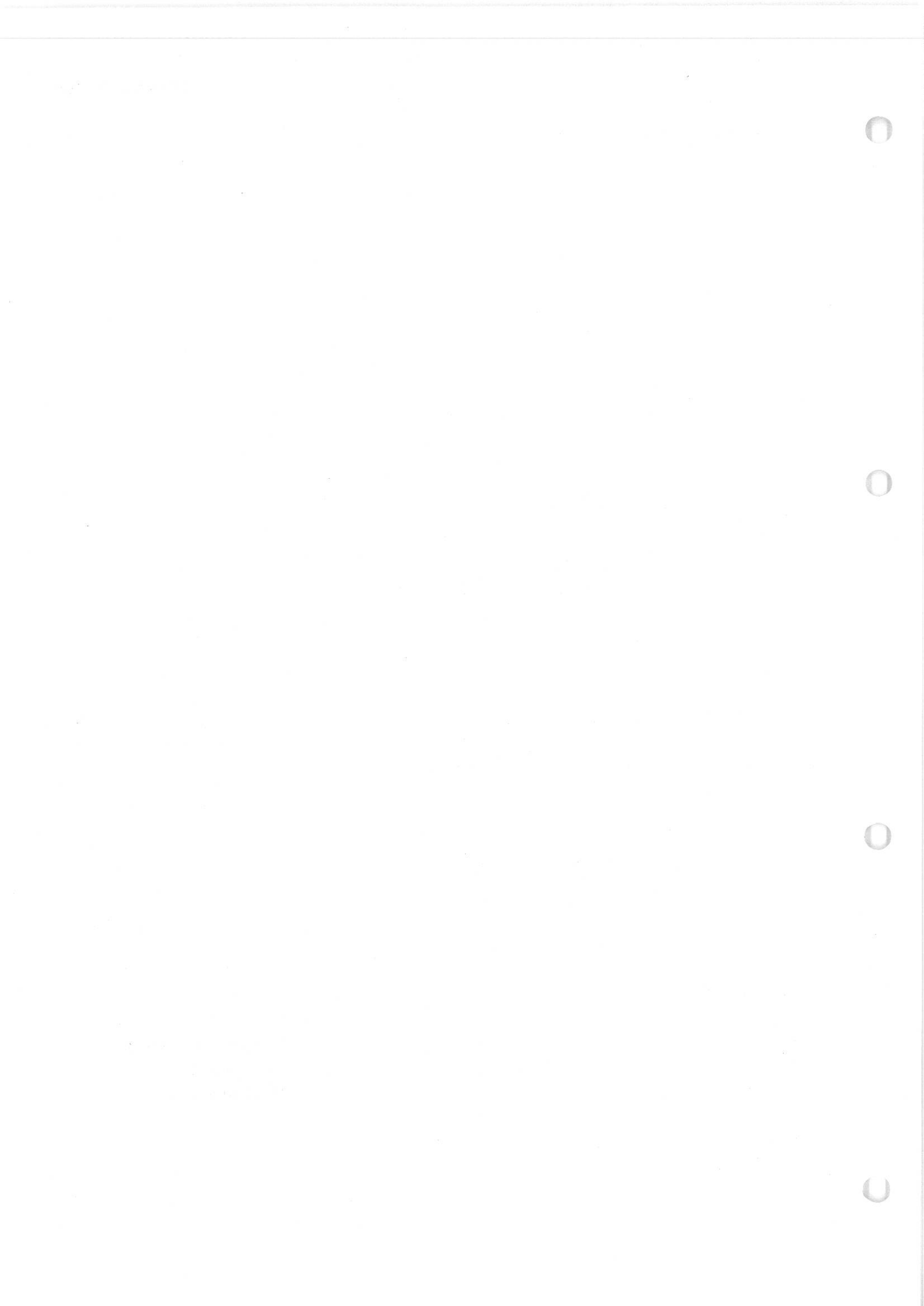


SW7502055

- 1. Cylinder
- 2. Piston rod
- 3. End cap
- 4. Bush
- 5. Lock ring
- 6. Piston
- 7. Nut

- 8. Washer
- 9. Dust seal
- 10. U-ring
- 11. Back-up ring
- 12. O-ring
- 13. Back-up ring
- 14. O-ring

- 15. Seal
- 16. Piston ring
- 17. Spherical bearing
- 18. Lock ring
- 19. Grease fitting



ELECTRICAL SYSTEM

ELECTRICAL SYSTEM

1. GENERAL SYSTEM CIRCUIT DIAGRAM

1-1. Electrical wiring diagram 5-002

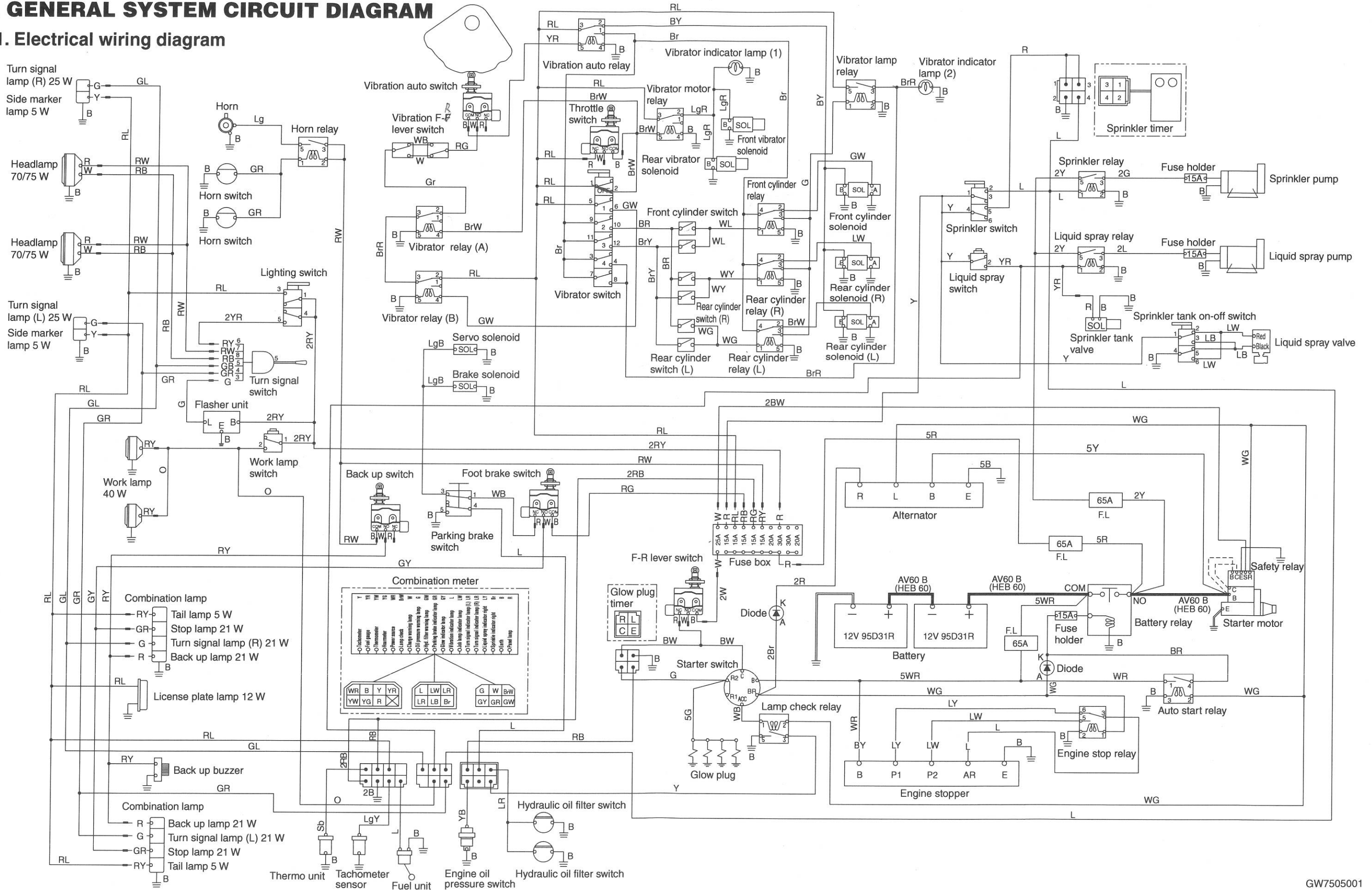
2. SENSORS AND SWITCH LOCATIONS

2-1. Instrument panel and Location of relays 5-003
2-2. Location of electrical components (1) 5-004
2-3. Location of electrical components (2) 5-005



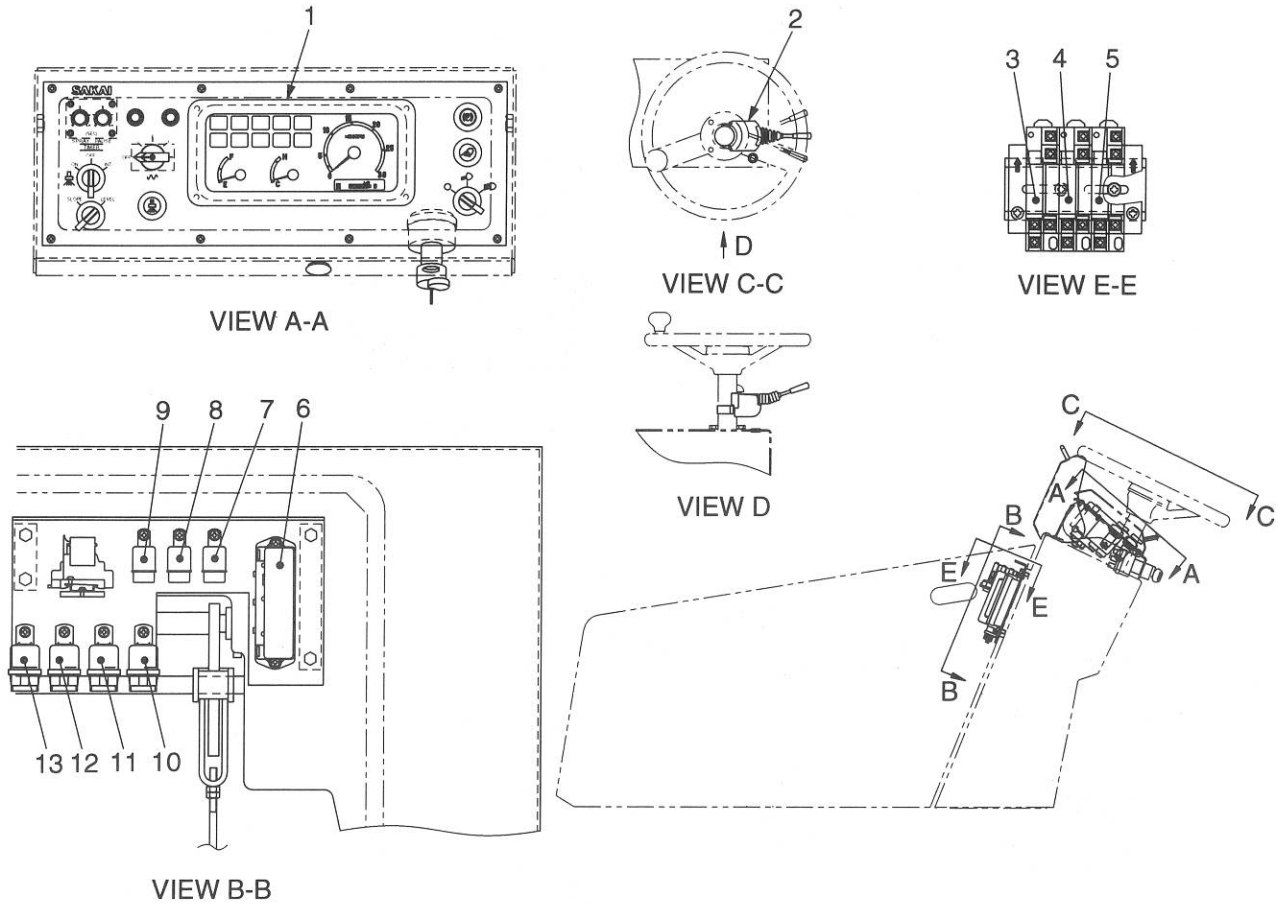
1. GENERAL SYSTEM CIRCUIT DIAGRAM

1-1. Electrical wiring diagram



2. SENSORS AND SWITCH LOCATIONS

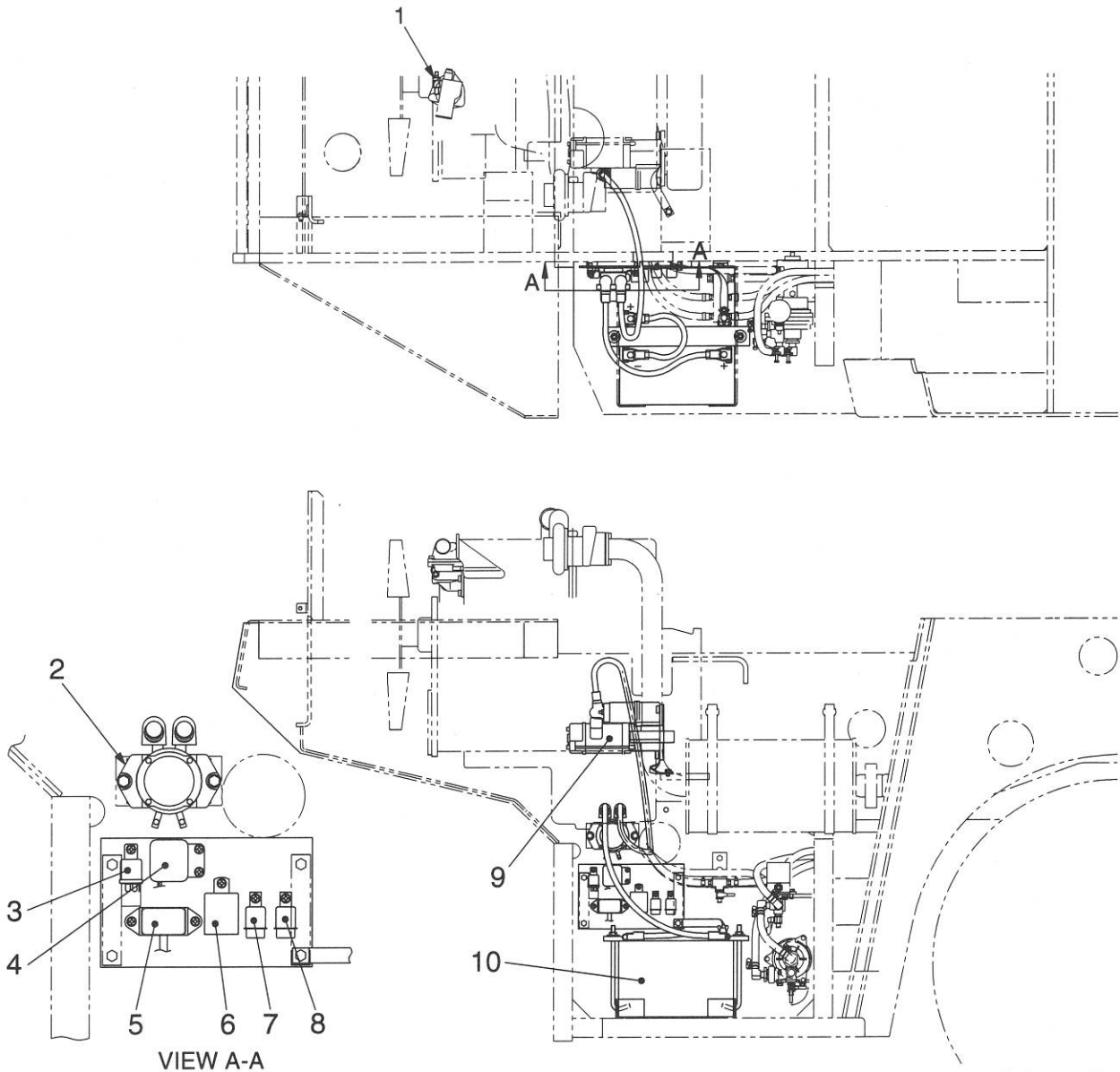
2-1. Instrument panel and Location of relays



GW7505002

- | | | |
|----------------------------|--------------------------|--------------------------|
| 1. Combination meter | 6. Fuse box | 11. Vibration auto relay |
| 2. Turn signal switch | 7. Lamp check relay | 12. Vibrator relay (B) |
| 3. Front cylinder relay | 8. Horn relay | 13. Vibrator relay (A) |
| 4. Rear cylinder relay (R) | 9. Vibrator lamp relay | |
| 5. Rear cylinder relay (L) | 10. Vibrator motor relay | |

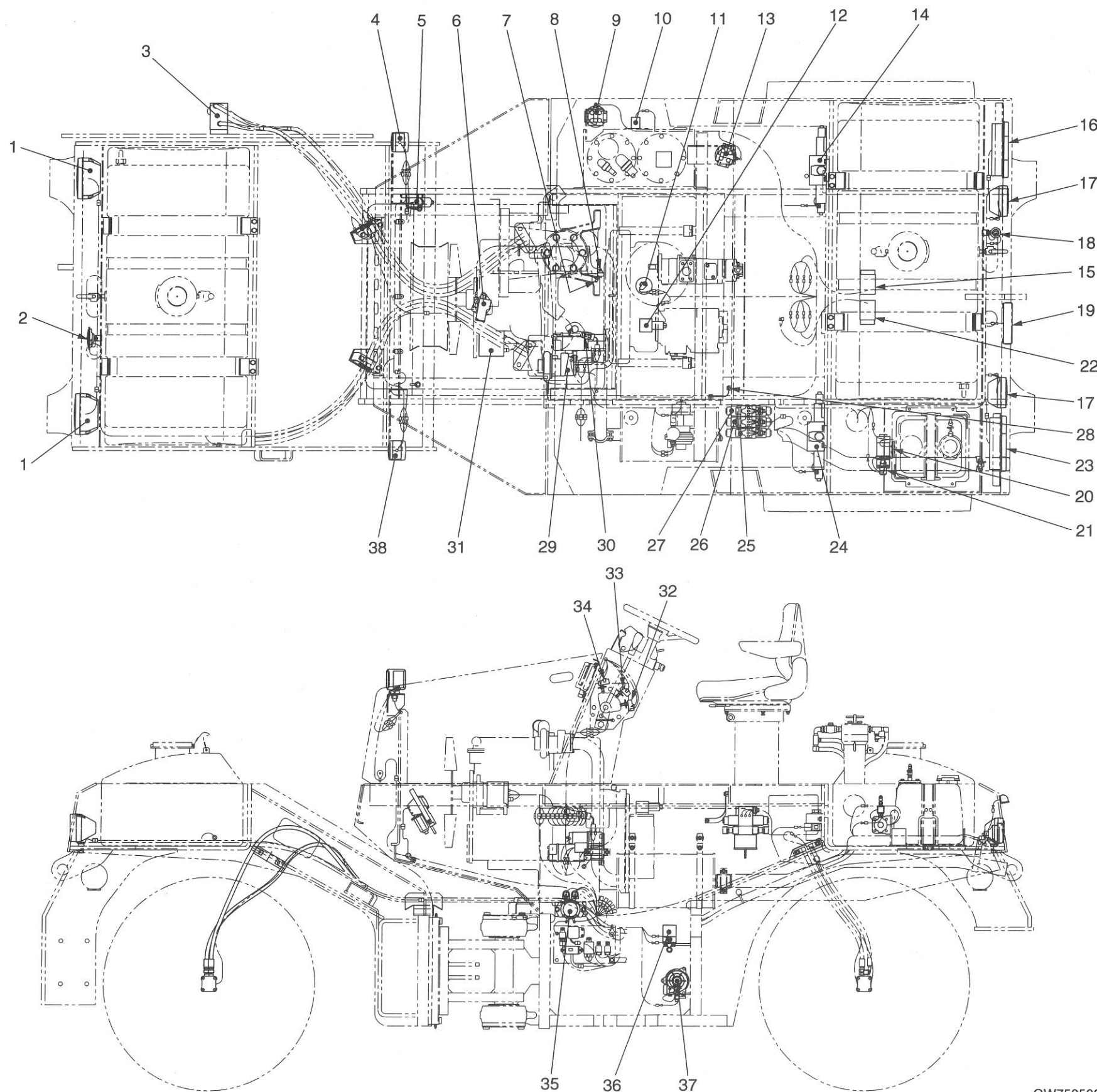
2-2. Location of electrical components (1)



GW7505003

- | | |
|----------------------|-----------------------|
| 1. Thermo unit | 6. Flasher unit |
| 2. Battery relay | 7. Sprinkler relay |
| 3. Engine stop relay | 8. Liquid spray relay |
| 4. Glow plug timer | 9. Starter motor |
| 5. Auto start relay | 10. Battery |

2-3. Location of electrical components (2)



- 1. Headlamp
- 2. Horn
- 3. Front cylinder
- 4. Front combination lamp (R)
- 5. Engine stopper
- 6. Thermo unit
- 7. Glow plug
- 8. Engine oil pressure switch
- 9. Hydraulic oil filter switch
- 10. Brake solenoid
- 11. Fuel unit
- 12. Servo solenoid
- 13. Hydraulic oil filter switch
- 14. Rear vibrato solenoid
- 15. Rear cylinder (R)
- 16. Rear combination lamp (R)
- 17. Work lamp
- 18. Back up sensor
- 19. License plate lamp
- 20. Liquid spray pump
- 21. Liquid spray valve
- 22. Rear cylinder (L)
- 23. Rear combination lamp (L)
- 24. Front vibrato solenoid
- 25. Front cylinder solenoid
- 26. Rear cylinder solenoid (L)
- 27. Rear cylinder solenoid (R)
- 28. Deck ground connection
- 29. Starter safety relay
- 30. Tachometer sensor
- 31. Alternator
- 32. F-R lever switch
- 33. Vibration auto switch
- 34. Back up switch
- 35. Battery
- 36. Sprinkler tank valve
- 37. Sprinkler pump
- 38. Front combination lamp (L)

GW7505004

WHEEL AND VIBRATOR ASSEMBLY

WHEEL AND VIBRATOR ASSEMBLY

1. FRONT WHEEL, TIRE AND VIBRATOR ASSEMBLY

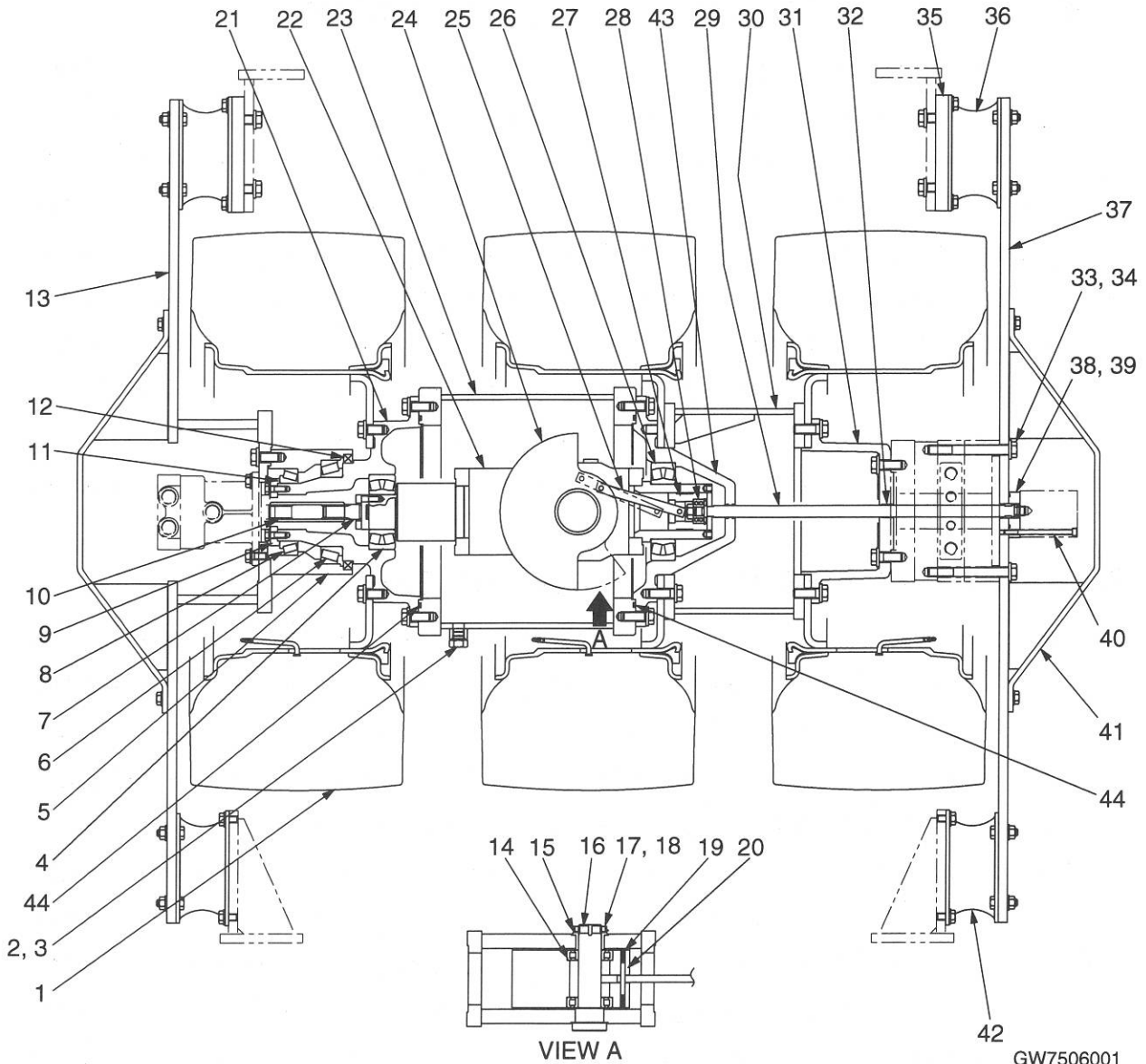
1-1. Front Wheel Assembly	6-002
1-2. Removal and Installation of Front Wheel Assembly	6-003
1-2-1. Removal of front wheel assembly	6-003
1-2-2. Installation of front wheel assembly	6-005
1-3. Disassembly and Reassembly of Front Wheel Assembly	6-006
1-3-1. Disassembly of front wheel assembly	6-006
1-3-2. Reassembly of the front wheel assembly	6-010
1-4. Disassembly and Reassembly of Front Axle Shaft Assembly	6-011
1-4-1. Disassembly of front axle shaft assembly	6-011
1-4-2. Reassembly of front axle shaft assembly	6-013

2. REAR WHEEL, TIRE AND VIBRATOR ASSEMBLY

2-1. Rear Wheel Assembly	6-016
2-2. Removal and Installation of Rear Wheel Assembly	6-017
2-2-1. Removal of rear wheel assembly	6-017
2-2-2. Installation of rear wheel assembly	6-019
2-3. Disassembly and Reassembly of Front Wheel Assembly	6-020
2-3-1. Disassembly of rear wheel assembly	6-020
2-3-2. Reassembly of the rear wheel assembly	6-024
2-4. Disassembly and Reassembly of Rear Axle Shaft Assembly	6-025
2-4-1. Disassembly of rear axle shaft assembly	6-025
2-4-2. Reassembly of rear axle shaft assembly	6-027

1. FRONT WHEEL, TIRE AND VIBRATOR ASSEMBLY

1-1. Front wheel assembly



GW7506001

- | | | | |
|-------------------|----------------------------|----------------------|---------------------|
| 1. Tire ass'y | 13. Front plate (L) | 24. Eccentric weight | 36. Damper |
| 2. Plug | 14. Roller bearing | 25. Arm | 37. Front plate (R) |
| 3. O-ring | 15. Collar | 26. Roller bearing | 38. Adapter |
| 4. Roller bearing | 16. Shaft | 27. Guide | 39. O-ring |
| 5. Housing | 17. Bearing nut | 28. Bearing | 40. Bolt |
| 6. Roller bearing | 18. Bearing washer | 29. Rod | 41. Protector |
| 7. Shaft | 19. Spring pin | 30. Adapter | 42. Damper |
| 8. Roller bearing | 20. Pin | 31. Adapter | 43. Axle |
| 9. Cover | 21. Axle shaft | 32. Bush | 44. O-ring |
| 10. Sleeve | 22. Eccentric weight shaft | 33. Bolt | |
| 11. Shim | 23. Vibrator case | 34. Washer | |
| 12. Oil seal | | 35. Base plate | |

1-2. Removal and Installation of Front Wheel Assembly

⚠ CAUTION

After your machine has operated for some time, hydraulic fluid will be hot and there may be residual pressure in the hoses. Disconnecting the hoses in this condition can burn you. Perform this work after the machine has cooled off.

1-2-1. Removal of front wheel assembly

1. Protector

Remove the mounting bolts and remove protector (1).

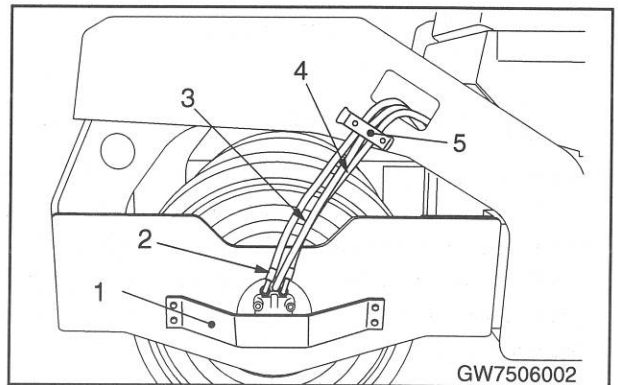
★ Also remove the opposite side protector.

2. Vibrator motor hoses

(1) Disconnect hydraulic hoses (2), (3) and (4) from the vibrator motor.

★ Cap and plug the openings of the hoses and motor.

(2) Remove hose clamp (5) and disconnect hoses from the frame.

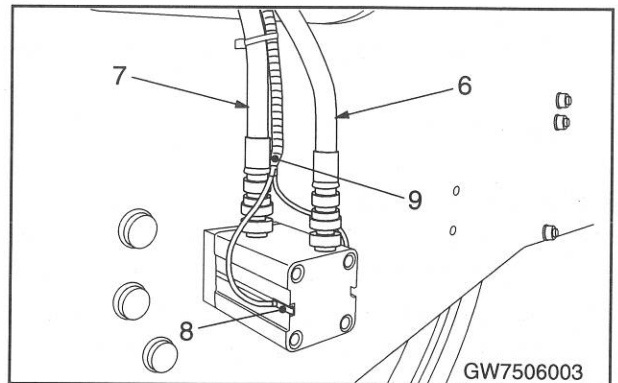


3. Hoses and wiring of amplitude selector cylinder

(1) Disconnect hoses (6) and (7) from the cylinder.

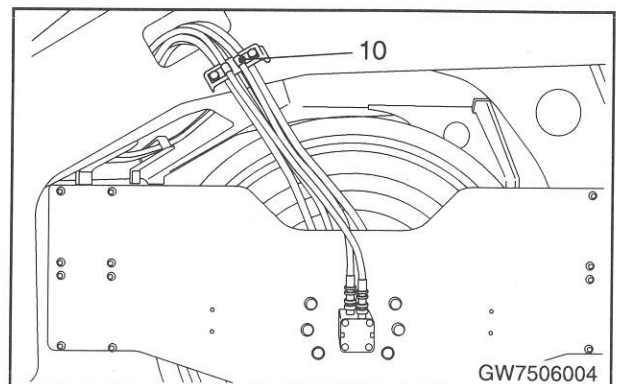
★ Cap and plug the openings of the hoses and cylinder.

(2) Loosen the set screw and remove cylinder switch (8) from the cylinder and switch wire (9), also disconnect the switch and wire from the other side.



(3) Remove hose clamp (10) and disconnect hoses from the frame.

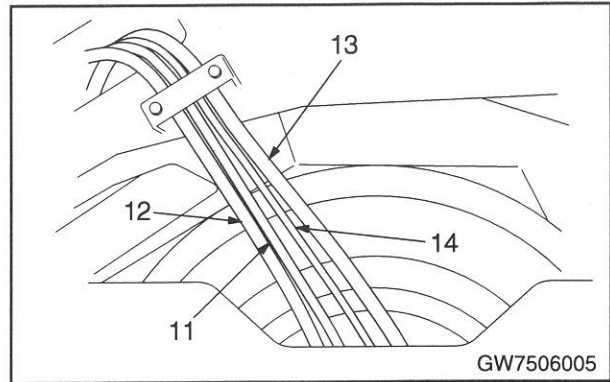
★ Hose clamp (10) also holds the propulsion motor hoses.



4. Propulsion motor hoses

(1) Disconnect hoses (11), (12), (13) and (14) from the propulsion motor.

★ **Cap and plug the openings of the hoses and motor.**



5. Side plate

⚠ WARNING

Use axle stands of sufficient strength. Operate forklift with extreme caution, especially when backing-up.

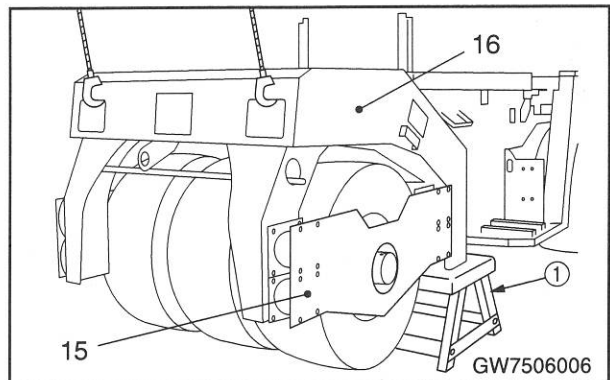
⚠ CAUTION

- Use a lifting device in good condition and with sufficient capacity for lifting components being serviced or repaired.
- Place the machine on a level floor. Block the rear wheels to prevent unexpected movement.

- (1) Temporarily lift side plate (15).
- (2) Remove the shock mount bolts on the side plate. Remove both right and left hand side plates.

[*1]

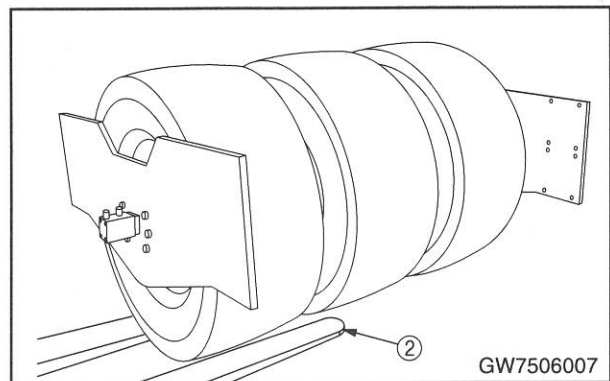
Disengage the hoist hook.



6. Front wheel assembly

- (1) Using a suitable lifting device, lift and support front frame (16) on axle stand ① .
- (2) Lift the frame high enough to allow clearance for the wheel assembly. Withdraw the front wheel assembly crosswise.

 Front wheel assembly: 1080 kg (2381 lb.)



1-2-2. Installation of front wheel assembly

- ★ The installation procedure is the reverse of the removal procedure.

CAUTION

When starting engine for the first time after repairs, operate the engine at low speed. If the engine is run at high speed or the steering cylinder is operated to full stroke, the piston packings can be damaged by the air admitted into the cylinder.

[*1] (size of bolt: M12 x 1.75)

- ★ Tightening torque of shockmount & side plate nuts: 108 N·m (79.6 lb·ft)
- ★ Add oil to the hydraulic tank to the specified level to compensate for any loss during removal.
- ★ Start the engine. Allow hydraulic oil to circulate through the hoses. Then recheck the oil level.
- ★ Ensure that the vibrator case has been filled with gear oil to the specified level.

1-3. Disassembly and Reassembly of Front Wheel Assembly

1-3-1. Disassembly of front wheel assembly

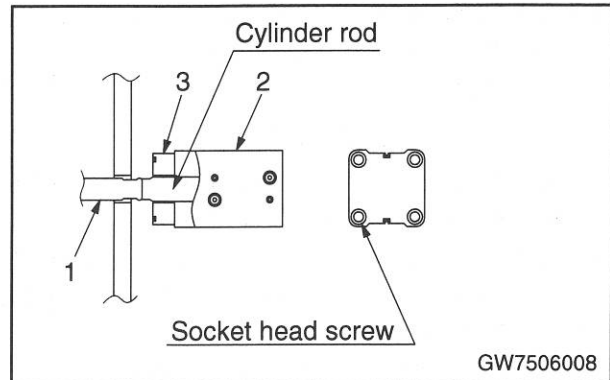
Preparation

- See "Removal of front wheel assembly" in this section.
- Remove the front wheel assembly and place it horizontally on the work floor.

1. Amplitude selector cylinder

- (1) Remove four socket head screws at the cylinder.
- (2) Pull out the cylinder for access to the eccentric weight rod (1). Slide the adaptor to one side.
Using a 17 mm wrench and a 19 mm wrench, break the bond between the rod (1) and cylinder (2).
- (3) Then rotate the cylinder to remove.


★ Because the threaded portion of the rod end has been treated with sealing compound, break the bonding with caution when removing the cylinder.

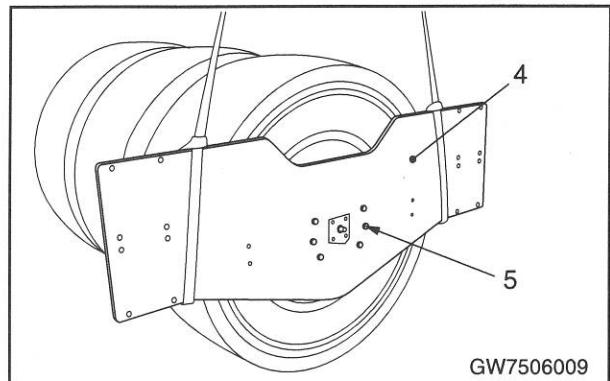


2. Plate on the propulsion motor side

- (1) Lift plate (4) using a lifting device.
- (2) Remove six bolts (5) and remove the plate. [^{*8}]
- (3) Lift the plate and place it on a pallet.

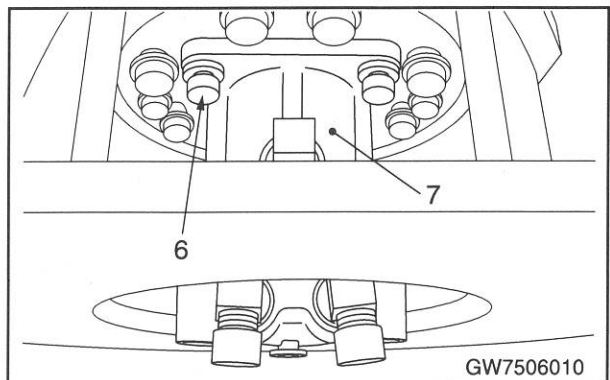
★ When removing the plate, use care not to damage the threaded portion of the eccentric weight rod.

 Plate (4): 75 kg (165.3 lb.)



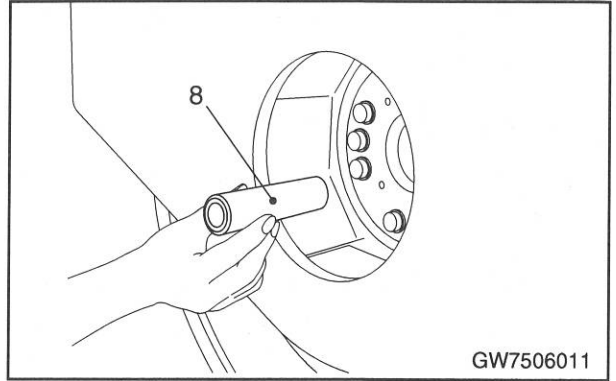
3. Vibrator motor assembly

- (1) Remove four securing bolts (6) and remove vibrator motor assembly (7). [^{*7}]



4. Sleeve

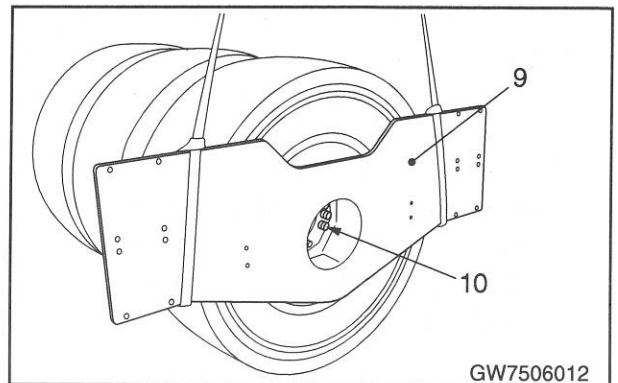
- (1) Remove sleeve (8).



