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Crawler Hydraulic Excavator
Shop Manual
SY365(B)H-9

SANY HEAVY MACHINERY LIMITED

318A, Lianggang Avenue, Lingang Industrial Park, Fengxian District, Shanghai, P.R. of China 201413

Tel: (86) 21 5700 8518
Service hotline: (86) 4006 098 318
E-mail: crd@sany.com.cn

Documentation No.: B06T03ENAN1-SY365(B)H-9



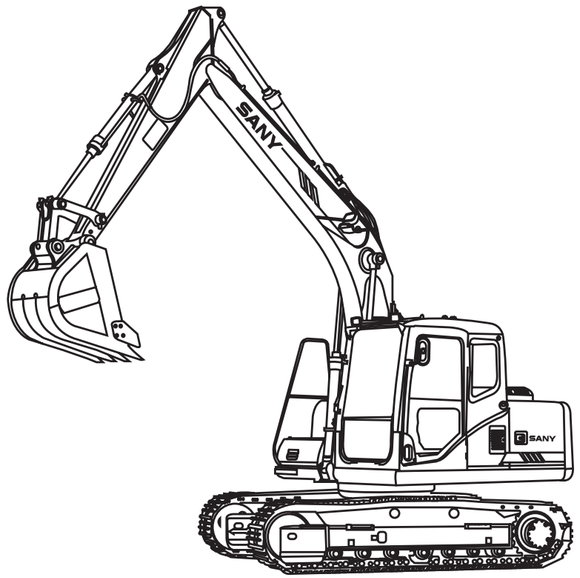
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Quality Changes the World

Crawler Hydraulic Excavator

SY365H-9

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Shop Manual

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SY365(B)H-9
Crawler Hydraulic Excavator

Shop Manual

⚠ WARNING

- **Read and follow the safety precautions and instructions in this manual and on the machine decals. Failure to do can cause serious injury, death or property damage. Keep this manual with the machine for reading and future reference.**

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Sany Group
Sany Heavy Machinery Limited
318A, Lianggang Avenue, Lingang Industrial Park,
Fengxian District, Shanghai, P. R. of China 201413

http://www.sanygroup.com

Tel: 0086-21-57008518 Fax: 0086-21-58596210
Service hotline: 0086-21-58592902
Complaint hotline: 0086-21-58590631
E-mail: sanyservice@sany.com.cn

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Introduction

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1 INTRODUCTION

1.1 How to Read the Manual

- Some attachments and optional parts in this shop manual may not be delivered to certain areas. If one of them is required, consult Sany distributors.
- Materials and specifications are subject to change without notice.

1.1.1 Shop manual organization

This shop manual contains the necessary technical information for services performed in a workshop. For ease of understanding, the manual is divided into the following sections.

Introduction

This section provides an overview of what is covered in the rest of this manual and how to use this manual,.

Shop Safety

This section covers basic shop safety information relating to this equipment. It also describes what the hazard alerts mean that are used throughout the manual.

Specifications

Technical specification of work equipment and optional parts are given in this section.

Structure and functions

This section explains the structure and function of each component. It helps the reader to get a better understanding of the machine structure, and also serves as a reference for troubleshooting.

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Standard Values

This section explains the standard values for a new machine and judgement criteria for testing, adjusting, and troubleshooting. This standard value table is used to check the standard values in testing and adjusting and to judge parts in troubleshooting.

Testing and adjusting

This section details the inspection before and after repair work as well as the adjustment during inspection and repair work. Troubleshooting table that involves "Fault" and "Cause" are also included in this section.

Troubleshooting

This section explains the way to detect faulty parts and the method to repair them. This section is divided into the following parts: Electrical system, Engine, Hydraulic and mechanical system and Monitoring system.

Disassembly and assembly

This section explains the procedures as well as precautions for removing, installing, disassembling and assembling of each component.

Engine

This section provides information the cooling system, lubricating system, electrical system and alternator in addition to disassembly and reassembly of the engine.

System Schematics

This section provides hydraulic circuit diagrams and electrical circuit diagrams.

1.1.2 Revision and distribution

Any complements, revisions, or other change of notices will be sent to Sany distributors. Get the most up-to-date information before you start any work.

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1.1.3 Symbols

Important safety and quality portions are marked with the following symbols so that the shop manual will be used practically.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing work.
★	Caution	Special technical precautions or other precautions for pre-serving standards are necessary when performing work.
	Weight	Weight of parts of component or parts. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives, etc. during assembly.
	Oil, Coolant	Places where oil, etc. must be added, and capacity.
	Drain	Places where oil, etc. must be drained, and quantity to be drained.

1.1.4 Units

In this shop manual, the units are indicated with International System of units (SI). For reference, conventionally used Gravitational System of units is indicated in parentheses { }.

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1.2 Technical Terms

The maintenance standard values necessary for judgment of products and parts are described by the following terms.

1.2.1 Standard size and tolerance

- To be accurate, the finishing size of parts is a little different from one to another.
- To specify a finishing size of a part, a temporary standard size is set and an allowable difference from that size is indicated.
- The above size set temporarily is called the "standard size" and the range of difference from the standard size is called the "tolerance".
- The tolerance with the symbols of + or – is indicated on the right side of the standard size.

Example

Standard size	Tolerance
120	–0.022 –0.126

★ The tolerance may be indicated in the text and a table as [standard size (upper limit of tolerance/lower limit of tolerance)]. Example) 120 (–0.022/–0.126)

- Usually, the size of a hole and the size of the shaft to be fitted to that hole are indicated by the same standard size and different tolerances of the hole and shaft. The tightness of fit is decided by the tolerance.
- Indication of size of rotating shaft and hole and relationship drawing of them.

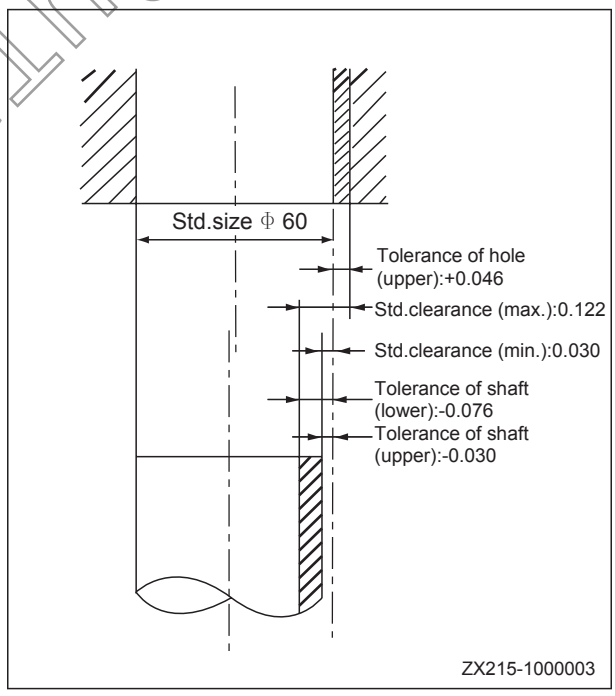


Fig. 1-1

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Example

Standard size	Tolerance	
	Shaft	Hole
Φ60	-0.030 -0.076	+0.046 0

1.2.2 Standard clearance and value

- The clearance made when new parts are assembled is called the "standard clearance", which is indicated by the range from the minimum clearance to the maximum clearance.
- When some parts are repaired, the clearance is generally adjusted to the standard clearance.
- A value of performance and function of new products or equivalent is called the "standard value", which is indicated by a range or a target value.
- When some parts are repaired, the value of performance/function is set to the standard value.

1.2.3 Standard interference

- When the size of a hole is smaller than the size of a shaft because of the standard size and tolerance, the difference between these sizes is called the "interference".
- The range (A – B) from the difference (A) between the minimum size of the shaft and the maximum size of the shaft to the difference (B) between the maximum size of the shaft and the minimum size of the hole is the "standard interference".
- After repairing or replacing some parts, measure the size of their hole and shaft and check that the interference is in the standard range.

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1.2.4 Repair limit and allowable value

- The size of a part changes due to wear and deformation while it is used. The limit of changed size is called the "repair limit".
- If a part is worn to the repair limit must be replaced or repaired.
- The performance and function of a product lowers while it is used. A value below which the product can be used without causing a problem is called the "allowable value".
- If a product is worn to the allowable value, it must be checked or repaired. Since the permissible value is estimated from various tests or experiences in most cases, however, it must be judged after considering the operating condition and customer's requirement.

1.2.5 Clearance limit

- Parts can be used until the clearance between them is increased to a certain limit. The limit at which those parts cannot be used is called the "clearance limit".
- If the clearance between the parts exceeds the clearance limit, they must be replaced or repaired.

1.2.6 Interference limit

- The allowable maximum interference between the hole of a part and the shaft of another part to be assembled is called the "interference limit".
- The interference limit shows the repair limit of the part of smaller tolerance.
- If the interference between the parts exceeds the interference limit, they must be replaced or repaired.

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1.3 Handling Electrical and Hydraulic Components

To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct "operation", "maintenance and inspection", "troubleshooting", and "repairs" must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric components" and "Handling hydraulic equipment" (particularly gear oil and hydraulic oil).

1.3.1 Points to remember when handling electric components

1.3.1.1 Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.

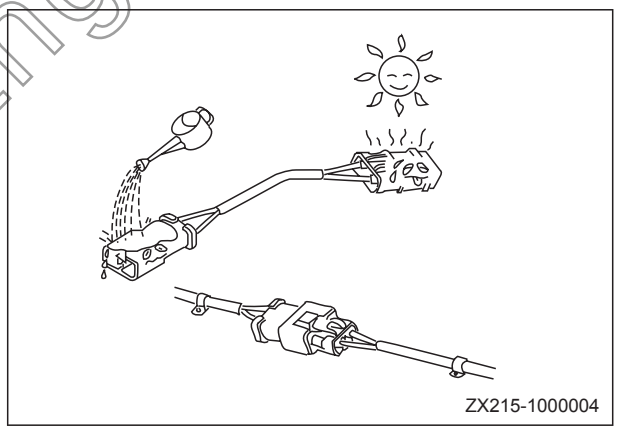


Fig. 1-2

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1.3.1.2 Main failures occurring in wiring harness

1. Defective contact of connectors (defective contact between male and female)

   Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidation of the contact surfaces.

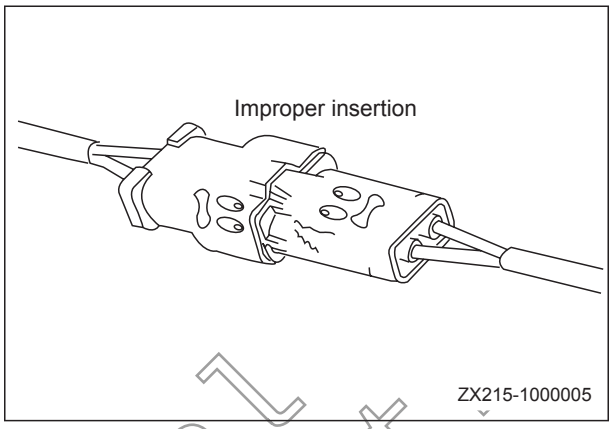


Fig. 1-3

2. Defective crimping or soldering of connectors

   The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.

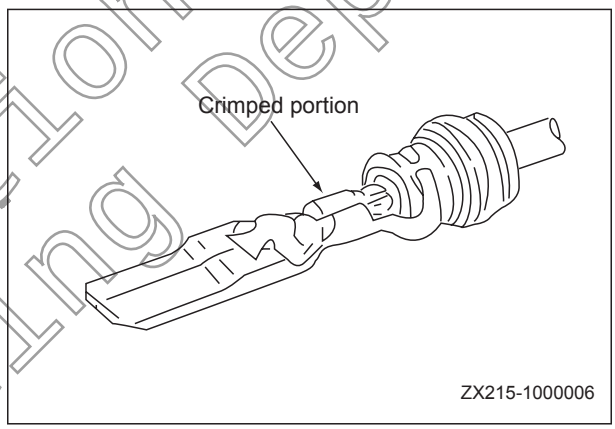


Fig. 1-4

3. Disconnections in wiring

   If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.

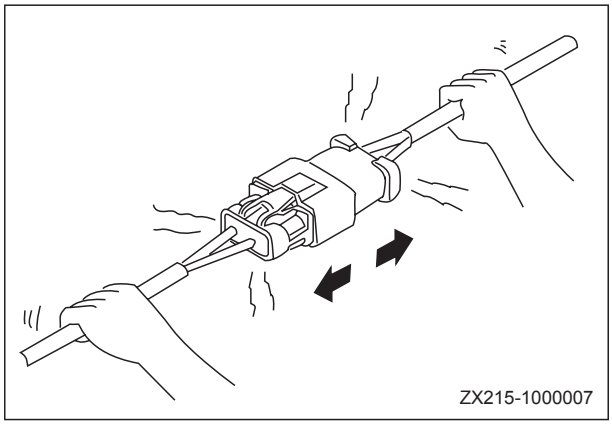


Fig. 1-5

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4. High-pressure water entering connector

   The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet. Accordingly, take care not splash water over the connector. The connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.

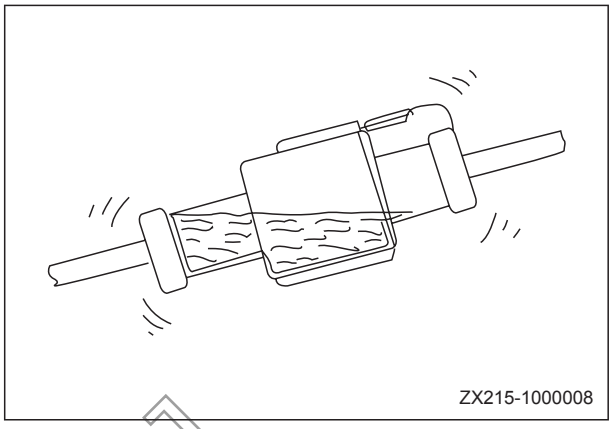


Fig. 1-6

5. Oil or dirt stuck to connector

   If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow it dry with compressed air and spray it with a contact restorer.

   ★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.

   ★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.

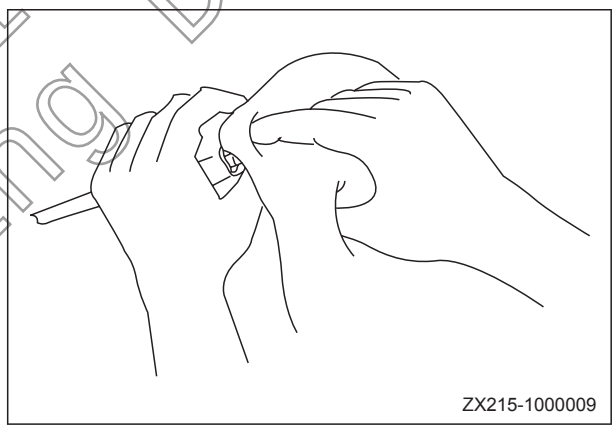


Fig. 1-7

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1.3.1.3 Removing, installing, and drying connectors and wiring harnesses

1. Disconnecting connectors

   A. Hold the connectors when disconnecting.

   When disconnecting the connectors, hold the connectors. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.

   ★ Never pull with one hand.

   B. When removing from clips

   - Both of the connector and clip have stoppers, which are engaged with each other when the connector is installed.

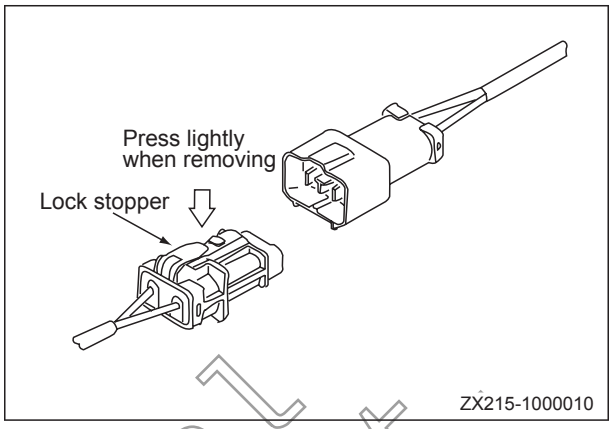


Fig. 1-8

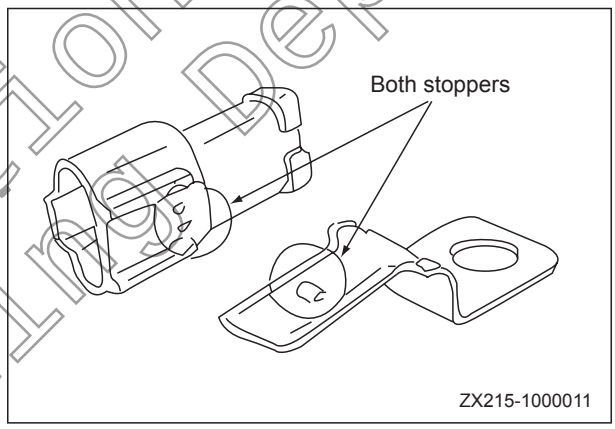


Fig. 1-9

   - When removing a connector from a clip, pull the connector in a parallel direction to the clip for removing stoppers.

   ★ If the connector is twisted up and down or to the left or right, the housing may break.

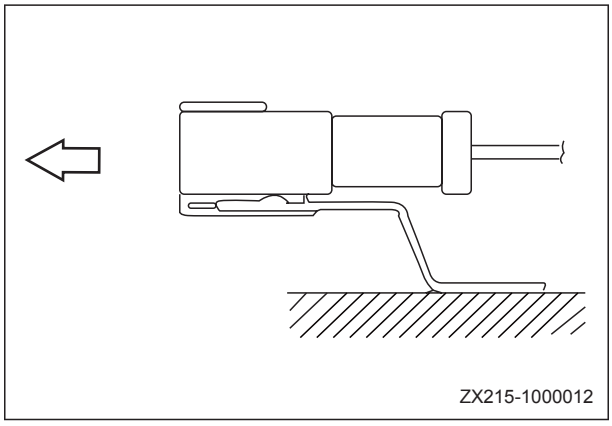


Fig. 1-10

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C. Action to take after removing connectors

After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.

★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always cover the connector.

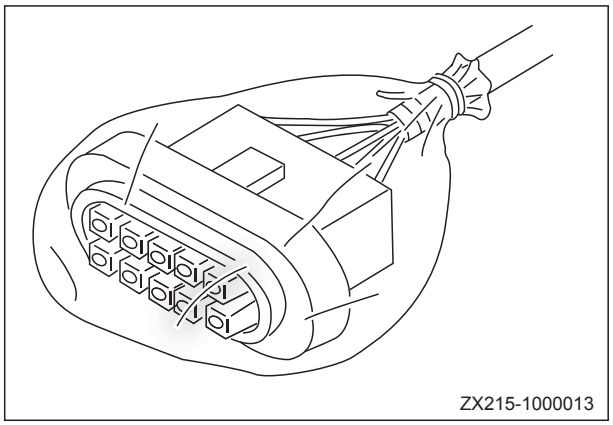


Fig. 1-11

2. Connecting connectors

A. Check the connector visually

Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).

Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.

Check that there is no damage or breakage to the outside of the connector.

★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.

★ If there is any damage or breakage, replace the connector.

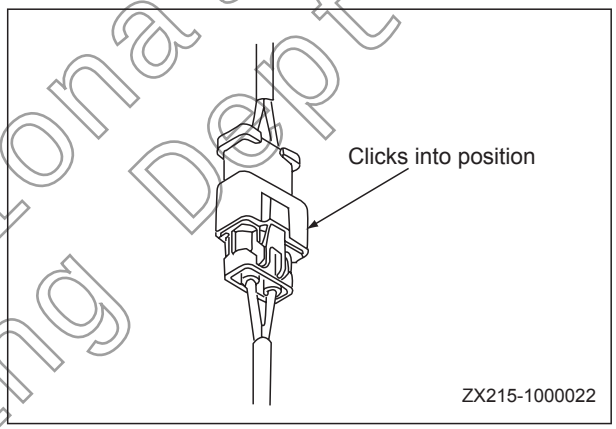


Fig. 1-12

B. Fix the connector securely.

Align the position of the connector cor-

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rectly, and then insert it securely. For connectors with lock stopper, push in the connector until the stopper clicks into position.

C. Correct any protrusion of the boot and any misalignment of the wiring harness.

For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

★ If the connector cannot be corrected easily, remove the clamp and adjust the position.

- If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.

3. Connecting DT connectors

Since the DT 8-pin and 12-pin heavy duty wire connectors have 2 latches respectively, push them in until they click 2 times.

- Male connector: 1
- Female connector: 2
- Normal locking state (Horizontal): a, b, d
- Incomplete locking state (Diagonal): c

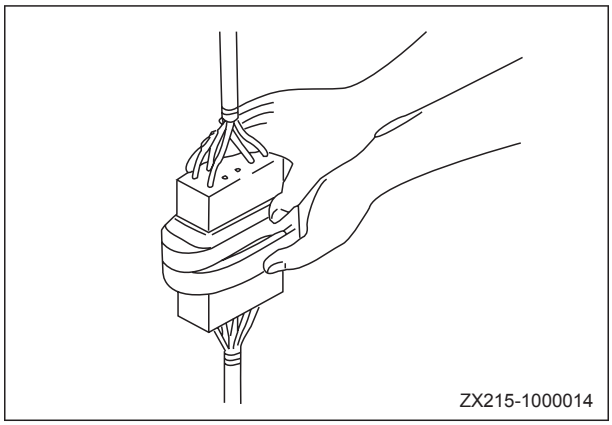


Fig. 1-13

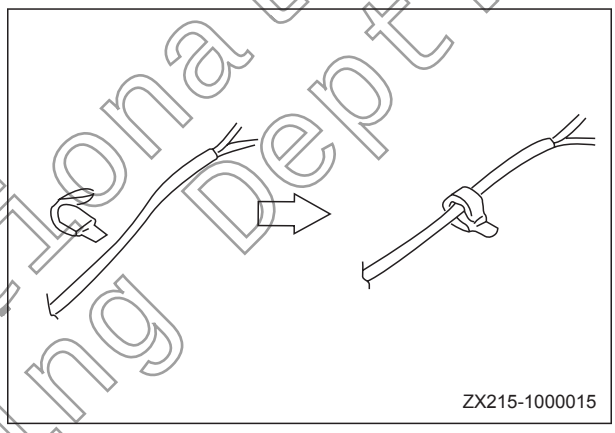


Fig. 1-14

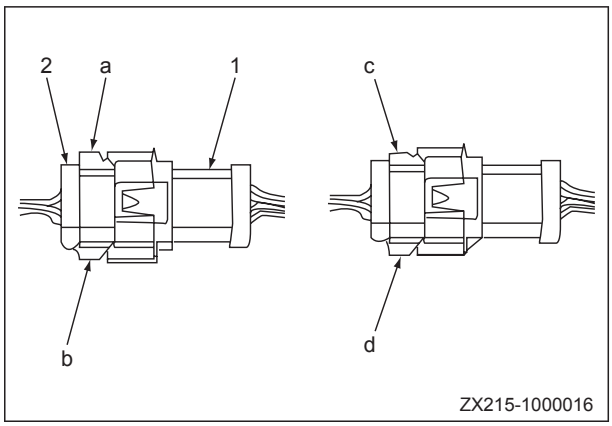


Fig. 1-15

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4. Drying wiring harness

If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.

A. Disconnect the connector and wipe off the water with a dry cloth.

★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.

B. Dry the connector with a dryer.

If water gets inside the connector, use a dryer to dry the connector.

★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.

C. Carry out a continuity test on the connector.

After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

★ After completely drying the connector, blow it with contact restorer and reassemble.

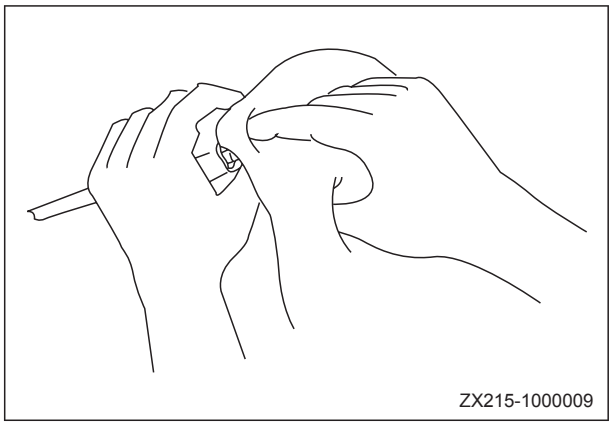


Fig. 1-16

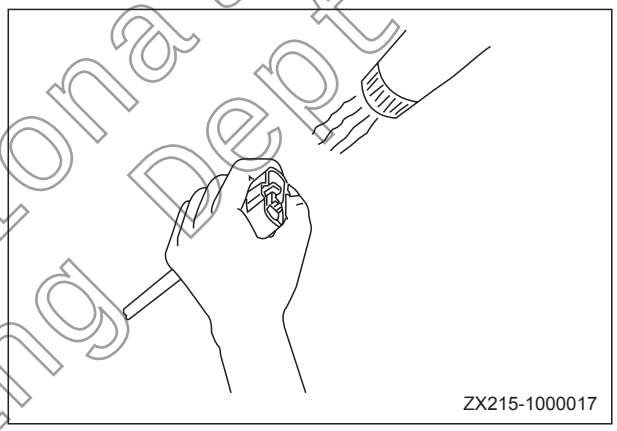


Fig. 1-17

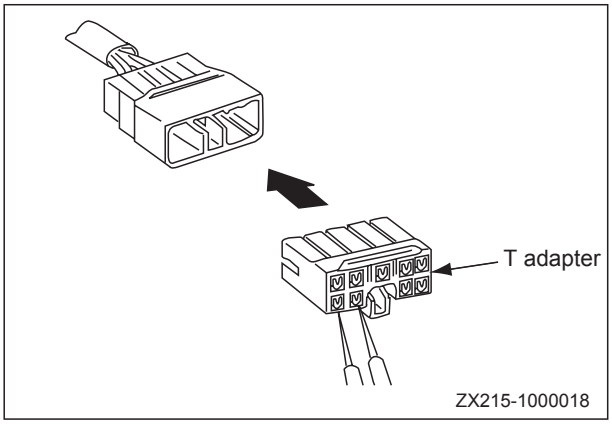


Fig. 1-18

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1.3.1.4 Handling the integrated control monitor

1. The integrated control monitor contains a microcomputer, an electronic control circuits, an LCD monitor and GPS positioning circuit. They control all of the electronic circuits on the machine, so be extremely careful when handling the integrated control monitor.
2. Do not place objects on the integrated control monitor.
3. Cover the control connectors with tape or a vinyl bag. Never touch the connector contacts with your hand.
4. Do not leave it where it may be exposed to rain.
5. Do not place the integrated control monitor on oil, water, or soil, or in any hot place, even for a short time.
6. Precautions for arc welding

   When welding on the controller, disconnect all wiring harness connectors connected to the controller. Fit an arc welding ground close to the welding point.

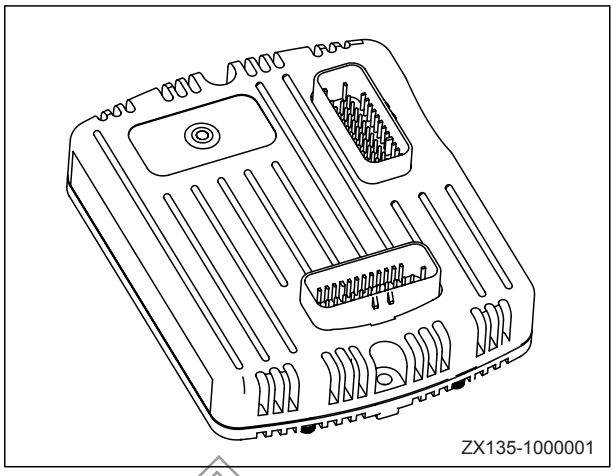


Fig. 1-19

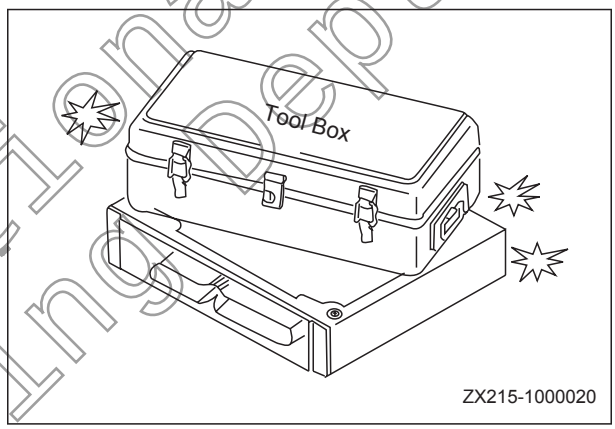


Fig. 1-20

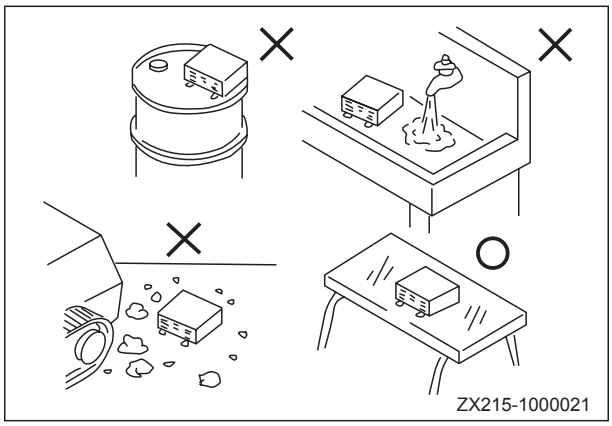


Fig. 1-21

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1.3.1.5 Electric circuits troubleshooting precautions

1. Always turn the power OFF before disconnecting or connecting connectors.
2. Before carrying out troubleshooting, check that all the related connectors are properly inserted.

   ★ Disconnect and connect the related connectors several times to check.
3. Always connect any disconnected connectors before going on to the next step.

   ★ If the power is turned ON with the connectors still disconnected, unnecessary abnormality displays will be generated.
4. When carrying out troubleshooting of circuits (measuring the voltage, resistance, continuity, or current), move the related wiring and connectors several times and check that there is no change in the reading of the tester.

   ★ If there is any change, there is probably defective contact in that circuit.

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1.3.2 Points to remember when handling hydraulic equipment

With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

1.3.2.1 Be careful of the operating environment

Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

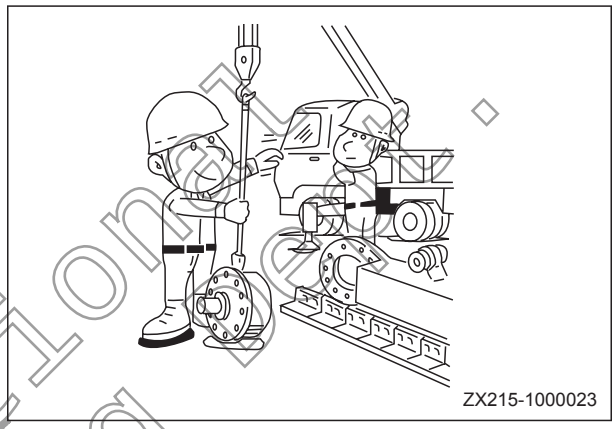


Fig. 1-22

1.3.2.2 Disassembly and maintenance work in the field

If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to check the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dust-proof workshop, and the performance should be checked with special test equipment.

1.3.2.3 Sealing openings

After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this. Do not simply drain oil out onto the ground, but collect it and ask the customer to dispose of it, or take it back with you for disposal.

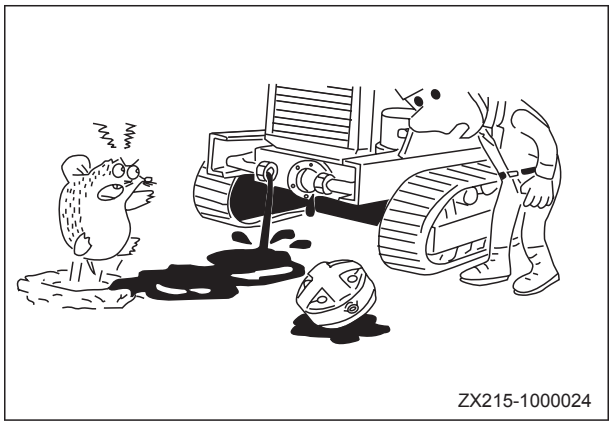


Fig. 1-23

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1.3.2.4 Do not let any dirt or dust get in during refilling operations

Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.

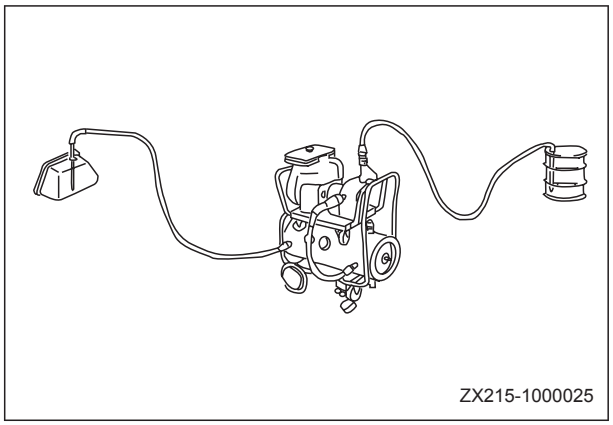


Fig. 1-24

1.3.2.5 Change hydraulic oil when the temperature is high

When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

1.3.2.6 Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit. Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.

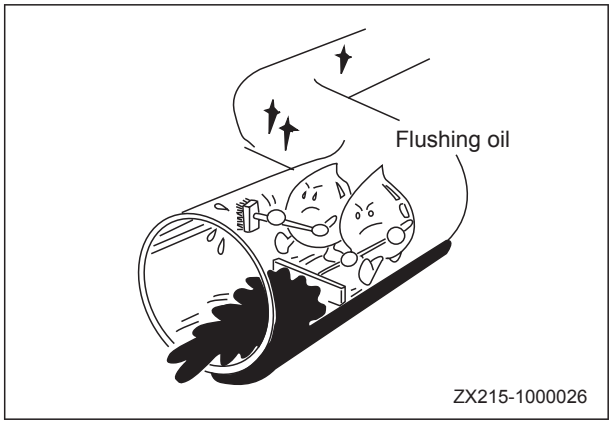


Fig. 1-25

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1.3.2.7 Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit. The oil cleaning equipment is used to remove the ultra fine (about 3 μ) particles that the filter built in the hydraulic equipment cannot remove, so it is an extremely effective device.

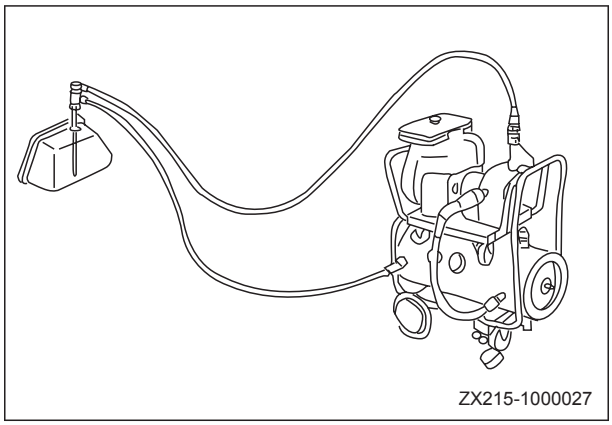


Fig. 1-26

1.4 Hose Connector

Hose connector is used to connect hoses with a small diameter. The metal sealing surface (4) of the joint (1) must be in close contact with the metal sealing surface (5) of the hose (2) to seal pressurized oil.

NOTICE

- **Do not over-tighten the nut (3). Excessive force applied on the metal sealing surface (4) and (5) may cause the joint (1) to break. Be sure to tighten nut (3) according to technical specifications.**
- **Scratches or other damages on sealing surface (4) and (5) may cause leaks at the joint. Be extremely careful not to damage the sealing surfaces during connecting and disconnecting work.**

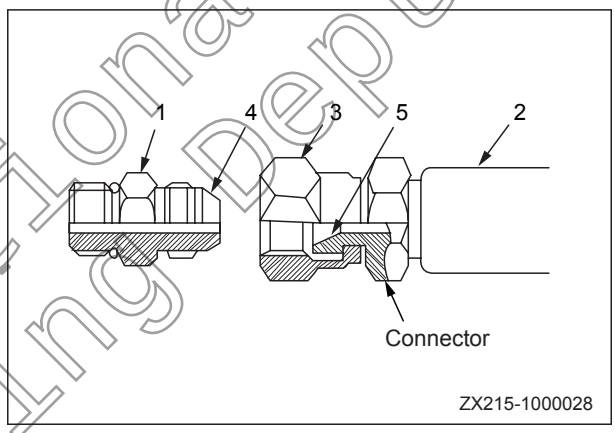


Fig. 1-27

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1.4.1 Type of hose connector

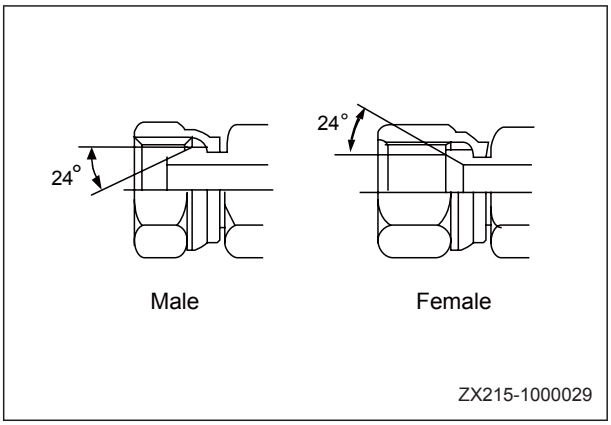


Fig. 1-28

1.4.2 Hose connector tightening torque table

Type	Wrench size mm	Wrench size mm	Tightening torque
	Connecting nut	Hose joint	N·m(kgf·m,lbf·ft)
24° Male	19	19	59(6,44)
	22	22	98(10,72)
	27	27	118(12,87)
	36	36	235(24,173)
	41	41	295(30,218)
	50	50	490(50,361)
	60	60	670(68,494)
	70	70	980(100,723)
24° Female	19	17	44(4.5,32)
	22	19	59(6,44)
	27	22	118(12,87)
	36	30, 32	235(24,173)
	41	36	295(30,218)
	50	46	490(50,361)

NOTICE

- **The torque values listed in the table are intended for general application.**
- **Do not use torque values listed in this table when different torque values are specified for a special purpose.**

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1.4.3 Connection of O-rings

Place O-ring (6) in contact with the contact surface of the joint (7) to seal the pressurized oil.

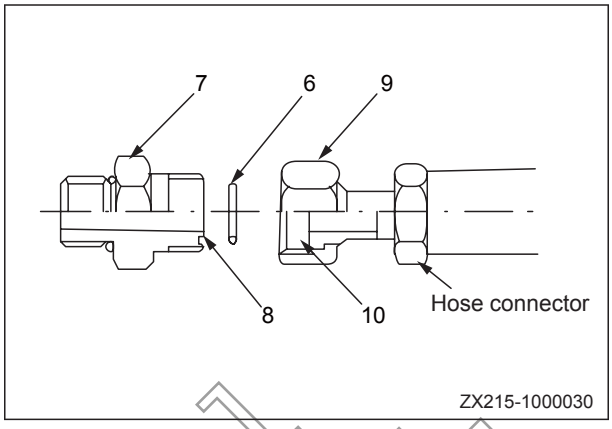


Fig. 1-29

NOTICE

- **Replace o-rings (6) with new ones when re-connecting hoses.**
- **Before tightening nut (9), make sure the o-ring (6) has been placed into the o-ring seat (8).Displacement of the o-ring may have it damaged and cause leaks.**
- **Be careful not to damage the o-ring seat (8) or the sealing surface (10). Damaged o-ring (6) may cause oil leakage.**
- **If oil leakage due to loosened nut (9) is detected, do not try to stop the leakage by tightening nut (9). Instead, replace o-ring (6) with a new one and make sure it is well positioned, and tighten nut (9).**

Wrench size mm	Wrench size mm	Tightening torque
Connecting nut	Hose joint	N·m (kgf·m,lbf·ft)
19	17	44(4.5,32)
22	19	59(6,44)
27	22	118(12,87)
36	30, 32	235(24,173)
41	36	295(30,218)
50	46	490(50,361)

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1.5 Table of Standard Tightening Torques

Table of tightening torques for bolts and nuts

★ Unless specified otherwise, tighten metric nuts and bolts to the torque below. (When using torque wrench)

Bolt diameter	Bolt grade	Wrench size	Hex wrench size	Hexagonal bolt			Hexagonal socket head bolt		
				N·m	kgf·m	lbf·ft	N·m	kgf·m	lbf·ft
M6	10.9	10	4	13.2	1.37	9.74	13.2	1.37	9.74
M8	10.9	13	6	31	3.16	22.87	31	3.16	22.87
M10	10.9	17	8	66	6.73	48.7	66	6.73	48.7
M12	10.9	19	10	113	11.53	83.39	113	11.53	83.39
M14	10.9	22	12	177	18.06	130.6	177	18.06	130.6
M16	10.9	24	14	279	28.47	205.9	279	28.47	205.9
M18	10.9	27	14	382	38.98	281.9	382	38.98	281.9
M20	10.9	30	17	549	56.02	405.16	549	56.02	405.16
M27	10.9	41	19	1320	134.7	974.16	1320	134.7	974.16
M10	12.9	17	6	78	7.96	57.76	78	7.96	57.76
M12	12.9	19	8	137	13.98	101.1	137	13.98	101.1
M16	12.9	24	14	339	34.6	250.18	339	34.6	250.18
M20	12.9	30	17	664	67.75	490	664	67.75	490

NOTICE

The following items apply to fine thread and coarse thread.

- **Apply grease (zinc white B dissolved in spindle oil) onto the nuts and bolts to reduce the friction coefficient. Thrust bolts do not require greasing.**
- **Torque tolerance is ±10%.**
- **Always use bolts of correct length. The tip of bolts with excessive length may contact the bottom of the bolt hole, resulting in under-tightening. Bolts with inadequate length may result in insufficient fastening.**
- **The torque values listed in the table are intended for general application. If different torque values are specified for a special purpose, the torque values in this table are not applicable any more.**
- **Make sure the threads are free of dirt or rusts before installation of nuts and bolts.**

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1.6 Type of Bolts

Tighten nuts and bolts properly to specified torque values. The type and grade of bolts are illustrated on the right.

Use correct bolts and tighten them properly when assembling machines or components.

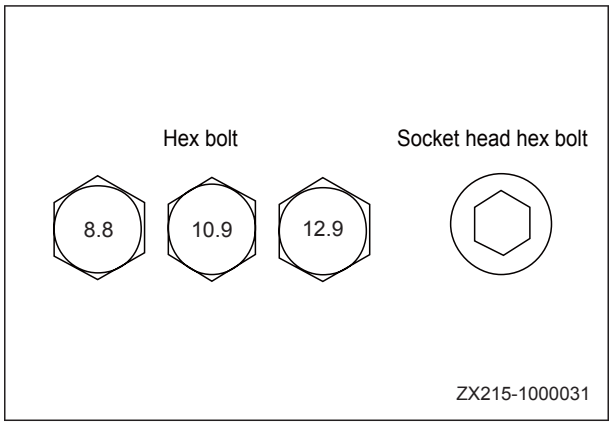


Fig. 1-30

1.7 Tightening Sequence

When two or more bolts are being tightened, follow the tightening sequence shown on the right to ensure even tightening.

⚠ CAUTION

- **Always use suitable tools for specific work. Use of improper tools and methods may cause a hazardous situation.**
- **Use tools of correct sizes when loosening or tightening the nuts or bolts. Otherwise, the tools may slide and cause personal injury.**

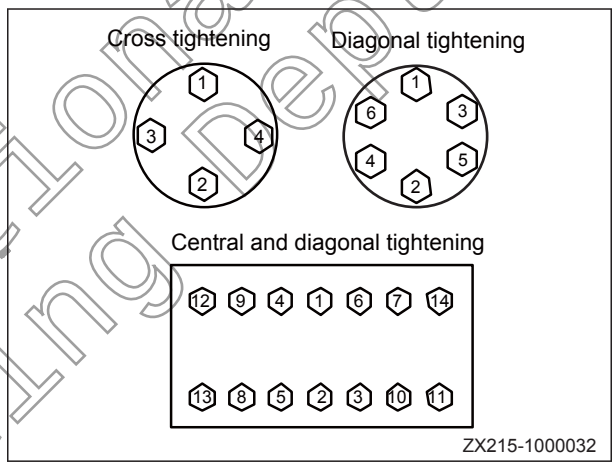


Fig. 1-31

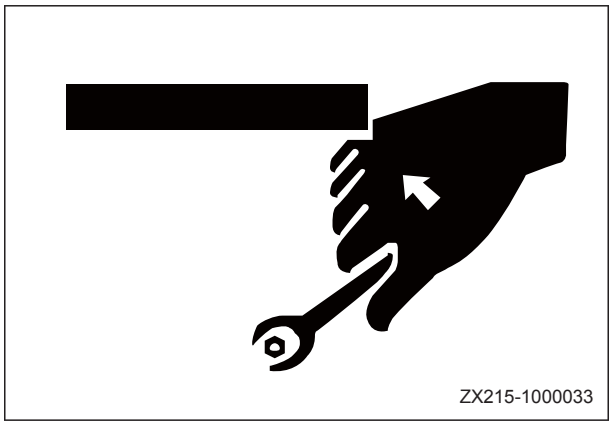


Fig. 1-32

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1.8 Maintenance of Half Flanges

1. Clean the sealing surface of the flange and check it carefully. Scratches and coarseness cause leaks or abrasion of seals. Uneven surface may squeeze the seal out. If these faults are not corrected properly, parts may have to be replaced.

2. Always use specified O-rings. Check that the O-rings are not damaged. Do not file the surface of the O-ring. Apply grease onto the O-ring to locate it.

3. Tighten the half flanges carefully. Locate the opening at the center so that it is perpendicular to the oil opening. Tighten the bolt manually to maintain the location of the components.

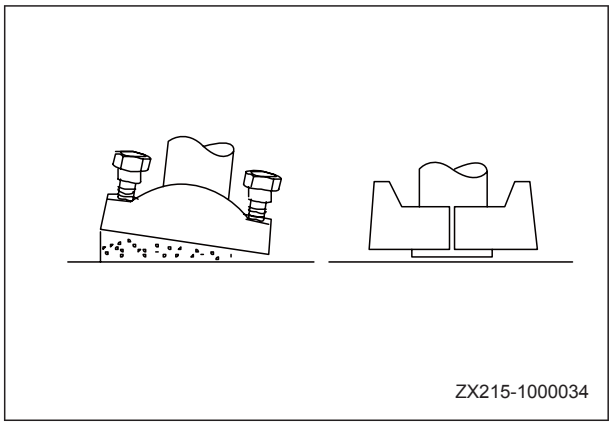


Fig. 1-33

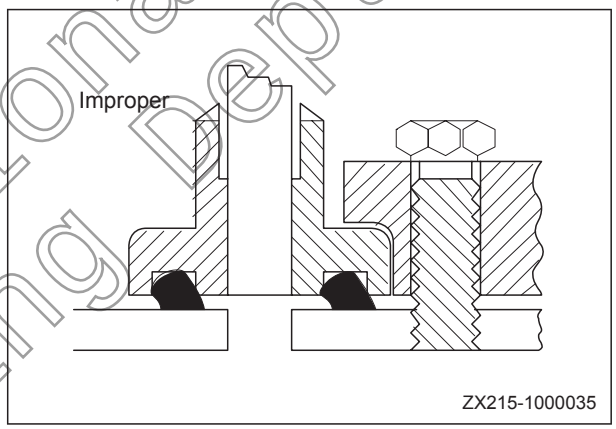


Fig. 1-34

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1.8.1 Table of tightening torques for half flange bolts

★ Unless specified otherwise, tighten the half flange bolts to the torques below.

Thread diameter of bolt	Width across flats	Tightening torque	
mm	mm	Nm	kgm
10	14	59~74	6.0~7.5
12	17	98~123	10.0~12.5
16	22	235~285	23.5~29.5

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Conversion Table

Method of using conversion table

The conversion table in this section is provided to enable simple conversion of figures. For details of the method of using the conversion table, see the example given below.

Example:

Method of using the conversion table to convert from millimeters to inches

Convert 55 mm into inches

Locate the number 50 in the vertical column at the left side, take this as (A), and then draw a horizontal line from (A).

Locate the number 5 in the row across the top, take this as (B), then draw a perpendicular line down from (B).

Take the point where the two lines cross as (C). This point (C) gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

Convert 550 mm into inches

The number 550 does not appear in the table, so divide it by 10 (move the decimal point one place to the left) to convert it to 55 mm.

Carry out the same procedure as above to convert 55 mm to 2.165 inches.

The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

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Millimeters to Inches

1mm=0.03937in

(B)

	0	1	2	3	4	5	6	7	8	9
0	0.000	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.535
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.031	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

(A)

(C)

Millimeters to Inches

1mm=0.03937in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.535
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.031	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

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Kilogram to Pound

1kg=2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	90.39	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	112.43	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	134.48	55.12	57.32	59.52	61.73	63.93
30	66.14	68.34	70.55	72.75	156.53	77.16	79.37	81.57	83.77	85.98
40	88.18	90.39	92.59	94.80	178.57	99.21	101.41	103.62	105.82	108.03
50	110.23	112.43	114.64	116.84	200.62	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	222.66	143.30	145.50	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	244.71	165.35	167.55	169.75	171.96	174.16
80	176.37	178.57	180.78	182.98	266.76	187.39	189.60	191.80	194.00	196.21
90	198.41	200.62	202.82	205.03	288.80	209.44	211.64	213.85	216.05	218.26

Liters to U.S. Gallons

1 L=0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.114	2.378
10	2.642	2.906	3.170	3.435	3.699	3.963	4.227	4.491	4.756	5.020
20	5.284	5.548	5.812	6.077	6.341	6.605	6.869	7.133	7.398	7.662
30	7.926	8.190	8.454	8.719	8.983	9.247	9.511	9.775	10.040	10.304
40	10.568	10.832	11.096	11.361	11.625	11.889	12.153	12.417	12.682	12.946
50	13.210	13.474	13.738	14.003	14.267	14.531	14.795	15.059	15.324	15.588
60	15.852	16.116	16.380	16.645	16.909	17.173	17.437	17.701	17.966	18.230
70	18.494	18.758	19.022	19.287	19.551	19.815	20.079	20.343	20.608	20.872
80	21.136	21.400	21.664	21.929	22.193	22.457	22.721	22.985	23.250	23.514
90	23.778	24.042	24.306	24.571	24.835	25.099	25.363	25.627	25.892	26.156

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Liters to U.K. Gallons

1 L=0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.739	3.959	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.779
50	10.999	11.218	11.438	11.658	11.878	12.098	12.318	12.538	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.038	18.258	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft.lb

1 kgm=7.233 ft.lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.3	390.6	397.8	405.0	412.3	419.5	426.7
60	434.0	441.2	448.4	455.7	462.9	470.1	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.6	1048.8	1056.0	1063.3	1070.5	1077.7
150	1085.0	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1229.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.2	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

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kg/cm² to lb/in²

1 kg/cm²=14.2233 lb/in²

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.3	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.0	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	996	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2133	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2390	2404
170	2418	2432	2446	2461	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2774	2788	2802	2816	2830
200	2845	2859	2873	2887	2902	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3342	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

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1.8.2 Temperature

Fahrenheit-Centigrade conversion: A simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center (boldface column) of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column to be a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column to be a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.0	**-40**	-40.0	-11.7	**11**	51.8	7.8	**46**	114.8	27.2	**81**	177.8
-37.2	**-35**	-31.0	-11.1	**12**	53.6	8.3	**47**	116.6	27.8	**82**	179.6
-34.4	**-30**	-22.0	-10.6	**13**	55.4	8.9	**48**	118.4	28.3	**83**	181.4
-31.7	**-25**	-13.0	-10.0	**14**	57.2	9.4	**49**	120.2	28.9	**84**	183.2
-28.9	**-20**	-4.0	-9.4	**15**	59.0	10.0	**50**	122.0	29.4	**85**	185.0
-28.3	**-19**	-2.2	-8.9	**16**	60.8	10.6	**51**	123.8	30.0	**86**	186.8
-27.8	**-18**	-0.4	-8.3	**17**	62.6	11.1	**52**	125.6	30.6	**87**	188.6
-27.2	**-17**	1.4	-7.8	**18**	64.4	11.7	**53**	127.4	31.1	**88**	190.4
-26.7	**-16**	3.2	-7.2	**19**	66.2	12.2	**54**	129.2	31.7	**89**	192.2
-26.1	**-15**	5.0	-6.7	**20**	68.0	12.8	**55**	131.0	32.2	**90**	194.0
-25.6	**-14**	6.8	-6.1	**21**	69.8	13.3	**56**	132.8	32.8	**91**	195.8
-25.0	**-13**	8.6	-5.6	**22**	71.6	13.9	**57**	134.6	33.3	**92**	197.6
-24.4	**-12**	10.4	-5.0	**23**	73.4	14.4	**58**	136.4	33.9	**93**	199.4
-23.9	**-11**	12.2	-4.4	**24**	75.2	15.0	**59**	138.2	34.4	**94**	201.2
-23.3	**-10**	14.0	-3.9	**25**	77.0	15.6	**60**	140.0	35.0	**95**	203.0
-22.8	**-9**	15.8	-3.3	**26**	78.8	16.1	**61**	141.8	35.6	**96**	204.8
-22.2	**-8**	17.6	-2.8	**27**	80.6	16.7	**62**	143.6	36.1	**97**	206.6
-21.7	**-7**	19.4	-2.2	**28**	82.4	17.2	**63**	145.4	36.7	**98**	208.4
-21.1	**-6**	21.2	-1.7	**29**	84.2	17.8	**64**	147.2	37.2	**99**	210.2
-20.6	**-5**	23.0	-1.1	**30**	86.0	18.3	**65**	149.0	37.8	**100**	212.0
-20.0	**-4**	24.8	-0.6	**31**	87.8	18.9	**66**	150.8	40.6	**105**	221.0
-19.4	**-3**	26.6	0.0	**32**	89.6	19.4	**67**	152.6	43.3	**110**	230.0
-18.9	**-2**	28.4	0.6	**33**	91.4	20.0	**68**	154.4	46.1	**115**	239.0
-18.3	**-1**	30.2	1.1	**34**	93.2	20.6	**69**	156.2	48.9	**120**	248.0
-17.8	**0**	32.0	1.7	**35**	95.0	21.1	**70**	158.0	51.7	**125**	257.0
-17.2	**1**	33.8	2.2	**36**	96.8	21.7	**71**	159.8	54.4	**130**	266.0
-16.7	**2**	35.6	2.8	**37**	98.6	22.2	**72**	161.6	57.2	**135**	275.0
-16.1	**3**	37.4	3.3	**38**	100.4	22.8	**73**	163.4	60.0	**140**	284.0
-15.6	**4**	39.2	3.9	**39**	102.2	23.3	**74**	165.2	62.8	**145**	293.0
-15.0	**5**	41.0	4.4	**40**	104.0	23.9	**75**	167.0	65.6	**150**	302.0
-14.4	**6**	42.8	5.0	**41**	105.8	24.4	**76**	168.8	68.3	**155**	311.0
-13.9	**7**	44.6	5.6	**42**	107.6	25.0	**77**	170.6	71.1	**160**	320.0
-13.3	**8**	46.4	6.1	**43**	109.4	25.6	**78**	172.4	73.9	**165**	329.0
-12.8	**9**	48.2	6.7	**44**	111.2	26.1	**79**	174.2	76.7	**170**	338.0
-12.2	**10**	50.0	7.2	**45**	113.0	26.7	**80**	176.0	79.4	**175**	347.0

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SANY

Shop Safety

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2 SHOP SAFETY

2.1 Hazard Alert Information

Most accidents are usually caused by the failure to follow fundamental repair procedures and safety rules for the system under repair. To avoid accidents it is important to read and understand all information outlined in this manual before performing repairs on the machine system.

The following (ANSI/ISO) signal words are used to inform you that there is a potentially hazardous situation that may lead to damage, personal injury or even death. In this manual, on the machine, part or component decals and different signal words are used to express the potential level of a hazard.

⚠ DANGER

- **Indicates an imminent hazard which WILL result in serious injury or death if message is ignored.**

⚠ WARNING

- **Indicates a potentially hazardous situation which COULD result in serious injury or death if message is ignored.**

⚠ CAUTION

- **Indicates a potentially hazardous situation which COULD RESULT IN MINOR OR MAJOR INJURY if message is ignored.**

NOTICE

- **Indicates THE MACHINE MAY BE DAMAGED if improperly operated or maintained.**

⚠ This is to alert the user of a hazard. It is usually used in a graphic.

⃠ This symbol is used in a graphic to alert the user to not do something.

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Besides the above signals words, the following words are also used to remind you of rules to be followed or to provide you with very useful information.

Note: It is followed by measures that must be taken to prevent reduction of machine service life.

Remark: It is followed by very useful information.

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⚠ WARNING

- Improper repair procedures on this machine can be hazardous and could result in serious injury or even death.
- All personnel involved with the repair of this machine must read this manual thoroughly before performing any procedures on this equipment.
- Some actions involved in the operation or repair of this machine could cause a serious accident if they are not performed in the manner described in this manual.
- All precautions outlined in this manual apply only to intended repair procedures of the machine or system. If you perform any repairs not specifically prohibited, you must be sure that it is safe for you and others. In no event should you or others engage in prohibited uses or actions as described in this manual.
- **SANY delivers machines that comply with all applicable regulations and standards of the country to which the machines have been shipped. If this machine has been purchased in another country or purchased from someone in another country, it may lack certain safety features and specifications that are necessary for use in your country. If there is any question about whether your product complies with the applicable standards and regulations of your country, contact your SANY representative before performing repairs on this machine.**

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2.2 General Shop Safety

It's important to establish good shop safety rules for everyone who enters or uses the shop area. Implementing shop safety rules will keep employees safe and provide the most productive environment for working or learning. Post rules where they can clearly be viewed at all times. If necessary, provide shop personnel with a written copy of the rules and discuss any questions or confusion with them.

Always keep in mind, shop safety is NOT something to be studied at the start of a project and then forgotten; most accidents are caused by carelessness, being in a hurry or by simply disregarding safety rules. Remember this, if you are DILIGENT and follow instructions outlined in this shop manual with care, repair operations can be safe and enjoyable. Safe work practices, should become a force of habit.

⚠ WARNING

- **Mistakes in operation are extremely hazardous. Read the Safety, Operation & Maintenance Manual that came with the machine carefully before operating the machine. Failure to follow this alert could result in serious injury or death.**

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2.2.1 Rules and shop behavior

- Study all shop rules relating to the procedure carefully and constantly apply them. When in doubt about any task, get help! DO NOT take chances.
- Know your job. It is foolish, and often disastrous, to make repairs to a machine without first receiving proper instructions. Always use the shop manual when performing any repair tasks. Get additional help if you are NOT sure what must be done or how a task should be performed.
- The shop is a place to work, not play. It is NOT a place for “horseplay”. A “joker” in a repair shop is a “walking hazard” to everyone. Daydreaming or socializing on the job also increases your chances of injury.
- If you must smoke, smoke only in the area provided for smoking. Never smoke while on the shop floor or work area.

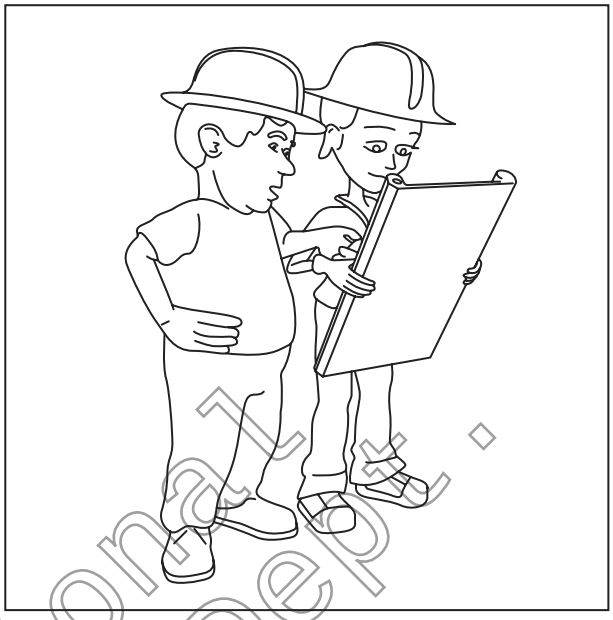


Fig. 2-2

2.2.2 Housekeeping

- Oils, grease, fuel, antifreeze or any fluid spills should be mopped up immediately. These items pose a serious slip hazard. Regardless of who was responsible for the spill, it is your job as a shop employee to secure and clean up the spill area.
- Keep the shop clean. Scrap or old parts should be disposed of properly. Never allow them to remain on the bench or shop floor.
- All equipment and tools must be put back in their proper storage areas after each use. It's imperative that you do not let a shop become cluttered and disorganized in order to prevent accidents.
- Always keep in mind, proper house cleaning is vital for a safe and pleasant work environment.

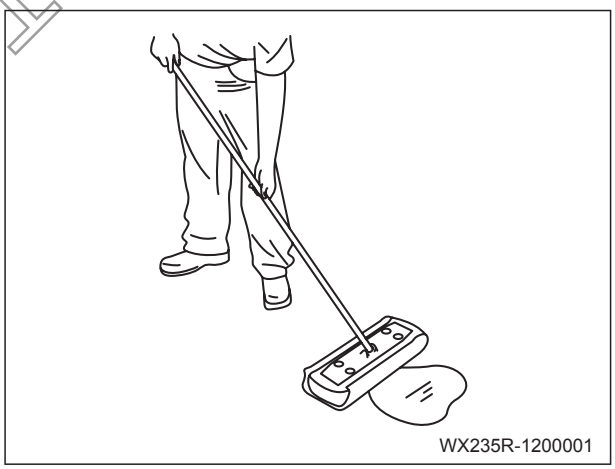


Fig. 2-1

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2.2.3 Shop Liquids Storage

- Liquids, cleaning solvents or machine fluids should be properly stored in an area away from work locations. These storage areas should be ventilated to an outdoor location to avoid any vapor accumulation in a confined shop area. Follow all OSHA regulations regarding fluid storage.
- Never leave open containers of liquids sitting around. These could spill or catch fire. Always read the container label for information on storage and handling of the liquids.
- Never store liquids in containers that are not properly labeled for that liquid. Confusion could result in equipment damage, fire or an unexpected explosion.
- Never smoke or bring open flames around liquids, doing so could result in an unexpected fire or explosion.
- Never handle liquids without using personal protective equipment. Treat all liquids with caution.

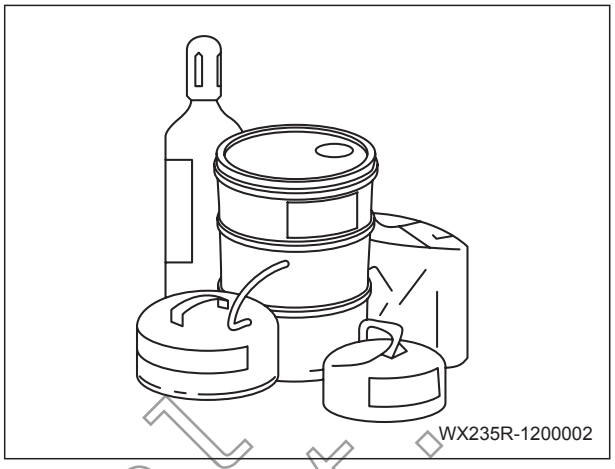


Fig. 2-3

2.2.4 Cleaning the Parts

Never use gasoline, diesel fuel or similar flammable liquids to clean parts. Always use approved non-flammable solvents to clean parts. Failure to do so could result in explosion or fire.



Fig. 2-4

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2.2.5 Cleaning the Machine

- Always use high-pressure hot water and mild, nonflammable grease-cutting soaps or cleaning agents to clean the machine parts. Never use flammable or caustic cleaning agents.
- Never use high-pressure steam cleaners to clean the machine. Steam cleaners will damage the paint, hoses or electrical system.
- Never pressure-wash or flood the inside of an operator cab. This will damage sensitive electrical components.

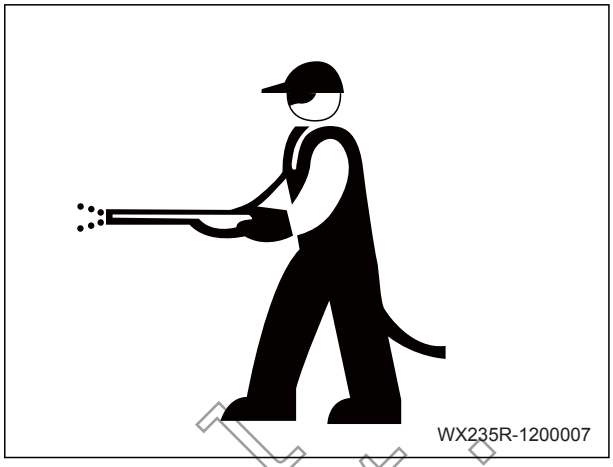


Fig. 2-5

2.2.6 Appropriate Working Apparel

Improper or loose clothing, casual dress clothing, jewelry, incorrect shoes or long hair can result in possible injury.

Make a list of the types of clothing that are not allowed in the shop area. Go over the list with personnel before they start a job.



Fig. 2-6

2.2.7 Personal Protective Equipment

If your shop specifies the use of safety equipment, OSHA requires this equipment to be used when on the shop floor or in the area where this equipment is required.

Never allow personnel in the shop area without the proper personnel protective equipment even for a moment.

Always keep personnel protective equipment in good condition and replace them as required.

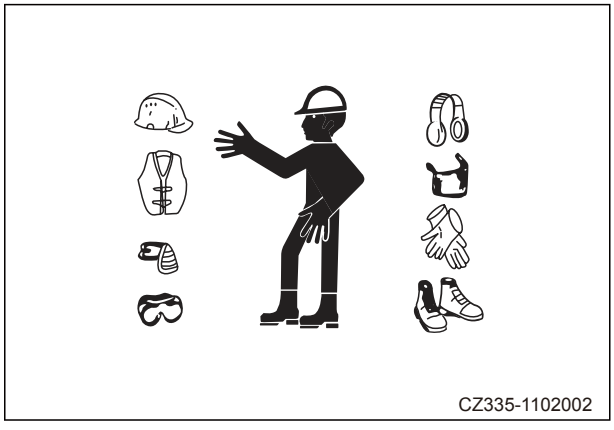


Fig. 2-7

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2.2.8 Using the Correct Tools

- Always use the proper authorized tools for the job. Using tools that are not authorized, incorrect for the job, defective or damaged could cause serious injury.
- Keep all tools in good condition, learn the correct way to use them.
- Before starting the work, thoroughly check the tools, machine, forklift, crane, service car, etc.
- Keep your tools clean, and when the job is complete, take inventory of the tools you were using to be sure no tools were left in the machine.
- Always put shop tools back in there proper storage location when finished.
- If welding repairs are needed, always have a trained, experienced or certified welder carry out the work.

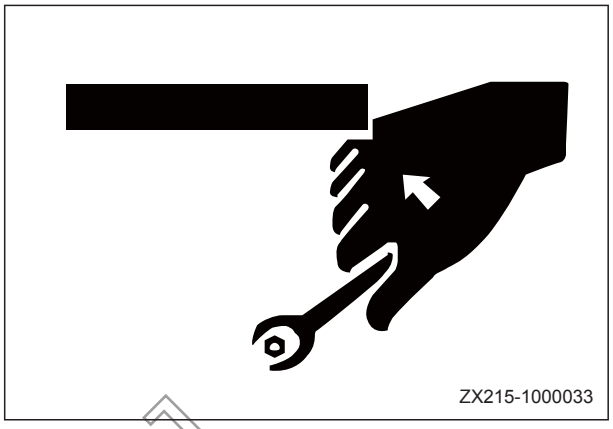


Fig. 2-8

2.2.9 Fire Extinguisher and Emergency Exits

- It is important to know where all emergency exits and fire extinguishing equipment are located if a fire should occur in the shop.
- Before preparing for work, take time and walk around the shop to make a mental note of where all exits and fire equipment are located. If you are performing repairs in the field, always have a fire extinguisher handy and within reach.
- If you do not know how to use a fire extinguisher contact someone who can instruct you in the proper use of this equipment.



Fig. 2-9

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2.2.10 Electrical Dangers

- When testing electrical circuits, always be aware of what you will be checking in these systems. High voltage or high amp circuits could damage your equipment or cause a spark, explosion or possible fire.
- Before performing any repairs or testing on an electrical system be sure of the system voltage dangers. Always check the circuit to be sure it is off before performing any repairs.
- When working around flammable liquids or explosive systems, use only approved anti-explosion proof work lamps. Non-approved work lamps can cause an explosion or fire.

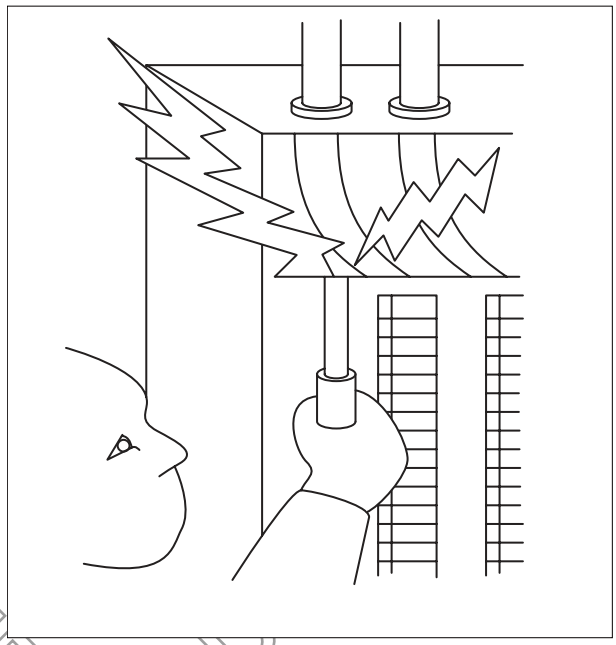


Fig. 2-10

2.2.11 Hoisting a Load

If you will be lifting parts or components that weigh more than 35 lbs (16 kg), it is important to follow some basic rules.

- Always use the appropriate lifting equipment such as hoist, crane, forklift etc. to handle a loads if possible.
- Be sure the lifting equipment is in good condition and rated for the load you are about to lift.
- If straps are to be used, ensure they are in good condition and rated for the load to be lifted with them.
- If you must lift the load by hand, keep your back straight and parallel with the load, and lift the load using your leg muscles to avoid back injuries. Always ask for a lifting assistant.

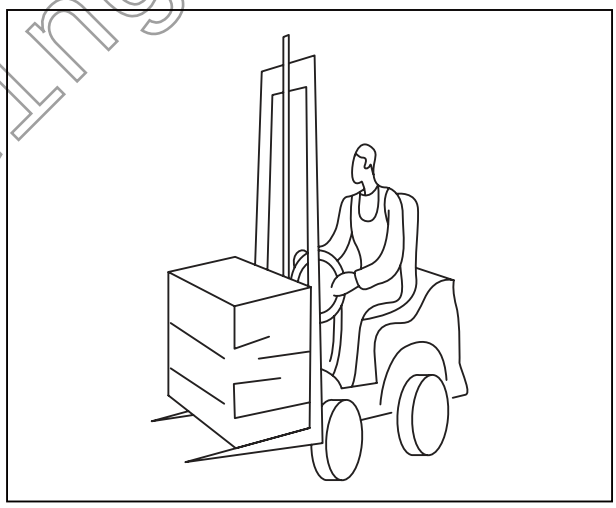


Fig. 2-11

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2.3 Before Repair

2.3.1 Safe Work Preparations

Before starting any repairs, be sure the machine is sitting on a level stable surface.

Lower all the work equipment to a safe and stable position on the ground. Turn the engine OFF and neutralize the work equipment controls by rotating them to the left and right (joystick control) or moving them back and forth (lever control). This function will relieve system pressure.

Block the tracks (if equipped) or wheels (if equipped) with chocks to prevent the machine from moving.

If equipped, set the hydraulic lock lever in the LOCKED position. If equipped, set the parking brake in the PARK position.

Be sure all personnel and equipment is clear of your work area and you can be seen by all working personnel especially if performing repairs in the field.

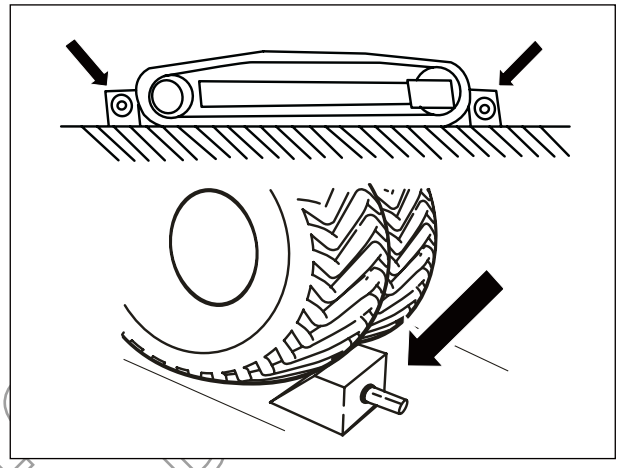


Fig. 2-12

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2.3.2 Preparing yourself

Only approved personnel can maintain or repair the machine. An observer may be assigned if necessary.

- Wear protective clothing and shoes necessary for the job.
- Wear rubber apron and rubber gloves when handling corrosive materials. Wear heavy gloves when handling wooden materials, wire ropes or sharp-edged metals.
- Wear a face shield when removing spring or elastic parts, or adding acid to battery. Wear safety hat and goggles when you weld or cut with a torch.
- Never carry out grinding, flame cutting or welding without an aspirator and ventilation equipment. If you have to weld on the machine, refer to related instructions and understand the correct operating procedure.

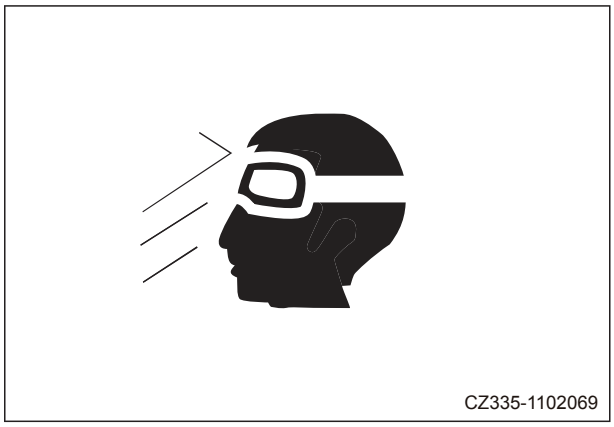


Fig. 2-13

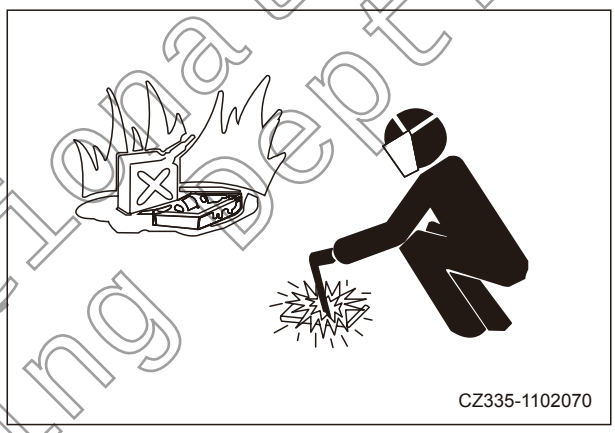


Fig. 2-14

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2.3.3 Lockout/Tagout

Due to the size and complexity of this machine, Lockout and Tagout procedures may be required by your company to ensure the safety of yourself and others involved in the repair process of the machine. While work is in progress, all power sources must be disabled, locked and tagged with a warning label. Lockout/Tagout procedure establishes the minimum requirements used to isolate all power sources from potentially hazardous energy, and to ensure that the machine is "locked out and tagged out" before anyone performs repairs on the machine.

Sequence of procedures

Only authorized employees performing repairs on the machine shall perform Lockout/Tagout in accordance with this procedure listed below.

If the employee performing repairs to the machine is issued a lock and key, the employee shall not share the lock or key with other employees until all repair procedures are complete and the machine is ready to put back into service.

The following steps shall be performed in the sequence listed when the equipment is to be either locked-out or tagged-out for repair.

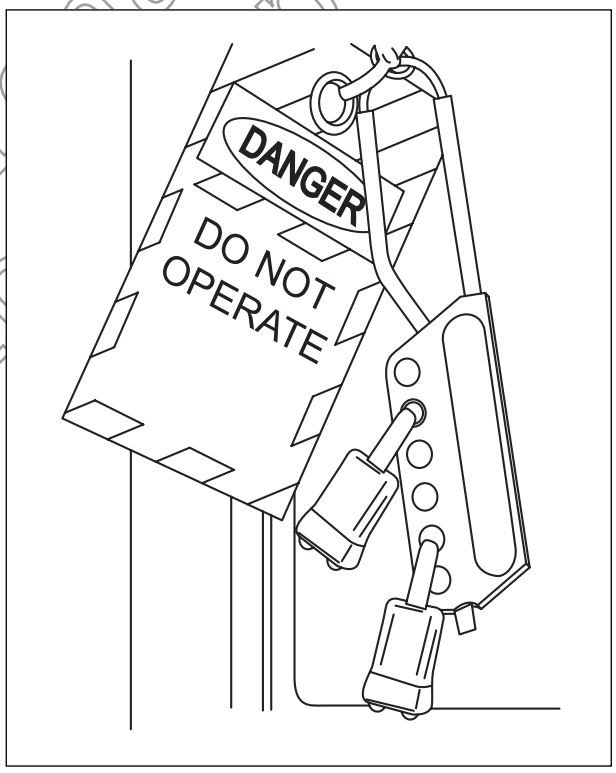


Fig. 2-15

Locking out of service

1. Notify all employees who may be potentially affected by the repair process on the machine.
2. Secure the machine in a safe position. If equipped, set the parking brake or hydraulic lock lever in the PARK or LOCKED position.
3. Identify, remove or disconnect all power

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or energy sources and be sure to install a Lockout/Tagout device on them. If the machine is equipped with a Maintenance Alert Tag, attach this tag to the machine controls.

4. Be sure all employees involved in the repairs have installed there lock on the power source before performing any repairs. Once an employee has completed there repair procedure, they must remove there lock and not access the machine in any manor.



Fig. 2-16

Returning to service

1. The authorized person who performed the Lock out/Tagout procedure shall check the area around the machine to ensure that no one is exposed to any hazard before start-up.
2. The authorized person who performed the Lock out/Tagout shall ensure that all guards have been reinstalled to their proper place, all tools and equipment have been removed and all locks are removed.
3. The authorized person who performed the Lock out/Tagout shall verify that all controls are in the neutral or "off" position and all personnel are aware of the time the machine will be back in service.
4. Remove the Lockout/Tagout equipment and any additional alert equipment and re-energize the machine for return to service.

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2.3.4 Two people when engine running

In order to prevent injury, do not perform the service while the engine is running. If the service must be performed while the engine is running, operate only when two people are on the spot and follow the regulations below:

- Always have one operator sit on the operation seat and be ready to turn off the engine at any time. All the operators must keep in touch with each other.
- Set the safety lock control lever to the lock position.
- Do not touch any control lever. If some control lever must be operated, send signal to other people and warn them to transfer to safe place quickly.
- Do not drop or insert the tools and other objects into the fan or fan belt, or the parts will be broken or thrown out.

2.3.5 Safety Partners

No one should be allowed to perform work operations in any shop alone. It should be a general shop safety rule for a minimum of two people in the shop area at all times when work procedures are performed. A person alone in the shop might not be able to get emergency help in the event of a shop accident.

When working together always maintain clear contact with each other at all times to avoid the occurrence of unexpected incidents.

When carrying out any operation with two or more workers, always agree on the operating procedures and signals before starting.

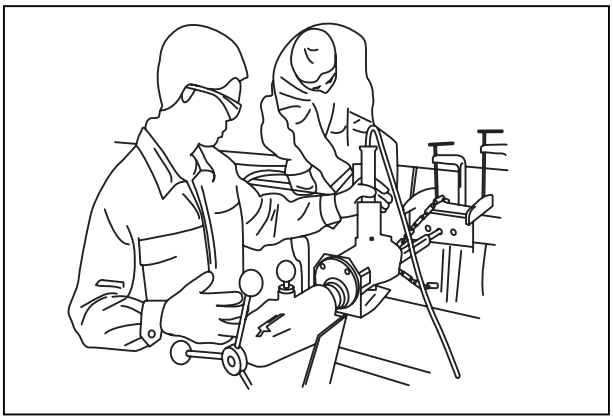


Fig. 2-17

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2.4 Repair Precautions

2.4.1 Running the Machine

Run the machine during repair procedures ONLY if directed to do so in this shop manual. If the machine must be run when making repairs, it is important to follow some basic safety rules.

- Always be aware of rotating components.
- During repair operations while the engine is running, one worker must remain in the operator seat of the machine with clear contact between the person performing the repairs on the machine at all times.
- If equipped, all lock levers must be in the LOCK position or the parking brake must be in the PARK position.
- The person in the cab must never touch any controls. If a control lever must be operated, always maintain a clear view to the person doing the repair and signal them when you are about to move the control lever.
- Be aware of hot surfaces. During running operations, most surfaces will be hot, and some surfaces will be extremely hot. If necessary, use personnel protective equipment when working around high temperature surfaces.
- Keep in mind that during running operations, hydraulic systems, cooling systems and fuel systems will be under extremely high pressure and at high temperatures.
- Always use caution when working on or near these systems.

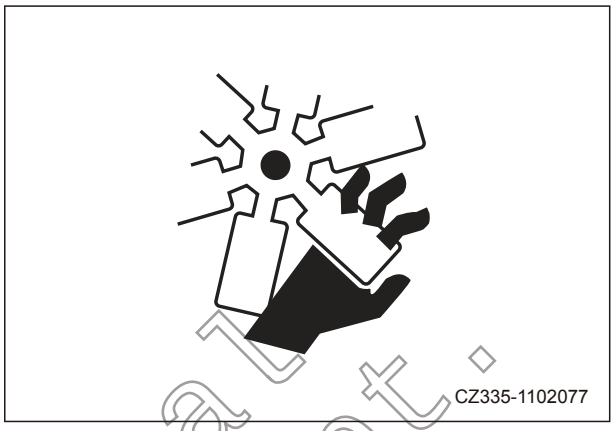


Fig. 2-18

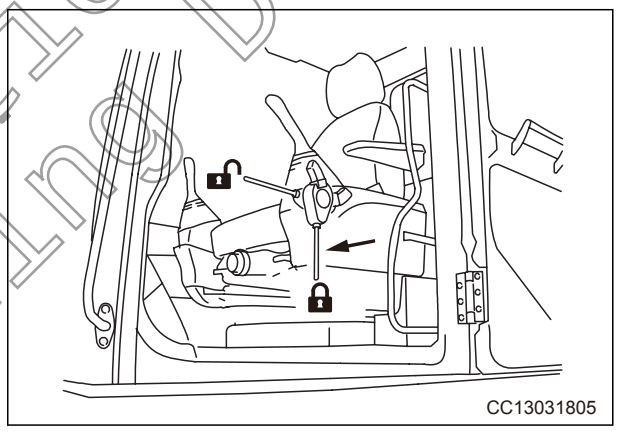


Fig. 2-19



Fig. 2-20

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2.4.2 Mounting and Dismounting

It is important to follow these procedures when mounting or dismounting the equipment:

- Use all hand-holds and step plates on your equipment.
- Never jump off or onto the equipment.
- Wipe off any oil, grease, or mud from your shoes, rails, steps or platforms before getting on the equipment; always keep these areas clean and in good condition.
- Never get on or off moving equipment. These actions may lead to serious injury. Always bring the equipment to a full stop and turn the engine OFF.
- When getting on or off the equipment, always face the equipment and maintain a three-point contact (both feet and one hand or one foot and both hands) with the handrails, steps and platforms to ensure that you support yourself correctly.
- Never climb on areas of the machine that are not designated walk areas.
- Never climb on or off the machine with tools, parts or similar objects in your hands.
- Never use machine controls or non-specified points on the equipment to get on or off the machine.
- Use all hand-holds when on the machine.

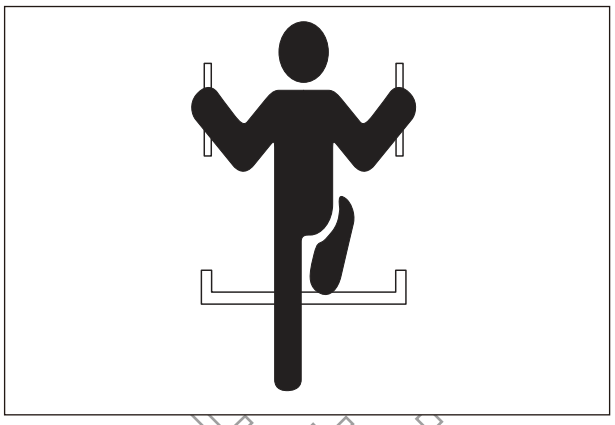


Fig. 2-21

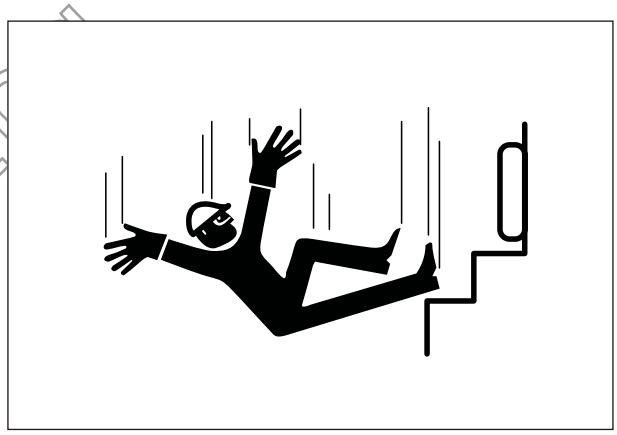


Fig. 2-22

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2.4.3 Removing Attachments

- If you will be removing large heavy attachments from the machine, always be sure to use the correct lifting equipment rated for the capacity of the load you will be lifting.
- After the attachment or part has been removed, store it where it cannot fall or move. Always be sure what you are storing is sitting stable on a stable surface and clear of all walkways or fire exits.

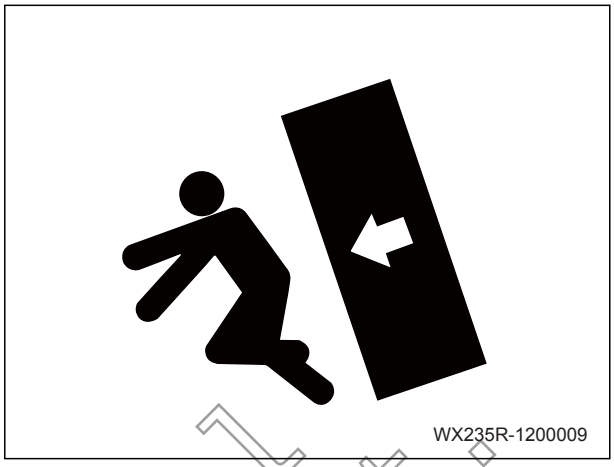


Fig. 2-23

2.4.4 Jacking Up the Machine

- If you will be working under the machine always use approved jack stands that will support the weight of the machine you are working on.
- Never rely on the hydraulics of the machine or a hydraulic jack to support the machine during repairs.
- Always lower the work equipment to the ground and check the stability of the machine before going under the machine.



Fig. 2-24

2.4.5 Adding Fluids to a System

If it should be necessary to add fluids to a system during running operations, always be aware that these systems may be hot and under high pressure.

Before adding fluids, shut the machine down and allow the systems to cool down to outdoor ambient temperatures before removing any caps. Failure to do so may result in serious burns or a sudden loss of fluid.

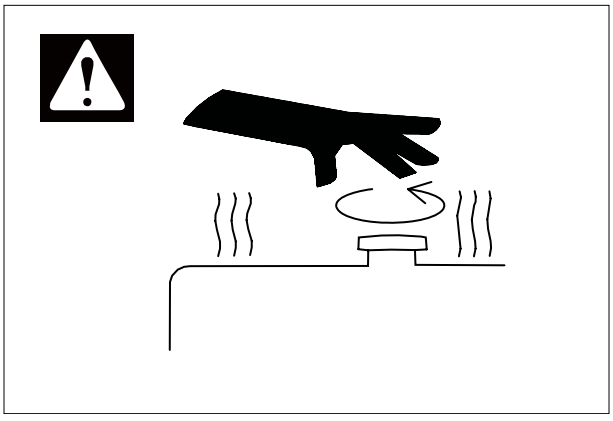


Fig. 2-25

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2.4.6 Aligning Parts or Components

- Be careful when installing or aligning parts or components.
- Avoid using your fingers or hands to position holes or part mating surfaces, serious injury could result if your hand or fingers should get ought between the surfaces.
- Always use tools to align a part or component to avoid any finger or hand injuries.

