REMINDERS

TRAINING

If you are a novice, please receive training by Shantui or its agent before operating the machine to ensure the safety of you and others.

SAFETY

Before operating the machine, please read this Operation and Maintenance Manual thoroughly first and ensure you can skillfully operate it. See Chapter 1 for details about the safety precautions.

INSPECTION

Before operating the vehicle, please check out the vehicle's conditions, climate conditions, and your surroundings. You can only operate the machine when all these conditions meet the requirements.

CAUTION

Please properly use the machine in accordance with the conditions of the construction site.

FOREWARD

The SD22 Series Bulldozers are the hydraulically transmitted bulldozers with a rated power of 162kw (220HP). Among them, SD22 is the standard machine, suitable for general earthwork operation; SD22C is for a coal handling machine with an air-conditioned driver's cab suitable for construction operation dealing with loose materials such as in power plants and harbors; SD22D is the desert model, suitable for earthwork operation on deserts and wilderness; SD22E is a crawler bulldozer with an extended length, suitable for general earthwork operation with a lower ground pressure; SD22S is the machine for wetter conditions, suitable for construction operation in areas with soft soil, wetland and swamp; and SD22R is designed for environmental protection purposes, suitable for burying, leveling and compacting landfills.

This manual provides detailed descriptions of the structures, performances, driving operation, maintenance, troubleshooting, as well as transportation and storage of the bulldozers in this series. It provides the basic knowledge for management personnel and operators to use the equipment efficiently, economically and properly.

This manual provides the rules and guidelines which will help you use this machine safely and effectively. The precautions in this manual must be followed at all times when performing operation and maintenance.

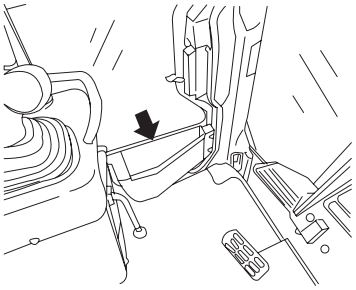
⚠ WARNING

Operators and maintenance personnel must always do as follows before beginning operation or maintenance:

- **Always be sure to read and understand this manual thoroughly before performing operation and maintenance.**
- **Read the safety messages given in this manual and the safety labels affixed to the machine thoroughly and be sure that you understand them fully.**
- **Keep this manual at the given storage location for the Operation and Maintenance Manual, and have all personnel read it periodically.**
- **If this manual has been lost or has become dirty and cannot be read, request a replacement manual immediately from Shantui or your Shantui distributor.**

If you sell the machine, be sure to give this manual to the new owners together with the machine.

LOCATION TO KEEP THE OPERATION & MAINTENANCE MANUAL:



As shown in the figure on the right, the Operation & Maintenance Manual is generally put in the magazine pockets on the right and left cab doors.

For the use, maintenance and troubleshooting of engine, apart from this manual, please also refer to the engine's operation manual for details.

All the areas regarding the safety of people and machine as well as all the important technical requirements in this manual are marked with ⚠ or ►. Please firmly remember them.

ABOUT THE WARRANTY

The warranty only covers faults caused by material or manufacturing defects, excluding other faults. Shantui is not responsible for faults or damages caused by improper use or omission, including but not limited to damages caused by operation without sufficient coolant or lubricant; excessive supply of fuel; operation above the speed limit; lack of maintenance to the cooling and lubricating systems; improper storage, start, warm-up, break-in or stop operation; unauthorized repairing of the engine; using fuels or lubricants that are not recommended for the machine or using fuels or lubricants mixed with dirty substances such as water or mud.

For faults that are really caused by material or manufacturing defects, Shantui is not responsible for collateral costs as well as all the business expenses and losses caused by the repair work.

BREAKING IN THE NEW MACHINE

Your Shantui machine has been thoroughly adjusted and tested before shipment. However, operating the machine under severe conditions at the beginning can adversely affect the performance and shorten the machine life.

Be sure to break-in the machine for the initial 100 hours.

During break-in operations, follow the precautions described below:

1. Check before starting;
2. Start the engine and let it run at idling for 5min, to let the temperature rise normally, and let the machine enter the working condition;
3. Avoid heavy-duty or high-speed operation;
4. Do not start the engine in a rush, do not accelerate sharply, and do not make an emergency brake or a sharp turn;
5. Watch the machine and make adjustment at any time, to keep the machine in the normal condition;
6. After using the machine for 250 hours, performance maintenance according to the initial 250 hours service table and the items listed below.

► The initial 250 hours service table.

► The operation hours will be indicated by the hour meter.

► When replacing the fuel filter, check if there is dirty stuff in it. If it is severely clogged, try to find out the reasons before replacement if possible.

⚠ **The disassembly and repair of the track tension must be performed under the guidance of the after-sales service personnel of Shantui (or its distributor), or damage may be caused to the track tension, resulting in danger!**

SAFETY LABELS AND WORDS

Safety labels are affixed to the machine to inform the operator or maintenance worker on the spot when carrying out operation or maintenance of the machine that may involve hazard.

The following signal words are used to inform you that there is a potential hazardous situation that may lead to personal injury or damage. In this manual and on machine labels, the following signal words are used to express the potential level of hazard.

⚠ DANGER **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

Example of safety label using words:

⚠ WARNING

When standing up from the operator's seat, always place the safety lock lever in the LOCK position. If you accidentally touch the control levers when they are not locked, this may cause a serious injury or death.

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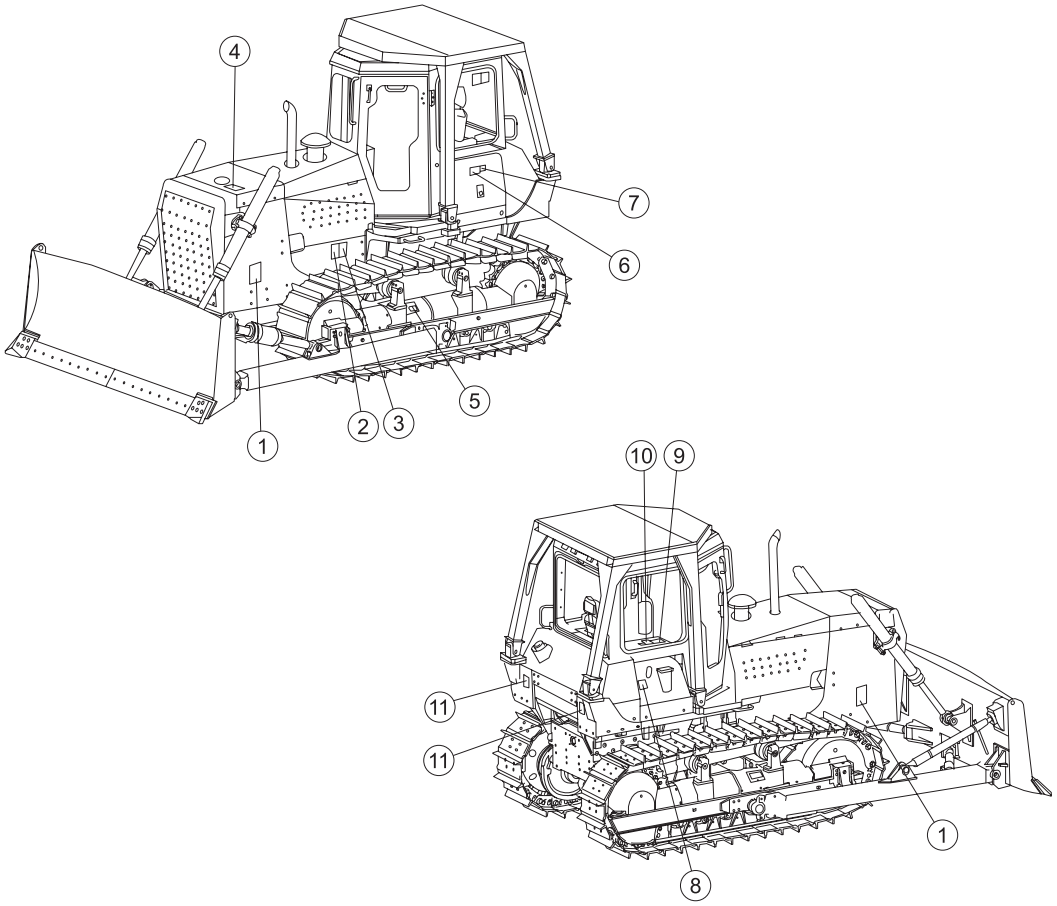
CHAPTER 1: SAFETY

1.1 SAFETY LABELS

The following warning signs and safety labels are used on this machine.

- Be sure that you fully understand the correct position and content of labels.
- To ensure that the content of labels can be read properly, be sure that they are in the correct place and always keep them clean. When cleaning them, do not use organic solvents or gasoline. These may cause the labels to peel off.
- There are also other labels in addition to the warning signs and safety labels. Handle those labels in the same way.
- If the labels are damaged, lost, or cannot be read properly, replace them with new ones. For details of the part numbers for the labels, see this manual or the actual label, and place an order with Shantui distributor.

1.1.1 POSITIONS OF SAFETY PICTOGRAMS



No.	Name	No.	Name
1	Signs (Caution: Approaching)	7	Signs (battery cable)
2	Caution: Engine is running	8	Safety and use of working oil tank
3	Sign (Caution: High temperature)	9	Caution signs
4	Signs for radiator	10	Sign (Warning: Backing)
5	Caution sign for track adjustment	11	Warning signs
6	Signs (battery)		

1.1.2 SAFETY LABELS

1. Precautions for operation, inspection, Leaving operator's seat and maintenance (09967-00200)

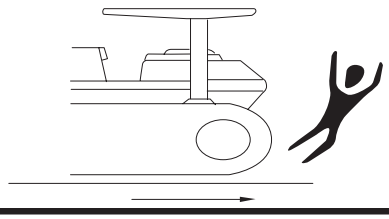
CAUTION

1. Read this manual carefully before operating the machine.
2. Before starting the engine, check if the water tank is full of cold water; and when the temperature is below 0°C, drain water or add coolant in a timely manner.
3. Before operating the machine each day, check if various oil levels meet the requirements, and drain the water from the fuel tank completely.
4. When starting or stopping the machine or leaving the operator's seat, follow the rules below:
   (1)Put the gear shift lever in the NEUTRAL position. If there is a safety mechanism, lock it with the safety lock lever.
   (2)Lock the brake.
   (3)When lowering the work equipment to the ground, set the work equipment's control lever to the LOCK position.
5. When the engine is running, follow the rules below:
   (1)Don't open the engine's side cover.
   (2)Don't get close to the fan or the fan's belt.
   (3)Make sure if the brake is reliable.
6. When you want to stop the engine, let it idle for 5min and then turn the key switch to the "OFF" position.
7. Precautions for traveling on slopes
   (1)Make sure if the brake is reliable.
   (2)The fuel should be added to the required level.
   (3)Don't step on the deceleration pedal when going up a slope (see the manual).
8. Check the engine and the parts that are easy to catch fire frequently, and clear flammable materials (e.g. twigs and leaves) accumulated, to avoid hampering operation and catching fire.
9. Precautions for repair and maintenance:
   (1)Park the bulldozer on a level ground.
   (2)When lowering the work equipment to the ground, set the work equipment's control lever to the LOCK position.
   (3)When the bulldozer is jacked up by the work equipment, don't go under the machine.
10. See the manual for lubrication points and lubrication cycles.

09967 - 00200

2. Precautions when traveling in reverse(09802-02000)

WARNING



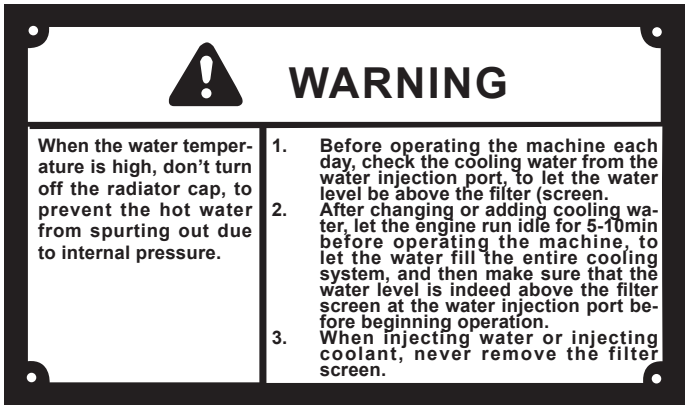
To prevents SEVERE INJULY or DEATH, do the following before moving machine or its attachments:

- Honk horn to alert people nearby.
- Be sure no one is on or near machine.
- Use apotter if view is obstructed.

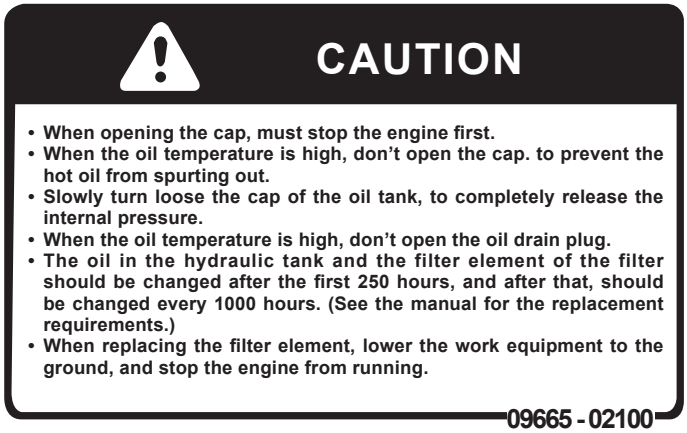
Follow above even if machine equipped with back-up alarm and mirrors.

09802- 02000

3. Precautions for high-temperature cooling water (09966-00200)

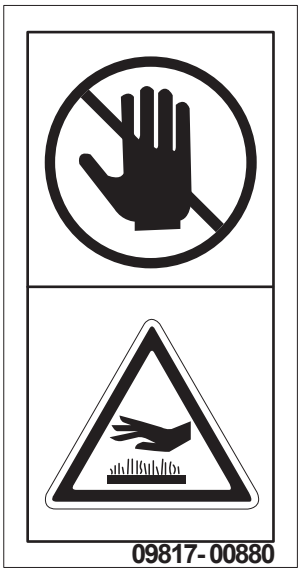


4. Precautions for high-temperature hydraulic oil (09965-02100)

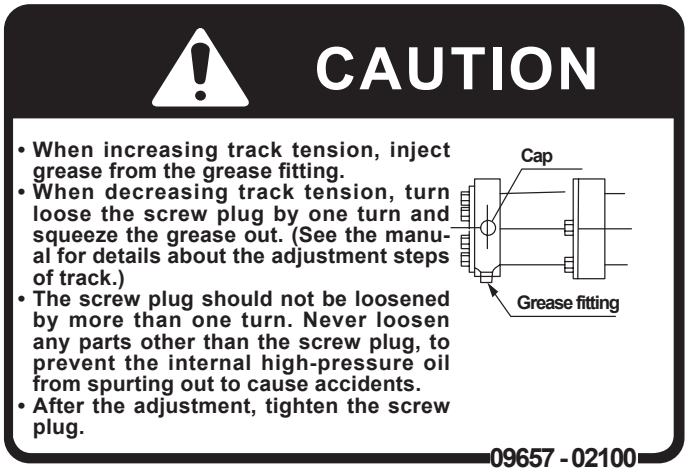


5. Caution for hot surface of engine (09817-00880)

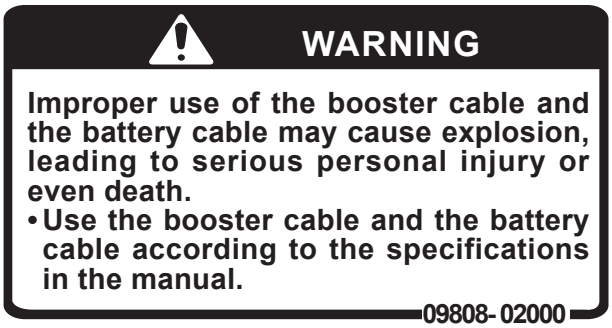
- This label indicates that touching hot parts such as a running engine, motor or muffler or one that has just run may have the risk of being scalded. Do not touch them at a high temperature.



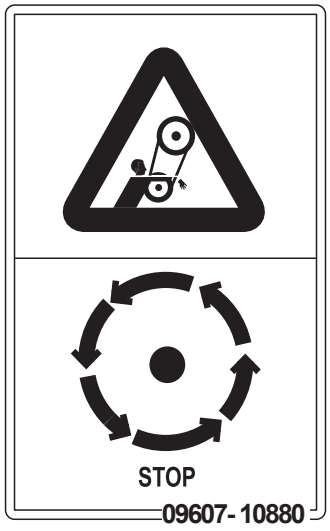
6. **Precautions for check and adjust track tension (09657-02100 is near or in the inner side of the track adjustment cover)**



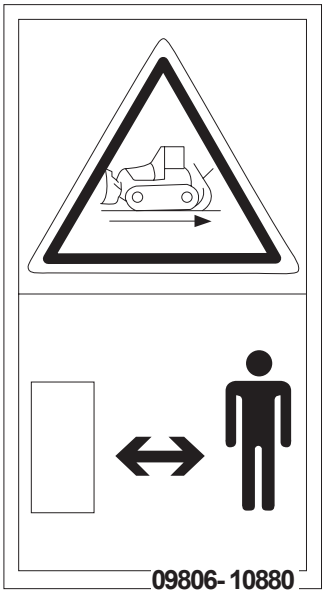
7. **Precautions for handling battery cables (09808-02000)**



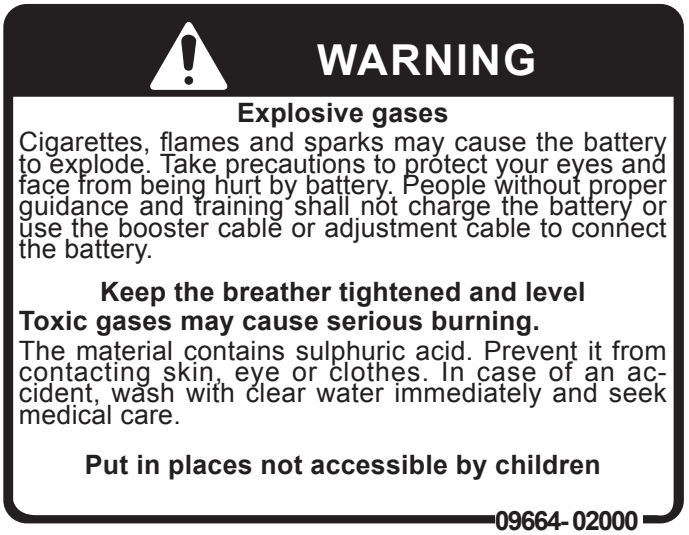
8. **Caution for engine running (09667-10880)**



9. Caution for approach when machine moving (09806-10880)



10. Precautions for handling accumulator (09664-02000)



1.2 SAFETY RULES

1.2.1 SAFETY PRINCIPLES

- Only trained and authorized personnel can operate and maintain the machine. If you are under the influence of alcohol or medication, your ability to safely operate or repair your machine may be severely impaired putting yourself and everyone else on your jobsite in danger.
- Follow all safety rules, precautions and instructions when operating or performing maintenance on the machine.
- When working with another operator or with a person on worksite traffic duty, be sure that all personnel understand all hand signals that are to be used.
- If you find any abnormality in the machine during operation or maintenance, stop the machine immediately and check it out. Do not operate the machine until the abnormality has been corrected.
- Follow all the requirements.
- This machine is suitable for use below 3000 meters above sea level. With the increase of altitude, the power will decrease. If used in a place above the required altitude for a long time, the parts may be damaged. If above this altitude, we recommend the use of Shantui's highland machines.

1.2.2 SAFETY FEATURES

- Be sure that all guards and covers are in their proper position. Have guards and covers repaired immediately if they are damaged.
- Understand the method of use of safety features and use them properly.
- Never remove any safety features. Always keep them in good operating condition.
- Improper use of safety features may cause serious personal injury or death.

1.2.3 CLOTHING AND PERSONAL PROTECTIVE ITEMS

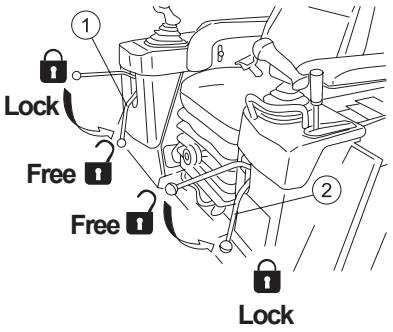
- Do not wear loose clothing and accessories. There is a hazard that they may catch on control levers or other protruding parts.
- Do not wear clothing with grease to prevent fire.
- You must wear helmets, safety glasses, masks, gloves and safety shoes when operating and maintaining the machine. If your work has contact with splashing metal chips and other fine particles, you must wear safety goggles, a hard hat and thick gloves. Especially, when you use a hammer to knock a pin or use the compressed air to clean the filter element, you must check if there are people near the machine.

1.2.4 UNAUTHORIZED MODIFICATION

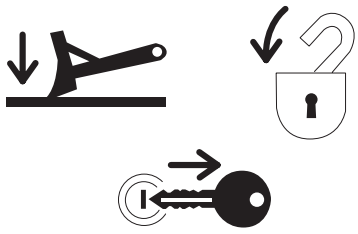
- Any modification made without authorization from Shantui can create hazards. Before making a modification, consult your Shantui distributor. Shantui will not be responsible for any injuries, accidents, or product failures resulting from modifications made without authorization from Shantui.

1.2.5 ALWAYS APPLY LOCK WHEN LEAVING OPERATOR'S SEAT

- When leaving the machine, ensure to set safety lock lever (1) and parking lever (2) securely to the LOCK position. If you accidentally touch the levers when they are not locked, there is a hazard that the machine may suddenly move and cause serious injury or property damage.

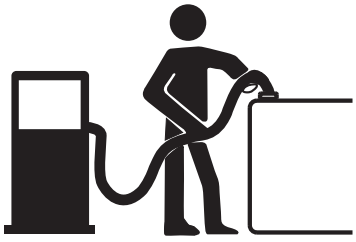


- When leaving the machine, always lower the work equipment completely to the ground, set safety lock lever to the LOCK position, then stop the engine, and use the key to lock all the equipment. Always remove the key, take it with you.

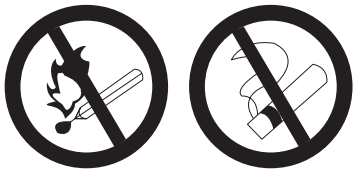


1.2.6 GETING ON OR OFF THE MACHINE

- Never jump on or off the machine. In particular, never get on or off a moving machine. This may cause serious injury.
- To ensure safety, always face the machine and maintain three-point contact (both feet and one hand, or both hands and one foot) with the handrails and steps (including the track shoe) to ensure that you support yourself.
- Do not grip the control levers when getting on or off the machine.
- Before getting on or off the machine, check the handrails and steps. If there is any oil, grease, or mud on the handrails or steps, wipe it off immediately. Repair any damage and tighten any loose bolts.

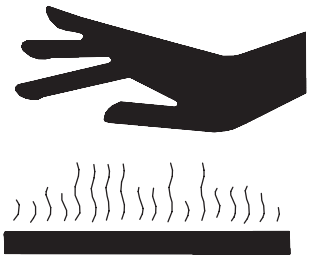


1.2.7 FIRE CAUSED BY FUEL OR OIL



- Fuel, oil, antifreeze, and window washer liquid are particularly flammable and can be hazardous.
- Keep the liquid away from flame.
- Stop the engine before refueling, and do not smoke.
- Tighten all fuel and oil caps securely.
- Use well-ventilated areas for adding or storing oil and fuel.
- Keep oil and fuel in the determined place and do not allow unauthorized persons to enter.

1.2.8 PREVENTION OF BURNS



- Immediately after the engine is stopped, the coolant is at a high temperature and the radiator is under high internal pressure. If the cap is removed to drain the coolant in this condition, there is a hazard of burns. Wait for the temperature to go down, and then turn the cap slowly to release the pressure before removing it.
- To prevent burns from hot water or hot oil spurting out, before removing the cap, you must stop the engine and let water or oil cool down, and then turn the cap slowly to release the pressure before removing it.
- (When checking after the water or oil is cooled down, you should use your hand to check the air temperature near the surface of the radiator and the hydraulic tank. Do not touch the radiator and the hydraulic tank.)

1.2.9 BE CAREFUL ABOUT ASBESTOS DUST

Asbestos dust in the air can cause lung cancer if it is inhaled. There is danger of inhaling asbestos when handling asbestos. Always observe the following:

- Do not use compressed air for cleaning.
- Spray water to keep down the dust when cleaning.
- Operate the machine from an upwind position if possible.
- Use a respirator if necessary.

1.2.10 PREVENTING INJURY FROM SQUEEZING OR CUTTING

- Do not extend or put your hands, arms or other parts of your body between moving parts (such as between the working parts and oil tanks or between vehicle body and working parts). When the machine is running, the clearance may change, leading to serious damage of parts or personal injury.

1.2.11 PRECAUTIONS WHEN USING ROPS (ROLL OVER PROTECTIVE STRUCTURE, IF ROPS ARE INSTALLED)

- If ROPS is installed, do not remove it when operating the machine.
- ROPS is installed to protect the operator when machine rolls over. When machine rolls over, ROPS supports its weight and absorbs its impact energy.
- Shantui's ROPS meets the ISO standard. If ROPS is modified without authorization, or if ROPS is deformed by falling objects or by rolling over, its strength may lower and it may no longer meet the designed functions.
- It can only play its role again when being repaired or reinstalled in the required way.
- When modifying or repairing it, consult your Shantui distributor. Even when the ROPS is installed, if you do not fasten your seat belt securely, it cannot protect you properly. Always fasten your seat belt when operating the machine.

1.2.12 PRECAUTIONS FOR OPTIONAL ATTACHMENTS

- When installing and using optional attachments, read the instruction manual for the attachment, and the general information related to attachments in this manual.
- Do not use optional attachments not authorized by Shantui or your Shantui distributor. Using unauthorized optional attachments may cause safety issues, and may also affect the normal operation and service life of the machine.
- Any injuries, accidents, or product failures resulting from the use of unauthorized attachments or parts will not be the responsibility of Shantui.

1.3 SAFETY PROCEDURES

1.3.1 BEFORE STARTING ENGINE

Safety at worksite

- Before starting operations, thoroughly check the area for any unusual conditions that could be dangerous.
- Check the terrain and condition of the ground at the worksite, and determine the safest method of operation. Do not carry out operations at places where there is a hazard of landslides or falling rocks.
- In particular, if you need to operate on a road, protect pedestrian and cars by designating a person for worksite traffic duty or by installing fences around the worksite.
- If water lines, gas lines, or high-voltage electrical lines may be buried under the worksite, contact each utility and identify their locations. Be careful not to sever or damage any of these lines.
- When traveling or operating in shallow water or on soft ground, check the shape and condition of the bedrock, and the depth and speed of flow of the water before starting operations.

Fire prevention

- Remove any dry leaves, chips, pieces of paper, dust, or any other flammable materials accumulated or affixed around the engine.
- Check if there is leakage in the fuel, lubricant and hydraulic systems, and repair any leakage. Remove any excessive oil, fuel or other flammable liquid.
- Ensure to have a reliable fire extinguisher (optional or provided by the user).
- Do not operate the machine near flame.

Inside operator’s compartment

- Do not leave parts or tools lying around the operator's compartment, to avoid them from damaging or breaking the control lever or switch. Put them in the tool box in the vehicle.
- Keep the floor of the operator’s compartment, the control lever, the pedal and the rail free of oil, grease, snow or other dirt.
- Check if the seatbelt, the buckles and the parts are damage or worn, and replace the damaged parts. You must wear the seatbelt when driving.
- Never bring any dangerous objects such as flammable or explosive items into the operator's compartment.
- Never smoke in the operator's compartment.

Ventilation for enclosed areas

- If you have to start the engine in an enclosed area, be sure to maintain sufficient ventilation. Exhaust fumes from the engine can kill.

Precautions for rearview mirrors, windows and lamps

- Clean all the windows and lamps, to ensure a clear vision.
- You should use a cleaning fluid containing aldehyde. Do not use a cleaning fluid containing form aldehyde, as it irritating to your eyes.
- Adjust the rearview mirrors, so that you can have a clear vision of the right and left side of the vehicle on when sitting your seat. You should replace them immediately if they have cracks.
- Ensure that the head lamps and the working lamps can work normally.

1.3.2 OPERATION

Precautions when starting

- Before mounting, do a walk-around check again, to ensure that there are no people or other obstacles in the surrounding area.
- You can only start the engine when you are seated.
- Do not allow anyone apart from the operator to enter the cab or other area of the vehicle.
- For a vehicle installed with a back-up alarm, ensure that the alarm can function normally.
- When starting the engine, after the key is turned to the START position, the starting time should not exceed 10 seconds. The interval between two starts should not be less than 2 minutes.

Precautions when reversing

Before operating the machine or the work equipment, do the following first:

- When starting the engine, sound the horn as a warning.
- Ensure that there are no people around the vehicle. Pay special attention to areas behind the vehicle.
- If needed, assign someone to check it out for you, especially when reversing.
- When in dangerous areas or when the visibility is very poor, assign a signalman.
- No one should be allowed to enter the travel route of the vehicle.
- You must still follow this rule if even your vehicle is installed with the back-up alarm and the rearview mirror.

Safety precautions

- Before starting the engine or operating the machine, ensure that the control lever is reliably in the NEUTRAL position.

Precautions when traveling

- When traveling on flat ground, pull the work equipment and keep its height at 40 to 50 cm above the ground.
- When traveling on rough ground, travel at low speed and do not operate the steering suddenly.
- Do not use cellular telephones inside the operator's compartment when driving or operating the machine.
- If the engine or the control lever shows abnormalities when traveling, stop the vehicle immediately and repair it.

Traveling on slops

- When traveling on steep hills, dams or slopes, the machine may tip over or slip to one side.
- When traveling on slops, keep the blade approximately 20 to 30cm above the ground. In case of emergency, quickly lower the blade to the ground to help the machine to stop.
- Do not turn on slopes or travel across slopes. Always go down to a flat place to change the position of the machine, and then travel on to the slope again.
- Do not travel on grass, fallen leaves, or wet steel plates. The machine may slip on these surfaces. When traveling on the edge of a slope, maintain a very low speed.
- When driving down a slope, lower the travel speed and use the engine as a brake.
- When the engine stops on a slope, apply the brake immediately, lower the blade to the ground, and use the parking brake.

Precautions when operating

- Do not bulldoze against wind, to prevent dust.
- When the machine is under full load, avoid sudden start, sudden turn or sudden brake.

Ensure good visibility

- When working in a dark area, use working lamps and head lamps, and set up additional lighting in the work area if necessary.
- Stop operations if the visibility is poor, such as in mist, snow, rain, or dust.

Do not let the work equipment hit anything

- When operating in tunnels, under bridges, under electric wires, or in warehouses, be extremely careful not to let the work equipment hit anything.

Working on loose ground

- Avoid traveling or operating your machine too close to the edge of cliffs, overhangs, and deep ditches. The ground may be weak in such areas. If the ground should collapse under the weight or vibration of the machine, there is a hazard that the machine may fall or tip over. Remember that the soil after heavy rain or blasting or after earthquakes is weak in these areas.
- When working on embankments or near excavated ditches, there is a hazard that the weight and vibration of the machine will cause the soil to collapse.
- When operating in a dangerous area or an area with the risk of falling objects, be sure to install the Falling Object Protective Structure (FOPS).
- When operating in an area with the risk of falling objects or in a dangerous area where the machine may tip over, be sure to install the Roll Over Protective Structure (ROPS) and seatbelt.

Do not go close to high-voltage cables

- Do not travel or operate the machine near electric cables. There is a hazard of electric shock, which may cause serious injury or property damage. On job sites where the machine may go close to electric cables, always do as follows:
- Before starting work near electric cables, inform the local power company of the work to be performed, and ask them to take the necessary action.
- Even going close to high-voltage cables can cause electric shock, which may cause serious burns or even death. Always maintain a safe distance (see the table on the right) between the machine and the electric cable. Check with the local power company about safe operating procedure before starting operations.
- To prepare for any possible emergencies, wear rubber shoes and gloves. Lay a rubber sheet on top of the seat, and be careful not to touch the chassis with any exposed part of your body. Use a signalman to give warning if the machine approaches too close to the electric cables. When carrying out operations near high voltage cables, do not let anyone come close to the machine. If the machine should come too close or touch the electric cable, to prevent electric shock, the operator should not leave the operator's compartment until it has been confirmed that the electricity has been shut off. Also, do not let anyone come close to the machine.

Voltage of Cables	Safe distance
100V-200V	Over 2 m
6600V	Over 2 m
22000V	Over 3 m
66000V	Over 4 m
154000V	Over 5 m
187000V	Over 6 m
275000V	Over 7 m
500000V	Over 11 m

Parking machine

- When leaving the machine, lower the work equipment to the ground, set the safety lock lever to the LOCK position, stop the engine, and use the key to lock all the equipment.
- Always remove the key and take it with you.

1.3.3 TRANSPORTATION

Loading and unloading

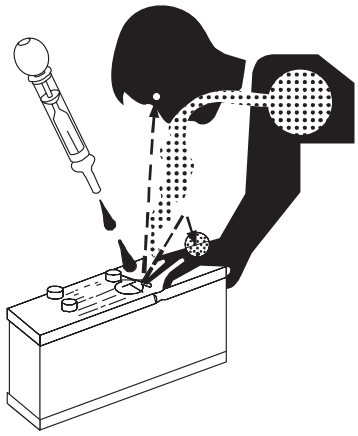
- There are always potential risks in loading or unloading the machine, so be especially careful. When loading and unloading the machine, the engine should run at a low speed and the machine should also travel at a low speed.
- Load and unload the machine on a flat firm roadbed, and keep a safe distance from the edge of the road.
- Before loading and unloading, be sure to insert cushion blocks beneath the trailer's tires and ramp.
- Make sure the ramp has sufficient width, length and thickness to enable the machine to be safely loaded and unloaded.
- Make sure the ramp is stably placed and secured, and the two ramps are on the same plane.
- Be sure the ramp surface is clean and free of grease, oil, ice and loose materials. Remove the mud from the track of the machine.
- Never change the direction of travel when on the ramps. If it is necessary to change direction, drive off the ramps and correct the direction, and then drive on to the ramps again.
- After loading, use blocks to stop the track, and enable the machine to remain in place reliably.

Shipping

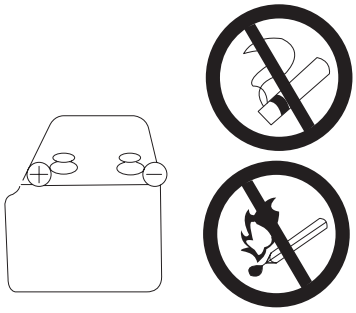
- When shipping the machine on a trailer, be sure to follow the rules of different countries and regions about the weight, transportation height, and overall length of the machine, and to abide by all the applicable laws.
- When determining the shipping route, take into consideration the length, the width and the height of the goods, to prevent them from exceeding the limits.

1.3.4 BATTERY

- Battery electrolyte contains sulphuric acid, and once spilled, it may quickly burn your skin and clothes. If you spill acid on your clothes, immediately flush the area with large amount of water.
- If acid gets into your eyes (you may become blind from this), flush them immediately with large amount of water and seek medical attention.
- If you accidently swallow the acid, immediately drink large amount of water or milk or egg or canola oil and seek medical attention.

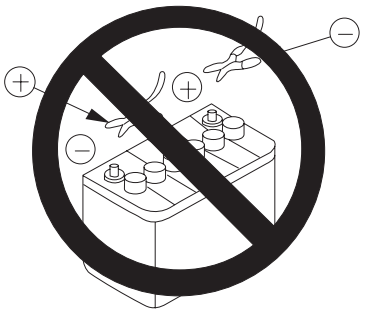


- When working with batteries, always wear safety glasses or goggles.
- The battery generates hydrogen gas, so there is danger of explosion. Do not bring lighted cigarettes near the battery or do anything that will cause sparks.
- When checking or handling the battery, stop the engine and turn the starting key to the OFF position before starting.
- Check the positive and negative terminals carefully when removing or installing the battery.
- Tighten the battery caps securely.

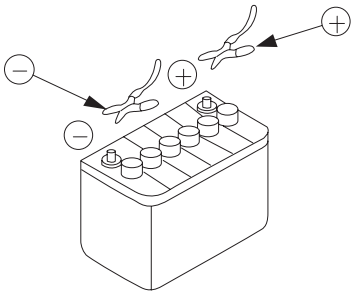


- Tighten the battery terminals securely. If the terminals are loose, there is danger that the defective contact may generate sparks that will cause an explosion.

► **Starting with booster cable**



- Always wear safety goggles when starting the engine with booster cables.
- When starting from another machine, do not allow the two machines to touch.
- When connecting booster cables, turn the start switch of the normal machine and the fault machine to OFF, or when power on, the machines may move.



- Be sure to connect the positive cable first when installing the booster cables. Disconnect the negative cable first when removing them.
- Note: Do not let the booster cable clamps contact each other or let the cable clamps contact the machine, as this may produce sparks, which are very dangerous. Therefore, be sure to operate carefully.
- When connection two batteries in parallel, connect the positive terminal to the positive terminal, and connect the negative terminal to the negative terminal.
- When connecting a ground cable to the chassis of a machine to be started, ensure that the connection is secure.

1.3.5 TOWING

► **When towing, fit the wire to the drawbar pin**

- Injury or death could result or the machine could be damaged if a disabled machine is towed incorrectly.
- When your machine is towed by another machine, ALWAYS use a wire rope with a sufficient towing capacity.
- Towing on slopes is prohibited.
- Do not use a broken, kinked or frayed wire rope.
- Do not straddle the towing cable or wire rope.
- When connecting up a towing machine, do not let anyone enter the area between the towing machine and the equipment being towed.
- Set the towing machine and the towing connection of the equipment being towed in a straight line when connecting it, and ensure they are in the correct position.

1.3.6 BEFORE CARRYING OUT MAINTENANCE

Proper tools

- Use only tools suited to the task and be sure to use the tools correctly. Using damaged, low quality, faulty, make-shift tools or improper use of the tools could cause serious personal injury.

Periodic replacement of safety critical parts

- Periodically replace the following parts that are easy to age. Fuel system: fuel inlet hose and fuel return hose. Hydraulic system: pump output hose and fuel pump's front and back manifolds.
- The above parts must be periodically replaced even if it looks that they are not damaged, because they will age over time.
- Replace or repair safety-critical parts if any defect is found, even when they have not reached the time specified interval.

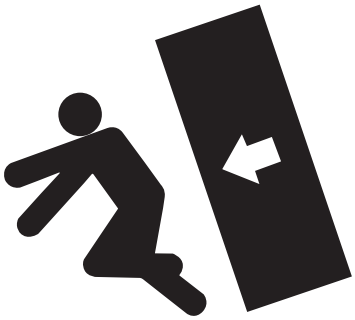
Stop engine before carrying out inspention and maintenance

- Stop the machine on flat hard ground when carrying out inspection and maintenance. Turn off the engine and take out the key before performing inspection and maintenance. Or, others may start the engine or operate the control levers when you are performing maintenance or lubrication,
- so that you could suffer injury.
- If maintenance must be carried out with the engine running, such as cleaning the inside of the radiator, place the parking lever and safety lock lever at the LOCK position to prevent the work equipment from moving and carry out the operation with two workers: One worker must always sit in the operator's seat and be ready to stop the engine at any time. This worker must be very careful, to avoid mistakenly touch any control levers to injure the other worker who is performing maintenance.
- The worker who is performing maintenance must be very careful, to avoid touching moving parts or being caught by them.

1.3.7 DURING MAINTENANCE

Personnal

- Only authorized personnel can service and repair the machine. Take precautions when grinding, cutting, welding or using a hammer.



Attachments

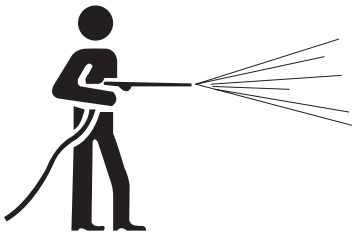
- Place attachments that have been removed from the machine in a stable condition so that they do not fall. And take steps to prevent unauthorized persons from entering the storage area.

Work under the machine

- Before performing maintenance or working under the machine, lower the work equipment to the ground or to the lowest position.
- Working under a machine that is not supported is prohibited.

Keep machine clean

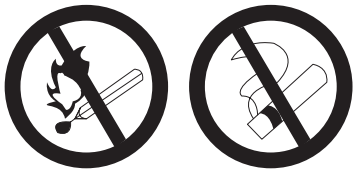
- Always keep the machine clean. If inspection and maintenance is carried out when the machine is still dirty with mud or oil, there is a hazard that you will slip and fall, or that dirt or mud will get into your eyes.
- Do not use water or steam to wash sensors, connectors or the interior of the cab. If water gets into the electrical system, there is a hazard that it will cause malfunctions or miss-operation.



Principles for adding fuel and oil

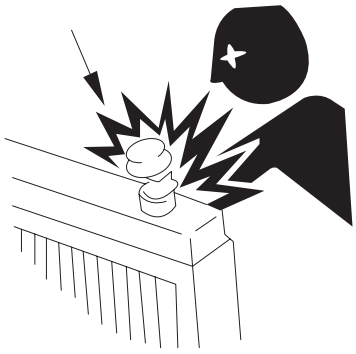
- After adding fuel or oil, wipe up any spilled fuel or oil, to prevent people from slipping and falling.
- Tighten all fuel and oil caps securely.
- Do not use fuel to wash parts.
- Use well-ventilated areas for adding oil and fuel.

- The models and types of oil and water used by the machine depend on the working environment and temperature. Follow the table of the “SELECTION OF FUEL, COOLANT AND LUBRICANTS”.
- Never use methanol, methanol or ethanol based antifreeze, to avoid engine from having faults. Antifreeze is flammable, so do not bring any flame close.
- Use “soft water” for cooling water if possible. Never use waste water for cooling water. Never add any leak preventive to the cooling water.
- Be sure to clean or replace various filters at required intervals.
- Check cooling water, fuel, lubricant and oil from time to time, and replenish them as required, to ensure the normal use of the machine.



Radiator coolant level

- When checking the cooling water level, check the sub-tank when the engine is cold.
- After the water temperature goes down, turn the cap slowly to release the pressure, and then remove it.



Lighting

- When checking fuel, oil, coolant or battery electrolyte, always use lighting with anti-explosion specifications. If such lighting equipment is not used, there is danger of explosion that may cause serious injury.

Precautions for maintenance battery

- When repairing the electrical system or when carrying out electrical welding, remove the negative terminal of the battery to prevent the flow of current.

Handling high-pressure hoses

- Do not bend or knock high-pressure hoses with a hard object. Do not use bent or cracked hoses or hard pipes, or there is a risk of burst during use.
- Be sure to repair loose or broken oil pipes. Oil leakage may cause fire.

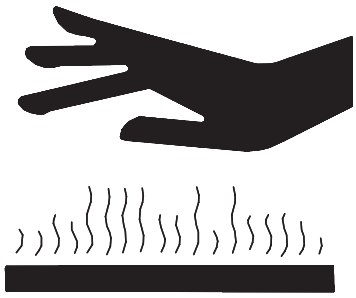
Precaution with high-pressure oil

- The hydraulic system is always under internal pressure.
- Do not carry out inspection or replacement work when the hydraulic system is under pressure.
- There is a hazard that high-pressure oil leaking from small holes may penetrate your skin or cause blindness if it contacts your eyes directly. When carry out inspection, wear safety glasses and leather gloves.

- If you are hit by a jet of high-pressure oil and suffer injury to your skin or eyes, wash the place with clean water, and consult a doctor immediately for medical attention.

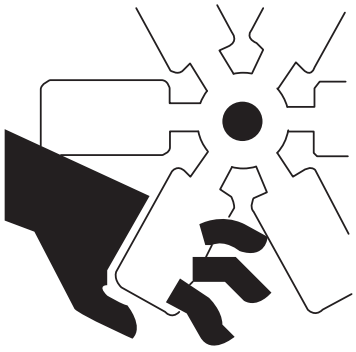
Precautions for maintenance under high-temperature or high-pressure

- When just stopped, the engine's cooling water and the oil in various parts are still under a high temperature and high pressure. If you remove the cap, drain the oil or water, or replace the filters in this situation, you may suffer burns or other injuries. Wait for the temperature to go down before performing inspection and maintenance according to the steps in this manual.



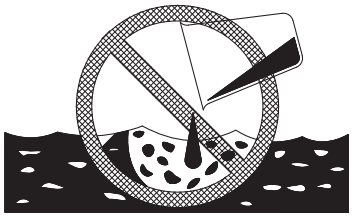
Rotating fans and belts

- Do not get close to rotating parts, to avoid being caught by them.
- If your body or a tool touches the blades of a fan, they may be cut or hit away, so don't touch any rotating parts.



Waste material

- Never drain oil directly onto the ground or dump into the sewage system or rivers.
- Always put oil drained from your machine in containers, not directly onto the ground.
- Obey appropriate laws and regulations when disposing of harmful objects such as oil, fuel, coolant, solvent, filters, and batteries and other toxic (harmful) substances.



Note paper

CHAPTER 2: OPERATION

2.1 CONTROLS

2.1.1 GENERAL VIEW OF CONTROLS (FIGURE 2-1)

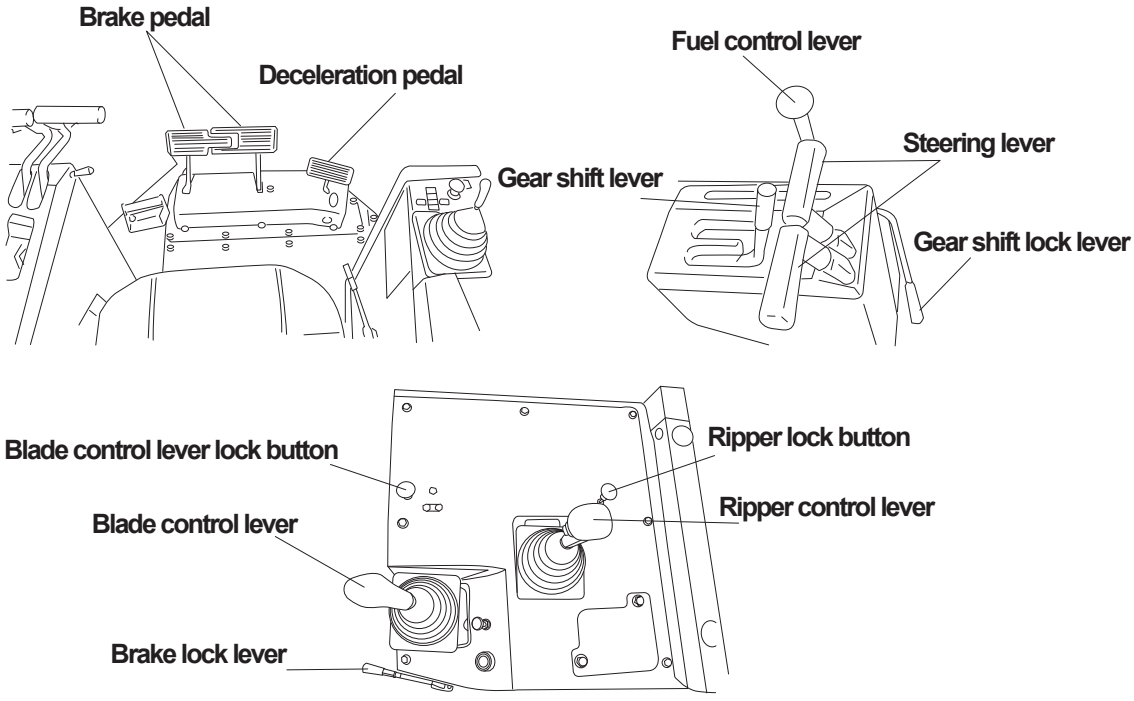


Figure 2-1

2.1.2 ROLES OF VARIOUS CONTROLS (FIGURE 2-2)

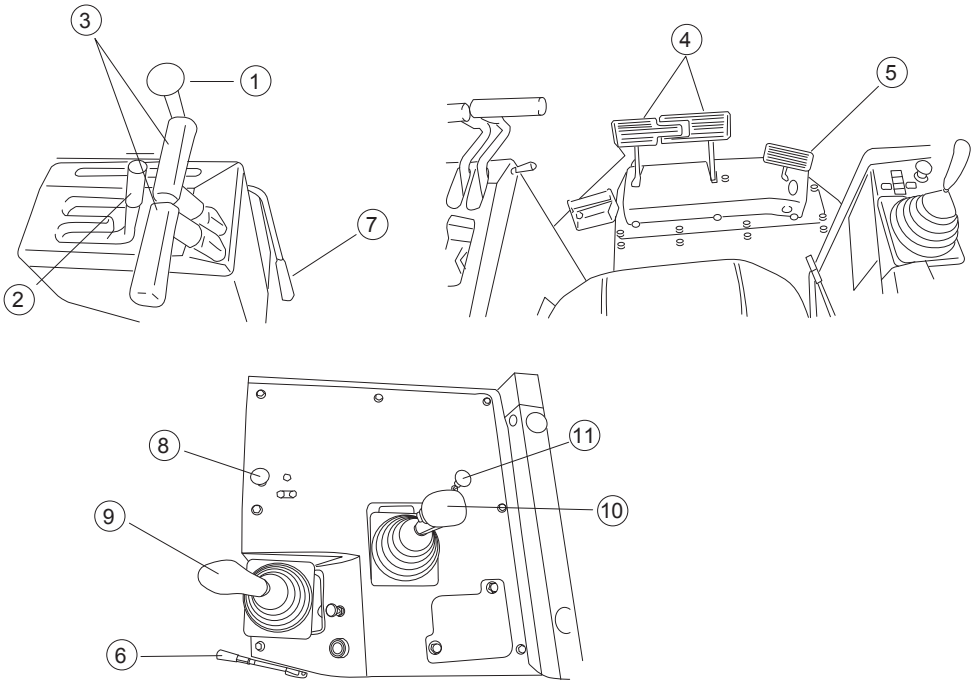


Figure 2-2

Fuel control lever (1) (Figure 2-3)
This control lever is used to control the engine speed and output.
(L) The Low idling position
(H) The High speed position

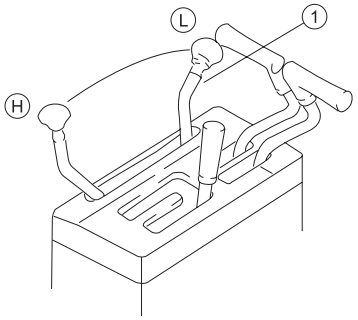


Figure 2-3

The gear shift lever (2) (Figure 2-4)
There are three forward gears and three reverse gears. The gear shift lever can be easily shifted, so that you can easily get the speed you want.
(F: Forward; R: Reverse; and N: Neutral)

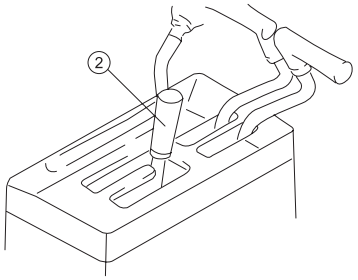


Figure 2-4

The steering lever (3) (Figure 2-5)
When the steering lever on one side is pulled to the middle position, the vehicle will slowly make a big turn to this side, and when the lever continues to be pulled to the end, the vehicle will make a turn on the original position.

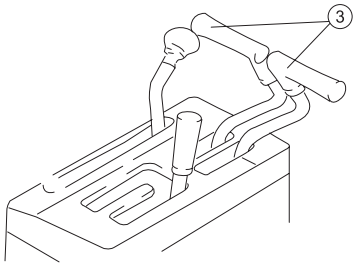


Figure 2-5

The brake pedal (4) (Figure 2-6)
If you step down the two pedals in the middle, both the left side and the right side will brake. Pull the steering lever on one side to the middle position, and simultaneously step down the brake pedal on the same side, the vehicle will make a turn on the original position to the same side.

⚠ CAUTION

Do not place your foot on this pedal unnecessarily.

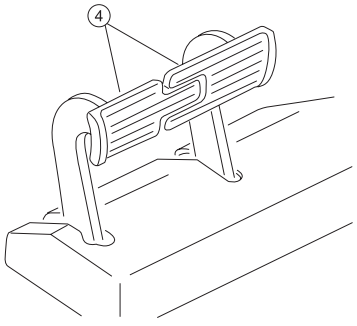


Figure 2-6

Deceleration pedal (5) (Figure 2-7)
This pedal is used to reduce the engine speed.

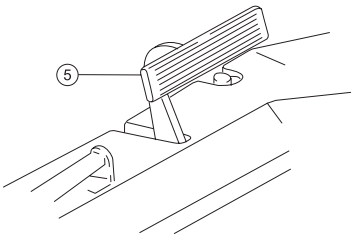


Figure 2-7

⚠ CAUTION

When passing over the top of a hill or when a load is dumped over a cliff, the load is suddenly reduced, so there is danger that the travel speed will also increase suddenly. To prevent this, depress the decelerator pedal to reduce the travel speed.

Brake lock lever (6) (Figure 2-8)
This device is used to lock the brake pedal when parking. Depress the brake pedal, and push the lock lever to the LOCK position, the brake will be locked. Depress the brake pedal, and push the lock lever to the FREE position, the brake will be released.

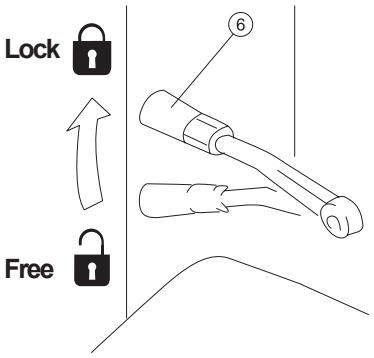


Figure 2-8

⚠ CAUTION

- **No matter when and where the machine is parked, the brake pedal must be locked.**
- **Using the brake lock lever to lock the brake pedal to stop the bulldozer must be performed when the engine is running. This is because when the engine stops running, the hydraulic brake booster is in the non-working state, so that braking force will be reduced. Be especially careful that parking on a slope is very dangerous, so you must operate this locking mechanism when the engine is running.**

The gear shift's lock lever (7) (Figure 2-9)
This device is used to lock the gear shift when parking.

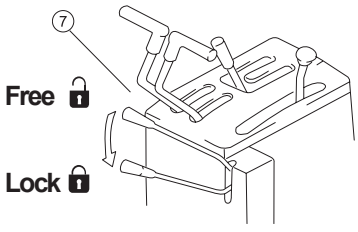


Figure 2-9

⚠ CAUTION

When the vehicle is stopped for a while, you must push the gear shift lever to the NEUTRAL position, and push the lock lever to the LOCK position.

Blade control lever lock button (8) (Figure 2-10)
Press the button, the blade control lever is locked; pull out the button, the blade control lever is free.

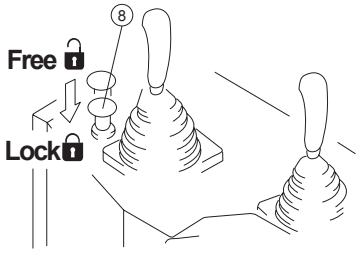


Figure 2-10

⚠ CAUTION

When the vehicle is parked or during troubleshooting, the blade should be put down, and the lock button should be put to the LOCK position.

Blade control lever (9) (Figure 2-11)
The control lever is normally in the fixed position (2), Pull the control lever to position (1), the blade is raised (Figure 2-12); and push it to position (3), the blade is lowered; continue to push it to position (4), the blade is in the floating state.

► When the control lever is in position (4), it cannot be automatically bounced back to the fixed position (2), and must be manually pulled back. When operating the straight tilt blade, the control lever is pulled to position (A), and the blade is tilted to the right; when it is pulled to position (B), the blade is tilted to the left. (Figures 2-11 and 2-13)

► The blade can tilt when it is in any position between (1) and (3);

► Positions (A) and (B) are used for straight tilt blade only;

► When the tilt cylinder reaches the end of its journey, the control lever should be immediately pulled to fixed position (2);

► When the blade is at the highest point or the lowest point, do not tilt the blade.

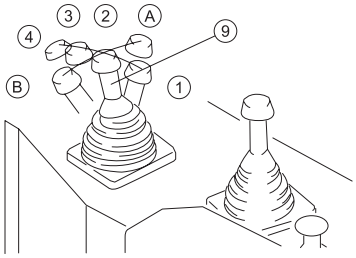


Figure 2-11

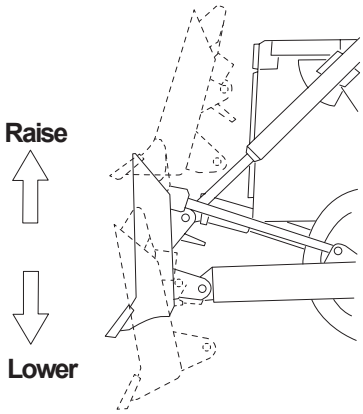


Figure 2-12

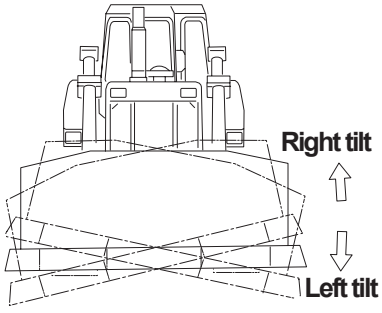


Figure 2-13

The ripper control lever (10) (Figure 2-14)

The control lever is normally in the fixed position (2). When the control lever is pulled to position (1), the ripper is raised (Figure 2-15a); and when it is pulled to position (3), the ripper is lowered.

Press the button in the center of the control lever to move the control lever to location (1), and the cutting angle of the ripper will become smaller (Figure 2-15b); if it is moved to location (3), the cutting angle of the ripper will become bigger.

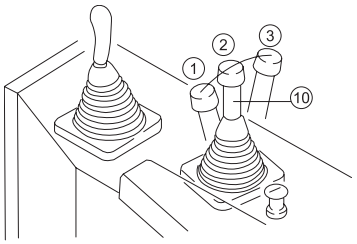


Figure 2-14

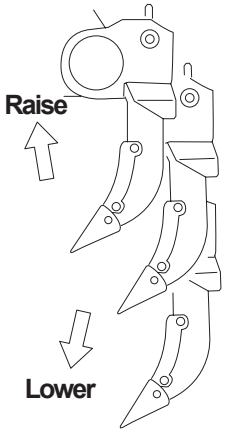


Figure 2-15a

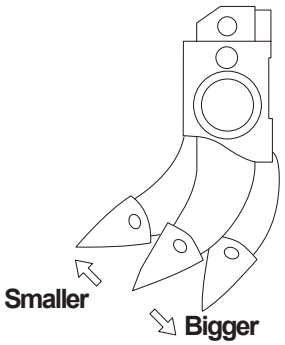


Figure 2-15b

The ripper lock button (11) (Figure 2-16)

Press the button, the ripper control lever is locked; pull out the button, the ripper control lever is free and can go up and down.

⚠ CAUTION

When the vehicle is parked or during troubleshooting, the ripper must be put down, and the lock button be put to the LOCK position.

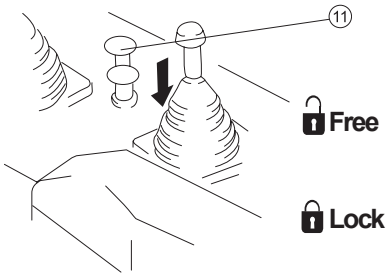


Figure 2-16

2.1.3 OTHER DEVICES

Adjusting operator's seat (Figure 2-17)

Fore-and-aft adjustment: Pull lever "(1)" , set the seat to a position where it is easy to operate, and then release the lever.
Height adjustment of seat: Pull up knob "(2)" with both hands to raise the seat. There is one knob "(2)" on left and right each in symmetry.

Adjust reclining angle: Pull up lever "(4)", set the seatback to a position where it is easy to operate, and then release the lever.
Adjust the softness of seat: Turn knob (3) clockwise, to make the seat harder; and turn it counterclockwise, to make the seat softer. You can adjust the seat to the most comfortable state based on your weight.

Figure 2-17

Seat belt (Figure 2-18)

Fasten the belt using the following methods.

1. Adjust the seat by following the above steps.
2. After adjusting the seat position, adjust tether belt (1). Tense the tether belt and install it when there is no one sitting on the seat.
3. Sit on the seat and hold the buckle (2), insert the tongue (3) in the buckle (2), and pull out the belt slowly so that the belt will cover your abdomen sufficiently.

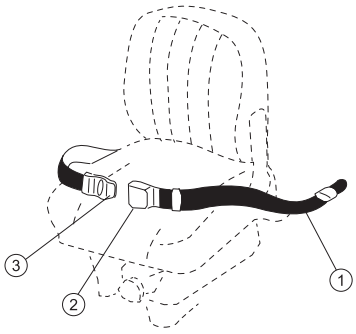


Figure 2-18

⚠ CAUTION

- **Before fastening the seat belt, inspect the securing brackets and belt for abnormal conditions.**
- **Inspect the belt for twisting.**

► Fasten the belt along your body, but don't wind the belt around your body. Belt length can be adjusted on both ends—the tongue end and the buckle end. The buckle should be right in front of your body.

Adjust belt length using the following methods. (Figure 2-19)

- In order to shorten the belt, you can pull any of the free ends of the belt—the buckle end or the tongue end.
- To increase the length, put the belt in right angle with the buckle or the tongue, and pull the belt.

4. When removing the belt, raise the cusp of the buckle lever and loosen the belt.
5. When operating a machine equipped with ROPS, be sure to use the seat belt.

► Check the bolts and fasteners on the chassis and re-tighten if necessary, to ensure that the tightening torque reaches 2-3kgm.

► If the seat belt is scratched or frayed, if any fittings are broken or deformed from long service, replace the seat belt immediately.

► The shock absorption ability of the seat meets the ISO7096 standard.

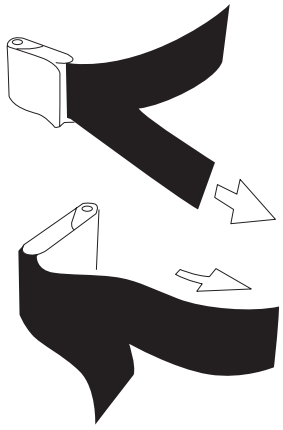


Figure 2-19

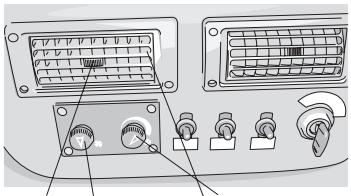


Figure 2-20

The use of the air conditioner (Figure 2-20, Figure 2-21, and Figure 2-22)

► When there are air bubbles in the window of the liquid container, or when the cooling effect is not very obvious, ask a specialised maintenance person to fix it.

