VANAIR

TECHNICAL MANUAL

EF453T

YANMAR

TECHNICAL MANUAL

DIESEL TRACTOR

EF453T

YANMAR AGRICULTURAL EQUIPMENT CO.,LTD.

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EF453T 06/2007 edition

SAFETY

WARNING

Never attempt to operate or service this machine until you have first read and understood all of the applicable Safety Instructions that are set forth in this Manual.

The failure to comply with all relevant Safety Instructions could result in bodily injury.

TABLE OF CONTENTS

0. INTRODUCTION

To The Owner

- This new machine is carefully designed and manufactured to give years of dependable service. To do the better and safer job, read the instructions in this manual. Failure to do so could result in personal injury or machine damage.
- Each section is clearly identified so you can easily find the information you need.
- Keep this manual next to your machine, after you have read through it.
- If you lose or damage this manual, ask a new manual to Yanmar dealer right away.
- The parts used in this machine are subject to change to improve the quality and capacity of the machine, and for safety.
- Therefore, please understand that the contents, photos and illustrations in the manual may differ from your machine.
- Please consult Yanmar dealer about any questions you may have and to receive updates to this manual.

IMPORTANT WARRANTY INFORMATION
The warranty condition of this machine appears on the "Yanmar LIMITED WARRANTY" attached to this manual.

DECLARATION OF CONFORMITY
The detail of the declaration is shown with this manual.

MAINTENANCE
When the machine is in abnormal condition, take the remedies. If the machine is still abnormal, ask Yanmar dealer and give the following information:

- Machine model
- Serial No.
- Detailed description of abnormal condition

SUPPLY PERIOD FOR MAINTENANCE PARTS
The period during which we supply maintenance parts for this machine is 9 years after we discontinue production of this machine.
The supply of maintenance parts will, in principle, terminate at the end of the supply period stated above. However, even after the supply period has terminated, we still consult with you about the delivery time and the prices for parts still in stock, if required.

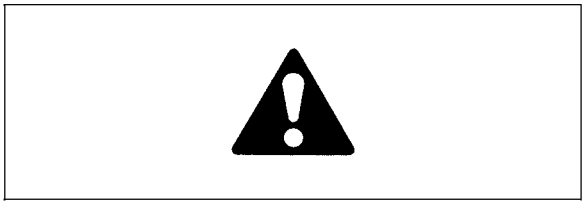
IMPROVEMENTS
To improve or upgrade the feature of the machine or for some other reason, parts are sometimes changed. In this case, parts of this manual may not apply to the machine.
The company has the right to improve or change when it becomes possible and practical to do so without incurring any obligations to make changes or additions to the equipment sold previously.

NOTE:
(1) All data are subject to alteration without notice.
(2) All photos, illustrations and descriptions show those of the vehicle model EF453T. Some illustrations and photos may show optional accessories.
(3) Right-hand (R.H.) and left-hand (L.H.) sides of this machine are determined by standing at the rear of this machine and facing the direction of forward travel.
(4) A rollover protective structure (ROPS) is optional.

SYMBOL INDICATION

1 Safety-alert Symbol

This is the safety-alert symbol. When you see this symbol on your tractor or in this manual, personal injury is possible or even likely if you do not follow the advice given. Read the messages that follow carefully.



2 Signal Words

The signal words "DANGER" "WARNING" "CAUTION" are used with the safety-alert symbol.

(1) "DANGER" indicates the extreme hazard that would result in high probability of irreparable injury if proper precautions are not taken.

(2) "WARNING" indicates the hazard that would result in injury if proper precautions are not taken.

(3) "CAUTION" indicates the general precautions.

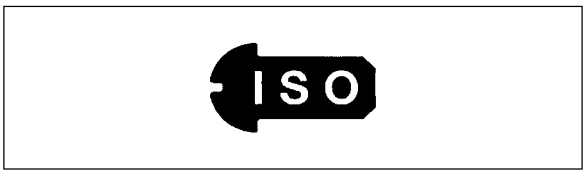
3 Service Instructions

(1) This stop symbol indicates an important message about proper operation or service. When you see this symbol, read the message that follows carefully.

(2) NOTE describes precautions to take while working.

4 Measurements

This tractor is based on metric measurements. All hardware is therefore metric (ISO). Make sure to use the specified metric hardware when service is necessary.



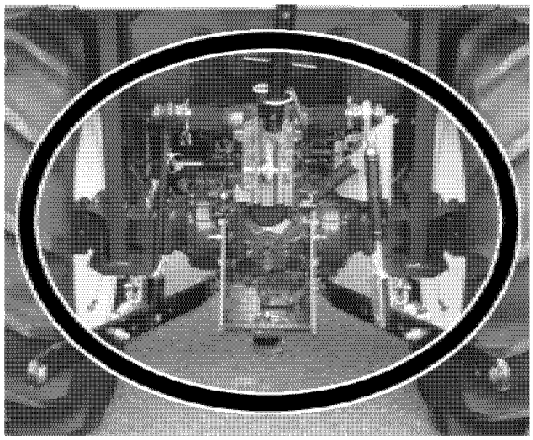
5 Direction

The right and left sides of the tractor are determined by facing in the same direction as the tractor moves when going forward.

WARNING

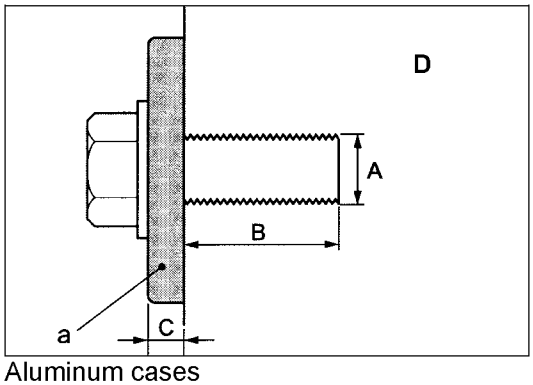
You must carefully note the length of the bolts when you install Yanmar recommended implements and equipment behind the transmission case.

1. First, it is necessary to measure the thickness of the parts. Then use bolts whose length includes the extra measured thickness.



2. When the original part is removed and a different part is installed, it is necessary to measure difference in thickness of the two parts and change the length of the bolts appropriately.

If you don't use appropriate consideration of these issues, you will damage the transmission case and create a dangerous situation.

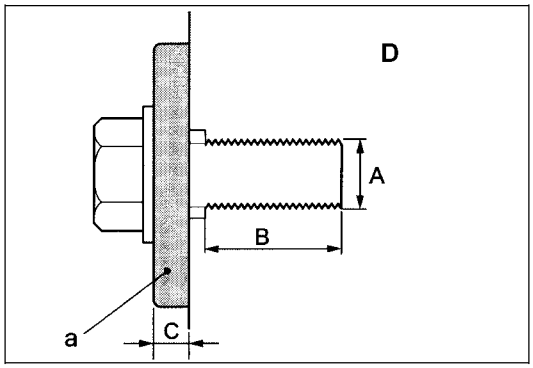


Aluminum cases

Reference
The bolt length "**B**" in the case must be 2.0 times the diameter of "**A**".

For casting metal cases, rear axles, etc.,
The bolt length "**B**" in the case must be 1.5 times the diameter "**A**".

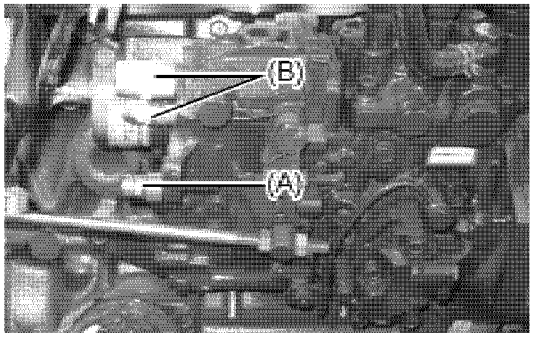
(D): Transmission case



Cast metal cases

When you install part "**a**" behind the transmission case, use bolts whose length includes measurement "**C**".

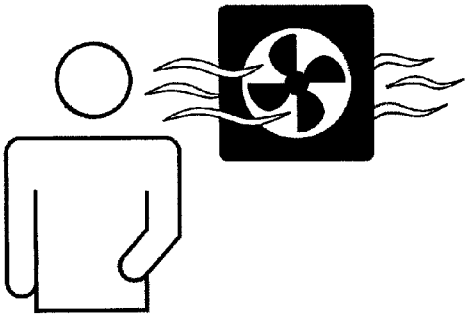
CAUTION
- Do not try to adjust engine speed adjuster screw (A) located on engine fuel injection pump. Any accident or failure resulting from adjusting the screw would not be covered by Yanmar's guarantee.
- Do not try to unseal and adjust engine fuel injection pump (B). Any accident or failure resulting from adjusting the pump would not be covered by Yanmar's guarantee.



0.1 PRECAUTIONS FOR THE SAFE SERVICES

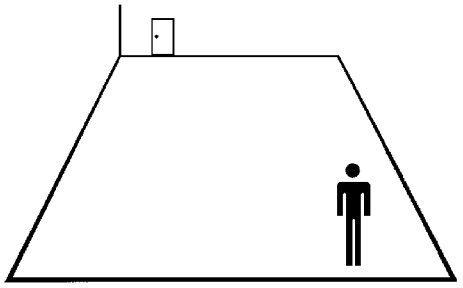
DANGER
SUFFICIENT VENTILATION
Be sure to work in the well-ventilated place when the engine runs, welding or grinding a painted part.

[If not]
Exhaust gas and paint dirt is poisonous and hazardous to human bodies.



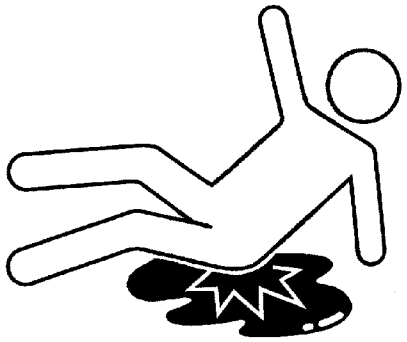
CAUTION
FLAT PLACE AND SUFFICIENT AREA
The floor area should be sufficient, flat without holes at the service factory (place) to perform check and service work.

[If not]
It may cause unexpected accidents such as falling down.



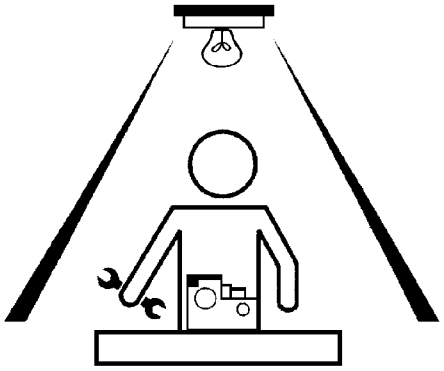
CAUTION
CLEANED AND WELL ARRANGED PLACE
Do not leave dust, mud, oil or any parts on the floor.

[If not]
It may cause unexpected accidents.

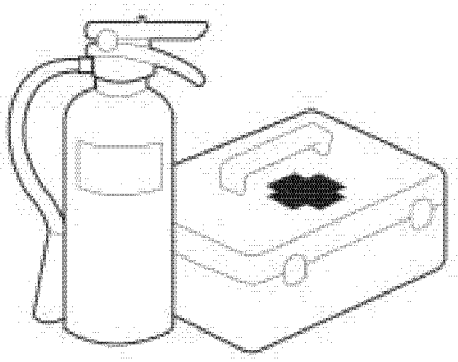


CAUTION
WELL AND SUFFICEINTLY LIGHTED PLACE
A working place must have enough lighting. Use a portable safety light with cage when you work inside or under the machine.

[If not]
The bulb may accidentally be broken and broken glass may cause injury or heat may cause fire.

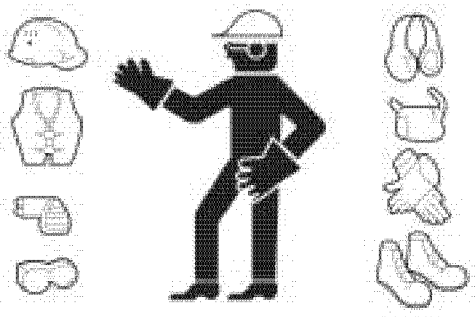


CAUTION
KEEP A FIRE EXTINGUISHER AND FIRST AID KIT HANDY



- The workplace must be provided with a fire extinguisher. Read instructions on the label to familiarize yourself with how to use it.
- Keep a first aid kit in a prescribed place.
- Advise what to do in the event of fire or accidents.
- Indicate who to contact in an emergency and keep their telephone number in a prominent place.

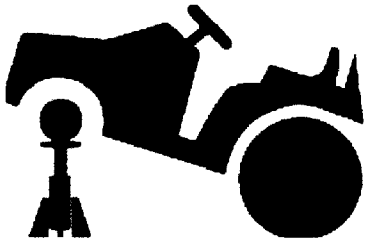
CAUTION
WEAR PROPER CLOTHING AND SAFETY ITEMS



- Do not wear loose clothing or jewelry that can be caught on the control levers and other machine parts. Also avoid wearing working clothes stained with oil as they can ignite.
- Be sure to wear a helmet, safety goggles, safety shoes, a mask, gloves and other protective items, as appropriate. Take particular precautions when generating metal debris, when striking metal objects with a hammer or when cleaning components with compressed air.
- Also make sure there are no persons near the machine.

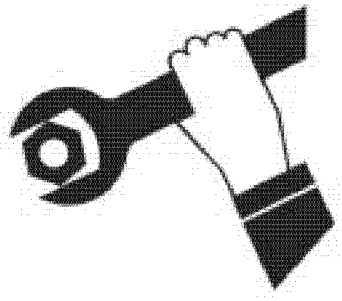
[If not]
Moving part may catch, dust may get in eye, heavy part may drop on foot, etc. It may cause serious injury.

DANGER
PROPER LIFTING AND SUPPORT
When you work under the machine, support it firmly with such a crane, hoist or rigid racks on a level place.



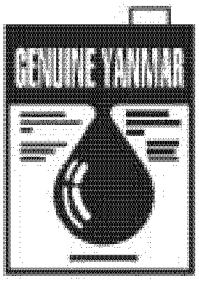
[If not]
It may cause severe accidents.

CAUTION
PROPER TOOLS
Using damaged or worn tools or using tools inappropriate for the required application is very dangerous, and may also cause damage to the machine. Make sure to use the tools that are appropriate for the specific job.



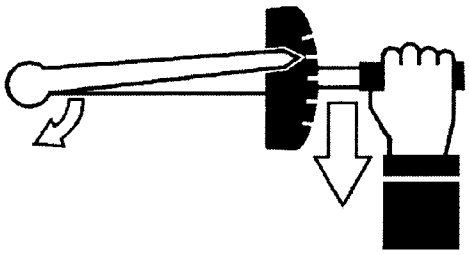
[If not]
It may cause severe injury and/or damages on machine.

CAUTION
GENUINE PRODUCTS
Be sure to use and install genuine products and spare parts.



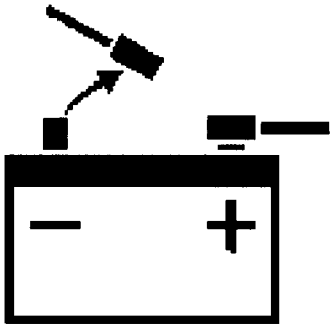
[If not obeyed]
It may cause unexpected failures and shorten the machine life span.

WARNING
TIGHTEN BOLTS AND NUTS WITH THE SPECIFIED TORQUE
Be sure to tighten bolts and nuts with the specified torque in this manual.



[If not]
Bolts or nuts may be loosen or drop. It may cause breakdown of components and/or injury.

WARNING
AVOID SHORT-CIRCUITING
Be sure to disconnect the (-) terminal of battery before servicing.



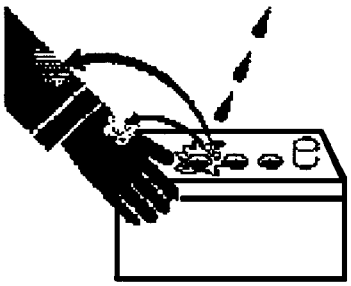
[If not]
Short circuit may cause a fire.

WARNING
CHARGING BATTERY
Keep a battery away from the fire while charging. Gas from battery electrolyte is flammable and explosive.

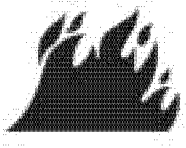
[If not]
It may explode or cause fire.

WARNING
HANDLING BATTERY ELECTROLYTE
The battery electrolyte is diluted sulfuric acid and poisonous. Refill battery electrolyte in well ventilated area and wear eye protection and rubber gloves.

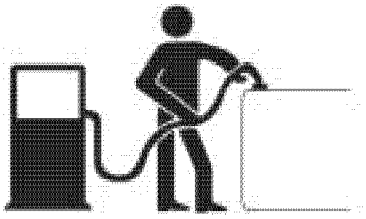
[If not]
Splashed solution can cause burning skin, cloths and blindness if it get into eyes.



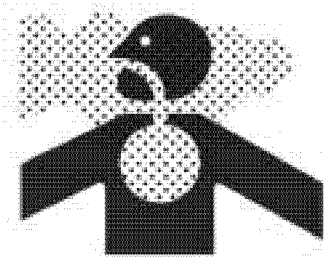
DANGER
KEEP FUEL AND OIL AWAY FROM SOURCES OF IGNITION
- Open flames can ignite fuel, oil, hydraulic oil or antifreeze solutions, which are flammable and dangerous.



Special attention must be paid to the following matters.
- Keep flammable materials away from lighted cigarettes or matches, or any other sources of ignition.
- Never refuel while the engine is running. Smoking during refueling must be strictly prohibited.
- Firmly tighten the caps on the fuel and oil tanks.
- Store fuel and oil in a cool and well-ventilated place where they are not subjected to direct sunlight.
- Fuel and oil must be stored in a place which meets all applicable safety regulations. Unauthorized persons should not be allowed entry.



DANGER
PROVIDE ADEQUATE VENTILATION WHEN WORKING IN AN ENCLOSED AREA
Engine exhaust fumes are harmful to the human body and their inhalation is extremely hazardous.
When starting the engine in an enclosed area, open the windows and doors for ventilation. Also do not idle the engine unnecessarily or leave the engine running while the machine is not in use.

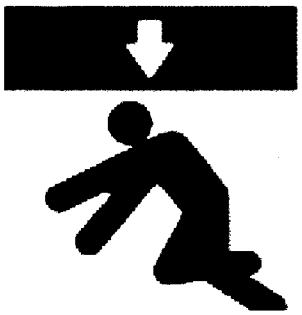


DANGER
REMOVED ATTACHMENTS
When an attachment is placed on the ground or against a wall after removing it or prior to reinstalling it, be sure that it is stable to prevent it from falling down.

DANGER

WORKING UNDER THE MACHINE

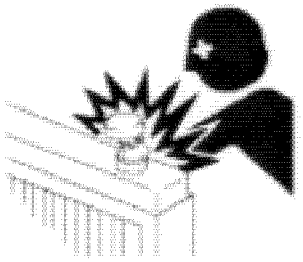
- Before performing service or repairs underneath the machine, place the implement on the ground in its lowest position.
- Be sure to apply blocks to the tracks to lock the tracks securely.
- Never perform service underneath the machine if it is not completely stable.



DANGER

RADIATOR COOLING WATER LEVEL

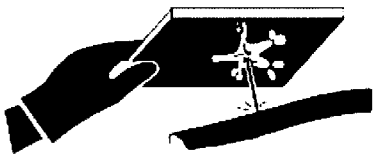
- Before checking the radiator cooling water level, stop the engine and wait until the engine and the radiator have cooled down.
- Slowly loosen the cap to release the inner pressure before removing the cap.



WARNING

BE CAREFUL OF HOT OIL UNDER HIGH-PRESSURE

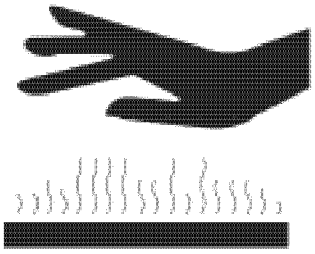
- Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and do serious damage and that immediate medical assistance be sought.
- The hydraulic system for the implement operates under high pressure.
- When replenishing or draining hydraulic oil, be sure to first relieve the high pressure.
- The emission of hot oil under high-pressure from a small leak could result in serious bodily injury.
- Wear safety goggles and thick gloves when checking for leaks. Use a piece of cardboard or a plywood block to detect emissions of hot oil.
- If the hot oil should contact your body, obtain prompt medical treatment.



WARNING

BE CAREFUL WHEN SERVICING SYSTEMS UNDER HIGH TEMPERATURE AND HIGH PRESSURE

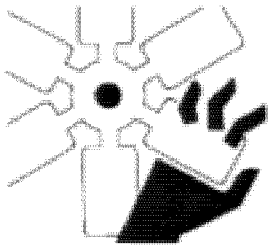
The engine cooling water and each lube oil system are still under high temperature and pressure immediately after the engine has stopped. Removing caps, draining oil and water, or replacing filter elements at that time may cause a burn. Wait until the temperature drops, then begin servicing in accordance with the procedures described in this manual.



WARNING

ROTATING RADIATOR FAN AND FAN BELT

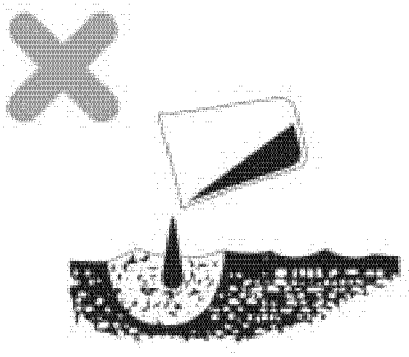
- Never contact the rotating radiator fan or fan belt with any object.
- Contacting the rotating radiator fan or fan belt with any object can result in serious bodily injury.



CAUTION

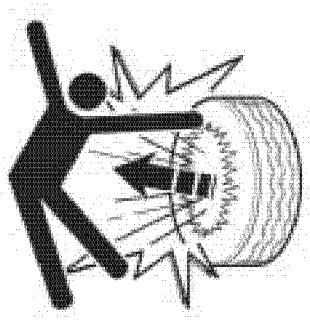
ALWAYS BE ENVIRONMENTALLY RESPONSIBLE

- Follow the guidelines of the governmental agency for the proper disposal of hazardous materials such as engine oil, diesel fuel, engine coolant and, machine fluid, grease.
- NEVER dispose of hazardous materials irresponsibly by dumping them into a sewer, on the ground, or into groundwater or waterways.
- Failure to follow these procedures may seriously harm the environment.
- Comply with legal regulations and guidelines for disposal of: empty containers for fuel, cooling water (coolant), oil, grease; fuel/oil filters; batteries; machine itself; machine accessories; and packaging materials.



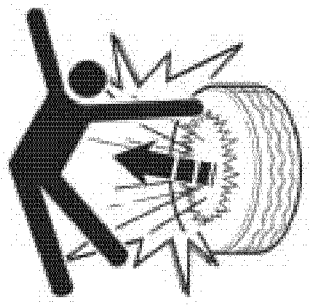
WARNING
INFLATING TIRE
When you inflate tire, use long hose with self-attaching air chuck for not standing in front of or over tire. Use safe cage if available. Do not inflate tire beyond maximum recommended pressure in operator's manual.

[If not]
An over-inflated tire can explode and cause injury or death.



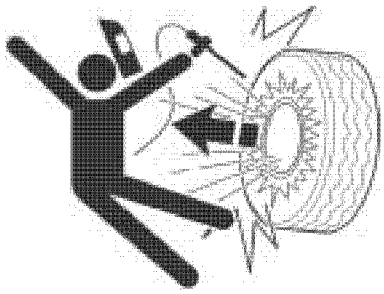
WARNING
MOUNT/DISMOUNT TIRE
Do not attempt to mount or dismount tire unless you have proper equipment and experience. Follow proper procedure when mounting or dismounting tire on wheel or rim.

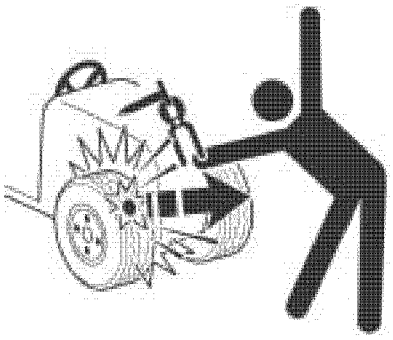
[If not]
It may cause explosion and may cause injury.



WARNING
RIM OR RIM PARTS
Do not cut or weld on rim or rim parts. Do not use damaged rims. If rim is damaged, replace it. Do not replace rims with anything but a genuine or a part of proper size, type and quality. Always deflate tire before removing spikes or other objects from tire carcass.

[If not]
Damaged rim may cause an explosion.





AFTER SERVICING THE MACHINE MAKE SURE TO:

a) Retighten all removed fasteners, bolts and nuts to specified torque.
b) Reinstall all safety shields and devices removed during service.
c) Refill radiator coolant, hydraulic oil, engine oil, etc. which are drained during service with approved or recommended fluid.
d) Start the engine and check for leaks. Operate all controls and make sure tractor and implements are functioning properly. After testing, shut down the engine and check the work you performed (any missing cotter pins, washers, locknuts, etc.) Recheck all fluid levels again.

0.2 AFTER SALES SERVICE AND WARRANTY

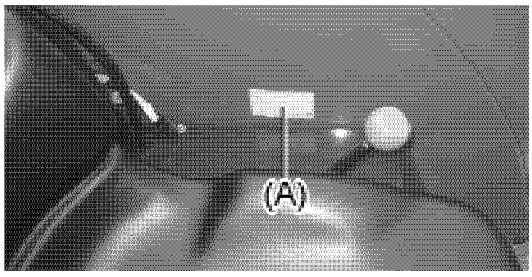
After sales service
If your tractor is not working normally, refer to the troubleshooting section in this manual. You can also consult with your service representative.

Information needed when asking for service:

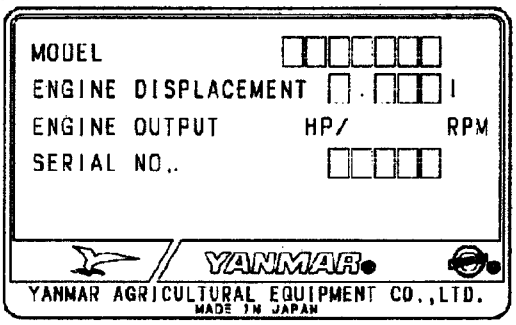
- Model name and serial number (A) of your tractor.
- Engine type number (B)
- Operating conditions. What type of work was being performed when the problem occurred?
- How long have you used your tractor? (total hours of operation)
- Any other information about the problem that has occurred.

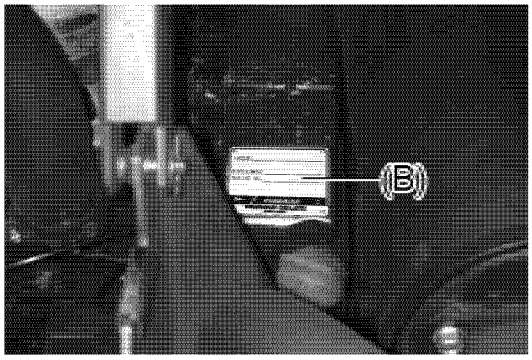
Availability of spare parts
Maintenance parts and spare parts will be available for 10 years after the production of this tractor series has been discontinued. However, special parts will be available subject to consultation. Yanmar may be able to supply a particular part after the normal supply period.

(A) Tractor serial number
(B) Engine type number

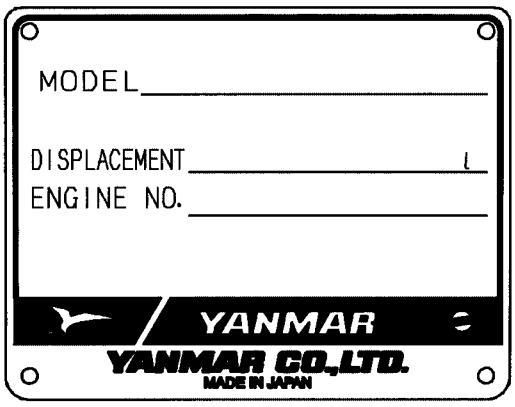


(A)





(B)



PURPOSE OF THIS MACHINE

This machine is designed to be operated with a various implement for particular tasks and for pulling a trailer in a variety of agricultural operations. Other use or modification is prohibited.

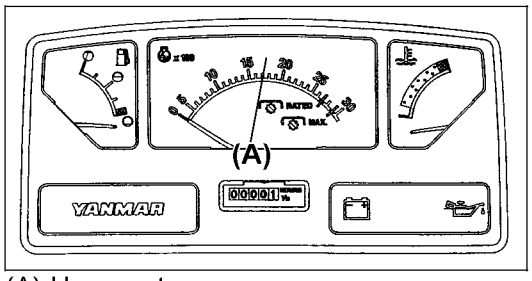
0.3 GENERAL PRECAUTIONS FOR SERVICES

0.3.1 GENERAL

When contacting us about your machine identify it with the model and serial numbers of the tractor and its engine, and the usage hours displayed on the hour meter.

Hour meter

The hour meter numerically indicates the operating hours of the tractor. The indicated number is used to determine when to check the engine oil and other similar consumables. (The hour meter starts counting when the engine is started.)

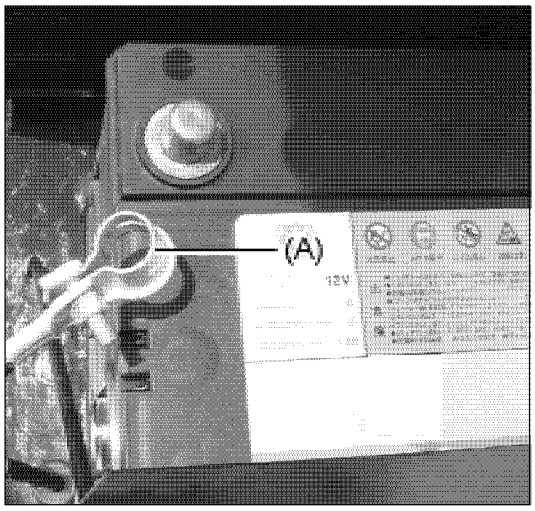


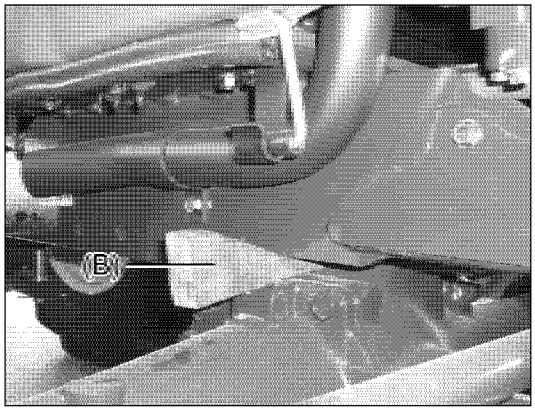
(A) Hour meter

WARNING

Prior to disassembly or reassembly, remove the negative terminal (A) on the battery.

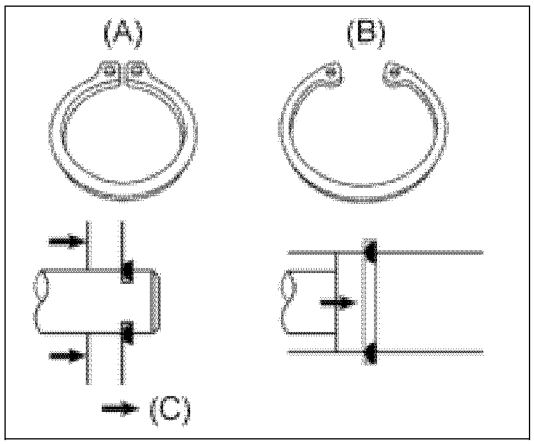
To separate the transmission, be sure to lock the front axle with the wedge (B) to prevent it from swinging.





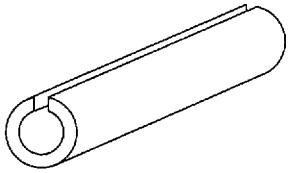
To replace components, always use the Yanmar genuine parts.
Be sure to replace packing and O-ring with new one.
Apply the grease slightly on O-ring and oil seal prior to install.

To install a snap ring, place the edged side in the direction that the force is loaded as the right figure shows.

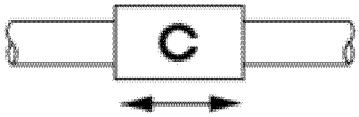


(A) External sanp ring
(B) Internal snap ring
(C) Arrow indicates force direction

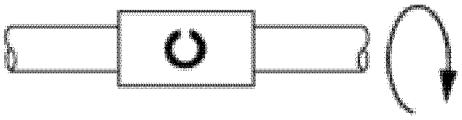
To drive in a spring pin (roll pin), place the split part (mating part) in the direction that the force is loaded as the right figure shows.



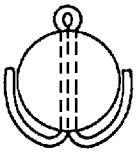
Force in axial direction



Force in rotating direction

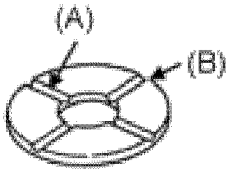


Once you remove a split pin, replace the split pin with a new one and split it surely.

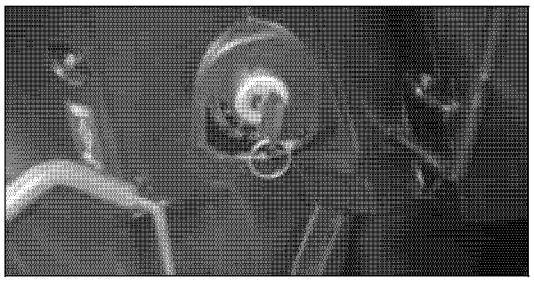


As for a thrust washer with grooves, pay attention to the assembling direction.

(A) Oil groove
(B) Thrust washer

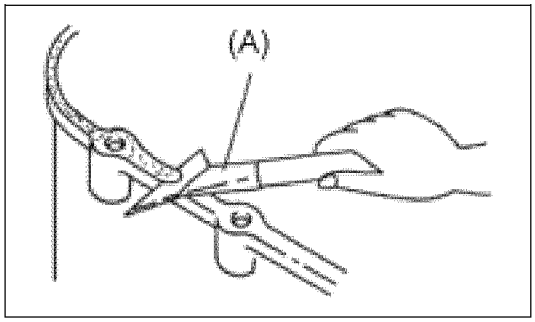


To connect or disconnect coupler (connector) of electric parts harness, be sure to switch off the starter switch.



0.3.2 USAGE OF THE LIQUID GASKET

<Paring sealant>
Pare off sealing material on the surface with a scraper. Do not to scratch or damage on the mating surface. If the surface gets scratch or damage, correct them by grinding with oilstone.

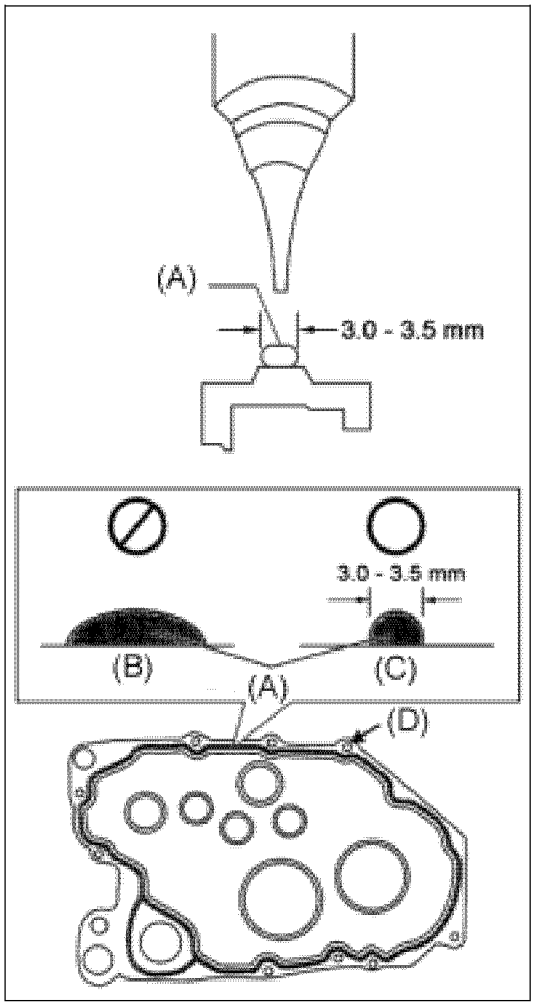


(A) Scraper

<Applying the liquid gasket>
1. Wipe the oil or dirt from the mating surface with a wiper dipped in cleaning solvent. Oil must be removed completely.
* Do not use kerosene or diesel oil.
2. Cut the applying nozzle as the bead width of squeezed liquid gasket is 3 to 3.5 mm. Set a squeezing tool if available.
* Do not level the applied liquid gasket with a finger or a spatula. It may cause incomplete sealing.
3. When the liquid gasket is supposed to be applied around a bolt hole, apply it inner side of the mating surface.
4. Assemble mating surfaces within 15 minutes after applying liquid gasket.
5. Tighten all bolts lightly and tighten them further till specified tightening torque is obtained. The bolts must be tightened diagonally.
6. Wait for more than 30 minutes after assembly to fill up lubricating oil or operate.

Apply liquid gasket
↓ Within 15 minutes
Assembly
↓ Leave for 30 minutes or longer.
Lubrication, operation

- Be sure to follow the specified time or it could cause leakage.

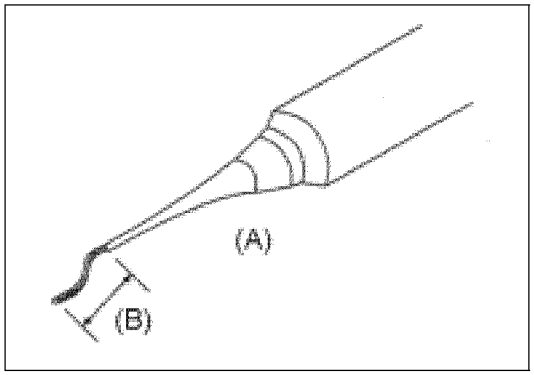


(A) Liquid gasket
(B) Bad
(C) Good
(D) Hole for bolt

<Deterioration of a liquid gasket>

1. When using the liquid gasket again after a tube is opened, the gasket in the nozzle part may have been hardened or deteriorated. Squeeze out the liquid gasket a little and then use it.
2. When the surface of squeezed out liquid gasket glitters, it means the filler (oil) is separated and the gasket is deteriorated.

* It sometimes is found the oil of liquid gasket is separated within the period of validity. It is not deteriorated.
* Normal gasket will be hardened in about 2 hours, but the deteriorated gasket would not be hardened.



(A) When liquid gasket is deteriorated, oil is separated from components.
(B) Squeeze out about 20 mm and check deterioration.

0.3.3 SCREW TIGHTENING TORQUE TABLE

Tighten screws, bolts and nuts according to the table below. If the tightening torque is specified, follow the specification.

General tightening torque Unit: N-m (kgf-m)

Items	Thread diameter	Tightening torque
PT plug	1/8	9.8 (1.0)
	1/4	19.6 (2.0)
	3/8	29.4 (3.0)
	1/2	58.8 (6.0)
Pipe joint bolt	M8	13.0 - 16.4 (1.3 - 1.7)
	M12	24.5 - 34.3 (2.5 - 3.5)
	M14	39.2 - 49.0 (4.0 - 5.0)
	M16	49.0 - 58.8 (5.0 - 6.0)

General tightening torque of bolts N-m (kgf-m)

	Standard thread screw	
Nominal size	4T	7T
M6	4.90 - 6.86 (0.5 - 0.7)	8 - 12 (0.8 - 1.2)
M8	12.74 - 16.66 (1.3 - 1.7)	23 - 29 (2.3 - 3.0)
M10	24.50 - 34.36 (2.5 - 3.5)	44 - 59 (4.5 - 6.0)
M12	44.10 - 58.80 (4.5 - 6.0)	78 - 98 (8.0 - 10.0)
M14	68.80 - 83.30 (7.0 - 8.5)	118 - 147 (12.0 - 15.0)
M16	107.80 - 137.20 (11.0 - 14.0)	167 - 206 (17.0 - 21.0)
M18	156.80 - 186.20 (16.0 - 19.0)	235 - 284 (24.0 - 29.0)
M20	215.60 - 264.60 (22.0 - 27.0)	324 - 402 (33.0 - 41.0)

IMPORTANT

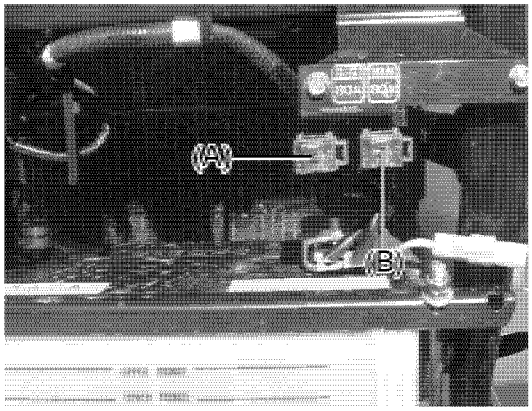
- **The tightening torque of fine thread screws shall be 80% of that of the standard thread screws.**
- **To tighten any aluminum part, apply torque equivalent to 80% of the specified value.**
- **Recently, all the bolts may be standardized to 7T bolts under the plant line management of Yanmar.**
- **When 7T bolt is used with rubber, rubber packing or aluminum parts, tighten the bolt following the values in the 4T-bolt table.**

Bolt standard

		4T	7T
Tensile Strength (kgf/sq.mm)	Minimum	40	70
Brinell Hardness (Hb)	Minimum	105	201
	Maximum	229	277
Yield Point (kgf/sq.mm)	Minimum	23	50

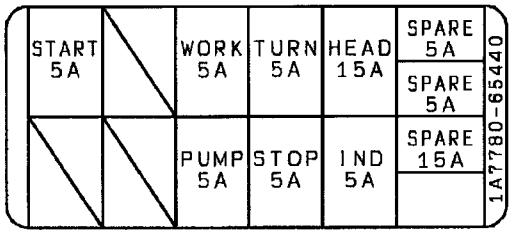
0.3.4 FUSE BOX

(1) The alternator and main fuses are 80A, slow-blow fuses.

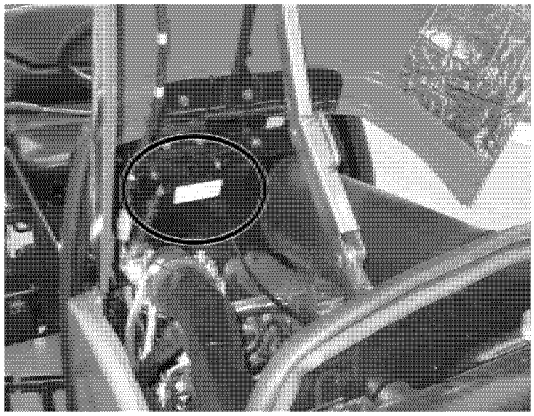


(A) Alternator fuse: 80A
(B) Main fuse: 80A

(2) The electrical fuses are in the engine compartment.



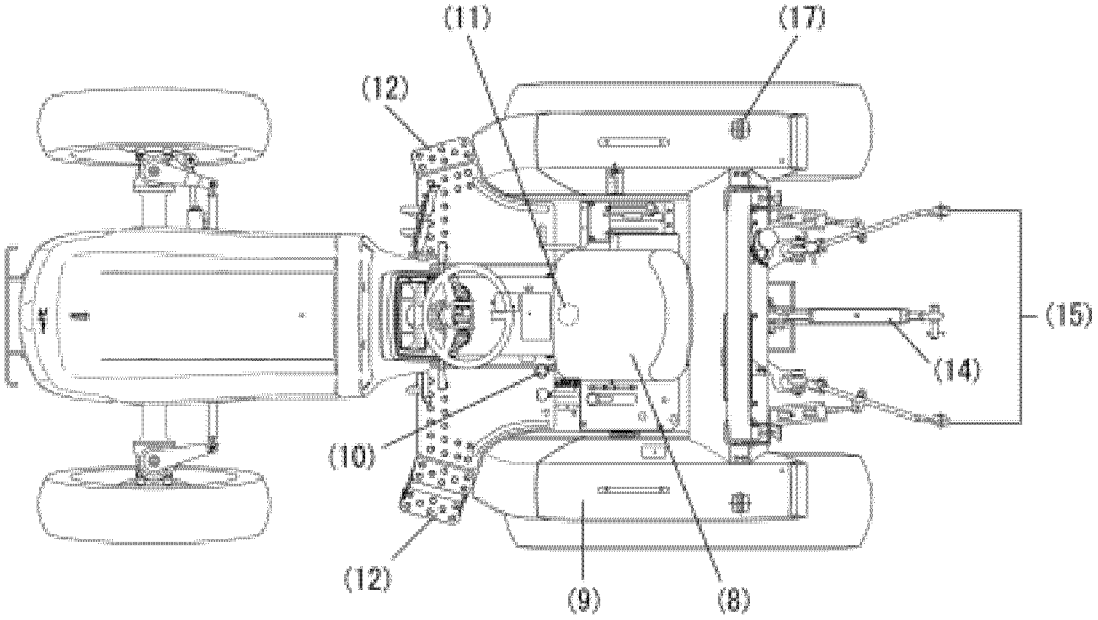
Starter motor: 5A
Working lamp: 5A
Head lamp: 15A
Fuel pump: 5A
Stop solenoid: 5A
Indicator: 5A

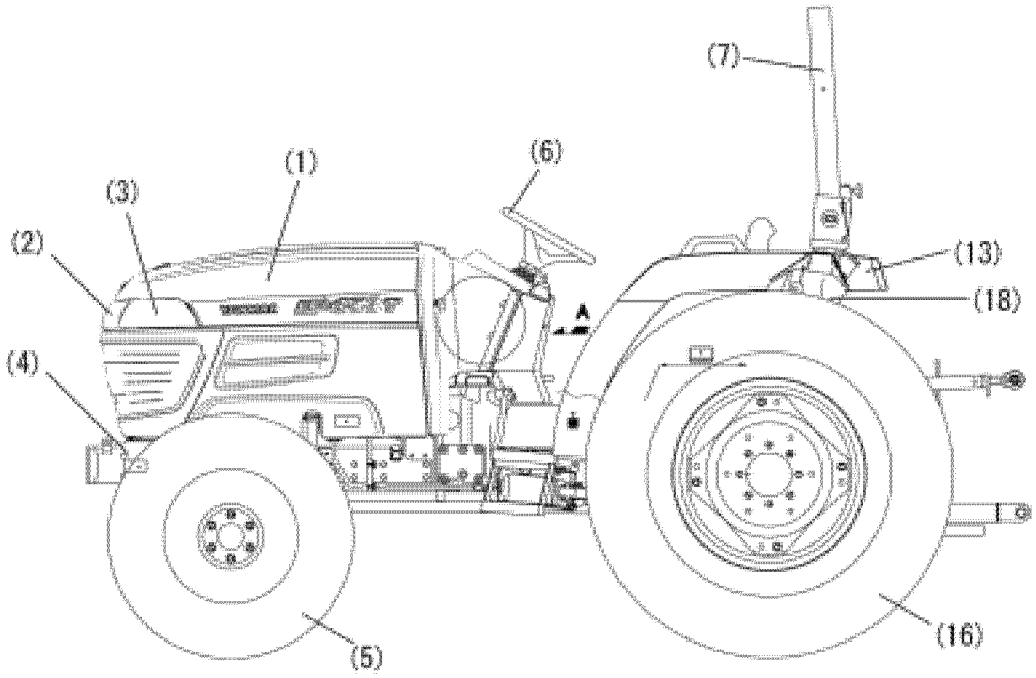


0.3.5 PART NAMES

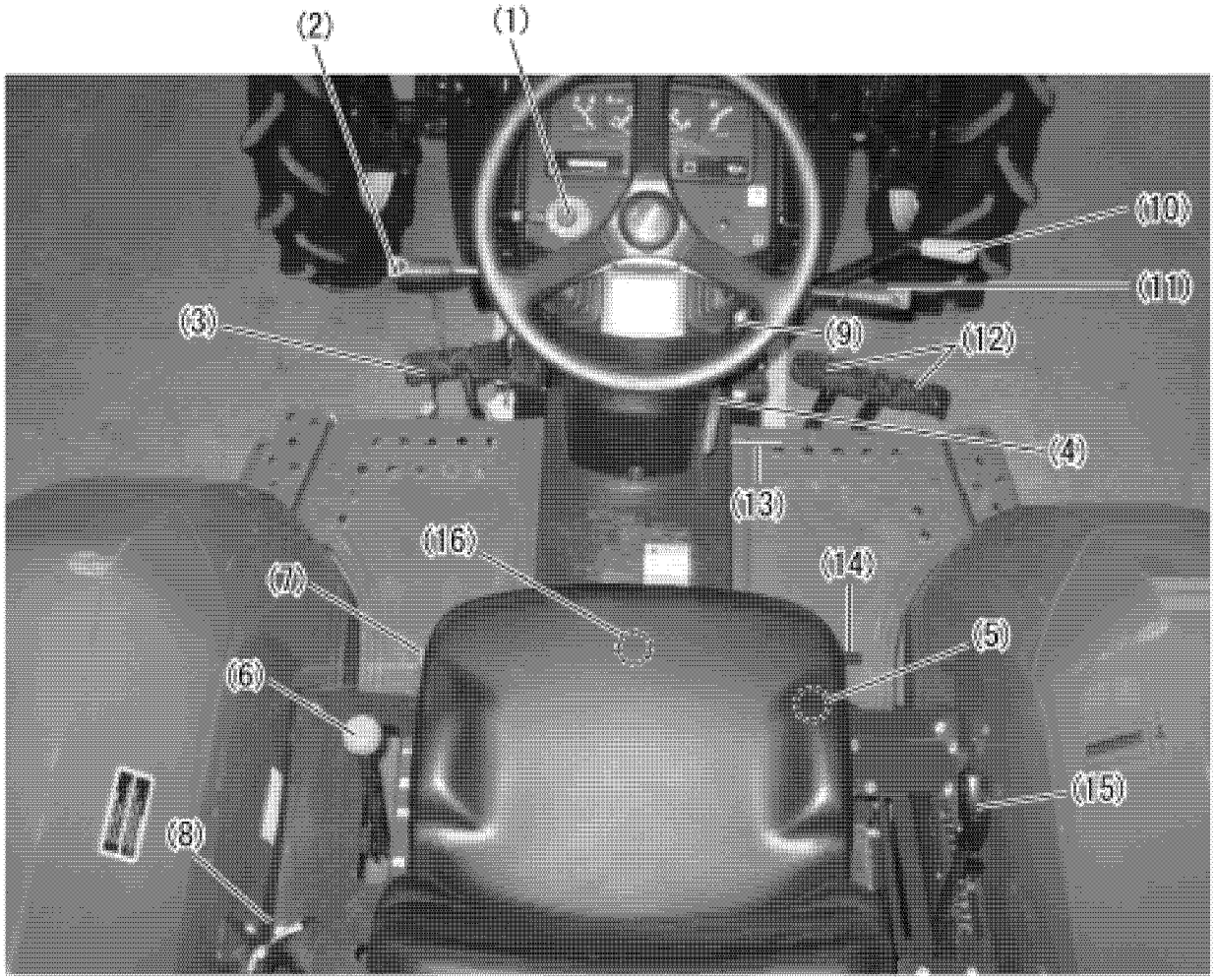
The illustration shows EF453T.

(1) Bonnet
(2) Headlights
(3) Side lens
(4) Front axle bracket
(5) Front tires
(6) Steering wheel
(7) Safety frame ROPS (Optional equipment)
(8) Operator's seat
(9) Rear fender
(10) PTO shift lever
(11) Hydraulic stop-slow turn valve
(12) Step
(13) Tail lamp
(14) Top link
(15) Lower link
(16) Rear tires
(17) Flasher lamp (Side marker lamps)
(18) Fuel tank



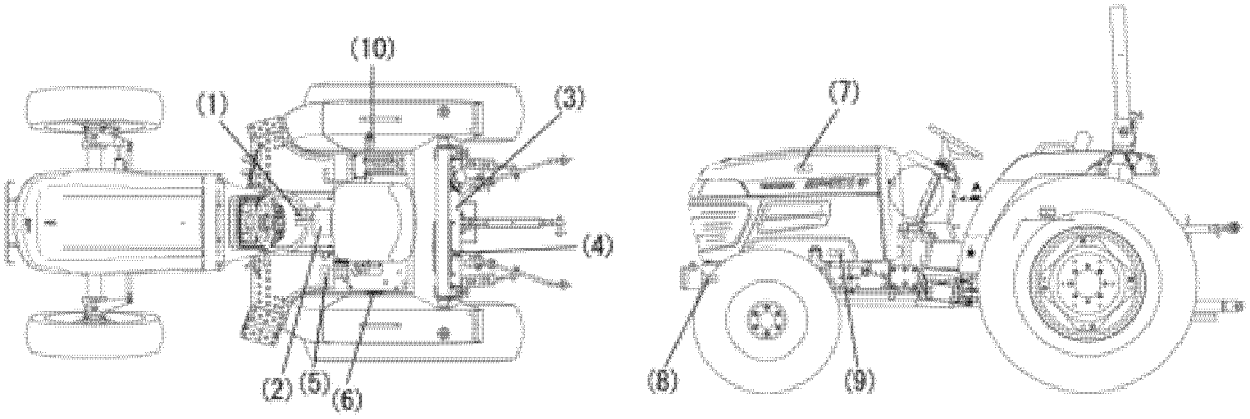


(1) Light switch, Horn switch, Flasher switch
(2) Reverser lever
(3) Clutch pedal
(4) Parking brake lever
(5) Operator's seat adjusting lever
(6) Range shift lever
(7) Front wheel drive lever
(8) Seat belt (Optional equipment)
(9) Main switch
(10) Accelerator lever
(11) Main shift lever
(12) Brake pedal
(13) Accelerator pedal
(14) Differential lock pedal
(15) Position control lever
(16) Draft control lever (Optional equipment)
(17) Hydraulic stop slow return valve

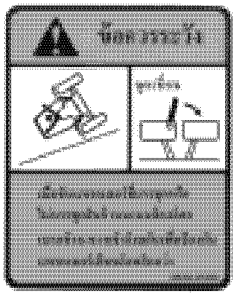


0.3.6 SAFETY LABEL LOCATION

(1) Label, Brake coupling
(2) Label, CAUTION
(3) Label, Fire caution
(4) Label, Danger shaft rotate
(5) Label, Thailand only
(6) Label, Machine ID
(7) Label, Engine ID (on the engine)
(8) Label, Caution muffler
(9) Label, safety cover
(10) Label, speed



(1) 198283-65360

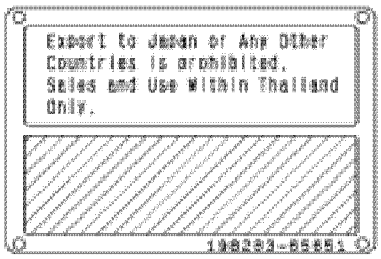


(2) 198283-65310

(3) 198283-65250

(4) 198163-65350

(5) 198283-65650



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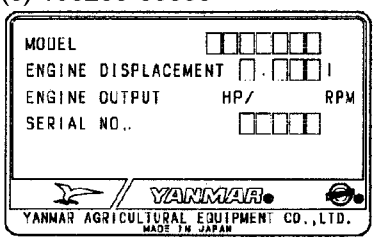
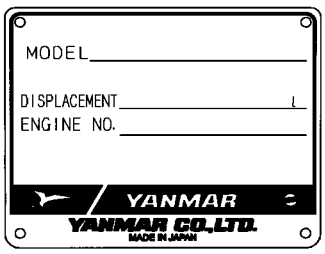
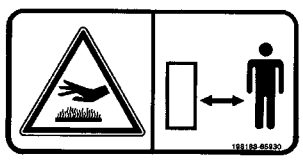


(7) 198283-65650



(8) 198283-65650



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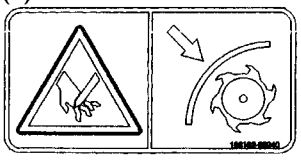

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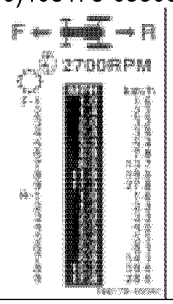


0.3.7 SPECIFICATIONS

Model			EF453T
Drive type			4-wheel Drive
Dimensions	Overall length (mm)		3,230
	Overall width (mm)		1,605
	Overall height (mm)		1,534 (ROPS 2,459)
	Wheelbase (mm)		1,830
	Tread	Front (mm)	1,290 - 1,570
		Rear (mm)	1,270 - 1,830
	Ground clearance (mm)		375
Weight (kg)			1,450 (ROPS 1,485)
Engine	Model		4TNV88
	Type		4-cycle, water-cooled diesel
	Output (SAE Gross) (HP/rpm)		45/2,700
	Number of cylinders		4
	Bore x Stroke (mm)		88 x 90
	Displacement (cc)		2,189
	Air cleaner		Dry, dual element
	Fuel tank capacity (liter)		40
	Battery		12V-64AH
Steering			Hydrostatic
Clutch			Dry, single
Brake			Mechanical, wet disc
Transmission	Type		Collar shift
	Gear shift (Forward x Reverse)		F9 x R9
	Forward speed (km/hr)		1.6-27.8
	Reverses speed (km/hr)		1.6-28.6
	Max. speed, forward (km/hr)		29.7
Tire	Front		8-18-6
	Rear		13.6-26
Rear PTO	Type		Continuous live PTO
	PTO shaft		SAE1-3/8 inch (35mm), 6 spline
	Speed (rpm)		547 741 at rated engine speed
Hydraulic	Type		Position control
	Hitch		3 point hitch, category SAE #1
Draw bar hitch			Clevis type

NOTE:
All technical data, measurement and weight are approximate, and the manufacturer has the right to make alteration without prior notice.

0.3.8 TRACTOR MASS AND TIRE SPECIFICATION

TIRE SIZE (Number of plies)		FRONT AXLE		REAR AXLE	
		Maximum working load of tires	Technically permissible mass on each axle	Maximum working load of tires	Technically permissible mass on each axle
F: 8-18(6), R: 13.6-26(4)	kg	650	980	1065	1675

IMPORTANT
Set up the implement so that the front wheel load and the rear wheel load are not greater than the smaller of the following: the permissible load capacity of the tires or the technically permissible mass on each axle.

1

PERIODICAL INSPECTION

1.1 CHECK INTERVALS

x: Checks required

CHECK ITEMS	50 h	100h	150h	200h	250h	300h	350h	400h	450h	500h	550h	600h
Engine lubrication oil	Replace	Replace		Replace		Replace		Replace		Replace		Replace
Engine oil element	Replace					Replace						Replace
Transmission oil	Replace	x	x	x	x	Replace	x	x	x	x	x	Replace
Line filter (Hydraulic)	Replace					Replace						Replace
Transmission oil strainer	Clean					Clean						Clean
Fuel filter						Replace						Replace
Water separator element	Clean			Clean		Replace		Clean		Clean		Replace
Radiator interior	Clean the interior of radiator when replacing cooling water											
Cooling water	Check before every work / Replacing every year											
Front axle oil	Replace	x	x	x	x	Replace	x	x	x	x	x	Replace
Air cleaner element	x	x	x	x	x	Replace	x	x	x	x	x	Replace
Radiator screen	x	x	x	x	x	x	x	x	x	x	x	x
Clean cooling fan, radiator	x	x	x	x	x	x	x	x	x	x	x	x
Battery liquid level	Check before every work											
Battery liquid gravity		x		x		x		x		x		x
Fuel piping, connections	x	x	x	x	x	x	x	x	x	x	x	x
Rubber hoses (Power steering)	x	x	x	x	x	x	x	x	x	x	x	x
Radiator hoses	Replace hoses every two years											
Hydraulic rubber hoses	Replace hoses every two years											
Fuel pipe, electric wires	Replace pipes and wires every two years											
Electric wiring, connections	x	x	x	x	x	x	x	x	x	x	x	x
Grease-up	x	x	x	x	x	x	x	x	x	x	x	x
Fastening of steering wheel fix nut		x		x		x		x		x		x
Important nuts and bolts	x	x		x		x		x		x		x
Cooling fan belt	x	x		x		x		x		x		x
Engine breather pipe	x	x	x	x	x	x	x	x	x	x	x	x
Engine crank case												x
Clearance of exhaust valve												x
Fuel injection valve												x
Generator, start motor	x	x				x				x		
Hydraulic system	x	x				x				x		

Break-in period is 50 hours. If not reached, take up 1 year instead.
Items marked "Replace" should be replaced every two years even before suggested time intervals.
Replace the power steering hoses every 2 years.

1.2 OIL AND GREASE

OIL, GREASE	Type
Fuel	Diesel fuel only
Engine oil	SAE 30 or 40 API Grade CD or better
Grease	Multipurpose Grease
Transmission oil, Hydraulic system oil	TF-500 Transmission fluid

* At temperature below – 10°C, use Super No.3 light oil.

1.3 OIL AND WATER VOLUME

(Unit: liters)

		EF453T	Oil type
Fuel		40	Diesel light oil
Cooling water	Radiator	4	Anti-rusting fluid
	Sub-tank	0.45	Anti-rusting fluid
Engine oil		5.3	10W-30, API Grade CD
Transmission oil		27	TF-500A Transmission fluid
Front axle oil		7.5	TF-500A Transmission fluid

1.4 EQUIVALENT TO TF-500

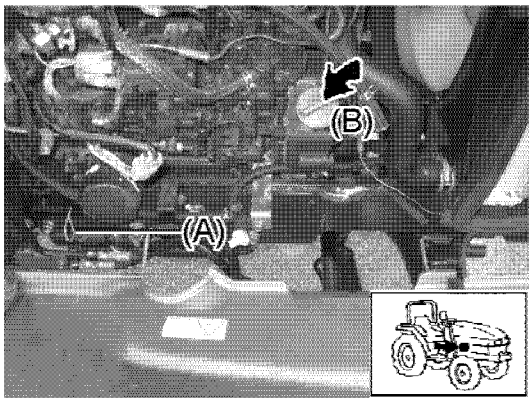
Supplier	Brand name
Mobil	Mobil Fluid 425, 424
Castrol	Agricastrol MP, CASTROL UTF
Shell	Tellus Oil 32 or 37, Donax TD
Ford	ESN-M-2C-134A
Esso	Torque Fluid 56
John Deere	J20B, J14A
BP	Tractran UTH

1.5 REPLACING OIL

DANGER
Never add oil while the engine is warm or running.
A fire may occur.

CAUTION
Never add oil just after stopping the engine. You may be burned.

Engine oil



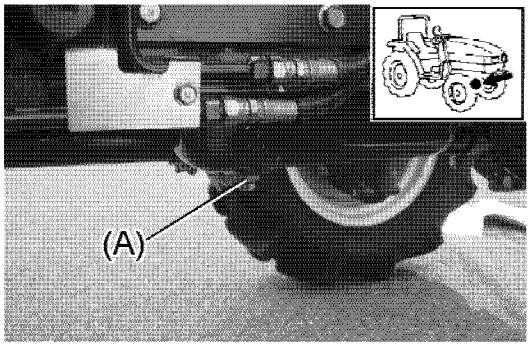
Check
Draw out the oil gauge on the right side of the engine and wipe off oil with a cloth. Reinsert and remove it again to see if the oil level is within the upper and lower marks.

If insufficient, add the new oil as much as the normal level through the supply port.

(A) Oil gauge
(B) Oil supply port

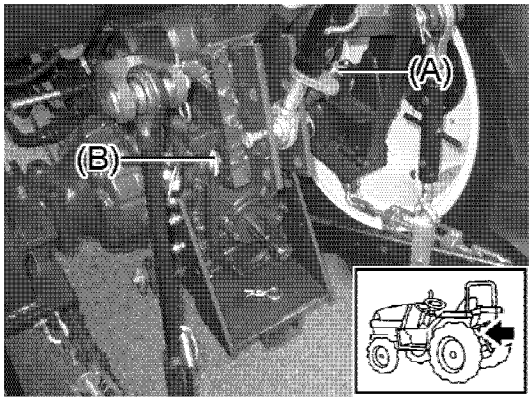
NOTE:
Check the oil level before the engine starts or when the engine is cool.

Replacing oil
Remove remaining oil through the drain plug on the lower part of the engine. Add the new oil through the oil supply port. Select a proper type of engine oil and replace it periodically considering the temperature and operating conditions.



(A) Drain plug

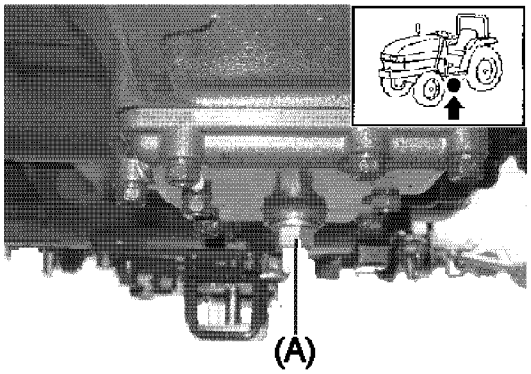
Transmission oil



Check

Draw out the oil gauge on the rear part of the transmission and check the oil level. The level should be between the upper and lower limits. If insufficient, add the new oil to the normal level. Also check for leaks.

(A) Oil supply port
(B) Oil gauge



Replacing oil

Remove the remaining oil through the drain plugs on the bottom of the transmission case. Removal is easy if the transmission case is warm. Add the new oil through the supply port on the rear part.

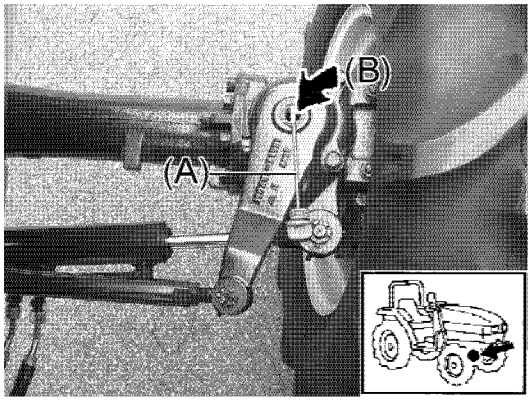
- Transmission oil is commonly used with hydraulic oil and power steering oil.
- Use Yanmar transmission fluid TF-500 or equivalent for transmission oil.

(A) Drain plug

Equivalent to TF-500A

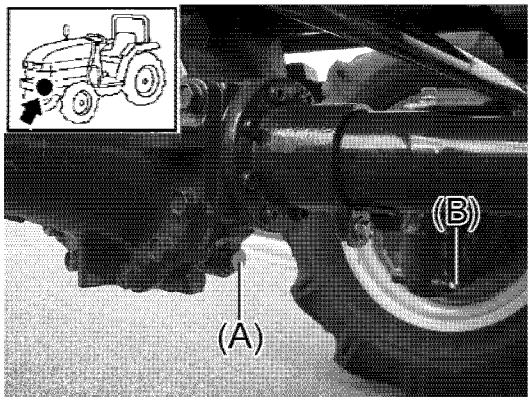
Supplier	Brand name
Mobil	Mobil Fluid 425, 424
Castrol	Agricastrol MP, CASTROL UTF
Shell	Tellus Oil 32 or 37, Donax TD
Ford	ESN-M-2C-134A
Esso	Torque Fluid 56
John Deere	J20B, J14A
BP	Tractran UTH

Front axle oil



Check
Remove the oil gauge plug on the top of the front axle. Wipe off the gauge rod and reinsert it without screwing. Redraw it and see if the oil level is within the upper and lower marks. If insufficient, add the new oil through the oil supply port to the normal level. Check also for oil leak.

(A) Oil gauge plug
(B) Oil supply port



Replacing oil
Remove oil through center drain plug on the lower part of the front axle and drain plugs on the bottom of the right and left gear cases. Add oil through the right port.

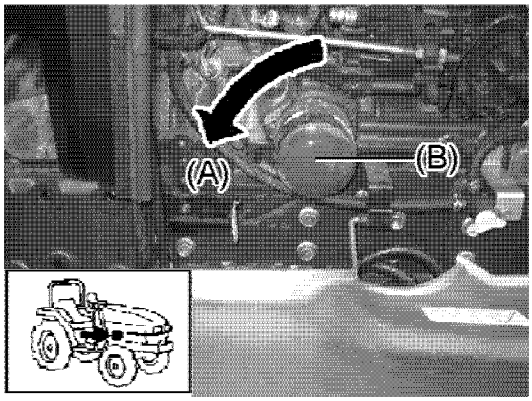
Use Yanmar TF500A transmission fluid or carrier red 80B for front axle oil.

Use Yanmar transmission fluid TF-500A or equivalent for front axle oil.

(A) Center drain plug
(B) Gear case drain plug

1.6 REPLACING RESPECTIVE ELEMENTS

Engine oil element



Replace the engine oil element at intervals of 300 hours or every 2-3 times of replacing the engine oil.

(A) Turn left to detach
(B) Oil element

Replacing oil

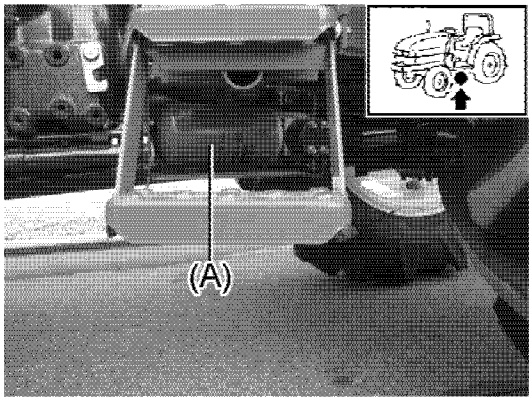
(1) Remove engine oil and turn the cartridge anticlockwise with a filter wrench.

(2) Apply a slight coating of oil on the rubber ring on the bottom of the new cartridge. Mount the cartridge with a filter wrench.

(3) After replacing the engine oil, run the engine until the hydraulic pilot lamp goes off.

(4) When the hydraulic lamp goes off, again check the oil level with the gauge. If insufficient, add the oil.

Line filter (Transmission oil element)



The line filter is of a cartridge type. Replace it with a new one at intervals of 300 hours thence.

(A) Line filter

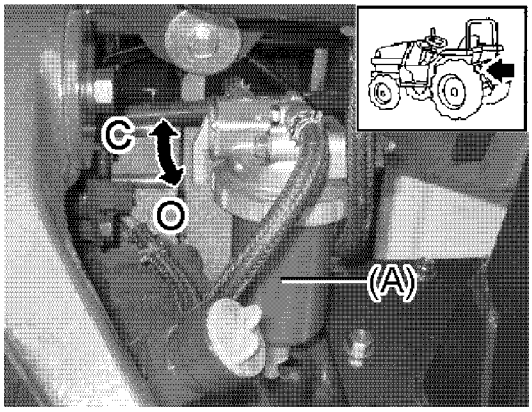
Replacement

(1) Remove the transmission oil and remove the cartridge by turning it anticlockwise.

(2) Apply a slight coating of oil on the rubber ring on the bottom of the new cartridge. Mount the cartridge securely.

(3) After replacing the transmission oil, idle the engine and check the oil level with an oil gauge. If insufficient, add the oil.

Replacing water separator element



(1) Put the fuel cock in the C (Close) position.

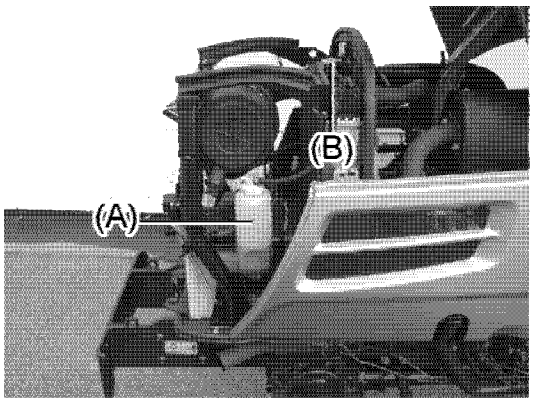
(2) Detach the strainer and remove water and dust from it.

(3) Remount the strainer to the original position. Open the fuel cock (turn to position O) to bleed the air from the fuel.

(A) Fuel strainer

(4) Replace the strainer element every 300 hours.

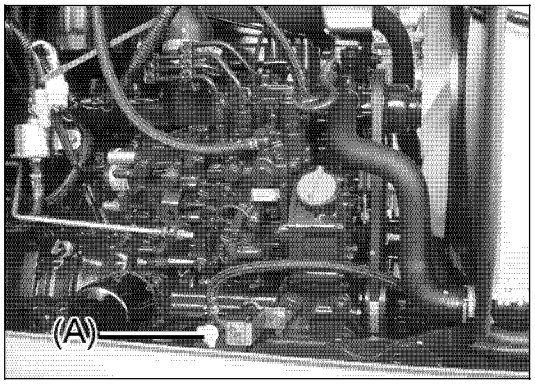
1.7 REPLACING COOLING WATER



DANGER
Never open the radiator cap when the radiator is hot. You may be burned by the hot vapor.

Check
Open the bonnet and right side cover of the engine and check if the sub tank water is within the upper and lower limit marks. If insufficient, add water through the supply port.

(A) Sub tank
(B) Supply port



Replacement
(1) Remove the radiator cap and the drain plug to drain off the engine cooling water.

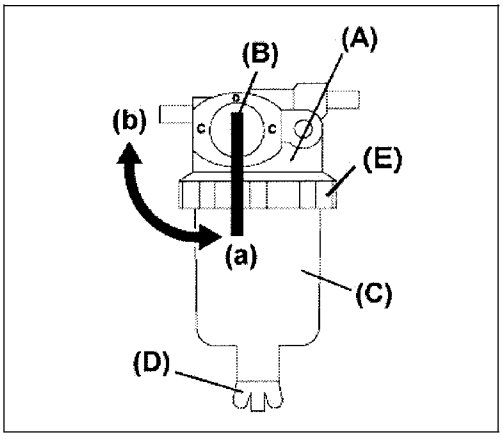
(A) Radiator drain plug

(2) Clean the radiator with tap water until dust or rust is all drained out.
- It is recommended to use radiator detergent. Idle-run the engine for more than 15 minutes, then remove the water.

(3) Remount the drain plug and add the anti-rusting fluid by an adequate amount. Fill fresh water until it overflows.
(4) Mount the lid of the radiator and start the engine to mix the anti-rusting fluid with fresh water.

NOTE:
- When the new cooling water has been added, never fail to put anti-rusting fluid and idle-run the engine for about 5 minutes to ensure mixing.
- The mixing ration varies with manufacturers; therefore, follow the relevant instruction sheet.
- It the cooling water is reduced by evaporation, add only fresh water.

1.8 REMOVING WATER FROM WATER SEPARATOR



The water separator is mounted on the lower part of the fuel tank. When the red O-ring comes up, put the fuel cock in the C position and detach the transparent case. Then, remove water.

(A) Water separator
(B) Fuel cock
(C) Strainer
(D) Drain cock
(E) Retaining ring
(a) Open
(b) Close

1.9 REPLACING RADIATOR SCREEN AND AIR CLEANER ELEMENTS

The air cleaner serves to keep the engine in favorable conditions by removing dust in air and preventing the cylinder liner and piston ring from wearing.

For operation in a dusty environment, clean the air cleaner element every 50 hours and replace it every 300 hours.

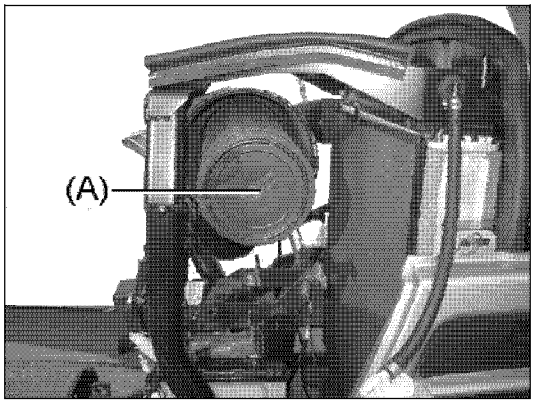
For operation in a normal condition, clean it every 100 hours and replace it every 1000 hours. Even before the said intervals, replace it every year.

Cleaning air cleaner element

(1) Open the bonnet.

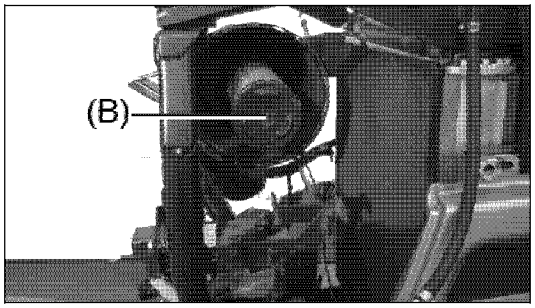
(2) Remove the sub tank.

(3) Open the lid and take out the element.



(A) Air cleaner (Outer)
(B) Air cleaner (Inner)

(4) Blow air from inside of the element or lightly pat it to take off dust. Be careful not to damage the fins.

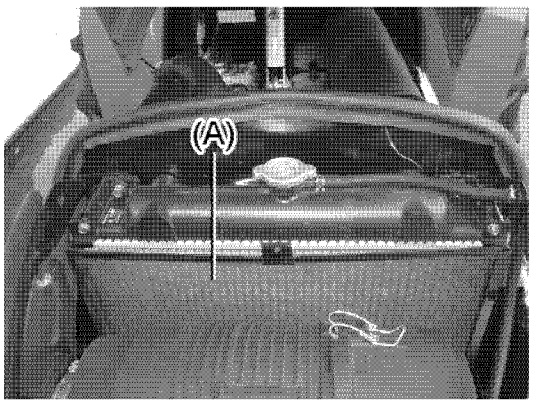


IMPORTANT

When the inner element (B) is dirty, replace it. It cannot be cleaned.

Cleaning radiator screen

Pull the radiator screen upward and remove straws and dust from it.



(A) Radiator screen

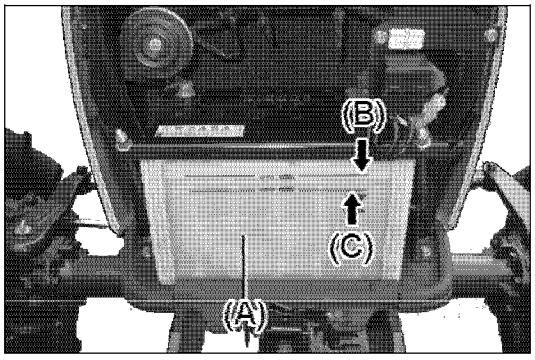
1.10 CHECKING BATTERY

DANGER

- Never use a fire while checking the battery or the battery cap is removed. Otherwise, a fire or gas explosion may result.
- Do not come in contact with the battery fluid. If the fluid attaches on your body or cloth, immediately wash out with water. Otherwise, you may be burnt.

CAUTION

To mount the battery, start with the positive lead (+). For removal, start at the negative lead (-). Otherwise, a short-circuit will burn you.



Check that the battery has its fluid between the upper and lower limit marks. If not, add the distilled water as high as the upper limit.

(A) Battery
(B) Upper limit
(C) Lower limit

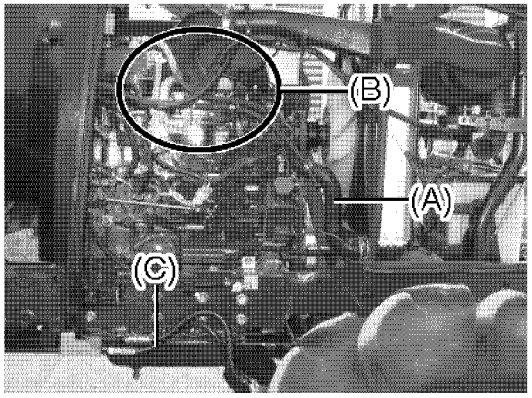
NOTE:

- Excessive battery fluid may overflow during recharging, damaging the metallic parts of the tractor.
- Quick charge is not recommended.
- When replacing the battery, use the specified battery.

1.11 CHECKING FLUID LINES

CAUTION

Aged or damaged pipes are subject to fuel leak which will cause a fire. Check for a leak and replace the pipe with new one.



Check the power steering pipes, fuel pipes and radiator hoses for leak or loose couplings. Replace them every two years, damaged or not damaged.

(A) Radiator hose
(B) Fuel pipe
(C) Power steering pipes

NOTE:

Bleed the air after the fuel pipe has been replaced.

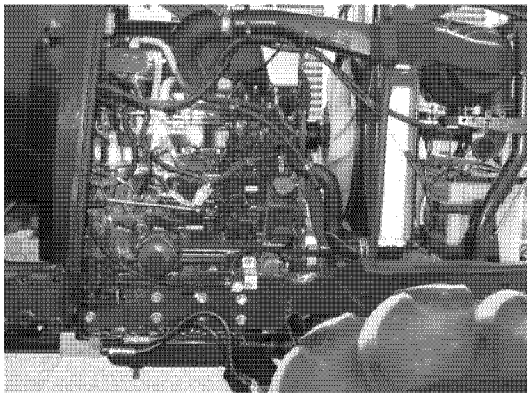
1.12 CHECKING ELECTRICAL WIRING

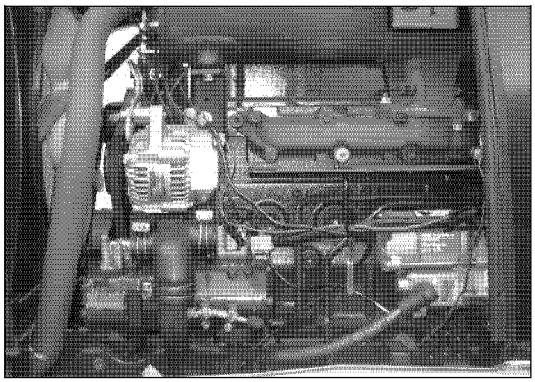
WARNING

- Check before starting day's work that the cables are not shortcircuit to other parts or insulator is not damaged, or contacts are not loosened.
- Remove straws and dust from the cables and joints before starting works. Otherwise, a shortcircuit can cause a fire.

Remove the engine side covers and check the electrical wires for damaged sheaths or loose connections. Repair them or consult your service representative.

Check them every 50 hours or replace them every year, damaged or not damaged.

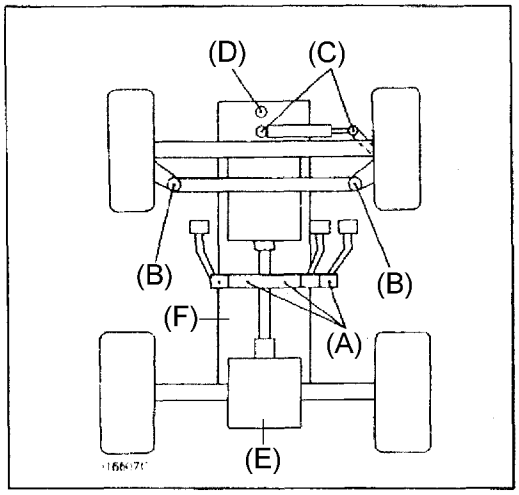




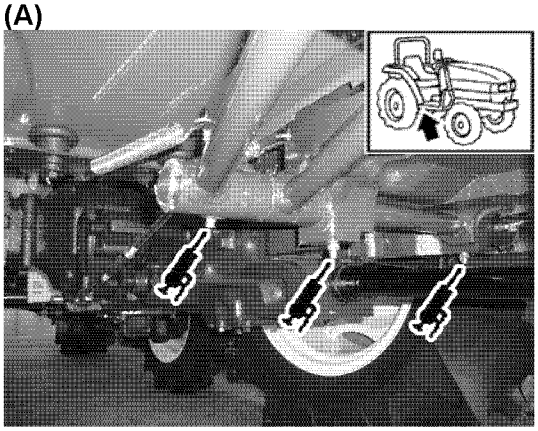
1.13 GREASING

Before initiating day's work, check the greasing condition at each point. Grease up after a work on a muddy field. As a general rule, grease up various points at intervals of 50 hours.

