

HS67ST

SHOP MANUAL

SAKAI®

3498-64784-0

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.

All information, specifications and illustrations in this publication are based on the product information available at the time that the publication was written. The contents may change without prior notice due to modifications of the model.

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SAFETY


1. GENERAL SAFETY

1-1. Understanding the Safety Symbols and 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 or important point to maintain of quality in maintenance works.

★: Indicates standard value to judge whether measured value is good or not.



Items that indicate the weight of a part or equipment and require attention in wire selection and operating posture for slinging operation.



In the assembly operation, tightening torque in locations that require particular attention.

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.

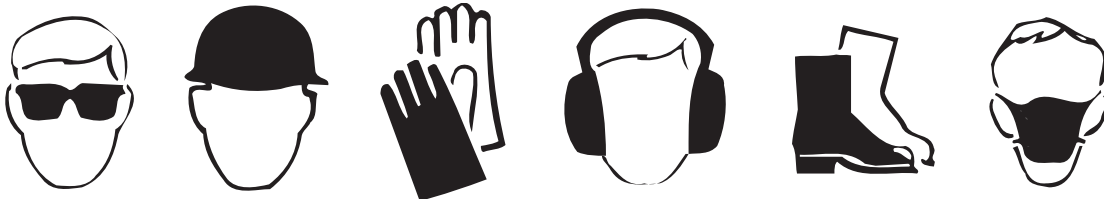
- The machine is designed specifically for the compaction of asphalt or soil road construction materials. Use of the machine for other purposes such as towing other equipment is considered contrary to the designated use. The manufacturer cannot be responsible or held liable for any damage resulting from 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 drums 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.

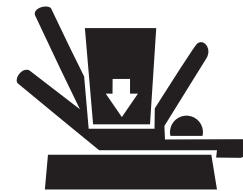
1-9. Stopping

- 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 drums 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 starter 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 starter key and attaching a warning sign to the starter switch.
- The machine must be parked on stable and level ground with the drums 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.
- 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 drums or tires are adequately blocked, the articulation lock bar is in the locked position and the parking brake is applied.



SAFETY

- 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.



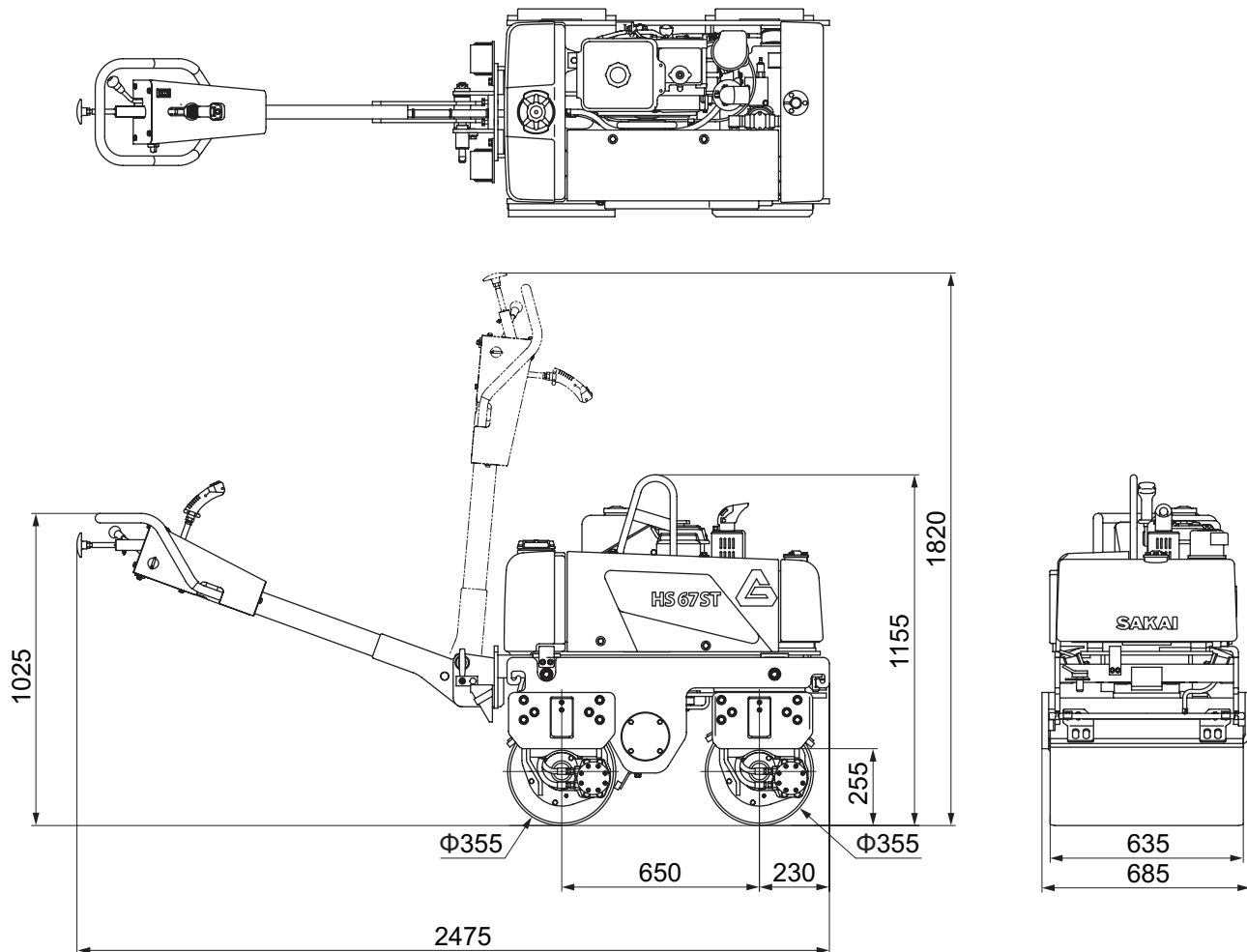
1-11. Transporting the Machine

- 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.
- Block the drums or tires (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 or tires 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

1. SPECIFICATION DATA

1-1. HS67ST (KUBOTA Engine Type)



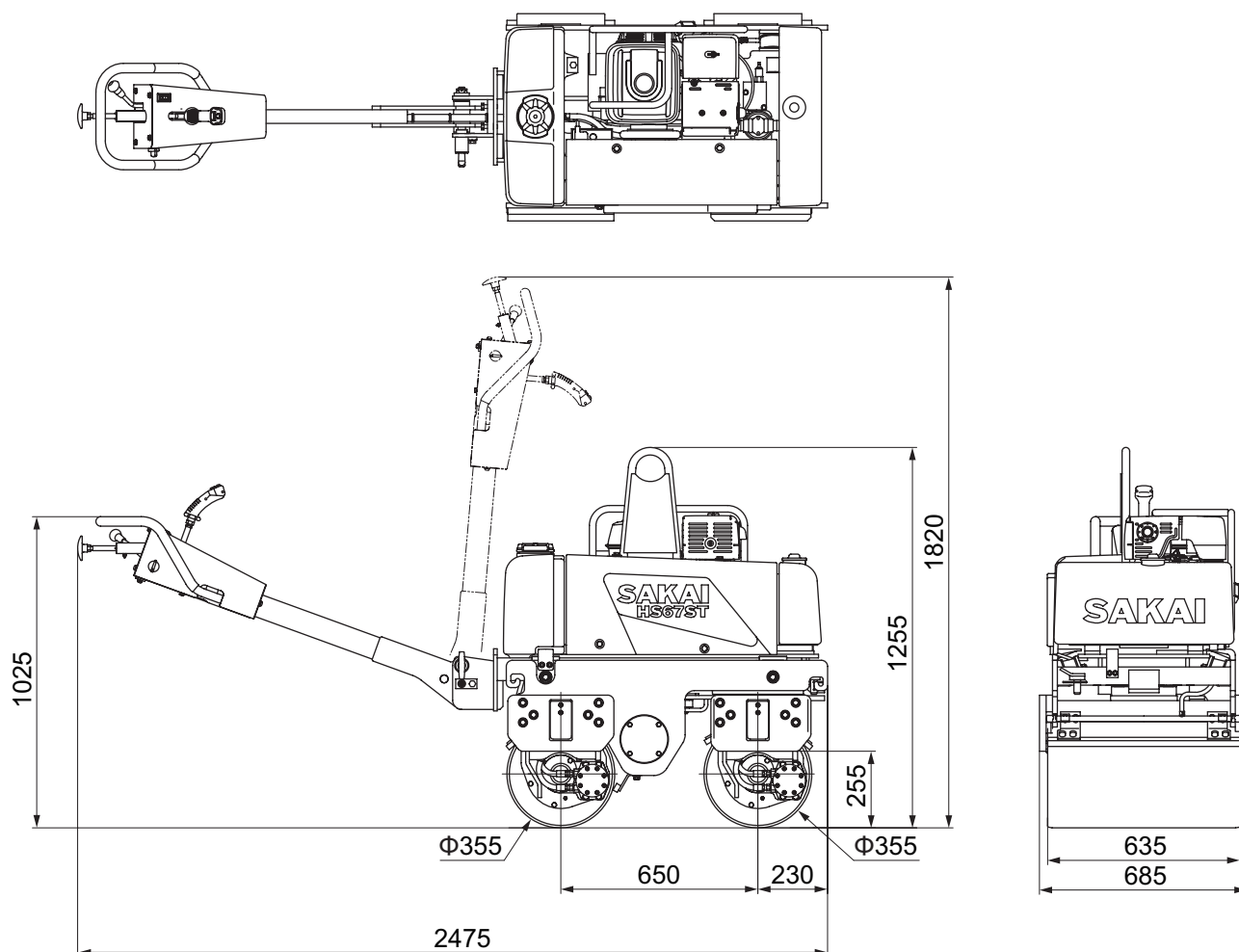
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Model		HS67ST (KUBOTA engine type)	
Weight	Operating weight	750 kg	(1,655 lbs.)
	Front axle	320 kg	(705 lbs.)
	Rear axle	430 kg	(950 lbs.)
Dimensions	Overall length	2,475 mm	(97 in.)
	Overall width	685 mm	(27 in.)
	Overall height	1,155 mm	(45 in.)
		1,820 mm	(72 in.)
	Wheelbase	650 mm	(25.5 in.)
	Compaction width	635 mm	(25 in.)
Curb clearance	255 mm	(10 in.)	
Speed (Forward & Reverse)		0 to 3.5 km/h	(0 to 2.2 mile/h)
Vibration performance	Frequency	55 Hz	
	Centrifugal force	11.8 kN	(2,650 lbs.)
Gradability *1		38 %	(21 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name		KUBOTA E75-ENB3 Diesel Engine		
	Model		Water-cooled, 4-cycle, 1-cylinder, horizontal mounted, overhead valve, swirl combustion chamber type		
	Number of cylinders - Bore × Stroke		1-77 mm × 70 mm (3.031 in. × 2.756 in.)		
	Displacement		0.325 L (19.8 cu.in)		
	Performance	Rated speed		2,500 min ⁻¹ (2,500 rpm)	
		Rated output		4.6 kW (6.2 HP) at 2,500 min ⁻¹	
		Max. torque		17.6 N·m (13 lbf·ft) at 2,000 min ⁻¹	
		Fuel consumption		283 g/kW·h (0.465 lb/HP·h) at rated speed	
	Governor		Mechanical all-speed type		
	Lubrication system		Pressure lubrication by gear pump		
	Air cleaner		Dry type		
	Cooling system		Condensor type		
	Starting system		Electrical type		
	Electrical system	Alternator		12 V 40 W	
		Starter		12 V 1.4 kW	
Battery		12 V 45 Ah × 1 pcs. (12 V)			
Min. starting temperature		-15 °C (5 °F)			
Power line	Transmission	Type	Hydrostatic transmission		
		Speed	Stepless		
	Reverser	Switching the direction of flow delivered from the variable pump			
Final drive		Spur gear			
Vibrating system	Clutch		Magnetic type		
	Vibrator		Eccentric shaft type		
Braking device	Parking brake		Mechanical, pin lock type		
Steering system	Steering control type		Hydraulic type		
	Steering angle (right & left)		15 °		
Drums	Use	Front drum		Drive × 1	
		Rear drum		Drive × 1	
	Dimension	Front drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
		Rear drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
	Suspension system	Front		Rubber damper type	
Rear		Rubber damper type			
Water spray system		Gravity			

1-2. HS67ST (HONDA Engine Type)



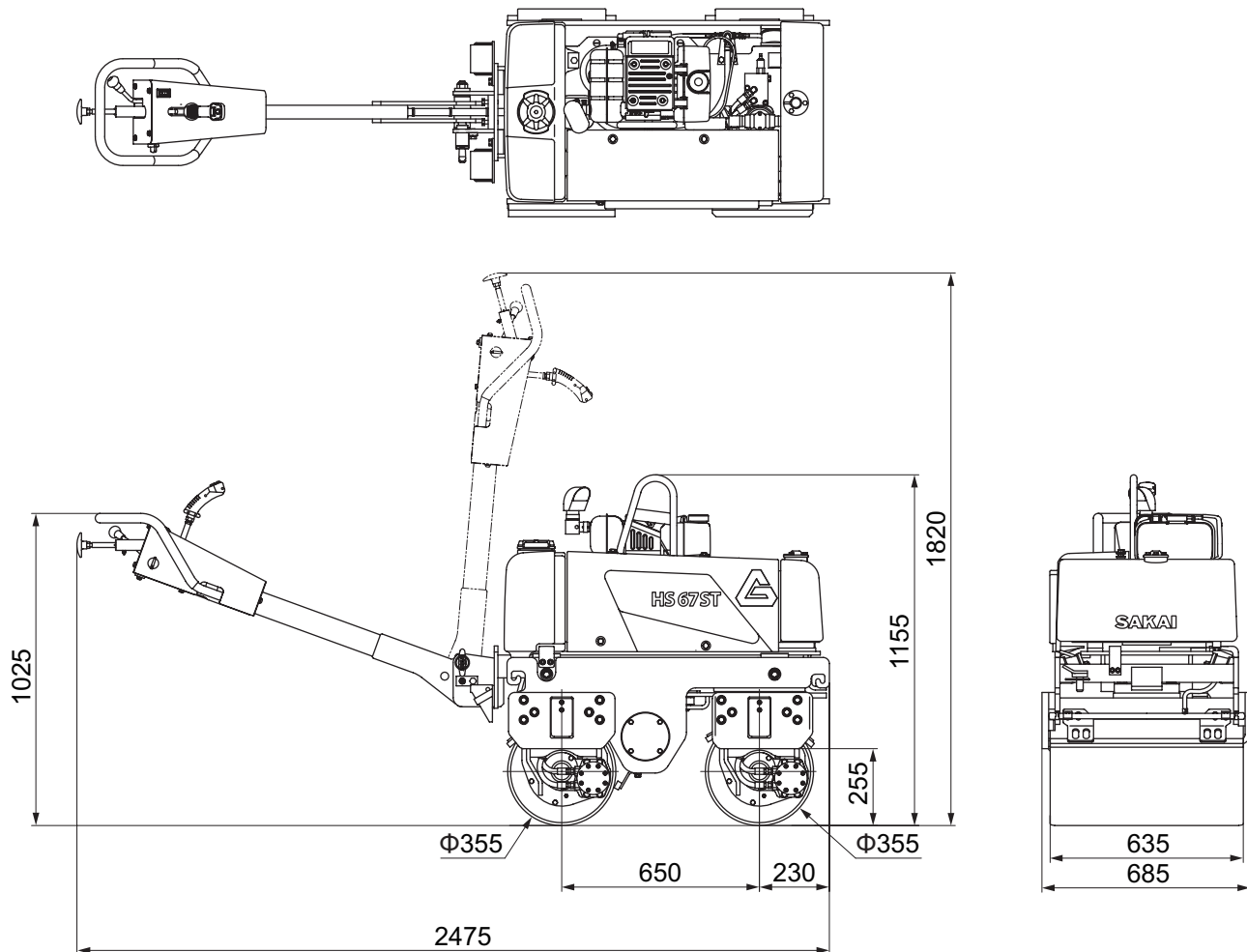
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Model		HS67ST (HONDA engine type)	
Weight	Operating weight	720 kg	(1,590 lbs.)
	Front axle	310 kg	(685 lbs.)
	Rear axle	410 kg	(905 lbs.)
Dimensions	Overall length	2,475 mm	(97 in.)
	Overall width	685 mm	(27 in.)
	Overall height	1,255 mm	(49 in.)
		1,820 mm	(72 in.)
	Wheelbase	650 mm	(25.5 in.)
	Compaction width	635 mm	(25 in.)
Curb clearance	255 mm	(10 in.)	
Speed (Forward & Reverse)		0 to 3.5 km/h	(0 to 2.2 mile/h)
Vibration performance	Frequency	55 Hz	
	Centrifugal force	11.8 kN	(2,650 lbs.)
Gradability *1		38 %	(21 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name		HONDA GX390U1 Gasoline Engine		
	Model		Air-cooled, 4-cycle, 1-cylinder, 25° inclined, overhead valve		
	Number of cylinders - Bore × Stroke		1-88 mm × 64 mm (3.465 in. × 2.520 in.)		
	Displacement		0.389 L (23.7 cu.in)		
	Performance	Rated speed		3,600 min ⁻¹ (3,600 rpm)	
		Rated output		6.6 kW (8.9 HP) at 3,600 min ⁻¹	
		Max. torque		26.5 N·m (19.5 lbf·ft) at 2,500 min ⁻¹	
		Fuel consumption		323 g/kW·h (0.531 lb/HP·h) at rated speed	
	Governor		Centrifugal mechanical		
	Lubrication system		Forced splash		
	Air cleaner		Dry type		
	Cooling system		Forced air type		
	Starting system		Recoil or electric starter		
	Electrical system	Alternator		12 V 10 A	
		Starter		12 V 0.5 kW	
Battery		12 V 45 Ah × 1 pcs. (12 V)			
Min. starting temperature		-15 °C (5 °F)			
Power line	Transmission	Type	Hydrostatic transmission		
		Speed	Stepless		
	Reverser		Switching the direction of flow delivered from the variable pump		
Final drive		Spur gear			
Vibrating system	Clutch		Magnetic type		
	Vibrator		Eccentric shaft type		
Braking device	Parking brake		Mechanical, pin lock type		
Steering system	Steering control type		Hydraulic type		
	Steering angle (right & left)		15 °		
Drums	Use	Front drum		Drive × 1	
		Rear drum		Drive × 1	
	Dimension	Front drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
		Rear drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
	Suspension system	Front		Rubber damper type	
Rear		Rubber damper type			
Water spray system		Gravity			

1-3. HS67ST (YANMAR Engine Type)



0478-99024-0-10325-0

Model		HS67ST (YANMAR engine type)	
Weight	Operating weight	740 kg	(1,630 lbs.)
	Front axle	320 kg	(705 lbs.)
	Rear axle	420 kg	(925 lbs.)
Dimensions	Overall length	2,475 mm	(97 in.)
	Overall width	685 mm	(27 in.)
	Overall height	1,155 mm	(45 in.)
		1,820 mm	(72 in.)
	Wheelbase	650 mm	(25.5 in.)
	Compaction width	635 mm	(25 in.)
	Curb clearance	255 mm	(10 in.)
Speed (Forward & Reverse)		0 to 3.5 km/h	(0 to 2.2 mile/h)
Vibration performance	Frequency	55 Hz	
	Centrifugal force	11.8 kN	(2,650 lbs.)
Gradability *1		38 %	(21 °)

*1: The gradability is the calculated value. It may vary based on the ground surface conditions.

Engine	Name		YANMAR L70V6-RESA Diesel Engine		
	Model		Air-cooled, 4-cycle, 1-cylinder, vertical mounted, overhead valve, direct-injection type		
	Number of cylinders - Bore × Stroke		1-78 mm × 67 mm (3.071 in. × 2.638 in.)		
	Displacement		0.32 L (19.5 cu.in)		
	Performance	Rated speed		3,600 min ⁻¹ (3,600 rpm)	
		Rated output		4.3 kW (5.8 HP) at 3,600 min ⁻¹	
		Max. torque		14.2 N·m (10.5 lbf·ft) at 3,000 min ⁻¹	
		Fuel consumption		284 g/kW·h (0.467 lb/HP·h) at rated speed	
	Governor		Mechanical all-speed type		
	Lubrication system		Pressure lubrication by gear pump		
	Air cleaner		Dry type		
	Cooling system		Forced air type		
	Starting system		Electrical type		
	Electrical system	Alternator		12 V 15.5 A	
		Starter		12 V 0.8 kW	
Battery		12 V 45 Ah × 1 pcs. (12 V)			
Min. starting temperature		-10 °C (14 °F)			
Power line	Transmission	Type	Hydrostatic transmission		
		Speed	Stepless		
	Reverser	Switching the direction of flow delivered from the variable pump			
Final drive		Spur gear			
Vibrating system	Clutch		Magnetic type		
	Vibrator		Eccentric shaft type		
Braking device	Parking brake		Mechanical, pin lock type		
Steering system	Steering control type		Hydraulic type		
	Steering angle (right & left)		15 °		
Drums	Use	Front drum		Drive × 1	
		Rear drum		Drive × 1	
	Dimension	Front drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
		Rear drum	width × diameter	635 mm × 355 mm (25 in. × 14 in.)	
	Suspension system	Front		Rubber damper type	
Rear		Rubber damper type			
Water spray system		Gravity			

2. TABLE OF STANDARD VALUES

2-1. Engine

2-1-1. Engine (KUBOTA)

Item	Standard value	Remarks
Engine model	KUBOTA E75-ENB3 Diesel Engine	
Rated output	4.6/2,500 kW/min ⁻¹ (6.2/2,500 HP/rpm)	
Max. rpm under no load	2,660 rpm	
Min. rpm under no load	Engine stops when throttle lever is at stop position	
Cylinder head tightening torque	59 to 64 N·m (44 to 47 lbf·ft)	
Fan belt tension	5 to 10 mm (0.2 to 0.39 in.)	When midpoint of belt pressed at 98 N (22 lbf)
Valve clearance (intake)	0.16 to 0.2 mm (0.006 to 0.008 in.)	
Valve clearance (exhaust)	0.16 to 0.2 mm (0.006 to 0.008 in.)	
Compression pressure	Standard value	3.33 MPa (483 psi)
	Allowable limit	2.45 MPa (355 psi)
Injection pressure	13.7 to 14.7 MPa (1,987 to 2,132 psi)	
Fuel consumption rate	283 g/kW·h (0.465 lb/HP·h)	
Engine dry weight	57 kg (126 lbs.)	