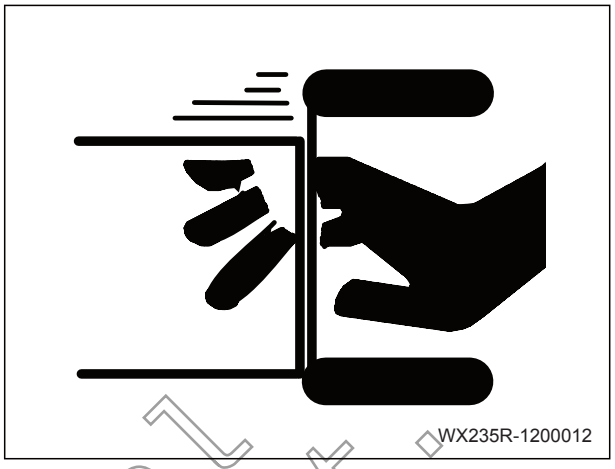


Fig. 2-26

2.4.7 Driving Pins

When using a hammer to drive pins, metal particles may fly off. This may lead to serious eye injuries. Always do the following:

- Always wear a face shield or goggles when striking a metal object with a metal hammer.
- Before performing any of these procedures, be sure all personnel are clear of your work area.
- If possible, avoid using a steel hammer to drive a component or pins in place. Damage to the component may result. Always use a soft or non-ferrous hammer to drive a component or a pin.

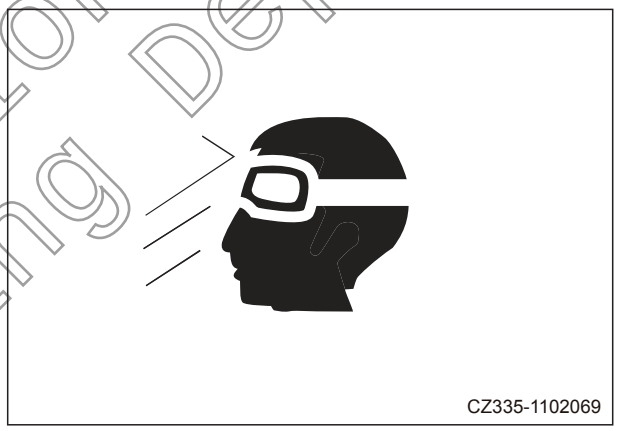


Fig. 2-27

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2.4.8 When compressed air is used

When compressed air is used for cleaning, flying particles may cause personal injury. In this case, wear goggles, dust-preventive mask, gloves and other protective gear.

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2.4.9 Welding operation

There is possibility of fire or electrocution during welding. Therefore, welding must be performed by qualified personnel with suitable equipment. Never allow other people to do the welding.

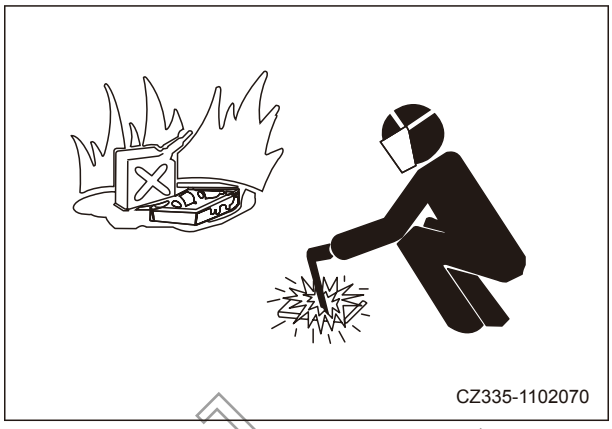


Fig. 2-28

2.4.10 Track Recoil Springs

If you are making repairs to a machine equipped with tracks, always be aware of the dangers involved with track recoil springs. This spring is under extreme pressure at all times. If it is disassembled by mistake, the spring may fly out and cause serious injury.

Be careful when removing or installing tracks on track-type machines. When removing the master track link the track system may separate suddenly and cause possible injury.

Always stand clear of the track travel path when separating the master link section of the track.

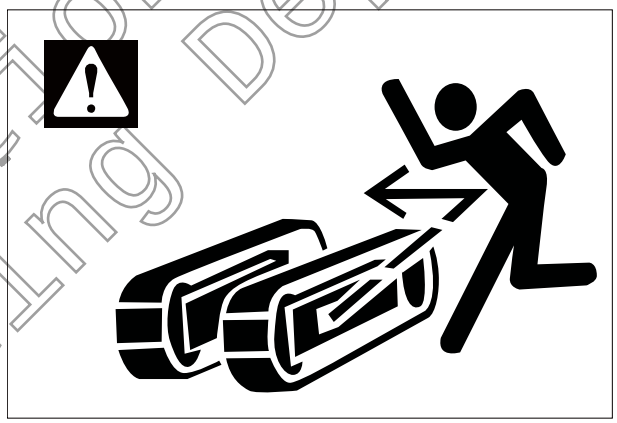


Fig. 2-29

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2.4.11 High-Pressure Fluid Lines

Always keep in mind that these systems are under high pressure. When inspecting or replacing piping or hoses, always check to be sure the pressure in the system has been relieved before proceeding. Working on a system still under pressure could lead to serious injury, always do as follows:

- If you will be removing a line or component with fluid in the system, always cap and seal the opening to avoid leakage or system contamination.
- Never carry out inspections or replace items while the system is under pressure.
- Never use any part of your body to check or feel for leaks. Always wear safety glasses and leather gloves when checking for leaks and use a piece of wood or cardboard when checking for leaks from small holes.
- If high pressure fluids should penetrate your skin or get into your eyes, seek medical attention immediately.

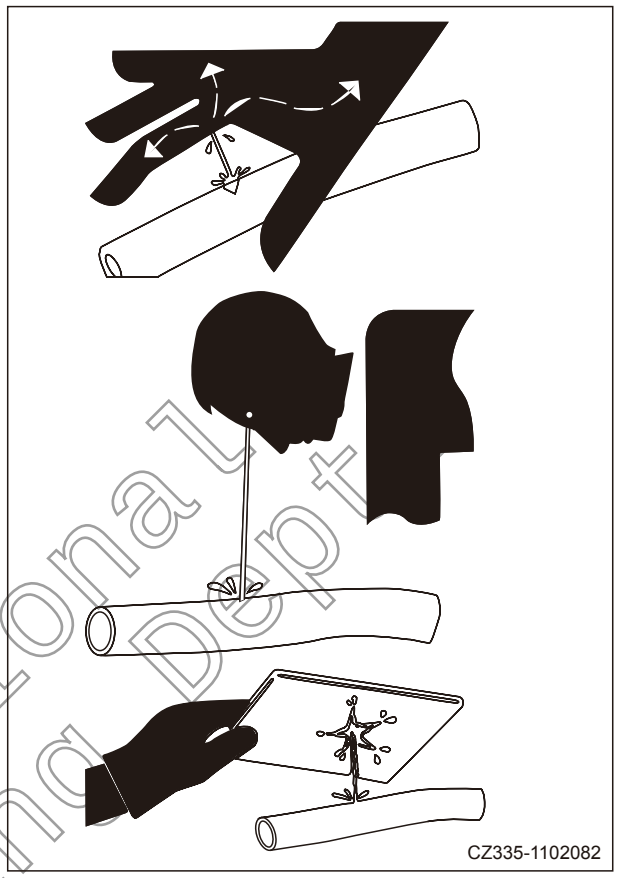


Fig. 2-30

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2.4.12 Air-conditioning system maintenance

⚠ WARNING

- **Refrigerant R134 a is a harmless gas under room temperature. It will change into highly toxic gas when burning.**
- **Refrigerant getting into eyes may cause blindness. It may cause frostbite if splashed on your skin.**

- Keep fire source away when servicing air-conditioning system.
- In maintenance of air-conditioning system, observe the instruction on the refrigerant cylinder and use it correctly. The type of refrigerant is R134a. Use of other refrigerants may damage the air-conditioning system.
- Obey local material disposal regulations. Never discharge refrigerant directly into the air.

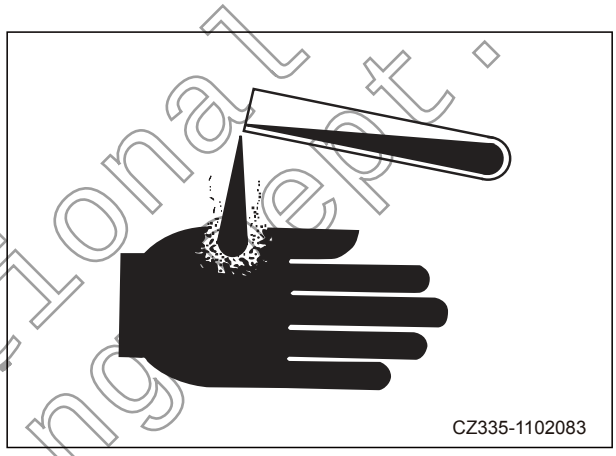


Fig. 2-31

2.4.13 High voltage precautions

You must understand the elements before testing electric circuit. High voltage or current could lead to machine damage, spark, explosion or fire.

You must know the voltage before repairing or testing electrical system. Always check the circuit and make sure it is disconnected before doing repair job.

Only explosion-proof light can be used when you work near flammable fluids or explosive system. Unapproved illumination equipment could lead to explosion or fire.



Fig. 2-32

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2.4.14 Disconnecting the System Power

Before starting any repair operations, remove the battery leads from the battery or set the main disconnect on the machine in the OFF position.

For the location of the machine main electrical disconnect switch, refer to the machines Safety, Operation & Maintenance Manual for location and procedures.

If the battery must be disconnected, remove the negative (-) terminal clamp first then remove the positive (+) clamp last.

When reconnecting the battery, be sure every electrical system switch is in the OFF position, connect the positive clamp (+) first, then the negative clamp(-) last.

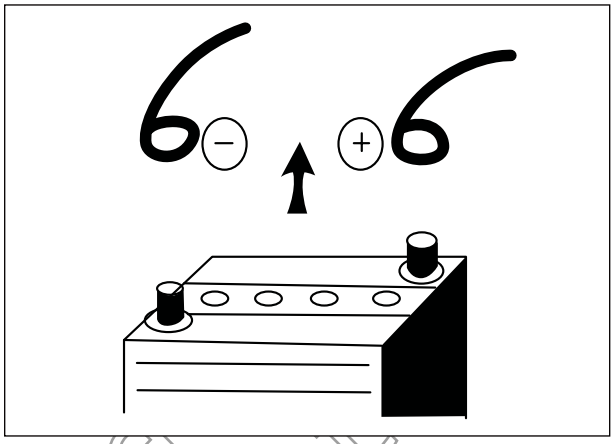


Fig. 2-33

2.4.15 Accumulator

If the machine is equipped with an accumulator charged with high-pressure nitrogen gas, it is important to follow these basic precautions.

- Do not disassemble the accumulator.
- Never expose the accumulator to high heat or open flames.
- Never weld on the accumulator.
- Never drill or cut on the accumulator.
- Never strike the accumulator.
- Use only nitrogen gas to charge the accumulator. Unapproved gases could be explosive.



Fig. 2-34

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2.4.17 Battery Hazards

Working around batteries always poses a hazard, especially if the battery has been in service for a long period of time.

Listed below are some basic precautions to be aware of when servicing or working around batteries.

- Always wear personal protective equipment when working around batteries.
- Battery gasses are extremely explosive. When opening a battery compartment, always allow ample time for the gasses to escape before servicing the battery.

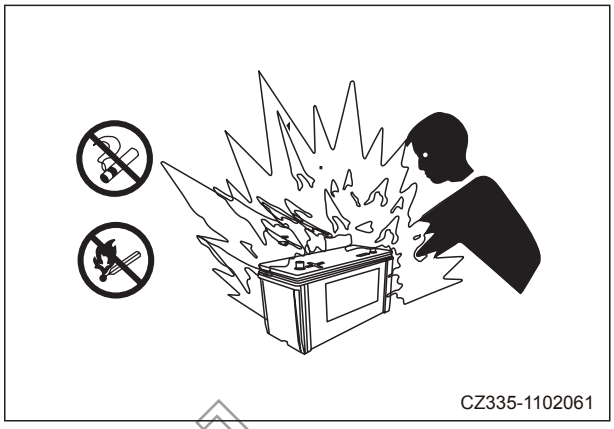


Fig. 2-35

- When working with batteries, always work in a well ventilated area.
- If the battery is corroded, flush the area with a baking soda and warm water mix.

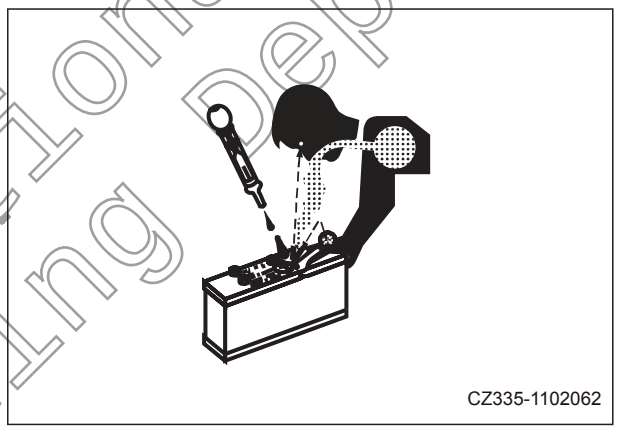


Fig. 2-36

- If battery acid should get on your skin or in your eyes, flush the area immediately with fresh water and seek medical attention.

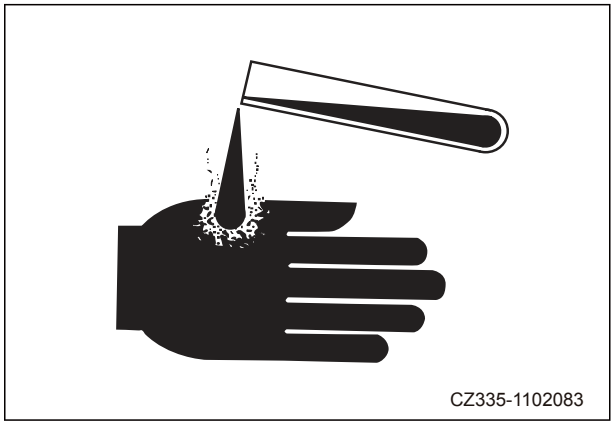


Fig. 2-37

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2.4.18 Jump-Start Safety

⚠ CAUTION

- **Never use a welder or a machine with a higher voltage system to jump-start the machine. Doing so may damage the machine's electrical system or cause an unexpected explosion or fire resulting in minor or major injury.**

When using jumper cables to start the machine, connect the positive (+) jumper first, then the negative (-) jumper to a remote location on the chassis away from the battery.

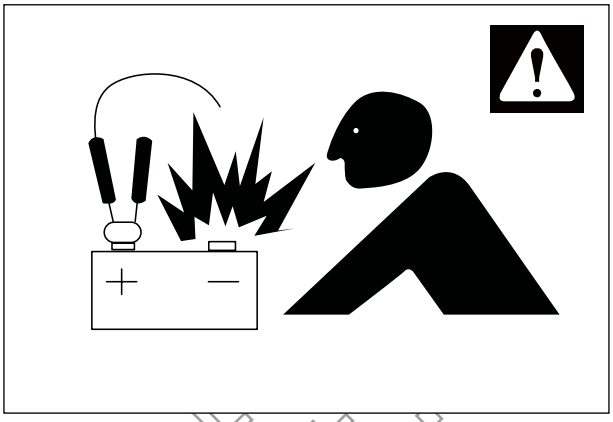


Fig. 2-38

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2.4.19 Avoiding fire and explosion

⚠ WARNING

- **Never smoke when handling the fuel or maintaining the fuel system. The gases in empty fuel tank can cause explosion easily. Never carry out flame-cutting or welding operation on fuel pipe, fuel tank or fuel vessels, which can lead to fire, explosion, injury or death.**

- Then engine must be shut down and electrical equipment must be switched off when refueling the tank. Be extremely careful when adding fuel to a hot engine. No sparks shall occur around the grounding nozzle.
- Handle all solvents and dry chemicals in a place with good ventilation according to the steps indicated on vessel.
- Clean the machine of all dust and residuals. Never place greasy rag or other flammable materials on machine.
- When cleaning the parts and components, use nonflammable solvents instead of gasoline, diesel oil or other flammable fluids.
- Store flammable liquids and materials in suitable vessels as required by safety laws and regulations.
- Check fire extinguishers, fire-fighting system and fire detectors (if equipment) and make sure they are ready for use.



Fig. 2-39

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2.4.20 Chemical hazard

Exposure to hazardous chemicals pose a serious danger if released or mishandled. Handling hazardous materials often releases substances that could pose a hazard. Temporary implication or possible residual injury may result unless proper precautions are observed while working with these materials. All workers involved in handling hazardous materials should use approved personal protective equipment and follow all environmental safety regulations.

2.4.21 Material Safety Data Sheets (MSDS)

Material Safety Data Sheet (MSDS) information relating to the materials the workers could be exposed to.

- MSDS data sheets provide both workers and emergency personnel with the proper procedures for handling or working with a particular substance. Information includes physical data, health effects, first aid, reactivity, storage, disposal and protective equipment required.
- Be sure all personnel involved are familiar with all MSDS-related information as it relates to the hazardous materials they could be exposed to. Keep MSDS data sheets handy in site of all employees and emergency personnel where they can be easily accessed.
- Never handle hazardous materials without the proper MSDS information. Always verify the data on the MSDS sheet before handling any hazardous materials.

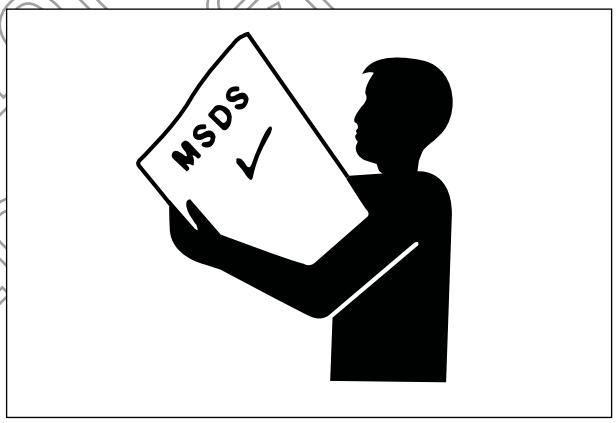


Fig. 2-40

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2.4.22 Proper disposal of wastes

Improper disposal of wastes harms the environment and ecology. Consult local environmental protection department or Sany distributors for methods of recycling and waste disposal.

- Potential harmful substances used in Sany products include hydraulic oil, fuel, cooling liquid, refrigerant, filter and batteries etc..
- Use leak-proof vessels to hold discharged fluids. Never use food or beverage containers.
- Never dump waste fluids directly to the ground, sewage or water source.
- Leaking of refrigerant from air conditioner can spoil the atmosphere of the globe. Related laws and regulations must be followed to recover or regenerate the refrigerant.

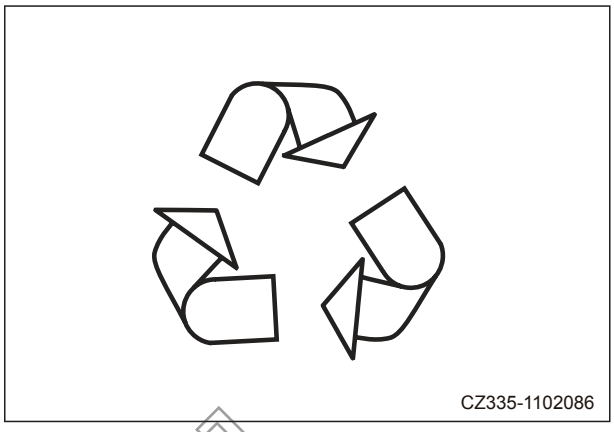


Fig. 2-41

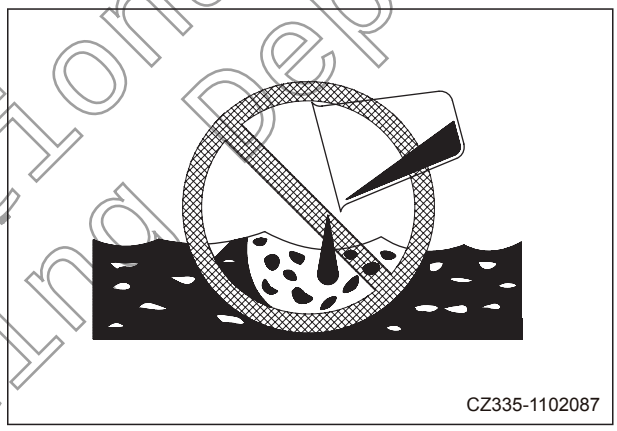


Fig. 2-42

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2.5 Other Precautions

2.5.1 Sling work and giving signals

1. Only one appointed worker is allowed to give signals and co-workers must communicate with each other frequently. The appointed signal person must give specified signals clearly at a place where he is seen well from the operator's seat and where he can see the working condition easily. The signal person must always stand in front of the load and guide the operator safely.
   - Do not stand under the load.
   - Do not step on the load.
2. Check the slings before starting sling work.
3. Always wear gloves during sling work. (Wear leather gloves, if available.)
4. Measure the weight of the load by the eye and check its center of gravity.
5. Use proper sling according to the weight of the load and method of slinging. If too thick wire ropes are used to sling a light load, the load may slip and fall.
6. Do not sling a load with 1 wire rope alone. If it is slung so, it may rotate and may slip out of the rope. Install 2 or more wire ropes symmetrically.
7. Limit the hanging angle to 60°, as a rule. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with 2 or more ropes, the force subjected to each rope will increase with the hanging angle. The table below shows the variation of allowable load in kN {kg} when hoisting is made with 2 ropes, each of which is allowed to sling up to 9.8 kN {1,000 kg} vertically, at various hanging angles. When the 2 ropes sling a load vertically, up to 19.6 kN {2,000 kg} of total weight can be suspended. This weight is reduced to 9.8 kN {1,000 kg} when the 2 ropes make a hanging angle of 120 ° . If the 2 ropes sling a 19.6 kN {2,000 kg} load

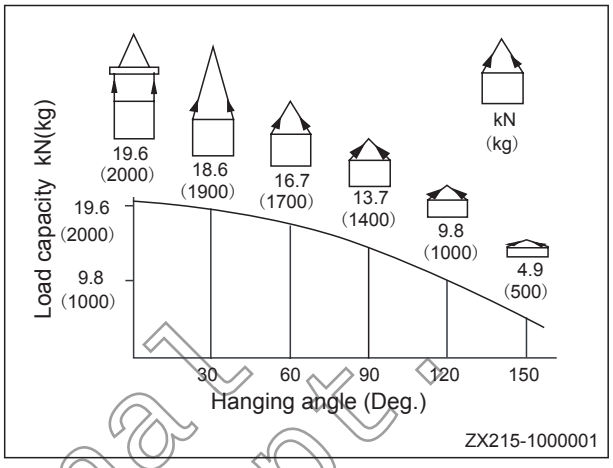


Fig. 2-43

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at a lifting angle of 150 ° , each of them is subjected to a force as large as 39.2 kN {4,000 kg}.

8. When installing wire ropes to an angular load, apply softeners to protect the wire ropes. If the load is slippery, apply proper material to prevent the wire rope from slipping.
9. Use the specified eyebolts and fix wire ropes, chains, etc. to them with shackles, etc.
10. Apply wire ropes to the middle portion of the hook.
    - Slinging near the tip of the hook may cause the rope to slip off the hook during hoisting. The hook has the maximum strength at the middle portion.
11. Do not use twisted or kinked wire ropes.
12. When lifting up a load, observe the following.
    - Wind in the crane slowly until wire ropes are stretched. When settling the wire ropes with the hand, do not grasp them but press them from above. If you grasp them, your fingers may be caught.
    - After the wire ropes are stretched, stop the crane and check the condition of the slung load, wire ropes, and softener.
    - If the load is unstable or the wire rope or chains are twisted, lower the load and lift it up again.
    - Do not lift up the load slantingly.
13. When lifting down a load, observe the following.
    - When lifting down a load, stop it temporarily at 30 cm above the floor, and then lower it slowly.
    - Check that the load is stable, and then remove the sling.

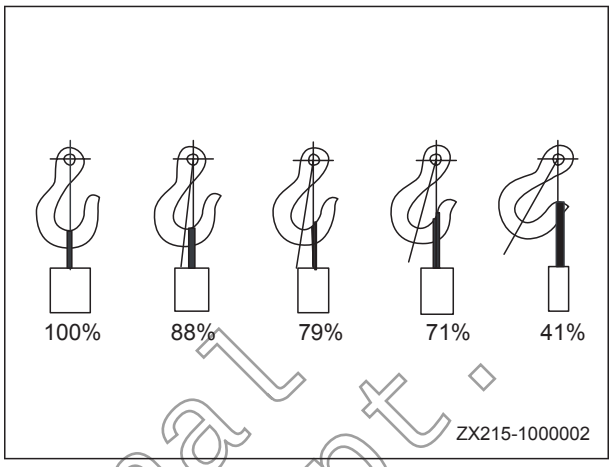


Fig. 2-44

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- Remove kinks and dirt from the wire ropes and chains used for the sling work, and put them in the specified place.

2.5.2 Using mobile crane

⚠ CAUTION

- **Read the Operation and Maintenance Manual of the crane carefully in advance and operate the crane safely.**

2.5.3 Using overhead hoist crane

1. Before starting work, inspect the wire ropes, brake, clutch, controller, rails, over wind stop device, electric shock prevention earth leakage breaker, crane collision prevention device, and power application warning lamp, and check safety.
2. Observe the signals for sling work.
3. Operate the hoist at a safe place.
4. Check the direction indicator plates (east, west, south, and north) and the directions of the control buttons without fail
5. Do not sling a load slantingly. Do not move the crane while the slung load is swinging.
6. Do not raise or lower a load while the crane is moving longitudinally or laterally.
7. Do not drag a sling.
8. When lifting up a load, stop it just after it leaves the ground and check safety, and then lift it up.
9. Consider the travel route in advance and lift up a load to a safe height.
10. Place the control switch on a position where it will not be an obstacle to work and passage.

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11. After operating the hoist, do not swing the control switch.
12. Remember the position of the main switch so that you can turn off the power immediately in an emergency.
13. If the hoist stops because of a power failure, turn the power switch OFF. When turning on a switch which was turned OFF by the electric shock prevention earth leakage breaker, check that the devices related to that switch are not in operation state.
14. If you find an obstacle around the hoist, stop the operation.
15. After finishing the work, stop the hoist at the specified position and raise the hook to at least 2 m above the floor. Do not leave the sling installed to the hook.

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2.5.4 Selecting wire ropes

Select adequate ropes according to the weight of parts to be hoisted. See the table below.

Wire Rope (Standard Z or S type of strand, ungalvanized)		
Nominal Diameter	Allowable Load	
mm	kN	t
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.5	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

⚠ CAUTION

- **The allowable load is one-sixth of the breaking strength of the rope used (Safety coefficient: 6).**

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SANY

Specifications

3 Specifications

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3.1.1 Dimension 1-3
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3 SPECIFICATIONS

3.1 Specific Dimension

3.1.1 Dimension

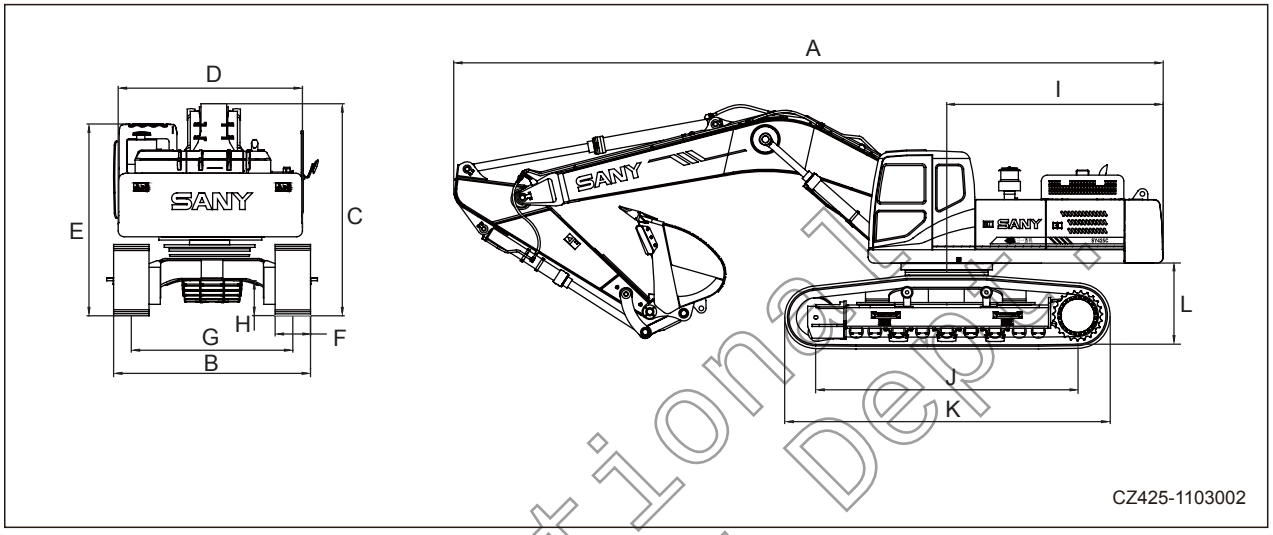


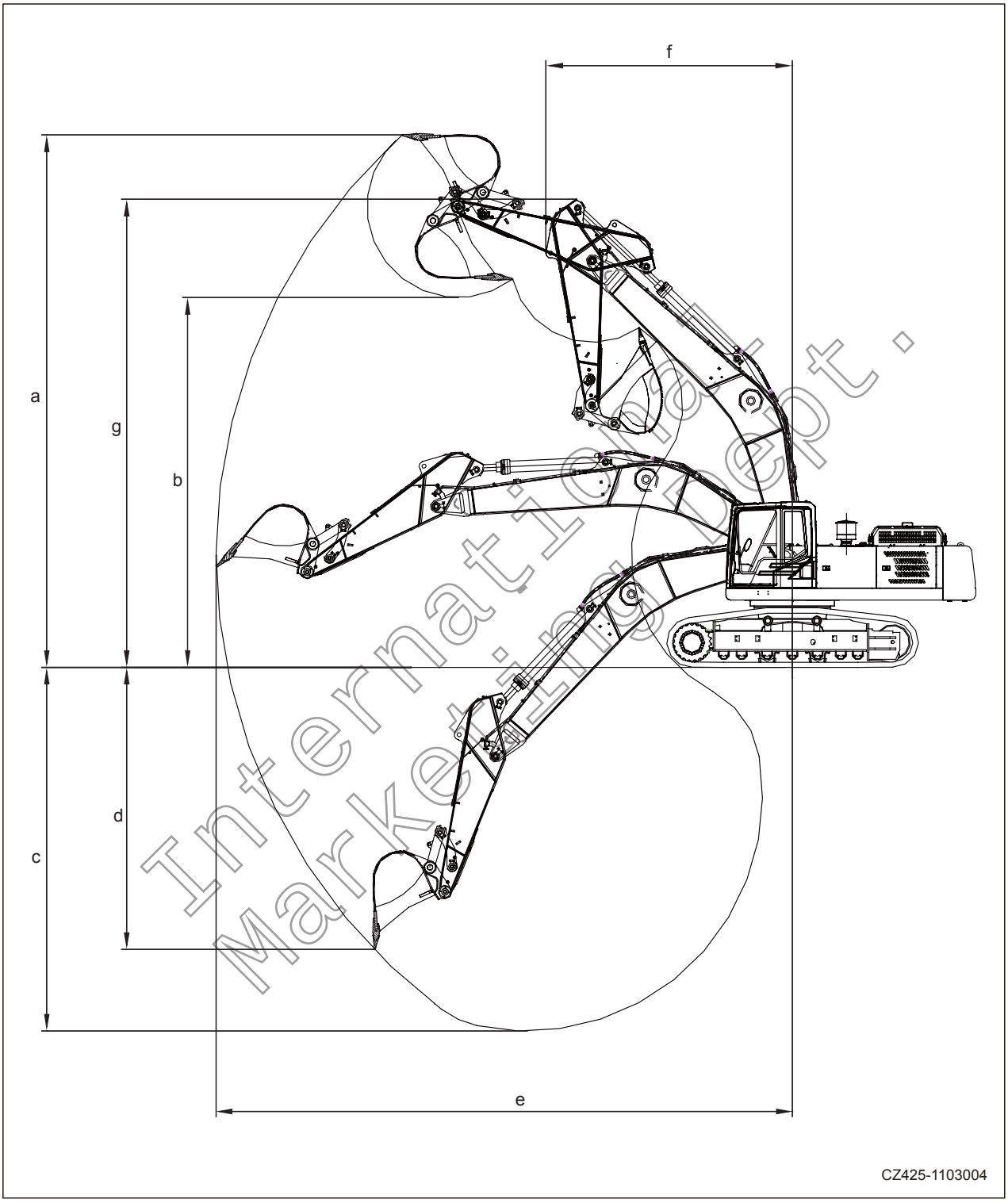
Fig. 3-1

Item		Unit	SY365H-9	SY365BH-9
A	Shipping length	mm	11,360	11,380
B	Overall width	mm	3,190	3,190
C	Shipping height	mm	3,550	3,640
D	Top width	mm	3,150	3,150
E	Overall height (to cab top)	mm	3,320	3,320
F	Standard width of track shoe	mm	600	600
G	Gauge	mm	2,590	2,590
H	Min. ground clearance	mm	550	550
I	Tail swing radius	mm	3,380	3,380
J	Track grounding length	mm	4,140	4,140
K	Track length	mm	5,065	5,065
L	Upper-structure ground clearance	mm	1,250	1,250

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3.1.2 Working ranges



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Fig. 3-2

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Item		Unit	SY365H-9	SY365BH-9
a	Max. cutting height	mm	9,900	9,850
b	Max. dumping height	mm	6,930	6,815
c	Max. digging depth	mm	7,040	6,750
d	Max. vertical wall depth	mm	5,180	4,870
e	Max. digging reach	mm	10,610	10,405
f	Min. swing radius	mm	4,330	4,300
g	Max. height at min. swing radius	mm	8,600	8,720

3.2 Technical Specifications

Item	Unit	SY365H-9	SY365BH-9
Bucket capacity	m^3	1.6（Rockwork）	1.8（Earthwork）
Operating weight	kg	35,000	35,000
Max bucket digging force	KN	235	235
Max arm-in force	KN	180	206
Swing speed	rpm	9.5	9.5
Travel speed (high/low)	km/h	5.5/3.5	5.5/3.5
Gradeability	Degree	35	35
Specific ground pressures	KPa	63	63

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Machine Model				SY365H-9			SY365BH-9		
Engine	Model			ISUZU AA-6HK1XQP-01					
	Type			6 cylinders, 4 cycles, water cooling, in-line, and direct injection					
	No. Of cylinder-bore × stroke		mm	6-Φ115mm×125mm					
	Total displacement		L	7.8					
	Performance	Rated power	kW/rpm	190.5/ 2000					
		Max. torque	N·m/rpm	873 / 1700					
		Max. speed at zero load	rpm	2200±25					
		Min. speed at zero load	rpm	1000±25					
		Min. fuel consumption	g/kWh	237					
	Start motor			24V/5kW					
	Alternator			24V/50A					
Undercarriage	Carrier roller (each side)			2					
	Track roller (each side)			9					
	Track shoe (each side)			49					
Hydraulic system	Hydraulic pump	Type		KAWASAKI (two variable swash plate plunger pumps, constant power control and proportional solenoid valve)					
		Max main pump delivery	L/min	2×158					
		Main safety valve pressure	Mpa	34.3					
	Control valve	Type X No.		KMX32NA/P45001×1					
		Control method		Hydraulic type					
	Hydraulic motor	Travel motor		Angle type variable plunger motor A6VE107HZ3/63W-VZL22XB-S Planetary gear reducer F80/121/OM/MB (Including brake valve and parking brake)×2					
		Swing motor		Angle type plunger motor - planetary gear reducer (upright) M5×180CHB-10A-3NA/265 - RG20D25G2-140 (Swing stop controller)×1					
	Hydraulic cylinder	Type		Boom	Arm	Bucket	Boom	Arm	Bucket
				Reciprocal plunger			Reciprocal plunger		
		Cylinder inner diameter	mm	140	170	140	140	160	140
		Piston rod diameter	mm	100	120	100	100	110	100
		Stroke	mm	1420	1748	1135	1480	1685	1748
	Hydraulic tank			Closed type					
	Hydraulic oil filter element			Tank return side					
	Hydraulic oil cooler			Air-cooling type					

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3.3 Weight Table

Unit: kg

Machine Model	SY365H-9	SY365BH-9
Engine	720	720
Radiator assembly	118	118
Hydraulic tank assembly (excluding hydraulic oil)	234	234
Fuel tank assembly (excluding fuel)	235	235
Swing platform	3040	3040
Operator station	150	150
Operator seat & console	76	76
Counterweight	6800	6800
Hydraulic pump	186	186
Main control valve	380	380
Swing reducer assembly	422	422
Travel reducer assembly	389×2	389×2
Swivel joint	45	45
Track frame Swing bearing Idler Tensioning device Carrier roller Track roller	4612 544 175×2 190×2 35×4 44×18	4612 544 175×2 190×2 35×4 44×18
Boom assembly	2574	2574
Arm assembly	1165	1200
Bucket assembly	1620	1582
Boom cylinder assembly	264×2	264×2
Arm cylinder assembly	484	484
Bucket cylinder assembly	150	150
Connecting rod	114	105
Rocker arm	35×2	40×2

Note: The weight table is only used as a reference for handling the components or transporting the machine.

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3.4 Engine oil, Fuel and Coolant

Reservoir	Liquid type	Ambient temperature
		-22 -4 14 32 50 68 86 104 122 °F
		-30 -20 -10 0 10 20 30 40 50°C
Engine oil pan	Engine oil	SAE 30 / SAE 10W / SAE 10W-30 / SAE 15W-40
Carrier roller	Engine oil	SAE 30
Idler	Engine oil	SAE 30
Track roller	Engine oil	SAE 30
Swing drive	Gear oil	
Final drive	Gear oil	
Hydraulic system	Engine oil	SAE 10W / SAE 10W-30 / SAE 15W-40
Hydraulic system	Hydraulic oil	HDZ32 low temp, wear-resistant / HDZ46 wear-resistant / HDZ68 wear-resistant
Fuel tank	Diesel oil	GB252 super 0# / GB252 super -20# / GB252 super -35#
Grease fitting	Grease	NLGI No.2
Cooling system	Coolant	TEEC-L35 antifreeze

Note: 1) Sany recommends using API CF-4 or above, not lower than API CD.

2) Sany recommends using gear oil GL-5.

3) To ensure oil quality, always buy genuine oil from Sany or your Sany distributor.

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3.5 Engine Performance Curves

AA-6HK1XQP-01

Test condition:

1. Temperature 298K, one standard atmospheric pressure.

2. Maximum output power: 183.9KW (with fan); 190.5KW (without fan)

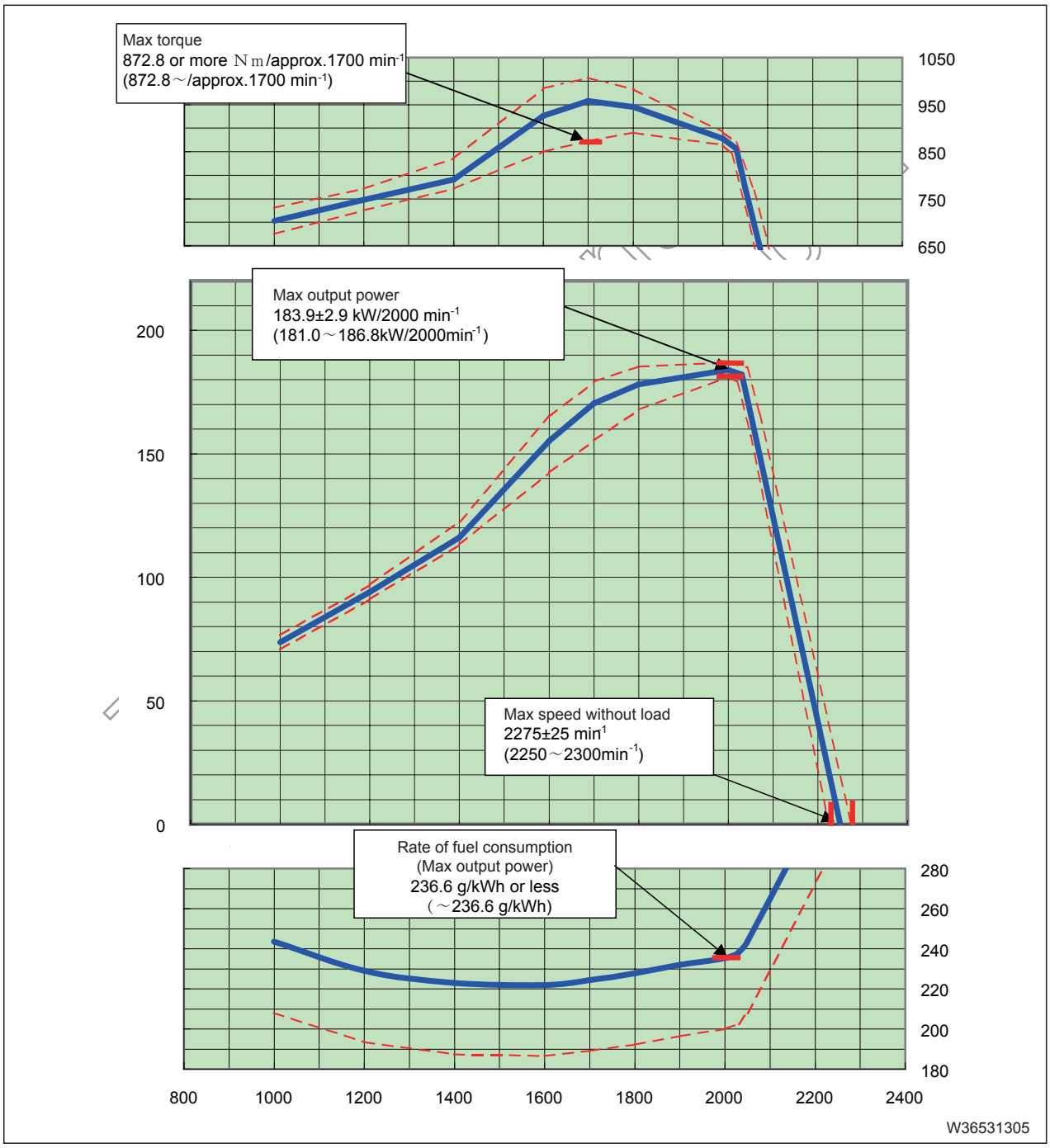


Fig. 3-3

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SANY

Structure and Functions

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4 Structure and Functions

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4 STRUCTURE AND FUNCTIONS

4.1 Engine and Cooling System

4.1.1 Engine-related parts

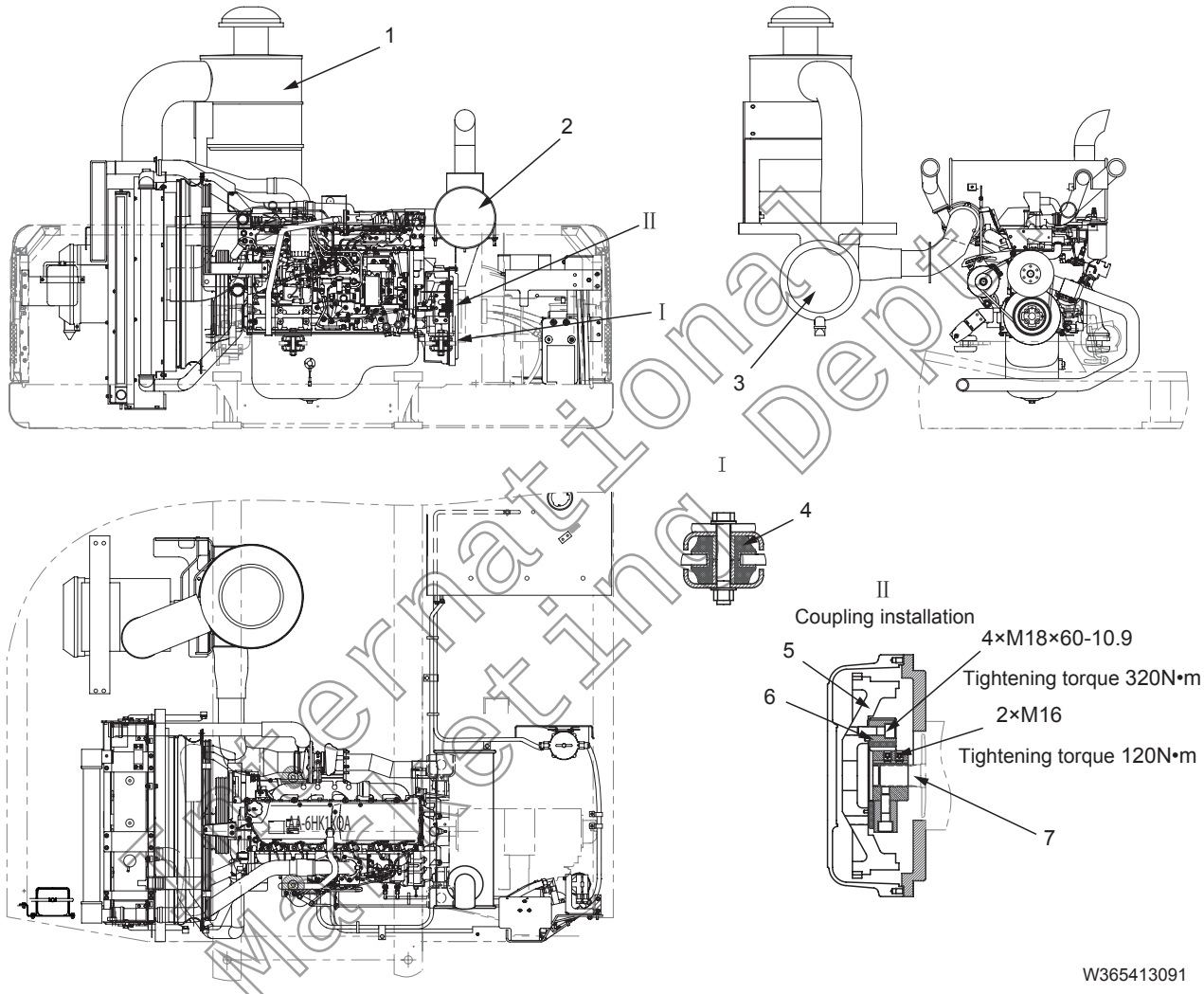


Fig. 4-1

(1) Air cleaner
(2) Muffler AS
(3) Air cleaner
(4) Damper
(5) Flywheel
(6) Coupling
(7) Plunger pump

Specification

Engine oil capacity: 35 L

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4.1.2 Radiator and intercooler

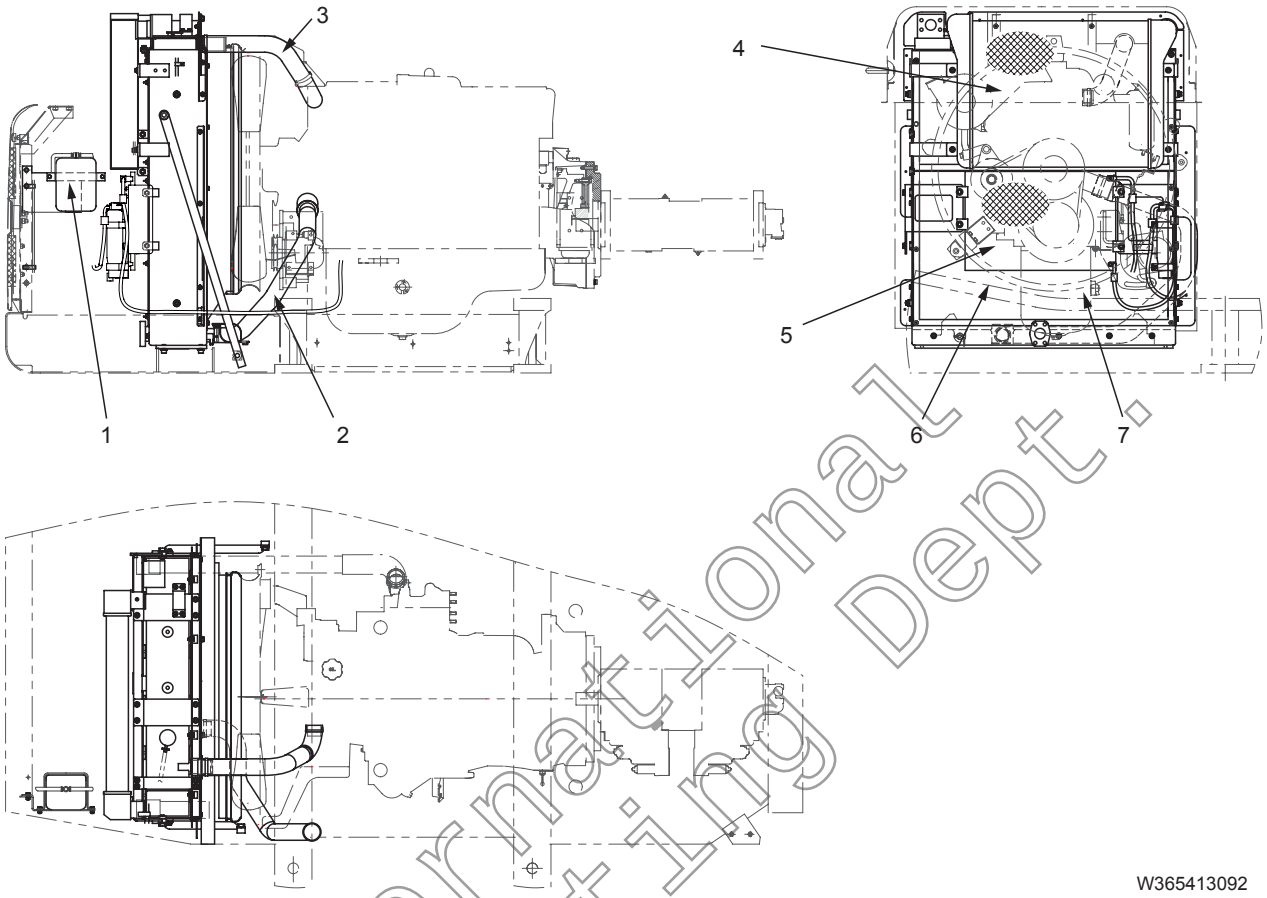


Fig. 4-2

(1) Coolant tank
(2) Water inlet pipe
(3) Water outlet pipe
(4) Air intercooler
(5) Condenser
(6) Oil radiator
(7) Water radiator

Specification

Radiator AS: H1260×460×1100-S105Y100Z30

Aluminum ribbon-tublar radiator

Tank capacity: 8.4 L

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4.2 Power Train

4.2.1 Overview

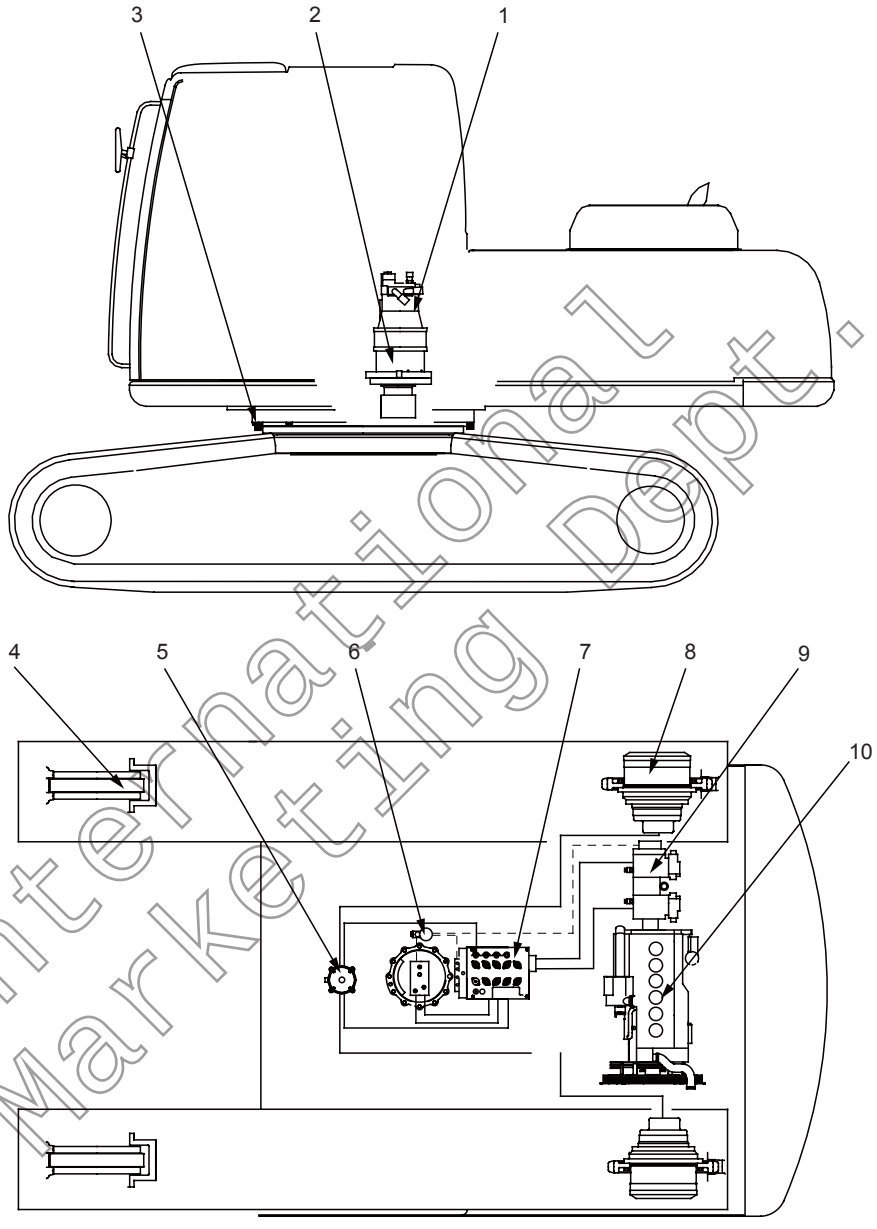


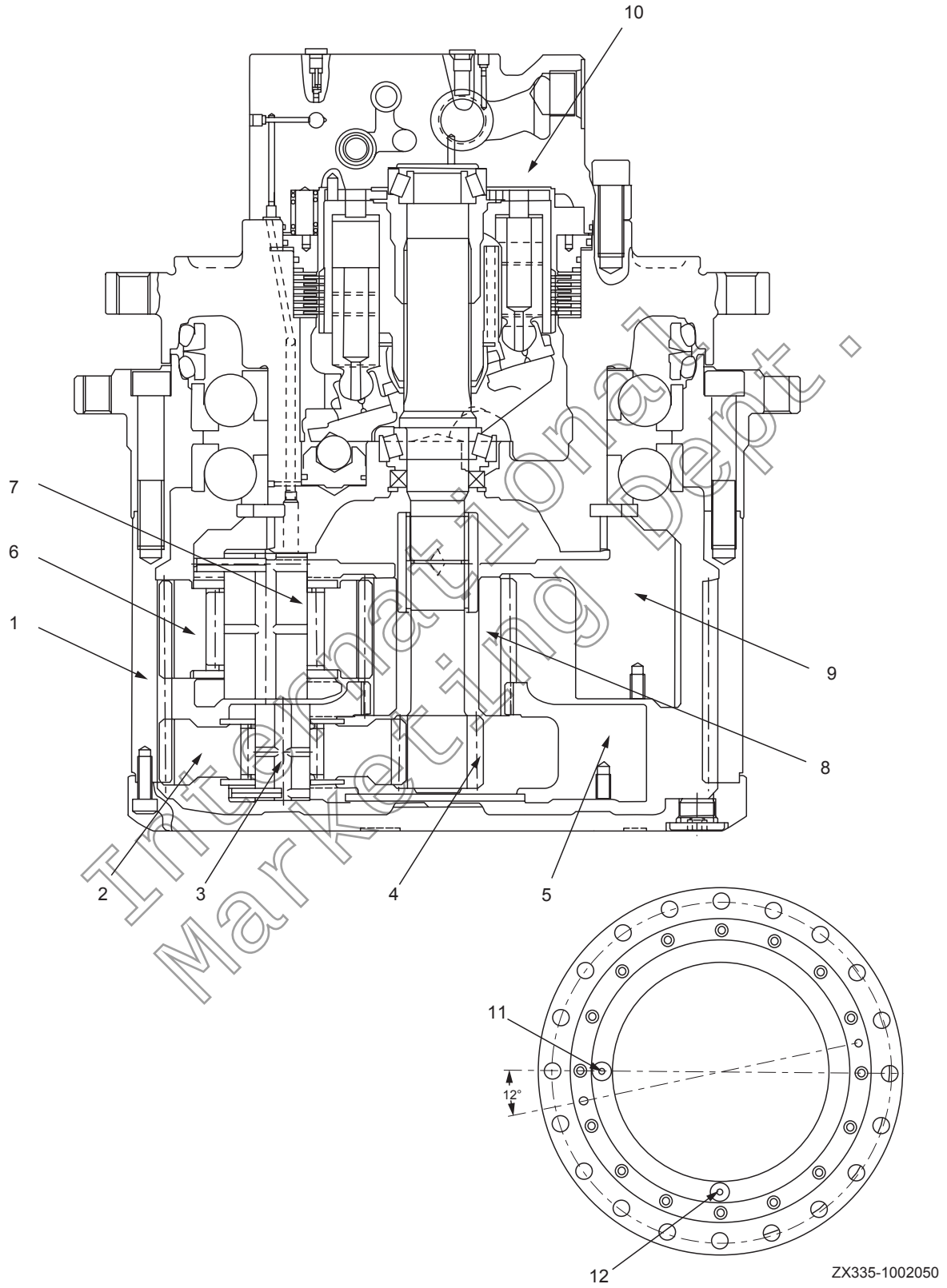
Fig. 4-3

(1) Swing motor (M5×180CHB-10A-3NA/265)
(2) Swing reducer (RG20D25G2-140)
(3) Swing bearing
(4) Idler
(5) Swivel joint
(6) Accumulator
(7) Main control valve (KMX32NA/P45001)
(8) Travel reducer (F80/121/OM/MB)
(9) Plunger pump (K5V160DTH1×4R-9T06-V)
(10) Engine (AA-6HK1XQP-01)

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4.2.2 Travel reducer AS



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Fig. 4-4

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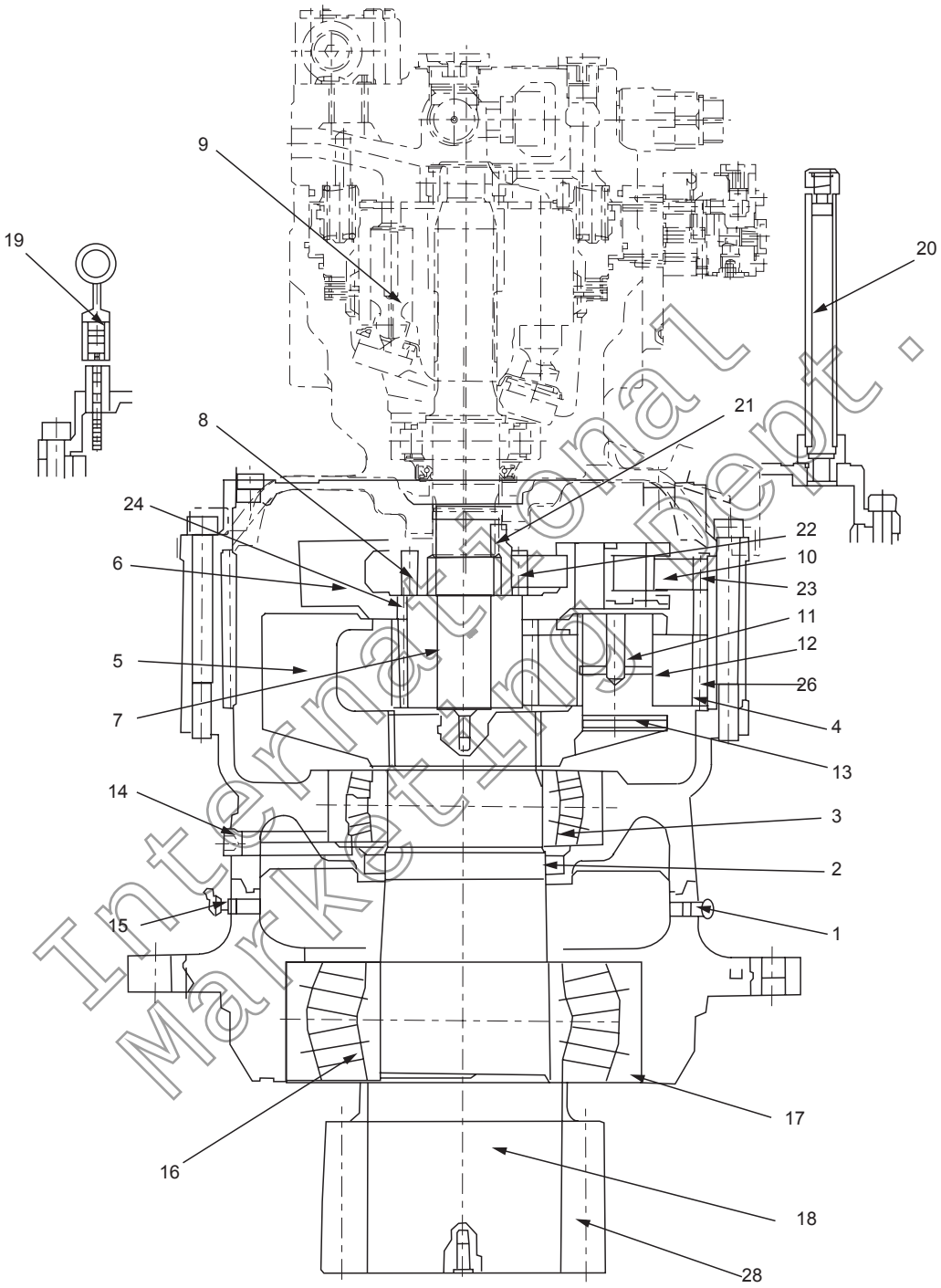
(1) Gear hub
(2) No.1 planetary gear
(3) No.1 planetary carrier pin
(4) No.1 sun gear
(5) No.1 planetary carrier
(6) No.2 planetary gear
(7) No.2 planetary carrier pin
(8) No.2 sun gear
(9) No.2 planetary carrier
(10) Motor
(11) Check port
(12) Filler/drain port

No.	Check item	Criteria		Remedy
13	Clearance between No.2 planetary gear and gear hub	0.100 ~ 0.356	1.10	Replace
14	Clearance between No.1 planetary gear and gear hub	0.133 ~ 0.386	1.00	
15	Clearance between No.1 sun gear and No.1 planetary gear	0.05 ~ 0.286	1.10	
16	Clearance between No.2 sun gear and No.2 planetary gear	0.076 ~ 0.304	1.00	

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4.2.3 Swing reducer mechanism



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Fig. 4-5

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(1) Plug
(2) Oil seal
(3) Self-aligning bearing
(4) Gear ring (teeth: 66)
(5) No.2 planetary carrier
(6) No.1 planetary carrier
(7) No.2 sun gear (teeth: 18)
(8) No.1 sun gear (teeth: 15)
(9) Swing motor
(10) No.1 planetary gear (teeth: 25)
(11) No.2 planetary gear GP
(12) No.2 planetary gear (teeth: 23)
(13) Spring pin
(14) Screw plug
(15) Grease fitting
(16) Self-aligning bearing
(17) Bearing seal
(18) Pinion gear
(19) Dipstick
(20) Oil-filling tube

Specification

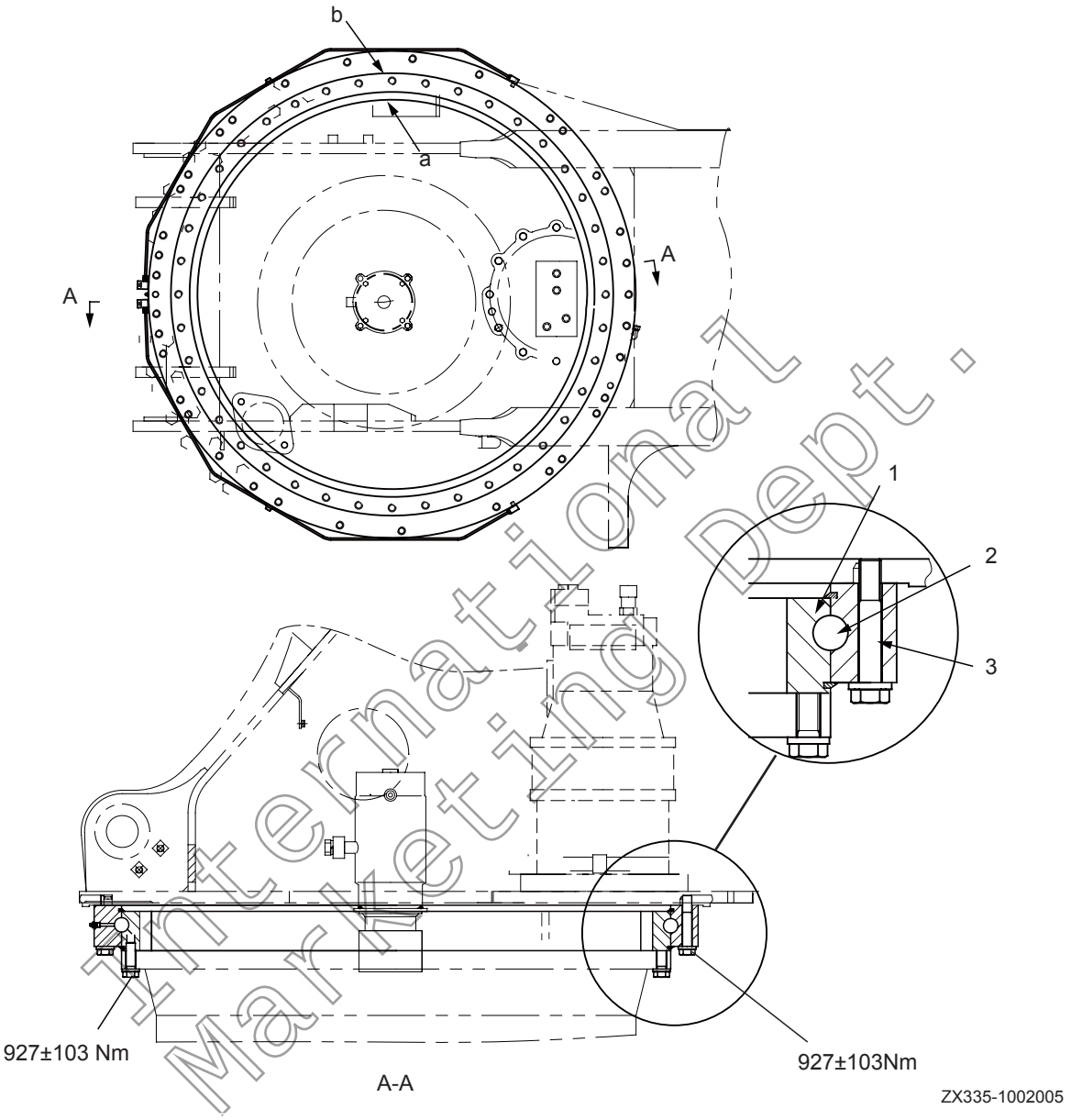
Reduction ratio: 25.2

No.	Check Item	Criteria		Remedy
21	Clearance between swing motor shaft and No.1 sun gear	Standard clearance	Clearance limit	Replace
		0.18- 0.28	—	
22	Clearance between No.1 sun gear and No.1 planetary gear	0.16- 0.50	1.00	Replace
23	Clearance between No.1 planetary gear and gear ring	0.18- 0.59	1.10	
24	Clearance between No.1 planetary carrier and No.2 sun gear	0.39- 0.71	1.20	
25	Clearance between No.2 sun gear and No.2 planetary gear	0.16- 0.50	0.90	
26	Clearance between No.2 planetary gear and gear ring	0.18- 0.59	1.00	
27	Clearance between No.2 planetary carrier and swing pinion gear	0.07- 0.23	—	
28	Clearance between swing pinion gear and swing bearing	0.22- 1.32	2.00	

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4.2.4 Swing bearing



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Fig. 4-6

(1) Inner race (teeth: 78)
(2) Steel ball
(3) Outer race

Specification

Reduction ratio: 78/11= 7

Grease volume filled: 27±1 Kg

a. Location S (soft zone of inner race)

b. Location S (soft zone of outer race)

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Check Item	Criteria		Remedy
Bearing axial clearance (Mounted on chassis)	Standard clearance	Clearance limit	Replace
	0.5-1.6	3.2	

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4.3 Undercarriage Travel System

4.3.1 Track frame and tensioning mechanism

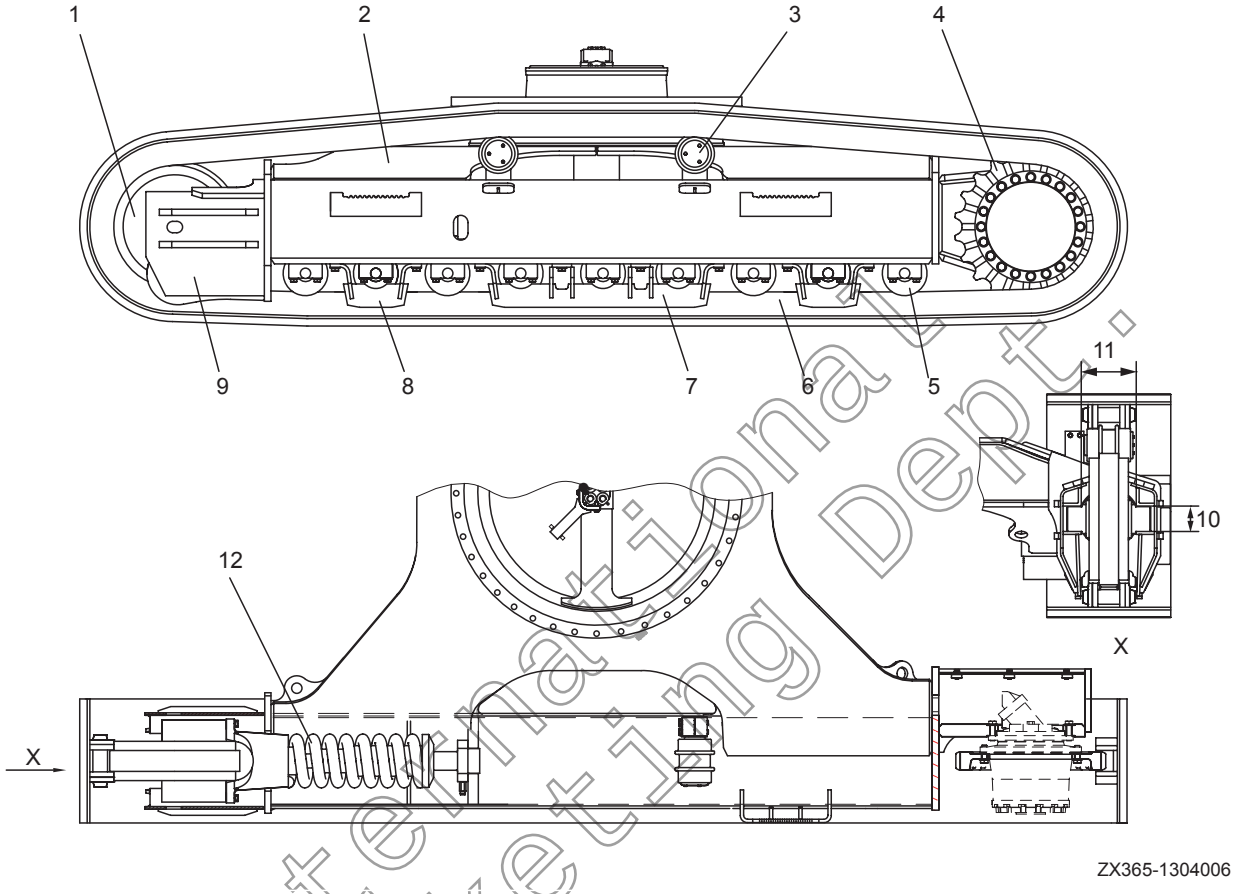


Fig. 4-7

(1) Idler
(2) Track frame
(3) Carrier roller
(4) Sprocket
(5) Track roller
(6) Track
(7) Long guard
(8) Short guard
(9) Guide seat

- Dimension and number of track rollers may vary depending on the machine model, but their basic structures are the same.
- Number of track rollers on one side: 9

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Unit: mm

<table>
<tr><th>No.</th><th>Check Item</th><th colspan="5">Standard</th><th>Remedy</th></tr>
<tr><td rowspan="3">10</td><td rowspan="3">Vertical width of idler guide</td><td colspan="2"></td><td>Standard size</td><td>Tolerance</td><td>Repair limit</td><td rowspan="5">Build-up welding or replace</td></tr>
<tr><td colspan="2">Track frame</td><td>123</td><td>+3
-1</td><td>—</td></tr>
<tr><td colspan="2">Idler support</td><td>120</td><td>±0.5</td><td>—</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">Horizontal width of idler guide</td><td colspan="2">Track frame</td><td>266</td><td>+4
-1</td><td>—</td></tr>
<tr><td colspan="2">Idler support</td><td>261</td><td>0
-0.5</td><td>—</td></tr>
<tr><td rowspan="3">12</td><td rowspan="3">Tension spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length × Outer diameter</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>1225x 262</td><td>655</td><td>{21280kg}
208.5KN</td><td>795</td><td>—</td></tr>
</table>

Standard track shoe

Model / Item	SY365H-9/SY365BH-9
Shoe width (mm)	600
Link pitch (mm)	216
Number of track shoes on one side	49

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4.3.2 Idler

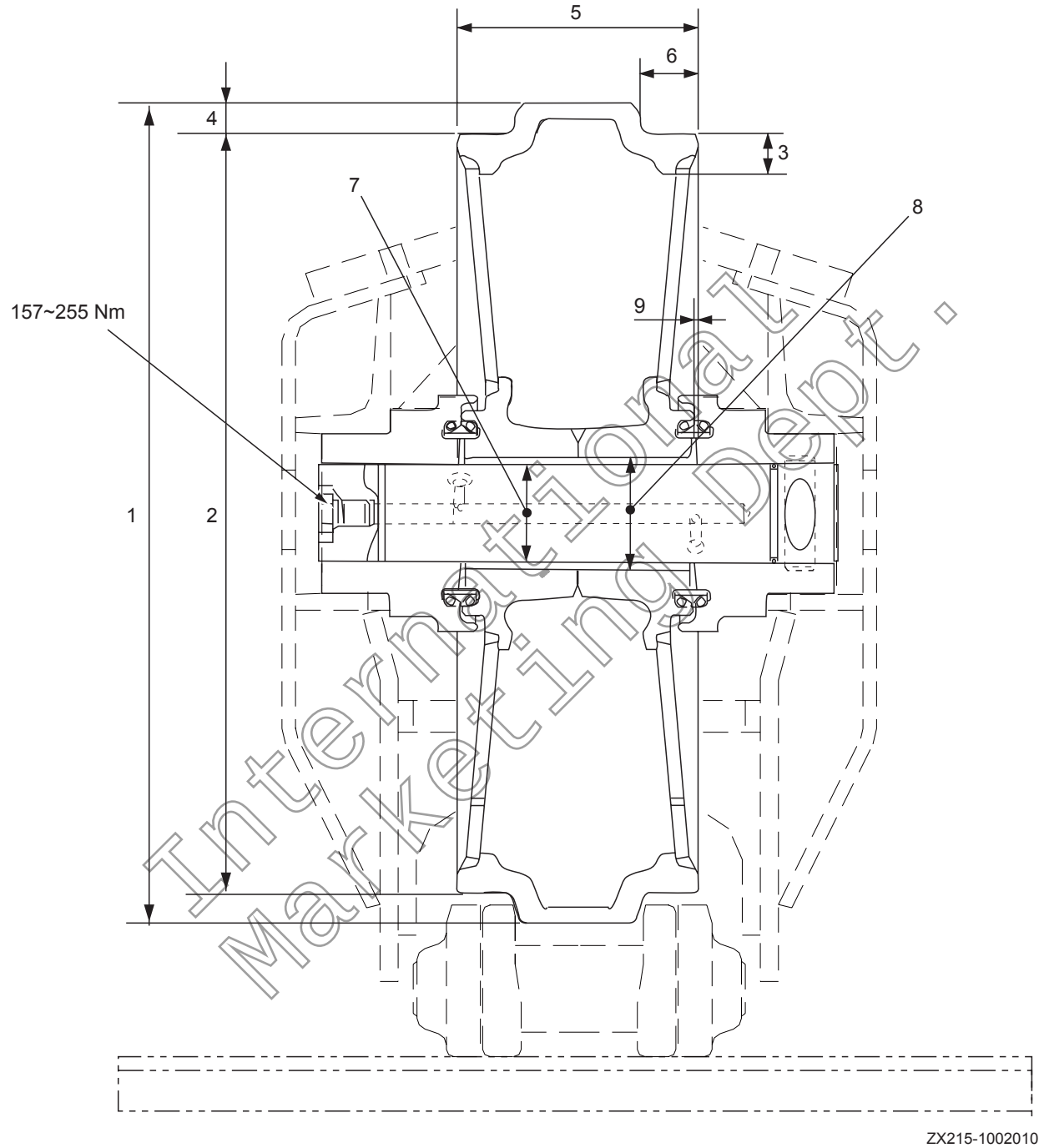


Fig. 4-8

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Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Protrusion outer dia.</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="7">Build-up welding or replace</td></tr>
<tr><td colspan="2">635</td><td colspan="3">—</td></tr>
<tr><td>2</td><td>Tread outer dia.</td><td colspan="2">590</td><td colspan="3">578</td></tr>
<tr><td>3</td><td>Tread thickness</td><td colspan="2">30</td><td colspan="3">24</td></tr>
<tr><td>4</td><td>Tread difference</td><td colspan="2">22.5</td><td colspan="3">26</td></tr>
<tr><td>5</td><td>Overall width</td><td colspan="2">190</td><td colspan="3">—</td></tr>
<tr><td>6</td><td>Tread width</td><td colspan="2">44</td><td colspan="3">—</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="5">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ϕ80</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Interference between idler and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ϕ86</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Clearance between bushing and support (Sum of clearances at both sides)</td><td colspan="2">Standard clearance</td><td colspan="3">Clearance limit</td></tr>
<tr><td colspan="2">0.5-1.0</td><td colspan="3">—</td></tr>
</table>

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4.3.3 Carrier roller

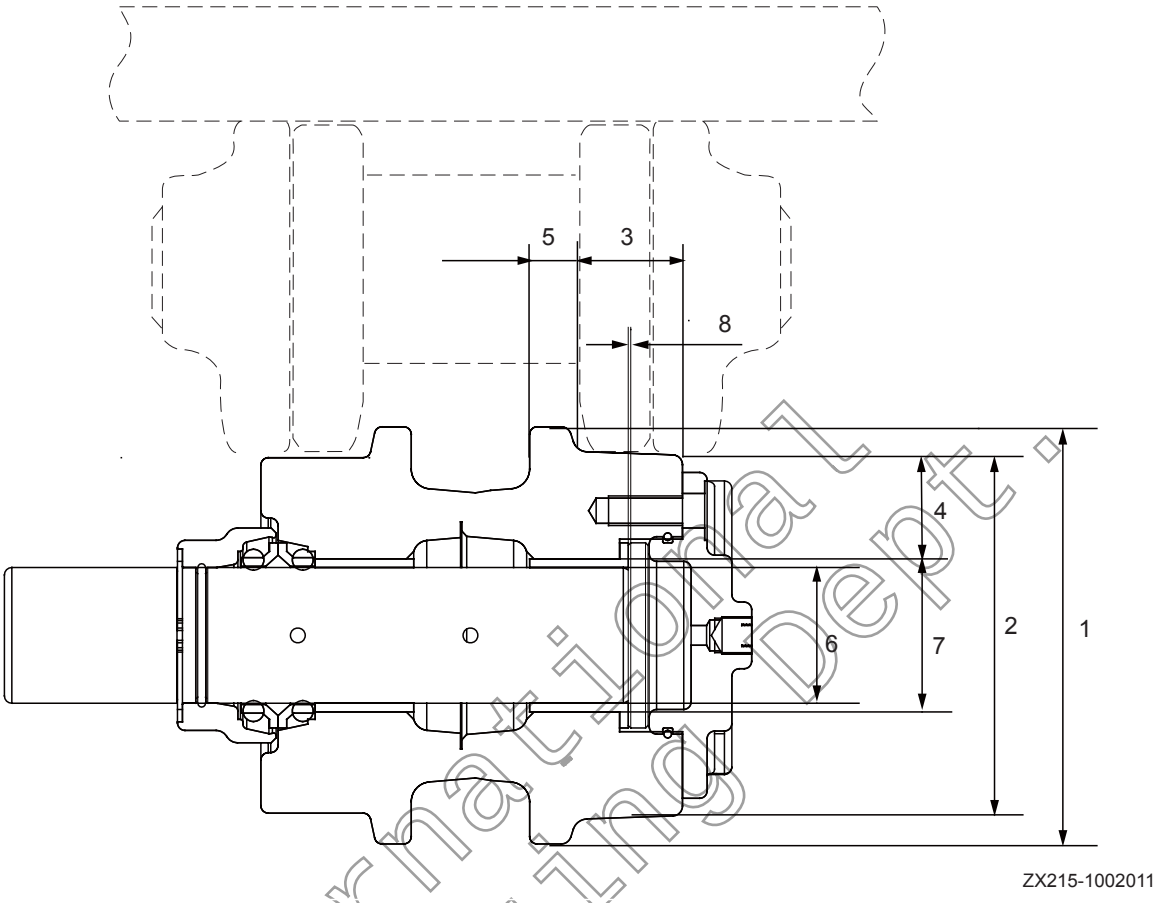


Fig. 4-9

Unit: mm

No.	Check item	Criteria					Remedy
1	Flange outer dia.	Standard size			Repair limit		Replace
		190			—		
2	Tread outer dia.	150			136		
3	Tread width	57			—		
4	Tread thickness	39			32		
5	Flange width	16			—		
6	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		65	—	—	—	—	
7	Interference between carrier roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		72	—	—	—	—	
8	Carrier roller axial clearance	Standard clearance			Clearance limit		
		0.44-0.76			—		

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4.3.4 Track roller

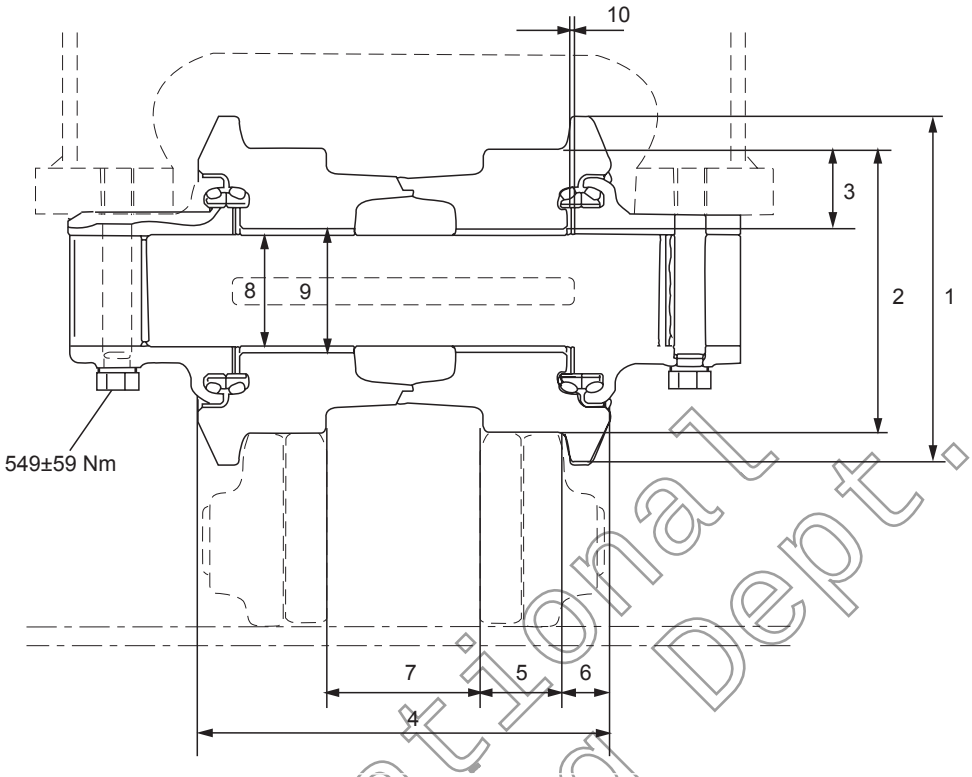


Fig. 4-10

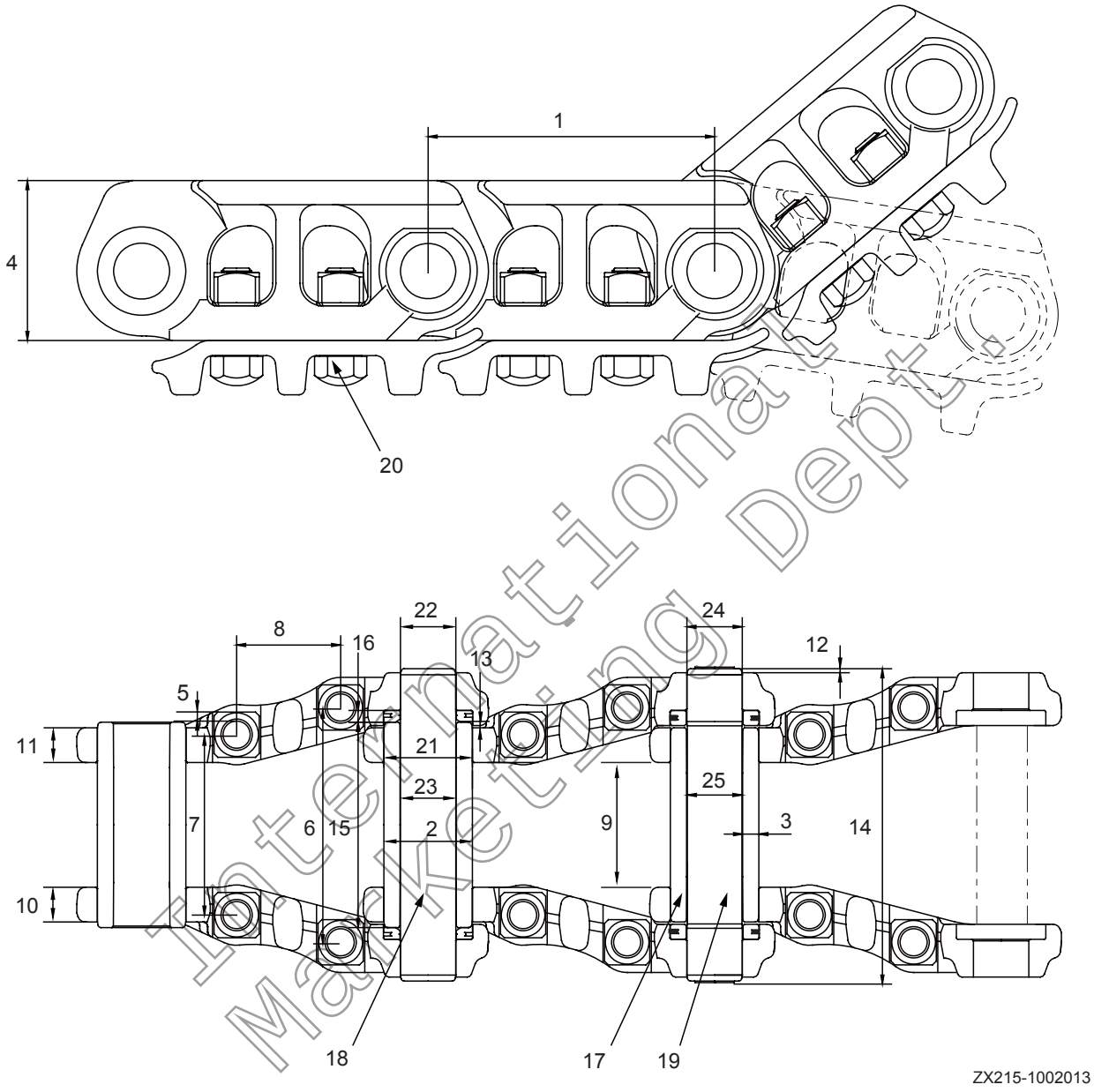
Unit: mm

No.	Check item	Criteria				Remedy
1	Flange outer dia.	Standard clearance		Repair limit		Build-up welding or replace
		216		—		
2	Tread outer dia.	180		168		
3	Tread thickness	51.5		40.5		
4	Overall width	250		—		
5	Tread width	50.5		—		
6	Flange width	27		—		
7	Inner width	95				
8	Clearance between shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole		
		70	—	—	—	—
9	Interference between track roller and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole		
		77	—	—	—	—
10	Clearance between bushing and collar (Sum of clearances on both sides)	Standard clearance		Clearance limit		Replace
		0.5 - 1.0		—		