5. Plate on the vibrator motor side

- (1) Temporarily lift plate (9) using a lifting device.
- (2) Remove ten bolts (10) and remove the plate and place on a pallet. [*6]

 Plate (9): 100 kg (220.5 lb.)

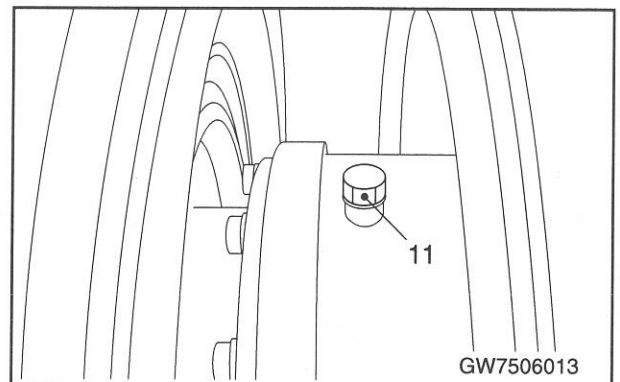


6. Draining the vibrator case

⚠ CAUTION

When removing the drain plug, be careful as the oil may be hot.

- (1) Remove drain plug (11) from the vibrator case and drain the oil.




7. Propulsion motor and right side tire assembly

CAUTION


Screw in lifting bolts fully into threaded holes of the propulsion motor.

- (1) When steps (1) to (6) above have been completed, lift the entire front wheel assembly using a lifting device and stand it vertically with the propulsion motor up.


 Front wheel assembly: 820 kg (1807.8 lb.)

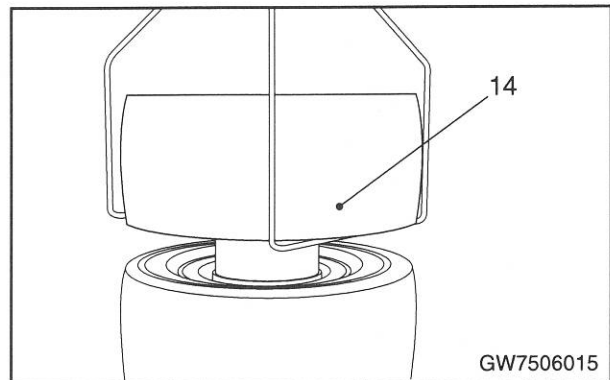
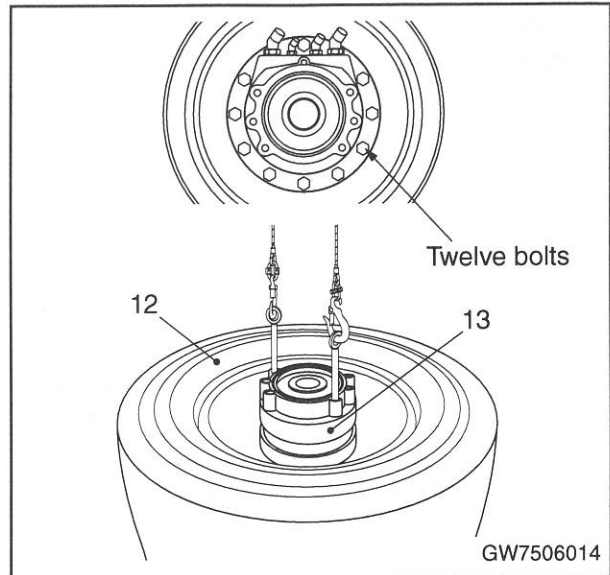
- (2) Remove twelve bolts which hold the adapter on the propulsion motor side and tire wheel to the adapter on the axle side. [*5]

- (3) Install lifting bolts at two locations of propulsion motor (13). Lift off the propulsion motor assembly together with the adapter.

 Propulsion motor assembly:
90 kg (198.4 lb.)

- (4) Lift off right side tire assembly (14).

 Tire assembly (14): 140 kg (308.6 lb.)

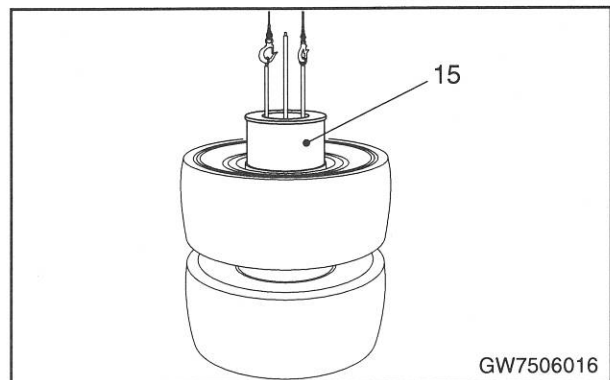


8. Adapter and center tire assembly


- (1) Remove twelve bolts which hold adapter (15) and tire wheel to the axle on the vibrator case side. [*4]

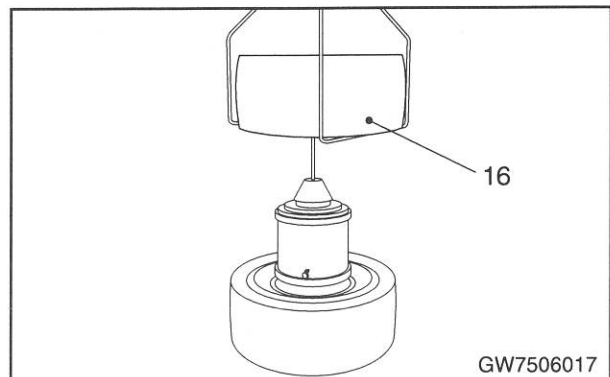
- (2) Fit lifting bolts at two locations of the adapter. Lift off the adapter.

 Adapter (15): 40 kg (88.2 lb.)




- (3) Lift off center tire assembly (16).

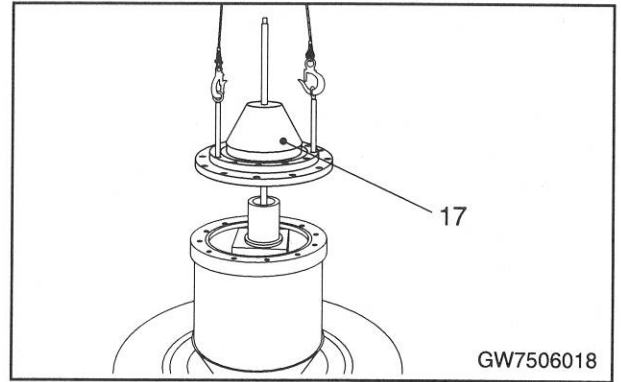
 Tire assembly (16): 140 kg (308.6 lb.)



9. Axle on the vibrator case side

Remove twelve bolts from axle (17). Install lifting bolts at two locations of axle (M16 x 2.0). Lift off the axle using caution not to damage the eccentric weight rod. [*3]

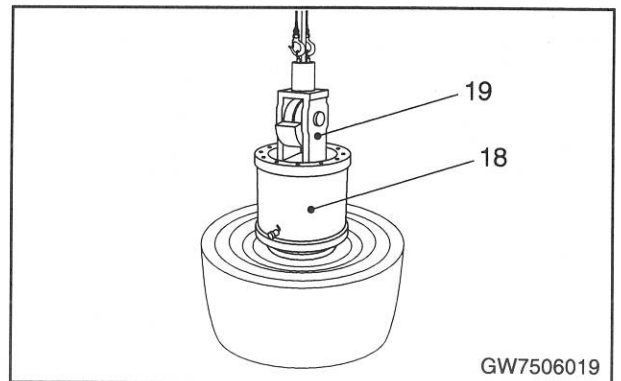
 Axle (17): 30 kg (66.1 lb.)



10. Eccentric weight assembly


Install lifting bolts at two locations of eccentric shaft (19) located inside vibrator case (18). Lift out the eccentric weight assembly.

 Eccentric weight assembly: 80 kg (176.4 lb.)



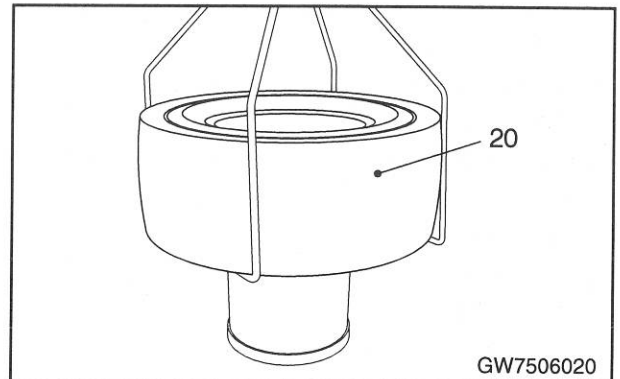
11. Left side tire assembly

(1) Turn over the whole body (20) including the vibrator case, axle shaft assembly, and left side tire assembly with the axle shaft assembly up.

 Whole body (20): 300 kg (661.4 lb.)


(2) Remove twelve bolts at the wheel. Lift off left side tire assembly. [*2]

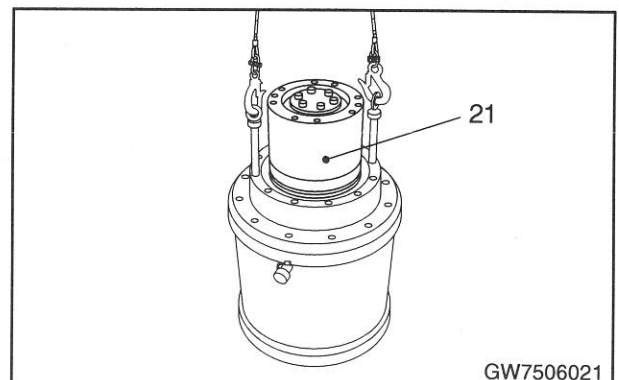
 Tire assembly: 140 kg (308.6 lb.)



12. Axle shaft assembly and vibrator case

(1) Remove twelve bolts. Install lifting bolts at two locations of axle shaft assembly (21). Lift off the axle shaft assembly from the vibrator case. [*1]

 Axle shaft assembly (21): 60 kg (132.3 lb.)



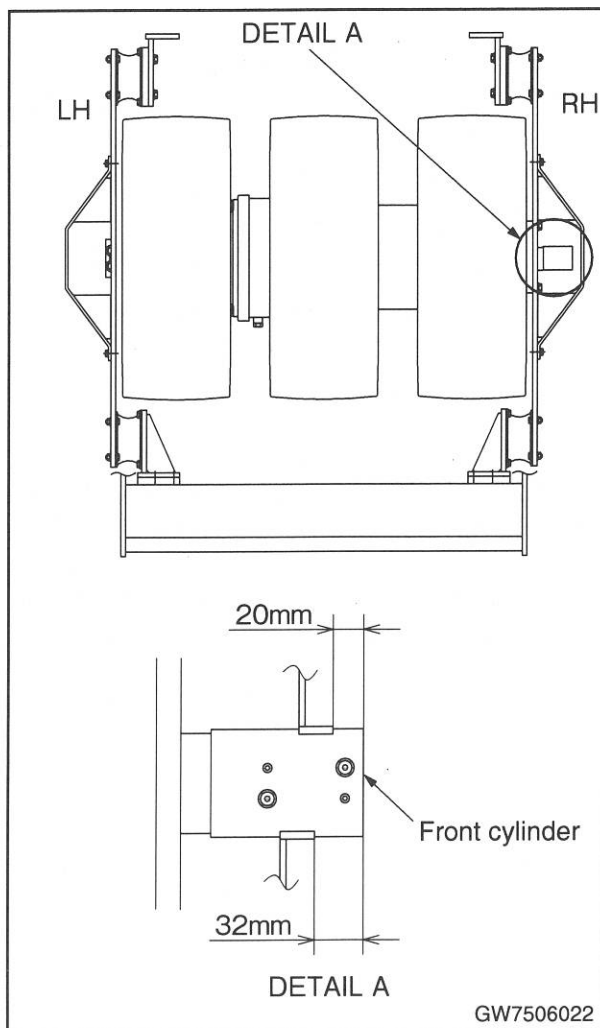
1-3-2. Reassembly of the front wheel assembly

★ Reverse the disassembling sequence.

- [*1] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*2] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*3] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*4] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*5] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*6] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)
- [*7] (size of bolt: M12 x 2.0)
 - Tightening torque: 108 N·m (79.6 lb·ft)
- [*8] (size of bolt: M16 x 2.0)
 - Tightening torque: 265 N·m (195.4 lb·ft)

★ The location of the cylinder switches mounted on both sides of the amplitude selector cylinder is as shown.

- ★ Apply sealing compound to bolts in [*2] and [*4] and [*5] above.
- ★ When assembling the sleeve, apply a coat of Molybdenum disulfide grease to the splines of the sleeve.
- ★ Install the wheels to position the air valves as close to the vibrator case drain plug as possible.
- ★ Vibrator oil: API-GL4 gear oil 3.2 L (0.85 gal.)
- ★ Apply liquid sealant to the mounting surface of vibrating motor and propulsion motor.
- ★ Apply liquid sealant to the mounting surface of plate (4) and plate (9) on the vibrator motor side.



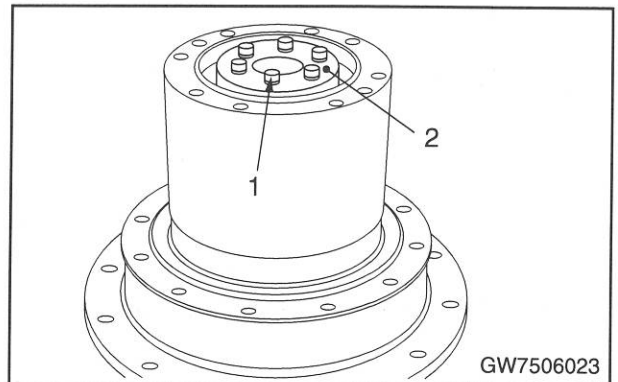
1-4. Disassembly and Reassembly of Front Axle Shaft Assembly

1-4-1. Disassembly of front axle shaft assembly

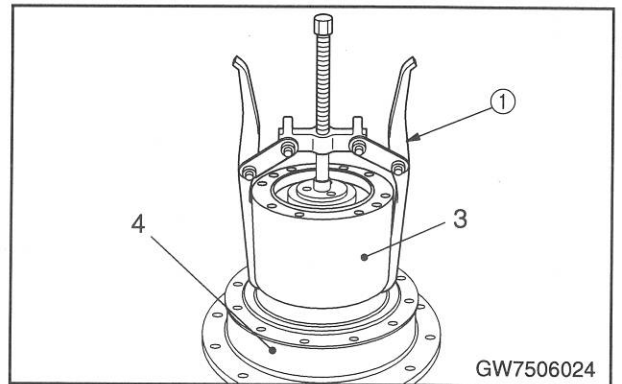
1. Housing

(1) Remove six bolts (1), and remove cover (2).

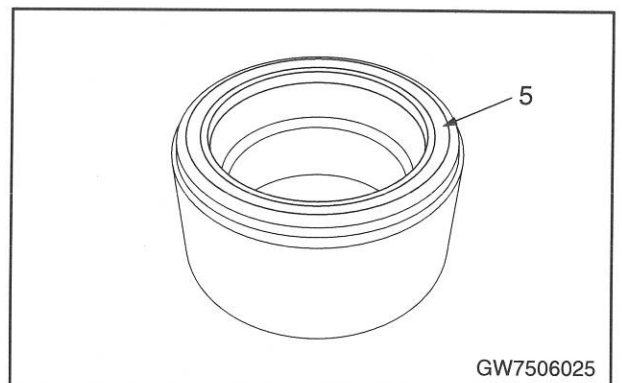
★ Note the total thickness and quantity of the shims and store them.



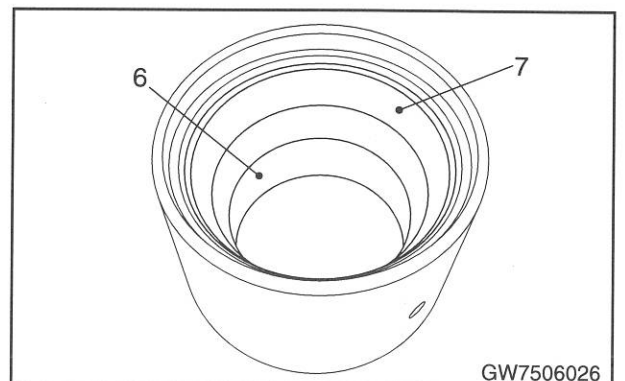
(2) Using a puller ①, pull off housing (3) from axle shaft (4).



(3) Remove oil seal (5) from the housing.



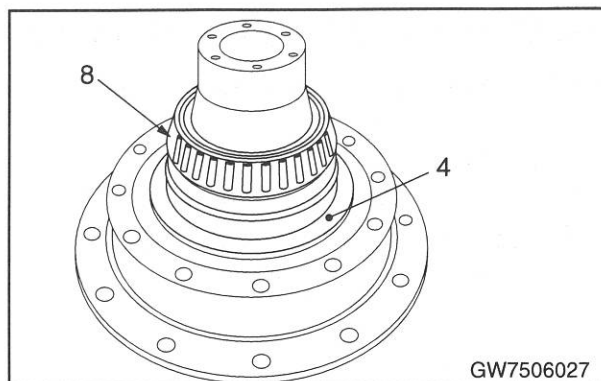
(4) Remove bearing outer races (6) and (7) from the housing.



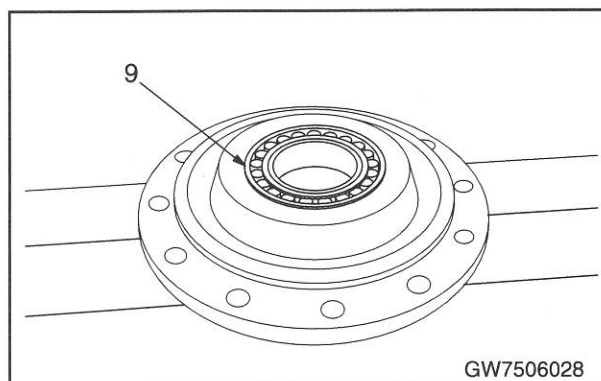
FRONT WHEEL, TIRE AND VIBRATOR ASSEMBLY

2. Axle shaft

(1) Remove bearing inner race (8) from axle shaft (4).



(2) Remove bearing (9) from the axle shaft.



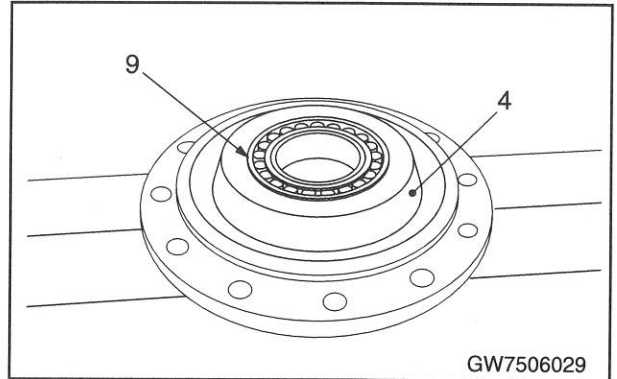
1-4-2. Reassembly of front axle shaft assembly

★ Thoroughly clean the parts, and repair parts if burrs or other damage is noticeable.

1. Axle shaft

(1) Assemble bearing (9) into axle shaft (4).

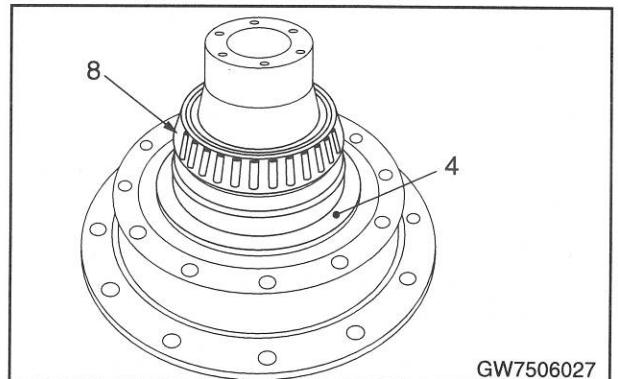
★ Apply a sufficient coat of lithium base grease over the bearing, and also pack it with the grease.



CAUTION

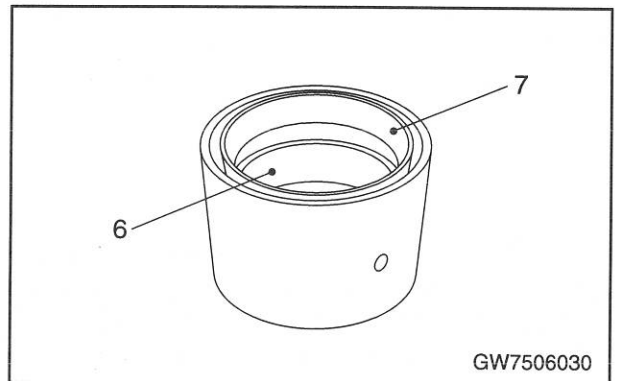
Do not heat the inner race to higher than 100 °C (212 °F). Temperature exceeding 120 °C (248 °F) can impair the hardness of the inner race.

(2) Expand inner race (8) by heating with a heater, and drive the inner race until it bottoms on the stepped portion of axle shaft (4). Keep the inner race in that state for one to two minutes. Then drive the inner race further until it is fully seated.



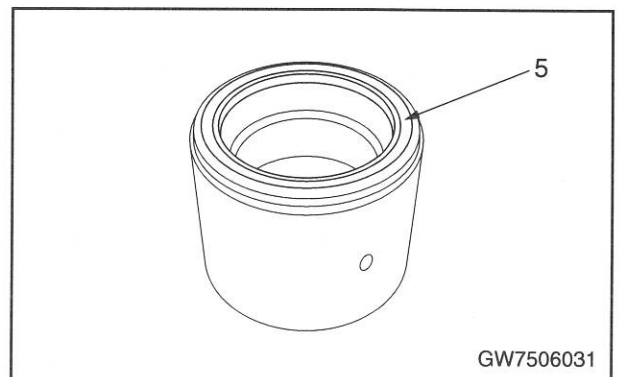
2. Housing

(1) Drive bearing outer races (6) and (7) until they are fully seated against the stepped portion of the housing.



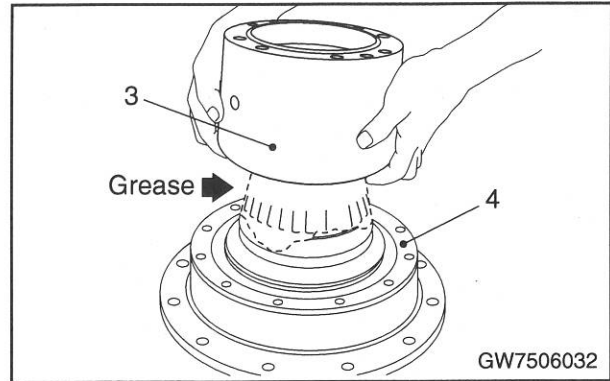
(2) Fit oil seal (5) in the housing.

★ Pack the oil seal lip with lithium base grease.



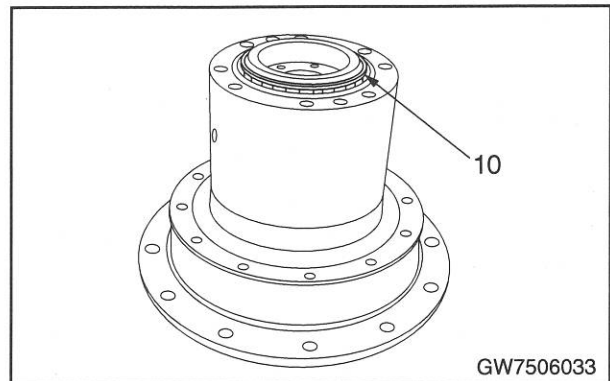
FRONT WHEEL, TIRE AND VIBRATOR ASSEMBLY

- (3) Apply a sufficient coat of lithium base grease over the bearing. Fit housing (3) onto axle shaft (4).



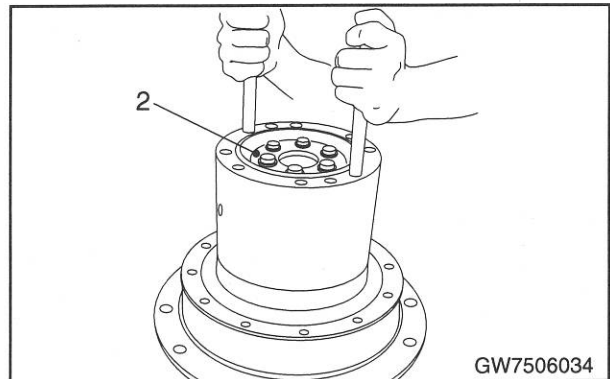
- (4) Apply a sufficient coat of lithium base grease on the inner race of bearing (10) and drive the inner race until the rollers make firm contact with the outer race.

★ Pack the bearing with lithium base grease.

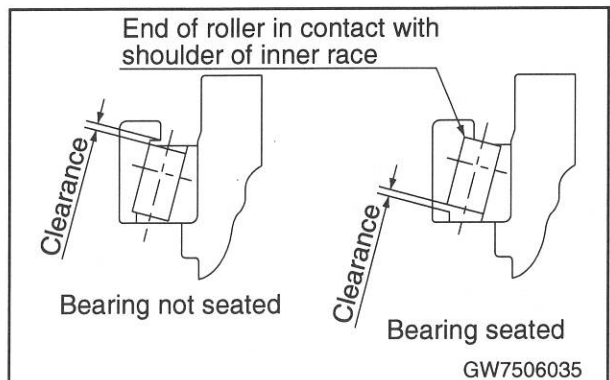


- (5) Before making the preload adjustment of the bearing, tighten the six bolts to 29 N·m (21.4 lb·ft) with cover (2)

Then, rotate the housing one full turn and retighten the bolts to 29 N·m (21.4 lb·ft). Allow the bearing to be securely seated by repeating this step two to three times until the tightening torque remains stable.



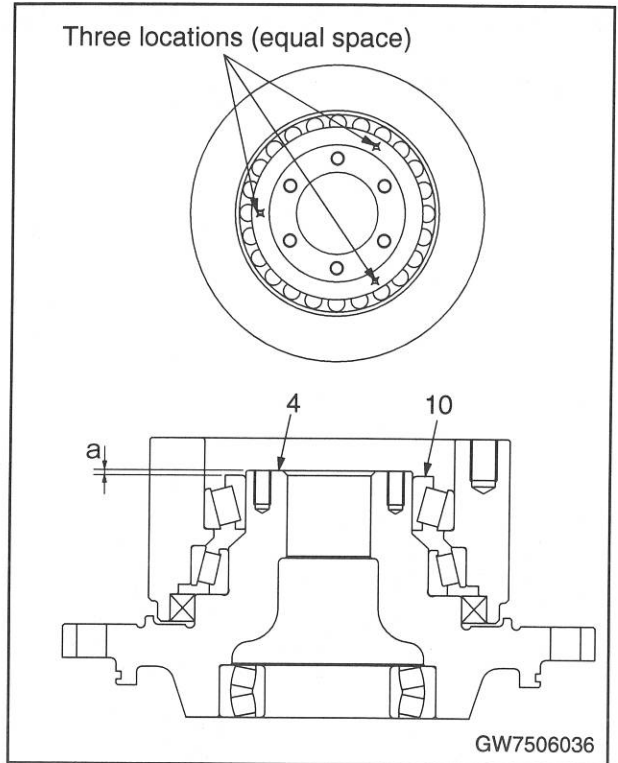
★ Driving the inner race without rotating the bearing will fail to achieve correct seating of the bearing even with greater effort. The rotation allows the inner race to seat fully and uniformly.



(6) Bearing preload adjustment

- 1) After ensuring that the bolt tightening torque remains stable, remove cover (2) measure dimension 'a' between the bearing and axle shaft at three locations using a depth gauge. Average the measurements.

Dimension 'a': 3.9 to 4.3 mm (0.15 to 0.17 in.)



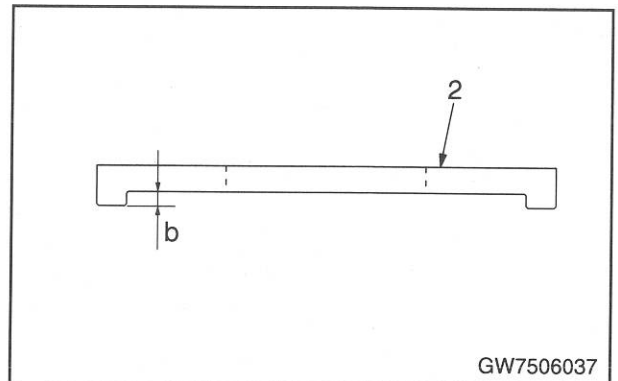
- 2) Measure dimension 'b' of cover (2).
- 3) Determine the necessary shim thickness using the following formula.

• Preload adjusting shim thickness = $(b - a) - 0.1$ (mm)

Example of the calculation:

$a=4, b=5, (5 - 4) - 0.1=0.9$ mm

(Insert Shim of 0.9 mm by an above calculation)

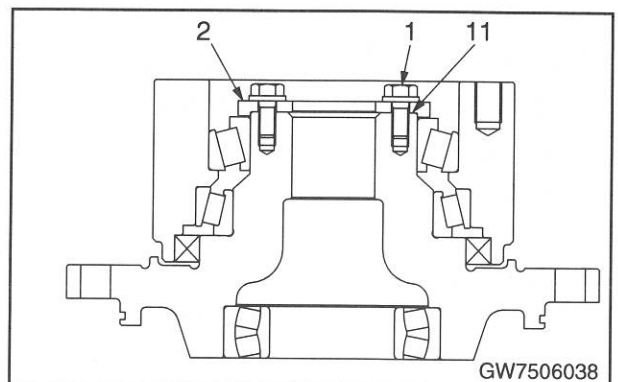


★ Above formula gives a preload of 0.1 mm to the inner Race from the unloaded state when seated fully on the axle shaft.

★ In determination of shim thickness (using 'mm'), round the number in the second decimal place.

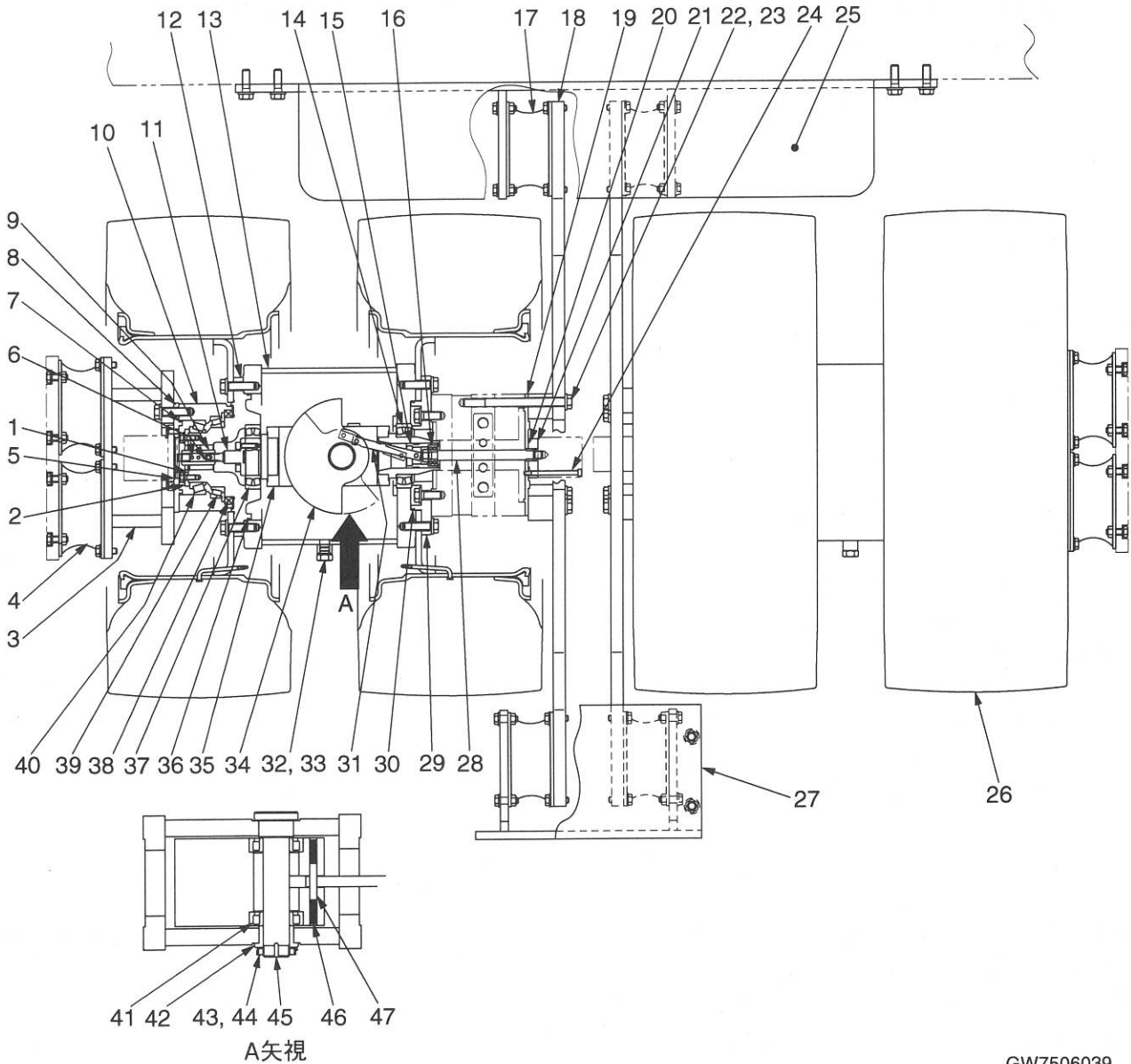
- 4) With the shims selected in step 3) above, install cover (2) and tighten the six bolts (1).

• Tightening torque: 59 N·m (43.5 lb.·ft)



2. REAR WHEEL, TIRE AND VIBRATOR ASSEMBLY

2-1. Rear wheel assembly



GW7506039

- | | | | |
|----------------|--------------------|----------------------|--------------------|
| 1. Shim | 13. Vibrator case | 25. Bracket | 36. O-ring |
| 2. Cover | 14. Roller bearing | 26. Tire assembly | 37. Roller bearing |
| 3. Bracket | 15. Guide | 27. Bracket | 38. Oil seal |
| 4. Damper | 16. Bearing | 28. Rod | 39. Roller bearing |
| 5. O-ring | 17. Damper | 29. Hub | 40. Roller bearing |
| 6. Spring pin | 18. Plate (R) | 30. O-ring | 41. Roller bearing |
| 7. O-ring | 19. Adapter | 31. Arm | 42. Collar |
| 8. Cover | 20. O-ring | 32. Plug | 43. Bearing nut |
| 9. Sleeve | 21. Adapter | 33. O-ring | 44. Bearing washer |
| 10. Housing | 22. Bolt | 34. Eccentric weight | 45. Shaft |
| 11. Shaft | 23. Washer | 35. Eccentric weight | 46. Spring pin |
| 12. Axle shaft | 24. Bolt | shaft | 47. Pin |

2-2. Removal and Installation of Rear Wheel Assembly

2-2-1. Removal of rear wheel assembly

CAUTION

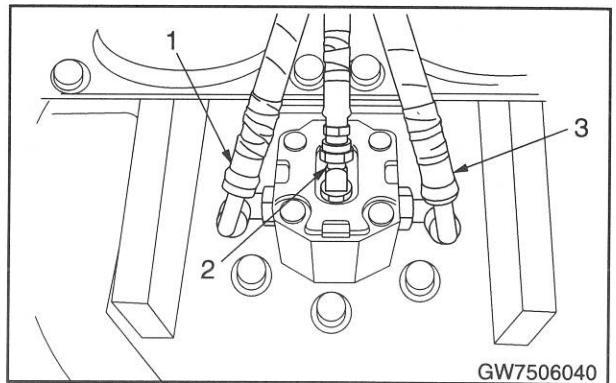
After your machine has operated for some time, hydraulic fluid will be hot and there may be residual pressure in the hoses. Disconnecting the hoses in this condition can burn you. Perform this work after the machine has cooled off.

1. Vibrator motor hoses

- (1) Disconnect hoses (1), (2) and (3) from the rear vibrator motor (Left). Also disconnect the three hoses from the rear vibrator motor (Right).

★ **Cap and plug the openings of the hoses and motor.**

- (2) Remove hose clamps (5) fitted on the inside of both right-hand and left-hand side of rear plates (4).
Disconnect three hoses from the frame.



2. Hoses and wiring of amplitude selector cylinder

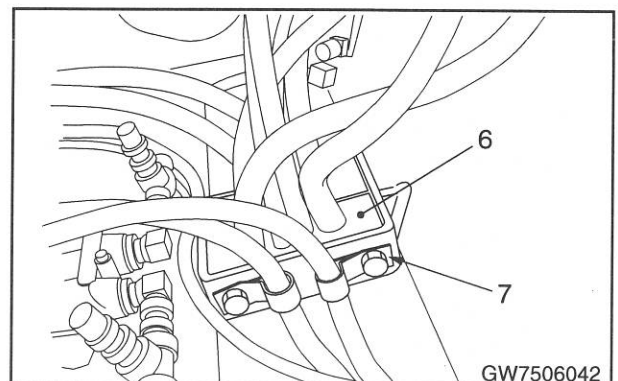
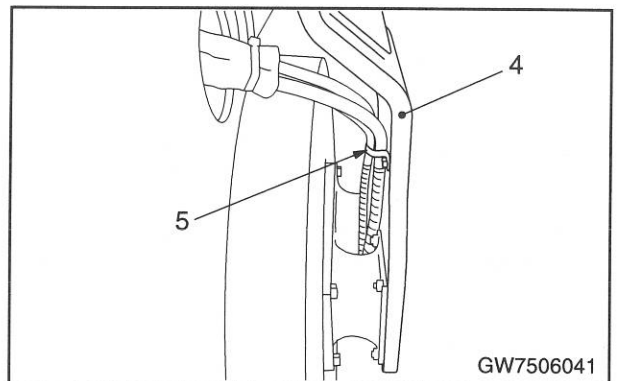
- (1) At the cylinder solenoid valve, disconnect two hoses which connect to the right side wheel assembly and two hoses which connect to left side wheel assembly.

★ **Cap and plug the openings of the hoses and solenoid valve.**

- (2) Remove bolts and nuts at hose clamps (6) and (7).
Remove 4 hose clamps on both sides, and disconnect the hoses from the frame. (The hose clamp assembly is comprised of four hose clamps.)

★ **Hose clamps (6) and (7) are also used for the propulsion motor hoses.**

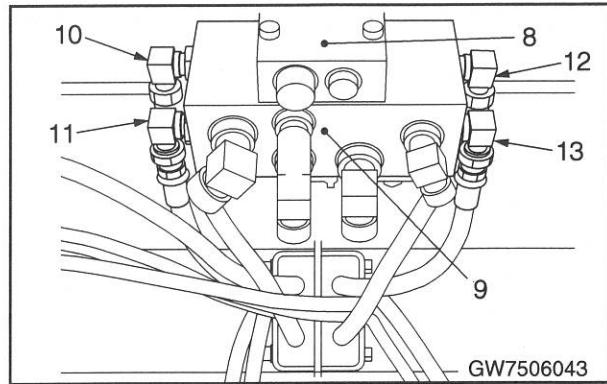
- (3) Disconnect the wires of the cylinder switches from the connectors.



3. Propulsion motor hoses

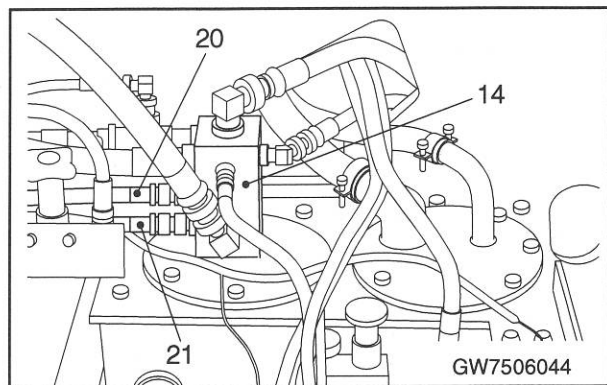
(1) At block (9) located under propulsion flushing valve (8), disconnect hoses (10) and (11) that connect to right side wheel assembly, and hoses (12) and (13) that connect to left side wheel assembly.

★ **Cap and plug the openings of the hoses and block.**



(2) At return block (14) on the hydraulic tank, disconnect the hoses (21) that connect to right side wheel assembly, and hoses (20) that connect to left side wheel assembly.

