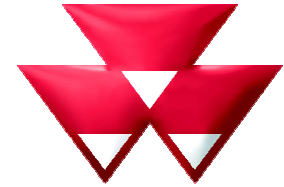


**Workshop Service Manual**



**MASSEY FERGUSON**

# **GC1700 Series Compact Tractor**

**GC1723E**

**GC1725M**

**North America**  
**4205 River Green Parkway, Duluth GA 30096 USA**  
**© AGCO 2019**

**January 2019**  
**4283625M1**  
**NA**  
**English**



**CALIFORNIA  
Proposition 65 Warning**

**WARNING: Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, or other reproductive harm.**

**WARNING: Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm. Wash hands after handling.**

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## 1.1 General information

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### 1.1.1 Introduction to this service manual

---

This service manual gives information from engineering tests, operating data, and the latest service techniques at the time of publication. Read this service manual carefully before doing any service on the machine.

The photos and illustrations used in this service manual were current at the time of publication. Production changes can cause machines to vary from the photos and the illustrations. The manufacturer reserves the right to redesign and change machines as necessary without notification.



**WARNING:**

**Some pictures in this manual show the machine with shields or guards removed to permit for a better view of the subject of the picture. All shields and guards must be in position before operating the machine.**

Machine movement when in normal use determines right-hand and left-hand.

---

### 1.1.2 Units of measurement

---

Measurements are given in metric units followed by the equivalent in US units. Hardware sizes are given in millimeters for metric hardware and inches for US hardware.



**1.1.3 Conversion table**

	MULTIPLY:	BY:	To Get:	MULTIPLY	BY:	To Get:
LINEAR	inches	x 25.4	= millimeters (mm)	x 0.03937	= inches	
	feet	x 0.3048	= meters (m)	x 3.281	= feet	
	yards	x 0.9144	= meters (m)	x 1.0936	= yards	
	miles	x 1.6093	= kilometers (km)	x 0.6214	= miles	
	inches	x 2.54	= centimeters (cm)	x 0.3937	= inches	
	microinches	x 0.0254	= micrometers (um)	x 39.37	= microinches	
AREA	inches <sup>2</sup>	x 645.16	= millimeters <sup>2</sup> (mm <sup>2</sup> )	x 0.00155	= inches <sup>2</sup>	
	inches <sup>2</sup>	x 6.4516	= centimeters <sup>2</sup> (cm <sup>2</sup> )	x 0.155	= inches <sup>2</sup>	
	feet <sup>2</sup>	x 0.0929	= meters <sup>2</sup> (m <sup>2</sup> )	x 10.764	= feet <sup>2</sup>	
	yards <sup>2</sup>	x 0.8361	= meters <sup>2</sup> (m <sup>2</sup> )	x 1.196	= yards <sup>2</sup>	
	acres	x 0.4047	= hectometers <sup>2</sup> (hm <sup>2</sup> )	x 2.471	= acres	
			= hectares (ha)			
VOLUME	inches <sup>3</sup>	x 16387	= millimeters <sup>3</sup> (mm <sup>3</sup> )	x 0.000061	= inches <sup>3</sup>	
	inches <sup>3</sup>	x 16.387	= centimeters <sup>3</sup> (cm <sup>3</sup> )	x 0.06102	= inches <sup>3</sup>	
	inches <sup>3</sup>	x 0.01639	= liters	x 61.024	= inches <sup>3</sup>	
	quarts	x 0.94635	= liters	x 1.0567	= quarts	
	gallons	x 3.7854	= liters	x 0.2642	= gallons	
	feet <sup>3</sup>	x 28.317	= liters	x 0.03531	= feet <sup>3</sup>	
	feet <sup>3</sup>	x 0.02832	= meters <sup>3</sup> (m <sup>3</sup> )	x 35.315	= feet <sup>3</sup>	
	fluid oz.	x 29.57	= milliliters (ml)	x 0.03381	= fluid oz.	
	yards <sup>3</sup>	x 0.7646	= meters <sup>3</sup> (m <sup>3</sup> )	x 1.3080	= yards <sup>3</sup>	
	teaspoons	x 4.929	= milliliters (ml)	x 0.2029	= teaspoons	
	cups	x 0.2366	= liters	x 4.227	= cups	
	bushel	x 35.239	= liters	x 0.02838	= bushels	
	bushel	x 0.03524	= meters <sup>3</sup> (m <sup>3</sup> )	x 28.378	= bushels	
	MASS	ounces (av)	x 28.35	= grams (g)	x 0.03527	= ounces (av)
pounds (av)		x 0.4536	= kilograms (kg)	x 2.2046	= pounds (av)	
tons (2000 lbs)		x 907.18	= kilograms (kg)	x 0.001102	= tons (2000 lbs)	
tons (2000 lbs)		x .90718	= metric tons(t)	x 1.1023	= tons(2000 lbs)	
tons (long)		x 1016.05	= kilograms (kg)	x .000984	= tons (long)	
(2240 lbs)					(2240 lbs)	
FORCE	ounces - f (av)	x 0.278	= newtons (N)	x 3.597	= ounces - f (av)	
	pounds - f (av)	x 4.488	= newtons (N)	x 0.2248	= pounds - f (av)	
	kilograms - f	x 9.807	= newtons (N)	x 0.10197	= kilograms - f	
PRESSURE OR STRESS	pounds/sq.in.	x 6.895	= kilopascals (kPa)	x 0.145	= pounds/sq. in.	
	pounds/sq.in.	x 0.0689	= bar	x 14.503	= pounds/sq. in.	
POWER	horsepower	x 0.746	= kilowatts (kW)	x 1.34	= horsepower	
	ft-lbf/min.	x 0.0226	= watts (W)	x 44.25	= ft - lbf/min.	
TORQUE	pound - inches	x 0.11298	= newton-meters (N.m)	x 8.851	= pound-inches	
	pound - feet	x 1.3558	= newton-meters (N.m)	x 0.7376	= pound-feet	
VELOCITY	miles/hour	x 1.6093	= kilometers/hour (km/h)	x 0.6214	= miles/hour	
	feet/sec.	x 0.3048	= meters/sec. (m/s)	x 3.281	= feet/sec.	
	kilometers/hr.	x 0.27778	= meters/sec. (m/s)	x 3.600	= kilometers/hr.	
	miles/hours	x 0.4470	= meters/sec. (m/s)	x 2.237	= miles/hour	
TEMPERATURE	<p>°F -40 0 32 80 120 160 200 240 280 320 °F</p> <p>°C -40 -20 0 20 40 60 80 100 120 140 160 °C</p> <p>°Celsius = 0.556 (°F - 32)      °Fahrenheit = (1.8° C) + 32</p>					
	MetConv.doc					

CMCHE0210035801

Fig. 1

### **1.1.4 Table of contents**

---

This manual has a table of contents at the front. The table of contents shows the divisions. The individual divisions also have a table of contents.

---

### **1.1.5 Page numbers**

---

All pages have two numbers, such as 01-25. The first number shows the division. The second number shows the page in the division.

Page numbers occur on the lower right-hand or lower left-hand corner of each page.

---

### **1.1.6 Intended use**

---

This machine is designed solely for use in customary agricultural operations.

Do not use this machine for any application or purpose other than those described in this manual. The manufacturer accepts no liability for damage or injury resulting from misuse of this machine.

Compliance with the conditions of operation, service and repair as specified by the manufacturer constitute essential elements for the intended use of this machine.

This machine should be operated, serviced and repaired only by qualified persons familiar with its characteristics and familiar with the relevant safety rules and procedures.

All generally recognized safety regulations and road traffic regulations must be obeyed at all times.

Any unauthorized modifications performed on this machine will relieve the manufacturer of all liability for any resulting damage or injury.

---

### **1.1.7 Proper disposal of waste**

---

Improper disposal of waste can pollute the environment and ecology. A few examples of potentially harmful equipment waste can include, but not limited to, items such as oil, fuel, coolant, brake fluid, filters, battery chemicals, tires, etc.

Use leak proof containers when draining fluids. Do not use food or beverage containers to collect waste fluids, as food or beverage container(s) may mislead someone into drinking from them.

Do not pour or spill waste onto the ground, down a drain, or into any water source.

Air conditioning refrigerants escaping into the air can damage the Earth's atmosphere. Government regulations may require a certified air conditioning service center to recover and recycle used air conditioning refrigerants.

Inquire with local environmental or recycling center on the proper way to recycle or dispose waste.

---



## 1.2 Safety

### 1.2.1 Safety symbol

The safety symbol tells you about a potentially hazardous area!

Look for the safety symbol in this manual and on the machine. The safety symbols tell you that there is important safety instructions in the manual.

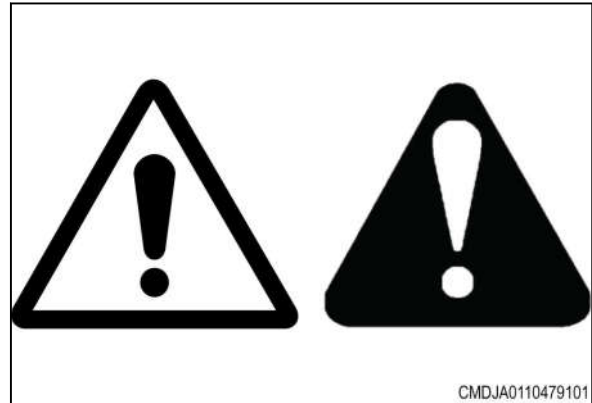


Fig. 2

### 1.2.2 Safety messages

The words DANGER, WARNING or CAUTION are used with the safety symbol. Learn these safety messages and obey the recommended precautions and safety instructions.



**DANGER:**  
If you do not obey the recommended precautions and safety instructions, DEATH OR INJURY will occur.



**WARNING:**  
If you do not obey the recommended precautions and safety instructions, DEATH OR INJURY can occur.



**CAUTION:**  
If you do not obey the recommended precautions and safety instructions, INJURY can possibly occur.



Fig. 3

### 1.2.3 Information messages

The words important and note are not related to personal safety, and are used to give information about the operation and servicing of the machine.

**IMPORTANT:** Identifies special instructions or procedures which, if not followed, can cause damage to the machine, the process, or the area around the machine.

**NOTE:** Information to make procedures easier.

### 1.2.4 Safety signs



**WARNING:**  
Do not remove the safety signs. Replace safety signs that you cannot read, are damaged, or are missing.

Clean the machine surface with a weak soap and water solution before you replace the safety signs. Replacement safety signs are available from your dealer.

Always make sure that safety signs are in the correct locations and that you can read the safety signs. Illustrations of safety sign locations are at in this section.

Keep the safety signs clean. If necessary, use a weak soap and water solution.

### 1.2.5 A word to the technician

Read and understand the safety section in this service manual before operating or servicing the machine. Read and understand the safety sections in the manuals for all attachments before operating or servicing attachments. The technician has the key to safety. Good safety practices protect everyone.

Study the safety information in this service manual. Make the safety information a working part of the safety program. The safety information in this service manual applies specifically to this type of machine. Always do all other usual and customary safe working precautions. Remember - The technician has the responsibility for safety. Good safety practices can prevent serious injury or death.

The safety section points out some basic safety situations that can occur during the operation and maintenance of the machine. The safety section also suggests possible ways to deal with these situations. The safety section does not replace safety practices in other parts of this service manual.

Practice good safety to help prevent injury or death.

Learn how to operate the machine and how to use the controls correctly.

Do not let other persons operate the machine without instruction and training.

Follow all safety precautions and instructions in the manuals and on safety signs affixed to the machine and all attachments.

Use only approved attachments and equipment.

Make sure the machine has the correct equipment needed by the local regulations.

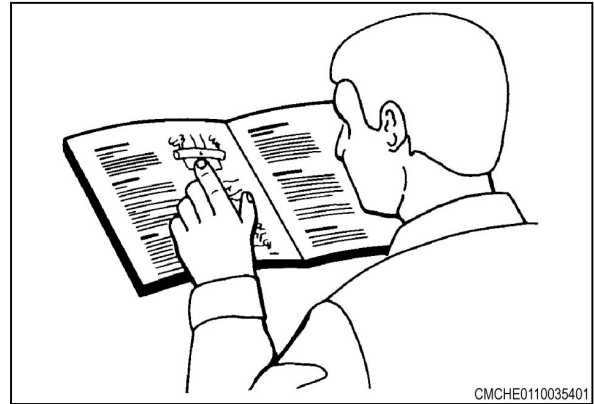


Fig. 4



**WARNING:**  
**An operator should not use alcohol or drugs which can affect their alertness or coordination. An operator on prescription or 'over the counter' drugs needs medical advice on whether or not they can properly operate machines. If any attachments used on this equipment have a separate Operator Manual, see that manual for other important safety information.**

---

## 1.2.6 The service manual

---

Read the table of contents and basic layout. Become familiar with all parts of this service manual. This service manual gives the technician very important information.

Machine movement when in normal use determines right-hand and left-hand.

This manual covers general safety practices for this machine.

The photos, illustrations, and data used in this manual were current at the time of printing. Inline production changes can make machines vary from the information in the service manual. The manufacturer reserves the right to redesign and change the machine as necessary without notification.



### **WARNING:**

**In some of the illustrations and photos used in this manual, shields or guards may have been removed for clarity. Never operate the machine with any shields or guards removed. If the removal of shields or guards is necessary to make a repair, they must be replaced before operation.**

---

## 1.2.7 Operation

---

### 1.2.7.1 Prepare for operation

Read and understand all operation instructions and precautions in this manual before you operate the machine or do the servicing.

Make sure that you know and understand the positions and operations of all controls. Make sure that all controls are in neutral and that the parking brake is applied before you start the machine.

Make sure that all persons are away from your area of work before you start and operate the machine. Examine and learn the controls in an area that is clear of persons and obstacles before you start work. Know the machine dimensions and make sure that you have sufficient space available to operate the machine. Do not operate the machine at high speeds in crowded areas.

It is important to know and use the correct procedures when you do work around and operate the machine. Do not let children or unqualified persons operate the machine. Keep others, especially children, away from your area of work. Do not let others to ride on the machine.

Make sure that the machine is in good condition for operation. Refer to the operator manual. Make sure that the machine has the correct equipment required by local regulations.

### 1.2.7.2 Roll over protective structure

The roll over protective structure (ROPS) is effective in reducing injuries during overturns. Overturning a tractor without ROPS or with the ROPS folded down can result in serious injury or death. Operate with ROPS folded down only when conditions make this necessary. Return ROPS to upright, locked position as soon as conditions permit.

Do not weld, drill, or alter the ROPS.

If the tractor has been rolled over or the ROPS frame has been damaged in any manner, the ROPS must be replaced. Do not attempt to repair a damaged ROPS. If damage does occur, consult your dealer and replace all damaged parts.

Before using the tractor make sure the ROPS frame is not damaged and it is securely fastened to the tractor .

Do not attach chains, ropes, or cables to the ROPS for pulling purposes - damage to the ROPS and/or overturn of the tractor may result. Always pull from the tractor drawbar.

Observe all recommendations and instructions regarding the installation of covers or roofs which are used as sunshields only, and do not afford the operator protection from falling objects.

### 1.2.7.3 General information

When parking, park the machine on a solid level surface and lower any implements to the ground. Put all controls in neutral and apply the park brake. Stop the engine and take the key with you.



**WARNING:**  
**Do not leave the machine unattended with any implement or attachment in the raised position. Lower the implement or attachment fully before leaving the machine. A sudden loss of hydraulic pressure can cause the implement or attachment to drop without warning.**

Make sure the machine is in the proper operating condition according to the Operator Manual.

Do not dismount from moving machinery.

Stay off slopes too steep for operation.

Be aware of the size of the machine and have enough space available to allow for operation.

Do not operate near the edge of banks. Setback distance from the bank must equal or exceed, the overall height of the bank.

Whenever possible, travel directly up or down slopes, keeping the heavy end of the tractor on the uphill side. If necessary to cross a steep slope, avoid turning uphill. Slow down and make a wide turn.

Do not operate on steep slopes as overturn may result.

On models with independent brake pedals, keep the brake pedals latched together at all times unless independent braking is required. Never use independent braking during transport.

Always drive at a proper speed relative to local conditions and ensure your speed is low enough for an emergency stop.

Reduce speed prior to turns to avoid the risk of overturning.

Keep speed to a minimum.

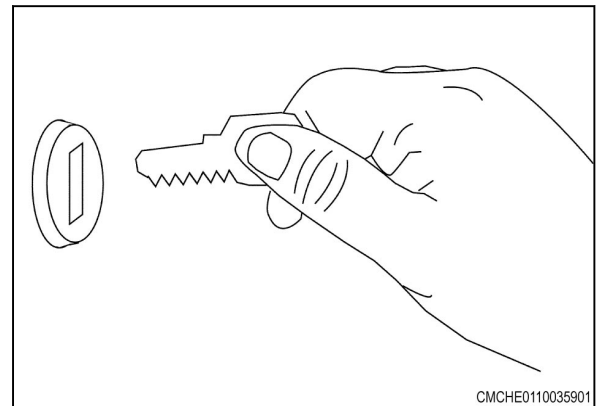


Fig. 5

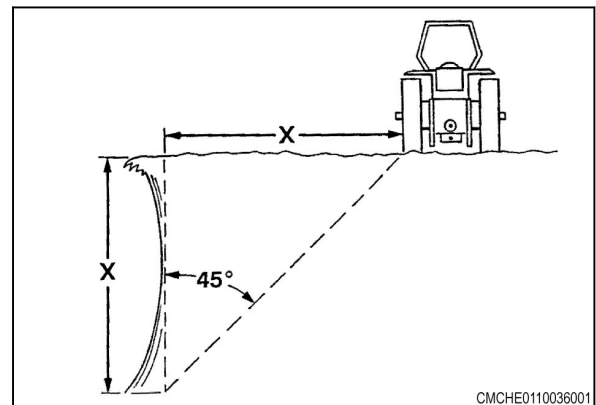


Fig. 6

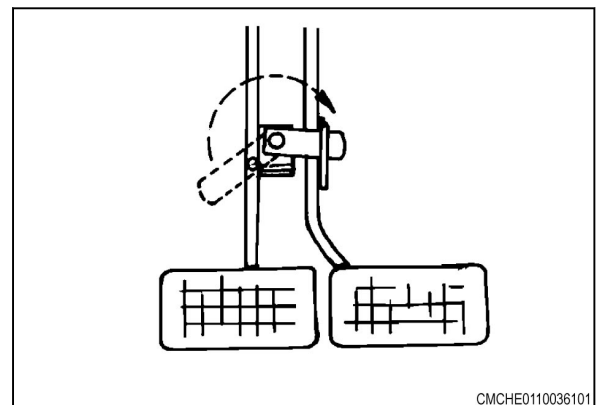


Fig. 7

## 1. General



Always keep the tractor in gear to provide engine braking when going downhill. Do not coast.

Avoid sudden or heavy brake applications when operating in wet, muddy, or icy ground conditions, or on loose surfaces, such as sand or gravel.

Sudden or heavy braking during turns increases the tendency to over steer. This effect is more pronounced with trailed equipment.

Keep a firm grip on the steering wheel at all times, with the thumbs clear of the spokes when driving the tractor.

Remain seated in operator's seat.

In the event of an overturn, hold the steering wheel firmly and keep your seat belt fastened. Do not attempt to leave the seat until the tractor has come to rest.

Watch for holes, rocks, or other hidden hazards. Always inspect area prior to operation.

Be observant of the operating area and terrain.

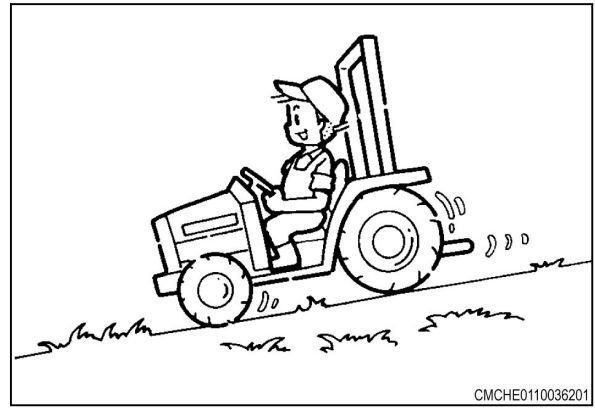


Fig. 8

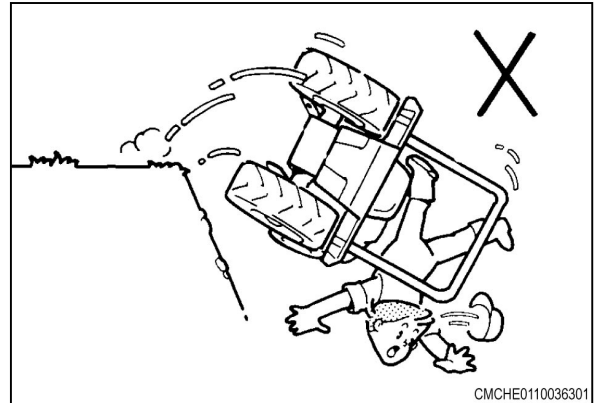


Fig. 9

Avoid contact with electrical power lines. Contact with electrical power lines can cause electrical shock, resulting in very serious injury or death.

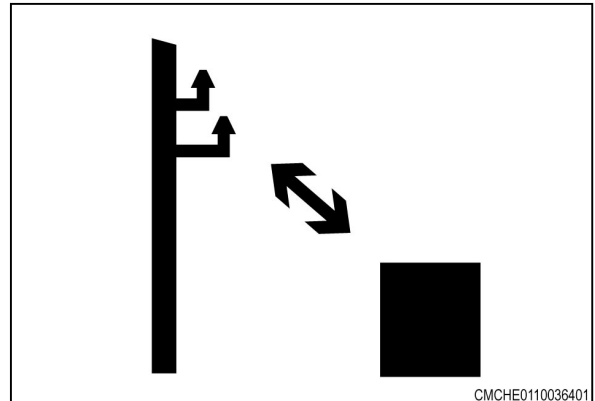


Fig. 10

Never allow anyone on any part of the tractor or attachments except in the operator's seat when the engine is running.

Do not get on or off the tractor or attachments while the tractor is moving.

Do not carry passengers.



Fig. 11

Always shut off the engine, shift the transmission to neutral, set park brake and remove the start key before leaving the operator's seat or before permitting anyone to inspect, clean, lubricate, adjust or repair any part of the tractor or attachments. Never leave the tractor unattended while the engine is operating.

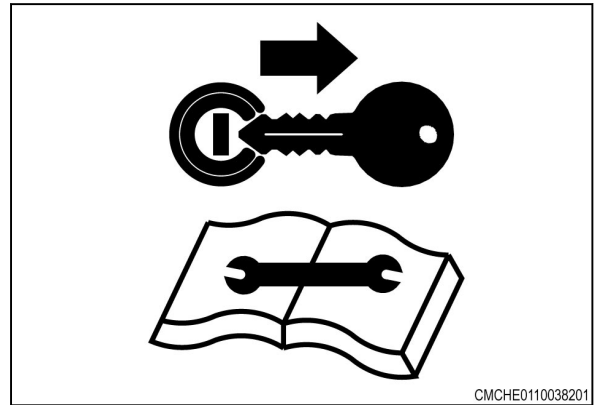


Fig. 12

Pull only from the approved drawbar.

Towing or attaching to other locations may cause the tractor to overturn.

Use a safety transport chain with towed implements. A safety transport chain connecting the tractor to the implement will help control pull-type equipment should it accidentally separate from the drawbar.

Always attach the safety transport chain to the tractor drawbar support.

Provide only enough slack in the safety transport chain to permit turning. See your dealer for a chain with strength rating equal to or greater than the gross weight of the towed machine.

For towed equipment without brakes, Do not tow equipment at speeds over 32 km/h (20 mph). Do not tow equipment that, when fully loaded, weighs more 1.5 times the weight of the towing unit.

For towed equipment with brakes, Do not tow equipment at speeds over 40 km/h (25 mph). Do not tow equipment that, when fully loaded, weighs more than 4.5 times the weight of the towing unit.

Stopping distance increases with speed and weight of towed loads, and on hills and slopes. Towed loads with or without brakes, that are too heavy for the tractor or are towed too fast, can cause loss of control. Consider the total weight of the equipment and load.

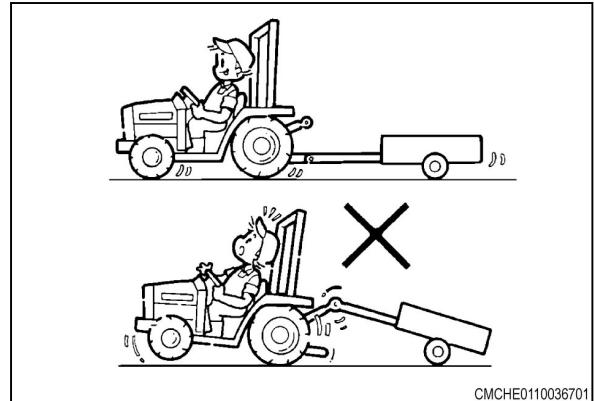


Fig. 13

When using a loader attachment, to avoid serious injury or death due to falling loads resulting from inadvertent raising or roll-back of the loader, do not connect loader hydraulics to any tractor auxiliary valve that has detents which cannot be locked out or removed, except for the float function in the loader lower circuit. If the tractor is equipped with such a valve, a dedicated, properly configured loader valve must be installed.

Make sure the proper attachment is on the loader so the load is restrained and cannot roll down the loader arms onto the operator.

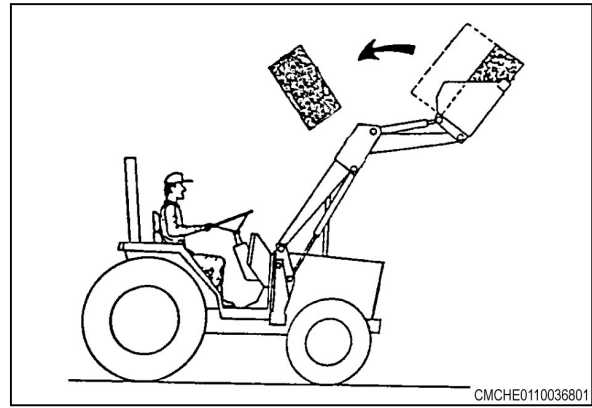


Fig. 14

**Related Links**

[Maximum load capacity](#) page 1-30

**1.2.74 Personal protective equipment**

Put on all personal protective equipment (PPE) and protective clothes that are supplied to you or that are necessary for the conditions and by applicable laws. PPE includes equipment to prevent injury to your eyes, lungs, ears, head, hands and feet.

Always keep hands, feet, hair, and your clothes away from parts that move. Do not put on loose clothing, jewelry, watches, or other items that can tangle in parts that move. Tie up long hair that can also tangle in moving parts.

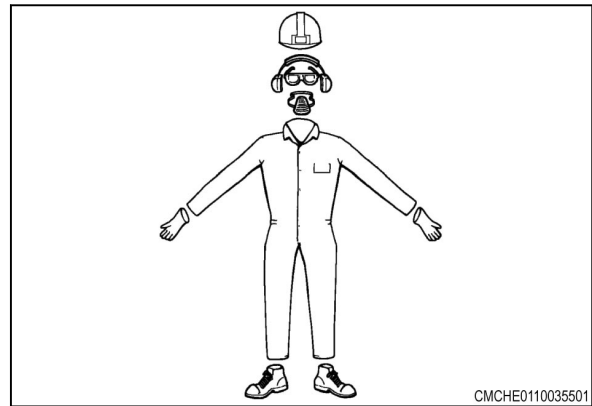


Fig. 15

**1.2.75 Seat instruction**

Securely fasten the seat belt before operating the machine. Always remain seated and have the seat belt fastened while operating the machine when the roll over protective structure (ROPS) is in the upright position. Replace the seat belts when they become worn or broken.

Never wear a seat belt loosely or with slack in the belt system. Never wear the seat belt in a twisted condition or pinched between the seat structural members.

Do not wear the seat belt when the ROPS is folded down.

Do not adjust the steering column or seat while driving.

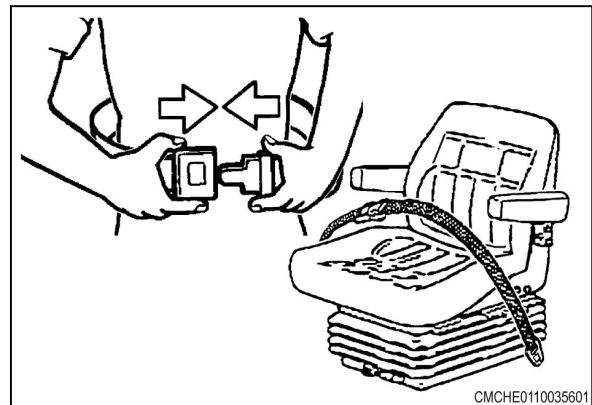


Fig. 16

### 1.2.7.6 Shield and guards



**WARNING: Entanglement hazard.  
Belts and components that rotate.**

**Severe personal injury or death can occur.**

**Do not open, remove, or put your hand behind shields if the engine is running. Stop the machine before doing service to the machine.**

All shields and guards must be in the correct position and in good condition. Keep away from the components that rotate.



**DANGER: Entanglement hazard.  
Rotating components.**

**Severe personal injury or death can occur.**

**Do not make adjustments or repairs to components while they are moving. Stop the machine before doing service to the machine.**

Do not operate the machine with the drive shaft shields open or removed.

Keep away from the components that turn.

Make sure guards that turn are free.

### 1.2.7.7 Power take-off safety

Keep all shields in place.

The rear power take-off (PTO) master shield (1) must be correctly installed at all times. The PTO shaft cover(s) must be installed when the PTO driveline is not in use.

Do not use PTO adapters. PTO shaft adapters, reducers and/or extensions extend the implement drive shaft coupler and universal joint beyond the protection of the PTO master shield.

Reduce PTO speed slowly. When stopping any PTO driven machine, idle the engine to reduce the PTO speeds before disengaging.

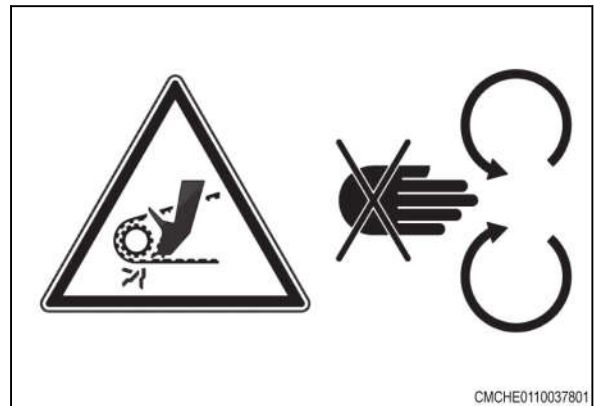


Fig. 17



Fig. 18

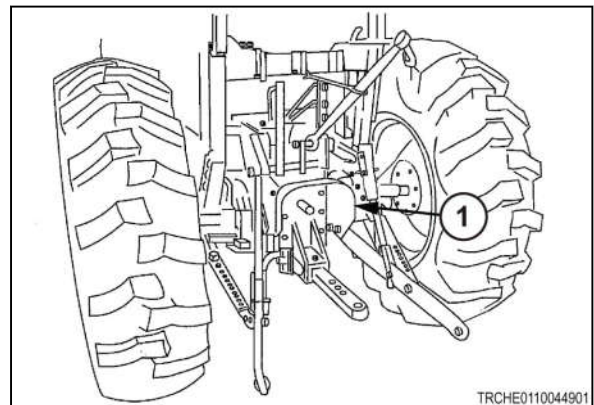


Fig. 19



The implement drive shaft coupler (1) must securely lock to, and be retained by the annular groove on the tractor PTO shaft.

Always disengage the PTO, park the tractor, shut off the engine and remove the key before:

- Connecting or disconnecting the implement drive shaft.
- Adjusting the PTO driveline or PTO driven machine.
- Cleaning, unplugging, or servicing the PTO driven machine.

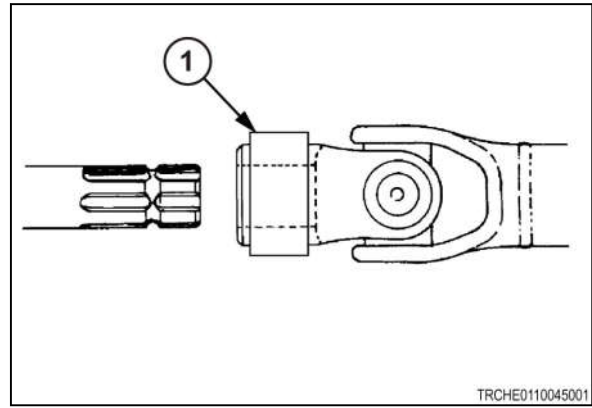


Fig. 20

### 1.2.7.8 Exhaust warning



**WARNING: Inhalation hazard. Exhaust gases.**

**Death or serious illness can occur.**

**Do not operate the engine in a closed building unless the exhaust is ventilated to the outside.**

Do not tamper with or modify the exhaust system with unapproved extensions.

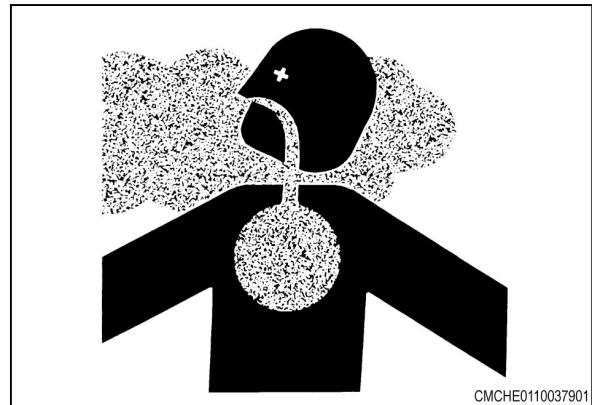


Fig. 21

### 1.2.7.9 Agricultural chemicals

Agricultural chemicals are very dangerous. Incorrect procedures with fertilizer, fungicides, herbicides, insecticides and pesticides can cause injuries to plants, animals, soil and other persons property.

Always read and follow all manufacturers instructions before you open chemical containers.

Read and follow instructions each time you use a chemical.

Use the same precautions when you do adjustments, do servicing, clean or store the machine as used when you put chemicals into the hoppers or tanks.

Tell all persons who are near chemicals of the possible dangerous results and the safety precautions that are necessary.

Stay upwind and away from smoke from a chemical fire.

Keep or discard all chemicals that are not used as specified by the chemical manufacturer.

### 1.2.7.10 Travel on public roads

Make sure that you understand the speed, brakes, steering, and load properties of this machine before you operate the machine on public roads.

Use good judgment when you operate the machine on public roads. Keep complete control of the machine at all times. Do not coast on the downhill.

The maximum speed of agricultural equipment is controlled by local regulations. Adjust travel speed to keep control of the machine at all times.

Learn and obey all road rules and laws that apply to your machine. Get information from your local law enforcement agency for local regulations about the movement of agricultural equipment on public roads. Use head lamps, flashing warning lamps, rear lamps and turn signals, day and night, unless local laws do not let you.

Make sure that all flashers operate before you operate the machine on a public road. Make sure that the reflectors are installed correctly, in good condition, and clean. Make sure that the Slow Moving Vehicle (SMV) emblem is clean, can be seen, and is installed correctly on the rear surface the machine.

If the machine has a loader, operate the machine with the loader as low as possible. Do not operate the machine with loader up.

If the machine has two brake pedals, lock the brake pedals together to make the two wheel brakes apply at the same time.

Lift implements to the transport position and lock the implement in position. Put all implements into the most narrow position.

Disengage the power take-off and the differential lock.

With towed implements, use a correct hitch pin with a clip retainer and safety transport chain.

Look at other traffic on the road. Keep to your side of the road and pull to the side of the road, when possible, to let faster traffic through.

Know the total width, length, height, and weight of the machine. Be careful when you operate the machine on narrow roads and across narrow bridges.

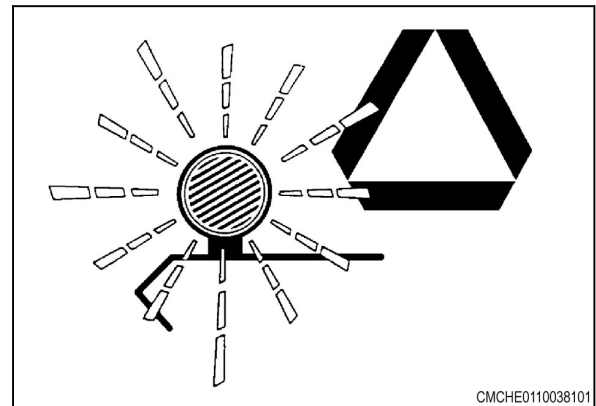


Fig. 22

Do not let the machine touch electrical power lines. If the machine touches electrical power lines, electrical shock injury and death can occur.

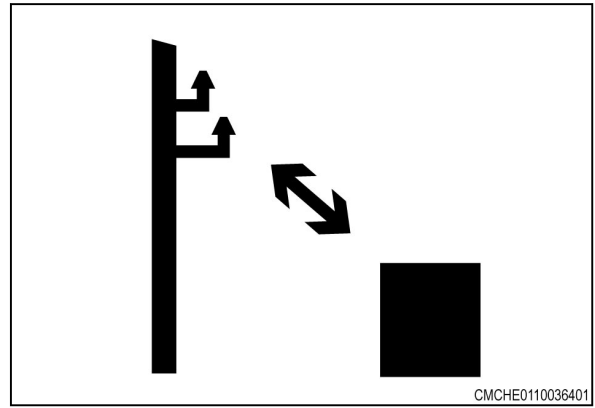


Fig. 23

### Related Links

[Maximum load capacity](#) page 1-30

## 1.2.8 Maintenance

### 1.2.8.1 General maintenance information

Before you do maintenance, lubricate, do servicing, clean, or make adjustments:

- Park the machine on a solid, level surface.
- Make sure that all the controls are in the neutral position and apply the parking brake.
- Make sure that the machine and the attachments are lowered to the ground.
- Stop the engine and take the key with you.
- Look and Listen! Make sure that all parts that move are stopped.
- Put chocks in front of and behind the wheels of the machine before you do work on or below the machine.

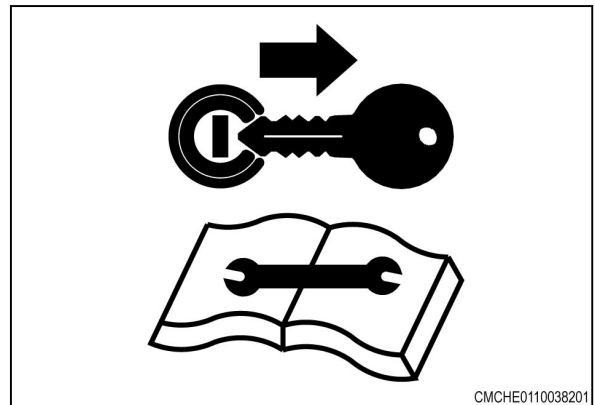


Fig. 24

After you do work on the machine, remove all tools from the machine.

Make sure that electrical connectors are clean before you connect them.

Do a check for loose, broken, missing, or damaged parts. Make sure that the machine is in good repair. Make sure that all guards and shields are in position.

Do not do the servicing, examine or adjust chains or belts while the engine is in operation.



Fig. 25

Do not operate the machine with the drive shaft shields open or removed. Entanglement in drive shafts that rotate can cause injury or death.

Stay clear of components that rotate.

Make sure that guards that rotate can rotate freely.

A loose yoke can come off a shaft and result in injury to persons or damage to the machine.

When you install a quick disconnect yoke, the spring activated locking pins must move freely and be in the groove on the shaft. Pull on the driveline to make sure that the quick disconnect yoke can not be pulled off the shaft.

Remove spilled oil, antifreeze or fuel immediately from the steps, platform, and other access areas.

Keep all access areas clean of unwanted materials.



Fig. 26



Fig. 27

### 1.2.8.2 Fire prevention and first aid

Be prepared for emergencies.

Keep a first aid kit available for use on small cuts and scratches.

Keep one or more fire extinguishers of the correct type. Examine fire extinguishers regularly as stated by the manufacturer. Make sure that the fire extinguishers are charged and in operating condition.

Crop material is flammable, there is a risk of fire. Use a water type fire extinguisher or other water source for a fire in crop.

For fires in material other than crop, such as oil or electrical components, use a dry chemical fire extinguisher with an ABC rating.

Keep fire extinguishers easy to access where fires can occur.

Frequently remove crop material from the machine and examine for components that are too hot. Do checks on the machine each day for noises that are not usual. Unusual noises can indicate a worn out component that can cause too much heat.

If flame cutting, welding, arc welding, or grinding is to be done on the machine or attachments, clear



Fig. 28

crop material and unwanted material from around the area. Make sure that the area below the work area is clear of flammable material because falling molten metal and sparks can cause ignition in the material.

If fire occurs, move upwind and away from the smoke from the fire.

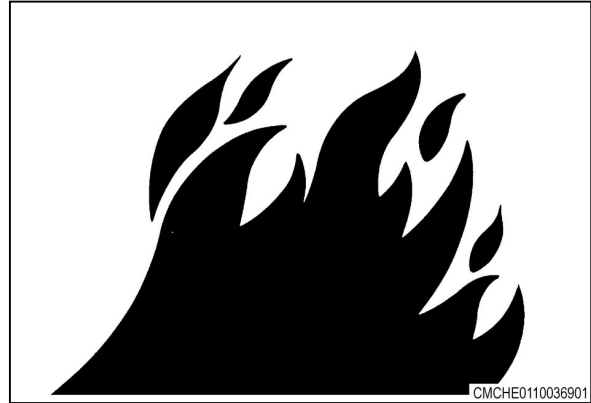


Fig. 29

### 1.2.8.3 High pressure leaks



**WARNING: Hydraulic fluid under pressure can penetrate the skin or eyes.**

**Serious personal injury, blindness, or death can occur.**

**Relieve the pressure from the system or component before disconnecting components. Wear personal protective gear while working on the machine or equipment. Use a piece of cardboard to check for leaks. Never use your hand.**

Fluid that leaks from the hydraulic system or the fuel injection system is high pressure and is not easily seen. The fluid can go into the skin causing injury.

Fluid that is injected into the skin must be surgically removed immediately. If not removed immediately, infection and reaction can occur. Go immediately to a physician who knows about this type of injury.

Use a piece of cardboard or wood to look for possible leaks. Do not use your bare hand. Wear leather gloves for hand protection and safety goggles for eye protection.

Remove all pressure before you loosen hydraulic lines. Lower equipment in the up position, close the accumulator valve, and stop the engine. Tighten all connections before you apply pressure.

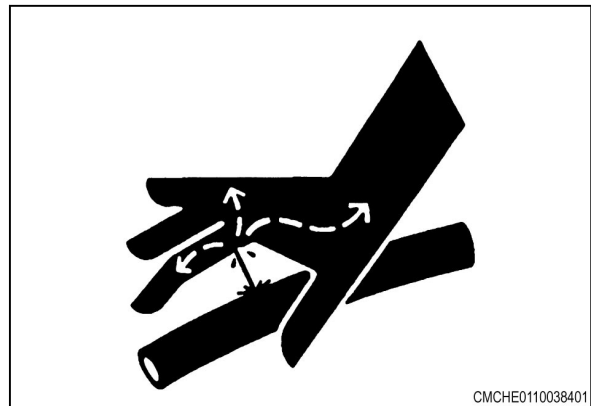


Fig. 30

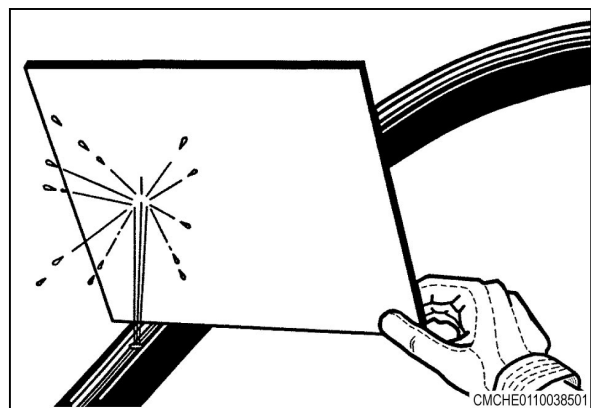


Fig. 31

### 1.2.8.4 Engine safety

Make sure all shields, guards and access doors are in position and are closed before you start the engine.

Start the engine from the operator seat only. Make sure that all controls are in neutral and the drives are disengaged.

Make sure all bystanders are clear of the machine before you start the engine.

Do not bypass the neutral start system. The neutral start system will not let the engine start if the machine is in gear. Manual override of this system can cause death and injury.

Do not connect booster cables to the starter terminals or short across the starter terminals.



**DANGER: Explosion hazard. Starting fluid.**

**Personal injury, death, or machine damage can occur.**

**Do not use starting fluid as a starting aid.**

Do not use aerosol starting fluid to start the engine. The heaters in the intake manifold can cause ignition and explosion of the starting fluid. This explosion can cause death, injury and damage to the engine.



**DANGER: Component movement hazard.**

**Personal injury, death, or machine damage can occur.**

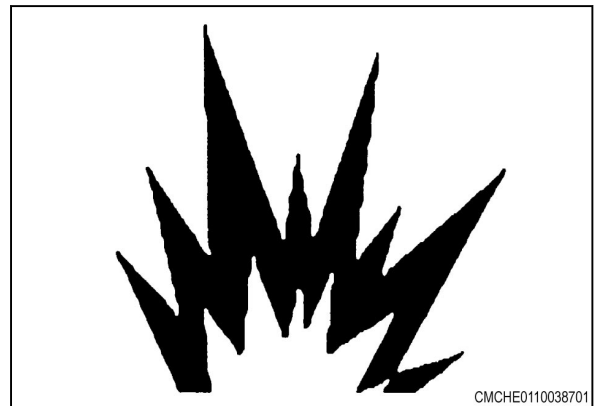
**Stop the engine and stop all components from moving before servicing.**

Keep out of the engine compartment while the engine is in operation. Before you open the engine cover, stop the engine and take the key with you.



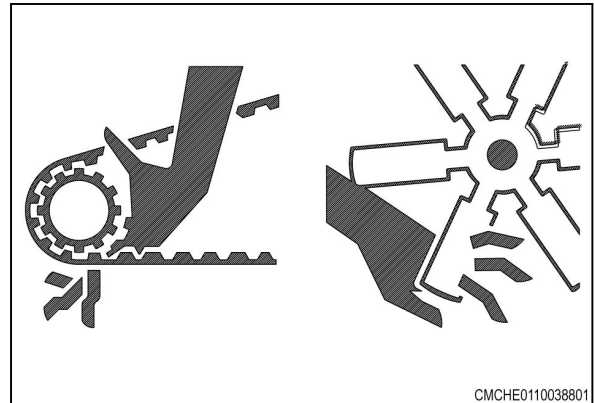
CMCHE0110038601

Fig. 32



CMCHE0110038701

Fig. 33



CMCHE0110038801

Fig. 34



**WARNING: Hot components can burn.**  
**Severe personal injury can result.**  
**Let the engine and components cool before doing maintenance.**

Know that the surfaces in and around the engine compartment will be hot if the engine has operated.

Always let parts that contain hot fluid or become gases cool to the touch before you handle or disconnect them.

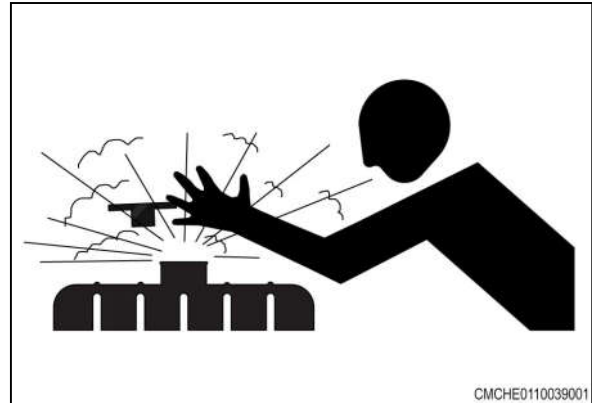


CMCHE0110038901

Fig. 35



**WARNING: Pressurized fluids can be hazards.**  
**Personal injury can result.**  
**Allow the engine to cool. Loosen the cap to allow pressure to escape, then remove the cap.**



CMCHE0110039001

Fig. 36

#### 1.2.8.5 Fuel safety



**WARNING: Fire hazard. Fuel safety.**  
**Personal injury or machine damage can occur.**

**Clean up any spilled oil immediately.**

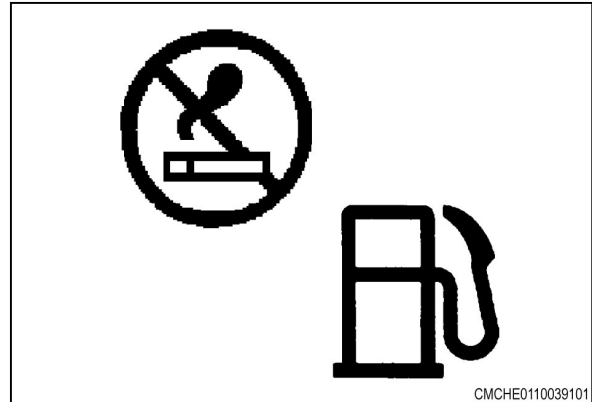
Fuel is flammable. Be careful with fuel.

Always stop the engine before you add the fuel.

Keep open flames and electrical sparks away from the area.

Do not smoke while you add the fuel.

Remove spilled fuel.



CMCHE0110039101

Fig. 37

### 1.2.8.6 Battery safety



**WARNING: Battery explosion and acid hazard.**

**Battery gases are explosive and acid is corrosive. Personal injury or death can occur.**

**Keep sparks or open flame away from the battery. Always disconnect the grounded (-) cable first. If fluid comes in contact with skin or cloths, wash fluid off immediately. If fluid is ingested or gets in the eyes, seek medical help immediately. Never charge a frozen battery.**

Electrical storage batteries give off flammable hydrogen gas. Do not smoke around batteries. Keep open flames and electrical sparks away from the battery.

Do not put tools or other objects on a battery.

Be careful when you connect booster cables to the machine. Electrical component damage and battery explosion can occur if the booster cables are not installed correctly.

Battery posts, terminals and other battery parts contain lead and lead compounds. Clean your hands after you touch a battery.

The fluid in the electrical storage batteries contains sulfuric acid. Do not let the fluid touch your eyes, skin, or clothing. Clean your hands after you touch a battery.

If battery fluids touch your skin, flush immediately with large quantities of water.

If battery fluids touch your eyes, flush with water for 15 minutes and get medical treatment immediately.

If swallowed, drink large quantities of water or milk. Do not induce vomiting. Get medical treatment immediately.

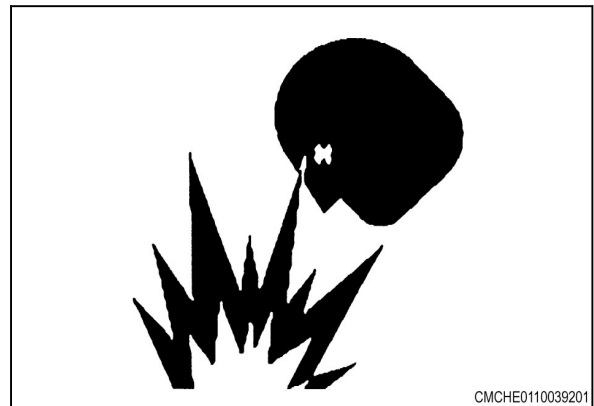


Fig. 38

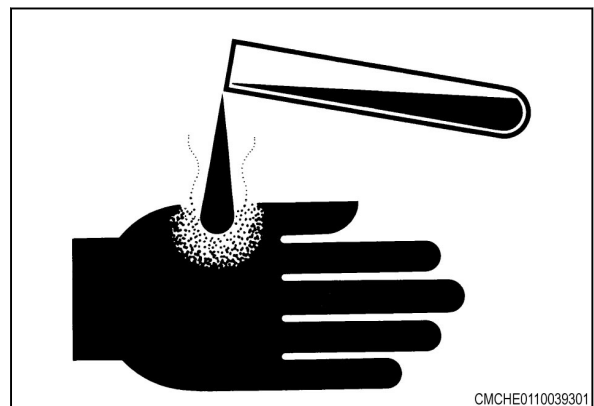


Fig. 39



### 1.2.8.7 Tire safety

Examine tires for cuts, bulges, and correct pressure. Replace worn or damaged tires. When tire service is needed, have a qualified tire mechanic service the tire. Tire changing can be very hazardous and must be done by qualified tire mechanic using proper tools and equipment.

Tire explosion and/or serious injury can result from over inflation. Do not exceed the tire inflation pressures.

Do not inflate a tire that is seriously under inflated or has been run flat. Have the tire examined by qualified tire mechanic.

Do not weld on the rim when a tire is installed. Welding will make an air/gas mixture that can cause an explosion and burn with high temperatures. This hazard applies to all tires, inflated or deflated. Removing air or breaking the bead is not enough. The tire must be completely removed from the rim prior to welding.

When preparing a calcium chloride solution for fluid ballast the tractor tires, never pour water onto the calcium chloride. A chlorine gas can be generated which is poisonous and explosive. This can be avoided by slowly adding calcium chloride flakes to water and stirring until they are dissolved.

When seating tire beads onto rims, never exceed 2.4 bar (35 psi) or the maximum inflation pressure specified on the tire. Inflation beyond this maximum pressure may break the bead, or even the rim, with explosive force.

#### Related Links

[Tire inflation pressures](#) page 1-30

### 1.2.8.8 Replacement parts

Where replacement parts are necessary for machine maintenance and servicing, you must use original equipment replacement parts.

The manufacturer will not accept responsibility for installation of unapproved parts and/or accessories and damages as a result of their usage.



Fig. 40

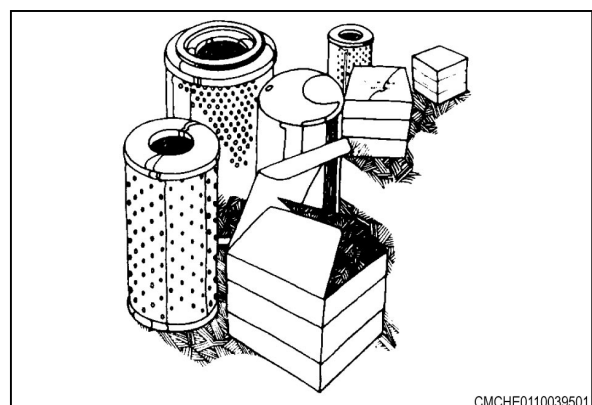


Fig. 41

### 1.2.8.9 Weld on the machine precautions

Before you weld on the machine:

- Disconnect battery terminals and put them out of the way.
- Disconnect all controllers and monitors.
- Connect the welding ground as close as possible weld area.

If you do not disconnect the electrical components, the component can be damaged.

When you connect the electrical connections, connect the battery cables last.

## 1.3 Machine identification

Each machine is identified by a model and a serial number.

Record these numbers in the spaces given.

Give the model number and serial number to your dealer when parts or servicing are necessary.

Machine model number: \_\_\_\_\_

Machine serial number: \_\_\_\_\_

Date of delivery: \_\_\_\_\_

Dealer name: \_\_\_\_\_

Dealer address: \_\_\_\_\_

\_\_\_\_\_

Dealer telephone number: \_\_\_\_\_

Dealer e-mail address: \_\_\_\_\_

Dealer fax number: \_\_\_\_\_

### 1.3.1 Serial number plate

The serial number plate (1) is located below the operator seat.

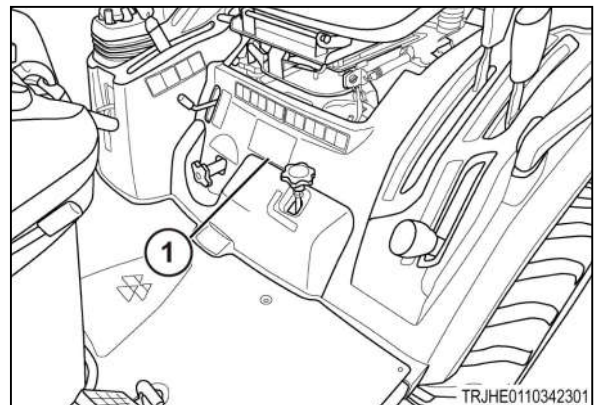


Fig. 42

The serial number plate contains the model number and serial number.



Fig. 43

### 1.3.2 Engine identification

The engine model number (1) is cast on the right-hand side of the engine block, below the injection pump.

The engine serial number (2) is stamped into the cylinder block, below the engine model number.

Engine model number:	
Engine serial number:	

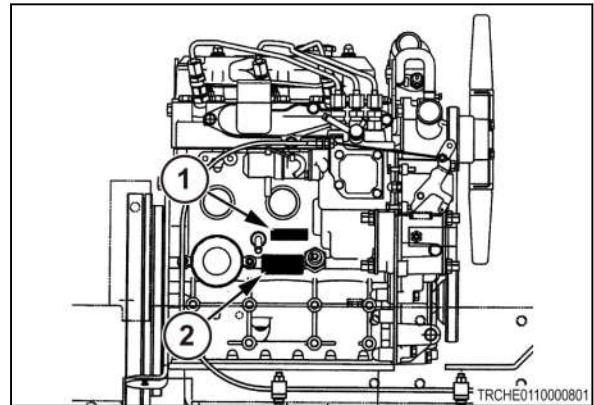


Fig. 44

### 1.3.3 Chassis number

The chassis number (1) is stamped in right-hand side of the front frame.

Chassis number:	
-----------------	--

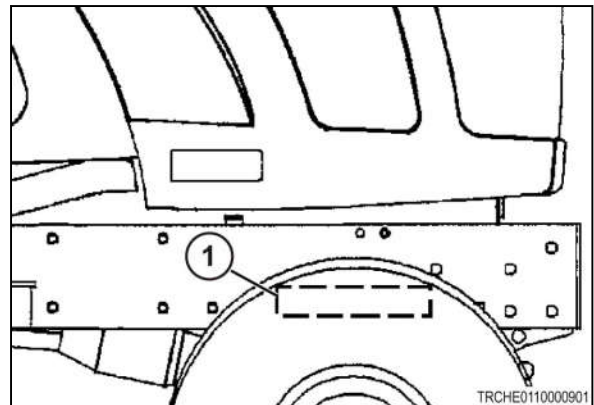


Fig. 45

## 1.4 Specifications

Specifications and design are subject to change without notice and without liability therefore.

### 1.4.1 Lubrication specifications

**IMPORTANT:** *Examine fluid levels after filling.*

AGCO Genuine lubricants are the recommended products for this machine. The use of other lubricants may not give the same level of necessary performance.

All models	
Grease fitting	AGCO Multi-Purpose Lithium II Grease or equivalent
Engine oil	Massey Ferguson Multiguard® or equivalent in the correct SAE viscosity. Oil must meet or exceed requirements API service classification CJ-4 class
<b>Recommended Viscosity:</b>	
Between -35 and 40 °C (-31 to 104 °F)	SAE 5W-30
Between -20 to 40 °C (-4 to 104 °F)	SAE 10W-30
Engine coolant	50/50 mixture ethylene glycol and water
Freezing protection (original factory fill)	-34° C (-30° F)
Transmission and differential housing (including hydraulic system)	Permatran® 821 XL or equivalent
Front axle	Permatran® 821 XL or equivalent

### 1.4.2 Capacities

**IMPORTANT:** *The capacities listed are approximate. Examine fluid levels after filling.*

AGCO Genuine lubricants are the recommended products for this machine. The use of other lubricants may not give the same level of necessary performance.

#### Engine oil

All models	
Quantity with filter change	2.6 liters (2.7 US qt)

**Cooling system**

	All models
Quantity	4.6 liters (4.9 US qt)

**Fuel tank**

	All models
Quantity	25 liters (6.6 US gal)

**Front drive axle**

	All models
Quantity	4.0 liters (4.2 US qt)

**Transmission and differential housing (including hydraulic system)**

	All models
Quantity	11 liters (2.9 US gal)

**1.4.3 Engine specifications**
**Engine**

	GC1723E	GC1725M
Model	E3112-XB03	E3112-XB02
Type	4 stroke diesel engine	
Aspiration	Natural	
Fuel injection	Indirect	
Rated power (gross estimate)	16.8 kW (22.5 hp) at 2600 rpm	18.3 kW (24.5 hp) at 3000
Rated power (net estimate)	16.1 kW (21.6 hp) at 2600 rpm	17.6 kW (23.9 hp) at 3000 rpm
Rated power (540 PTO)	13.6 kW (18.3 hp)	13.8 kW (18.5 hp)
Low idle	1250 rpm to 1350 rpm	
High idle	2760 rpm to 2860 rpm	3170 rpm to 3270 rpm
Firing Order	1-3-2	1-3-2
Number of cylinders	3	3
Compression ratio	22.5 to 1	
Bore	78.2 mm (3.08 in)	
Stroke	78 mm (3.07 in)	
Displacement	1123 cc (68.5 cu in)	
Engine cooling	Liquid, forced circulation	
Air cleaner	Single stage, dry element	
Cold start help	Glow plugs	
Valve clearance: intake and exhaust, hot or cold	0.25 mm (0.010 in)	

### 1.4.4 Electrical specifications

	All models
System voltage	12 Volt
Grounding	Negative
Battery cold cranking amperes (cca) @ - 18 degrees C (0 degrees F)	433 CCA
Charging system	40 ampere alternator with internal regulator/rectifier

### Battery case size

	All models
Length	238 mm (9 3/8 in)
Width	129 mm (5 in)
Height	203 mm (8 in)

### 1.4.5 Fuel specifications

	All models
Type	Ultra low sulfur fuel only
Above 4 °C (39 °F)	No. 2-D
Below 4 °C (39 °F)	No. 1-D

### 1.4.6 Front axle specifications

	GC1723E		GC1725M	
	AG tire	Turf tire	AG tire	Turf tire
Engagement	Mechanical			
Joint axle	Bevel gear			
Turn angle	Left turn: 53°			
	Right turn: 49°			
Oscillation angle	6° to 8°			
Steering	Hydraulic			
Front wheel drive ratio	1.5018 to 1			

### 1.4.7 Hydraulic specifications

#### Main hydraulic

	GC1723E	GC1725M
Pump	Transmission mounted gear pump	
Maximum output	24.0 liter/min (6.3 US gal/min)	26.3 liter/min (6.9 US gal/min)
System pressure (relief valve)	13244 kPa (1920 psi)	

**Steering system**

	All models
Type	Steering control unit
Pump	Transmission mounted gear pump with flow divider
Maximum output	7.5 liter/min (2.0 US gal/min)
Pressure relief valve	8339 kPa (1209 psi)

**Rear linkage**

	All models
Type	3-point linkage
Size	Category 1
Control	Lift control valve
Lift capacity	540 kg (1191 lb) measured at ball ends

**Filters**

	All models
Suction filter	150 micron mesh
Spin-on filter	10 micron

**1.4.8 Power take-off specifications**

	All models
Type	Independent, engine driven
Control	Hydraulic control
Clutch	Mechanically engaged, multi-plate wet disk

**Rear PTO shaft**

	GC1723E	GC1725M
Type	35 mm (1.375 in) diameter, six spline	
Output	Clockwise rotation	
Engine speed at 540 PTO rpm	2532 rpm	2829 rpm

**Mid PTO shaft**

	GC1723E	GC1725M
Type	25.4 mm (1 in) diameter, 15 spline	
Output	Clockwise rotation	
Engine speed at 540 PTO rpm	2476 rpm	2947 rpm



### 1.4.9 Transmission specifications

	All models
Type	Hydrostatic
Transmission speeds	Infinite (to maximum speed)
Range transmission	2-speed constant mesh
Clutch	None
Brakes	Mechanically actuated, sealed wet disk

### Hydrostatic transmission pressures

	All models
Charge pressure	393 kPa to 586 kPa (57 psi to 85 psi)
High pressure relief	17609 kPa to 18615 kPa (2554 psi to 2700 psi)
Filter bypass	98 kPa (14.2 psi)
Case pressure	Less than 98 kPa (14.2 psi)

### 1.4.10 Maximum load capacity

Location	Weight
Front axle	880 kg (1940 lb)
Rear axle	950 kg (2094 lb)
Maximum tractor weight	1220 kg (2690 lb)

### 1.4.11 Tire inflation pressures

Tire Type	Tire Location	Tire Size	Pressure kPa (psi)
Ag	Front	18 x 8.50-10	155 (23)
	Rear	26 x 12.0-12	140 (20)
Turf	Front	18 x 8.50-10	150 (22)
	Rear	26 x 12.0-12	140 (20)
R4	Front	18 x 8.50-10	150 (22)
	Rear	26 x 12.0-12	140 (20)

## 1.5 Dimensions

### 1.5.1 Tractor dimensions

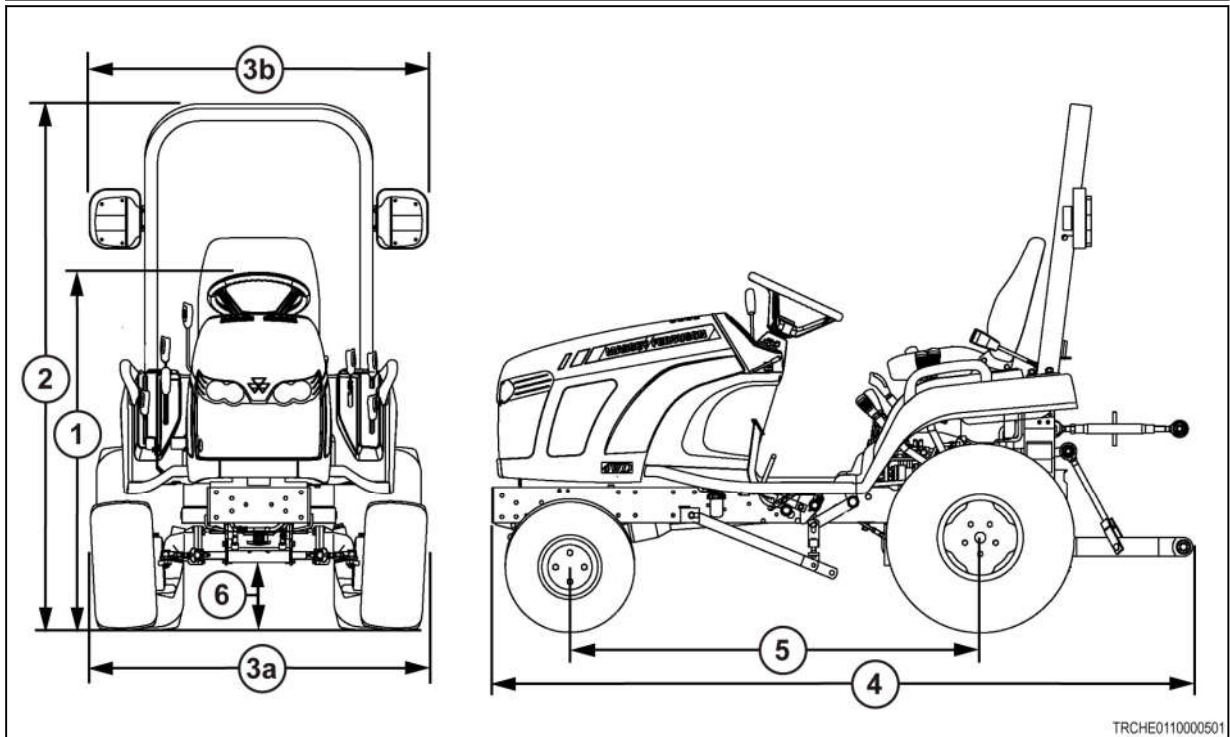


Fig. 46

		GC1723E		GC1723E (TLB)		GC1725M		GC1725M (TLB)	
		Ag tires	Turf tires	Ag tires	Turf tires	Ag tires	Turf tires	Ag tires	Turf tires
1	Height of Steering Wheel	1320 mm (52 in)		1320 mm (52 in)		1320 mm (52 in)		1320 mm (52 in)	
2	Overall Height ROPS	1850 mm (72.8 in)		2180 mm (85.8 in)		1850 mm (72.8 in)		2180 mm (85.8 in)	
3a	Overall Width (tires)	1185 mm (46.7 in)	1190 mm (46.9 in)	1185 mm (46.7 in)	1190 mm (46.9 in)	1185 mm (46.7 in)	1190 mm (46.9 in)	1185 mm (46.7 in)	1190 mm (46.9 in)
3b	Overall Width (combination rear light)	1126 mm (44.3 in)		1271 mm (50 in)		1170 mm (46.1 in)		1315 mm (51.8 in)	
4	Overall Length	2480 mm (97.6 in)		2480 mm (97.6 in)		2480 mm (97.6 in)		2480 mm (97.6 in)	
5	Wheelbase	1450 mm (57.1 in)		1450 mm (57.1 in)		1450 mm (57.1 in)		1450 mm (57.1 in)	
6	Minimum Ground Clearance	170 mm (6.7 in)		170 mm (6.7 in)		170 mm (6.7 in)		170 mm (6.7 in)	
	Turning Radius without Brake	Right	2550 mm (100.4 in)	2550 mm (100.4 in)	2550 mm (100.4 in)	2550 mm (100.4 in)	2550 mm (100.4 in)	2550 mm (100.4 in)	2550 mm (100.4 in)



			GC1723E		GC1723E (TLB)		GC1725M		GC1725M (TLB)	
			Ag tires	Turf tires	Ag tires	Turf tires	Ag tires	Turf tires	Ag tires	Turf tires
		Left	2400 mm (94.5 in)		2400 mm (94.5 in)		2400 mm (94.5 in)		2400 mm (94.5 in)	
	Weight (bare tractor with R4 tires and wheels) Does not include loader, backhoe, or mounted equipment.	With joystick	665 kg (1466 lb)		690 kg (1521 lb)		670 kg (1477 lb)		695 kg (1532 lb)	
		No joystick	640 kg (1411 lb)							

## 1.6 Bolt torque

### 1.6.1 Bolt torque chart

Tighten all fasteners using this torque chart unless a specific torque value is shown.

	4T		7T	
	Nm	lbf ft	Nm	lbf ft
M6	5 to 7	4 to 6	10 to 12	7 to 9
M8	12 to 17	9 to 13	24 to 30	17 to 22
M10	22 to 30	16 to 22	45 to 58	33 to 43
M12	41 to 59	30 to 43	79 to 93	59 to 69
M14	55 to 78	41 to 58	123 to 147	90 to 108
M16	82 to 118	61 to 87	196 to 230	145 to 170
M20	132 to 186	98 to 137	333 to 448	246 to 330

### 1.6.2 Wheel bolt torque chart

Wheel bolts	Torque
Front wheel bolts	147 Nm (108 lb ft)
Rear wheel bolts	95 Nm (70 lb ft)

## 1.7 Lubrication and maintenance

### 1.7.1 Lubrication and maintenance chart for daily inspection

Daily	
x	Examine and repair all the controls and switches.
x	Examine and tighten all the fasteners and hardware.
x	Examine and repair the hoses, belts and wiring.
x	Examine and fill the engine oil level.
x	Examine and fill the transmission oil level.
x	Clean debris from the air screens and radiator.
x	Examine and fill the radiator coolant level.
x	Examine and adjust belt tension.
x	Examine and fill the fuel tank level.
x	Examine and clean the fuel filter sediment bowl.
x	Examine and repair the lamps and flashers.
x	Examine and adjust the brake.
x	Examine, adjust, or replace the tire condition and pressure.
x	Examine and tighten the wheel bolt torque.
x	Examine and adjust the steering free play.

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### 1.7.2 Lubrication and maintenance chart

First 50 hours	Every 250 hours	Every 500 hours	Other	
x				Examine and adjust the toe in.
x				Examine, adjust and tighten the tie rod ends.
x			Yearly	Examine the power steering hoses.
x			Yearly	Examine the fuel hoses.
x				Examine the electrical wiring.
x				Examine and tighten the hardware on the outside of the engine.
			Every 50 hours	Brake pivots (apply grease to fitting)
			Every 50 hours	3-point turnbuckle (apply grease to fitting)
			Every 50 hours	Hydrostatic pedals (apply grease to fitting)

First 50 hours	Every 250 hours	Every 500 hours	Other	
x	x		First 50 hours then yearly or every 250 hours	Replace the engine oil and engine oil filter.
	x		Yearly or every 250 hours	Replace the transmission oil and filter. Clean the filter screen.
	x			Examine the radiator fins
	x			Examine and adjust the front wheel alignment.
	x		Yearly or every 250 hours	Examine and fill the front axle oil level.
		x	Every two years or 500 hours	Replace the front axle oil.
		x		Inspect the engine valve clearance.
		x	Every two years or 500 hours	Change the fuel filter element.
x		x	First 50 hours then every 500 hours	Examine and adjust the belt and belt tension.
			1000 hours	Examine the starter.
			1000 hours	Examine the alternator.
			1000 hours	Examine and tighten the hardware on the outside of the engine.
			Every two years or 1000 hours	Change the engine coolant.
			As necessary	Bleed the air from the fuel system
			As necessary	If the engine has not been started for 12 months or longer, replace the engine oil and filter.
			As necessary	Examine, clean, or replace the air cleaner element.
			As necessary	Examine the condition of the battery.
			As necessary	Fill and bleed the air from the coolant system.

### Related Links

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### 1.7.3 Lubrication fill and drain locations

- Grease fittings
- ⊙ Fill location
- ⊕ Drain location
- ▲ Oil check window
- ⊗ Coolant fill location
- △ Coolant drain location
- Oil check dipstick

Item	Component	Description
1	Engine crankcase	Engine oil
2	Engine radiator	Coolant
3	Overflow tank	Coolant
4	Fuel tank	Diesel fuel - Ultra Low Sulfur diesel fuel only
5	Rear housing	Hydraulic oil
6	Four-wheel drive axle	Hydraulic oil
7	Brake pivots	Grease
8	3-point turnbuckle	Grease
9	Hydrostatic pedals	Grease
10	Mower linkage	Grease
11	3-point top link	Grease

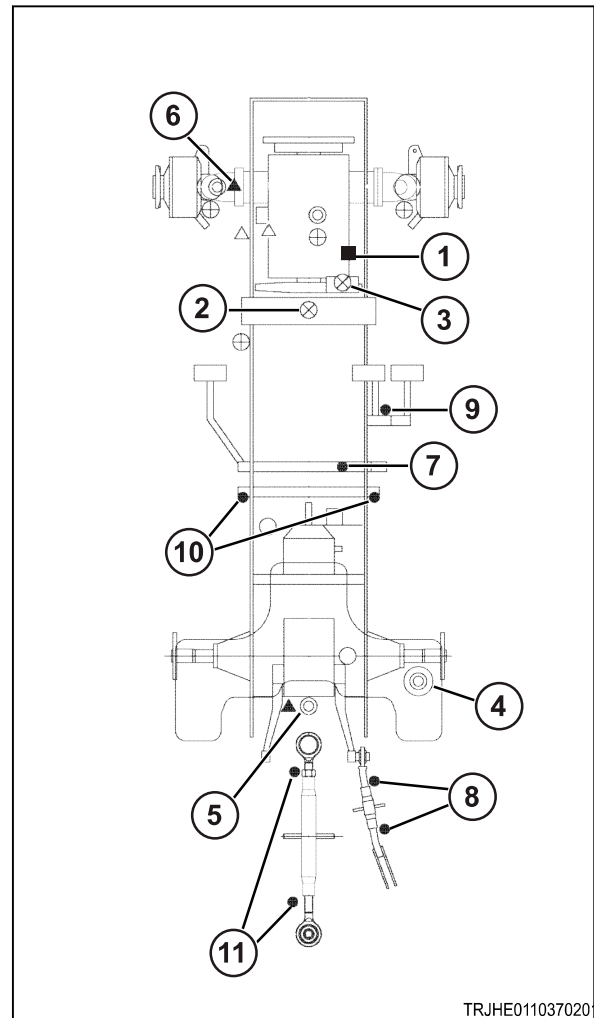


Fig. 47

### 1.7.4 Lubrication fittings

Clean the grease gun and the lubrication fittings before and after lubricating to prevent contamination from dirt.

**NOTE:**

*When operating in muddy or extremely wet conditions, lubricate the fittings daily.*

**Related Links**

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## 1.8 Machine components

### 1.8.1 Machine components

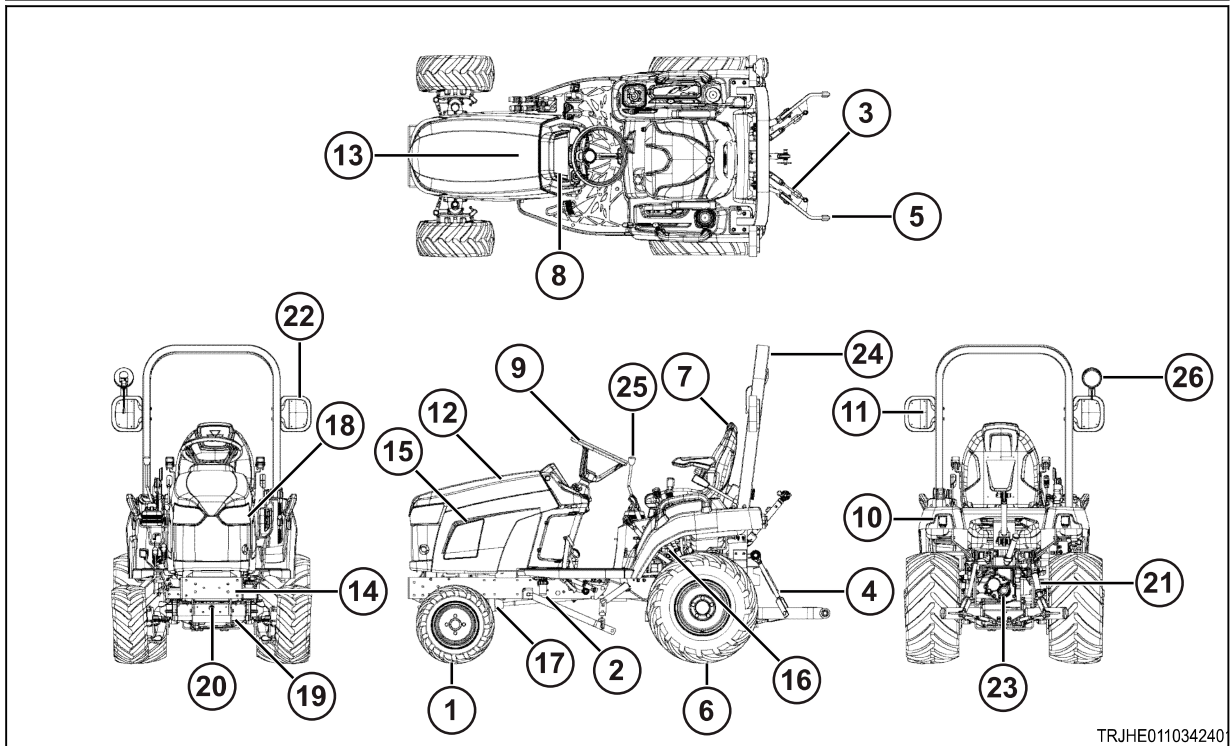


Fig. 48

- |                                    |  |
|------------------------------------|--|
| (1) Front wheels                   | (14) Front bumper                          |
| (2) Fuel filter                    | (15) Engine                                |
| (3) Stabilizer                     | (16) Transmission                          |
| (4) Lift rod                       | (17) Front wheel drive shaft               |
| (5) Lower link                     | (18) Headlamp                              |
| (6) Rear wheels                    | (19) Front axle                            |
| (7) Operator seat                  | (20) Front axle pivot                      |
| (8) Instrument panel               | (21) Lift arm                              |
| (9) Steering wheel                 | (22) Turn/warning lamp                     |
| (10) Reflector                     | (23) PTO shaft                             |
| (11) Tail lamp                     | (24) Roll-over protective structure (ROPS) |
| (12) Engine cover and front grille | (25) Joystick lever, if equipped           |
| (13) Battery                       | (26) Work lamp (GC1725M)                   |



---

## 1.9 General precautions for the repair

---

### 1.9.1 Parts removal, disassembly, and assembly precautions

---

#### Before the procedure

Wear the correct clothing/safety wear.

Always use the correct tool for the procedure.

Before you disassemble a part, make sure you know how to re-assembled part.

Keep parts, and tools in the correct order during the procedure.

When parts are assembled, use new gasket, O-rings, or oil seals.

Put blocks in front of and behind of the wheels not being lifted.

When the tractor is lifted up, make sure to support the tractor with a stand.

---

### 1.9.2 Parts installation precautions

---

#### Bearings

Use an installer when installing a bearing in a housing by the outer race. The installer is specially used to push on only the outer race and vice versa.

The installer must is used to install the bearing on the shaft in a parallel position.

When installing a bearing which looks the same on both sides, install the face with the identification number visible. Install all bearings in the transmission housing with their identification number pointing outward.

Push a bearing fully until seated, when installed in a shaft or a hole with an inner seat.

Bearings must turn smoothly.

#### Oil seals

A oil seal installer must not deform the oil seals.

During installation, be careful not to damage the lips. Make sure to push the bearing in parallel to the shaft or hole.

Installed oil seals must have no turnover of the lips and no dislocation of the springs.

When installing a multiple lip, fill the grooves between the lips with grease.

Use a lithium-based grease.

There must not be any oil, or water leaks around the new seals.

#### O-rings

Coat O-rings with grease before installing.

Installed O-rings must not have any tension or twist.

Installed O-rings must keep correct tightness.

### Retainer rings

Retainer ring installers must not permanently deform the retainer rings (1).

Install the retainer rings correctly in the groove.

Be careful not to overload the retainer ring to the point that the retainer ring is permanently damaged.

Install a retainer ring as shown in the figure, with its round edge turned toward the retained part. Pressing the retainer ring out will round the edge.

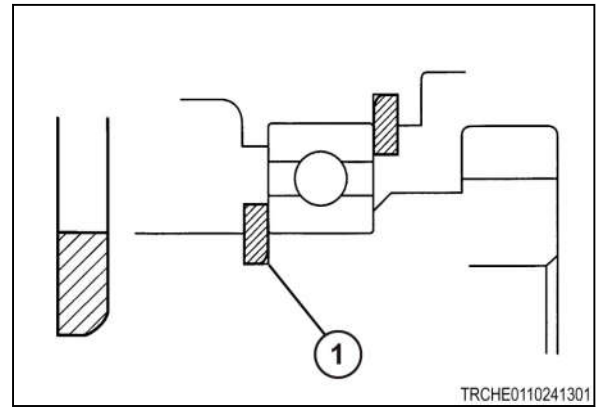


Fig. 49

### Spring (roll) pin

Spring pins must install tightly.

Install the retainer rings with the seams pointing in the direction of the applied load.

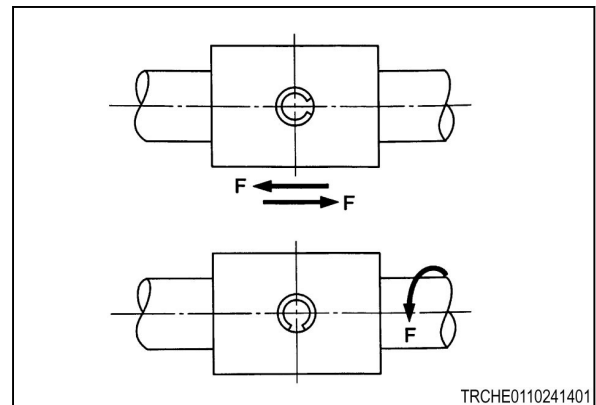


Fig. 50

### Cotter pins

Correctly bend the cotter pins at the ends as shown in the figure when installing.

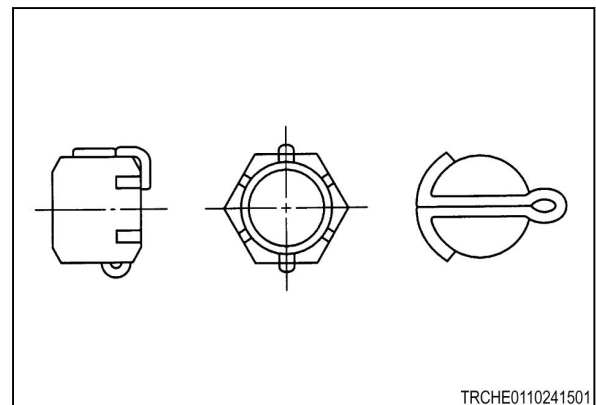


Fig. 51

### Bolts and Nuts

Special bolts are installed at some locations, so make sure not to interchange the special bolts with the other bolts.

Use a torque wrench to tighten the bolts and nuts to their specified torque .

When locking the bolts or nuts with wire, take note in the winding direction to hold the bolt tight.

When locking the bolts or nuts with a extension lock washer, bend the extension against the hexadecimal. This will give secure locking.

When locking bolts and nuts with an adhesive apply the adhesive on the thread and tighten correctly.  
Apply a sealant to components which have any risk of oil leaks, such as stud bolts and treaded holes.  
Tighten each lock nut tight.

### **Grease fittings**

After installation, fill each grease fitting with grease.

When installing 45° or 90° grease fittings, make sure to turn the fitting. Turn the fitting in a direction that will let easy access for a grease gun.

### **Other precautions**

Make sure not to damage any finished surfaces or parts.

Always refrain from forcing installation.

Install each lever knob coated with an adhesive.

Coat each contact surface with an adhesive and tighten equally with bolts. Install adhesive coated surfaces within 30 minutes after application of the adhesive.

The contact surface must be flawless and free from unwanted material. Remove all grease before application of the adhesive.

Precautions for applying adhesives:

- The surface or the thread where an adhesive is applied, must be fully free of chips.
- The surface of the thread where an adhesive is applied must be fully free of oil.

## 2 Engine, Fuel, and Exhaust System

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## 2.1 Engine oil

### 2.1.1 Examine the engine oil

#### Procedure

1. Park the machine on a solid, level surface. Apply the parking brake, stop the engine, and take the key with you.
2. Wait a short time to let the oil stabilize in the crankcase.
3. Open the engine cover.
4. Pull out the dipstick (1) from the level gauge guide pipe.

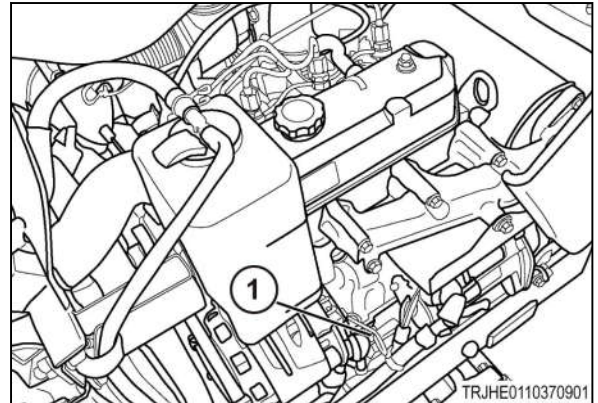


Fig. 1

5. Make sure the oil level is between the full (1) and the lower limit (2) on the dipstick.

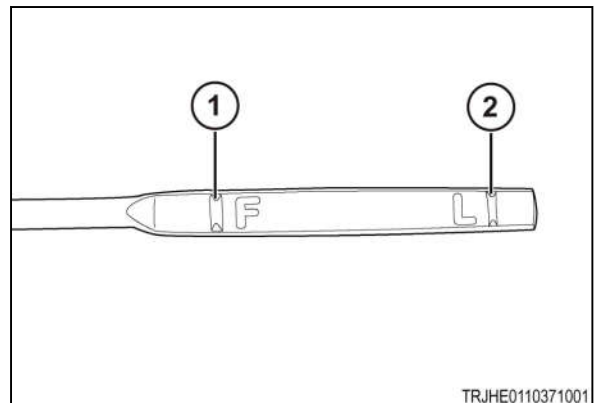


Fig. 2

6. Wipe off the dipstick (1), momentarily install in the engine, and examine the oil level again.
7. Add oil through filler opening (2) as required.

**NOTE:**

*Add oil slowly to let the air leave the crankcase.*

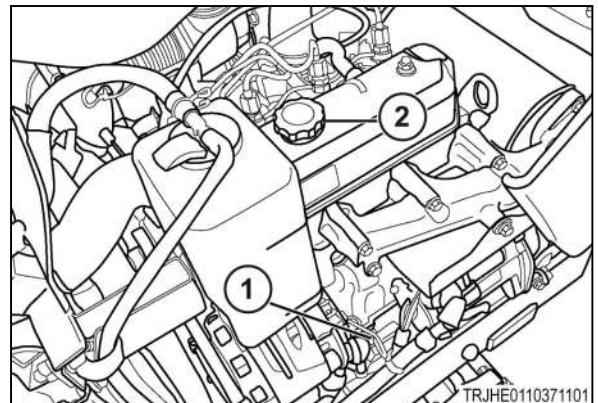


Fig. 3

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## 2.1.2 Change the engine oil

---



**WARNING: Fire hazard. Fuel safety.**

**Personal injury or machine damage can occur.**

**Clean up any spilled oil immediately.**

**IMPORTANT:**

*Do not leave a combustible material such as cloth and work gloves on and around the engine. Spilled fuel can cause a fire.*

**IMPORTANT:**

*Be careful not to let dust to enter through the oil filler when adding oil. Foreign material, like dust, entering the system can cause engine damage.*

**IMPORTANT:**

*The oil level above the full mark on the dipstick can cause engine problems. Be sure to examine the oil level with the oil level gauge.*

**IMPORTANT:**

*Do not dump used oil. It is against by law. For discarding of used oil, see with your local dealer. Change engine oil and the oil filter at the same time. Engine oil analysis is recommended when changing engine oil.*

**IMPORTANT:**

*Do not reuse oil filter elements.*

**Procedure**

1. Operate the machine until the engine is warm (temperature gauge must show above the cold mark).
2. Park the machine on a solid, level surface. Apply the parking brake, stop the engine, and take the key with you.
3. Put a catch pan in position.

4. Remove the drain plug (1) from the oil pan.



**CAUTION: Hot components can burn.**

**Personal injury can occur.**

**Use suitable personal protective equipment.**

5. Install the drain plugs. Tighten to 40 Nm to 50 Nm (29.5 lbf ft to 36.9 lbf ft)
6. Fill the engine crankcase through the filler opening (2) to the full mark on the dipstick.

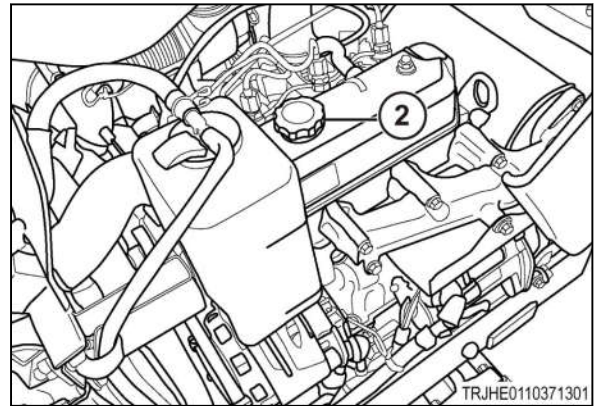
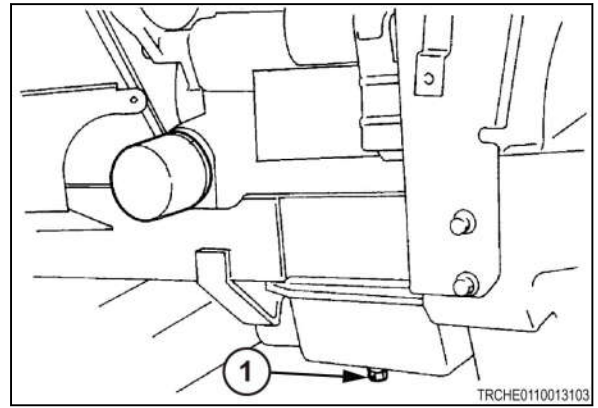


Fig. 4

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[Lubrication and maintenance chart](#) page 1-34

### 2.1.3 Replace the engine oil filter

#### Procedure

1. Remove the engine oil filter (1) from the engine and discard.
2. Make sure the original filter gasket has been removed.
3. Lubricate the new gasket on the replacement element with clean engine oil.
4. Install a new oil filter until the gasket contacts the adapter.
5. Tighten the oil filter 2/3 turn.
6. Add engine oil to the engine.
7. Clean any spilled oil.
8. Start the engine and examine for leaks.
9. Examine the engine oil level and add oil as required

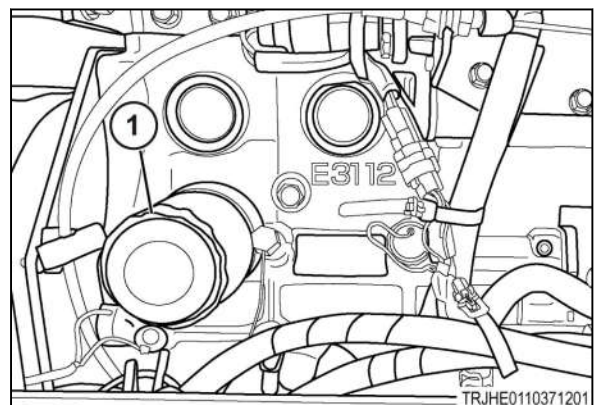


Fig. 5

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[Lubrication and maintenance chart](#) page 1-34

## 2.2 Engine belt



**WARNING: Hot components can burn.**

**Severe personal injury can result.**

**Let the engine and components cool before doing maintenance.**

**IMPORTANT:**

*If too much tension is applied to the belt, the bearings in the fan will be damaged.*

The correct engine belt tension helps to make sure there is correct coolant flow through the cylinder block and the radiator.

The tension on the engine belt must be 13 mm (1/2 in) deflection at 2.3 kg (5.0 lb) of force.

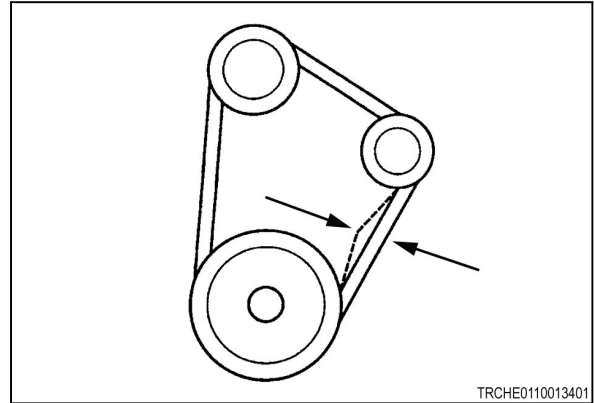


Fig. 6

### 2.2.1 Adjust the engine belt

**Procedure**

1. Loosen the alternator pivot bolt (1).
2. Loosen the tensioner bracket bolt (2).
3. Pull outward on the top of the alternator to get the correct tension on the belt.
4. Tighten the tensioner bracket bolt.
5. Tighten the alternator pivot bolt.

**IMPORTANT:**

*Do not pry against the alternator housing or pulley. Carefully pry against the alternator mounting flange to prevent damage.*

**IMPORTANT:**

*If too much tension is applied to the belt drive, the bearing in the alternator will be damaged.*

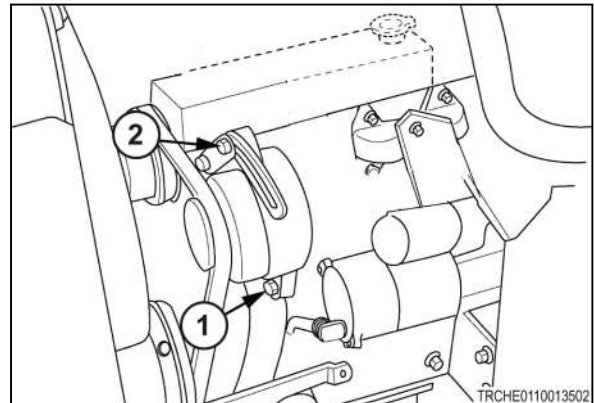


Fig. 7

**Related Links**

[Engine belt](#) page 2-9

## 2.3 Engine air filter

**IMPORTANT:** Never operate the engine with the air filters removed.

Open cover to access the air filter (1) and the dust ejector (2).

The dust ejector traps dust deposits that fall from the outer element.

Weekly or as necessary, remove dust from the ejector. To remove the dust, squeeze the dust ejector. If the dust is damp, clean the ejector with a cloth.

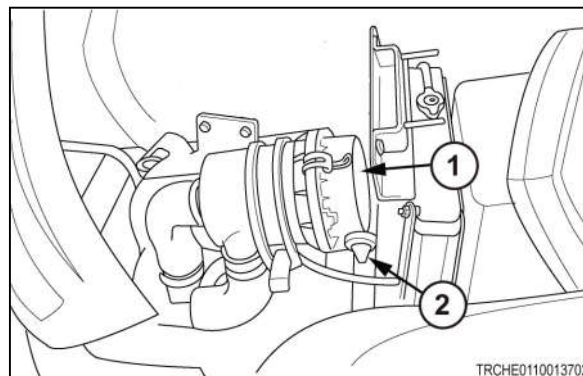


Fig. 8

The air filter (1) is a dry paper element that filters dust particles from the intake air.

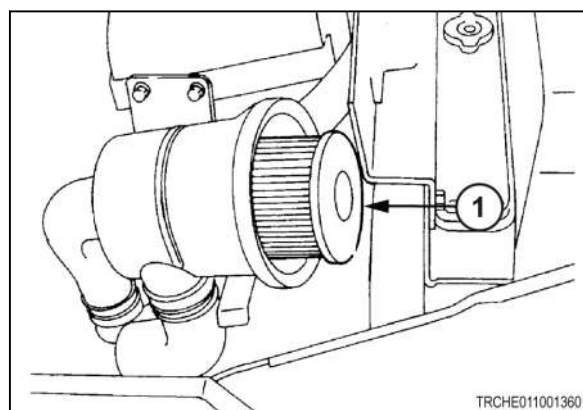


Fig. 9

### 2.3.1 Clean the engine air filter

The air filter (1) can be cleaned (if in good condition).

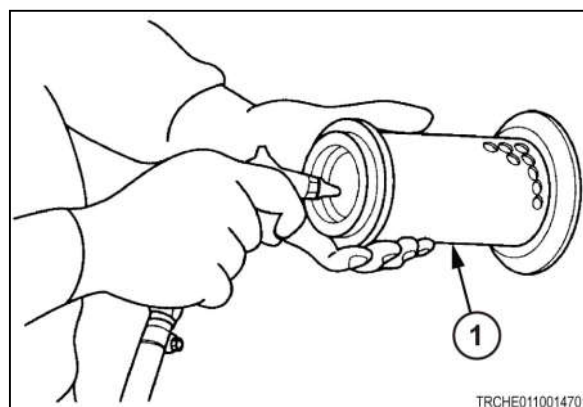


Fig. 10

#### Procedure

1. Remove loose dirt, grass, chaff, and other debris using compressed air not more than 200 kPa (30 psi) from inside the element. Be careful not to damage the element pleats with air flow.
2. If the air filter is coated with oil or soot:
  - a) Prepare a solution of warm water and non-foaming detergent.
  - b) Soak the element for 30 minutes.



- c) Shake the element in the solution until the oil and soot are loosened.
  - d) Wash the element with clean water until the water is clear.
  - e) Let the element dry completely. Do not dry by using compressed air or heat.
- 3.** After the element is clean, examine the element for pin holes, punctures, or tears. If the element paper, canister or seal show any signs of damage, replace the element.

**IMPORTANT:**

*Do not hit the filter element against a rock, concrete or other hard item when cleaning. This can result in damage of the filter element, reducing engine performance.*

**NOTE:**

*Replace the air filter after washing five times.*

## 2.4 Engine coolant

### 2.4.1 Coolant

The engine coolant mixture must be 40 to 60 percent ethylene or propylene-glycol based antifreeze and water. The best mixture is 50 percent antifreeze and 50 percent water.

Do not use water only as coolant.



Fig. 11

### 2.4.2 Coolant level



**CAUTION:**

**DO NOT** remove radiator cap if engine is hot. If the cap is removed while engine is hot, steam and hot coolant will be discharged, resulting in burns or other injury. Allow engine to cool until cap can be comfortably touched with bare hand. Then, loosen cap to first notch to allow pressure to escape, then remove cap.

The radiator is equipped with an overflow tank to keep the coolant in the radiator at the correct level. Examine the coolant level in the overflow tank during the daily inspection.

Open the engine cover. Make sure the coolant level in the overflow tank is between FULL and LOW.

If the coolant is below the LOW level, add coolant to the overflow tank so the level is between FULL and LOW.

**IMPORTANT:**

*Do not fill the overflow tank above the FULL level. Overfilling will prevent the radiator from correctly operating and can cause a coolant leak.*

Periodically check the condition of the hoses, belt, and clamps. Tighten or replace as necessary.

Keep the radiator, radiator screen, and engine cover screens clean for maximum cooling.

**IMPORTANT:** *Be careful when you clean the radiator, not to damage the radiator fins.*

**Related Links**

[Capacities](#) page 1-26

[Lubrication fill and drain locations](#) page 1-36

[Lubrication specifications](#) page 1-26

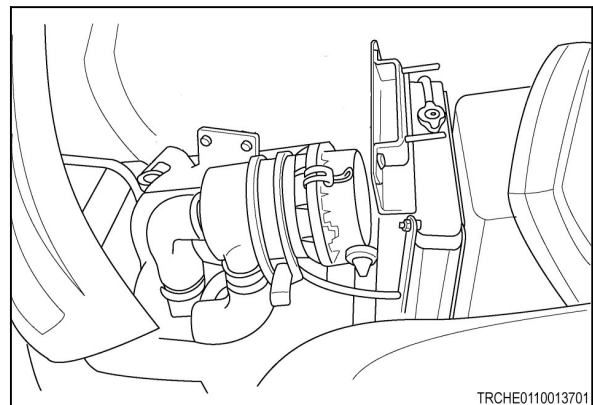


Fig. 12

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### 2.4.3 Replace the engine coolant

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#### Procedure

1. Park the tractor on a solid, level surface. Apply the parking brake, stop the engine, and take the key with you.
2. Make sure the engine is cool.
3. Put a catch pan in position.
4. Remove the drain hose (1) on the left side.
5. Remove the drain plug (2) on the left side.

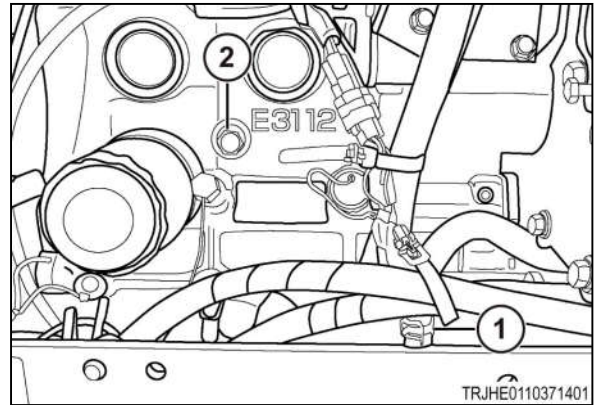


Fig. 13

6. Remove the radiator cap. Let the coolant drain completely.
7. Remove the overflow tank.
8. Flush the inside of the radiator and the overflow tank with water.
9. Install the overflow tank.
10. Install the drain plug and the drain hose.
11. Fill the cooling system with coolant.
12. Install the cap on the overflow tank.
13. Install the radiator cap.
14. Operate the engine for five minutes at approximately 1500 rpm.
15. Stop the engine and take the key with you.
16. Examine the coolant level and add coolant as necessary. The coolant level must be between LOW and FULL.

#### Related Links

- [Capacities](#) page 1-26
- [Lubrication fill and drain locations](#) page 1-36
- [Lubrication specifications](#) page 1-26
- [Lubrication and maintenance chart](#) page 1-34

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### 2.4.4 Thermostat

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The thermostat is rated at 75 °C to 78 °C (167 °F to 172°F).



## 2.5 Engine removal and installation

### 2.5.1 Remove the engine

#### Procedure

1. Disconnect the battery.
2. Drain the engine coolant.
3. Disconnect the wire harness connector between the main harness and the headlamp harness.

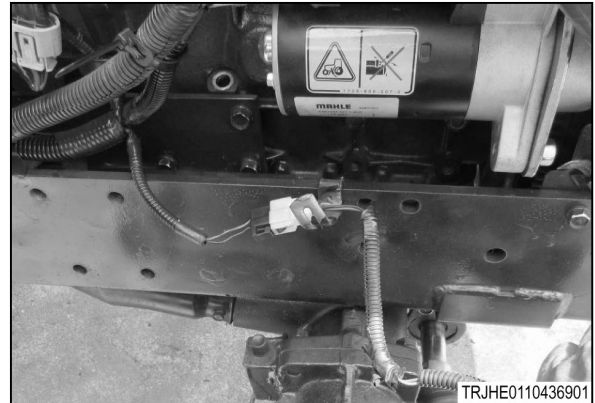


Fig. 14

4. Remove the bolts that fasten the engine cover to the chassis.
5. Remove the engine cover.

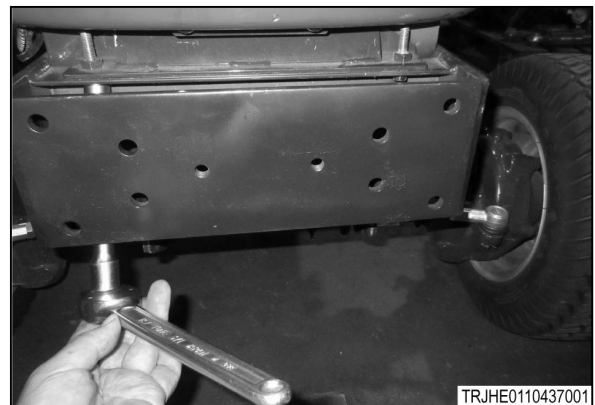


Fig. 15

6. Remove the wing bolt (1) that fastens the lower steering console cover.
7. Remove the lower steering console cover.



Fig. 16

8. Remove the bolts that fastens the drive shaft coupler to the engine.
9. Slide the coupler rearward.



Fig. 17

10. Remove the nuts that fastens the steering column and move the steering column back.



Fig. 18

11. Loosen the jam nut (1) and disconnect the throttle cable at the injection pump.

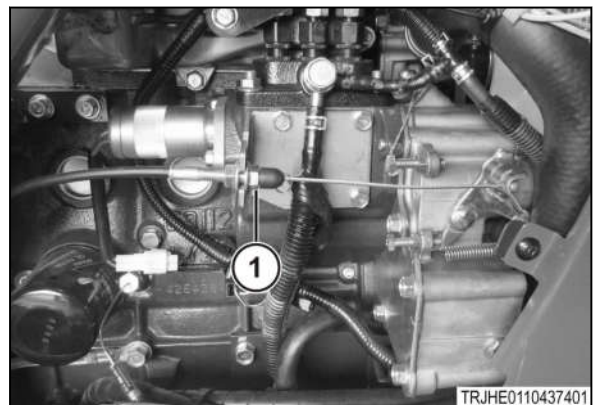


Fig. 19

12. Loosen the air cleaner and engine side clamps. Remove air intake pipe.
13. Remove the upper and lower radiator hoses.
14. Disconnect the wire harnesses from the engine:
  - Ground straps
  - Glow plug terminals
  - Oil pressure switch
  - Starter
  - Alternator
  - Fuel cut-off solenoid
  - Thermometer
15. Remove the fuel lines and fuel return lines.
16. Remove the bolts that tighten the engine mount isolators.

**NOTE:** *The isolators are located on each corner of the engine.*

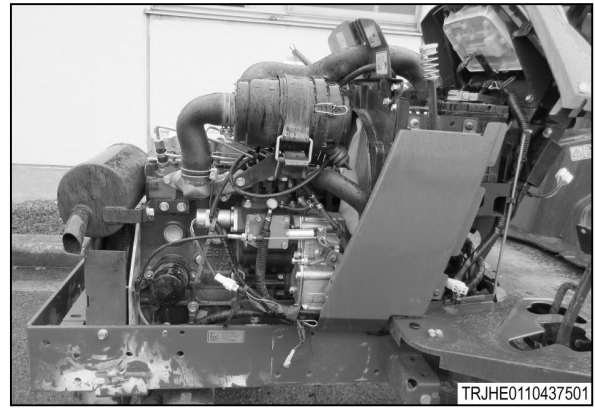


Fig. 20

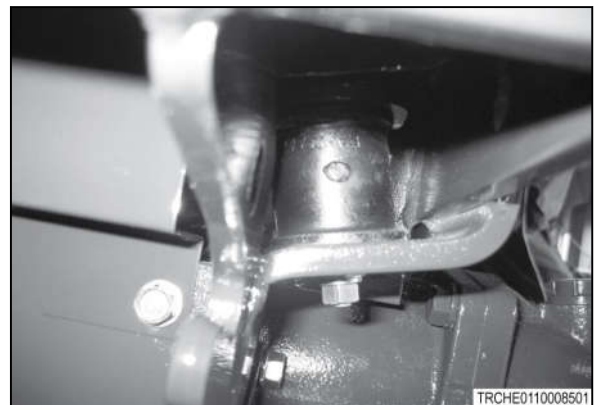


Fig. 21

17. Connect a lift to the engine hanger. Remove the engine.

**NOTE:** Push the engine forward while you lift the engine. This will help to prevent damage to the radiator shroud and the cooling fan.

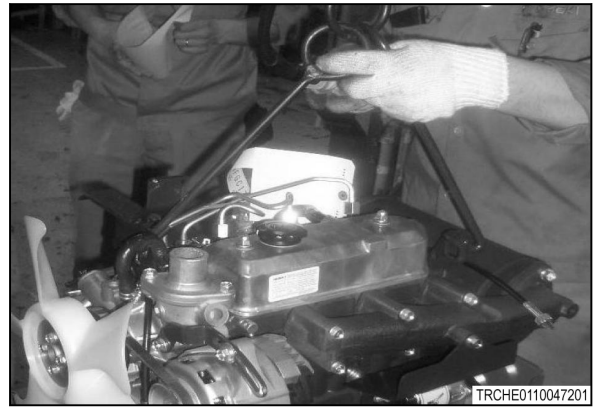


Fig. 22

## 2.5.2 Install the engine

Make sure to route the fuel lines and the wire harnesses so they do not pinch or rub sharp objects.

### Procedure

1. Connect a lift to the engine hanger. Install the engine.

**NOTE:** Push the engine rearward while you lower the engine. This will help to prevent damage to the radiator shroud and the cooling fan.

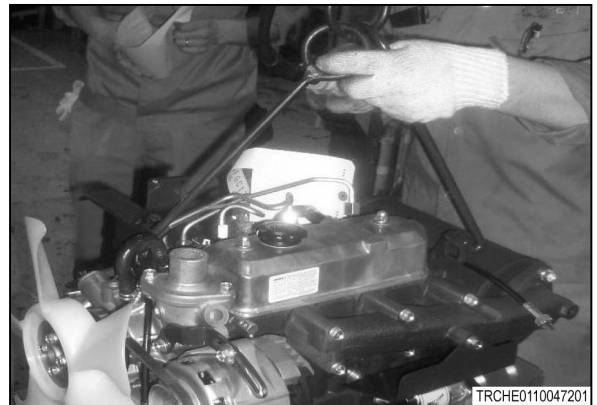


Fig. 23

2. Install the bolts for the engine mount isolators.

**NOTE:** The isolators are located on each corner of the engine.

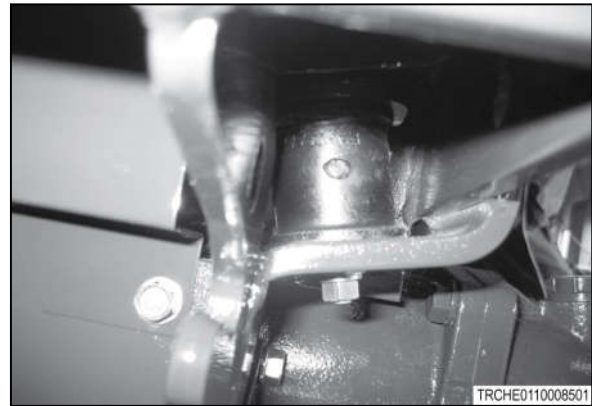
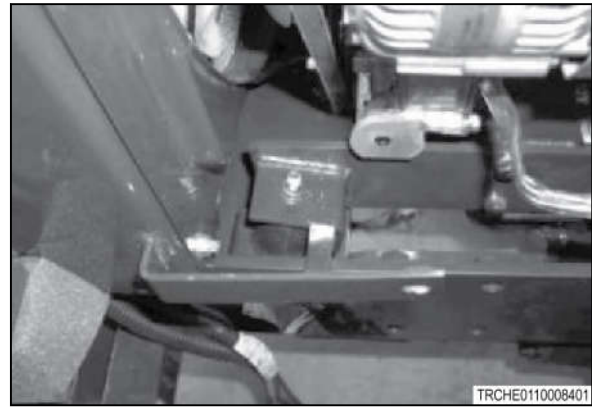


Fig. 24

3. Install the fuel lines and fuel return lines.
4. Connect the wire harnesses to the engine:
  - Ground straps
  - Glow plug terminals
  - Oil pressure switch
  - Starter
  - Alternator
  - Fuel cut-off solenoid
  - Thermometer
5. Install the upper and lower radiator hoses.
6. Put the air intake pipe into position. Move the clamps into the correct position and tighten the clamps.



Fig. 25

7. Connect the throttle cable at the injection pump. Tighten the jam nut (1).

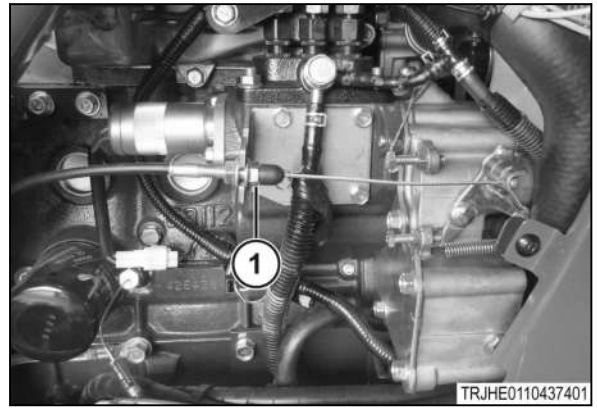


Fig. 26

8. Move the steering column into position. Install the nuts that fastens the steering column.

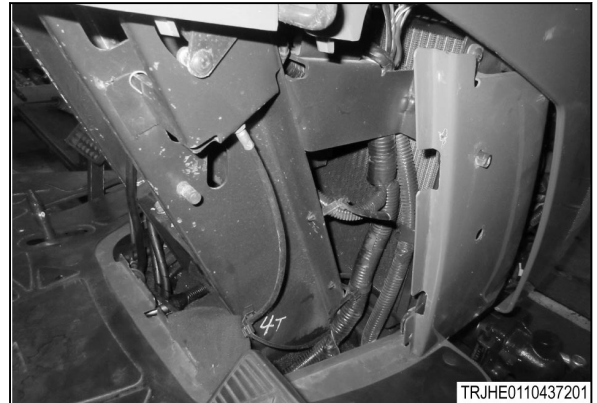


Fig. 27

9. Slide the coupler forward.
10. Install the bolts that fastens the drive shaft coupler to the engine.



Fig. 28

11. Put the lower steering console cover into position.
12. Install the wing bolt (1) that fastens the lower steering console cover.