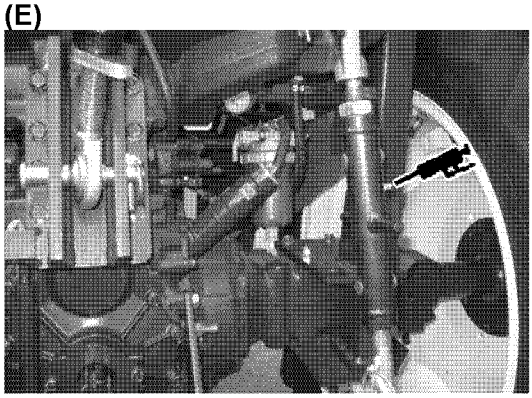
(A) Brake pedal shaft
(B) Tie rod
(C) Power steering rod
(D) Front center pin
(E) Lift link
(F) Range shift lever



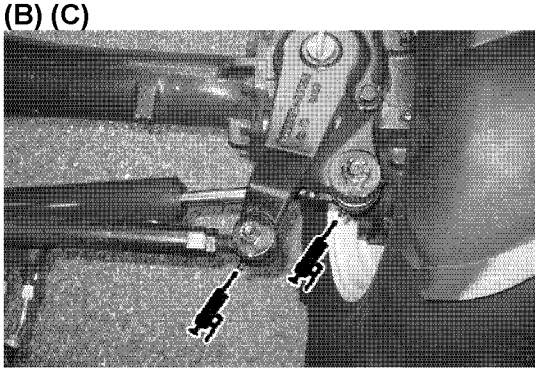
(A)



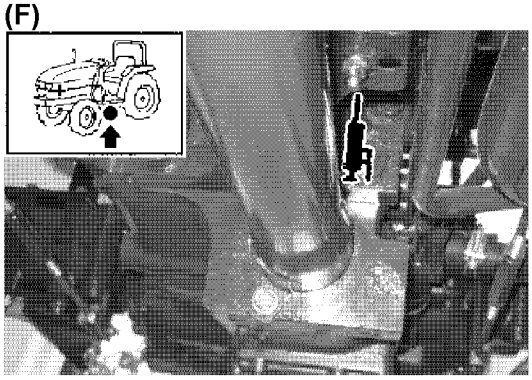
(E)



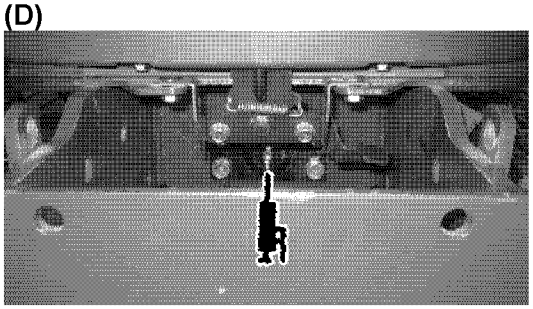
(B) (C)



(F)



(D)



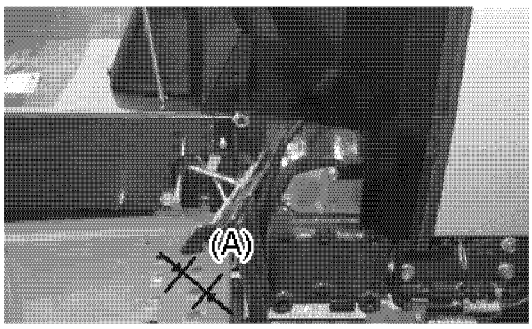
1.14 ADJUSTING BRAKE

WARNING

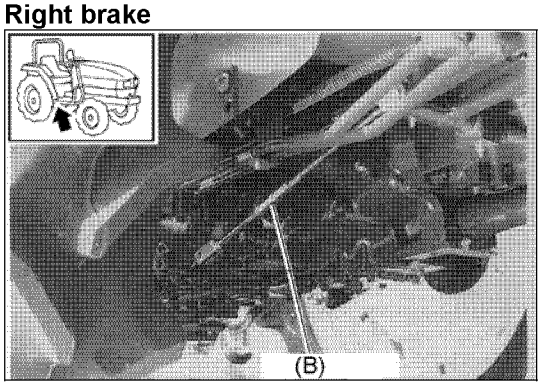
- Check if the brake is effective or not one-sided. An accident can result.
- Unbalanced play at left and right brake pedals can cause one-sided braking effect. Keep the same amount of play; otherwise, an accident can result.

Depress the brake to see a required play of 30-40 mm is available and if the left and right pedals work together. If not, adjust the turn buckles behind the pedals for a play of 30 mm. Secure the turn buckle with the lock nuts. Make sure the parking brake lock is put on when the brake pedals are fully stepped in.

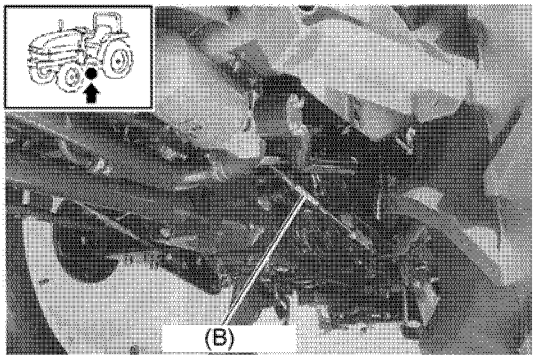
(A) Play 30-40 mm
(B) Turn buckle



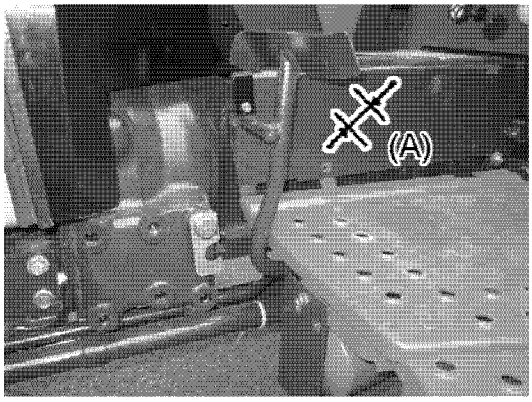
Right brake

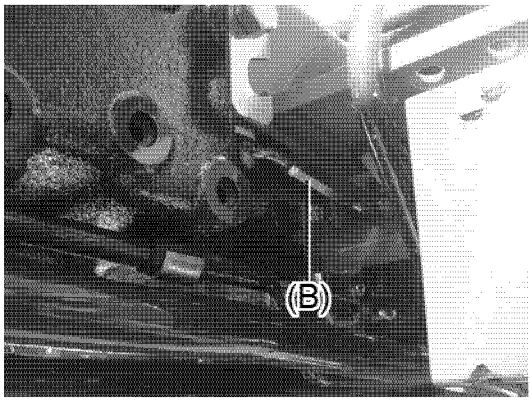


Left brake



1.15 ADJUSTING CLUTCH

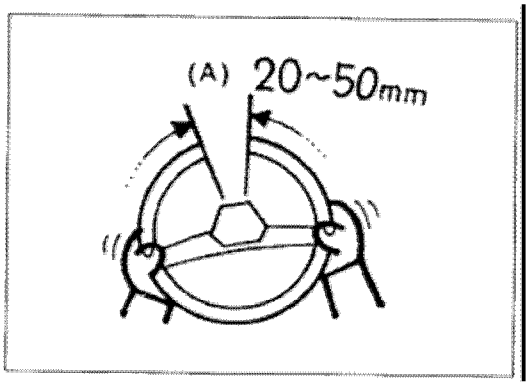




Standard version
Depress the clutch pedal to see it there is a specified play of 15-25 mm. It not, adjust the turn buckle for a play of 15-25 mm. Securely lock the nut after adjustment.

(A) Play 15-25 mm
(B) Turn buckle

1.16 ADJUSTING STEERING WHEEL

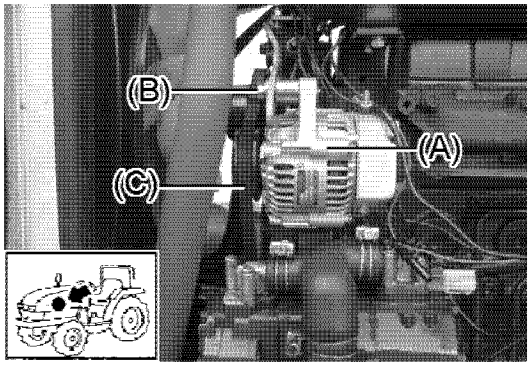


WARNING
Check a play for the steering wheel. It should be within a tolerable range. Otherwise, an accident may occur.

Turn the steering wheel slightly left and right to see if there is a play of 20-50 mm. Improper play will fail to provide the smoothness and linearity of steering function. If a play is not adequate, contact your service representative.

(A) Play

1.17 ADJUSTING FAN BELT



CAUTION
Wait until the engine is sufficiently cooled down. Otherwise, you may be burned.

(1) Switch off the engine.

(2) Open the bonnet, then the left sidecover of the engine.

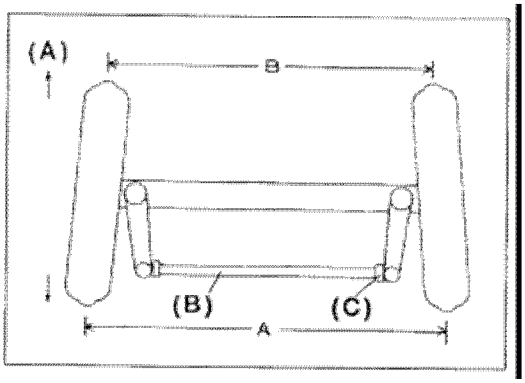
(3) Press the fan belt with a finger at the midpoint to see the belt deflections 10-15 mm.

(4) If not, loosen the alternator fastening bolt and shift the alternator to adjust the belt tension.

If the belt still slips after full shift of the alternator, replace the belt with a new one. Check the new belt at intervals of 50 hours.

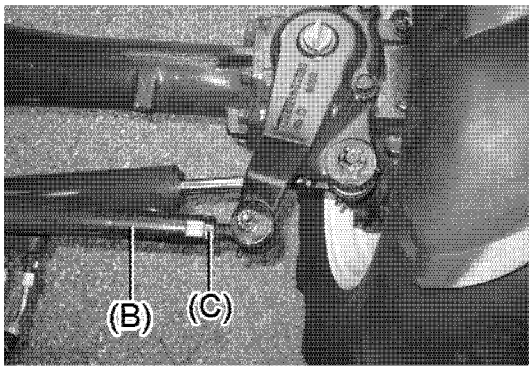
(A) Alternator
(B) Alternator fastening bolts
(C) Fan belt

1.18 ADJUSTING TOW-IN

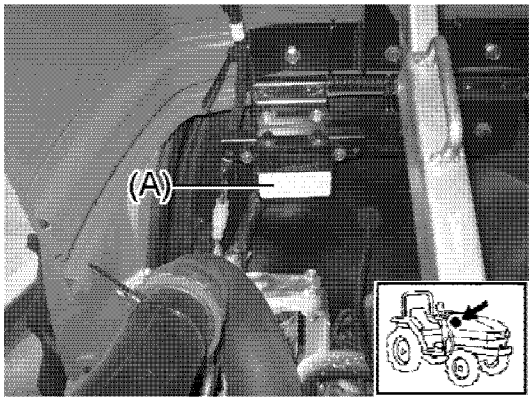


Poor adjustment of tow-in will result in an abnormal steering performance. Measure the front wheel dimension A and B. The difference of A-B should be 4-8 mm. If out of this range, loosen the lock nut of the tie rod end and adjust the turn buckle. Fasten the lock nut where the tow-in is 4-8 mm.

(A) Front
(B) Tie rod
(C) Lock nut

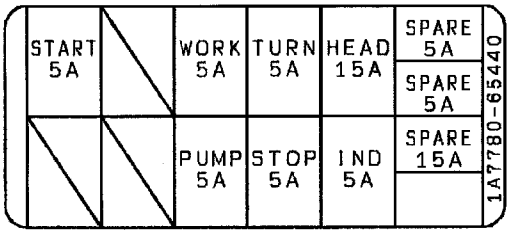


1.19 REPLACING FUSE



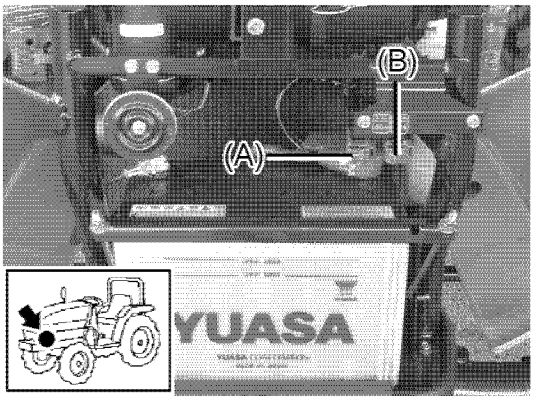
Remove the lid of the fuse box and check the fuse.
Replace the blown fuse with new one.
Stop the engine and check the main fuse (slow blow fuse) which shuts off the electrical circuit when an excessive current flows. Fused condition can be checked by the changed color of the outer sheath.

(A) Fuse box



Starter motor:	5A
Working lamp:	5A
Head lamp:	15A
Fuel pump:	5A
Stop solenoid:	5A
Indicator:	5A

(A) Alternator fuse: 80A
(B) Main fuse: 80A

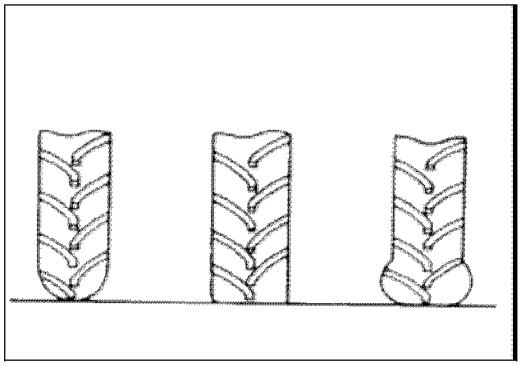


1.20 CHECKING TIRES

Adjust the air pressure of front and rear tires to the standard pressure. Check the tires for cracks or damage.
Adjust the front tire pressure for a maximum in the following table if a load is to be imposed on the front tires through the front weight or front loader.

		Air pressure (kg/cm^2)
Standard	Front tire	2.4
	Rear tire	1.0
Maximum	Front tire	3.0
	Rear tire	1.6

Fastening torque
Fixing bolts for rim and disk: 28±2 kgf-m
Fixing bolts for wheel and axle shaft: 19 kgf-m


Excessive Standard Insufficient

1.21 COLOR OF EXHAUST GAS

The color of exhaust gas is black when the engine is started and gray during normal operation.

Black: Incomplete combustion due to dense fuel
White: Engine oil is burning. Normal exhaust may look white at extremely low temperature.

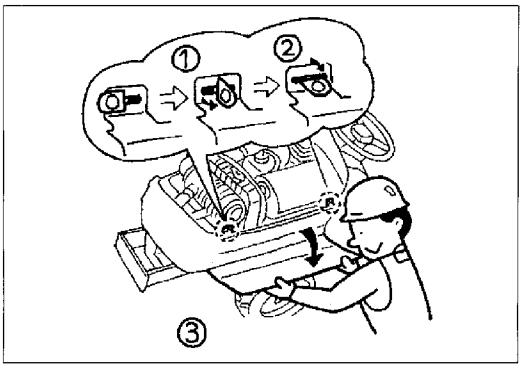
If exhaust gas is black or white without a load on the tractor, consult your service representative.

2

ROUGH DISASSEMBLY OF COMPONENTS

2.1 REMOVING THE ENGINE BONNET COVER

2.1.1 Removing/mounting the side covers



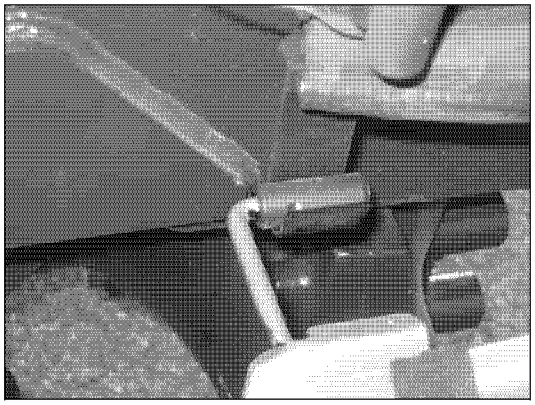
<Removing>

(1) Open the bonnet.

(2) Put the locking knobs in the vertical position (each forward and rear).

(3) Remove the side covers.

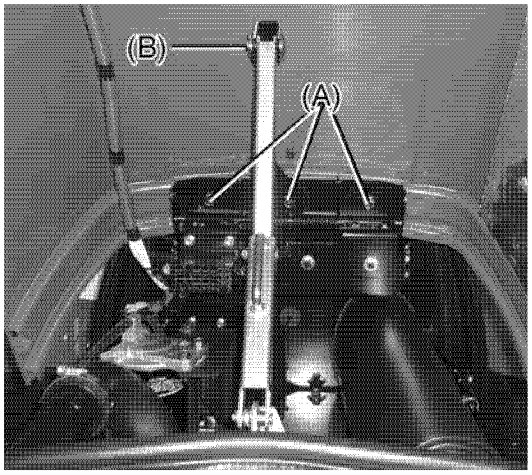
<Mounting>



(1) Clamp the cover lower hooks (x 2).

(2) Fix the cover top with the locking knob.

2.1.2 Removing the engine bonnet cover

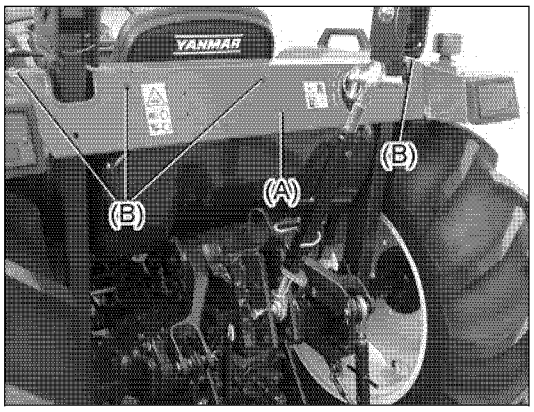


Remove the three bolts (A) and the pin (B), and remove the engine bonnet cover.

CAUTION
This operation should be done by two people. If you don't use two people, you may be injured.

2.2 REMOVING THE FENDER

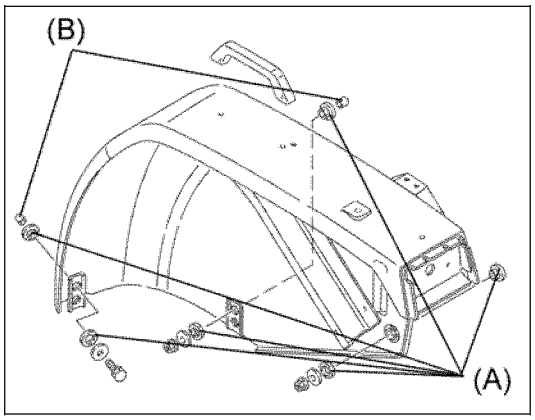
2.2.1 Removing the fuel tank shroud



(A) Fuel tank shroud
(B) Bolt M8x16, 7pcs.

Note:
Pay attention to the lamp harness.

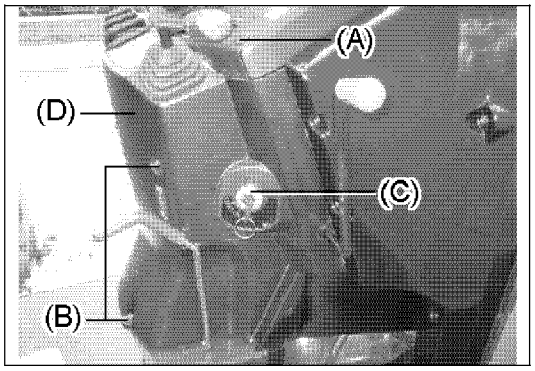
2.2.2 Removing the nuts and bolts that secure the fender



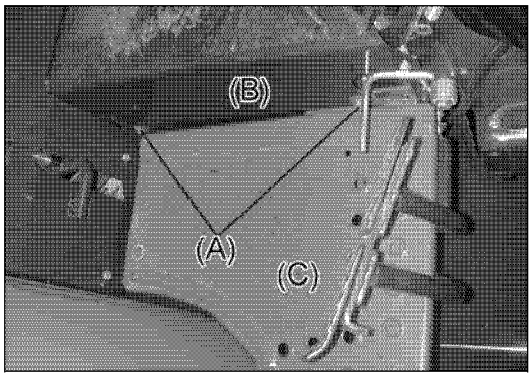
Note:
- Be careful not to lose the rubber washers (A) or the collars (B).
- The fender can be removed without removing the rear tire.

2.3 REMOVING THE STEP

(1) Remove the two screws (A), the three M6x20 bolts (B), and pull the front column cover (D). Then, it is possible to detach the key switch coupler.

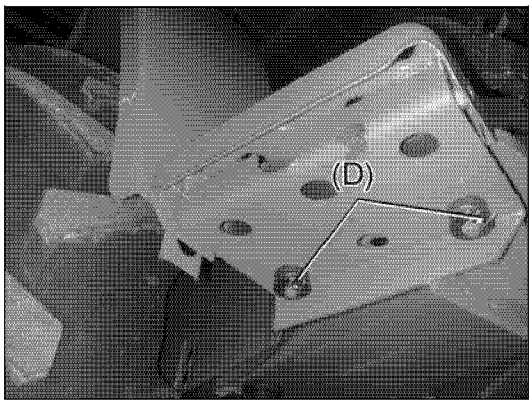


(2) Remove the four M6x20 bolts (A), and remove the cover (B).

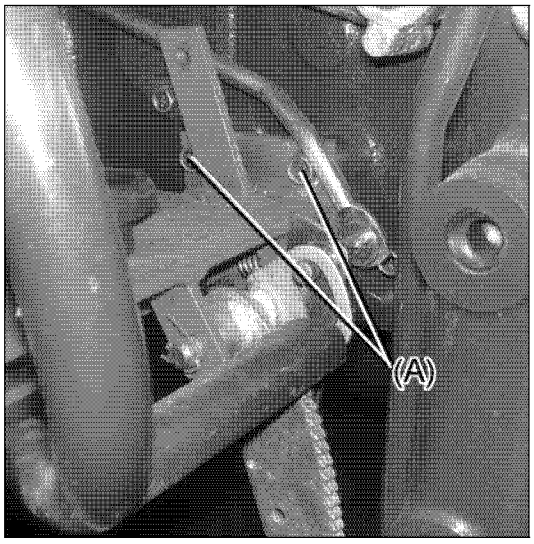


Note:
Be careful not to lose the rubber washers or the collars.

(3) Remove the four mounting pins (D), and remove the right floor (C). (Remove the left floor the same way.)



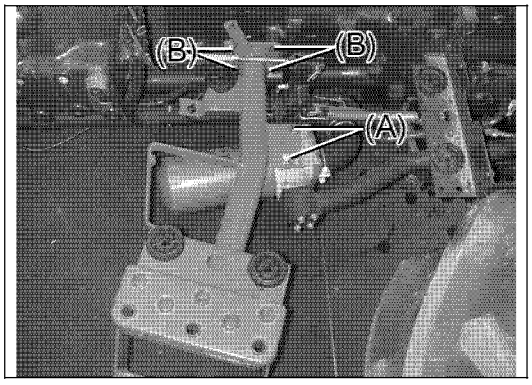
(4) Remove the three M8x20 bolts (A), and remove the right floor stay.



IMPORTANT

The entire parking brake assembly can be removed. Remember the relative positions of the various parts.

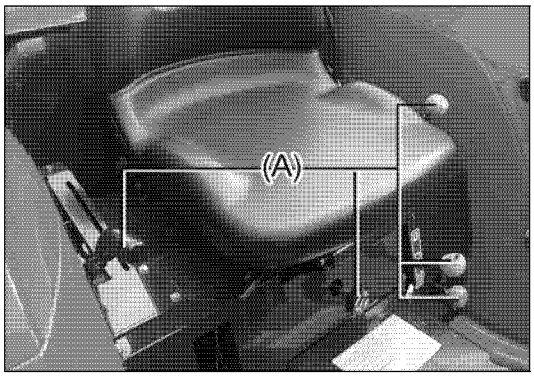
(5) Remove the two M8x20 bolts (A) for mounting the oil filter, the four M8x20 bolts (B), and then the left floor stay.



2.4 REMOVING THE SEAT STAY

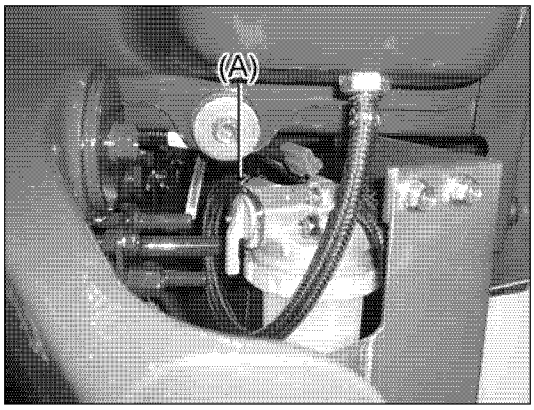
Note:
It is necessary to remove the fuel tank.

(1) Remove the seat, the knob (A) for each lever, and the front cover (B) (M6x16: 4 pcs.).

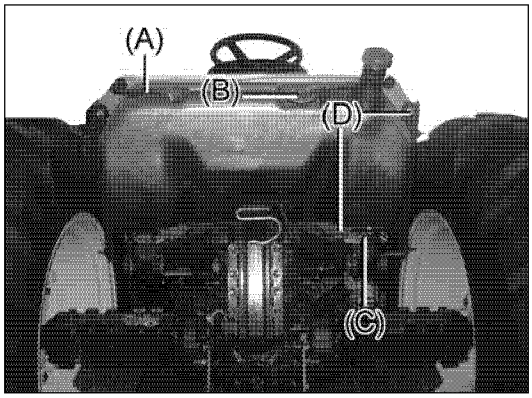


(2) Remove the fender. See “2.2 REMOVING THE FENDER”.

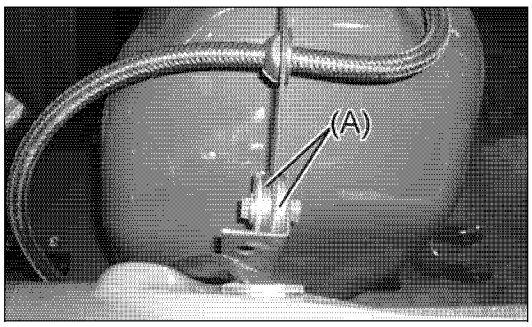
(3) Drain the fuel from the fuel tank. Fuel can be drained easily from section A.

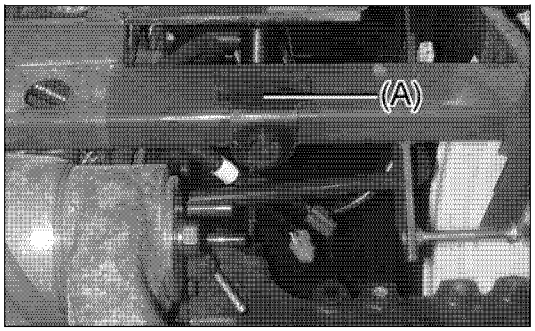


(4) Remove the return pipe (A) from the fuel tank, and remove the coupler to the fuel gauge (B), located in section C. Then, remove the bolts (D).

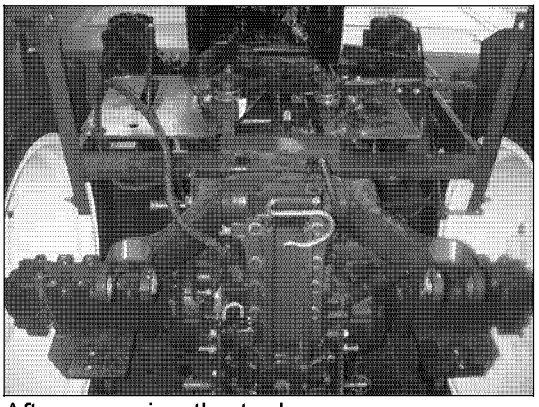


CAUTION
The rubber packing (A) is used when installing the fuel tank. Be sure to reinstall it when reassembling the tractor.





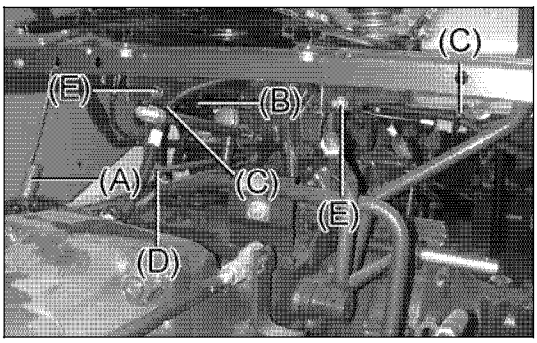
(5) Slide the fuel tank up to remove it.



After removing the tank

(6) Remove the diff-lock pedal return spring (A) from the seat stay, the transmission breather (B), and then the piping and wiring clamps (C) and (D).

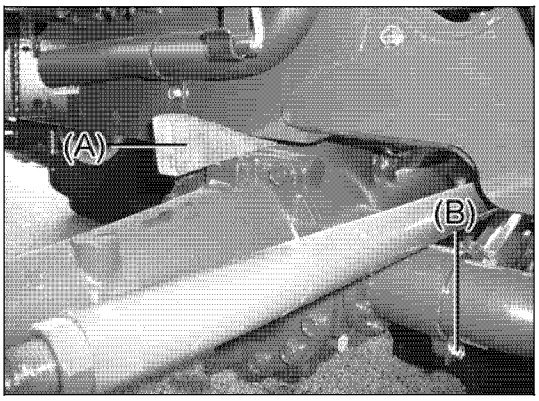
(7) Remove the four M8x16 bolts (E) and the two M8x25 bolts on the back of the seat, and remove the seat stay.



2.5 CLUTCH HOUSING

2.5.1 Separation

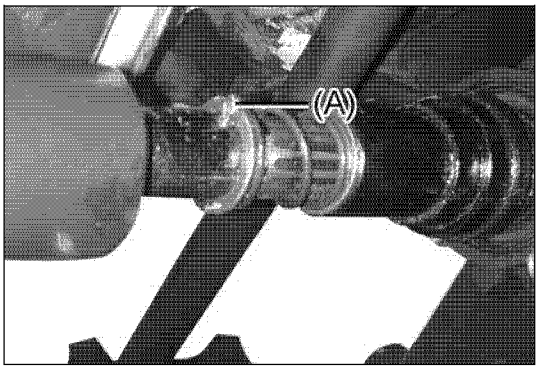
(1) Place chocks at the front and back of the rear wheels. Remove the negative battery terminal and attach the wedges (A) to the left and right of the front axle swing section.



WARNING
Be sure to attach the wedges. If you do not, when the clutch housing is separated, the engine will tilt and the front axle section will turn over. This may cause an accident.

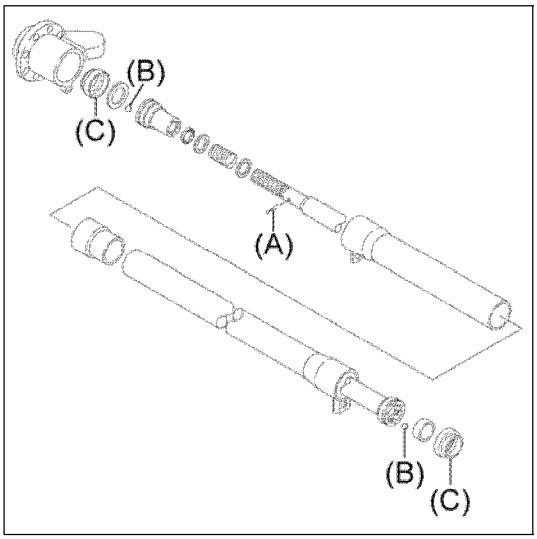
(2) Remove the M8x12 bolts (B) that secure the front and back of the propeller shaft cover.

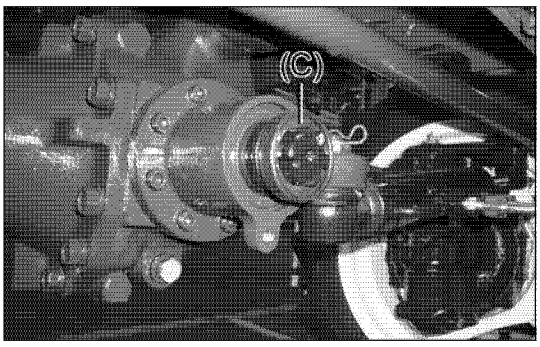
(3) Remove the 4.0x40 cotter pin (A). Then, move the propeller shaft to the center position and remove it.



WARNING
Since the propeller shaft is heavy. Be careful so that you are not injured if the shaft falls when removing it.

IMPORTANT
- When reinstalling the cotter pin (A), be sure to replace it with a new one.
- Be careful not to lose the six steel balls (B) each, on the front and back of the propeller shaft.
- Before reinstalling the rubber boots (C), put grease in them.

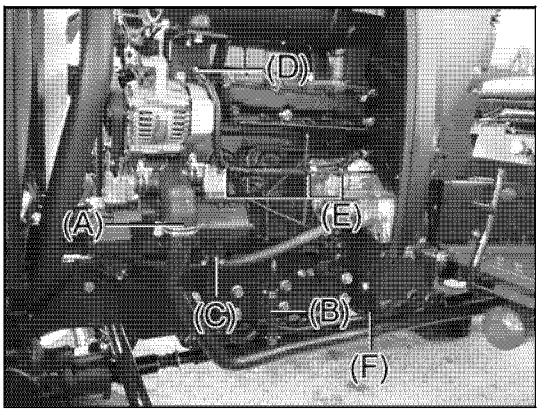




(4) Remove the following parts from the left side of the machine.

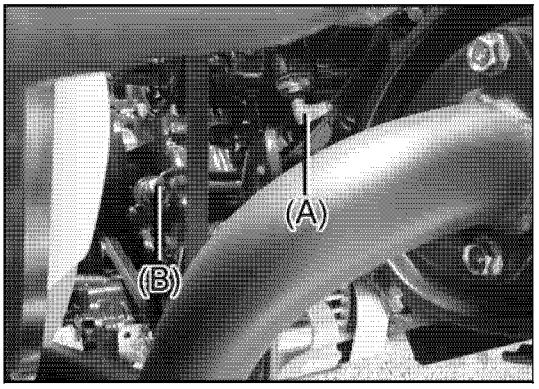
(A)(B) Low-pressure hydraulic pipes
(C) High-pressure hydraulic pipe M6 Bolts: 4 pcs.
(D) Generator harness
(E) Harness clamps: 3 places

Note:
When you have removed the section (F) where the hydraulic pipe is locked, it will become easier to do the rest of the job.



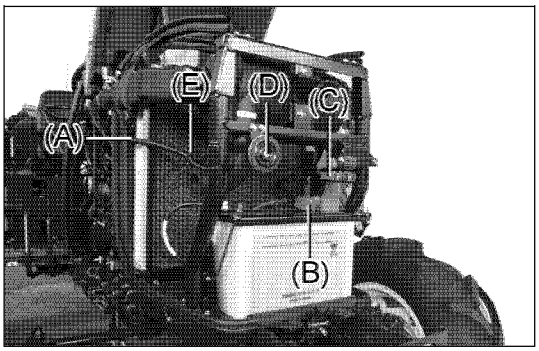
(5) Remove the following parts from the upper part of the engine.

(A) Water meter harness
(B) Engine rpm cable



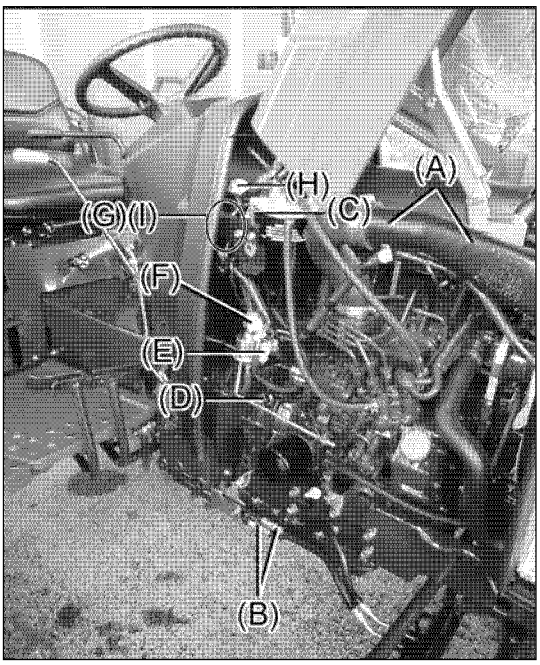
(6) Remove the following parts from the front of the machine and then pull the harness from section A toward the back.

(B) Positive battery terminal
(C) Slow blow fuse holder
(D) Horn coupler
(E) Harness clamp



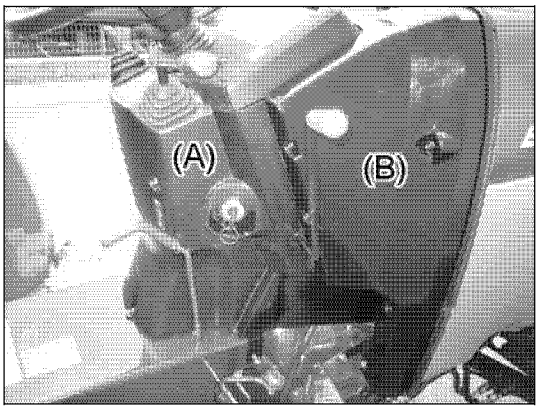
(7) Remove the following parts from the right side of the machine.

(A) Harness clamps
(B) Power steering cylinder pipes
(C) Combustion hose
(D) Hydraulic switch coupler
(E) Fuel feed pump coupler
(G) Relay coupler
(H) Head lamp coupler
(I) Body earth (ground)



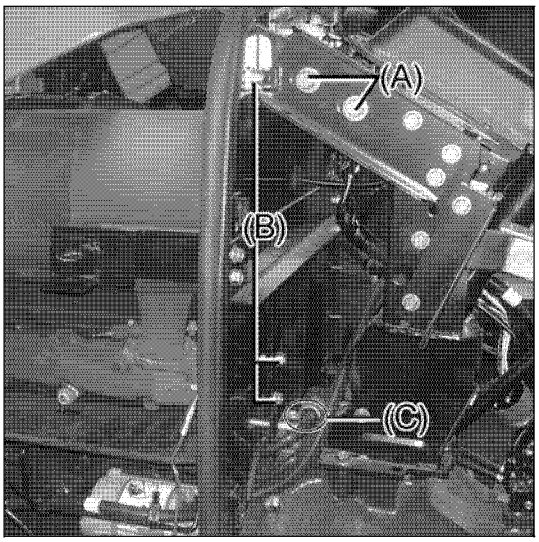
(8) See “2.1 REMOVING THE ENGINE BONNET COVER”.

(9) Remove the front column cover (A) and the dashboard cover (B).



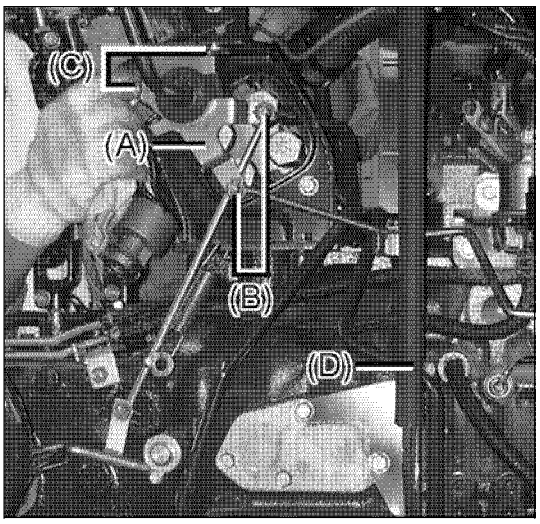
(10) Remove the bonnet stay mounting bolt (A), the air cut plate (air deflection plate) mounting bolts (B), and the hydraulic pipe mounting bolt (C).

Note:
When the air cut plate (air deflection plate) is removed, the clutch housing case can be separated easily.



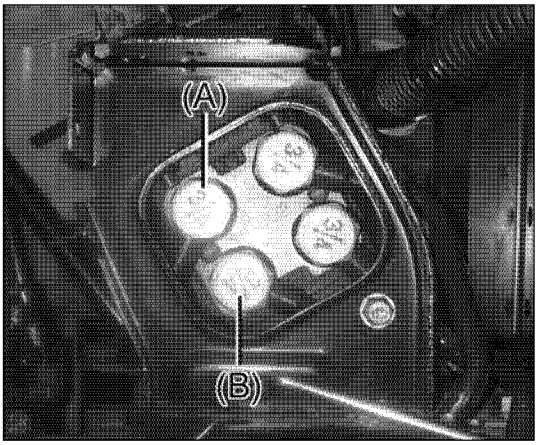
(11) Remove the accelerator lever assembly (A) and the air cut plate (air deflection plate) (D).

(A) Accelerator lever assembly
(B) Accelerator links
(C) Mounting bolts



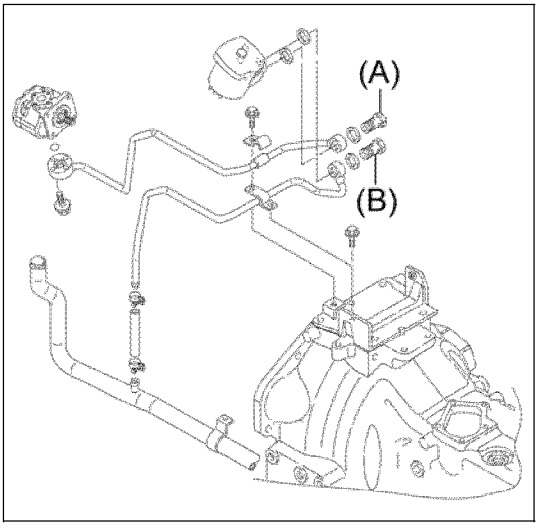
(12) Remove the following parts from the power steering valve.

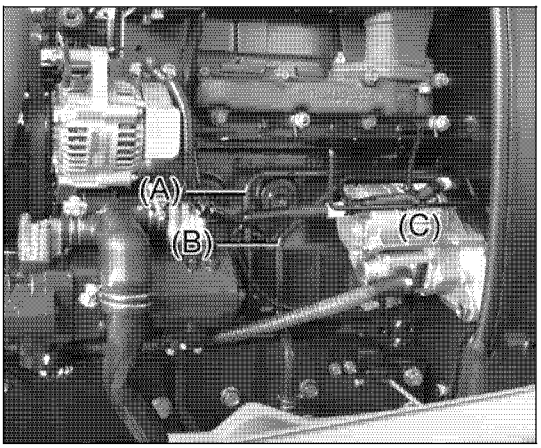
(A) Pipe from the hydraulic pump
(B) Return pipe



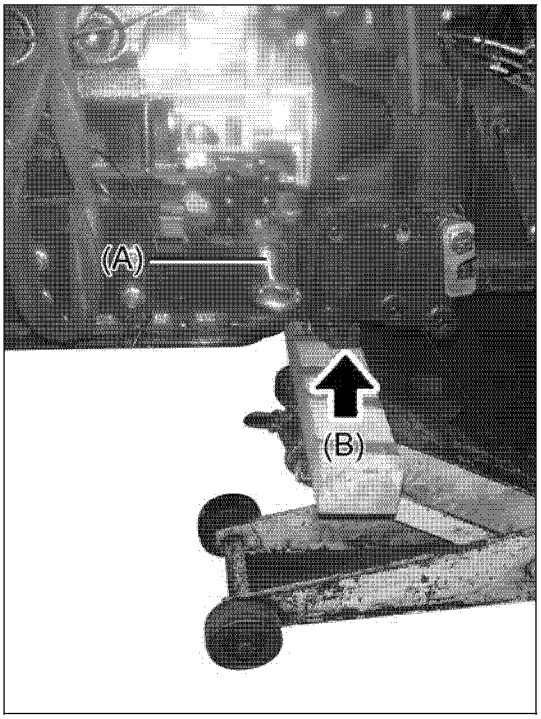
IMPORTANT

- When the clutch housing section is separated without removing the pipes (A) and (B), the pipes can get caught in the starter and destroy it.
- When removing the pipes (A) and (B), remember the position they were in, in order to reassemble them correctly.





(13) Remove the bolt (A) on the top of the clutch housing side of the front axle bracket, and attach a lifting bolt, as shown in the photo.



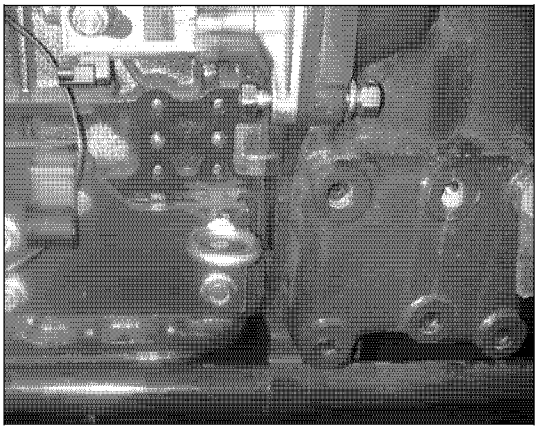
DANGER

- Screw the lifting bolt all the way into the engine block side.
- **When reinstalling the bolt after reassembling, tighten it securely to the torque specified below.**
  167-186 N/m (17.0-19.0 kgf/m)

IMPORTANT

- If a short lifting bolt is used, the lifting rope may touch peripheral equipment on the engine and some damage could occur.
- Do not jack up the engine oil pan. The oil pan may deform and this can cause oil leaks.

(14) Place the jack under the transmission (B), and raise the jack until the jack is lightly supporting the transmission.



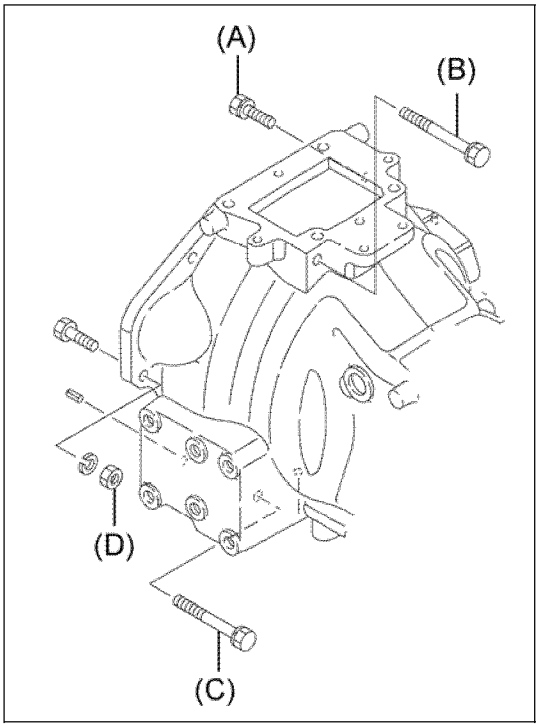
(15) Lift the engine section until it is supported lightly.

IMPORTANT

If the engine section is lifted too much, it may damage or deform parts.

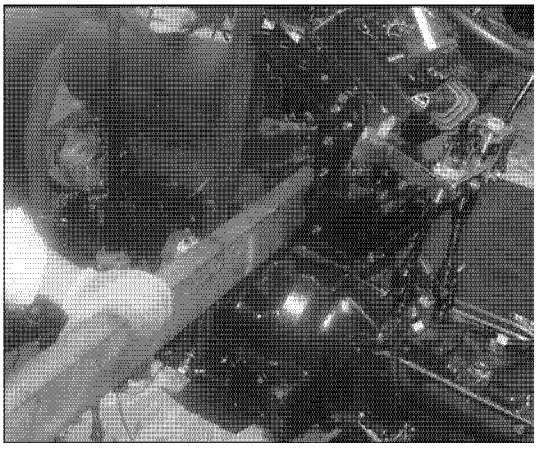
(16) Remove the nuts and bolts that connect the engine to the clutch housing.

(A) Bolt M12x30: 3 pcs.
(B) Bolt M12x170: 2 pcs.
(C) Bolt M12x100: 2 pcs.
(D) Bolt M12: 1 pc.



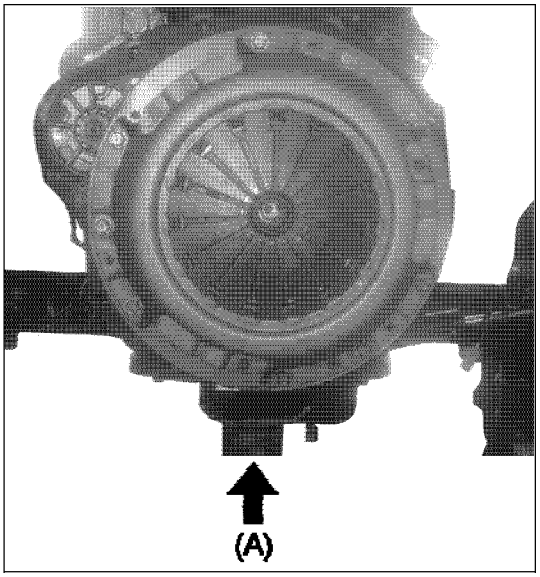
(17) Separate the engine and the clutch housing.

Note:
If the liquid packing glue on the mating surfaces is too strongly attached, place a piece of wood as shown in the photo and push or tap on it lightly. It will be easy to separate the assemblies.



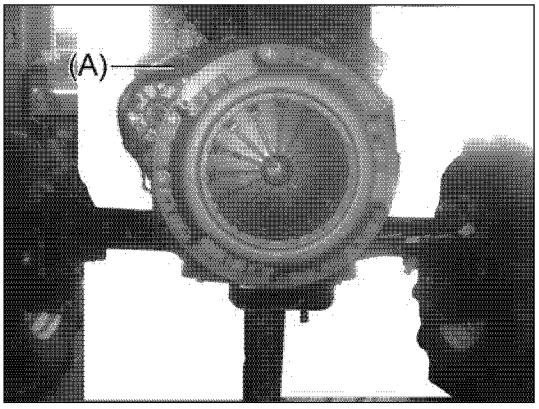
WARNING
Be careful that the jack supporting the transmission does not slide off. This operation should be done by at least two people.

IMPORTANT
After separating the assemblies, attach a rigid rack to section A and remove the lifting bolt. If you don't, the lifting bolt may be deformed and you may not be able to remove it.



2.5.2 Docking

(1) Remove the old liquid packing from the mounting flange (A) on the engine side. Then, apply Three bond 1215 or use the same type of liquid packing as was used originally.

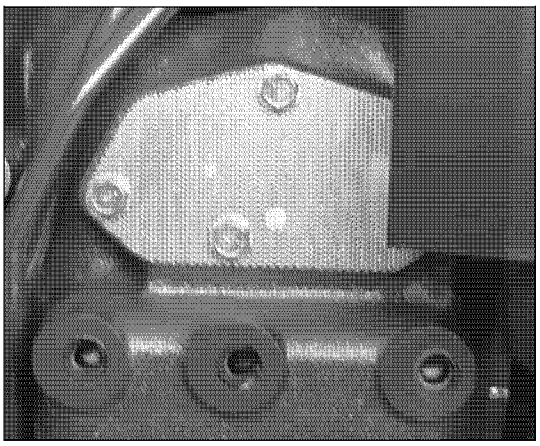


WARNING
The disassembled machine is very unstable. Be careful not to let it fall over and be sure to attach a wedge to the front axle swing section.

(2) Move the main shift lever to N and the PTO to the shift position. Dock the machine by turning the rear axle PTO shaft by hand. Note: The shaft is docked to the clutch plate when the PTO shaft does not turn any more.

(3) Move the main shift lever and the sub-shift lever to ON. Insert a screwdriver though the view port on the flywheel and complete the docking procedure by turning the flywheel.

(4) After docking the machine, reinstall the parts by reversing the procedure described in "2.5.1 Separation".


View port on the flywheel

2.6 TRANSMISSION

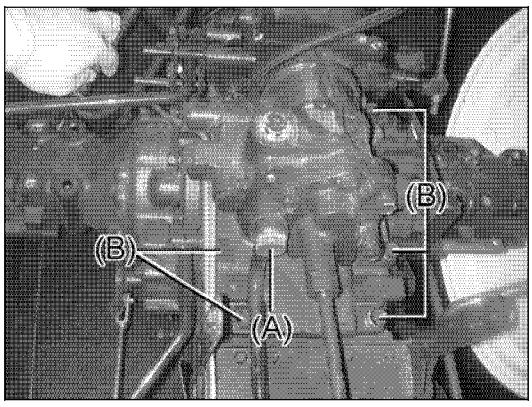
2.6.1 Separating the hydraulic cylinder case

(1) Remove the seat stay. See "2.4 REMOVING THE SEAT STAY".

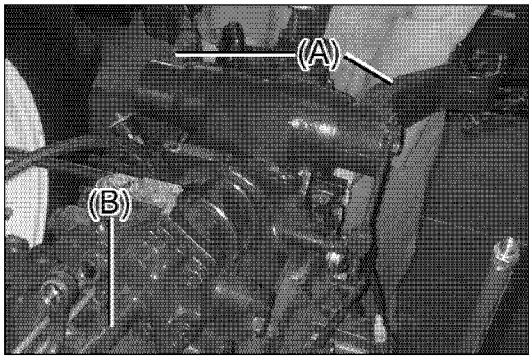
(2) Remove the bolt (A), and disconnect the hydraulic pipe.

IMPORTANT
Replace the copper packing with a new one.

(3) Remove the 12 M12x35 bolts (B).



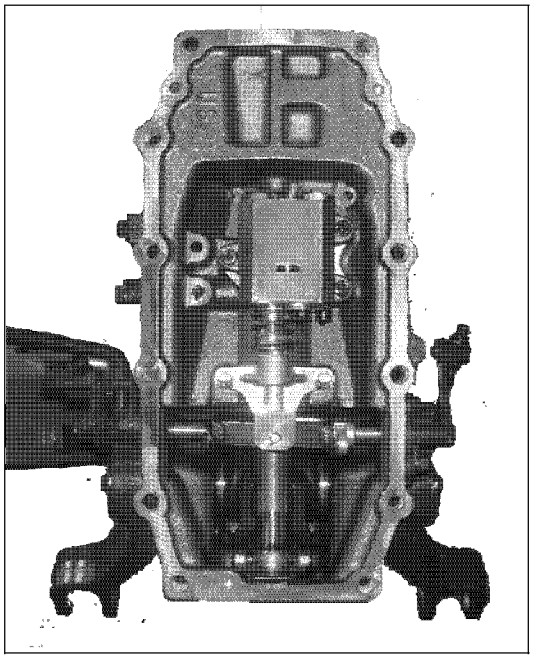
(4) Raise the lift arms (A) and the stopper & slow return valve section (B), and then separate the hydraulic cylinder case.



WARNING
Since this is a difficult operation, it should be done by at least two people.

IMPORTANT
Two positioning pins are used between the transmission case and the hydraulic cylinder case. When you push the lift arms (A) up from the bottom, the pins will come off and the hydraulic cylinder case can be separated easily.

(5) Keep the hydraulic cylinder case upright, as shown in the photo, so that the mating surface is not damaged.



IMPORTANT
Completely remove the packing located between the transmission case and the hydraulic cylinder case.

2.6.2 Separating the clutch housing and transmission

WARNING
The disassembled machine is very unstable. Be careful not to let it fall over.

(1) Drain the transmission oil.

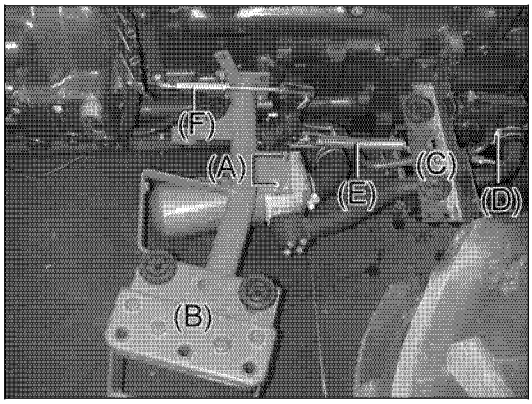
(2) Remove the step. See 2.3.

(3) Remove the seat stay. See 2.4.

(4) Remove the propeller shaft. See 2.5.1 (2) (3).

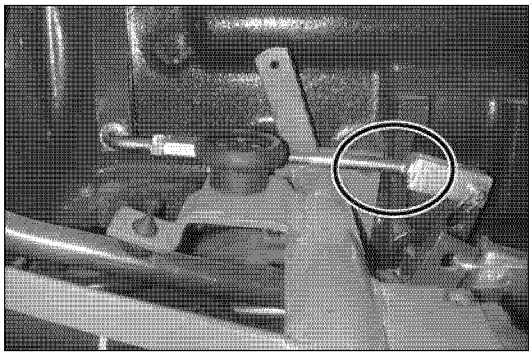
(5) Remove the front column cover and the dashboard. See 2.5.1 (9).

(6) Remove the bolts (A) in order to take out the oil filter. Then, remove the left step stays (B) and (C). At the same time, remove the low-pressure hydraulic pipe at section D.



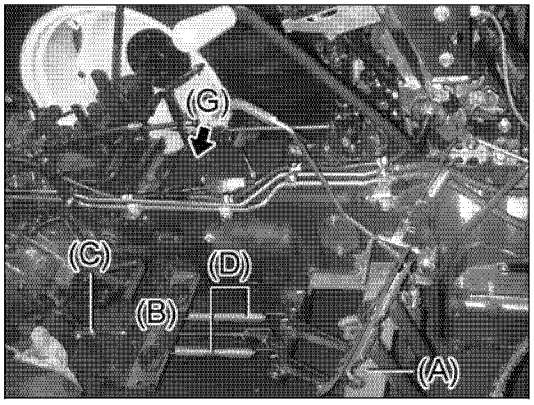
IMPORTANT
The clutch pedal return spring (E) must be installed in the correct direction.

Note:
When the clutch rod (F) is new, it will curve as shown in the photo. This is normal.

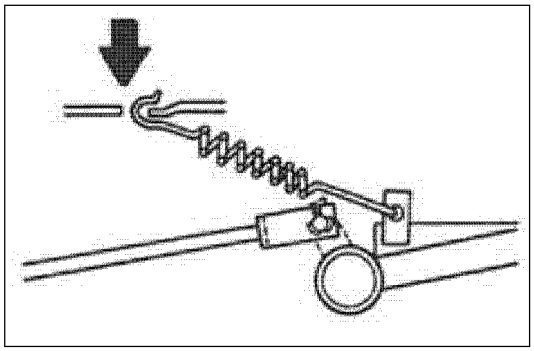


(7) Remove the right step stays (A) and (B), and remove the left and right brake rods (C).

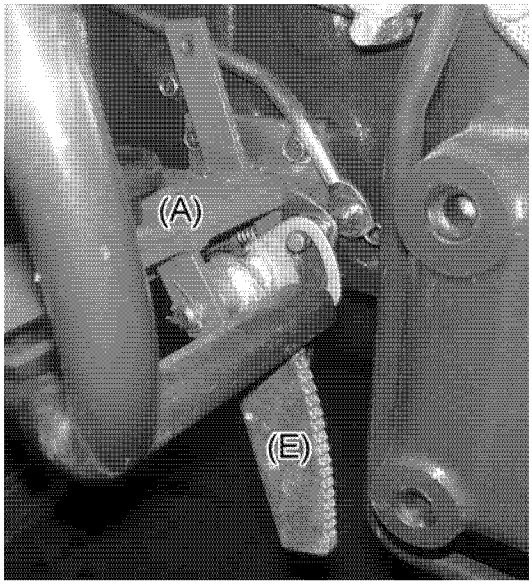
(G) Separation position



IMPORTANT
The brake pedal return springs (D) must be installed in the correct directions.



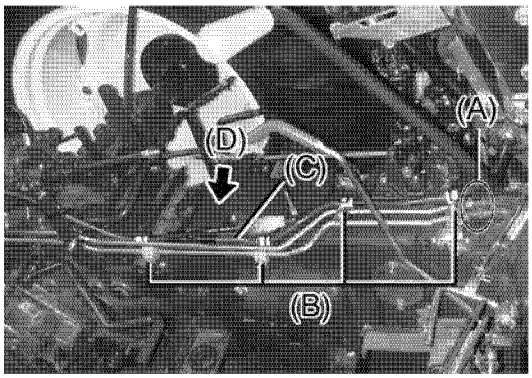
Note:
Remember the position of the parking brake (E).



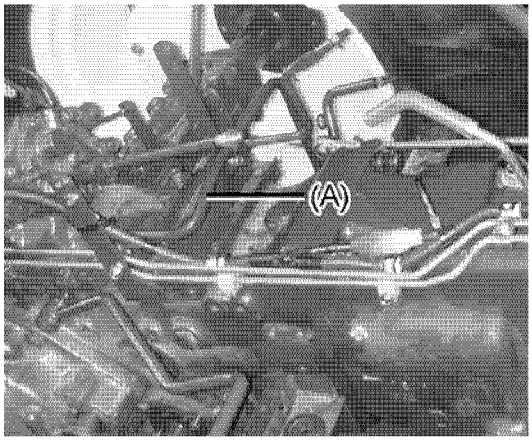
(8) Remove the fuel pipe at section A, and remove the four pipe clips (B).

(9) Remove the coupler to the PTO neutral switch on the rear end of the transmission.

IMPORTANT
Remember the route the harness follows.



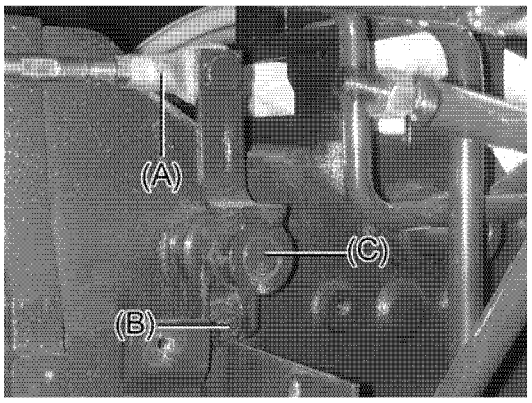
(10) Remove the high-pressure pipe (A).



(11) Move the reverser lever to the neutral position, and remove the reverser rod (A).

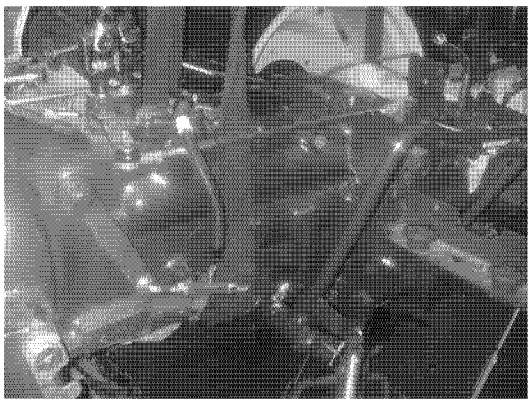
IMPORTANT
Before removing the reverser rod, be sure that the reverser lever is in the neutral position.

(12) Remove the nut (B) and pull the reverser (C) change arm out about 15 mm.

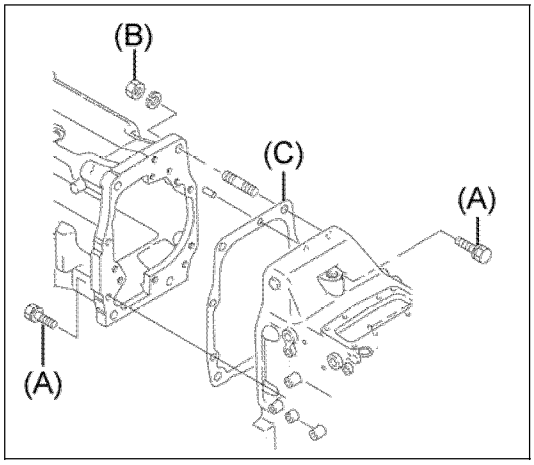


(13) Attach a support to the front and back at the separation point.

Note:
When the front section is lifted, the preferred position is shown in the photo.



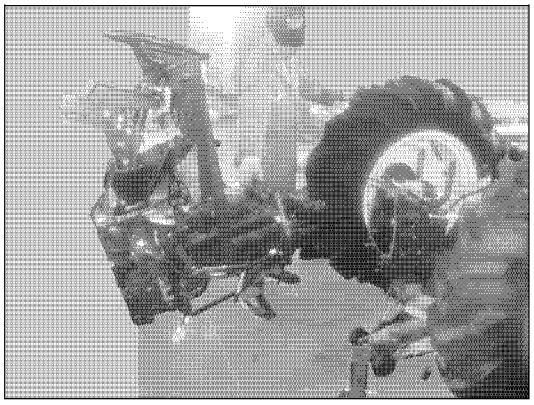
(14) Remove the four M12 bolts (A) and the two nuts (B), and separate the clutch housing and the transmission slowly.



CAUTION
This operation should be done by at least two people.

IMPORTANT
Before joining the clutch housing and the transmission, remove the old packing (C) completely, and use a new one.

Note:
If the engine section has already been separated, separate the clutch housing and the transmission as shown in the photo. However, pass a lifting rope through the steering wheel to prevent it from turning over.



2.6.3 Rear axle

Disassembling the rear axle housing

(1) Drain the transmission oil.
(2) Remove the fender seat and rear
(3) Remove the 3-point link.
(4) Remove the roll guard.

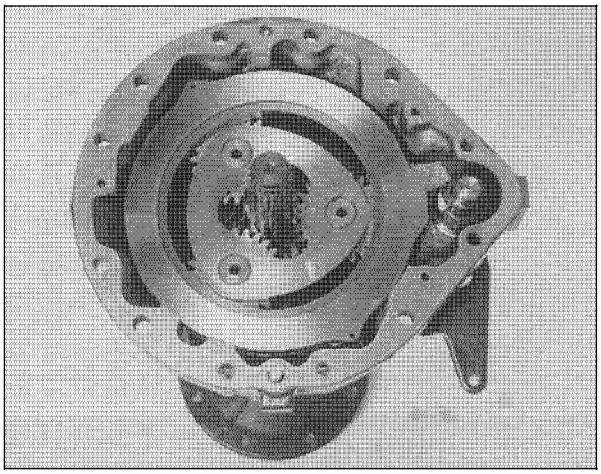
<Reassembling>

(5) Remove the rear wheels. (jack set as well)

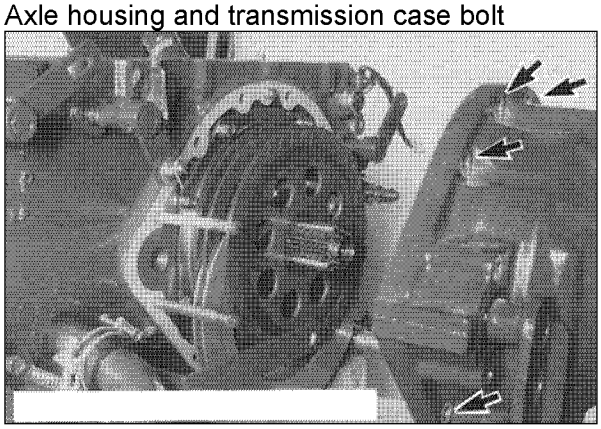
Tightening torque
M16: 1800-2000 kgf-cm

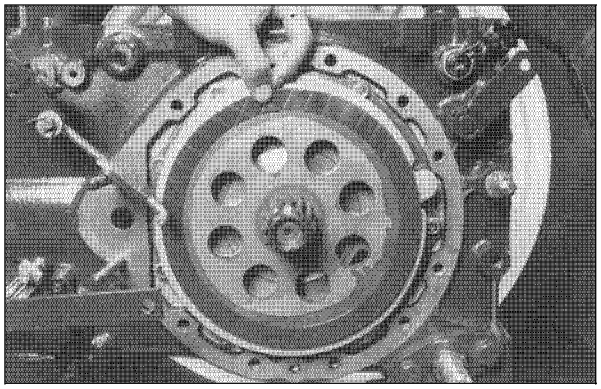
(6) Remove the brake rod.
(7) Loosen the bolts securing the rear axle housing to the transmission case, in order to separate them. Be careful not to drop the friction plate or the steel brake plate.

Tightening torque
M10: 450-600 kgf-cm
M12: 800-1000 kgf-cm



Axle housing and transmission case bolt





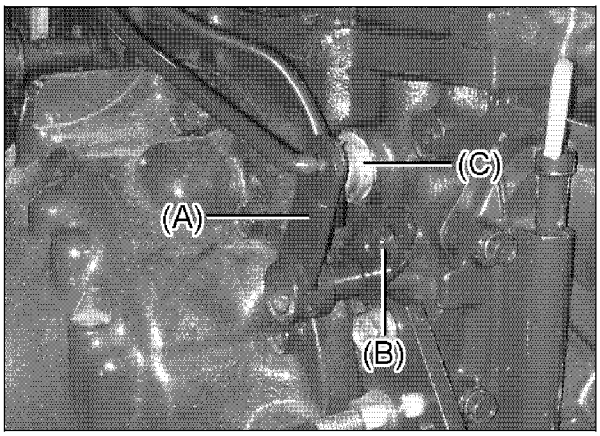
2.6.4 PTO module

Removing PTO covers

(1) Drain the transmission oil.
(2) Remove the 3-point link.
(3) Remove the draw-bar hitch and braw-bar bracket.
(4) Set the PTO to first or second gear.
(5) Remove the keeper plate and pull the shift arm out of the PTO shift module.

NOTE:
If the PTO is left in the neutral position, the PTO safety switch and the shift arm will hit each other and the shift arm cannot be pulled out.

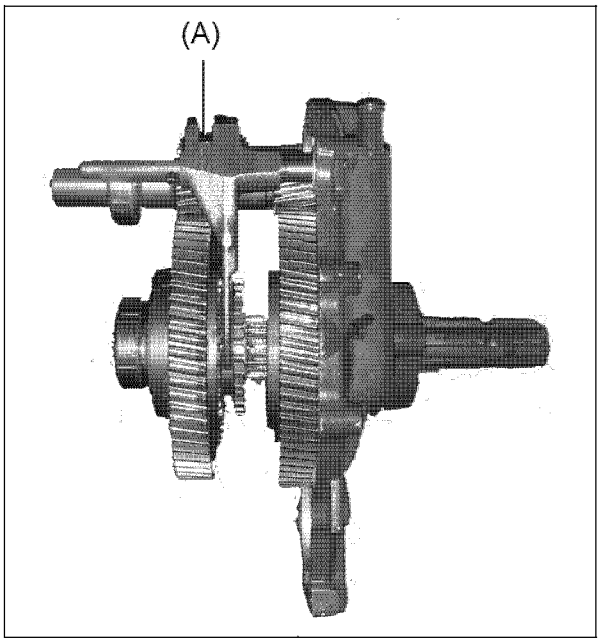
(6) Remove the rear cover bolts and separate the PTO assembly.

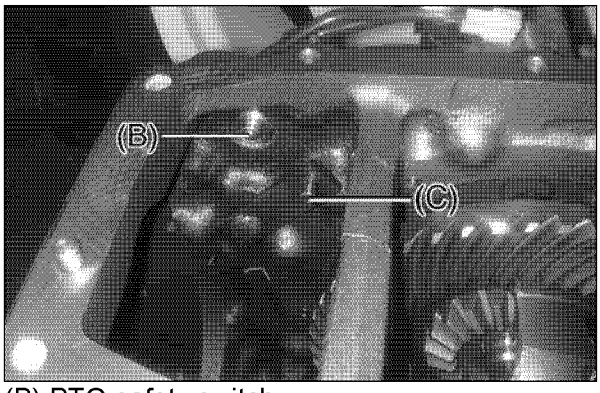


(A) Shift arm
(B) Keeper plate
(C) PTO safety switch

<Reassembling>
Tightening torque: 230-300 kgf-cm

IMPORTANT
- Pay attention to the clearance between the change arm and the PTO safety switch.
- Push the change arm (C) into the PTO module groove (A) to reassemble them. After reassembly, move the PTO shift lever and make sure you can change gears.



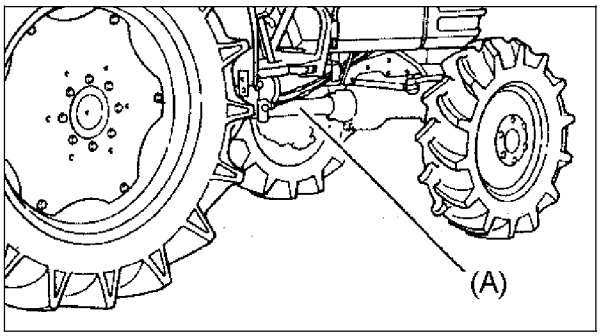


(B) PTO safety switch
(C) Change arm

2.7 FRONT AXLE UNIT

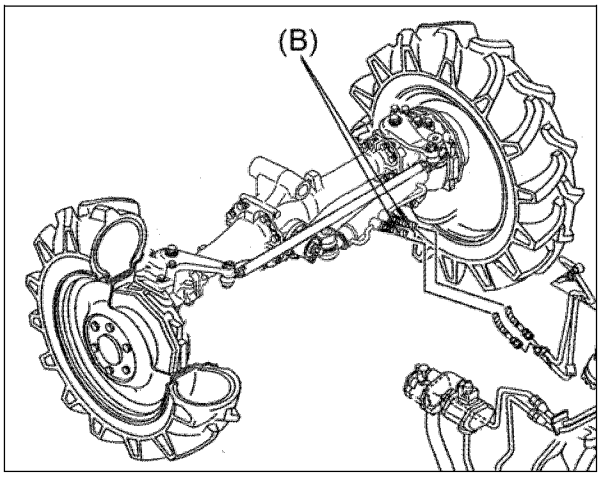
<Disassembly>

(1) Drain the oil from the front axle.
(2) Remove the propeller shaft.
See 2.5.1 (2) (3).

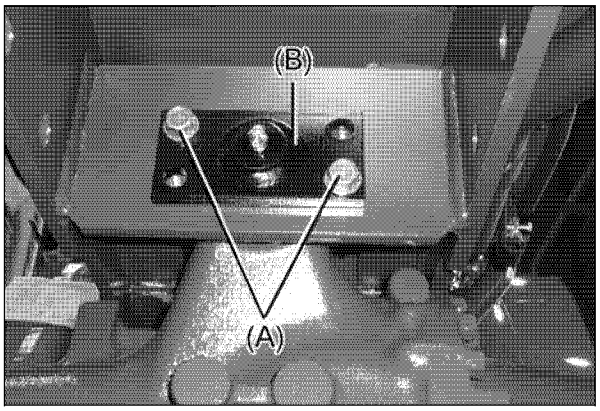


(A) Propeller shaft

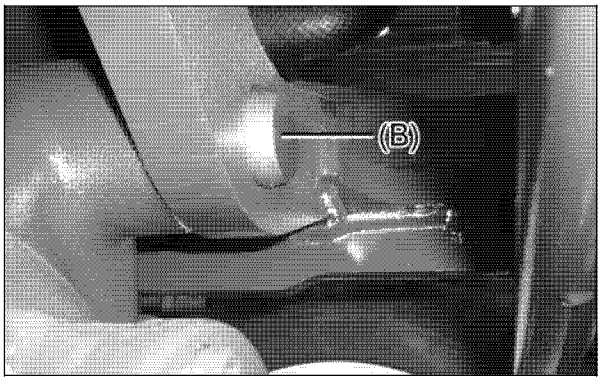
(3) Remove the power steering hose (B).
(4) It loosens bolts of the front wheels.
(5) Jack up the front part of the tractor and take out front wheels.
(6) Set the jack or the support under the front axle.



(7) Remove 4 bolts (A) and take out the center pins (B). Then the front axle is separated from the tractor.



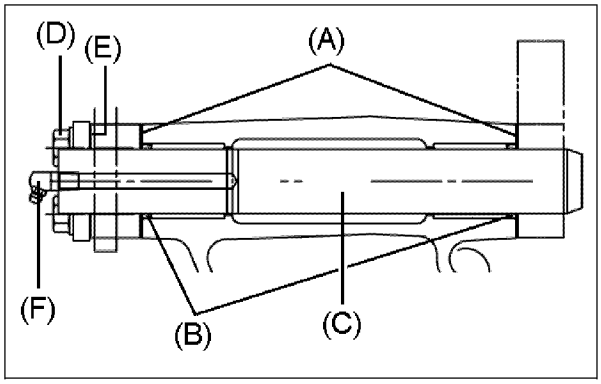
WARNING
When removing the center pins, be careful that the front axle does not topple forward or backward.



IMPORTANT
Adjustment shims are included.

<Reassembling>

(1) Jack up the front axle, after that insert the center pin, and tighten 2 bolts. Then, check the free play of the front axle to be 0–0.6 mm adjusted by shims.



(A) Shims
(B) Oil seal
(C) Center pin
(D) Tighten torque : 78-98 N/m (8.0-10.0 kgm)
(E) Free play of axle to be 0-0.6 mm adjusted by shims.
(F) Enclose grease. The injection entrance to be assembled downward.

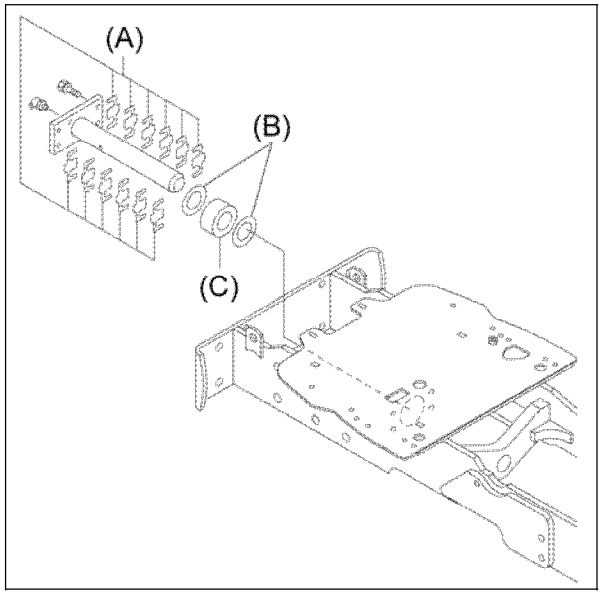
DANGER

Spread screw lock on the bolt (D). If you don't, it may cause the central pin to come off and this is dangerous.

IMPORTANT

- When reassembling the front axle unit on a new tractor
- When raising and lowering the front wheels while jacked-up, make sure the front axle swings smoothly.
- If there is no free play, the front axle will be too stiff.

During maintenance
The number of shims counted during disassembly is only a rough guide. When the spacer (C) is worn, it will be necessary to reduce the number of shims.



(A) Adjust shim
(B) Shim
(C) Spacer

(2) Reinstall the front wheels, lower the jack, and tighten the wheel bolts.

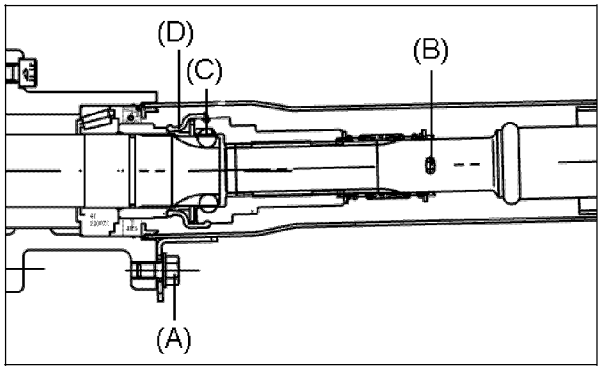
IMPORTANT

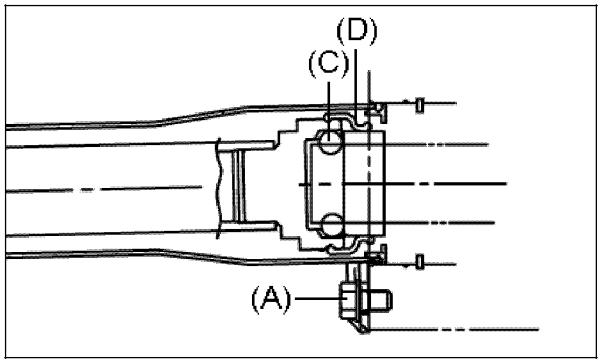
Wheel bolt torque
177-196 N/m (18.0-20.0 kgf/m)

(3) Reinstall the propeller shaft.

IMPORTANT

- Put grease into the rubber boots on both sides.
- Replace the split pin (B) with a new one.
- There are 6 steel balls (C) on each side.