2-1-2. Engine (HONDA)

Item	Standard value	Remarks
Engine model	HONDA GX390U1 Gasoline Engine	
Rated output	6.6/3,600 kW/min ⁻¹ (8.9/3,600 HP/rpm)	
Max. rpm under no load	3,850 ± 150 rpm	
Min. rpm under no load	1,400 ± 150 rpm	
Cylinder head tightening torque	35 N·m (26 lbf·ft)	
Valve clearance (intake)	0.15 ± 0.02 mm (0.006 ± 0.001 in.)	
Valve clearance (exhaust)	0.20 ± 0.02 mm (0.008 ± 0.001 in.)	
Compression pressure	0.51 to 0.69 MPa (74 to 100 psi)	600 min ⁻¹ (rpm)
Fuel consumption rate	323 g/kW·h (0.531 lb/HP·h)	
Engine dry weight	31 kg (68 lbs.)	

2-1-3. Engine (YANMAR)

Item	Standard value	Remarks
Engine model	YANMAR L70V6-RESA Diesel Engine	
Rated output	4.3/3,600 kW/min ⁻¹ (5.8/3,600 HP/rpm)	
Max. rpm under no load	3,800 ± 30 rpm	
Min. rpm under no load	Engine stops when throttle lever is at stop position	
Cylinder head tightening torque	47 to 51 N·m (35 to 38 lbf·ft)	
Valve clearance (intake)	0.15 ± 0.05 mm (0.006 ± 0.002 in.)	
Valve clearance (exhaust)	0.15 ± 0.05 mm (0.006 ± 0.002 in.)	
Compression pressure	Standard value	2.9 MPa (421 psi)
	Allowable limit	2.3 MPa (334 psi)
Injection pressure	19.6 MPa (2,842 psi)	
Fuel consumption rate	284 g/kW·h (0.467 lb/HP·h)	
Engine dry weight	41 kg (90 lbs.)	

2-2. Propulsion

Item	Standard value	Remarks
Travel speed (Forward/reverse)	0 to 3.5 km/h (0 to 2.2 mile/h)	

2-3. Hydraulic System

Item		Standard value	Remarks	
Propulsion	Relief valve pressure setting	17.7 ± 1.5 MPa (2,567 ± 218 psi)		
	Charge relief pressure setting	0.98 ± 0.1 MPa (142.1 ± 15 psi)		
	Drainage	KUBOTA engine type	2.2 L/min (0.58 gal./min)	
		HONDA engine type	1.9 L/min (0.50 gal./min)	
YANMAR engine type		1.9 L/min (0.50 gal./min)		
Steering oil pressure		3.98 ± 0.2 MPa (577 ± 29 psi)	(Steering relief pressure + charge relief pressure)	

2-4. Capacities

Item		Standard value	Remarks
Engine oil pan	KUBOTA engine	1.3 L (0.3 gal.)	
	HONDA engine	1.1 L (0.3 gal.)	
	YANMAR engine	1.1 L (0.3 gal.)	
Fuel tank	KUBOTA engine type	4.8 L (1.3 gal.)	
	HONDA engine type	6.0 L (1.6 gal.)	
	YANMAR engine type	3.3 L (0.9 gal.)	
Coolant	KUBOTA engine	1.2 L (0.3 gal.)	
Hydraulic oil tank		16 L (4.2 gal.)	
Water spray tank		30 L (7.9 gal.)	

3. FUEL AND LUBRICANTS SPECIFICATION

3-1. Rating

3-1-1. Rating (KUBOTA and YANMAR engine types)

Lubricant	Service classification	Ambient temp. and applicable viscosity rating			Applicable Standards
		-15 to 30°C (5 to 86°F) Cold	0 to 40°C (32 to 104°F) Moderate	15 to 55°C (59 to 131°F) Tropical	
Engine oil	API grade CD	SAE10W-30	SAE30	SAE40	MIL-L-2104D
Hydraulic oil	Wear resistant	ISO-VG32 Over VI 140	ISO-VG32 Over VI 140	ISO-VG68 Over VI 110	ISO-3448
Grease	Lithium type extreme pressure				NLGI-2
Fuel	Diesel fuel				ASTM-D975-2D

3-1-2. Rating (HONDA engine type)

Lubricant	Service classification	Ambient temp. and applicable viscosity rating			Applicable Standards
		-30 to 0°C (-22 to 32°F) Cold	-20 to 40°C (-4 to 104°F) Moderate	10 to 40°C (50 to 104°F) Tropical	
Engine oil	API grade SE	SAE5W-30	SAE10W-30	SAE30	MIL-L-2104C
Hydraulic oil	Wear resisting	ISO-VG32 Over VI 140	ISO-VG32 Over VI 140	ISO-VG68 Over VI 110	ISO-3448
Grease	Lithium type extreme pressure				NLGI-2
Fuel	Unleaded gasoline, pump octane rating 86 or higher				

3-2. Recommended Lubricants

Lubricant Oil company	Engine oil API CD	Gear oil API GL 4	Hydraulic oil VG 46	Grease (NLGI-2)
CALTEX	RPM DELO 300 oil	Universal Thuban 90	Rando Oil HD 46	Martifack EP 2
BP	BP Vanellus C3-30	BP Gear Oil EP 90	BP Energol HLP 46	BP Energrease LS-EP 2
ESSO	Esso Lube D3-30	Esso Gear Oil GP 90	Nuto H 46	Beacon EP 2
MOBIL	Mobile Delvac 1330	Mobil Pegasus Gear oil 90	Mobile DTE 25	Mobil Lux EP 2
SHELL	Shell Rotella CT oil 30	Shell Spirax 90 EP	Shell Tellus Oil T46	Shell Alvania EP Grease 2

4. TIGHTENING TORQUE CHART

N·m	(lbf·ft)
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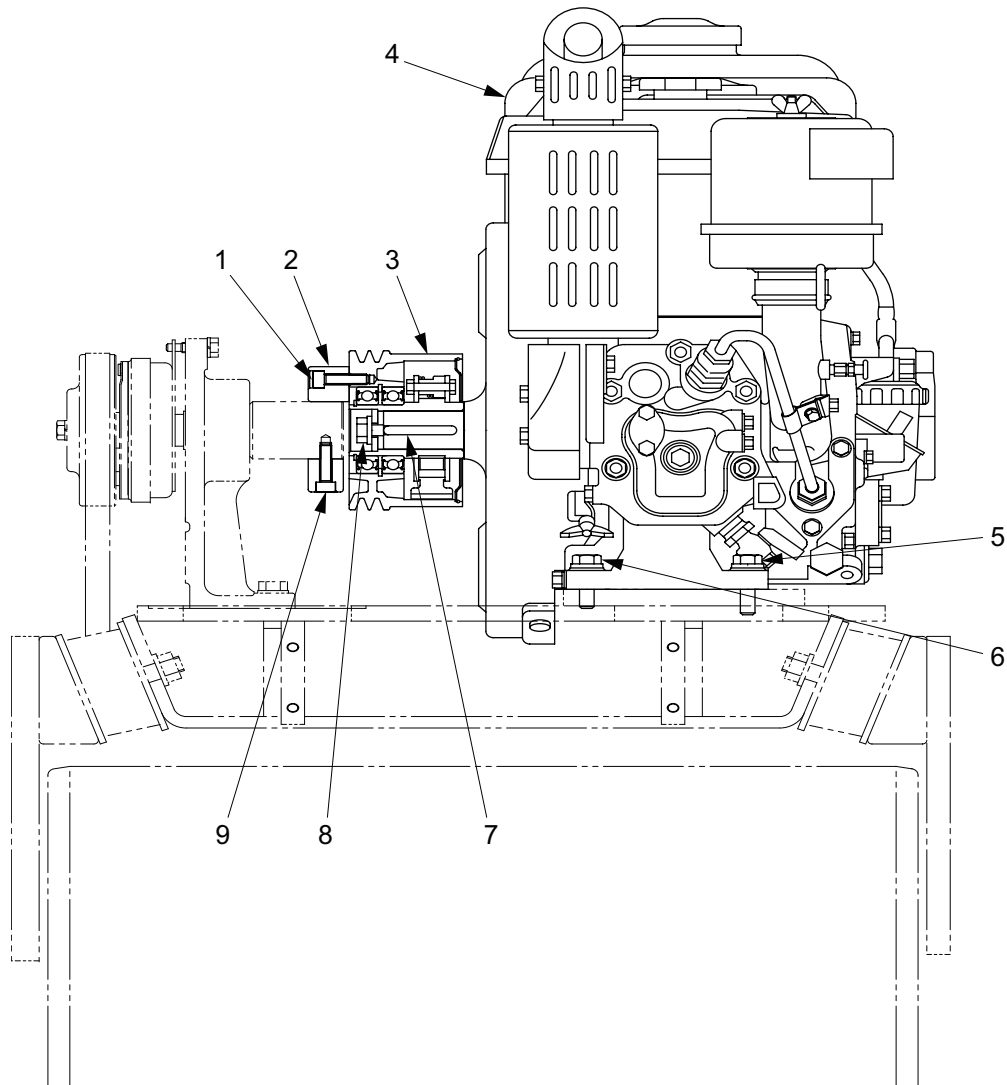
	Nominal Dia.	Pitch	Strength Classification							
			6.8		8.8		10.9		12.9	
Metric coarse screw	5	0.8	4.9	(3.6)	5.9	(4.4)	7.8	(5.8)	7.8	(5.8)
	6	1.0	7.8	(5.8)	9.8	(7.2)	13	(9.6)	13	(9.6)
	8	1.25	17	(13)	23	(17)	31	(23)	31	(23)
	10	1.5	39	(29)	49	(36)	59	(44)	59	(44)
	12	1.75	69	(51)	78	(58)	108	(80)	108	(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	(434)
	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

1. ENGINE

1-1. Engine Mount

1-1-1. Engine mount (KUBOTA engine)



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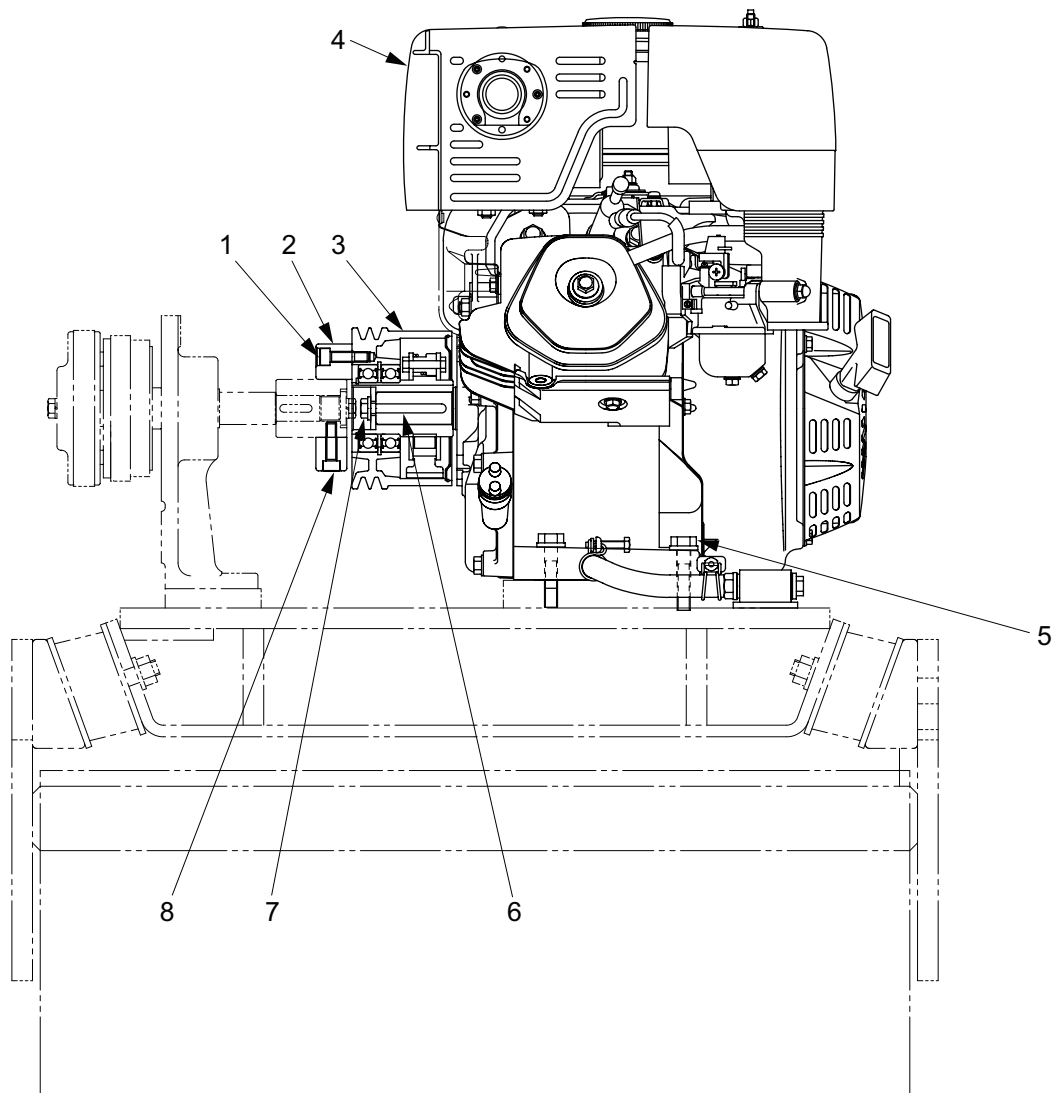
(1) Bolt : M 8×30
 (2) Coupling
 (3) Clutch
 (4) Engine
 (5) Bolt : M10×40

(6) Bolt : M10×35
 (7) Sunk key
 (8) Bolt : M10×35
 (9) Bolt : M 8×30



(1) Bolt M 8×30 : 23 N·m (17 lbf-ft)
 (5) Bolt M10×40 : 49 N·m (36 lbf-ft)
 (6) Bolt M10×35 : 49 N·m (36 lbf-ft)
 (8) Bolt M10×35 : 39 N·m (29 lbf-ft)
 (9) Bolt M 8×30 : 23 N·m (17 lbf-ft)

1-1-2. Engine mount (HONDA engine)



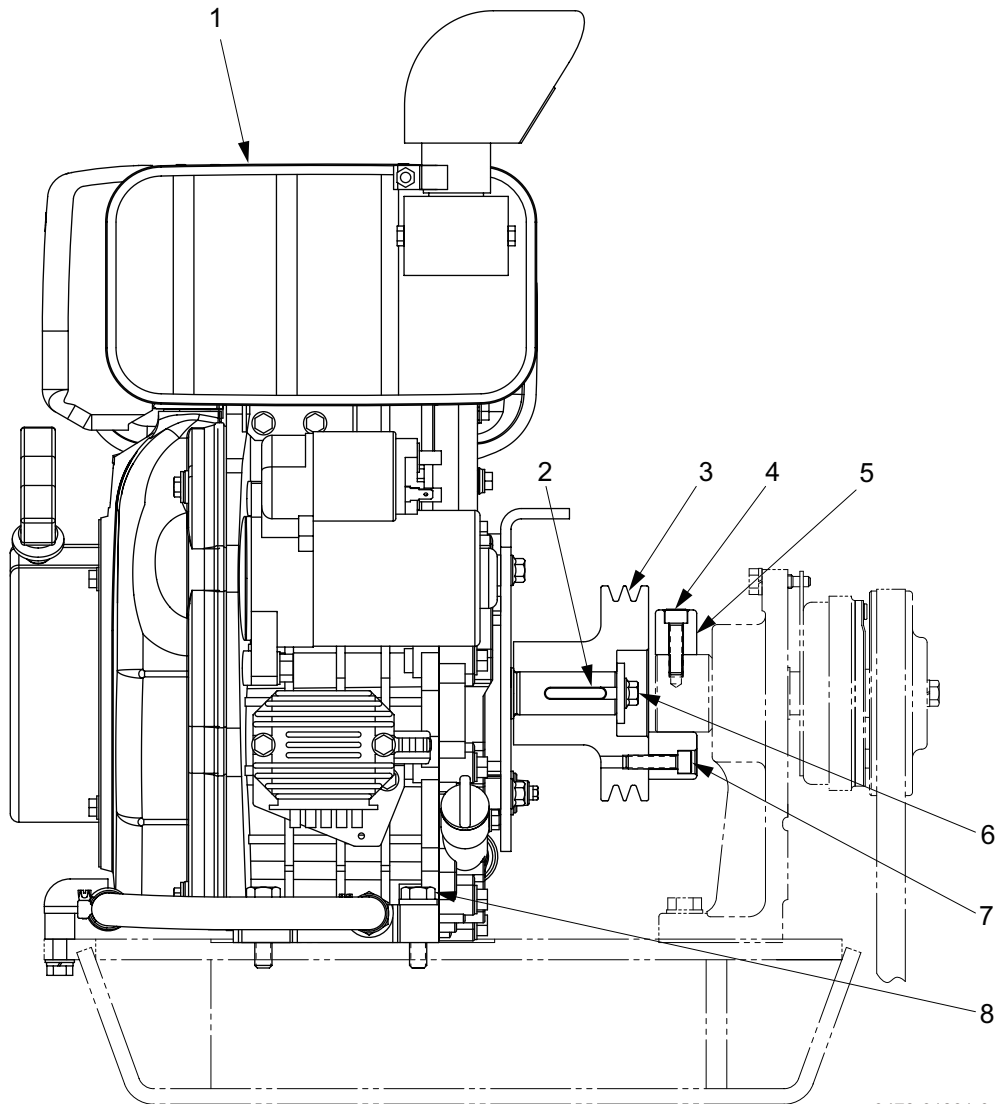
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- | | | | |
|--------------|----------|--------------|----------|
| (1) Bolt | : M 8×30 | (5) Bolt | : M10×50 |
| (2) Coupling | | (6) Sunk key | |
| (3) Clutch | | (7) Bolt | : M 8×20 |
| (4) Engine | | (8) Bolt | : M 8×30 |



- | | |
|-----------------|----------------------|
| (1) Bolt M 8×30 | : 23 N·m (17 lbf·ft) |
| (5) Bolt M10×50 | : 39 N·m (29 lbf·ft) |
| (7) Bolt M 8×20 | : 39 N·m (29 lbf·ft) |
| (8) Bolt M 8×30 | : 23 N·m (17 lbf·ft) |

1-1-3. Engine mount (YANMER engine)