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4.3.5 Track



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Fig. 4-11

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Unit: mm

No.	Check item		Criteria		Remedy
1	Link pitch		Standard size	Repair limit	Reverse or replace
			216	219	
2	Bushing outer diameter		Standard size	Reverse	
			66.9	60.23	
3	Bushing metal thickness		11.1	—	Repair or replace
4	Link height		Standard size	Repair limit	
			116	104.4	
5	Link metal thickness (bushing press-fitting portion)		30.65	22.5	
6	Shoe bolt pitch		178.4		Adjust or replace
7			140.4		
8			76.2		
9	Link	Inside width	102		
10		Overall width	23.2		
11		Tread width	21.3		
12	Pin protrusion		4.2		
13	Bushing protrusion		5.3		
14	Overall length of pin		242		
15	Overall length of bushing		158.9		
16	Spacer thickness		—		
17	Press-fitting force	Bushing	88.2 -245 kN{9-25 ton}		—
18		Regular pin	127.4 -274.4 kN{13-28 ton}		
19		Master pin	78.4 -147 kN{8-15 ton}		

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Unit: mm

<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="4">20</td><td rowspan="4">Shoe bolt</td><td rowspan="2">a. Regular link</td><td colspan="2">Tightening torque(Nm{kgm})</td><td colspan="2">Retightening angle (deg)</td><td rowspan="4">Retighten</td></tr>
<tr><td>Tri-grouser track shoe</td><td>1100±55
{112.2±5.6}</td><td colspan="2">120±10</td></tr>
<tr><td rowspan="2">b. Master link</td><td>Tightening torque
(Nm)</td><td colspan="2">Retightening angle (deg)</td><td>Lower torque limit
(Nm{kgm})</td></tr>
<tr><td>—</td><td colspan="2">—</td><td>—</td></tr>
<tr><td rowspan="2">21</td><td colspan="2" rowspan="2">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="6">Adjust or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>22</td><td colspan="2">Interference between pin and link</td><td>66.5</td><td>+0.46
+0.41</td><td>+0.074
0</td><td>0.36-0.464</td></tr>
<tr><td>22</td><td colspan="2">Interference between pin and link</td><td>44.6</td><td>+0.19
+0.09</td><td>–0.188
–0.20</td><td>0.285-0.485</td></tr>
<tr><td rowspan="2">23</td><td colspan="2" rowspan="2">Clearance between pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td colspan="2">Clearance between pin and bushing</td><td>44.6</td><td>+0.19
+0.09</td><td>+1.35
+0.85</td><td>0.18-0.83</td></tr>
</table>

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4.3.6 Tri-grouser track shoe

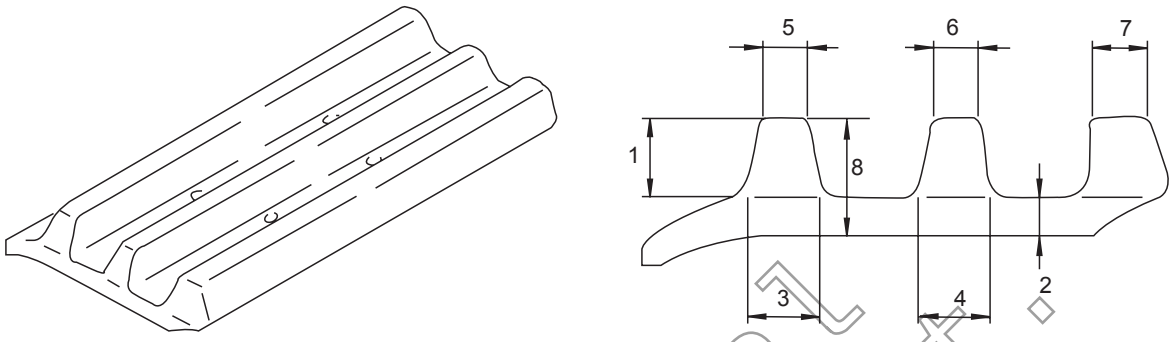


Fig. 4-12

Unit: mm

No.	Check item	Criteria		Remedy
1	Height	Standard size	Repair limit	Build-up welding or replace
		30	20	
2	Thickness	11		
3	Length of base	29		
4		24		
5	Length at tip	22		
6		16		
7		22		
8	Thickness	Standard size	Repair limit	
		41	31	

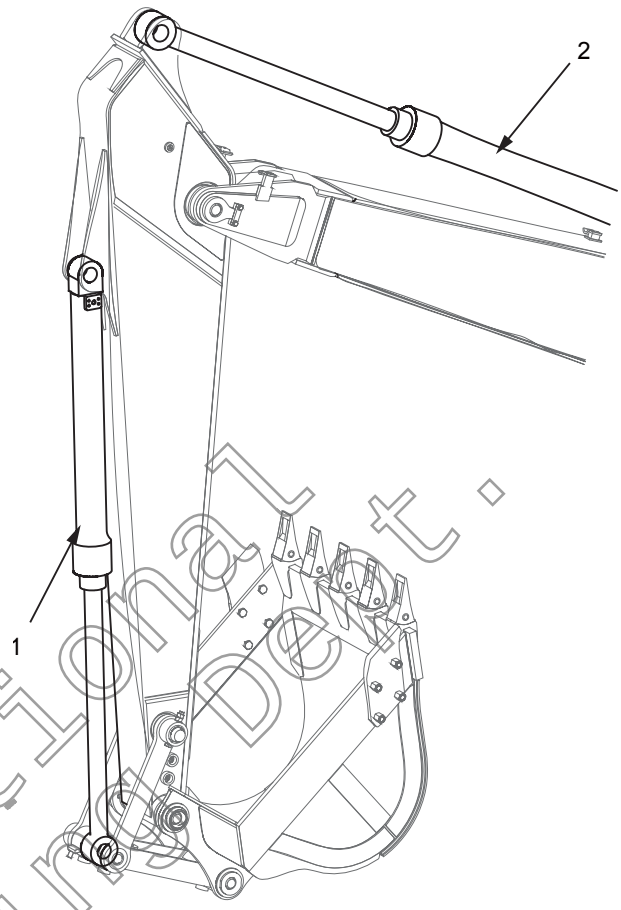
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4.4 Hydraulic System, Part 1

4.4.1 Deployment of hydraulic parts

(1) Bucket cylinder
(2) Arm cylinder
(3) Boom cylinder
(4) Hydraulic tank
(5) Hydraulic oil filter
(6) Main control valve
(7) Main pump
(8) Radiator
(9) Accumulator
(10) Left travel motor
(11) Right travel motor
(12) Swing motor
(13) Hydraulic lockout control
(14) Left pilot valve
(15) Central swivel joint
(16) Right pilot valve
(17) Travel pilot valve
(18) Solenoid valve AS
18A. Hi/Lo travel speed shift solenoid valve
18B. Negative flow solenoid valve (front pump)
18C. Negative flow solenoid valve (rear pump)
18D. Pilot lockout solenoid valve



ZX335-1002007

Fig. 4-13

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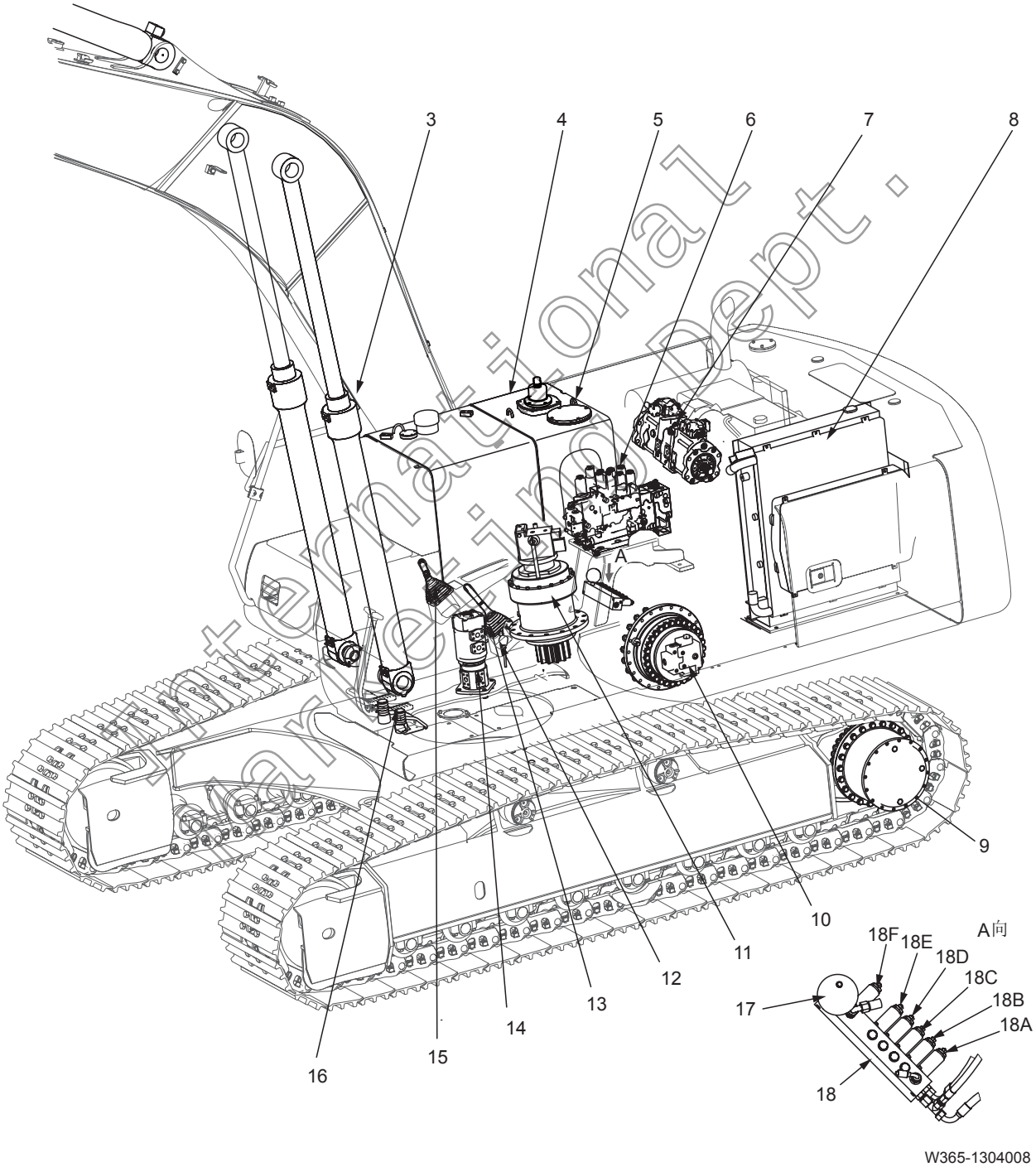


Fig. 4-14

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4.4.2 Hydraulic tank and filter

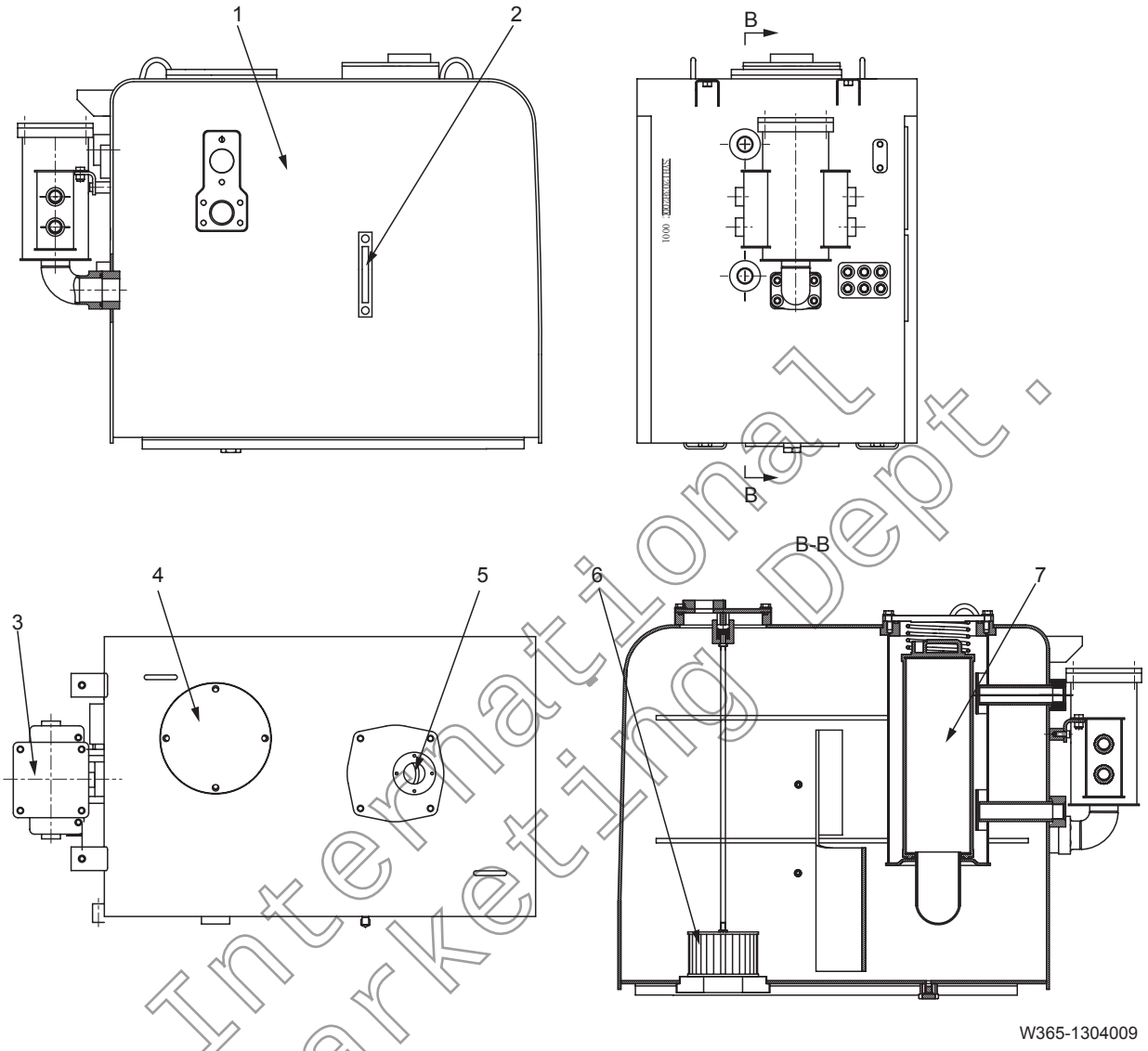


Fig. 4-15

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(1) Hydraulic tank
(2) Level gauge
(3) Filter element (oil drain)
(4) Filler cap
(5) Breather valve
(6) Filter element (oil suction)
(7) Filter element (oil return)

Specification

Tank capacity: 340 L

Breather valve

Filter fineness: 10 μm

Ambient temp: -30℃ -100℃

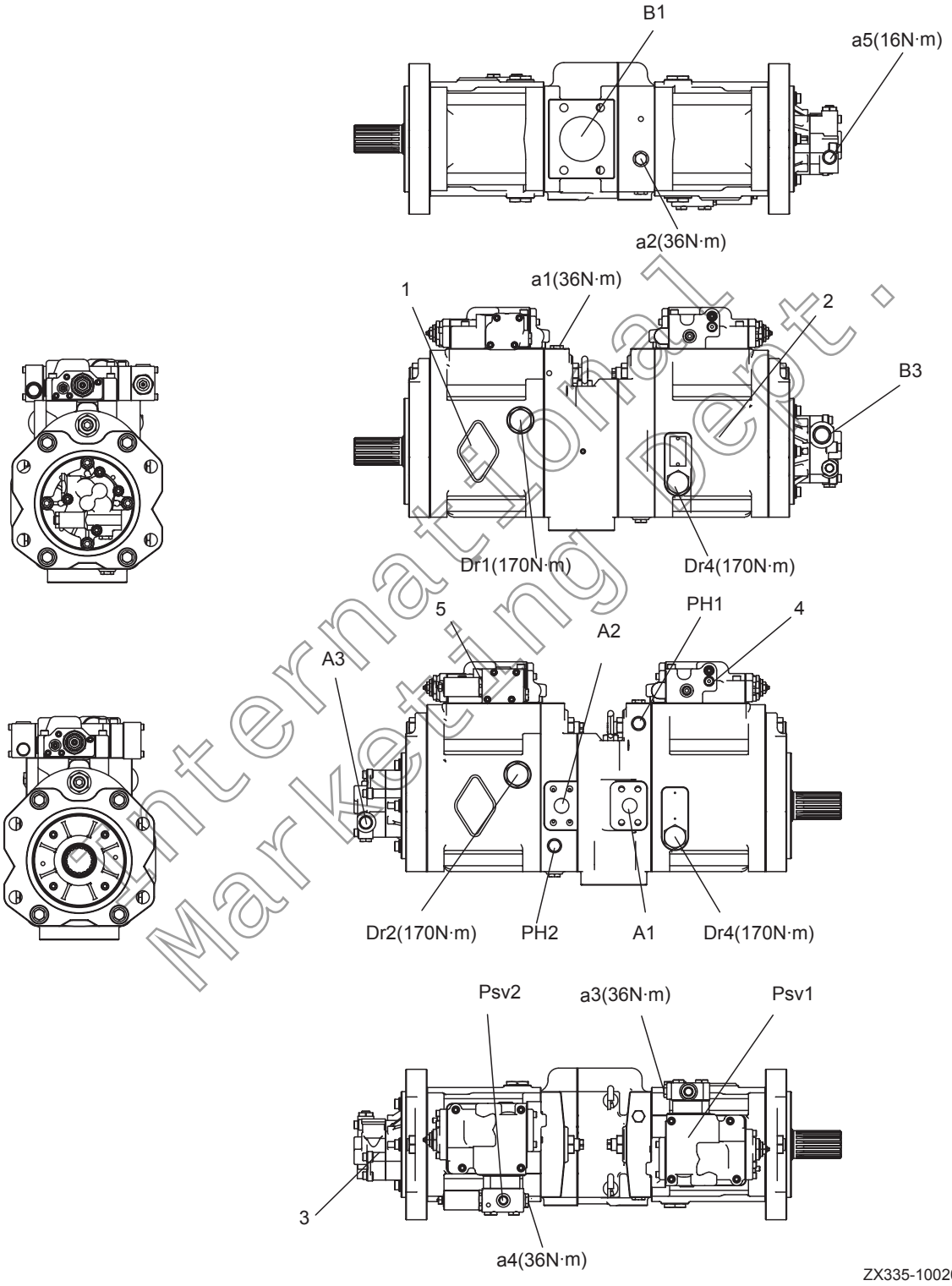
Pressure setting: Air inlet side → 0.005 MPa
Air outlet side → 0.05 MPa

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4.4.3 Hydraulic pump

Type: K5V160DTH1×4R-9T06-V



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Fig. 4-16

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4.4.3.1 Outline

- This pump consists of 2 variable swash plate plunger pumps, 2 adjustors, and 1 pilot gear pump.

a1: Main pressure detection port (front pump)

a2: Main pressure detection port (rear pump)

a3: Regulator pressure detection port (front pump)

a4: Regulator control pressure detection port (rear pump)

a5: Delivery pressure detection port (pilot gear pump)

PH1: Pressure sensor mounting port (front pump)

PH2: Pressure sensor mounting port (rear pump)

A1: Oil delivery port (front pump)

A2: Oil delivery port (rear pump)

A3: Oil delivery port (pilot gear pump)

Psv1: Regulator control port (front pump)

Psv2: Regulator control port (rear pump)

Dr1: Drain plug (front pump)

Dr2: Drain plug (rear pump)

Dr4: Oil drain port

B1: Oil suction port (pump)

B3: Oil suction port (pilot gear pump)

(1) 1: Front pump

(2) 2: Rear pump

(3) 3: Pilot gear pump

(4) 4: Regulator (front pump)

(5) 5: Regulator (rear pump)

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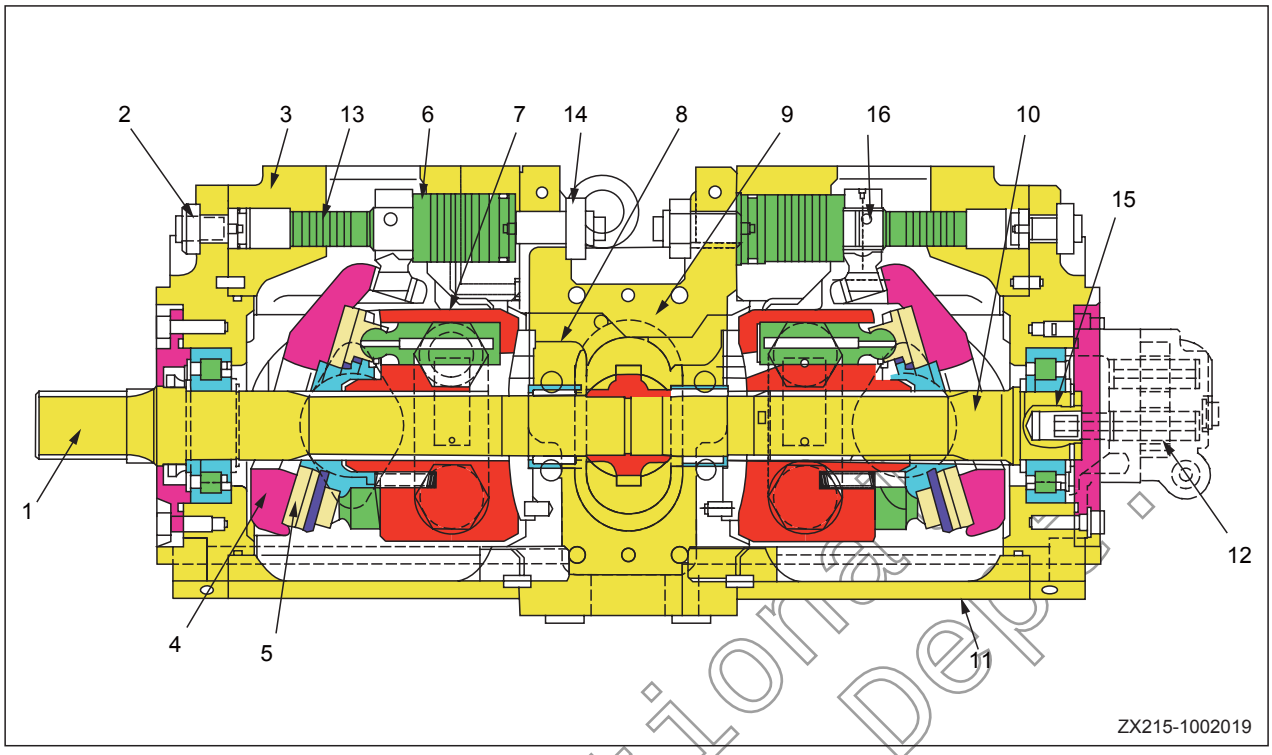


Fig. 4-17

(1) Front shaft
(2) Min. delivery adjusting screw
(3) Front casing
(4) Swash plate
(5) Slipper
(6) Plunger
(7) Cylinder block
(8) Oil distributor
(9) End cap
(10) Rear shaft
(11) Rear casing
(12) Gear pump
(13) Piston
(14) Max. delivery adjusting screw
(15) Gear pump shaft
(16) Driving pin

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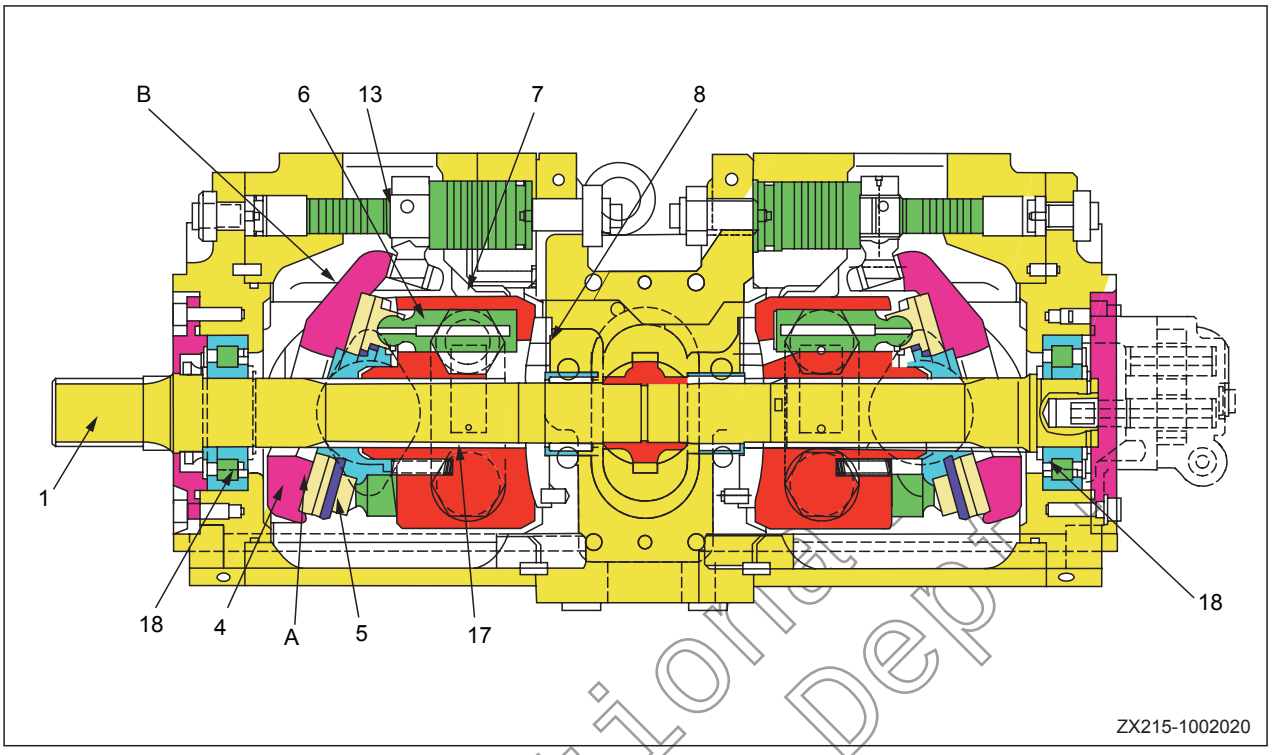


Fig. 4-18

4.4.3.2 Function

- The torque of the engine is transmitted to the pump shaft (1), and drives cylinder block (7) to rotate. At the same time, nine plungers (6) slide along the oil distributor (8). Plunger (6) moves back and forth inside cylinder block (7) and pressurized oil is sucked in and discharged alternatively.
- It is possible to change the displacement by changing the swash plate angle.

4.4.3.3 Structure

- Cylinder block (7) is supported to shaft (1) by spline (17).
- Shaft (1) is supported by front and rear bearings (18).
- Tip of plunger (6) is shaped as a concave ball and slipper (5) is caulked to it to form one unit.
- Plunger (6) and slipper (5) constitute the spherical bearing.
- Swash plate (4) has flat surface (A), and slipper (5) is always pressed against this surface while sliding in a circular movement.
- Swash plate (4) conducts high pressure oil to cylinder surface (B), and forms a static pressure bearing when it slides.
- Plunger (6) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (7).
- Cylinder block (7) seals the pressurized oil to oil distributor (8) and carries out relative rotation.
- This surface is designed so that the oil pressure balance is maintained at a suitable level.
- The oil inside the respective cylinder chambers of cylinder block (7) is sucked in and delivered through oil distributor (8).

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4.4.3.4 Operating principle

- Cylinder block (7) rotates together with shaft (1), and slipper (5) slides on flat surface (A).
- When this happens, swash plate (4) moves along cylindrical surface (B), so angle (a) between central line (X) of swash plate (4) and the axial direction of cylinder block (7) changes.
- (a) stands for the angle of the swash plate.
- With central line (X) of swash plate (4) at a swash plate angle (a) in relation to the axial direction of cylinder block (7), flat surface (A) acts as a cam in relation to slipper (5).
- In this way, plunger (6) slides on the inside of cylinder block (7), so a difference between volumes (E) and (F) is created inside cylinder block (7).
- A single plunger sucks and discharges the oil by the amount (F) – (E).
- As cylinder block (7) rotates and the volume of chamber (E) becomes smaller, the pressurized oil is discharged.
- On the other hand, the volume of chamber (F) grows larger and, in this process, the oil is sucked in.
- As central line (X) of swash plate (4) overlaps the axial direction of cylinder block (7) (swash plate angle (a) = 0), the difference between volumes (E) and (F) inside cylinder block (7)becomes 0.
- Suction and discharging of pressurized oil is not carried out in this state. Namely pumping action is not performed. (In reality, however, the swash plate angle is not set to 0)

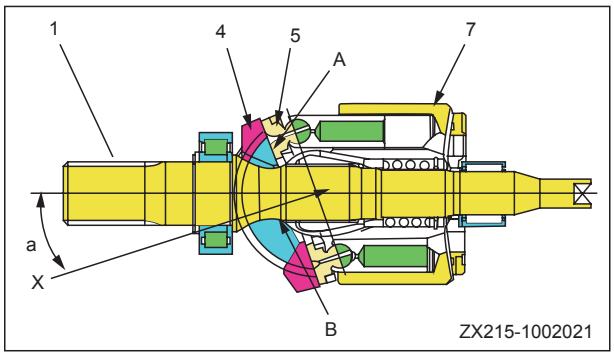


Fig. 4-19

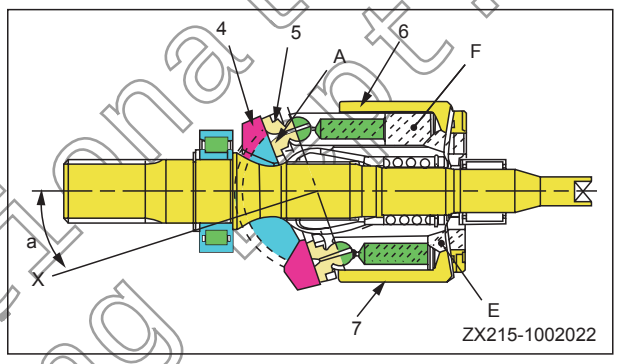


Fig. 4-20

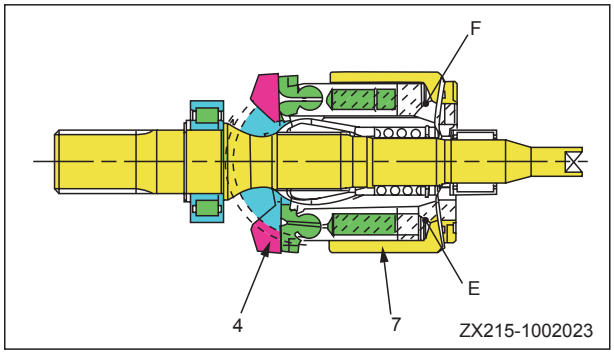


Fig. 4-21

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4.4.3.5 Oil delivery control

- If swash plate angle (a) becomes larger, the difference between volumes (E) and (F) becomes larger and pump delivery (Q) increases.
- Piston (13) is used for changing swash plate angle (a).
- Piston (13) makes linear reciprocal movement under the control of the regulator.
- This linear motion is transmitted to swash plate (4) via drive pin (16). The sliding of the swash plate changes the swash plate angle and changes the displacement of the main pump.

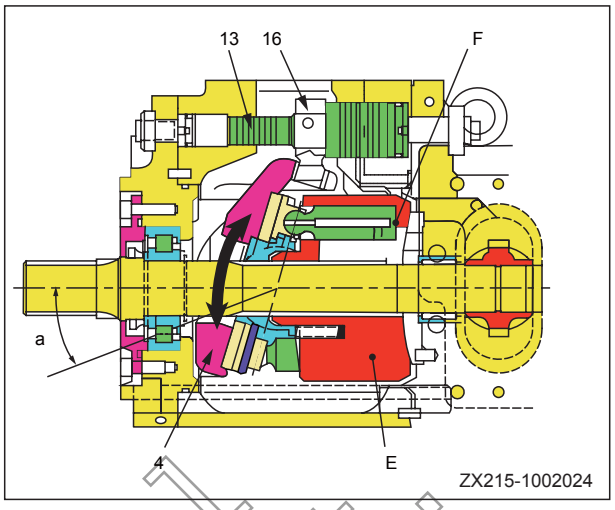


Fig. 4-22

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4.4.4 Pilot pump

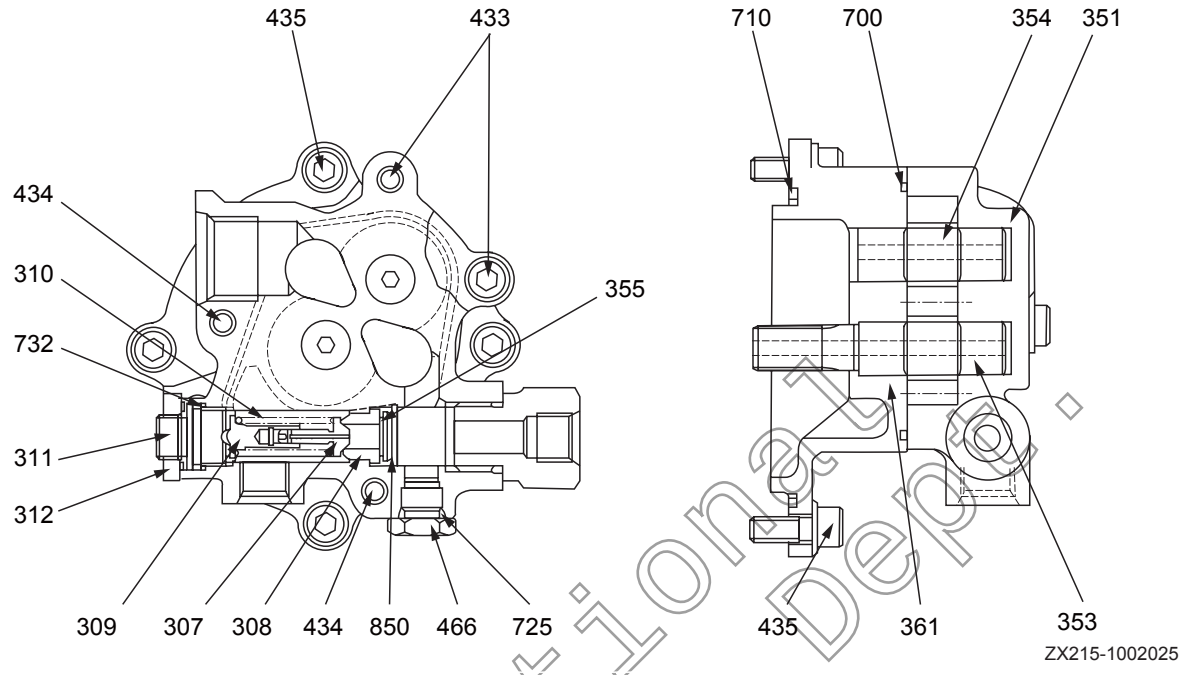


Fig. 4-23

307: Valve stem
308: Valve base
309: Retainer
310: Spring
311: Adjusting screw
312: Nut
351: Body
353: Gear shaft
354: Gear shaft
355: Filter element
361: Body
433: Screw
434: Screw
435: screw
466: Plug
700: Washer
710: O-ring
725: O-ring
732: O-ring
850: Washer

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Function

The engine drives the main pump shaft and the pilot pump shaft through the gearbox. The pilot pump is operated through gear engagement.

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4.4.5 Regulator

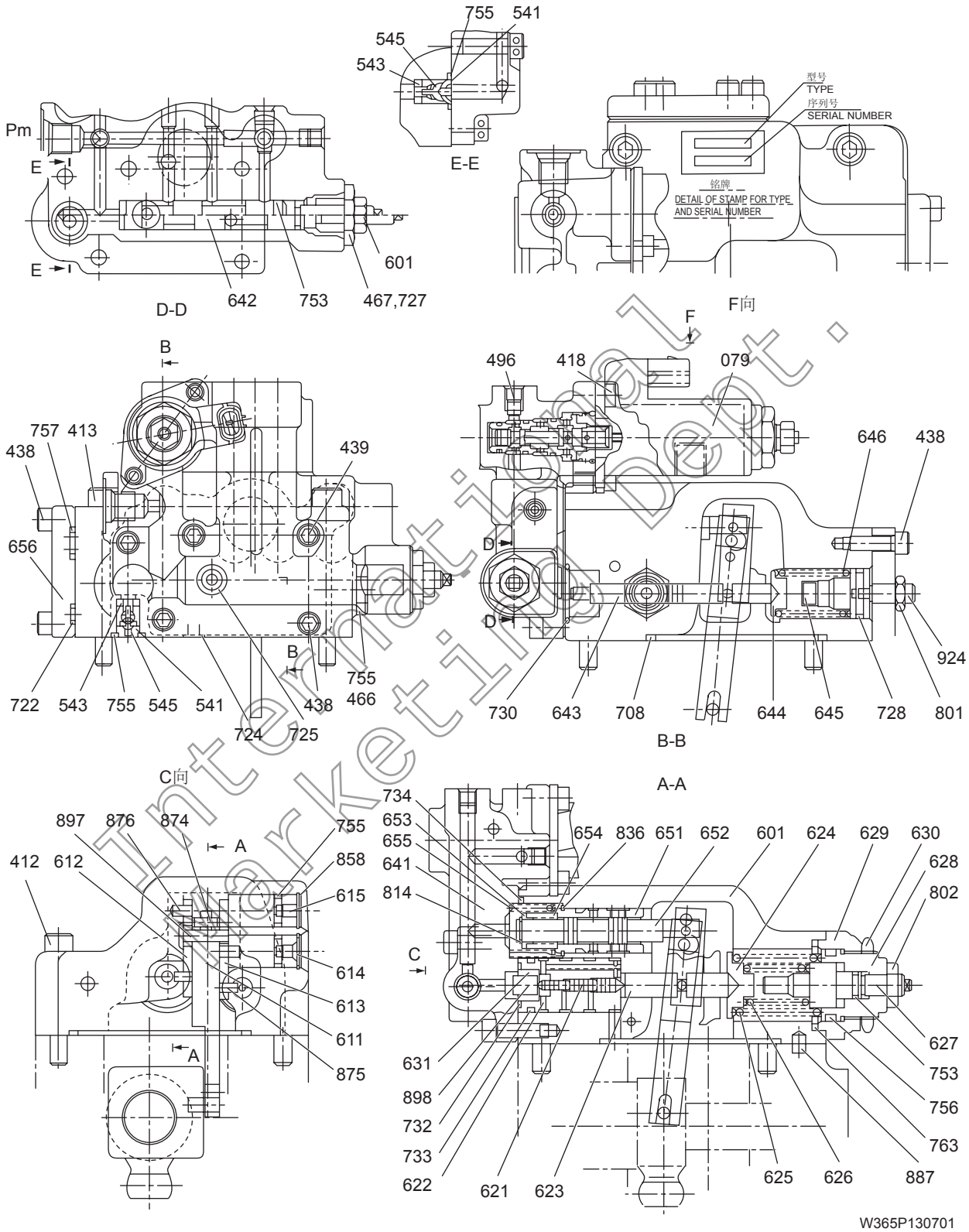


Fig. 4-24

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No.	Part name	Material	Quantity	Part code	Remark
—	Regulator	Alloy steel	1		
412	Screw, socket head	Alloy steel	2	60150559	JIS B1176 M8-50
413	Screw, socket head	Alloy steel	2	60150560	JIS B1176 M8-70
418	Screw, socket head	Alloy steel	2	60150556	JIS B1176 M5-12
438	Screw, socket head	Alloy steel	10	60150557	JIS B1176 M6-20
439	Screw, socket head	Rolled steel	3	60150558	JIS B1176 M6-35
466	Plug	Rolled steel	1	60008724	G1/4
467	Plug	Carbon steel	1	60008507	G3/8×M8
496	Plug	Alloy steel	15	60008728	
497	Plug	Alloy steel	4		
541	Seat	Alloy steel	2	60008884	
543	Stopper 1	Alloy steel	2	60008885	
545	Steel ball	Bearing steel	2		
601	Housing	Cast iron	1	60197213	
611	Feedback rod block	Alloy steel	1	60075481	
612	Lever（1）	Alloy steel	1	60008532	
613	Lever（2）	Alloy steel	1	60008522	
614	Pivot pin	Carbon steel	1	60008533	
615	Compensation piston	Carbon steel	1	60008534	
621	In-cavity piston	Alloy steel	1	60008535	
622	Piston shell	Cast iron	1	60008536	
623	Compensation piece	Alloy steel	1	60008524	
624	Spring seat（C）	Alloy steel	1	60008494	
625	Outer spring	Spring steel	1		
626	Inner spring	Spring steel	1	60075415	
627	Adjusting ring（C）	Carbon steel	1	60008526	
628	Adjusting bolt（C）	Carbon steel	1	60008497	
629	Cover（C）	Aluminum alloy	1	60008529	
630	Locknut	Rolled steel	1	60008537	
631	PF sleeve	Cast iron	1	60150553	
641	Guide cover	Aluminum alloy	1	60008510	
642	Valve stem	Carbon steel	1	B229900001021	
643	Guid piston	Alloy steel	1	60008520	
644	Spring seat（Q）	Alloy steel	1	60008495	
645	Adjusting ring（Q）	Carbon steel	1	60197211	

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No.	Part name	Material	Quantity	Part code	Remark
646	Guide spring	Spring steel	1		
651	Sleeve	Alloy steel	1	60008503	
652	Spool	Alloy steel	1	60008538	
653	Spring seat	Carbon steel	1	60008539	
654	Reset spring	Spring steel	1	60008541	
655	Adjusting spring	Spring steel	1	60008540	
656	Cover plate	Cast iron	1	60008548	
708	O-ring seal	NBR	1	60008694	JISB 2401
722	O-ring seal	NBR	3	60008707	JISB 2401
724	O-ring seal	NBR	8		JISB 2401
725	O-ring seal	NBR	1	60008696	JISB 2401
727	O-ring seal	NBR	1	60008700	JISB 2401
728	O-ring seal	NBR	1	60008702	JISB 2401
730	O-ring seal	NBR	1	60008704	JISB 2401
732	O-ring seal	NBR	1	60008701	JISB 2401
733	O-ring seal	NBR	1	60221603	JISB 2401
734	O-ring seal	NBR	1	60008692	JISB 2401
753	O-ring seal	NBR	2	60008709	JISB 2401
755	O-ring seal	NBR	5	60008697	JISB 2401
756	O-ring seal	NBR	1	60008706	JISB 2401
757	O-ring seal	NBR	1	60008698	JISB 2401
763	O-ring seal	NBR	1	60039416	JISB 2401
801	Nut, hexagon	Rolled steel	2	60150561	JIS B1181 RN-M8
802	Nut, hexagon	Rolled steel	1	60008506	M10
814	Collar	Tool steel	1	60009938	JIS B 2B04 SR-10
836	Collar	Tool steel	1	60008748	
858	Collar	Tool steel	2	60009937	JIS B 2B04 RR-15
874	Pin	Bearing steel	1	60008734	Φ4×11.7L
875	Pin	Bearing steel	2	60008733	Φ4×8L
876	Pin	Bearing steel	2	60008735	Φ5×8L
887	Pin	Carbon steel	1	60008546	
897	Pin	Bearing steel	1	60008736	Φ5×19L
898	Pin	Bearing steel	1	60150562	Φ8.5×10L
924	Screw, socket head	Alloy steel	1	60008743	
079	Pressure-reducing solenoid valve		1	60125194	
041	Check valve block		2	60117792	

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Operating principle

- The regulator controls the flow of the main pup through various pressure signal commands, keeping the pump’ s driving power lower than the engine power
- Pump 1 and pump 2 are each equipped with a regulator. Primary components of the regulator are electromagnetic proportional pressure-reducing valve (1), electro-hydraulic converter valve (2), variable power regulator (3), positive flow regulator (4), servo piston (5) and servo directional valve (6). The regulator opens or closes the oil passage of servo piston (5) according to various pressure signal commands, change the inclination of swash plate, and control the flow of pump as a result.

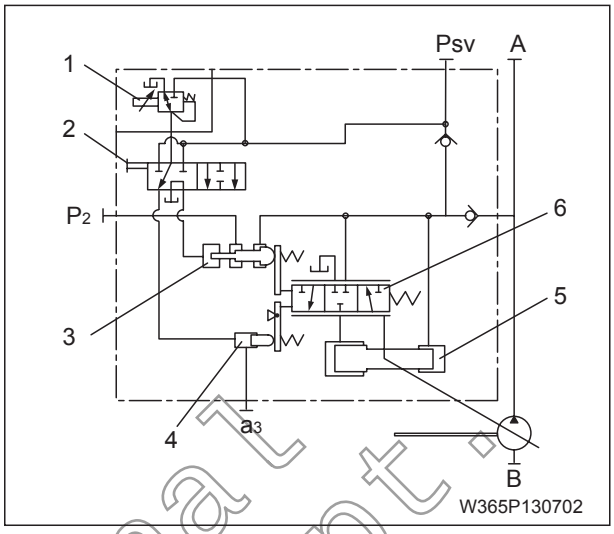


Fig. 4-25

Components of control mechanism

Electric current flow control: when normal

By changing the value I of command current flowing to the electromagnetic proportional pressure reducing valve, the inclination angle (output flow) of pump can be controlled freely. This is a regulator featured with positive flow control (forward control), in which the output flow Q increases with the value I of command current. With such a device, when you input a current necessary for flow required by corresponding operation, the pump only delivers a flow as desired and no power will be wasted.

Power control (+ power shift): For emergency (with rod pulled out)

- In case of emergency, the power shift command pressure Pf is used to change the value of power setting. The power shift command pressure (secondary pressure P2 of electromagnetic proportional pressure reducing valve) is introduced via in-pump passage to the power control component of each regulator and shifted to respective similar power setting value.
- When power shifting is being performed, the rising of self-pump output pressure Pd1 automatically reduces the inclination (output flow) of the pump. As a result, the input torque is limited under certain value. (In case of constant speed, the input power becomes constant too.)
- When power control is exercised, regulator of each pump is controlled to the same inclination (output flow). Therefore, power control is performed irrelevant to the load of both pumps. Overload of prime mover is prevented as a result. In addition, the normal pressure for power shift is 0 MPa. So the power control is inactive in normal hours.
- With this mechanism, optimum power can be achieved in butting operation.

Although the regulator has the two control mechanisms described above, each control in joint action can put small inclination (flow) command to priority via mechanical calculation.

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Regulator adjustment

- Adjusting the adjusting screws (953, 954) at the pump body side can obtain the minimum flow and the maximum flow. Power control characteristics can be changed by adjusting the screw (C) (628) and the wheel (C) (627) of this adjustor. The flow control characteristics can be achieved by adjusting the socket-headed setscrew (924).

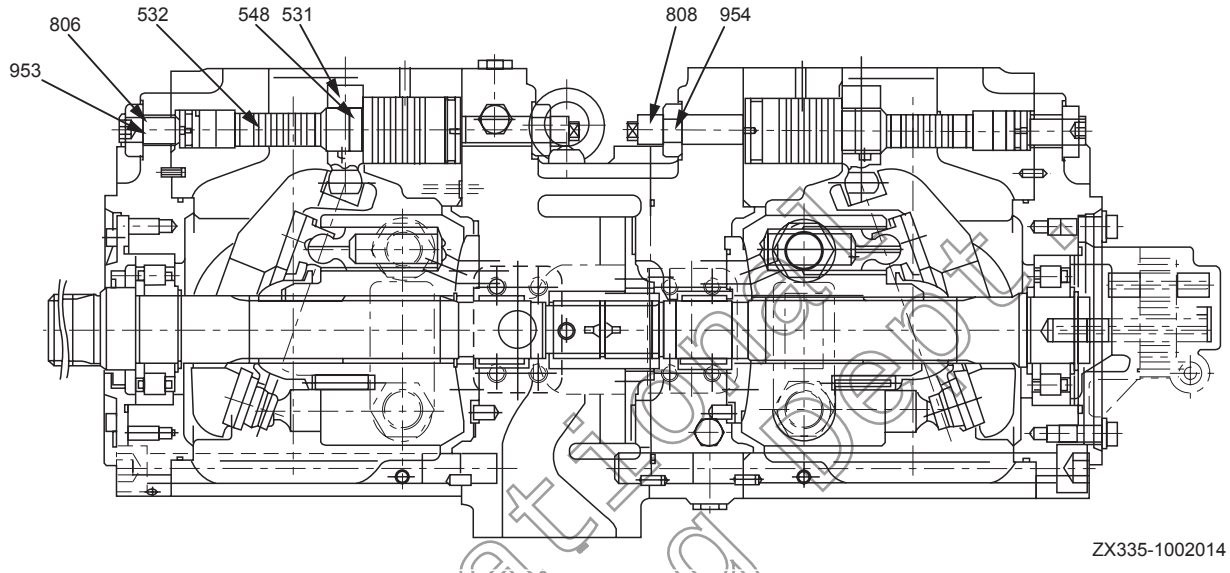


Fig. 4-26

531: Inclination pin
532: Servo piston
548: Feedback pin
806: Retaining nut
808: Retaining nut
953: Adjusting screw (min. flow)
954: Adjusting screw (max. flow)

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Maximum flow adjustment (pump body side)

- Loosen the hex nut (808). Tighten (or loosen) socket-headed setscrew (954). No control characteristics except the maximum flow changes.

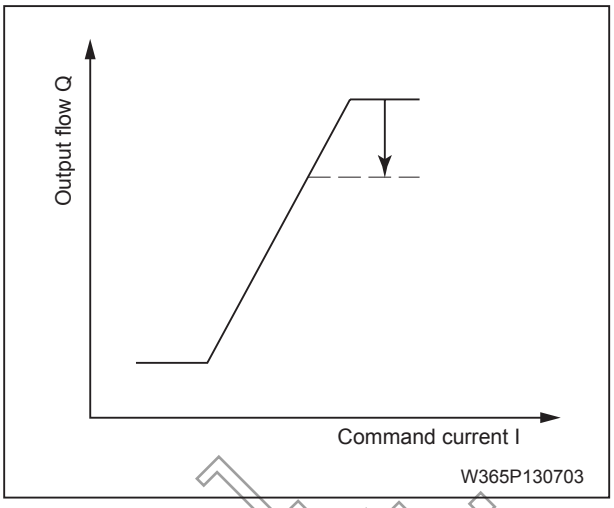


Fig. 4-27

Minimum flow adjustment (pump body side)

- Loosen the hex nut (806). Tighten (or loosen) the socket-headed setscrew (953). Though this action is the same as the adjustment of maximum flow and all the other control characteristics do not change, power required for maximum output pressure (at relief) is likely to increase if overtightened. Be careful in this case.

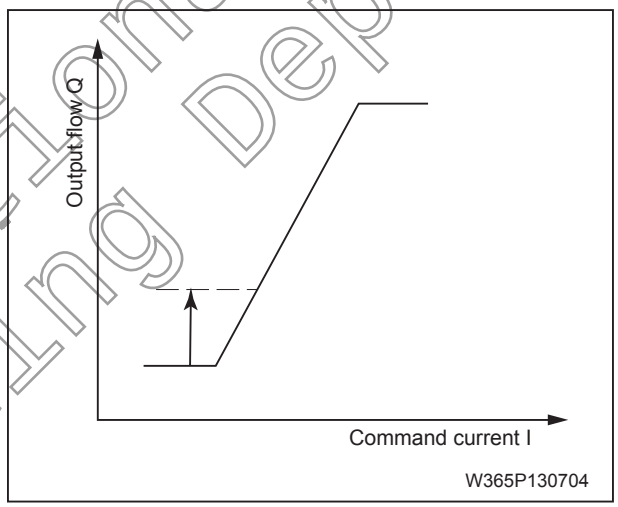


Fig. 4-28

Input power

1) Adjustment of the outer spring

Loosen the nut (630) and tighten or loosen the screw (C) (628) to perform adjustment. When screw (C) (628) is tightened, the control line, as shown in the right figure, moves rightward. The input power increases. Moreover, When the screw (C) (628) is turned by N turns, inner spring (626) also changes along with its setting. So turn the adjusting wheel (C) (627) in the opposite direction by N×A turns. (For value of A **"Annexed Table: Regulator adjusting values" on page 4-47**.)

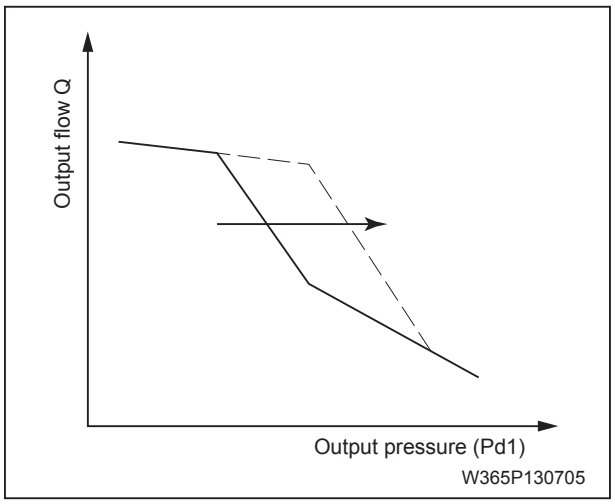


Fig. 4-29

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2) Adjustment of inner spring

After hex nut (802) is loosened, tighten (or loosen) the adjusting roller (C) (627) to carry out adjustment. When adjusting roller (C) (627) is being tightened, the flow (as shown) will increase and input power will also increase.

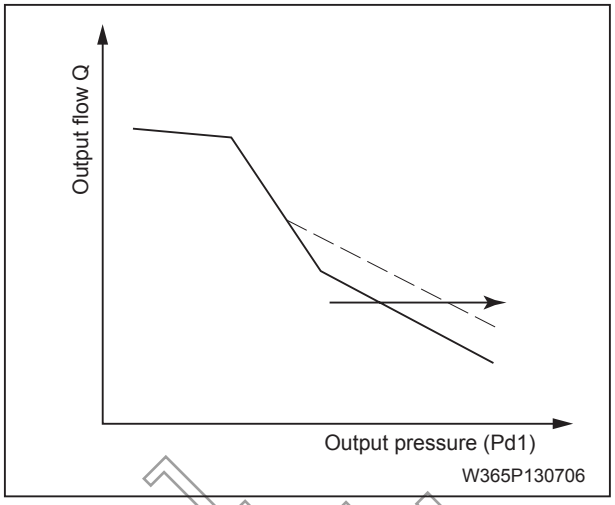


Fig. 4-30

Adjustment of flow control characteristics

Loosen the hex nut (801) and tighten (or loosen) the socket-headed setscrew (924) for adjustment. When the setscrew (924) is being tightened, The control lines will move rightward as shown by the illustration.

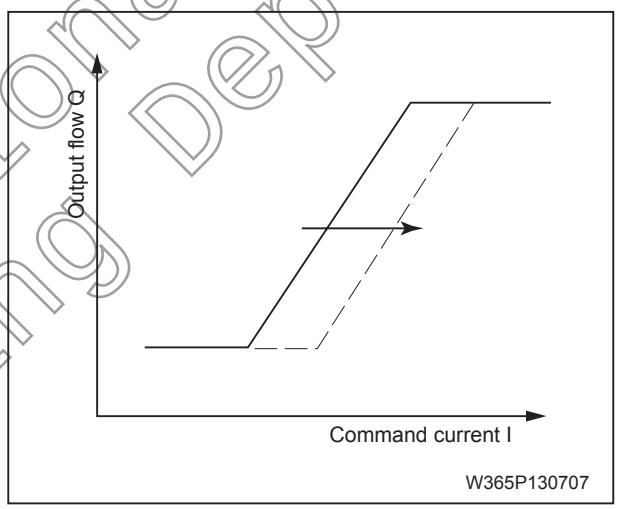


Fig. 4-31

Operating principle

Flow control

As shown in the illustration on the right, the outflow of pump can be controlled indefinitely via feedback pressure value.

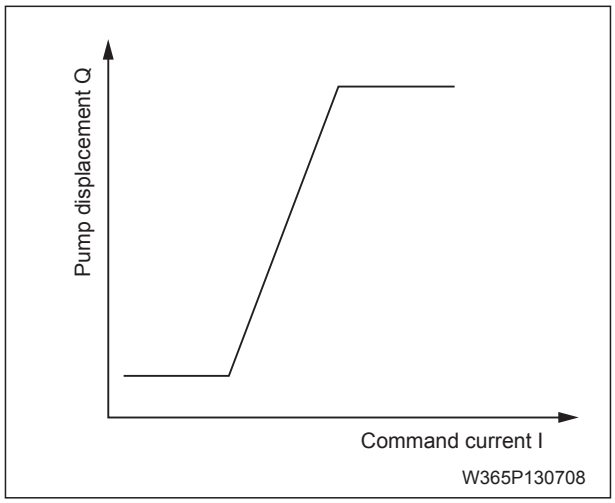


Fig. 4-32

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Increasing the flow

When the negative feedback pressure Pi2 reduces, the pilot plunger (643) will move in direction A until a relative balance between P2 and the resilient force of the guide spring (646) is achieved. The movement of the pilot plunger is transmitted to lever (2) (613) via pin (875) and rotates towards the arrow direction with B as the pivot. The movement of lever (2) is transmitted to the feedback rod (611)via pin shaft (897) and rotates in the same direction of B with C as the pivot. Along with this, the spool (652) connected to the feedback rod moves towards direction D. The spool moving in direction D connects port C1 with the oil tank port, and the pressure inside the large diameter end of the servo piston is relieved. As a result, the output pressure Pd1 inside the small diameter end moves the servo piston (532) in direction E and flow is increased. Since the feedback rod is connected with the servo piston and the spool, movement of the servo piston in direction E makes the feedback rod rotate with F as the pivot. In this way, the spool is moved to the original position. Through this movement, the opening portion between the spool and the valve block is closed slowly. The servo piston stops moving when the opening portion is completely closed.

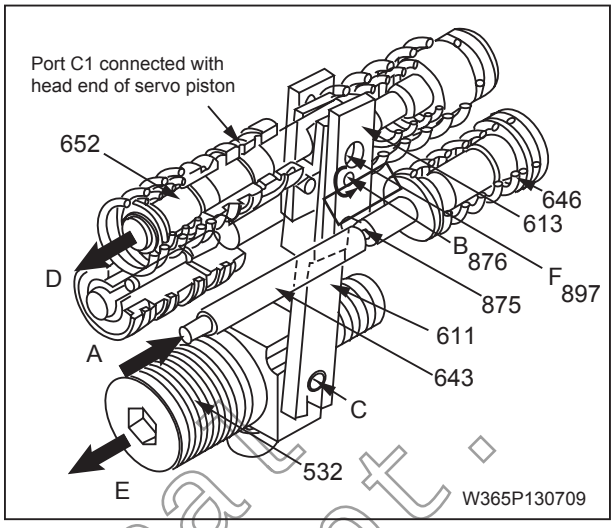


Fig. 4-33

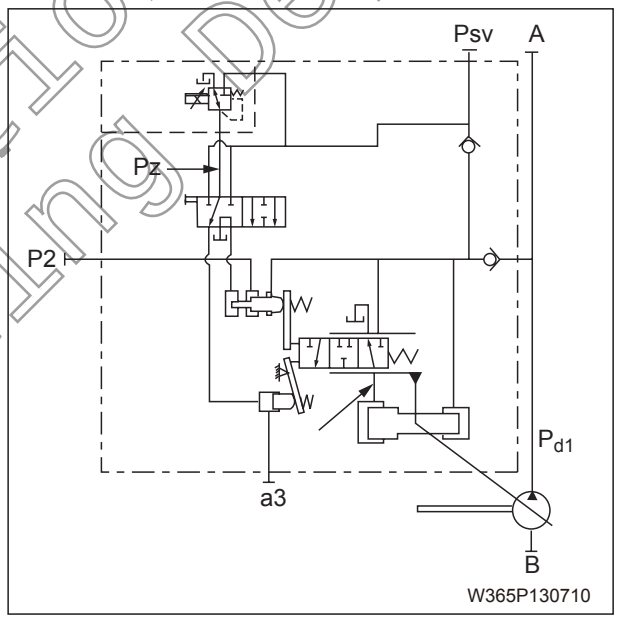


Fig. 4-34

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Decreasing the flow

When the negative feedback pressure Pi2 rises, the pilot plunger (643) will move in direction G until a relative balance between P2 and the resilient force of pilot spring (646) is achieved. The movement of pilot plunger is transmitted to the feedback rod (611) via pin (897) and rotates in the same direction as H with I as the pivot. Along with this, spool (652) connected to the feedback rod moves in direction J. If the spool moves in direction J, output pressure Pd1 enters the large diameter end of the servo piston through the spool and port C1. On the other hand, output pressure Pd1 enters the small diameter end of the servo piston. As a result of the area difference, the servo piston moves in direction K and the inclination is reduced, and the flow is also reduced. Since the feedback rod, the servo piston and the spool form a whole unit, when the servo piston is moving in direction K, the feedback rod rotates with L as the pivot. This makes the spool move to its original position. As a result, the opening portion between the spool and the valve block is slowly closed. The servo piston stops moving when the opening portion is completely closed.

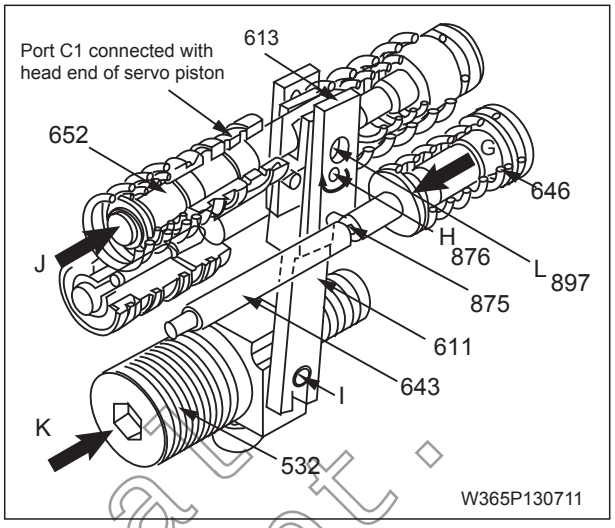


Fig. 4-35

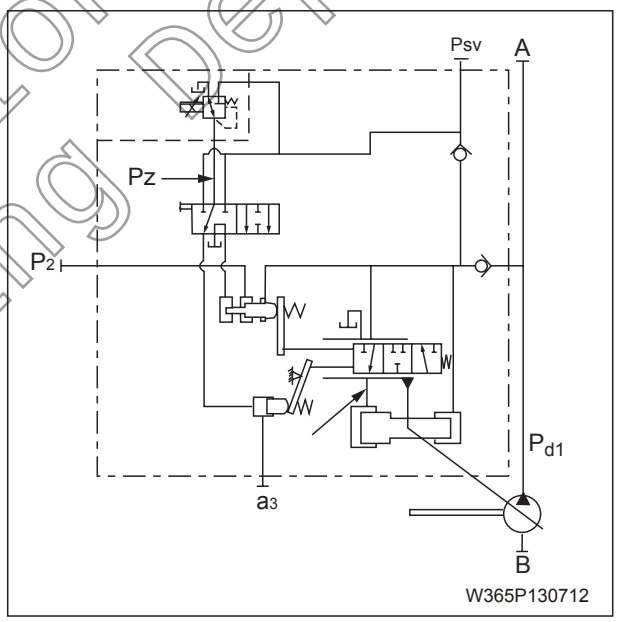


Fig. 4-36

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Power control (for emergency)

- As shown in the illustration, when load pressure increases, pump inclination is reduced to prevent the overloading of the prime mover.
- The action of power control is the same as that of the flow control. The following is a brief description.

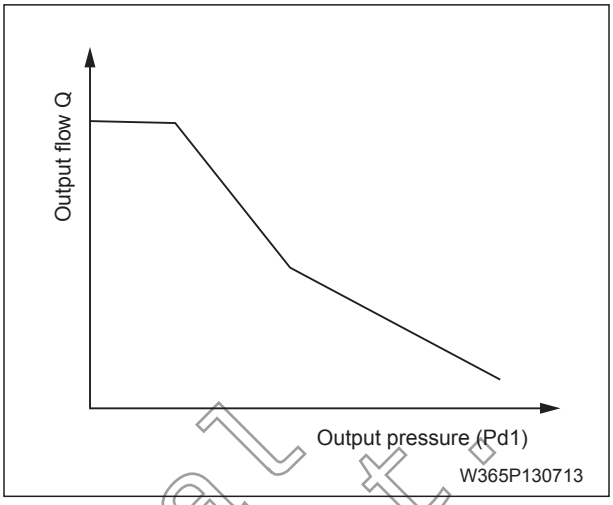


Fig. 4-37

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Action against overloading

When the self pump output pressure Pd1 increases, the output pressure Pd1 is acted onto the ladder portion of the offset piston (621) , and as a result, the offset rod (623) moves in direction M until the output pressure Pd1 balances the elastic forces of outer spring (625) and inner spring (626). The movement of the offset rod is transmitted to the lever (1) (612) via pin (875) and rotate in the arrow direction with N as the pivot. Then, the movement of lever (1) is transmitted to feedback rod (611) via pin (897) and rotates in the same arrow direction as N with O as the pivot. Along with this, spool (652) which is connected to the feedback rod moves in direction P. If the spool moves in direction P, output pressure Pd1 enters the large diameter end of the servo piston through the spool and port C1. However, output pressure Pd1 enters the small diameter end of the servo piston, and as a result of the area difference, the servo piston moves in direction Q. The inclination is reduced as a result and the flow is also reduced. Since the feedback rod, the servo piston and the spool is a whole unit, when the servo piston is moving in direction Q, the feedback rod rotates with R as the pivot. This allows the spool to move to its original position. Through this movement, the opening portion between the spool and the valve block is slowly closed. The servo piston stops moving when the opening portion is completely closed.

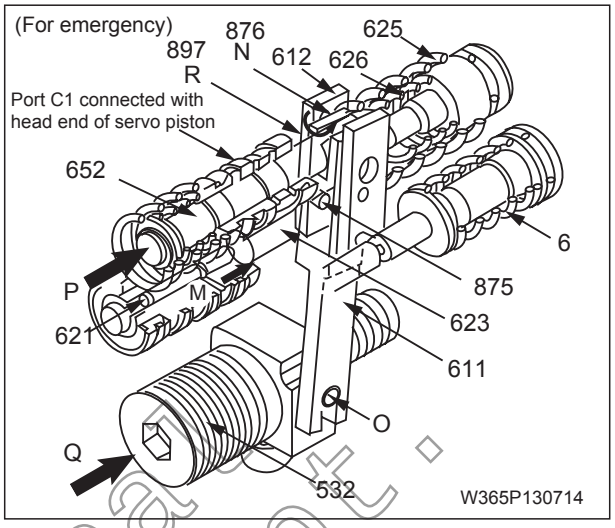


Fig. 4-38

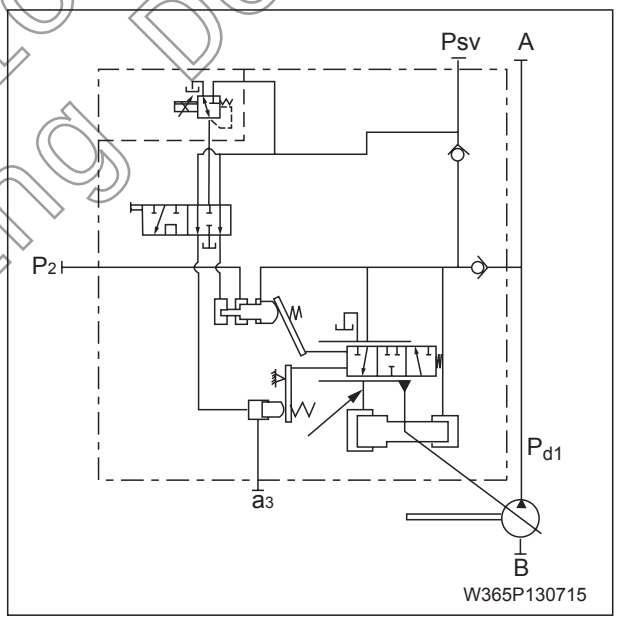


Fig. 4-39

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Action of flow recovery

When the self pump output pressure Pd1 drops, elastic force offset rod (623) of outer spring (625) and inner spring (626) moves in direction S to a point where the elastic force of the outer spring and the inner spring balances the output pressure Pd1. The movement of the offset rod (623) is transmitted to lever (1) (612) via pin (875) and rotates in the arrow direction with T as the pivot. Then, the movement of lever (1) is transmitted to feedback rod (611) via pin (897) and rotates in the same arrow direction as T with U as the pivot. Along with this, spool (652) which is connected to the feedback rod moves in direction V. If the spool is moving in direction V, port C1 is connected with the tank port, and the pressure inside the large diameter end of the servo piston is relieved as a result. Servo piston (532) moves in direction W through the output pressure Pd1 of the small diameter end. The flow is increased in this way. Since the feedback rod, the servo piston and the spool is a whole unit, if the servo piston is moving in direction W, the feedback rod will rotate with X as the pivot. This allows the spool to move to its original position. Through this movement, the opening portion between the spool and the valve block is slowly closed. The servo piston stops moving when the opening portion is completely closed.

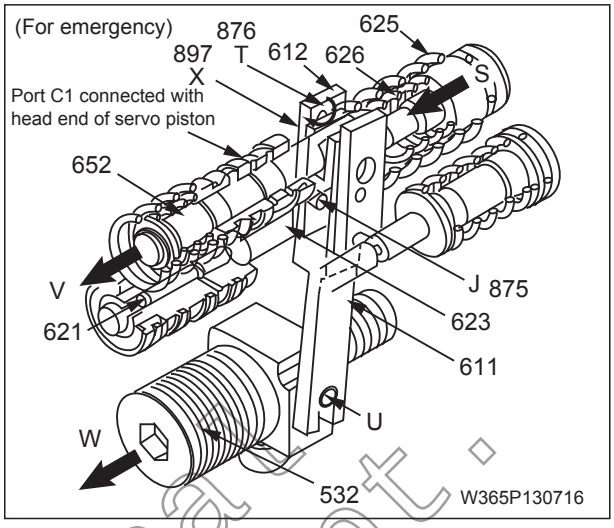


Fig. 4-40

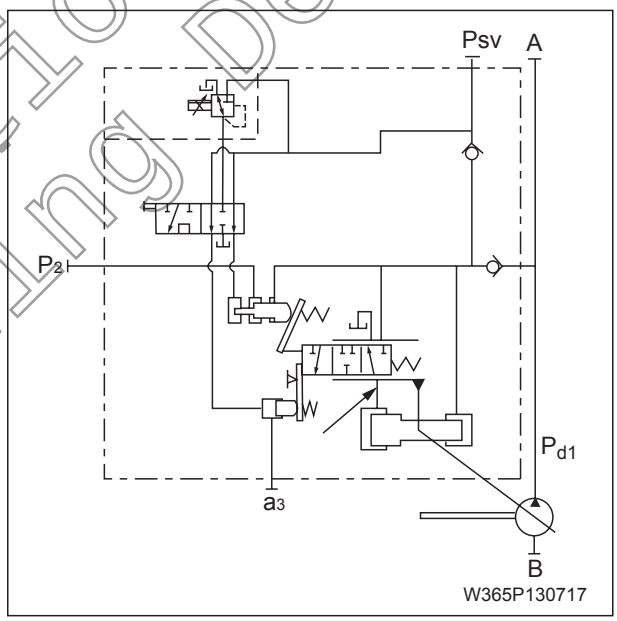


Fig. 4-41

Prior mechanism of small inclination (small flow) command

- As described above, though the inclination command of delivery control and power control is transmitted to the feedback rod (611) and spool (652) via lever (2) (613) and the big diameter end of lever (1) (612) respectively, pin (Φ 5) on the big hole (Φ 9) , as a protrusive structure, only contacts with the rod and pin at the small inclination side. It does not contact with the rod Φ 9 and pin (897) on the large inclination side. Through this mechanical option, the inclination command of the delivery control and power control is placed in priority.

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Power shift control (power control reduction)

- As shown in the right diagram, the power of the pump can be set freely through power shift pressure Pf.
- If the power shift pressure Pf is increased, compensating rod (623) will be pushed to the right side via pin (898) and the offset piston (621). Through the same action as described in the power control overloading prevention, the power set value can be reduced by reducing pump inclination. On the contrary, the power set value can be increased by reducing the power shift pressure Pf.
- When the pump is under normal condition, the power shift pressure Pf is 0 MPa. In an emergency, the power shift pressure Pf is 4.9 MPa.

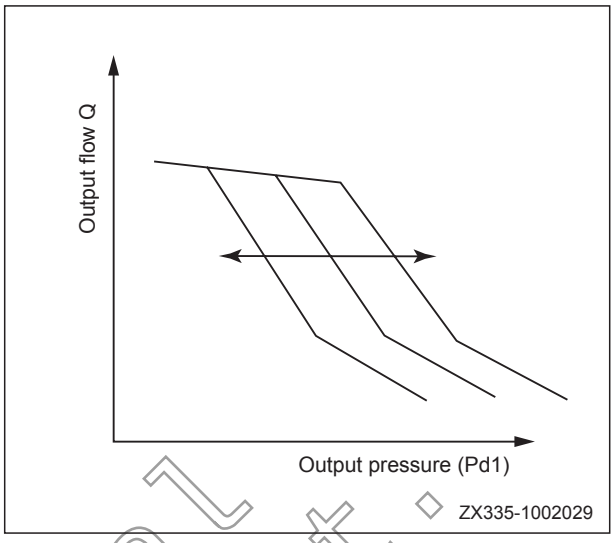


Fig. 4-42

Annexed Table: Regulator adjusting values

Model of regulator			KR3K-9T06-V
		RPM (min-1)	2100
Max flow regulation		Adjusting screw (954) screw-in (rotation)	+1/4
		Delivery change (l/min-1)	6
Min flow regulation		Adjusting screw (953) screw-in (rotation)	+1/4
		Delivery change (l/min-1)	+4.8
Adjustment of input horse power	Adjustment of outer spring	Adjusting screw (928) screw-in (rotation)	+1/4
		Compensation control initial pressure change (MPa)	+1.88
		Input torque change (N·m)	+50.8
		A	1.87
	Adjustment of inner spring	Adjusting wheel (627) screw-in (rotation)	+1/4
		Flow change (l/min-1)	+10
		Input torque change (N·m)	+39
Adjustment of flow control characteristics		Adjusting screw (924) screw-in (rotation)	+1/4
		Flow control initial current change (mA) (Secondary pressure of proportional valve)	Around 35mA (+0.18)
		Delivery change (l/min-1)	-19.4

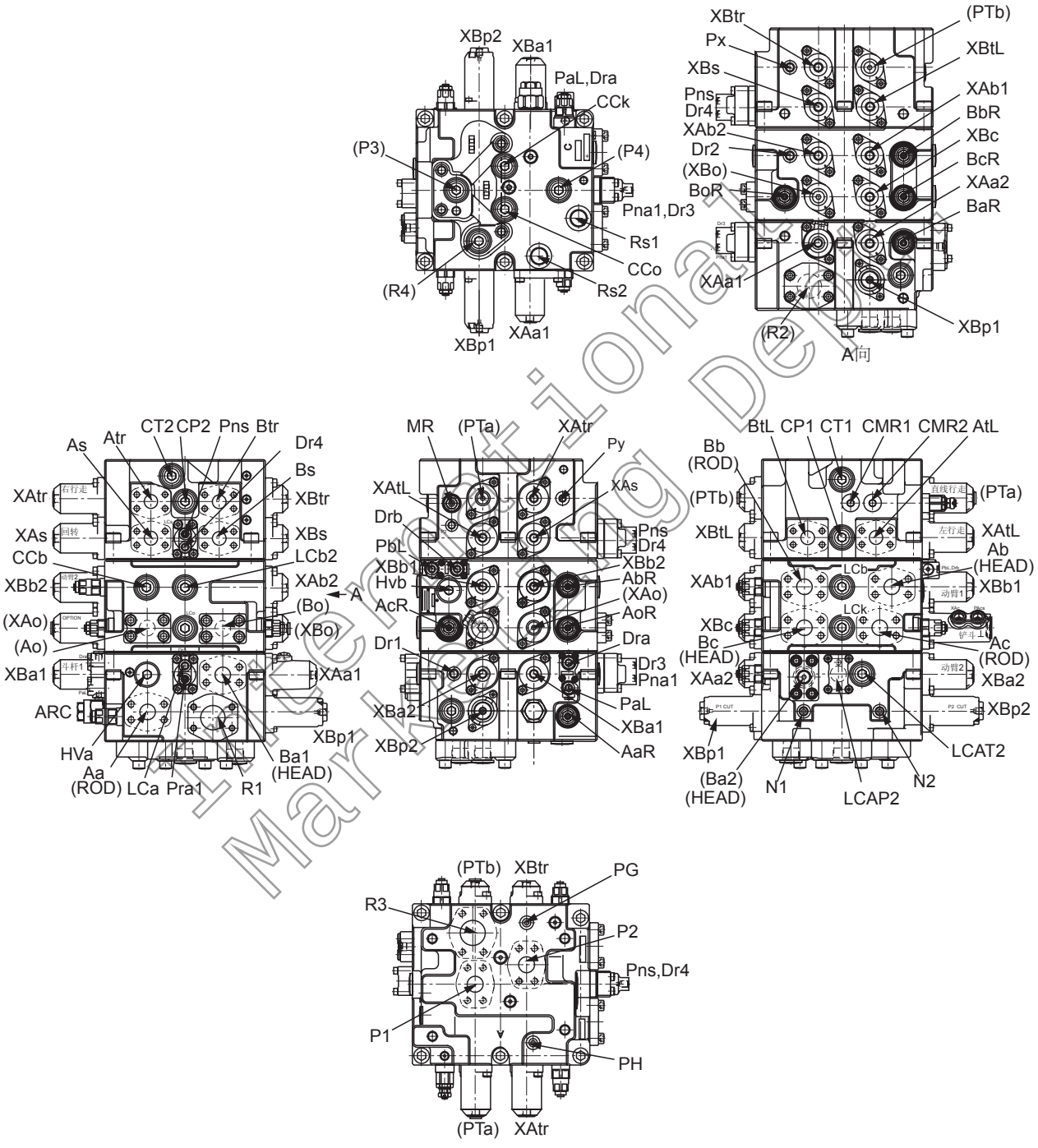
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4.5 Hydraulic system, Part 2

4.5.1 Main control valve

4.5.1.1 Overview



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Fig. 4-43

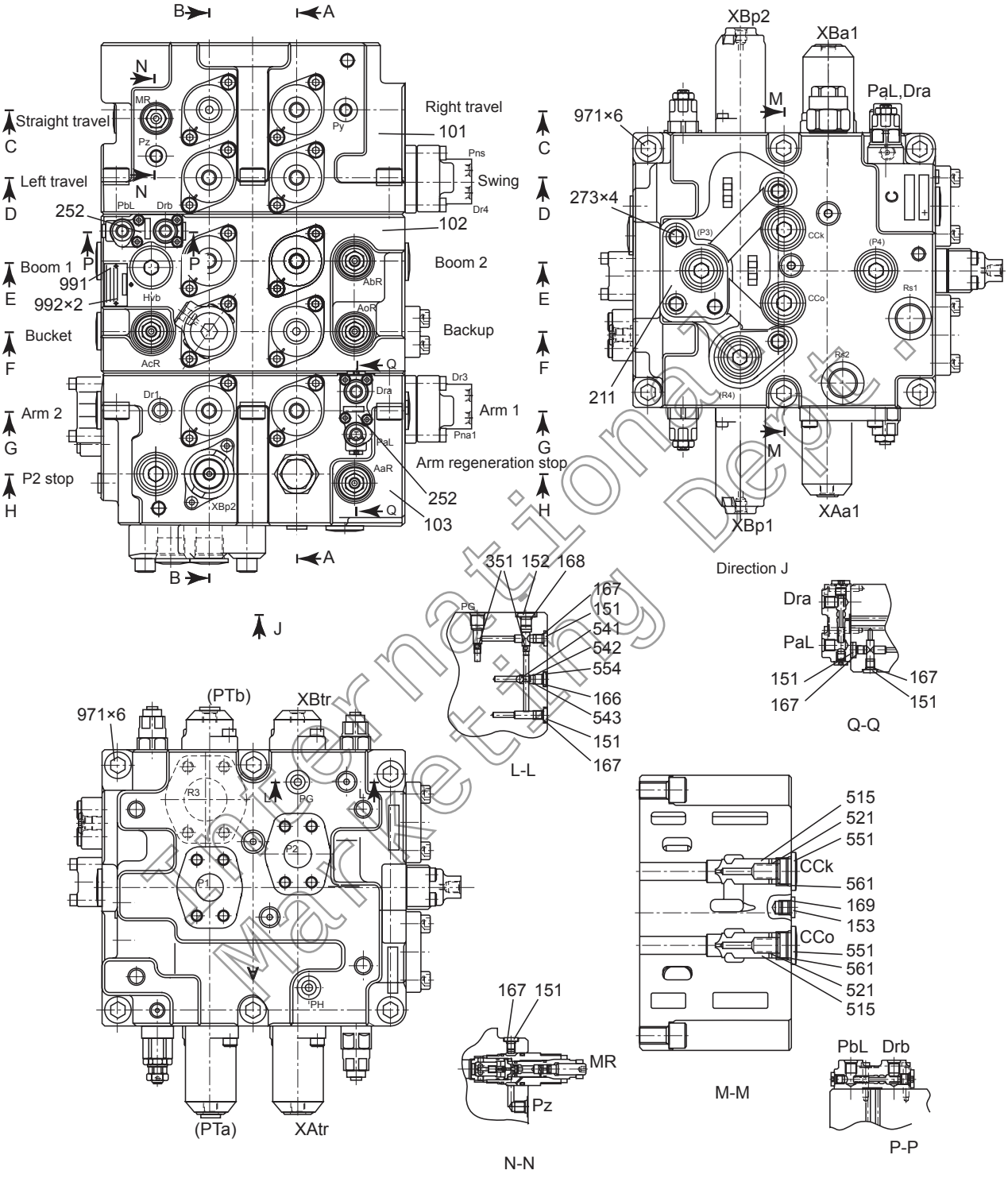
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P1 : Pump port (P1 side)
P2 : Pump port (P2 side)
Aa : Rod end port, arm cylinder (OUT)
Ba1 : Head end port, arm cylinder (IN)
(Ba2) : Head end port, arm cylinder (IN)
Ab : Head end port, boom cylinder (UP)
Bb : Rod end port, boom cylinder (DOWN)
Ac : Rod end port, bucket cylinder (DUMP)
Bc : Head end port, bucket cylinder (DIG)
Atr : Motor port, right travel
Btr : Motor port, right travel
AtL : Motor port, left travel
BtL : Motor port, left travel
As : Motor port, swing
Bs : Motor port, swing
XAtr : Pilot port, right travel
XBtr : Pilot port, right travel
XAtL : Pilot port, left travel
XBtL : Pilot port, left travel
XAs : Pilot port, swing
XBs : Pilot port, swing
XBb1 : Pilot port, boom 1 (DOWN)
XAb1 : Pilot port, boom 1 (UP)
XBb2 : Pilot port, boom confluence (DOWN)
XAb2 : Pilot port, boom confluence (UP)
XBa1 : Pilot port, arm 1 (IN)
XAa1 : Pilot port, arm 1 (OUT)
XBa2 : Pilot port, arm 2 (IN)
XAa2 : Pilot port, arm 2 (OUT)
XAc : Pilot port, bucket (DUMP)
XBc : Pilot port, bucket (DIG)
XBp1 : Pilot port, bypass stop valve spool (P1 side)
XBp2 : Pilot port, bypass stop valve spool (P2 side)
PAcs : Pilot port, bucket (DIG) travel limit
Pna1 : Pilot port, arm 1 logic control valve
Pns : Pilot port, swing logic control valve
PG : Pilot pressure source port
PH : Pilot pressure source port
Pz : Pilot pressure for boosting main relief valve
PaL : Pilot port, lock valve (arm rod end)
PbL : Pilot port, lock valve (boom head end)
Px : Signal port used for work equipment
Py : Signal port used for travel
Drl : Oil drain port
Dr2 : Oil drain port
Dr3 : Oil drain port
Dr4 : Oil drain port
Dra : Oil drain port
Drb : Oil drain port
R1 : Oil return port
(R2) : Oil return port
R3 : Oil return port
Rs1 : Oil refi lling port
Rs2 : Oil refi lling port
(Ao) : Backup port
(Bo) : Backup port
(XAo) : (Backup pilot port)
(XBo) : (Backup pilot port)
(PTa)
(PTb)
(N1)
(N2)
(P3)
(P4)
(R4)

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4.5.1.2 Main valve structure

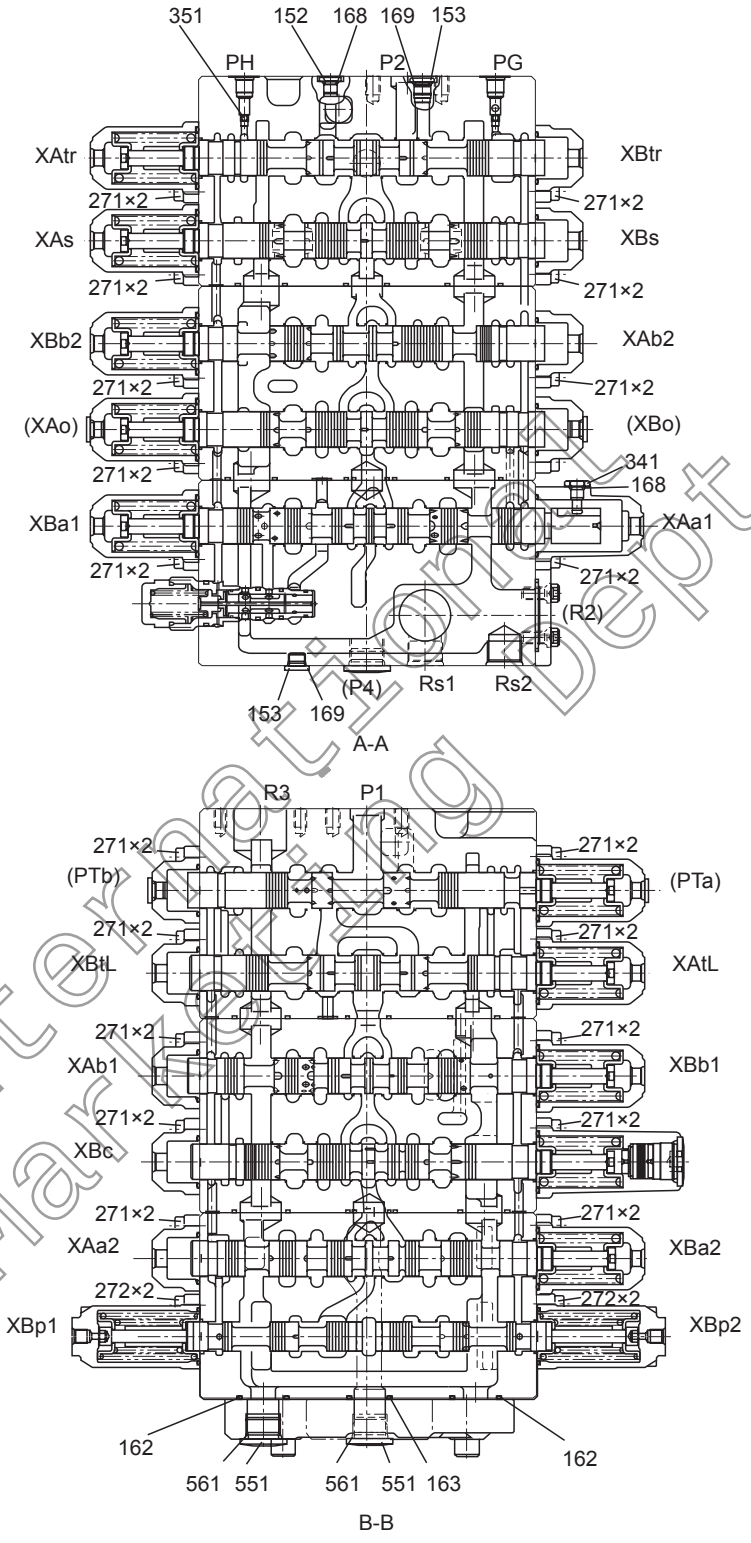


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Fig. 4-44

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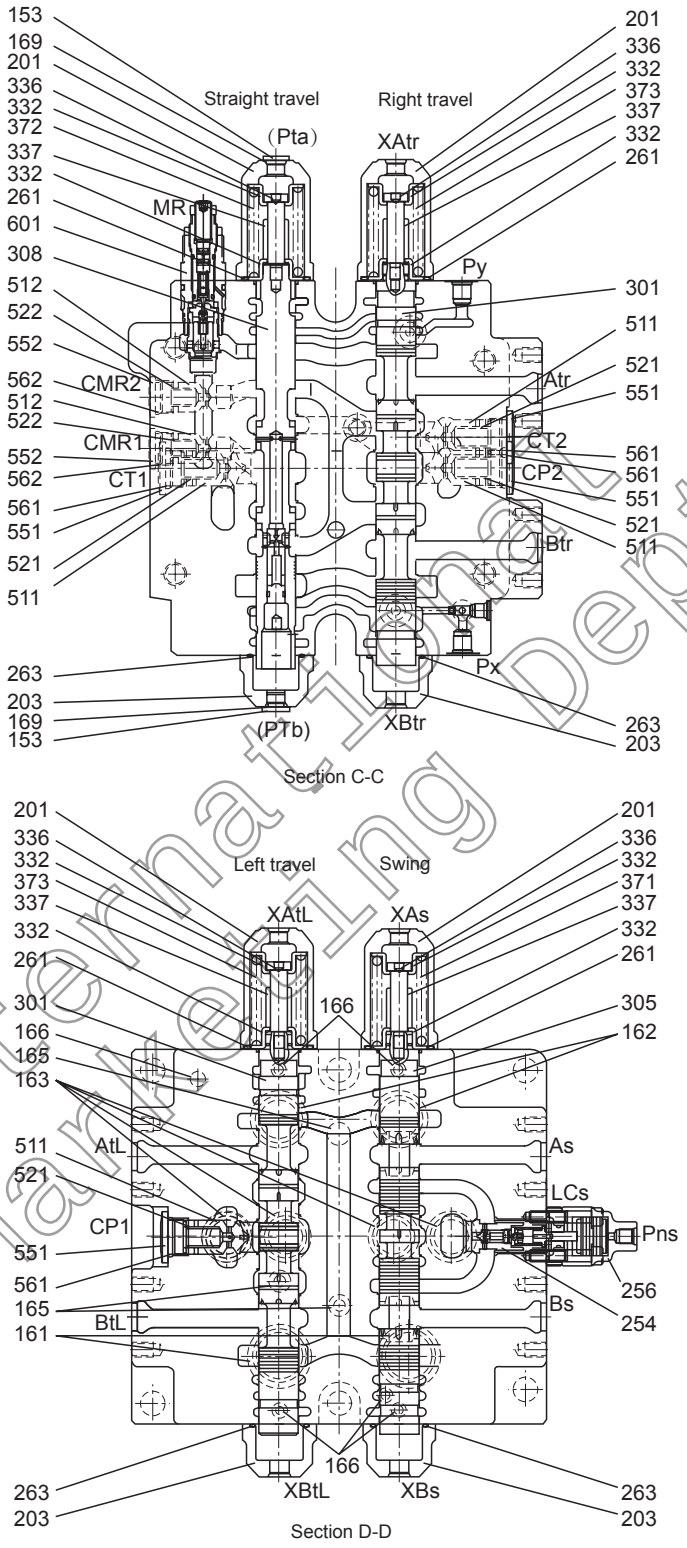