(A) Mounting bolt
(B) Split pin
(C) Steel balls
(D) Rubber boots

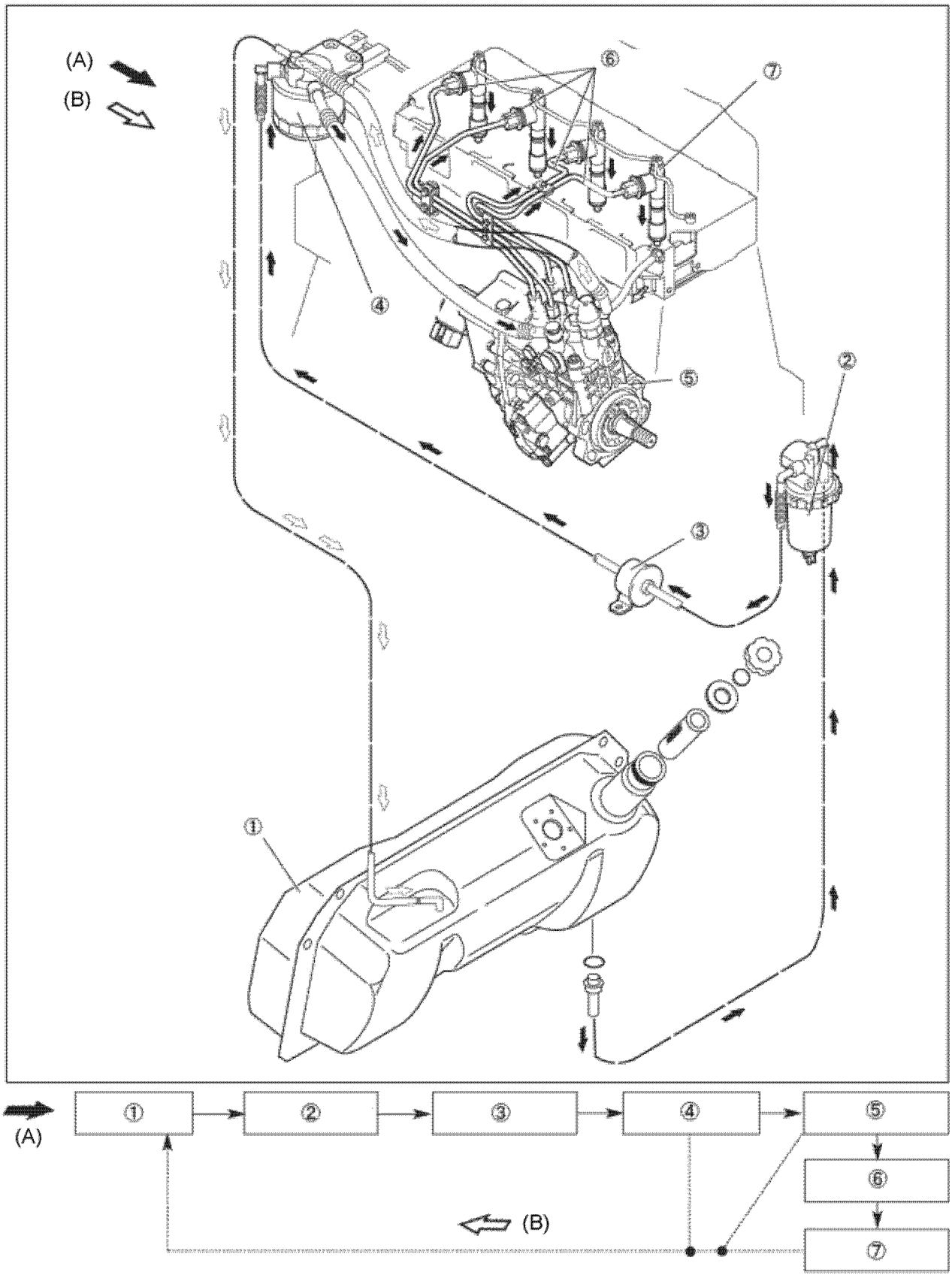
(4) Connect the pipe to the power steering cylinder.
(5) Supply oil to the front axle.

3

ENGINE

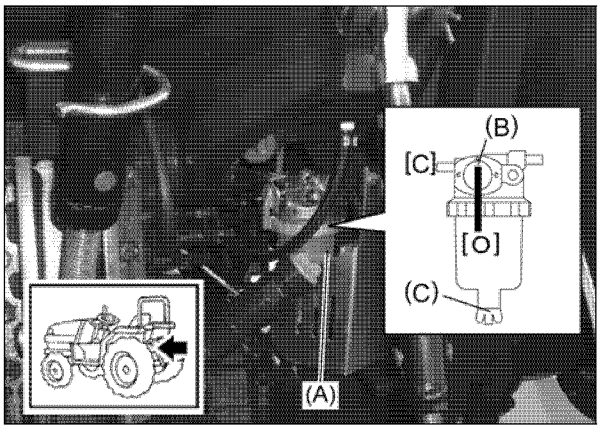
3.1 FUEL SYSTEM

3.1.1 Flow of fuel and layout of components



(1) Fuel tank
(2) Water separator
(3) Fuel feed pump
(4) Fuel filter
(5) Fuel injection pump
(6) High-pressure tubes
(7) Injection nozzles
(A) Feed
(B) Return

3.1.2 Water separator

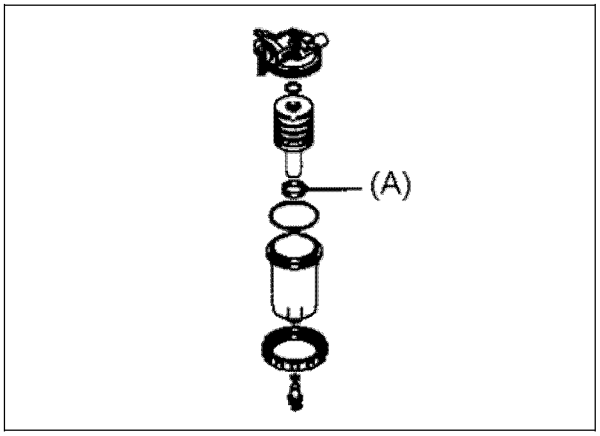


Eliminates contaminants, sediments and water from the fuel to prevent them from entering the fuel feed pump.

[C] Close
[O] Open
(A) Water separator
(B) Fuel cock
(C) Drain cock

Cleaning the water separator
Move the fuel cock to position C (close) and loosen the cup mounting screws.
Replace the filter assembly. Open the cock to bleed out the air.

Cleaning: first 50 hr, every 200hr
Replacement: every 300 hr



(A) Water indicator ring

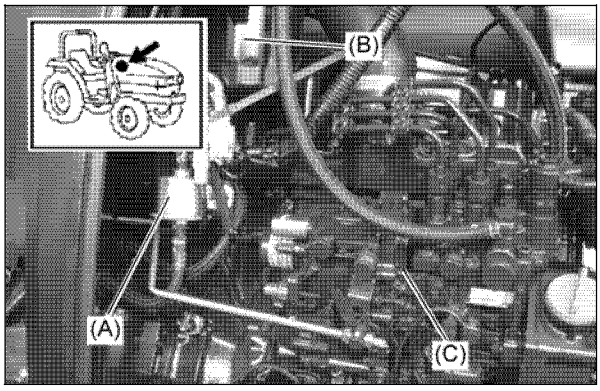
IMPORTANT
When the water indicator ring (A) is floating up, should clean the water separator as soon as possible. If not, it be cause of the engine trouble.

3.1.3 Fuel feed pump

Draws the fuel from the fuel tank and delivers it to the fuel injection pump.

(A) Fuel feed pump

3.1.4 Fuel filter



Removes foreign particles from the fuel to prevent them from entering the fuel injection pump.

Replacement interval	Every 300 operating hours or 6 months, whichever is earlier

(B) Fuel filter

3.1.5 Fuel injection pump (Type MP4 direct-injection pump)

A mono-plunger pump where, in response to the signal from the actuator of the Eco-governor, a pinion rotates the plunger to adjust the relative positions of the plunger notch and the fuel port, thereby controlling the fuel injection quantity.

(C) Fuel injection pump

3.1.6 Fuel injection nozzles

The use of Yanmar's original direct-injection combustion chamber plus hole valve ensures the ideal mixing of fuel with air, thereby enabling complete combustion.

Combustion chamber	Direct-injection type
Nozzle	Hole valve (5 injection holes)
Initial injection pressure	21.6MPa (220kg/cm2)

<Precautions for assembling the injection valve>

(1) The nuts and case nuts used to assemble the fuel injection valve should be tightened to the specified torque.

Tightening torque	Mounting bolt for fuel injection valve retainer(M8 x 1.25)	24.4 to 28.4N•m (2.3 to 2.9kgf•m)
	Case nut	39 to 44N•m (4 to 4.5kgf•m)

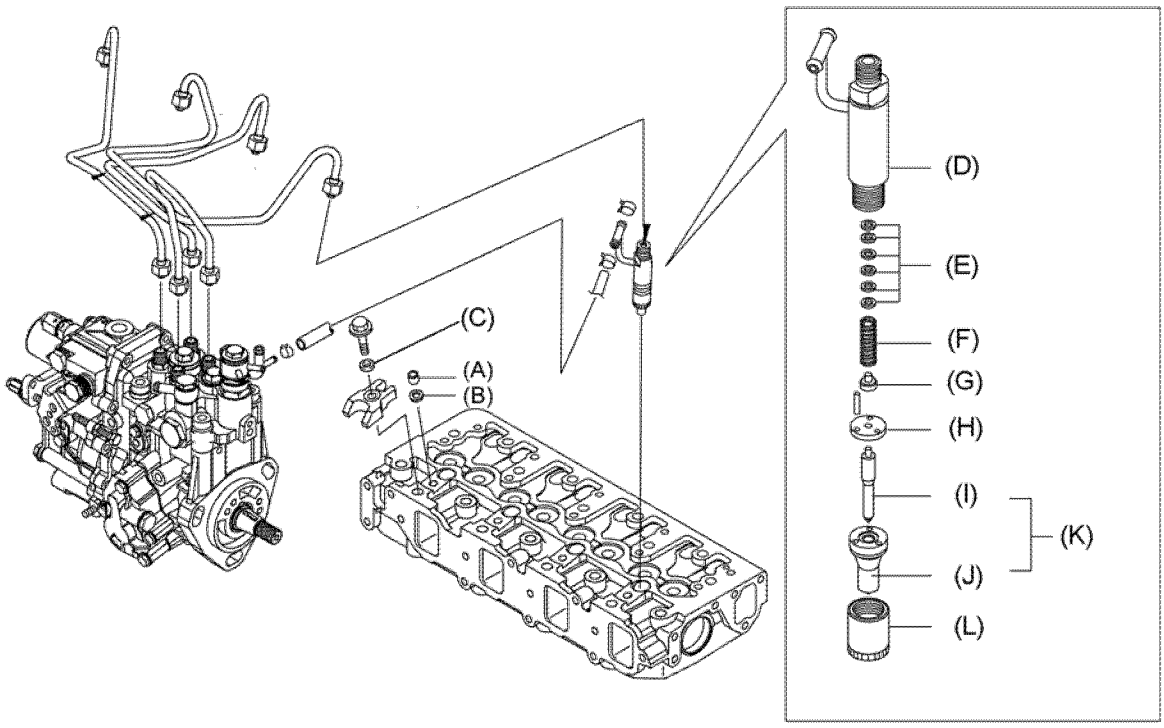
Note: Do not lubricate the bolt threads and the nut face.

(2) When removing the injection valve, make sure that protector (A) and packing (B) do not remain in the cylinder head. Replace them whenever reinstalling the injection valve.

(3) An increase of 0.1 mm in thickness of the pressure adjusting shim section will result in an increase of about 19 MPa in injection pressure.

IMPORTANT

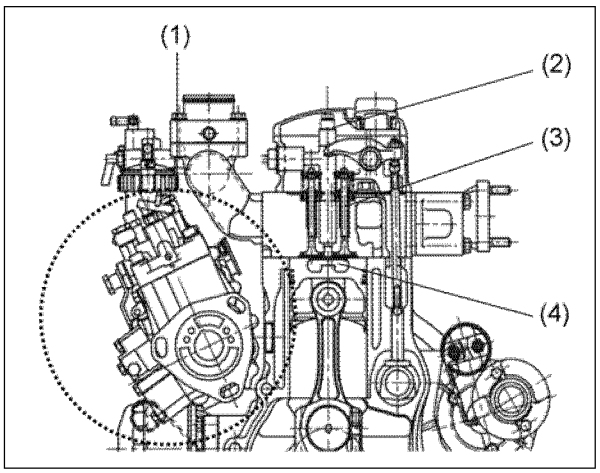
- When the install the fuel injection nozzle, apply the molybdenum grease to the outside of the (D).
- The flat surface of the washer (C) is upturned.



(A) Protector
(B) Packing
(C) Washer
(D) Nozzle holder
(E) Pressure adjusting shim section
(F) Nozzle spring
(G) Nozzle spring seat
(H) Valve stop spacer
(I) Nozzle valve
(J) Nozzle body
(K) Nozzle
(L) Nozzle mounting nut Tightening torque: 39 – 44 N•m (4 – 4.5 kgf•m)

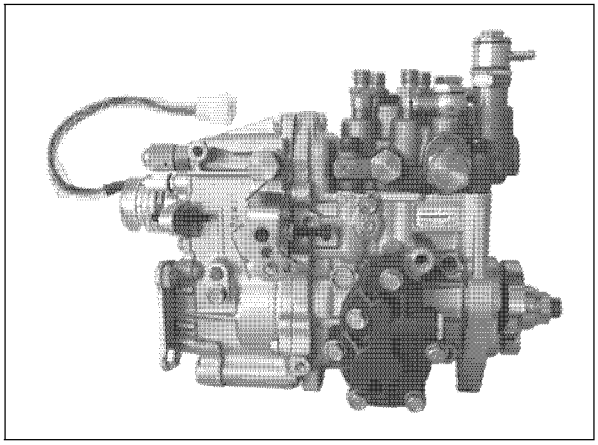
3.2 COMBUSTION SYSTEM

3.2.1 Low emission technology applied to TNV engine



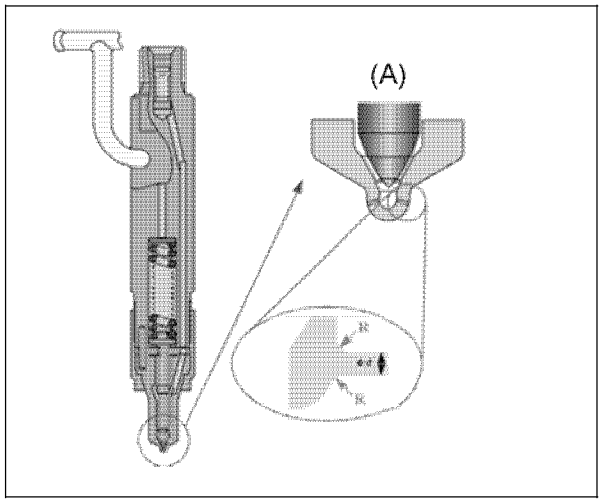
<Fuel injection technology>
(1) MP4 pump

- Atomization by high-pressure injection (70 MPa)
- Injection timing optimized by using a multi-functional timer mechanism



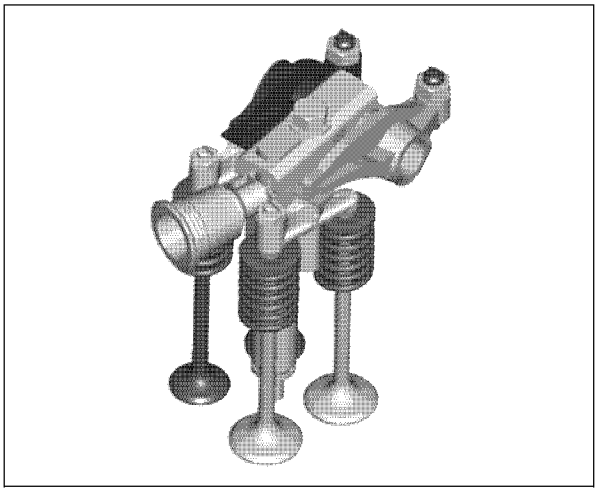
<Fuel injection technology>
(2) New type nozzle

Increased number of nozzle hoes (5 nozzle holes)
Finer atomization by making the nozzle hole diameter smaller
Uniform injection by rounding the edge of each nozzle hole

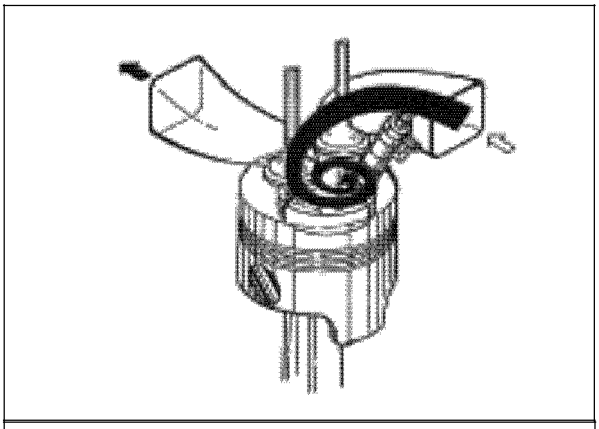


(A) Nozzle for TNV engine
(R) Rounded inlet of nozzle hole

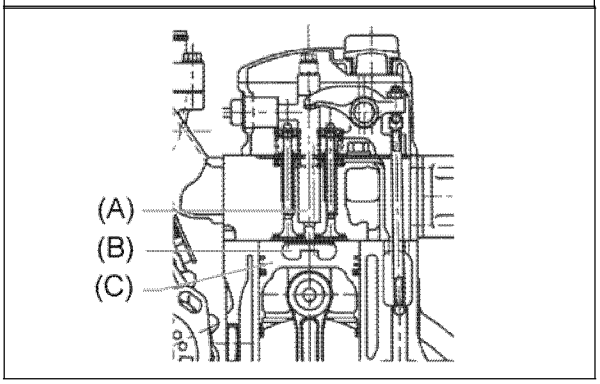
<Emission control technology>
(3) : The TNV engine features 2 intake valves and 2 exhaust valves per cylinder. The fuel direct-injection valve is of vertical type and is center located and the combustion chamber is located at the center of the cylinder, thereby enabling a decrease in emission of PM and NOx.



< Fuel technology >
(4) Intake and exhaust
- Swirl ratio optimized by redesigning the intake port
- Air-fuel mixture optimized by reviewing the compression ratio



Combustion chamber
- Air-fuel mixture optimized by using a new combustion chamber
- Uniform injection achieved by reviewing the nozzle mounting angle (locating it at the center of the combustion chamber)

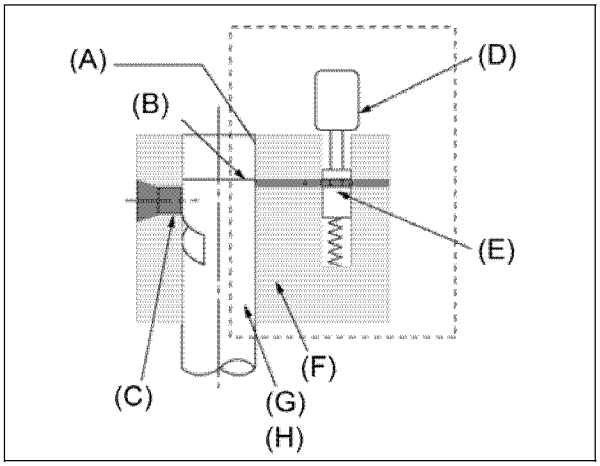


(A) Injection nozzle
(B) Combustion chamber
(C) Piston

Three new mechanisms of the MP4 pump

The mono-plunger type fuel pump uses a single plunger to distribute fuel uniformly to each cylinder, thereby eliminating the variation in fuel distribution between the cylinders. Fuel is atomized by high-pressure injection and the fuel timing at each engine speed and load condition is optimized by using a revolution timer and a load timer. This has achieved clean exhaust and high-efficient combustion performance.
The new TNV diesel engine ensures low fuel consumption and high eco-friendliness.

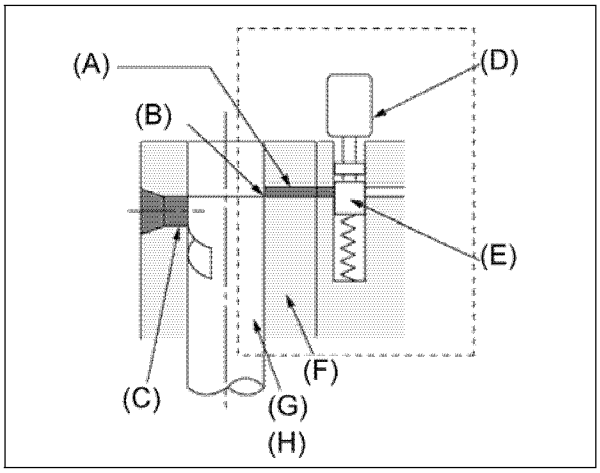
3.2.2 Cold starter



The injection timing at cold start is made earlier to improve startability.
The piston of the cold starter is operated by the CSD solenoid valve depending upon the temperature of cooling water for the engine, thereby opening/closing the sub-port.

At hot start:
The sub-port is open and the plunger blocks the sub-port. In this state, fuel starts being pumped. Hot start assumes a temperature of about 5°C minimum.

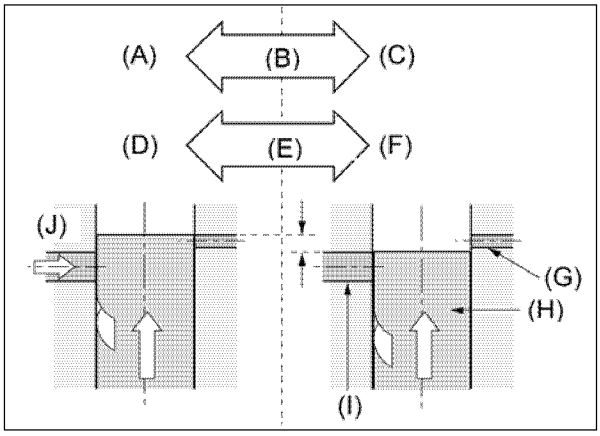
(A) (When sub-port is open) Sub-port
(B) Start pumping
(C) Main port
(D) CSD valve
(E) Piston
(F) Barrel
(G) Plunger
(H) Hot state (About 5°C minimum)



At cold start:
The sub-port is closed and the plunger blocks the main port. In this state, fuel starts being pumped. (At cold start, the fuel injection timing is advanced.) Cold start assumes a temperature of about 5°C maximum.

(A) (When sub-port is closed) Sub-port
(B) Start pumping
(C) Main port
(D) CSD valve
(E) Piston
(F) Barrel
(G) Plunger
(H) Cold state (About 5°C maximum)

3.2.3 Revolution timer



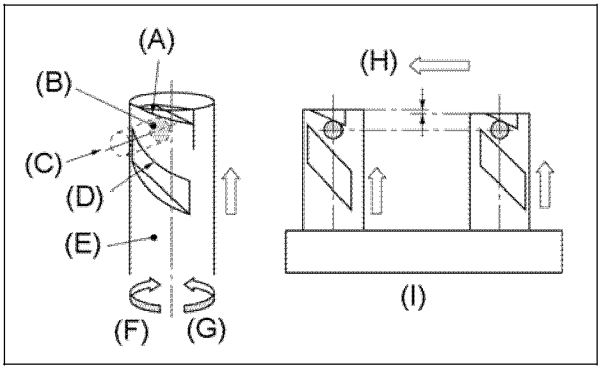
Clean exhaust gas is assured over the entire range of engine speeds by changing the fuel injection timing according to the engine speed.

At low engine speed
Fuel injection is less affected by the viscosity of fuel and starts after the sub-port has been closed. (At a low engine speed, the injection timing is delayed.)

At high engine speed
Fuel injection is affected by the viscosity of fuel and starts even if the sub-port is not closed.

(A) Low
(B) Engine rpm
(C) High
(D) Delay
(E) Timing
(F) Advance
(G) Sub-port
(H) Plunger
(I) Main port
(J) Load timer

3.2.4 Load timer



The fuel injection timing is changed in accordance with the load condition of the engine, thereby optimizing the injection timing over the entire range from the no-load condition to the full-load condition and making exhaust gas clean.

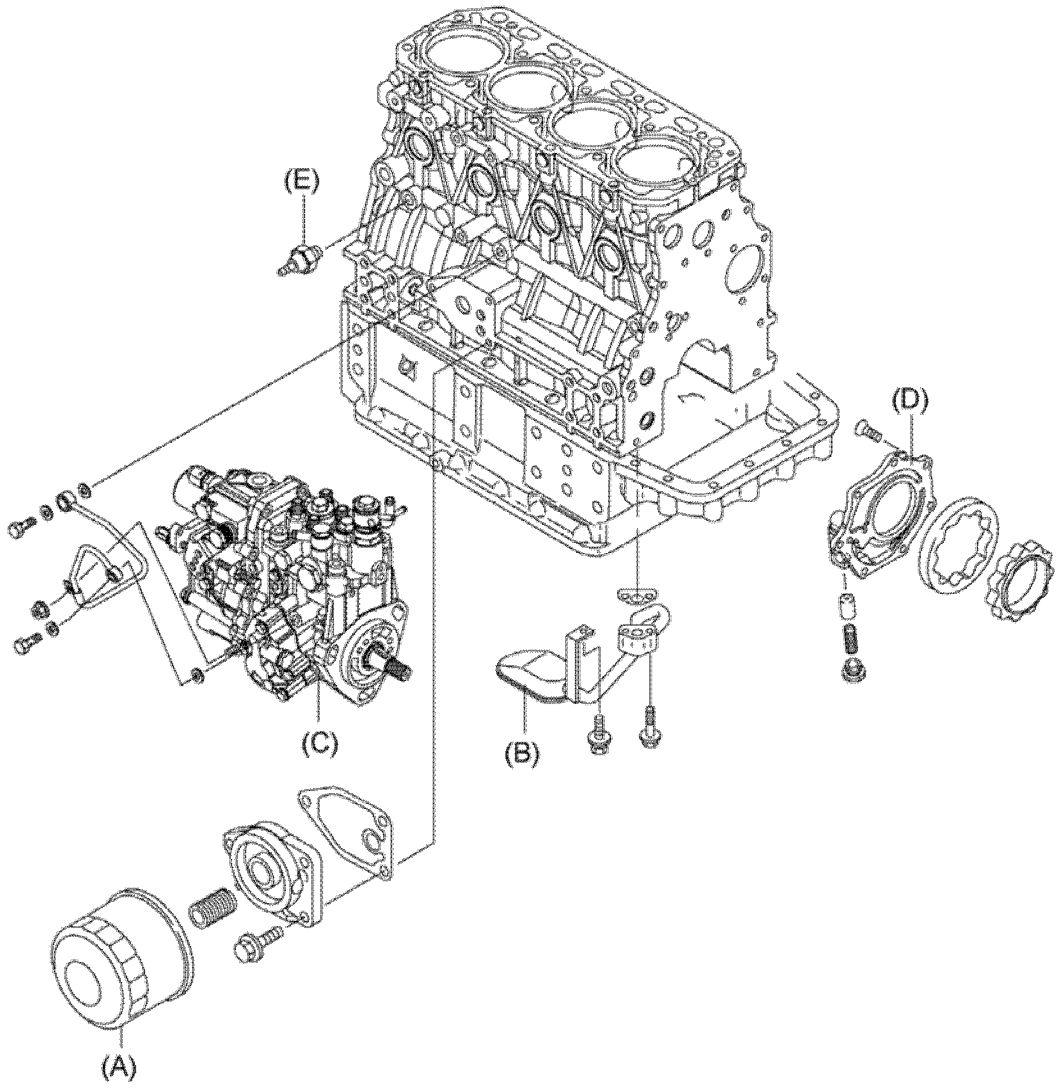
When the upper leading part of the plunger goes beyond the main port, fuel injection starts.
Once load is applied, the plunger starts operating and the stroke length of the upper part of the plunger increases. The fuel injection timing is delayed accordingly. (The injection timing is delayed when load is applied.)

(A) Upper leading part
(B) Main port
(C) Fuel
(D) Main leading part
(E) Plunger
(F) Fuel increase
(G) Fuel decrease
(H) Load increase
(I) The injection timing is delayed and the stroke length of the upper leading part increases as the load increases.

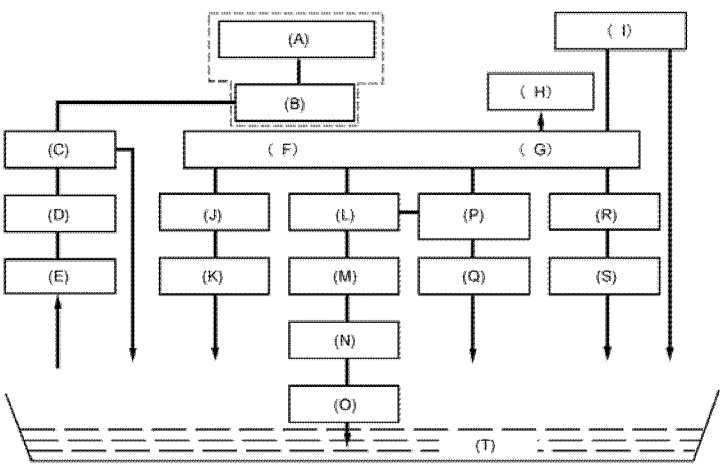
3.3 LUBRICATING OIL SYSTEM

3.3.1 Flow of lubricating oil

The oil in the oil pan passes through the strainer, is sucked up by the lubricating oil pump, and then lubricates the interior of the engine block and cylinder head through the oil filter and cooler.

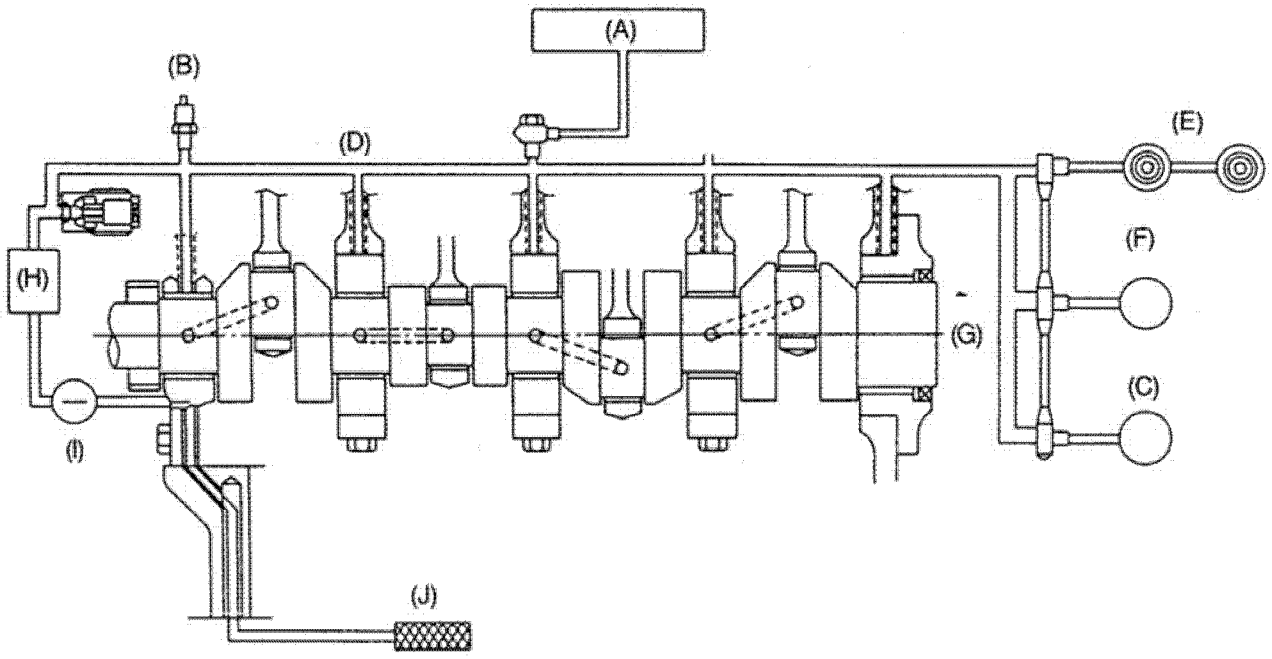


(A) Oil filter
(B) Strainer
(C) Fuel injection pump
(D) Lubrication pump
(E) Hydraulic pressure switch



(A) Relief valve (bypass)
(B) Lubricating oil filter
(C) Regulator
(D) Lubricating oil pump
(E) Lubricating oil filter
(F) Cylinder body
(G) Main gallery
(H) Hydraulic switch
(I) Fuel injection pump
(J) Intermediate gear shaft
(K) Gear shaft
(L) Cam bearing
(M) Valve arm pin
(N) Valve arm
(O) Tappet-cam face
(P) Crank journal
(Q) Crank pin
(R) Injection nozzle
(S) Piston
(T) Oil pan

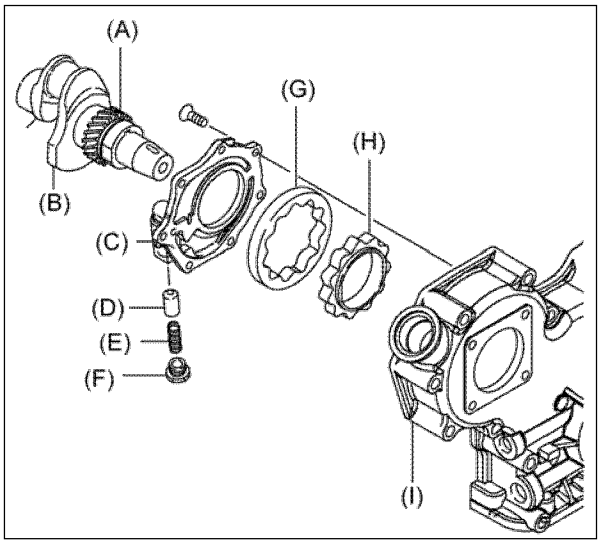
(A) Fuel injection pump
(B) Hydraulic switch activation Pressure (0.5±0.1 kg/cm^2)
(C) Blancer shaft
(D) Oil circuit
(E) Valve arm shaft
(F) Camshaft
(G) Crankshaft
(H) Filter
(I) Pump
(J) Strainer
(K) Oil filter(secondary)
(L) Oil pump



3.3.2 Lubrication oil pump (LO pump)

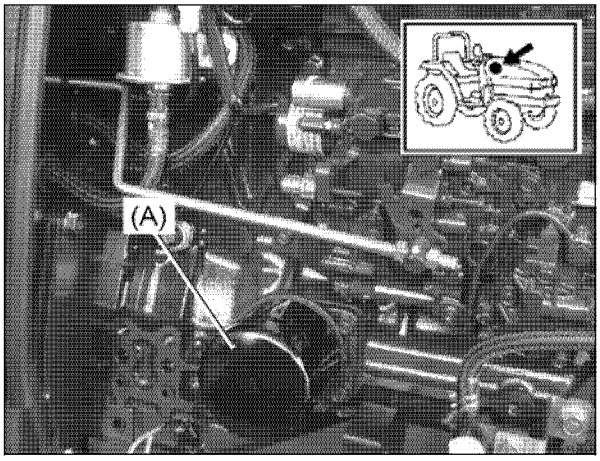
A trochoid pump installed on the cylinder block, driven by a crank gear, and provided with a relief valve to protect the oil cooler.

Discharge pressure (at rated rpm)	0.44 MPa (4.5 kgf/cm^2)



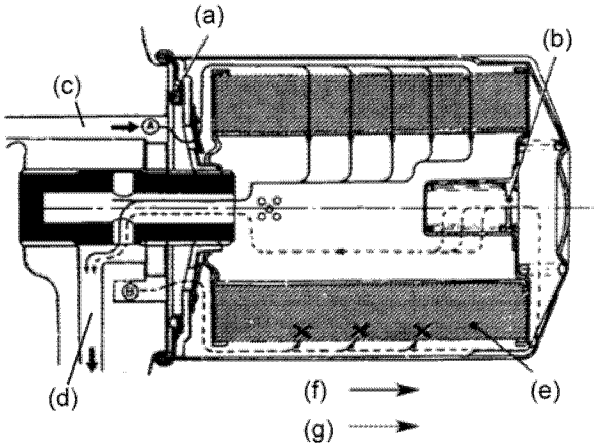
(A) Crank gear
(B) Cranks shaft
(C) Cover
(D) Relief valve
(E) Spring
(F) Plug
(G) Outer rotor
(H) Inner rotor (Driven by crank gear)
(I) Gear case

3.3.3 Lubricating oil filter (LO filter)

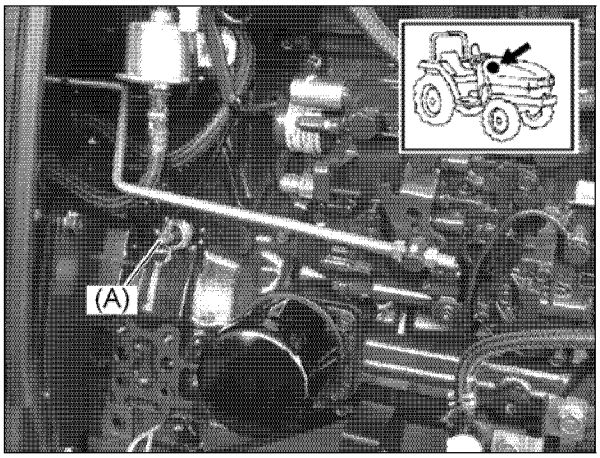


Has a built-in bypass valve in case of blockage. The vale will be activated at a differential pressure of 1.0 ±0.2 kgf/cm^2 across the paper filter element and enable the oil to flow through the bypass circuit.

(A) Oil filter
(a) Rubber packing
(b) Bypass valve (safety valve)
Activation pressure: 0.6 kgf/cm2 (Low idling RPM)
(c) Lubricating oil pump
(d) Lubricating oil
(e) Paper filter element
(f) Normal flow path
(g) Bypass flow path



3.3.4 Hydraulic switch

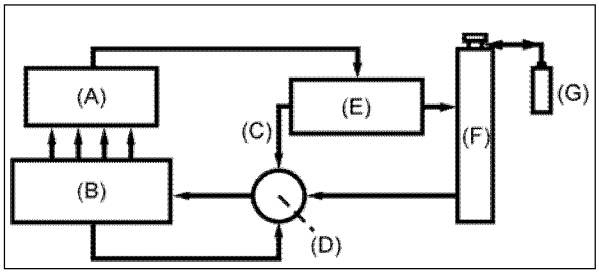


Closes to provide an alarm (illuminate an alarm LED on the combination meter) when the lubricating oil pressure decreases to a certain limit.

(A) Hydraulic pressure switch

3.4 COOLING WATER SYSTEM

3.4.1 Flow of cooling water

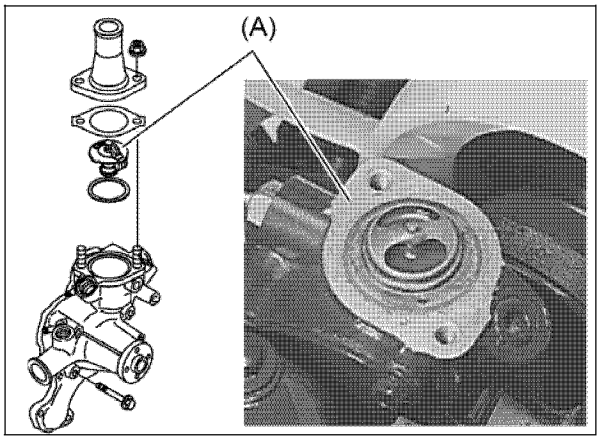


(A) head
(B) Cylinder block
(C) Bypass
(D) Cooling water pump
(E) Thermostat
(F) Radiator
(G) Sub-tank

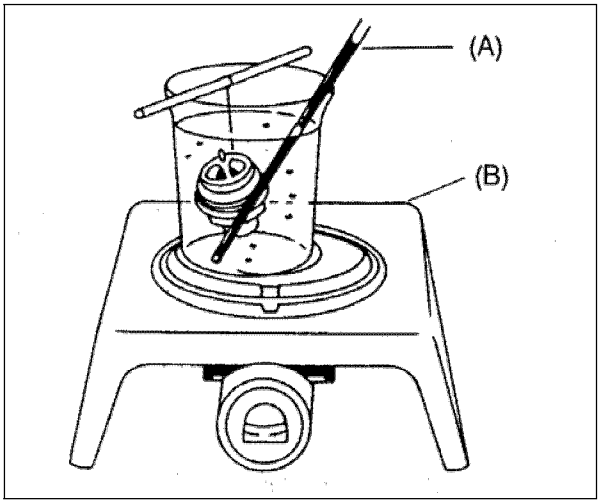
3.4.2 Main components

<Thermostat>
Maintains a constant temperature for the cooling water, thereby preventing the engine from being excessively cooled. If the water temperature is low, the valve closes to circulate cooling water without sending it to the radiator. If the water temperature increases, the valve opens to send cooling water to the radiator.

Thermostat	
Temperature at which the valve is opened	85°C
Temperature at which the valve is fully opened	95°C
Valve lift	8mm minimum

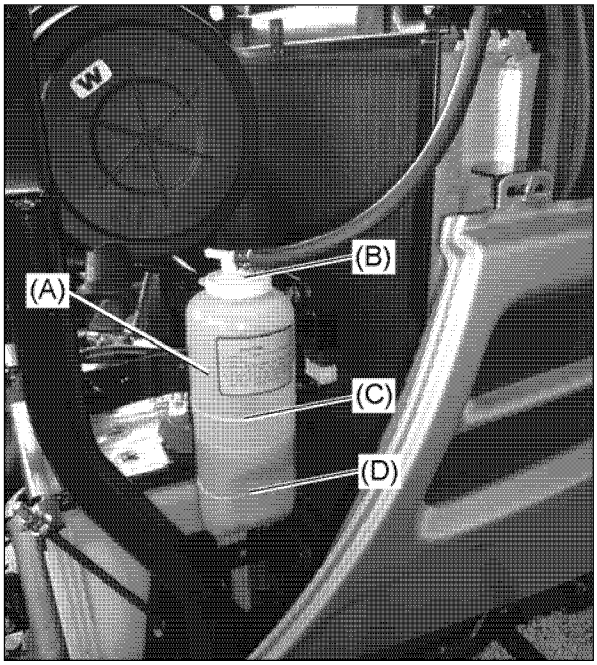


(A) Thermostat



(A) Thermometer
(B) Heater

<Radiator (with sub-tank)>



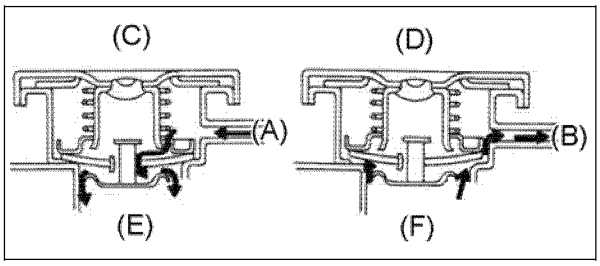
Sub-tank

The sub-tank is used to store evaporated cooling water, thereby preventing cooling water from being consumed.

(A) Sub-tank
(B) Supply port
(C) Upper limit
(D) Lower limit

Radiator cap

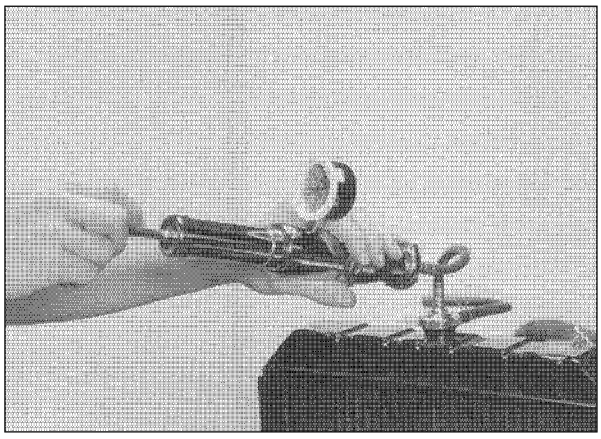
When the internal pressure of the radiator rises because of an increase in water temperature, the valve opens to send water vapor to the sub-tank (to prevent the radiator from deforming or otherwise changing).
When the water temperature decreases, the valve closes, the internal pressure of the radiator becomes negative, and then the water in the sub-tank is sucked back to the radiator.



(A) From sub-tank
(B) To sub-tank
(C) When vapor pressure decreases
(D) When vapor pressure increase
(E) Water is sucked from the sub-tank back to the radiator.
(F) Steam is sent to the sub-tank.

Checking a leak from the radiator or engine cylinder block

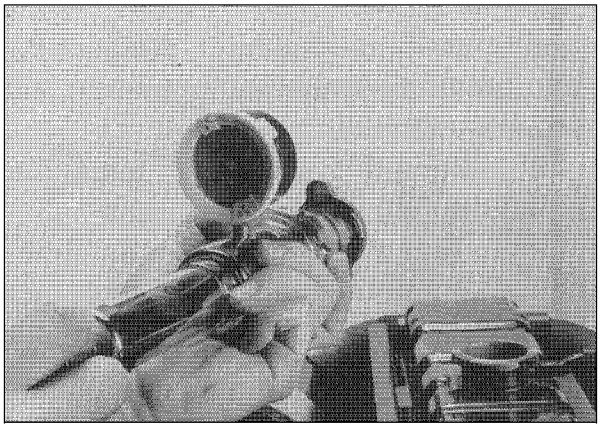
(1) Remove the radiator cap and add cooling water until it is full.
(2) Install the tester.
(3) Apply a pressure of 1.0-1.2 kgf-cm/cm^2.



CAUTION
Too much pressure can damage the hose and radiator.

(4) Leave for approximately 10 minutes while watching the gauge on the tester.
(5) A falling reading means that there is a leak. Check the radiator and internal engine parts (gaskets, seals, etc.).

Checking the radiator cap



(1) Put the cap on the tester adaptor.
(2) Run the pump to apply pressure. If the gauge stays in the normal range for 6 seconds it means the cap is holding the correct pressure. If the pressure does not go up, suspect a damaged spring or worn gaskets. Replace the cap.

.

Normal pressure: 0.9 0.1 kgf ±0.15 cm/cm ^{2}

CAUTION

To deal with variations in the size of the cap tabs, check the pressure twice, once with the cap turned 180°.

3.4.3 Fuel injection pump

Removal

(1) Loosen the cooling fan V-belt.
(2) Remove the engine coolant fan guard (if equipped), engine coolant fan (Figure 1, (2)), spacer (Figure 1, (3)) if equipped, V-pulley (Figure 1, (4)) and cooling fan V-belt (Figure 1, (1)).

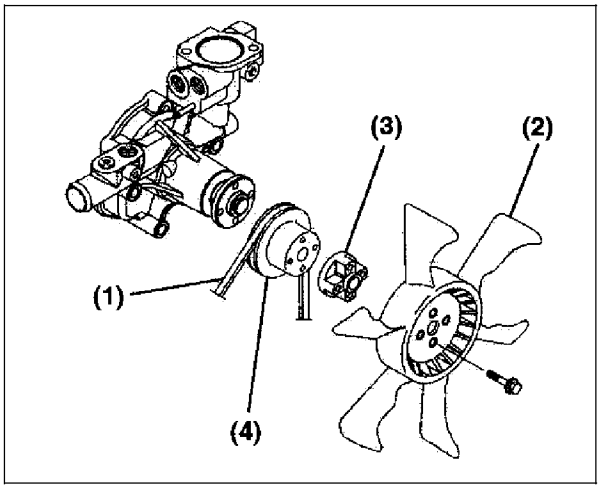


Figure 1

(3) Close any fuel valves in the fuel supply line.
(4) Place a drain pan under the fuel injection pump to catch any spillage.

(5) Remove the high-pressure fuel injection lines as an assembly (Figure 2, (1)).

Note:
To prevent "rounding" the fuel line nuts always use a "line" or "flare nut" wrench. When loosening the fuel line nuts, always hold the fuel injection pump delivery valves with a "back up" wrench to prevent loosening of the delivery valves.

(6) First loosen the fuel line nuts at the fuel injectors and then at the fuel injection pump.

CAUTION
Remove or install the high-pressure fuel injection lines as an assembly whenever possible. Disassembling the high-pressure fuel injection lines from the retainers or bending any of the fuel lines will make it difficult to reinstall the fuel lines.

(7) Finish loosening all the fuel line nuts and remove the high-pressure fuel lines as an assembly being careful not to bend any of the fuel lines. Be sure to protect the fuel system from contamination by covering all open connections.
(8) Disconnect the coolant lines from the cold start device (Figure 2, (3)) on the fuel injection pump. Plug the open ends of the lines to minimize leakage and prevent contamination.
(9) Disconnect the fuel return lines from the fuel return fitting (Figure 2, (2)). Plug the open ends of the lines to minimize leakage and prevent contamination.
(10) Remove the fuel supply line (Figure 2, (4)). Plug the open end of the line to minimize leakage and prevent contamination.
(11) Remove the throttle cable from the fuel injection pump.

(12) Separate the stop solenoid wiring connector (Figure 3, (2)).
(13) Remove the rear fuel injection pump bracket(s) (Figure 3, (1)) from the fuel injection pump.

Note:
Configuration of the fuel injection pump rear brackets may vary depending upon engine model.

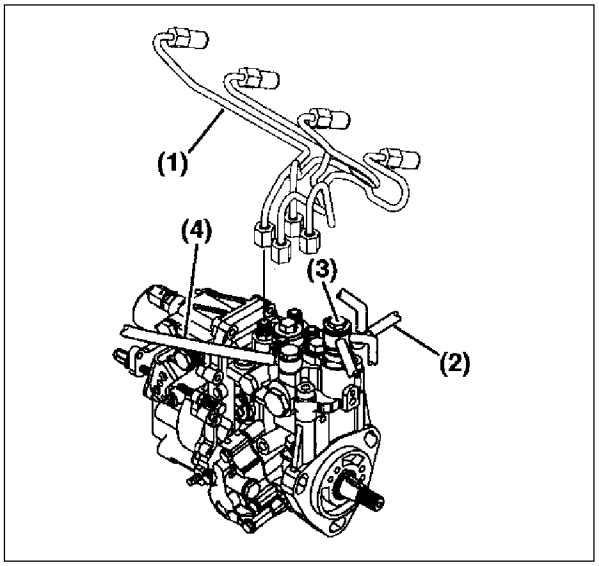


Figure 2

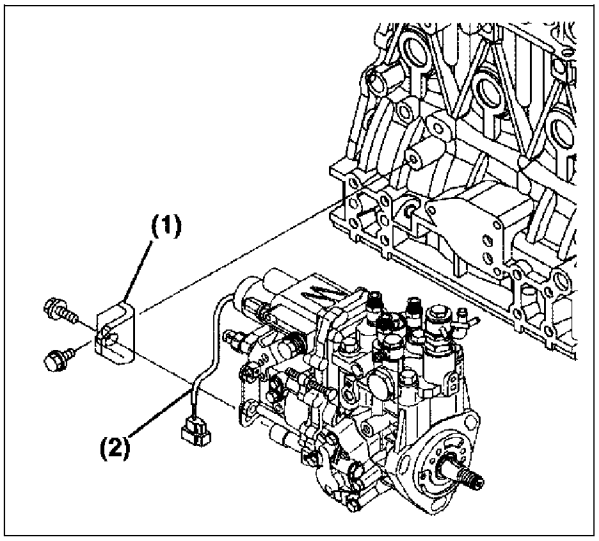


Figure 3

(14) Disconnect the lube oil line (Figure 4, (1)) and the clamp (Figure 4, (2)) from the pump.

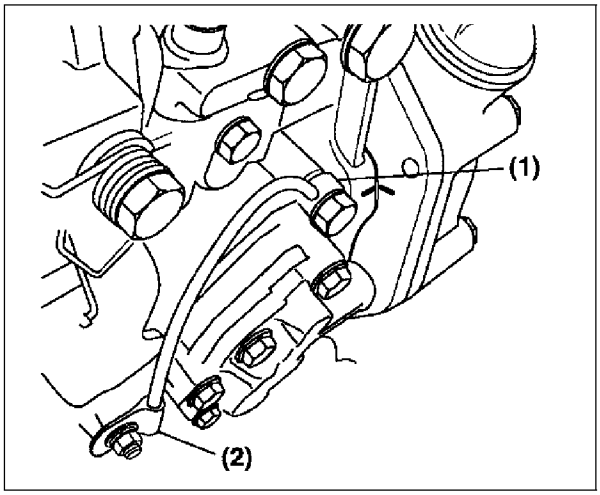


Figure 4

IMPORTANT

Take care to not damage or bend the oil line. In some applications, it may be preferable to remove the complete oil line assembly from the engine before proceeding.

(15) Remove the fuel injection pump drive gear cover (Figure 5, (1)).

Note:

- The fuel injection pump drive gear cover is secured with an adhesive sealant. Use a gasket scraper to separate the fuel injection pump cover from the gear case cover.
- The fuel injection pump drive gear cover is retained to the gear case cover by 4 bolts.

(16) To position the fuel/injection pump for easier removal and installation, install a dial indicator into the injection pump plunger opening. Using a wrench on the crankshaft pulley bolt, rotate the crankshaft until the dial indicator shows that injection pump plunger is at the bottom of it's stroke.

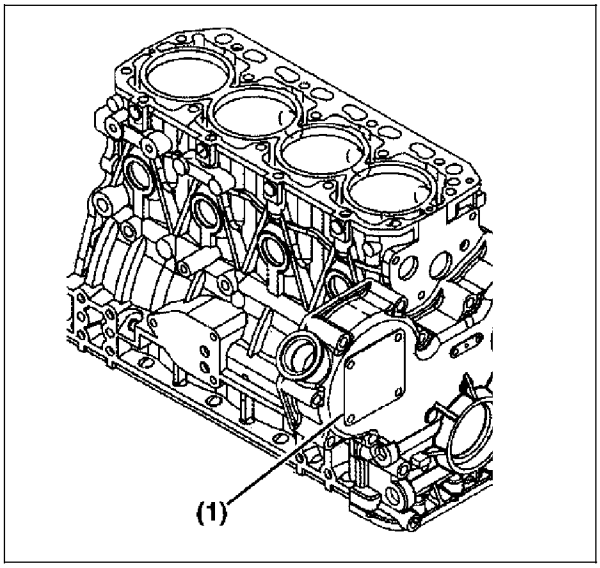


Figure 5

(17) To aid in reassembly, make reference marks on the fuel injection pump drive gear, and on either the gear case cover or idler gear.

CAUTION
After marking the position of the pump drive gear, do not rotate the engine crankshaft. Rotating the crankshaft will cause the fuel injection pump to become misaligned.

The idler gear is not visible. Make a reference mark on the fuel injection pump drive gear (Figure 6, (1)) and a matching mark on the bore of the gear case opening (Figure 6, (2)).

CAUTION
Do not loosen or remove the four bolts retaining the fuel injection pump drive gear to the fuel injection pump hub. Do not disassemble the fuel injection pump drive gear from the hub. Correct fuel injection timing will be very difficult or impossible to achieve.

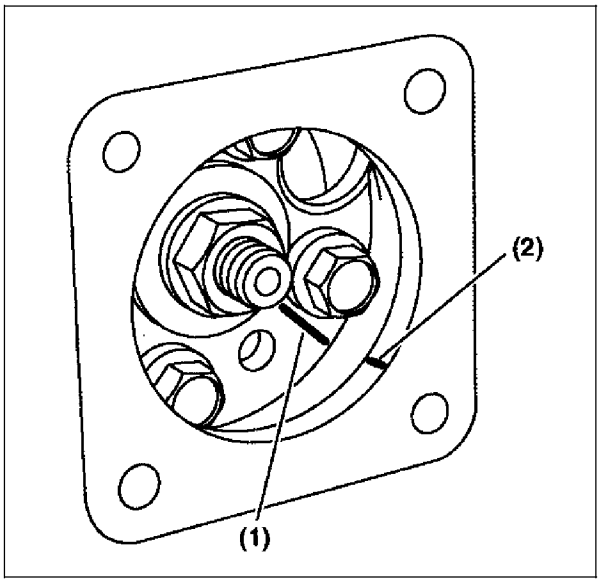


Figure 6

(18) Do not loosen or remove the four bolts (Figure 7, (3)) retaining the pump drive gear nut (Figure 7, (1)) and washer to the hub. Only remove the single drive gear (Figure 7, (2)), leaving the hub attached to the gear.

(19) Hold the gear train using a large socket wrench on the crankshaft pulley nut. Loosen the fuel injection pump drive gear retaining nut (Figure 7 (1)) and turn it out to the end of the fuel injection pump shaft.

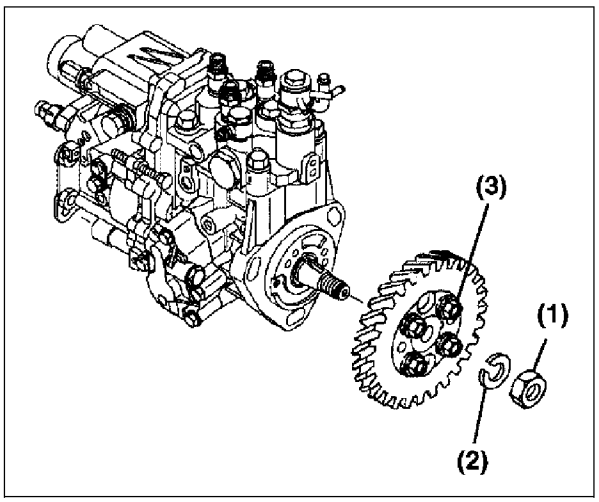


Figure 7

(20) Remove the pump drive gear and hub as an assembly using an appropriate two-bolt gear puller (Figure 8).

Note:
The injection pump drive gear will remain "captured" in the gear case.

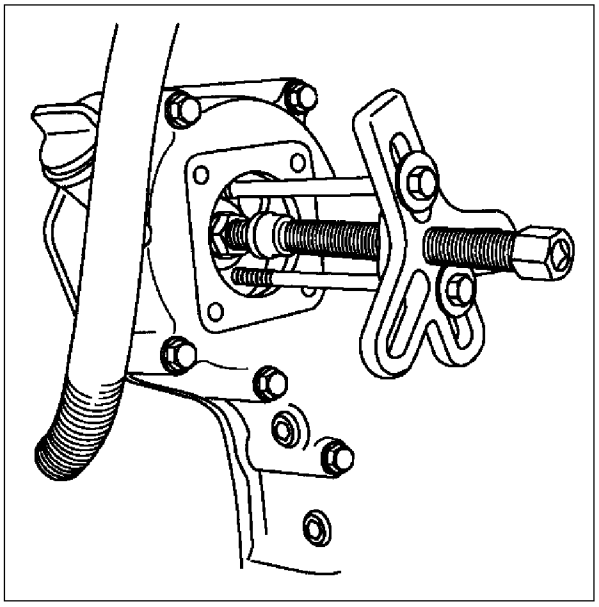


Figure 8

(21) Once the fuel injection pump drive gear and hub assembly has "popped" loose from the tapered fuel injection pump drive shaft, carefully remove the drive gear nut (Figure 9, (1)) and lock washer (Figure 9, (2)).

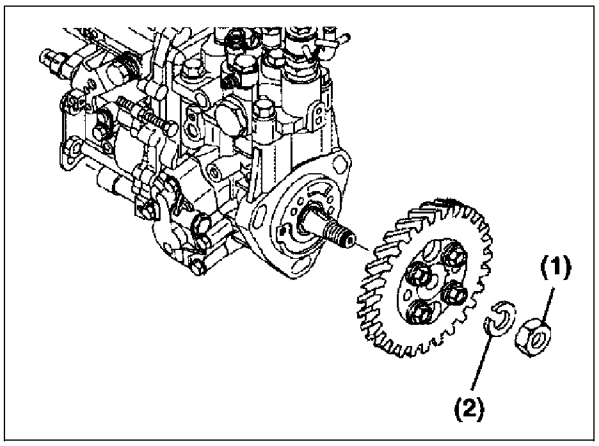


Figure 9

(22) Locate the mark stamped into the upper outside mounting boss of the fuel injection pump. Highlight this mark and make a corresponding mark on the gear case or front plate (Figure 10, (1)).

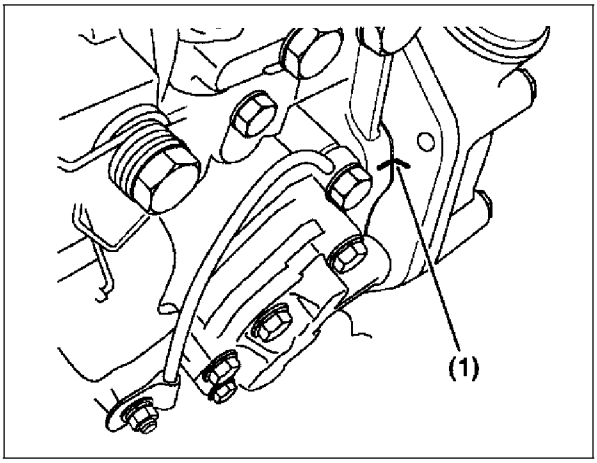


Figure 10

Note:
Some model engines may require the intake manifold and fuel injection pump insulator (Figure 11, (2)) be removed to access the inner fuel injection pump (Figure 11, (1)) retaining nuts.

(23) If required, remove the intake manifold and fuel pump insulator to access the fuel injection pump mounting nuts.

Note:
The MP2 fuel injection pumps (TNV 88 model engine) are fastened to the gear case with three (3) studs and nuts.

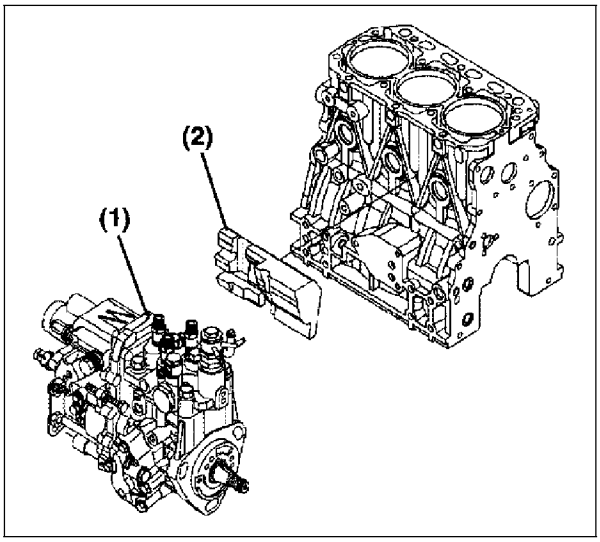


Figure 11

(24) Remove the fuel injection pump (Figure 11 (1)). For purposes of future injection timing purposes, record the fuel injection pump timing index number located on the boss on the engine side (back) of the of the fuel injection pump (Figure 12 (1)).

CAUTION
Do not rotate the crankshaft with the injection pump removed.

(25) If the fuel injection pump requires servicing, it must be sent to an authorized Yanmar FIE repair facility for repair and calibration, or replaced with a new fuel injection pump.

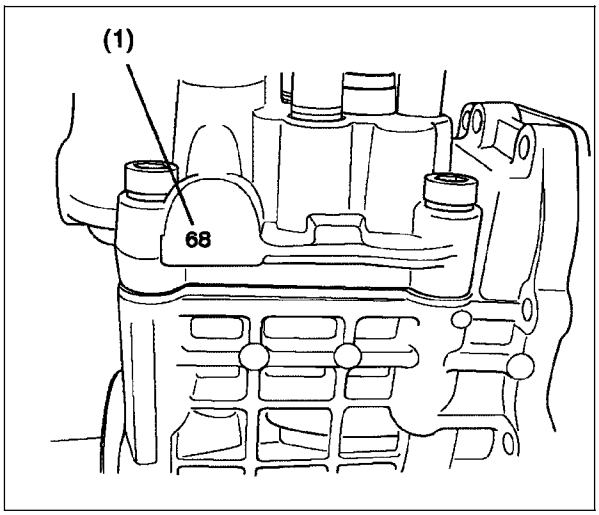


Figure 12

CAUTION

- NEVER remove or attempt to remove the tamper-proof devices from the full-load fuel adjusting screw or the high-speed throttle limit screw on the fuel injection pump and governor assembly. These adjustments have been made at the factory to meet all applicable emissions regulations and then sealed.
- NEVER attempt to make any adjustments to these sealed adjustment screws. If adjustments are required, they can be made only by a qualified fuel injection shop that will ensure the injection pump continues to meet all applicable emissions regulations and then replace the tamper-proof seals.
- Tampering with or removing these devices may void the "Yanmar Limited Warranty".

Installation of fuel injection pump

IMPORTANT

If installing a new or recalibrated fuel injection pump, locate and record the timing index number located on the pump housing boss on the engine side of the new or recalibrated fuel injection pump (Figure 12, (1)) This number will be used to calculate and adjust the final fuel injection timing.

Note:

If either or both of the fuel injection pumps do not have a timing index number, note the injection pump ID (example: XK42) on the injection pump ID label.
To locate the timing index number for the engine being serviced use the Timing Index Chart under "FIE Specs" on the Yanmar Distributor Website (http://distributor.yanmar. co.jp).

If additional assistance is needed in locating the engine timing index number See To Locate an Authorized Yanmar Industrial Engine Dealer or Distributor- on page 2-4 and follow the instructions to locate an authorized Yanmar industrial engine dealer or distributor for assistance.

Note:

Treat the timing index number as if it has a decimal point (68 = 6.8).

(1) Align the pump drive gear with the idler gear using the reference marks made earlier.

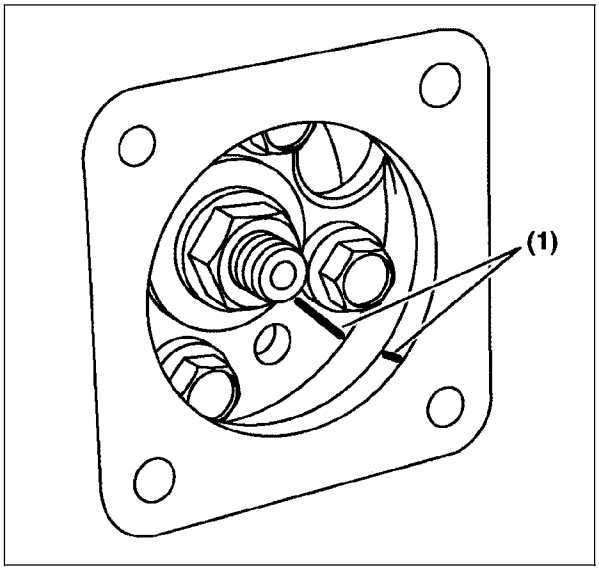


Figure 13

(2) If installing the fuel injection pump on an engine with the front gear case cover removed, the fuel injection pump drive gear can be aligned with the idler gear by aligning the stamped marks (A, B, C) on the fuel injection pump drive gear, idler gear, and crankshaft drive gear. Ensure all three timing marks (Figure 15, (A, B, C)) are aligned.

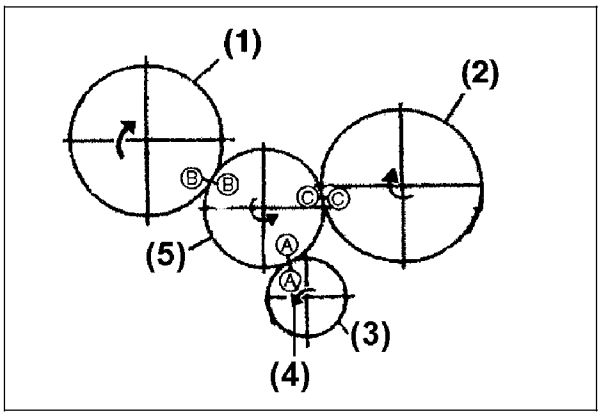


Figure 14

1 Fuel Injection Pump Drive Gear
2 Camshaft Drive Gear
3 Crankshaft Drive Gear
4 Direction of Rotation
5 Idler Gear

(3) Install a new O-ring on the pump mounting flange. Apply grease to the O-ring to hold it in place during installation of the injection pump.

Note:
Ensure the tapered surface of the fuel injection pump shaft is clean and dry.

(4) Align the key on the fuel injection pump shaft with the keyway in the fuel injection pump drive gear hub. Reinstall the fuel injection pump into the fuel injection pump drive gear and gear housing. Reinstall the pump retaining nuts finger tight.

(5) Reinstall the fuel injection pump drive gear lock washer (Figure 15, (2)) and nut (Figure 15, (1)). Do not lubricate the threads of the nuts or shaft. Hold the crankshaft pulley bolt with a socket wrench and tighten the drive gear nut to the specified torque.

Note:
Ensure the tapered surface of the fuel injection pump shaft is clean and dry.

(6) Align the key on the fuel injection pump shaft with the keyway in the fuel injection pump drive gear hub. Reinstall the fuel injection pump into the fuel injection pump drive gear and gear housing. Reinstall the pump retaining nuts finger tight.

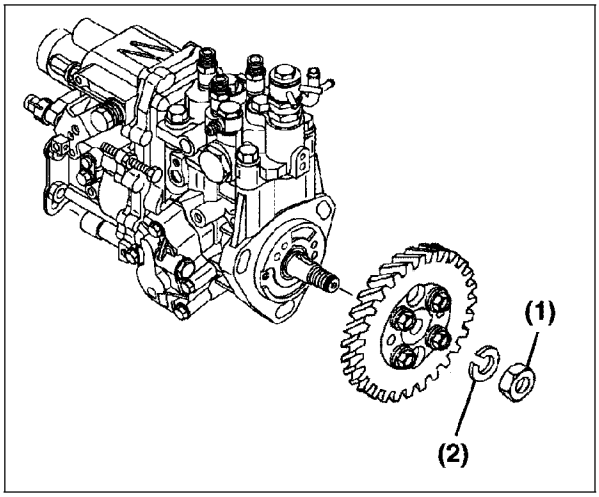


Figure 15

If reinstalling the original fuel injection pump:
- Align the reference marks (Figure 16, (1)) previously made on both the fuel injection pump mounting flange and gear case or front plate.
- Tighten the fuel injection pump retaining nuts to specification.

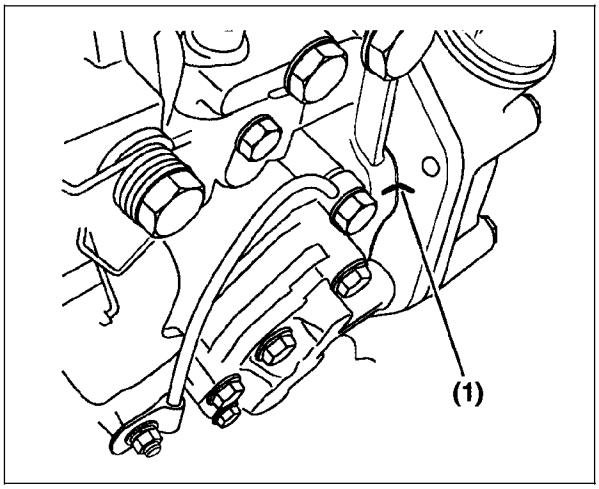


Figure 16

If installing a new fuel injection pump:

- Reinstall the timing grid sticker, provided with the new fuel injection pump, onto the back of the gear case / front plate (Figure 17). Align the "standard mark" (Figure 17, (1)) with the reference mark (Figure 17, (2)) made on the gear case during disassembly.

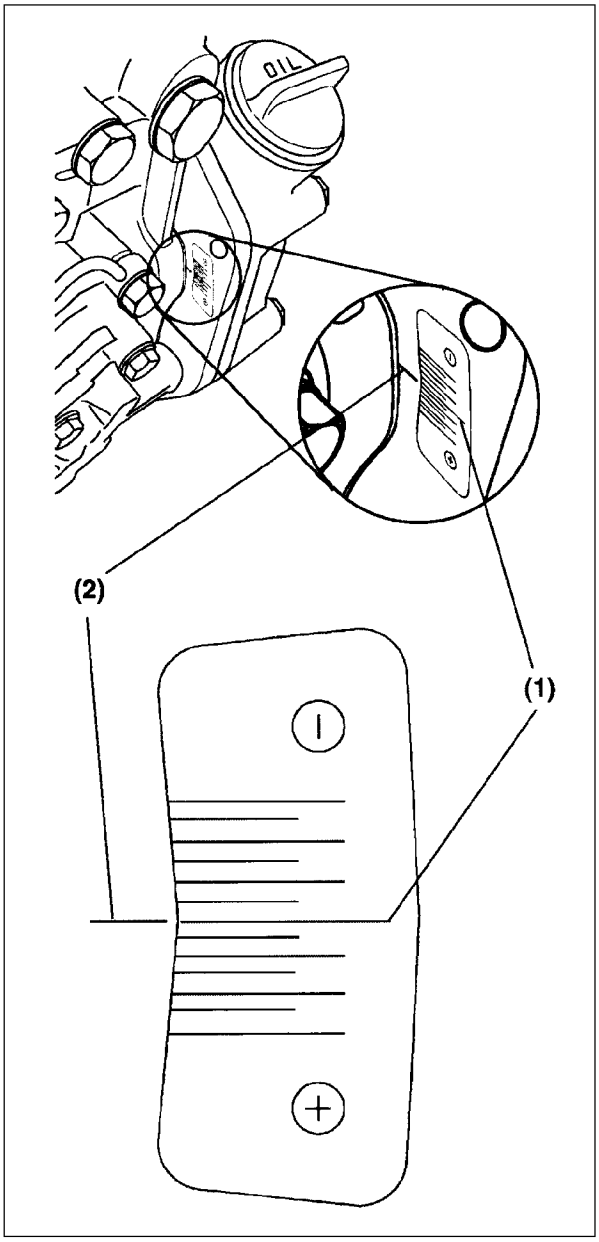


Figure 17

- Calculate the difference between the timing index numbers (Figure 18, (1)) of the fuel injection pump that you removed and the replacement fuel injection pump. See Calculation Example below.

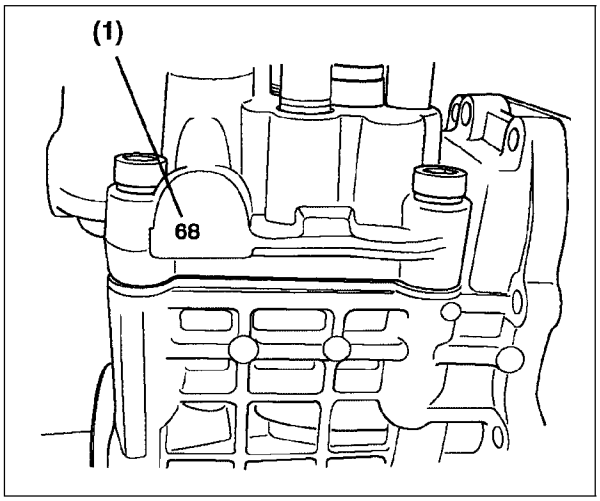


Figure 18

Adjusting the fuel injection timing to compensate for the difference in pump timing index numbers:

Calculation Example

Timing Index Number	
Original injection pump=	6.8
Replacement injection pump=	7.3
Difference=	+0.5

- If the difference between the timing index numbers is a positive number, the fuel injection pump mounting position must be advanced (Figure 19, (2)) (rotated away from the engine) as compared to the "standard mark" (Figure 19, (1)) by the calculated positive amount, adjust the fuel injection pump to the calculated value.
- If the difference between the timing index numbers is a negative number, the replacement injection pump must be retarded (Figure 19, (3)) (rotated toward the engine) by the calculated negative amount.
- Each mark on the timing sticker represents 0.50 timing change. The above calculated difference indicates that the replacement fuel injection pump is to be installed at +0.5° (advanced) from the "Standard Mark" (Figure 19, (1)) on the timing sticker.

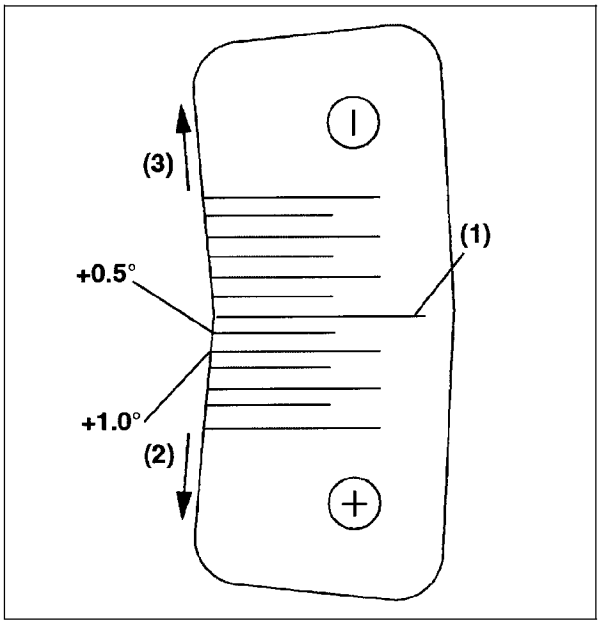
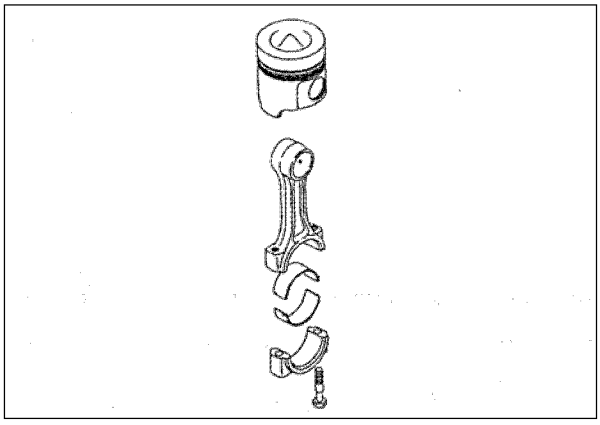


Figure 19

IMPORTANT

When installing a new or repaired fuel injection pump, it is important to add engine oil to the fuel injection pump to provide lubrication for initial start-up. Add 5-7 oz (150-200 cc) of clean engine oil to the fuel injection pump at the fill plug located in the upper outside section of the governor housing.

3.4.4 Piston



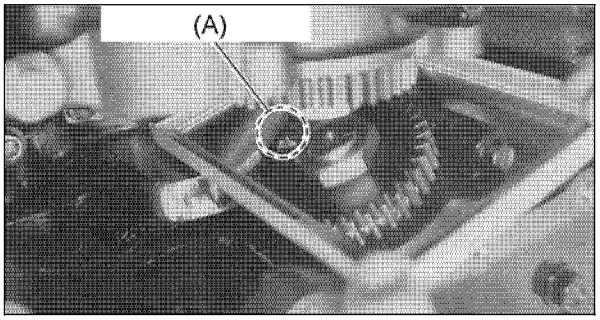
Disassembling
(1) Remove the cylinder head.
(2) Drain the engine oil.
(3) Remove the propeller shaft.
(4) Remove the oil pan.

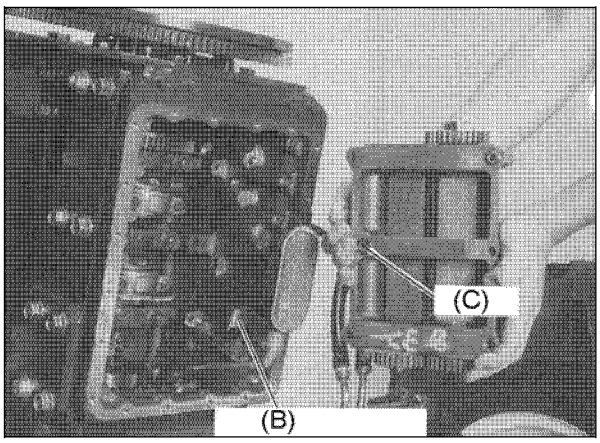
Assembling
Use Three Bond 1212.

(5) Remove the dual-axis balancer assembly.

Note:
Mate the balancer gear A (hollow) with the crankshaft balancer gear (mark A) (tooth).

Remove the connecting rod through the bottom of the engine and pull the piston up.

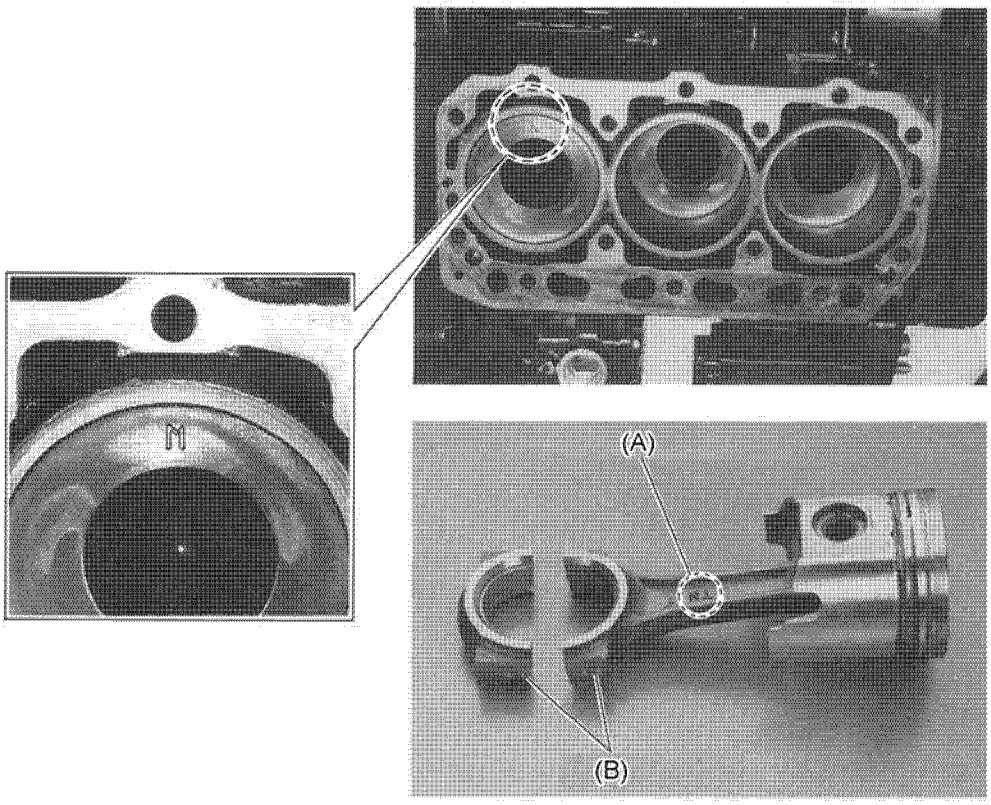




(A) Balancer gear mark A
(B) Strainer mounting stay
(C) O-ring

Notes when assembling

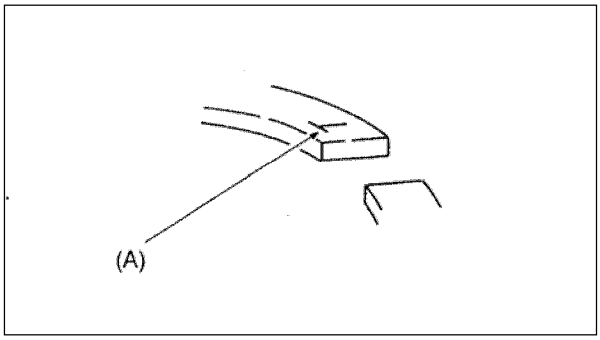
- Aim the piston seal mark at the camshaft (away from the nozzle).
- Aim the embossed mark on the connecting rod to the flywheel.
- Match the marks on the connecting rod cap to those on the connecting rod.



(A) Embossed brand name
(B) Alignment marks on large end of connecting rod

Assembling the piston rings

- Install the top piston ring and the second ring so that their openings are 120° away from each other. Install the oil ring so that its opening and the second ring opening are also 120° away from each other.
- Install the piston rings with the embossed side up. The oil ring may be installed with either side up.



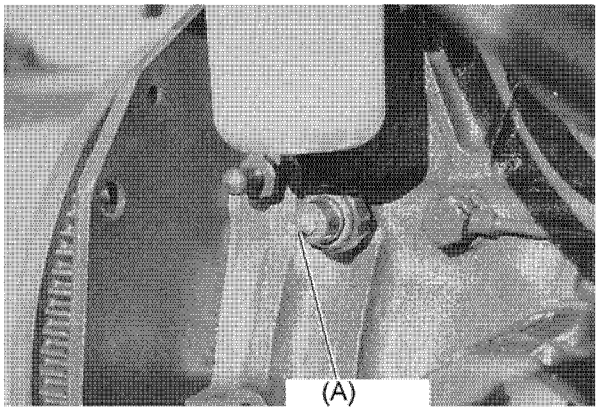
(A) Marking on top.