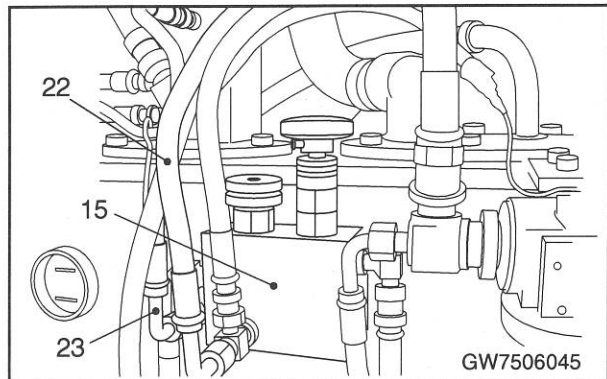
★ **Cap and plug the openings of the hoses and return block.**



(3) At brake valve (15) (parking brake release hand pump + manual selector valve), disconnect the hoses (23) that connect to right side wheel assembly, and hoses (22) that connect to left side wheel assembly.

★ **Cap and plug the openings of the hoses and brake valve.**

★ **For easy assembly, mark the hoses disconnected in steps (1) to (3) above.**




4. Side plates

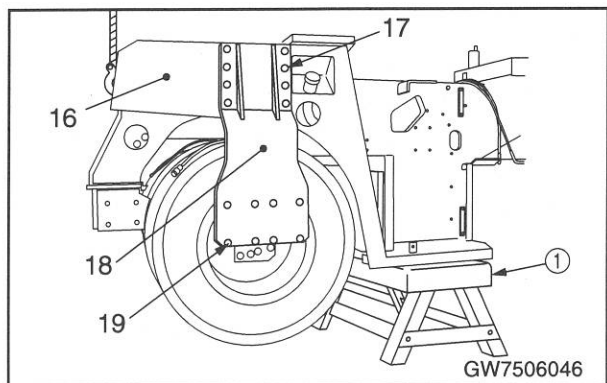
(1) Lift the frame (16) just enough to remove the load from shockmounts. Place an axle stand ① under the machine frame.

(2) Temporarily support side plate (18).

(3) Remove eight nuts and bolts (19) from the shock mounts [*3]. Remove eight bolts (17) [*2]. And lift off the side plate.

 Side plate: 70 kg (154.3 lb.)

★ **Remove the side plate on the opposite side using the same procedure.**



5. Rear wheel assemblies

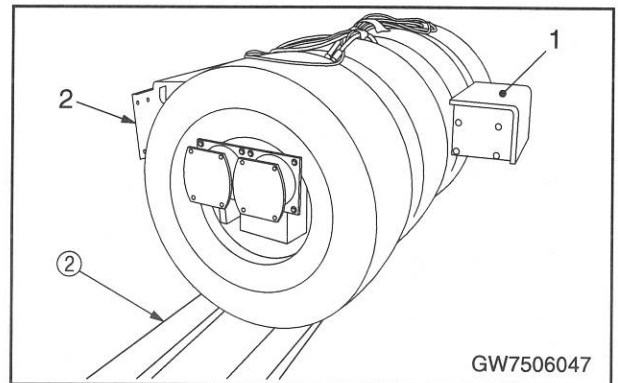
CAUTION

- Use a lifting device in good condition and with sufficient capacity for lifting components being serviced or repaired.
- Place the machine on level floor. Use blocks under the rear wheels to prevent unexpected movement.
- Use axle stand of ample strength. Operate forklift with extreme caution, when backing-up in particular.

(1) Remove eight bolts at rear bracket (1), and eight bolts at front (2). [*1]

(2) Using a Forklift (2), remove wheel assemblies to a side.

 Rear wheel assembly: 1400 kg (3086.5 lb.)



2-2-2. Reassembly of rear wheel assembly

CAUTION

When starting the engine for the first time after repairs have been completed run the engine at slow speed.

If run at high speed or the cylinder is operated at full stroke, piston packing may be damaged by air trapped in the cylinder.

★ Install in the reverse order of removal.

[*1] (size of bolt: M12 x 1.75)

• Tightening Torque : 108 N·m (79.6 lb.-ft)

[*2] (size of bolt: M16 x 2.0)

• Tightening Torque : 265N·m (195.4 lb.-ft)

[*3] (size of bolt: M12 x 1.75)

• Tightening Torque : 108 N·m (79.6 lb.-ft)

★ To compensate for leakage during removal, add oil to the hydraulic tank to the specified level.

★ Start the engine. Allow hydraulic oil to circulate.

★ Check that both vibrator cases have been filled with gear oil to the specified level.

2-3. Disassembly and Reassembly of Rear Wheel Assembly

2-3-1. Disassembly of rear wheel assembly

⚠ WARNING

Use axle stand of sufficient capacity.
Operate a forklift with extreme caution,
especially when backing up.

⚠ CAUTION

Block the wheels in both directions to
prevent unexpected movement. Remove
both rear wheel assemblies together. Drain
both vibrator cases.

⚠ CAUTION

Use a lifting device with sufficient capacity.

1. Front and rear brackets

- (1) Temporarily lift rear bracket (1).
- (2) Remove the eight nuts at the shockmount bolts and lift off the rear bracket. [*7]

 Rear bracket: 50kg (110.2 lb.)

- (3) Temporarily lift front bracket (2).
- (4) Remove the eight nuts at the shockmount bolts and lift off the front bracket. [*6]

 Front bracket: 110kg (242.5 lb.)

★ When both brackets have been removed,
disassemble each side in a similar
manner.

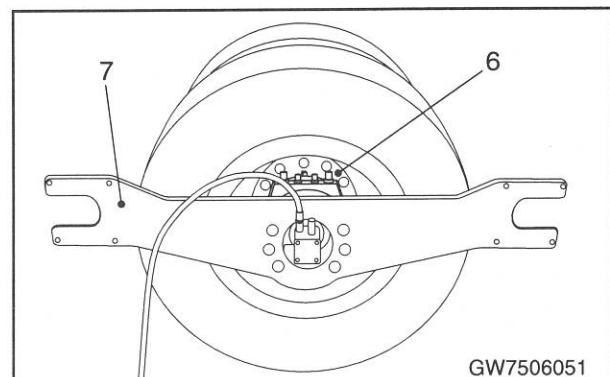
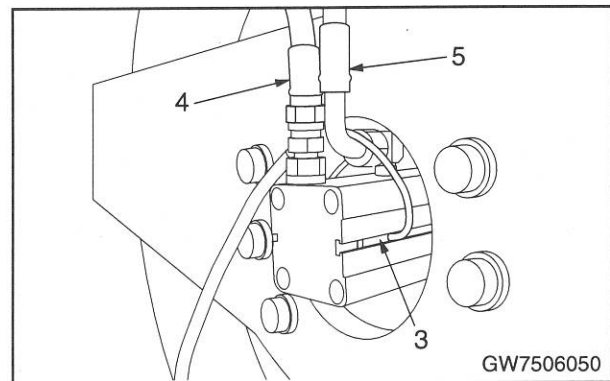
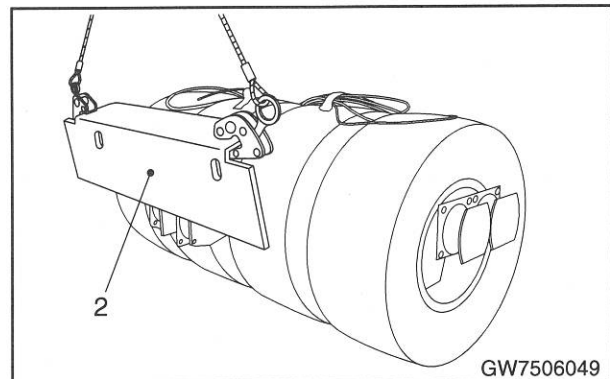
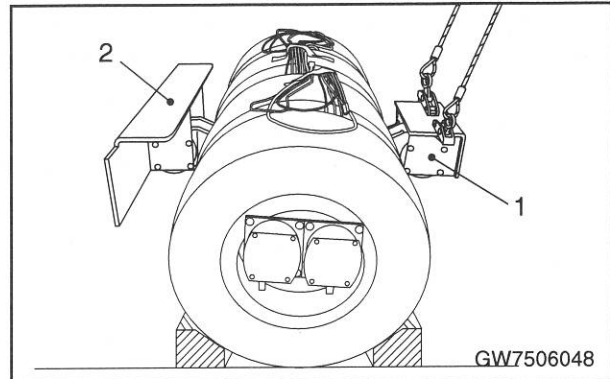
2. Hoses and electrical wiring of amplitude selector cylinder

- (1) Loosen the screws and remove cylinder switches (3) from the cylinder groove. Disconnect wiring from the connector.
- (2) Disconnect near side hose (4). Far side hose (5) should be disconnected after removal of plate (7).

3. Hydraulic motor hoses

- (1) Disconnect four hoses from propulsion motor (6).

★ Cap and plug the openings of the hoses
and motor.

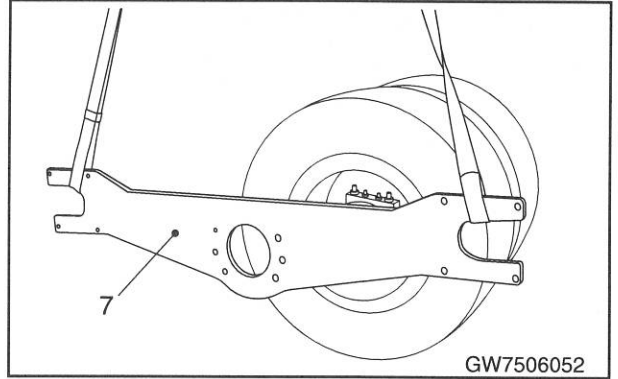


4. Plate on propulsion motor side

- (1) Remove the eight bolts and remove the front and rear damper.
- (2) Temporarily lift plate (7) on the propulsion motor side.
- (3) Remove six bolts and lift off the plate (7).[*5]

★ **When removing the plate, use caution not to damage the hoses.**

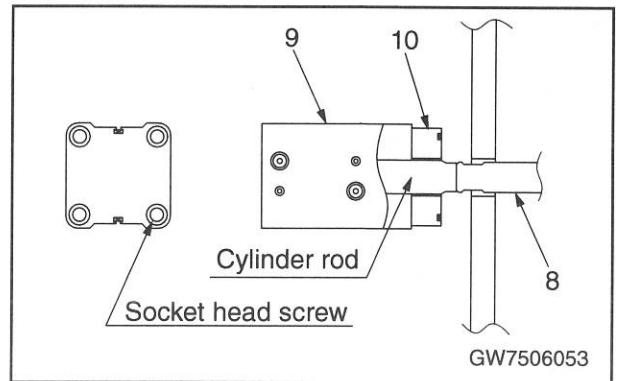
 Plate: 60 kg (132.3 lb.)



5. Amplitude selector cylinder

- (1) Remove four socket head screws at the cylinder.
- (2) Pull out the cylinder for access to the eccentric weight rod (8). Slide the adaptor to one side.
Using a 17 mm wrench and a 19 mm wrench, break the bond between the rod (8) and cylinder (9).
- (3) Then rotate the cylinder to unscrew from the rod.

★ **Because the threaded portion of the rod end has been treated with sealing compound, break the bonding with caution when removing the cylinder and adaptor from the eccentric weight rod.**

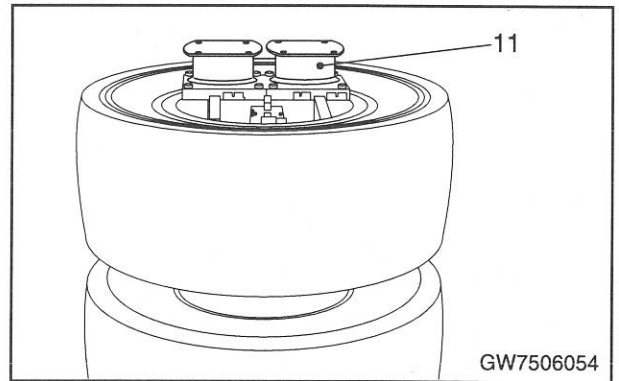


6. Plate and damper on vibrator motor side

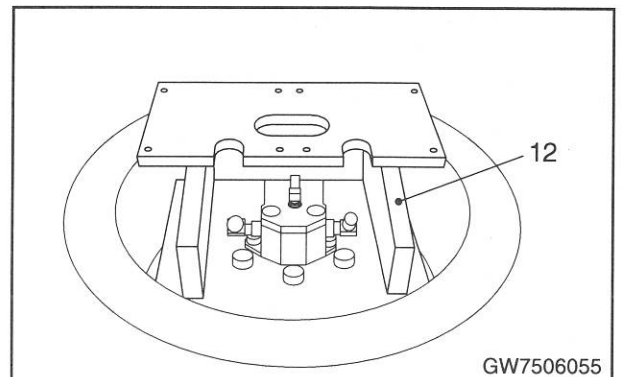
- (1) When the steps on items 1 to 5 above have been completed, stand the wheel assembly vertically with the shock mounts up.

 Rear wheel assembly: 550 kg (1212.5 lb.)

- (2) Remove eight bolts from two damper (11).
Remove damper. [*4]



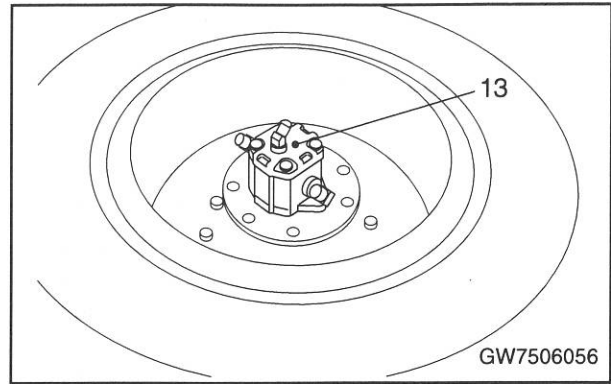
- (3) Remove seven bolts and remove bracket (12) on the vibrator side. [*3]



REAR WHEEL, TIRE AND VIBRATOR ASSEMBLY

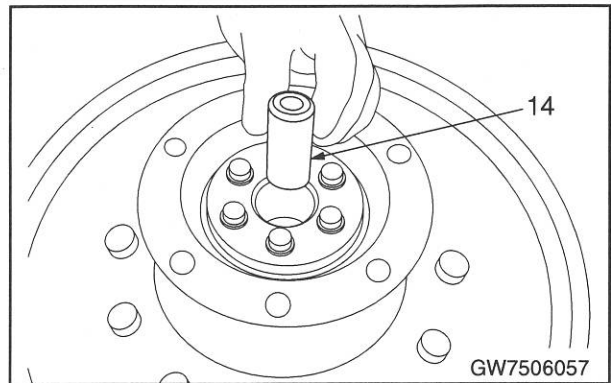
7. Vibrator motor assembly

- (1) Remove four bolts and remove vibrator motor assembly (13).



8. Sleeve

- (1) Remove sleeve (14).

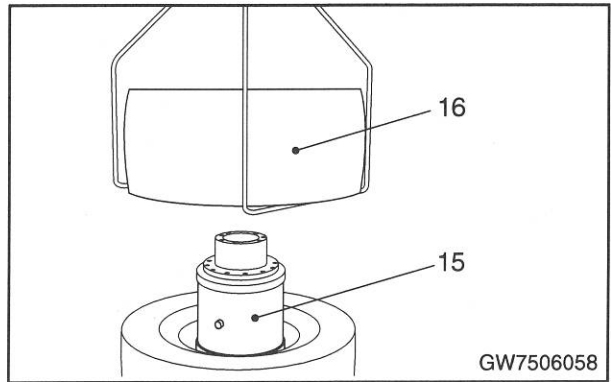


9. Tire assembly and axle shaft assembly

- (1) Remove twelve bolts which hold the axle shaft assembly and tire wheel to vibrator case (15). [*2]

- (2) Lift off tire assembly (16).

 Tire assembly: 150 kg (330.7 lb.)

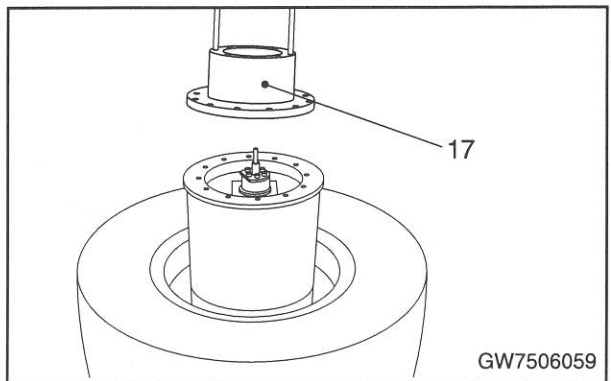


CAUTION

Screw in the lifting bolts fully into the threaded holes of the axle shaft assembly.


- (3) Insert lifting bolts at two locations of axle shaft assembly (17) and lift off the axle shaft assembly.

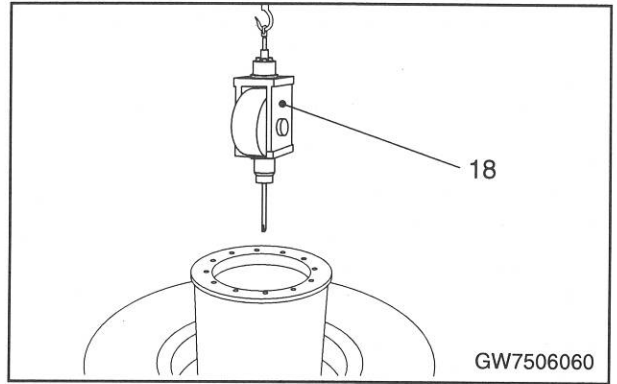
 Axle shaft assembly: 40 kg (88.2 lb.)



10. Eccentric weight assembly

- (1) Screw a lifting bolt (M8X1.25) into end of eccentric weight shaft, and lift off eccentric weight assembly (18).

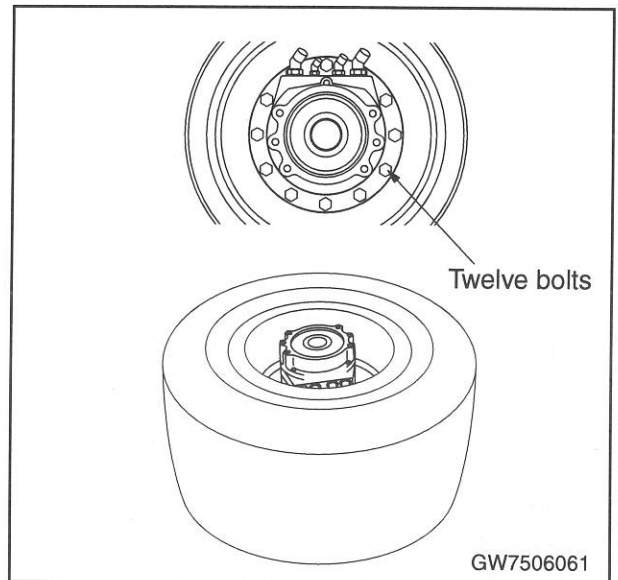
 Eccentric weight assembly:
85 kg (187.4 lb.)




- (2) Turn the whole body including the vibrator case over with the propulsion motor up.

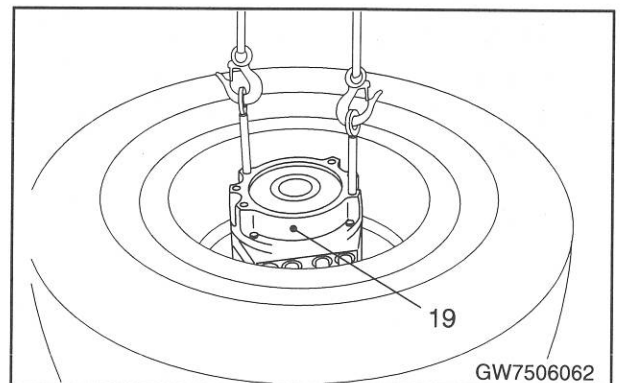
11. Propulsion motor assembly (hub included)

- (1) Remove twelve bolts which hold the hub and tire wheel to the vibrator case together with the propulsion motor assembly. [*1]



- (2) Insert lifting bolt (M16 x 2.0) at two locations of propulsion motor assembly. Lift off the propulsion motor assembly (19) together with the hub.

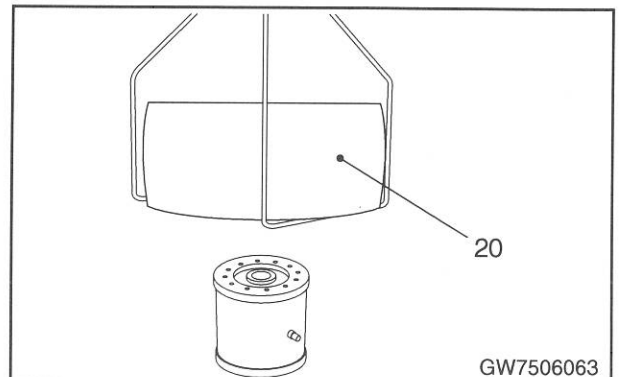
 Propulsion motor assembly:
90 kg (198.4 lb.)



12. Tire assembly and vibrator case

- (1) Lift off tire assembly (20) from the vibrator case.

 Tire assembly: 150 kg (330.7 lb.)



2-3-2. Reassembly of rear wheel assembly

★ Reverse the disassembly instructions.

[*1] (size of bolt: M16 x 2.0)

• Tightening torque: 265 N·m (195.4 lb·ft)

[*2] (size of bolt: M16 x 2.0)

• Tightening torque: 265 N·m (195.4 lb·ft)

[*3] (size of bolt: M16 x 2.0)

• Tightening torque: 265 N·m (195.4 lb·ft)

[*4] (size of bolt: M12 x 1.75)

• Tightening torque: 108N·m (79.6 lb·ft)

[*5] (size of bolt: M16 x 2.0)

• Tightening torque: 265 N·m (195.4 lb·ft)

[*6] (size of bolt: M12 x 1.75)

• Tightening torque: 108 N·m (79.6 lb·ft)

[*7] (size of bolt: M12 x 1.75)

• Tightening torque: 108 N·m (79.6 lb·ft)

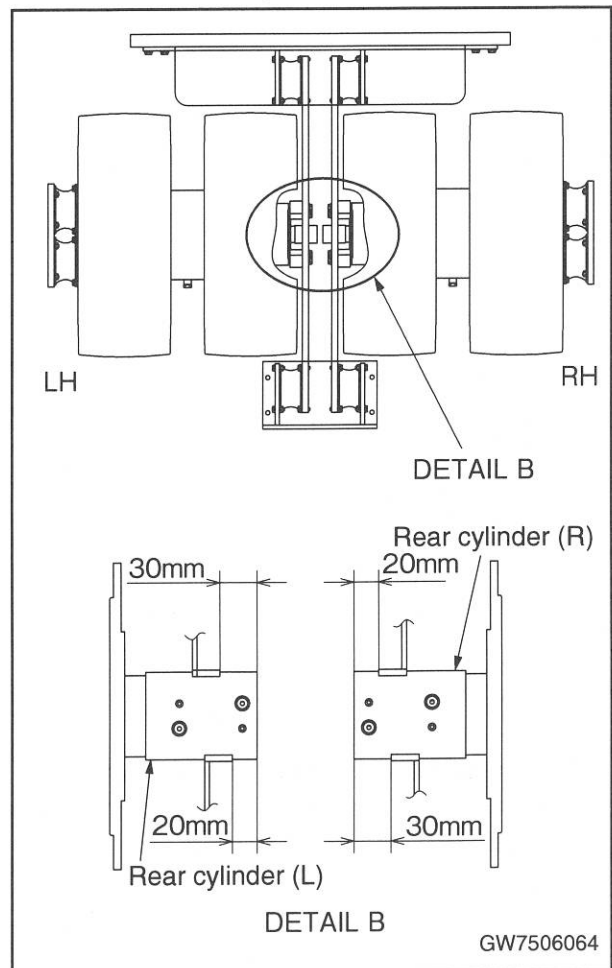
★ The location of cylinder switches on both sides of the cylinder is as illustrated.

★ When assembling the sleeve, apply a coat of molybdenum disulfide grease to the splines of the sleeve.

★ Install the wheels to position the air valves as close as possible to the vibrator case drain plug.

★ Vibrator oil: API-GL4 gear oil 2.5 L at two places (0.66 gal at two places)

★ Apply liquid sealant to the mounting surface of propulsion motor and side of adaptor to cylinder.



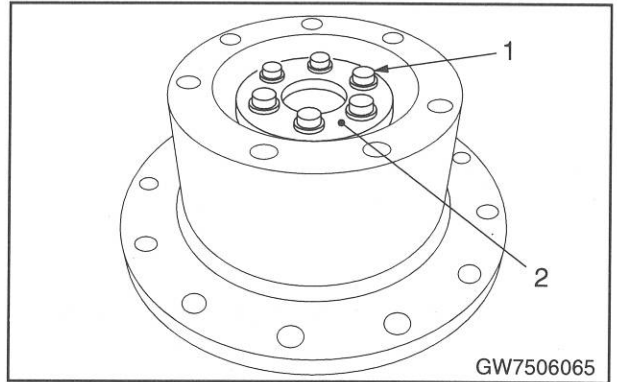
2-4. Disassembly and Reassembly of Rear Axle Shaft Assembly

2-4-1. Disassembly of rear axle shaft assembly

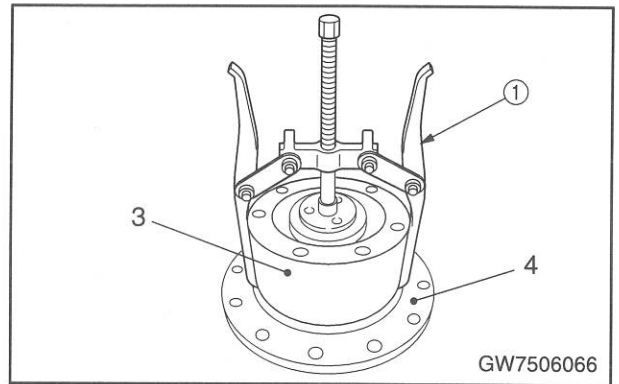
1. Housing

(1) Remove six bolts (1), and remove cover (2).

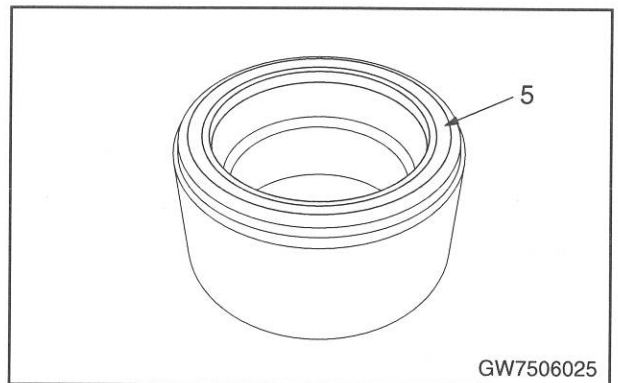
★ **Note the total thickness and quantity of the shims and store them.**



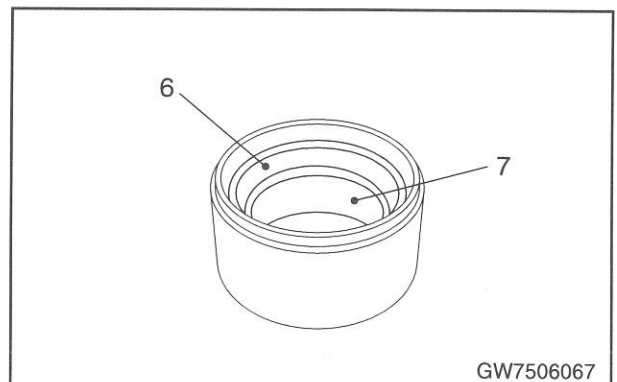
(2) Using puller ①, pull off housing (3) from axle shaft (4).



(3) Remove oil seal (5) from the housing.



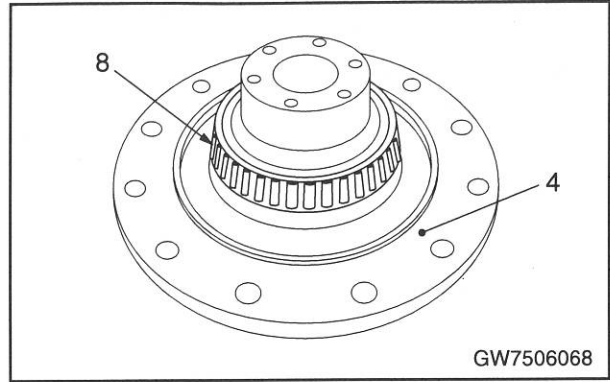
(4) Remove bearing outer races (6) and (7) from the housing.



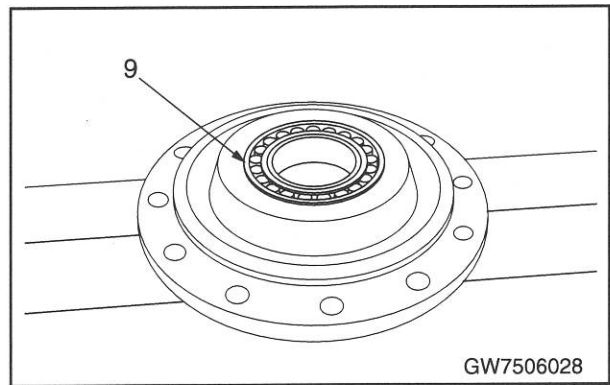
REAR WHEEL, TIRE AND VIBRATOR ASSEMBLY

2. Axle shaft

- (1) Pull off bearing inner race (8) from axle shaft (4).



- (2) Remove bearing (9) from the axle shaft.



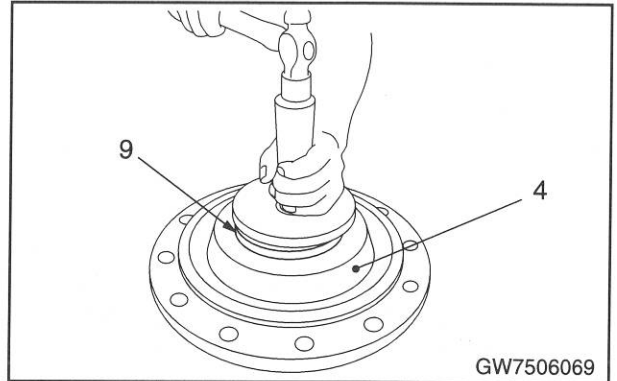
2-4-2. Reassembly of rear axle shaft assembly

★ Thoroughly clean the parts, and repair parts if burrs or other damage is noticeable.

1. Axle shaft

(1) Assemble bearing (9) into axle shaft (4).

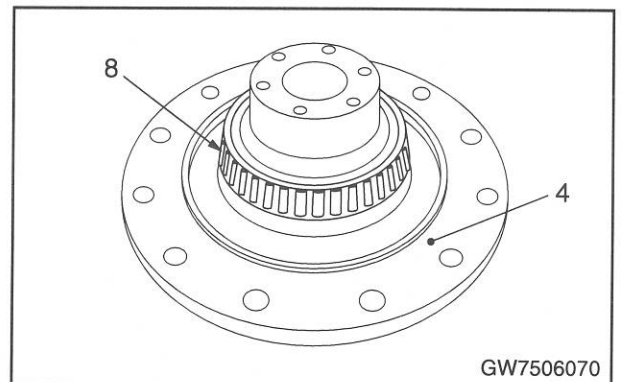
★ Apply a sufficient coat of lithium base grease over the bearing, and also pack it with the grease.



⚠ CAUTION

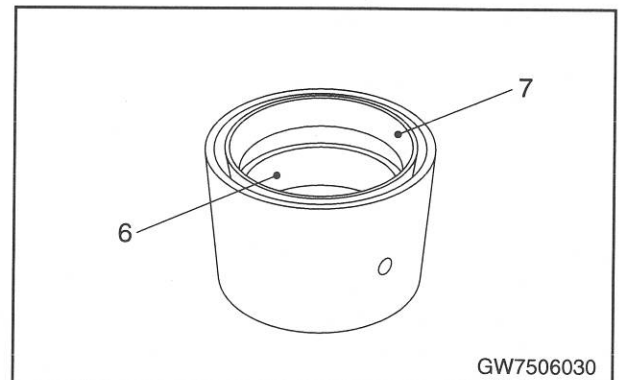
Do not heat the inner race to higher than 100 °C (212 °F). Temperature exceeding 120 °C (248 °F) can impair the hardness of the inner race.

(2) Expand inner race (8) by heating with a heater, and drive the inner race until it bottoms on the stepped portion of axle shaft (4). Keep the inner race in that state for one to two minutes. Then drive the inner race further until it is fully seated.



2. Housing

(1) Drive bearing outer races (6) and (7) until they are fully seated against the stepped portion of the housing.



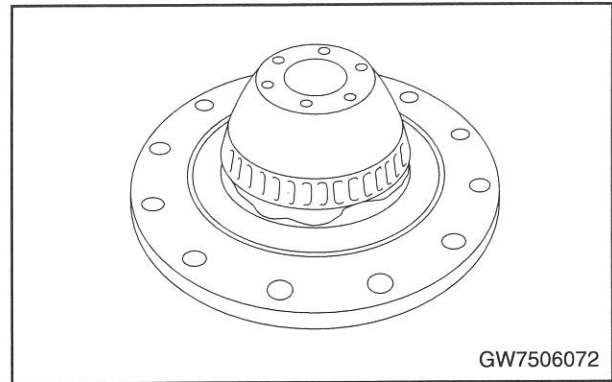
(2) Fit oil seal (5) in the housing.

★ Pack the oil seal lip with lithium base grease.



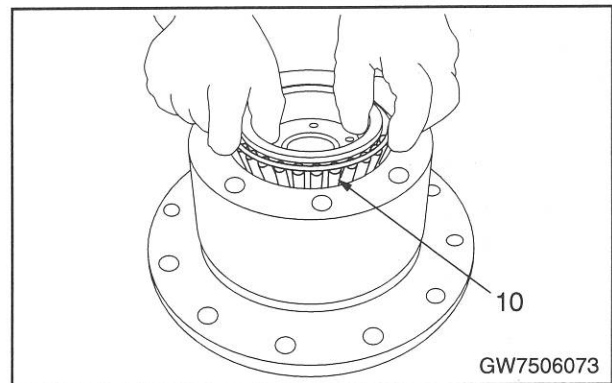
REAR WHEEL, TIRE AND VIBRATOR ASSEMBLY

- (3) Apply a sufficient coat of lithium base grease over the bearing. Fit housing (3) onto axle shaft (4).



- (4) Apply a sufficient coat of lithium base grease on the inner race of bearing (10) and drive the inner race until the rollers make firm contact with the outer race.

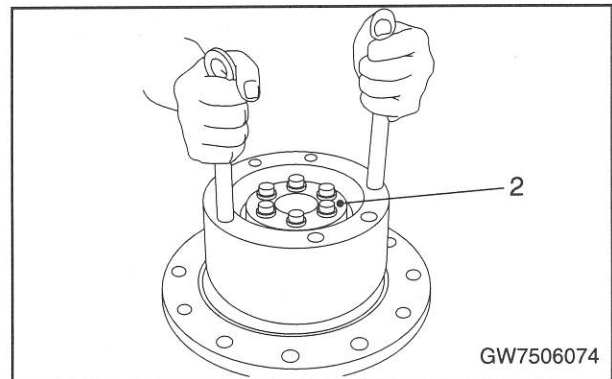
★ **Pack the bearing with lithium base grease.**



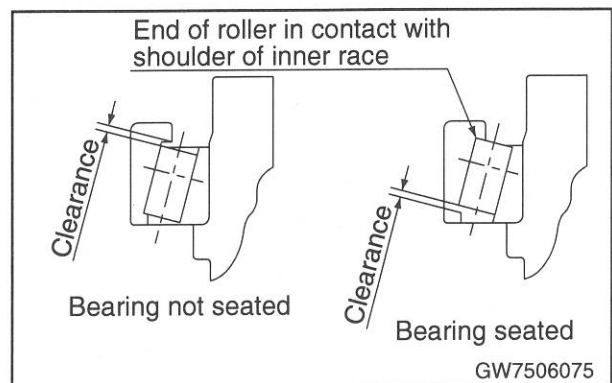
- (5) Before making the preload adjustment of the bearing, tighten the 6 bolts to 29 N·m (21.4 lb·ft) with cover (2).

Then, rotate the housing one full turn and retighten the bolts to 29 N·m (21.4 lb·ft).

Allow the bearing to be securely seated by repeating this step two to three times until the tightening torque remains stable.



★ **Driving the inner race without rotating the bearing will fail to achieve correct seating of the bearing even with greater effort. The rotation allows the inner race to seat fully and uniformly.**

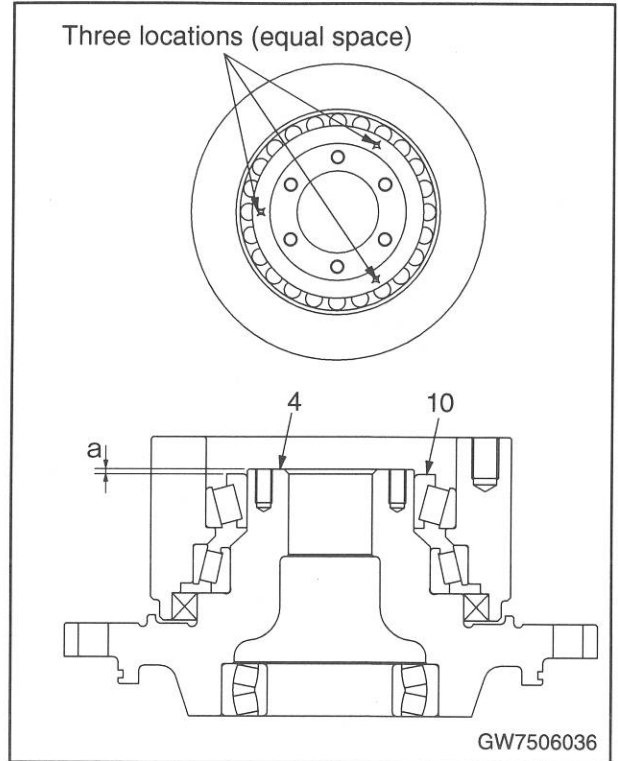


(6) Bearing preload adjustment

- 1) After ensuring that the bolt tightening torque remains stable, remove cover (2). Measure dimension 'a' between the bearing and axle shaft at three locations using a depth gauge.

Average the measurements.

Dimension 'a': 3.9 to 4.3 mm (0.15 to 0.17 in.)



- 2) Measure dimension 'b' of cover (2).
- 3) Determine the necessary shim thickness using the following formula.