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Fig. 4-45

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Fig. 4-46

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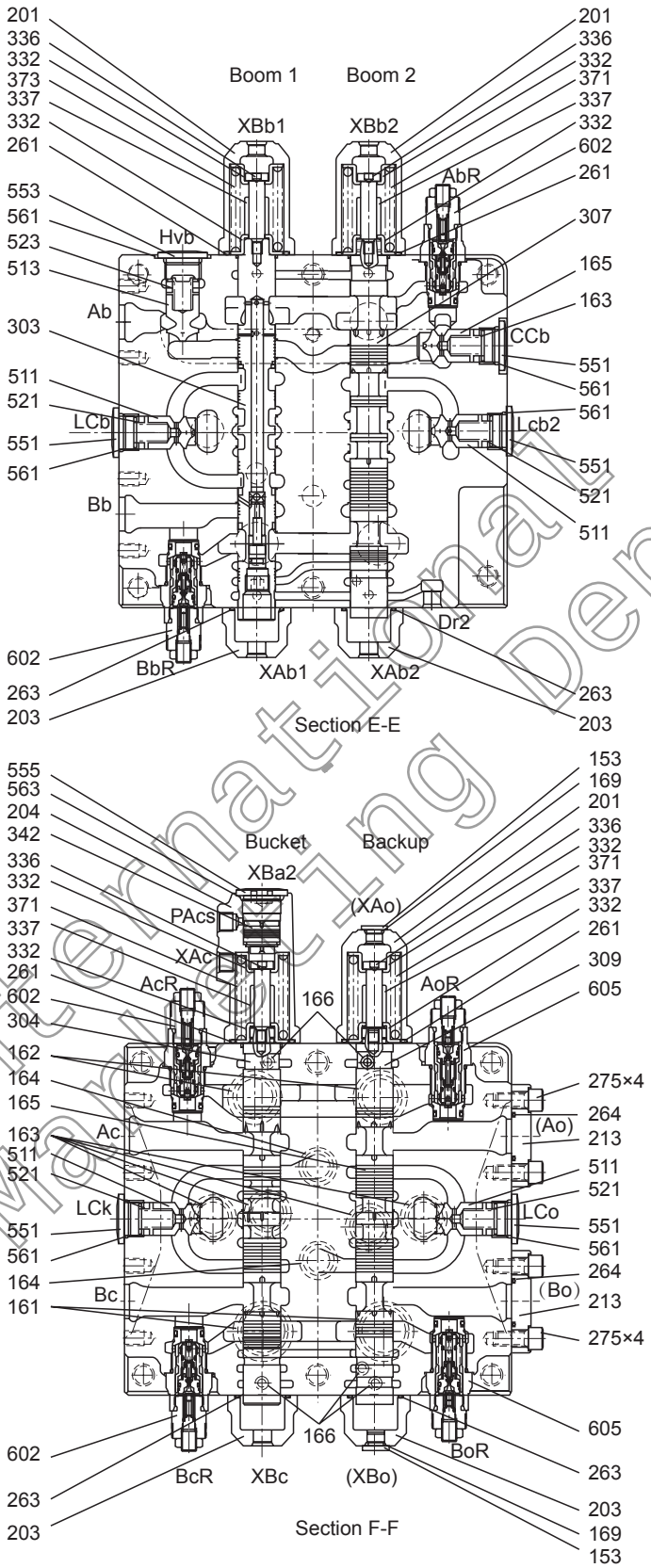
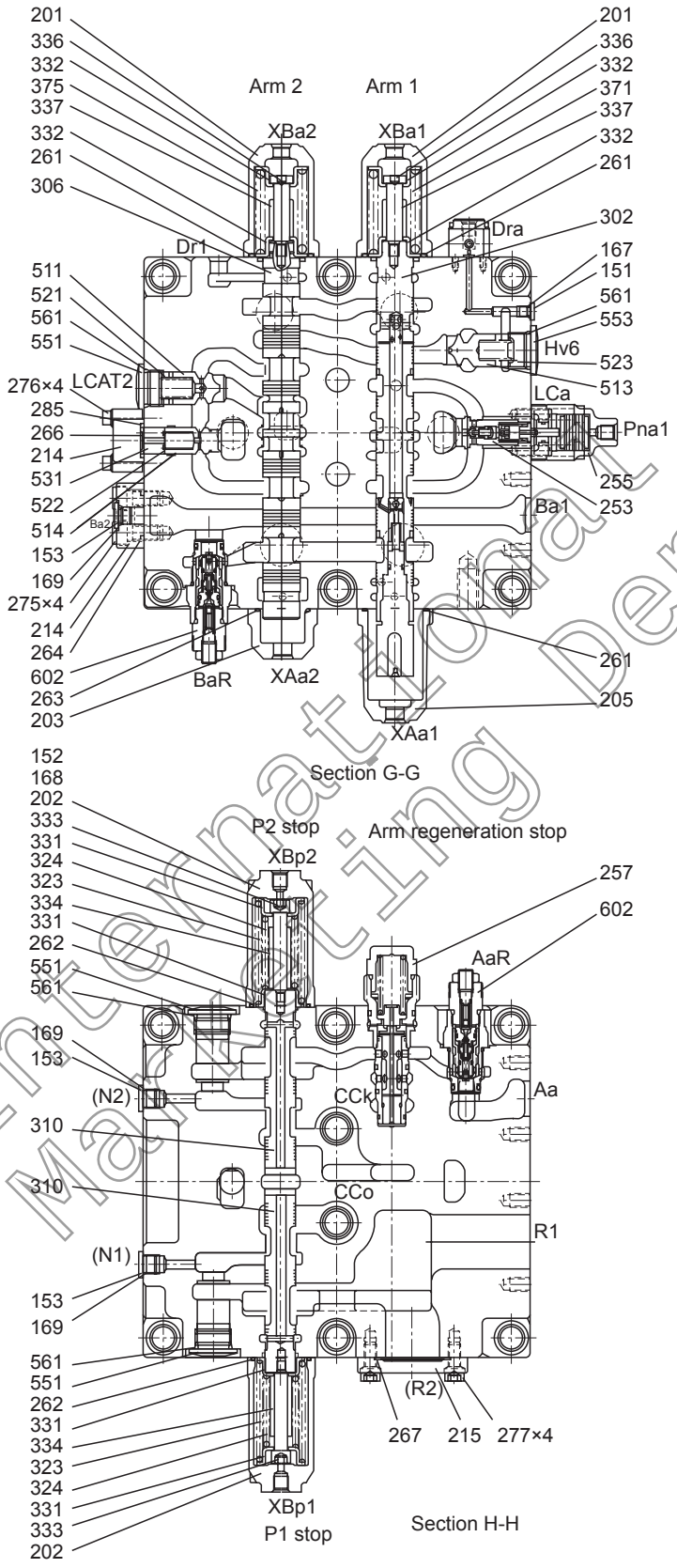


Fig. 4-47

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Fig. 4-48

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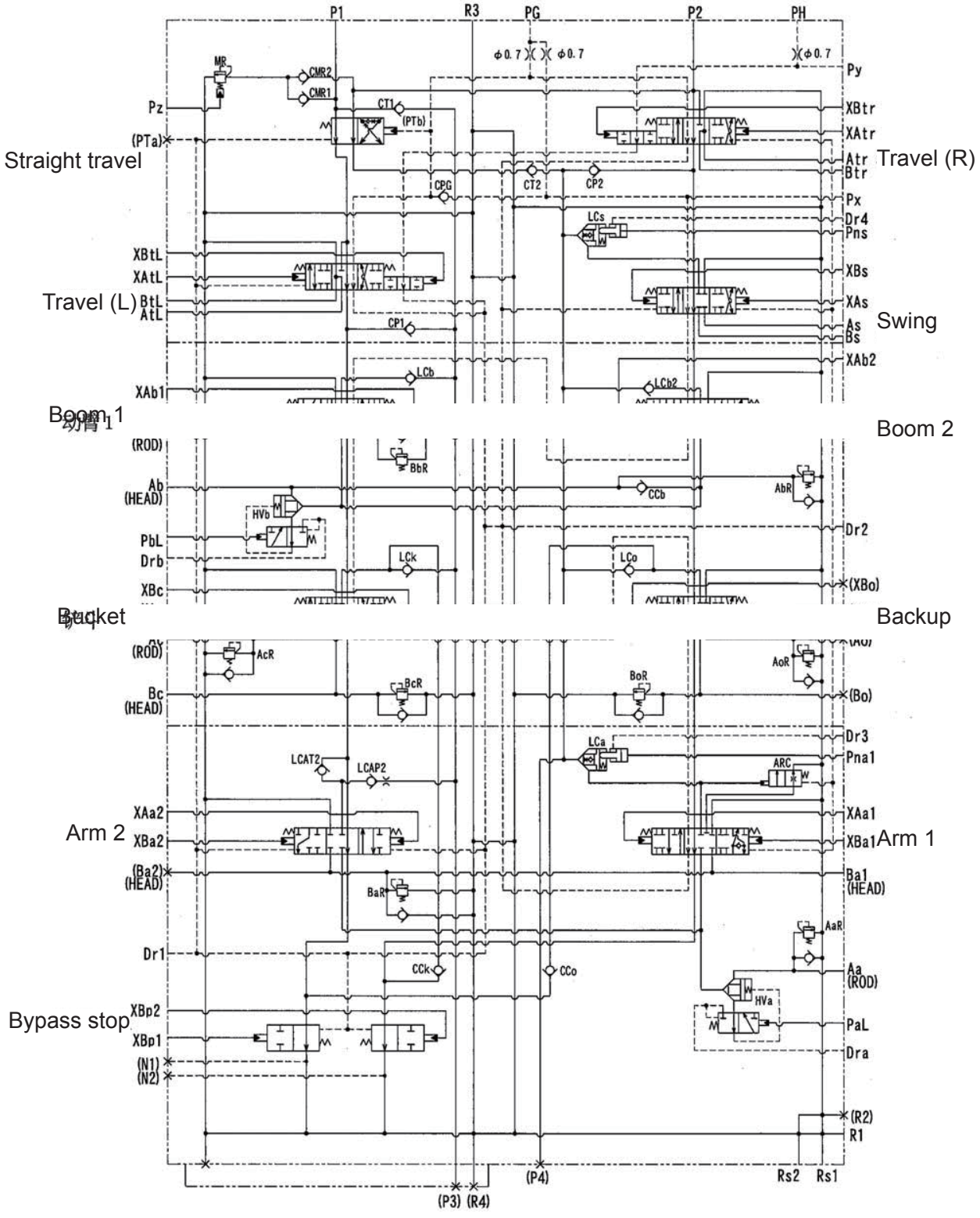
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No.	Part name	Qty	Torque (N.m)	No.	Part name	Qty	Torque (N.m)
101	Valve body A	1		305	Swing spool	1	
102	Valve body B	1		306	Spool, arm 2	1	
103	Valve body C	1		307	Spool, boom 2	1	
151	Oil plug	6	13~17	308	Spool AS, straight travel	1	
152	Oil plug	2	34~39	309	Backup	1	
153	Oil plug	10	69~78	310	Spool, bypass stop	2	
161	O-ring seal	4		323	Spring	2	
162	O-ring seal	6		324	Spring	2	
163	O-ring seal	9		331	Spring seat	4	
164	O-ring seal	2		332	Spring seat	20	
165	O-ring seal	4		333	Bolt with washer	2	16~18
166	O-ring seal	12		334	Stopper	2	
167	O-ring seal	6		336	Bolt with washer	10	37~41
168	O-ring seal	3		337	Stopper	10	
169	O-ring seal	10		341	Oil plug	1	34~39
201	Spring cap	9		342	Piston	1	
202	Spring cap	2		351	节流塞（φ0.7）	3	7.8~9.8
203	Spool cap	9		371	Spring	8	
204	Spring cap	1		372	Spring	1	
205	Spool cap	1		375	Spring	1	
211	Plate	1		511	Cone valve	10	
213	Flange	2		512	Cone valve	2	
214	Check valve plate	1		513	Cone valve	2	
275	Pipeless opening cover plate	1		514	Cone valve	1	
216	Pipeless opening cover plate	1		515	Cone valve	2	
252	Lock valve selector GP	2	9.8~14	521	Spring	12	
253	Logic valve component, arm 1	1		522	Spring	3	
254	Logic valve component, swing	1		523	Spring	2	
255	Logic control valve	2	52~62	531	Spring seat	1	
257	Stop valve GP, arm regeneration	1	120~140	541	Steel ball	1	
261	O-ring seal	11		542	Spring seat	1	
262	O-ring seal	2		543	Spring	1	
263	O-ring seal	9		551	Oil plug	17	370~410
264	O-ring seal	3		552	Oil plug	2	230~260
265	O-ring seal	1		553	Oil plug	2	370~410
266	O-ring seal	1		554	Oil plug	1	25~29
267	O-ring seal	1		555	Oil plug	1	220~260
271	Bolt, socket head	40	52~62	561	O-ring seal	19	
272	Bolt, socket head	4	25~34	562	O-ring seal	2	
273	Bolt, socket head	4	210~260	563	O-ring seal	1	
275	Bolt, socket head	12	140~180	601	Main relief valve	1	120~140
276	Bolt, socket head	4	25~34	602	Port relief valve	6	120~140
277	Bolt, socket head	4	83~110	605	Port relief valve	2	120~140
301	Travel spool	2		971	Bolt, socket head	12	390~470
302	Spool GP, arm 1	1		991	Nameplate	1	
303	Spool GP, boom 1	1		992	Rivet	2	
304	Bucket spool	1					

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4.5.2 Hydraulic circuit (With bucket confluence function)



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Fig. 4-49

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Operating principle

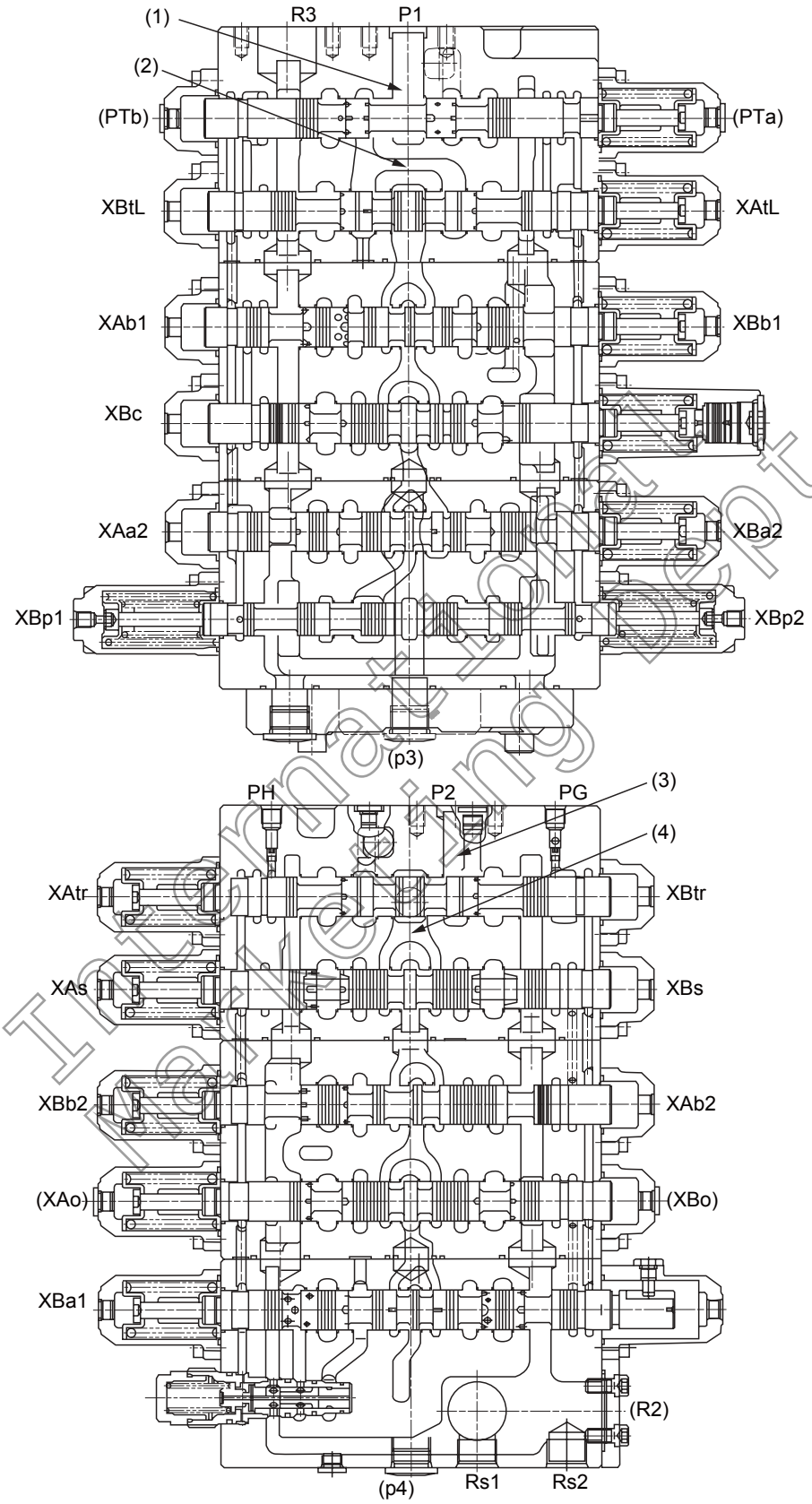
1) When spool is neutral position

(Main circuit)

- When all spools are in neutral position, the working oil from (front) hydraulic pump enters the pump port P1, is guided to the main oil passage (1), and returns to the oil tank via the return ports R1 and R3 by passing through the neutral bypass (2) (function of neutral M-shaped spool) of each spool in straight travel (308), left travel (301), boom 1 (303), bucket (304) and arm 2 (306).
- The working oil from (rear) hydraulic pump enters the pump port P2, is guided to the main oil passage (3), and returns to the oil tank via the return ports R1 and R3 by passing through the neutral bypass (4) (function of neutral M-shaped spool) of each spool in right travel (301), swing (305), boom 2 (307), backup (309) and arm 1 (302).

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Fig. 4-50

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2) Travel

(Pilot circuit)

- When switched to left travel spool or right travel spool, the side oil passage closes and the pressure in port Py (travel signal port) rises.

(Main circuit)

- When pressure is present in pilot port XBtL used for left travel spool (301), the neutral bypass (2) at the side of boom 1 closes. The working oil fed from (front) hydraulic pump is delivered through port BtL to the left travel motor.
- Likewise, when pressure is present in pilot port XBtr used for right travel spool (301), the neutral bypass (2) at the side of arm 1 closes. The working oil fed from (rear) hydraulic pump is delivered through port Btr to the right travel motor.
- On the other hand, the oil returning from both the left and right travel motors via port AtL (Atr) passes the left (right) travel spool and goes back to the oil tank via return ports R1 and R3.
- When operating travel in the opposite side (pressurizing the pilot ports XAtr and XAtL), the above principle also applies.

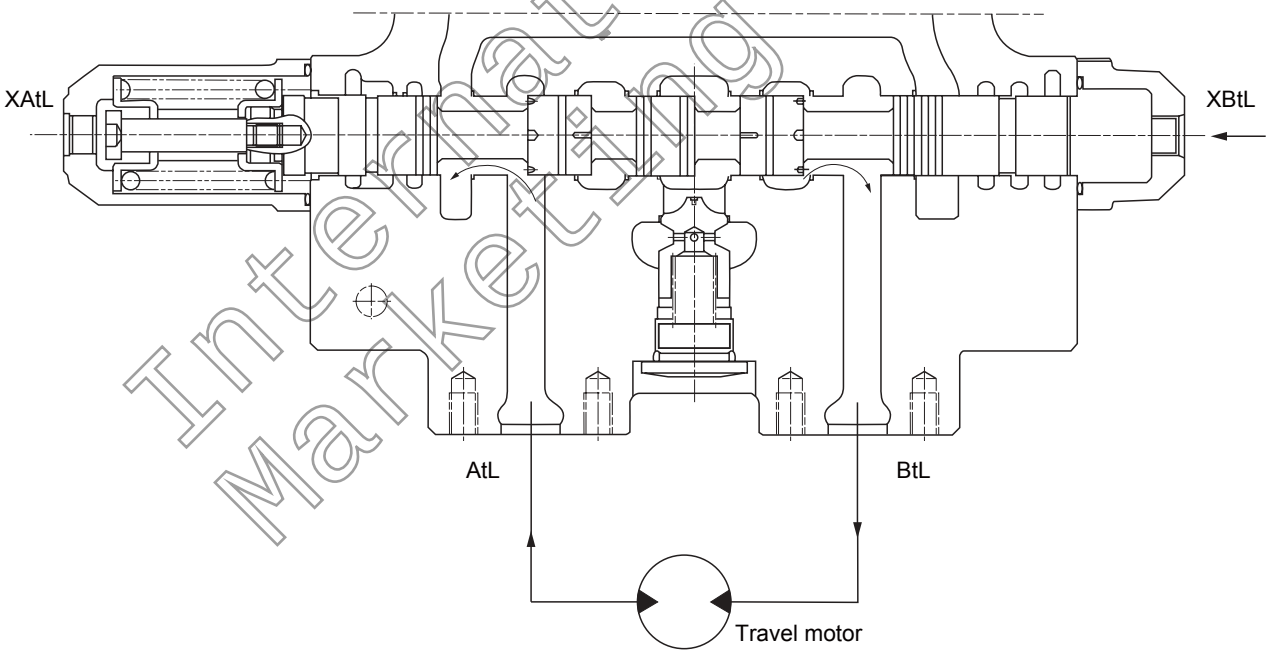


Fig. 4-51

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3) Arm

Arm-out operation

(Pilot circuit)

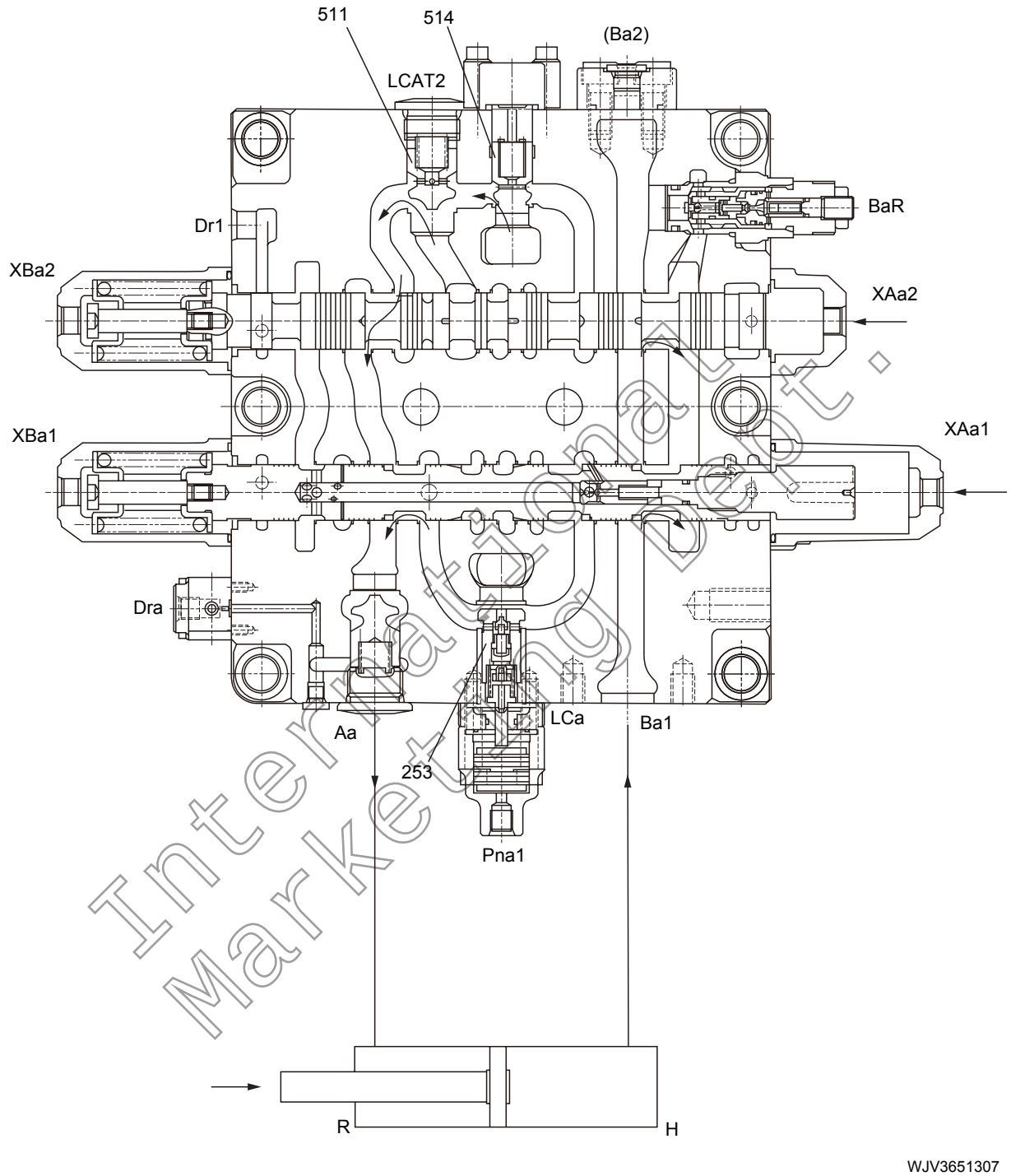
- When switched to the arm 2 spool (302), the side oil passage closes and the pressure in port Px (work equipment signal port) rises.

(Main circuit)

- When performing the arm-out operation, the pilot oil is fed to port XAa1 and port XAa2. When pilot oil is delivered to the two sides of port XAa1 and port XAa2, arm 1 spool and arm 2 spool are switched to the left, as shown in Fig. 4-52. As a result, the working oil from port P2 is introduced into the neutral bypass (4) via the main passage (3). The neutral bypass is cut off by switching the arm 1 spool (302). Therefore, the working oil in the parallel passage pushes open the cone valve (253) of the logic valve, and enters the arm 1 spool (302) via the U passage. The oil from arm 1 spool (302) is then delivered to the rod end (R) of arm cylinder.
- On the other hand, the working oil coming from port P1 is guided to the neutral bypass (2) via the main oil passage (1). The neutral bypass is cut off by switching the arm 2 spool (306). Therefore, the working oil in the parallel passage pushes open the cone valve (514) of logic valve, and working oil from neutral bypass pushes open the cone valve (511) of the check valve and flows into the arm 2 spool (306) via the U passage. The oil then comes into confluence with oil from port Aa in the passage of neutral bypass (306) and is fed to the rod end (R) of the arm cylinder.
- Return oil from the arm cylinder head end (H) via port Bal flows respective tank circuits of arm 1 and arm 2, and returns to working oil tank via tank ports R1 and R3.

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Fig. 4-52

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Arm-in operation

(Pilot circuit)

- When switched to the arm 1 spool (302), the side oil passage closes and the pressure in port Px (work equipment signal port) rises. Pressurized oil is fed to the port PaL at the same time. Relief signal is sent to the lock valve selector GP (252).

(Main circuit)

- When performing the arm-in operation, pilot oil is fed to ports XBa1 and XBa2. When pilot oil is delivered to the two sides of port XBa1 and port XBa2, arm 1 spool and arm 2 spool are switched to the right as shown in Fig. 4-53. As a result, working oil from P2 is guided to the neutral bypass (4) via the main passage (3). The neutral bypass is cut off by switching arm 1 spool (302). Therefore, the working oil in the parallel passage pushes open the cone valve (253) of the check valve and flows to the arm 1 spool (302) via the U passage. Then, it flows to the periphery of arm 1 spool (302) and is delivered to the arm cylinder head end (H) via port Ba.
- On the one hand, the working oil from port P1 is guided to the neutral bypass (2) via the main passage (1). The neutral bypass is cut off by switching the arm 2 spool (306). Therefore, the working oil in the parallel passage pushes open the cone valve (514) of the arm 2 check valve, and the working oil from neutral bypass pushes open the cone valve (511) of the check valve and flows to the arm 2 spool (306) via the U passage. Then, it comes into confluence with oil from port BaI in the internal passage of arm 2 spool (306).
- On the other hand, the oil returning from the arm cylinder rod end (R) and the working oil whose pressure rises due to the dead weight of arm goes back to the port Aa. The working oil returned to the port Aa flows into the valve spool via the holes (a) on the periphery of arm 1 spool (302), pushes open the cone valve (302-317) only under light load, and comes into confluence in the peripheral holes with oil from port BaI.
- If the pressure at the arm cylinder head end and in the U passage rises, arm regeneration check valve spool (257-103) switches to the left, as shown in Fig. 4-54, and closes due to the back pressure of the cone valve (302-317) in the spool. In this way, the arm regeneration function is deactivated and return oil from the arm cylinder rod end (R) flows to the spool via the hole (a) on the periphery of arm 1 spool (302). Then, it flows into arm regeneration stop valve (257) via hole (c) on the periphery of arm 1 spool (302), and returns to the working oil tank via tank ports R1 and R3.

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- **Light load**

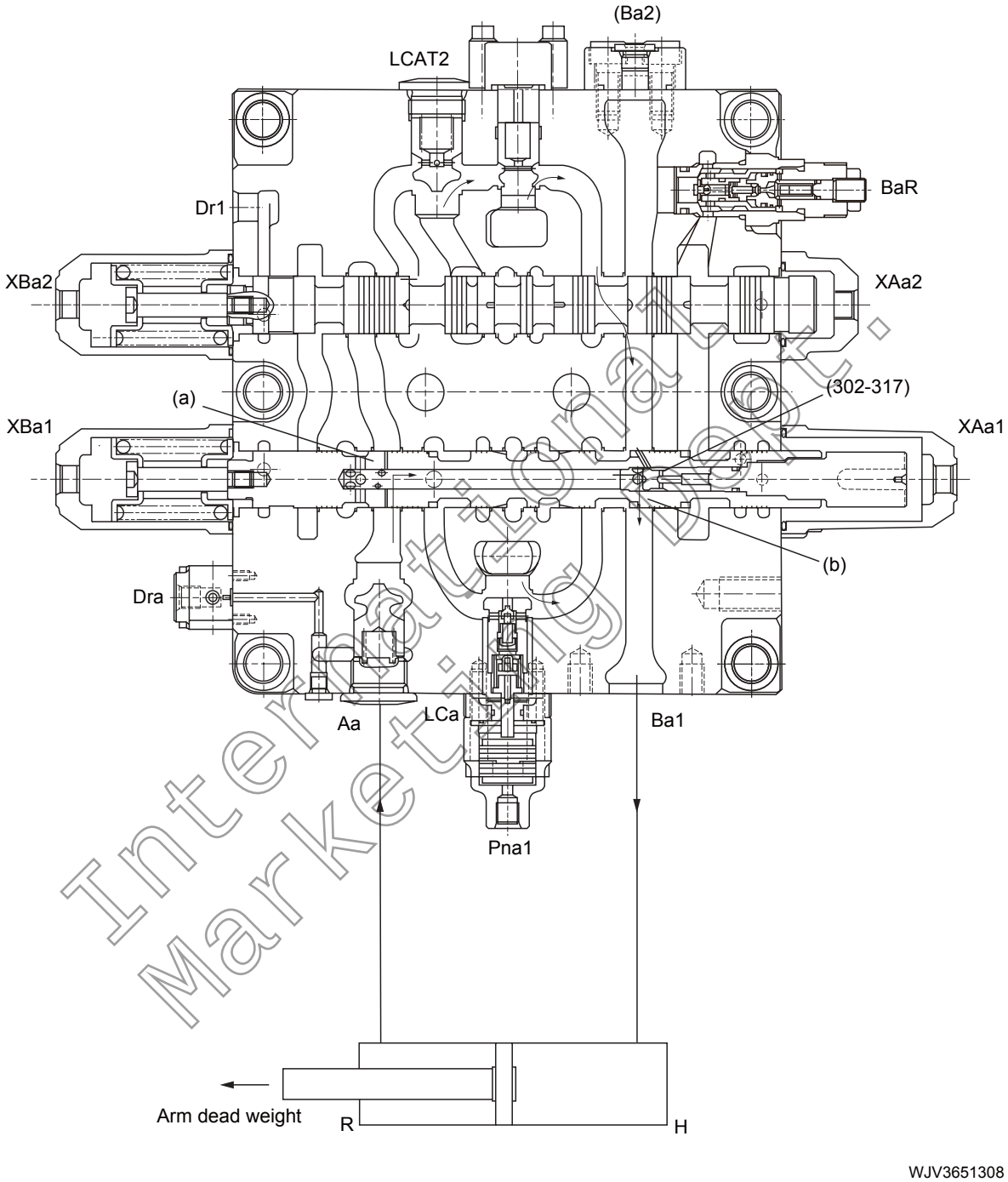


Fig. 4-53

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- **When pressure in arm cylinder head end (H) rises**

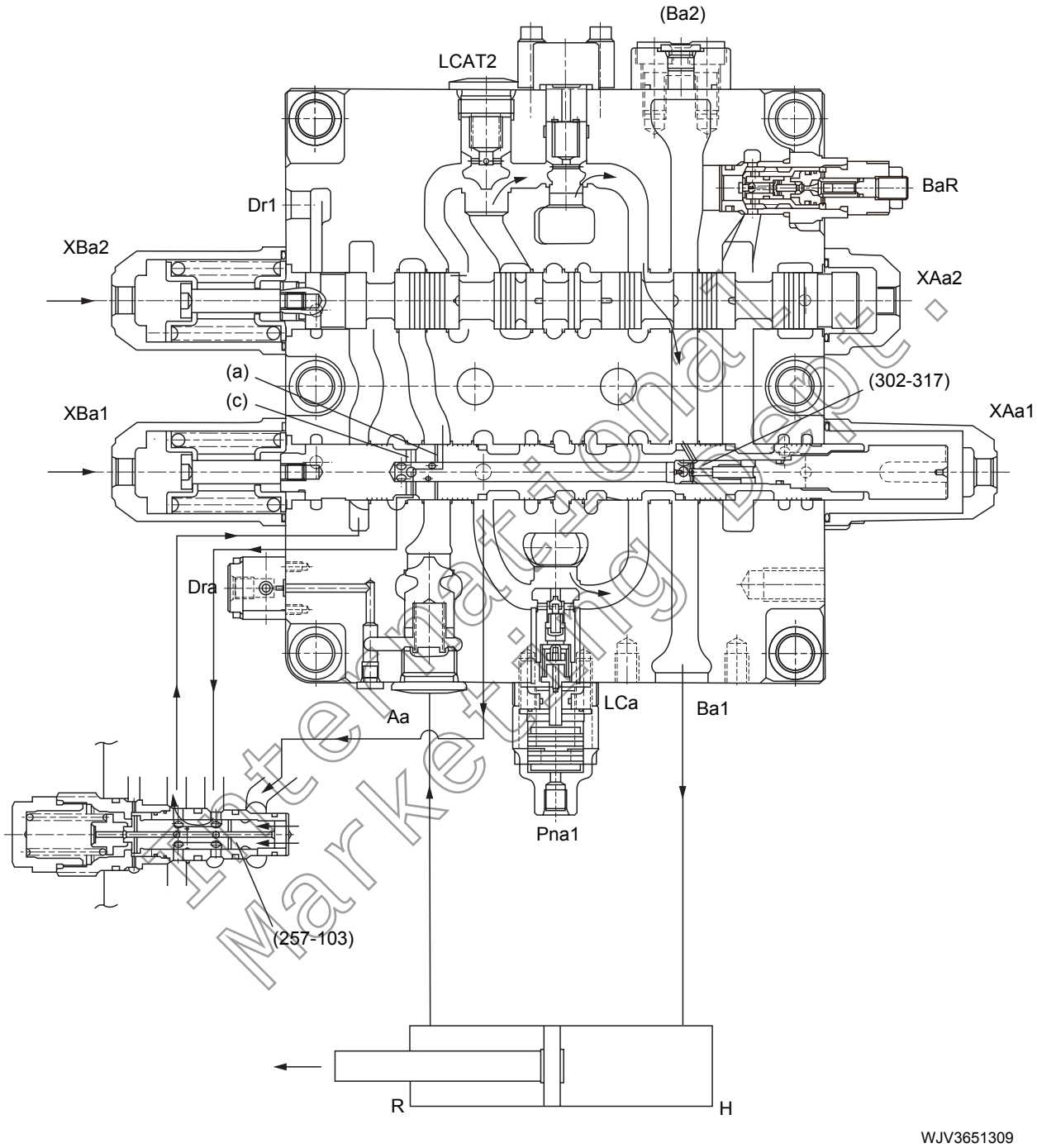


Fig. 4-54

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4) Boom

Boom-up operation

(Pilot circuit)

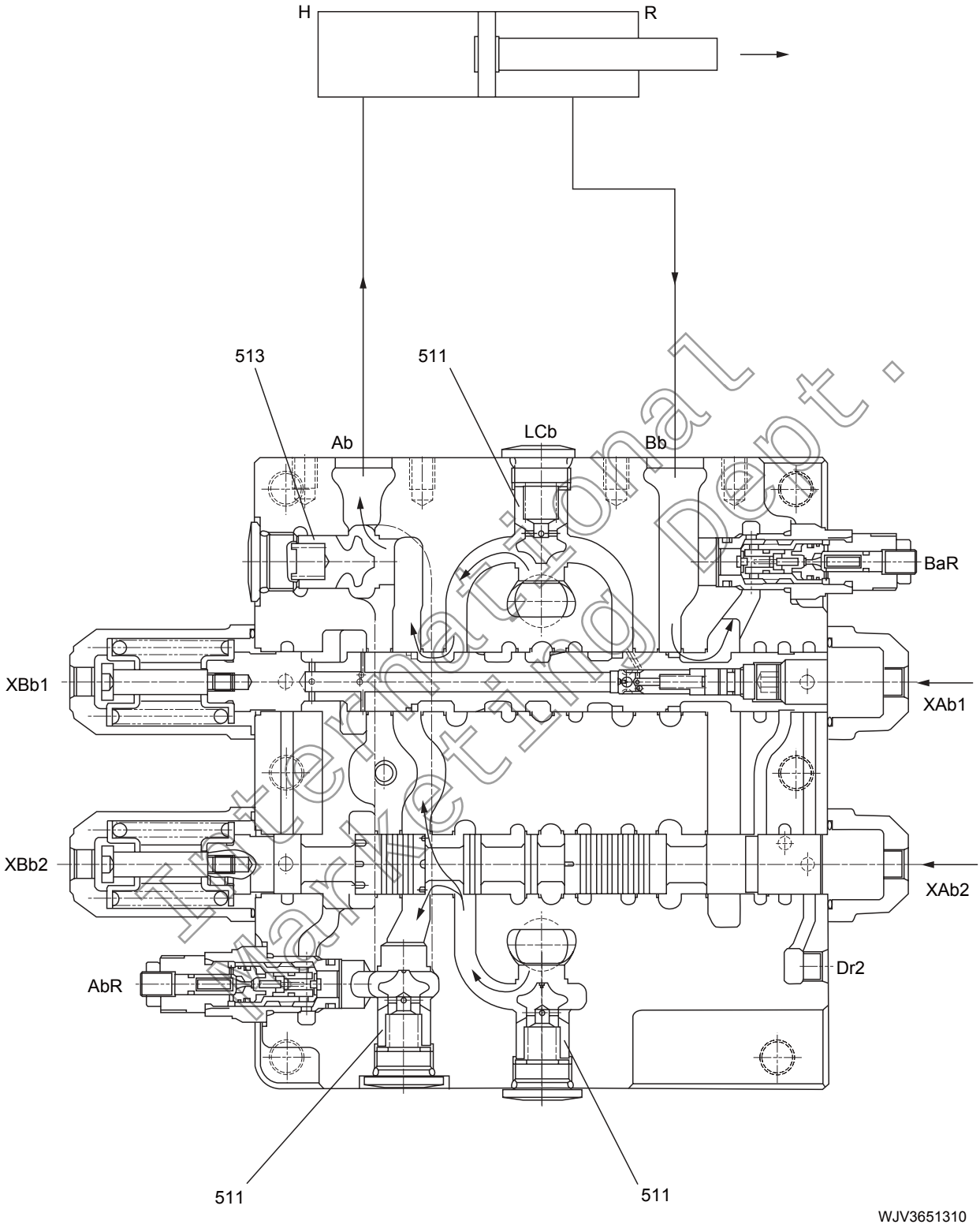
- When switched to the boom 1 spool (307), the side passage is closed and the pressure in port Px (work equipment signal port) rises.

(Main circuit)

- When boom-up operation is performed, the pilot oil is fed to port XAb1 and boom 1 spool (303) moves to the left as shown in Fig. 4-55. The working oil from port P1 is introduced to the neutral bypass (2) via the main passage (1). The neutral bypass is cut off by switching boom 1 spool (303). In this way, the working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows to the boom 1 spool (303) via the U passage. It then flows to the periphery of boom 1 spool (303) and is delivered to the boom cylinder head end (H) via port Ab.
- At the same time, the pilot oil is also fed to port XAb2 and boom 2 spool (307) moves to the left as shown in Fig. 4-55. The working oil from P2 flows the parallel passage. As the switching boom 2 spool (307) cuts off the neutral bypass, the working in the parallel passage flows into boom 2 spool (307) via the U passage. The oil then pushes open the cone valve (511) of the check valve, comes into confluence with the oil from port Ab, and is fed to the boom cylinder head end (H). (This is called the boom confluence function.)
- On the other hand, the oil flows to the periphery of boom 1 spool (303) via port Bb from oil return side of the boom cylinder rod end (R) and goes back to the working oil tank via the ports R1 and R3.

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Fig. 4-55

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Boom-down operation

(Pilot circuit)

- When switched to the boom 1 spool (303), the side passage is closed and the pressure in port Px (work equipment signal port) rises. Pressurized oil is fed to the port PbL at the same time. Relief signal is sent to the lock valve selector GP (252).

(Main circuit)

- When boom-down operation is performed, the pilot oil is fed to port XBb1 and boom 1 spool (303) moves to the right as shown in Fig. 4-56. The working oil from port P1 is introduced to the neutral bypass (2) via the main passage (1). The neutral bypass is cut off by switching boom 1 spool (303). In this way, the working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows to the boom 1 spool (303) via the U passage. It then flows to the periphery of boom 1 spool (303) and is delivered to the boom cylinder rod end (R) via port Bb.
- On the other hand, the oil returning from the head end (H) of boom cylinder flows to the hole (a) and periphery of boom 1 spool (303).
- The pressure of return oil rises due to the dead weight of boom. To maintain sufficient pressure, with the help of the oil passage inside the spool, the cone valve (303-317) in spool is pushed to the right, as shown in Fig. 4-56, and the oil flows out of the spool. As the working oil for boom-down operation, the pressurized oil is again delivered to the boom cylinder rod end (R) (which is called boom regeneration function). The return oil entering the internal passage of spool via the hole (a) partially goes back to the oil tank via the hole (b).

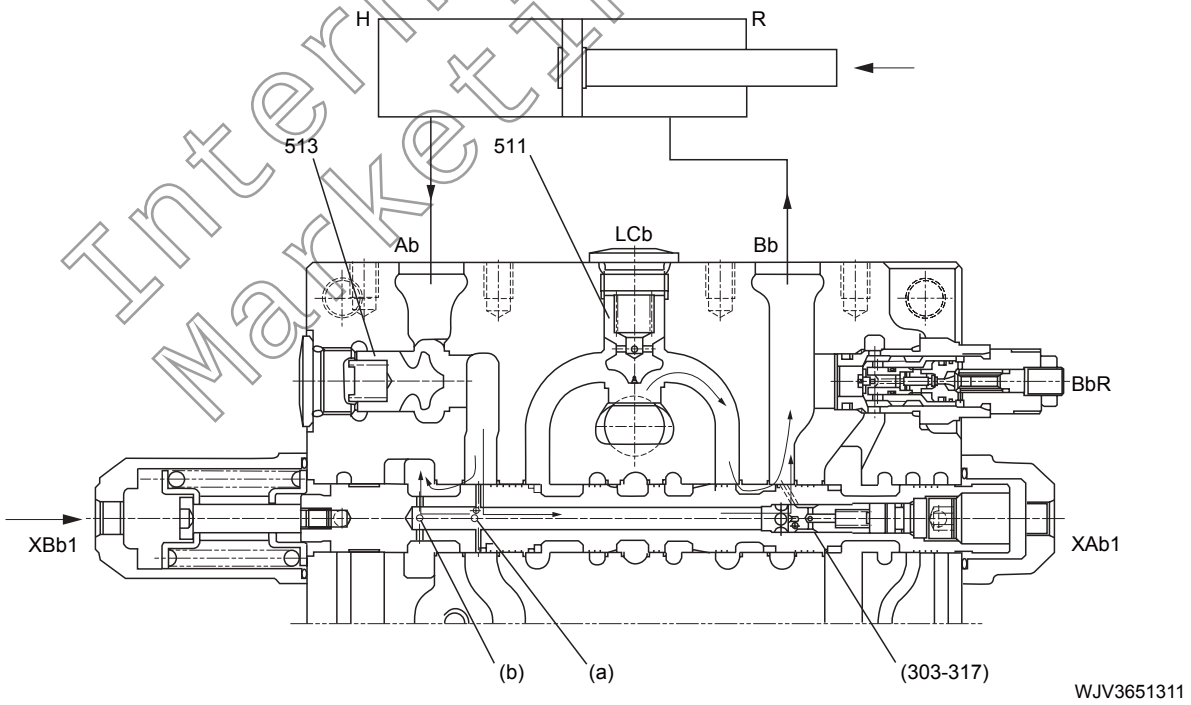


Fig. 4-56

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5) Bucket

Bucket-dig operation

(Pilot circuit)

- When switched to the bucket spool (304), the side passage is closed and the pressure in port Px (work equipment signal port) rises. The pressure oil is fed to port XBp2 at the same time.

(Main circuit)

- When bucket-dig operation is performed, the pilot oil is fed to the port XBc and the bucket spool (304) moves to the left as shown in Fig. 4-57. The working oil from port P1 is guided to the neutral bypass (2) via main passage (1). As the neutral bypass is cut off by switching bucket spool (304), the working oil in the parallel passage pushes open the cone valve (511) of the check valve, and flows to the bucket spool (304) via the U passage. It then flows to the periphery of bucket spool (304) and is fed to the bucket cylinder head end (H) via port Bc.
- On the other hand, return oil from the bucket cylinder rod end (R) flows in via port Ac. It then goes back to the oil tank via the ports R1 and R3 from the periphery of spool.
- When boom-up and bucket-dig operations are performed at the same time, the pilot oil is led to the port PAcs. Therefore, the travel of bucket spool is not restricted to the end, but can be held in a position on the way. As a result, bucket cylinder passage is throttled and working oil flows to boom 1 spool (303) via bucket spool (304). In this way, boom-up operation have the priority.

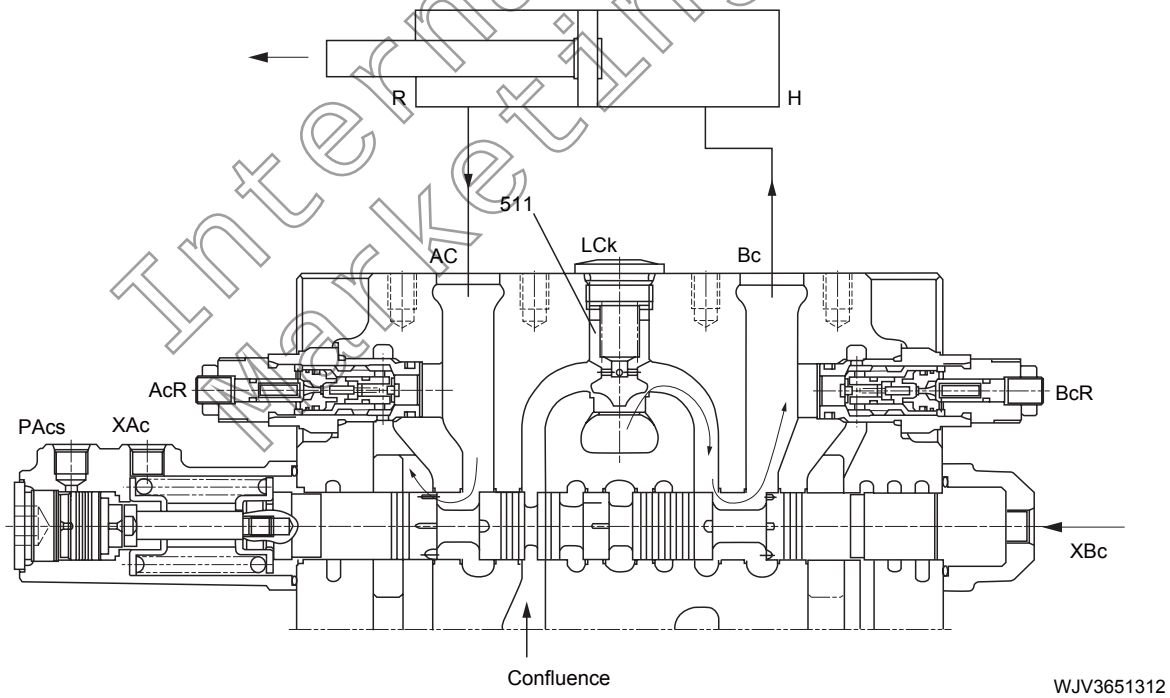


Fig. 4-57

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Bucket-dump operation

(Pilot circuit)

- When switched to the bucket spool (304), the side passage is closed and the pressure in port Px (work equipment signal port) rises. The pilot oil is also fed to the port XBp2 at the same time.

(Main circuit)

- When bucket-dump operation is performed, the pilot oil is fed to the port XAc and bucket spool (304) moves to the right as shown in Fig. 4-58. The working oil from port P1 is led to the neutral bypass (2) via the main passage (1). The neutral bypass is cut off by switching bucket spool (304). Therefore, the working oil in the parallel passage pushes open the cone valve (511) of the check valve and flows to the bucket spool (304) via the U passage. It then flows to the periphery of bucket spool (304) and is fed to the bucket cylinder rod end (R) via the port Ac.
- On the other hand, return oil from the bucket cylinder head end (H) enters via the port Bc, passes the spool periphery of spool, and goes back to working oil tank via the ports R1 and R2.

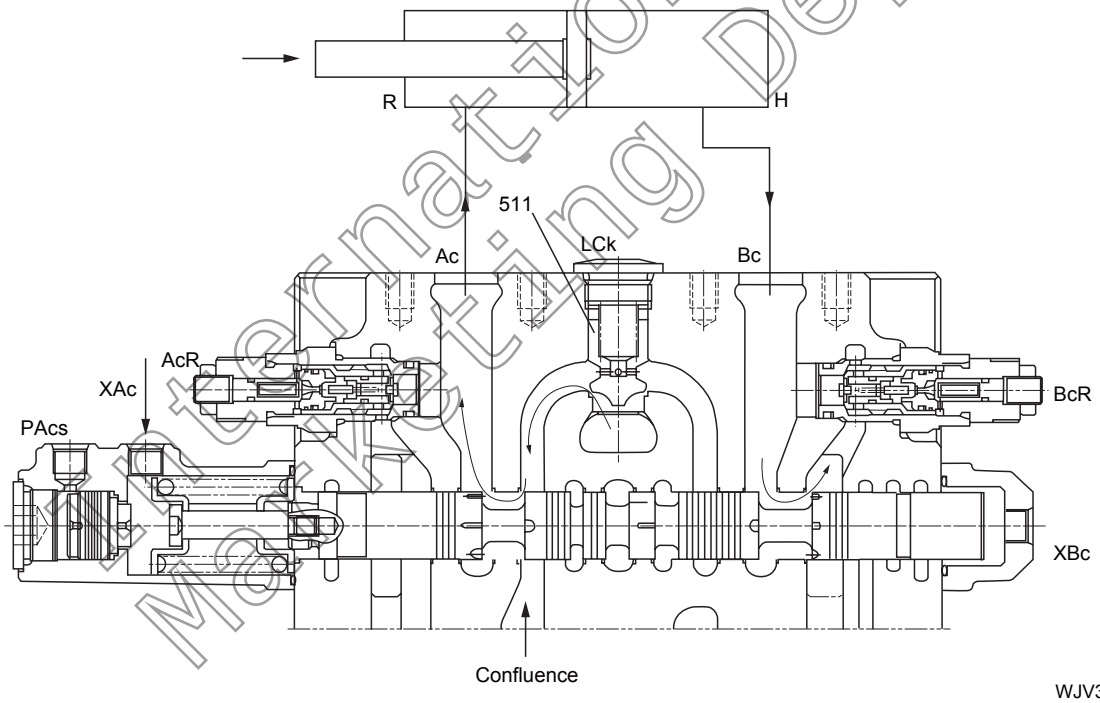


Fig. 4-58

Bucket confluence

- When bucket-dig or -dump operation is performed, the pilot oil is fed to the port XBp2 and the neutral bypass stop valve spool (310) is switched. Working oil from port P2 is led to the neutral bypass (4) via the main passage (3). The neutral bypass is cut off by switching neutral bypass valve spool (310). Therefore, working oil pushes open the check valve (515) and comes into confluence with bucket spool (304) via the internal passage and the U passage.

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6) Swing

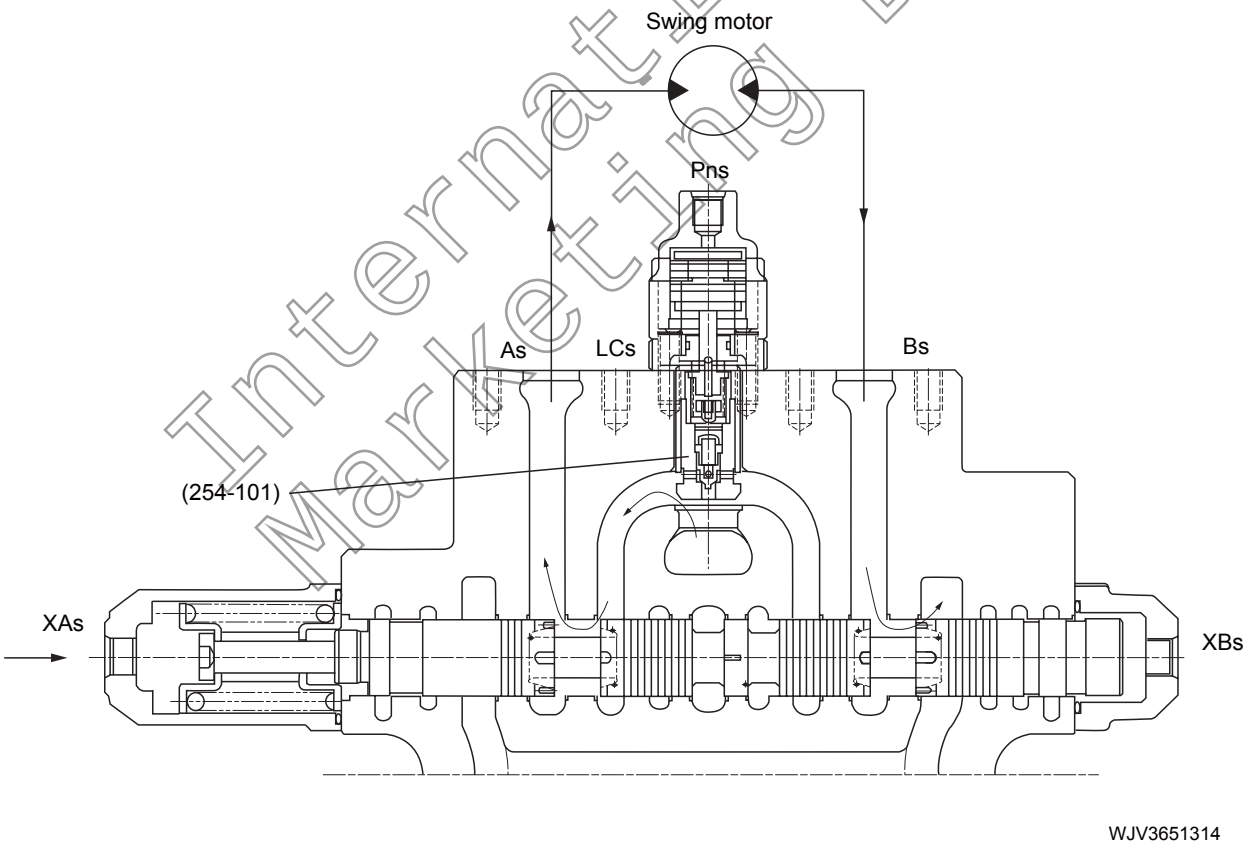
When swing operation performed separately

(Pilot circuit)

- When switched to the swing spool (305), the side passage is closed and the pressure in the port Px (work equipment signal port) rises.

(Main circuit)

- When swing is operated separately, the pilot oil is fed to the port XAs (or XBs) and swing spool (305) is switched. Working oil from port P2 is led to the neutral bypass (4) via the main passage (3). Neutral bypass is cut off by switching swing spool (305). Therefore, working oil in the parallel passage pushes open the logic cone valve (254-101) of the swing logic component and flows to the swing spool (305) via the U passage. It then flows to the periphery of swing spool (305) and is delivered to the swing motor via port As (or Bs).
- On the other hand, return oil from the swing motor flows in via port Bs (or port As). Then, it flows into tank ports R1 and R2 from the periphery of spool and goes back to the working oil tank.



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Fig. 4-59

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7) Priority function

- This function enables the working oil from port P to be sufficiently allocated to the work equipment under higher load in order to improve the operability when the arm-in operation is performed along with swinging operation.
- The following shows the priority of swinging operation relative to the arm-in operation.

(Main circuit)

- When pressure oil is applied to the port Pna1 of the logic control valve (255), the piston (255-356) and spool (253-107) move upward. The lifting distance of cone valve (253-101) is limited.
- In this way, the passage from the parallel passage to the U passage is throttle. As a result, oil from the arm 1 spool has the priority to go to the swing spool, giving the priority to the boom-up operation.

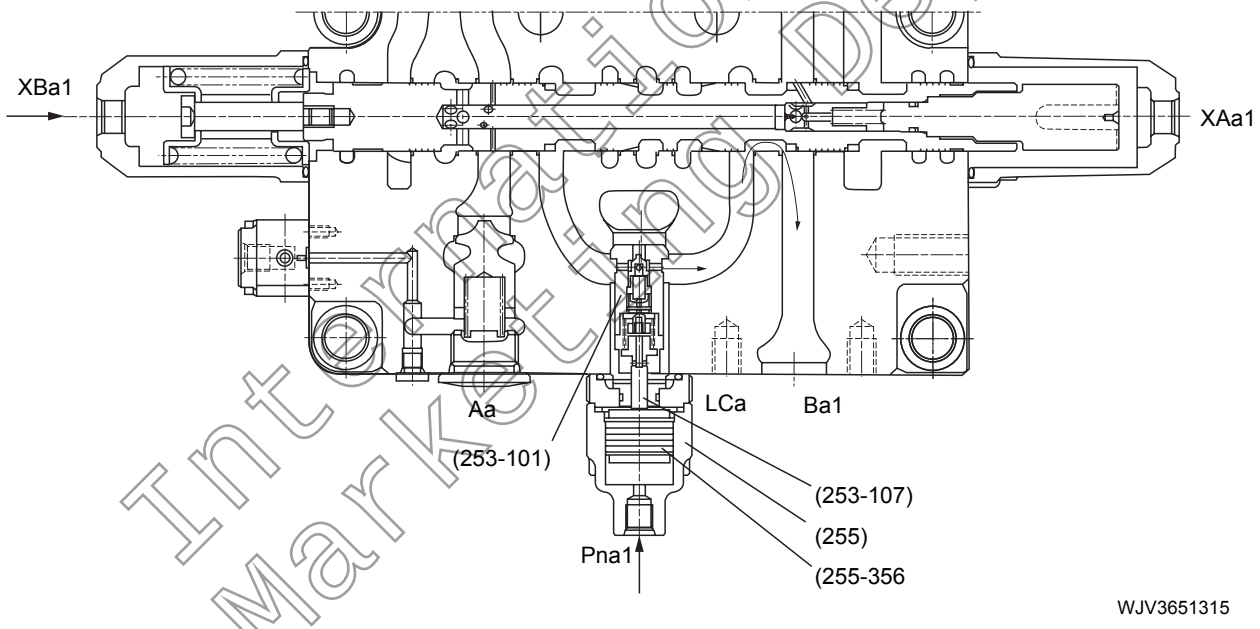


Fig. 4-60

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8) Backup

The backup spool is used to control attachment such as hydraulic shear.

Backup operation

(Pilot circuit)

- When switched to the backup spool (309), the side passage is closed and the pressure in port Px (work equipment signal port) rises.

(Main circuit)

- When the backup is operated, the pilot oil is fed to the port XAo (or XBo) and the backup spool (309) is switched. Working oil from port P2 is fed to the neutral bypass (4) via the main passage (3). Neutral bypass is cut off by switching backup spool (309). Therefore, working oil in the parallel passage pushes open the cone valve (511) of the check valve and flows to the backup spool (309) via the U passage. Then, it flows into the periphery of backup spool (309) and is supplied into the attachment via port Ao (or Bo).
- On the other hand, return oil from the attachment flows in via port Bo (or port Ao). Then, it flows into tank ports R1 and R2 from the spool periphery and returns to the working oil tank.

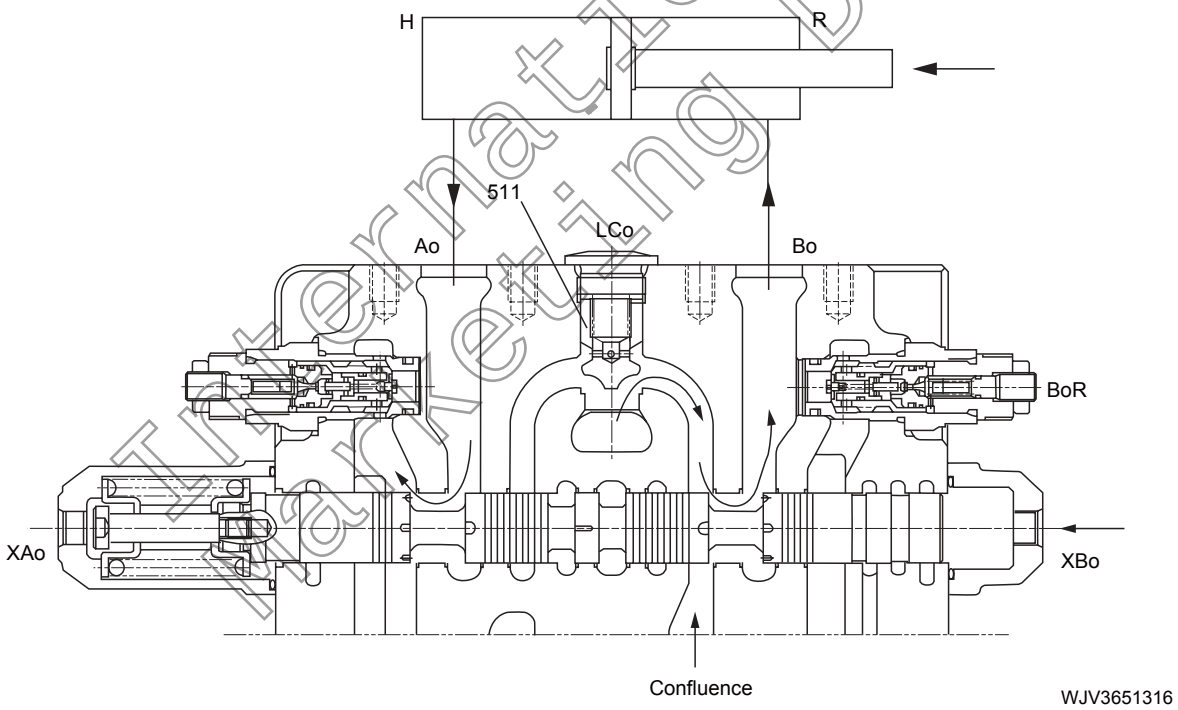


Fig. 4-61

Backup confluence

To achieve backup confluence, pilot oil is also fed to port XBp1 and the bypass stop valve spool (310) is switched. Working oil from port P1 is introduced into neutral bypass (2) via main passage (1). Neutral bypass is cut off by switching bypass valve spool (310). Therefore, working oil pushes open the cone valve (515) of check valve and comes into confluence with backup spool (309) via the internal passage and the U passage.

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9) Straight travel

When travel spool (301) is operated along with other spools at the same time.

The following case shows when travel spool (301) and swing spool (305) are operated at the same time.

(When pilot oil is delivered to the ports XAtL, XAtr and Xas)

(Pilot circuit)

- Close the side passage of right/left travel spool (301) and the downstream side passage of swing spool (305). Pilot oil from port PG is fed to port PTa in order to switch the straight travel spool (308).

(Main circuit)

- When straight travel spool (308) is switched, the port P2 and the right/left travel spool (301) are interconnected through for priority. The port 1 and the parallel passage of swing - boom 2 - backup - arm 1 oil circuit / boom 1 - bucket/ - arm 2 circuit are interconnected through for priority. Therefore, the working oil from port P2 is mainly delivered to the ports Atl and Atr and distributed evenly to the two travel motors.
- On the other hand, the working oil from port P1 is delivered to the swing motor via port As.
- When oil pressure in the port P2 is lower than that in the port P1, the working oil form port P1 will be partially delivered to the port P2. In this way, sudden drop of travel speed can be prevented.

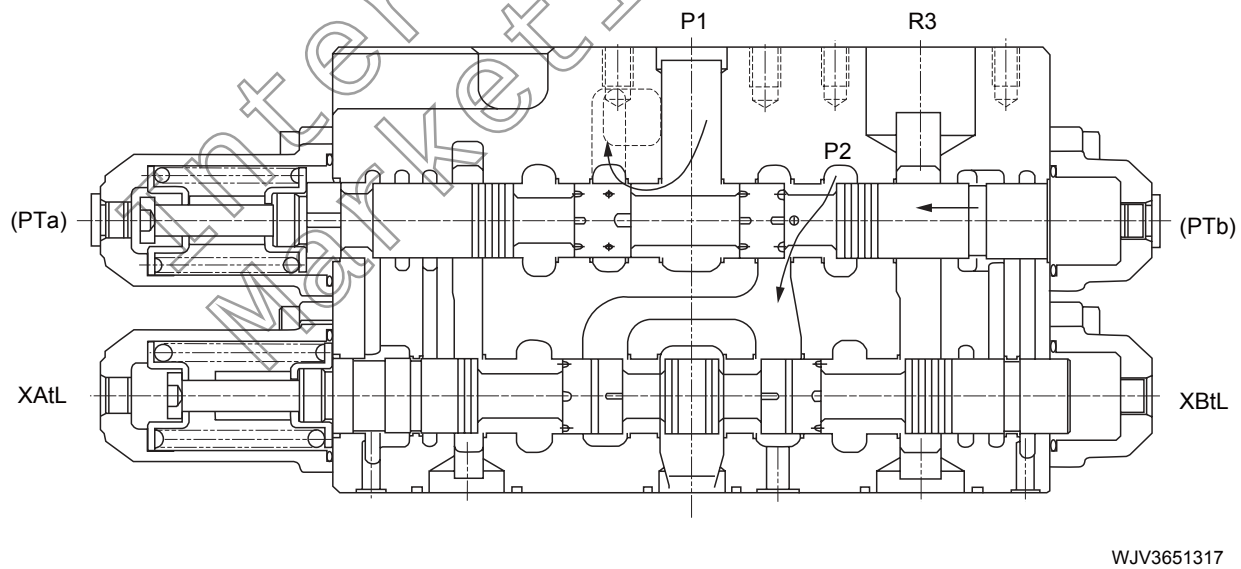


Fig. 4-62

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10) Function of lockout valve

The lockout valve selector module (252) is mounted between the arm cylinder rod end (R) and the arm 2 spool (302) and arm 2 spool (306). It is used to reduce the internal leakage of the spool due to cylinder pressure.

Likewise, lockout valve selector module (252) is also mounted between the boom cylinder head end (H) and the arm 1 spool (303) and boom 2 spool (307) to reduce the internal leakage of he spool due to cylinder pressure.

The figure below shows the case of boom cylinder head end (H). (Similar case applies to the arm cylinder rod end (R).)

Spool in neutral position

- When boom 1 spool (303) and boom 2 spool (307) are in a neutral position, the spool (252-511) inside the lockout valve selector module is pressed against the seat of the body (252-101) of the lockout valve selector module, as shown in Fig. 4-63, by the preload of spring (252-512).
- In this position, working oil in the boom cylinder head end (H) flows in via hole (a) and flows out from hole (b) through the periphery of the lockout valve selector module spool (252-511), pressing the cone valve (513) against the seat of the valve block via hole (b). By this means, oil leakage is reduced.

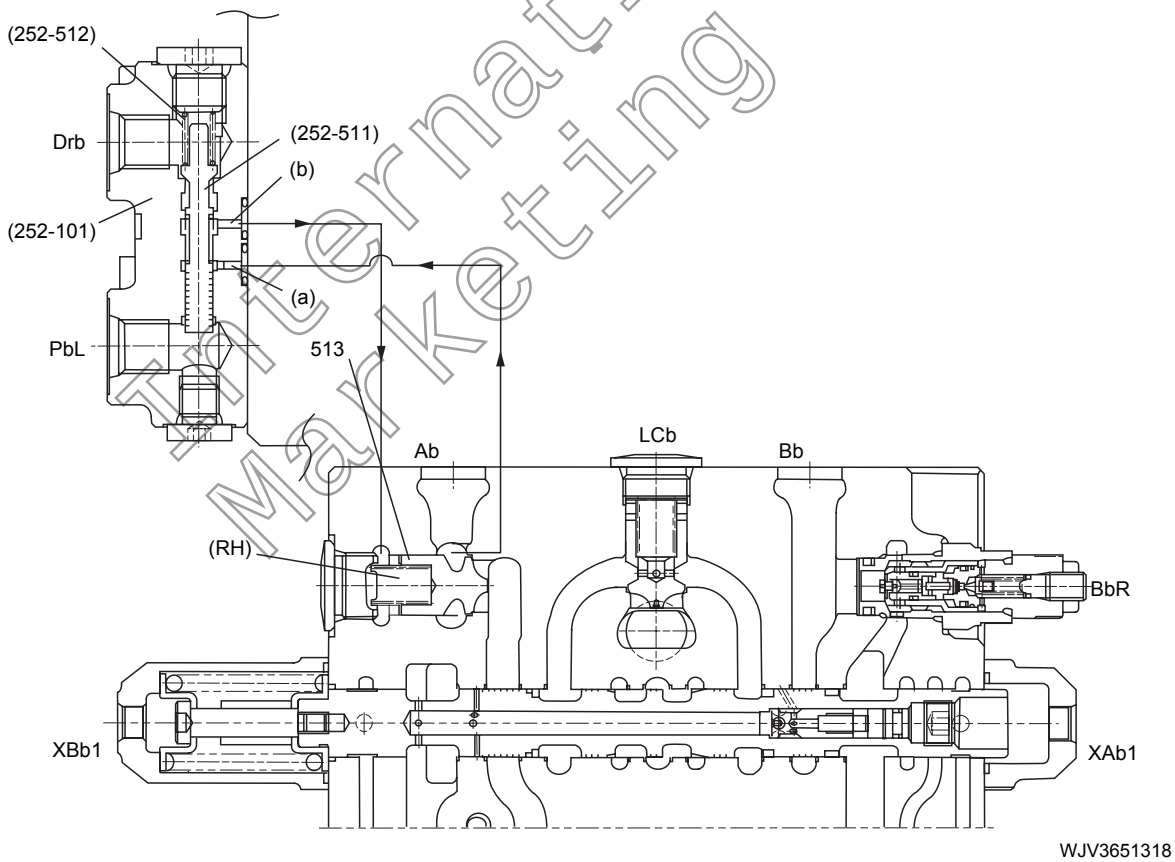


Fig. 4-63

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Boom-down operation

In boom-down operation the pilot oil is fed to the ports PbL, XBb1 and XBb2. Spool (252-511) inside the lockout valve selector module is pushed to the top by the pilot oil as shown in Fig. 4-64. Due to the movement of spool (252-511) inside the lockout valve selector module, hole (a) is cut off and working oil from boom cylinder head end (H) does not go to spring chamber (RH). In addition, oil in the spring chamber (RH) enters the oil leak circuit via the hole (b). In this way, the cone valve (513) is pushed open by the pressure in boom cylinder head end (H) and the function of the lockout valve selector module (252) is deactivated.

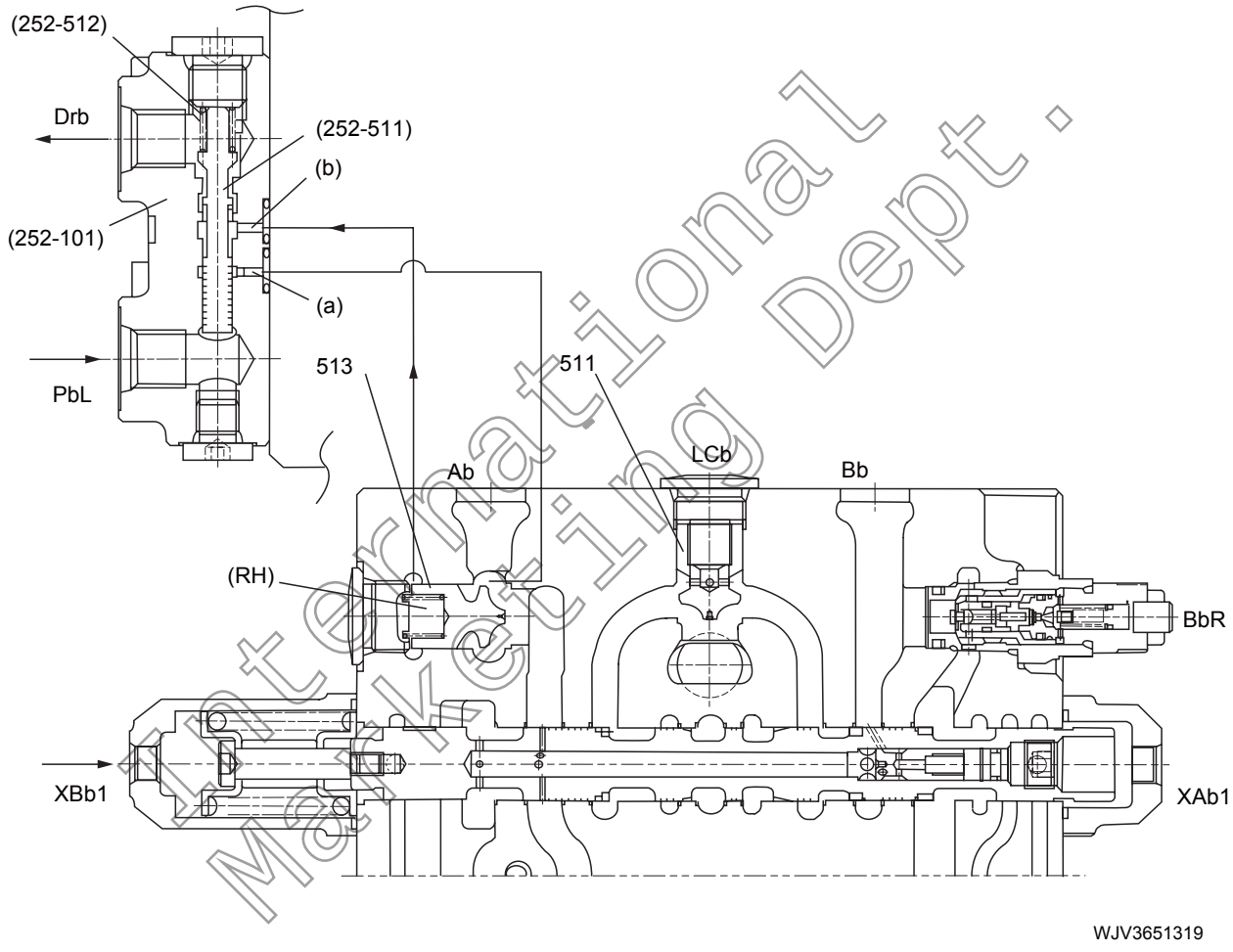


Fig. 4-64

Boom-up operation

In boom-up operation the pilot oil is fed to the ports XAb1 and XAb2. The cone valve (513) is pushed open by the oil from boom 1 spool (303) and boom 2 spool (307). The working oil goes to the port Ab as a result.

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11) Function of main relief valve

The main relief valve is mounted on the valve block A (101). It has the following functions:

- Working oil fulfils the cavity (a) through the hole in valve post housing (601-101) and valve post (601-511). The valve post (601-511) is therefore pressed against the housing (601-101). Reliable sealing has formed as a result.
- When pressure in passage (P) exceeds the preload of spring (601-521), the cone valve (611) opens. Therefore, the working oil passes through the gap between the housing (601-101) and valve pocket (601-102) from the periphery of cone valve (601-401) and goes to the low pressure passage (R).
- Opening of cone valve (601-401) causes pressure drop in cavity (a). So the valve post (601-511) is opened. In this way, working oil in passage (P) flows to the low pressure passage (R) directly.
- When pressure oil higher than 3MPa is fed to the port Pz, it pushes plunger (601-302) to the left. The preload of spring (601-512) increases as a result and pressure boosts at the moment.

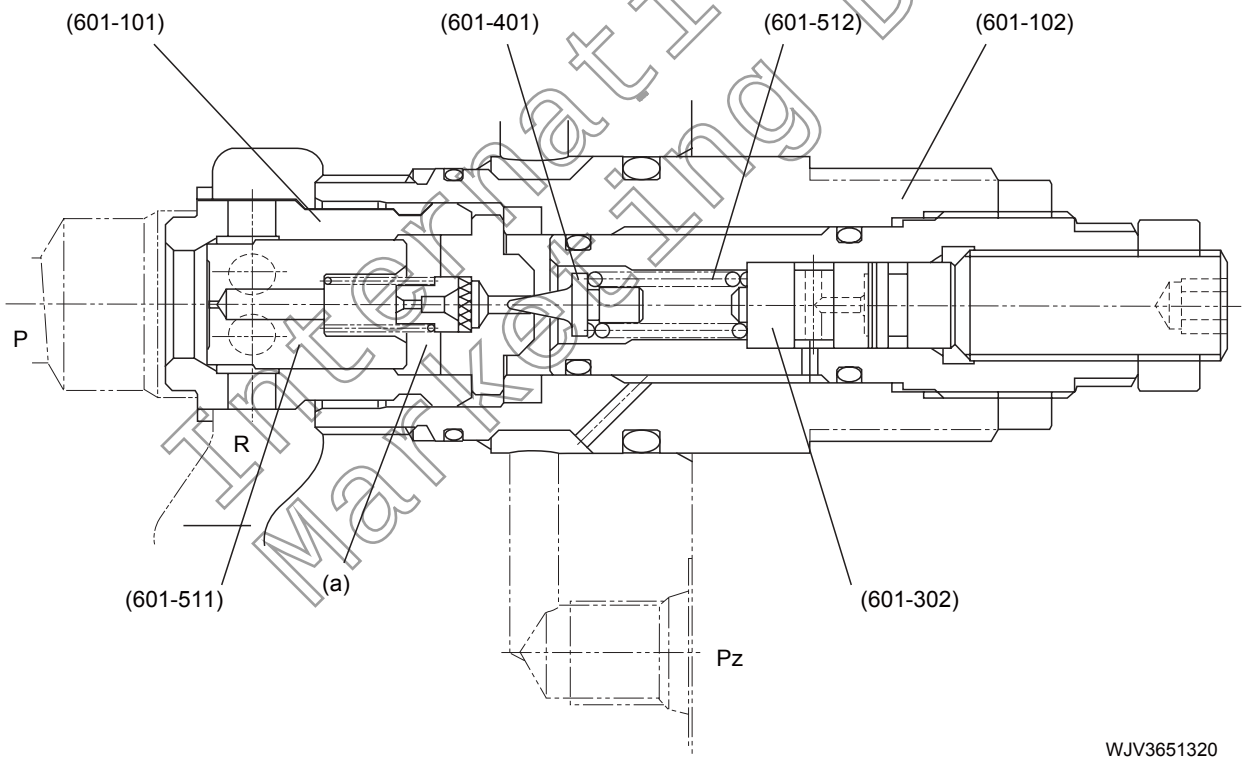


Fig. 4-65

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12) Function of port relief valve

The port relief valve, mounted between the oil tank port and low pressure passage, can prevent cavitation as an oil compensation check valve except working as a port relief valve. Functions of the valve are given below:

Functioning as a relief valve

- Working oil fulfils into cavity (B) via the hole (A) on plunger (301). Valve post (511) is pressed against valve seat (541), and valve seat (541) is pressed onto the seat of the valve block, forming a reliable sealing.

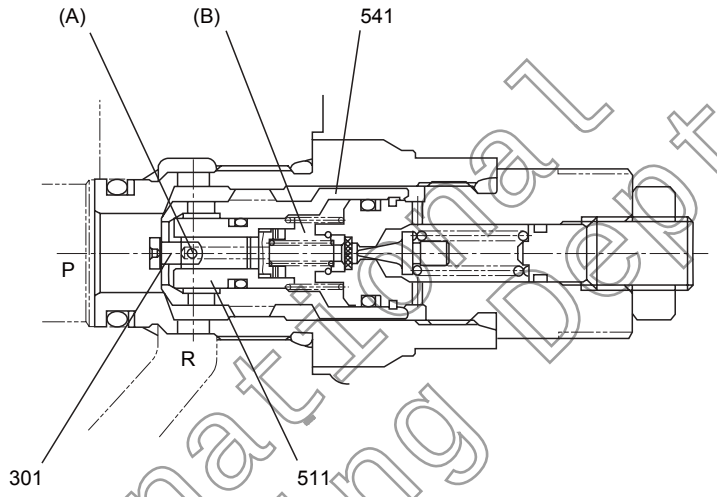


Fig. 4-66

- When pressure in passage (P) exceeds the preload of spring (621), cone valve (611) is pushed open. Therefore, working oil flows through hole (C) via the periphery of cone valve (611) and enters the low pressure passage (R).

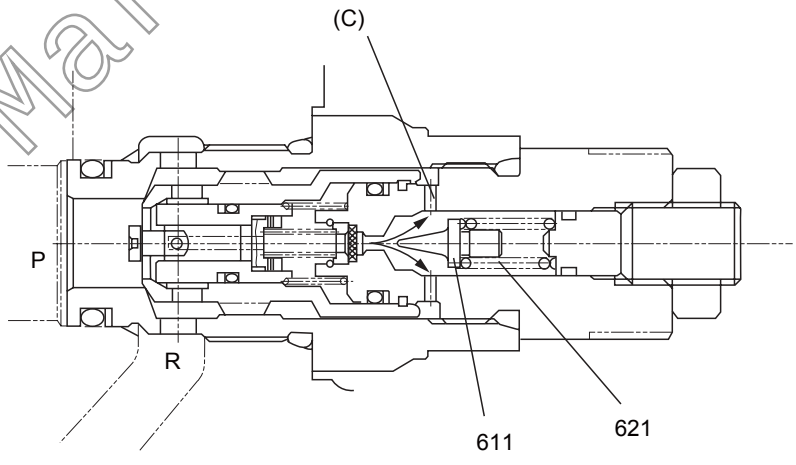
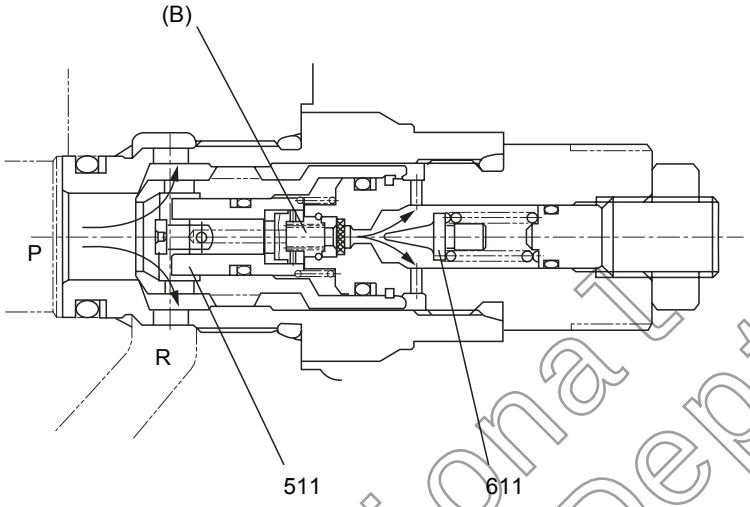


Fig. 4-67

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- Opening of cone valve (611) causes pressure in cavity (B) to drop and valve post (511) is opened. In this way, working oil in passage (P) goes to the low pressure passage (R) directly.

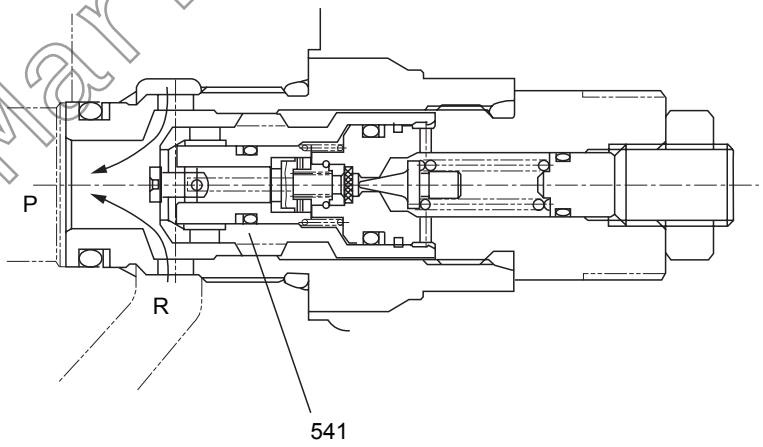


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Fig. 4-68

Functioning as oil complement check valve against cavitation

When negative pressure is formed in passage (P), working oil is fed from passage (R). When pressure in passage (R) exceeds the pressure in passage (P), valve seat (541) moves to the right direction. Therefore, working oil is delivered from passage (R) to passage (P) via the periphery of valve seat (541). Cavitation is prevented as a result.