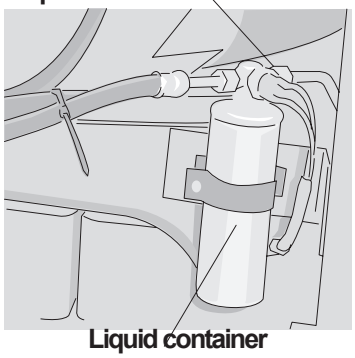


Figure 2-21

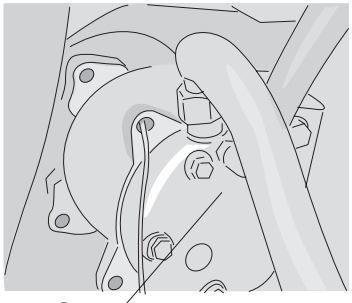


Figure 2-22

The use of the air conditioner's fresh air ventilator (Figure 2-23)

In order to keep the air in the closed space clean, the air conditioner's fresh air ventilator is provided.

► When the fresh air effect is not obvious after long-time use, please replace the internal filter of the fresh air ventilator.

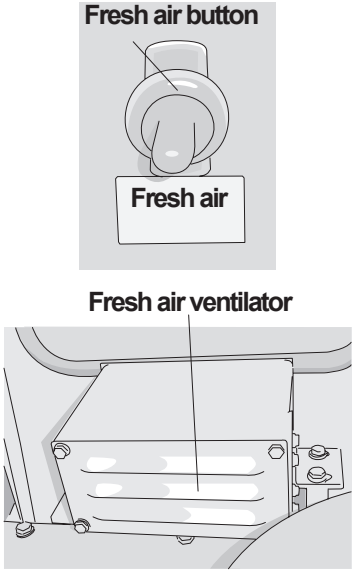


Figure 2-23

Front and rear window defroster

Front window defroster (Figure 2-24)

Front window defroster uses the warm air from the A/C to heat the front window, so as to achieve the purpose of defrosting.

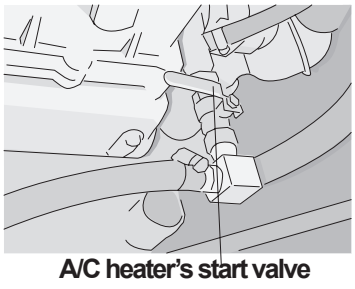


Figure 2-24

Rear window defroster (Figure 2-25)

Rear window defroster uses the resistance wire on the rear window to heat the window after being charged with electricity, so as to achieve the purpose of defrosting.

Figure 2-25

When there is dust on the front or the rear window obstructing your view, use the windshield wiper along with the windshield washer to clean them. (Figure 2-26)

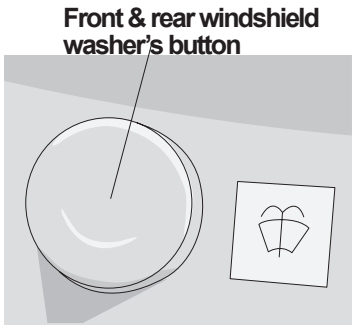


Figure 2-26

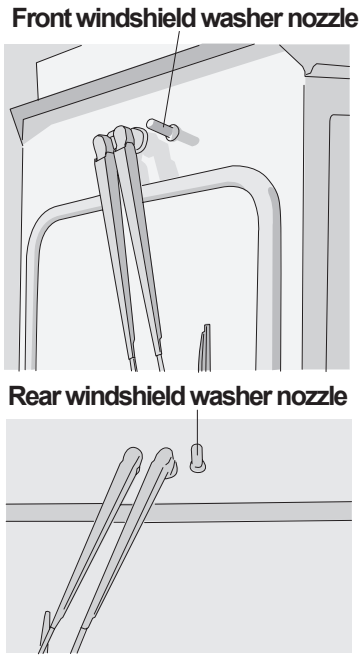


Figure 2-26

⚠ **Frequently check the liquid level of the windshield washer tank, which is located within the battery cover on the left side of the vehicle. (Figure 2-27)**

► If the liquid level of the windshield washer tank is too low, add some windshield washer. Loosen the screw on the back of the windshield washer tank, pull it out from the bottom, and add the windshield washer from the mouth.

⚠ **When the temperature is too low, be careful to prevent the liquid from freezing.**

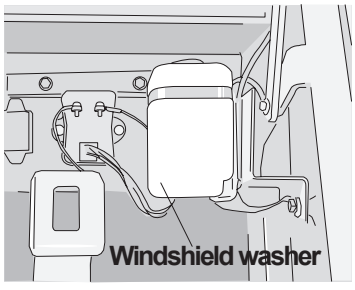
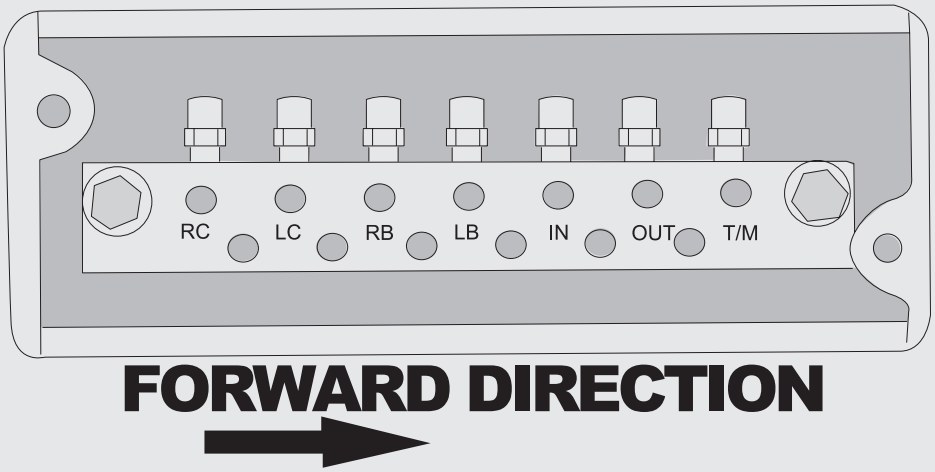


Figure 2-27

The centralized pressure measurement system (Figure 2-28)

To facilitate routine maintenance and troubleshooting, the centralized pressure measurement system is designed. The pressure detection of all the seven key points of the entire vehicle is concentrated on a pressure measurement plate (located on the right side of the floor frame).



RC	LC	RB	LB	IN	OUT	T/M
Right steering pressure	Left steering pressure	Left brake pressure	Right brake pressure	Pressure at torque converter's inlet	Pressure at torque converter's outlet	Transmission case's set pressure

Figure 2-28

► The pressure measurement conditions and normal values of various pressure-measuring points:

No.	Items to be checked	Detection conditions		Detection locations and methods		Technical requirements (normal values) Unit: Mpa
1	Torque converter	Oil temperature of torque converter when engine is running: 75±5°C	Low speed	"OUT" Port		0.2~0.3
			High speed			0.46±0.15
			High speed	"IN" Port		0.85+0.2
2	Transmis-sion case	Oil temperature of transmission case when engine is running: 75±5°C	Low speed	"T/M" Port		2.25±0.2
			High speed			2.4±0.25
3	Steering clutch	Oil temperature of steering clutch when engine is running: 75±5°C		Left	"LC" Port	1.6+0.3
				Right	"RC" Port	
4	Brake	Oil temperature of brake when engine is running: 75±5°C		Left	"LB" Port	2.0+0.25
				Right	"RB" Port	
5	Steering baking pressure	Oil temperature of steering clutch and brake when engine is running: 75±5°C		Left	"LC" Port	When brake's oil pres-sure changes from 0, measure the pressure of the steering clutch: 1.08~1.35
					"LB" Port	
				Right	"RC" Port	
					"RB" Port	

Noise

When carrying out maintenance of the engine and you are exposed to noise for long periods of time, wear ear covers or ear plugs while working. If the noise from the machine is too loud, it may cause temporary or permanent hearing problems.

2.2 THE ELECTRIC SYSTEM (WITHOUT GPS)

Functions of the combination meter (Figure 2-29)

The combination meter mainly includes engine oil pressure gauge, the water temperature gauge, the oil temperature gauge, the voltmeter, and the hour meter.

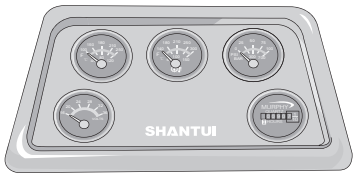


Figure 2-29

The engine oil pressure gauge (See Figure 2-30)

The range of the engine oil pressure gauge is 0KPa-700KPa. When the engine runs at a low speed, the oil pressure should be bigger than 100KPa, and when the engine runs normally, the oil pressure should be between 250KPa and 550KPa. During cold start, the pressure is sometimes higher, so you should warm-up the engine first to bring the readings of the meters within the normal operating range before starting operation.

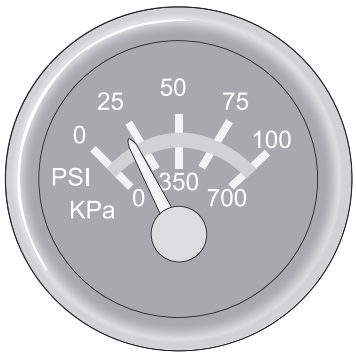


Figure 2-30

The voltmeter (See Figure 2-31)

The range of the voltmeter is 16-36V. Before the normal operation, the reading of the voltmeter is over 24V, indicating that the battery's voltage is normal; if the reading is below 24V, it means that the battery's voltage is too low and may make it difficult to start the vehicle. If you cannot start the engine, charge the battery.

When the machine is running normally, the engine charges the battery, and the voltmeter's reading is around 28V. If the voltage is too low or too high, find out the reason and eliminate the problem before operation.

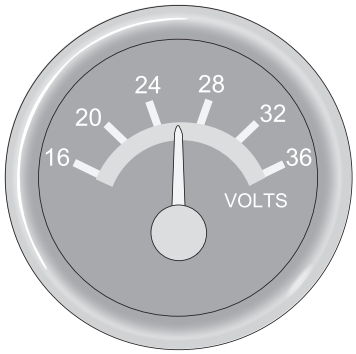


Figure 2-31

The water temperature gauge (See Figure 2-32)

The range of the water temperature gauge is 40-120°C, indicating the engine's water temperature. When the machine runs normally, the reading of the water temperature gauge is 40-100°C. If the temperature is too high and above 100°C, reduce the engine speed, to bring the reading back to the normal range; stop the vehicle to check the water level if necessary.

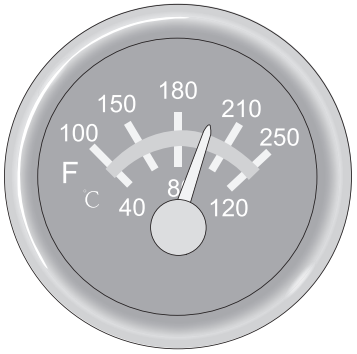


Figure 2-32

The oil temperature gauge (See Figure 2-33)

This indicates the oil temperature of the hydraulic torque converter, and the normal operating range is 60°C-120°C. During operation, if the temperature is too high and above 120°C, reduce the load, to bring the reading back to the normal range.

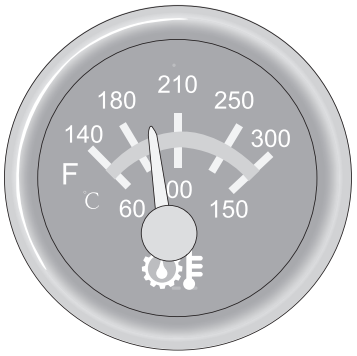


Figure 2-33

The hour meter (See Figure 2-34)

This meter records the operation time of the engine, to be used as the basis for regular maintenance.

⚠ CAUTION

Check the instruments from time to time during operation, to ensure that the operation is normal.

Figure 2-34

2.3 THE ELECTRIC SYSTEM (WITH GPS)

The bulldozer's GPS electric system mainly includes the temperature sensor, the pressure sensor, the fuel level sensor, the smart unit for signal collection & conversion, and the LCD smart monitor, and the GPS smart service terminal etc. The sensors are installed in various working parts of the bulldozer, to collect working parameters in real time, and to transmit the data through LAN; various smart units can use each other's data and share the same ports, to carry out various safety protection and strategic actions.

Note: If the product pictures in this manual are different from the actual products, the actual products should be based on, and the pictures in this manual are for reference only.

This section aims to provide instructions for users to realize safe and efficient operation as well as the effective maintenance of the vehicle's electric system. Understanding the various precautions as well as the repair & troubleshooting instructions can help effectively avoid various dangerous accidents.

⚠ WARNING

- **Before operating or maintaining and troubleshooting the electric system, you must read this section thoroughly.**
- **The meters are precision instruments, and in the installation process you should handle them gently. You cannot directly wash the instruments and any part of the entire electric system with water.**
- **The negative pole's wire of the meters and the earth wire's calibration wire should be separately connected to the main switch end of the power supply or be connected to the ground through a reliable nearby bond strap; never connect them together with other equipment to the battery's negative pole using the same wire.**
- **The connection of all the signal lines of meters (switch value and analog value) should be reliable and firm.**
- **The four screws connecting the dashboard and the instrument box should be tightened to ensure the normal use of the meters.**
- **The installation of all the sensors should ensure that the sensor's outer threads and their surface are connected properly, to ensure that the sensor's bond strap is in good condition. (We don't recommend the use of sealant on the mounting face)**
- **Before the installation of cables, the installation points of all the bond straps (the surface in contact with the cable's terminals) must be rigorously treated to remove the paint and the oxidized substance, to ensure that the contact surface is smooth and flat and has good conductance.**
- **The protective insulating rubber cover at the end of all the bond straps should not be too long to negatively affect the normal connection of the bond strap surface.**
- **When multiple bond straps are installed at one bond strap point, they should be alternated with each other, to ensure the complete contact after installation.**
- **The bond strap's mounting pedestal should be fully soldered, and should not be cold-soldered or contain slag.**
- **Ensure that the power switch has good contact during operation, and the contact resistance of the switch's contact should be within 0.001Ω.**

⚠ CAUTION

- **To avoid causing vehicle-locking fault, the users are strictly forbidden to modify or remove the GPS system's elements and circuits.**

2.3.1 PRECAUTIONS FOR TURNING ON AND OFF THE MAIN MACHINE

STARTING UP——
1. Put the mains switch to ON
2. Apply the brake
3. Adjust the seat and tighten the seat belt
4. Ensure that all the work equipments (blade and ripper etc.) are on the ground
5. Put the gear on NEUTRAL
6. Ensure that the control levers (for blade and ripper etc.) are locked
7. Ensure that people around the bulldozer are in safe places
8. Put the valve control to LOW IDLE
9. Put the key switch to ON, and the monitor will begin self-test
10. Put the key switch to START to start the engine: in winter when temperature is low, start the engine after the automatic warm up
WARMING UP——
1. Warm up the machine for 5min when the engine is idling
2. Unlock the control levers of the work equipments, and cycle the control levers, to ensure that the work oil runs through all the cylinders and pipes
3. Check the instruments and monitors
WORKING——
1. Observe the surroundings of the bulldozer to ensure clear vision
2. Raise all the work equipments (blade and rippers etc.)
3. Ensure that the walking control lever is being pressed down
4. Release the brake
5. Change the gear to the needed position
6. Release the walking control lever to begin operation appropriate to the conditions

SHUTTING DOWN——

STEPS	REMARKS
1. Stop the bulldozer in a level area	
2. Apply the brake	
3. Reduce the speed of all the hydraulic elements	
4. Let the engine idle for 5min	
5. Put the key switch to OFF	
6. Get off the vehicle safely with the help of hands	
7. Observe if there are obvious issues around the bulldozer that need to be addressed after operation	

2.3.2 THE ENVIRONMENTAL REQUIREMENTS OF THE CONTROLLERS AND MONITORS

1. Power supply: 18~32VDC
2. Operating temperature: -30~+70°C
3. Storage temperature: -40~+85°C
4. Relative humidity: (30~90)%RH
5. Atmospheric pressure: 86~106KPa
6. Protection class: IP65

When one or more of the above parameters is out of the required range, the electric system may not work normally or may become damaged. Please use the system strictly following the above requirements on the operating environment, to ensure that the system can work normally.

2.3.3 DESCRIPTION OF THE MONITOR PANEL

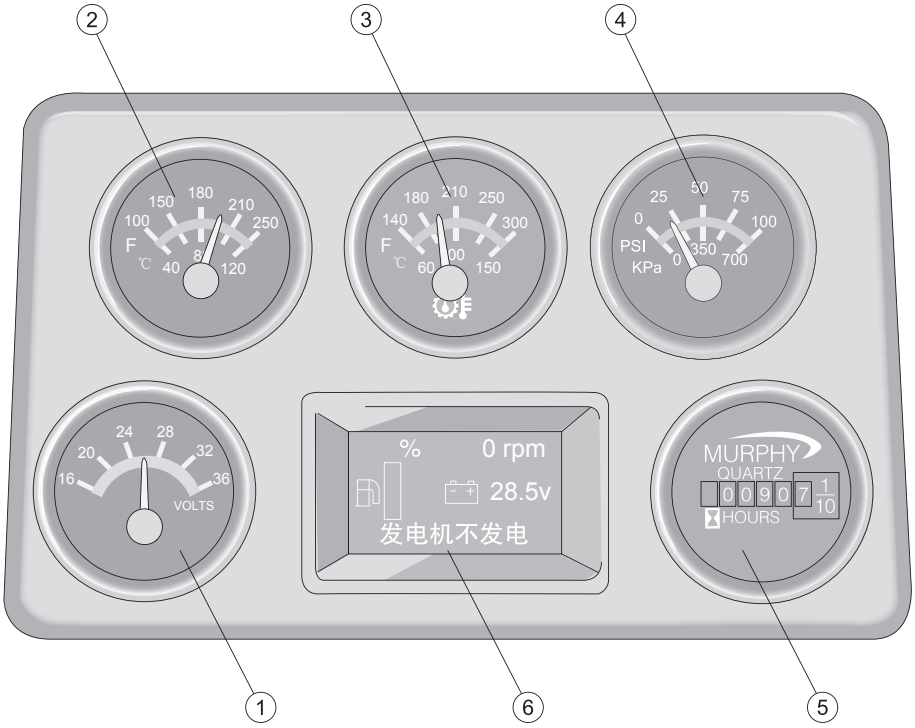


Figure 2-35: GPS system's monitor panel

This monitor panel consists of 5 dial pointers and 1 LCD smart monitor, as shown in Figure 2-35.

No.	Name	No.	Name
1	Meter displaying system voltage	2	Meter displaying water temperature of the engine
3	Meter displaying oil temperature of the hydraulic torque converter	4	Meter displaying engine oil pressure
5	Hour meter	6	LCD Smart monitor

2.3.4 DESCRIPTION OF THE SWITCH BUTTON PANEL

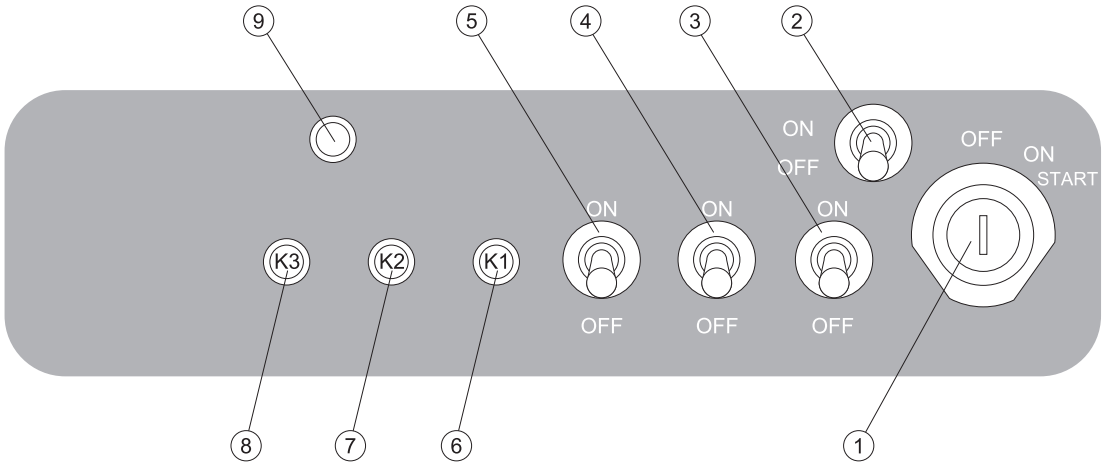


Figure 2-36: GPS system's switch button panel

This switch panel consists of 3 reset switch buttons, 4 toggle switches and 1 key switch, as shown in Figure 2-36:

No.	Name	No.	Name
1	Key starting switch	2	Side lamp switch
3	Front lamp switch	4	Rear lamp switch
5	Instrument light switch	6	K1—LCD smart monitor's Mute/OK key
7	K2—LCD smart monitor'sUP/Down key	8	K3—LCD smart monitor's Menu/Left & Right key

Operation of the reset switch buttons:

1. K1 Mute/Confirmation Key:
   a. When there is a warning buzz, activating this key can stop the buzz;
   b. Choose the confirmation function in the menu, to enter the next level of menu;
   c. In the setup state, press this key to confirm the current operation.
2. K2 Up/Down Key:
   a. Move the cursor up or down;
   b. Display the next page or the previous page;
   c. Change value (i.e. the increase or decrease function).
3. K3 Menu/Left and Right Key:
   a. Enter the main menu, exit to the last menu, and return to the main window;
   b. Move the cursor left or right to select the numerical digits.

2.3.5 OPERATION OF THE ELECTRIC SYSTEM

The power supply's main switch

The power supply's main switch is installed near the battery, to connect the battery's negative terminal and the bulldozer's body; the power supply's main switch has a switch-blade structure, and has two positions: ON and OFF (as shown in Figure 2-37); When the bulldozer does not work for a long time, you should push the knob of the power supply's main switch to the OFF position, to reduce the battery's consumption. Before the bulldozer is started, push the knob of the power supply's main switch to the ON position.

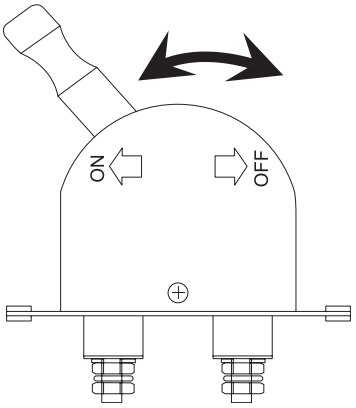


Figure 2-37: Power switch

Key starting switch

The starting switch is located on the instrument box's switch panel. It has four positions (as shown in Figure 2-38), which are the HEATER position, the OFF position, the ON position and the START position. When the starting switch is in the OFF position, the system is in the power off state; when you insert the key, and turn the starting switch from OFF to ON, the entire electric system is powered on, and after a short self-test, the monitors enter the main working window, as shown in Figure 2-38. Turn the starting switch from ON to START, and release the key after ensuring that the engine is started, the starting switch will automatically return to the ON position. When the starting switch is turned to the OFF position, the engine will stop working.

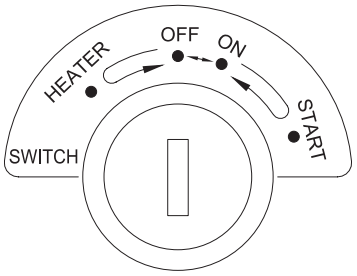


Figure 2-38: Key starting switch

Smart monitor

The main working window of the smart monitor displays the fuel level (%), the system's voltage, the current gear position, the engine speed and the warnings, as shown in Figure 2-39. The main functions of this monitor are as follows:

a. Displays the operation the vehicle's parameters in real time
b. Provide warning information
c. System setup and vehicle management

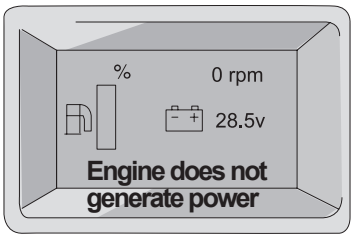
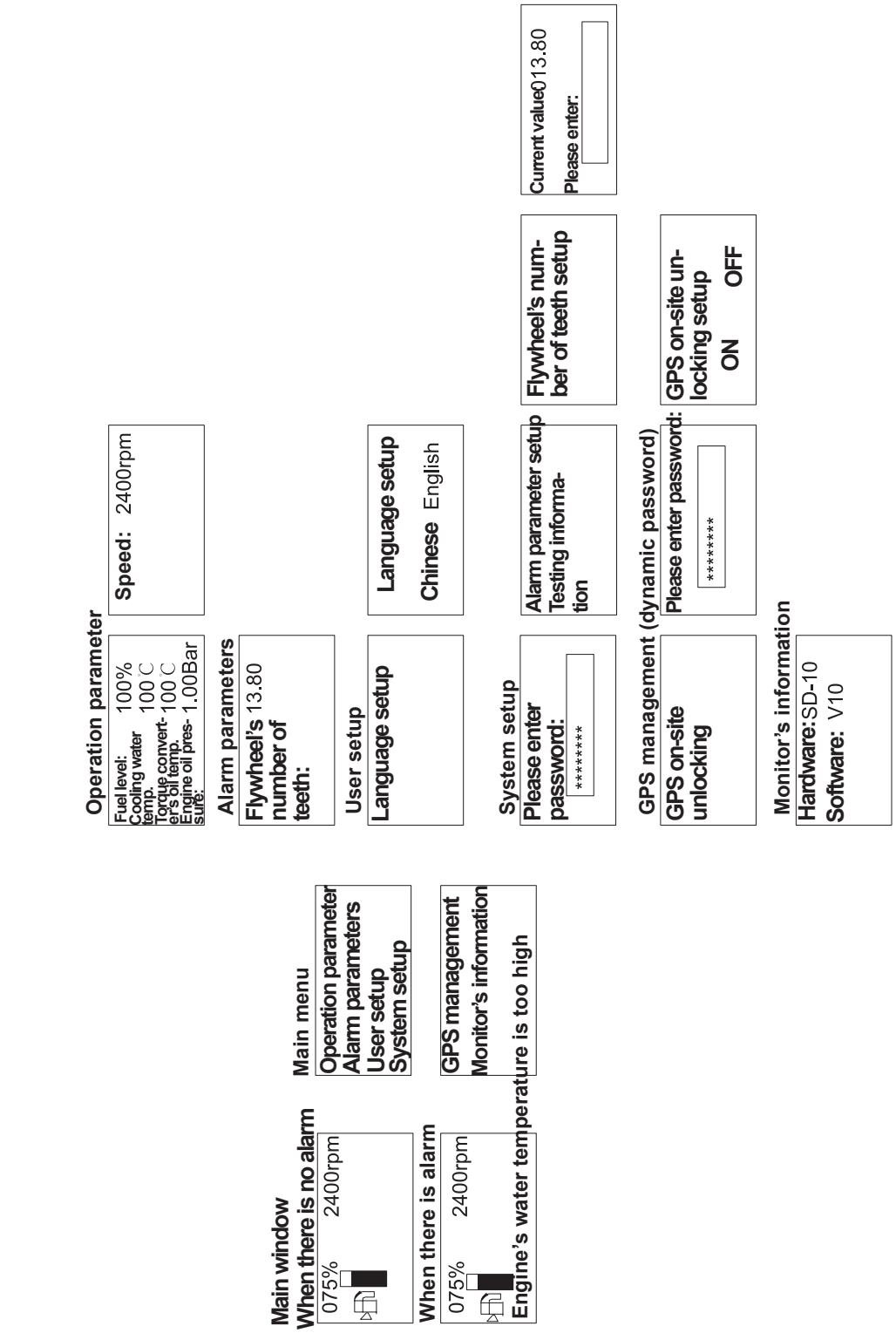


Figure 2-39: Smart monitor's window

1. The smart monitor's working menu is as follows:

Window	Check content		Setup management
Main window	Fuel level %		
	Engine speed rpm		
	System voltage		
	Warm-up indication		
	Gear position indication		
	Fault alarm	Alarm for parameters out of range	
		Device fault alarm	
		Vehicle management alarm	
Operation parameter	Fuel level %		
	Cooling water temperature °C		
	Torque converter's oil temperature °C		
	Engine oil pressure Bar		
	Engine speed rpm		
	System voltage		
Alarm parameters	Flywheel's number of teeth		
User setup	Language setup		Chinese
			English
System setup	Alarm parameter setup		Flywheel's number of teeth (range: 000.00-300.00)
	Testing information (backup)		
Vehicle management	On-site unlocking (dynamic password)		Vehicle is unlocked on-site to be opened
			Vehicle is unlocked on-site to be closed
Monitor's information	Hardware: D2460-00030		
	Software: V10		

2. Illustration of work menu cascade (Chinese)



3. Warnings

When the LCD smart monitor detects a fault of the bulldozer, it will display the related warnings in its main window, and give out the buzz to alert the operator. Types of the warning information are as follows:

Chinese	English
水温传感器断路	Water temp sensor open
水温传感器短路	Water temp sensor short
发动机水温高	Engine water too hot
燃油传感器断路	Fuel sensor open
燃油传感器短路	Fuel sensor short
燃油液位低	Fuel level low
油温传感器断路	Oil temp sensor open
油温传感器短路	Oil temp sensor short
传动油温高	Trans oil temp too high
油压传感器断路	Oil pressure sensor open
油压传感器短路	Oil pressure sensor short
机油压力过低	Engine oil pressure low
预热进行中	Warming
空档	Neutral
发电机不发电	Alternator failed
车辆故障：0010	Vehicle fault: 0010
车辆故障：0011	Vehicle fault: 0011
车辆故障：0012	Vehicle fault: 0012
车辆故障：0020	Vehicle fault: 0020
车辆故障：0030	Vehicle fault: 0030
车辆故障：0031	Vehicle fault: 0031
车辆故障：0032	Vehicle fault: 0032

Check system voltage

The dial pointer intuitively displays system voltage in real time (as shown in Figure 2-40). When the key starting switch is in OFF, the pointer is back to zero, and when it is in ON, the pointer points at around 24V. When the engine is running, pointer should point at around 28V. This meter has a backlight in purple red, to facilitate use during nighttime.

The LCD smart monitor's main window dispalys system voltage.

When the system voltage is lower than 22V, the charging indicate on the smart monitor will blink, the warming message "System voltage low" will occur, and the buzzer will sound.

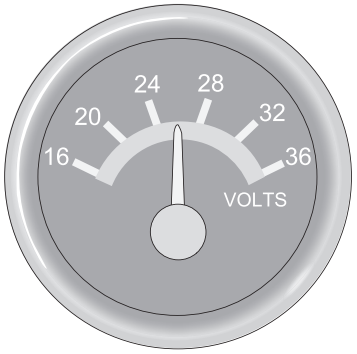


Figure 2-40: Meter displaying system voltage

Check the temperature of the cooling water

The dial pointer displays the temperature of the cooling water in real time (as shown in Figure 2-41), and the display range is 40-120°C. This meter has a backlight in purple red, to facilitate use during nighttime.

The LCD smart monitor displays the engine's cooling water temperature in real time, and you can check it out by entering the menu of operation parameters.

1. When the water temperature sensor's circuit is open, the pointer is back to zero, the smart monitor gives warning "Water temperature sensor's circuit is open", and the buzzer sounds.
2. When the water temperature sensor's circuit is short, the pointer is at full scale, the smart monitor gives warning "Water temperature sensor's circuit is short", and the buzzer sounds.
3. When the water temperature sensor detects a temperature ≥100°C, the smart monitor gives warning "Engine water temperature high", and the buzzer sounds.
4. Cancelling a warning should be done about 10s later after the parameter is back to normal.
5. Pressing the K1 key (as shown in Figure 2-36) can shield the buzzer's sound.

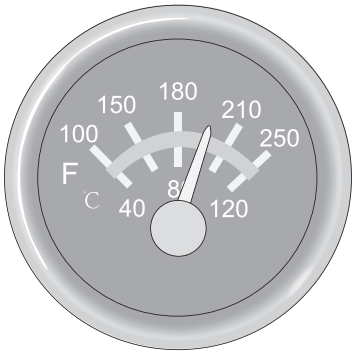


Figure 2-41: Meter displaying the temperature of the cooling water

Check the oil temperature of the torque converter

The dial pointer displays the hydraulic oil's temperature intuitively and in real time (as shown in Figure 2-42), and the display range is 60-150°C. This meter has a backlight in purple red, to facilitate use during nighttime.

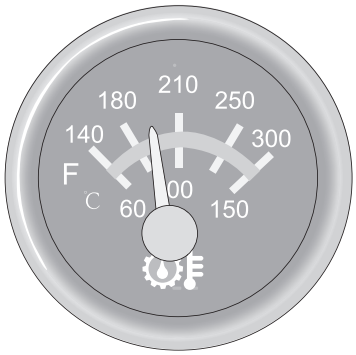


Figure 2-42: Meter displaying hydraulic oil temperature

The LCD smart monitor displays the oil temperature of the torque converter in real time, and you can check it out by entering the menu of operation parameters.

1. When the oil temperature sensor's circuit is open, the pointer is back to zero, the smart monitor gives warning "oil temperature sensor's circuit is open", and the buzzer sounds.
2. When the oil temperature sensor's circuit is short, the pointer is at full scale, the smart monitor gives warning "oil temperature sensor's circuit is short", and the buzzer sounds.
3. When the oil temperature sensor detects a temperature ≥120°C, the smart monitor gives warning "Transmission oil temperature high", and the buzzer sounds.
4. Cancelling a warning should be done about 10s later after the parameter is back to normal.
5. Pressing the K1 key (as shown in Figure 2-36) can shield the buzzer's sound.

Check engine oil pressure

The dial pointer intuitively displays engine oil pressure in real time (as shown in Figure 2-43), and the display range is 0-700KPa. This meter has a backlight in purple red, to facilitate use during nighttime.

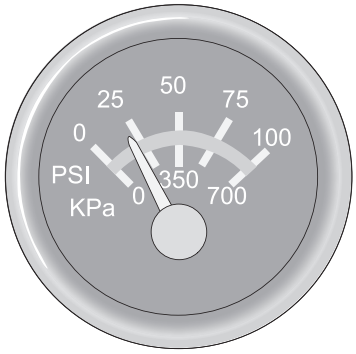


Figure 2-43: Meter displaying engine oil pressure

The LCD smart monitor displays engine oil pressure in real time, and you can check it out by entering the menu of operation parameters.

1. When the oil pressure sensor's circuit is open, the pointer is back to zero, the smart monitor gives warning "oil pressure sensor's circuit is open", and the buzzer sounds.
2. When the oil pressure sensor's circuit is short, the pointer is at full scale, the smart monitor gives warning "oil pressure sensor's circuit is short", and the buzzer sounds.
3. When oil pressure sensor detects a pressure ≤1Bar, the smart monitor gives warning "Engine oil pressure too low", and the buzzer sounds.
4. Cancelling a warning should be done about 10s later after the parameter is back to normal.
5. Pressing the K1 key (as shown in Figure 2-36) can shield the buzzer's sound.

Check bulldozer's operation hours

The dial pointer intuitively displays the bulldozer's operation hours in real time (as shown in Figure 2-44), the time is show in hours, and the smallest display unit is 1/10h.

Figure 2-44: Hour meter

Check fuel level

Fuel level is displayed as a percentage in real time in the smart monitor's main window (as shown in Figure 2-39).

1. When fuel level sensor's circuit is open, the smart monitor gives warning "Fuel sensor is open", and the buzzer sounds.
2. When fuel level sensor is short, the smart monitor gives warning "Fuel sensor is short", and the buzzer sounds.
3. When fuel level sensor detect fuel level ≤10%, the smart monitor gives warning "Fuel level low", and the buzzer sounds.
4. Cancelling a warning should be done about 10s later after the parameter is back to normal.
5. Pressing the K1 key (as shown in Figure 2-36) can shield the buzzer's sound.

Check engine speed

Engine speed is displayed in real time in the smart monitor's main window (as shown in Figure 2-39).

Definitions and descriptions of other warnings

1. When the engine does not have output, the smart monitor gives warning “Engine does not generate power”, and the buzzer sounds.
2. When the smart monitor detects that the gear is in the NEUTRAL position, it blinks to remind “NEUTRAL position”; and when it detects a gear, it blinks to remind the gear.
3. When warm-up is normal, the smart monitor reminds “Warming up”, and also blinks to remint it.
4. When the bulldozer’s smart monitor gives warning “Vehicle fault 0010”, all the dial pointers (except for the meter displaying battery voltage) are back to zero. You need to contact your equipment supplier.
5. When the bulldozer’s smart monitor gives warning “Vehicle fault 0011”, all the dial pointers (except for the meter displaying battery voltage) are back to zero. The GPS antenna is not properly connected, and you should check it out and fix it.
6. When the bulldozer’s smart monitor gives warning “Vehicle fault 0012”, all the dial pointers (except for the meter displaying battery voltage) are back to zero. The communication card of the smart service system does not work properly, and you should check it out and fix it.
7. When the bulldozer’s smart monitor gives warning “Vehicle fault 0020”, all the dial pointers (except for the meter displaying battery voltage) are back to zero, and the engine cannot be started normally. You need to contact your equipment supplier.
8. When the bulldozer’s smart monitor gives warning “Vehicle fault 0030”, all the dial pointers (except for the meter displaying battery voltage) are back to zero, and the engine cannot be started normally. You need to contact your equipment supplier.
9. When the bulldozer’s smart monitor gives warning “Vehicle fault 0031”, all the dial pointers (except for the meter displaying battery voltage) are back to zero, and the engine cannot be started normally. You need to contact your equipment supplier.
10. When the bulldozer’s smart monitor gives warning “Vehicle fault 0032”, all the dial pointers (except for the meter displaying battery voltage) are back to zero, and the engine cannot be started normally. You need to contact your equipment supplier.

⚠ CAUTION

The display of the oil level gauge has a delay. Please pay special attention to this during operation.

2.3.6 OPERATION OF THE HORN BUTTON

When you press this button (as shown in Figure 2-45), the horn will sound.

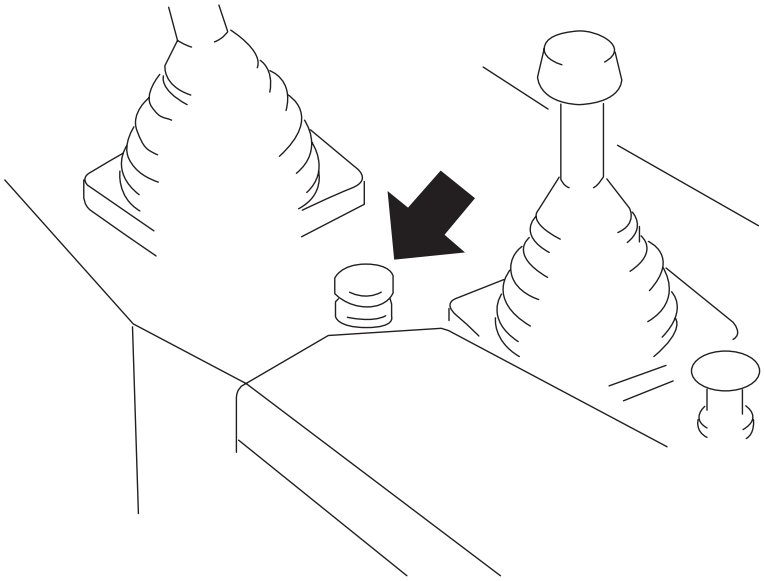


Figure 2-45: Horn button

2.3.7 PRECAUTIONS FOR FUSE BOX

If a fuse becomes corroded, or white powder can be seen, or a fuse is loose in the holder, replace the fuse.

► Replace a fuse with another of the same capacity.

⚠ **Before replacing a fuse, be sure to turn off the starting switch.**

The arrangements and capacities of the fuses are shown in Figure 2-46:

FUSE BOX WIRING CHART

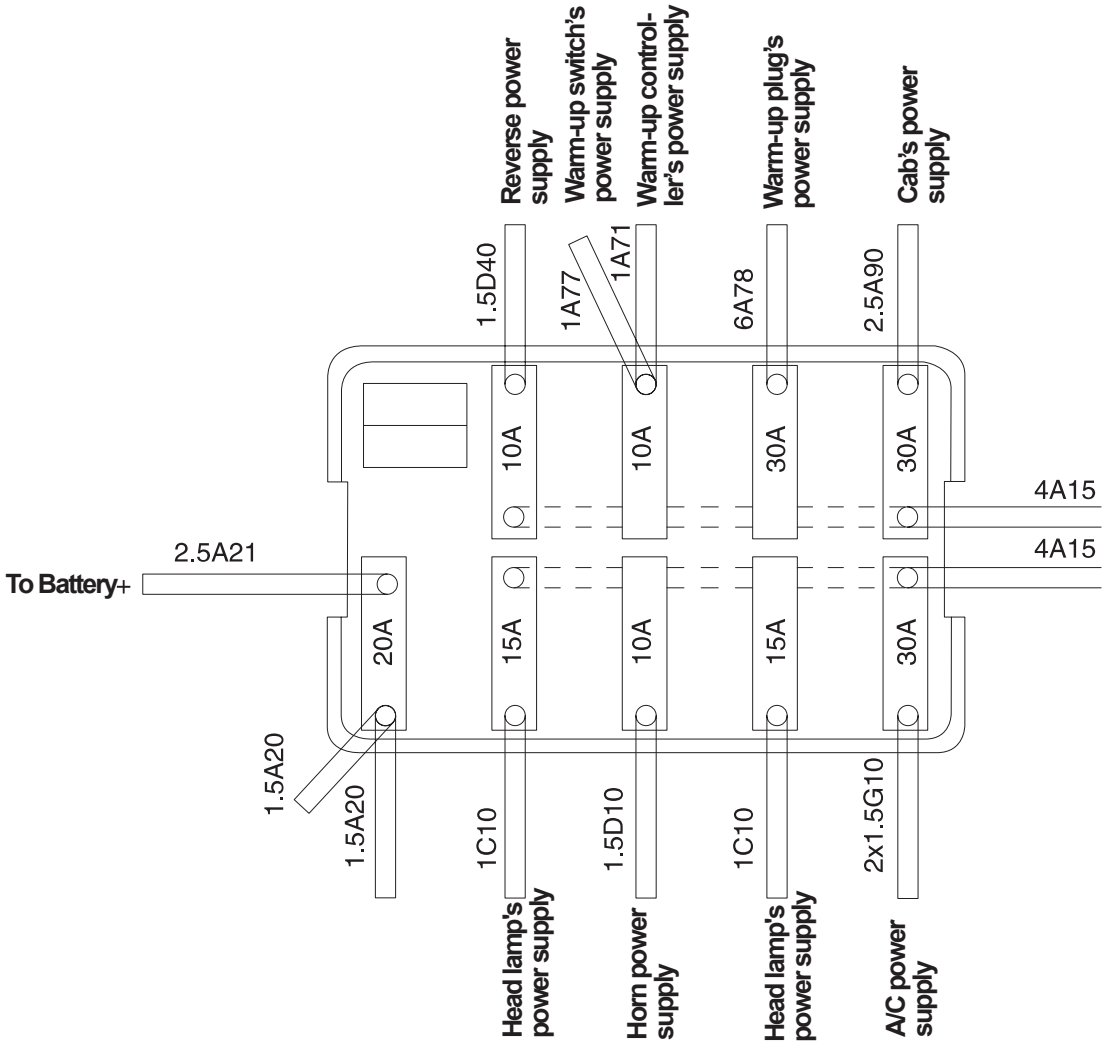


Figure 2-46: Fuse box wiring chart

2.3.8 IN-LINE FUSE

There are some in-line fuses in the instrument box of this machine, as shown in Figure 2-47. When the meters and the GPS system do not have power supply, you need to check the corresponding inline fuses to see if they are already blown. Replace the fuses after eliminating the corresponding faults.

► Replace a fuse with another of the same capacity.

⚠ **Before replacing a fuse, be sure to turn off the starting switch.**

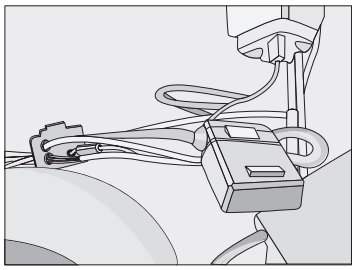


Figure 2-47: Illustration of In-line fuse

2.3.9 POWER SOCKETS

This machine provides the 24V power socket in the accumulator box. If you repair the machine during nighttime and temporarily need the 24V power supply, you can open the accumulator box's cover to see the 24Vpower socket.

2.3.10 WARM-UP AND START

Turn the key switch to ON (Figure 2-48) to turn on the warm-up switch (Figure 2-48). When the engine's water temperature is above 0°C, the system will not enter the warm-up state, and will only indicate it by lighting up the warm-up indicator for 2 seconds. When the engine's water temperature is below 0°C, the system will automatically enter the warm-up state, and the duration that the indicator is on is the warm-up time, which is related to the voltage. When the voltage is 24V, the warm-up time is 26±2 seconds.

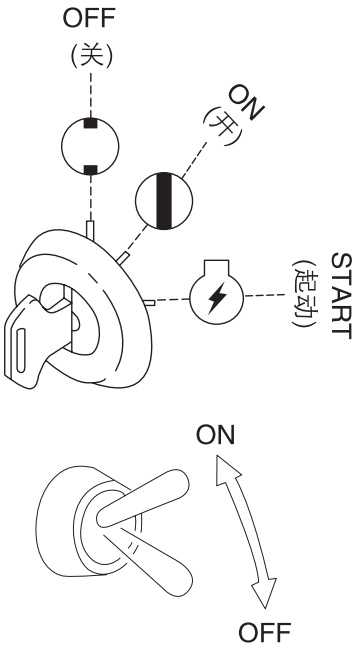


Figure 2-48

When the indicator is off, it means that the warm-up is over, and the engine can be started; if the engine is not started within 30 seconds (during this period the warm-up plug remains electrified), the system will automatically stop working; if the engine is started, the indicator will be on, the warm-up plug will continue to be electrified, the solenoid valve will automatically connect the oil circuit, the system will automatically enter the post-heating stage (during this stage the warm-up plug, the solenoid valve and the indicator remain electrified), and the post-heating time is determined by the engine's water temperature. When the battery's voltage is below 15V or when the temperature sensor has an open circuit, the system will not enter the warm-up state, and the indicator will blink for 15 seconds to alarm.

2.3.11 CAB'S HEAD LAMP SWITCH

When the switch is pulled to the "ON" position, the cab's head lamp lights up. as shown in Figure (2-49)

2.3.12 WINDSHIELD WIPER SWITCH

These switches (as shown in Figure 2-49) are used to operate the following windshield wipers:
(1)—Rear Window Wiper (2)—Front Window Wiper

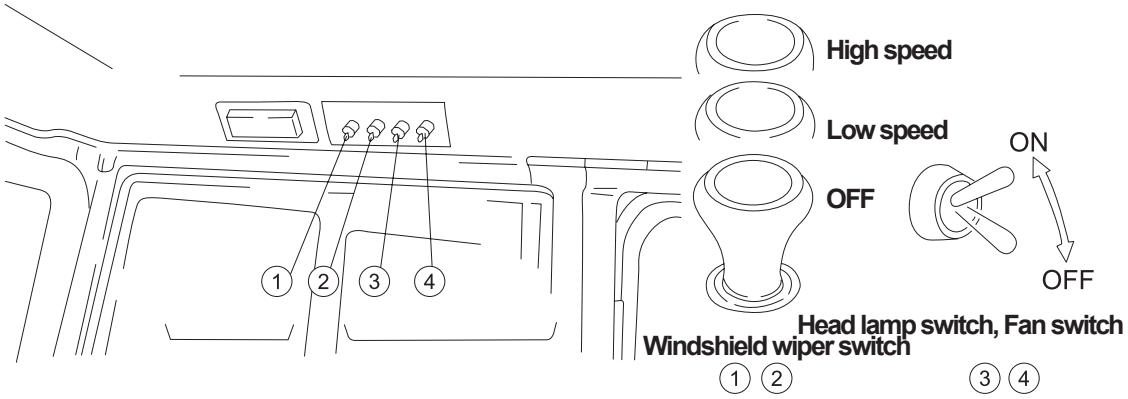


Figure 2-49

2.3.13 DESCRIPTION OF THE BOND STRAPS OF CONSTRUCTION MACHINERY'S ELECTRIC SYSTEM

The bond straps of construction machinery's electric system can have many types of faults. For example, the engine does not have sufficient power or is not easy to be started, the lamps are not lit up, the meters do not have accurate displays or are easy to give false alarms, etc.

The construction machinery's electric system uses the low-voltage DC power supply, adopts the serial connection, parallel connection or mixed connection circuits, and all the circuits have a positive terminal and negative terminal. All the circuits from the loads would need to be directly connected to the battery's negative terminal through wires. If separate wiring is adopted, there would be more than one hundred wires on the battery. In order to save the wires and to facilitate installation, the circuits of general construction vehicles would use a single wire, which means that the battery's positive terminal is directly connected to various electric devices, the battery's negative terminal is directly strapped to the metal part of the vehicle's frame, the negative terminals of electric devices are strapped to the nearby metal part of the vehicle's frame, and the metal part of the engine and the chassis (beam frame) is used as the public pathway. This type of connection in which the negative terminal is connected to the body of the vehicle is called bond strapping. It is also known as earthing or metal connecting. Negative terminal's bond strapping has a number of benefits including less interference to the electronic devices, less electrochemical corrosion to frame and body, and firm connection. Today most construction machines and vehicles adopt negative terminal's bond strapping.

The body of a construction machine generally has more than two main bond straps. One of them is the battery's negative terminal wire, and the other is the bond strap between the engine and the beam. The form of these bond straps is different from ordinary wires. They are usually copper wires above 50mm2, and the current carrying capacity is large. Malfunction of bond strap is very easy to occur. For example, the failure to clean the paint on the frame before the entire vehicle leaves the factory, a loose fastening bolt of the engine's bond strap, the makeshift installation during the reconnection of bond straps, or the increased resistance of bond strap's connector due to corrosion all can cause improper contact, forcing the current to try to go through other circuits, causing voltage drop or failure. Malfunction of bond straps can cause many obvious or hidden faults to circuits. In the ignition system, if engine's bond strap does not function properly, the engine may not be started. In the starting circuit, if engine's bond strap does not function properly, the starter's speed will be reduced, the armature will be heated, and over time, it will be very easy to have the starter burned. In the lighting circuit, if the bond straps of the lamps do not function properly, the lamps may not be lit or the lamps may be dim. Therefore, knowing the role of bond straps can avoid many faults and the wrong judgment during the troubleshooting of the electric system.

2.4 OPERATION

WARNING

Please read and make sure that you understand the SAFETY section before reading this section.

2.4.1 CHECK BEFORE STARTING ENGINE

► Form a habit to check before starting engine. Never be imprudent and careless. This is good for the safety of both people and vehicle.

Check oil or water leakage

Before starting the engine, look around the machine and under the machine to check for loose nuts and bolts, or leakage of oil, fuel, or coolant, and check condition of the work equipment and hydraulic system. Check also for loose wiring, play, and collection of dust at places which reach high temperatures.

Check bolts and nuts

Check for loose nuts and bolts, and tighten them if necessary. Pay special attention to air cleaner, carrier roller bracket and track shoe bolts.

Check electric circuits

Check to see if the wires are damaged or shorted or if the terminals are loose.

Check cooling water level (Figure 2-50)

Turn open the radiator cap (1) (Figure 2-50), and check if the water is at the required level. Add water if necessary.

Add cooling water after the engine has stopped. Add water to the sub-tank to the full (until the water overflows), and then start the engine and let it idle for 5min and check again. If the water level is lower than required, continue to add water. If the water added is increased abnormally, look for leakage and solve it in time.

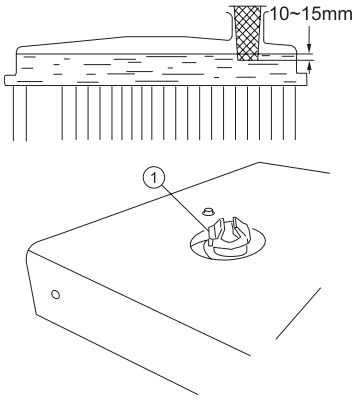


Figure 2-50

⚠ CAUTION

When cooling water is overheated, turn the cap (1) loose slowly, to release the internal pressure before opening it, to avoid boiling water from spurting out to have people injured.

Check oil level in engine oil pan (Figure 2-51)

When the engine has stopped, take out the dipstick(G), and check the oil level on the side marked “Engine stopped”. When the engine is idling, check to see if the engine oil pressure gauge and water thermometer are within the normal range first, and then take out the dipstick (G) to look at the oil level on the side marked “Engine idling”. If oil needs to be added, open the injection mouth to add oil. The types of engine oil depend on the ambient temperature. See the “USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE”. When checking oil level, park the vehicle on a level ground. When adding engine oil, do not let the oil level be higher than the “(H)”mark. When checking oil level, do not rely on engine oil level monitor alone.

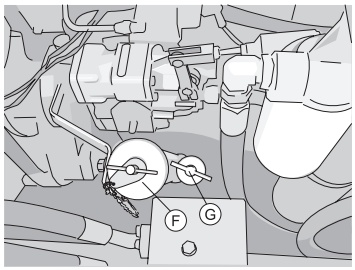


Figure 2-51

Check fuel level

Remove the fuel tank cap, and pull out the dipstick (G) (as shown in Figure 2-52) to check the oil level.

After completing work, fill the fuel through filter screen. Before operating the bulldozer, make sure there is plenty of fuel in the tank so that the engine fuel line does not become aerated.

Fuel tank capacity: 450L

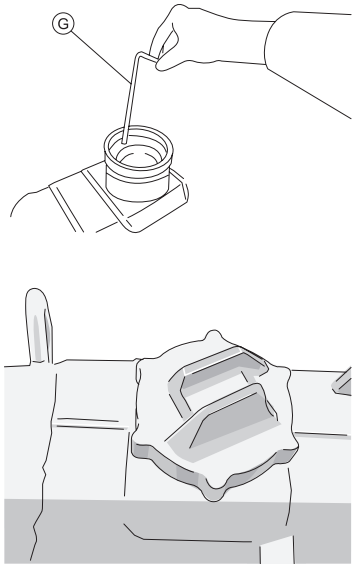


Figure 2-52

⚠ CAUTION

When adding fuel, never let the fuel overflow. This may cause a fire.

Check steering clutch case oil level (including transmission case and torque converter)

As shown in Figure 2-53, use dipstick (G) to check the oil level. If needed, oil should be added through the filter screen (F). The lubricant type used depends on the ambient temperature. See the “USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE” for reference.

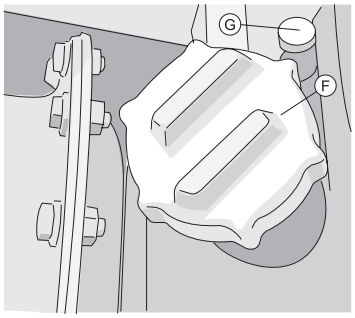


Figure 2-53

When checking oil level, stop the engine.

When operating on a slope of over 20 degree, the oil level should be at the (H) HIGH level.

Drain the sediment in fuel tank (Figure 2-54): Turn loose the valve (1) on the bottom of fuel tank, to drain the water and sediment in the fuel.

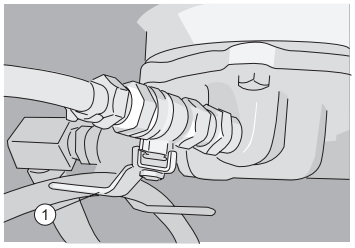


Figure 2-54

Check brake pedal’s journey (Figure 2-55)

When the engine is running, the standard journey is 110-130mm (operating force is 15kg). When the engine stops, the stroke is about 75mm. If the pedal’s stroke is over 190mm, the brake function is not adequate, and you should make adjustment following the “Adjustment” section.

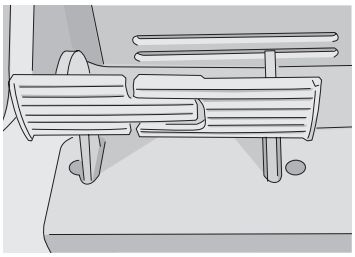


Figure 2-55

2.4.2 OPERATION METHODS AND STEPS

1. Check the positions of various control levers before starting (Figures 2-56 and 2-57). (1)—Brake lock lever, (2)—Gear shift lock lever, (3)—Steering control lever, (4)—Gear shift lever, (5)—throttle gear shift lever. Adjust the operator's seat, so that the operator can completely step down the brake pedal while leaning against the seat back.
2. Brake lock lever (1) is in the LOCK position, as shown in Figure (2-56)

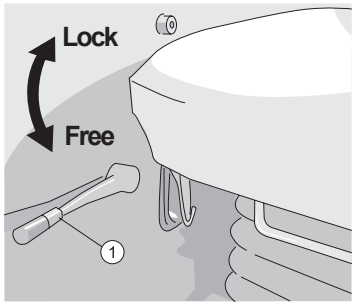


Figure 2-56

3. Gear shift lever (4) is in the NEUTRAL position, and gear shift lock lever (2) is in the LOCK position (Figure 2-57).

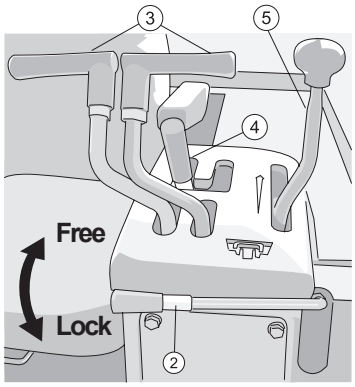


Figure 2-57

4. The blade and ripper should be lowered to the ground, and their control lever lock button should be in the LOCK position. (Figure 2-58)

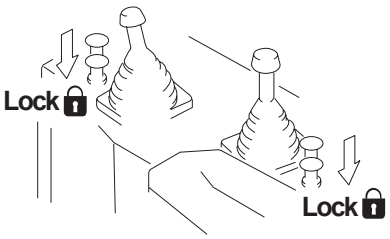


Figure 2-58

5. Starting engine

- Pull the throttle level (5) to the idling position. (Figure 2-57) Turn the starting key (1) to the starting position. (Figure 2-59)
- When engine started, release the starting key (1), and the key will automatically return to the (ON) position. (Figure 2-59)

- If engine is not started, re-start it after 2min.
- The key should not stay in the “Starting” position for more than 10s.
- When the fuel is empty and you want to start the engine, add sufficient fuel first and then let the fuel fill the core of fuel filter and exhaust the air in the fuel system before starting the engine again.

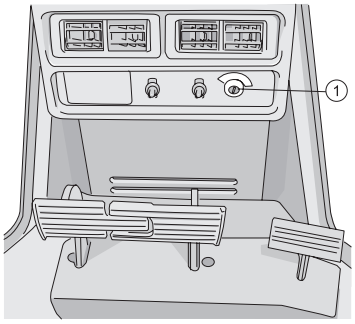


Figure 2-59

6. Checks after starting engine

- After starting the engine, perform the following checks:
- Let the engine run at a low speed, until the engine oil pressure is within the normal range.
- Pull the throttle control lever (5) to let the engine idle at a mid-range speed for about 5 min. (Figure 2-60)
- Do not run the engine at low or high idle for more than 20 minutes. If it is necessary to run the engine at idling, apply a load from time to time or run the engine at a mid-range speed.
- After engine temperature is increased, check various meters for abnormality.
- Let the engine continue to run at a low-load, to let water temperature rise. Water temperature between 74-91°C is most ideal.
- Check the color of exhaust for abnormalities, such as abnormal sound or vibration.
- Do not suddenly accelerate the engine before the machine reaches full operating temperature.
- If engine oil pressure is not within the normal range, stop the engine immediately, and check for reasons.

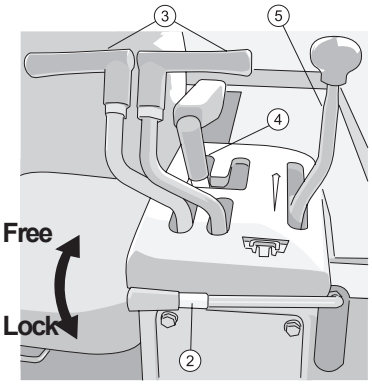


Figure 2-60

2.4.3 OPERATION WHEN MOVING

Before moving, check the safety around you.

1. Release blade and ripper lock button (1) and (2) respectively. (Figures 2-61 and 2-62)
2. Pull blade and ripper control lever (3) and (4), to raise blade and ripper 40-50cm above ground. (Figures 2-61 and 2-62)

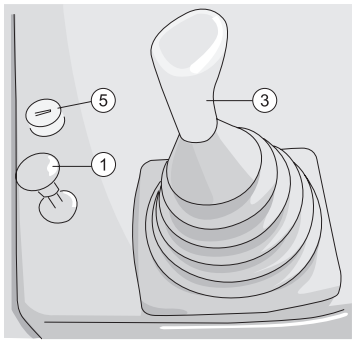


Figure 2-61

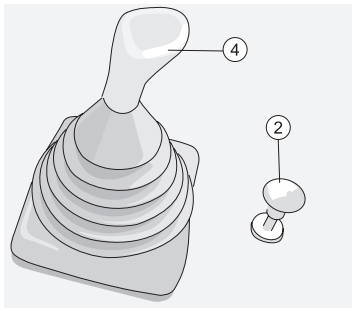


Figure 2-62

3. Step down the crossing part in the middle of the left and right brake pedal, put the brake lock lever (1) to the FREE position, and then release the brake pedal. (Figures 2-63 and 2-64)

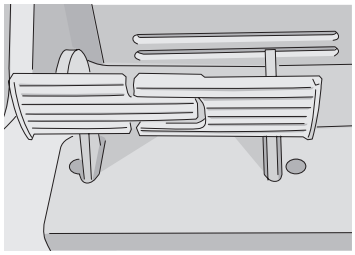


Figure 2-63

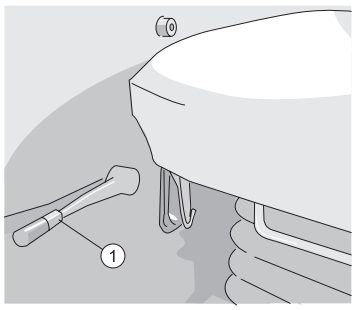


Figure 2-64

4. Release the gear shift lock lever (2) (Figure 2-57)

- Step down the deceleration pedal (1) to reduce engine speed, so that there is no impact when the vehicle is started (Figure 2-65).

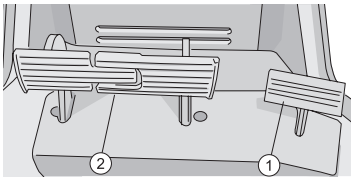


Figure 2-65

- Put the gear shift lever (4) to the needed position, and the vehicle will start to move (Figure 2-66)

5. Pull throttle control lever (5), to accelerate the engine (Figure 2-66)
6. Through the gear shift lever (4) you can select any speed without stopping the vehicle. (Figure 2-66)

- Forward←→Reverse
- After reducing vehicle speed, change Forward←→Reverse. This can preventing impacting vehicle. Step down the deceleration pedal, to reduce engine speed, bring the gear shift lever to the needed Forward or Reverse gear, and then release the deceleration pedal, to accelerate the engine.