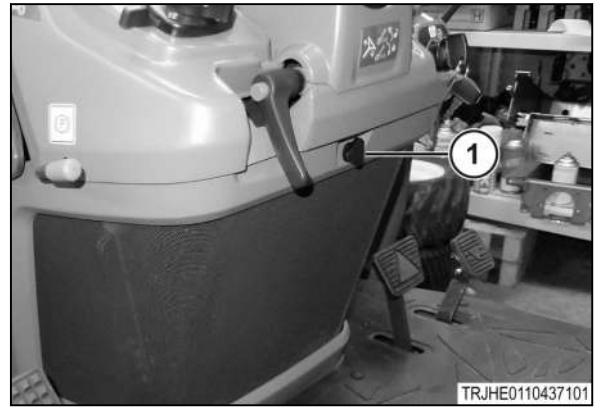


Fig. 29

13. Put the engine cover into position.
14. Install the bolts that fasten the engine cover to the chassis.

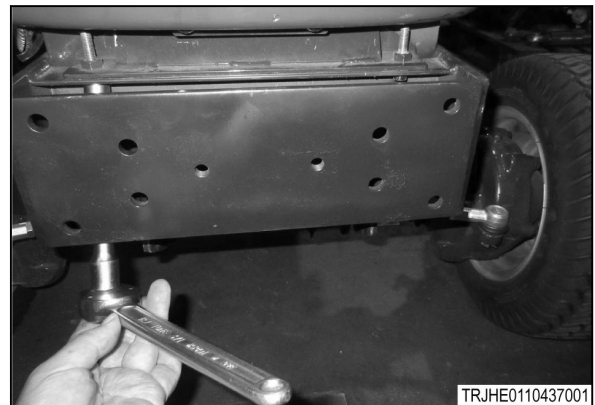


Fig. 30

15. Connect the wire harness connector between the main harness and the headlamp harness.
16. Fill the cooling system with engine coolant.
17. Connect the battery.

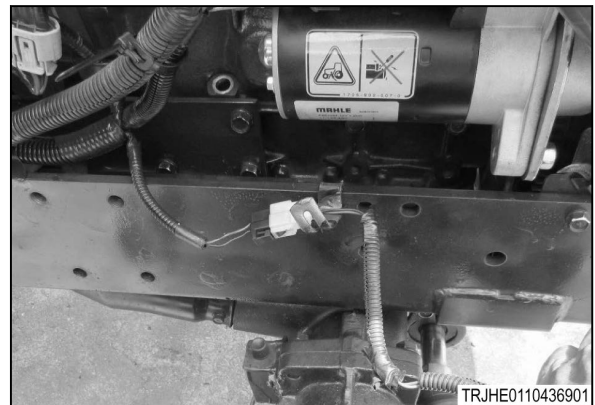


Fig. 31

## 2.6 Service standards

### 2.6.1 Precaution for service operation

Always keep safety in mind.

- Chock the wheels on the ground before you lift the tractor with a jack.
- After the tractor is up, support specified parts with the correct support.
- When more than two persons work together, think about each other's safety.
- Before you start the engine, make sure that there is no risk.

Clothing

- Wear correct work clothes, head gear, and safety shoes.

Preparation for Operation

- Prepare all tools, gauges, jigs, etc. which are necessary before you start an operation.
- Also prepare all parts which are to be replaced during operation.

Precautions During Operation

- Put removed parts in order of disassembly to prevent an interchange of parts.
- Keep the parts to be discarded isolated from the parts to be used again to prevent confusion at assembly.
- Before assembly, clean the parts and remove oil from the surfaces to which liquid packing is to be applied.
- When servicing the electrical system, disconnect the negative (-) terminal of the battery.
- When you disconnect an electrical connector, hold the connector body. Do not pull the wire. When you disconnect a connector which has a lock, be sure to release the lock.

### 2.6.2 Service standards

#### Cylinder

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Cylinder compression kg/cm <sup>2</sup> (psi)	30 (441) or more	22 (341) or less			200 rpm
Cylinder bore wear Boring-Size	Ø78.2 (3.08)	0.2 (0.008) or more	0.01 (0.0004)		Hone after boring. Finish the bore with a tolerance of 0+40μ against nominal diameter of over-size piston.
			0.05 (0.020) 1.0 (0.039)		Over-size piston and ring.



Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Clearance Between Piston to Cylinder mm (in)	0.071-0.090 (0.0028-0.0035)				
Flatness of cylinder block top surfaces		0.15 (0.006) or more	0.08 (0.003) or less		Correct on a surface grinder Ground down limit: 0.4 (0.015)
Flatness of cylinder block bottom surface		0.15 (0.006) or more	0.08 (0.003) or less		Correct on a surface grinder. Ground down limit: 0.4 (0.015)

### Cylinder head

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Depth of valve seats		1.4 (0.055) or more			Correct valve seats Valve seat angles: 45 degrees
Contact width of valve seats		2.0 (0.08) or more	1.3-1.6 (0.051-0.063)		Correct with a 75 degree valve seat cutter.
Torque of cylinder head bolts kg m (lbf ft)			6.0-7.0 (43.4-50.6)		Head gasket is carbon. Head gasket is steel.

### Piston

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Piston pin wear.	Ø22 (0.866)			Ø21.98 (0.365)	Replace
Piston clearance in cylinder			0.061-0.099 (0.0021-0.0038)		

**Piston rings**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Piston ring gaps:					
Compression 1st			0.20-0.35 (0.0079-0.0138)	1.5 (0.059)	
Compression 2nd			0.40-0.55 (0.0157-0.0217)	1.5 (0.059)	Replace.
Oil			0.20-0.40 (0.0079-0.157)	1.0 (0.0394)	
Clearance in piston groove:					
Compression 1st			0.06-0.10 (0.0024-0.0039)	0.3 (0.012)	Replace piston or rings – Installed with notch mark turned up with gaps apart 120 degrees to each other.
Compression 2nd			0.07-0.11 (0.0028-0.0043)	0.3 (0.012)	
Oil			0.02-0.06 (0.0008-0.0024)	0.15 (0.006)	
Ring gap position					120 degrees apart from each other.  Gap of oil ring and gap of expander to be 180 degrees from each other.

**Connecting rod**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Thrust play between small end and piston pin boss.			1.97-2.8 (0.08-0.112)		
Clearance between small end bushing and piston pin.			0.028-0.02 (0.08-0.112)	0.05 (0.002)	Replace piston pin or bushing. Clearance must be such that piston pin turns smoothly in small end bushing with large end held by hand.
Clearance between connecting rod bearing and crankpin.			0.027-0.068 (0.08-0.004)	0.12 (0.005)	Replace bearing.
Inspection of connecting rod and crank pin faces.					Correct or replace bearing.
Thrust play of connecting rod large end.			0.175-0.35 (0.007-0.014)	0.35 (0.014)	Replace connecting rod.
Parallelism between large end and small end holes. [per 100 (3.94)]			0.05 (0.002) or less	0.15 (0.006)	Correct or replace.
Weight difference between assembled piston g (lb)			15 (33) or less		Examine the weight classification of connecting rods.
Tightening torque of bearing cap bolts kg m (ft lb)			3.2-3.8 (26.6-27.5)		

**Crankshaft**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Journal wear diameter mm (in)	50 (1.970)	0.05 (0.002) or more		49.50 (1.949)	Use under-size bearings: 0.05-1.0 (0.02-0.04) When below the limit for use, replace crankshaft.
Crankpin wear	40 (1.576)	0.05 (0.002) or more		39.50 (1.556)	Use under-size bearings: When below the limit for use, replace crankshaft
Clearance between journal and bearing.		0.12 (0.047) or more	0.034-0.099 (0.0013-0.0039)		Replace bearings.
Thrust play of crankshaft.		0.3 (0.012) or more	0.04-0.215 (0.0016-0.0085)		Replace thrust bearings.
Run-out of crankshaft.			0.025 (0.001) or less		
Crankshaft balance (reference value) g cm (lbf ft)			36 (0.0026) or less		Static and dynamic balance.
Tightening torque of journal bearing caps kgf m (lbf ft)			5.0-6.0 (36-43)		

**Camshaft**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Journal wear diameter mm (in)	33 (1.3)	0.05 (0.002) or more		32.75 (1.290)	Replace camshaft.
Run-out of camshaft		0.105 (0.0041) or more	0.05 (0.0020) or less		Replace camshaft.
Cam lobe height	27 (1.06)			26.6 (1.048)	Replace camshaft.
Thrust play of camshaft.		0.2 (0.008) or more	0.05-0.174 (0.002-0.007)		Replace thrust plate.

**Timing gears**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Timing gear backlash.			0.04-0.12 (0.0016-0.0047)	0.30 (0.0118)	Replace gears.
Interference between cam gear and camshaft.			0.033-0.067 (0.0013-0.0026)		
Clearance between idle gear bushing and idle shaft.		0.15 (0.0059) or more	0.016-0.050 (0.0006-0.0019)		Replace gear or shaft.
Idle gear shaft wear.	18 (0.71)	0.05 (0.002) or more			Replace idle gear shaft.

**Valve and spring**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Wear of inlet valve stem	Ø7 (0.28)			Ø6.90 (0.272)	Replace valve.
Wear of exhaust valve stem	Ø7 (0.28)			Ø6.89 (0.271)	Replace valve. Replace the valve guide when the valve is replaced for wear of the valve seat.
Clearance between inlet valve stem and valve guide.		0.15 (0.006) or more	0.035-0.067 (0.0013-0.0026)		Replace valve or valve guide
Clearance between exhaust valve stem and valve guide.		0.20 (0.008) or more	0.035-0.072 (0.0014-0.0029) 0.0028)		Replace valve or valve guide.
Interference between valve guide and cylinder head.			0.004-0.046 (0.0002-0.0018)		Apply oil to valve guide, and install on a press.
Valve thickness	0.8 (0.03)			0.55 (0.022)	Replace valve.
Inspection of valve springs:					
Valve spring tension (when compressed to X mm:) kg (lb)	X = 31 (1.22)	6.3 (13.9)		5.4 (11.9)	Replace valve spring.

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Free length	36.0 (1.42)			35.0 (1.38)	Replace valve spring.
Deviation from vertical			1.0 (0.039) or less	1.0 (0.04)	Replace valve spring.
Valve clearance (for the inlet and exhaust valves)			0.25 (0.010)		Adjust while engine is cool.

**Rocker arm and related parts**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Clearance between rocker arm bushing and rocker arm shaft		0.2 (0.008) or more	0.01-0.05 (0.004-0.002)		Replace bushing or shaft.
Wear of rocker arm shaft.	16 (0.63)			15.85 (0.62)	Replace.
Push rod bend.		0.3 (0.012) or more			Replace.

**Tappet**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Tappet clearance in cylinder block		0.1 (0.004) or more	0.02-0.062 (0.0008-0.0024)		Replace tappet.
Tappet wear	20 (0.788)			19.95 (0.786)	Replace tappet.
Contact surface of tappet and cam.					If worn or damaged, replace.

**Oil pump**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Lubricant pressure kg/cm <sup>2</sup> (psi)		2.0 (28.4) or less	3.5-4.0 (49.7-56.8) or more		Repair oil leaks and clogs of lubrication line. At 1400 rpm of engine.
Oil pump delivery liter (IMP gal.)/min at 2600 rpm-E3112 Oil temp: 50+/- 3 degrees C Delivery pressure: 6 kg/cm <sup>2</sup> (85 psi)			13.6 (2.99)		

**Fan belt**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Belt deflection			14.0 (0.6)		Adjust.

**Water pump**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Delivery liter (IMP gal.)/min. Pump speed: 3000 rpm Total lift: about. 2.8 m-Aq Water temp: 80 degrees C		55 (12.11)			
Nozzle opening pressure kg/cm <sup>2</sup> (psi)			120 (1707)	110-130 (1654-1849)	Adjust or replace.

**Thermostat**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Starts to open at temp. degrees C (degrees F) (atmospheric pressure)			75-78 (167-172)		Replace defective thermostat.
Fully open at temperature degrees C (degrees F) (atmospheric pressure)			90 (194)		

**Fuel system**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Clogged or cracked fuel pipes, injection pipes, nozzle hoses or loose joints, or defective packing					Repair or replace defective parts.
Clogged or damaged fuel filter element.					Replace.

**Fuel injection system**

Parts names and inspection items	Nominal dimensions	Values where repair is necessary	Standard values for assembly	Limits for use	Instructions and notes
Spraying condition	<ol style="list-style-type: none"> <li>1. The spray must be fine and the same to the eye and free from large droplets.</li> <li>2. Fuel injection must in the correct direction without spray to the side.</li> <li>3. Nozzle body must be free from fuel drops before and after injection is complete.</li> </ol>				
Nozzle opening pressure kg/cm <sup>2</sup> (psi)			120 (1707)	110-130 (1654-1849)	Adjust or replace.



### 2.6.3 Torque of primary fasteners

Location	Part	Torque	
		kgf m	lbf ft
Cylinder head	Cylinder head	6.5 to 7.0	43.4 to 50.6
	Rocker shaft	1.4 to 2.4	10.1 to 17.3
	Injection nozzles	4.0 to 5.0	28.9 to 36.1
	Glow plugs	1.5 to 2.0	10.9 to 14.5
	Glow plug connectors	0.1 to 0.15	0.72 to 1.08
	Hangers (M10)	3.5 to 4.7	25.4 to 34
	Hangers (M8)	1.4 to 2.4	10.1 to 17.3
	Cylinder block	Bearing Caps	5.0 to 6.0
Front plate (M8)		1.4 to 2.4	10.1 to 17.3
Front plate (M12)		—	—
—		—	—
Thrust Plate		0.6 to 1.0	4.4 to 7.2
Rear Plate (M10)		3.5 to 4.7	25.4 to 34
Rear Plate (M12)		—	—
—		—	—
Oil strainer clamp		1.4 to 2.4	10.1 to 17.3
Injection pump cover		0.6 to 1.0	4.4 to 7.2
Crankshaft		Connecting-rod bearing caps	3.2 to 3.8
	Flywheel	8.5 to 10.5	61.5 to 75.9
	Crankshaft pulley	17 to 20.8	122.9 to 150.3
Timing gear case	Gear case	1.4 to 2.4	10.1 to 17.3
	Plug (governor fulcrum cover)	0.8 to 1.8	5.8 to 13
	Oil pump	0.6 to 1.0	4.4 to 7.2
	Angleichung (adaption) unit	2.0 to 3.0	14.5 to 21.7
Other	Water pump	1.4 to 2.4	10.1 to 17.3
	Thermostat housing	1.4 to 2.4	10.1 to 17.3
	Water pump outlet	1.4 to 2.4	10.1 to 17.3
	Pipe	1.4 to 2.4	10.1 to 17.3
	Inlet manifold	1.4 to 2.4	10.1 to 17.3
	Exhaust manifold	1.4 to 2.4	10.1 to 17.3
	Fan	0.6 to 1.0	4.4 to 7.2
	Starter (M10)	3.5 to 4.7	25.4 to 34
	Generator (M8)	3.5 to 4.7	25.4 to 34
	(M10)	1.4 to 2.4	10.1 to 17.3
Solenoid	0.6 to 1.0	4.4 to 7.2	



Location	Part	Torque	
		kgf m	lbf ft
Fuel injection pump	Injection pump body	1.4 to 2.4	10.1 to 17.3
	Fuel pump connector	2.0 to 2.5	14.5 to 18.1
	Injection pipe	2.0 to 2.5	14.5 to 18.1
	Delivery valve holders	4.0 to 4.5	28.9 to 32.5
	Weight bracket	0.6 to 1.0	4.4 to 7.2

## 2.6.4 Torque of standard bolts

### Three-cylinder engine

	(kgf m)	(lbf ft)
M6x1 (7T)	0.6 to 1.0	4.5 to 7.0
M8 x 1.25 (7T)	1.4 to 2.4	10 to 17
M10 x 1.25 (7T)	3.5 to 4.7	25 to 34
M12 x 1.2 (7T)	7.6 to 9.2	55 to 67

### 2.6.5 Troubleshooting

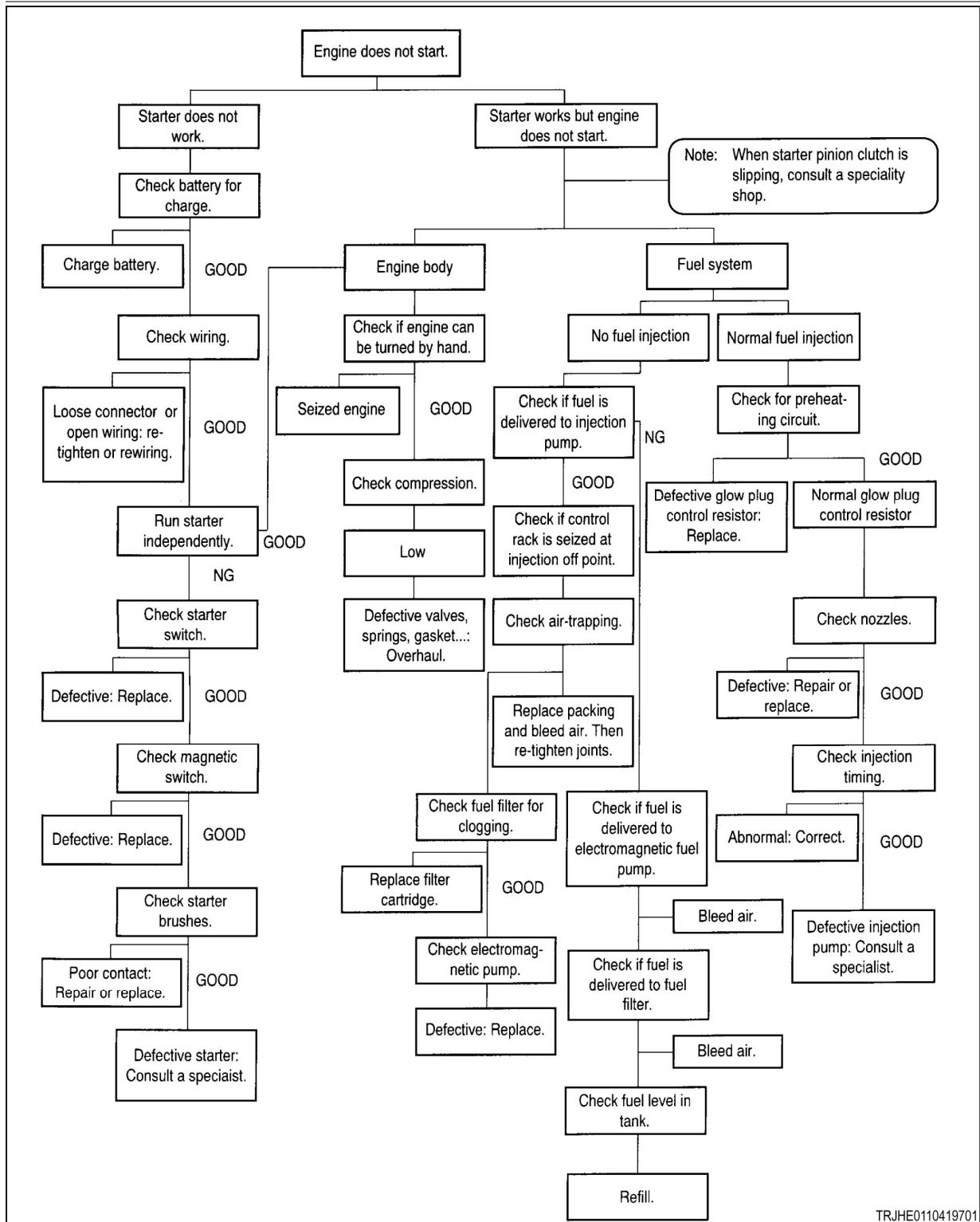
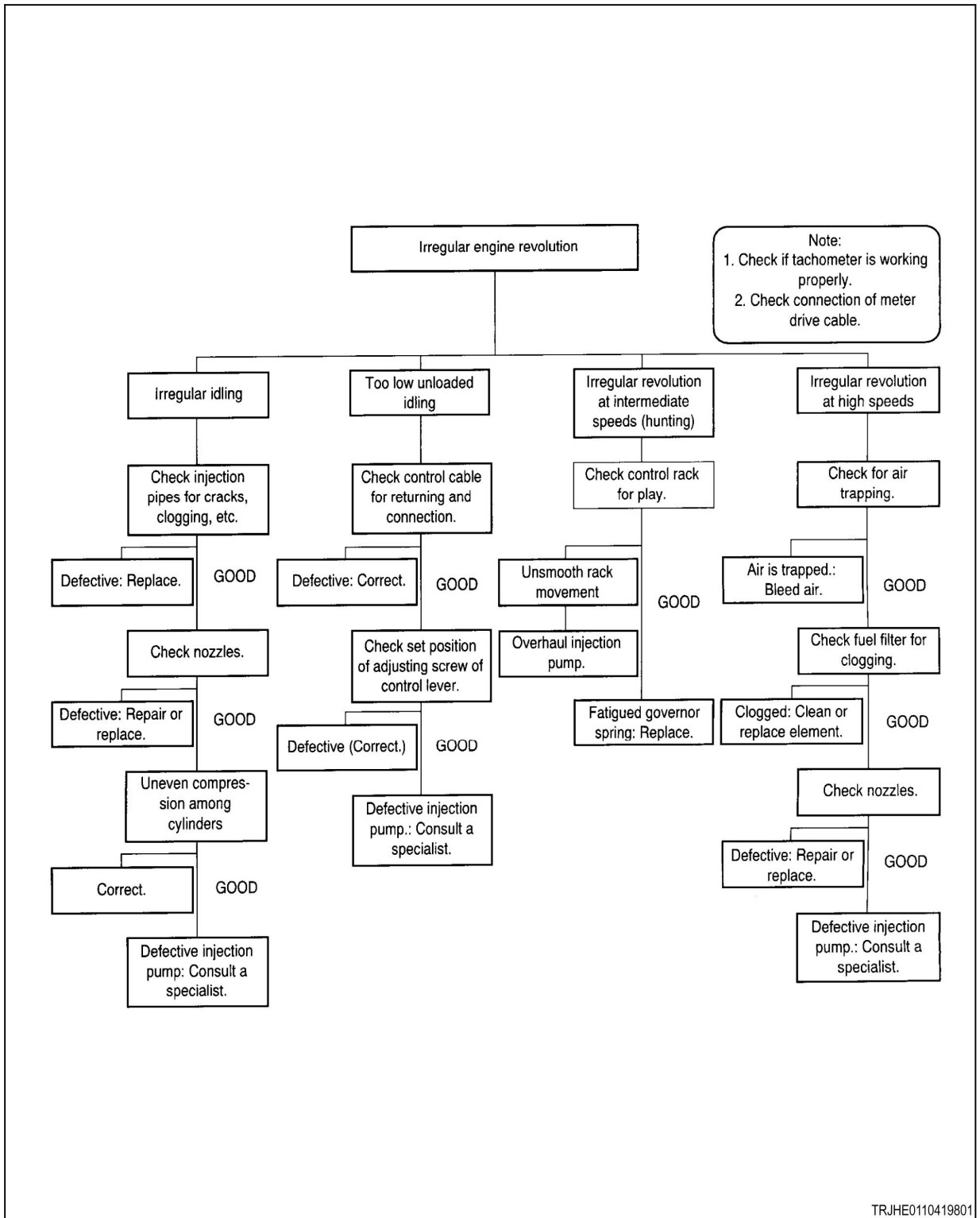


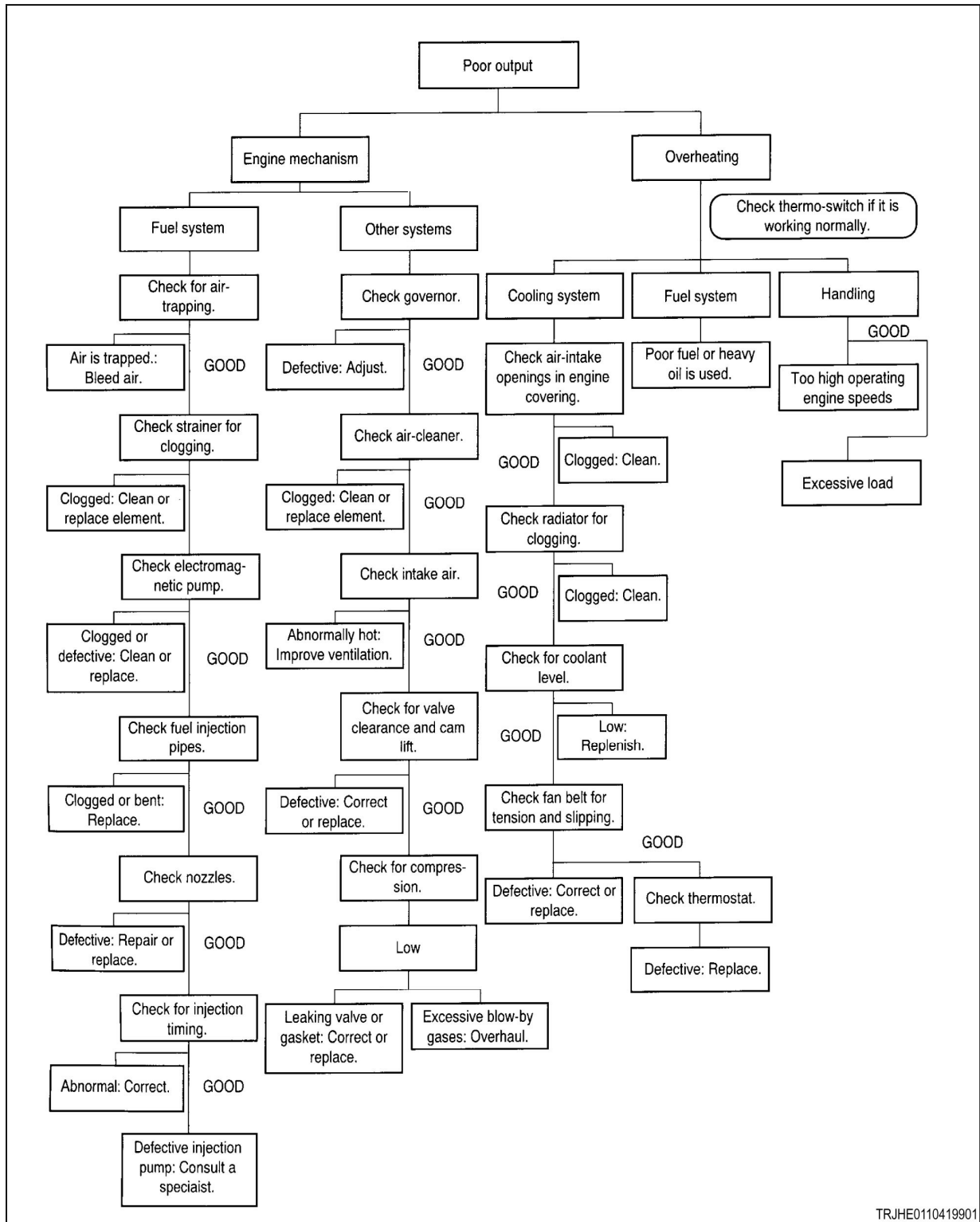
Fig. 32  
Troubleshooting diagram



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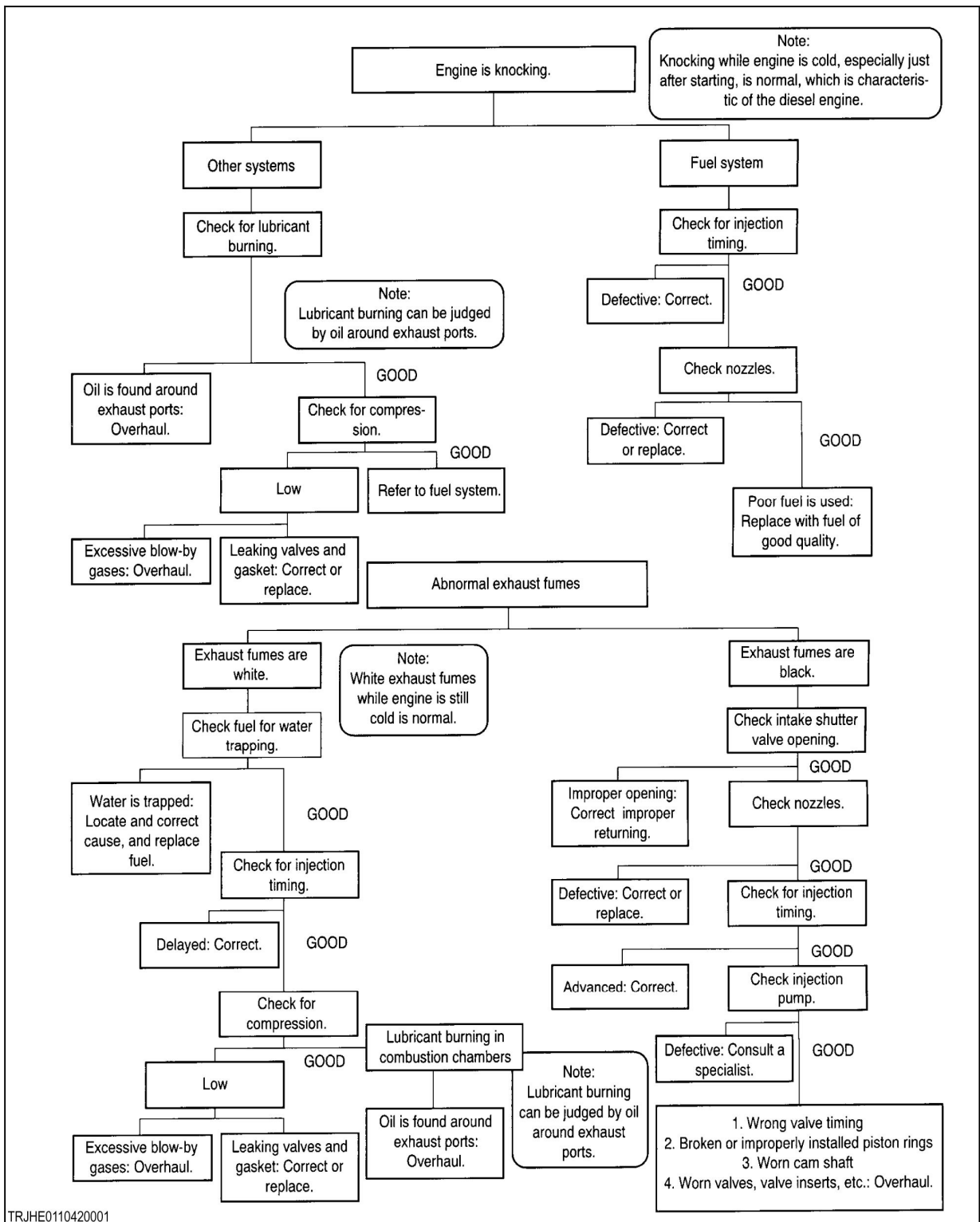
Fig. 33

Troubleshooting diagram



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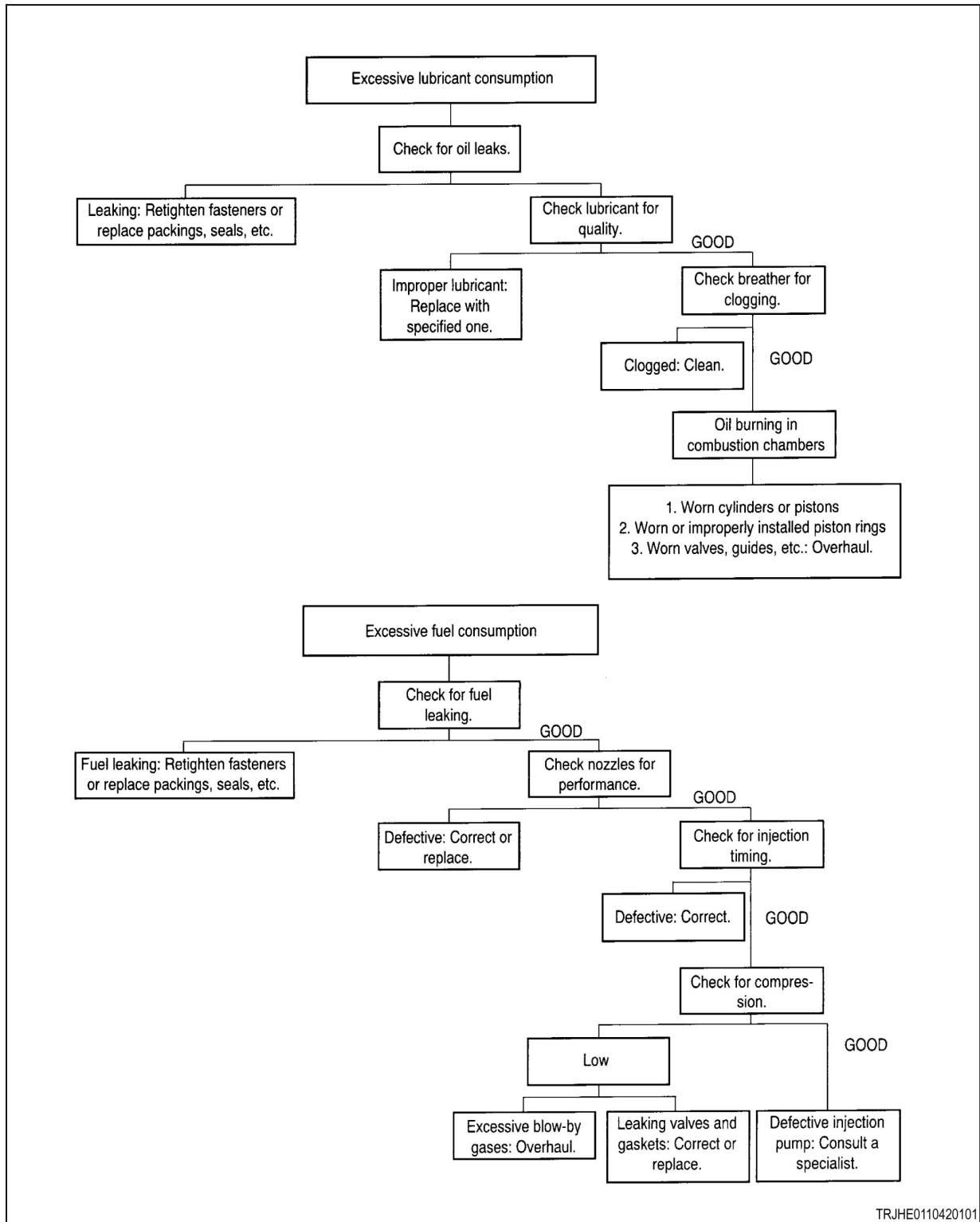
Fig. 34  
Troubleshooting diagram



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Fig. 35

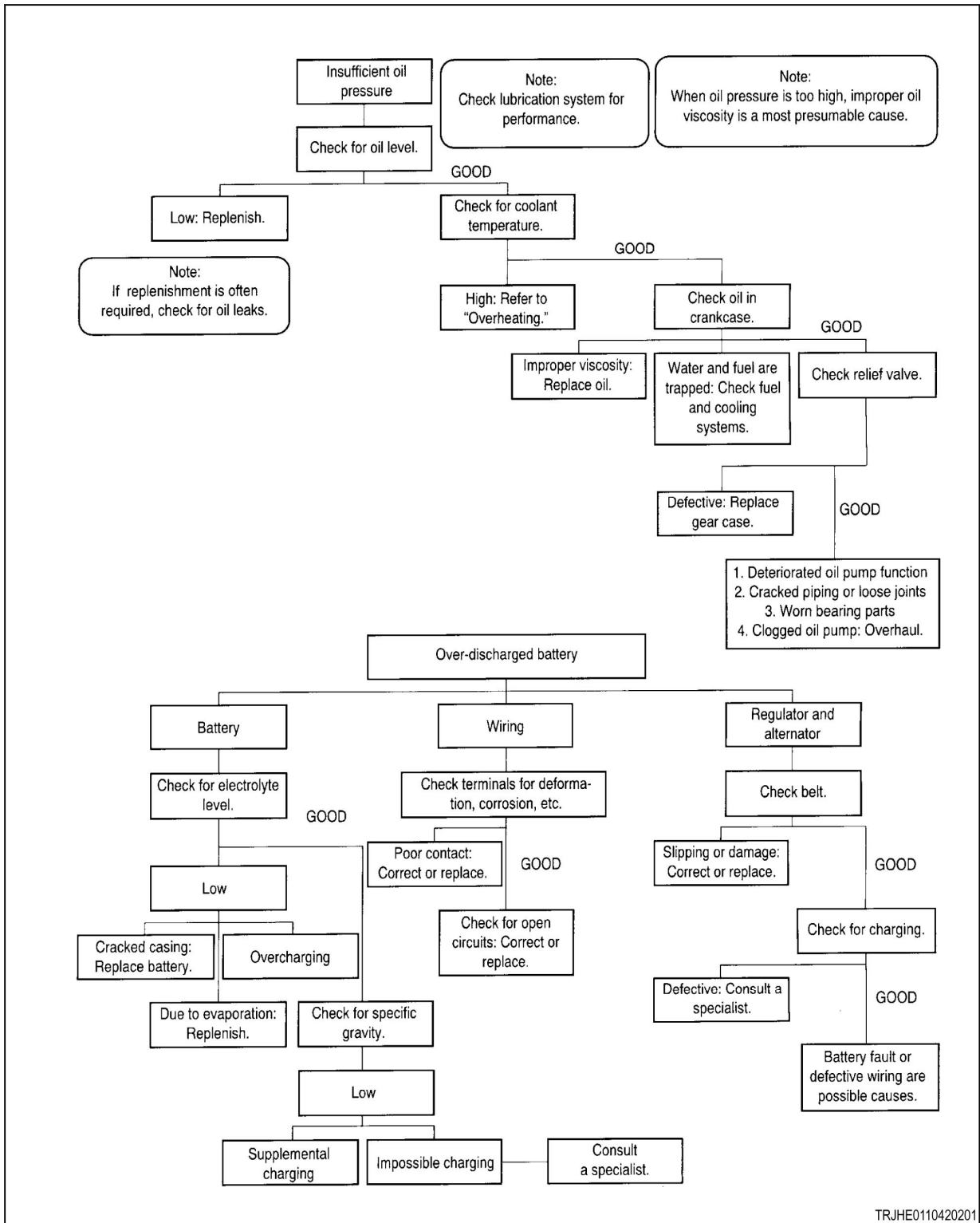
Troubleshooting diagram



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Fig. 36

Troubleshooting diagram



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Fig. 37

Troubleshooting diagram



## 2.7 Inspection and adjustment

### 2.7.1 Examine and adjust the valve clearances

#### Procedure

1. Remove the cylinder head cover.
2. Turn the crankshaft by hand to put piston 1 at top dead center (TDC). Align the TDC notch in the crankshaft pulley with the projection on the gear case.

**NOTE:** When the height of the push rods (number 1, 2, 3, and 6 from the fan) are about 5 mm (0.2 in) lower than those of number 4 and 5, the piston in number 1 cylinder is at TDC in compression stroke.

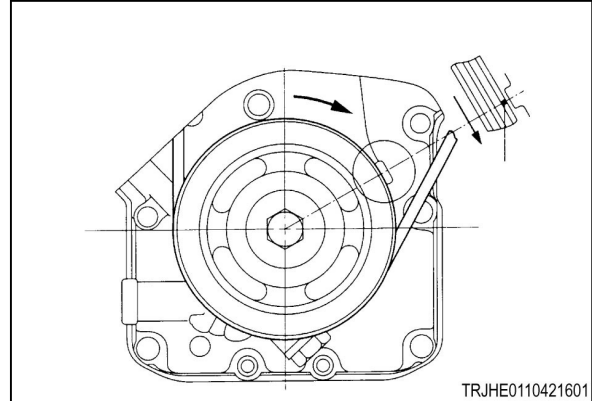


Fig. 38

3. Insert a feeler gauge of a specified thickness and adjust the clearance with the adjustment screw.

Specified valve clearance (cold):

Valve	Clearance
Intake	0.25 mm (0.0098 in)
Exhaust	0.25 mm (0.0098 in)

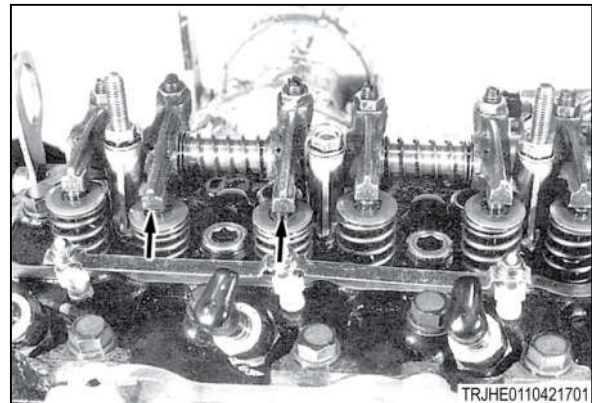


Fig. 39

4. Adjust the clearances of the valves shown by the arrow heads.

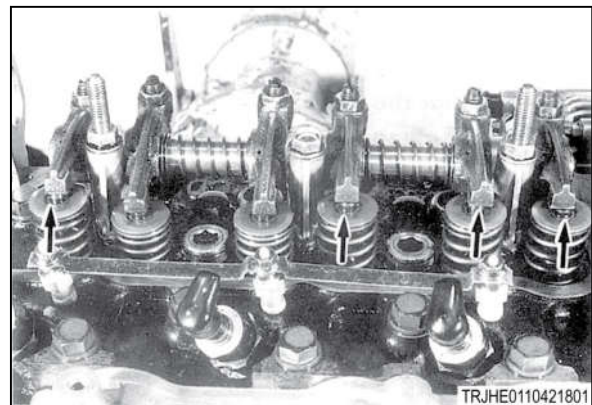


Fig. 40

5. Turn the crankshaft by 360 degrees and adjust the other valves shown by the arrow heads.

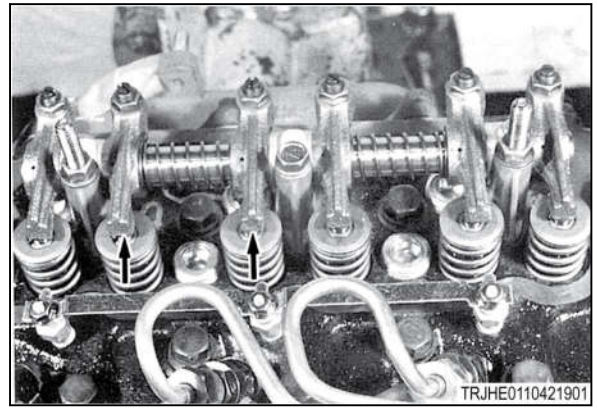


Fig. 41

## 2.7.2 Examine and adjust the nozzle opening pressure

### Procedure

1. Measure the pressure of initial fuel injection on a nozzle tester.

Specified Pressure	120 kg/cm <sup>2</sup> to 130 kg/cm <sup>2</sup> (1707 psi to 1849 psi)
--------------------	---

- When the pressure is too high, decrease the shim thickness for the nozzle, or replace the nozzle assembly.
- When the pressure is too low, increase the shim thickness, or replace the nozzle assembly.

2. Examine the spray condition of the nozzle.
3. Inspect the valve seal for leaks.

Set a nozzle on a nozzle tester, and apply and hold a pressure of 100 kg/cm<sup>2</sup> to 110 kg/cm<sup>2</sup> (1422 psi to 1565 psi). Examine for fuel leaks through the seat.

If there is a fuel leak, the nozzle is defective.

If a nozzle is not oil tight, disassemble and remove carbon deposits. If this does not stop the oil leak, replace the nozzle assembly.

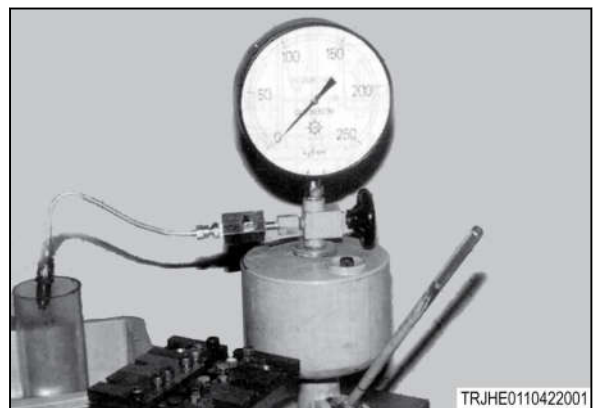


Fig. 42

## 2.7.3 Examine the injection timing

### Before starting the procedure

Supply fuel only when fuel injection timing is measured.

It is not possible to measure the fuel injection timing when the crankshaft is turned counterclockwise.

During this operation, keep the fuel system clean.

### Timing marks on the flywheel

The flywheel (1) has three marks. One mark (2) is for TDC and the other two marks (4 and 5) are for injection pump timing. Use timing mark (4) when you time the engine. The marks on the flywheel are to be aligned with a dowel pin (3) on the engine backing plate.

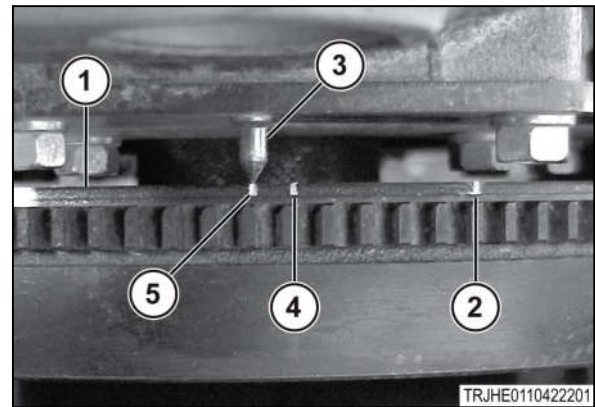


Fig. 43

### Procedure

1. Turn the engine by hand to move piston 1 (front cylinder) to top dead center (TDC) on the compression stroke. Align the TDC mark on the crankshaft pulley or flywheel with the mark or pin.

**NOTE:** When the height of the push rods (numbers 1, 2, 3, and 6 from the fan) are about 5 mm (0.2 in) lower than those of numbers 4 and 5, the piston in number 1 cylinder is at TDC in compression stroke.

2. Remove the injection pipes.
3. Put caps and plugs on the openings of the injection nozzle, injection pump, and injection pipe.
4. Remove the delivery valve holder for piston 1.



Fig. 44

5. Remove number one delivery spring (1) and install the delivery valve holder
6. Turn the crankshaft by hand to the point about 10 degrees before the injection timing (clockwise or counterclockwise).
7. Open the fuel shut off and turn the key switch to the ON position to operate the fuel pump.
8. Make sure that fuel flows from the delivery valve holder. Turn the crankshaft slowly in the correct direction (clockwise from the fan) until fuel flow stops.

**IMPORTANT:** On some engines, the engine stop solenoid must be removed from the injection pump. If fuel does not flow to the delivery holder, remove the engine stop solenoid.

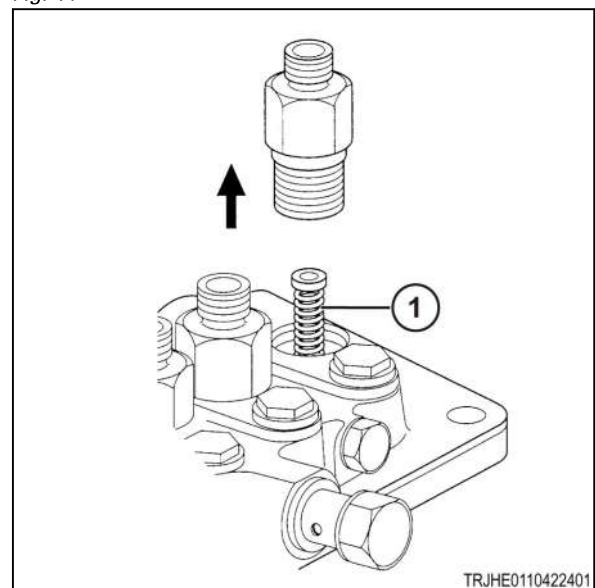


Fig. 45

The injection timing is right before fuel flow stops.

When fuel flow stops, the injection timing point is passed.

**NOTE:** If fuel flow does not stop out of the delivery valve holder when the point of injection timing has passed, cylinder 1 is on the exhaust stroke. Turn the crankshaft 360 degrees.

9. Turn the crankshaft back and do the operation again.

10. Blow off the fuel delivery valve holder.

11. Examine the time to fill the delivery valve holder in the position right before the fuel stops.

When it is 1 to 2 seconds to fill, it is the fuel injection timing point.

12. Make sure the timing mark on the flywheel or the crankshaft pulley is aligned correctly.

If the timing mark is not aligned correctly, adjust the injection timing.



**TIP:** The crank angle 1 degree is about 1 mm (0.04 in) on the crankshaft pulley and about 2.5 mm (0.1 in) on the flywheel.

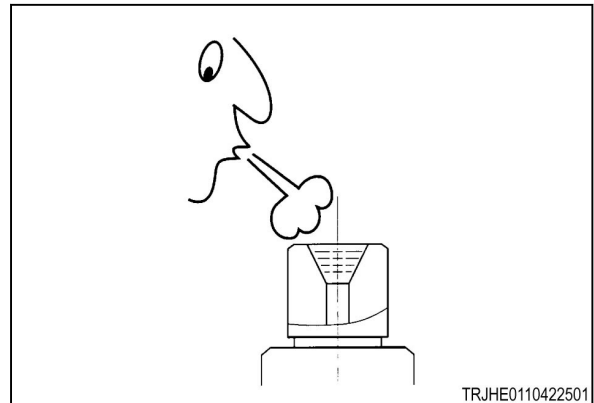


Fig. 46

13. Turn the key switch to OFF and close the fuel shutoff.

14. Remove the delivery valve holder and install the delivery spring and stopper. Tighten the delivery valve holder to the specified torque.

15. Install the injection pipe and tighten the nut to 2.0 kgf m to 2.5 kgf m (14.5 lbf ft to 18.0 lbf ft).

## 2.7.4 Adjust the injection timing

Adjust the injection timing if the injection timing is not correct.

To change the injection timing, add or remove shims to change the distance between the camshaft and pump mount surface.

During this operation, keep the fuel system clean.

### Procedure

1. Remove the injection pump cover.
2. Remove the control link and starting spring from the control rack.
3. Remove the injection pump.
4. Add or remove shims between the camshaft and pump mount surface.

Available shims: 0.1, 0.2, 0.3, 0.4, and 0.5 mm thick.

- Add 0.1 mm for a 1 degree delay.
- Remove 0.1 mm for a 1 degree advance.

5. Install the injection pump.
6. Make sure that the the injection timing is correct.

If the injection timing is not correct, do the adjustment procedure again.

## 2.7.5 Inspect the compression

### Procedure

1. Remove the injection pipes.
2. Remove an injection nozzle.  
Remove only the nozzle for the cylinder to be measured. Leave the other nozzles installed.
3. Put caps and plugs on the openings of the injection nozzle, injection pump, and injection pipe.
4. Install a compression gauge. Use adapter part number ATP 8048.
5. Operate the starter and measure the compression.



**WARNING: Crushing hazard.**

**Personal injury or death can occur.**

**Stay clear of machine while the machine components are being operated.**

Use a fully charged battery.

Standard	Limit	Difference
26 (370)	20 (285)	3 (43) or less
kgm/cm <sup>2</sup> (psi) at 200 rpm.		

6. Remove the compression gauge.
7. Install the injection nozzle.
8. Install the injection pipes.

## 2.7.6 Examine and adjust the idle speed

### Procedure

1. Measure the idle speed.
2. If the idle speed is not correct, adjust the stop bolt.

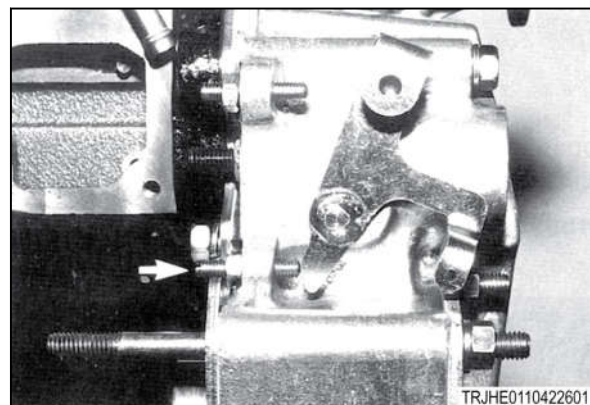


Fig. 47

### Related Links

[Engine specifications](#) page 1-27

## 2.8 Cylinder head

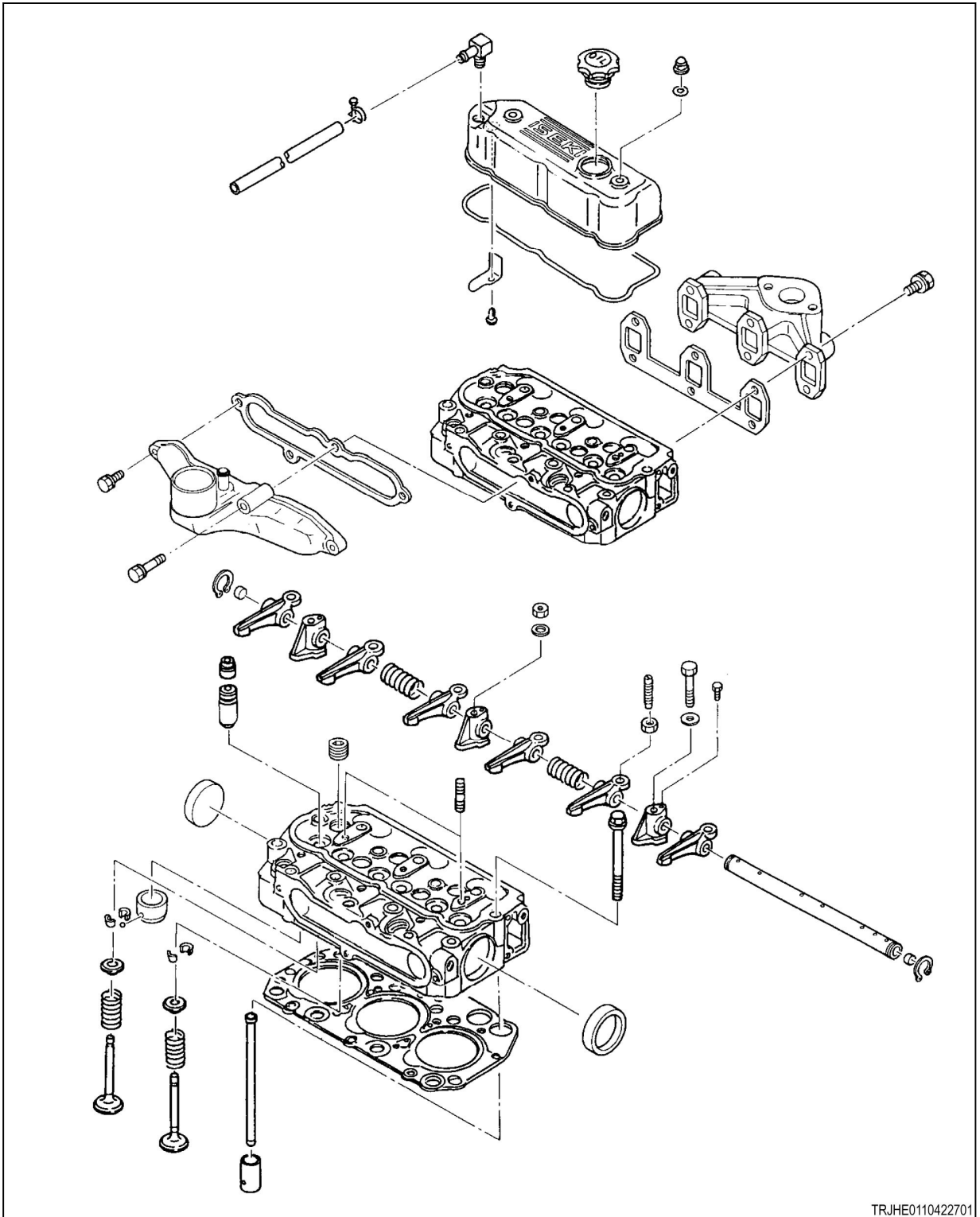


Fig. 48

Exploded view.

## 2.8.1 Remove the cylinder head

### Procedure

1. Remove the cylinder head cover.



Fig. 49

2. Remove the injection pipes.
3. Put caps and plugs on the openings of the injection nozzle, injection pump, and injection pipe.
4. Remove the fan belt.

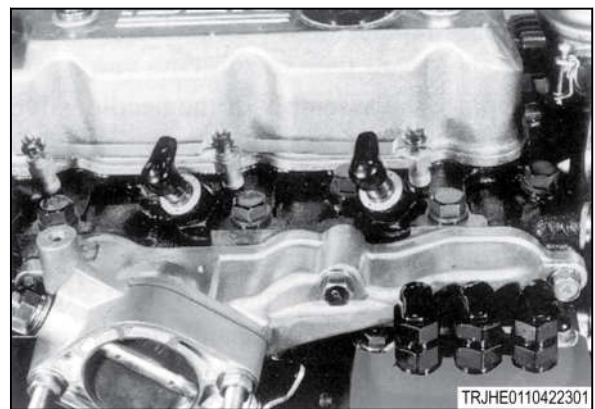


Fig. 50

5. Remove the oil pipe.
6. Remove the rocker shaft assembly.
7. Remove the push rods.
8. Remove the water by-pass hose.

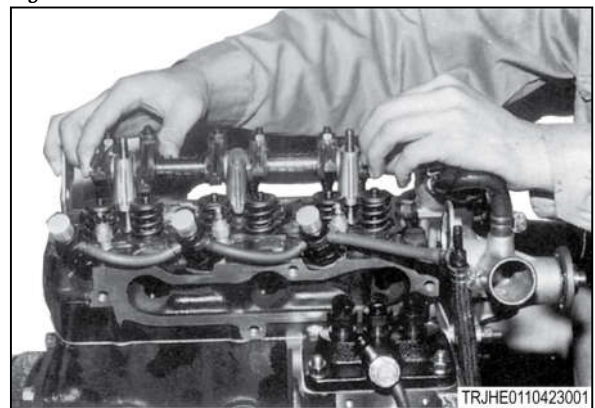


Fig. 51

9. Remove the nozzles.
10. Remove the cap.
11. Remove fuel-return pipes.
12. Remove the nozzle with the gasket.  
Keep the nozzle free from dust.
13. Remove the glow plugs.

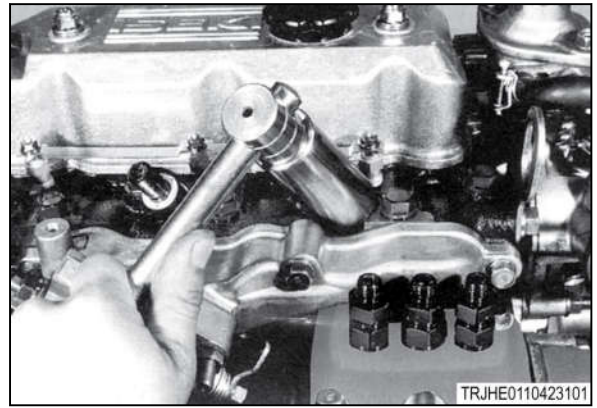


Fig. 52

14. Loosen the cylinder head bolts in the sequence shown.
15. Remove the cylinder head.
16. Remove the dowels and tappets.

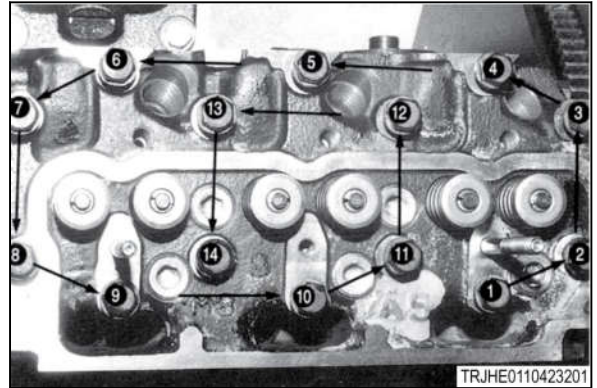


Fig. 53

## 2.8.2 Disassemble the cylinder head

### Procedure

1. Remove the inlet manifold.
2. Remove the exhaust manifold.
3. Remove the thermostat housing.
4. Compress the valve spring along with the spring seat with a spring compressor. Remove the cotter spring seat retainer.
5. Remove the valves.  
Keep valves and related parts in the order of valve numbers.
6. Remove and discard the valve seals.

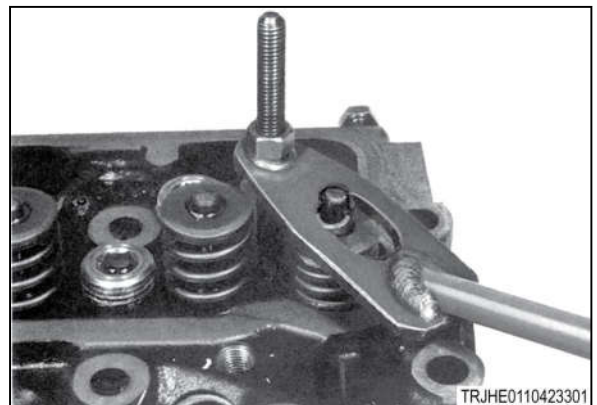


Fig. 54

## 2.8.3 Examine the cylinder head

### Procedure

1. Examine the cylinder head for cracks.



2. Remove carbon from the bottom surface of the cylinder head.
3. Use Color Check to inspect the bottom surface and inlet and exhaust ports.



Fig. 55

4. Measure the cylinder head for distortion.  
Measure the flatness of the bottom surface of the cylinder head. Put a straight rule diagonally across the four corners on the bottom face and examine the clearance with thickness gauges.
5. When the distortion is more than the limit, correct on a surface grinder.  
The grind-down limit is 0.4 mm (0.016 in). Replace the cylinder head when more than the grind-down limit is necessary to correct.

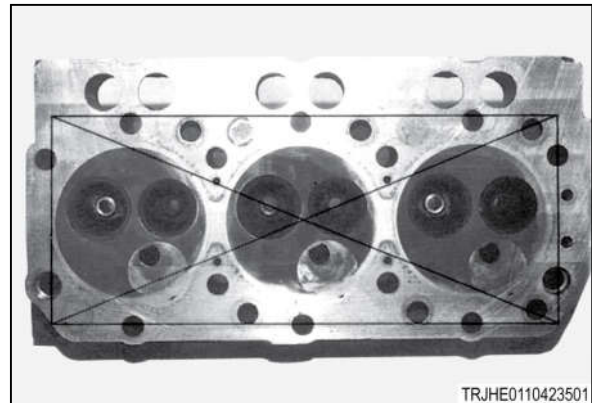


Fig. 56

6. Measure the clearance between the valve guide and valve stem.  
Examine the valve for play with a dial indicator. If the play is more than 0.15 mm (0.0059 in) for the inlet valve and 0.2 mm (0.008 in) for the exhaust valve, replace the valve and valve guide as an assembly. Measure the play at a point 10 mm (0.39 in) above the valve oil seal when the valve lift is 0 mm (0 in).

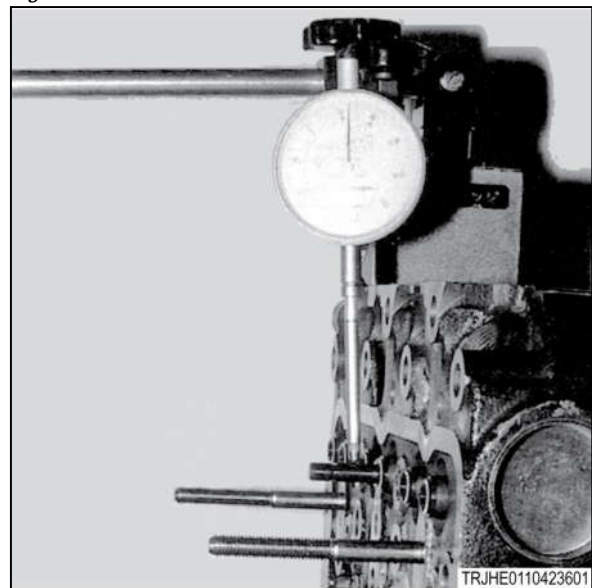


Fig. 57

7. If necessary, replace the valve guide.
- Drive out the valve guide up from the cylinder head bottom.
  - Apply oil to the new valve guide.
  - Press in a new valve guide from the cylinder head top. Do not damage the valve guide.

Press until the distance from the cylinder head top to the valve guide end is 7 mm (0.276 in).

- Ream the bore to the specified diameter.

Specified bore	70.000 mm to 70.017 mm (2.7559 in to 2.7565 in)
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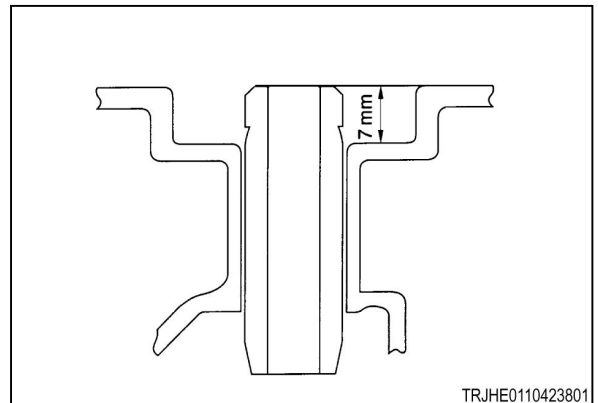
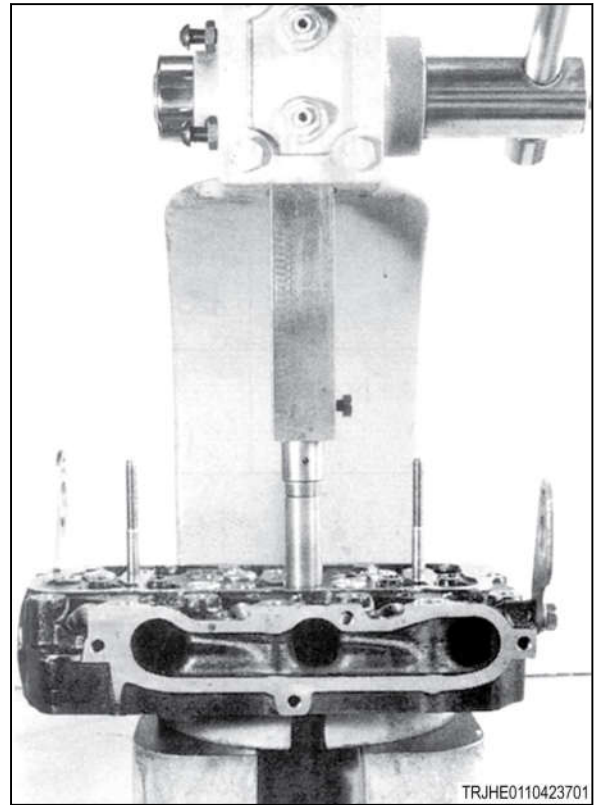


Fig. 58

8. Examine the valve contact width (1) and depression (2).

When the contact width is wider than specified, correct with a 75 degree valve seat cutter. When the valve depression is more than specified, replace the cylinder head assembly.

	Standard value	Limit
Contact width	1.3 mm - 1.6 mm (0.051 in - 0.063 in)	2.0 mm (0.079 in)
Valve depression	0.7 mm (0.028 in)	1.4 mm (0.055 in)

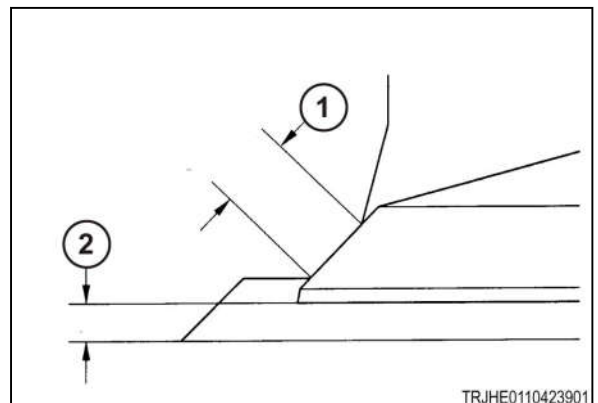


Fig. 59

9. Apply polishing compound to the valve seat surface. Lap with the valve and tap the valve for good contact with the circumference.
10. Remove all the polishing compound.



Fig. 60

11. Measure the valve stem diameter with a micrometer.

	Standard Value	Usable Limit
Inlet Valve	7.00 mm (0.2756 in)	6.90 mm (0.2719 in)
Exhaust Valve	7.0 mm (0.2756 in)	6.89 mm (0.2713 in)

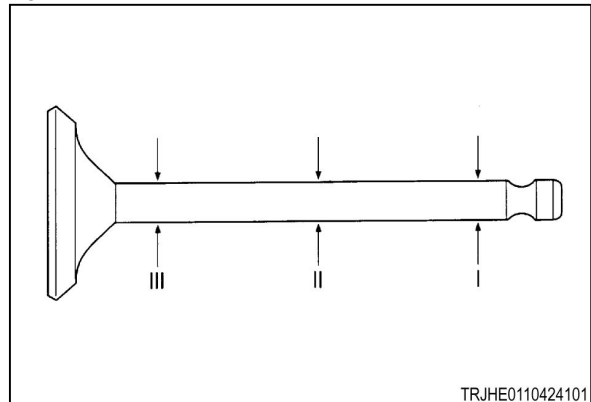


Fig. 61

12. Examine the valve thickness.

Valve thickness standard values	0.8 mm (0.0315 in)
Usable limits	0.55 mm (0.0217 in)

13. When the valve thickness is less than the usable limit, replace the valve.
14. Measure the free length of each valve spring with calipers.

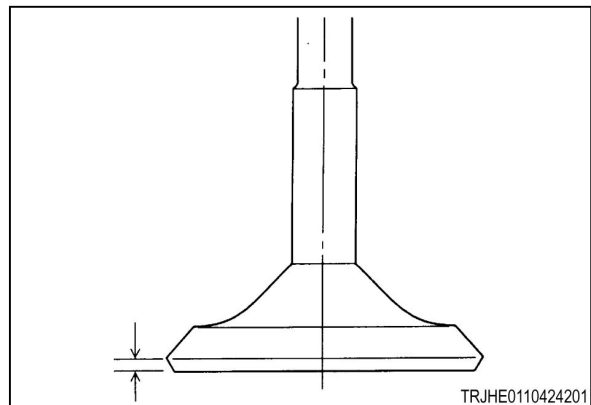


Fig. 62

	Standard Value	Usable Limit
Free length	36 mm (1.42 in)	35 mm (1.38 in)
When compressed	31 mm (1.22 in)	

15. Put a spring on a surface table and measure distance from vertical (1). Spring shown compressed (2).

Usable Limit	1.0 mm (0.039 in)
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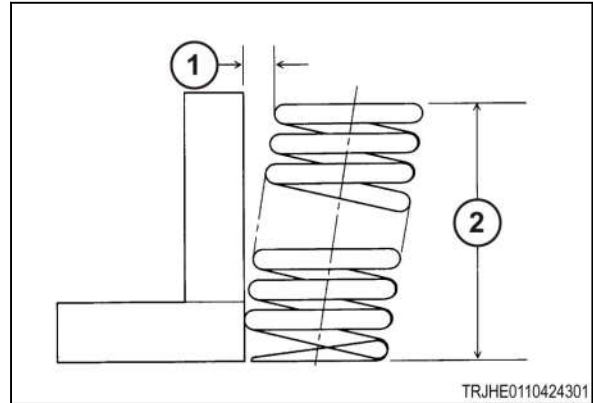


Fig. 63

16. Inspect the intake and exhaust manifold contact surfaces. Measure flatness with a straight rule and thickness gauges.

When the measurement is more than the usable limit, replace the manifold.

Usable Limit	0.2 mm (0.008 in) For intake and exhaust.
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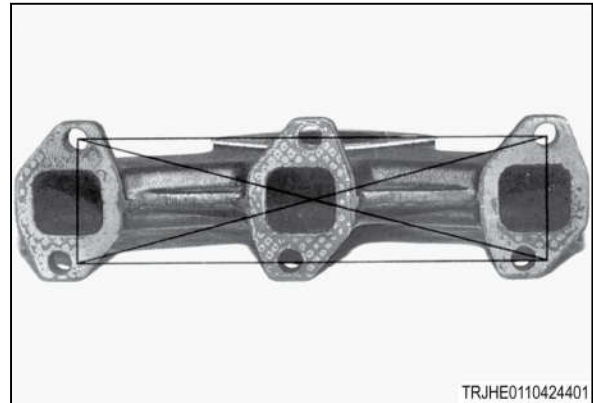


Fig. 64

## 2.8.4 Assemble the cylinder head

### Procedure

1. Install the new new valve guides with a press.

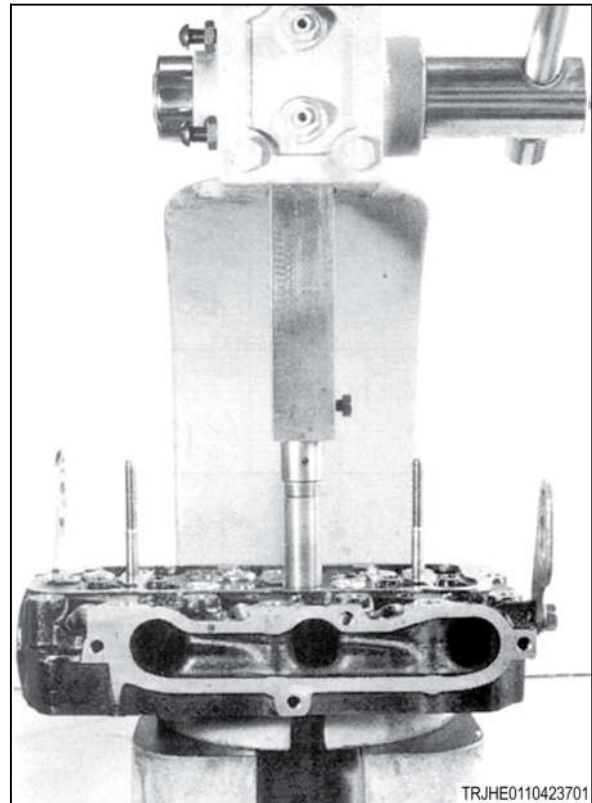


Fig. 65

2. Install new valve oil seal. Drive or press the valve oil seals.
3. Apply oil to all the valve stems.

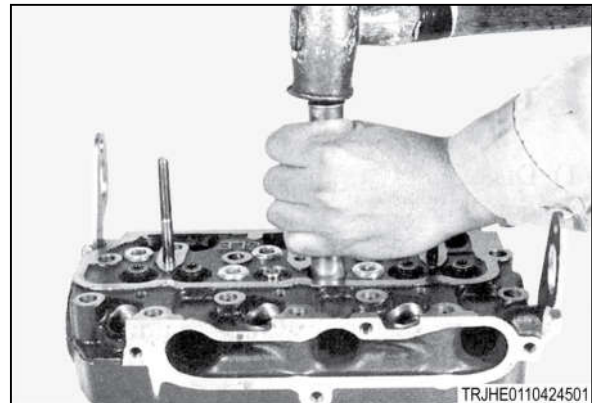


Fig. 66

4. Install the valves into the valve guides.
5. Install the valve springs.
6. Install the spring seats.
7. Compress each valve spring and valve seat. Install the cotter spring seat retainer.
8. Put a new manifold gasket into position.
9. Install the inlet manifold.
10. Put a new manifold gasket into position.
11. Install the exhaust manifold.
12. Install the thermostat housing. Use a new gasket.

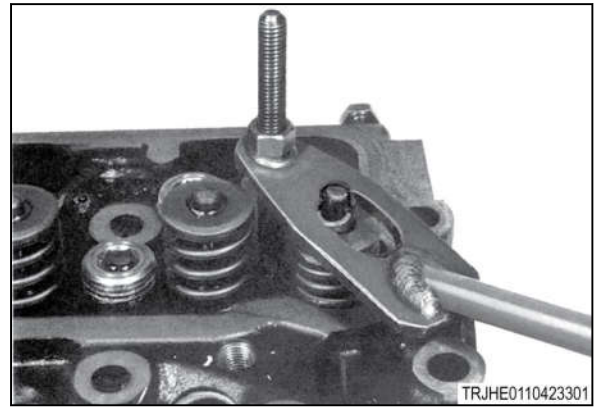


Fig. 67

### 2.8.5 Disassemble and examine the rocker arm shaft

#### Procedure

1. Put an identification mark on the front side top of the rocker arm shaft for assembly.
2. Remove snap rings and remove arm brackets.
3. Keep the brackets in order.

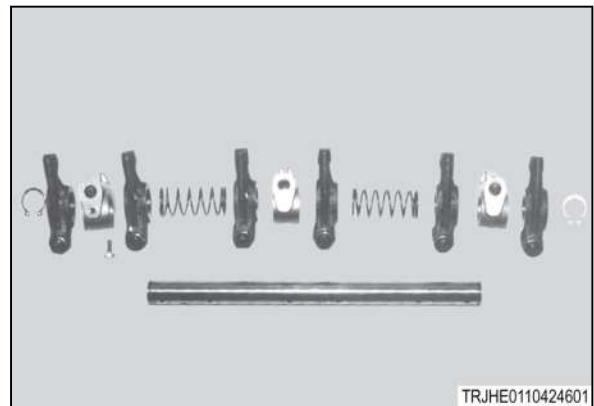


Fig. 68

4. Examine for a bend with a dial gauge.

Usable limit	0.5 mm (0.02 in)
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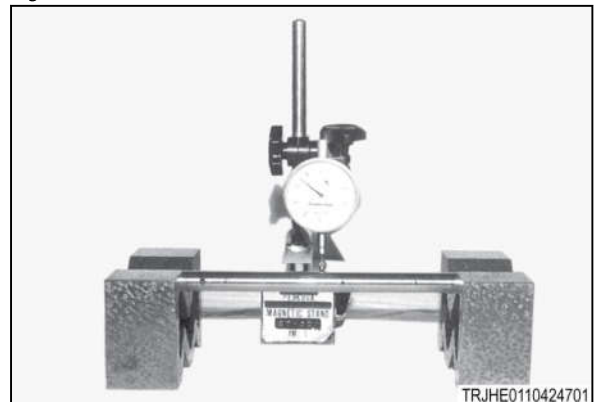


Fig. 69

5. Measure the diameter of the rocker arm shaft at the four points where rocker arms move.

When the wear is more than the usable limit, replace the rocker arm shaft.

Standard value	16 mm (0.6299 in)
Usable limit	15.85 mm (0.6240 in)

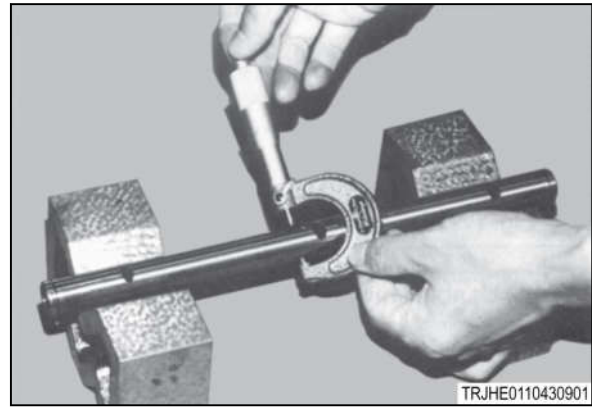


Fig. 70

6. Measure the bore diameter of each rocker arm and calculate the difference from the diameter of the rocker arm shaft.

When the difference is more than the usable limit, replace the rocker arm and rocker arm shaft assembly.

Standard value	0.01 mm to 0.05 mm (0.0004 in to 0.002 in)
Usable limit	0.2 mm (0.008 in)

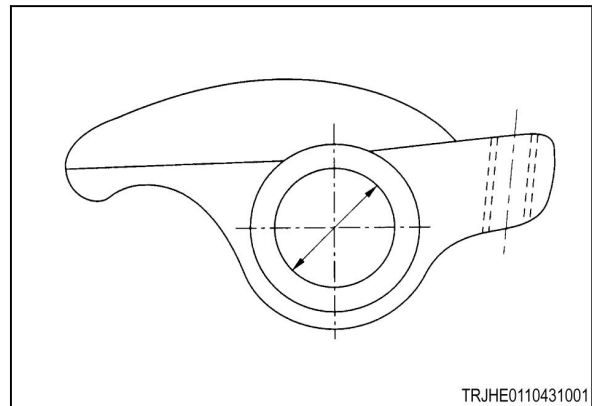


Fig. 71

### 2.8.6 Assemble the rocker arm shaft

#### Procedure

1. Put the identification marks on the rocker arms forward. Make sure that the end with an off-set position bolt hole is forward.

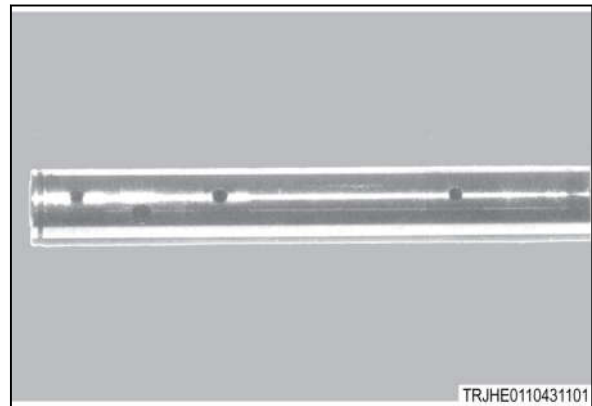


Fig. 72

2. Install the rocker arms, brackets, and springs on the rocker arm shaft as shown.
3. Install the snap rings on each end.

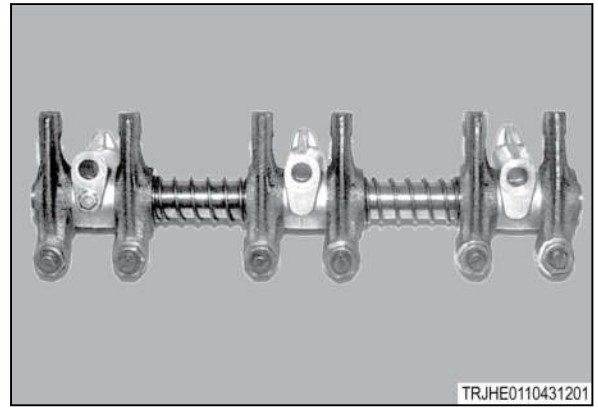


Fig. 73

### 2.8.7 Examine the push rods

#### Procedure

1. Examine the ends of each push rod for wear. Replace push rods that are worn too much.
2. Examine the push rods for a bend. Put the push rod on a surface table and measure the bend with a thickness gauge.

Usable limit	0.3 mm (0.012 in)
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Fig. 74

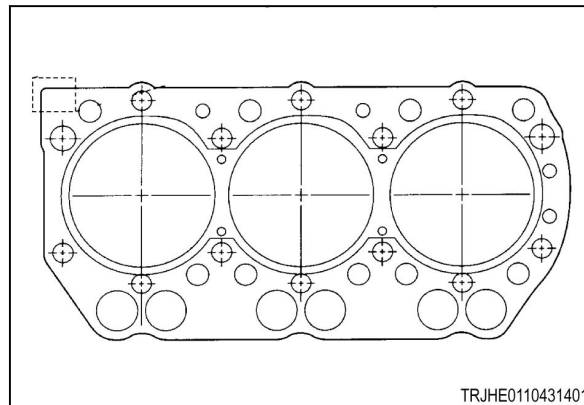
### 2.8.8 Install the cylinder head

#### Procedure

1. Clean the bottom surface of the cylinder head and the top surface of the cylinder block.
2. Drive in the dowels.
3. Insert the tappets.



4. Put a new gasket onto the cylinder block with the TOP mark up.  
The gasket for different models has a different identification mark: notches in the top left corner.
5. Put the cylinder head carefully onto the cylinder block.



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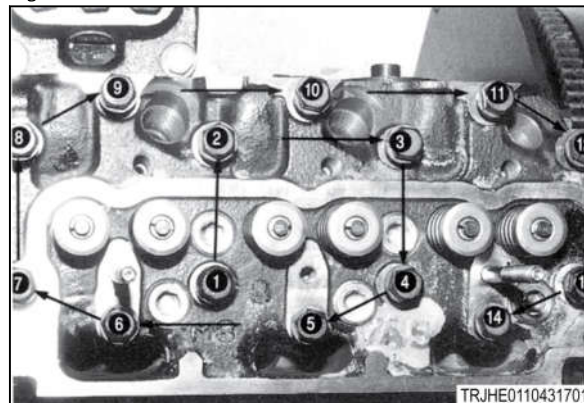
6. Apply engine oil to the threads of the cylinder head bolts.
7. Install the cylinder head bolts.  
Tighten the cylinder head bolts in the sequence shown to the specified torque.  
Tighten the bolts step by step: first to 2 kgf m (14 lbf ft), second to 4 kgf m (29 lbf ft), and then to the specified torques:

Torque
6.0 kgf m to 7.0 kgf m (43.3 lbf ft to 50.6 lbf ft)

8. Install the glow plugs.
9. Install the injection nozzles.  
Use a new gasket and tighten the injection nozzles to the specified torque.

Torque
4.0 kgf m to 5.0 kgf m (28.9 lbf ft to 36.1 lbf ft)

Fig. 75



TRJHE0110431701

Fig. 76



TRJHE0110431801

Fig. 77

10. Install the leak hoses.

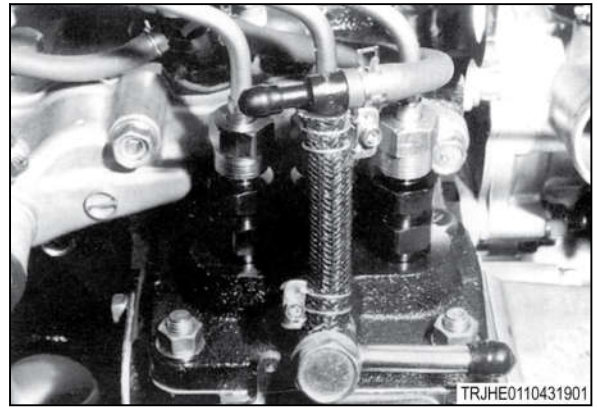


Fig. 78

11. Install the push rods.

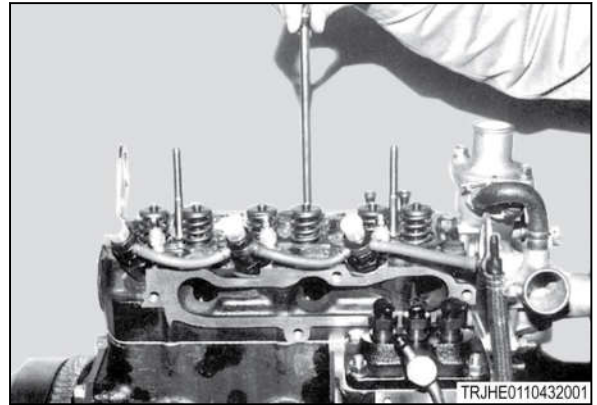


Fig. 79

12. Install the rocker arm assembly.
13. Loosen all the rocker arm adjustment screws.
14. Install the rocker arm assembly and tighten to 1.4 kgf m to 2.4 kgf m (10.1 lbf ft to 17.3 lbf ft).
15. Install the injection pipes and tighten.
16. Install the water by-pass hose.
17. Adjust the valve clearances.
18. Install the valve cover.

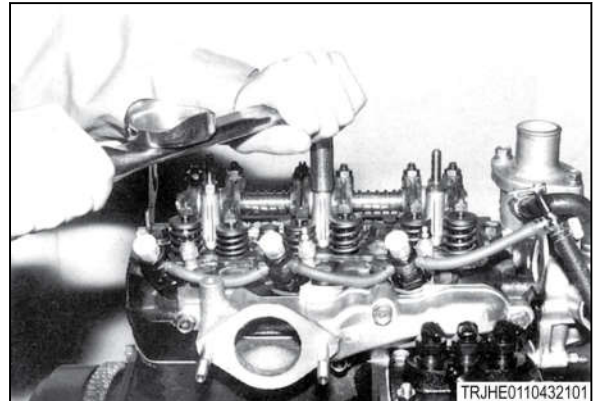


Fig. 80

The valve cover seal and gasket are made of rubber. Do not to tighten the valve cover too much.

## 2.9 Gear case

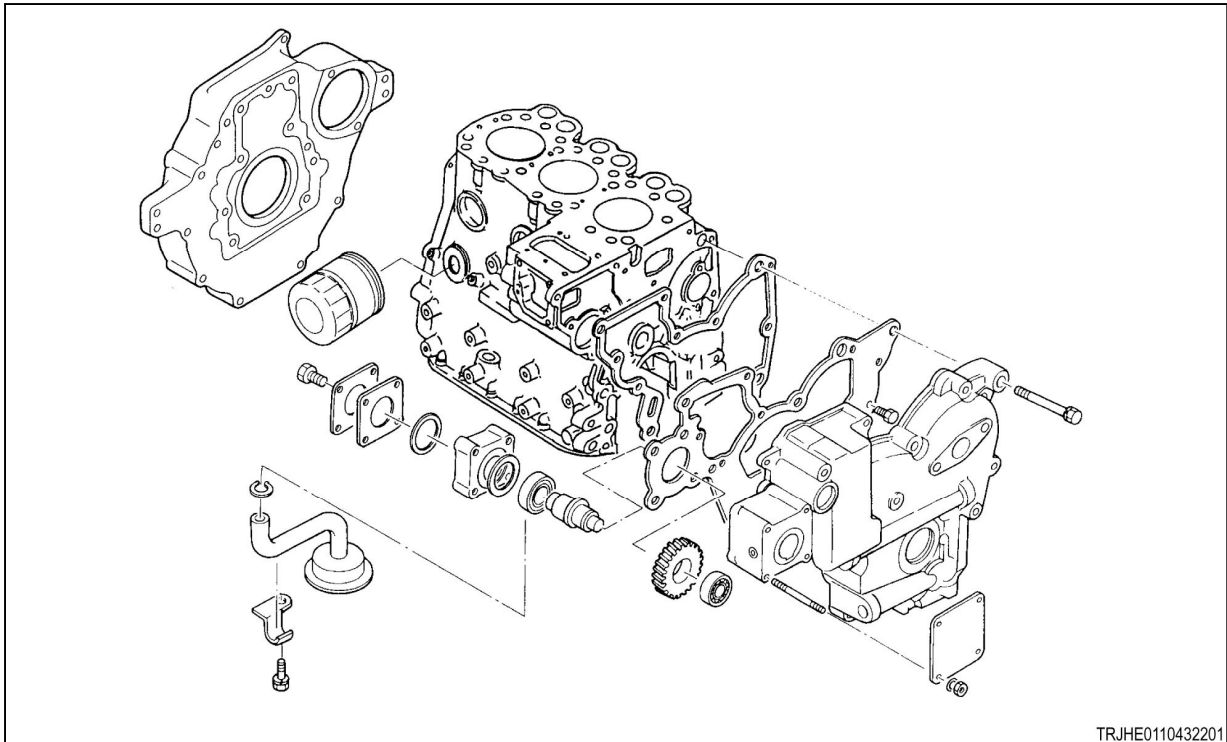


Fig. 81

Exploded view

### 2.9.1 Remove the gear case

#### Procedure

1. Remove the cooling fan.
2. Remove the fan belt.
3. Remove the crankshaft pulley.
4. Remove the alternator.
5. Remove the injection pump cover.
6. Remove the starting spring, setting spring, and control link from the rack.
7. Remove the return spring from the control lever.
8. Remove the hydraulic pump.
9. Remove the hydraulic pump drive gear.

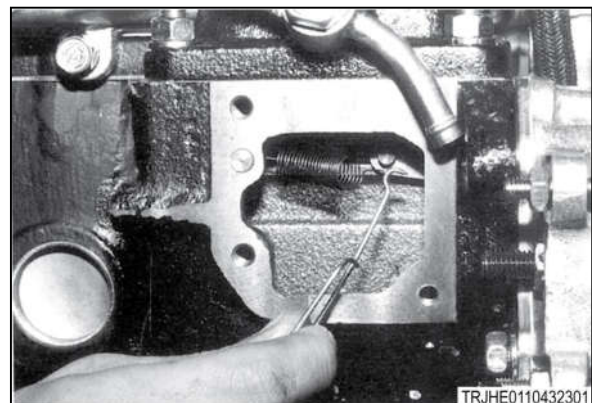


Fig. 82

10. Remove the gear case bolts.  
Some bolts have nuts behind the gear case.  
Make a note of the installation location for the bolts.

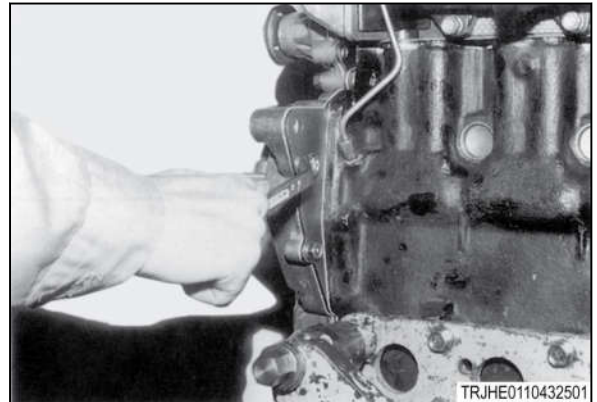
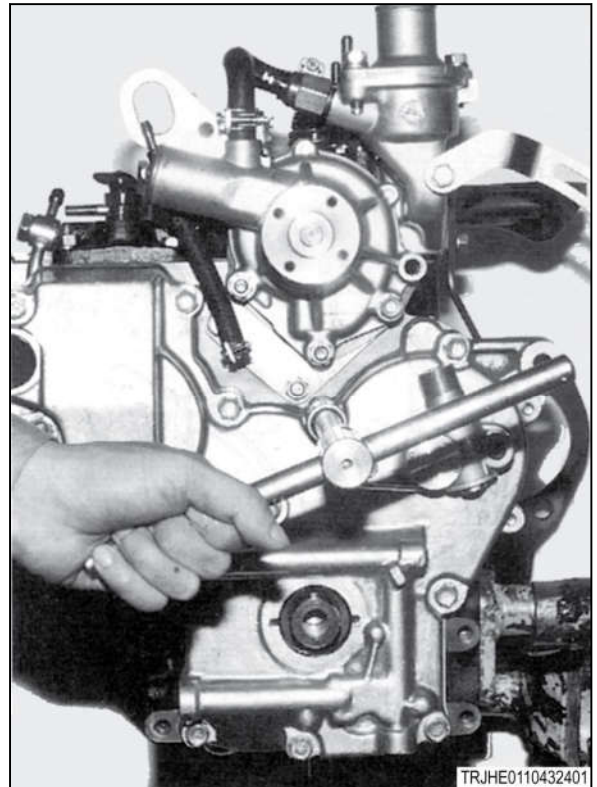


Fig. 83

11. Remove the gear case.
12. Remove and discard the gasket and oil seals.

**NOTE:** Unless necessary, do not disassemble the oil pump assembly, relief valve, governor, and the related parts installed in the gear case.

**NOTE:** Removal of the gear pump and camshaft is in the information for disassembly of the cylinder block.

13. If necessary, remove the idler gear.

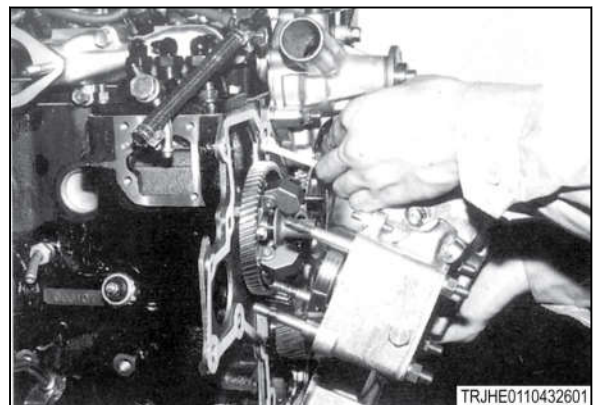


Fig. 84

## 2.9.2 Install the gear case

### Procedure

1. Apply oil to the bore surface of the idle gear and install. Align the timing marks with those of other gears.
2. Install the gear case.
3. Install the bolts in the correct location.  
Tighten the bolts to 1.4 kgf m to 2.4 kgf m (10.1 lbf ft to 17.3 lbf ft)
4. Connect the rack of the injection pump and the control link with a setting spring.  
Move the rack to make sure that the operation is smooth.
5. Install the starting spring.  
Do not drop the starting spring.
6. Install the injection pump cover. Use a new gasket.
7. Install the crankshaft pulley. Tighten the bolt to 17 kgf m to 20.8 kgf m (123 lbf ft to 150.4 lbf ft)
8. Install the alternator.
9. Install the fan belt.
10. Install the cooling fan.

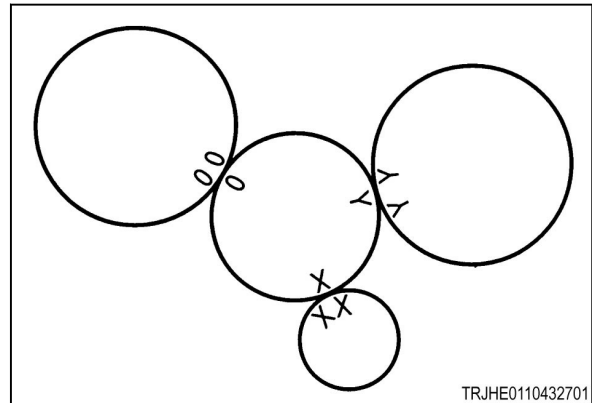


Fig. 85

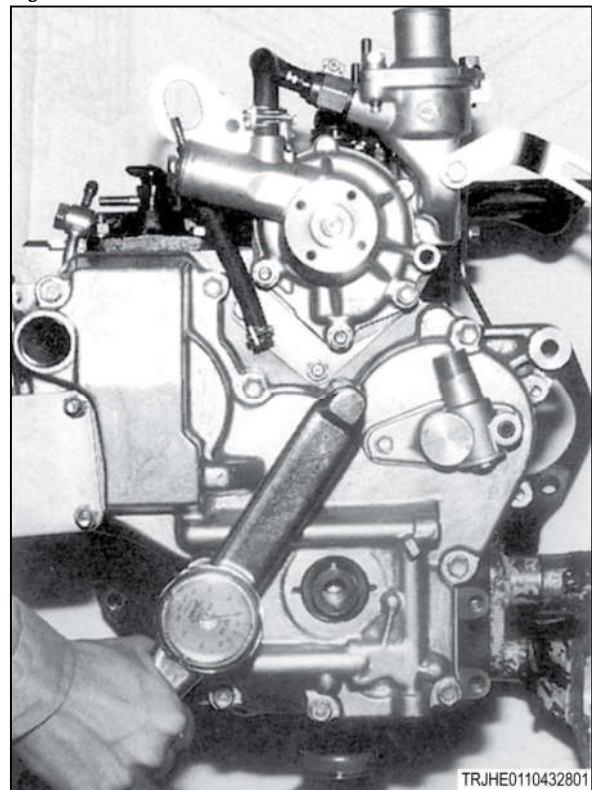
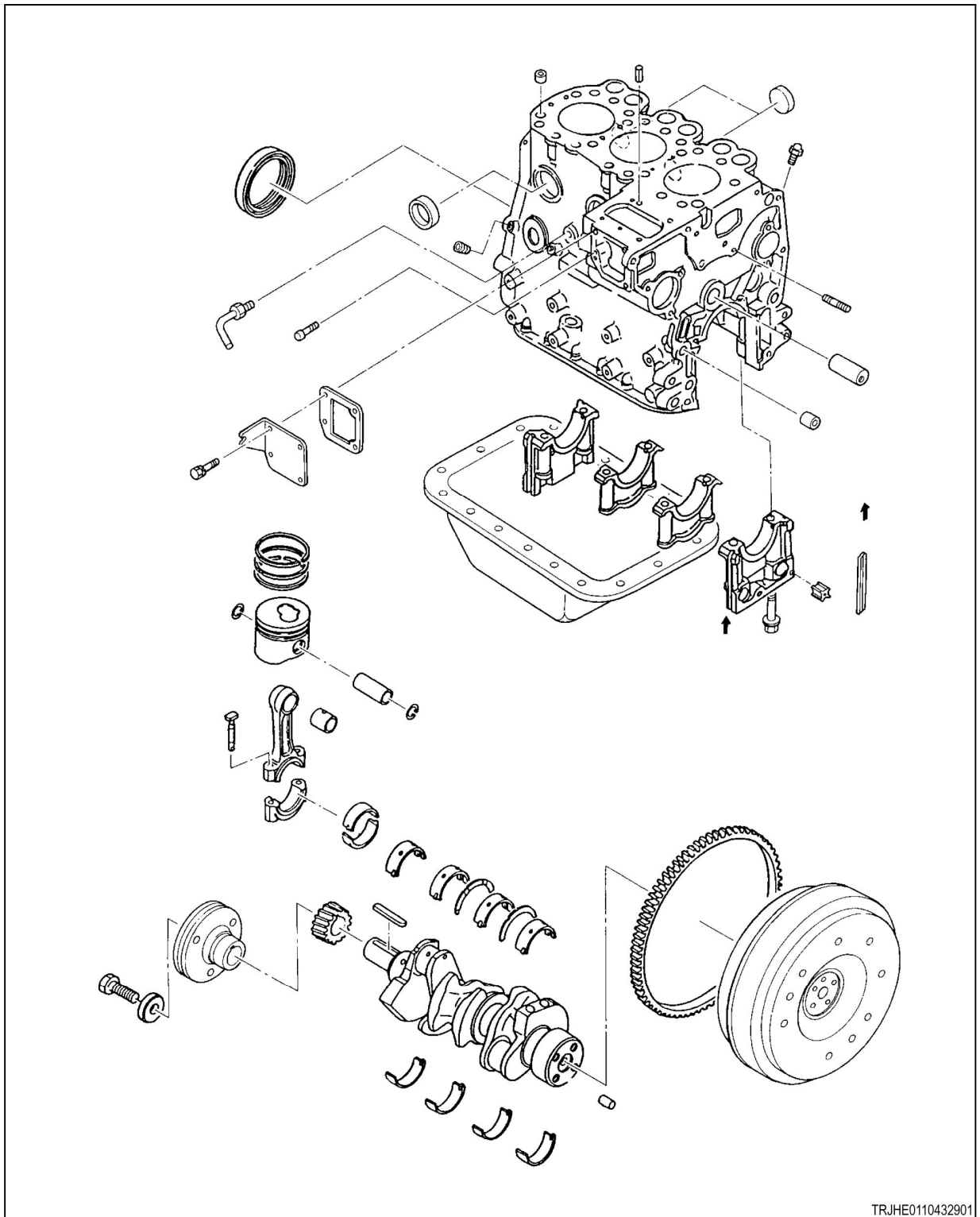


Fig. 86

## 2.10 Cylinder block



TRJHE0110432901

Fig. 87  
Exploded view.

### 2.10.1 Disassemble the cylinder block

#### Procedure

1. Install the engine on an engine stand.
2. Drain the engine oil.
3. Remove the cylinder head.
4. Remove the tappets.
5. Remove the gear case.
6. Remove the camshaft.
7. Remove the injection pump.
8. Remove the pump cam.
9. Remove the solenoid.
10. Remove the water pump.
11. Remove the water pump spacer.
12. Remove the oil filter.
13. Remove the oil pan and oil strainer.
14. Clean the cylinder bores of carbon deposits. Remove carbon deposits from the top part of the cylinder bore with a scraper  
Do not damage the cylinder walls.

#### Pistons and connecting rods

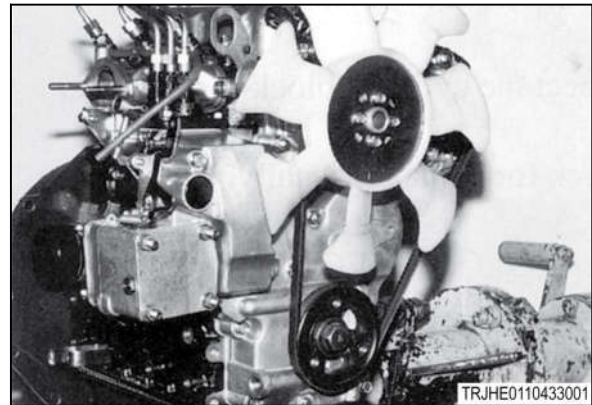


Fig. 88

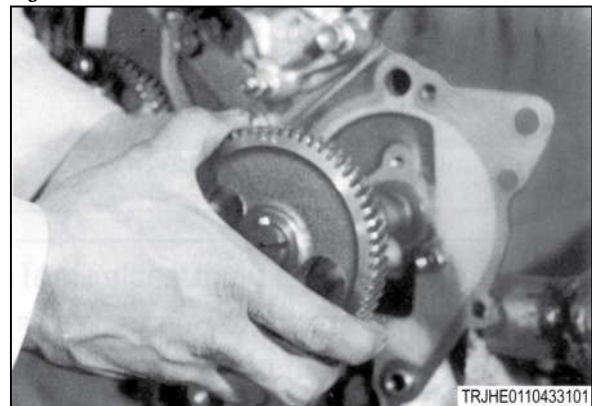


Fig. 89



Fig. 90

15. Remove the nuts which tighten the connecting rod bearing cap.
16. Remove the pistons and connecting rods from the top of the cylinder block.
17. Keep the pistons, connecting rods, and connecting rod caps in the cylinder order.

#### Flywheel

18. Hold the flywheel.
19. Remove the flywheel.
20. Remove the rear plate.

#### Crankshaft

21. Remove the bearing caps.  
Keep the bearing caps and bearings in order of the bearing location.
22. Remove the crankshaft.
23. Remove the oil pressure switch.

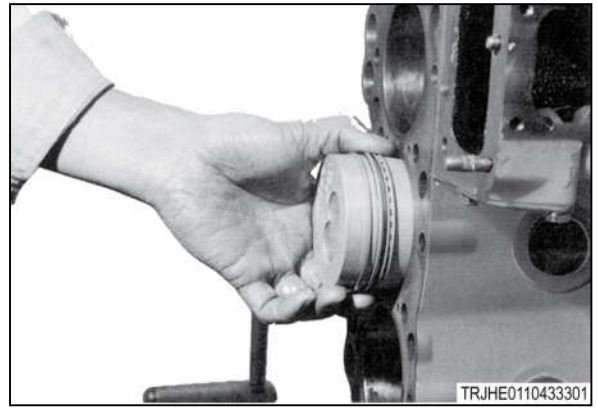


Fig. 91

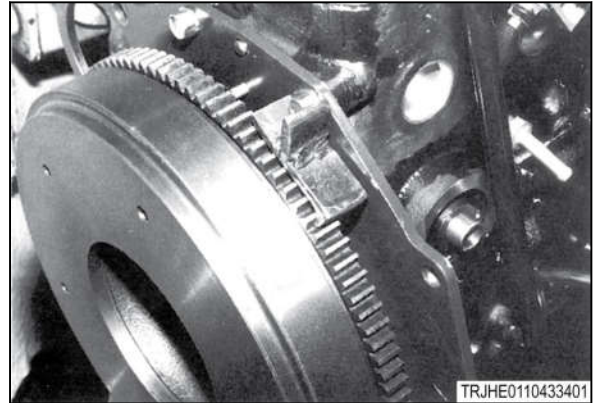


Fig. 92

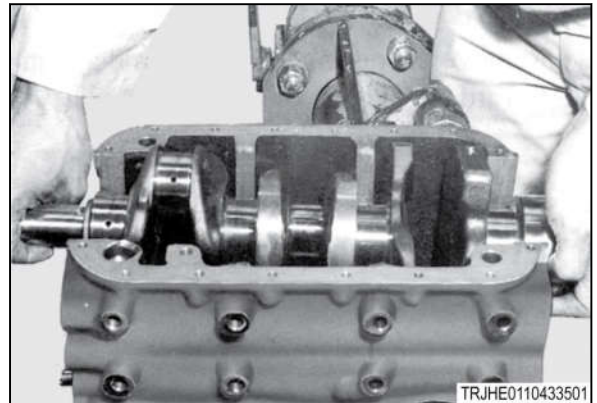


Fig. 93

### 2.10.2 Examine the cylinder block

#### Procedure

1. Look for damage on the cylinder block.  
If necessary, use Color Check to test for cracks and other damage.  
If necessary, repair or replace the cylinder block.



2. Make sure that the top of the cylinder block is flat.

Use a straight rule and thickness gauges parallel and at a diagonal as shown to examine for flat.

If the distortion is more than the usable limit, correct on a surface grinder. The ground-down limit is 0.4 mm (0.016 in). Replace a cylinder block which cannot be corrected in the ground-down limit.

Standard value	0.08 mm to 0.003 mm (0.0004 in to 0.002 in) or less
Ground-down limit	0.4 mm (0.016 in)

3. Measure the cylinder bores for wear.

Measure the cylinder bore diameter at a point of 12 mm to 14 mm (0.47 in to 0.55 in) below the cylinder block top surface in two directions: one is in parallel with the crankshaft and the other is at right angles to the crankshaft.

Wear limit	0.2 mm (0.008 in)
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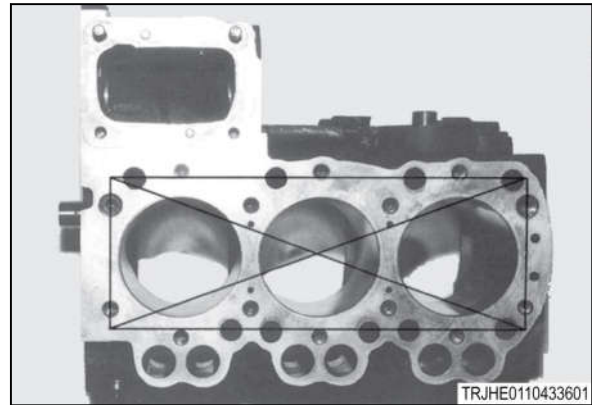


Fig. 94

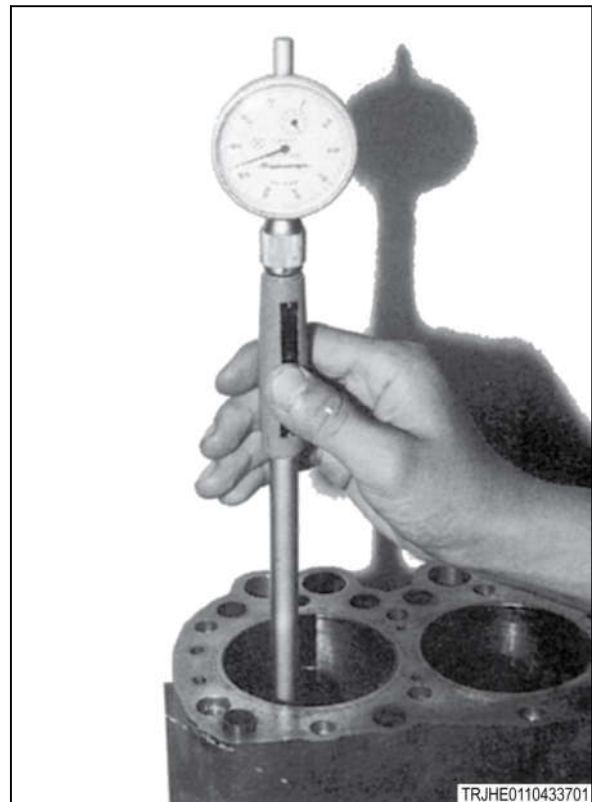


Fig. 95

- If the wear is more than 0.2 mm (0.008 in), correct with a hone.

Hone to fit an oversize piston.

Oversize	0.5 mm (0.02 in)
	1.0 mm (0.039 in)
Bore tolerance	0.30 mm (0.0012 in) nominal

Measure the bore diameter at three levels (a), (b), and (c) in two directions (A) and (B). The measurements must not be different by more than 0.02 mm (0.0008 in) from each other.

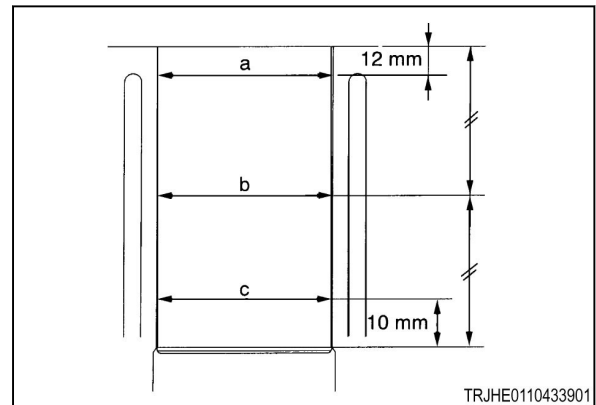
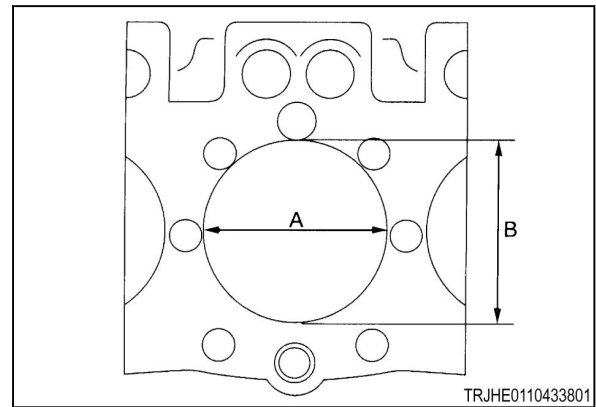


Fig. 96

### 2.10.3 Examine the crankshaft

#### Procedure

- Inspect the crankshaft journals for oil clearance.
- Clean the journals and bearings.
- Install the top bearings and crankshaft in the cylinder block.
- Put plastic gauge over the journal width.
- Install the bottom bearings in the bearing caps.
- Install the bearings and caps. Tighten the bolts to the specified torque.

Do not let the crankshaft turn.

5.0 kgf m to 6.0 kgf m (36 lbf ft to 43 lbf ft)

- Remove the bolts and carefully remove the bearings and caps.

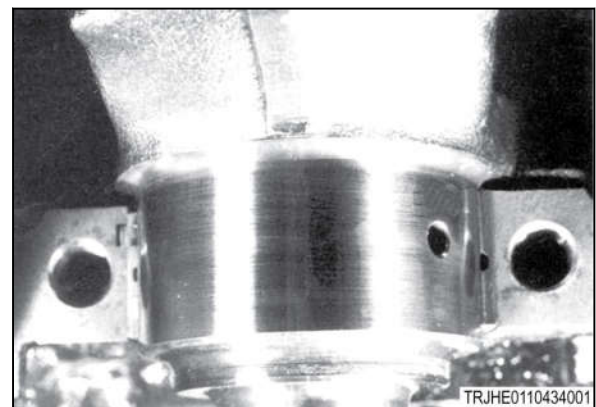


Fig. 97

8. Measure the widest areas of the plastic gauge.

0.034 mm to 0.099 mm (0.0013 in to 0.0039 in)
---

If the oil clearance of a journal is more than the usable limit, replace the bearings with new bearings and examine for oil clearance again. If the clearance is more than the usable limit with new bearings, polish the journal and use undersized bearings.

Under-size bearings	0.5 mm (0.02 in)
	1.0 mm (0.039 in)



Fig. 98

If the crankshaft requires more than the grind down limit of 1.0 mm (0.039 in), replace the crankshaft and bearings.

9. Clean the crankshaft pins, connecting rod large ends, and bearings.
10. Put plastic gauge over the pin width.

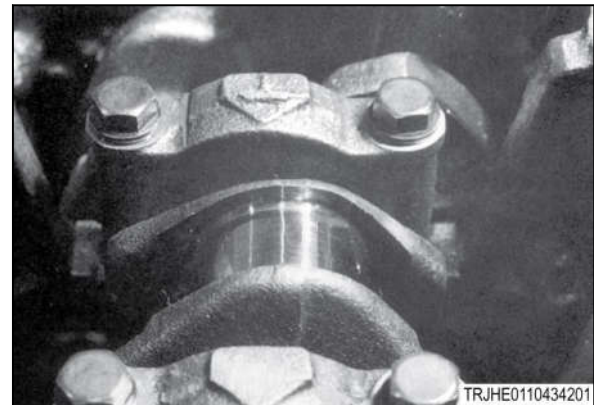


Fig. 99

- 11.** Tighten the bearings on the connecting rods to the specified torque.