- Preload adjusting shim thickness = $(b - a) - 0.1$ (mm)

Example of the calculation:

$a=4, b=5, (5 - 4) - 0.1=0.9$ mm

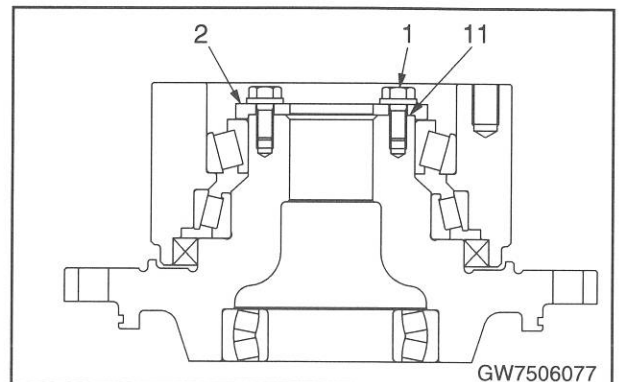
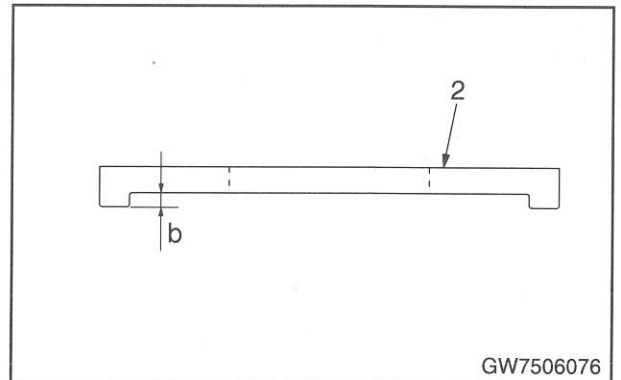
(Insert Shim of 0.9 mm by an above calculation)

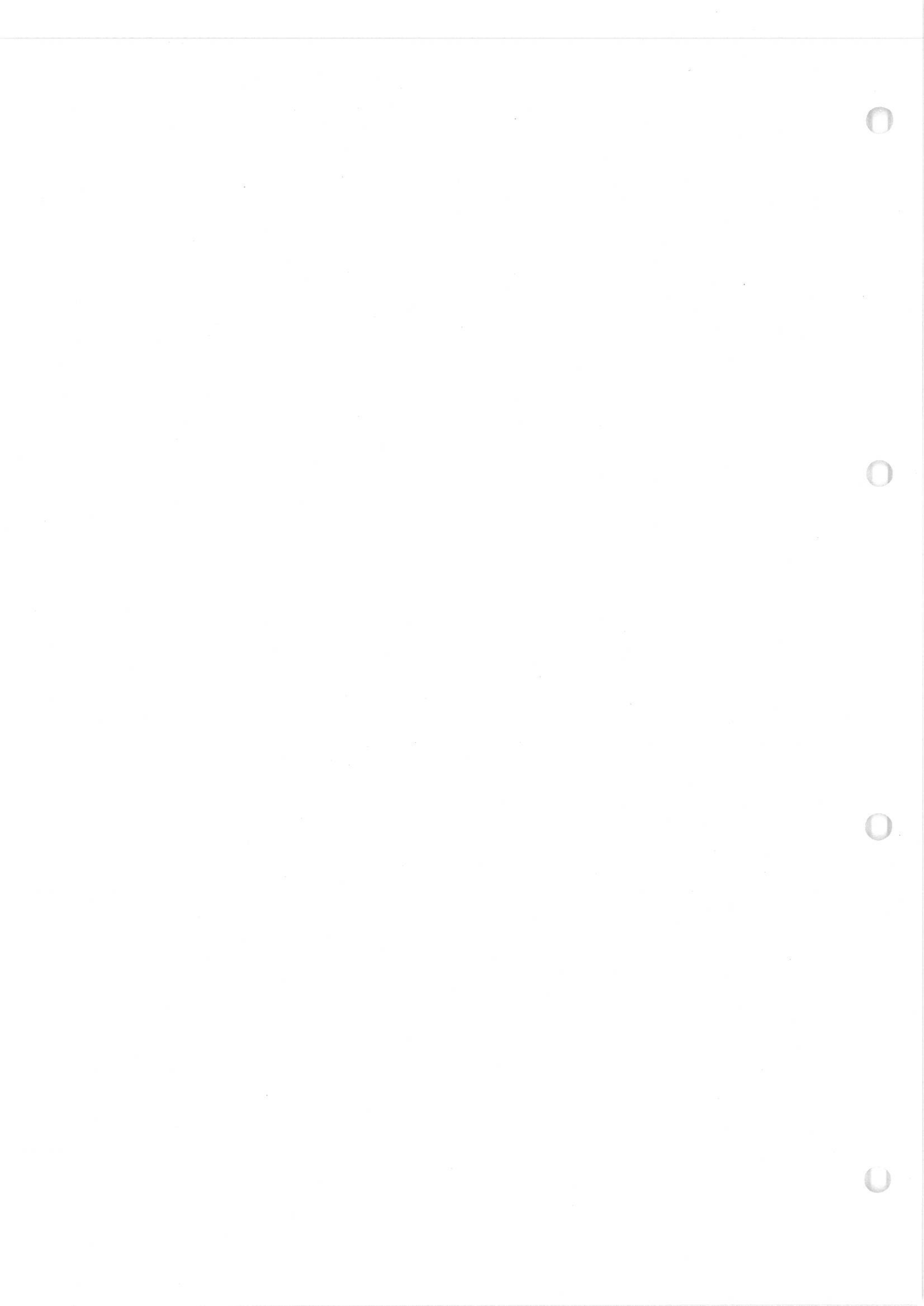
★ Above formula gives a preload of 0.1 mm to the inner race from the unloaded state when seated fully on the axle shaft.

★ In determination of shim thickness (using 'mm') round the number in the second decimal place.

- 4) With the shims selected in step 3) above, install cover (2) and tighten the six bolts.

★ Tightening torque: 59 N·m (43.5 lb·ft)





BRAKES

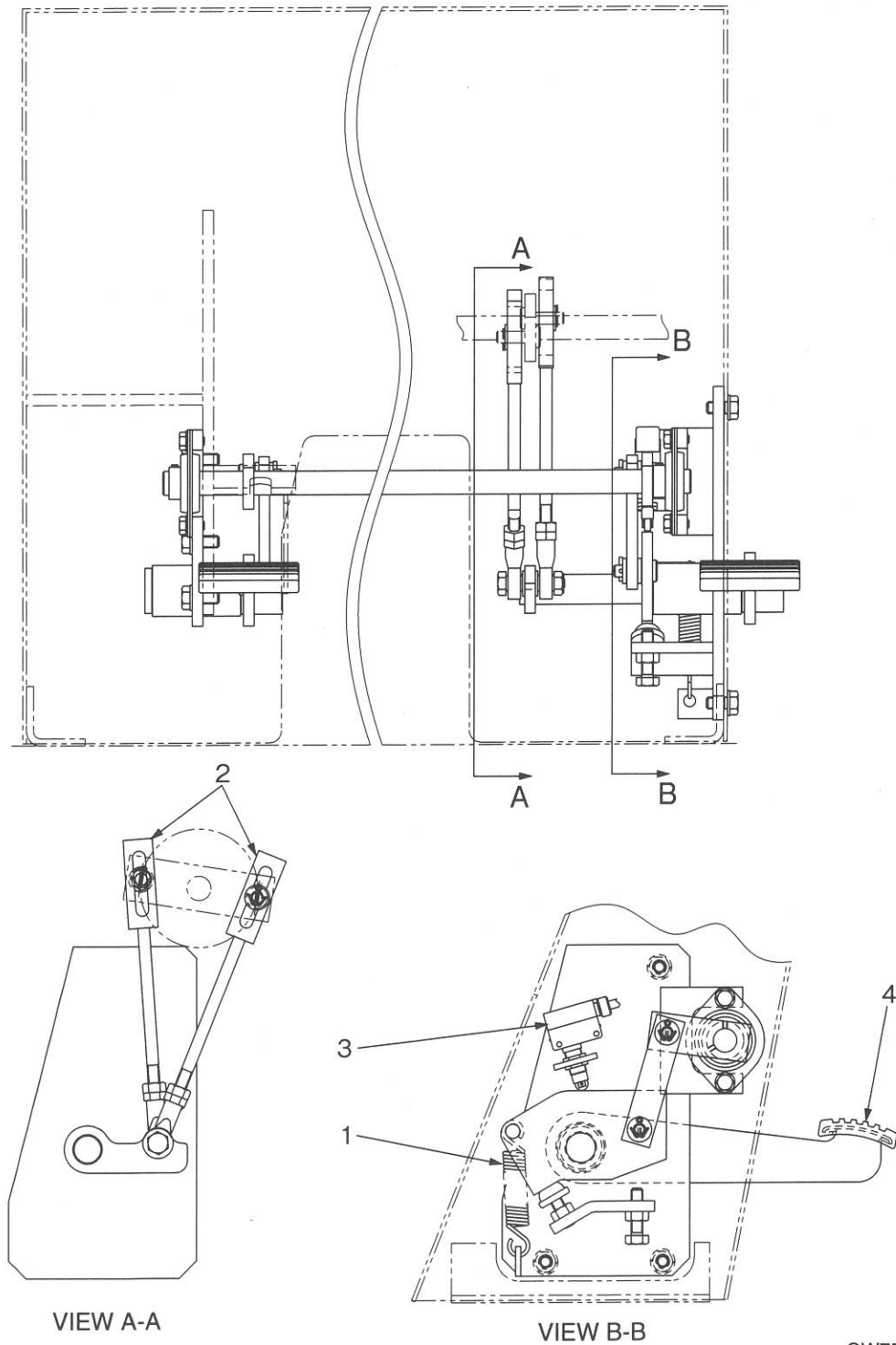
BRAKES

1. BRAKE SYSTEM

1-1. Brake pedal	7-002
1-2. Parking brake circuit	7-003

1. Brake System

1-1. Brake pedal



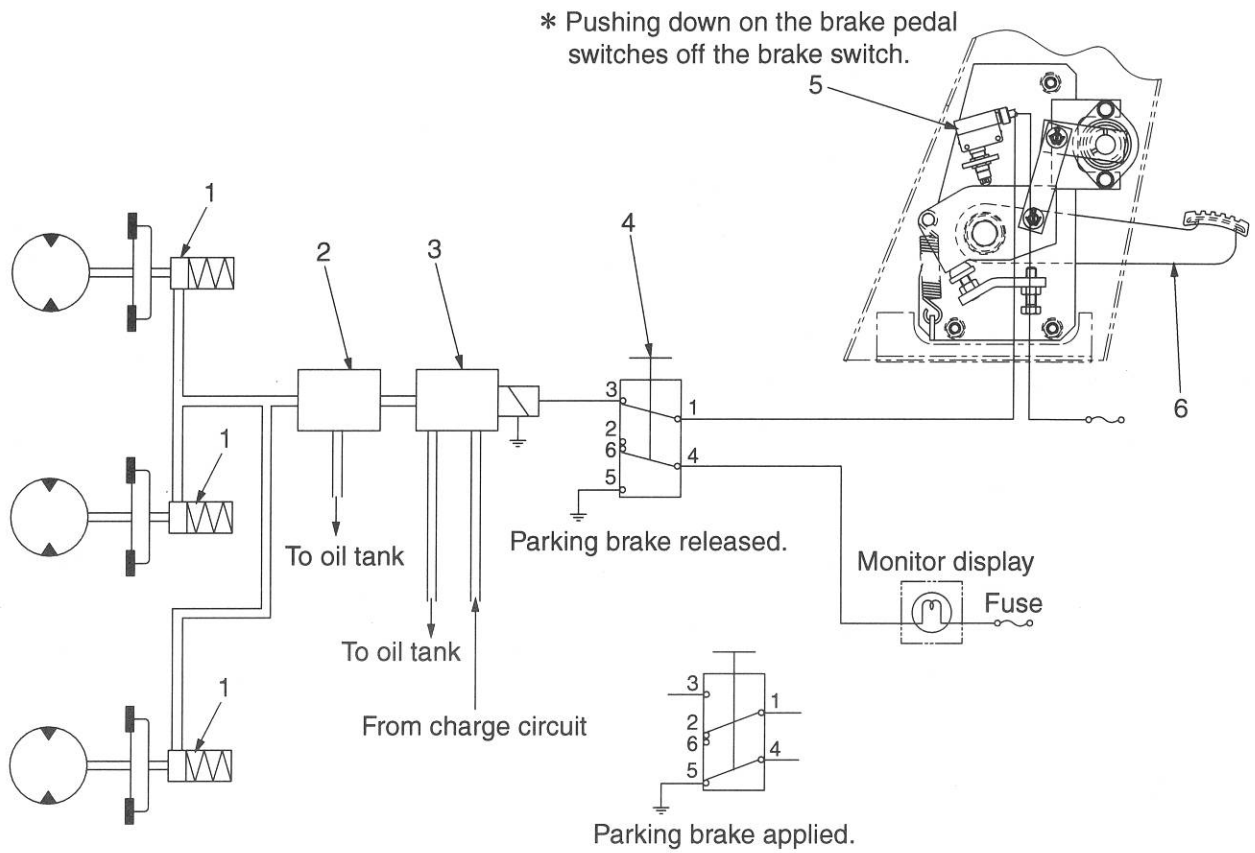
VIEW A-A

VIEW B-B

GW7507001

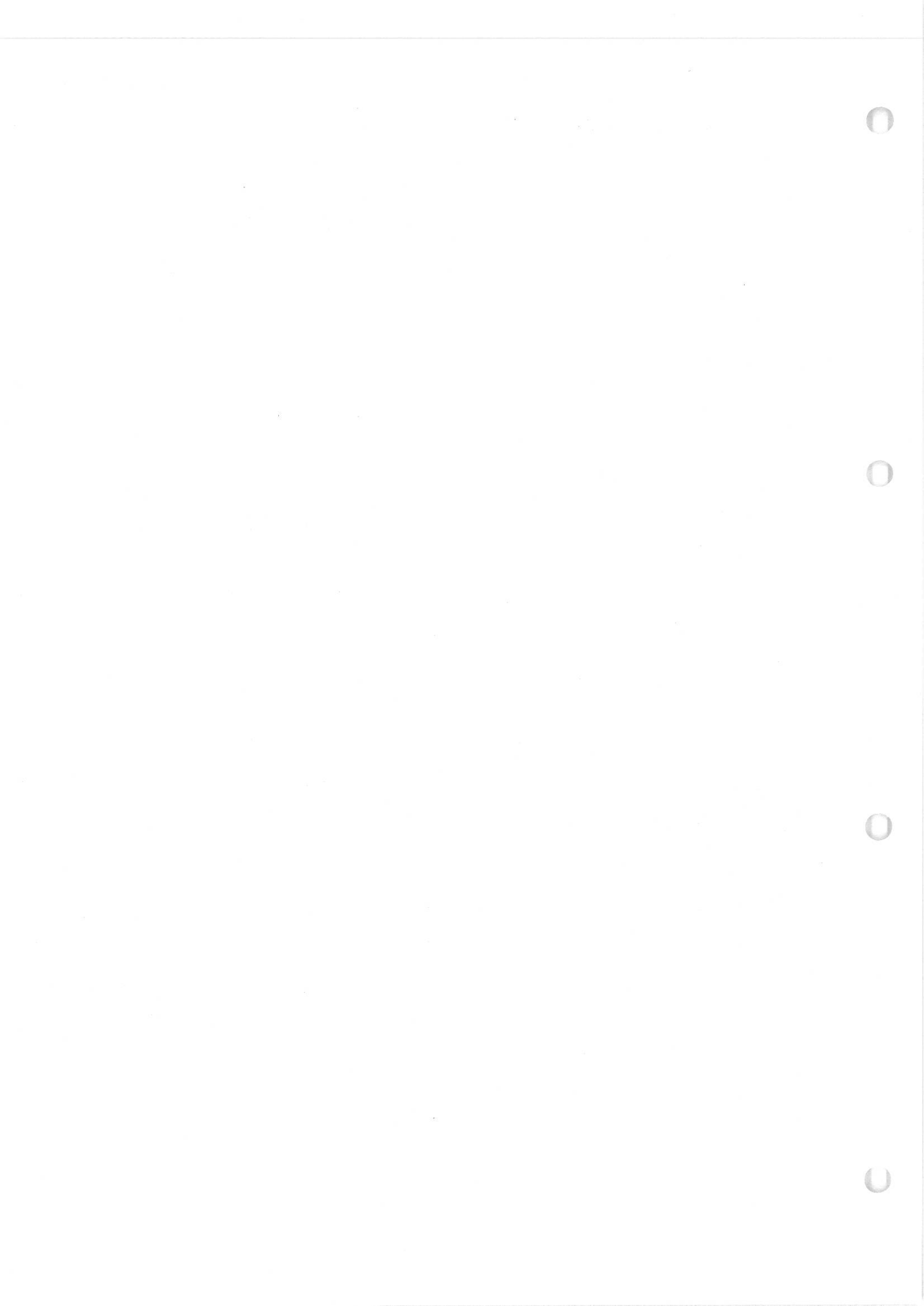
- 1. Spring
- 2. Centering rod (F-R lever)
- 3. Foot brake switch
- 4. Brake pedal

1-2. Parking brake circuit



GW7507002

1. Parking brake (Spring applied hydraulically released brake)
2. Brake valve (parking brake release hand pump + manual selector valve)
3. Brake solenoid valve
4. Parking brake switch
5. Foot brake switch
6. Brake pedal



WATER SYSTEM

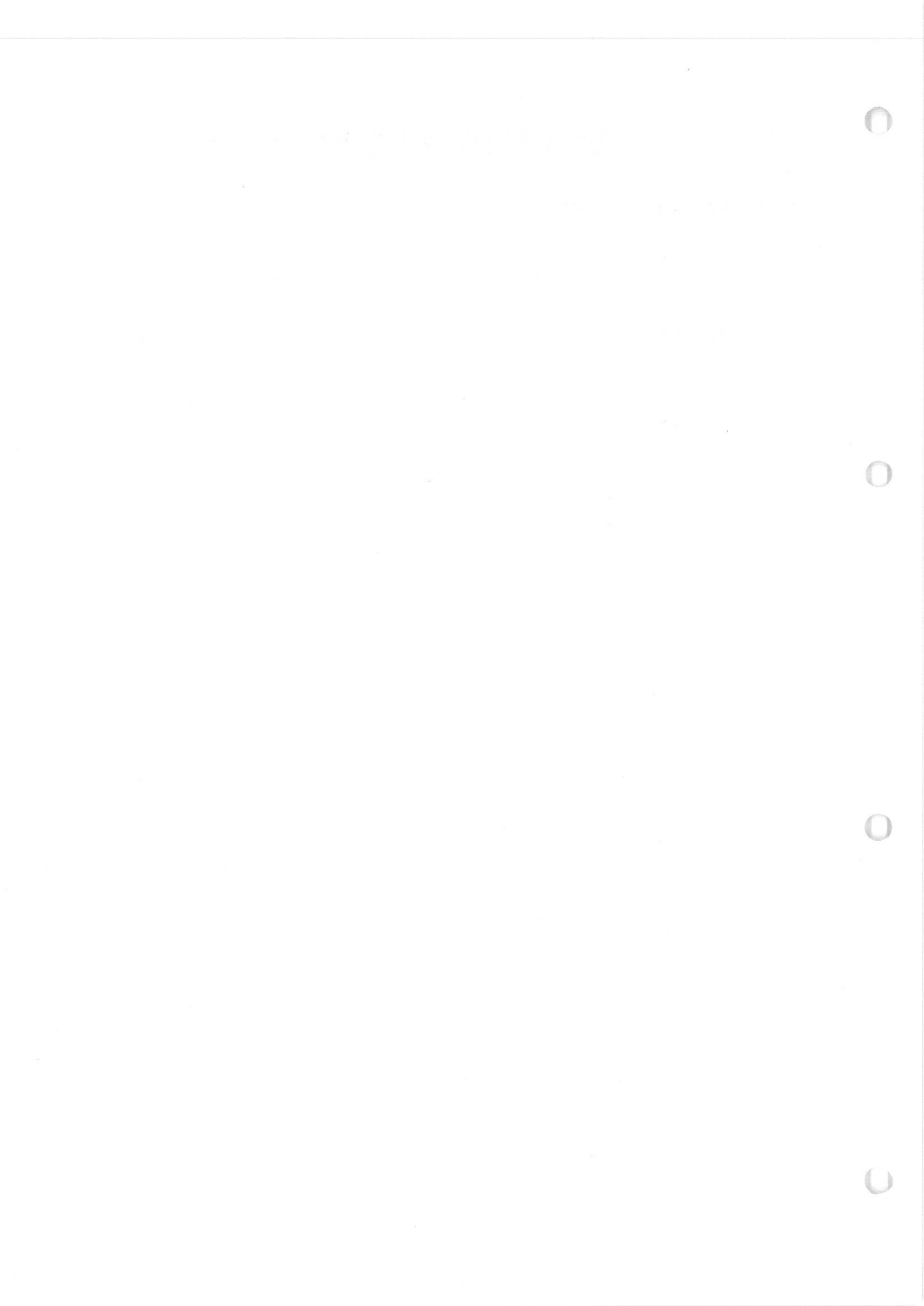
WATER SYSTEM

1. WATER SPRAY SYSTEM

- 1-1. Water spray system 8-002
 - 1-1-1. Water spray pump/motor assembly 8-003

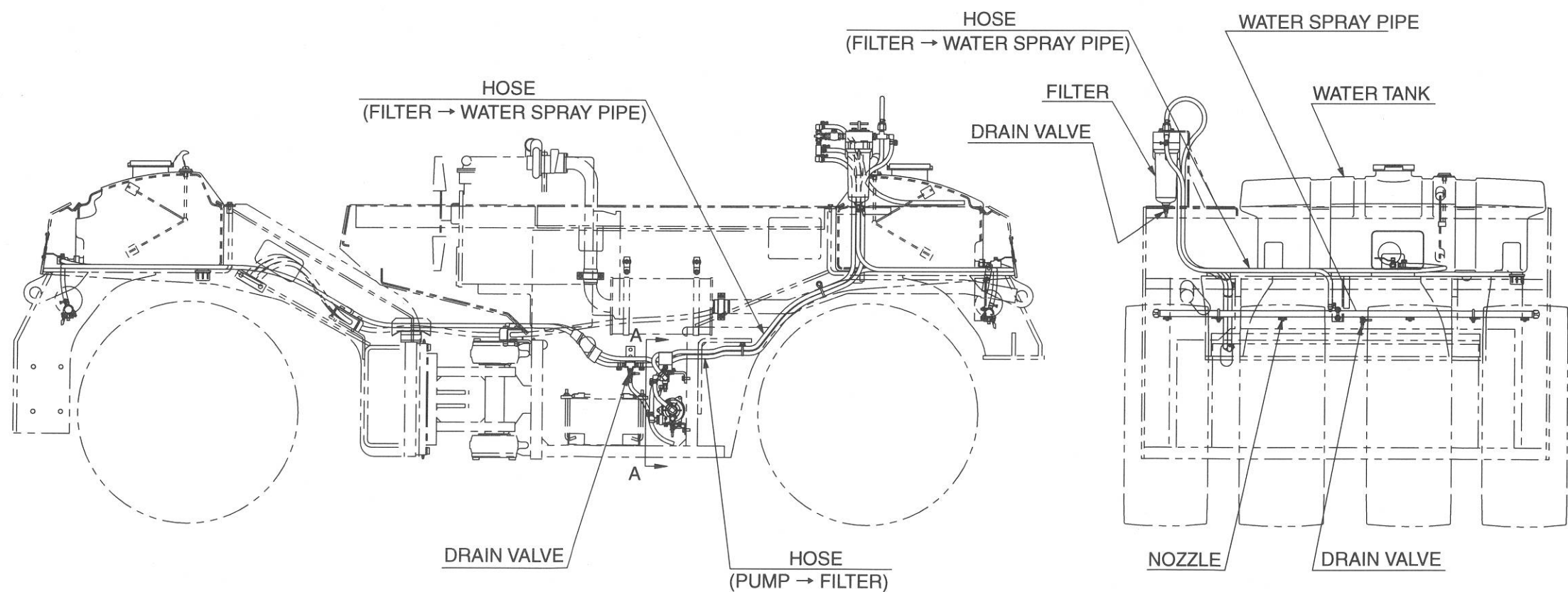
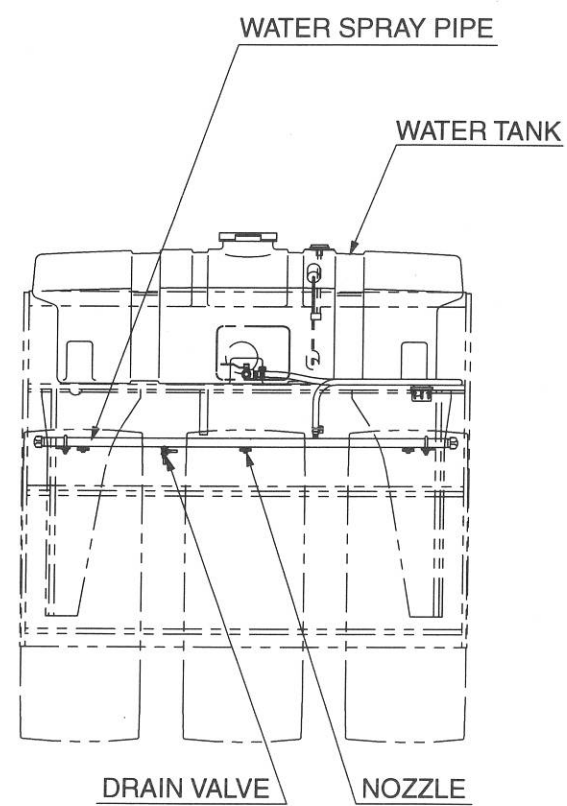
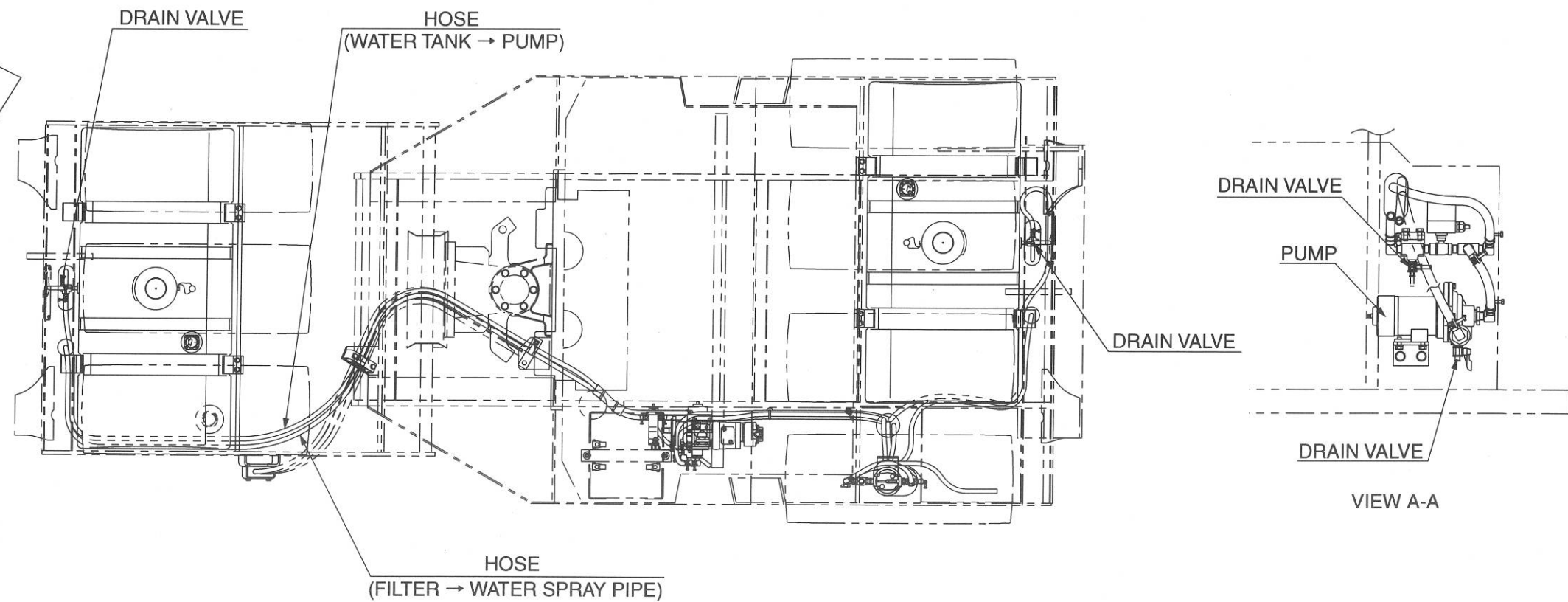
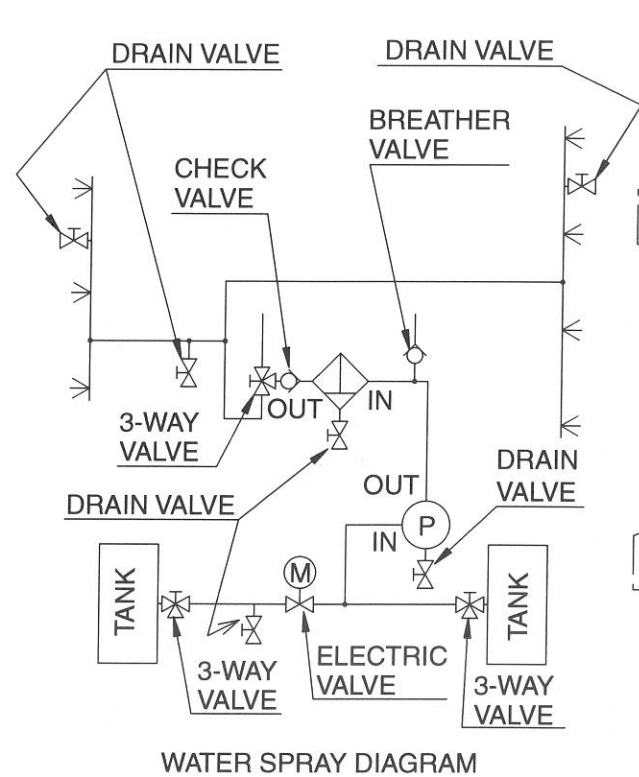
2. LIQUID SPRAY SYSTEM

- 2-1. Liquid spray system 8-004
 - 2-1-1. Liquid spray pump/motor assembly 8-005

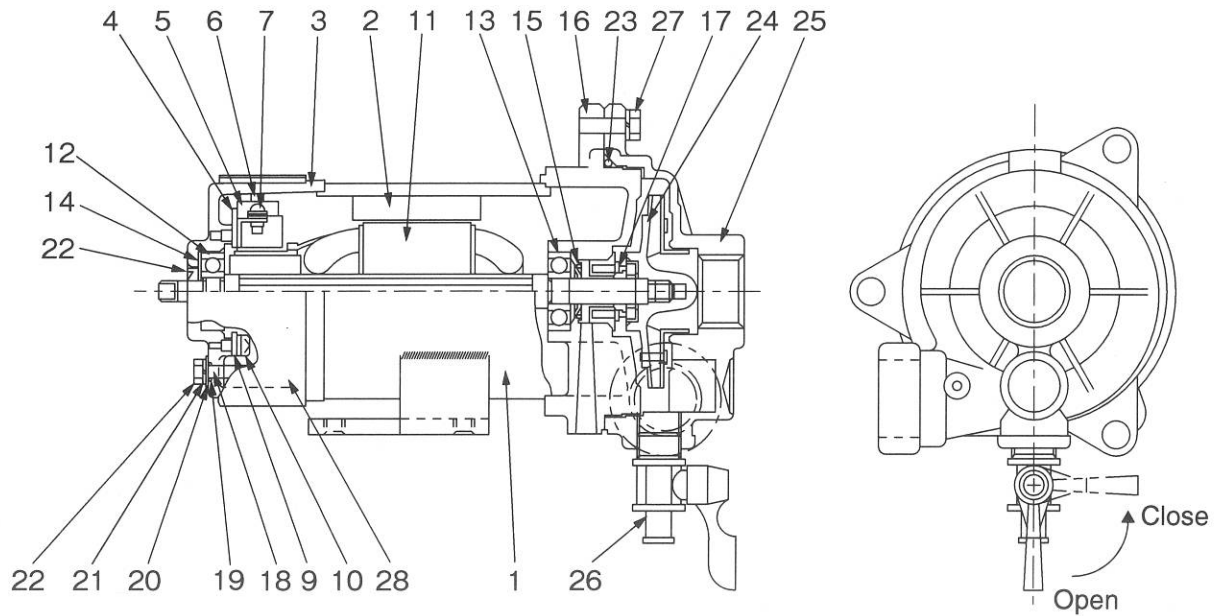


1. WATER SPRAY SYSTEM

1-1. Water spray system



1-1-1. Water spray pump/motor assembly



GW7508002

- | | | |
|-----------------------|---------------------|-------------------|
| 1. York Ass'y | 11. Armature Ass'y | 21. Spring washer |
| 2. Magnet | 12. Bearing | 22. Nut |
| 3. Cover | 13. Bearing | 23. O-ring |
| 4. Brush Holder Ass'y | 14. Washer | 24. Impeller |
| 5. Brush Ass'y | 15. Oil seal | 25. Pump casing |
| 6. Brush spring | 16. Cover | 26. Ball valve |
| 7. Screw | 17. Mechanical seal | 27. Bolt |
| 8. Grommet | 18. Bolt | 28. Band Ass'y |
| 9. Washer | 19. O-ring | 29. Screw |
| 10. Screw | 20. Washer | |

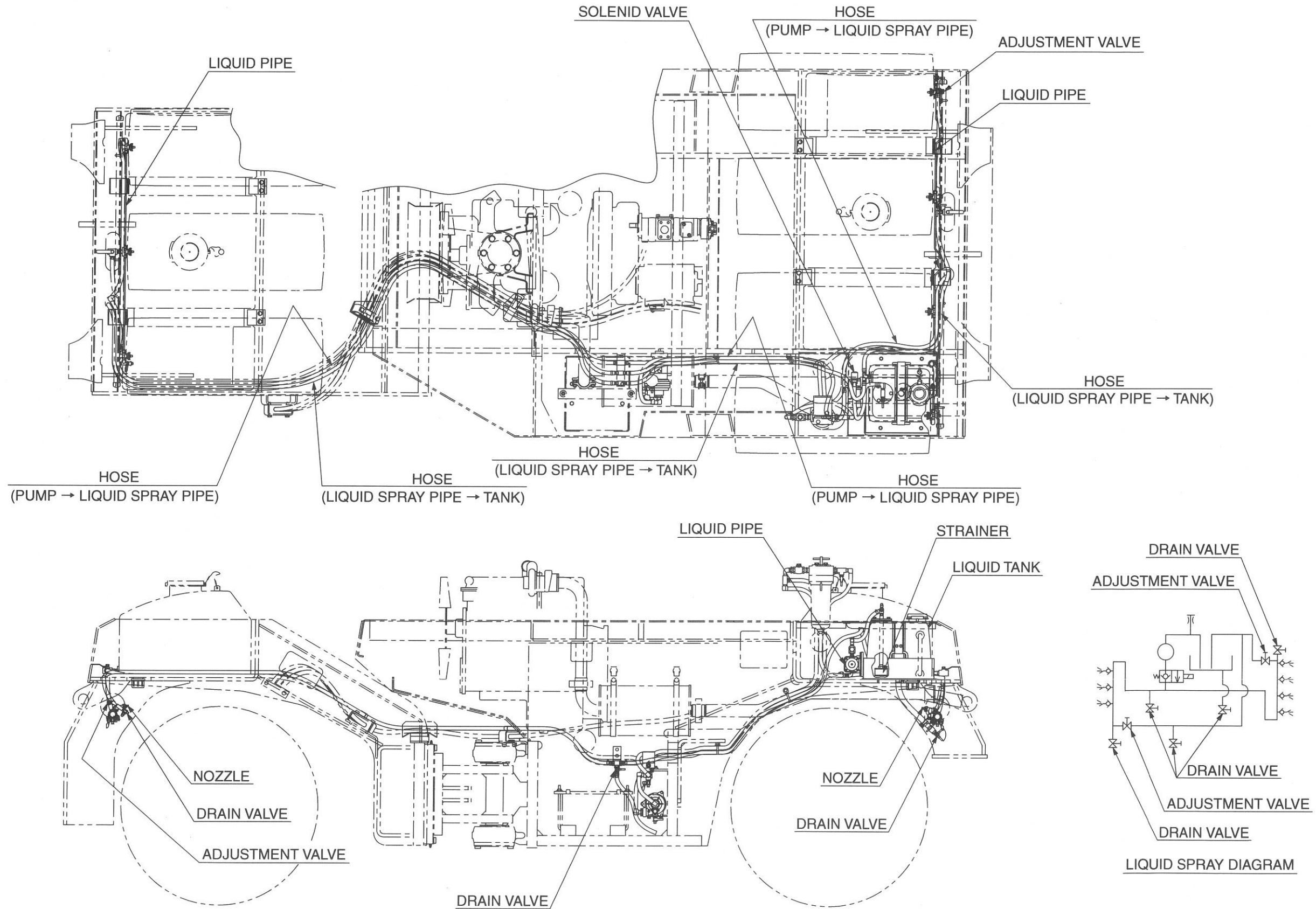
Specification

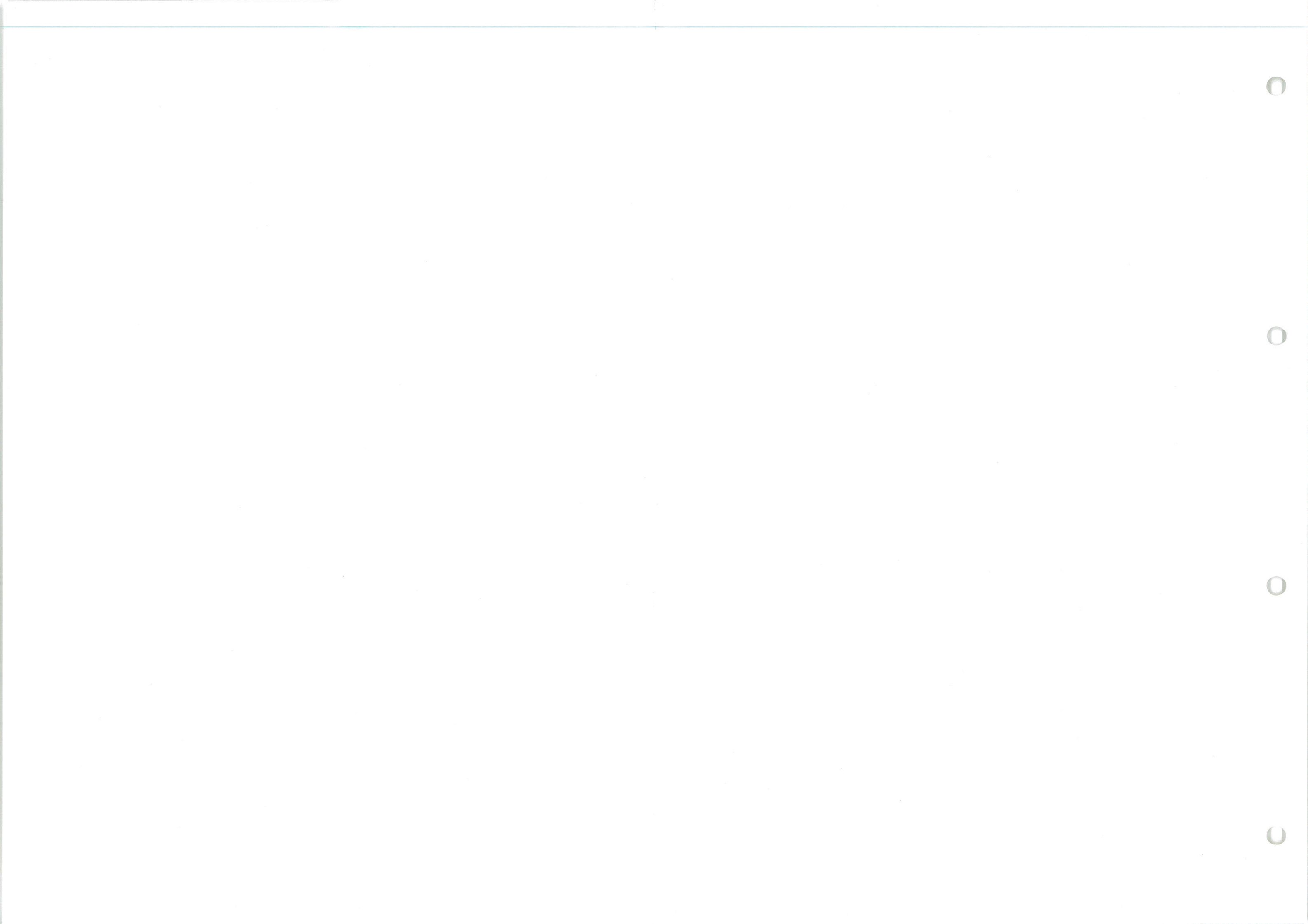
- Flow Volume : 2.4 l/min (0.63 gal/min)
- Operating Pressure : 0.18MPa (26 psi)



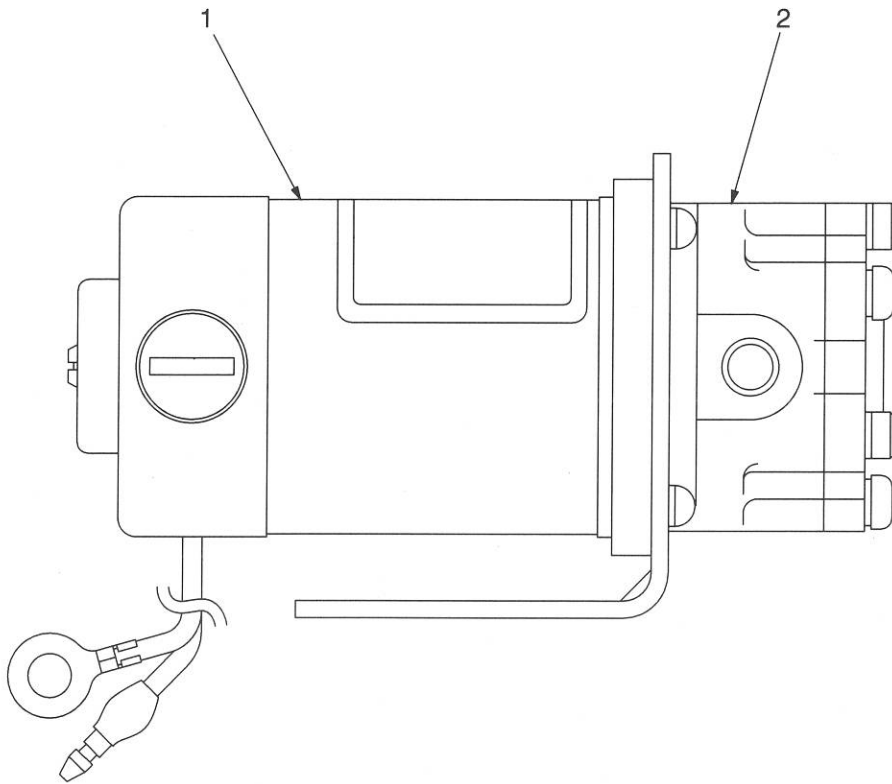
2. LIQUID SPRAY SYSTEM

2-1. Liquid spray system





2-1-1. Liquid spray pump/motor assembly



GW7508004

1. Motor Sub ass'y
2. Pump Sub ass'y

Specification

- Flow Volume : 1.3 l/min (0.34 gal/min)
- Operating Pressure : 0.55MPa (80 psi)



INSPECTION, ADJUSTMENT AND TROUBLESHOOTING

INSPECTION, ADJUSTMENT AND TROUBLESHOOTING

1. INSPECTION, ADJUSTMENT

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 - 1-1-1. Safety precaution for inspection and adjustment 9-004
 - 1-1-2. Preparation for inspection and adjustment 9-005
 - 1-1-3. Precaution for inspection and adjustment 9-005
 - 1-1-4. Warm-up 9-005
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- 1-4. Measurement and adjustment of vibrator circuit pressure 9-008
- 1-5. Measurement of steering circuit pressure 9-009
- 1-6. Measurement of brake release pressure 9-010
- 1-7. Throttle linkage adjustment 9-011
- 1-8. Adjustment of F-R lever linkage 9-012

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 - 2-1-2. Important information for troubleshooting 9-014
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 - 4. No charging 9-018
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 - 6. Starter motor runs even without Forward/Reverse lever in neutral 9-020
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 - 3. Brake will not applied 9-024
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2-3-2. Vibration	9-059
1. No vibration in each vibration mode	9-059
2. Vibration frequency is too low	9-060
3. Amplitude does not change	9-060
4. Vibration does not stop	9-061

- 5. Vibration system is overheating 9-061
- 6. Vibration system is noisy 9-061
- 2-3-3. Steering 9-062
 - 1. Steering wheel is hard to turn 9-062
 - 2. Steering response is slow 9-063
 - 3. Steering wheel backlash or play is large 9-063
 - 4. Steering system is overheating 9-063
 - 5. Steering system is noisy 9-064

1. INSPECTION, ADJUSTMENT

1-1. Inspection and Adjustment

1-1-1. Safety precautions for inspection and adjustment

Warning

Unexpected vehicle movement may cause a serious accident. When inspecting the machine while the engine is running, always follow the instructions below.