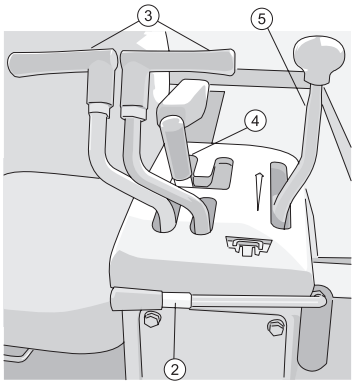


Figure 2-66

2.4.4 TURNING

Make a big turn to the left (right):
Pull left (right) steering lever half way, and the vehicle will make a big turn to the left (right) (Figures 2-67);

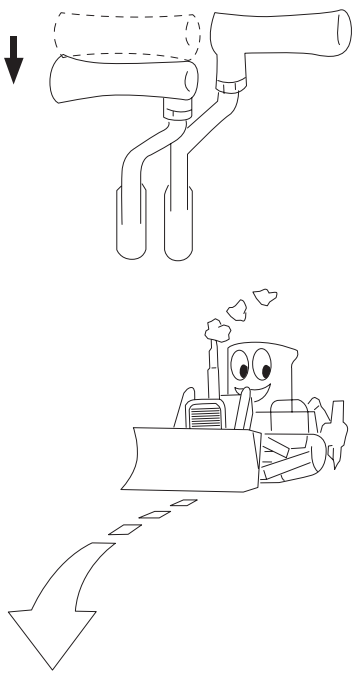


Figure 2-67

Make a small turn to the left (right):
Pull the left (right) steering lever to the bottom, the left (right) steering clutch will detach, the brake will be activated, and the vehicle will make a small turn to left (right). (Figure 2-68)

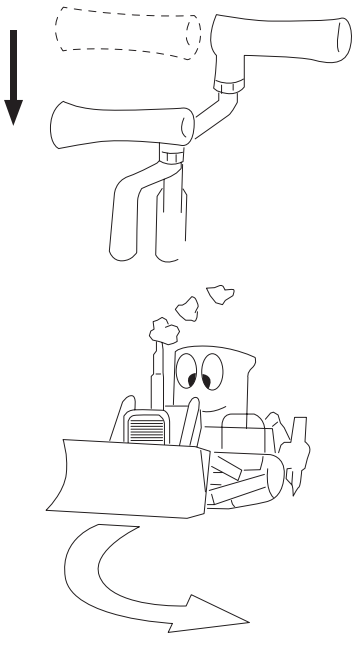


Figure 2-68

2.4.5 PARKING

Push the throttle control lever (5) to the idling position, to reduce engine speed. Push the gear shift lever (4) to the NEUTRAL (N) position. (Figure 2-66)
Step down the crossing part in the middle of the left and right brake pedal (2), and the vehicle stops (Figure 2-65); pull the brake lock lever (1) to the LOCK position (Figure 2-69), to lock the gear shift lock lever (2) (Figure 2-66).

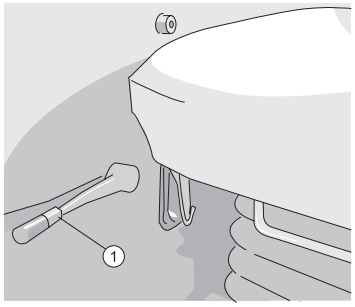


Figure 2-69

Push the blade control lever (3) and ripper control lever (4) to the Lowering position, to lower the blade and ripper to the ground. And then press the blade control lever's lock button (1) and ripper control lever's lock button (2). (Figure 2-70, 2-71)

⚠ CAUTION

Park the vehicle on a firm and level ground as far as possible, and avoid parking it in a dangerous place.

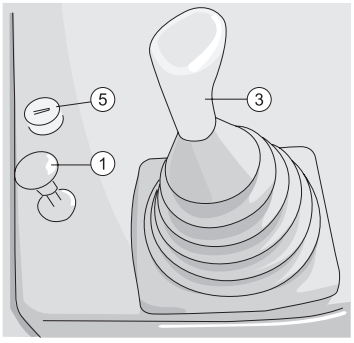


Figure 2-70

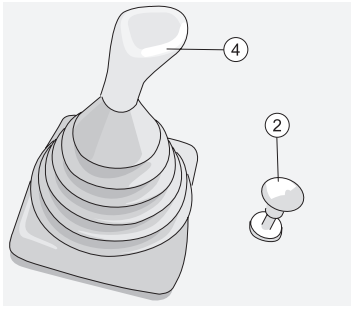


Figure 2-71

2.4.6 STOPPING ENGINE

Let the engine idle for 5min, to cool it down. Turn the key to the ◐ (OFF) position, and the engine will stop running. Pull out the key. If you suddenly stop the vehicle when the engine is not cooled, it will dramatically shorten the lifecycle of the engine. Never suddenly stop the vehicle unless in emergency.

2.4.7 OPERATION IN SPECIAL CLIMATE CONDITIONS

Precautions for low temperature:

1. If the temperature is too low, it will be difficult to start the engine, and the cooling water will be frozen, causing negative impacts on the vehicle, so you should take appropriate measures, and select oil and water according to the “USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE”.
2. When the atmospheric temperature is lower than 0°C, to prevent the cooling water from freezing, you can use the antifreeze based on the lowest temperature. For the mixing proportion and usage methods of water and antifreeze, see “CLEAN INSIDE OF COOLING SYSTEM”.
3. Before adding the mixed antifreeze, thoroughly clean the cooling system.
4. When the weather becomes warm, drain the antifreeze (except for the permanent antifreeze), and clean the cooling system, before replacing the clean water.
5. Be sure to clean the snow or water on the hydraulic oil cylinder’s piston rod. If they freeze into ice, they will damage the oil cylinder’s oil seal.

⚠ CAUTION

- **Water without antifreeze should be thoroughly drained during the nighttime of winter, to prevent the parts from being cracked by freezing. Note: Do not drain water in areas such as oil cooler.**
- **Use standard antifreeze. Never use methanol or ethanol based antifreeze, as it may cause malfunction of engine.**
- **Antifreeze is flammable, so be careful of fire.**
- **When the ambient temperature drops, the capacity of the battery will also drop. If the battery charge ratio is low, the battery electrolyte may freeze. Maintain the battery charge as close as possible to 100%, and insulate it against cold temperature so that the machine can be started easily the next morning.**

2.4.8 OPERATING ON SLOPES

Make a big turn to left (right) :
When going down a slope (Figure 2-72). Pull the right (left) steering control lever half way, and the vehicle will make a big turn to left (right).

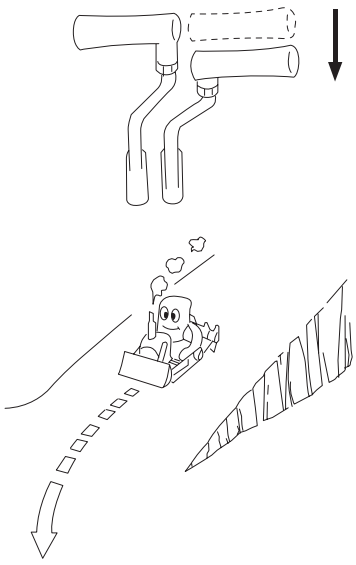


Figure 2-72

Make a small turn to left (right):
When going down a slope (Figure 2-73). Pull left (right) steering control lever to the bottom, and the vehicle will turn to left (right).

Figure 2-73

2.4.9 PRECAUTIONS

1. Do not park vehicle on a slope unless in special situations.
- If you do need to park the vehicle on a slope, face the head of vehicle downhill, and lock the brake pedal. When the slope is big, you can slightly cut the blade into the ground, to prevent vehicle from slipping.
2. When the vehicle travels on a slope, the longitudinal slope should not be over 30 degree, and when going uphill, do not travel backward.
3. When you start the vehicle on a slope, step down the left-right brake pedal first, and then pull the gear shift lever to Gear 1, while slowly releasing the brake pedal. If the engine speed is too fast, you can use the brake pedal to reduce speed.
4. When going downhill, pull the gear shift lever to a low-speed gear, and use the engine to brake.
5. When operating machine on sloped areas of more than 20°, fill all appropriate components with oil to H level.

⚠ CAUTION

- **Always travel straight up or down a slope. Traveling at an angle or across the slope is extremely dangerous.**
- **Do not shift gear or cross obstacles on a slope.**
- **If the fuel level in the fuel tank becomes low when working on slopes, the engine may suck in air because of the angle of the machine or the swaying of the machine. If this makes the engine stop, the braking effect will be reduced, so be careful not to let the fuel level in the fuel tank become too low.**

2.4.10 OPERATING IN WATER

When the vehicle is travelling in water, check out water depth and the soil under water first, to avoid accidents because the water is too deep and the soil sinks from carrying the load. Water level should not exceed the center of the idler (Figure 2-74).

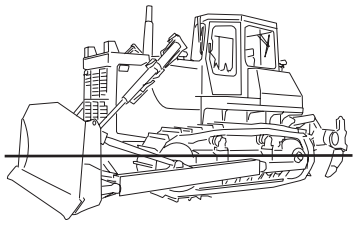


Figure 2-74

When operating in sea water or other corrosive water, wash the vehicle with clean water after completion.

2.4.11 OPERATING ON DESERT

When operating on desert or other types of dusty ground, try to keep the vehicle sealed off from the outside world, and clean the air cleaner at any time.

2.5 DOZING OPERATION

Reasonably choosing the models as well as the adjustment and operation methods of the blade according to the dozing objects is very important to extending the lifecycle of the vehicle, reducing the operator's fatigue, and increasing productivity.

The SD22 bulldozer is suitable for the general operating conditions. The SD22E bulldozer is suitable for loose soil. The SD22S is suitable for operating in swamps.
There are three types of blades: the "straight tilt blade", the "angle blade", and the "U-Blade". They are suitable for different terrains and operation objects.
The effective dozing distance is 70m at the maximum. For long-distance application, using a fork lift is more economical.

2.5.1 OPERATION OF BLADE AND RIPPER

The control levers and buttons of the work equipments. See "The Roles of Various Controls" (See 2-1-2)

2.5.2 BLADE ADJUSTMENT

Angle blade adjustment

1. Adjustment of angle blade's turning angle

► The two sides of the blade can be adjusted to be 25º. (Figure 2-75)

- Raise the blade to be 400-500mm above ground, and put a block under the C-Frame.
- Pull out the pins (1) on both sides to remove the push rod's arm (2) from the C-Frame (Figure 2-76)
- After putting the blade into an angle, install the push rod's arm (2) to the needed position. (the push rod frame has three supports on each side), and then insert the pin (1).

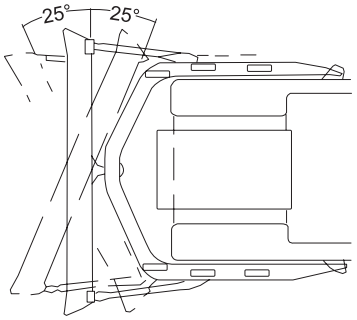


Figure 2-75

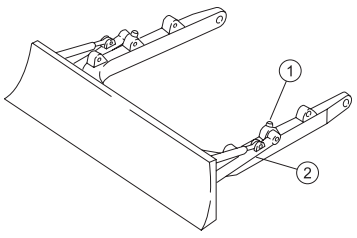


Figure 2-76

CAUTION

After removing push rod's arm, be careful that the blade will swing freely.

2. Adjust of angle blade's tilt

► The biggest tilt of blade: 500mm (Figure 2-77)

a. Raise the blade to be 400-500mm above ground, and put a block under the C-Frame.

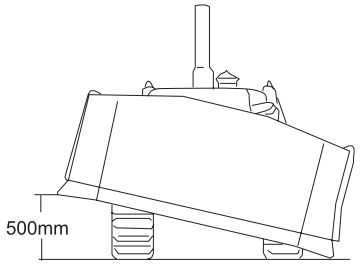


Figure 2-77

b. Loosen jack bolt (1), insert an iron bar into the hole of the support rod (2) to rotate the support rods on the two sides, to elongate and shorten them respectively. Tilt the blade to the required height, and then tighten jack bolt. (Figure 2-78)

- L, the length of the support rod (Figure 2-78), is generally 1338mm, and the blade's tilt should be within 500mm.
- Do not attempt to tilt the blade to more than 500mm, to prevent unwanted effect.

► When using the adjusting rod to turn the support arm, the blade should be above ground before tilting it.

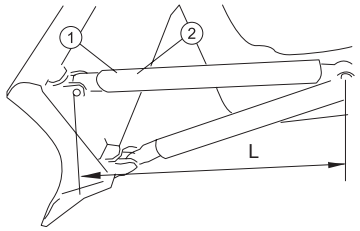


Figure 2-78

c. Adjustment of gaskets

- The standard thickness of the adjustment gaskets between the blade lift cylinder's piston rod and cap is 4mm (Figure 2-79).
- Remove some gaskets, to adjust the spherical clearance between oil cylinder's piston rod and cap. The suitable clearance maintained with gaskets is 0.2~0.6mm.

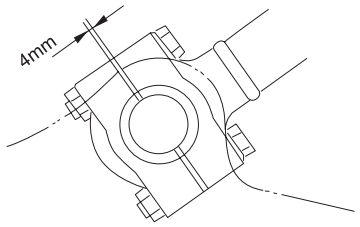


Figure 2-79

Adjustment of straight tilt blade

1. Adjustment of straight tilt blade's tilt

- Simply operate blade control lever to let the blade tilt 425mm. If necessary, changing the left support arm's length L (Figure 2-80) can further tilt it to 500mm. The support rod's length L is generally 1287mm, and the blade's tilt should be within 500mm. Do not attempt to tilt the blade to more than 500mm, to prevent unwanted effect.

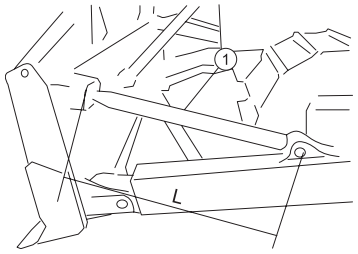


Figure 2-80

2. Adjustment of gaskets

- Adjust the thickness of the gaskets, to let the clearance of the spherical joint in the axle direction be not over 1mm (Figure 2-81, the position pointed by arrow).
- Remove gasket (1), and tighten bolt (2), to eliminate the spherical joint's clearance. (Figure 2-82) Measure the clearance A, and remove bolt (2). Put in a gasket with a thickness of A+1mm (1), and tighten bolt (2). Confirm if after the bolt is tightened the spherical joint can flexibly rotate.

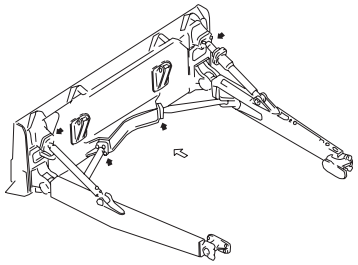


Figure 2-81

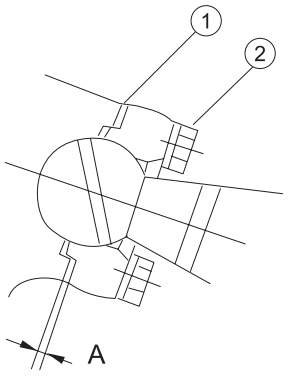


Figure 2-81

2.5.3 DOZING OPERATION

Cutting of hard earth or frozen earth (Figure 2-83)
When operating on hard earth or frozen earth, using straight tilt blade or angle blade can effectively dig; if the earth is very hard, using ripper can increase efficiency.

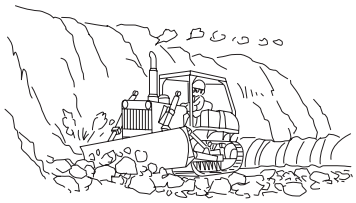


Figure 2-83

2.5.4 LEVELING OPERATION (FIGURE 2-84)

The uneven ground after excavating dozing can be leveled using the following methods:

- Fill the blade with soil, let the vehicle run at a low speed, and level the uneven areas when moving.
- Put the blade in the “floating” state, move the vehicle slowly backward to smooth the ground.

⚠**Smoothing cannot be used on rocks, as it can damage the blade.**

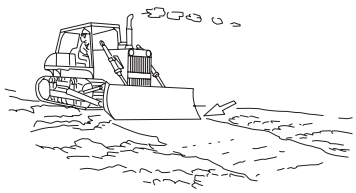


Figure 2-84

2.5.5 DOZING SIDEWAYS

When dosing sideways, use the angle blade. (Figure 2-85)

⚠ CAUTION

- **Do not use the blade to dig tree root etc.**
- **During dozing and moving, avoid sudden start, sudden brake and sudden turn if possible.**

Figure 2-85

2.5.6 METHODS FOR EXTENDING MACHINE LIFE

The life of the vehicle, especially the walking parts, is dependent on the maintenance and operation methods to a big extent. Therefore, remember the following points:

1. Select different models with different types of tracks according to soil type.
2. During operation, reduce track slip as far as possible. If the track slips, reduce the load until it no longer slips.
3. Avoid sudden start, sudden acceleration, unnecessary high-speed operation, as well as sudden brake or sudden turn if possible.
4. Always operate the vehicle to travel in a straight line as far as possible. Do not always turn to one side. Turn to left and right alternately and at the biggest radius.
5. During dozing, if the terrain forms a gentle slope to left or right, reverse the vehicle to the level ground and level it again. Do not continue to operate on the slope.
6. Do not let the vehicle try to handle a hard object or an obstacle that is hard to handle, or the idler or Sprocket will leave the ground. (Figure 2-86)
7. When operating on an inner slope, the vehicle should travel along the slope from top to bottom, and should not cross the slope. When travelling uphill, do not back. (Figure 2-87)

- Before operation, clear the big rocks and other obstacles from the jobsite.

Figure 2-86

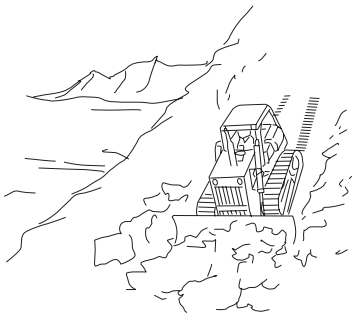


Figure 2-87

2.6 TOWING, LIFTING, TRANSPORTATION AND STORAGE

2.6.1 TOWING (FIGURE 2-88)

Towing is the operation to draw the bulldozer using the front and rear towing devices for darwing or self-rescue.

► When using front and rear towing devices for drawing or self-rescue, ensure that the towwing cables and the towing devices can be reliably connected and locked, and that the towing cables can safely carry the towing load.

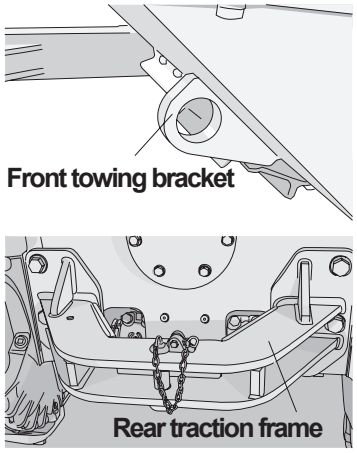


Figure 2-88

⚠ CAUTION

The effective safe load of the bulldozer's front and rear towing devices is 15tons.

2.6.2 LIFTING (FIGURE 2-89)

When the bulldozer is lifting, operate in the way shown in the figure below.

► During lifting, ensure that the lift rope can be reliably locked, and avoid the direct contact between the weight-bearing point and the bulldozer's edge (put a block beneath the corner of the track). (Bulldozer's dead weight: 23.4tons)

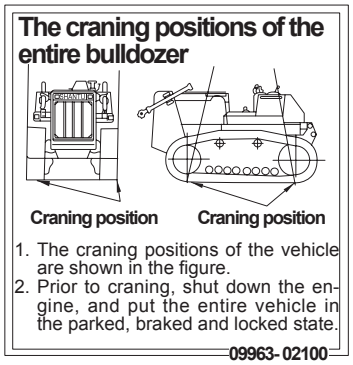


Figure 2-89

⚠ CAUTION

During lifting, ensure that the bulldozer is locked. (Step down the brake pedal, and raise the brake lock lever)

2.6.3 TRANSPORTATION

During the vehicle transportation process, be familiar with and abide by various road rules as well as the traffic rules including the rules about the transportation of vehicles on the road and the restrictions on vehicles. When going through bridges and tunnels, measure the allowed weight of the bridges and the space sizes of the tunnels.

It's best to create a special loading/unloading platform. If using a ramp to load the machine to a trailer, follow the rules below. (Figure 2-90)

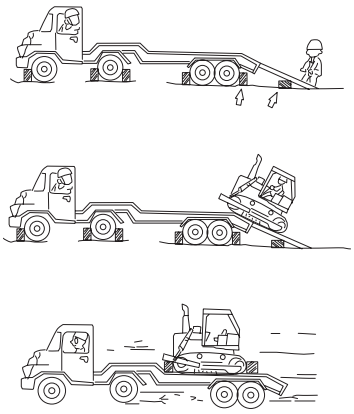


Figure 2-90

⚠ CAUTION

When traveling up a ramp, do not adjust the travel direction. If you need to adjust the direction, back the vehicle to the ground and make the adjustment.

1. The brake of the trailer should be applied, and the wheels are secured with blocks.
2. Make sure the ramp has sufficient width, length and thickness to enable the machine to be safely loaded and unloaded.
3. Make the ramp properly aligned, and then slowly load/download the machine.
4. The vehicle should be put in the trailer's appropriate position, insert blocks beneath the track in front and back, and then use solid and firm chains or ropes to secure it, to prevent it from falling off during the transportation process to cause accidents.
5. Lower the blade, and put various levers to the following positions.

- Put the throttle control lever in the low-speed position, and remove the starting key.
- Put the gear shift lever in the NEUTRAL position.
- Put the blade control lever in the KEEPING position.
- Put the brake lock lever in the LOCK position.

⚠ CAUTION

- **If the blade head's width is wider than the trailer's width, you can change the blade's angle or unload it and load it again.**
- **For long-distance water transportation, take anti-rust measures, and apply anti-rust oil to the exposed oil cylinder's piston rod etc.**

2.6.4 STORAGE

Before storage

When you expect the machine will be stored for a significantly long period of time, be sure to take the following measures, to reduce the repair work when using the machine again.

1. After cleaning each part of the machine, store the machine in a dry building. If the machine has to be put outdoors due to limited conditions, put wood planks on the ground, put the machine on the wood planks, and cover the machine with canvas.
2. Before putting into garage, add sufficient fuel and lubricant, and change new engine oil.
3. Apply a layer of lubricant on metal surface. (At the piston rod)
4. Remove the terminals of the battery, cover them properly or store them separately.
5. If you expect the ambient temperature can be lowered to below 0°C, add antifreeze to the cooling water beforehand.
6. Set various control levers and pedals as follows:

► Put the gear shift lever to the NEUTRAL position.
► Put the throttle control lever to the LOW SPEED position.
► Put the blade control lever to the KEEPING position.
► Put the brake pedal to the FREE position.

During storage

Start the engine once a month, and operate the vehicle for a distance. This is in order to let the machine's parts and the surface of the engine's various areas have a new layer of oil membrane.

► When operating the work parts, wipe off the lubricant grease on the hydraulic piston rod.

After storage

After storage (if not covered or not performing the anti-rust operation once a month), you must do the following before use:

1. Remove the engine oil pan and other drain plugs of the oil tank, to drain the mixed water.
2. Remove the cylinder cap, lubricate various air throttles and rock arms, and check the action of air throttles.
3. In order to exhaust hydraulic system's air, run the engine at a low speed, and operate as follows:

• Operate each hydraulic cylinder back and forth 4-5 times, and let the piston stop at a place 100mm from the end of its journey.
• Continue to operate each hydraulic cylinder back and forth 3-4 times to the end of its journey.

► If the engine runs at a high speed at the beginning or if the piston runs to the end of its journey, then the air getting into it may damage piston disc.

4. After the engine is started, let it run, until the temperature reaches the required value.

Note paper

CHAPTER 3: STRUCTURE AND PRINCIPLE

3.1 MACHINE STRUCTURE AND MAIN PARAMETERS

3.1.1 MACHINE APPEARANCE (FIGURE 3-1)

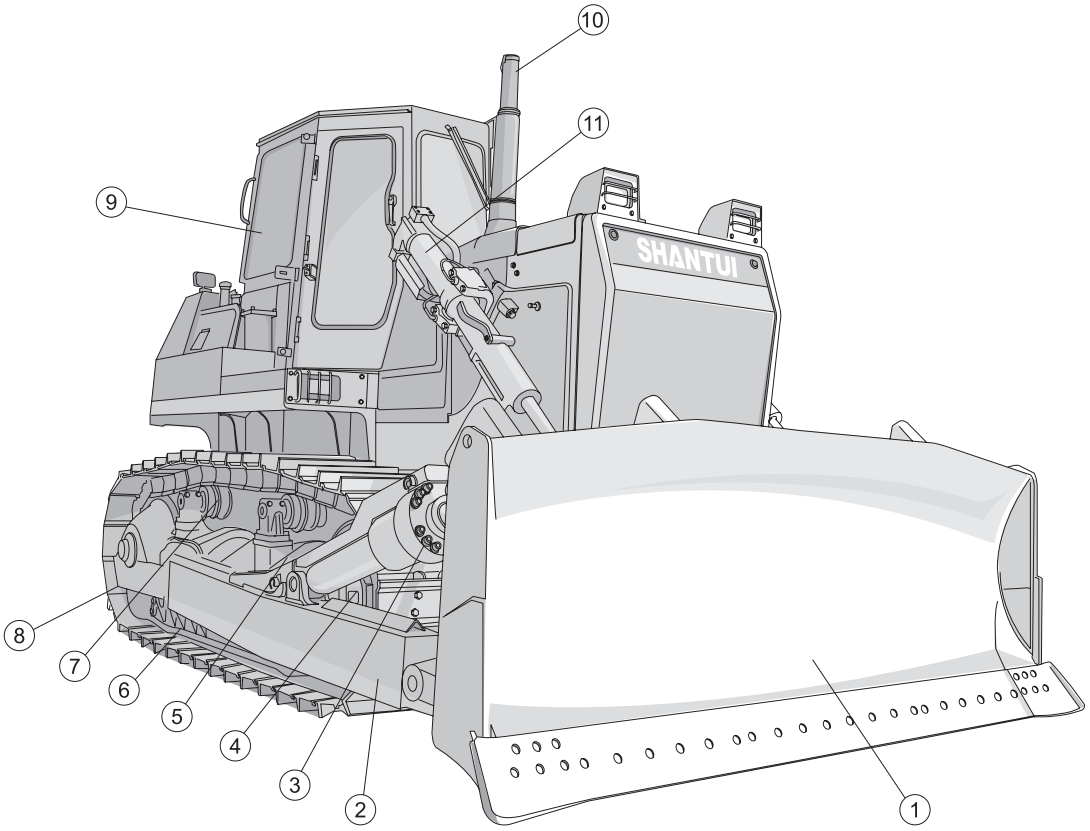


Figure 3-1

No.	Name	No.	Name
1	Blade	2	Push rod
3	Tilt oil cylinder	4	Idler
5	Track frame	6	Track roller
7	Carrier roller	8	Track
9	Cab	10	Exhaust pipe
11	Lift oil cylinder		

3.1.2 SPECIFICATIONS AND TECHNICAL PARAMETERS

Engine

Model	Cummins NT855-C280(BC III)	Weichai WD12
Type	Inline, water-cooled, four-stroke, top-valve direct injection, and turbo diesel engine	
Rate speed	1800rpm	
Rate power	162kw (220HP)	175kW
Cylinder number-cylinder diameter ×stroke	6-139.7mmX152.4mm	6-126mmX155mm
Piston displacement	14.01 L	11.596 L
Minimum fuel consumption	≤205g/kw.h(153g/ps.h)	208g/kW.h
Suitable altitude	Below 3000m	

Travel speed (km/h)

	Gear I	Gear II	Gear III
Forward	0~3.6	0~6.5	0~11.2
Reverse	0~4.3	0~7.7	0~13.2

Track performance curve

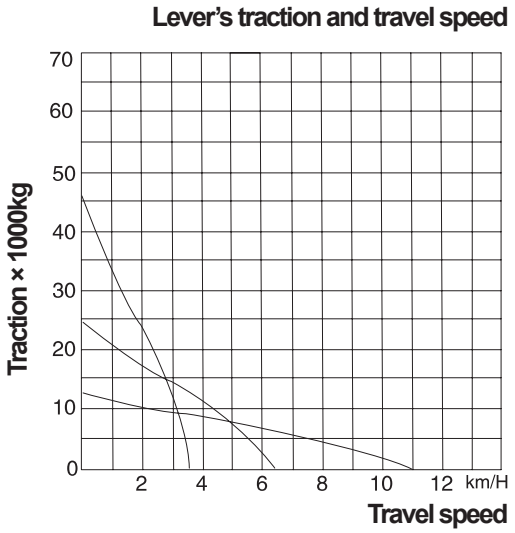


Figure 3-2: Track performance curve

Characteristics of the drive system

1. The hydraulic torque converter: three assemblies, single-level and single-phase.
2. Transmission case: planetary gear, multi-piece clutch, hydraulic, and forced lubrication.
3. Central drive: spiral bevel gear, primary reduction, and splash lubrication.
4. Steering clutch: wet, multi-spring pressed, hydraulic detach, and manual-hydraulic operation.
5. Steering brake: wet, floating band, and hydraulically assisted.
6. Final drive: two-stage straight gear reduction, and splash lubrication.

Walking system

Type:	Swing type of sprayed beam, suspended structure of equalizer bar
Number of carrier roller	2/each side
Number of track rollers:	SD22: 6/each side (four for one-sided and two for two-sided)
	SD22E: 7/each side (four for one-sided and three for two-sided)
Track type:	SD22S: 8/each side (five for one-sided and three for two-sided)
	SD22: Assembled single-track tooth (38 pieces each side)
Track shoe width:	SD22E: Assembled single-track tooth (41 pieces each side)
	SD22S: Assembled arched triangle tooth (45 pieces each side)
	SD22 and SD22E: 560mm (Straight tilt blade, angle blade)
Track pitch:	610mm (U-Blade)
	SD22D: 610mm
	SD22S: 910mm
	216mm

Dozing devices

Parameter \ Model	SD22 and SD22E			SD22S	SD22D
	Straight tilt blade	Angle blade	U-Blade	Straight tilt blade	
Blade width (mm)	3725	4365	3800	4365	4365
Blade height (mm)	1315	1055	1343	1248	1248
Maximum Cutting Depth (mm)	540	535	540	550	550
Maximum lift height (mm)	1210	1290	1210	1330	1420
Blade-maximum tilt (mm)	>735	>500	>755	>500	>800
Maximum blade angle (°)	/	25	/	/	/
Cutting angle (°)	55	55	55	55	55
Mass (Kg)	3630	3850	4196	3478	2900

Ripper

Type: Parallelogram adjustable and removable
Number of gear teeth: 1-3 teeth
Pitch: 1000mm (Three teeth)
2000mm (Two teeth)
Maximum ripping depth: 665 mm
Maximum lift height: 555 mm
Mass: 2900 Kg

Hydraulic system (work equipment)

Maximum operating oil pressure: 14Mpa(140kg/cm^2)
Oil pump type: gear oil pump
Flow: 262L/min (engine speed 1800rpm)
Control value type: Lubricating valve
Tilt cylinder's inner diameter×quantity: Φ120mm×2 (dual-acting)
Tilt cylinder's inner diameter×quantity: Φ200mm×1
Ripping oil cylinder's inner diameter×quantity: Φ150mm×1
Ripper's safety valve pressure: 16Mpa(160kg/cm^2)

Dimensions (Unit: mm)

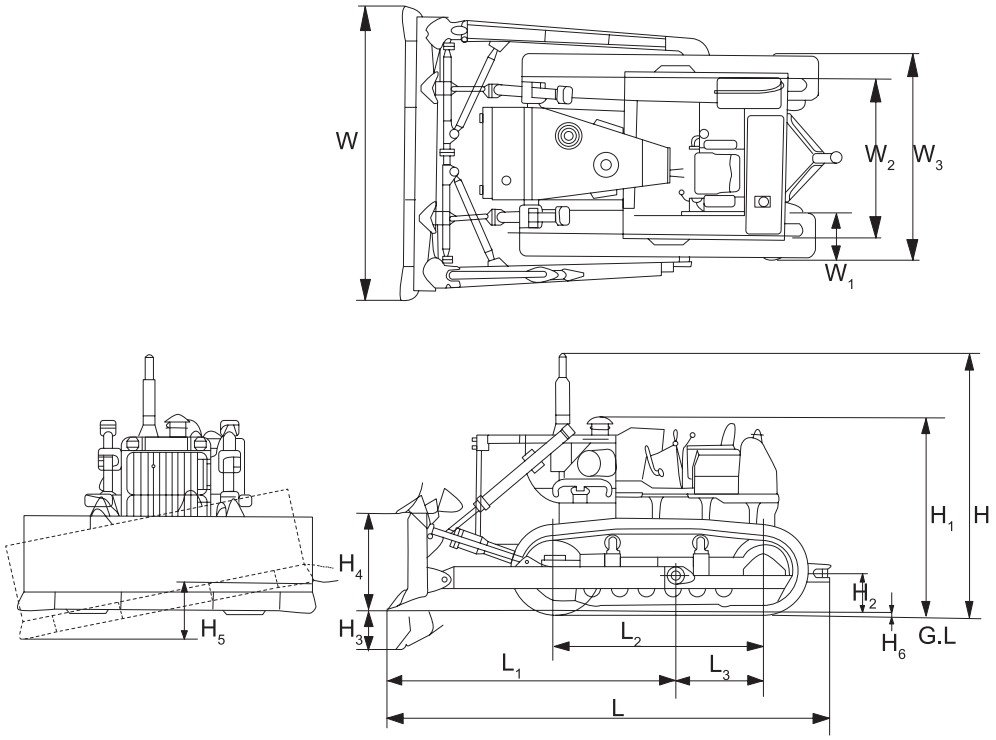


Figure 3-3

Unit: mm

Dimensions (Unit: mm) \ Model		SD22	SD22E	SD22S	SD22D
L		5750	6000	6060	6150
W		3725	3725	4365	4365
H	Do not install the driver's cab	3395	3395	3435	/
	Install the 23Y-56B-00000 cab	3402	3402	3402	3807
L_1		3725	3725	3850	3806
L_2		2730	3050	3480	3050
L_3		1155	1405	1595	1405
W_1		560	560	910	660
W_2		2000	2000	2250	2000
W_3		2620	2620	3160	2660
H_1		2610	2610	2645	2610
H_2		470	470	805	470
H_3		540	540	550	550
H_4		1210	1416	1330	1420
H_5		735	735	500	800
H_6		72	72	123	72

Note: When H>3395. H is the distance from the top surface of the cab installed to the ground. For SD22D, H is the height of the air cleaner's cap from the ground.

Other performance parameters

Parameter \ Model		SD22 and SD22E			SD22S	SD22D
		Straight tilt blade	Angle blade	U-Blade		
Minimum ground clearance (mm)		405	405	405	513	405
Operating weight (kg)	Tractor	19800 (21000)	19800 (21000)	19800 (21000)	22250	/
	Bulldozer	23450 (24600)	23670 (24800)	24020 (25200)	25700	28000
Contact pressure (Mpa)	Tractor	0.065 (0.061)	0.065 (0.061)	0.059 (0.061)	0.034	/
	Bulldozer	0.077 (0.072)	0.077 (0.072)	0.078 (0.073)	0.041	0.070
Minimum turning radius (mm)		3300 (4000)	3300 (4000)	3300 (4000)	3800	4100
Slope climbing performance		30	30	30	30	30
Caterpillar's central distance (mm)		2000	2000	2000	2250	2000
Single blade capacity (m^3)		5.6	4.2	6.2	5.9	5.9
Productivity (m^3/h)		330	245	365	345	345

Note: Operating weight and contact pressure do not include the weight of the cab and the ripper.
Productivity refers to the theoretic value for transporting 40 meters.
The parameter values within the parentheses are the corresponding parameter values of SD22E

TRANSMISSION PRINCIPLE ILLUSTRATION (FIGURE 3-4)

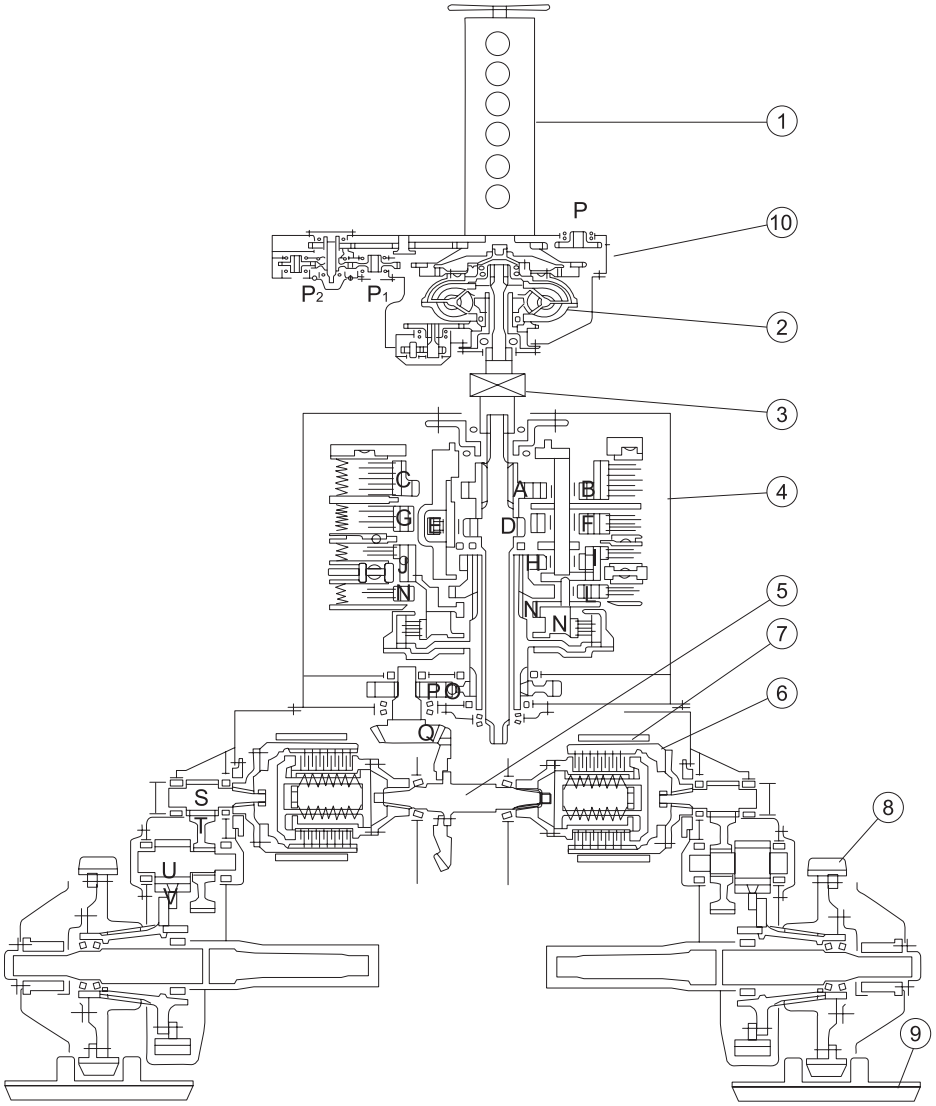


Figure 3-4

No.	Name	No.	Name	No.	Name
1	Engine	5	Central drive	9	Walking system
2	Hydraulic torque converter	6	Steering clutch	10	Transfer case
3	Universal joint	7	Steering brake		
4	Transmission case	8	Final drive		

3.2 ENGINE

3.2.1 ENGINE APPEARANCE (SEE FIGURE 3-5,3-6)

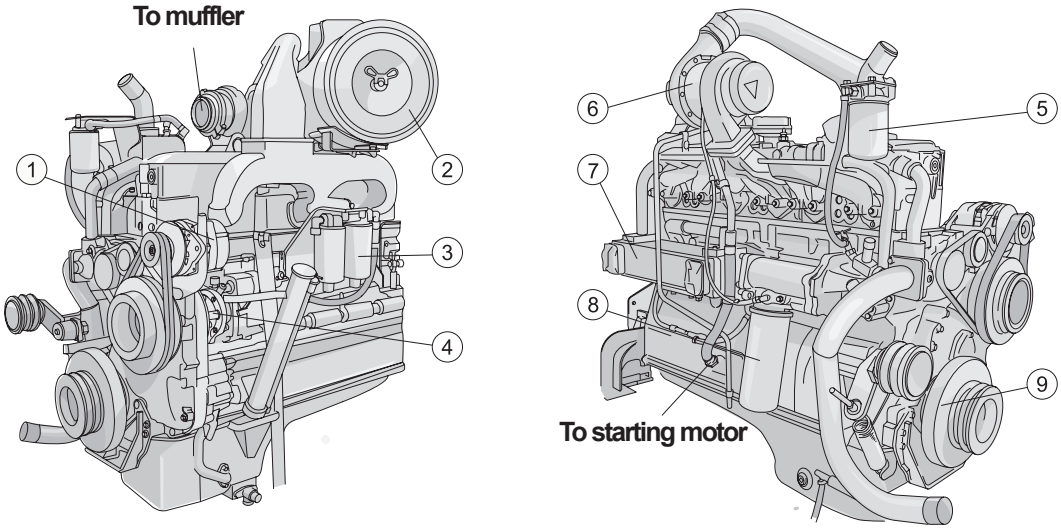


Figure 3-5

No.	Name	No.	Name	No.	Name
1	Alternator	4	P.T. Fuel pump	7	Oil cooler
2	Air cleaner	5	Anti Corrosion tank	8	Engine oil filter
3	Fuel filter	6	Tubocharger	9	Damper

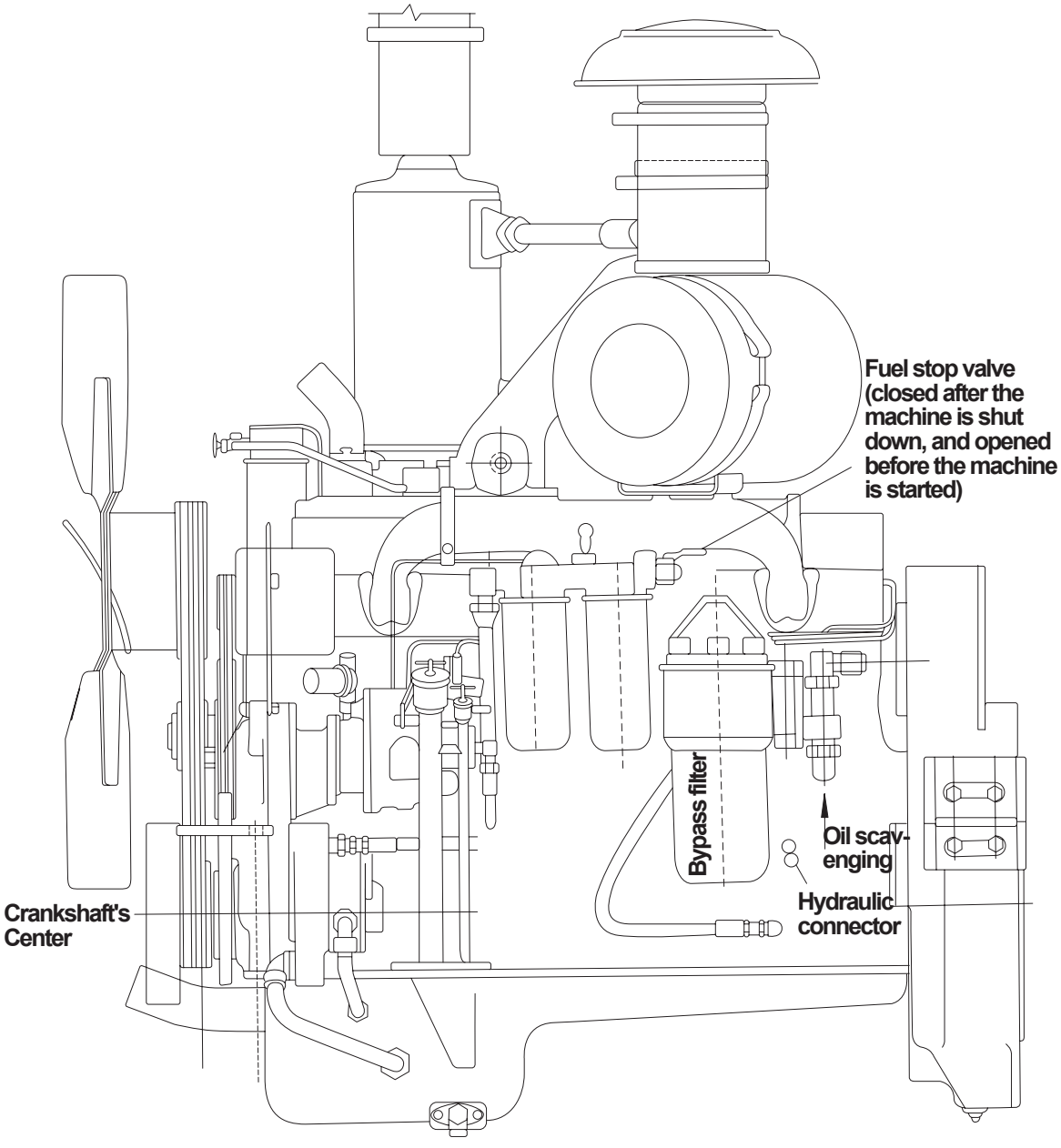

Fuel stop valve (closed after the machine is shut down, and opened before the machine is started)
Bypass filter
Oil scav-enging
Hydraulic connector
Crankshaft's Center

Figure 3-6

3.2.2 ENGINE'S MAIN PERFORMANCE INDICATORS

Main performance parameters

Engine Model		NT855-C280(BC III)	WD12
Number of cylinders-cylinder diameter × stroke (mm)		6—139.7×152.4	6—126×155
Total replacement (L)		14.01	11.596
Ignition sequence		1-5-3-6-2-4	1-5-3-6-2-4
Dimensions	**Overall length (mm)**	1691 (Flywheel housing ~ fan's front end)	1478.9 (Flywheel-Fan pulley's front end)
	Overall width (mm)	1116 (Rear bracket~Rear bracket)	1110 (Rear bracket~Rear bracket)
	Overall height (mm)	2741.9 (Exhaust pipe~Oil pan's purge valve)	2015.5 (Pre-filter~Oil pan's purge valve)
Net weight(kg)		1750	1150
Performance	**Rate speed (rpm)**	1800	1800
	Rate power (kw)	162(220PS)	175
	Maximum torque (N•m/rpm)	1030/1250	1120
	Highest speed without load (rpm)	1950±50	1940+40
	Lowest speed without load (rpm)	600±50	750±50
Minimum fuel consumption rate (g/kw•h)		≤205	208
Charging engine		Silicon rectified generator 24V35A	Silicon rectified generator 24V55A
Starting form		Starting motor 24V11KW	Starting motor 24V6.6KW
Battery		24V195A-h×2	24V195A-h×2
Engine oil pan capacity (L)		45	30
Cooling water capacity (L)		20.8	22

Description of engine's various systems

See engine's User Manual for details.

3.2.3 POWER OUTPUT DEVICES

1. FLYWHEEL HOUSING ASSEMBLY (SEE FIGURE 3-7)

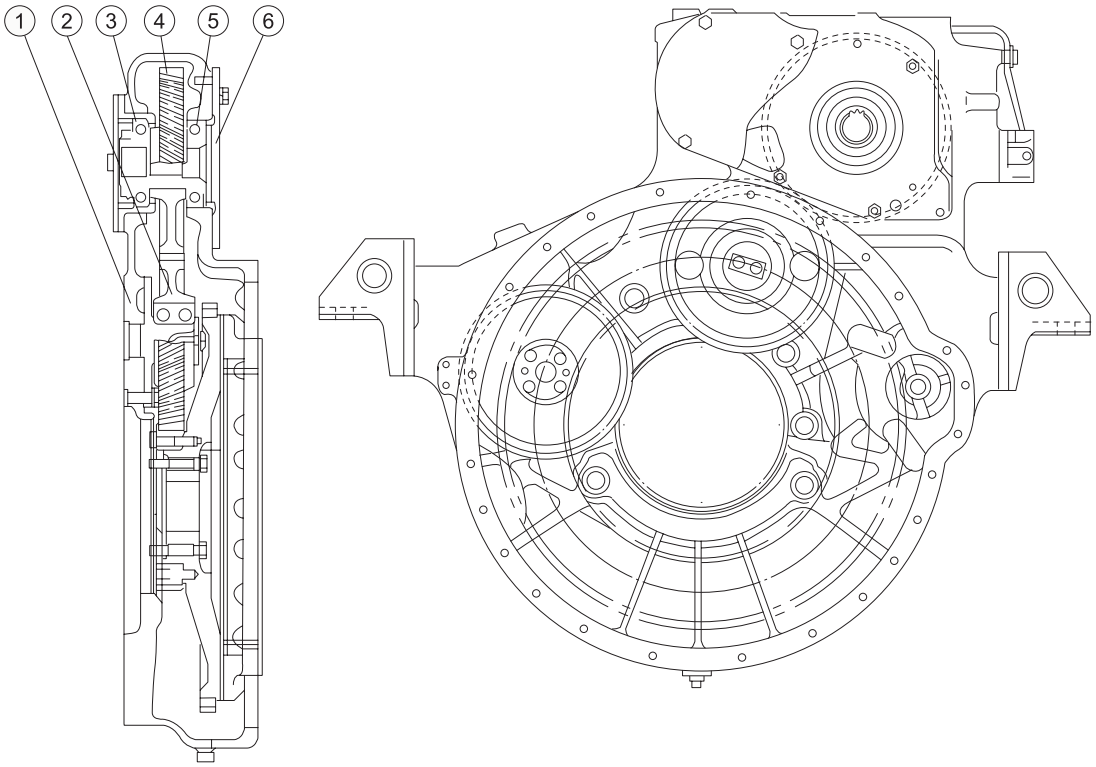


Figure 3-7

No.	Name	No.	Name
1	Flywheel housing	2	Idler (Z=51)
3	Bearing	4	Transfer case's drive gear (Z=56)
5	Bearing	6	Cover

Its main function is power output.

2. TRANSFER CASE (FIGURE 3-8)

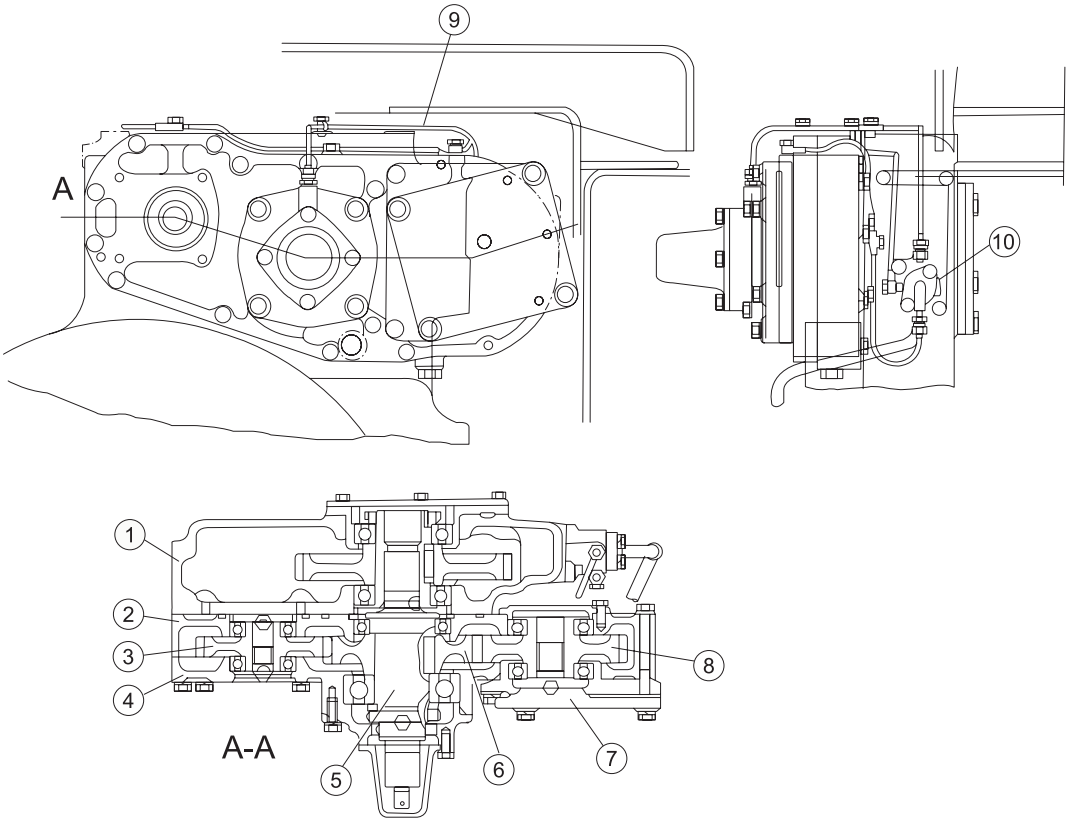


Figure 3-8

No.	Name	No.	Name	No.	Name
1	Flywheel housing	5	Main shaft	9	Lubrication tube
2	Transfer case body	6	Driving wheel	10	Distributer
3	Driven wheel	7	Cover		
4	Transfer case cover	8	Driven wheel		

Transfer case is installed in the upper part of the flywheel's housing. The gear in the upper part of the flywheel's housing drives the main axle (5) and the driving wheel (6) to rotate, thus making the driven wheels (3) and (8) rotate. Remove cover (7) to install the working oil pump. Driven wheel (3) drives the transmission pump. Install the steering pump on the front side of the flywheel's housing. The lubricating oil of the transfer case's gear and bearing comes from the oil cooler's oil returning hose, to be distributed by the distributor (10), and drop to various related parts via the lubricating pipe (9).

3.2.4 RADIATOR ASSEMBLY (SEE FIGURE 3-9)

Radiator mainly consists of upper box (1), radiator (12), lower box (10) and related attachments.

The cooling water flows through thermostat to enter upper box (1), removes air from water, and then flows through the radiator core (12) to enter lower box (10). When the cooling water flows through the radiator core (12), due to the role of the fan in the back end of the radiator, the water in the core is cooled. The cooled cooling water is pumped out from lower box by water pump to the engine's cylinders.

This radiation system is a closed system. The pressure valve installed on the water tank maintains water tank pressure within a range 0.075MPa lower than the gauge pressure, so as to increase the evaporation temperature of the cooling water, to reduce water loss, and to increase cooling efficiency.

The fan's (13) power is transmitted by the V-shaped belt wheel on the front of the engine. The forced air from the fan can enhance the cooling effect.

The SD22D bulldozer's fan pulley (6) is designed to have two specifications. Small pulley is used in summer, and big pulley is used instead in winter when the engine is too cold.

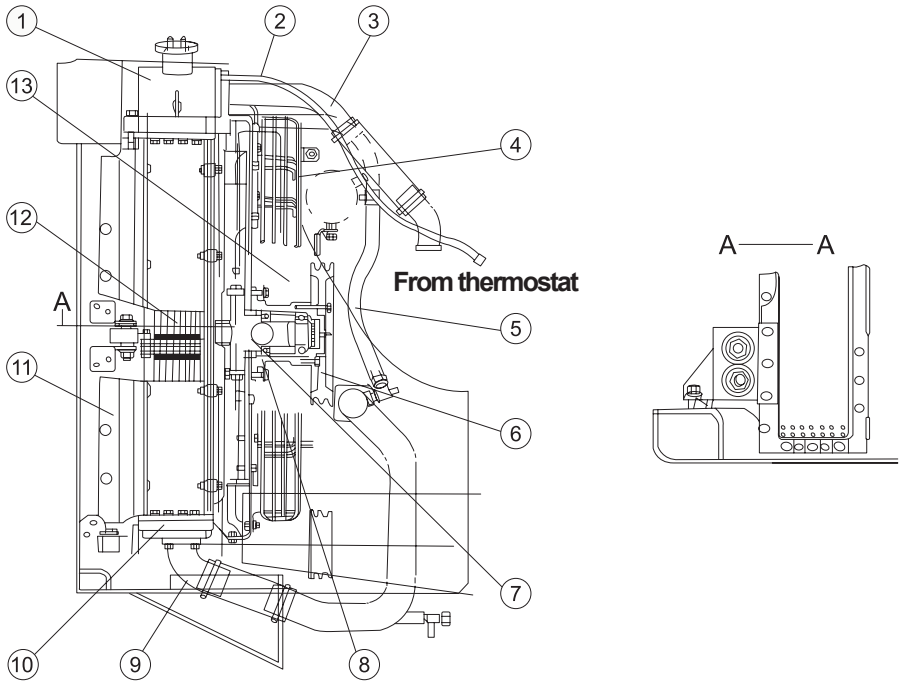


Figure 3-9

No.	Name	No.	Name	No.	Name
1	Upper tank	6	Pulley	11	Guard
2	Hose	7	Shaft	12	Radiator's core
3	Inlet pipe	8	Casing	13	Fan
4	Fan cover	9	Outlet pipe		
5	Hose for adding water	10	Lower tank		

3.2.5 FUEL TANK AND PIPING (SEE FIGURE 3-10)

The fuel tank is installed in the back part of the vehicle. Fuel is injected into the fuel tank through the filter screen. Removing the entrance's cap, you can find the dipstick. Fuel flows from the fuel tank into the fuel injection pump's fuel filter The fuel tank has a fuel stop valve and an oil drain valve on the back.