3.4.5 Checking pressures

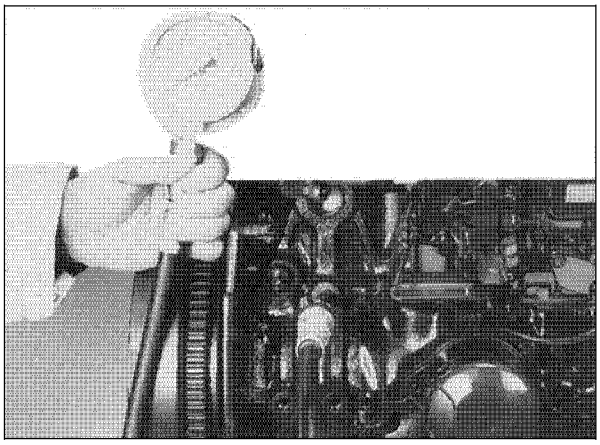
Checking the lubrication oil

(1) Run the engine to warm it up and raise the oil temperature.
(2) Remove the pressure switch and install the oil tester.
(3) If the pressure is not working properly, check the oil level.

Regulator valve pressure: 3-4 kgf/cm^2



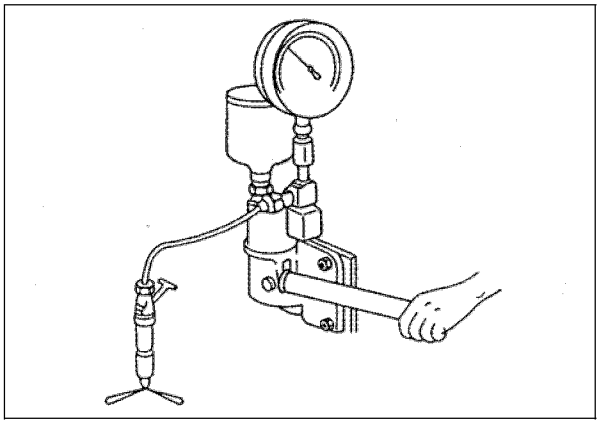
(A) Oil switch



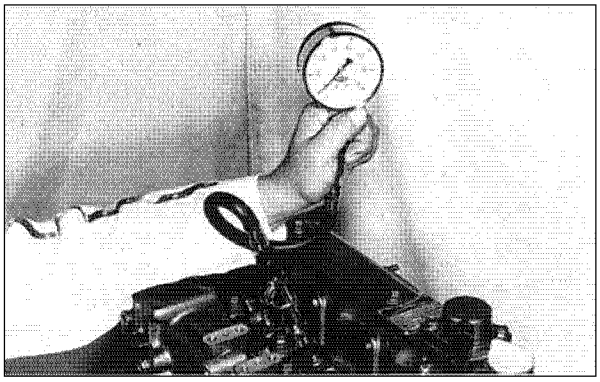
Fuel injection pressure

Detach the fuel injector and place it on the nozzle tester. Operate the tester lever slowly and read the pressure when the nozzle starts to spray fuel.

Injection starting pressure:
21.6 MPa (220 kgf/cm^2)



Engine compression pressure



(1) After warming up the engine, stop it and remove the air cleaner and all the fuel injectors.
(2) Install the diesel engine compression gauge in the injector hole of each cylinder.
(3) Move the accelerator lever to the STOP position (the zero position for fuel injection) and operate the starting motor for 5-10 seconds (at 200-300 rpm). Read the maximum value when the gauge has stabilized. Make the measurement twice.
(4) If the pressure is below the operating limit, put 2 cc of engine oil through the nozzle hole. Idle the engine for a while to let the oil penetrate and check the pressure again.
(5) If the compression pressure returns to normal, check the cylinder, piston, and piston ring.
(6) If the compression pressure does not return to normal, check the valve and cylinder head and related parts.

Compression pressure

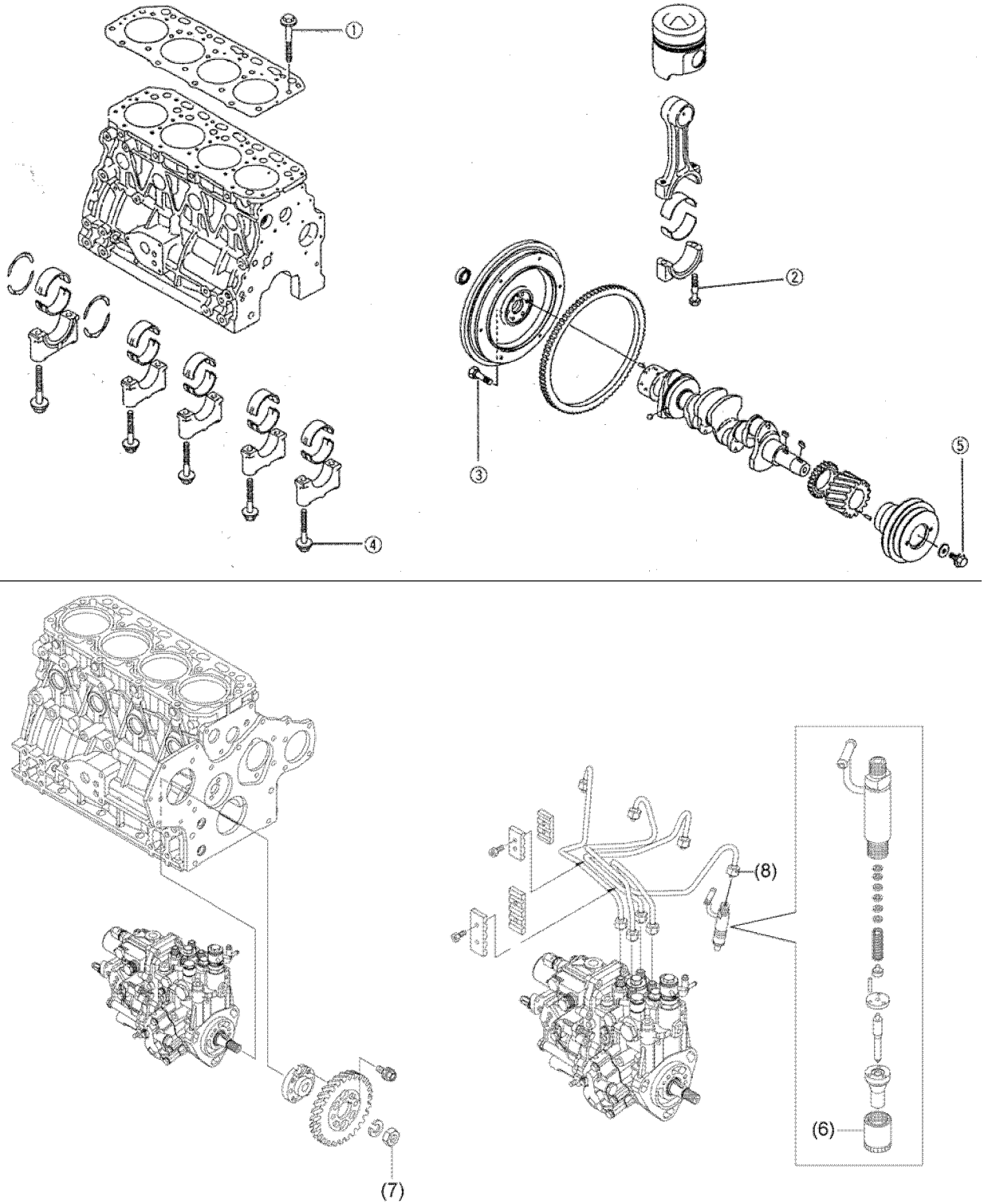
Condition	Battery fully charged Valve clearance is normally 0.2 mm, permitting the self-starting motor to run at 300 rpm.
Criteria	30-35 kg/cm^2
Limit	30-35 kg/cm^2
Tolerance	10% max difference between cylinders

3.4.6 Maintenance criteria

For any other details, refer to the relevant technical manuals for the TNV series.

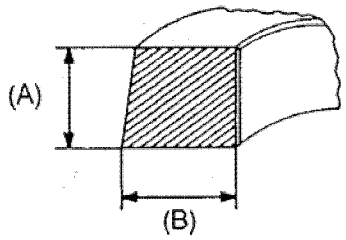
(Unit: kgf • m)

No.	Parts	Lube oil	Torque	Model
1	Head bolt	Yes	8.7-9.3 (M10 x 1.25)	
2	Rod bolt	Yes	4.5-5.0 (M9 x 1.0)	
3	Flywheel bolt	Yes	8.5-9.0 (M10 x 1.25)	
4	Metal cap bolt	Yes	9.5-10.5 (Ml2 x 1.5)	
5	Crank V-pulley bolt	Yes	8.7-9.3 (M14 x 1.5)	
6	Nozzle lock bolt	No	2.5-2.9 (M8 x 1.25)	
7	FO pump gear nut	No	8.0-9.0 (M14 x 1.5)	
8	High pressure sleeve lock nut	No	3.0-3.5 (M12 x 1.5)	



Unit: mm

Parts		4TNV88	
		Criteria	Limit
Top ring	Groove width	2.060-2.075	—
	Dimension B	1.970-1.990	1.950
	Min gap between groove and ring	0.070-0.105	—
	Opening	0.200-0.400	0.490
Second ring	Groove width	2.025-2.040	2.140
	Dimension B	1.970-1.990	0.195
	Min gap between groove and ring	0.035-0.070	0.190
	Opening	0.200-0.400	0.490
Oil ring	Groove width	4.015-4.030	4.130
	Dimension B	3.970-3.990	3.950
	Min gap between groove and ring	0.025-0.060	0.180
	Opening	0.200-0.400	0.490

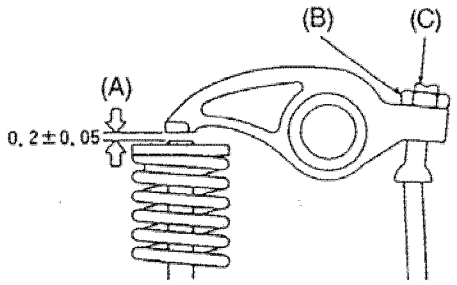


(A) Dimension B (width)
(B) Thickness

Piston and piston ring table, oversize (0.25 mm)

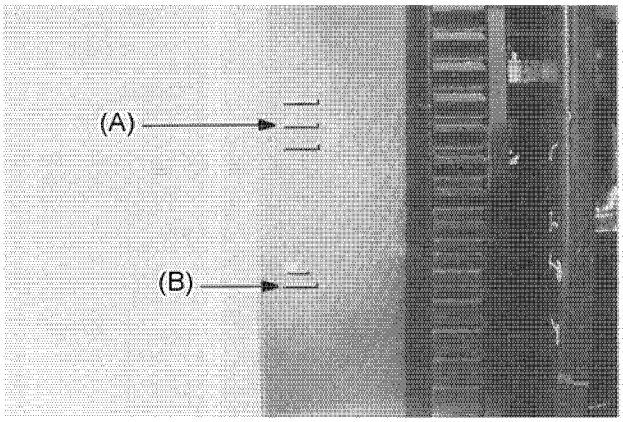
Model	Piston assembly code	Piston assembly code
4TNV88	129005-22700	129005-22900

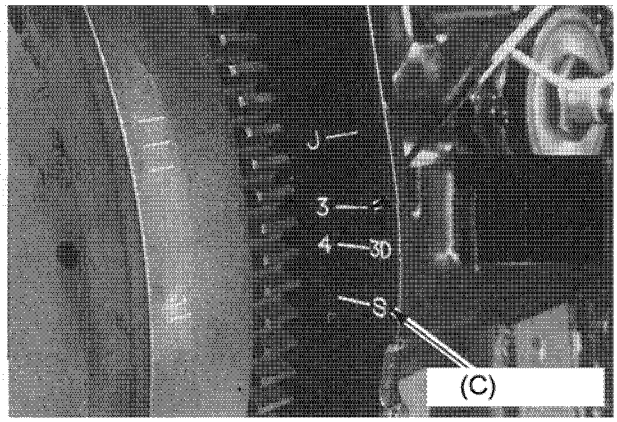
Valve clearance



(A) Valve clearance
(B) Lock nut
(C) Adjusting screw

Injection timing marks





(A) Injection timing gauge (B) Cylinder Top Dead Center (TDC) (C) Alignment point

3.5 ADJUSTMENT SPECIFICATIONS

3.5.1 Engine adjustments

No.	Inspection item			Standard	Limit
1	Intake/exhaust valve clearance (mm)			0.15 to 0.25	—
2	Tension of V-belt at 98 N (10 kgf) (mm)	Between alternator and crank pulley	For used product	10 to 14	—
			For new product	8 to 12	—
3	Fuel valve injection pressure MPa (kgf/cm^2)			21.57 to 22.55 (220 to 230)	—
4	Compression pressure MPa (kgf/cm^2)			3.43 (35)±0.1 (1)	2.75 (28)±0.1 (1)
5	Cooling water quantity (L)			2.4 (Sub tank 0.45)	—
6	Lubricating oil quantity (in oil pan) (L)			5.3	2.4
7	Lubricating oil pressure MPa (kgf/cm^2)			At rated speed : 0.29 (3.0) to 0.39 (4.0)	At idling speed : 0.06 (0.6)minimum
8	Hydraulic switch actuating pressure MPa (kgf/cm^2)			50±10 (0.5±0.1)	—
9	Thermosta			Temperature at which the valve is opened (°C)	Lift to fully open the valve (mm) (temperature)
				85	8 minimum (95°C)

3.5.2 Cylinder head

No.	Inspection item			Standard	Limit
1	Distortion of combustion surface (mm)			0.05 maximum	0.15
2	Valve recession (mm)		Intake	0.30 to 0.50	0.8
			Exhaust	0.36 to 0.56	0.8
3	Valve seat	Seat angle (degrees)	Intake	120	—
			Exhaust	90	—
		Seat correction angle (degrees) *See the engine service manual.		40、150	—

3.5.3 Intake/exhaust valve and guide

No.	Inspection item		Standard	Limit
1	Intake valve	Guide I.D. (mm)	8.010 to 8.250	8.10
		Stem O.D. (mm)	7.955 to 7.975	7.90
		Clearance (mm)	0.035 to 0.070	0.18
	Exhaust valve	Guide I.D. (mm)	80.15 to 8.030	8.10
		Stem O.D. (mm)	7.955 to 7.960	7.90
		Clearance (mm)	0.045 to 0.075	0.18
2	Valve guide projection from cylinder head (mm)		14.7 to 15.0	
3	Valve guide installation method		Expansion fit	—

3.5.4 Valve spring

No.	Inspection item	Standard	Limit
1	Free length (mm)	42.0	41.5
2	Squareness (mm)	—	1.4

3.5.5 Locker arm and shaft

No.	Inspection item	Standard	Limit
1	Arm hole I.D. (mm)	16.000 to 16.020	16.07
	Shaft O.D. (mm)	15.966 to 15.984	15.94
	Clearance (mm)	0.016 to 0.54	0.13

3.5.6 Push rod

No.	Inspection item	Standard	Limit
1	Bending (mm)	—	0.03

3.5.7 Camshaft

No.	Inspection item	Standard	Limit
1	End play (mm)	0.05 to 0.20	0.30
2	Bending (1/2 reading from dial) (mm)	0 to 0.02	0.05
3	Cam height (mm)	38.600 to 38.800	38.350

Outer diameter of camshaft and inner diameter of bearing

No.	Inspection item		Standard	Limit
1	Gear end (mm)	Bushing I.D	44.990 to 45.055	45.130
		Can shaft O.D.	44.925 to 44.950	44.890
		Clearance	0.040 to 0.130	0.240
	Intermediate (mm)	Bushing I.D	45.000 to 45.025	45.100
		Can shaft O.D.	44.910 to 44.935	44.875
		Clearance	0.065 to 0.115	0.225
	Flywheel end (mm)	Bushing I.D	45.000 to 45.025	45.100
		Can shaft O.D.	49.925 to 49.950	44.890
		Clearance	0.050 to 0.100	0.210

3.5.8 Idle gear shaft and bushing

No.	Inspection item	Standard	Limit
1	Shaft O.D. (mm)	45.950 to 45.975	45.900
2	Bushing I.D. (mm)	46.000 to 46.025	46.075
3	Clearance (mm)	0. 025 to 0.075	0.175

3.5.9 Timing gear backlash

No.	Inspection item	Standard	Limit
1	Crank gear, cam gear, idle gear, fuel injection pump gear, PTO gear (mm)	0.07 to 0.15	0.17

3.5.10 Cylinder block

No.	Inspection item		Standard	Limit
1	Cylinder I.D. (mm)		88.000 to 88.030	88.200
2	Cylinder bore	Circularity (mm)	0.01 maximum	0.030
		Taper (mm)		

3.5.11 Crankshaft

No.	Inspection item			Standard	Limit
1	Bend (1/2 the dial gauge reading) (mm)			—	0.02
2	Clamp pin (mm)		O.D.	47.925 to 47.962	47.902
			Bearing I.D.	48.000 to 48.026	—
			Bearing insert thickness	1.492 to 1.500	
			Clearance	0.038 to 0.074	0.150
3	Journal (mm)	Selective combination	O.D.	53.952 to 53.962	53.902
			Bearing I.D.	54.000 to 54.020	
			Bearing insert thickness	1.995 to 1.990	
			Clearance	0.038 to 0.068	0.150

3.5.12 Thrust bearing

No.	Inspection item	Standard	Limit
1	Crankshaft end play (mm)	0.13 to 0.23	0.28

3.5.13 Piston

No.	Inspection item		Standard	Limit
1	Piston O.D. (Measure at 90° to the piston pin) (mm)		87.940 to 87.970	87.895
2	Piston O.D. measuring point (Upward from the bottom of the piston) (mm)		24	—
3	Piston pin (mm)	Hole I.D.	26.000 to 26.009	26.039
		Pin O.D.	25.995 to 26.000	25.965
		Clearance	0.000 to 0.014	0.074

3.5.14 Piston rings

No.	Inspection item		Standard	Limit
1	Top ring (mm)	Ring groove width	2.060 to 2.075	2.170
		Ring width	1.970 to 1.990	1.950
		Clearance	0.070 to 0.105	0.200
		End gap	0.200 to 0.400	0.490
	Second ring (mm)	Ring groove width	2.025 to 2.040	2.140
		Ring width	1.970 to 1.990	1.950
		Clearance	0.035 to 0.070	0.190
		End gap	0.200 to 0.400	0.490
	Oil ring (mm)	Ring groove width	4.015 to 4.030	4.130
		Ring width	3.970 to 3.990	3.950
		Clearance	0.025 to 0.060	0.180
		End gap	0.200 to 0.400	0.490

3.5.15 Connecting rod

No.	Inspection item	Standard	Limit
1	Thrust clearance (mm)	0.2 to 0.4	

Dimensions of connecting rod small end

No.	Inspection item	Standard	Limit
1	Bushing I. (mm)	26.025 to 26.038	26.068
	Pin O.D. (mm)	25.955 to 26.000	25.967
	Clearance (mm)	0.025 to 0.043	0.101

3.5.16 Tappet

No.	Inspection item	Standard	Limit
1	Tappet bore I.D. (mm)	12.000 to 12.025	12.045
	Stem diameter (mm)	11.975 to 11.990	11.955
	Clearance (mm)	0.010 to 0.050	0.090

3.5.17 Lubricating oil pump (trochoid pump)

Outer rotor outside clearance

No.	Standard	Limit
1	0.12 to 0.21	0.30

Outer rotor side clearance

No.	Standard	Limit
1	0.02 to 0.07	0.12

Inner rotor-to-gear boss clearance

No.	Inspection item		Standard dimension	Standard	Limit
1	Inside clearance of inner rotor (mm)	Gear box diameter	53.05 to 53.15	0.3 to 0.5	0.6
		Rotor I.D.	53.45 to 53.55		
2	Clearance in width across flats of inner rotor (mm)	Width across flats of gear boss	49.45 to 49.75	0.2 to 0.6	0.7
		Width across flats of rotor	49.95 to 50.05		

3.5.18 Tightening torque tables

Main bolts and nuts

Bolt/nut	Thread size x pitch (mm)	Tightening torque N•m (kgf•m)	Application of lubricating oil (to threads/seat)	Remarks
Cylinder head bolt	M10× 1.25	85.3 to 91.1 (8.7 to 9.3)	Yes	—
Connecting rod bolt	M9× 1.25	44.1 to 49.0 (4.5 to 5.0)	Yes	
Flywheel mounting bolt	M10× 1.25	83.3 to 88.2 (8.5 to 9.0)	Yes	
Bearing cap mounting bolt	M12× 1.5	93.2 to 98.1 (9.5 to 10.5)	Yes	—
Crankshaft pulley mounting bolt	M14× 1.5	112.7 to 122.7 (11.5 to 12.5)	Yes	
Fuel valve retainer mounting bolt	M8× 1.25	24.4 to 28.4 (2.5 to 2.9)	No	
Fuel pump drive gear mounting bolt	M14× 1.5	78 to 88 (8 to 9)	No	—
High-pressure fuel line tightening nut	M12× 1.5	29.4 to 34.3 (3.0 to 3.5)	No	

Bolts and nuts for general use (lubricating oil not applied)

No.	Item	Thread size x pitch (mm)	Tightening torque N•m (kgf•m)	Remarks
1	Hexagon head bolt (7T) and nut	M6× 1	9.8 to 11.8 (1.0 to 1.2)	If these kinds of bolts and nuts are tightened for any aluminum part, use 80% of the torque values indicated here. For 4T bolts and lock nuts, use 60% of the torque values indicated here.
		M8× 1.25	22.6 to 28.4 (2.3 to 2.9)	
		M10× 1.5	44.1 to 53.9 (4.5 to 5.5)	
		M12× 1.75	78.4 to 98.0 (8.0 to 10)	
		M14× 1.5	127.5 to 147.1 (13 to 15)	
		M14× 1.5	215.7 to 235.4 (22 to 24)	
2	PT plug	1/8	9.8 (1.0)	—
		1/4	19.6 (2.0)	
		3/8	29.4 (3.0)	
		1/2	58.8 (6.0)	
3	Pipe fitting bolt	M8	12.7 to 16.7 (1.3 to 1.7)	—
		M10	19.6 to 25.4 (2.0 to 2.6)	
		M12	24.5 to 34.3 (2.5 to 3.5)	
		M14	39.2 to 49.0 (4.0 to 5.0)	
		M16	49.0 to 58.8 (5.0 to 6.0)	

4

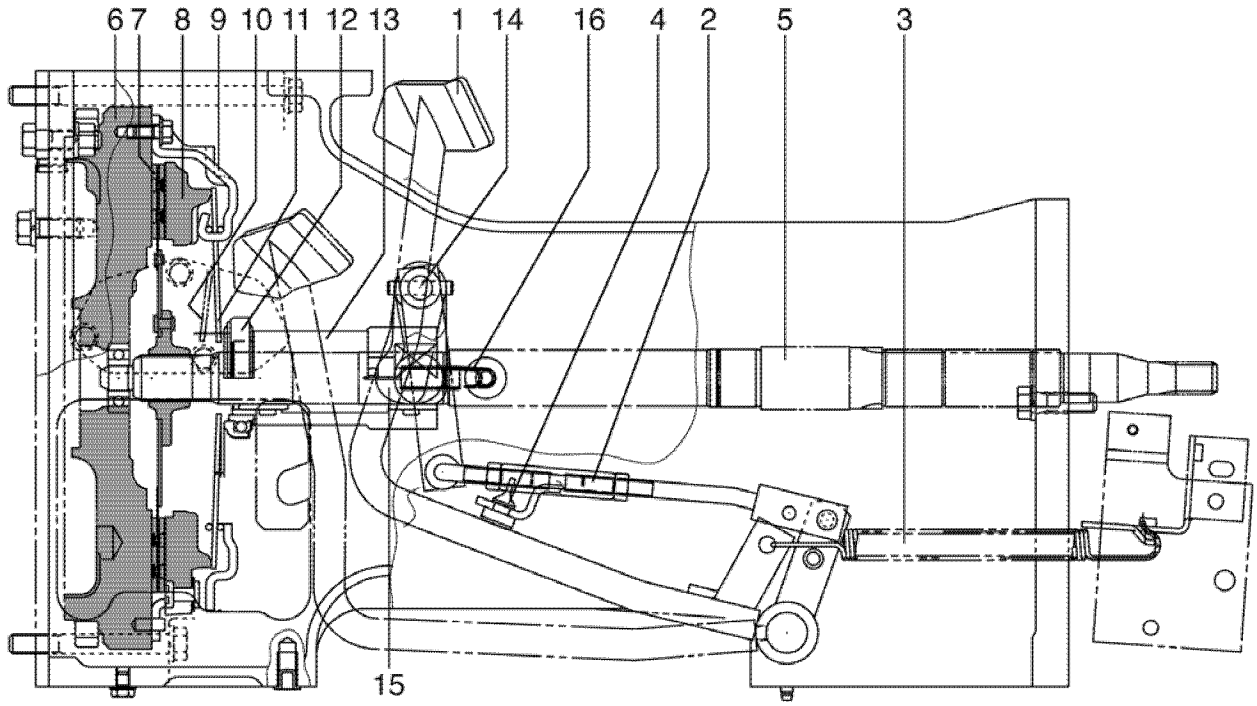
CLUTCH

4.1 STRUCTURE AND FUNCTIONS

4.1.1 Outline

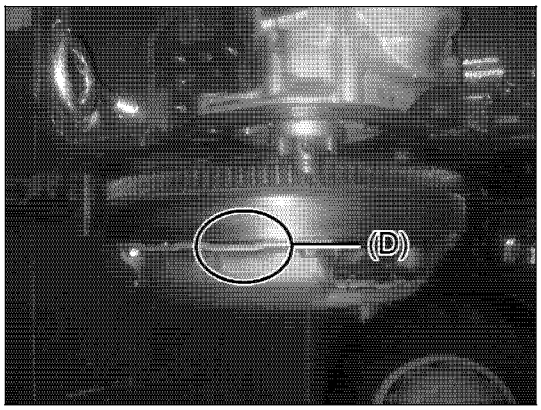
Diaphragm type dry single plate clutch is adopted.
It has a simple structure, and a pressure works on the circumference of it uniformly.
It also features light release load (pedal depressing force), and reduction in decrease of spring pressure regardless of wear of the clutch fading.

Clutch size (mm)
ϕ 260



(1) Clutch pedal
(2) Release rod
(3) Pedal return spring
(4) Pedal stopper
(5) Main drive shaft
(6) Flywheel
(7) Clutch disc
(8) Pressure plate
(9) Clutch cover
(10) Diaphragm plate (Engage)
(11) Diaphragm plate (Release)
(12) Release bearing
(13) Clutch release sleeve
(14) Release shaft
(15) Clutch shift yoke
(16) Release spring

4.2 DISASSEMBLY AND ASSEMBLY



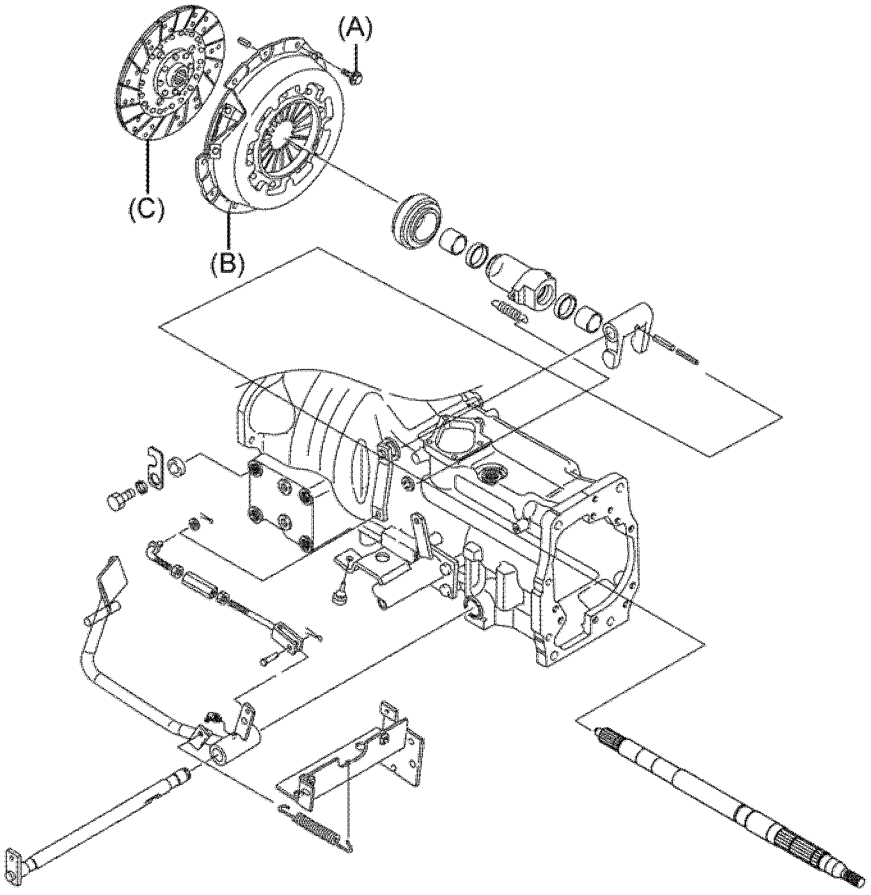
4.2.1 Disassembly

(1) As for disassembly of the clutch housing, refer to 2.5.

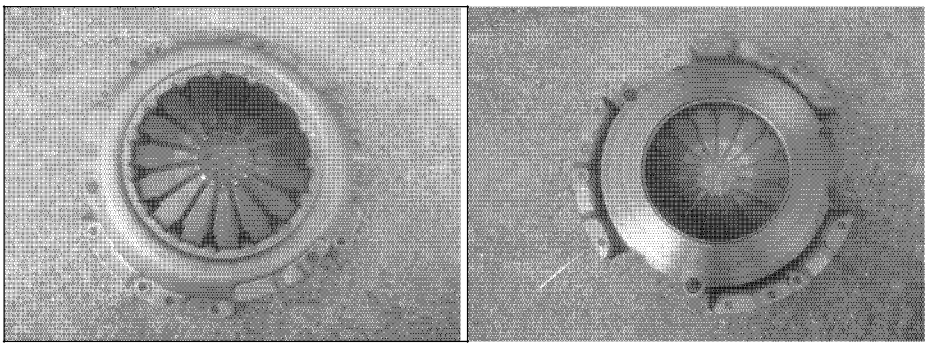
(2) Remove the nine M8x16A bolts (A).

(3) Remove the pressure plate (B) together with the clutch disc (C) from section D using a flathead screwdriver.

CAUTION
- Be careful not to drop the clutch disc (C).
- Be careful not to get oil or grease on the clutch disc (C).

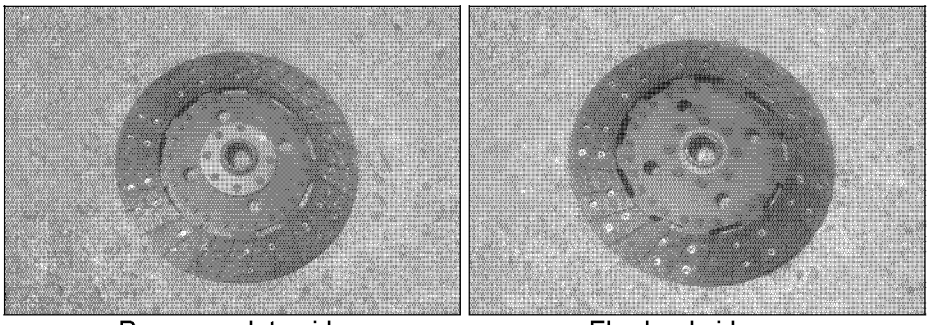


- Pressure plate



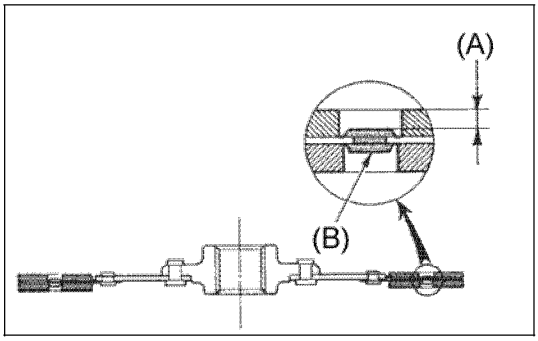
- Clutch disk

IMPORTANT
Pay attention to the direction of the clutch disc.



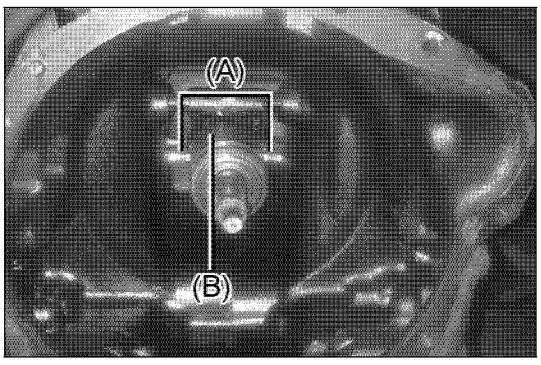
Pressure plate side Flywheel side

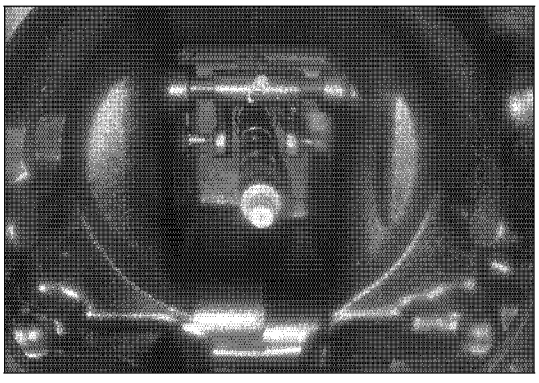
(4) Inspecting the clutch disc



- Measure the wear on the clutch face (measure the depth of the rivet). If there is 0.5 mm or less of clutch face remaining, replace the clutch disc.
- If hardened material or a distorted clutch face is seen, replace the clutch disc.
- If the clutch disc has oil on it, wash it with gasoline.
- If the wear is seen in the splined section, or runout is seen, replace the clutch disc.

(5) Remove the release spring (A), and separate the clutch release section (B).

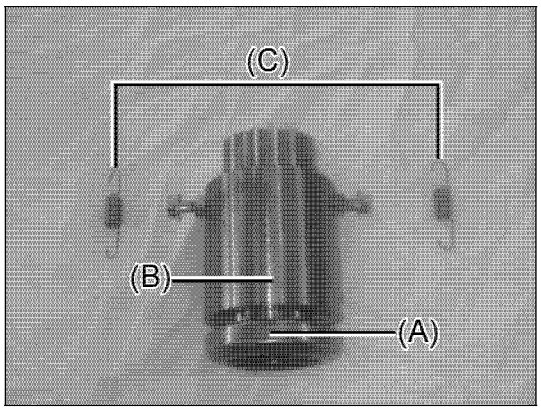




IMPORTANT

If the release bearing (A) has backlash or does not rotate smoothly, replace the release bearing.

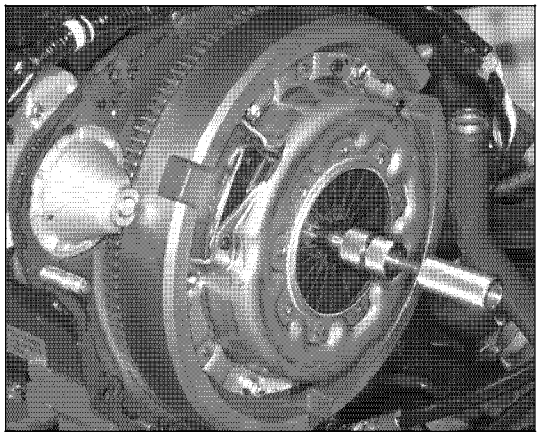
(A) Release bearing
(B) Bearing sleeve
(C) Release spring

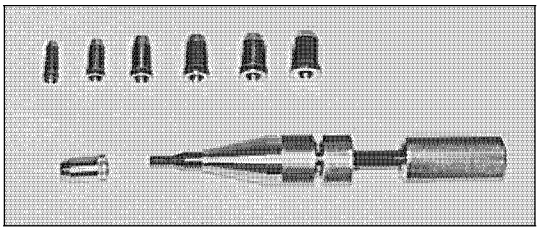


4.2.2 Reassembly

(1) Match the clutch disc and pressure plate to the flywheel of the engine with the clutch guide tool. Then, tighten the pressure plate by the 9 bolts M8x16 with the specified torque.

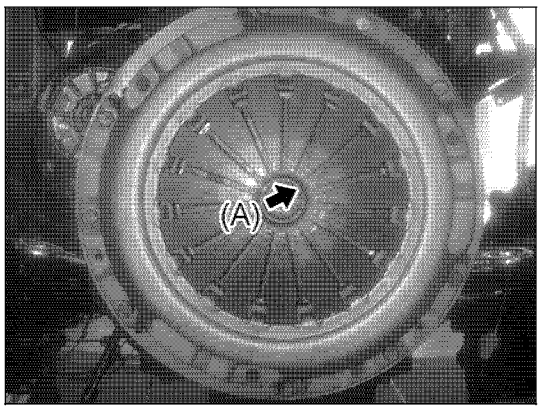
Tightening torque of pressure plate
23-29 N/m (2.3-3.0 kgf/m)



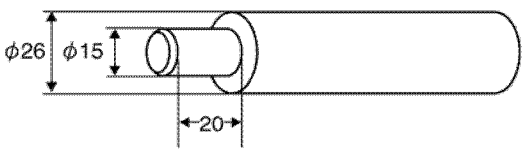


IMPORTANT

- Clean each part off oil, dirt.
- Pay attention to the direction of the clutch disc. See 2.1 (3).
- When reassembling, apply heat-resistant grease to the inside (A) of the clutch disc splines.



Note:
If the tool is not available, make a jig.



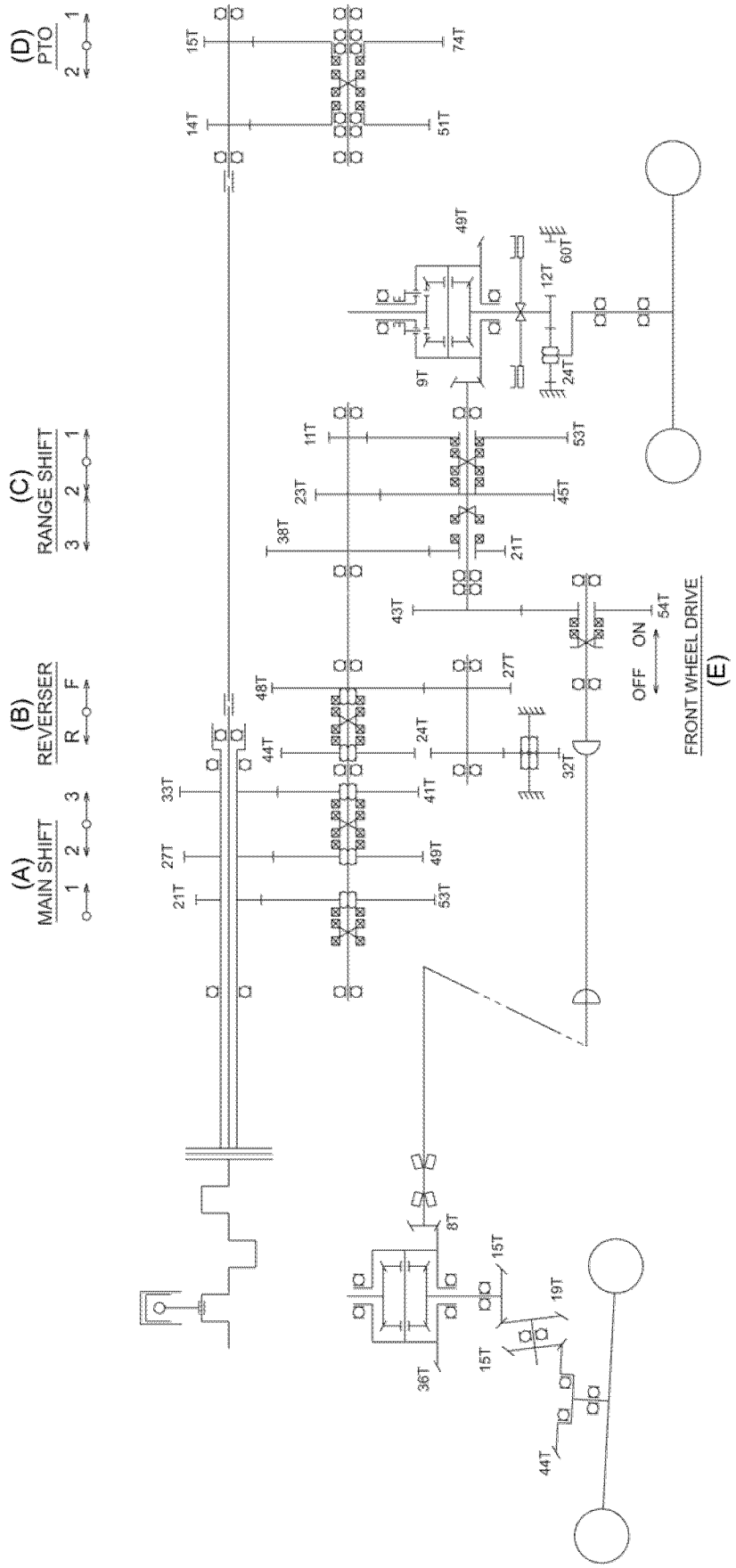
(2) For details about adjusting the clutch, see 1.1 (15).

5

TRANMISSION

5.1 POWER TRANSMITTING DIAGRAM

Engine model: 4TNV88, kw (PS): 33.1 (45), RPM: 2700



		GEAR RATIO		13.6-26	
GEAR	CHANG GEAR			Km/h	Mile/h
F1	53/21x53/11	12.16	397.23	1.57	0.97
F2	49/27x53/11	8.74	285.64	2.18	1.36
F3	41/33x53/11	5.99	195.55	3.19	1.98
F4	53/21x45/23	4.94	161.30	3.86	2.40
F5	49/27x45/23	3.55	115.99	5.37	3.34
F6	41/33x45/23	2.43	79.41	7.84	4.88
F7	53/21x21/38	1.39	45.56	13.67	8.50
F8	49/27x21/38	1.00	32.76	19.01	11.82
F9	41/33x21/38	0.69	22.43	27.77	17.26
R1	53/21x32/44x24/32x48/27x53/11	11.79	385.19	1.62	1.01
R2	49/27x32/44x24/32x48/27x53/11	8.48	279.99	2.25	1.40
R 3	41/33x32/44x24/32x48/27x53/11	5.80	189.62	3.29	2.04
R 4	53/21x32/44x24/32x48/27x45/23	4.79	156.42	3.98	2.48
R 5	49/27x32/44x24/32x48/27x45/23	3.44	112.48	5.54	3.44
R 6	41/33x32/44x24/32x48/27x45/23	2.36	77.00	8.09	5.03
R 7	53/21x32/44x24/32x48/27x21/38	1.35	44.18	14.10	8.76
R 8	49/27x32/44x24/32x48/27x21/38	0.97	31.77	19.61	12.19
R 9	41/32x32/44x24/32x48/27x21/38	0.67	21.75	28.64	17.80

MAX SPEED

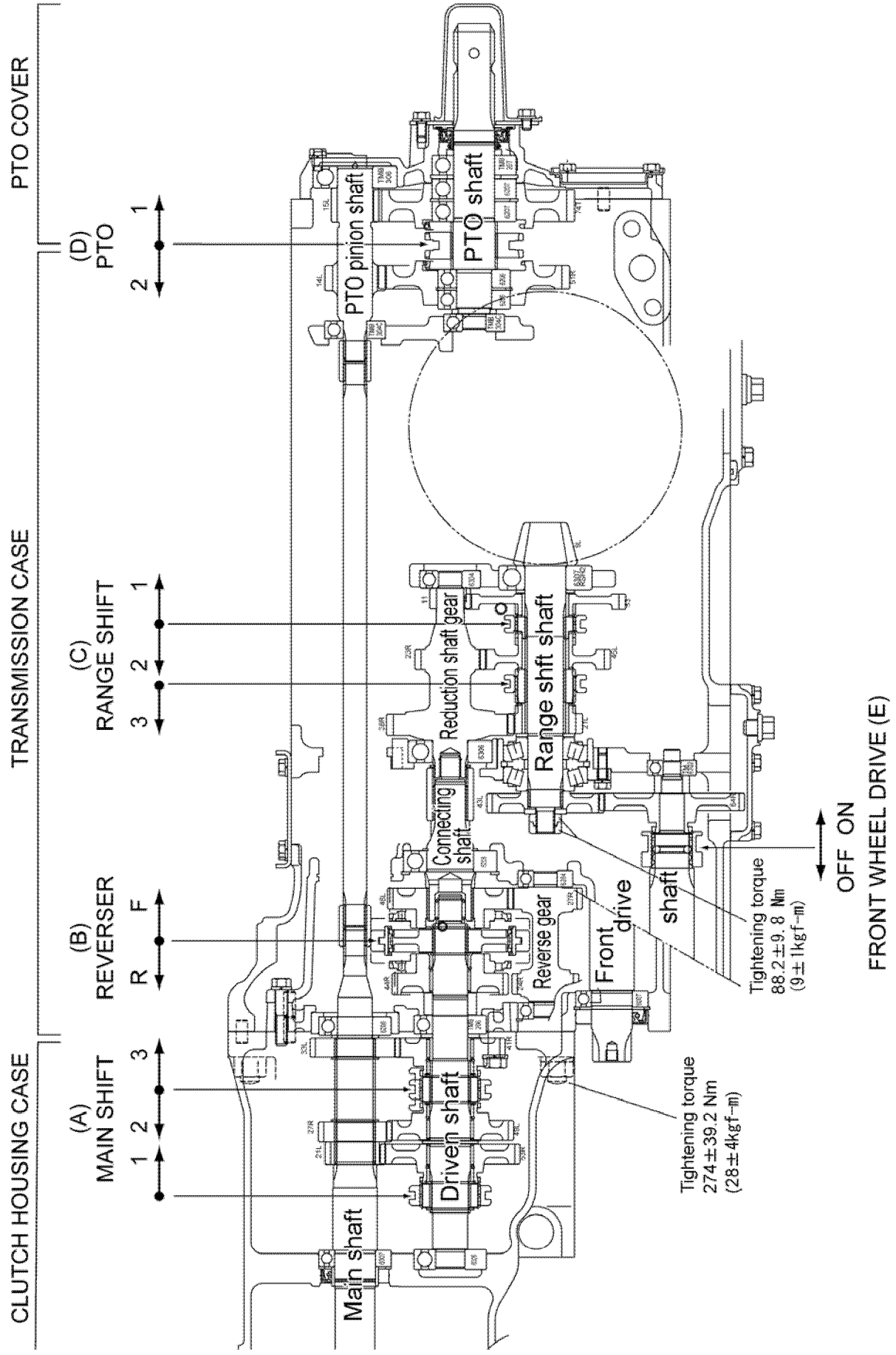
(ENG. rpm)	REAR TIRE	Km/h	Mile/h
2890	13.6-26	29.7	18.5

	FRONT TIRE		REAR TIRE		OVER SPEED RATIO
EF453T	8-18-6PR	0.406	13.6-26-4H	0.612	1.032

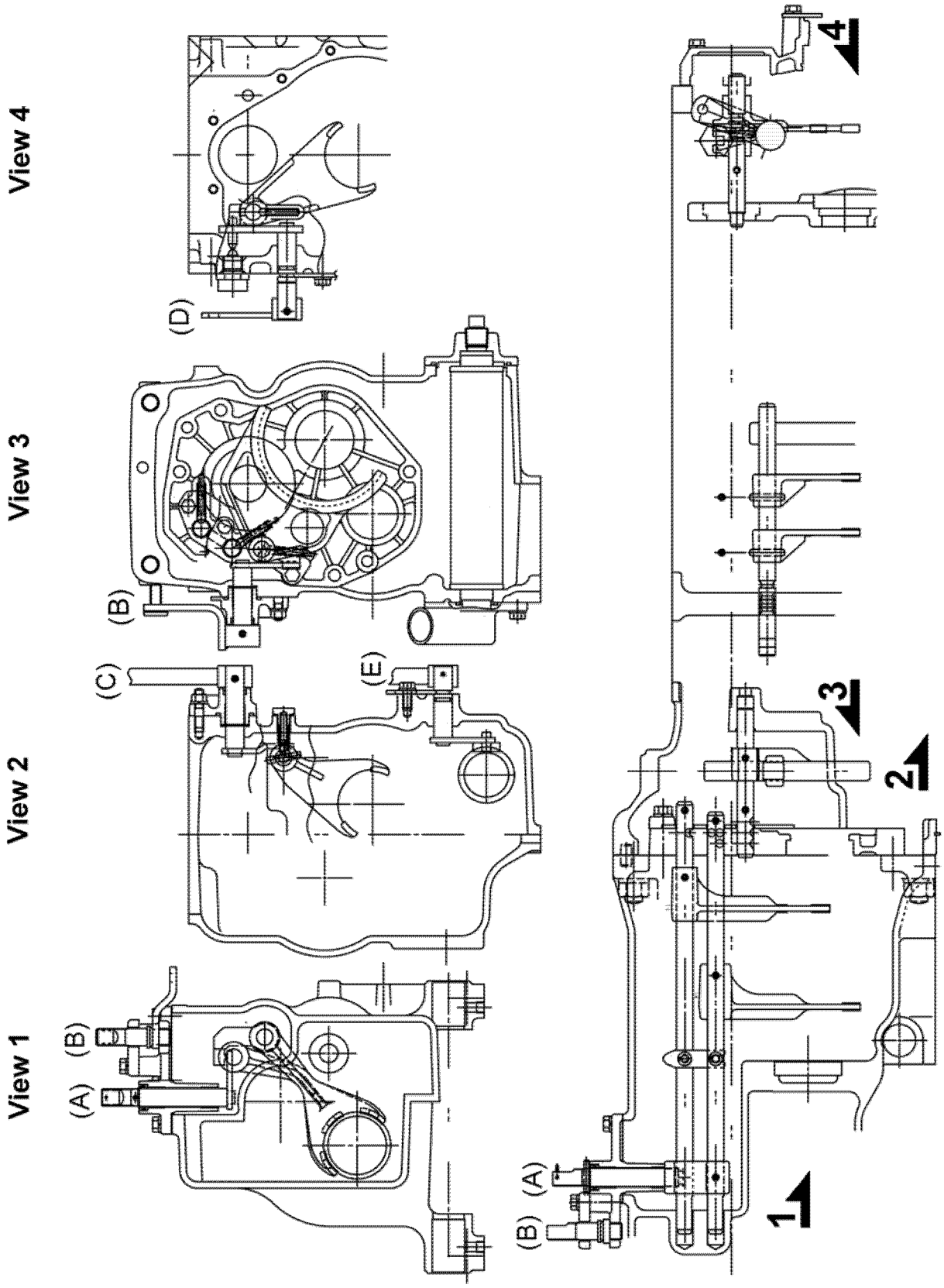
(ENG. 2700 rpm)

PTO SPEED (rpm)	
PTO-1	547
PTO-2	741

5.2 TRANSMISSION SYSTEM CROSS-SECTION



(A) Main shifting lever
(B) Reverser lever
(C) Range-shifting lever
(D) PTO lever
(E) Front drive lever

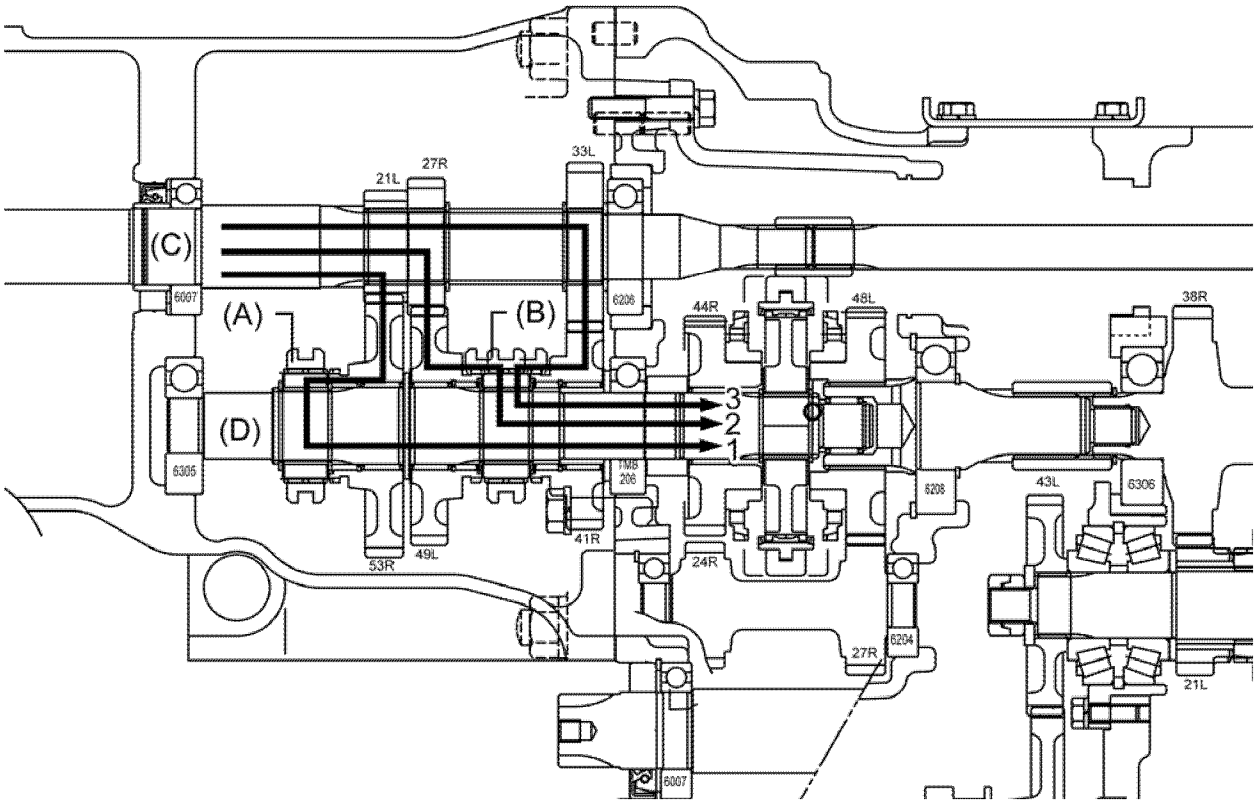


5.3 TRANSMISSION SYSTEM

5.3.1 Main shift module

The main shift module is a constant-mesh type transmission.

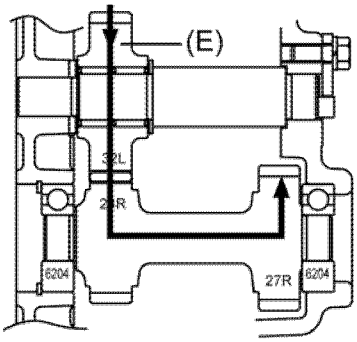
(1) Operating the main shift lever activates the shift forks (A) (B) so that they engage gears 53R, 49L and 41R.
(2) Gears 53R, 49L and 41R are always engaged with gears 21L/27R/33L on the main shaft (C). The engine rotation is transferred to the driven shaft (D).

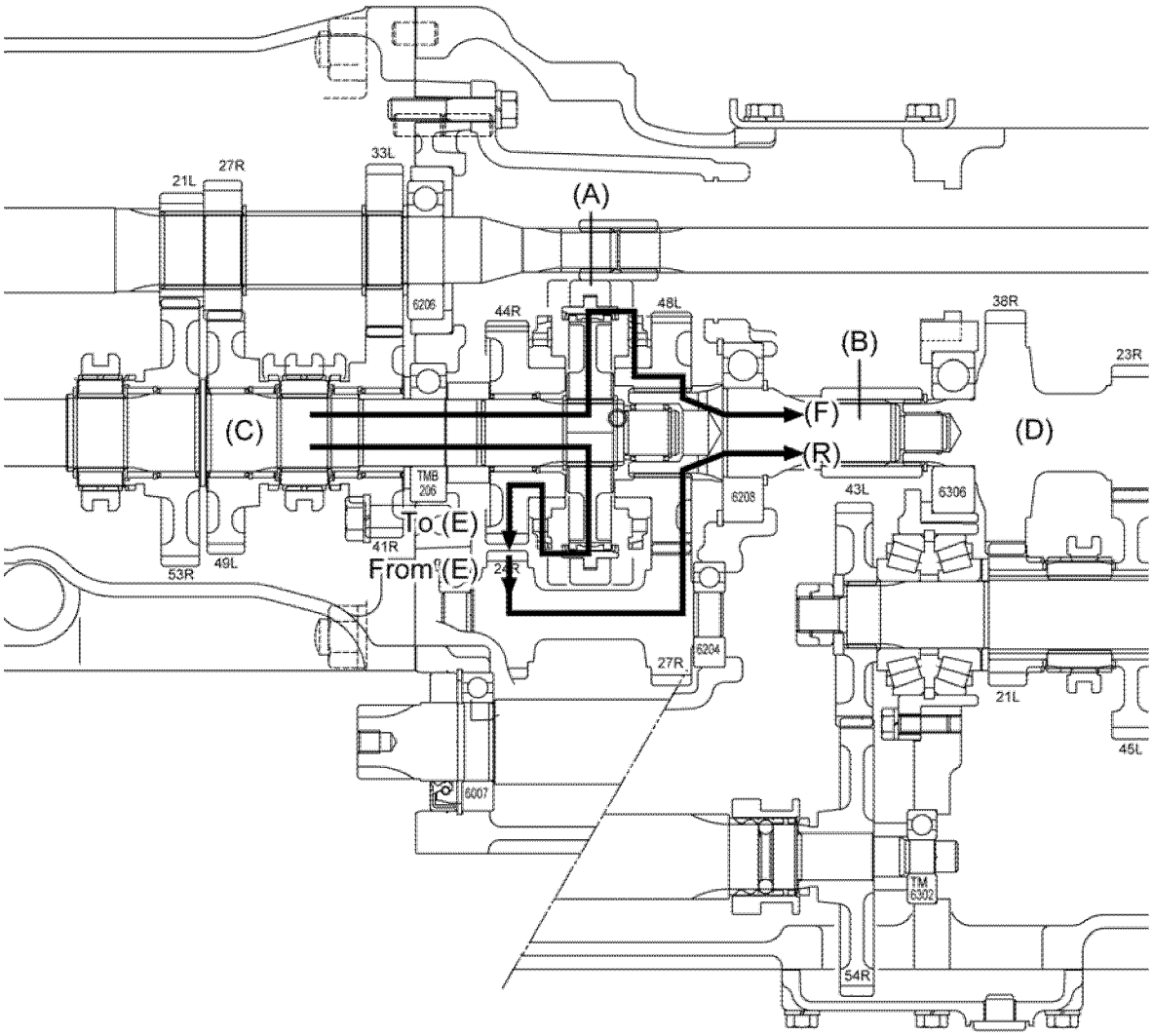


5.3.2 Reverse shift module

The reverse shift module is a constant-mesh type transmission.

(1) Operating the reverser shift lever activates the shift fork (A) so that it engages gears 44R and 48L.
(2) Gear 48L is always engaged with the connecting shaft (B). The rotation of the driven shaft (C) is transferred to the reduction gear (D) by way of the connecting shaft (B) to provide forward force.
(3) Gear 44R is always engaged with the driven shaft (C) and the reverse idle gear 32L (E). The rotation is reversed by this gear and transferred to the reverse gear (E). The rotation of the driven shaft (C) is transferred to the reduction gear (D) by way of gear 48L and the connecting shaft (B), to reverse gear (E).

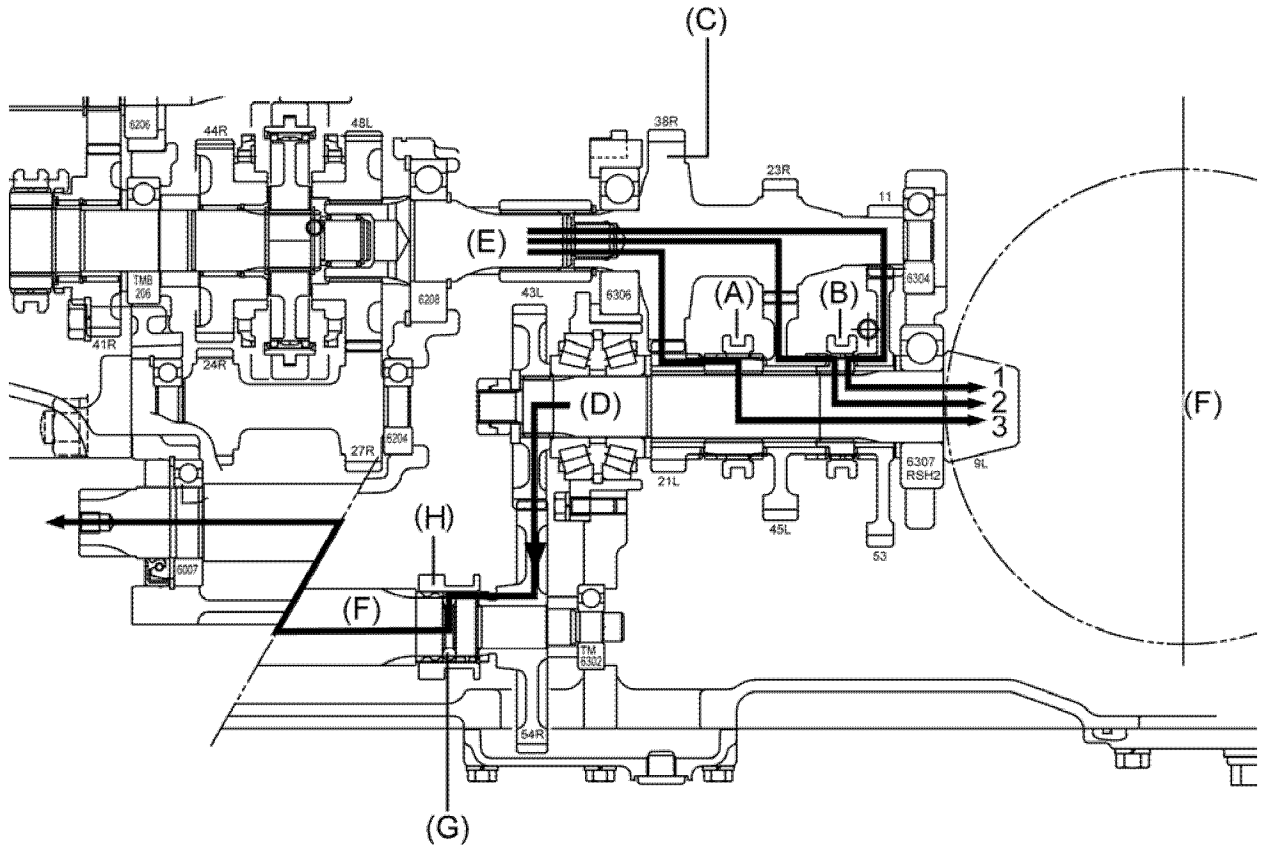




5.3.3 Range shift module

The range shift module is a constant-mesh type transmission.

(1) Operating the range shift lever activates the shift forks (A) (B) so that they engage gears 21L, 45L and 53.
(2) These gears are always engaged with the reduction gear (C) and the range shift shaft (D). Then the rotation (E) of the connecting shaft is transferred to the differential gear module (F).



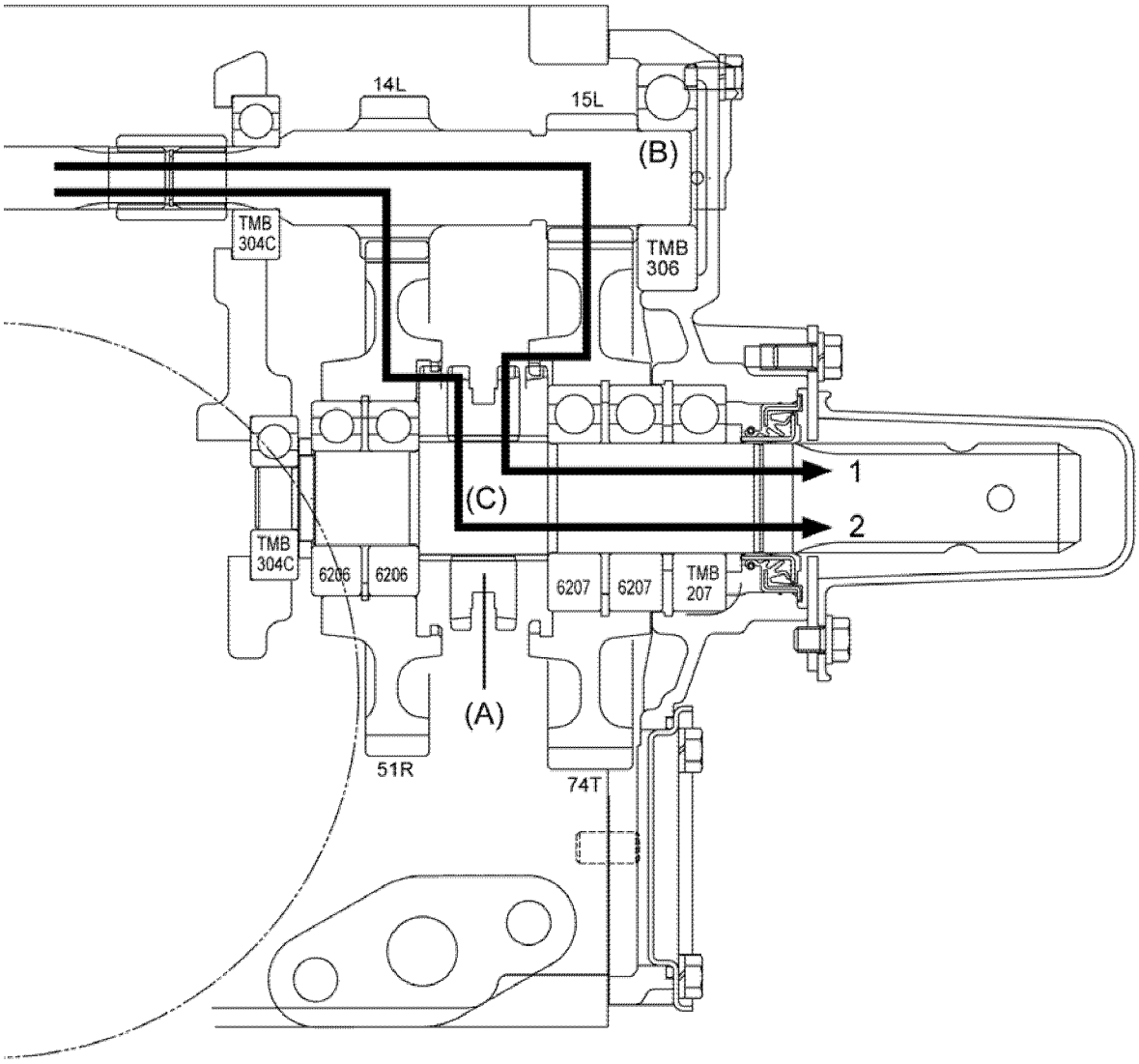
5.3.4 Front drive

(1) Operating the front drive lever activates the shift fork (H) so that it engages the gear 54R.
(2) Then the rotation of range shift shaft (D) is transferred to the front drive shaft (F) by way of the steel balls (G) to provide front drive output.

5.3.5 PTO shift module

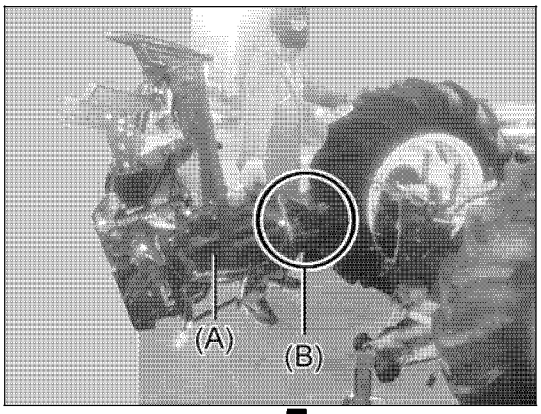
The PTO shift module is a constant-mesh type transmission.

(1) Operating the PTO shift lever activates the shift fork (A) so that it engages gears 51R and 74T.
(2) They are always engaged with gears 14L and 15L on the PTO pinion shaft (B). Then engine rotation is transferred to the PTO shaft (C) to provide PTO output.



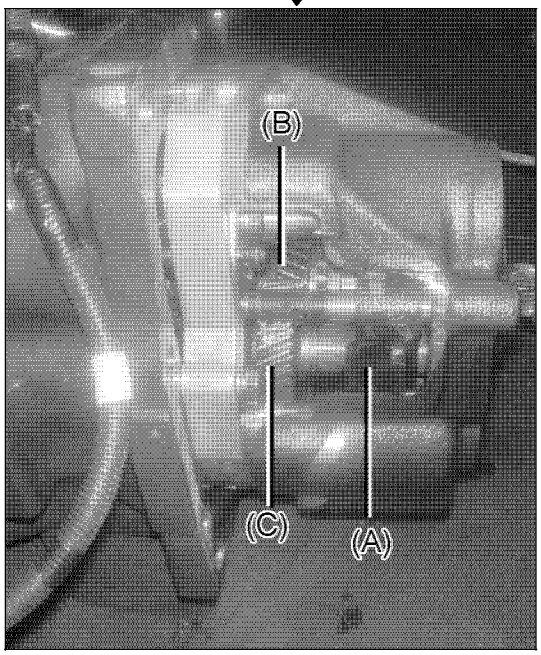
5.4 TRANSMISSION (CLUTCH HOUSING CASE SIDE)

5.4.1 Each gear in the main shift module (A) and reverse module (B) is contained in the front of the transmission.



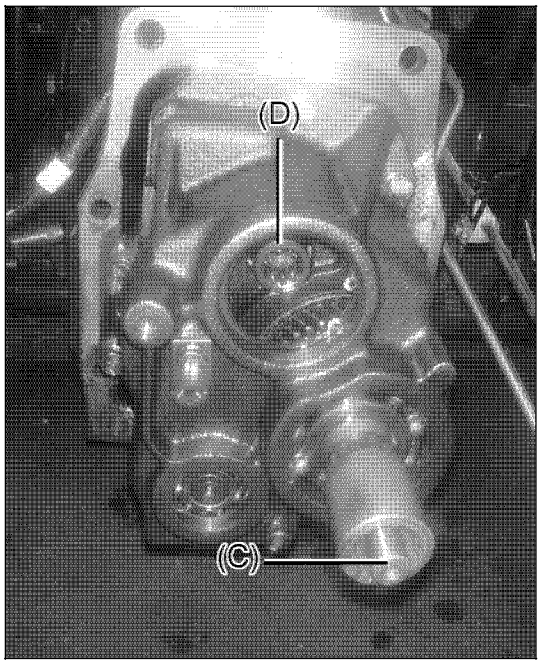
(1) Left side of the reverser section

(A) Reverser shift fork
(B) Reverser gear
(C) Reverse gear



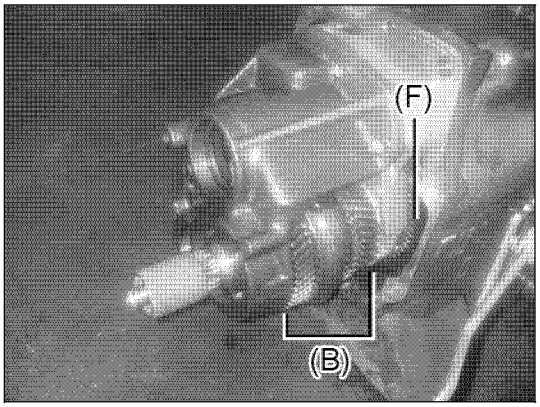
(2) Rear of the reverser section

(D) Engine to PTO
(E) Reverser to Range shift



(3) Right side of the reverser section

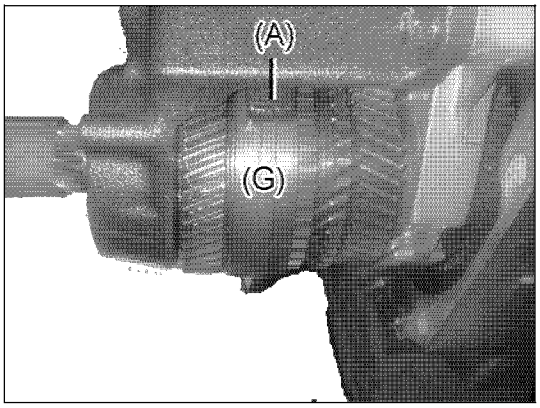
(F) Main shift gears



(4) Reverser gear

(G) Reverser slider

Note:
The photo shows the forward position.

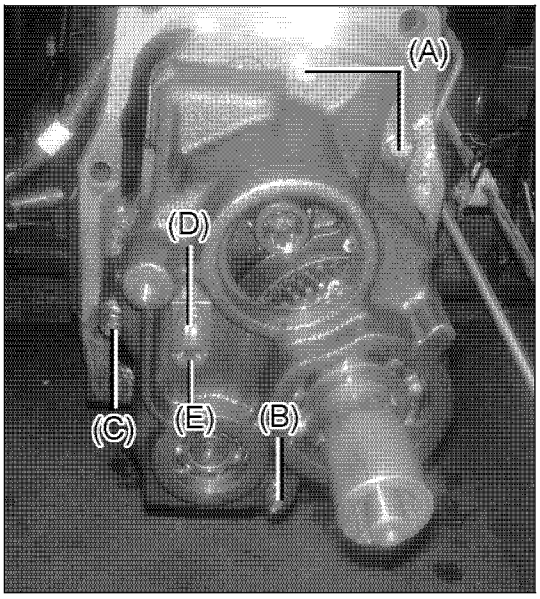


5.4.2 Disassembly

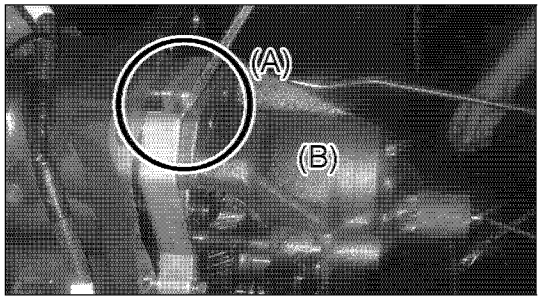
(1) Rough disassembly of components
Perform the steps described in 2.6.2 “Separating the clutch housing and transmission”.

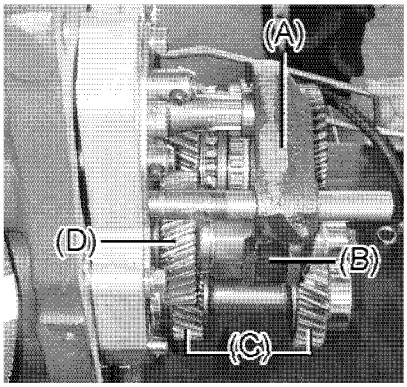
(2) Remove the M10x55 bolts (A), the M10x85 bolt (B), and the M10x150 bolt (C).

IMPORTANT
Pay attention so that the idle gear shaft (E) fits securely into the keeper plate (D) when reassembling these parts.

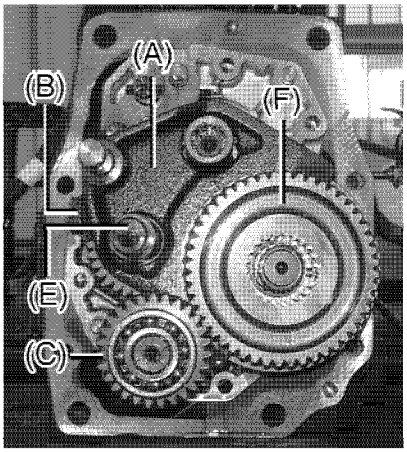


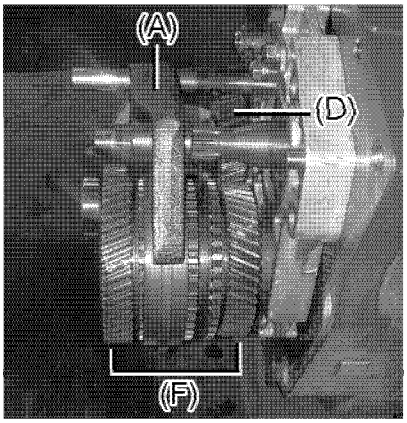
(3) Remove the reverser cover (B) from section A using a flat blade screwdriver.





Left



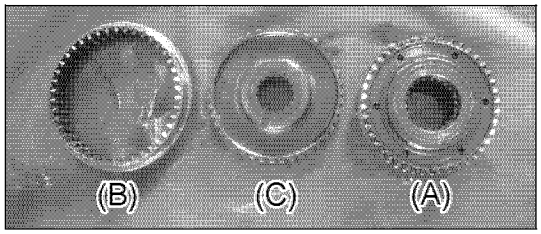


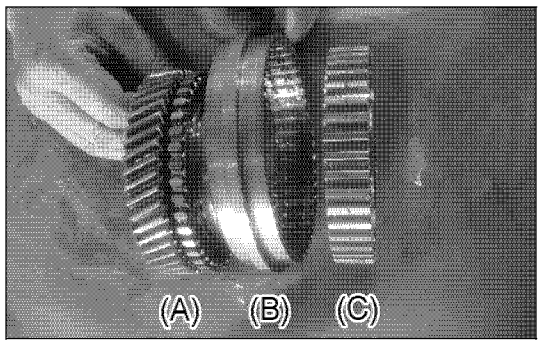
Right

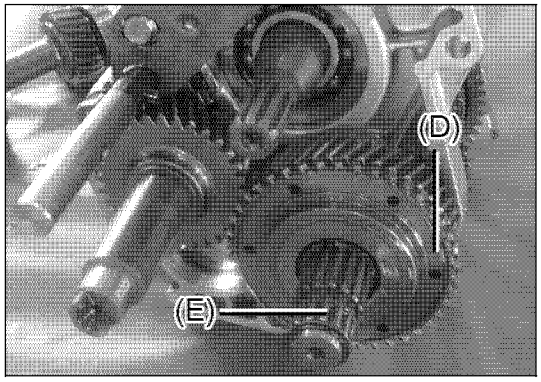
(A) Reverser shift fork
(B) Shift arm mounting section
(C) Reverser idle gear
(D) Reverse gear
(E) Reverse idle shaft
(F) Reverser gear

(4) Reverser gear

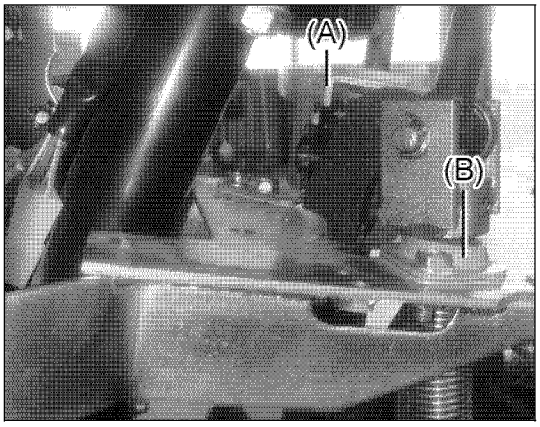
(A) Reverser gear (forward)
(B) Slider
(C) Reverser hub gear
(D) Reverser gear (backward)
(E) Needle bearing



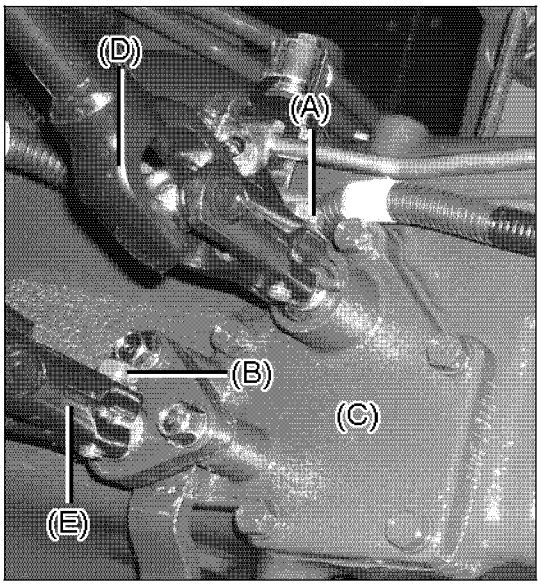




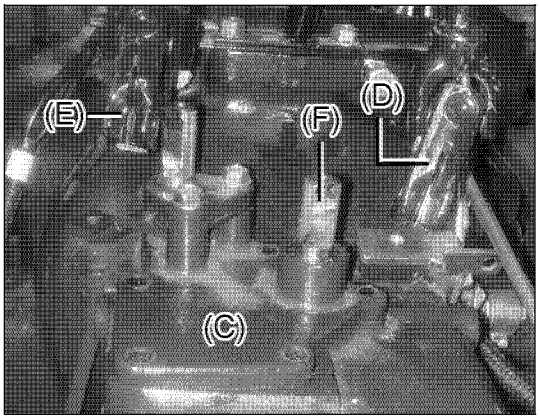
(5) Remove the mounting bolts in order to remove the main shift lever mounting section (A), located under the steering wheel, and the reverser lever mounting section (B).



(6) Remove bolts (A) and (B) on the lower part of the steering wheel and the five M8x25 bolts that secure the change lever retainer. Then slide shafts (D) and (E) upward.

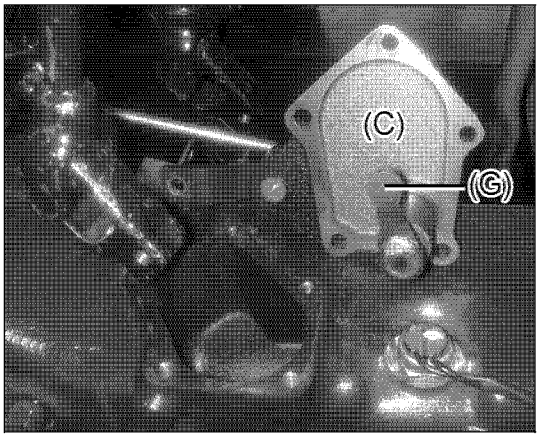


Note :
The shaft (D) mounting section has a positioning pin (F) on the main shift lever.



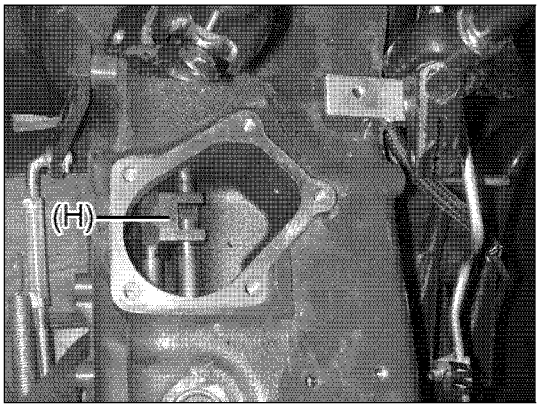
(7) Remove the change lever retainer (C).