- Park the machine on level, flat ground.
- Apply the parking brake.
- Set a stopper in front and behind each drum or tire.
- Make sure that service personnel are given the appropriate information at the appropriate time.
- Make sure that no one can enter any hazardous area.

Caution

Do not work on the hydraulic system while the engine is running and the system is hot and under pressure. Do not disconnect hydraulic hoses or fittings until the system has cooled and pressure has been properly relieved.

Before removing any plugs from the pressure measurement ports, always release any residual pressure from the piping and open the cap of the fluid tank to release and pressure.

Warning

Inadvertent starting the engine may cause a serious accident.

When inspecting the engine, make sure to exchange the appropriate cues and hand signal with the person at the operator station to avoid any accidents.

Caution

Before inspecting inside of the engine compartment, always stop the engine.

Contact with the fan, V-belt or exhaust system parts while the engine is running may cause serious injury.

1-1-2. Preparation for inspection and adjustment

- Prepare the necessary measuring instruments. In addition, particularly when measuring pressure values, make sure to prepare the appropriate hoses, adapters and a plug removal tool for the pressure reading port.
- Make sure that the instruments to be used operate normally.
When handling the instruments, exercise sufficient caution not to drop or apply any impact to them. Doing so may adversely affect the calibration. Another important point is to inspect the instruments regularly. An instrument that does not start from the appropriate zero point may give an inaccurate reading.

1-1-3. Precautions for inspection and adjustment

- When performing inspections and adjustments, pay special attention to safety.
- For each inspection, always take three measurements for each measurement point. If the measurements significantly differ, the measurement method may be incorrect. In such a case, take measurements once again and calculate their average.

1-1-4. Warm-up

- Machinery will not exhibit their true performance under the cold condition. Before taking measurements, always warm up the engine and make sure that the fluid and engine coolant are warmed to their specified normal operating temperatures.

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

1. Measurement

CAUTION

- Park the machine on level ground. Stop the engine. Block the wheels.
- Make certain that the parking brake functions correctly.

★ Carefully perform disassembly and reassembly to prevent ingress of foreign matter.

★ Hydraulic oil temperature:
 $50 \pm 5^\circ\text{C}$ ($122 \pm 41^\circ\text{F}$)

- 1) Remove plugs from the gauge ports (1) and (2) of propulsion pump. Install a pressure gauge with adapter ①.
 - Gauge port: 9/16-18UNF-2B
 - Forward travel gauge port: (1)
 - Backward travel gauge port: (2)
 - Pressure gauge: 0 to 49.0 MPa (0 to 7107 psi)

- 2) Apply the parking brake by pressing the parking brake switch button. Set the speed selector switch to the 1st speed.

- 3) Start and run the engine at the rated speed. Move the F-R lever slowly forward, and observe the pressure gauge reading. Do the same with the F-R lever moved in the opposite direction.

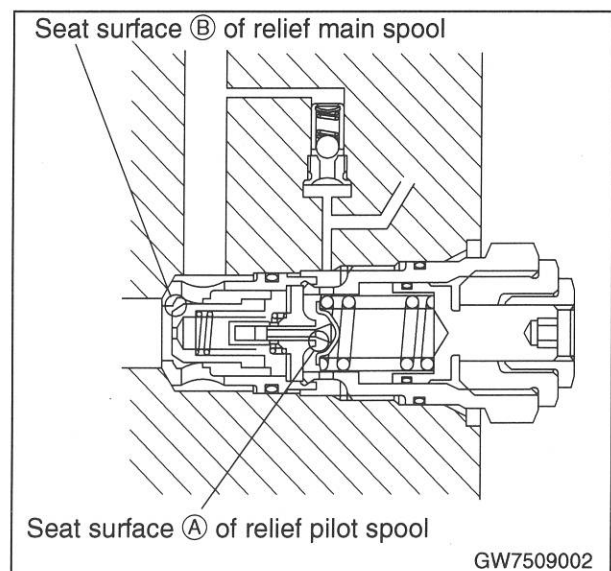
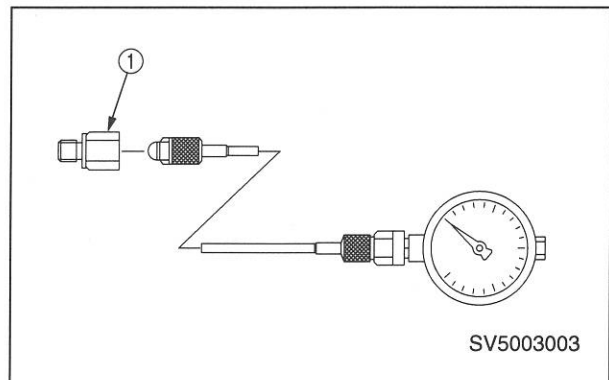
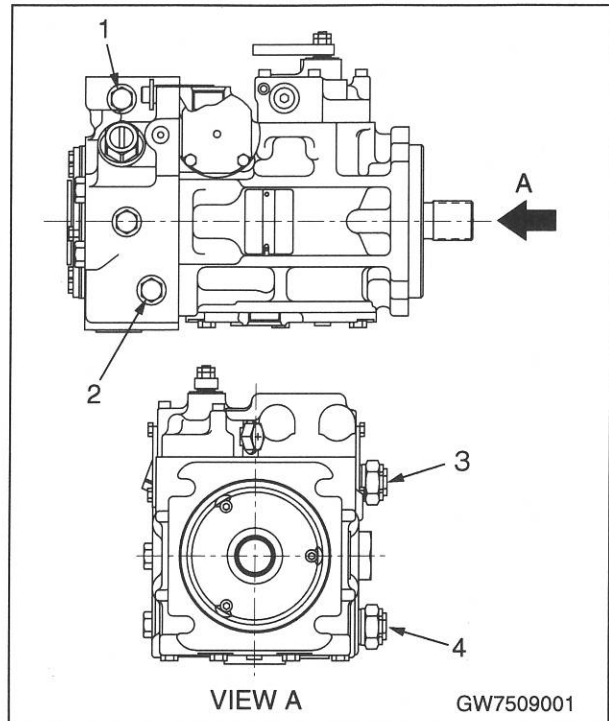
★ When the measurement is complete, return the F-R lever to the neutral position immediately.

★ Standard value: 32.4 ± 1.0 MPa
 (4,698 \pm 145 psi)

2. Adjustment

If the measured value falls outside the permissible range, remove the multi-function valves (3) and (4) from the pump, and check the seat surface of both relief pilot spool **A** and relief main spool **B** for presence of foreign matter or scores. If foreign material is present, disassemble and wash clean.

So, the damage were so severe replace the valve assembly. After wash set the multi-function valve to the pump again, then the measured value falls outside the permissible range, replace the valve assembly.



1-3. Measurement and adjustment of propulsion charge circuit pressure

1. Measurement

CAUTION

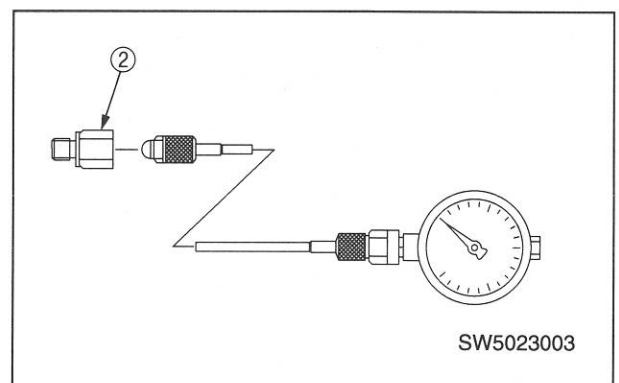
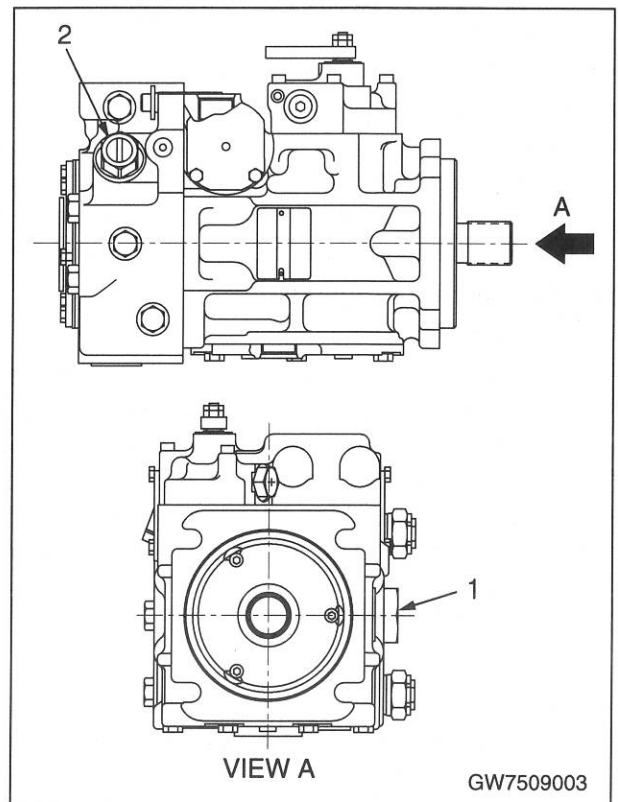
Position the machine on level ground. Stop the engine and block the wheels.

- ★ Carefully perform disassembly and reassembly to prevent ingress of foreign matter.
- ★ Hydraulic oil temperature:
50±5°C (122±41°F)
- ★ Because oil is supplied from the steering/charge pump, make sure, prior to measurement, that the steering system works correctly.
- ★ Ensure that the pump swash plate is in the exact neutral position with the F-R lever placed in the neutral position.

- 1) Remove the plug from charge pressure gauge point (1) of the propulsion pump. Attach a pressure gauge with adapter (2).
 - Charge pressure gauge port:
9/16-18UNF-2B
 - Pressure gauge: 0 to 4.9 MPa
(0 to 710.7 psi)
 - 2) Start the engine and set the throttle lever to the high idle position.
 - 3) Make sure that the F-R lever is in the neutral position. Take the gauge reading.
- ★ Standard value: 2.4±0.2 MPa
(348±29 psi)

2. Inspection

If the measured value is not within the specified limit, remove the charge relief valve (2) from the pump, and check it for presence of foreign matter or signs of scores etc. If foreign material is present, disassemble and wash clean. If scores or other damage is noticeable, replace the charge relief valve assembly.



1-4. Measurement and adjustment of vibrator circuit pressure

1. Measurement

CAUTION

Position the machine on level surface. Stop the engine and block the wheels.

★ Carefully perform disassembly and reassembly taking necessary means to avoid ingress of dust or other contaminants.

★ Hydraulic oil temperature:
 $50 \pm 5^\circ\text{C}$ ($122 \pm 41^\circ\text{F}$)

1) The vibration system uses two separate pumps one for the front vibrator and another for the rear vibrators. Remove the plugs from gauge points (1) of front and rear vibrator solenoid valves. Install a pressure gauge at both valves using adapter (4).

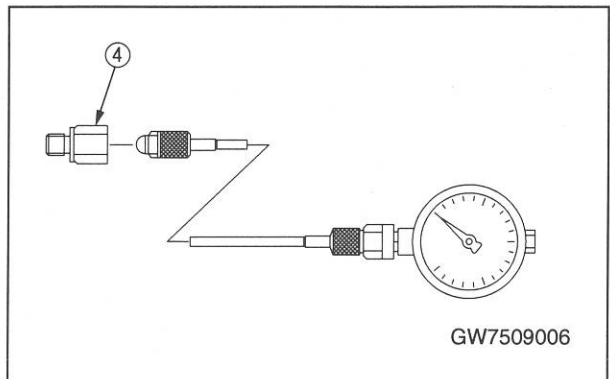
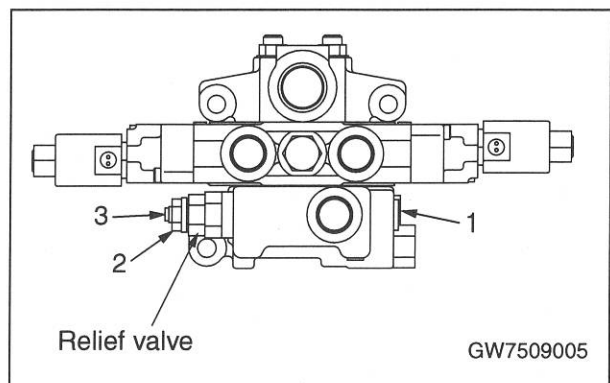
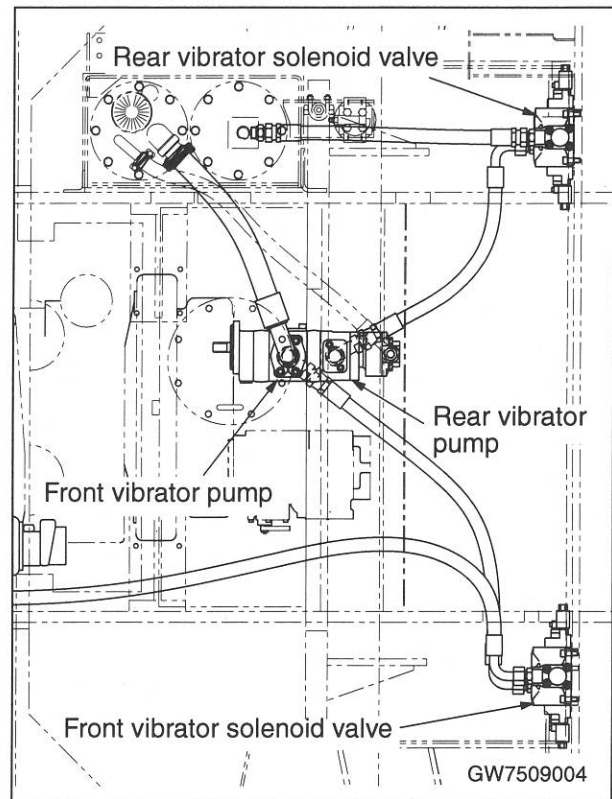
• Gauge port: G1/4

• Pressure gauge: 0 to 24.5 MPa
 (0 to 3553.5 psi)

2) Start the engine. Move the throttle lever to the high idle position.

3) Move the vibrator mode selector switch from OFF to position 4. Then push on the vibrator on-off switch located on top of the F-R lever, and move the F-R lever slowly forward to start the vibrator. Observe the gauge reading. Check the pressure at both the front and rear valves.

★ Standard value: 17.2 ± 1.0 MPa
 ($2,495 \pm 145$ psi)



2. Adjustment

If measured values fall outside the stated limits, adjust as follows:

1) To adjust pressure, loosen the locknut (2) of the relief valve, and turn adjusting screw (3).
 • Clockwise rotation raises the pressure.
 • Counterclockwise rotation lowers the pressure.

★ Make the adjustment with the solenoid energized.

2) When adjustment is complete, check that the pressure has been correctly set.

3) If the valve is beyond adjustment, disassemble and clean or renew the relief valve assembly.

1-5. Measurement of steering circuit pressure

1. Measurement

⚠ CAUTION

Position the machine on level ground. Stop the engine. Block the wheels.

⚠ CAUTION

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

- ★ Carefully perform disassembly and reassembly taking necessary means to avoid entry of foreign matter.
- ★ Hydraulic oil temperature:
50±5°C (122±41°F)
- ★ The steering circuit also provides flow to the propulsion charge circuit and the brake release circuit. It is very important that the steering system operates correctly.

- 1) Disconnect hose (1) at the outlet port of the steering pump, and install adapter (5). Then reconnect the hose.
 - Size of adapter: 3/8
 - Pressure gauge: 0 to 24.5 MPa
(0 to 3553.5 psi)

- 2) Start the engine. With the F-R lever in the neutral position, set the throttle lever to high idle speed.

- 3) Rotate the steering wheel fully in one direction in order to allow the pressure relief valve to reach the maximum pressure.

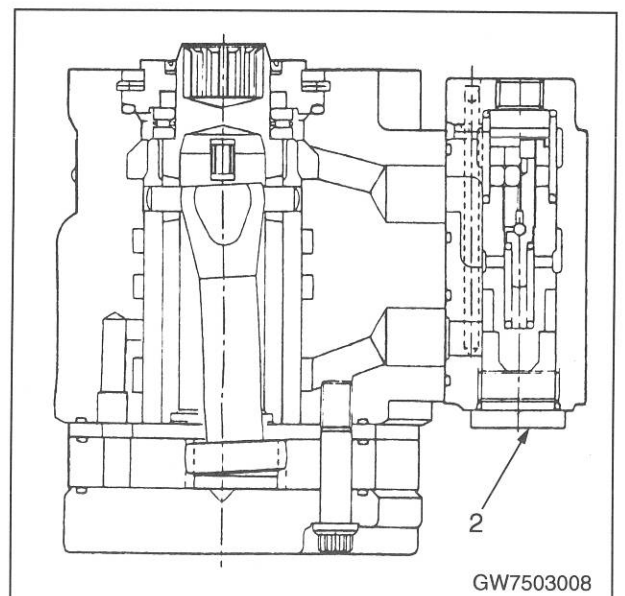
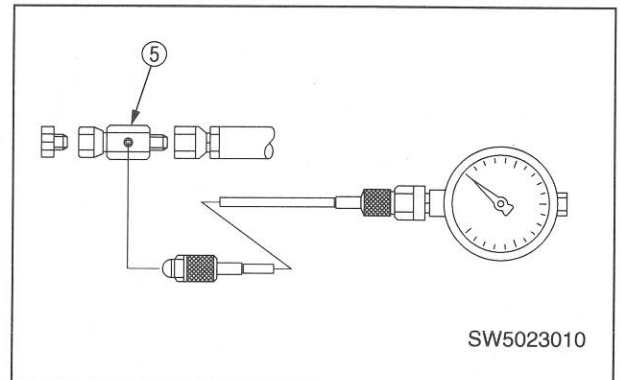
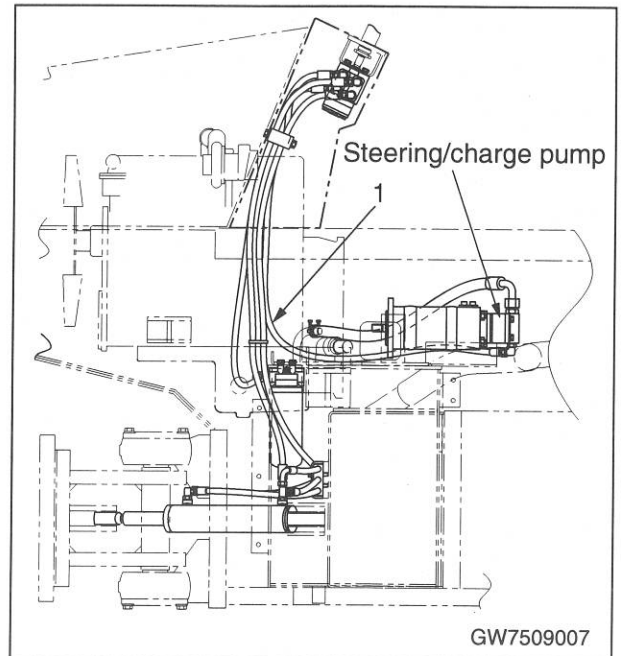
Observe the gauge reading. Also check the pressure in the other direction.

- ★ Standard value: 18.1±1.0 MPa
(2,625±145 psi)

2. Inspection

If the measured value is outside the stated range, disassemble and clean the relief valve.

If relief pressure cannot be adjusted to the specified setting, replace the Orbitrol assembly or the relief valve assembly.



1-6. Measurement of brake release pressure

1. Measurement

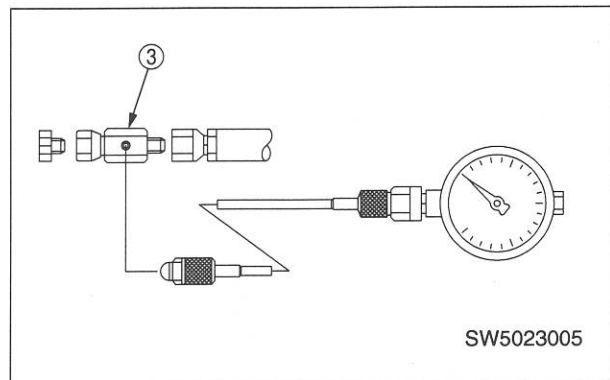
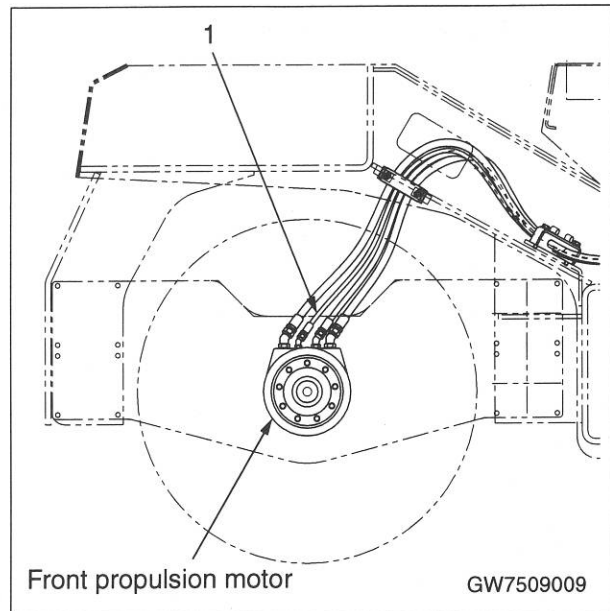
CAUTION

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

★ Hydraulic oil temperature:
 $50 \pm 5^{\circ}\text{C}$ ($122 \pm 41^{\circ}\text{F}$)

★ Make certain that, prior to measurement, the steering system functions correctly, since oil to release brake is fed from the steering circuit.

- 1) Disconnect brake release hose (1) from the front propulsion motor. Attach a pressure gauge with adapter ③.
 - Size of adapter : G1/4
 - Pressure gauge: 0 to 4.9 MPa
(0 to 710.7 psi)
 - 2) Making sure that the F-R lever is in the neutral position, start the engine and move the throttle lever to the high idle position.
 - 3) Observe the gauge reading with the parking brake switch in the "off" position; the pressure "HOLDS" the brakes in the RELEASED, position.
- ★ Standard value: 1.4 - 3.0 MPa



1-7. Throttle linkage adjustment

CAUTION

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

★ When any parts in the throttle linkage have been replaced or if the high idle or low idle rpm is not to specification, adjust the linkage as follows:

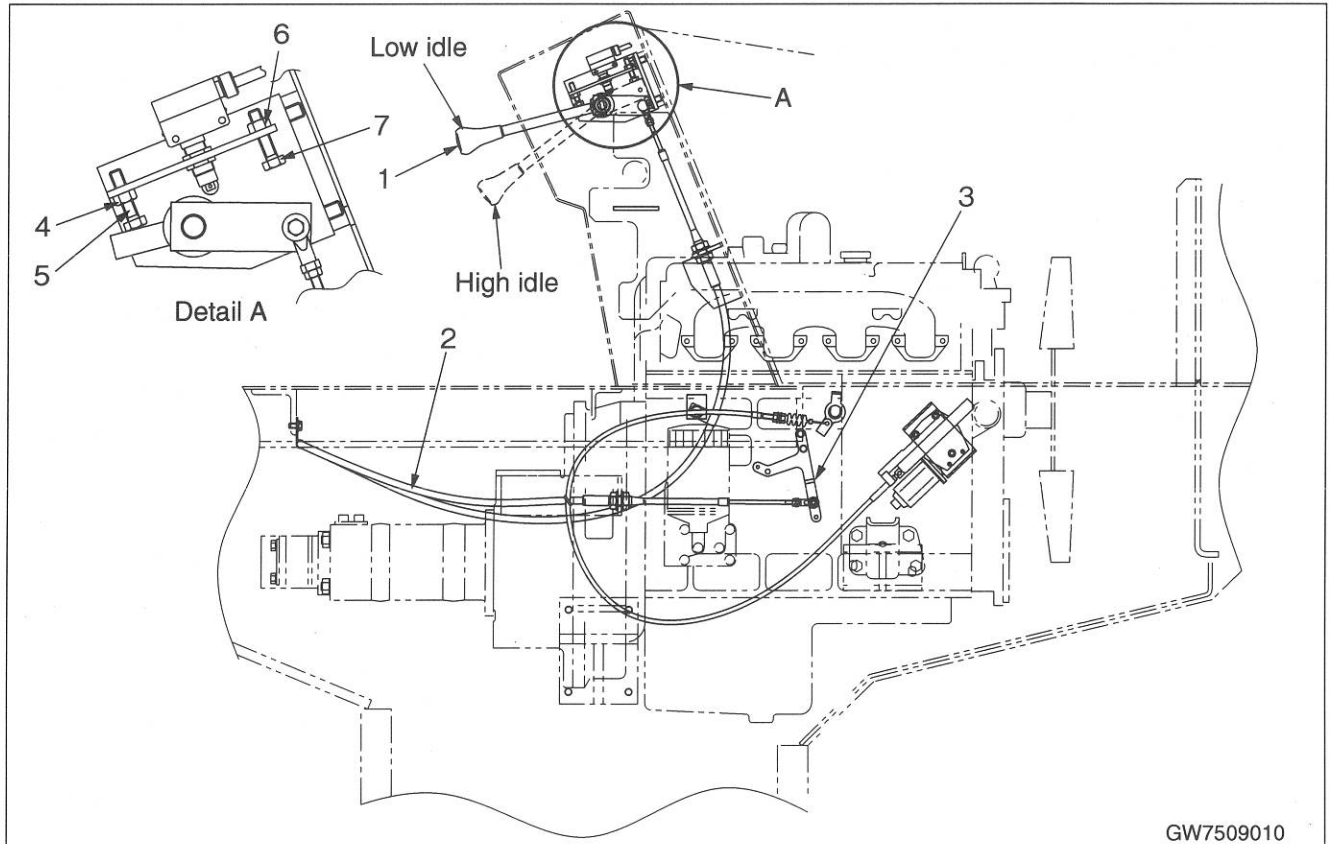
1. Adjustment

- 1) Set throttle lever (1) to the LOW idle position.
- 2) Connect control 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 rpm is obtained.
- 4) With throttle lever (1) positioned to the high idle position, loosen locknut (6) and adjust stop bolt (7) so that governor lever (3) makes contact with the stopper at the full throttle position.
- 5) Start the engine. Check that the high idle rpm is to specification.

- Low idle: 900 ± 25 rpm

★ If high idle rpm is lower than specified with governor lever (3) in contact with the stopper on the throttle control lever end of the linkage, adjust the fuel injection nozzles or repair or replace the fuel injection pump.

★ Throttle linkage adjustments can only be made at the control lever end of the linkage. No adjustments can be made at the engine end of throttle linkage.



GW7509010

1-8. Adjustment of F-R lever linkage

⚠ CAUTION

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

★ When the propulsion pump or F-R lever linkage has been replaced or if the F-R lever fails to move smoothly, adjust the F-R lever as described below:

1. Adjustment

★ Hydraulic oil temperature: $50 \pm 5^\circ\text{C}$ ($122 \pm 41^\circ\text{F}$)

★ Because the maximum stroke of F-R levers (1) and (2) are positively set by a detent in forward and reverse, adjust rods (4) and (5) to the specified length. Tighten the lock nuts when adjustment is complete.

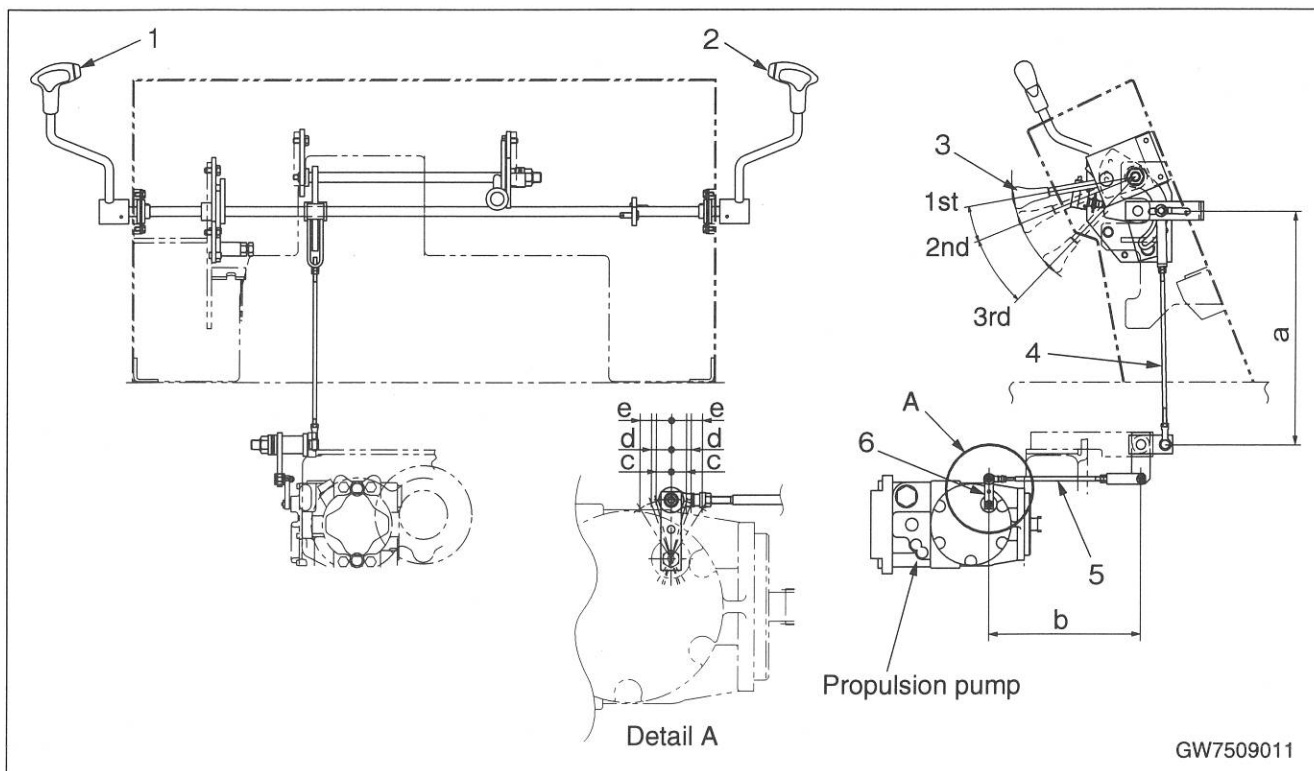
- Dimension 'a': 479 mm (18.8 in.)
- Dimension 'b': 313 mm (12.3 in.)

1) With F-R levers (1) and (2) set in the neutral detent position, shift speed lever (3) to the 1st speed position and pump displacement control lever (6) to the neutral position, connect rods (4) and (5).

★ Check for smooth movement of the F-R levers and the shift lever.

★ Ensure that the stroke of pump displacement control lever (6) in each speed range is as specified below:

- 1st speed: 'c' = 13 mm (0.5 in.)
- 2nd speed: 'd' = 17 mm (0.7 in.)
- 3rd speed: 'e' = 28 mm (1.1 in.)



GW7509011

2. TROUBLESHOOTING

2-1. Troubleshooting

2-1-1. Safety precautions for troubleshooting

Warning

Unexpected vehicle movement may cause a serious accident. When inspecting the machine while the engine is running, always follow the instructions below.

- Park the machine on level, flat ground.
- Apply the parking brake.
- Set a stopper in front and behind each drum or tire.
- Make sure that service personnel are given the appropriate information at the appropriate time.
- Make sure that no one can enter any hazardous area.

Caution

Do not work on the hydraulic system while the engine is running and the system is hot and under pressure. Do not disconnect hydraulic hoses or fittings until the system has cooled and pressure has been properly relieved.

Before removing any plugs from the pressure measurement ports, always release any residual pressure from the piping and open the cap of the fluid tank to release and pressure.

Warning

Inadvertent starting the engine may cause a serious accident.

When inspecting the engine, make sure to exchange the appropriate cues and hand signal with the person at the operator station to avoid any accidents.

Caution

Before inspecting inside of the engine compartment, always stop the engine.

Contact with the fan, V-belt or exhaust system parts while the engine is running may cause serious injury.

TROUBLESHOOTING

2-1-2. Important information for troubleshooting

Before conducting troubleshooting, it is important to carefully read the operation manual and workshop manual and understand the electric circuits for each component as well as the structure and function of each system. Sufficient knowledge of the systems will enable you to identify a possible cause much faster.

A fault or problem may seem to be related to many different factors. To identify the true cause, some experience is needed.

To perform the appropriate troubleshooting, it is important to learn not only the normal operations of the systems but also the possible symptoms that may occur when an abnormal condition is present. This chapter explains the possible causes and remedies for likely incidents taken from past experience.

2-1-3. Before starting a troubleshooting session

The information in this section is provided to assist the troubleshooter in understanding the systems and quickly determine the causes when operating abnormalities occur.

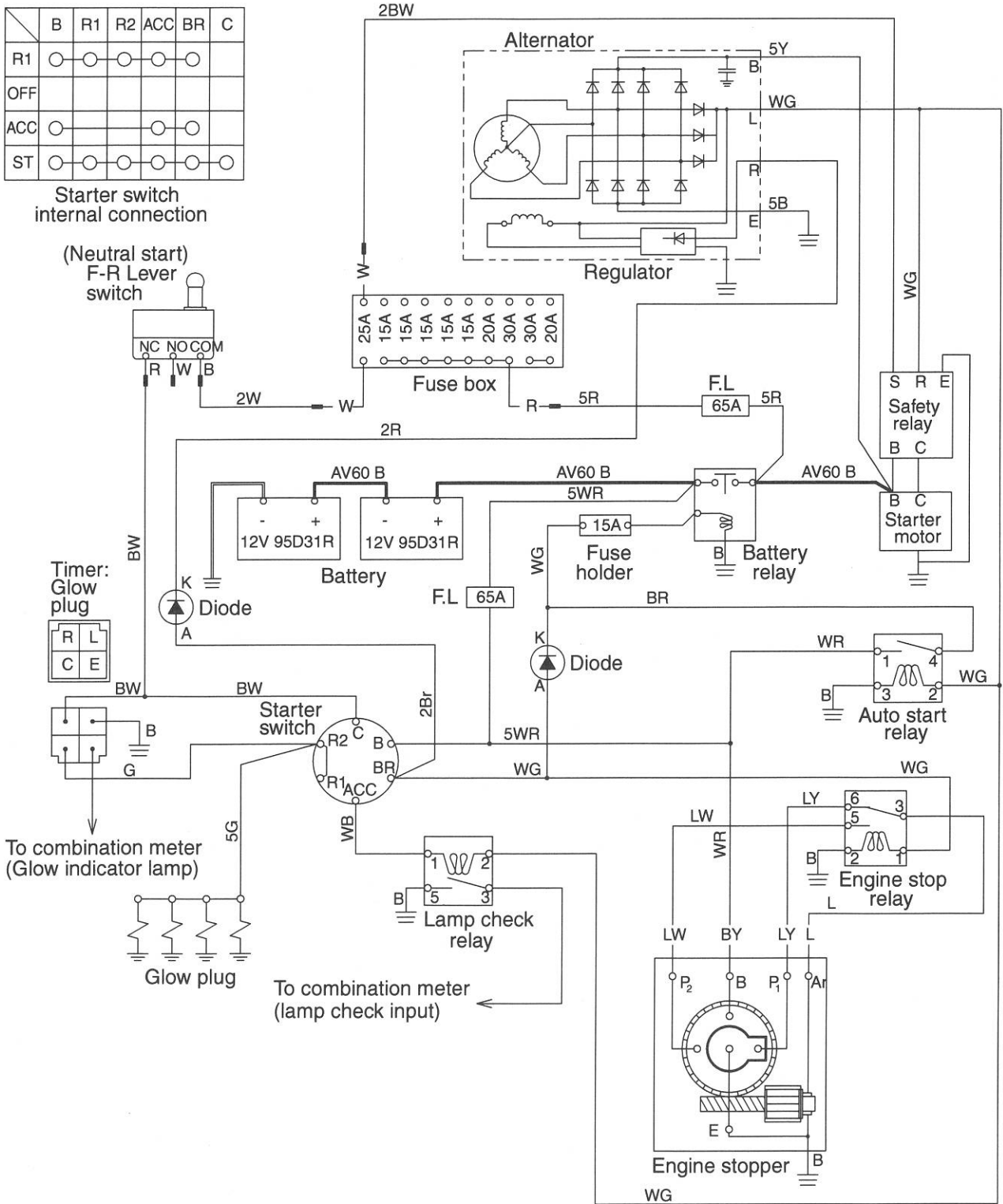
The following steps are recommended:

- If not familiar with the machine, study the Operator's Manual and this Shop Manual.
- Check with the operator for full details of the trouble, ask questions.
- Verify the trouble by warming up the machine and operating it. Check the problem yourself.
- Identify the problem with either a mechanical, hydraulic or electrical system source.
- Isolate the problem to a particular component or circuit.
- Eliminate the simplest or easiest to check possibilities first to prevent unnecessary disassembly of components.
- Following repair or replacement of any parts, perform operational tests to verify that the problem has been eliminated and the performance of all the systems is normal.

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		

Fig. : 2-2-1



2-2. Electrical troubleshooting

2-2-1. Engine

Check the following items before troubleshooting.

* Forward/reverse lever is in "neutral" position.

* No fuse blew.