Do not let the crankshaft turn.

3.2 kgf m to 3.8 kgf m (23 lbf ft to 27.5 lbf ft)

- 12.** Remove the bolts and connecting rod caps.

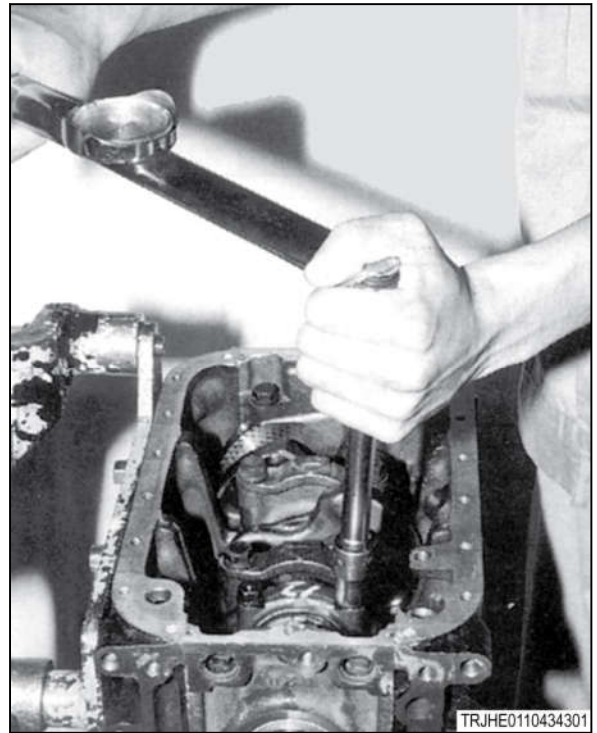


Fig. 100

- 13.** Measure the widest areas of the plastic gauge.

0.027 mm to 0.084 mm (0.0011 in to 0.0033 in)

If the oil clearance of a journal is more than the usable limit, replace the bearings with new bearings and examine for oil clearance again. If the clearance is more than the usable limit with new bearings, polish the pin and use undersized bearings.

Under-size bearings	0.5 mm (0.02 in)
	1.0 mm (0.039 in)

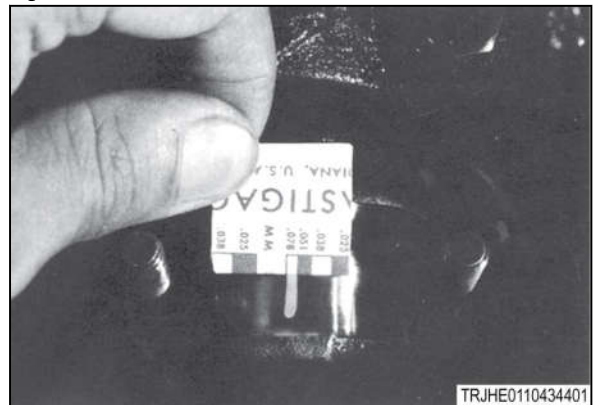


Fig. 101

If more than the grind down limit of 1.0 mm (0.039 in) is necessary, replace the crankshaft and bearings.

- 14.** Install the connecting rod to the crank pin.

- 15.** Measure the thrust play with thickness gauges.  
If the play is more than the usable limit, replace the connecting rod.

Standard value	Usable limit
0.175 mm to 0.035 mm (0.007 in to 0.014 in)	0.35 mm (0.0138 in)



Fig. 102

### 2.10.4 Examine the flywheel

**Procedure**

1. Examine the friction surface for cracks and other damage.  
If defective, repair or replace with a new flywheel.
2. Examine the ring gear teeth for too much wear or damage.  
If defective, replace the ring gear.
3. Examine the pilot bearing for noise or movement that is not smooth.  
Replace a defective pilot bearing.

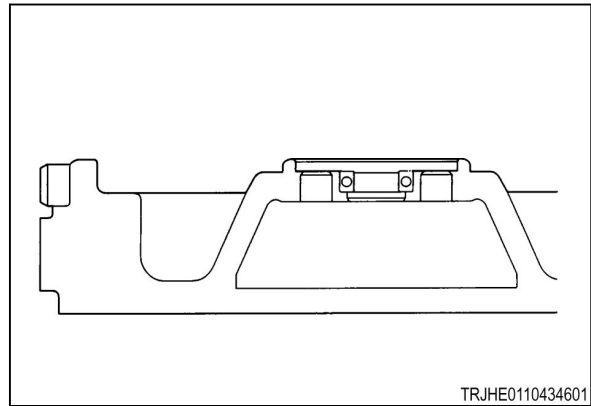


Fig. 103

### 2.10.5 Replace the ring gear

**Procedure**

1. Drive the ring gear off the flywheel with a rod and hammer. Drive the ring gear gradually and equally around the circumference.



Fig. 104

2. Apply heat to the new ring gear.
3. Drive the new ring gear onto the flywheel.  
Install the ring gear with the chamfered side turned to the starter.  
After installation, make sure the ring gear is tight to the flywheel.

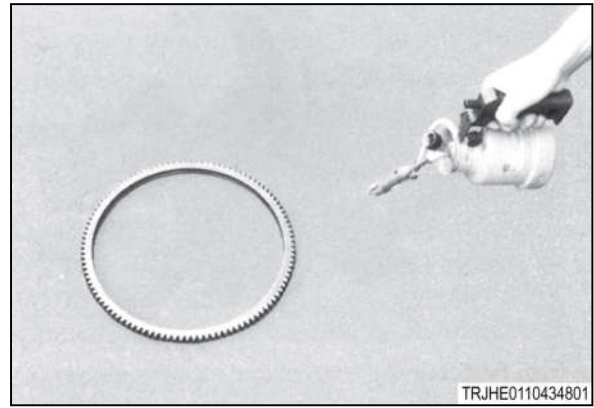


Fig. 105

### 2.10.6 Replace the pilot bearing

#### Procedure

1. Remove the flywheel.
2. Drive the bearing out from the front to the rear.
3. Drive the new bearing into the flywheel gradually and equally.  
Do not install the bearing at an angle.  
Do not apply a load to the inner race.



Fig. 106

## 2.10.7 Examine the camshaft

### Procedure

1. Examine the camshaft journal and cams for wear and other damage.  
Replace a worn or defective shaft.



TRJHE0110435101

Fig. 107

2. Measure the cam height with a micrometer.

Standard value	Usable limit
27 mm (1.06 in)	266 mm (1.048 in)

If the wear is more than the usable limit, replace the camshaft.



TRJHE0110435201

Fig. 108

3. Measure the diameter of each journal.

Standard value	Usable limit
33 mm (1.299 in)	32.75 mm (1.290 in)

If the wear is more than the usable limit, replace the camshaft.



TRJHE0110435301

Fig. 109

4. Measure the bore diameter of each bearing. Calculate the difference between the cam journal diameter and bearing bore diameter.

Standard value	Usable limit
0.05 mm to 0.105 mm (0.002 in to 0.0041 in)	0.12 mm (0.0047 in)

If the clearance is more than the usable limit, replace the camshaft.

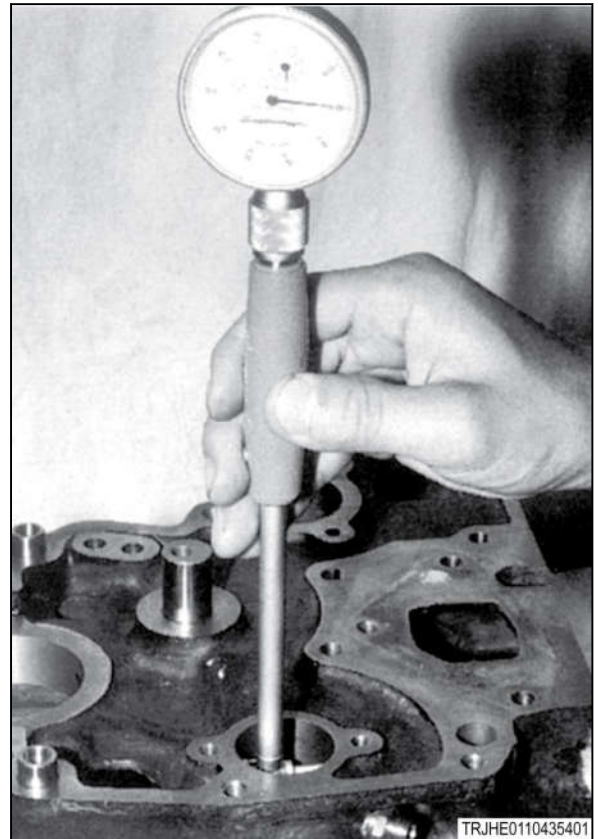


Fig. 110

5. Install the thrust plate and cam gear to the camshaft.
6. Push the thrust plate against the cam gear and measure the clearance between the thrust plate and journal with a thickness gauge.

Standard value	Usable limit
0.05 mm to 0.174 mm (0.002 in to 0.0069 in)	0.3 mm (0.012 in)

If the clearance is more than the usable limit, replace the thrust plate.

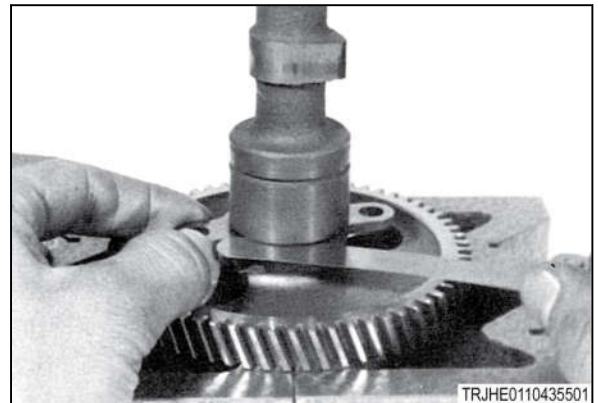


Fig. 111



### 2.10.8 Examine the tappets

**Procedure**

1. Examine the contact surface with the camshaft for pits, cracks, and other damage.  
Replace defective tappets.

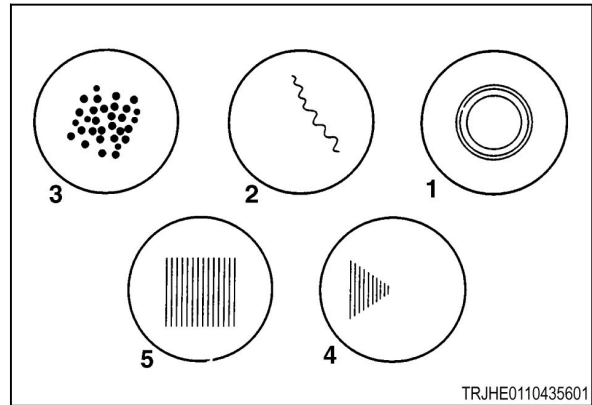


Fig. 112

2. Measure the outer diameter for wear.

Standard value	Usable limit
20 mm (0.7874 in)	19.95 mm (0.7854 in)

Replace tappets with a diameter less than the usable limit.

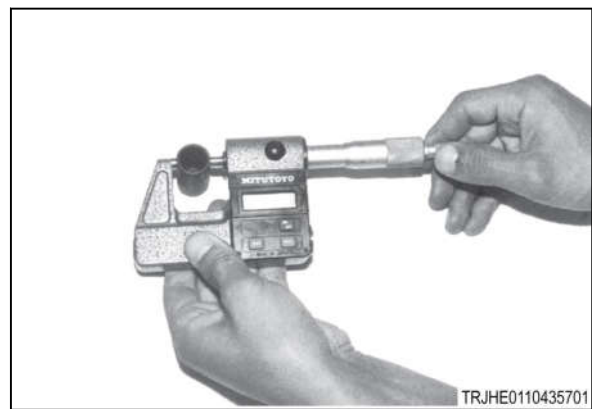


Fig. 113

3. Measure the bore diameter of each tappet hole in the cylinder block and the outer diameter of each tappet. Calculate the difference.

Standard value	Usable limit
0.02 mm to 0.062mm (0.0008 in to 0.0024 in)	0.1 mm (0.004 in)

Replace tappets that have a clearance more than the usable limit.

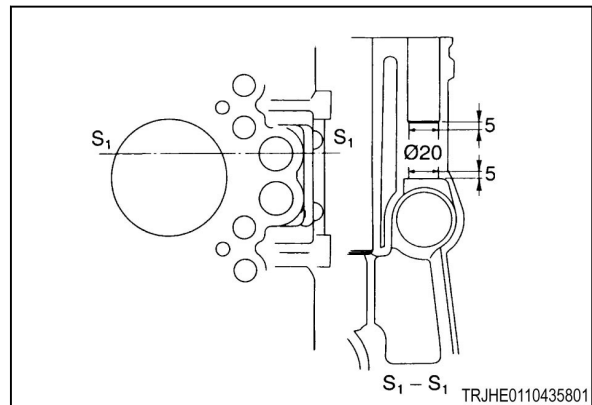


Fig. 114

## 2.10.9 Disassemble and examine the pistons

### Procedure

1. Use a piston ring expander to remove the piston rings.  
Keep the piston rings in order of removal and with the piston number for assembly.



Fig. 115

2. Use a snap ring pliers to remove the snap ring.  
**NOTE:** Do not close the snap ring too much.



Fig. 116

3. Remove the piston pin.



Fig. 117

4. Put a mark on the piston pin to identify the front and rear.  
  
Keep the pistons, piston pins, and connecting rods in order of the cylinder numbers.

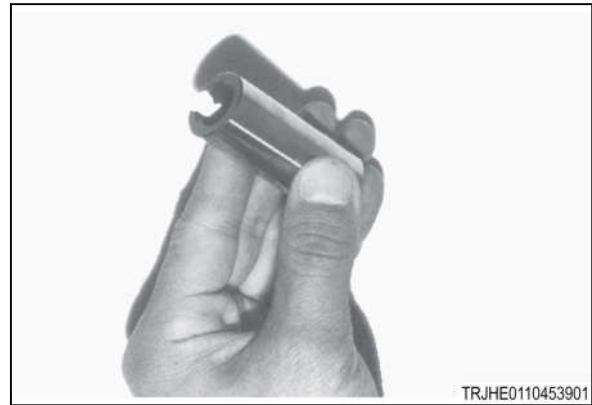


Fig. 118

5. Put a piston ring into the wear area (lower end of the cylinder wall) of the cylinder. Use the piston as a push tool.

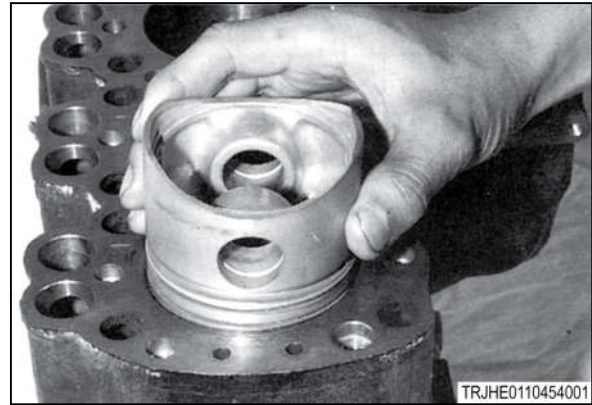


Fig. 119

6. Measure the gaps of each piston ring with a thickness gauge.

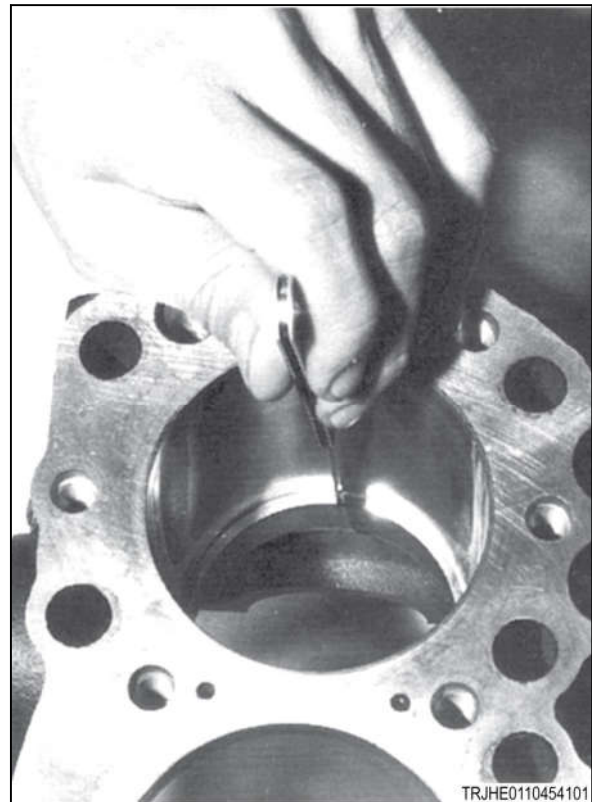


Fig. 120

	Standard value	Usable limit
Number 1 compression ring	0.20 mm to 0.35 mm (0.0079 in to 0.0138 in)	1.5 mm (0.059 in)
Number 2 compression ring	0.40 mm to 0.55 mm (0.0157 in to 0.0217 in)	1.5 mm (0.059 in)
Oil ring	0.20 mm to 0.40 mm (0.0079 in to 0.0158 in)	1.0 mm (0.039 in)

Replace the ring when the gap is more than the usable limit.

7. Use a used piston ring to clean the ring grooves.
8. Measure the clearance at the outer circumference with thickness gauge.

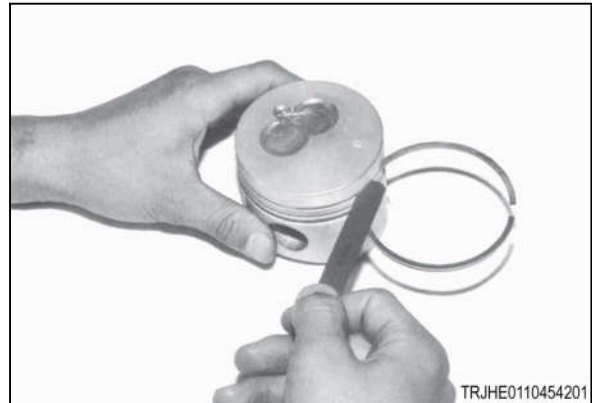


Fig. 121

	Standard value	Usable limit
Number 1 compression ring	0.06 mm to 0.10 mm (0.0024 in to 0.0039 in)	0.3 mm (0.0118 in)
Number 2 compression ring	0.07 mm to 0.11 mm (0.51 in to 0.80 in)	0.3 mm (0.0118 in)
Oil ring	0.02 mm to 0.06 mm (0.0008 in to 0.0024 in)	0.15 mm (0.0059 in)

Replace the piston and rings when the clearance is more than the usable limit.

### 2.10.10 Examine the piston pin

#### Procedure

1. Examine the fit between the piston pin and the piston pin hole.  
 The piston pin must fit smoothly at room temperature.  
 If the pin has too much play, replace the piston or piston pin.



Fig. 122

2. Calculate the difference between the bore in the small end and piston pin diameter.

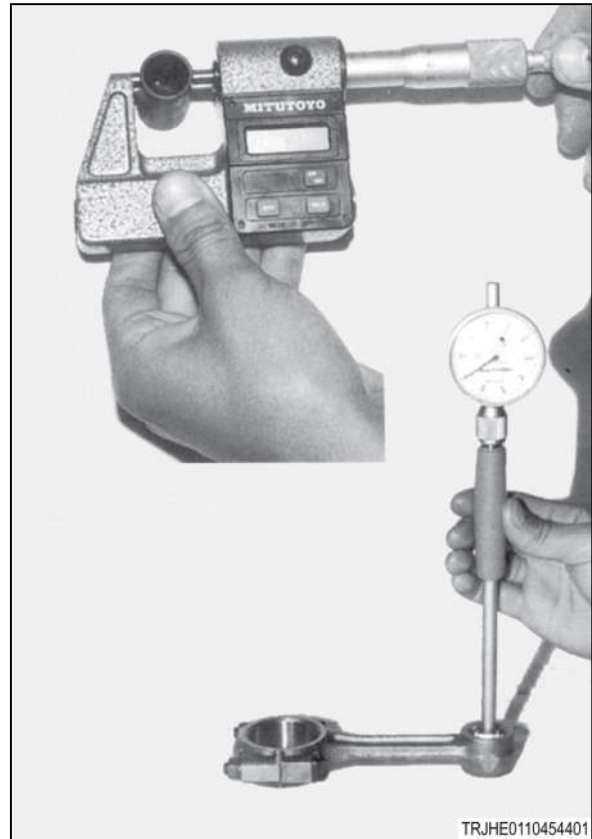


Fig. 123

	Standard value	Usable limit
Clearance	0.008-0.02 mm (0.00031-0.00079 in)	0.05 mm (0.00197 in)

Replace the connecting rod or the piston pin when the clearance is more than the usable limit.

### 2.10.11 Examine the connecting rod

#### Procedure

1. Measure the twist and parallelism between the large and small end of the connecting rod.

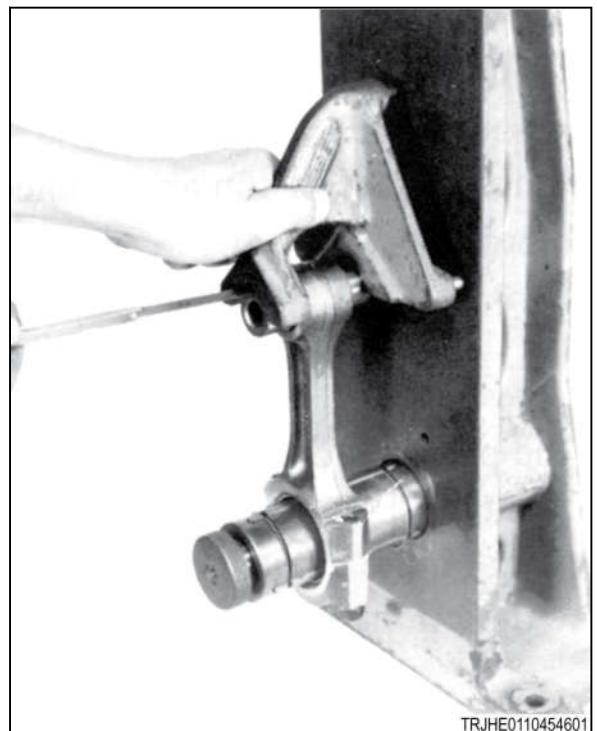
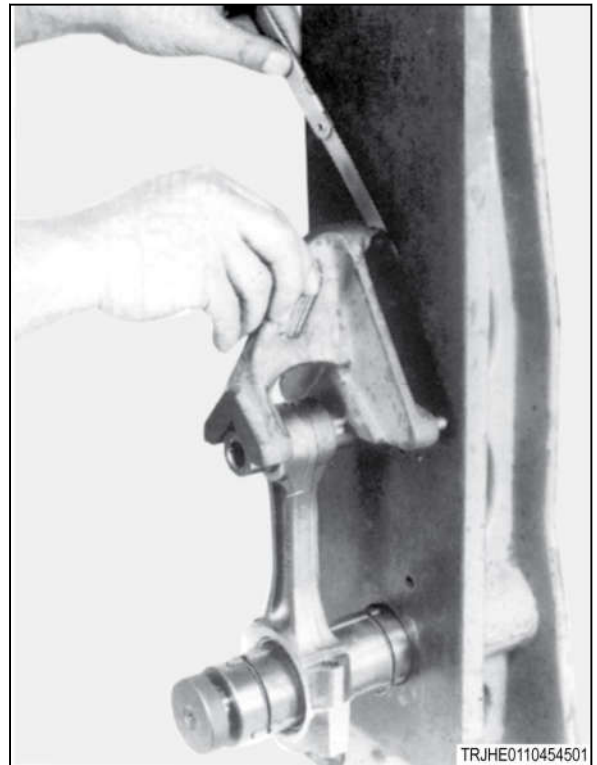


Fig. 124

	Standard value	Usable limit
Twist	0.05 mm (0.002 in) or less	0.2 mm (0.0078 in)
Parallelism	0.05 mm (0.002 in) or less	0.15 mm (0.0059 in)

- If a measurement is more than the specified value, replace the connecting rod.

### 2.10.12 Assemble the piston and connecting rod

#### Procedure

- Install a snap ring in one end of the piston pin hole.
- Set the piston and the connecting rod that the front mark on the piston and ISEKI mark on the connecting rod are turned in the same direction.
- Apply engine oil to the piston pin and push into the hole by hand.
- Install the other snap ring in the groove.



Fig. 125



Fig. 126

5. Install the piston rings with a piston ring expander.
- Put the T mark to the top.
- The oil rings do not have a mark. Oil rings can be installed with either side up.
- The gap of the ring and the ring expander of the oil ring must be set 180 degrees apart.
- The number one and number two compression rings have a different cross section. Do not install in the incorrect order.
- Oil ring height - 2.7 mm (0.106 in)
- Install the rings with the gaps 120 degrees apart as shown.

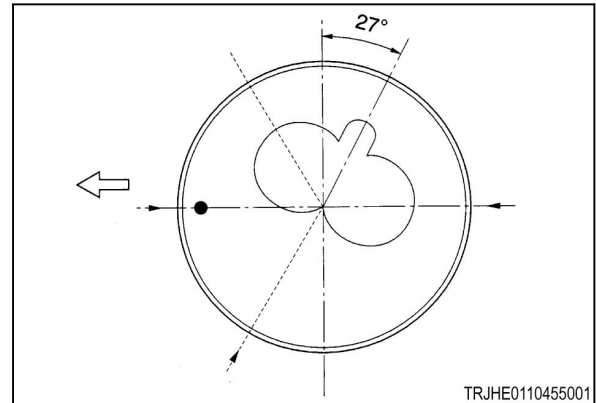
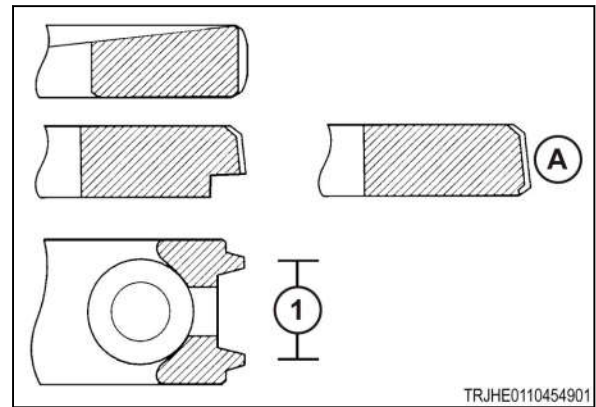


Fig. 127

### 2.10.13 Replace the gear case oil seal

#### Procedure

1. Put a wood block below the gear case.
2. Drive out the oil seal to the rear.



Fig. 128



3. Drive in the new oil seal gradually and equally.  
Drive in the oil seal until the oil seal is to the step part of the gear case.

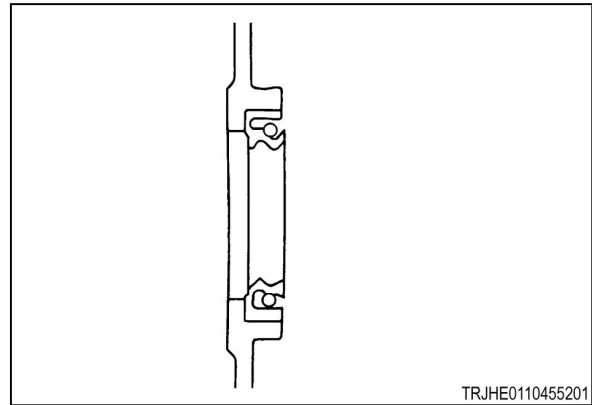


Fig. 129

### 2.10.14 Assemble the cylinder block

#### Procedure

1. Clean the cylinder block.  
The bearing surfaces must be clean.
2. Install the top bearings in the cylinder block.  
The top bearings have oil grooves or oil holes.  
Put the projection of the bearing into the notch in the cylinder block.
3. Apply oil to the top bearing surfaces.
4. Carefully put the crankshaft into the top bearings.
5. Install the bottom bearings into the bearing caps.  
The bottom bearings do not have oil grooves or oil holes.  
Make sure that the bearing cap surfaces are clean.  
Put the projection of the bearing into the notch in the bearing cap.

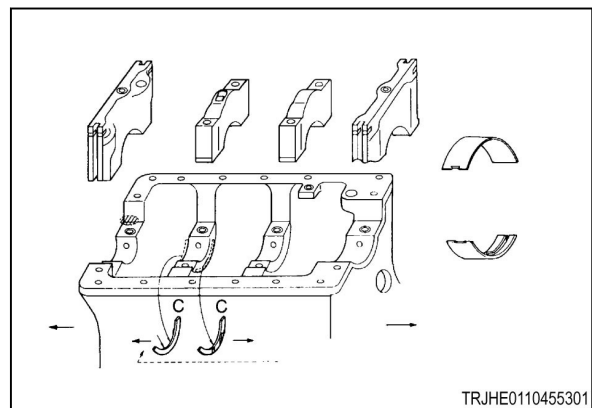


Fig. 130

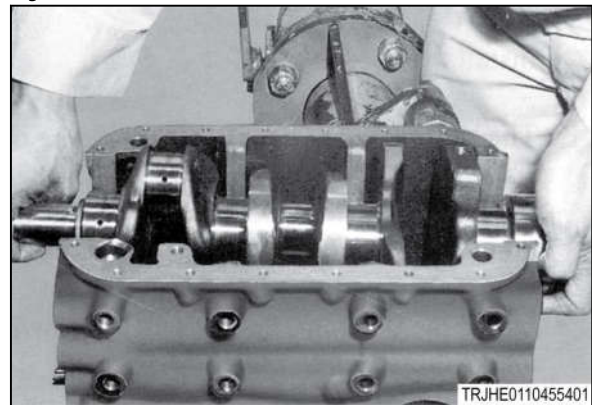


Fig. 131

6. Install the thrust bearing on the number 3 journal with the oil groove to the crankshaft.
7. Apply silicone compound (Three Bond number 1215B: liquid seal) to the shaded parts on the bearing caps (F and R) as shown.
8. Apply engine oil to the lower bearing surfaces.

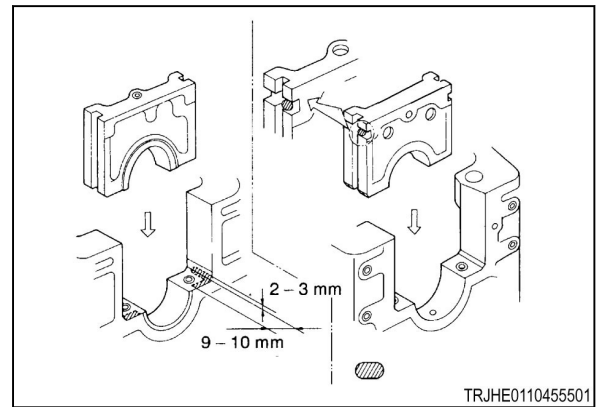


Fig. 132

9. Install the bearing caps (F and R).  
The outer face must be flush with the cylinder block walls within 0.05 mm (0.002 in).  
Install the bearing cap with T park on number 3 journal with the arrow head marks forward.

Bearing cap bolt torque
5.0 kgf m to 6.0 kgf m (36.2 lbf ft to 43.4 lbf ft)

10. Make sure the crankshaft turns smoothly.
11. Install the bearing cap seals (A) and apply silicone compound (Three Bond number 1215B) on the shaded part as shown. Install with the chamfered part, (a), turned out.
12. Push the bearing cap seal until it depresses 1 mm to 2 mm (0.04 in to 0.08 in) below the bearing cap top.

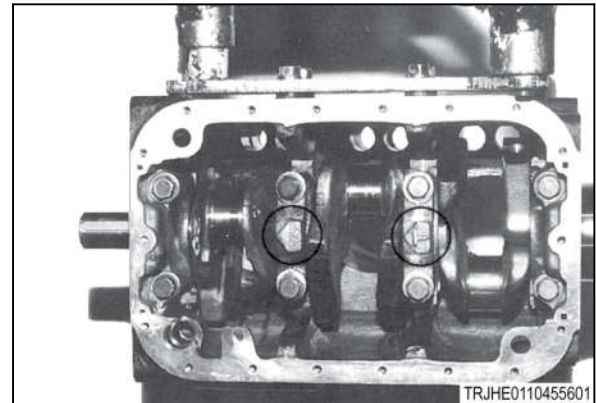


Fig. 133

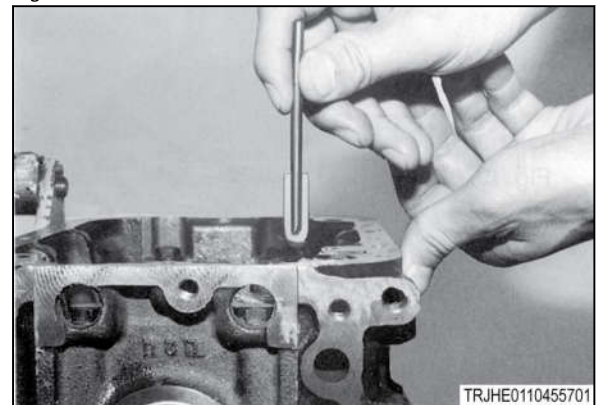
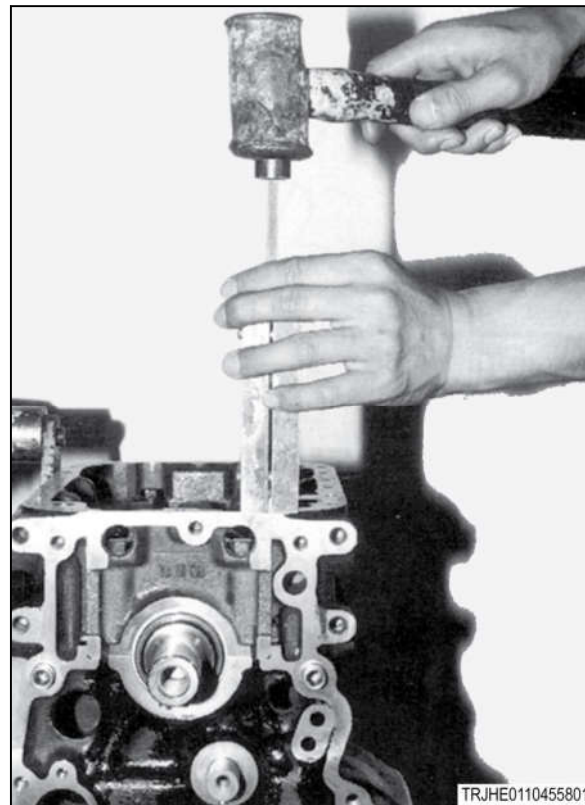


Fig. 134

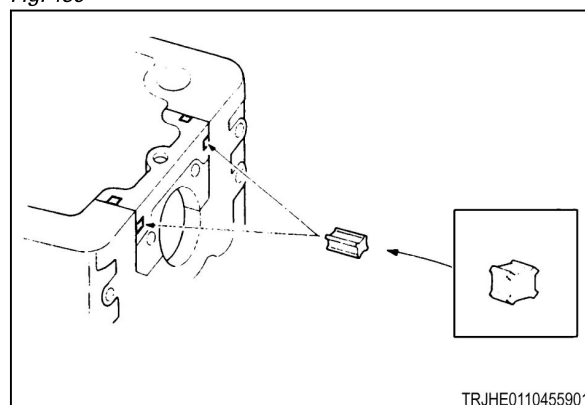
13. Use a punch to drive the bearing seal more until it depresses 0.3 mm to 0.5 mm (0.012 in to 0.02 in).  
Do not damage the end seal.
14. Fill in the gap with silicone compound.



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Fig. 135

15. Install the bearing cap seals (B). Drive in until they stop 0 mm to 0.3 mm (0 in to 0.012 in) from the cylinder block end.
16. Fill the gaps with silicone compound.



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Fig. 136

### 2.10.15 Install the piston and connecting rod

#### Procedure

1. Install bearings on the connecting rod large end and bearing cap with the bearing projections in the notches.
2. Apply engine oil to the bearing surfaces.
3. Clean the cylinder bores and crankshaft.
4. Apply oil to the cylinder bores and crankshaft.
5. Set the crankshaft at BDC.
6. Turn the front mark on the piston head to the front and make sure that the piston ring gaps are 120 degrees apart from each other.

7. Compress the piston rings with a piston ring compressor.
8. Push the piston and connecting rod assembly into the cylinder block until the connecting rod bearing is on the crankpin.

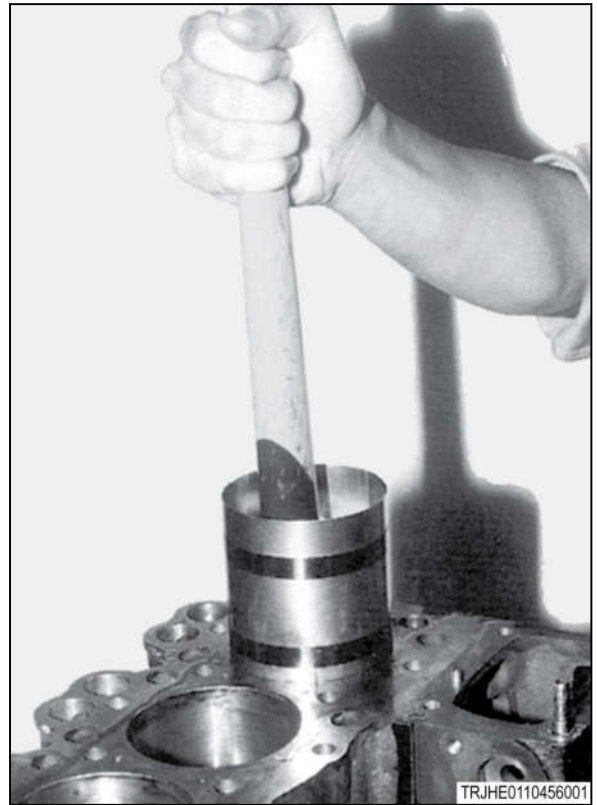


Fig. 137

9. Install the connecting rod bearing cap that has the same number as the connecting rod.



Fig. 138

10. Tighten the connecting rod bearing cap to the specified torque.

**Specified torque**

3.2 kgf m to 3.8 kgf m (23.1 lbf ft to 27.5 lbf ft)

11. Turn the crankshaft. The crankshaft must turn smoothly.
12. Install the other pistons and connecting rods.

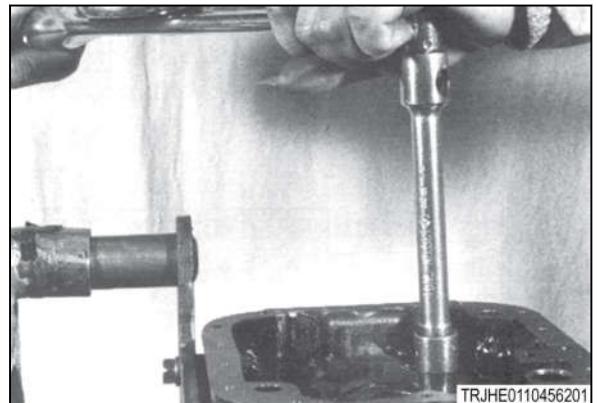


Fig. 139

### 2.10.16 Install the rear oil seal

#### Procedure

1. Apply silicone compound (Three Bond number 1215B) to the outside of the rear oil seal.
2. Drive the new seal in gradually and equally.



Fig. 140

3. Examine the rear projection of the rear oil seal.  
The rear projection must be 1.5 mm (0.059 in)
4. Make sure that the crankshaft turns smoothly.

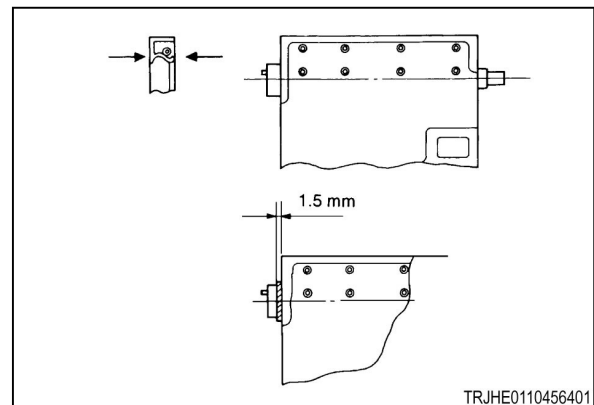


Fig. 141

### 2.10.17 Install the oil strainer

#### Procedure

1. Install the O-ring in the groove in the hold for oil strainer installation.
2. Apply engine oil to the outer surface of the strainer pipe.
3. Install the strainer pipe. Turn the strainer pipe to prevent dislocation of the O-ring.  
Do not damage the O-ring.
4. Tighten to 1.9 kgf m (13.7 lbf ft).

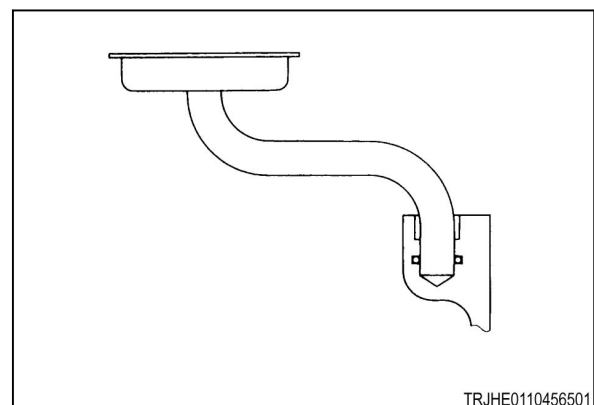


Fig. 142

### 2.10.18 Install the rear plate

#### Procedure

1. Put the rear plate on the cylinder block. Use the straight pins to align the rear plate.
2. Put Loctite® 242 on the bolts.
3. Install and tighten the bolts.

Bolt size	Torque
M10	4.1 kgf m (30 lbf ft)
M12	8.4 kgf m (61 lbf ft)

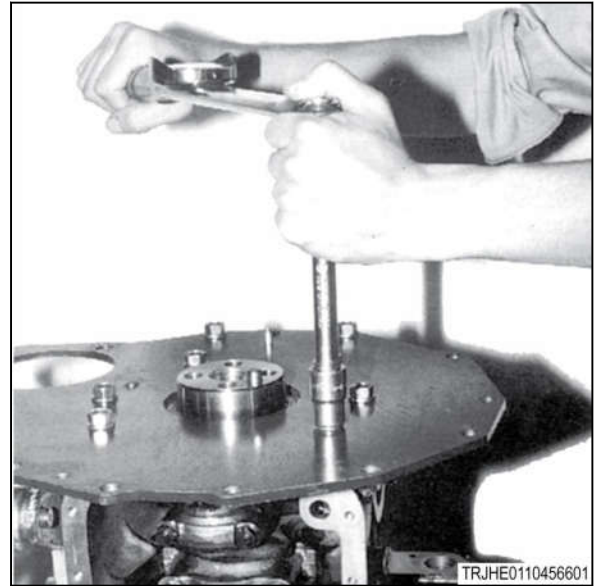


Fig. 143

### 2.10.19 Install the flywheel

#### Procedure

1. Apply engine oil to the seats and threads of the bolts for the flywheel.
2. Put the flywheel into position on the crankshaft.
3. Install and tighten the bolts.
4. Hold the flywheel and tighten the bolts to 8.5 to 10.5 kgf m (60 to 75 lbf ft).



Fig. 144

### 2.10.20 Assemble the cylinder block

#### Procedure

1. Apply silicone compound (Three Bond number 1215B) to the contact surfaces of the cylinder block and bearing cap.
2. Put the front plate into position on the cylinder block.
3. Install new packing and tighten the front plate bolts to 1.4 to 2.4 kgf m (10.1 to 17.3 lbf ft).
4. Install the key on the crankshaft.
5. Install the crankshaft gear on the crankshaft with the front mark to the front of the engine.
6. Apply engine oil to the camshaft bearing parts.
7. Install the camshaft assembly. Tighten the retainer bolts to 0.8 kgf m (6 lbf ft).
8. Assemble the pump cam and the thrust plate.  
Make note of the thrust plate direction.

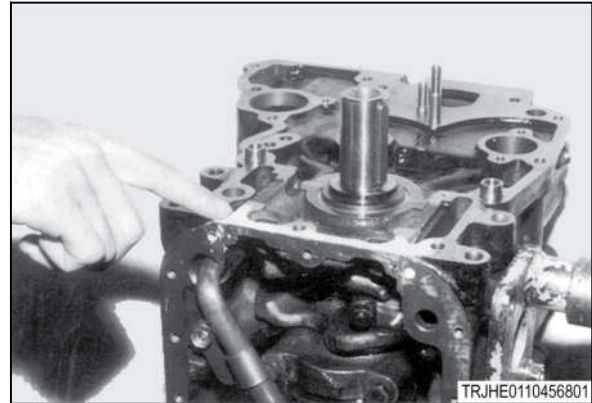


Fig. 145

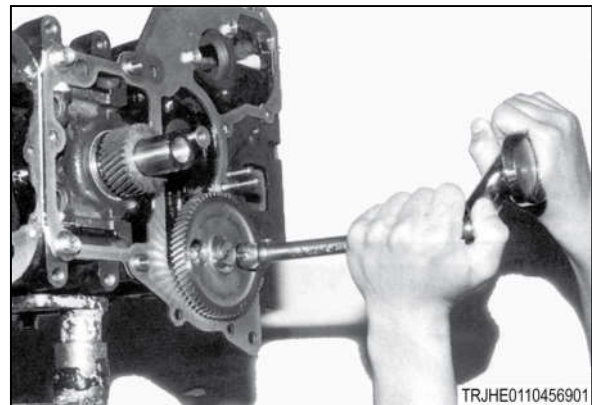


Fig. 146

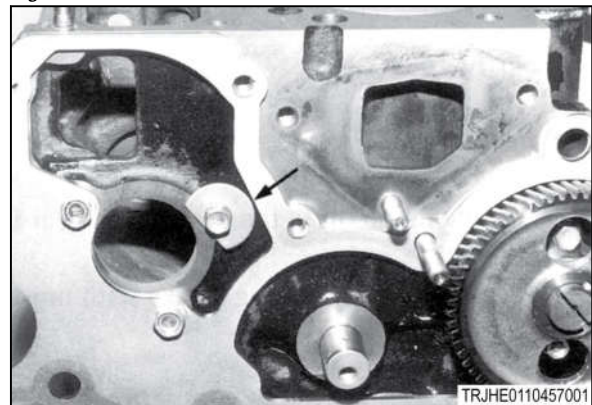


Fig. 147

9. Insert the starting spring pin (1) into the cylinder block and install the starting spring (2).  
Put the spring into the groove.

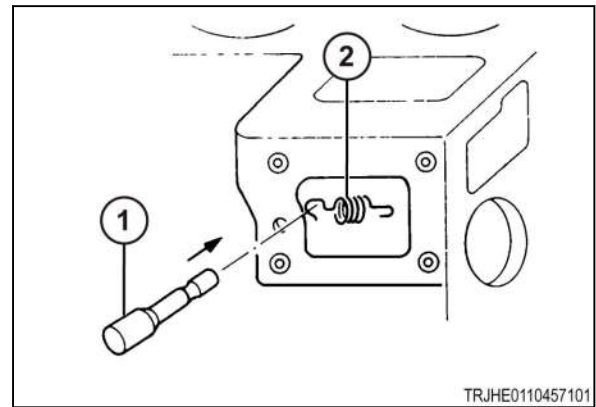


Fig. 148

10. Install the injection cam gear assembly.
11. Hold the injection pump cam shaft with the thrust plate and tighten the gear to 0.8 kgf m (6 lbf ft).
12. Apply oil to the bore of the idler gear.

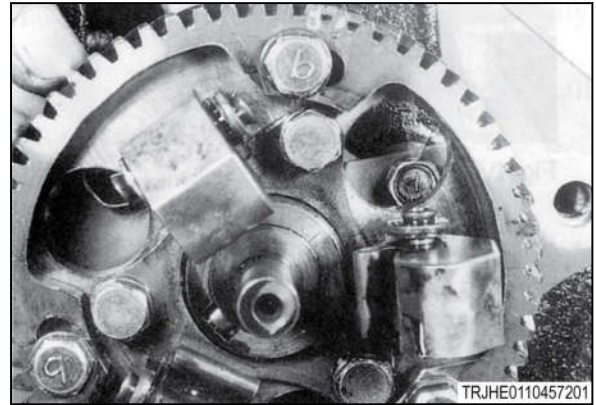


Fig. 149

13. Install the idler gear. Align the timing marks of all the gears.

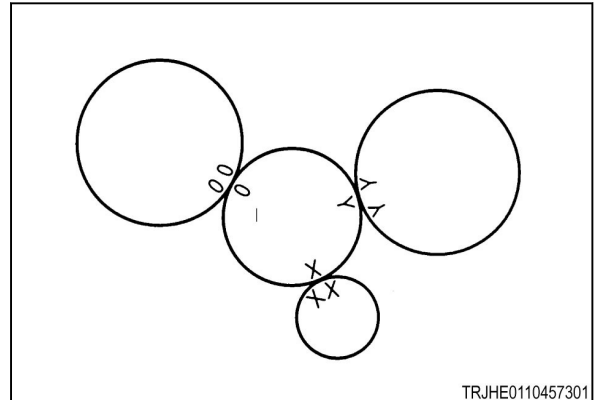


Fig. 150

14. Install the injection pump. Tighten the bolts in the sequence shown to 1.4 to 2.4 kgf m (10.1 to 17.3 lbf ft).  
Install the adjusting shims.

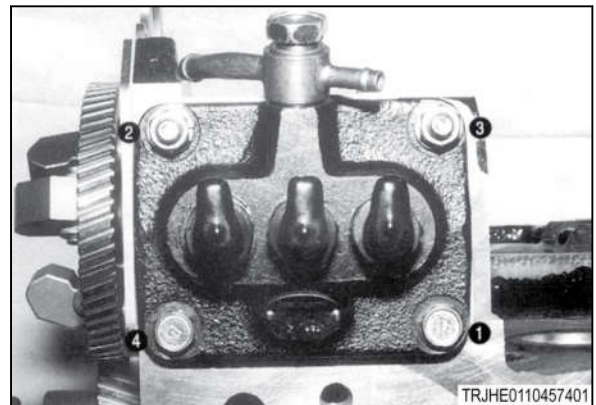


Fig. 151



15. Apply liquid gasket (Three Bonds 1207D) to the cylinder block in a 3 to 3.5 mm (0.12 to 0.14 in) bead.

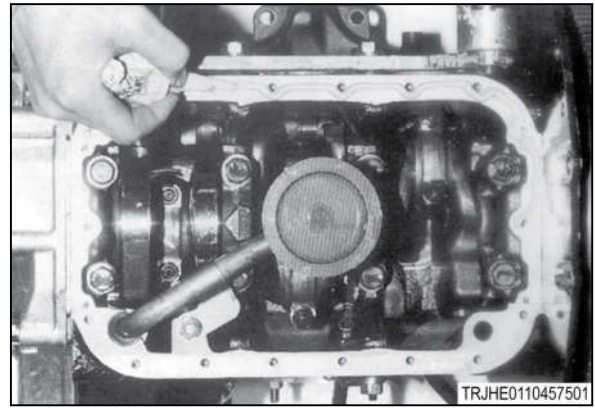


Fig. 152

16. Install the oil pan and tighten the bolts to 0.8 kgf m (6 lbf ft).  
Install the oil pan with the recess part forward.
17. Install the gear case.
18. Install the cylinder head.
19. Install the water pump spacer.

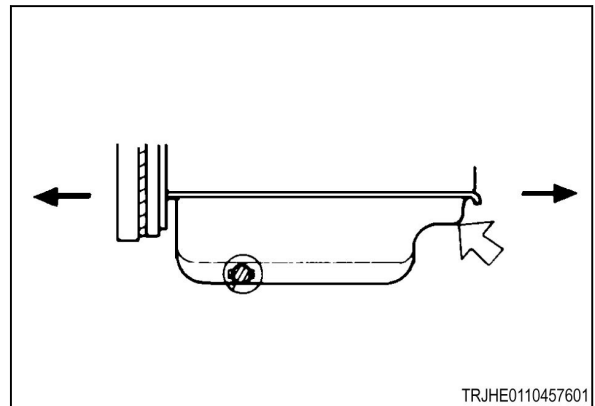


Fig. 153

20. Install the water pump with a new gasket.  
Tighten the bolts to 1.4 to 2.4 kgf m (10.1 to 17.3 lbf ft).
21. Install the water by-pass hose.
22. Install the alternator.
23. Install the fan.
24. Put the bolt on the fan pulley.
25. Install the spacer and the fan.

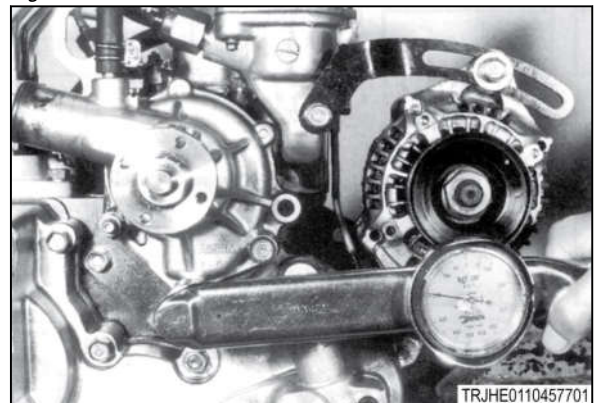


Fig. 154

## 2.11 Lubrication system

Lubrication diagram

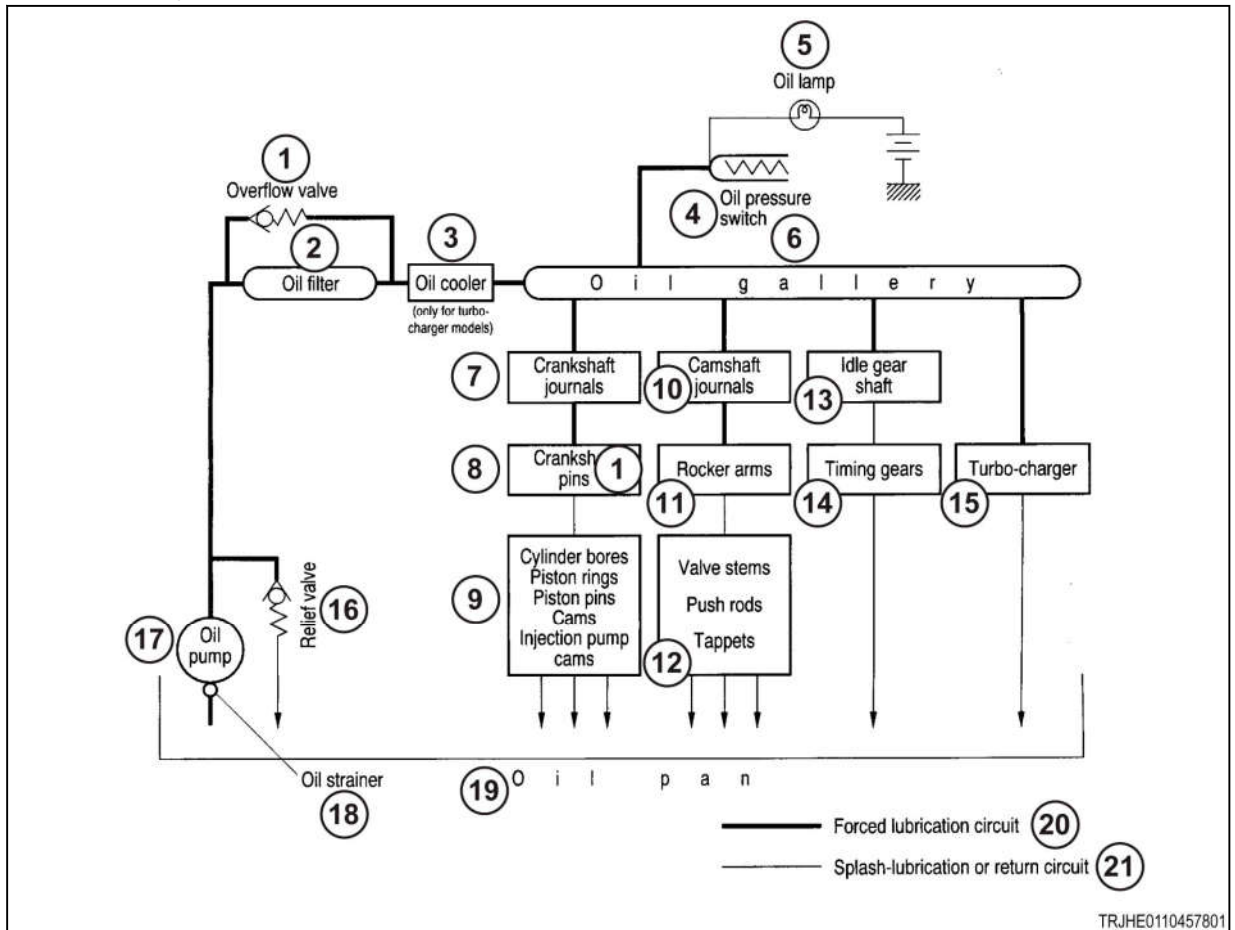


Fig. 155

- |  |   |
|--|---|
| (1) Overflow valve   | (11) Rocker arms                          |
| (2) Oil filter   | (12) Valve stems, push rods, tappets      |
| (3) Oil cooler - only for models with a turbocharger.                    | (13) Idler gear shaft                     |
| (4) Oil pressure switch  | (14) Timing gears                         |
| (5) Oil lamp   | (15) Turbocharger                         |
| (6) Oil gallery  | (16) Relief valve                         |
| (7) Crankshaft journals  | (17) Oil pump                             |
| (8) Crankshaft pins  | (18) Oil strainer                         |
| (9) Cylinder bores, piston rings, piston pins, cams, injection pump cams | (19) Oil pan                              |
| (10) Camshaft journals   | (20) Forced lubrication circuit           |
|  | (21) Splash lubrication or return circuit |

### 2.11.1 Relief valve

The lubrication oil from the oil pump must lubricate all engine parts for all engine speed ranges. A relief valve is installed to hold constant oil pressure to the oil for this purpose. Regulation pressure that is too high will cause oil leaks. Regulation pressure that is too low will lead to seizure of parts from defective lubrication.

The illustration shows the relief valve components. The relief valve is installed in the gear case. Oil released from the relief valve is sprayed in the gear case and on the gears.

Operating pressure	4.0 to 4.5 kgf/cm <sup>2</sup> (57 to 64 psi)
--------------------	---

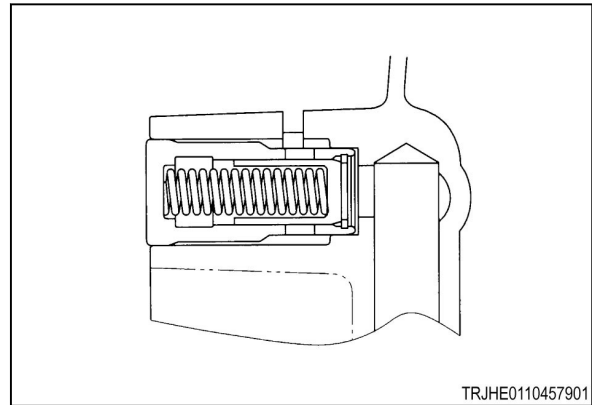


Fig. 156

### 2.11.2 Oil filter specifications

Filter type	Full flow
Filter area	70 cm <sup>2</sup>
Oil capacity	140 cc
Opening pressure of the overflow valve	0.8 to 1.2 kgf/cm <sup>2</sup> (11 to 17 psi)

### 2.11.3 Oil filter construction and operation

This filter is a cartridge type.

The oil from the oil pump flows into the relief valve which keeps the oil pressure at a constant level. Oil is then sent through the oil gallery to the outside chamber in the oil filter. The oil is cleaned by the element and goes out through the center port. From the center port, the oil flows through the oil gallery and lubricates the crankshaft journals and other engine parts.

When an element is clogged with dust, the oil in the outside chamber of the oil filter cannot pass smoothly through the element. As a result oil supply to the central port is decreased. This can lead to seizure of engine parts from unsatisfactory lubrication. To prevent seizure from unsatisfactory lubrication, the overflow valve opens and bypasses the filter element. This supplies oil to the engine.

Replace the oil filter after every 300 hours of operation.

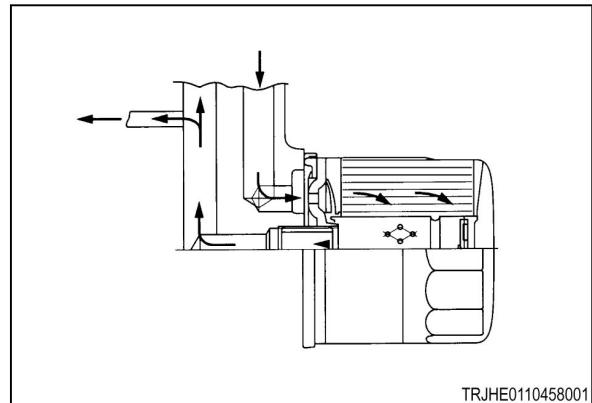


Fig. 157

### 2.11.4 Oil cooler specifications

The oil cooler is only on engines with a turbocharger.

The oil cooler is a multi disk type that is cooled by water. The oil cooler is located between the engine block and the oil filter.

Heat radiating capacity	3200 kcal/hr
Core type	Water cooled, multi disk type
Core dimensions	83 mm (3.27 in) by 7 mm (0.276 in)

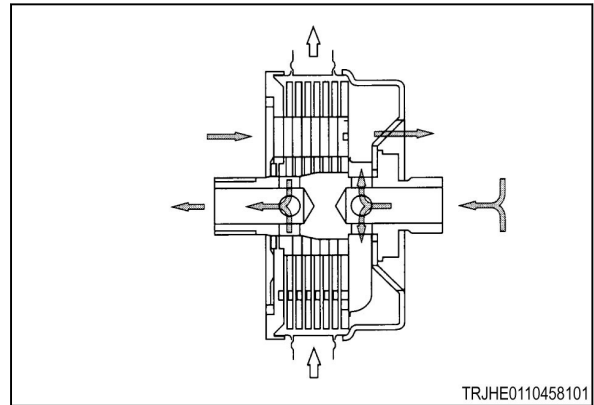


Fig. 158

### 2.11.5 Oil Pump

Exploded view of oil pump.

- (1) Pump housing
- (2) Outer rotor
- (3) Inner rotor
- (4) Shaft
- (5) Cover
- (6) Cover
- (7) Drive gear
- (8) Bolts
- (9) Pins

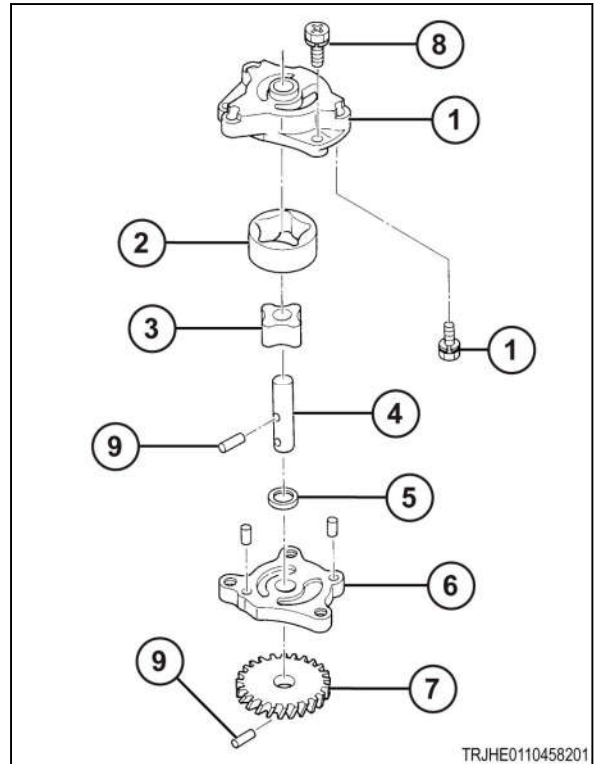


Fig. 159

### 2.11.6 Remove the oil pump

#### Procedure

1. Drain the oil.

2. Remove the gear case.
3. Remove the oil pump.
4. Remove the oil cover bolts.
5. Remove the cover, inner rotor, and outer rotor.

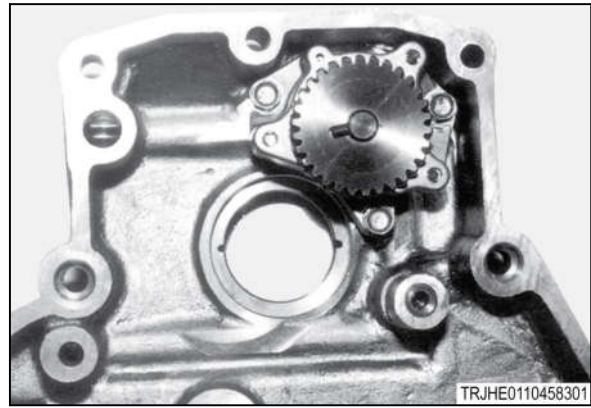


Fig. 160

### 2.11.7 Examine the oil pump

If the inner rotor or outer rotor is worn or damaged, replace the pump assembly.

#### Procedure

1. Remove the oil pump gear and cover.
2. Measure the clearance of the inner and outer rotor with the cover.

	Standard value	Usable limit
Clearance	0.03-0.07 mm (0.008-0.0028 in)	0.15 mm (0.0059 in)

If the clearance is more than the usable limit, replace the pump assembly.

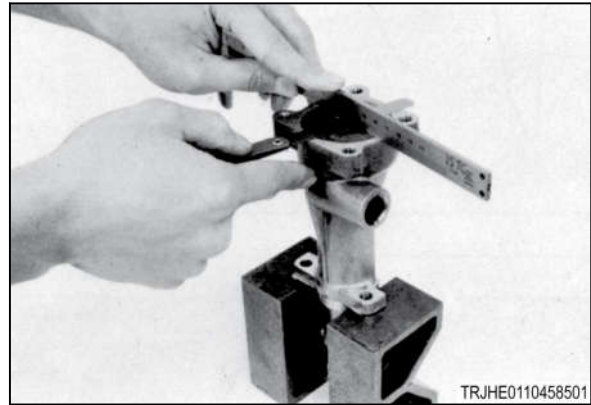


Fig. 161

3. Measure the clearance between the inner rotor and outer rotor.

Standard value	0.14 mm (0.005 in) or less
----------------	----------------------------

If the clearance is more than the usable limit, replace the pump assembly.

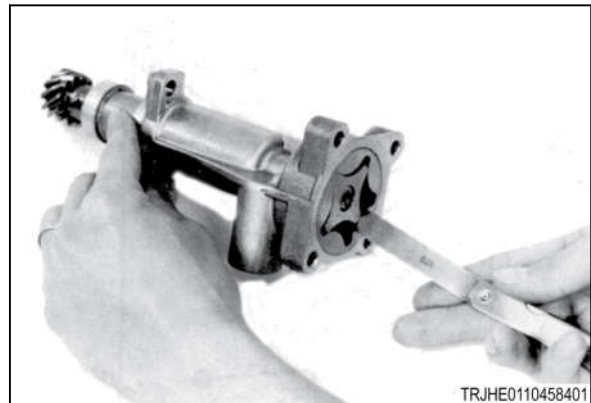


Fig. 162

4. Measure the clearance between the pump body and outer rotor with thickness gauges.

	Standard value	Usable limit value
Clearance	0.04 mm (0.0016 in)	0.2 mm (0.008 in)

If the clearance is more than the usable limit, replace the pump assembly.

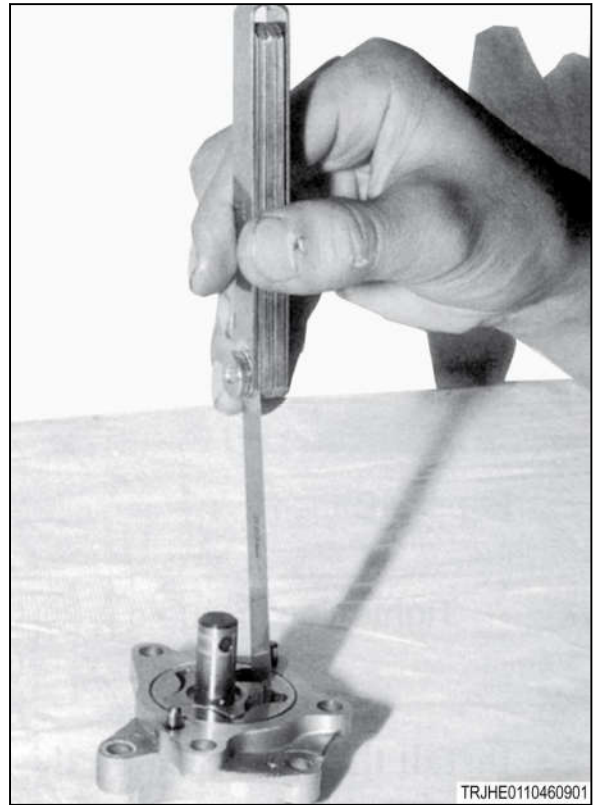


Fig. 163

### 2.11.8 Install the oil pump

#### Procedure

1. Put a small quantity of engine oil in the oil pump and in the oil passage in the gear case.
2. Install the pump into the gear case.  
Tighten the bolts to 0.06 to 1.0 kgf m (5 to 7 lbf ft).
3. Install the gear case on the cylinder block.

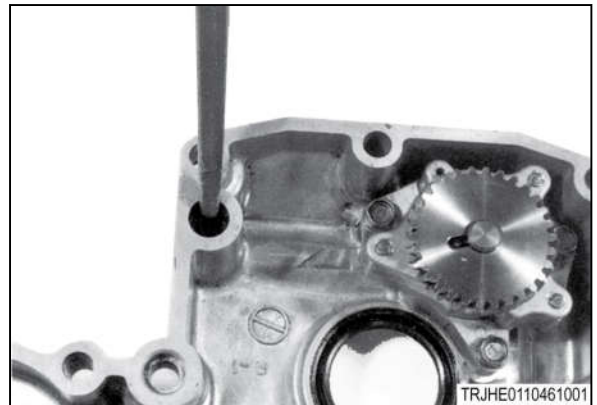


Fig. 164

## 2.11.9 Replace the engine oil filter

### Procedure

1. Remove the engine oil filter (1) from the engine and discard.
2. Make sure the original filter gasket has been removed.
3. Lubricate the new gasket on the replacement element with clean engine oil.
4. Install a new oil filter until the gasket contacts the adapter.
5. Tighten the oil filter 2/3 turn.
6. Add engine oil to the engine.
7. Clean any spilled oil.
8. Start the engine and examine for leaks.
9. Examine the engine oil level and add oil as required

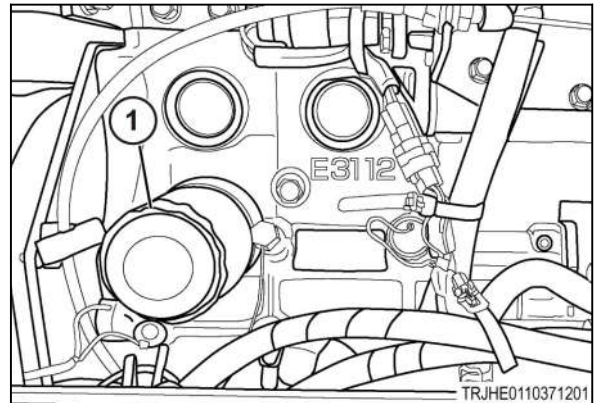


Fig. 165

### Related Links

[Capacities](#) page 1-26

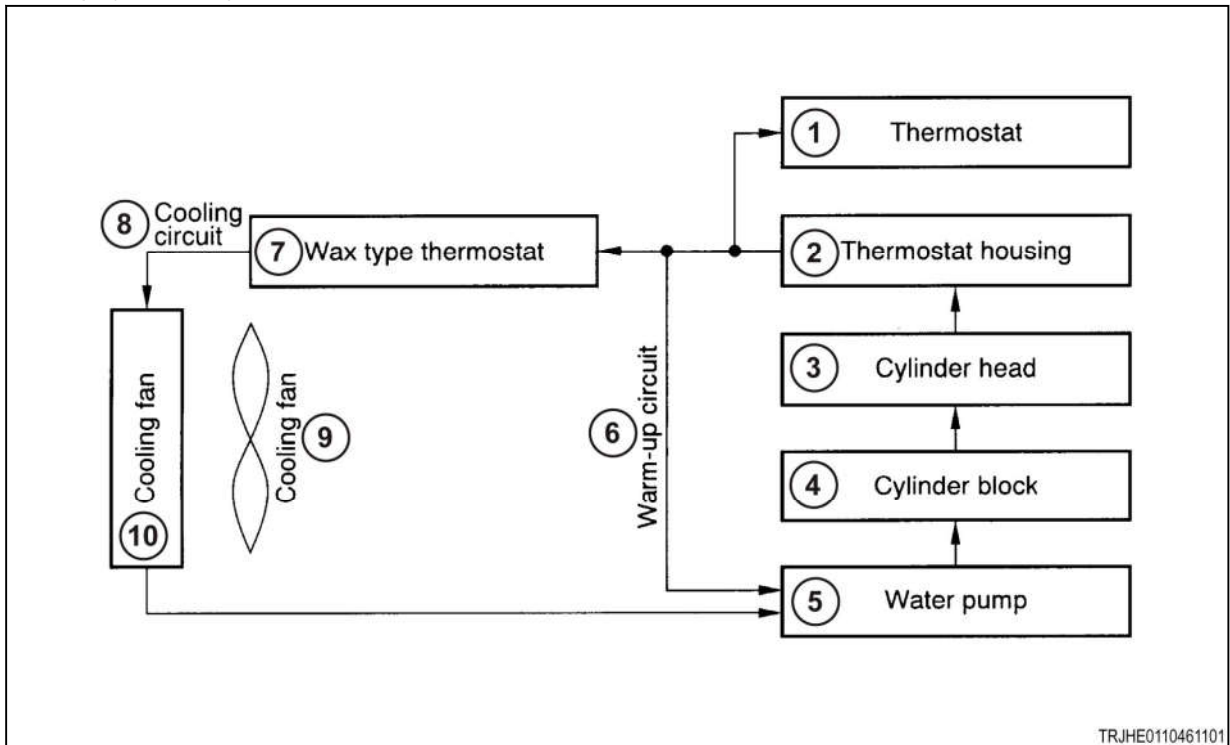
[Lubrication fill and drain locations](#) page 1-36

[Lubrication specifications](#) page 1-26

[Lubrication and maintenance chart](#) page 1-34

## 2.12 Cooling system

Cooling system diagram



TRJHE0110461101

Fig. 166

- |                        |                         |
|------------------------|-------------------------|
| (1) Thermostat         | (6) Warm-up circuit     |
| (2) Thermostat housing | (7) Wax type thermostat |
| (3) Cylinder head      | (8) Cooling circuit     |
| (4) Cylinder block     | (9) Cooling fan         |
| (5) Water pump         | (10) Cooling fan        |

This section only gives procedures for the thermostat and the water pump, which are directly installed on the engine.

### 2.12.1 Remove the thermostat

#### Procedure

1. Drain the coolant.
2. Remove the radiator hoses.
3. Remove the water outlet.
4. Remove the thermostat.

### 2.12.2 Install the thermostat

#### Procedure

1. Install the thermostat with a new O-ring.
2. Install the water outlet.  
Tighten the bolts to 1.4 to 2.4 kgf m (10 to 18 lbf ft).



3. Install the radiator hoses.
4. Fill the coolant.

---

### 2.12.3 Examine the thermostat

---

Find the temperatures when the thermostat:

- starts to open
- opens fully.

The valve reaction to temperature change can an interval of three to five minutes.

#### Procedure

1. Put the thermostat in a container of water.  
Do not heat the thermostat directly. Put something below the thermostat or hang the thermostat in the water.
2. Heat the water gradually. Stir the water.
3. Make a note of the temperature when the thermostat starts to open and when the thermostat opens fully.  
Replace the thermostat when the specified temperatures are different from specified values.

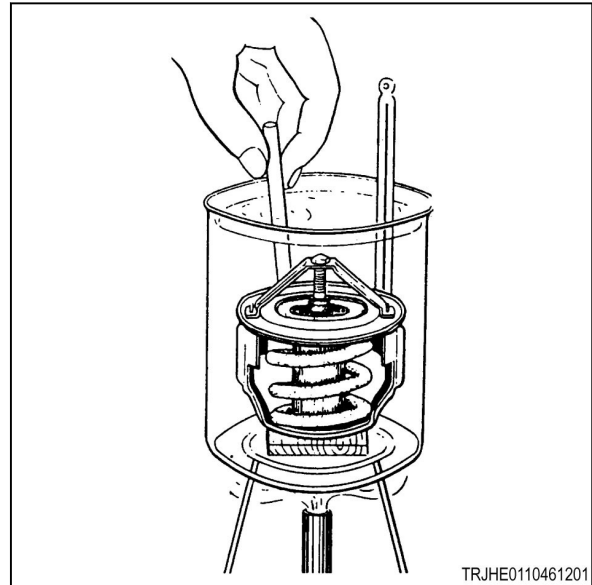


Fig. 167

---

### 2.12.4 Remove the water pump

---

#### Procedure

1. Drain the coolant.
2. Remove the cooling fan, belt, and pulley.
3. Remove the water by-pass hose.
4. Remove the water pump.
5. Remove the water pump spacer.

---

### 2.12.5 Install the water pump

---

#### Procedure

1. Install the water pump spacer with a new gasket.

2. Install the water pump with a new gasket.  
Tighten the bolts to 1.4 to 2.4 kgf m (10 to 18 lbf ft).
3. Install the water by-pass hose.
4. Install the cooling fan, belt, and pulley.
5. Fill the coolant.

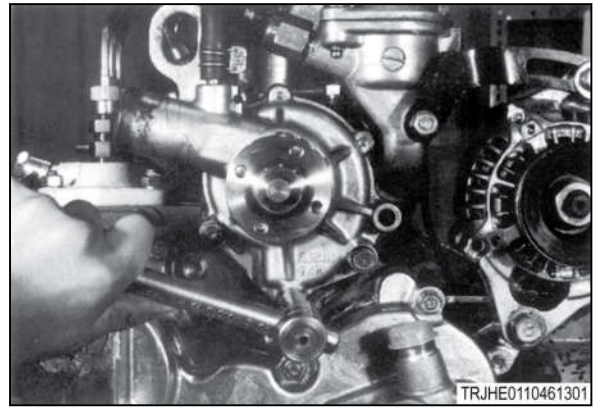


Fig. 168

### 2.12.6 Examine the water pump

#### Procedure

1. Turn the water pump pulley. Apply a load vertically to the pump axis.  
If noise or roughness occurs, replace the pump assembly.
2. Examine the bearing unit for run-out.  
If the run-out is more than 0.2 mm (0.008 in), replace the pump assembly.



Fig. 169

## 2.13 Fuel system

### 2.13.1 Injection pump

Injection pump components

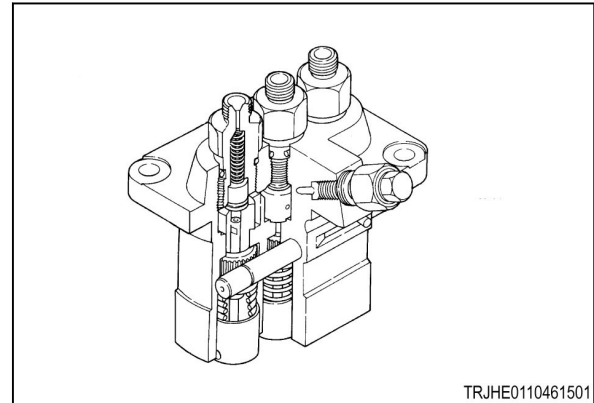


Fig. 170

#### Specifications

Pump type	ND-PFR3M
Pre-stroke	1.85 to 1.95 mm (0.073 to 0.078 in)* [with rack at 8 mm (0.3 in)]
Plunger lift	7 mm (0.28 in)
Rack stroke	16 mm (0.63 in)
Permitted maximum speed	$N_p = 2200$ rpm

#### 2.13.1.1 Remove the injection pump

##### Procedure

1. Remove the injection pipes.
2. Open the injection pump side cover and remove the control rack and starting spring and control link.
3. Remove the bolts.

#### 2.13.1.2 Disassemble the injection pump

##### Procedure

1. Remove the delivery holder.
2. Remove the valve spring and delivery valve with a tweezer.  
Do not use a magnet.
3. Discard the removed O-rings.

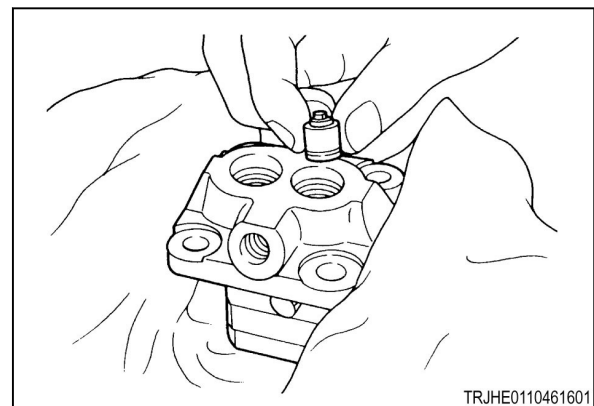


Fig. 171

4. Clean the delivery valve in clean fuel.
5. While the delivery valve is wet, close the opening with a finger and pull up the valve. Release the valve midway.  
The delivery valve is good if the valve comes down smoothly without hesitation and stops at the relief valve.

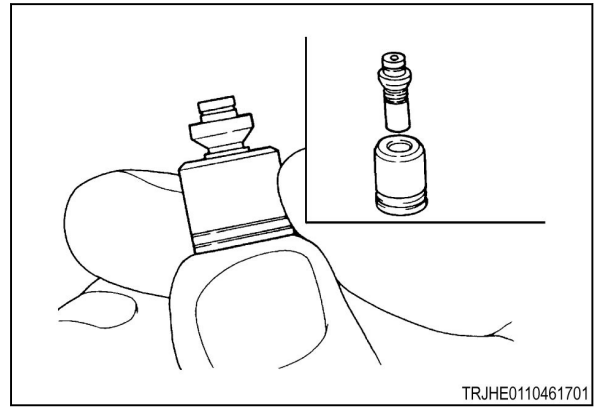


Fig. 172

### 2.13.1.3 Assemble the injection pump

#### Procedure

1. Install the delivery valve, valve gasket, valve spring, and O-ring. Temporarily tighten the delivery holder.  
Do not damage the O-ring by other parts such as the threads of the valve holder.

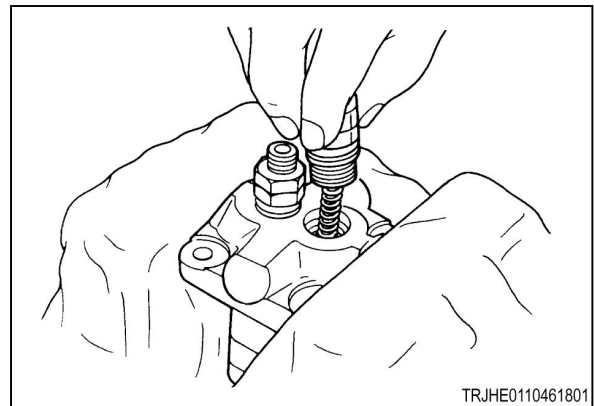


Fig. 173

2. Tighten the delivery holders to 4.0 to 4.5 kgf m (28.9 to 32.5 lbf ft).  
Tighten to the specified value. Too much torque can cause seized plungers.

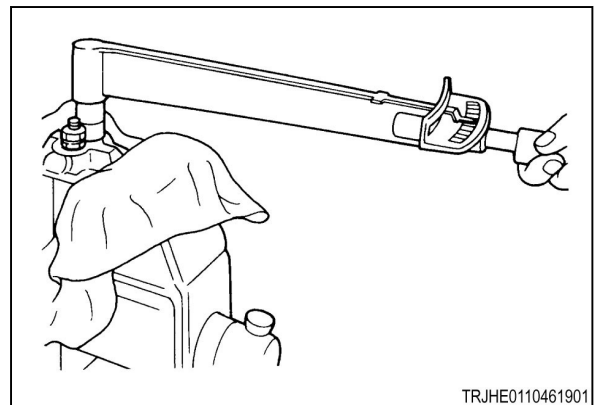


Fig. 174

3. Make sure that the control rack moves smoothly.

Possible cause of movement that is not smooth:

- Defective plunger-rack movement
- Contamination caught in teeth of the control rack or control sleeves
- Delivery holders too tight

If necessary, disassemble and inspect the pump again.

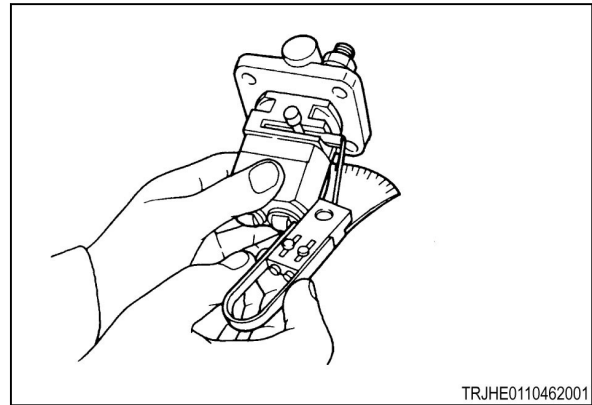


Fig. 175

## 2.13.2 Injection nozzles and holders

### 2.13.2.1 Remove the injection nozzles and holders

#### Procedure

1. Remove the injection pipes and leak-off pipes.
2. Put caps on the delivery holders, nozzles, and injection pipes.
3. Loosen the nuts with a 22 mm wrench.

**IMPORTANT:** Do not loosen the 19 mm holder body. If removed, the holder will be disassembled.



Fig. 176

### 2.13.2.2 Clean the injection nozzle

#### Procedure

1. Clean the nozzle in clean gasoline.
2. Clean the nozzle again with clean diesel fuel before assembly.
3. If the nozzle is seized, soak the nozzle in carbon cleaning liquid.  
Clean the nozzle again in clean diesel fuel.

### 2.13.2.3 Injection nozzle replacement

Replace the assembly of the needle valve and nozzle body. Before you install a new nozzle, move the needle valve sufficiently in the nozzle body in clean diesel fuel at 50 to 60 degrees C (122 to 140 degrees F) to remove the anti-crosswise.

### 2.13.2.4 Examine the needle valve

#### Procedure

1. Move the needle valve in and out of the nozzle body several times in clean diesel fuel to make sure the movement is smooth.
2. Tilt the nozzle body by about 60 degrees, pull out the needle valve by about one-third of its length, and release.

Do three tests with the needle valve turned by 120 degrees at each test.

The needle valve must go back smoothly.

If the needle valve does not move smoothly, replace the assembly of the needle valve and nozzle holder.

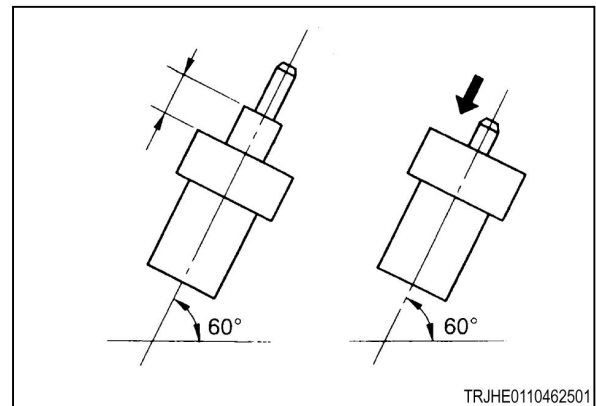


Fig. 177

### 2.13.2.5 Install the injection nozzles and holders

#### Procedure

1. Clean all parts in clean diesel fuel or cleansing oil.
2. Put the adjustment shim, spring, pressure pin, and distance piece on the nozzle holder body in this order.
3. Install the nozzle assembly and hold with the retainer nut.  
Make note of the installation direction of the pressure pin and distance piece.
4. Hold the nozzle holder body in a vise and tighten the retainer nut to 3.5 to 4 kgf m (25 to 28 lbf ft).  
Incorrect torque will cause fuel leakage or nozzle seizure.
5. Remove the assembly from the vise.
6. Install a new washer, the sealing ring, and nut.  
Make sure that you discard the removed washer and install a new washer.
7. Test each assembly on a nozzle tester for spray and valve-opening pressure.  
If necessary, adjust the valve-opening pressure with shims.
8. Install the nozzle gasket into the head.
9. Install the retaining nut by hand.
10. Tighten the retaining nut to 4 to 5 kgf m (30 to 36 lbf ft) with a 21 mm wrench.  
If an air wrench is used, tighten as slowly as possible.  
Do not touch the nozzle body with a wrench. This can cause fuel leaks.
11. Install the sealing ring and tighten the joint nut to 2 to 2.5 kgf m (14 to 18 lbf ft).
12. Install the injection pipe and leak-off pipe.  
Tighten to 2.5 kgf m (18 lbf ft) or less.

### 2.13.3 Governor

#### Govenor components

Flyweights are installed on the injection pump cam gear and turn along with the injection pump camshaft.

A thrust piece is installed on the camshaft and can move along the shaft.

A tension arm and a floating arm are installed to turn on a pin.

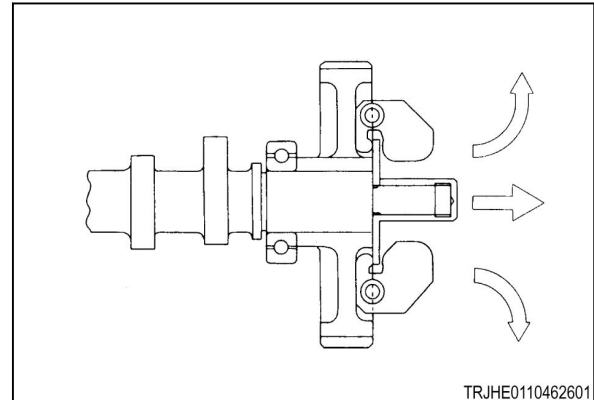


Fig. 178

The center piece is cast in the center of the floating arm and touches the thrust piece which moves as the injection pump camshaft turns.

The floating arm end is connected with a pin to control link, which is connected with control rack of injection pump.

The tension arm end is connected with the governor spring, which is connected with a control arm. The control arm is connected with a control lever.

The Angleichung (adaptation) device is installed in the tension arm. The Angleichung pin end touches the control link pin, which is connected with the control lever.

The starting spring is installed on control link.

The return spring is installed on control lever. Two adjustment screws limit the movement.

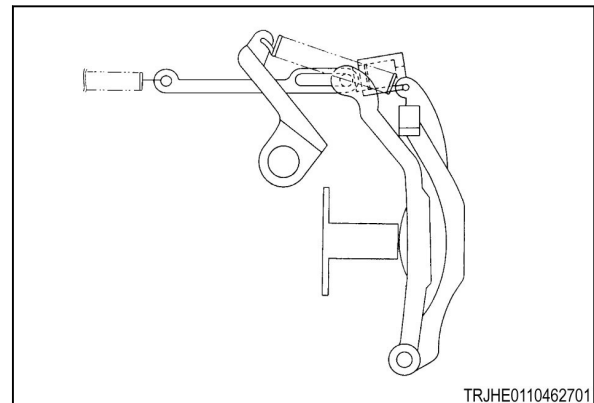


Fig. 179

#### Govenor operation

The control lever is released in the engine starting position and is set in the idle position by the return spring. In this state no centrifugal force is applied to the governor, The control rack of the injection pump is moved by the starting spring to the position for increased fuel supply.

When the engine is started, the governor controls engine speed automatically. When engine speed is more than the set value, the thrust plate moves by centrifugal force of the flyweights. This moves the control rack to decrease the fuel supply. When engine speed is below the set value, the force of the governor spring and starting spring is more than the centrifugal force and the thrust piece is pushed back. The control rack is moved to increase fuel and increase engine speed. Engine speed is held at a constant level.

When the control lever is set in the full load position, tension of the tension spring is increased and the tension arm touches with the full load stop. The floating arm, control link, and control rod work to control the fuel supply to keep the engine speed below the maximum engine speed. Full-load, maximum speed operation is possible. When the load is removed during operation, the engine speed increases, This leads to increased centrifugal force of the flyweights. Then the thrust piece pushes the floating arm and the control rod is moved to decrease fuel.

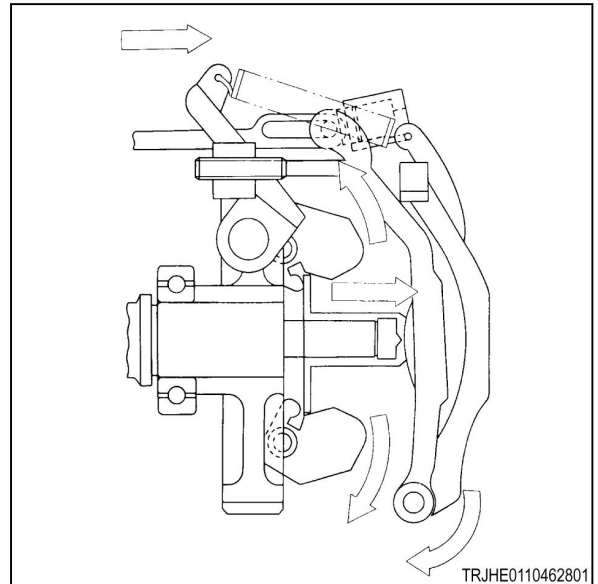


Fig. 180

### 2.13.4 Angleichung device

The Angleichung device gives:

- Average ratio of intake air and fuel injection volume
- Increased torque at low speeds

The Angleichung device is installed on the tension arm. It touches the floating arm pin and the control link.

When the full-load stop touches the tension arm and centrifugal force of the flyweights is weaker than force of the Angleichung spring during full-load, low speed operation, the spring pushes the thrust piece. This moves the control rack to increase fuel supply and gives more torque.

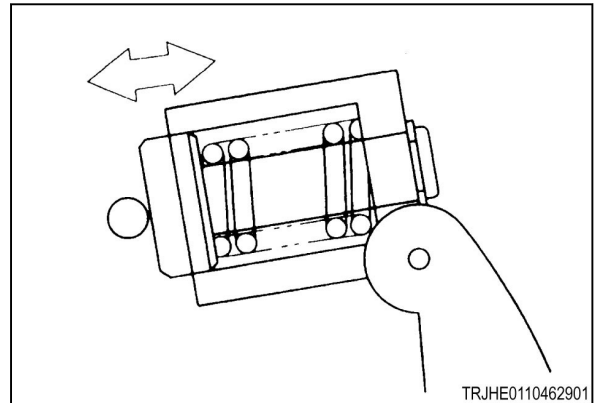


Fig. 181



## 2. Engine, Fuel, and Exhaust System



When engine load is released, engine speed increases. The centrifugal force increases, which pushes out the thrust piece. The thrust piece pushes the float arm, which results in compression of the Angleichung spring, which makes the control rod move to decrease fuel supply. The Angleichung operation is completed when the control link and control rod touch each other because of the complete compression of the spring.

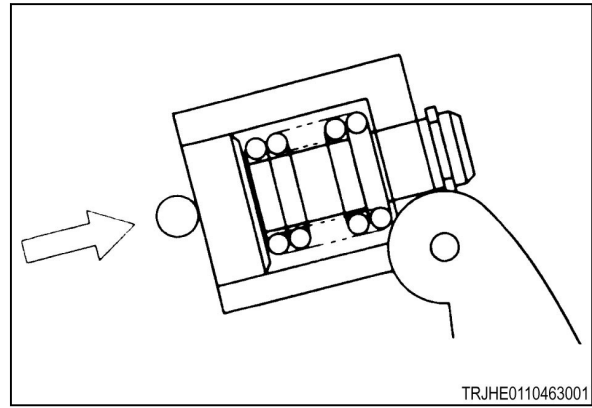


Fig. 182

## 2.14 Electrical system

### 2.14.1 Starter

#### Components

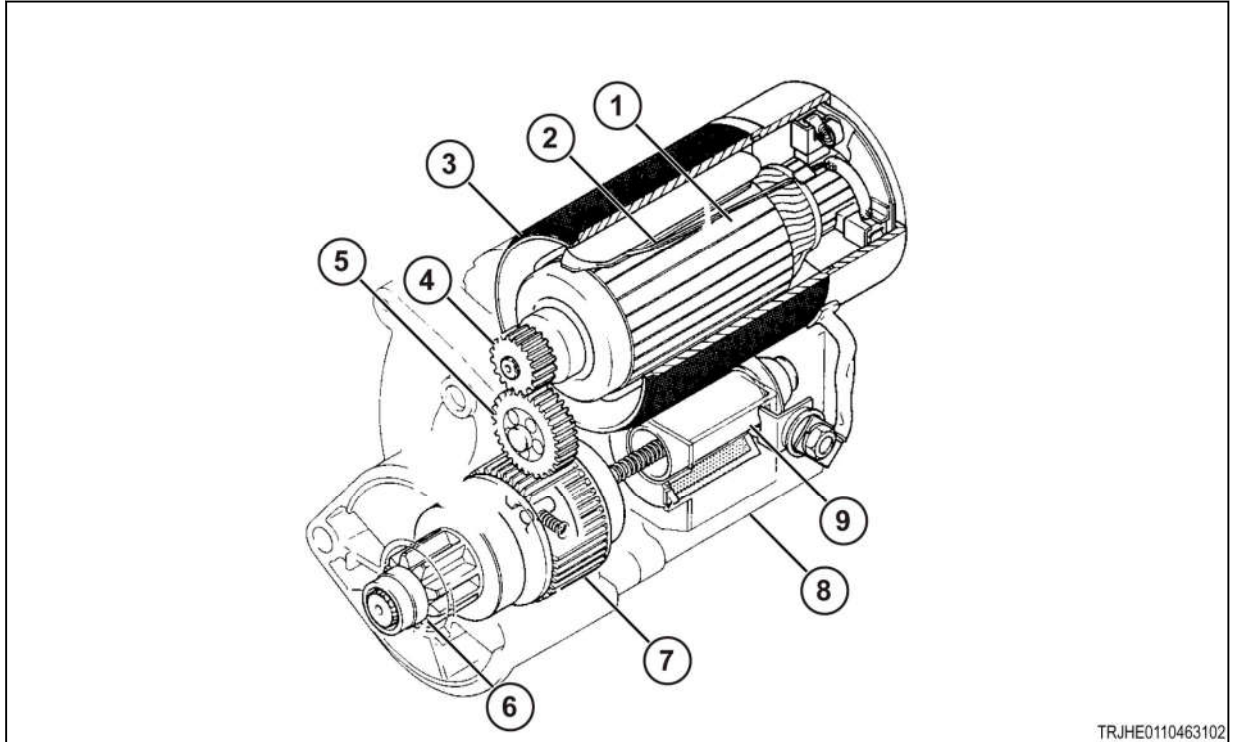


Fig. 183

- (1) Armature
- (2) Field coil
- (3) Yoke
- (4) Drive gear
- (5) Idler gear
- (6) Pinion gear
- (7) Over-run clutch
- (8) Magnetic switch
- (9) Plunger
- (10) Brush
- (11) Brush spring

#### Specifications

	E3CF, E3CD
Nominal voltage	12v
Nominal output	1.4 kW
Pinion teeth	9
Direction of rotation	Clockwise (from pinion)

### 2.14.1.1 Remove the starter

#### Procedure

1. Remove the negative (-) battery cable.
2. Remove the starter wiring.
3. Remove the nut and disconnect the wire harness from terminal 30 battery lead.
4. Remove the connector from terminal 50 (solenoid lead).
5. Remove the starter from the engine.

### 2.14.1.2 Disassemble the starter

#### Procedure

1. Remove the lead from terminal (C).

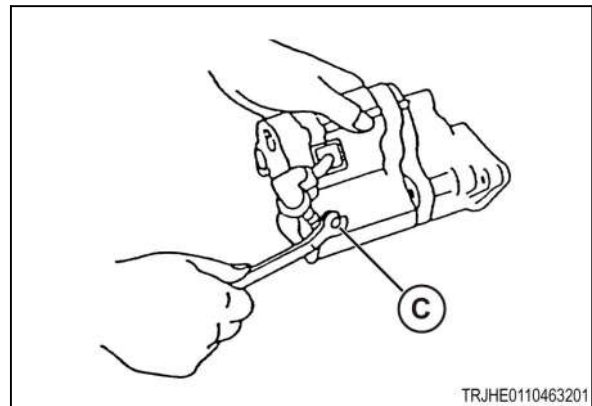


Fig. 184

2. Remove the two through bolts.
3. Remove the starter yoke/amature assembly and O-ring.
4. Remove the commutator end frame and O-ring.

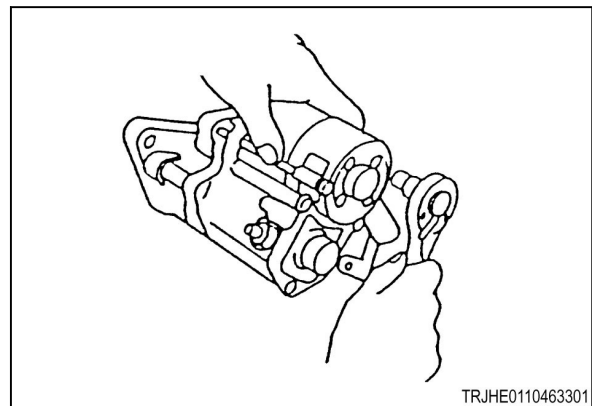


Fig. 185

5. Disconnect the starter housing from the magnetic switch.
6. Remove the drive pinion.
7. Remove the idler gear and retainer with roller.
8. Remove the clutch assembly from the magnetic switch.

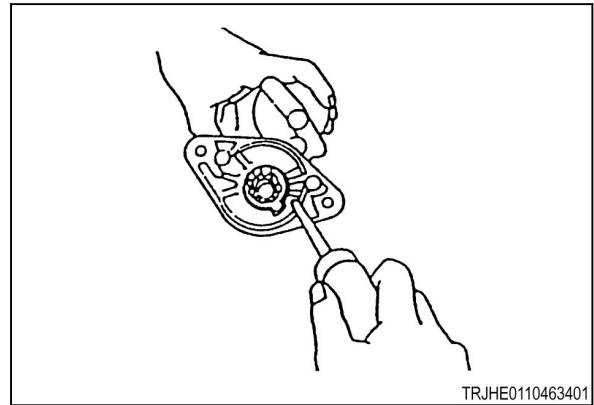


Fig. 186

9. Remove the steel ball and spring.

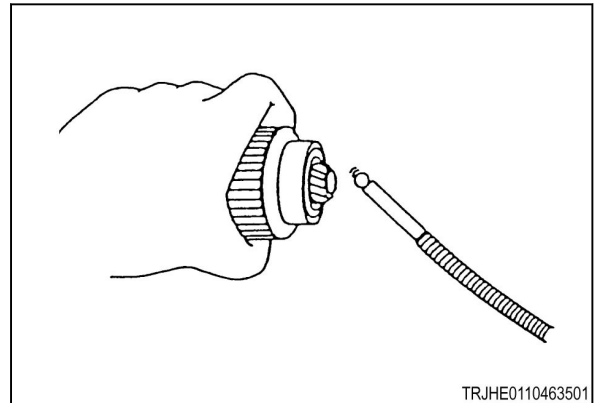


Fig. 187

10. Remove the brush spring and remove the brush.
11. Disconnect the brush holder from the starter yoke.
12. Remove the armature from the starter yoke.

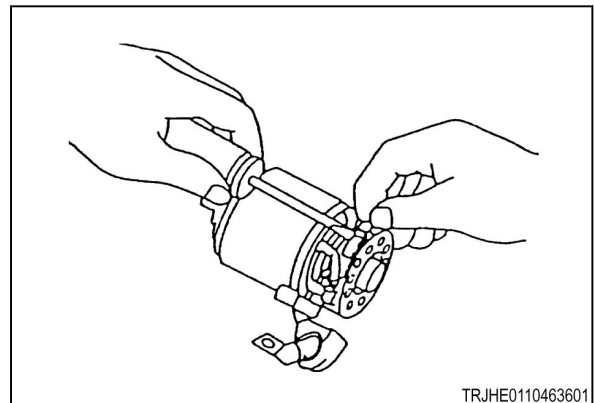


Fig. 188

### 2.14.1.3 Examine starter components

#### Armature coil ground test

1. Examine for continuity across the commutator and an armature coil core.  
If there is no continuity, the armature coil is correct.

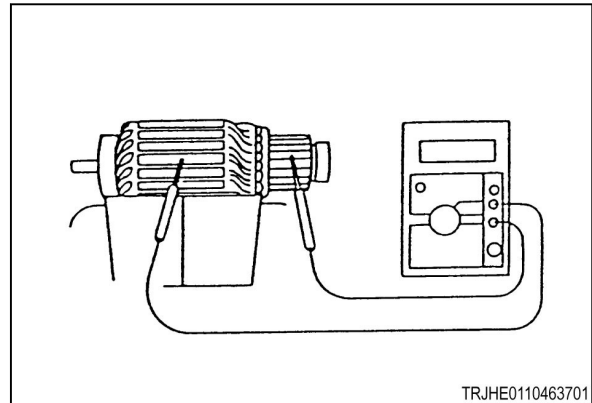
#### Armature coil short circuit test

2. Clean the coil surfaces of the armature.
3. Turn the armature coil on an armature coil tester. Hold a piece of iron close above the armature.  
If the iron does not vibrate or is not attracted to the armature, the armature is correct.

#### Commutator inspection

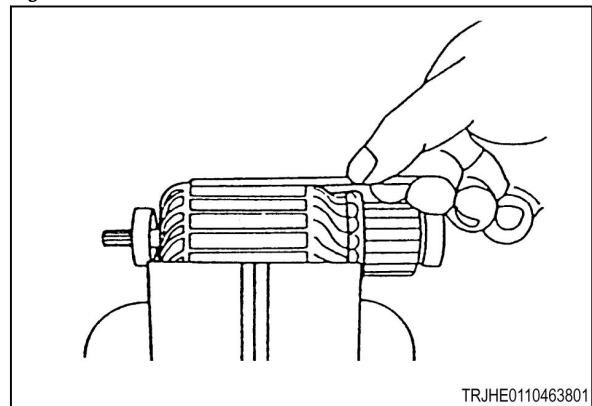
4. Examine the commutator surfaces for dirt, burning, or other damage.  
If necessary, correct light damage with number 400 sandpaper or higher.
5. Examine the commutator for run-out with a dial gauge on a V-block.

Standard value	Usable limit
0.02 mm (0.00079 in)	0.05 mm (0.0020 in)



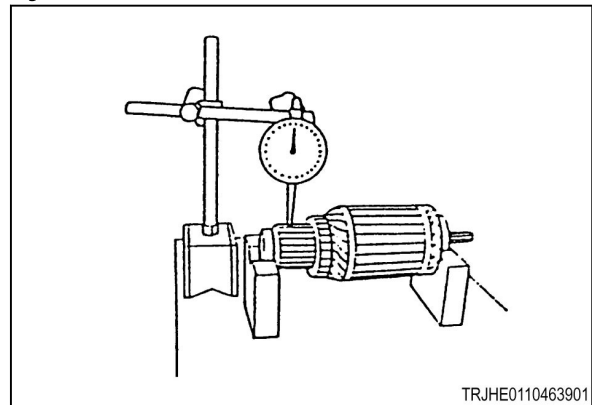
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Fig. 189



TRJHE0110463801

Fig. 190



TRJHE0110463901

Fig. 191

6. Measure the commutator diameter with vernier calipers.

Standard value	Usable limit
30 mm (1.181 in)	29 mm (1.142 in)

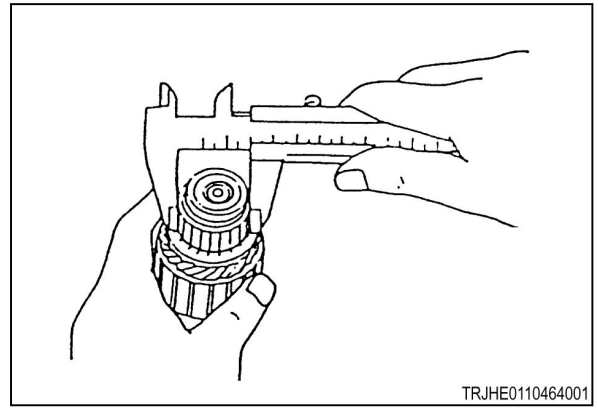


Fig. 192

7. Measure the mica depth against the segment top.

Standard value	Usable limit
0.5 to 0.8 mm (0.196 to 0.315 in)	0.2 mm (0.0078 in)

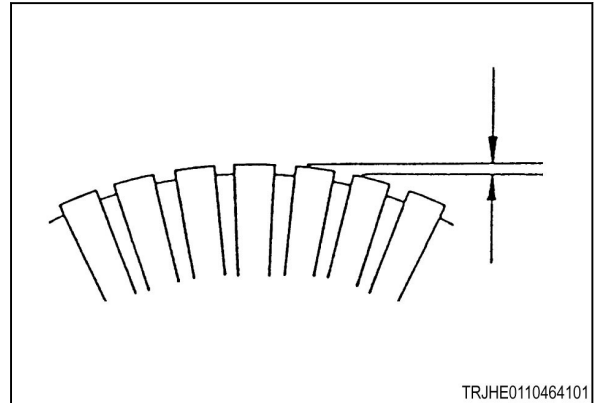


Fig. 193

**Field coil short circuit test**

8. Inspect for continuity across the lead from terminal C and field coil brush.  
If there is continuity, the coils are correct.

**Field coil ground test**

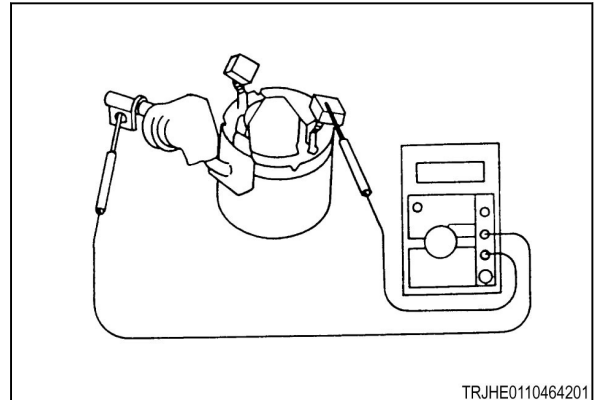


Fig. 194

9. Inspect continuity across the field coil brush and field coil.  
If there is no continuity, the coils are correct.

**Brushes**

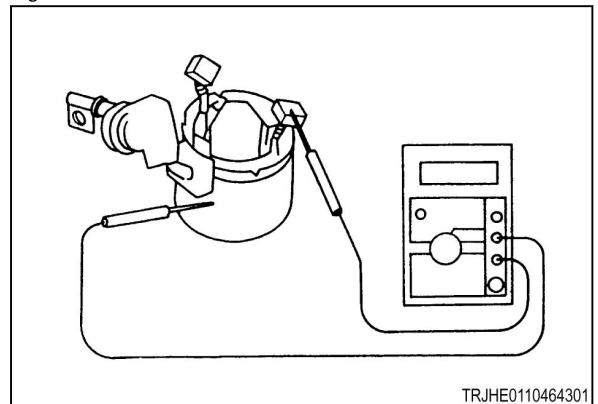


Fig. 195

10. Measure the brush length in the middle.

Standard value	Usable limit
15 mm (0.590 in)	10.0 mm (0.394 in)

11. Correct the contact surfaces of the brushes with sandpaper wrapped around the commutator.

**Brush spring tension**

12. Measure spring tension with a spring balance. Read the balance at the moment when the spring is about to leave the brush.

Standard value	Usable limit
1785 to 2415 g (4 to 5.3 lb)	1200 g (2.6 lb)

**Brush holder**

13. Inspect for insulation across positive (+) side and negative (-) side of the brush holder.  
If there is no continuity, the brush holders are correct.

**Clutch**

14. Inspect the gear for wear and damage.  
15. Make sure that the gear locks when turned in drive direction and turns smoothly in the other direction.

**Bearing**

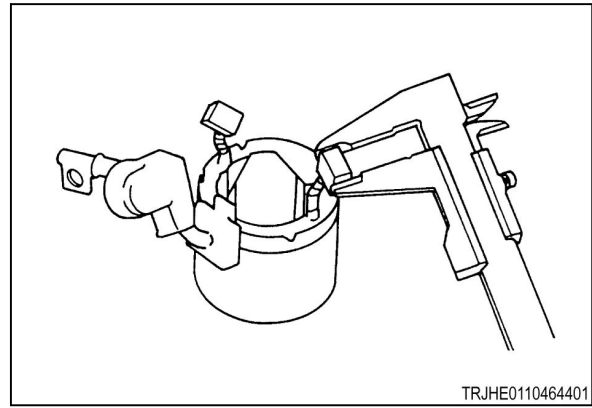


Fig. 196

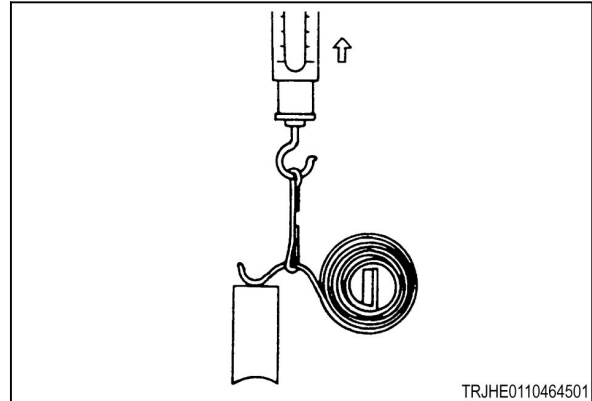


Fig. 197

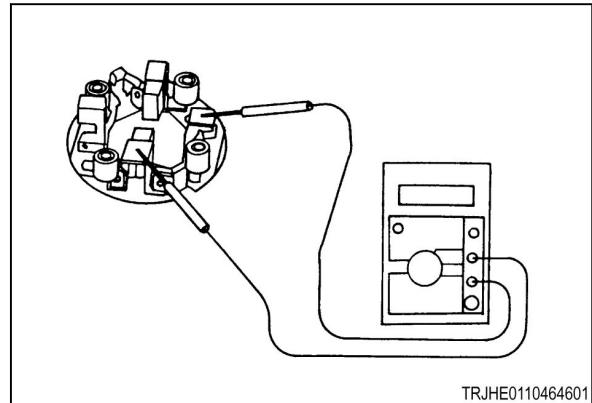


Fig. 198

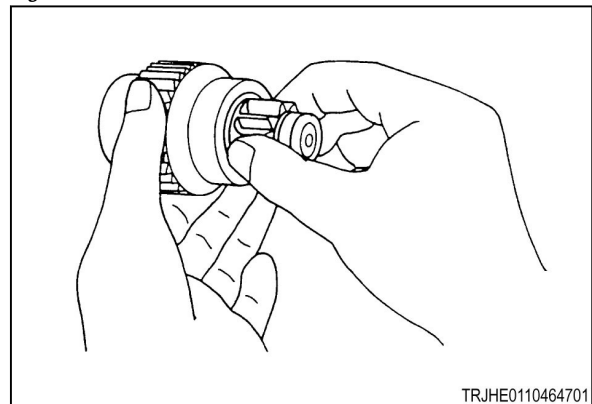


Fig. 199

- 16.** Examine the bearing for noise and rough operation. Apply force to the bearing with your fingers.