(G) Main shift arm

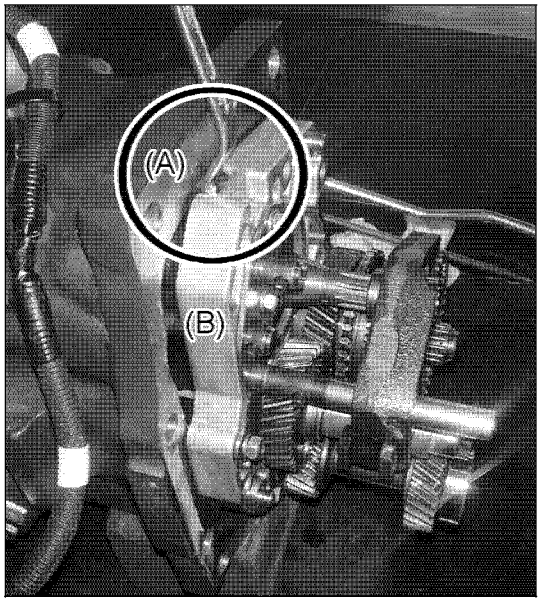


IMPORTANT

Pay attention so that the main shift arm (G) fits into the main shift shifter (H) when reassembling them.

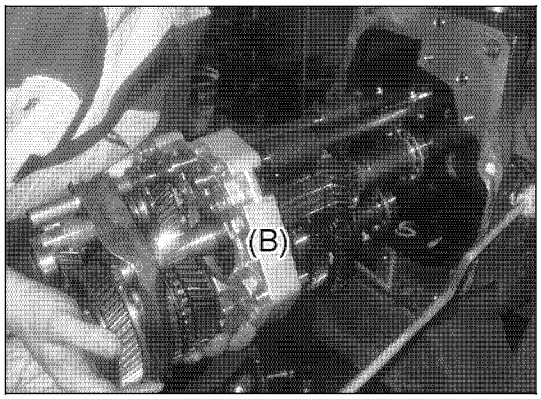


(8) Remove the center plate section (B) from section (A) using a wrench, and take it out.



CAUTION

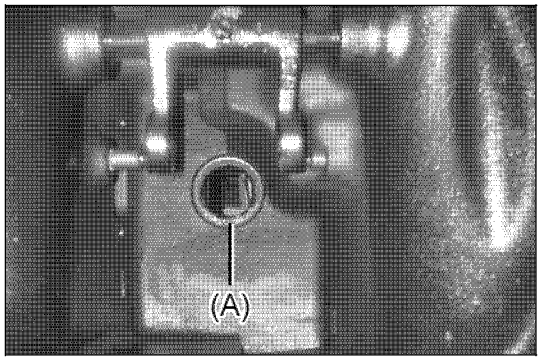
Be careful because the center plate section (B) is heavy and it will be slippery because it is covered in oil.

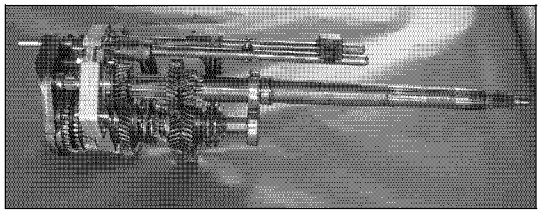


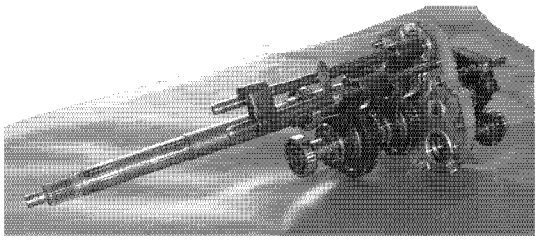
IMPORTANT

Replace the oil seal (A) on the engine side of the clutch housing with a new one when reassembling the unit.

To prevent the oil seal from deforming due to the weight of the center plate section (B), reinstall the oil seal from the clutch side after reinstalling the center plate section (B).

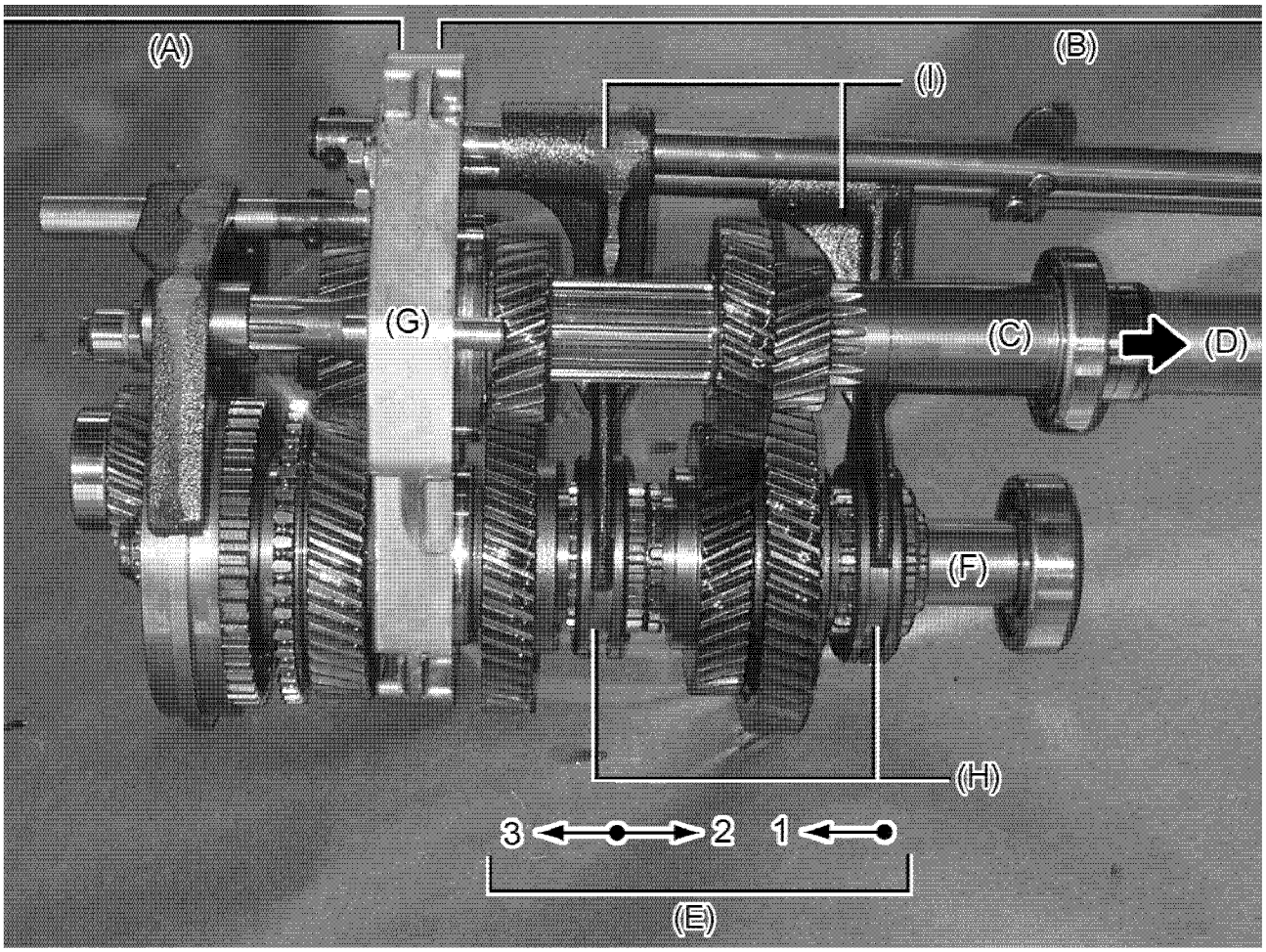






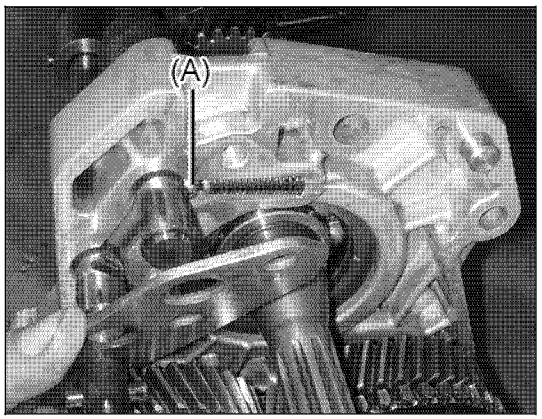
5.4.3 Main shift section

(1)



(A) Reverser section
(B) Main shift section
(C) Main shaft
(D) Clutch
(E) Main shift
(F) Drive shaft
(G) Center plate
(H) Shifters
(I) Shift forks

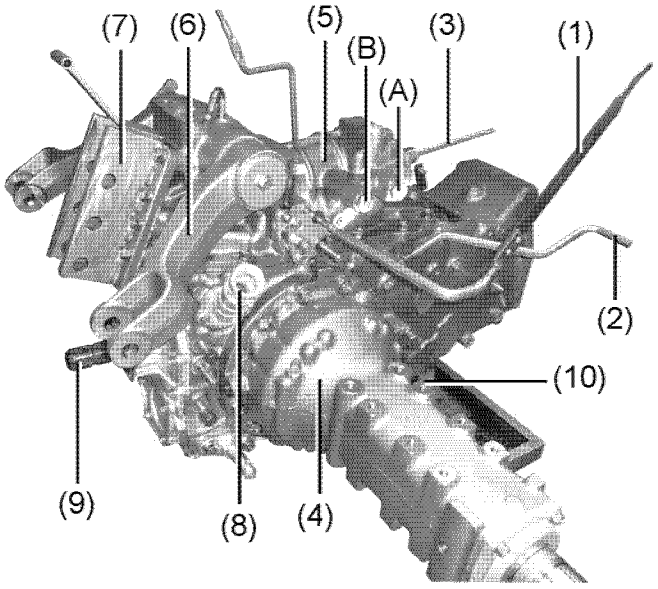
(2) The main shift detent (A) is located on the reverser side of the center plate.



5.5 TRANSMISSION (TRANSMISSION HOUSING CASE SIDE)

5.5.1 You will find the range shift, PTO, and rear axle gears in the section located on the back of the transmission. The hydraulic cylinder case is in the upper part, inside the transmission.

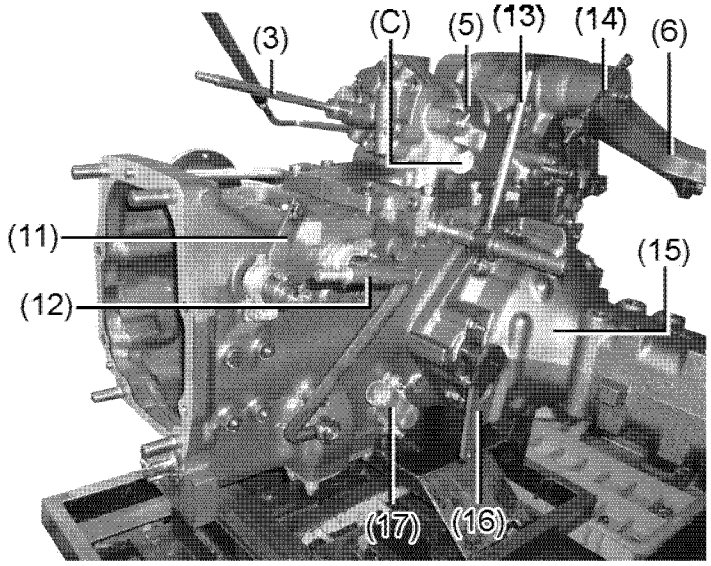
(1) Right side



1. Position control lever
2. Diff-lock pedal
3. Stop & slow return valve
4. Rear axle (Right)
5. Hydraulic cylinder case
6. Lift arm
7. Top link hinge
8. Transmission oil filler opening
9. PTO shaft
10. Brake arm (Right)

(A) Double-action output port
(B) Double-action input port

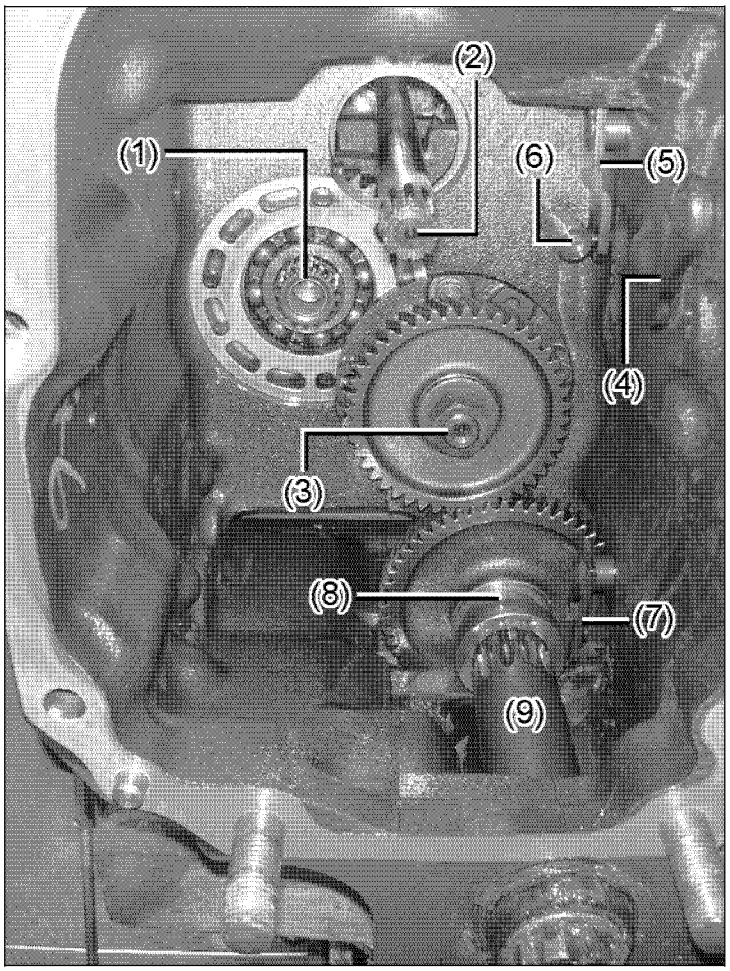
(2) Left side



11. Range shift lever
12. Front wheel drive lever
13. PTO lever (lever for a trial run)
14. Lift angle feedback rod
15. Rear axle (Left)
16. Brake arm (Left)
17. Oil suction port
18. Transmission oil filler opening

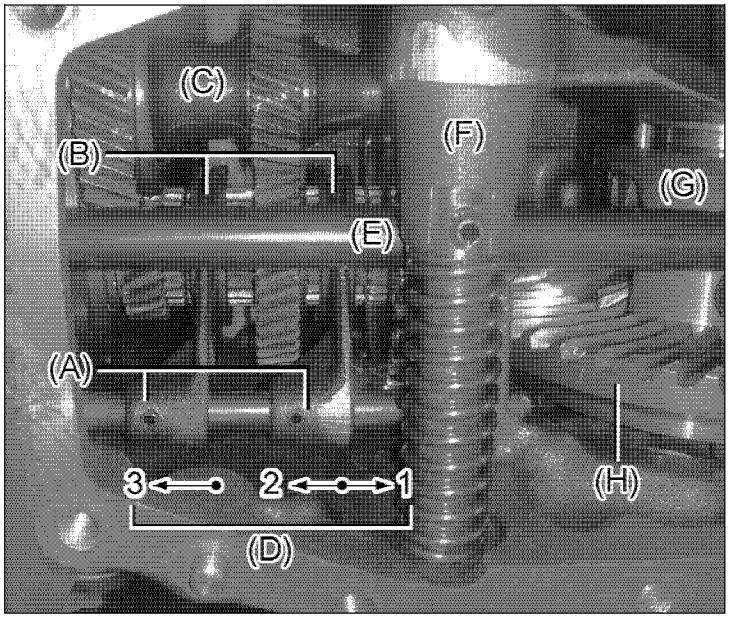
(C) Single-action output port

(3) Center plate side



1. PTO shaft
2. Reduction shaft
3. Counter shaft Hard Lock nut
4. Reverser shift arm
5. Range shift arm
6. Range shift shaft
7. Front wheel drive shift arm
8. Front wheel drive shifter
9. Front wheel drive shaft

(4) Inside



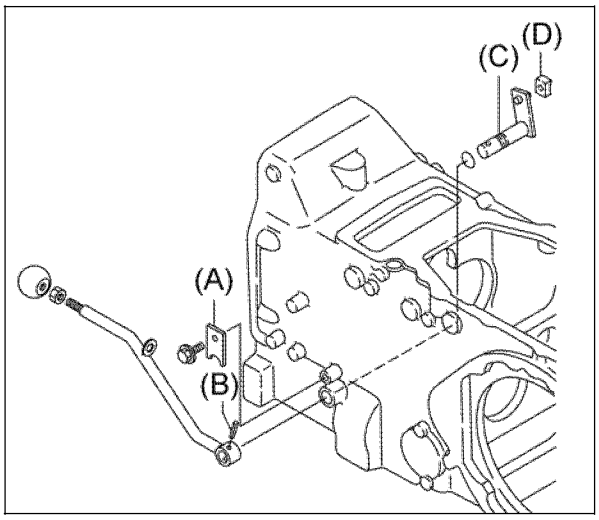
(A) Range shift arm
(B) Range shifter
(C) Reduction gear
(D) Range shift
(E) PTO shaft
(F) Differential lock shaft
(G) Differential
(H) Ring gear

5.5.2 Disassembly

(1) Remove the hydraulic cylinder case. See "2.6.1".

(2) Wheel
Separate the transmission and clutch housing.

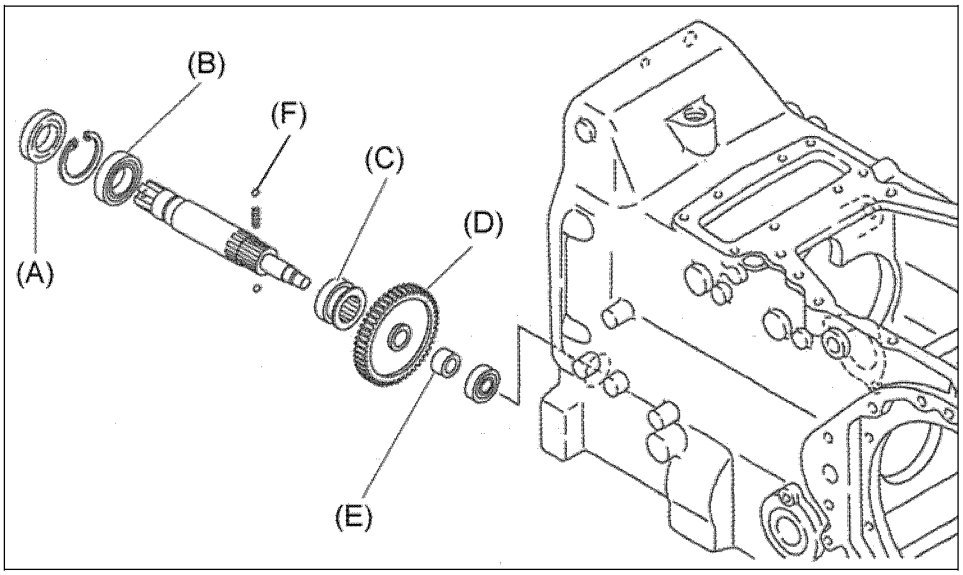
(3) Remove the retainer plate and pull the front shift arm outward about 5mm.



(A) Retainer plate
(B) Keep the roll pin as it is.
(C) Front shift arm
(D) Shift block

IMPORTANT
The shift block must enter the slider groove when the unit is reassembled.

(4) Remove the oil seal and snap ring, then remove the front drive shaft assembly. The oil seal can be replaced from the outside.

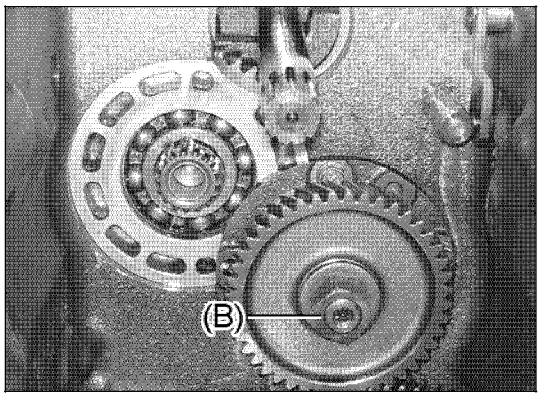


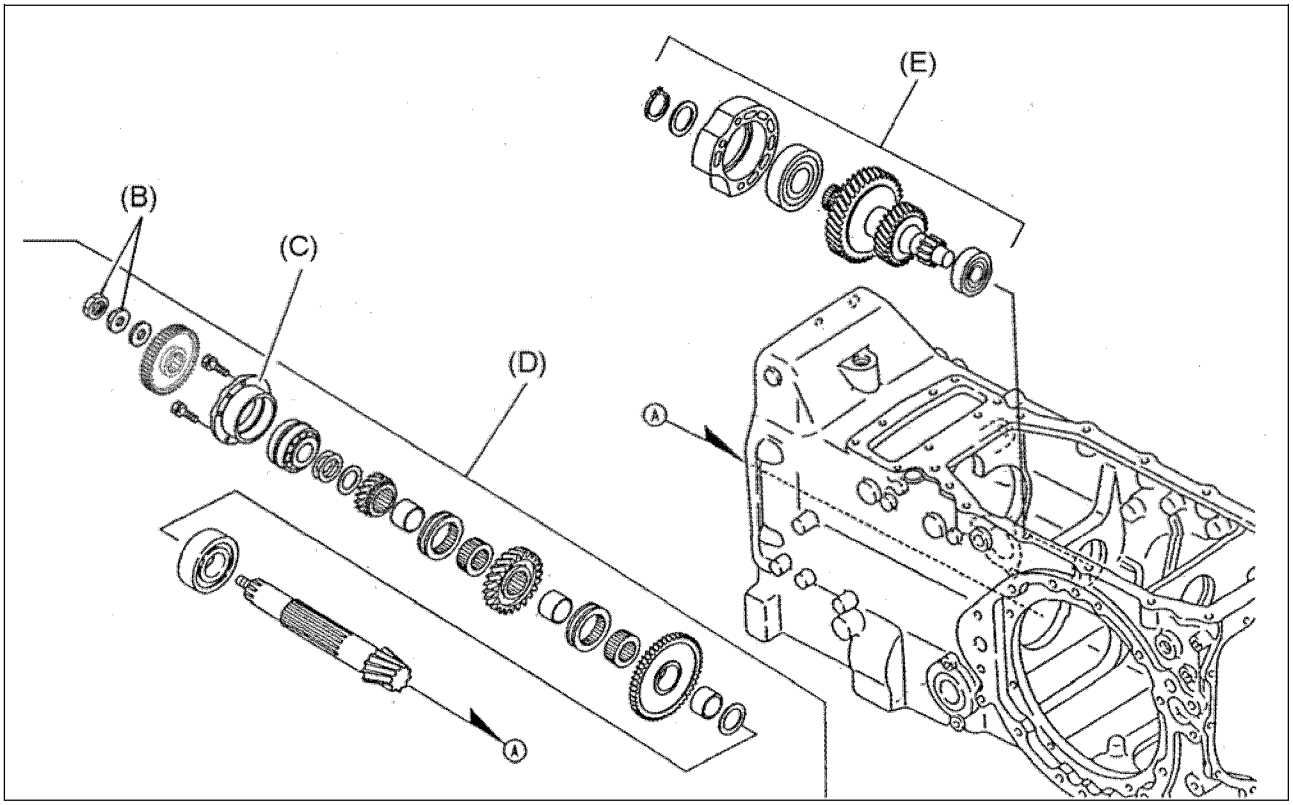
(A) Oil seal TC356212 (24421-356212)
(B) Bearing 6007
(C) Slider
(D) Drive gear
(E) Collar 18 x 30 x 15 (Be sure to install)
(F) Steel ball

NOTE:
Collar 18 x 30 x 15 may fall down. Make sure it is installed in position. To remove it, give a light shock to it with a sliding hammer.

IMPORTANT
When pulling the slider (C) out from the shaft, be careful not to lose the steel ball that fits in the detent.

(5) Remove the Hard Lock nut (B), and take out the inside gear.

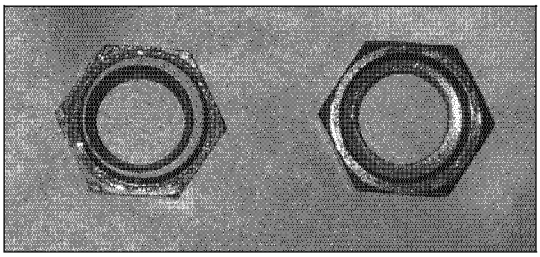




(B) Hard lock nut (C) Bearing retainer (D) Counter shaft (E) Reduction shaft

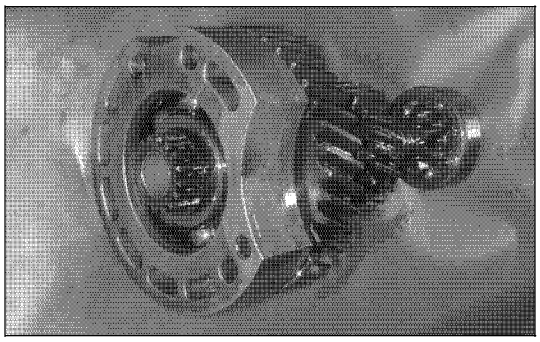
IMPORTANT

The Hard Lock nut is a special type of double nut. Both nuts must be tightened to the specified torque.

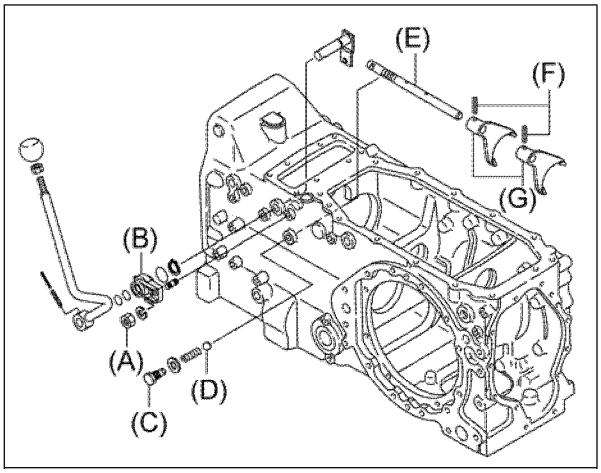


Tightening torque for installation:
Hard lock nut: 800-1000 kgf-cm

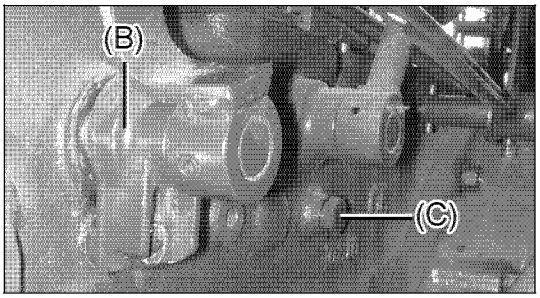
(6) Remove the reduction shaft (E).



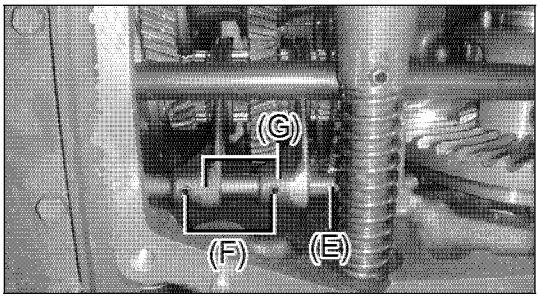
(7) Remove the nut (A), and pull out the shift arm holder (B) about 5 mm.



(8) Remove the bolt (C), and take out the ball (D) in the detent.



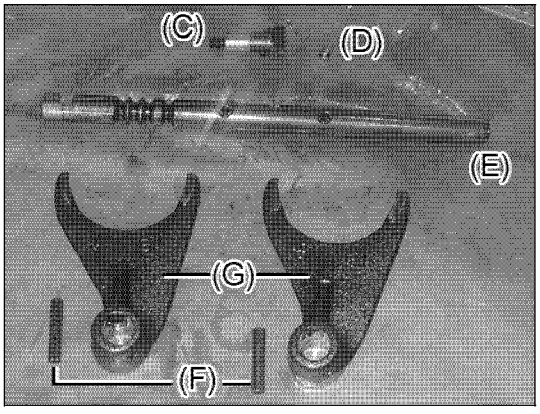
(9) Remove the roll pins (F), and remove the fork shaft (E) and the shift forks (G).



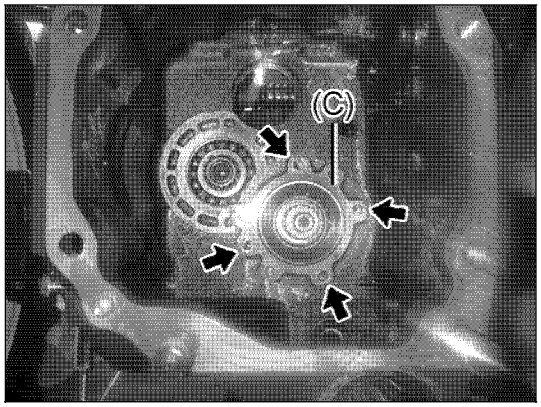
STOP

IMPORTANT

When you remove something else, the roll pins fall inside the transmission. Therefore, be sure to take them out using a magnet or some other tool.

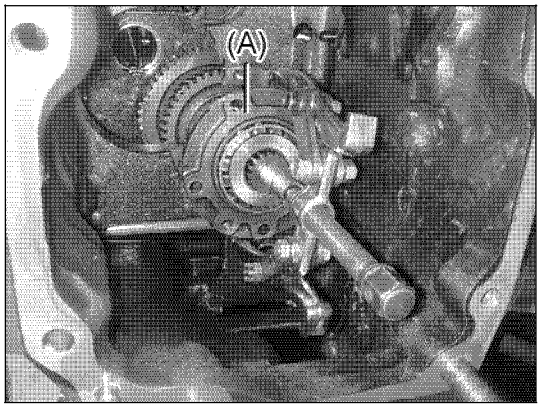


(10) Remove the four M8x25 bolts that secure the bearing retainer (C) on the counter shaft (D).

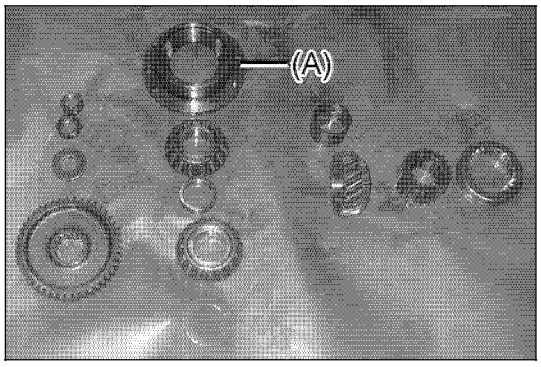


Note:
The bearing retainer can only be mounted in the position shown in the photo.

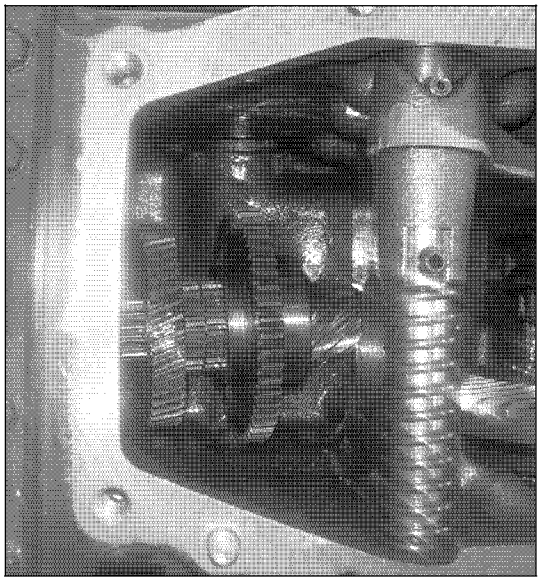
(11) Remove the bearing retainer (A) using a coupler.



(12) The parts shown in the photo can be taken out from the center case side of the counter shaft.

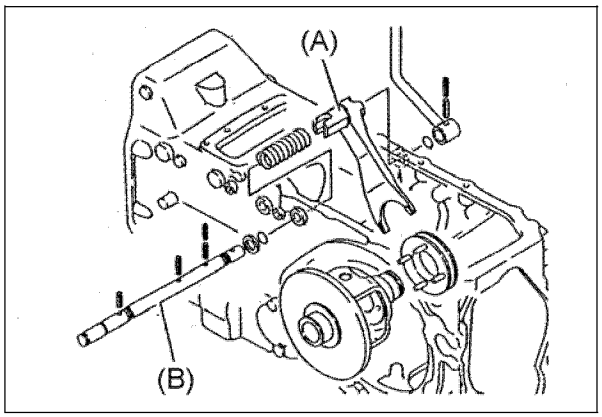


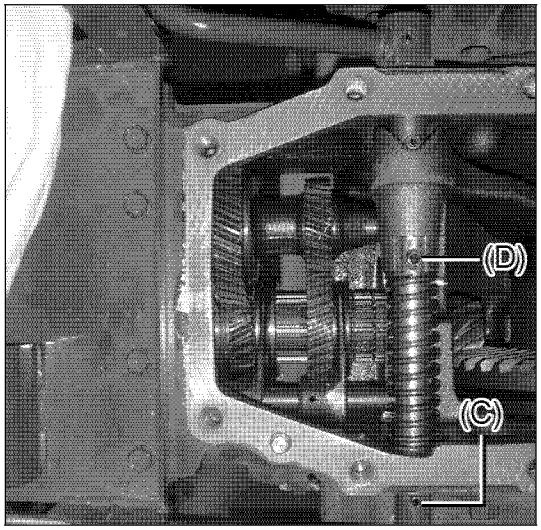
Note:
The counter shaft cannot be taken out through the back without removing the differential lock shaft.



(13) Remove the spring pins (C) and (D), and remove the fork (A) and the differential lock shaft (B).

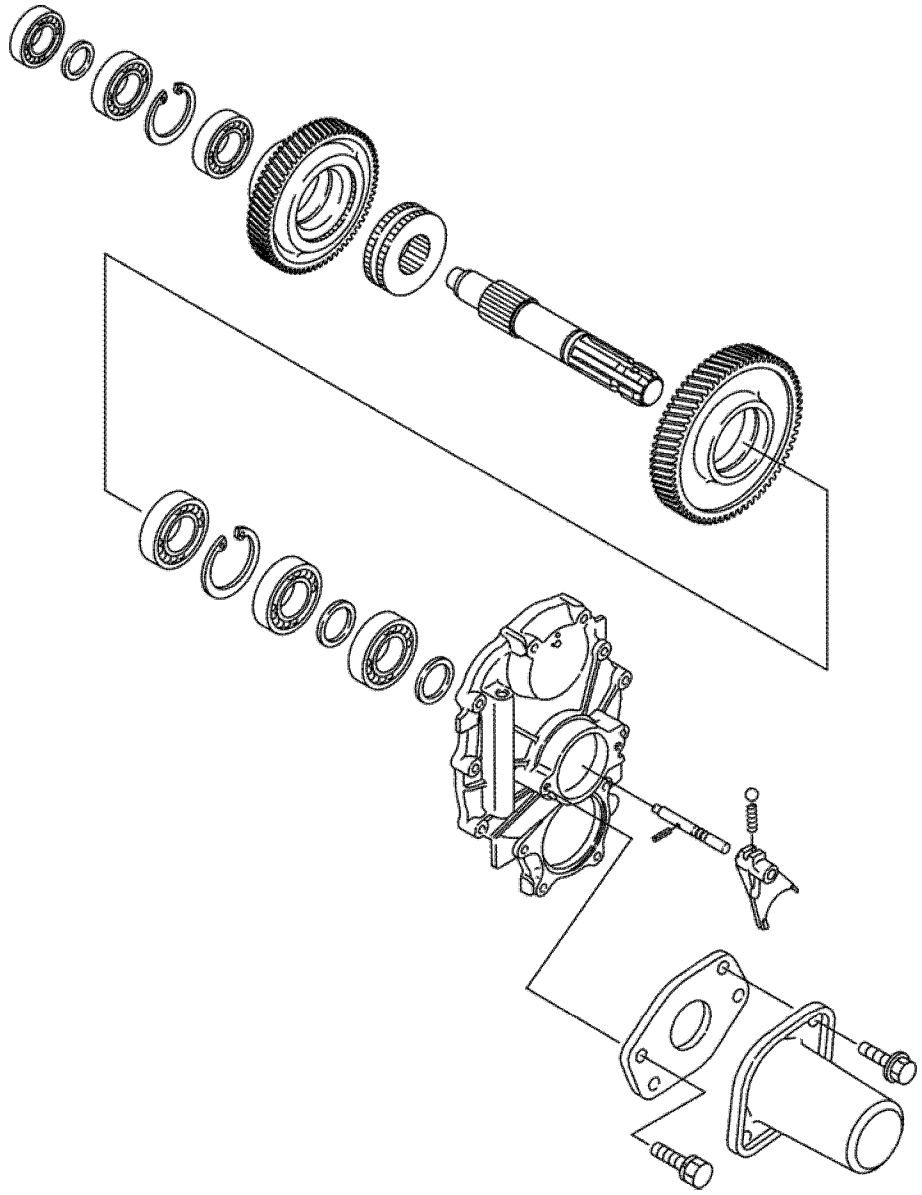
(A) Fork
(B) Differential lock shaft



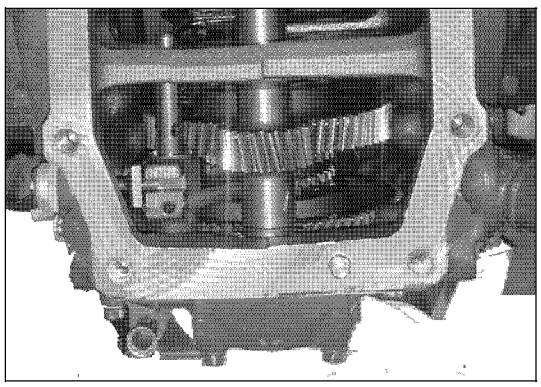


5.5.3 PTO module

(1) To remove the PTO module, see “2.6.4”.

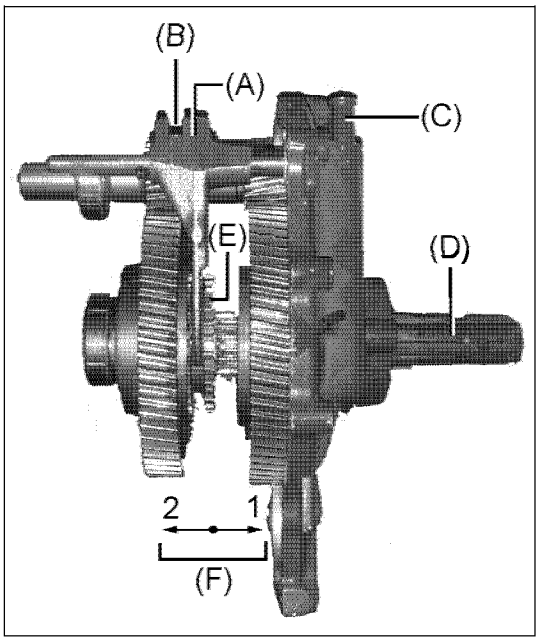


Note:
When the hydraulic cylinder case is removed, the PTO module can be seen, as shown in the photo on the right.

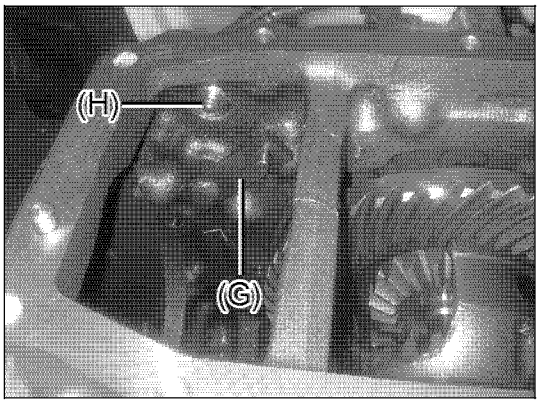


(2) To remove the PTO module, see “2.6.4”.

(A) Shift arm
(B) Change arm position
(C) Oil level check port
(D) PTO shaft
(E) Shifter
(F) PTO shift



Note:
When the PTO lever is in the neutral position, the change arm (G) pushes on the neutral switch (H).



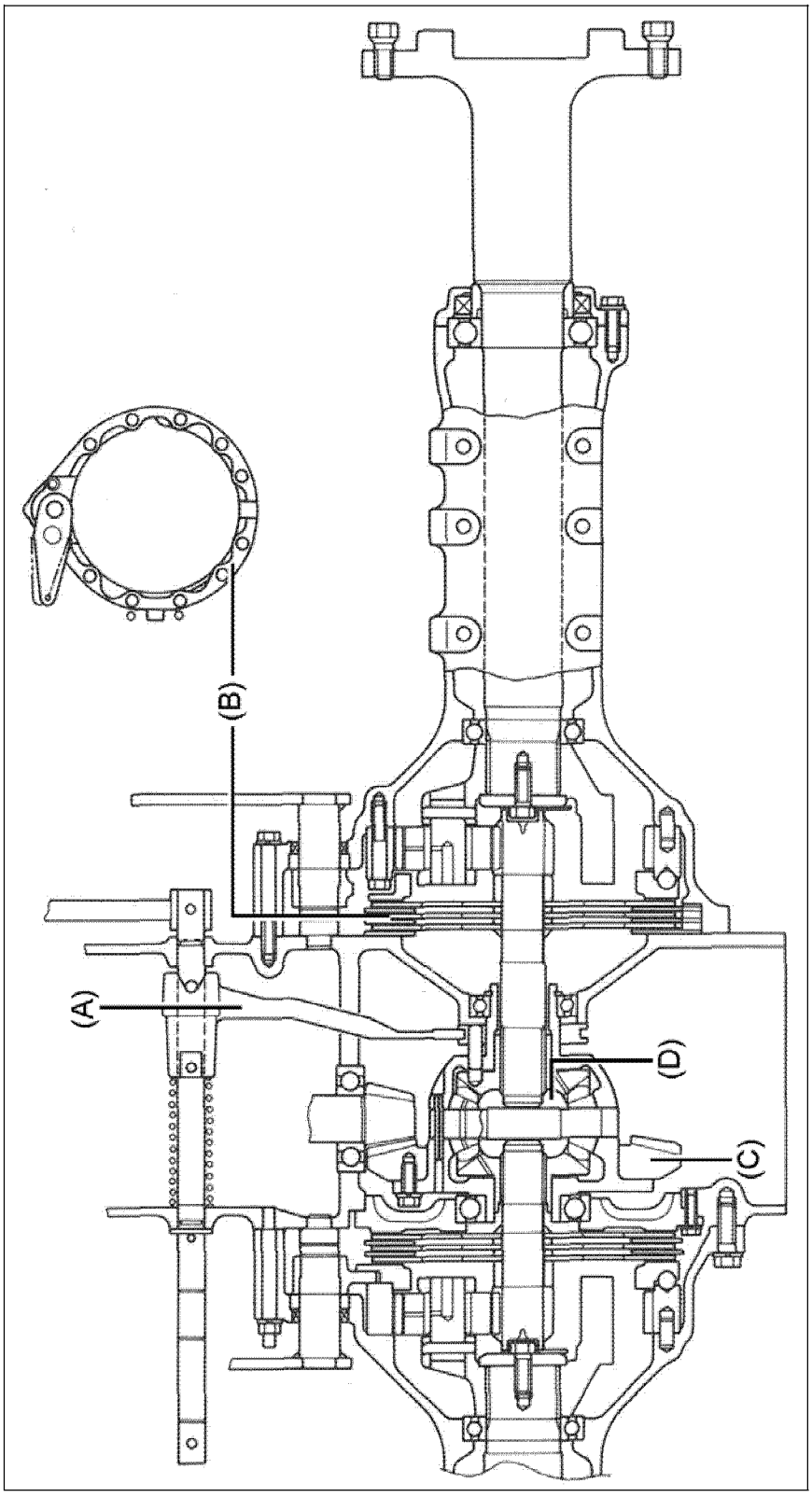
6

REAR AXLE AND BRAKE

6.1 STRUCTURE AND FUNCTIONS

6.1.1 Structure drawing

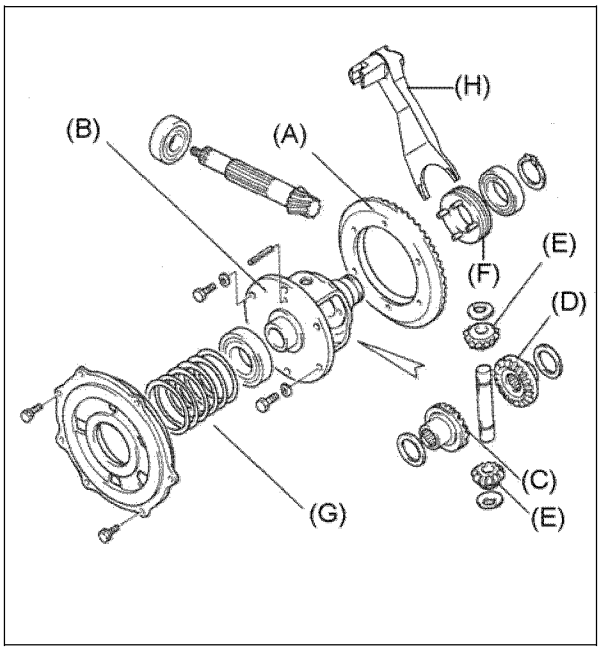
The rear axle is designed to effectively convey the transmission output to the rear wheels.
It consists of a differential gear and final reduction gears (planetary gears).



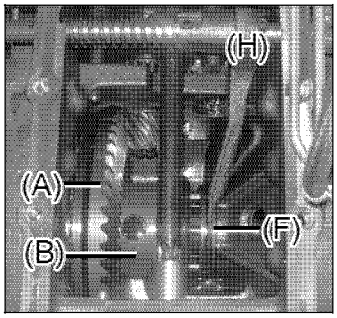
(A) Differential lock arm
(B) Brake
(C) Differential ring gear
(D) Differential gears

6.1.2 Differential

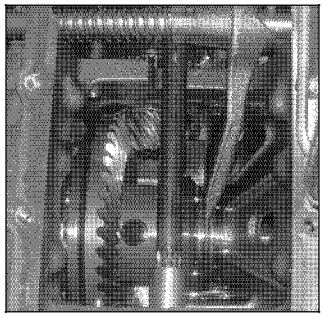
The differential gear provides the left and right wheels with different revolutions to permit a smooth turning or cornering.
Depending on the traveling conditions, if one of wheels slips resulting in a difficulty of travel, the differential gear could be locked.
The illustration shows 2-pinion type differential gear and pin type differential lock.
Never turn tractor when differential lock is applied.



(A) Differential ring gear
(B) Differential case
(C) Differential sidegear (free)
(D) Differential sidegear (lock)
(E) Differential pinion
(F) Slider (Differential lock)
(G) Shims (for adjusting backlash)
(H) Differential lock arm

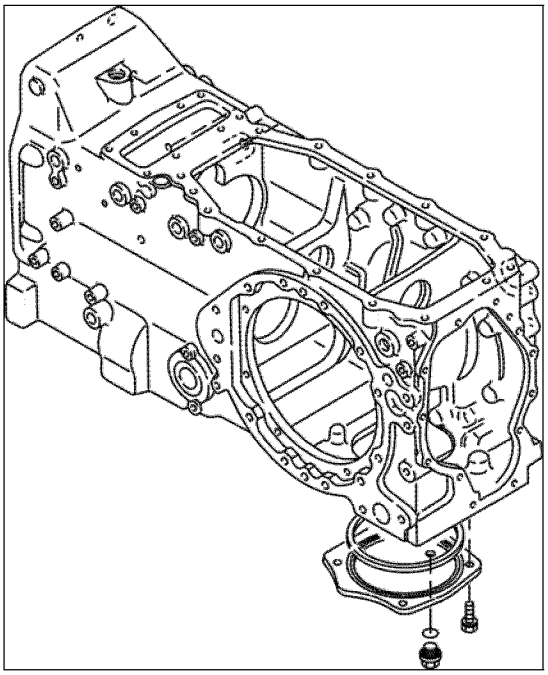


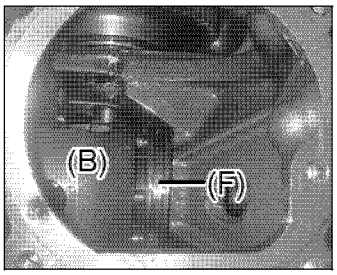
Free



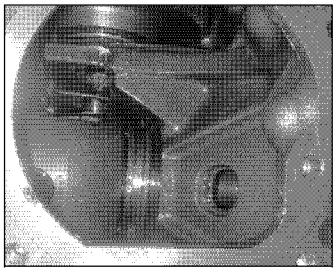
Locked

Note:
The operating condition of the differential locking device can be checked, even when the cover under the transmission is removed.





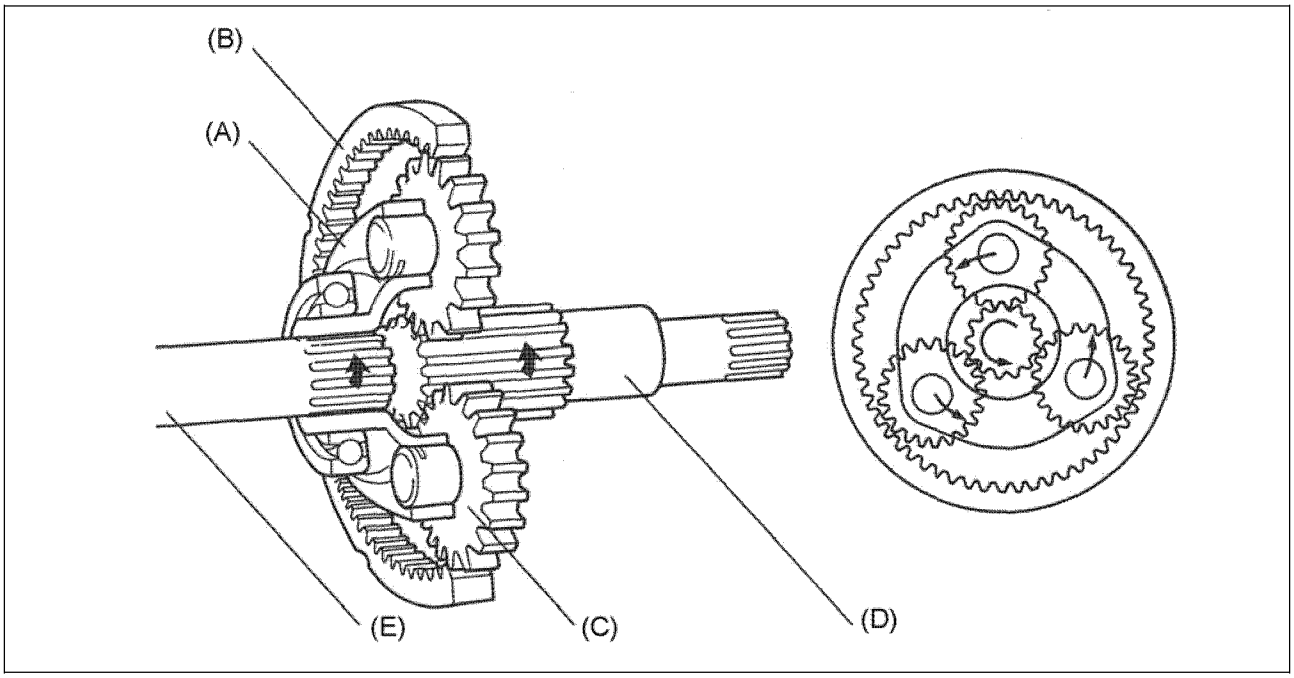
Free



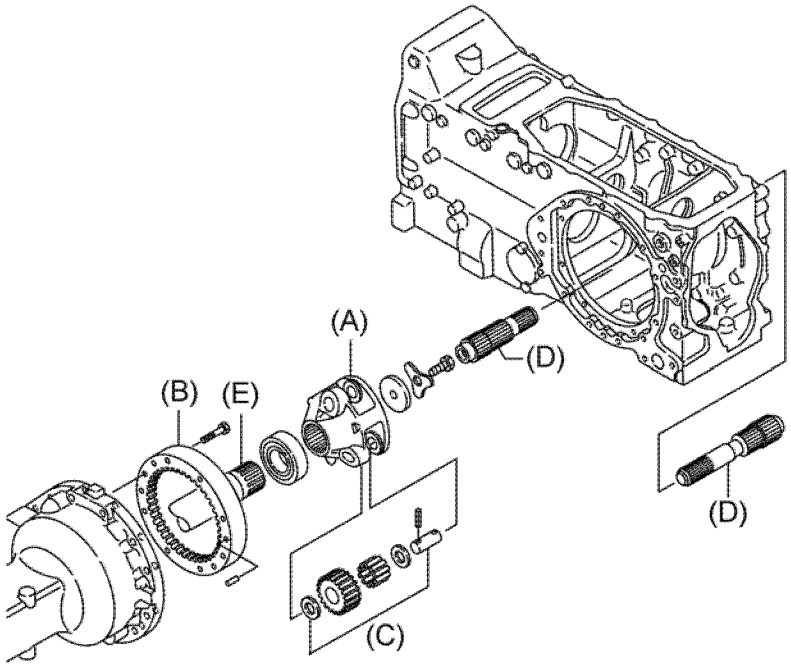
Locked

6.1.3 Final drive system

The final drive is a ring gears type planetary system.
This provides high torque load capabilities and proper reduction ratio.

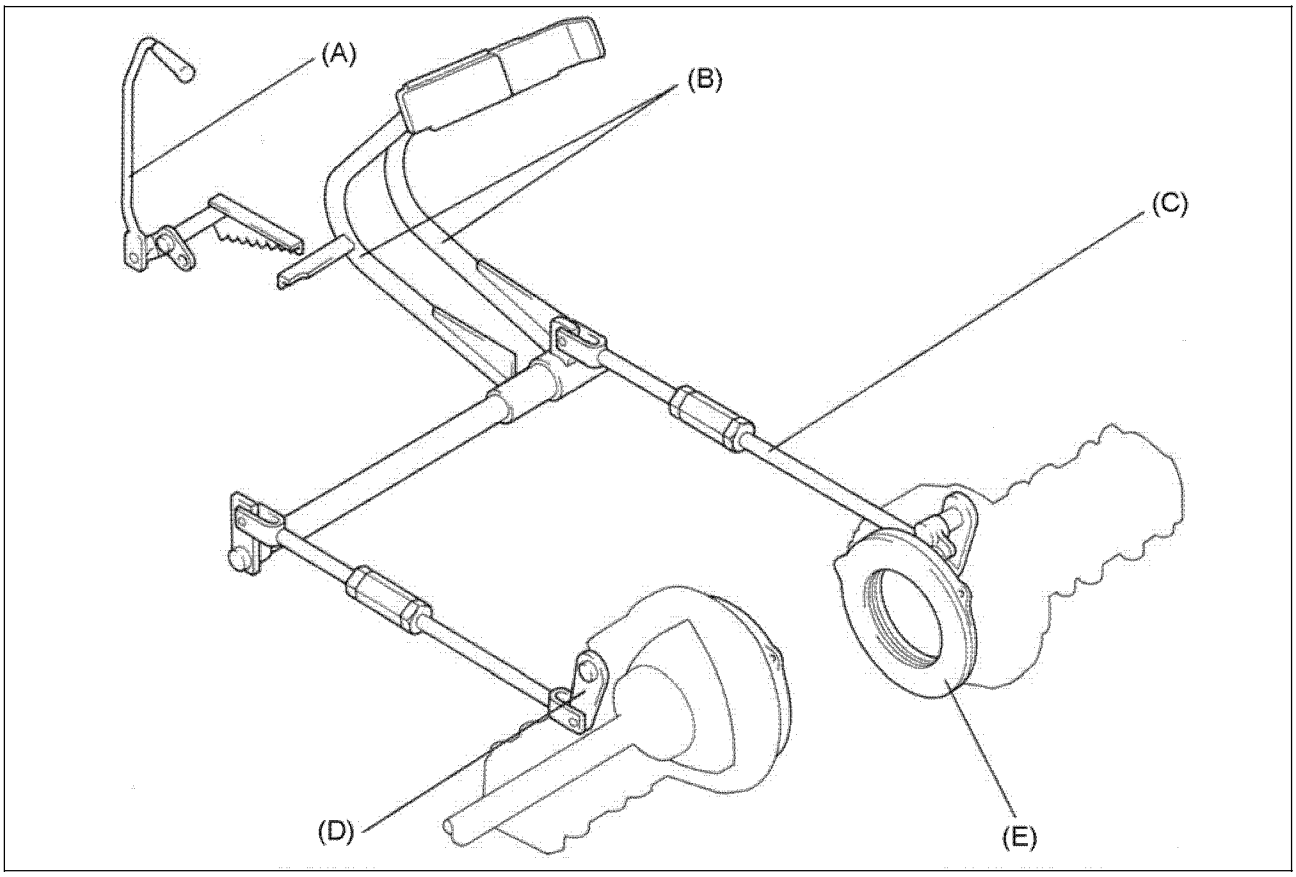


(A) Planetary carrier
(B) Ring gear
(C) Planetary gear
(D) Final drive pinion shaft
(E) Rear axle shaft

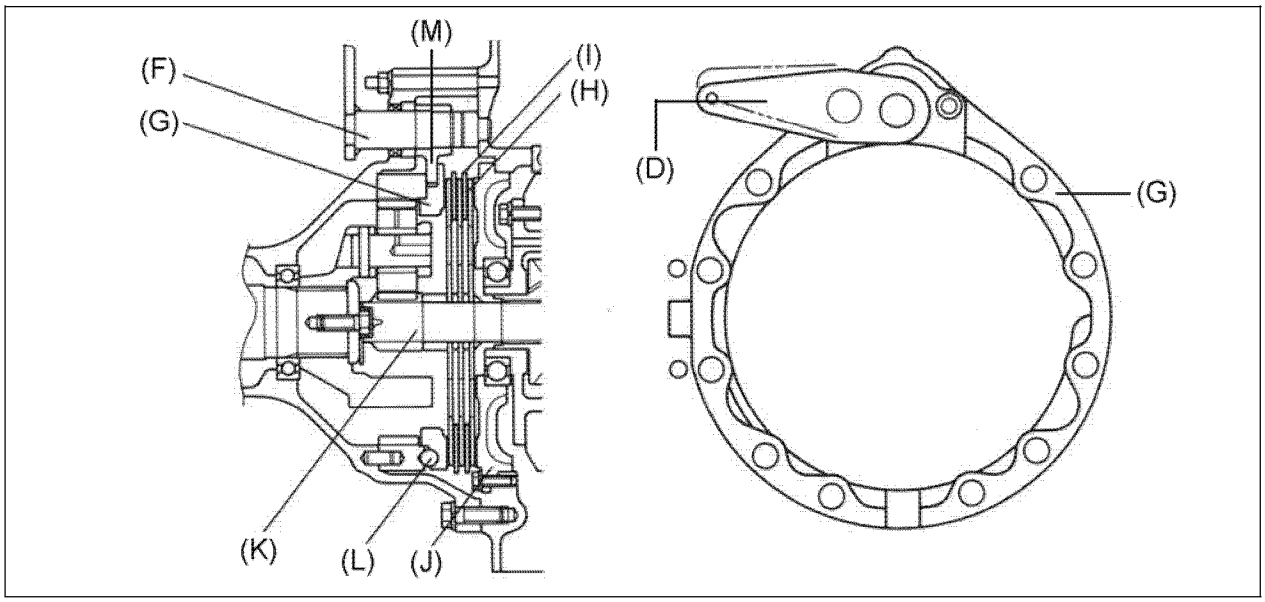


6.1.4 Brake

(1) The brake is a wet type disk brake system. When brake pedal is depressed, the brake rod pulls brake lever to rotate cam lever which rotates actuator. As the actuator rotates, the balls farce the actuator toward the differential carrier support. This compresses the disks between the friction plates and stops rotation of the shaft.
The parking brake is of the pedal lock system and works the same way as the brake above.

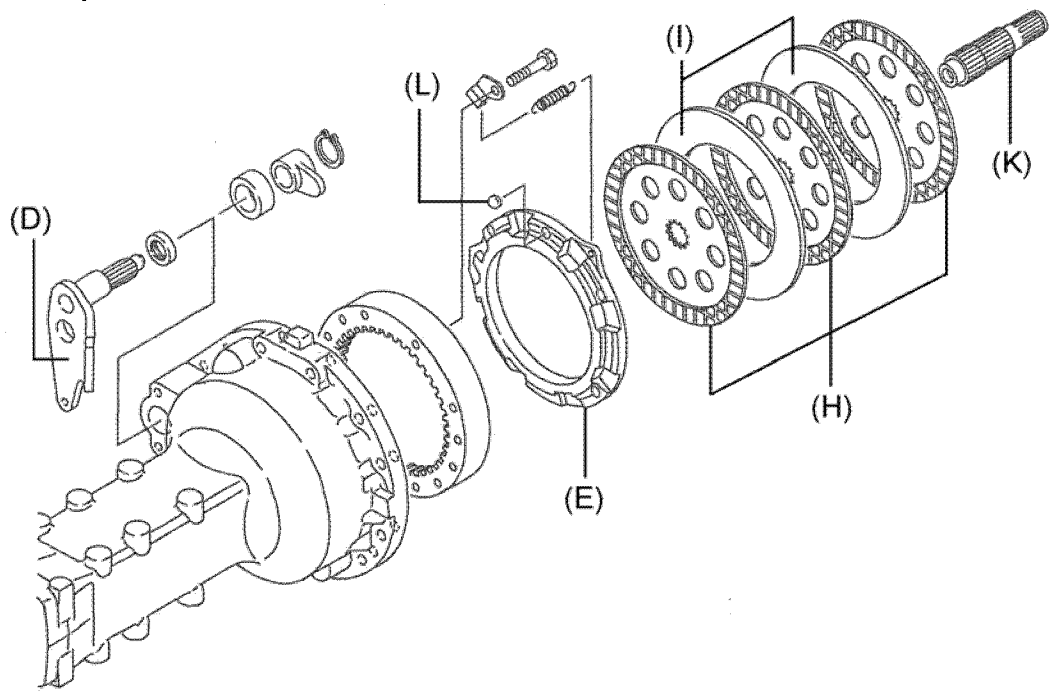


(A) Parking brake lever (B) Brake pedal (C) Brake rod (D) Cam shaft lever (E) Actuator



(F) Cam lever shaft
(G) Actuator
(H) Friction plate
(I) Steel plate
(J) Differential carrier support
(K) Final drive pinion shaft
(L) Steel ball 9/16
(M) Cam shaft

<Actuator, exploded view>

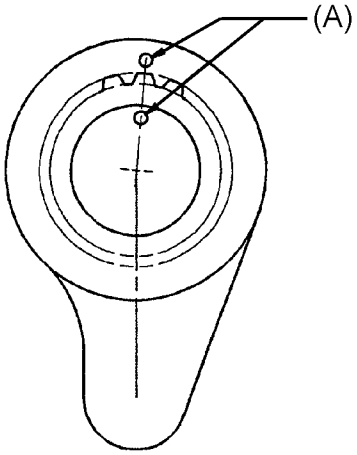


IMPORTANT

When disassembling the actuator, lay out the steel plates (I) and the friction plate (E) in the order and position they were in when removed. When reassembling them, do not change the position of any of the plates (front, back, left, and right) or the order in which they are reassembled.

CAUTION

- Match the camshaft lever (0 mark) with the camshaft (punched mark: A).
- Apply a good amount of TF500 over the friction plate and steel plate when they are replaced with new ones, before installing them in the assembly.



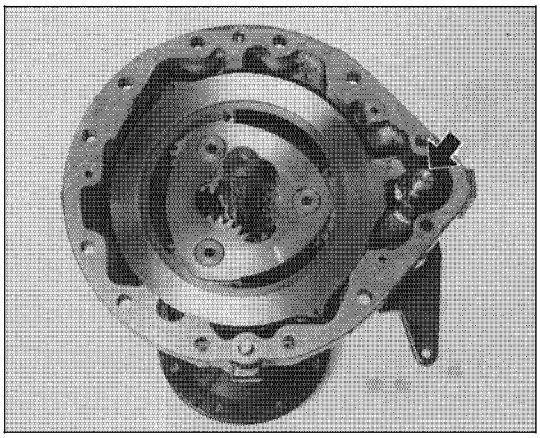
Note:

Wear limit of the brake discs
4.8mm (When the brake discs are new: 5.3±0.1mm)

Inspecting and adjusting the brakes

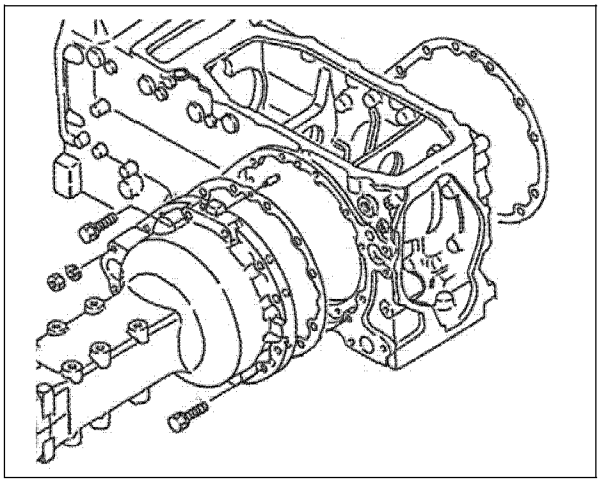
Step on the brake pedal to see if the specified amount of play (30-40 mm) is present and if both left and right pedals have the same amount of play. If not, do the following:

(1) Adjust the turn-buckle behind the brake pedals so that left and right pedals have the same amount of play.
(2) After adjusting, tighten the nut securely.
* By stepping hard on the pedal, make sure the parking brake lever works effectively.



6.2 DISASSEMBLY AND ASSEMBLY

6.2.1 Differential

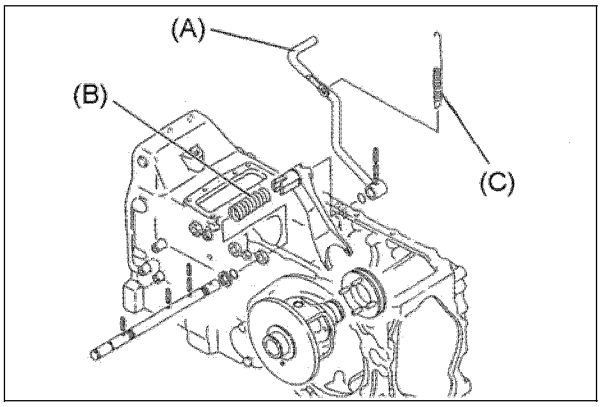


(1) Remove the hydraulic cylinder case.
(2) Remove the left rear axle housing assembly.

- 8 pcs of M12 bolts with spring washer M 12 x 40
- 2 pcs of M12 bolts with spring washer M12 x 50
- 1 pc of M10 bolt M10 x 85

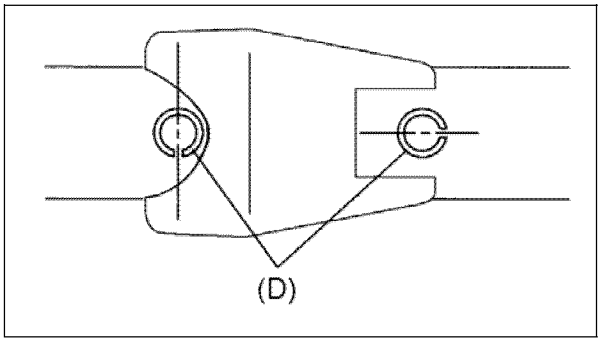
Note:
See “2.6” for details.

(3) Remove the differential lock fork. To assemble, make sure the return spring is positioned as shown to the right.



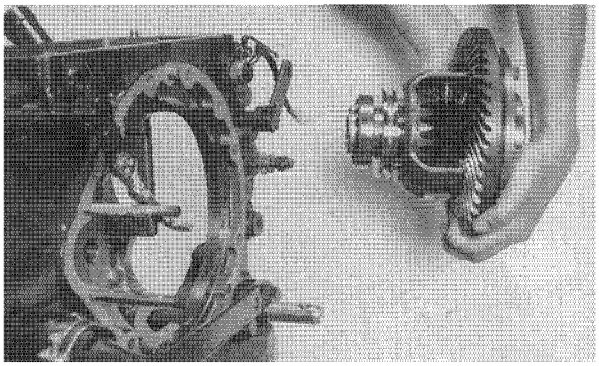
(A) Differential lock pedal
(B) Differential lock fork
(C) Return spring (Note direction)

IMPORTANT
When attaching the roll pins of the differential pedal shaft, match the match positions as shown in the figure below.

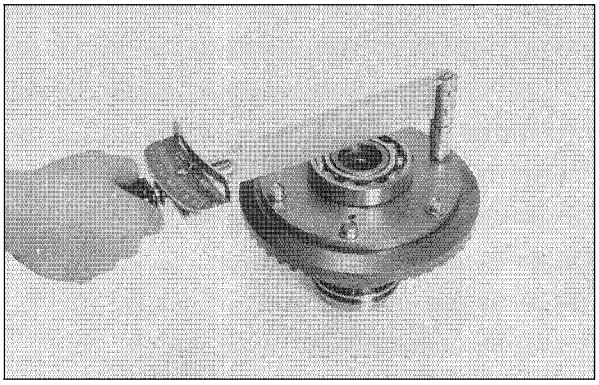


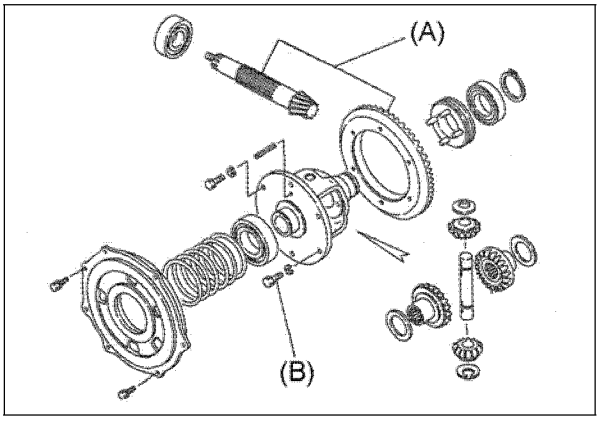
(D) Roll pin

(4) Remove the friction plate of the brake system, and remove the differential carrier.



Notes to assemble:
- Shims are required to adjust a backlash. Be sure to install.
- When the ring gear has been disassembled, apply the screw lock glue to bolts and tighten them with a torque of 450-600 kgf-cm for M10 (fine thread) size.



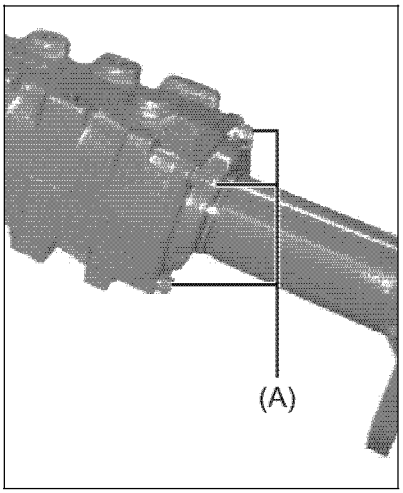


(A) Ring gear CMP
(B) Apply screw lock glue

6.2.2 Axle oil seal

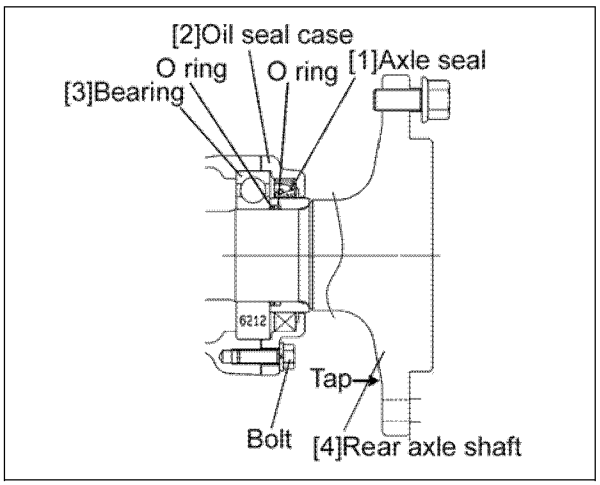
* The axle oil seal can be replaced without the rear axle housing being removed.

<Removal>
(1) Detach the four oil seal case mounting bolts (A).
(2) Tap the flange of the rear axle shaft outward.
(3) Assembly of the axle seal and the bearing can be removed.



<Removal>
Numbers from ([1]) to ([4]) indicate assembly order.

(1) When fitting the axle seal ([1]) to the oil seal case ([2]), apply oil to the circumference of ([1]), and fully press-fit it to the bottom of the case ([2]).
(2) When press-fitting the rear axle shaft ([4]) to the bearing ([3]), press the inner race of the bearing ([3]).

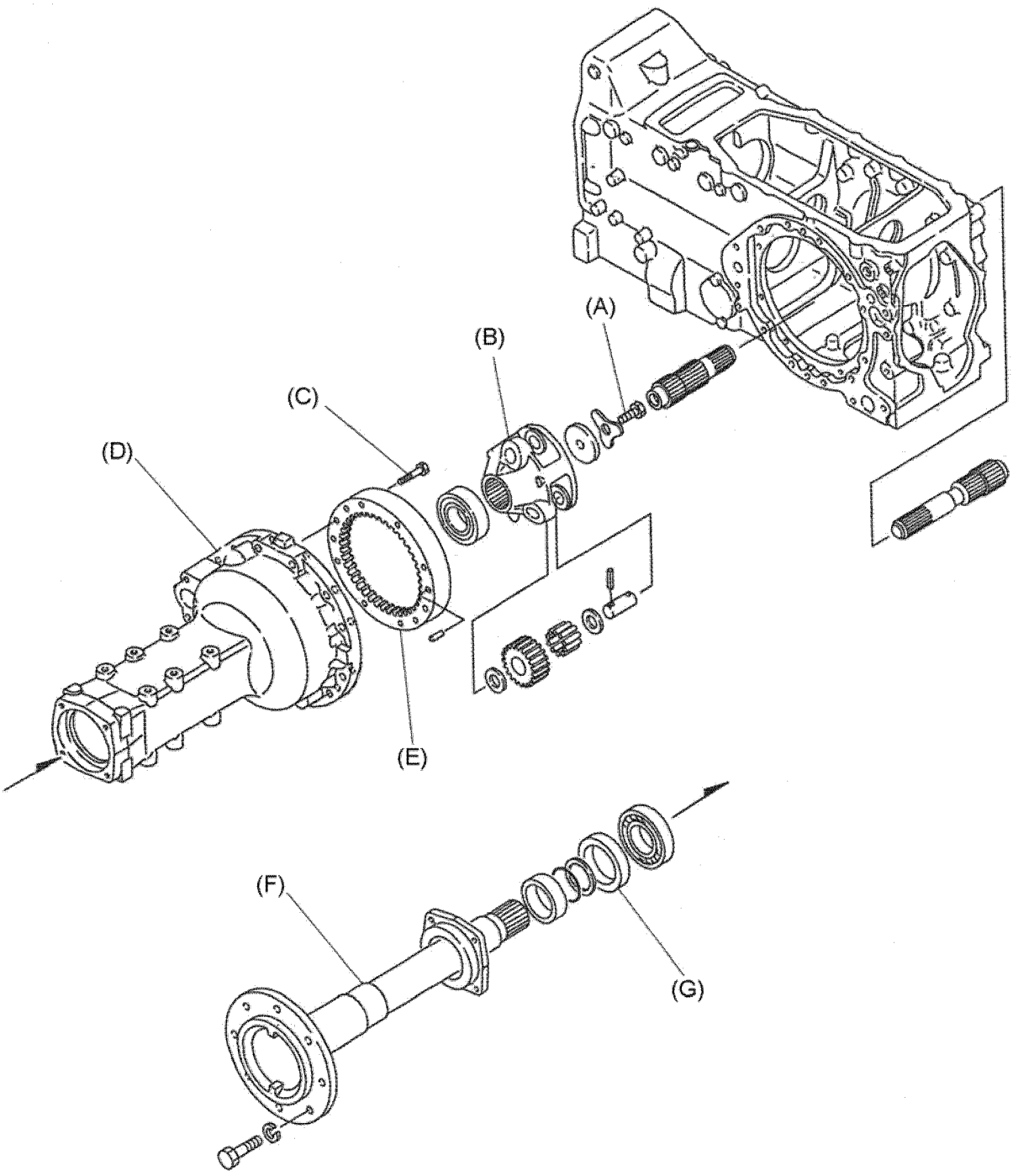


6.2.3 Planetary gears and axle shaft

(1) Remove the rear axle housing.
(2) Remove bolt (A) below to remove the planetary gears (B).

Assembling

Bolt (fine thread) (A) 12 x 30:	8 pcs. 800-1000 kgf-cm
Bolt (C) M10x55	450-600 kgf-cm



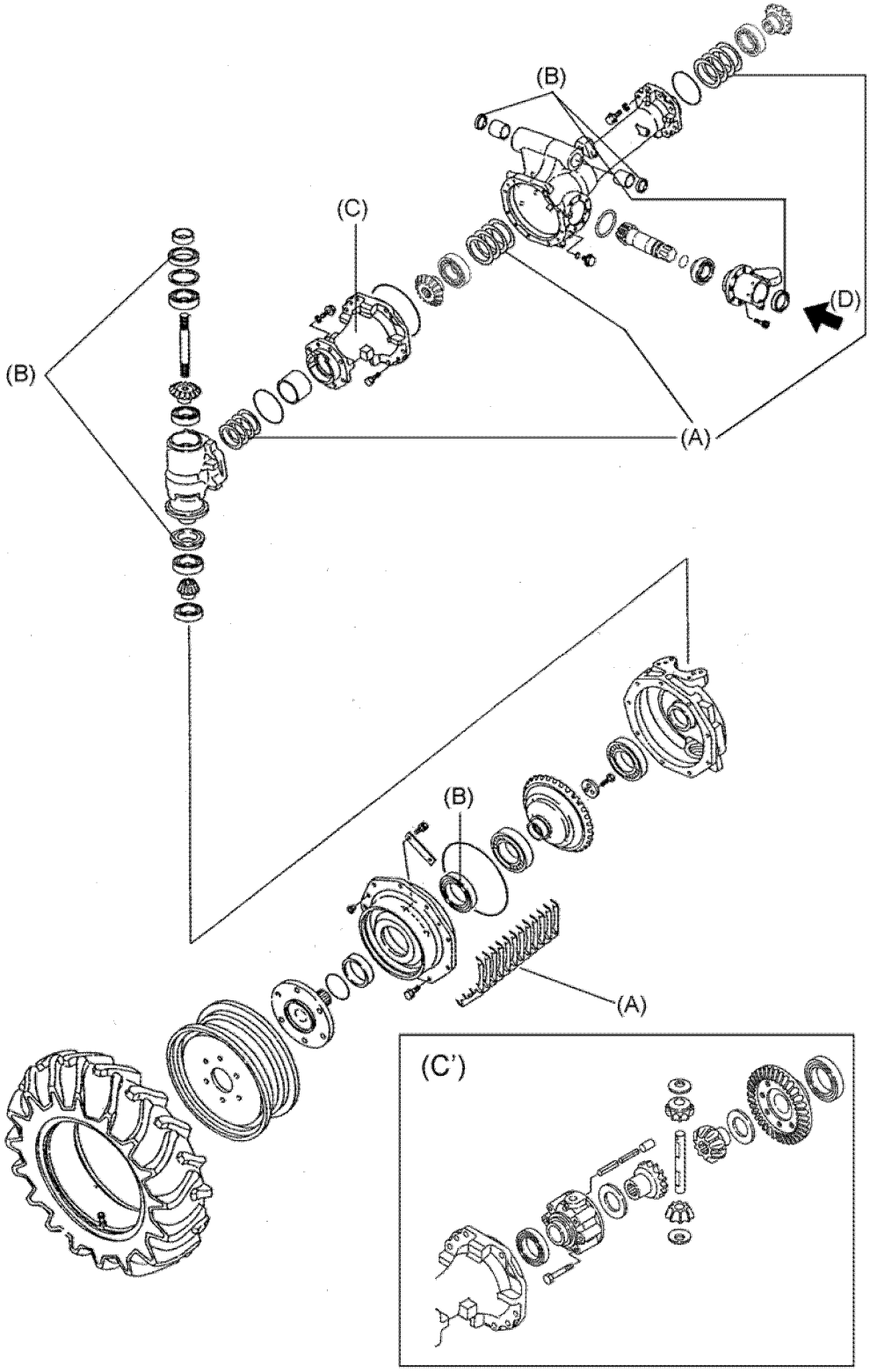
(A) Shaft end bolt
(B) Planetary gears
(C) Ring gear fixing bolt
(D) Rear axle housing
(E) Ring gear
(F) Rear axle shaft
(G) Oil seal

7

FRONT AXLE

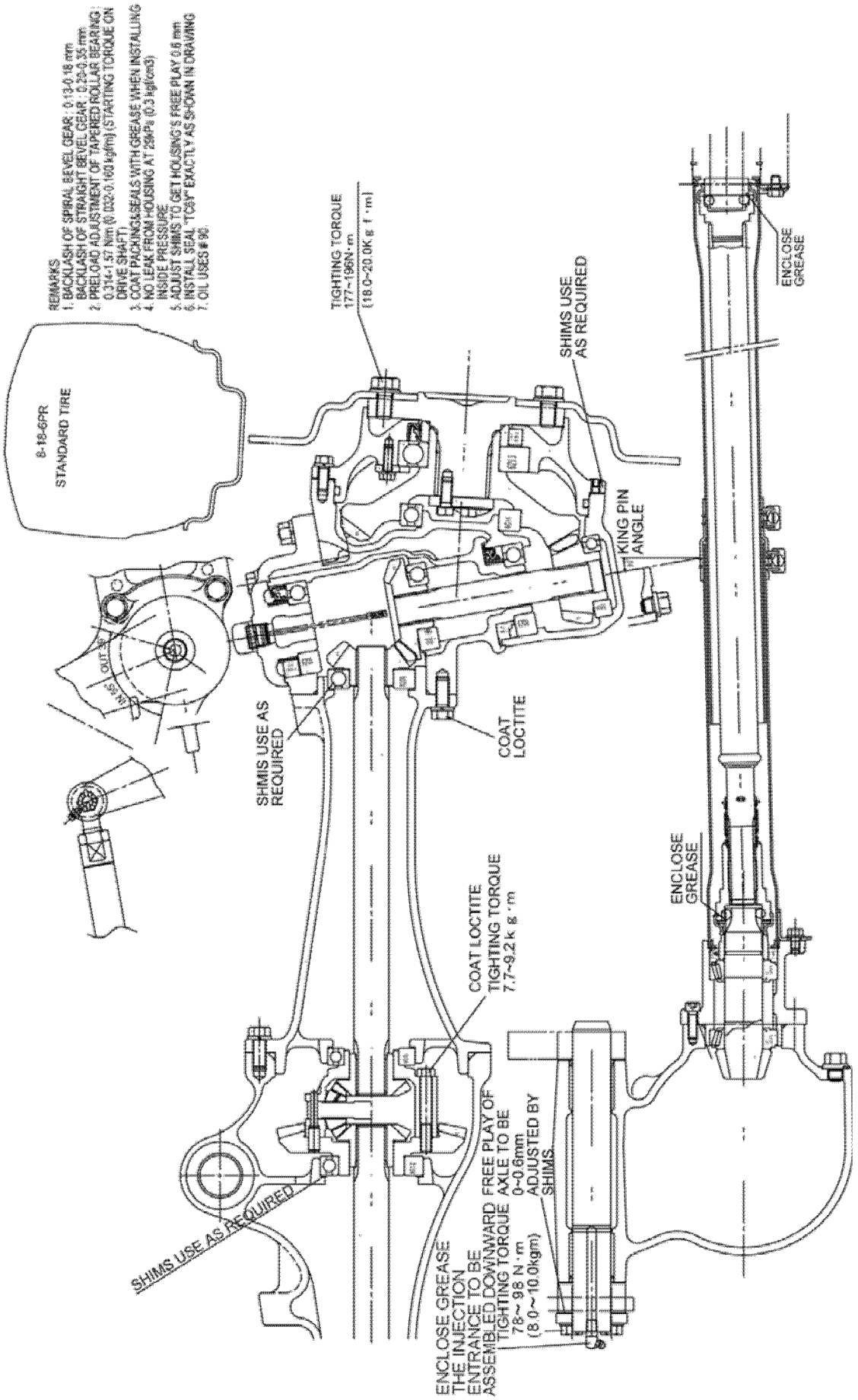
7.1 STRUCTURE AND FUNCTIONS

Four-wheel drive front axle has a wheel speed proportional to the rear axle. The drive power is conveyed from the drive pinion of the rear axle assembly (counter shaft) to the drive gear and drive shaft, then to the front axle through the propeller shaft.