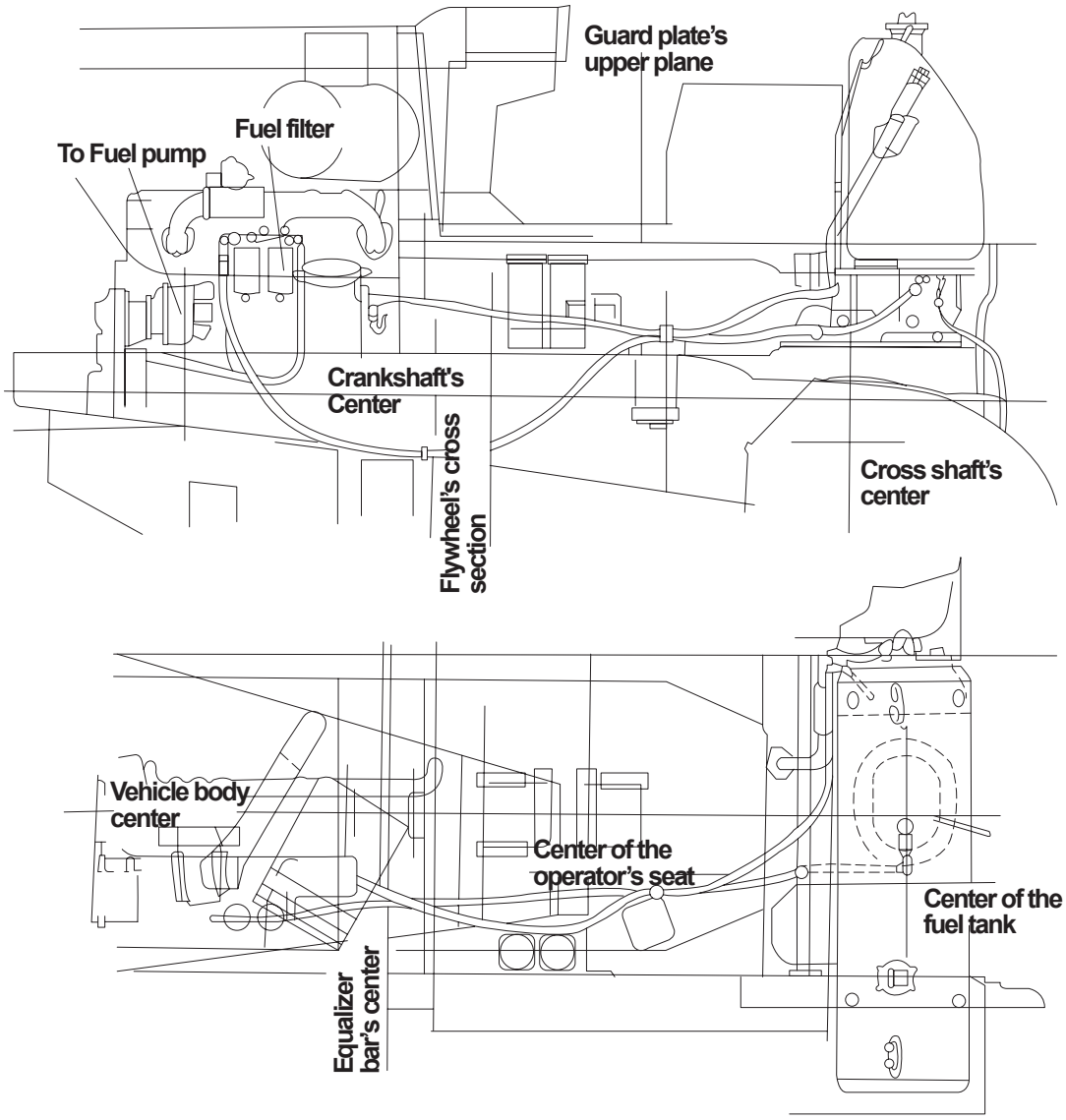


Figure 3-10

3.2.6 ENGINE OPERATION (SEE FIGURE 3-11)

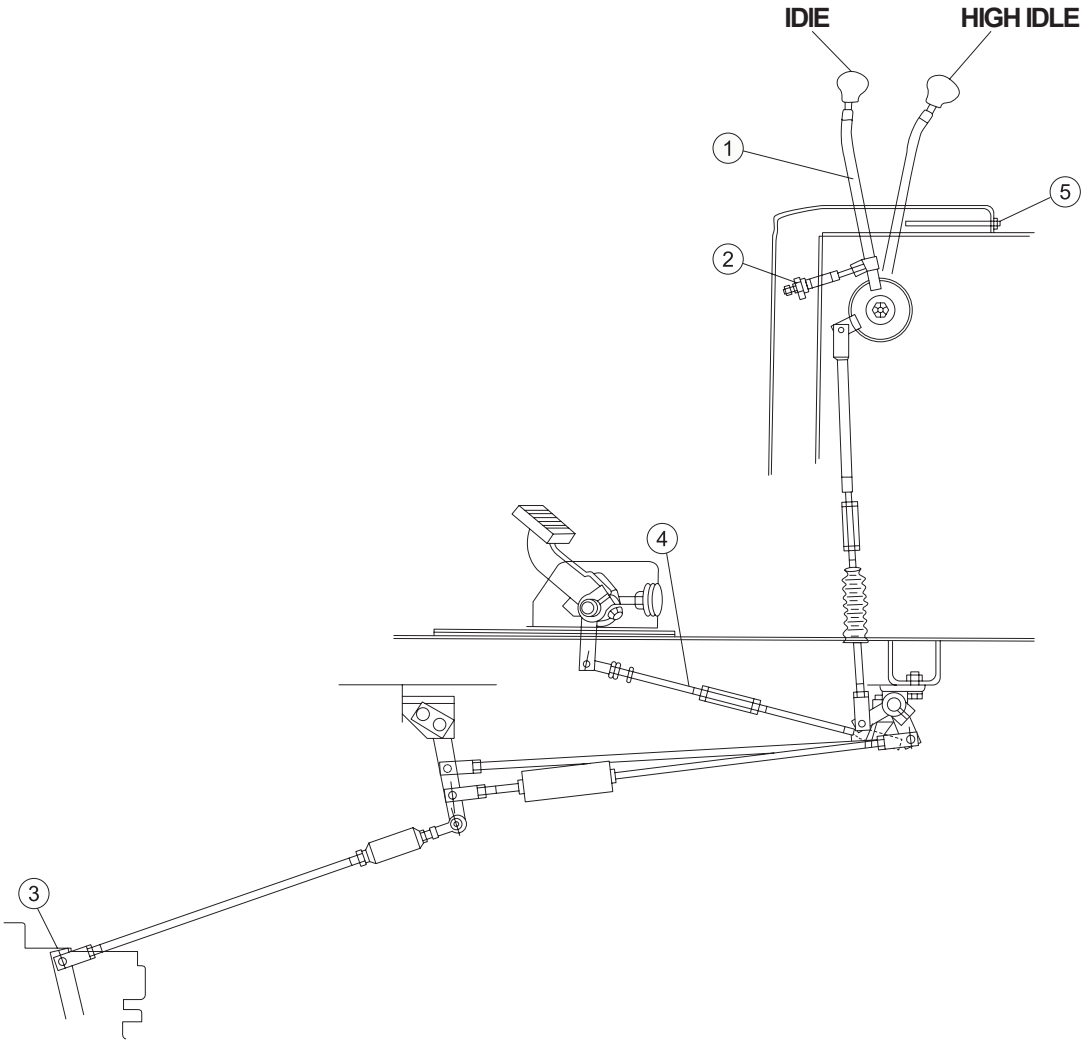


Figure 3-11

No.	Name	No.	Name	No.	Name
1	Fuel control lever	3	Rock arm	5	High-speed adjustment screw
2	Idle adjustment screw	4	Lever		

3.2.7 HYDRAULIC TORQUE CONVERTER (FIGURE 3-12)

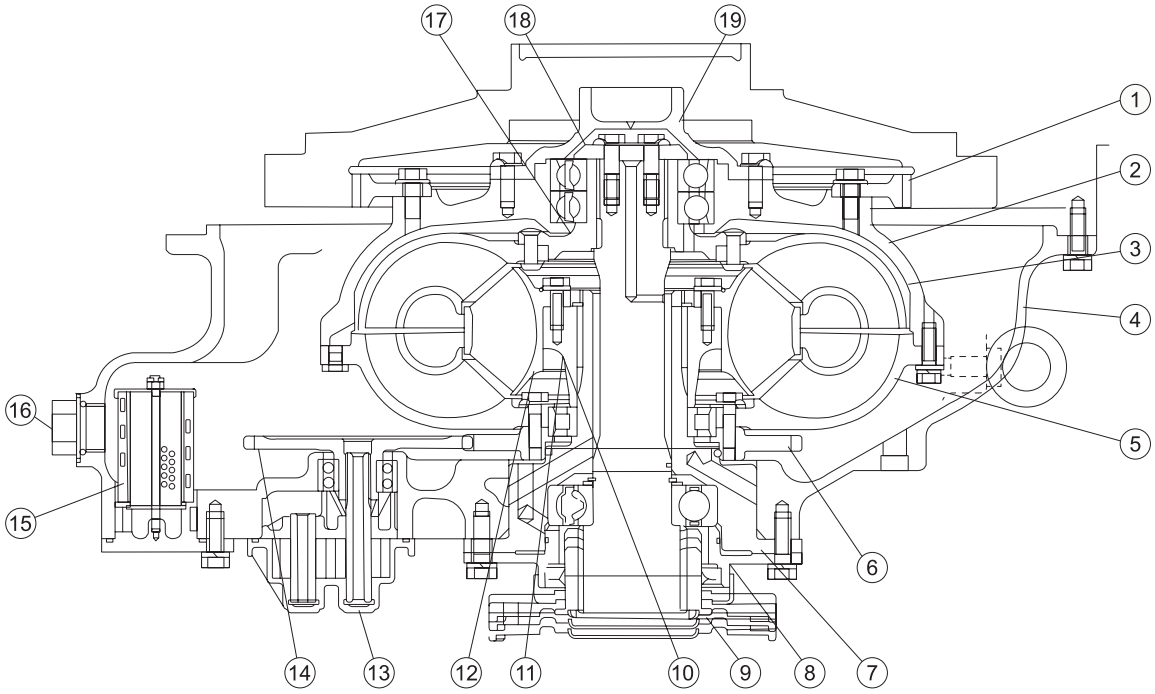


Figure 3-12

No.	Name	No.	Name	No.	Name
1	Driving gear	8	Cover	14	Driving gear
2	Drive shell	9	Shaft coupling	15	Coarse strainer
3	Turbine	10	Turbine output shaft	16	Discharge outlet
4	Torque converter housing	11	Guide roller axle's hub	17	Turbine hub
5	Pump impeller	12	Guide roller	18	Binder plate
6	Driving gear	13	Fuel pump housing	19	Guider
7	Guide roller’s axle	14	Driving gear		

This machine uses the three-component one-stage and one-phase hydraulic torque converter.

The pump impeller (5), turbine wheel (3) and guide roller (12) are full of the operating oil. When the pump impeller (5) rotates, the pump impeller will force the oil to impact the turbine wheel's blade, so as to make the turbine wheel rotate. The oil flows from the turbine wheel into the guide roller, and flows out of the guide roller, to enter the pump impeller's intake and complete the cycling process of the oil.

The guide roller can change the rotation movement of the liquid, so it make increase the turbine wheel's torque. But the turbine wheel's torque changes with the operating conditions. Therefore, when load increases, the turbine wheel will bear a higher resisting torque, so as to automatically reduce speed. Therefore, the hydraulic torque converter can ensure the smooth operation of the machine.

The power input route is: Driving gear (1) → Drive shell (2) → Pump impeller (2).

The power output route is: Turbine wheel (3) → Turbine hub (17) → Turbine wheel's output shaft (10).

3.3 UNIVERSAL JOINT (FIGURE 3-13)

The role of the universal joint is to transmit the power between the hydraulic torque converter and the transmission case. It can ensure that when the coaxiality of the turbine wheel's output shaft and the center line of the transmission case's main is within the allowed range, the power can be smoothly transmitted.

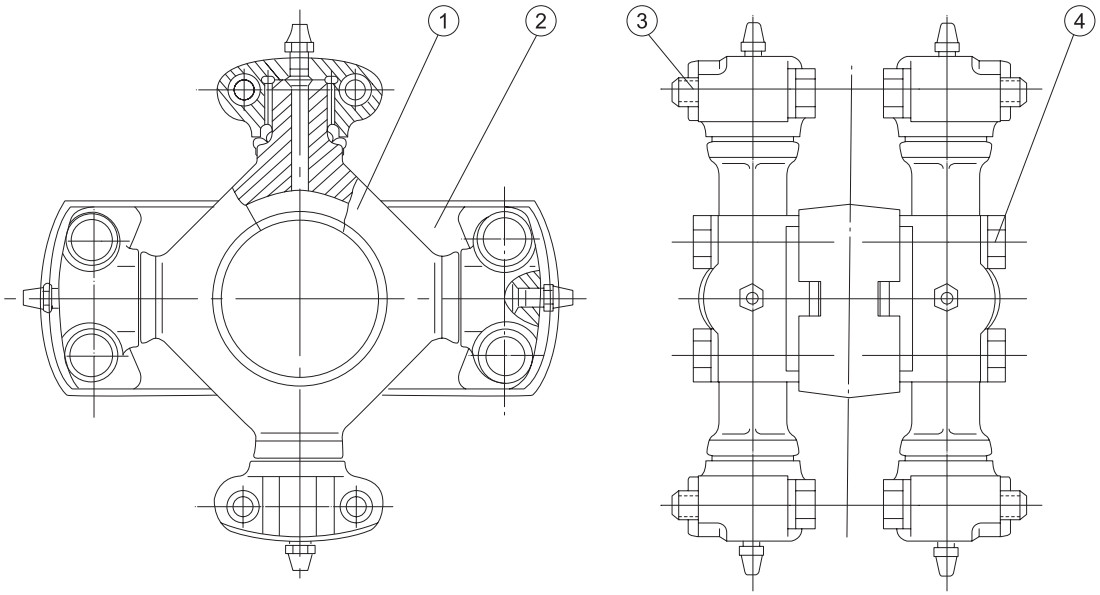


Figure 3-13

No.	Name	No.	Name
1	Cross shaft coupling assembly	2	Connecting plate
3	Bolt	4	Bolt

3.4 TRANSMISSION CASE (FIGURE 3-14)

The role of the transmission case is:

1. To realize the machine's FORWARD and REVERSE.
2. To get different transmission ratios (including stopping).

- This machine uses the planetary gear multi-disc clutch structure. Relying on hydraulic force and operated by the control valve, it can provide three forward gears and three reverse gears.
- No.1 Clutch is FORWARD, No.2 is REVERSE, No.3 is the third gear, No.4 is the second gear, and No.5 is the first gear.

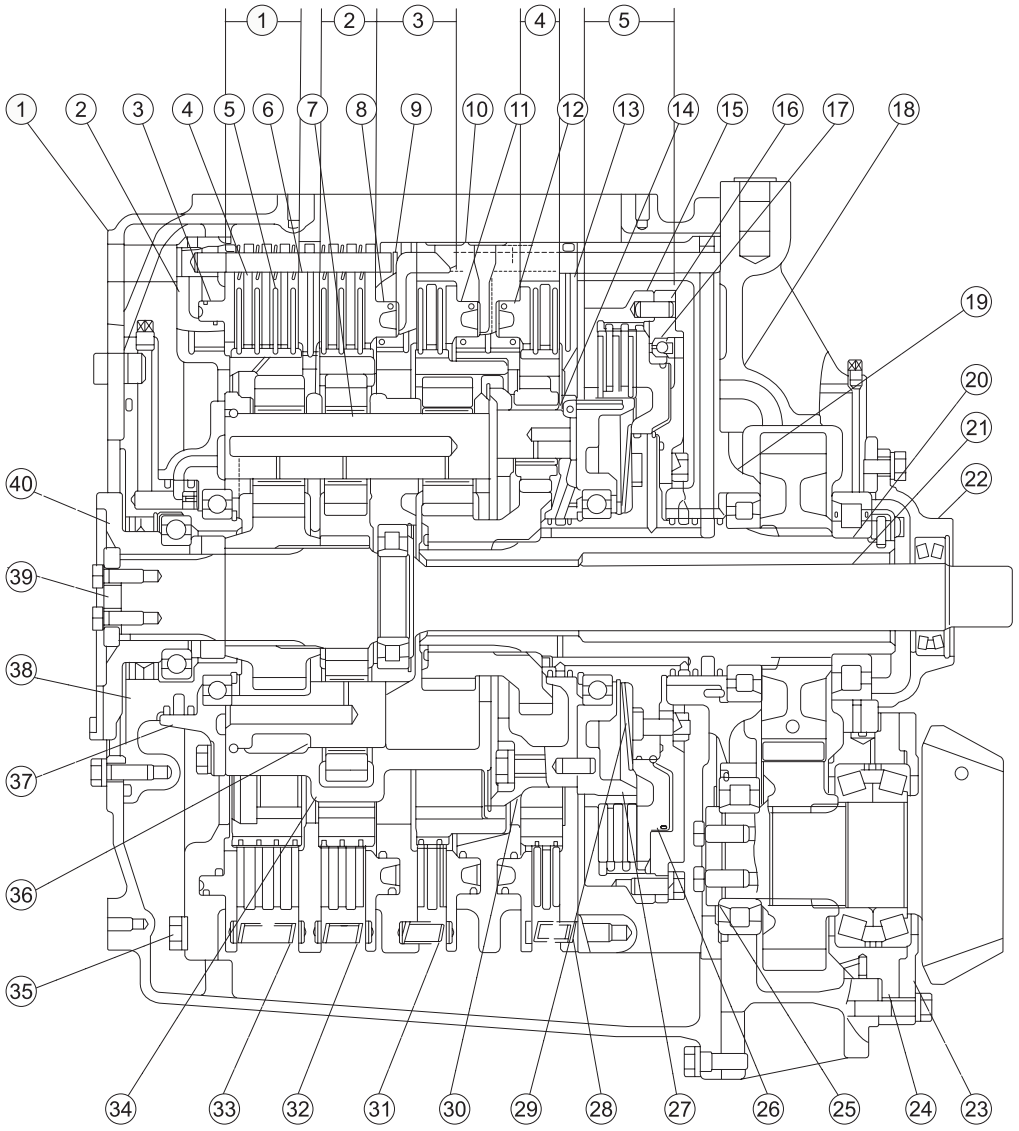


Figure 3-14

No.	Name	No.	Name
1	Transmission case housing	21	Input shaft
2	The first clutch's oil cylinder body	22	Bearing support
3	The first clutch's piston	23	Cover
4	The brake's driving disc	24	Bearing Cover
5	Friction disk	25	Bearings' guard plate
6	Plate	26	The fifth clutch's piston
7	The first, the second and the third rows of planetary pinion's axis	27	The fifth clutch's inner hub
8	The second clutch's piston	28	The fourth planetary row's spring
9	The second clutch's oil cylinder body	29	Butterfly-shaped spring
10	The third and the fourth clutchs' oil cylinder body	30	The fourth row of carrier
11	The third clutch's piston	31	The third planetary row's spring
12	The fourth clutch's piston	32	The second planetary row's spring
13	Plate	33	The first planetary row's spring
14	The fourth row of planetary pinion's axis	34	The first, the second and the third rows of carrier
15	The fifth clutch's outer hub	35	Bolt
16	The fifth clutch's oil cylinder body	36	The second row of planetary pinion's axis
17	Check valve's steel ball	37	Bearing support
18	Box body (Rear)	38	Bearing support
19	Housing body	39	Retainer
20	Out sleeve	40	Shaft coupling

Gear position		Working clutch
FORWARD	Gear 1	No.1, No.5
	Gear 2	No.1, No.4
	Gear 3	No.1, No.3
REVERSE	Gear 1	No.2, No.5
	Gear 2	No.2, No.4
	Gear 3	No.2, No.3

3.4.1 PLANETARY GEAR MECHANISM'S PRINCIPLE AND CLUTCH MECHANISM

Planetary gear's operating principle (See figure 3-15)
The planetary gear mechanism shown in the figure is consisted of sun wheel (A), planetary pinion (B), gear rim (C), and carrier (D). planetary pinion (B) is installed on carrier (D). It also engages with sun wheel (A) and gear rim (C) at the same time.

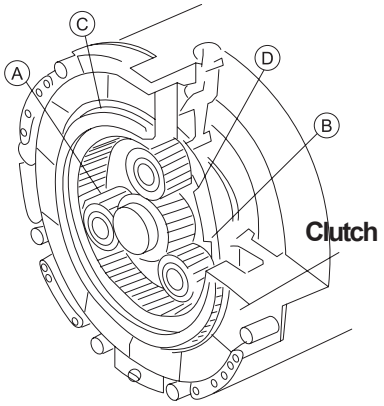


Figure 3-15

No.	Name	No.	Name
A	Sun wheel	B	Planetary pinion
C	Gear ring	D	Carrier

1. If the gear rim is fixed, the motion is transmitted from sun wheel (A) to planetary pinion (B). In this case, planetary pinion (B) rotates on its own on the one hand, and its axis also revolves around sun wheel (A). In the structure shown in the figure, the revolution direction of the planetary pinion's axis is the same as that of sun wheel (A). (See Figure 3-16) (See Figure 3-16)

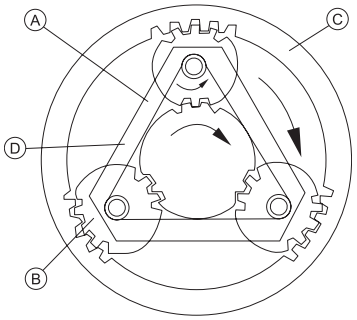


Figure 3-16

2. If carrier (D) is fixed, the motion is transmitted from sun wheel (A) to planetary pinion (B), and is again transmitted by (B) to gear rim (C), to make gear rim (C) rotate. In the structure shown in the figure, the rotation direction of gear rim (C) is opposite to that of sun wheel (A). (See Figure 3-17) (See Figure 3-17)

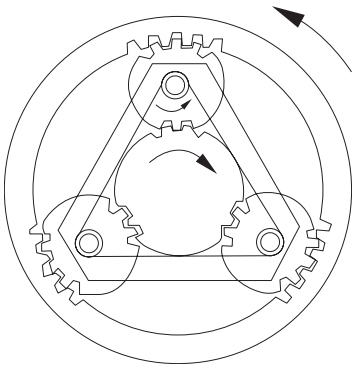


Figure 3-17

The above principle is the structural principle of the first, third, and fourth rows of the planetary gear mechanism.
In the first row of the planetary gear mechanism, sun wheel (A) is the driving part. In the third and the fourth rows of the planetary gear mechanism, carrier (D) is the driving part.

To obtain an output rotation direction opposite to that described above, you just need to add a group of planetary gear (E) (see Figure 3-18). The (A)→(B)→(E)→(C) motion transmission form is the structural principle of the second row of the planetary gear mechanism.

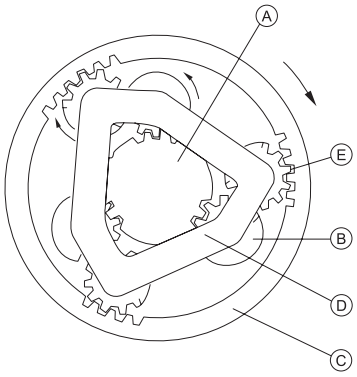


Figure 3-18

No.	Name	No.	Name
A	Sun wheel	B, E	Planetary pinion
C	Gear ring	D	Carrier

Various clutch mechanisms (see Figure 3-28)
The transmission case's fifth row of clutch is a lock clutch.

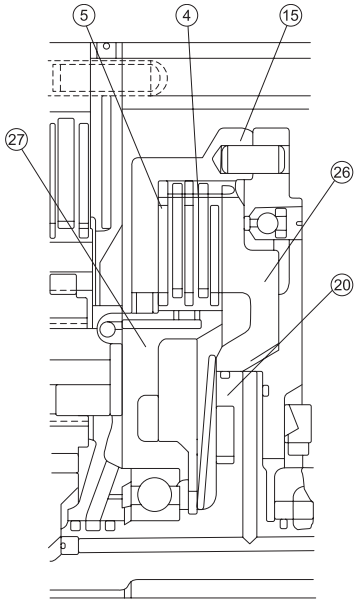


Figure 3-19

The fixing method for each row of the planetary gear rim is shown in Figure 3-29. It is realized through clutch.

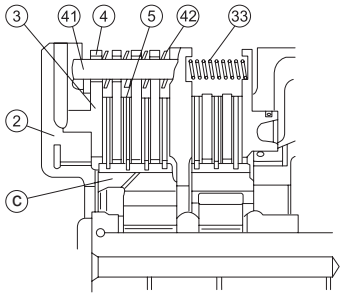


Figure 3-20

The engagement of clutch is realized by driving piston (3) through the pressure from the control valve. (See Figure 3-21) (See Figure 3-21)

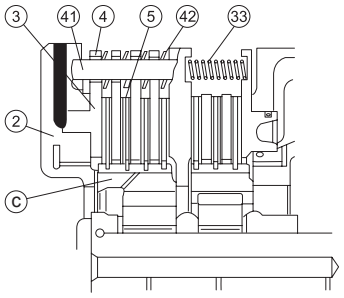


Figure 3-21

The disengagement of clutch is realized by pushing piston (3) to its original place through reset spring (33) after the pressure oil is cut off (see Figure 3-22). (42) is the butterfly-shaped spring. Its role is to accelerate the returning speed of piston (3), to improve the separation effect of the driving and driven friction disks.

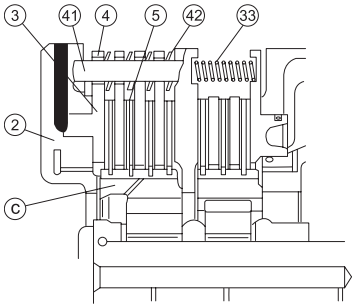


Figure 3-22

Figure 3-23 is the structural scheme of the fifth row of clutch. When this clutch is disengaged, the working oil in the back space of oil cylinder (16) is under the action of the centrifugal force generated through rotation, and therefore relying on the butterfly-shaped spring (29) alone can't ensure the rapid separation of the friction disks. This will put the clutch in a semi-disengaged state, and a fault may occur when you change the gear next time. In order to eliminate this phenomenon, the steel ball check valve (17) is put inside.

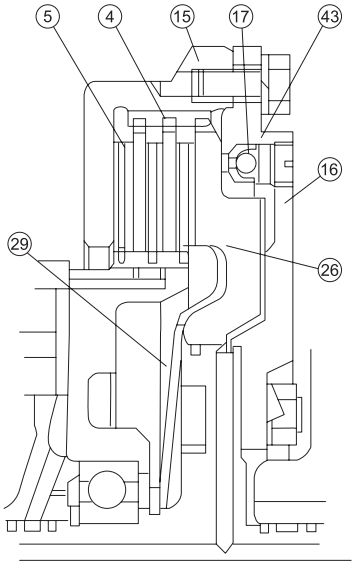


Figure 3-23

When the fifth row of clutch is engaged (see Figure 3-24), the pressure oil from the control valve enters the oil chamber to push piston (26). Meanwhile, the pressure oil also pushes the check valve's steel ball (17), to block the valve seat's orifice, so that the clutch is rapidly engaged.

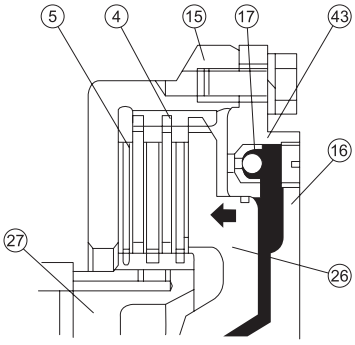


Figure 3-24

When the pressure oil from the control valve is cut off, due to the centrifugal force, the steel ball (17) moves toward the direction indicated by the arrow in Figure 3-25. In this case, the valve seat's orifice is opened, and the working oil in the back space of oil cylinder (16) is drained out through the valve seat's orifice, to ensure the normal separation of the friction disks.

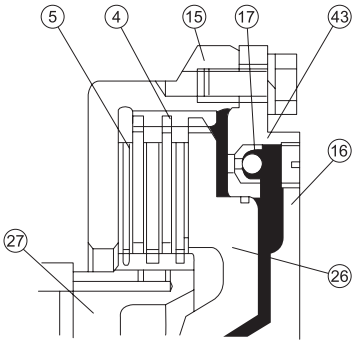


Figure 3-25

3.4.2 THE POWER TRANSMISSION ROUTE OF THE VARIOUS GEARS OF THE TRANSMISSION CASE

Transmission route of the first gear FORWARD (See Figure 3-26)

In this case, the first and the fifth clutches are engaged at the same time.

The power transmission sequence is: A→B→(34)→J→O→P→Q (Clutches J, N, H, K, and L are combined into one)

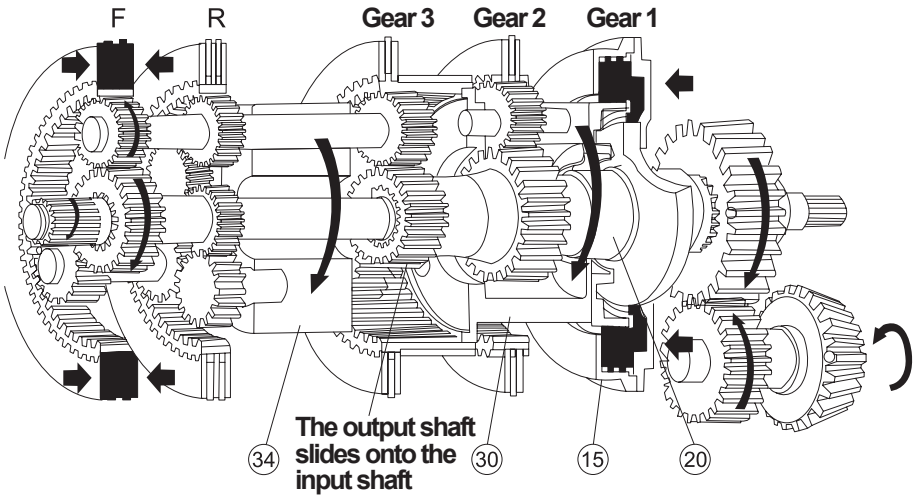


Figure 3-26

Transmission route of the second gear FORWARD (See Figure 3-27)

At this point, the first and the fourth clutches are in the engaged state, and the first and the fourth gear rims are fixed.

The power transmission route is: A→B→(34)→J→(30)→L→K→O→P→Q

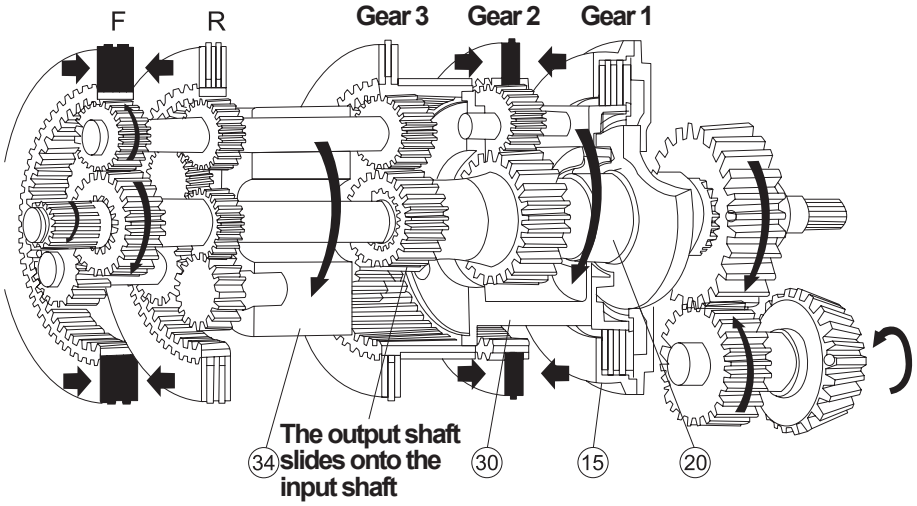


Figure 3-27

Transmission route of the third gear FORWARD (See Figure 3-28)
At this point, the first and the third clutches are in the engaged state at the same time.
The power transmission route is: A→B→(34)→J→I→H→O→P→Q

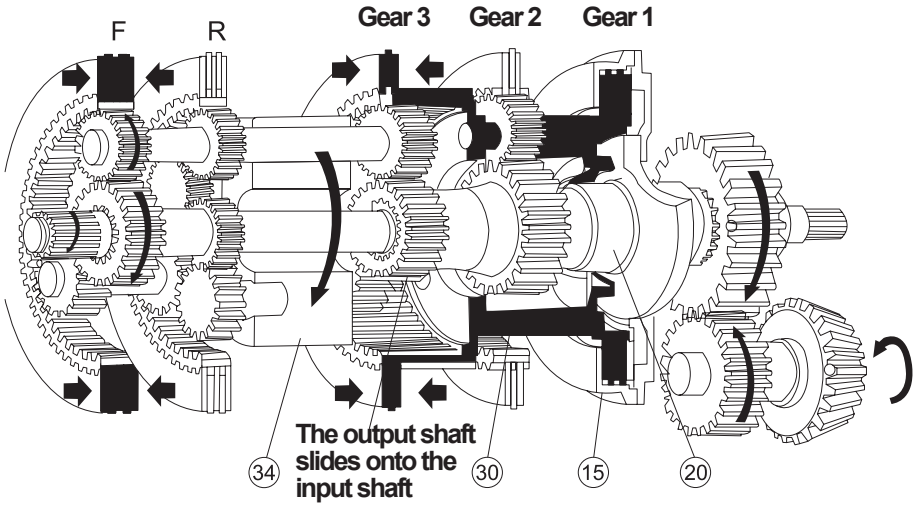


Figure 3-28

Transmission route of the first gear REVERSE (See Figure 3-29)
At this point, the second and the fifth clutches are in the engaged state at the same time.
The power transmission sequence is: D→E→F→(34)→I→J→O→P→Q (Clutches J and K are combined into one)

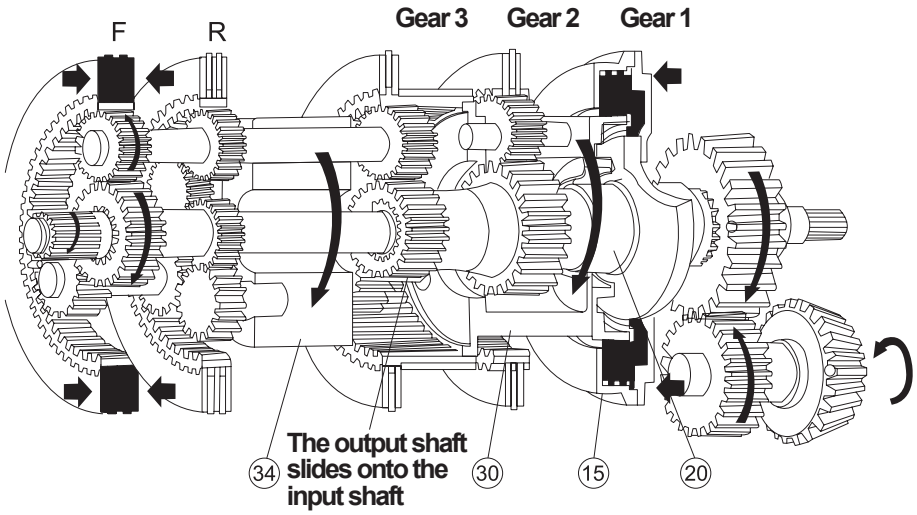


Figure 3-29

The transmission route of the second gear REVERSE and the third gear REVERSE is omitted.
As long as the second and the fourth clutches can be engaged at the same time, you can get the second gear REVERSE. And as long as the second and the third clutches can be engaged at the same time, you can get the third gear REVERSE.

3.5 CENTRAL DRIVE (SEE FIGURE 3-30)

The main role of the Central drive is: 1. To change the power transmission direction (to change from longitudinal to horizontal). 2. To apply primary reduction, to increase torque. The Central drive, the steering clutch and the steering brake are all installed in the cavity of the steering case.

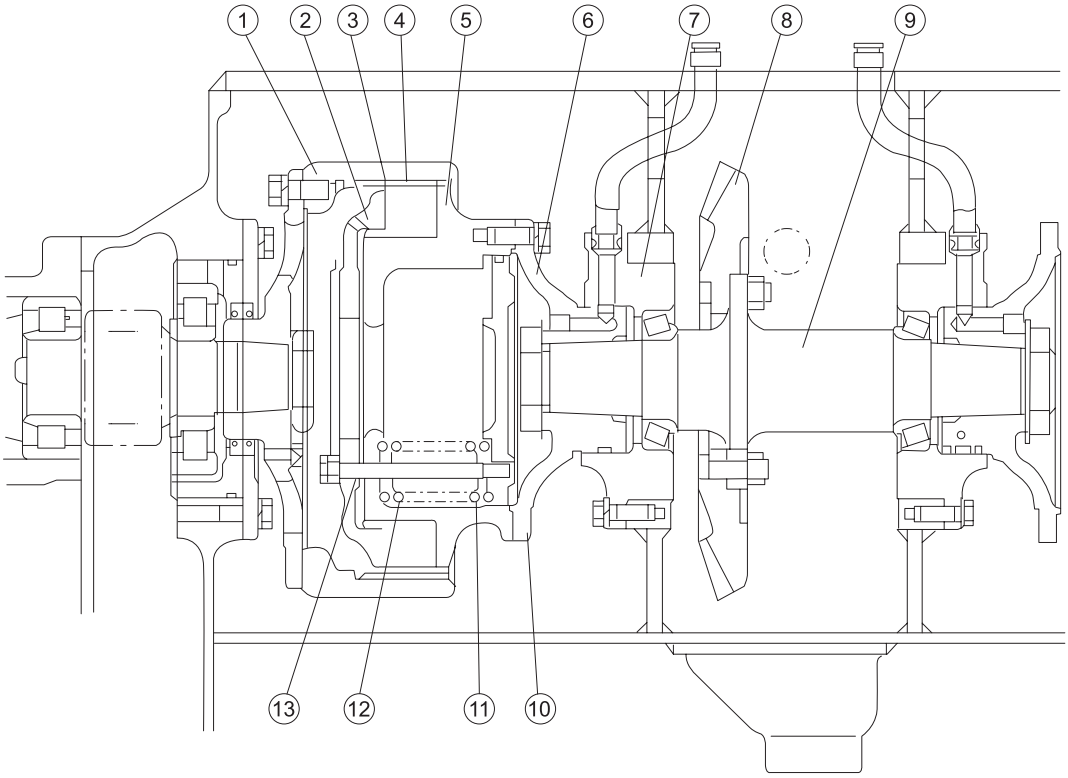


Figure 3-30

No.	Name	No.	Name	No.	Name
1	Outer hub	6	Hub	11	Big spring
2	Platen	7	Bearing support	12	Small spring
3	Outer friction disk	8	Big bevel gear	13	Bolt
4	Inner tooth	9	Cross shaft		
5	Inner drum	10	Adjusting gasket		

The central drive consists of the big bevel gear (8) (engaged with the transmission case's output gear), the cross shaft (9), the bearing support (7), and the bearings. The correct engagement of a pair of bevel gears can be achieved by adjusting the adjusting gasket (10) as well as the adjusting gasket between the transmission case's small bevel gear assembly and the housing. You can judge it by checking the tooth side's clearance and the engagement impression.

The standard clearance of a pair of the spiral bevel gears is 0.25~0.33mm. The engagement impression along the tooth length direction should not be smaller than half of the tooth's length, and should be closer to the smaller end along the tooth length direction (30% more on the smaller end). The height should be half of the tooth's height. See Figure 3-31.

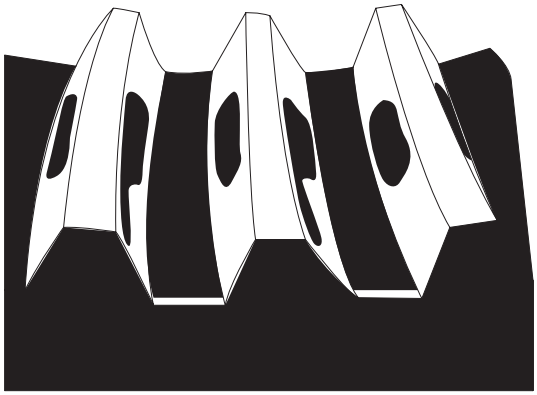
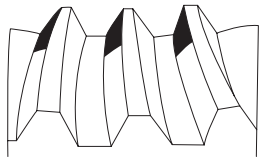
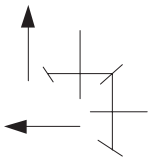
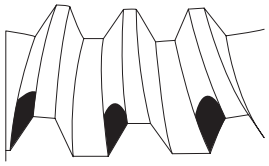
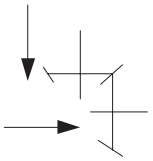
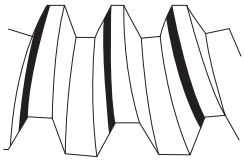
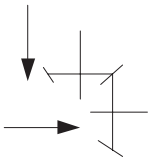
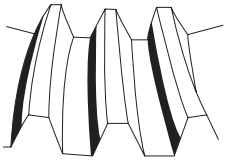
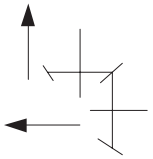
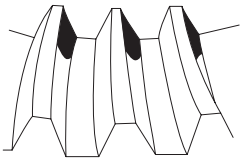
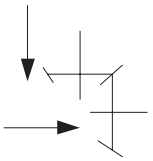
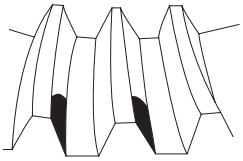
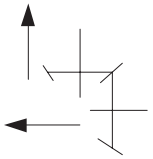
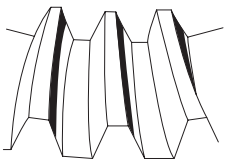
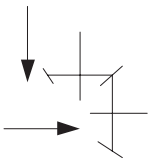
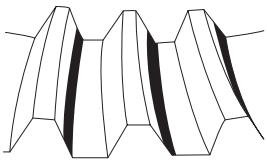
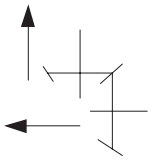


Figure 3-31

If the engagement is not normal, make adjustment using the methods in the table below.

Position of the contact impression on the passive tooth surface		Adjustment method	Gear moving direction
FORWARD		Move the driven gear toward the driving gear. If this makes the clearance too small, move the driving gear outward.	
		Move the driven gear away from the driving gear. If this makes the clearance too big, move the driving gear inward.	
REVERSE		Move the driving gear toward the driven gear. If this makes the clearance too small, move the driving gear outward.	
		Move the driving gear away from the driven gear. If this makes the clearance too big, move the driving gear inward.	
FORWARD		Move the driving gear toward the driven gear. If this makes the clearance too small, move the driving gear outward.	
		Move the driving gear away from the driven gear. If this makes the clearance too big, move the driving gear inward.	
REVERSE		Move the driven gear away from the driving gear. If this makes the clearance too big, move the driving gear inward.	
		Move the driven gear toward the driving gear. If this makes the clearance too small, move the driving gear outward.	

3.6 STEERING CLUTCH

The steering clutches are located in the left & right chambers of the steering case, with one on each side. Their role is to connect or cut off the power from the central drive to the final drive, to realize various actions including the entire vehicle's forward, reverse, turn, and stop.

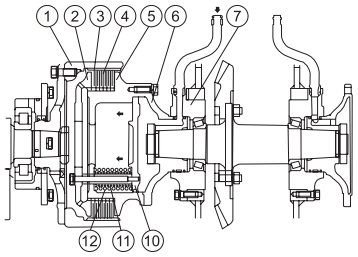


Figure 3-32

Steering clutch's structure mainly consists of the inner & outer drums, the platen, the inner & outer friction disks, and the spring.

This machine adopts a wet, multi-piece, spring-pressed, hydraulically-detached long-engagement structure.

Normally, due to the spring, the inner & outer friction disks are connected, and the power from the cross shaft is transmitted to the final drive disc through wheel (6)→inner drum (5)→inner tooth (4)→outer friction disk (3)→outer drum (1).
When the steering lever is pulled, the pressure oil from the steering control valve enters the inner cavity of the inner drum (6) (See Figure 3-32) to push the piston (10), bolt and platen (2) to move to the arrow direction (Overcome the pressure of the big and small springs), so as to disengage the friction connection between the inner tooth (4) and the outer friction disk (3), to stop the outer drum (1) from rotating, so as to cut off the power transmission.

When the steering lever is released, the oil pressure is cut off, and due to the pressure of the big & small springs, the above parts are forced to move in the direction indicated in the figure, to enable the inner tooth (4) and the outer friction disk to become engaged, to realize the transmission of power. (See Figure 3-33)

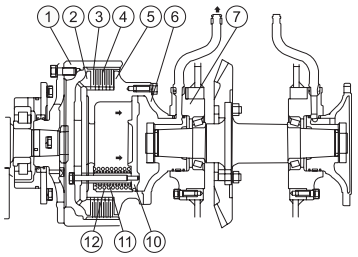


Figure 3-33

3.7 STEERING BRAKE

This machine uses the wet, belt-style floating brake with a hydraulic booster.

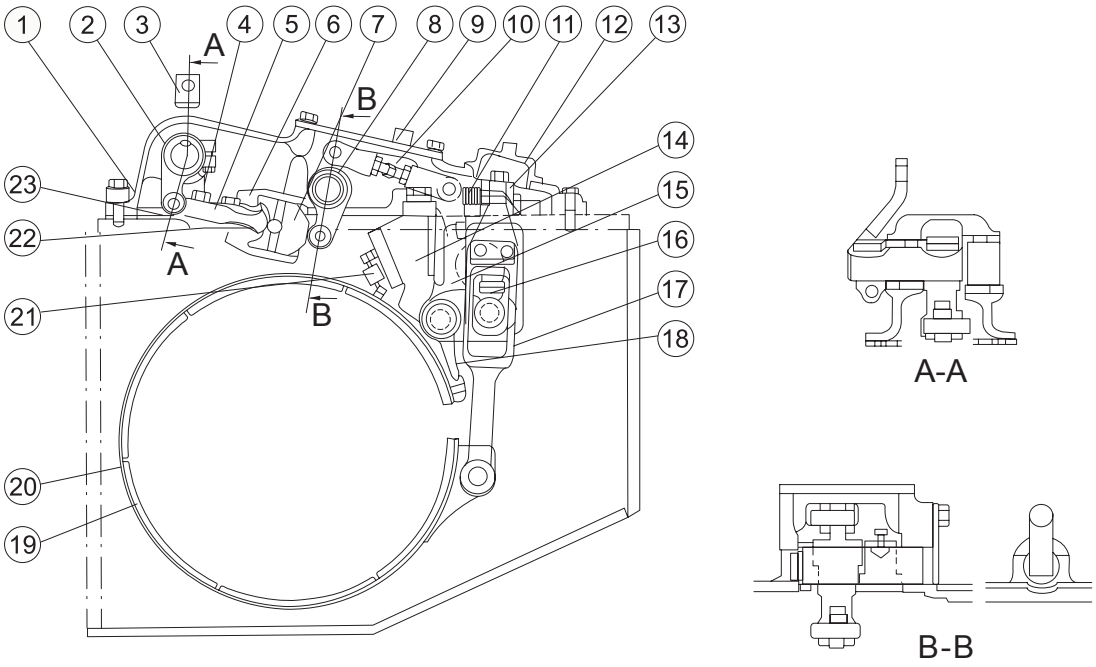


Figure 3-34

No.	Name	No.	Name	No.	Name
1	Brake cover	9	Cover	17	Lever
2	Rock arm	10	Studs	18	Tail end
3	Rock arm	11	Adjusting spring	19	Brake lining
4	Spring	12	Cover	20	Brake band
5	Slide valve	13	Adjusting bolt	21	Spring
6	Valve body	14	Bracket	22	Bushing
7	Piston	15	Lever	23	Spring seat
8	Rock arm	16	Block		

Its role is to hold the steering clutch's outer drum tightly, to stop the final drive's gear from rotating, so as to let the vehicle turn or stop.

3.7.1 WORKING PRINCIPLE

When the vehicle moves forward, the steering clutch's outer drum rotates forward (See Figure 3-35). Slightly apply brake force on the brake pedal, the clearance between the brake band and the outer drum will be reduced until certain points are in contact. Due to the friction force, the upper part of the brake band pushes against the tail end, to let Pin A enter the groove of lever (15). If the brake force continues to be applied, lever (17), Pin B, and lever (15) will move in the arrow direction, to hold the outer drum tight. At this point, A is the fulcrum of rotation.

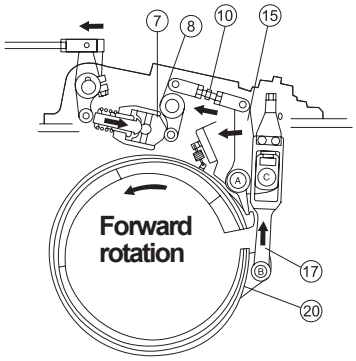


Figure 3-35

When the vehicle moves in the reverse direction, the clutch's outer drum rotates backward (See Figure 3-36), whereas lever (17), Pin B, and lever (15) move in the direction indicated in the figure, to hold the outer drum tight. But at this point, the rotation fulcrum has already been transferred Point C.
The brake results of the two are basically the same.

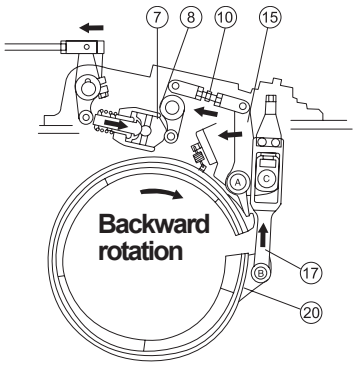


Figure 3-36

3.7.2 SERVO MOTOR VALVE'S WORKING PRINCIPLE

The use of the servo motor valve can dramatically reduce the brake operation force of the driver. During braking, rock arm (2) pushes slide valve (5), to make the clearance between slide valve (5) and piston (7) disappear, and the oil pressure from the pump pushes piston (7) to operate rock arm (8) to realize braking. But due to the movement of piston (7), a clearance will appear again between slide valve (5) and piston (7) for sure. In order to ensure uninterrupted move, the brake pedal must move continuously.

3.8 FINAL DRIVE

This machine uses the two-stage straight gear reduction mechanism.
The role of the final drive is to increase the output torque through the two-stage reduction, and at the same time, to transmit the power through the sprocket to the walking mechanism.

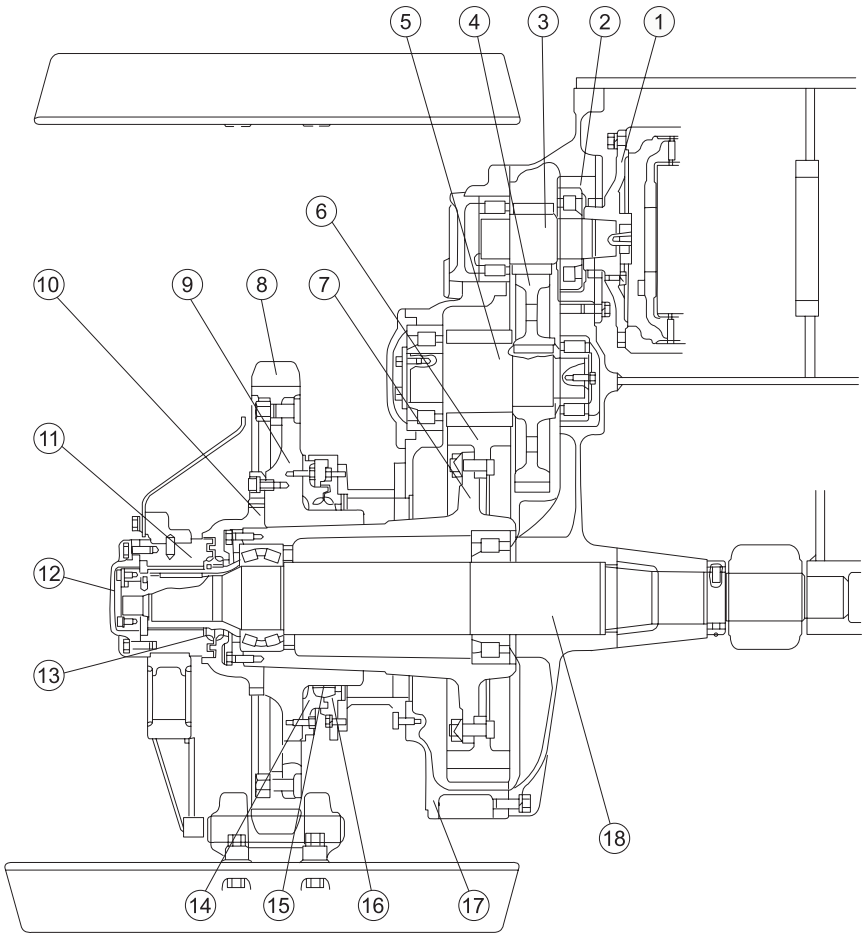


Figure3-37: The final drive's mechanism of SD22S and SD22R

No.	Name	No.	Name	No.	Name
1	Drive disc	7	Hub	13	Floating oil seal
2	Bearing support	8	Drive sprocket	14	Oil seal cover
3	Primary driving gear	9	Sprocket hub	15	Floating oil seal
4	Primary driven gear	10	Driving wheel's nut	16	Oil seal cover
5	Secondary driving gear	11	Support	17	Casing body
6	Secondary driven gear	12	Cover	18	Half shaft

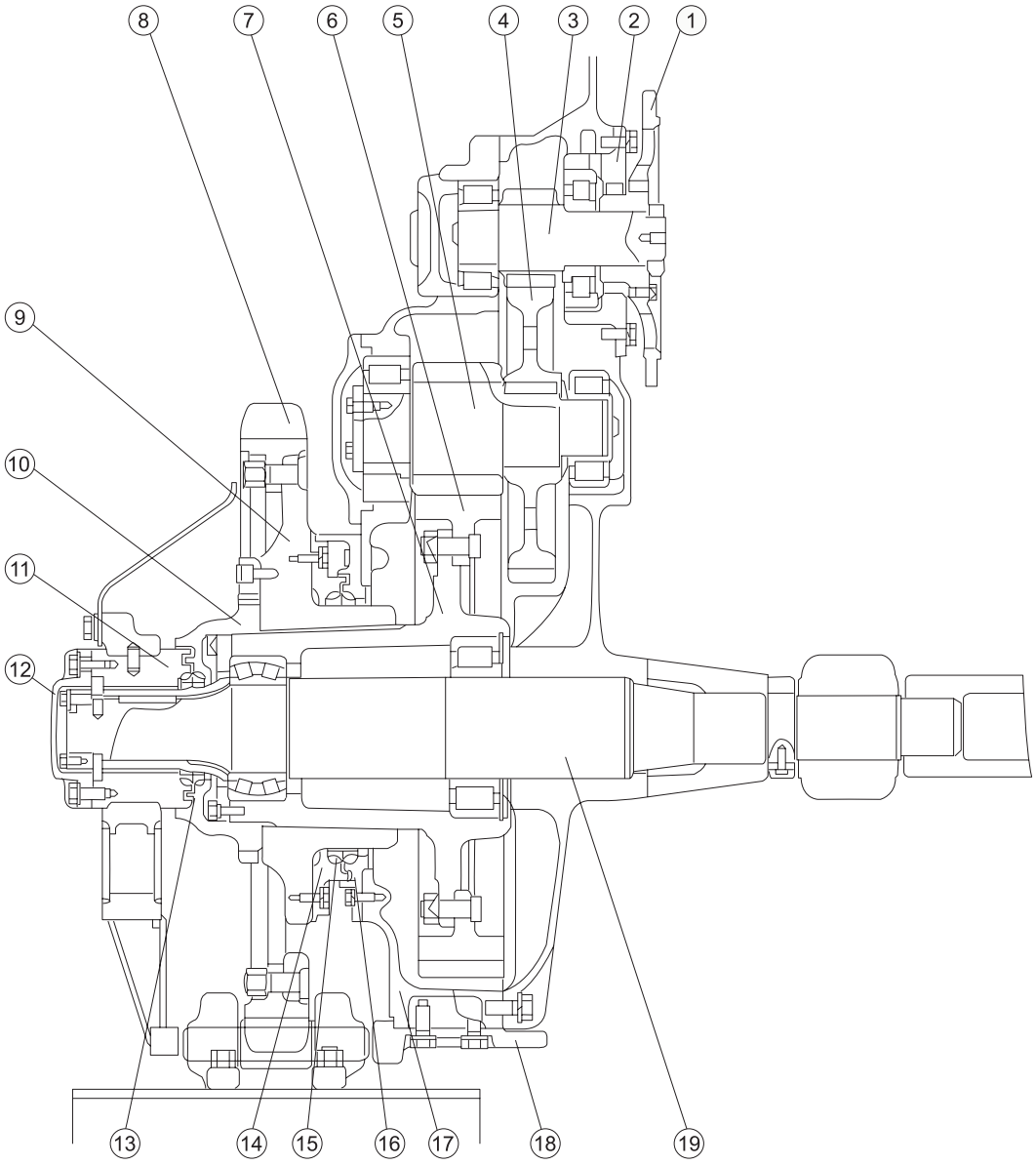


Figure3-38: The final drive's mechanism of SD22, SD22E and SD22D

No.	Name	No.	Name	No.	Name
1	Drive disc	8	Drive sprocket	15	Floating oil seal
2	Bearing support	9	Sprocket hub	16	Oil seal cover
3	Primary driving gear	10	Driving wheel's nut	17	Casing body
4	Primary driven gear	11	Support	18	Guard plate
5	Secondary driving gear	12	Cover	19	Half shaft
6	Secondary driven gear	13	Floating oil seal		
7	Hub	14	Oil seal cover		

3.9 DRIVE SYSTEM'S OPERATION

3.9.1 GEAR SHIFT (SEE FIGURE 3-39)

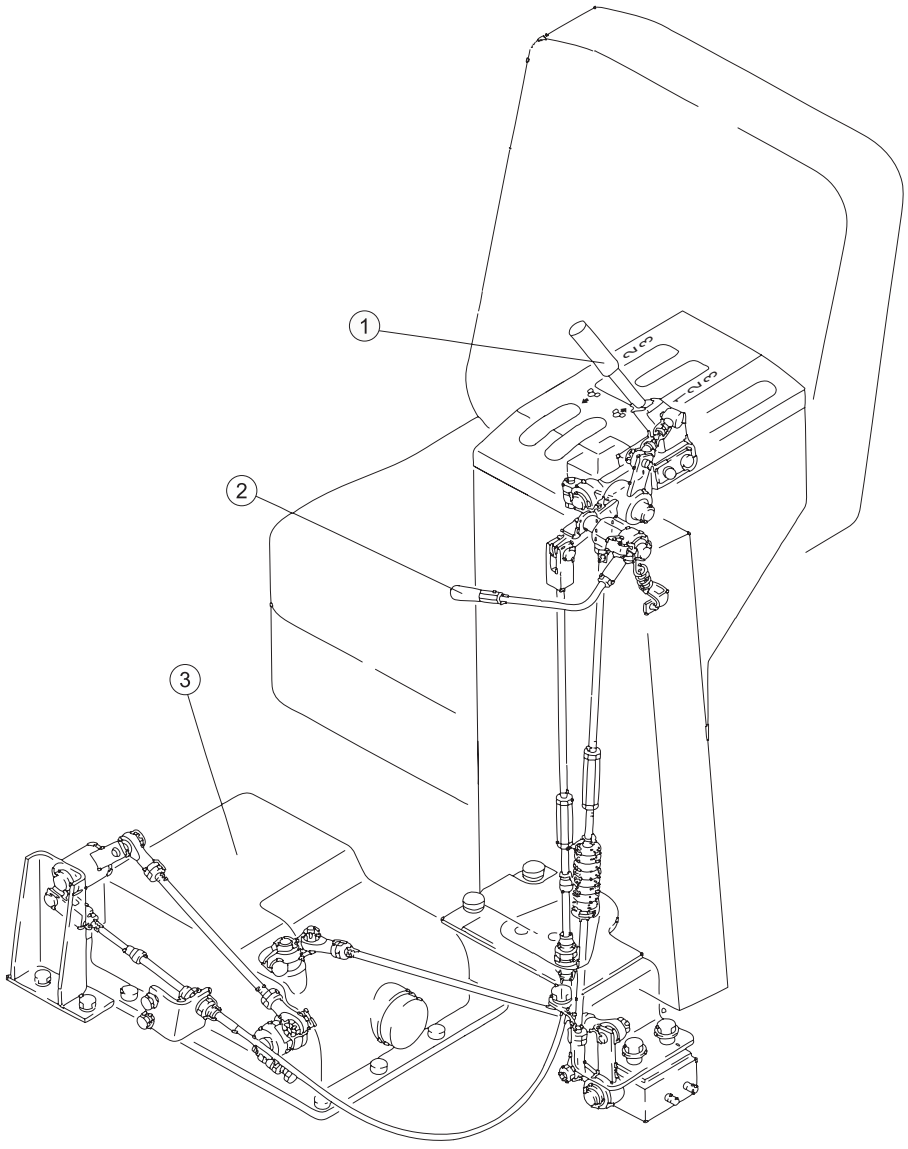


Figure 3-39

No.	Name	No.	Name	No.	Name
1	Gear shift lever	2	Gear shift lock lever	3	Transmission Valve

3.9.2 STEERING (SEE FIGURE 3-40)

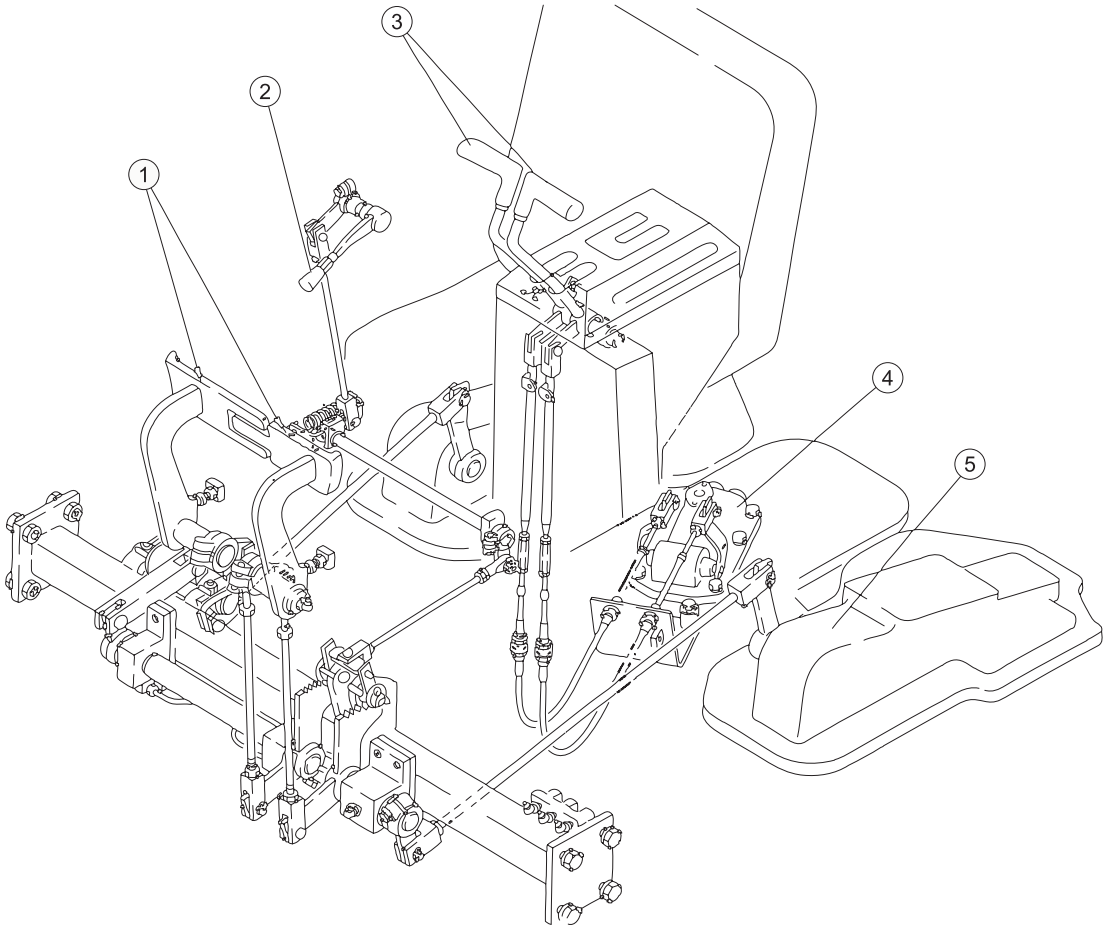


Figure 3-40

No.	Name	No.	Name	No.	Name
1	Brake pedal	3	Steering control lever	5	Brake valve
2	Brake lock lever	4	Steering valve		

3.10 WALKING MECHANISM

The walking mechanism (See Figure 3-41) mainly consists of the track frame (7), the driving wheel (4), the idler (1), the track roller (6), the carrier roller (3), as well as the track and the track tension device, to realize the walking of the bulldozer.

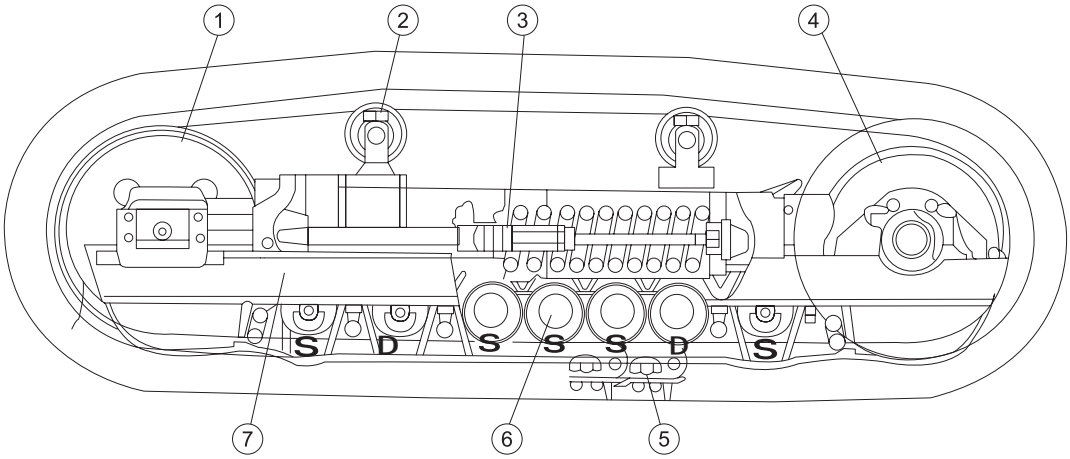


Figure 3-41: The walking mechanism of SD22

No.	Name	No.	Name	No.	Name
1	Idler	4	Driving wheel	7	Track frame
2	Carrier roller	5	Track		
3	Spring	6	Track roller		

Model \ Content	Number and sequence
SD22/F/C/W/H	6 (S. D. S. S. D. S)
SD22E/D	7 (S. D. S. D. S. D. S)
SD22S/R	8 (D. S. D. S. S. S. D. S)

3.10.1 TRACK TENSION DEVICE (SEE FIGURE 3-42)

The role of the tension device is to ensure that the track has sufficient tension, to reduce the shock jump of track during walking and prevent it from falling off during winding.