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Fig. 4-69

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4.6 Hydraulic System, Part 3

4.6.1 Swing motor

Type: M5X180CHB-10A-3NA/265

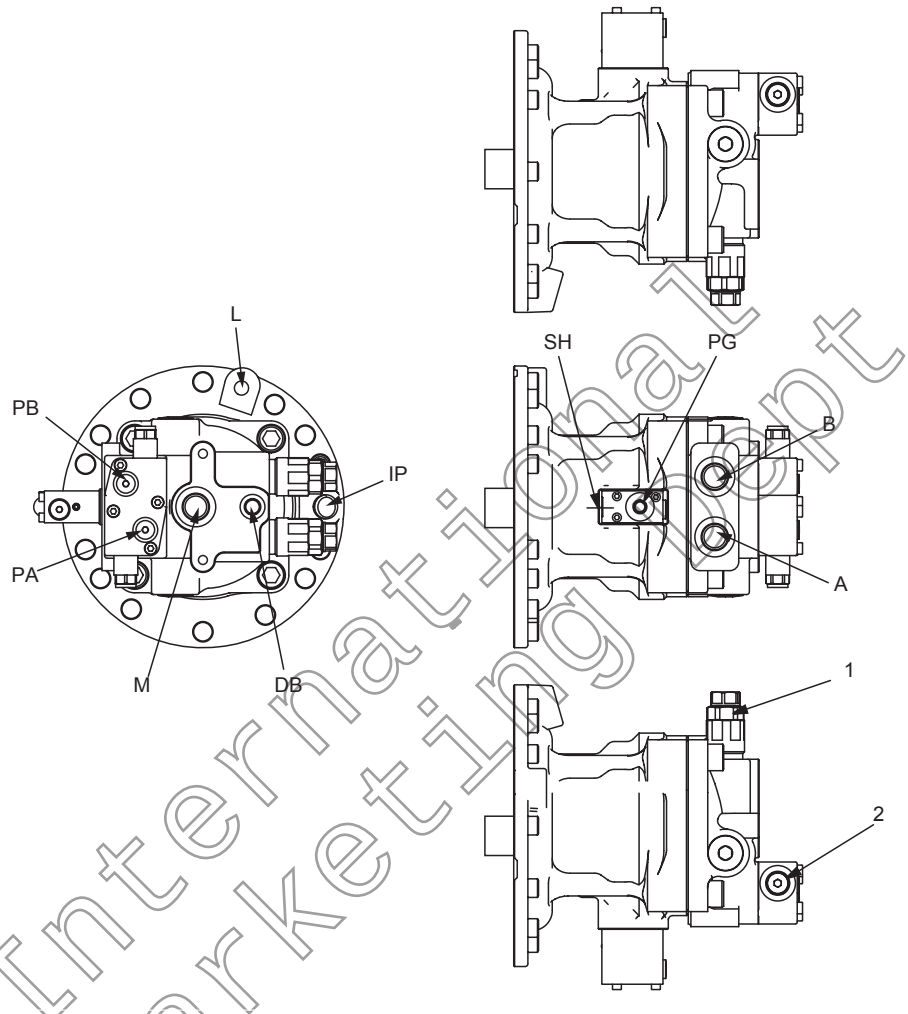


Fig. 4-70

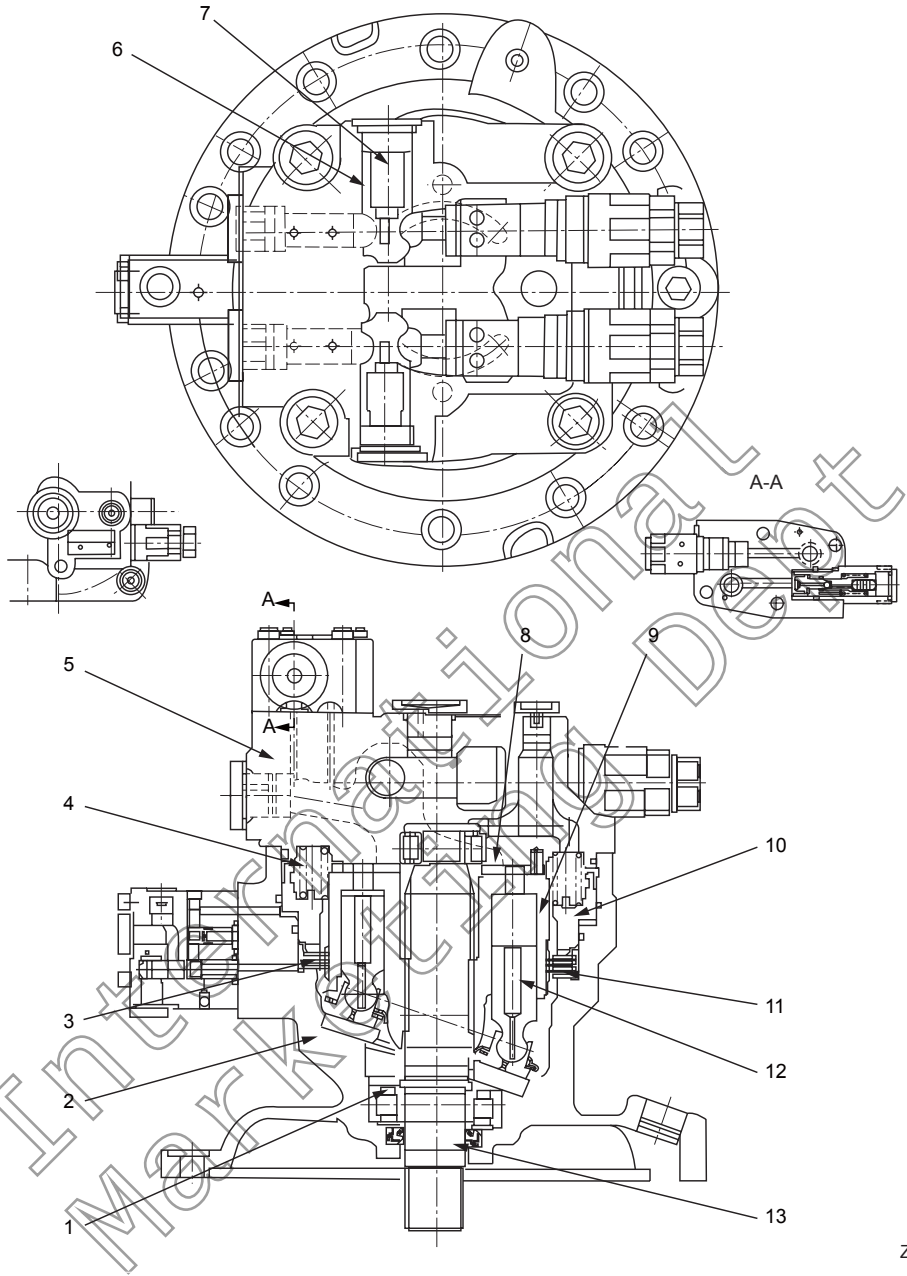
A: Main oil port
B: Main oil port
M: Makeup port
PA: Pressure detection port
PB: Pressure detection port
DB: Lubricant port
PG: Brake release port
SH: Brake command port
L: Level stick
IP: Gear oil feed port
(1) Safety valve
(2) Anti-swing valve

Specifications

Model	M5X180CHB-10A-3NA/265
Theoretical displacement	180.1 cm^3/rev
Safety valve press. setting	26.0 MPa
Max swing speed	1470 rpm
Brake release pressure	2.7-4.9 MPa

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Fig. 4-71

(1) Spacer
(2) Housing
(3) Disc
(4) Brake spring
(5) Shell
(6) Spring
(7) Check valve
(8) Oil distributor
(9) Cylinder barrel
(10) Brake piston
(11) Plate
(12) Piston
(13) Drive shaft

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4.6.2 Swing holding brake

- Port PG is directly connected with the pilot gear pump and it is always under a pressure of 3.9MPa.

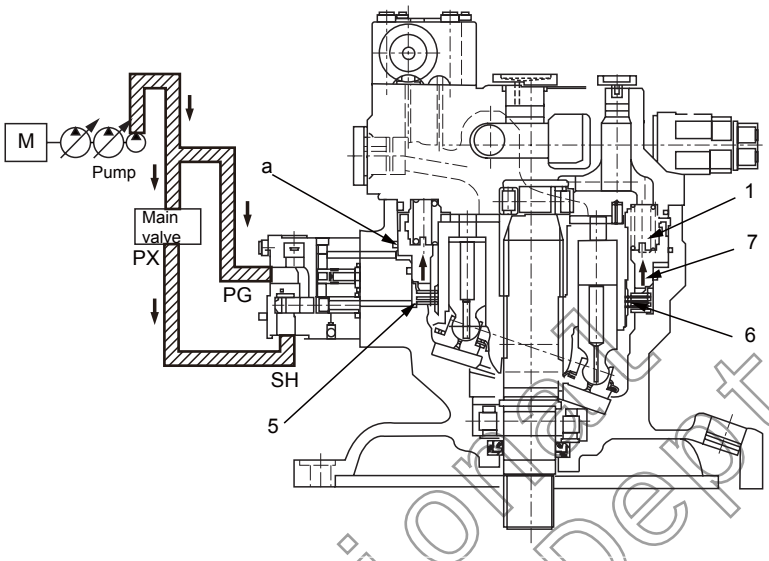


Fig. 4-72

- Port SH is in connection with port (PX) of the main control valve. In case of any operation (except travel) is performed by the main control valve, Port (PX) will be put under pressure. This pressure establishes connection between PG and chamber (a) below piston (7). The pressurized oil pushes the brake piston upward to compress spring (1) and separate disc (5) from plate (6). The brake is released.

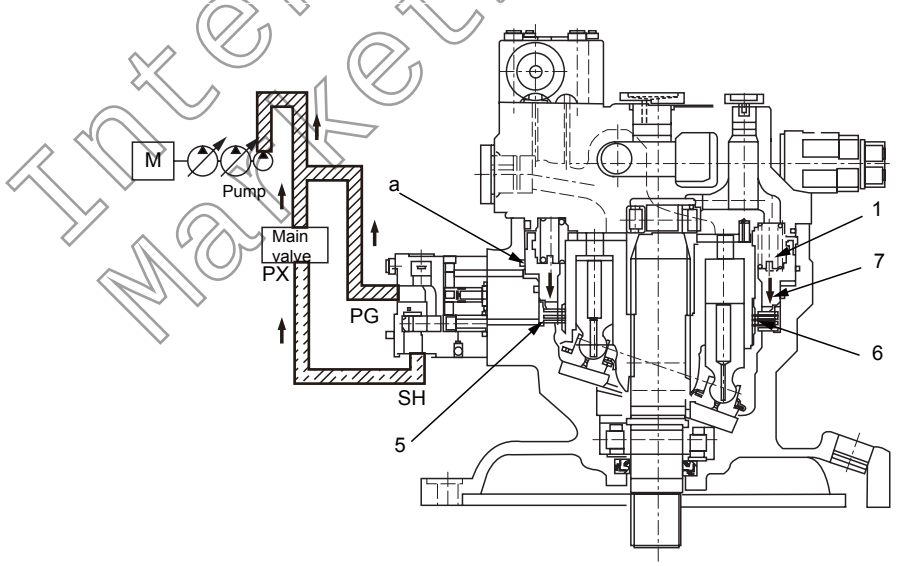


Fig. 4-73

- Otherwise, without pressure acting upon the port (PX), the connection between (PG) and chamber (a) below piston (7) is blocked. Brake spring (1) pushes the brake piston to press disc (5) against plate (6). The brake is engaged.

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4.6.3 Relief valve section

Structure

- The relief valve section consists of relief valves (1) and (2) and check valves (3) and (4).

Function

- When the machine is in the swing holding mode, control valve (5) closes the motor outlet circuit, but the motor rotation is continued due to inertial force. The motor output is, therefore, abnormally increased, which could damage the motor.
- In order to prevent the motor from being damaged, the relief valve relieves the abnormally high pressure oil to port (M) from the outlet side (high-pressure side) of the motor.

Operating principle

1. When starting swing (suppose pressurized oil is delivered to port A)

- When the swing control lever is set to the right- swing, pressurized oil from the pump is delivered to port (A) via control valve (5).
- The pressure at port (A) rises, the starting torque is generated in the motor, and the motor starts to rotate.
- The pressurized oil from the outlet port of the motor passes from port (B) through the control valve (5) and returns to the tank.

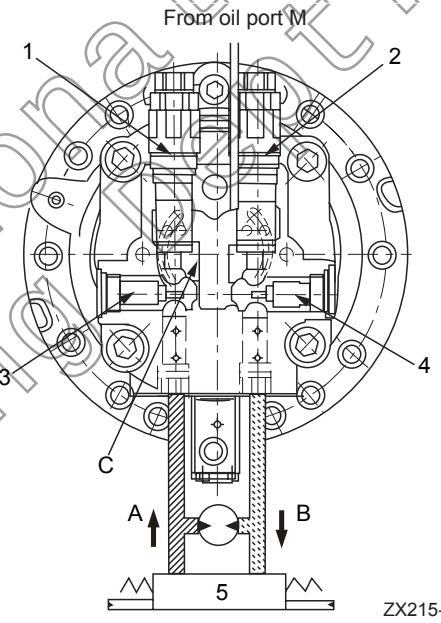


Fig. 4-74

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2. When swing is stopped

- When the swing control lever is set neutral, the supply of pressurized oil from the pump to port (A) is stopped.
- The pressurized oil from the motor outlet can't return to the tank since the returning circuit to the tank is closed from control valve (5). Thus, the pressure on port (B) increases.
- Swing resistance is generated on the motor and hence the brake starts working.
- Pressurized oil will be relieved when the pressure on port (B) rises to the set pressure of relief valve (2).
- A high braking torque acts on the motor, thereby stopping the motor.
- When relief valve (2) is being actuated, the relieved oil and the pressurized oil from port (M) are fed to port (B) via check valve (4).
- The above prevents the formation of cavitation on port (B).

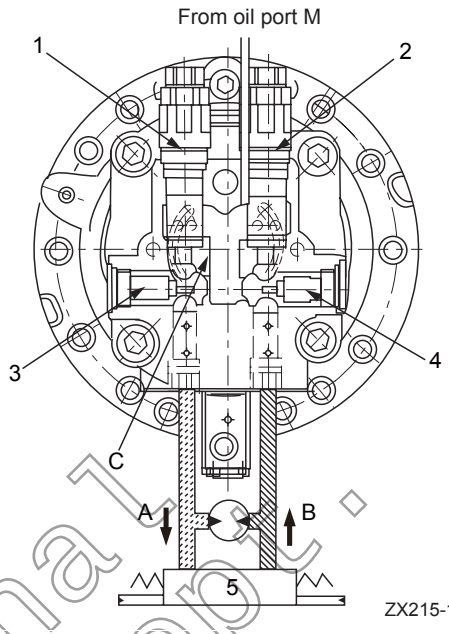


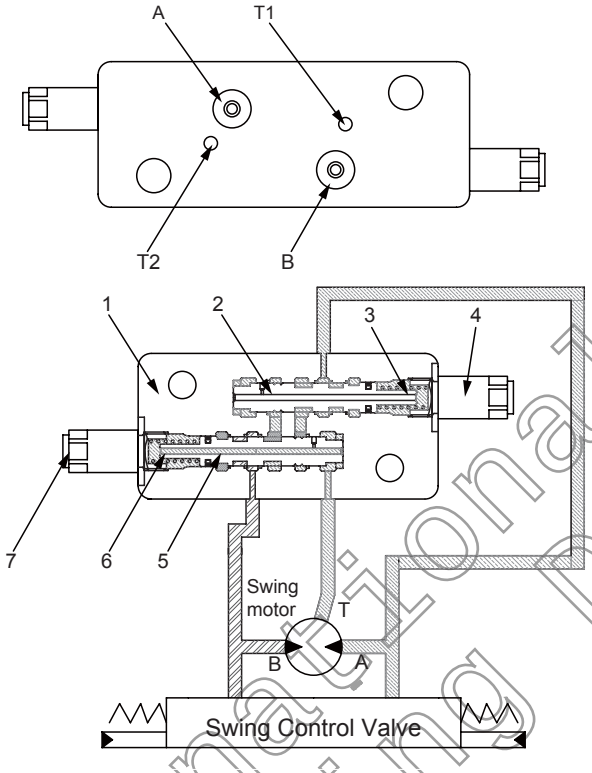
Fig. 4-75

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4.6.4 Anti-jerk valve

4.6.4.1 Operation diagram

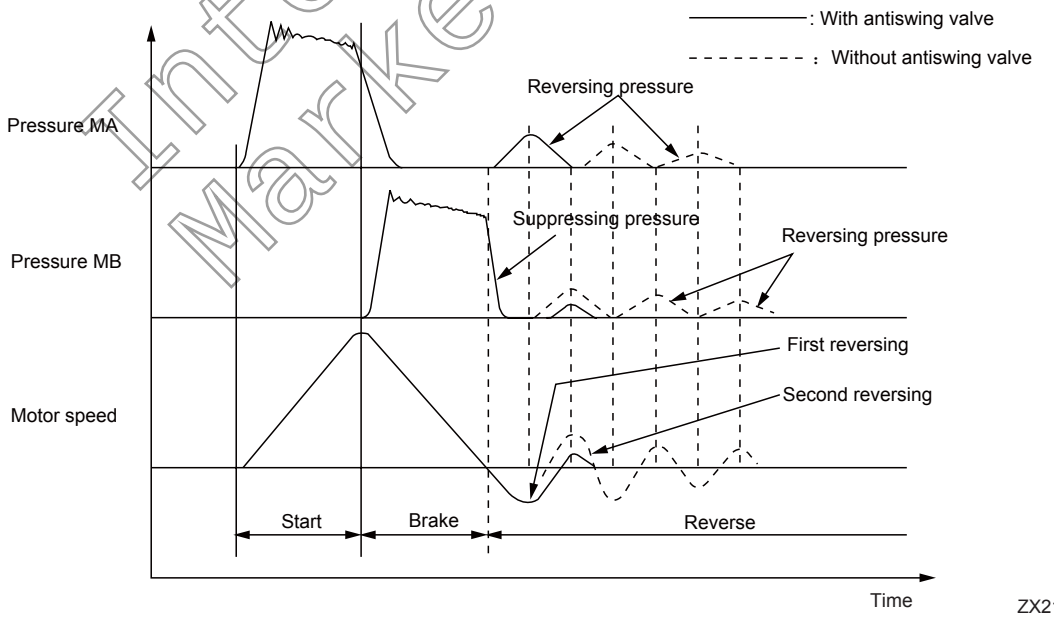


(1) Valve body
(2) Spool (side A)
(3) Spring (side A)
(4) Plug
(5) Spool (side B)
(6) Spring (side B)
(7) Plug

ZX215-1002087

Fig. 4-76

4.6.4.2 Effect illustration



ZX215-1002088

Fig. 4-77

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Outline

- The inertia of the swing body, the counteraction and rigidity of the mechanical system, or the compressibility of the hydraulic oil can cause shaking of machine during swing operation. The anti-jerk valve is able to reduce such impact. It is effective in preventing collapsing of load when the swing is stopped and in reducing the cycle time (by better positioning performance and quicker movement for next operation).

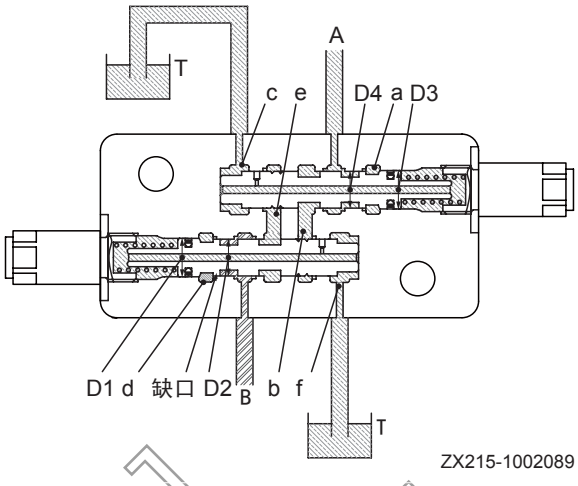


Fig. 4-78

Operation

1. When braking pressure is generated at port (B)

- Pressure (MB) is conducted to chamber (d) via the notch. The pressure compresses spring (6) by use of the difference in areas of circles (D1 > D2) of spool (5) and moves the spring (6) to the left side. Port (B) and chamber (e) will be interconnected. Since pressure (A) is lower than the set pressure of spring (3), spool (2) does not move and the pressurized oil is stopped by spool (2). Thus the braking force is ensured.

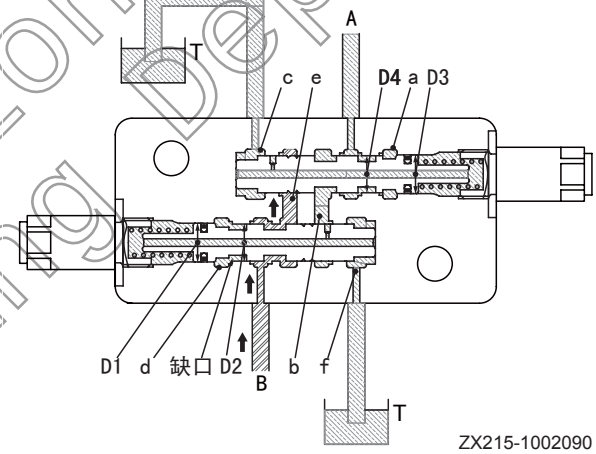


Fig. 4-79

2. When motor is stopped

- The motor rotation is reversed by the closing pressure generated at port (B). (1st reversing) Reversing pressure is generated on port (A) under the above condition. Pressure (A) is conducted to chamber (a), and spool (2) moves spring (3) to the right side, and A and B is interconnected. At this time, b is interconnected with f via the orifice on spool (5), and reversing pressure on port A is bypassed to port T in order to prevent second reversing.

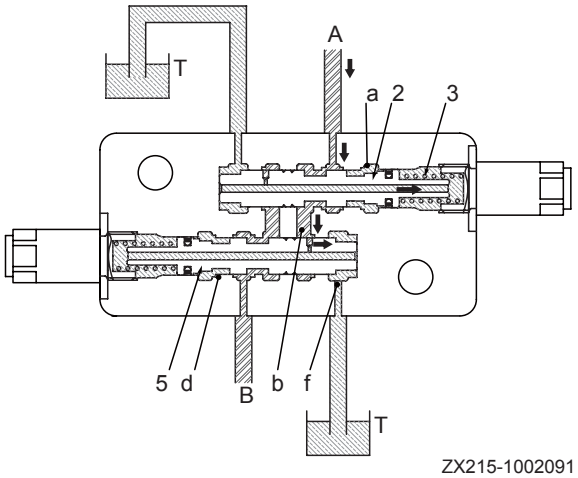


Fig. 4-80

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4.6.5 Central Swivel Joint

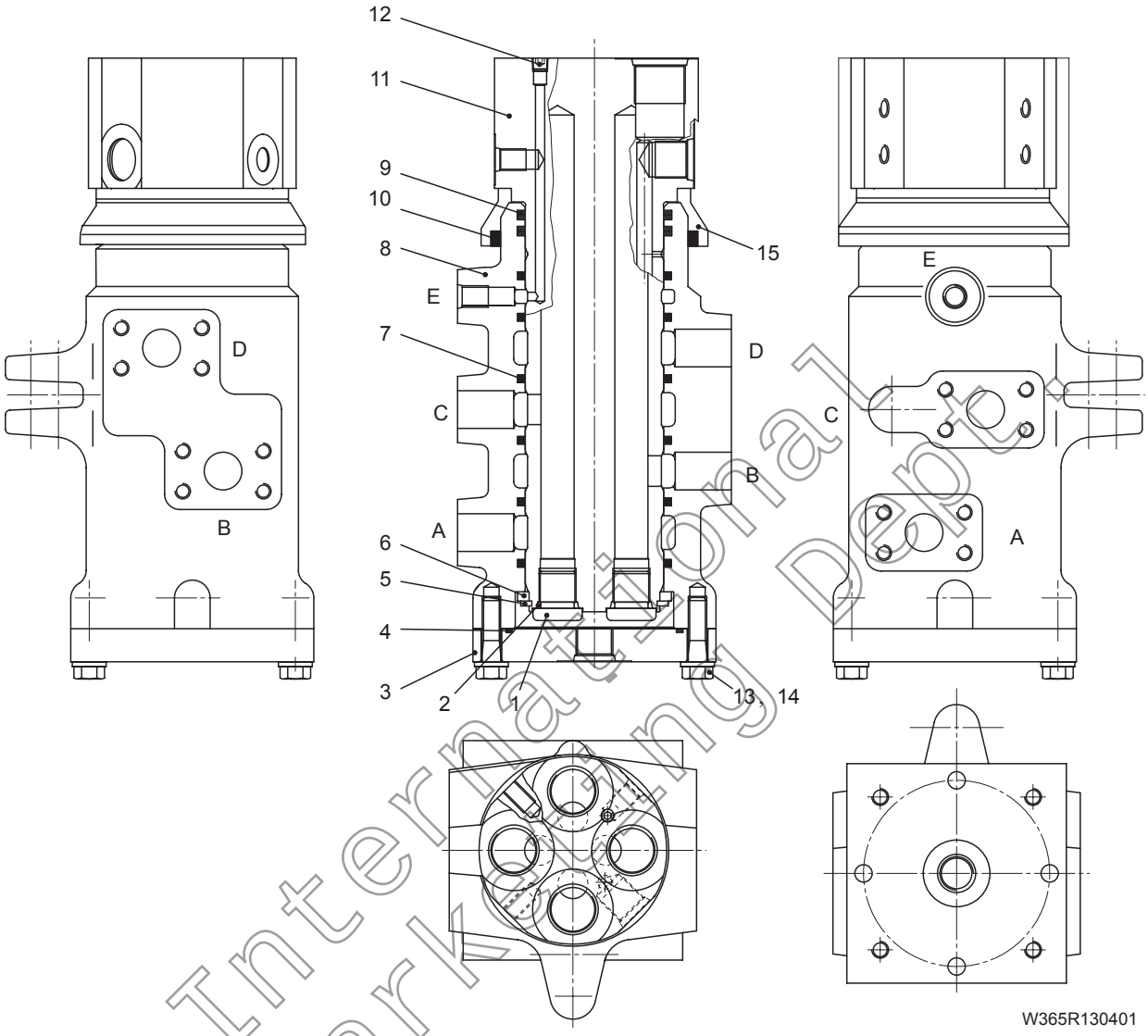


Fig. 4-81

(1) Bolt
(2) O-ring
(3) Cap
(4) O-ring
(5) Washer
(6) Collar
(7) Rotary seal (CSI)
(8) Housing
(9) O-ring
(10) Swivel shaft
(11) Rotor
(12) Plug
(13) Bolt, socket-head
(14) Flat washer
(15) Dust boot

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4.6.6 Travel motor

Type: MAG-170VP-3800E

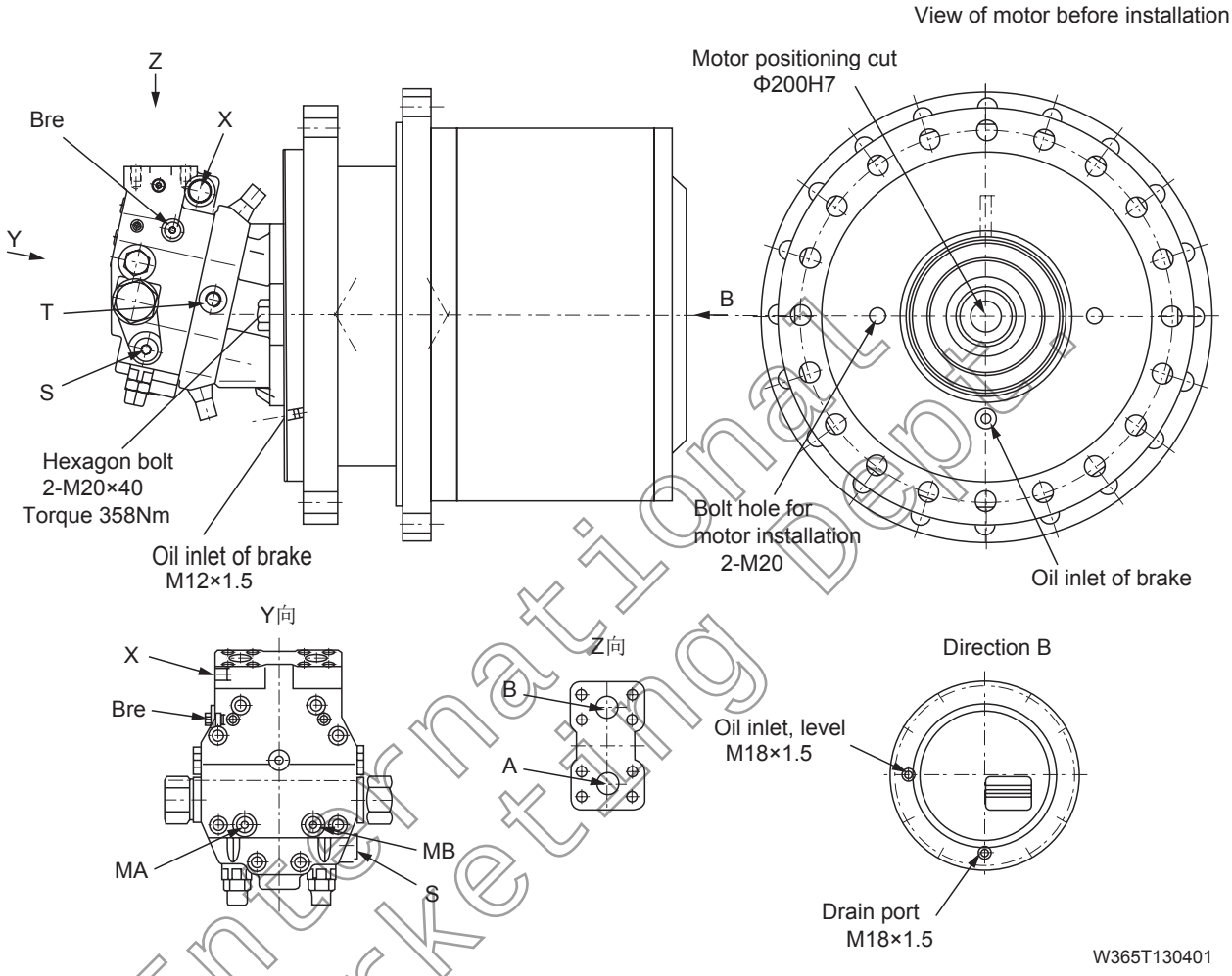


Fig. 4-82

A, B: Working oil port

T: Oil drain port

MA, MB: Test port

S: Oil compensation port

X: Control pressure port

Bre: Oil port for releasing external brake

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Table 1 - Motor Specifications

Item	Unit	Specifications
Max input torque	N·m	546
Max input speed	r/min	4788
Max output torque	N·m	69309
Max output speed	r/min	37.7
Basic braking torque (without back pressure)	N·m	730
Starting pressure	bar	18
Max withstanding pressure	bar	50
Oil refilling capacity	L	8.5
Speed ratio	-	126.94
Weight	kg	400
Brake disc	Disc type brake	
Lubricant oil	220（40℃）industrial application	

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4.6.7 Reducer

Type: GFT80

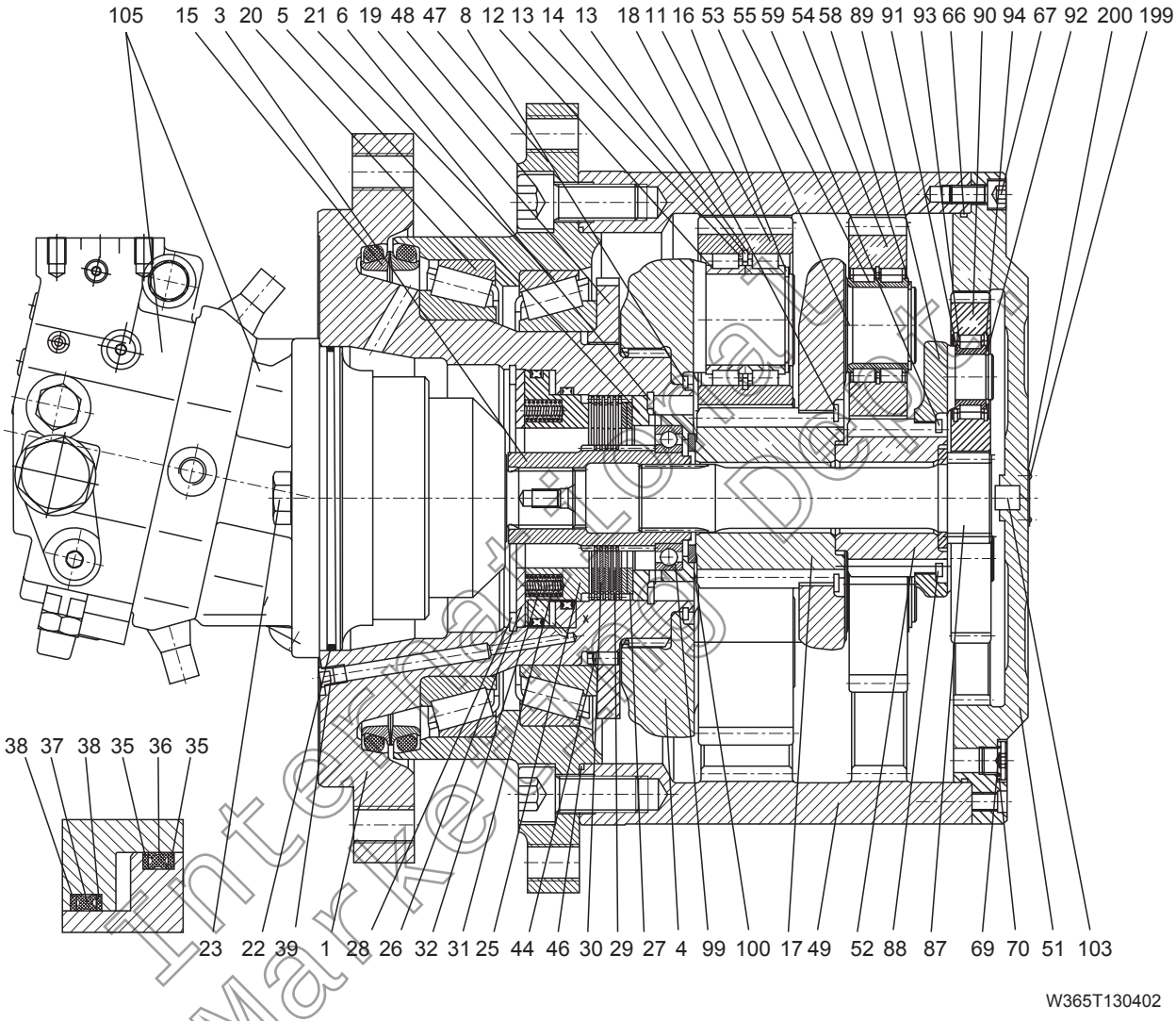


Fig. 4-83

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No.	Code	Description	Qty
E001	R988011946	Support shaft	1
E003	R988012090	Drive shaft	1
E004	R988011553	Planetary carrier	1
E005	R988012073	Bearing seat	1
E006	R916452282	Collar	1
E008	R916452408	Collar	1
E011	R988011587	Planetary gear	5
E012	R916411696	Cylidrical roller bearing	10
E013	R988012373	Collar	10
E014	R916452254	Collar	5
E015	R988013065	Float seal	1
E016	2916650025	Elastic collar	5
E017	R988011192	Sun gear	1
E018	R916452068	Elastic collar	1
E019	R988011289	Round nut	1
E020	R916412778	Tapered roller bearing	1
E021	R916412722	Tapered roller bearing	1
E022	R988012516	O-ring	1
E023	R913006409	Bolt, hexagon	2
E025	R988011598	Piston	1
E026	R988012185	Collar	1
E027	R988012320	Collar	2
E028	R916452300	Collar	1
E029	R988012929	Friction disc, outside	6
E030	R988012931	Friction disc, inside	5
E031	R916423354	Spring	18
E032	R916423355	Spring	18
E035	R988012913	Collar	2
E036	R988012397	Spring sleeve	1
E037	R988012404	X -ring	1
E038	R988012914	X -ring	2
E039	R902602007	Plug	1
E044	2917890148	Pin	2
E046	R988012493	O-ring	1
E047	R988011215	Bearing seat	1

No.	Code	Description	Qty
E048	R913006477	Bolt, hexagon	24
E049	R988010958	Gear ring	1
E051	R988011457	End cover	1
E052	R988011597	Sun gear	1
E053	R988011951	Planetary carrier	1
E054	R988011483	Planetary gear	3
E055	R988012459	Cylindrical roller bearing	3
E058	2916650023	Collar	3
E059	R913003909	Collar	1
E066	R988012492	Ring	1
E067	R913006441	Bolt, hexagon	12
E069	R913003865	Plug	2
E070	R916462052	Washer	2
E087	R988011630	Sun gear	1
E088	R988012341	Collar	1
E089	R988011188	Planetary carrier	1
E090	R988011840	Planetary gear	3
E091	R988012458	Cylindrical roller bearing	3
E092	R916452026	Collar	3
E093	R916462507	Collar	6
E094	R916452244	Collar	6
E099	R988012398	Deep-grooved ball bearing	1
E100	R916462138	Collar	1
E103	R988012357	Cylidrical roller	1
E105	R902165278	Motor	1
E199	R988012436	Rivet	4
E200	R909830326	Nameplate	1

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4.6.8 Travel motor (Nabtesco)

Type: GM60VA

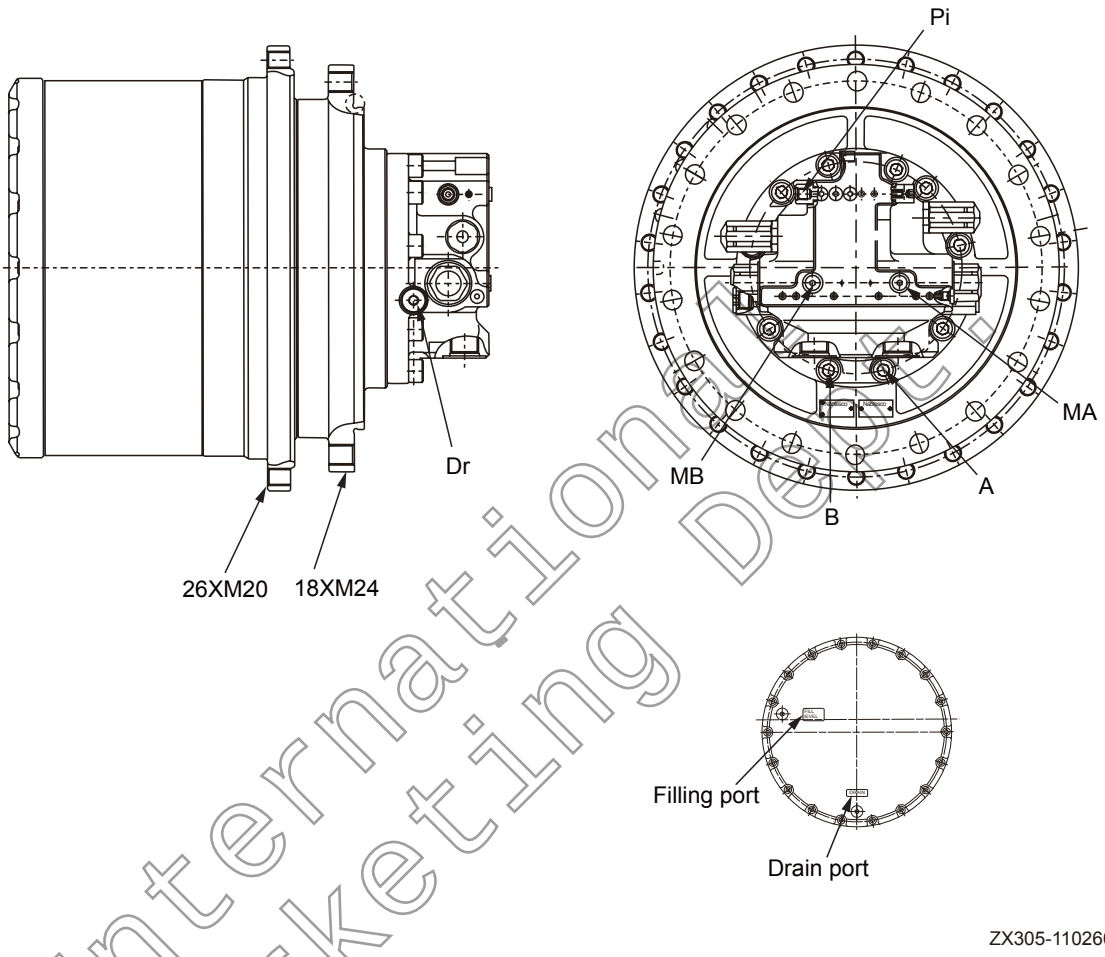


Fig. 4-84

A: Main oil port

B: Main oil port

Am: Pressure detection port

Bm: Pressure detection port

Pi: Two-speed pilot tubing port

Dr: Oil drain port

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Item	Unit	Specifications
Input flow	L/min	280
Relief valve pressure setting	Mpa	34.3
Motor displacement	cm^2/rev	290.7/170.1
Reduction ratio	—	40.67
Total displacement	cm^2/rev	—
Theoretical output torque	KN·m	64.3/37.6
Theoretical output speed	r·p·m	23.8/40.7
Braking torque	KN·m	1.17
Brake release pressure	Mpa	1.54
Auto switching pressure	Mpa	26.5
Operating temperature range	℃	-20~90
Total weight	kg	399

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4.6.9 Operating principle of the basic components

4.6.9.1 Double-balanced valve

Function:

- When external load makes the plunger motor tend to go faster than the rated rotating speed of feed flow (hereunder referred to pump effect), this valve controls motor speed and prevents over-speed of the motor in relation with the feed flow.
- The double-balanced valve and the relief valve constitute the braking circuit. The braking circuit applies braking force onto the swing of plunger motor and stops the motor gradually.
- This valve can serve as a shuttle valve for high pressure selection to release the brake under its own pressure.
- The structure of a standard double-balanced valve is shown below. The following information describes the operating principle of a standard double-balanced valve.

A. When stopped

- When the main valve is neutralized (motor stopped), port M1 and port M2 are shut off by spool (1) and check valve (2) since no pressure is generated at port P1 and port P2. The motor is not rotating.

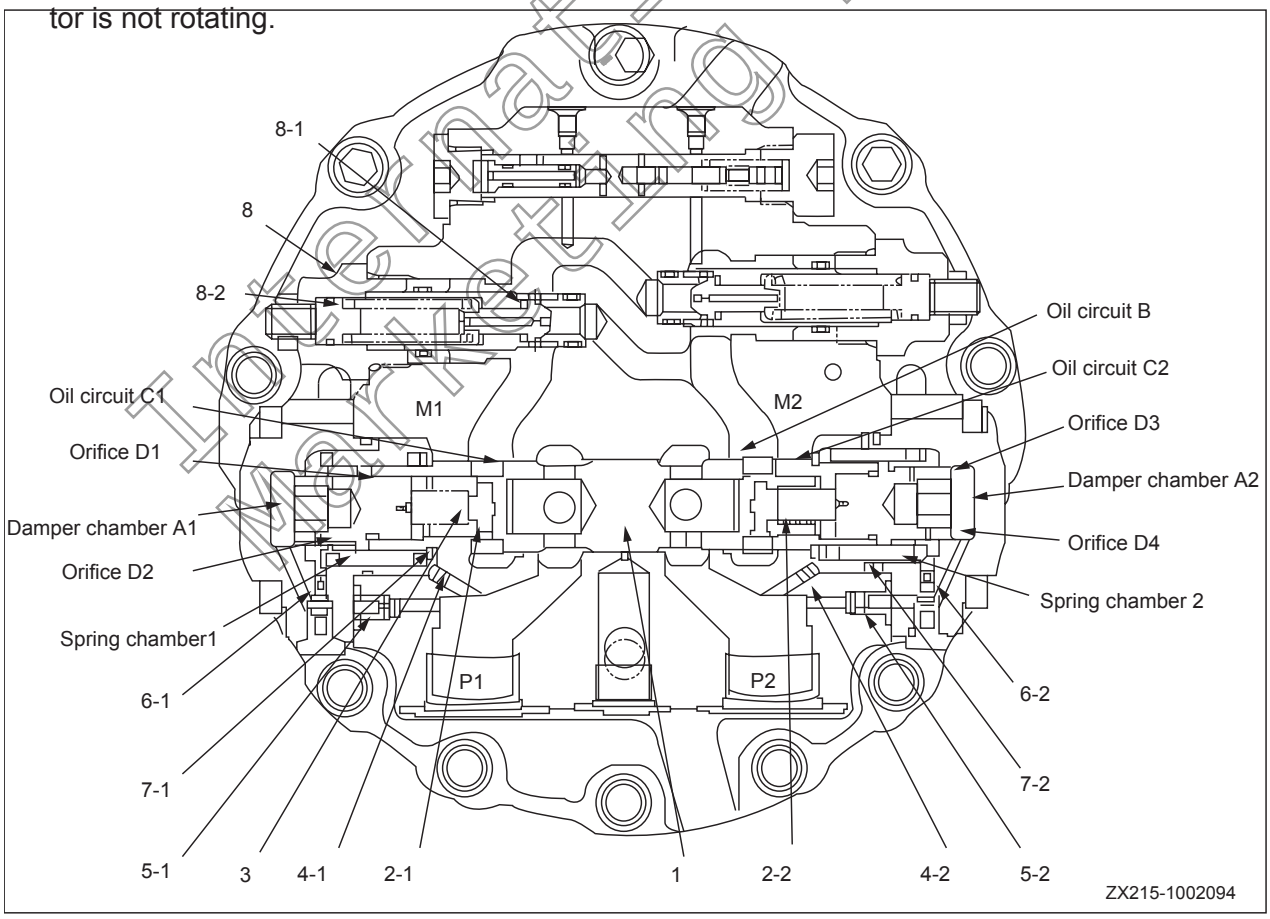


Fig. 4-85

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B. When motor is started

- When the hydraulic oil from the main pump enters port P1 of the double-balanced valve, spring (3) is pushed to the left by check valve (2-1), opening circuit C1. The hydraulic oil enters the plunger motor via port M, trying to make the motor rotating. At the same time, return oil from the plunger motor enters the counterbalance valve via port M2, but it is stopped by check valve (2-2). The output pressure of the main pump increases as a result, and the hydraulic oil works on the inside of spring chamber (1) and damper chamber (A1) via orifice (4-1) and check valve (5-1). The force generated in this way pushes spring (7-2) on the other side and moves plunger (1) to the right. At this time, return oil from port M2 passes through circuit of the notch on the periphery of plunger (1), and through port P2 when pressure is generated at port M2, and enters the tank via the main valve finally. The motor starts rotating at this time.

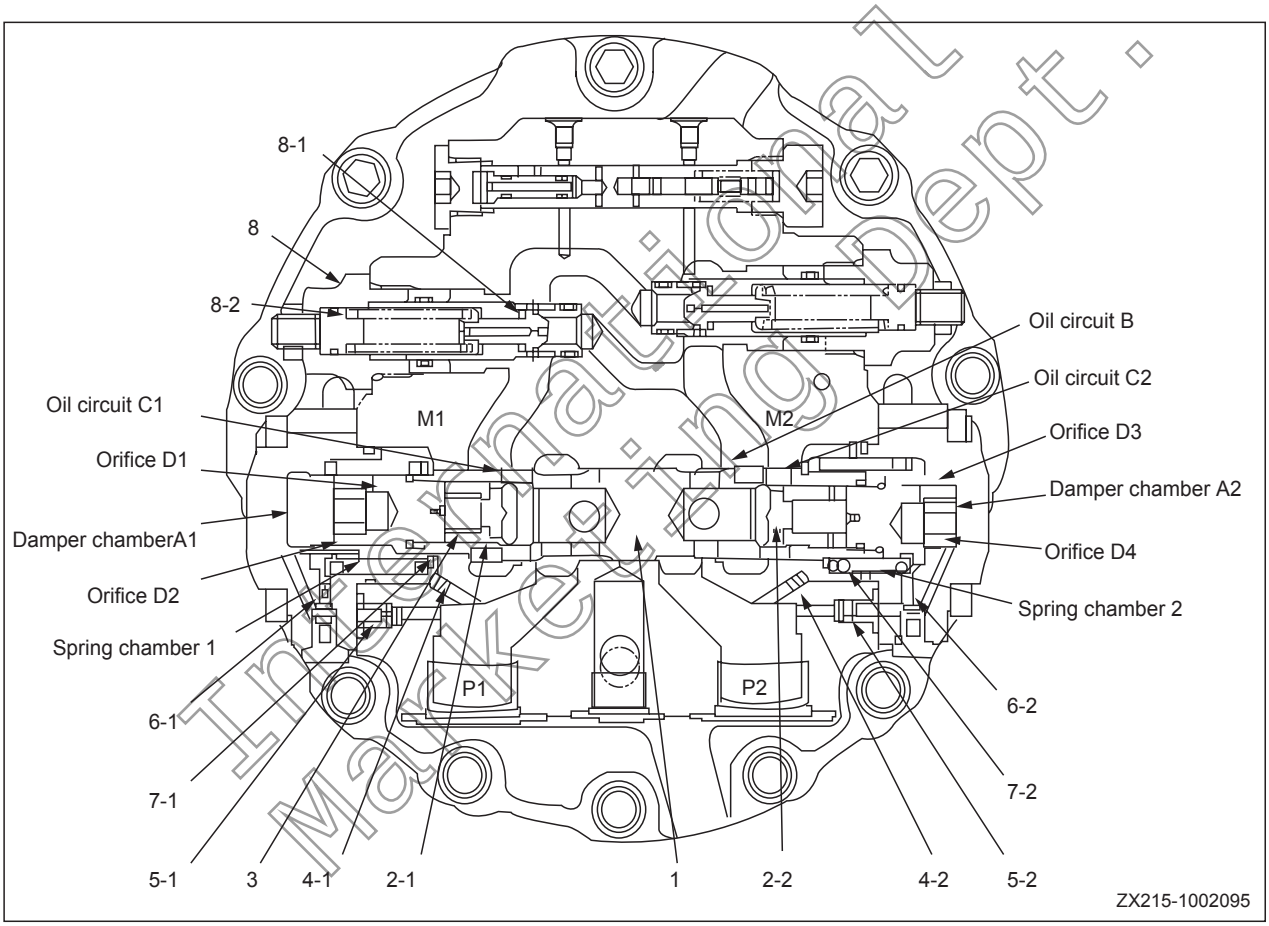


Fig. 4-86

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C. Counterbalance function

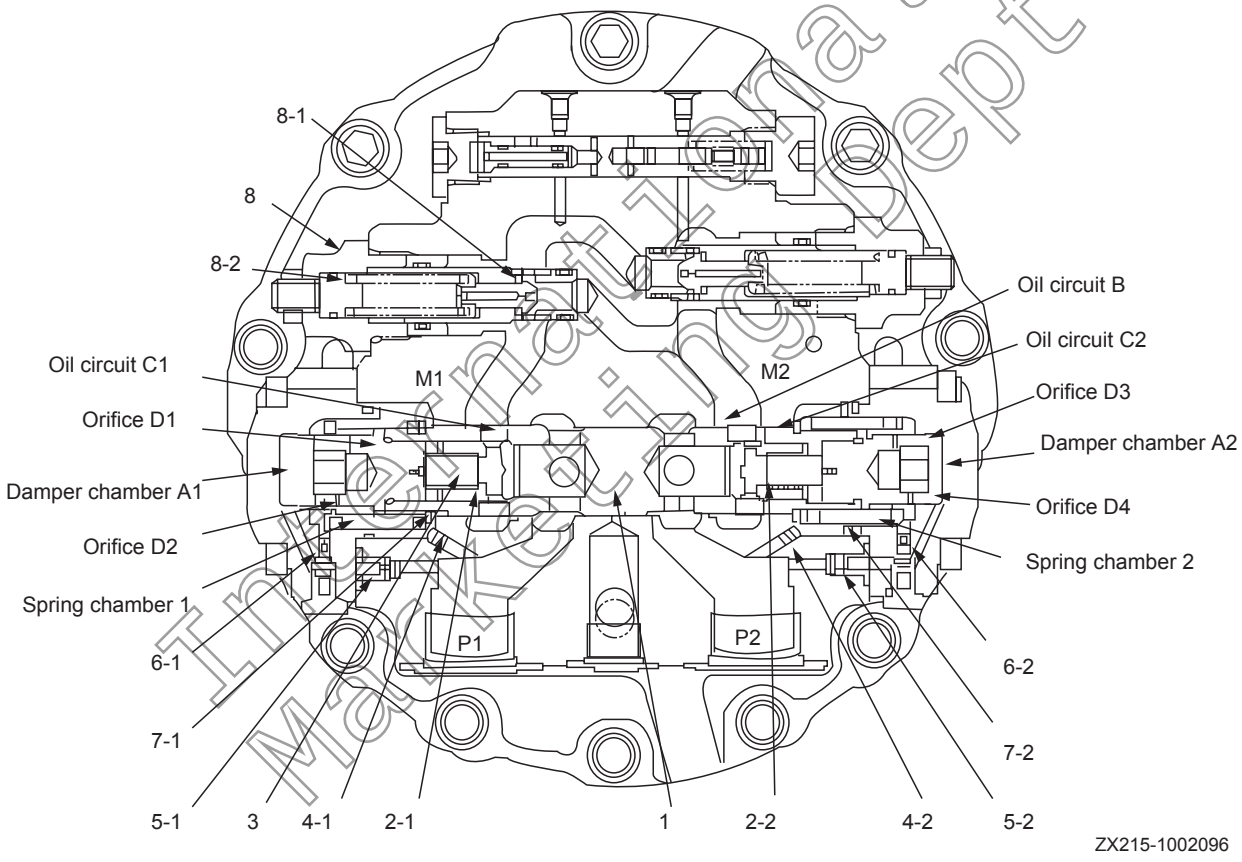
- When the engine runs at an excessively high speed because of external force applied on it, the motor may lose control. At this time, port P1 serves as the inlet side, and the pressure drops. Pressure in spring chamber (1) and damper chamber A1 also drop. As a result, plunger (1) moves to the left under the force of spring (7-2), closing circuit B. Circuit at the suction side is also closed at the same time when the circuit at return side is closed. When circuit B is closed, pressure at port P1 rises due to hydraulic oil from the main pump, moving plunger (1) to the right again. In this way, when external load generates pump effect, slight movement of plunger (1) keep circuit B open. The rotation speed of the motor keeps in line with fuel supply of the main pump, and the motor will not lose control because of the vacuum in the hydraulic system.

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D. Braking of motor

- The double-balanced valve and the relief valve forms the braking circuit.
- When the main valve is in neutral position, hydraulic oil from the main pump is cut off, and pressure at port P1 and P2 is the same. As a result, plunger (1) moves to the neutral position, and the opening area of circuit B decreases.
- At the same time, because of the inertia of external force, the motor does not stop rotating (pump effect), and pressure at port M2 rises and serves as the braking force of motor rotation.
- When the pressure at port M2 reaches the set pressure of relief valve (8), cone valve (8-1) at port M1 overcomes the force of spring (8-2) and moves to the left, and hydraulic oil flows to the port M1. In this way, the impacting force due to inertia at port M2 is under control, and vacuum at port M1 is avoided.



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Fig. 4-87

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E. Shuttle valve function for high pressure selection

- The double-balanced valve can function as a shuttle valve to release travel brake.
- When hydraulic oil is fed to port P1, plunger (1) moves to the right, as shown in fig. 4. At this time, drain passage F of motor housing is cut off, and passage D leading to cylinder chamber E for travel braking is opened.
- Hydraulic oil flows to passage G via the orifice, and enters travel brake cylinder chamber E to release the travel brake. In addition, plunger (1) moves to neutral position, as shown in fig 5 when motor stops. Passage D is closed and drain passage F of motor housing is opened.
- Hydraulic oil in travel braking cylinder chamber E is conducted to the drain passage of motor housing, and travel brake is applied.

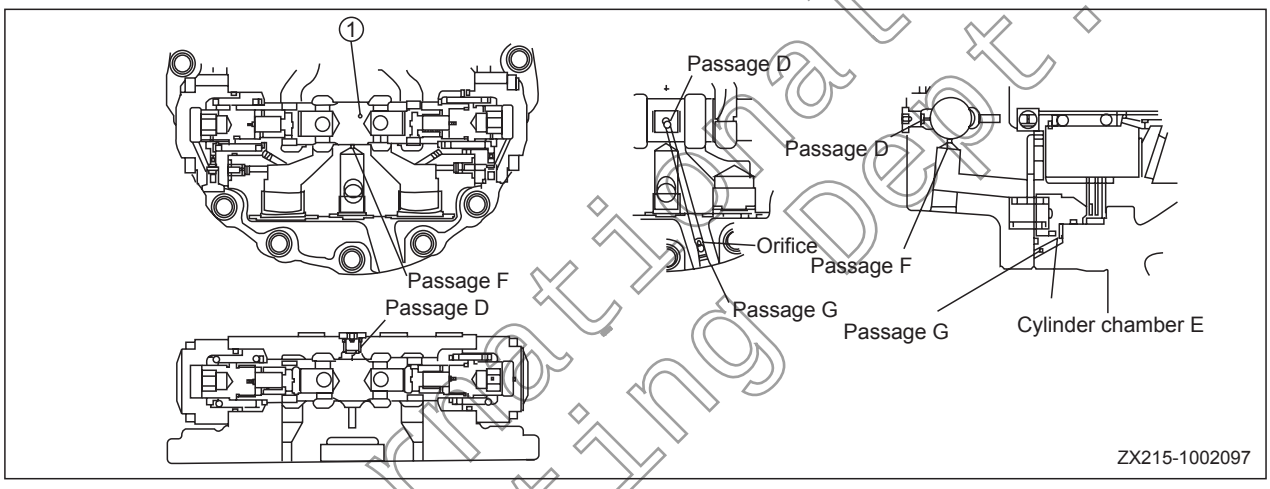


Fig. 4-88

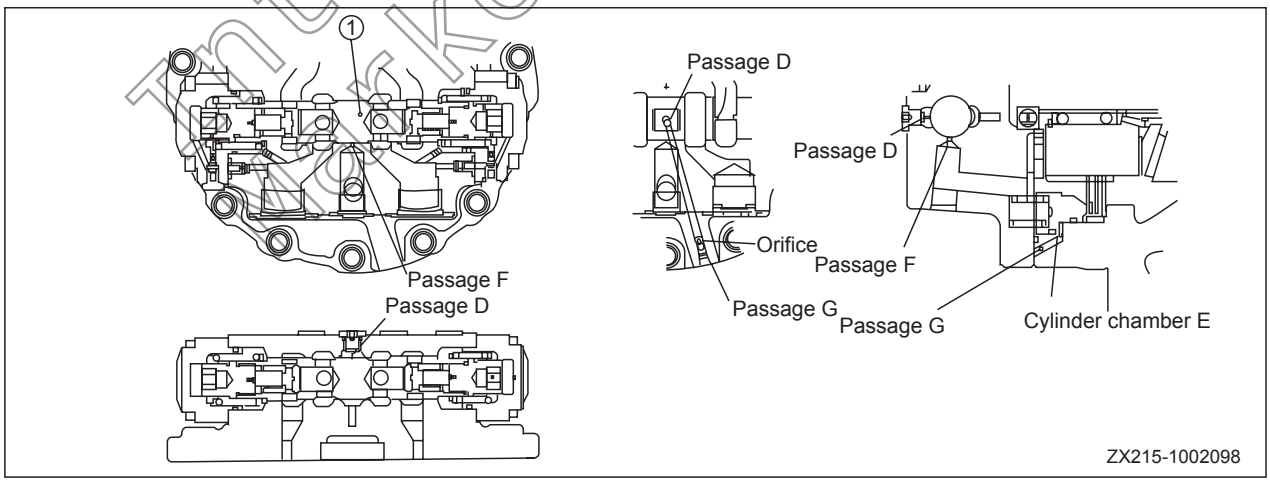


Fig. 4-89

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4.6.9.2 Operation of parking brake

1) When starting travel

- As the travel lever is operated, pressurized oil from the pump activates back pressure valve spool (10), opens the parking brake circuit, and flows to chamber A of brake piston (12). Pressurized oil overcomes the force of spring (11) and pushes piston (12) toward the left.
- Since the pushing force to plate (13) and disc (14) disappears, plate (13) is separated from disc (14) and the brake is released.

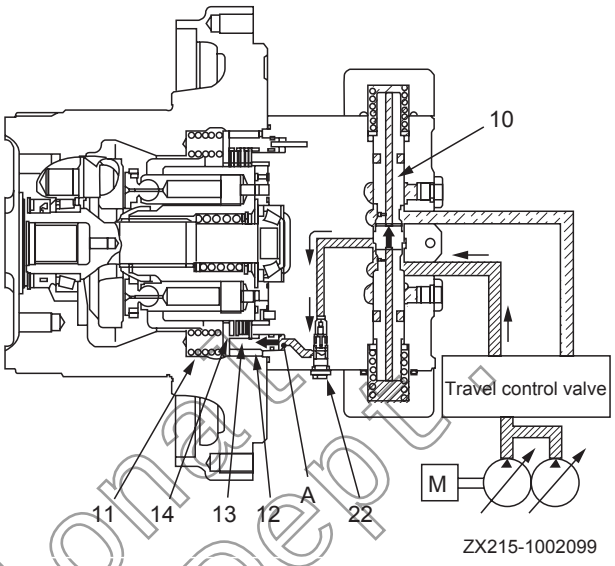


Fig. 4-90

2) When travel is stopped

- As the travel lever is placed in neutral, back pressure valve spool (10) returns to the neutral position and closes the parking brake circuit. T
- he pressurized oil in chamber (A) of brake piston (12) passes through the orifice of the brake piston and is drained to the motor casing. Brake piston (12) is pushed to the right by spring (11).
- Plate (13) and disc (14) are pushed against each other, and the brake is applied. As brake piston (12) returns, a time delay is formed by making the pressurized oil pass through a throttle valve in the slow return valve (22). This time delay ensures an active brake after the machine is stopped.

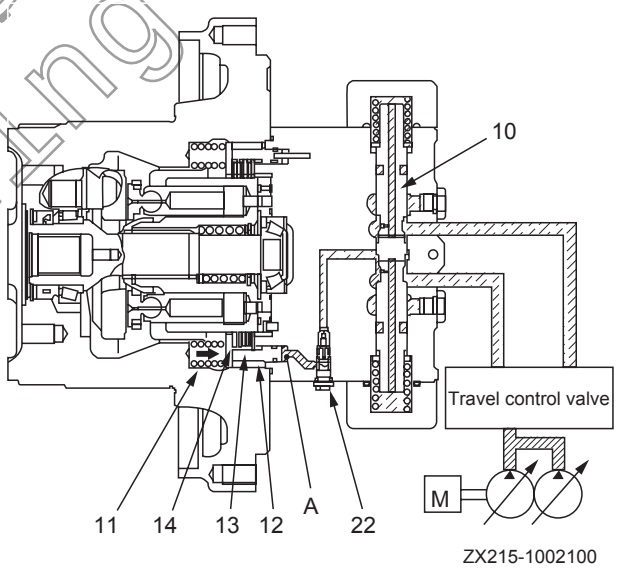


Fig. 4-91

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4.6.9.3 Operation of braking valve

- The brake valve consists of a suction safety valve (8A) and a counterbalance valve (18). As shown in the illustration on the right, functions and operations of respective components are described below.

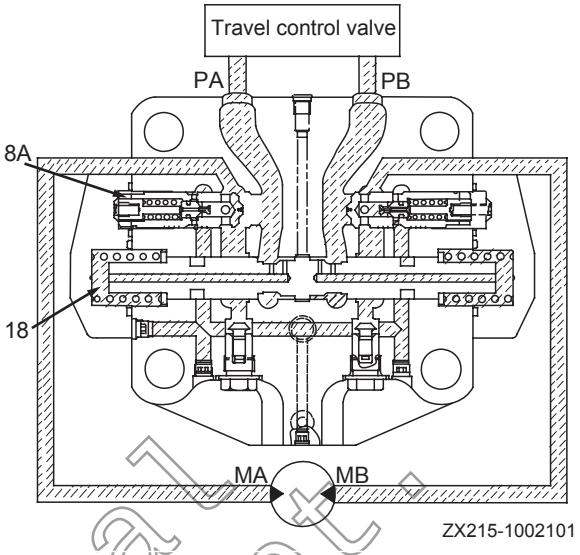


Fig. 4-92

1. Counterbalance valve and check valve

Function

- When traveling downhill, the weight of the machine tends to make the travel speed faster than the motor speed. If the machine travels with the engine at low speed, the motor may rotate at zero load, resulting in runaway and inviting a very dangerous situation. These valves are used to avoid such a situation by controlling the machine to travel according to the engine speed (pump flow).

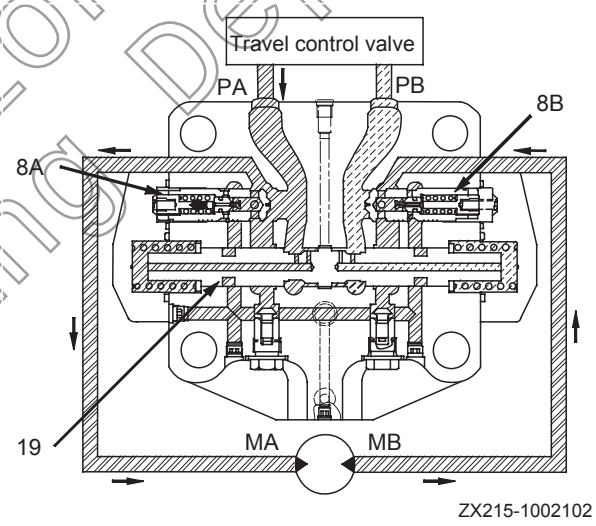


Fig. 4-93

Operation when pressurized oil is supplied

- Operating the travel control lever conducts the pressurized oil from the control valve to port (PA). The pressurized oil opens suction safety valve (8A) and then flows to motor outlet port (MB) via motor inlet port (MA). The motor outlet side is closed by suction safety valve (8B) and spool (19), so the pressure at the supply side rises, as shown in the right illustration.

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- The pressurized oil on the supply side flows to chamber (S1) via orifice (E1) and orifice (E2) of the spool (19). As the pressure in chamber (S1) goes above the spool shift pressure, spool (19) is pushed toward the right. Port (MB) and port (PB) are connected, the motor outlet port side opens and the motor starts rotating, as shown in the right illustration.

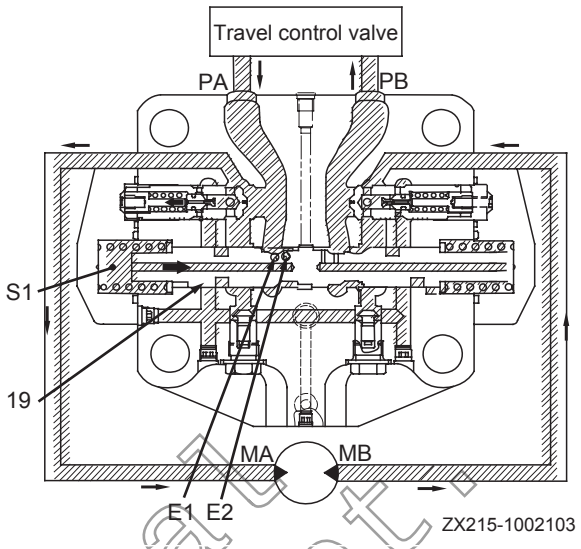


Fig. 4-94

Brake operation in downhill travel

- If the machine goes out of control while travelling downhill, the motor will be caused to rotate without load to decrease the inlet side oil pressure. Pressure in chamber (S1) drops via orifices (E1) and (E2). As the pressure in chamber (S1) goes below the spool shift pressure, spool (19) is returned to the left by spring (20) and outlet port (MB) is throttled. The pressure at the outlet port side rises, generating rotation resistance on the motor to prevent the machine from losing control. On the other hand, the spool moves to a position where the pressure on outlet port (MB) can be balanced against the machine's own weight and the inlet port pressure. Oil flow from the outlet circuit is reduced to ensure the travel speed corresponded to the pump delivery, as shown in the right illustration.

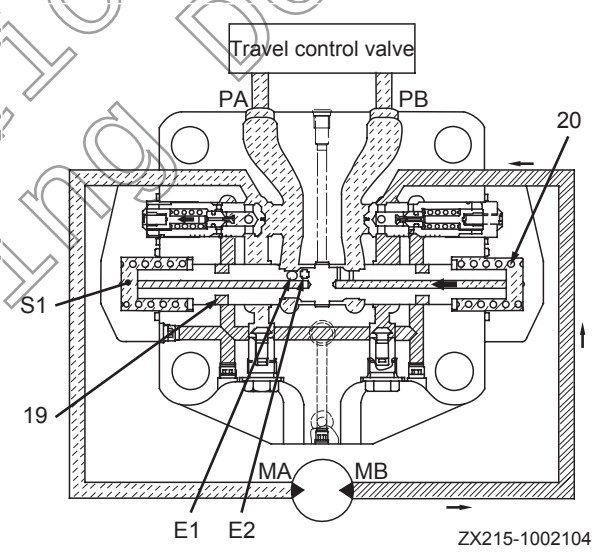


Fig. 4-95

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2. Safety valve

Function

- When the machine travel is stopped (or it is travelling downhill), the double-balanced valve closes the inlet and outlet circuits of the motor. Since the motor is rotated by inertial force, pressure in the motor outlet port side is abnormally increased, potentially resulting in damages on the motor and piping. The safety valve relieves this abnormal pressure to the inlet port side of the motor in order to prevent damages to the equipment.

Operation

1) When travel is stopped (or when travelling downhill or swinging to the right)

- Reduction of the pressure at motor inlet (PA) decreases the pressure in chamber (S1). When it drops beyond the spool shift pressure, the spool is returned to the left by spring (20), throttling the oil outlet passage (B1). At this time, the motor continues rotating due to its inertial force, thus pressure on the outlet port (MB) is increased, as shown in the right illustration.

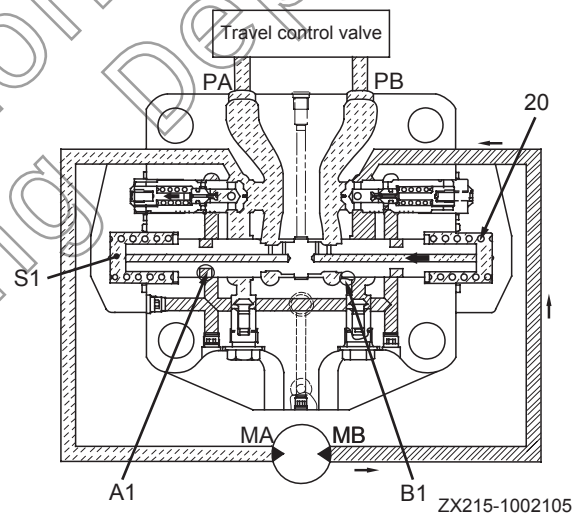


Fig. 4-96

- When the pressure rises above the set pressure of the suction safety valve (8A), the spool opens. The pressurized oil passes through notch (A1) of the counterbalance valve spool (19) into chamber (MA) of the circuit at the opposite side, as shown in the right illustration.

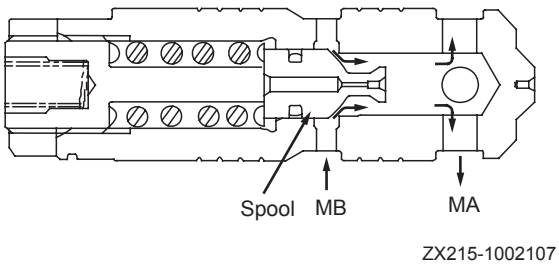


Fig. 4-97

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2) When starting travel (or traveling normally)

- As the travel control lever is operated, the pressurized oil from the pump moves the counterbalance valve spool (19) toward right. In this case, the passage to the suction safety valve functions as a circuit which passes through notch (B2) of spool (19), producing large differential pressure. The pump pressure rises, providing a large tractional force to the valve, as shown in the right illustration.

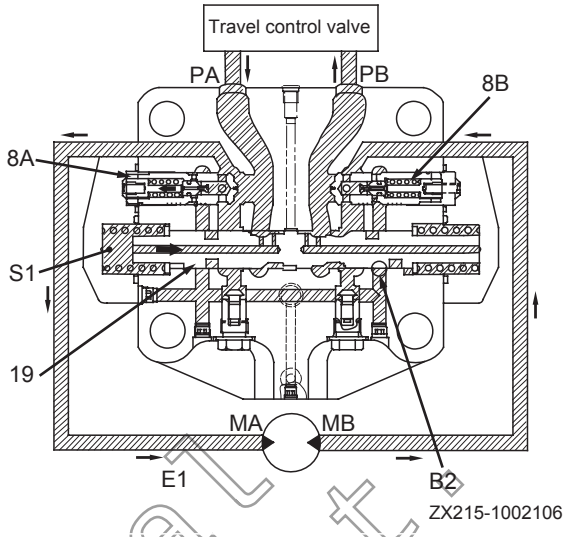


Fig. 4-98

3. Overload relief valve

- The structure of the relief valve is shown in the right figure. This valve is an area-differential and direct-acting relief valve. It has impact damping function during starting and braking.

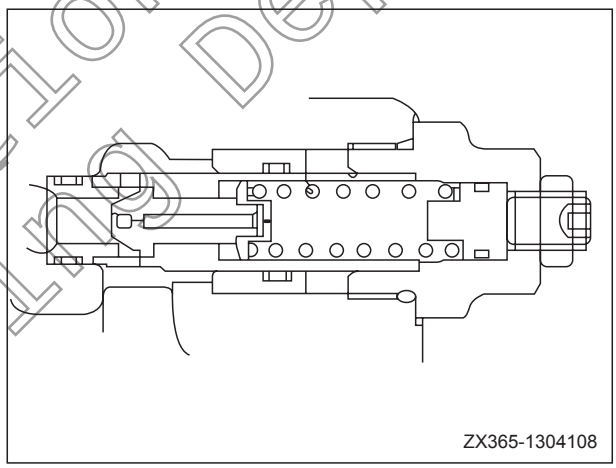


Fig. 4-99

A. Operating principle and function

- When the main control valve makes the motor to start or brake, front pressure of cone valve (2-9-2) rises above the set pressure and the force of spring (2-9-5), and moves cone valve (2-9-2) to the right and off the valve seat (2-9-3). Pressurized oil in the front of cone valve (2-9-2) is bypassed to the low pressure side. The impact due to inertia energy at the high pressure side is put under control and vacuum is prevented from occurring at the low pressure side through bypassing pressurized oil to the low pressure side.

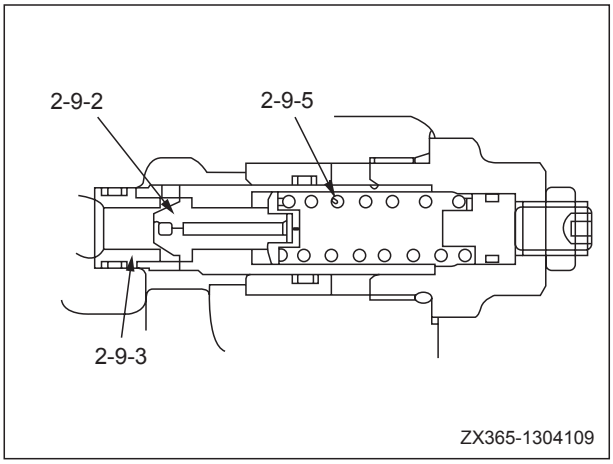


Fig. 4-100

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B. Damping function

- When the relief valve begins to function, damping piston (2-9-9) moves to the left. As a result, low pressure is maintained in spring chamber D. At this time, the loaded area of cone valve (2-9-2) is S1, and generally it is much larger than the set loaded area S1-S2 of the relief valve. So, when damping piston (2-9-9) is moving, the functional pressure of relief valve is maintained at 1/3 of normal set pressure in order to absorb the impact at the high pressure circuit side due to inertial energy. When the movement of damping piston stops, pressure in spring chamber D rises. Pressure at both side of cone valve (2-9-2) is the same, and the relief valve is working at normal set pressure. In this way, the relief valve reduces the impact during motor starting and braking by a two-stage action to provide excellent performance.

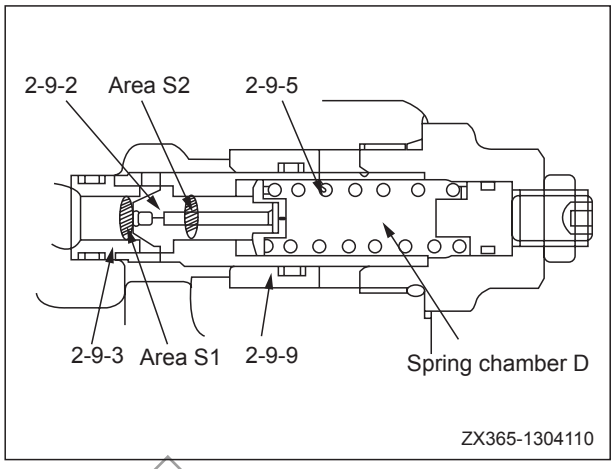


Fig. 4-101

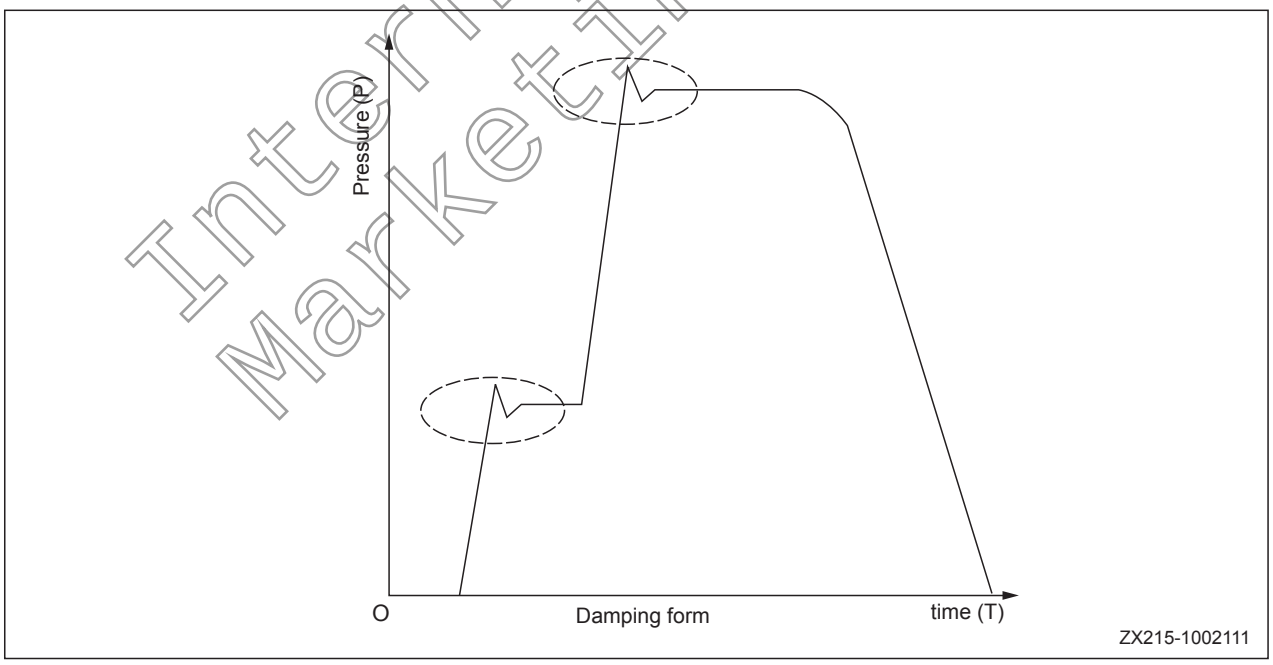


Fig. 4-102

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Table 2 Repair standard of motor components

Components	Check item	Allowable limit	Remedy
1-4-2 Plunger assembly	1. Boot sliding surface	Roughness 0.8a or surface roughness, scratch 0.02mm+	Grind the boot sliding surface. Replace the cylinder block assembly if the scratch cannot be corrected.
	2. Plunger outer diameter	Roughness 1.2a or surface roughness, scratch 0.02mm+	Replace the cylinder block assembly.
	3. Plunger outer diameter and cylinder block inner diameter	Clearance 0.060.	
	4. Boot head clearance	Clearance 0.4.	
1-4-1 Cylinder block	1. Valve leaf and sliding surface	Roughness 0.8a or surface roughness, scratch 0.02mm+.	Grind the boot sliding surface. Replace the cylinder block assembly if the scratch cannot be corrected.
	2. Shaft hole inner diameter	Roughness 1.6a or surface roughness, scratch 0.02mm+.	Replace the cylinder block assembly
	3. Shaft hole inner diameter and 4-2 plunger assembly outer diameter	Clearance 0.060.	
	4. Spline at shaft joint	Roller distance below 38.749 (measuring pin diameter Φ3.333(V1=2.80)); or damaged	
1-21 Oil distribution plate	1. Sliding surface	Roughness 0.8a, scratch 0.02mm+ on sliding surface or burned sign	Grind the sliding surface. Replace the valve sheet if the scratch cannot be corrected.
1-4-3 Retainer 1-4-4 Retaining assembly	1. Sliding surface	Roughness 0.8a, scratch 0.02mm+ on sliding surface or sign of burning	Replace the retaining plate or the retainer.
1-5 Swash plate	1. Sliding surface	Roughness 0.8a, abrasion on sling surface or scratch 0.02mm+	Grind the sliding surface. Replace the valve sheet if the scratch cannot be corrected.
	2. Hole for assembling steel ball	Roughness 1.6a.	Replace the swash plate.
		Scratch on spherical surface 0.02mm+ or surface roughness	
	3. Hole for assembling steel ball	Ball depth 14.5	

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Components	Check item	Allowable limit	Remedy
1-3 Shaft	1. Oil seal sliding portion outer diameter	Roughness 1.6a, rough surface, or scratch 0.02mm+	Replace the swash plate.
	2. Cylinder block matching spline	Stick spans below 47.380 (testing pin diameter Φ3.00), or the stick breakage.	Replace the shaft.
	3. Drive gear connection	Stick spans below 30.498 (testing pin diameter Φ3.33), or the stick breakage.	
1-15 Brake piston	1. Dimension	Height 38.2	Replace the brake piston.
	2. Sliding surface	Roughness 2.5a	
	3. Appearance	Scratch 0.02mm+ or rough surface	
1-13 Disc plate	1. Dimension	Thickness 3.2	Replace the disc plate.
	2. Appearance	Deep scratch on sliding surface or friction material peeling	
1-8 Ball bearing 1-9 Ball bearing	1. Rolling surface	Peeling or fracture	Replace the ball bearing.
	2. Action	Abnormal rotation (noise•uneven rotation)	
1-7 Plunger assembly	1. Boot sliding surface	Roughness 1.6a, rough surface, or scratch 0.02mm+	Grind the sliding surface. Replace the flange plate parts if the scratch cannot be corrected
	2. Plunger outer diameter	Roughness 1.2a, rough surface, scratch 0.02mm+	Replace the flange plate parts.
	3. Plunger outer diameter and flange part inner diameter	Gap 0.040.	
	4. Boot head clearance	Clearance 1.0	
1-2-2 Plunger assembly	1. Plunger outer diameter	Roughness 0.8 a, scratch 0.02mm+ or rough surface	Replace the valve sheet.
	2. Plunger outer diameter and valve sheet inner diameter	Clearance 0.060.	
1-2-1 Valve sheet	1. Assemble the plunger assembly hole	Roughness 0.8 a, scratch 0.02mm+ or rough surface	Replace the valve sheet and the parts.
	2. Valve sheet inner diameter and plunger outer diameter	Clearance 0.060	
	3. Valve spool assembly installation hole	Roughness 0.8 a, scratch 0.02mm+ or rough surface	
	4. Spool valve sheet inner diameter and valve spool outer diameter	Clearance 0.060.	
	5. Movable plunger sliding part and seat of the relief valve	Scratch 0.02mm+ or surface roughness	

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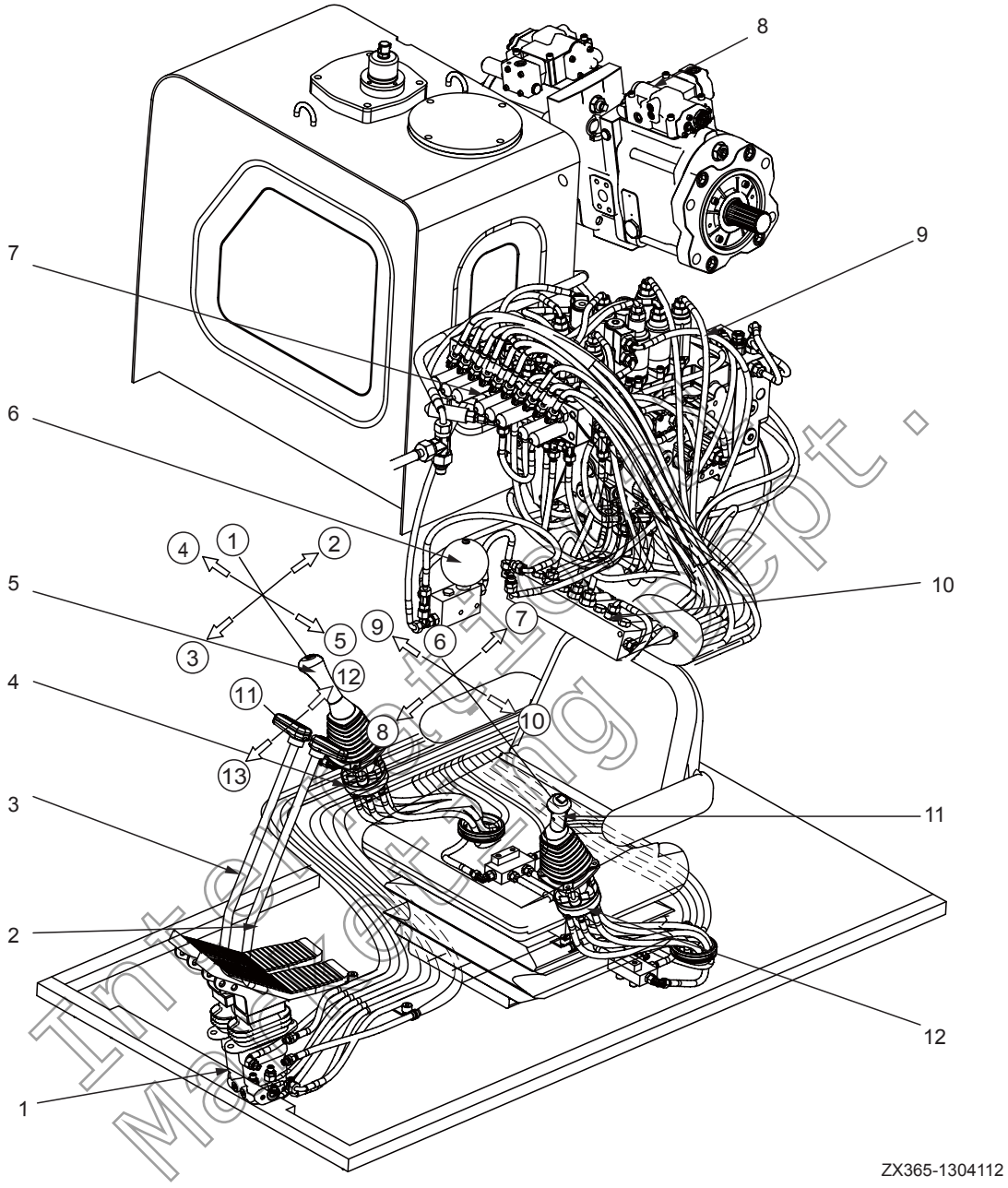
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Components	Check item	Allowable limit	Remedy
1-2-9 Spool assembly	1. Valve spool out diameter	Roughness 0.8 a, scratch 0.02mm+ or surface roughness	Replace valve sheet and parts
	2. Valve spool outer diameter and valve sheet inner diameter	Clearance 0.060.	
1-2-7-9 Movable plunger	1. Sliding portion of valve sheet and valve seat	Scratch 0.02mm+ or surface roughness	Replace relief valve assembly
1-2-7-1 Case	1. Sling portion of the movable piston (outer diameter)	Scratch 0.02mm+ or surface roughness	
1-4-7 Spring	1. Dimension	Free length 61.0	
	2. Appearance	Deformation and surface damage	
1-18 Spring	1. Dimension	Free length 39.0	
	2. Appearance	Deformation and surface damage	
1-20 Spring	1. Dimension	Free length 41.5	
	2. Appearance	Deformation and surface damage	
1-2-4 Spring	1. Dimension	Free length 48.5	
	2. Appearance	Deformation and surface damage	
1-2-10 Spring	1. Dimension	Free length 28.3	
	2. Appearance	Deformation and surface damage	
O-ring and oil seal		When removed	Replace o-ring and oil seal

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4.6.10 Control system



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Fig. 4-103

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(1) Pilot valve (travel)
(2) Control lever (left travel)
(3) Control lever (right travel)
(4) Pilot valve (Right)
(5) Control lever (right work equipment)
(6) Accumulator
(7) Block
(8) Hydraulic pump
(9) Main control valve
(10) Solenoid valve
(11) Control lever (left work equipment)
(12) Relay

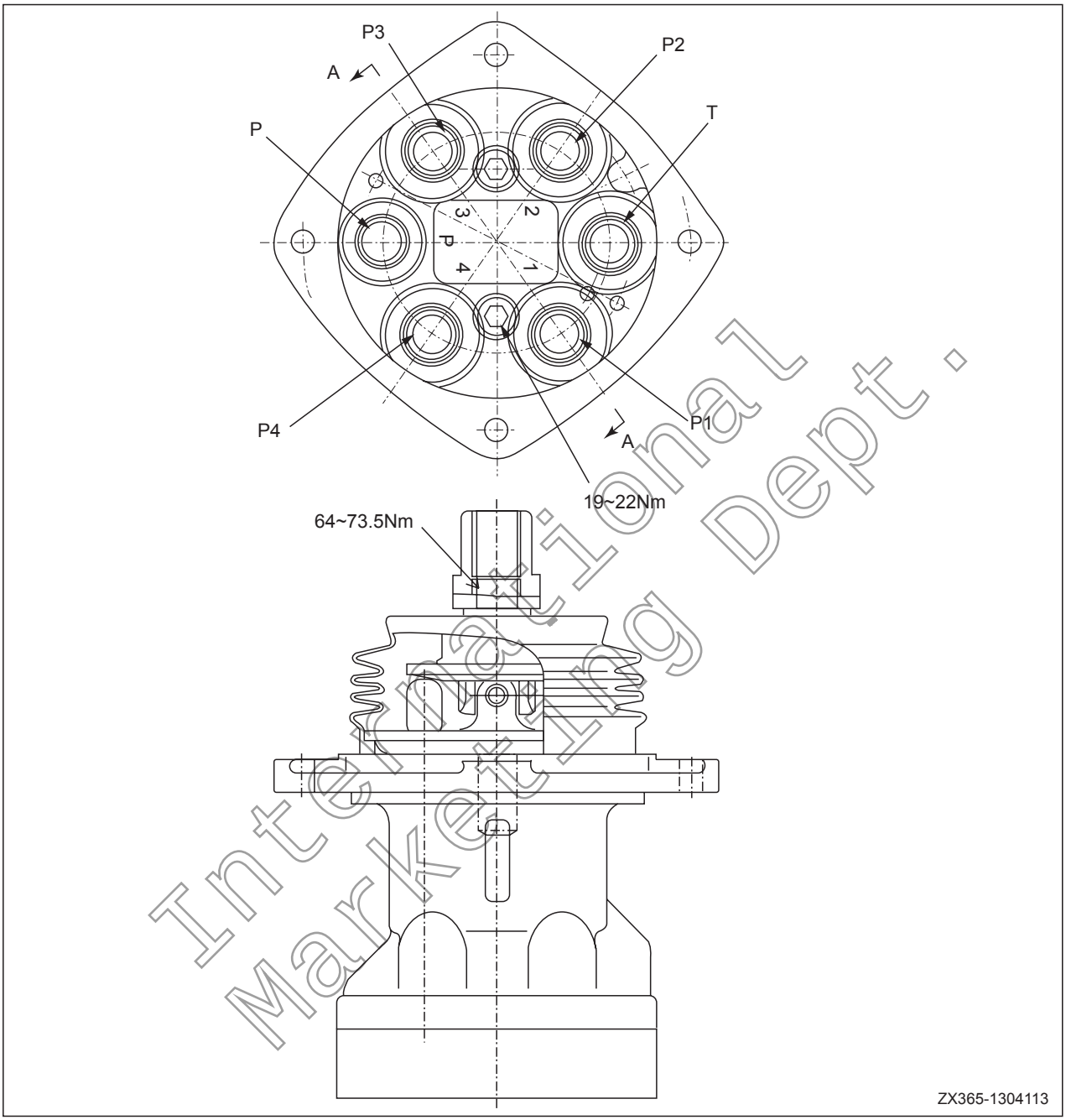
Control lever positions

① HOLD
② Boom UP
③ Boom DOWN
④ Bucket DUMP
⑤ Bucket DIG
⑥ HOLD
⑦ Arm IN
⑧ Arm OUT
⑨ Right swing
⑩ Left swing
⑪ Neutral
⑫ Travel BACKWARD
⑬ Travel FORWARD

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4.6.11 Manual pilot valve



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Fig. 4-104

P: From pilot pump relief valve
P1: Left pilot valve: Arm OUT / Right pilot valve: Boom DOWN
P2: Left pilot valve: Arm IN / Right pilot valve: Boom UP
P3: Left pilot valve: Swing LEFT / Right pilot valve: Bucket DIG
P4: Left pilot valve: Swing RIGHT / Right pilot valve: Bucket DUMP
T: To tank

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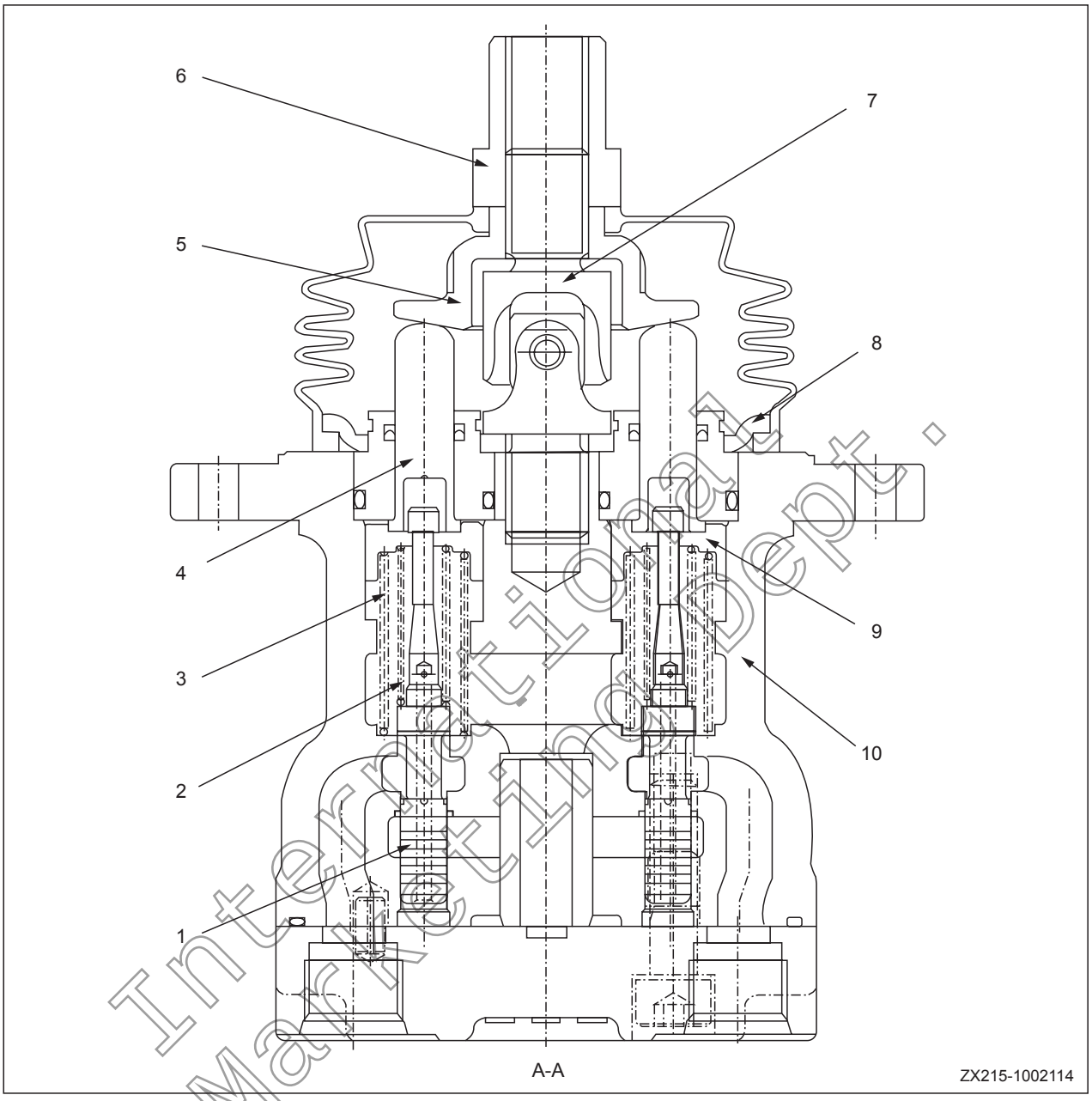


Fig. 4-105

(1) Plunger
(2) Adjusting spring
(3) Center spring
(4) Piston
(5) Disc
(6) Nut (for control lever connection)
(7) Connector
(8) Plate
(9) Retainer
(10) Valve body

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Operation

1. When in neutral

- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the pilot valve are connected to drain chamber (D) via orifice (f) in plunger (1).