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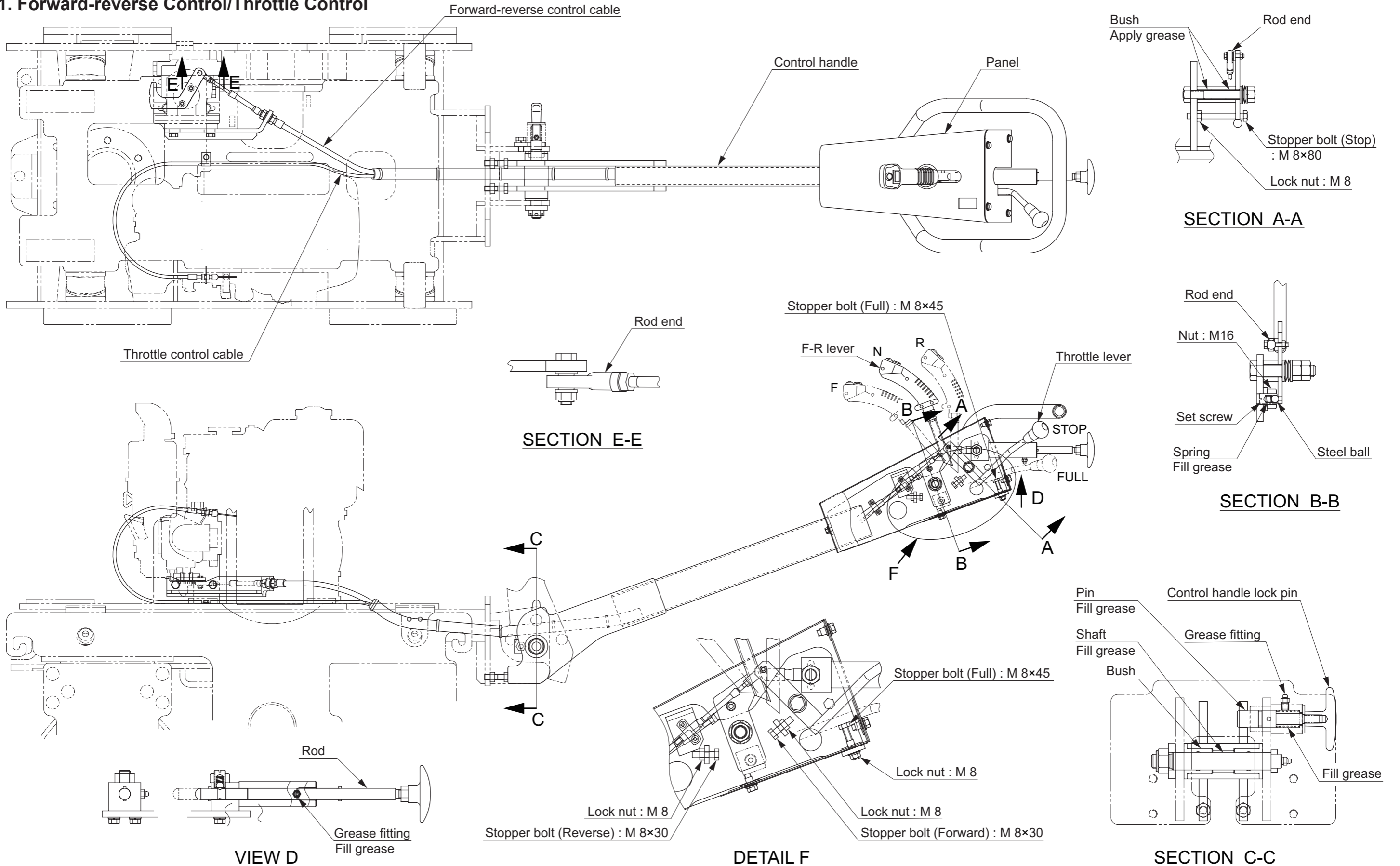
- | | |
|-------------------|-------------------|
| (1) Engine | (5) Coupling |
| (2) Sunk key | (6) Bolt : M 8×20 |
| (3) Pulley | (7) Bolt : M 8×30 |
| (4) Bolt : M 8×30 | (8) Bolt : M10×40 |



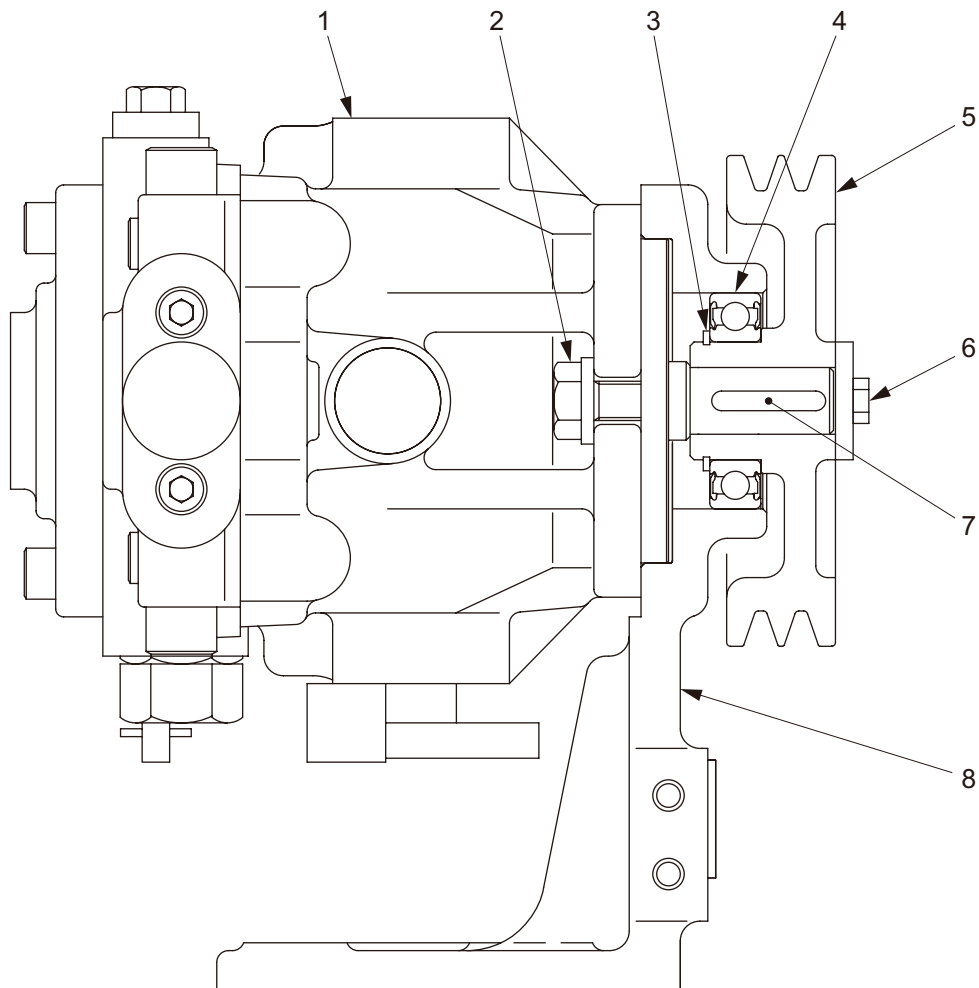
- | | |
|-----------------|----------------------|
| (4) Bolt M 8×30 | : 27 N·m (20 lbf-ft) |
| (6) Bolt M 8×20 | : 17 N·m (13 lbf-ft) |
| (7) Bolt M 8×30 | : 27 N·m (20 lbf-ft) |
| (8) Bolt M10×40 | : 39 N·m (29 lbf-ft) |

2. CONTROL SYSTEMS

2-1. Forward-reverse Control/Throttle Control



3. PUMP MOUNT



0472-36001-1-20203-A

- | | | | |
|--------------------|----------|--------------|----------|
| (1) Pump | | (5) Pulley | |
| (2) Bolt | : M10×30 | (6) Bolt | : M 6×16 |
| (3) Retaining ring | | (7) Sunk key | |
| (4) Ball bearing | | (8) Bracket | |

HYDRAULIC SYSTEMS

1. SYSTEM CIRCUIT DIAGRAM

1-1. Graphic Symbols for Hydraulic Circuits



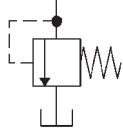

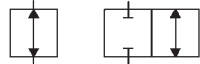
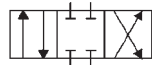

Basic Symbols

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.	


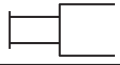

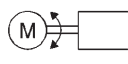
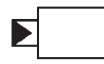

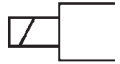
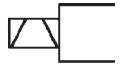

Pump, Motors and Cylinders

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	

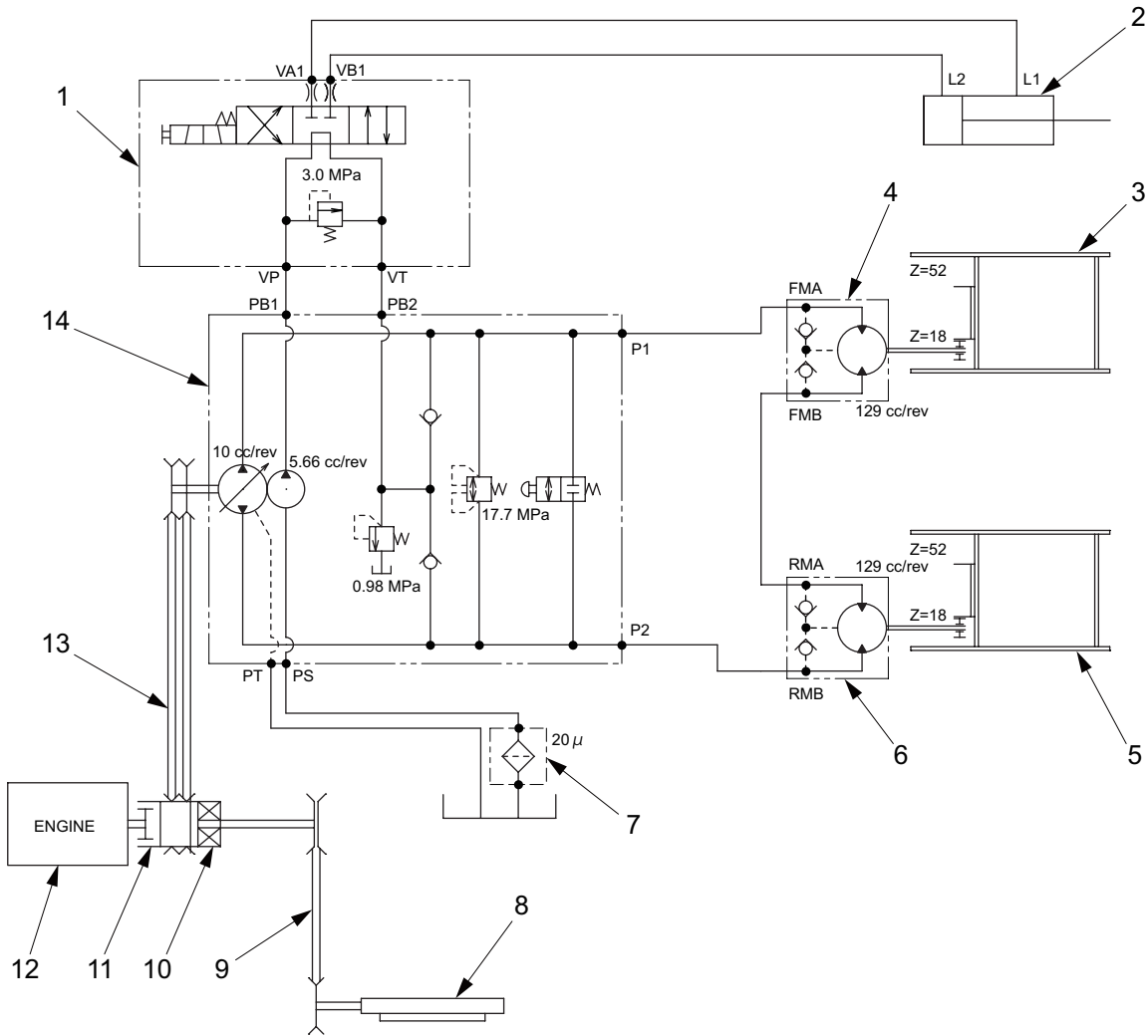
Valves

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.	

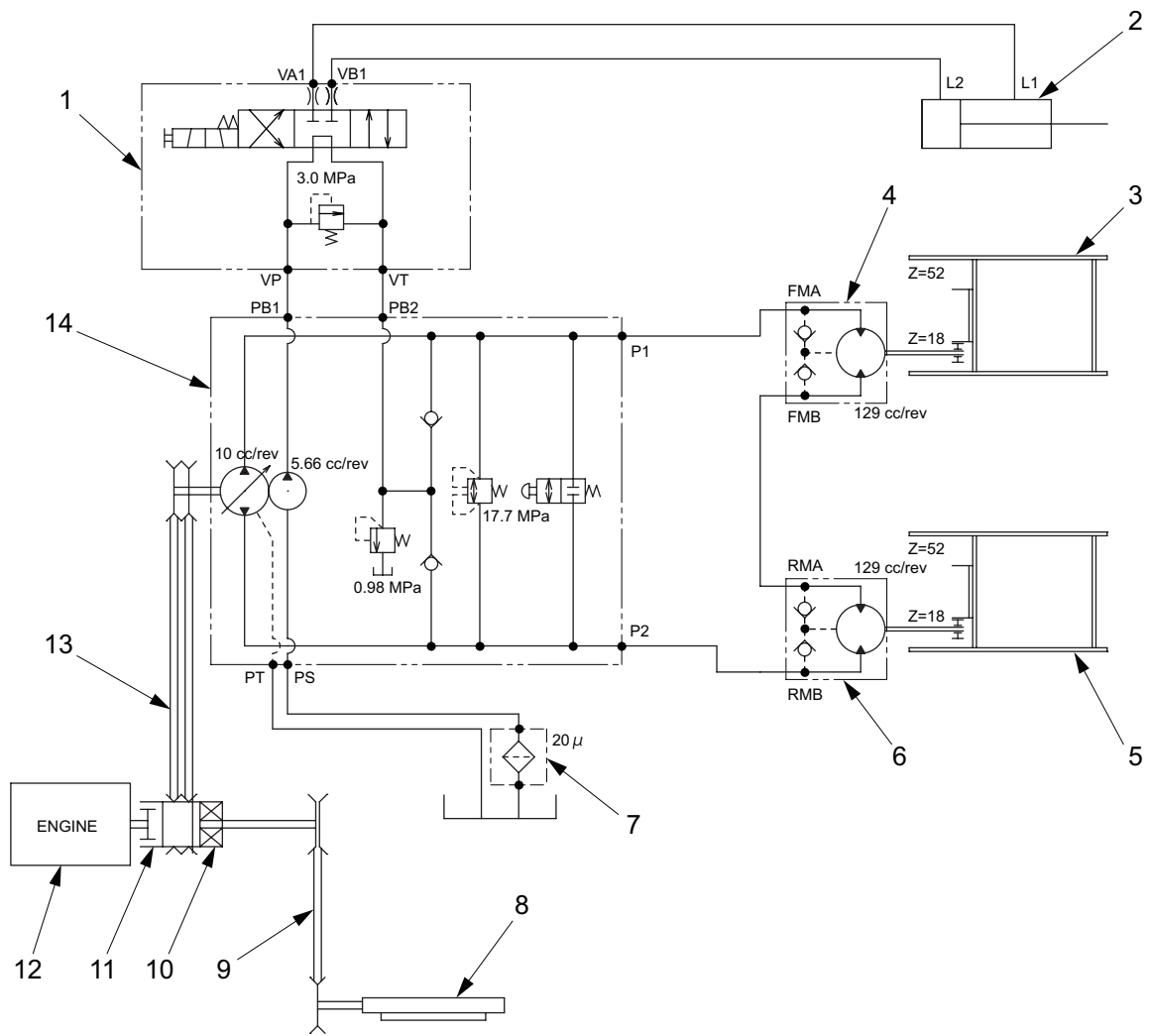
1-2. Hydraulic Circuit Diagram (KUBOTA Engine Type)



0478-99012-0-20198-0

- | | | |
|------------------------------|-----------------------------|----------------------|
| (1) Valve block | (6) Propulsion motor (Rear) | (11) Clutch |
| (2) Steering cylinder | (7) Hydraulic oil filter | (12) Engine |
| (3) Drum (Front) | (8) Eccentric shaft | (13) V-belt |
| (4) Propulsion motor (Front) | (9) V-belt | (14) Propulsion pump |
| (5) Drum (Rear) | (10) Coupling | |

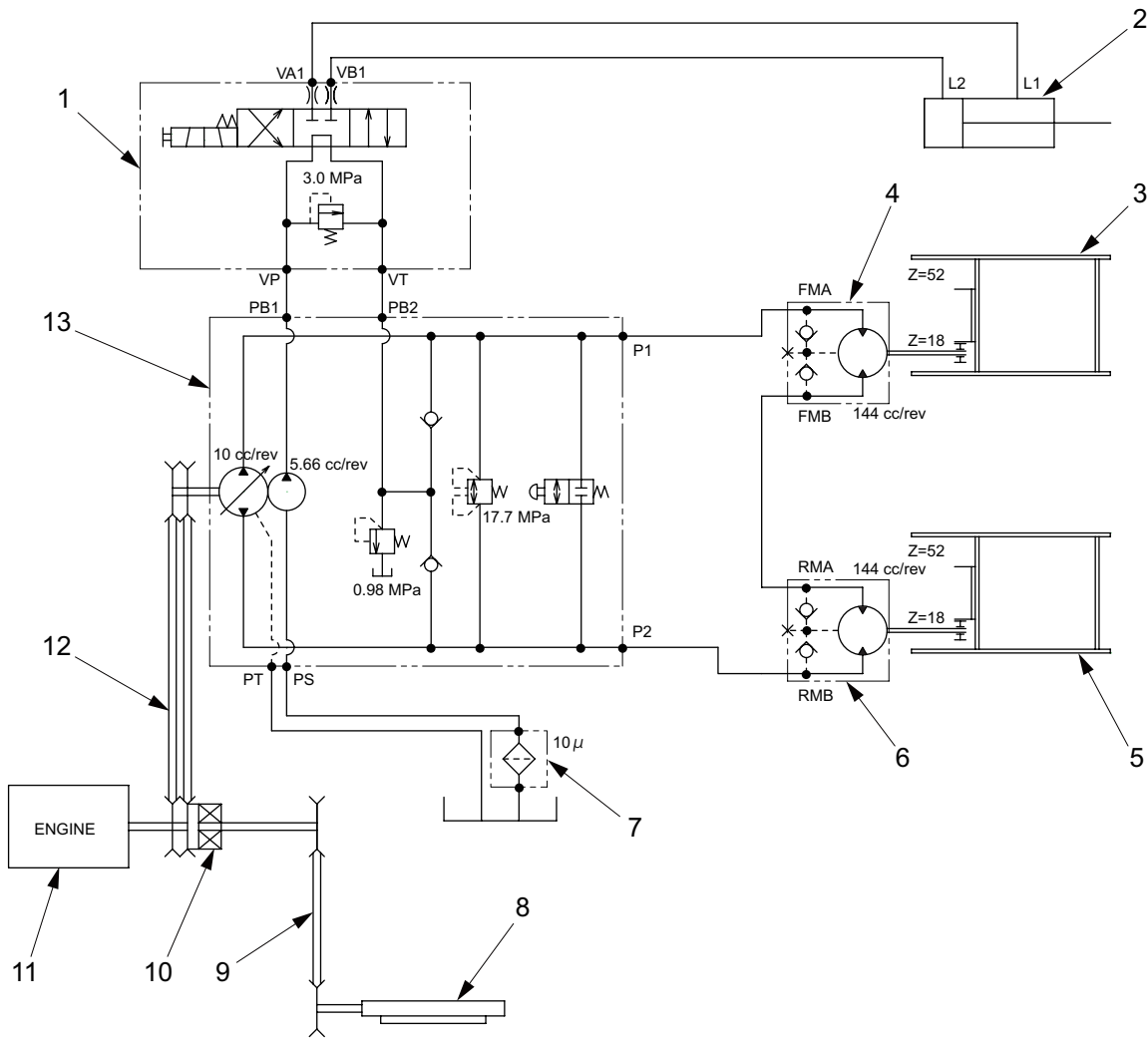
1-3. Hydraulic Circuit Diagram (HONDA Engine Type)



0478-99013-0-20199-0

- | | | |
|------------------------------|-----------------------------|----------------------|
| (1) Valve block | (6) Propulsion motor (Rear) | (11) Clutch |
| (2) Steering cylinder | (7) Hydraulic oil filter | (12) Engine |
| (3) Drum (Front) | (8) Eccentric shaft | (13) V-belt |
| (4) Propulsion motor (Front) | (9) V-belt | (14) Propulsion pump |
| (5) Drum (Rear) | (10) Coupling | |

1-4. Hydraulic Circuit Diagram (YANMER Engine Type)