Replace a bearing that is rough or makes noise when turned quickly.

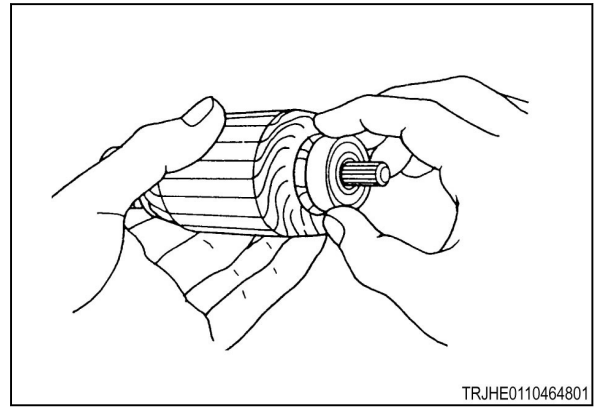


Fig. 200

- 17.** If necessary, replace the bearing as shown.

### Magnetic switch

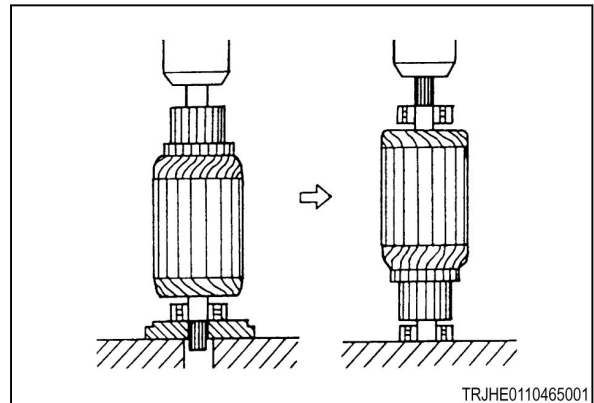
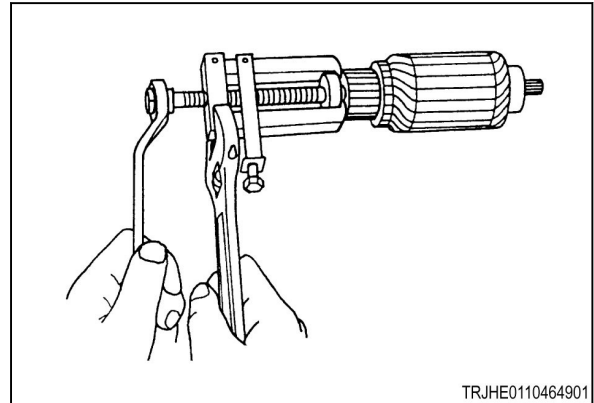


Fig. 201

- 18.** Inspect for continuity across terminal 50 and terminal C.

If there is continuity, the switch is correct.

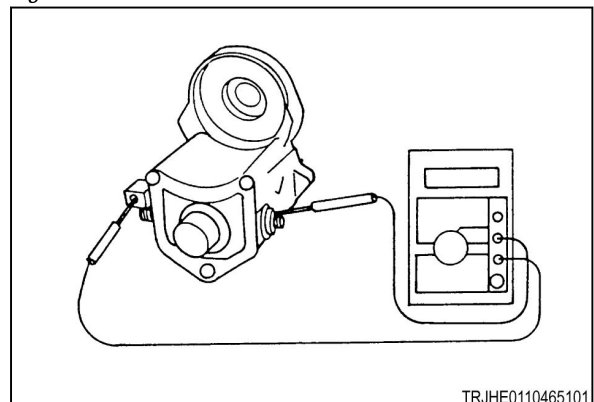


Fig. 202



19. Inspect for continuity across terminal 50 and magnetic switch body.  
If there is continuity, the switch is correct.

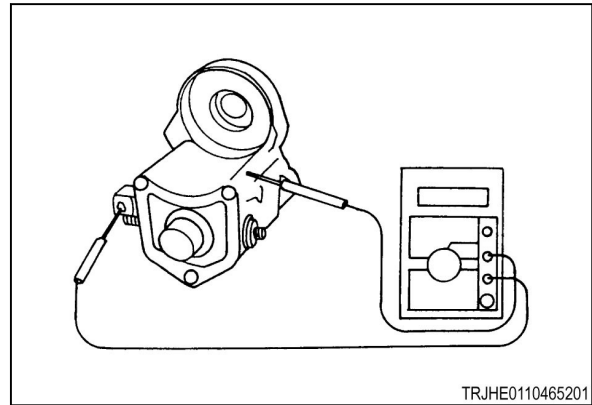


Fig. 203

#### 2.14.1.4 Assemble the starter

##### Procedure

1. Apply grease to the armature bearing.
2. Install the armature on the starter yoke.
3. Lift up and hold the spring and install the brush.
4. Install the commutator end frame and O-ring (on all but 1.0 kW starter).
5. Install the start yoke on the magnetic switch with an O-ring (on all but 1.0 kW starter).

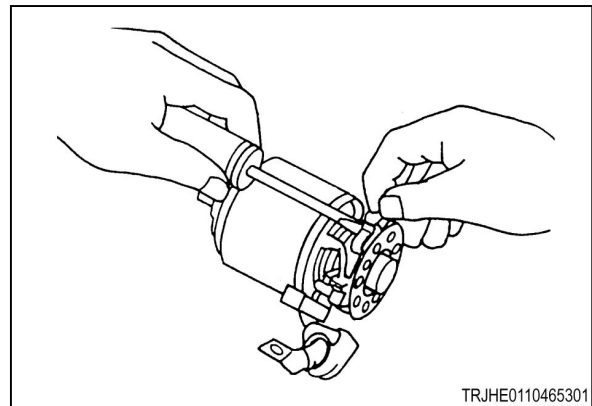


Fig. 204

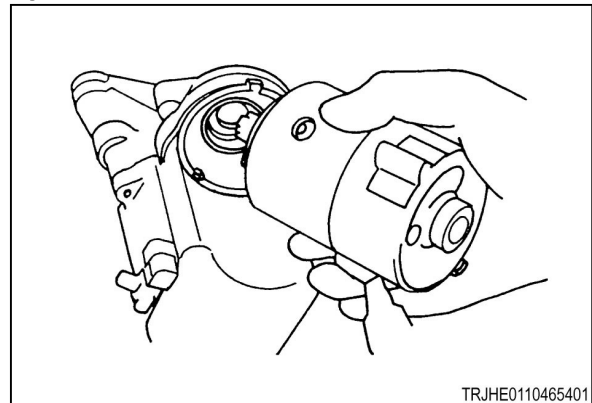
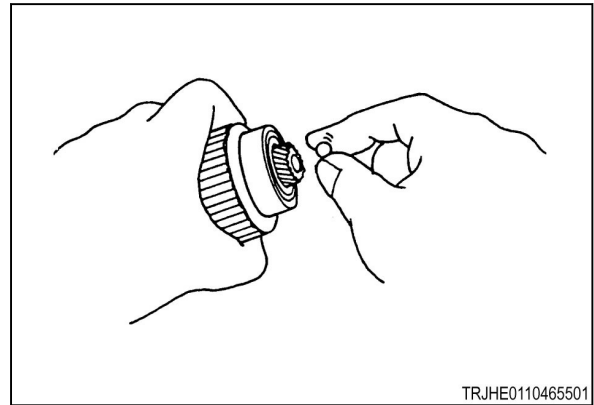


Fig. 205

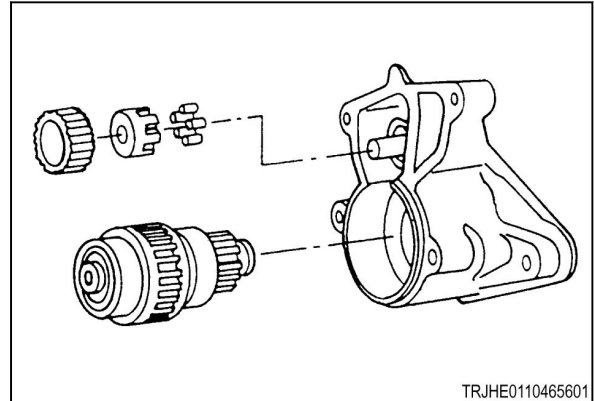
6. Apply grease to the ball.
7. Install the ball and spring.



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8. Apply grease to the roller/retainer assembly and idle gear and then install.
9. Install the drive pinion on the armature shaft.
10. Apply grease to the gear.
11. Install the starter housing on the magnetic switch.
12. Install the two through bolts.
13. Connect the lead to terminal C.

Fig. 206



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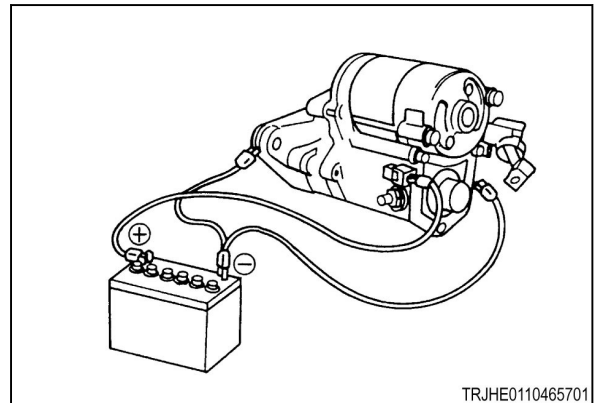
Fig. 207

#### 2.14.1.5 Starter tests

**IMPORTANT:** To prevent damage, do not operate the starter for more than three to five minutes.

##### Pull-in test

Make sure the pinion is pushed out when the starter is connected as shown.



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Fig. 208

**Coil hold Test**

In the state of the pull-in test, the gear must stay pushed out when the lead is disconnected from terminal C.

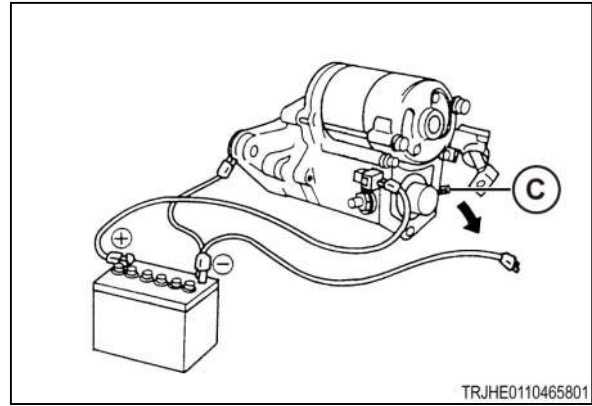


Fig. 209

**Plunger return test**

In the state of the coil hold test, the pinion must retract when the connection is removed as shown.

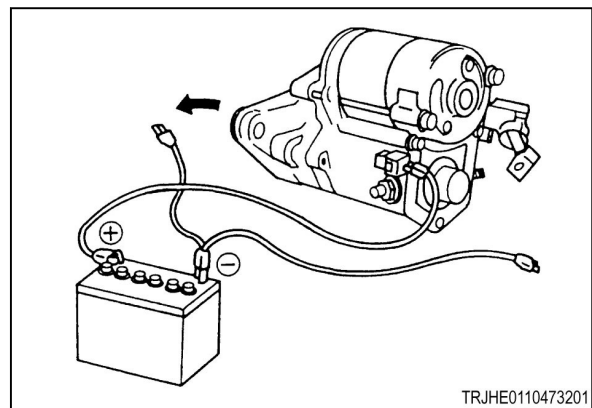


Fig. 210

**2.14.1.6 Performance tests**

Hold the starter in a vise.

Use heavy wires because of high current.

**No load test**

Drive the starter independently with a specified battery and without a load. Examine for spin speed, voltage, and current.

Values must be as shown below:

Voltage	11.5V
Current	90A or less
Speed	3000 rpm or more

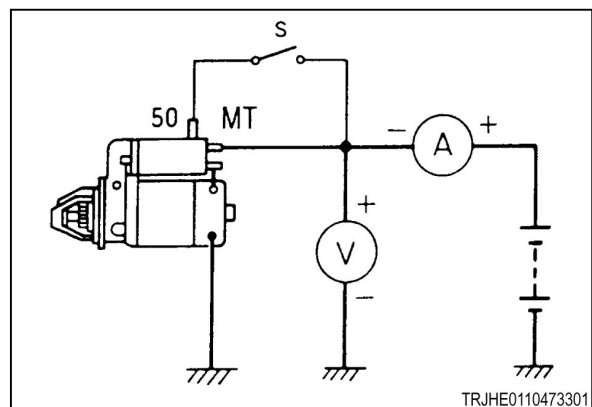


Fig. 211

**Brake test**

Install the starter on a test bench and apply the brake. Measure each value while the starter operation is prevented.

Each value must be as shown below:

1.0 kW Starters	
Voltage	8.0V
Current	230A or less at 1180 rpm or over
Torque	0.65 kgf m (4.7 lbf ft) or over

1.4 kW Starters	
Voltage	8.5V
Current	350A or less at 1000 rpm or over
Torque	1.35 kgf m (9.7 lbf ft) or over

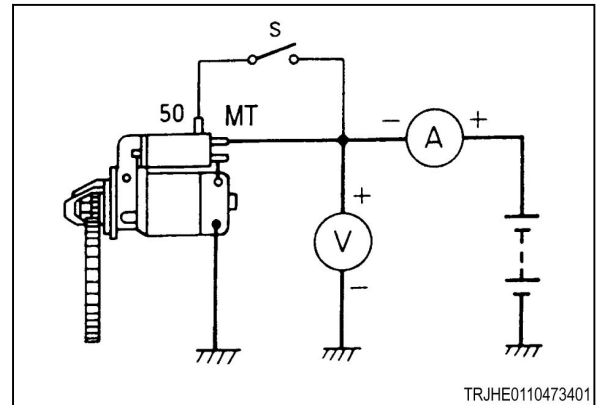


Fig. 212

**2.14.1.7 Install the starter**

**Procedure**

1. Install the starter onto the engine.
2. Install the connector on terminal 50 (solenoid lead).
3. Connect the wire harness to terminal 30 battery lead and install the nut.
4. Connect the starter wiring.
5. Connect the negative (-) battery cable.

## 2.14.2 Alternator

### Exploded view

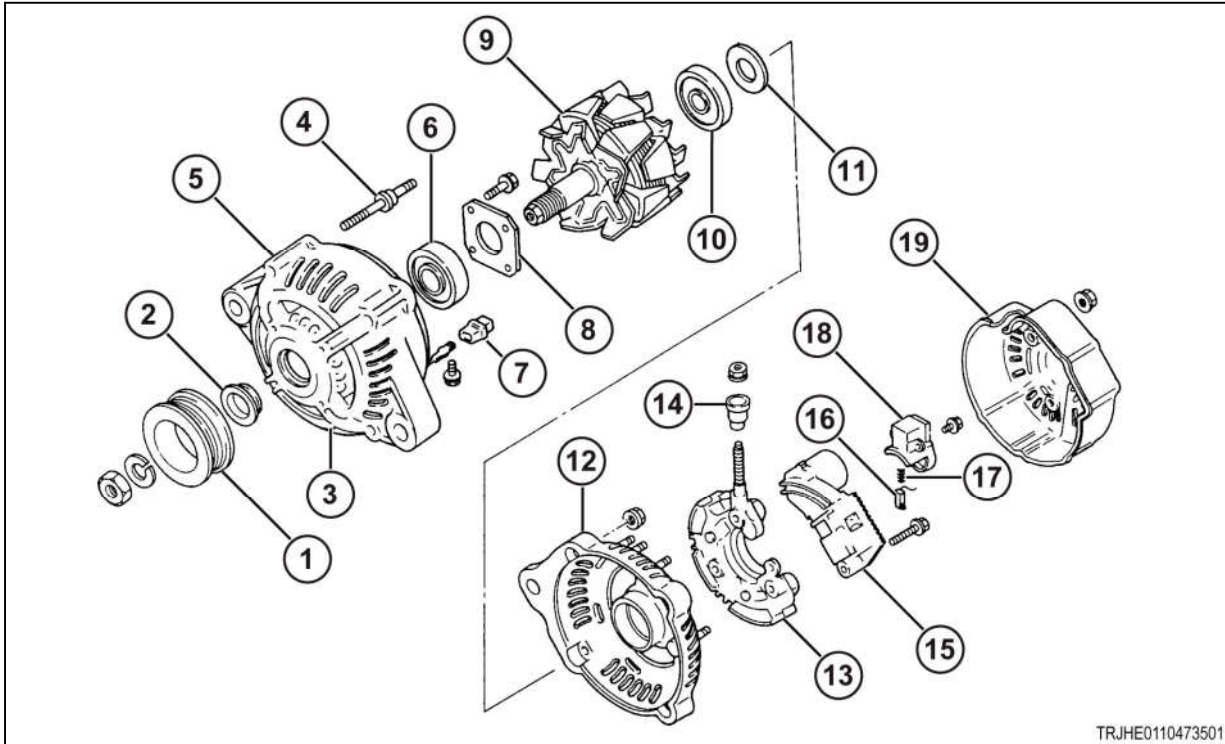


Fig. 213

- |                     |                         |
|---------------------|-------------------------|
| (1) Pulley          | (11) Bearing cover      |
| (2) Spacer          | (12) Rear end frame     |
| (3) Drive end frame | (13) Rectifier          |
| (4) Stud bolt       | (14) Terminal insulator |
| (5) Stator          | (15) IC regulator       |
| (6) Bearing         | (16) Brush              |
| (7) Connector       | (17) Spring             |
| (8) Retainer plate  | (18) Brush holder       |
| (9) Rotor           | (19) Rear end cover     |
| (10) Bearing        |                         |

### 2.14.2.1 Alternator specifications

#### Specifications

Nominal voltage	12V
Nominal output	40A
Rated speed	5000 rpm
Start speed	1350 rpm
Permitted maximum speed	15000 rpm
Permitted outside temperatures	-30 degrees +/- 90 degrees C
Direction of rotation	Clockwise (as seen from pulley)
Polarity	Negative ground
Regulated voltage	14.2 - 14.8V

**Performance curves**

Output performance curves.

- (1) Cool
- (2) Warm

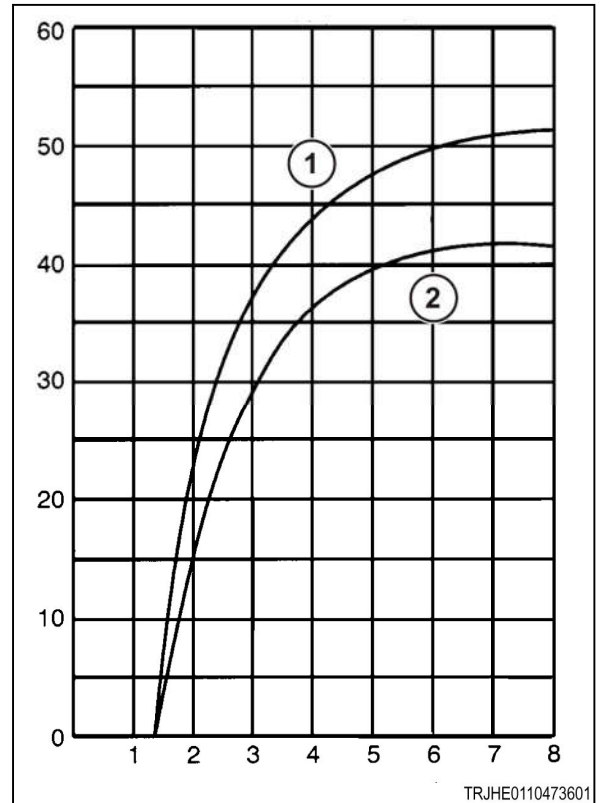


Fig. 214

**2.14.2.2 Alternator troubleshooting**

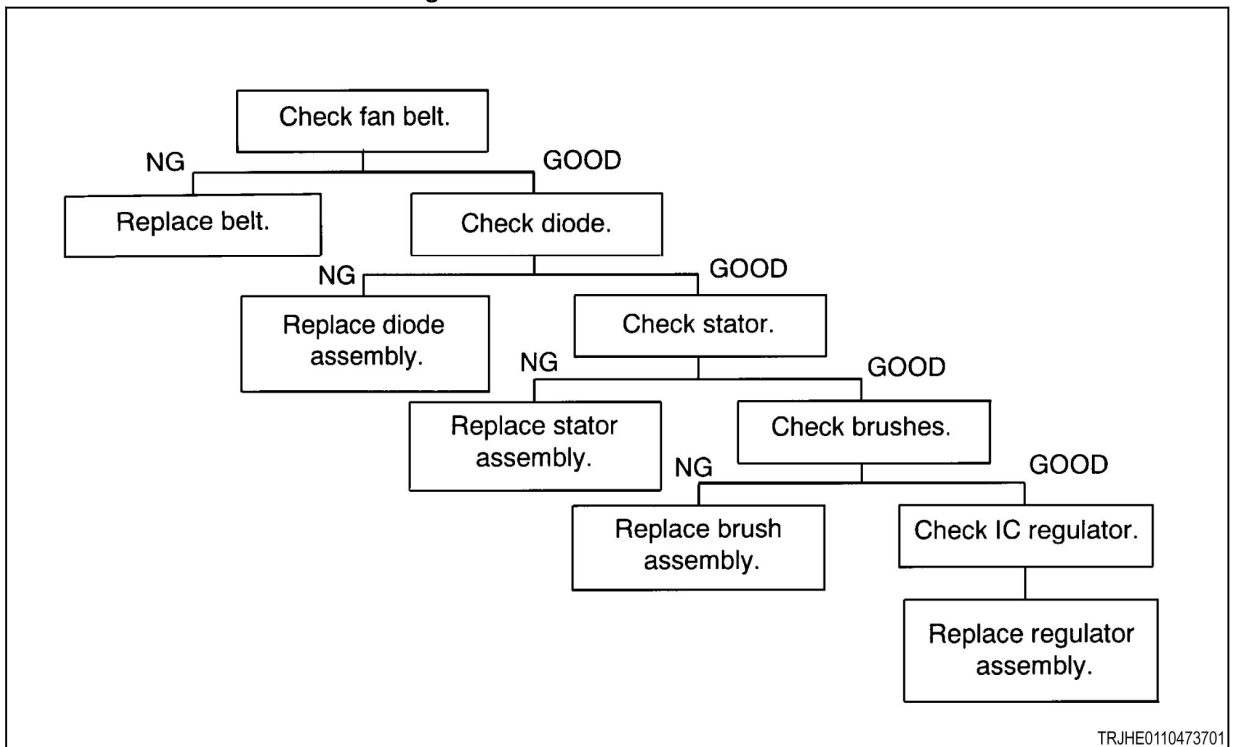


Fig. 215

### 2.14.2.3 Remove the alternator

#### Procedure

1. Remove the battery negative cable.
2. Remove the alternator wires.
3. Remove the fan and fan belt.
4. Remove the bolts and remove the alternator.

### 2.14.2.4 Disassemble the alternator

#### Procedure

1. Hold the hexagonal part of the shaft with a socket wrench and remove the pulley nut with an open end wrench.

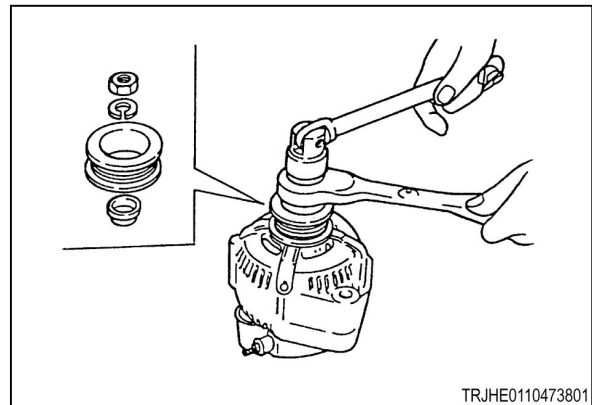


Fig. 216

2. Remove the three rear end cover bolts (1) and nut for terminal B (2).
3. Remove the cover (3).

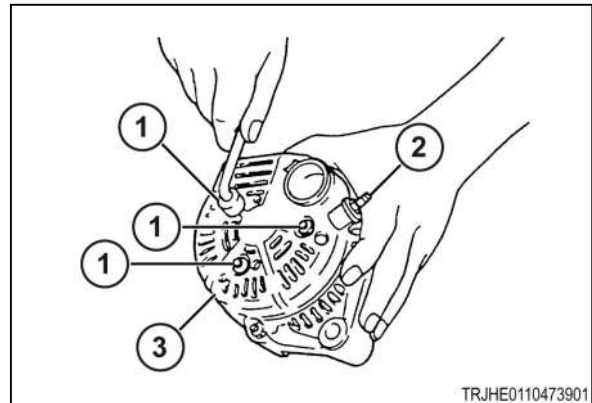


Fig. 217

4. Remove the screws (1) which hold the brush holder (2) and rectifier.
5. Remove the brush holder.

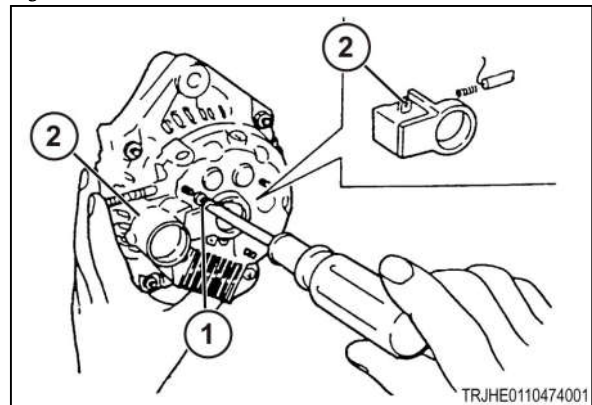
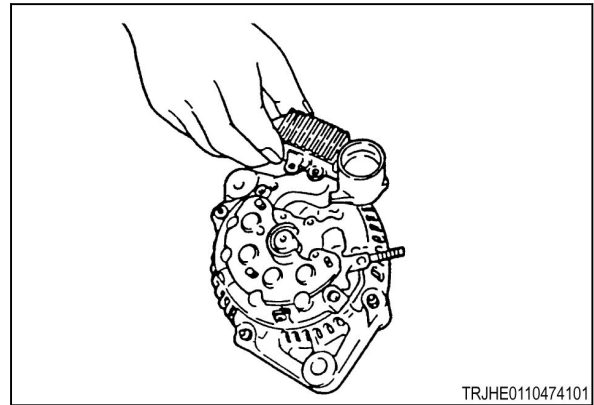


Fig. 218

6. Remove the three screws which hold the IC regulator.

**IMPORTANT:** Screws of different length are used for the terminals. Keep the screws in order for assembly. A incorrect screw can touch the end frame and cause the regulator to be out of control, which will lead to battery overcharging and result in damage.

7. Remove the IC regulator.

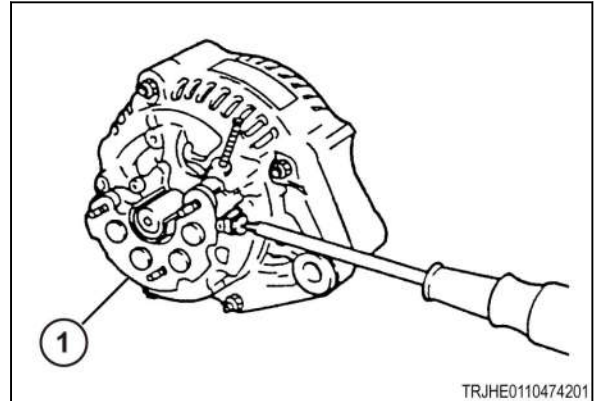


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Fig. 219

8. Remove the four screws which hold the leads for the rectifier (1) and stator.

9. Remove the rectifier and stator.



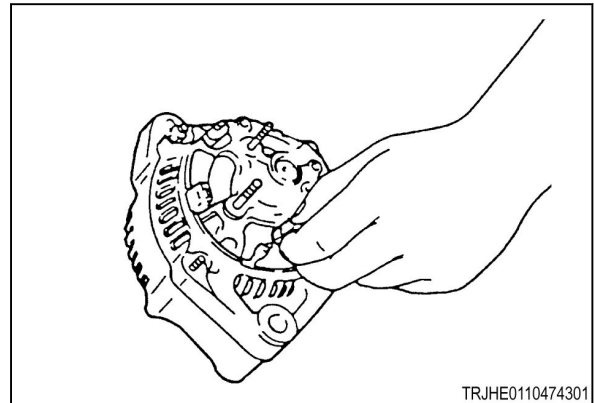
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Fig. 220

10. Remove the four nuts and bushes which hold the drive end frame and rear end frame.

11. Remove the brush assembly.

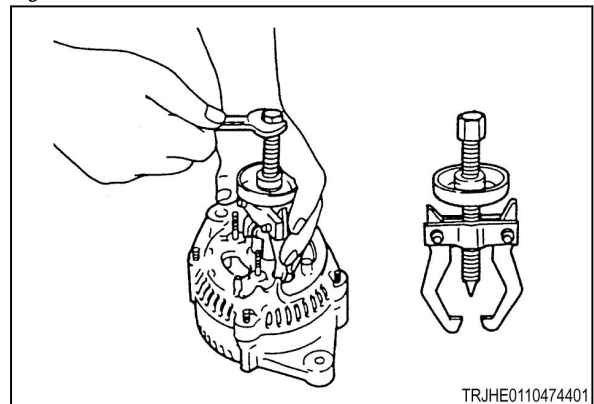
Do not stretch the wire from the stator.



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Fig. 221

12. Use a puller to remove the rear end frame.

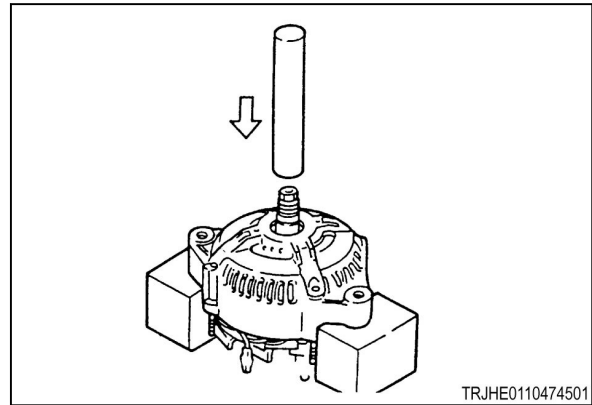


TRJHE0110474401

Fig. 222



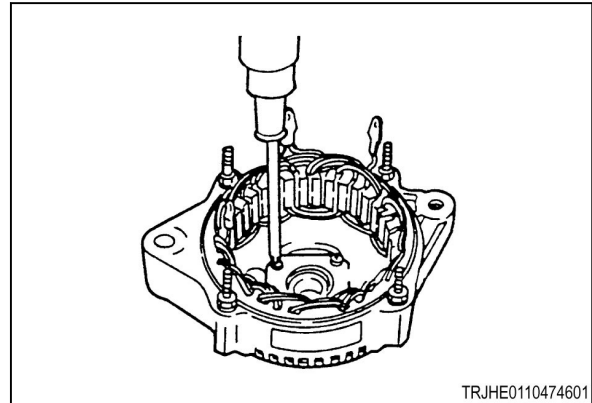
- 13.** Put the drive end frame on blocks. Push out the rotor on a press.
- Do not let the rotor fall to prevent damage to the slip ring and fan.



TRJHE0110474501

Fig. 223

- 14.** Remove the four screws which hold the retainer plate.
- 15.** Remove the plate.

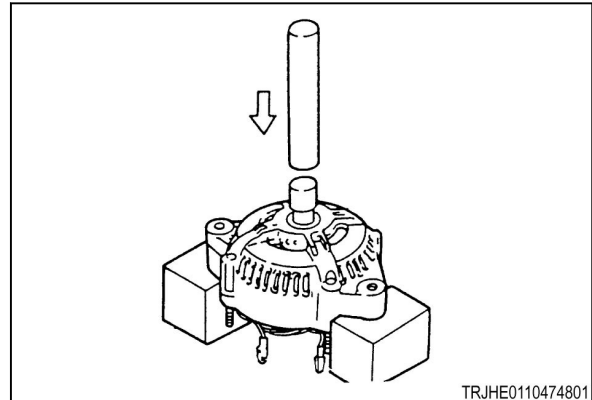


TRJHE0110474601

Fig. 224

- 16.** Put the drive end frame level on blocks as shown and put a jig on the bearing.
- 17.** Press out the bearing on a press.

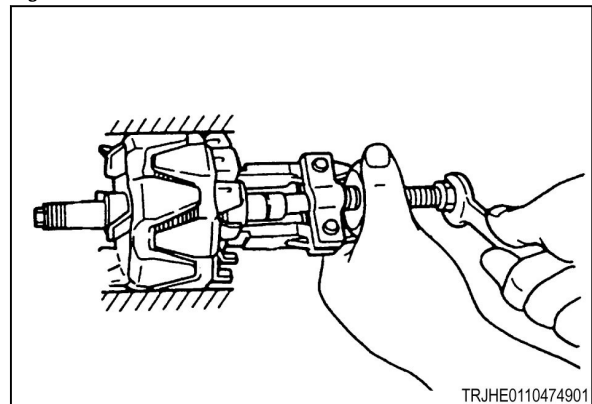
**IMPORTANT:** *The bearing is a high-speed type. Be sure to use a specified one by AGCO. Do not drive it out.*



TRJHE0110474801

Fig. 225

- 18.** Use a puller to remove the bearing on the slip ring side.



TRJHE0110474901

Fig. 226

### 2.14.2.5 Examine the alternator

#### Procedure

1. Measure the outer diameter of the rotor slip rings.

Standard value	Usable limit
14.4 mm (0.57 in)	14.0 mm (0.55 in)

If the measured value is less than the usable limit, replace the rotor.

2. Make sure that the slip rings are smooth, clean, and free from oil.

If the surface is rough, polish with fine sand paper (number 500 to number 600).

If there is oil on the surface, clean with a cloth and alcohol.

3. Examine for continuity across the slip rings.  
If there is no continuity, replace the rotor.

4. Examine for continuity across a slip ring and the rotor core or the shaft.  
If there is continuity, replace the rotor.

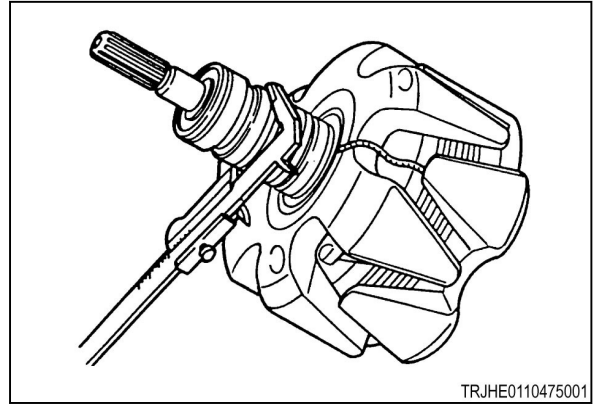


Fig. 227

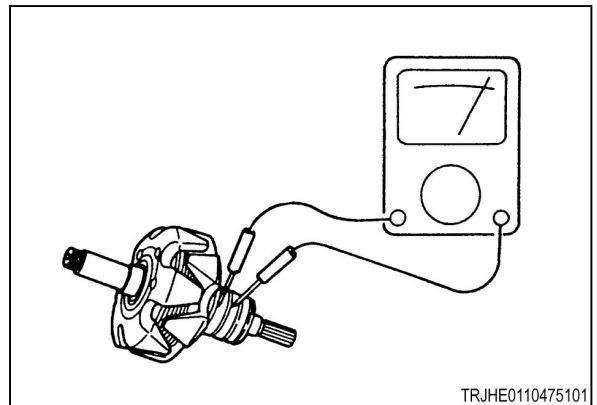


Fig. 228

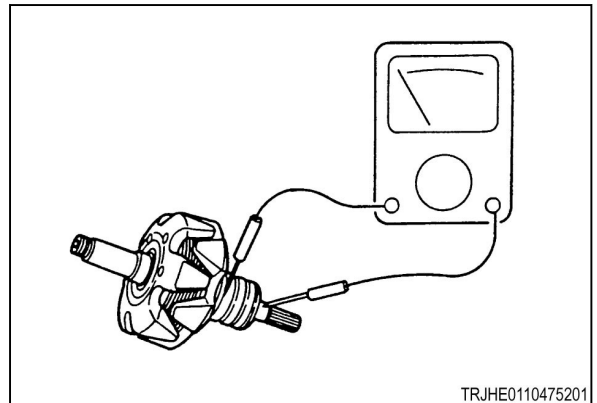


Fig. 229

5. Examine the bearings.  
Replace bearings that make a noise or are rough.

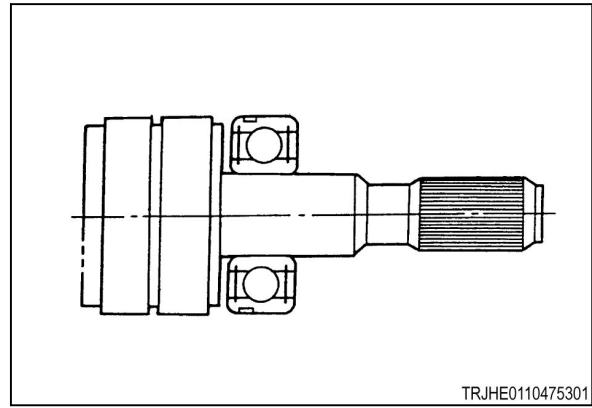


Fig. 230

6. Examine for continuity across the coil terminals.  
If there is no continuity, replace the stator.

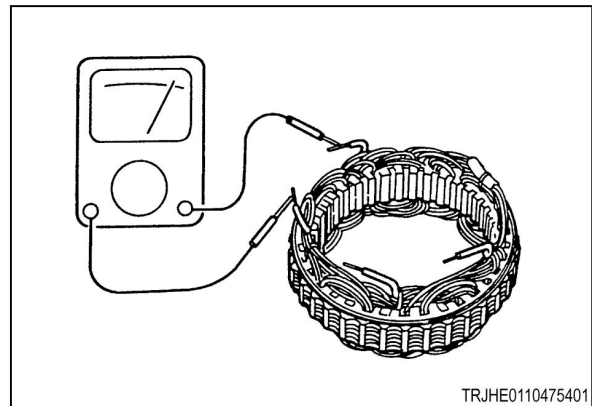


Fig. 231

7. Examine for continuity across one of the stator terminals and stator core.  
If there is continuity, replace the stator.

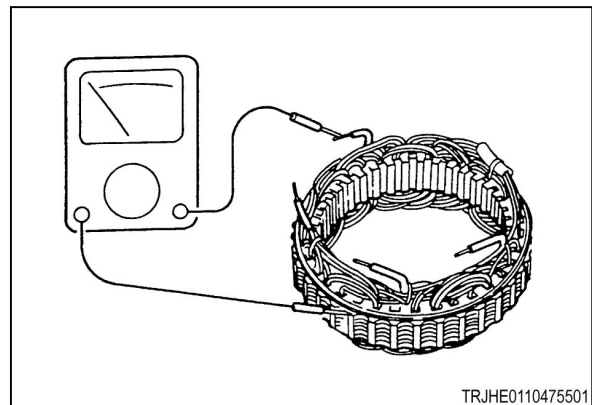


Fig. 232

8. Set the multimeter to the K range. Examine for continuity across the respective terminals.  
The diode must show continuity only in one direction.  
Do not test the rectifier by the resistance value shown in forward direction. The current flow of the diode changes with the voltage applied. The tester type and resistance range used effect the resistance measurement. The diode is good when the resistance difference between the forward direction and reverse direction is large enough.

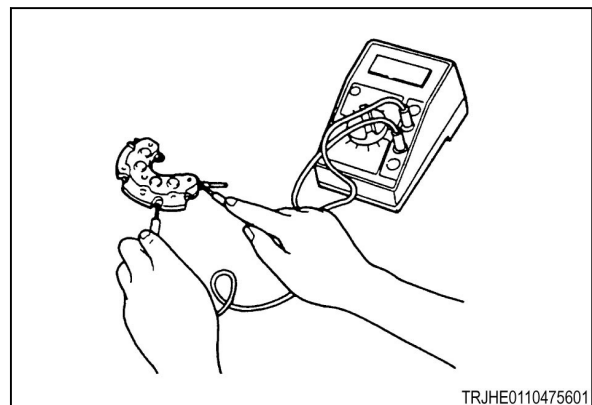


Fig. 233

Do not apply the MW range of the tester, which can damage the diode.

9. Measure the length of the brush above the brush holder.

If the length is less than the usable limit, replace the brush.

Standard value	Usable limit
10.5 mm (0.41 in)	4.5 mm (0.18 in)

If the measured value is less than the usable limit, replace the rotor.

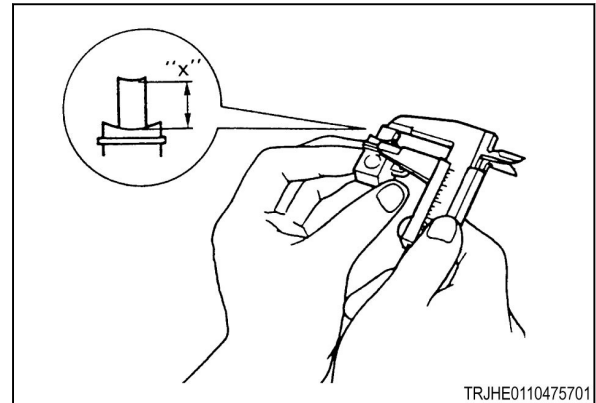


Fig. 234

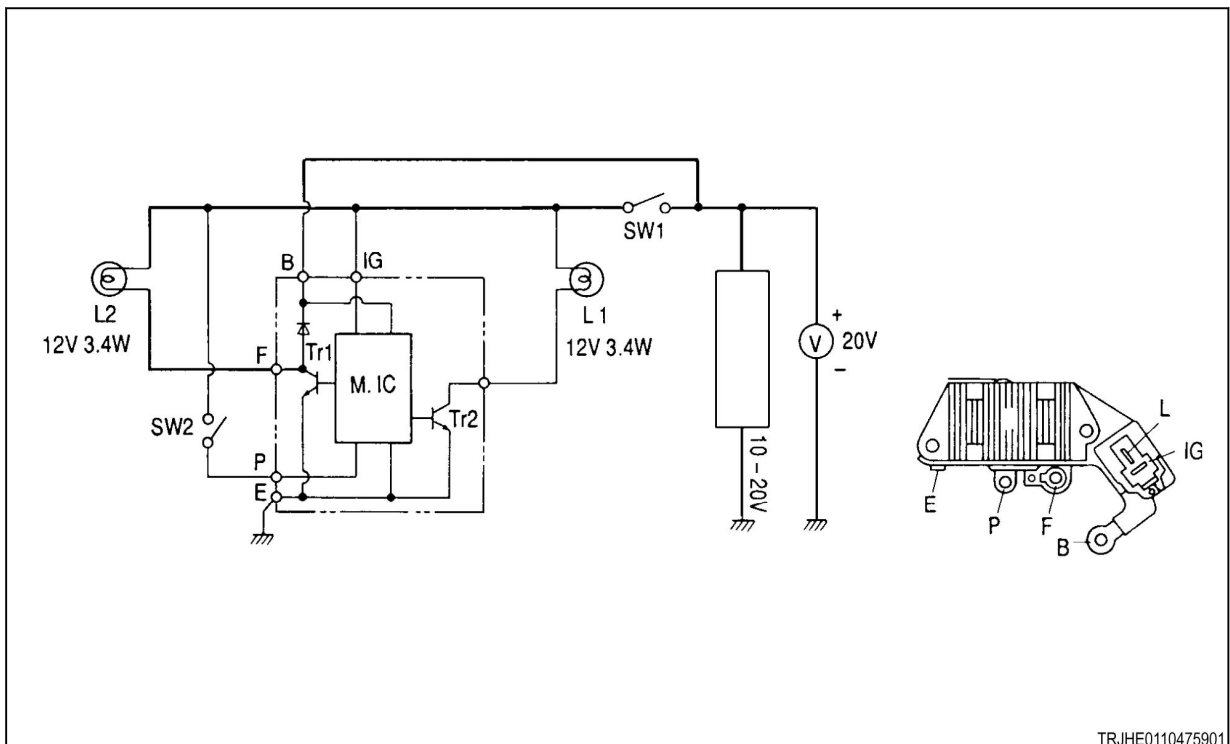


Fig. 235

10. Connect the IC regulator, variable DC power supply voltmeter, and a lamp as shown.  
Keep SW1 and SW2 off.
11. Set the power supply at 12v.
12. Move SW1 to on.  
The lamp at L1 (in the location of the charge lamp) must be illuminated.  
The lamp at L2 (in the location of the rotor coil) must be illuminated.
13. Move SW2 and SW1 to on.  
The bulb at L1 must be off and the bulb at L2 must be on.
14. Increase the power supply voltage gradually from 12v to about 14.5v (13.9v to 15.1v). Move SW1 and SW2 to on.  
At 25 degrees C (77 degrees F), the bulb at L1 must be off and the bulb at L2 must also be off.

- 15.** Set the tester at KW range and examine for continuity across terminals B and F.  
Change the polarity of the tester.  
There must be continuity in one direction and no continuity in the other direction.

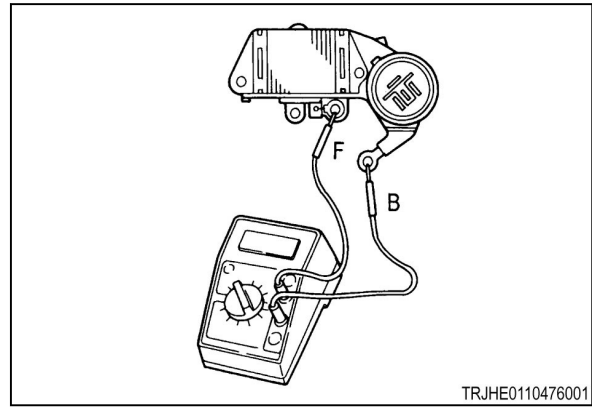


Fig. 236

### 2.14.2.6 Assemble the alternator

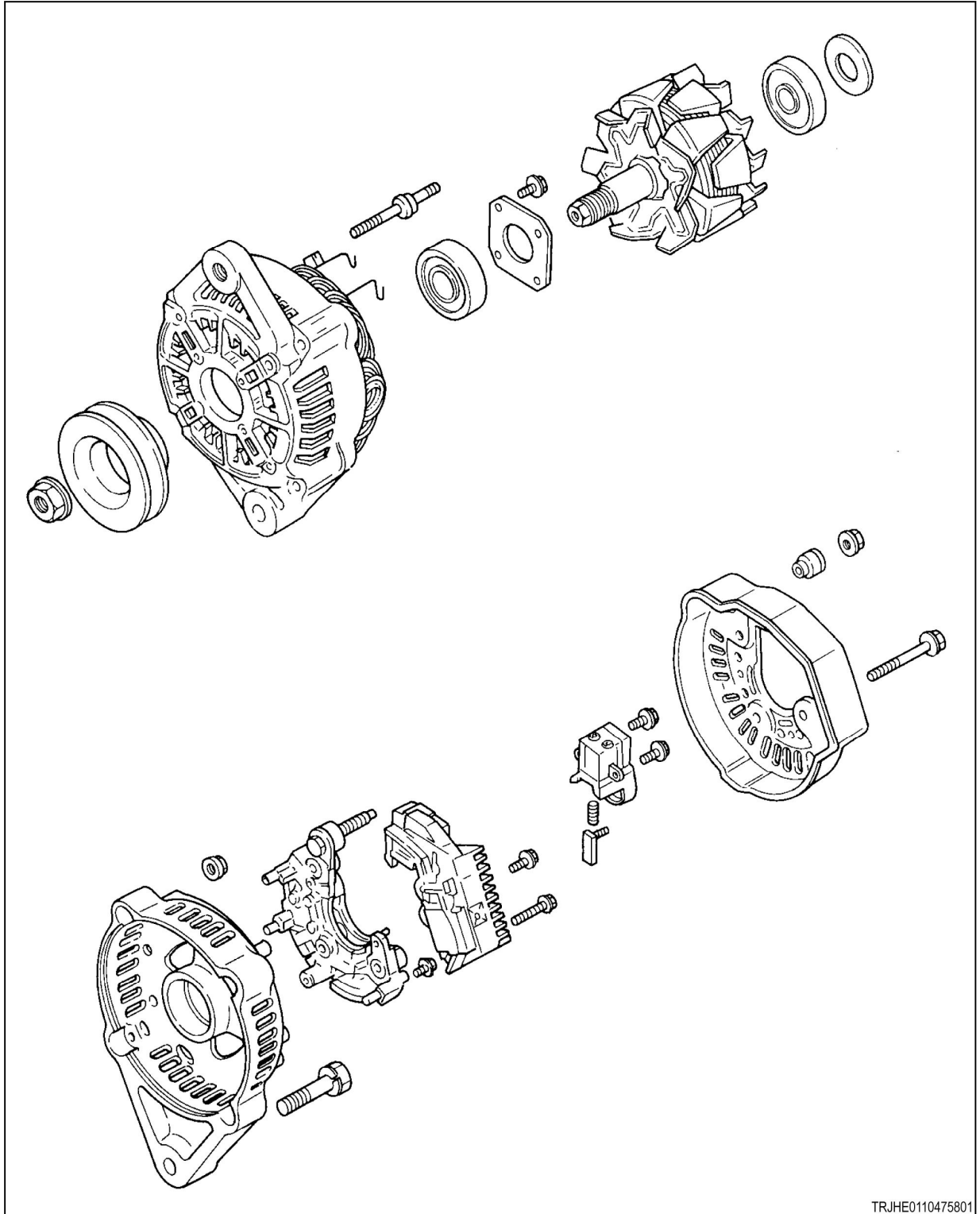


Fig. 237

TRJHE0110475801

**Procedure**

1. Press in the bearings with a hand press. Make sure that the bearing is installed straight.
2. Heat the frame to about 100 degrees C (212 degrees F).  
**NOTE:** At room temperature, it is very hard to press in the bearing.

3. Press the bearings into the frame.  
Use a jig which presses only the outer race. Support the frame at the bearing box and not at the stay.

4. Install the retainer plate.

5. Install the brush holder sideways along with the IC regulator.

The clearance between the brush holder and the connector must be 1 mm (0.04 in) or more.

The rubber gasket for the brush holder must not be deformed or pinched.

The terminals have different screw lengths. Install the correct screw in the correct location.

6. Install the rectifier.
7. Install the end cover.
8. Install the pulley.

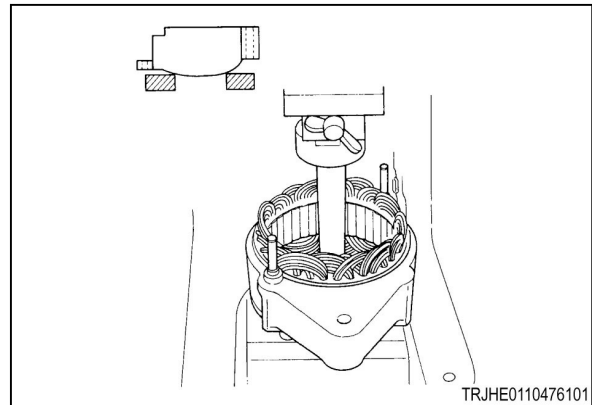


Fig. 238

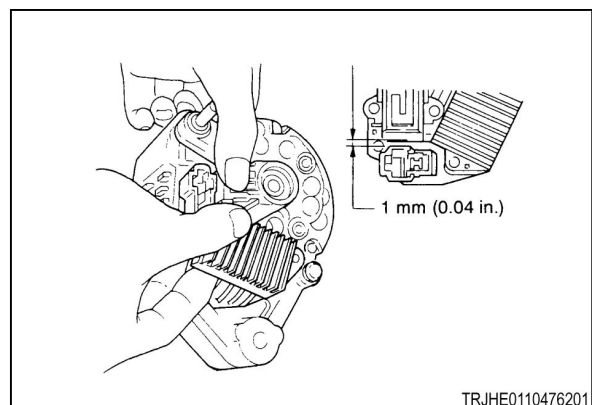


Fig. 239

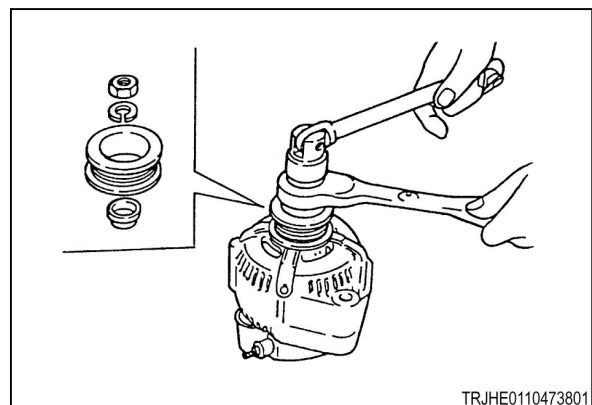


Fig. 240

### 2.14.3 Glow plugs

Section view

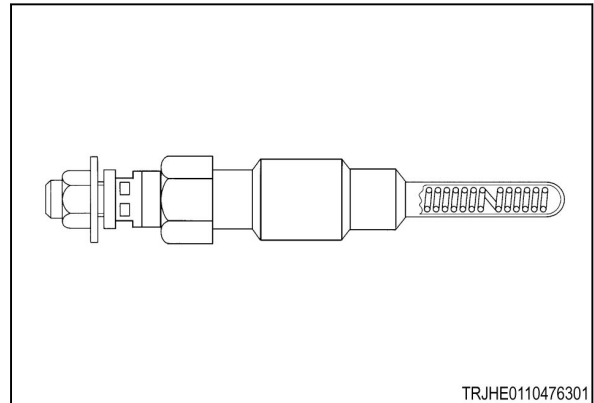


Fig. 241

#### Troubleshooting

Troubleshooting

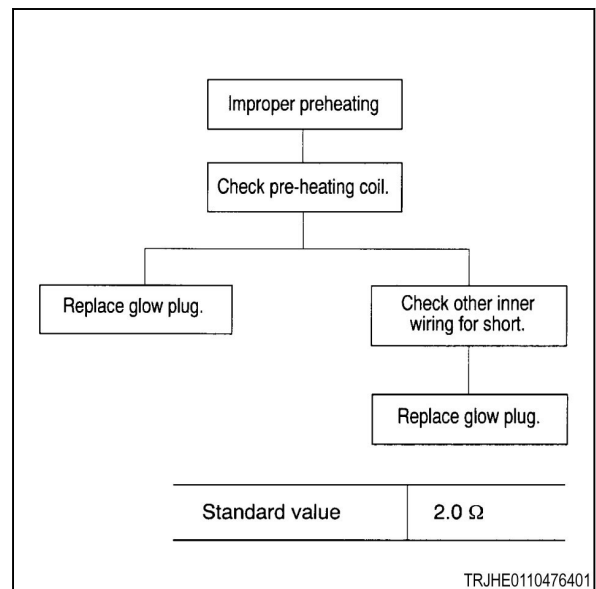


Fig. 242

#### 2.14.3.1 Remove the glow plugs

##### Procedure

1. Loosen the glow plug nut installed on the cylinder head. Remove the connector.
2. Remove the glow plug.

#### 2.14.3.2 Examine the glow plugs

##### Procedure

1. Examine the glow plug.
2. Examine for continuity across the sheath and center electrode.  
If there is no resistance, there is a short circuit. Replace the glow plug.  
If the resistance is infinite, the pre-heating coil is burnt out. Replace the glow plug.



### 2.14.3.3 Install the glow plugs

#### Procedure

1. Install the glow plug.
2. Install the nut on the glow plug and connect the connector.

## 2.15 Fuel system



**WARNING: Fire hazard. Fuel safety.**

**Personal injury, death, or machine damage can occur.**

**Stop the engine and let the engine cool before fueling. Never smoke while fueling the machine.**

**IMPORTANT:**

*Do not tamper with the injection pump or the injector adjustments. Tampering will cause severe engine damage or engine failure. The warranty will not cover a machine with tampering.*

Use only clean ultra low sulfur diesel fuel of correct grade. Water or dirt in the fuel tank or other parts of the fuel system can cause repeated blockage of the fuel filter and possible injection pump damage.

Keep the area around the fuel cap clean and use only clean diesel fuel to prevent dirt and water from getting into the fuel tank when filling.

Do not let the fuel tank go completely empty.

Keep the fuel tank full to reduce condensation.

### 2.15.1 Fuel filter

The fuel filter assembly (1) is located on the right side. The fuel filter removes particles in the fuel before the fuel reaches the injection pump. The fuel filter assembly has a valve (2) to help with filter replacement and to bleed the air from the fuel system.

Examine and clean the filter bowl to remove deposits of sediment or water.

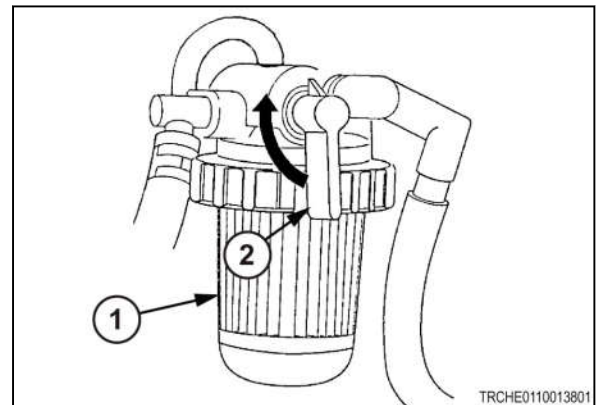


Fig. 243

### 2.15.2 Replace the fuel filter

**Procedure**

1. Turn the fuel valve to the off position (handle to the rear).
2. Carefully loosen the spanner nut (1).
3. Remove the spanner nut, sediment bowl (2), and O-ring (3).
4. Clean the sediment bowl.
5. Pull down on the filter element (4) and discard.
6. Examine the small O-ring (5) in the filter head and replace as necessary.
7. Install the new filter into the housing until its seated.

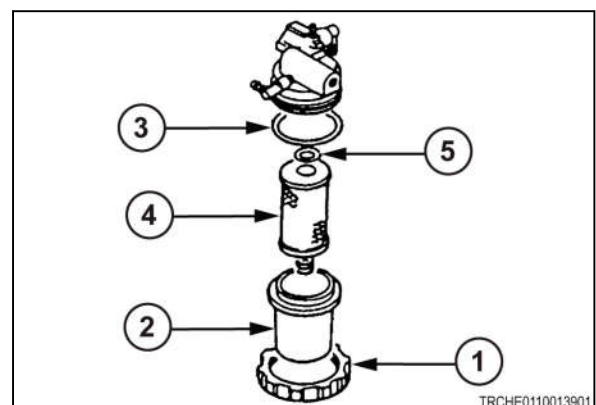


Fig. 244

8. Install the sediment bowl, O-ring, and spanner nut.
9. Tighten the spanner nut.
10. Clean up and spilled fuel.

**Related Links**

[Lubrication and maintenance chart](#) page 1-34

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### 2.15.3 Fuel pump

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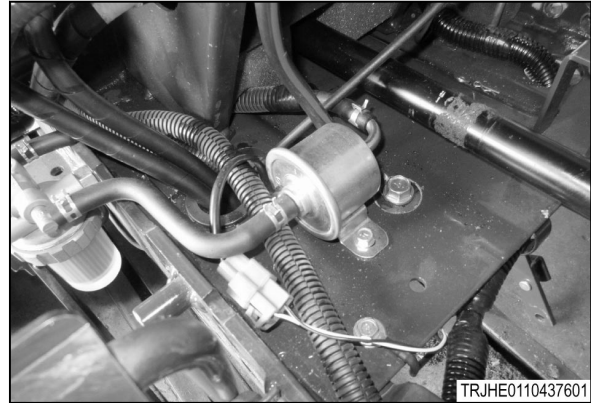


Fig. 245

The fuel pump specifications are:

- Rated voltage: 12VDC
- Operating current: 1.5 amp or less
- Delivery: 400 cc/min (0.1 gpm) at free flow
- Cut off pressure: 5.4 psi or less

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### 2.15.4 Fuel system components

---

- (1) Fuel tank
- (2) Filter valve
- (3) Fuel pump
- (4) Injection pump

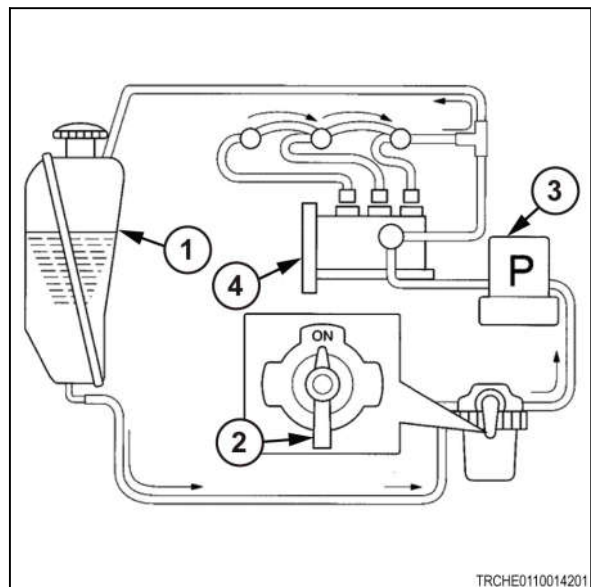


Fig. 246

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## 2.15.5 Remove air from the fuel system

---

### Before starting the procedure

If any of the following conditions have occurred, bleeding the the system is necessary:

- The fuel tank is empty.
- The fuel lines, the filter elements, and other components within the system have been disconnected or removed.
- The engine has not operated for a long period of time.
- The engine fails to start, or starts but stops again after a short time of operation.

### Procedure

1. Fill the fuel tank.
2. Turn the fuel filter valve (1) to the open (ON) position.
3. Loosen filter air bleed screw (2) and let out the air bubbles.
4. Loosen air bleed screw (3) on the fuel injection pump, and let out air bubbles from the fuel injection pump.
5. Tighten the injection pump air bleed screw.
6. Tighten the filter air bleed screw.

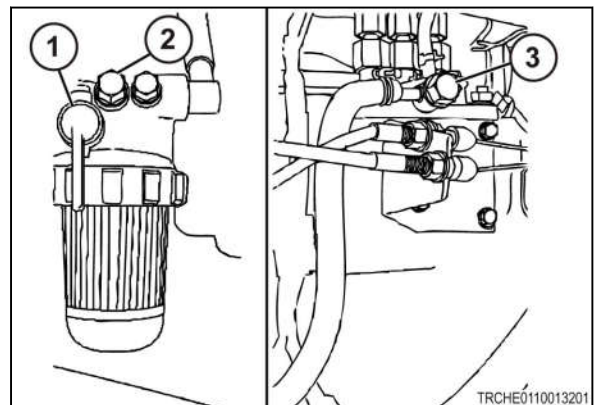


Fig. 247

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## 2.15.6 Fuel tank filler cap

---

When the fuel tank filler cap is removed, a hissing or popping noise can be heard. This is because of the cap design and is a normal condition. Do not change the cap or use an unapproved replacement as fuel leakage can occur during possible machine upset.

---

## 2.15.7 Remove the fuel tank

---

### Procedure

1. Disconnect the wire connectors:
  - Left turn lamp
  - Right turn lamp
  - 12 volt power socket, if equipped
  - Work lamp, if equipped

2. Remove the seat assembly.
3. Remove the ROPS.



Fig. 248

4. Remove the floor mat.
5. Remove the bolts that fasten the floor to the rear fender.
6. Remove the knobs:
  - Rate of lowering valve
  - Cutting height adjustment
  - PTO select lever
  - Mid mount PTO select lever
  - PTO clutch lever
  - Three-point control lever
  - Range transmission lever
7. Lift the boot on the joystick lever to access the bolt that fastens the joystick lever. Remove the bolt and then remove the lever.
8. Remove the joystick lever lockout.
9. Remove the rear fender.



Fig. 249



Fig. 250

10. Remove the bracket for the ROPS.
11. Disconnect the fuel sensor wire.
12. Disconnect the fuel hoses from the fuel tank.
13. Remove the fuel tank.

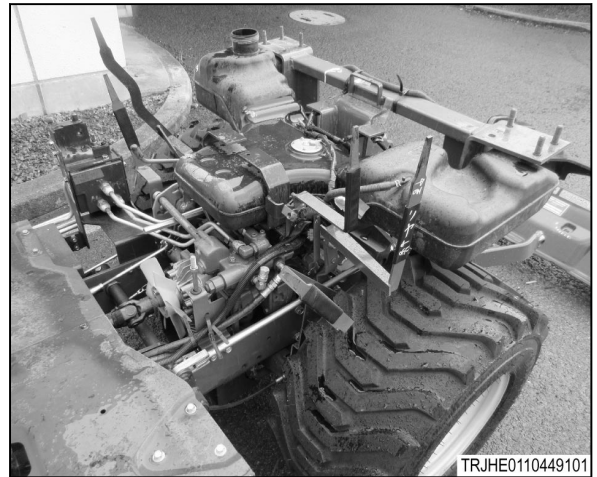


Fig. 251

### 2.15.8 Install the fuel tank

#### Procedure

1. Put the fuel tank into position on the tractor.
2. Connect the fuel sensor wire.
3. Connect the fuel hoses from the fuel tank.
4. Install the bracket for the ROPS.
5. Put the rear fender into position on the tractor.
6. Install the joystick lever lockout.
7. Put the joystick lever into position. Install the bolt that fastens the lever. Lower the boot on the joystick lever.



Fig. 252



Fig. 253

8. Install the bolts that fasten the floor to the rear fender.
9. Install the floor mat.



Fig. 254

10. Install the seat assembly.
11. Install the ROPS.  
Tighten the nuts to 85 Nm (63 lbf ft).
12. Install the knobs:
  - Rate of lowering valve
  - Cutting height adjustment
  - PTO select lever
  - Mid mount PTO select lever
  - PTO clutch lever
  - Three-point control lever
  - Range transmission lever



Fig. 255

13. Connect the wire connectors:
  - Left turn lamp
  - Right turn lamp
  - 12 volt power socket, if equipped
  - Work lamp, if equipped

## 2.16 Hand throttle lever

The hand throttle lever must remain in the position selected by the operator. Through normal use, friction against the hand throttle lever can decrease, causing the hand throttle lever to move out of the selected position. Turn the adjusting nut (1) as required to hold the hand throttle lever in the selected position.

**NOTE:**

*Remove the steering column cover and the instrument panel to get access to the adjusting nut.*

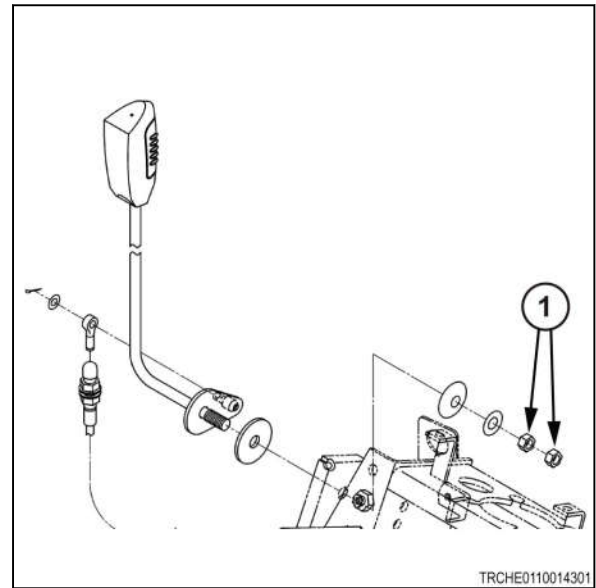


Fig. 256





## 3 Axles

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## 3.1 Front axle

### 3.1.1 Remove the front axle

#### Procedure

1. Remove the fill plug from the top of the front axle.
2. Remove the drain plug (1) from both sides of the front axle and drain the oil.

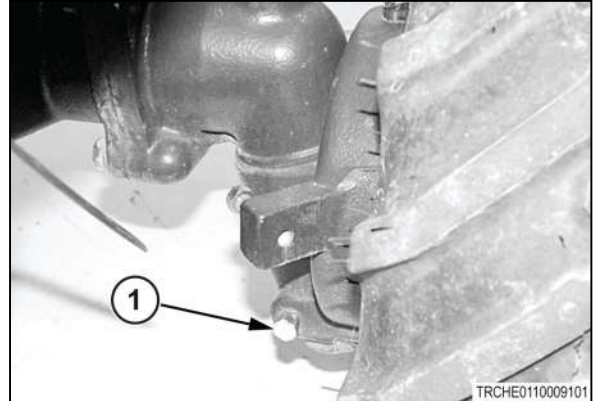


Fig. 1

3. Remove the bolt (1) that fastens the front drive shaft shield to the front axle.
4. Slide the front axle shield rearwards to expose the U-joint at the front of the drive shaft.

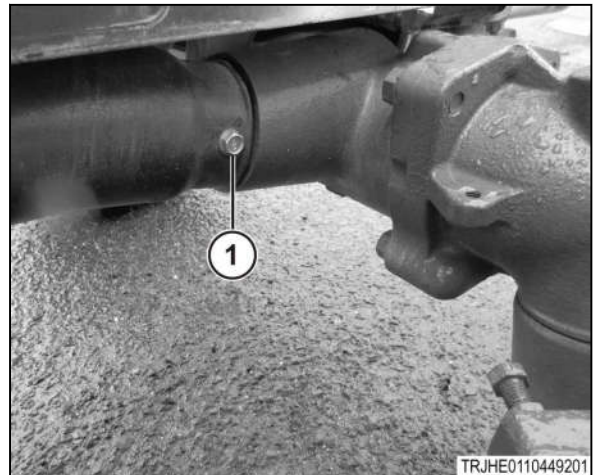


Fig. 2

5. Remove the bolt that fastens the U-joint to the front axle input shaft and slide the U-joint rearwards.



Fig. 3

### 3. Axles



6. Remove the front axle drive shaft.

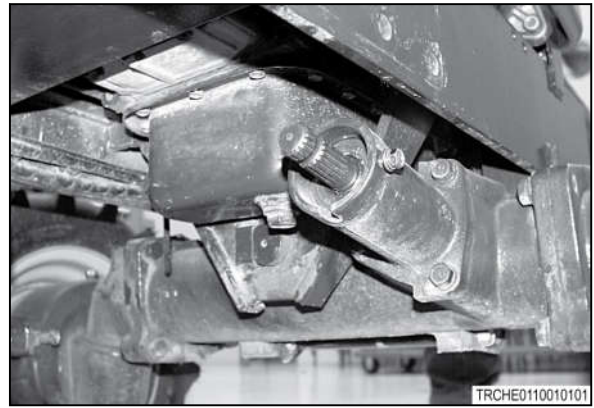


Fig. 4

7. Remove the cotter pin and the nut from the pivot pin.
8. Remove the bolt that fastens the pivot pin assembly.

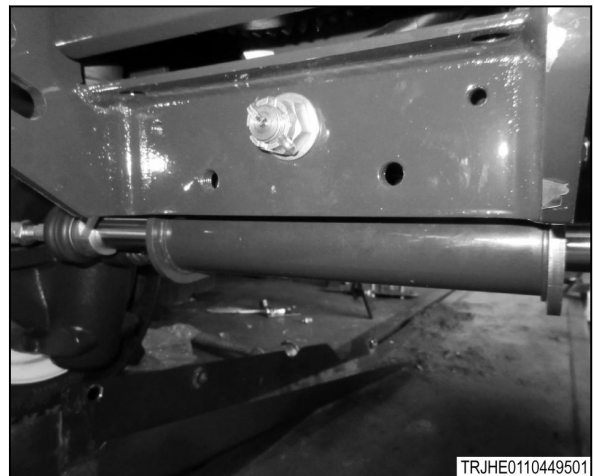


Fig. 5

9. Raise the front of the machine up 5 cm to 8 cm (2 in to 3 in) and support the machine with a suitable jack stand.

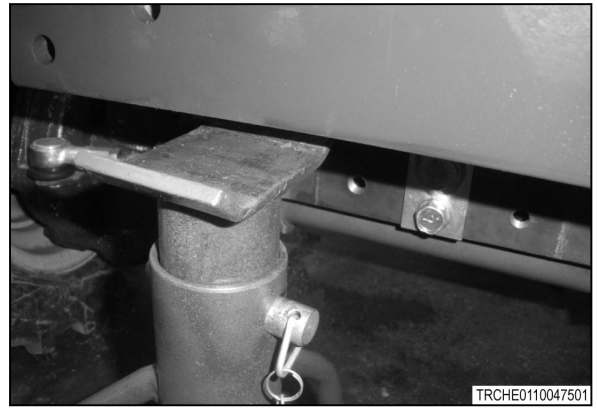


Fig. 6

10. Drive the pivot pin forward with a brass hammer until the axle is free from the machine.

**NOTE:** Be careful not to damage the threads on the pivot pin. Do not stretch the hoses on the steering cylinder.



Fig. 7

11. Put identification tags on the steering cylinder hoses to note their position on the steering cylinder.
12. Disconnect the two hoses from the steering cylinder.
13. Support the front axle, remove the front wheels and slide the front axle out from under the machine.

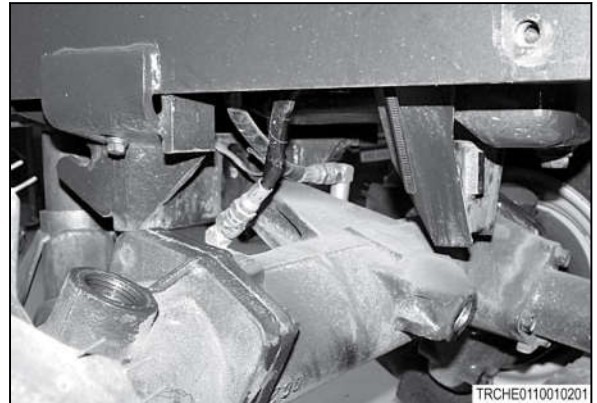


Fig. 8

### 3.1.2 Install the front axle

#### Procedure

1. Lubricate the O-ring (1) and the backup ring (2) before installing the pivot pin.
2. Put the front axle into position under the tractor.
3. Connect the two hoses from the steering cylinder.

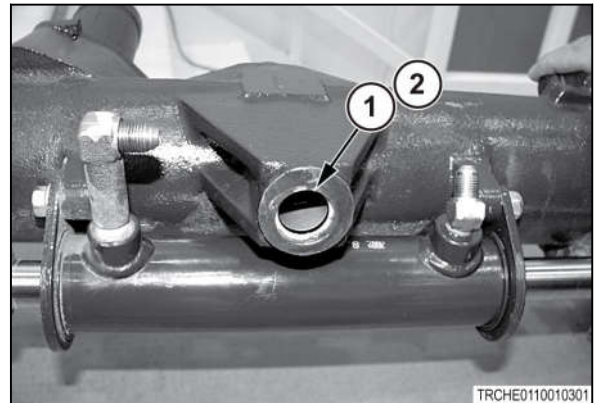


Fig. 9



Fig. 10

4. Install the pivot pin assembly and the bolt that fastens the pivot pin.
5. Install and tighten the nut on the pivot pin to standard torque value and then rotate the nut counter clockwise 60°. Install the cotter pin.

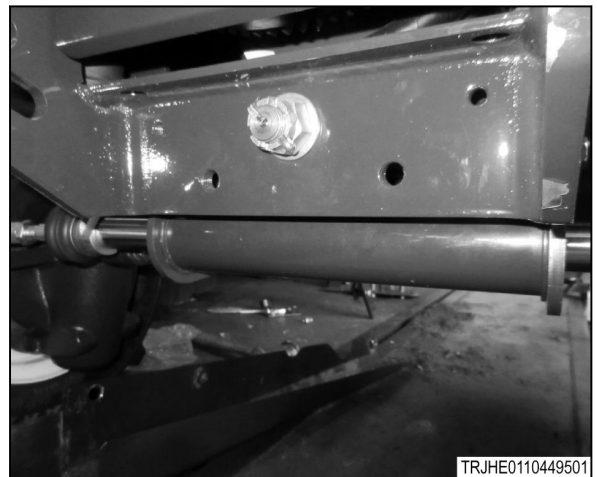


Fig. 11

6. Install the front axle drive shaft onto the shaft of the front axle.  
Install the front drive shaft so that the U-joints are in phase with each other.
7. Install the bolt for the U-joint.



Fig. 12



8. Slide the drive shaft shield onto the front axle.
9. Install the bolt (1) that fastens the front drive shaft shield to the front axle.

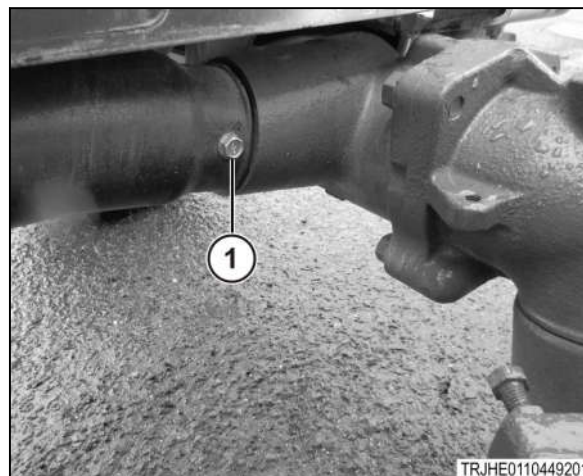


Fig. 13

10. Install the drain plug (1) from both sides of the front axle and drain the oil.
11. Fill the front axle with oil.

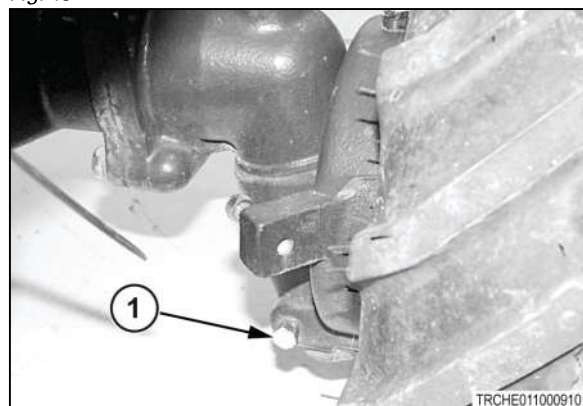


Fig. 14

### 3.1.3 Front axle view

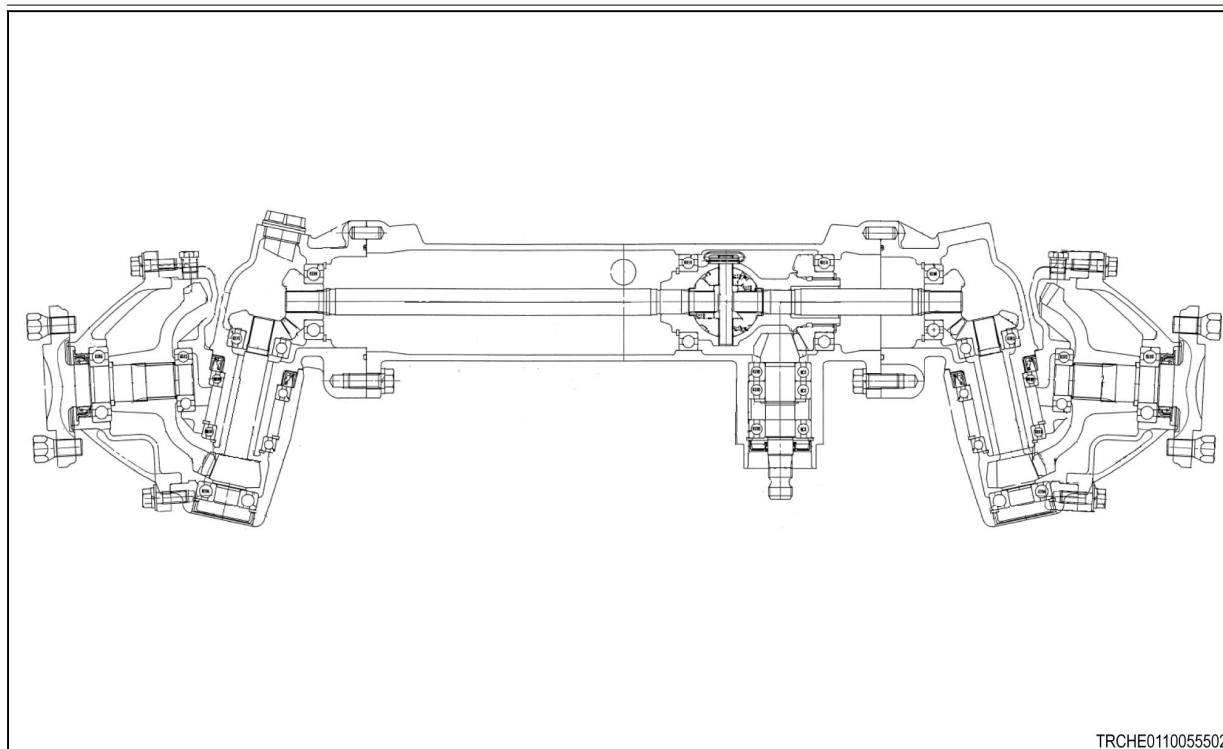


Fig. 15

### 3.1.4 Front axle final drive view

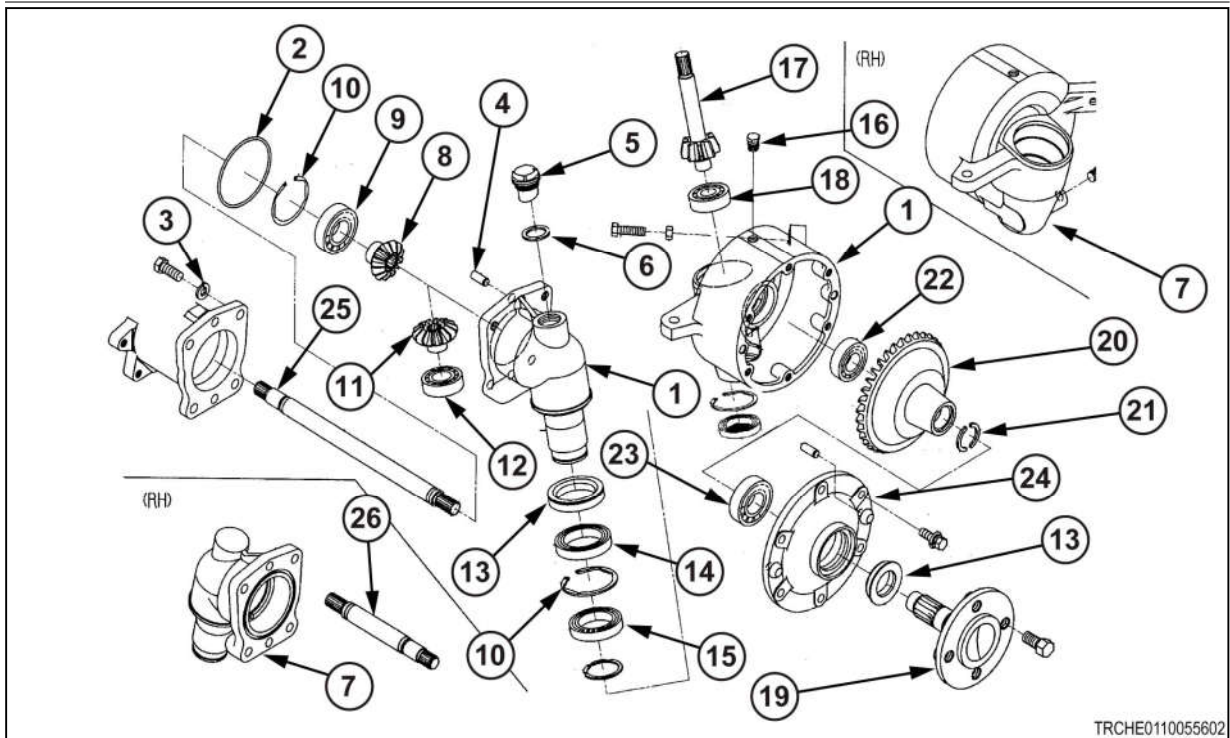


Fig. 16

- |                            |                      |
|----------------------------|----------------------|
| (1) Final case, left-hand  | (14) Bearing         |
| (2) O-ring G90             | (15) Bearing         |
| (3) Lock washer            | (16) Seal plug screw |
| (4) Pin                    | (17) Bevel gear 09   |
| (5) Oil cap                | (18) Ball bearing    |
| (6) Gasket                 | (19) Wheel shaft     |
| (7) Final case, right-hand | (20) Bevel gear 35   |
| (8) Bevel gear 13          | (21) Washer 27x36x03 |
| (9) Ball bearing           | (22) Ball bearing    |
| (10) Retainer ring         | (23) Ball bearing    |
| (11) Seal bevel gear 14    | (24) Wheel cover     |
| (12) Ball bearing          | (25) Shaft           |
| (13) Oil seal              | (26) Shaft           |

### 3.1.5 Front axle differential components

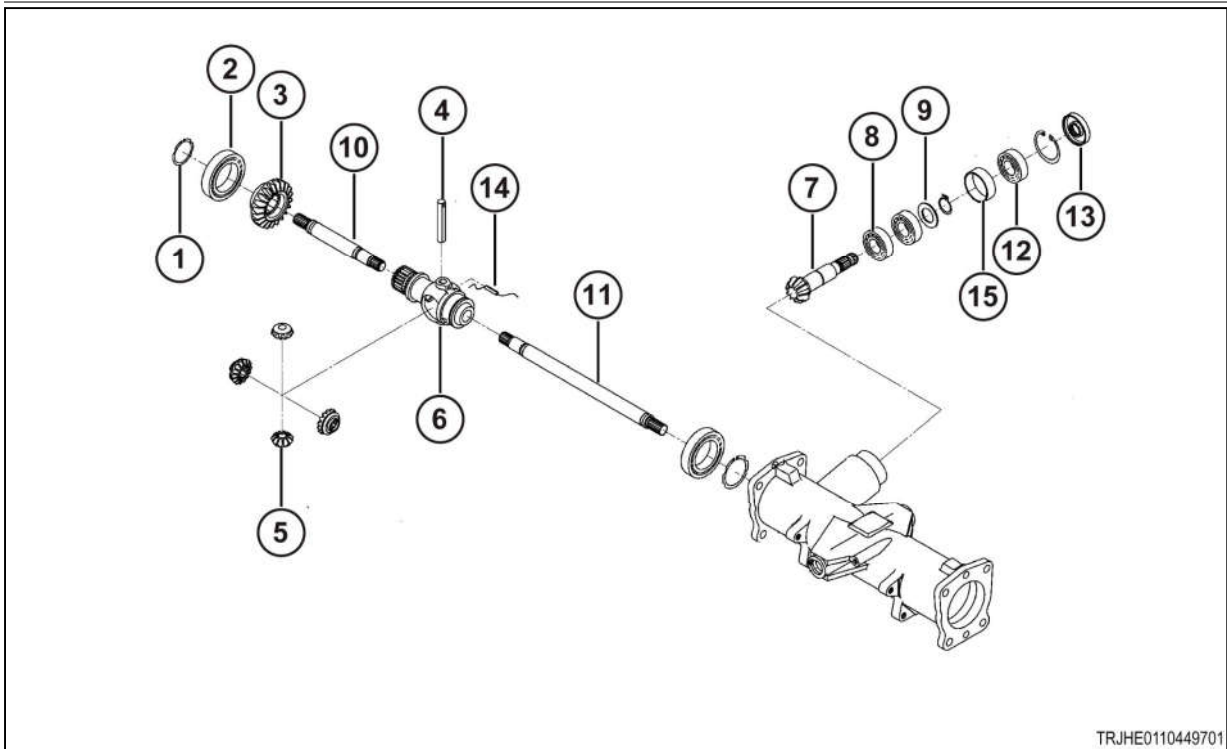


Fig. 17

- |                       |                        |
|-----------------------|------------------------|
| (1) Retaining ring    | (9) Shim               |
| (2) Bearing           | (10) Axle shaft, right |
| (3) Side gear         | (11) Axle shaft, left  |
| (4) Pinion shaft      | (12) Bearing           |
| (5) Pinion gear       | (13) Seal              |
| (6) Differential case | (14) Retaining pin     |
| (7) Pinion            | (15) Spacer            |
| (8) Bearing           |                        |

### 3.1.6 Front axle housing components

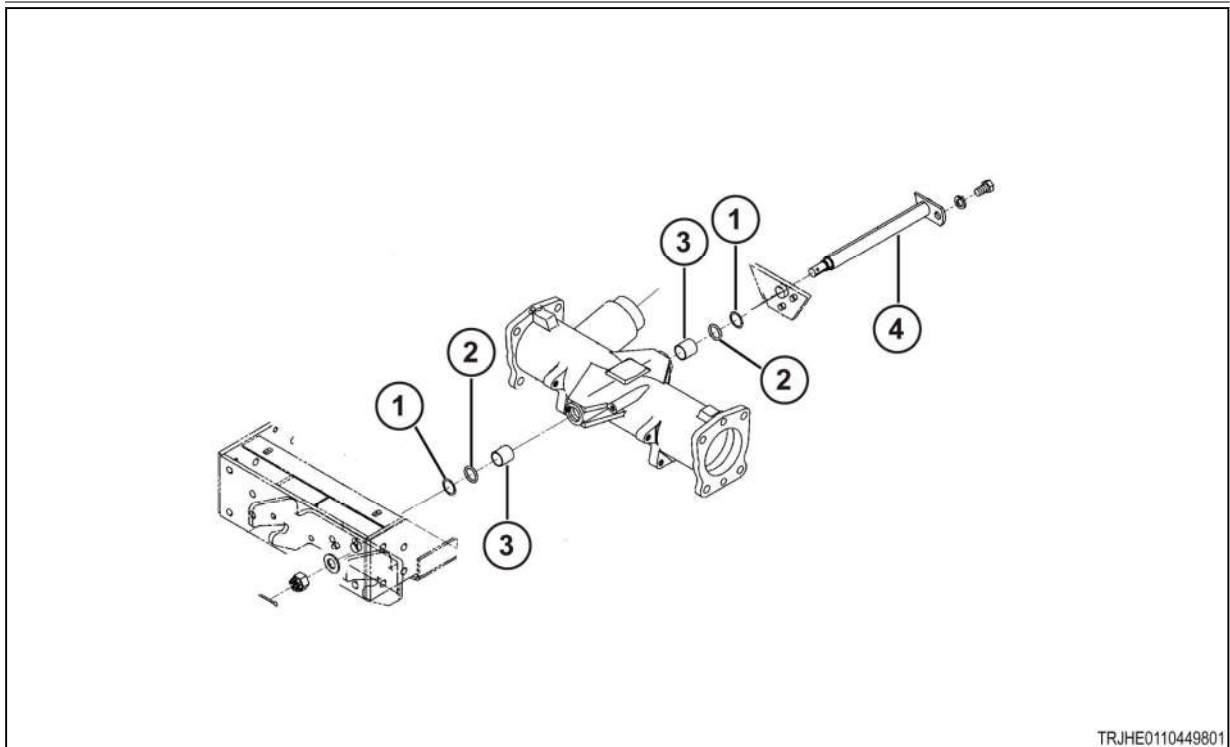


Fig. 18

(1) Backup ring  
(2) O-ring

(3) Bushing  
(4) Pivot pin

### 3.1.7 Disassemble the front axle

#### Before starting the procedure

To disassemble the entire front axle, remove the front axle from the tractor.

#### Procedure

1. Remove the rod ends (1) on the steering cylinder from the steering arms.

**NOTE:** Measure the number of exposed threads on the rod ends to aid in assembly.



Fig. 19

### 3. Axles



2. Remove the steering cylinder.

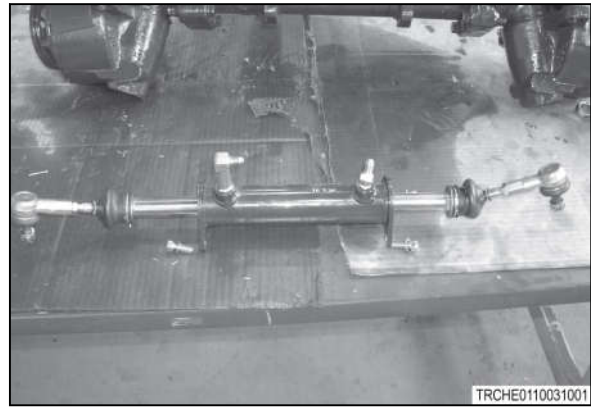


Fig. 20

3. Support the left-hand and right-hand final case assemblies and remove the retaining bolts.

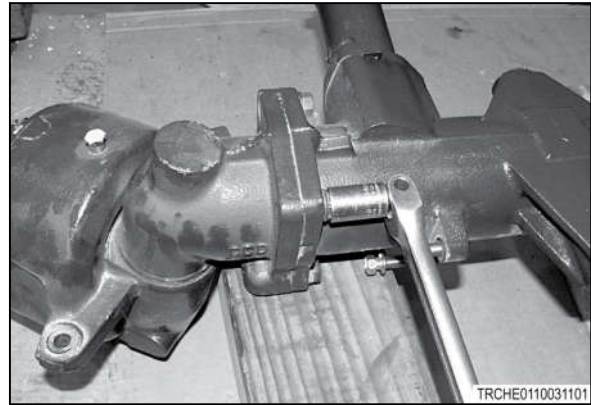


Fig. 21

4. Remove the final case assemblies.

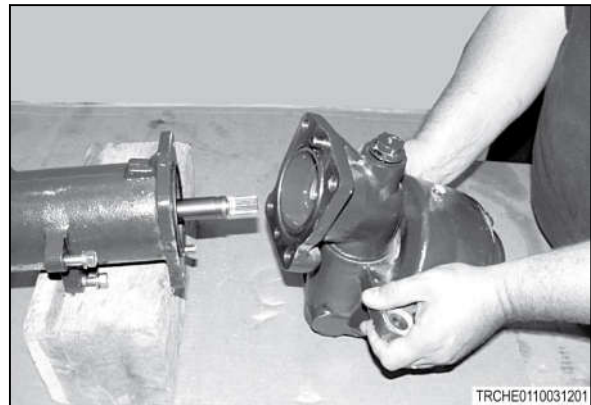


Fig. 22

5. Pull the axle shafts from both sides of the axle housing.

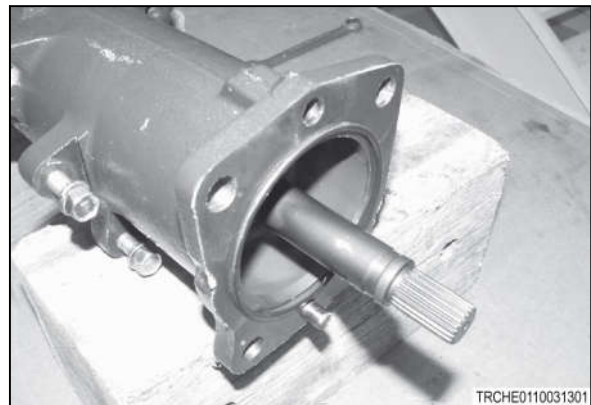


Fig. 23

6. Separate the pinion shaft from the axle housing.

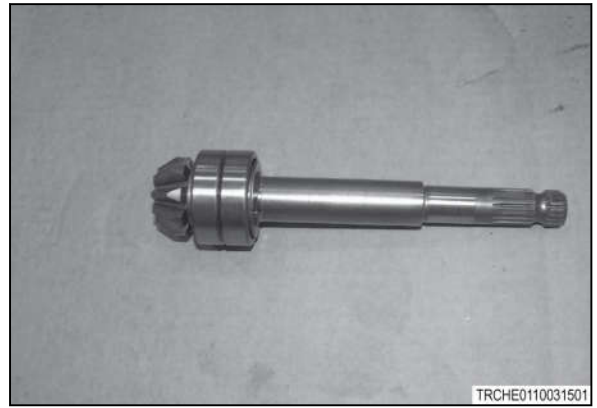


Fig. 24

7. Insert an axle shaft in the axle housing.

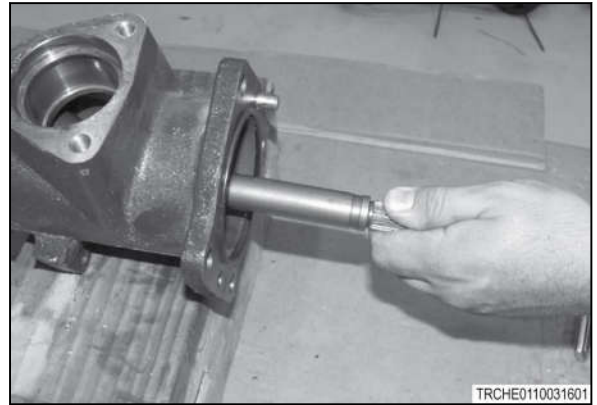


Fig. 25

8. Remove the differential assembly through the left-hand end of the axle housing using the axle shaft to push or pull the differential assembly.



Fig. 26

9. Remove the retaining ring (1) from the differential assembly.
10. Remove the ring gear.
11. Remove the pin (2).
12. Remove the differential gears and cross shaft.

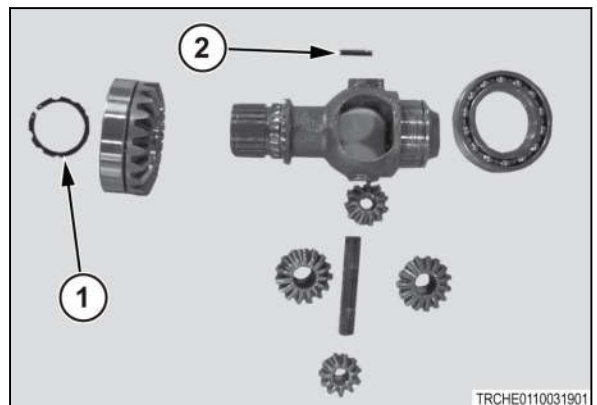


Fig. 27

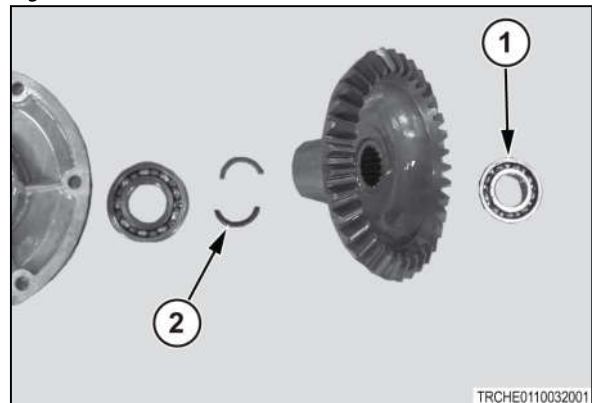
- 13. Support the outer wheel housing and remove the retaining bolts.
- 14. Separate the outer wheel housing.



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Fig. 28

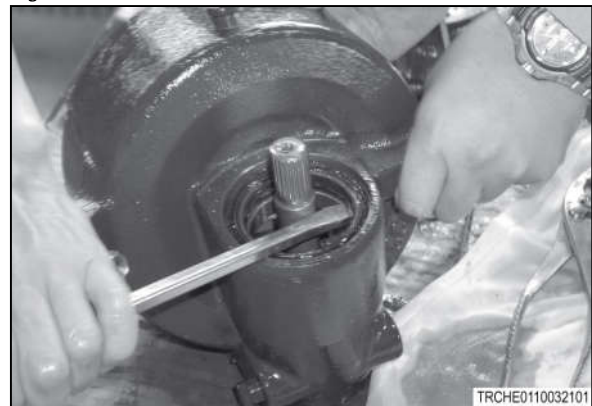
- 15. Pull the inner bearing (1) from the wheel shaft.
- 16. Pull the bevel gear from the wheel shaft.
- 17. Remove the split ring (2).
- 18. Remove the bearing and outer seal from the wheel housing.



TRCHE0110032001

Fig. 29

- 19. Remove the seal from the final case.



TRCHE0110032101

Fig. 30

20. Remove the retainer rings to disassemble the final case.

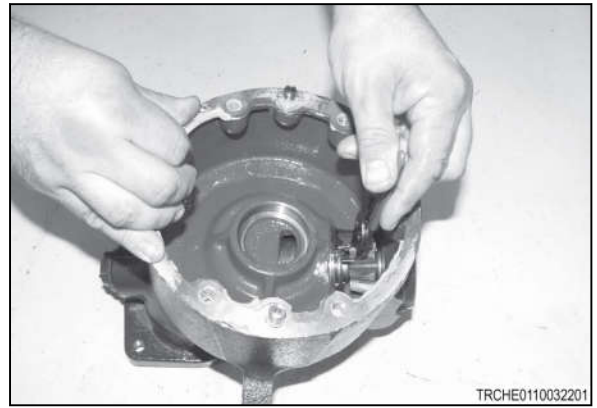


Fig. 31

21. Disassemble the bevel gear shaft assembly.



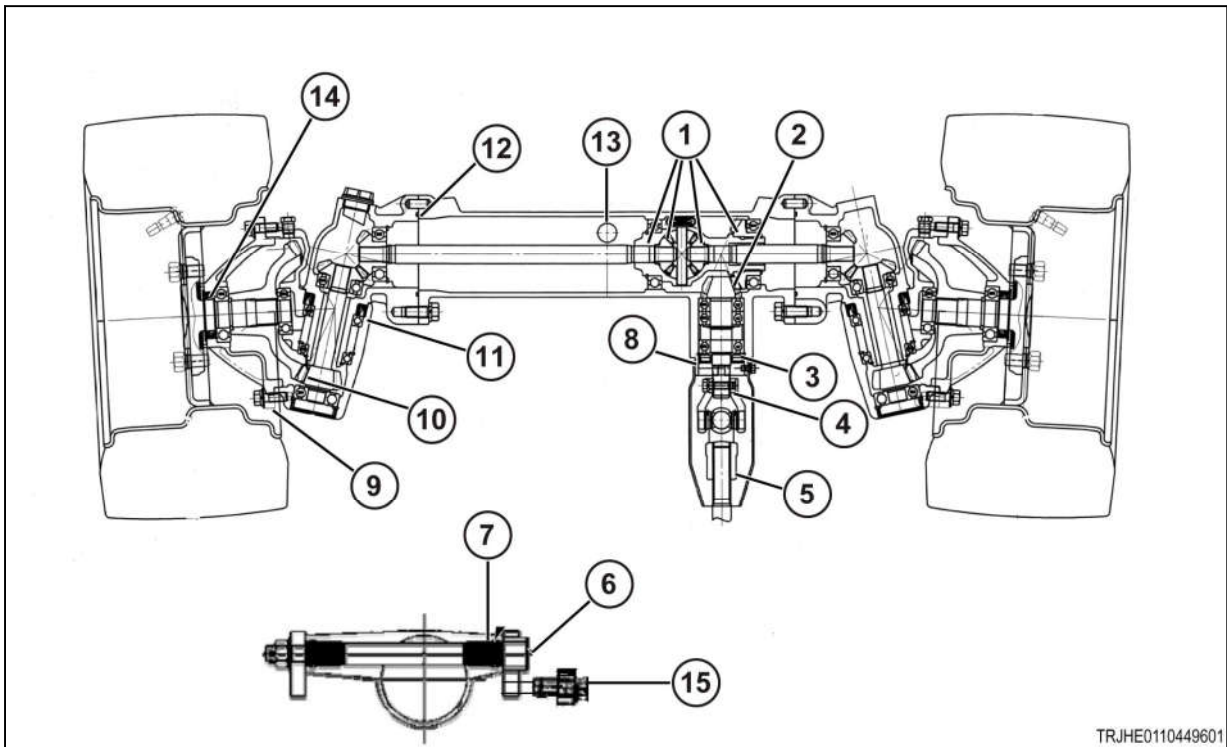
Fig. 32

### 3.1.8 Assemble the front axle

- Lubricate the seals and the O-rings prior to assembly.
- Use silicone between the outer wheel housing and the final case.
- Tighten all the hardware to standard torque values.

**NOTE:** The front ring and pinion backlash cannot be adjusted. The backlash is preset by the machine tolerance of the components.





TRJHE0110449601

Fig. 33

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>(1) Apply adhesive.</li> <li>(2) Backlash: 0.1 mm to 0.3 mm (0.004 in to 0.012 in)</li> <li>(3) Apply grease between the bearing and oil seal</li> <li>(4) Apply a thread lock compound</li> <li>(5) Apply adhesive</li> <li>(6) Apply grease to the bushings</li> <li>(7) Lubricate the O-ring</li> </ul> | <ul style="list-style-type: none"> <li>(8) Lubricate the lip on the oil seal</li> <li>(9) Apply adhesive to the face</li> <li>(10) Backlash: 0.15 mm to 0.25 mm (0.006 in to 0.01 in)</li> <li>(11) Lubricate the lip on the oil seal</li> <li>(12) Lubricate the O-ring</li> <li>(13) Angle of oscillating: 6° to 8°</li> <li>(14) Lubricate the lip on the oil seal</li> <li>(15) Apply a thread lock compound</li> </ul> |
|---|---|

**Procedure**

1. Assemble the bevel gear shaft assembly.



TRCHE0110032301

Fig. 34

2. Assemble the final case, then install the retainer ring.

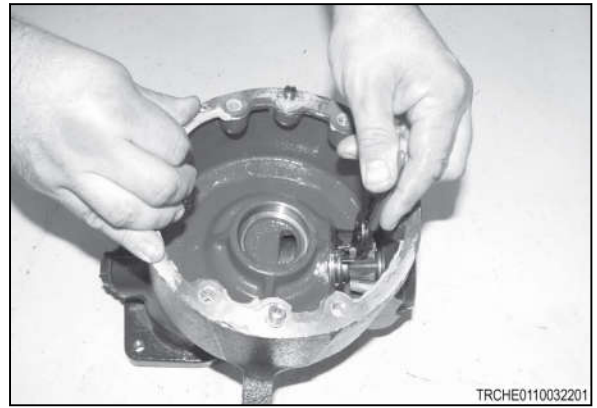


Fig. 35

3. Install the seal into the final case.

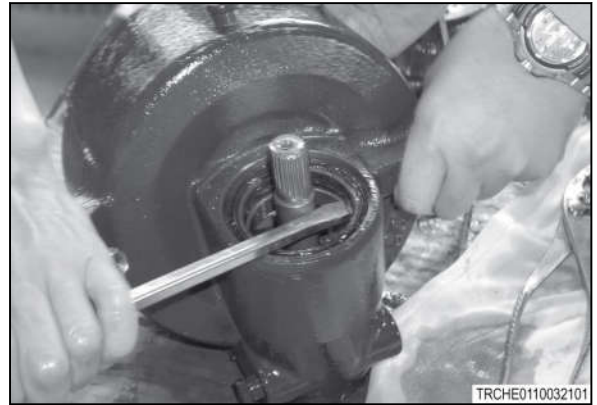


Fig. 36

4. Install the bearing and outer seal onto the wheel housing.
5. Install the split ring (2).
6. Install the bevel gear onto the wheel shaft.
7. Install the inner bearing (1) onto the wheel shaft.

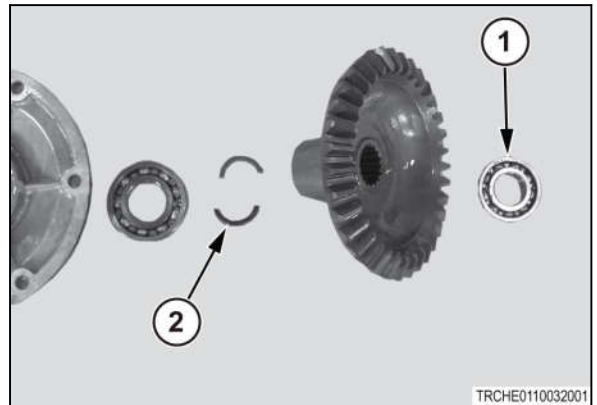


Fig. 37

8. Assemble the outer wheel housing.
9. Install the retaining bolts.



Fig. 38

10. Install the differential gears and cross shaft.
11. Install the pin (2).
12. Install the ring gear.
13. Install the retaining ring (1) from the differential assembly.

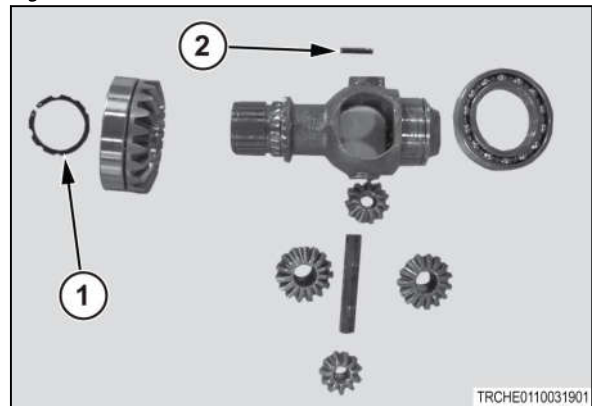


Fig. 39

14. Install the pinion shaft into the axle housing.



Fig. 40

15. Install the differential assembly through the left-hand end of the axle housing using the axle shaft to push or pull the differential assembly.

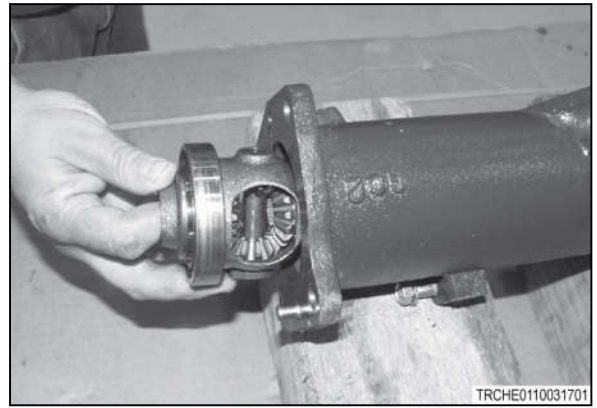


Fig. 41

16. Install the axle shafts.

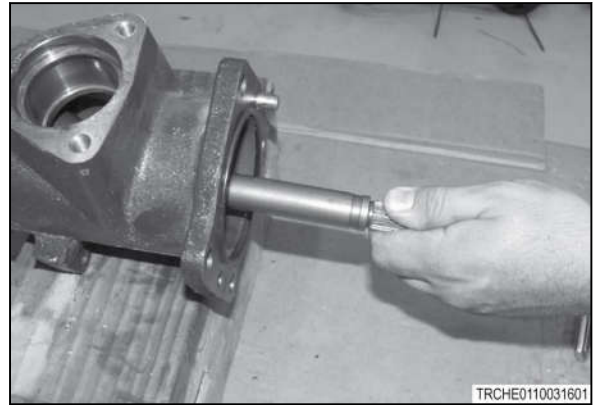


Fig. 42

17. Install the final case assemblies.

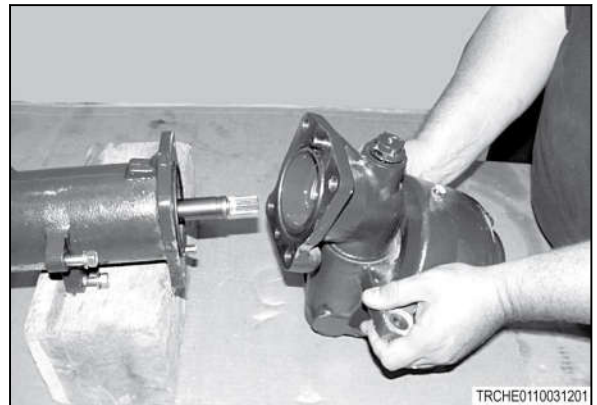


Fig. 43

18. Install the retaining bolts.

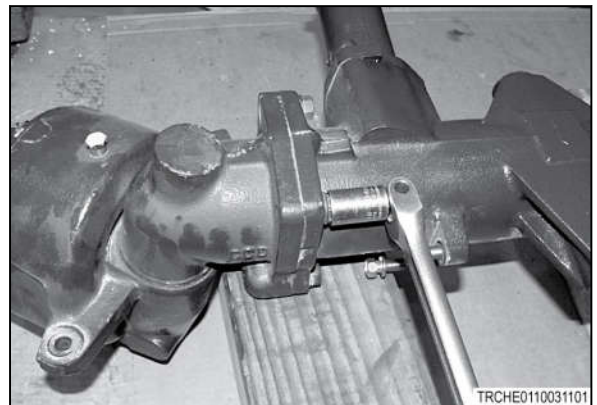


Fig. 44

19. Install the steering cylinder.

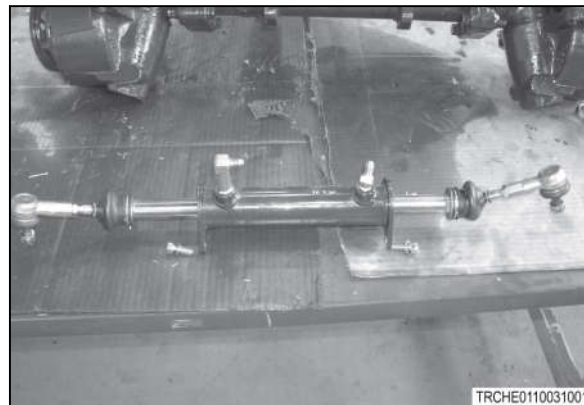


Fig. 45

20. Install the rod ends (1) on the steering cylinder to the steering arms.



Fig. 46

### 3.1.9 Front axle oil

The front drive axle has a common oil level for the front differential housing and each wheel reduction unit.

### 3.1.10 Examine the front axle oil level

#### Procedure

1. Park the machine on a solid, level surface. Stop the engine, apply the parking brake, and take the key with you.
2. Remove the oil fill plug (1) on the top of the right-hand front axle.
3. Remove the plugs (2) on the top of the final case on both sides of the axle.
4. Examine the oil level.  
Make sure that the oil level is at the mid point of the axle shaft inside the front axle housing. If the oil level is low, add oil to the front axle through the fill plug.
5. Install the plugs on the top of the final case on both sides of the axle.
6. Install the oil fill plug.

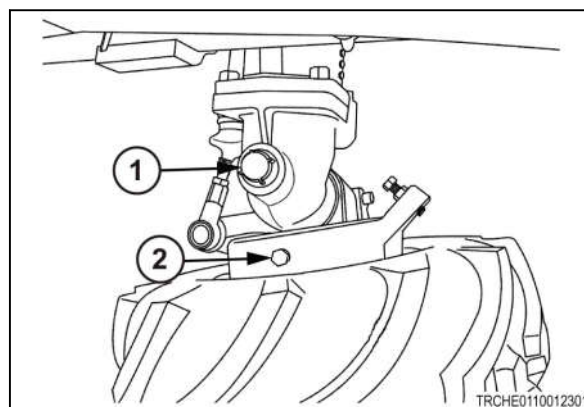


Fig. 47

#### Related Links

[Capacities](#) page 1-26

### 3.1.11 Change the front axle oil

#### Procedure

1. Park the machine on a solid, level surface. Stop the engine, apply the parking brake, and take the key with you.
2. Put suitable catch pans under the drain plugs (1).
3. Remove the drain plugs and drain the oil out of the final case on the front axle.
4. Wrap the threads of the drain plugs with sealing tape.
5. When the oil has drained completely, install the drain plugs securely.
6. Remove the plugs (2) on the top of the final case on both sides of the axle to let air out of the front axle.
7. Fill with oil through the oil fill hole (3).
8. Wait 5 minutes to let air to escape from the front axle.
9. Examine the oil level.
10. Install the plugs on the top of the final case on both sides of the axle.