2. During fine control (Neutral to fine control)

- When piston (4) is pushed by disc (5), retainer (9) is pushed, plunger (1) is also pushed by adjusting spring (2), and moves down.
- When orifice (f) is shut off from drain chamber (D), it is almost simultaneously interconnected to pump pressure chamber (PP). Pilot pressurized oil of the control pump is led to port (A) from port (P1) via orifice (f). When the pressure at port (P1) becomes higher, plunger (1) is pushed back and orifice (f) is shut off from pump pressure chamber (PP). At almost the same time, it is connected to drain chamber (D) to release the pressure at port (P1). As a result, plunger (1) moves up and down until the force of adjusting spring (2) is balanced with the pressure at port (P1).
- The relationship of the position of plunger (1) and body (10) [orifice (f) is in the middle between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (9) contacts plunger (1). Adjusting spring (2) contracts in proportion to the stroke of the control lever. Pressure at port (P1) also rises in proportion to the stroke of the control lever. In this way, the control valve plunger moves to a position where the pressure of chamber (A) (same as pressure at port (P1)) and the force of the return spring of the control valve plunger are balanced.

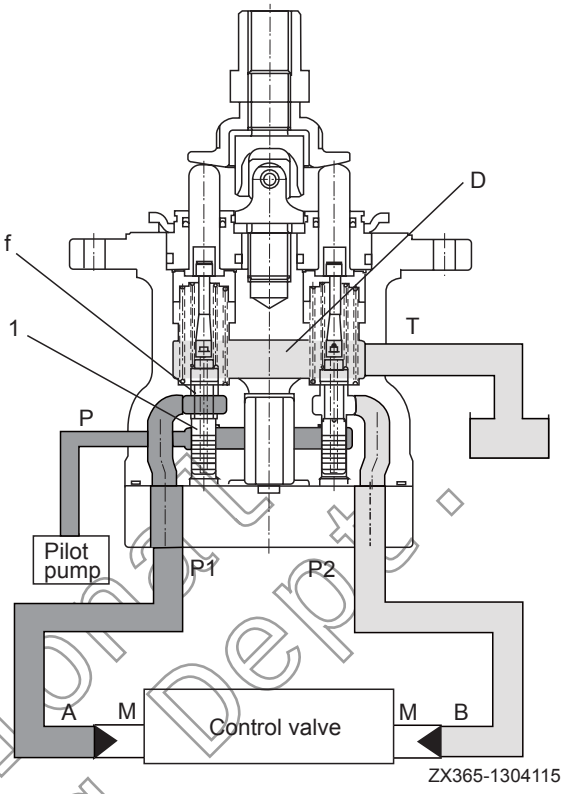


Fig. 4-106

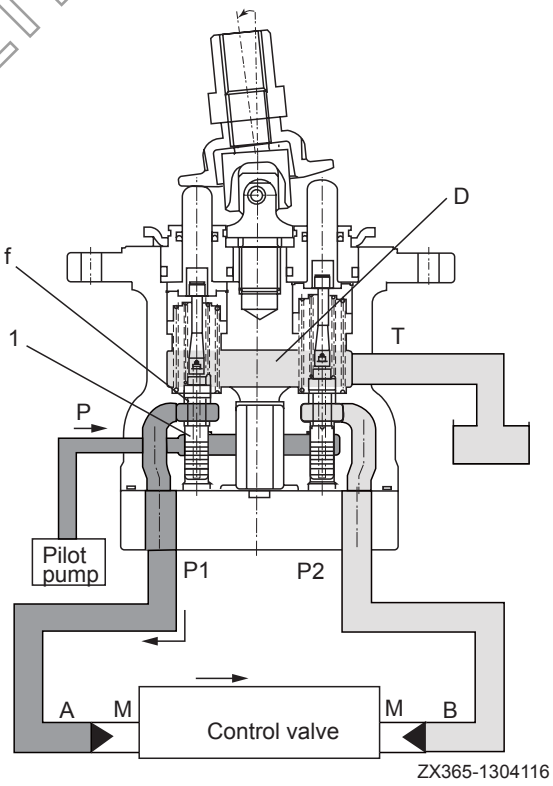


Fig. 4-107

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3. Fine control (When control lever returns)

- When disc (5) starts to return, plunger (1) is pushed up by the force of center spring (3) and the pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (1) is pushed down by adjusting spring (2).
- Orifice (f) is shut off from drain chamber (D), and it is almost simultaneously interconnected to pump pressure chamber (PP). Pump pressure is supplied until the pressure at port (P1) recovers to the level equivalent to the lever position.
- When the plunger of the control valve returns, the oil in drain chamber (D) flows in from orifice (f) in the valve on the side that is not working. The oil passes through port (P2) and enters chamber (B) to replenish the chamber with pressurized oil.

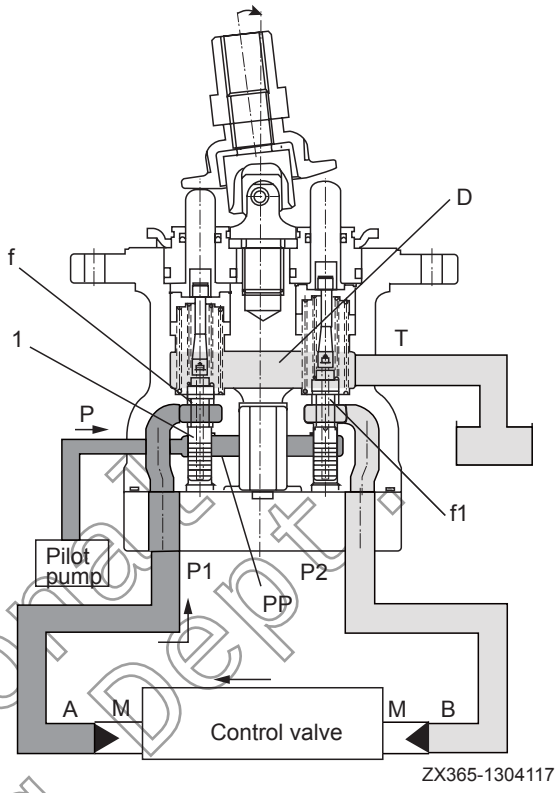


Fig. 4-108

4. At full stroke

- Disc (5) pushes down piston (4), and retainer (9) pushes down plunger (1).
- Orifice (f) is shut off from drain chamber (D), and is interconnected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil from the self pressure reducing valve passes through orifice (f) and flows to chamber (A) from port (P1) to push the control valve plunger.
- The oil returning from chamber (B) passes from port (P2) through orifice (f) and flows to drain chamber (D).

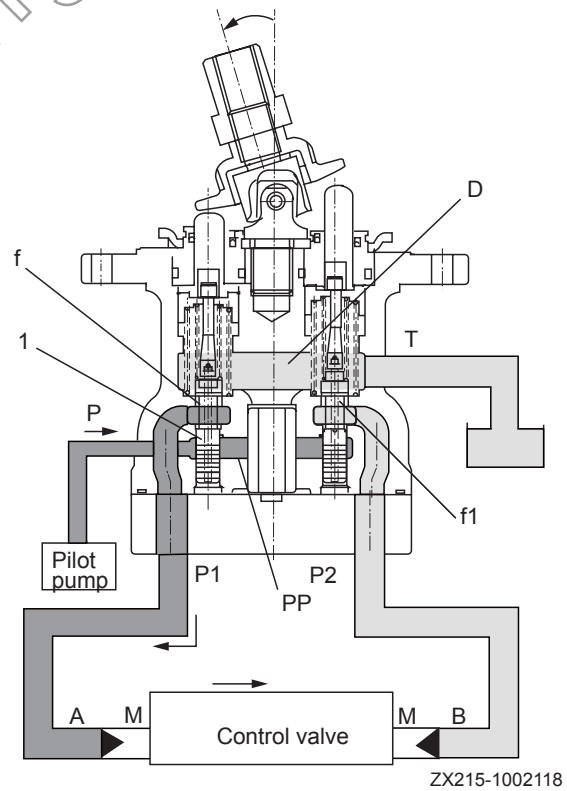
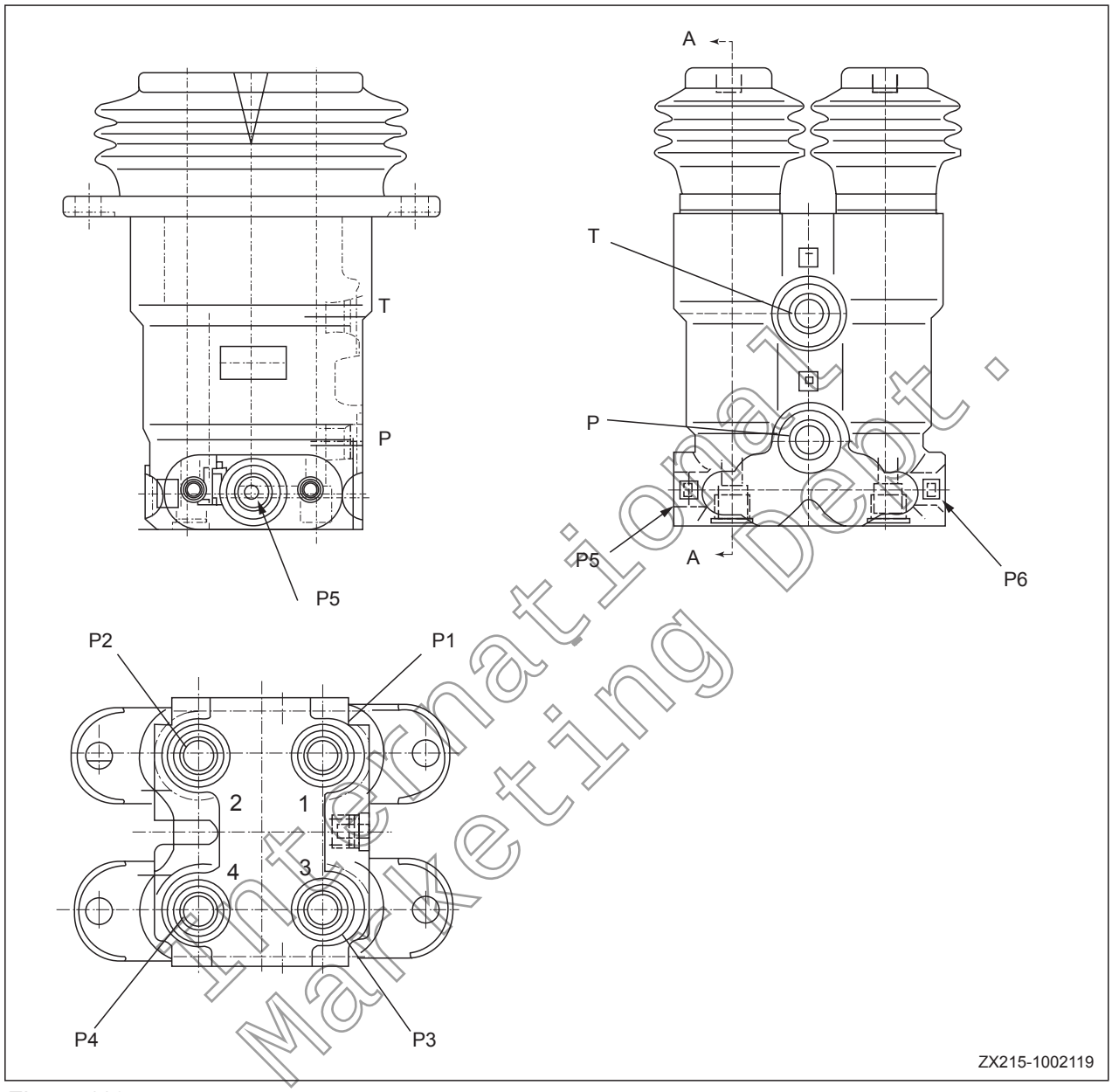


Fig. 4-109

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4.6.12 Travel pilot valve



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Fig. 4-110

P: From pilot pump
P1: L.H. reverse
P2: L.H. forward
P3: R.H. reverse
P4: R.H. forward
P5: Travel signal
P6: Travel signal
T: To tank

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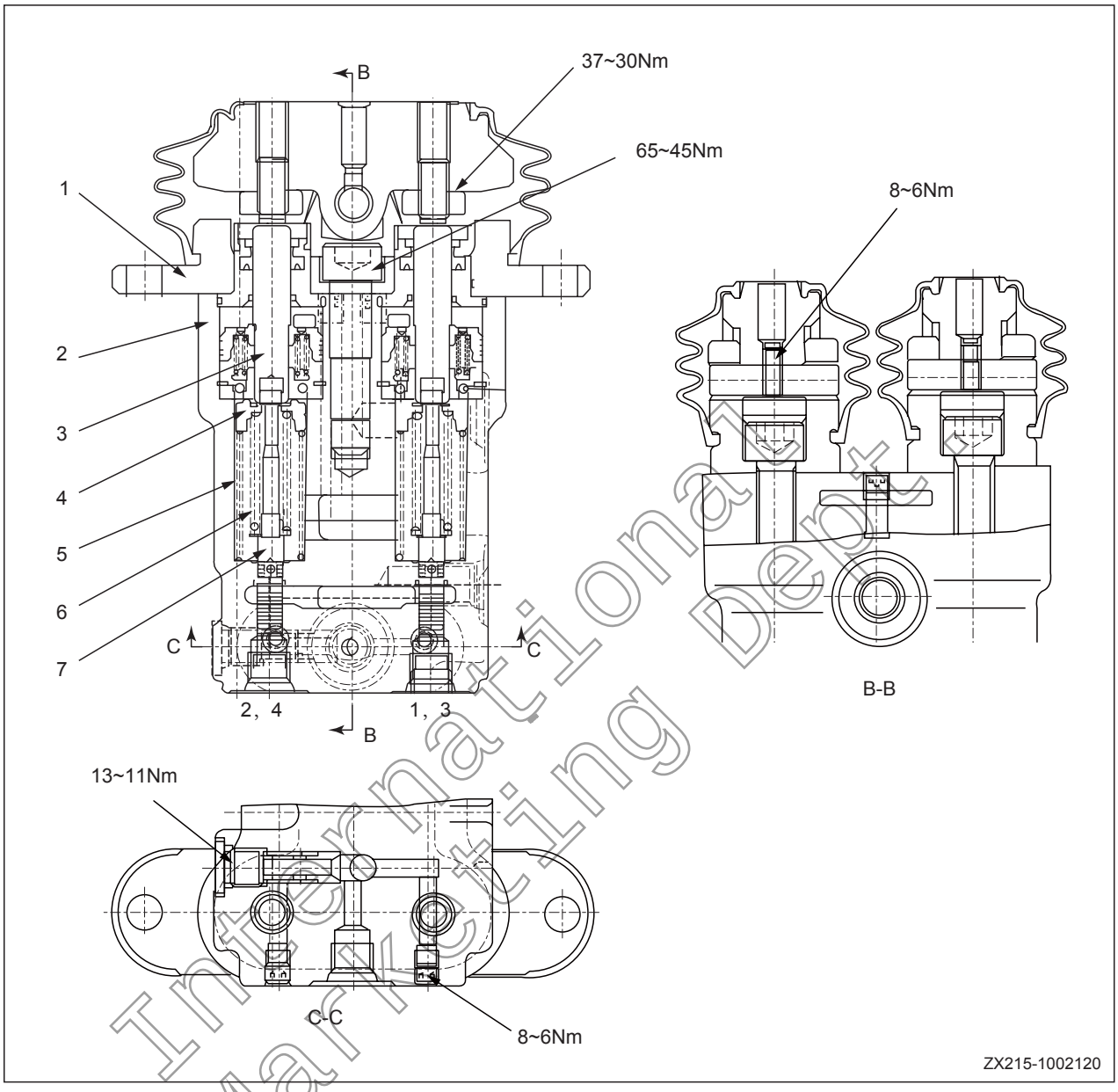


Fig. 4-111

(1) Plate
(2) Body
(3) Piston
(4) Collar
(5) Center spring
(6) Adjusting spring
(7) Valve

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4.6.12.1 Operating principle

1) When in neutral

- Ports (A) and (B) of the control valve and ports (P1) and (P2) of the pilot valve are connected to drain chamber (D) via orifice (f) in spool (1).

2) Fine control (Neutral to fine control)

- When piston (4) is pushed by lever (5), retainer (9) is pushed, and plunger (1) is also pushed by adjusting spring (2), and moves downward.
- When orifice (f) is shut off from drain chamber (D), it is almost simultaneously interconnected to pump pressure chamber (PP).
- Pilot pressurized oil of the control pump is led to port (A) from port (P1) via orifice (f).
- When the pressure at port (P1) becomes higher, plunger (1) is pushed back and orifice (f) is shut off from pump pressure chamber (PP). At almost the same time, it is connected to drain chamber (D) to release the pressure at port (P1).
- As a result, plunger (1) moves up and down until the force of adjusting plunger (2) is balanced with the pressure at port (P1).
- The relationship of the position of plunger (1) and body (10) [orifice (f) is in the middle between drain chamber (D) and pump pressure chamber (PP)] does not change until retainer (9) contacts plunger (1).
- Adjusting spring (2) contracts in proportion to the stroke of the control lever.
- Pressure at port (P1) also rises in proportion to the stroke of the control lever.
- In this way, the control valve spool moves to a position where the pressure of chamber (A) (same as pressure at port (P1)) and the force of the return spring of the control valve spool are balanced.

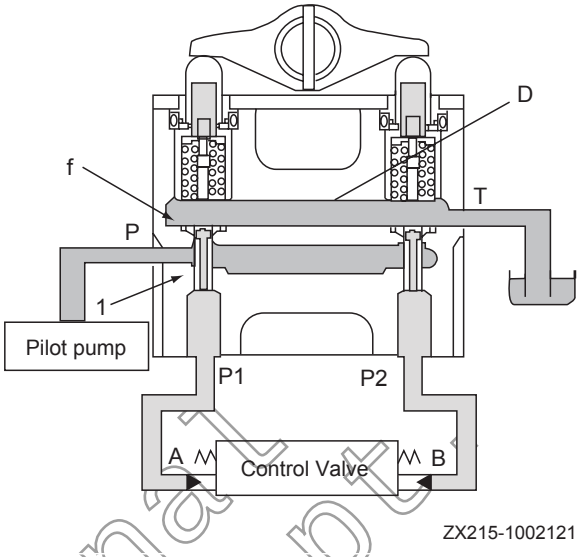


Fig. 4-112

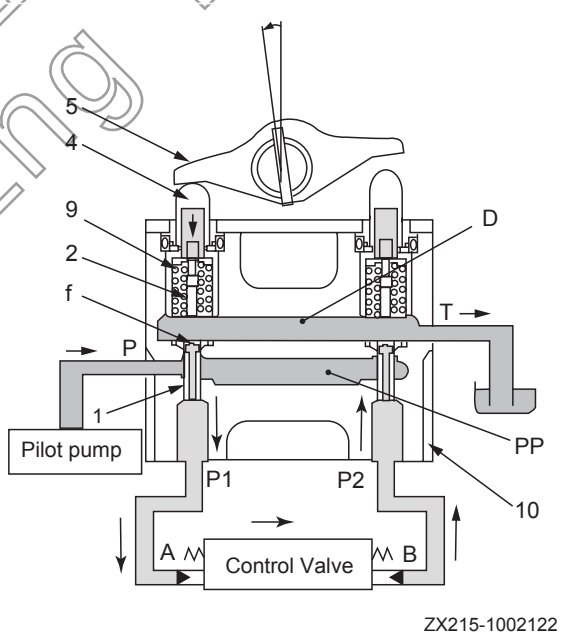


Fig. 4-113

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3) Fine control (When control lever returns)

- When lever (5) starts to return, plunger (1) is pushed up by the force of center spring (3) and pressure at port (P1).
- Because of this, orifice (f) is connected to drain chamber (D), and the pressurized oil at port (P1) is released.
- If the pressure of port (P1) is lowered excessively, plunger (1) is pushed down by adjusting spring (2).
- Orifice (f) is shut off from drain chamber (D), and it is almost simultaneously interconnected to pump pressure chamber (PP).
- Pump pressure is supplied until the pressure at port (P1) recovers to the level equivalent to the lever position.
- When the spool of the control valve returns, the oil in drain chamber (D) flows in from orifice (f) in the valve on the side that is not working. The oil passes through port (P2) and enters chamber (B) to replenish the chamber with pressurized oil.

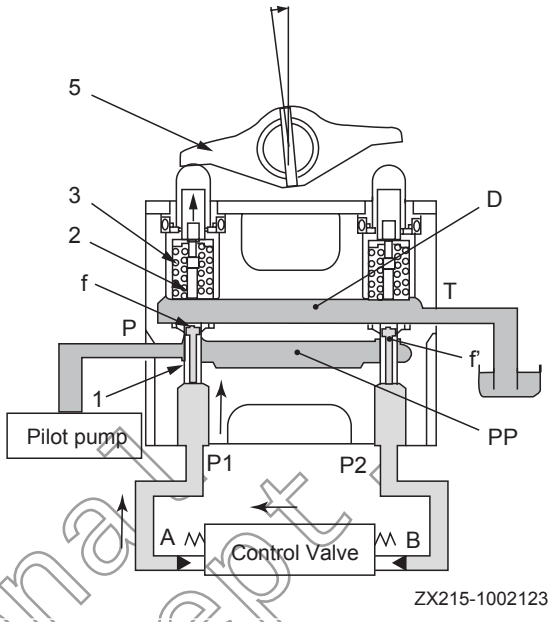


Fig. 4-114

4) At full stroke

- Lever (5) pushes down piston (4), and retainer (9) pushes down plunger (1).
- Orifice (f) is shut off from drain chamber (D), and is interconnected to pump pressure chamber (PP).
- Therefore, the pilot pressure oil from the self pressure reducing valve passes through orifice (f) and flows to chamber (A) from port (P1) to push the control valve spool.
- The oil returning from chamber (B) passes from port (P2) through orifice (f) and flows to drain chamber (D).

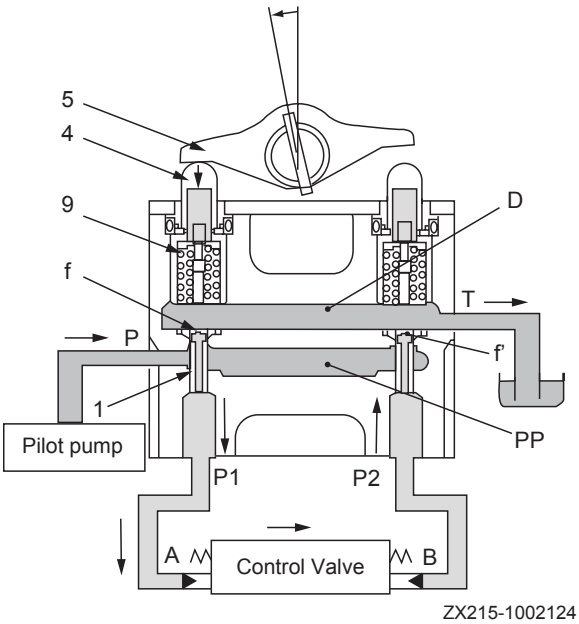


Fig. 4-115

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4.6.13 Solenoid valve

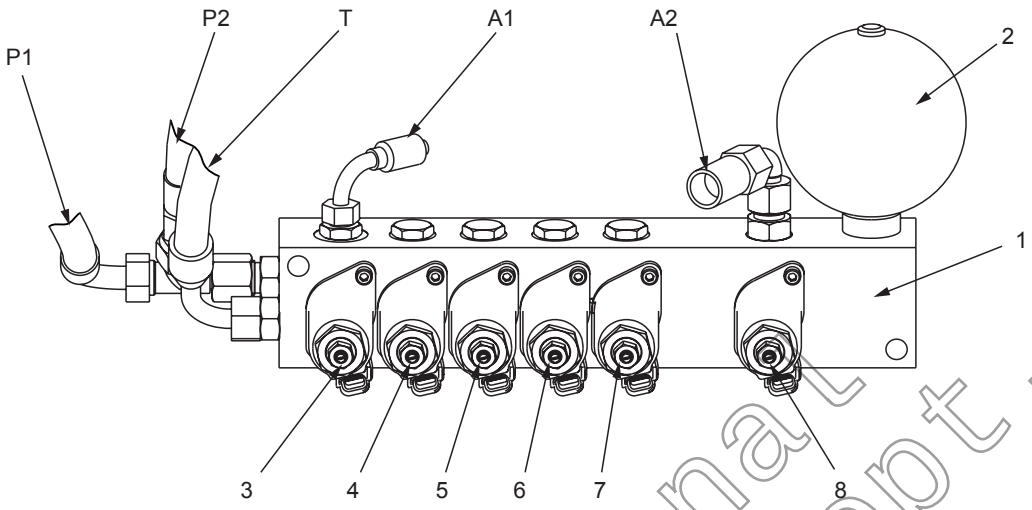


Fig. 4-116

(1) Solenoid valve block
(2) Accumulator
(3) High-speed travel solenoid valve
(4) Backup valve
(5) Backup valve
(6) Bucket confl uence solenoid valve
(7) Backup
(8) Pilot pressure solenoid valve

P1: To pilot fi lter
P2: To main valve port G
T: To oil tank
A1: To swivel joint port X
A2: To pilot oil circuit block P

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4.6.14 PPC accumulator

(1) Gas plug
(2) Shell
(3) Poppet
(4) Holder
(5) Bladder
(6) Oil port

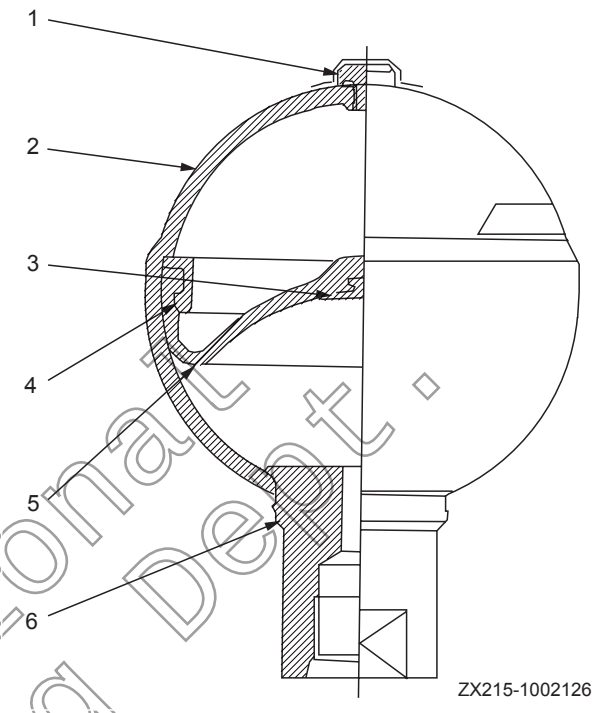


Fig. 4-117

Specifications

Gas capacity: 300 cc (for PPC)

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4.6.15 Pilot oil filter

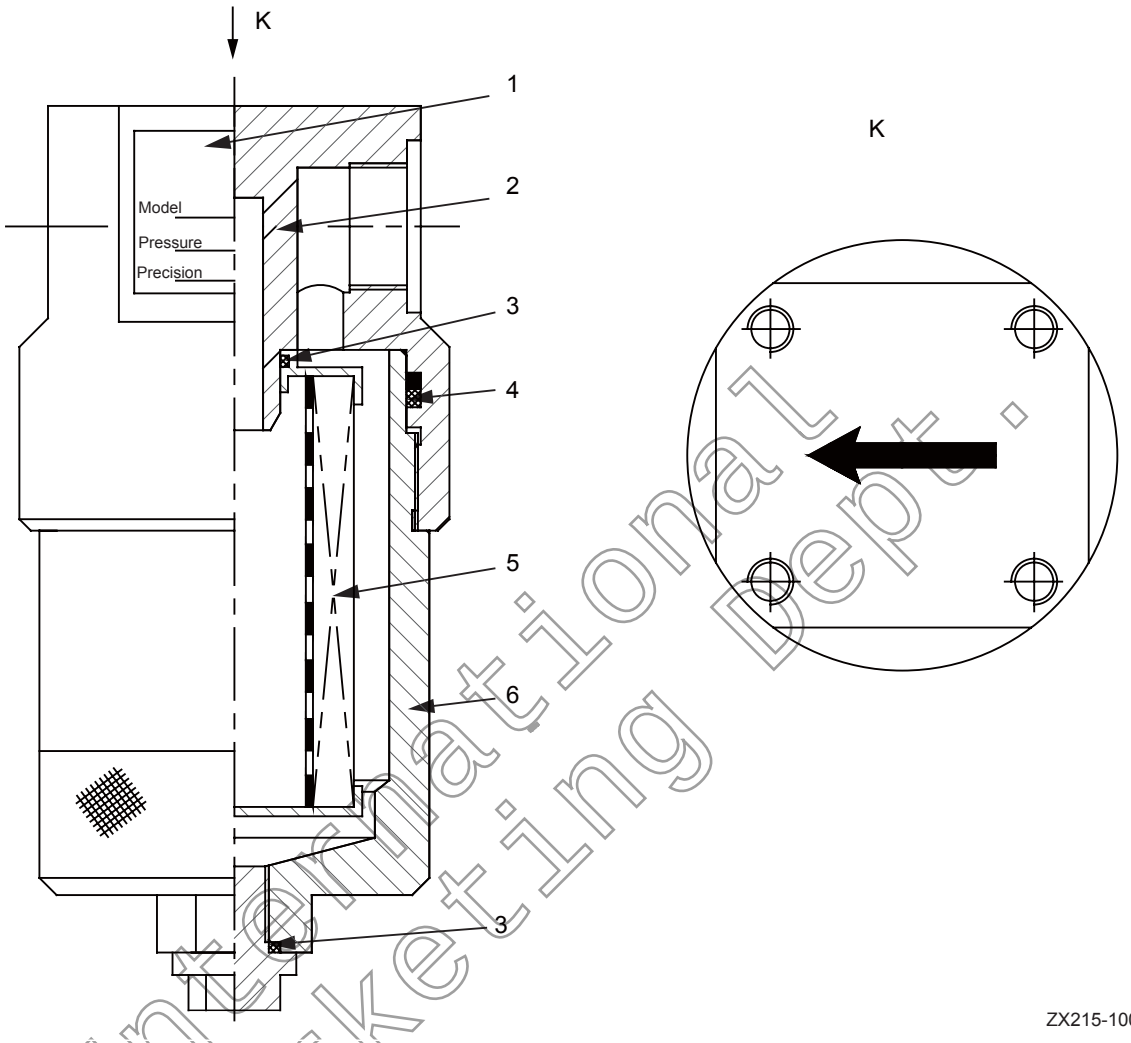


Fig. 4-118

(1) Nameplate
(2) Head cover
(3) O-ring
(4) Seal ring
(5) Filter
(6) Casing

Specifications
Max. delivery: 40 L/min
Filter fineness: 10 um
Operating pressure: 20 Mpa
Max. operating pressure: 40 Mpa
Pressure loss: 0.05 Mpa
Max. allowable pressure difference: 1 Mpa
Specification of inlet/outlet port O-ring: 30×3.1

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4.6.16 Hydraulic cylinders

Boom cylinder

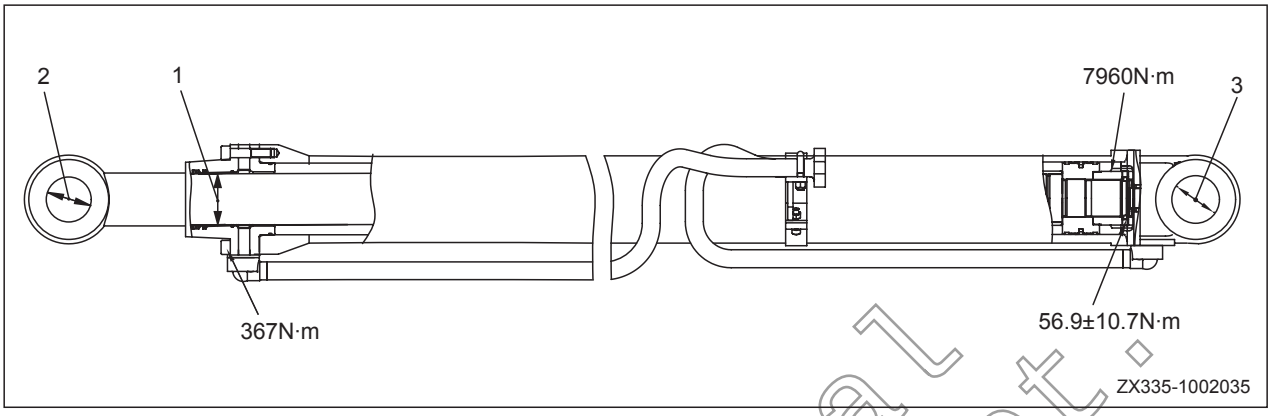


Fig. 4-119

Arm cylinder

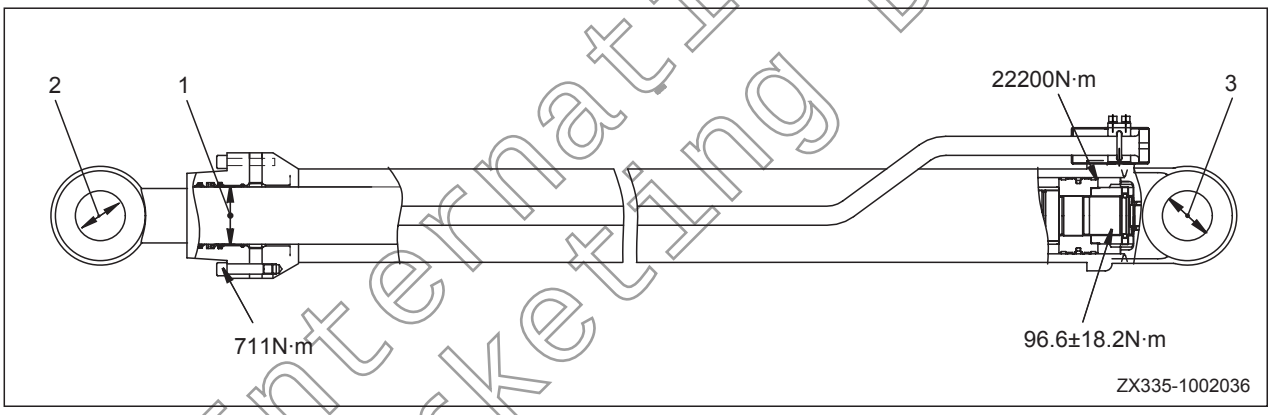


Fig. 4-120

Bucket cylinder

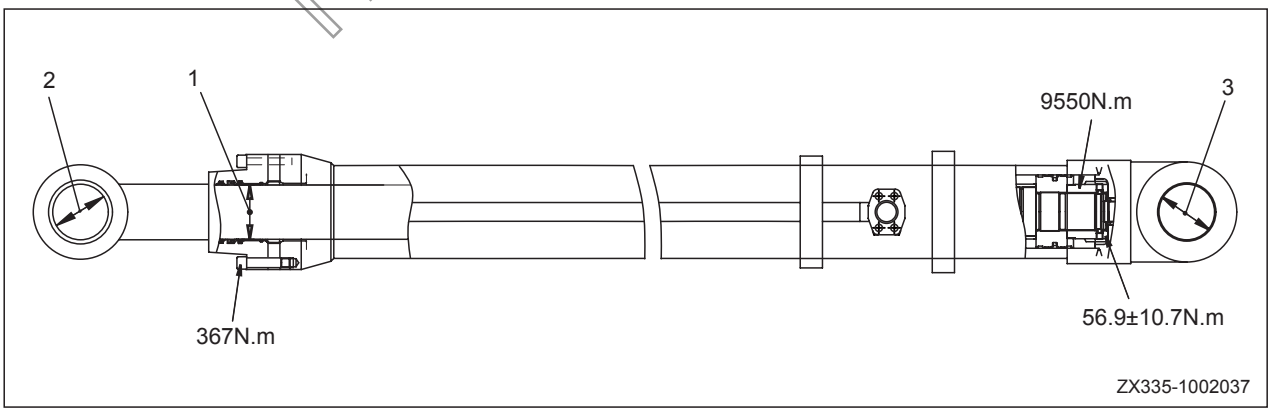


Fig. 4-121

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4.6.16.2 Lubrication at every 100 service hours

Unit: mm

No.	Check Item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	100	-0.012 -0.034	+0.222 +0.047	0.083-0.312	0.412	Replace the bushing.
		Arm	120	-0.012 -0.047	+0.222 +0.047	0.083-0.312	0.412	
		Bucket	100	-0.012 -0.034	+0.258 +0.048	0.078-0.334	0.434	
2	Clearance between piston rod support pin and bushing	Boom	100	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	Replace the pin or bushing.
		Arm	110	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Bucket	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Arm	110	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Bucket	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	

4.6.16.1 Lubrication at every 500 service hours

Unit: mm

No.	Check Item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	100	-0.012 -0.034	+0.222 +0.047	0.083-0.312	0.412	Replace the bushing.
		Arm	120	-0.012 -0.047	+0.222 +0.047	0.083-0.312	0.412	
		Bucket	100	-0.012 -0.034	+0.258 +0.048	0.078-0.334	0.434	
2	Clearance between piston rod support pin and bushing	Boom	100	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	Replace the pin or bushing.
		Arm	110	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Bucket	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
3	Clearance between cylinder bottom support pin and bushing	Boom	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Arm	110	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	
		Bucket	90	-0.036 -0.071	+0.25 +0.05	0.086-0.321	1.0	

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4.7 Work Equipment

4.7.1 Component dimensions

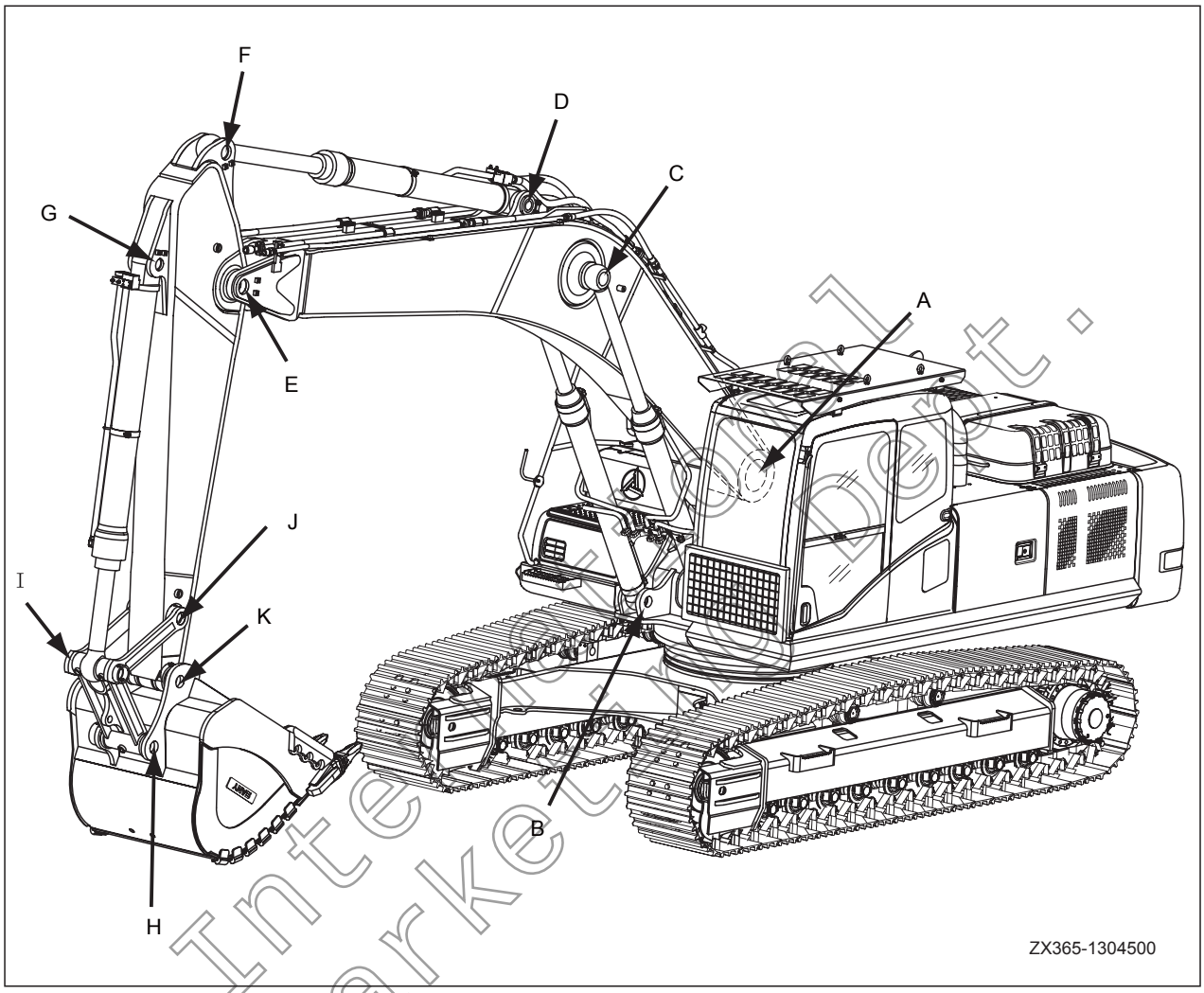


Fig. 4-122

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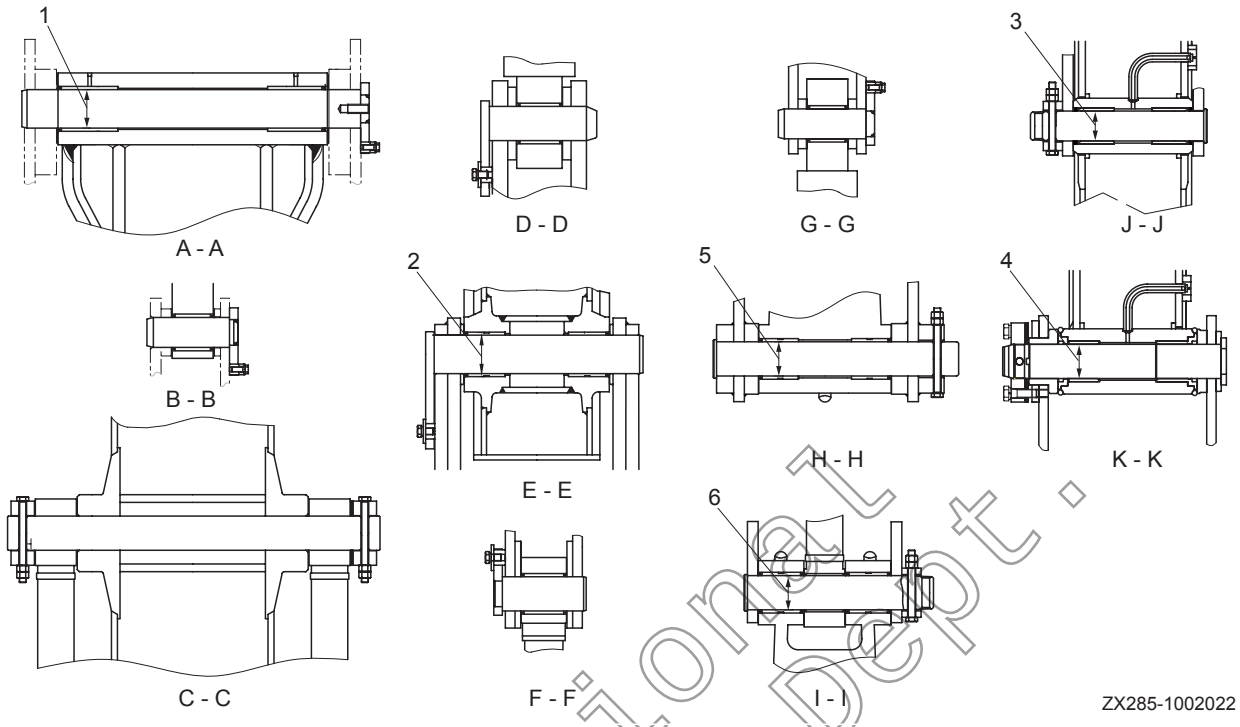


Fig. 4-123

Lubrication

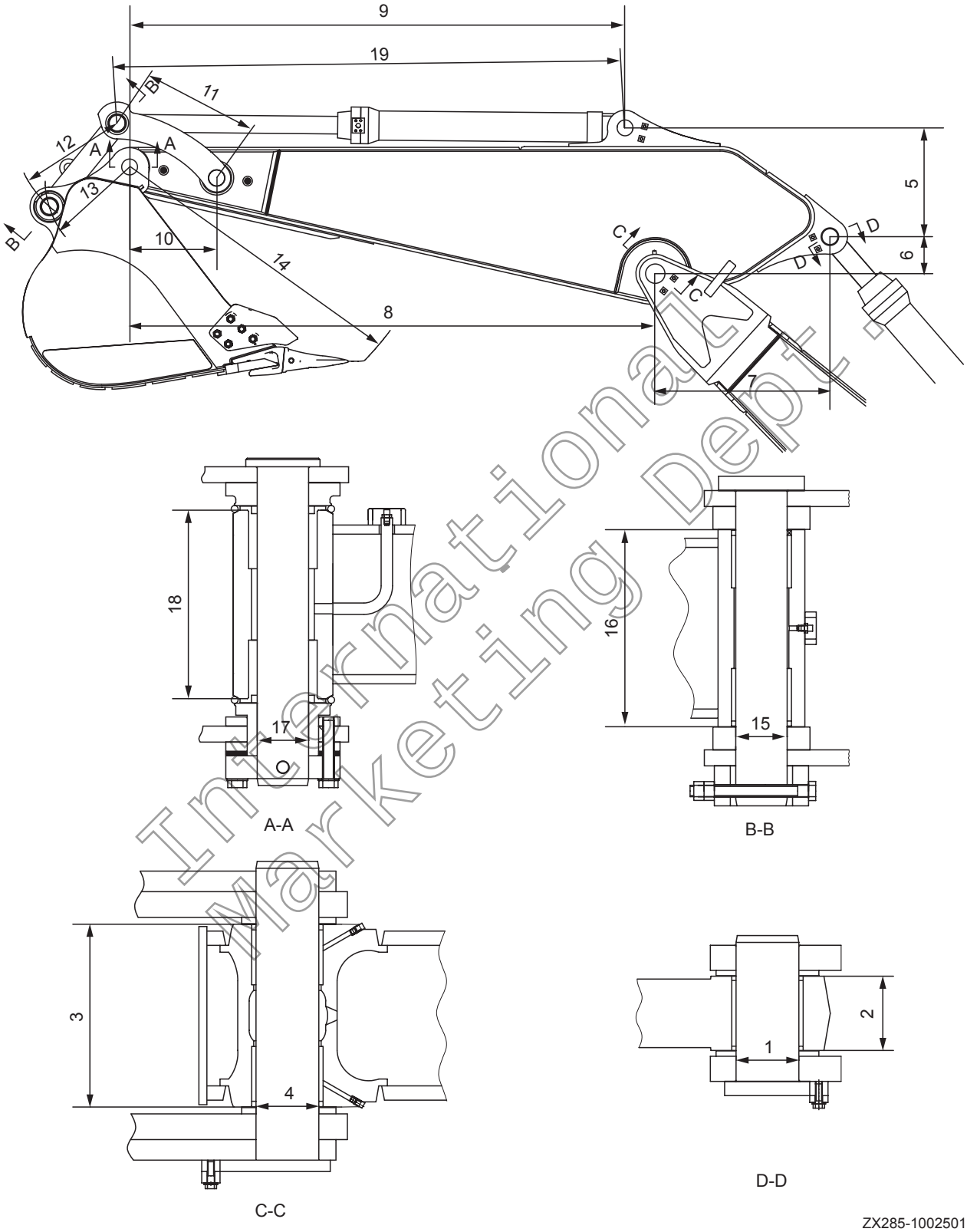
Unit：mm

No.	Item	Bushing material	Lube interval	Std. size	Std. tolerance		Std. clearance	Clearance limit	Remedy
					轴	孔			
1	Clearance between the pin and bushing connecting the boom with swing platform	Copper	500 h	Φ110	–0.036 –0.071	+0.063 0	0.036 ～ 0.134	1.0	Replace
2	Clearance between the pin and bushing connecting the boom with arm	Copper	500 h	Φ110	–0.036 –0.071	+0.087 0	0.036 ～ 0.158	1.0	
3	Clearance between the pin and bushing connecting the arm with rocker	Steel	100 h	Φ90	–0.036 –0.071	+0.054 0	0.036 ～ 0.125	1.0	
4	Clearance between the pin and bushing connecting the arm with bucket	Steel	100 h	Φ90	–0.036 –0.071	+0.054 0	0.036 ～ 0.125	1.0	
5	Clearance between the pin and bushing connecting the linkage with bucket	Steel	100 h	Φ90	–0.036 –0.071	+0.2 0	0.036 ～ 0.271	1.0	
6	Clearance between the pin and bushing connecting the linkage with rocker	Steel	100 h	Φ90	–0.036 –0.071	+0.054 0	0.036 ～ 0.125	1.0	

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4.7.2 Arm dimensions



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Fig. 4-124

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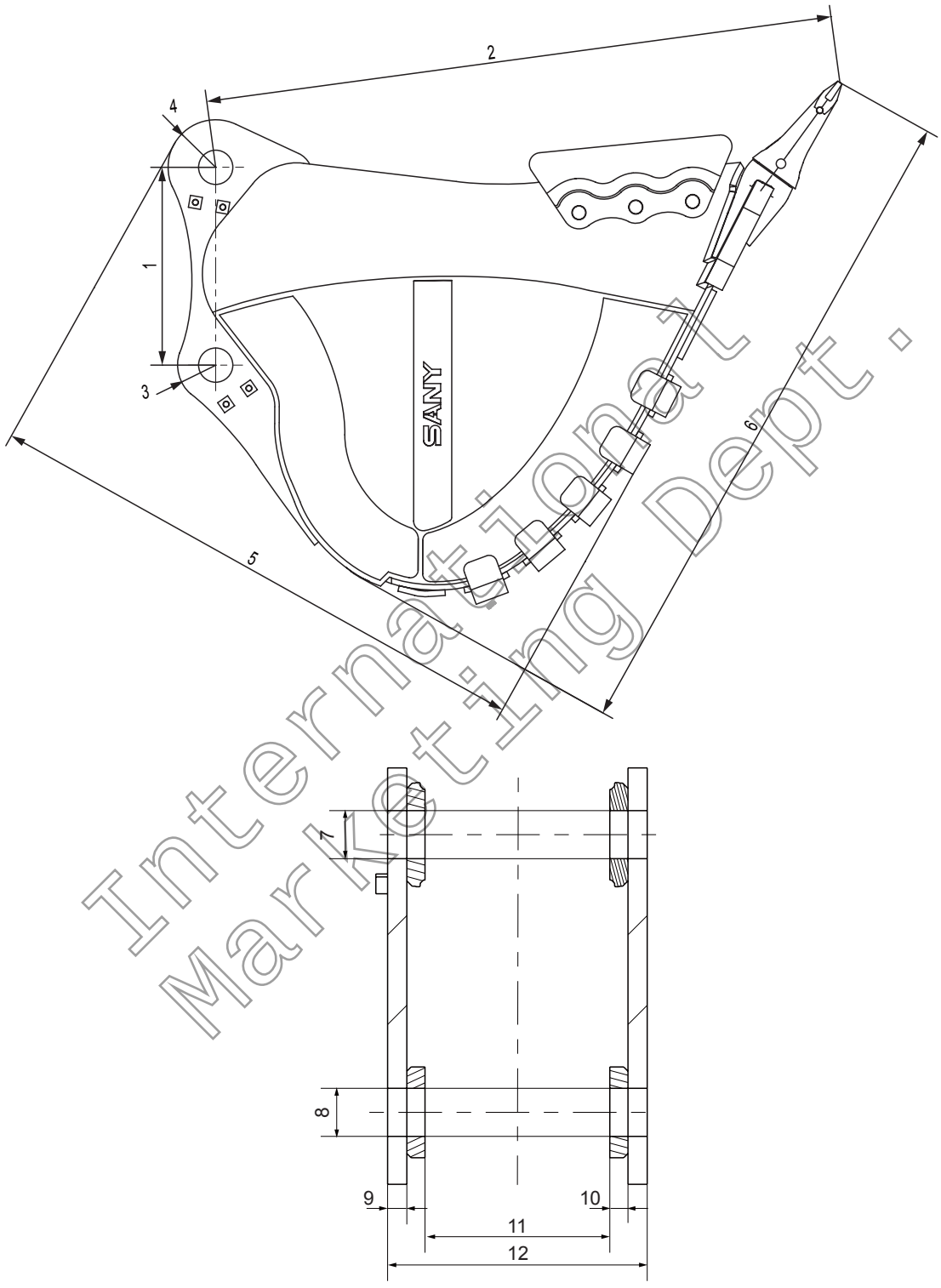
单位：mm

No.		SY365H-9		SY365BH-9	
		Standard size	Tolerance	Standard size	Tolerance
1		Φ100	+0.087 0	Φ100	+0.087 0
2		131	+1.5 0	131	+1.5 0
3		345	0 -0.5	316	0 -0.5
4		Φ90	-0.036 -0.071	Φ110	-0.071 -0.036
5		473	±1	602	±0.8
6		354	±1	215	±0.5
7		989	±1	976.6	±0.8
8		2914	±3	2906	±2
9		3018	±3	3071	±2
10		473	±1	458	±0.8
11		740	±0.3	770	±0.3
12		728	±0.5	728	±0.5
13		520	±0.5	513.6	—
14		1,661	—	1570	—
15		Φ90	-0.036 -0.071	Φ90	-0.036 -0.071
16		345	0 -0.5	346	+1 0
17		Φ90	-0.036 -0.071	Φ90	-0.03 -0.06
18	Arm body	345	0 -0.5	329	0 -0.5
	When bushing is pressed on	345	—	344	—
19	Minimum	2,395	—	1,990	—
	Maximum	4,145	—	3,275	—

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4.7.2.1 Bucket dimensions



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W365-1304502

Fig. 4-125

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Unit：mm

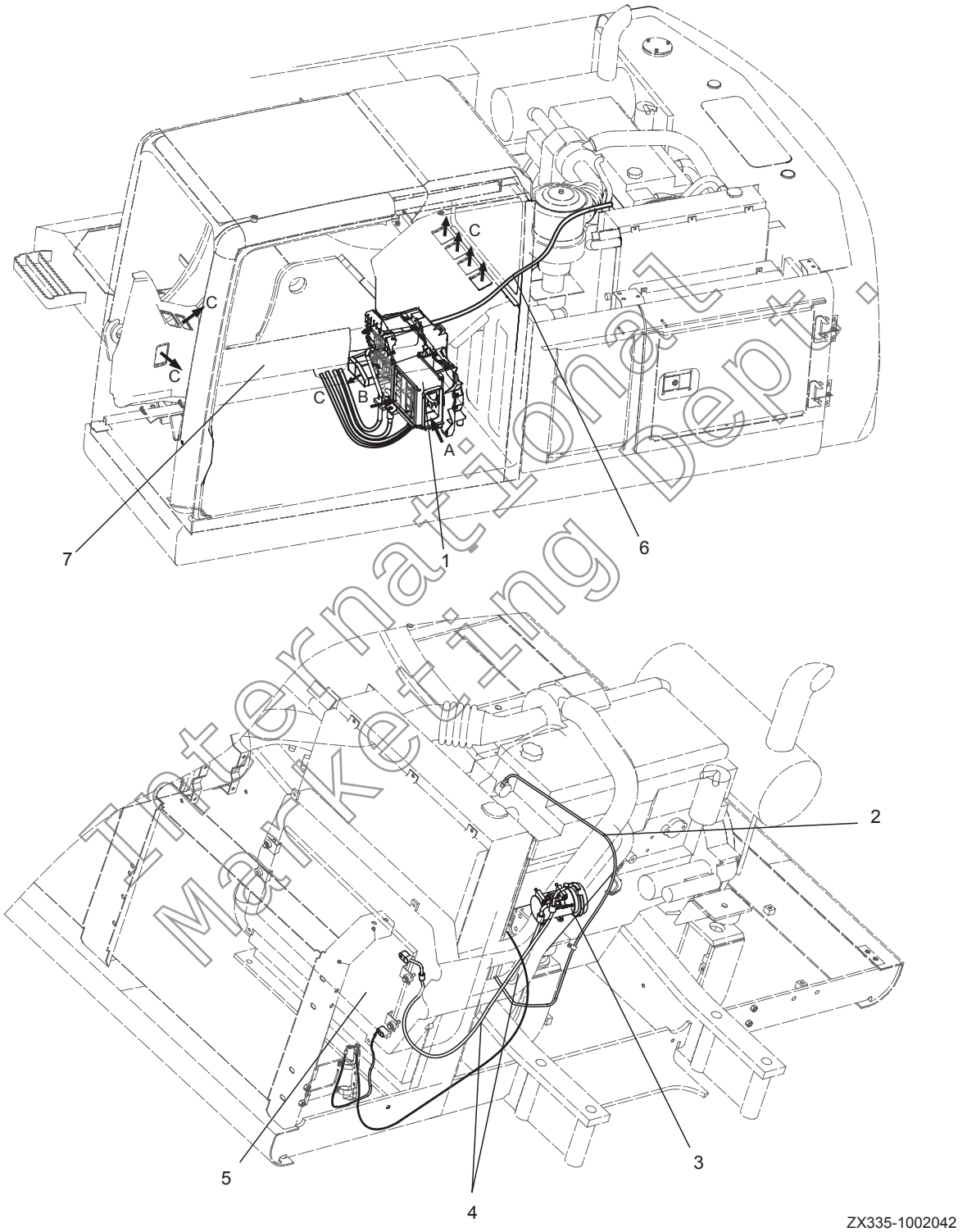
No.	SY365H-9		SY365BH-9	
	Standard size	Tolerance	Standard size	Tolerance
1	520	±0.5	567	±0.5
2	1661	—	1714	—
3	R100	—	R130	—
4	R125	—	R130	—
5	1478	—	1451	—
6	1570	—	1889	—
7	ϕ90	+0.2 0	ϕ100	+0.2 0
8	ϕ90	+0.2 0	ϕ90	+0.2 0
9	36	—	36	—
10	34	—	36	—
11	346	+1 0	346	+1 0
12	486	—	500	—

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4.8 Operator Station and Its Attachments

4.8.1 Air conditioner lines



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Fig. 4-126

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(1) Air conditioner
(2) Hot water pumping line
(3) Air compressor
(4) Refrigerant line
(5) Condenser
(6) Hot water return line
(7) Duct

A: Fresh air
B: Recirculated air
C: Warm air / cool air

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4.8.1.1 Layout of A/C components

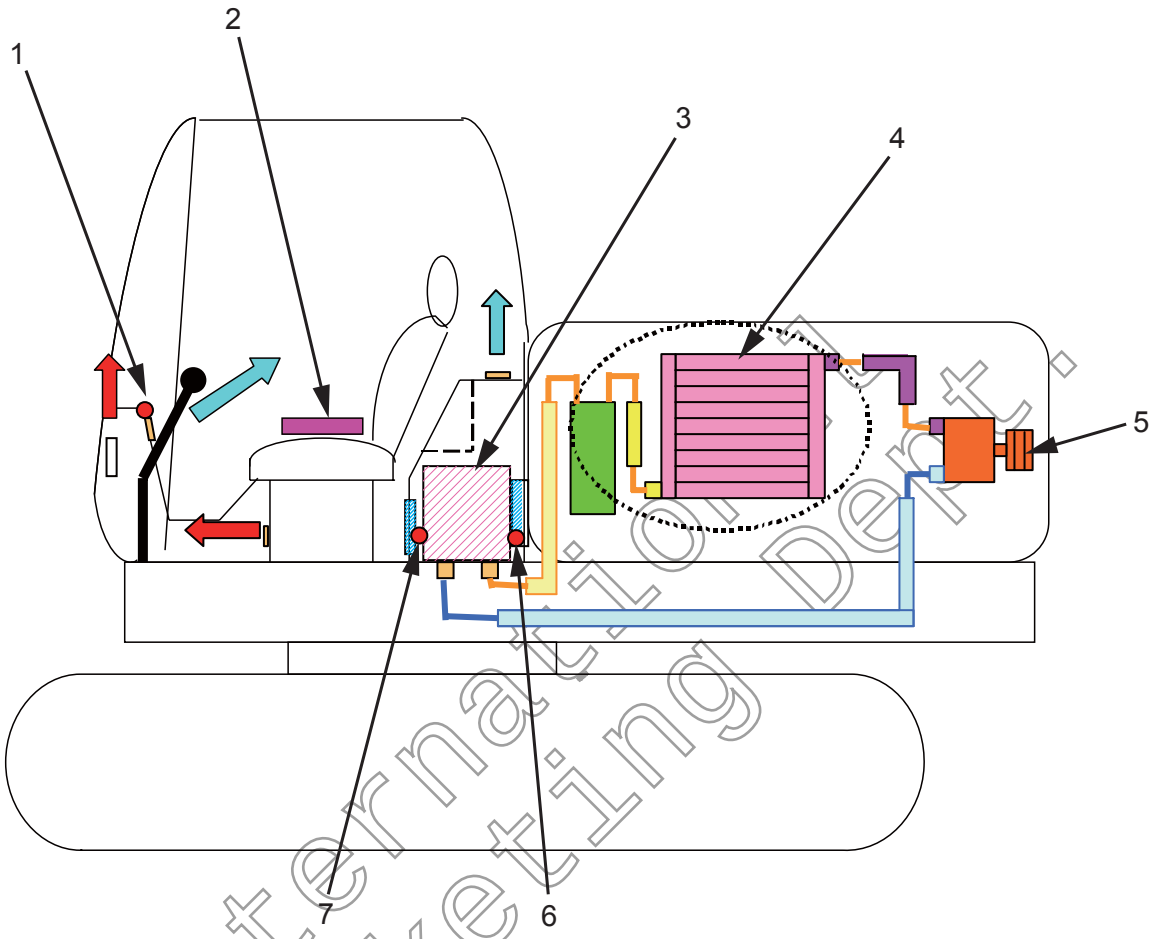


Fig. 4-127

(1) Sunlight sensor
(2) Control panel
(3) Air conditioning unit
(4) Condenser
(5) Compressor
(6) Fresh air sensor
(7) Recirculated air sensor

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4.8.1.2 A/C control panel

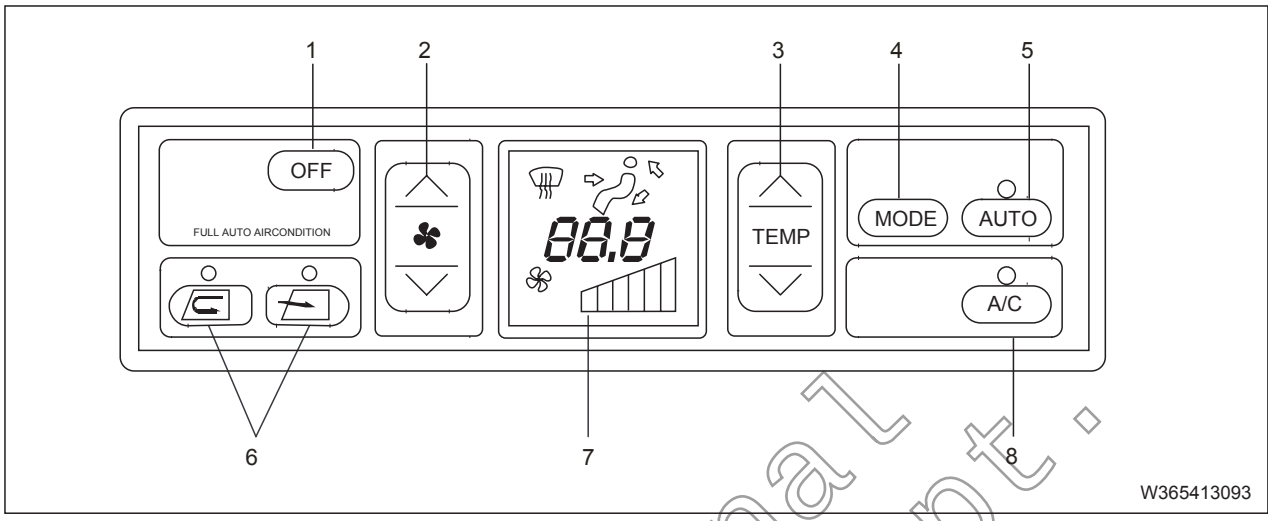


Fig. 4-128

(1) OFF switch
(2) Fan speed control switch
(3) Temperature control switch
(4) Air outlet mode switch
(5) Auto mode switch
(6) Fresh air/recirculation control
(7) LCD display
(8) A/C power

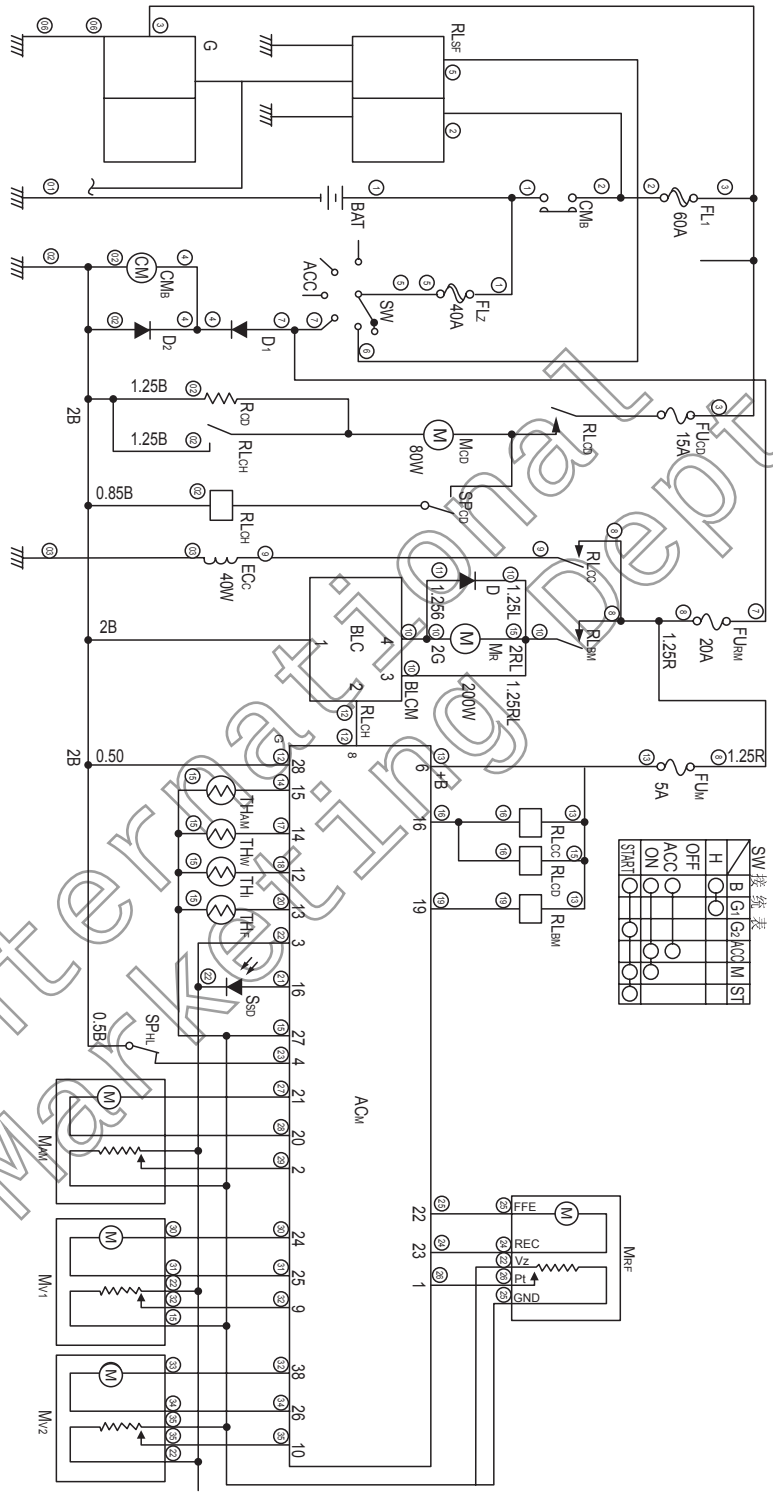
Remark:

When auto mode switch (5), fresh air/recirculation control (6) and A/C power (8) are turned on, indicator lights above these switches will light up.

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4.8.1.3 Diagram of electrical circuit



ZX215-1002140

Fig. 4-129

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Wire No.	Diameter/Color Code	Wire Color	Wire No.	Diameter/Color Code	Wire Color
⑫	B	Black	㉔	0.5VW	Violet+white
⑧	Br(R)	Brown	㉕	0.5YB	Yellow+black
⑨	0.85W	White	㉖	0.5WO	White+orange
⑩	RL	Red+blue	㉗	0.5PB	Pink+black
⑪	G	Green	㉘	0.5VR	Violet+red
⑫	0.5BL	Black+blue	㉙	0.5BG	Black+green
⑬	0.5R	Red+blue	㉚	0.5WY	White+yellow
⑭	0.5Y	Yellow	㉛	0.5WR	White+red
⑮	0.5BR	Black+red	㉜	0.5BrW	Brown+white
⑯	0.5BrY	Brown+yellow	㉝	0.5GO	Green+orange
⑰	0.5BY	Black+yellow	㉞	0.5Sb	Sky blue
⑱	0.5GW	Green+white	㉟	0.5OW	Orange+white
⑲	0.5LO	Blue+orange	㊱	1.25V	Violet
⑳	0.5PG	Pink+green	㊲	1.25RG	Red+green
㉑	0.5RY	Red+yellow	㊳	1.25RW	Red+orange
㉒	0.5BW	Black+white	㊴	0.85GL	Green+Blue
㉓	0.5LgR	Light green+red			

Code	Name	Code	Name	Code	Name
AC_M	A/C amplifier	FU_{CD}	Condenser fuse	RL_{CH}	Condenser high speed relay
BAT	Battery	FU_M	A/C main fuse	RL_{SF}	Protective relay
BLC	Speed regulating resistor	G	Alternator	S_{SD}	Sunlight sensor
CM_B	Battery relay	M_{AM}	A/M servo motor	SP_{CD}	Condenser pressure switch
D	Diode	M_B	Blower motor	SP_{HL}	Hi\Lo pressure switch
D_1	Diode 1	M_{CD}	Condenser motor	SW	Switcher
D_2	Diode 2	M_{RF}	Fresh/recirculated air servo motor	TH_{AM}	Recirculated air thermistor
EC_C	Compressor clutch	M_{V1}	Air outlet servo motor	TH_F	Anti-frosting thermistor
FL_1	Fuse	M_{V2}	FRONT outlet servo motor	TH_I	Recirculated air thermistor
FL_2	Fuse	R_{CD}	Condenser resistor	TH_W	Water temp thermistor
FU_{BM}	Blower fuse	RL_{BM}	Blower main relay		
RL_{CC}	Compressor relay	RL_{CD}	Condenser relay		

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4.8.1.4 Operating principle

Refrigeration cycle diagram

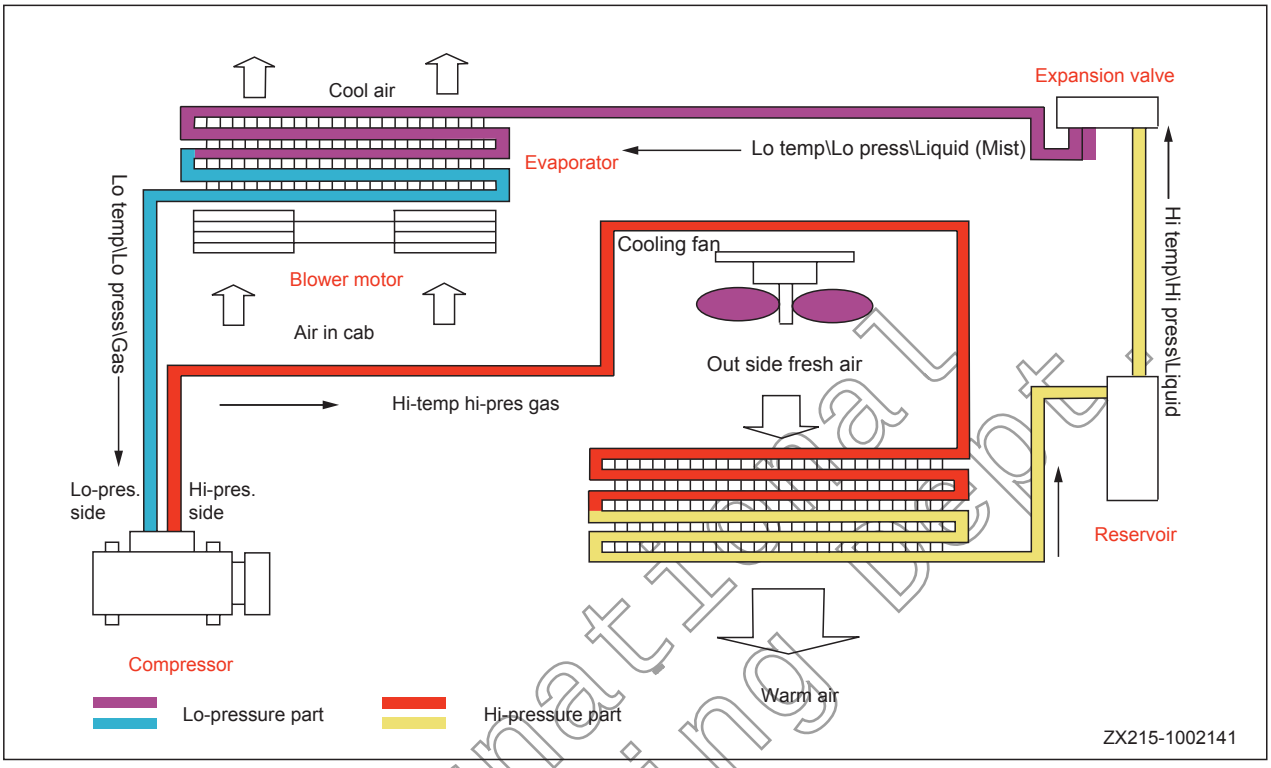


Fig. 4-130

Heating cycle diagram

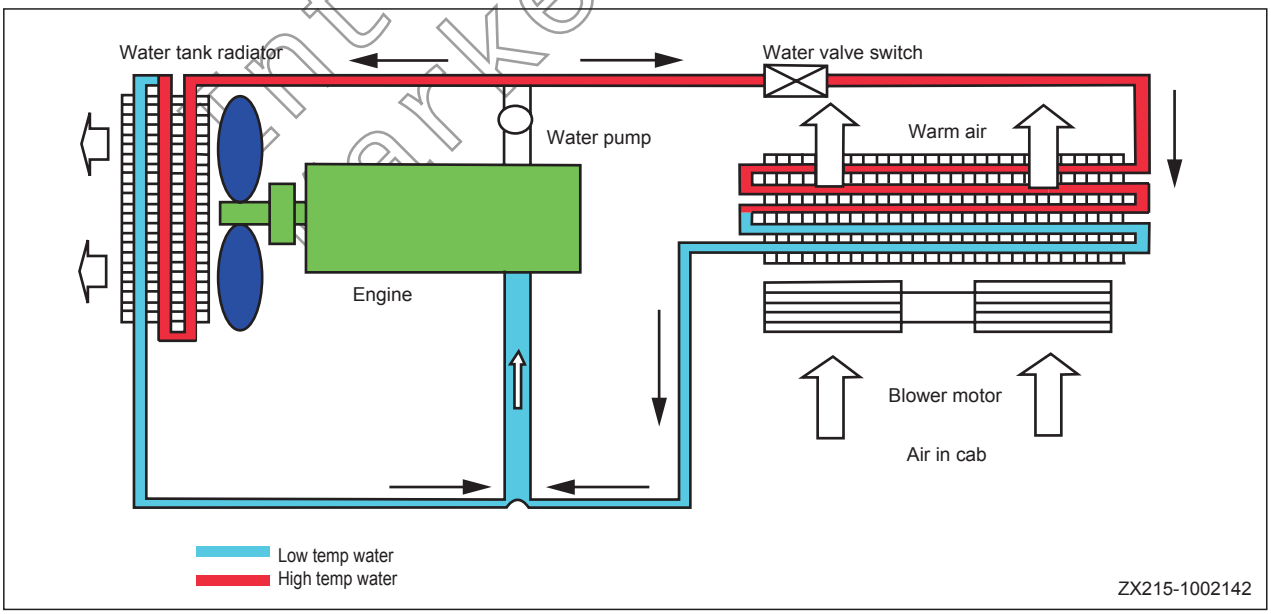


Fig. 4-131

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4.8.1.5 Compressor

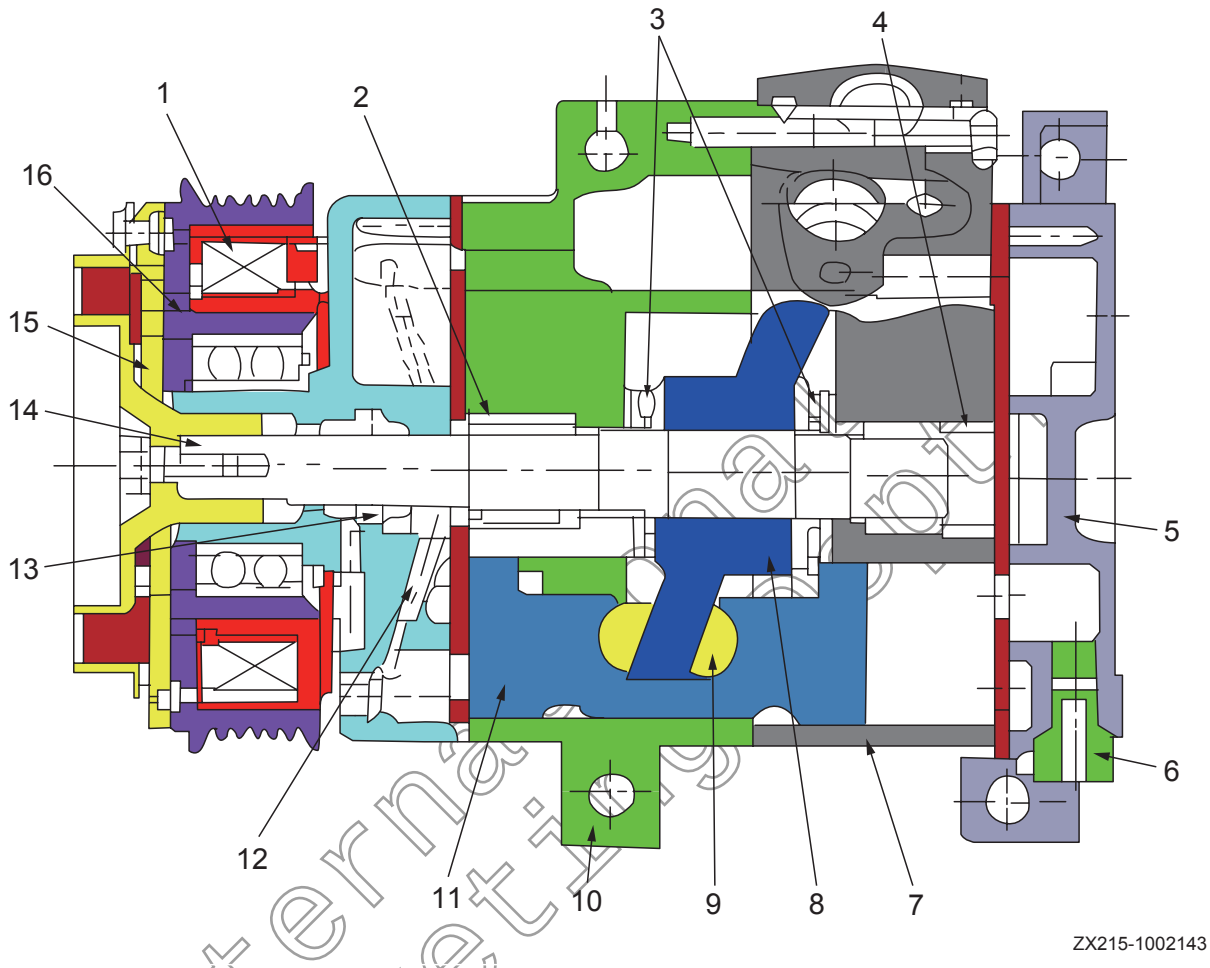


Fig. 4-132

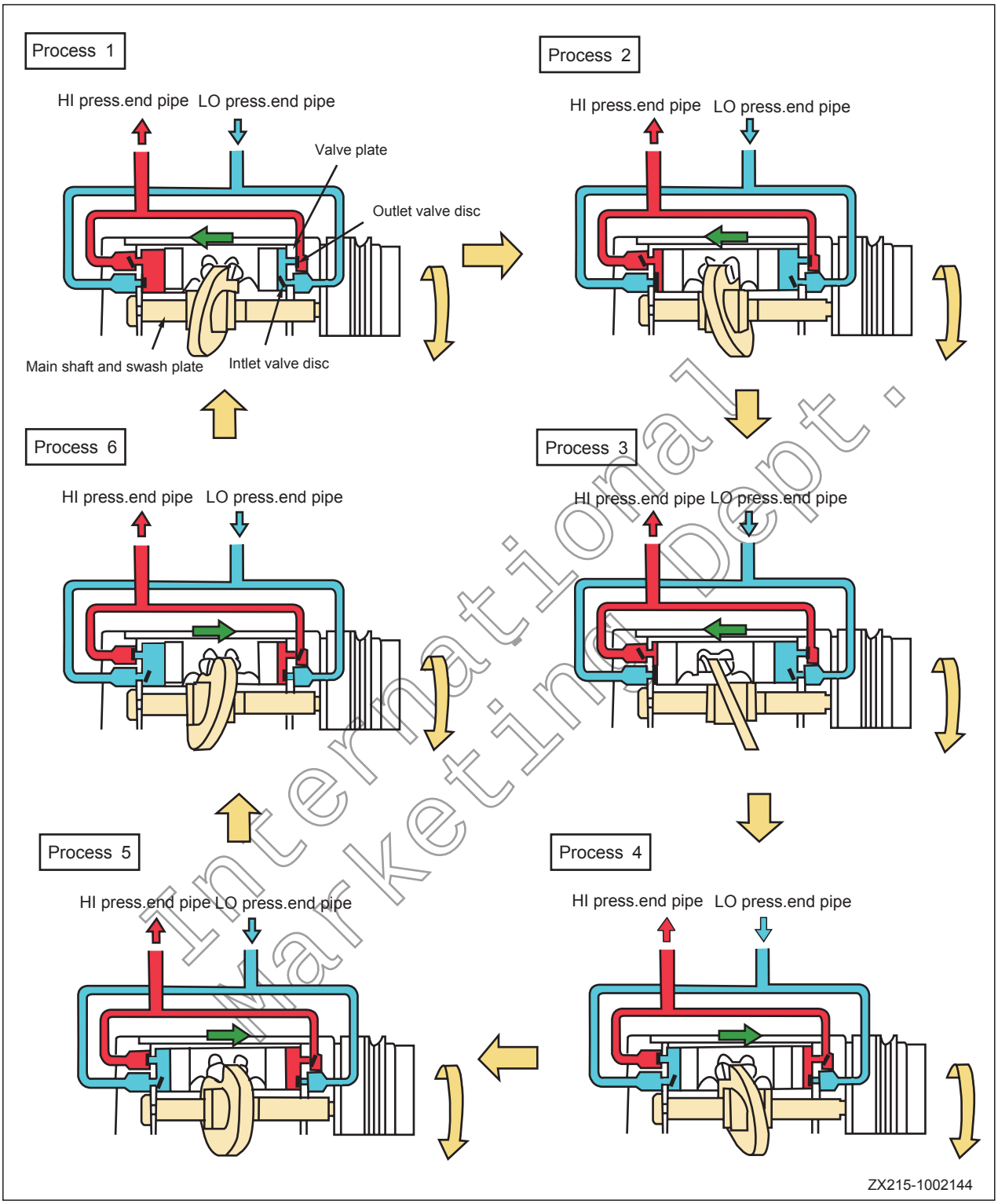
(1) Stator
(2) Front radial bearing
(3) Thrust bearing
(4) Front radial bearing
(5) Rear cylinder head
(6) Safety valve
(7) Rear cylinder block
(8) Swash plate
(9) Slipper
(10) Front cylinder block
(11) Piston
(12) Front cylinder head
(13) Shaft seal
(14) Main shaft
(15) Boss
(16) Rotor

Operating principle

Compressor type: 10S15C. This compressor has 5 plungers in total with a piston at both sides of each plunger. The rotation of the swash plate drives the pistons to move back and forth and transforms the refrigerant sucked from the evaporator from low temperature and low pressure gas state to high temperature and high pressure state.