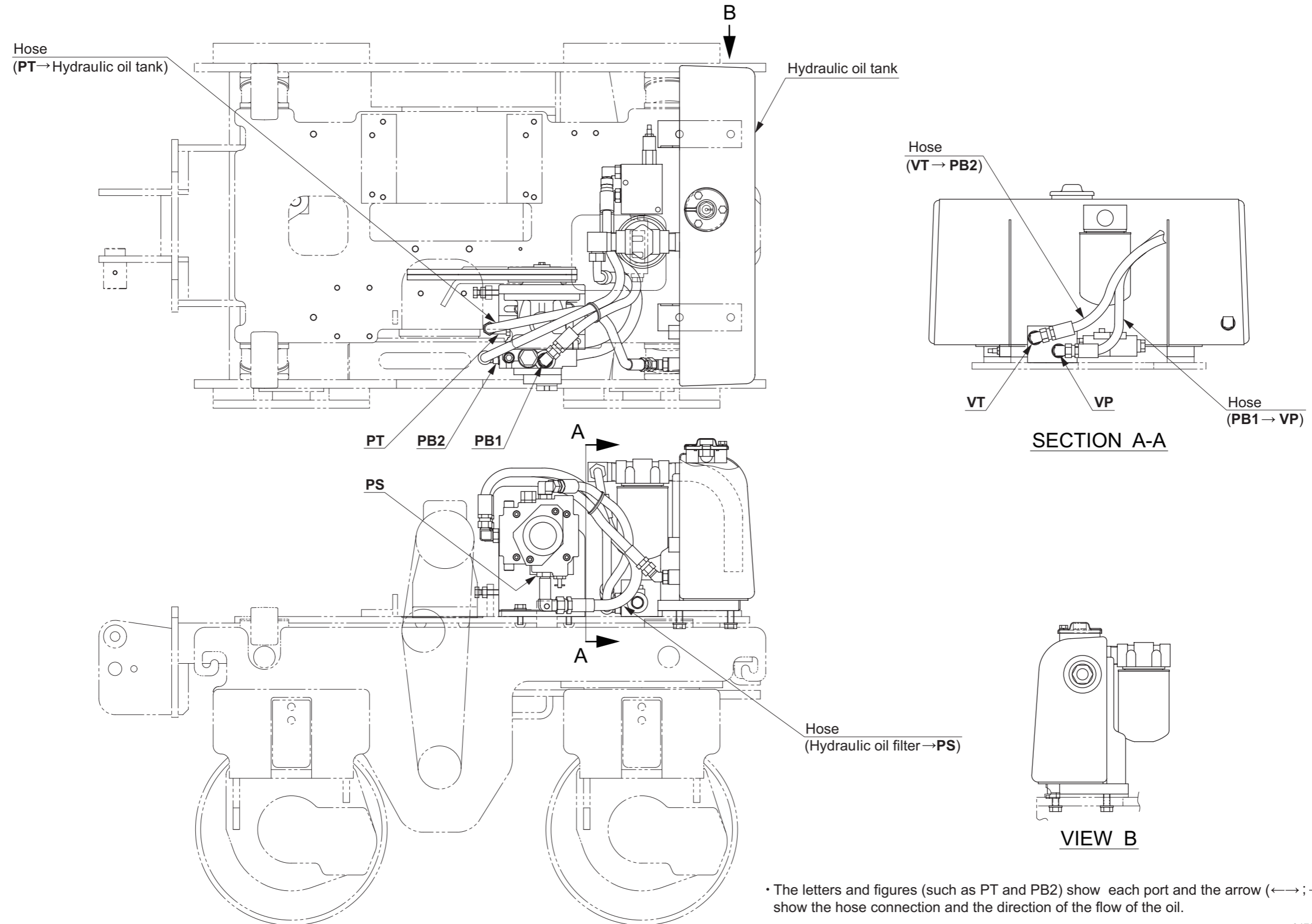
0478-99025-0-10326-0

- | | | |
|------------------------------|-----------------------------|----------------------|
| (1) Valve block | (6) Propulsion motor (Rear) | (11) Engine |
| (2) Steering cylinder | (7) Hydraulic oil filter | (12) V-belt |
| (3) Drum (Front) | (8) Eccentric shaft | (13) Propulsion pump |
| (4) Propulsion motor (Front) | (9) V-belt | |
| (5) Drum (Rear) | (10) Coupling | |

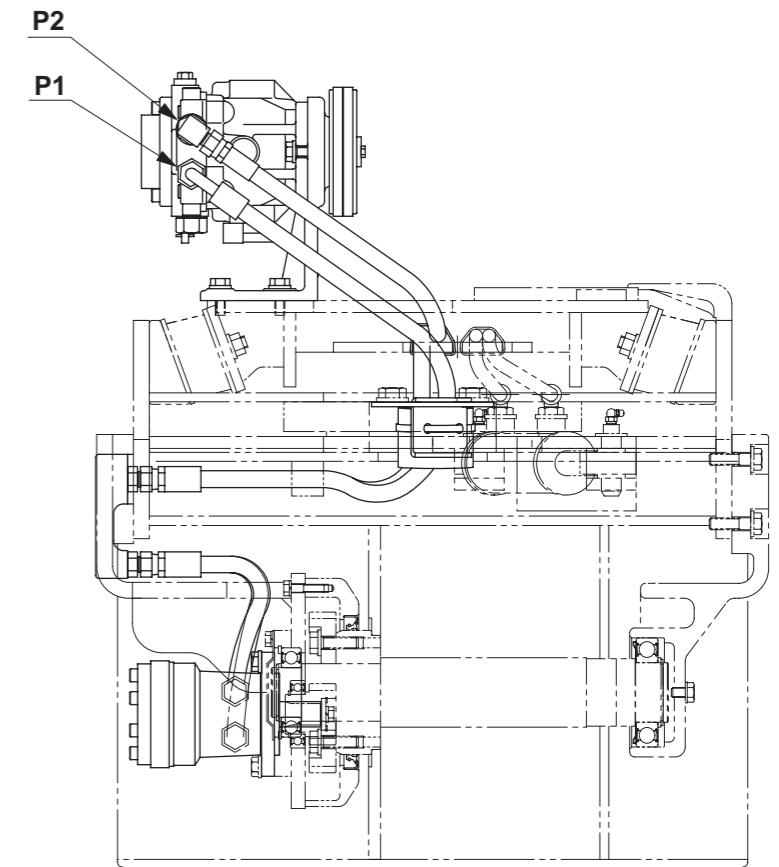
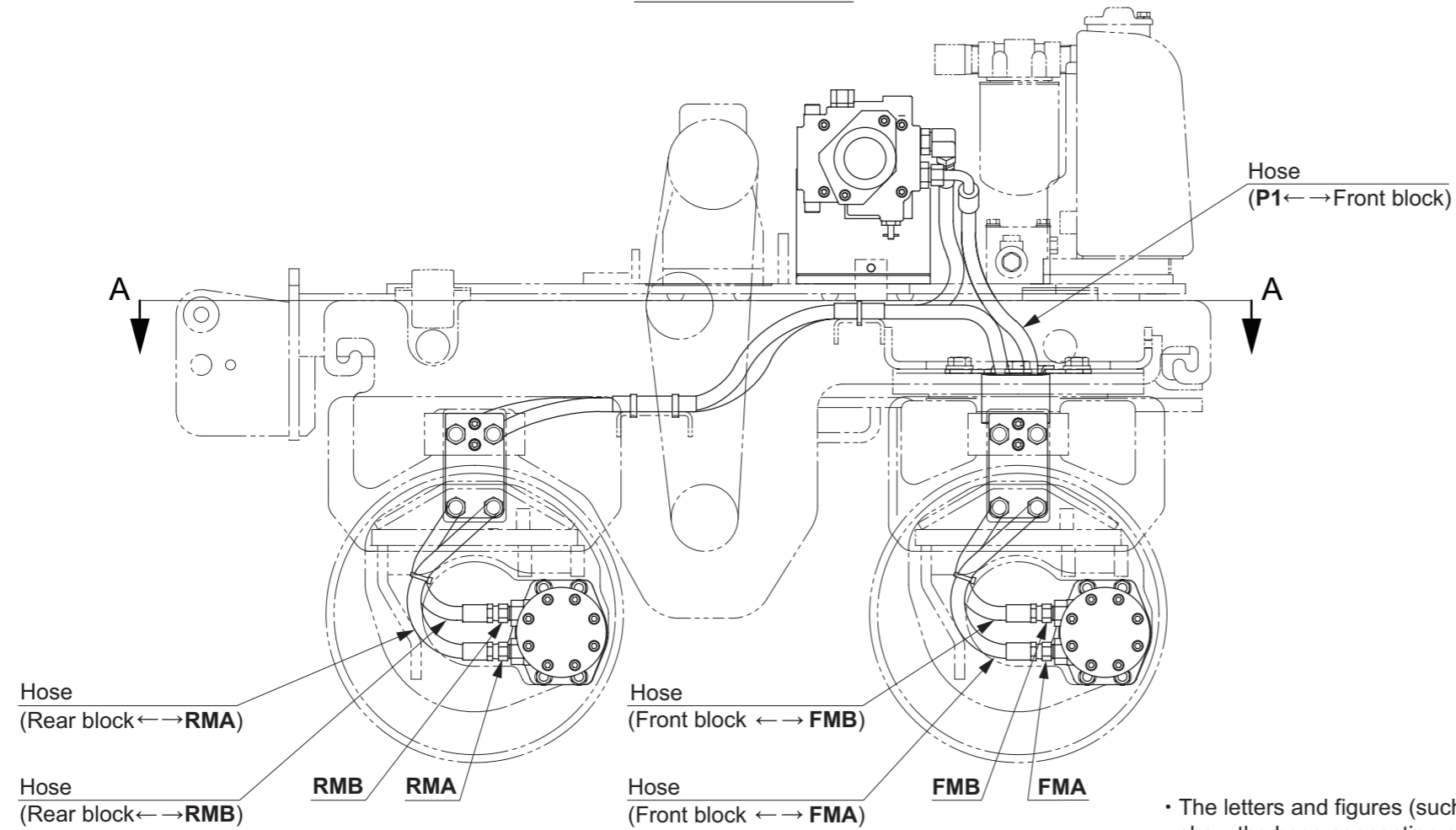
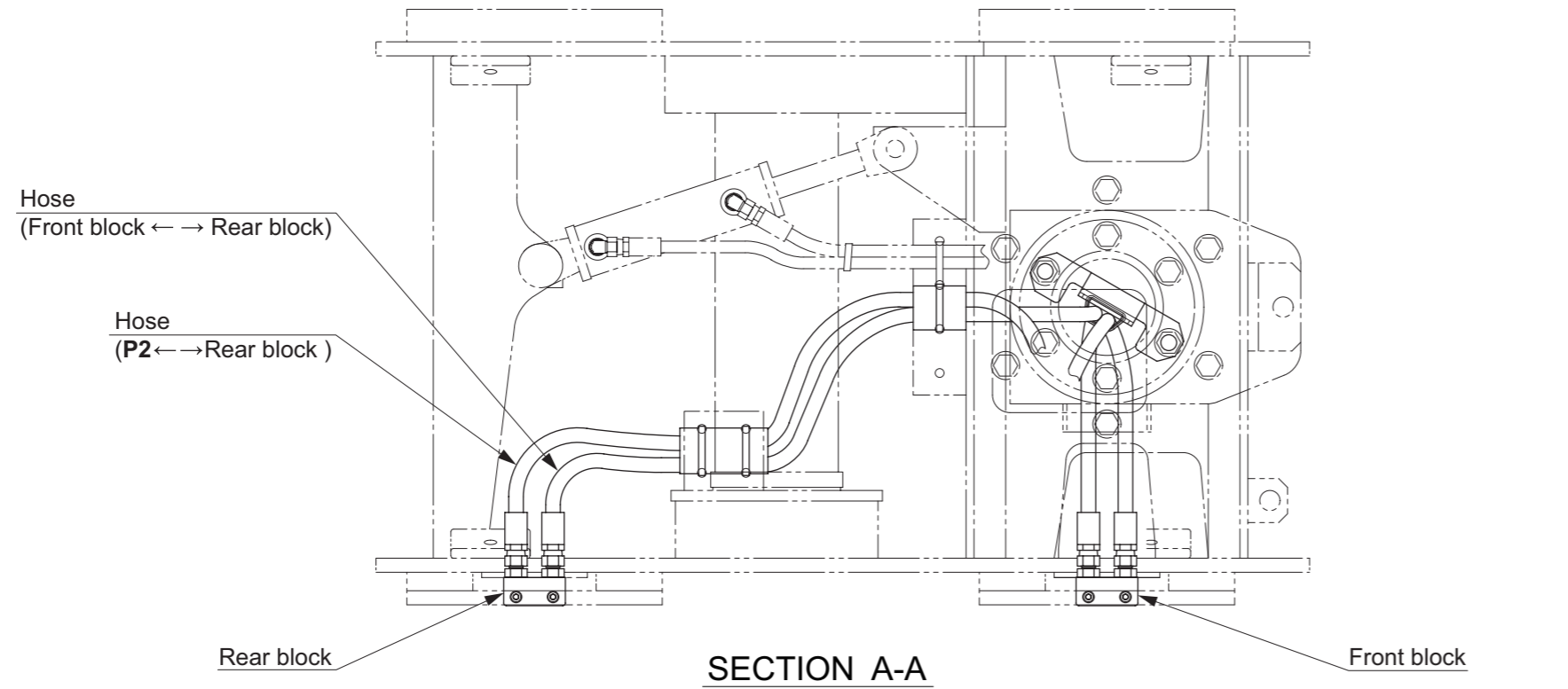
2. PROPULSION HYDRAULIC SYSTEM

2-1. Propulsion Hydraulic Piping

2-1-1. Propulsion hydraulic piping (1)



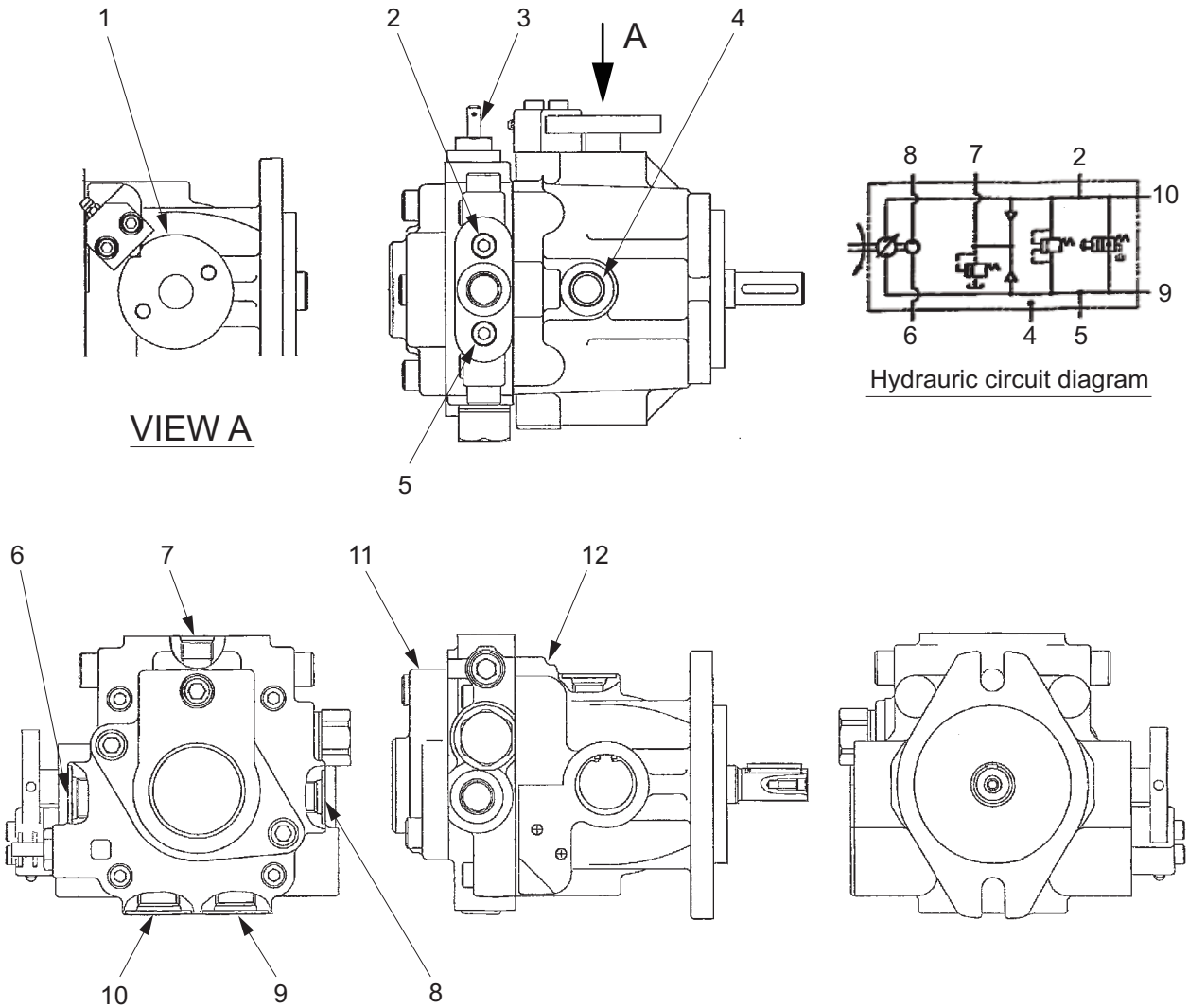
2-1-2. Propulsion hydraulic piping (2)



• The letters and figures (such as FMA and FMB) show each port and the arrow (←→ ; →) symbols show the hose connection and the direction of the flow of the oil.

2-2. Hydraulic Component Specifications

2-2-1. Hydraulic pump (1)



HS67ST-04001

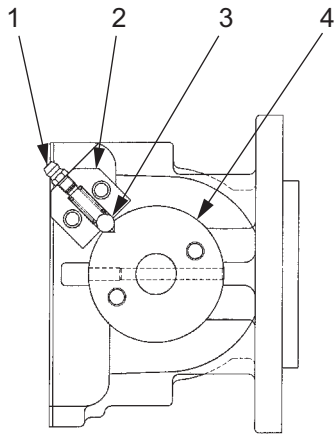
- | | | |
|--|------------------------|---------------------|
| (1) Cam | (7) Port B2 | [PB2] : G3/8 |
| (2) High pressure gauge port (Port P1) : RC1/4 | (8) Port B1 | [PB1] : G3/8 |
| (3) Unload valve | (9) Port P2 (Reverse) | [P2] : G1/2 |
| (4) Port T (Drain) [PT] : G3/8 | (10) Port P1 (Forward) | [P1] : G1/2 |
| (5) High pressure gauge port (Port P2) : RC1/4 | (11) Charge pump | |
| (6) Port S [PS] : G1/2 | (12) Piston pump | |

Specifications

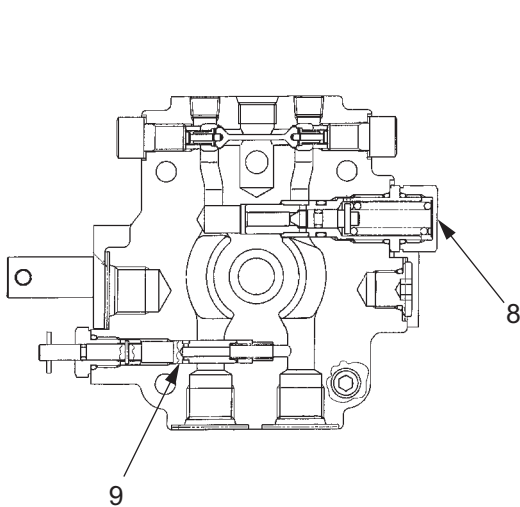
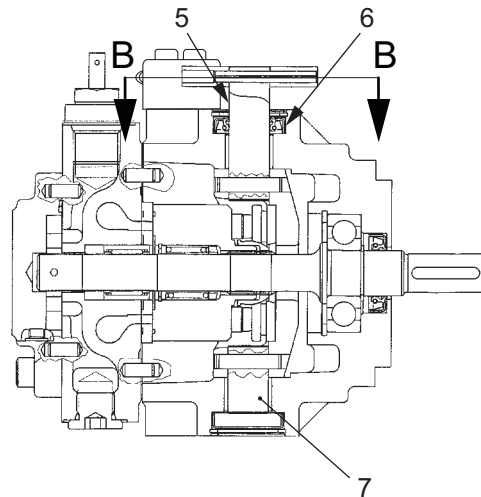
- Displacement

Piston pump	:	0 to 10.0 cm ³ /rev (0 to 0.61 cu.in./rev)
Charge pump	:	5.66 cm ³ /rev (0.345 cu.in./rev)
- Relief valve pressure setting : 17.7 MPa (2,567 psi)
- Charge relief pressure setting : 0.98 MPa (142.1 psi)
- Pump assembly weight : 7.3 kg (16.1 lbs.)