Note:
A: The need for adjustment shims, and the number of shims used, varies with the machine.
B: Oil seals
C: Front differential unit. C': Detailed view of C
D: Front drive input from transmission

7.2 CROSS-SECTION VIEW



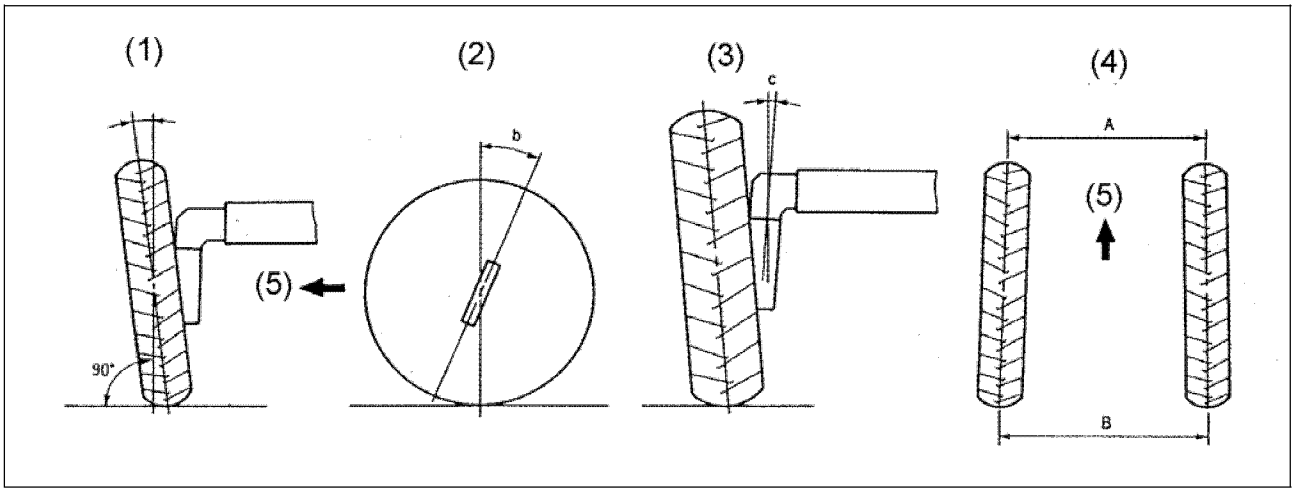
7.3 FRONT WHEEL ALIGNMENT

The tractor front wheels have a certain angle in the lateral and back-and-forth direction for easy steering performance; reliability, safety, stability and linearity of motion; and reduction of tire wearing.

This is called "front wheel alignment" and includes the following four factors:

(1) Camber angle, a: 2°
(2) Caster angle, b: 0°
(3) Kingpin tilt, c: 12°
(4) Toe-in, B-A: 2-8 mm
(5) Traveling direction

These factors are shown below:

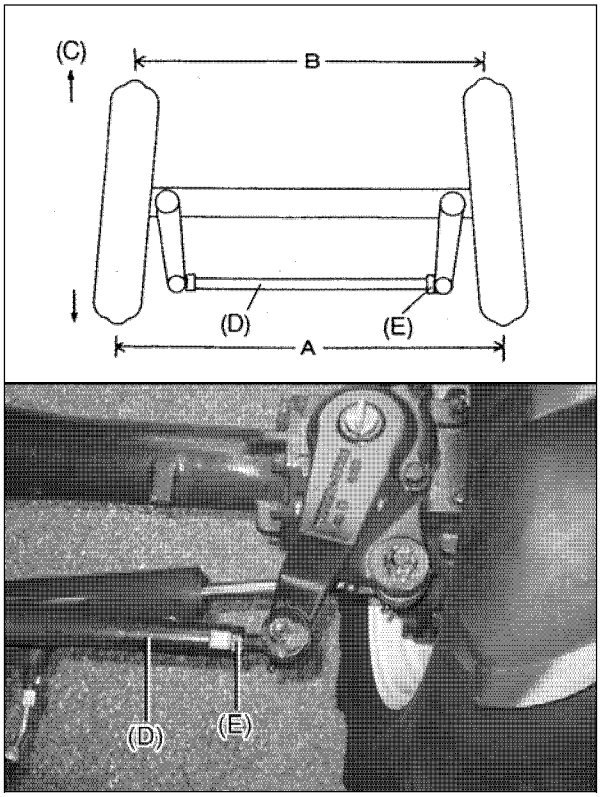


Note: (1), (2), and (3) cannot be adjusted.

Adjusting the toe-in

If the steering response is irregular or subject to vibration, check the toe-in. Toe-in is the arrangement in which the front wheels are oriented slightly inward so that the distance between the front edges of the wheels (A) is slightly smaller than the distance between the rear edges (B). The toe-in (difference) should be 4-8 mm. If it is not within this range, adjust the toe-in as described below:

(1) Loosen the locknuts at the ends of the tie rod.
(2) Turn tie rod A until the toe-in is 4-8 mm.
(3) When the toe-in is 4-8 mm, tighten the locknuts.



(C) Front
(D) Tie rod
(E) Lockout

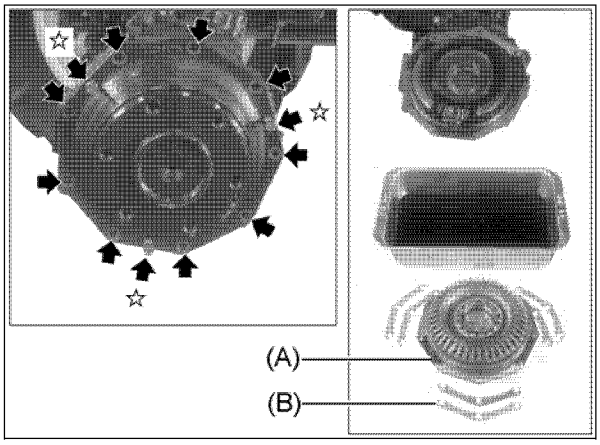
7.4 DISASSEMBLING THE FRONT BEARING CASE

(1) Remove the front wheels.

(2) Drain the front axle oil.

(3) Remove the nine M8 bolts.

(4) Put a bolt into the three places marked with an asterisk, tighten the bolts evenly, and then remove the bearing case (A).



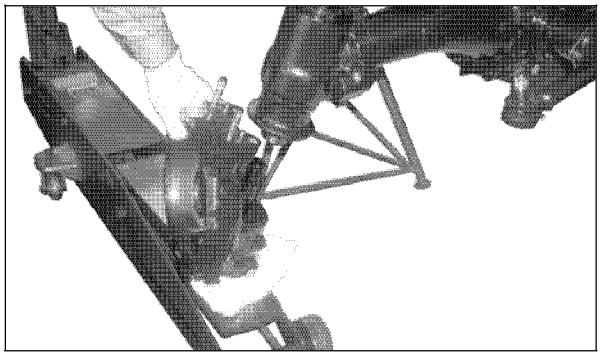
STOP

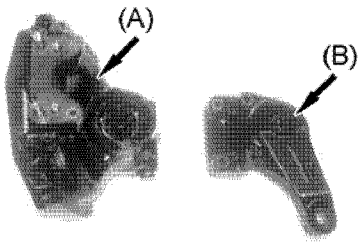
IMPORTANT

- The number of shims (B) and their positions varies with each machine.
- When reassembling the front bearing case, use the same number of shims, in the same positions, as were found during disassembly.

7.5 DISASSEMBLING THE FRONT GEAR BOX

Support the bearing case (A) using a garage jack, and remove the knuckle arm (B) (2 x M12 bolts and 2 x M12 nuts) and the bearing case.

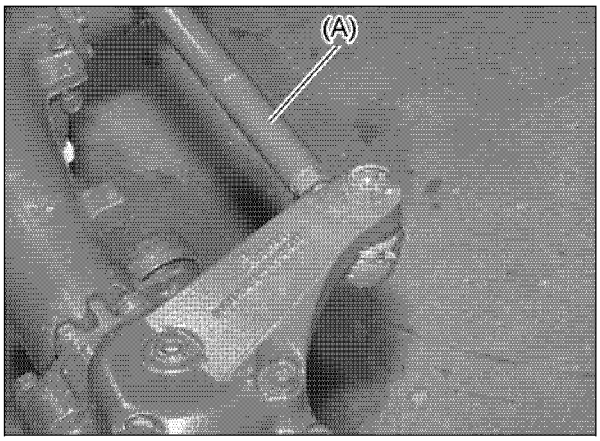




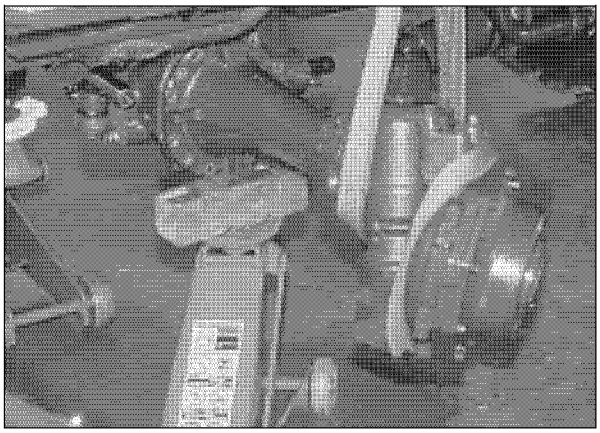
7.6 DISASSEMBLING AND REASSEMBLING THE FRONT DIFFERENTIAL SECTION

7.6.1 Disassembly

(1) Drain the front axle oil.
(2) Remove the propeller shaft. See “2.5.1”.
(3) Remove the left front wheel.
(4) Remove the tie rod (A).

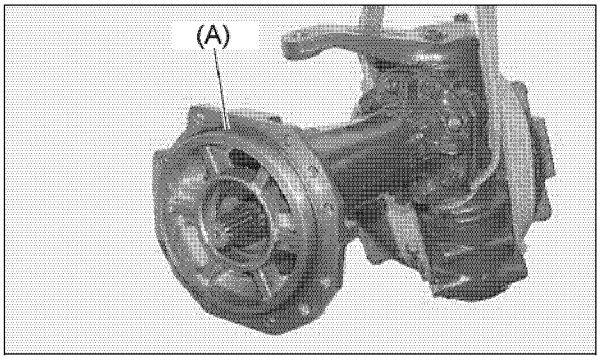


(5) Put a rope around the front gear case and prepare to lift the front gear case with a crane.
(6) Remove the 11 M12x30 bolts that secure the left front axle case.
(7) With the front gear case supported by the crane, separate the left front axle case from the gear case.

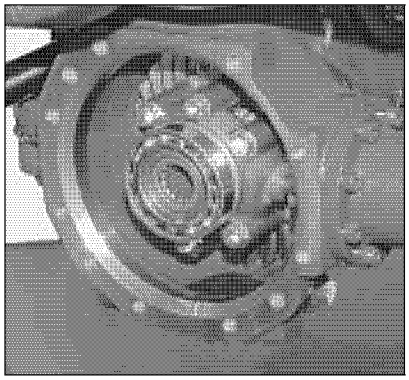


STOP **IMPORTANT**

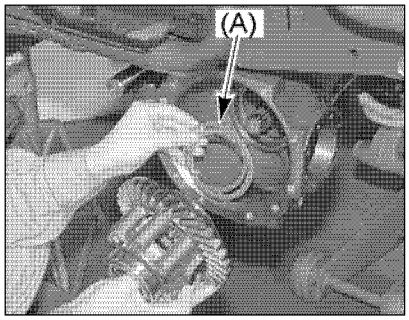
When disassembling and reassembling the front differential section, be careful not to damage the O-ring (A).



(8) Remove the pinion and the bearing as an assembly.

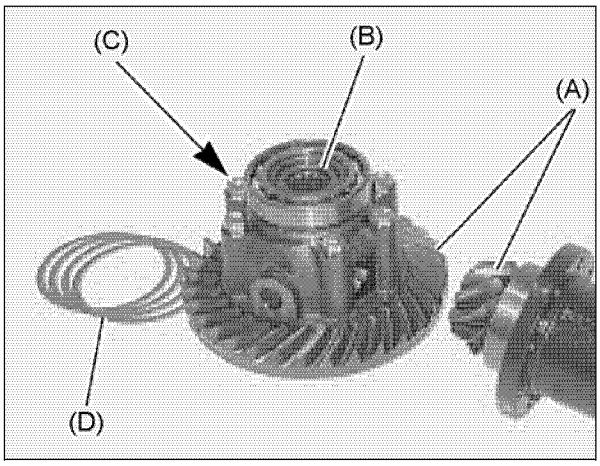


Note:
There are some ring gear adjustment shims (A).

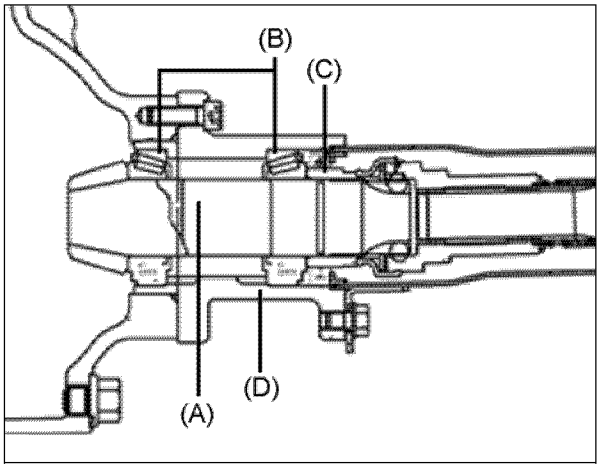


IMPORTANT
Apply screw lock to the six M10x70 bolts (C) shown in the drawing on the right.

(A) Ring gear CMP
(B) Differential gear
(C) M10x70 bolt
(D) Shims

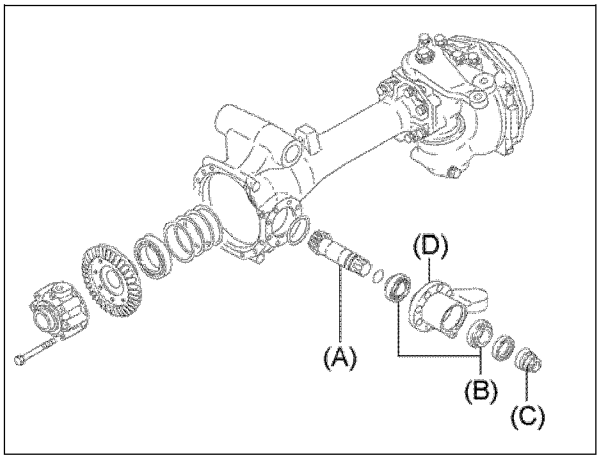


7.6.2 Reassembly

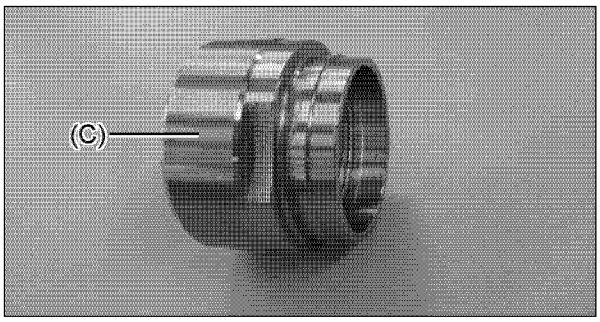


IMPORTANT
When disassembling the drive pinion (A), perform a preload adjustment of the tapered roller bearings (B) using the following method.

(C) Seal collar
(D) Bearing retainer

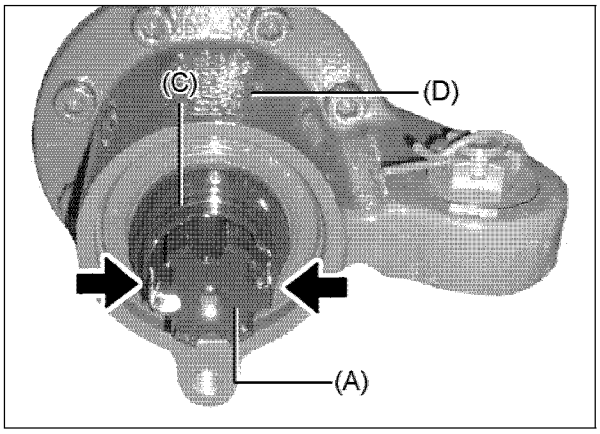


(1) Set the drive pinion (A), tapered roller bearings (B), O-ring, and oil seal into the bearing retainer (D). Temporarily tighten everything with the seal collar (C).

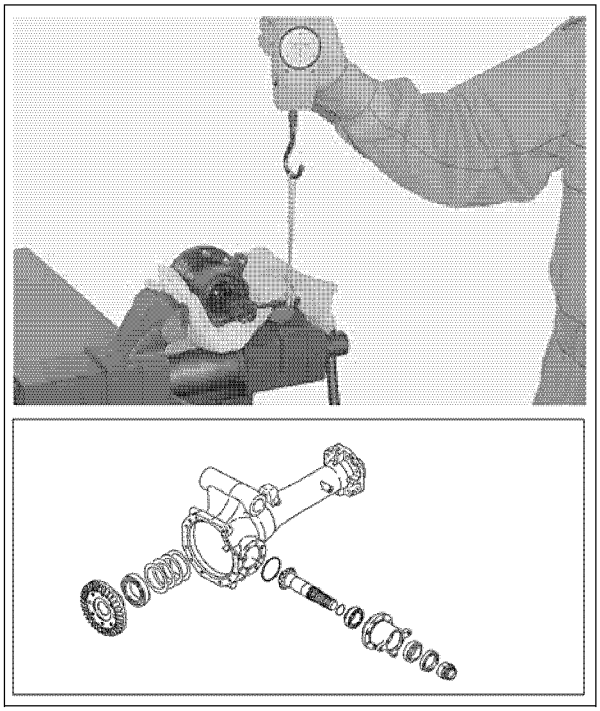


(2) Secure the parts indicated by the arrows with a hand vice.

Note :
Secure only the drive pinion (A). The hand vice should not come into contact with the other parts.



(3) Set up a spring balance as shown in the drawing on the right. Measure the torque created when the drive pinion starts rotating.

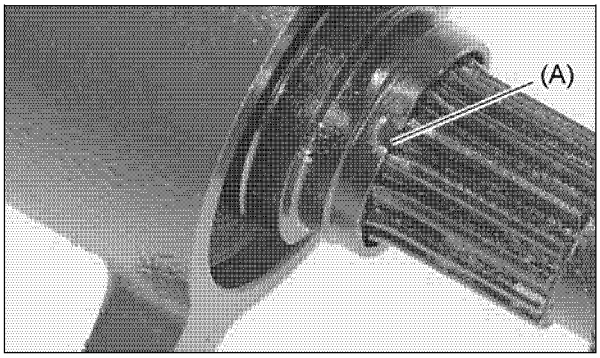


(4) Tighten the seal collar little by little until the torque reaches the specified level of 0.032 to 0.160 kgf-m. Make sure to measure the torque repeatedly.

IMPORTANT

- The seal collar should be replaced with a new one.
- If the torque is less than specified, the gear may be damaged.
- If the torque is greater than specified, the bearing may be damaged.

(5) After the adjustments are finished, tap section (A) and the opposite side on the seal collar using a screwdriver to create detents.

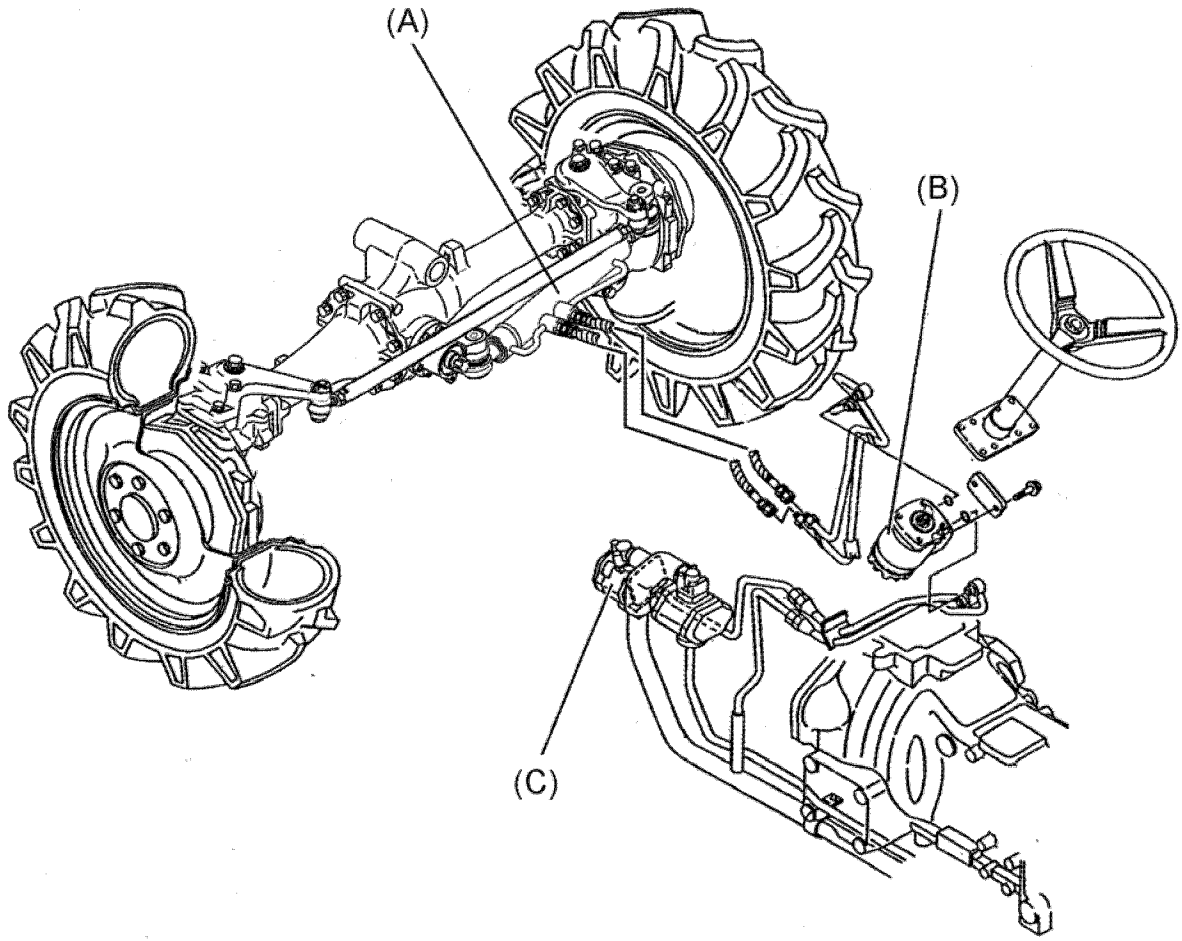


8

POWER STEERING

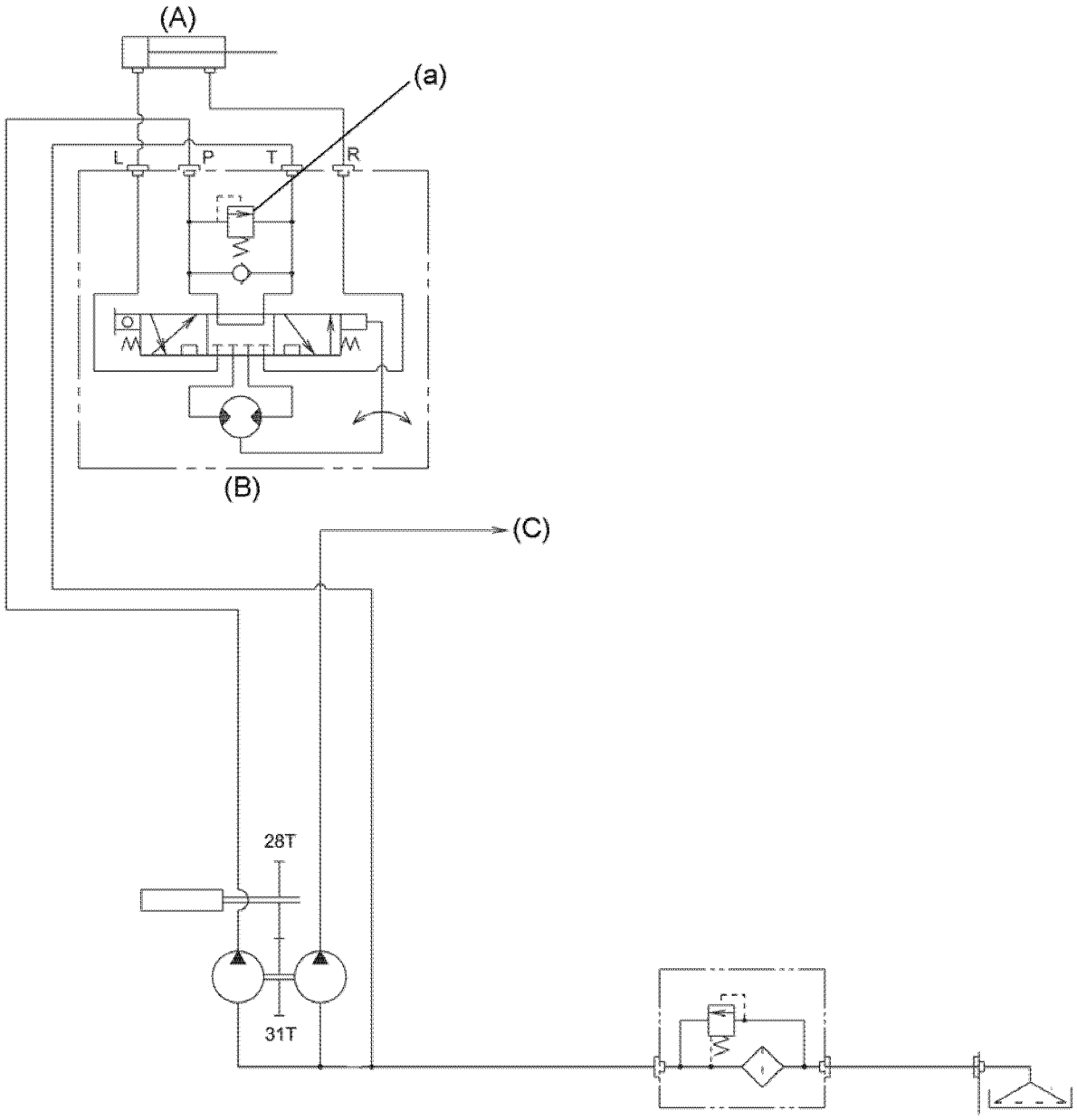
8.1 STRUCTURE AND FUNCTIONS

8.1.1 Structure drawing



(A) Power steering cylinder (B) Power steering valve (C) Hydraulic pump

8.1.2 Hydraulic circuit



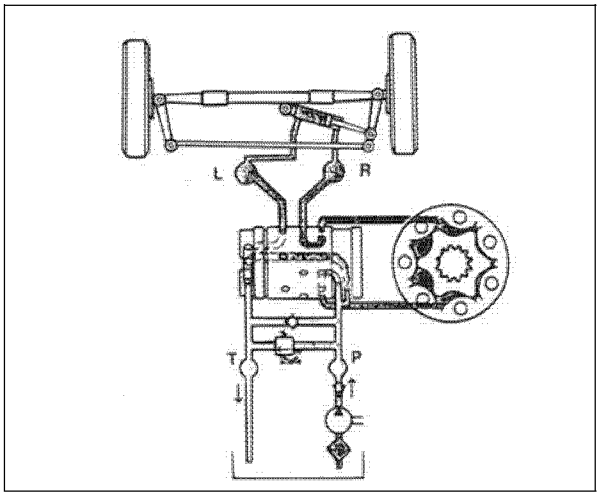
(A) Power steering cylinder
(B) Power steering valve
(C) To transmission

(a) Power steering relief valve: Pressure 12.2～12.9 MPa (125-132 kgf/cm^2)

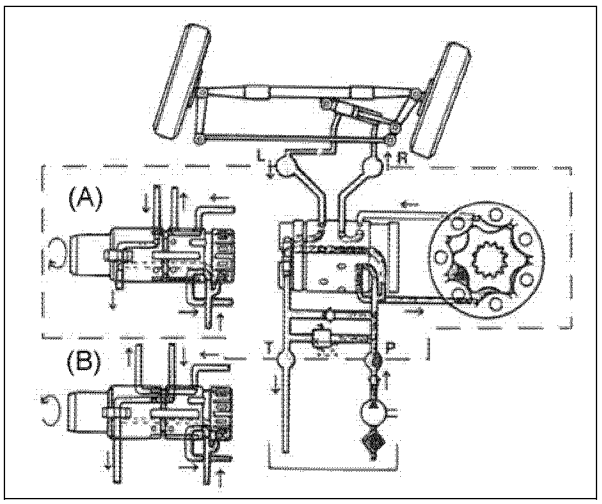
Remarks
The power steering system is fully hydraulic. The cylinder is a double rod type featuring excellent stability while moving. Oil from the power steering module is returned to the sump through the line marked *.

8.1.3 Power steering valve functions

*** When in neutral**
The oil from the hydraulic pump flows into the power steering valve. However, since the control spool is in "neutral," the oil will return to the tank.

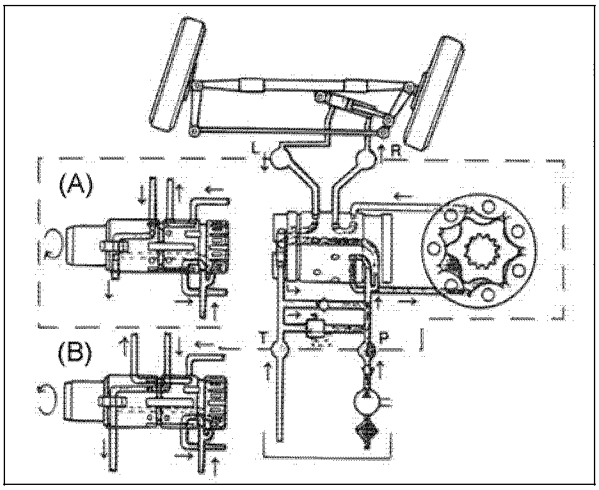


*** During rotation**
(1) The oil from the hydraulic pump flows into the power steering valve. Under these conditions, since there is a displacement between the inner and outer valves of the control spool in the power steering valve, the circuit will open and the oil will flow into the gyrator.
(2) The oil of the gyrator flows into the cylinder through the control spool.
(3) The oil of the cylinder opposite the cylinder into which the oil flowed returns to the tank through the control spool.
(4) If the hydraulic pump pressure becomes too high (125 + 7 kgf/cm2), the relief valve will be activated and the oil will return to the tank.



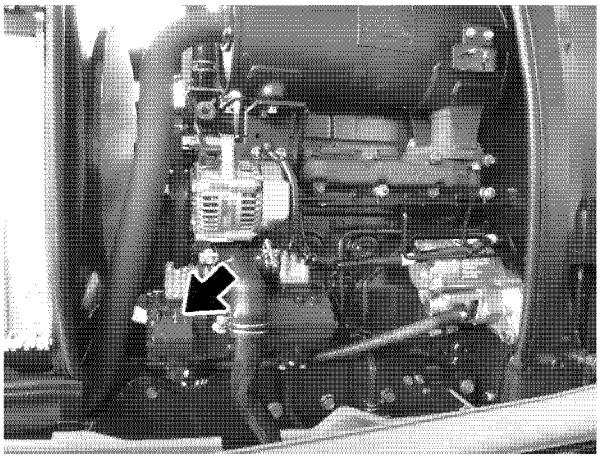
(A) Right turn
(B) Left turn

*** During manual rotation**
If there is a problem with the hydraulic pump or when the engine is stopped, if the steering wheel is turned the gyrator will function as a gear pump, allowing oil to be sucked up from the tank. This causes the check valve to open, and the sucked oil flows into the control spool and the gyrator, and is force fed to the cylinder.

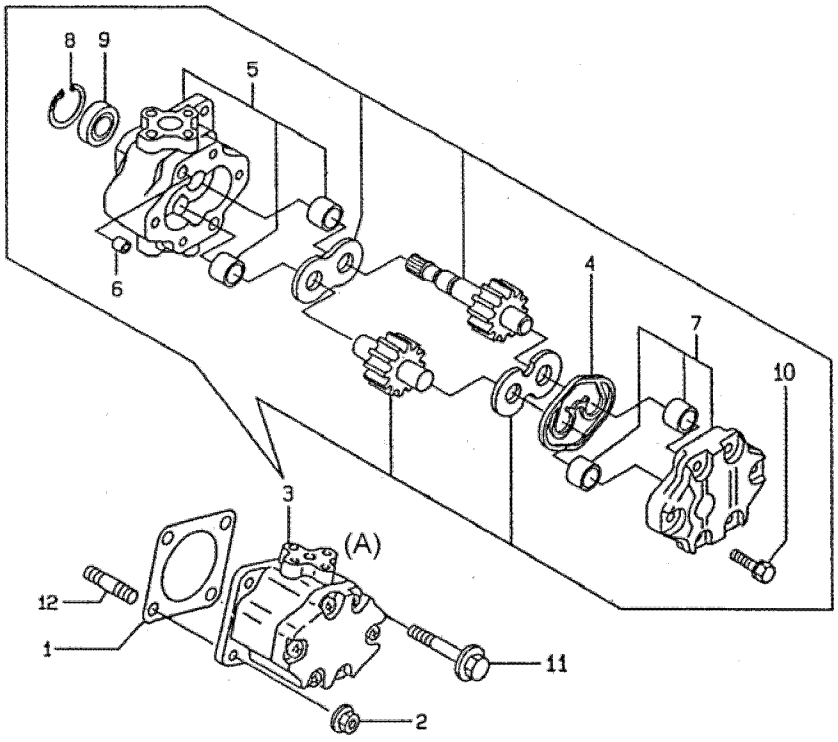


(A) Right turn
(B) Left turn

8.1.4 Hydraulic pump



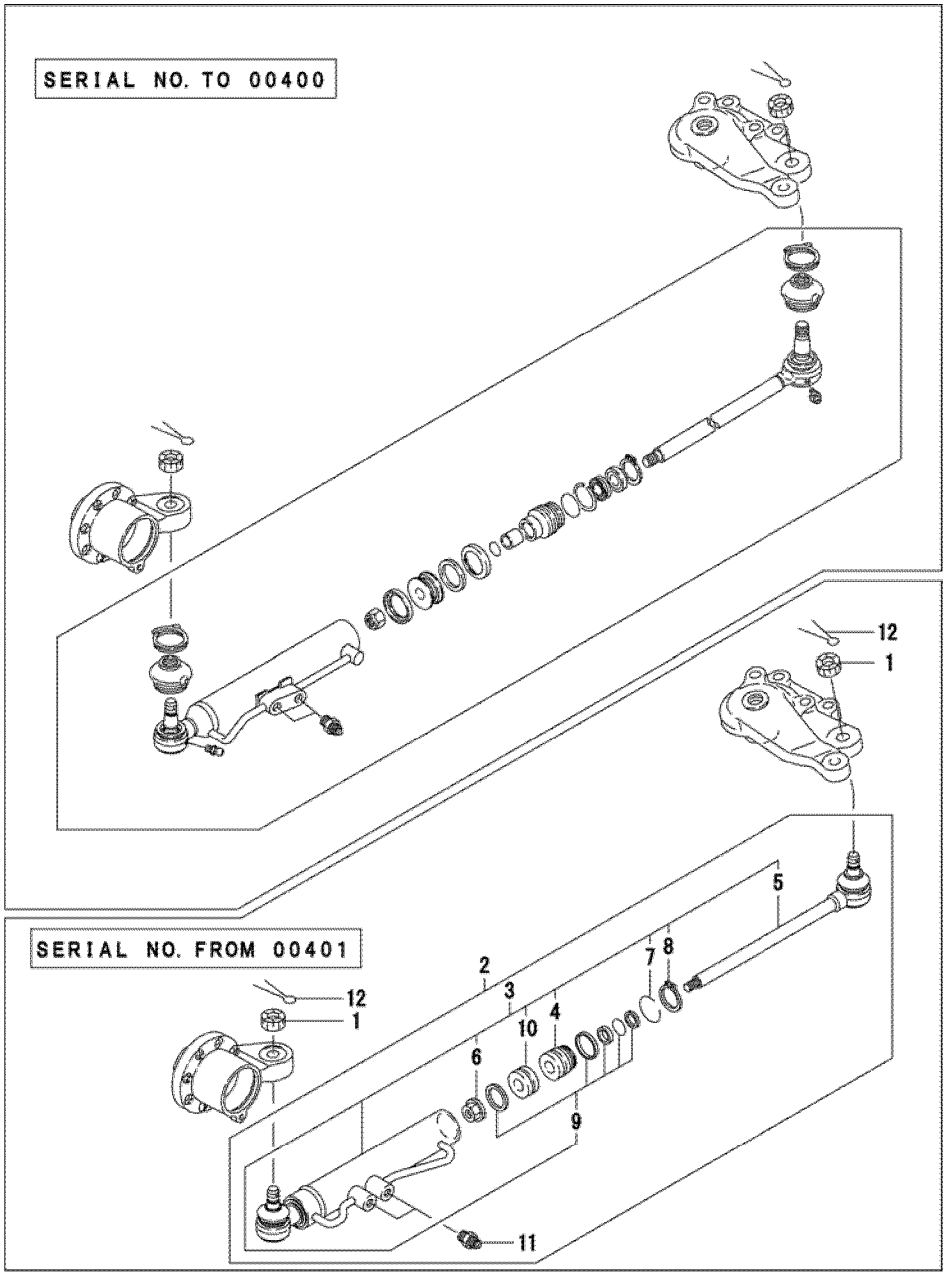
No.	Parts name
1	Gasket (HO-P)
2	Nut (Supack 8)
3	Hydraulic pump CMP (7C)
4	Ring
5	Housing CMP
6	Pin 11x 7
7	Cover CMP
8	Circlip (Hole 32)
9	Oil seal TC153207
10	Bolt M8 x 35
11	Bolt M8 x 80
12	Stud bolt



(A) Front H. O. Pump

- Oil: Transmission oil TF500
- Pump output: 17 litre at engine speed 2700 rpm (pump shaft speed 2438 rpm)
  7 cc/REV

8.1.5 Power steering



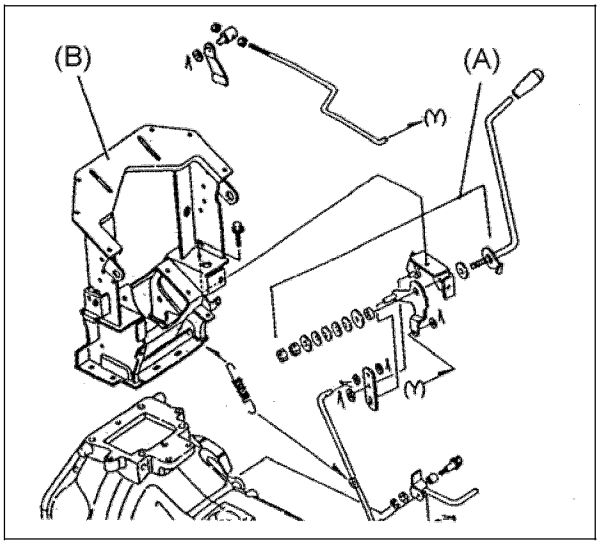
No.	Parts name	Q'ty
1	Nut, Castle	2
2	Cylinder assy.	1
3	Cylinder assy.	1
4	Cap, Cylinder	1
5	Rod assy.	1
6	Lock nut	1
7	Circlip 120	1
8	Circlip 120	1
9	Seal kit	1
10	Piston	1
11	Adaptor 1/4	2
12	Cotter pin 4.0x25	2

Cylinder (bore x shaft diameter x stroke) ----- 50 x 30 x 214 mm
Single rod type

8.2 POWER STEERING VALVE

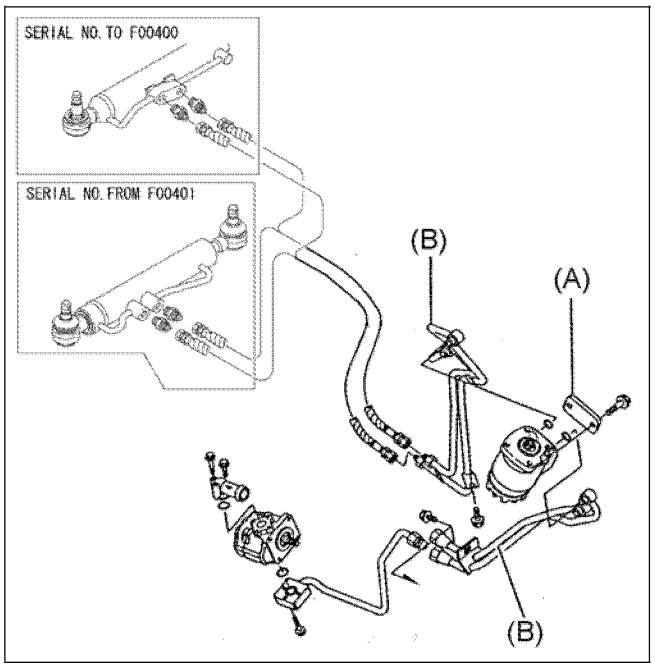
8.2.1 Removing power steering valve assembly

(1) Remove the covers around the dashboard and take out the accelerator lever assembly (A).



(A) Accelerator lever assembly
(B) Dashboard

(2) Remove the retainer plate on the right side of the power steering valve and remove 4 pcs of high pressure pipes.

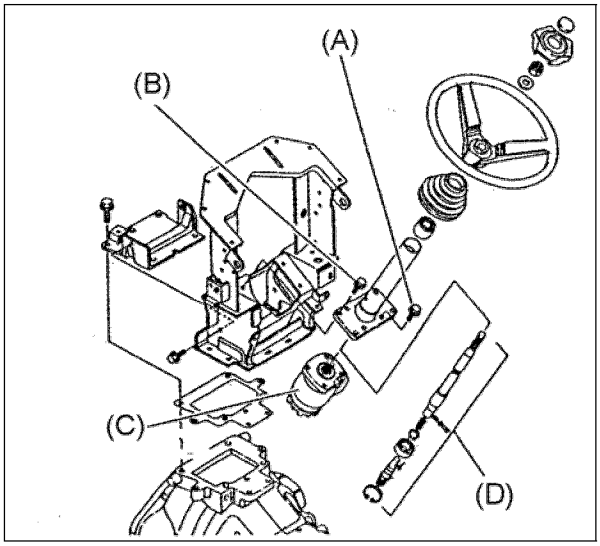


Assembling
Be sure all O-rings are installed in position to the pipes.

(A) Power steering high pressure pipe
(B) Retainer plate

(3) Loosen 4 bolts fixing the power steering valve and column CMP (A). Remove 4 bolts fixing the dashboard and column CMP (B).

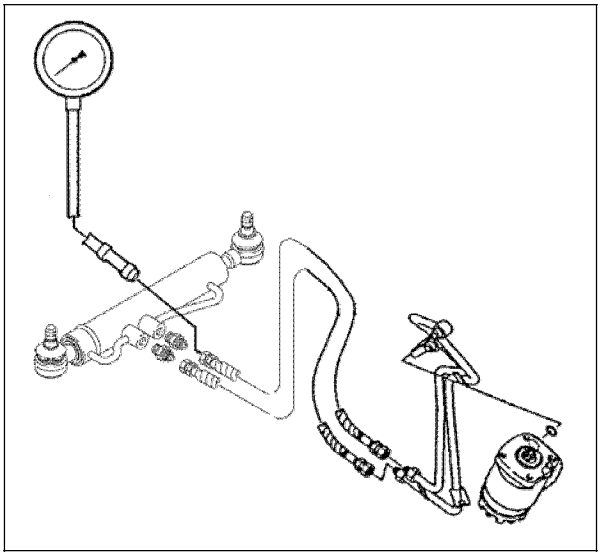
(4) Pull the steering column upward and loosen bolts fixing the valve assembly to remove it.



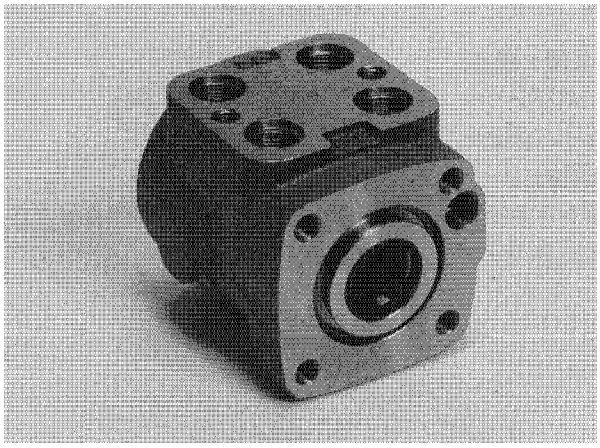
(A) Fixing bolt (x 4)
(B) Fixing bolt (x 4)
(C) Power steering valve CMP
(D) Steering column

8.2.2 Power steering relief pressure

NOTE:
A reduced relief pressure in the power steering system can cause the steering to seem heavy.



HOW TO MEASURE THE RELIEF PRESSURE:
(1) Remove the right hose from the power steering cylinder.
(2) Connect the hose to the hydraulic tester (maximum pressure 250 kgf/cm^2).



(3) Start the engine and raise the engine speed to 2500 rpm.
(4) Turn the steering wheel clockwise until a relief sound is heard. Read the tester.

NOTE:
Do not turn the wheel the wrong direction. Otherwise, the cylinder will blow oil out of its port.
Specified pressure: 90-97 kgf/cm2 (8.8-9.5 MPa)

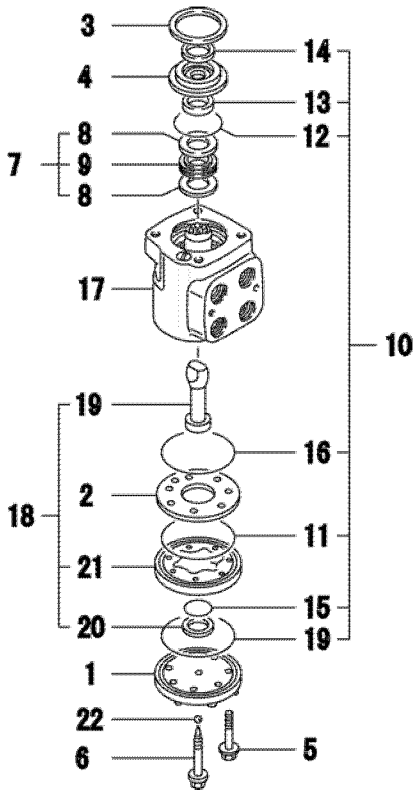
- If the pressure is too high: Loosen the adjusting screw (the oil temperature will increase)
- If the pressure is too low: Screw in the adjusting screw.

IMPORTANT
- Never remove the adjusting screw unless absolutely necessary.
- Note the anti-loosening punch.
- If it becomes necessary to remove the adjusting screw, note the number of turns it was screwed in.

8.2.3 Disassembly

When the oil leak occurs, o-ring, packing, bush, and the oil seal are replaced referring to this item.

No.	Parts name	Q'ty
1	Cap	
2	Plate, Spacer	
3	Ring	
4	Bush	
5	Screw	
6	Screw	
7	Bearing comp., Needle	
8	Bearing	
9	Thrush needle	
10	Kit, Seal	
11	O-ring	
12	O-ring	
13	Seal, Oil	
14	Seal, Dust	
15	Packing	
16	O-ring	
17	Valve assy	
18	Drive comp., Dirotor	
19	Gerotor	
20	Seal	
21	Drive	
22	Ball 7/32	

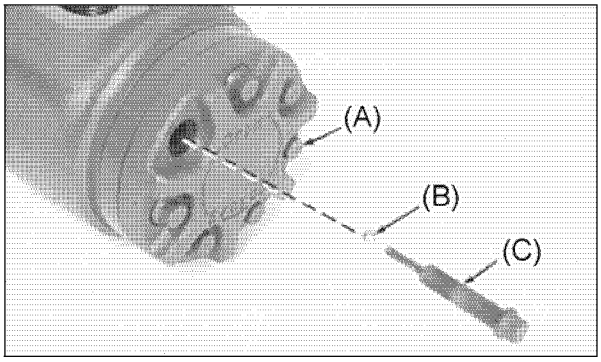


DANGER

Do not disassemble the inside of Valve assembly (17). If not, it may cause a serious accident.

<DISASSEMBLE AND INSPECT THE POWER STEERING VALVE>

(1) Take off the cap screw (C).
(2) Turn the valve upside down to remove ball (B).
(3) Put the valve in a vise with padded jaws and take off the six screws from cap (A).

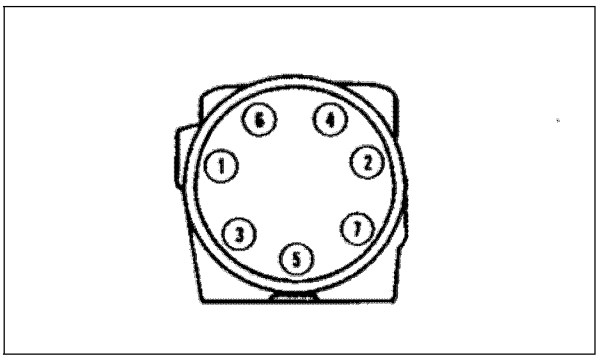


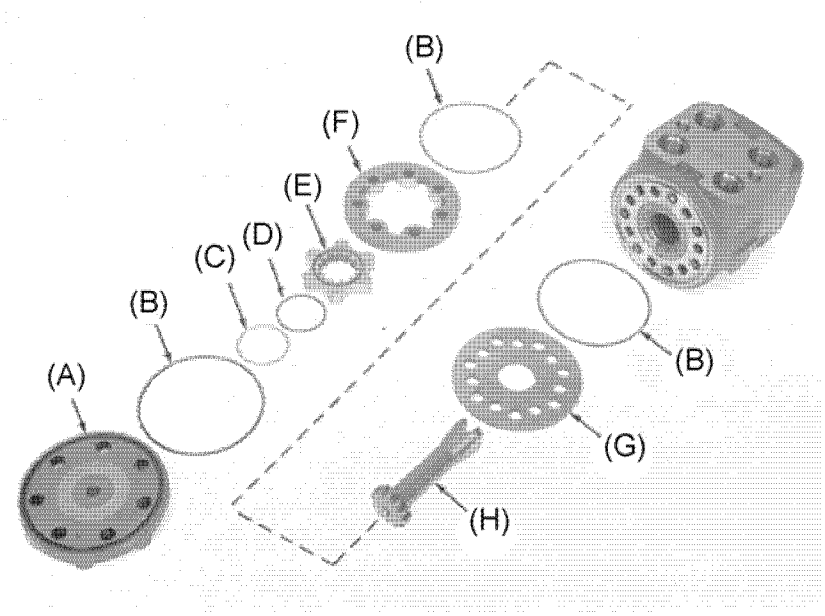
IMPORTANT

The steel ball is only in one place. Remember the mounting place.

Torque specifications

Initial Sequence: 11 N m (95 lb-in.)
Final Sequence: 21 N-m (182 lb-in.)





(A) Cap
(B) O-Ring (3 used)
(C) Seal
(D) Packing
(E) Cam
(F) Drive
(G) Spacer plate
(H) Gerotor

Note:

Be careful not to drop cam (E) when taking off the drive (F).

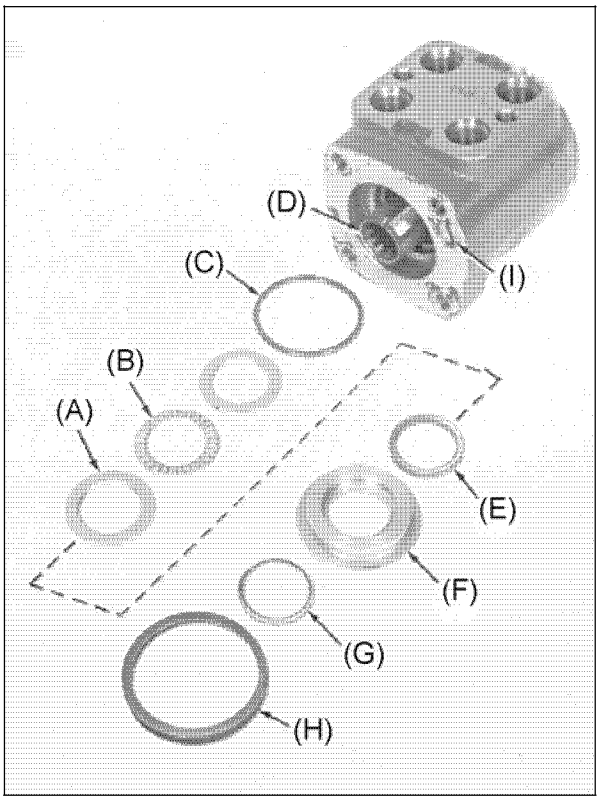
(4) Take off parts A thru H.

(5) Take off the valve from the padded-jaw vise.
(6) Use a screwdriver to pry ring (H) out of the valve housing.
(7) Rotate spool and sleeve (D), while pushing the assembly toward the top of the housing just far enough to unseat bushing (F).
(8) Take off parts A thru C and E thru G.

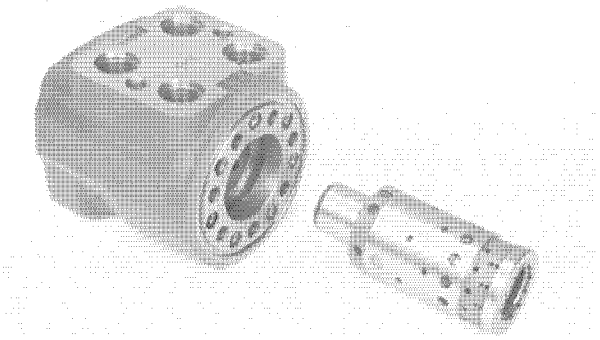
WARNING
Relief valve (I) cannot be serviced by the user. Do not remove it.

(9) Inspect all parts for damage or wear. Replace any defective parts.

(A) Bearing Races (2)
(B) Thrust Bearing
(C) O-Ring
(D) Spool and Sleeve
(E) Oil Seal
(F) Seal Gland Bushing
(G) Dust Seal
(H) Retaining Ring
(I) Relief Valve



Note:
The housing, spool and sleeve must be serviced as a single unit. Do not disassemble it by things except the cleaning.



IMPORTANT
If it is necessary to remove the spool and sleeve from the housing to clean them, do not let these parts bind. The tolerances here are very close. If these parts need to be replaced, the spool, sleeve and housing must be ordered as a unit.

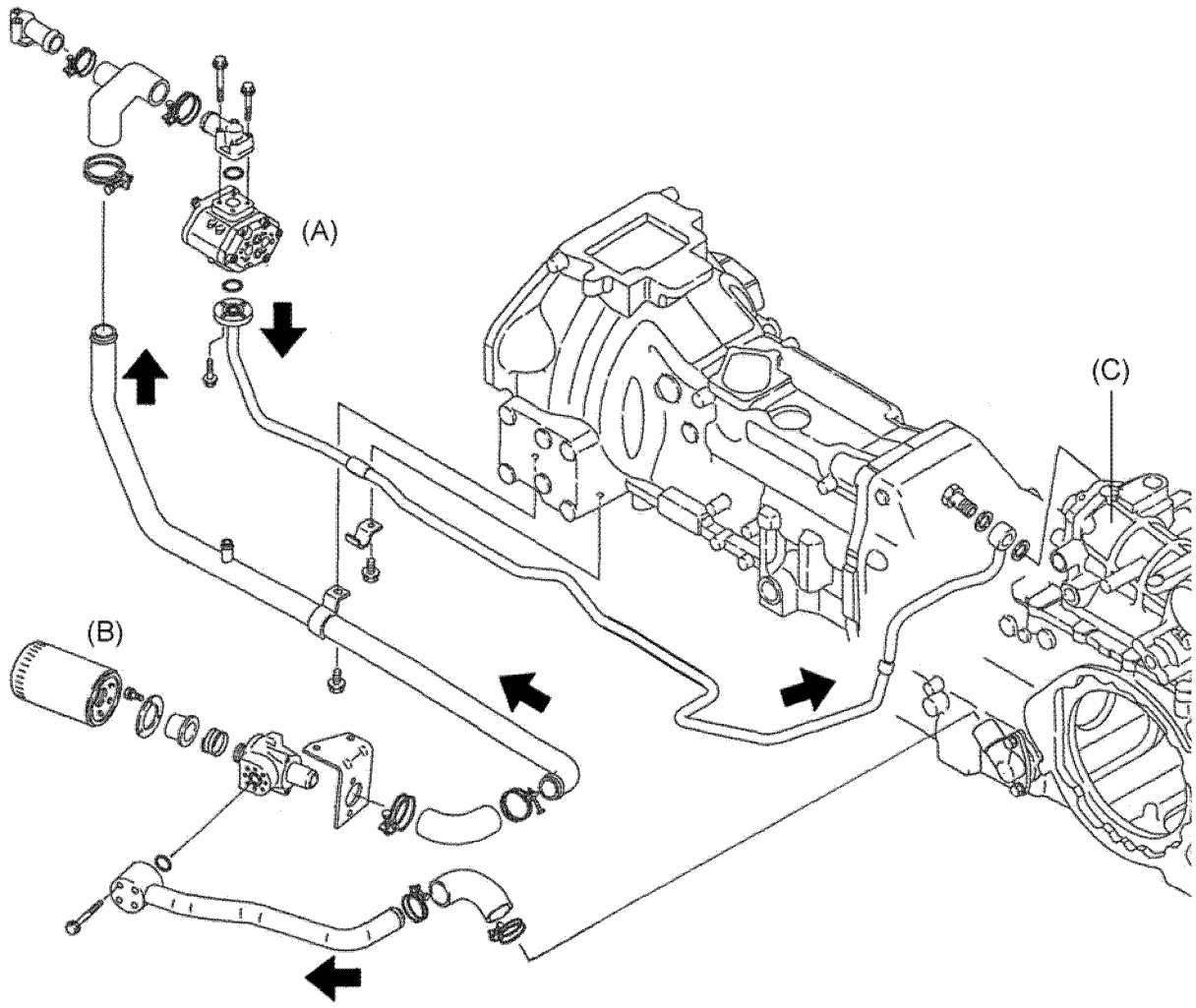
(10) Rotate the spool and sleeve, to remove them from the bottom of the housing.

9

HYDRAULIC LIFT UNIT

9.1 STRUCTURE AND FUNCTIONS

9.1.1 Hydraulic line



(A) Hydraulic pump
(B) Filter
(C) Hydraulic cylinder case

9.1.2 Hydraulic cylinder case

No.	Parts
1	Piston
2	Sleeve
3	Packing
4	Piston rod
5	Lift crank
6	Lifting shaft
7	Sleeve (Lifting shaft)
8	Thrust washer 50 x 82 x 2
9	O-ring
10	Lift arm
11	O-ring 1A G 65.0
12	Plug PTF1/4-18
13	Plug 1/4-16UNF
14	Packing

Relief valve

No.	Parts
15	Relief valve CMP
16	Relief valve assembly
17	Spring (Relief valve)
18	O-ring 2.5 x 23
19	Plug (Relief valve)
20	Packing 20 x 27.8 x 2
21	Shim CMP (Relief valve)

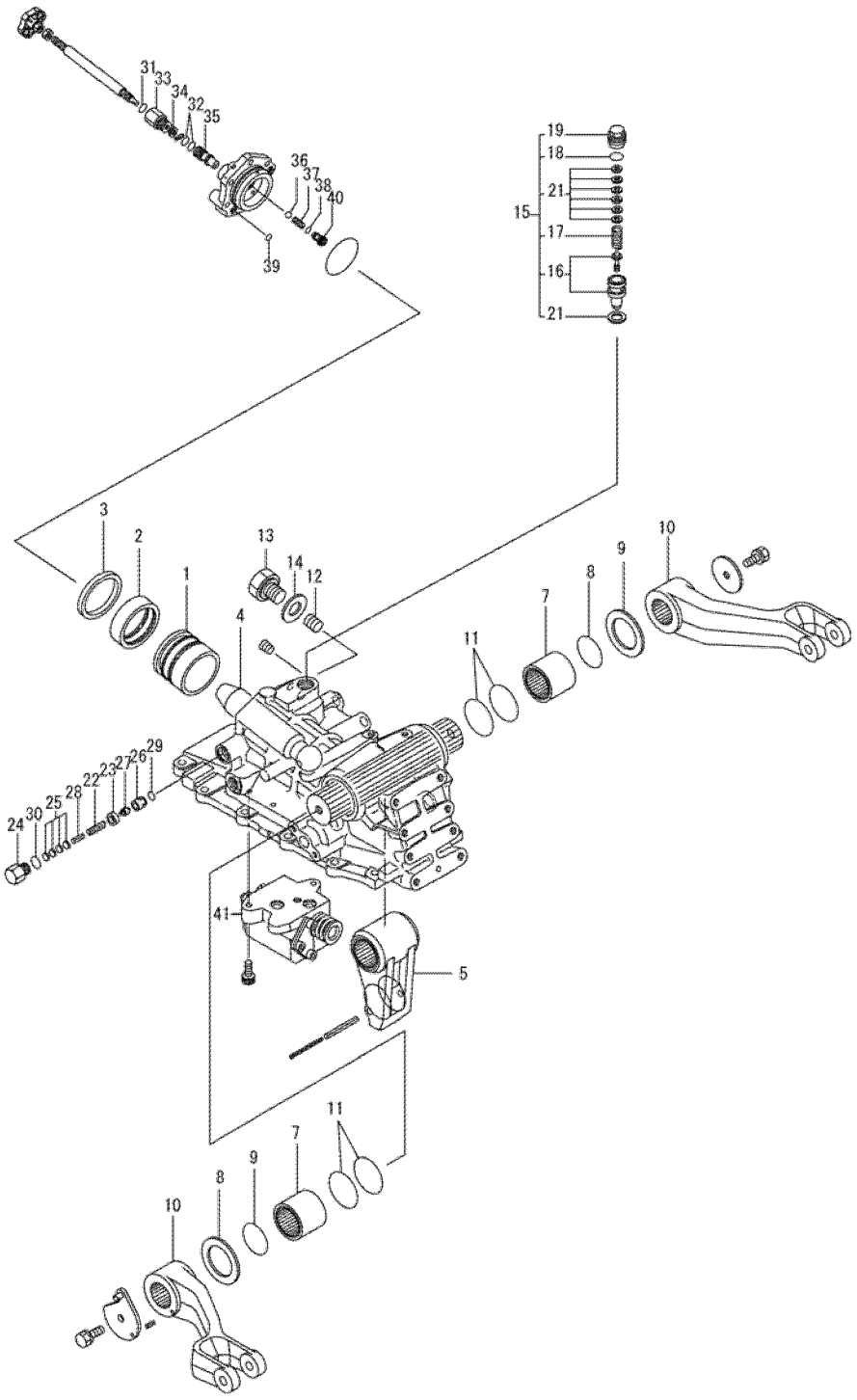
Safety valve

No.	Parts
22	Spring (Relief valve)
23	Collar (Valve)
24	Plug (Safety valve)
25	Shim CMP (Relief valve)
26	Seat (Safety valve)
27	Puppet
28	Spring pin 6.0A x 28
29	O-ring 1A P 12.0
30	O-ring 1A P 18.0

Cylinder head

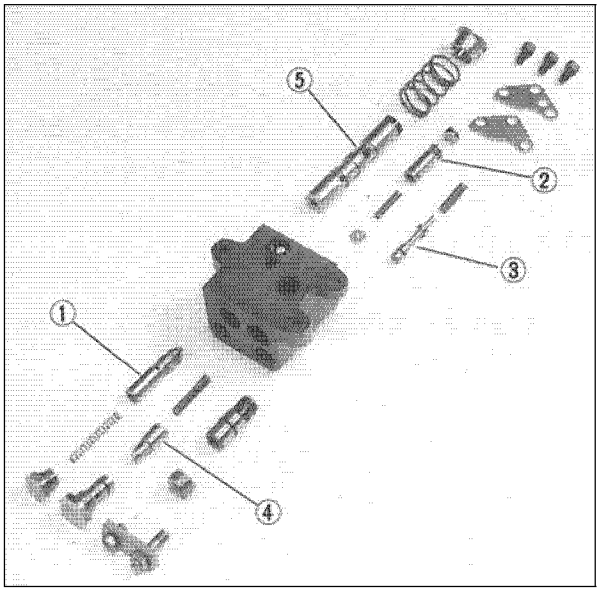
No.	Parts
31	O-ring 1A P 12.0
32	O-ring 1A P 11.0
33	Valve holder
34	washer
35	Stop valve
36	Steel ball 12/32
37	Check spring
38	O-ring 1 B P 12.0
39	O-ring 1 B G 80.0
40	Check valve plug

41	Control valve



9.1.3 Control valve

Operate the spool according to the control lever position to allow the lift arm to be put in the "neutral," "up" or "down" position.

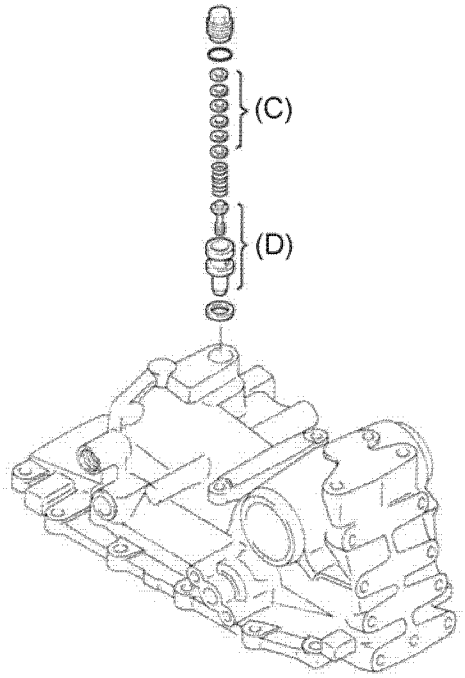


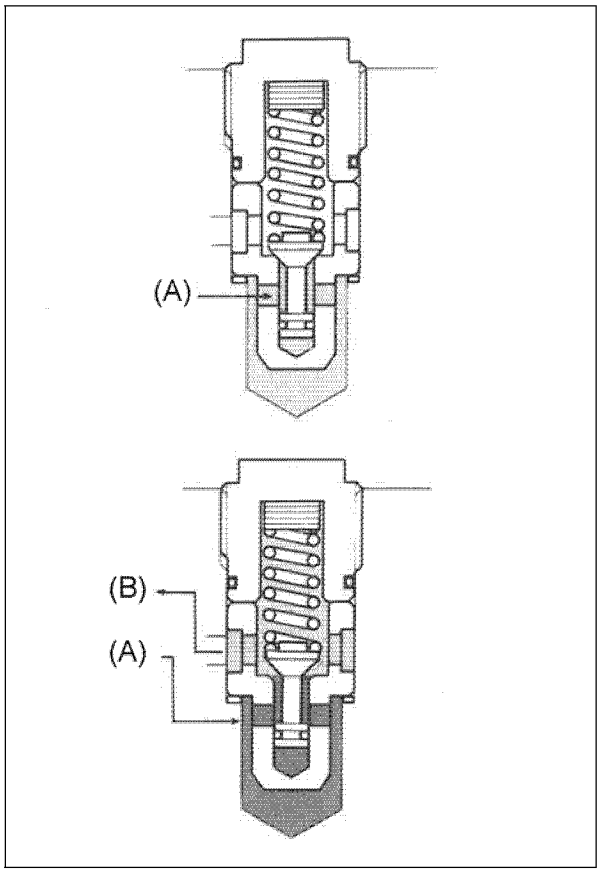
(1) Unload valve
Prevents the oil temperature from rising excessively.
(2) Flow control valve
(3) Reduces shock when the lift arm is at its highest position.
(4) Mechanical check valve
Prevents the implement from being lowered. This valve allows oil to escape from the cylinder when the lift arm is in the "down" position.
(5) Load check valve
Prevents back flow.
(6) Main spool
Switches between the circuits used for changing the lift arm positions ("neutral," "up," and "down").

9.1.4 Relief valve

If the pressure in the hydraulic circuit becomes excessively high, this valve will open to allow oil to escape to the tank.
The pressure setting of the valve can be adjusted by increasing or decreasing the size of shims.

Relief pressure setting:
16.7±17.4 MPa (170-178 kgf/cm^2)



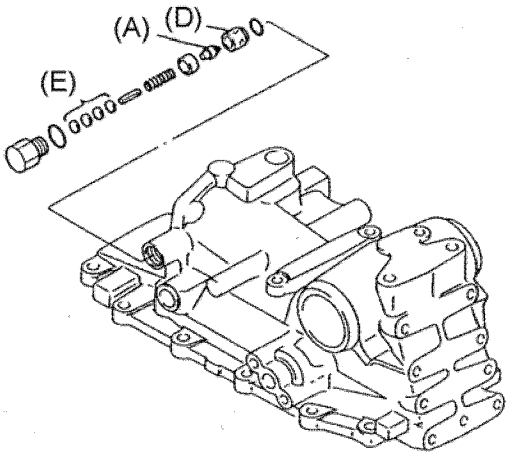


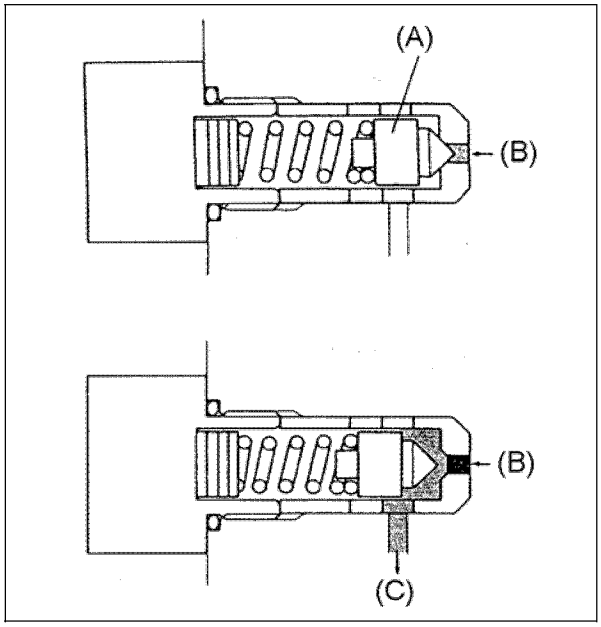
(A) From the hydraulic pump
(B) To the tank
(C) Pressure adjustment shims
(D) Relief valve mechanism

9.1.5 Safety valve

If an external impact force is applied to the implement, this valve will open to protect the hydraulic system and cause oil in the cylinder to escape to the tank.
The pressure setting can be adjusted by increasing or decreasing the size of shims.

Pressure setting:
20.6±1 MPa (200-220 kgf/cm^2)

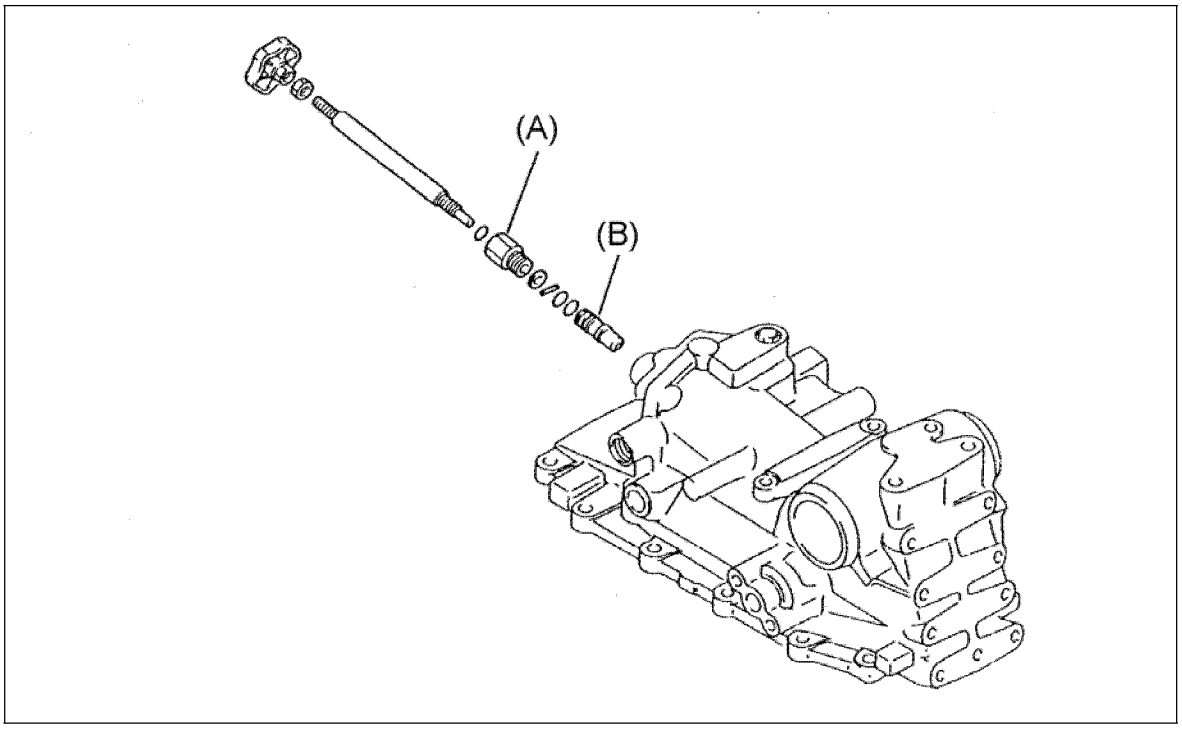




(A) Safety valve
(B) From the hydraulic cylinder
(C) To the tank
(D) Valve seat
(E) Pressure adjustment shims

9.1.6 Stop valve

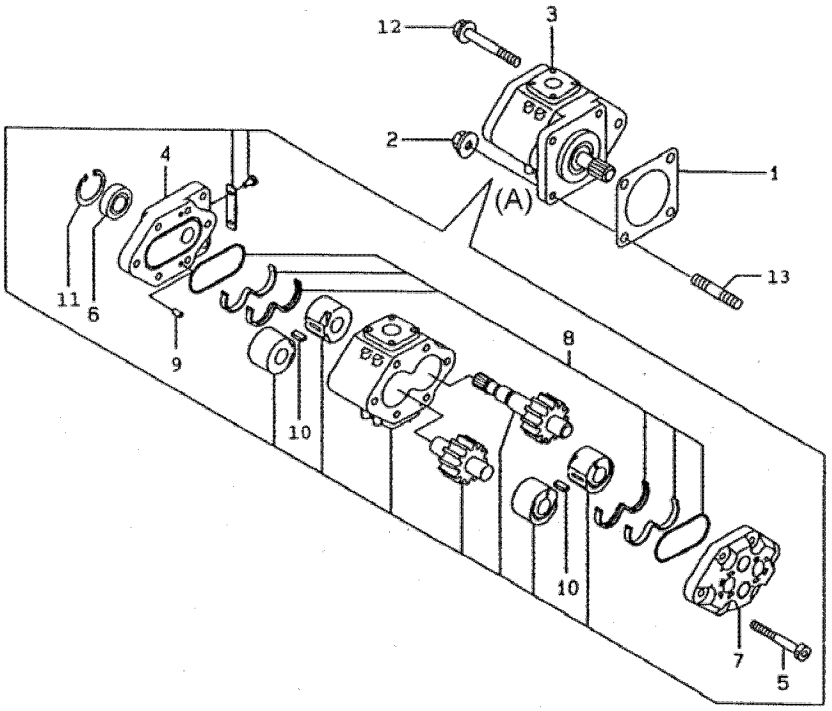
Used to stop motion and to adjust the speed during lowering of the hydraulic lift.



(A) Valve holder (B) Stop valve

9.1.7 Hydraulic pump, exploded view

No.	Parts name
1	Gasket (HO-P)
2	Nut (Supack 8)
3	Hydraulic pump CMP (13A)
4	Flange
5	Bolt 8 x 83.5
6	Oil sea]
7	End plate
8	Seal kit
9	Pin 6x 12
10	Key
11	Circlip (30 dia.)
12	Bolt 8 x 120
13	Stud bolt 8 x 40



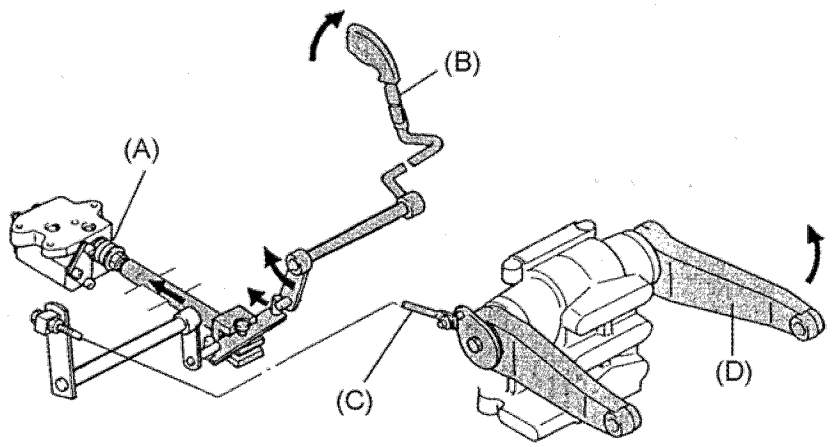
(A) Rear H. O. Pump

9.1.8 Position feedback link

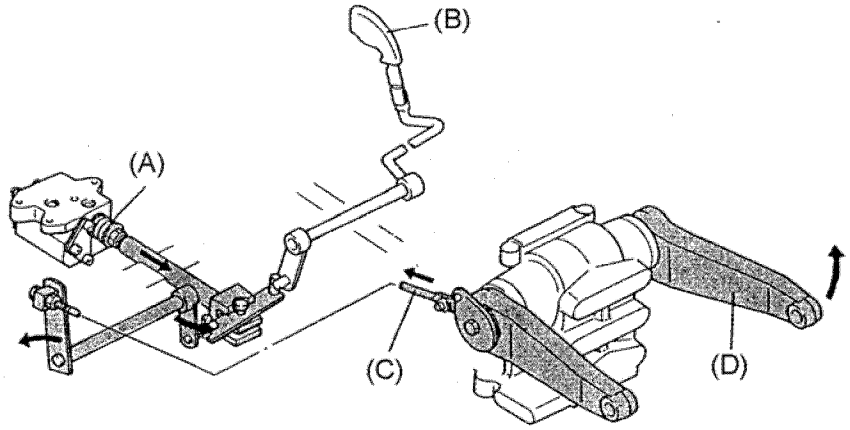
When the control lever is set to the "up" position, it will push the spool of the control valve, located at the rear of the hydraulic cylinder case, through the link. The oil will flow into the cylinder to push up the piston, causing the lift arm to rise.
However, if the lift arm fails to move, a "rise" signal continues to be output.
For this reason, even if the control lever is in the "up" position, the spool of the control valve will be returned to the "neutral" position by the action of the feedback rod attached to the lift arm. The same applies when the control lever is in the "down" position.

When the control lever is set in the "up" position

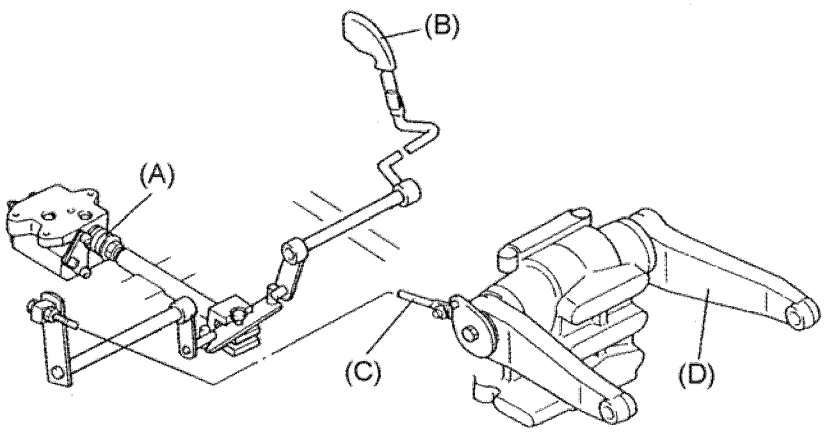
Sudden rise



Slow rise



Neutral

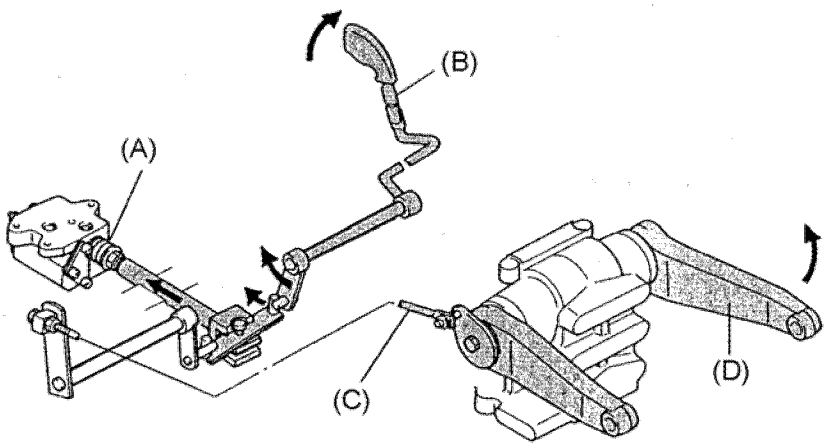


(A) Main spool (B) Control lever (up) (C) Feedback rod (D) Lift arm

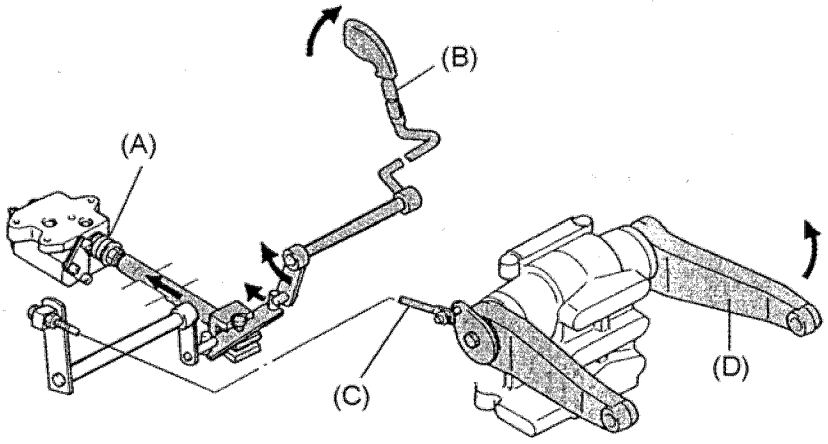
When the control lever is set to the "down" position

When the control lever is set to the "down" position, the force applied by the spool will be released, and the spool will return to its original position by the action of the spring, and the oil in the cylinder will return to the tank. The lift arm will be lowered, and the spool will be returned to "neutral" by the action of the feedback rod.