1. Engine Will Not Start (Starter Motor Does Not Run)

Reference Fig. : 2-2-1

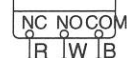
Check point	Check/Cause	Action
1. Battery Capacity	<ul style="list-style-type: none"> - Measure battery voltage or specific gravity. Standard voltage: 24V or more Standard specific gravity: 1.26 or more - If the measured value is below the standard one, the battery is weak. 	Charge or replace the battery.
2. Ignition Switch	<ul style="list-style-type: none"> - Check continuity between ○ and ○ according to ignition switch connection table. It is normal that continuity between all connections ○ is present according to switch position. - If continuity is abnormal, the ignition switch is faulty. 	Replace the ignition switch.
3. Starter Motor	<ul style="list-style-type: none"> (1) When starting ignition switch, measure voltage between starter motor pin B and chassis ground. Standard voltage: 24V or more (2) When starting ignition switch, measure voltage between starter motor pin C and chassis ground. Standard voltage: 24V or more - If the starter motor does not run even though above items (1) and (2) are OK, the motor is faulty. 	Replace the starter motor.
4. Safety Relay	<ul style="list-style-type: none"> (1) When starting ignition switch, measure voltage between safety relay pin S and chassis ground. Standard voltage: 24V or more (2) When starting ignition switch, measure voltage between safety relay pin B and chassis ground. Standard voltage: 24V or more (3) When starting ignition switch, measure voltage between safety relay pin C and chassis ground. Standard voltage: 24V or more - If above items (1) and (2) are OK, and item (3) is NG, the safety relay is faulty. 	Replace the safety relay.
5. Battery Relay	<ul style="list-style-type: none"> (1) When turning ignition switch OFF, measure voltage between battery relay primary terminal and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between battery relay WG wire terminal and chassis ground. Standard voltage: 24V or more - If above items (1) and (2) are OK and the battery relay switching click does not sound when the ignition switch is turned ON, the battery relay is faulty. 	Replace the battery relay.
6. F-R Lever Switch (neutral start switch)	<ul style="list-style-type: none"> - Check continuity between F-R lever switch COM terminal and NC terminal with forward/reverse lever in neutral and with ignition switch OFF. - Continuity present indicates normal condition. If there is no continuity, the F-R lever switch is faulty. 	Replace the F-R lever switch.
7. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

Fig. : 2-2-1

	B	R1	R2	ACC	BR	C
R1	○	○	○	○	○	
OFF						
ACC	○			○	○	
ST	○	○	○	○	○	○

Starter switch internal connection

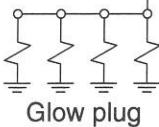
(Neutral start) F-R Lever switch



Timer: Glow plug

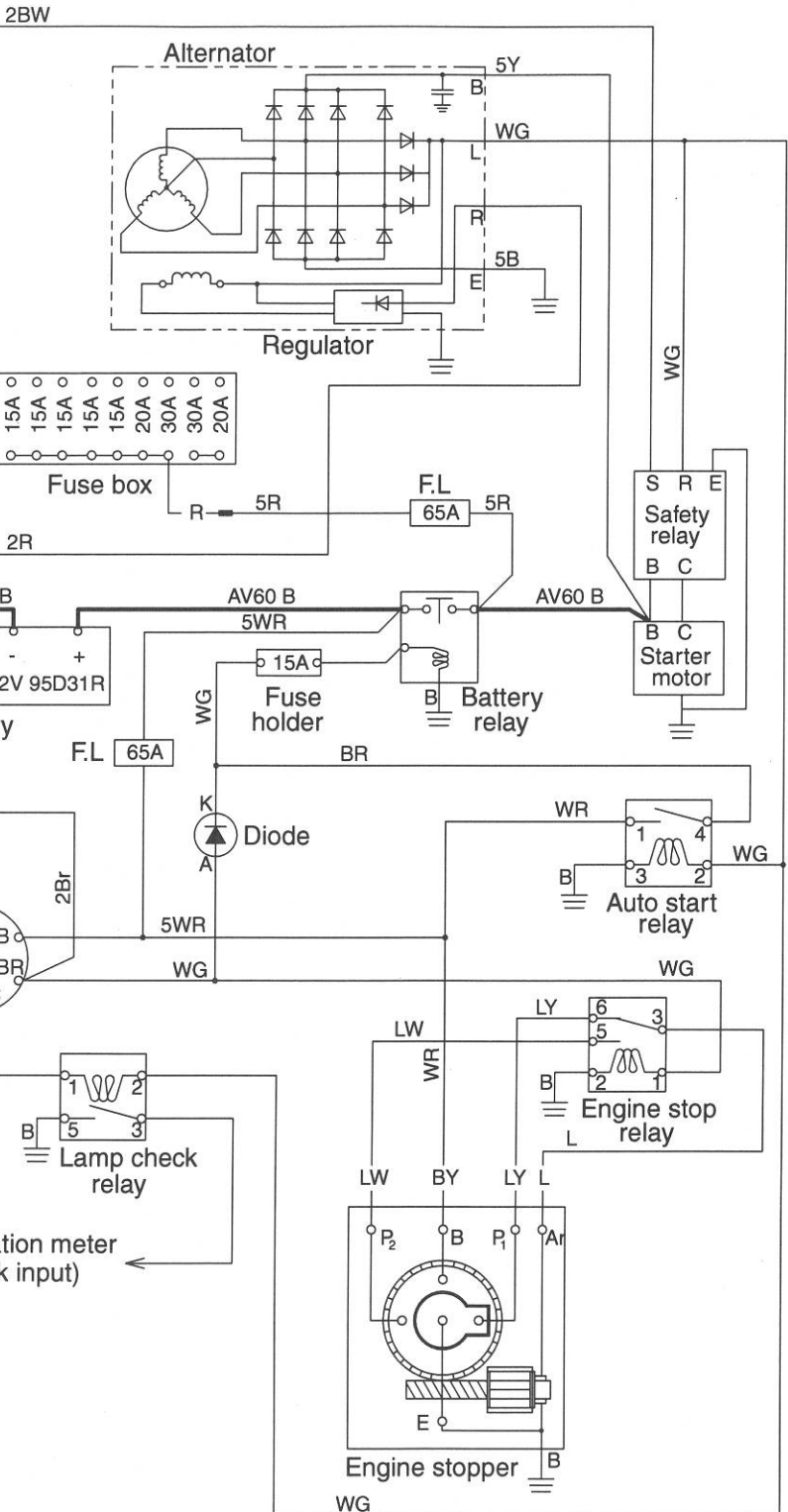


To combination meter (Glow indicator lamp)



Glow plug

To combination meter (lamp check input)



2. Engine Will Not Start (But Starter Motor Runs)

* Confirm that fuel is being sent to the injection pump inlet.

Reference Fig. : 2-2-1

Check point	Check/Cause	Action
1. Engine Stopper	(1) When turning ignition switch ON, measure voltage between engine stopper pin B and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between engine stopper pin P2 and chassis ground. It is normal that no electrical flows. - If above items (1) is OK and electricity flows in item (2), the engine stopper is faulty.	Charge or replace the battery.
2. Engine Stop Relay	(1) When turning ignition switch ON, measure voltage between engine stop relay pin 1 and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between engine stop relay pin 5 and chassis ground. Standard voltage: 24V or more - If above items (1) and (2) are OK and electricity does not flow through engine stop relay pin 3, the engine stop relay is faulty.	Replace the ignition switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

3. Engine Does Not Stop Running

Reference Fig. : 2-2-1

Check point	Check/Cause	Action
1. Engine Stopper	(1) When turning ignition switch OFF, measure voltage between engine stopper pin B and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch OFF, measure voltage between engine stopper pin P2 and chassis ground. Standard voltage: 24V or more - If above items (1) is OK and item (2) is NG, the engine stopper is faulty.	Replace the engine stopper.

4. No Charging

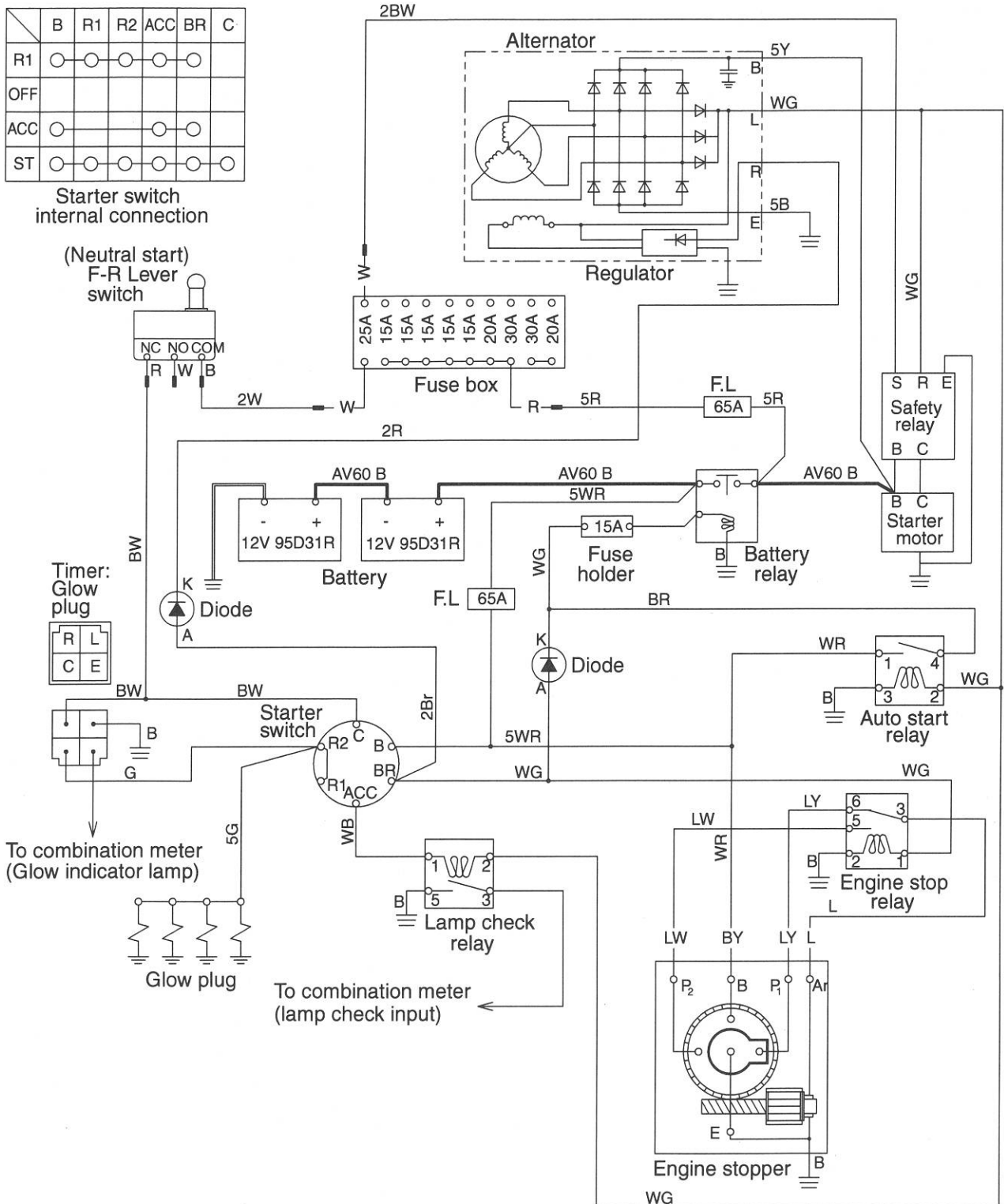
Reference Fig. : 2-2-1

Check point	Check/Cause	Action
1. Alternator	(1) When turning ignition switch ON, measure voltage between alternator pin B and chassis ground. Standard voltage: At least the intermediate engine speed, or 27V or more (2) When turning ignition switch ON, measure voltage between alternator pin R and chassis ground. 27V or more - If above item (1) is NG, the alternator is faulty. - If above item (1) is OK and item (2) is NG, the regulator is faulty. - If battery is not charged even though above items (1) and (2) are OK, the battery is faulty.	Replace the alternator. Replace the regulator. Replace the battery.

Fig. : 2-2-1

	B	R1	R2	ACC	BR	C
R1	○	○	○	○	○	
OFF						
ACC	○			○	○	
ST	○	○	○	○	○	○

Starter switch internal connection



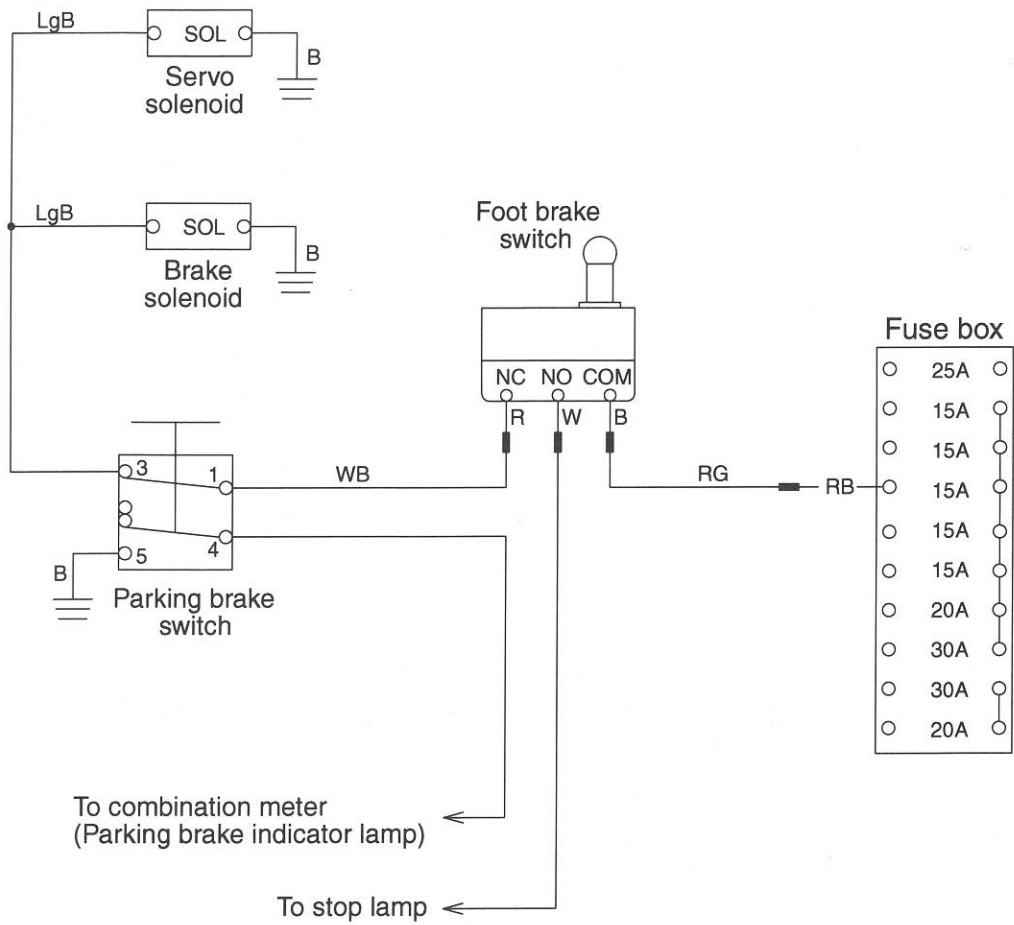
5. Glow Plug Is Not Heated (Engine Starting Performance Is Bad)**Reference Fig. : 2-2-1**

Check point	Check/Cause	Action
1. Glow Plug	<ul style="list-style-type: none"> - When heating (preheating) ignition switch, measure voltage between glow plug inlet G wire and chassis ground. Standard voltage: 24V or more - If measurement is within the standard range, the glow plug is faulty. 	Replace the glow plug.
2. Glow Plug Timer	<ul style="list-style-type: none"> (1) When ignition switch is turned to R1 (preheated) and ACC in a short time, measure voltage between glow plug timer pin L and chassis ground. Standard voltage: 24V or more (2) When ignition switch is turned to R1 (preheated) and ACC in a short time, measure voltage between glow plug timer pin R and chassis ground (electricity flows for a definite time). Standard voltage: 24V or more - If above items (1) is OK and item (2) is NG, the glow plug timer is faulty. 	Replace the glow plug timer.
3. Glow Plug Indicator Lamp (Combination Meter)	<ul style="list-style-type: none"> - When heating (preheating) ignition switch, measure voltage between combination meter inlet RB wire and chassis ground. Standard voltage: 24V or more - If measurement is abnormal, the combination meter is faulty. 	Replace the combination meter.
4. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

6. Starter Motor Runs Even Without Forward/Reverse Lever In Neutral**Reference Fig. : 2-2-1**

Check point	Check/Cause	Action
1. F-R Lever Switch (Neutral start switch)	<ul style="list-style-type: none"> (1) When turning forward/reverse lever to forward with ignition switch OFF, check continuity between F-R lever switch COM terminal and NC terminal. (2) When turning forward/reverse lever to reverse with ignition switch OFF, check continuity between F-R lever switch COM terminal and NC terminal. - No continuity indicates normal condition. If any continuity is present, the F-R lever switch is faulty. 	Replace the F-R lever switch.

Fig. : 2-2-2



2-2-2. Propulsion

Check the following items before troubleshooting.

* No fuse blew.

1. Vehicle Moves Neither Forward Nor Backward

* Parking brake switch is turned OFF.

* Foot brake switch is turned OFF.

Reference Fig. : 2-2-2

Check point	Check/Cause	Action
1. Servo Solenoid	- Disconnect harness and measure resistance of coil. Standard resistance: 44Ω - If measured resistance is abnormal, the servo solenoid is faulty.	Replace the servo solenoid.
2. Parking Brake Switch	(1) When turning ignition switch ON, measure voltage between parking brake switch pin 3 inlet LgB wire and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between parking brake switch pin 1 inlet WB wire and chassis ground. Standard voltage: 24V or more - If above item (2) is OK and item (1) is NG, the parking brake switch is faulty.	Replace the parking brake switch.
3. Foot Brake Switch	(1) When turning ignition switch ON, measure voltage between foot brake switch COM terminal inlet RG wire and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between foot brake switch NC terminal inlet WB wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the foot brake switch is faulty.	Replace the starter motor.
4. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Replace the safety relay.

2. Brake Is Not Released

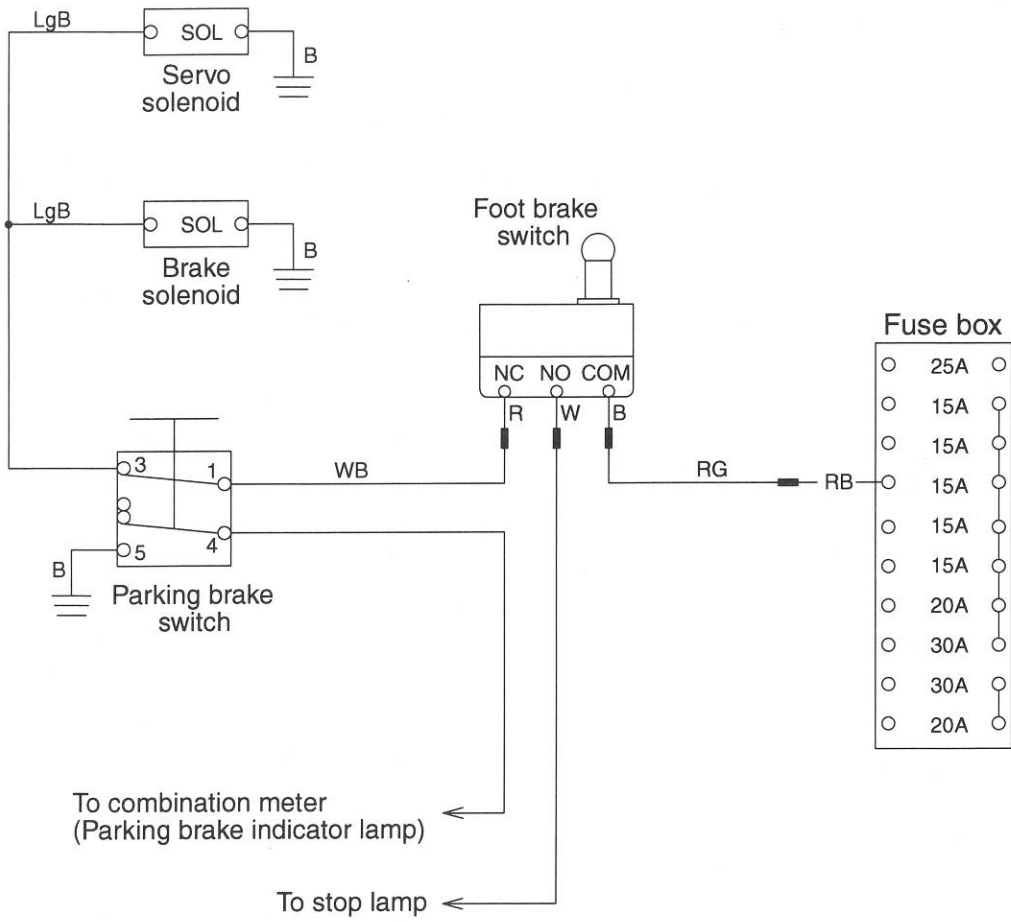
* Parking brake switch is turned OFF.

* Foot brake switch is turned OFF.

Reference Fig. : 2-2-2

Check point	Check/Cause	Action
1. Brake Solenoid	- Disconnect harness and measure resistance of coil. Standard resistance: 44Ω - If measured resistance is abnormal, the brake solenoid is faulty.	Replace the brake solenoid.

Fig. : 2-2-2



2. Brake Is Not Released

* Parking brake switch is turned OFF.

* Foot brake switch is turned OFF.

Reference Fig. : 2-2-2

Check point	Check/Cause	Action
2. Parking Brake Switch	(1) When turning ignition switch ON, measure voltage between parking brake switch pin 3 inlet LgB wire and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between parking brake switch pin 1 inlet WB wire and chassis ground. Standard voltage: 24V or more - If above item (2) is OK and item (1) is NG, the parking brake switch is faulty.	Replace the parking brake switch.
3. Foot Brake Switch	(1) When turning ignition switch ON, measure voltage between foot brake switch COM terminal inlet RG wire and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between foot brake switch NC terminal inlet WB wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the foot brake switch is faulty.	Replace the parking brake switch.
4. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

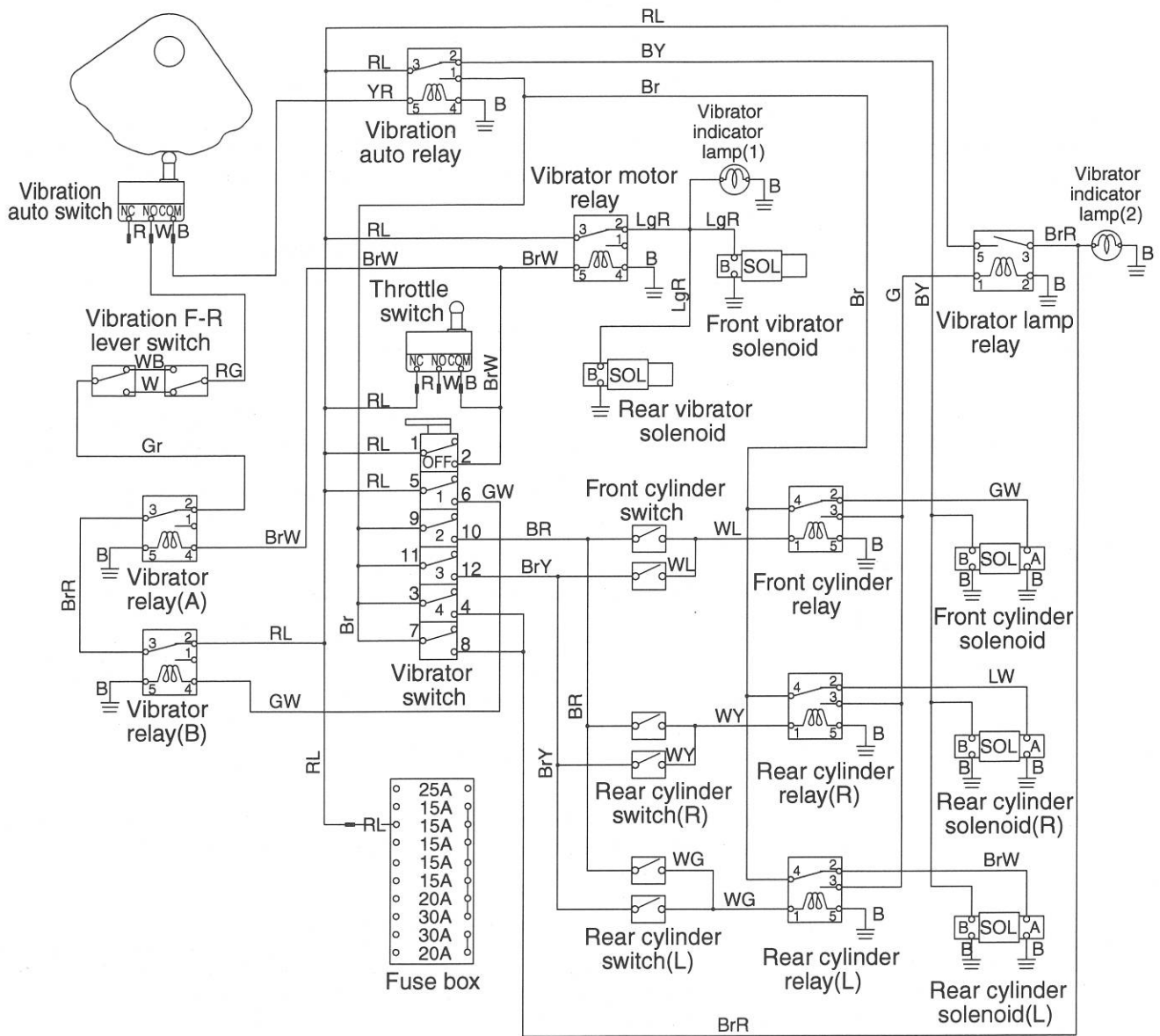
3. Brake will not applied

* When parking brake switch is turned ON or foot brake switch is turned ON

Reference Fig. : 2-2-2

Check point	Check/Cause	Action
1. Brake Solenoid	- Disconnect harness and measure resistance of coil. Standard resistance: 44Ω - If measured resistance is abnormal, the brake solenoid is faulty.	Replace the brake solenoid.
2. Parking Brake Switch	When turning parking brake switch ON with ignition switch ON, measure voltage between parking brake switch pin 3 inlet LgB wire and chassis ground. It is normal that no electricity flows. - If electricity flows, the parking brake switch is faulty.	Replace the parking brake switch.
3. Foot Brake Switch	- When turning foot brake switch ON with ignition switch ON, measure voltage between foot brake switch NC terminal inlet WB wire and chassis ground. It is normal that no electricity flows. - If electricity flows, the foot brake switch is faulty.	Replace the foot brake switch.

Fig. : 2-2-3



2-2-3. Vibration

Check the following items before troubleshooting.

- * Engine speed is higher than 1800 rpm (vibration does not work when engine speed is below 1800 rpm).
- * No fuse blew.

1. No Vibration Occurs

- * Vibration switch at control panel is turned ON.

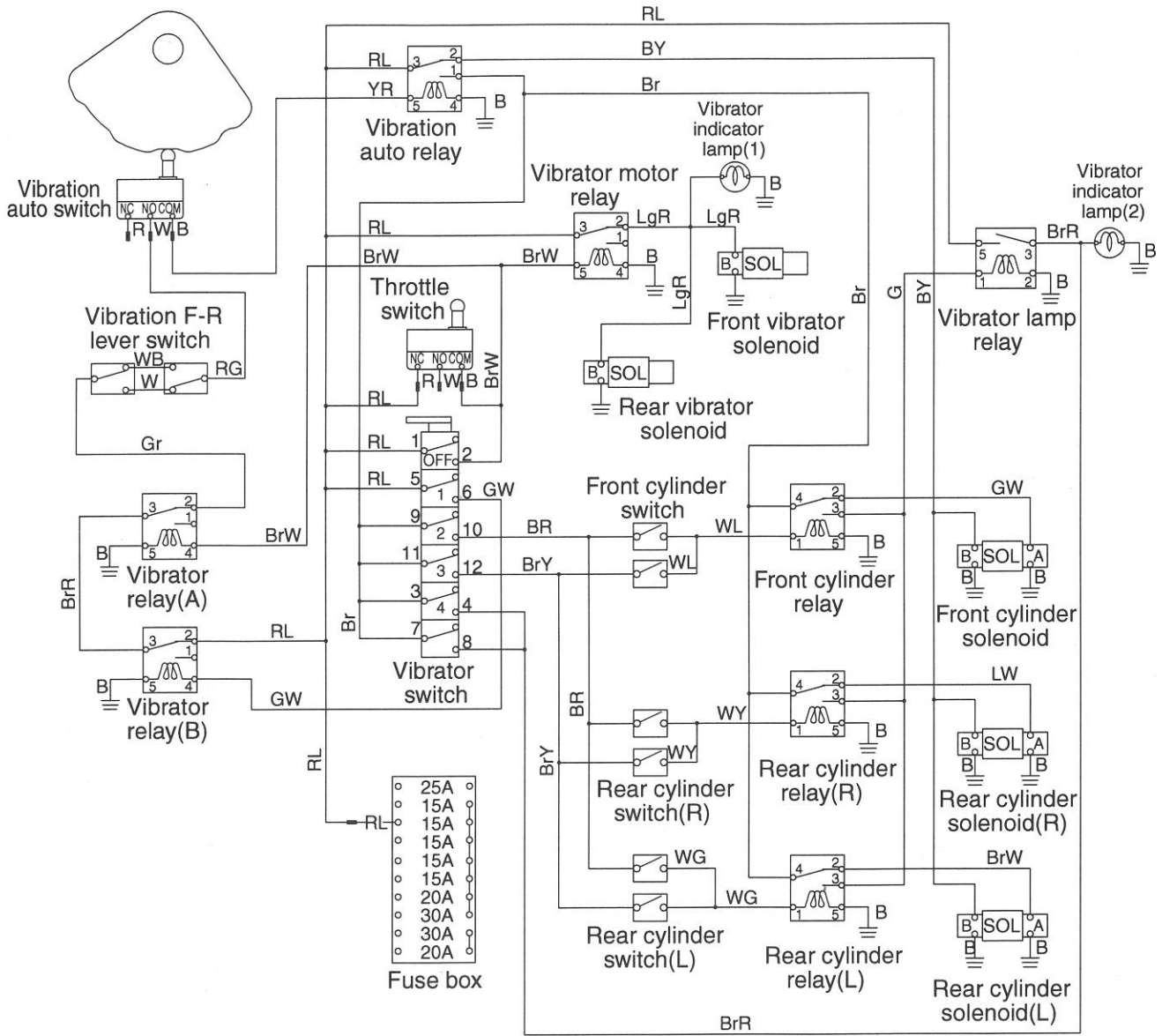
Reference Fig. : 2-2-3

Check point	Check/Cause	Action
1. Vibration Solenoid	- Disconnect harness and measure resistance of coil. Standard resistance: 39Ω - If measured resistance is abnormal, the vibration solenoid is faulty.	Replace the vibration solenoid.
2. Throttle Switch	- When engine throttle lever is in full-high position, measure voltage between throttle switch COM terminal and chassis ground. It is normal that no electricity flows. - If electricity flows, the throttle switch is faulty.	Throttle switch is faulty.
3. Vibration Motor Relay	(1) Measure voltage between the vibration motor relay pin 3 inlet RL wire and chassis ground. Standard voltage: 24V or more (2) Measure voltage between the vibration motor relay pin 5 inlet BrW wire and chassis ground. It is normal that no electricity flows. (3) Check that vibration motor relay ground is good. - If above items (1), (2) and (3) are OK and the electricity does not flow through vibration relay pin 2, the vibration motor relay is faulty.	Replace the vibration motor relay.
4. Vibration Switch	- Turn vibration switch ON (to any position other than OFF) and measure current between vibration switch pin 2 and chassis ground. It is normal that no electricity flows. - If electricity flows, the vibration switch is faulty.	Replace the vibration switch.
5. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

2. Amplitude Does Not Change, Vibration Occurs Amplitude 1 only, but Does Not Increase when Vibration switch is moved to "2 or 3 or 4" position.**Reference Fig. : 2-2-3**

Check point	Check/Cause	Action
1. Cylinder Solenoid	- Disconnect harness and measure resistance of coil. Standard resistance: 19.5Ω - If measured resistance is abnormal, the cylinder solenoid is faulty.	Replace the cylinder solenoid.

Fig. : 2-2-3

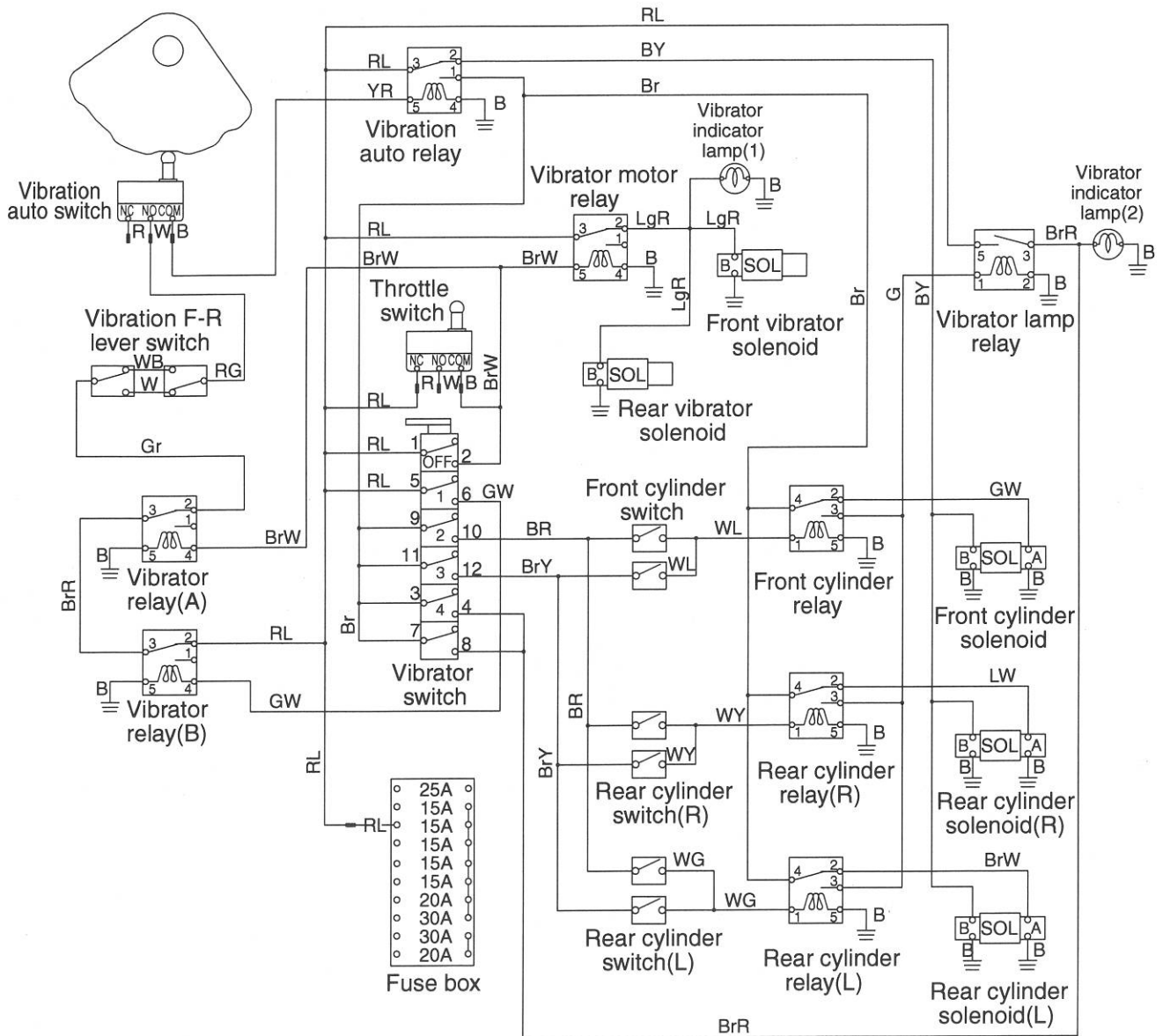


2. Amplitude Does Not Change, Vibration Occurs Amplitude 1 only, but Does Not Increase when Vibration switch is moved to "2 or 3 or 4" position.

Reference Fig. : 2-2-3

Check point	Check/Cause	Action
2. Vibration Auto Relay	<p>(1) Measure voltage between the vibration auto relay pin 3 inlet RL wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) Measure voltage between the vibration auto relay pin 5 inlet YR wire and chassis ground. Standard voltage: 24V or more</p> <p>- If above items (1) and (2) are OK and electricity does not flow through vibration auto relay pin 1, the vibration auto relay is faulty.</p>	Replace the vibration auto relay.
3. Cylinder Relay	<p>(1) Measure voltage between the cylinder relay pin 4 inlet Br wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) Measure voltage between cylinder relay pin 1 inlet WL, WY or WG wire and chassis ground. It is normal that no electricity flows.</p> <p>- If above items (1) and (2) are OK and electricity does not flow through cylinder relay pin 2, the cylinder relay is faulty.</p>	Replace the cylinder relay.
4. Vibration Auto Switch	<p>(1) With forward/reverse lever in neutral position, check continuity between vibration switch COM terminal and NO terminal. No continuity indicates normal condition.</p> <p>(2) With forward/reverse lever moved in forward or reverse direction, check continuity between vibration switch COM terminal and NO terminal. Continuity present indicates normal condition.</p> <p>- If above items (1) and (2) are NG, the vibration auto switch is faulty.</p>	Replace the vibration auto switch.
5. Vibration Forward/Reverse Lever Switch	<p>- When turning vibration forward/reverse lever switch to ON and OFF, check if continuity between switch terminals changes between presence and absence.</p> <p>- If continuity between switch terminals does not change between presence and absence, the vibration forward/reverse lever switch is faulty.</p>	Replace the vibration forward/reverse lever switch.
6. Vibration Relay (B)	<p>(1) Measure voltage between vibration relay (B) pin 2 inlet RL wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) Measure voltage between vibration relay (B) pin 4 inlet GW wire and chassis ground. It is normal that no electricity flows.</p> <p>- If above items (1) and (2) are OK and electricity does not flow through vibration relay (B) pin 3, the vibration relay (B) is faulty.</p>	Replace the vibration relay (B).
7. Vibration Relay (A)	<p>(1) Measure voltage between vibration relay (A) pin 3 inlet BrR wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) Measure voltage between vibration relay (A) pin 4 inlet BrW wire and chassis ground. It is normal that no electricity flows.</p> <p>- If above items (1) and (2) are OK and electricity does not flow through vibration relay (A) pin 2, the vibration relay (A) is faulty.</p>	Replace the vibration relay (A).

Fig. : 2-2-3



2. Amplitude Does Not Change, Vibration Occurs Amplitude 1 only, but Does Not Increase when Vibration switch is moved to "2 or 3 or 4" position.