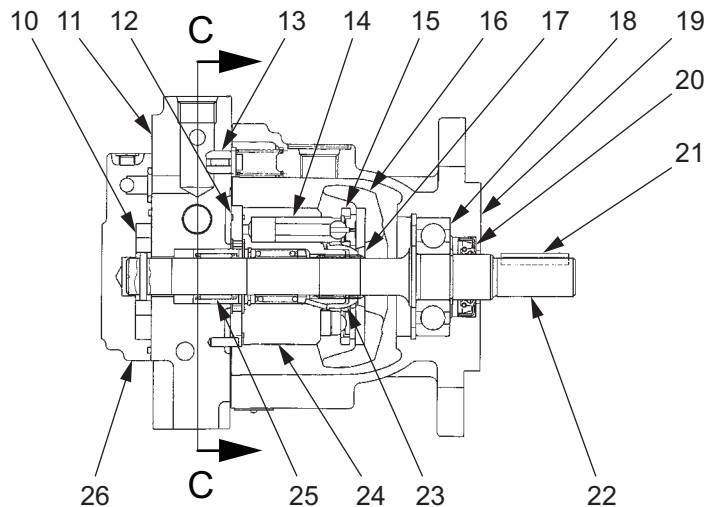
1) Internal structure of propulsion hydraulic pump



SECTION B-B



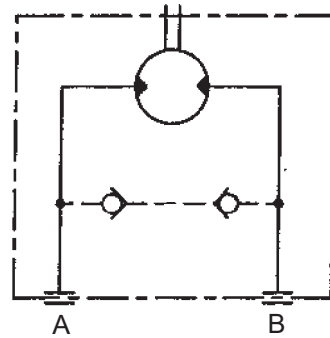
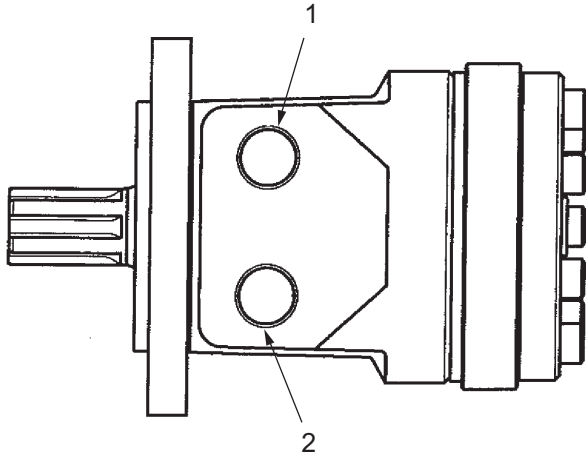
SECTION C-C



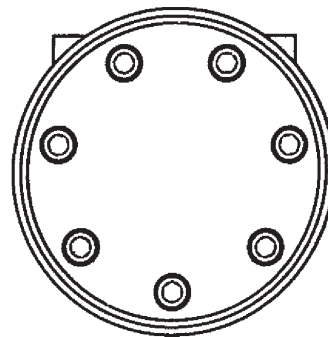
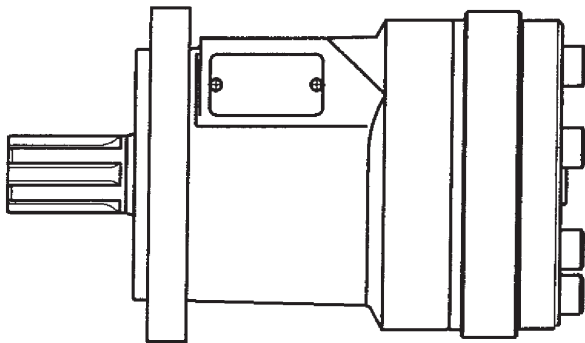
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- | | |
|---------------------|-----------------------|
| (1) Grease fitting | (14) Piston assembly |
| (2) Holder | (15) Retainer plate |
| (3) Steel ball | (16) Swash plate |
| (4) Cam | (17) Thrust plate |
| (5) Trunnion | (18) Ball bearing |
| (6) Oil seal | (19) Case |
| (7) Trunnion pin | (20) Oil seal |
| (8) Valve | (21) Sunk key |
| (9) Spool | (22) Shaft |
| (10) Trochoid rotor | (23) Retainer holder |
| (11) Port block | (24) Cylinder block |
| (12) Valve plate | (25) Needle bearing |
| (13) Valve | (26) Charge pump case |

2-2-2. Propulsion hydraulic motor (KUBOTA and HONDA engine types)



Hydraulic circuit diagram



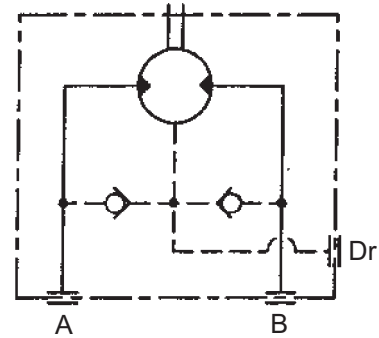
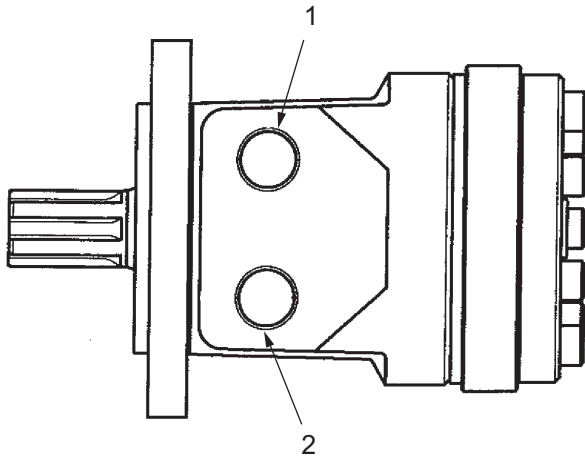
HS67ST-04004

- (1) Port B (Reverse) **[FMB, RMB]** : G1/2
- (2) Port A (Forward) **[FMA, RMA]** : G1/2

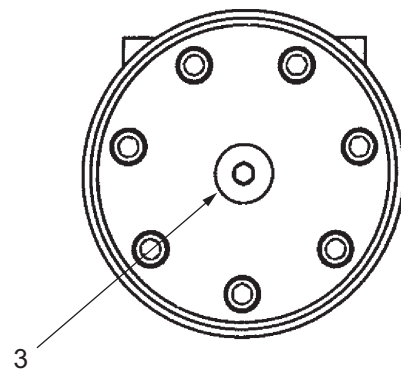
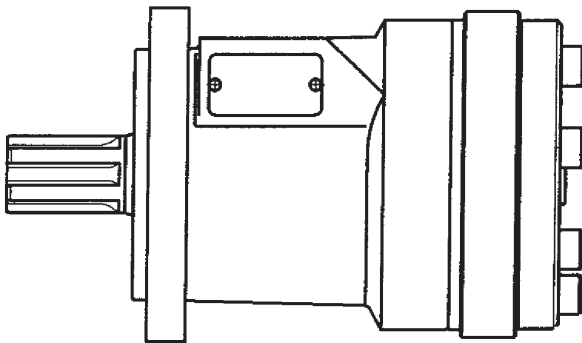
Specifications

- Displacement : 129 cm³/rev (7.87 cu.in./rev)
- Rated pressure : 13.7 MPa (1,987 psi)
- Weight : 7.3 kg (16.1 lbs.)

2-2-3. Propulsion hydraulic motor (YANMER engine type)



Hydraulic circuit diagram



HV80-04002

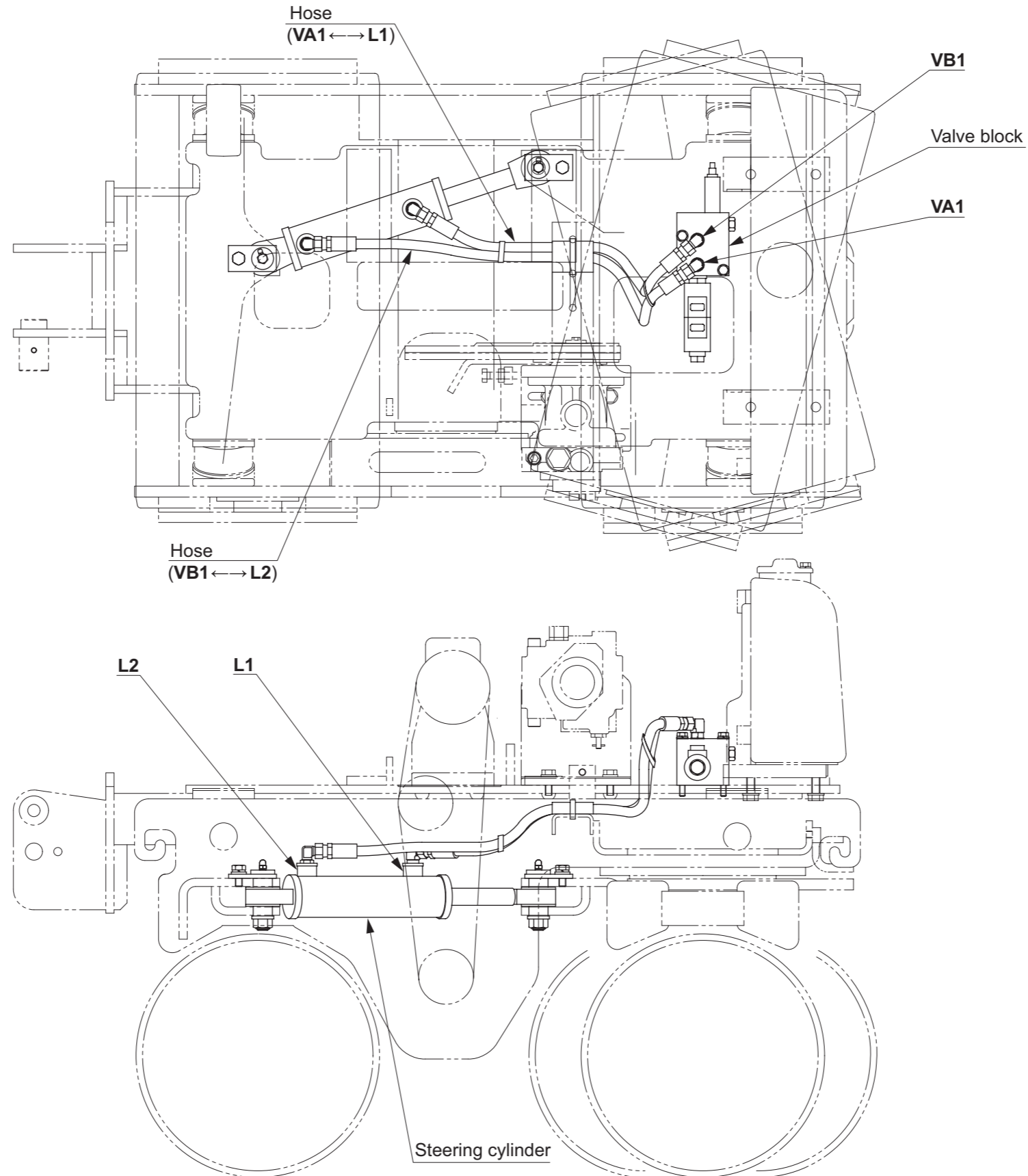
- (1) Port B (Reverse) **[FMB, RMB]** : G1/2
- (2) Port A (Forward) **[FMA, RMA]** : G1/2
- (3) Drain port : G1/4

Specifications

- Displacement : 144 cm³/rev (8.79 cu.in./rev)
- Rated pressure : 13.1 MPa (1,900 psi)
- Weight : 7.3 kg (16.1 lbs.)

3. STEERING SYSTEM

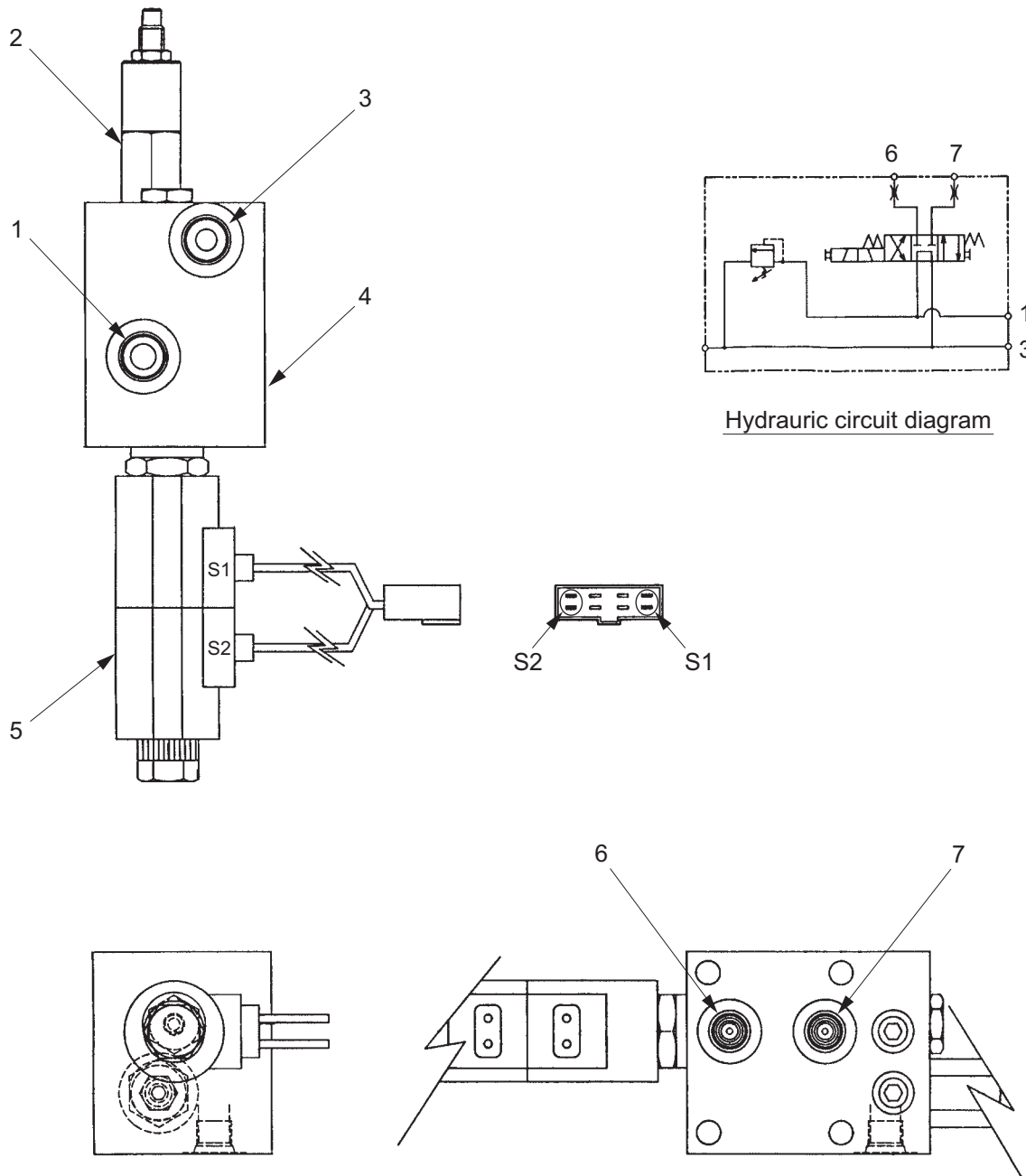
3-1. Steering Hydraulic Piping



• The letters and figures (such as L1 and L2) show each port and the arrow (↔ ; →) symbols show the hose connection and the direction of the flow of the oil.

3-2. Hydraulic Component Specifications

3-2-1. Valve block



Hydraulic circuit diagram

HS67ST-04002

- | | | | |
|------------------|--------------------|--------------------|---------------------|
| (1) Port P | [VP] : G3/8 | (5) Solenoid valve | |
| (2) Relief valve | | (6) Port A1 | [VA1] : G1/4 |
| (3) Port T | [VT] : G3/8 | (7) Port B1 | [VB1] : G1/4 |
| (4) Block | | | |

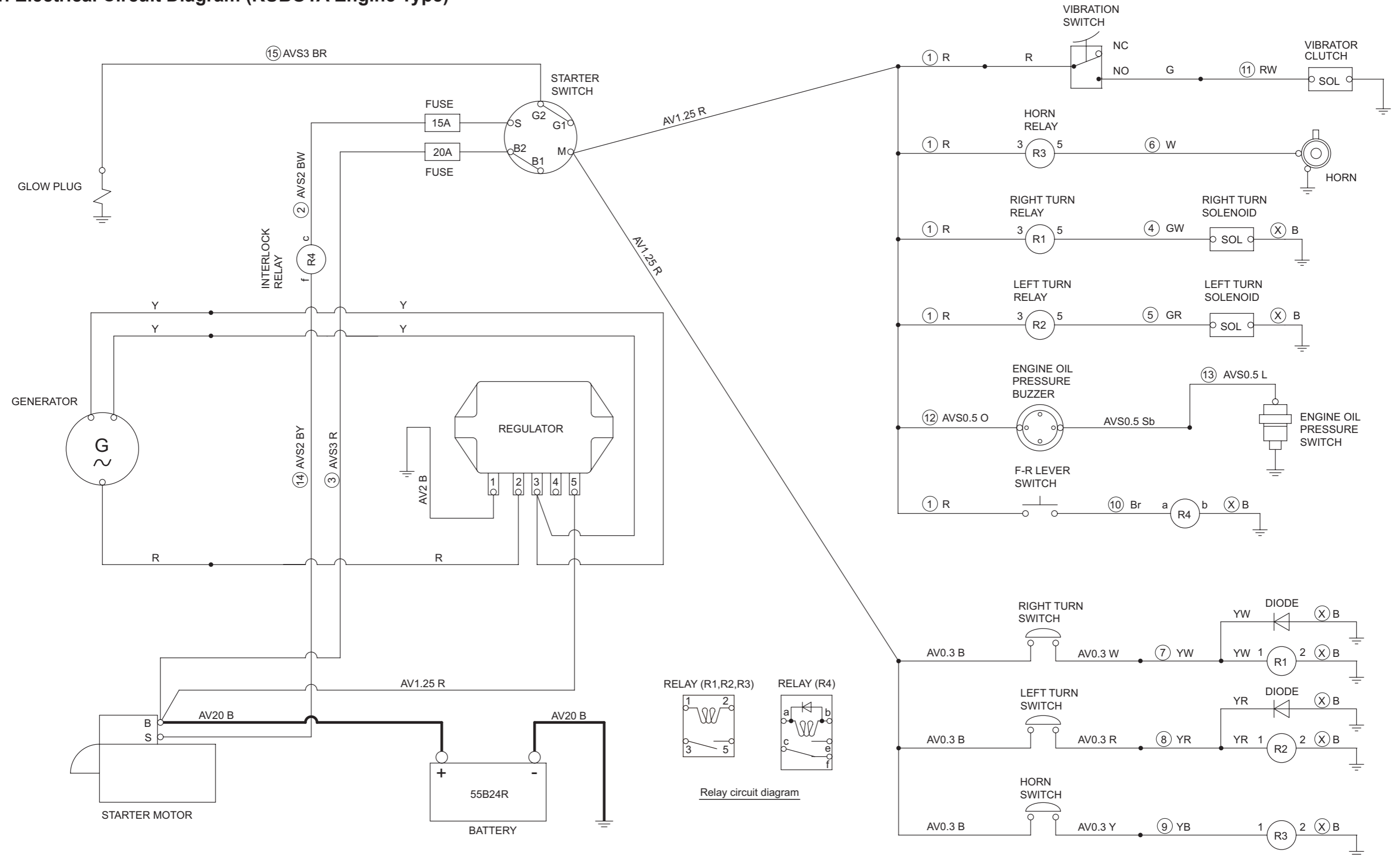
Specifications

- Maximum working pressure : 21 MPa (3,045 psi)
- Maximum flow : 15 L/min (4.0 gal./min)
- Relief valve pressure setting : 3.0 MPa (435 psi)
- Weight : 1.5 kg (3.3 lbs.)