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Fig. 4-133

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4.8.1.6 Clutch

- The electromagnetic clutch is used to transmit moment of torsion. When the engine is operating, the compressor may not be working. The clutch controls the operation of the compressor only when the air conditioner is under refrigerating mode.
- **Operating principle**

  When the A/C power is turned on, the clutch coil with an electromagnet generates a magnetic field and attracts the metal piece. The stator and rotor of the clutch are engaged and bring the main shaft of the compressor into rotation.

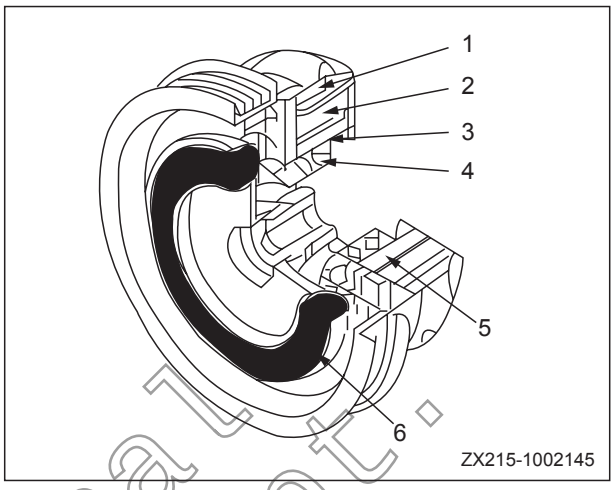


Fig. 4-134

(1) Rotor
(2) Stator coil
(3) Clasp
(4) Ball bearing
(5) Stator
(6) Center piece

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4.8.1.7 Condenser

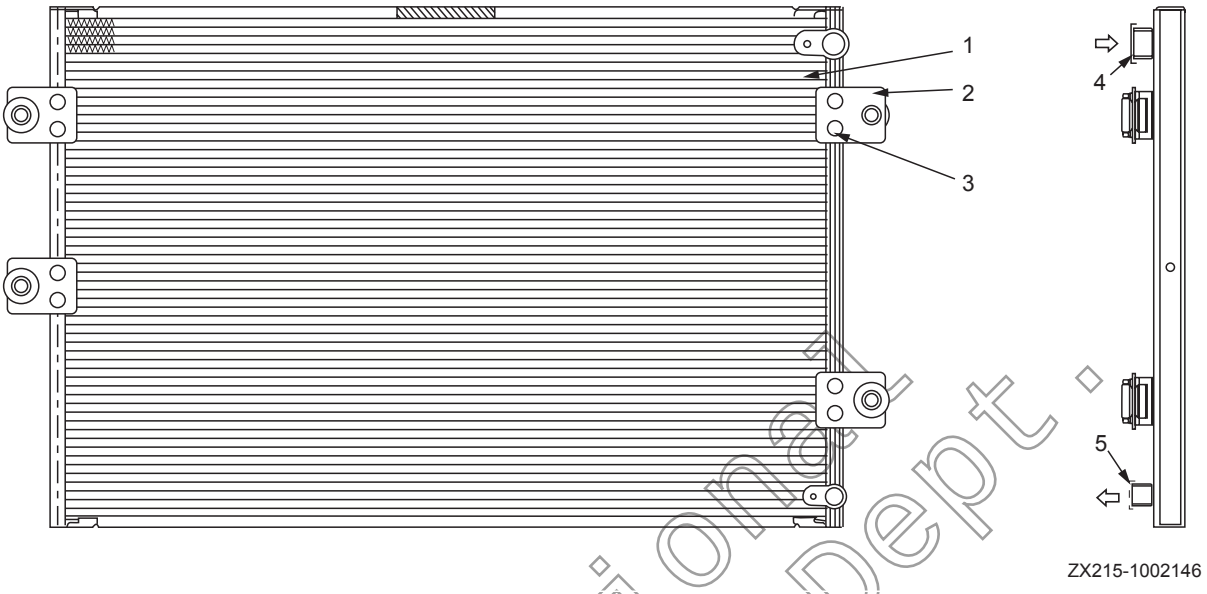


Fig. 4-135

(1) Condenser core
(2) Bracket
(3) Bolt with washer
(4) Refrigerant inlet
(5) Refrigerant outlet

Function

- The condenser changes high-temperature, high-pressure gas refrigerant (16Kg/cm², approx. 80 ℃) to high-temperature and high-pressure liquid refrigerant (16Kg/cm², below approx. 60℃) through radiating.

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4.8.1.8 Expansion valve

Operating principle

Refrigerant from the reservoir spurts out via the orifice, turns into low-temperature, low-pressure liquid (mist) after immediate expansion, and enters the evaporator.

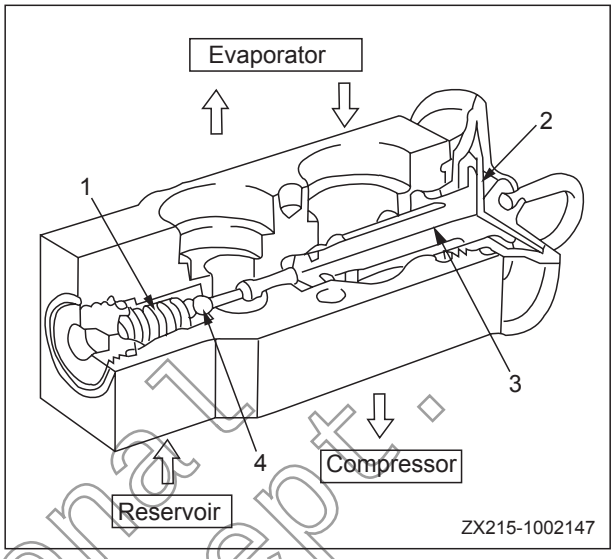


Fig. 4-136

(1) Spring
(2) Diaphragm
(3) Probe
(4) Needle valve

4.8.1.9 Evaporator

Operating principle

The evaporator is a kind of heat exchanger that looks like a condenser. Warm air in the cab is conducted into the evaporator via the blower motor and undergoes heat exchange with the surface of the evaporator. Heat is absorbed and warm air turns into cool air, which flows into the cab through the air ducts. Evaporator surface absorbs heat → Refrigerant in the evaporator absorbs heat → Refrigerant evaporates . Evaporated refrigerant (gas) is absorbed by the compressor.

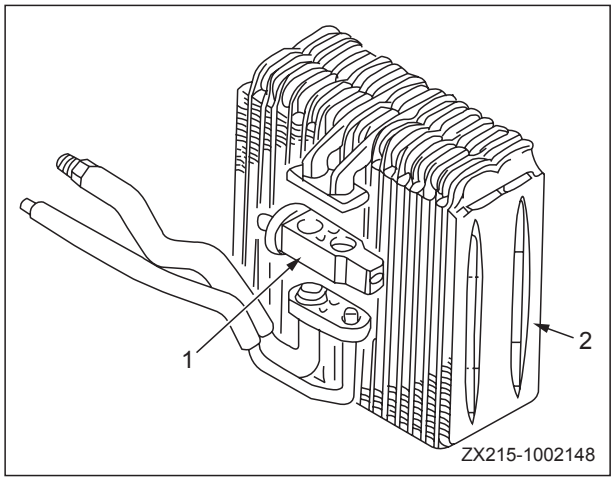


Fig. 4-137

(1) Expansion valve
(2) Evaporator

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4.8.1.10 Dehydrator

Function

- Temporary storage of refrigerant
- Dehydration of refrigerant
- Removing dust from refrigerant
- Measuring the volume of refrigerant

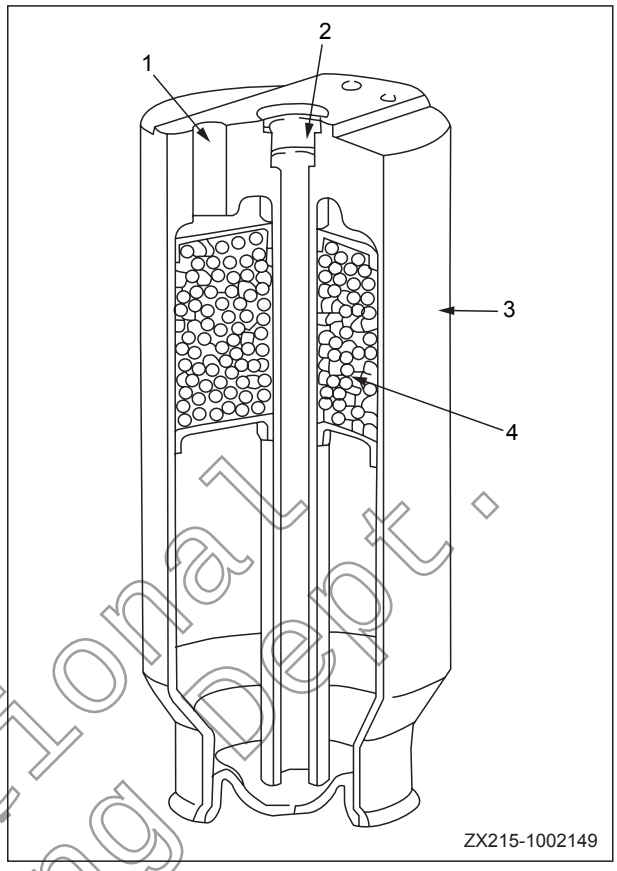


Fig. 4-138

(1) Inlet
(2) Outlet
(3) Receiver/dehydrator
(4) Desiccant

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4.8.1.11 Pressure switch

Function

- The pressure switch is installed between the reservoir and the expansion valve (hi-pressure pipe). It is a combination switch (Hi-Lo pressure combination switch).
- When pressure is excessively high, the compressor stops.
- When pressure is excessively low, the low-temperature condition disappears.

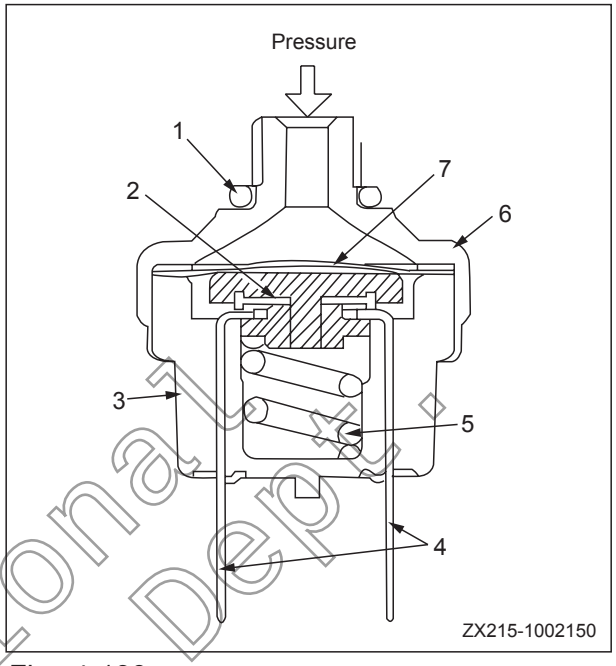


Fig. 4-139

(1) O-ring
(2) Mobile contact point
(3) Hood
(4) Plug and fixed contact
(5) Spring
(6) Chamber
(7) Diaphragm

Operating features:

	Feature
High pressure Low pressure	DIFF Above 0.02 MPa OFF 0.196±0.02 MPa ON 0.196~0.250 MPa DIFF 0.59±0.2 MPa 2.94~3.19 MPa
Medium pressure	OFF 1.23±0.1 MPa ON 1.52±0.08 MPa

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4.8.1.12 Fresh air sensor

Fresh air temperature sensor is mounted beside the condenser or at the fresh air inlet. Consisting of thermistors, it is used to detect ambient temperature.

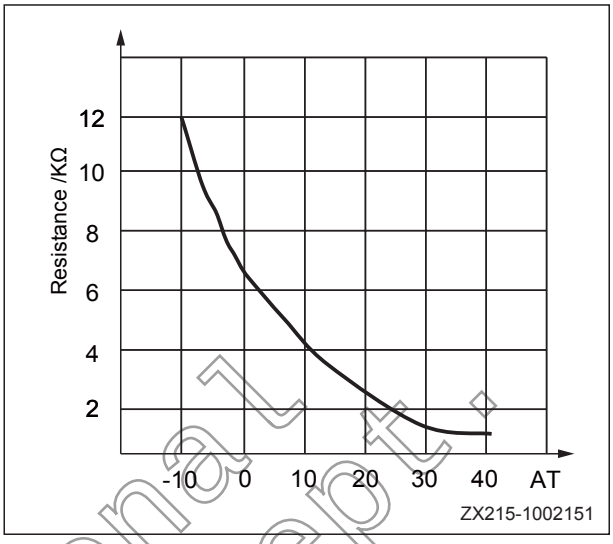


Fig. 4-140

Specification

Item	Specification
Applicable voltage	4.4~5.6 V
Applicable temperature	-30~60 ℃
Storage temperature	-40~90 ℃
Resistance	1700±85 Ω
B Constant	3900±195 K
Permissible working current	1.6 mA (MAX)

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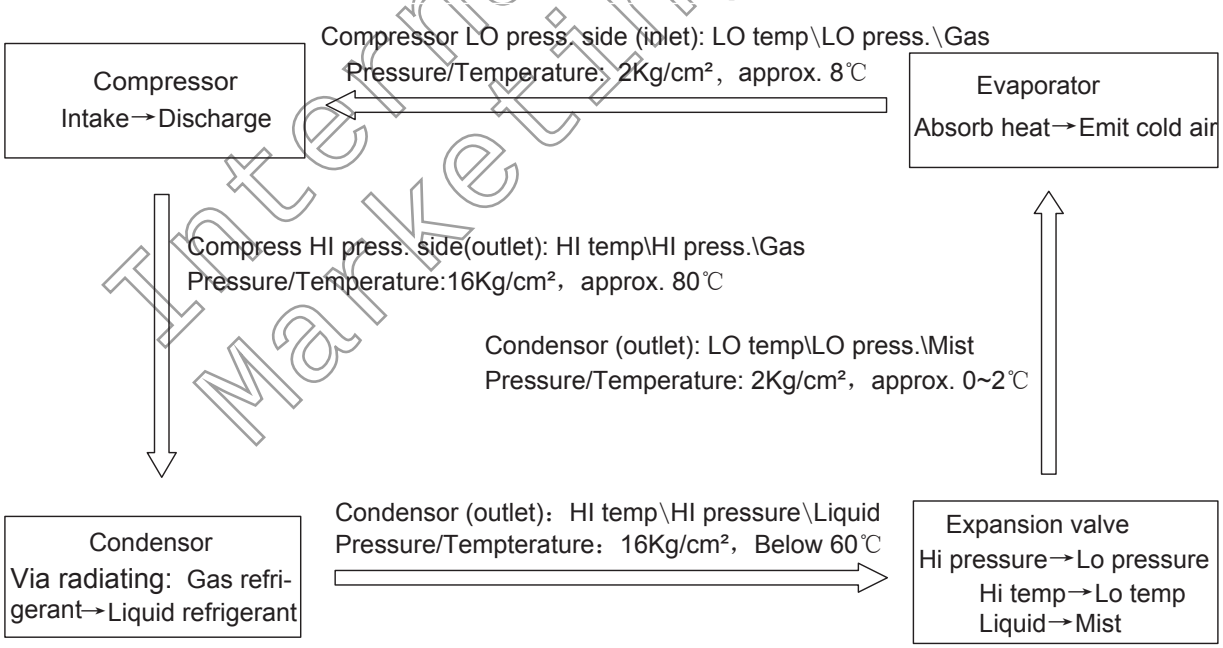
4.8.2 Refrigerant

1. General property

- High heat absorption and easy liquefaction
- Non-flammable, nonexplosive
- Stable chemical composition and quality
- Non-toxic
- Non-corrosive
- No hazard to clothing

2. Refrigerant circulation

- After evaporation in the evaporator, refrigerant turns from gas into liquid via the compressor and the condenser, which finishes a refrigerant cycle.



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- Refrigerant cycle principle (pressure - enthalpy diagram)

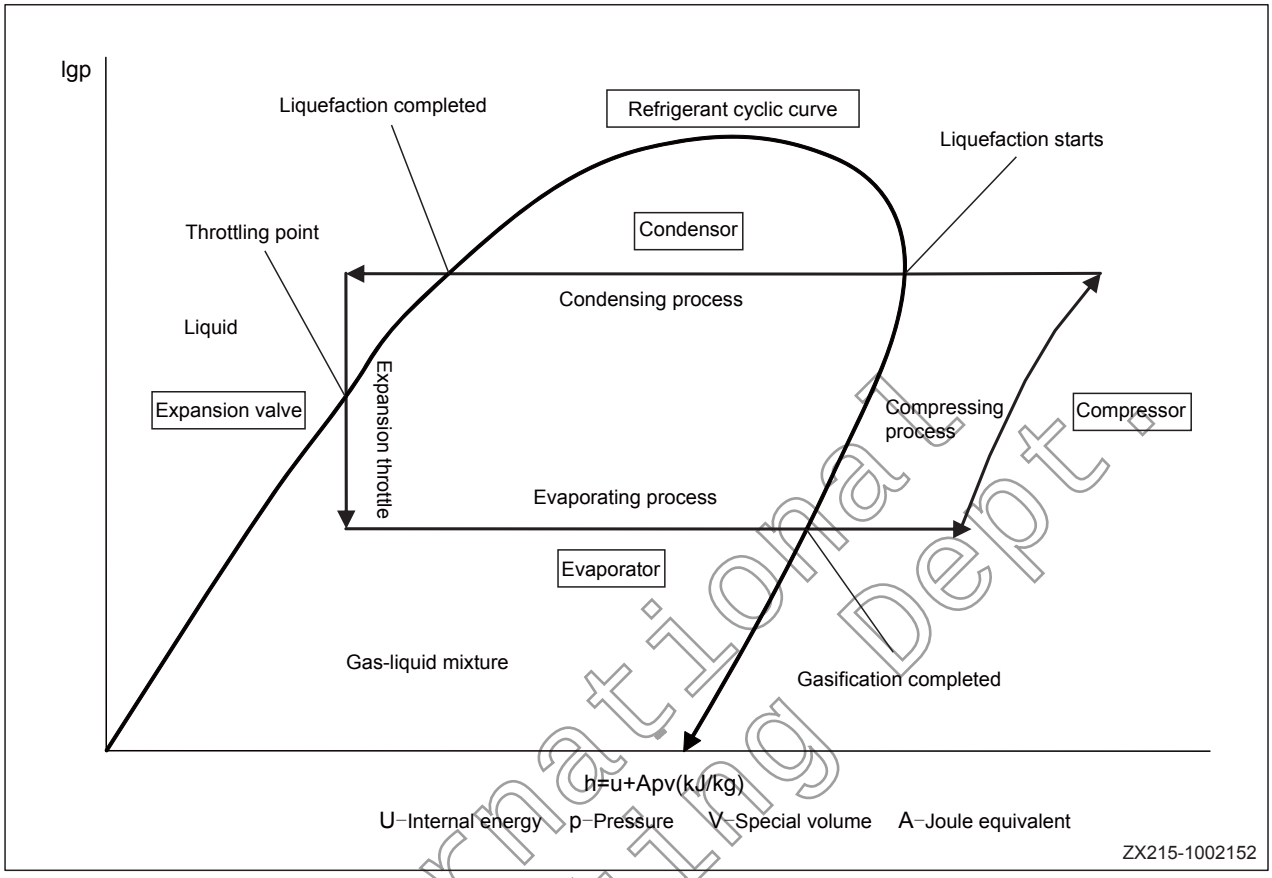


Fig. 4-141

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3. Feeding of refrigerant

- Filling method and volume:
  1) Refrigerant: HFC-134a
  2) Feeding volume: 900±50 g (for reference)
  3) Feeding method: Feeding of liquid refrigerant from the low-pressure end is not allowed. If feeding operation fails, discharge the refrigerant that has been fed before re-feeding.

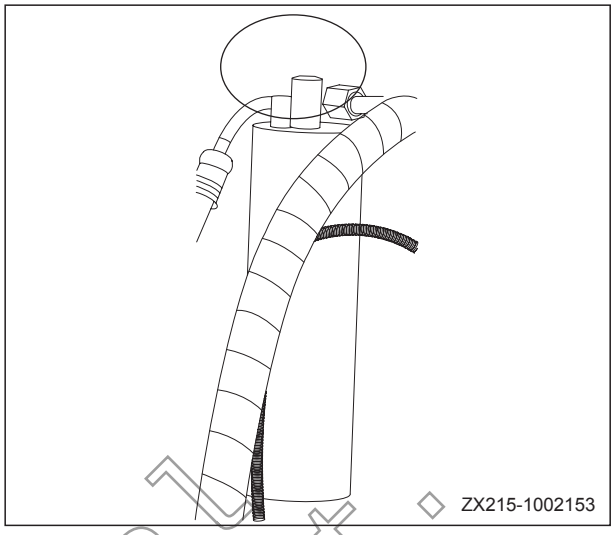


Fig. 4-142

- Inspect the state of the refrigerant in the A/C circulation system through the sight glass:
  1) Correct feeding: Foam is hardly observed when the refrigerant is flowing. When engine speed increases from idling to 1500 rpm, foam disappears and the refrigerant turns clear.
  2) Over-feeding: No foam can be observed when refrigerant is flowing.
  3) Under-feeding: Foam is always observed when refrigerant is flowing.

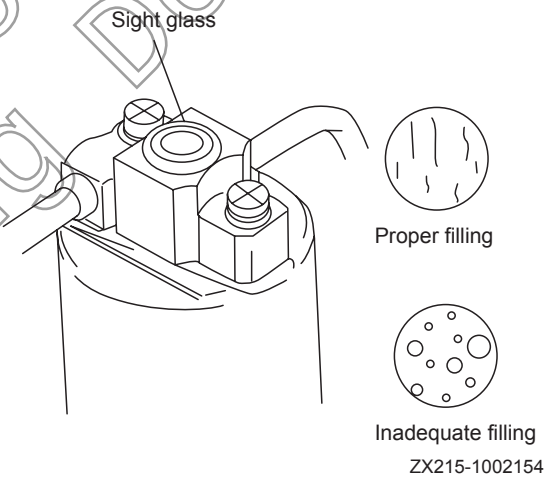


Fig. 4-143

4. Evacuation

- Reason of evacuation

  No moisture shall be mixed inside the air conditioning unit. Refrigerant (R134a) is soluble in water. Very small amount of moisture in the unit can cause the orifice of the expansion valve to ice up, or cause the valve of the compressor to rust. To avoid such problems, moisture in the system shall be removed before refrigerant is fed. To reduce the residual moisture in the system to the minimum, moisture in the system can evaporate through evacuating. No better means is available so far.

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- Evacuating steps

1) Connection of manifold pressure gauge:

a) Close the high-pressure valve (HI) and low-pressure valve (LO) of the manifold pressure gauge.

b) Connect the air hose (red, blue) to the auxiliary valve of the compressor.

Red hose——High pressure side (Mark D)

Blue hose——Low pressure side (Mark S)

★ Connect the end of the air hose with a L to the auxiliary valve of the compressor. If connected inversely, the valve will not open. Besides, do not inversely connect the high-pressure end and the low-pressure end.

c) Connect the middle hose (green) to the vacuum pump.

2) Evacuating

a) Open the high-pressure valve (HI) and low-pressure valve (LO) on the manifold pressure gauge.

b) Turn on the vacuum pump and evacuate for about 15 minutes.

c) When negative pressure reading on the gauge (degree of vacuum) reaches above 750 mmHg, turn off the vacuum pump and close the Hi-pressure valve and the Lo-pressure valve on the gauge.

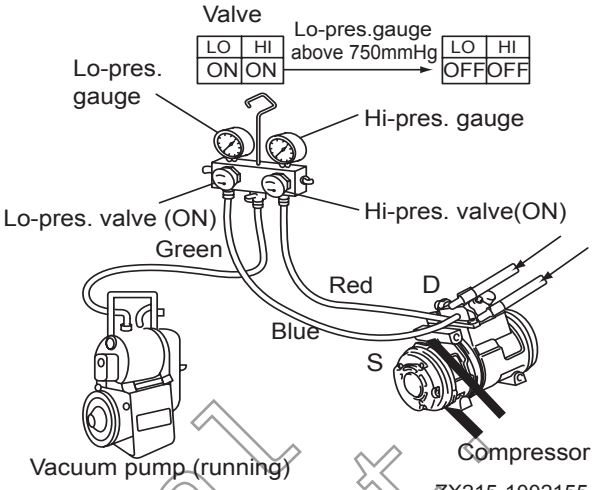


Fig. 4-144

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3) Air - proof check

a) Keep the Hi- and Lo-pressure valve of the manifold pressure gauge under closed state for more than 5 minutes, and make sure the pointer on the gauge does not return to zero.

b) If the pointer returns to near zero, a leakage is available somewhere. Check and adjust the pipe joint. Tighten the joint and conduct another evacuating operation until no leakage is detected.

4) Leak check

a) Connect the air hose (green) that is previously connected to the vacuum pump to the fluorine cylinder.

b) Connect the other end of the hose (green) to the pressure gauge. Open the valve of the cylinder and press the vent valve of the pressure gauge. (Do not press the valve with naked hand to avoid frostbite caused by refrigerant). Release the air in the hose with the pressure of the refrigerant. (Release the vent valve when you hear a squeezing sound).

c) Add refrigerant until pressure reading on the Lo-pressure gauge is 1kgf/cm^2. Hi-pressure valve of the gauge is open at this time. Close the Hi-pressure valve when feeding is finished.

d) Use a leak detector to check if leakage is present in the cooling system.

e) Make necessary repairs (tightening) if leakage is observed.

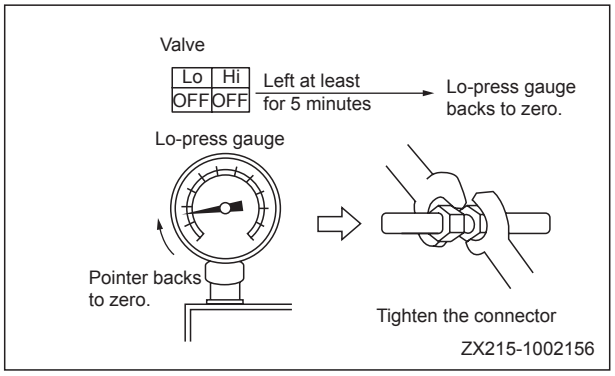


Fig. 4-145

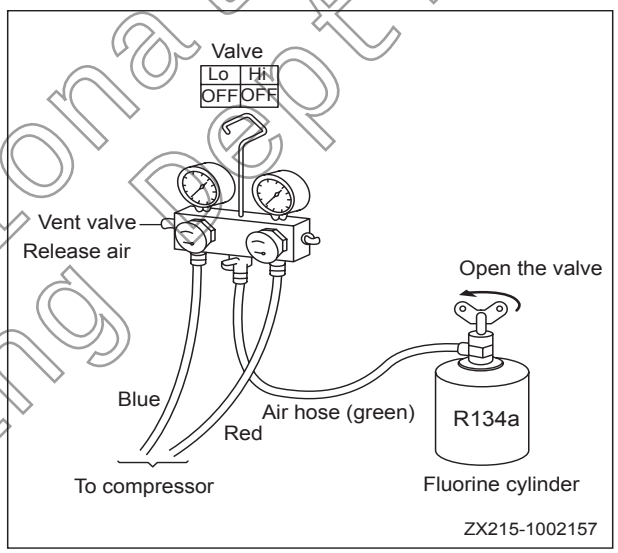


Fig. 4-146

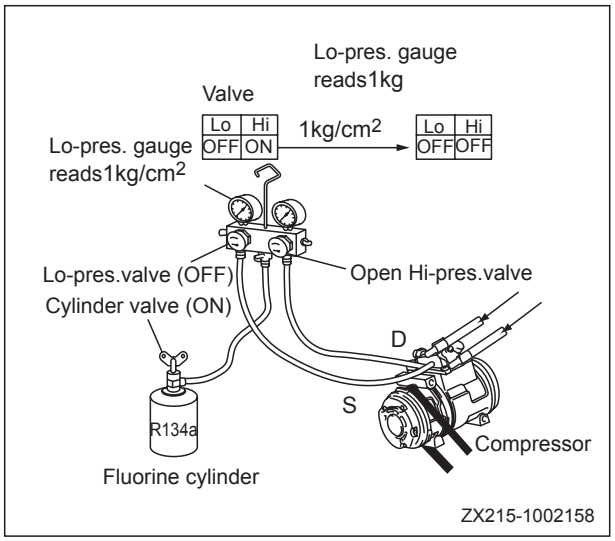


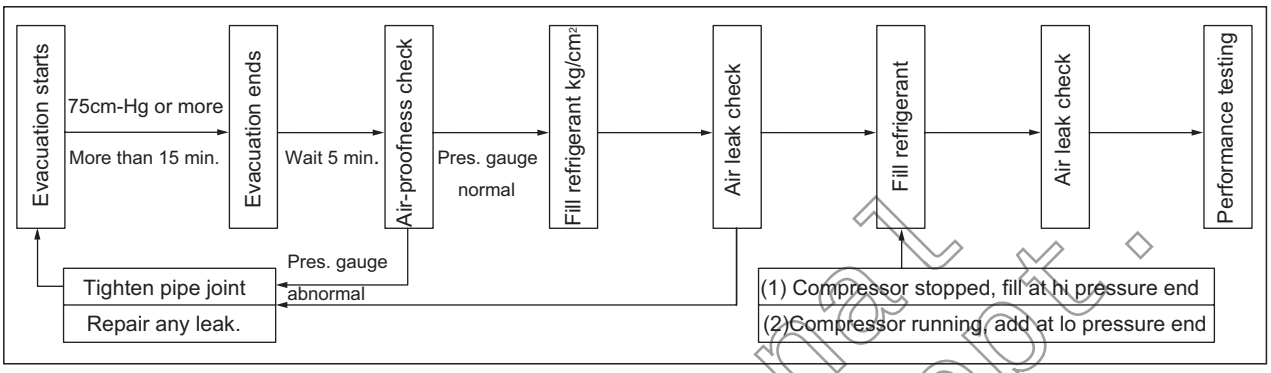
Fig. 4-147

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5. Refrigerant filling operation

- When evacuation is finished, fill refrigerant into the cooling system as per the following instruction:



- **Fill from the hi-pressure side**

  1) Remove the air hose (green) of the manifold pressure gauge from the vacuum pump and connect it to the fluorine cylinder.
  2) Open the valve of the cylinder and press the vent valve on the pressure gauge. Use the pressure of the refrigerant to release the air in the hose.

  ⚠ Release the vent valve when you hear a squeezing sound. Do not press the vent valve with naked hand to avoid frostbite.

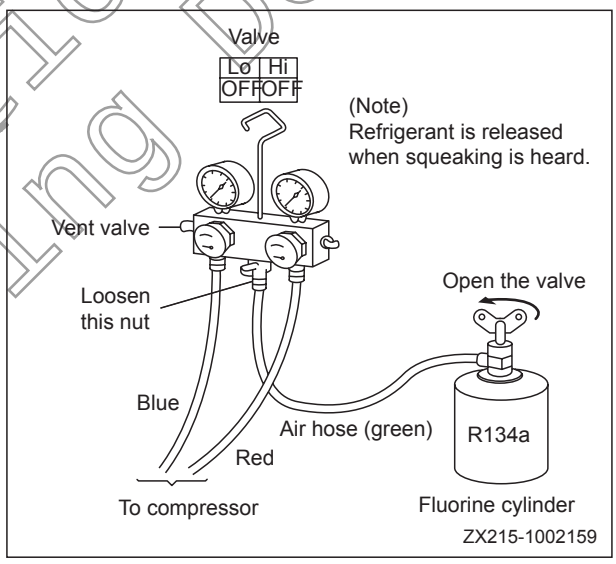


Fig. 4-148

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3) With the engine stopped, open the high-pressure valve on the manifold pressure gauge and the fluorine cylinder valve and fill in one and a half cylinder of fluorine (approximate 600g).

⚠ Do not run the compressor at this moment. Once the compressor is started, the refrigerant could flow back, causing the fluorine cylinder and hose to burst.

⚠ Operating the compressor without refrigerant will burn the compressor. Never run the compressor without refrigerant.

⚠ Do not open the low-pressure valve on the manifold pressure gauge (liquid compression will occur, causing damage tot he compressor).

4) Close the high-pressure valve on manifold pressure gauge and the fluorine cylinder valve.

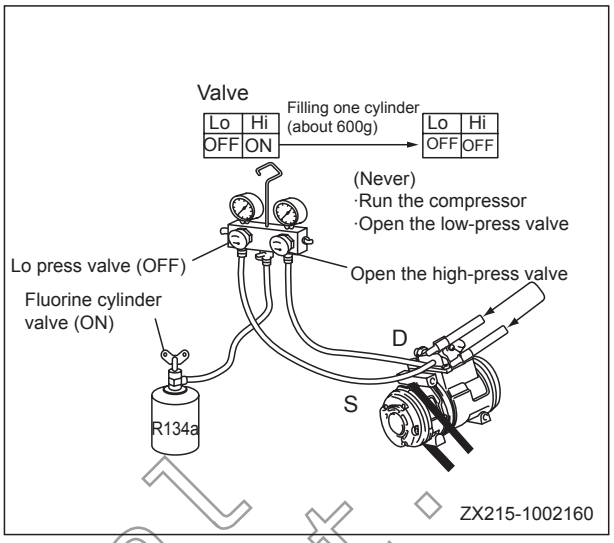


Fig. 4-149

- **Fill from lo-pressure side (additional filling)**

1) Confirm the hi-pressure valve of the manifold pressure gauge is closed.
2) Start the engine and open the cab door.
3) Turn on the air conditioner, and set Temperature control switch to minimum.
4) Adjust engine speed to 1300 – 1500 rpm.
5) Open the Lo-pressure valve of the manifold pressure gauge and the valve of the fluorine cylinder, and fill refrigerant into the reservoir until no foam is observed.

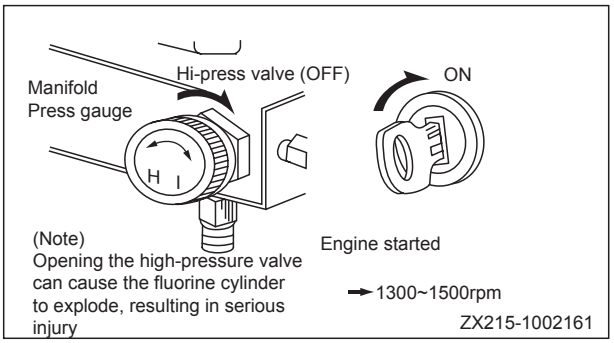


Fig. 4-150

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Note:

Manifold pressure gauge reading (for reference):

High pressure 13~17kg/cm^2 (ambient temperature 30℃);

Low pressure 1.5~2kg/cm^2 (ambient temperature 30℃).

6) When refrigerant filling is finished, close the Lo-pressure valve of the manifold pressure gauge and the valve of the fluorine cylinder.

7) Check carefully for air leaks with a leak detector.

⚠ Never open the Hi-pressure valve of the manifold pressure gauge. If it is opened, high-pressure gas will counterflow and cause the air hoses and the fluorine cylinder to explode, resulting in serious injury.

⚠ Do not position the fluorine cylinder upside down (when engine is operating and filling in progress). If the cylinder is placed upside down, liquid refrigerant will be sucked directly into the compressor and cause liquid compression, resulting in damage to the compressor valve and the gaskets. Place the cylinder vertically and fill gas refrigerant.

8) When ambient temperature is low
When refrigerant filling can not be performed due to low ambient temperature, place the cylinder in water of less than 40 ℃ to increase the pressure of the refrigerant inside the cylinder.

9) When ambient temperature is high

When ambient temperature is very high, cool the compressor with an electrical fan.

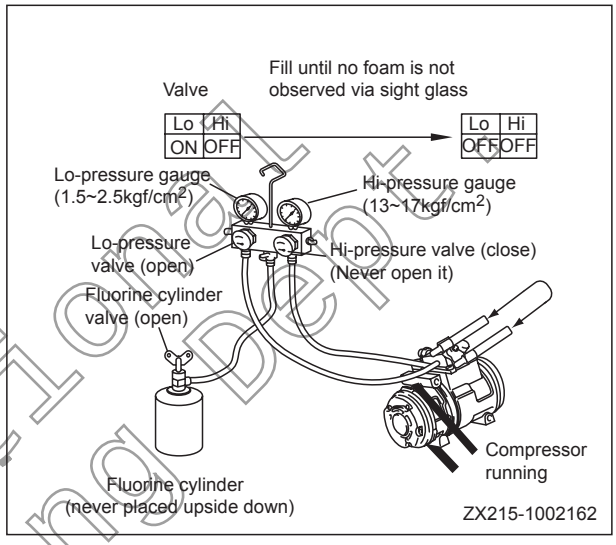


Fig. 4-151

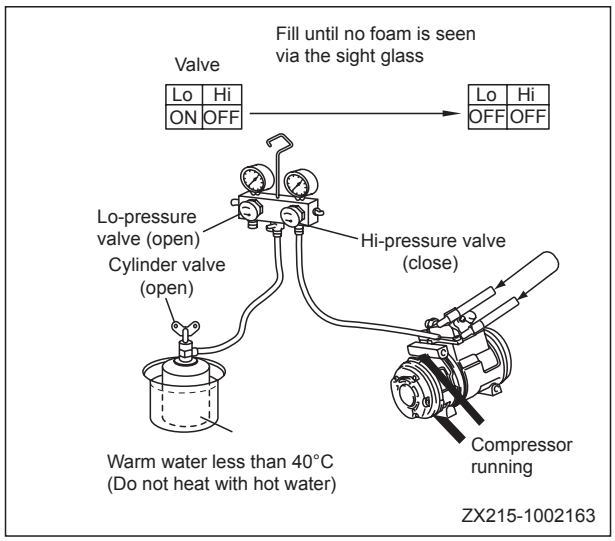


Fig. 4-152

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- **Replace the fluorine cylinder**

  When the refrigerant in a cylinder is used up, replace the cylinder as per the following instruction:

  1) Close the Hi- and Lo-pressure valves of the manifold pressure gauge.
  2) Raise the needle and disc plate of the cylinder and remove the empty cylinder.
  3) Install a new cylinder onto the cylinder valve.
  4) Release the air in the hose as per the following instruction:
     a) Tighten the valve of the fluorine cylinder, and then, loosen it a bit.
     b) Open the Lo-pressure valve of the manifold pressure gauge a bit.
     c) Press the vent valve and allow a little refrigerant to come out. Immediately close the valve of the cylinder and the Lo-pressure valve of the manifold pressure gauge.

     ★ Do not press the vent valve with naked hand to avoid frostbite by refrigerant.
  5) Turn the handle of the cylinder valve to pierce the cylinder and continue filling operation.

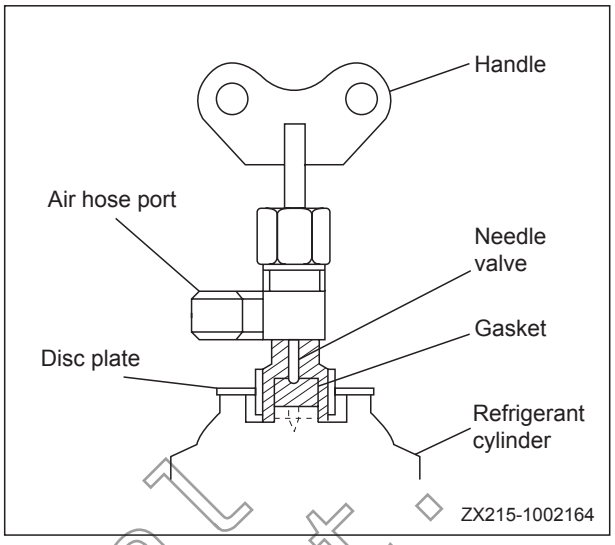


Fig. 4-153

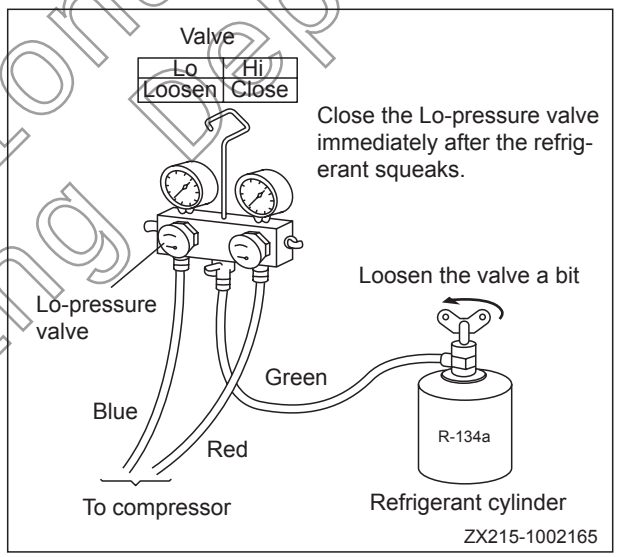


Fig. 4-154

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6. Troubleshooting with manifold pressure gauge

After the engine has been preheated, read the pressure value on the gauge under the following conditions:

1) Temperature at air inlet: 30 – 35℃
2) Engine speed: 1500 rpm
3) Fan speed: High
4) Temperature control: Minimum.
5) Air mode: Recirculation

- Refrigerating system under normal condition

Gauge reading:

Lo-pressure end 0.15~0.25 Mpa (1.5~2.5 Kg/cm²)

Hi-pressure end 1.37~1.57 Mpa (14~16 Kg/cm²)

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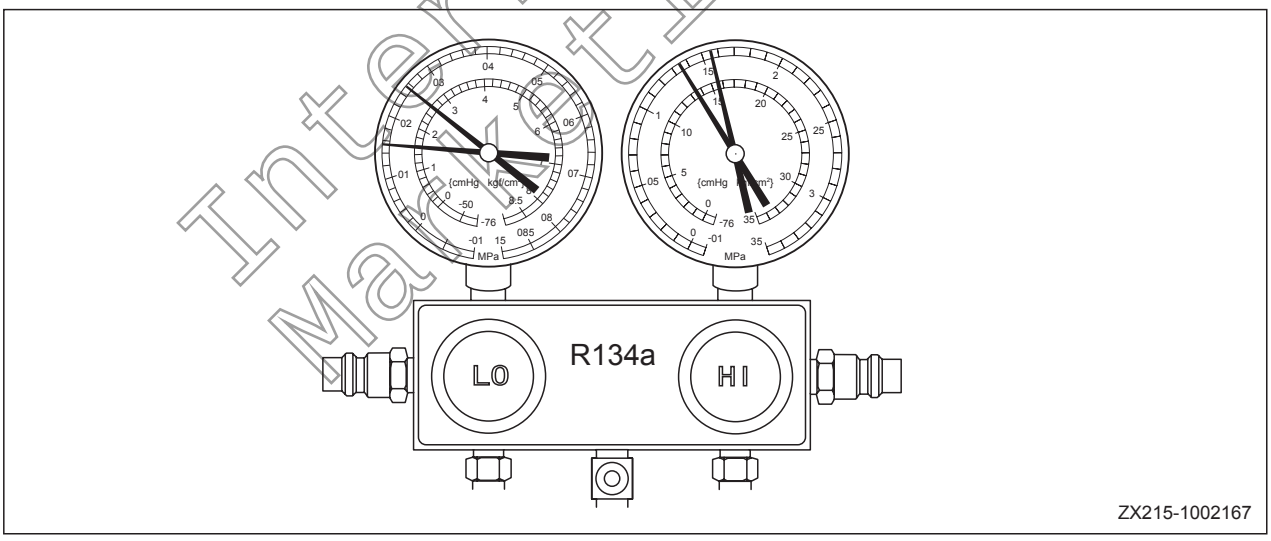


Fig. 4-155

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- Moisture in the refrigerating system

Fault: Intermittent refrigeration to non-refrigeration

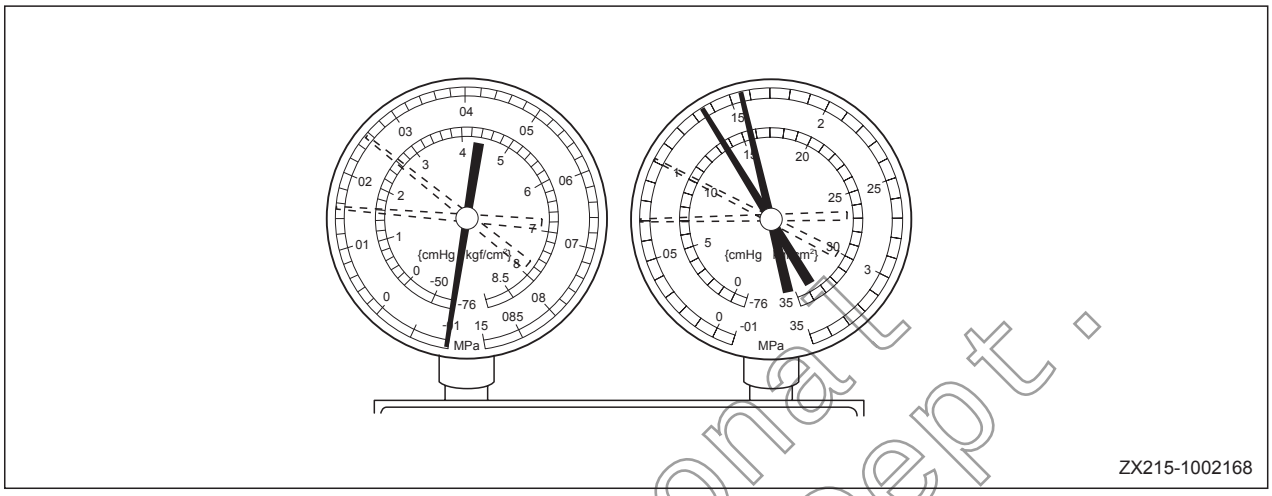


Fig. 4-156

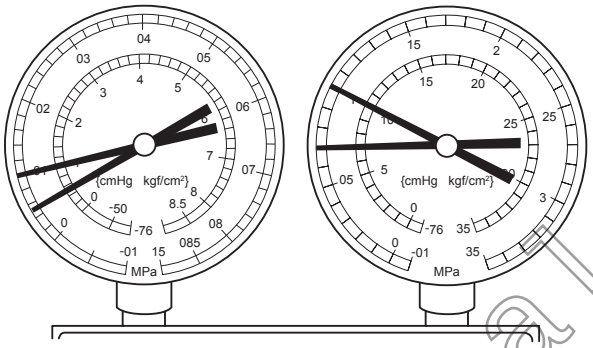
Symptom	Cause	Analysis	Remedy
• When the system is operating, pressure at the Lo-pressure end unstable (sometimes vacuum, sometimes normal)	• Moisture in the system ices up at the expansion valve causing temporary stop of circulation. When ice melts, the system becomes normal again.	• Over-saturation of dehydrator. • Moisture in the system ices up at the expansion valve and hinders the circulation of the refrigerating system.	• Replace receiver/ dehydrator • Remove the moisture in the system through constant pumping. • Add proper volume of new refrigerant.

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- Insufficient refrigeration

Fault: Insufficient refrigeration.



ZX215-1002169

Fig. 4-157

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Ho-pressure ends very low • Foam is continuously observed via the sight glass • Insufficient refrigeration.	• Air leaks somewhere in the refrigerating system	• Insufficient refrigerant in the system • Leak of refrigerant	• Check for air leakage with a leak detector. Make necessary repairs. • Add proper amount of refrigerant. • When connected with the gauge, if the reading is near zero, set the system under vacuum state after inspection and repair.

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- Defective refrigerant circulation

Fault: insufficient refrigeration

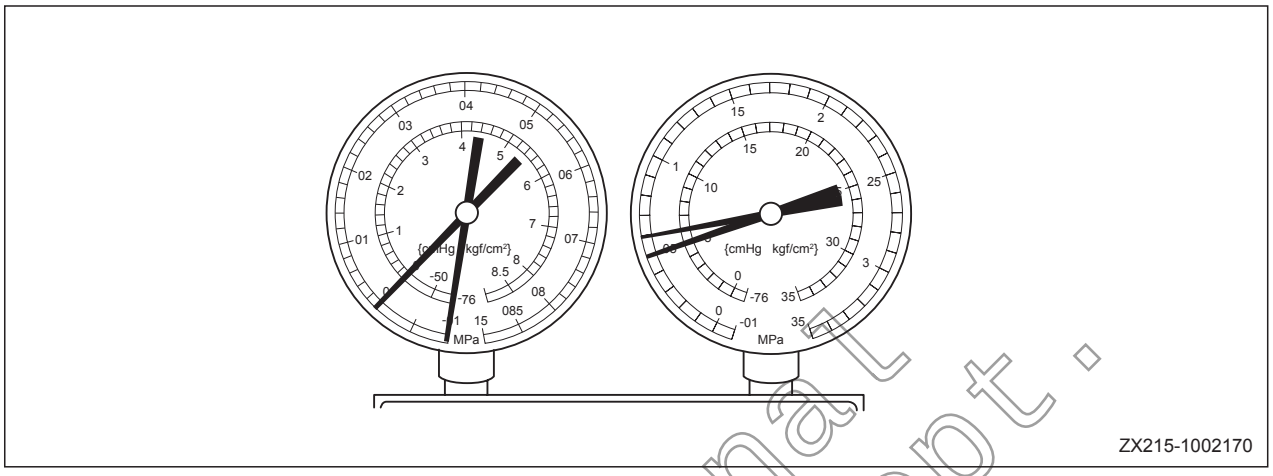


Fig. 4-158

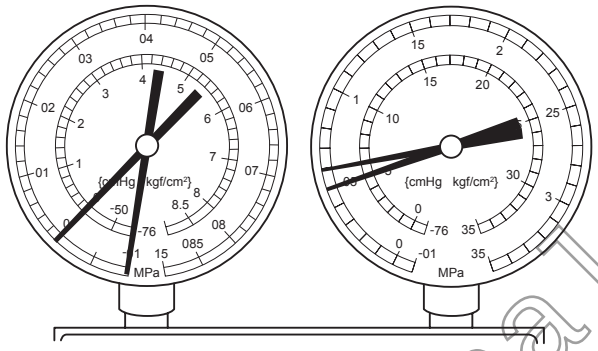
Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Lo-pressure sides very low • Frosting on the piping between parts and reservoir	• Contaminant in the reservoir hinders the flow of refrigerant.	• Blocked reservoir	• Replace reservoir

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- Refrigerant not circulating

Fault: Non-refrigeration (intermittent refrigeration)



ZX215-1002171

Fig. 4-159

Symptom	Cause	Analysis	Remedy
• Vacuum at Lo-pressure side; pressure at Hi-pressure side extremely low • Frosting or condensation on the pipes around the expansion valve or receiver/dehydrator	• Moisture or contaminant in the refrigerant hinders the flow of refrigerant. • Air leak at the thermal pipe of the expansion valve hinders the flow of refrigerant.	• Refrigerant not circulating	• Check the expansion valve and ERP. • Blow the contaminant in the expansion valve or replace the expansion valve if necessary. • Replace the receiver • Release internal air and add refrigerant. If air leaks from thermal pipe, replace expansion valve.

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- Over-filling of refrigerant or insufficient refrigeration of condenser

Fault: Insufficient refrigeration

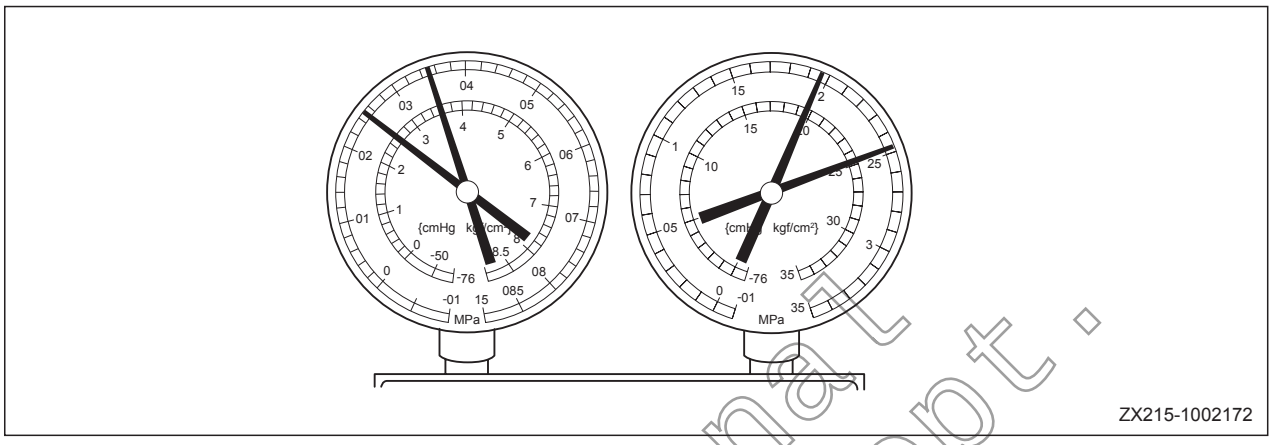


Fig. 4-160

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Lo-pressure sides very high • No foam can be observed via the sight glass even when engine speed drops.	• Over-filling of refrigerant in the system. Refrigerating performance inadequate. • Insufficient refrigeration of condenser	• Excessive refrigerant in system → Over-filling of refrigerant • Insufficient refrigeration of condenser → Radiator fins of condenser plugged or failure of fan motor	• Clean the condenser • Check the working condition of fan motor • If the two above items are normal, check the volume of refrigerant. Add refrigerant as required.

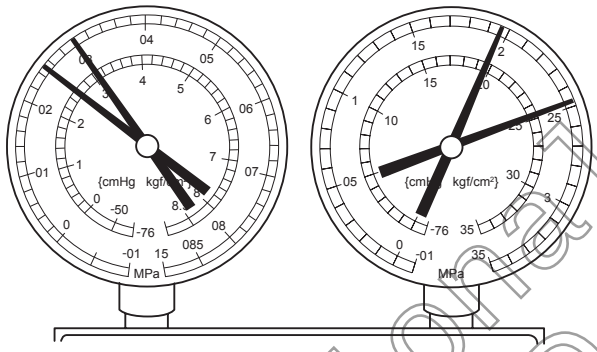
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- Air present in refrigerating system

Fault: Poor refrigeration

⚠ If refrigerant is added with no evacuation operation performed, the following gauge reading will appear:



ZX215-1002173

Fig. 4-161

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Lo-pressure ends very high • Lo-pressure piping feeling hot • Foam is observed through the sight glass	• Air enters the refrigerating system	• Air enters the refrigerant system • Insufficient evacuation	• Check if compressor oil is contaminated or inadequate. • Evacuate and add new refrigerant.

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- Improper installation of expansion valve/ thermal pipe defect (wide opening)

Fault: insufficient refrigeration

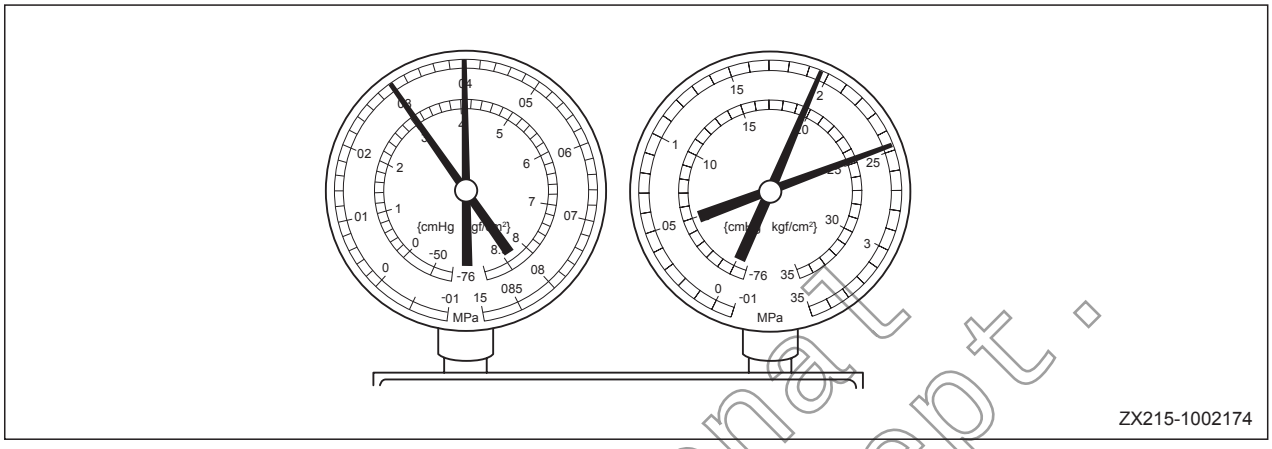


Fig. 4-162

Symptom	Cause	Analysis	Remedy
• Pressure at both Hi- and Lo-pressure ends very high • Frosting or condensation on Lo-pressure piping	• Improper installation of thermal pipe/defective thermal pipe (excessively wide opening)	• Excessive refrigerant in Lo-pressure piping • Expansion valve opening too wide	• Check the installation of thermal piping • If thermal piping is normal, check the expansion valve. Replace expansion valve if found defective.

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- Compressing error

Fault: No refrigeration

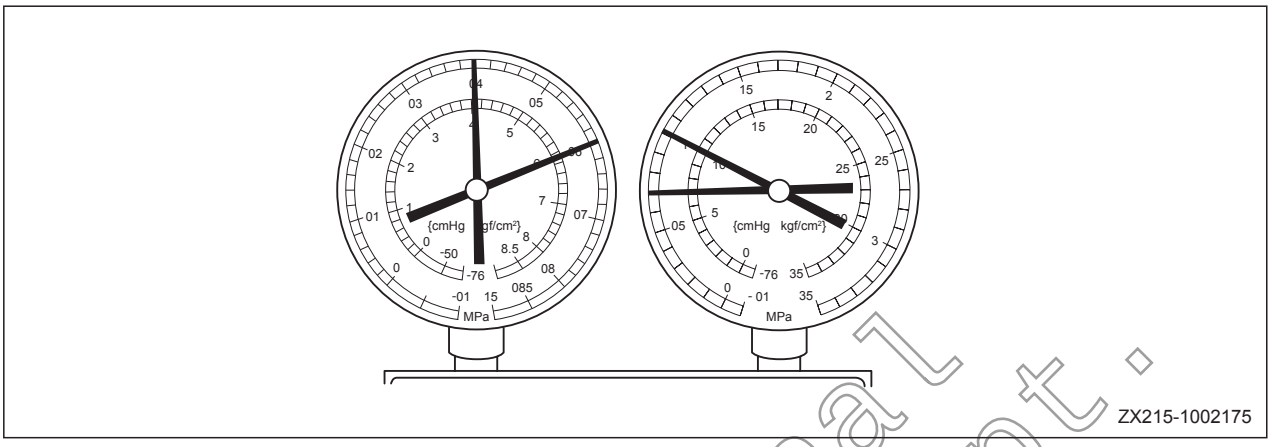


Fig. 4-163

Symptom	Cause	Analysis	Remedy
• Pressure at Lo-pressure side very high • Pressure at Hi-pressure side very low	• Compressor internal leakage	• Compressing fault; • Leaking or damaged valve, or missing parts	• Repair or replace compressor

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4.8.2.1 Compressor oil

Oil shall be added into the A/C system for lubrication. Compressor oil is solved in the refrigerant and circulates in the system. When the air conditioning system is shut down, compressor oil will stay inside the components. If no compressor oil is added into the system when replacing components, inadequate lubrication will result. Add compressor oil according to the chart below:

	Replaced component		
	Compressor	Condenser	Evaporator
Volume (CC)	See "NOTICE" below	40	40
Compressor oil grade	ND8# (10P, 10PA, 10S series compressor)		
	ND9# (TV series compressor)		

NOTICE

- **Add oil into a new compressor according to the required volume of the system. When the compressor is to be replaced, discharge the surplus oil in it.**
- **Filling of improper amount of compressor oil: Over-filling of compressor oil will reduce the refrigerating capacity. Short of compressor oil in the system will lead to an abnormal compressor.**
- **Keep the pipe connectors and O-ring seals free from contamination when disassembling the compressor.**

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4.9 Engine Control

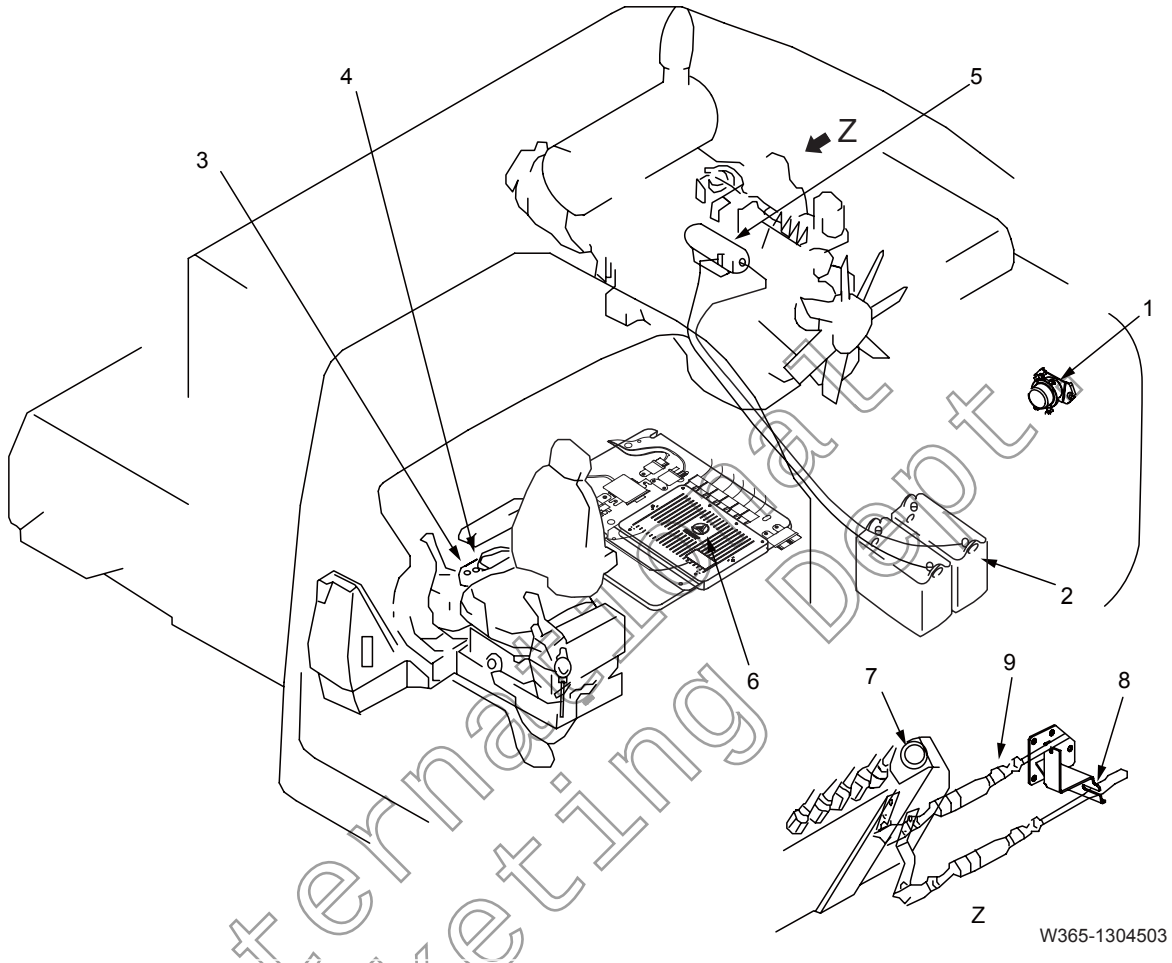


Fig. 4-164

(1) Battery relay
(2) Battery
(3) Start switch
(4) Fuel control dial
(5) Start motor
(6) Controller
(7) Fuel injection pump
(8) Throttle motor
(9) Shutdown device

Outline

- The engine is only started and stopped with the start witch (3).
- The engine controller (6) receives the signal from the fuel control dial (4) and transmits the drive signal to the throttle motor (8) to control the governor lever angle of fuel injection pump (7) in order to regulate engine speed.
- When the start switch (3) is turned to the OFF position, the shutdown device (9) closes the injection nozzle of the fuel injection pump to cut off the engine fuel supply. Then, the engine stops.

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4.9.1 System operation

4.9.1.1 Engine starting

- When the start switch is turned to the START position, the starting signal is sent to the start motor. Then, the start motor starts the engine.

  When it happens, the engine controller detects the signal voltage sent from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.

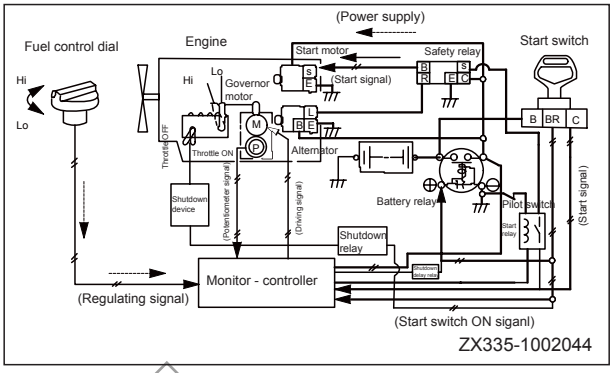


Fig. 4-165

4.9.1.2 Engine speed control

- The fuel control dial sends to the controller a signal voltage corresponding to its angle.

  According to the signal voltage, the controller sends a driving signal to throttle motor in order to control the fuel injection pump, hence controlling the engine speed.

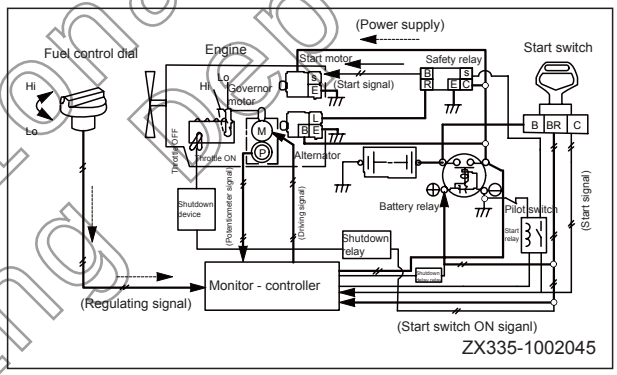


Fig. 4-166

4.9.1.3 Engine shutdown

- When the start switch is turned to the STOP position, the shutdown controller controls the shutdown device to stop fuel supply to the fuel feed pump. The engine is then stopped.

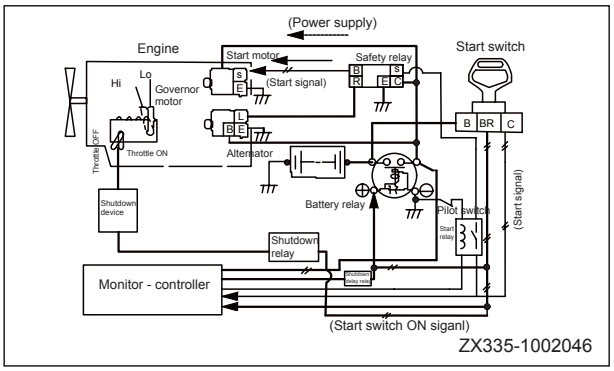


Fig. 4-167

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4.9.2 System components

4.9.2.1 Fuel control dial

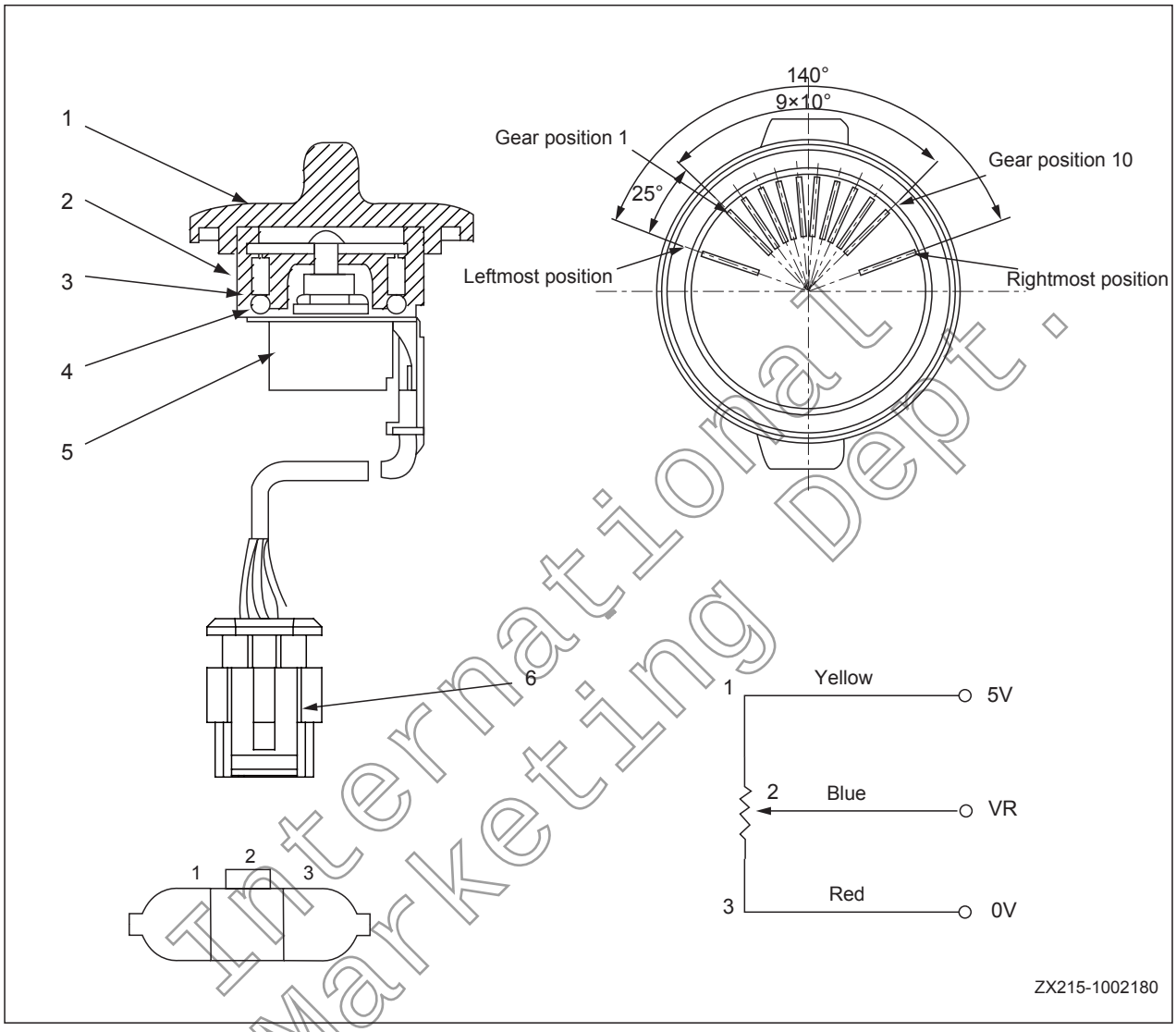


Fig. 4-168

(1) Knob
(2) Dial
(3) Spring
(4) Ball
(5) Potentiometer
(6) Plug

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Function

- Turning of the fuel control dial changes the resistance of the sliding rheostat inside the dial and the voltage signal collected by the controller. The controller calculates the collected signals and drives the governor motor via signal output and controls the injection of the fuel pump so that the engine can run at an optimal speed.
- When throttle voltage is beyond the area, the controller sends out alarm code and the engine runs at low idle. The area under the sloping line is the abnormality detection area.

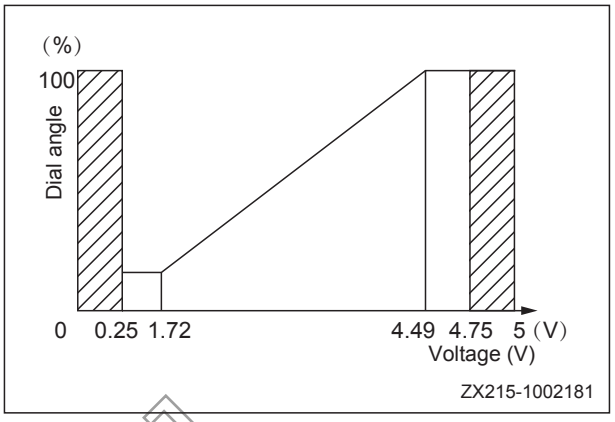


Fig. 4-169

Remark:

The leftmost position is 0%; and the rightmost position is 100%.

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4.9.2.2 Controller

SEHC-281A (Huaxing)



Fig. 4-170

Controller ports

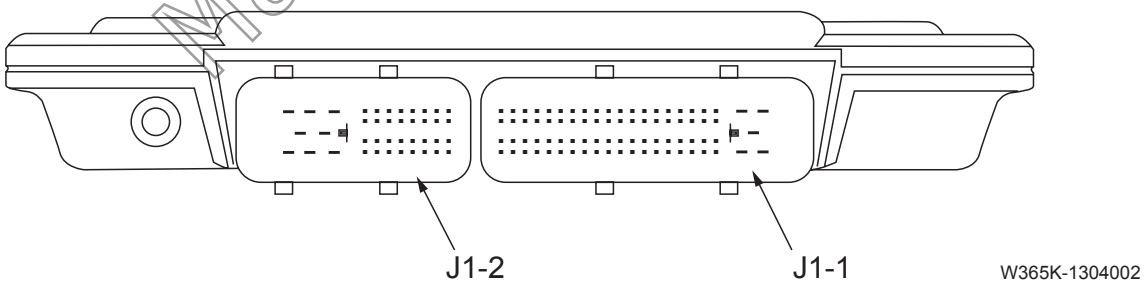


Fig. 4-171

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Controller signal distribution

J1-1

No.	Signal name	I/O
1	Power ground	
2	Power ground	
3	Power ground	
4	Power（24V）	Input
5	Power（24V）	Input
11	Fuel level sensor signal	Input
13	GPS detecting signal	
15	Throttle position signal	Input
23	RX232	
28	Air filter plugging sensor signal	Input
30	Water temp sensor signal	Input
31	Oil temp sensor signal	Input
34	Fuel control dial signal	Input
38	Engine speed signal	
39	2RS	
40	RS	
41	TX232	
42	2nd boost button signal	
48	Engine oil pressure signal	Input
49	L. travel pressure sensor	Input
50	Bucket-dig pressure sensor	Input
51	Boom-down pressure sensor	Input
52	Arm-in pressure sensor	Input
53	Rear pump principal pressure sensor	Input
54	Sensor power ground	Input
55	Sensor power ground	Input
56	Sensor power	Output
58	Monitor CAN low	
60	Calibrator CAN high	
65	Pilot switch	
66	Coolant temp high	Input
67	R. travel pressure sensor	Input
68	Swing pressure sensor	Input
69	Bucket-dump pressure sensor	Input
70	Boom-up pressure sensor	Input
71	Arm-out pressure sensor	Input
72	Front pump principal pressure sensor	Input
73	Sensor power ground	Input
74	Sensor power	Output
75	Sensor power	Output
77	Monitor CAN low	
78	Calibrator CAN high	
79	Engine shutdown signal	
80	Engine start signal	

J1-2

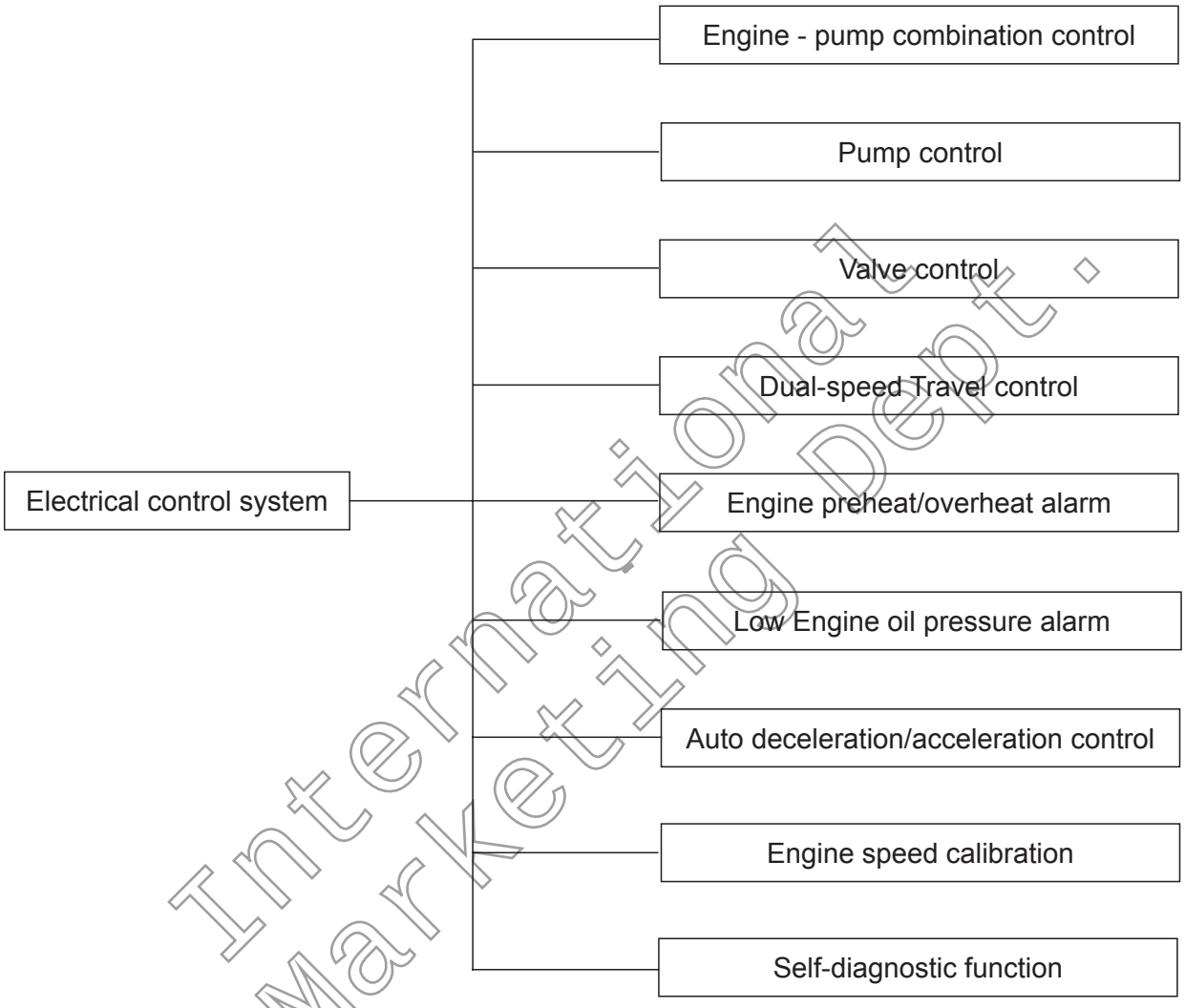
No.	Signal name	I/O
82	High/low speed shift valve	
88	Front pump proportional valve	
89	Rear pump proportional valve	
98	Bucket confluence valve	
99	Engine start control	
100	Shutdown delay signal	
101	Bucket solenoid valve	
105	Throttle motor drive signal+	
113	Throttle motor drive signal-	
114	Power ground	
115	Power ground	
116	Power ground	
117	Power ground	
118	Power（24V）	
119	Power（24V）	
120	Power（24V）	
121	Power（24V）	

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4.10 Electrical Control System

4.10.1 Control function



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4.10.2 Diagram of machine control system

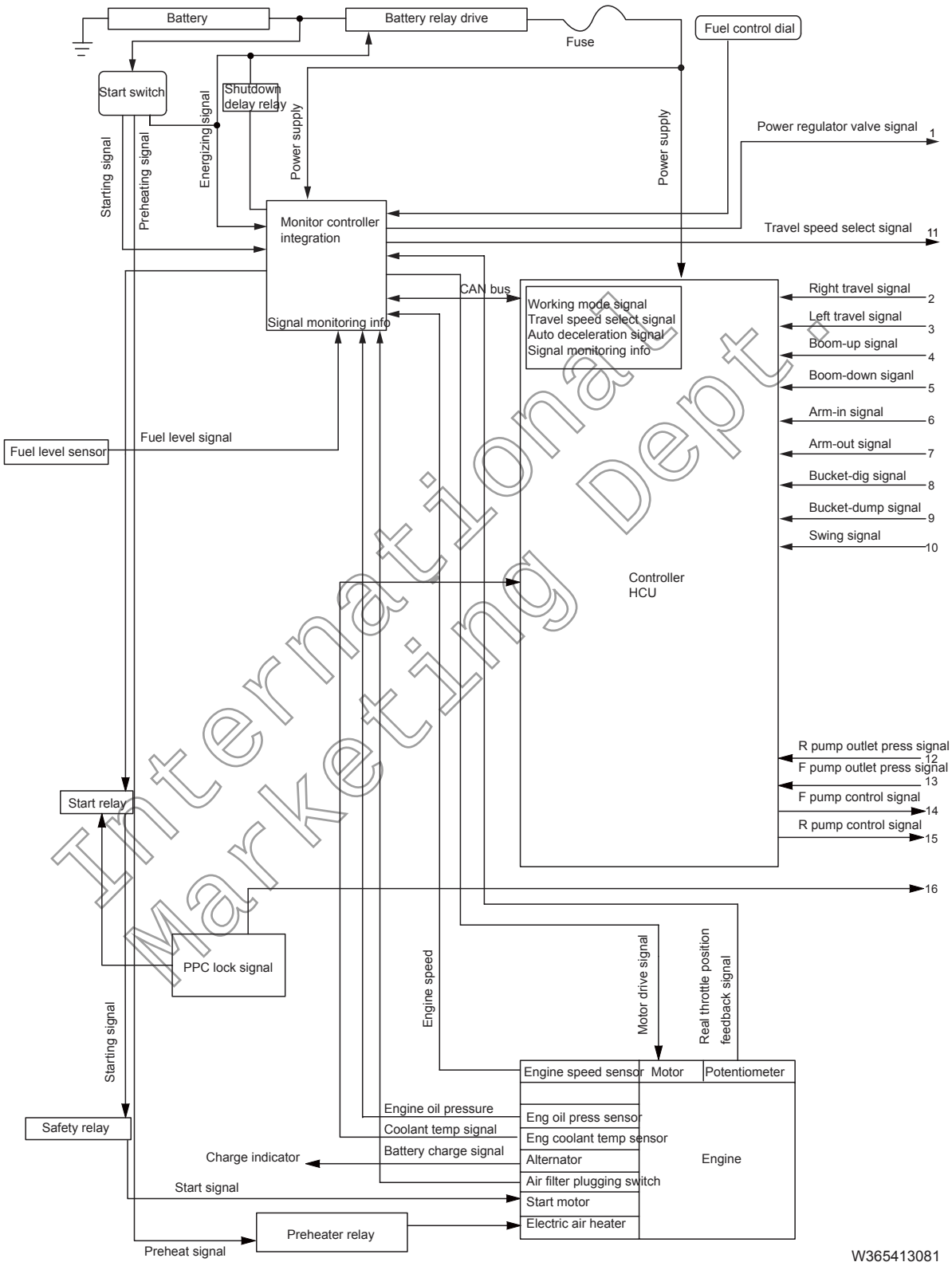


Fig. 4-172

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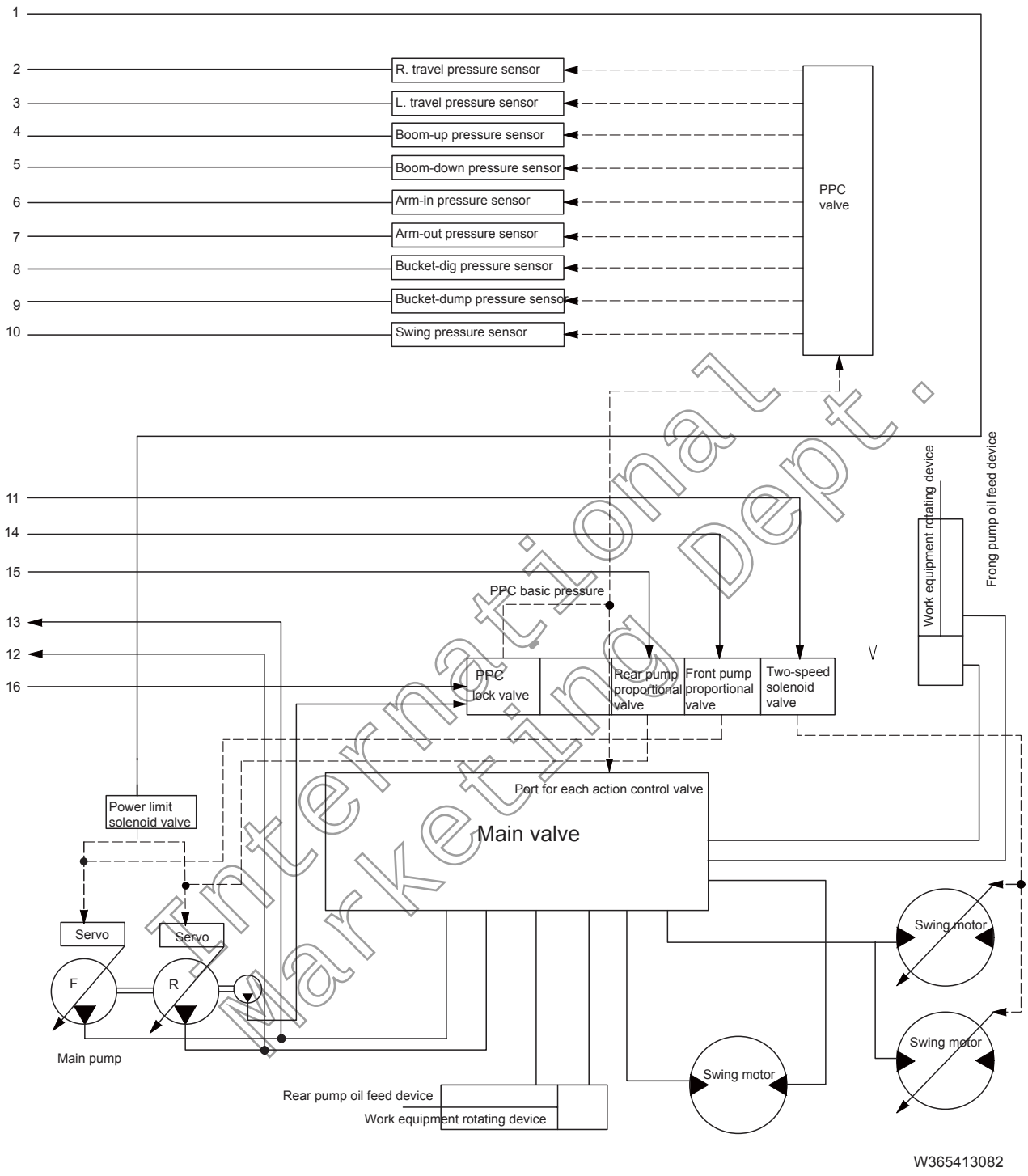


Fig. 4-173

Note: The diagram above is a schematic diagram of electrical control. See the hydraulic section for more information on the hydraulic circuits.