Reference Fig. : 2-2-3

Check point	Check/Cause	Action
8. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

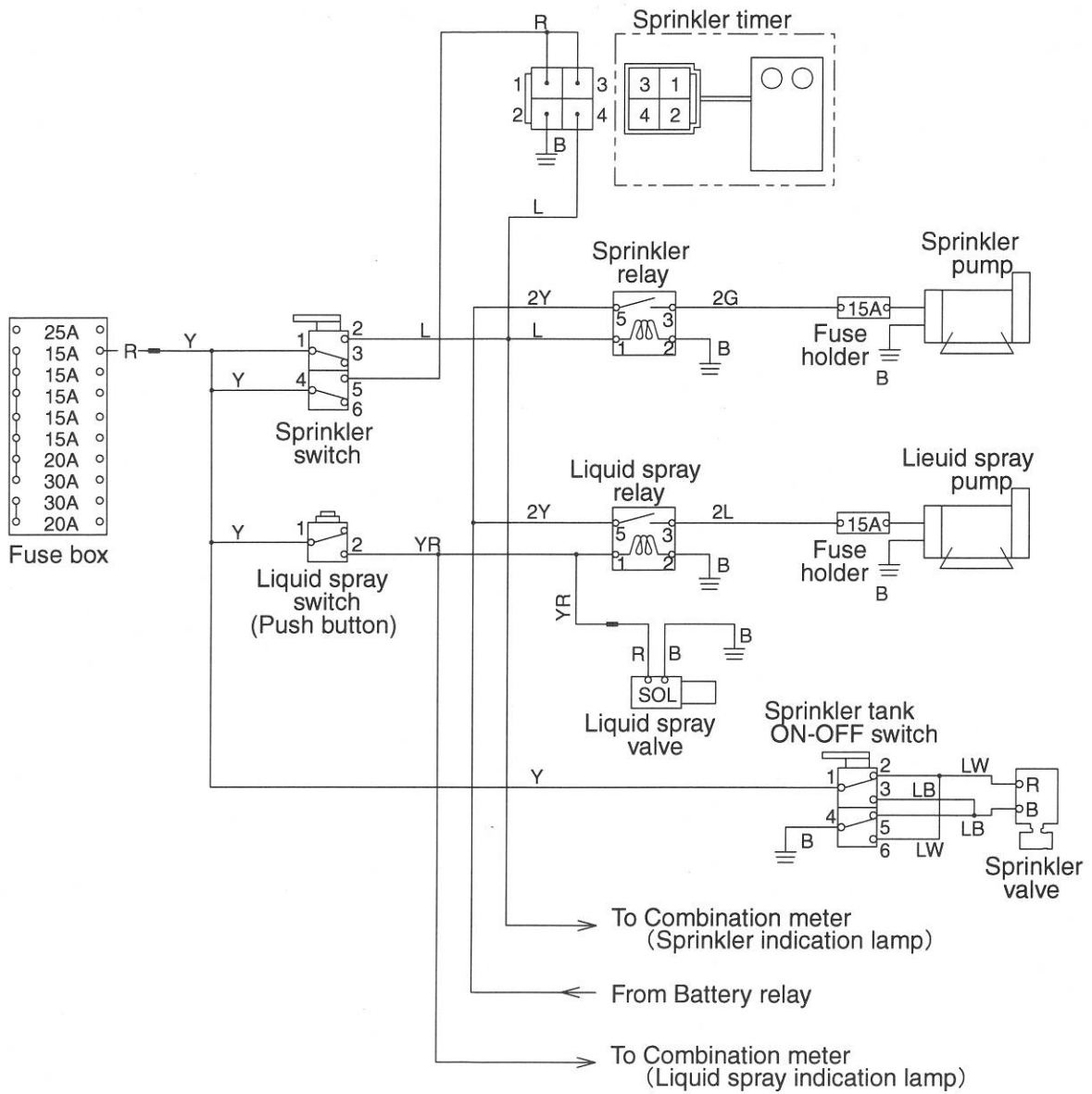
3. Amplitude Does Not Change Correctly (Amplitude Changes Only Between Minimum (Amplitude 1) and Maximum (Amplitude 4))

* Vibration switch is in "2 or 3" position.

Reference Fig. : 2-2-3

Check point	Check/Cause	Action
1. Cylinder relay	(1) Measure voltage between cylinder relay pin 1 inlet WL, WY or WG wire and chassis ground. Standard voltage: 24V or more (2) Measure voltage between the cylinder relay pin 4 inlet Br wire and chassis ground. Standard voltage: 24V or more - If above items (1) and (2) are OK and electricity does not flow through cylinder relay pin 3, the cylinder relay is faulty.	Replace the cylinder relay.
2. Cylinder Switch	- When moving cylinder rod for changing amplitude between stroke ends, check if continuity between cylinder switch terminals changes between presence and absence. - If continuity between switch terminals does not change between presence and absence, the cylinder switch is faulty.	Replace the cylinder switch.
3. Vibration Switch	(1) Measure current between vibration switch pin 9 or 11 inlet Br wire and chassis ground. Standard voltage: 24V or more (2) Measure current between vibration switch pin 10 or 12 inlet BR or BrY wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the vibration switch is faulty.	Replace the vibration switch.
4. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

Fig. : 2-2-4



2-2-4. Water Spray

Check the following items before troubleshooting.

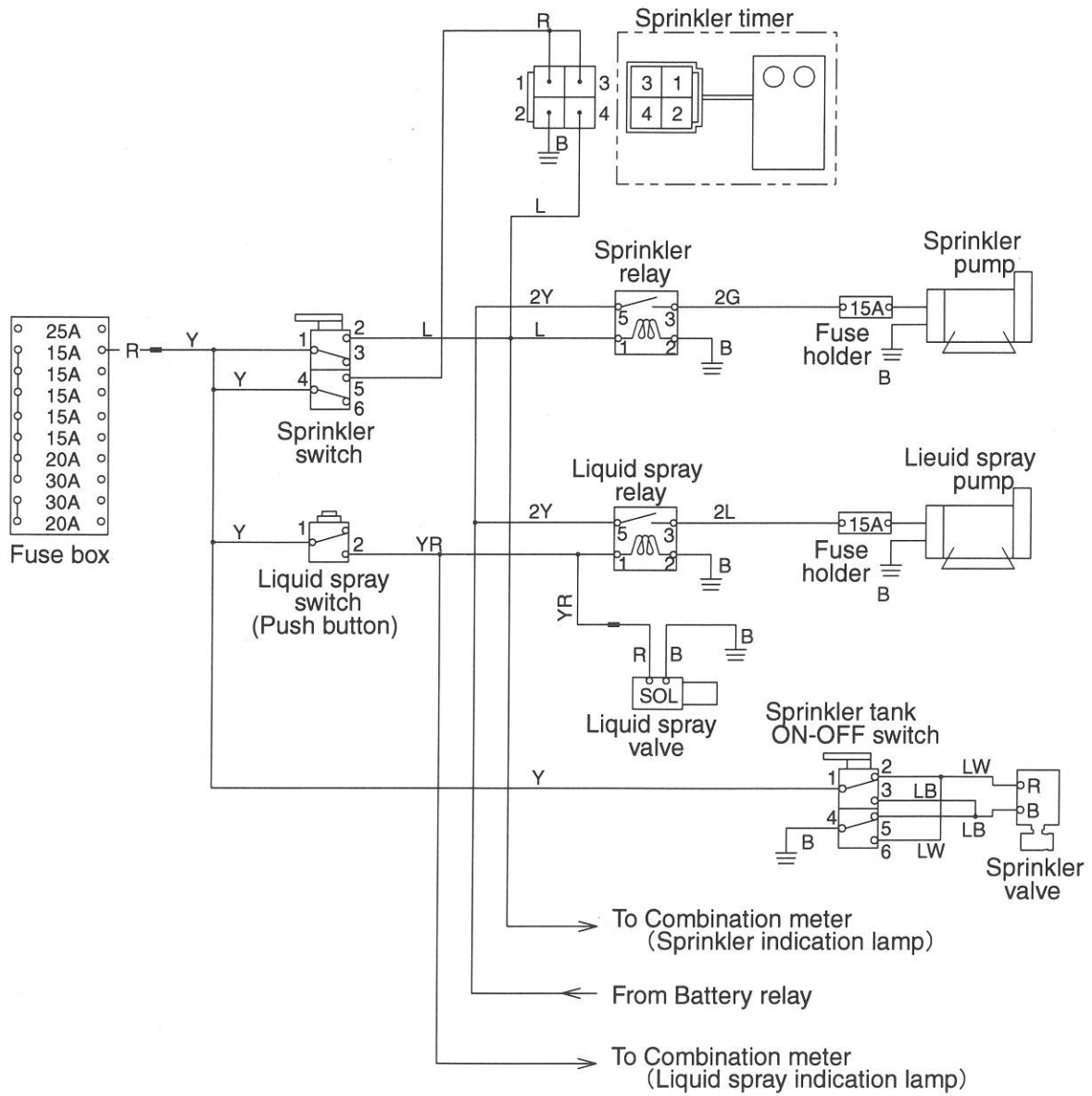
* No fuse blew.

1. Water spray pump does not work

Reference Fig. : 2-2-4

Check point	Check/Cause	Action
1. Battery Capacity	<ul style="list-style-type: none"> - Measure battery voltage or specific gravity. Standard voltage: 24V or more Standard specific gravity: 1.26V or more - If the measured value is below the standard one, the battery is weak. 	Charge or replace the battery.
2. Water Spray Pump	<ul style="list-style-type: none"> (1) When turning water spray switch ON with ignition switch ON, measure voltage between water spray pump inlet G wire and chassis ground. Standard voltage: 24V or more (2) Check that water spray pump ground is good. - If the water spray pump does not operate even though above items (1) and (2) are OK, the water spray pump is faulty. 	Replace the water spray pump.
3. Water Spray Switch	<ul style="list-style-type: none"> (1) When turning water spray switch ON with ignition switch ON, measure voltage between water spray switch pin 1 inlet Y wire and chassis ground. Standard voltage: 24V or more (2) When turning water spray switch ON with ignition switch ON, measure voltage between water spray switch pin 2 inlet L wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the water spray switch is faulty. 	Water spray switch is faulty.
4. Water Spray Relay	<ul style="list-style-type: none"> (1) When turning water spray switch ON with ignition switch ON, measure voltage between water spray relay pin 1 inlet L wire and chassis ground. Standard voltage: 24V or more (2) When turning water spray switch ON with ignition switch ON, measure voltage between water spray relay pin 5 inlet Y wire and chassis ground. Standard voltage: 24V or more (3) Check that water spray relay ground is good. - If above items (1), (2) and (3) are OK and electricity does not flow through water spray relay pin 3, the water spray relay is faulty. 	Replace the water spray relay.
5. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

Fig. : 2-2-4



2. Continuous Water Spray works, but Intermittent Water Spray does not work

Reference Fig. : 2-2-4

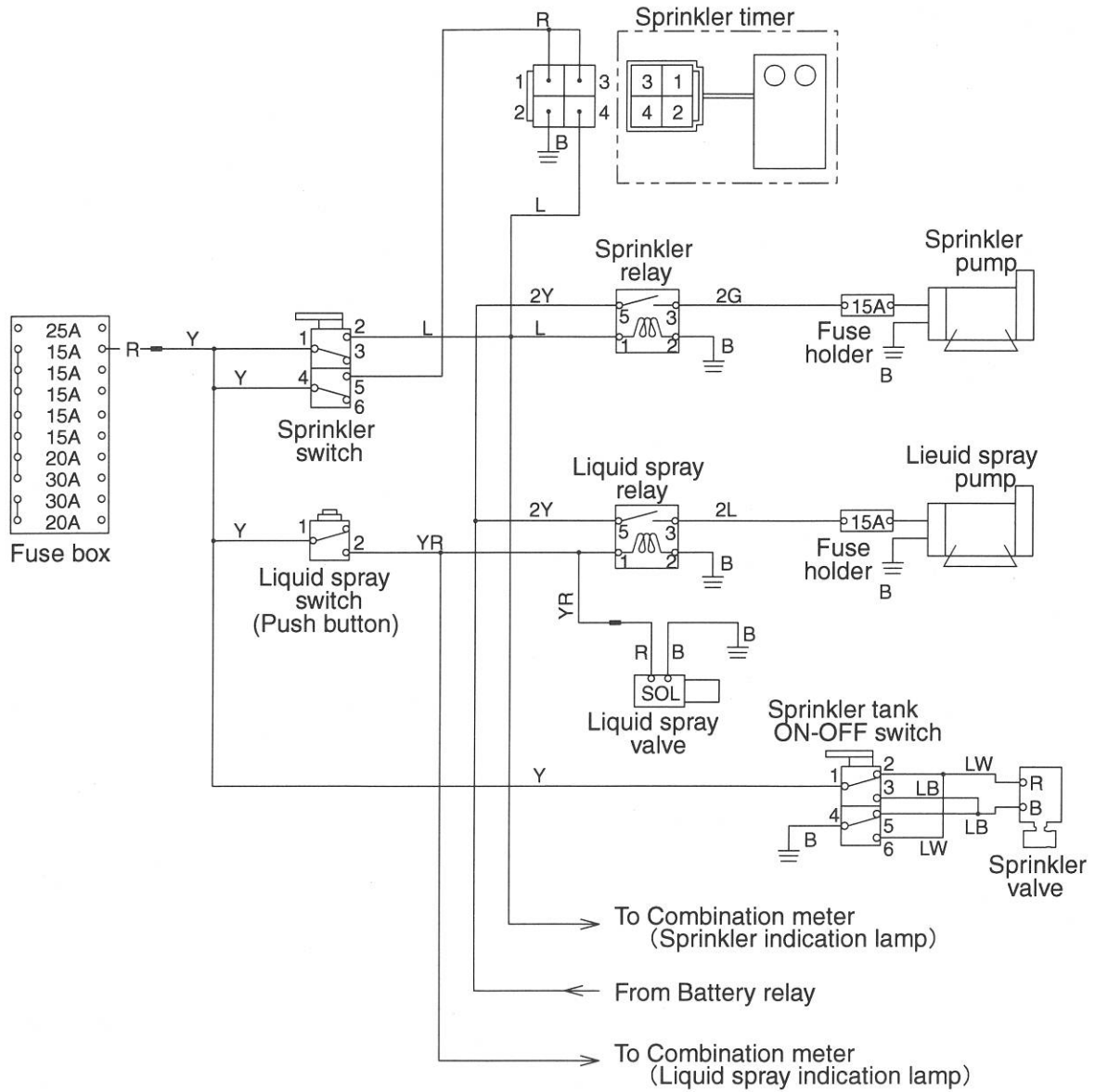
Check point	Check/Cause	Action
1. Water Spray Timer	<ul style="list-style-type: none"> - When turning water spray switch to INT with ignition switch ON, measure voltage between water spray timer pin 4 inlet L wire and chassis ground. Standard voltage: 24V or more - If measurement is abnormal, the water spray timer is faulty. 	Replace the water spray timer.
2. Water Spray Switch	<ul style="list-style-type: none"> (1) When turning water spray switch to INT with ignition switch ON, measure voltage between water spray switch pin 4 inlet Y wire and chassis ground. Standard voltage: 24V or more (2) When turning water spray switch to INT with ignition switch ON, measure voltage between water spray switch pin 5 inlet R wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the water spray switch is faulty. 	Replace the water spray switch.
3. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

3. Liquid Spray does not work (Push Button)

Reference Fig. : 2-2-4

Check point	Check/Cause	Action
1. Solution Spray Pump	<ul style="list-style-type: none"> (1) When solution spray switch is pushed ON with ignition switch ON, measure voltage between solution spray pump inlet L wire and chassis ground. Standard voltage: 24V or more (2) Check that solution spray pump ground is good. - If the solution spray pump does not operate even though above items (1) and (2) are OK, the solution spray pump is faulty. 	Replace the solution spray pump. Before replacing the solution spray pump, check that pump shaft is free to rotate, use a short screwdriver to turn the shaft. If solution is not flushed out it can harden as it dries preventing shaft rotation.
2. Solution Spray Solenoid	<ul style="list-style-type: none"> - Disconnect harness and measure resistance of coil. Standard resistance: 19.5Ω - If measured resistance is abnormal, the solution spray solenoid is faulty. 	Replace the solution spray solenoid.
3. Solution Spray Switch	<ul style="list-style-type: none"> (1) When pushing solution spray switch ON with ignition switch ON, measure voltage between solution spray switch pin 1 inlet Y wire and chassis ground. Standard voltage: 24V or more (2) When pushing solution spray switch ON with ignition switch ON, measure voltage between solution spray switch pin 2 inlet YR wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the solution spray switch is faulty. 	Replace the solution spray switch.

Fig. : 2-2-4



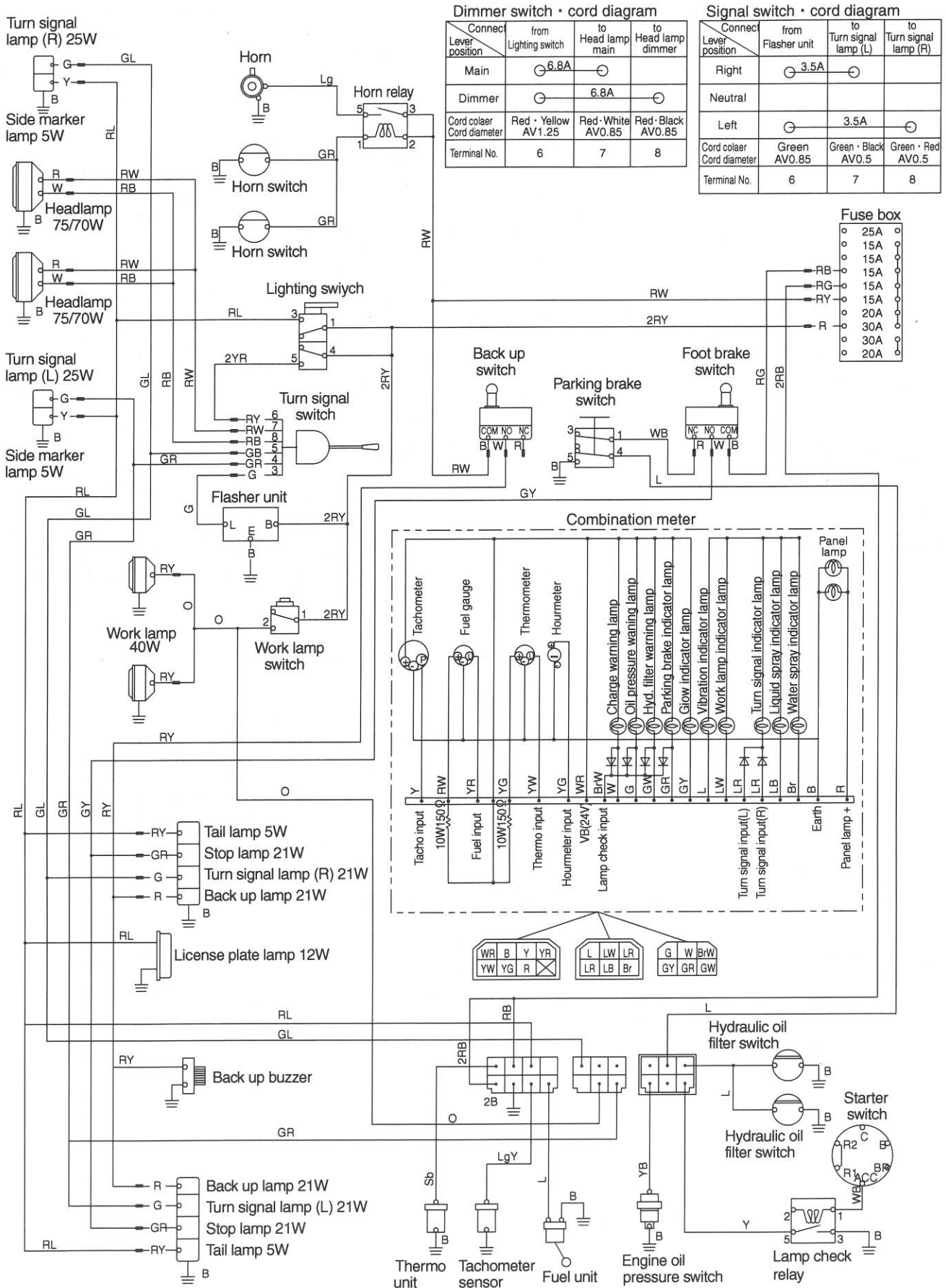
3. Liquid Spray does not work (Push Button)**Reference Fig. : 2-2-4**

Check point	Check/Cause	Action
4. Water Spray Relay	(1) When pushing solution spray switch ON with ignition switch ON, measure voltage between solution spray relay pin 1 inlet YR wire and chassis ground. Standard voltage: 24V or more (2) When pushing solution spray switch ON with ignition switch ON, measure voltage between solution spray relay pin 5 inlet Y wire and chassis ground. Standard voltage: 24V or more (3) Check that solution spray relay ground is good. - If above items (1), (2) and (3) are OK and electricity does not flow through solution spray relay pin 3, the solution spray relay is faulty.	Replace the solution spray relay.
5. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

4. Water Spray Tank Selector Cannot Switch (Between SLOPE And LEVEL)**Reference Fig. : 2-2-4**

Check point	Check/Cause	Action
1. Water Spray Tank Valve	(1) When turning selector switch to LEVEL (flat road) with ignition switch ON, measure voltage between water spray tank valve inlet LW wire and GND LB wire. Standard voltage: 24V or more (2) When turning selector switch to SLOPE (uphill road) with ignition switch ON, measure voltage between water spray tank valve inlet LB wire and GND LW wire. Standard voltage: 24V or more - If the water spray tank valve does not operate even though above items (1) and (2) are OK, the water spray tank valve is faulty.	Adjust or replace the water spray tank valve.
2. Water Spray Selector Switch	- When turning selector switch to LEVEL (flat road) or SLOPE (uphill road) with ignition switch ON, measure voltage between selector switch pin 1 inlet Y wire and selector switch pin 4 GND B wire. Standard voltage: 24V or more - If measurement is abnormal, the water spray selector Switch is faulty.	Replace the water spray selector switch.
3. Harness Connecting Between Terminals	- No continuity indicates that harness is open or poorly connected. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

Fig. : 2-2-5



2-2-5. Lighting and Accessories

Check the following items before troubleshooting.

* No fuse blew.

1. Headlamp, Side Lamp, Tail Lamp, License Plate Lamp, Or/And Combination Meter Lamp Do (es) Not Light

Reference Fig. : 2-2-5

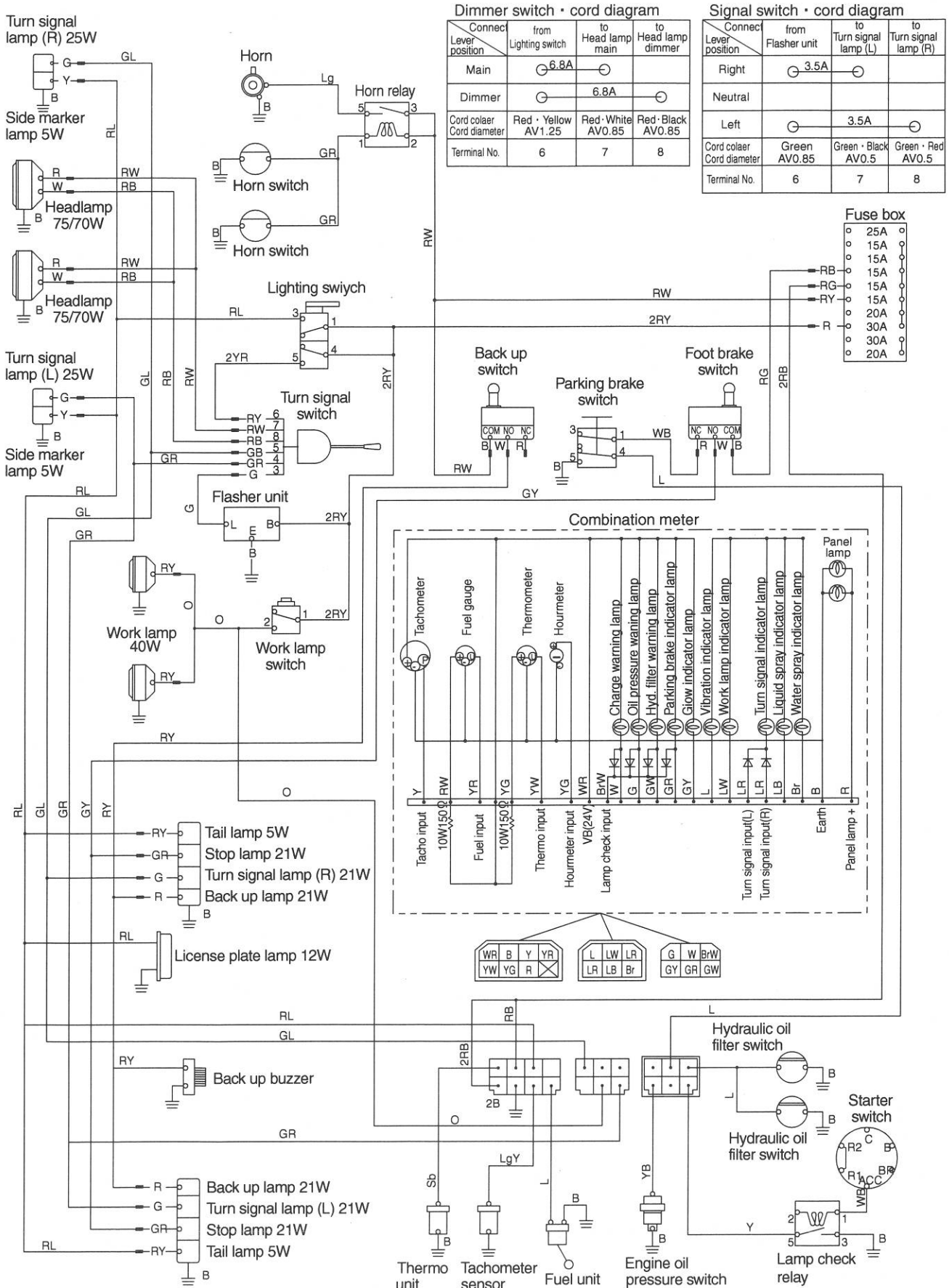
Check point	Check/Cause	Action
1. Battery Capacity	- Measure battery voltage or specific gravity. Standard voltage: 24V or more Standard specific gravity: 1.26V or more - If the measured value is below the standard one, the battery is weak.	Charge or replace the battery.
2. Each Bulb	- Check if each lamp bulb has burnt out or is poorly connected (for headlamp, side lamp, tail lamp, license plate lamp, and combination meter lamp). - Bulb is faulty or poorly connected.	Replace each bulb.
3. Lamp Switch	(1) When turning ignition switch ON, measure voltage between lamp switch pins 1, 4 inlet RY wire and chassis ground. Standard voltage: 24V or more (2) When turning lamp switch to first position with ignition switch ON, measure voltage between lamp switch pin 3 inlet RL wire and chassis ground. Standard voltage: 24V or more (3) When turning lamp switch to second position with ignition switch ON, measure voltage between lamp switch pin 5 inlet YR wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) or (3) is NG, the lamp switch is faulty.	Replace the lamp switch.
4. Turn Signal Switch (If Headlamp Does Not Light)	(1) When turning lamp switch to second position with ignition switch ON, measure voltage between turn signal switch pin 6 inlet RY wire and chassis ground. Standard voltage: 24V or more (2) When turning lamp switch to second position with ignition switch ON, measure voltage between turn signal switch pin 8 inlet RB wire or pin 7 inlet RW wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the turn signal switch is faulty.	Replace the turn signal switch.
5. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

2. High Beam Headlamp Does Not Activate

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.

Fig. : 2-2-5



2. High Beam Headlamp Does Not Activate**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
2. Turn Signal Switch	(1) When turning lamp switch to second position with ignition switch ON, measure voltage between turn signal switch pin 6 inlet RB wire and chassis ground. Standard voltage: 24V or more (2) When turning lamp switch to second position with ignition switch ON and turning high beam ON using turn signal switch, measure voltage between turn signal switch pin 7 inlet RW wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the turn signal switch is faulty.	Replace the turn signal switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

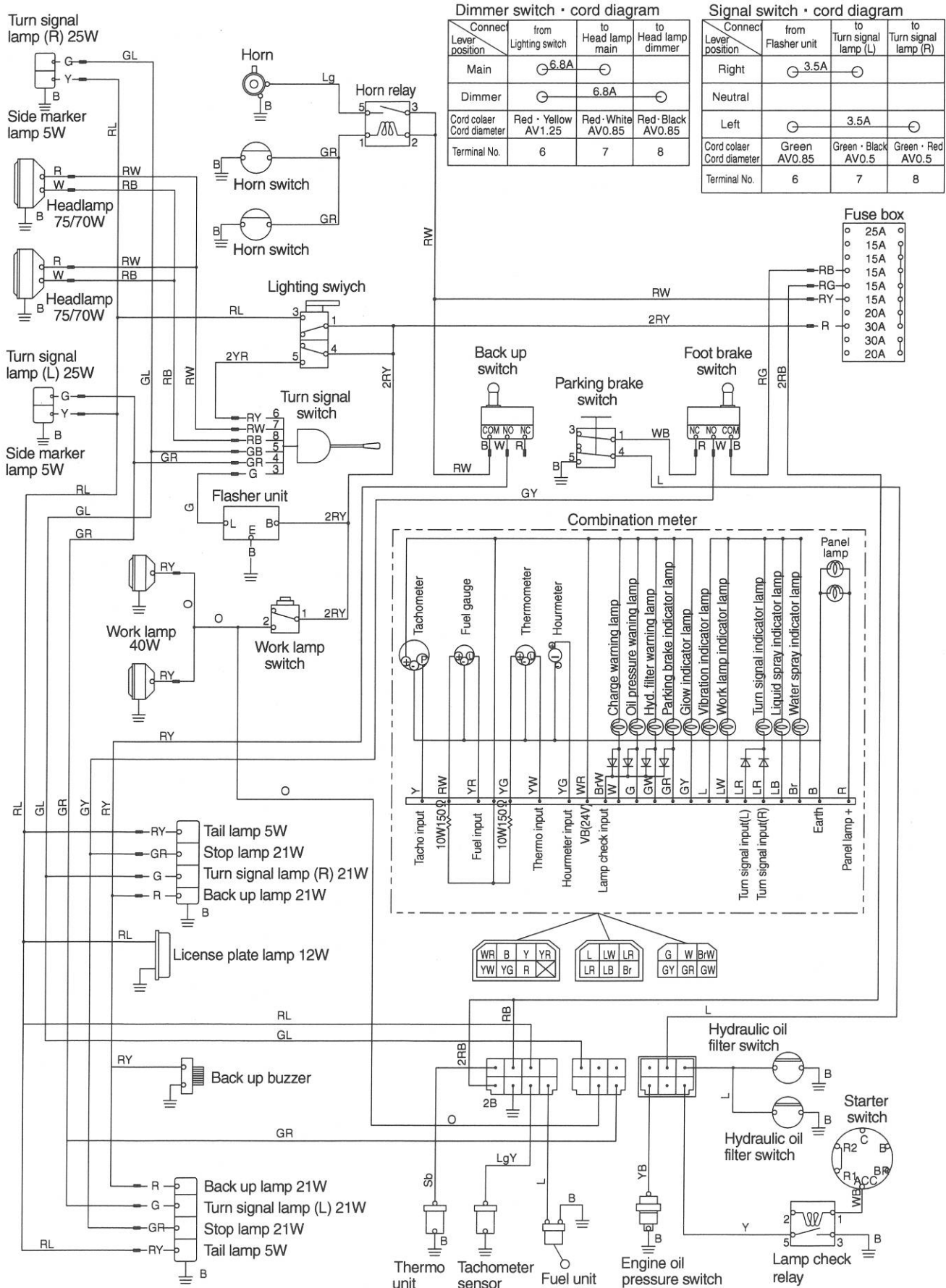
3. Working Lamp Does Not Light**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.
2. Working Lamp Switch	(1) When turning working lamp switch ON with ignition switch ON, measure voltage between working lamp switch pin 1 inlet RY wire and chassis ground. Standard voltage: 24V or more (2) When turning working lamp switch ON with ignition switch ON, measure voltage between working lamp switch pin 2 inlet RY wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the working lamp switch is faulty.	Replace the working lamp switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

4. Turn Signal Indicator Lamp Does Not Flash**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Each Bulb	- Check if each bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.

Fig. : 2-2-5



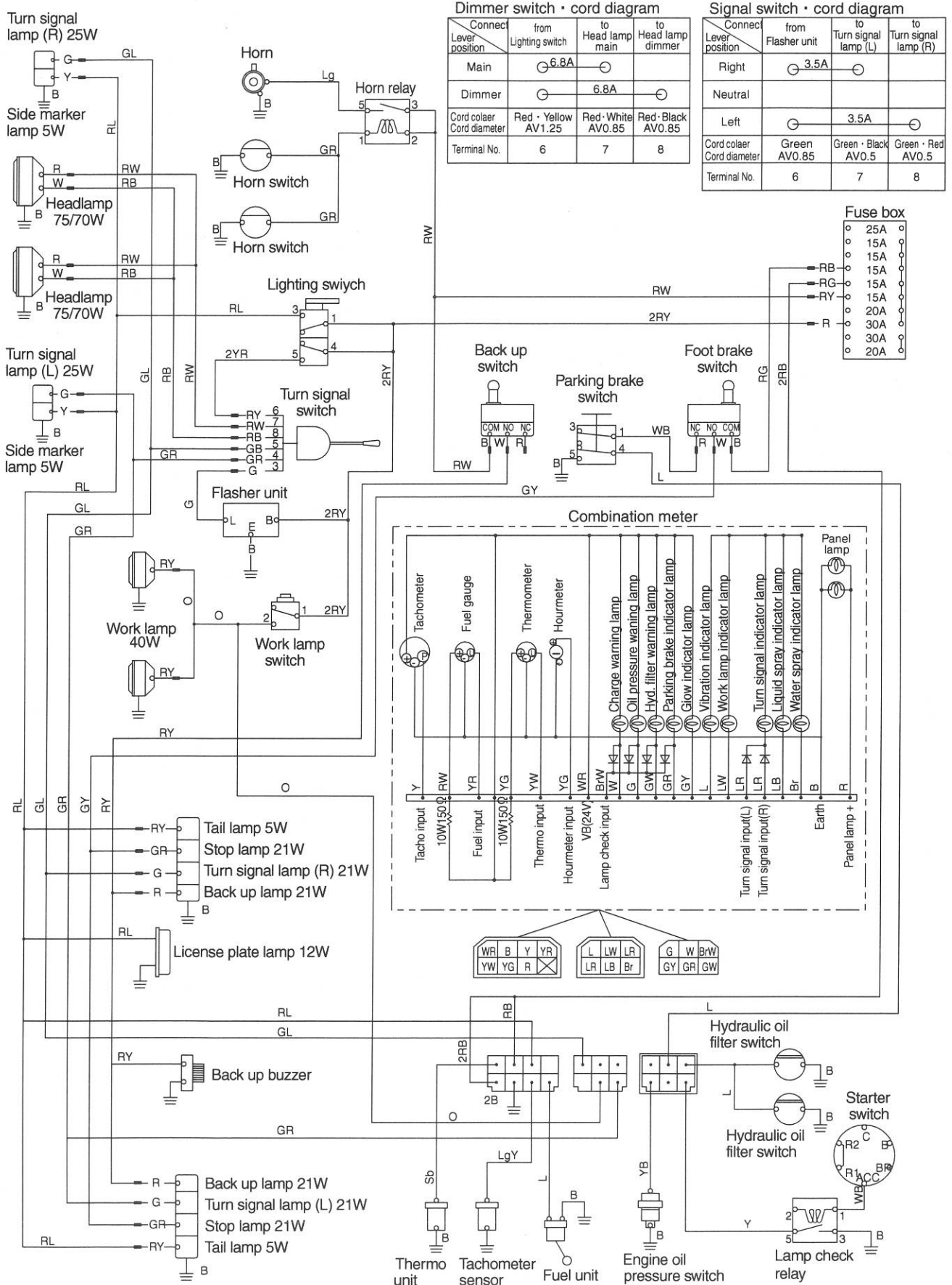
4. Turn Signal Indicator Lamp Does Not Flash**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
2. Flasher Unit	<p>(1) When turning ignition switch ON, measure voltage between flasher unit pin B inlet RY wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) When activating turn signal switch with ignition switch ON, measure voltage between flasher unit pin L inlet G wire and chassis ground. Standard voltage: 24V or more at specified intervals</p> <p>- If above item (1) is OK and item (2) is NG, the flasher unit is faulty.</p>	Replace the flasher unit.
3. Turn Signal Switch	<p>(1) When activating turn signal switch with ignition switch ON, measure voltage between turn signal switch pin 3 inlet G wire and chassis ground. Standard voltage: 24V or more at specified intervals</p> <p>(2) When activating turn signal switch with ignition switch ON, measure voltage between turn signal switch pin 4 inlet GR wire and chassis ground as well as between turn signal switch pin 5 inlet GB wire and chassis ground. Left front/rear lamp: GR Right front/rear lamp: GB Standard voltage: 24V or more at specified intervals</p> <p>- If above item (1) is OK and item (2) is NG, the turn signal switch is faulty.</p>	Replace the turn signal switch.
4. Harness Connecting Between Terminals	<p>- Check harness between terminals for continuity.</p> <p>- No continuity indicates that harness is open or poorly connected.</p>	Repair or replace the harness.

5. Backup Lamp Does Not Light**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Each Bulb	<p>- Check if bulb has burnt out or is poorly connected.</p> <p>- Bulb is faulty or poorly connected.</p>	Replace the bulb.
2. Backup Switch	<p>(1) When turning ignition switch ON, measure voltage between backup switch COM terminal RW wire and chassis ground. Standard voltage: 24V or more</p> <p>(2) With ignition switch ON and forward/reverse lever in reverse position, measure voltage between backup switch NO terminal RY wire and chassis ground. Standard voltage: 24V or more</p> <p>- If above item (1) is OK and item (2) is NG, the backup switch is faulty.</p>	Replace the backup switch.
3. Harness Connecting Between Terminals	<p>- Check harness between terminals for continuity.</p> <p>- No continuity indicates that harness is open or poorly connected.</p>	Repair or replace the harness.

Fig. : 2-2-5



6. Brake Lamp Does Not Light

Reference Fig. : 2-2-5

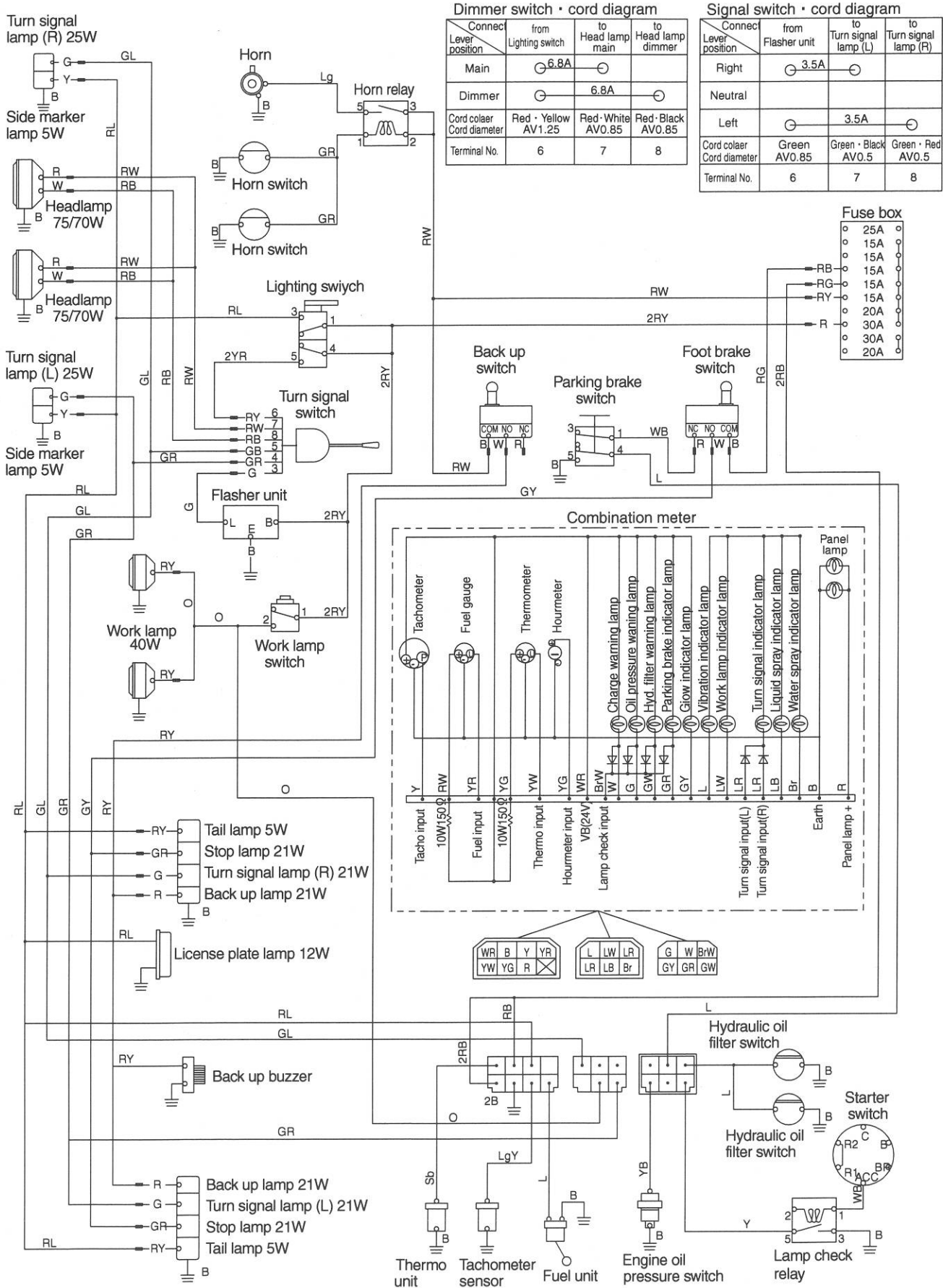
Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.
2. Foot Brake Switch	(1) When turning ignition switch ON, measure voltage between foot brake switch COM terminal RG wire and chassis ground. Standard voltage: 24V or more (2) Press and hold foot brake with ignition switch ON, measure voltage between foot brake switch NO terminal GY wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the foot brake switch is faulty.	Replace the foot brake switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

7. Combination Meter Monitor Lamps do not light

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Each Bulb	- Check if each bulb of combination meter has burnt out or is poorly connected (for charge warning lamp, oil pressure warning lamp, glow plug indicator lamp, working indicator lamp, turn signal indicator lamp, solution spray indicator lamp and water spray indicator lamp). - Bulb is faulty or poorly connected.	Replace the bulb.
2. Foot Brake Switch	(1) When turning ignition switch ON, measure voltage between lamp check relay pin 1 inlet WB wire and chassis ground. Standard voltage: 24V or more (2) When turning ignition switch ON, measure voltage between lamp check relay pin 3 inlet Y wire and chassis ground. (3) When turning ignition switch ON, measure voltage between lamp check relay pin 5 and chassis ground. Standard voltage: 24V or more - If the warning lamp does not light when above items (1) and (2) are OK and item (3) is NG, the lamp check relay is faulty.	Replace the lamp check relay.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

Fig. : 2-2-5



8. Tachometer Reading Is Abnormal

* The other lamps light correctly.