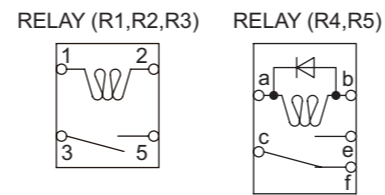
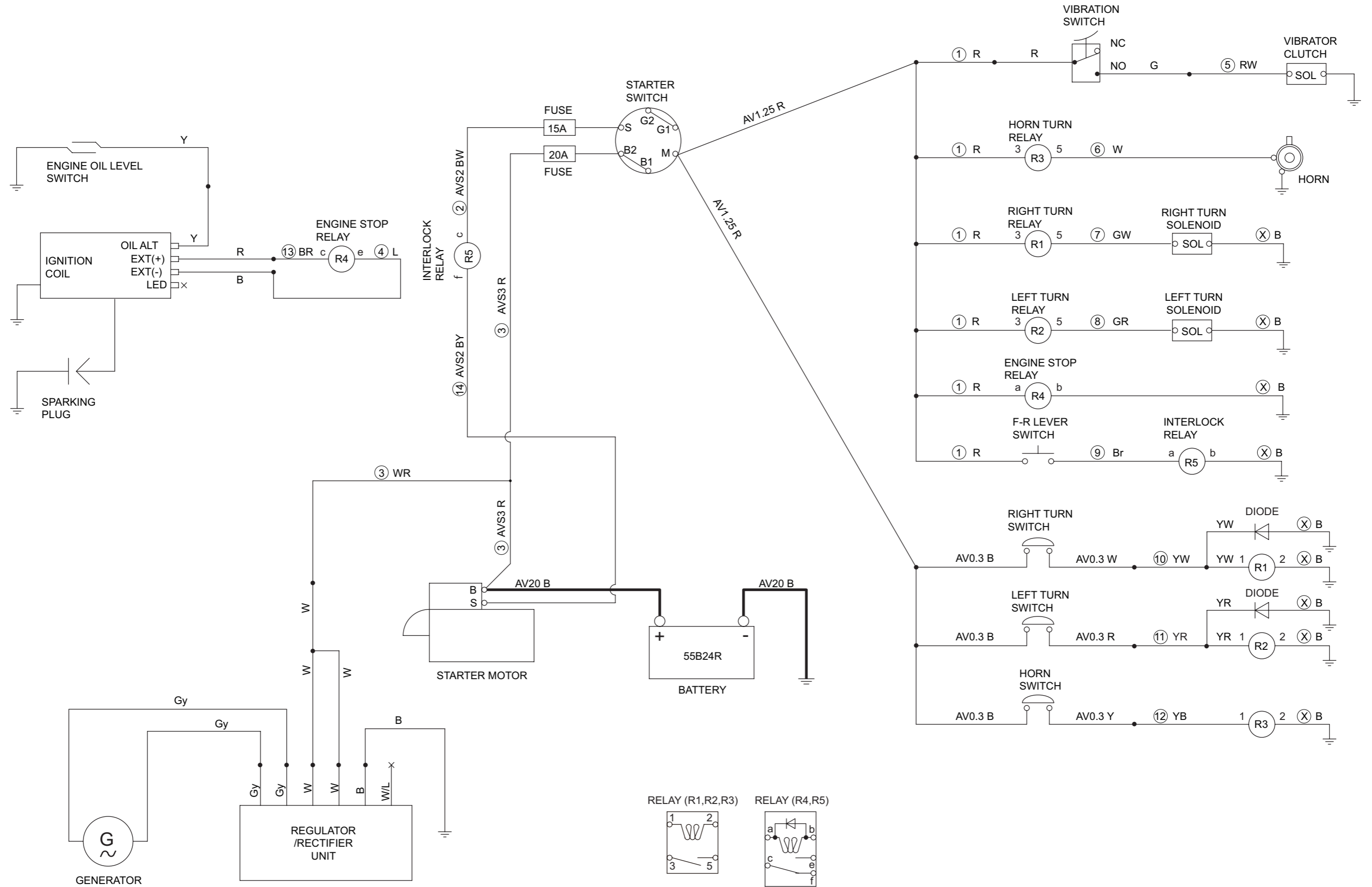
ELECTRICAL SYSTEM

1. SYSTEM CIRCUIT DIAGRAM

1-1. Electrical Circuit Diagram (KUBOTA Engine Type)



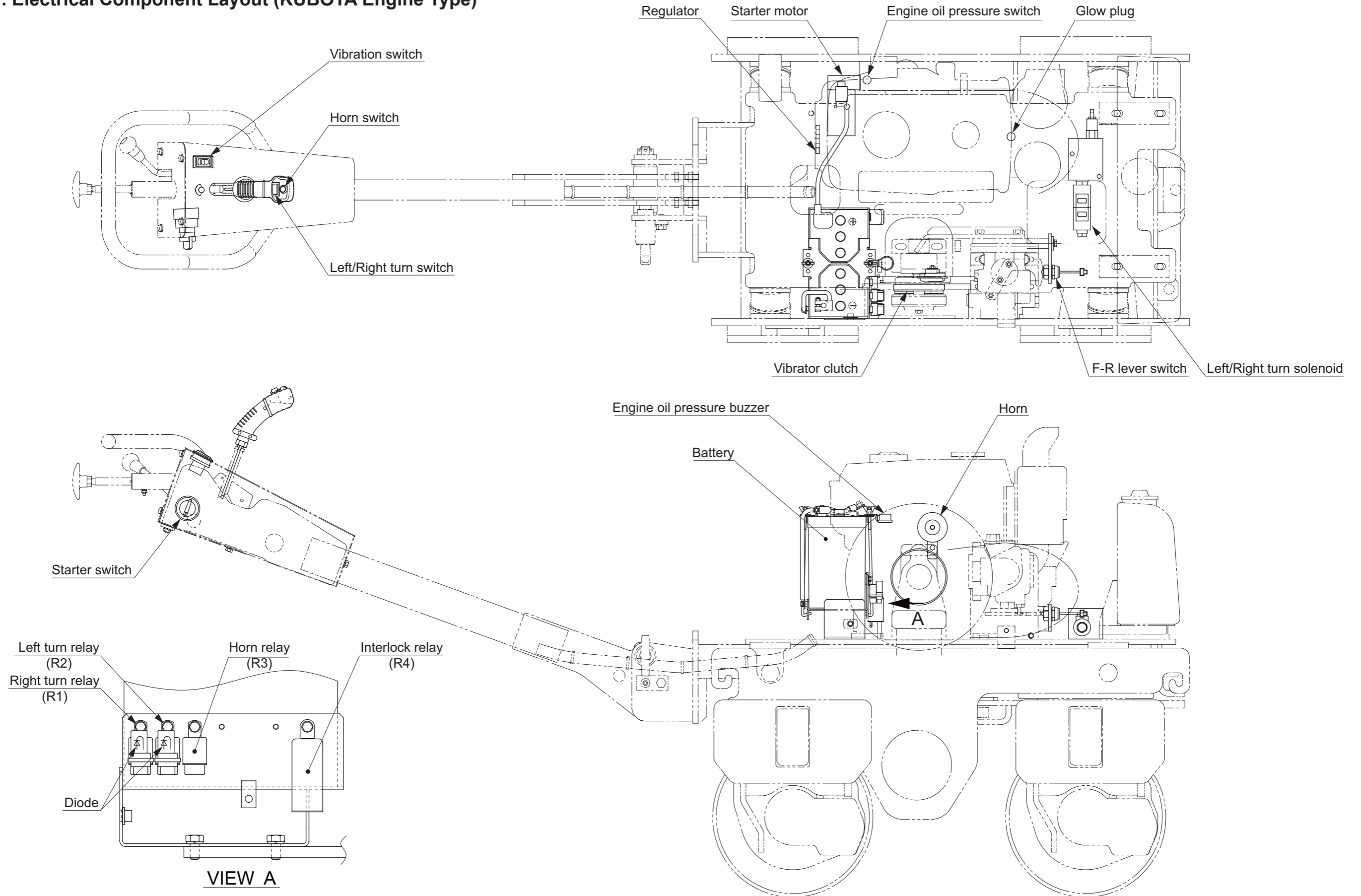
1-2. Electrical Circuit Diagram (HONDA Engine Type)



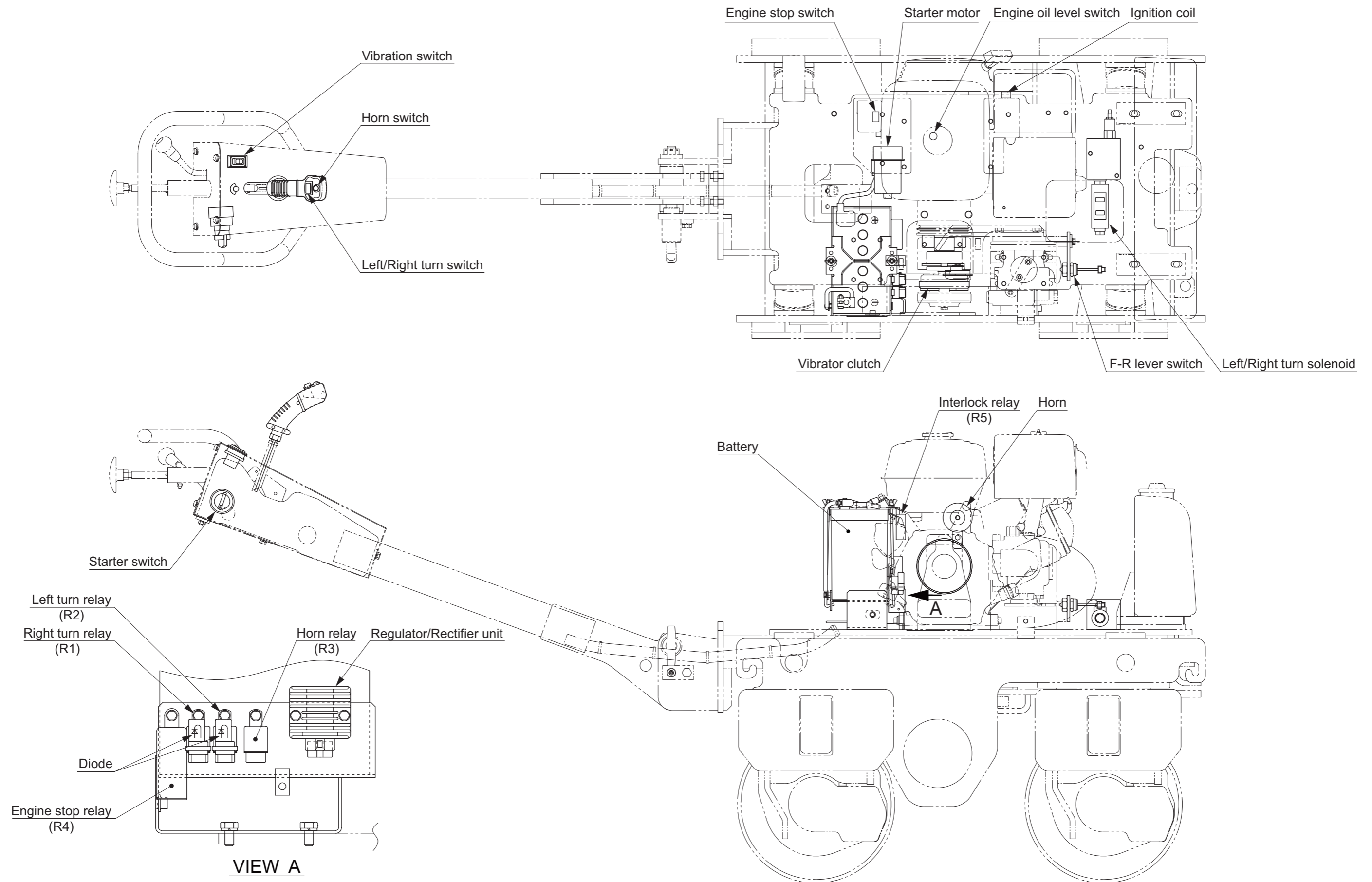
Relay circuit diagram

2. ELECTRICAL COMPONENTS

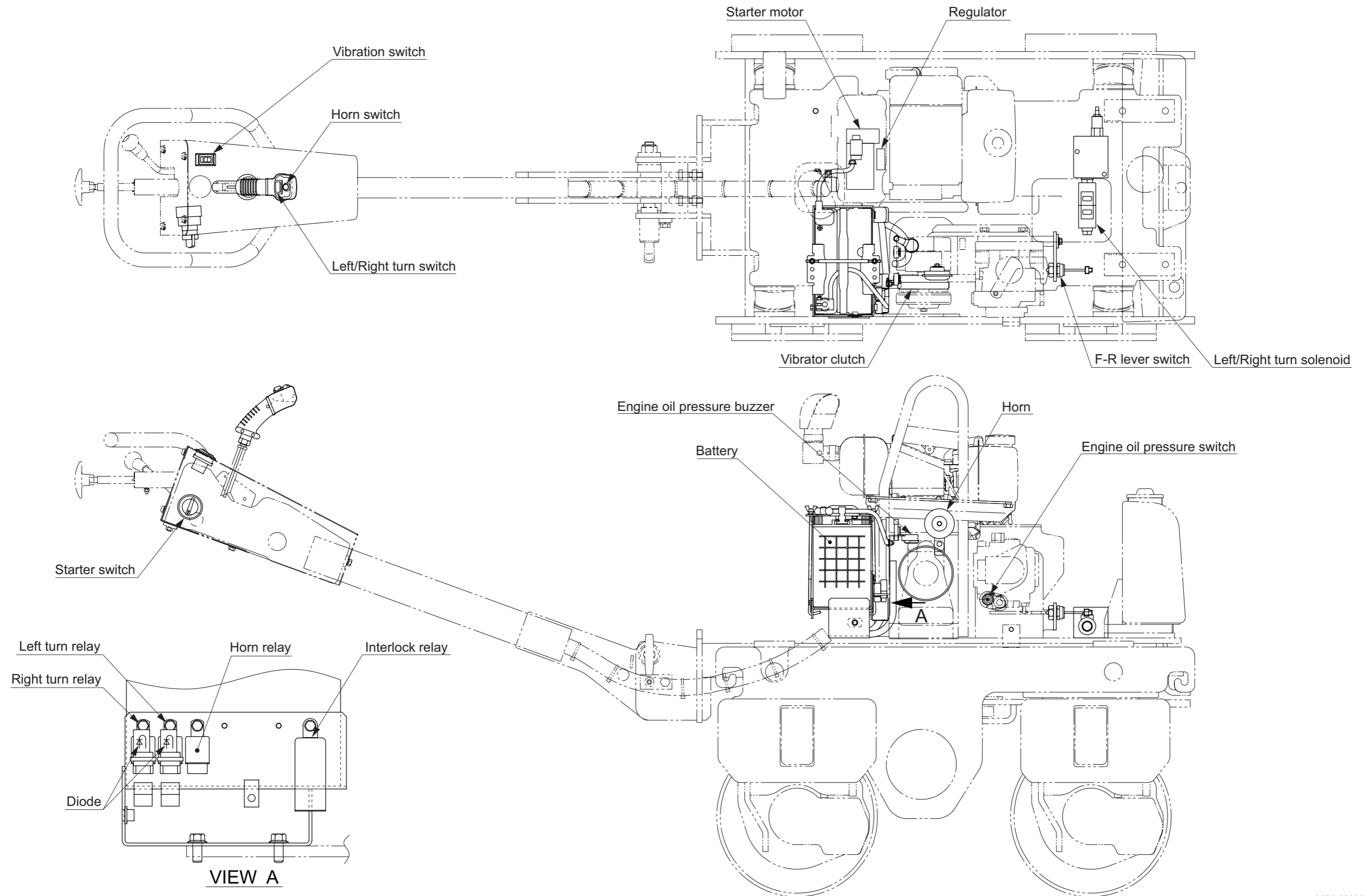
2-1. Electrical Component Layout (KUBOTA Engine Type)



2-2. Electrical Component Layout (HONDA Engine Type)

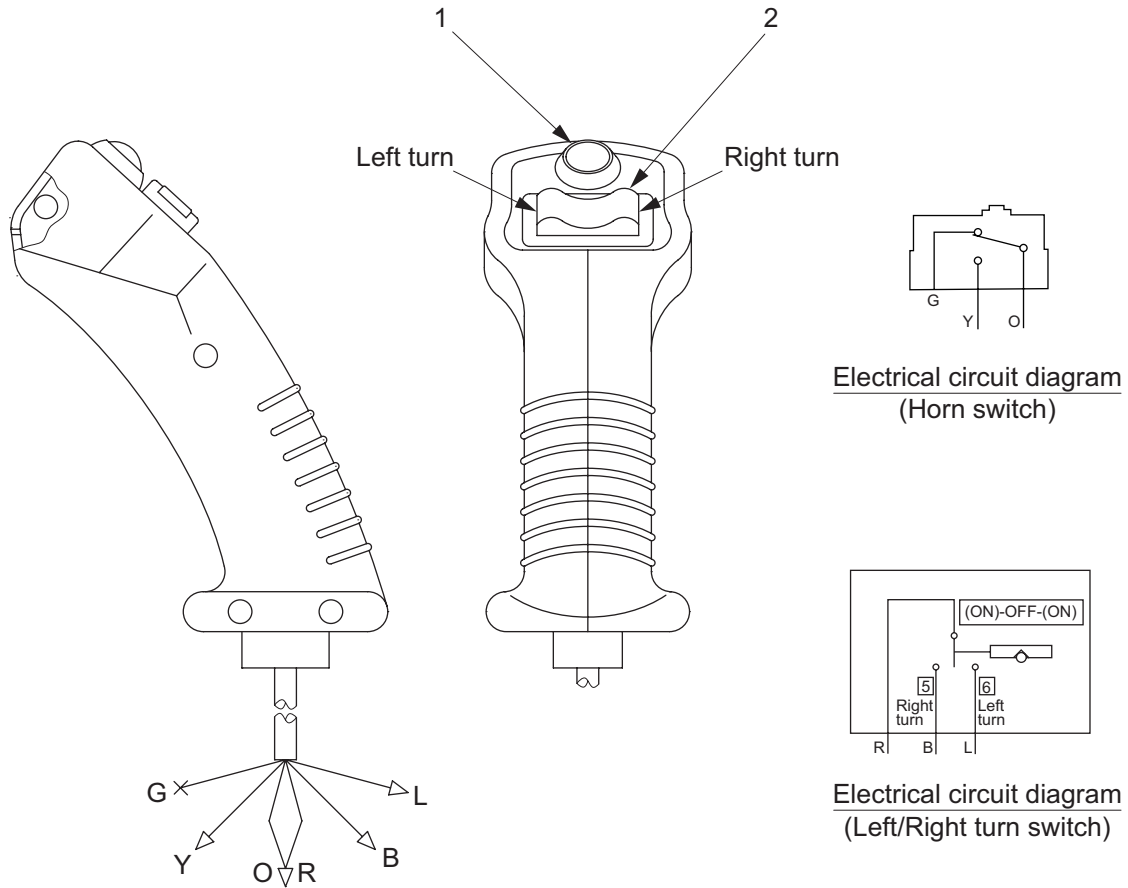


2-3. Electrical Component Layout (YANMER Engine Type)



3. ELECTRICAL COMPONENT SPECIFICATIONS

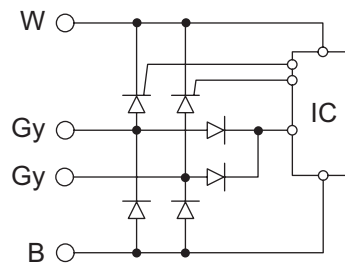
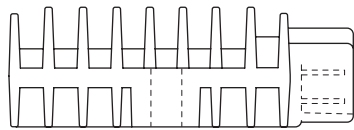
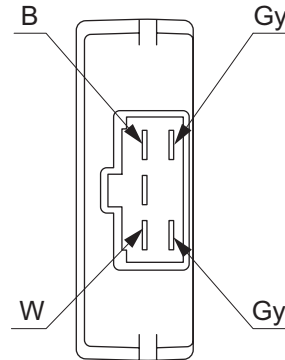
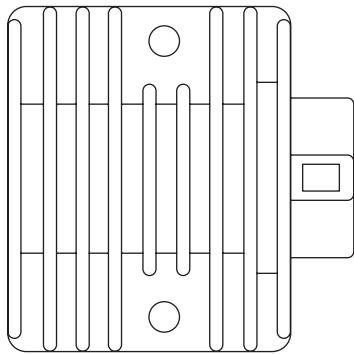
3-1. Lever Switch



HS67ST-05001

- (1) Horn switch
- (2) Left/Right turn switch

3-2. Regulator/Rectifier Unit (HONDA Engine Type)