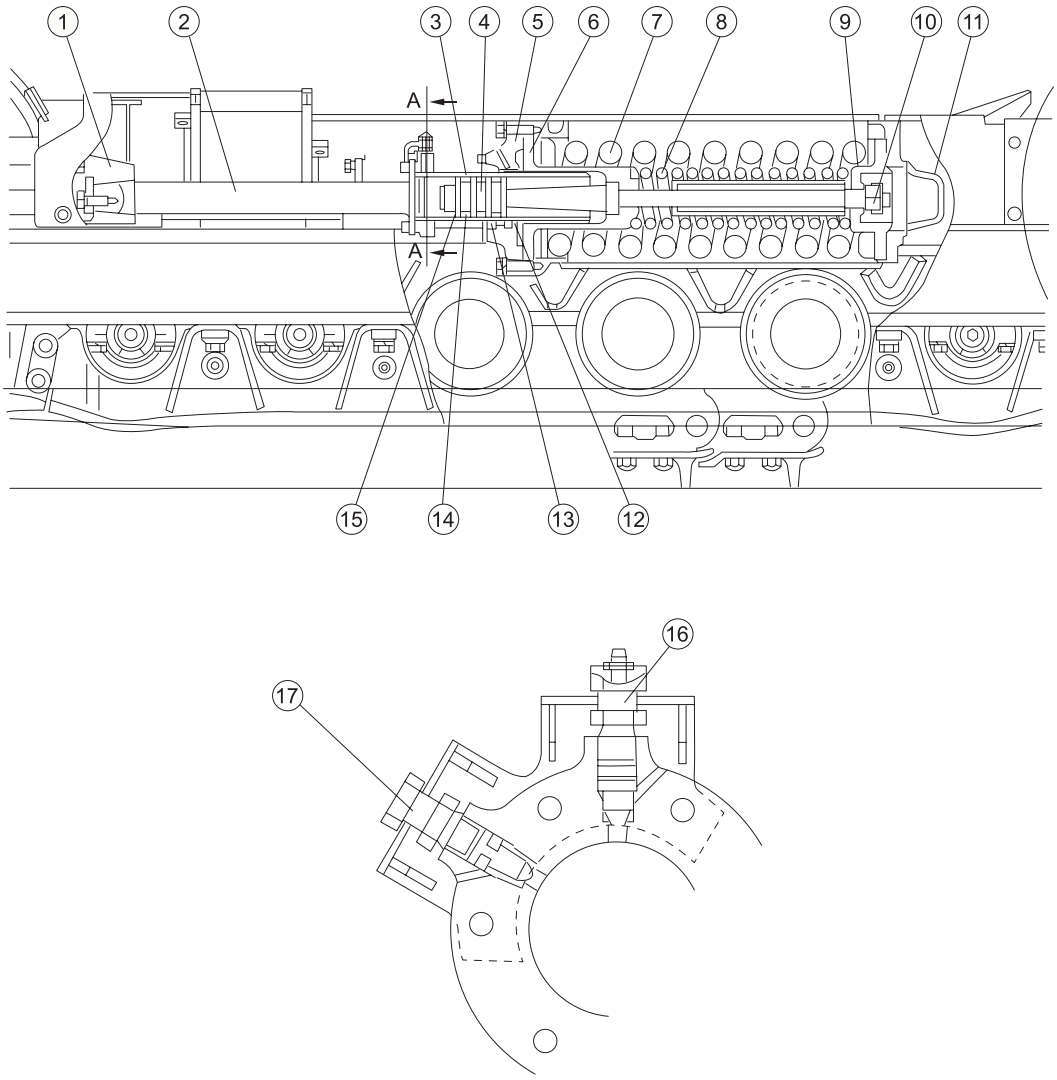


Figure 3-42

No.	Name	No.	Name	No.	Name
1	Seat	6	Sleeve, Guide	11	Sleeve, Guide
2	Shaft	7	Limit pipe	12	Oil plug
3	Oil cylinder	8	Spring	13	Oil injection nozzle
4	Piston	9	Lever		
5	Cover	10	Tube		

3.10.2 IDLER (SEE FIGURE 3-43)

The idler is mainly to guide the track link and track.

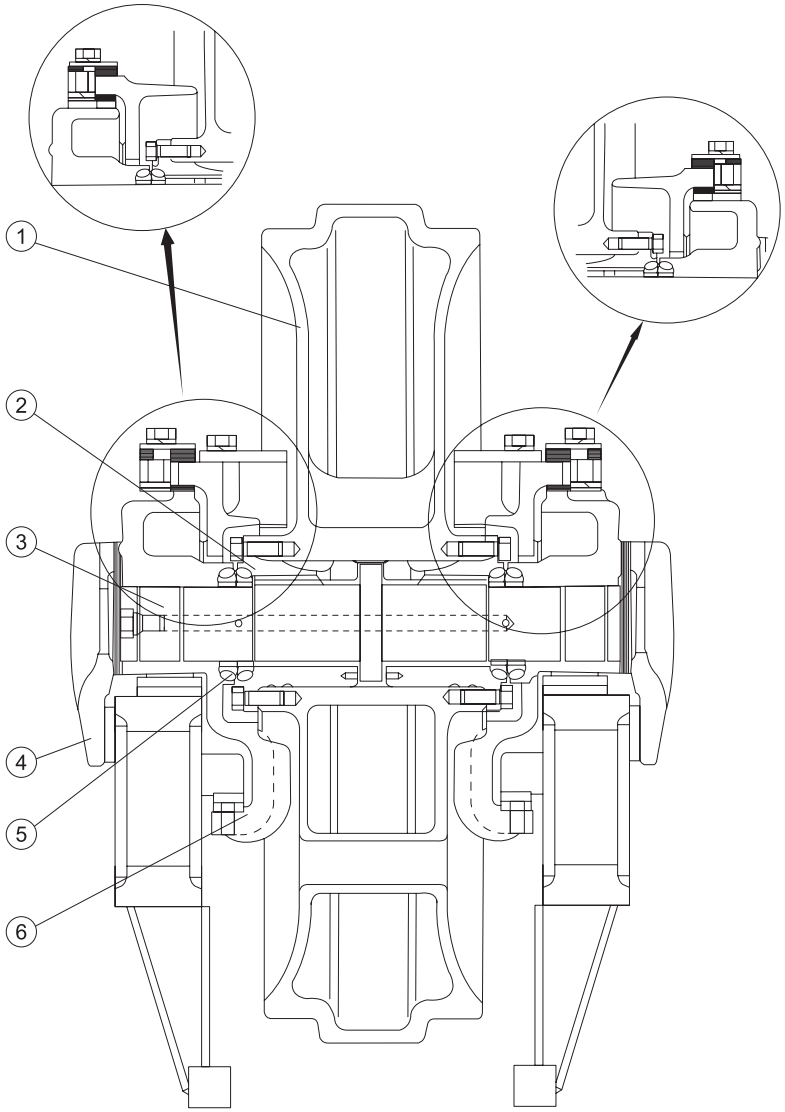


Figure 3-43

No.	Name	No.	Name	No.	Name
1	Idler	3	Idler axle	5	Floating seal ring
2	Sleeve	4	Side plate	6	Guider

3.10.3 TRACK ROLLER (SEE FIGURE 3-44)

It supports the weight of the bulldozer, to prevent the lateral derail of the track. Track roller can have a single flange and double flange structure. This figure shows a double flange track roller's structure. Except for the shape of the track roller's hub (1), other structures of the single-flange track roller and the double-flange track roller are the same.

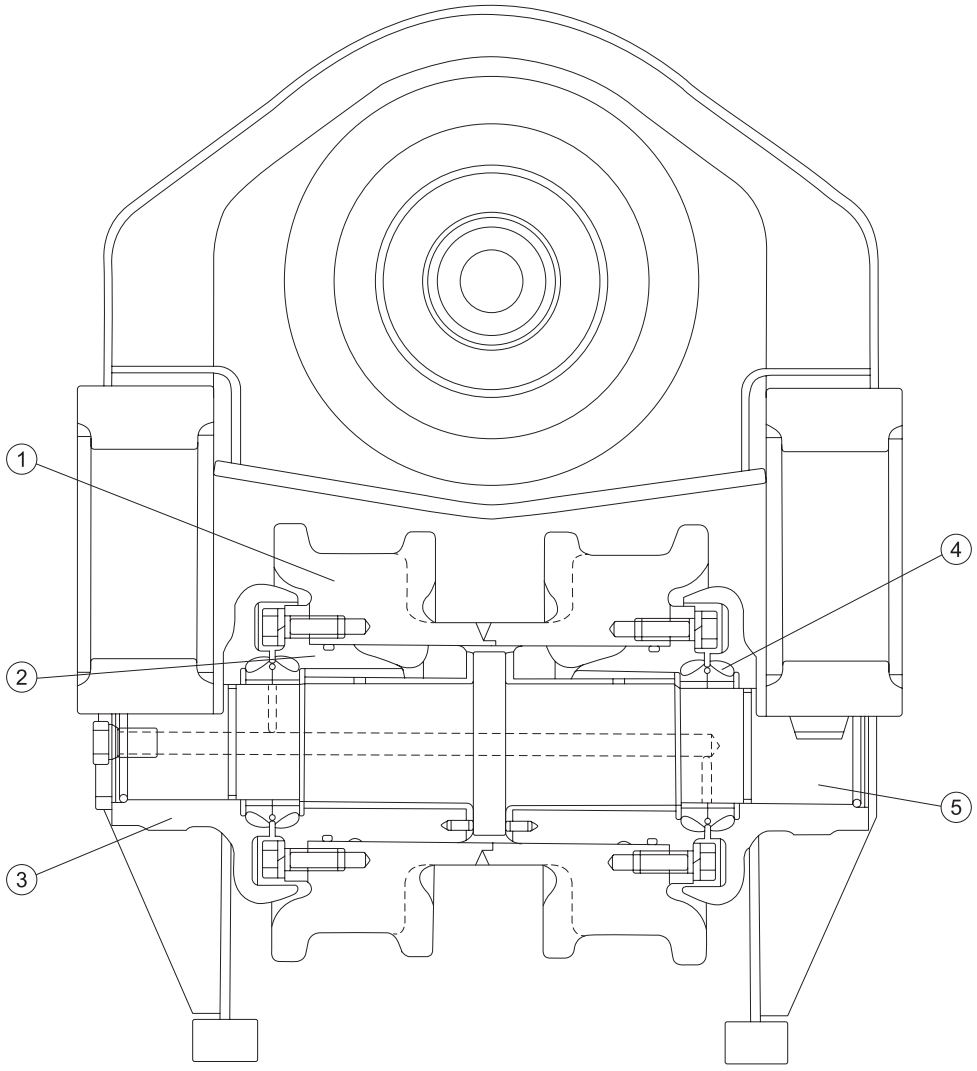


Figure 3-44

No.	Name	No.	Name	No.	Name
1	Track roller hub	3	Cover	5	Shaft
2	Bushing	4	Floating oil seal		

3.10.4 CARRIER ROLLER (SEE FIGURE 3-45)

It supports the upper track, to prevent the track from dropping too much, and to reduce the track's shock-jump during moving as well as void the track from fall slipping off sideways.

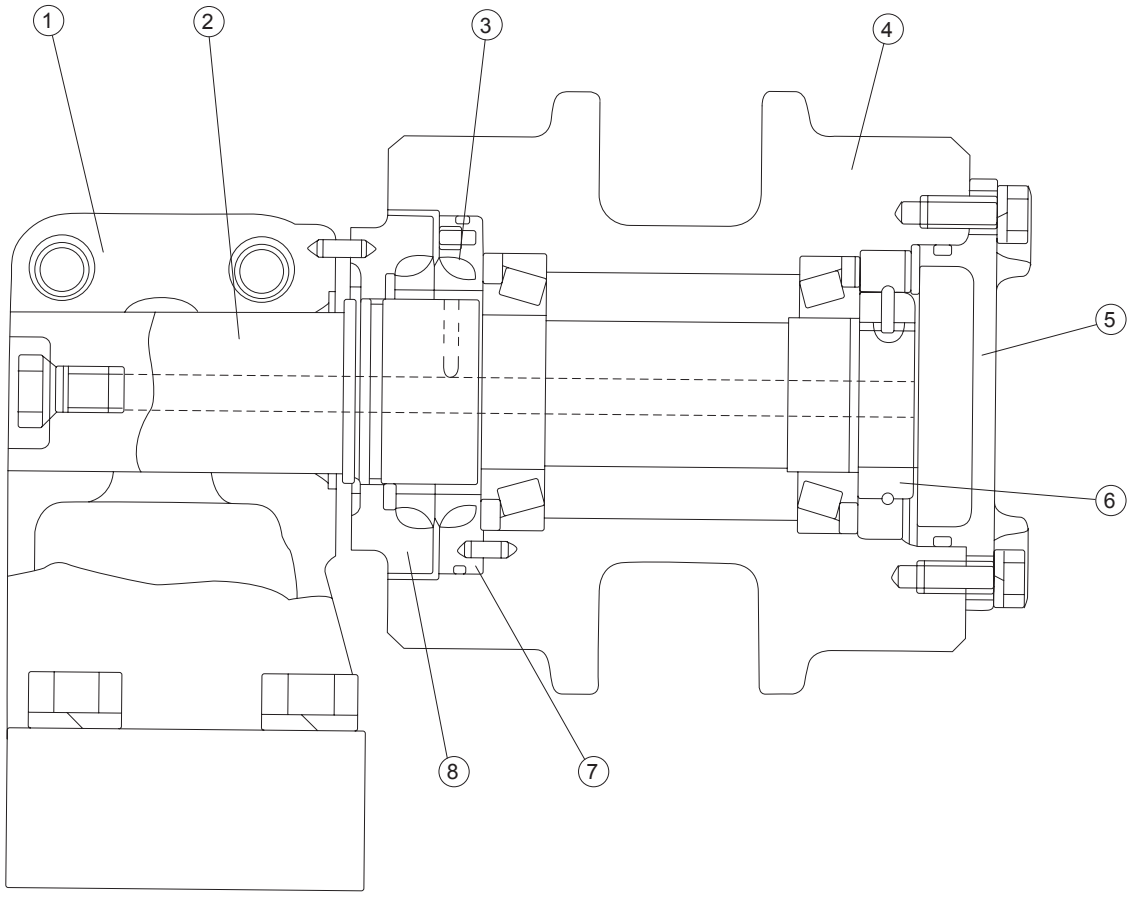


Figure 3-45

No.	Name	No.	Name	No.	Name
1	Bracket	4	Carrier roller	7	Floating seal seat
2	Shaft	5	Cover	8	Floating seal seat
3	Floating oil seal	6	Nut		

3.10.5 TRACK

Track's role is to support the bulldozer's weight, to ensure the bulldozer's traction, to enable it to have sufficient driving force.

Figure 3-46 is the track assembly of bulldozers SD22, SD22E, and SD22D. Figure 3-47 is the track assembly of bulldozer SD22S.

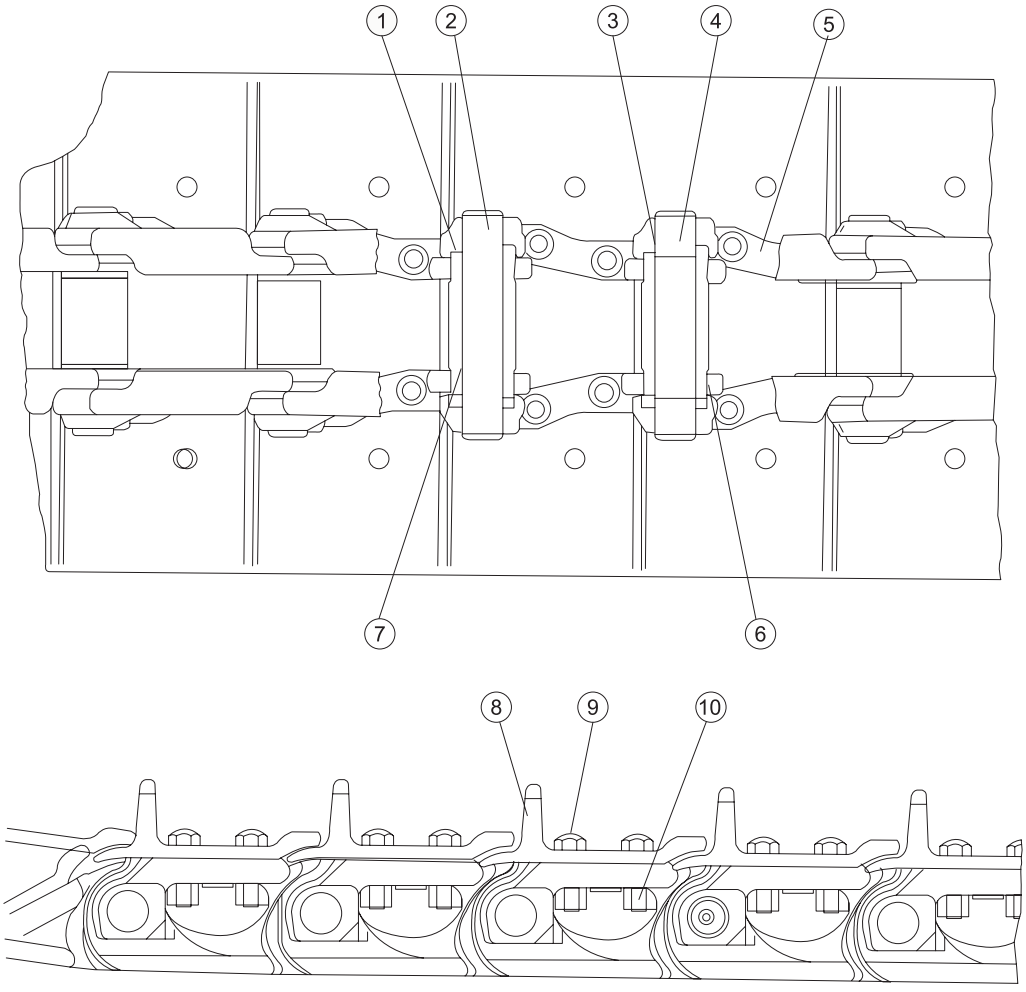


Figure 3-46

No.	Name	No.	Name	No.	Name
1	Ring, Dust	5	Track link	9	Track bolt
2	Fixed pin	6	Spindle sleeve	10	Track Nut
3	Seal ring	7	Sleeve		
4	Master pin	8	Track shoe		

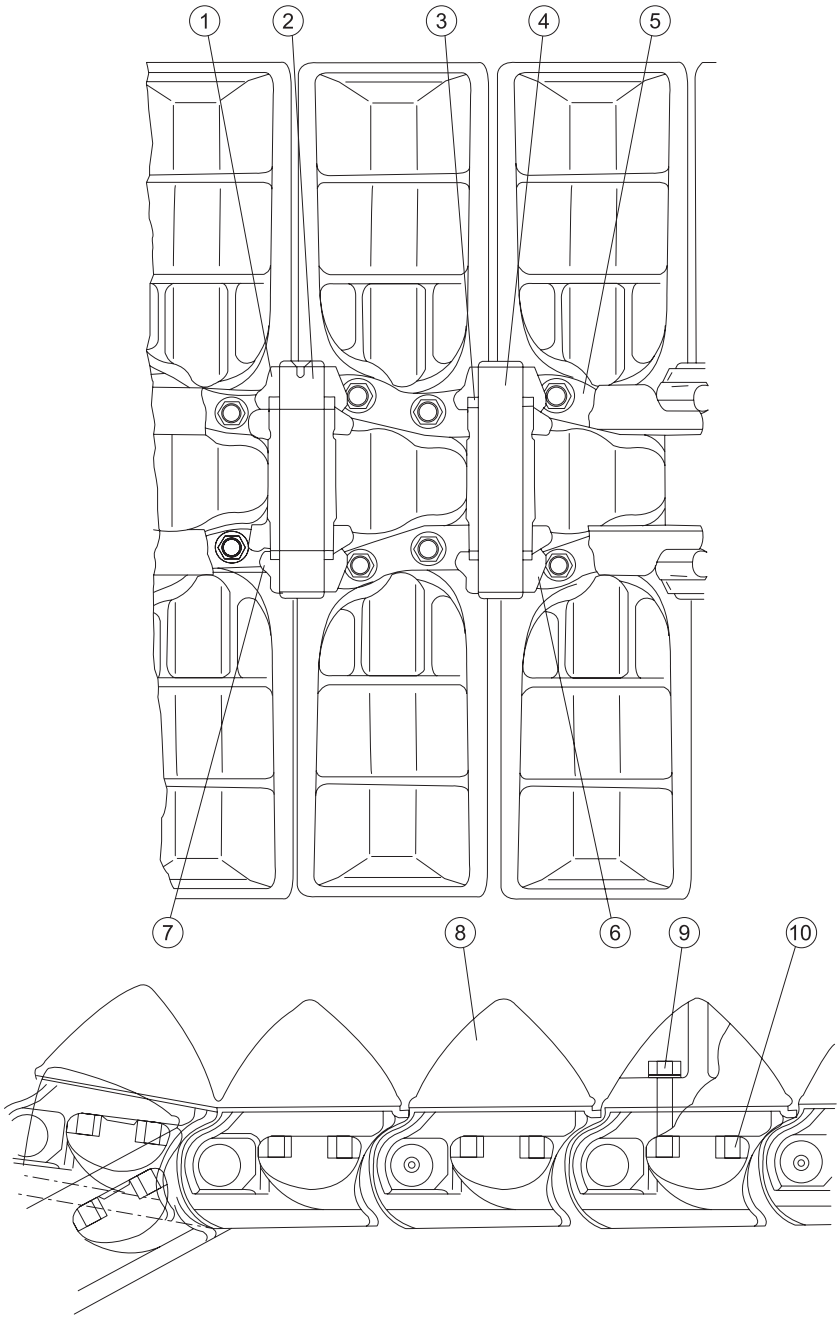


Figure 3-47

No.	Name	No.	Name	No.	Name
1	Ring, Dust	5	Track link	9	Track bolt
2	Fixed pin	6	Spindle sleeve	10	Track Nut
3	Seal ring	7	Sleeve		
4	Master pin	8	Track shoe		

3.10.6 EQUALIZER BAR (SEE FIGURE 3-48)

It connects the frame and the walking system, to play a buffering role; at the same time, when the ground is not even, it can ensure that the track frame can swing up and down.

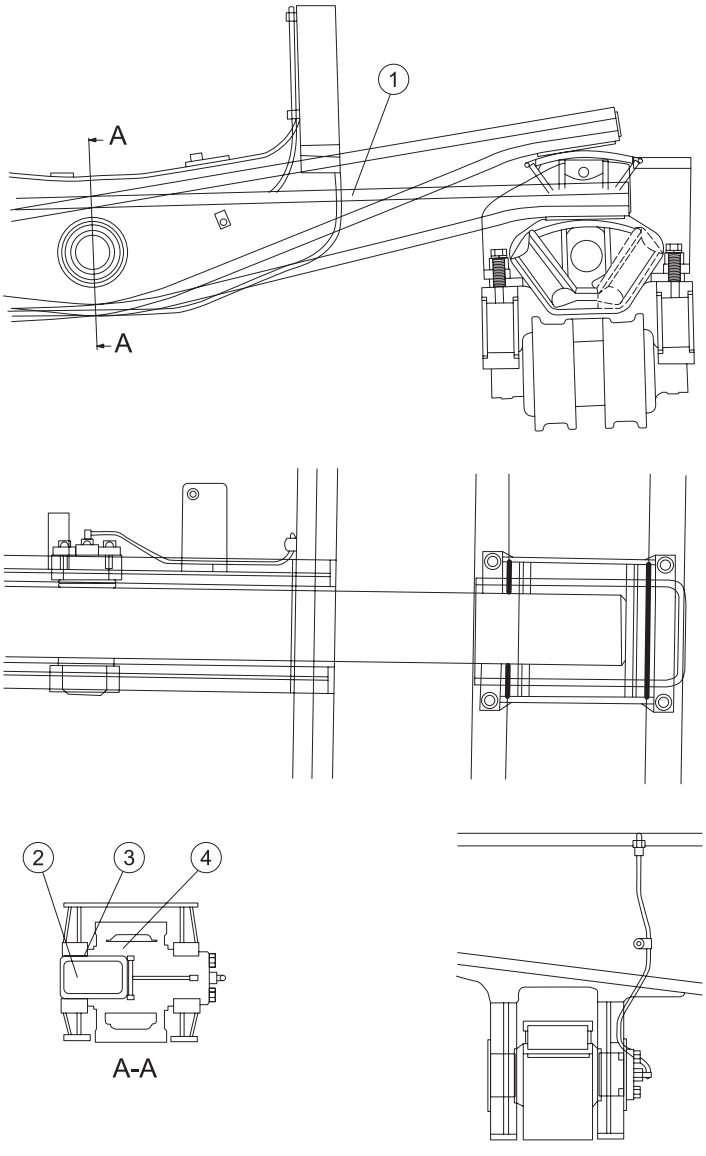


Figure 3-48

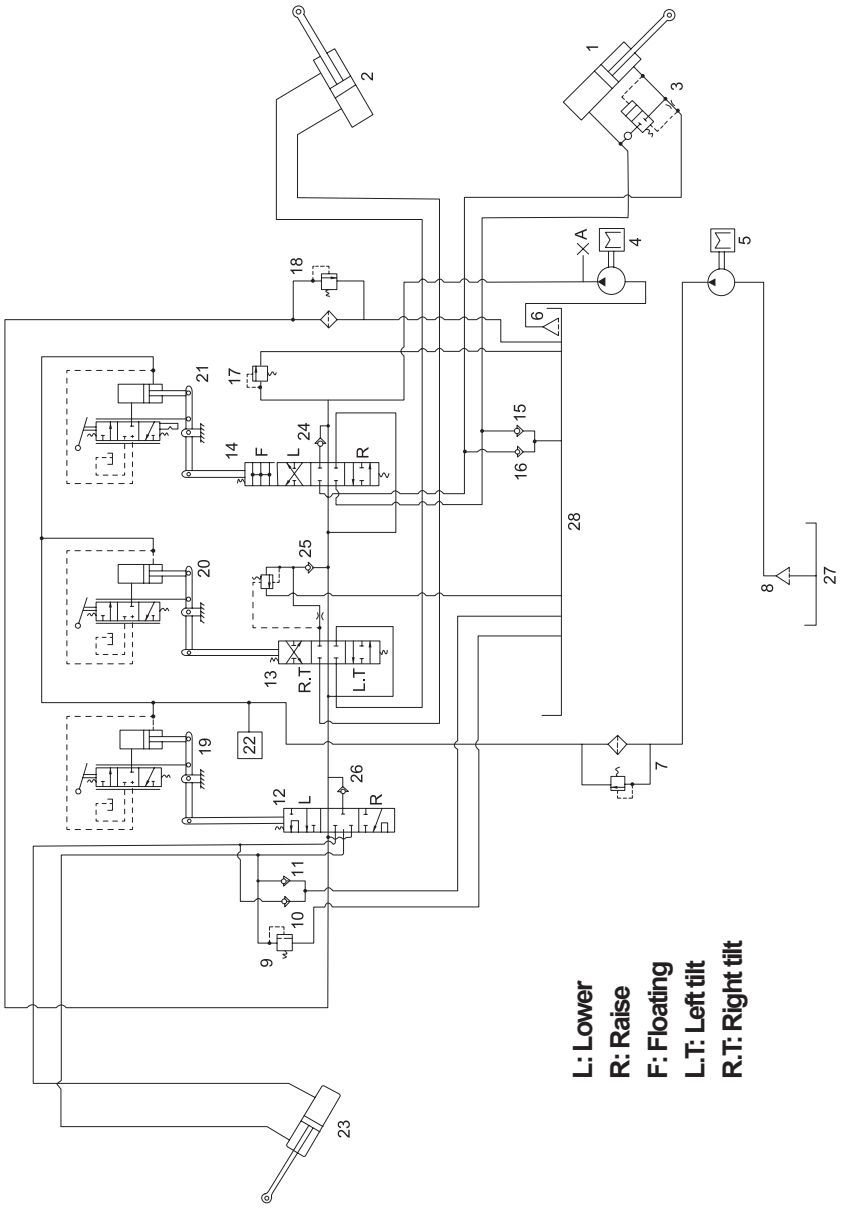
No.	Name	No.	Name
1	Equalizer Bar	2	Shaft
3	Sleeve	4	Sleeve

3.11 HYDRAULIC SYSTEM

Hydraulic system consists two parts: the work equipment's hydraulic system and the gearshift steering hydraulic system.

3.11.1 WORK EQUIPMENT'S HYDRAULIC SYSTEM

Figures 3-49 through 3-52 are the schematics showing the hydraulic principle and structure of bulldozers SD22, SD22E, SD22D, and SD22S.



Figures 3-49: Illustration of the hydraulic principle of the bulldozers (SD22, SD22E and SD22D)

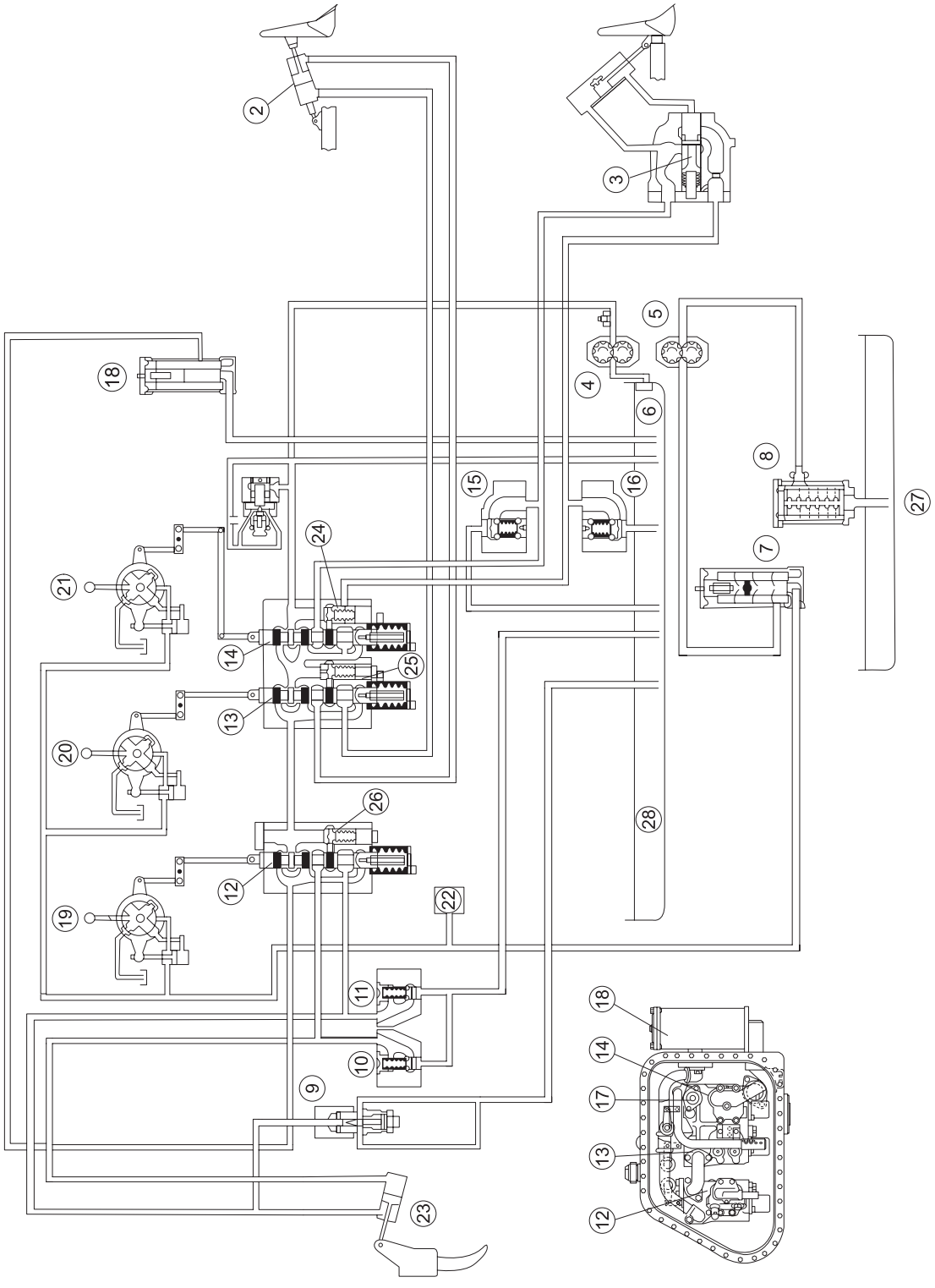
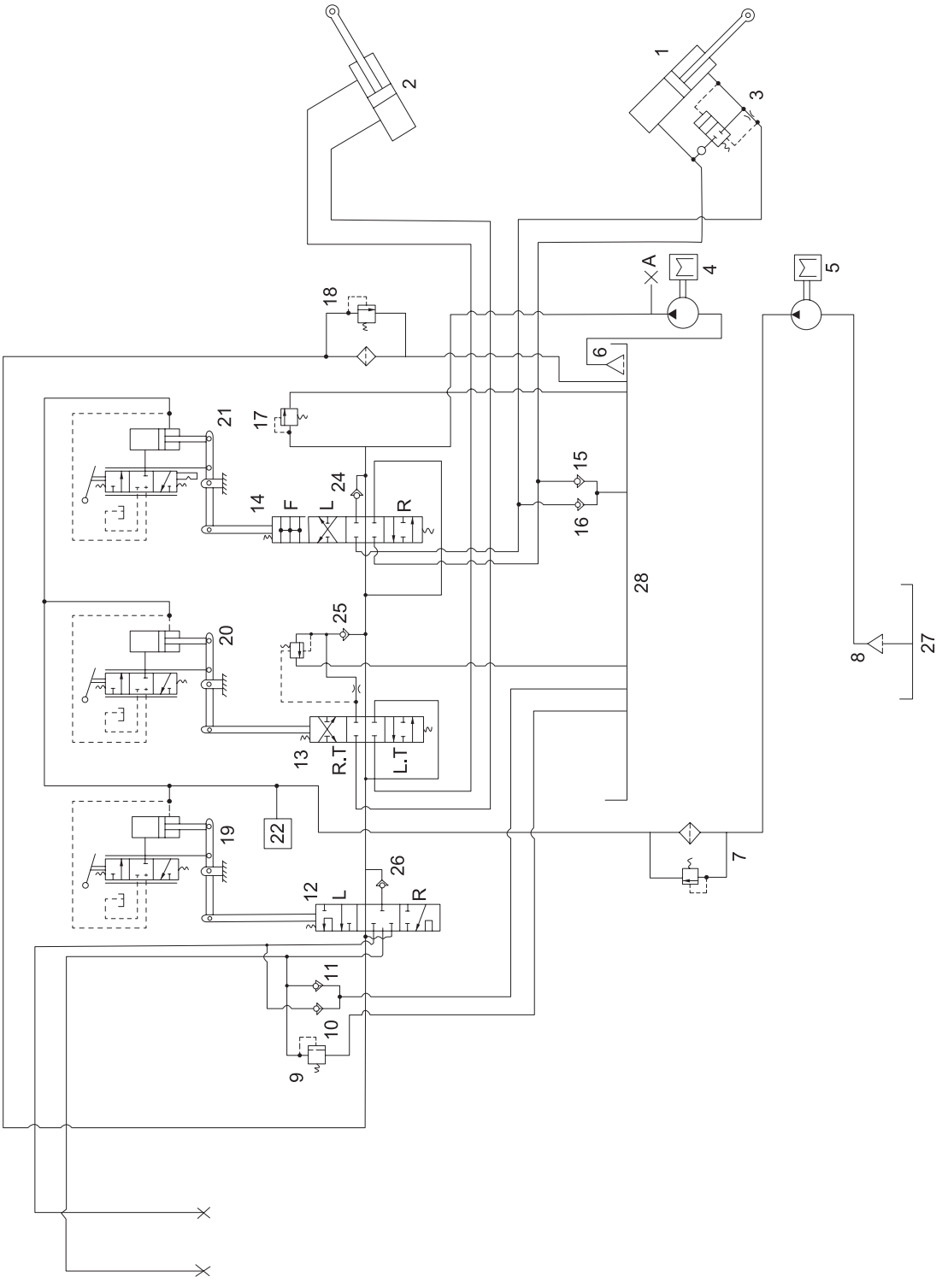


Figure 3-50 is the schematic of the hydraulic system of bulldozers SD22, SD22E, and SD22D



Figures 3-51: Illustration of the hydraulic principle of the bulldozer (SD22S)

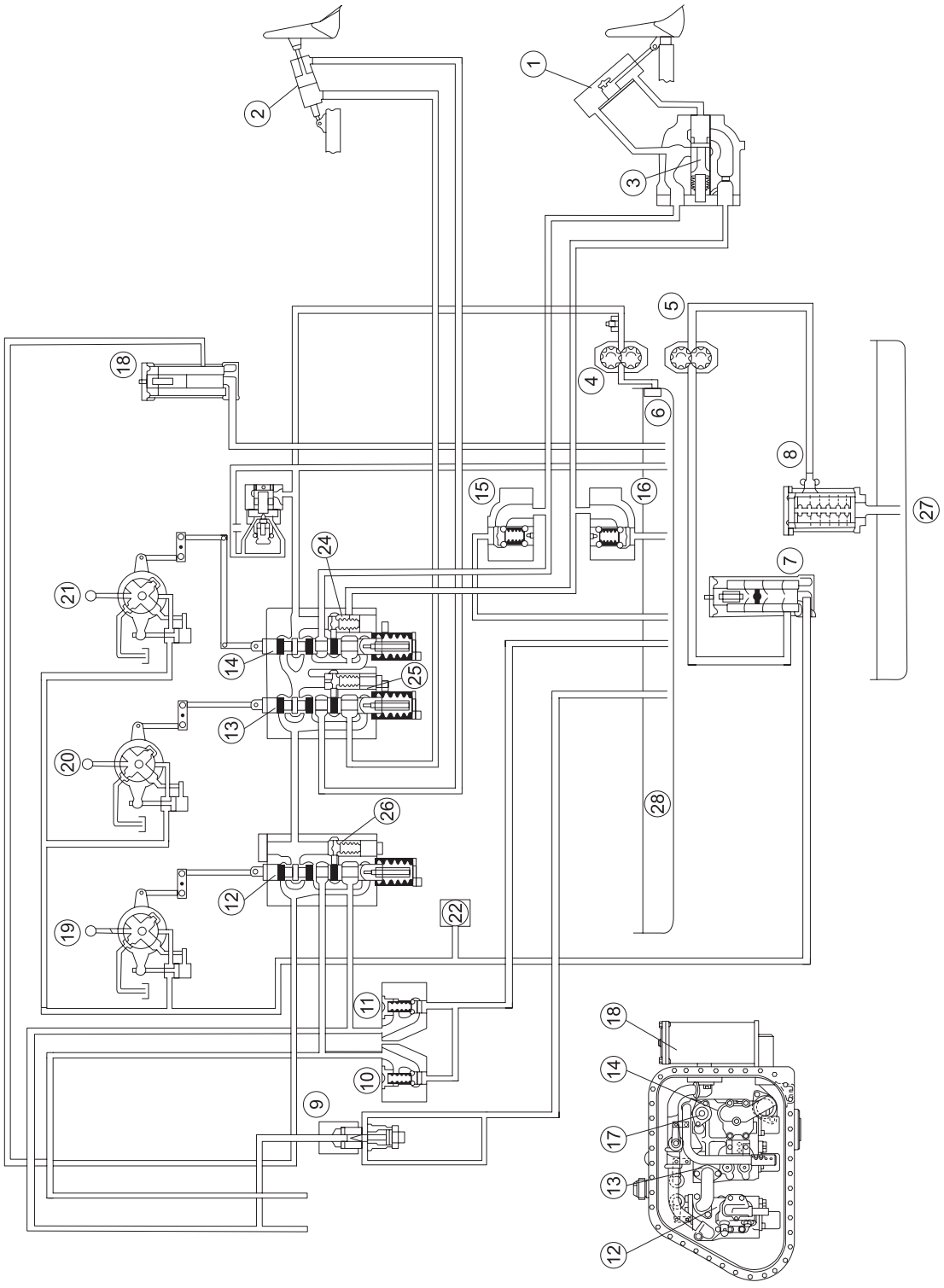


Figure 3-52 is the schematic of the hydraulic system of bulldozers SD22S

No.	Name	No.	Name
1	Hydraulic oil tank	12	Blade lift valve
2	Hydraulic pump (SAL080+036)	13	Shuttle Valve
3	Main overflow valve	14	Oil-replenishing valve (blade-raising end)
4	Check valve	15	Oil-replenishing valve (blade-lowering end)
5	Ripper lift valve	16	Quick drop valve
6	Oil-replenishing safety valve (ripper-lowering end)	17	BLADE LIFT CYLINDER
7	Oil-replenishing valve (ripper-raising end)	18	Main overflow valve
8	RIPPER LIFT CYLINDER	19	Check valve
9	Check valve	20	Blade tilt valve
10	Flow control valve	21	Blade tilt cylinder
11	Check valve	22	Hydraulic oil filter

GEAR OIL PUMP (SEE FIGURE 3-53)

Gear oil pump is driven by the transfer case's gear, to convert mechanical energy into pressure energy.

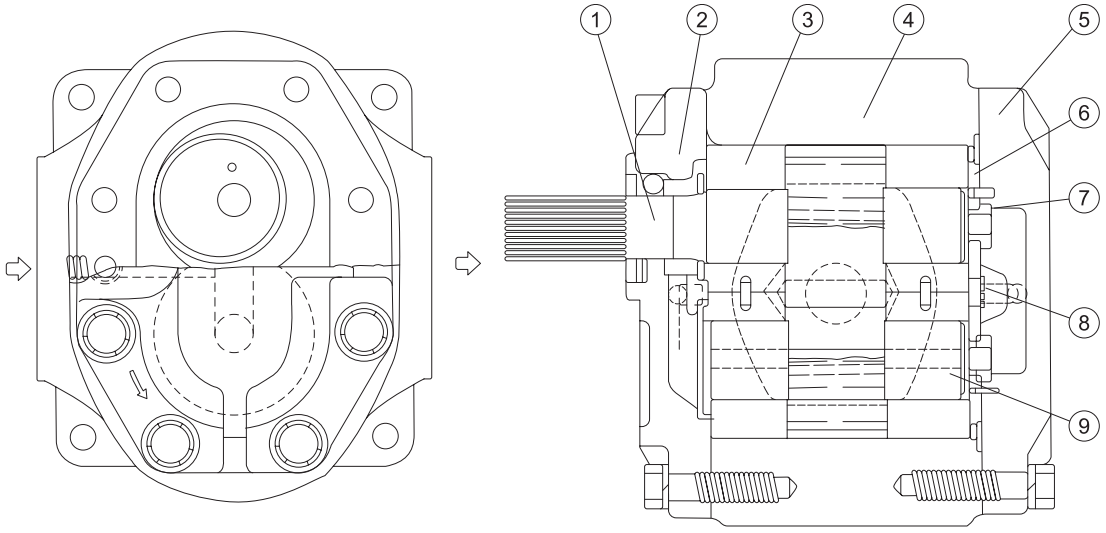


Figure 3-53

No.	Name	No.	Name	No.	Name
1	Driving gear	4	Body, Pump	7	Ring
2	Front pump cover	5	Rear pump cover	8	Seal ring
3	Bushing	6	Sealing film	9	Driven gear

Work equipment's hydraulic operating principles (See Figure 3-54)

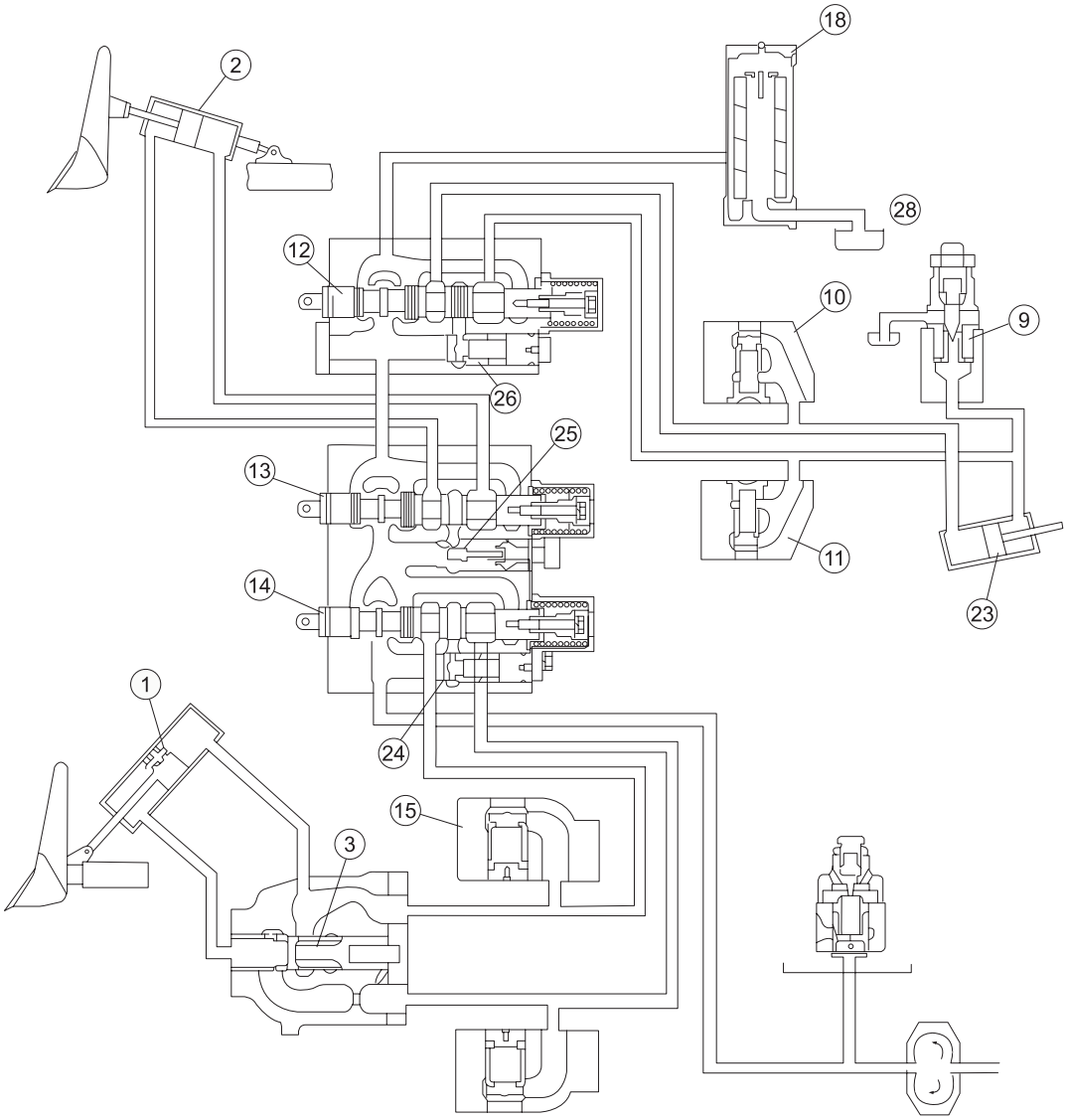


Figure 3-54

The gear pump sucks out the operating oil from the hydraulic tank (28), and pumps it into the change valve (12), (13), (14). If various work equipment is not operated, the oil will return to the hydraulic tank through the change valve (28) and the oil filter (18). If the oil filter is blocked at this point, the oil will push open the oil filter's safety valve to return to the hydraulic tank. If you operate change valves (14) or (13), you can control the blade's cylinder to raise, lower, keep or float the blade, as well as control the tilting cylinder to tilt the blade to the left or to the right or to keep the blade unmoved. Operating the change valve (12) can control the ripper oil cylinder, to realize the ripper's raising, lowering and keeping.

There is an intake check valve (24), (25), (26) before change valve to overcome the possible "nodding impact" from the circular movement of various working mechanisms.

In order to let the tilt cylinder have an ideal movement speed, we have provided the flow control valve (25). (See Figure 3-55)

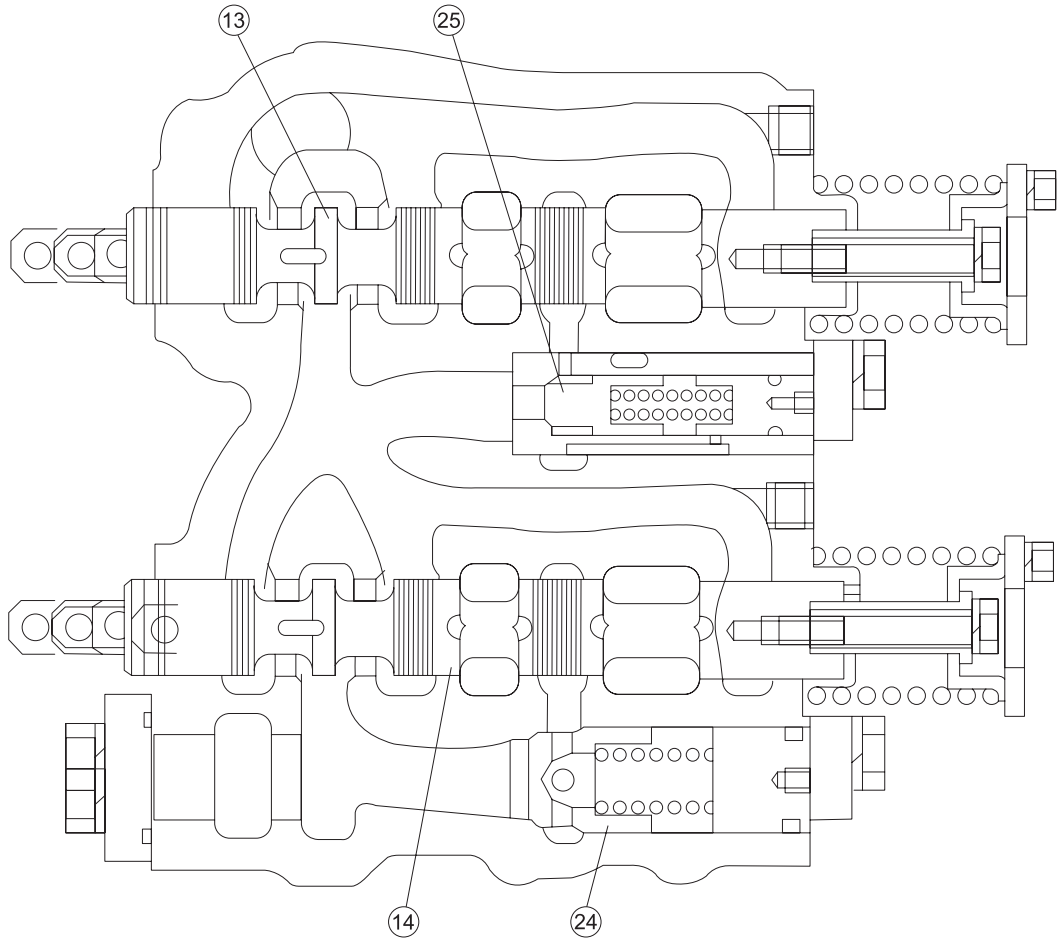


Figure 3-55

The overload valve (9) is provided in order to avoid that the system pressure from becoming too high due to the exessive load during the ripping operation.

During operation, if the load is too high, system pressure will exceed the set pressure of 14Mpa for a short time. In this case, the main overflow valve (17) is opened, and the operating oil returns to the oil tank through the overflow valve, to protect the system . The main overflow valve's structure is shown in Figure 3-56.

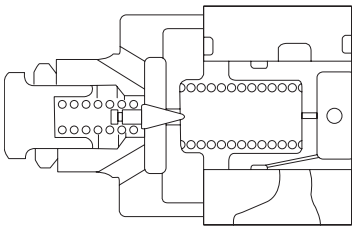


Figure 3-56

When the external force's direction is the same as the oil cylinder piston's moving direction, in order to avoid a vacuum from occurring within the oil cylinder, the oil-replenishing valves (10), (11), (15), (16) are provided (See Figure 3-52) Oil-replenishing valve's structure shown in Figure 3-57 and Figure 3-58

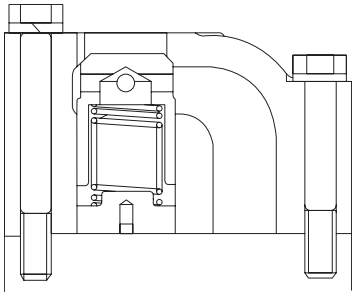


Figure 3-57

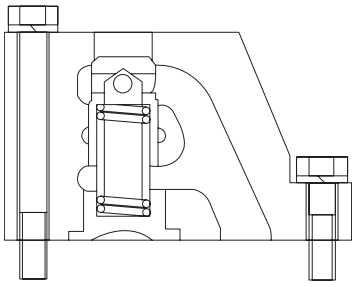


Figure 3-58

All the above valves are within the hydraulic tank.
In order to prevent dust from contaminating the operating oil, the operating oil tank is made into a closed structure (Figure 3-59)

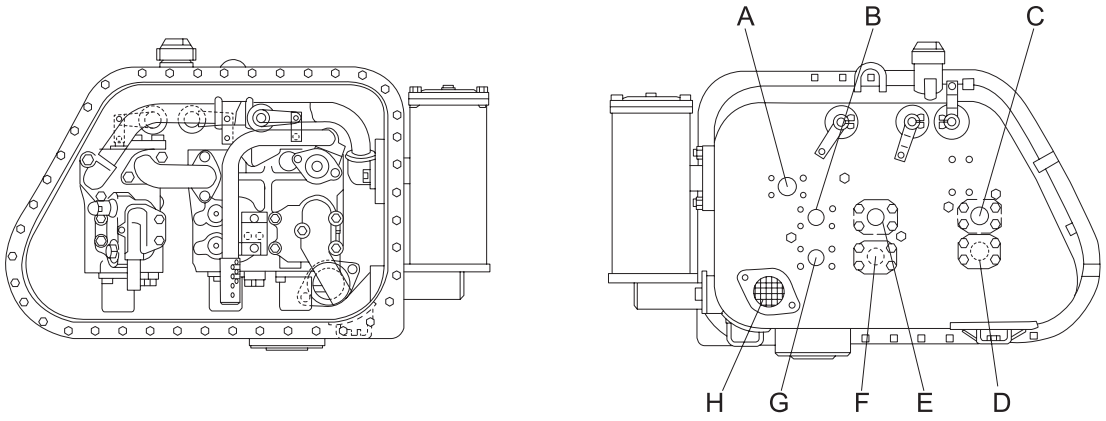


Figure 3-59

No.	Name	No.	Name
A	Inlet	B	To blade cylinder bottom (lower)
C	To ripper cylinder head	D	To ripper cylinder bottom
E	To the head of the tilting cylinder (tilt to the right)	F	To the bottom of the tilting cylinder (tilt to the left)
G	To blade cylinder head (raise)	H	The pump's oil intake

ROTARY SERVO VALVE (SEE FIGURE 3-60)

A rotation servo valve is provided in order to reduce the force needed to operation the work equipment's change valve and improve its tuning performance.

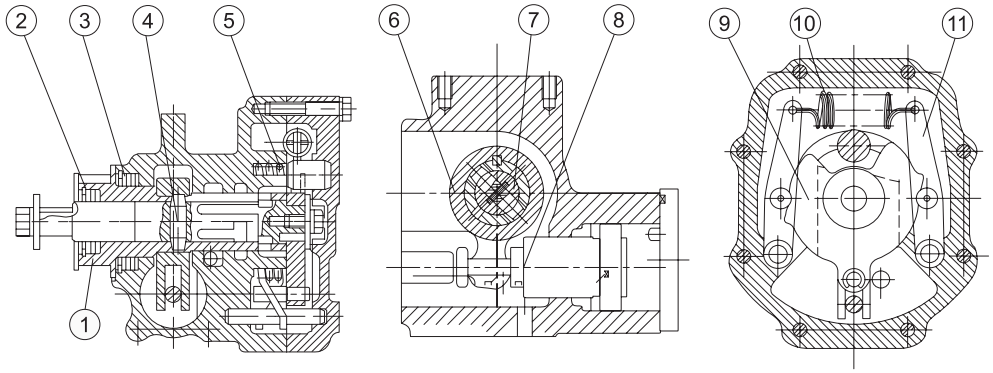


Figure 3-60

No.	Name	No.	Name	No.	Name
1	Sleeve	5	Spring	9	Detent
2	Oil seal	6	Lever	10	Spring
3	Oil seal	7	Roller	11	Lever
4	Pin	8	Piston		

The oil of the rotation servo valve comes from the steering pump, and the oil returns to the steering case. (See Figure 3-61)

No.	Name	No.	Name
1	Valve cover	6	Handle
7	Valve core	8	Piston
12	Oil cylinder	13	Connecting rod

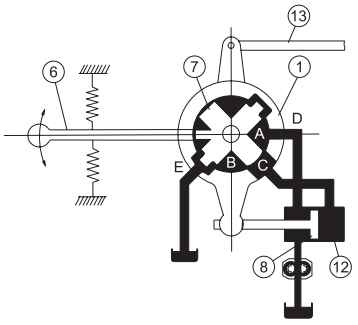


Figure 3-61

The action output end of the rotation servo valve connects to the valve stem of the work equipment's change valve through the connecting rod, to operate the change valve t change direction. There is a positioning mechanism in the floating position.

If lever (6) is operated to let valve core (7) rotate clockwise for an angle (see Figure 3-62), the passage between A and C will be opened, the pressure oil will enter the bottom of oil cylinder (12) to push piston (8) and valve cover (1) to rotate clockwise for an angle too, and the connecting rod (13) will operate the change valve's stem to move a distance. As at this point the rotation of valve cover (1) cuts off the passage between A and C, piston (8) will stop moving immediately. It can move continuously only when (6) continues to be operated.

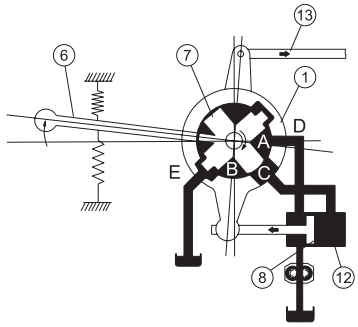


Figure 3-62

If lever (6) is operated to let valve core (7) rotate clockwise for an angle (see Figure 3-62), the passage between A and C will be opened, the pressure oil will enter the oil cylinder to push piston (8) and valve cover (1) to rotate clockwise for an angle too, and the connecting rod (13) will operate the change valve's stem to move a distance. As at this point the rotation of valve cover (1) cuts off the passage between A and C, piston (8) will stop moving immediately. It can move continuously only when (6) continues to be operated.

Figure 3-66 shows a neutral operating condition. At this point, neither the passage between A and C nor the passage between B and C is opened, the oil cylinder's piston does not move, and the valve cover does not rotate either.

As the operation force to the lever just needs to overcome the friction between valve cores (7) and (1), and the output force is provided by the oil cylinder, the operation force is dramatically reduced.

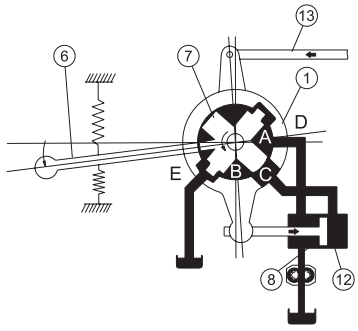


Figure 3-63

3.11.2 GEARSHIFT AND STEERING HYDRAULIC SYSTEM

The schematic showing the principle of bulldozer's gearshift steering hydraulic system (see Figure 3-64) and bulldozer's structural schematic (see Figure 3-65).