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Tachometer Sensor	<ul style="list-style-type: none"> - Start the engine and fix 1,000rpm. - Set the digital pulse meter between 2 terminals of tachometer sensor. Then to measure the pulse in one minute. Standard value is 2000. - If the value is abnormal, the tachometer sensor is defective. 	Replace the tachometer sensor.
2. Tachometer	<ul style="list-style-type: none"> - When turning ignition switch ON, measure voltage between tachometer plus (+) terminal WR wire and chassis ground. Standard voltage: 24V or more - If measurement is normal, the tachometer is faulty. 	Replace the combination meter.
3. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

9. Hour Meter does not work

* The other lamps light correctly.

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Hour Meter	<ul style="list-style-type: none"> - When turning ignition switch ON, measure voltage between hour meter plus (+) terminal YG wire and chassis ground. Standard voltage: 24V or more - If measurement is normal, the hour meter is faulty. 	Replace the combination meter.
2. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

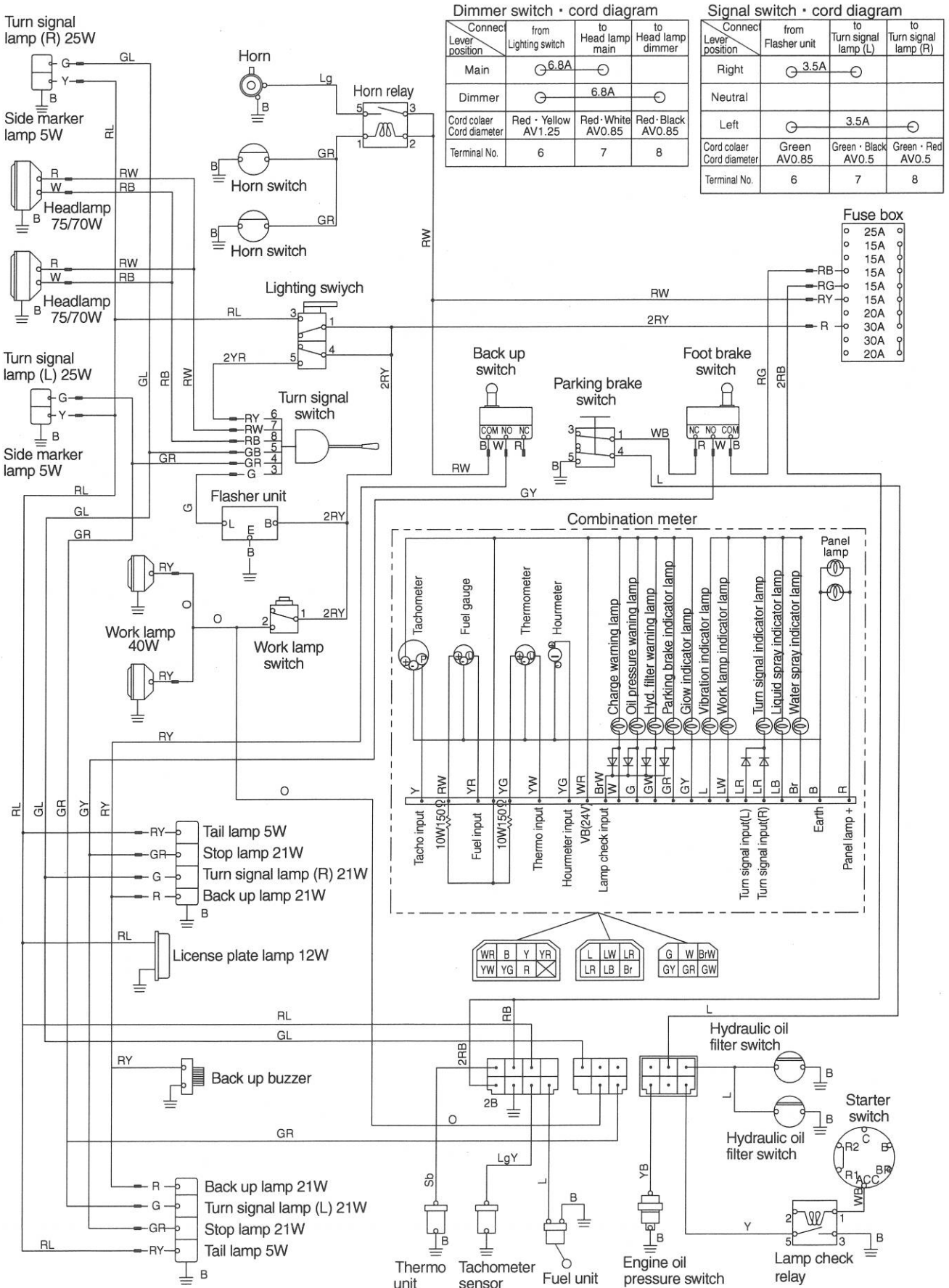
10. Temperature Gauge Is Abnormal

* The other lamps light correctly.

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Thermo-unit	<ul style="list-style-type: none"> - Disconnect harness and measure resistance of thermo-unit. Standard resistance: 153.9Ω (when unit temperature is 50°C) 24.9Ω (when unit temperature is 103°C) - If measured resistance is abnormal, the thermo-unit is faulty. 	Replace the thermo-unit
2. Temperature Gauge	<ul style="list-style-type: none"> - When turning ignition switch ON, measure voltage between temperature gauge plus (+) terminal WR wire and chassis ground. Standard voltage: 24V or more - If measurement is normal and thermo-unit is normal, the temperature gauge is faulty. 	Replace the combination meter.
3. Harness Connecting Between Terminals	<ul style="list-style-type: none"> - Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected. 	Repair or replace the harness.

Fig. : 2-2-5



11. Fuel Gauge Is Abnormal

* The other lamps light correctly.

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Fuel unit	- Disconnect harness and measure resistance of fuel unit. 10Ω (when float is at FULL position) 90Ω (when float is at EMPTY position) - If measured resistance is abnormal, the fuel unit is faulty.	Replace the tachometer sensor.
2. Fuel Gauge	- When turning ignition switch ON, measure voltage between fuel gauge plus (+) terminal WR wire and chassis ground. Standard voltage: 24V or more - If measurement is normal and the fuel unit is normal, the fuel gauge is faulty.	Replace the combination meter.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

12. Hydraulic Oil Filter Warning Lamp Remains ON**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Hydraulic Oil Filter Switch	- Check continuity between hydraulic oil filter switch inlet terminal and chassis ground. - No continuity indicates normal condition. If any continuity is present, the hydraulic oil filter switch is faulty.	Replace the hydraulic oil filter switch.

13. Oil Pressure Warning Lamp Remains ON**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Oil Pressure Switch	- Check continuity between oil pressure switch inlet terminal and chassis ground. - No continuity indicates normal condition. If any continuity is present, the oil pressure switch is faulty.	Replace the oil pressure switch.

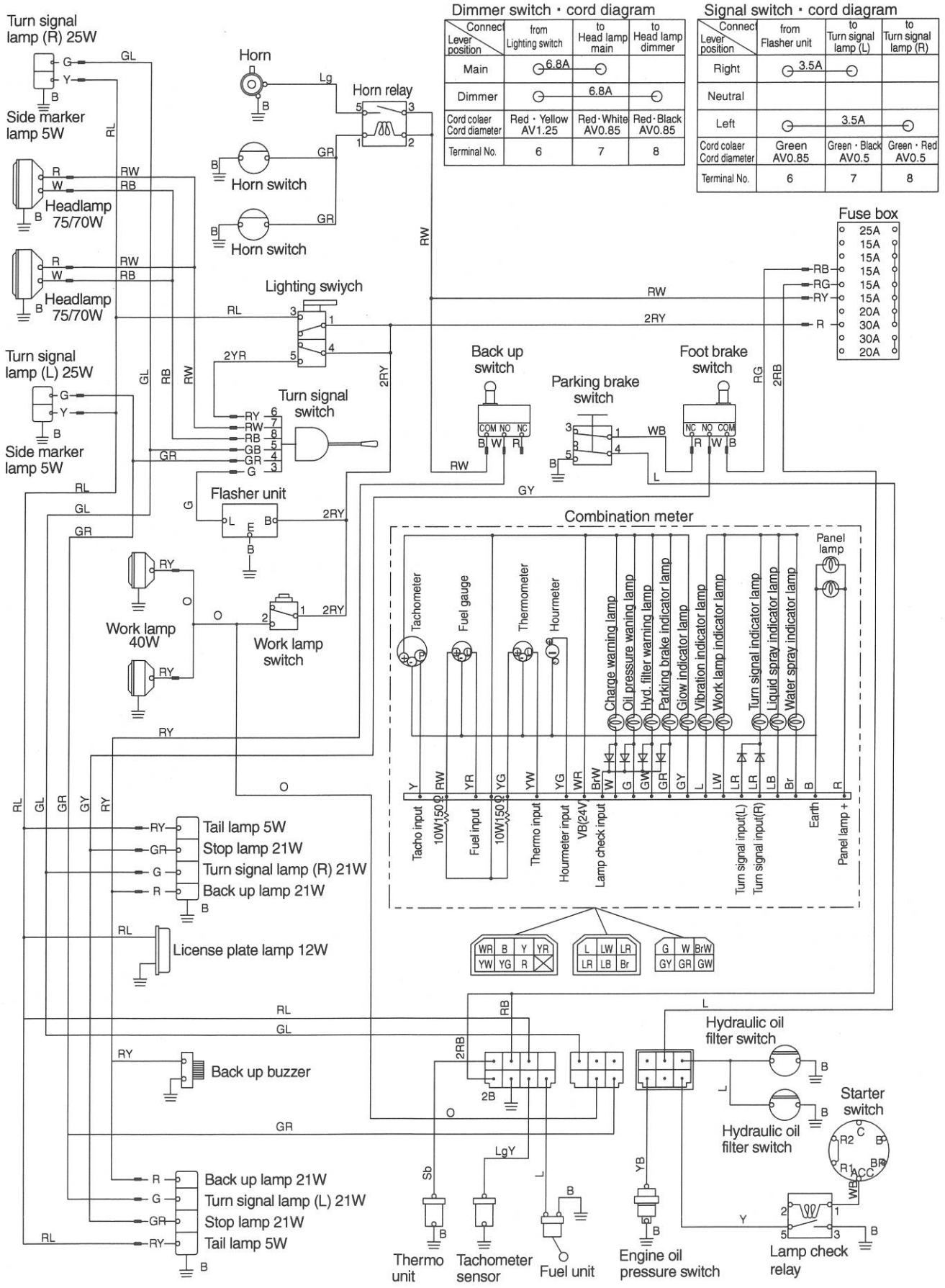
14. Charge Warning Lamp Remains ON

* Engine start state.

Reference Fig. : 2-2-5

Check point	Check/Cause	Action
1. Lamp Check Relay	- Check continuity between lamp check relay pin 5 and chassis ground. Standard voltage: 24V or more - If voltage is detected by the above check, the alternator generates power poorly.	Repair or replace alternator.

Fig. : 2-2-5



15. Parking Brake Indicator Lamp Does Not Light**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.
2. Parking Brake Switch	- When turning ignition switch ON, measure voltage between parking brake switch pin 4 inlet L wire and chassis ground. Standard voltage: 24V or more - If the above item is OK and the parking brake lamp does not light even though the parking brake switch is turned ON/OFF, the parking brake switch is faulty.	Replace the parking brake switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

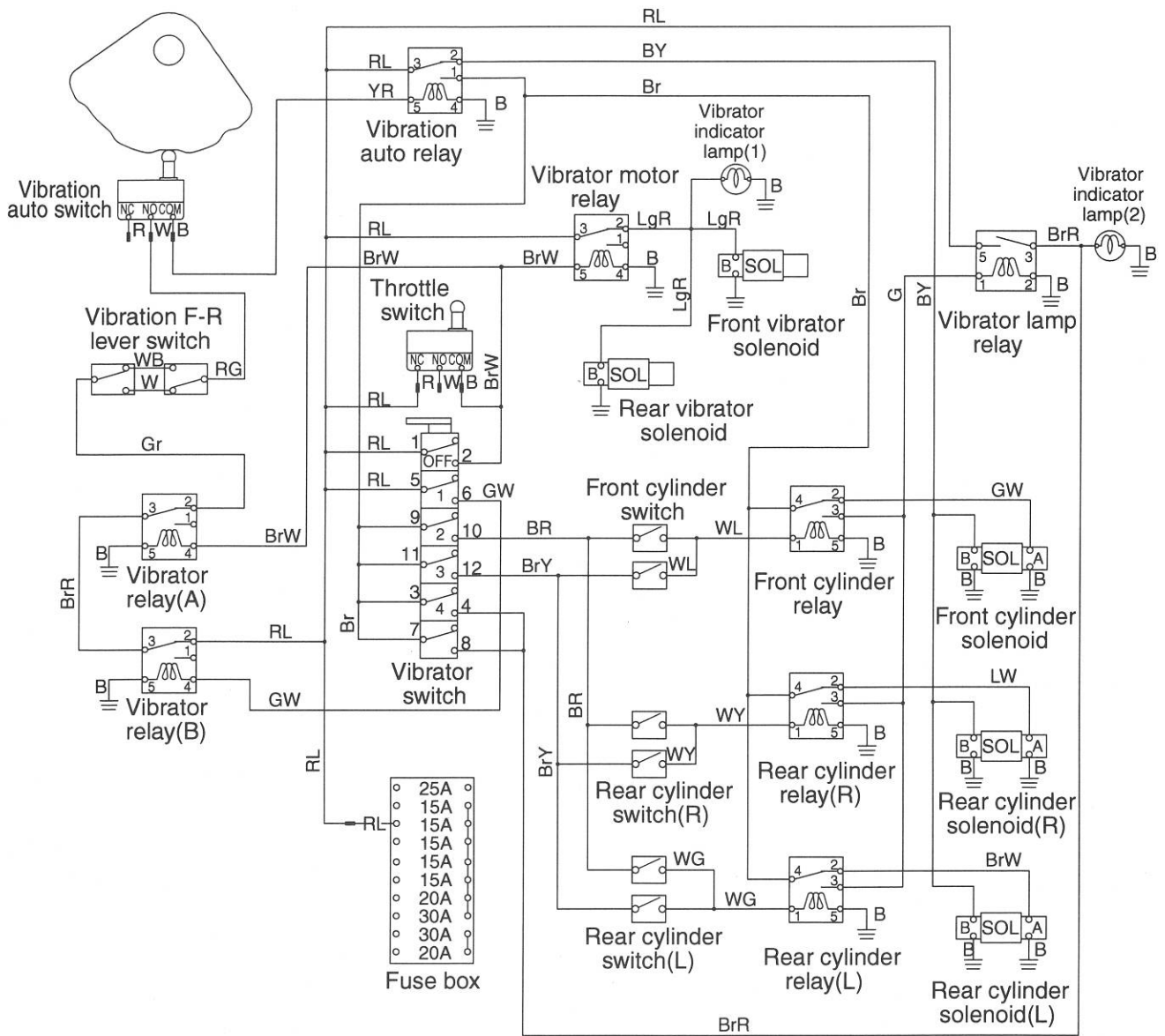
16. Horn Does Not Sound**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Horn	- Disconnect horn and connect the horn terminal to the battery directly. - If the horn does not sound, it is faulty.	Replace the horn.
2. Horn Relay	(1) When pressing horn switch with ignition switch ON, measure voltage between horn switch relay pin 2 RW wire and chassis ground. Standard voltage: 24V or more (2) When pressing horn switch with ignition switch ON, measure voltage between horn switch relay pin 5 Lg wire and chassis ground. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the horn relay is faulty.	Replace the horn relay.
3. Horn Switch (push button)	- When horn switch is pushed ON and OFF, check if continuity between switch terminals changes between presence and absence. - If continuity between switch terminals does not change between presence and absence, the horn switch is defective	Repair or replace the harness.
4. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

17. Backup Buzzer Does Not Beep**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
1. Buzzer	- Disconnect buzzer and connect the buzzer terminal to the battery directly. - If the buzzer does not beep, it is faulty.	Replace the buzzer.

Fig. : 2-2-3



17. Backup Buzzer Does Not Beep**Reference Fig. : 2-2-5**

Check point	Check/Cause	Action
2. Backup Switch	(1) When turning ignition switch ON, measure voltage between backup switch COM terminal RW wire and chassis relay. Standard voltage: 24V or more (2) With ignition switch ON and forward/reverse lever in reverse position, measure voltage between backup switch NO terminal RY wire and chassis relay. Standard voltage: 24V or more - If above item (1) is OK and item (2) is NG, the backup switch is faulty.	Replace the backup switch.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

18. Vibration Indicator Lamp Does Not Light (Left Pilot Lamp Of Vibration Indicator Lamp)

Check the following items before troubleshooting.

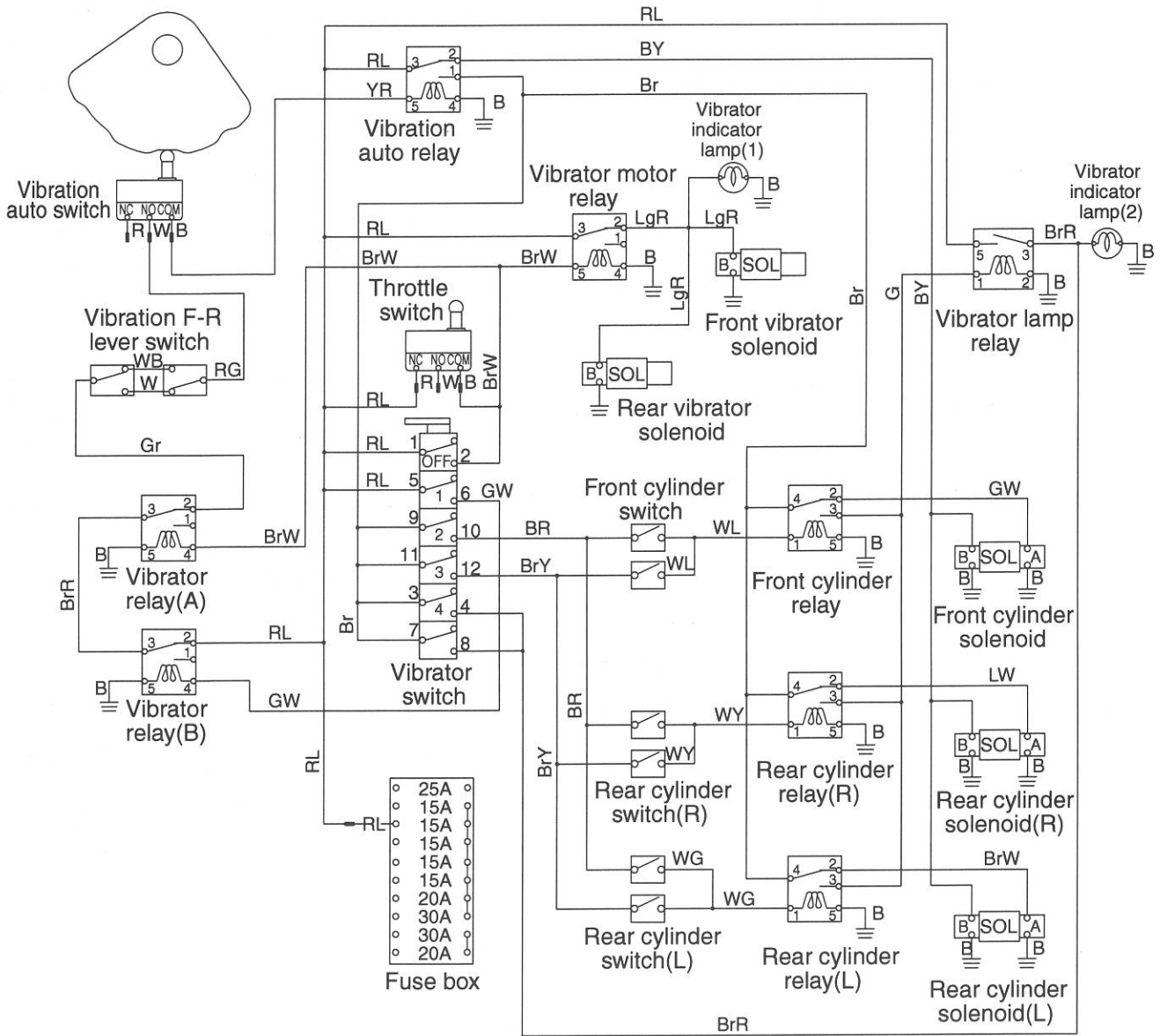
*Set the throttle lever to HIGH IDLE position without starting engine.

* Vibration switch is in position 1 and forward/reverse lever is in neutral position.

Reference Fig. : 2-2-3

Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.
2. Vibration Motor Relay	(1) Measure voltage between the vibration motor relay pin 3 inlet RL wire and chassis ground. Standard voltage: 24V or more (2) Measure voltage between the vibration motor relay pin 5 inlet BrW wire and chassis ground. It is normal that no electricity flows. (3) Check that vibration motor relay ground is good. - If above items (1), (2) and (3) are OK and the electricity does not flow through vibration relay pin 2, the vibration motor relay is faulty.	Replace the vibration motor relay.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

Fig. : 2-2-3



19. Vibration Indicator Lamp Does Not Light (Left & Right Pilot Lamps Of Vibration Indicator Lamp)

Check the following items before troubleshooting.

* Set the throttle lever to HIGH IDLE position without starting engine.

* Vibration switch is in 2, 3 or 4 position and forward/reverse lever is in forward or reverse position.

Reference Fig. : 2-2-3

Check point	Check/Cause	Action
1. Each Bulb	- Check if bulb has burnt out or is poorly connected. - Bulb is faulty or poorly connected.	Replace the bulb.
2. Vibration Lamp Relay	(1) Measure voltage between the vibration lamp relay pin 5 inlet RL wire and chassis ground. Standard voltage: 24V or more (2) Measure voltage between the vibration lamp relay pin 1 inlet G wire and chassis ground. Standard voltage: 24V or more - If above items (1) and (2) are OK and electricity does not flow through vibration lamp relay pin 3, the vibration lamp relay is faulty.	Replace the vibration lamp relay.
3. Harness Connecting Between Terminals	- Check harness between terminals for continuity. - No continuity indicates that harness is open or poorly connected.	Repair or replace the harness.

2-3. Hydraulic troubleshooting

2-3-1. Propulsion

If a problem occurs in the propulsion system such as propulsion pump, propulsion motor or brake, determine the cause and carry out action as required, according to the following general troubleshooting items.

* When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.

1. Vehicle Moves Neither Forward Nor Backward

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Forward/Reverse Lever Linkage	Forward/reverse lever linkage is faulty.	Check the forward/reverse lever linkage, and then adjust or replace as required.
3. Bypass Valve (unloader valve)	Bypass valve is open.	Close the valve.
4. Charge Circuit Pressure	Propulsion pump does not discharge oil because charge pressure is low.	Measure the charge pressure. If low, check the charge relief valve, and then adjust the pressure setting or replace the valve. Repair or replace charge pump.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. - Brake Solenoid Valve - Front cylinder Solenoid Valve - Left rear cylinder Solenoid Valve - Right rear cylinder Solenoid Valve	When the solenoid is not energised, check if oil flows in return circuit to tank. If oil flows, carry out the following actions. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve.
5. Servo Solenoid Valve	Propulsion pump does not discharge oil because the spool of the servo solenoid valve does not shift.	Repair or replace the servo solenoid valve if the spool of the valve does not shift.
6. Suction Filter for Charge Pump	The charge pump flow is reduced due to clogged filter.	Clean or replace the suction filter.
7. Pressure in Propulsion Circuit	The circuit does not obtain the required pressure because the setting pressure of relief valve is low.	Measure the propulsion circuit pressure. If low, check multifunction valve, and then adjust or replace as required.(2 valves not bat at sametime)
8. Propulsion Motor (there are 3 propulsion motors, one at the front tires and two at the rear tires.)	Internal leakage of propulsion motor	Measure the case drain from each propulsion motor. If the drain quantity is larger than the standard value, repair or replace the motor.
	Disc brake sticking	Replace the disc brake.
9. Brake Cylinder Inlet Pressure	Brake is not released because the brake cylinder inlet pressure is low.	Measure the brake cylinder inlet pressure. If low, check items 10 and 11 below.
10. Brake Solenoid Valve	Brake is still applied because the spool of the brake solenoid valve does not shift.	Repair or replace the brake solenoid valve.

1. Vehicle Moves Neither Forward Nor Backward

Check point	Check/Cause	Action
11. Brake Valve	Brake is not released because brake valve circuit is closed.	Check the brake valve, and then repair or replace as required.
12. Coupling	Drive torque is not transmitted to pump due to faulty coupling.	Replace the coupling.

2. Vehicle Moves In One Direction Only (Forward Or Backward)

Check point	Check/Cause	Action
1. Forward/Reverse Lever Linkage	Forward/reverse lever linkage is faulty.	Check the forward/reverse lever linkage, and then adjust or replace as required.
2. Multifunction Valve	Circuit pressure decreases due to high-pressure relief setting failure or internal leakage of multifunction valve.	Swap the two multifunction valves, If the problem changes direction when multifunction valves are swapped, check the multifunction valve, then adjust or replace the defective valve.

3. Slow Vehicle Speed Or Small Drive Force

Check point	Check/Cause	Action
1. Forward/Reverse Lever Linkage	Forward/reverse lever linkage is faulty.	Check the forward/reverse lever linkage, and then adjust or replace as required.
2. Bypass Valve	Bypass valve is slightly open.	Close the bypass valve completely.
3. Charge Circuit Pressure	Stroke of the propulsion pump swash plate is small because charge pressure is low, decreasing the discharge rate of propulsion pump.	Measure the charge pressure. If low, check the charge relief valve, and then adjust the setting pressure or replace the valve.
	Charge pressure decreases due to internal leakage of solenoid valve connecting oil supply circuit with charge circuit. - Brake Solenoid Valve - Front cylinder Solenoid Valve - Left rear cylinder Solenoid Valve - Right rear cylinder Solenoid Valve	When the solenoid is not energised, check if oil flows in return circuit to tank. If oil flows, carry out the following actions. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve. - Repair or replace the Solenoid valve.
4. Suction Filter for Charge Pump	The flow rate of charge pump decreases as well as the charge pressure decreases due to clogged filter.	Clean or replace the suction filter.
5. Propulsion Motor Inlet Pressure	Propulsion motor inlet pressure is low.	Measure propulsion motor inlet pressure. If low, check multifunction valve, and then adjust the setting pressure or replace the valve.
6. Internal Leakage of Propulsion Motor	The output of propulsion motor decreases and the number of revolutions decreases due to internal leakage of propulsion motor.	Measure the drain quantity from propulsion motor. If the drain quantity is larger than the standard value, repair or replace the motor.
7. Propulsion Motor	Discharge flow rate is insufficient due to efficiency degradation of propulsion pump.	Measure the discharge flow rate of propulsion pump with flow meter. If the discharge flow rate is not within the specified range, repair or replace the propulsion pump.

TROUBLESHOOTING

4. Vehicle Does Not Stop Completely With Forward/Reverse Lever In Neutral Position

Check point	Check/Cause	Action
1. Forward/Reverse Lever Linkage	Forward/reverse lever linkage is out of adjustment.	Check the forward/reverse lever linkage, and then adjust or replace as required.
2. Servo Control Valve	Servo control valve neutral position adjustment failure	Check the servo control valve, and then adjust or replace as required.
3. Propulsion Pump Servo Cylinder	Faulty propulsion pump servo cylinder or pump swash plate setting failure	Replace the propulsion pump.

5. Propulsion System is Overheating

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is reduced due to clogged oil cooler fins.	Clean the oil cooler fins.
3. Flushing Valve	Hydraulic oil in propulsion closed circuit is insufficiently cooled due to flushing valve shuttle spool sticking.	Repair or replace the flushing valve.
	Hydraulic oil in the propulsion closed circuit is insufficiently cooled because flushing valve relief setting pressure is excessively high.	Adjust the flushing valve relief setting pressure or replace the flushing valve.
4. Propulsion Circuit Setting Pressure	If the circuit setting pressure is excessively low, the relief valve(s) open frequently, causing the temperature of hydraulic oil in circuit to rise.	Measure the propulsion circuit pressure. If low, increase the relief setting pressure.
	If the load is excessively heavy, the relief valve(s) open frequently, causing the temperature of hydraulic oil to rise.	Measure the propulsion circuit pressure. If high, decrease the propulsion load.
5. Suction Filter for Charge Pump	The load of charge pump increases due to clogged filter, causing the temperature of hydraulic oil in circuit to rise.	Clean or replace the suction filter.
6. Charge Line Filter	Charge circuit pressure increases due to clogged filter.	Clean or replace the line filter.

6. Propulsion System is Noisy

Check point	Check/Cause	Action
1. Axle Bearing	Axle bearing supporting front and rear wheels is damaged.	Replace the axle bearing.
2. Hydraulic Hose Clamp	Vibration sound of hydraulic hose is generated because the clamp securing the hydraulic hose is loose.	Tighten bolts of the loose hydraulic hose clamp to the specified torque.
3. Suction Filter for Charge Pump	Cavitation is occurring in charge pump due to clogged filter.	Clean or replace the suction filter.
4. Charge Circuit Pressure	If charge circuit pressure is low, the brake cannot be released completely, causing brake drag.	Measure the charge pressure. If low, check the charge relief valve, and then adjust the setting pressure or replace the valve.
5. Propulsion Motor	Internal bearing of propulsion motor is damaged.	Repair or replace the propulsion motor.

2-3-2. Vibration

If a problem occurs in the vibration system such as vibration pump, vibration motor, or vibration solenoid valve, determine the cause and carry out action as required, according to the following general troubleshooting items.

* When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.

1. No Vibration In Each Vibration Mode

Check point	Check/Cause	Action
1. Engine RPM	The system does not vibrate until engine speed is above 1800 rpm.	If engine RPM is low, adjust engine speed to 2400 rpm.
2. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
3. Vibration Circuit Pressure	The circuit does not obtain the required pressure because the pressure setting of relief valve is low.	Measure the vibration circuit pressure. If low, check the relief valve, and then adjust or replace as required.
4. Vibration Solenoid Valve	Oil is not supplied in vibration motor suction port because the spool of the vibration solenoid valve does not shift.	Repair or replace the vibration solenoid valve if the spool of the valve is not shifting.
	Circuit pressure decreases due to relief valve setting failure or internal leakage.	Measure the vibration circuit pressure. If low, check the relief valve, and then adjust or replace as required.
5. Suction Filter for Vibration Pump	The discharge rate of vibration pump decreases due to clogged filter.	Clean or replace the suction filter.
6. Vibration Pump	The pump discharge rate is insufficient due to efficiency degradation of vibration pump.	Measure the discharge flow rate of vibration pump with flow meter. If the discharge flow rate is not within the specified range, repair or replace the vibration pump.
	Pump discharge rate decreases due to worn spline of vibration pump drive shaft.	Replace the vibration pump.
7. Vibration Motor	Internal leakage of vibration motor	Measure the drain quantity from vibration motor. If the drain quantity is larger than the standard value, repair or replace the motor.
	Output torque is not transmitted due to worn spline of vibration motor output shaft.	Replace the vibration pump.
8. Flow Divider	Oil passage is closed due to flow divider spool sticking.	Repair or replace the flow divider.

TROUBLESHOOTING

2. Vibration Frequency is too low

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Vibration Motor Inlet Pressure	Vibration motor inlet pressure is low.	Measure vibration motor inlet pressure. If low, check relief valve, and then adjust the setting pressure or replace the valve.
3. Internal Leakage of Vibration Motor	Vibration motor revolutions decrease due to internal leakage of the vibration motor.	Measure the drain quantity from vibration motor. If the drain quantity is larger than the standard value, repair or replace the motor.
4. Vibration Circuit Pressure Setting Relief Valve	Circuit pressure decreases due to relief setting failure or internal leakage.	If the reverse phenomenon occurs when the relief valves in front/rear wheel vibration circuits are exchanged with each other, check the relief valves, and then adjust setting pressure or replace the valve(s).
5. Suction Filter for Vibration Pump	The discharge rate of vibration pump decreases due to clogged filter.	Clean or replace the suction filter.
6. Vibration Pump	The pump discharge rate decreases due to efficiency degradation of vibration pump.	Measure the discharge flow rate of vibration pump with flow meter. If the discharge flow rate is not within the specified range, repair or replace the vibration pump.

3. Amplitude Does Not Change

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Circuit pressure of amplitude switching cylinder is low because oil level of hydraulic oil tank is low, deactivating the cylinder.	Fill the tank until the correct oil level is obtained.
2. Inlet Pressure of Amplitude Switching Cylinder	Inlet pressure of the amplitude switching cylinder is low.	Measure the inlet pressure of amplitude switching cylinder. If low, check charge relief valve, and then adjust the setting pressure or replace the valve.
3. Cylinder Solenoid Valve	Oil is not supplied to amplitude switching cylinder inlet because the spool of the cylinder solenoid valve does not shift.	Repair or replace the cylinder solenoid valve if the spool of the valve is not shifting.
4. Suction Filter for Charge Pump	The discharge rate of charge pump decreases due to clogged filter, decreasing the amplitude switching circuit pressure.	Clean or replace the suction filter.
5. Internal Leakage of Amplitude Switching Cylinder	Cylinder malfunction due to internal leakage of amplitude switching cylinder	If cylinder rod can be moved by hand with inlet/outlet port of oil-filled cylinder plugged, repair or replace the cylinder.

4. Vibration Does Not Stop

Check point	Check/Cause	Action
1. Engine RPM	Vibration does not stop completely until the engine speed is below 1800 rpm.	If engine speed is high, reduce engine speed.
2. Vibration Solenoid Valve	Spool of vibration solenoid valve does not return to neutral position.	Repair or replace the vibration solenoid valve if the spool of the valve does not return to neutral position.

5. Vibration System is overheating

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is degraded due to clogged oil cooler fins.	Clean the oil cooler fins.
3. Vibration Circuit Pressure Setting	If the circuit pressure setting is excessively low, the relief valve is open, causing the temperature of hydraulic oil in circuit to rise.	Measure the vibration circuit pressure. If low, increase the relief pressure setting.
	If the load is excessively heavy, the relief valve is open, causing the temperature of hydraulic oil in circuit to rise.	Measure the vibration circuit pressure. If high, decrease the vibration load.
4. Suction Filter for Vibration Pump	The load of charge pump increases due to clogged filter, causing the temperature of hydraulic oil in circuit to rise.	Clean or replace the suction filter.

6. Vibration System is Noisy

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Pump suction pressure is high because oil level of hydraulic oil tank is low, causing cavitation in vibration circuit.	Fill the tank until the correct oil level is obtained.
2. Air in Vibration Hydraulic Circuit	Cavitation is the result of air entering the circuit.	Check pump inlet hoses and hydraulic tank connections.
3. Vibration Bearing	Vibration bearing supporting the eccentric shaft is damaged.	Replace the vibration bearing.
4. Hydraulic Hose Clamp	Vibration noise of hydraulic hose is generated because the clamp securing the hydraulic hose is loose.	Tighten bolts of the loose hydraulic hose clamp to the specified torque.
5. Suction Filter for Vibration Pump	Cavitation can result in vibration pump due to clogged filter.	Clean or replace the suction filter.
6. Power Transmission Coupling	Noise is generated from power transmission shaft because coupling backlash is large.	If coupling wear is large, replace the coupling.

TROUBLESHOOTING

2-3-3. Steering

If a problem occurs in steering system such as steering pump or orbitroll, determine the cause and carry out action as required, according to the following general troubleshooting items.

* When checking whether or not the pressure is correct, refer to the pressure standard value for each hydraulic circuit.

1. Steering Wheel Is Hard to Turn

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low or setting pressure is low.	Fill the tank until the correct oil level is obtained.
2. Oil Level of Hydraulic Oil Tank	Relief valve is open or setting pressure is low.	Measure the steering circuit pressure. If low, check relief valve, and then clean the valve or increase the pressure setting.
	Flow rate to steering cylinder circuit is insufficient due to check valve sticking.	Check the check valve, and then clean or replace as required.
	Spool and sleeve of the orbitroll are contaminated or clearance is incorrect.	Check the orbitroll, and then clean or replace as required.
3. Steering Circuit Pressure	Pressure in the return circuit from orbitroll increases due to clogged charging line filter.	Repair or replace the steering cylinder.
4. Suction Filter for Steering Pump	Steering pump discharge rate decreases due to clogged filter.	Clean or replace the suction filter.
5. Steering Pump	Discharging pressure is insufficient due to efficiency degradation of steering pump.	Measure the steering circuit pressure. If low, replace the steering pump.
6. Steering Column	Tension of the chain interlocking with left and right steering wheel is excessive.	Adjust the chain tension correctly.
	Column shaft and orbitroll shaft center are misaligned.	Align the column shaft with orbitroll shaft center or replace column shaft.
	Column shaft bearing is worn or damaged.	Repair or replace the column shaft.

2. Steering Response Is Slow

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Orbitrol	Oil bypasses the passage from relief valve because the relief valve is open.	Measure the steering circuit pressure. If low, check relief valve, and then clean the valve or increase the setting pressure.
3. Steering Cylinder	Internal leakage of steering cylinder	Repair or replace the steering cylinder.
4. Suction Filter for Steering Pump	Steering pump discharge rate decreases due to clogged filter.	Clean or replace the suction filter.
5. Steering Pump	Discharge rate is insufficient due to efficiency degradation of steering pump.	Measure the steering circuit pressure. If low, replace the steering pump.

3. Steering Wheel Backlash Or Play Is Large

Check point	Check/Cause	Action
1. Steering Column	Spline of column shaft or orbitroll is worn.	Replace the column shaft or orbitroll.
	Column shaft bearing is worn.	Repair or replace the column shaft bearing.
2. Steering Wheel	Serration (spline) of wheel or column shaft is worn.	Replace the wheel or column shaft.

4. Steering System is Overheating

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Oil level in hydraulic oil tank is low.	Fill the tank until the correct oil level is obtained.
2. Oil Cooler	Cooling efficiency is degraded due to clogged oil cooler fin.	Clean the oil cooler fin.
3. Steering Circuit Pressure Setting	If the circuit pressure setting is excessively low, the relief valve is open, causing the temperature of hydraulic oil in circuit to rise.	Measure the steering circuit pressure. If low, increase the relief setting pressure.
	If the load is excessively heavy, the relief valve is open, causing the temperature of hydraulic oil in circuit to rise.	Measure the steering circuit pressure. If high, decrease the steering load.
4. Suction Filter for Steering Pump	The load of steering pump increases due to clogged filter, causing the temperature of hydraulic oil in circuit to rise.	Clean or replace the suction filter.

TROUBLESHOOTING

5. Steering System is Noisy

Check point	Check/Cause	Action
1. Oil Level of Hydraulic Oil Tank	Pump suction pressure is high because oil level of hydraulic oil tank is low, causing cavitation in the steering system circuit.	Fill the tank until the correct oil level is obtained.
2. Air in Steering hydraulic Circuit	Cavitation is caused by air entering the circuit.	Check pump inlet hose connection and hydraulic tank connection
3. Hydraulic Hose Clamp	Vibration sound of hydraulic hose is generated because the clamp securing the hydraulic hose is loose.	Tighten bolts of the loose hydraulic hose clamp to the specified torque.
4. Suction Filter for Steering Pump	Cavitation results at the steering pump due to clogged filter.	Clean or replace the suction filter.