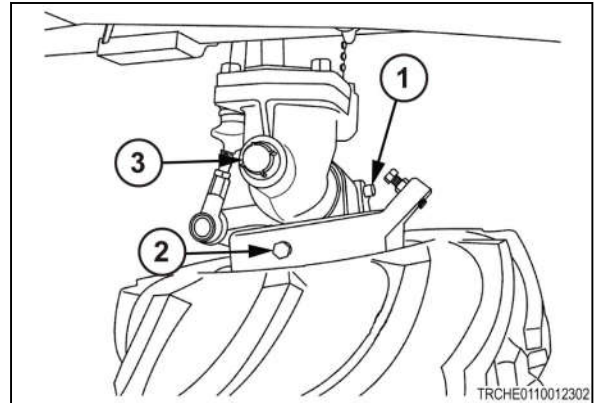


Fig. 48

#### Related Links

[Capacities](#) page 1-26

[Lubrication fill and drain locations](#) page 1-36

[Lubrication specifications](#) page 1-26

[Lubrication and maintenance chart](#) page 1-34

### 3.1.12 Adjust the front wheel alignment

The correct toe-in dimensions of the front wheels (A minus B) are 2 mm to 6 mm (0.08 in to 0.24 in).

#### NOTE:

Measure toe-in from the tire center to the tire center at a point halfway up on the face of each tire.

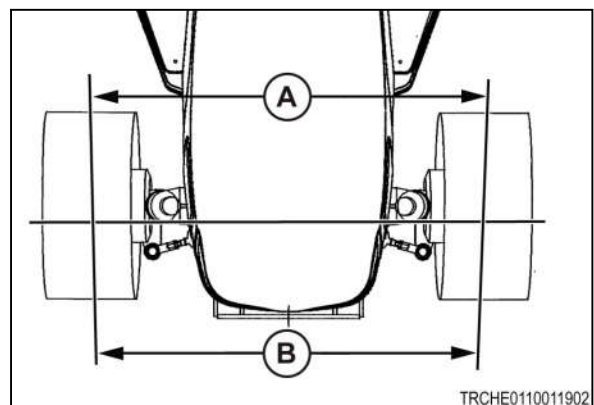


Fig. 49

#### Procedure

1. Remove the clip securing the rubber boot to the tie rod.
2. Loosen the lock nut.

3. Rotate the tie rod to adjust.

**NOTE:**

*Adjust each side evenly.*

4. Tighten the lock nut.

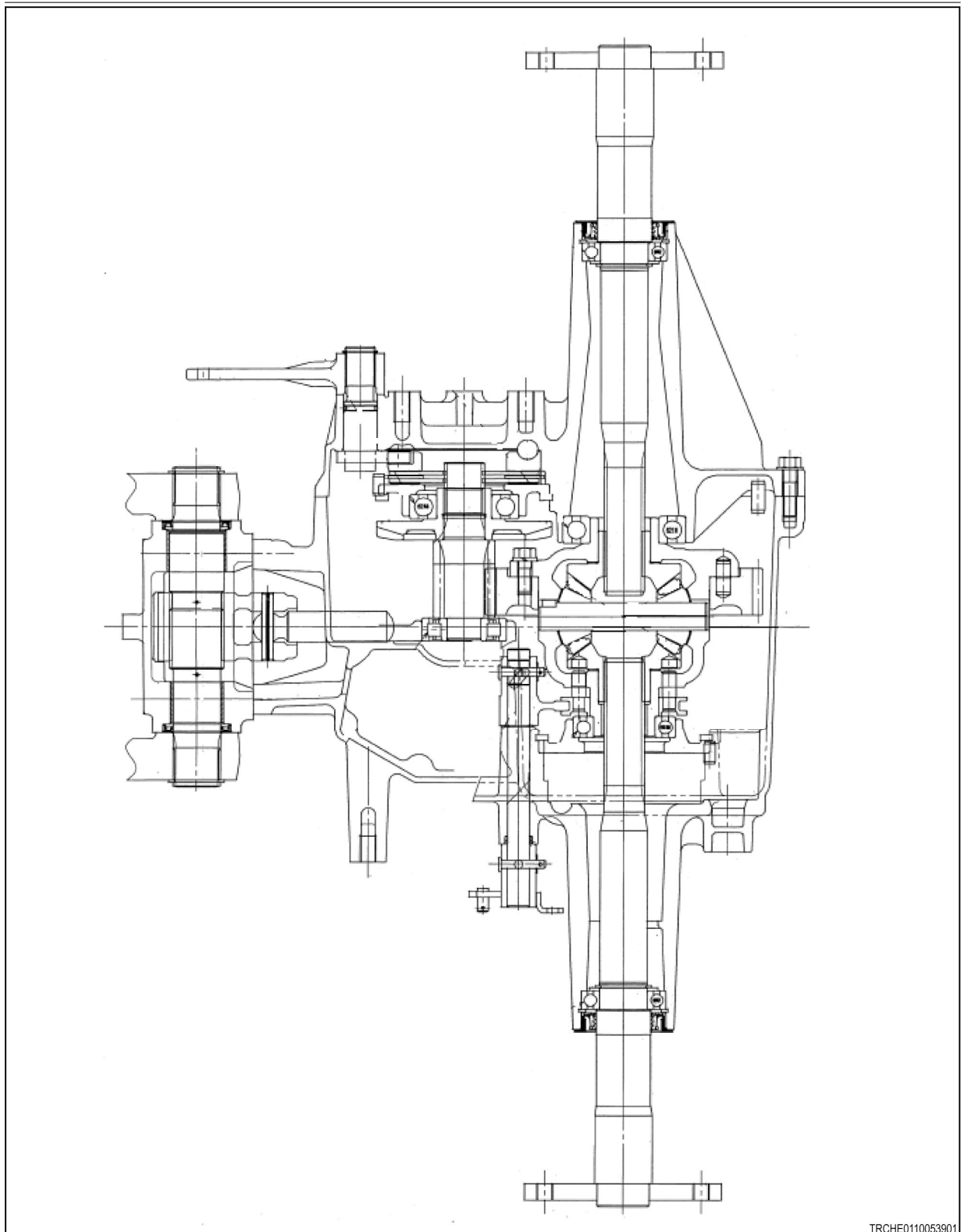
**NOTE:**

*The tie rod ball joints must rotate freely in the cylinder ends. The ball joints must move freely after the nuts are tightened.*

5. Install the clip securing the rubber boot to the tie rod.

## 3.2 Rear axle

### 3.2.1 Rear axle view

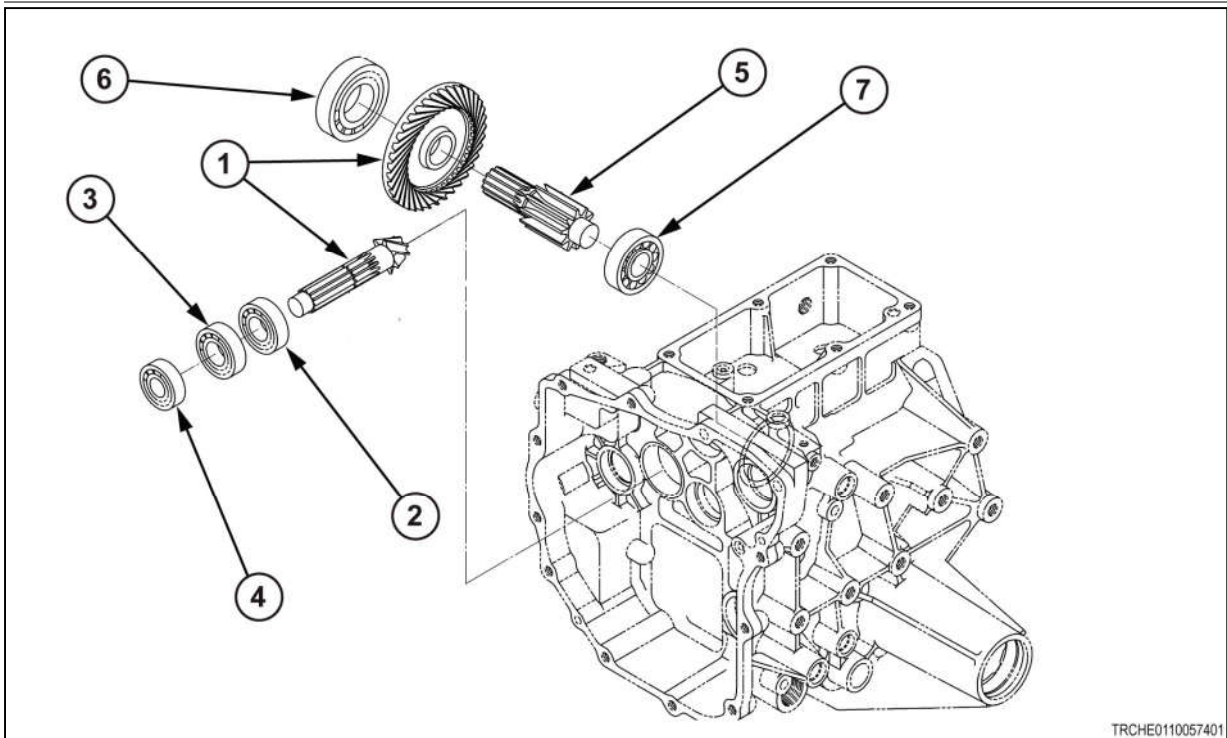


TRCHE0110053901

Fig. 50



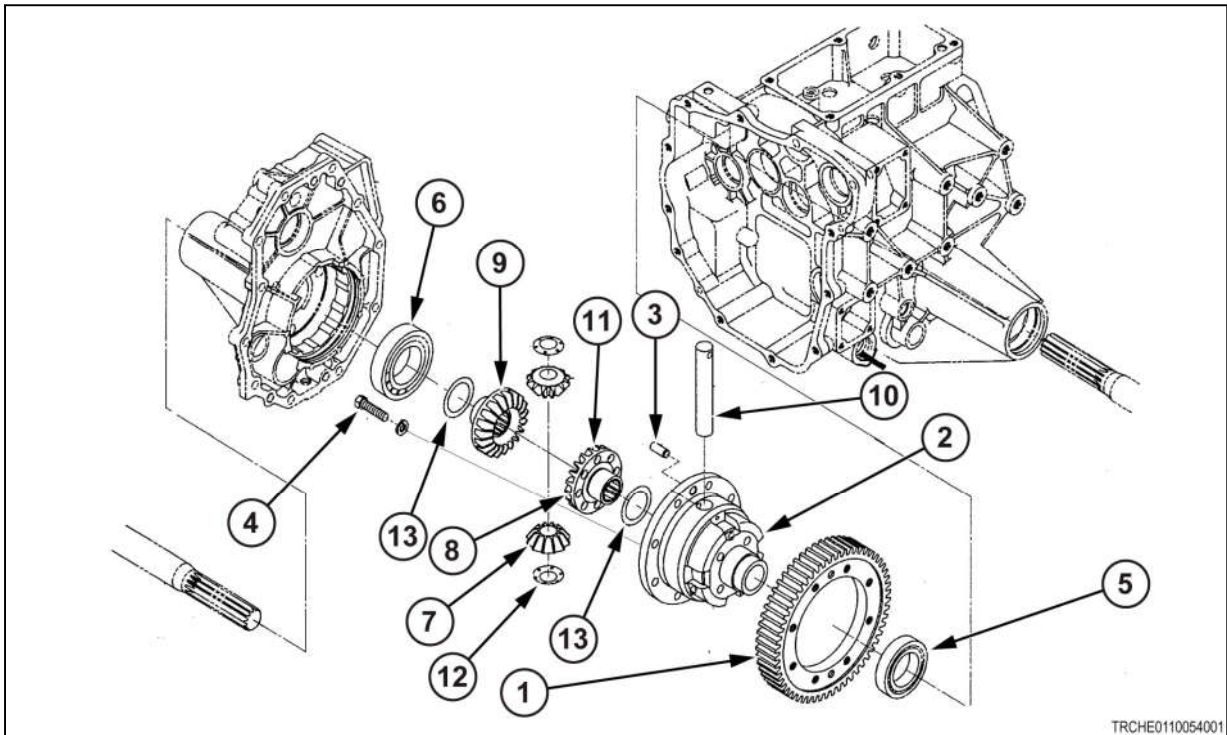
### 3.2.2 Rear axle ring and pinion components



TRCHE0110057401

Fig. 51

- |                                 |                    |
|---------------------------------|--------------------|
| (1) Ring and pinion kit         | (5) Spur gear 10   |
| (2) Ball bearing                | (6) Ball bearing   |
| (3) Bearing with retaining ring | (7) Roller bearing |
| (4) Ball bearing                |                    |



TRCHE0110054001

Fig. 52

- |                           |                                  |
|---------------------------|----------------------------------|
| (1) Spur gear, 56         | (8) Bevel gear, 20 with holes    |
| (2) Differential case     | (9) Bevel gear, 20 without holes |
| (3) Pin                   | (10) Pinion shaft                |
| (4) Bolt with lock washer | (11) Pin 08x45                   |
| (5) Bearing               | (12) Pinion washer               |
| (6) Bearing               | (13) Washer 38x52x01             |
| (7) Bevel pinion, 12      | (14) Key 05x05x10                |

### 3.2.3 Disassemble the rear axle ring and pinion

#### Procedure

1. Remove the rear transmission housing assembly.
2. Remove the retainer ring.
3. Remove the differential lock arm from the left-hand side.

**IMPORTANT:** Do not lose or damage the O-rings (1) on the differential lock shaft.

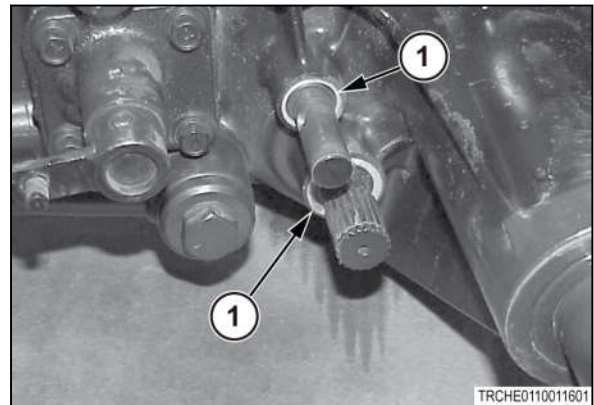


Fig. 53

4. Remove the hardware from the right-hand axle housing.

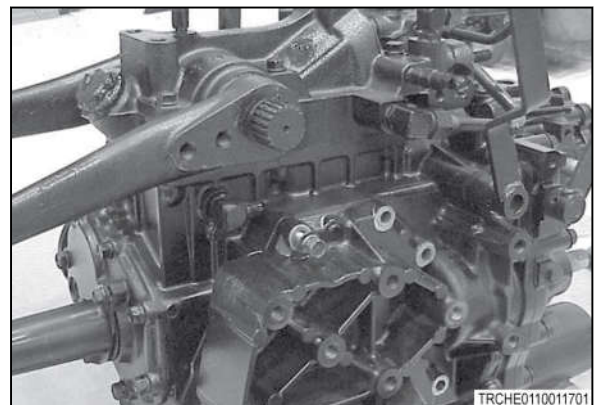


Fig. 54

5. Remove the right-hand axle housing.

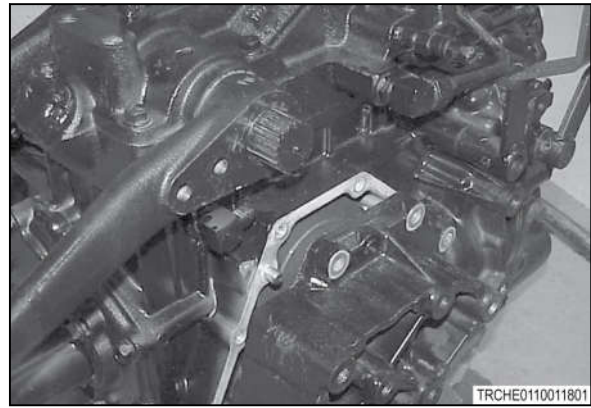


Fig. 55

6. Remove the ring gear.
7. Remove the bearing from the ring gear.



Fig. 56

8. Remove the pinion shaft.

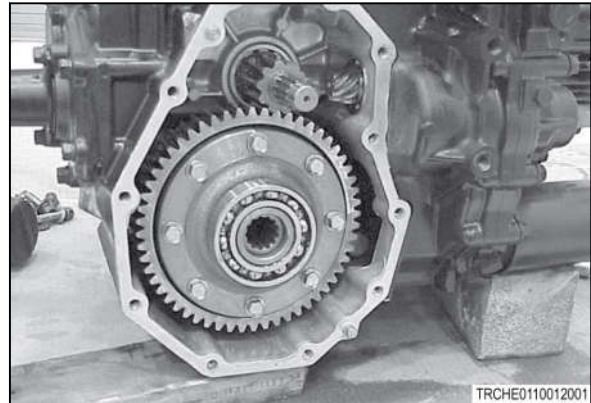


Fig. 57

9. Remove the inner side of the bearing from the pinion gear.

**NOTE:** The roller bearing is still remaining on the transmission case side.

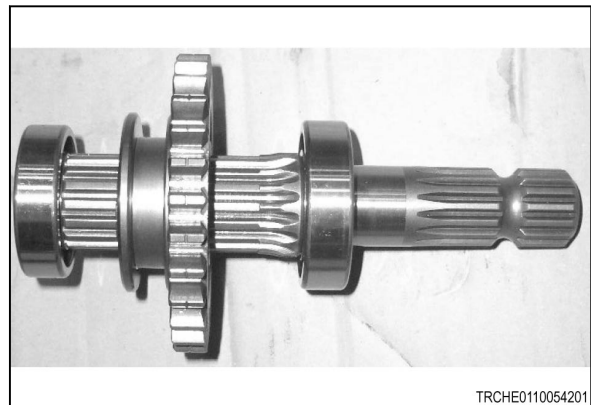


Fig. 58

10. Remove the differential assembly.

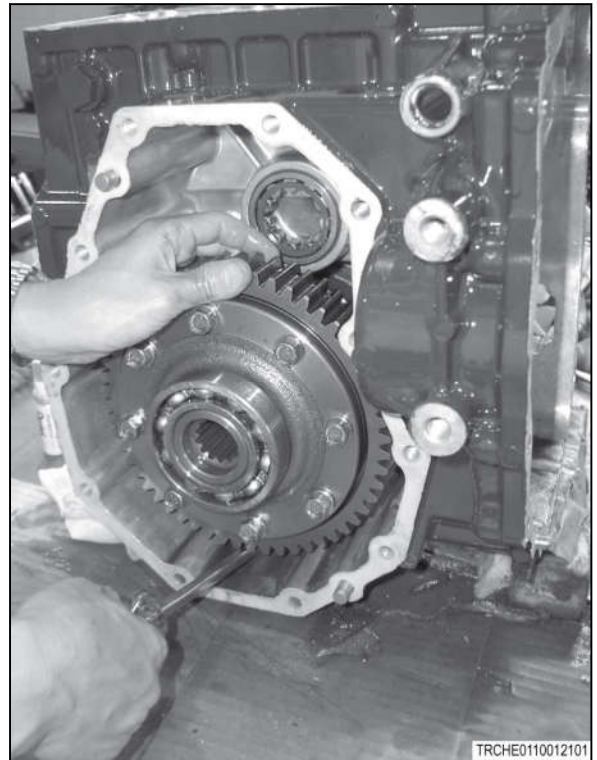


Fig. 59

11. Remove the differential lock shift fork assembly.

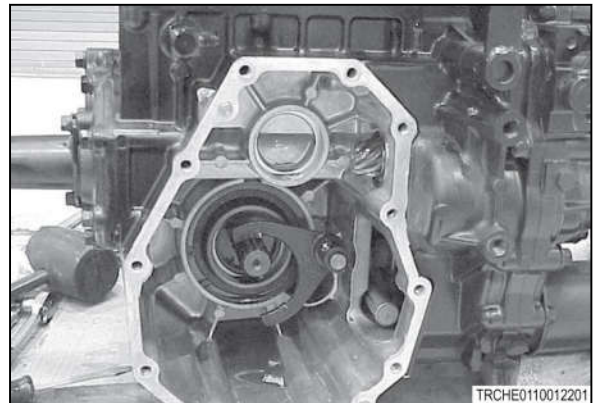


Fig. 60

12. Remove the hardware securing the bull gear to the differential case.



Fig. 61

13. Remove the spur gear.

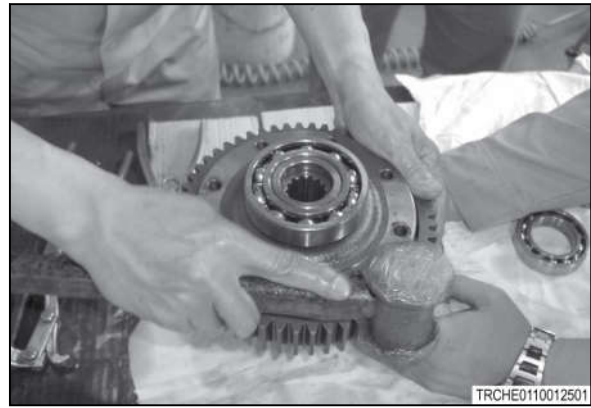


Fig. 62

14. Separate the differential case halves.



Fig. 63

15. Insert a punch in the hole (1), located in the case, to remove the locking key.

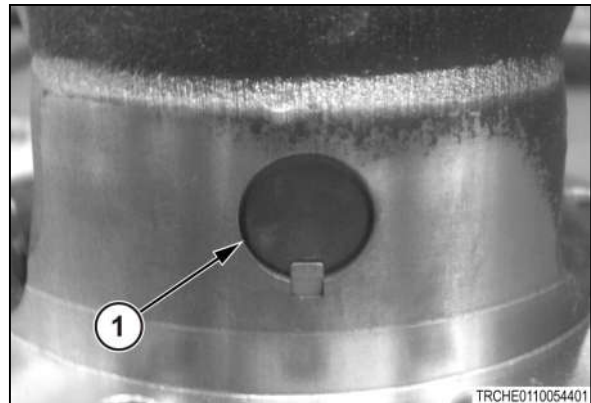


Fig. 64

16. Remove the pinion shaft, pinion gears and washers.

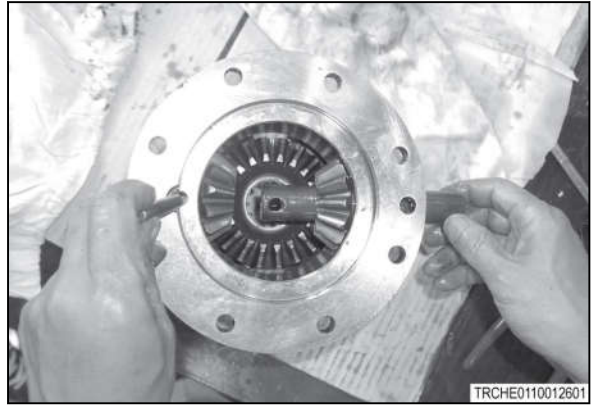


Fig. 65

17. Remove the side gears.

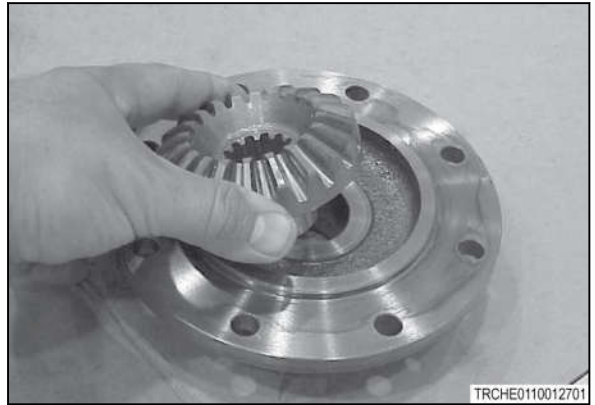


Fig. 66

18. Remove the shims between the side gear and the case.

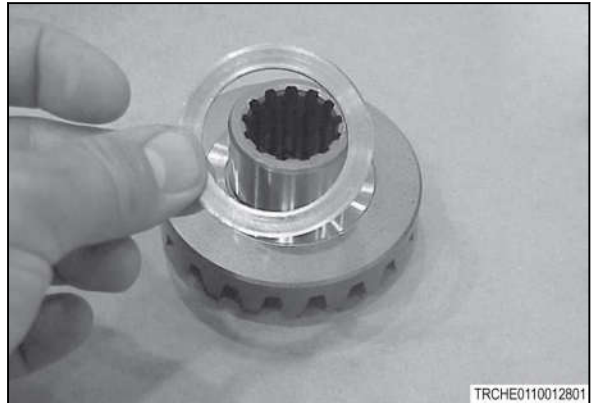


Fig. 67

19. Remove the bearings from the case.



Fig. 68

### 3.2.4 Rear axle assembly specifications

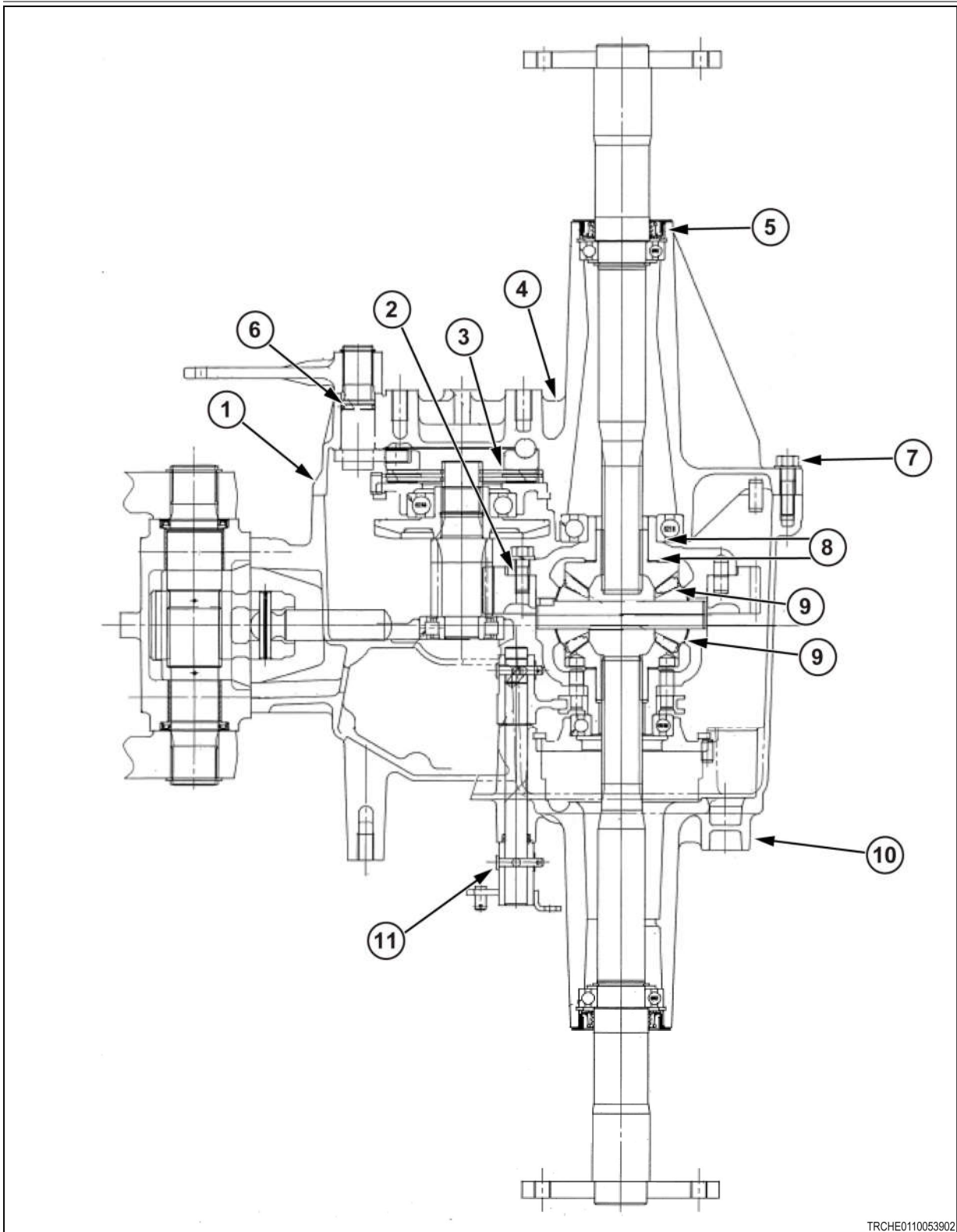


Fig. 69

- |  |   |
|--|---|
| (1) Apply adhesive to the face             | (3) Apply grease to the periphery of the pressure plate |
| (2) Apply thread lock compound to the bolt | (4) Apply grease to the steel ball                      |

- |  |                                 |
|--|---------------------------------|
| (5) Apply grease to the oil seal lip                           | (8) Apply adhesive              |
| (6) Apply grease to the O-ring                                 | (9) Apply adhesive              |
| (7) Tighten to 41.2 Nm to 46.1 Nm (30.4 lbf ft to 34.0 lbf ft) | (10) Apply grease to the O-ring |
|  | (11) Apply grease to the O-ring |

### 3.2.5 Assemble the rear axle ring and pinion

- The ring and pinion backlash is preset by the machine tolerances of the component parts. No adjustment is necessary.
- Use silicone between the axle housing and the final case.
- Tighten all hardware to the standard torque values.

#### Procedure

1. Install the bearings onto the case.
2. Install the shims between the side gear and the case.

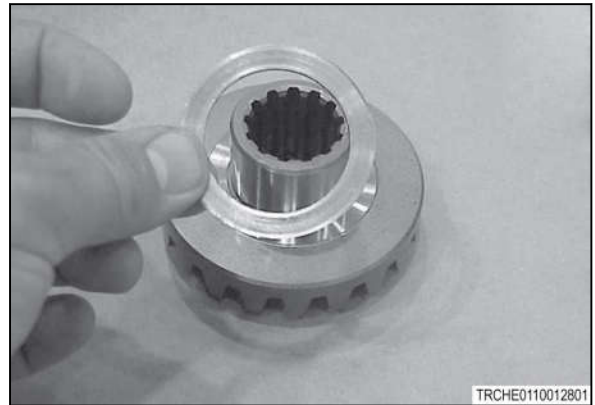


Fig. 70

3. Install the side gears.

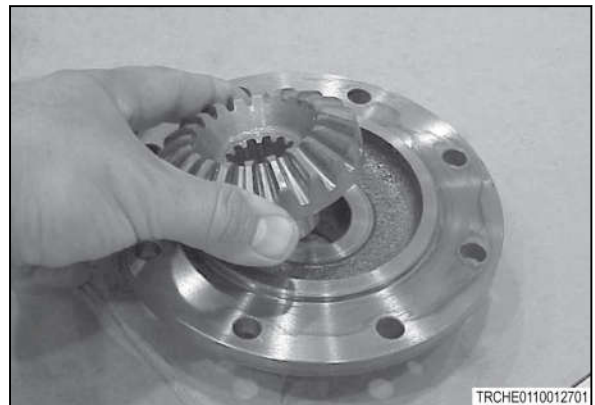


Fig. 71



### 3. Axles



4. Install the pinion shaft, pinion gears and washers.
5. Install the locking key.

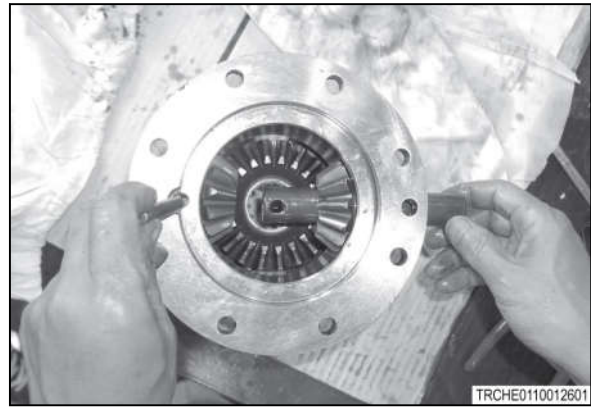


Fig. 72

6. Put the differential case halves together.



Fig. 73

7. Install the hardware securing the bull gear to the differential case.

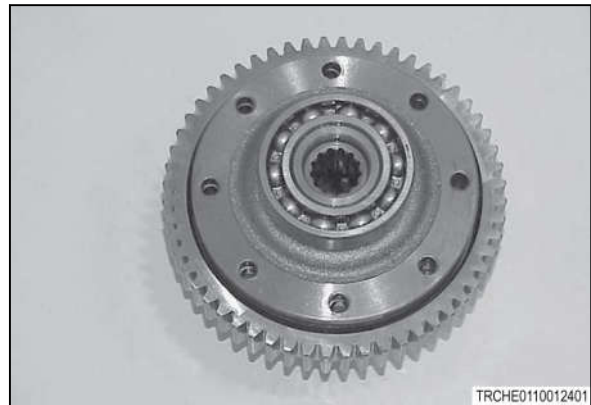


Fig. 74

8. Install the differential lock shift fork assembly.

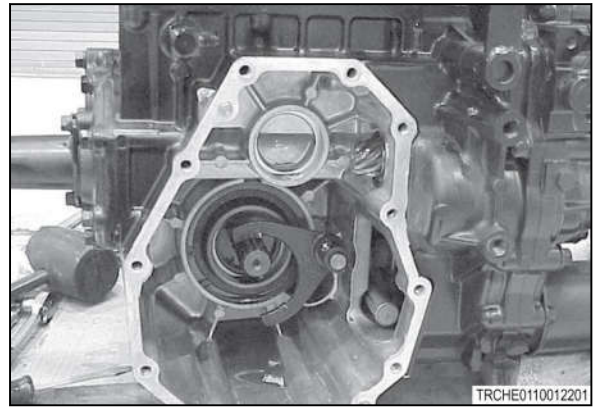


Fig. 75

9. Install the differential assembly.

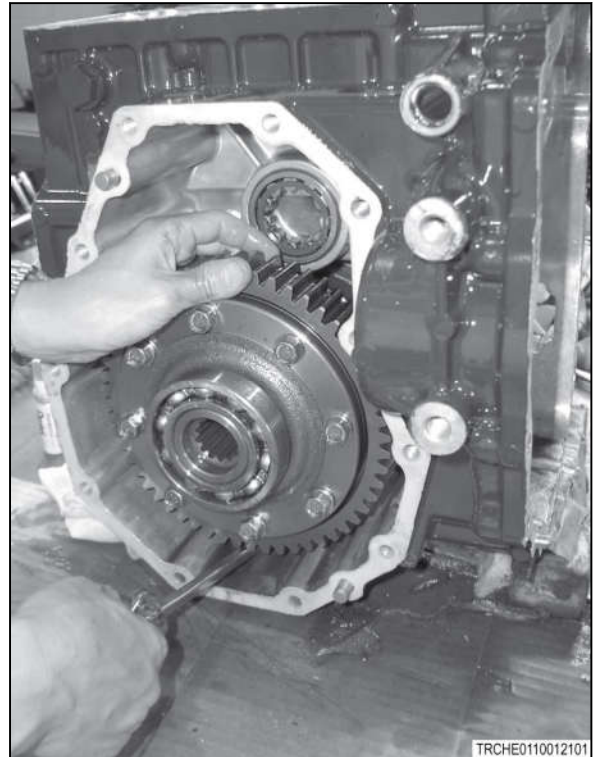


Fig. 76

10. Install the inner side of the bearing onto the pinion gear.

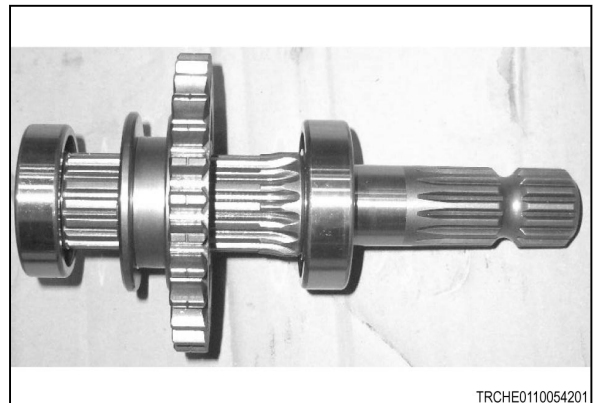


Fig. 77

- 11. NOTE:** Make sure that the roller bearing is still in the transmission case.

Install the pinion shaft.

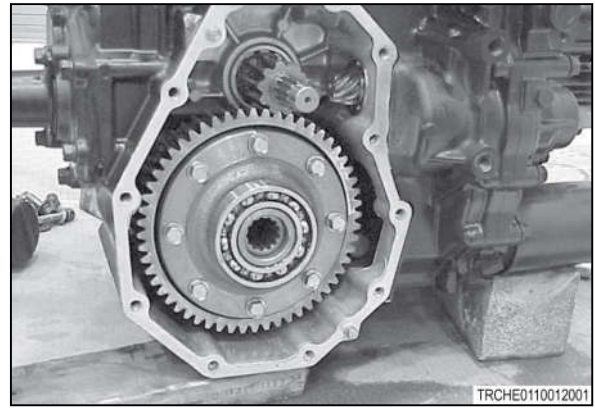


Fig. 78

- 12.** Install the ring gear and the bearing.



Fig. 79

- 13.** Install the right-hand axle housing.

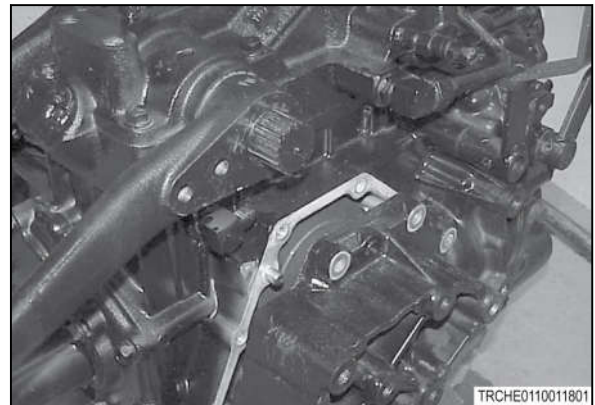


Fig. 80

- 14.** Install the hardware on the right-hand axle housing.

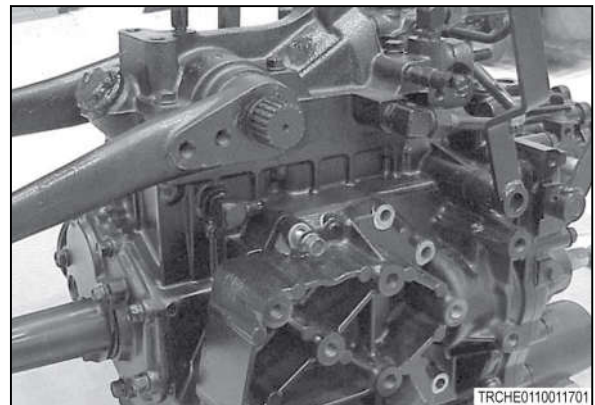


Fig. 81

15. Install the O-rings (1) on the differential lock shaft.
16. Install the differential lock arm.
17. Install the brake arms.
18. Install the retainer ring.

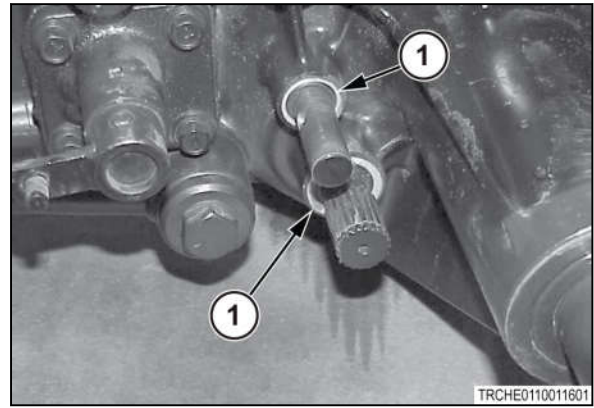


Fig. 82

### Related Links

[Rear axle assembly specifications](#) page 3-30

## 3.2.6 Differential lock

### Differential lock components.

- (1) Differential lock sleeve
- (2) Differential lock shift fork
- (3) Differential lock shaft
- (4) Pin 06x32
- (5) Washer
- (6) Cotter pin
- (7) Retainer ring
- (8) O-ring

The differential lock is a pin type differential lock. The differential case must be removed to access the differential lock.

Inspect all components for wear or damage. Do not forget to install O-rings on the shift rail. All linkages must move freely.

When the shift collar is in the out position, the differential lock is disengaged.

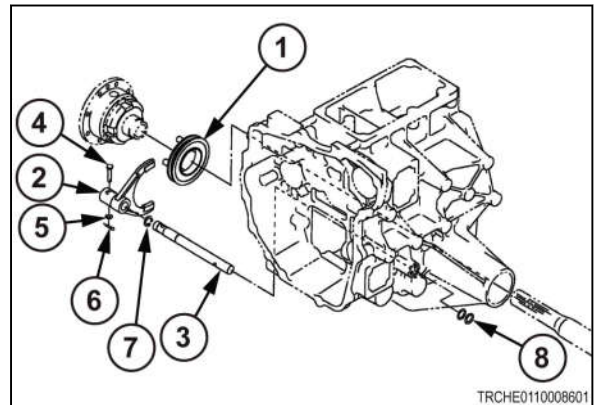


Fig. 83

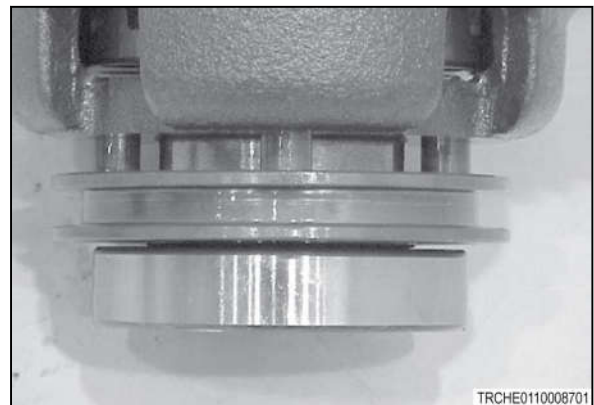


Fig. 84

When the shift collar is in the in position, the differential lock is engaged.

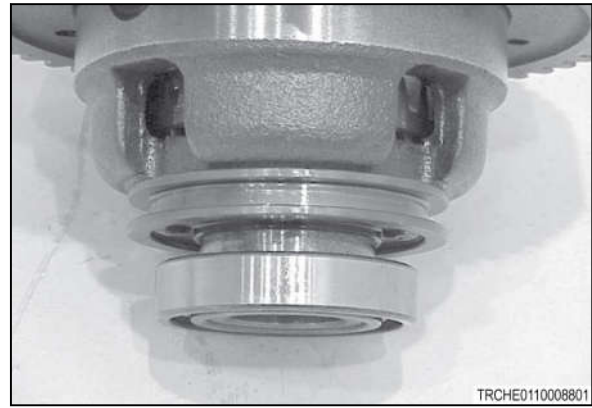


Fig. 85

### Differential lock linkage

Make sure the linkage moves freely.

- (1) Pedal
- (2) Bushing
- (3) Spring
- (4) Washer

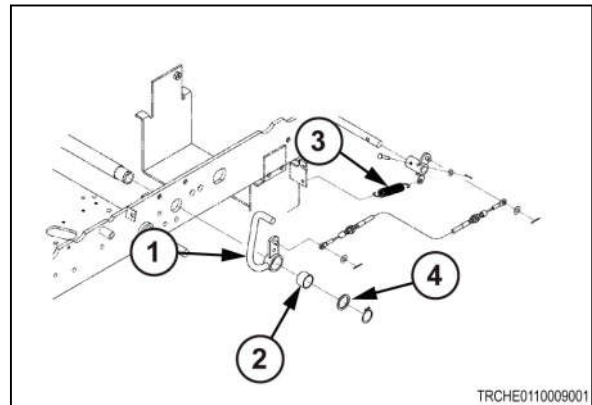


Fig. 86

### 3.2.7 Assemble the differential lock

- Use silicone between the axle housing and the final case.
- Tighten all hardware to the standard torque values.
- Make sure the differential lock shift fork is engaged.

#### Procedure

1. Install the differential lock shift fork assembly.

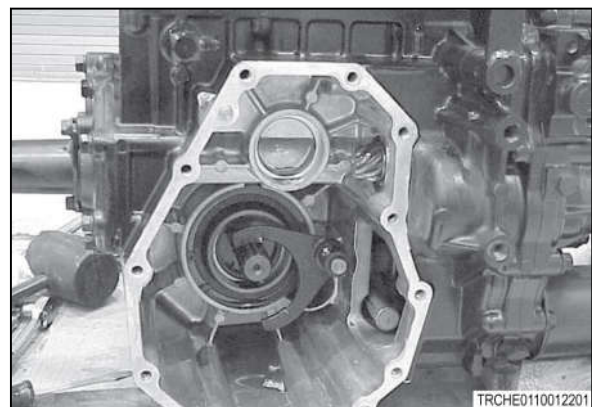


Fig. 87

2. Install the differential assembly.

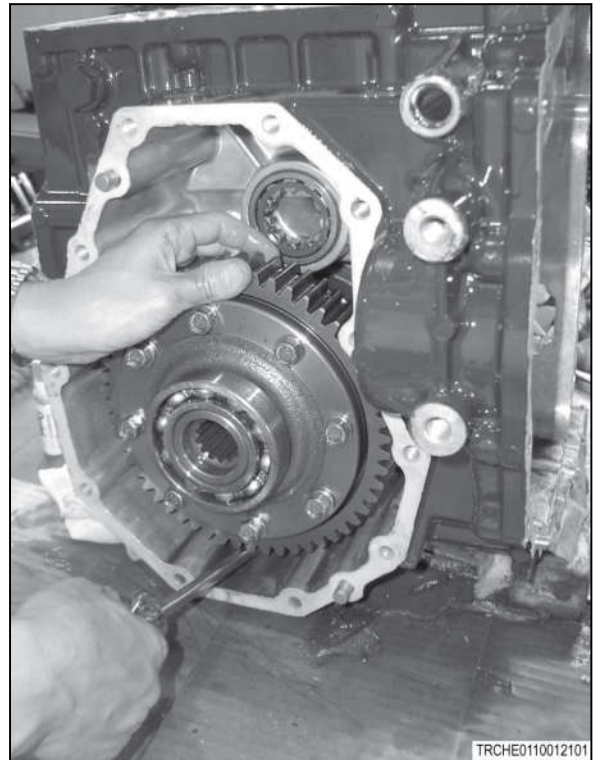


Fig. 88

3. Install the inner side of the bearing onto the pinion gear.

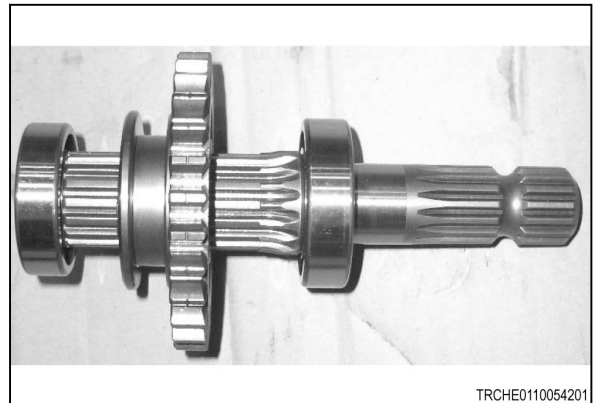


Fig. 89

4. **NOTE:** Make sure that the roller bearing is still in the transmission case.  
Install the pinion shaft.

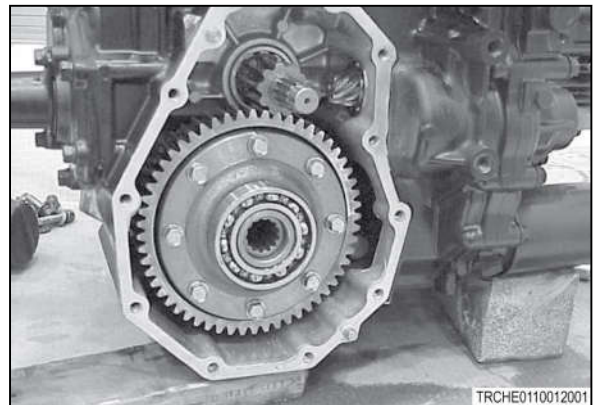


Fig. 90

5. Install the ring gear and the bearing.

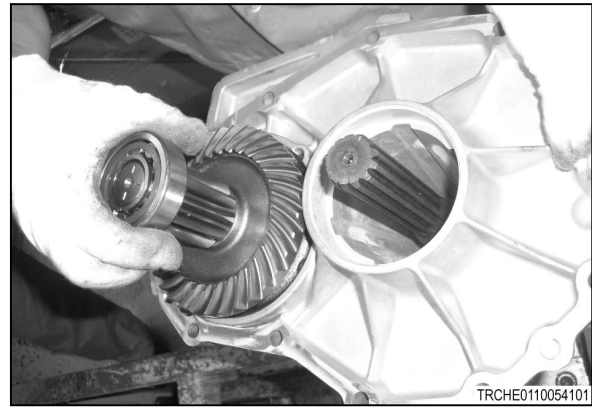


Fig. 91

6. Install the right-hand axle housing.

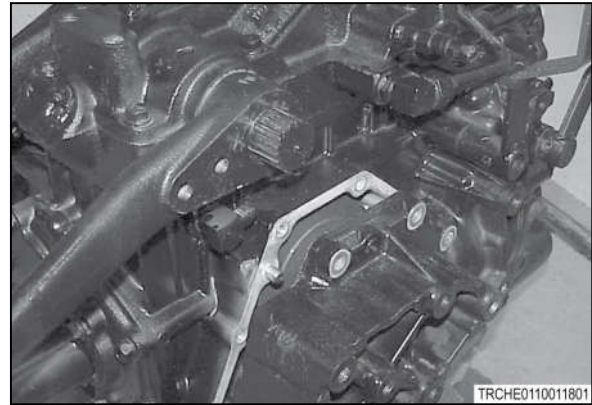


Fig. 92

7. Install the hardware on the right-hand axle housing.

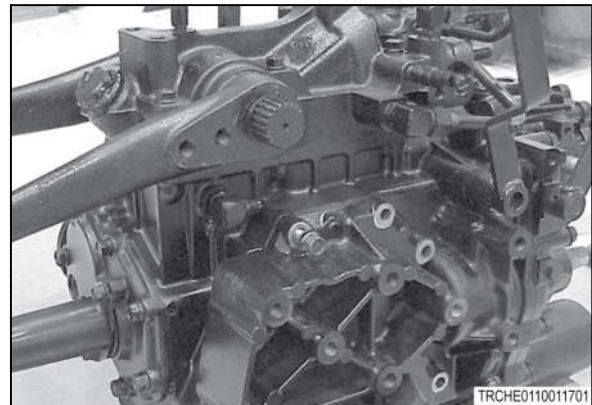


Fig. 93

8. Install the O-rings (1) on the differential lock shaft.
9. Install the differential lock arm.
10. Install the brake arms.
11. Install the retainer ring.

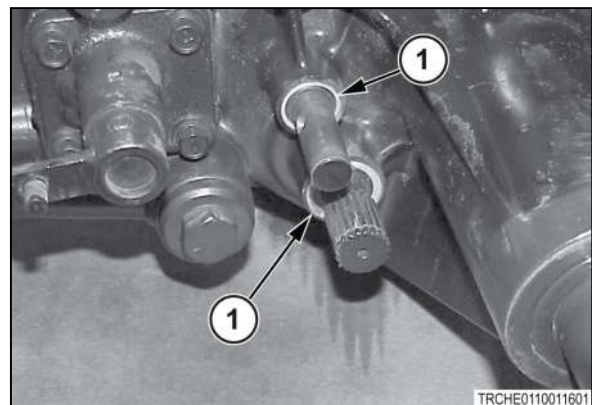


Fig. 94

**Related Links**

[Rear axle assembly specifications](#) page 3-30

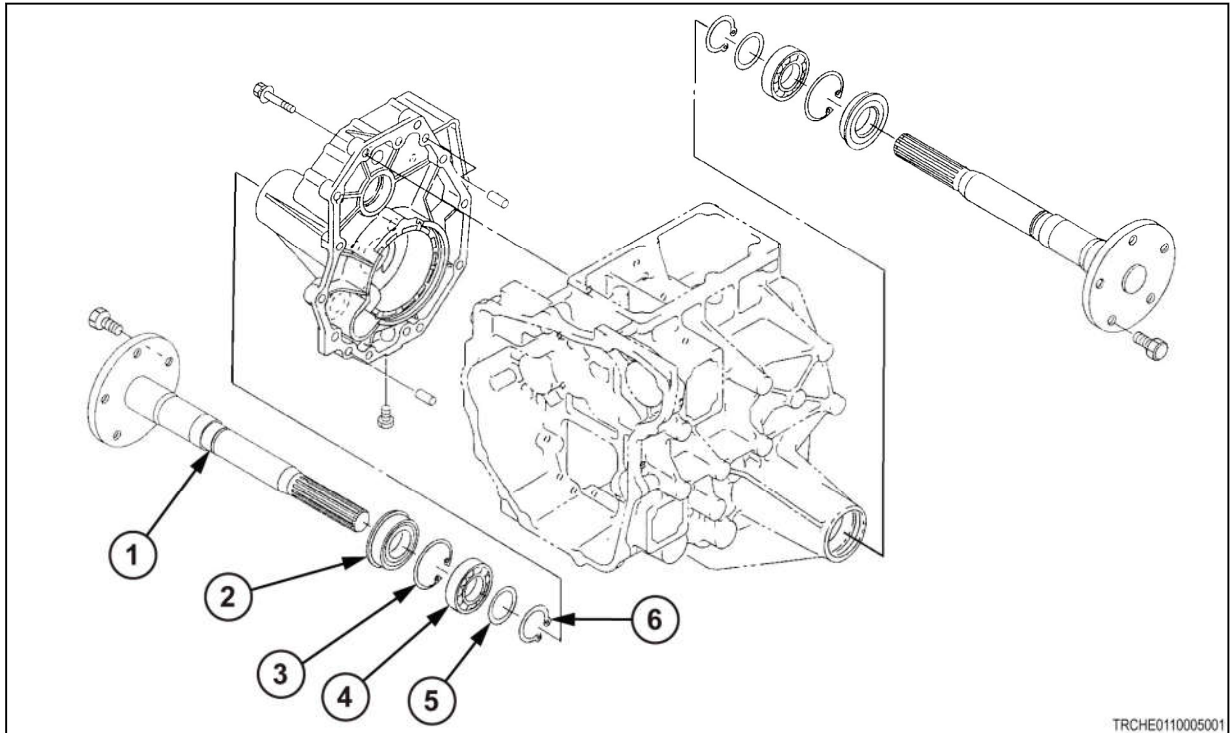
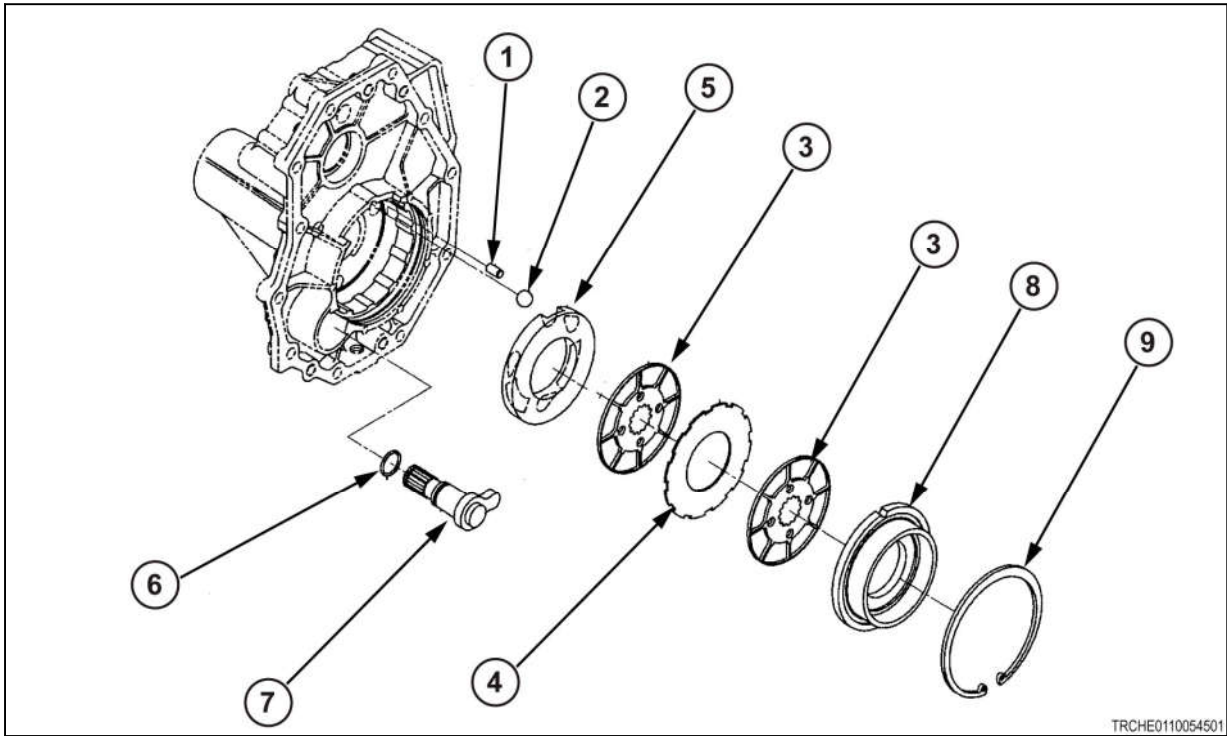
**3.2.8 Rear axle and brake components****Rear axle shaft**

Fig. 95

- |                   |                   |
|-------------------|-------------------|
| (1) Axle          | (4) Bearing       |
| (2) Seal          | (5) Collar        |
| (3) Retainer ring | (6) Retainer ring |



**Brake components**

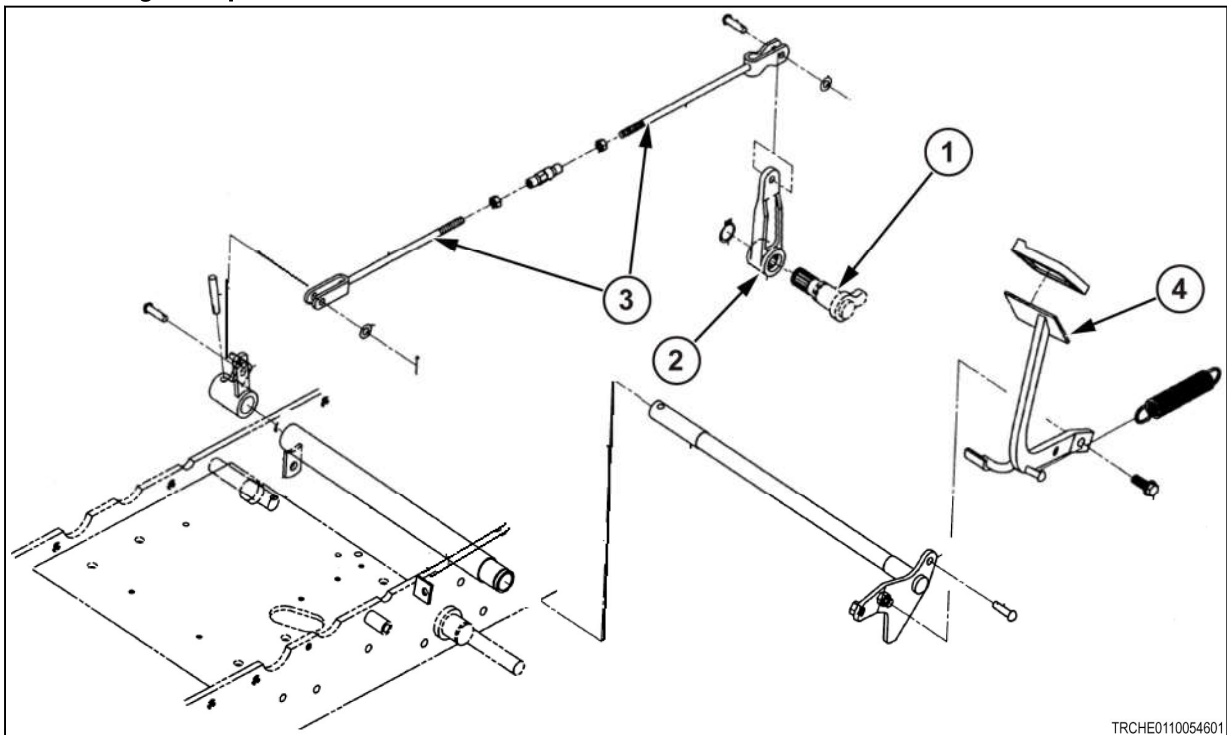


TRCHE0110054501

Fig. 96

- |                     |                   |
|---------------------|-------------------|
| (1) Pin             | (6) O-ring        |
| (2) Ball            | (7) Cam           |
| (3) Friction plate  | (8) Brake metal   |
| (4) Separator plate | (9) Retainer ring |
| (5) Pressure plate  |                   |

**Brake linkage components**



TRCHE0110054601

Fig. 97

- (1) Cam
- (2) Arm

- (3) Rod
- (4) Pedal

### 3.2.9 Remove the rear axles and the brakes

#### Procedure

1. Remove the right axle housing from the transmission.

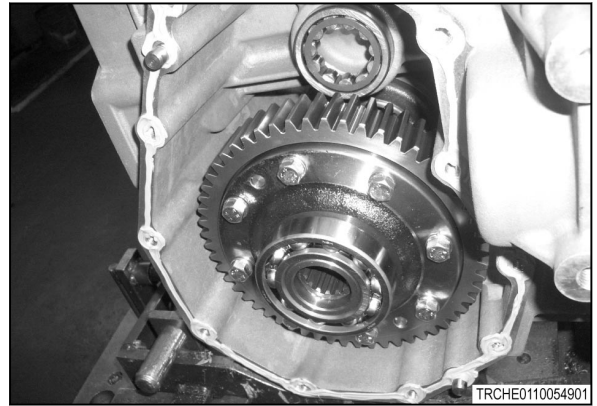


Fig. 98

2. Note the spline alignment marks on the brake arms.
3. Remove the retainer ring.
4. Remove the right brake arm and the left brake arm.

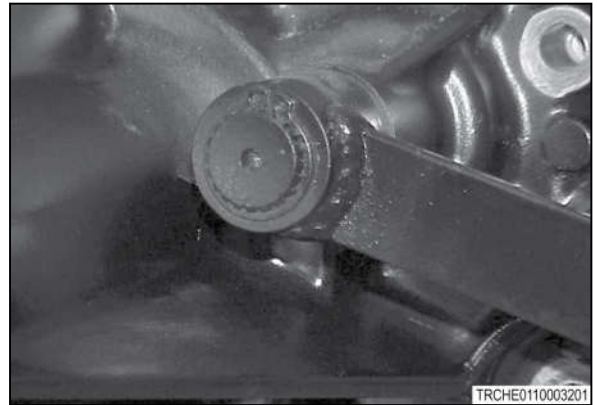


Fig. 99

### 3. Axles



5. Remove the retainer ring from the right brake housing.

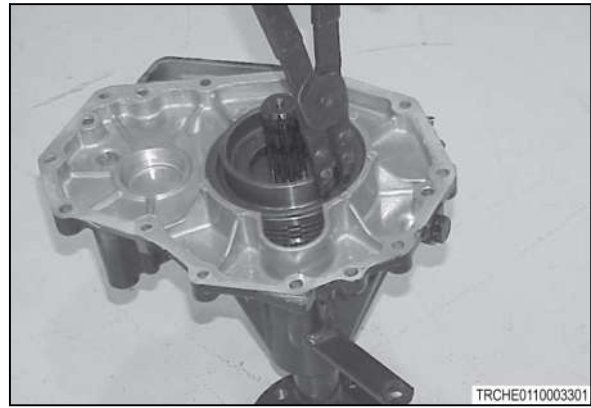


Fig. 100

6. Remove the brake cover.

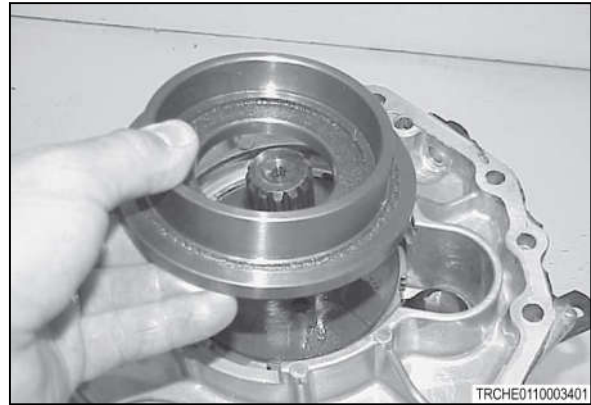


Fig. 101

7. Remove the brake discs and the separator plates.

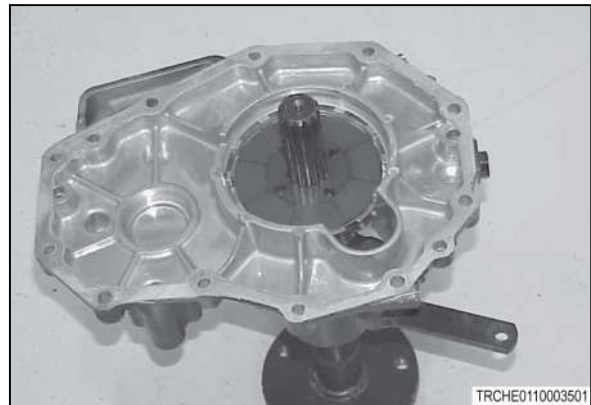


Fig. 102

8. Remove the pressure plate. The ramps (1) in the pressure plate ride up the steel balls in the axle housing when the fork on the brake cam rotates the pressure plate. The fork on the brake arm engages in the notch in the pressure plate.

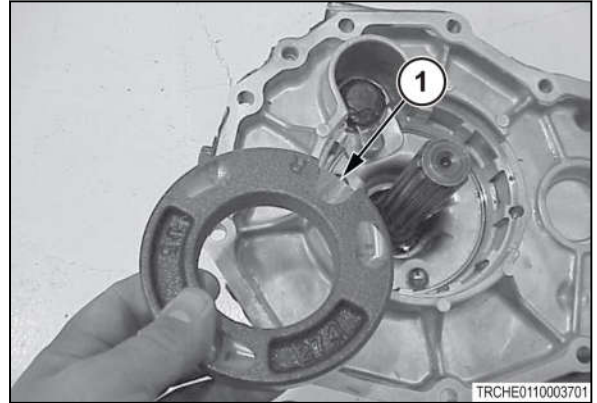
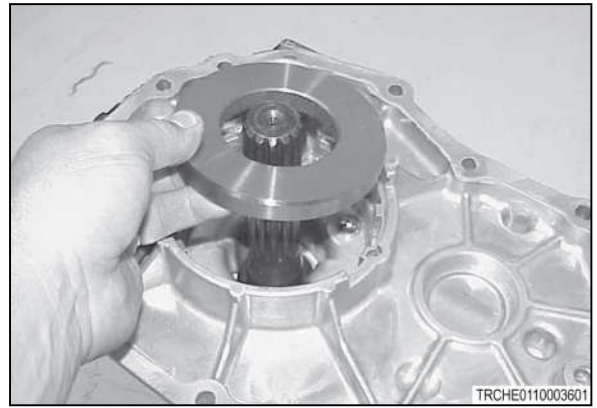


Fig. 103

9. Remove the balls (1) and the brake arms.

**NOTE:** Note the position of the O-ring seal on the brake arm.

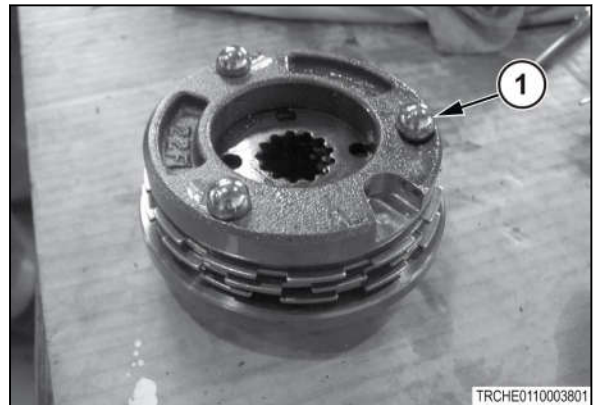


Fig. 104

10. Remove the seal from the axle.
11. Remove the retainer ring from the axle.



Fig. 105

12. Pull the axle out of the housing.

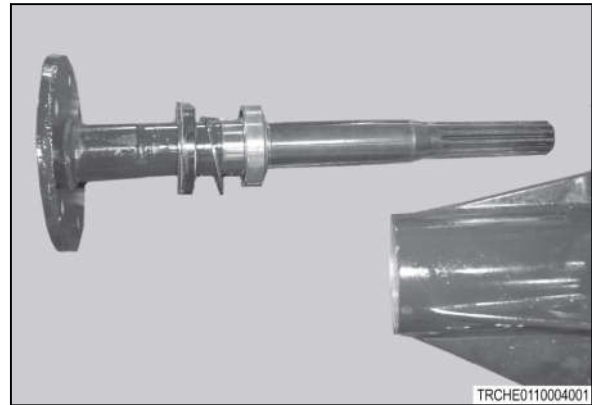


Fig. 106

13. To service the left axle, remove the ring gear, differential assembly, and differential lock fork.
14. Remove the retainer ring from the housing.
15. Repeat the procedure used to remove the right axle and the brake.

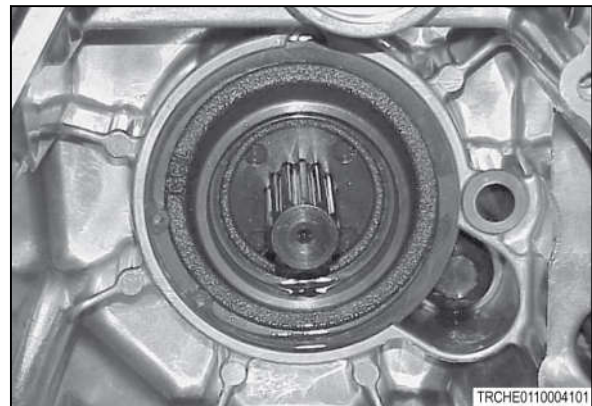


Fig. 107

---

### 3.2.10 Examine the rear axle and the brakes

---

#### Procedure

1. Examine the friction plates, separator plates, and actuator. Replace if worn excessively or warped.
2. Examine the bearings and the retainer rings.
3. Examine the linkage. All parts must move freely.

---

### 3.2.11 Install the rear axle and the brakes

---

- Make sure the fork on the brake cam aligns with the notch in the actuator.
- Align the notch in the brake cover with the dowel pin.
- Use silicone between the axle housing and the final case.
- Tighten all hardware to the standard torque values.
- Make sure the differential lock shift fork is engaged.
- Lubricate the O-rings and the seals prior to assembly.

**Procedure**

1. Install the balls and the pressure plate.

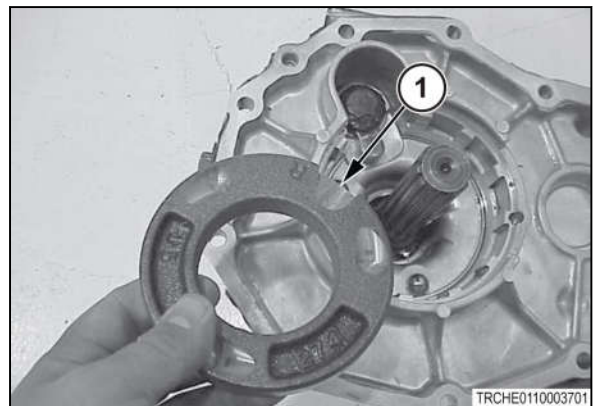
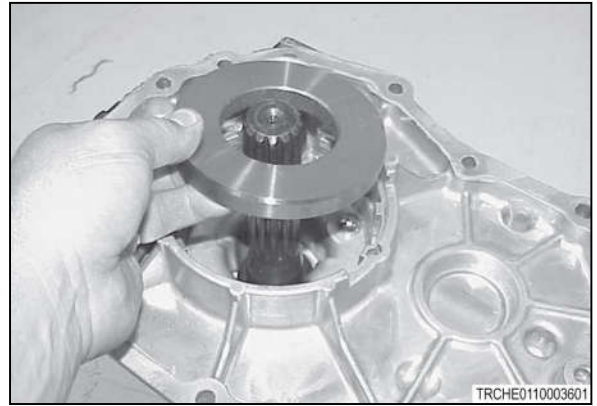


Fig. 108

2. Install the brake discs and the separator plates.

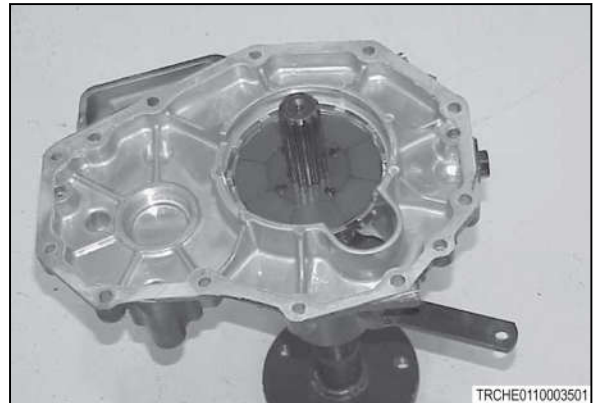


Fig. 109

3. Install the brake cover.

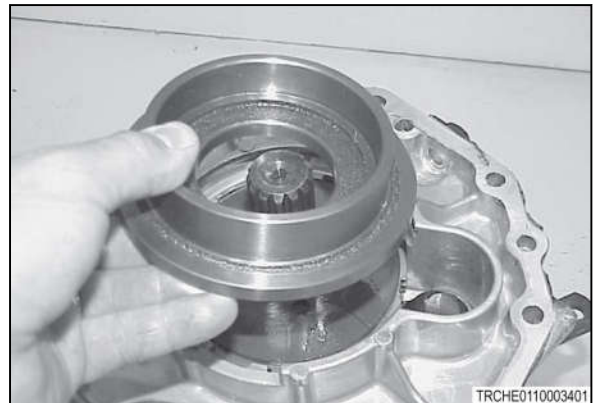


Fig. 110

### 3. Axles



4. Install the retainer ring.
5. For the left axle, Install the differential lock fork, ring gear, and differential assembly.

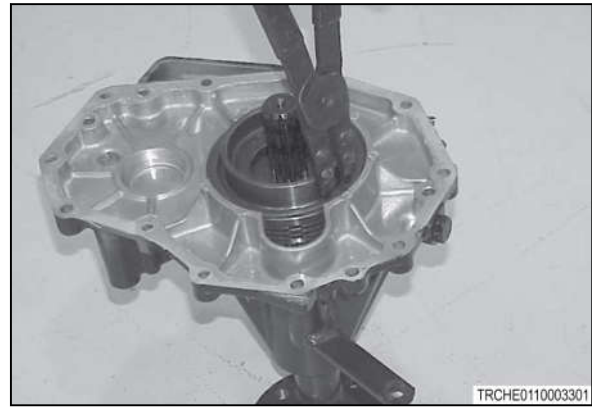


Fig. 111

6. Put a new axle seal on the axle shafts. Install the axle into the housing.



Fig. 112

7. Install the retainer ring.
8. Install the seal into the axle.



Fig. 113

9. Install the right-hand axle housing.



Fig. 114

10. Install the hardware on the right-hand axle housing.

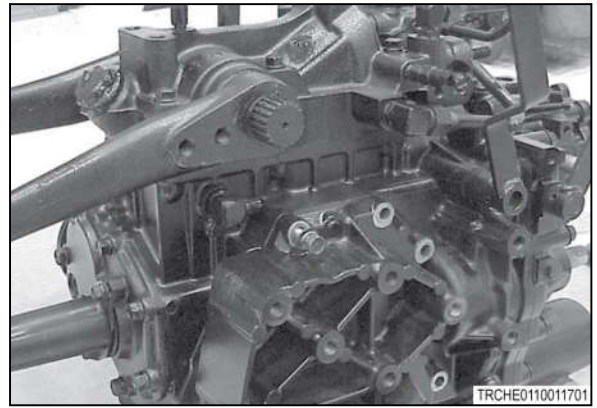


Fig. 115

11. Install the O-rings (1) on the differential lock shaft.
12. Install the differential lock arm.
13. Install the brake arms.
14. Install the retainer ring.

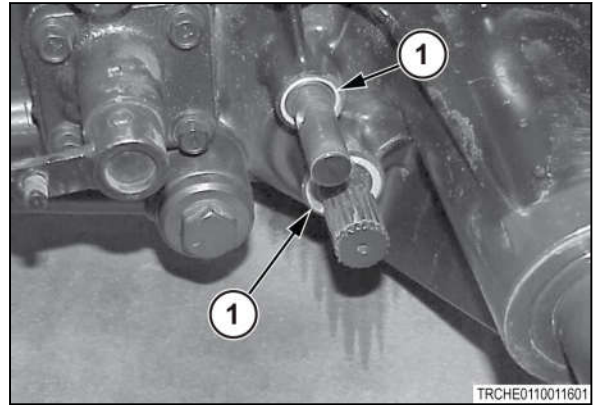


Fig. 116

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[Assemble the rear axle ring and pinion](#) page 3-31





# 4 Steering System

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## 4.1 Steering system

The hydraulic steering system consists of a steering wheel, steering control unit, and steering cylinder. The rotary valve and a meter device built into the steering control unit control the direction and flow rate of hydraulic oil in the steering system. The relief valve, which is non-adjustable, for the steering system is located in the steering control unit.

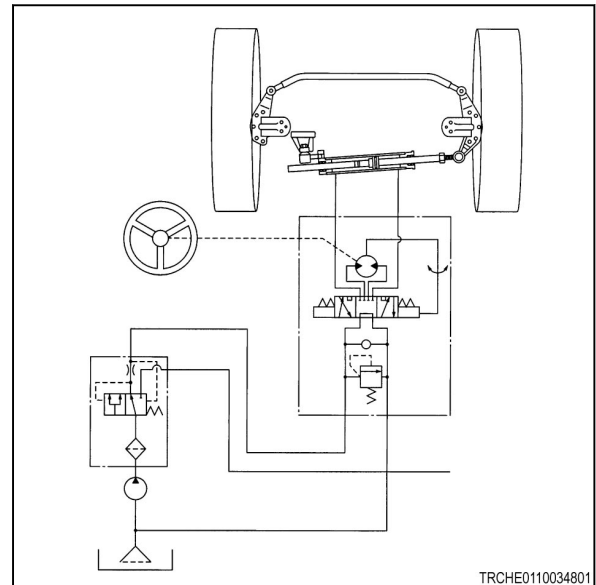


Fig. 1

- (P) Pressure from the three point control valve
- (T) Tank or return to the front transmission case
- (L) Left turn
- (R) Right turn

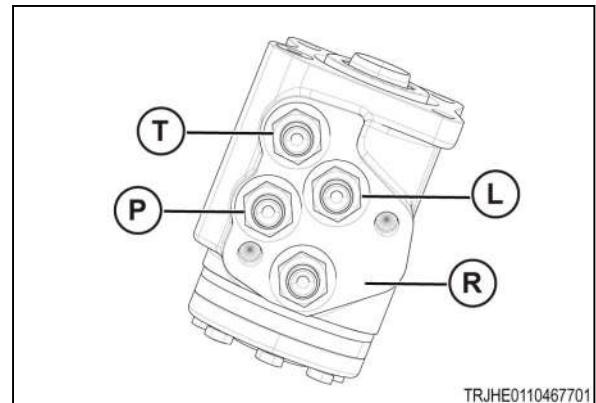
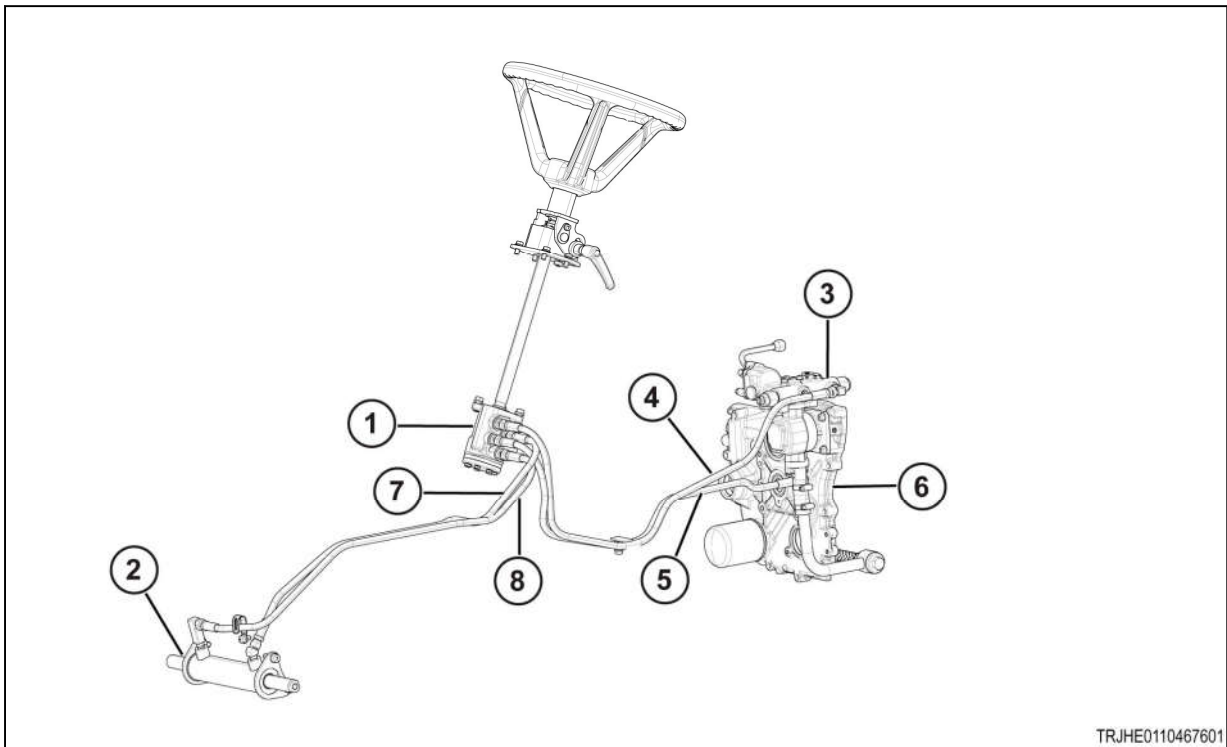


Fig. 2



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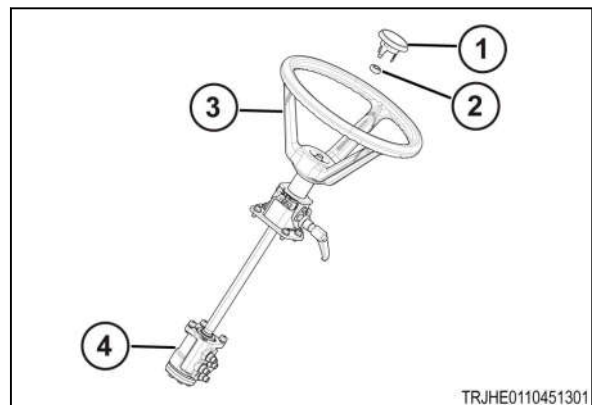
Fig. 3

The steering control unit (1) controls the flow of oil to the steering cylinder (2). When the steering wheel is motionless, pressurized oil travels from the three point control valve (3) through the pressure hose (4) to the steering control unit pressure port . Return oil travels from the steering control unit tank port through the return hose (5) to the front transmission cover (6).

When the steering wheel is turned to the left, the steering control unit will send oil from left turn port through the left turn steering hose (7) and move the steering cylinder rod so the wheels turn to the left. When the steering wheel is turned to the right, the steering control unit will send oil from right turn port through the right turn steering hose (8) and move the steering cylinder rod so the wheels turn to the right.

#### 4.1.1 Steering wheel and steering control unit

- (1) Cap
- (2) Nut
- (3) Steering wheel
- (4) Steering control unit



TRJHE0110451301

Fig. 4

### 4.1.2 Steering control unit specifications

Specifications	
Displacement	50 cc/rev
Relief valve setting	85 kg/cm <sup>2</sup> to 90 kg/cm <sup>2</sup> (1208 psi to 1280 psi)

### 4.1.3 Remove the steering control unit

#### Procedure

1. Use a flat screwdriver to remove the middle cap on the steering wheel.
2. Remove the nut.
3. Pull the steering wheel upwards off the splined steering shaft.
4. Remove the screw (1) then remove the lower dash cover.



Fig. 5



Fig. 6

#### 4. Steering System



5. Remove the screws that fastens the dash in place.
6. Move the dash out of the way.



Fig. 7

7. Put labels the hoses at the bottom of the steering control unit to help with installation.
8. Remove the hoses.
9. Remove the hardware that fastens the steering control unit to the steering column support assembly.
10. Remove the steering control unit.



Fig. 8

#### 4.1.4 Install the steering control unit

##### Procedure

1. Put the steering control unit into position on the machine.
2. Install the hardware that fastens the steering control unit to the steering column support assembly.
3. Install the hoses.

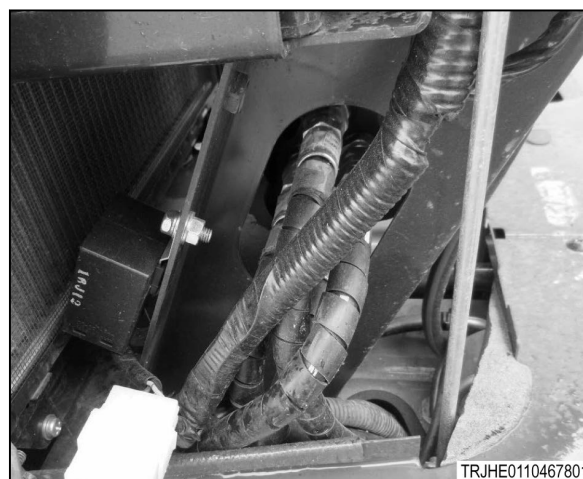


Fig. 9

4. Install the dash and the lower dash cover.  
Install the screw (1).



Fig. 10

5. Put the steering wheel onto the splined steering shaft.
6. Install the nut.
7. Install the middle cap onto the steering wheel.



Fig. 11

#### 4.1.5 Steering cylinder

The steering cylinder can be removed from the axle to be serviced.

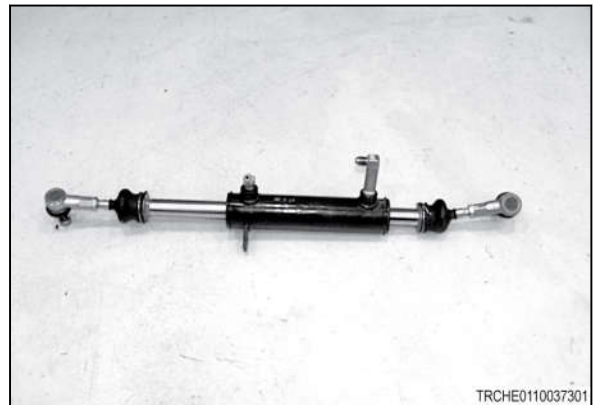
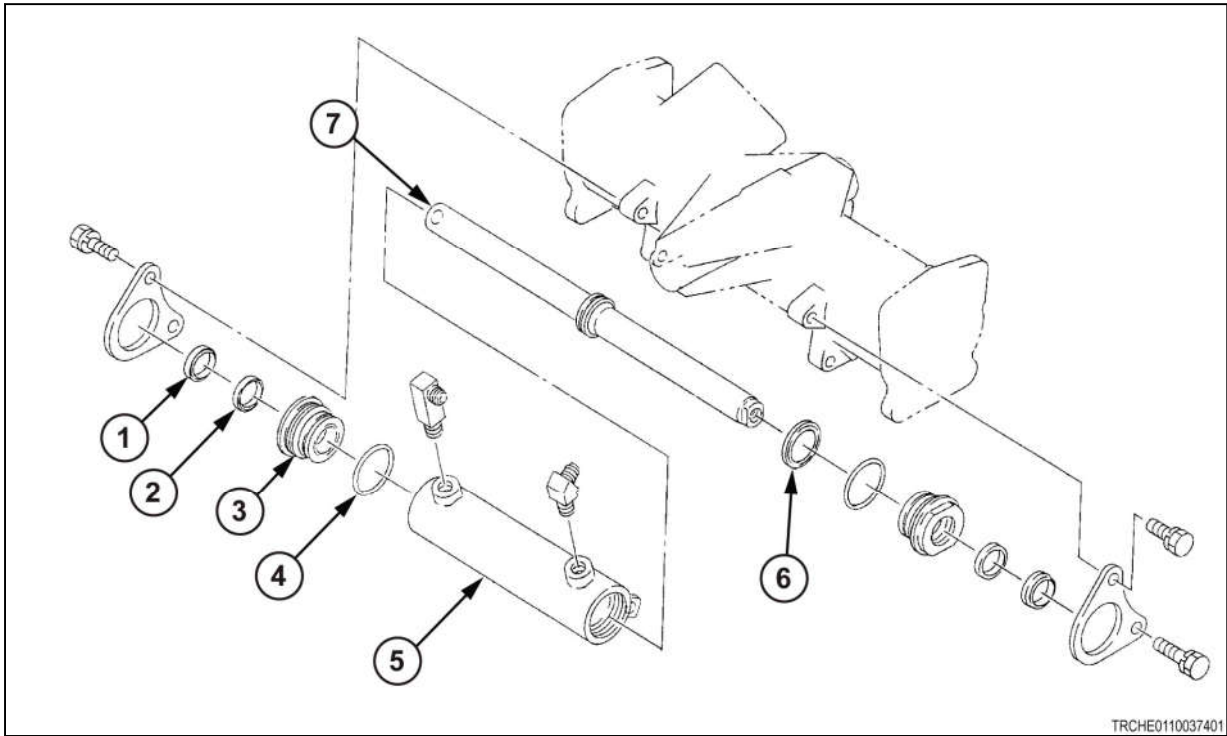


Fig. 12

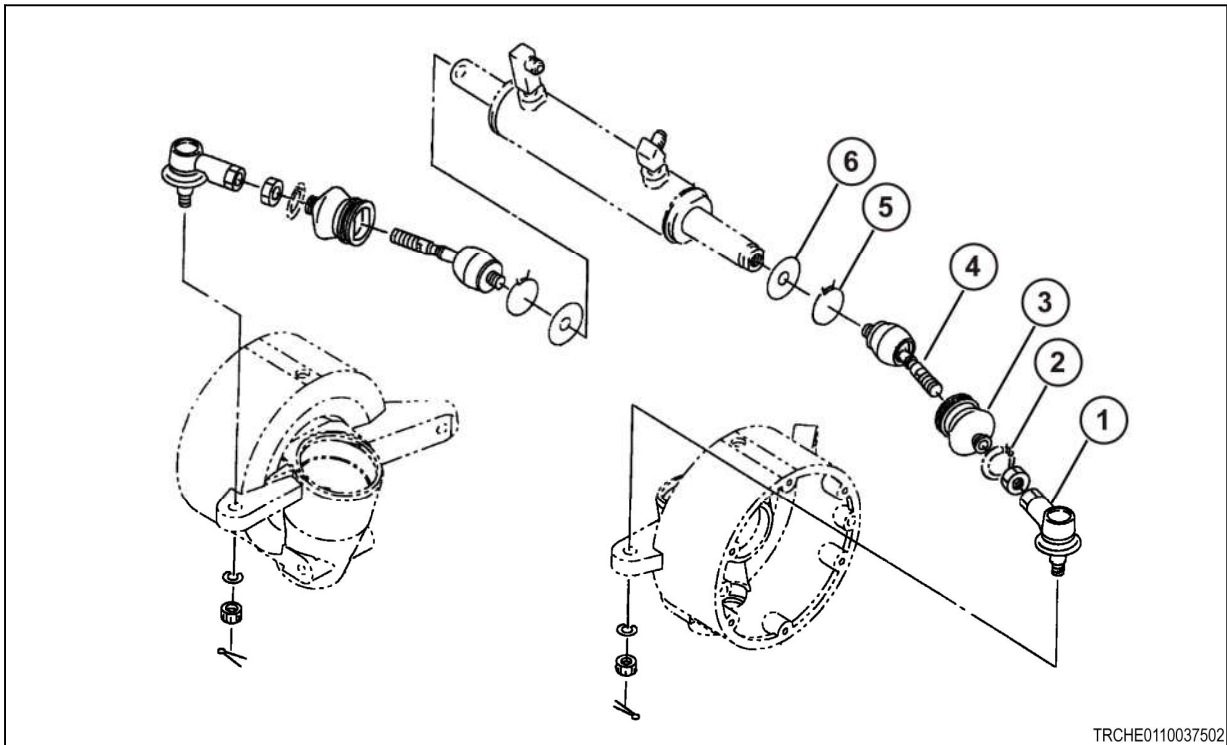




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Fig. 13

- |                 |                    |
|-----------------|--------------------|
| (1) Seal        | (5) Barrel         |
| (2) Rod packing | (6) Piston packing |
| (3) Head        | (7) Rod and piston |
| (4) O-ring      |                    |



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Fig. 14

- |                 |             |
|-----------------|-------------|
| (1) Rod end     | (4) Knuckle |
| (2) Boot spring | (5) Clamp   |
| (3) Boot        | (6) Washer  |

### 4.1.6 Steering free play



**WARNING: Machine control hazard.**

**Personal injury or machine damage can occur.**

**Excessive steering free play must be corrected before use.**

Check steering for excessive looseness, as indicated by steering wheel free play. Maximum free play (1) is approximately 30 mm (1.25 in) when measured at outside of the steering wheel rim.

Excessive free play can be caused by:

- Air in the steering system
- Worn or damaged power steering unit
- Worn or damaged steering cylinder

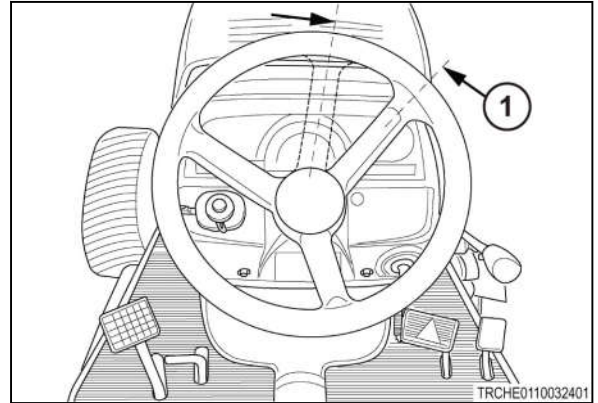


Fig. 15



# 5 Drive Train System

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## 5.1 Transmission

### 5.1.1 Transmission oil

The transmission oil lubricates the transmission, center housing, and rear axles, and is used as hydraulic fluid.

**NOTE:**

*Adding oil to the transmission will also keep the oil level correct in the center housing and rear axles.*

**Related Links**

[Capacities](#) page 1-26

[Lubrication fill and drain locations](#) page 1-36

[Lubrication specifications](#) page 1-26

### 5.1.2 Examine the transmission oil level

**Procedure**

1. Lower the 3-point linkage and all external hydraulically controlled equipment.
2. Park the machine on a solid, level surface. Stop the engine, apply the parking brake, and take the key with you.
3. Examine the oil level in the oil level window (1).

**Result**

The oil level must be seen in the middle of the oil level window.

4. If necessary, add oil.
  - a) Remove the filler plug (2).
  - b) Add oil through the filler opening.
  - c) Install the filler plug.

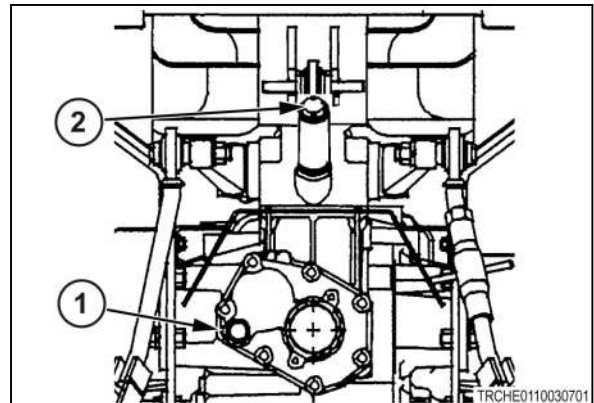


Fig. 1

**Related Links**

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[Lubrication specifications](#) page 1-26

### 5.1.3 Change the transmission oil and filter

**Procedure**

1. Lower the 3-point linkage completely.
2. Park the tractor on a solid, level surface. Apply the parking brake, stop the engine, and take the key with you.
3. Place a suitable catch pan in position.

4. Remove the drain plug (1) and let all oil drain from the system.
5. If equipped, remove the filter guard.

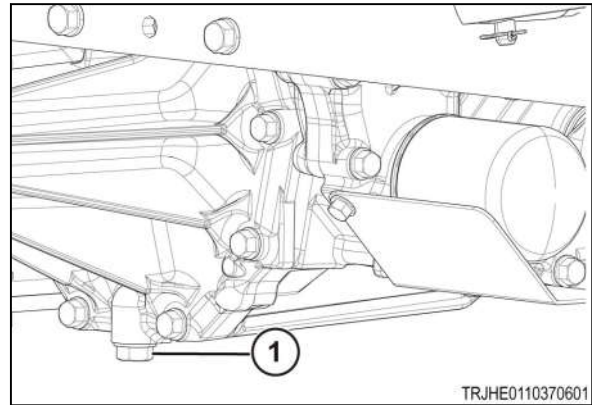


Fig. 2

6. Remove the transmission oil filter (1) from the adapter. Use a filter wrench, if required.
7. Make sure the original filter gasket has been completely removed.
8. Clean the filter adapter.
9. Lubricate the gasket on the new filter with clean hydraulic oil.
10. Install the new filter until the gasket contacts with the adapter and tighten additional 2/3 turn by hand. Do not use a filter wrench to install the filter.
11. If removed, install the filter guard.

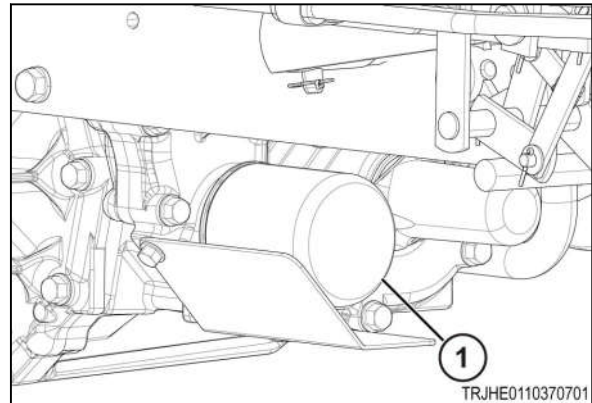


Fig. 3

12. Use a jack to lift the left tire off the ground.
13. Use a stand to support the left side of the tractor.
14. Remove the left rear wheel.
15. Remove the transmission suction filter (1).
16. Clean the transmission suction filter screen in solvent or kerosene.
17. Dry the transmission suction filter completely.
18. Install the transmission suction filter. Make sure the O-rings (2) are not damaged.
19. Apply sealant to the threads on drain plug(s) and install.
20. Fill the system with new transmission oil.
21. Start the tractor and let idle several minutes while you operate the hydraulic controls.
22. Stop the engine and lower the 3-point linkage.
23. Examine the oil level. Add transmission oil as necessary.
24. Examine for leaks and repair as necessary.

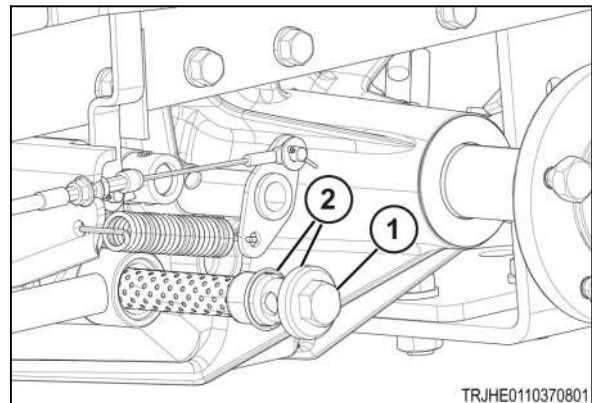


Fig. 4

#### Related Links

[Capacities](#) page 1-26

[Lubrication fill and drain locations](#) page 1-36

[Lubrication specifications](#) page 1-26

[Lubrication and maintenance chart](#) page 1-34

### 5.1.4 Remove the transmission

#### Procedure

1. Remove the drain plug (1) located on the bottom of the transmission case and drain the oil.
2. Disconnect the wire connectors:
  - Left turn lamp
  - Right turn lamp
  - 12 volt power socket, if equipped
  - Work lamp, if equipped
3. Remove the seat assembly.
4. Remove the ROPS.
5. Remove the wing bolt (1) that fastens the lower steering console cover.
6. Remove the lower steering console cover.
7. Remove the hydrostatic pedal pads from the hydrostatic pedal assembly.
8. Remove the brake pedal pad from the brake pedal.

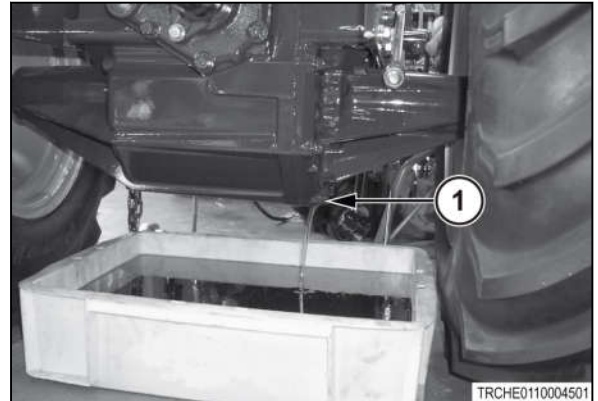


Fig. 5



Fig. 6



Fig. 7



9. Remove the floor mat.
10. Remove the bolts that fasten the floor to the rear fender.
11. Remove the knobs:
  - Rate of lowering valve
  - Cutting height adjustment
  - PTO select lever
  - Mid mount PTO select lever
  - PTO clutch lever
  - Three-point control lever
  - Range transmission lever
12. Lift the boot on the joystick lever to access the bolt that fastens the joystick lever. Remove the bolt and then remove the lever.
13. Remove the joystick lever lockout.



Fig. 8



Fig. 9

14. Remove the four hydraulic quick couplers.
15. Remove the left and right step.
16. Remove the rear fender.

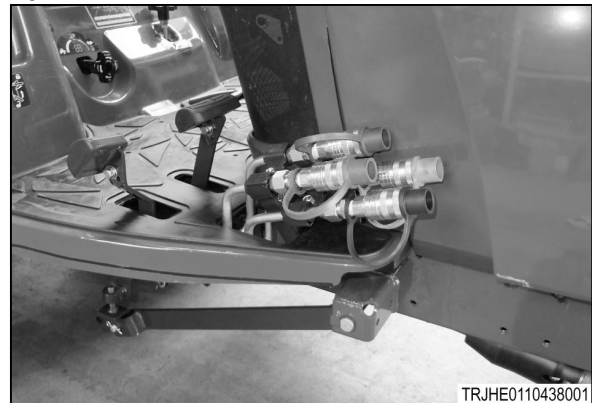


Fig. 10

17. Drain any remaining fuel from the fuel filter and fuel lines into a suitable container.
18. Disconnect the wire harness from the chassis.



Fig. 11

19. Remove the hydraulic oil lines (1).

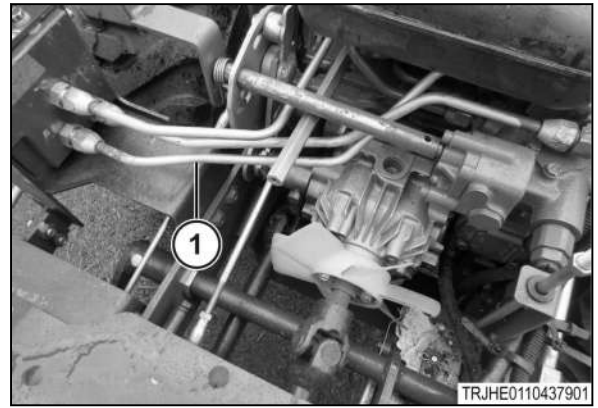


Fig. 12

20. Remove the hydraulic oil lines (1).

21. Remove the joystick valve.

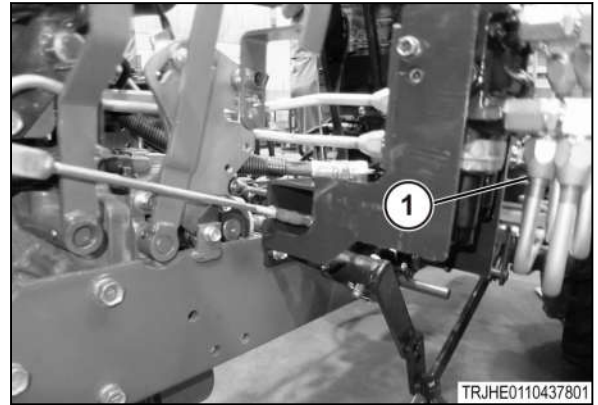


Fig. 13

22. Put identification tags on the hoses to the steering control unit. Remove the hoses.

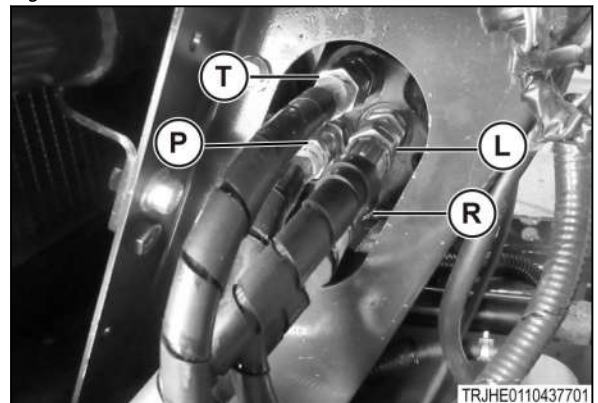


Fig. 14

(T) Tank  
(P) Pressure  
(L) Left  
(R) Right

23. Remove the U-joint (1) that connects the engine to hydrostatic motor.

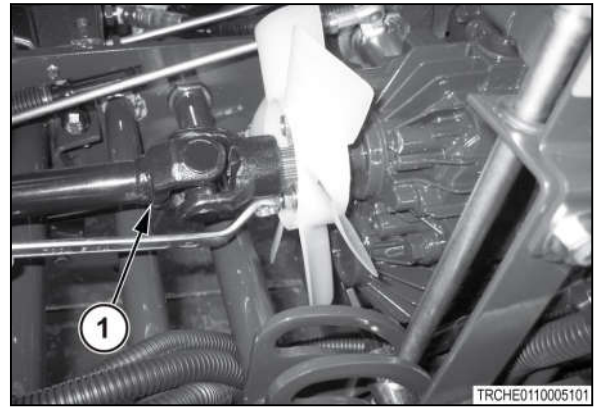


Fig. 15

24. Remove the hydrostatic transmission linkage (1).

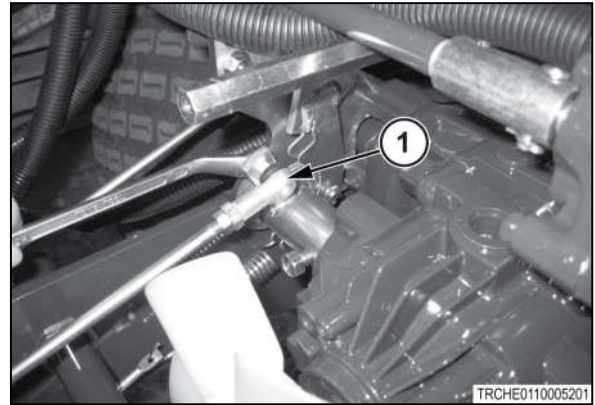


Fig. 16

25. Remove the bolt on the four-wheel drive (4WD) shaft U-joint.
26. Remove the 4WD shaft.

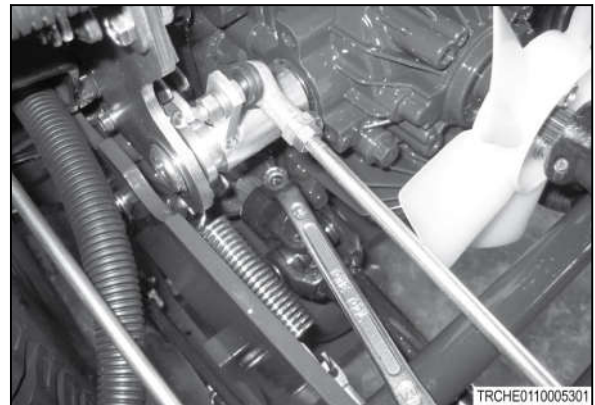
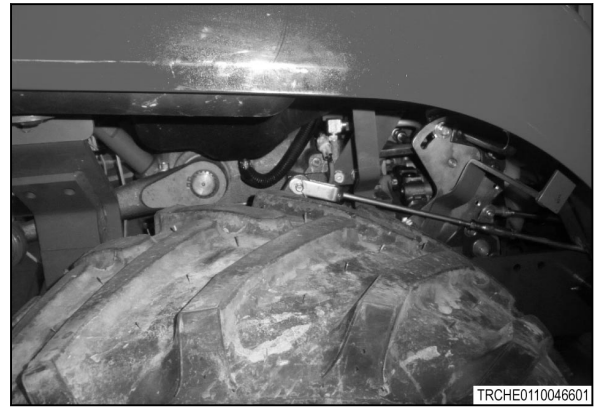


Fig. 17

**27.** Remove the following linkages:

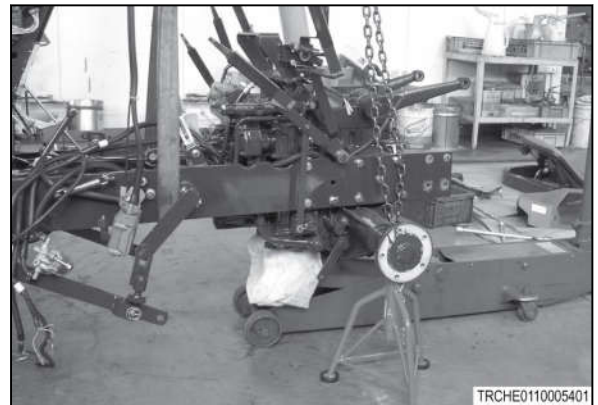
- Brake linkage
- Differential lock linkage
- Mower deck lift linkage



*Fig. 18*

**28.** Support the frame rail with an overhead hoist or jack stands and remove the rear wheels.

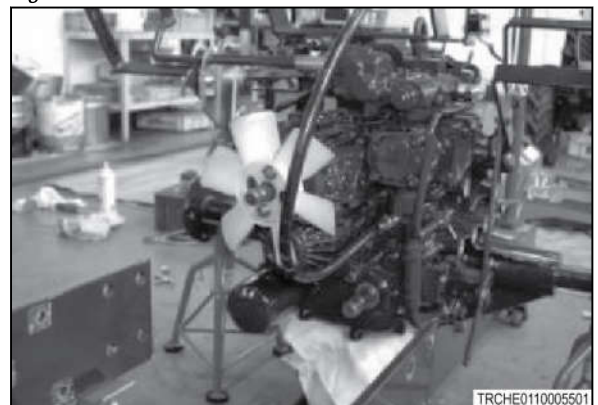
**29.** Insert tapered wedges above the front axle on both sides to keep the front axles from oscillating as the machine is split.



*Fig. 19*

**30.** Remove the bolts that fasten the transmission to the frame.

**31.** Roll the front frame assembly forward to remove the transmission.



*Fig. 20*

## 5.1.5 Install the transmission

### Before starting the procedure

- Install new O-rings on the hydraulic pipes as required.
- Tighten each bolt and nut to respective specified torque values referring to the tightening torque chart.
- Route the fuel lines and the wire harnesses properly.

### Procedure

1. Roll the front frame assembly rearward to install the transmission.
2. Install the bolts that fasten the transmission to the frame.

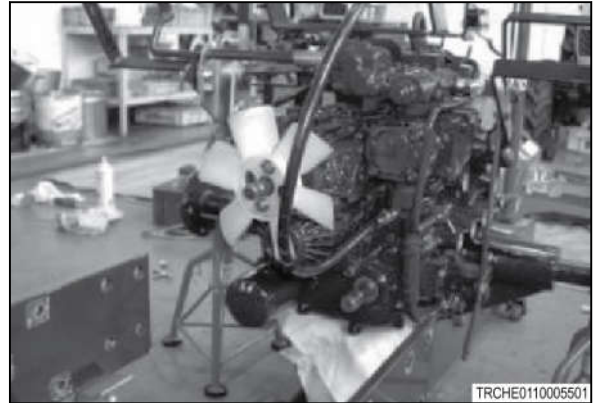


Fig. 21

3. Install the following linkages:
  - Brake linkage
  - Differential lock linkage
  - Mower deck lift linkage
4. Install the 4WD shaft.