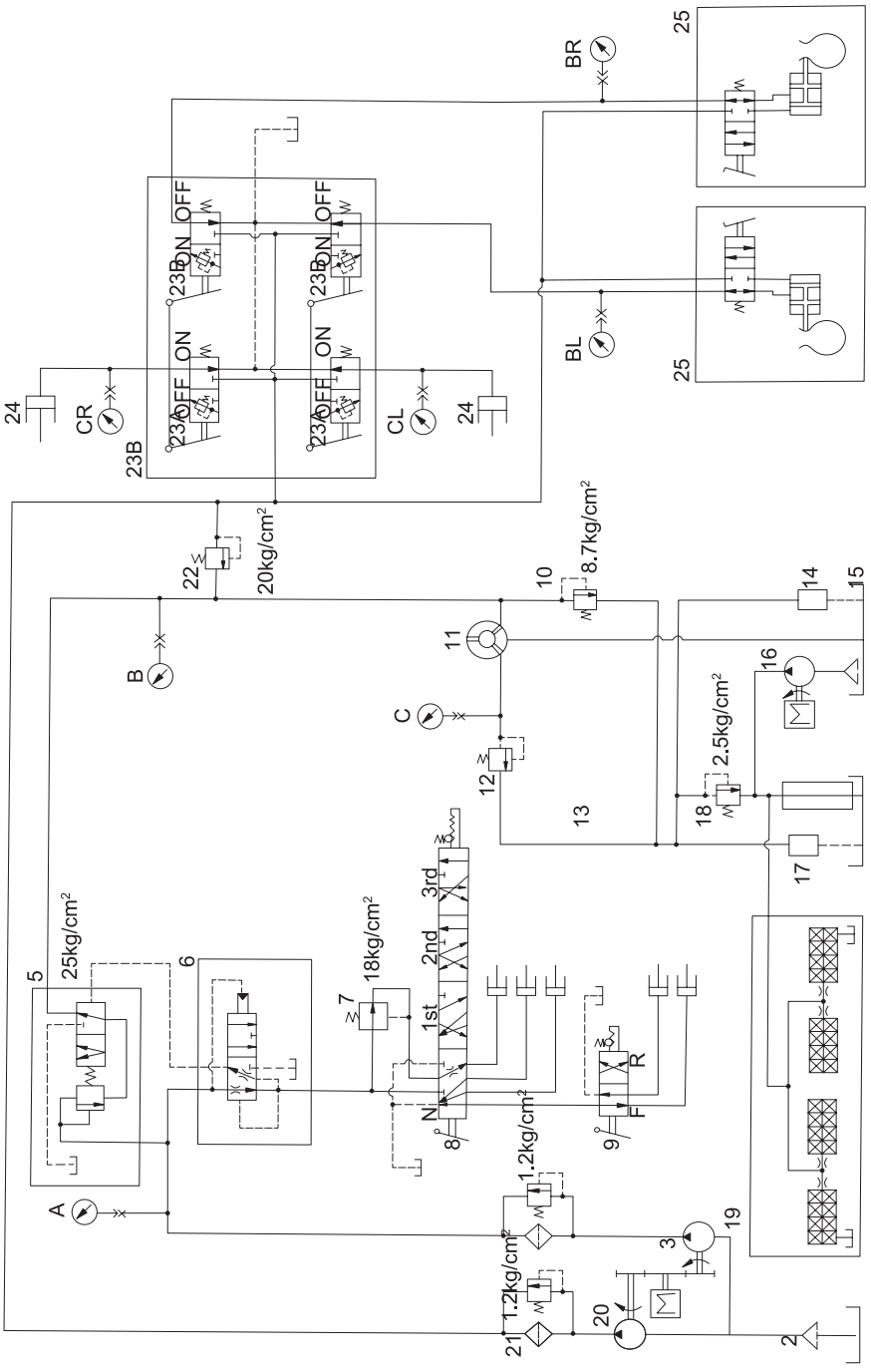


Figure 3-64: The schematic showing the principle of bulldozer's gearshift steering hydraulic system

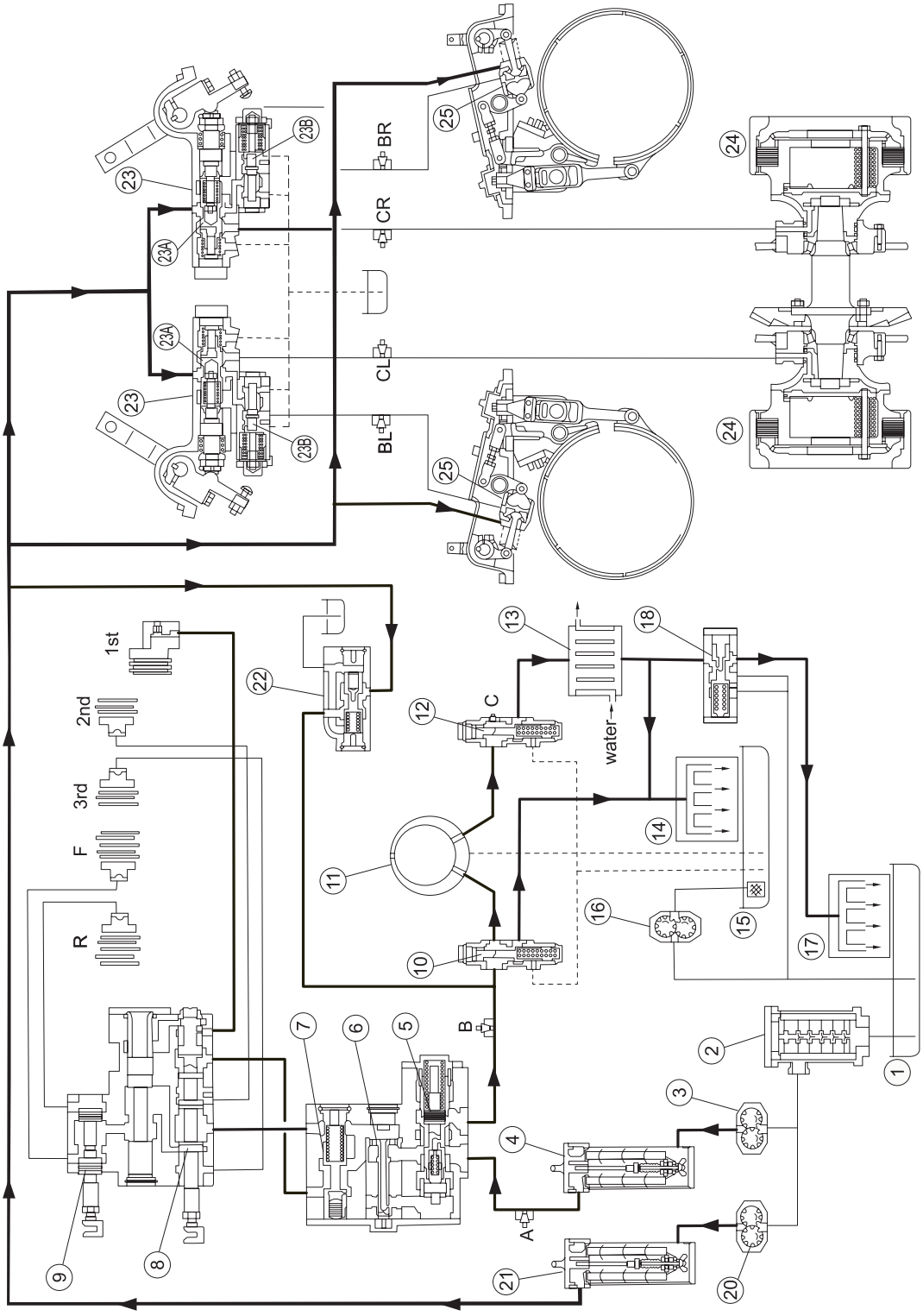


Figure 3-65: The illustration of gearshift steering's structure

GEARSHIT'S HYDRAULIC SYSTEM

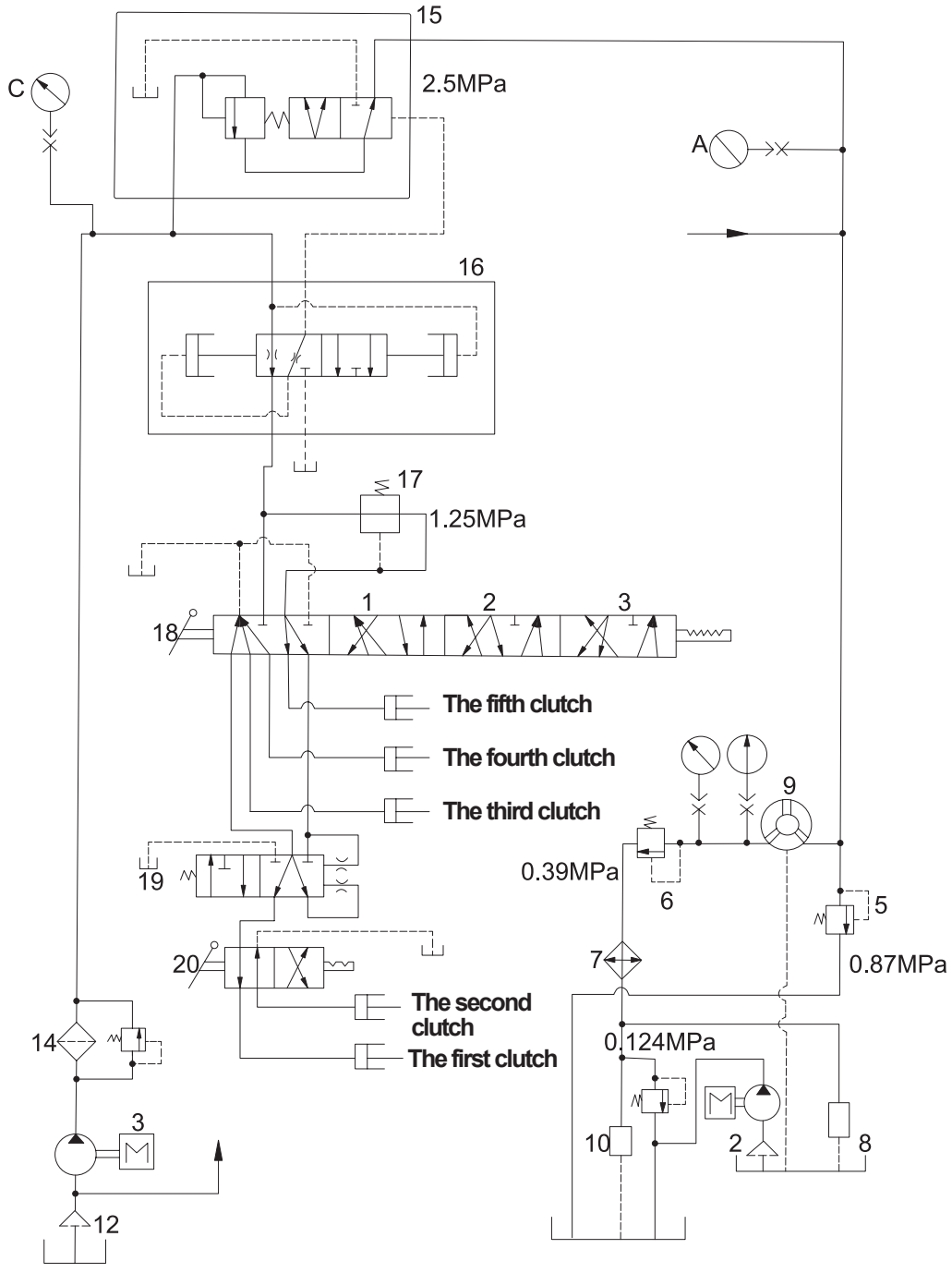


Figure 3-67: The illustration of gearshift circuit's system principle

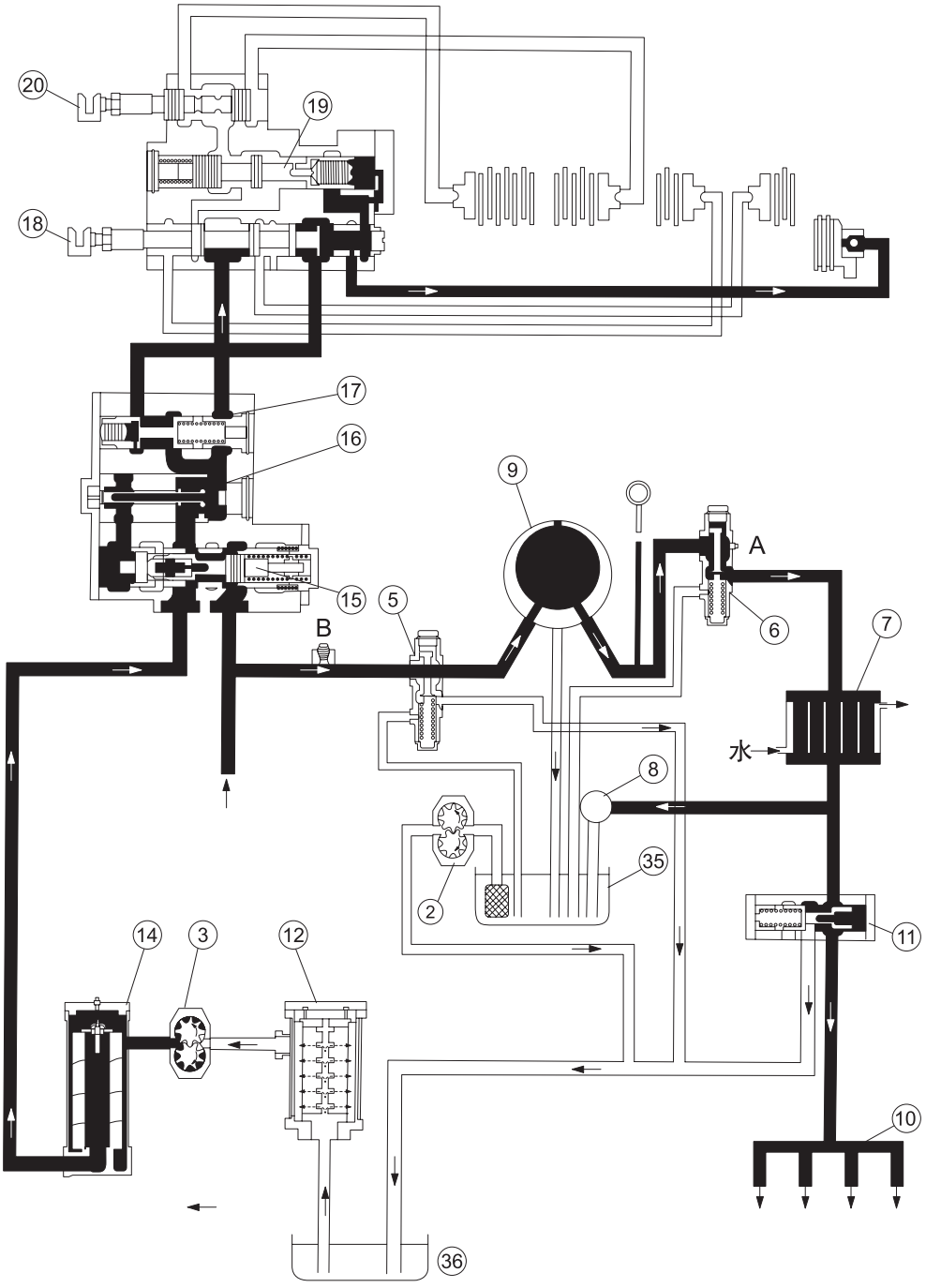


Figure 3-67: The illustration of gearshift circuit's structure

Transmission pump is a gear pump (See Figure 3-68). The transmission pump is connected with the transfer case, to convert the mechanical energy into the hydraulic energy. The transmission pump sucks the hydraulic oil from the steering case through the strainer (12), and the exhausted oil enters the pressure-adjusting valve (15) through the fine filter (14). After pressure adjustment, the oil enters the hydraulic torque converter's overflow valve (5) (The valve's set pressure is 0.87MPa), and the overflow oil returns to the steering case. Pressurized oil going through the overflow valve enters the hydraulic torque converter(9), to let the hydraulic torque converter's back pressure valve (6) ensure that the oil in the torque converter has sufficient operating pressure. The oil going through the back pressure valve, after being cooled by the oil cooler, returns to the lubricating valve (11), to lubricate the transfer case due to the lubricating valve being pressed. After lubrication, the oil flows to the inner of the torque converter housing; The oil overflow from the lubricating valve again goes to lubricate the transmission case, and after lubrication, the oil flows into the steering case. The oil scavenger pump ensures that the oil within the torque converter's housing can continuously returns to the steering case.

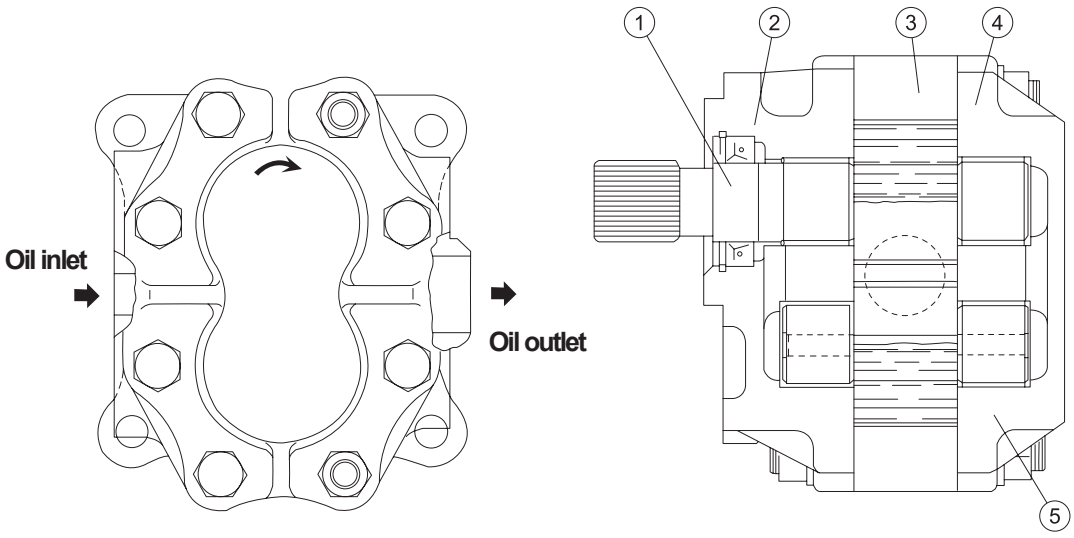


Figure 3-68

No.	Name	No.	Name	No.	Name
1	Driving gear	3	Body, Pump	5	Driven gear
2	Front pump cover	4	Rear pump cover		

Coarse stainer's structure (see figure 3-69)

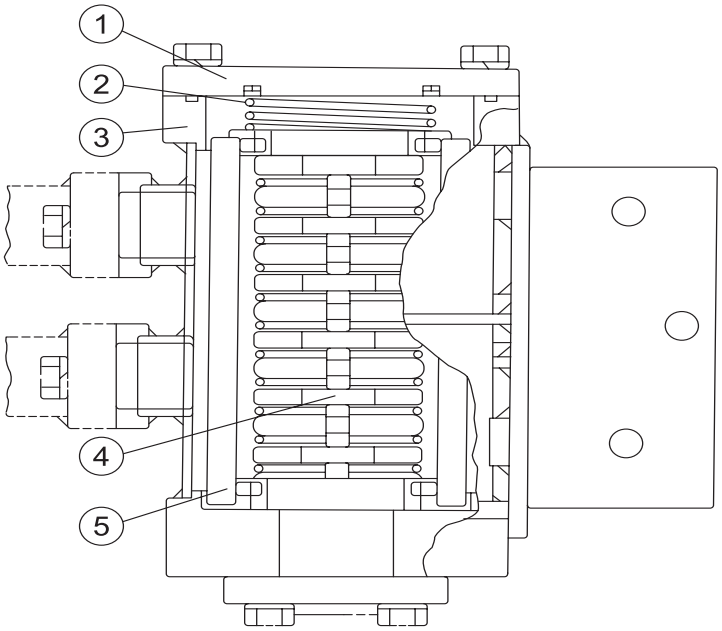


Figure 3-69

Fine filter's structure (see figure 3-70)

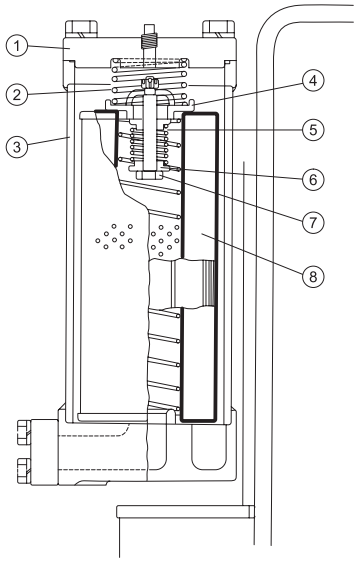


Figure 3-70

Install a control valve on the transmission case (See Figure 3-71)

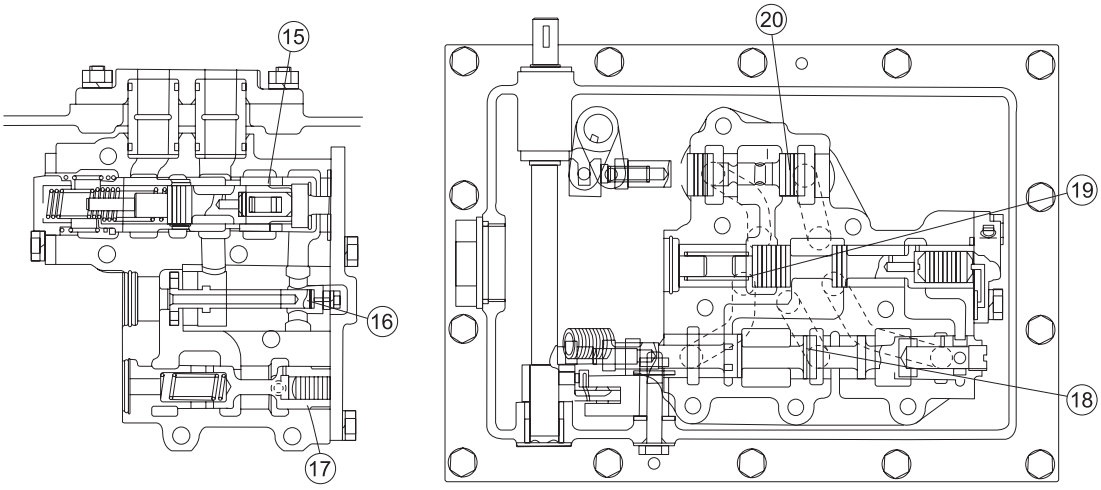


Figure 3-71

Valve (15) is the pressure-adjusting valve, and the adjusting pressure is 2.5Mpa, to ensure the engagement of all the clutches except for Gear 1. After reaching this pressure, the pressure-adjusting valve is opened, to supply oil to the torque converter. Valve (16) is the fast return valve. The joint action of this valve and the pressure-adjusting valve (15) can ensure that when the transmission case's various clutches are activated, they can be smoothly engaged or thoroughly disengaged.

When the transmission case's control lever is operated, the system's pressure changes according to the curve in Figure 3-72. At the moment the transmission case is operated to shift a gear, the pressure drops suddenly, to have the clutch be thoroughly separated. And then, the pressure slowly rises, to let the clutch smoothly engage, to avoid shock, and to help increase the service life of the drive system.

Valve (17) is the pressure relief valve, provided specifically for the Gear 1clutch, and the pressure at its exit is 1.25MPa. (i.e. the engagement pressure of the Gear 1 clutch)

Valve (18) is the starting safety valve. It is provided in order to avoid the unexpected accidents when the engine is started while the gearshift knob is on a gear (Gear I, II, III) to let the vehicle move suddenly. the vehicle will only start to move when the gearshift knob is in the NEUTRAL position, and then is put on a gear.

Valve (19) is the speed valve. It is used to operate the transmission case's clutches to get different forward and reverse speeds.

Valve (20) is the direction valve. It is used to operate the transmission case's first clutch and second clutch , to let the bulldozer move forward or backward. Valves (15) through (20) return oil into the steering case.

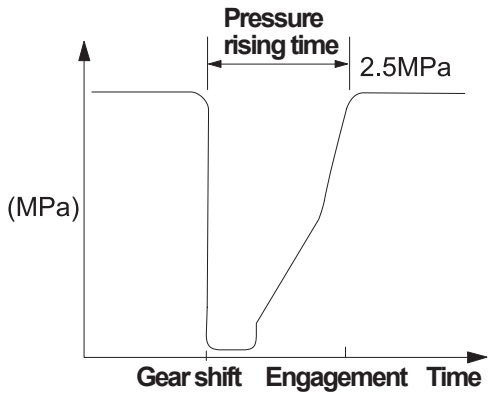


Figure 3-72

3.12 WORK EQUIPMENT

The work equipment mainly refers to the blade and the ripper, used to perform various operations of the bulldozer. Bulldozer SD22S only has the straight tilt blade. Bulldozers SD22, SD22E, and SD22D have three types of blades: straight tilt blade, angle blade, and U-Blade.

3.12.1 STRAIGHT TILT BLADE

The push rod of the straight tilt blade is a box-shaped structure, with a good anti-bending strength, a good anti-pressure stability and good rigidity. The front end is hinged together with the blade using a cross connector, and the back end is hinged together with the seat (8) fixed on the track frame.

Under the action of the blade's oil cylinder, both the push rod and the blade's head rotate with the seat (8) as the axle, to realize the blade's raising and lowering. Changing the length of adjusting screw (5) can change the cutting angle of the blade. Tilting the oil cylinder (6) can enable the blade to tilt to left or right in a direction perpendicular to the ground.

After being used for a period of time, the cutting edge (2) can be turned around and used again.

3.12.2 U-BLADE

The structure of the U-Blade is slightly the same as that of the straight tilt blade, the action principle is completely the same, and the only difference is in the shape of the blade. No detailed description will be made here.

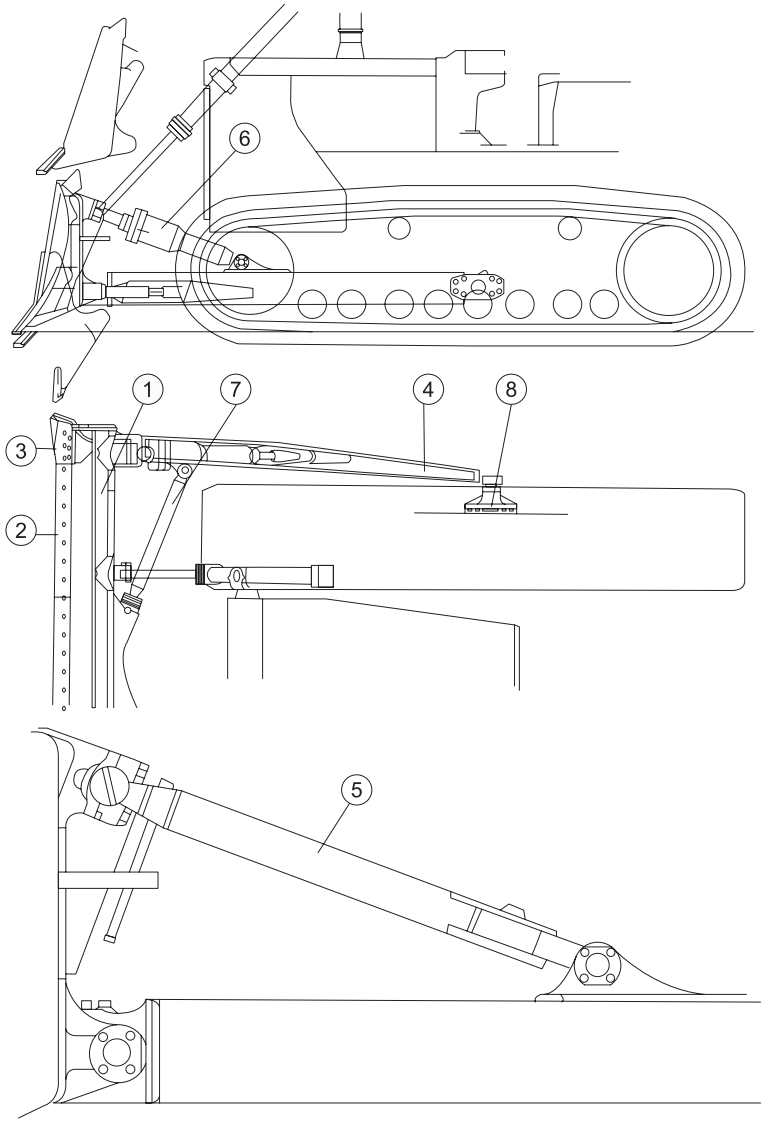


Figure 3-73

No.	Name	No.	Name	No.	Name	No.	Name
1	Dozer blade	2	Edge, Cutting	3	End bit	4	Push rod
5	Adjusting screw	6	Tilt oil cylinder	7	Arm	8	Seat

3.12.3 ANGLE BLADE

Angle blade's structure is shown in Figure 3-74.

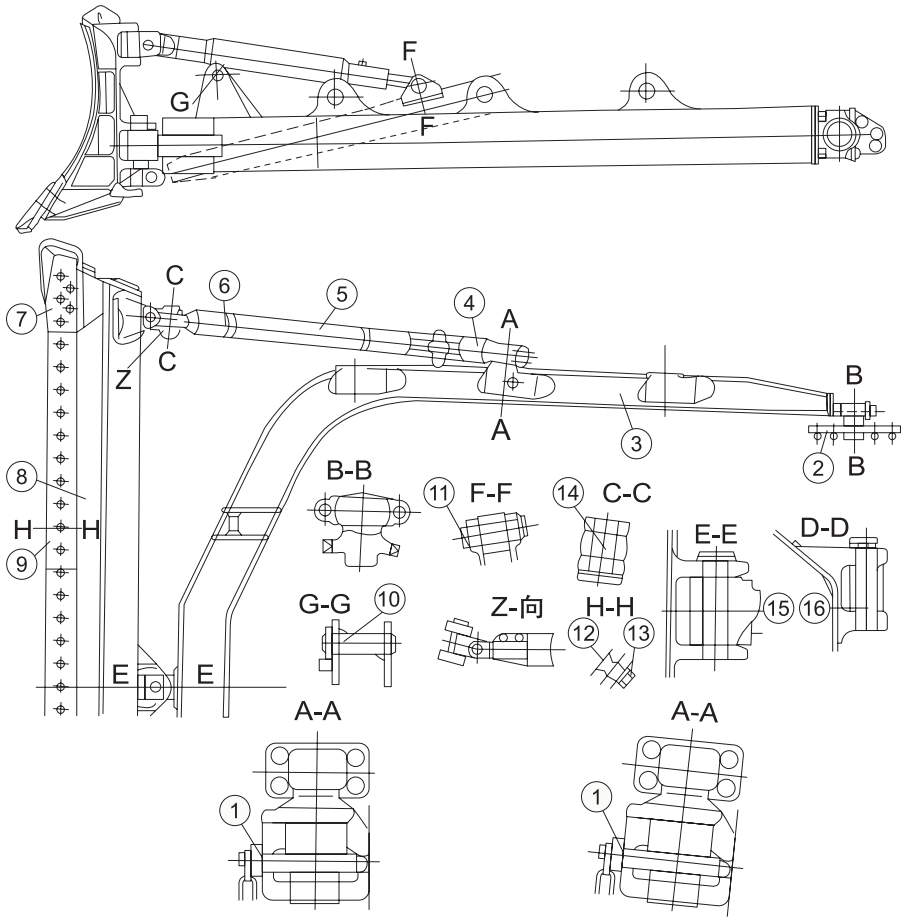


Figure 3-74

No.	Name	No.	Name	No.	Name	No.	Name
1	Pin	2	Seat	3	C-Frame	4	Lower support
5	Upper support	6	Screw	7	End bit	8	The blade's head
9	Edge, Cutting	10	Pin	11	Pin	12	Bolt
13	Nut	14	Pin	15	Pin	16	Pin

The blade (8) is hinged together with the C-Frame (3) through the upper support (5) and the lower support (4). The C-Frame (3) is hinged together with the seat (2), which is fixed on the track frame. The blade's cylinder lets the C-Frame (including the blade) make the fixed-axis swing with seat (2) as the axis.

Installing the lower support (4) on the C-Frame's different seats through the unplug pin (1) can let the blade have three different work positions, to realize 25° rotation to the left or right.

3.12.4 RIPPER (SEE FIGURE 3-75)

The ripper can be used in conjunction with the straight tilt blade and the angle blade.

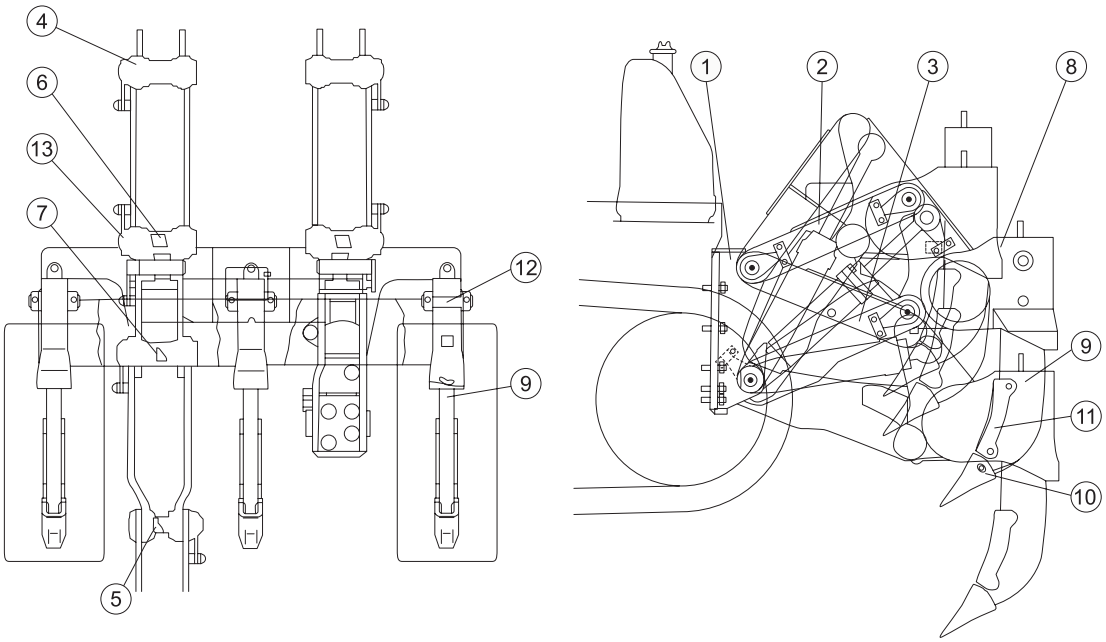


Figure 3-75: Angle blade

No.	Name	No.	Name	No.	Name	No.	Name
1	Bracket	2	Connecting rod	3	Connecting frame	4	Pin
5	Pin	6	Pin	7	Pin	8	Cross beam
9	Tooth	10	Tooth tip	11	Guard plate	12	Pin
13	Pin						

The ripper is a mechanism with four connecting rods installed behind the frame. The bracket (1), the connecting rod (2), the connecting frame (3) and the cross beam (8) are all connected through a hinge, and the four hinging points are the four apexes of a parallelogram. So, no matter how the ripper's cylinder moves, when the tooth tip cuts soil, the best cutting angle can be ensured.

The cross beam (8) has two sets of holes to provide two installation locations. After being used for a while, the tooth tip (10) can be turned 180° to be installed again, to extend its service life. For hard soil, you can operate using one tooth in the middle or two teeth on the two ends.

3.13 ELECTRIC SYSTEM

3.13.1 DESCRIPTION OF THE ELECTRIC SYSTEM

The bulldozer's electric system is mainly used to start the diesel engine, the lamps. It consists of the starting motor, the silicon rectified generator, the magnetic switch, the voltage stabilizer and two 12V batteries.

Notes:

1. The advanced magnetic switch and voltage relay are used, to better protect elements such as the starter and starting switch;
2. The silicon rectified generator is used, together with an IC adjuster;
3. When the starting switch is in the "open" position, the Battery relay can automatically cut off the power supply, to prevent electric leakage;
4. When installing the connectors of various electric assemblies, be sure to pay attention to their colors, specifications and locations, and never make a wrong connection.
5. When replacing the battery, product of the same model should be used. If a battery with a small capacity is used, it may be damaged during the starting process due to overload;
6. Each time the continuous start should not be over 10 seconds. The interval between 2 starts should be around 2 minutes.

3.13.2 ELECTRIC WIRING CHART

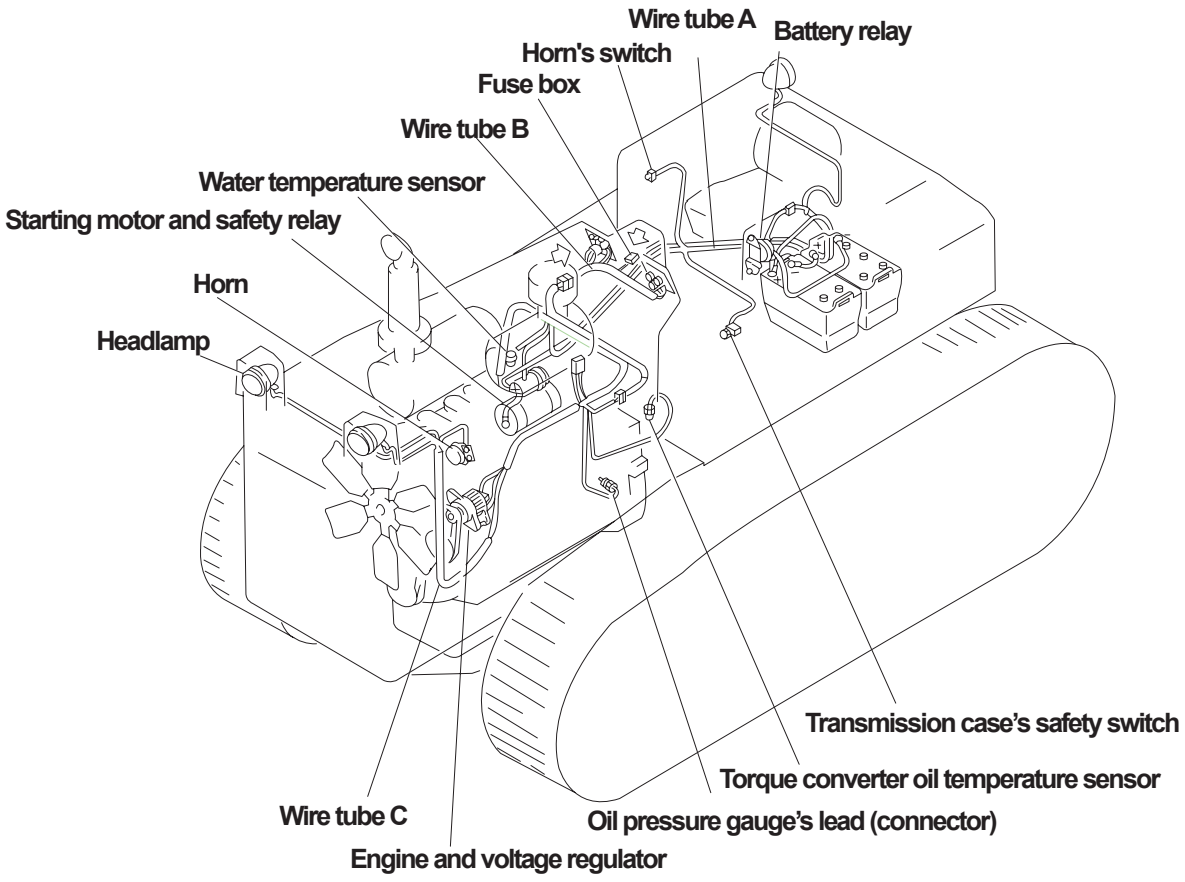


Figure 3-76

3.13.3 WIRE CODES

The following wire codes can help to understand circuit diagrams
Example: wire code 70A01
"70" represents the wire's standard cross-section, as shown in the table below:

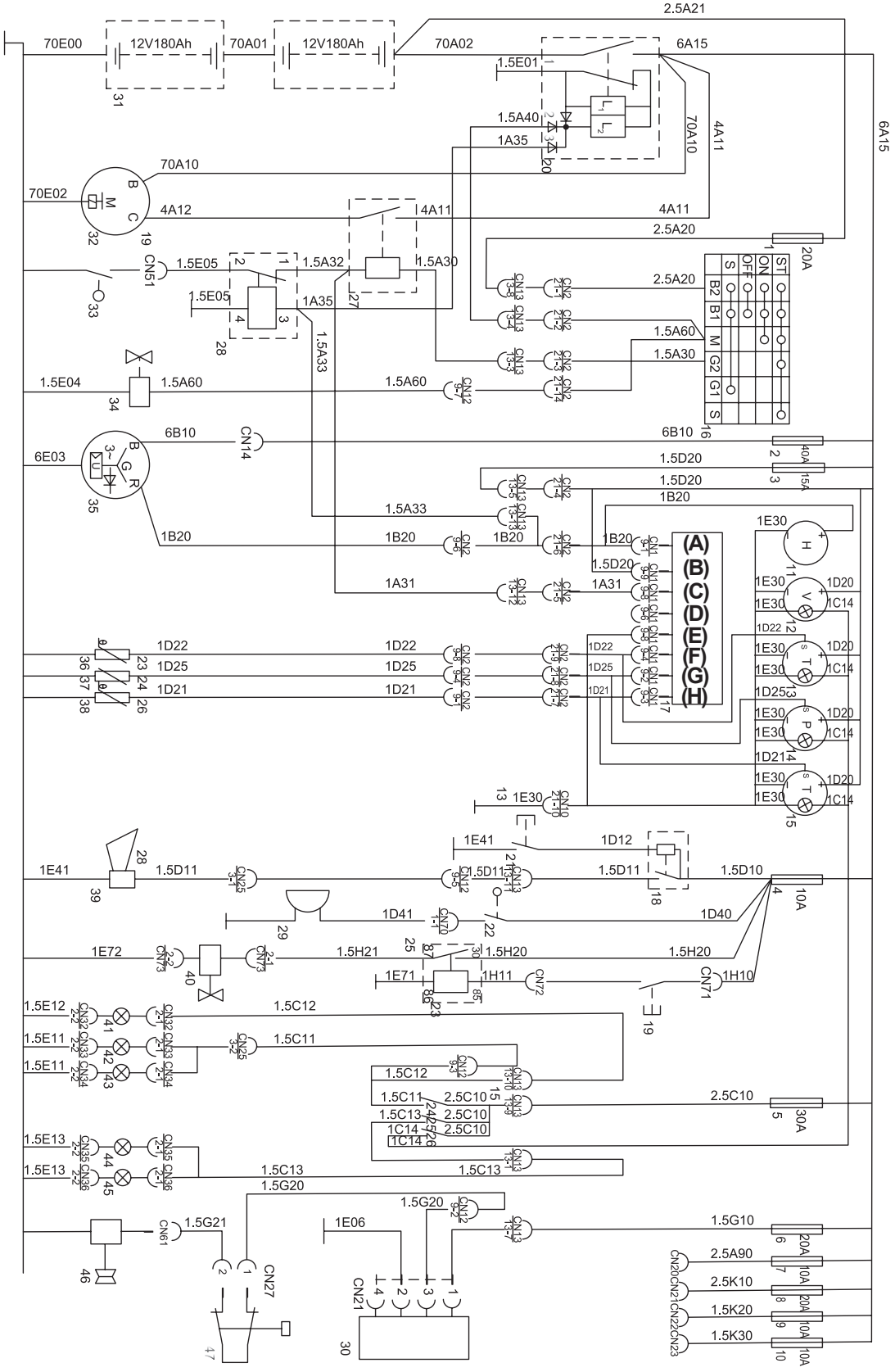
Clutch's number of teeth	Number of strands	Diameter of each strand (mm)	Wire's outer diameter (mm)	Main application circuit
0.5	16	0.2	2.4	
0.75	24	0.2	2.6	
1	32	0.2	2.8	Instrument, Lighting, Signal
1.5	30	0.25	3.1	Instrument, Lighting, Signal, Start
2.5	49	0.25	3.7	Lighting, Signal
4	59	0.3	4.5	Power supply, Start
6	84	0.3	5.1	Start, Warm-up, Charge
10	84	0.4	6.7	Start, Warm-up, Charge
16	126	0.4	8.5	Starting circuit
25	196	0.4	10.6	Starting circuit
70	360	0.5	15.7	Starting circuit
95	475	0.5	18.2	Starting circuit

"A" represents circuit or functional group, as shown in the table below:

Code	Circuit or functional group	Functional assembly
A	Starting	Main circuits for starting, pre-heating, and stopping as well as their control circuits, main power cables
B	Charging	Circuits for charging and charging indication etc.
C	Lighting	Lighting by front and rear working lamps, indoor lighting, and lighting of the dashboard
D	Signal, instrument	Various meters and alarms, braking, steering, backing, and horn etc.
E	Bond strap	Various bond straps
F	Windshield wiper and cigarette lighter	Windshield wiper, cigarette lighter, and washer etc.
G	Air conditioner, radio & tape recorder	Air conditioner, fan, heater, and radio & tape recorder etc.
H	Automatic control	Oil temperature sensor

"01" represents numbering within the group.

3.13.4 ELECTRIC PRINCIPLE DIAGRAM



No.	Name	No.	Name
1-10	Fuse	33	NEUTRAL switch
11	Hour meter	34	Solenoid valve
12	Voltmeter	35	Generator
13	Oil temperature gauge	36	Oil temperature sensor
14	Engine oil pressure gauge	37	Pressure sensor
15	Water temperature gauge	38	Water/oil sensor
16	Starting switch	39	Horn
17	Alarm unit	40	Ripper tilt solenoid valve
18	Horn relay	41	Rear lamp
19	Ripper tilt switch	42	Left front lamp
20	Battery relay	43	Right front lamp
21	Horn's switch	44	Lamp on the left side
22	Reversing switch	45	Lamp on the right side
23	Relay	46	Compressor
24	Switch of front & rear lamps	47	High and Low Voltage switch
25	Side lamp switch	A	Charging indicator
26	Instrument light switch	B	Power supply
27	Starting relay	C	Neutral signal
28	Safety relay	D	Charging indicator
29	Back-up alarm	E	Earthing
30	Thermostat	F	Torque converter’s oil temperature indicator
31	Battery	G	Engine oil pressure indicator
32	Starter	H	Engine water temperature indicator

Note paper

CHAPTER 4: MAINTENANCE

4.1 MAINTENANCE

PRECAUTIONS:

Properly servicing and maintaining the vehicle is very helpful for extending the vehicle's service life, ensuring personal & machine safety, increasing productivity, and improving economic benefits.

Operators and maintenance personnel, apart from reading the related requirements mentioned in the "safety precautions", should also observe the following.

- Servicing and maintenance personnel must be very familiar with the machine's structure, performance, assembly & disassembly procedures, technical requirements and precautions etc. before doing related work. Never act blindly. For a difficult service & maintenance project, if you are not very sure you can do it, you'd better consult your Shantui distributor. Routine maintenance is usually performed before the vehicle is started and after work each day. Before maintenance, park the vehicle on a level ground, lower the blade and ripper, lock the locking mechanisms, and then go ahead with the maintenance. If maintenance is performed without stopping the engine, it must be carried out by two persons. One person sits in the cab, and the other person performs the maintenance. Be careful not to touch the moving parts with your body.
- Prior to maintenance, thoroughly clean, brush or wash the surrounding areas of the parts to be maintained. Pay special attention to the surrounding areas of the oil injection port, the filter, the oil nozzle, and the housing cover, and these places must be made very clean, to prevent dust from entering the oil.

⚠ CAUTION

- **Do not handle electric systems in rain;**
- **When checking or cooling water, be careful, as hot water may spurt out to injure people;**
- **After the engine oil filter or strainer is replaced, exhaust the air from the oil circuit;**
- **Never add oil by taking out the filter screen of the oil injection port.**

⚠Remember that there is high pressure within the hydraulic oil circuit. When you add oil, drain oil or perform check and maintenance, release the pressure first. The method for releasing pressure is as follows:

- Lower the blade and ripper to ground, extinguish the engine, pull the hydraulic system's control lever to each gear position 2-3 times continuously, and then slowly turn loose the oil tank's cap or the pipe connector;
- Before changing engine oil, start the vehicle to raise the oil temperature to 30-40°C strain the oil;
- Use clean oil and grease. When checking or changing oil, do not do it in a dusty location, or the dust can get into the oil;
- Before servicing the gearbox, take all the objects out of your pockets. Be careful, wrenches or nuts may fall into the box, to create a big trouble;
- Fuel and oil should be kept away from fire;
- Do not use fire to replace lamps for lighting; When changing O-rings, gaskets or other sealing items, rigorously clean part's surface, and install them carefully;
- Within the battery box, there is a 24V DC socket, which can be used directly during servicing & maintenance.

4.1.1 SERVICE TABLE

NO.	MAINTENANCE ITEMS	MAINTENANCE CONTENTS
CHECK BEFORE STARTING		
1	Checking oil or water leakage	Checking
2	Checking bolts and nuts	Checking and tightening
3	Checking electric circuits	Checking and tightening
4	Checking coolant water level	Checking and replenishing
5	Checking oil level in engine oil pan	Checking and replenishing
6	Checking fuel level	Checking and replenishing
7	Checking oil level in steering clutch	Checking and replenishing
8	Discharging impurities from fuel tank	Draining water and sediments
9	Checking dust indicator	Checking and cleaning air filter
10	Checking brake pedal travel	Checking and adjusting
INITIAL 250 HOURS SERVICE		
1	Fuel filter	Changing the filter's cartridge
2	Steering clutch case (including transmission case and torque converter)	Changing oil and washing the strainer
3	Hydraulic tank and filter	Changing oil and Replacing filter element
4	Final drive case	Changing oil
5	Engine valve's clearance	Checking and adjusting
EVERY 250 HOURS SERVICE		
	Lubricating (Checking the following areas, lubricating them and applying grease to them)	
1	Fan pulley	1 place
	Tension roller and tension roller's bracket	2 places
	Support arm's screw rod	1 places of straight tilt blade, and 2 places of angle blade
	Oil cylinder bracket shaft	2 places
	Oil cylinder bracket yoke	4 places
	Tilt oil cylinder ball joint	Straight tilt blade: 1 place
	Support arm's spherical hinge	Straight tilt blade: 1 place
	Blade arm ball joint	3 places
	Oblique arm's spherical hinge	2 places
	Various hinged joints of the ripper	18 places
2	Engine oil pan and filter	Draining oil and replacing the filter element
3	Gearshift's oil filter and steering oil filter	Replacing filter element
4	Final drive case	Checking oil level and replenishing
5	Hydraulic tank	Checking oil level and replenishing
6	Generator's driving belt	Adjusting tension
7	Water pump's driving belt	Adjusting tension

CONTINUED		
CHECK BEFORE STARTING		
8	Battery electrolyte	Checking level
9	Strainer on the bottom of fuel tank	Washing
EVERY 500 HOURS SERVICE		
1	Fuel filter	Replacing filter element
2	Breather	Washing
3	Fan belt	Adjusting tension
EVERY 1000 HOURS SERVICE		
	Lubricating (Checking the following areas, lubricating them and applying grease to them)	
1	Universal joint	8 places
	Oblique support arm	2 places
	Idler's tensioning oil cylinder	2 places
2	Water tank's radiation fin	Checking and cleaning
3	Steering clutch's case	Changing oil and washing the strainer
4	Final drive case	Changing oil
5	Hydraulic tank and filter	Changing oil and Replacing filter element
6	Walking parts	Checking and lubricating
7	Tubocharger	Checking roller's clearance
8	Corrosion resistor	Changing the filter's cartridge
EVERY 2000 HOURS SERVICE		
	Lubricating	(Checking the following areas, lubricating them and applying grease to them)
1	Equalizer bar's axle	1 places
	Brake pedal	5 places
2	Breather of the engine's crankcase	Washing
3	Tubocharger	Washing
4	Valve clearance	Checking and adjusting
5	Engine's damper	Checking or changing
EVERY 4000 HOURS SERVICE		
1	Water pump	Checking if the belt is loose and if there is water leakage
2	Fan pulley and tension wheel	Checking if it is loose
MAINTENCE WHEN NEEDED		
1	Air cleaner	Cleaning and changing
2	Coolant system	Washing the inside and changing the coolant
3	Track tension	Checking and adjusting
4	Track bolt	Checking and tightening
5	Ed bit and cutting edge	Inverting or changing

4.1.2 INITIAL 250 HOURS SERVICE

Perform the following maintenance only after the first 250 hours:

1. Fuel filter
2. Steering clutch case (including transmission case and torque converter)
3. Hydraulic tank and filter
4. Final drive case
5. Engine valve's clearance

For the replacement and maintenance methods, see "Maintenance for Every 250 Hours, 1000 Hours and 2000 Hours".

4.1.3 EVERY 250 HOURS SERVICE

Inject grease to the grease nozzle shown in the figure.

1. 1 place: Fan pulley (Figure 4-1)
2. 2 places: Tension roller and tension roller's bracket

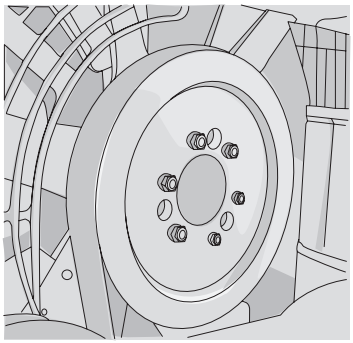


Figure 4-1

3. 1 place of the support rod (Figure 4-2) 3 places of straight tilt blade, and 2 places of angle blade

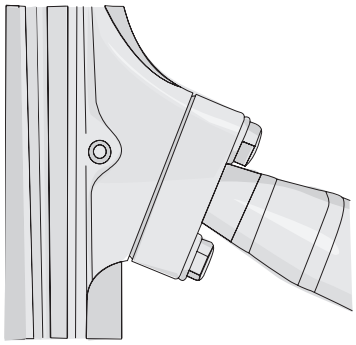


Figure 4-2

4. 4 places of oil cylinder's bracket (Figure 4-3)

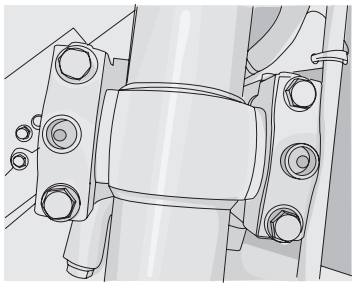


Figure 4-3

5. 1 place of the tilt cylinder's spherical hinge (straight tilt blade) (Figure 4-4)

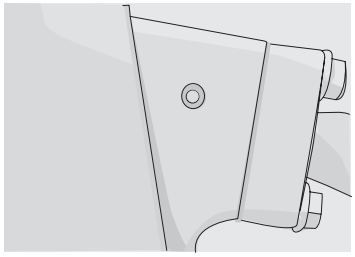


Figure 4-4

6. 1 place of the support arm's spherical hinge (straight tilt blade) (Figure 4-5)

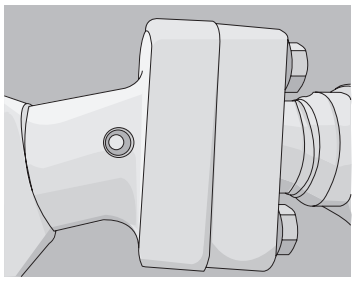


Figure 4-5

7. Oblique arm's spherical hinge (Straight tilt blade) (Figure 4-6) 2 places

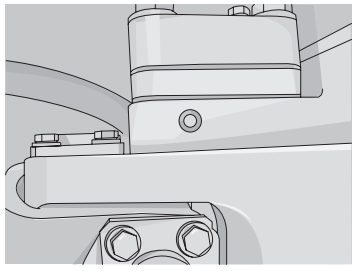


Figure 4-6

8. Applying grease to the connector of the blade's oil cylinder

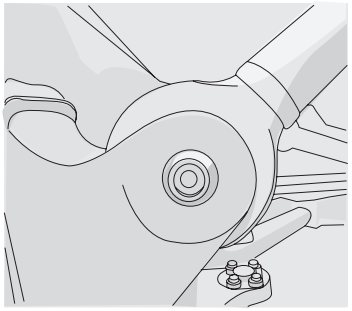


Figure 4-7

9. Ripper's various hinges (Figure 4-8-4-13):

a. Upper connecting rod (8 places);

b. The top part of the oil cylinder's piston rod (2 places);

c. The lower connecting frame's pin (4 places).

d. The lower connecting frame's shaft (4 places).

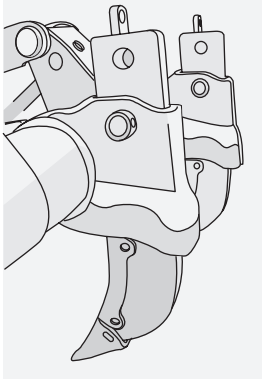


Figure 4-8

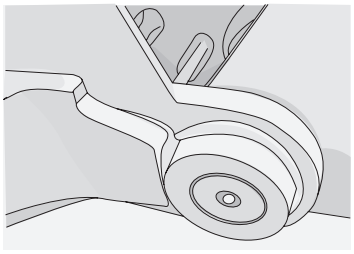


Figure 4-9

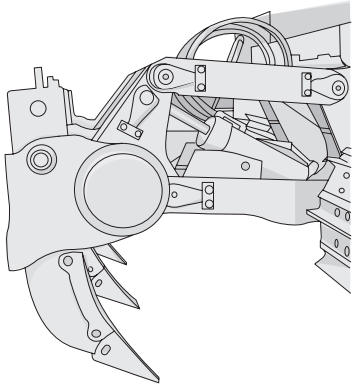


Figure 4-10

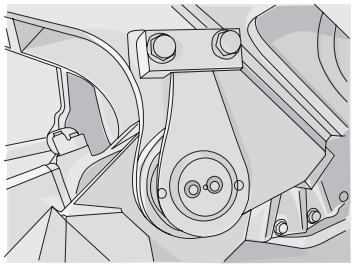


Figure 4-11

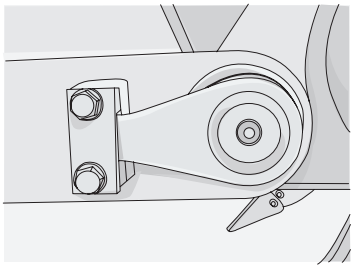


Figure 4-12

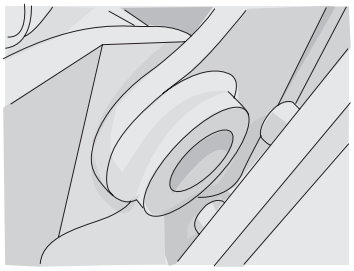


Figure 4-13

10. Engine oil pan and filter

- Remove the cover installed on the bottom of the body. Remove the drain plug and release the drain valve. After draining, tighten the drain valve and the drain plug.
- Use filter wrench to rotate it counterclockwise, to remove the engine oil filter's and bypass oil filter's cartridges. Fill the new engine oil filter's and bypass oil filter's cartridges with engine oil, apply a small amount of the engine oil on the gasket, and screw it on the filter's seat. When the gasket touches the sealing surface, make 3/4-1 more turns. After replacing the filter's cartridge, add engine oil through the oil injection port (F) (Figure 4-14).
- And then, let the engine idle for a while, and detect the oil level. The type of lubricant used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference. The oil should be changed every 6 months. Before installing the filter's cartridge, you must inject the engine oil into the filter's cartridge.

⚠ **Always use Shantui genuine filters.**

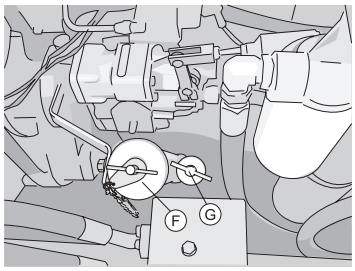


Figure 4-14

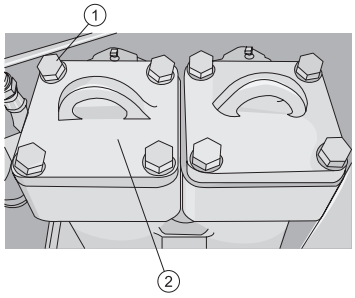


Figure 4-15

11. Gearshift's oil filter and steering oil filter.

- Remove the bolt (1), pull up the cap (2), and take out the filter element and the valve along with the cap (2). Remove the butterfly-shaped nut of the tightening valve (4), and take out the filter element (3) from the oil filter. Clean the inner part of the housing and the parts removed, and install the new filter element in the oil filter. (See Figure 4-15 and Figure 4-16)

⚠ **Always use Shantui genuine filters.**

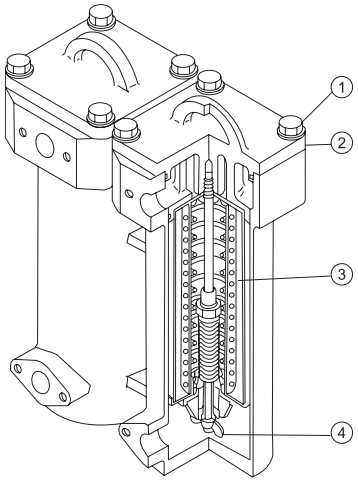


Figure 4-16

CHAPTER 4

12. Final drive case

- Remove Plug (G). If it is found that the oil is not filled near the bottom side of the plug's hole, add lubricant via the plug's hole. The lubricant used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference. When performing maintenance, park the vehicle on a level ground.

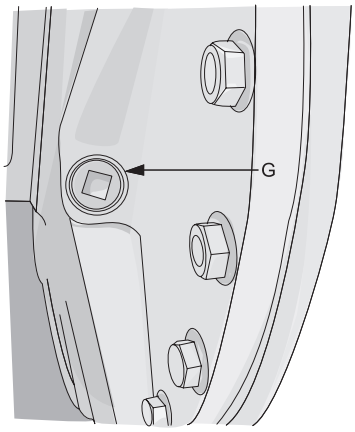


Figure 4-17

13. Hydraulic tank (See Figure 4-18)

- Put the blade and the ripper on the ground horizontally, stop the engine, and wait for 5min to check the oil level. If the oil level is not within the red circle in the Observation Window (G), replenish the hydraulic oil to the oil tank via the Oil Injection Port (F).

⚠ CAUTION

- **When the oil temperature is high, do not remove the cap. Hot oil sometimes can spurt out. When removing the cap, slowly rotate the cap, to release the internal pressure. The lubricant type used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference.**
- **Before the engine is started, perform the routine check.**

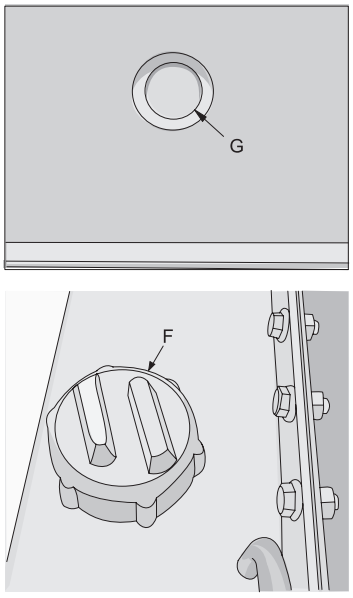


Figure 4-18

14. Generator's driving belt

- The standard is that when you use a force of about 60N to press the belt in the direction shown by the arrow in Figure 4-19, you can press it down by 10mm, or adjustment should be made. You should also check the belt for damage. When the belt is extended and cannot be adjusted any more, or when there are cuts and cracks, replace the belt immediately. The two belts should be replaced. After the new belts are installed, test run them for one hour before check and adjusting. The V-shaped belt is not allowed to contact the V-groove's bottom.

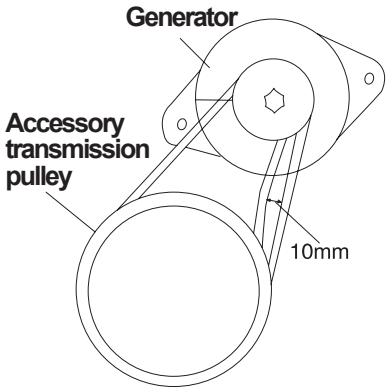


Figure 4-19

15. The water pump's driving belt (Figure 4-20)

- The check and adjustment method is the same as that of the engine's driving belt.

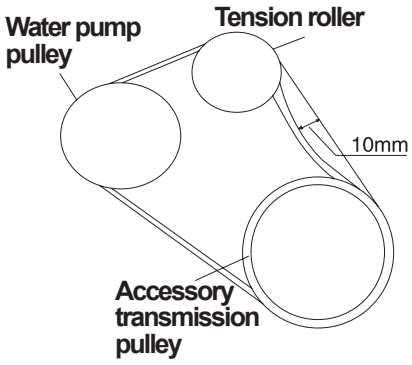


Figure 4-20

16. Battery electrolyte (Figure 4-21)

- If the liquid level of the battery is lower than the required level (10-12mm above the limit level), distilled water will need to be added. If the electrolyte is reduced because of overflow, inject dilute sulphuric acid of the same concentration to the battery. Clean the breather hole on the battery's cap when checking the liquid level.
- Don't use the metal funnel to add liquid.

⚠ WARNING

- **To avoid the gases from explosion, keep fire or sparks away from the battery.**
- **If the electrolyte is spilled to skin or clothes, wash with plenty of clean water immediately.**

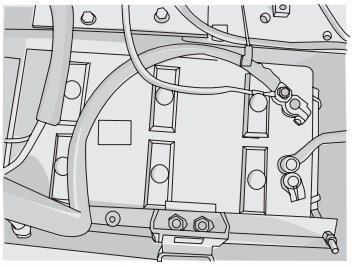


Figure 4-21

17. Exhaust impurities and water from fuel tank (Figure 4-22)

- Open the back cover, and loosen the valve on the fuel tank's bottom, to exhaust water and impurities.

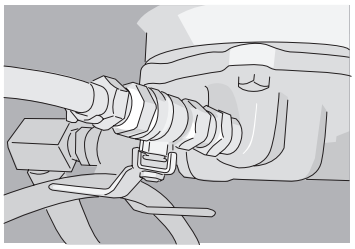


Figure 4-22

4.1.4 EVERY 500 HOURS SERVICE

Maintenance for every 250 hours service should be carried out at the same time.