Electrical circuit diagram

HS67ST-05002

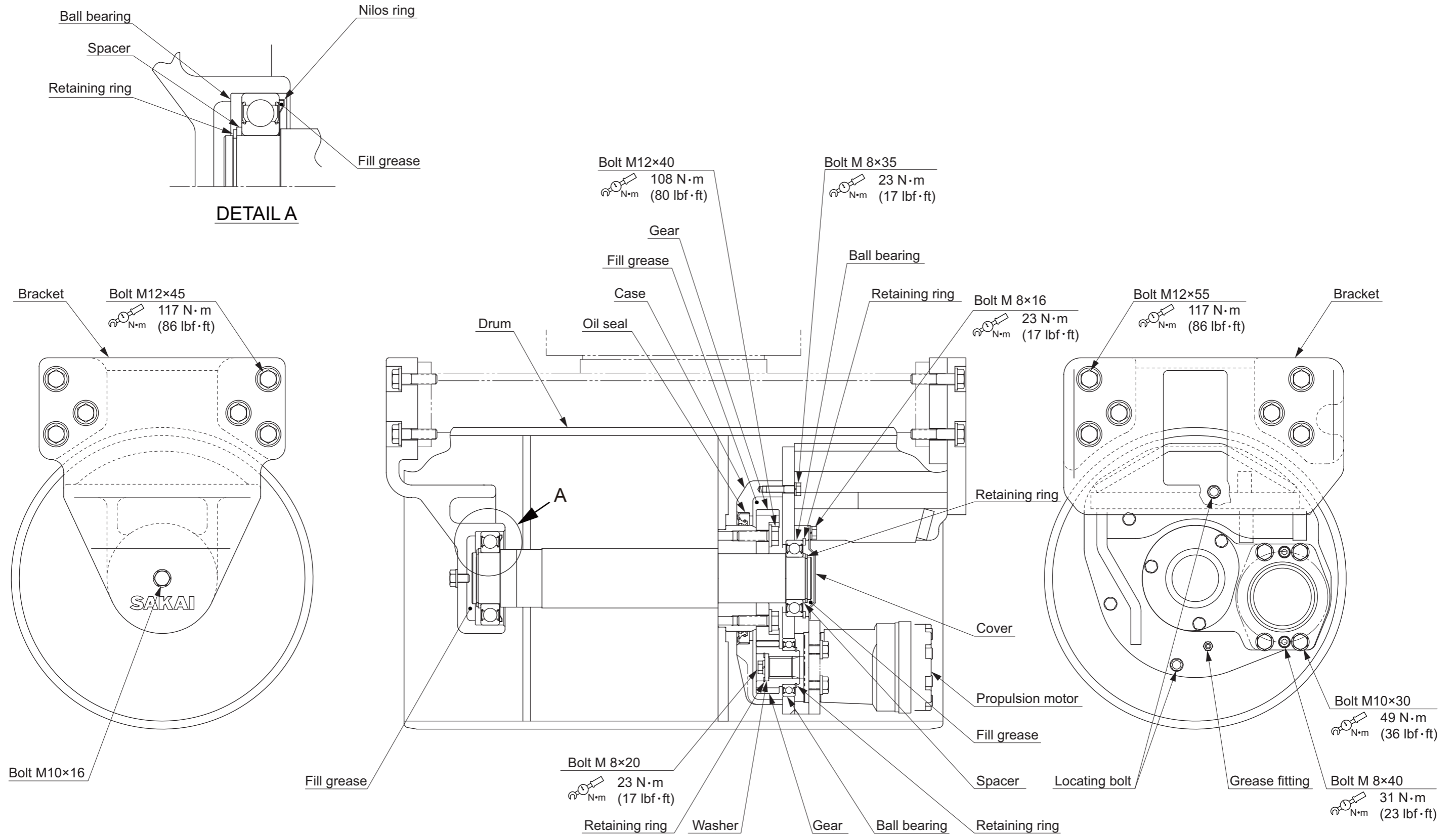
Specifications

- Average rectified current : 10 A
- Regulated voltage : 14.5 ± 0.5 V

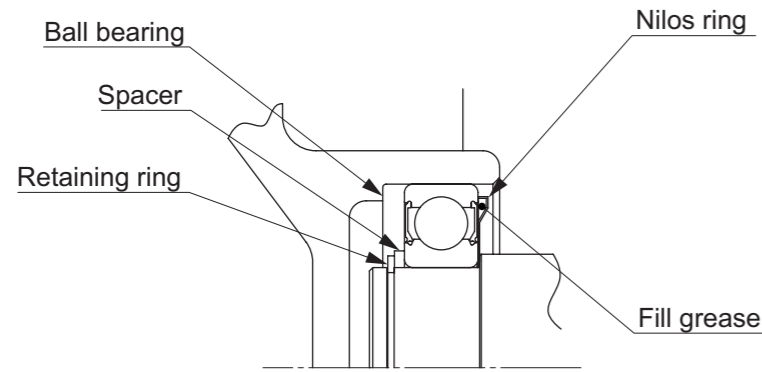
DRUMS

1. DRUMS

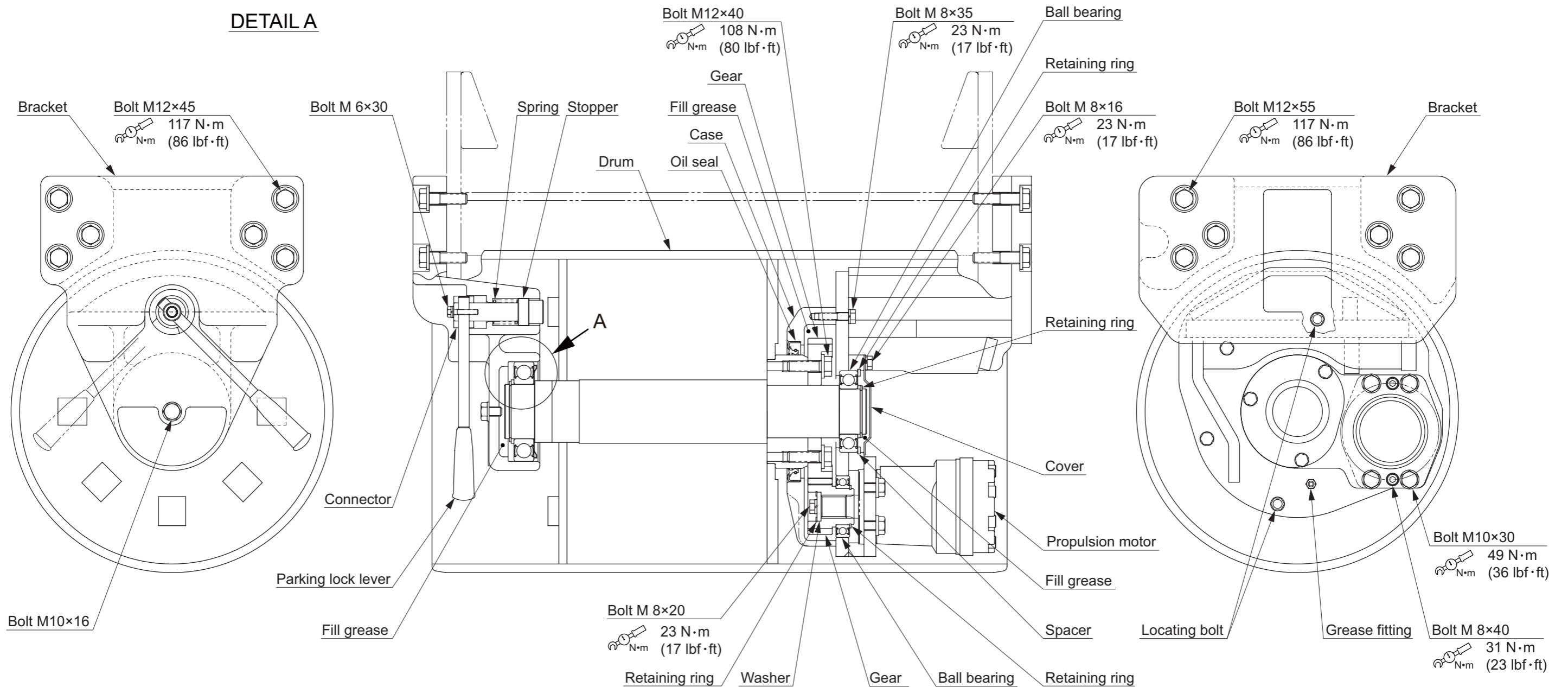
1-1. Front Drum



1-2. Rear Drum



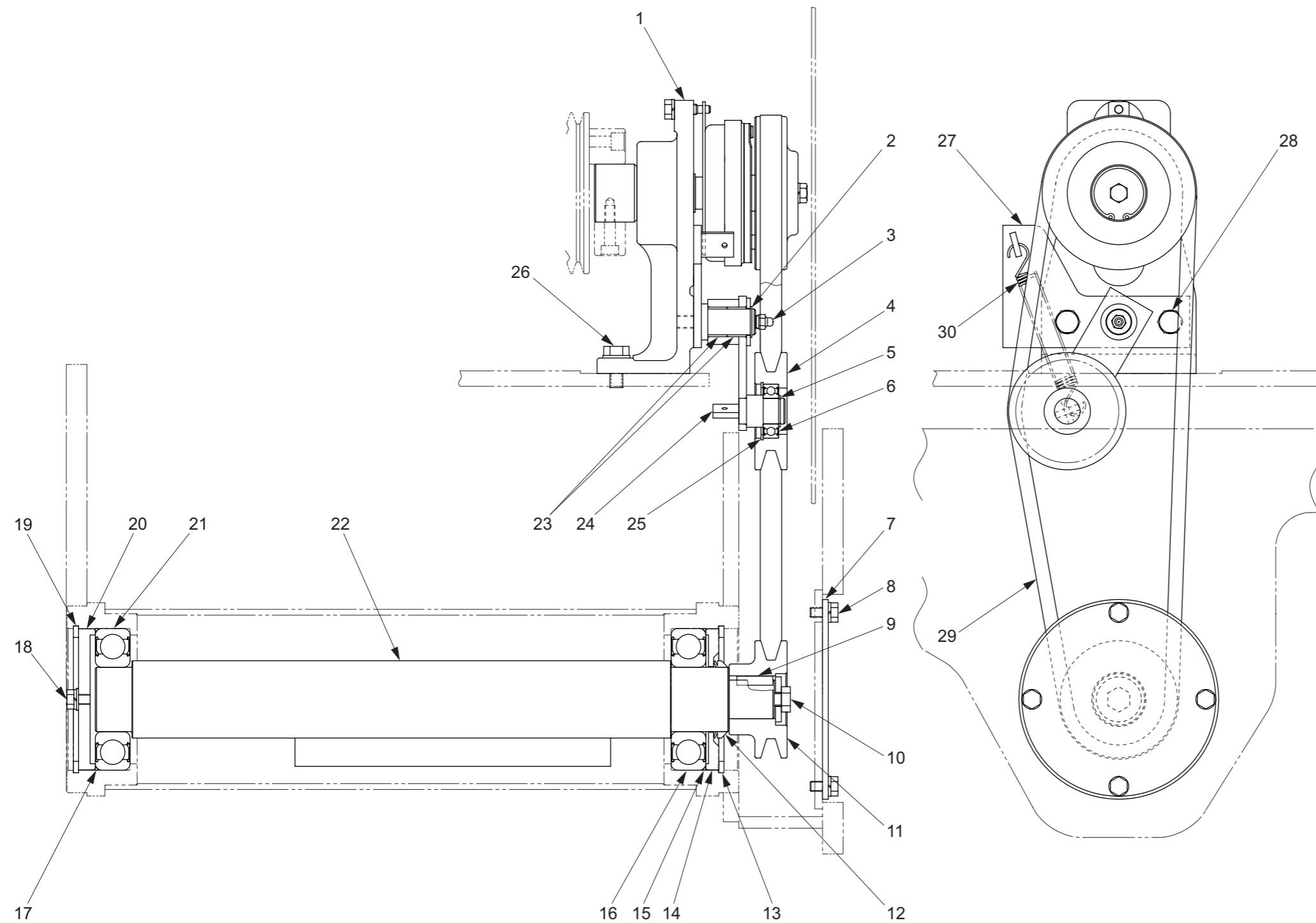
DETAIL A



VIBRATING SYSTEM

1. VIBRATING SYSTEM

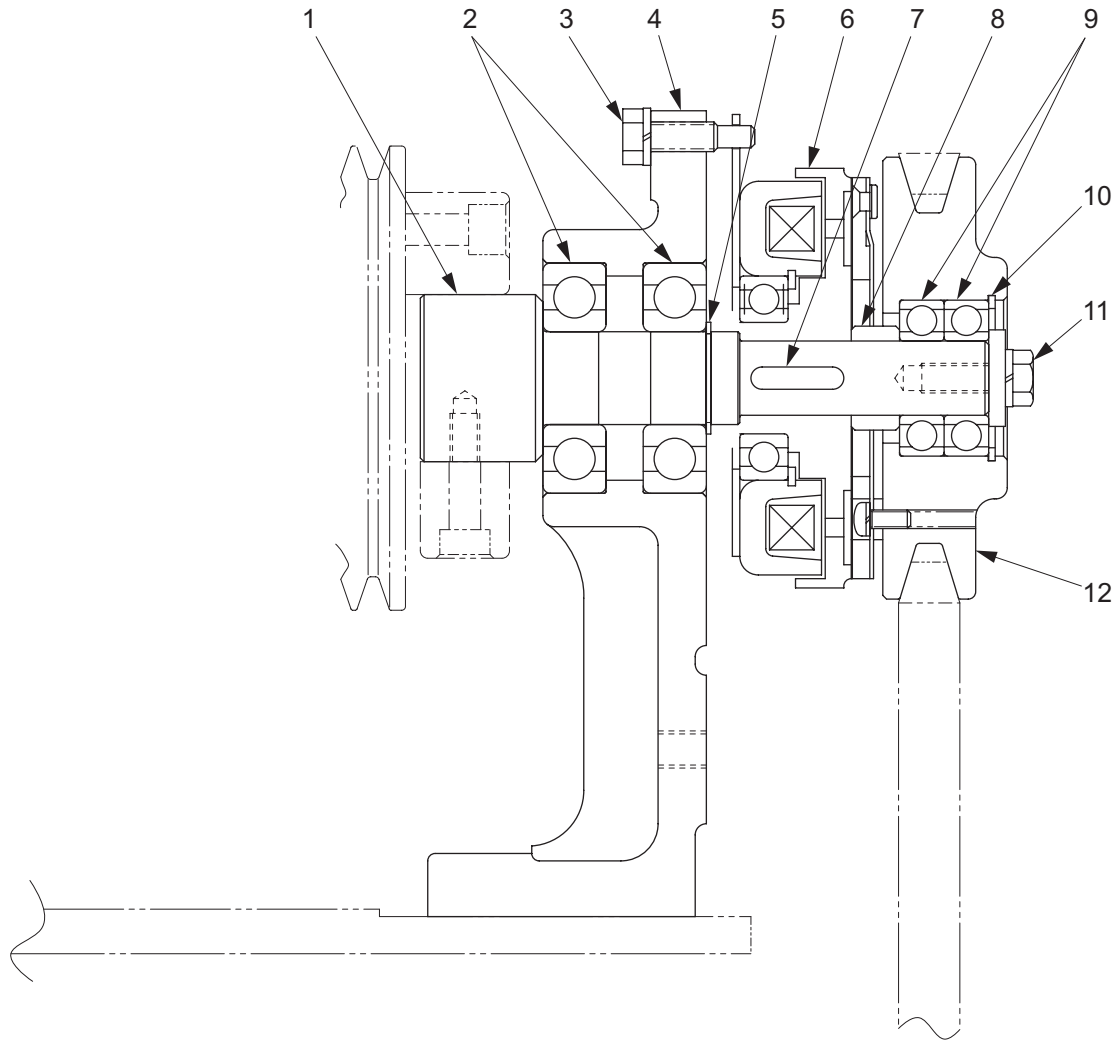
1-1. Vibrating System



- (1) Clutch assembly
- (2) Retaining ring
- (3) Grease fitting
- (4) Tension pulley
- (5) Retaining ring
- (6) Ball bearing
- (7) Cover
- (8) Bolt : M 8×16
- (9) Sunk key : M10×20
- (10) Bolt : M10×20
- (11) Pulley
- (12) V-ring
- (13) Retaining ring
- (14) Cover
- (15) O-ring
- (16) Ball bearing
- (17) O-ring
- (18) Bolt : M 8×12
- (19) Retaining ring
- (20) Cover
- (21) Ball bearing
- (22) Eccentric shaft
- (23) Bush
- (24) Arm
- (25) Retaining ring
- (26) Bolt : M10×30
- (27) Bracket
- (28) Bolt : M10×25
- (29) V-belt
- (30) Spring

0478-43801-0-20036-0
0478-43802-0-20039-0

1-2. Clutch Assembly

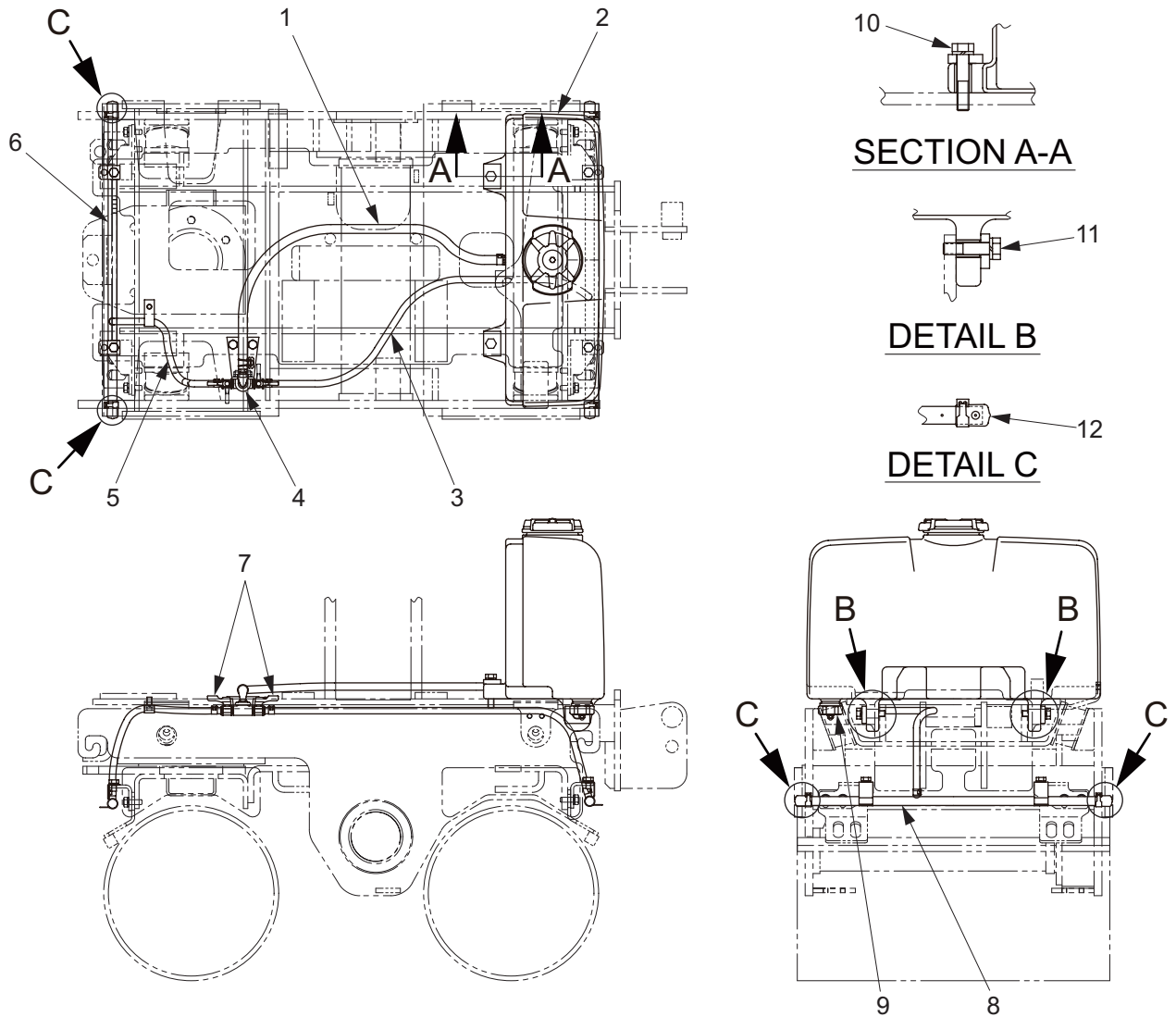


HS67ST-07001

- | | |
|--------------------|---------------------|
| (1) Shaft | (7) Sunk key |
| (2) Ball bearing | (8) Collar |
| (3) Bolt : M 8×30 | (9) Ball bearing |
| (4) Flange | (10) Retaining ring |
| (5) Retaining ring | (11) Bolt : M 8×20 |
| (6) Clutch | (12) Pulley |

WATER SPRAY SYSTEM

1. WATER SPRAY SYSTEM



0478-75801-0-10048-E

- | | | |
|-----------------------------------|---------------|----------|
| (1) Vinyl hose (Tank → Tee) | (7) Valve | |
| (2) Water tank | (8) Rear pipe | |
| (3) Vinyl hose (Tee → Rear pipe) | (9) Drain cap | |
| (4) Tee | (10) Bolt | : M12×60 |
| (5) Vinyl hose (Tee → Front pipe) | (11) Bolt | : M12×50 |
| (6) Front pipe | (12) Cap | |

(NOTICE)

- Align the cap hole with a hole on the pipe.

INSPECTION AND ADJUSTMENT

1. INSPECTION AND ADJUSTMENT

1-1. Safety Precautions for Inspection and Adjustment

WARNING

Unexpected machine 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 chocks 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.

1-2. 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.

1-3. 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.

1-4. 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.

1-5. Inspection and Adjustment of Engine Related Items

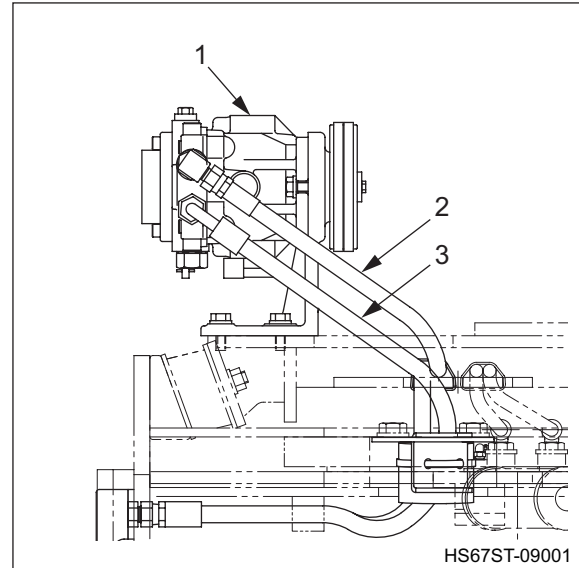
- Refer to shop manual of engine manufacturer for inspection and adjustment of engine itself.

2. MEASUREMENT OF PROPULSION CIRCUIT PRESSURE

⚠ WARNING

Confirm that the parking lock works properly before measurement.