Fig. 22

5. Install the bolt on the four-wheel drive (4WD) shaft U-joint.

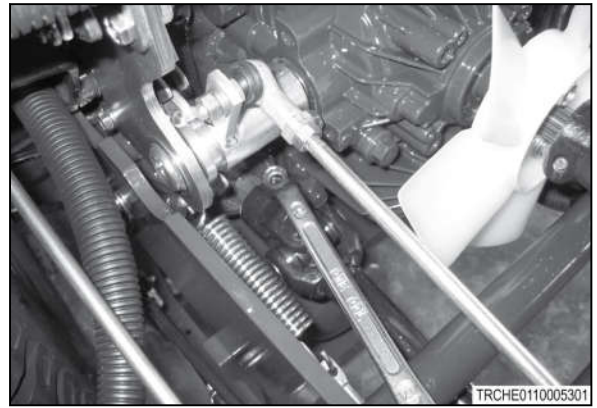


Fig. 23

6. Install the hydrostatic transmission linkage (1).

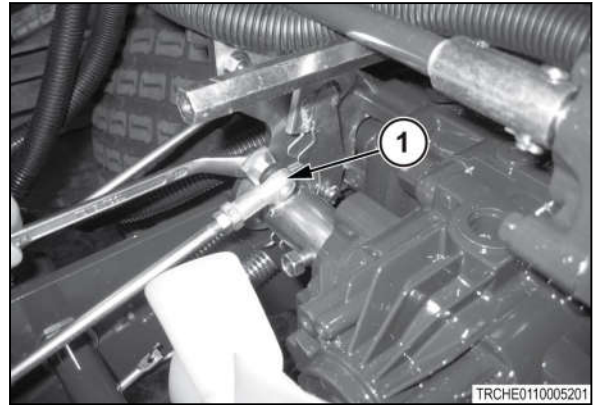


Fig. 24

7. Install the U-joint (1) that connects the engine to hydrostatic motor.

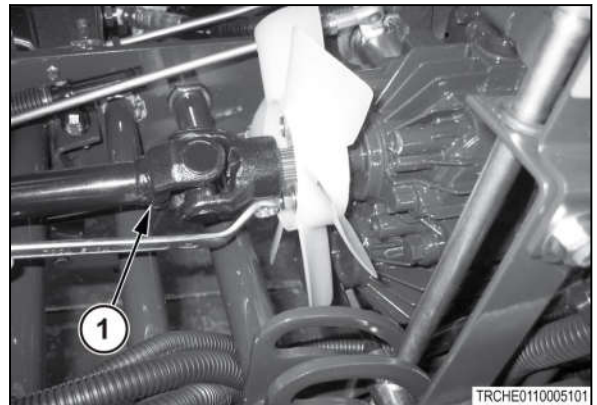


Fig. 25

8. Install the steering hoses.
9. Install the joystick valve.

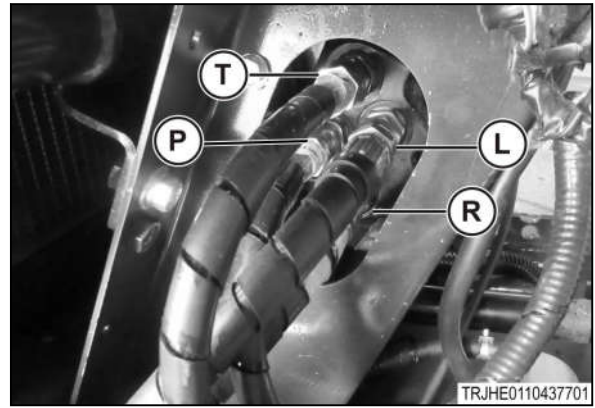


Fig. 26

- (T) Tank
- (P) Pressure
- (L) Left
- (R) Right

10. Install the hydraulic oil lines (1).

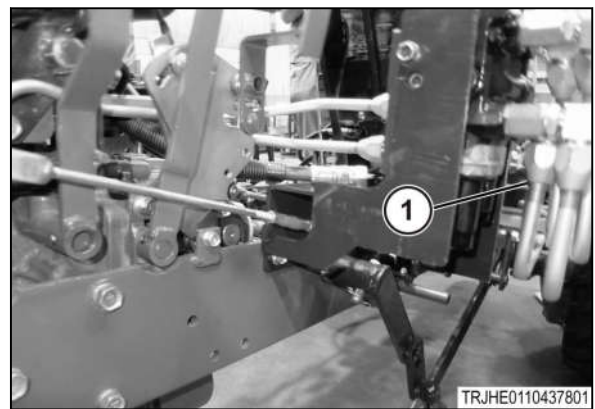


Fig. 27

11. Install the hydraulic oil lines (1).
12. Connect the wire harness to the chassis.

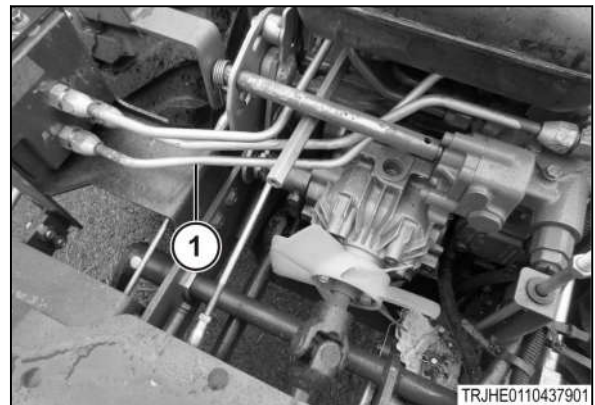


Fig. 28

13. Put the left and right step into position on the tractor.
14. Put the rear fender into position on the tractor.

15. Install the four hydraulic quick couplers.

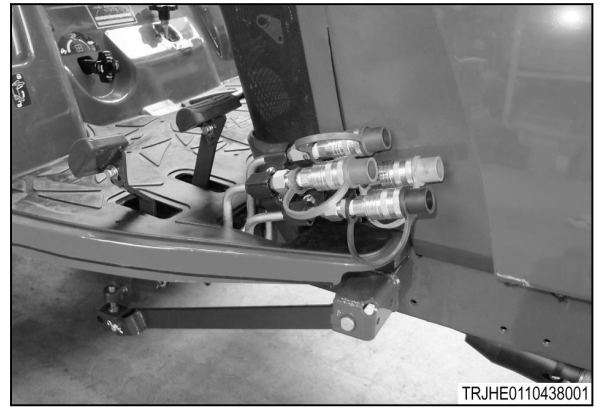


Fig. 29

16. Install the joystick lever lockout.
17. Put the joystick lever into position. Install the bolt that fastens the lever. Lower the boot on the joystick lever.



Fig. 30

18. Install the bolts that fasten the floor to the rear fender.
19. Install the floor mat.
20. Install the hydrostatic pedal pads onto the hydrostatic pedal assembly.
21. Install the brake pedal pad onto the brake pedal.



Fig. 31

22. Put the lower steering console cover into position.
23. Install the wing bolt (1) that fastens the lower steering console cover.



Fig. 32



**24.** Install the seat assembly.

**25.** Install the ROPS.

Tighten the nuts to 85 Nm (63 lbf ft).

**26.** Install the knobs:

- Rate of lowering valve
- Cutting height adjustment
- PTO select lever
- Mid mount PTO select lever
- PTO clutch lever
- Three-point control lever
- Range transmission lever

**27.** Connect the wire connectors:

- Left turn lamp
- Right turn lamp
- 12 volt power socket, if equipped
- Work lamp, if equipped

**28.** Remove the tapered wedges from the front axle.

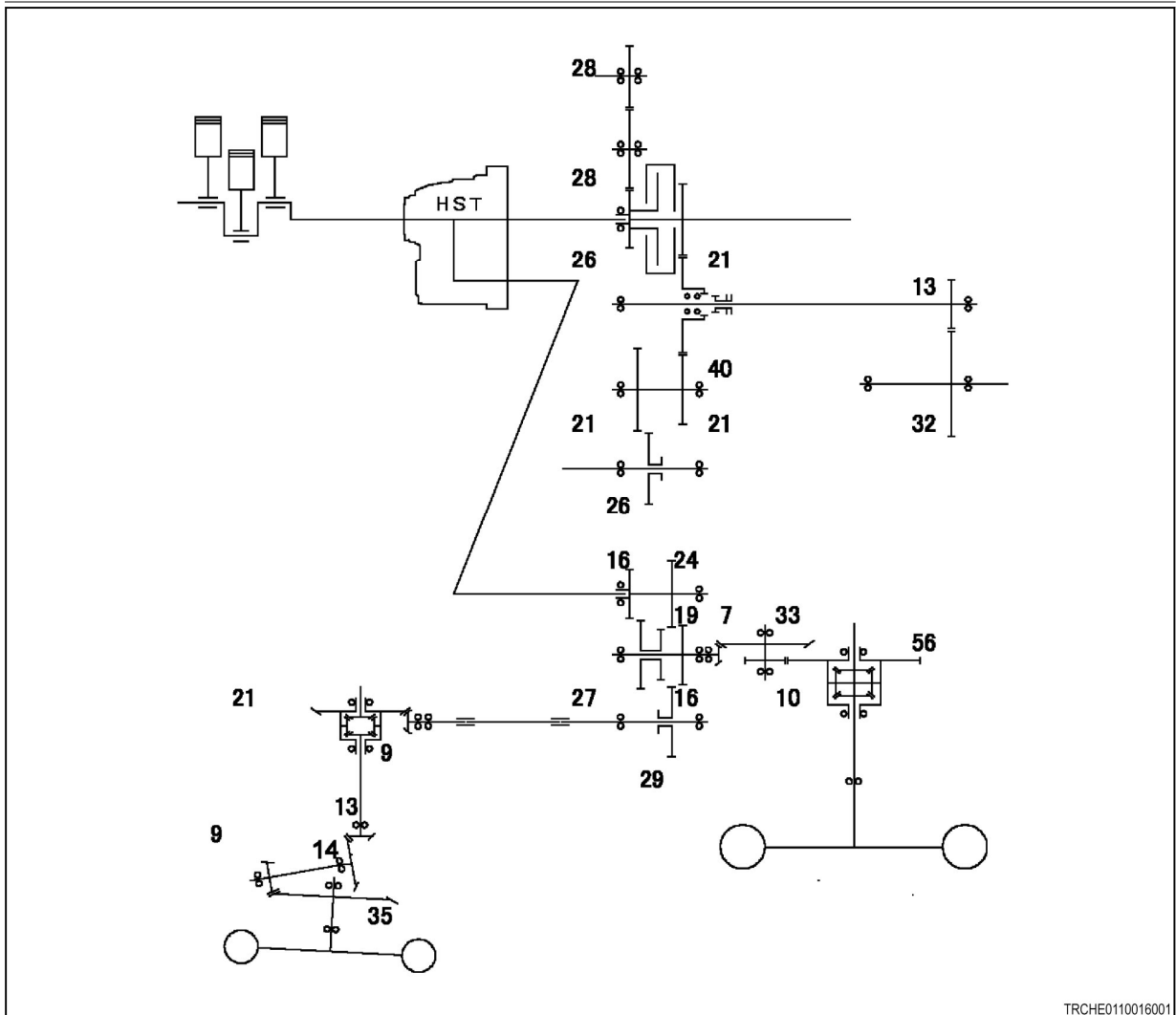
**29.** Install the drain plug located on the bottom of the transmission case and fill the transmission with oil.

**30.** Add fuel to the fuel tank.



Fig. 33

### 5.1.6 Drive train power flow - GC1723E



TRCHE0110016001

Fig. 34

Ag tire (revolution of shafts) .

Engine speed (RPM)	2600
Hydrostatic transmission pump capacity (cc)	21.0
Hydrostatic transmission motor capacity (cc)	21.0
Hydrostatic transmission volumetric capacity (-)	0.95

**5.1.7 Drive train power flow - GC1725M**

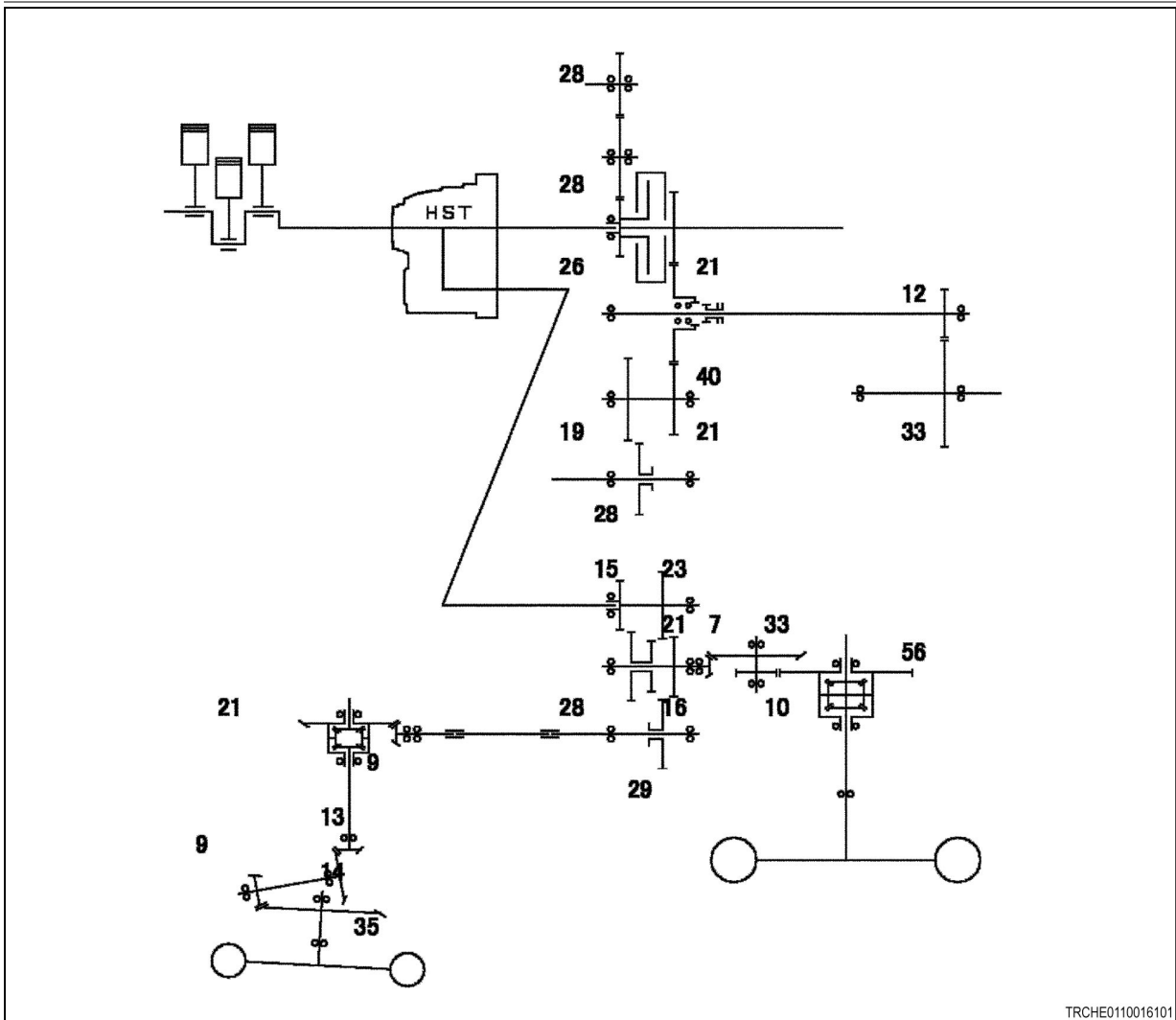
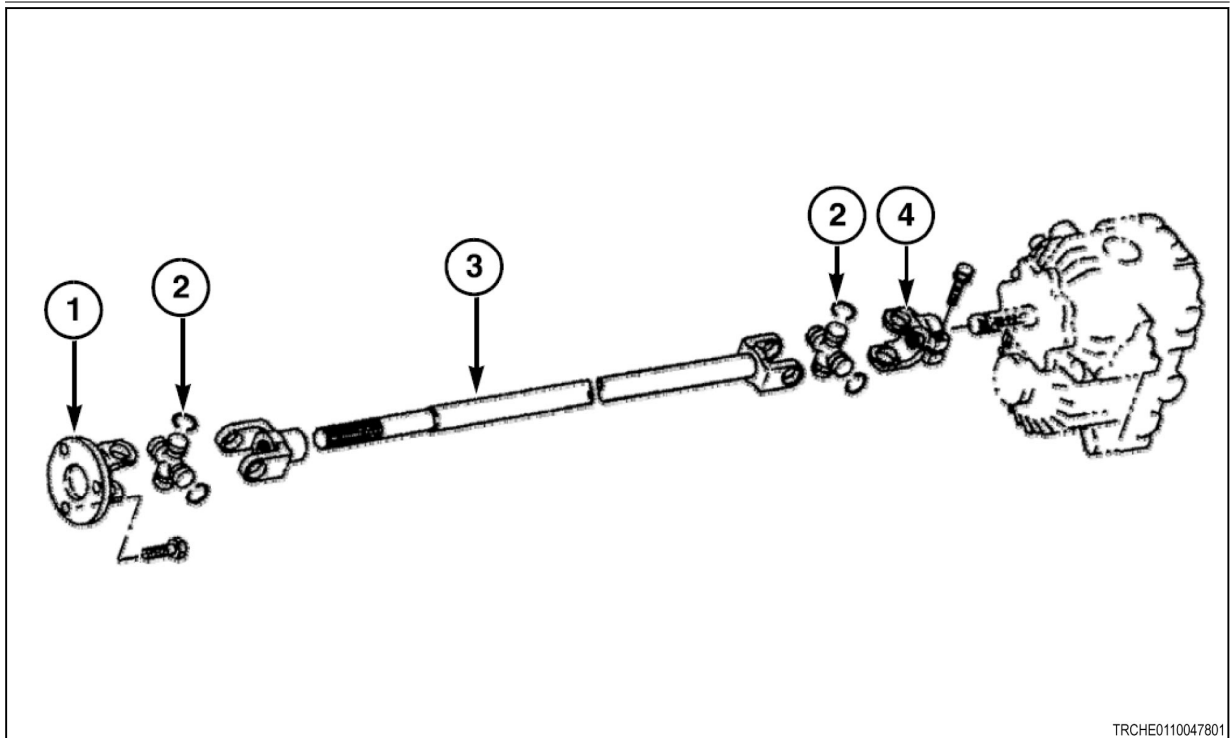


Fig. 35

Ag tire (revolution of shafts).

Engine speed (RPM)	3000
Hydrostatic transmission pump capacity (cc)	21.0
Hydrostatic transmission motor capacity (cc)	21.0
Hydrostatic transmission volumetric capacity (-)	0.95

### 5.1.8 Input shaft

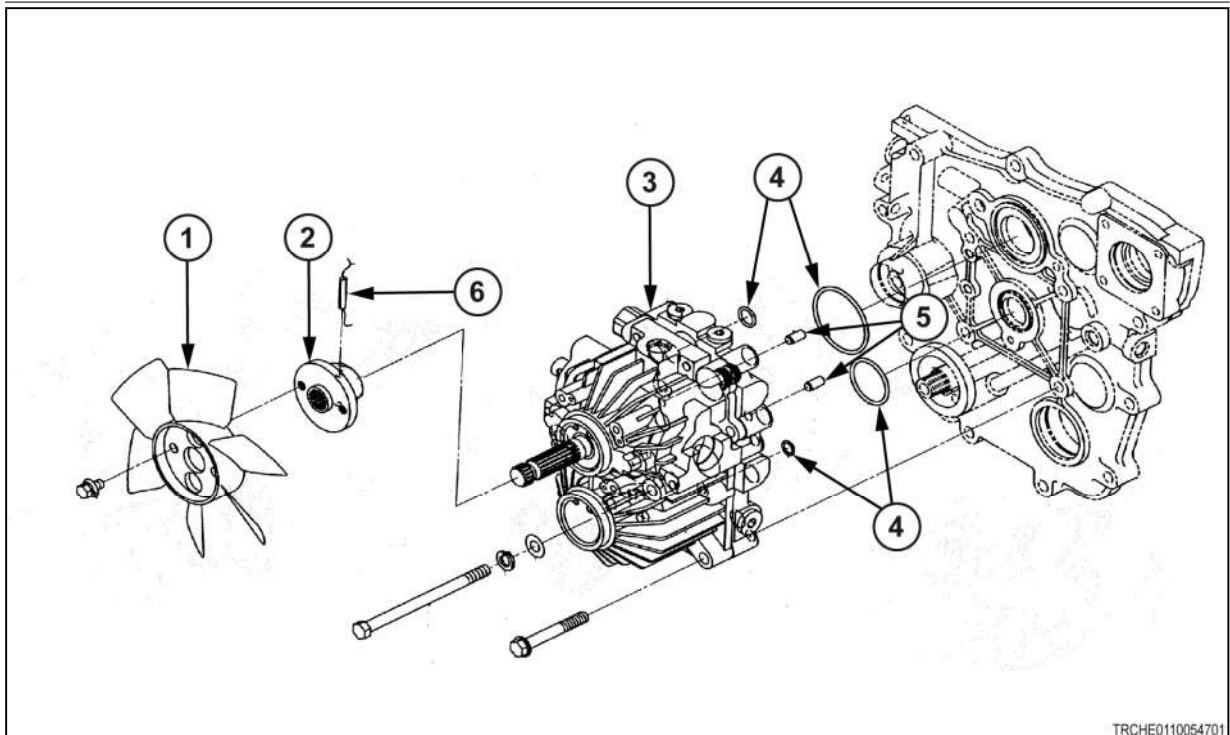


TRCHE0110047801

Fig. 36

- |                    |                                      |
|--------------------|--------------------------------------|
| (1) Engine coupler | (3) Drive shaft                      |
| (2) U-joint        | (4) Hydrostatic transmission coupler |

### 5.1.9 Hydrostatic transmission assembly



TRCHE0110054701

Fig. 37

- |                              |                             |
|------------------------------|-----------------------------|
| (1) Cooling fan              | (4) O-rings                 |
| (2) Fan hub                  | (5) Dowel pin               |
| (3) Hydrostatic transmission | (6) Roll pin and steel wire |

### 5.1.10 Drivetrain construction view

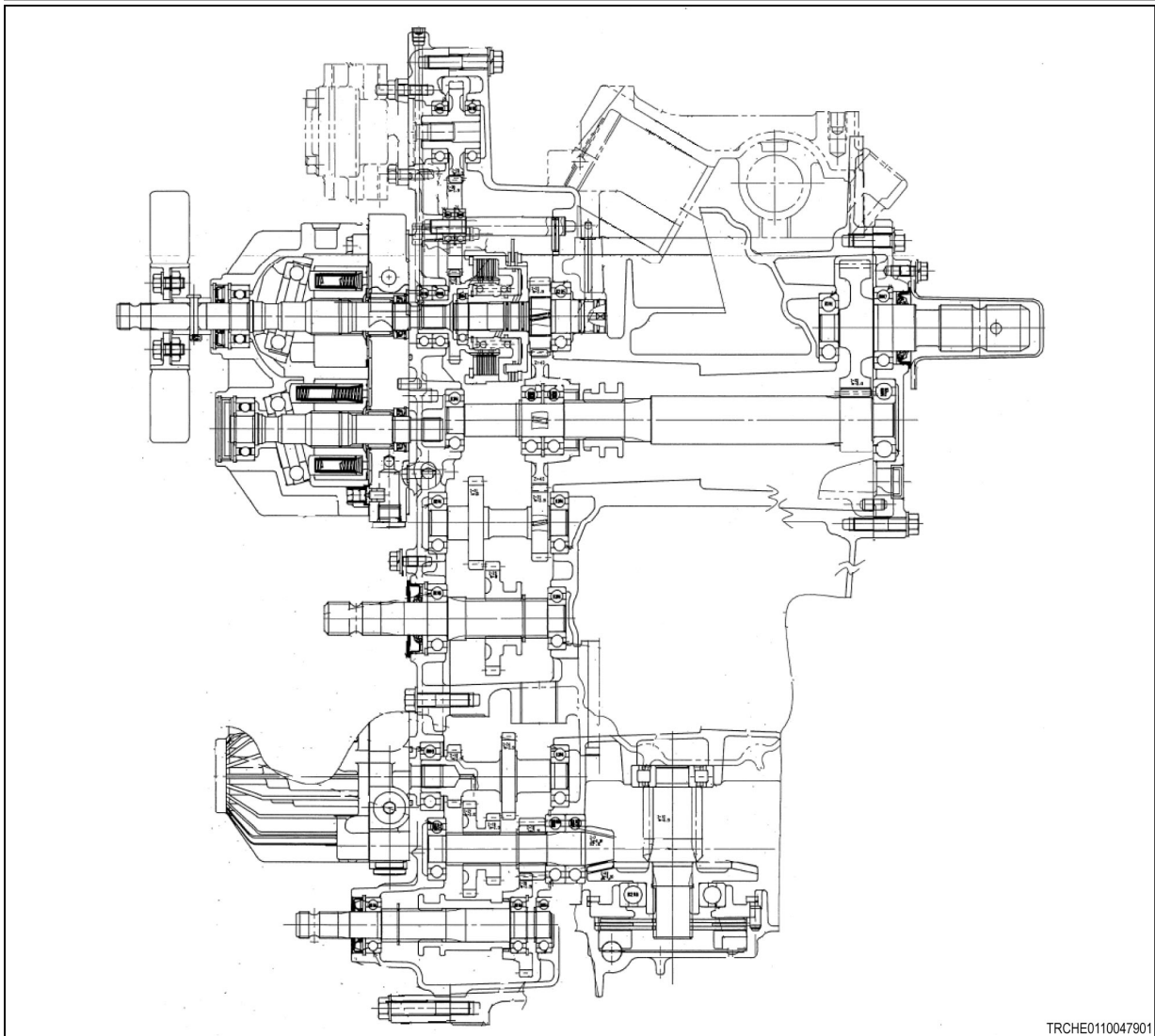


Fig. 38

### 5.1.11 Front transmission cover

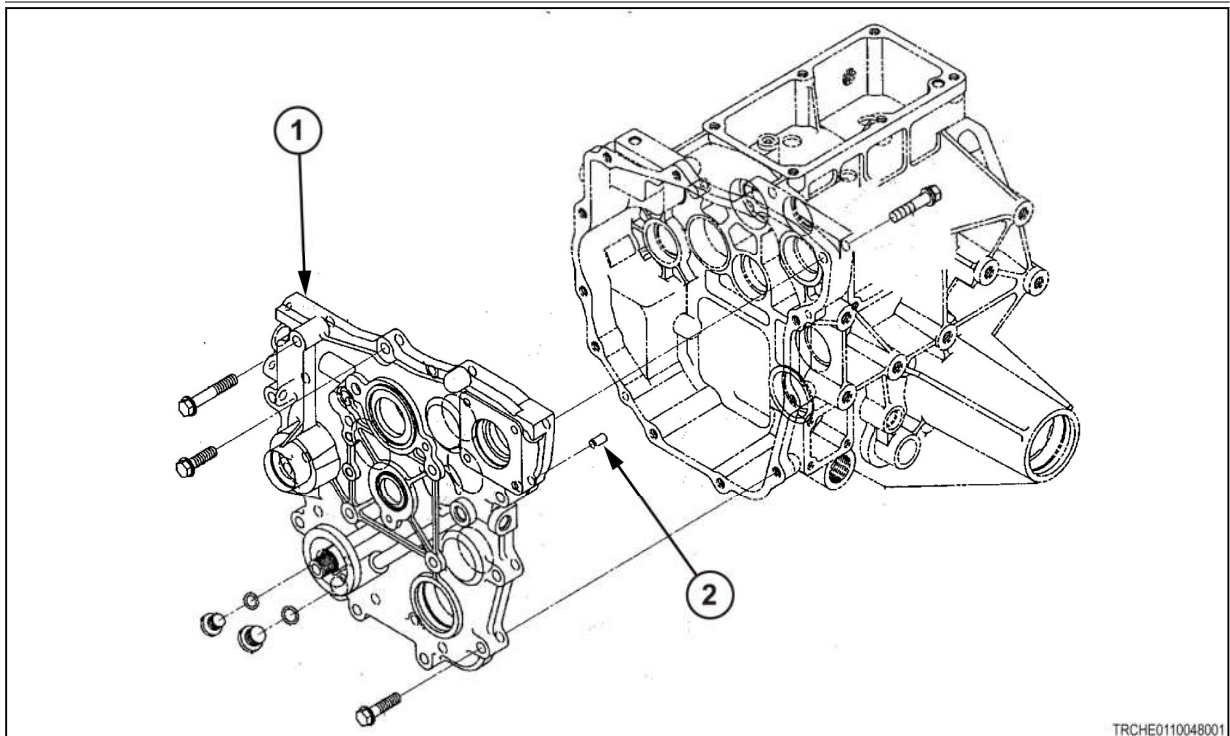


Fig. 39

(1) Front cover

(2) Dowel pin

### 5.1.12 Pump drive system

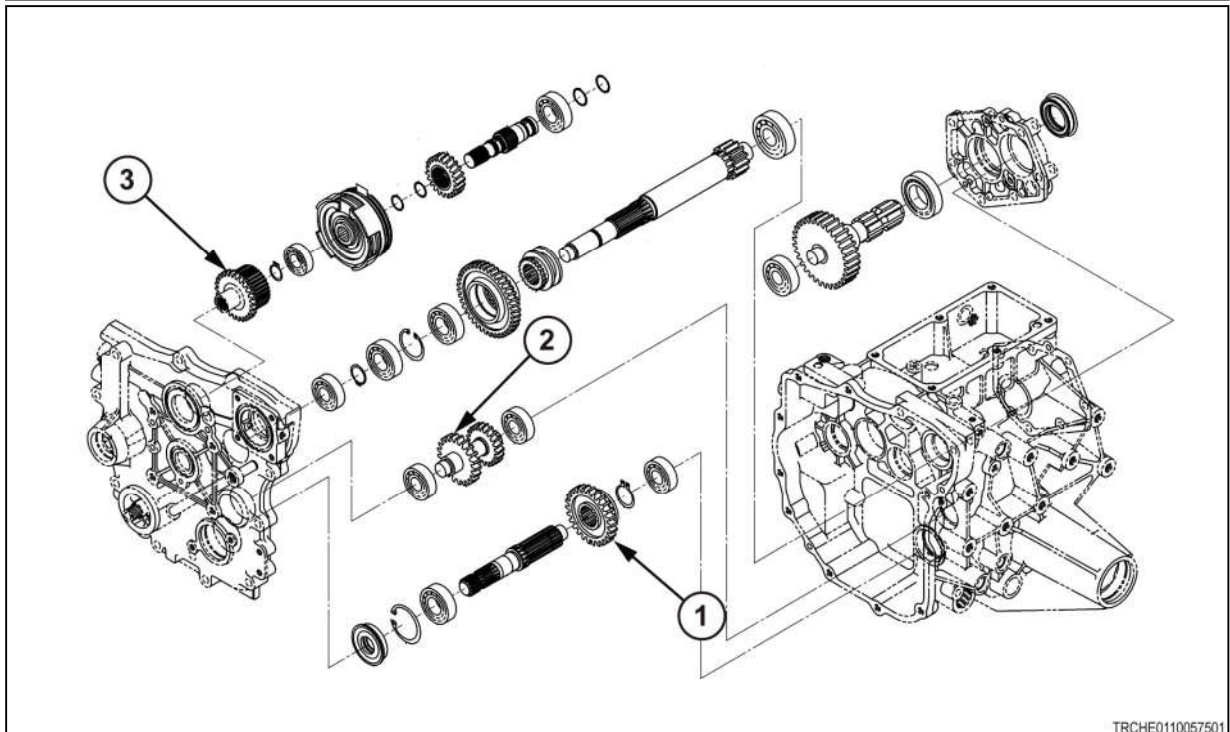


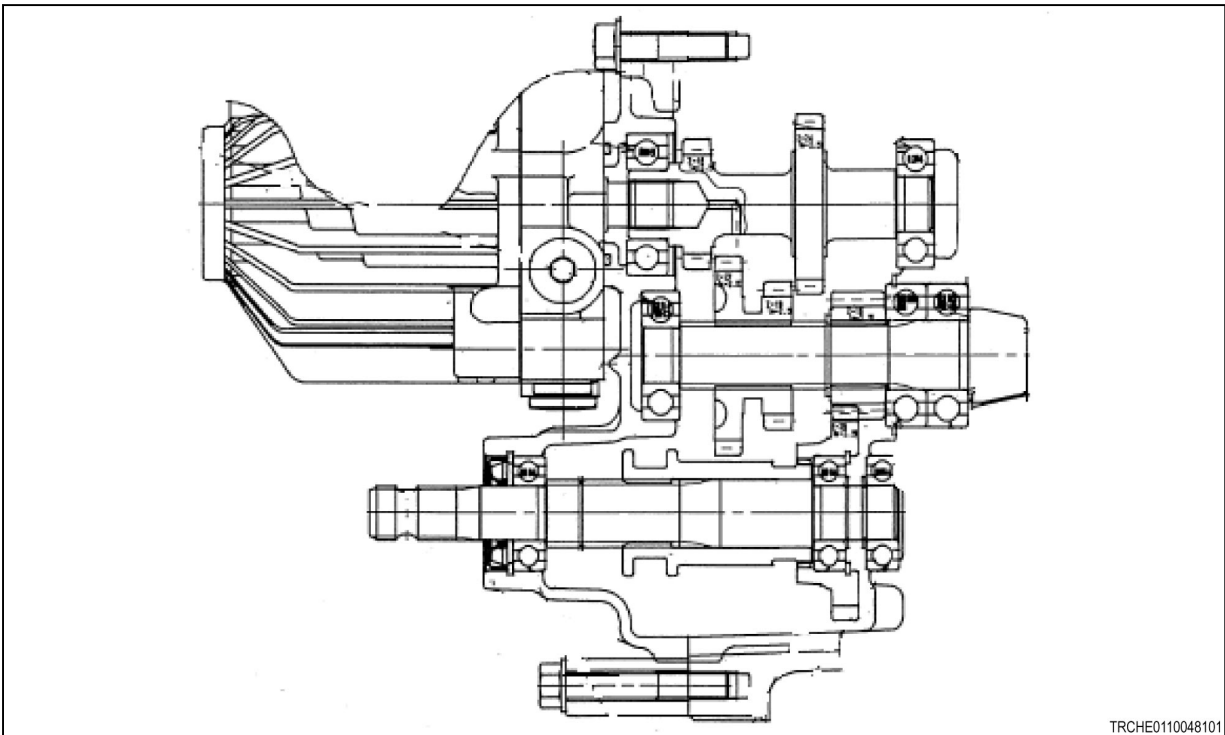
Fig. 40

(1) Pump drive gear

(2) Idler gear

(3) Power take-off drive gear

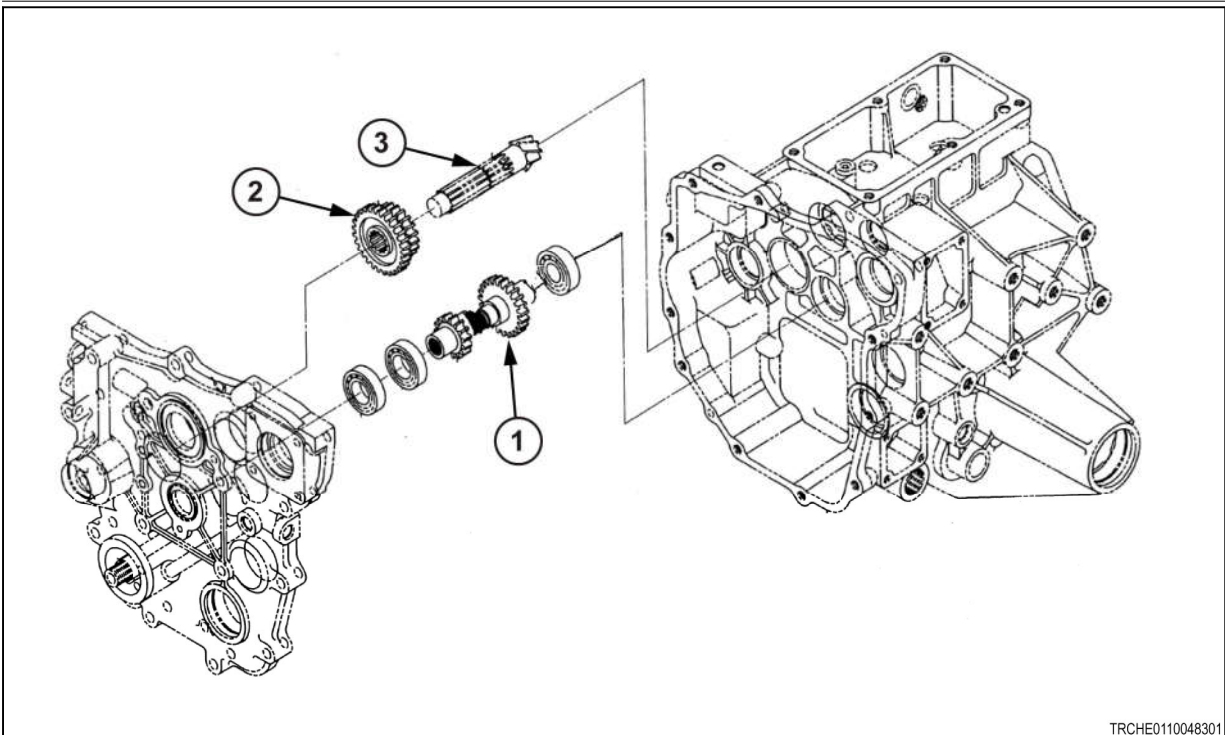
### 5.1.13 Transmission gear construction



TRCHE0110048101

Fig. 41

### 5.1.14 Range gears



TRCHE0110048301

Fig. 42

- (1) Input shaft
- (2) Sliding gear (hi/lo range)

- (3) Pinion shaft

### 5.1.15 Four-wheel drive gear system

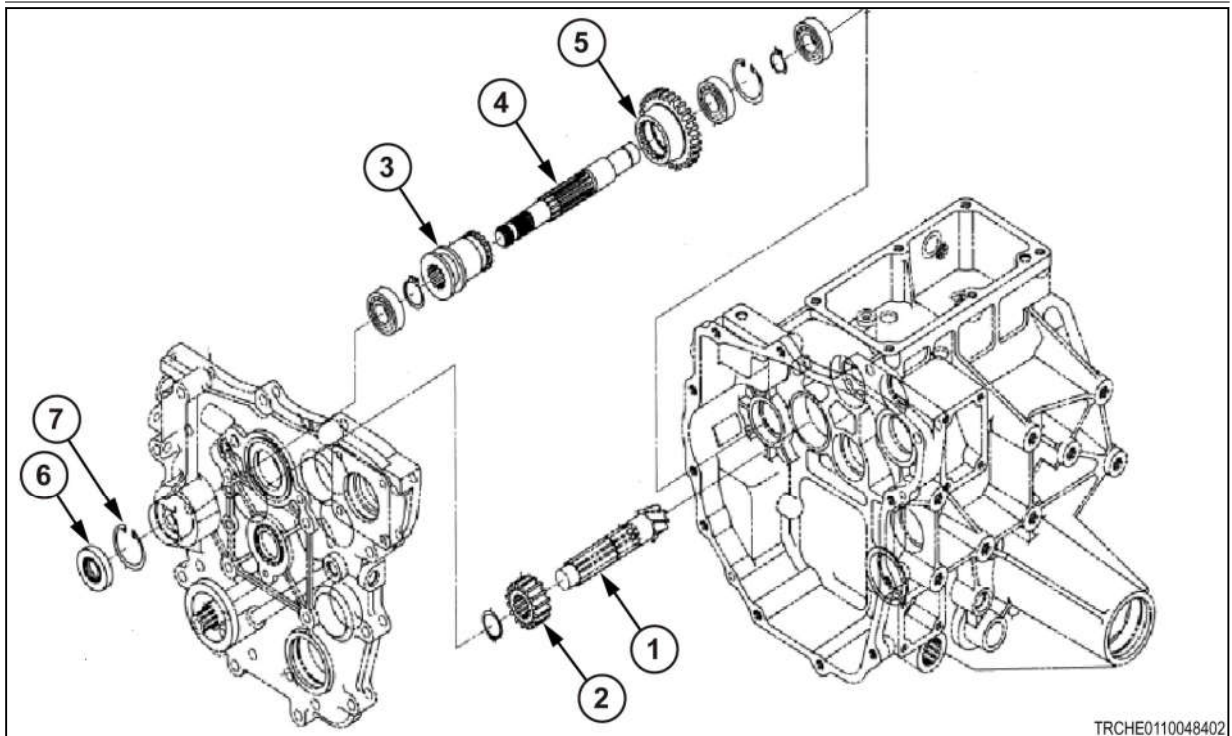


Fig. 43

- |                                   |                                  |
|-----------------------------------|----------------------------------|
| (1) Pinion shaft                  | (5) Four-wheel drive output gear |
| (2) Four-wheel drive input gear   | (6) Seal                         |
| (3) Four-wheel drive shift collar | (7) Retainer ring                |
| (4) Four-wheel drive output shaft |                                  |

### 5.1.16 Disassemble the transmission

**NOTE:** The image appearance may be slightly different than the tractor, but the procedures is the same.

#### Procedure

1. Shift the range transmission into the neutral position.
2. Remove the transmission from the machine.
3. Remove the seat support assembly.
4. Remove the oil filter.

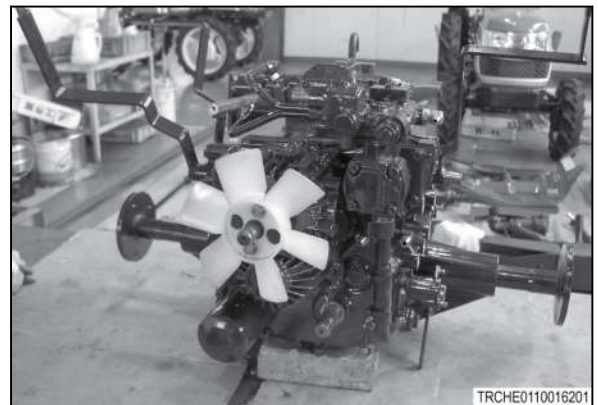


Fig. 44



5. Remove the hydrostatic transmission (HST) linkage assembly and the up/down control lever.

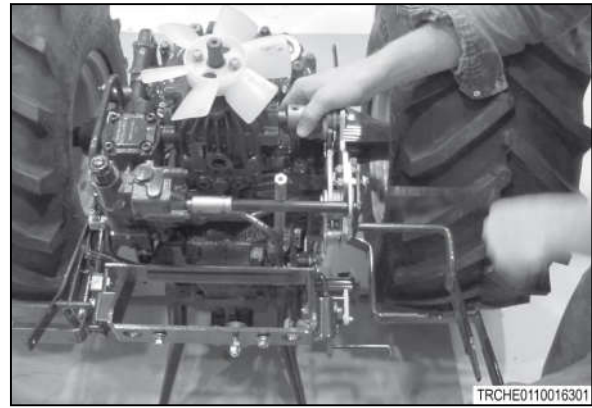


Fig. 45

6. Remove the cooling fan from the front of the HST.

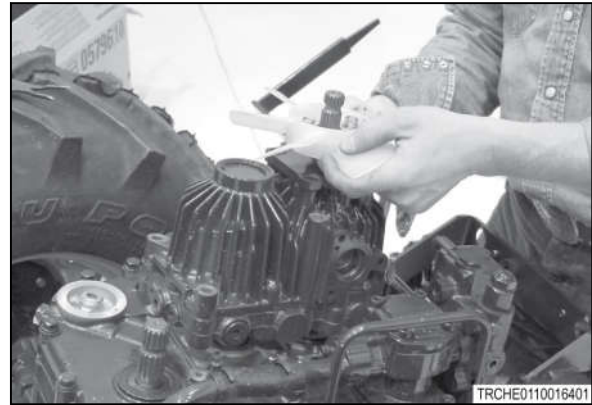


Fig. 46

7. Remove the four bolts securing the HST assembly to the front transmission cover.

8. Remove the HST.

**NOTE:** Do not lose the O-rings between the HST and the front cover.

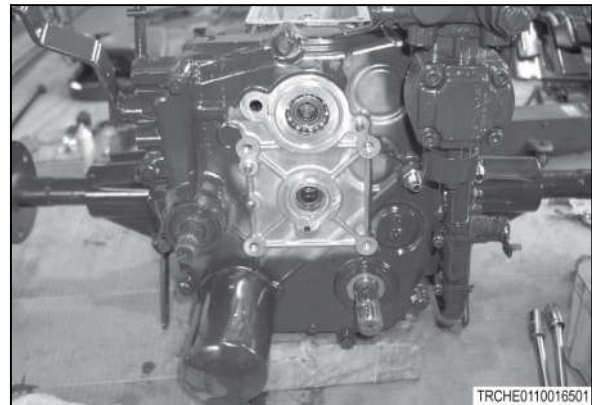


Fig. 47

9. Remove the suction screen (1) from the side of the transmission or separate the lower half of the pump suction line from the upper half.

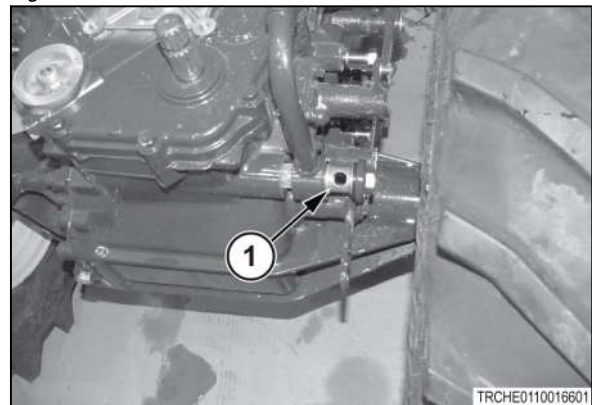


Fig. 48

10. Remove the up/down control lever assembly.
11. Disconnect the pressure and return lines from the control valve.

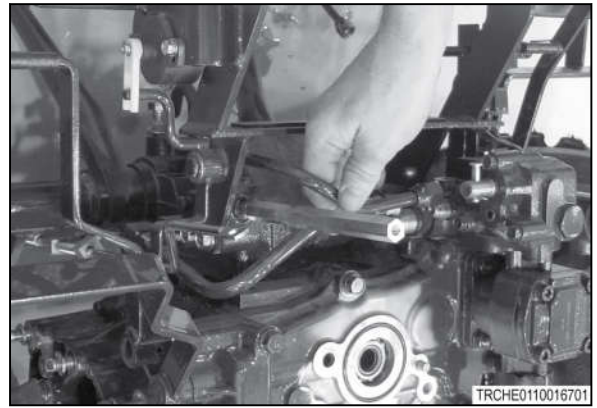


Fig. 49

12. Remove the pump and control valve as an assembly.



Fig. 50

13. Remove the four-wheel drive (4WD) detent cap, spring, ball, and sealing washer from the front transmission cover.

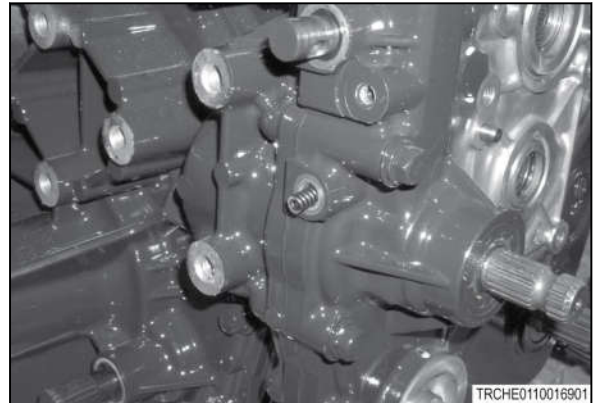


Fig. 51

14. Drive out the roll pin and remove the range shift lever and the 4WD shift lever.

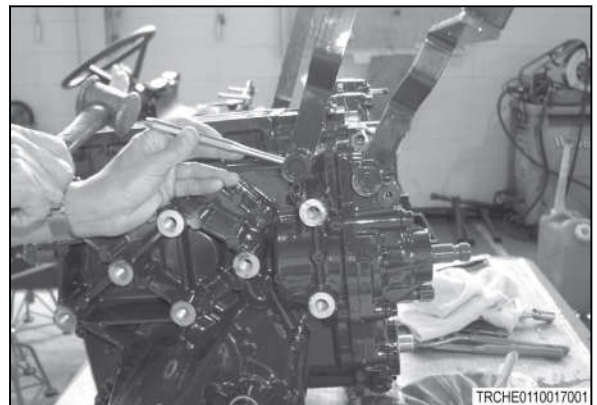


Fig. 52

- 15. Remove the rear power take-off (PTO) and mid PTO shift lever.
- 16. Remove the mid and rear PTO detent caps, spring ball, and bearing washer from the transmission case on the left side.

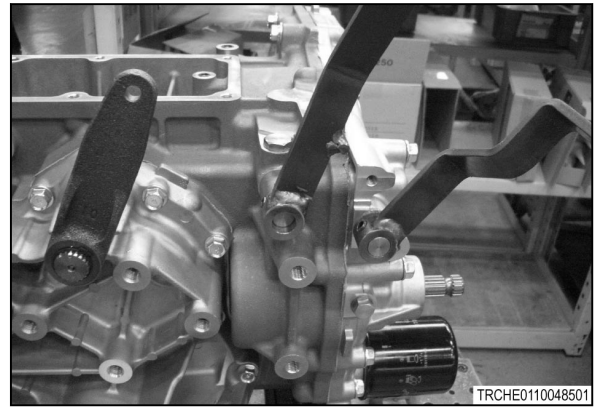


Fig. 53

- 17. Remove the front transmission cover.

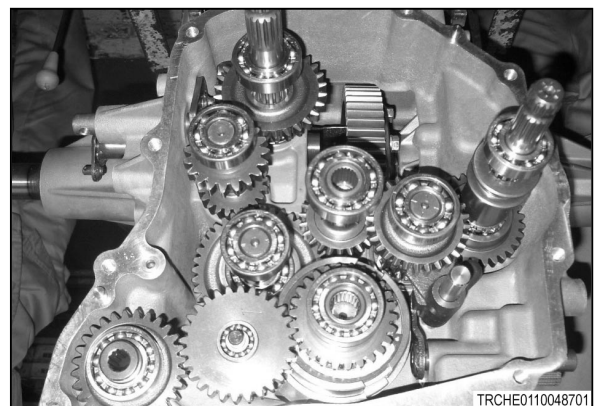


Fig. 54

18. Remove the hydraulic pump drive gear.

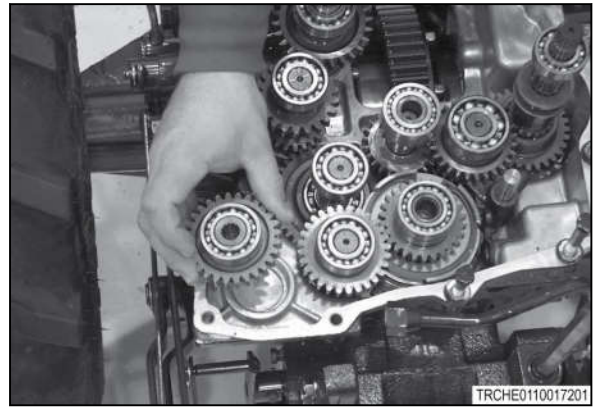


Fig. 55

19. Remove the mid PTO shaft.

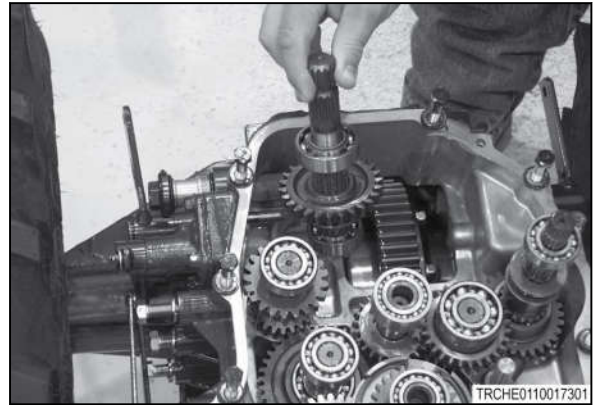


Fig. 56

20. Remove the mid PTO drive gear assembly.

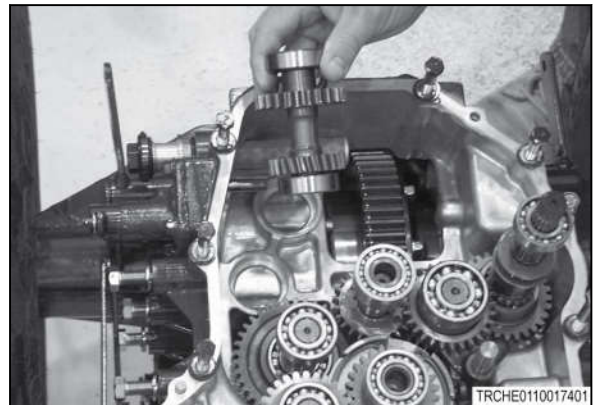


Fig. 57

21. Remove the PTO drive gear from the PTO clutch.

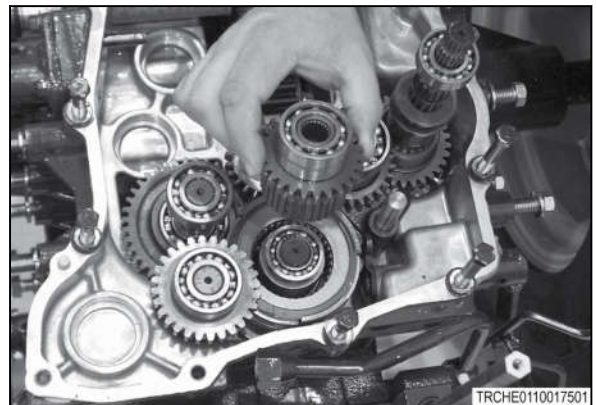


Fig. 58

- 22.** Remove the 4WD shaft and shift collar.

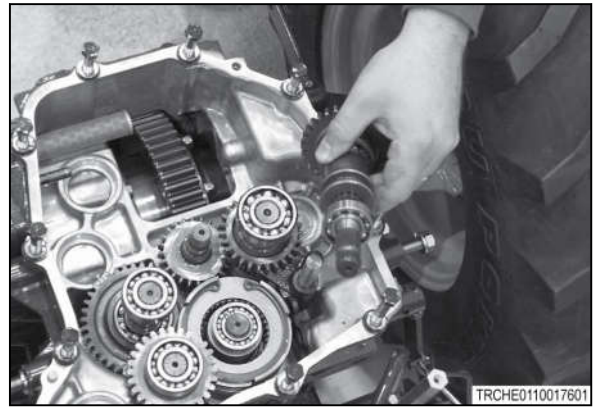


Fig. 59

- 23.** Remove the pinion shaft, range gears, range gear shift fork and shift rail as an assembly.

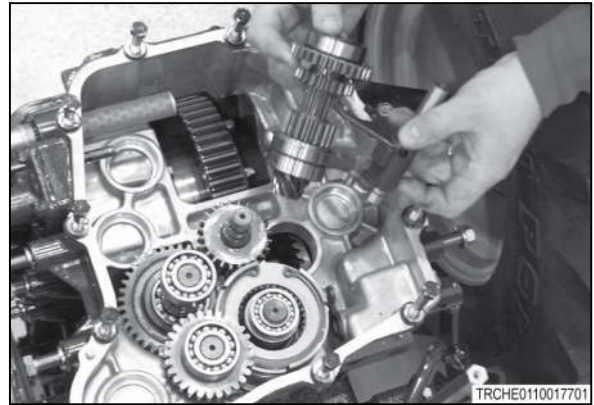


Fig. 60

- 24.** Remove the shift fork.

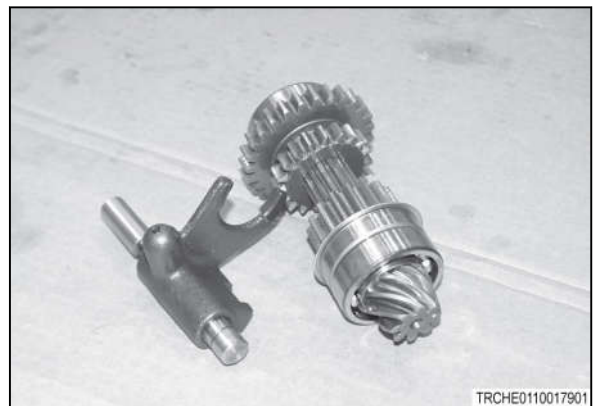


Fig. 61

25. Remove the bearing from the pinion shaft.

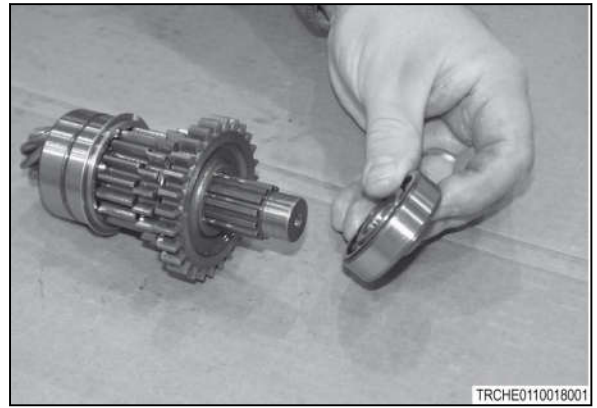


Fig. 62

26. Remove the hi/lo range sliding gear from the pinion shaft.

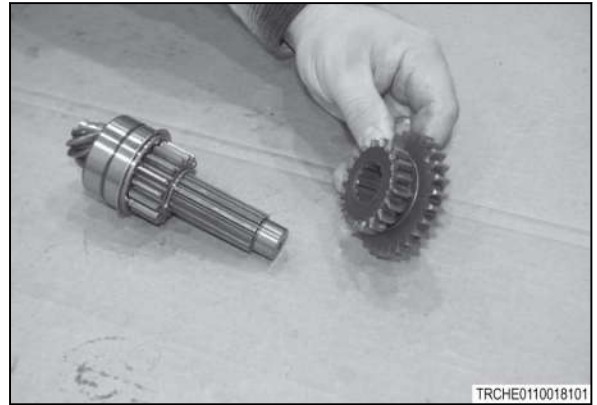


Fig. 63

27. Remove the retainer ring.

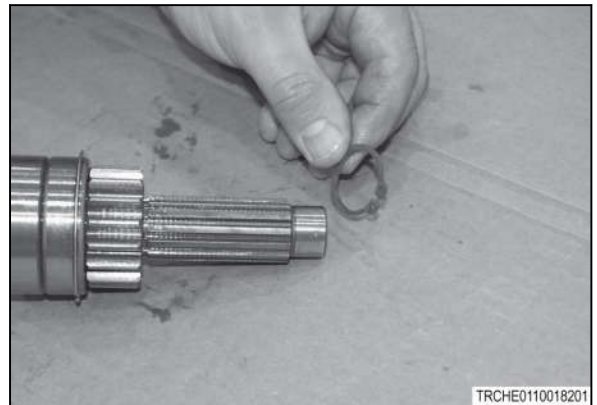


Fig. 64

28. Remove the 4WD input gear from the pinion shaft.

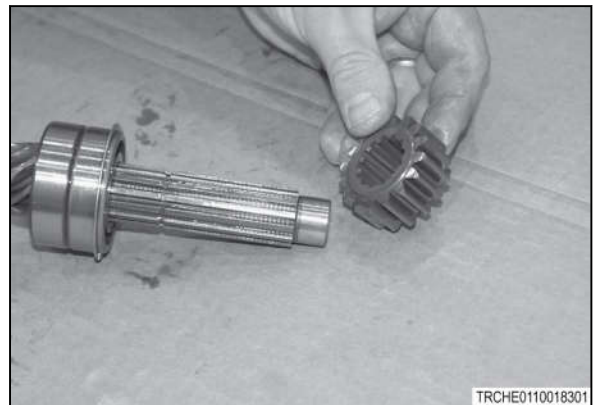


Fig. 65

- 29.** Remove the bearing and gear from the rear PTO drive shaft.

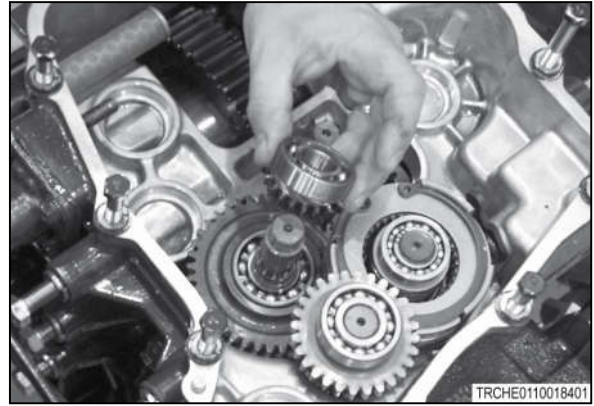


Fig. 66

- 30.** Remove the retainer ring from the rear PTO drive shaft.

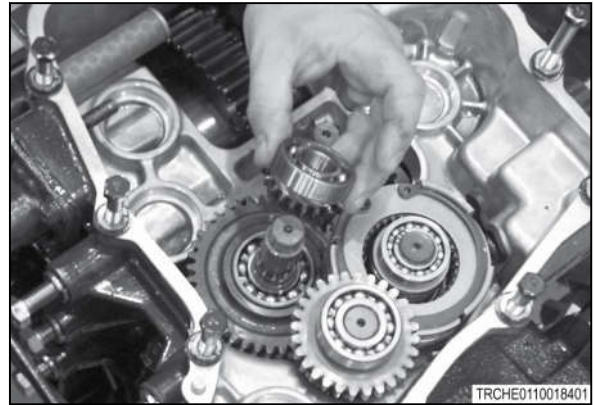


Fig. 67

- 31.** Remove the pump idler gear.

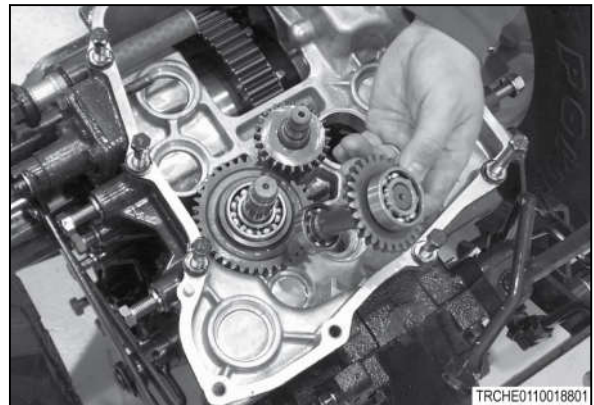


Fig. 68

- 32.** Remove the PTO clutch pack. Note the position of the brake tab (1) inside the notch on the housing.

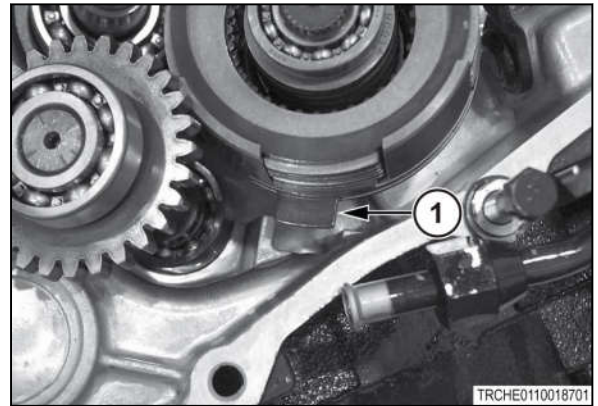
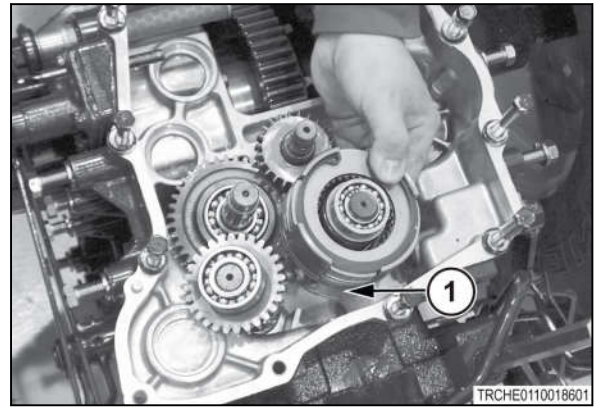


Fig. 69

- 33.** Remove the gear from the PTO drive shaft.  
**34.** Remove the input shaft.

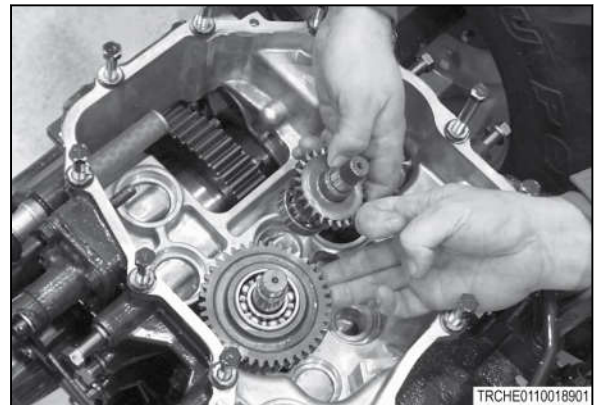


Fig. 70



35. Remove the shift collar from the PTO drive shaft.

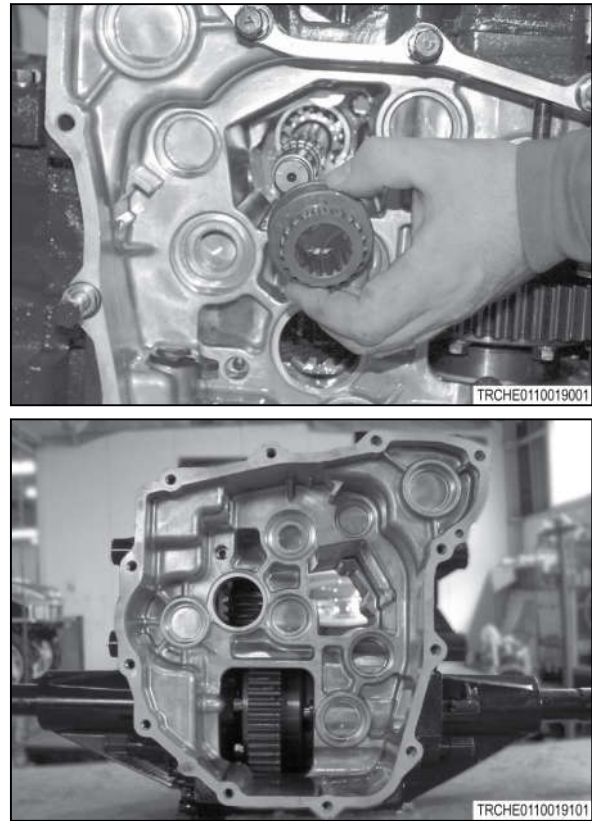


Fig. 71

### 5.1.17 Examine the transmission parts

#### Procedure

1. Examine the O-rings and seals.
2. Examine the condition of the bearings.  
All bearings must rotate smoothly.
3. Examine the condition of the shift forks.
4. Examine the contact surface on the gears.
5. Examine the retainer rings.

### 5.1.18 Examine the shift linkages

#### Procedure

1. Examine the power take-off (PTO) shift forks (1).
2. Examine the O-rings (2).
3. Examine the detents (3).
4. Make sure the PTO linkage moves freely.
5. Examine the detent assembly (1) of the four-wheel drive shift fork.
6. Examine the shift fork (2).
7. Make sure the two O-rings (3) are installed on the shift fork.
8. Examine the range shift fork (1).
9. Examine the shift arm.
10. Examine the shift rail.
11. Examine the O-ring (2).
12. Examine the detents.

**NOTE:** Make sure the range shift lever shifts smoothly.

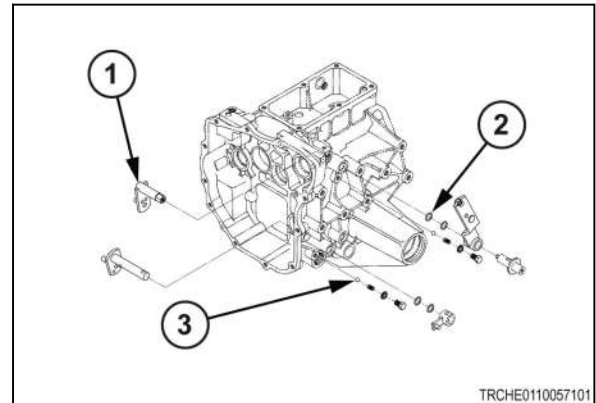


Fig. 72

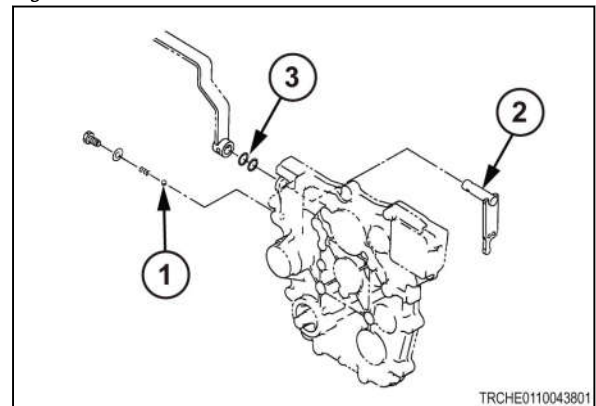


Fig. 73

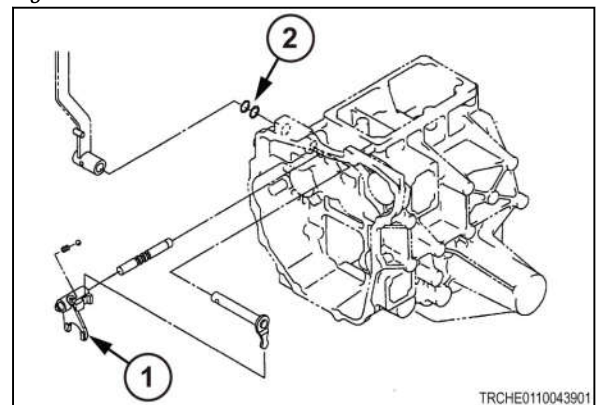
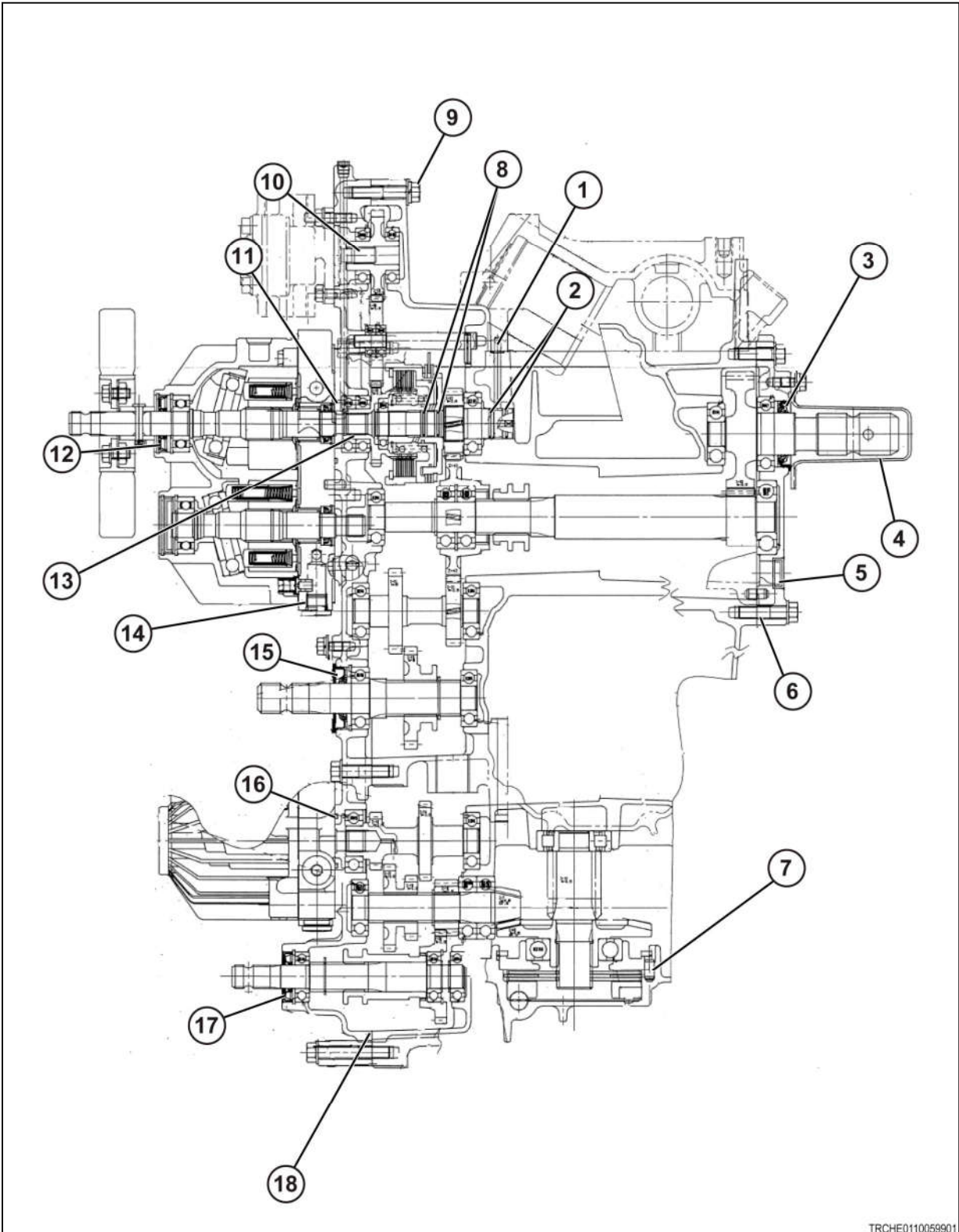


Fig. 74

### 5.1.19 Specifications to assemble the transmission

#### Procedure



TRCHE0110059901

Fig. 75

1. Apply grease to the O-ring (1).

2. Apply grease to the seal ring (2).
  3. Apply grease to the oil seal lip (3).
  4. Apply grease to the power take-off shaft (4).
  5. Apply adhesive to the periphery (5).
  6. Apply adhesive to the face (6).
  7. Apply adhesive to the face (7).
  8. Apply grease to the seal ring (8).
  9. Tighten cap screws (9) to 41.2 Nm to 46.1 Nm (30.4 lbf ft to 34.0 lbf ft).
  10. Apply adhesive (10).
  11. Apply grease to the O-ring (11).
  12. Tighten cap screws (12) to 41.2 Nm to 46.1 Nm (30.4 lbf ft to 34.0 lbf ft).
  13. Apply adhesive (13).
  14. Tighten cap screws (14) to 41.2 Nm to 46.1 Nm (30.4 lbf ft to 34.0 lbf ft).
  15. Apply grease to the oil seal lip (15).
  16. Apply grease to the O-ring (16).
  17. Apply grease to the oil seal lip (17).
  18. Apply adhesive to the face (18).
- 

#### **5.1.20 Assemble the transmission**

---

**NOTE:** *The image appearance may be slightly different than the tractor, but the procedures is the same.*

- Install new seals.
- Lubricate all the O-rings and the seals prior to assembly.
- Use silicone sealant between all housings.
- Use standard torque values.

**Procedure**

1. Install the shift collar onto the PTO drive shaft.
2. Install the input shaft.

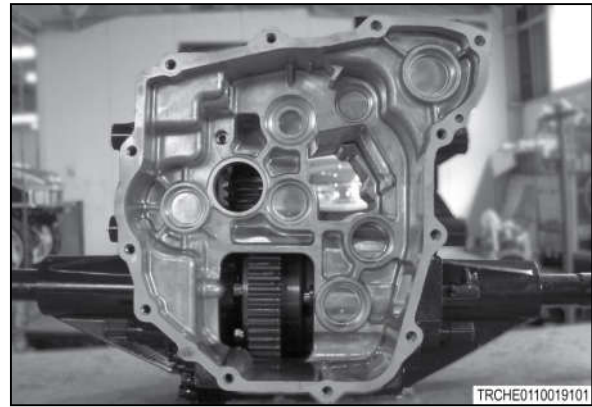
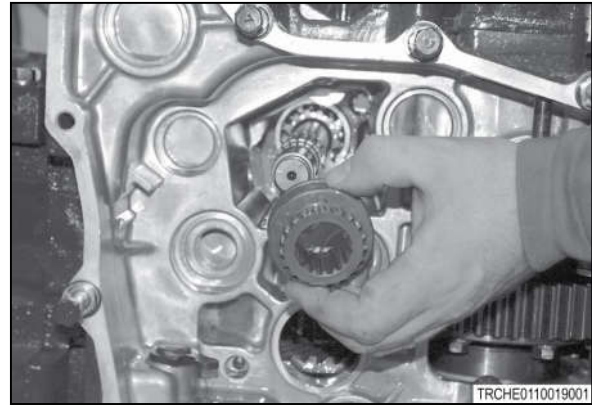


Fig. 76

3. Install the gear onto the PTO drive shaft.

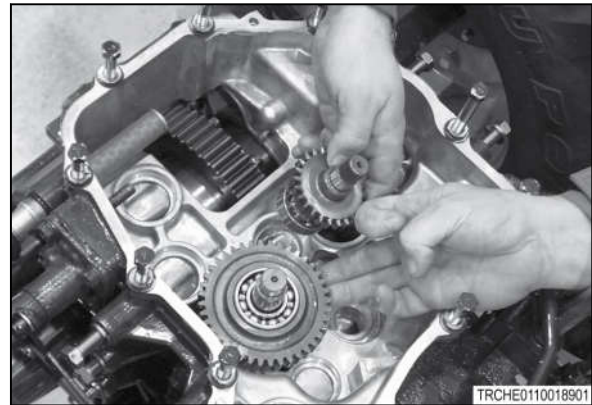


Fig. 77

4. Install the PTO clutch pack. Note align the brake tab (1) on the PTO clutch pack with the notch in the housing.

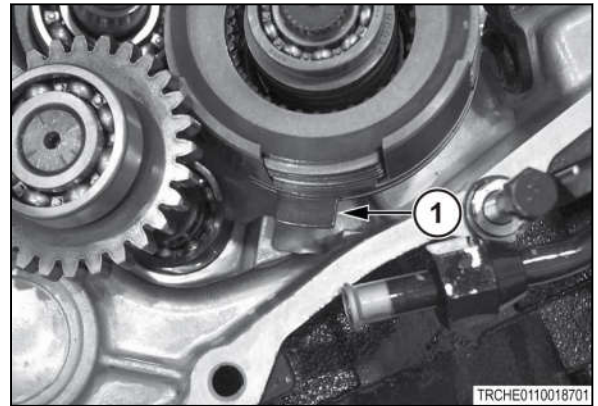
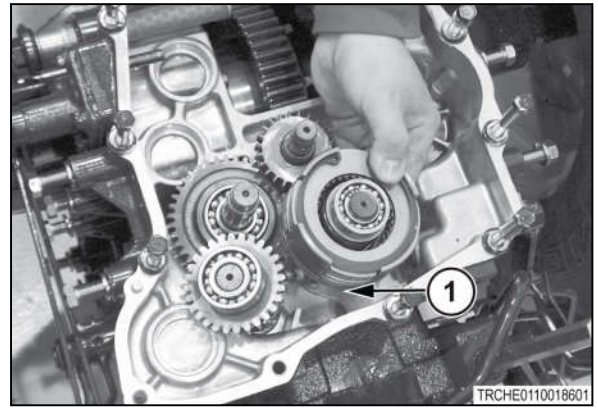


Fig. 78

5. Install the pump idler gear.

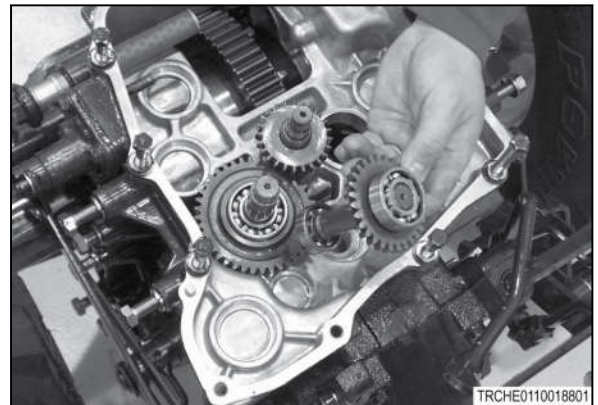


Fig. 79

6. Install the retainer ring onto the rear PTO drive shaft.

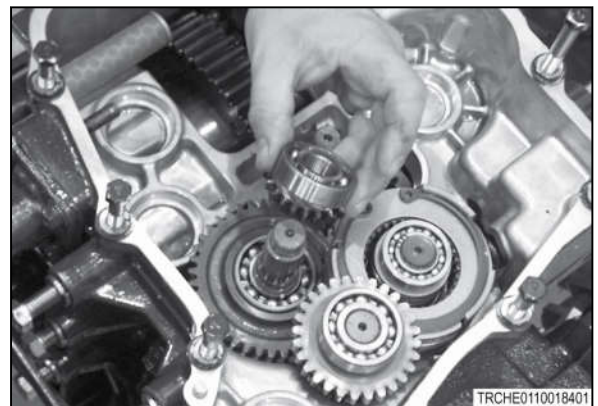


Fig. 80

7. Install the bearing and gear onto the rear PTO drive shaft.

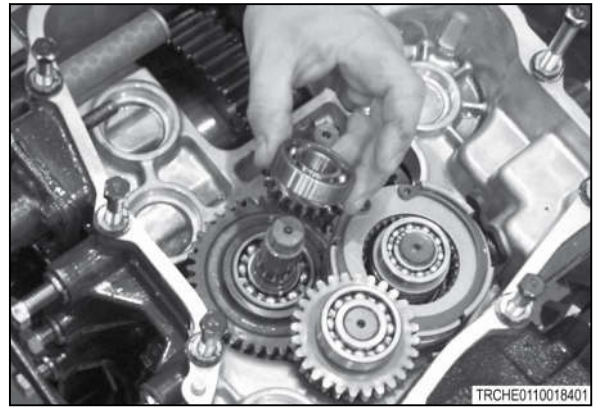


Fig. 81

8. Install the four-wheel drive input gear onto the pinion shaft.

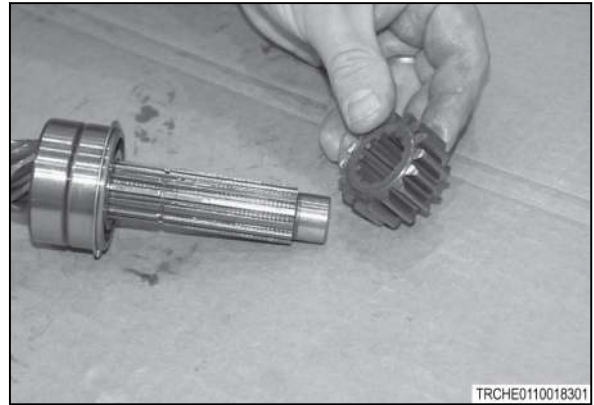


Fig. 82

9. Install the retainer ring.

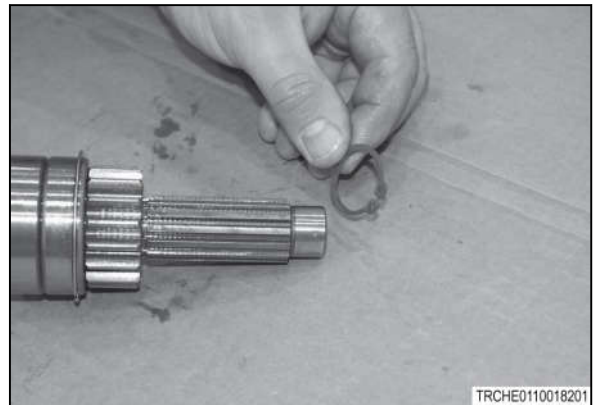


Fig. 83

10. Install the hi/lo range sliding gear onto the pinion shaft.

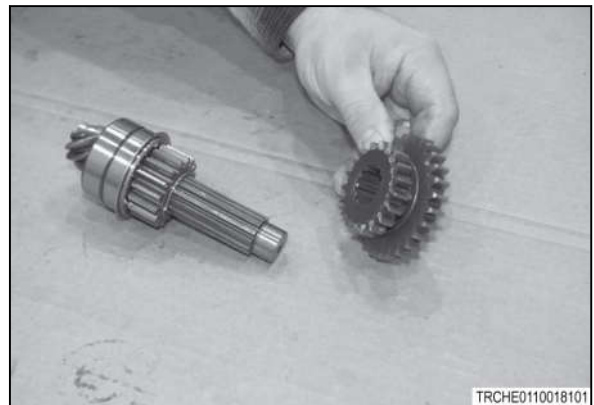


Fig. 84

11. Install the bearing onto the pinion shaft.

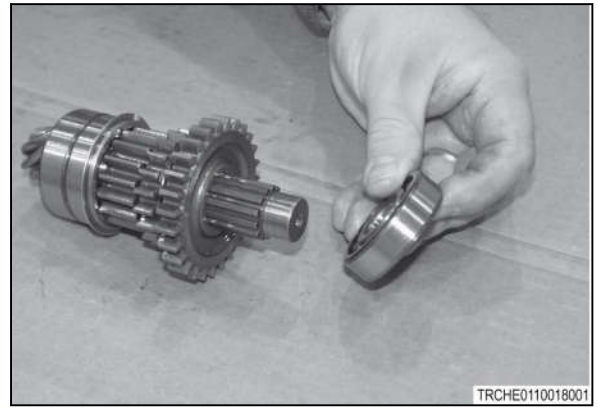


Fig. 85

12. Install the shift fork.

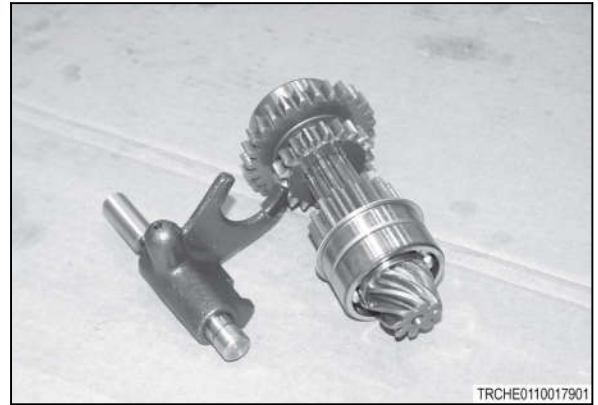


Fig. 86

13. Install the pinion shaft, range gears, range gear shift fork and shift rail as an assembly.

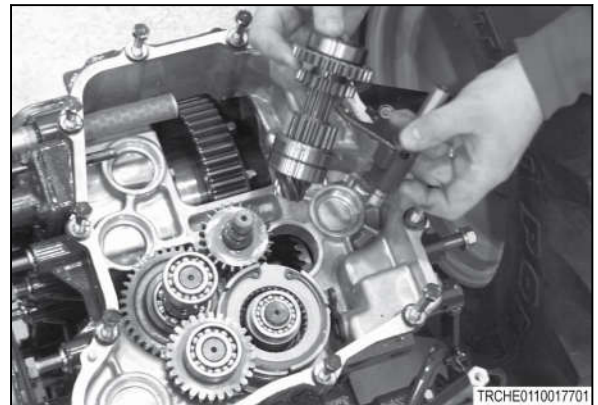


Fig. 87



14. Install the 4WD shaft and shift collar.

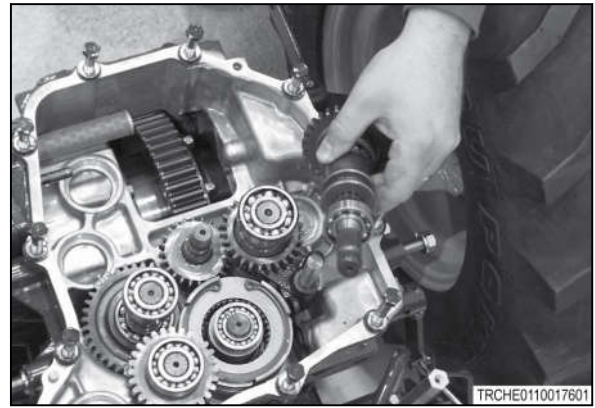


Fig. 88

15. Install the PTO drive gear onto the PTO clutch.

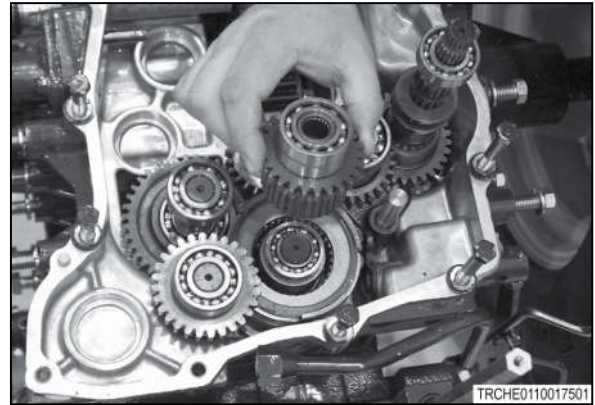


Fig. 89

16. Install the mid PTO drive gear assembly.

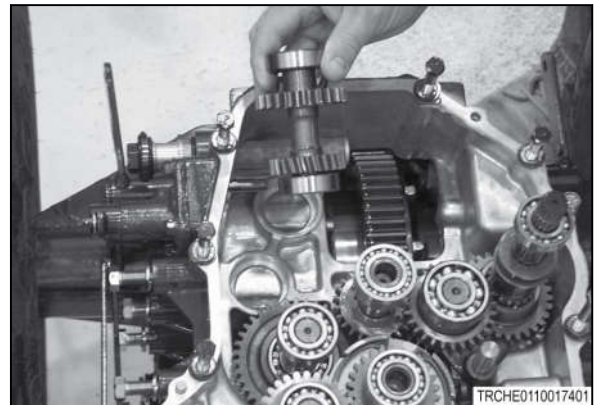


Fig. 90

17. Install the mid PTO shaft.

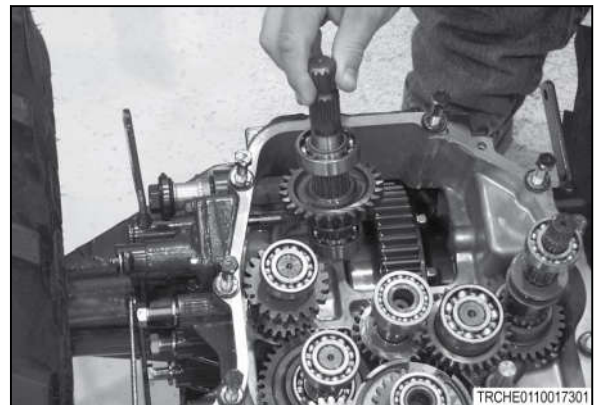


Fig. 91

18. Install the hydraulic pump drive gear.

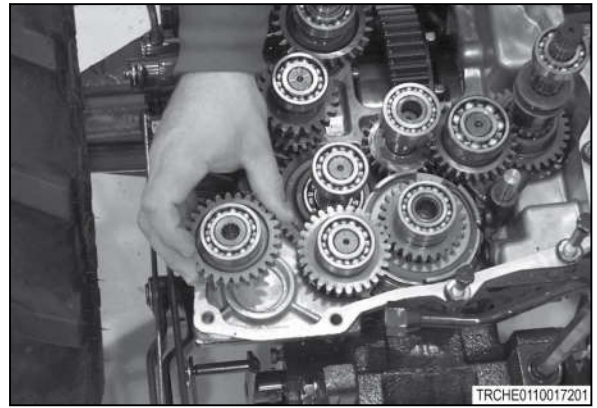


Fig. 92

19. Install the front transmission cover.

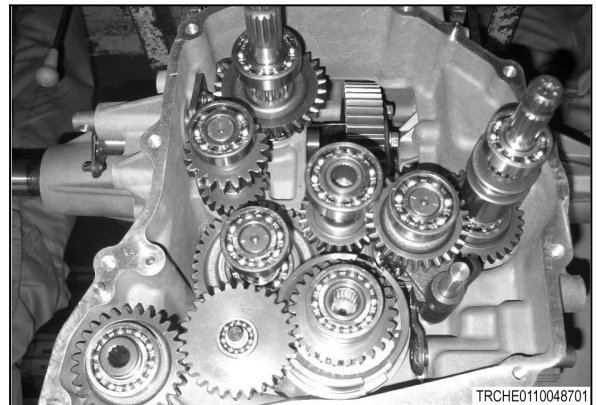
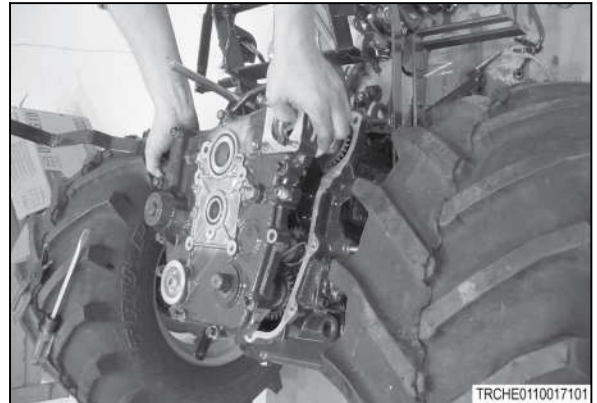


Fig. 93

- 20. Install the mid and rear PTO detent caps, spring ball, and bearing washer into the transmission case on the left side.
- 21. Install the rear PTO and mid PTO shift lever.

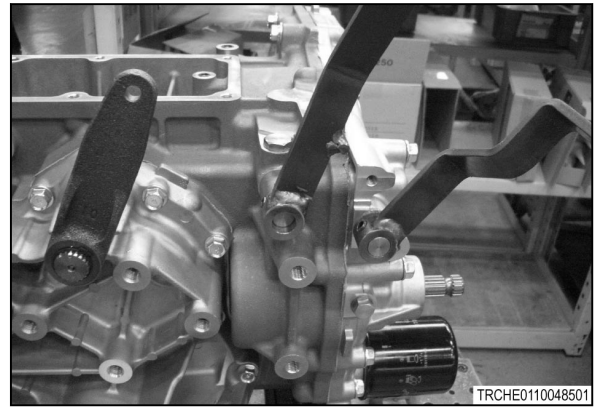


Fig. 94

- 22. Install the range shift lever and the four-wheel drive shift lever. Install the roll pins.

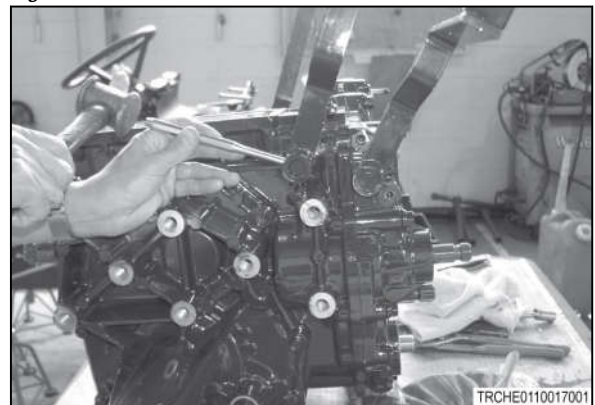


Fig. 95

- 23. Install the four-wheel drive detent cap, spring, ball, and sealing washer into the front transmission cover.

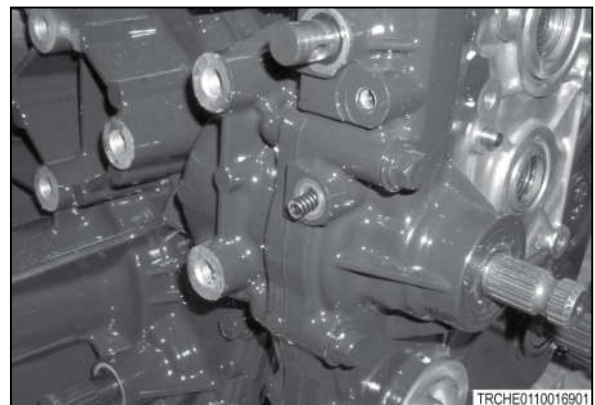


Fig. 96

24. Install the pump and control valve as an assembly.
25. Connect the pressure and return lines onto the control valve.

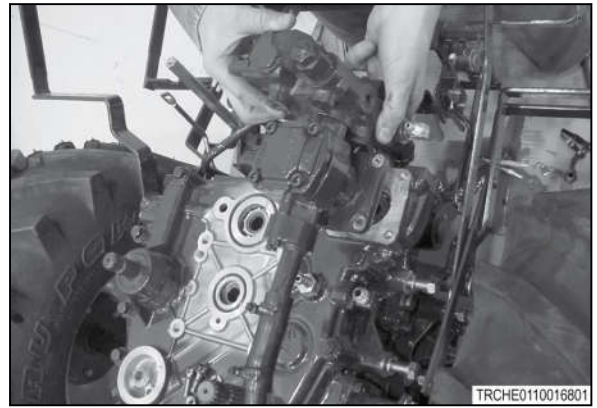


Fig. 97

26. Install the up/down control lever assembly.

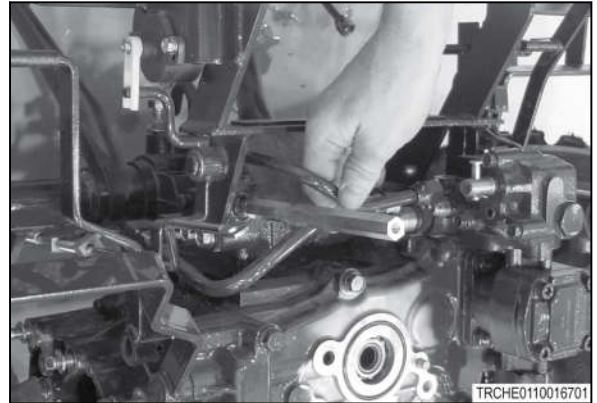


Fig. 98

27. Install the suction screen (1) into the side of the transmission or connect the lower half of the pump suction line to the upper half.

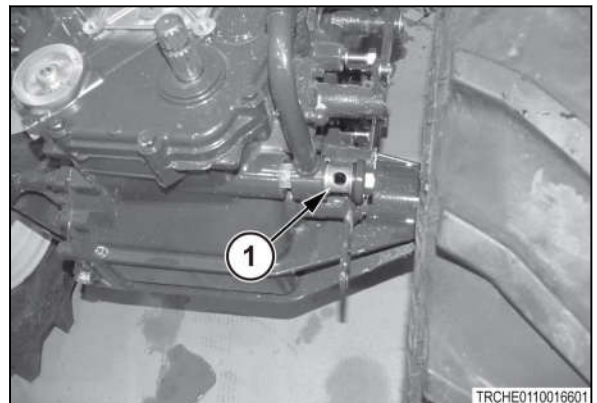


Fig. 99

28. **NOTE:** Make sure that the O-rings are between the hydrostatic transmission and the front cover.

Install the hydrostatic transmission.

29. Install the four bolts securing the hydrostatic transmission assembly to the front transmission cover.

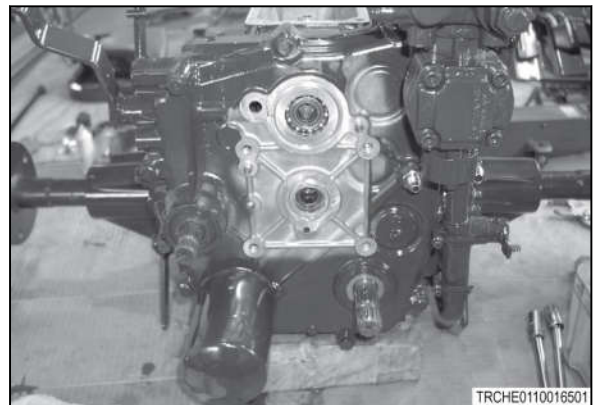


Fig. 100

30. Install the cooling fan onto the front of the hydrostatic transmission.

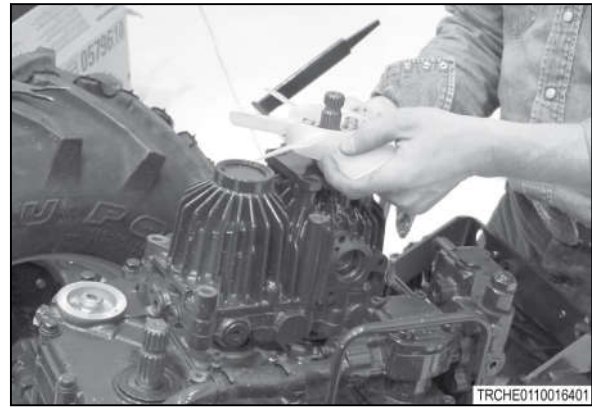


Fig. 101

31. Install the hydrostatic transmission linkage assembly and the up/down control lever.
32. Install the oil filter.
33. Install the seat support assembly.
34. Install the transmission onto the machine.

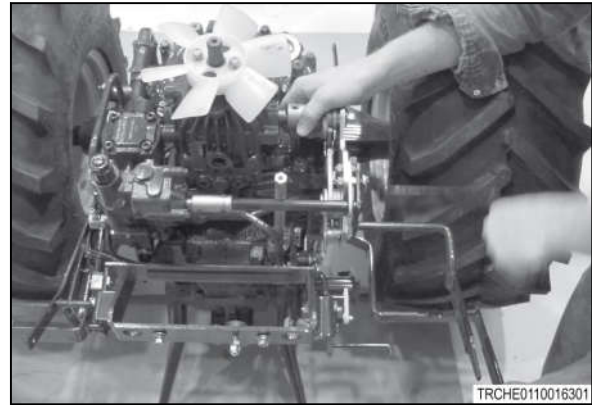


Fig. 102

#### Related Links

[Specifications to assemble the transmission](#) page 5-32

## 5.2 Power takeoff

### 5.2.1 Power take-off controls



**CAUTION:**  
Always turn off the PTO and turn off the tractor engine before servicing the PTO driveline or implement. Let all movement stop before you move off the operator's seat.

The rear power take-off (PTO) and mid PTO are controlled by the PTO clutch lever (1).

The rear PTO and mid PTO can be operated at the same time or independent of each other.

To decrease the shock load on the driveline, decrease the engine speed when you engage the PTO clutch.

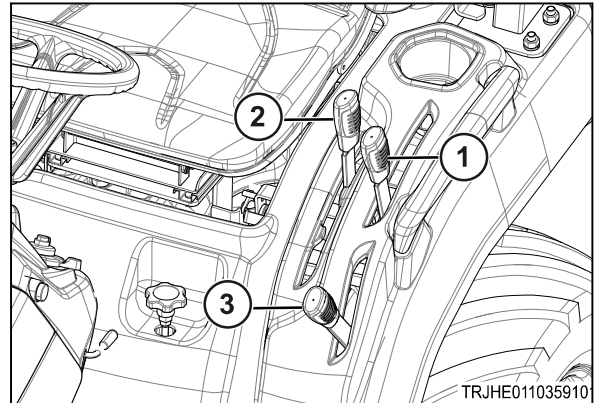


Fig. 103

#### Rear PTO Operation



**WARNING:**  
Do not move the rear PTO selector lever rearward to the 540 position to engage gear when the PTO clutch lever is moved forward.

The rear PTO selector lever (2) is used to select the position of the rear PTO drive gears.

To select the rear PTO, make sure the PTO clutch lever is in the off position. Then move the rear PTO selector lever rearward to the 540 position to engage the gear.

To engage the PTO, move the PTO clutch lever forward.

To disengage the PTO, move the PTO clutch lever rearward.

#### Mid PTO Operation



**WARNING:**  
Do not move the mid PTO selector lever rearward to the 2000 position to engage gear when the PTO clutch lever is moved forward.

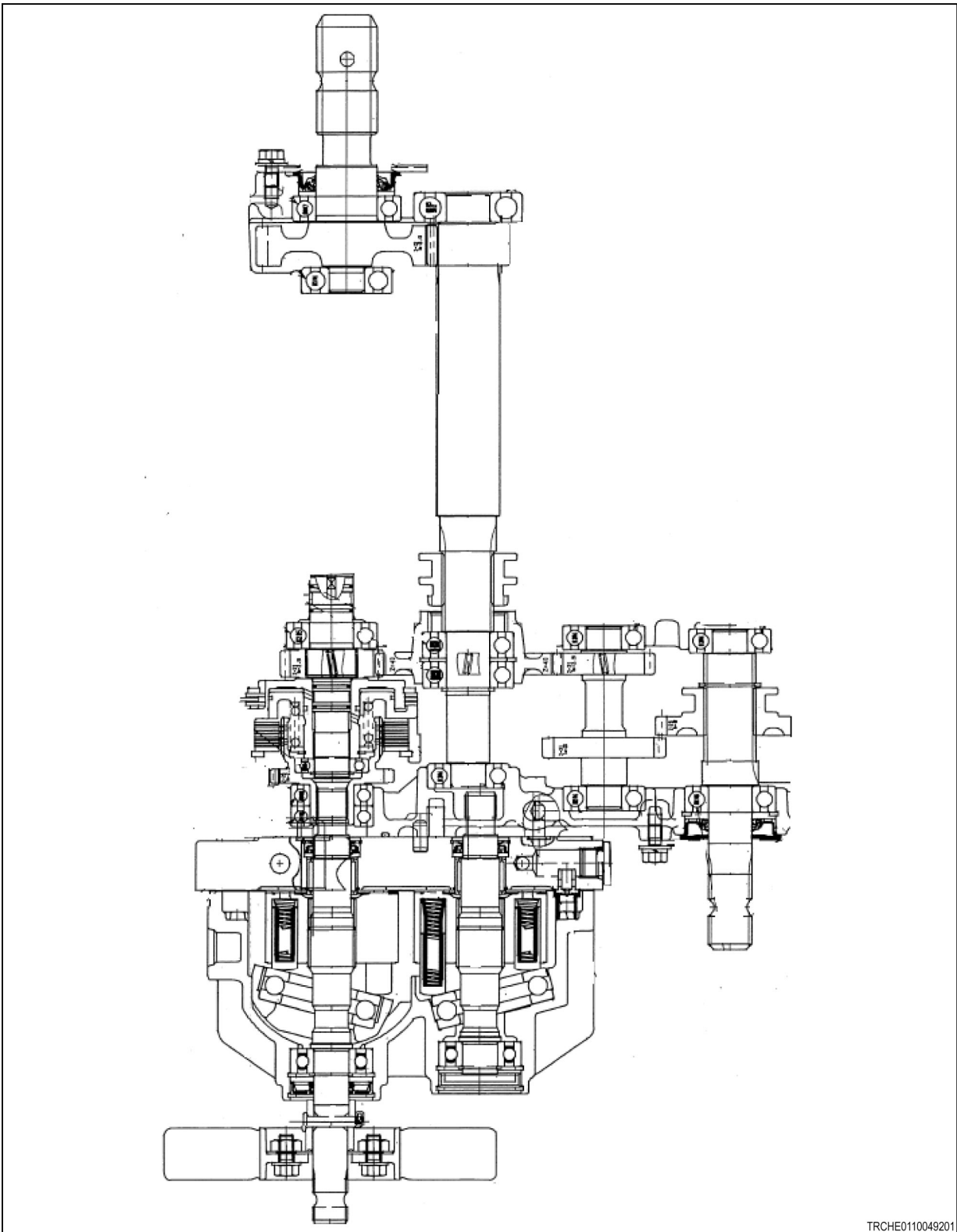
The mid PTO selector lever (3) is used to select the position of the mid PTO drive gears.

To select the mid PTO, make sure the PTO clutch lever is in the off position. Then move the mid PTO selector lever rearward to the 2000 position to engage the mid PTO gear.

To engage the mid PTO, move the PTO clutch lever forward.

To disengage the mid PTO, move the PTO clutch lever rearward.

### 5.2.2 Power take-off assembly construction



TRCHE0110049201

Fig. 104

### 5.2.3 Power take-off gear train components

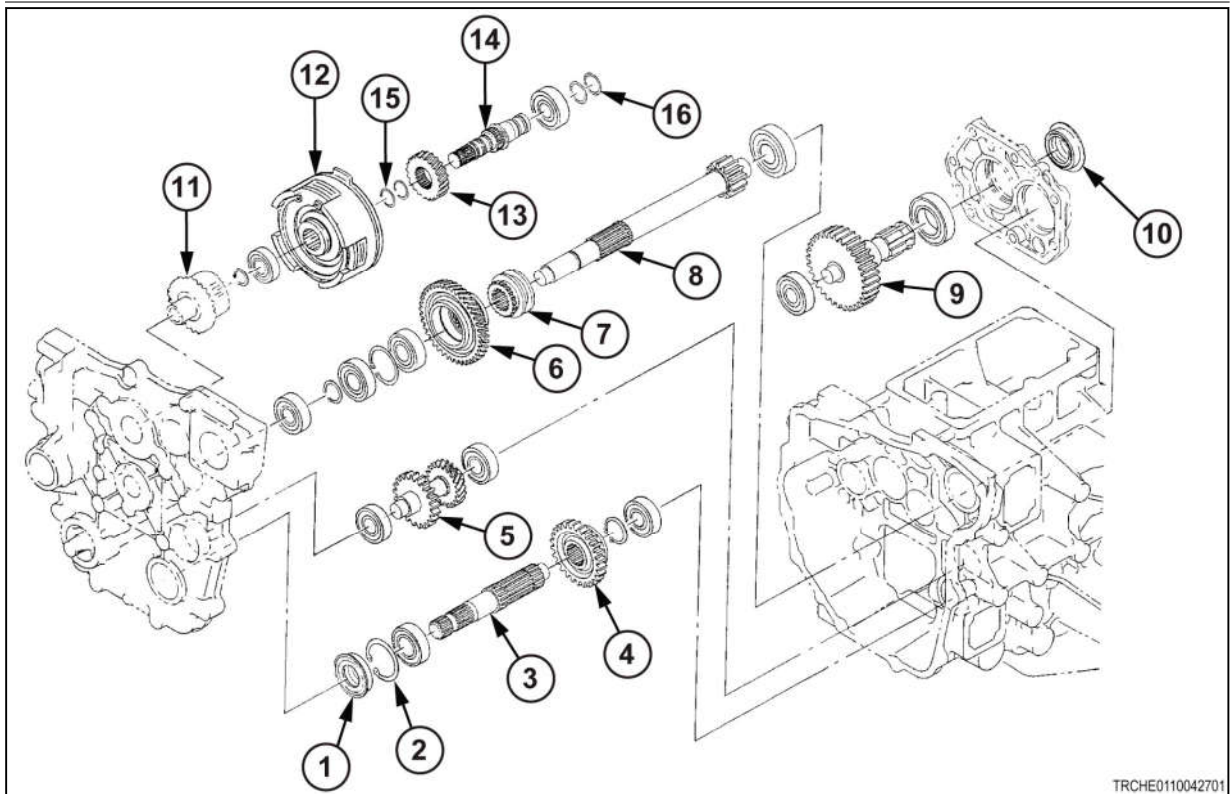


Fig. 105

- |                                    |                     |
|------------------------------------|---------------------|
| (1) Seal                           | (9) 540 PTO         |
| (2) Retainer ring                  | (10) Seal           |
| (3) Mid power take-off (PTO) shaft | (11) PTO drive gear |
| (4) Mid PTO gear and shift collar  | (12) Clutch         |
| (5) Idler                          | (13) Gear           |
| (6) Rear PTO gear                  | (14) Clutch shaft   |
| (7) Rear PTO shift collar          | (15) Seal ring      |
| (8) PTO shaft                      | (16) Seal ring      |



### 5.2.4 Power take-off relief valve

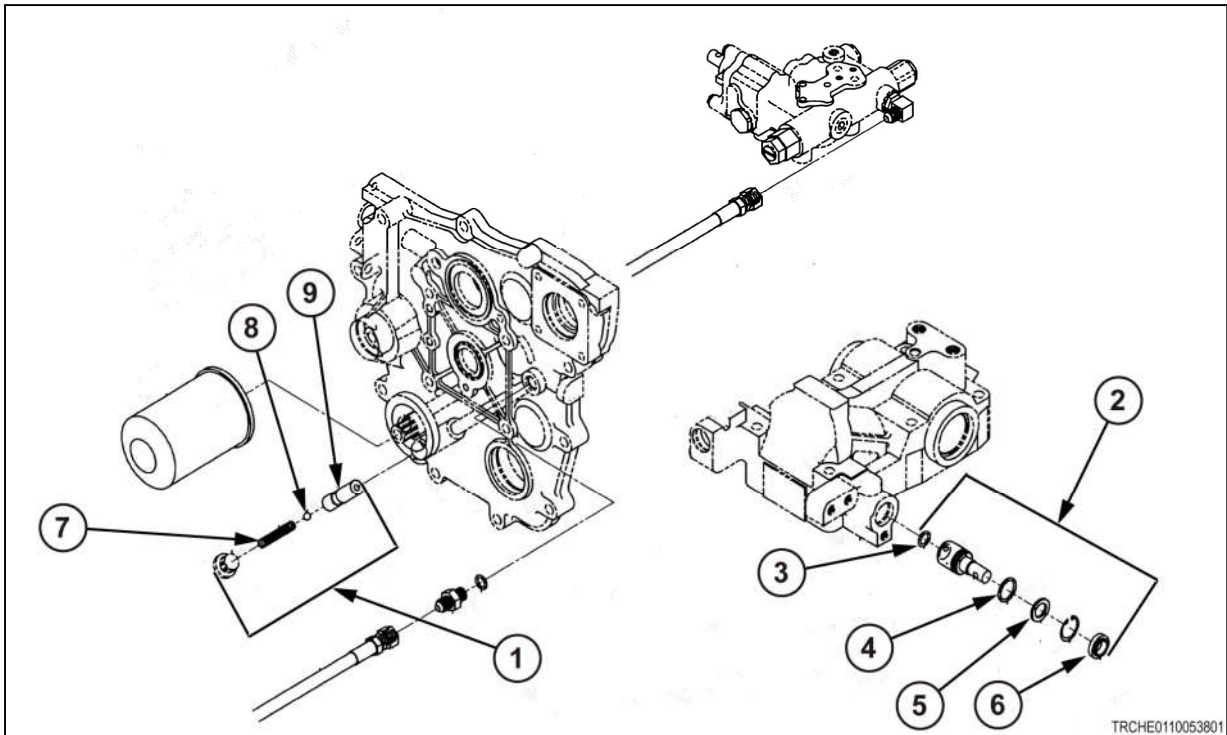


Fig. 106

- |  |               |
|--|---------------|
| (1) Power take-off (PTO) relief assembly | (6) Dust seal |
| (2) PTO rotary valve                     | (7) Spring    |
| (3) O-ring                               | (8) Ball      |
| (4) O-ring                               | (9) Housing   |
| (5) Stopper plate                        |               |

## 5.3 Power takeoff clutch

### 5.3.1 Power take-off clutch pack assembly view

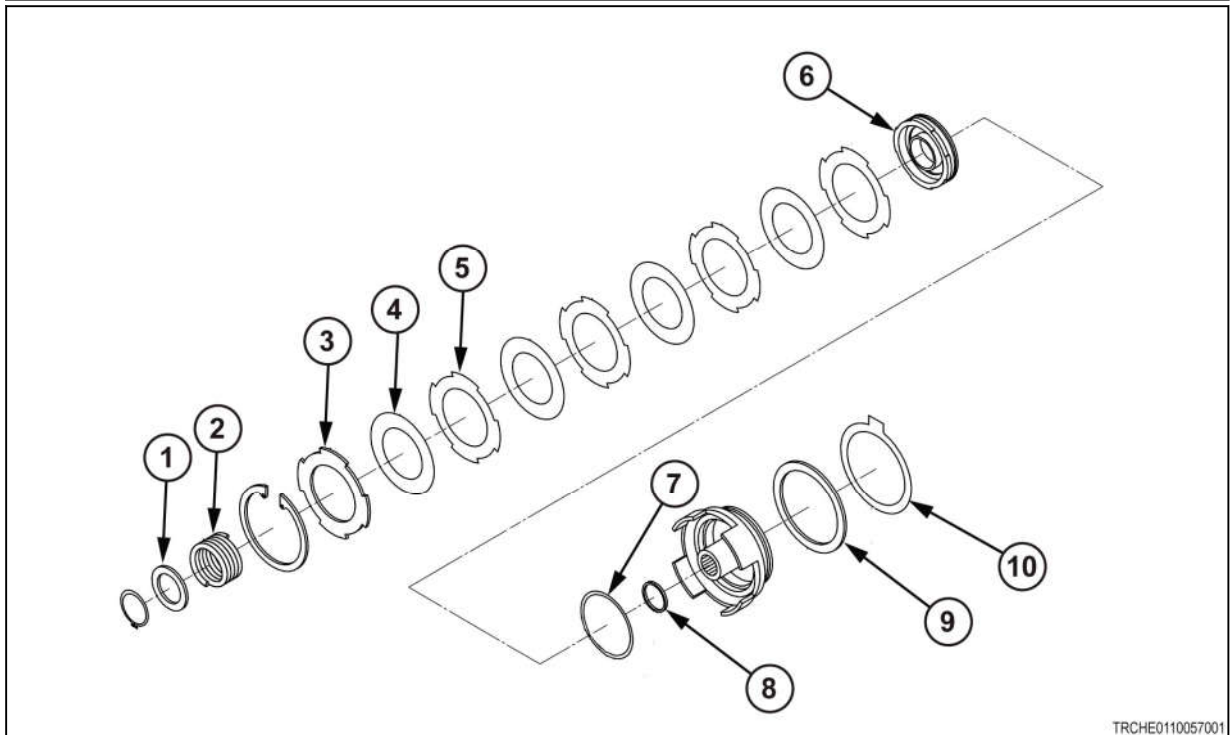


Fig. 107

- |                     |                    |
|---------------------|--------------------|
| (1) Washer          | (6) Piston         |
| (2) Spring          | (7) Ring           |
| (3) Plate           | (8) Ring seal      |
| (4) Friction disc   | (9) Pressure plate |
| (5) Separator plate | (10) Brake         |

### 5.3.2 Disassemble the power take-off clutch pack

#### Procedure

1. Remove the transmission.
2. Remove the power take-off (PTO) clutch pack.
3. Inspect the seals (1) on the PTO clutch pack and replace if needed.