1. Fuel filter

- Close the valve on the fuel tank's bottom (See Figure 4-22), and use the filter's wrench to remove the fuel filter's cartridge (Figure 4-23). Fill the new filter's cartridge with clean fuel, and apply a small amount of engine oil on the gasket. Install the filter's cartridge, tighten it with hand until the gasket contacts the filter's seat, and then tighten it 1/2-3/4 more turns (Do not tighten it too much).

⚠ **Always use Shantui genuine filter's cartridge.**

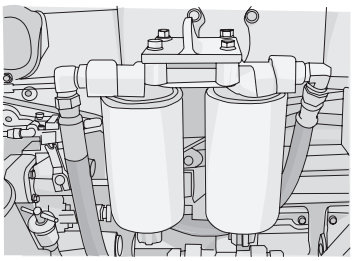


Figure 4-23

2. Breather

Remove the breather, and use diesel to flush the dust accumulated within it.

- Steering clutch's case (1 place)
- Final drive's case (2 places)

3. Fan belt

- Check the V-shaped belt, and if there are the following circumstances, replace the V-shaped belt:
- When the V-shaped belt contacts the bottom of the pulley's groove; when the V-shaped belt is worn, and its surface is lower than the pulley's outer diameter;
- when the V-shaped belt has cracks or peels off. For details about the replacement procedure, see the "Fan belt adjustment".

4.1.5 EVERY 1000 HOURS SERVICE

Maintenance for every 250 and 500 hours service should be carried out at the same time. Inject grease to the grease nozzle shown in the figure.

1. Universal joint (8 places)
2. Add lubricating grease to the half shaft's bush (Figure 4-24) (2 places)
3. Oil cylinder for idler tension (Figure 4-25) (2 places)

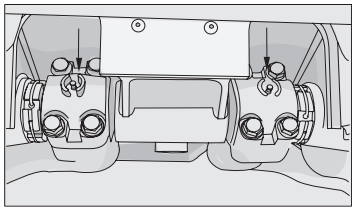


Figure 4-24

4. Water tank's radiation fin (Figure 4-26)

- Loosen the guard gate's bolt, and open the guard gate. Use compressed air to blow sundries such as mud, dust or leaves off from the water tank's radiation fin. You can also use steam or water to replace the compressed air. Check the water tank's rubber tube for cracks or embrittlement, and replace it if necessary. Check the rubber tube's clamp to see if it's loose.

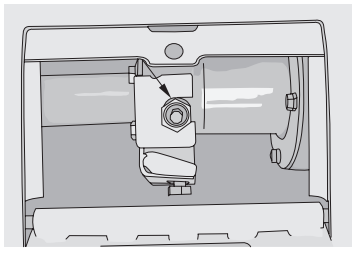


Figure 4-25

5. Steering clutch case (including the bevel gear case) and transmission case.

- Screw off the oil drain plug on the transmission case's housing, and tighten it again after draining the old engine oil.
- Add the engine oil to the required oil level through the transmission case's oil port.
- Choose an oil listed in the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE", and add it from the oil injection port.
- Remove the drain plug on the bottom of the body (the arrow in Figure 4-27) to drain the oil, and tighten the drain plug again after draining the oil.

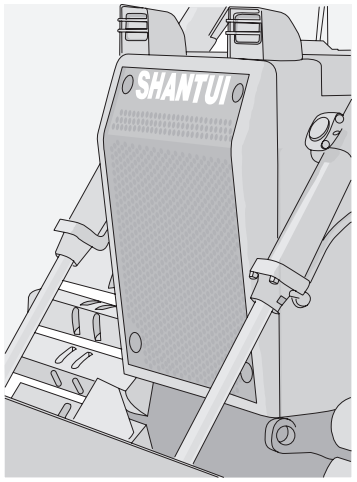


Figure 4-26

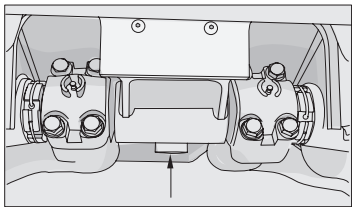


Figure 4-27

- Remove the left floor, the bolt, the cap, the steering clutch's strainer and the magnet; loosen the bolt, and after cleaning the inside of the housing, the strainer and other parts removed, re-install them back to their appropriate positions.
- If the strainer is damaged, change a new strainer.
- After replacing the gearshift and steering oil filter's element (See "EVERY 250 HOURS SERVICE"), add the required amount of engine oil through the oil injection port. Amount of oil added: 90L (Figure 4-28). The lubricant used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference.

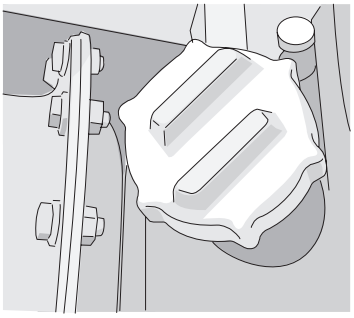


Figure 4-28

6. Final drive case (Figure 4-29 and Figure 4-30)

- Remove the oil filler plug from two sides of the body, and then remove the drain plug to drain the oil. After the draining, tighten the drain plug.
- Inject the required amount of the engine oil through the oil filler plug (See "EVERY 250 HOURS SERVICE"). The lubricant type used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference. Amount of oil added on each side: SD22, SD22E and SD22D: 41L; SD22S and SD22R: 51L.

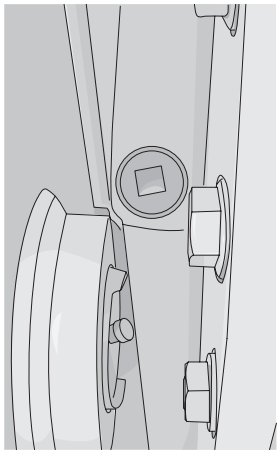


Figure 4-29

7. Hydraulic tank and filter(Figure 4-31-Figure 4-33)

- Remove the drain plug on the bottom of the oil tank, and loosen the drain valve. After draining, tighten the valve and drain plug. Remove the bolt, cap and filter element. Clean the removed parts and filter's inside, and install the new filter element. Inject the required amount of the hydraulic oil through the oil injection port-F (See the "EVERY 250 HOURS SERVICE"). Amount of oil added: 110L. The lubricant type used depends on the ambient temperature. See the "USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE" for reference.

⚠ **Always use Shantui genuine filters.**

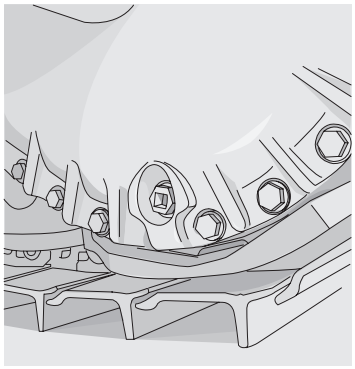


Figure 4-30

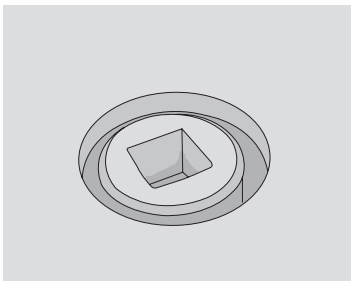


Figure 4-31

8. Walking parts

- Stop the vehicle on a level ground, and check the oil consumption in the track roller, carrier roller, and idler one by one. (Figure 4-34)
- Slowly screw loose the seal bolt (Figure 4-35) to see if there is oil seeping out from the threads. If yes, it means that there is enough oil, and you should tighten the bolt immediately. If there is still no oil flowing out after the seal bolt is completely removed, it means that there isn't enough oil. In this case, you should require your local Shantui distributor to make necessary repair.

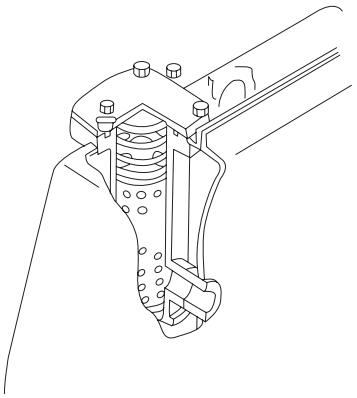


Figure 4-32

9. The roller of the tubocharger has clearance

- Contact your local Shantui distributor for necessary check or repair.

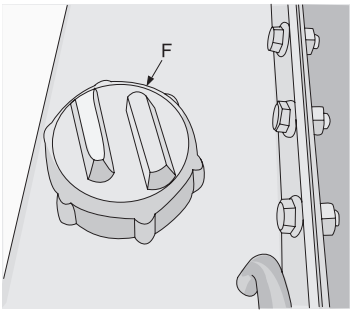


Figure 4-33

10. Corrosion resistor (water filter)

- Shut down the corrosion resistor's water inlet/outlet valve. Use the filter's wrench to turn the corrosion resistor's filter cartridge counterclockwise to remove it. Apply a small amount of oil on the sealing surface and install a new element. During installation, tighten 1/2-3/4 turns after the sealing surface is in contact with the cap. (Don't turn it too tight.) After the replacement, open the valves.

⚠ **Always use Shantui genuine filters.**

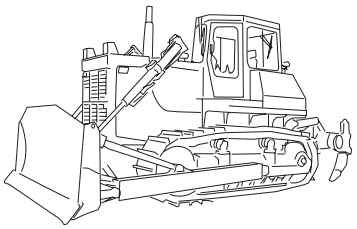


Figure 4-34

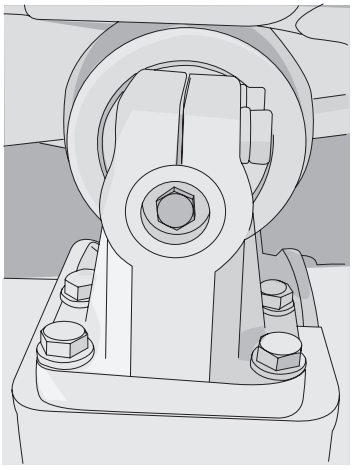


Figure 4-35

4.1.6 EVERY 2000 HOURS SERVICE

Maintenance for every 250, 500, and 1000 hours service should be carried out at the same time.
Lubricating, Inject grease to the grease nozzle shown in the figure.

1. Equalizer bar's shaft (1 place)
2. Brake pedal's axle (Figure 4-36) (5 places)

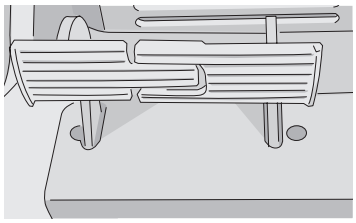


Figure 4-36

3. Tubocharger

- The excessive carbon black or grease adhered to the tubocharger pump impeller may influence the normal performance of the tubocharger, and sometimes may damage the tubocharger. Contact your local Shantui distributor for necessary check or cleaning. Do not use steel brush or similar things to do that, to avoid the pump impeller's surface from being damaged.

4. Valve clearance

- Contact your local Shantui distributor to check the valve clearance, because this requires special tools.

4.1.7 EVERY 4000 HOURS SERVICE

Maintenance for every 250, 500, 1000, and 2000 hours service should be carried out at the same time.

1. Water pump

- Check pulley to see if it's loose or if there is leakage of grease or water. If yes, contact your local Shantui distributor to repair or replace the water pump.

2. Fan pulley and tension wheel

- Check the wheels to see if they are loose or if there is leakage of grease. If yes, contact your local Shantui distributor to repair or replace the wheel assembly.

4.1.8 MAINTENCE WHEN NEEDED

The following items should be checked and serviced when required depending on the result of visual inspection.
Air cleaner

1. Inspection:

- If the monitor lamp of the monitor's air filter blinks, you should clean the air cleaner's element. Stop the engine when doing the cleaning.

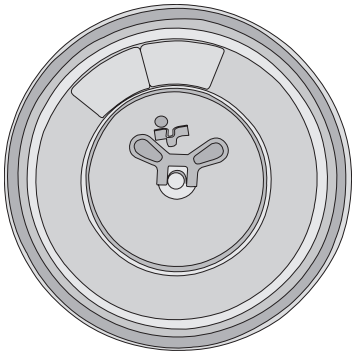


Figure 4-37

2. Clean or replace the outer filter element:

- Remove the butterfly-shaped nut (1) and the outer filter element (Figures 4-37 and 4-38), and clean the inside of the air cleaner's housing. Clean and check the outer filter element (For the cleaning method, See the "Outer filter element cleaning method"). For every time the outer filter element is cleaned, tear off one letter sticker on the inner element's label plate (Figure 4-39), and install the cleaned outer filter element.
- When the sealing gasket (2) or the butterfly-shaped nut (1) is damaged, they should be replaced. (Figure 4-38)
- Check the inner filter element's mounting nut to see if it's loose. If yes, tighten it.

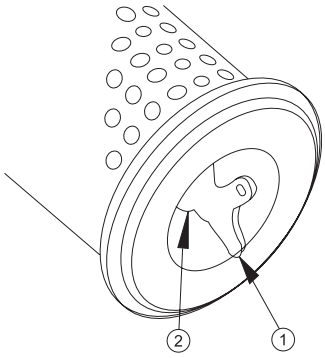


Figure 4-38

3. Replace the inner filter element (when the outer filter element has been cleaned for 6 times or when the inner filter element is damaged)

- Remove the outer filter element first, and then remove the inner filter element. Cover the air intake. Clean the inside of the air cleaner's housing, and remove the air intake's cap.
- Install the new inner filter element to the connector, and then tighten it with nut. Install the outer filter element.

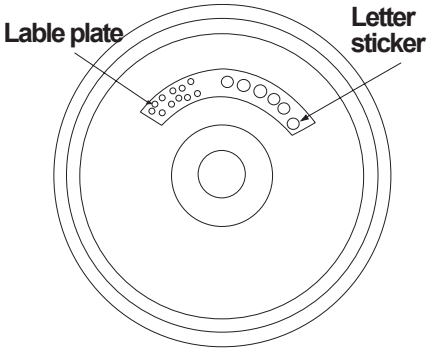


Figure 4-39

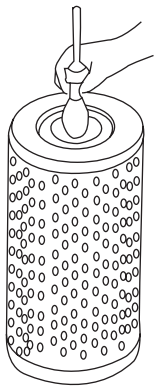


Figure 4-40

⚠ CAUTION

- **An outer filter element that has been cleaned for 6 times and has been used for 1 year should be replaced, and the inner filter element should also be replaced at the same time.**
- **Do not clean or replace the air cleaner's element when the engine is running.**
- **Do not attempt to clean the inner filter element and use it again.**

4. Outer filter element cleaning method

a .Cleaning using the compressed air

- Use dry compressed air (less than 0.7Mpa) to blow the inside of the filter element directly along the pleat. Continue to directly blow it along the outer pleat, and then repeatedly blow the inner side. Finally check if the filter element is already clean.

b. Washing with water

- Use tap water (less than 0.3Mpa) to flush along the inner pleat of the filter element, and then flush along the outer pleat. Repeat this, and check after it is dry.

c. Using a cleaning agent

- In order to remove the grease and carbon black on the filter element, you can dip it in the lukewarm water containing a neutral cleaning agent to clean it, and then use clean water to rinse it. Check after it is dry.
- Using dry compressed air (less than 0.7Mpa) to repeatedly blow it inside out can dry it more quickly.
- Do not heat it to dry it.
- Using lukewarm water (about 40°C) to replace soap water is also very effective.
- After cleaning and drying it, when checking it by dropping a lamp into the outer filter element, if you find that there are small holes or there are already some very thin parts, replace the outer filter element. (Figure 4-40)
- If the outer filter element can still be used, after dusting, keep it in a dry location.
- When cleaning the outer filter element, do not use other objects to knock or impact it.
- An outer filter element with an unevenly or deformed pleat or a damaged gasket cannot continue to be used.

⚠ CAUTION

- **When using the compressed air, wear the safety glasses and other objects that can ensure safety.**

Clean the inside of the cooling system

1. **Replace coolant, corrosion resistor and clean the inside of the cooling system according to the table below.**

Kind of coolant	Cleaning inside of cooling system and changing coolant	Replacing corrosion resistor
Permanent type antifreeze (All season type)	Every year (autumn) or every 2000 hours, whichever comes first	Every 1000 hours and when cleaning the inside of the cooling system or when changing coolant
Non permanent type antifreeze containing ethylene glycol (winter, one season type)	Every 6 months (spring, autumn) (Drain antifreeze in spring, add antifreeze in autumn)	
Not using antifreeze	Every 6 months or every 1000 hours, whichever comes first	

- Stop the machine on level ground when cleaning or changing the coolant.
- Use a permanent type of antifreeze. If, for some reason, it is impossible to use permanent type antifreeze, use an antifreeze containing ethylene glycol.
- The corrosion resistor (water filter) must be replaced.
- The cooling water has to be the tap water used in cities. When diluting the coolant, use distilled water or tap water (soft water). Natural water, such as river water or underground water (hard water), contains a large amount of minerals (calcium, magnesium etc), and is easy to form water scale inside the engine or the radiator. Once scale accumulates in the engine or the radiator, it's very hard to be removed. We recommend you to use water less than 100PPM.
- The ratio of antifreeze to water depends on the ambient temperature. When deciding the ratio of antifreeze to water, check the lowest temperature in the past, and decide from the mixing rate table given below.
- It is actually better to estimate a temperature about 10°C lower when deciding the mixing rate.
- The ratio of antifreeze to water during the transportation of the machine should be determined according to a temperature about 20°C lower than the expected lowest temperature during the transportation. (If you cannot make an estimate, please mix them at the biggest ratio, or if the conditions cannot be met, drain all the coolant, and re-add it as required before operation).

The blending ratios of water and antifreeze are shown in the table below:

Min. atmospheric temperature °C	Above -10	-15	-20	-25	-30	-35	-40
Amount of antifreeze %	30	36	41	46	50	54	58
Amount of water %	70	64	59	54	50	46	42

2. Clean the cooling system

- Turn off the engine, and shut down the corrosion resistor's water inlet/outlet valve.
- Slowly rotate the radiator's cap until it is open. (Figure 4-41)
- When removing the radiator's cap, you must slowly rotate the cap, to release the pressure.
- Loose the water drain valve on the bottom of the water tank and the water drain valve on the two ends of the oil cooler, to drain the cooling water. (Figure 4-42)
- Close the water tank's water drain valve and the water drain valve on the two ends of the oil cooler, and add clean water (tap water used in cities), until the water is added to the water intake's edge. When the water reaches the water intake's edge, let the engine idle, open the water tank's water drain valve and the water drain valve on the two ends of the oil cooler, and continue to add clean water to the water tank, until the clean water continuously flows out from the water drain valve for 10min.
- When draining the water, adjust water flow, to ensure that the water added is equivalent to the water drained, and to keep the water tank full of water all the time. When the water becomes completely clean, stop the engine. Open the water drain valve and the water drain valve on the two ends of the oil cooler to drain the water, and then close the water drain valve and the water drain valve on the two ends of the oil cooler.
- Use the cleaning agent bought in the market to clean the cooling system. Follow the instructions of the cleaning agent.

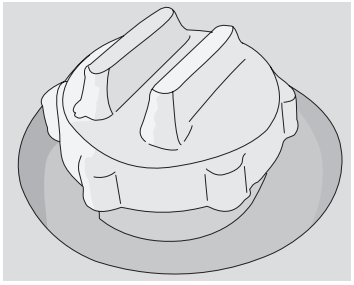


Figure 4-41

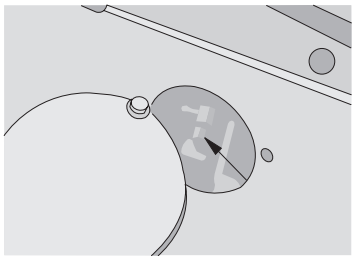


Figure 4-42

⚠ CAUTION

- **Antifreeze is flammable, so keep it away from flame.**
- **If the water temperature is high, don't remove the cap, as hot water may spurt out.**

3. Add the coolant

- After cleaning the cooling system, drain all the water, and then close the water drain valve, and slowly add the coolant (the coolant mixed according to the region where the machine is used), until coolant overflows from the water intake.
- Let the engine idle for 5min, and then run at an intermediate speed for 5min, to exhaust the air accumulated in the cooling system. (During operation, open the radiator's cap). After the engine has stopped running, wait for 3min, add coolant, until it reaches the required level, and then tighten the cap.

Track tension

1. Inspection

- Stop the machine on level ground (stop with the transmission in FORWARD without applying the brake). Then place a straight bar on the track shoes between the carrier roller and the idler (Figure 4-43), and measure the clearance between the bar and the grouser at the midpoint. If the clearance is 20 to 30mm, the tension is standard.

2. Adjustment

- In order to increase tension, pump in grease through the grease fitting with a grease pump (Figure 4-44). On the other hand, in order to loosen tension, slowly rotate the plug in the opposite direction for one turn, to squeeze out the grease. If pump in the grease until S is 0mm (Figure 4-45), and the tension is still loose, this shows that the bushing is seriously worn and thinned. Contact your local Shantui distributor to repair or replace the track.
- If the plug or other parts are made too loose, due to the high pressure from pumping in the grease, the parts are easy to fly out. If the grease cannot be pumped in smoothly, move the vehicle forward and backward for a distance.

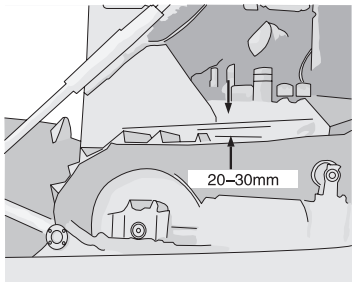


Figure 4-43

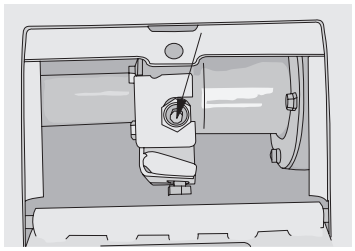


Figure 4-44

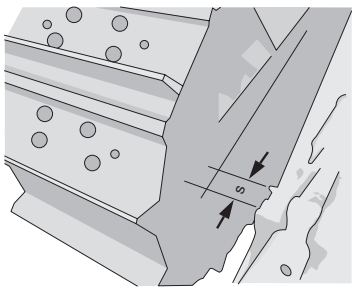


Figure 4-45

⚠ CAUTION

- **When loosening the plug, do not do it by more than an entire turn. Also, do not loosen any other parts except for the plug.**

Check and tighten track shoe bolts

- If the machine is used with track shoe bolts being loose, they will break, so tighten any loose bolts immediately. First tighten to a tightening torque of 400±40N•m, then check that the nut and shoe are in close contact with the link contact surface.
- After checking, tighten a further 120° ± 10°.

Turn or Replace the end bit and the cutting edge (Figure 4-46)

- Before the end bit and the cutting edge is worn to the edge of the blade, turn the cutting edge over and replace the end bit. If both sides of the cutting edge are worn, replace the cutting edge. Raise the blade to a suitable height, put the block beneath the push rod, to prevent the blade from falling down. Remove the end bit and the cutting edge, and clean the mounting face. Replace the new end bit, turn over the cutting edge (or change a new one), and tighten with nuts. Tightening torque: 627±78N•m (64±8kgm). After operating for a few hours, tighten the nuts.

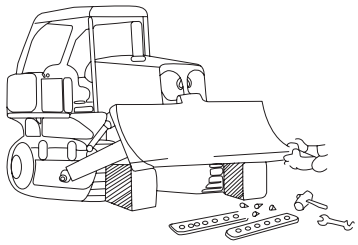
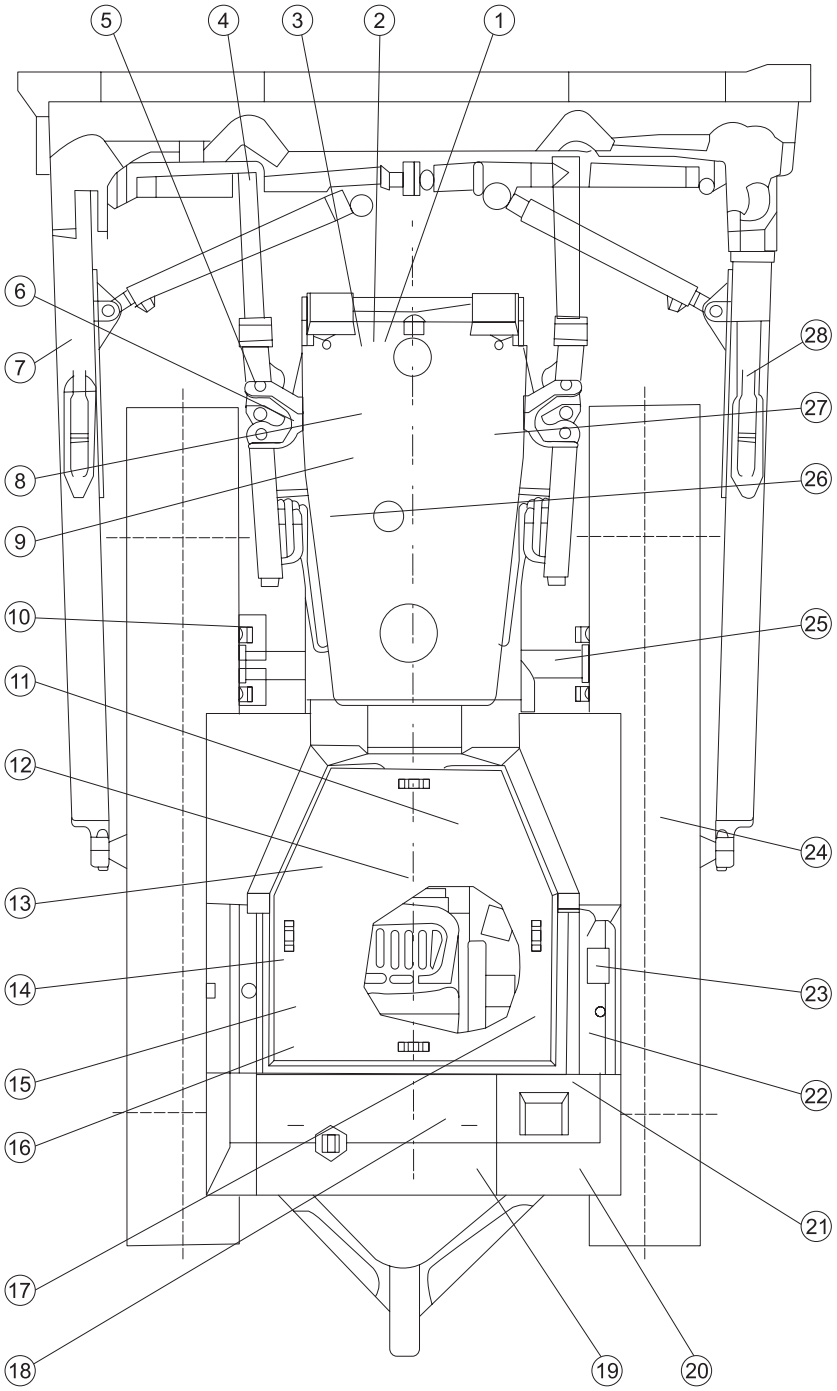


Figure 4-46

4.1.9 LUBRICATION DIAGRAM AND LUBRICATION TABLE

THE SD22 BULLDOZER'S LUBRICATION DIAGRAM:



LUBRICATION TABLE (THE SD22 SERIES BULLDOZERS)

No.	Parts to be lubricated	Number of points	Lubricants	Lubricating tools	Lubrication cycles (hours)
1	Fan pulley	1	Grease	Grease gun	250
2	Tension roller	1	Grease	Grease gun	250
3	Tension roller's bearing support	1	Grease	Grease gun	500
4	Oil cylinder's spherical hinge	2	Grease	Grease gun	250
5	Oil cylinder's supporting shaft	4	Grease	Grease gun	250
6	Support arm's spherical hinge	2	Grease	Grease gun	250
7	Lubrication support arm's screw bar	2	Grease	Grease gun	250
8	Oil cylinder's support	2	Grease	Grease gun	250
9	Engine oil pan	1	Oil	Oil pot	Adding oil every 10 hours, and changing oil every 250 hours
10	Steering oil filter element	2			250
11	Brake pedal	6	Grease	Grease gun	2000
12	Universal joint	8	Grease	Grease gun	1000
13	Washing the strainer	1			Washing it once every 500 hours
14	Fuel control lever's shaft	3	Grease	Grease gun	2000
15	Brake lock lever	1	Grease	Grease gun	2000
16	Transmission case control lever	3	Grease	Grease gun	2000
17	Blade control lever's shaft	3	Grease	Grease gun	2000
18	Oblique support arm for lubrication	2	Grease	Grease gun	1000
19	Washing the fuel strainer	1			Washing it once every 250 hours
20	Final drive's gearbox	2	Oil	Oil pot	Checking it every 250 hours, and changing it every 1000 hours
21	Steering case	1	Oil	Oil pot	Adding oil every 10 hours, and changing oil every 1000 hours
22	Hydraulic tank	1	Oil	Oil pot	Checking it every 250 hours, and changing it every 1000 hours
23	Hydraulic tank's oil filter element	1			Replacing it every 1000 hours
24	Idler's adjusting rod	2	Grease	Grease gun	250
25	Equalizer bar's main shaft	1	Grease	Grease gun	250
26	Fuel filter element	1			Replacing it every 250 hours
27	Engine oil filter	1			Replacing it every 250 hours
28	Oblique oil cylinder's spherical hinge	2	Grease	Grease gun	250
	Various hinged joints of the ripper (optional)	18	Grease	Grease gun	250 hours

4.1.10 ADJUSTMENT OF VARIOUS PARTS

Adjusting the brake pedal

1. Inspection

- When the brake lining is worn, the stroke of the steering pedal will increase to make steering difficult. When the stroke is over 190mm (when the braking force is reduced), make adjustment as follows: standard stroke: 110-130mm (when the engine is idling and the operation force is 150N) Figure 4-47); 75mm (the stroke when the engine is not running).

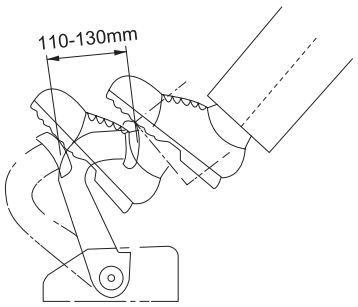


Figure 4-47

2. Adjustment

- Remove the rear cover and the inspection cover. Tighten the adjusting bolt until the tightening torque is 50N.m, to make the lining and the braking drum in close contact (step down the braking pedal to confirm the contact condition). And then, rotate the adjusting bolt for 7/6 turns in the opposite direction. The stroke of the two brake pedals should be made the same, or the brake flexibility of the two sides will not be the same. If A, the size of the adjusting bolt, is less than 71mm, please contact your local Shantui dealer to get the new brake lining.

Idler

If the idler is forced to rotate for a long time, the guide plates on the side, on the top and on the bottom as well as the directing plate will gradually become worn, causing the idler to swing left and right, or the track's links will get out of the idler because the idler becomes tilted, or the idler and the links will become unevenly worn. Therefore, you must adjust the idler whenever it's necessary according to the following procedure, to enable it to be in a good operational state.

1. Adjusting the guide plates on the side(Figures 4-48~49)

- Drive the machine for 1-2m on a level ground, to tighten the track evenly, and then stop the vehicle. Check the clearance "A" between the side guide plate and the track frame (the guide plate on each side has 4 clearances: left, right, top, and bottom).
- If any of the clearances is over 4mm, loosen bolt (1), remove certain number of shims (2), and then adjust the clearances to the standard values: 0.5~1.0mm. The shim's thickness is 0.5~1.0mm.
- When loosening the bolt (1), be sure not to rotate the bolt for more than 3 turns.

2. Adjusting the directing plates (4) and the top & bottom guide plates (6) (Figures 4-50~4-51)

- Measure the clearance “B” between the track frame’s upper wearing plate (3) and the directing plate (4) as well as the clearance “C” between the top & bottom guide plates (6) and the track frame’s lower wearing plate. If the sum of the two clearances “B” and “C” is over 5mm, reduce it to 2mm. The method is to pull out shim (7), to reduce it to the required thickness, and add a shim of the same thickness to shim (8). Such adjustment can be completed using the following procedure.
- It is normal if clearance “C” is 0mm. Measure clearance “B” and minus 2mm from the value of “B” to get the shim’s thickness (for example, if B=5mm, then the adjusting shim’s thickness should be 5-2=3mm). Shims (7) and (8) can be shims that can be pulled out.
- Loosen bolt (9) (there are a total of 4 bolts inside and outside) until you can’t feel the force of the spring.
- Loosen bolt (1). Be sure not to rotate the bolt for more than 3 turns.
- Use a stick to adjust guide frame (5) upward, to make clearance “C” 0mm. Remove shim (7) according to the required shim’s thickness determined in the first step. Add shim (7) to shim (8) (you need to complete this process for 8 places: the inside and outside of the left and right guide plates as well as the front and back of each side. Before and after the adjustment, the total thickness of shim (7) and shim (8) combined remains the same. If the total thickness of the two shims is increased or decreased due to carelessness, the preload of the spring installed within the guiding device will become inappropriate. Shim (7) and shim (8) are consisted of several pieces of two types of shims: the 1mm shim and the 2mm shim. Tighten the spring seat’s bolt (9). The tightening torque of bolt (1) is 500~620Nm. The maximum adjustment allowed for the top & bottom guide plate is 6mm.

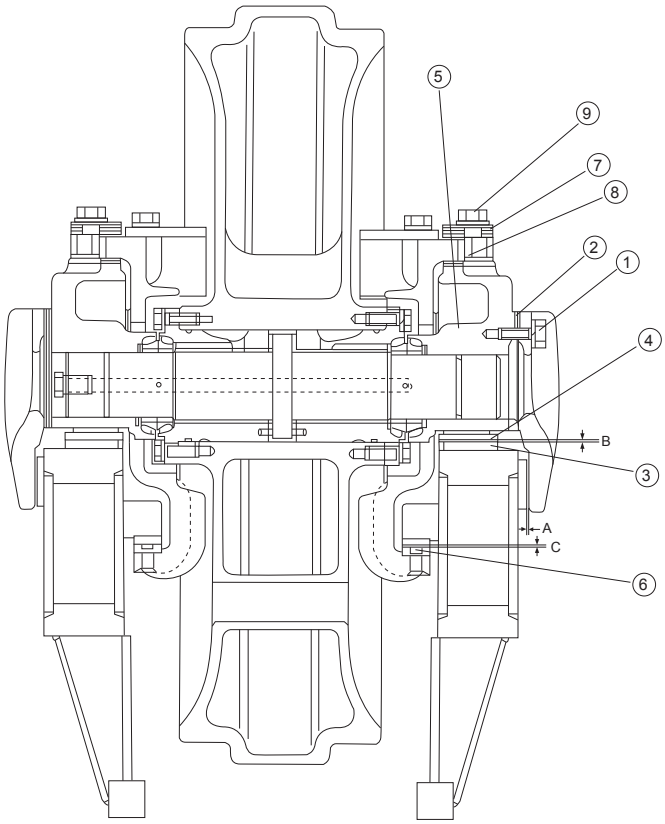


Figure 4-48

Fan belt

Because fan belt has an automatic tension device, its tension always remains constant and has nothing to do with the V-belt. The belt does not need to be adjusted until it is damaged. But when replacing the old belt with a new one, you should check if size “A” is 113±5mm (Figure 4-49), and when its value is not within this range, it should be adjusted.

When changing the V-belt, you should change both belts at the same time.

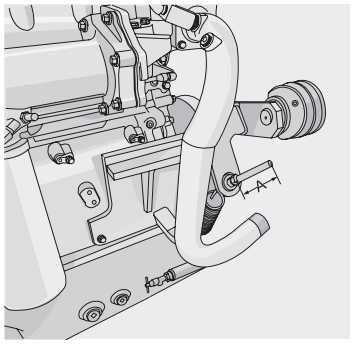


Figure 4-49

Walking parts

The check and adjustment of track tension: For rocky areas, the track should be slightly tighter. For areas with clay and sandy soil, the track should be a little bit loose (See “Maintenance when needed” for check and adjustment methods).

1. Measuring height of grouser

- Take a tight track shoe and measure the height of grouser. (Figures 4-50 and 4-51)
  Standard height (H): 72mm
  Repair limits (H):25mm

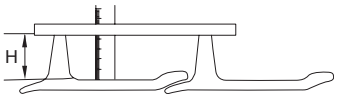


Figure 4-50

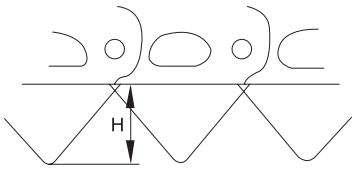


Figure 4-51

2. Measuring outside diameter of track roller (Figure 4-52)

- Measure the dimensions (size C and B) of link tread as shown. Calculate outside diameter of track roller (Size A): A=(B-C)X2
  Standard size (A): 222mm
  Repair limits (A):198mm

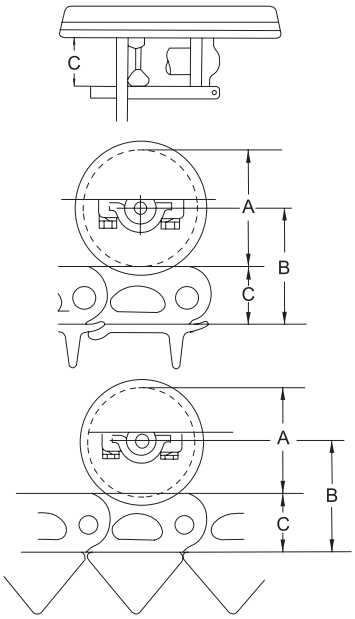


Figure 4-52

Adjustment of blade (See "Chapter 3, Bulldozing Operation")

1. Adjustment of the ripper's ripping depth (Figure 4-53)

- Use the two pin holes on the ripper shank to make the adjustment, and generally the hole on the bottom is used. When you need to increase the ripping depth, use the upper hole. You can point an iron rod with a sharp end to pin (1) and hit it with a hammer, and then pull out pin (2), to change the mounting hole's position of the tooth angle (top or bottom).

2. The replacement of the ripper tooth tip and the guard plate after being worn (Figure 4-54)

- After the ripper tooth tip and the guard plate ripper are worn, when replacing them, use a hammer to knock out the pins in the figure. You can switch the three tooth tips according to their wear level, to extend their service life.

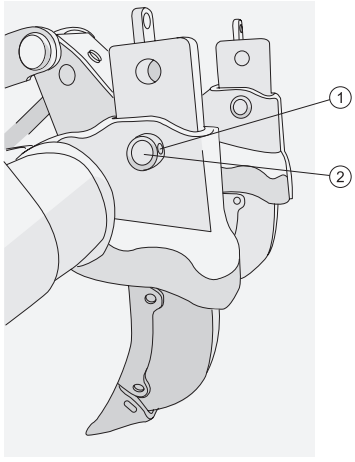


Figure 4-53

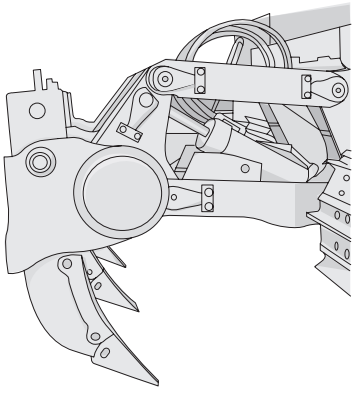


Figure 4-54

4.1.11 SERVICE STANDARDS FOR MAIN PARTS

HYDRAULIC TORQUE CONVERTER

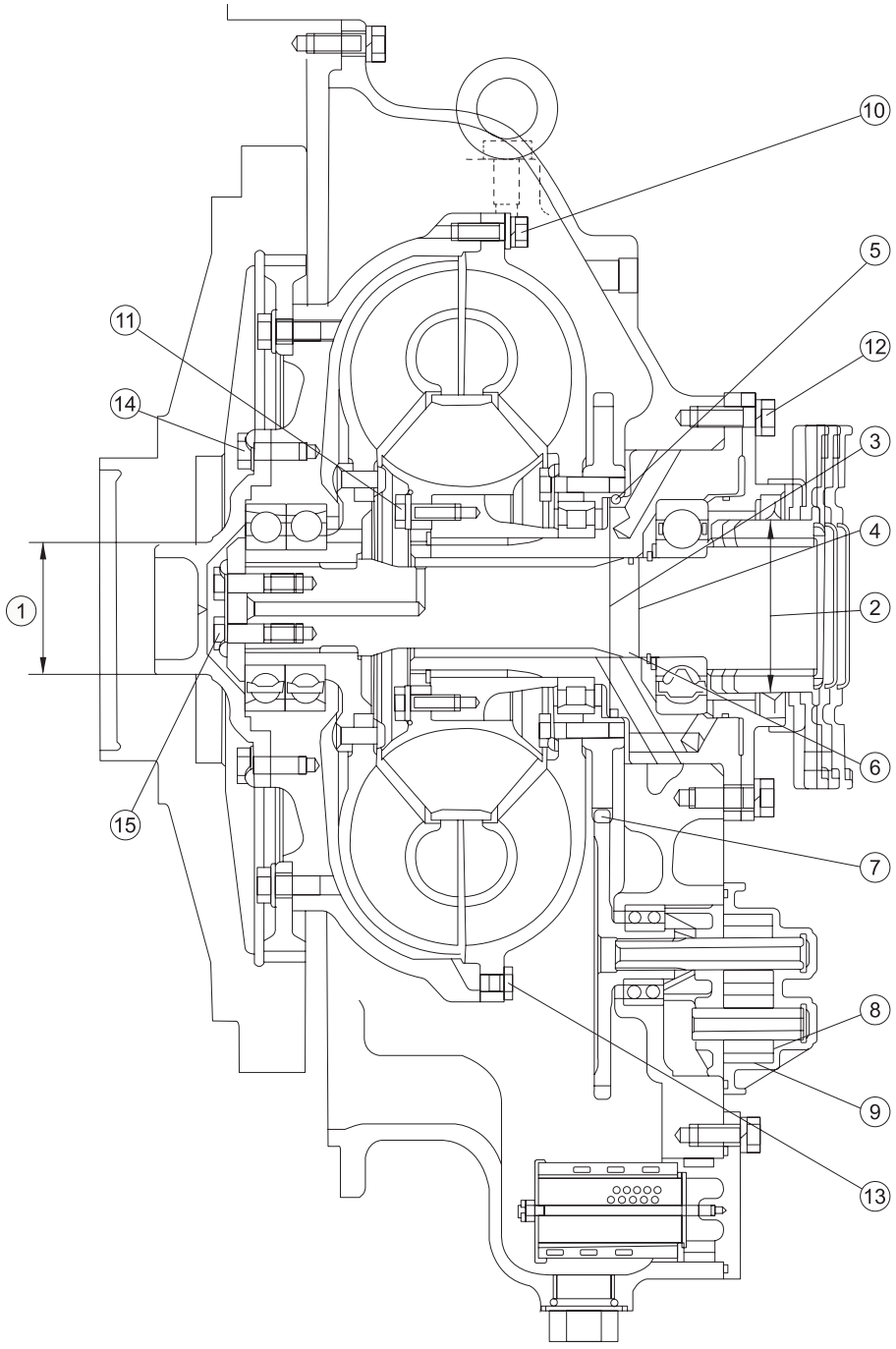


Figure 4-55

Unit: mm

No.	Items to be checked	Specifications			Measures
1	The outer diameter of the guider's neck	Standard size	Standard clearance	Repair limit	Chrome plating or replacing
		78	—	77.75	
2	The outer diameter of the contact surface of the shaft coupling's oil seal	105	—	104.9	
3	The inner diameter of the contact surface of the gear sealing ring	135	—	135.3	
4	The inner diameter of the sealing ring's contact surface of the guide roller's axle	60	—	60.1	
5	The sealing ring of the guide roller's axle	Width: 4.0; Thickness: 5.2	—	Width: 3.5; Thickness: 4.9	Changing
6	The sealing ring of the turbine shaft	Width: 2.5; Thickness: 2.5	—	Width: 2.0; Thickness: 2.2	
7	The clearance between the oil scavenger pump's driving gear and pump impeller	—	0.16~0.43	0.50	
8	Oil scavenger pump's axial clearance	—	0.13	0.25	
9	Oil scavenger pump's radial clearance	—	0.15	0.30	
10	Tightening torque	55±5N.m			Adjustment
11	Tightening torque	70±5N.m			
12	Tightening torque	115±10N.m			
13	Tightening torque	12±1N.m			
14	Tightening torque	115±10N.m			
15	Tightening torque	58±2N.m			

SAFETY VALVE AND ADJUSTER'S VALVE

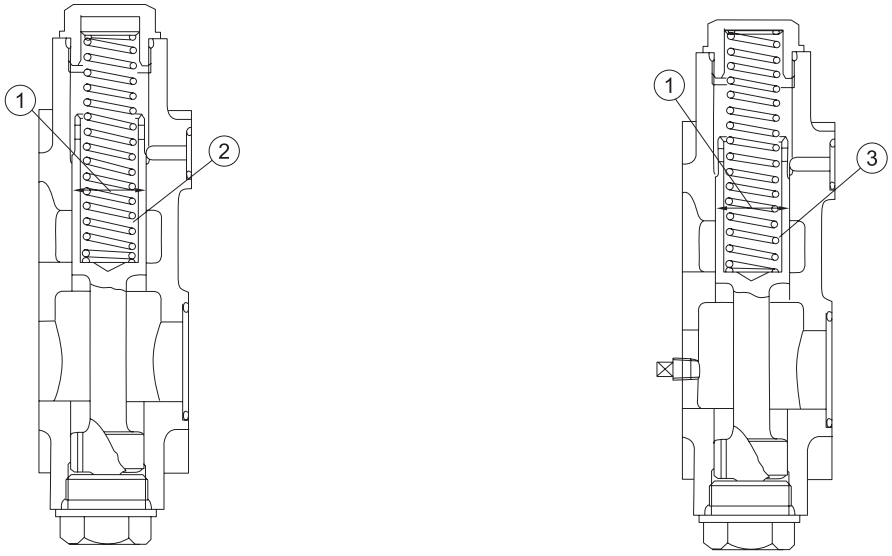


Figure 4-56

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	The clearance between valve body and slide valve	—		0.05~0.091	0.20	Replacing
2	Safety valve's spring	Free length	137.7	—	134.2	
		Installation load	635N		579N	
3	Spring of adjuster's valve	Free length	126.6	—	120	
		Installation load	209N		140N	

TRANSMISSION CASE

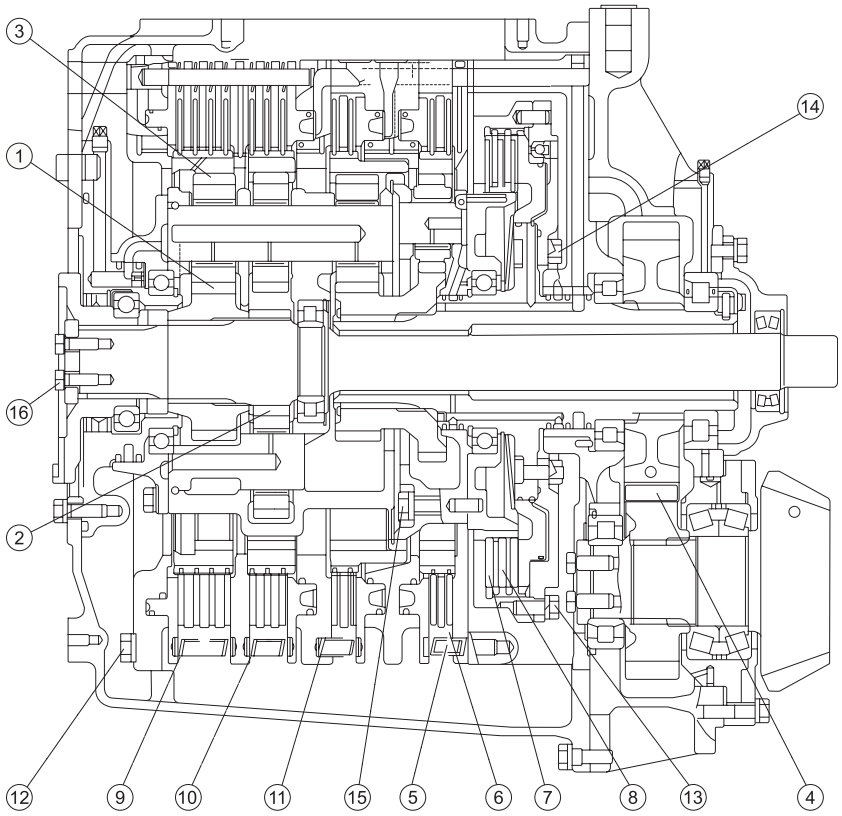


Figure 4-57

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	The clearance between the No.1, No.3 and No.4 sun wheels and the planetary gear	—		0.14~0.37	—	Replacing
2	The clearance between the No.2 sun wheel and the planetary gear	—		0.13~0.43	—	
3	The clearance between the gear ring and the planetary gear	—		0.13~0.48	—	
4	The tooth clearance of the output gear	—		0.20~0.51	—	
5	The thickness of the driven plate of clutches numbers 1 through 4	5.4			4.6	
6	The thickness of the drive plate of clutches numbers 1 through 4	7.0			6.2	
7	The thickness of the No.5 clutch's driven plate	5.4			4.6	
8	The thickness of the No.5 clutch's drive plate	5.0			4.2	
9	The spring of the No.1 clutch	Free length	66	—	64.1	
		Installation load	133N		106N	
10	The spring of the No.2 clutch	Free length	45.7	—	44.8	
		Installation load	96N		77N	
11	The spring of the No.3 and No.4 clutches	Free length	45.7	—	44.5	
		Installation load	126N		101N	

TRANSMISSION VALVE

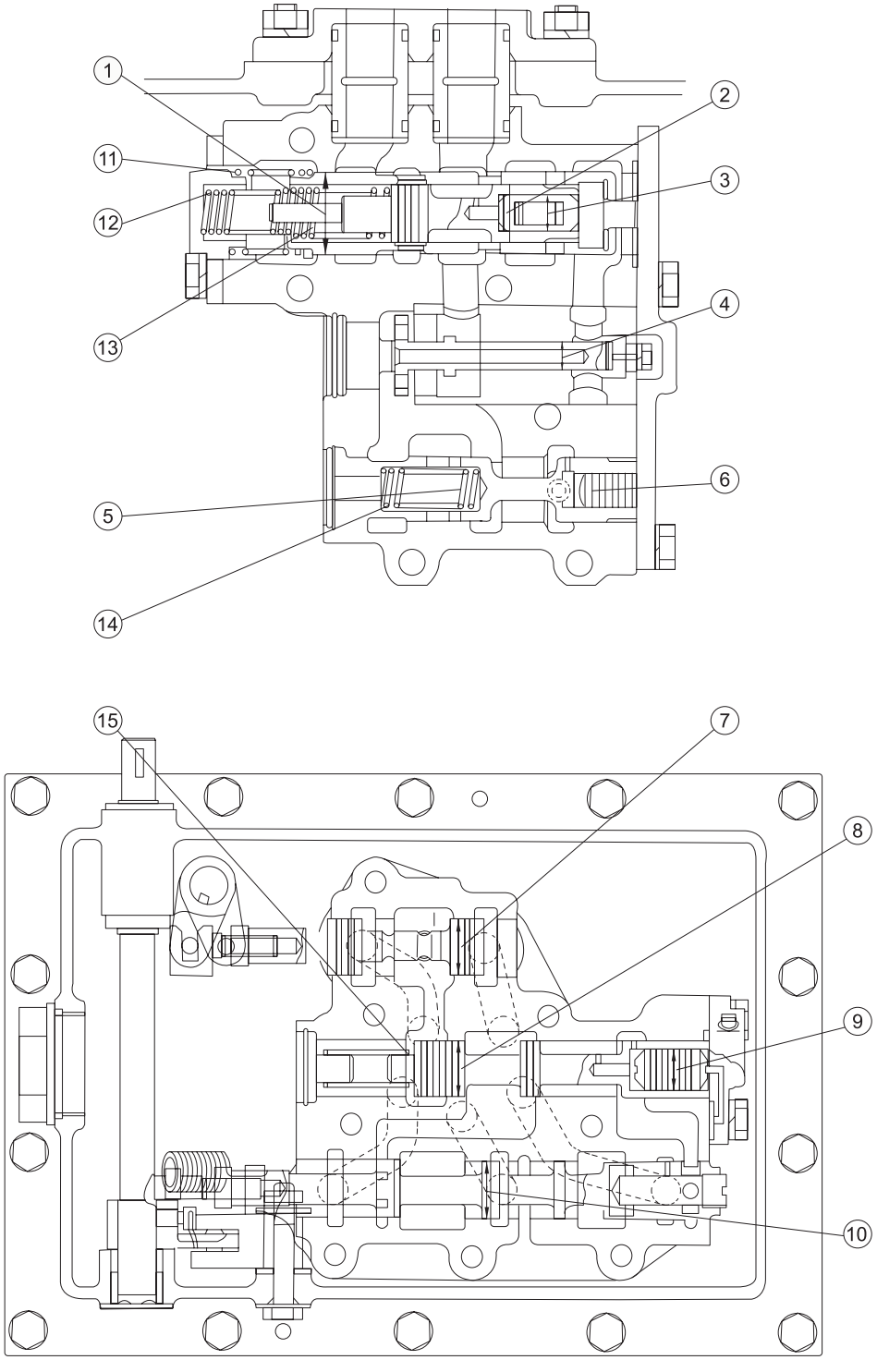


Figure 4-58

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	The clearance between the pressure-adjusting valve and valve body	—		0.035~0.058	0.064	Replacing
2	The clearance between the safety valve and the Slave valve	—		0.035~0.058	0.064	
3	The clearance between the safety valve and the piston	—		0.020~0.048	0.054	
4	The clearance between the fast return valve and valve body	—		0.035~0.056	0.062	
5	The clearance between the pressure relief valve and valve body	—		0.035~0.058	0.064	
6	The clearance between the pressure relief valve and the piston	—		0.020~0.048	0.054	
7	The clearance between the change valve and valve body	—		0.035~0.058	0.064	
8	The clearance between the safety valve and valve body	—		0.035~0.058	0.064	
9	The clearance between the safety valve and the piston	—		0.020~0.048	0.054	
10	The clearance between the speed valve and valve body	—		0.035~0.058	0.064	
11	The pressure-adjusting valve's spring	Free length	53	—	51.2	
		Installation load	86.5N		77.9N	
12	The pressure-adjusting valve's spring (big)	Free length	38.5	—	37.3	
		Installation load	217N		195N	
13	The pressure-adjusting valve's spring (small)	Free length	43.8	—	42.6	
		Installation load	403N		363N	
14	Pressure relief valve's spring	Free length	52	—	50.7	
		Installation load	219N		197N	
15	Safety valve's spring	Free length	79	—	75.8	
		Installation load	14.1N		13.4N	

CENTRAL DRIVE

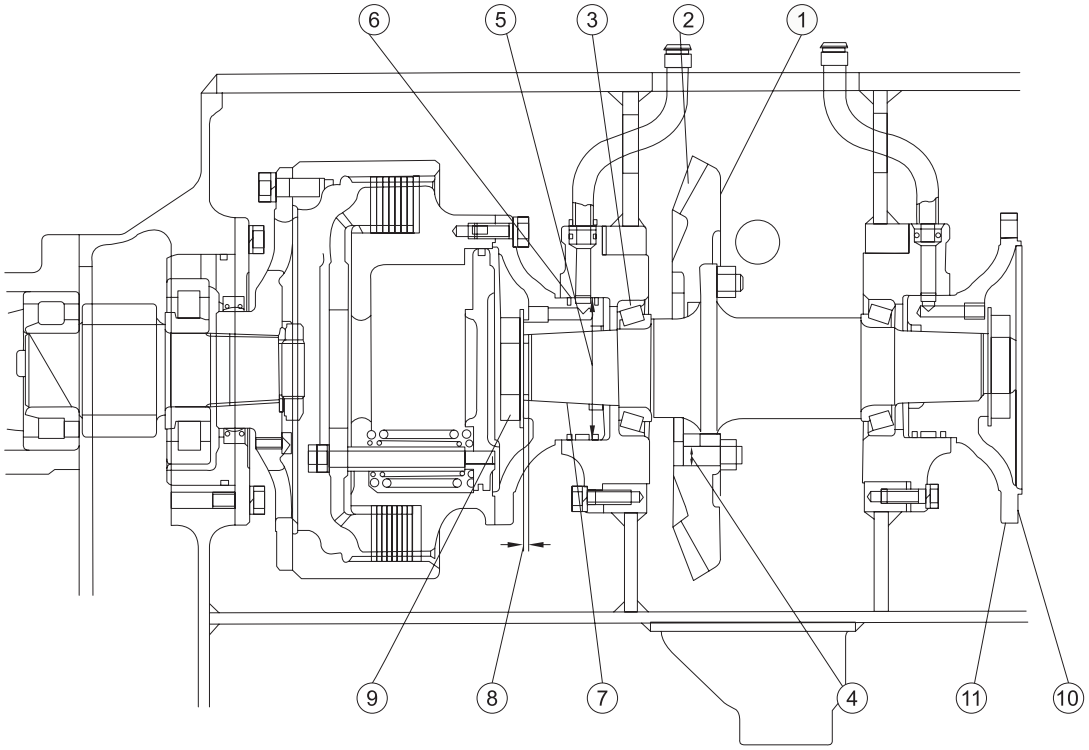


Figure 4-59

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The clearance between the pressure-adjusting valve and valve body	—	—	0.1 (Measured by being installed behind the cross shaft)	Repairing or Replacing
2	The clearance between the safety valve and the Slave valve	—	0.25~0.33	0.75	
3	The clearance between the safety valve and the piston	Rotational torque: 20~30N.m (Measuring at the end based on the small bevel gear)			Adjustment
4	The match of bevel gear's bolt	—	0~0.042	0.1	Replacing
5	The inner diameter of the contact surface of the bearing support's sealing ring	145	—	145.3	
6	The width of the sealing ring	4.5	—	4.0	
	The width of the sealing trough	4.5	—	5.0	
7	The press-in force of the coned splint	150~300KN (15~30T)	—	—	Adjustment
8	The size of the central drive shaft after being pressed in	6±0.5	—	—	
9	Tightening torque	700±50N.m	—	—	
10	The connecting disc's end jump	—	—	0.03	
11	The connecting disc's radial jump	—	—	0.08	

STEERING CLUTCH

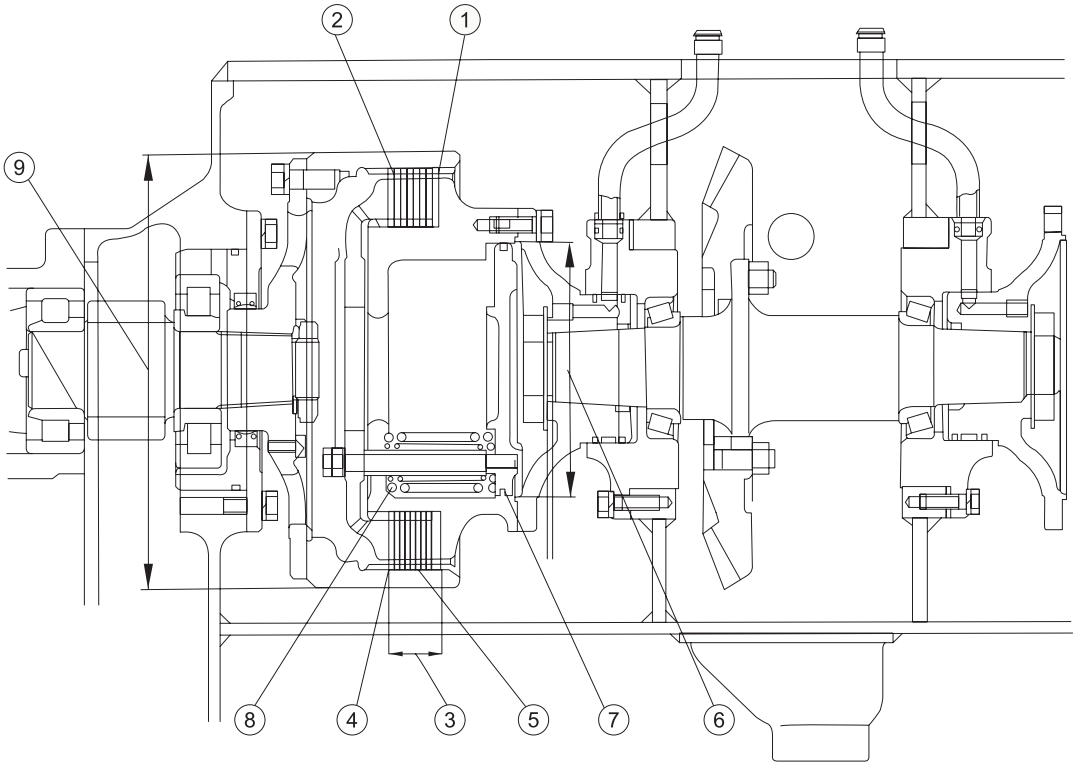


Figure 4-60

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	The thickness of the drive tooth piece	2.9		—	2.0	Replacing
	The unevenness of the drive tooth piece	<0.20		—	0.3	Correction or replacement
2	The thickness of the driven tooth piece	4.7		—	3.7	Replacing
	The unevenness of the driven tooth piece	<0.20		—	0.3	Correction or replacement
3	The thickness of the assembly of the drive tooth piece and the driven tooth piece	50.3		—	46	Replacing
4	The tooth clearance between the drive tooth piece and the inner hub	—		0.3~0.4	1.0	
5	The tooth clearance between the driven tooth piece and the outer hub	—		0.3~0.4	1.0	
6	The inner diameter of the inner hub and the sealing ring's contact	245		—	245.3	
7	The width of the sealing ring	4.9		—	—	
	The width of the sealing trough	5		—	—	
8	Spring (big)	Free length	145.15	—	141	
		Installation load	2420N		2291N	
	Spring (small)	Free length	137.83	—	146.5	
		Installation load	1380N		1320N	
9	The diameter of the outer hub	425		—	420	