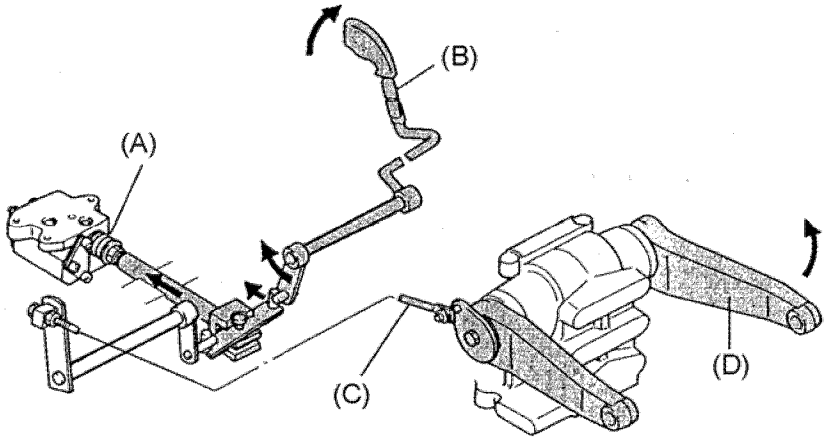
Control lever (down)



Lift arm (down)



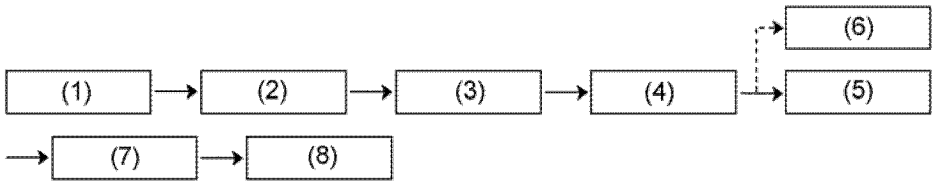
Neutral



(A) Main spool (B) Control lever (up) (C) Feedback rod (D) Lift arm

9.1.9 Oil flow

Oil flow at Neutral

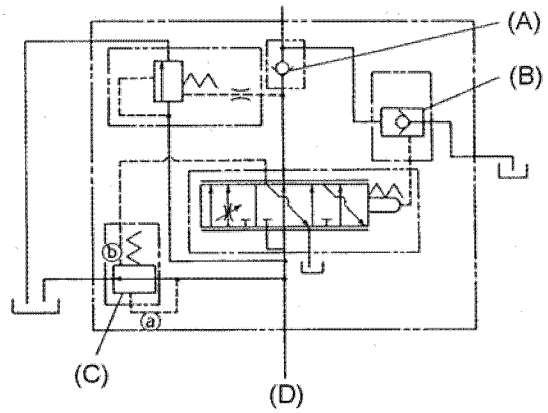


(1) Tank
(2) Strainer
(3) Filter
(4) Hydraulic pump
(5) Intake block
(6) Relief valve
(7) Control valve
(8) Tank

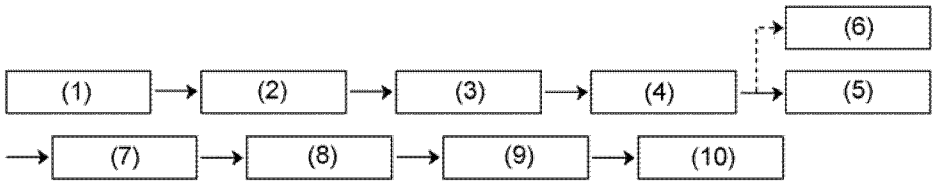
Circuit in the control valve

Back pressure (b) of the unload valve spring chamber disappears and the oil pressure (a) from the pump pushes up the unload valve.
The oil returns to the tank reducing the pressure.
The load check valve and the mechanical valve remain closed.

(A) Load check valve
(B) Mechanical check valve
(C) Unload valve
(D) From pump



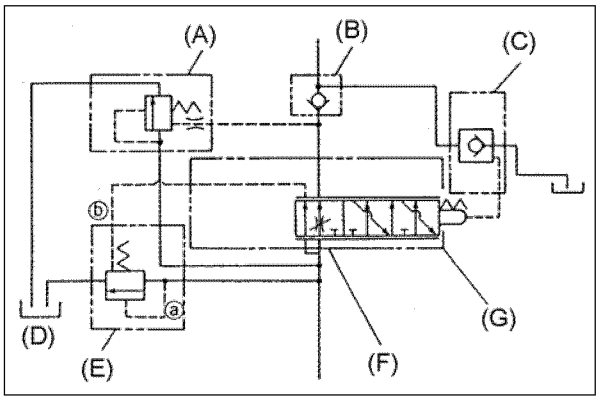
Oil flow in lift operation



(1) Tank
(2) Strainer
(3) Filter
(4) Hydraulic pump
(5) Intake block
(6) Relief valve
(7) Control valve
(8) Load check valve
(9) Cylinder head (Check valve)
(10) Hydraulic cylinder

Circuit in the control valve

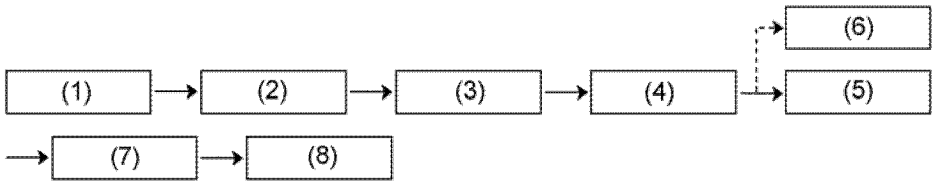
The unload valve is applied with the pilot pressure (a) and (b) at an equal level. It is closed by means of the spring and the oil pressure from the pump increases to cause the oil to go through the throttle in the spool to the cylinder after opening the check valve.
This is the process of a rapid pressure increase. The flow control valve and mechanical check valve are both closed. When the hydraulic lift rises, a feedback takes place to make the spool return to the neutral position and the main spool throttle makes part of oil flow through the tank after opening the flow control valve. The remaining oil flows to the cylinder to eliminate a shock at the upper dead point.



(A) Flow control valve
(B) Load check valve
(C) Mechanical check valve
(D) Tank
(E) Unload valve
(F) Variable flow control throttle
(G) Main spool

Oil flow in lowering operation

Oil in hydraulic pump

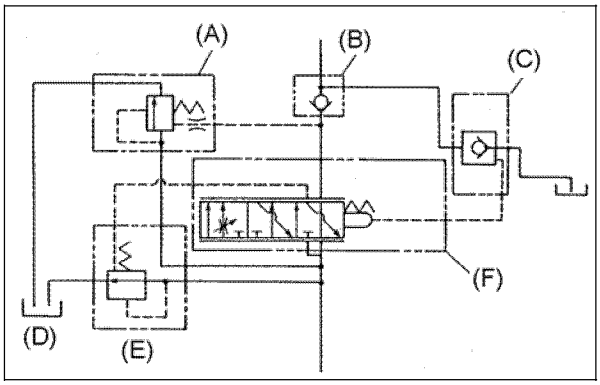


(1) Tank
(2) Strainer
(3) Filter
(4) Hydraulic pump
(5) Intake block
(6) Relief valve
(7) Control valve
(8) Tank

Oil in hydraulic cylinder

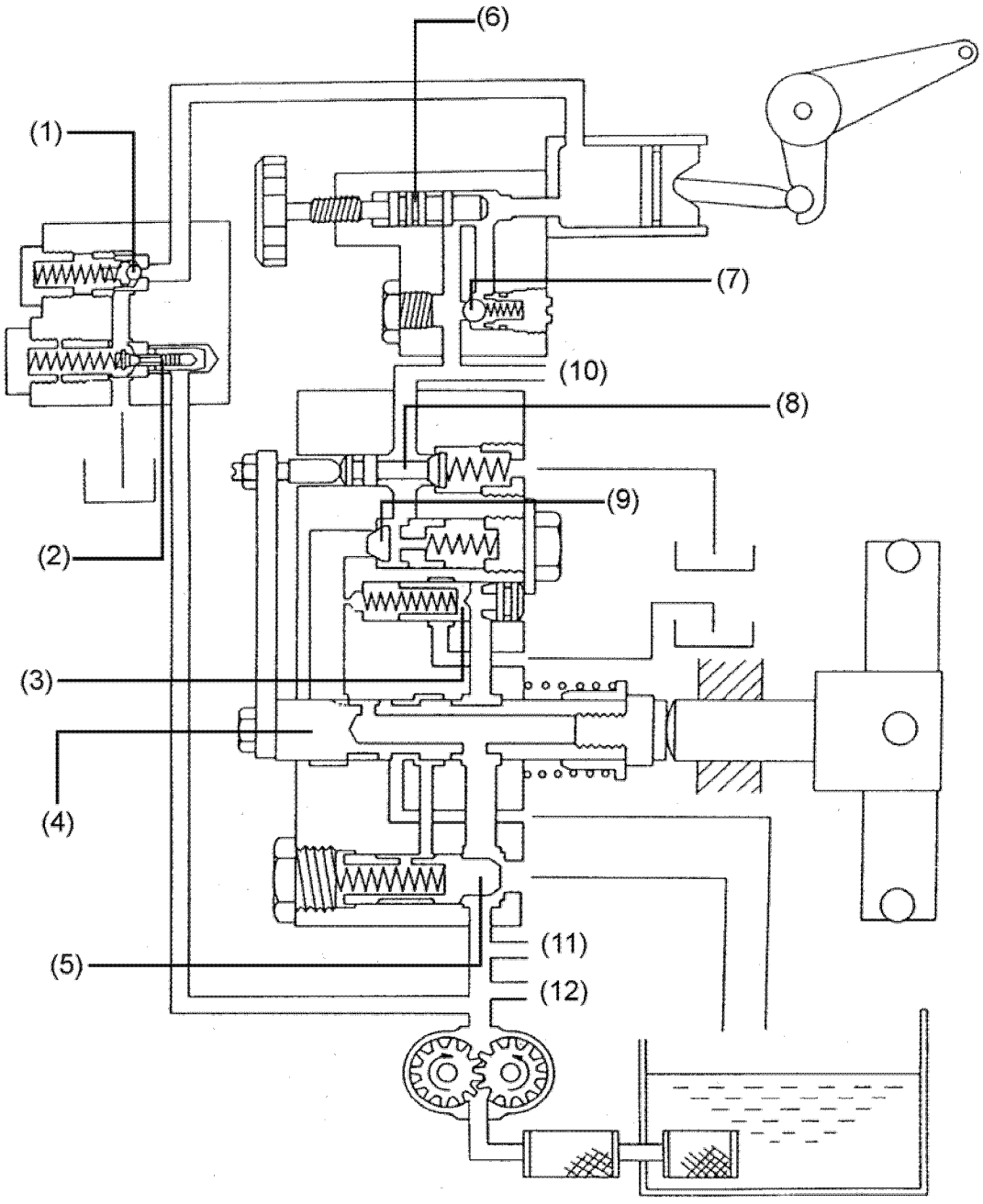
(1) Cylinder (2) Slow return valve (3) Mechanical check valve (4) Tank

Oil from the hydraulic pump opens the unload valve and returns to the tank, likewise in the neutral condition. The oil in the cylinder returns to the tank by opening the mechanical check valve by moving the spool through the pin.



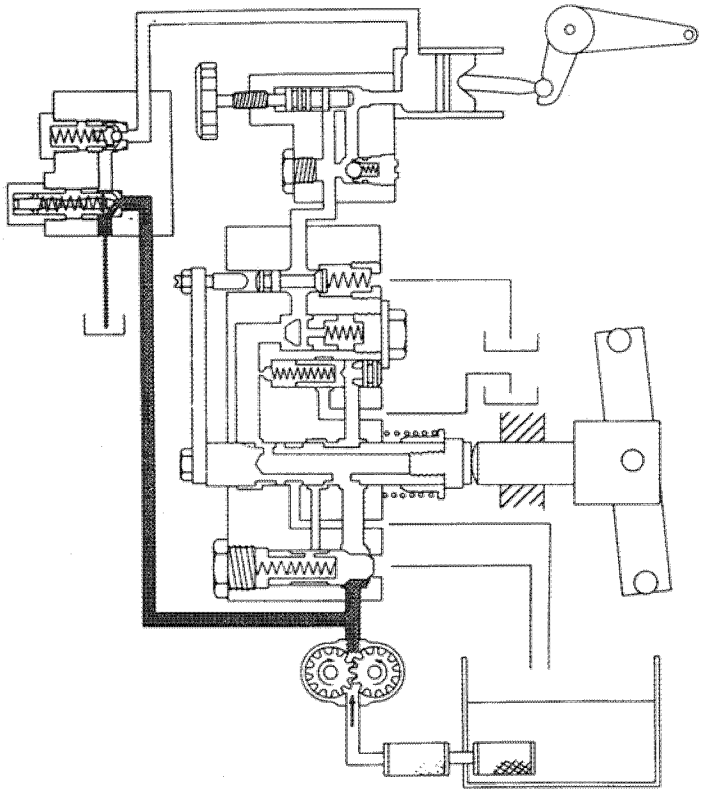
(A) Flow control valve
(B) Load check valve
(C) Mechanical check valve
(D) Tank
(E) Unload valve
(F) Main spool

9.1.10 Oil flow at Neutral

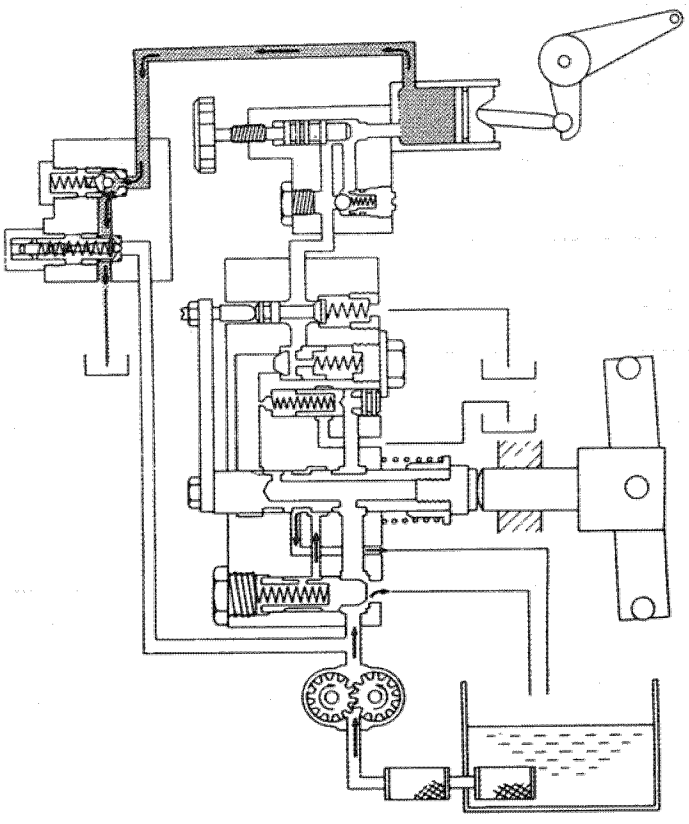


(1) Safety Valve
(2) Relief Valve
(3) Flow Control Valve
(4) Valve Spool
(5) Unload Valve
(6) Stop Valve
(7) Check Valve
(8) Mechanical Check Valve
(9) Load Check Valve
(10) Outlet (single action)
(11) Outlet (IN)
(12) Outlet (OUT)

(1) When operating the relief valve
For details about the valve operating principle, see “9.1.4”.



(2) When operating the safety valve
For details about the valve operating principle, see “9.1.5”.

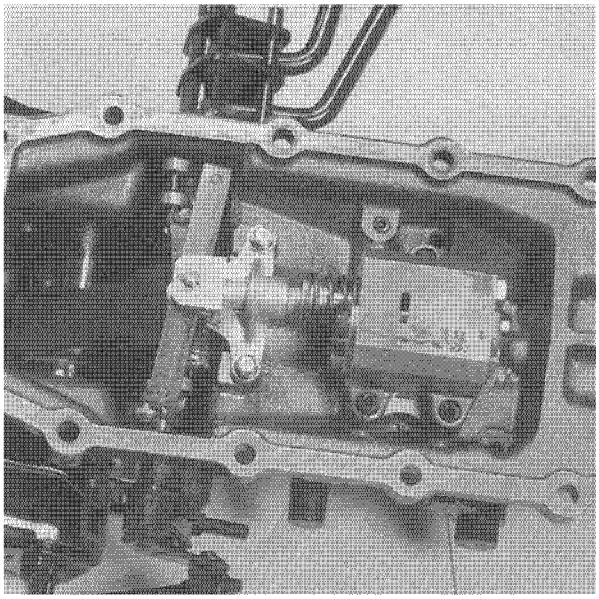


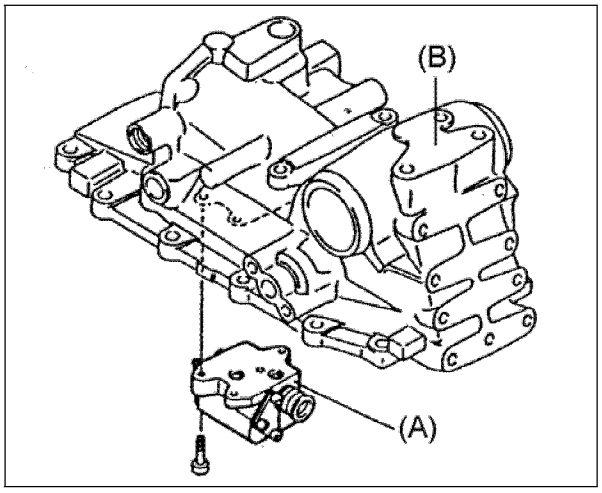
9.2 ASSEMBLY AND CHECK

9.2.1 Assembling/disassembling the control valve

The control valve is located in the back of the hydraulic cylinder case. First remove the hydraulic cylinder case assembly.

NOTE:
Never fail to adjust the feedback link after the control valve assembly is adjusted and installed.

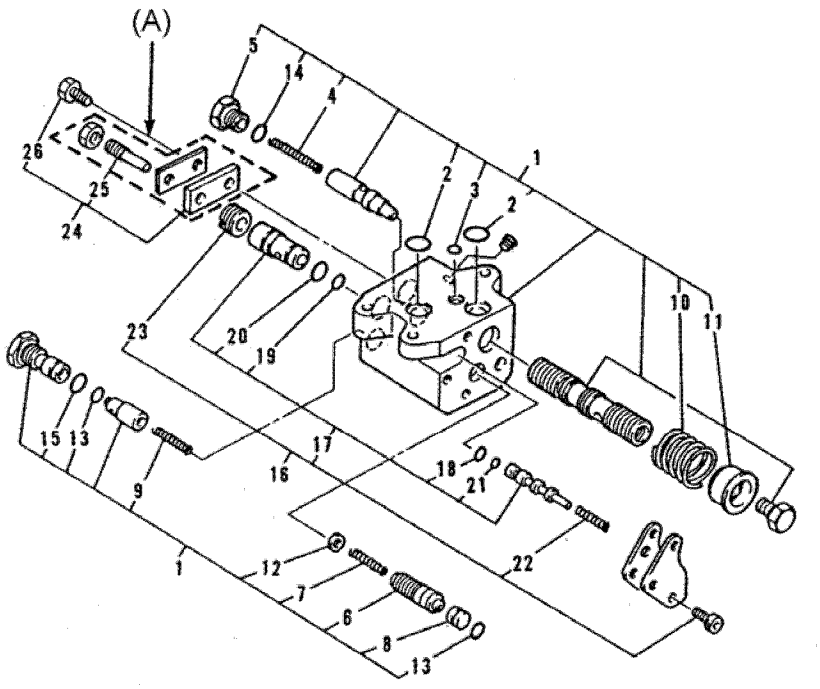




(A) Control valve
(B) Hydraulic cylinder case

9.2.2 Control valve, exploded view

No.	Parts name
1	Valve body CMP
2	0-ring 113 P 14.0
3	0-ring IB P 7.0
4	Unload SP
5	Plug (unload)
6	Spool (flow control)
7	Flow control SP
8	Plug (flow control)
9	Load check SP
10	Spring (Spool)
11	Spring seat
12	Shim (0.2)
13	O-ring 1BS12.0
14	0-ring IA P 14.0
15	0-ring IA P 16.0
16	Mechanical check valve CMP
17	Mechanical check valve sub CMP
18	Backup ring
19	0-ring ID S14.0
20	O-ring 1BS16.0
21	0-ring 1 A P 7.0
22	Mechanical check SP
23	Plug (M check seat)
24	Push bar
25	Push bar
26	Bolt 8 x 14

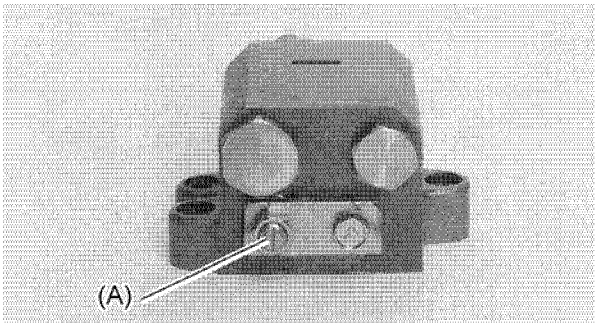


(A) Do not disassemble.

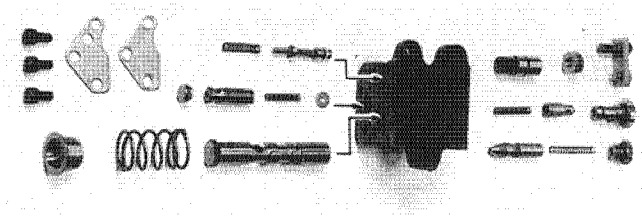
Only the O-ring can be supplied as a separate part.
The other parts can only be supplied as a complete control valve assembly.

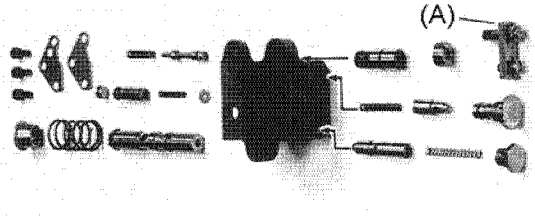
NOTES:
When disassembling
Do not loosen M10 bolts fixing the push bar of the mechanical check valve.
Springs of respective valves look like; do not mix them up.

When assembling
- Before reassembling, wash each part in cleaning oil and remove dust and dirt with compressed air. Apply oil TF500 to the parts.
- Be careful not to lose or drop 0-rings. Insert them in position.
- Punch lock the plug for the mechanical check valve seat.



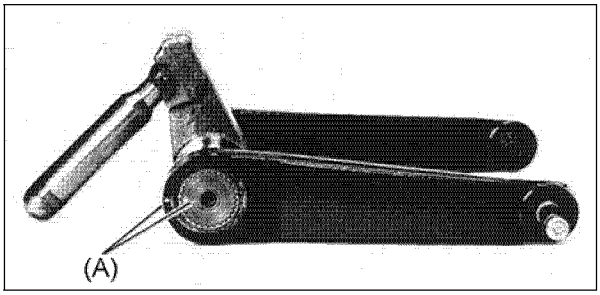
(A) Do not disassemble.



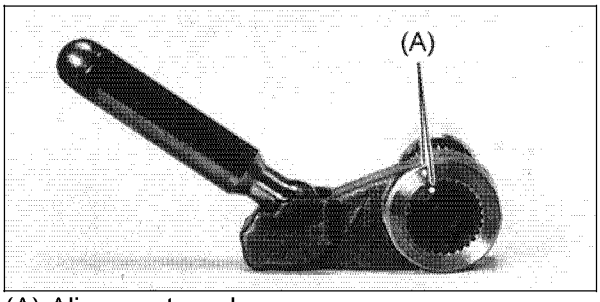


Caution when assembling
The lift arm, lift crank and lift shaft on the hydraulic cylinder casing have alignment marks.

Lift arm and lift shaft



Lift shaft and shift crank



(A) Alignment mark

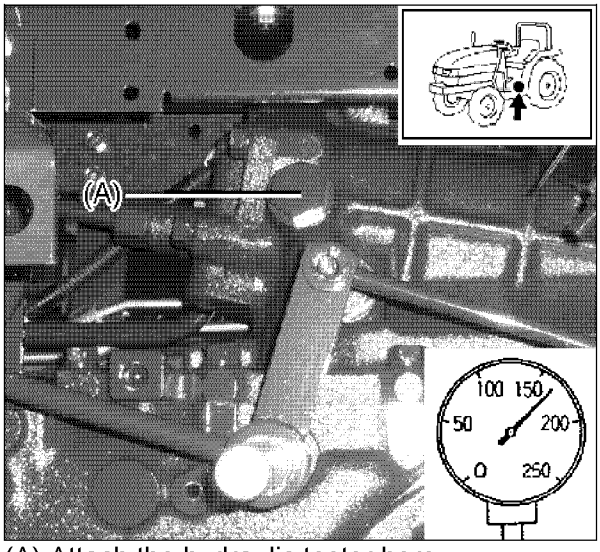
The photos show white paint on the mark, for reference.

9.2.3 Main relief pressure

(1) Remove the single output plug lower the seat.
(2) Attach the hydraulic tester to the output block.

Note:
Size: 3/4-16 UNF

(3) Start the engine and lower the hydraulic lift arm.
(4) Close the stop valve, increase the engine speed, and set the control lever to the position of UP. Read the tester when a relief sound is heard.



(A) Attach the hydraulic tester here.

Set pressure: 170-178 kgf/cm^2 (16.7-17.4 MPa)

If pressure is too high: Decrease the number of shims.
If pressure is too low: Increase the number of shims to the relief valve.

Shim's effect:
Shim 0.25 mm thick: 3.9 kgf/cm^2
Shim 0.5 mm thick: 7.7 kgf/cm^2
Shim 1.0 mm thick:15.5 kgf/cm^2

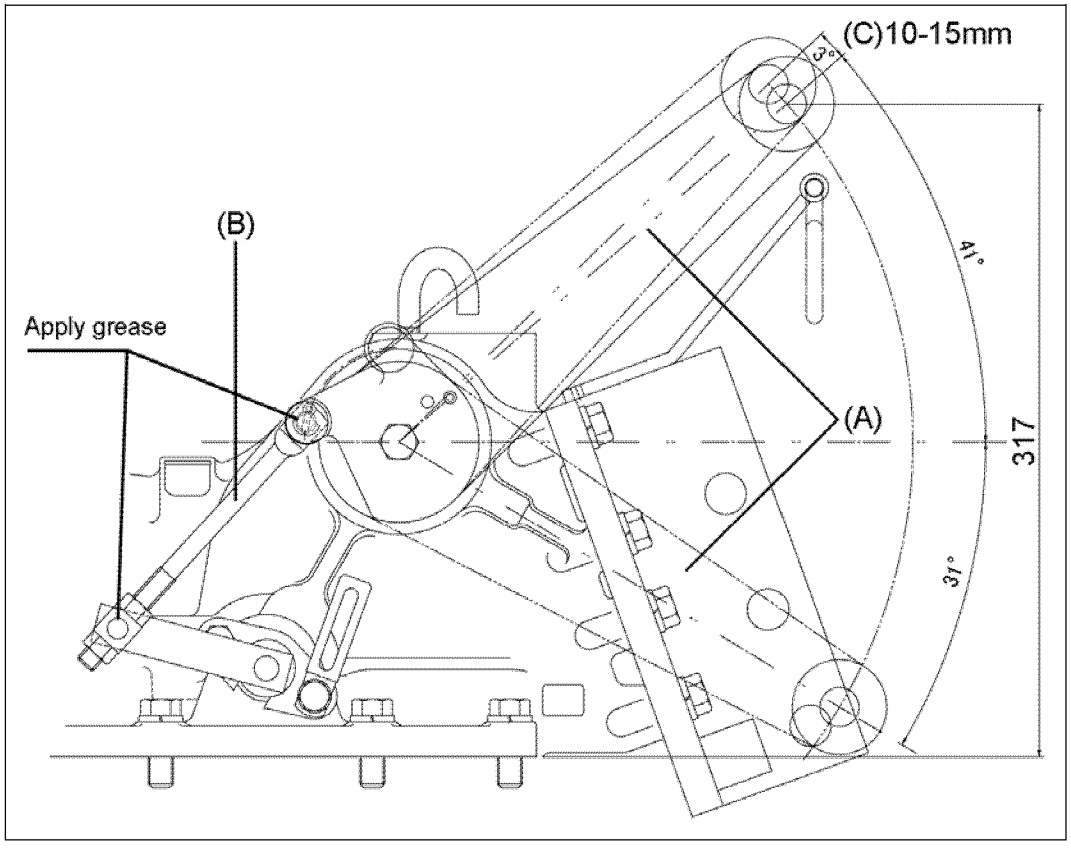
9.2.4 Adjusting the position feedback rod

<Adjustment>
Position control feedback
(1) Turn the stop valve until it is “Fully open”.
(2) Start the engine, put the position control lever in the “Lowest” position, and put the lift arm in the lowest position.
(3) Run the engine at the maximum speed, put the position control lever in the “Highest” position, and put the lift arm (A) in the highest position.
(4) Adjust the length of the position feedback rod (B) using an adjuster so that the height of the lift arm (A) is 317 mm.

IMPORTANT
As a guide, adjust the play (C) in the lift arm (A) to 10 to 15 mm, when in the highest position.

The rod is lengthened.: The lifting height is reduced.
The rod is shortened.: The lifting height is increased.

Note:
After each adjustment is performed, lower the lift arm (A).



(A) Lift arm (B) Position feed-back rod (C) Lift arm free play

9.3 HYDRAULIC POWER TAKE OFF

The hydraulic pressure for single and double action devices can be taken from the hydraulic cylinder case.

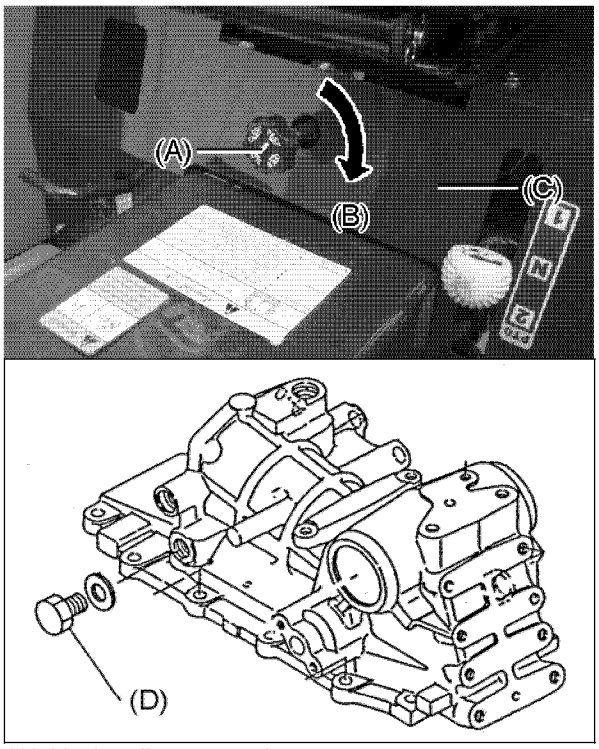
The hydraulic pressure capacity is as follows:
Oil flow: 32.2 lit./min/2700 rpm (engine)
Pressure: 170-178 kg/sq.cm

9.3.1 For single action, pump trailer etc.

In the case of a single action cylinder, remove the hydraulic output plug on cylinder head and connect the hose from an implement.

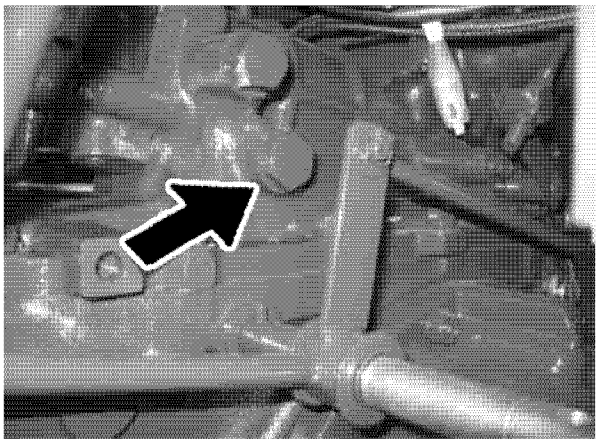
<Operation>
(1) Set the position control lever at about 50 mm below the highest position.
(2) Screw the hydraulic stop valve clockwise fully to close.
(3) Remove the front cover and plug of the hydraulic output. Connect hydraulic hose of the implement.

NOTE:
Keep copper packing and plugs not to lose them.



(A) Hydraulic stop valve
(B) Close
(C) Front cover
(D) Plug 3/4-16 UNF

IMPORTANT
Single action operation should be performed using the tractor's position lever.



9.3.2 For double action, front blade etc.

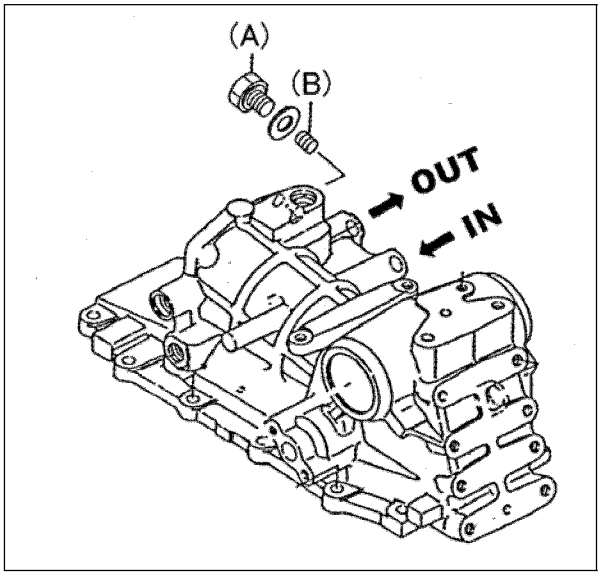
<Operation>

(1) Remove the right side plug on the hydraulic cylinder head and connect the valve of the implement.

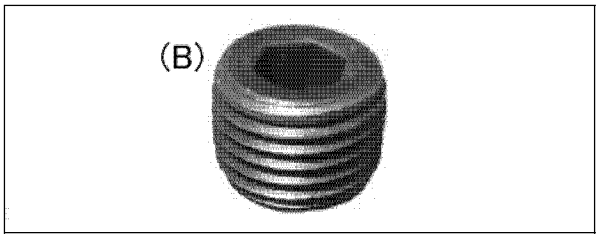
(2) Remove the plug and tighten the plug (PTF 1/4) to switch inner hydraulic oil flow.

Front: OUT (to take out, to SCV valve
Size : 3/4-16 UNF)
Rear: IN (to return, from SCV valve
Size : 3/4-16 UNF)

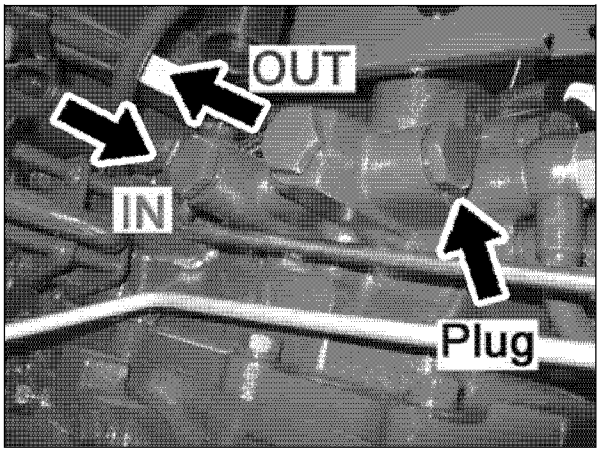
NOTE:
For operation of implement, refer to the operation manual of the relevant equipment.



(A) Plug
(B) Screw plug (PTF 1/4-18 : 198245-42160)



IMPORTANT
Double action operation should be performed using the implement's operation lever.



CAUTION

- Takeoff of the external hydraulic pressure should always be performed at the specified place.
- Do not try to make a take off for the external hydraulic pressure by modifying the lines between the hydraulic pump and the hydraulic cylinder case. Otherwise, it may cause damage to the hydraulic pump.
- The reasons for this will be explained on the following pages.

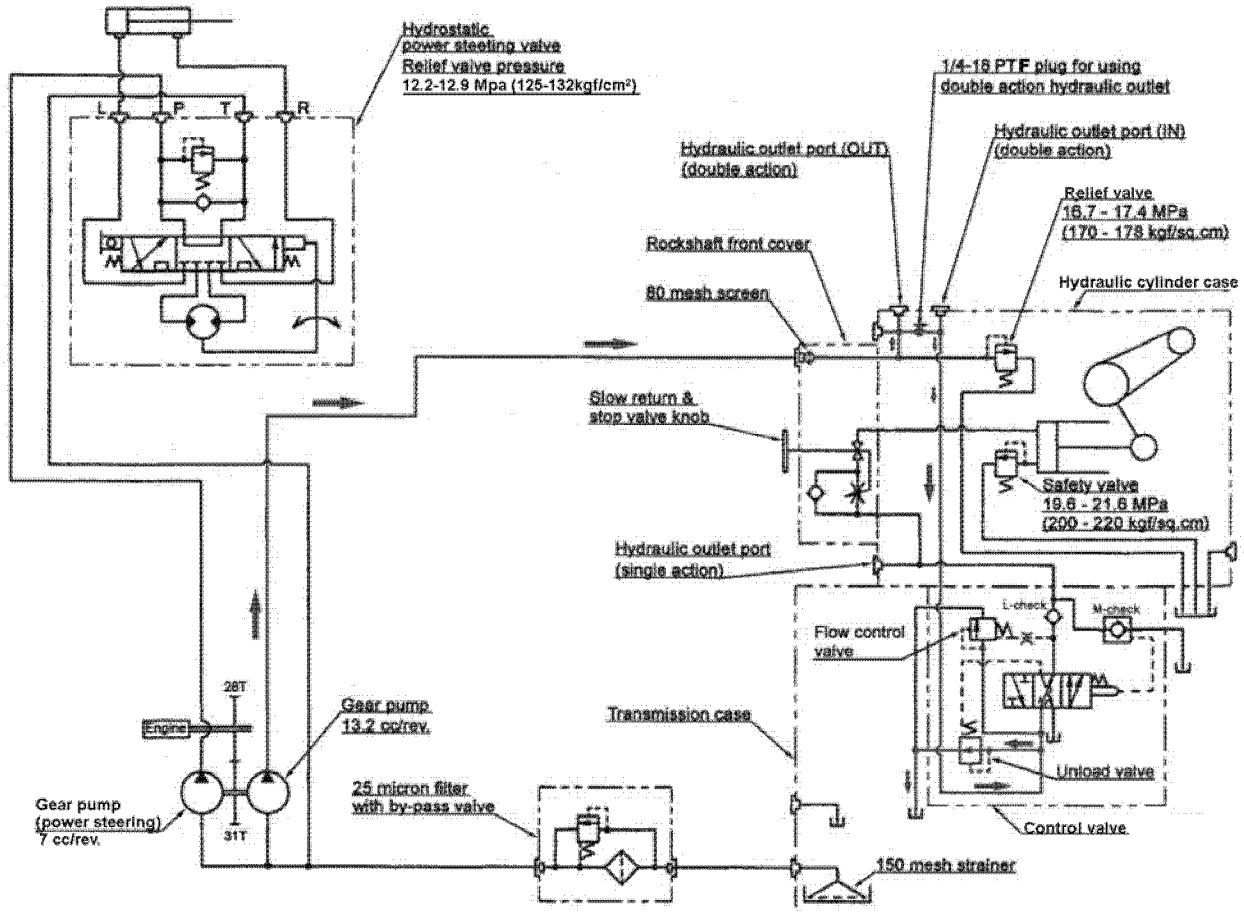
9.3.3 Hydraulic pressure flow

(1) Hydraulic circuit, 3-P, Neutral
New hydraulic lift units are set up to use a 3-point hitch.

- The hydraulic oil that is highly pressurized by the gear pump is fed to the hydraulic cylinder case.
  ↓
- After any particles have been removed from the hydraulic oil using an 80-mesh screen, and if the pressure is below the setting for the relief valve, the high-pressure hydraulic oil is fed to the control valve mounted under the hydraulic cylinder case.
  ↓
- The hydraulic circuit is switched by the control valve, to move the 3-point hitch up and down. When the control valve is in the neutral position, the hydraulic oil under pressure is returned to the transmission through the unload valve.

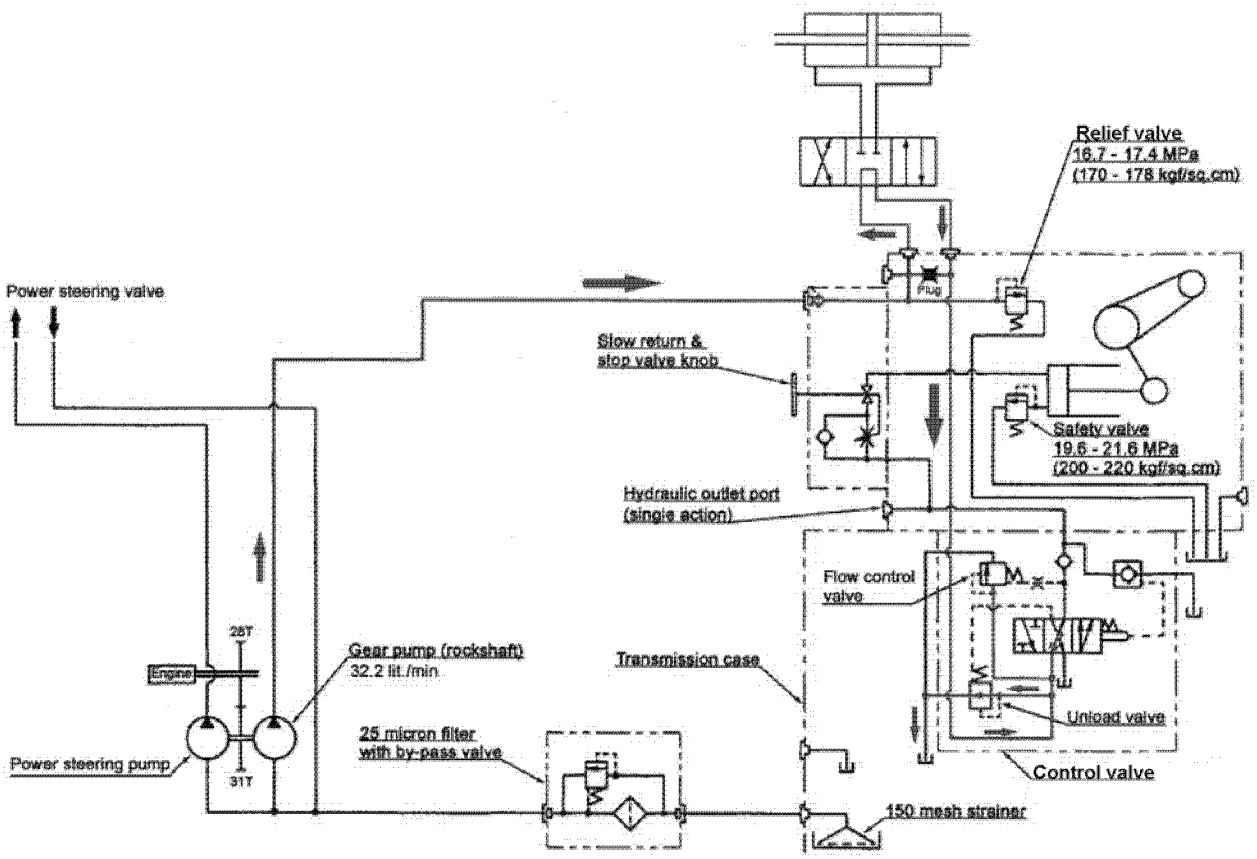
IMPORTANT

If the implement is too heavy or the 3-point hitch cannot move because of obstacles in its way, the hydraulic circuit is protected by a relief valve that opens, which returns the hydraulic oil to the transmission.



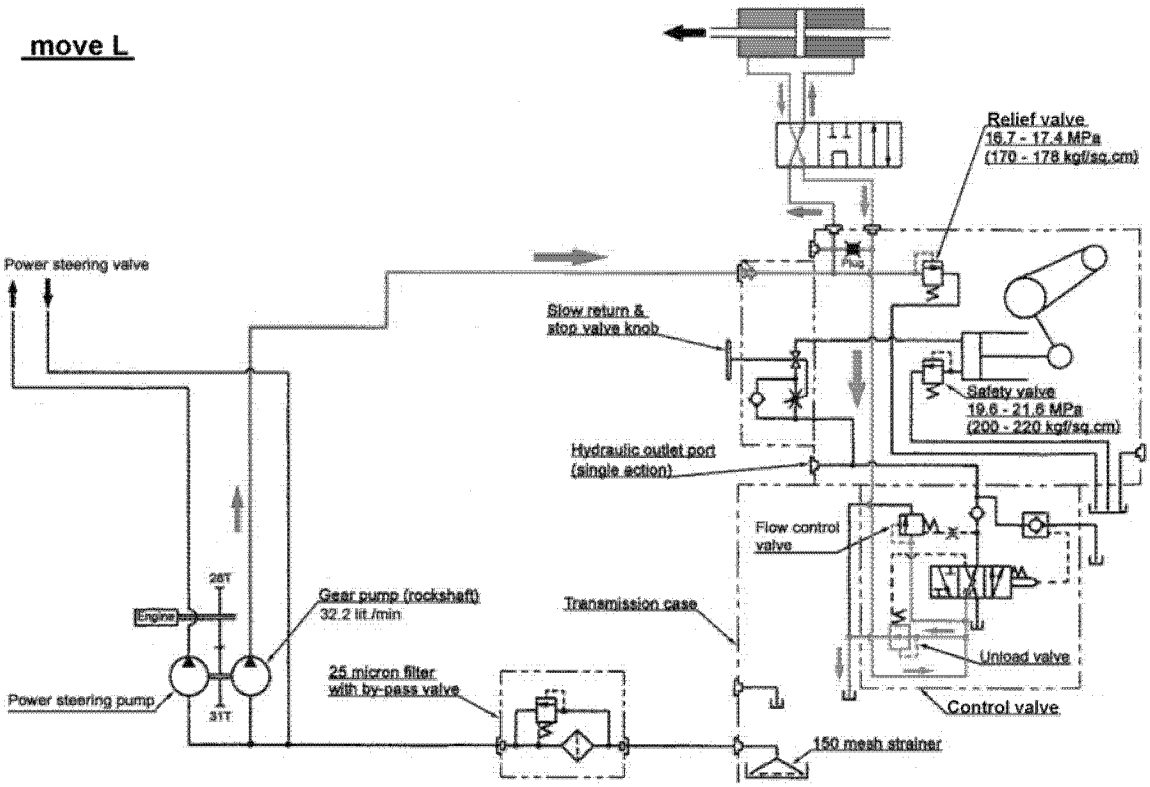
(2) Hydraulic take off, double action, neutral
If a 1/4-18 PTF screw plug is mounted on the hydraulic cylinder case in order to create a take off for the double-action hydraulic pressure:

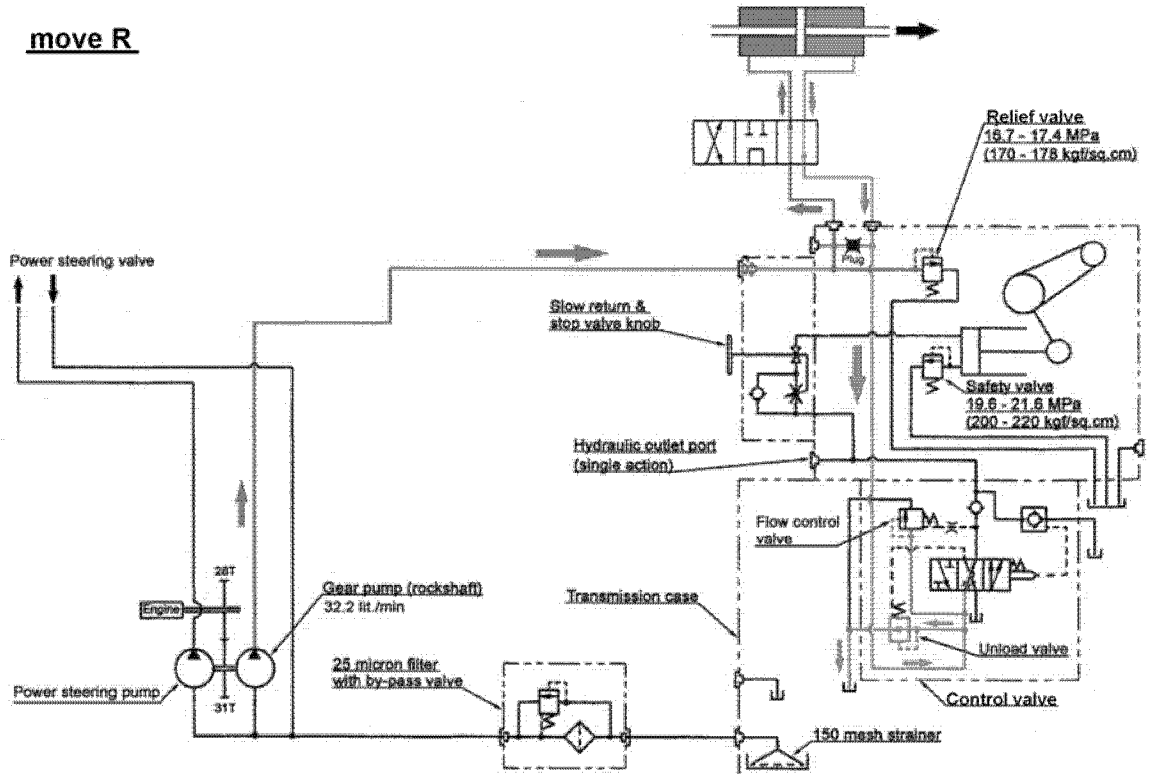
- Since high-pressure hydraulic oil fed into the hydraulic cylinder case can not escape through the hole closed by the screw plug, it will be fed to the implement's valve through the external takeoff port.
  ↓
- When the implement's valve is in the neutral position, the high-pressure hydraulic oil is returned to the transmission, just as in the case of the 3-point hitch.



(3) Hydraulic take off, double action, move L & R
The implement's cylinder moves in the direction controlled by the implement's valve, and the returning hydraulic oil is sent to the transmission through the control valve.

- When the implement's cylinder stops moving, due to an obstacle, the high-pressure hydraulic oil will not flow from the takeoff outlet into the implement's valve. Instead, it will flow to the transmission through the relief valve, which will open due to the increased pressure. This action protects the hydraulic circuit.



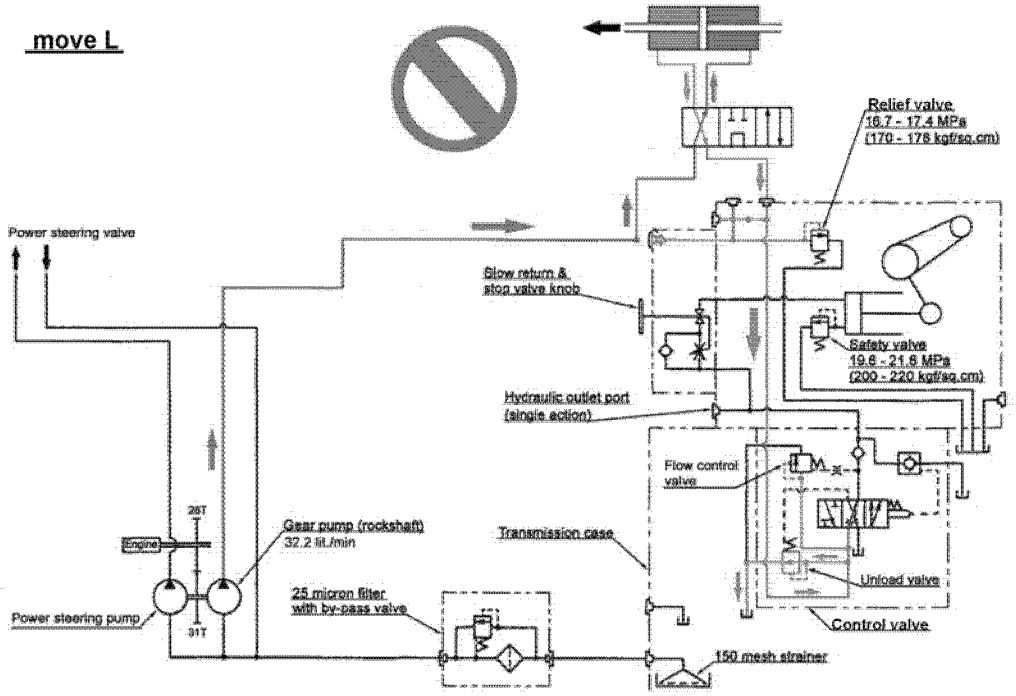


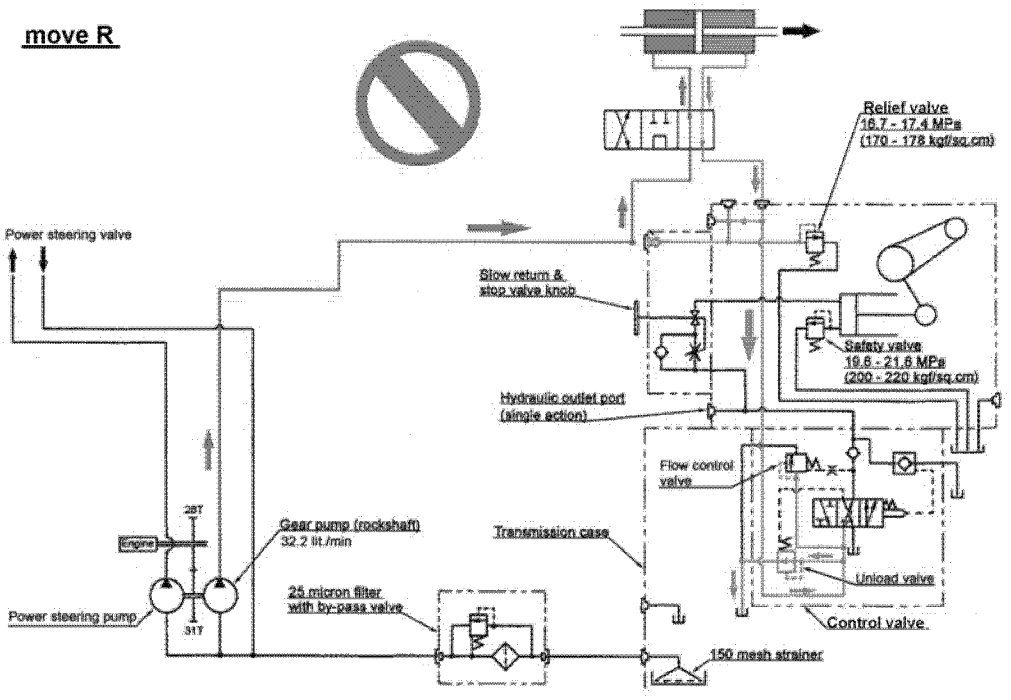
(4) Hydraulic take off, wrong connection
If the lines between the gear pump and the hydraulic cylinder case are modified and a connection is made that goes directly to the implement's valve.

- When the implement's cylinder stops moving, due to an obstacle, and since there is no relief valve in the hydraulic circuit, there is no place where the high-pressure hydraulic oil can escape. Then, the high-pressure hydraulic oil will flow from the unload valve to the transmission while applying high pressure to all of the hydraulic circuits.

CAUTION

- The hydraulic circuit and other parts will be damaged.
- The supply of external hydraulic pressure to an implement should only ever be performed from the specified place.



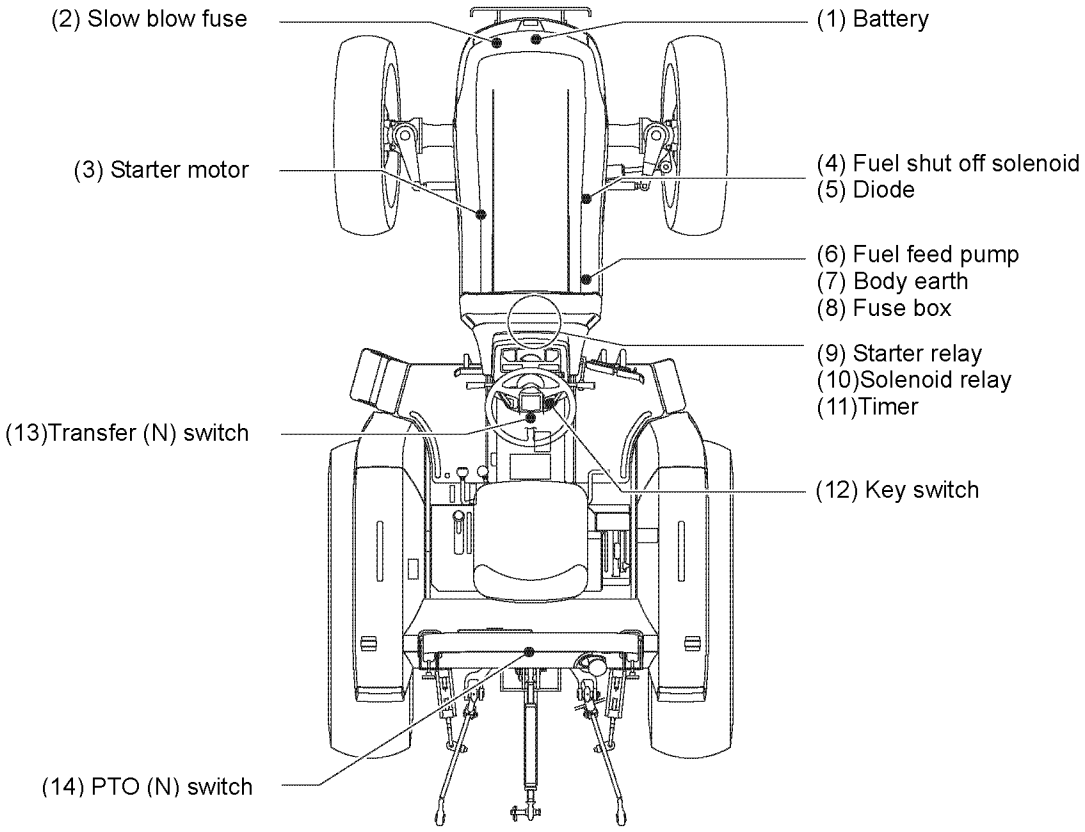


10

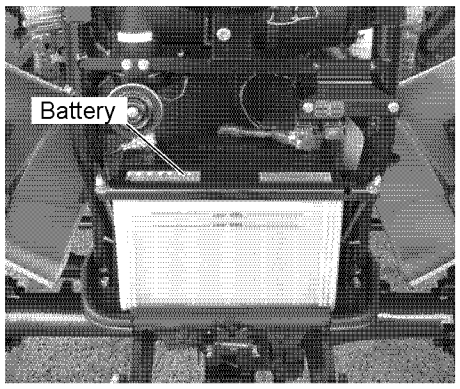
ELECTRIC EQUIPMENT

10.1 ENGINE START CIRCUIT

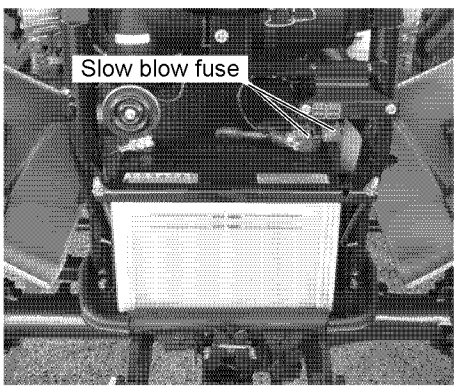
10.1.1 Location and operation of components



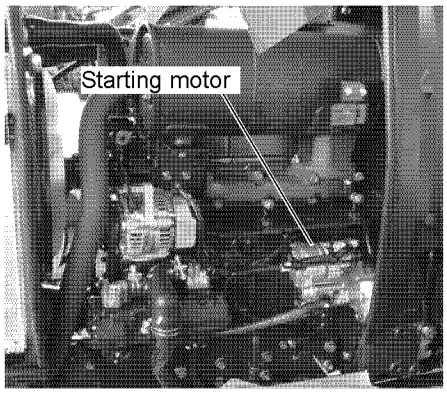
(1)



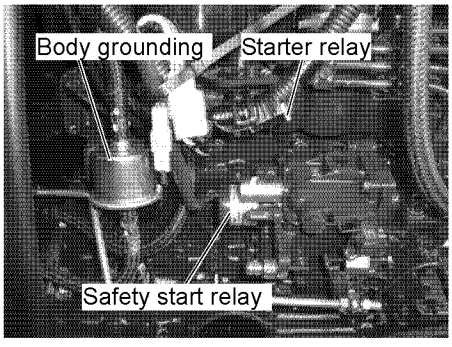
(2)



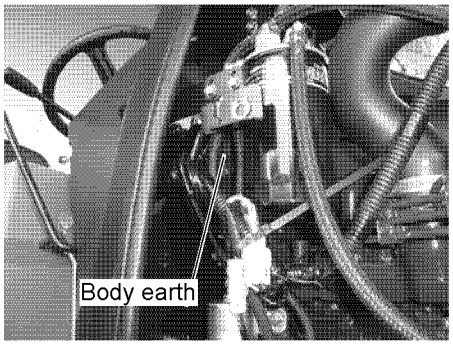
(3)



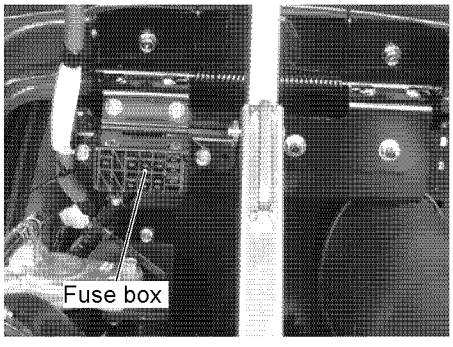
(4) (5) (6)



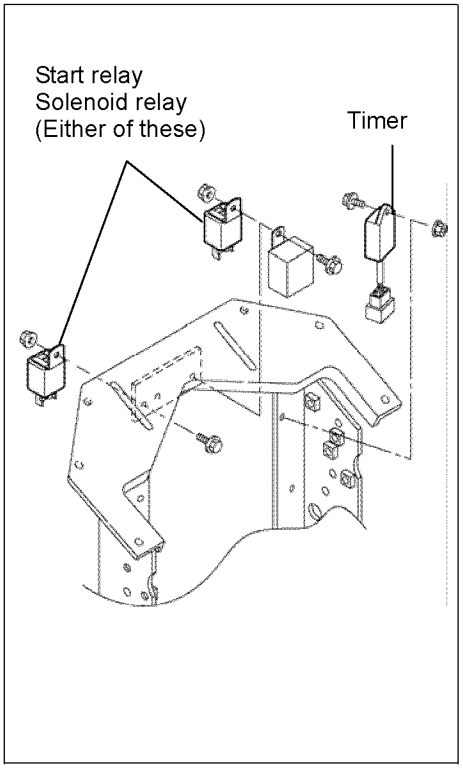
(7)



(8)



(9) (10) (11)



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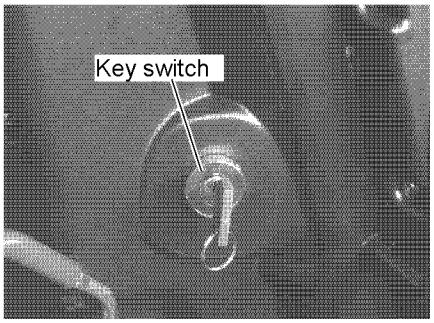

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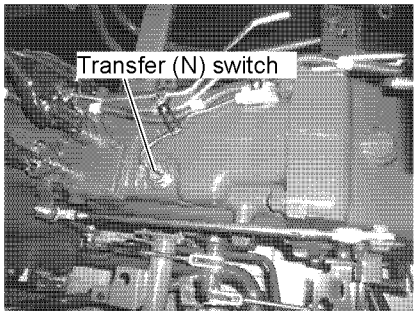

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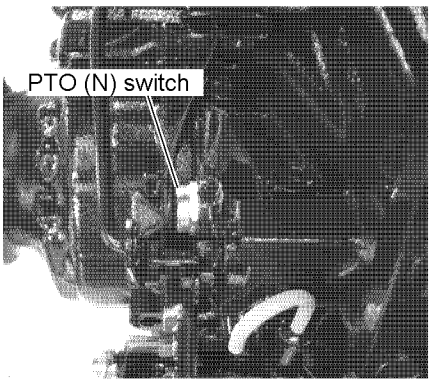
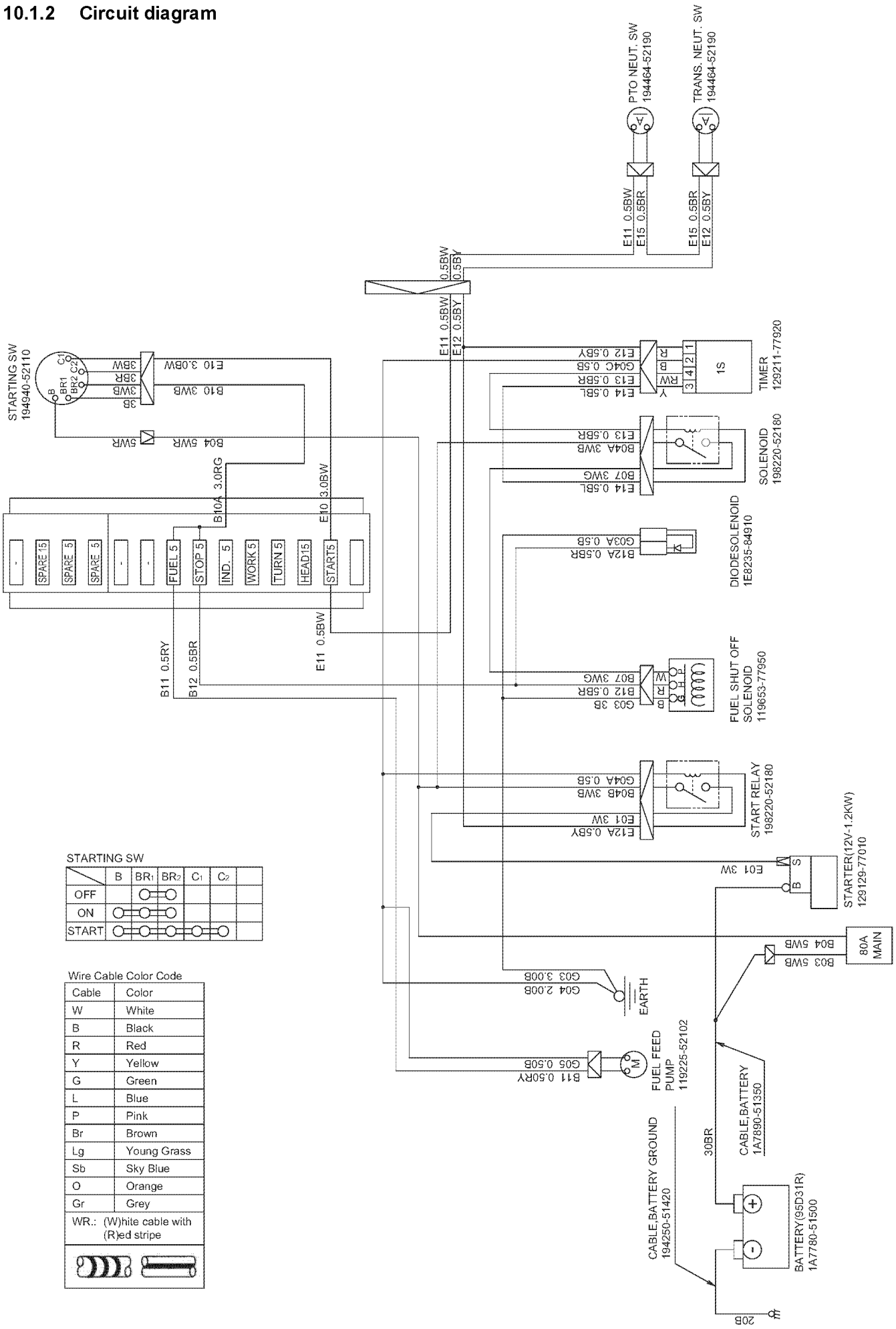


Location	No.	Parts name	Parts catalogue name Parts catalogue number	Operation and remarks
Engine front	1	Battery	Battery 95D31R 1A7780-51500	Supplies power to the circuits.
	2	Slow blow fuse (main)	Fuse 80A slow blow 198153-51700	Protects wiring & electric equipment related to engine start.
Engine left side	3	Starter motor (12V-1.2KW)	Starter assy. 129129-77010	Cranks the engine when the key switch is set to the "ST" position, the range shift to the "N", and the PTO to the "N" status.
Engine right side	4	Fuel shut off solenoid	Stop solenoid 119653-77950	Cuts off the fuel to the fuel injection pump to stop the engine when the key switch is turned off.
	5	Diode	Diode 1E8235-84910	Provides protection to the wiring and electric equipment against surge current that occurs when the fuel shut-off solenoid is activated.
	6	Fuel feed pump	Fuel feed pump assy. 119225-52102	Supplies the fuel to the fuel injection pump.
	7	Body earth		
	8	Fuse 5A	Fuse 198535-52110	Fuse for Fuel feed pump, Stop solenoid and Neutral switches.
Inside of front Column	9	Start relay	Starter relay 198220-52180	It is activated when the range shift lever & PTO lever are set to the "N" position. It gives requisites for application of 12 V to the terminal S of the starter motor.
	10	Solenoid relay		It is activated when the range shift lever & PTO lever are set to the "N" position. It gives requisites for application of 12 V to the fuel shut off solenoid.
	11	Timer	Timer 129211-77920	It is activated when the range shift lever & PTO lever are set to the "N" position. It gives requisites for application of electric power for 1 second to the pull coil of fuel shut off solenoid.
Front column	12	Key switch	Starter switch CMP 194940-52110	Used for ON/OFF of the battery power to the circuits.
Transmission case upper side	13	Transfer (N) switch	Safety starter switch 194464-52190	Detects the "N" position of the range shift.
Transmission case rear side	14	PTO (N) switch		Detects the "N" position of the PTO.

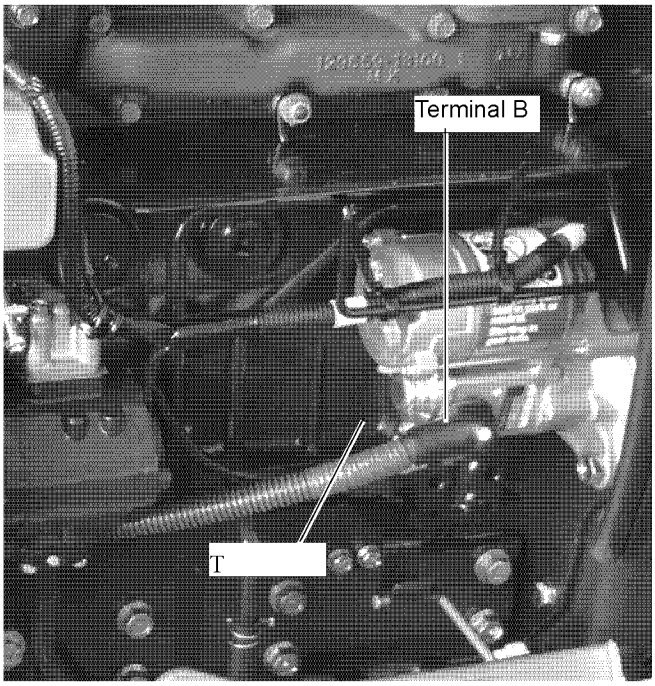
10.1.2 Circuit diagram



10.1.3 Checkpoints of electrical equipment

3. Starter motor

Starter (129129-77010)

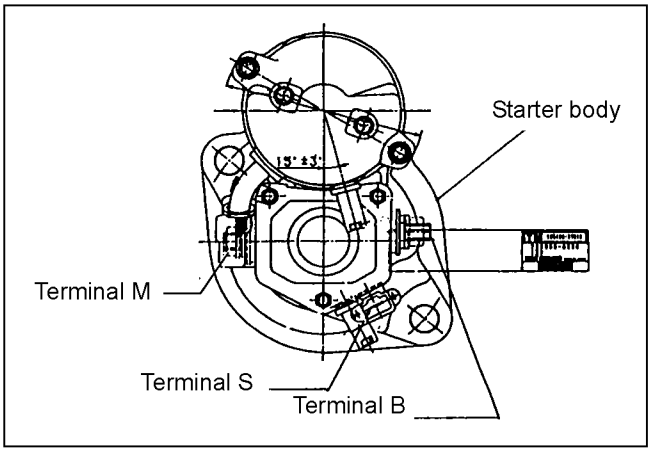


Continuity test of single item

Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
Continuity	Starter body	Terminal S		Continuity
	Terminal M	Terminal S		Continuity
	Terminal M	Terminal B	The pinion is drawn out.	Continuity

Measurement of voltage at harness of machine

Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
DCV	Terminal B	Chassis grounding		Approx. 12 V
	Terminal S	Chassis grounding	Reverser (N) PTO (N)	Approx. 12 V

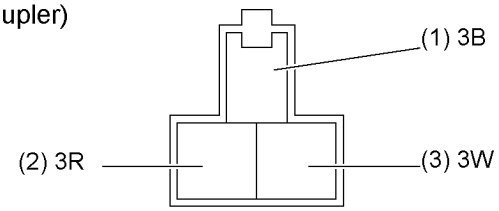


[Reference] Direct connection test (Single item check)

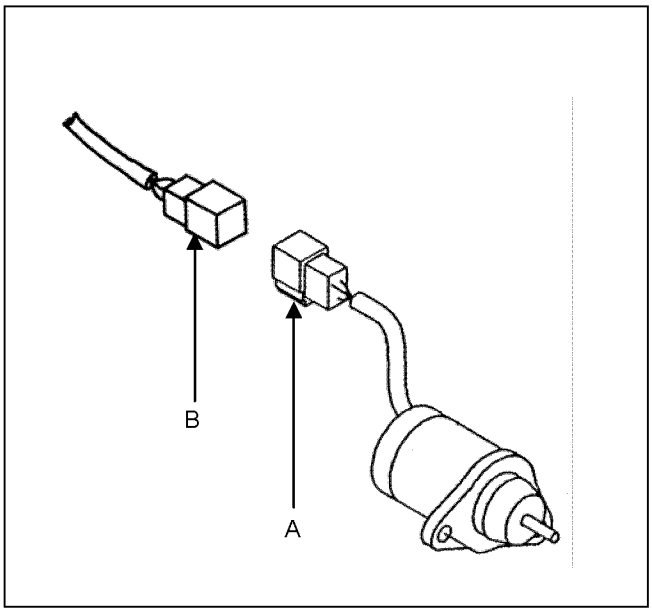
Battery – terminal	Battery + terminal	Result
Starter body	Connect to terminal M	The motor runs.
Starter body	Connect to terminal S	The pinion is drawn out
Starter body	Connect to terminal B	None
Starter body	Connect to terminals B and S	The pinion is drawn out and the motor runs.

4. Fuel shut off solenoid

Measurements on an individual component basis (A-end coupler)



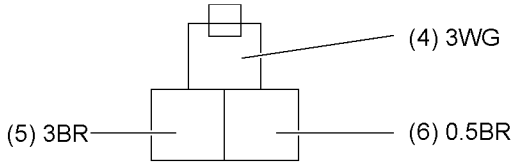
Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
Ω	(2)	(1)		Approx.12.4 Ω
Ω	(3)	(1)		Approx.0.33 Ω



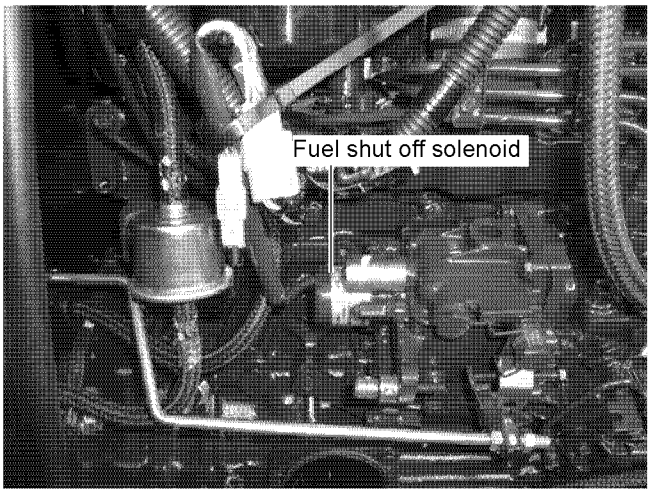
Check of the coupler on the main body side (B-end coupler)

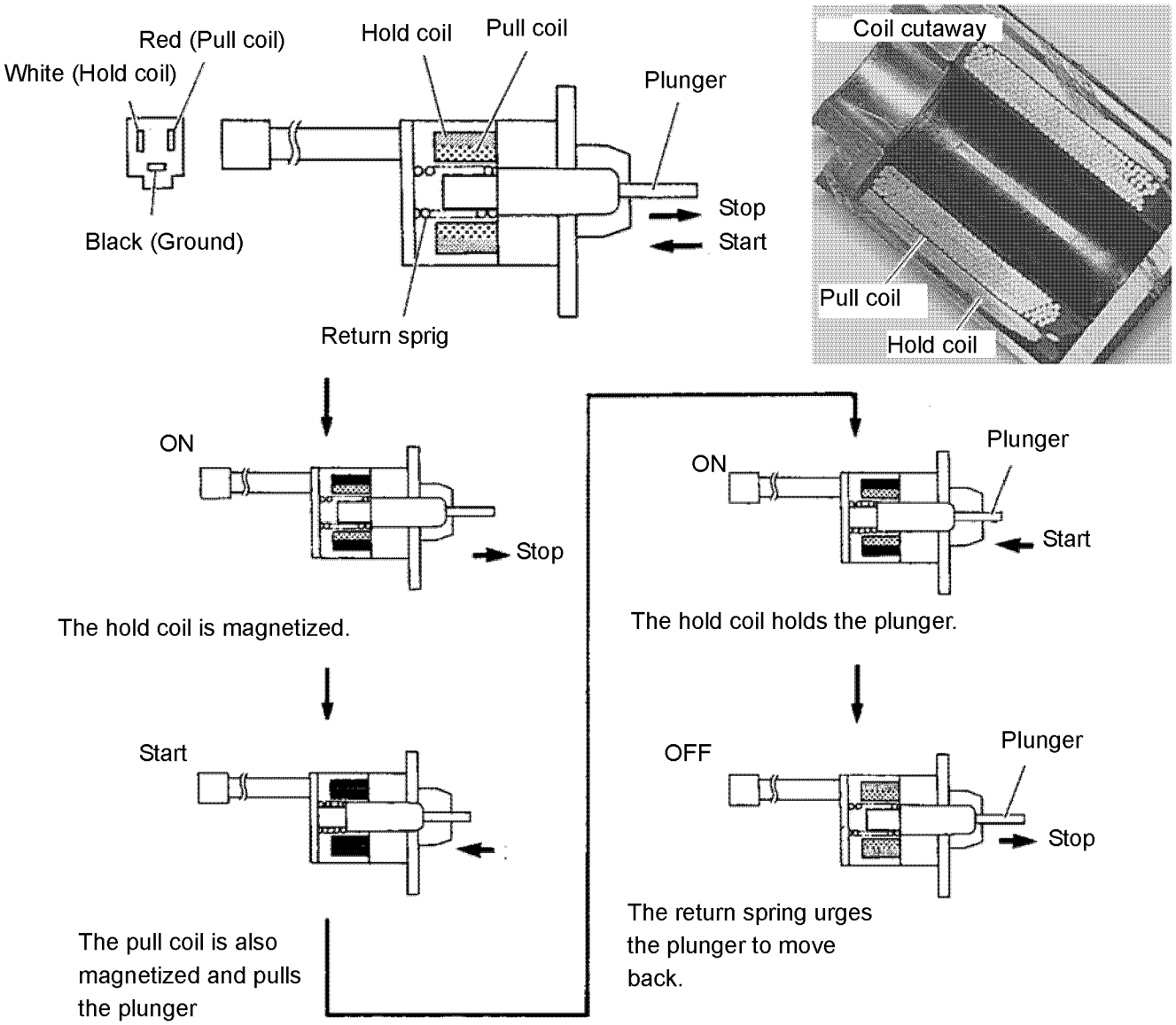
Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
Continuity	(4)	Chassis grounding	Starter switch “OFF”	Yes
DCV	(5)	Chassis grounding	Starter switch “ST”	Approx. 12 V
DCV	(6)	Chassis grounding	Starter switch “ON”	Approx. 12 V

B-end coupler



The fuel system consists of two circuits: one is the fuel feed pump circuit that supplies the fuel to the fuel injection pump through the filter and the other is the fuel shut-off solenoid circuit that activates the stop lever of the governor.
The fuel shut-off solenoid allows the operator to start or stop the diesel engine using the starter switch only. This is a dual-coil type solenoid having a fail-safe feature; if a failure occurs in the electric system, the return spring in the solenoid will cause the engine to stop.