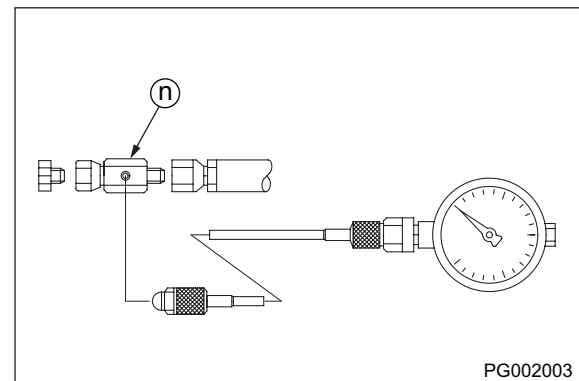
- Oil temperature during measurement : $50 \pm 5^{\circ}\text{C}$ ($122 \pm 41^{\circ}\text{F}$)
- ① Disconnect hoses (2) and (3) from propulsion pump (1).
Attach pressure gauge through adapter (n) .
 - Adapter (n) : G3/8
 - Hose (3) : (Forward)
 - Hose (2) : (Reverse)
 - Pressure gauge: 0 to 50 MPa (0 to 7,250 psi)
- ② Start the engine and set throttle lever to "Full".
- ③ Establish a condition in which machine propulsion load becomes maximum.
(Pressure does not build up unless propulsion load is applied.)
- ④ With propulsion load at maximum, slowly move F-R lever to the side to be measured.
 - Then, read pressure indicated by pressure gauge.
- ⑤ After measuring, promptly return F-R lever to "N".



★ Maximum circuit pressure

(Relief valve pressure setting)

: $17.7 \pm 1.0 \text{ MPa}$ ($2,567 \pm 145 \text{ psi}$)



3. MEASUREMENT OF PROPULSION CHARGE CIRCUIT PRESSURE

- Oil temperature during measurement: $50 \pm 5^{\circ}\text{C}$ ($122 \pm 41^{\circ}\text{F}$)

① Disconnect hose (1) from propulsion pump.

Attach pressure gauge through adapter (n) .

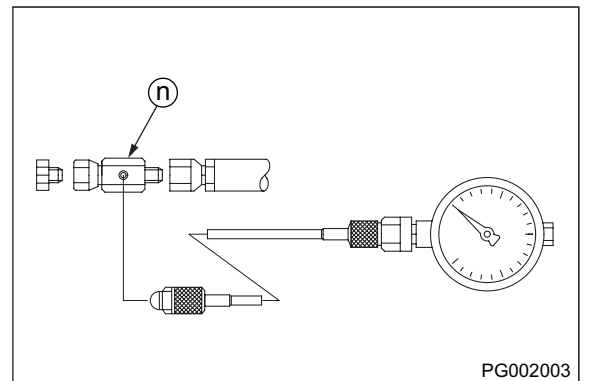
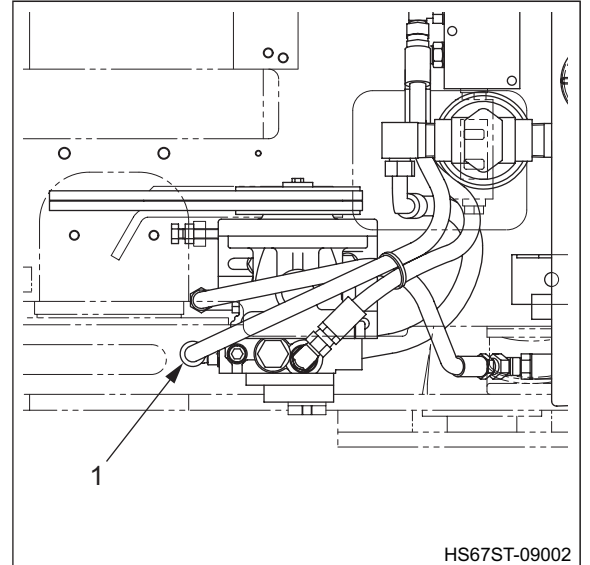
- Adapter (n) : G3/8
- Pressure gauge : 0 to 5 MPa (0 to 725 psi)

② Start the engine and set throttle lever to "FULL".

- Then, read pressure indicated by pressure gauge.

★ Standard charge relief pressure setting

: 0.98 ± 0.2 MPa (142 ± 29 psi)



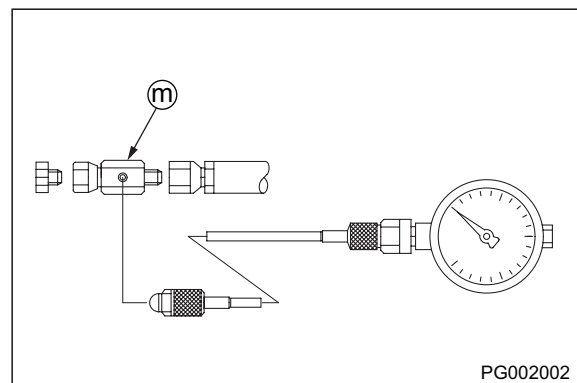
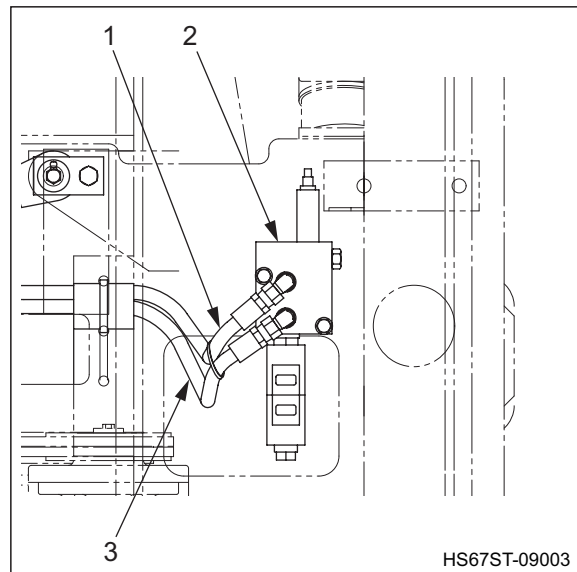
4. MEASUREMENT OF STEERING CIRCUIT PRESSURE

⚠ WARNING

Make sure that there is no person around the articulated portion of the machine before operating the steering switch.

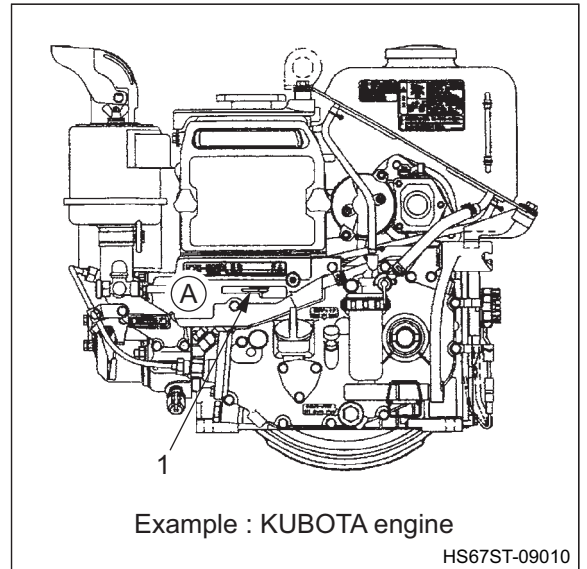
- Oil temperature during measurement : $50 \pm 5^{\circ}\text{C}$ ($122 \pm 41^{\circ}\text{F}$)
- ① Disconnect hose (1) and (3) from valve block (2).
Attach pressure gauge through the adapter Ⓜ .
 - Adapter Ⓜ : G1/4
 - Pressure gauge: 0 to 5 MPa (0 to 725 psi)
- ② Confirm that F-R lever is in "N" properly.
- ③ Start the engine and set throttle lever to "Full".
 - Press steering (Left/right turn) switch to operate relief valve.
 - Then, read pressure indicated by pressure gauge.

★ **Standard maximum circuit pressure**
(orbitroll relief pressure + charge relief pressure)
: 3.98 ± 0.2 MPa (577 ± 29 psi)

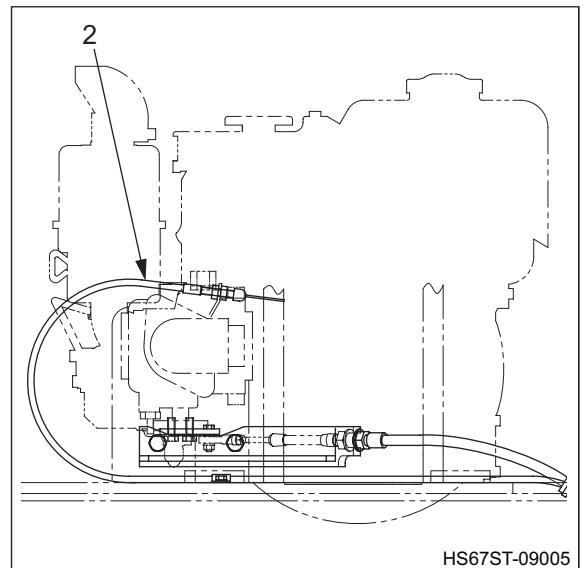


5. ADJUSTMENT OF THROTTLE LEVER LINKAGE

- In cases such as maximum no-load rotational speed deviating from standard value, control cable is replaced, or throttle lever does not move smoothly, make an adjustment in accordance with procedure described below.
 - Make the adjustment after amply warming up engine.
 - Oil temperature during measurement : $50 \pm 5^{\circ}\text{C}$ ($122 \pm 41^{\circ}\text{F}$)
- ① Set speed adjusting lever (1) of the engine to the maximum speed position (A).



- ② Attach control cable (2) to speed adjusting lever (1).



INSPECTION AND ADJUSTMENT

- ③ Set throttle lever (3) to the "FULL".
- ④ Attach control cable (2) to throttle lever (3).
- ⑤ Start the engine.
- ⑥ Loosen locknut (4).
- ⑦ Using stopper bolt (5), adjust so that standard maximum no-load rotational speed is achieved.

★ **Standard maximum no-load rotational speed**

KUBOTA : 2,660 rpm

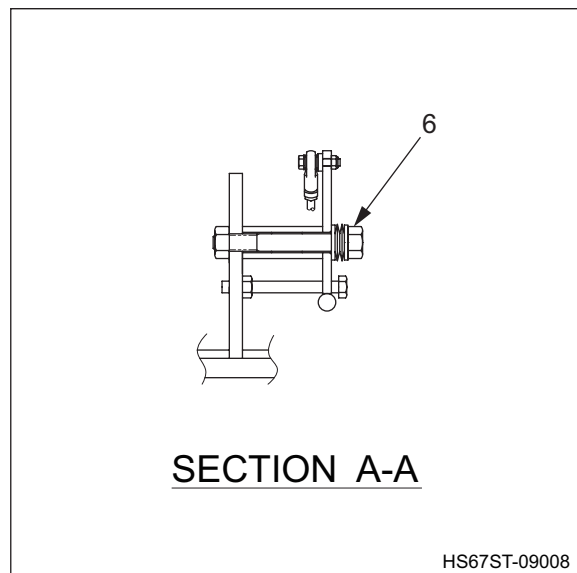
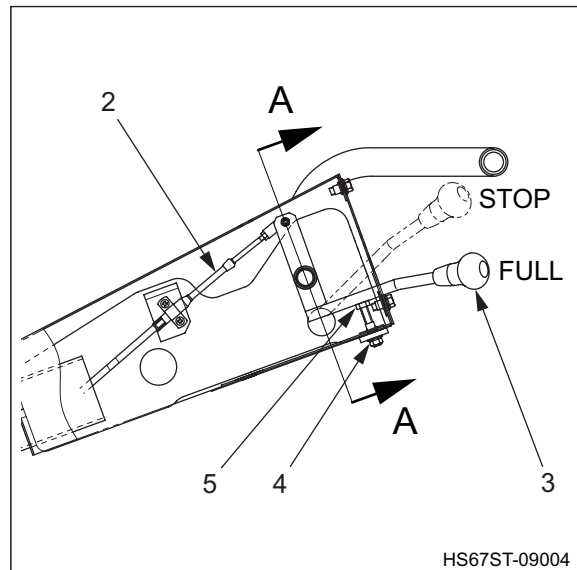
HONDA : 3,850 ± 150 rpm

YANMAR : 3,800 ± 30 rpm

- ⑧ Using lock nuts (4), firmly secure stopper bolts (5).

(NOTICE)

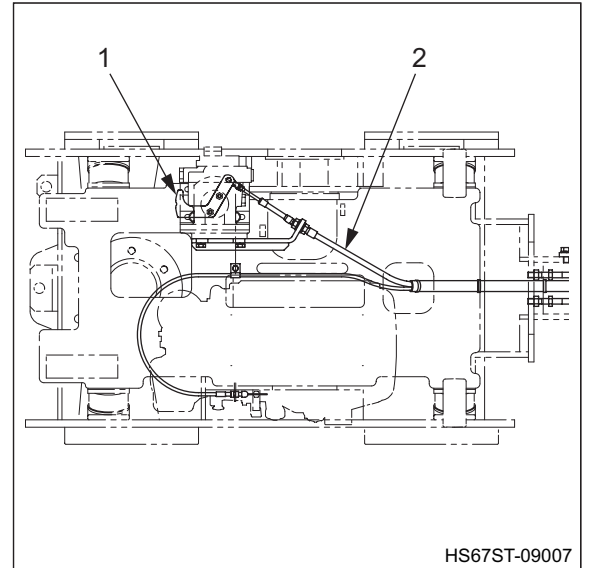
- **If maximum no-load rotational speed is not in standard range, adjust injection nozzle, or repair or replace fuel injection pump or carburetor.**
- ⑨ Adjust lever operating force so that it is between 29.4 to 39.2 N (6.6 to 8.8 lbf.) at center of knob of F-R lever.
 - Adjust lever operating force with nut (6).



6. ADJUSTMENT OF F-R LEVER LINKAGE

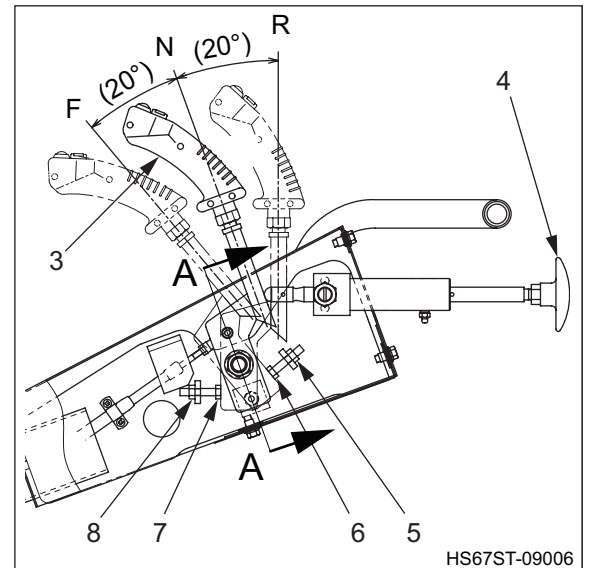
- In cases such as propulsion hydraulic pump is replaced, control cable is replaced, or F-R lever does not move smoothly, make an adjustment in accordance with procedure described below.
- “N” positions of F-R lever (3) and control lever (1) on propulsion pump are positioned by notches.

- ① Set control lever (1) on propulsion pump side at “N”.
- ② Attach control cable (2) to control lever (1).



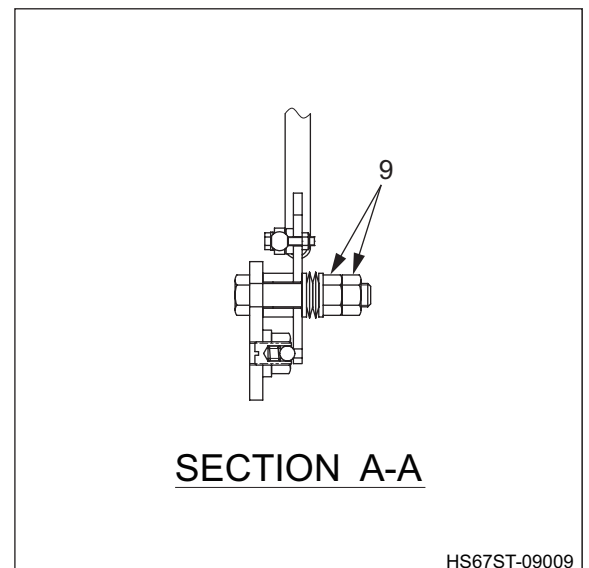
HS67ST-09007

- ③ Set F-R lever in “N”.
- ④ Attach control cable (2) to F-R lever (3).
- ⑤ Loosen locknuts (5) and (8) and make adjustments with stop bolts (6) and (7) so that lever operating angle is 20 degrees for both “F” and “R” sides.



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- Adjust lever operating force so that it is between 29.4 to 39.2 N (6.6 to 8.8 lbf.) at center of knob of F-R lever.
- Adjust lever operating force with nut (9).
- Make sure that when safety device knob (4) is operated, machine moves forward at slow speed.
(Machine speed: 0.3 to 0.5 km/h [0.19 to 0.31 mph])



SECTION A-A

HS67ST-09009

TROUBLESHOOTING

1. BASIC TROUBLESHOOTING

Refer to following basic troubleshooting table if product have some problems or failures.

If the problem cannot be remedied, contact to SAKAI authorized dealer or SAKAI service department.

Symptom	Cause	Action
KUBOTA, YANMER Engine		
Engine will not start or engine malfunction.	Starter motor does not run.	
	Battery terminals are disconnected, loosened or corroded.	Repair terminals corrosion and reconnect them securely.
	Battery capacity is insufficient.	Charge or replace battery.
	Starter motor is faulty.	Disassemble, check or repair starter motor.
	Starter switch is faulty.	Check or replace starter switch.
	F-R lever is not at neutral position.	Shift F-R lever at neutral position.
	F-R lever interlock switch is faulty.	Check or replace F-R lever interlock switch.
	Interlock relay is faulty.	Check or replace interlock relay.
	Starter motor runs.	
	No fuel in tank.	Confirm no fuel leak and fill with fuel in tank.
	Water, dust or air in fuel system.	Flush fuel system.
	Use deteriorated fuel.	Flush fuel system and fill with recommended fuel.
	Air cleaner is dirty or clogged.	Check and clean air cleaner. Replace it if necessary.
	Fuel is not supplied to fuel injector valve.	Check and adjust entire fuel system (fuel valve, filter, hose or fuel pump).
	Fuel injector does not inject fuel or inject faulty.	Disassemble, clean or adjust injector.
	Cylinder compression is too low.	Check cylinder head, gasket, valve, valve spring or valve seat.
		Check excessive carbon has accumulated at valve, valve seat, piston head or combustion chamber.
		Retighten fuel injector and case nut or replace nozzle gasket.
		Check piston ring, piston or cylinder for worn.
		Check and adjust valve clearance.
Governor malfunctions	Check governor components for deformation and malfunction. Make adjustments if necessary.	

TROUBLESHOOTING

Symptom	Cause	Action	
HONDA Engine			
Engine will not start or engine malfunction.	No fuel in tank.	Confirm no fuel leak and fill with fuel in tank.	
	No fuel at carburetor.	Clean fuel filter or strainer.	
	Fuel valve does not open properly.	Disassemble and check fuel valve.	
	Main jet or nozzle in carburetor clogged or fuel overflowing.	Disassemble, clean or adjust carburetor.	
	No spark.		Check spark plug gap, insulation, dirt or damage and adjust plug gap. Replace it if necessary.
			Check ignition coil and adjust coil gap.
	Starter switch is faulty.	Check starter switch.	
	Water, dust or air in fuel system.	Flush fuel system.	
	Air cleaner is dirty or clogged.	Check and clean air cleaner. Replace it if necessary.	
	Use deteriorated fuel.	Flush fuel system and fill with recommended fuel.	
	Cylinder compression is too low.		Check cylinder head, gasket, valve or valve seat.
			Check excessive carbon has accumulated in combustion chamber.
			Check piston ring, piston or cylinder for worn.
			Check and adjust valve clearance.
		Tighten cylinder head and spark plug correctly.	
		Check governor components for deformation and malfunction. Make adjustments if necessary.	
Machine moves neither forward nor backward or slow machine speed.	Oil level is low.	Fill tank until correct oil level is obtained.	
	Bypass (unload) valve is open.	Close bypass (unload) valve.	
	F-R lever linkage is faulty.	Check and adjust F-R lever linkage.	
	Propulsion pump does not discharge oil because charge relief pressure is low.	Measure charge pressure.	
	Clogged suction filter.	Clean suction filter or replace it if necessary.	
	Circuit does not obtain required pressure because pressure of relief valve pressure is low.	Measure propulsion circuit pressure.	
	Loosen or slip V-belt.	Check and adjust V-belt. Replace it if necessary.	
Vibration does not work or weak.	Vibration switch is faulty.	Check vibration switch.	
	Loosen or slip V-belt.	Check and adjust V-belt. Replace it if necessary.	
	Engine speed is too low.	Adjust correct engine speed.	
	Electromagnetic clutch is faulty.	Check and replace electromagnetic clutch.	
	Eccentric shaft hold bearing damaged.	Check bearing and replace it if necessary.	

Symptom	Cause	Action
Steering dose not turn or hard to turn.	Left/right turn switch is faulty.	Check and replace left/right turn switch.
	Relief valve is open or setting pressure is low.	Measure steering circuit pressure.
	Internal leakage of steering cylinder.	Repair steering cylinder or replace it if necessary.
	Clogged suction filter.	Clean suction filter or replace it if necessary.

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