BRAKE

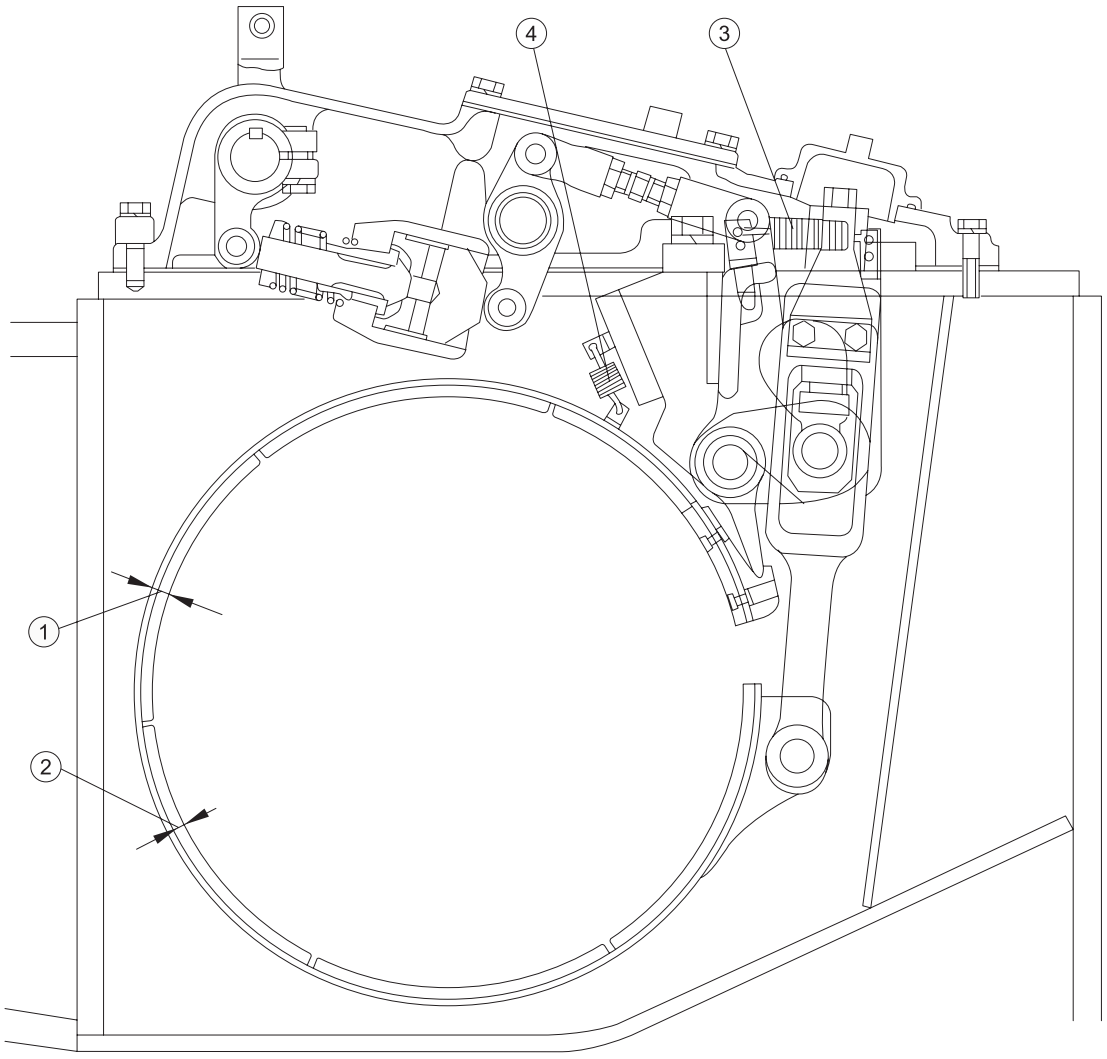


Figure 4-61

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	The thickness of the brake lining and the brake band	14		—	9.5	Replacing
2	The thickness of the brake lining	9.5		—	5	
3	Spring	Free length	78.3	—	82	
		Installation load	200N		160N	
4	Spring	Free length	42.4	—	43.3	
		Installation load	45.4N		36N	

STEERING CONTROL VALVE

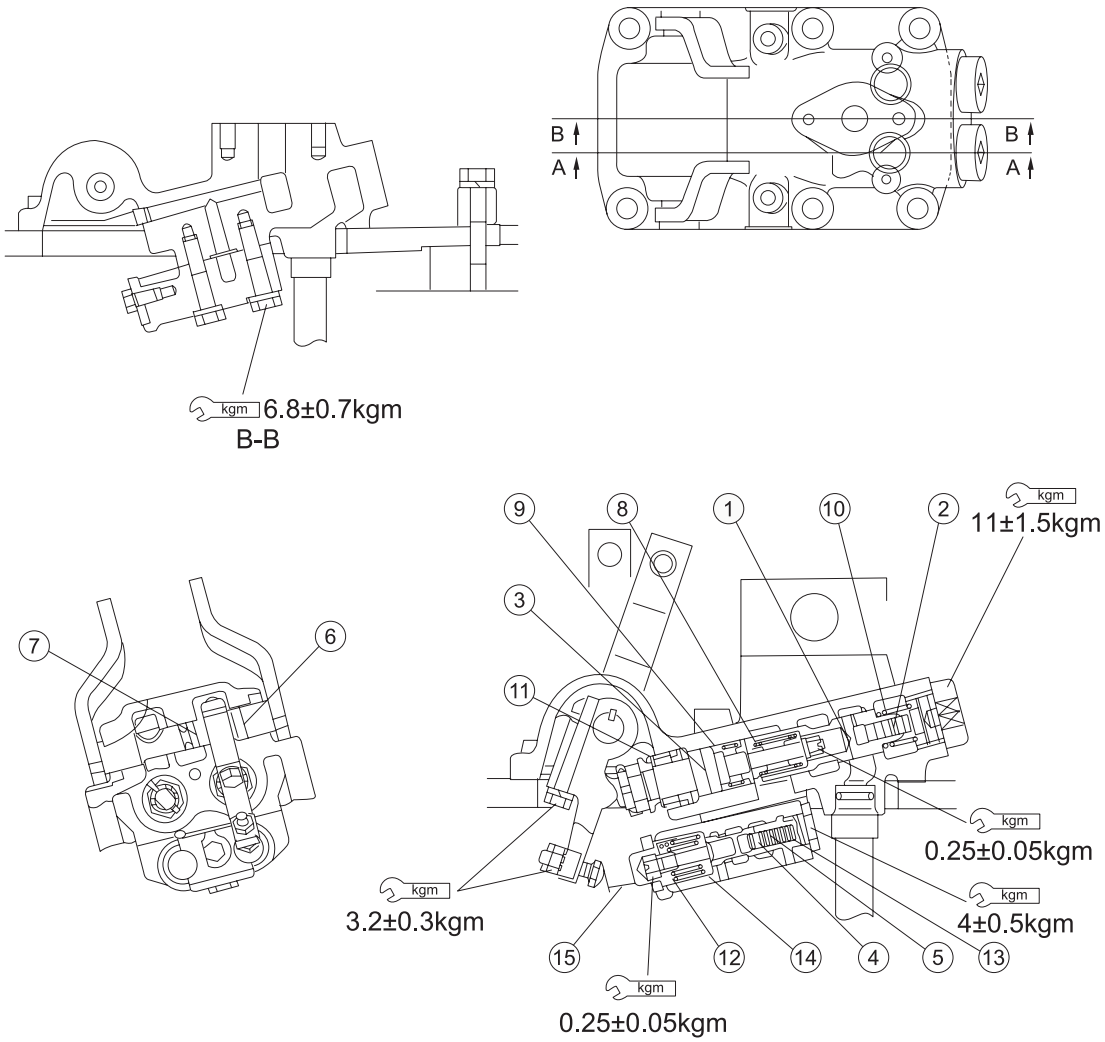


Figure 4-62

Unit: mm

No.	Items to be checked	Specifications					Measures
1	The clearance between valve body and valve core	Standard size	Tolerance		Standard clearance	Allowable limit	Replacing
			Shaft	Hole			
		26	-0.035 -0.045	+0.013 0	0.035~ 0.058	0.08	
2	The clearance between the valve core and the piston	10	-0.030 -0.040	+0.015 0	0.030~ 0.055	0.08	
3	The clearance between valve stem and valve body	26	-0.035 -0.045	+0.013 0	0.035~ 0.058	0.08	
4	The clearance between brake valve and valve body	16	-0.030 -0.035	+0.018 0	0.030~ 0.053	0.08	
5	The clearance between brake valve and piston	9	-0.030 -0.040	+0.015 0	0.030~ 0.055	0.08	
6	The clearance between the control lever and the bushing	22	+0.023 +0.002	+0.170 +0.086	0.068~ 0.168	0.2	
7	The clearance between the control lever and the bushing	18	+0.019 +0.001	+0.156 +0.086	0.067~ 0.155	0.2	
8	Axle reset spring	Standard size			Repair limit		
		Free length	Installation length	Installation load	Free length	Load	
		36	27.2	6.02kg	35.3	5.7kg	
9	Steering valve spring	62	15.8	3.5kg	60.9	3.2kg	
10	Steering valve reset spring	91.6	25	4.53kg	90.6	4.3kg	
11	Steering valve spring	55	20.5	3.61kg	54	3.3kg	
12	Brake adjusting spring	28.5	25.5	3.0kg	28	2.8kg	
13	Brake valve reset spring	50.5	14	2.36kg	49.5	2.2kg	
14	Brake valve reset spring	90	27	4.48kg	88.5	4.15kg	
15	Brake valve's action trip	13.7					Adjustment

FINAL DRIVE

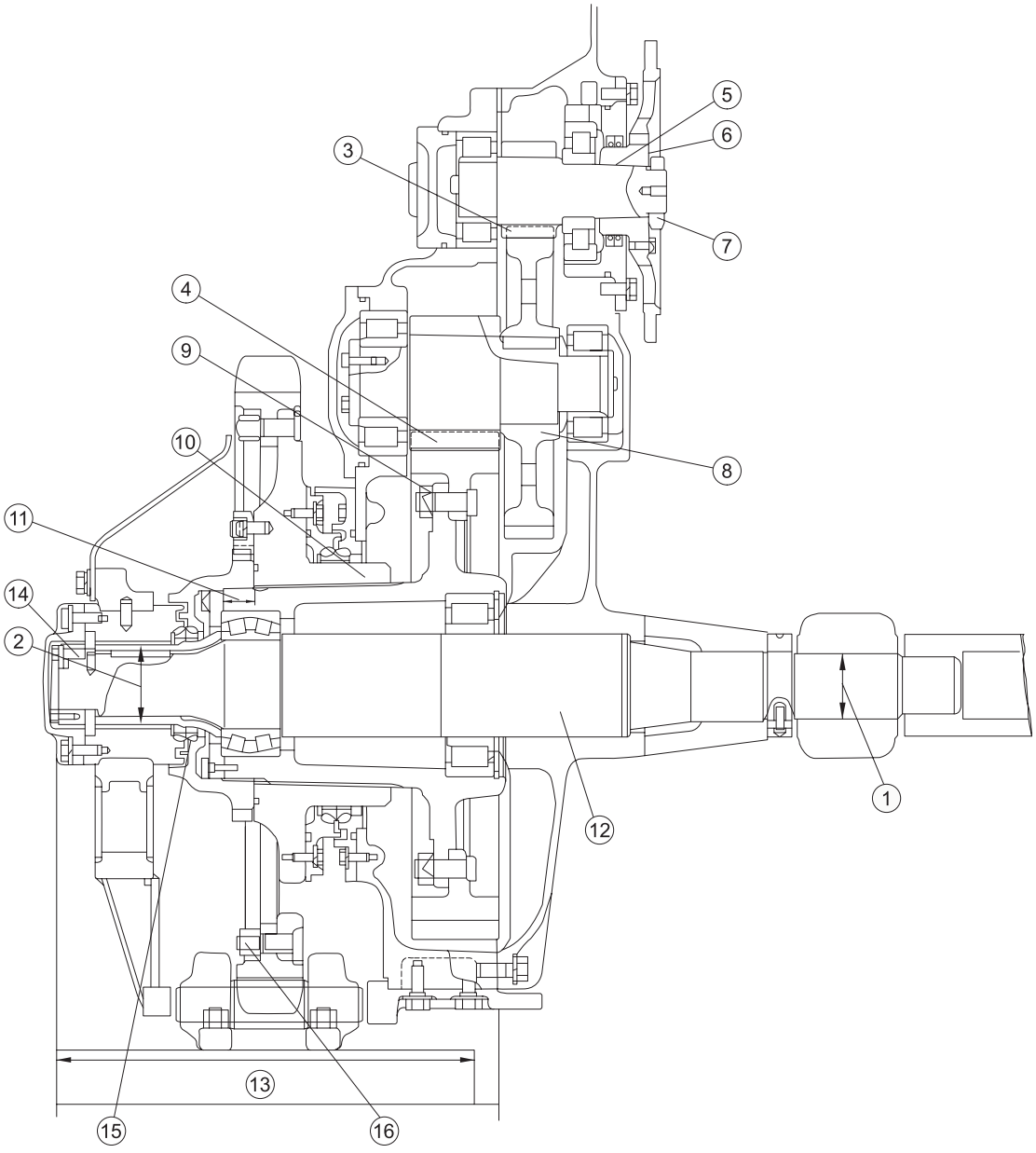


Figure 4-63

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The clearance between the half shaft and the bushing	—	0.036~0.106	0.5	Replacing Bushing
2	The clearance between the half shafts out bushing and spacer	—	0.12~0.270	0.5	
3	Primary gear's engagement back-lash	—	0.40~0.623	1.5	Replacing
4	Secondary gear's engagement backlash	—	0.48~0.85	1.5	
5	Press-in force	300 ~ 400KN (30 ~ 40t)			Adjustment
6	Size of the drive disc after being pressed in	2~3.5			
7	Nut's tightening torque	700±50Nm			
8	Press-in force	50 ~ 160KN (5 ~ 40t)			
9	Size of the sprocket hub after be-ing pressed in	39~41			
10	Press-in force	500 ~ 600KN (50 ~ 40t)			
11	Size of the sprocket hub after be-ing pressed in	39~41			
12	Press-in force	120 ~ 460KN (12 ~ 40t)			
13	Size of half shaft's end surface and steering case	599.9(SD22S is 724.5)			
14	Nut's tightening torque	1050±150Nm			
15	Sprocket nut's tightening torque	1050±150Nm			
16	Nut's tightening torque	950~1150Nm			

TRACK

1. TRACK FRAME

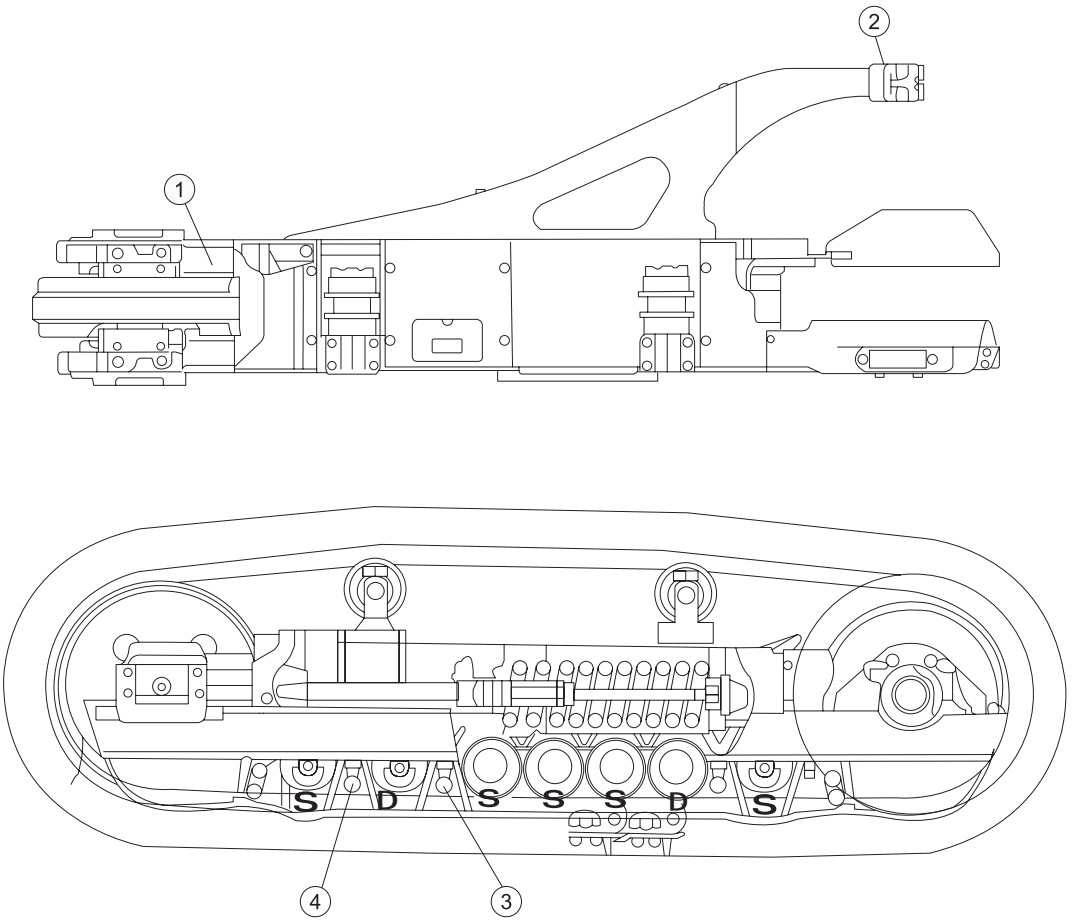


Figure 4-64

Unit: mm

No.	Items to be checked		Basic size	Standard clearance	Application limit	Treatment methods
1	Deformation of track frame	Horizontal deformation	—	—	7/300	Repairing and changing
		Twisted	—	—	3/300	
		The place where the idler is installed is outwardly opened	—	—	5	
2	The clearance between the half shaft and the bushing		—	0.036~0.106	0.5	
3	Tightening torque		760±85N.m			Adjustment
4	Tightening torque		825±225N.m			

2. TRACK TENSION DEVICE

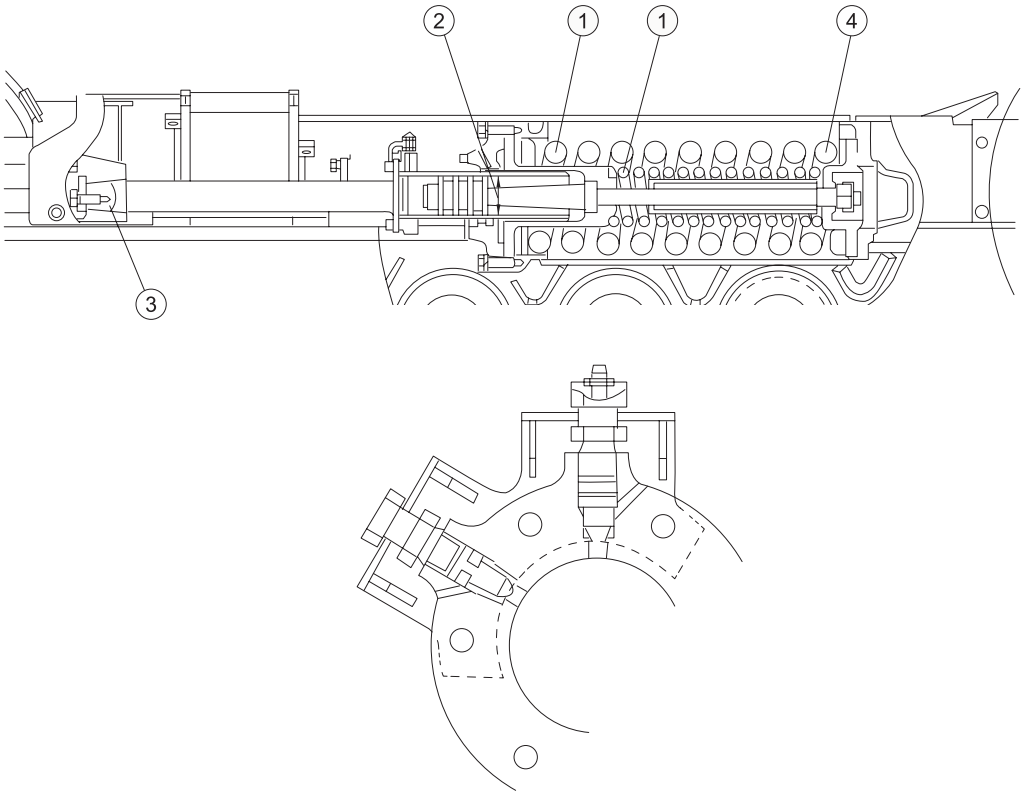


Figure 4-65

Unit: mm

No.	Items to be checked	Basic size		Standard clearance	Application limit	Treatment methods
1	Buffering spring (big)	Free length Installation load	817 171300N	—	154000N	Replacing
	Buffering spring (small)	Free length Installation load	530 32500N	—	29000N	
3	The clearance between oil cylinder and bushing	—		0.101~ 0.226	0.5	
4	Tension rod assembly's press-in force	150KN (15t)				Adjustment
5	The clearance between control seat and nut	10				

3. IDLER

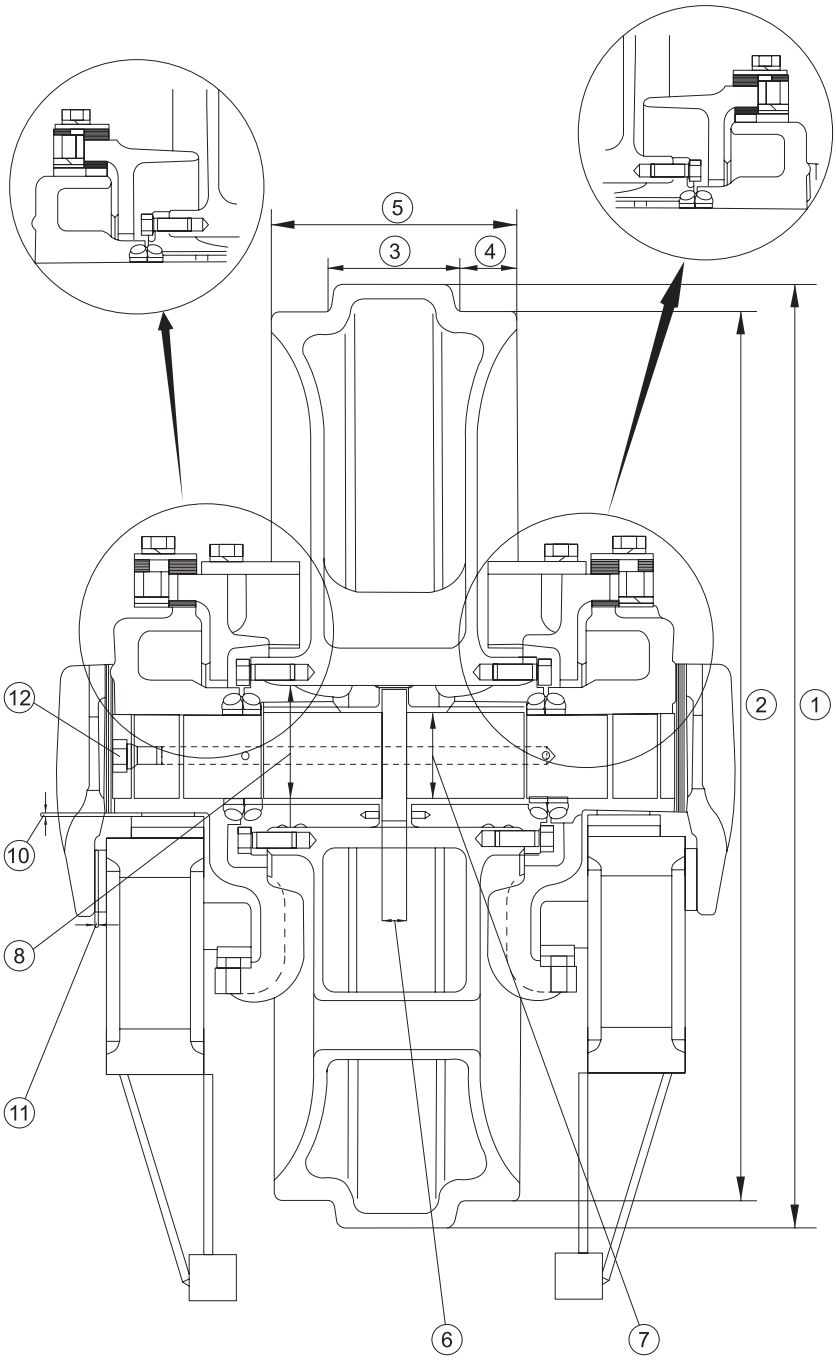


Figure 4-66

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	Idler's outer diameter	774	—	760	Repairing through overlay welding or replacing
2	Roller track surface's outer diameter	730	—	715	
3	Width of the raised part	105	—	89	
4	Width of the roller track	49.5	—	51.5	
5	Overall width	204	—	194	
6	Shaft collar's width	20	—	19.5	Replacing
7	The clearance between the shaft and the dual-metal bushing	—	0.270~0.390	1.5	
8	The interference between the idler and the bushing	—	-0.03~-0.144	-0.35	
9	The axial clearance of the idler's axle	—	0.27~0.39	1.5	
10	The clearance between the sliding plate and the bracket	—	2	—	
11	The clearance between the side guide and the bracket	—	0.5~1.0	3	
12	Tightening torque	210±5N.m			Adjustment

4. SINGLE FLANGE TRACK ROLLER, DOUBLE FLANGE TRACK ROLLER

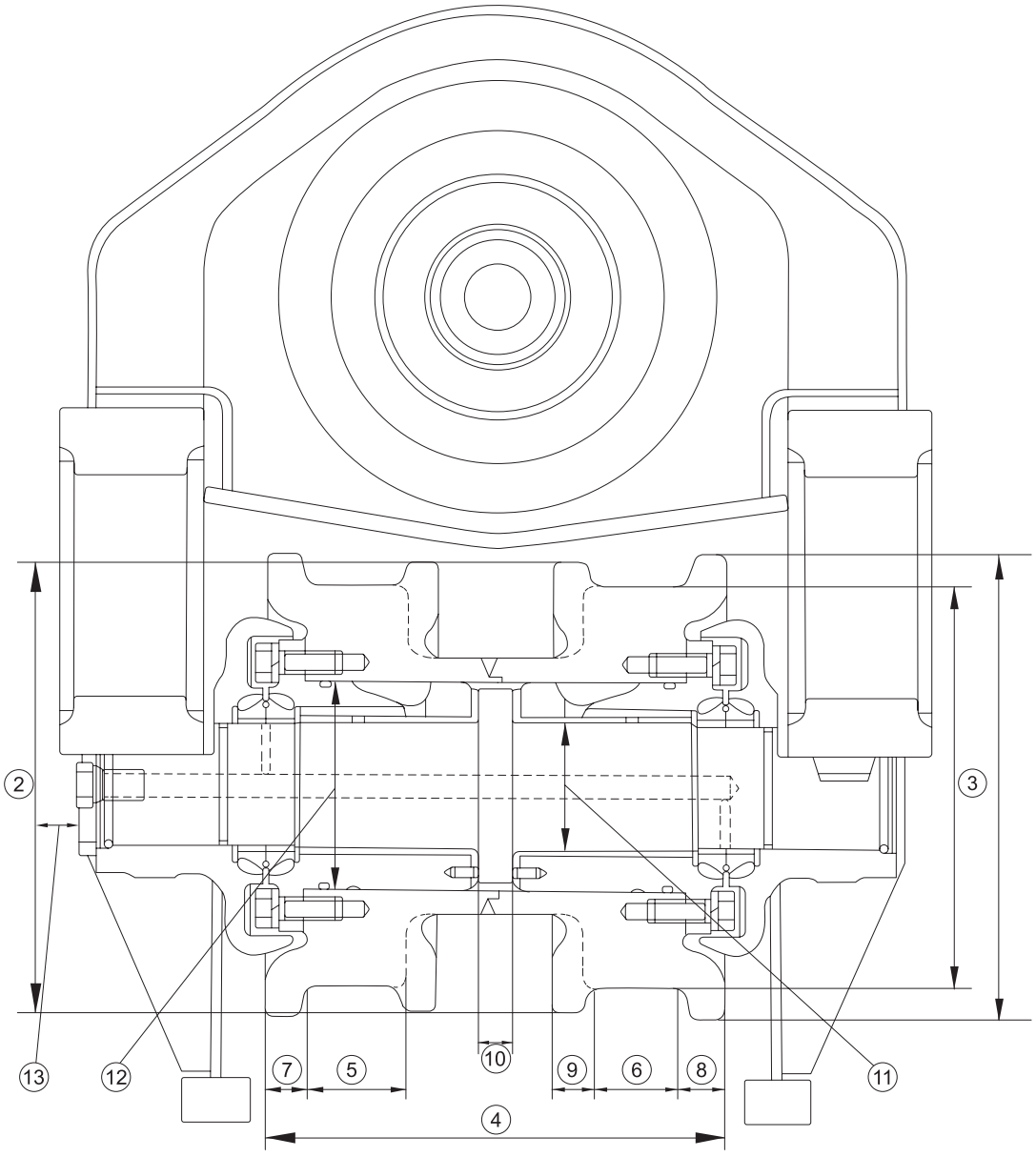


Figure 4-67

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The outer diameter of the track roller	257	—	247	Repairing through over-lay welding or replacing
2	The outer diameter of the track roller	249	—	239	
3	Roller track surface's diameter	222	—	198	
4	Overall width	251.2	—	—	
5	The width of the roller track of the single flange track roller	55.6	—	66.6	
6	The width of the roller track of the double flange track roller	51.6	—	68.6	
7	The width of the raised shoulder of the single flange track roller	21	—	6	
8	The width of the raised shoulder of the double flange track roller	21	—	6	
9	The width of the raised shoulder of the double flange track roller	21	—	6	
10	Shaft collar's width	20	—	18.5	Replacing
11	The clearance between the shaft and the dual-metal bushing	—	0.31~0.39	1.0	
12	The interference between the bushing and the track roller	—	-0.013~-0.121	-0.35	
13	The axial clearance of the track roller's axle	—	0.40~0.80	1.5	

5. CARRIER ROLLER

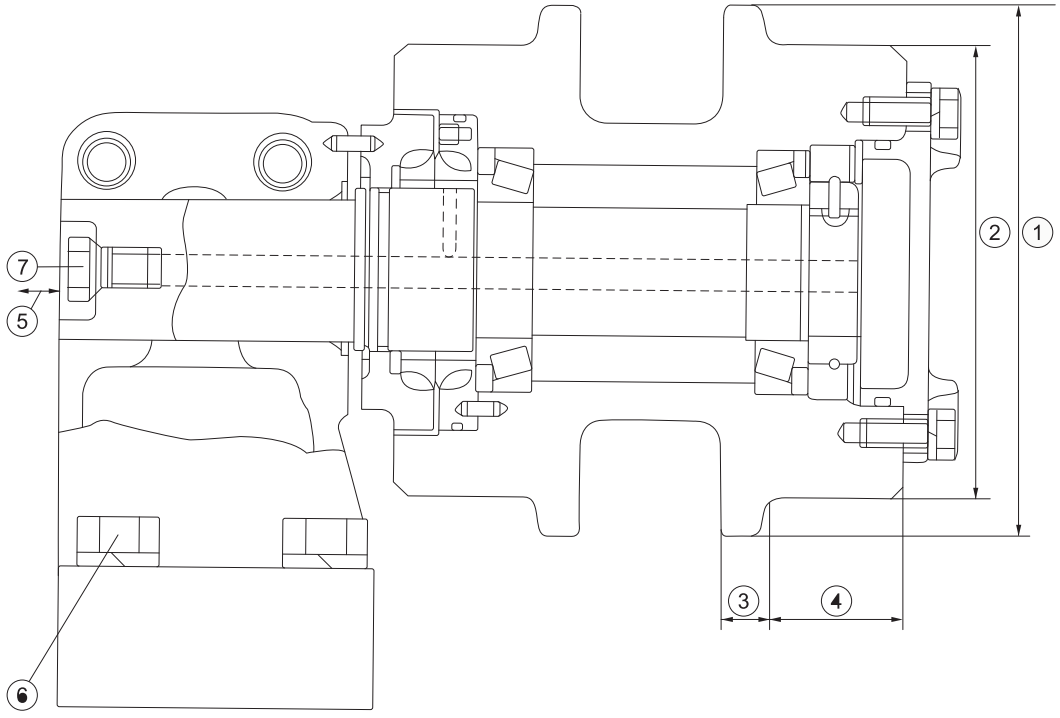


Figure 4-68

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The outer diameter of the carrier roller	217	—	207	Repairing through over-lay welding or replacing
2	The outer diameter of the roller track	185	—	166	
3	The width of the raised shoulder	19	—	10	
4	The width of the roller track	57	—	66	
5	The axial clearance of the carrier roller	—	0.10~0.13	0.2	Adjusting or Replacing
6	Tightening torque	560±60N.m			Adjustment
7	Tightening torque	210±50N.m			

6. TRACK

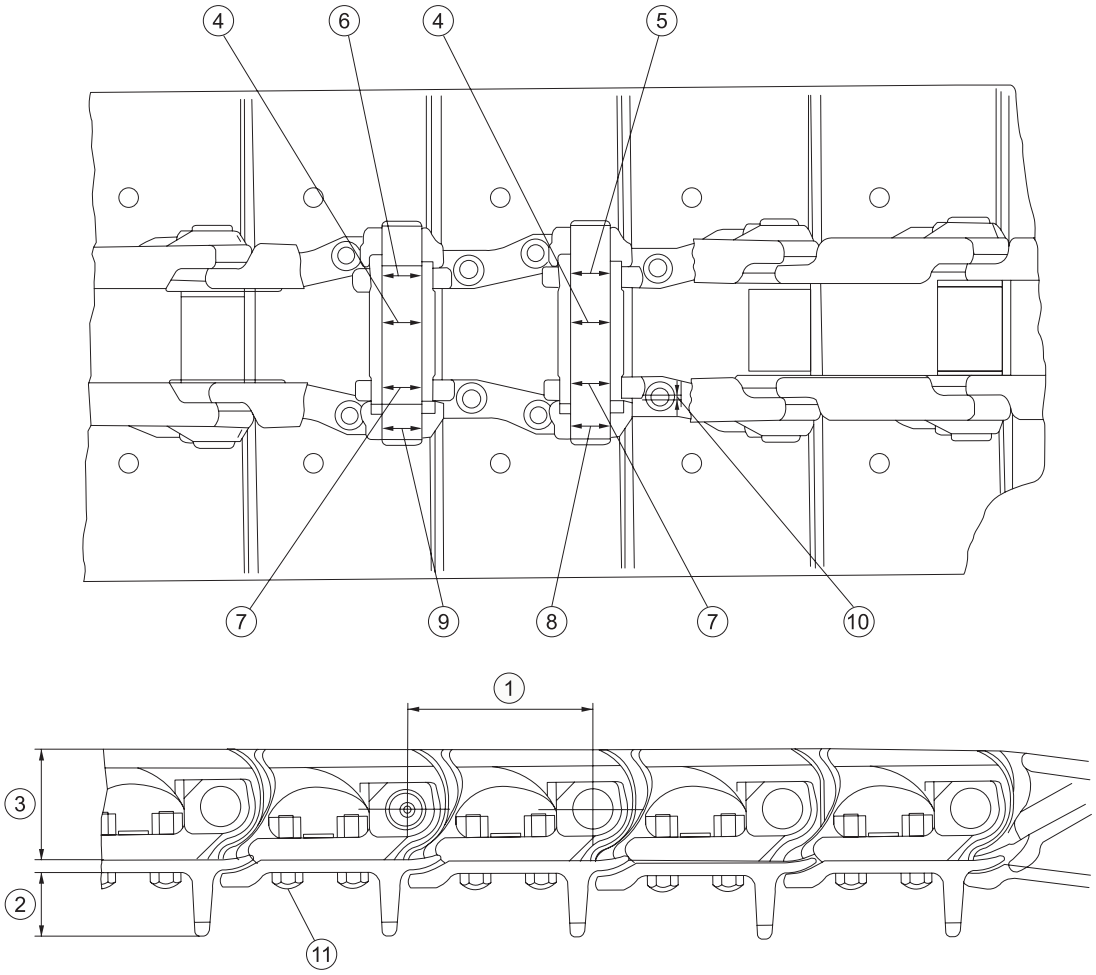


Figure 4-69

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	Track link	216.25	—	219.25	Inverting or replacing
2	Grouser's height	72 123(SD22S)	—	25 101	
3	Track link's height	129	—	117	
4	Bushing's outer diameter	74.3	—	70.8	Replacing
5	The clearance between the pin and the bushing	—	0.230~0.830	—	
6	The clearance between the master pin and the bushing	—	0.430~1.030	—	
7	The interference between the bushing and the track link	—	0.230~0.344	0.22	
8	The interference between the pin and the track link	—	0.023~-0.185	0.203	
9	The interference between the master pin and the track link	—	0.138~0.230	0.138	
10	The clearance of the track link's joint surface	—	One-sided: 0~1.1 Two-sided: 0~2.2	8	
11	Tightening torque		0.5~1.0	3	Adjustment

STRAIGHT TILT BLADE

1. BLADE

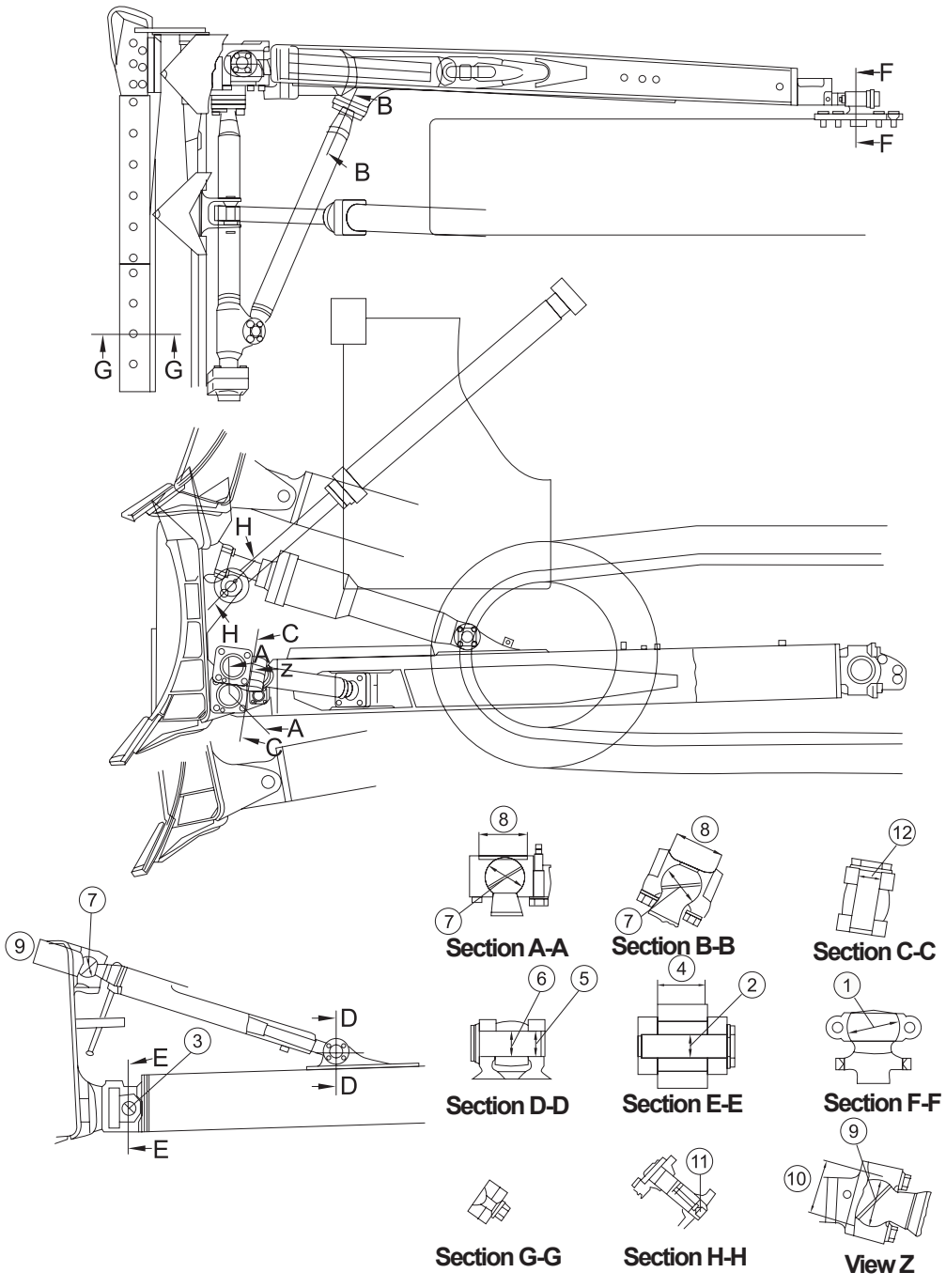


Figure 4-70

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The clearance between the seat and the spherical head	—	0.5~0.15	10	Replacing
2	The clearance between the pin and the blade rack's connector	—	0.3~0.8	3	
3	The clearance between the push rod's pin and the connector	—	0.3~0.8	3	
4	The clearance between the connector and the blade rack	—	0.3~1.1	6	
5	The clearance between the pin and the seat	—	0.5~1.0	2	
6	The clearance between the pin and the screw	—	0.6~1.0	2	
7	The clearance between the spherical head and the seat	—	0.2~0.6	1	
8	The clearance between the cover and the spherical seat	—	0.1~-0.4		
9	The clearance between the spherical head and the seat	—	0.2~0.6	1	
10	The clearance between the cover and the spherical seat	—	0.046~0.206		
11	The clearance between the pin and the seat	—	0.4~0.8	2	
12	The clearance between the bracket and the pin	—	0.3~0.7	1	

2. END BIT AND CUTTING EDGE

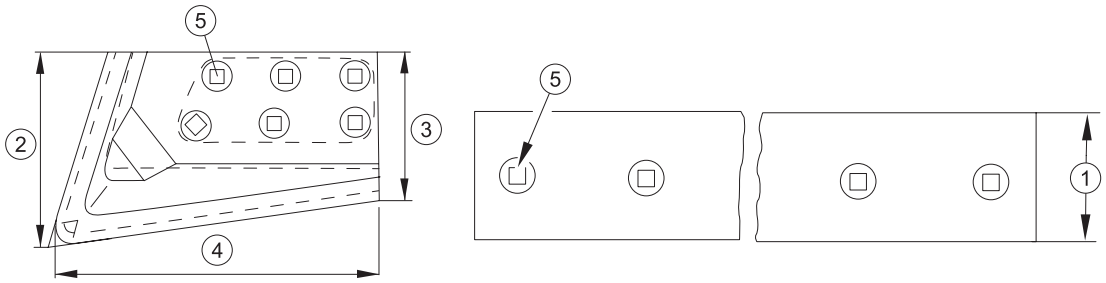


Figure 4-71

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The cutting edge's height	254	—	213	Replacing
2	The height of end bit's outer side	292	—	211	
3	The height of end bit's inner side	254	—	211	
4	End bit's width	435	—	360	
5	Tightening torque	540±80N.m			Adjustment

OIL CYLINDER BRACKET

1. OIL CYLINDER BRACKET OF SD22, SD22E AND SD22D

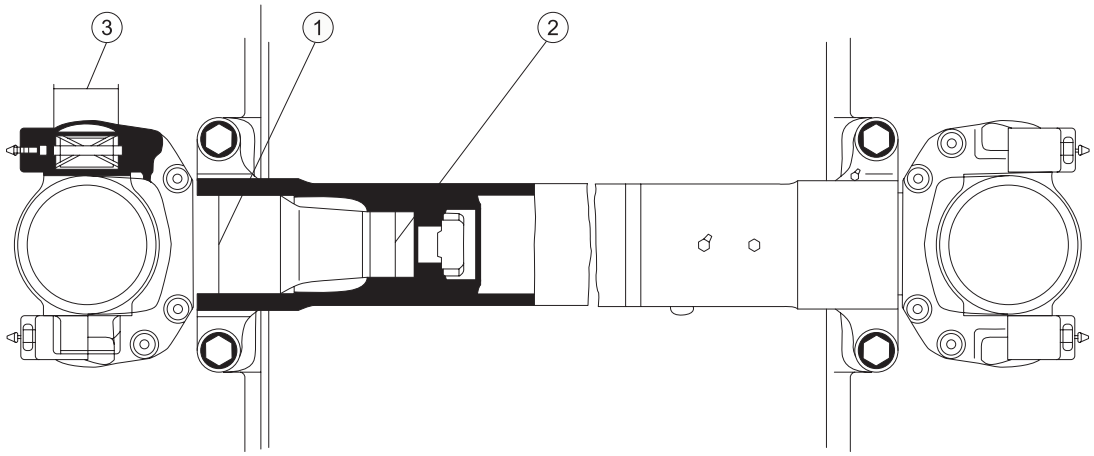


Figure 4-72

2. OIL CYLINDER BRACKET OF SD22S

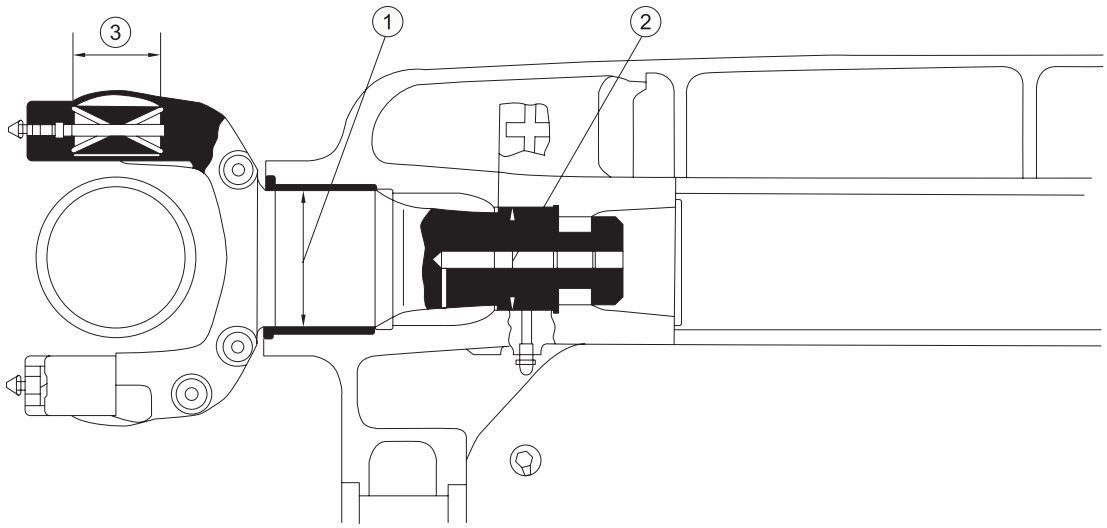


Figure 4-73

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The clearance between the shaft and the bushing	—	0.072~0.180	0.5	Replacing
2	The clearance between the shaft and the bushing	—	0.060~0.152	0.5	
3	The clearance between the shaft and the bushing	—	0~0.074	0.5	

RIPPER

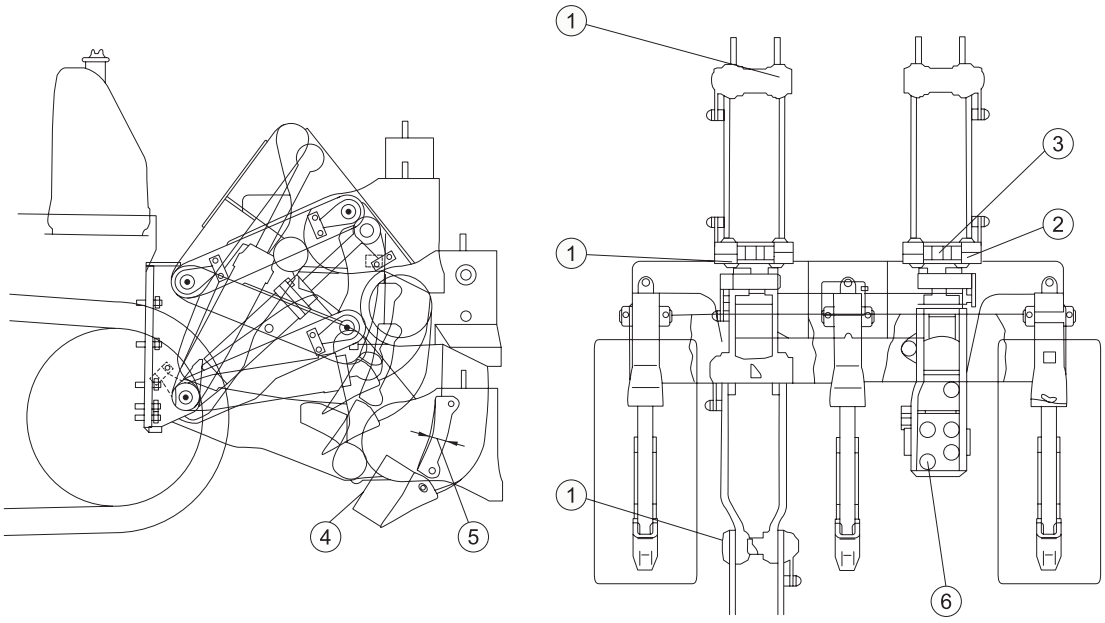


Figure 4-74

Unit: mm

No.	Items to be checked	Basic size	Standard clearance	Application limit	Treatment methods
1	The clearance between the circular pin and the bushing	—	0.230~0.476	1.5	Replacing
2	The clearance between the tooth rack's hole and the pin	—	1.4~2.6	10	
3	The clearance between the pin and the rack hole	—	3.7~6.5	15	
4	The wearing of the tooth tip	335	—	225	
5	The wearing of the tooth sleeve	75	—	55	
6	Tightening torque		2250±250N.m		

4.1.12 STANDARD TIGHTENING TORQUES FOR BOLTS AND NUTS

⚠ CAUTION

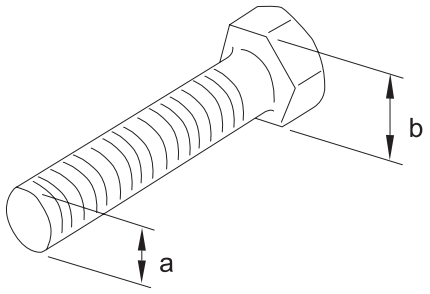
- **If nuts, bolts, or other parts are not tightened to the specified torque, it will cause looseness or damage to the tightened parts, and this will cause failure of the machine or problems with operation.**
- **Always pay careful attention when tightening parts.**

TORQUE LIST

1. Unless otherwise specified, tighten the metric nuts and bolts to the torque shown in the table below.

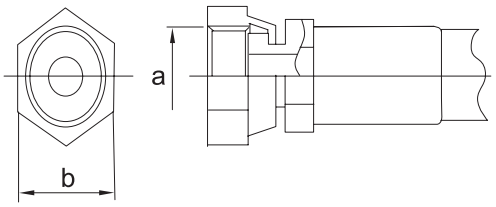
- If it is necessary to replace any nut or bolt, always use a Shantui genuine part of the same size as the part that was replaced.

Thread diameter of bolt (a) (mm)	Width across flats (b) (mm)	Specifications					
		Target value			Torque range		
		N.m	kgf.m	ibft	N.m	kgf.m	ibft
6	10	13.2	1.35	9.8	11.8-14.7	1.2-1.5	8.7-10.8
8	13	31	3.2	23.1	27-34	2.8-3.5	20.3-25.3
10	17	66	6.7	48.5	59-74	6.0-7.5	43.4-54.2
12	19	113	11.5	83.2	98-123	10.0-12.5	72.3-90.4
14	22	172	17.5	126.6	153-190	15.5-19.5	112.1-141
16	24	260	26.5	191.7	235-258	23.5-29.5	170.0-213.4
18	27	360	37	267.6	320-400	33.0-41.0	238.7-296.6
20	30	510	52.3	378.3	455-565	46.5-58.5	336.3-419.5
22	32	688	70.3	508.5	610-765	62.5-78.0	452.1-564.2
24	36	883	90	651	785-980	80.0-100.0	578.6-723.3
27	41	1295	132.5	958.4	1150-1440	118.0-147.0	853.5-1063.3
30	46	1720	175.0	1265.8	1520-1910	155.0-195.0	1121.1-1410.4
33	50	2210	225.0	1627.4	1960-2450	200.0-250.0	1446.6-1808.3
36	55	2750	280.0	2025.2	2450-3040	250.0-310.0	1808.3-3242.2
39	60	3280	335.0	2423.1	2890-3630	295.0-370.0	2133.7-2676.2



2. Tighten the hydraulic hoses according to the tightening torque in the table below

Thread diameter of bolt (a)(mm)	Width across flats (b)(mm)	Specifications					
		Target value			Torque range		
		N.m	kgf.m	ibft	N.m	kgf.m	ibft
9/16-18UNF	19	44	4.5	32.5	35-63	3.5-6.5	25.3-47.0
11/16-16UN	22	74	7.5	54.2	54-93	5.5-9.5	39.8-68.7
13/16-16UN	27	103	10.5	75.9	84-132	8.5-13.5	61.5-97.6
1-14UNS	32	157	16	115.7	128-186	13.0-19.0	94.0-137.4
13/16-12UN	36	216	22	159.1	177-245	18.0-25.0	130.2-180.8



4.2 TROUBLESHOOTING

Although not all the faults are included in this chapter, most common faults are included.

4.2.1 ENGINE

Engine oil pressure monitor flashes when engine speed is raised after completion of warm-up.

1. Add oil to specified level;
2. Replace engine oil filter element;
3. Check the tubes and connectors for oil leakage.

Steam is emitted from top part of radiator (pressure valve).

1. Add cooling water, and check for water leakage;
2. Adjust fan belt's tension;
3. Clean inside of cooling system;
4. Clean or repair the water tank's radiation fin;
5. Replace thermostat.
6. Tighten radiator cap or replace its gasket.

Water temperature is higher than 100°C.

1. Replace thermostat;
2. Check water temperature sensor ;
3. Check water temperature gauge and water temperature sensor.

Engine does not start when starting motor is turned

1. Add fuel;
2. Check if air has entered the fuel system;
3. Calibrate or replace oil pump and oil nozzle;
4. Check valve clearance;
5. Run the starting motor at a low speed (See ELECTRIC SYSTEM).

Exhaust gas is white or blue

1. Add oil to specified level;
2. Change to specified fuel;
3. Check supercharger for leakage.

Exhaust gas turns black

1. Clean or replace air filter;
2. Replace oil nozzle;
3. Clean or replace supercharger.

Abnormal noise generated (combustion or mechanical)

1. Change to specified fuel;
2. Check if the engine is overheated;
3. Replace muffler;
4. Adjust valve clearance.

4.2.2 ELECTRIC SYSTEM

Lamp does not glow brightly even when the engine runs at high speed.

1. Check, repair loose terminals, disconnections;
2. Adjust engine belt tension.

When the engine runs at a high speed, voltmeter indicates not charging (not within the green zone)

1. Check generator;
2. Check and repair circuit.

Abnormal noise is generated from alternator

Replace generator.

Starting motor does not crank when ignition switch is turned ON.

1. Check and repair circuit and relay;
2. Charge the battery;
3. Replace starting motor.

Pinion of starting motor keeps going in and out

1. Charge the battery;
2. Replace starting motor.

Starting motor disengages before engine starts

1. Check and repair circuit ;
2. Charge the battery.

When the engine stops (starting switch is in the "ON" position, engine oil pressure gauge is 0.

1. Replace engine oil pressure sensor;
2. Check and repair circuit.

4.2.3 CHASSIS

Oil pressure in torque converter fails to rise (the vehicle cannot start to move)

1. Check and repair oil pipes or connectors for air leakage;
2. Check or replace gear pump;
3. Add oil to transmission case;
4. Clean and replace transmission case's filter.

The hydraulic torque converter is overheated

1. Tighten or replace fan belt.
2. See the ENGINE part.
3. Clean or replace oil cooler.
4. See the "Oil pressure in torque converter fails to rise" part.

The vehicle does not move when gear shift lever in any position

1. Add oil to the steering clutch case.
2. See the "Oil pressure in torque converter fails to rise" part.
3. Check or replace gear pump.
4. Clean oil filter.

When pull the steering lever on one side, the vehicle continues to move forward without steering.

- Adjust brake.

Machine doesn't stop when brake pedal are depressed.

- Adjust brake.

Track comes off

- Sprocket is abnormally worn
- Adjust track tension

Blade rises too slowly or does not rise at all

- Add oil to the hydraulic tank

4.3 PRECAUTIONS FOR DISASSEMBLY AND ASSEMBLY

4.3.1 DISASSEMBLY

1. Before disassembling bulldozer's any part, read the manual carefully, so that you have a thorough understanding of the parts to be disassembled. Knowing the structure and role of various parts is an important factor in successfully performing the servicing.
2. During disassembly, pay adequate attention to the direction and position of every part. If necessary, make the identification marks. Meanwhile, pay attention to the sequence of removing various parts from the bulldozer, to ensure the correct installation of the parts.
3. Use special tools required. If you don't have special tools, use similar ones. When ordinary tools can damage related parts in one way or another, you must use special tools.
4. Tapered or closely matched parts should be closely installed in their original places. If these parts are already loose, check their wear.
5. The removed parts should be cleaned and orderly put together. Measures should be taken so that they will not be covered by dust. Two types of cleaning liquids should be used: one for washing away the dirty things, and another for rinsing.

⚠ CAUTION

Filters, magnetic plugs and breather covers are all parts that you should pay special attention to when washing and cleaning them

4.3.2 ASSEMBLY

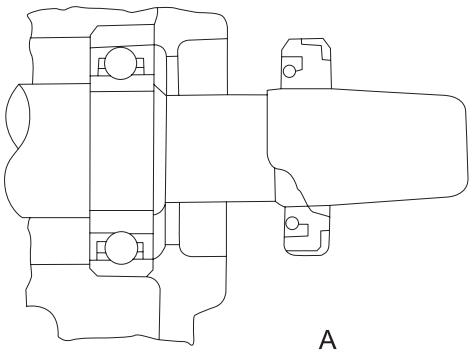
1. All the parts should be clean before being assembled. Replacement parts are usually covered with anti-rust agent, and you should wipe off the anti-rust agent first.
2. In most cases, the installation of bearings, bushing, oil seals and other similar parts should use the special installation tools. Using a hammer to directly knock a part into place is a bad habit. Usually, you need to put a wood block or soft metal part beneath the part to be installed to transmit the impact from the hammer.
3. Spring washers, flat washers, tongue washers and cotter pins are all very important parts. But because of their small size, they are easy to be missed out during assembly. When installing fasteners such as bolts and nuts, check the tightening methods of these parts for compliance.
4. A torque wrench should be used in places where the torque limit is specified. When fixing covers or similar parts with many bolts (such as valve body etc), tighten the bolt symmetrically and gradually, to let the pressure be evenly distributed.
5. The matching markings are not the identification markings for parts that go with each other, and instead they represent a way to show that you should align them as much as possible. Never misunderstand them.

4.3.3 ASSEMBLY AND DISASSEMBLY OF BEARINGS

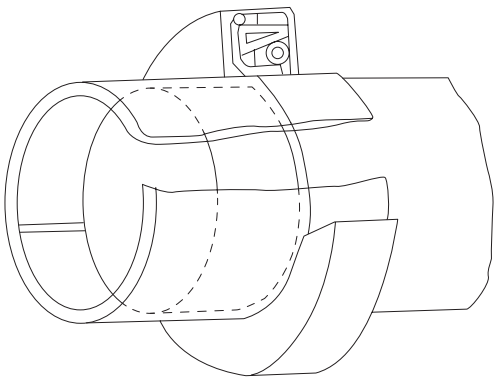
1. Dust is harmful to all the bearings. Dust is often the cause of the noise from bearings and the cause for the accelerated deterioration of lubricant. When replacing bearings, you can only open the package of the bearings after all the other installation work has been completed.
2. Use gasoline as the cleansing liquid for bearings. If you have access to the compressed air, you can also use kerosene and diesel for cleaning, and then use the compressed air to blow away the dust.
3. When installing the bearings, the position should be correct. Let the bearings closely contact the raised shoulder or the bearing support's ring, to reduce the excessive clearance on both ends.

4.3.4 OIL SEAL INSTALLATION

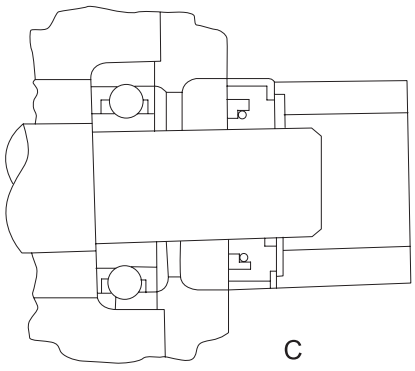
1. When installing the oil seal, the oil seal's labial margin sealing engine oil or gear oil should face inward (the side used to seal the oil), to improve the oil sealing performance; the oil seal's labial margin sealing the lubricating grease should face outward, and when sufficient new lubricating grease is pumped in, the old lubricating grease is easy to be squeezed out.
2. The oil seal should closely contact the raised shoulder or the oil seal's seat ring.
3. Before installing the oil seal, apply a layer of lithium-based lubricating grease on the labial margin, or the oil seal may be scratched due to the friction from the dry friction surface during the initial period of operation.
4. When installing the oil seal, you can use a conduit to let the oil seal slip into the seat (See Figure 4-75A). If you don't have such as conduit, you can use a brass sheet to produce a makeshift conduit (See Figure 4-75B).
5. When pressing the oil seal into the seat (See Figure 4-75C), you must use a suitable tool, to make the pressure applied on the end surface of the oil seal even. The diameter of the tool should be 0.5-1mm smaller than the seat hole, and its free end should have a shape suitable for being hammered.



A



B



C

Figure 4-75: Oil seal installation of the A, B and C

4.4 ADDITIONAL TABLE: USE OF FUEL, COOLANT AND LUBRICANTS ACCORDING TO AMBIENT TEMPERATURE

Locations	Ambient temperature and suitable oil	Rated usage (liter)
	-30 -20 -10 0 5 10 15 20 25 30 35 40 45°C	
Engine Fuel tank	-10~ -30 light diesel	450
Engine oil pan	SAE10W-30 *SAE15W-40	45
Torque converter Transmission case Steering case	SAE10W-30 *SAE15W-40 SAE30	122
Hydraulic oil tank	SAE10W-30 *SAE15W-40	110
Final drive case	SAE10W-30 *SAE15W-40	SD22: 82 SD22E: 82 SD22S: 102
Track roller Carrier roller Idler	SAE85W-140	0.28~0.32 0.47~0.53 0.28~0.53
The remaining lubricating locations	No.2 and No.3 lithium-based lubricating grease	Suitable amount
Engine Coolant	Soft water + antifreeze Soft water	79

Note:

1. Oil marked with "*" is the alternative to the oil in the column, and when the oil in the above line is not available, the oil with * can be used as the alternative.
2. All the lubricant brands are the CF Class. If the CD Class is used, the oil change time should be 1/2 of the required time.
3. When ambient temperature is lower than -20°C, the oil in the engine oil pan should be changed to SAE5W-20.
4. When adding oil, pull out the filter screen from the oil injection port first, use clean diesel to wash it clean, and then put it back to the oil injection port before going ahead to add oil. Oil that has been fully sedimented should be used.
5. The amount of oil or grease added should meet the requirement, not too much or too less.
6. The tools for adding oil or water must be clean, and they should be put in covered boxes or cabinets after use.
7. Before draining oil, preheat the oil to 30-40°C.

SAE is the internationally accepted oil numbering system.

Note paper