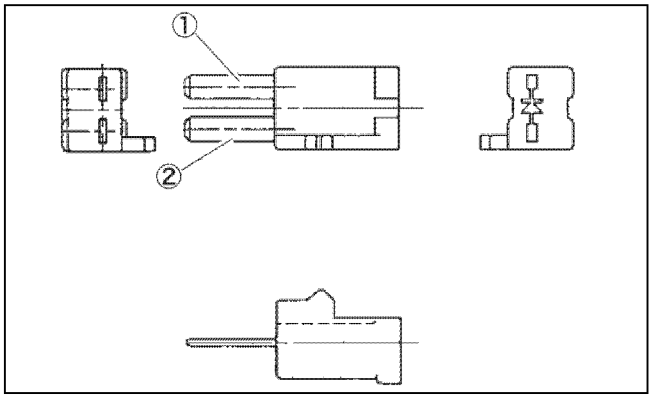


5. Diode

Diode : 1E8235-84810

Individual component check (A-end)

Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
Continuity	(1)	(2)		None
	(2)	(1)		Yes



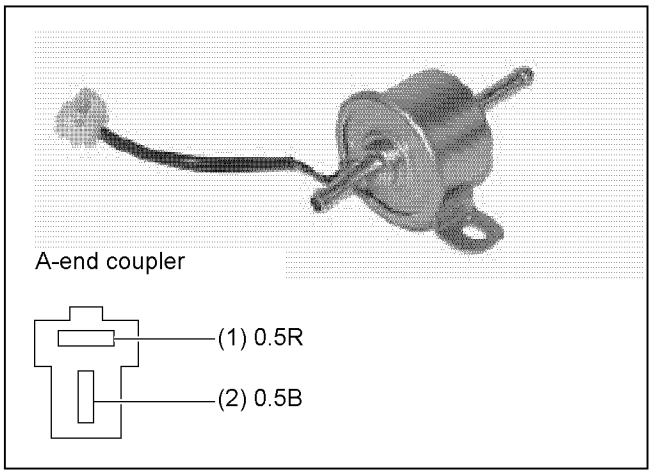
6. Fuel feed pump

Fuel feed pump : 119225-52102

Individual component check (A-end)

Range	Measuring point		Status	Result
	Tester probe +	Tester probe –		
Resistance	(1)	(2)		Approx. 11 M Ω
Continuity	(2)	(1)		None

A digital tester is used.

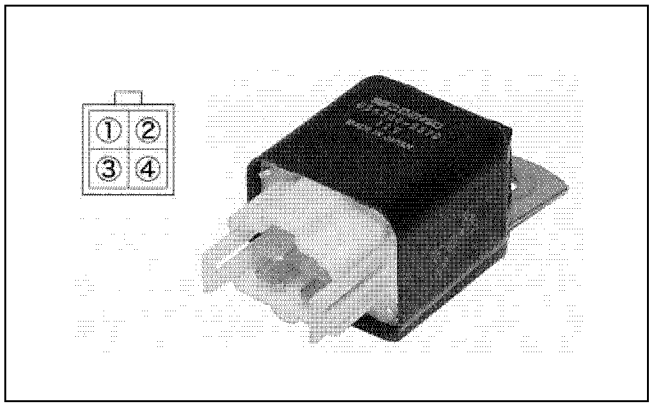


10. Solenoid relay

Relay: 198220-52180

Single item check

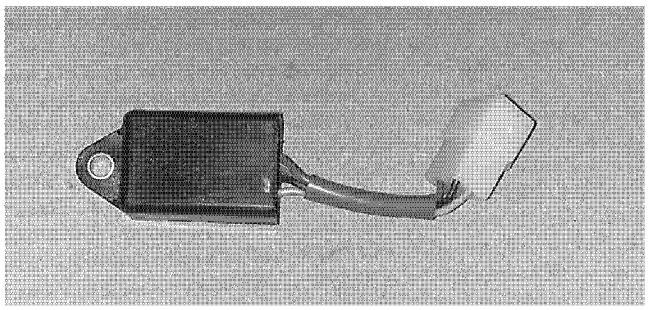
Range	Measuring point		Status	Result
	Tester probe +	Tester probe -		
Continuity	[1]	[2]		No continuity
Resistance	[3]	[4]	Cold	Approx. 58Ω



11. Timer

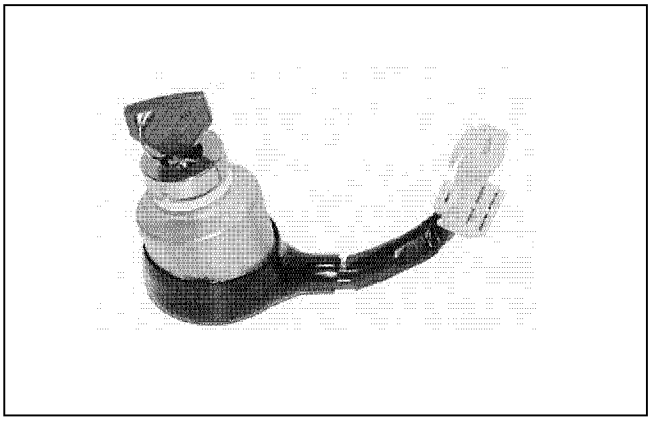
Timer: 129211 – 77920

Single item check cannot be done.



12. Key switch

Starter switch CMP: 194940-52110

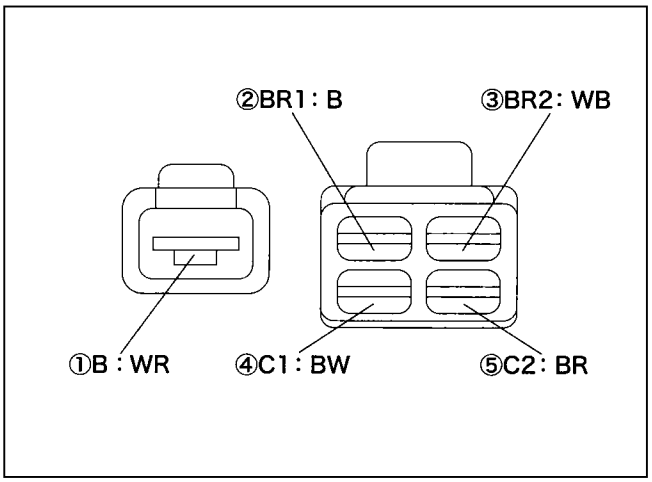


Switch terminal connection table

	B	BR1	BR2	C2	C1
OFF		○	○		
ON	○	○	○		
START	○	○	○	○	○

Single item check

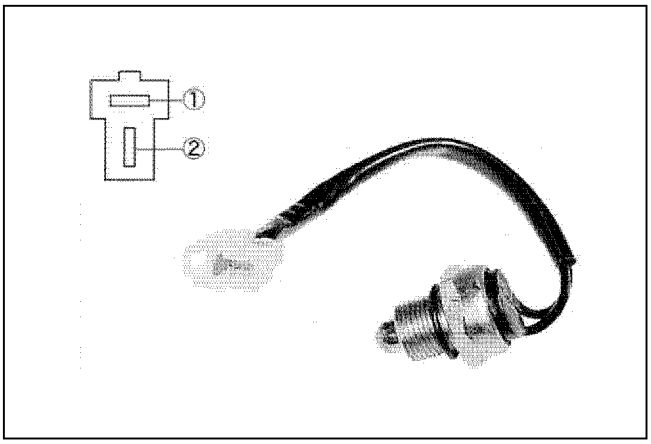
Range	Measuring point		Key switch status	Result
	Tester probe +	Tester probe -		
Continuity	[3]	[2]	OFF	Continuity
	[2]	[1]	ON	Continuity
	[3]	[1]	ON	Continuity
	[2]	[1]	ST	Continuity
	[3]	[1]	ST	Continuity
	[4]	[1]	ST	Continuity
	[5]	[1]	ST	Continuity



13. Transfer (N) switch

14. PTO (N) switch

Safety starter switch: 194464-52190

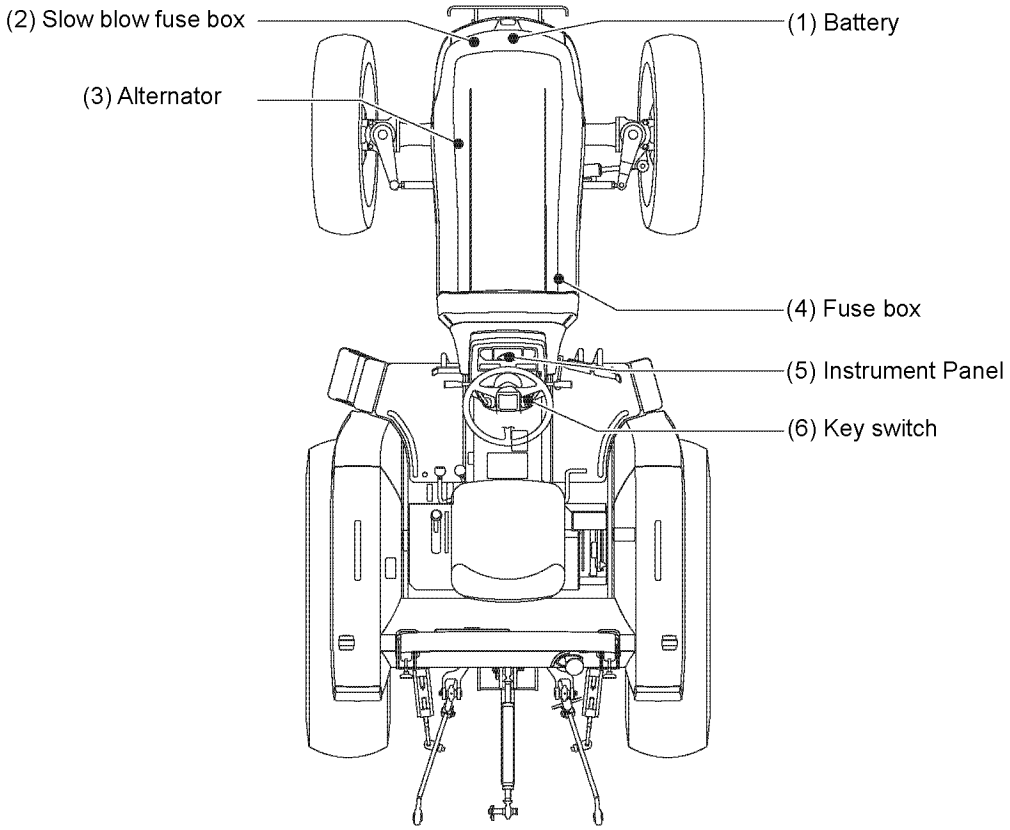


Single item check

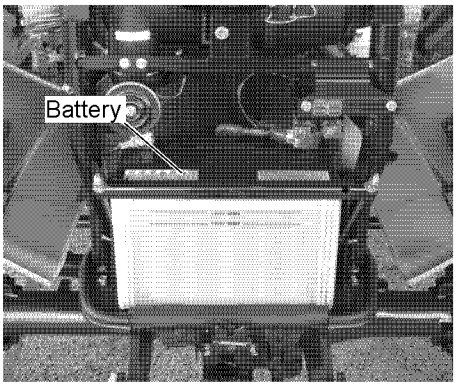
Range	Measuring point	Status	Result
Continuity	Between terminals (1) and (2)	Plunger pressed	Continuity
	Between terminals (1) and (2)	Plunger free	No continuity

10.2 CHARGING CIRCUIT

10.2.1 Location and operation of components



(1)



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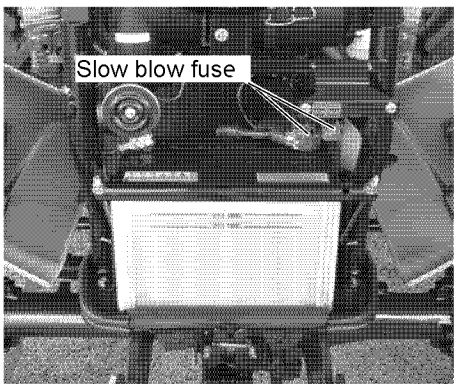

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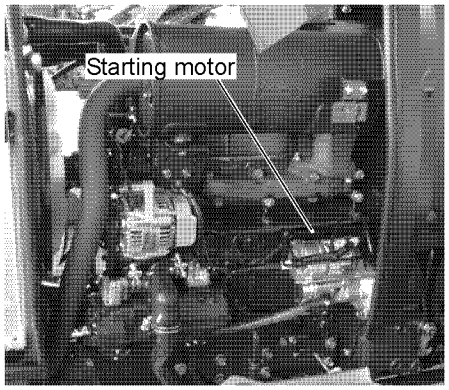
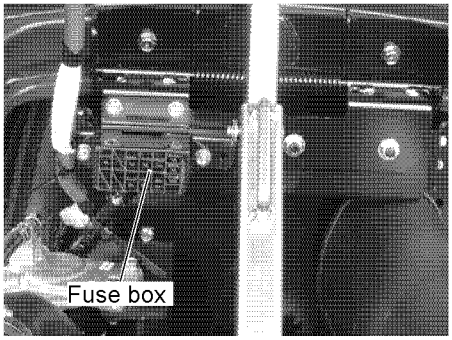
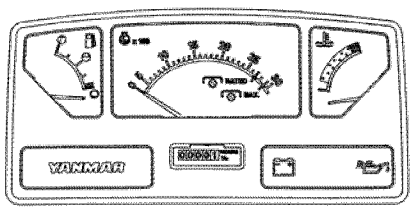


(4)

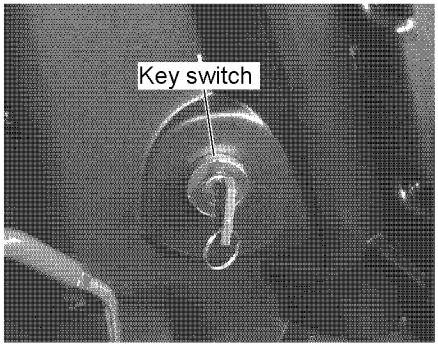


(5)



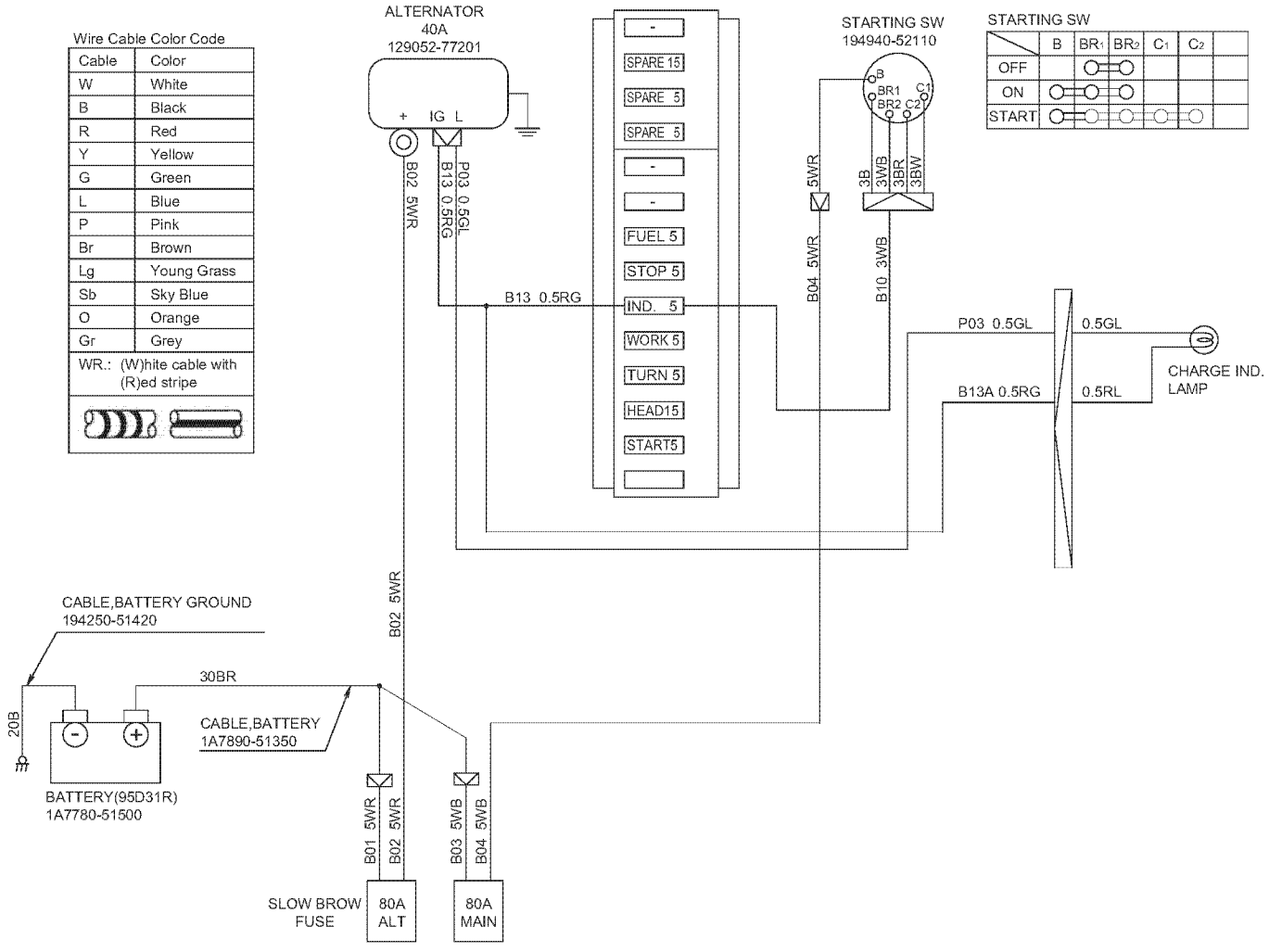
Instrument Panel

(6)



Location	No.	Parts name	Parts catalogue name Parts catalogue number	Operation and remarks
Engine front	1	Battery	Battery 95D31R 1A7780-51500	Supplies power to the circuits.
	2	Slow blow fuse (main) (alter)	Fuse 80A slow blow 198153-51700	Protects wiring & electric equipment related to battery charge.
Engine left side	3	Alternator 40 A	Generator 119620-77201	Generates electric power while the engine runs, and accumulates power in the battery. (IC regulator incorporated type)
Front column	4	Fuse box	Fuse 5A	Fuse for indicator lamp
	5	Instrument panel	Panel assy. 1A7780-56100	Displays information of the machine.
	6	Key switch	Starter switch CMP. 194940-52110	Used for ON/OFF of the battery power to the circuits.

10.2.2 Circuit diagram

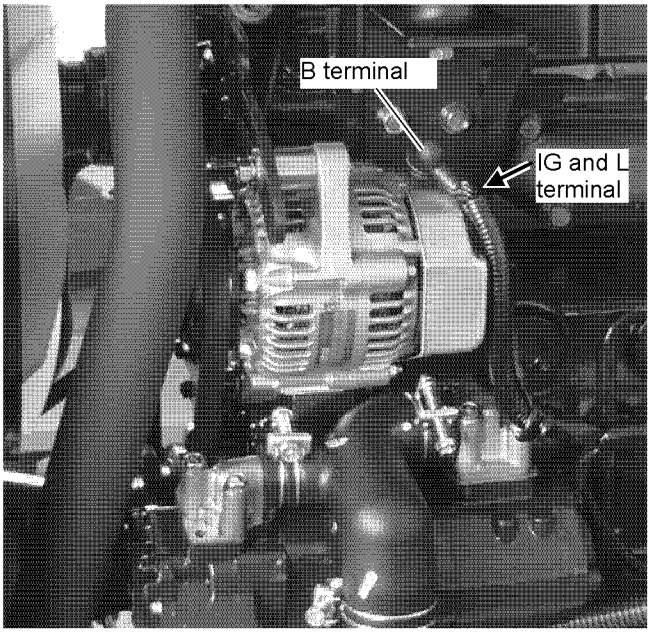


10.2.3 Checkpoints of electrical equipment

2. Alternator

Generator 40A: 119620-77201
The alternator has a built-in IC regulator. The alternating current produced by the alternator is rectified into direct current.

1. Do not reverse polarity between the IG and L terminals.
2. Do not shortcircuit the IG and L terminals.
3. Do not remove the battery terminals and the B terminal when the alternator is running.

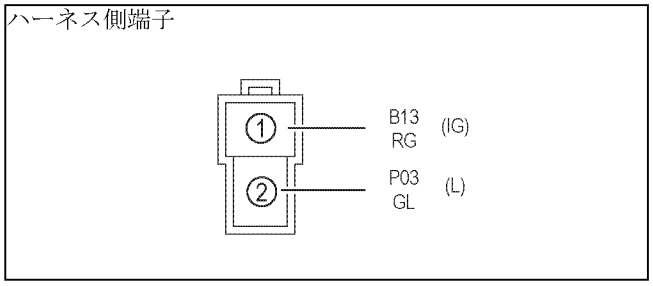


Check of alternator coupler
Without removal of B terminal

Range	Measuring point		Status	Result
	Tester probe +	Tester probe -		
DCV	B	Chassis grounding	Starter switch "OFF"	Approx. 12 V

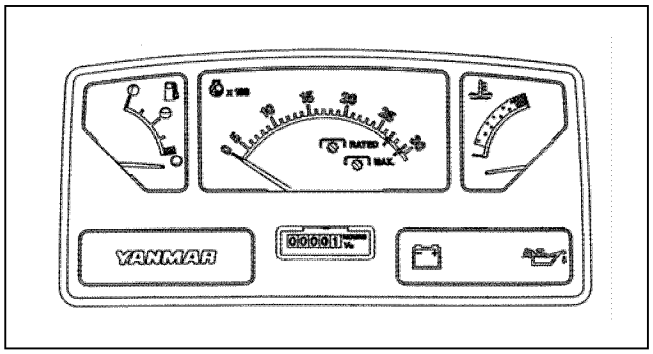
With removal of IG and L terminal couplers

Range	Measuring point		Status	Result
	Tester probe +	Tester probe -		
DCV	[1]	Chassis grounding	Starter switch "ON"	Approx. 12 V
DCV	[2]	Chassis grounding	Starter switch "ON"	Approx. 12 V



5. Instrument panel

See. ■ Electric equipment 2-3“12. Key switch”.

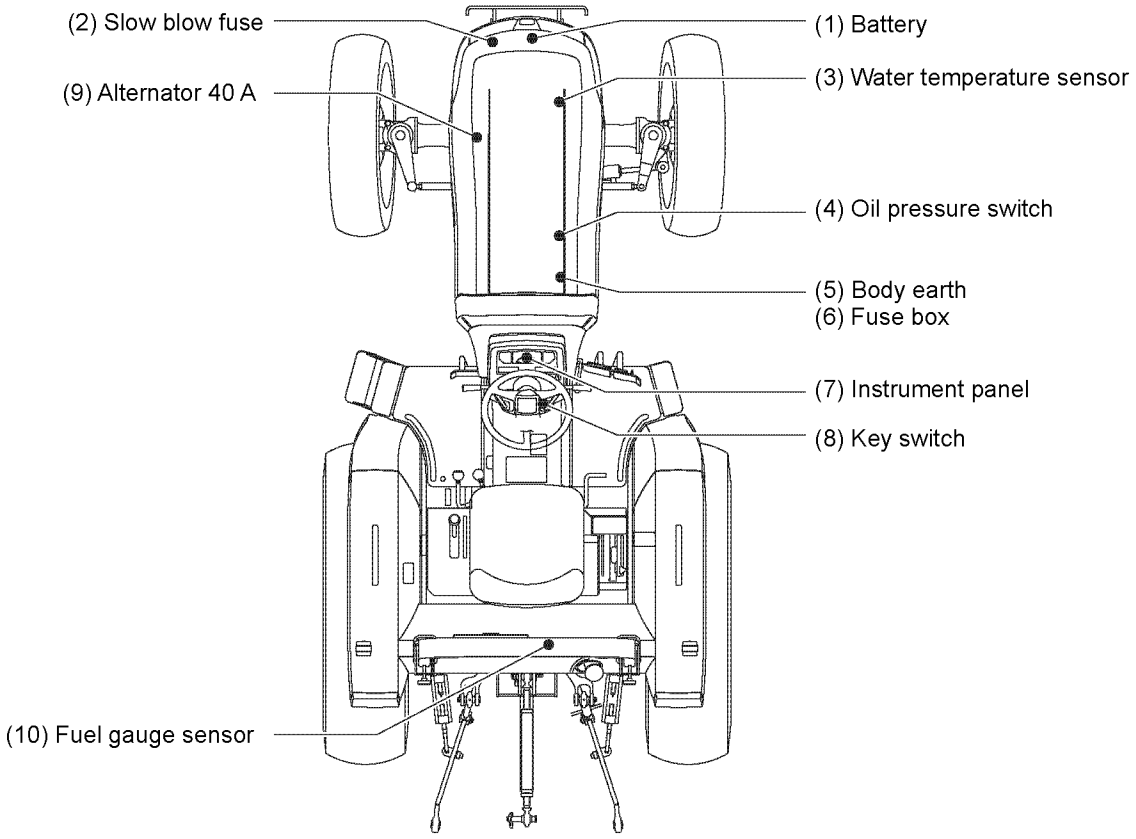


6. Key switch

See. ■ Electric equipment “12. Key switch”.

10.3 ALARM CIRCUIT

10.3.1 Location and operation of components



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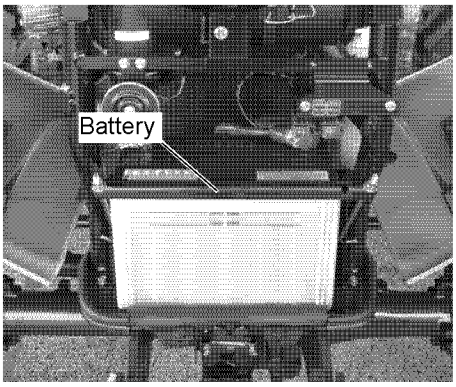

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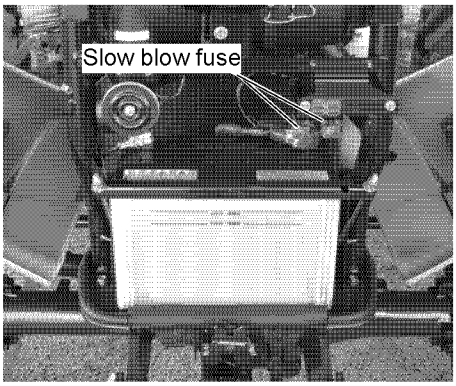

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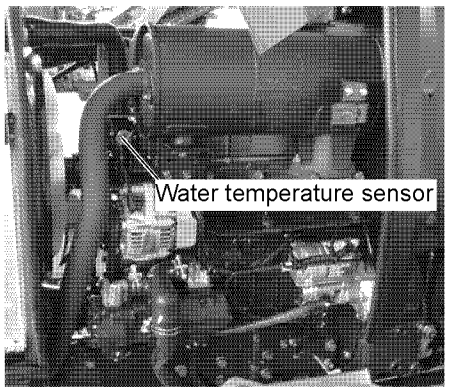

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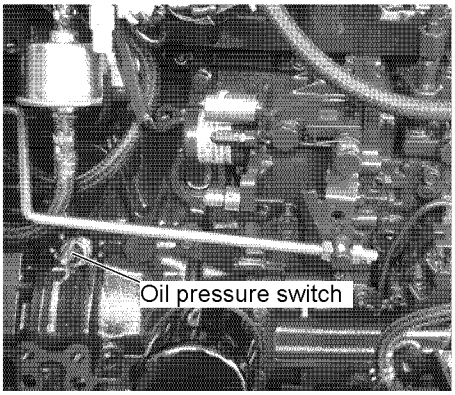

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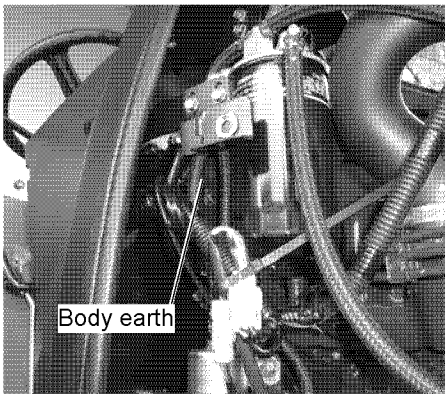

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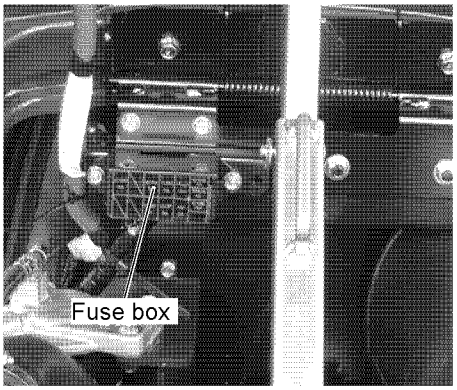

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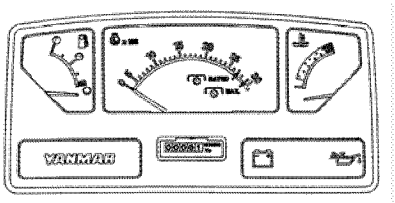

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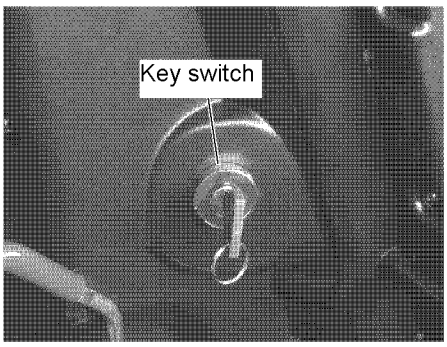

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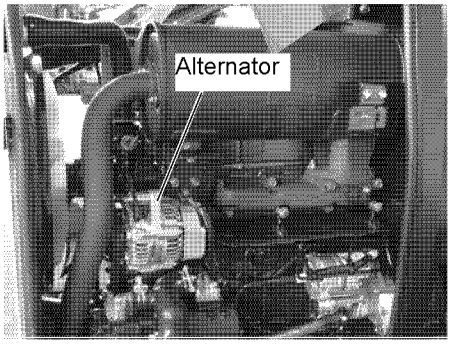

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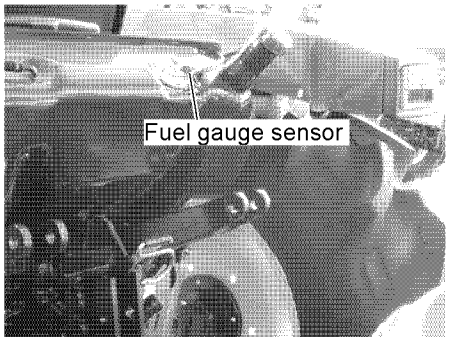
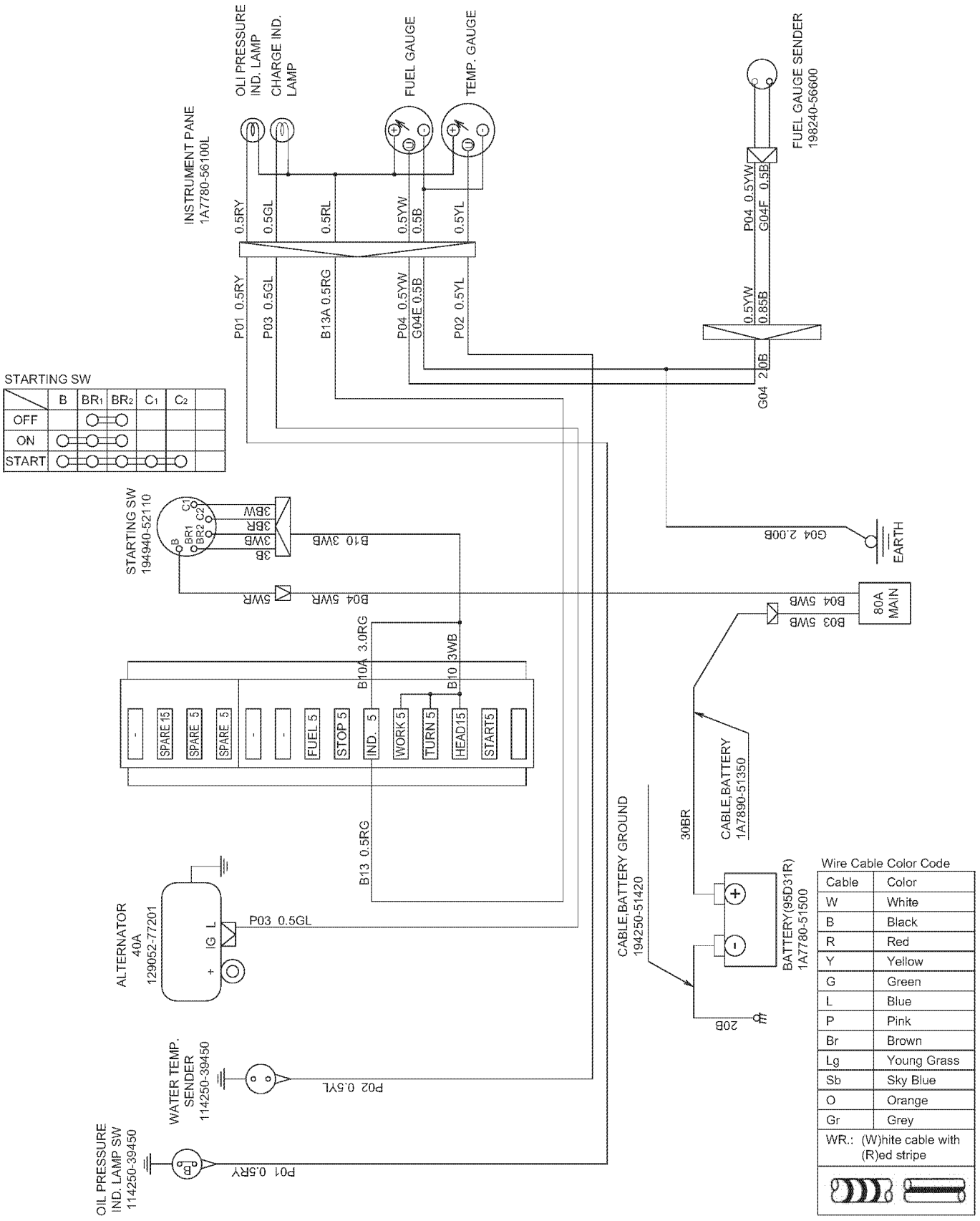


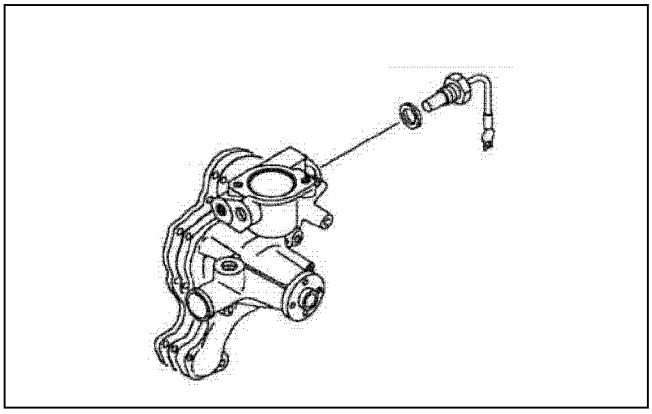
Location	No.	Parts name	Parts catalogue name Parts catalogue number	Operation and remarks
Engine front	1	Battery	Battery 95D31R 1A7780-51500	Supplies power to the circuits.
	2	Slow blow fuse (main)	Fuse 80A slow blow 198153-51700	Protects wiring & electric equipment related to engine start.
Engine left front	3	Water temperature sensor	Thermometer 124250-49351	Indicates change in temperature of coolant water on the coolant temperature gauge of the meter panel.
Engine right side	4	Oil pressure switch	L.O. switch (0.5 KG) 114250-39450	When the engine lubricating oil pressure is decreased, the meter lamp "Engine oil pressure pilot lamp" blinks.
	5	Body earth		
	6	Fuse 5A	Fuse 198535-52110	Fuse for alarm circuit, Stop solenoid and Neutral switches.
Front column	7	Instrument panel	Panel assy. 1A7780-56100	Displays information of the machine.
	8	Key switch	Starter switch CMP 194940-52110	Used for ON/OFF of the battery power to the circuits.
Engine left side	9	Alternator 40 A	Generator 119620-77201	The signal of the generating electric power send to the instrument panel.
Fuel tank top face	10	Fuel gauge sensor	Fuel sensor assy. 198240-56600	Displays remaining fuel amount on the fuel gauge of the meter panel.

10.3.2 Circuit diagram



10.3.3 Checkpoints of electrical equipment

3. Water temperature sensor



Coolant temperature: 124250-49351

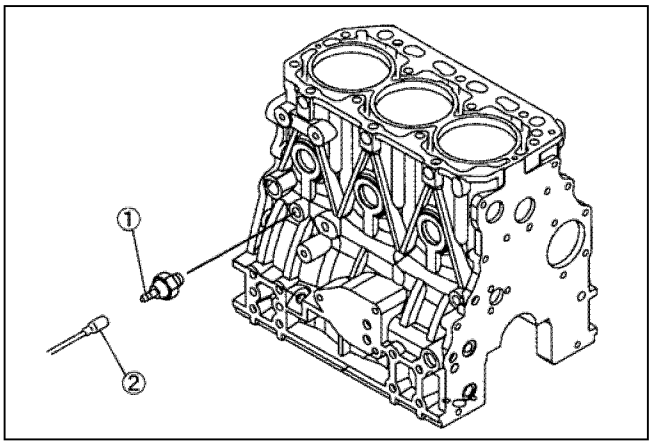
Range	Measuring point		Result
	Tester probe +	Tester probe –	
Ω	[1]	Chassis grounding	Resistance alters depending on the coolant temperature.
DCV	[2]	Chassis grounding	Approx. 5.0 V DC when the key switch is turned on.

Table of sensor characteristics

Temperature (°C)	Resistance (Ω)	Temperature (°C)	Resistance (Ω)
(35)	(670)	(105)	(54.5)
(50)	(350)	115	42 ± 2.5
80	118 ± 6	(120)	(36.2)
100	(63.5)	(140)	(22)

* Values in parentheses are references.

4. Oil pressure switch



Oil pressure switch 0.5 KG plug: 114250-39450

Single item check

Range	Measuring point		Result
	Tester probe +	Tester probe –	
Continuity	[1]	Chassis grounding	Continued while the engine is stopped. Discontinued while the engine is running.
DCV	[2]	Chassis grounding	12 V DC when the starter switch is turned on. As for DCA, the oil lamp is lit up at approx. 0.08 A.

As for DCA, pay attention to prevent wrong connection of the tester.

*Oil pressure setting : 0.5 ± 0.1 kgf/cm^2

7. Instrument panel

See. ■ Electric equipment 2-3“12. Key switch”.

8. Key switch

See. ■ Electric equipment 1-3 “12. Key switch”.

9. Alternator 40 A

See. ■ Electric equipment 2-3 “12. Key switch”.

10. Fuel gauge sensor

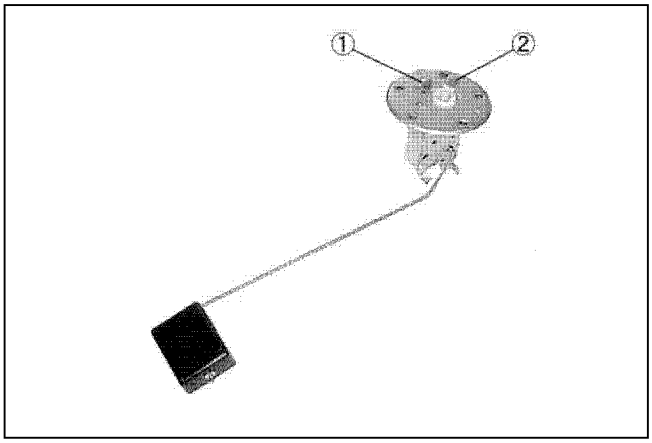
Fuel sensor assy : 198240 - 56600

Single item check

Range	Measuring point		Float position	Result
	Tester probe +	Tester probe –		
Ω	[1]	[2]	F	3 ± 2 Ω
			1/2	(32.5Ω)
			E	110 ± 7 Ω

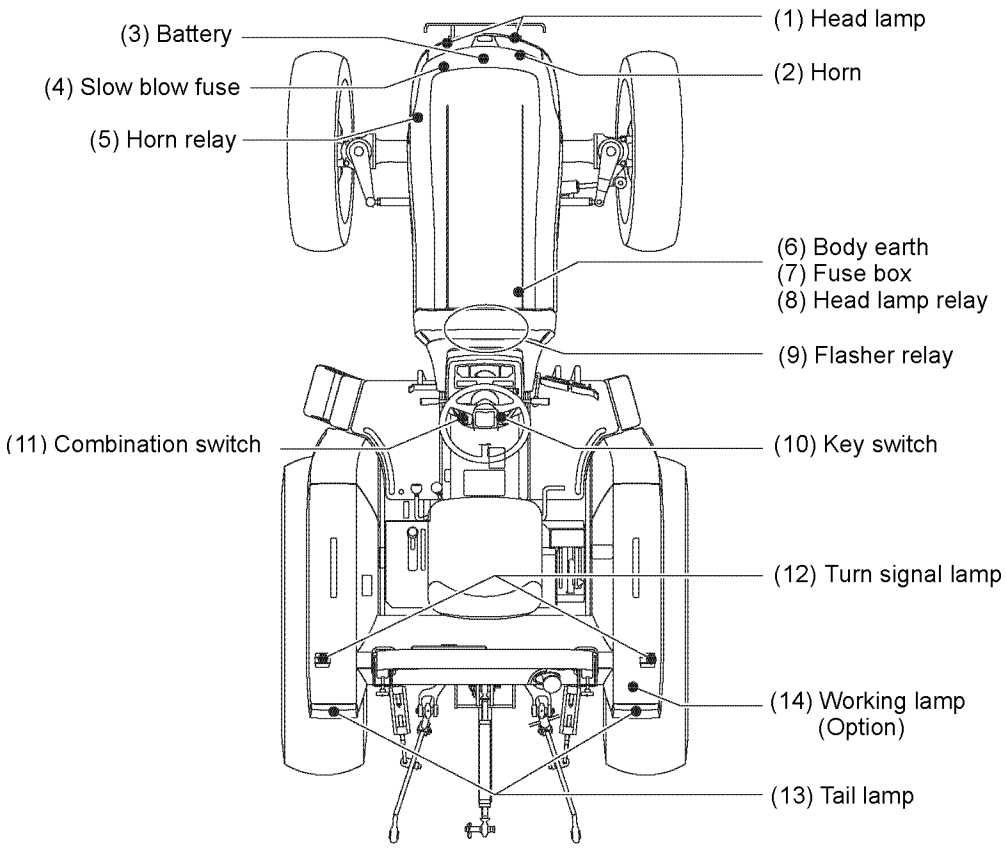
* Values in parentheses are references.

数値保留　実測する



10.4 SAFETY CIRCUIT

10.4.1 Location and operation of components



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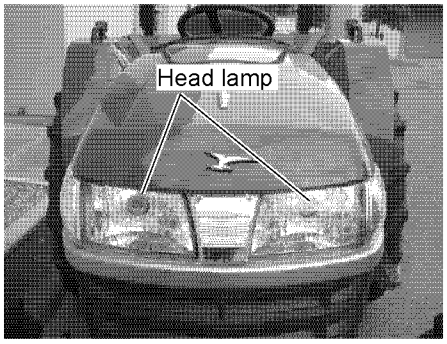

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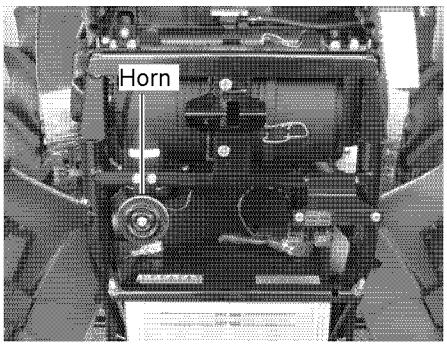

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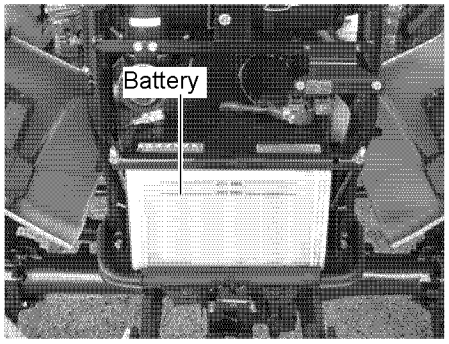

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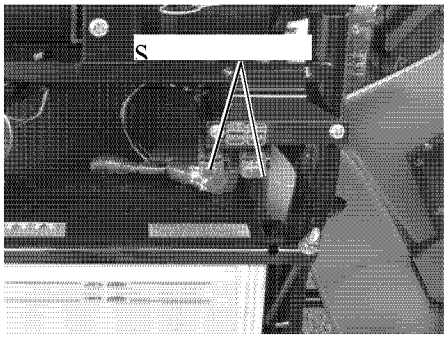

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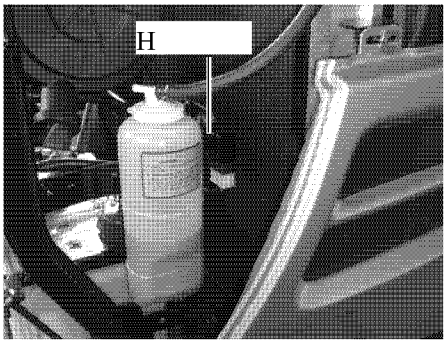

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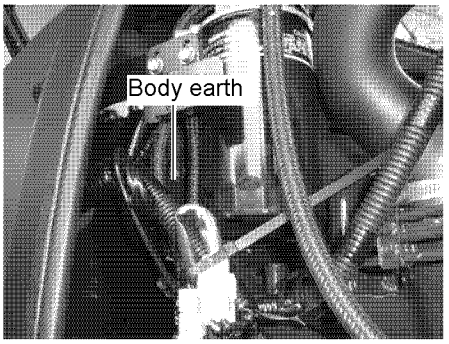

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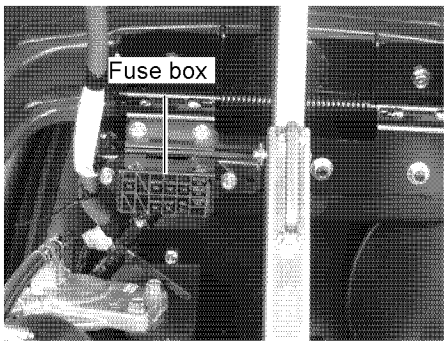

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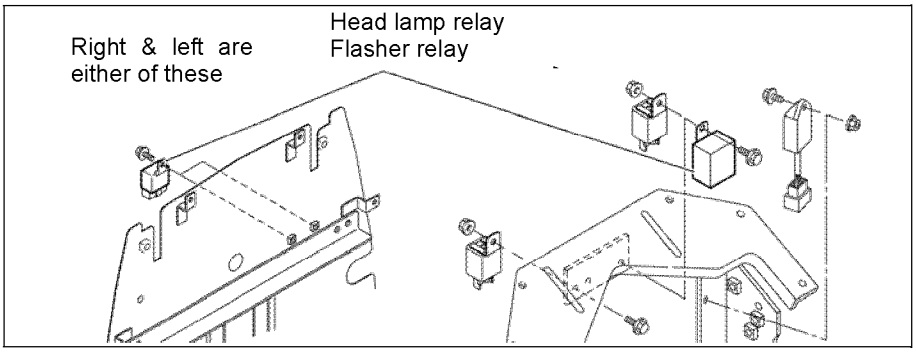

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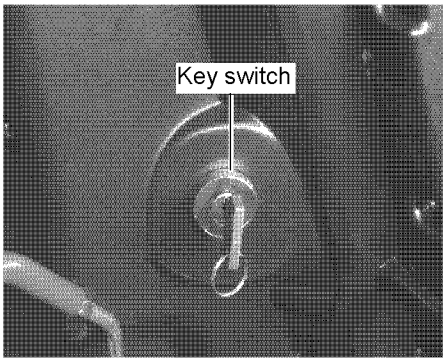

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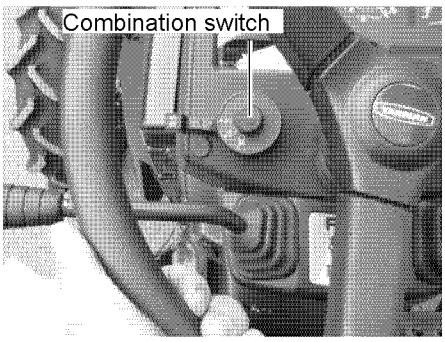
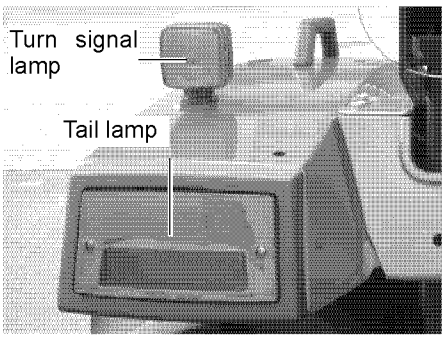
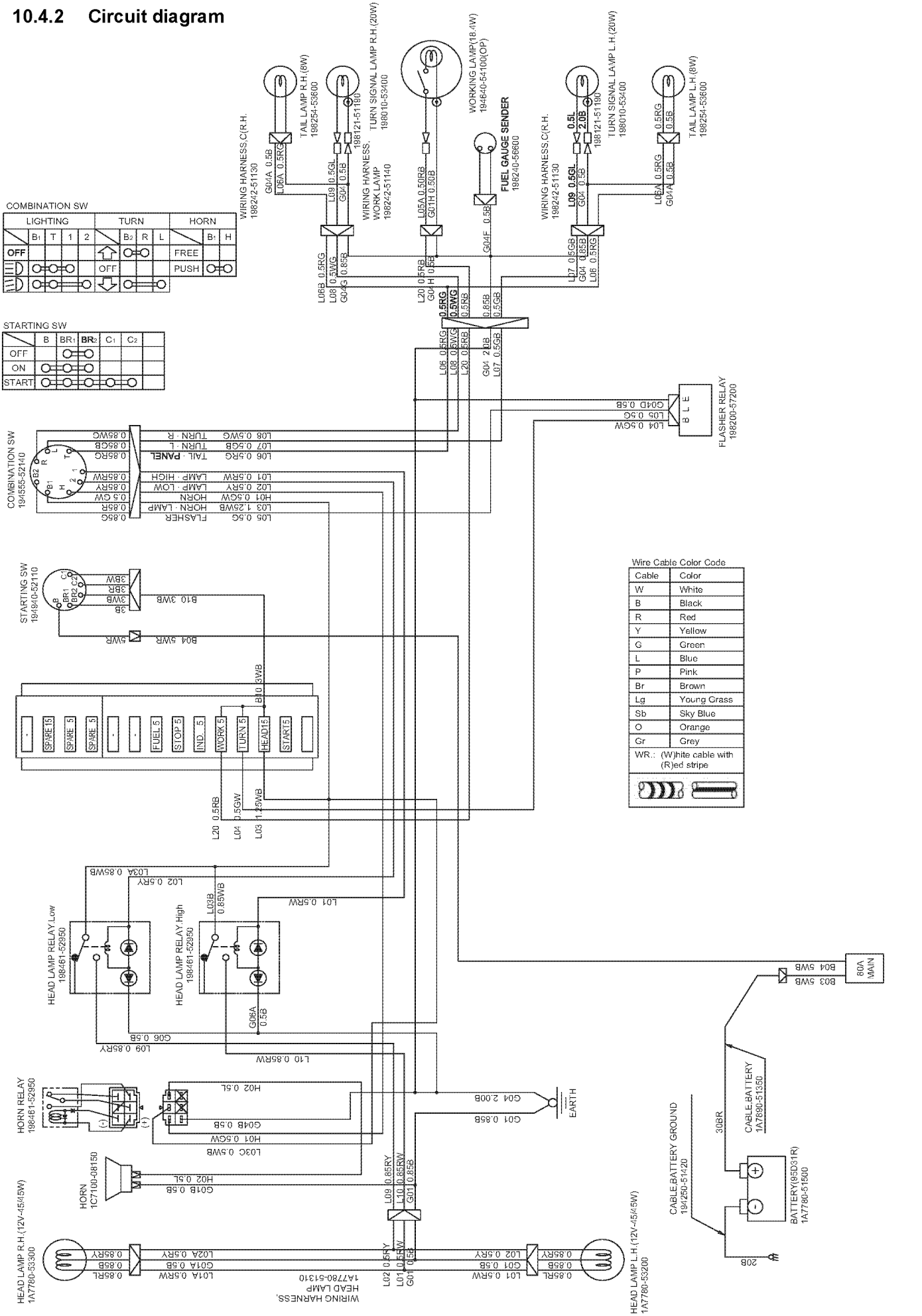


(12)(13)



Location	No.	Parts name	Parts catalogue name Parts catalogue number	Operation and remarks
Front of hood	1	Head lamp (12V/45W)	Head lamp ASSY 1A7780-53200 (L) 1A7780-53300 (R)	Bulb: 198448-53320
	2	Horn	Horn 1C7100-08150	Alarm horn
	3	Battery (80R26R)	Battery 80D26R 198280-51540	Supplies power to the circuits.
	4	Slow blow fuse	Fuse 80A slow blow 198153-51700	Protects wiring & electric equipment related to safety circuits.
	5	Horn relay	Relay CA, type C 198461-52950	It is activated when the horn button of combination switch is “ON”. It gives requisites for application of 12 V to the horn.
Engine left side front column	6	Body earth		
	7	Fuse box	Fuse 5A 198535-52110 Fuse 15A 198535-52130	Fuse for lamp circuits.
	8	Head lamp relay	Relay CA, type C 198461-52950	It is activated when the combination switch is “Low” or “High”. It gives requisites for application of 12 V to the head lamps.
Inside of front column	9	Flasher relay	Flasher relay 198200-57200	Relay for blinking flasher lamps
Front column	10	Key switch	Starting switch 194940-52110	Used for ON/OFF of the battery power to the circuits.
	11	Combination switch	Combination switch 194555-52140	For operation of head light, turn signal, and horn
Fender	12	Turn signal lamp	Turn signal lamp 198010-53400	For indication of direction
	13	Tail lamp	Stop lamp ASSY 198254-53600	For indication of the machine width at night

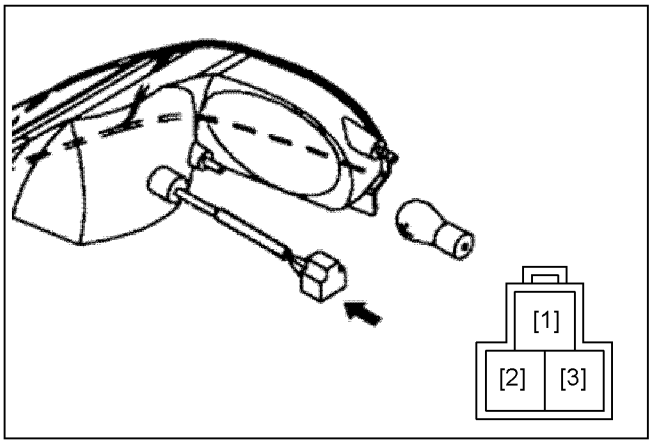
10.4.2 Circuit diagram



10.4.3 Checkpoints of electrical equipment

1. Head lamp (12V45W/45W)

Head lamp CMP: 1A7780-53200(L)
Valve (12V45W): 198448-53320

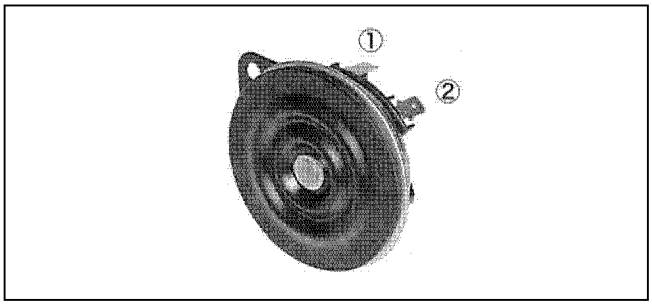


Single item check

Range	Measuring point	Result	Remarks
Resistance	[1] - [2]	Approx. 0.3 Ω	Low beam side
	[1] - [3]	Approx. 0.3 Ω	High beam side

It alters depending on the ambient temperature.

2. Horn (18W)

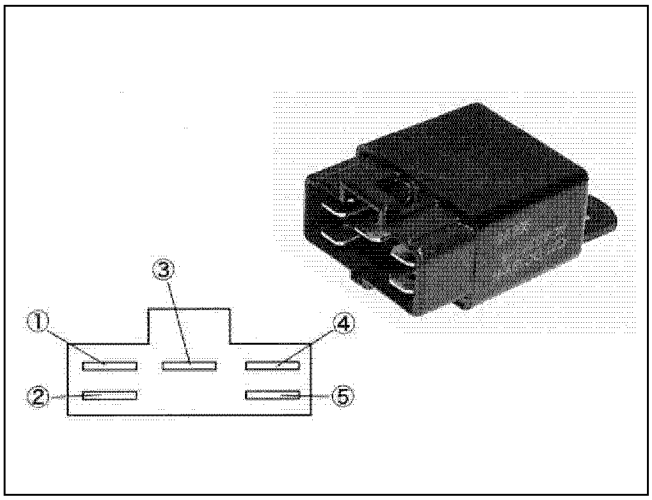


Horn: 1C7100-08150

Single item check

Range	Measuring point		Result
Resistance	[1]	[2]	Approx. 1.8 Ω

5. 8. Safety start relay (1.8W)

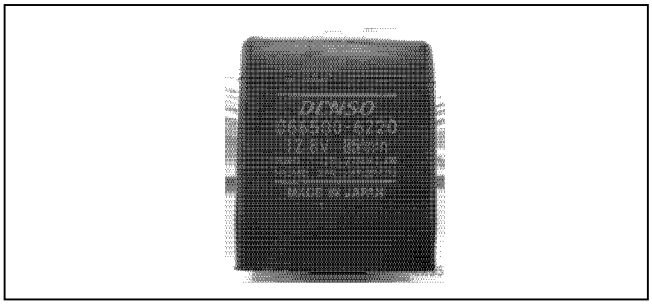


CA relay (C type: 198461-52950)

Single item check

Range	Measuring point		Result
	Tester probe +	Tester probe -	
Continuity	[1]	[3]	No continuity
Continuity	[1]	[2]	No continuity
Continuity	[2]	[3]	Continuity
Ω	[4]	[5]	Approx. 78Ω

9. Flasher relay



Flasher relay: 198200-57200

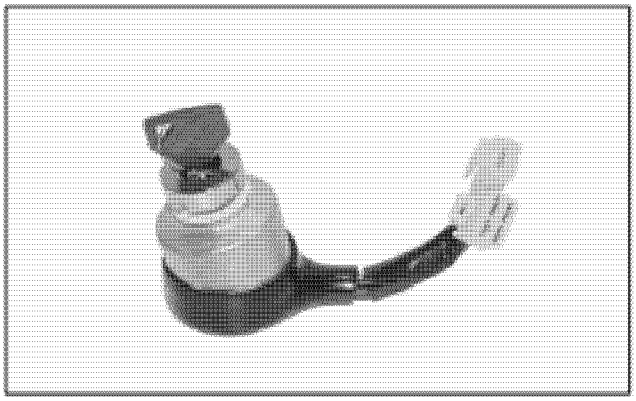
Single item check cannot be done.

10. Key switch

Starter switch CMP:194940-52110

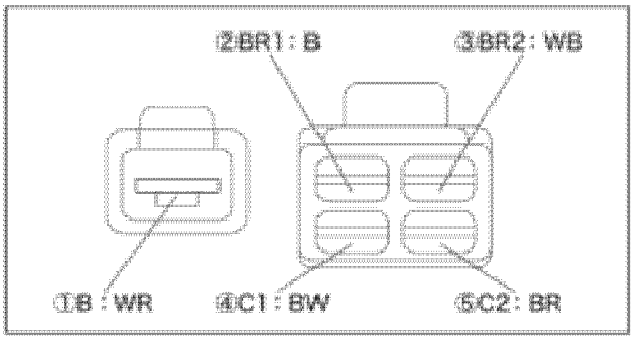
Connections of switch terminals

	B	BR1	BR2	C2	C1
OFF		○	○		
ON	○	○	○		
START	○	○	○	○	○



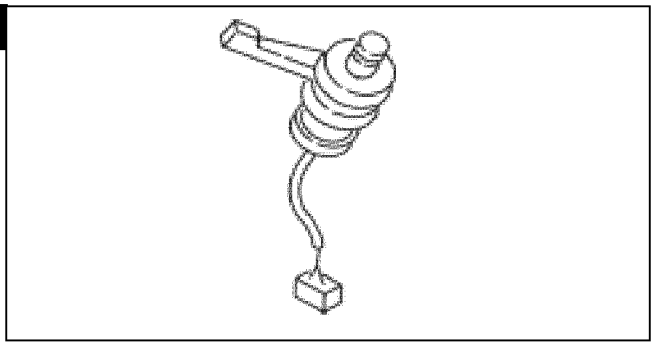
When checked alone

Range	Measurement location		Key switch status	Result
	Tester electrode ①	Tester electrode ②		
Conductivity	③	②	OFF	Conductive
	②	①	ON	
	③	①	ON	
	②	①	ST	
	③	①	ST	
	④	①	ST	
	⑤	①	ST	



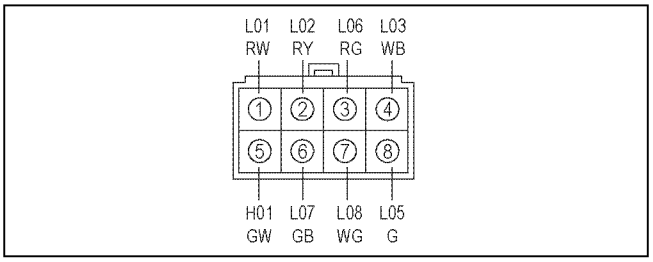
11. Combination switch

Combination switch : 194555-52140



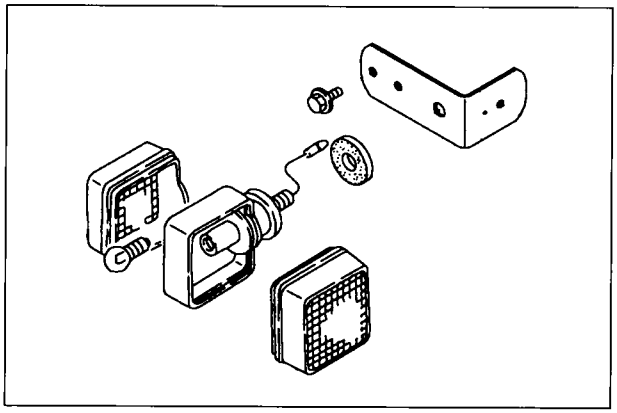
Single item check

Range	Measuring point		Conductive
	Tester probe +	Tester probe -	
Conductivity	[8]	[1]	Horn switch ON
	[2]	[1]	Light switch「LO」「HI」
	[3]	[1]	Light switch [HI]
	[4]	[1]	Light switch 「LO」
	[6]	[5]	Flasher lever「R」
	[7]	[5]	Flasher lever「L」



12. Turn signal lamp right and left (20 W)

Turn signal lamp: 198010-53400
Valve (12V20W): 194200-53400



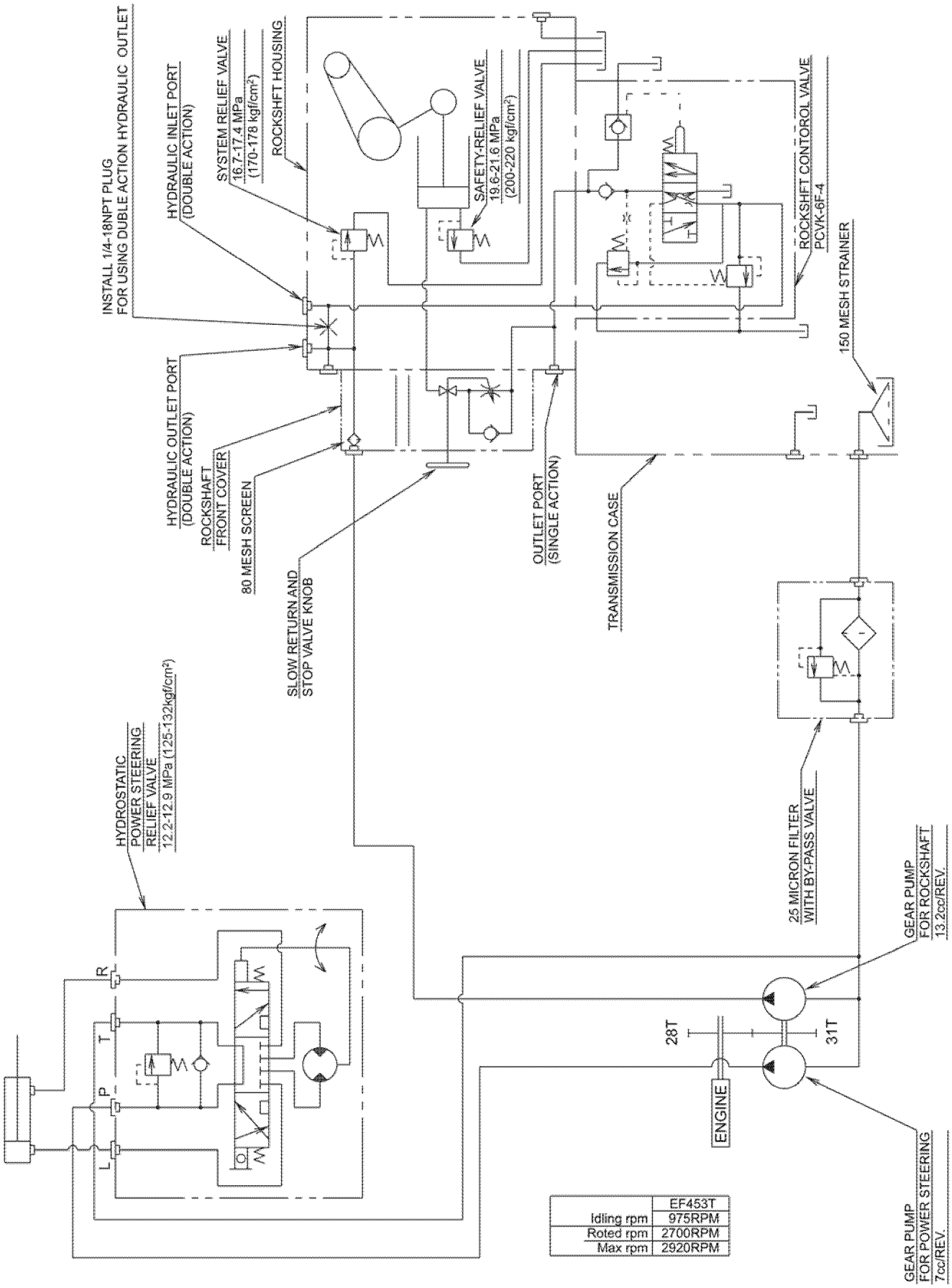
Single item check

Range	Measuring point		Result
	Tester probe +	Tester probe –	
Resistance	Terminals	Body	Approx. 7 Ω

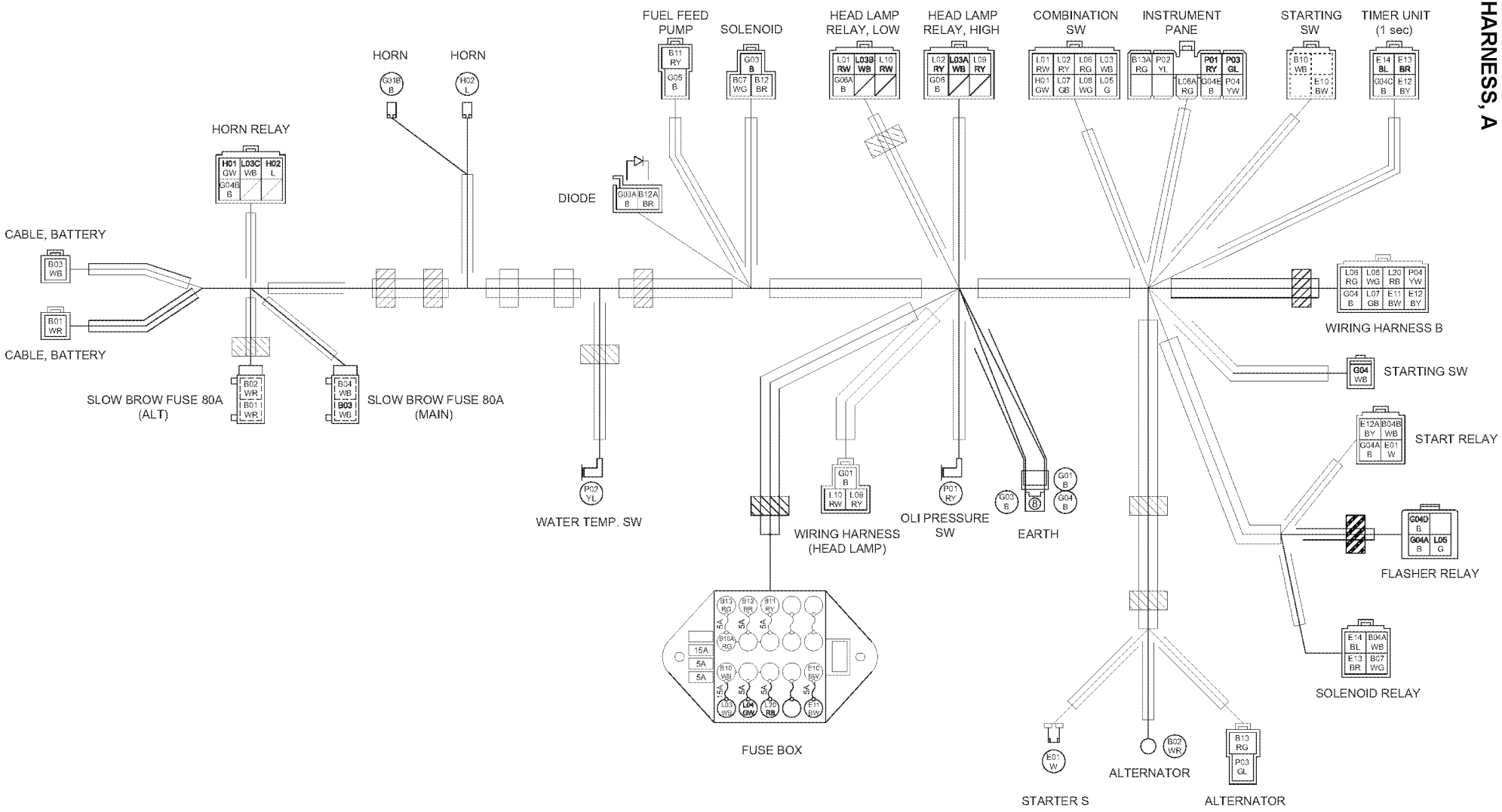
11

APEENDIXES

11.1 HYDRAULIC CIRCUIT DIAGRAM

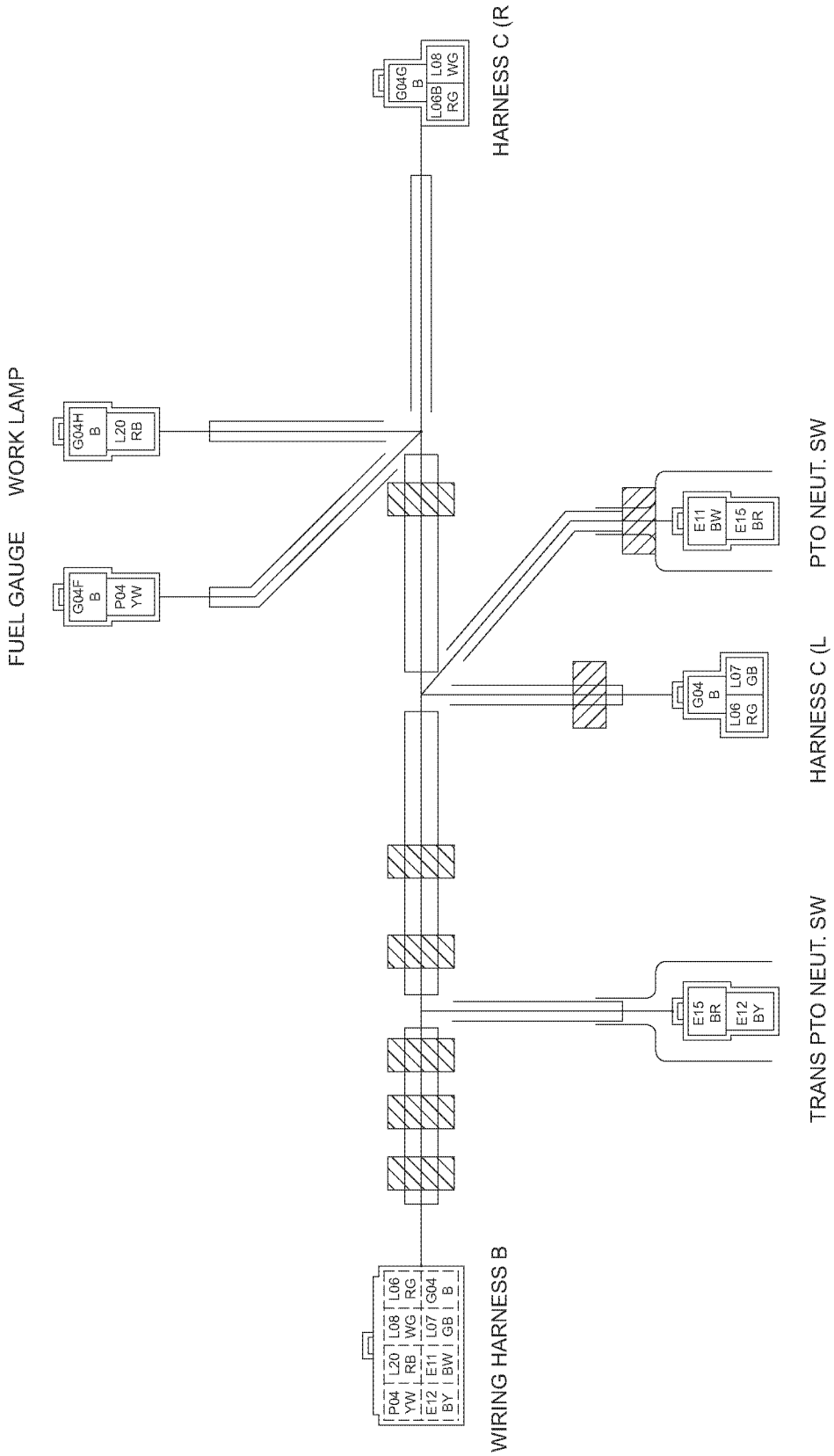


11.1.1 WIRING HARNESS, A



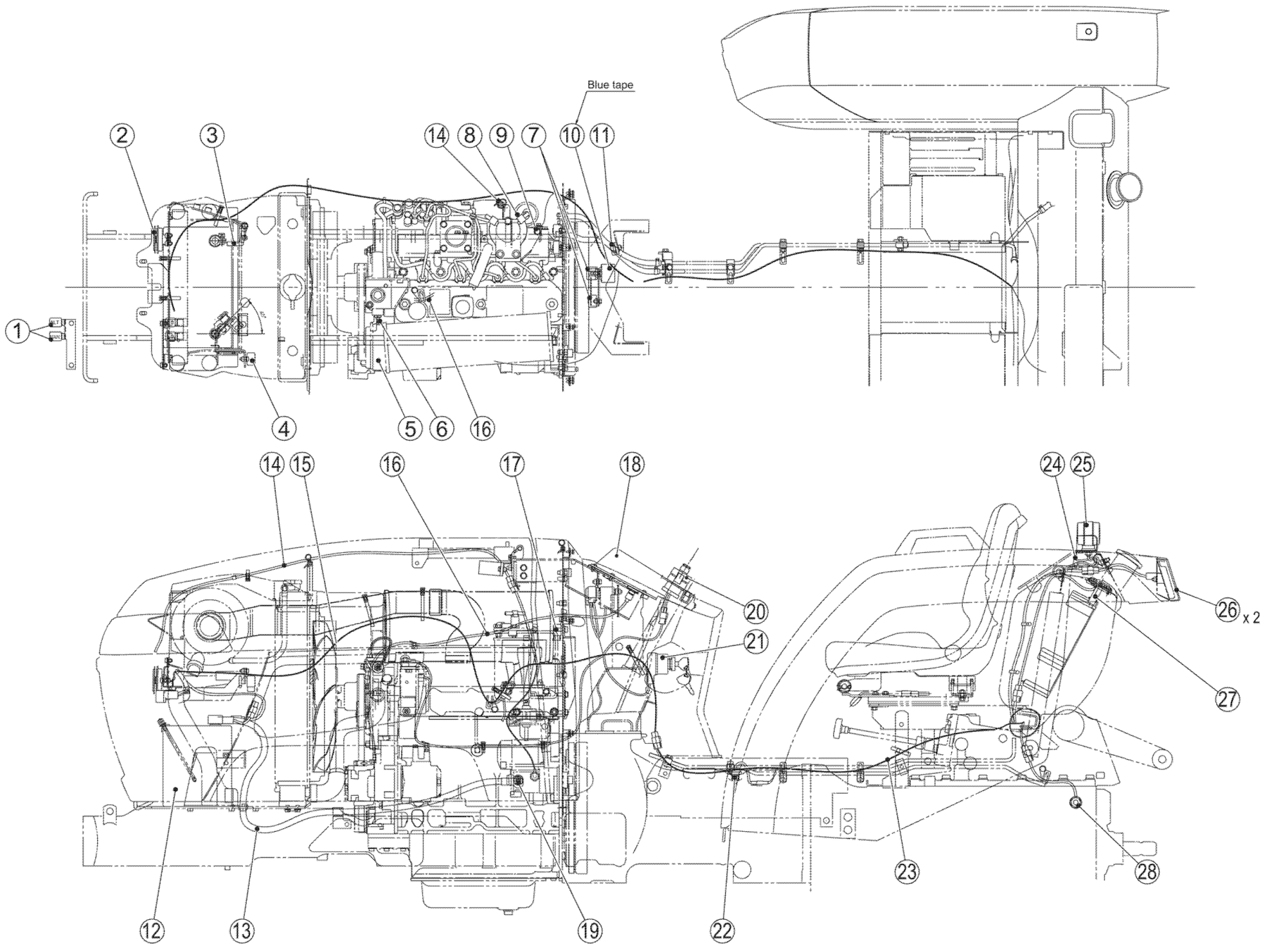
11 APPENDIXES

11.1.2 WIRING HARNESS, B



11 APPENDIXES

11.2 LOCATION OF ELECT

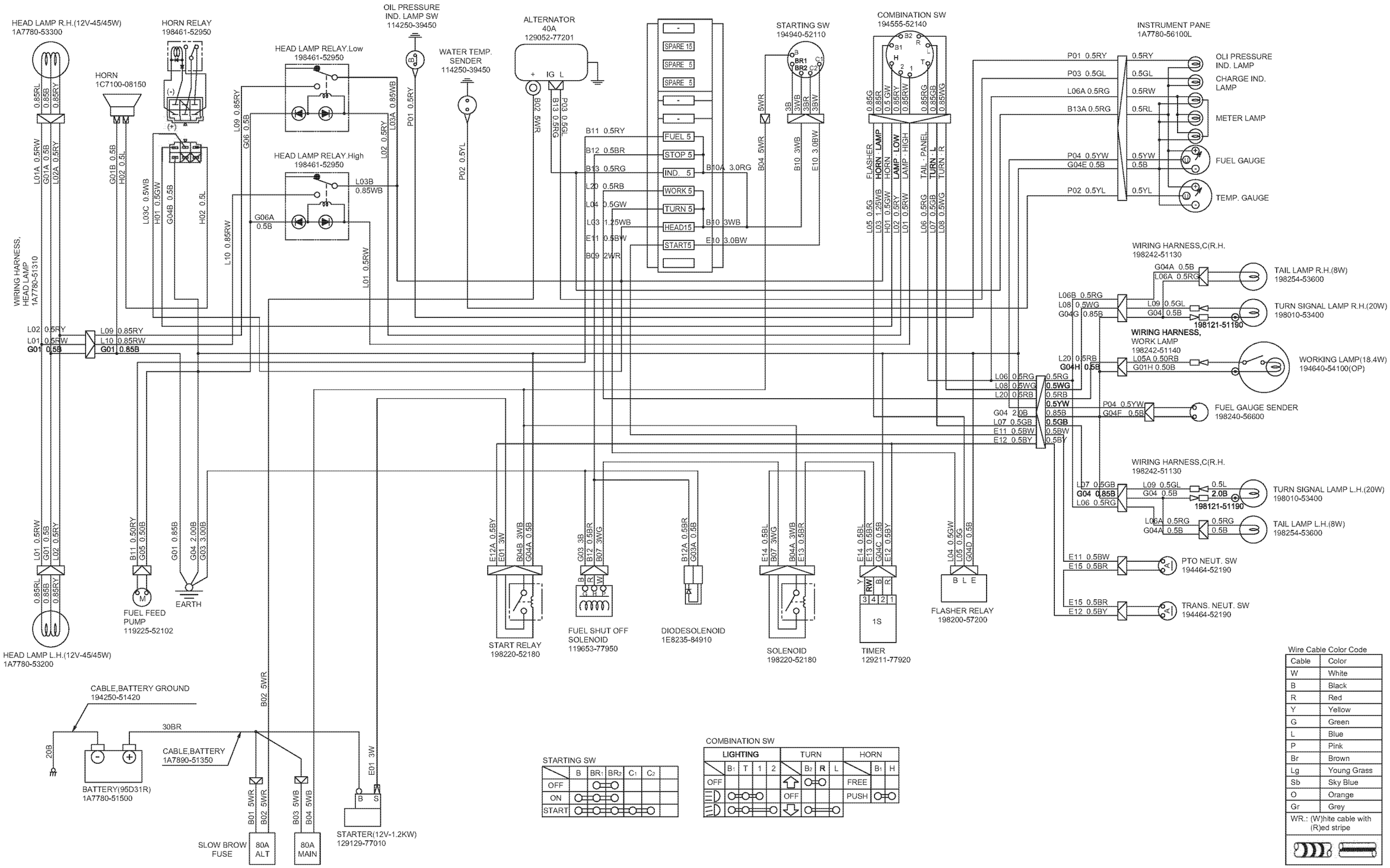


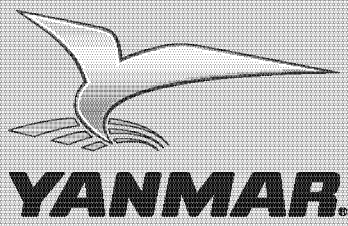
(1)	Slow blow fuse 80A
(2)	Horn
(3)	Battery earth cable
(5)	Generator
(6)	Thermometer
(7)	Start relay
	Solenoid relay
(8)	FO pump
(9)	Oil puressure switch
(11)	Timer, 1sec
(12)	Battery
(13)	Battery cable (+)
(14)	Harness (Head lamp)
(15)	Harness A
(16)	Meter cable
(17)	Head lamp relay (x2)
(18)	Instrument panel
(19)	Starting motor
(20)	Combination switch
(21)	Key switch
(22)	Trans. Neutral switch
(23)	Harness B
(24)	Harness flasher
(25)	Flasher lamp
(26)	Tail lamp
(27)	Fuel gauge
(28)	PTO neutral switch

11 APPENDIXES

11.3 ELECTRICAL WIRING DIAGRAM

Electrical Wiring Diagram





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