**NOTE:** If the seals are damaged, the hydraulic system will not maintain enough pressure to keep the clutch engaged.

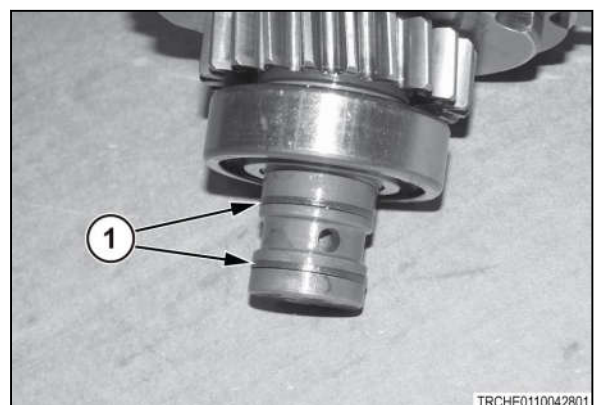


Fig. 108

4. Remove the retainer ring from the clutch pack.

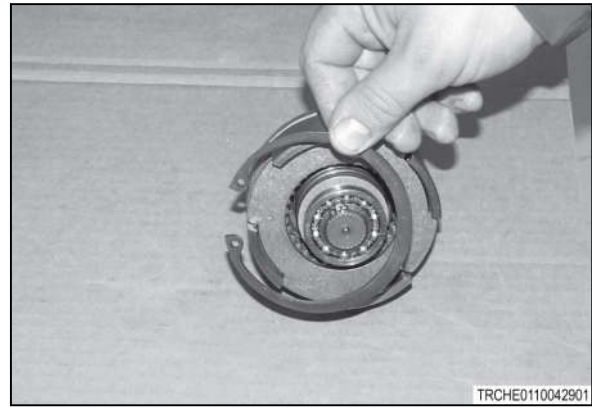


Fig. 109

5. Disassemble the clutch pack and inspect the friction plates and separator plates.

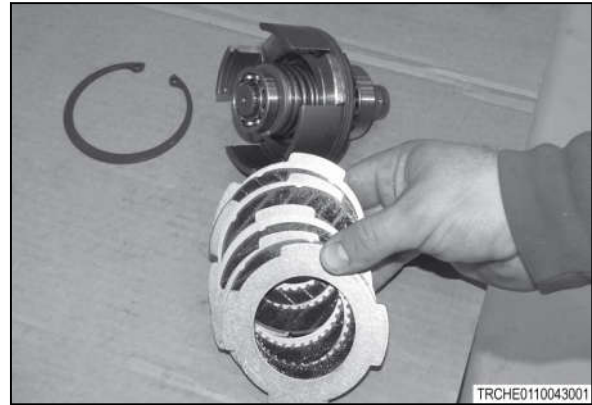



Fig. 110

6.  **WARNING:**  
The piston is under spring pressure. Use a press to apply slight pressure to the piston before you continue.

Remove the retainer ring and the bearing.

7. Disassemble the remainder of the clutch pack.
8. Inspect the components.

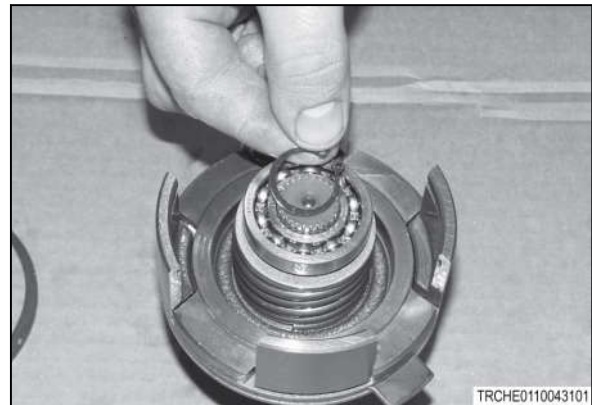


Fig. 111

### 5.3.3 Assemble the power take-off clutch pack

#### Procedure

1. Install the O-ring, sealing ring, and piston into the clutch housing.

2.  **WARNING:**  
The piston will be under spring pressure. Use a press to apply slight pressure to the piston before you continue.

Install the spring, flat washer, and the small retainer ring.

3. Install the retainer ring and the bearing.
4. Slowly release the pressure from the press.

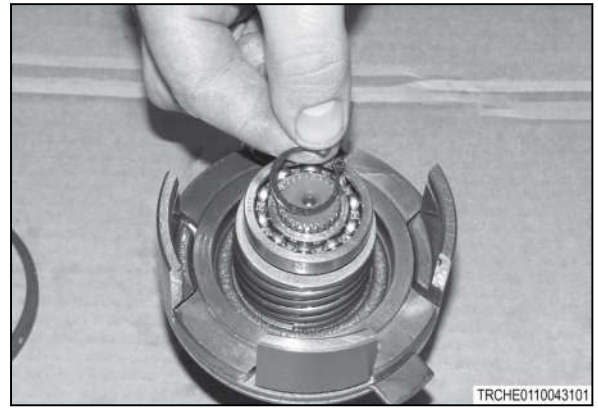


Fig. 112

5. Install the friction discs and separator plates.

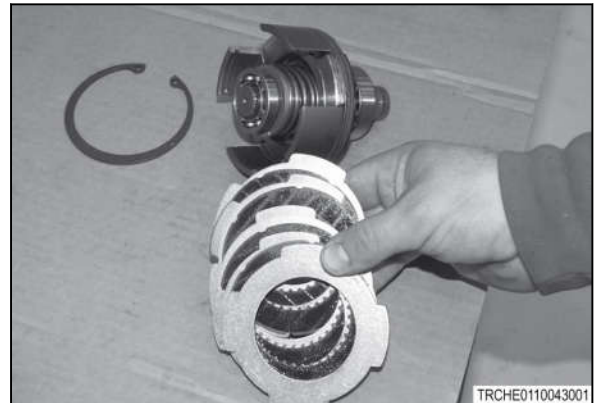


Fig. 113

6. Install the large retainer ring.

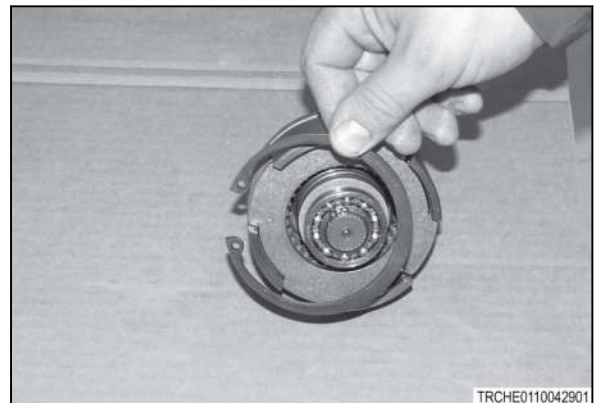


Fig. 114

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## 5.4 Rear power takeoff

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### 5.4.1 Remove the rear power take-off shaft

---

#### Procedure

1. Drain the oil from the rear housing.
2. Remove and discard the rear PTO oil seal.
3. Remove the bolts that fasten the rear pto housing to the rear housing.
4. Remove the rear pto housing, bearings, and pto shaft.

---

### 5.4.2 Install the rear power take-off shaft

---

#### Procedure

1. Make sure that the PTO shift forks are engaged with the PTO shift collars.
2. Make sure the sealing surface on the rear housing and rear PTO housing is clean and dry.
3. Install the bearings and the rear shaft into the rear housing.
4. Apply a gasket sealant to the sealing surface on the rear PTO housing.
5. Install the rear PTO housing.
6. Lubricate the lip on the new seal and install the seal into the rear PTO housing.

## 5.5 Ground speed controls

### 5.5.1 Range gear shift lever

The range gear shift lever is used to select a range of ground travel speeds through different gear reductions within the drive train. A hydrostatic control unit has infinitely variable speeds, from zero to top speed in each range gear.

The range gear shift lever (1) is located to the right of the operator seat, and supplies two major speed changes. This lever has tortoise (slow), neutral, and hare (fast) positions.

**IMPORTANT:**

*Completely stop all the machine movement before you shift the range gear shift lever.*

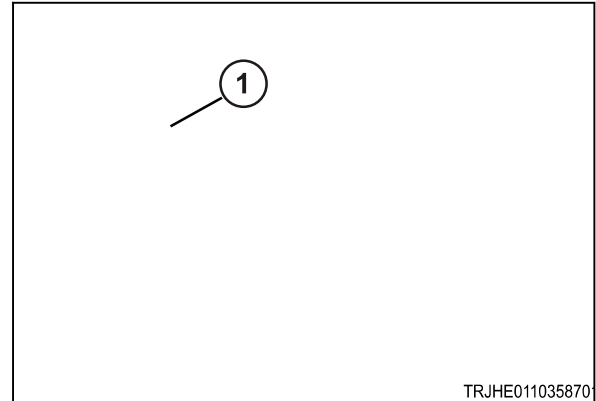


Fig. 115

### 5.5.2 Hydrostatic control pedals

The hydrostatic control pedals are located on the right side of the platform. The pedals operate the hydrostatic unit in forward or reverse travel direction, when the range gear shift lever is in the tortoise (slow) or hare (fast) position.

- Press the forward pedal (1) to move the machine forward.
- Press the reverse pedal (2) to move the machine rearward.
- Ground speed will increase as the pedal is pressed.

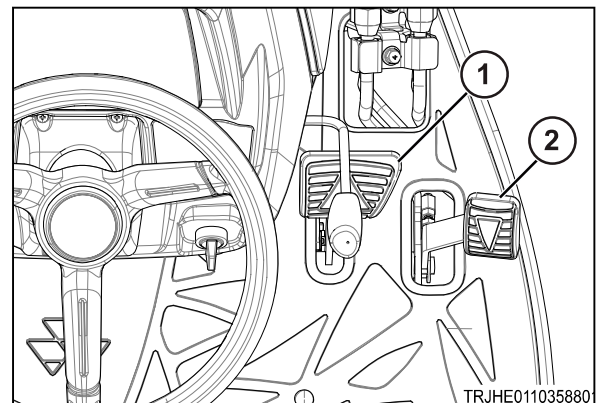


Fig. 116

When the pedal is released, the spring-loaded pedal will return to the neutral position. The machine will slow, then stop when the hydrostatic neutral position is reached. When the pedal is completely released and in the neutral position, the machine will remain stopped.



**CAUTION:**





**The hydrostatic unit will not stop the tractor when on a slope. Use the brakes to stop and hold the machine when on a slope.**

For maximum response, keep the engine speed above 2400 rpm when operating the hydrostatic control pedal. When starting on an upward slope, increase the engine speed to high idle.

### 5.5.3 Ground speed chart

Gear arrangement with the proper ground speeds, in order from slow to fast, are shown in the chart.

**NOTE:** Ground speed indicated at 2600 engine rpm for GC1723E, and 3000 engine rpm for GC1725M with 26 x 12.0-12 agriculture type rear tires and with 26 x 12.0-12 turf type rear tires.

Shift Position Range	AG Tire		Turf Tire	
	kph	mph	kph	mph
Forward				
	0 - 6.90	0 - 4.29	0 - 6.72	0 - 4.18
	0 - 14.70	0 - 9.13	0 - 14.33	0 - 8.90
Reverse				
	0 - 5.18	0 - 3.22	0 - 5.04	0 - 3.13
	0 - 11.03	0 - 6.85	0 - 10.75	0 - 6.68

### 5.5.4 Set the cruise control lever

#### Before starting the procedure



**WARNING:**

Cruise control should only be used in open spaces, without obstacles, with unobstructed view or traveling on the road. Be thoroughly familiar with cruise control operation before using.

**IMPORTANT:** To prevent mechanical failures, do not move the cruise control lever without first pressing the forward hydrostatic control pedal.

**NOTE:** Cruise control is not available in the reverse direction.

#### Procedure

1. Press the forward hydrostatic control pedal (1) until the desired speed is reached.
2. Push the cruise control lever (2) until resistance is felt.
3. Release the hydrostatic control pedal.  
The tractor will continue to move at the set position.

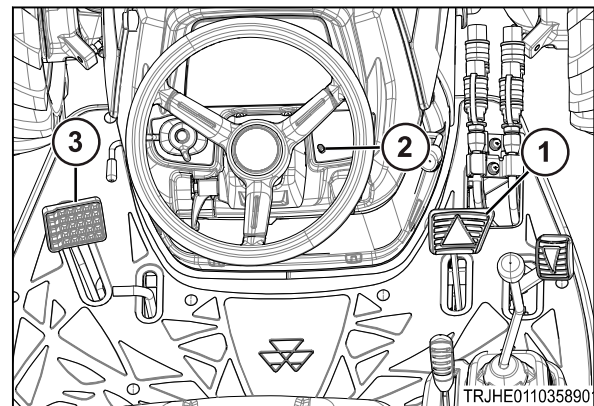


Fig. 117

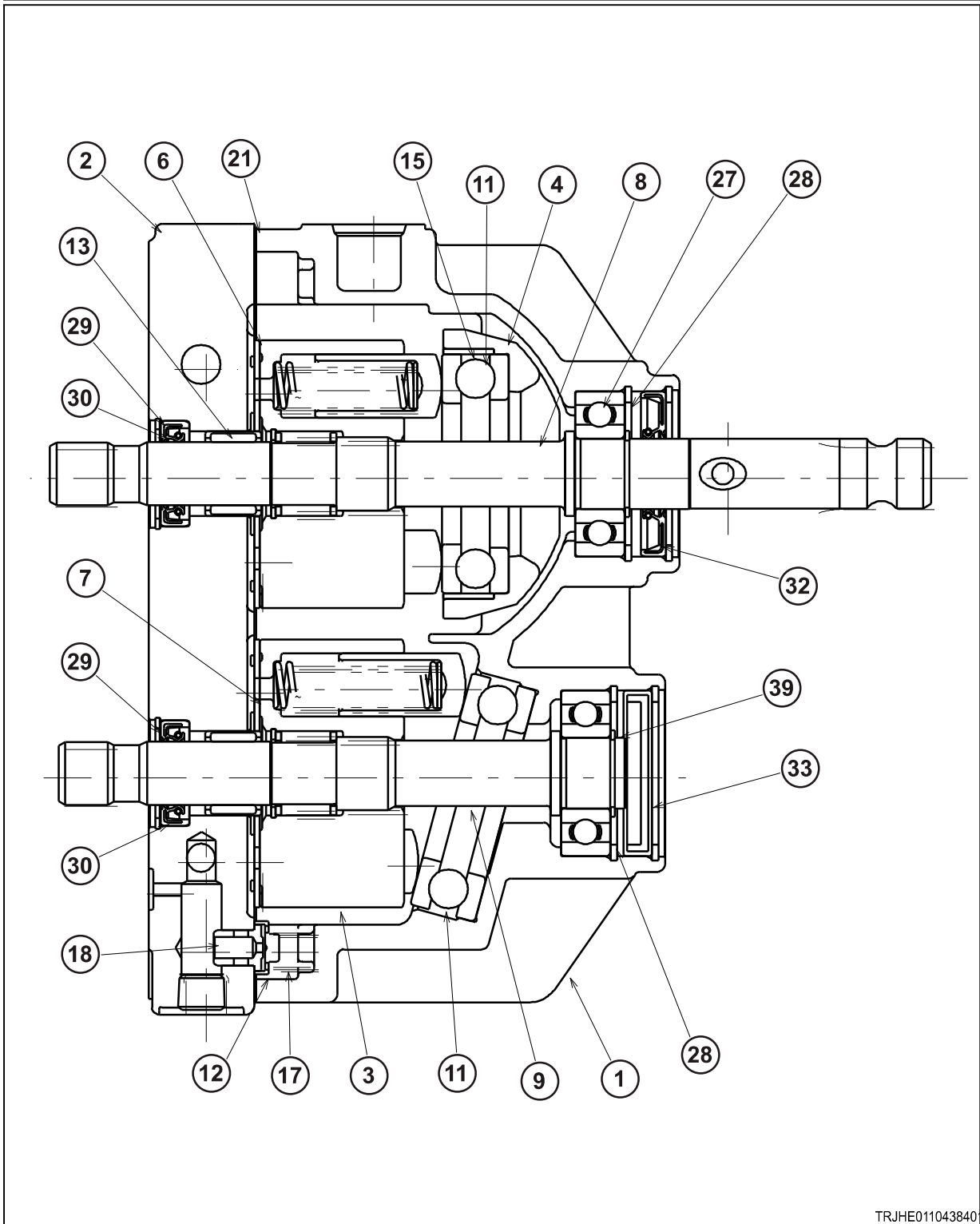
**After finishing the procedure**

To release the cruise control, firmly press the brake pedal (3) or lightly press the forward hydrostatic control pedal.

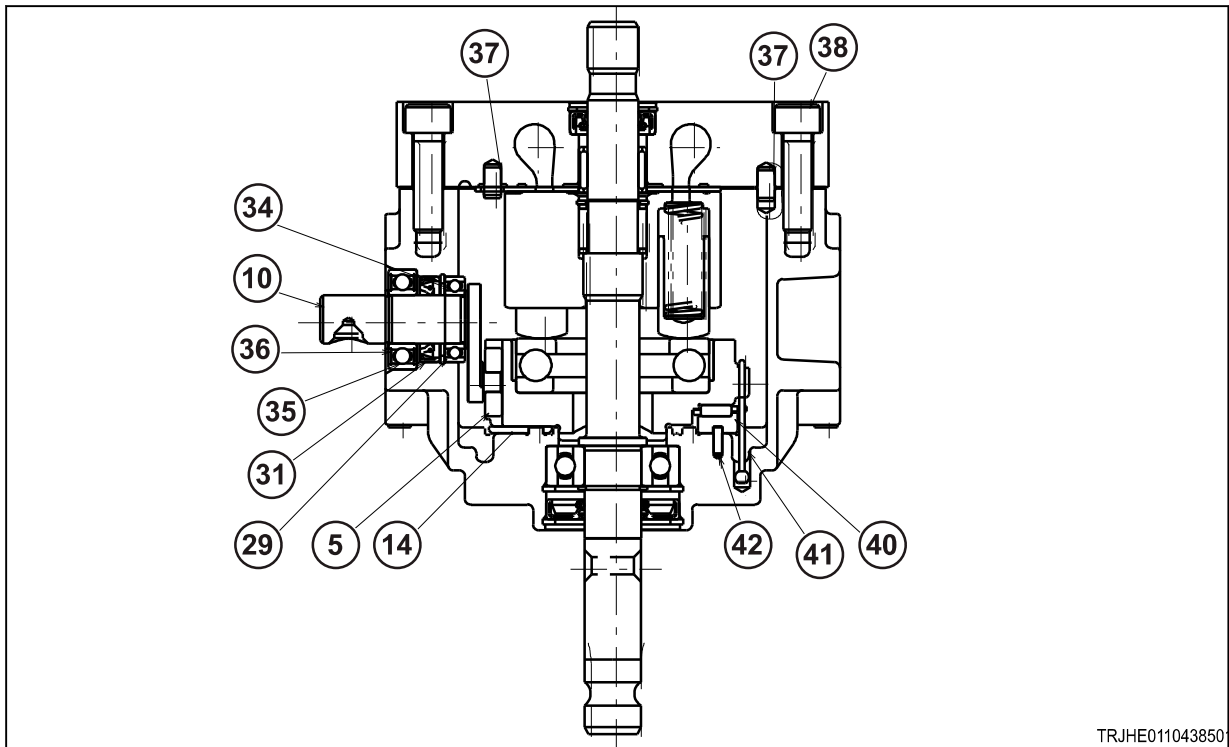


## 5.6 Hydrostatic Transmission

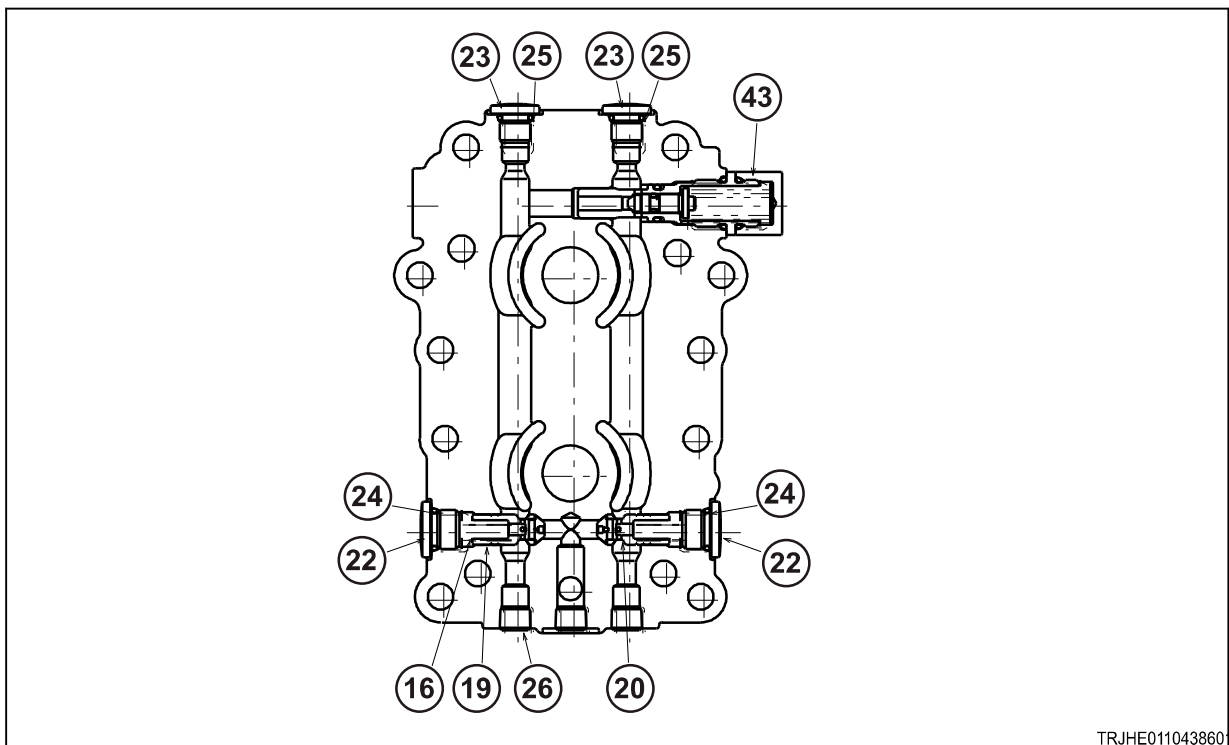
### 5.6.1 Hydrostatic transmission components



TRJHE011043840



TRJHE011043850



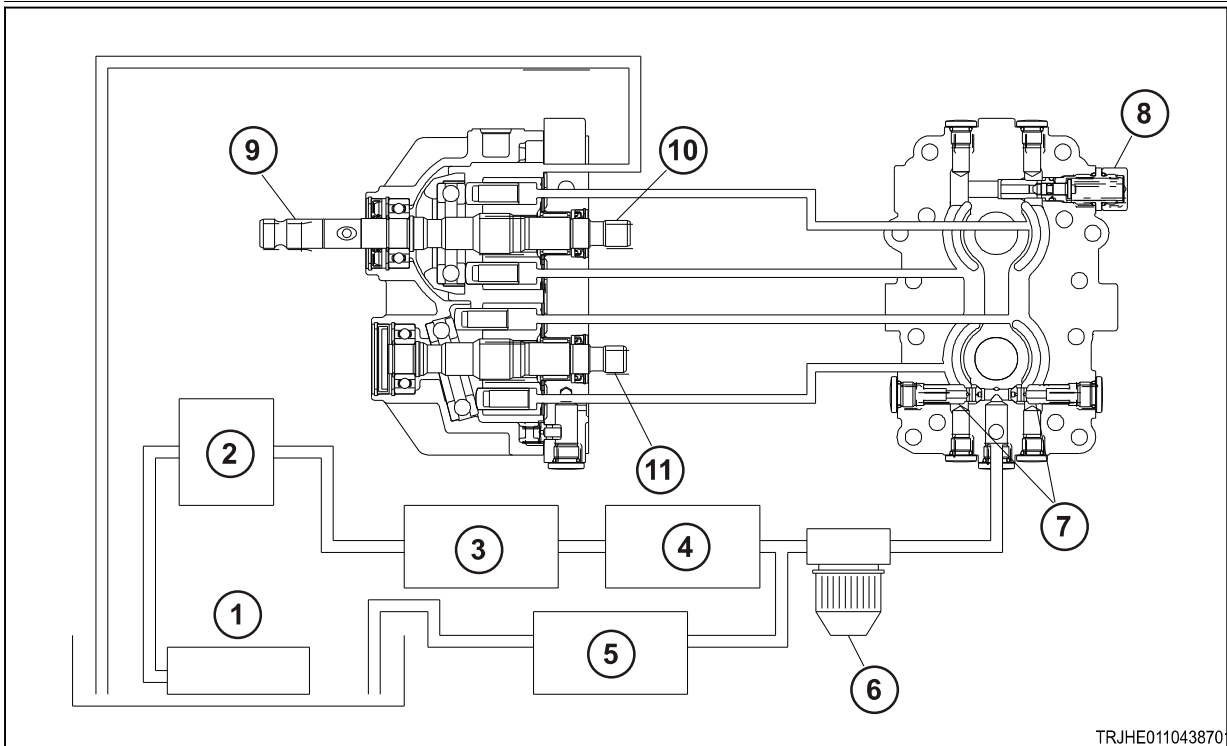
TRJHE011043860

Fig. 118

- |                        |                     |
|------------------------|---------------------|
| (1) Case               | (9) Motor shaft     |
| (2) Port block         | (10) Trunnion shaft |
| (3) Cylinder block     | (11) Thrust bearing |
| (4) Swash plate        | (12) Spring guide   |
| (5) Slide              | (13) Needle bearing |
| (6) Valve plate, pump  | (14) Bushing        |
| (7) Valve plate, motor | (15) Bushing        |
| (8) Pump shaft         | (16) Spring         |

- |                    |                       |
|--------------------|-----------------------|
| (17) Spring        | (31) Oil seal         |
| (18) Relief        | (32) Oil seal         |
| (19) Poppet 0.5    | (33) Oil seal         |
| (20) Poppet 1.6    | (34) Bearing          |
| (21) Gasket        | (35) Bearing          |
| (22) Plug          | (36) Retainer ring    |
| (23) Plug          | (37) Pin              |
| (24) O-ring        | (38) Socket head bolt |
| (25) O-ring        | (39) Retainer ring    |
| (26) Plug          | (40) Bearing          |
| (27) Bearing       | (41) Pin              |
| (28) Retainer ring | (42) Pin              |
| (29) Retainer ring | (43) Relief valve     |
| (30) Oil seal      |                       |

### 5.6.2 Hydrostatic transmission diagram



TRJHE011043870

Fig. 119

- |                               |                                |
|-------------------------------|--------------------------------|
| (1) Suction filter            | (7) Check valve                |
| (2) Ger pump                  | (8) High pressure relief valve |
| (3) Three point control valve | (9) Input shaft                |
| (4) Steering control unit     | (10) PTO shaft                 |
| (5) PTO valve                 | (11) Output shaft              |
| (6) Filter                    |                                |

### 5.6.3 Adjust the hydrostatic transmission

#### Procedure

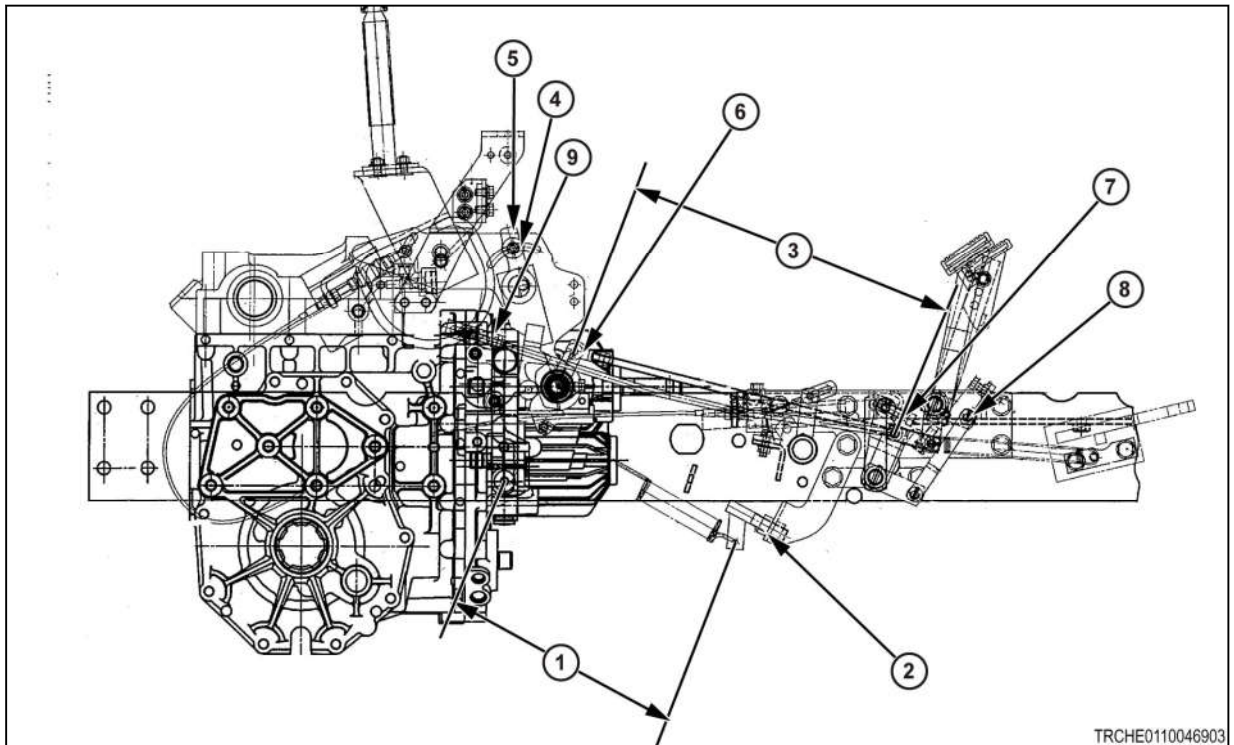


Fig. 120

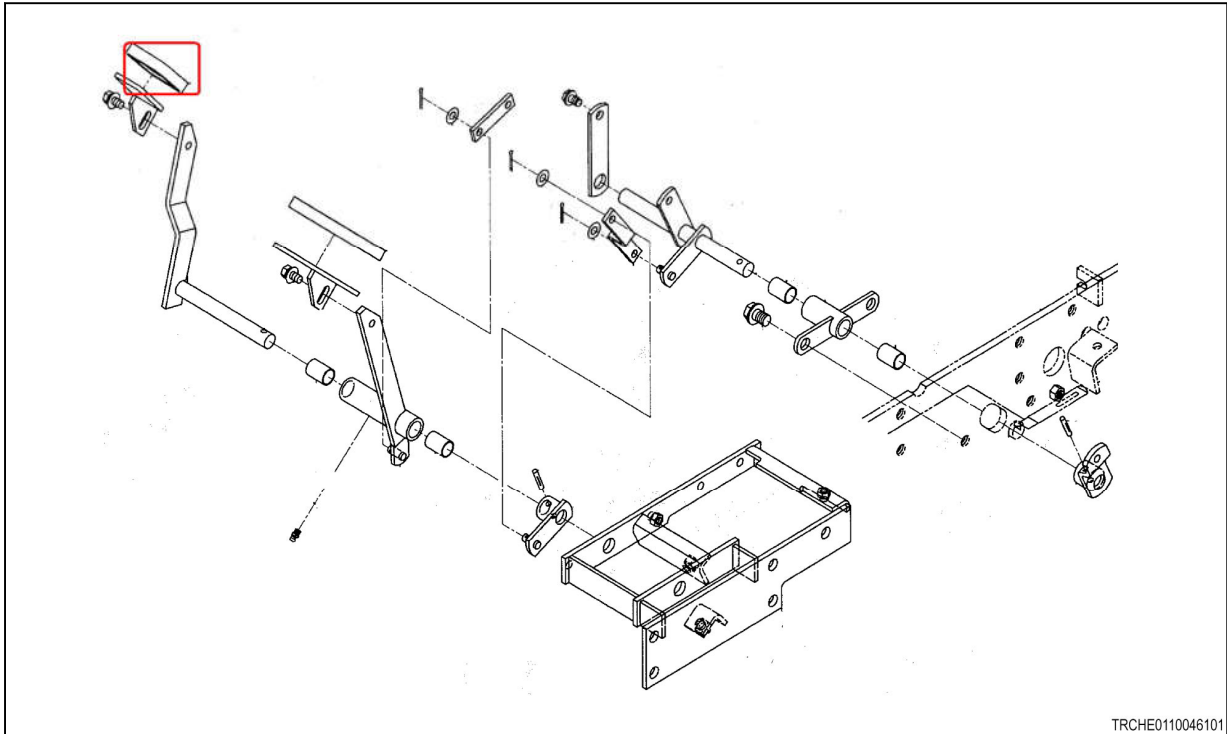
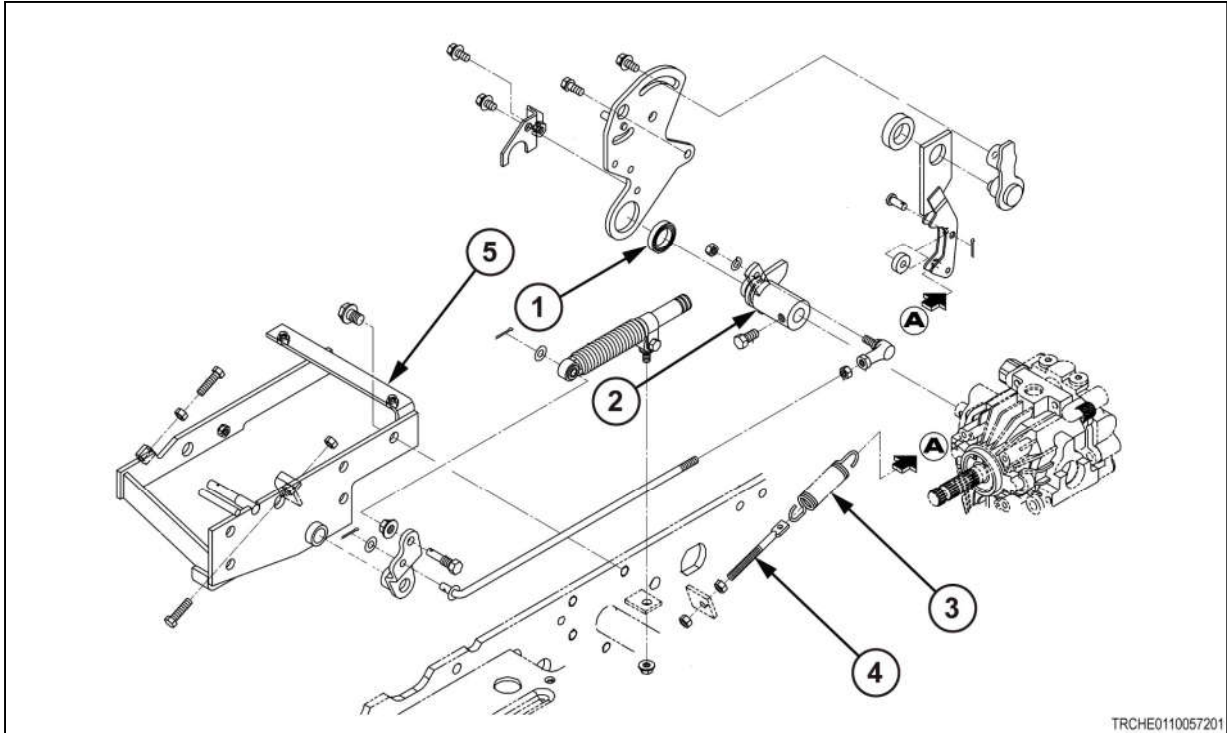
1. Adjust the length of the spring (1) to 120 mm to 125 mm (4.7 in to 4.9 in) by using the spring length adjustment nut (2).
2. Adjust the turnbuckle (3) to 386 mm (15 in).
3. Park the tractor on level, hard ground. Position the tire chocks with a small gap between the tire chocks and the front and rear wheels.
4. Start the engine and release the parking brake. Observe the direction of the tractor in hydrostatic transmission (HST) pedal position.
5. Stop the engine and apply the park brakes.
6. Loosen the HST neutral adjusting bolt (4) for the adjusting lever (5).
7. When the tractor creeps forward, tilt the adjusting lever (5) slightly forward and when the tractor creeps in reverse, tilt the adjusting lever rearward.
8. Tighten the adjusting lever temporarily with the adjusting bolt (4).
9. Start the engine and release the park brake.  
The neutral position is properly set when the tractor does not start moving.
10. Tighten the lock nuts.  
**NOTE:** Shift the power take-off (PTO) clutch lever to the OFF position when the engine is running.
11. Adjust the effective length of the HST rod so that the top faces of both the forward and reverse HST pedals are at the same angle and height. Make sure to lock the rod with the pedal height adjusting lock nut (6).
12. The HST pedal stopper bolt (7) on the forward side should be slightly adjusted before the HST mechanical lock position. Adjust the stopper bolt (8) length on the reverse side to 42 mm (1.65 in).

13. These stopper bolts work to prevent the HST pedal from being depressed past the operating limits of the slant board of the HST motor.

**NOTE:** If the stopper bolt is not adjusted correctly, the inside of the HST unit will be damaged.

14. The HST rod should be adjusted to 19 mm (0.75 in) by using the cruise lever adjusting nut (9).

### 5.6.4 Hydrostatic transmission linkage



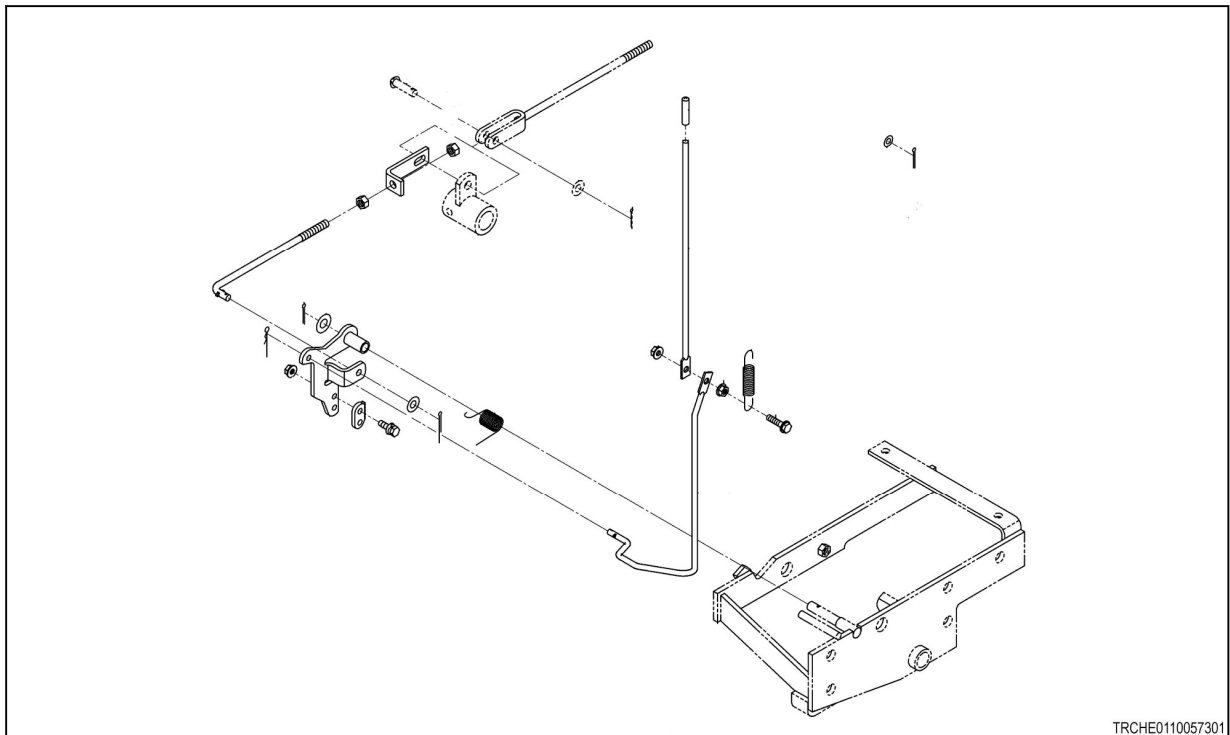


Fig. 121

- |                  |                |
|------------------|----------------|
| (1) Bearing      | (4) Rod M08X85 |
| (2) Trunnion arm | (5) Link base  |
| (3) Spring HE108 |                |

## 5.6.5 Function

### 5.6.5.1 Hydrostatic transmission, variable type pump

The input shaft (1) is connected to the engine. When the engine is on, the input shaft will turn. The cylinder block (2), which is connected to the input shaft, has seven pistons (3). When the swash plate (4) and the input shaft are perpendicular to each other, the cylinder displacement volumes A and B are the same. As a result, no delivery or suction takes place.

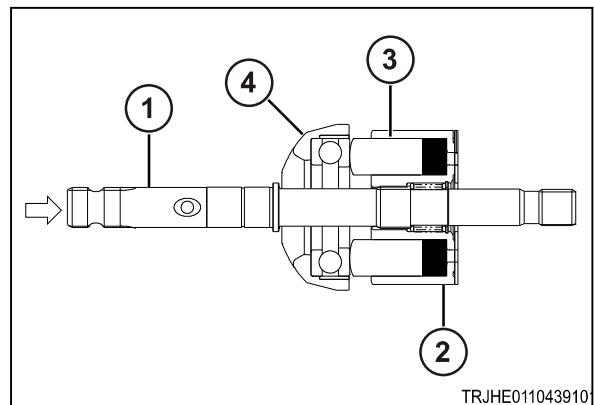


Fig. 122

When a hydrostatic pedal is pressed, the angle (A) swash plate (1) changes and the displacement volumes of the piston cylinders (2) become different. Hydraulic oil will come from the suction port (3), through the cylinder block to the delivery port (4) and to the cylinder block on the output shaft.

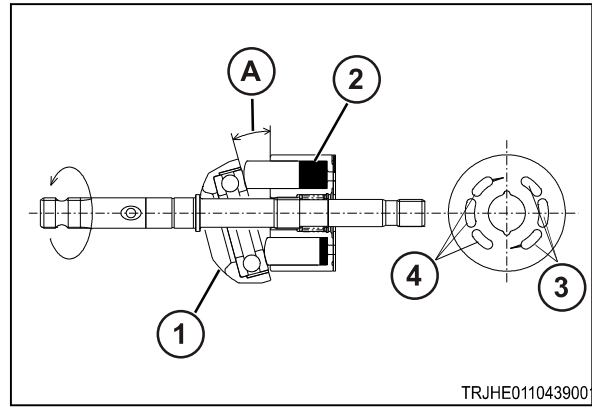


Fig. 123

**5.6.5.2 Hydrostatic transmission, fixed type motor**

The cylinder block (1), which is connected to the output shaft (2), has seven pistons (3). When pressurized oil enters the cylinder block, the pistons push against the fixed slant board (4), which causes the output shaft to turn.

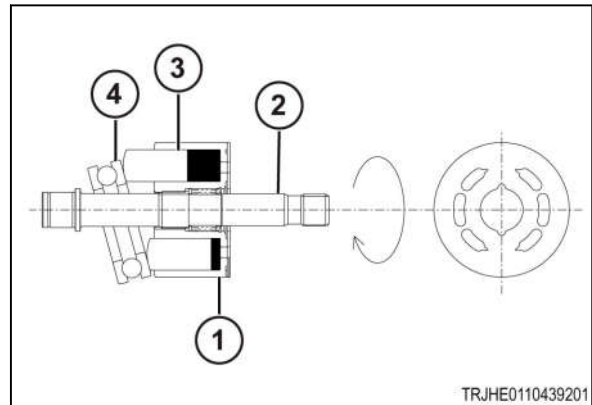


Fig. 124

**5.6.6 Valves**

**5.6.6.1 Low pressure relief valve and suction check valve**

The low pressure relief valve works to maintain the specified charge pressure from the gear pump. Charge pressure replenishes the lowered flow rate of the charge fluid due to leaks by letting fluid into the case through the check valve.

Excessive fluid is drained to the case through the low pressure relief valve (1).

When the tractor is parked on a slope with the engine shut off, some reverse torque is applied to the output shaft through the rear axle, causing the high pressure side to leak. In this state, if no fluid were replenished to the closed circuit, air would become trapped inside the circuit, spoiling the braking effect of the circuit and allowing the tractor to start rolling down the slope. The suction check valve (2) however prevents materialization of this no braking effect by replenishing the closed circuit.

The suction valve maintains the specified pressure in the closed circuit when there is charging pressure by letting in oil, thus compensating the loss due to leaking.

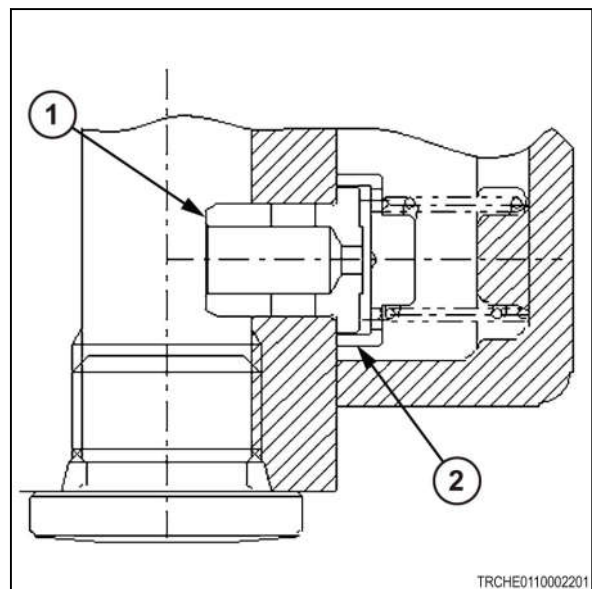


Fig. 125

### 5.6.6.2 High pressure relief valve

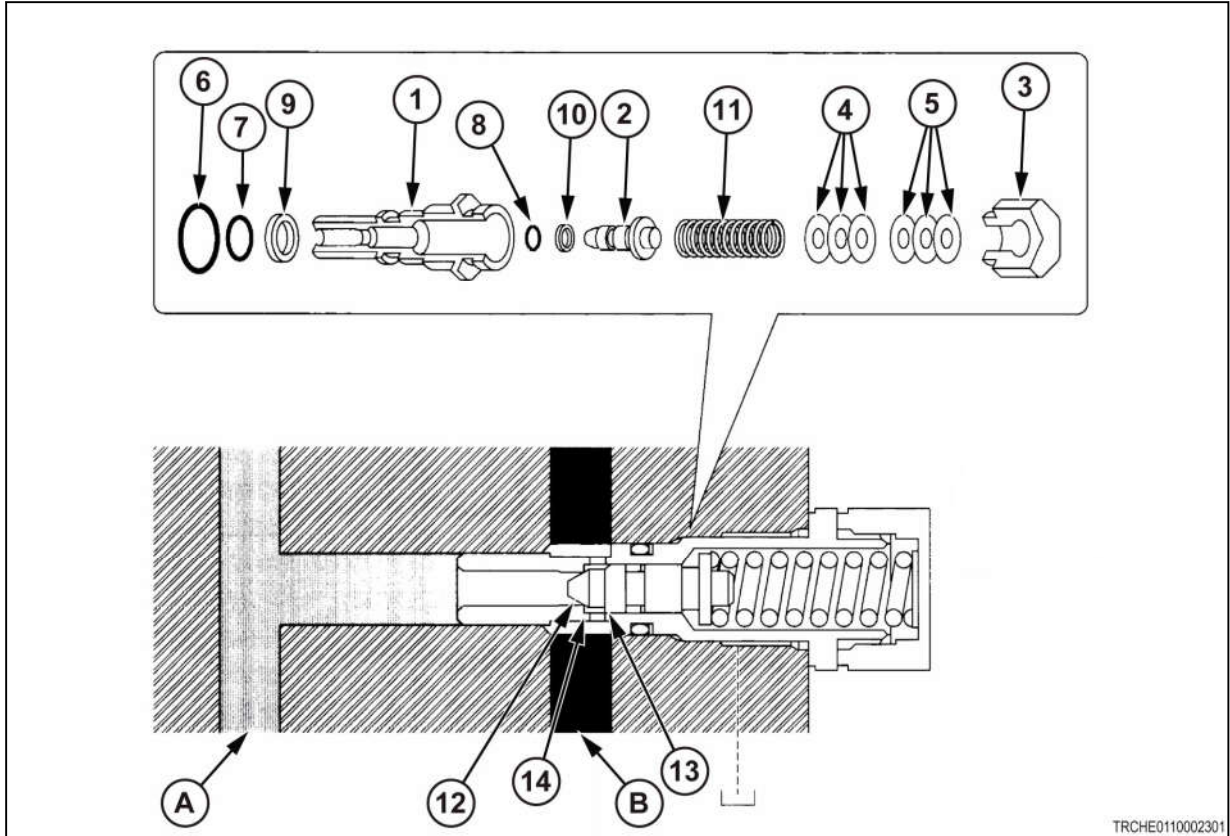


Fig. 126

A direct type both-direction relief valve is installed across the main passages (A) and (B). The valve controls the pressure in both passages.

When the pressure in the passage (A) is higher, the surface (12) of the poppet receives pressure, which pushes the poppet, overcoming the force of the spring and opens the valve to the left as shown in the figure. When the valve (14) opens, the fluid in the passage (A) flows to the passage (B).

When the pressure in the passage (B) is higher, the surface (13) of the poppet receives pressure, which pushes the poppet overcoming the force of the spring and opens the valve to the right as shown in the figure. When the valve (14) opens, the fluid in the passage (B) flows to the passage (A).

**NOTE:** 1 mm increase in shimming thickness of shims (4) and (5) increases 40 kgf to 50 kgf (88.2 lbf to 110.2 lbf) in spring force.

- |            |                  |
|------------|------------------|
| (1) Body   | (7) O-ring       |
| (2) Poppet | (8) O-ring       |
| (3) Nut    | (9) Backup ring  |
| (4) Shim A | (10) Backup ring |
| (5) Shim B | (11) Spring      |
| (6) O-ring |                  |



### 5.6.6.3 Check valve

The check valves are installed symmetrically in both sides across the charge passage (C).

The check valve prevents the fluid from the high pressure passage (A) from flowing into the charge passage (C) and replenish the charge fluid in the passage (B).

The check valve in the high pressure side (A) closes and that in the low pressure side (B) is pushed open by the charge pressure and the check valve end in the high pressure side.

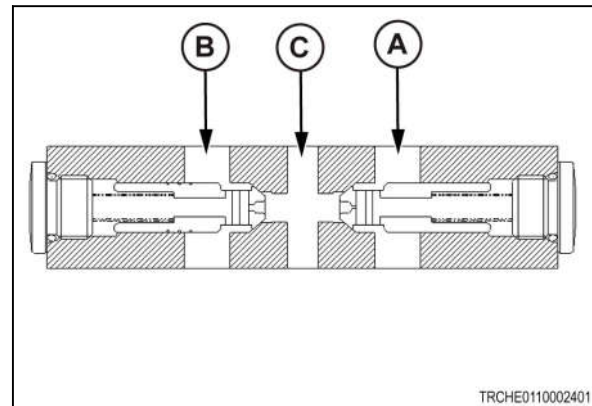


Fig. 127

### 5.6.6.4 Neutral valve

The forward circuit and the reverse circuits are communicating with the tank through the neutral valves.

The motor is not rotated because the oil travels from the pump to the tank if there is a slight pressure increase.

A neutral stop is secured by installing a charge circuit and a leading minute orifice, (1) and (2), in the check valve of the forward circuit and the reverse circuit, and returning a part of a high-voltage circuit to the charge circuit.

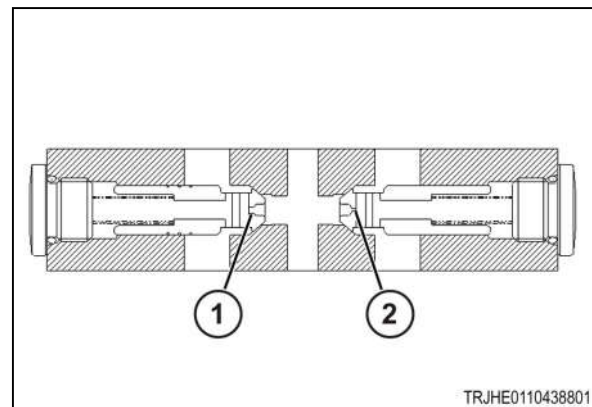


Fig. 128

### 5.6.7 Required tools for disassembly/assembly

Name	Size and Specified Values	English	Metric
Plastic hammer	Hammering light alloy parts	10 oz	2.9 N
Retainer ring pliers (for hole type)	H-2, H-3		
Retainer ring pliers (for shaft type)	S-1, S-3		
Hexagonal spanner	Face-to-face width	0.24 in	6 mm
		0.32 in	8 mm
Torque wrench	Specified torque	37.6 lbf ft	51.0 Nm
		36.1 lbf ft	49.0 Nm
		27.1 lbf ft	36.8 Nm
		21.7 lbf ft	29.4 Nm
		19.6 lbf ft	26.5 Nm

Name	Size and Specified Values	English	Metric
Hexagonal bits for torque wrench	Face-to-face width	0.24 in	6 mm
		0.32 in	8 mm
Socket for torque wrench	Face-to-face width	1.06 in	27 mm

### 5.6.7.1 Press-in jigs

#### Oil seal press-in jigs

(1) 1421-201-002-0

(3) K510-001-031-0

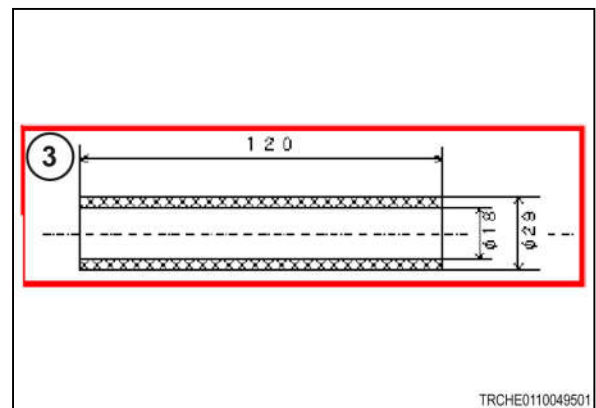
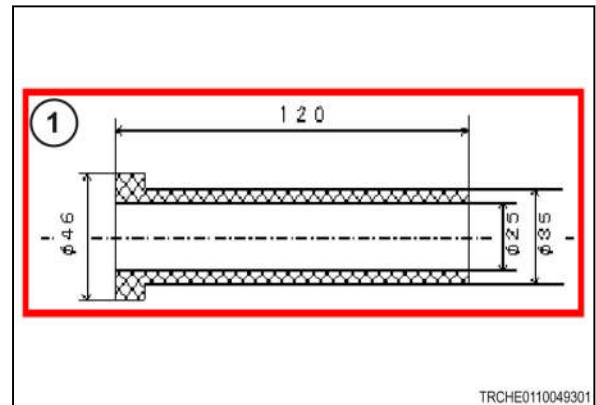


Fig. 129

- K510-021-030-0

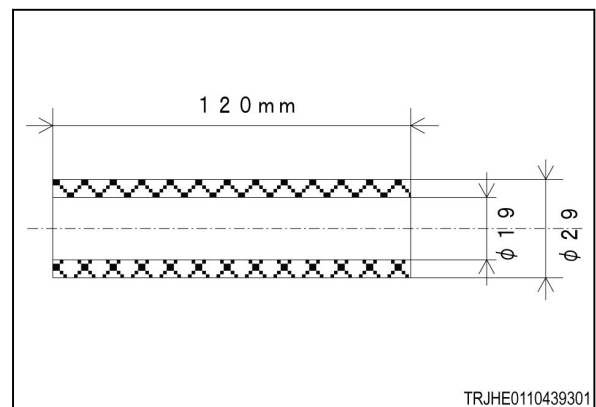


Fig. 130

**Bushing press-in jig**

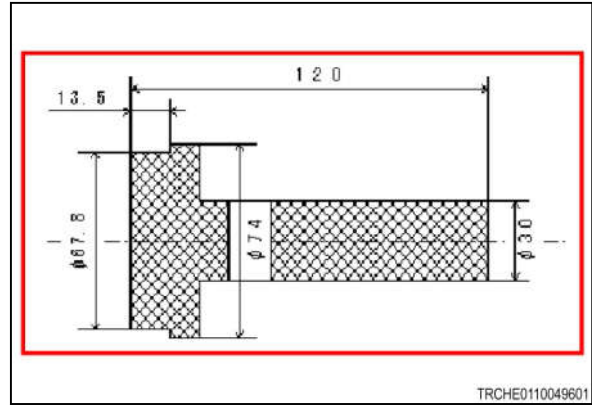


Fig. 131

**Shaft bearing press-in jig**

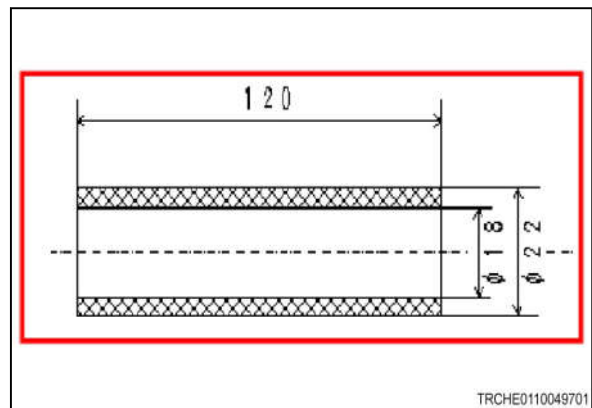


Fig. 132

**Arm trunnion bearing press-in jig**

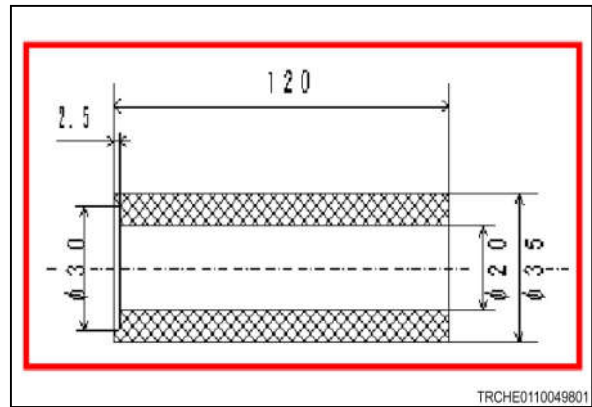


Fig. 133

### Needle bearing press-in jig

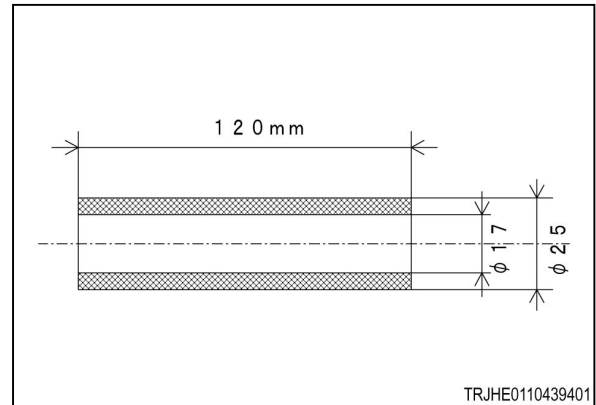


Fig. 134

### 5.6.8 Hydrostatic transmissions, precautions for disassembly

Completely clean the exterior of the casing, taking care to cover all ports to avoid the entry of dust.

Drain the oil from the case.

Select a clean, dust free place to work to prevent contamination of precision parts.

Handle the disassembled parts carefully to avoid damage.

### 5.6.9 Disassemble the hydrostatic transmission

#### Procedure

1. Remove the eight socket head bolts that fastens the port block to the case.

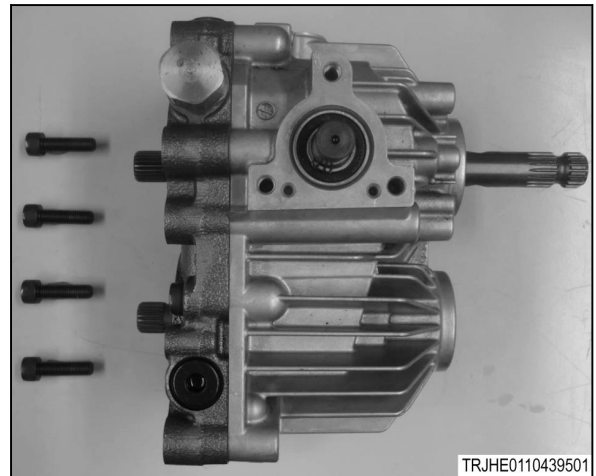


Fig. 135

2. **NOTE:** Do not let the valve plate fall. As the low pressure relief valve and spring becomes free, take care not to lose them. Remember to remove the two knock pins when the port block is removed.

Remove the port block (1).

3. **IMPORTANT:** The valves are different. Make a note of their correct position and orientation.

Remove the valve plates (2).

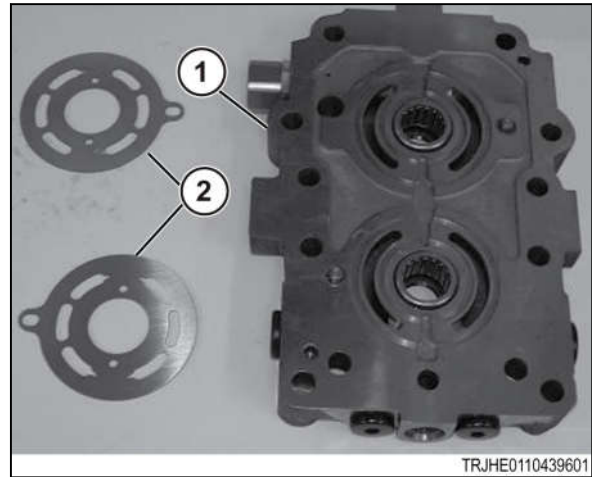


Fig. 136

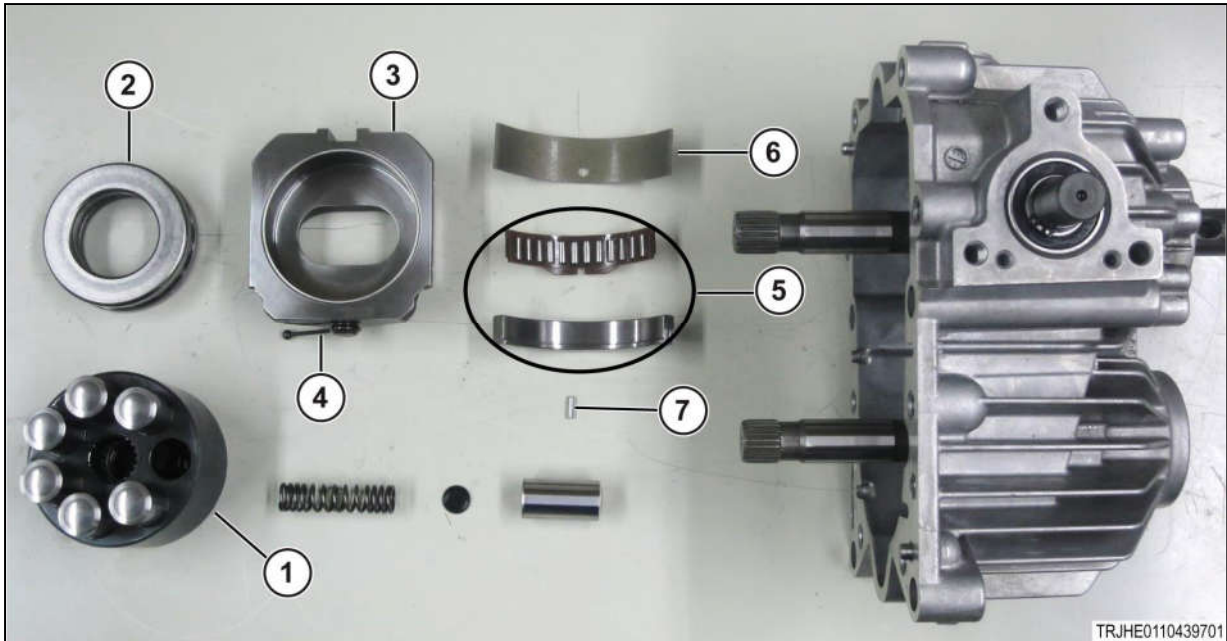


Fig. 137

- (1) Cylinder block assembly (include: pistons, springs, and shims)
- (2) Thrust bearing
- (3) Swath plate
- (4) Pin
- (5) Bearing
- (6) Bushing
- (7) Pin
4. **IMPORTANT:** Make a note of the thrust plate orientation.
- Remove the parts from the input shaft:

5. **IMPORTANT:** Make a note of the thrust plate orientation.

Remove the parts from the output shaft:

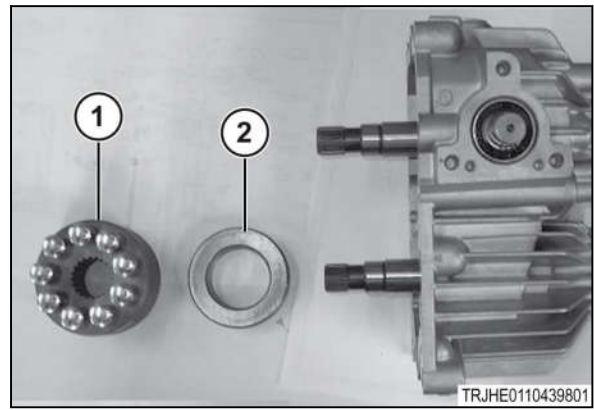


Fig. 138

- (1) Cylinder block assembly  
(2) Thrust bearing

6. Remove the retainer ring (1) and then remove the oil seal (2) from the output shaft.

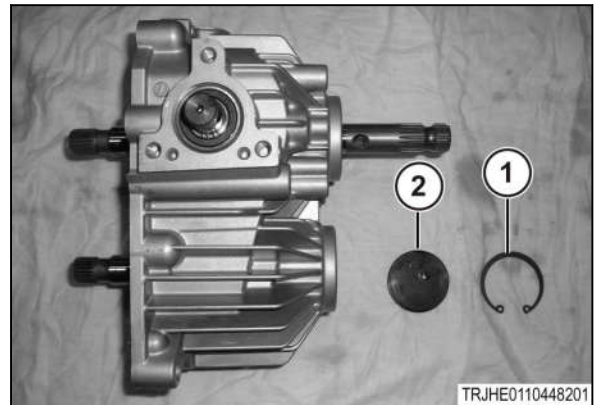


Fig. 139

7. Remove the retainer ring (1) and then remove the oil seal (2) from the input shaft.

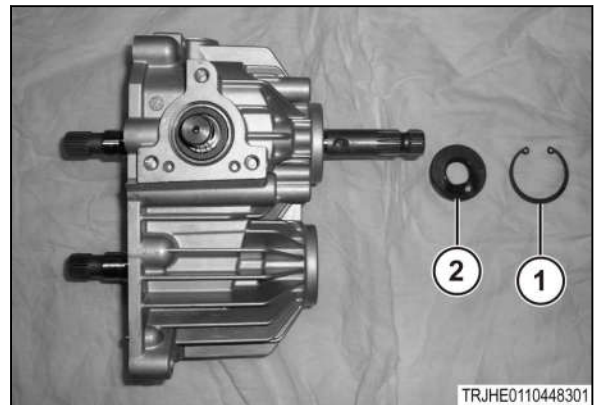


Fig. 140

8. Remove the retainer ring (1) for the output shaft (2).
9. Remove the output shaft from the inner case through the small opening.

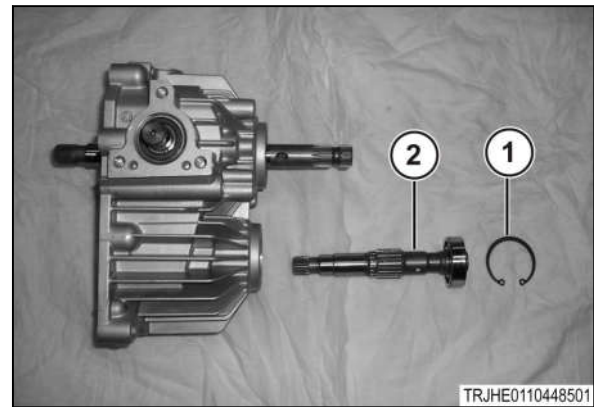


Fig. 141

10. Remove the retainer ring (1) for the input shaft (2).
11. Remove the input shaft from the inner case through the small opening.

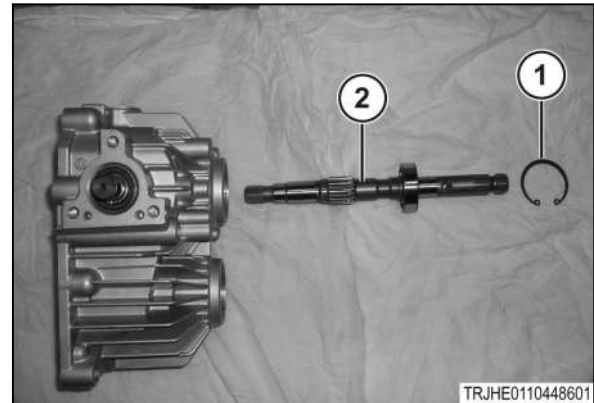


Fig. 142

12. Remove the retainer ring (1).
13. Use a plastic hammer and move the trunnion arm (2) to the inside of the case.
14. Remove the trunnion arm and the slide (3) from the case.
15. Remove the ball bearing (4).
16. Remove the oil seal (5) from the case.
17. Remove the retainer ring (6) from the case.

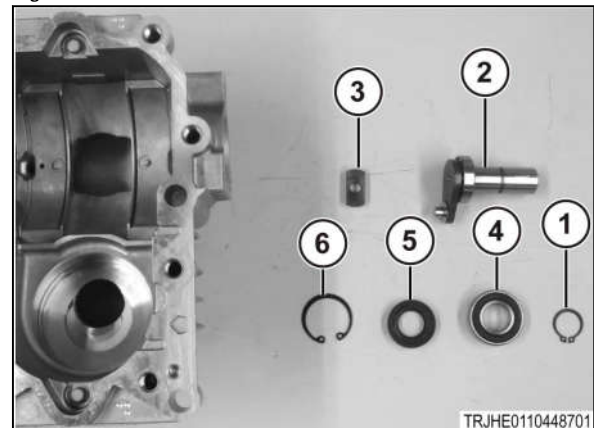


Fig. 143

18. Remove the relief valve (1).
19. Remove the three plugs (2).
20. Remove the two plugs (3).
21. **IMPORTANT:** *The check valves are different. Make a note of their correct position.*  
Remove the plugs (4), springs (5) and check valves (6).
22. Remove the charge pressure relief poppet (7), spring (8) and spring guide (9).

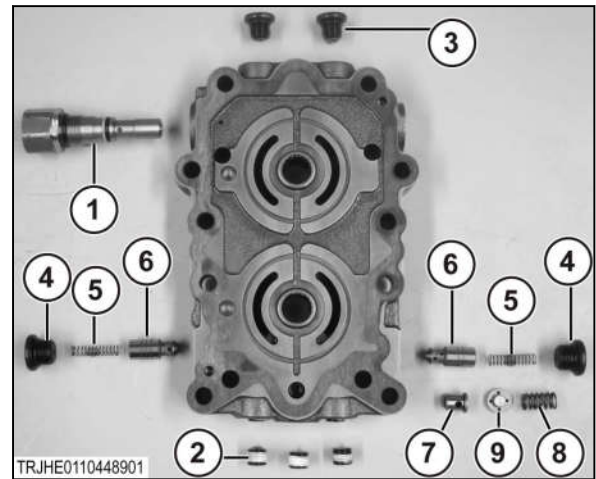


Fig. 144

### Related Links

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[Required tools for disassembly/assembly](#) page 5-62

[Press-in jigs](#) page 5-63

[Required tools for disassembly/assembly](#) page 5-62

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### 5.6.10 Worn part replacement

Friction parts which have worn and exceed the specified limit must be replaced with new ones.

No.	Name	Inspection Items	Criteria for Correction or Replacement
1	Piston	Friction surfaces of pistons and cylinder block	When flaws, dents, or damage are found on such surfaces, it is impossible to correct these corresponding parts, so replace with new ones.  The maximum clearance of the piston in the cylinder bore is set at 25 micro-m (aimed value) when shipped. If the clearance is larger by more than 10 micro-m, replace the piston set with a new one.
		Piston sphere	When flaws, dents or damage are found, replace the piston with a new one.
2	Cylinder block	Friction surface against valve plate	When flaws, dents or damage are found, correct them by lapping.  If 10 micro-m of lapping cannot correct the damage, replace the cylinder block with a new one.
3	Valve plate	Friction surface against cylinder block	When flaws, dents or damage are found, correct them by lapping.  If 10 micro-m of lapping cannot correct the damage, replace the cylinder block with a new one.
4	Thrust bearing	Friction surface against piston	When pitting or flaking is found, replace the bearing with a new one.



### 5.6.11 Hydrostatic transmission, precautions before assembly

Wash the disassembled parts in fresh cleaning oil and blow dry with clean compressed air.

Handle the parts carefully to avoid damage.

All of the removed sealing parts must be discarded and replaced with new ones.

All the fasteners must be tightened to specified values.

Apply lithium based grease to the oil seals, lips of the oil seals, and O-rings.

Use the proper jigs for installing the oil seals, bearings, and bore plugs.

### 5.6.12 Assemble the hydrostatic transmission

#### Procedure

1. Install the retainer ring (6) for the trunnion shaft into the case.
2. Install the oil seal (5) so that the seal is 12.5 mm (0.49 in) below case surface.
3. Put tape over the groove on the trunnion shaft (2).
4. Install the trunnion arm from inside the case.
5. Put the slide (3) onto the trunnion arm
6. Install ball bearing (4), and the retainer ring (1).
7. Remove the retainer ring (1) for the output shaft (2).

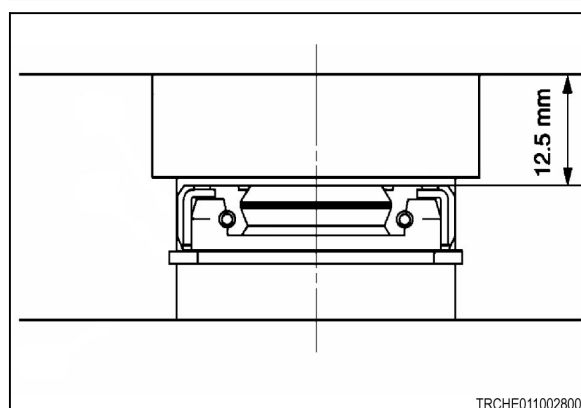
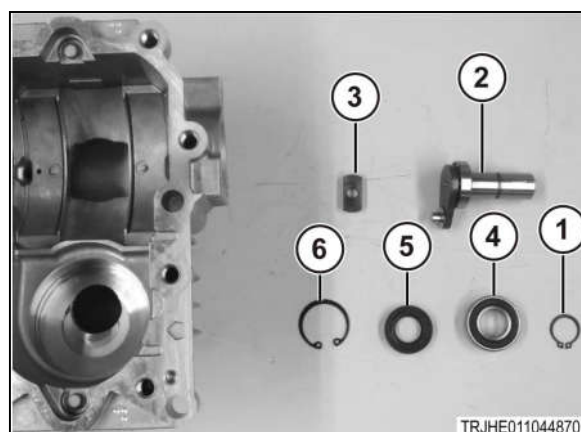


Fig. 145

8. Install the output shaft through the small opening into the inner case.
9. Install the retainer ring (1).

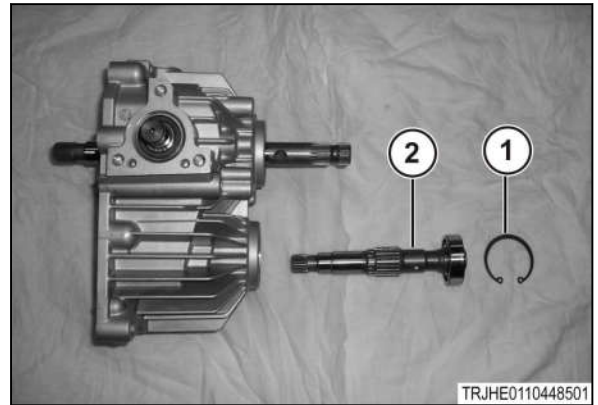


Fig. 146

10. Install the input shaft (2) through the small opening into the inner case.
11. Install the retainer ring (1).



Fig. 147

12. Install the oil seal (2) and the retainer ring (1) for the output shaft.

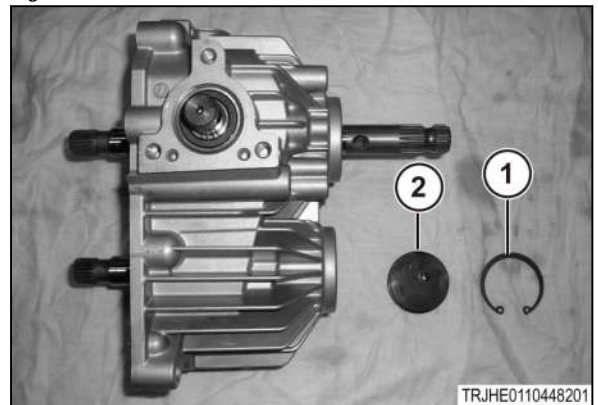


Fig. 148

13. Install the oil seal (2) and the retainer ring (1) for the input shaft.

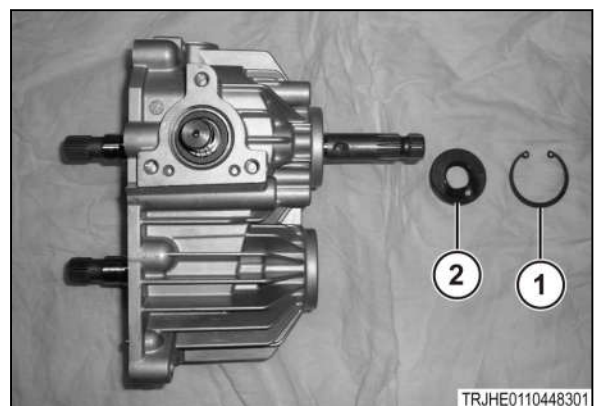


Fig. 149

14. Install the bushing and bearing/needle into the case.
15. Press in the bushing into the slant board. The distance between the bushing end and the bottom of the bore must be 18.7 mm.

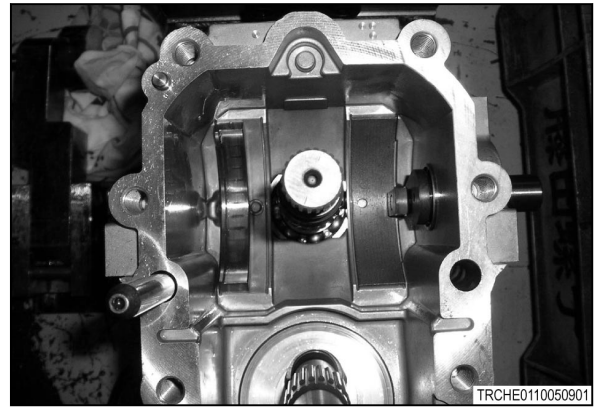


Fig. 150

16. Install the slide so that it engages the slant board.
17. Install the thrust bearing into the slant board.

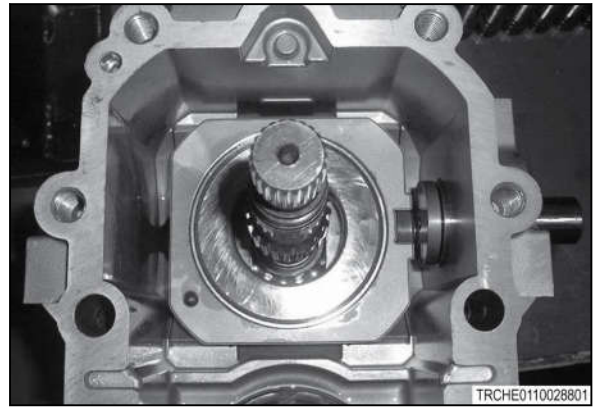


Fig. 151

18. Install the assembled cylinder block onto the input shaft.

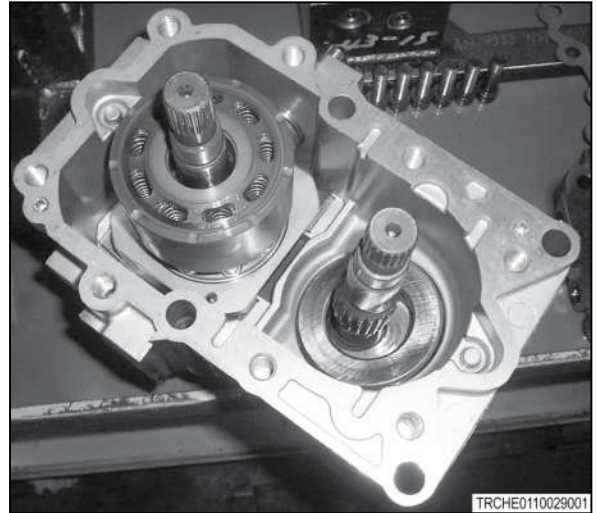


Fig. 152

19. Install the thrust bearing (2) into the case.
20. Install the assembled cylinder block (2) onto the output shaft.

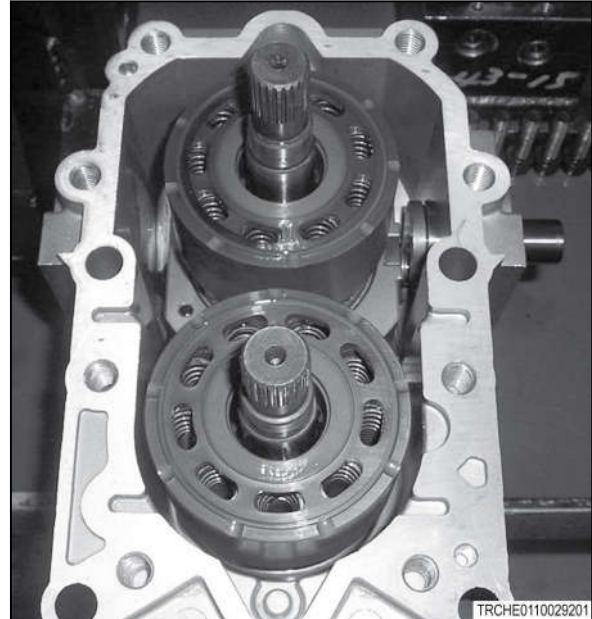
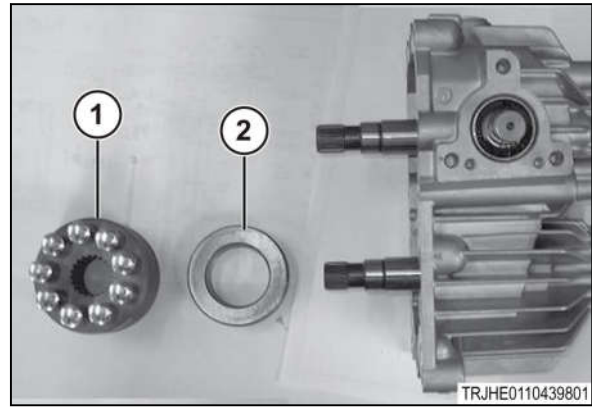


Fig. 153

21. Press in the needle bearing into the port block so that the bearing end projects 2.0 mm (0.079 in) above the port block surface.

Press in extent	2.0 mm (0.079 in) above port block surface
-----------------	--

22. Use the press-in jig to hand press the two oil seals into the port block.

Press in extent	3.5mm (0.138 in) below port block surface
-----------------	---

23. Install the retainer rings.

- 24. Apply some grease to the low pressure relief poppet (7) and spring guide (9). Install the low pressure relief poppet and spring guide. The spring (8) will be installed later.
- 25. Install the check valves(6), springs (5) and plugs (4). The check valve with more grooves goes to the left side as shown.

Tightening torque	51.0 +/- 4.9 Nm (37.6 +/- 3.6 lbf ft) Face to face width: 8 mm (0.315 in)
-------------------	---

- 26. Install the two plugs (3) on the top and the three plugs (2) on the bottom.
- 27. Install the high pressure relief assembly (1).

Tightening torque	36.8 +/- 2.9 Nm (27.1 +/- 2.2 lbf ft) Face to face width: 27 mm (1.06 in)
-------------------	---

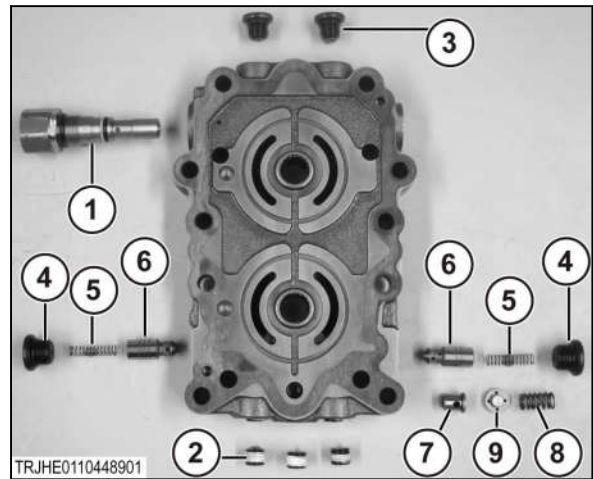


Fig. 154

- 28.** Install the valve plates.

**NOTE:** The pump and the motor use different valve plates, install them properly as illustrated. The surface of the cylinder block side is brass colored.

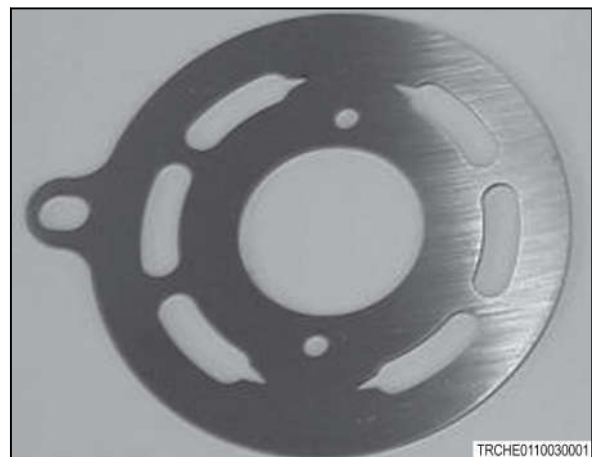
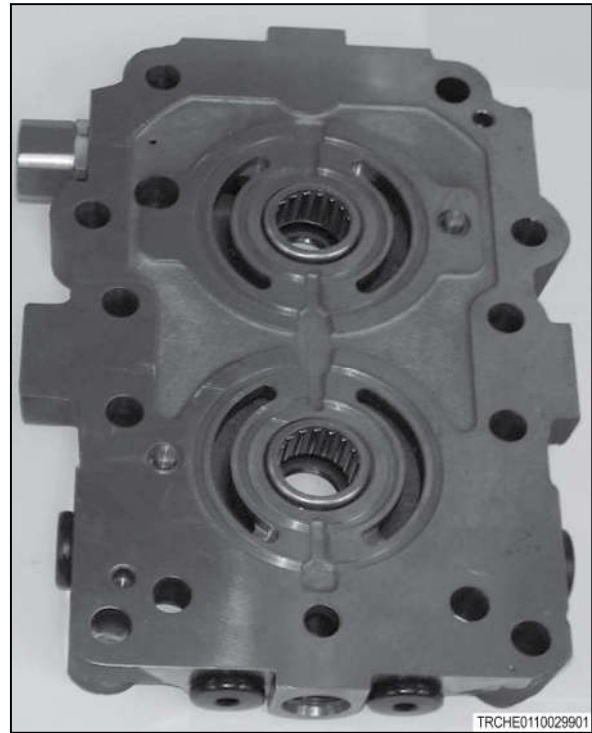


Fig. 155

29. Install the straight pins into the case.
30. Apply thin coat of lithium-based grease to the surface contacting the gasket and apply the gasket to the case.

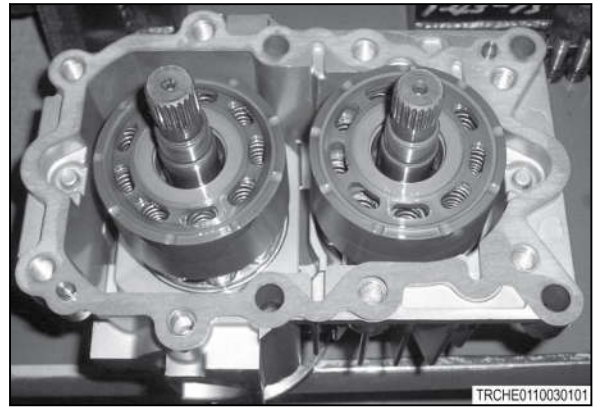


Fig. 156

31. Apply grease to the spring and put the spring in the case.

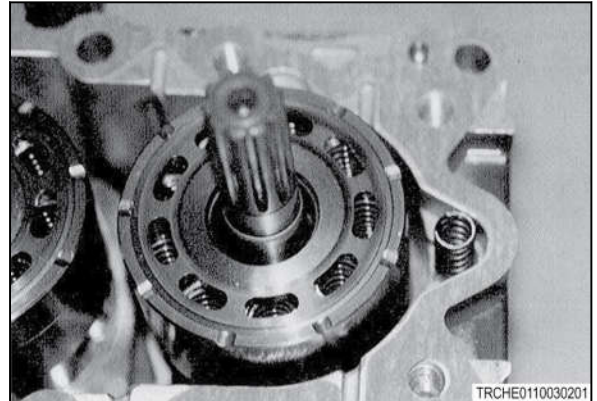


Fig. 157

**32. NOTE:**

- Do not let the valve plates fall.
- Make certain that the piston assemblies are properly incased in the cylinder blocks.
- Make sure that the spring for the low pressure relief valve is properly positioned in the case.
- Before you install the port block onto the input and the output shafts, the splined parts of the shafts must be wrapped with paper tape to protect the lips of the oil seals in the port block.

Install port blocks into the case.

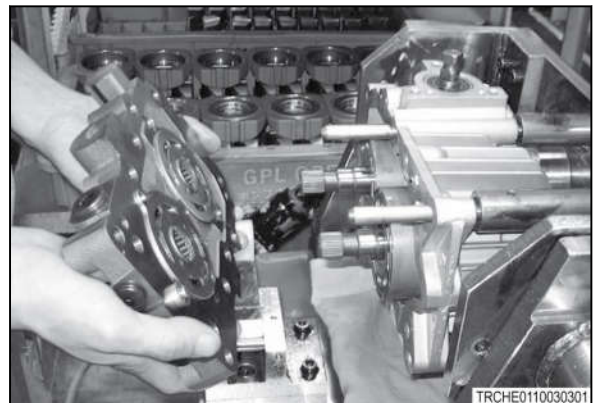


Fig. 158



33. Tighten the eight socket head bolts to the specified torque.

Tightening torque	51.0 +/- 4.9 Nm (36.1 +/- 3.6 lbf ft) Face to face width: 8 mm (0.315 in)
-------------------	---

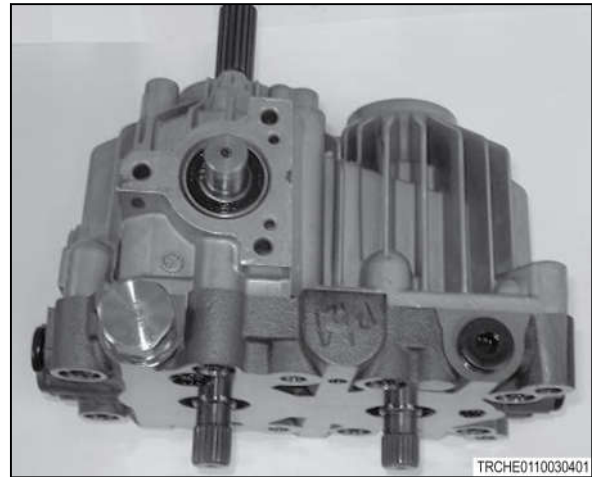


Fig. 159

34. Use a wrench to make sure that the input and the output shafts turn smoothly.
35. Make sure that the trunnion turns smoothly.

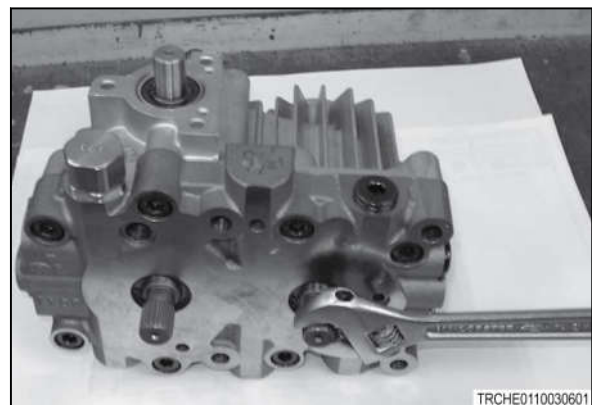


Fig. 160

### Related Links

[Hydrostatic transmission, precautions before assembly](#) page 5-70

[Required tools for disassembly/assembly](#) page 5-62

[Press-in jigs](#) page 5-63

### 5.6.13 Hydrostatic transmission troubleshooting

The output shaft does not turn with the control lever tilted in either direction.	
Cause(s)	Solution(s)
Defective hydrostatic transmission(HST) pump or motor.	If the trunnion shaft is positively activated, replace the HST unit with a new one.
Defective check valve seat.	Replace with a new one.
Defective unloading valve.	Measure the pressures in the high and low pressure circuits and then disassemble and wash the valve and assemble it. Adjust it if necessary.

The output shaft does not stop with the control lever shifted in the neutral position.	
Cause(s)	Solution(s)
Worn trunnion lever and linking parts.	Replace worn parts with new ones.

Insufficient output shaft speeds.	
Cause(s)	Solution(s)
High pressure oil is leaking from the pump or motor due to wearing.	Replace the HST unit with a new one.
Defective check valve seat.	Replace with a new one.
Unloading valve is stuck in working position.	Disassemble and wash the valve and assemble it. Adjust it if necessary.

Oil is leaking through the shafts and sealing parts.	
Cause(s)	Solution(s)
Due to broken oil seals or O-rings .	Replace defective parts with new ones. Oil seals must be installed, taking care not to damage the lips.
Clogged air breather in the oil reservoir cap causes temperature rise and resulted thermal expansion of the oil in the reservoir, which causes internal pressure rise and leads to oil seal damage .	Clean the air breather. If it is badly clogged, replace the cap with a new one. Replace a damaged oil seal with a new one.



# 6 Brake System

<b>6.1</b>	<b>Brakes</b> .....	<b>6-3</b>
6.1.1	Friction plates .....	6-3
6.1.2	Pressure Plate Assembly .....	6-3
6.1.3	Separator plate .....	6-3
6.1.4	Adjust the brakes .....	6-3
6.1.5	Parking brakes .....	6-4



## 6.1 Brakes

### 6.1.1 Friction plates

Replace a friction plate if the surface is glossy due to carbonization or if the thickness is not within the usable limit.

**NOTE:** Replace the friction plate if grooves are completely worn, even if only on one side.

Standard thickness	3.3 mm to 3.4 mm (0.130 in to 0.134 in)
Usable limit	3.0 mm (0.118 in)

### 6.1.2 Pressure Plate Assembly

Inspect the ball, spring, pressure plate, and brake rod. Replace the parts as needed. Replace the actuator if the thickness is reduced beyond the usable limit.

**NOTE:** Slight scratches on the friction surface can be removed with 1000 grit sandpaper.

Standard thickness	13.5 mm to 14.5 mm (0.53 in to 0.57 in)
Usable limit	13.0 mm (0.51 in)

### 6.1.3 Separator plate

Replace the separator plate if the thickness is not within the usable limit or if the surfaces are damaged.

Standard thickness	2.42 mm to 2.58 mm (0.094 in to 0.100 in)
Usable limit	2.2 mm (0.086 in)

### 6.1.4 Adjust the brakes

The correct free play (A) of the brake pedal is 30 mm to 40 mm (1 1/8 in to 1 3/4 in).

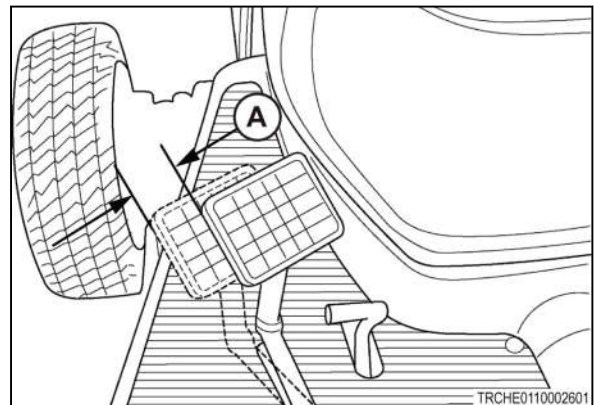


Fig. 1

**Procedure**

1. Loosen the right-hand thread lock nut (1).
2. Loosen the left-hand thread lock nut (2).
3. Adjust the turnbuckle (3) so free play is correct for the brake pedal.
4. Tighten the lock nuts.
5. Examine the operation of the brakes.

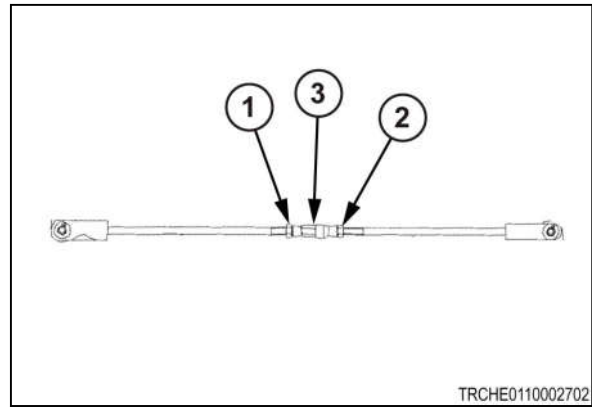


Fig. 2

**6.1.5 Parking brakes**

- (1) Latch
- (2) Spring

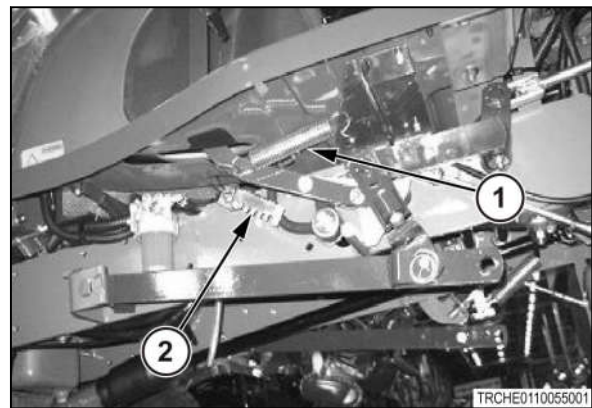


Fig. 3

## 7 Chassis

<b>7.1</b>	<b>Engine Cover</b> .....	<b>7-3</b>
7.1.1	Open the engine cover .....	7-3
<b>7.2</b>	<b>Roll over protective structure</b> .....	<b>7-4</b>
7.2.1	Remove the roll over protective structure (ROPS) .....	7-4
7.2.2	Install the roll over protective structure (ROPS) .....	7-4
<b>7.3</b>	<b>Platform and fenders</b> .....	<b>7-5</b>
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<b>7.5</b>	<b>Mower lift linkage</b> .....	<b>7-13</b>





## 7.1 Engine Cover

### 7.1.1 Open the engine cover

Open the engine cover to access the radiator, battery, and engine components.

#### Procedure

1. Press the release button for the engine cover.
2. Lift the engine cover up and forward.
3. Use the rod to hold the engine cover at a 45 degree angle.
  - a) Remove the J hook side of the rod from the engine cover.
  - b) Slide the end J hook end through the eyelet on the engine.
4. After maintenance, put the rod back into the storage position on the engine cover.
5. To close and lock the the engine cover, pull the engine cover down and push lightly on the rear.

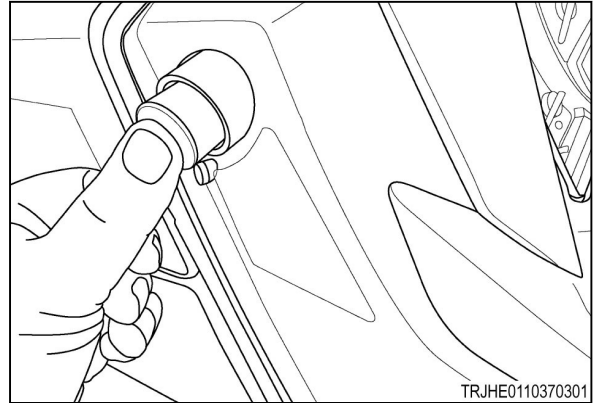


Fig. 1

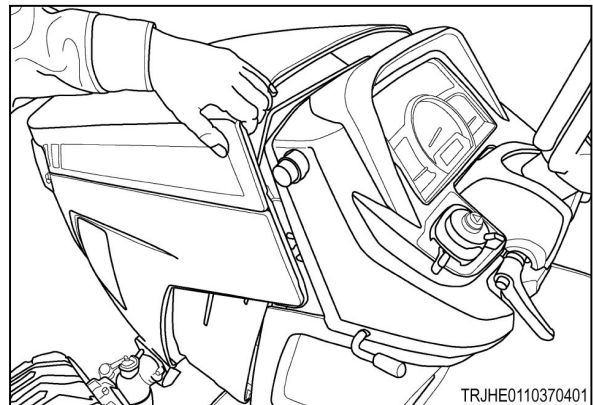


Fig. 2

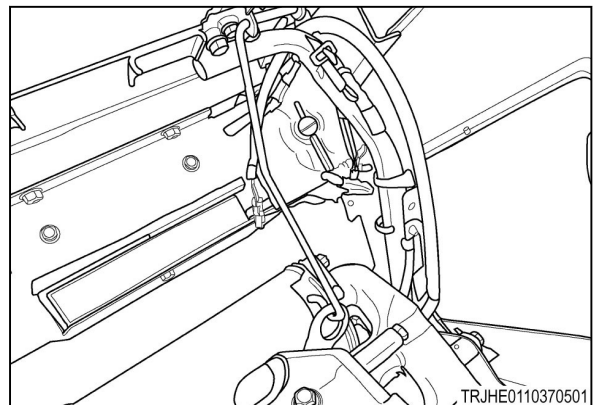


Fig. 3

## 7.2 Roll over protective structure

### 7.2.1 Remove the roll over protective structure (ROPS)

#### Procedure

1. Disconnect the wire connectors.
  - Turn lamps
  - Tail lamps
  - Work lamp, if equipped
2. Support the roll over protective structure (ROPS) and remove the nuts and lock washers.
3. Remove the ROPS assembly.



Fig. 4

### 7.2.2 Install the roll over protective structure (ROPS)

#### Procedure

1. Put the the ROPS assembly into position.
2. Install the lock washers and the nuts.  
Tighten the nuts to 85 Nm (63 lbf ft).
3. Connect the wire connectors.
  - Turn lamps
  - Tail lamps
  - Work lamp, if equipped
  - 12V socket, if equipped
4. Make sure that the seat belts are securely mounted to the brackets.



Fig. 5

## 7.3 Platform and fenders

### 7.3.1 Remove the platform and fender

#### Procedure

1. Disconnect the wire connectors:
  - Left turn lamp
  - Right turn lamp
  - 12 volt power socket, if equipped
  - Work lamp, if equipped
2. Remove the seat assembly.
3. Remove the ROPS.
4. Remove the wing bolt (1) that fastens the lower steering console cover.
5. Remove the lower steering console cover.
6. Remove the hydrostatic pedal pads from the hydrostatic pedal assembly.
7. Remove the brake pedal pad from the brake pedal.



Fig. 6



Fig. 7

8. Remove the floor mat.
9. Remove the bolts that fasten the floor to the rear fender.
10. Remove the knobs:
  - Rate of lowering valve
  - Cutting height adjustment
  - PTO select lever
  - Mid mount PTO select lever
  - PTO clutch lever
  - Three-point control lever
  - Range transmission lever
11. Lift the boot on the joystick lever to access the bolt that fastens the joystick lever. Remove the bolt and then remove the lever.
12. Remove the joystick lever lockout.



Fig. 8



Fig. 9

13. Remove the four hydraulic quick couplers.
14. Remove the left and right step.
15. Remove the rear fender.

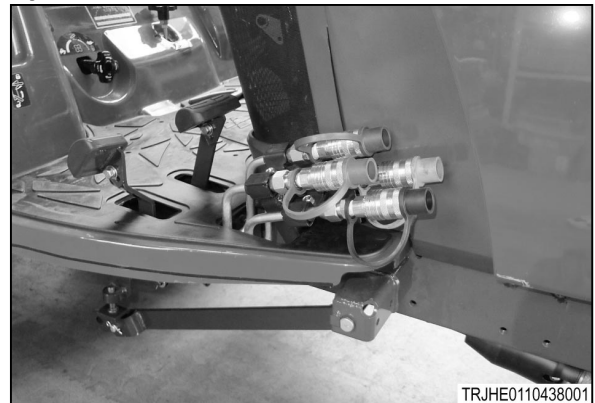


Fig. 10

### 7.3.2 Install the platform and fender

#### Procedure

1. Put the left and right step into position on the tractor.
2. Put the rear fender into position on the tractor.

3. Install the four hydraulic quick couplers.

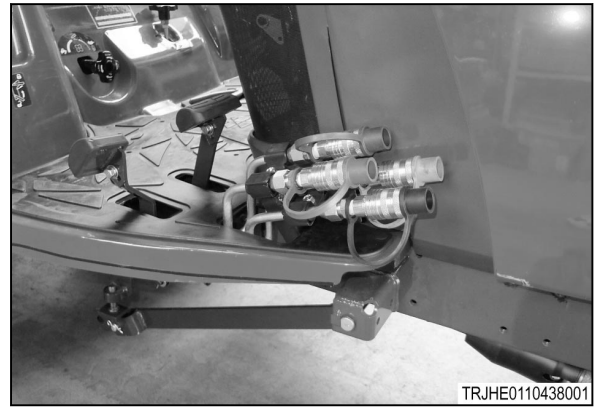


Fig. 11

4. Install the joystick lever lockout.
5. Put the joystick lever into position. Install the bolt that fastens the lever. Lower the boot on the joystick lever.



Fig. 12

6. Install the bolts that fasten the floor to the rear fender.
7. Install the floor mat.
8. Install the hydrostatic pedal pads onto the hydrostatic pedal assembly.
9. Install the brake pedal pad onto the brake pedal.



Fig. 13

10. Put the lower steering console cover into position.
11. Install the wing bolt (1) that fastens the lower steering console cover.



Fig. 14

12. Install the seat assembly.
13. Install the ROPS.  
Tighten the nuts to 85 Nm (63 lbf ft).
14. Install the knobs:
  - Rate of lowering valve
  - Cutting height adjustment
  - PTO select lever
  - Mid mount PTO select lever
  - PTO clutch lever
  - Three-point control lever
  - Range transmission lever
15. Connect the wire connectors:
  - Left turn lamp
  - Right turn lamp
  - 12 volt power socket, if equipped
  - Work lamp, if equipped



Fig. 15

## 7.4 Seat

### 7.4.1 Seat view

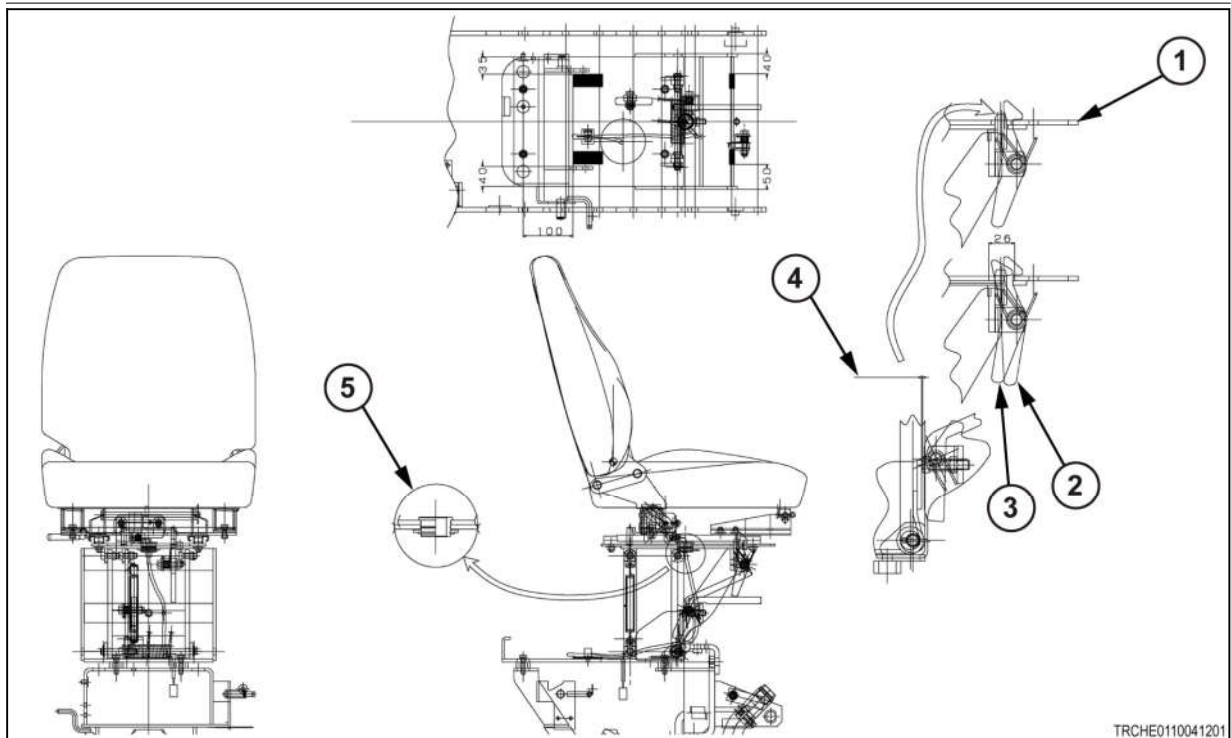


Fig. 16

- (1) Make sure guide pin goes through the hole.
- (2) Unlatched position
- (3) Latched position
- (4) Stopper adjustment 1.0 mm (0.34 in)
- (5) Apply grease



## 7.4.2 Rotate operation of the TLB type seat

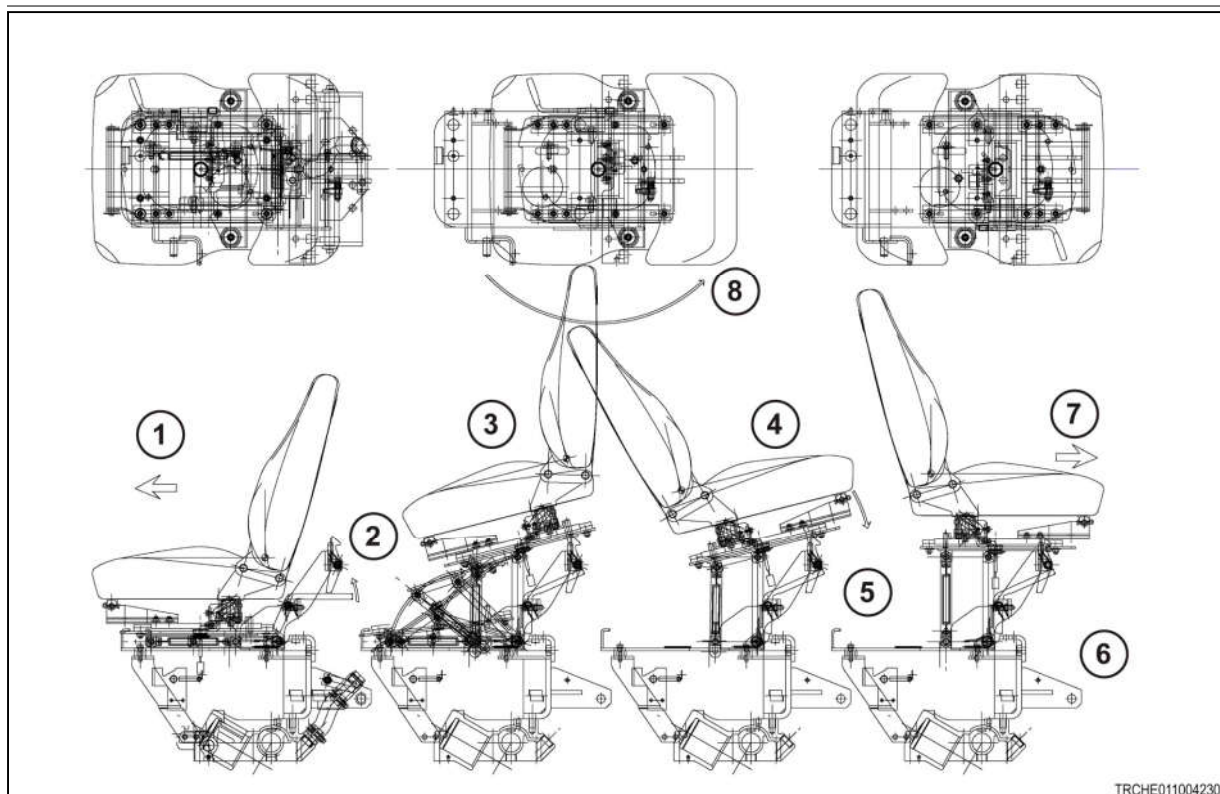


Fig. 17

- |  |   |
|--|---|
| (1) Forward  | (6) Make sure engage latch locks the seat securely. |
| (2) Lift lever   | (7) Rearward  |
| (3) Seat lifting   | (8) Seat rotating                                   |
| (4) Seat rotating  |   |
| (5) After rotation, set guide pin and engage latch. Push down on the seat. |   |

## 7.4.3 Remove the seat

### Procedure

1. Disconnect the wire harness for the seat switch.

**NOTE:** The seat switch wire harness is located under the seat.



Fig. 18

2. Support the seat and remove the hairpin (1) at the front of the seat.
3. Remove the seat.

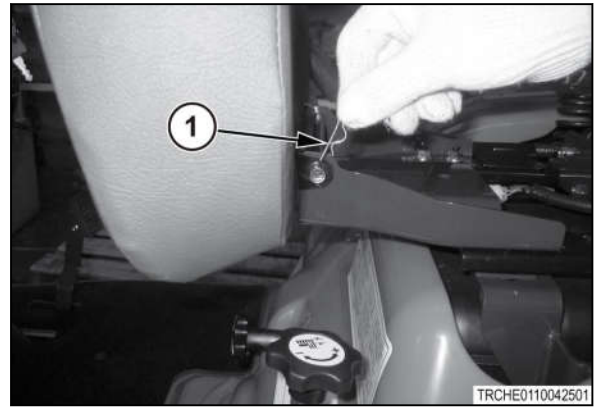


Fig. 19

#### 7.4.4 Install the seat

##### Procedure

1. Put the seat in position and install the hairpin (1) at the front of the seat.

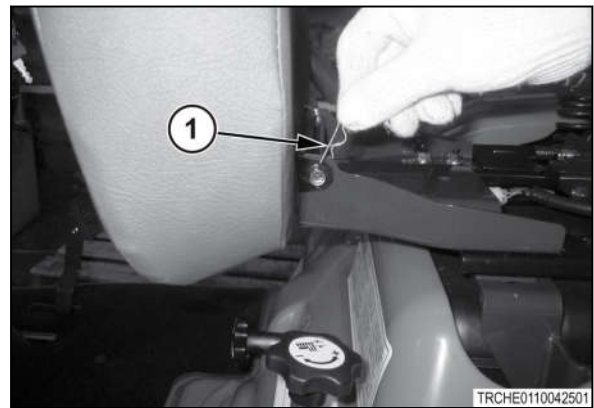


Fig. 20

2. Connect the wire harness for the seat switch.

**NOTE:** The seat switch wire harness is located under the seat.

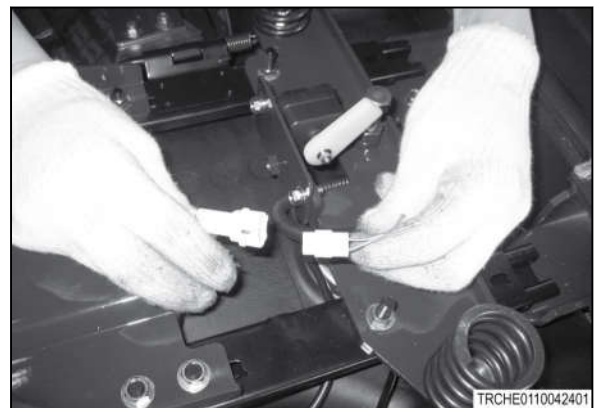


Fig. 21

---

### 7.4.5 Remove the armrest from the seat

---

**Procedure**

1. Remove the three bolts (1) that fasten each armrest to the seat.
2. If needed, remove the speed nuts from the seat.



Fig. 22

---

### 7.4.6 Install the armrest onto the seat

---

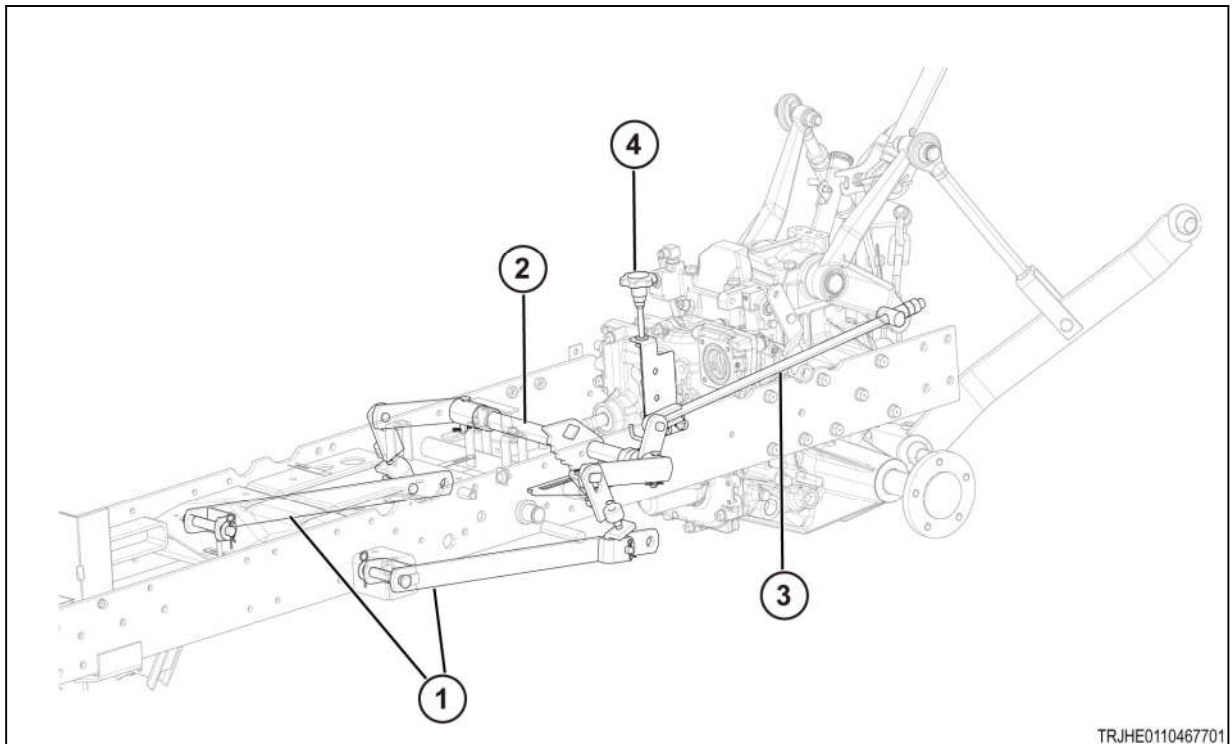
**Procedure**

1. If needed, install the speed nuts from the seat.
2. Install the three bolts (1) that fasten each armrest to the seat.



Fig. 23

## 7.5 Mower lift linkage



TRJHE0110467701

Fig. 24

(1) Lift links  
(2) Lift arm shaft

(3) Lift rod  
(4) Cut height adjustment



## 8 Hydraulic System

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## 8.1 Joystick valve (factory installed)

### 8.1.1 Joystick valve, factory

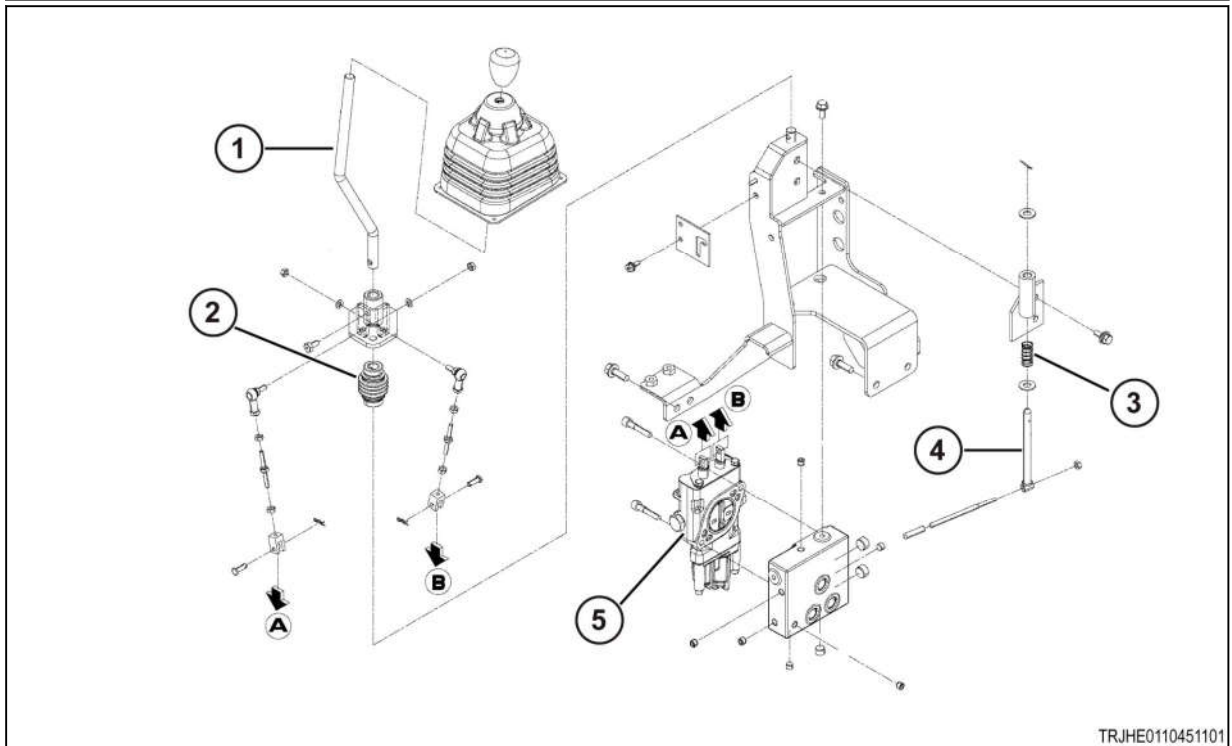


Fig. 1

- |                     |                |
|---------------------|----------------|
| (1) Joystick lever  | (4) Lock pin   |
| (2) Assembly joint  | (5) Valve body |
| (3) Pressure spring |                |



### 8.1.2 Joystick control lever lockout

The joystick control lever has a lockout (1) that will keep the joystick in the neutral position.

- To lock the joystick, move the lockout lever up and to the left.
- To unlock the joystick, move the lockout lever to the right and down.

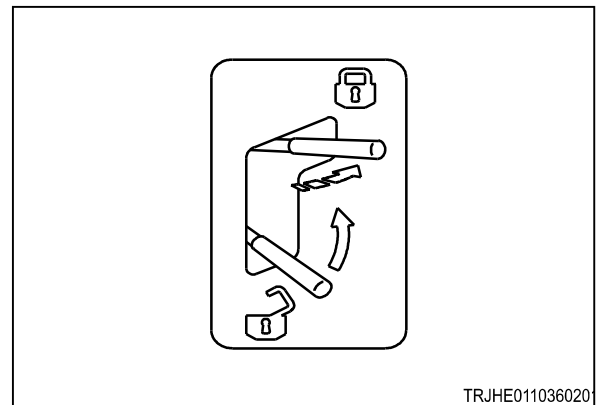
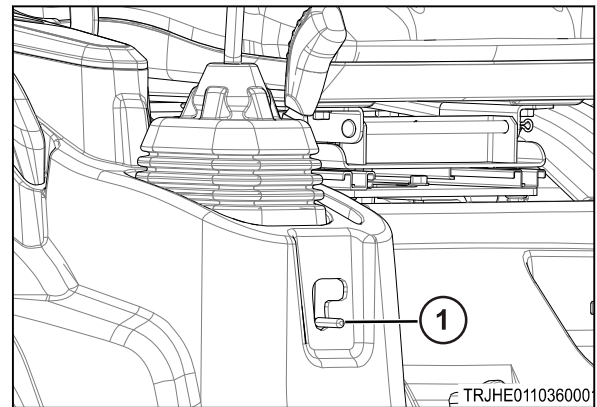


Fig. 2

### 8.1.3 Remote valve hardline routing

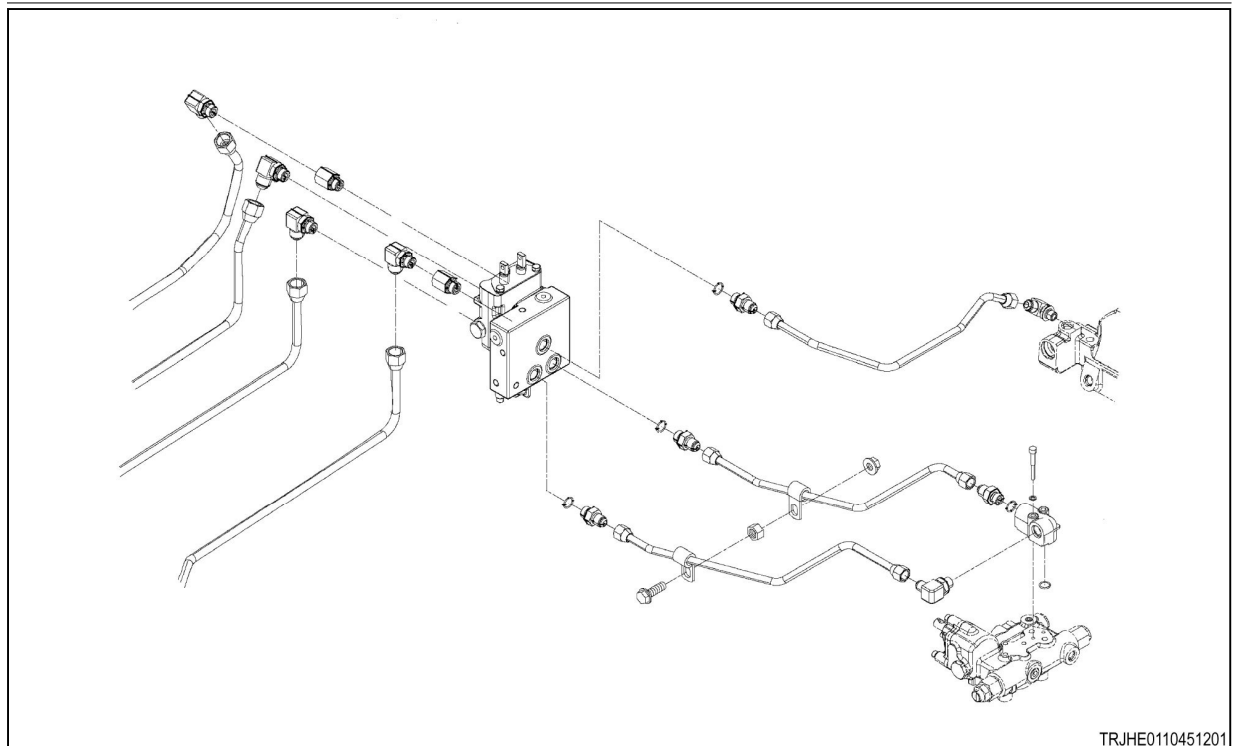
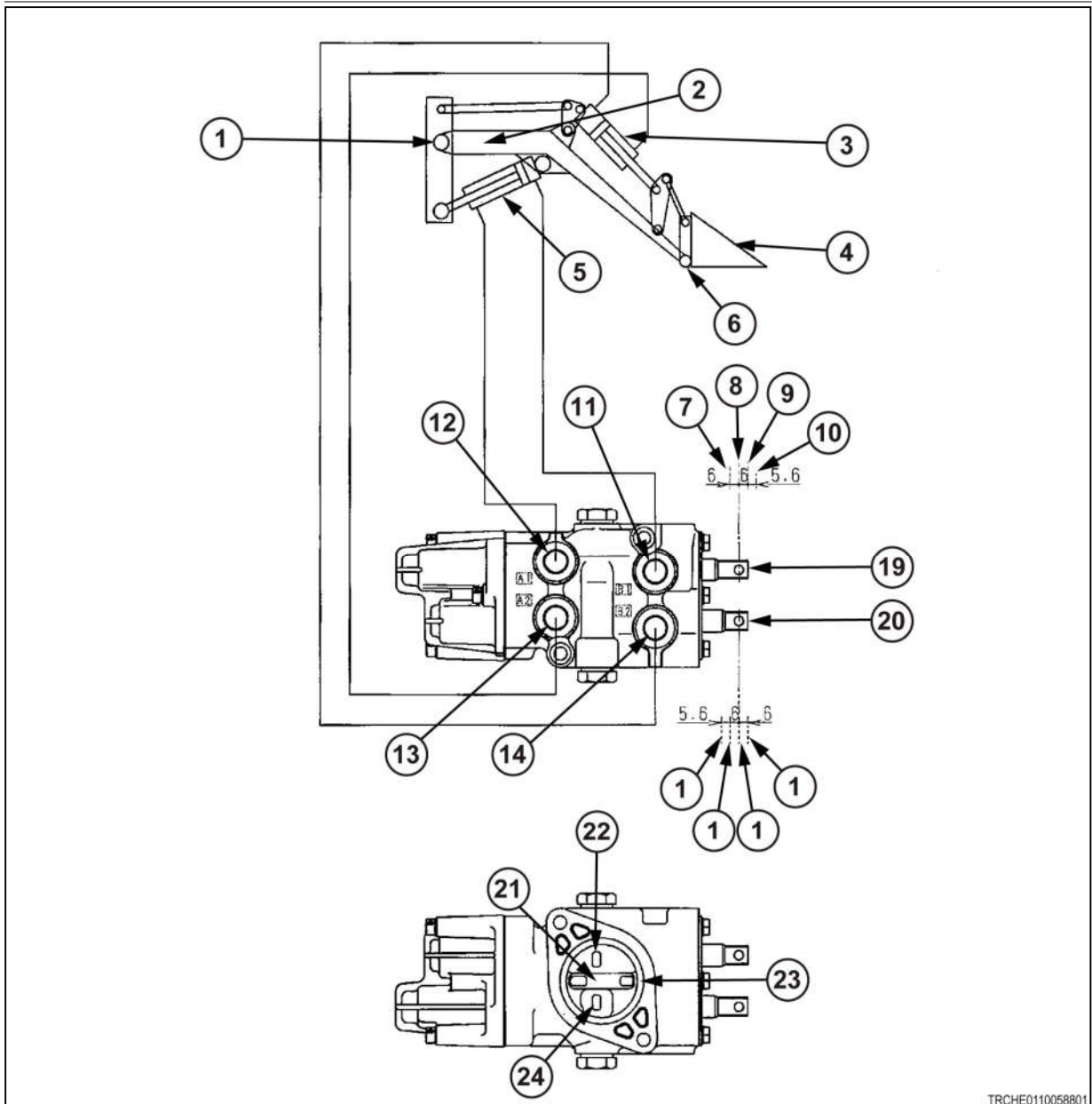


Fig. 3

### 8.1.4 Joystick valve - major components



TRCHE0110058801

Fig. 4

- |                                 |                          |
|---------------------------------|--------------------------|
| (1) Supporting point for boom   | (13) Port A2             |
| (2) Boom                        | (14) Port B2             |
| (3) Bucket cylinder             | (15) Quick dump position |
| (4) Bucket                      | (16) Dump position       |
| (5) Boom cylinder               | (17) Neutral position    |
| (6) Supporting point for bucket | (18) Curl position       |
| (7) Lift position               | (19) Spool for boom      |
| (8) Neutral position            | (20) Spool for bucket    |
| (9) Down position               | (21) Port T              |
| (10) Float position             | (22) Port BP             |
| (11) Port B1                    | (23) Port P              |
| (12) Port A1                    | (24) O-ring              |

## 8.2 Operation Mechanism

### 8.2.1 Boom valve

#### Lift up

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction

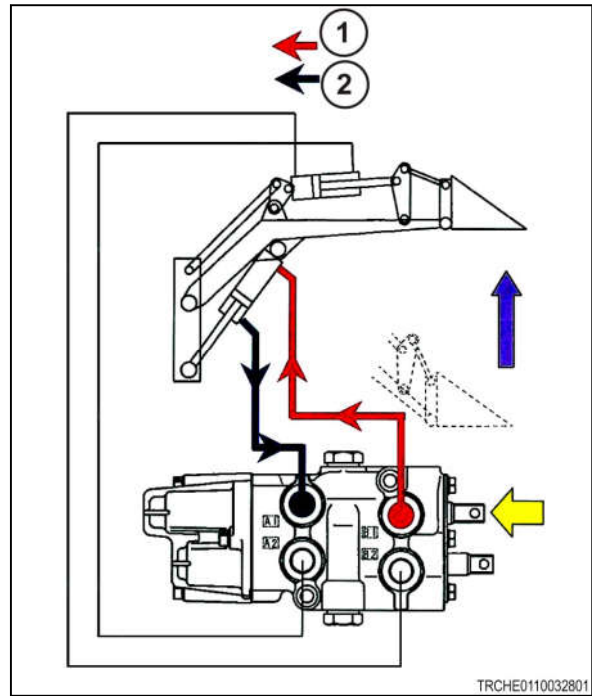


Fig. 5

#### Lift down

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction

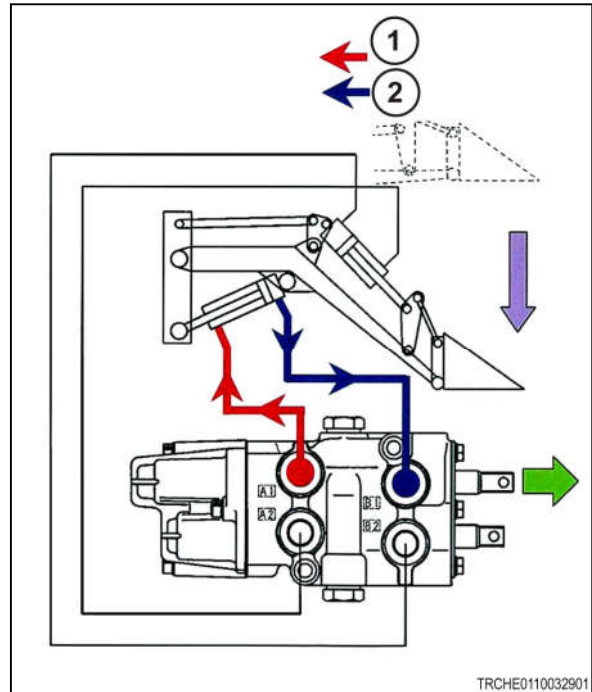


Fig. 6

**Float**

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction
- (3) Detent

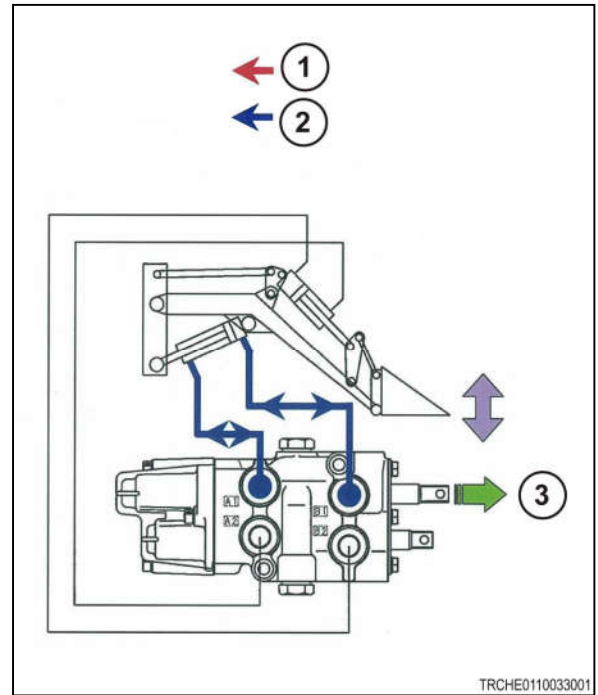


Fig. 7

**8.2.2 Bucket valve****Dump**

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction

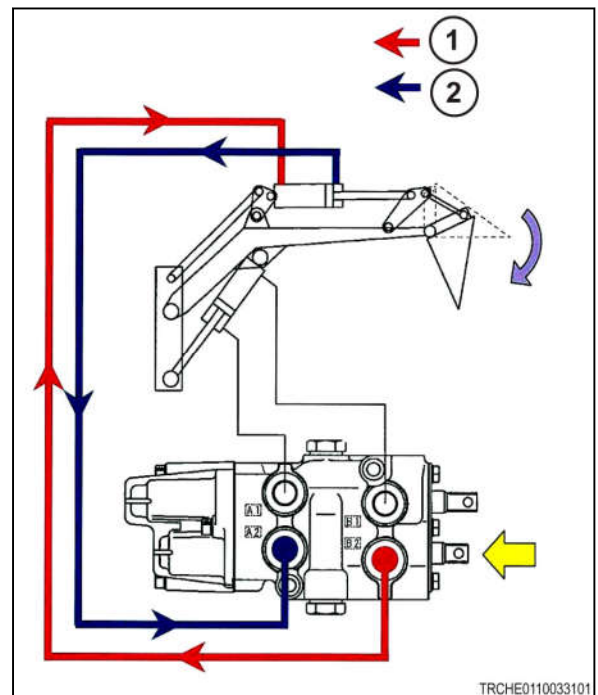


Fig. 8

**Quick dump**

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction

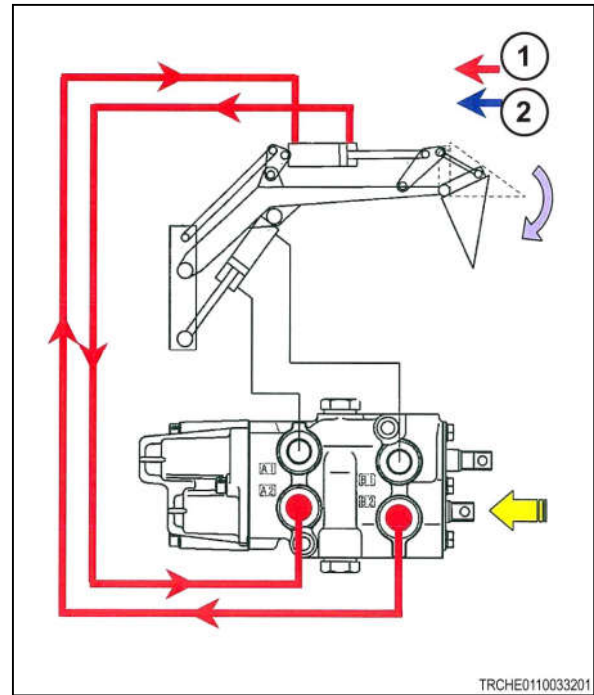


Fig. 9

**Curl**

- (1) High pressure oil flow direction
- (2) Low pressure oil flow direction

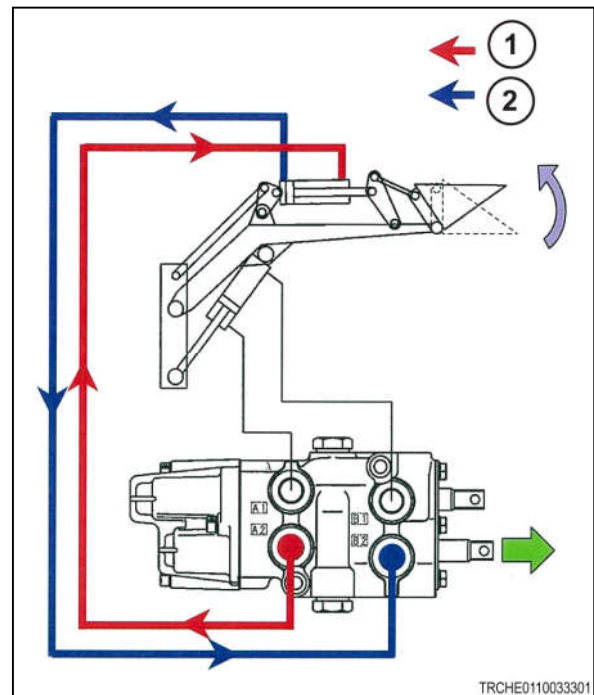


Fig. 10

## 8.3 Control valve

### 8.3.1 Control valve components

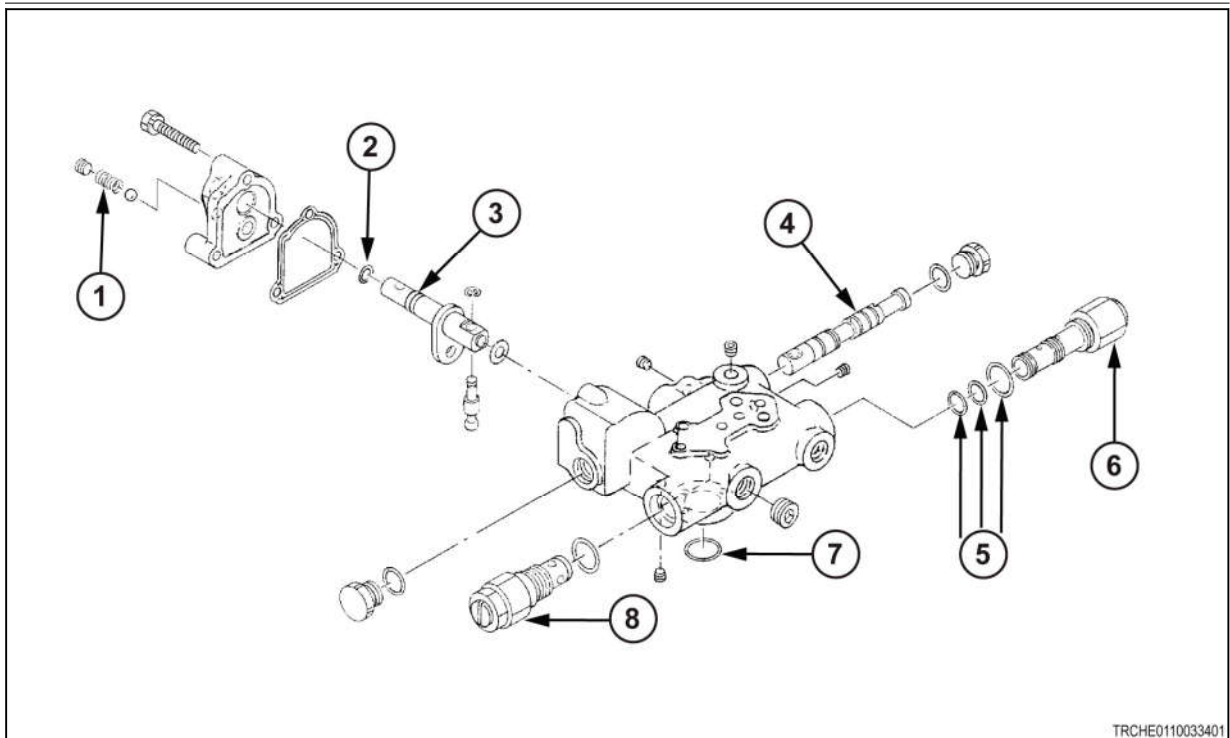
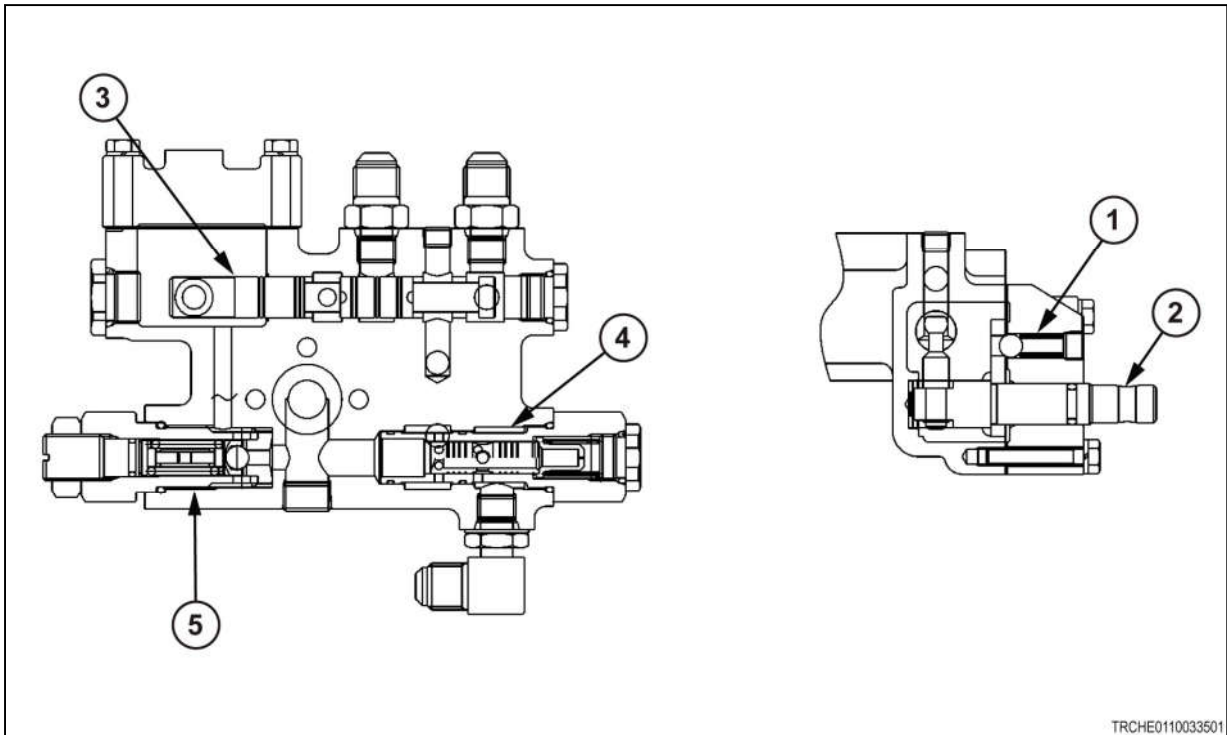


Fig. 11

- (1) Detent assembly
- (2) O-ring
- (3) Rotary arm
- (4) Main spool

- (5) O-ring
- (6) Flow divider
- (7) O-ring
- (8) Main relief valve

### 8.3.2 Control valve assembly

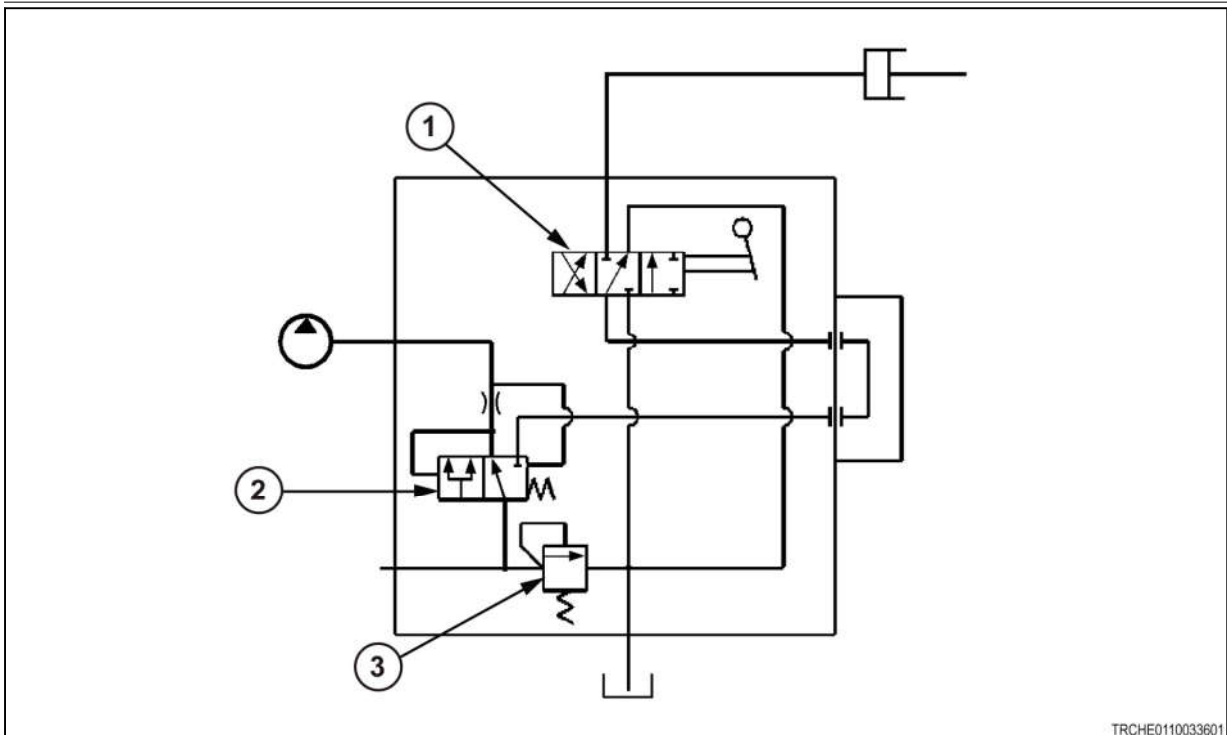


TRCHE0110033501

Fig. 12

- |                     |                       |
|---------------------|-----------------------|
| (1) Detent assembly | (4) Flow divider      |
| (2) Rotary arm      | (5) Main relief valve |
| (3) Main spool      |                       |

### 8.3.3 Control valve hydraulic circuit



TRCHE0110033601

Fig. 13

- (1) Main spool
- (2) Flow divider

- (3) Main relief valve

### 8.3.4 Adjust the control valve linkage

#### Procedure

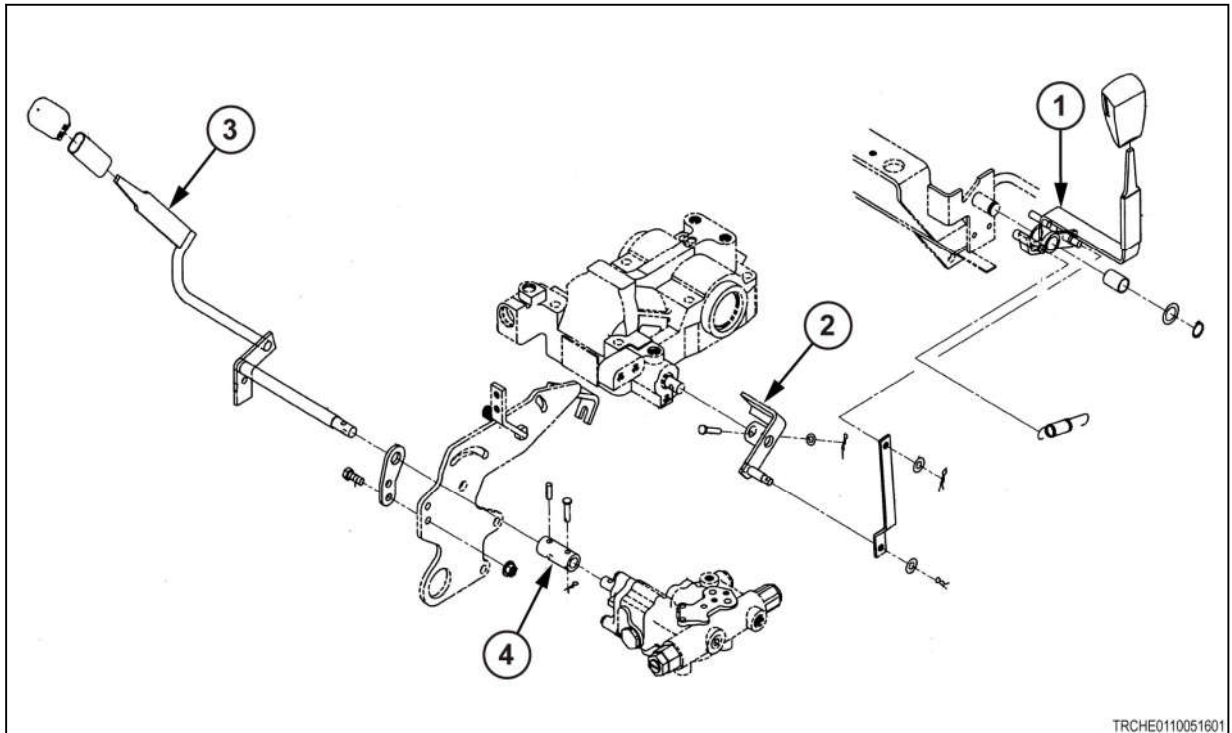


Fig. 14

- (1) Power take-off lever
- (2) Power take-off arm
- (3) Three-point lever
- (4) Coupler

1. Adjust linkage so that the back side of the stay is 189.2 mm (7.45 in) from the end of the rod.
2. Position the washer 24.5 mm (0.96 in) from the end of the rod.

**NOTE:** The collapsed length of the spring must be 42 mm to 43 mm (1.65 in to 1.69 in) when the lift arms are lowering.

**NOTE:** The collapsed length of the spring must be 42 mm to 43 mm (1.65 in to 1.69 in) when the lift arms are raising.



## 8.4 Lift cylinder

### 8.4.1 Lift cylinder components

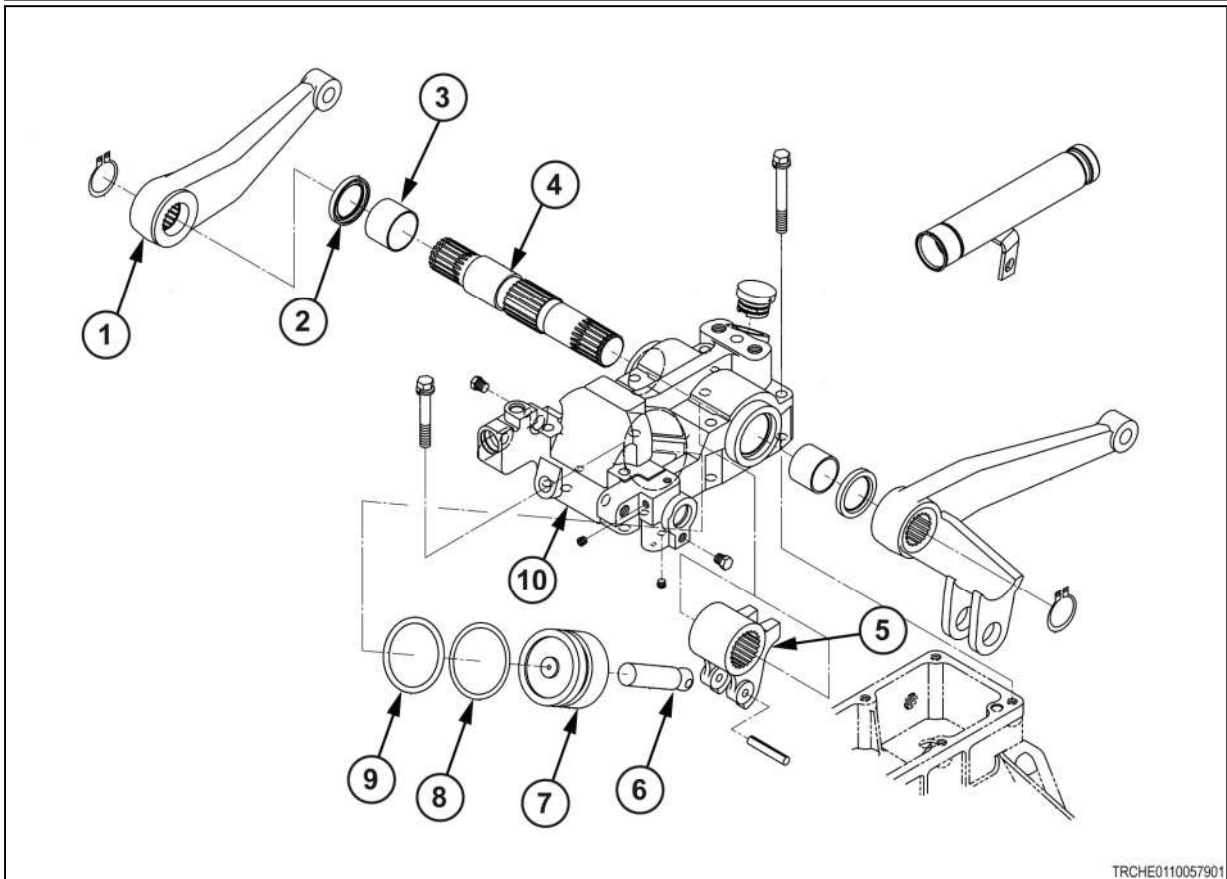


Fig. 15

- |                |                         |
|----------------|-------------------------|
| (1) Lift arm   | (6) Rod                 |
| (2) Seal       | (7) Piston              |
| (3) Bushing    | (8) Backup ring         |
| (4) Rock shaft | (9) O-ring              |
| (5) Lift crank | (10) Lift cylinder case |

### 8.4.2 Disassemble the lift cylinder

#### Procedure

1. Remove the fenders and the fuel tank.

2. Remove the lift cylinder case. Do not lose the O-ring (1) from the transmission case.

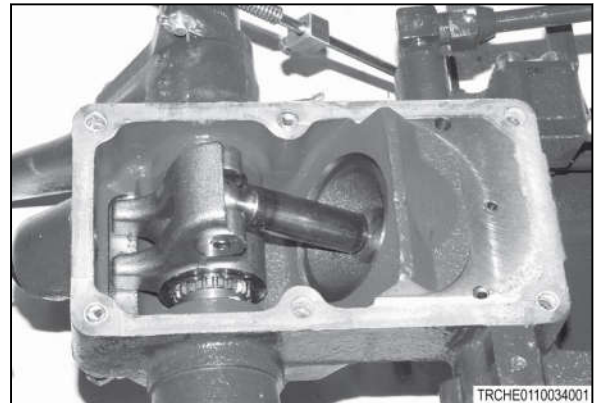
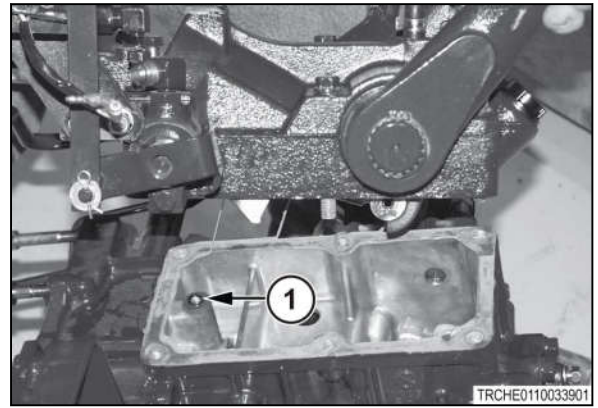


Fig. 16

3. Remove the seal and retainer ring.

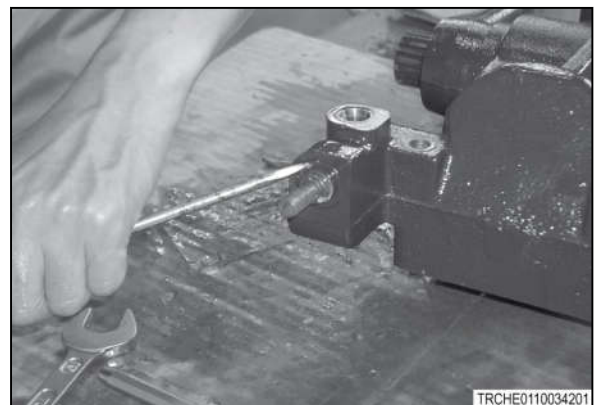


Fig. 17

4. Remove the slow return valve from the lift cylinder case.



Fig. 18

5. Remove the power take-off rotary valve from the lift cylinder case.



Fig. 19

6. Make match marks with a punch on the lift arms and the rock shaft to aid in assembly.
7. Remove the retainer ring and the left-hand lift arm from the rock shaft.

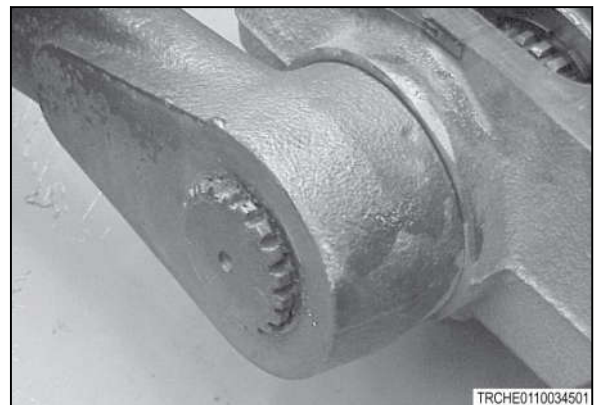


Fig. 20

8. Record the position of the timing mark (1) on the lift crank in relation to the splines on the rock shaft to aid in assembly. If no timing mark is found, make match marks with a punch to aid in assembly.
9. Remove the rock shaft out of the right-hand side of the lift arm housing.

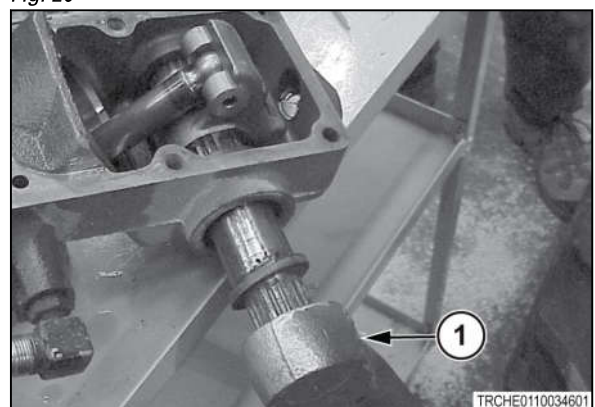


Fig. 21

### 8.4.3 Examine the lift cylinder

#### Procedure

1. Examine the seals, O-rings, and piston rings.
2. Examine the cylinder wall and the piston for damage.
3. Examine the bushings.
4. Examine the power take-off rotary valve assembly.
5. Examine the slow return valve assembly.

### 8.4.4 Assemble the lift cylinder

#### Before starting the procedure

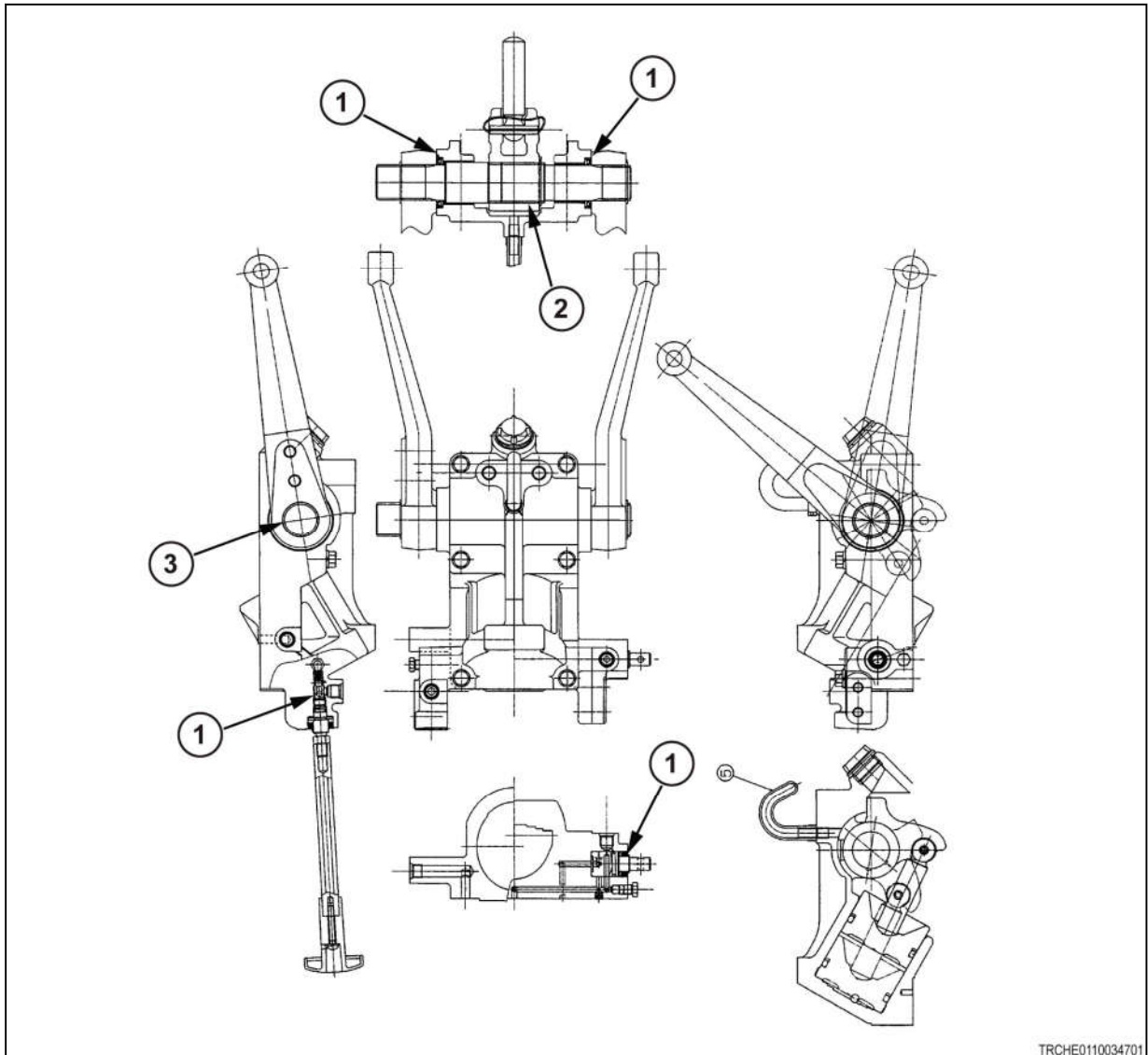


Fig. 22

- Lubricate the seal lips (1) and O-rings (1).
- Use silicone sealer between the cylinder case and rear housing.
- Align the match mark (2) on the center of rock shaft with the center line of lift arm.

- Align the match mark (3) made during disassembly.

**Procedure**

1. Install the rock shaft oil seals into the lift arm housing.
2. Align the timing marks (1) and install the rock shaft.
3. Align the timing marks and install the lift arm.
4. Install the retainer ring.
5. Install the power take-off rotary valve.

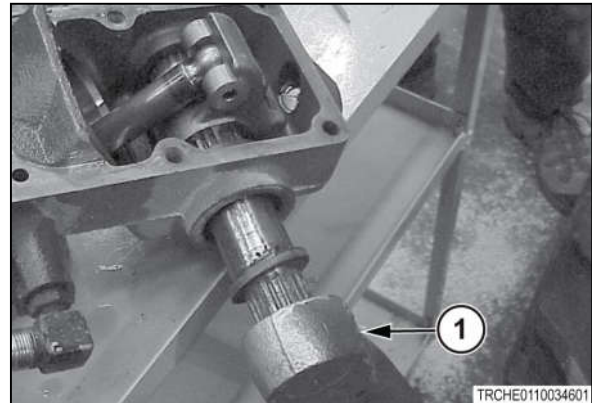


Fig. 23

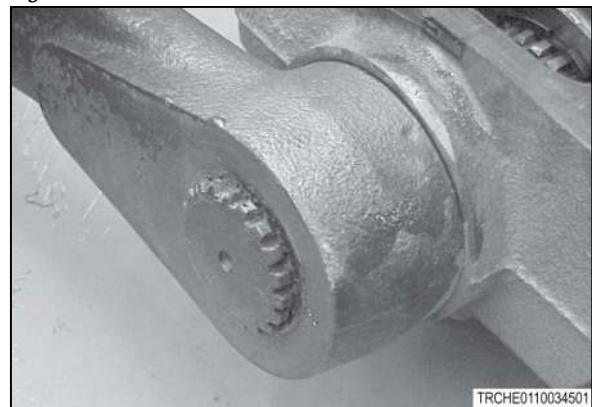


Fig. 24



Fig. 25

6. Install the slow return valve.

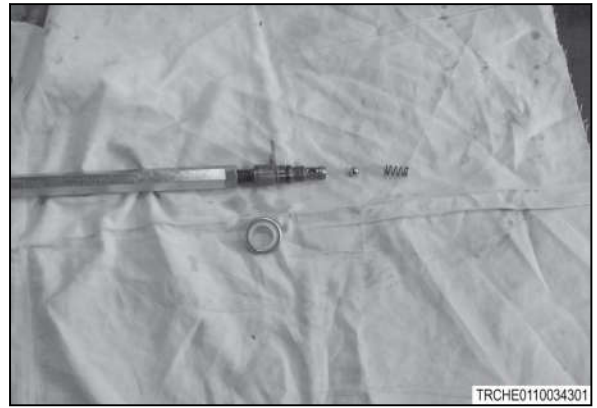


Fig. 26

7. Install the seal and retainer ring.

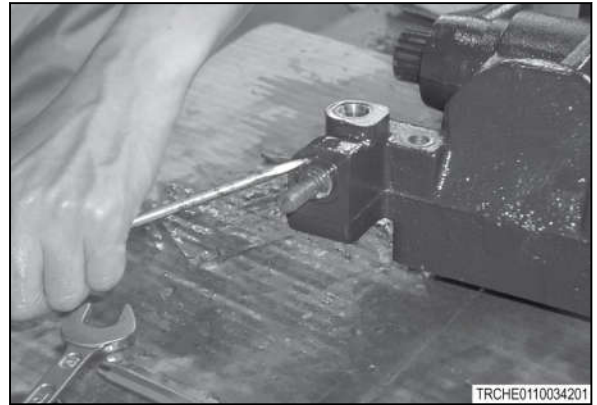


Fig. 27

8. Make sure that the O-ring (1) is installed in the transmission case and install the lift cylinder case.

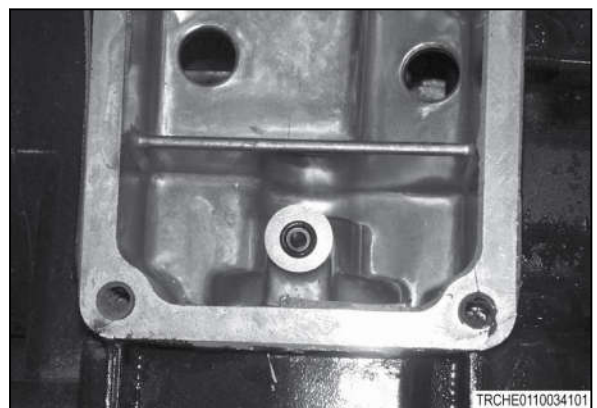
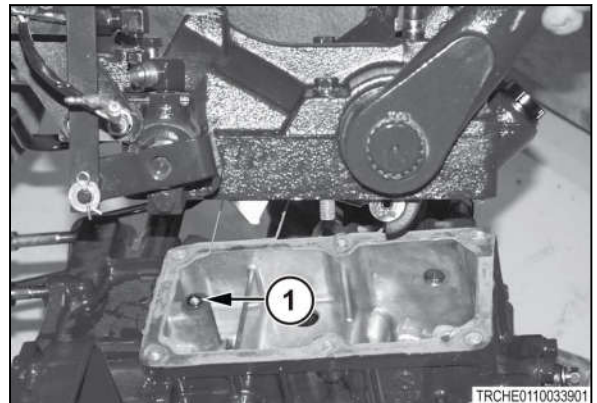


Fig. 28



## 9 Electrical System

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## 9.1 Wiring harness

### 9.1.1 Wiring harness layout - chassis

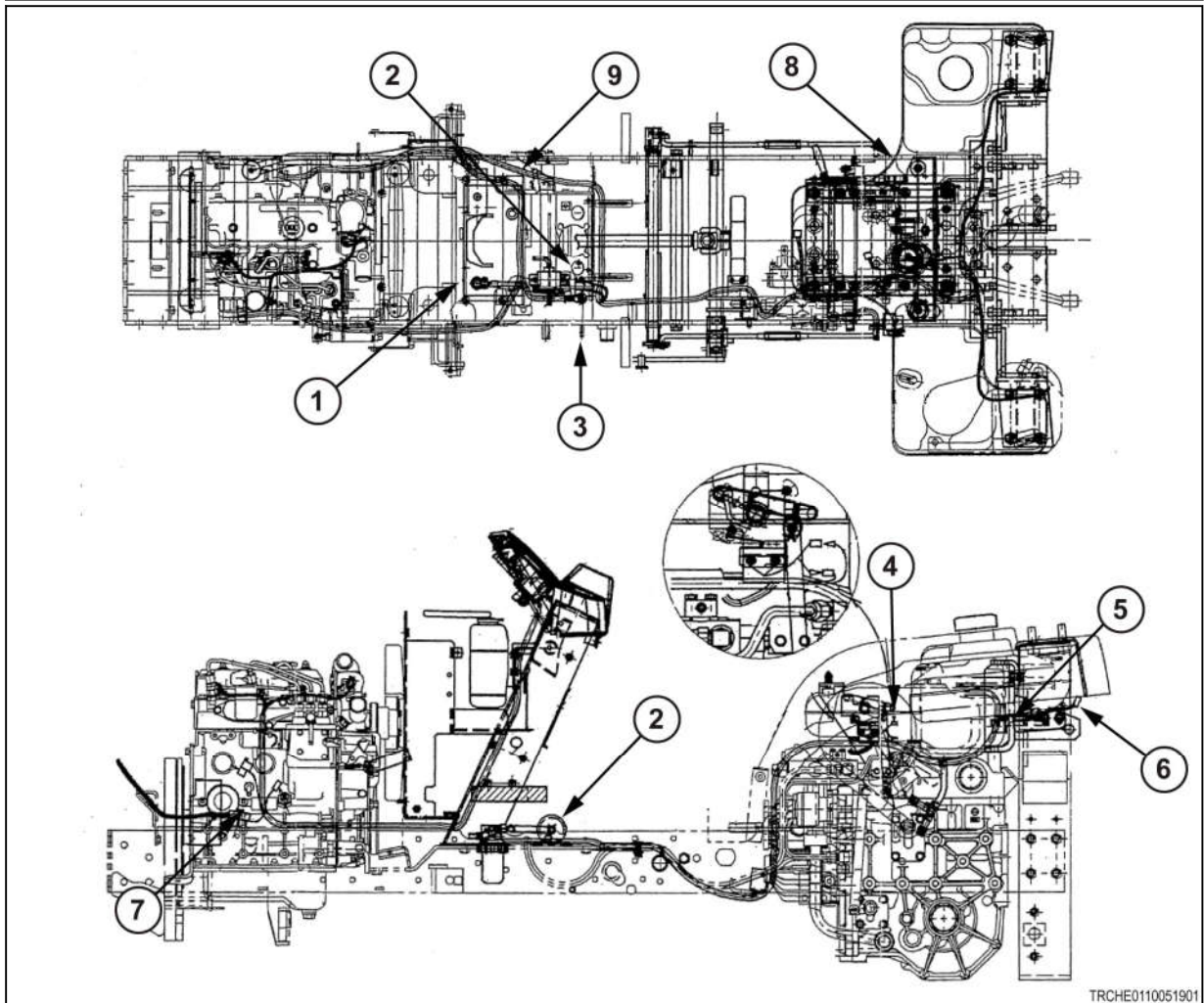


Fig. 1

- |                           |                           |
|---------------------------|---------------------------|
| (1) Battery               | (6) Rear combination lamp |
| (2) Fuel pump             | (7) Headlamp              |
| (3) Main harness ground   | (8) Neutral switch        |
| (4) Power take-off switch | (9) Fuses and relays      |
| (5) Power outlet          |                           |

### 9.1.2 Wiring harness layout - engine

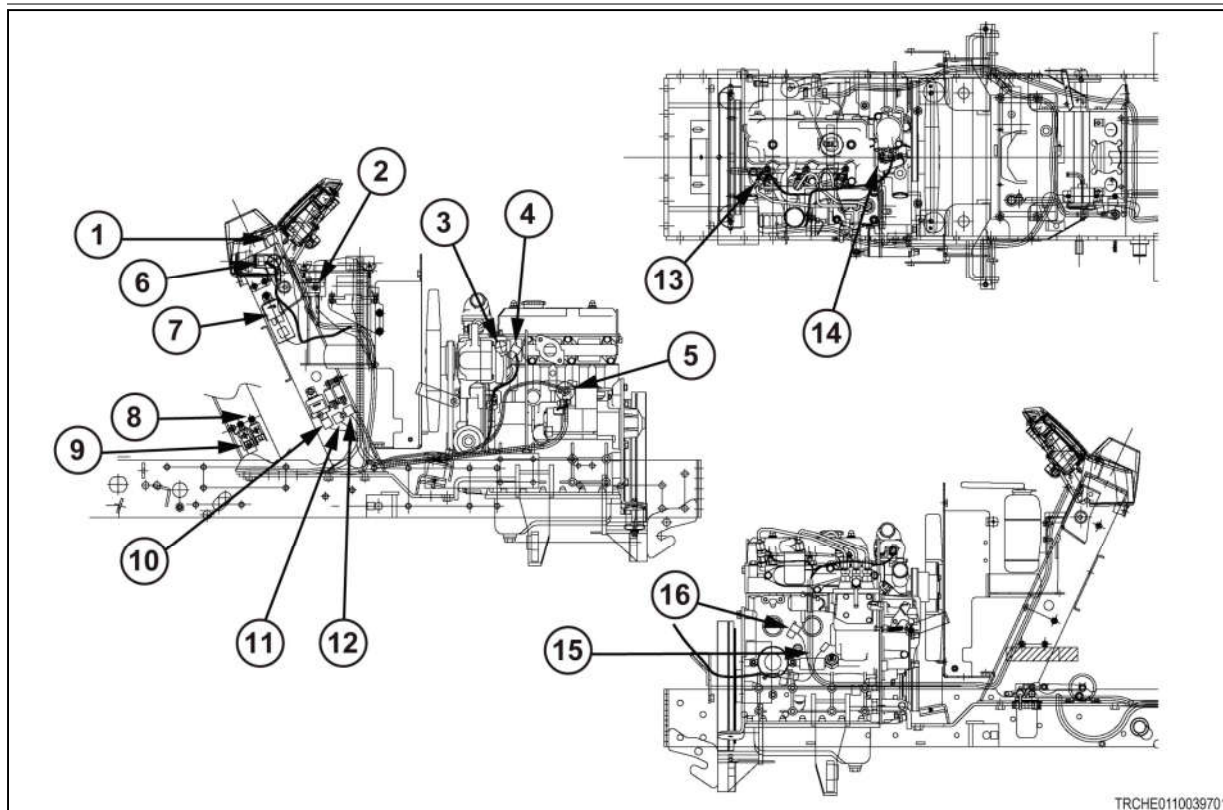


Fig. 2

- |   |                             |
|---|-----------------------------|
| (1) Flashing warning lamp switch  | (9) Turn signal lamp switch |
| (2) Slow blown fuse (L: for main circuit (40A)) (R: for alternator (40A)) | (10) Key stop relay         |
| (3) Alternator B terminal   | (11) Turn signal lamp relay |
| (4) Alternator L and R terminal   | (12) Engine safety relay    |
| (5) Starter B terminal  | (13) Engine glow plugs      |
| (6) Main switch   | (14) Temperature sender     |
| (7) Flasher   | (15) Oil pressure switch    |
| (8) Engine safety switch  | (16) Key stop solenoid      |

## 9.2 Electrical system

### 9.2.1 Battery



**WARNING:**  
Never disassemble the battery.



**WARNING:**  
When charging the battery from an external source, set charging voltage below 16 volts. Set charging ampere below 1/10 (one tenth) of the battery capacity.



**WARNING:**  
When connecting and disconnecting the battery cables, turn off the power of the battery charger. If you have any questions about the battery, consult you dealer.



**CAUTION:**  
Batteries produce explosive hydrogen gas when charged. Keep all sparks and open flames away from the battery.



**CAUTION:**  
When necessary to disconnect the battery cables, always disconnect the grounded (-) cable first to prevent short circuits.



**CAUTION:**  
Batteries contain sulfuric acid electrolyte (fluid). Wear eye and face protection. If electrolyte comes in contact with skin or clothes, wash immediately. Contact a physician if electrolyte is ingested or gets in eyes.

The battery (1) is located under the engine cover in front of the instrument panel. Open the engine cover to remove the battery or to clean the battery cables.

Keep the top of the battery clean. Make sure the cable connections are clean and tight. Debris on the battery can cause discharge of the battery and fire.

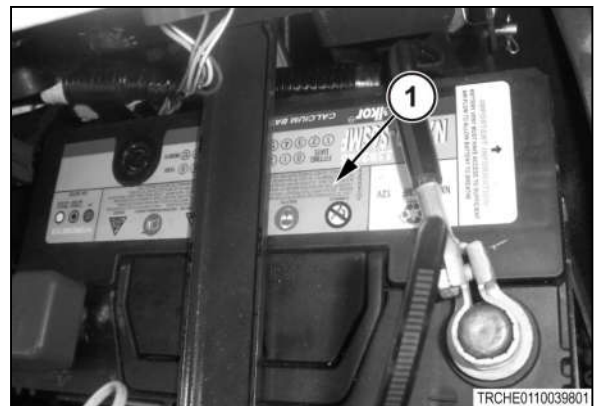
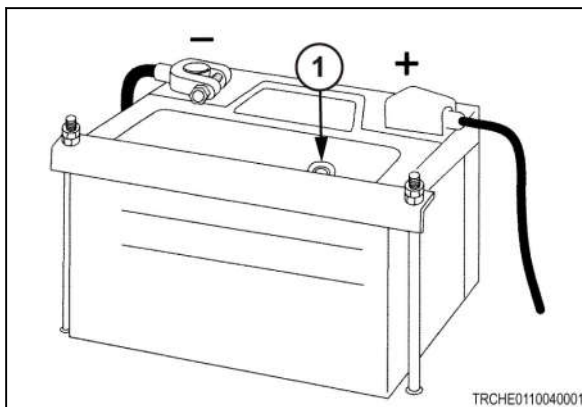


Fig. 3



Indicator Color		Condition	Correction
	Green	Charged	Usable
	Black	Discharged	Charge battery
	Clear	Low electrolyte	Replace battery

Fig. 4

The battery indicator (1) color shows the battery condition. When checking the battery, park the machine on a level surface and check the indicator at the top of the battery.

If the indicator shows a clear or light green color, tap the battery body to remove the bubble inside the indicator.

If battery performance is questioned, the battery can be removed and charged from an external source following the battery charger instructions. Repeated battery charging can be caused by a defect in the machine charging system and/or a defective battery.

**NOTE:** When charging the battery from an external source, the battery temperature must not become more than 54 degrees C (125 degrees F). If the battery does become too hot, reduce or stop the charge rate.

### 9.2.2 Fuses



**WARNING: Electrical system failure.**

**Serious personal injury or major damage to equipment and components can occur.**

**Check all electrical systems and connections after working on the machine and before returning the machine to normal operation.**



**WARNING: Wiring and fuse modification.**

**Fuse protection and safety features can be bypassed causing personal injury or death.**

**Do not change the wiring or fuses.**



**CAUTION: Negative ground system.**

**Positive circuits can short circuit and be a potential personal injury or fire hazard.**

**Insulate and shield positive circuits.**



**WARNING: Fire hazard. Electrical system failure.**

**Personal injury or machine damage can occur.**

**Do not replace any fuse with a fuse of higher amperage rating. Do not use wire or foil to bypass the fuse protection.**

**IMPORTANT:**

*If fuses blow repeatedly, examine the electrical system for grounded or shorted circuits.*

### 9.2.2.1 Fuses locations



**CAUTION:**  
Keep all wiring connections clean and tight. Make sure wiring is correctly secured to prevent damage.



**CAUTION:**  
Do not alter wiring by adding homemade extensions or replacements. Doing so can eliminate fuse protection and/or eliminate safety features of the system.



**CAUTION:**  
The machine is equipped with a negative (-) ground system. Machine metal parts provide many electrical connections. For this reason, all positive (+) circuits must be insulated to prevent grounding or short circuits and prevent possible fire.



**CAUTION:**  
Do not replace any fuse with a fuse of higher amperage rating. Do not use wire (or foil) to bypass fuse protection. A fire can result.



**CAUTION:**  
If fuses blow repeatedly, examine electrical system for grounded or shorted circuits.

The main fuse box (1) is located on the right side at the rear of the engine.

Slow blow fuses (2) are located above and to the right of the battery. Slow blow fuses are inline fuses that protect a circuit by melting when a sustained heavy electrical load or short circuit is found. Slow blow fuses give a delayed action to prevent current break when short surges are found.

**IMPORTANT:** Fuses have a specific amperage for the circuit. Do not replace fuses with unauthorized parts.

**IMPORTANT:** Failure of the alternator circuit slow blow fuse is normally caused by incorrect polarity (such as reversed cables when using a booster battery). A failed fuse will not let the battery be charged during normal operation.

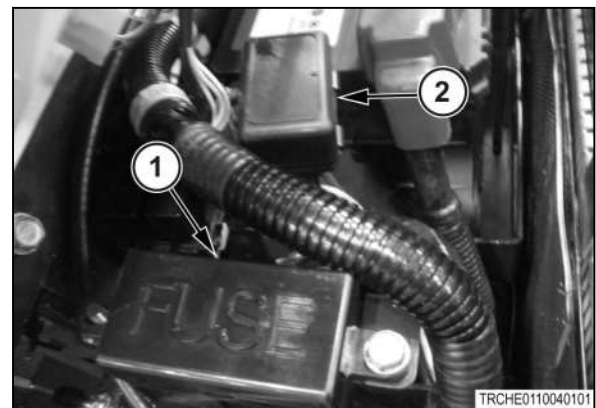


Fig. 5

Ref	Amp	Function
1	15A	Turn signals, hazard lamps
2	10A	Headlamp and tail lamps
3		Not used
4	5A	Glow signal
5	10A	Engine solenoid
6		Not used

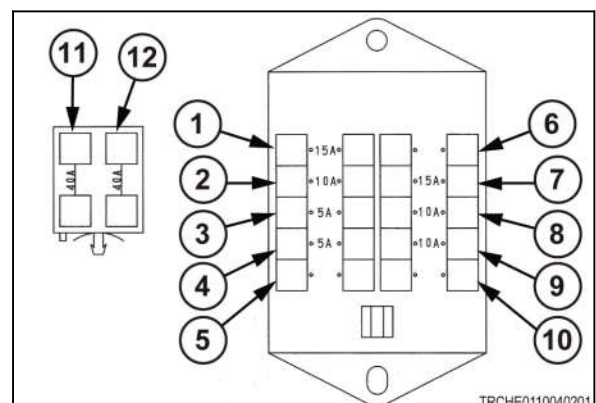


Fig. 6 Main fuse box components

Ref	Amp	Function
7	15A	Accessory power
8	10A	Instrument panel, engine start system
9	10A	Work lamp
10		Not used
11	40A	A slow blow fuse that is green and protects the alternator circuit.
12	40A	A slow blow fuse that is green and protects the main circuit.

### 9.2.3 Neutral start switches



**WARNING:**

**Do not bypass or modify the neutral switch. If the neutral start system does not operate properly, see your dealer immediately.**

The machine is equipped with a neutral start system made up of neutral switches and a relay. To start the machine:

- Sit in the operator's seat.
- Put the range shift lever in the neutral position.
- Put the power take-off control lever in the OFF position.

### 9.2.4 Combination lamp switch

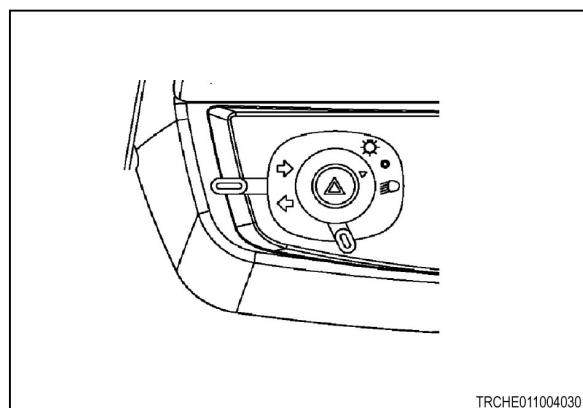


Fig. 7

Combination Switch Diagram		B3	H	B2	R	L	B1	1	T
Lamp switch	OFF								
	1						X	X	X
Turn signal switch	Left			X		X			
	OFF								
	Right			X	X				
Hazard switch	ON	X	X						
	OFF								

### 9.2.5 Main switch

The main switch (1) has the four following positions:

Off (stop) - Engine and all electrical circuits are off. The key can be removed.

On - Power is supplied to all circuits. This is the normal operating position.

Glow - Energizes glow plugs to warm the combustion chambers and help with starting. This position is spring-loaded to on.

Start - Starter is activated. This position is spring-loaded to on.

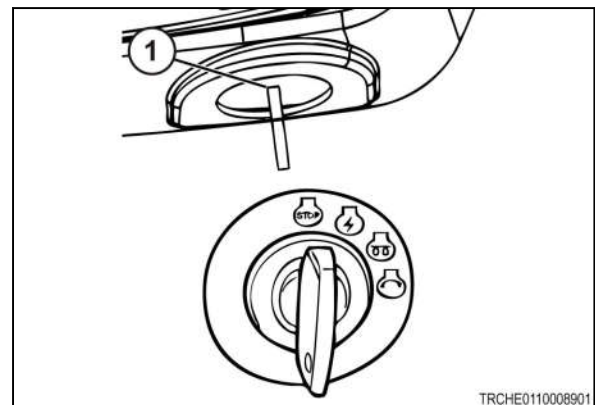


Fig. 8

**NOTE:** The main switch must be turned to the on position before any circuits will operate.

Main Switch				
	B	AC	G	ST
OFF				
ON	X	X		
GLOW	X	X	X	
START	X	X	X	X



### 9.2.6 Spare power supply

A spare power supply receptacle (1) is located at the rear of the machine on the left-hand side of the top link. Use a male bullet connector 4 mm (0.156 in) with 0.85 mm<sup>2</sup> (18 ga) wire size.

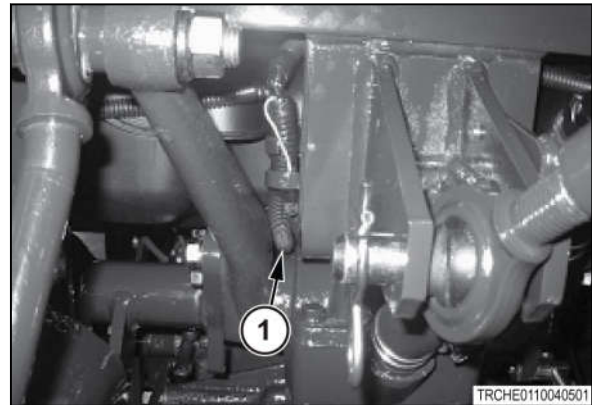


Fig. 9

## 9.3 Safety switches, fuses, and relays

### 9.3.1 Safety switches

The seat switch (1) is located under the seat.

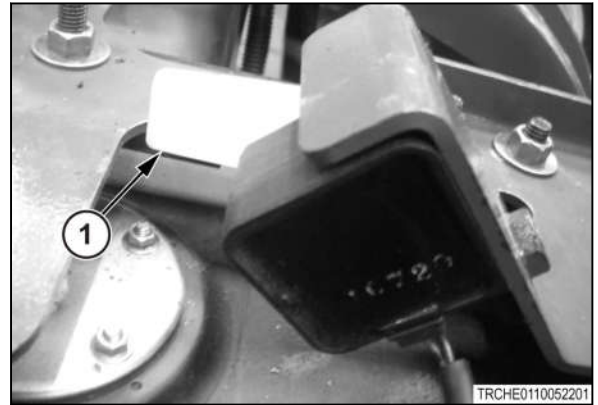


Fig. 10

The power take-off (PTO) switch (1) is located on the left-hand side at the base of the PTO shift linkage.

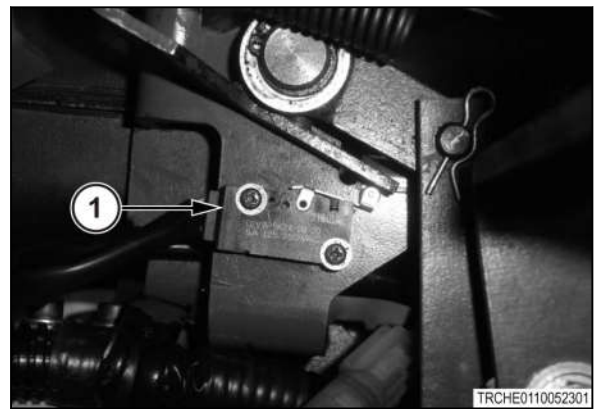


Fig. 11

The neutral start switch (1) is located below the base of the range lever on the right-hand side.

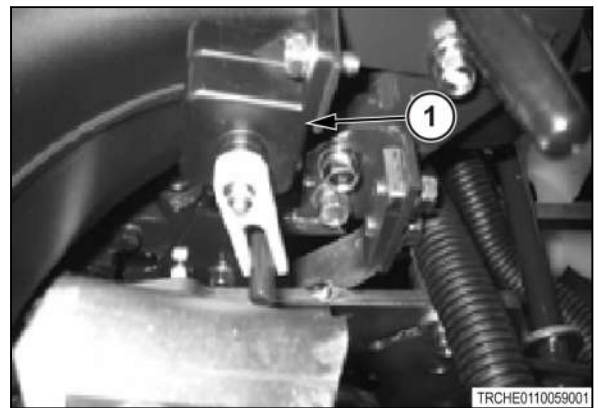


Fig. 12

### 9.3.2 Relays

The left-hand and right-hand turn signal relays (1) are mounted on the left-hand side of the steering column.

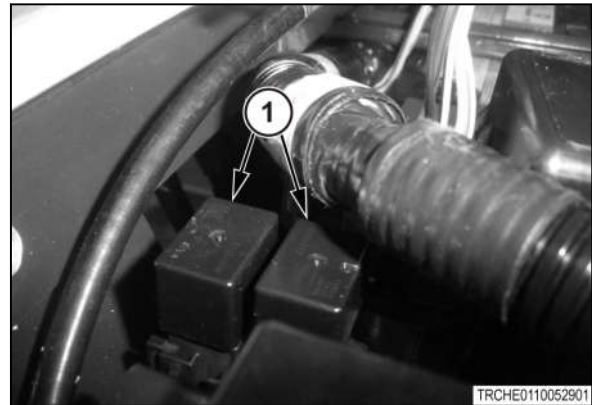


Fig. 13

The engine timer relay (1) and hazard/turn signal relay for the amber lights on the fender are mounted on the left-hand side of the battery. The engine timer relay keeps the fuel shut off solenoid energized for approximately 0.5 second after the seat switch opens.

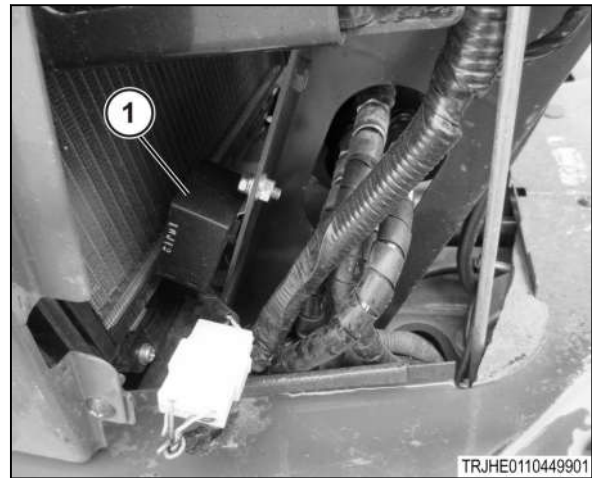


Fig. 14

The safety start relay (1) is located on the right-hand side of the steering column. The safety relay will not let the engine start if the power take-off (PTO) is engaged or if the range lever is in gear. The safety relay will also shut the engine off if the PTO is engaged or the range lever is engaged and the operator is not sitting in the seat.

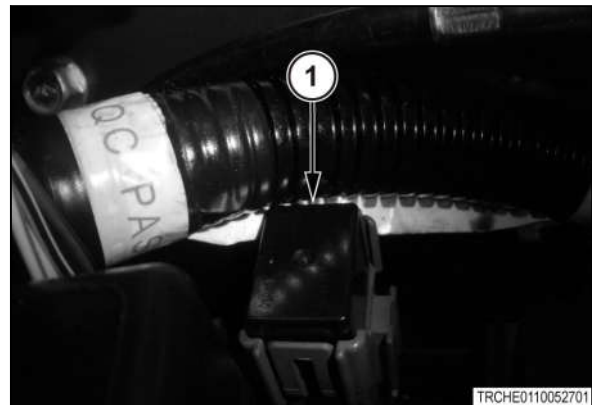


Fig. 15

The diode (1) is located in front of the steering column behind the battery.

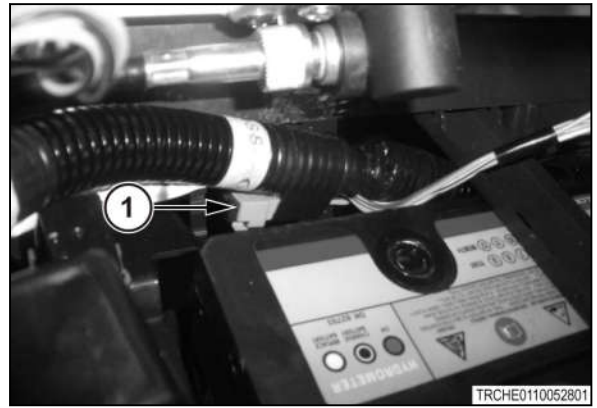


Fig. 16

### 9.3.3 Fuel shut off solenoid

The fuel shut off solenoid (1) is located on the injection pump.

The fuel shut off solenoid is energized, lets the flow of fuel to the injection pump, when the main switch is in the On position.

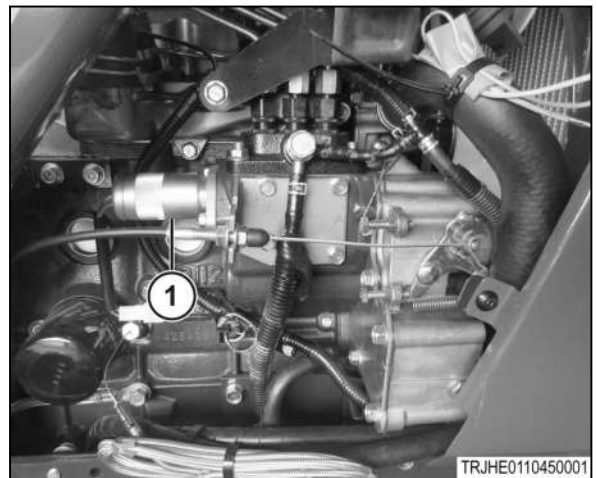


Fig. 17

### 9.3.4 Oil pressure sending unit

The oil pressure sending unit (1) is located on the left-hand side of the engine. The oil pressure lamp will turn on when the engine oil pressure drops below 68 kPa (10 psi).

Tighten the sending unit 10.85 Nm to 19.0 Nm (8 lbf ft to 14 lbf ft).

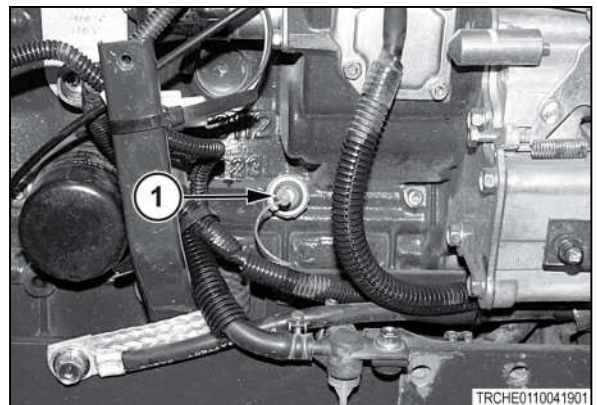


Fig. 18

### 9.3.5 Coolant temperature sending unit

The coolant temperature sending unit change resistance as the coolant heats or cools. As the coolant temperature increase, the resistance in the sending units gets lower. As the resistance lowers, the current increases to the temperature gauge in the instrument panel.

Resistance	Coolant temperature
600 Ohms	45 °C (113 °F)
84.5 Ohms	85 °C (185 °F)
47.5 Ohms	110 °C (230 °F)

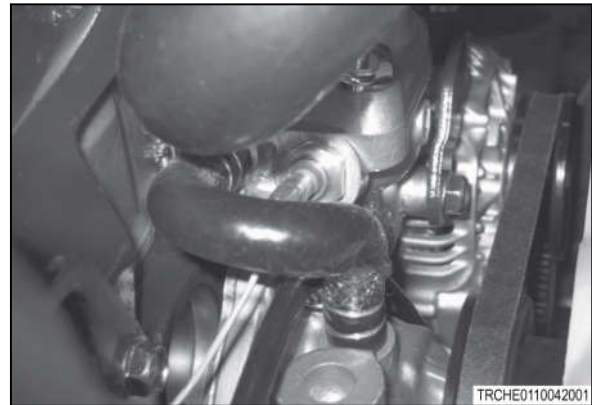


Fig. 19

### 9.3.6 Fuel gauge sending unit

The fuel tank sending unit is located on the fuel tank.

The fuel gauge sending unit moves the fuel gauge needle by changing the resistance as the float moves up and down. The resistance on the sending unit should measure:

- Full: 7 ohms
- Half Full: 38 +/- ohms
- Empty: 95 ohms

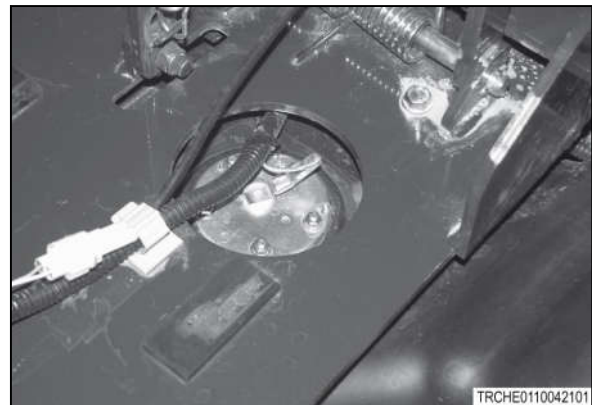


Fig. 20

## 9.4 Instrument panel

### 9.4.1 Instrument panel

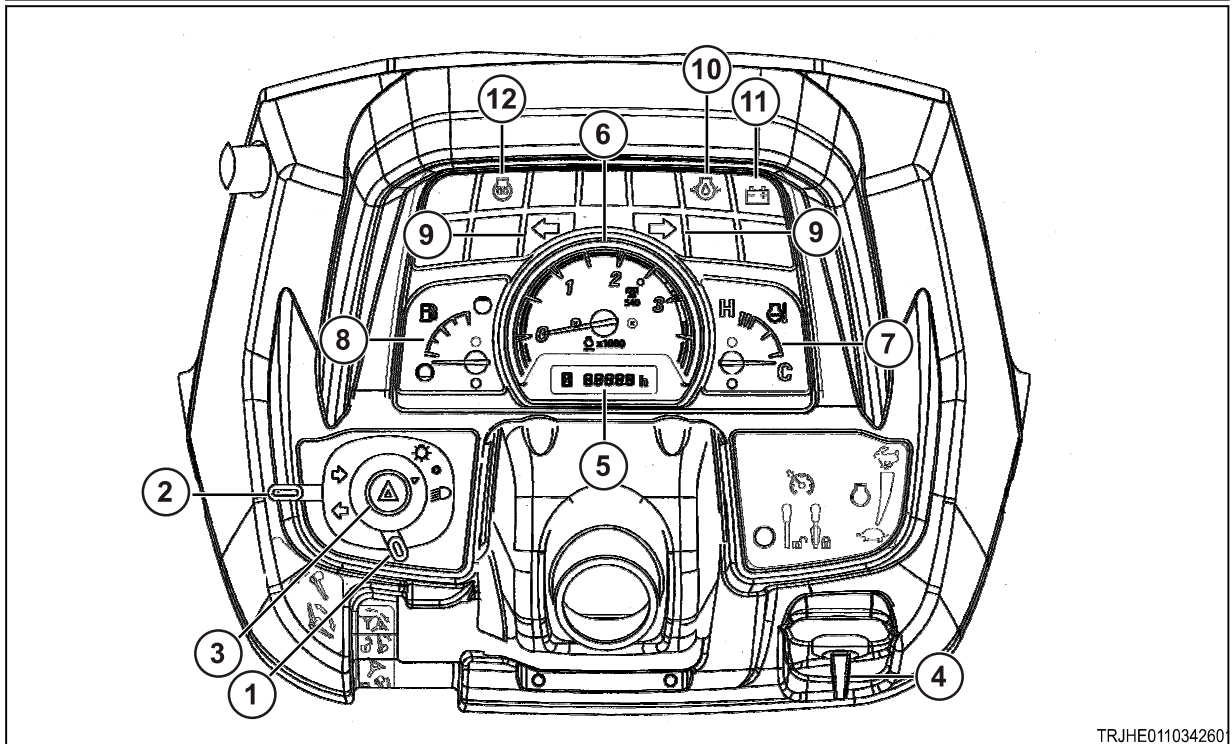


Fig. 21

- |                        |   |
|------------------------|---|
| (1) Headlamp switch    | (7) Engine coolant temperature gauge    |
| (2) Turn switch        | (8) Fuel gauge                          |
| (3) Hazard lamp switch | (9) Turn indicator lamp                 |
| (4) Main switch        | (10) Engine oil pressure indicator lamp |
| (5) Hourmeter          | (11) Battery charge lamp                |
| (6) Tachometer         | (12) Glow lamp                          |

**NOTE:** Instrument panel and switches can vary from what is shown.

#### 9.4.1.1 Indicators and gauges

### Indicators

The battery charge indicator (1) illuminates when the main switch is turned to the on position. The lamp will go out after the engine starts, to indicate the battery is being charged.

The engine oil pressure indicator (2) illuminates if engine oil pressure is low. If the lamp comes on while the engine is running, stop the engine immediately and find the cause.

**IMPORTANT:** If the battery charge indicator or engine oil pressure indicator stays illuminated, stop the engine immediately and contact your dealer.

The turn signal indicators (3) flash when the turn signal is turned on.

The glow indicator (4) illuminates when the main switch is in the glow position.

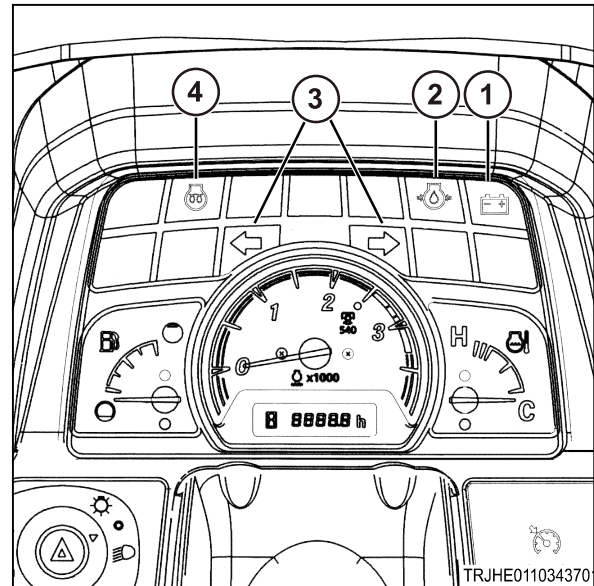


Fig. 22

### Coolant temperature gauge

The coolant temperature gauge needle (1) indicates the temperature of the engine coolant.

Cold (2) indicates the engine temperature is too cool for a heavy work load. Let the engine warm (needle in mid position) before applying a heavy load.

Hot (3) indicates the engine is too warm. Decrease the engine speed to idle. Let the tractor run at no load for several minutes. Stop the engine and find the cause.

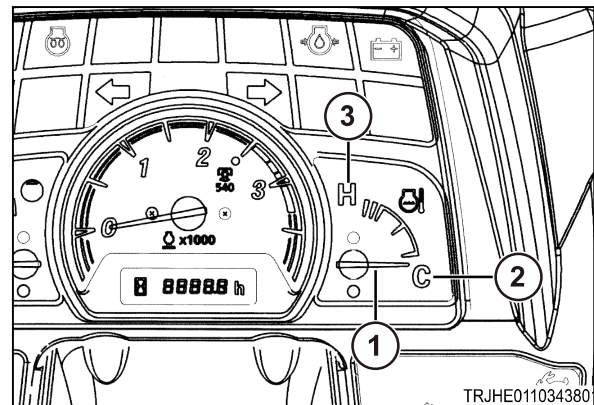


Fig. 23

### Tachometer and hourmeter

The needle (1) and scale on the gauge indicates engine speed on crankshaft revolutions per minutes (RPM).

The dot (2) on the gauge indicates 540 PTO speed. The GC1723E gauge is shown.

The hourmeter (3) in the center of the gauge indicates engine and tractor use to help in maintenance intervals. The extreme right digit indicates 1/10 hour increments.

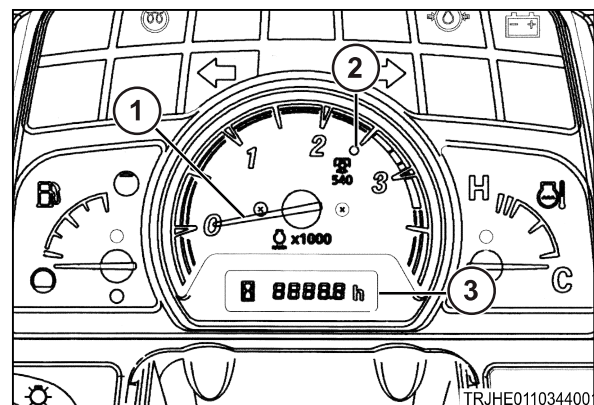


Fig. 24

### Fuel gauge

When the main switch is in the on position, the fuel gauge needle (1) indicates the diesel fuel level.

The closer the needle is to the full icon (2), the more fuel is in the fuel tank.

Do not let the fuel gauge reach the empty icon (3).

**NOTE:** The gauge does not indicate an accurate fuel level when the tractor is on a slope. A short time is needed to indicate an accurate level after the tractor gets back onto level ground.

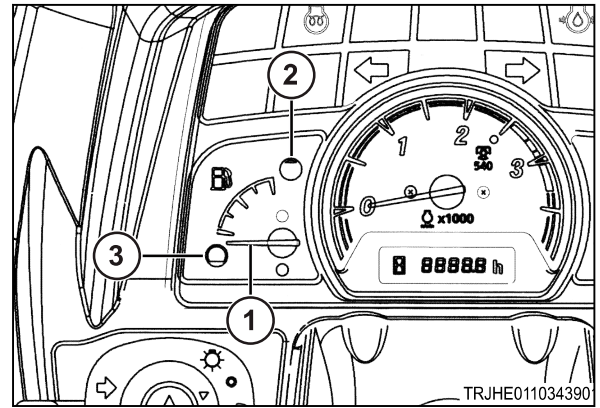


Fig. 25

## 9.4.2 Remove the instrument panel

### Before starting the procedure

**NOTE:** To get to the main switch, combination switch, and instrument panel, remove the dash

### Procedure

1. Remove the steering wheel.



Fig. 26



## 9. Electrical System



2. Remove the hardware securing the dash to the machine.
3. Disconnect the electrical connections.
4. Remove the instrument panel assembly.



Fig. 27

## 9.5 Head and combination lamp

### 9.5.1 Replace a head lamp bulb

#### Procedure

1. Open the engine cover.

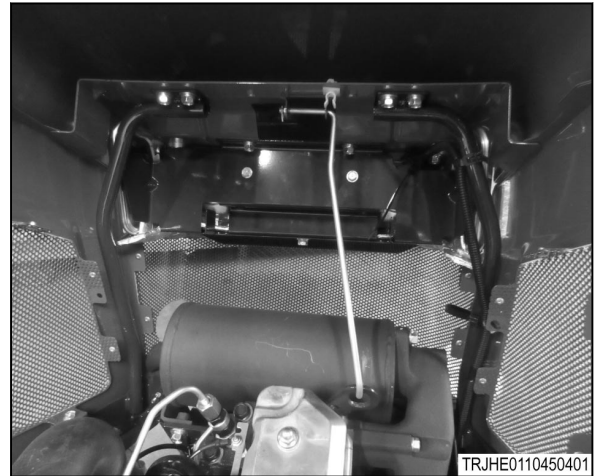


Fig. 28

2. Remove the capscrews from the cover. Remove the cover.

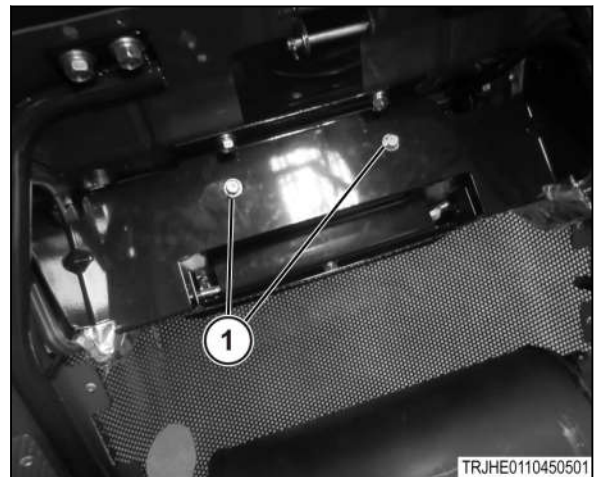


Fig. 29

3. Remove the capscrews from the bracket. Remove the bracket.

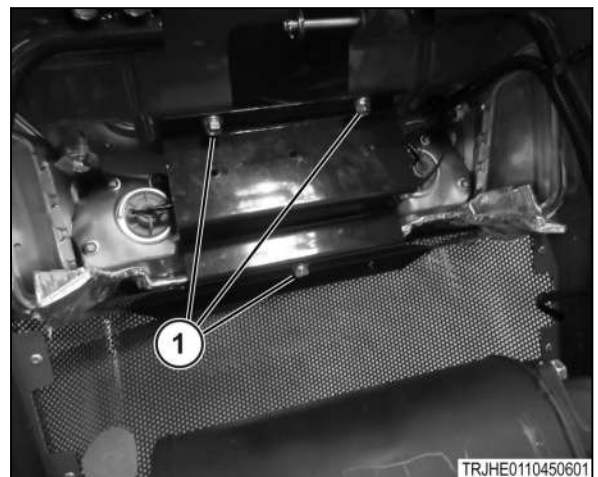


Fig. 30

4. Turn the electrical socket to remove it from the lamp assembly. Remove the bulb from the electrical socket.
5. Install a new bulb into the electrical socket. Install the electrical socket into the lamp assembly.

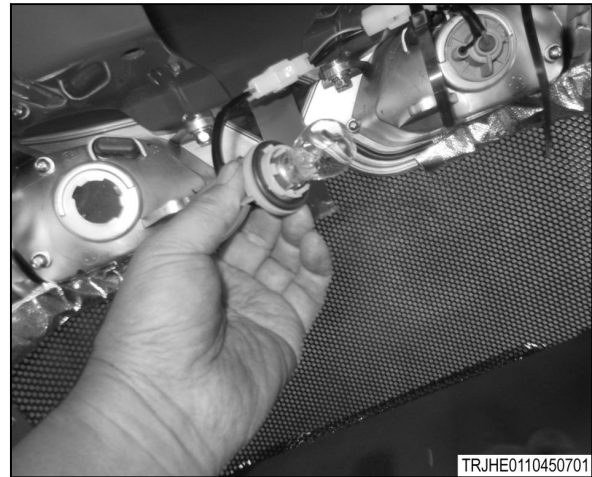


Fig. 31

6. Put the bracket into position and install the capscrews.
7. Put the cover into position and install the capscrews.
8. Close the engine cover.

### 9.5.2 Replace the combination lamp assembly

#### Procedure

1. Disconnect the wire for the lamp assembly.
2. Support the lamp assembly while you remove the two capscrews (1). Be careful not to lose the washers between the lamp assembly and ROPS.
3. Put the capscrews through the ROPS.
4. Put one washer on each capscrew.
5. Route the wire through the hole in the ROPS.
6. Install a new lamp assembly. Do not over tighten the capscrew.
7. Connect the wire.

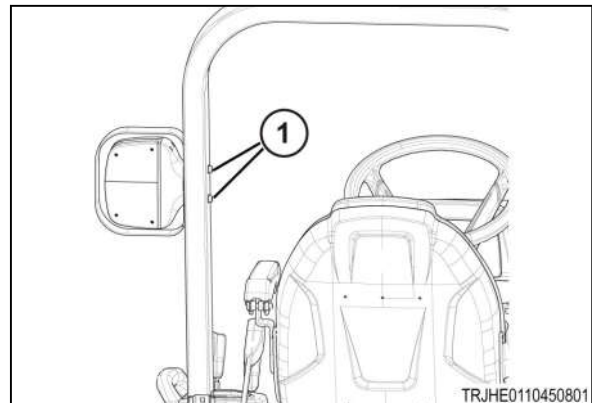


Fig. 32

### 9.5.3 Replace a bulb in the combination lamp assembly

#### Procedure

1. Remove the screws (1) that fasten the lens to the lamp assembly.
2. Remove the lens.
3. Remove the old bulb.
4. Install a new bulb.
5. Put the lens onto the lamp assembly.
6. Install the screws.

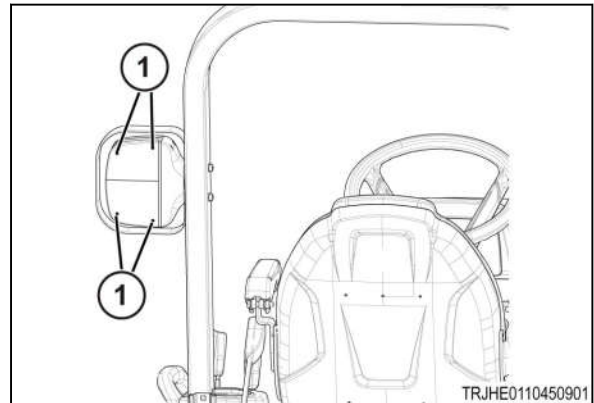


Fig. 33

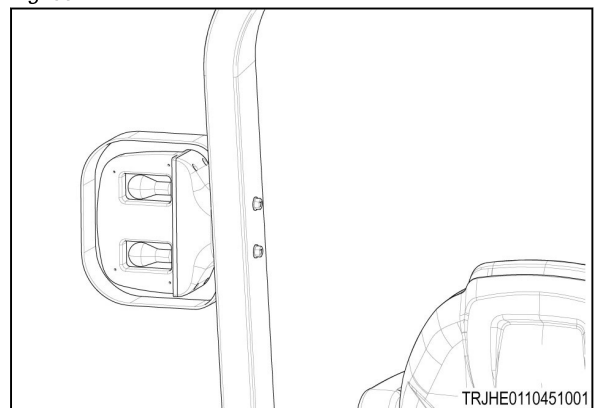


Fig. 34



## 10 Diagrams

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## 10.1 Wiring diagrams

### 10.1.1 Wiring diagram legend

- (1) Wire size
- (2) Wire color code
- (3) Ground

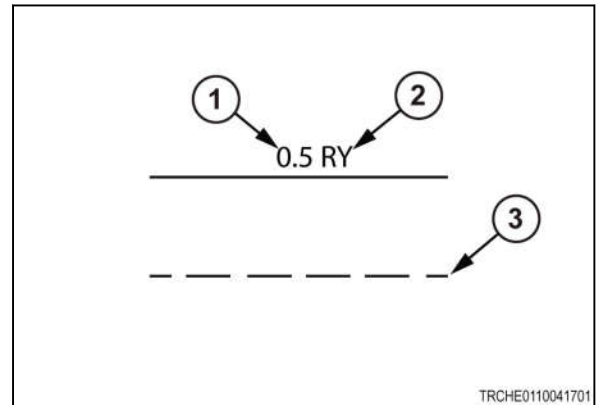


Fig. 1

Wire Color Code	Wire Color		Wire Color Code	Wire Color
W	White		YR	Yellow/Red
B	Black		WR	White/Red
R	Red		WB	White/Black
Y	Yellow		WY	White/Yellow
G	Green		WL	White/Blue
L	Blue		BR	Black/Red
Br	Brown		RY	Red/Yellow
Lg	Light green		WG	White/Green
O	Orange		YB	Yellow/Black
P	Pink		GB	Green/Black
Gr	Gray		GR	Green/Red
sB	Sky blue		GY	Green/Yellow
RW	Red/White		GW	Green/White
BY	Black/Yellow			

### 10.1.2 Wire color chart

Mark	Color	Color strip
R	Red	
B	Black	
W	White	
L	Blue	
SB	Sky blue	
G	Green	
Y	Yellow	
O	Orange	



Mark	Color	Color strip
P	Pink	
BR	Brown	
LG	Light green	
GY	Gray	
V	Violet	
W/B	White	Black
W/R	White	Red
W/L	White	Blue
W/G	White	Green
W/O	White	Orange
Y/R	Yellow	Red
Y/L	Yellow	Blue
Y/B	Yellow	Black
L/W	Blue	Red
L/B	Blue	Black
L/W	Blue	White
L/G	Blue	Green
L/Y	Blue	Yellow
G/W	Green	White
G/B	Green	Black
G/Y	Green	Yellow
R/B	Red	Black
R/G	Red	Green
R/W	Red	White
R/Y	Red	Yellow
B/R	Black	Red
B/G	Black	Green
B/W	Black	White
LG/R	Light green	Red
LG/B	Light green	Black
O/W	Orange	White

---

**10.1.3 Wiring diagram**

---

- (1) Battery
- (2) Alternator
- (3) Slow blow fuse
- (4) Starter
- (5) Starter relay
- (6) Flasher unit
- (7) Diode
- (8) Relay, tail lamp, right
- (9) Relay, tail lamp, left
- (10) Lamp switch (head, turn, hazard)
- (11) Combination lamp, left
- (12) Combination lamp, right
- (13) 12V socket
- (14) Accessory power plug
- (15) Optional work lamp
- (16) Seat switch
- (17) Fuse block
- (18) Main switch
- (19) Neutral start relay
- (20) Switch, PTO clutch lever
- (21) Switch, range gear
- (22) Instrument panel
- (23) Fuel pump
- (24) Fuel shut off solenoid
- (25) Glow plugs
- (26) Diode
- (27) Fuel level sender
- (28) Engine oil pressure
- (29) Engine coolant temperature
- (30) Headlamp, right
- (31) Headlamp, left
- (32) Engine stop relay

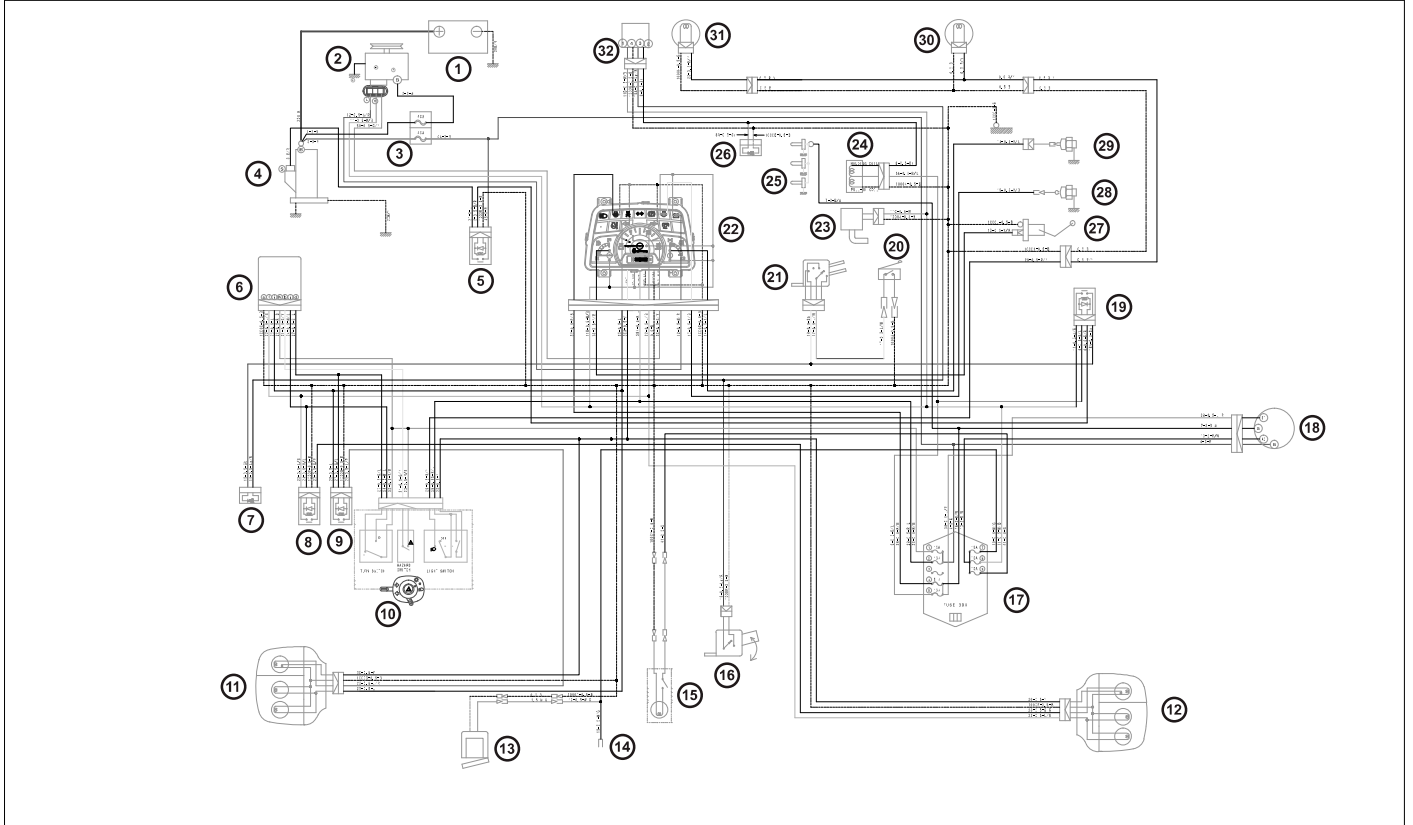


Fig. 2

## 10.2 Hydraulic schematic



---

**10.2.1 Hydraulic schematic**

---

- |                               |                              |   |  |
|-------------------------------|------------------------------|---|--|
| (1) Steering cylinder         | (7) Boom cylinder            | (13) Suction screen 80 mesh   | (17) Hydrostatic transmission relief valve (high pressure) |
| (2) Steering control unit     | (8) Slow return valve        | (14) Gear pump  | (18) Hydraulic bypass filter                               |
| (3) Three-point lift cylinder | (9) Auxiliary valve manifold | (15) Suction screen   | (19) Power take-off relief valve                           |
| (4) Bucket cylinder           | (10) Main relief valve       | (16) Hydrostatic transmission relief valve (low pressure - charge pressure) | (20) Power take-off valve                                  |
| (5) Joystick valve            | (11) Three point valve       |   | (21) Power take-off clutch                                 |
| (6) Backhoe control valve     | (12) Flow dividing valve     |   | (22) Hydrostatic transmission assembly                     |

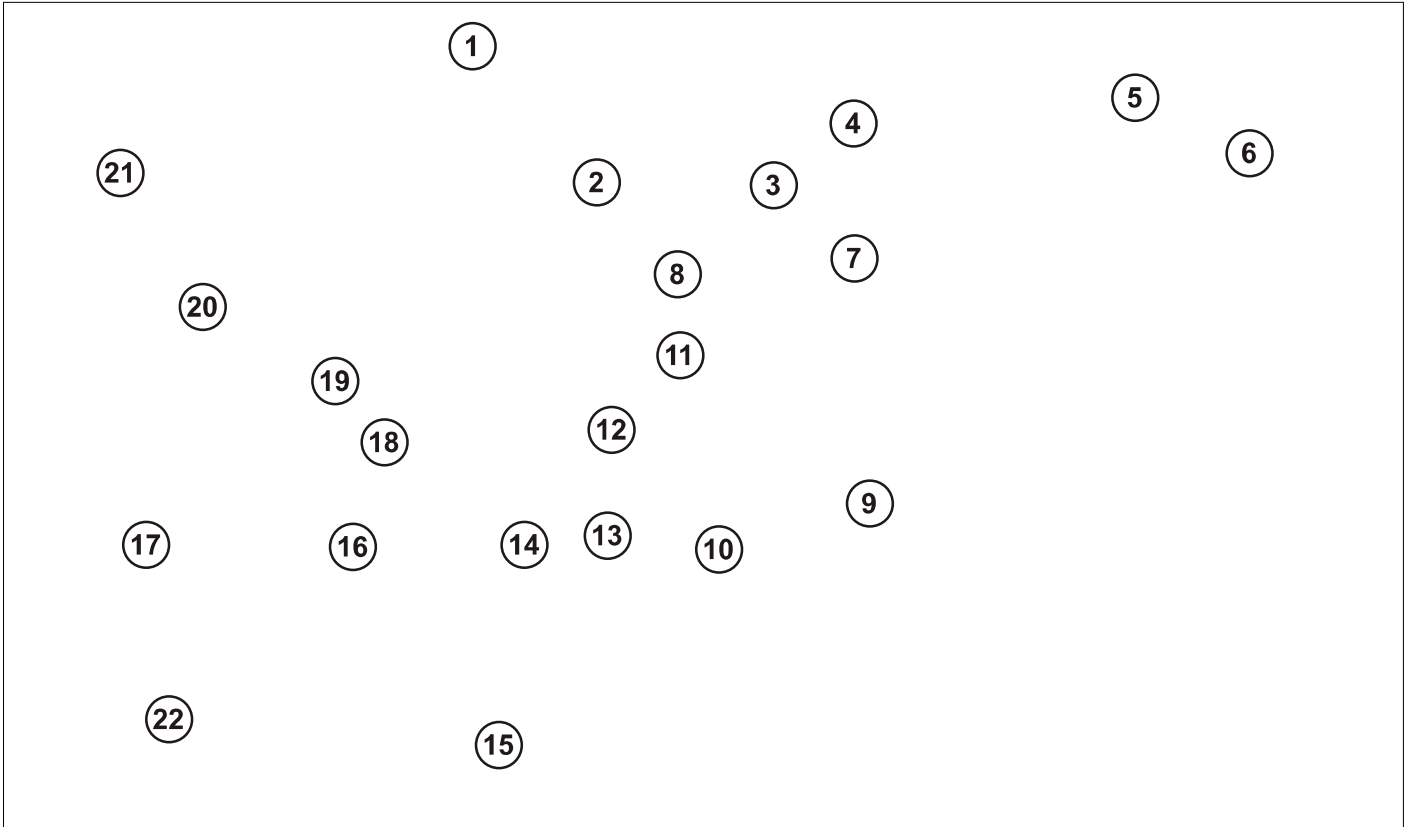


Fig. 3

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