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4.10.3 Engine-pump combination control

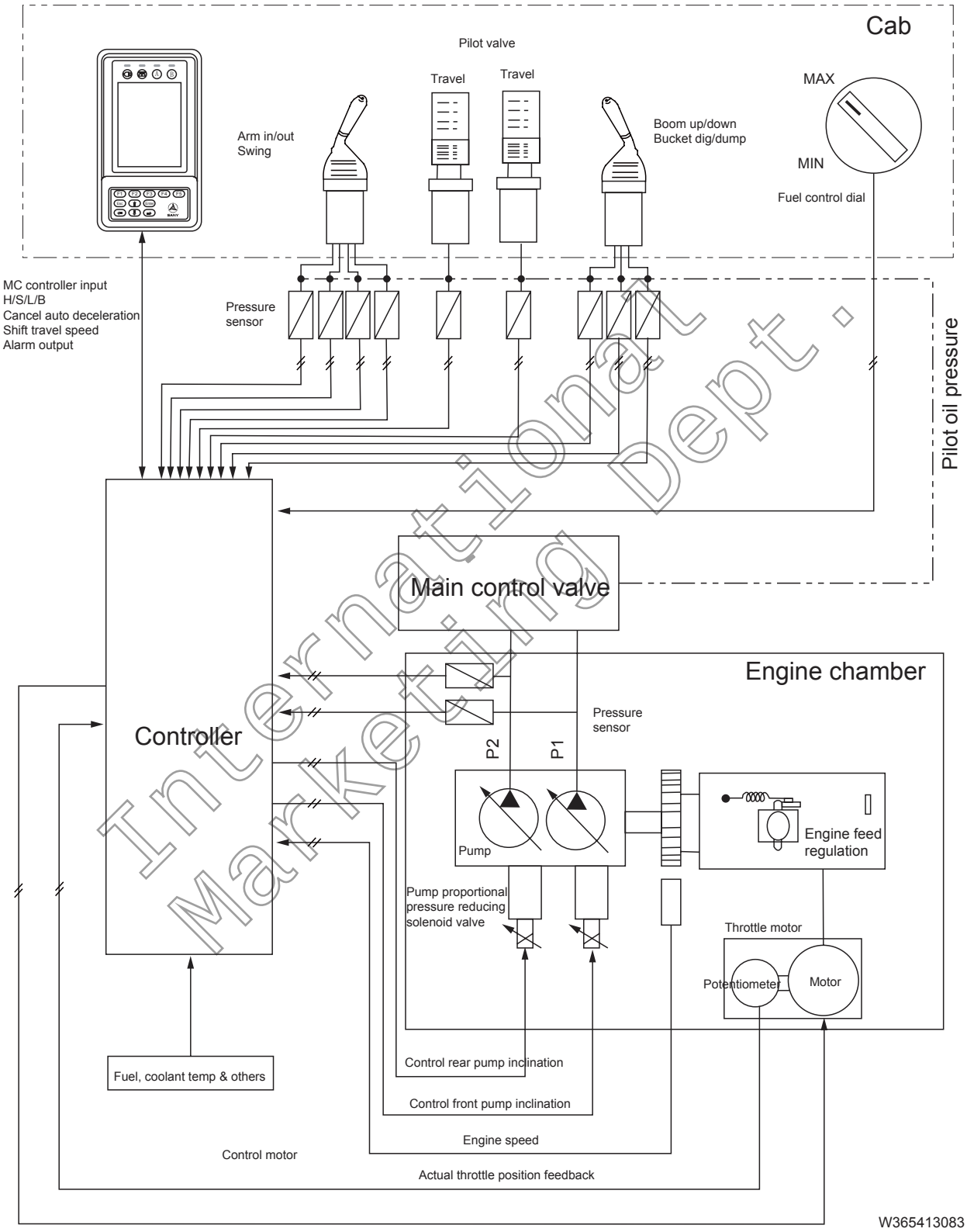


Fig. 4-174

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Function

- This function allows operator to select a working mode and change the engine power output according to the kind of job that the machine is to be engaged. The working modes include H, S, L and B. A selector button on the monitor is available for selection of a working mode.
- Pump controller controls the pump so that the pump is able to absorb all torques at engine output point. These torques are determined by the pump absorption torque specification, fuel control dial setting and real engine speed under each mode.

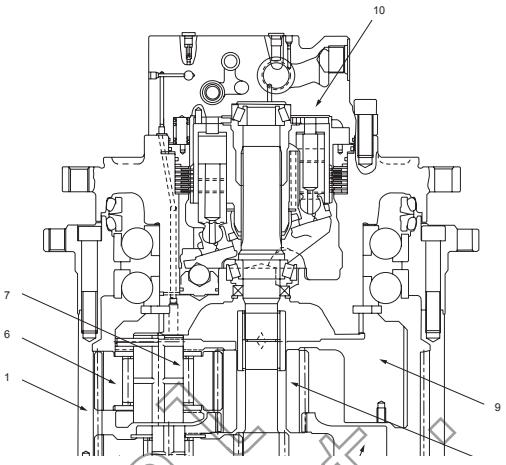


Fig. 4-175

Technical specifications

H mode

Speed (rpm)	~1750	1750~1900	1900~2180
Power(KW)	143	159	174

S mode

Speed (rpm)	~1750	1750~2180
Power(KW)	133	166

L mode

Speed (rpm)	~1850
Power(KW)	150

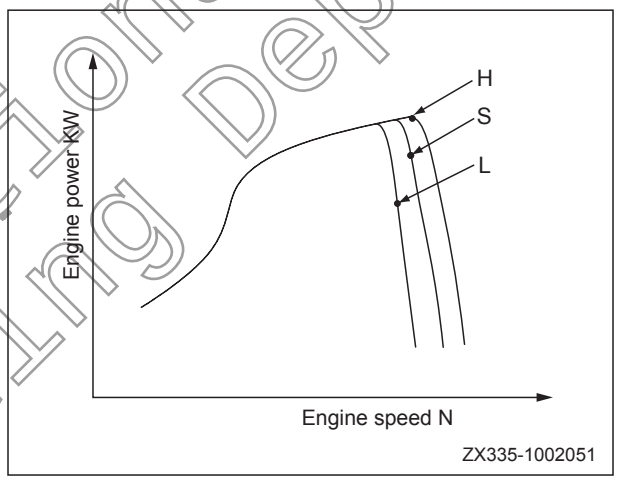


Fig. 4-176

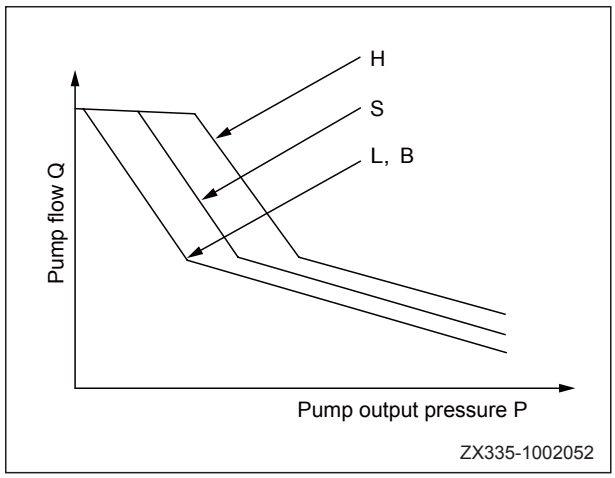


Fig. 4-177

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Mode control methods

- Mode H
- H mode matching point: Rated speed
  184kW/2180rpm

- Engine speed decreases when pump load increases and the pressure rises. In this case, engine speed will be up to the proximity of matching point, allowing pump controller to reduce output. On the contrary, when pump load reduces and the pressure decreases, the pump controller will keep increasing pump output until engine speed reaches the proximity of matching point.

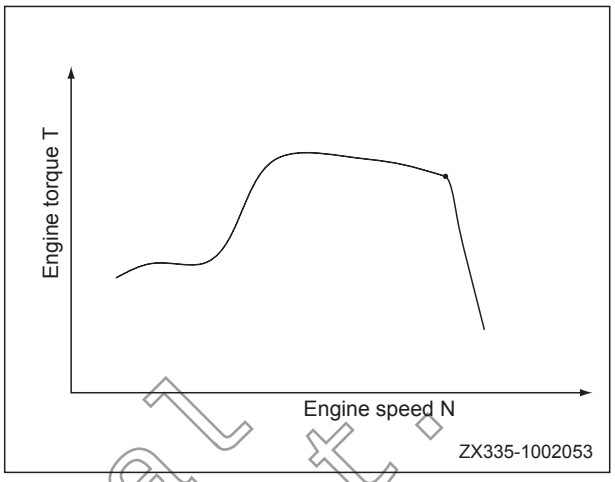


Fig. 4-178

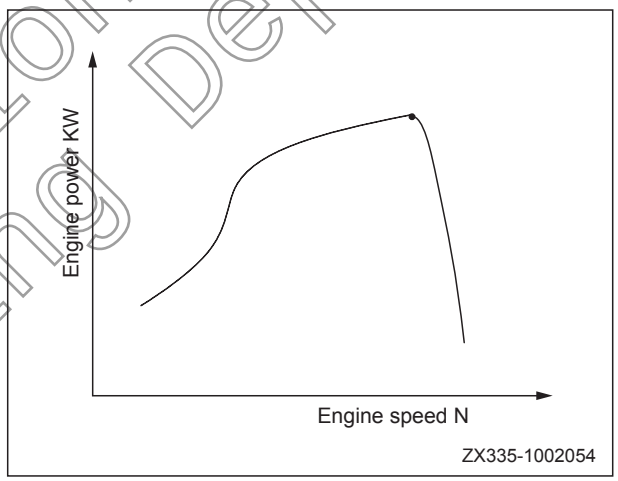


Fig. 4-179

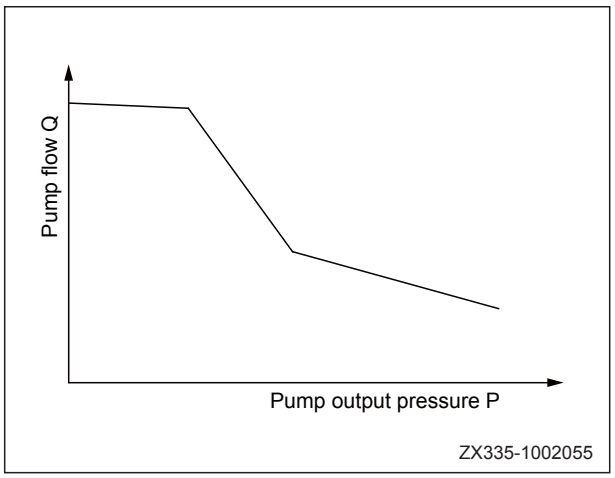


Fig. 4-180

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- Power output percentage corresponding to each mode

Mode	H	S	L	B
Power output percentage	95%	90%	80%	80%

- The controller maintains the pump suction force along the stable horse power curve and controls engine speed through engine-pump combination control.

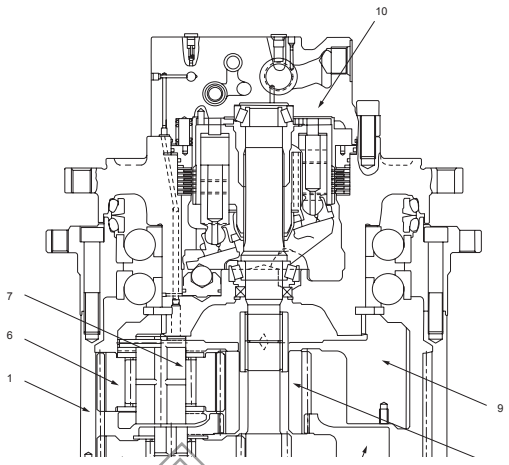


Fig. 4-181

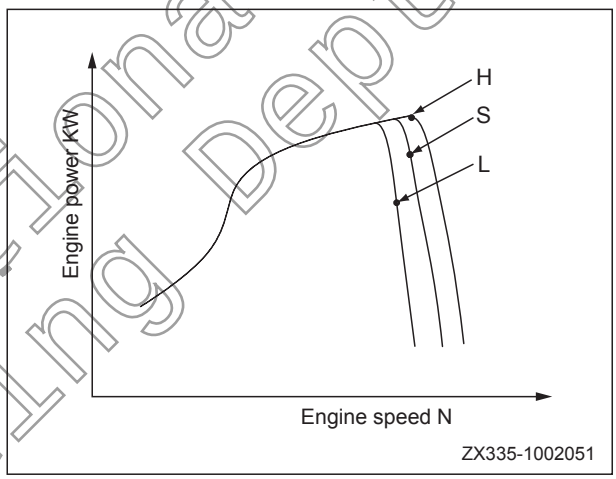


Fig. 4-182

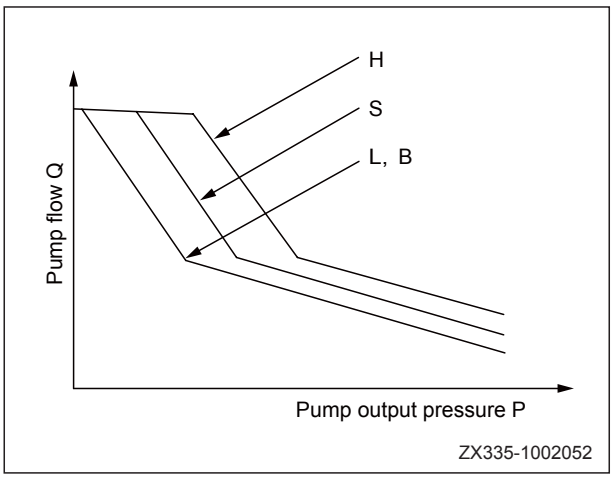
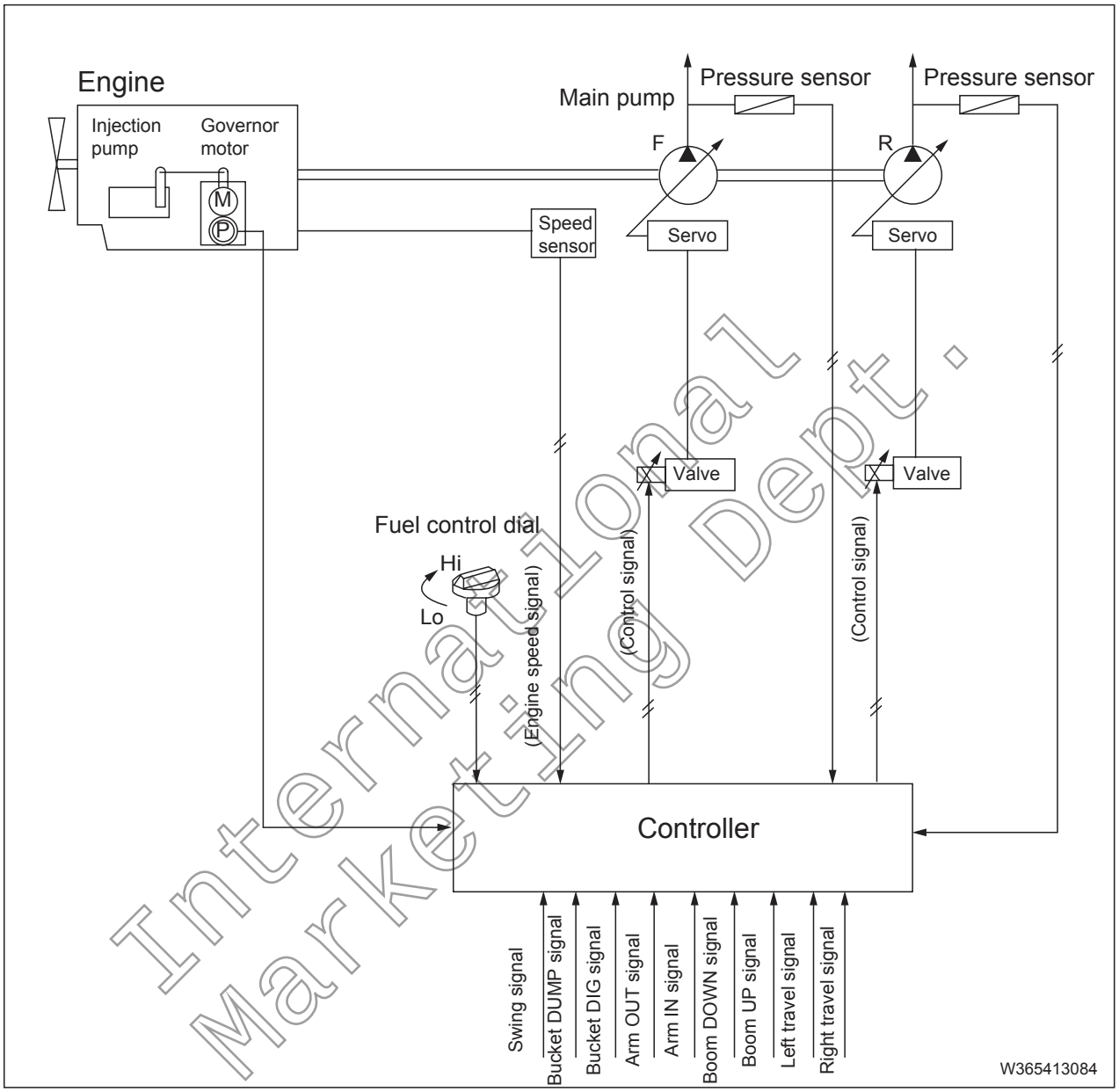


Fig. 4-183

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4.10.4 Pump control function



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Fig. 4-184

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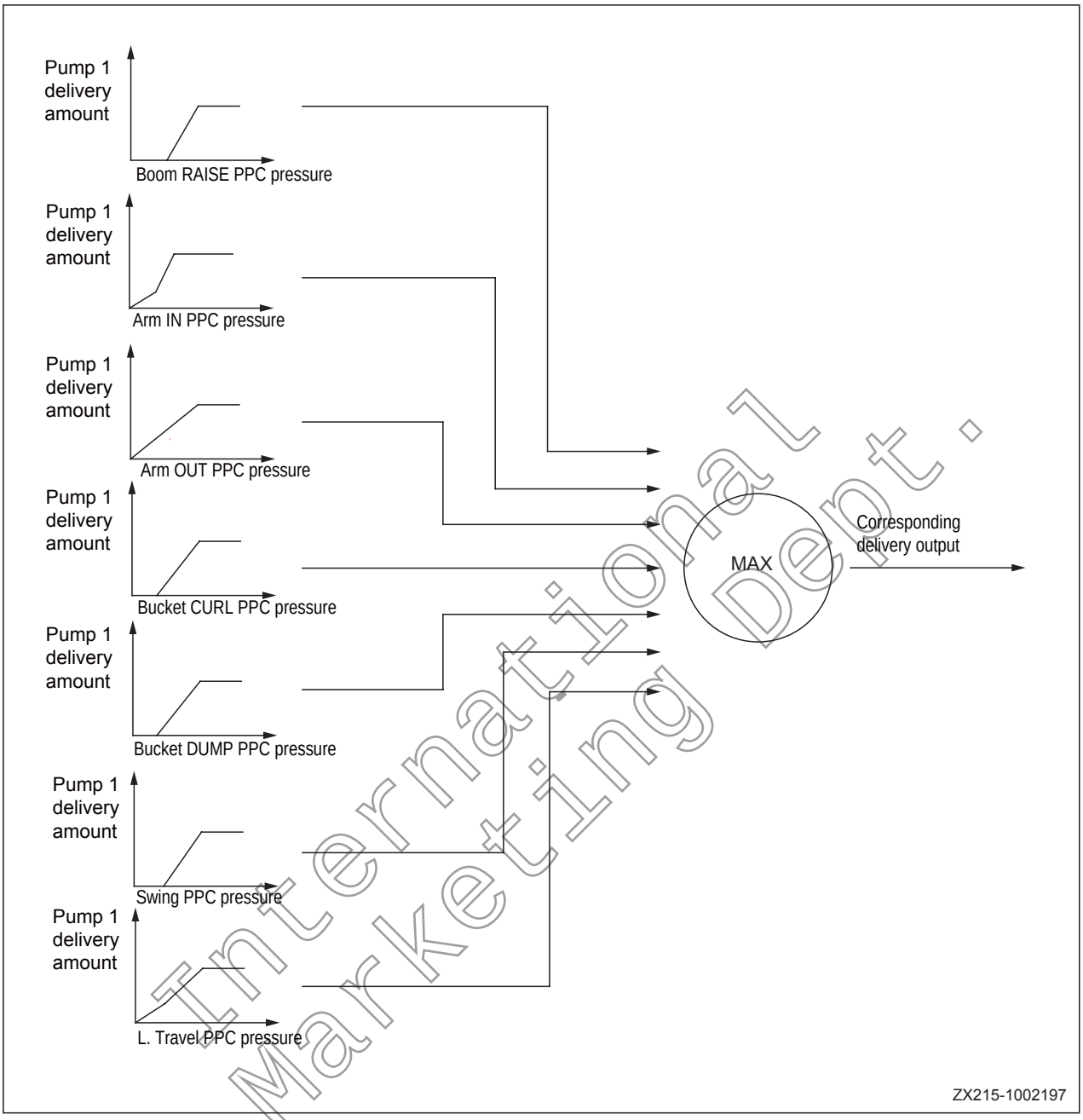


Fig. 4-185

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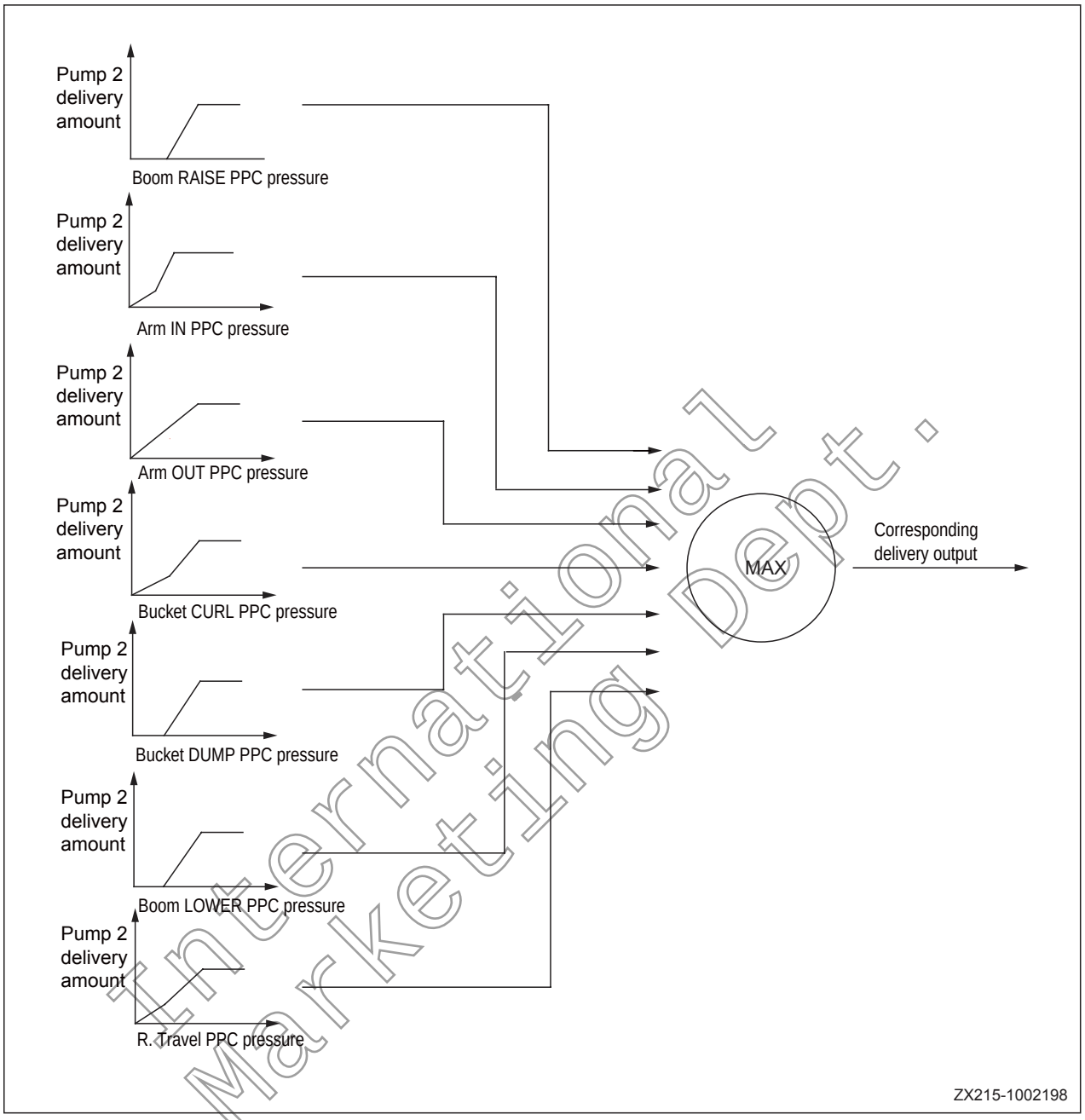


Fig. 4-186

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Function

Use the work equipment and swing pilot pressure signal directly as the hydraulic pump discharge control signal. Pilot pressure is applied on the valve stem and, on the other hand, is collected by the controller. The controller keeps the discharge amount of the hydraulic pump at the specified value of the corresponding pilot pressure according to the functional relation between the set hydraulic pump discharge amount and pilot pressure. During combined operation, the set discharge amount of each operation shall be added.

Operation

When the work equipment is operating, the controller collects the signal of pilot pressure sensor, and determines the control discharge amount of pump 1 and pump 2 according to the pressure signal.

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4.10.4.1 Constant power control

Function

- It is mainly used to calculate the theoretical maximum displacement. The system employs constant power control. Two regulators are interconnected hydraulically, enabling synchronized operation of two actuators of the same specification at the same time. Change of pump flow is determined by the sum $P_{\sum}$ of working pressures of both hydraulic pumps. So long as it satisfies $2P_0 \le P_{\sum} \le 2\ P_{Max,}$ the sum of powers of both hydraulic pumps remains constant, exceeding not the power of diesel engine.

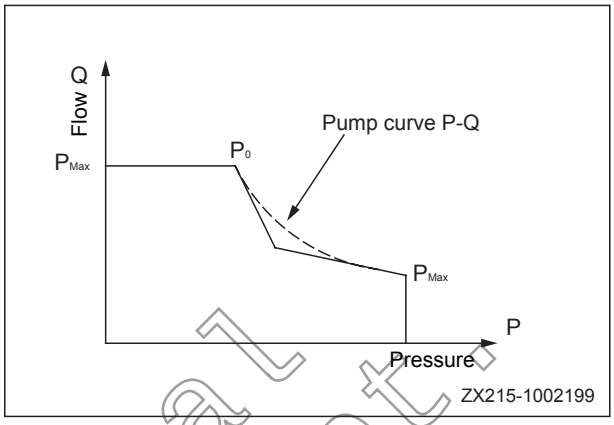


Fig. 4-187

Operation

- When work equipment is working, the controller collects throttle position signal and gives a constant current in order to control power of pump.

4.10.4.2 ESS control

Function

- Changing of the engine speed due to load change controls the pump power, and engine output can be used more efficiently. (This function can also prevent the engine from losing control when the machine is operating under harsh conditions (eg. high - altitude area).

Operation

The engine control panel controls the target operating speed of the engine.

- The engine controller collects the actual speed signal from the speed sensor, and preform a loop control with the target operating speed. Then, the controller involves the output of loop control with the calculation of the solenoid valve control signal, and sends the final regulating current signal to the pump proportional solenoid valve.
- The solenoid valve controls pump flow by feeding pilot oil to the pump regulator according to the signal sent from the controller.

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4.10.5 Valve control function

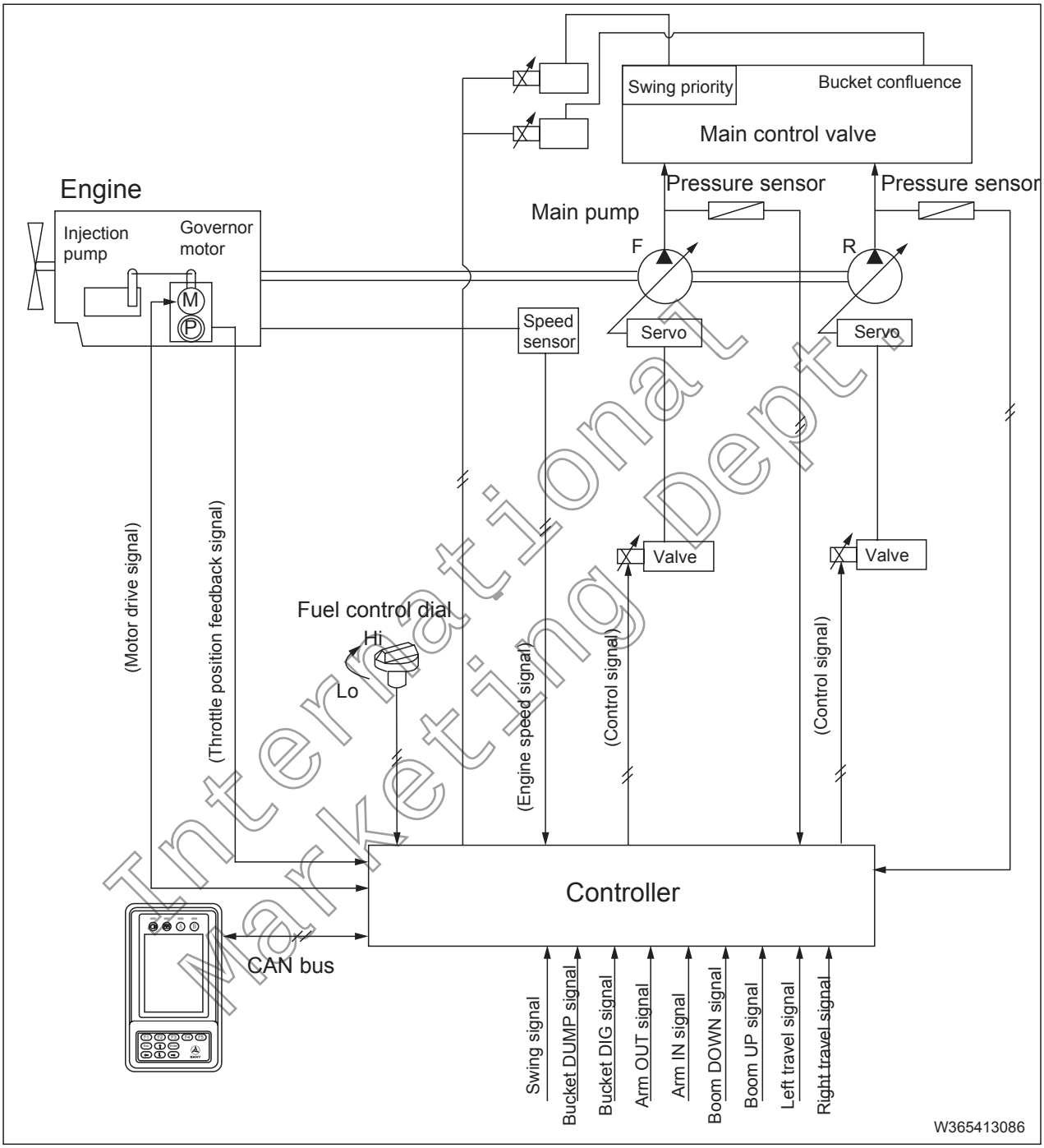


Fig. 4-188

- Bucket fl ow control
- Swing priority control

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1) Bucket flow control

Function

Control the pump swash plate angle according to the operation of bucket control lever.

Operation

When the bucket control lever is operated, the controller collects the signal from the bucket DUMP pressure sensor and bucket CURL pressure sensor, and controls the bucket confluence proportional valve.

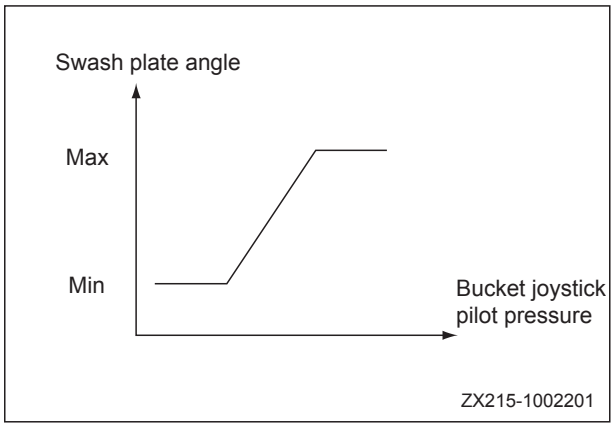


Fig. 4-189

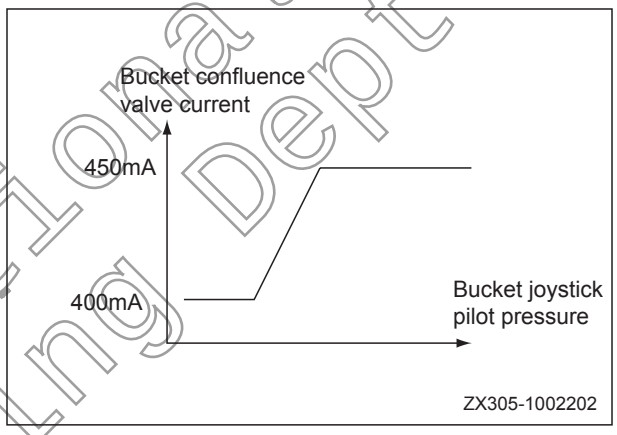


Fig. 4-190

2) Swing priority control

Function

- Pressurized oil from pump 1 bypasses bucket 1 valve spool, and flows first to swing motor valve spool to activate swing first.

Operation

- When signals from pump 1 pressure sensor, arm pressure sensor and swing pressure sensor meet the following conditions, the controller activates the solenoid valve. The solenoid valve conducts pilot pressure oil to arm flow controller and limits the alternate circuit of arm 1 valve spool. Swing valve spool first ensures swing motor power, preventing the counter acting force when the arm is retracting from affecting the positioning of the upper swing structure.

Operating condition

- Swing pressure sensor: signal output available

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4.10.6 Dual travel speed control

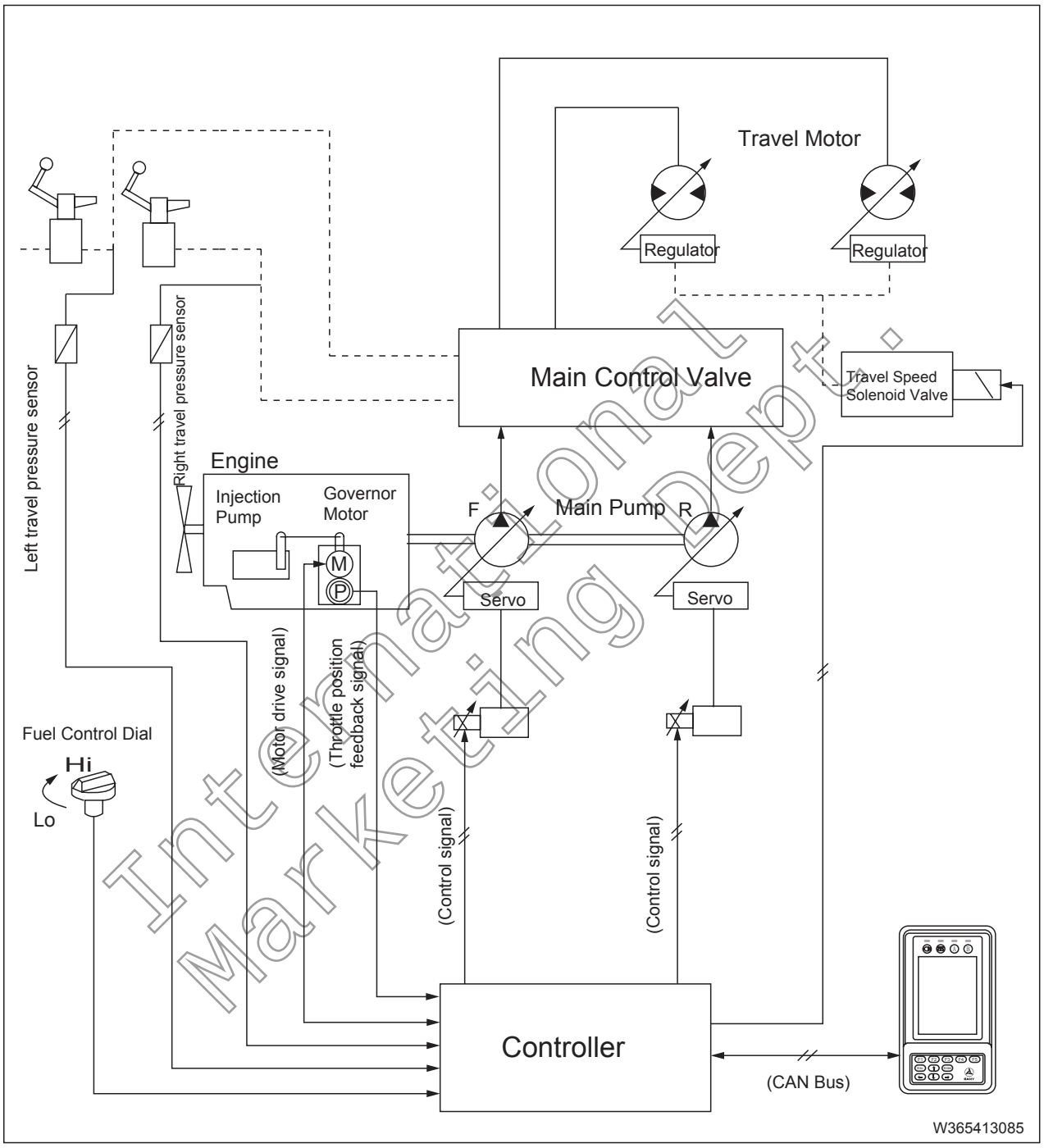


Fig. 4-191

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Function

Travel mode control

Operation

- When travel mode is set to LOW, the angle travel motor swashplate reaches its maximum and travel speed is slow.
- When the controller receives signal from travel pressure sensor under the following condition, it activates the solenoid valve. The solenoid valve delivers pilot oil to the travel motor swashplate angle control valve in order to reduce the angle to its minimum and increase travel speed.

Operating condition

Fast travel function on the monitor is on.

Note: When lifting the track on one side with the help of work equipment and running the track, the pump control pressure on the side increases to enable fast running of the track. When the machine is traveling under HIGH mode, the travel mode cannot be changed even if work equipment is operated (work equipment pressure sensor is turned ON).

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4.10.7 Engine preheat/overheat alarm

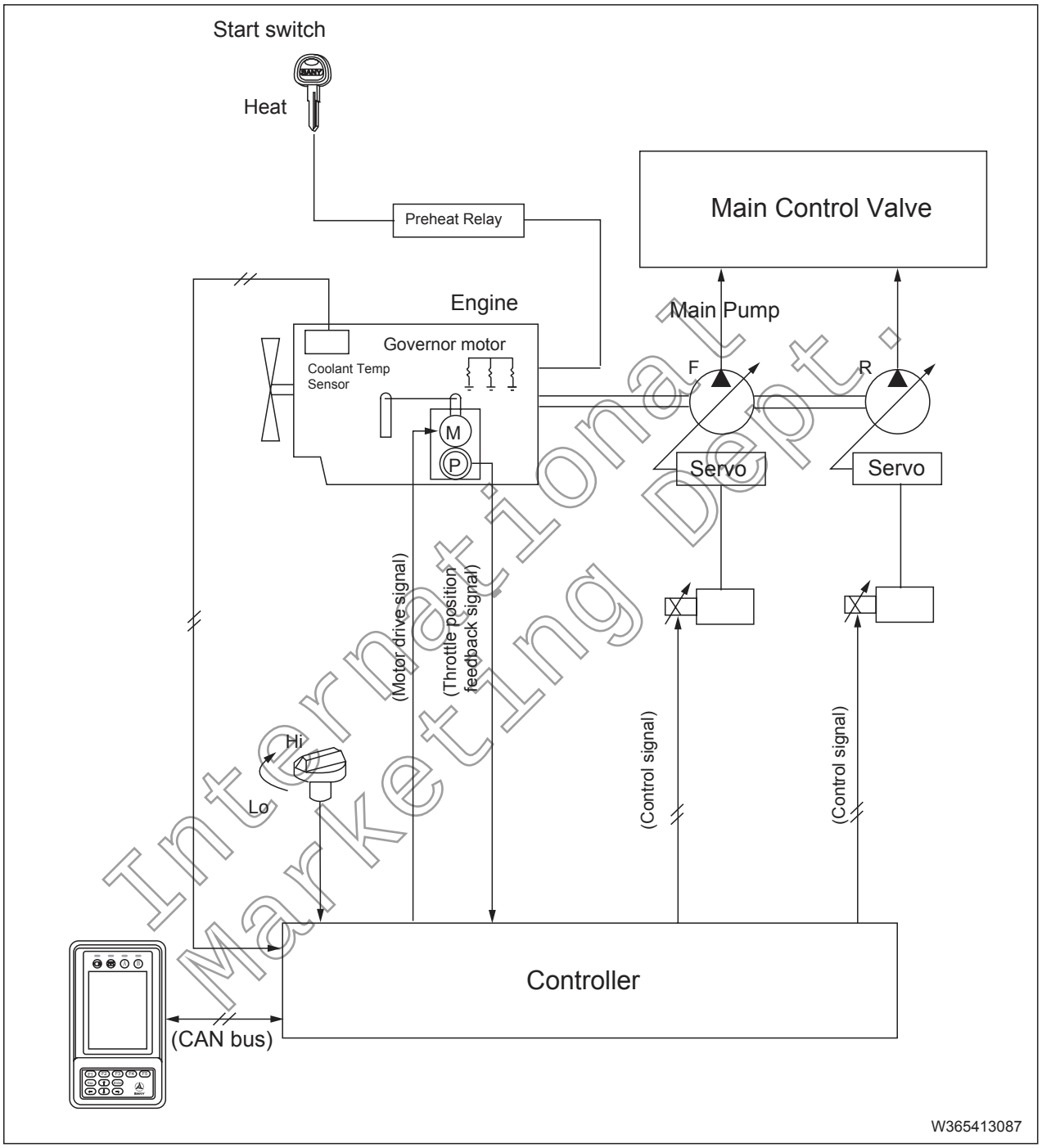


Fig. 4-192

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1) Engine preheating

Function

- Preheat control

Operation

- The excavator starts preheating when it is powered on.

Operating condition

- Low temperature switch is closed; excavator is energized; auto preheating begins at starting.

2) Engine overheat alarm

Function

- When coolant temperature is high (over 103℃) during operation, the monitor displays alarm.

Operation

- The controller collects signal from coolant temperature sensor. If coolant temperature is too high, alarm message will be generated and sent to the monitor. Receiving the alarm message, the monitor will illuminate the alarm indicator light.

Operating condition

- Power on
- Coolant temperature greater than 103℃

3) Alarm - low engine oil pressure

Function

- The controller collects signal from engine oil pressure sensor. When engine speed is greater than 600 rpm and engine oil pressure is too low, alarm message will be generated and sent to the monitor. Receiving the alarm message, the alarm indicator lights up.

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4.10.8 Auto deceleration/acceleration control

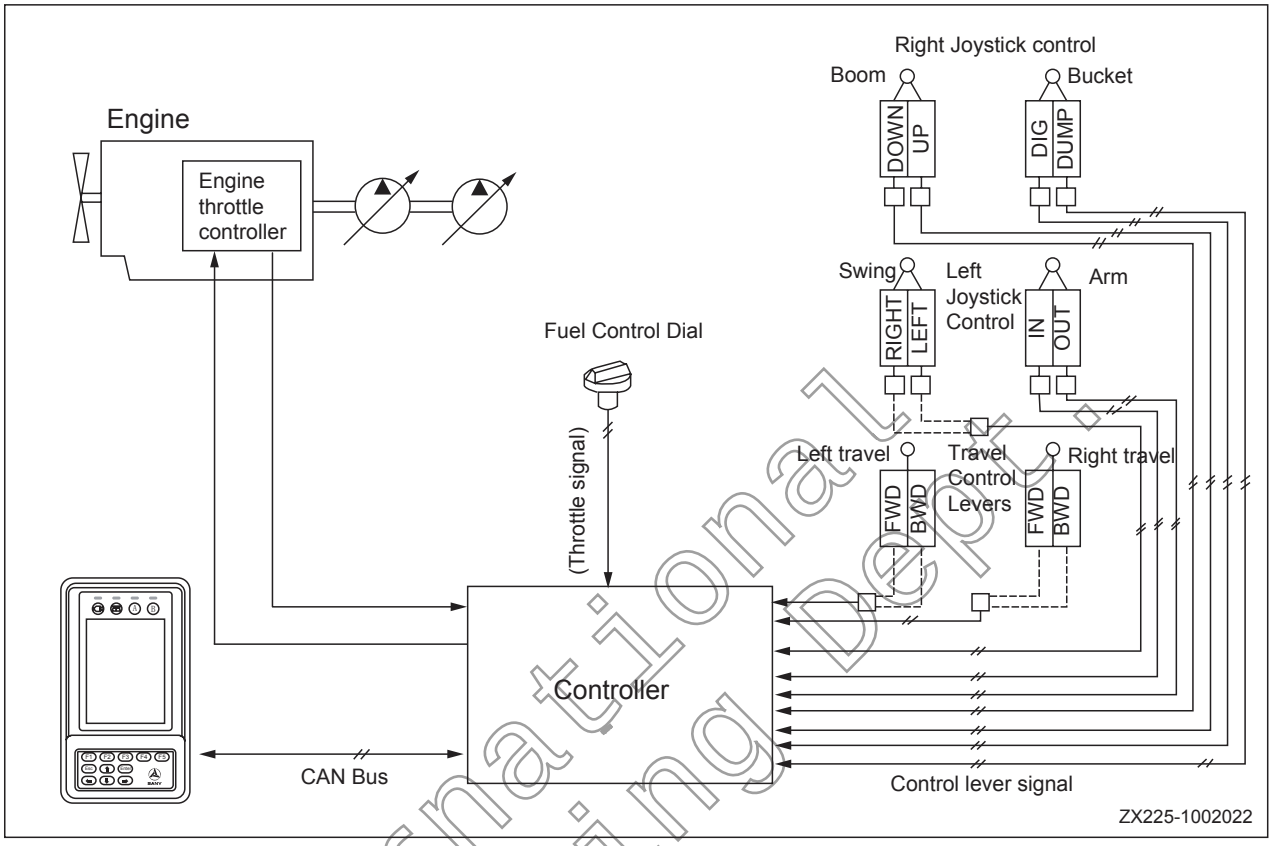


Fig. 4-193

Function

- When all control levers are in the neutral position, lower engine speed in order to reduce fuel consumption and noise.
- When any control lever is operated, engine speed will be back to the setting of the fuel control dial.

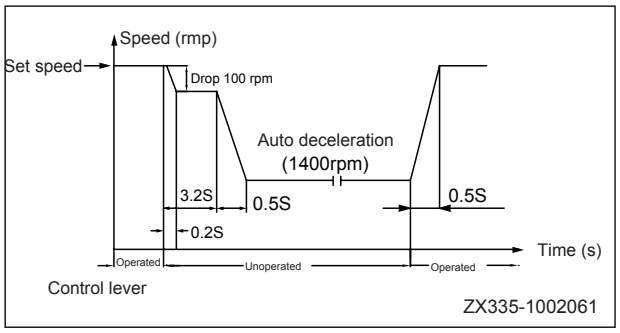


Fig. 4-194

Operation

- Engine speed will drop to the speed of gear position 1 (100 rpm lower than the set speed) 0.2 second after the control levers are placed in the neutral position. The engine will run at low speed (1400 rpm) after another three (3) seconds. This can reduce void flow of hydraulic system and wear of the engine, hence saving energy and reducing noise. When any control lever is operated to resume the operation, the engine speed will be restored.
- When any control lever is operated during engine deceleration, engine speed will increase immediately to the speed set by the fuel control dial.

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4.10.9 Engine speed calibration function

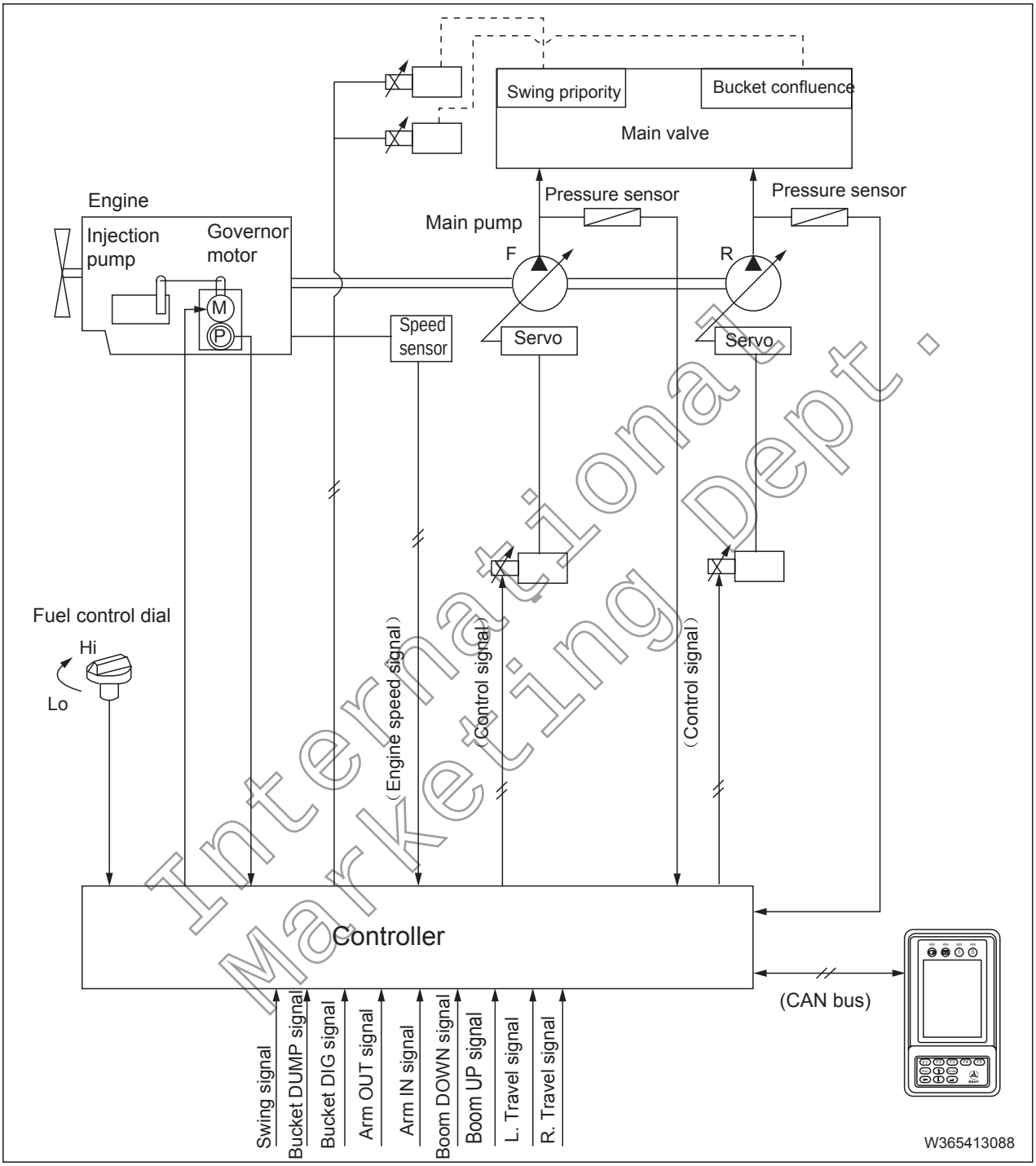


Fig. 4-195

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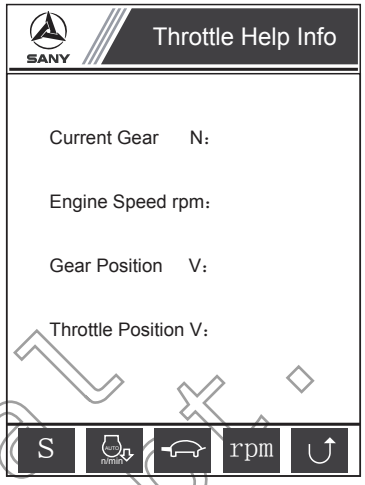
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Function

Enter the maximum engine speed for each working mode as a criteria for engine speed control.

Operation

1. Auto calibration of engine speed requires starting the engine.
2. Call the interface of System Information and select Throttle Installation Aid.
   A. Turn the fuel control dial to position 1.
   B. Press the key [F4] to start speed calibration process.
   C. Turn the fuel control dial after calibration.
   D. Repeat step (2) to finish calibration of speed at all positions.
   E. Press the key [F5] or [ESC] to end calibration.



XP2051203013

Fig. 4-196

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4.10.10 System parts and components

1) Pump pressure sensor

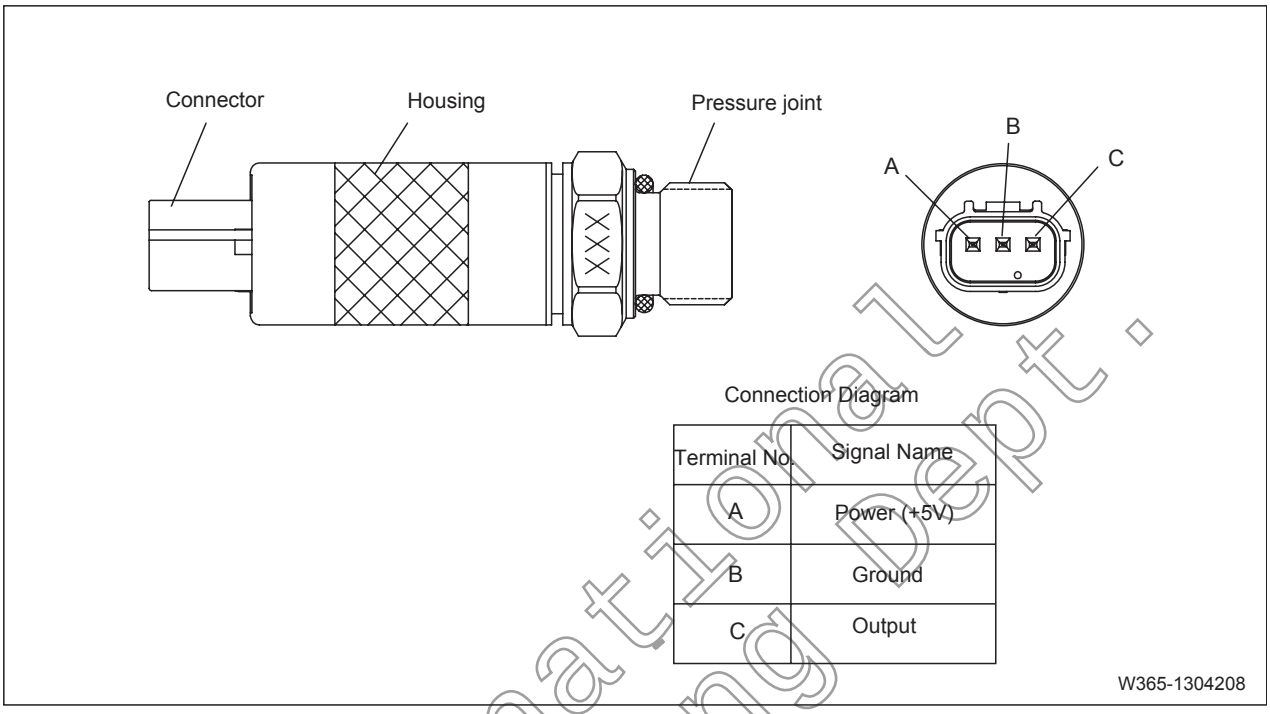


Fig. 4-197

Operation

- The illustration on the right shows the relationship between the pressure acting upon the sensor and the output voltage.

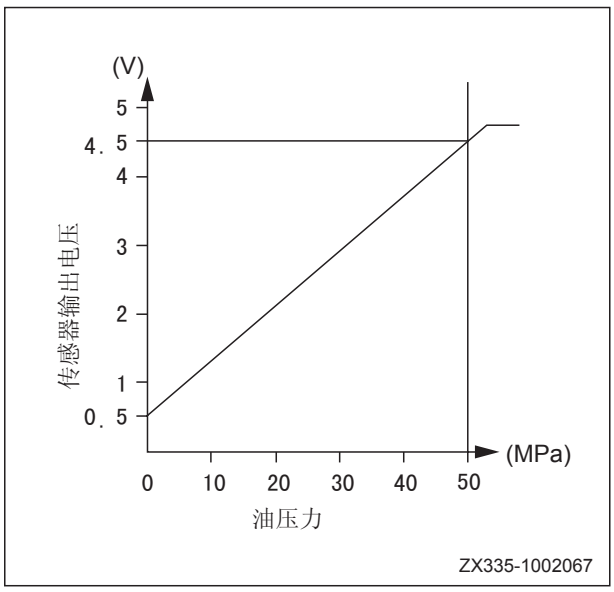


Fig. 4-198

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2) Pilot pressure sensor

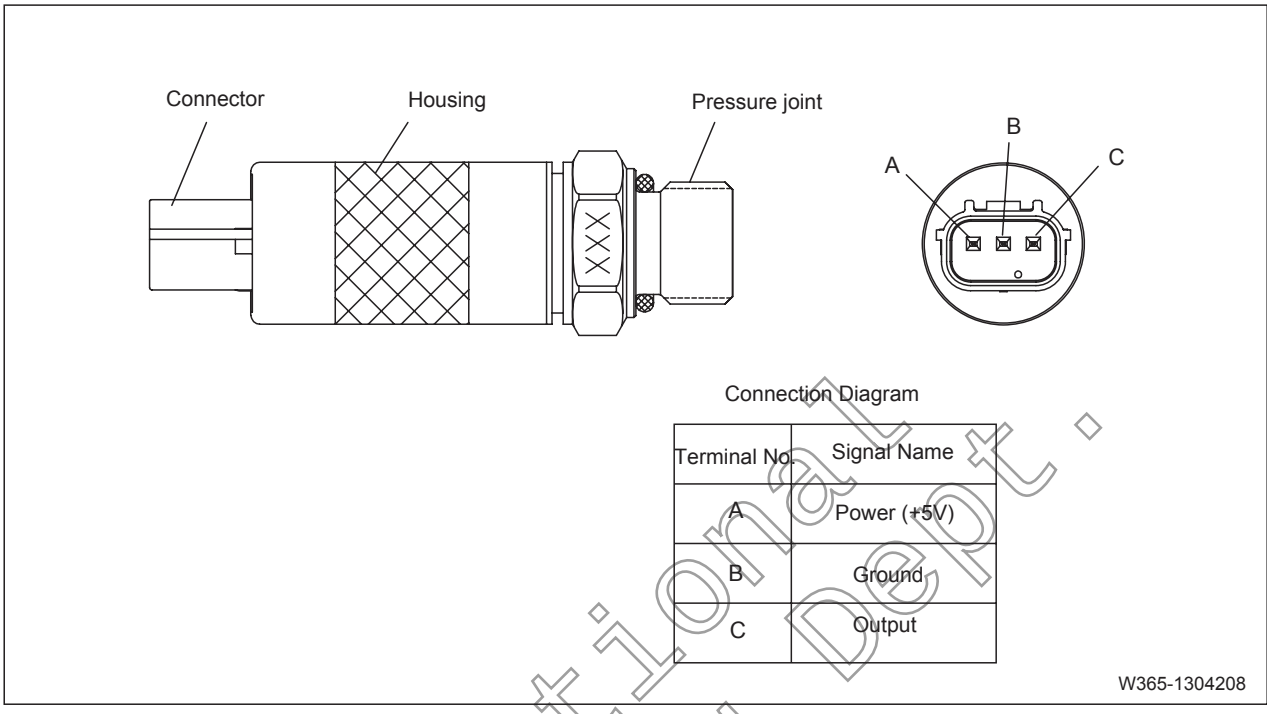


Fig. 4-199

Operation

- The illustration on the right shows the relationship between the pressure acting upon the sensor and the output voltage.

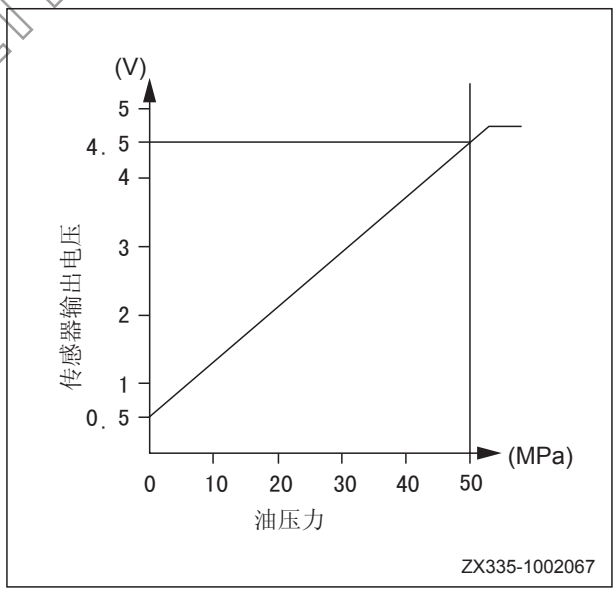
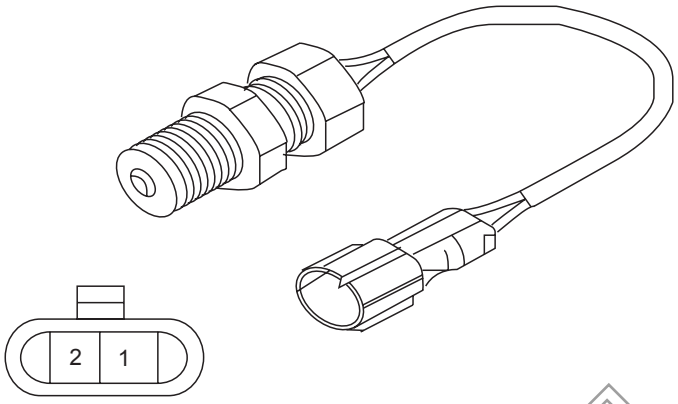


Fig. 4-200

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3) Engine speed sensor



ZX335-1002070

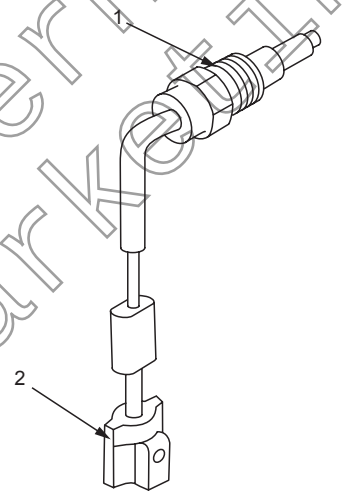
Fig. 4-201

Function

- Engine speed sensor is mounted on the gear ring of flywheel. It calculates the number of gear teeth passing before the sensor and sends the result to the controller.

Note: If the engine speed sensor has not been tightened to the specific torque, it may fail to produce signal. Always tighten the engine speed sensor to the specific torque.

4) Engine oil pressure switch



W365413089

Fig. 4-202

(1) Pressure detector

(2) Connector

Function

Engine oil pressure switch is mounted on the delivery pipe of engine oil filter. It detects engine oil pressure and sends generated pressure signal or alarm signal to the controller.

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5) Fuel level sensor

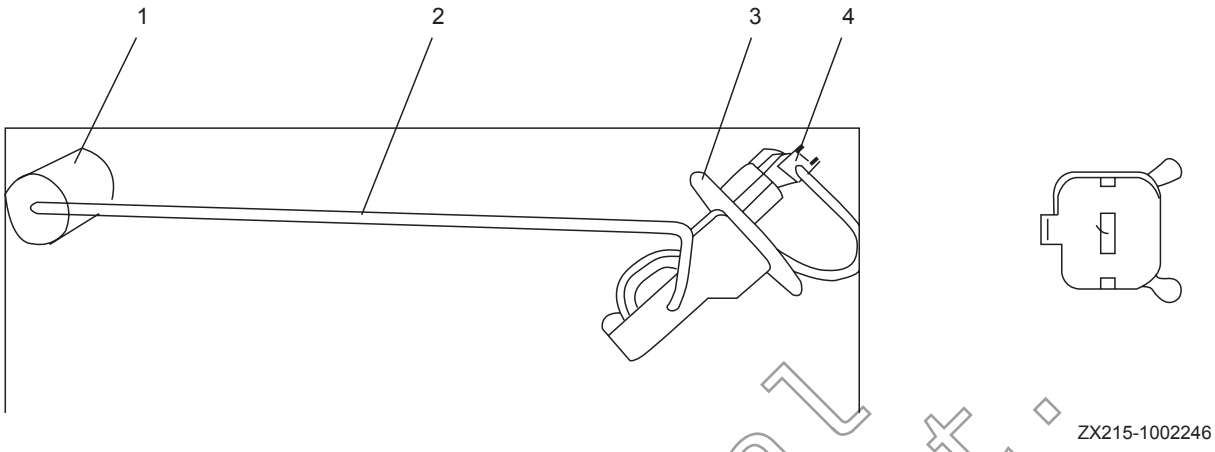


Fig. 4-203

(1) Float

(2) Lever

(3) Shell

(4) Connector

Function

Signal from the sensor will be collected by the controller and displayed on the monitor. Resistance output sensors like hydraulic oil temperature sensor, fuel level sensor and coolant temperature sensor send signal to the controller. The controller collects, process and calculate voltage signals and converts it into related information that will be displayed on the monitor.

Specifications

Electrical parameters:

- Total resistance: 100 Ω
- Tolerance: ±5%
- Upper limit: Ru ≤ 9.6 Ω
- Lower limit: Rd ≥ 86 Ω
- Variation: Nonlinear
- Max. input volt: 12VDC

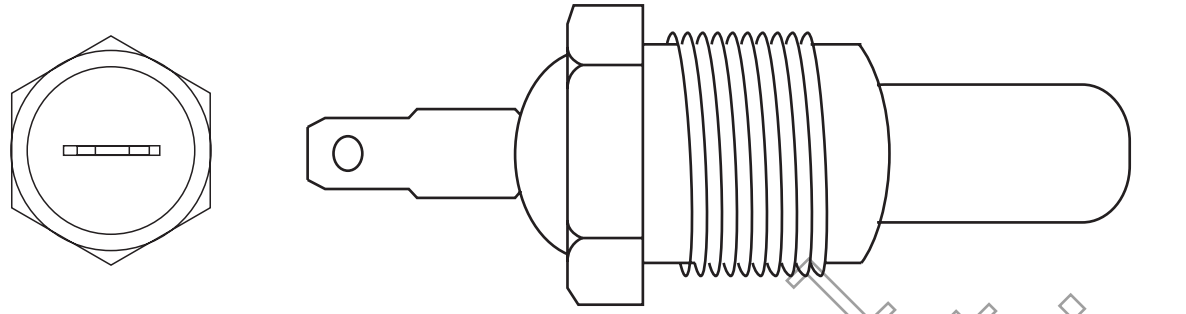
Mechanical parameters:

- Rotor angle: 105°
- Vertical distance between upper and lower limits of the float (measurable range of fluid level): 500 mm

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6) Coolant temperature sensor



ZX335-1002071

Fig. 4-204

Function

The output resistance of engine coolant temperature sensor changes with the temperature. The controller collects signal and works out a cooling temperature.

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4.11 Monitoring System

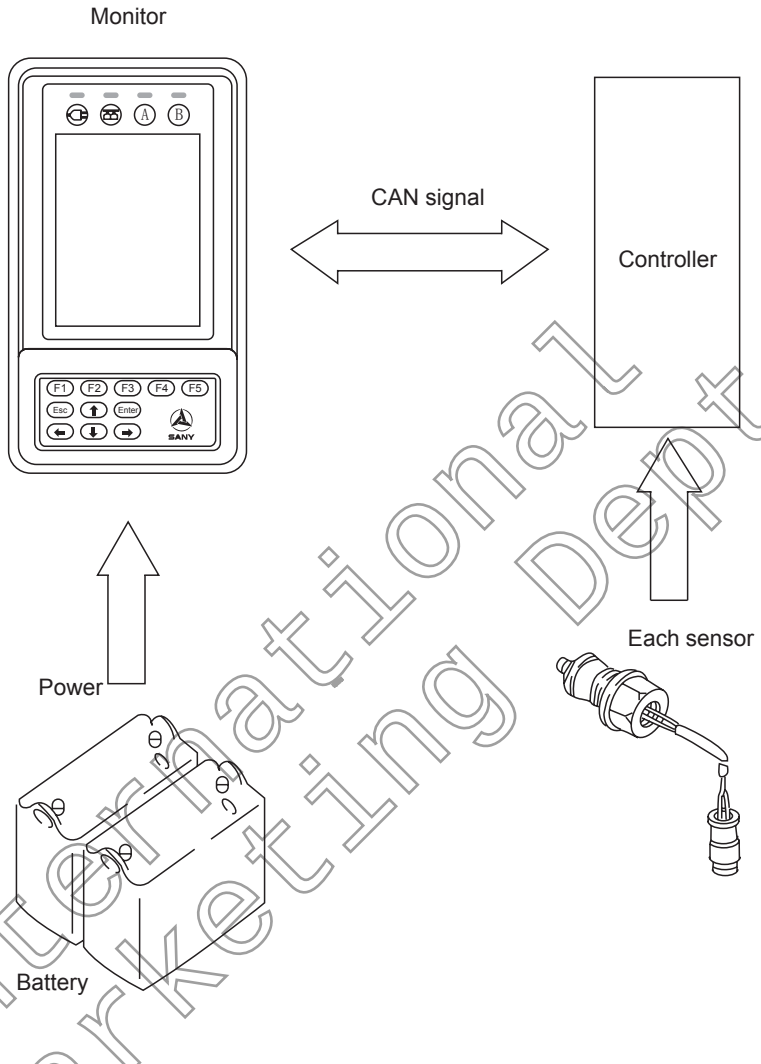


Fig. 4-205

- The machine condition is monitored by the sensors mounted on different locations of the machine. The controller processes the signals and transmits the signals to the monitor display, informing the operator of the machine condition.
- The monitor panel also contains mode selector, functional keys and machine operation control outputs.
- Information on the monitor display includes primarily:
  1. Alert information in case of machine failure
  2. Operating condition (coolant temperature, hydraulic oil temperature, fuel level, etc.)

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4.11.1 Monitor

SECD_5I7D

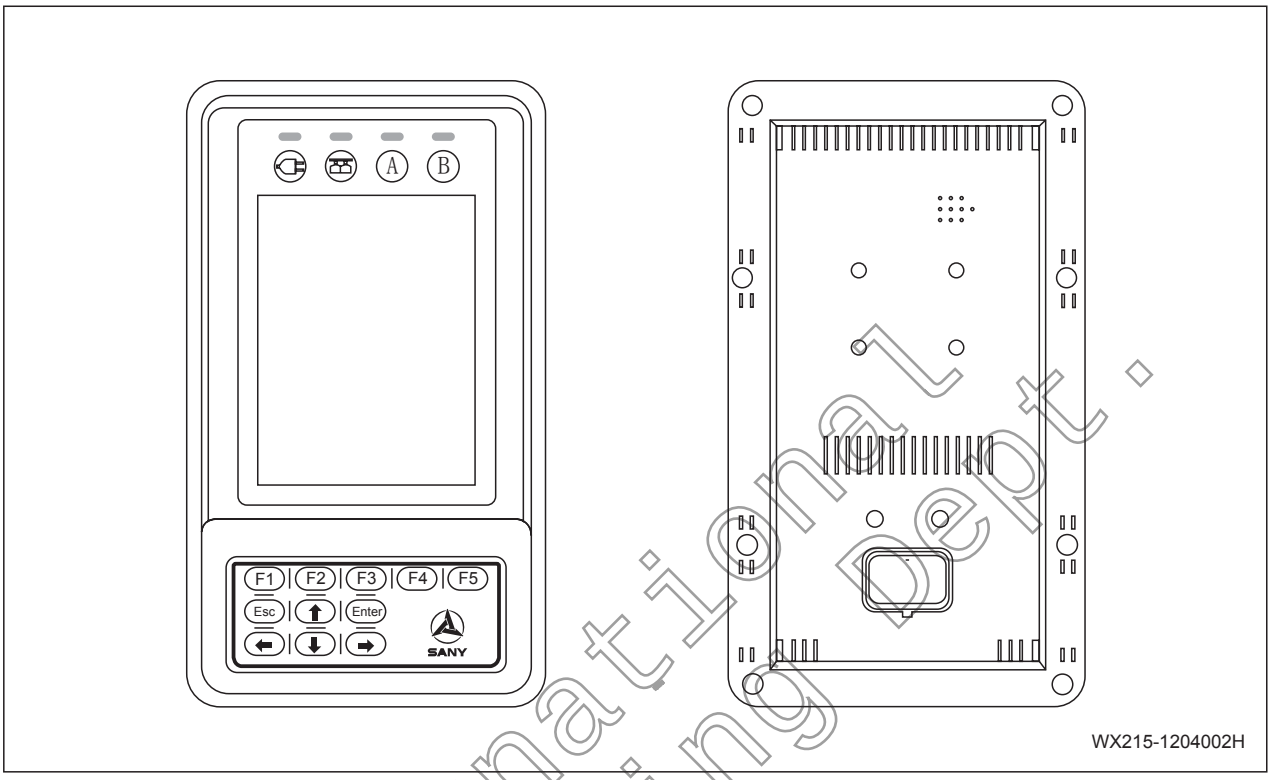


Fig. 4-206

Outline

- The monitor is used to display monitoring information and select a working mode.
- The monitor has a CPU (Central Processing Unit) which processes, displays, and outputs information.
- The monitor uses a LCD (Liquid Crystal Display).

Port I/O signals

No.	Signal name	I/O
1	Digital input A	Input
3	CAN high	
4	CAN low	
8	Trigger power (24V)	
9	Power supply (24V)	
10	Ground	
12	Ground	

IMPORTANT

- Technical specification allows a screen to have not-more-than 10 dark spots (not illuminated) or bright spots.
- It is normal to have blue bright spots on the screen when the monitor is on for a quite period of time.
- It is normal to have blinking strips on the screen when the monitor initializes.

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4.11.2 Monitor panel

NOTICE

- **Stop operation immediately when the alert indicator is on. Check and repair related parts.**
- **The monitor does not display all working conditions of the machine.**
- **Do not solely depend on what is displayed on the monitor when maintaining and checking the machine.**

The monitor panel performs the functions of monitoring and displaying, selecting a working mode, and switching on/off an electrical element.

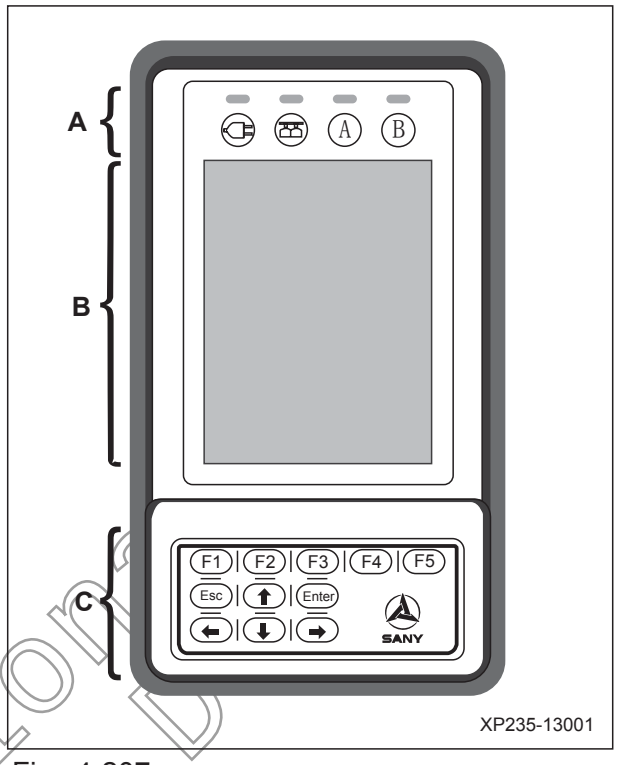


Fig. 4-207

Overview

The monitor consists of three parts:

A: Alert indicators

B: LCD display

C: Operation keys

4.11.2.1 Alert and signal indicators

Alert indicator

When the excavator has a problem, the alert indicator flashes five times along with five buzzing. If the fault is still there, the indicator light A will be kept on, telling user to solve the problem.

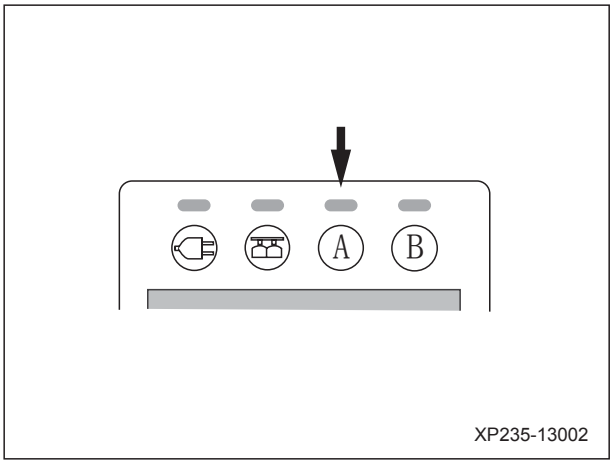


Fig. 4-208

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4.11.2.2 LCD display

When start switch of excavator is turned to the ON position, the monitor is energized by machine batteries and enters the initializing screen. As shown by the figure on the right, a fully displayed screen includes the following information:

(1) Working mode

(2) Coolant temperature gauge

(3) Fuel level gauge

(4) Failure code

(5) Total service hours

(6) Function icons

(7) Local time

(8) Local date

(9) GPS signal indication

(10) Engine speed level

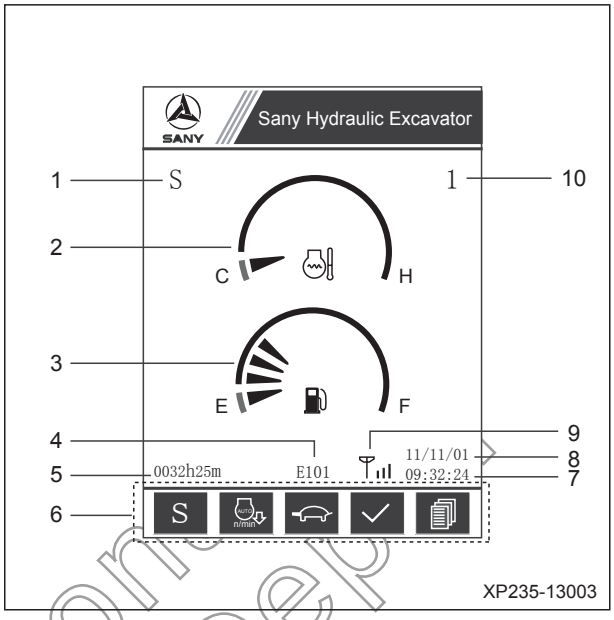


Fig. 4-209

Coolant temperature gauge

There are a total of 13 segments (yellow) for the full range from zero to 120 degrees.

A: When the engine is just started.

B: When temperature is between zero and 110 degrees.

C: When temperature is over 110 degrees, the last segment turns red and the alert indicator is on at the same time. When the temperature goes back to a level under 110 degrees, the alert indicator goes off automatically.

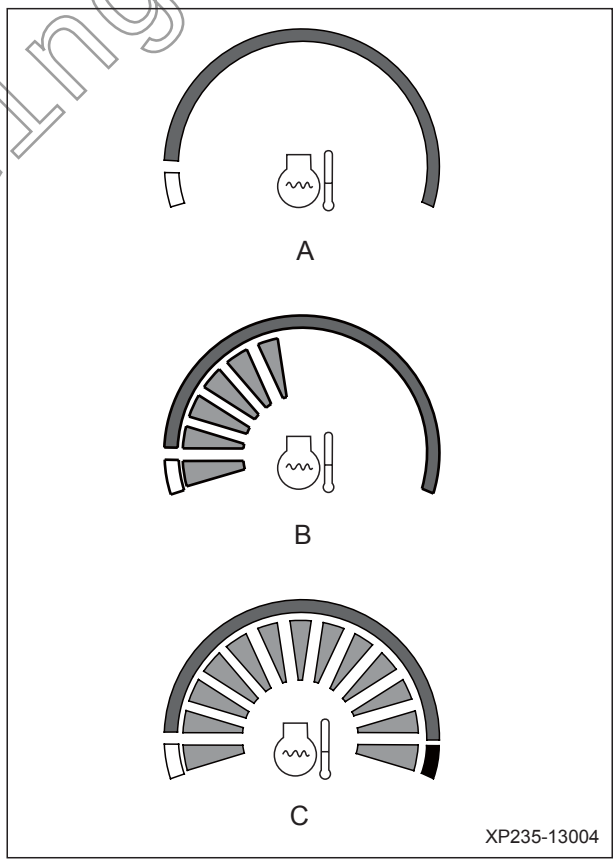


Fig. 4-210

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Fuel level gauge

There are 13 yellow segments indicating a range from 0 to 100%.

A: Fuel level is lower than 8%. There is no segment shown. Alert indicator is on at the same time.

B: Fuel level is over 8%. Alert indicator goes off.

C: Fuel level is 100%.

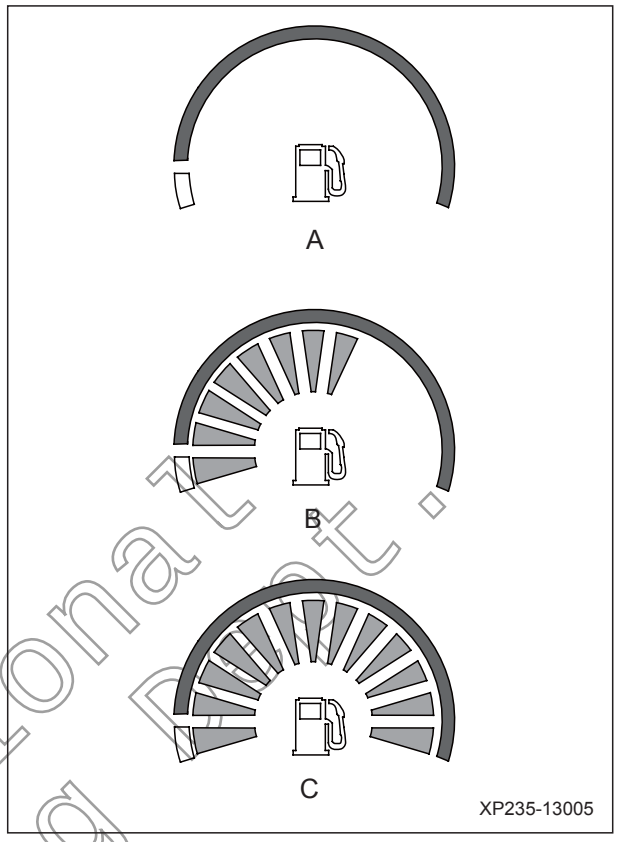


Fig. 4-211

4.11.2.2 Operation keys

The operation keys include function keys and navigation keys.

A: Function keys

B: Navigation keys

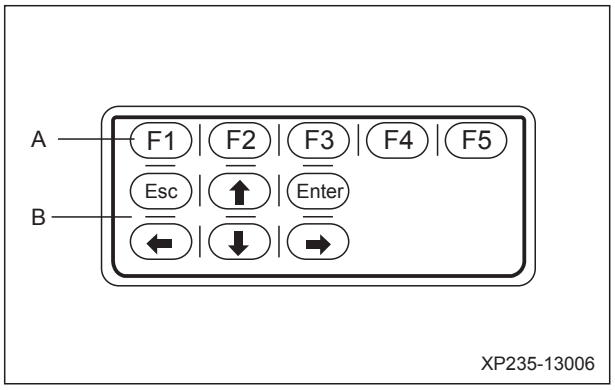


Fig. 4-212

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Function keys

There are five function keys, i.e. F1, F2, F3, F4 and F5. These keys are defined by the icons displayed above them.

- Function of the same key may vary as the icon above it changes.
- A key is disabled when no icon is displayed above it.

Common icons and corresponding keys are given in the following table.

Function keys	Icon displayed	Functions	Display range
F1	S	Change working mode.	H → S → L → B
F2		Shift to full speed/auto idling.	Full speed/auto idling
F3		Shift to high/low travel speed.	High/low speed
F4		Enter an option/setup item.	Same as the Enter key
F5		View system information.	——
		Back to previous page.	Same as the ESC key

Operation keys

Operation keys	Functions
Enter	Enter an option/setup item.
ESC	Back to previous page.
	UP (The highlight goes to the bottom item after the top one.) Increase the value of digit at the cursor.
	DOWN (The highlight goes to the top item after the bottom one.) Decrease the value of digit at the cursor.
	LEFT (The highlight goes to the right most item after the left most one.) Move the cursor leftward.
	RIGHT (The highlight goes to the left most item after the right most one.) Move the cursor rightward.

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4.11.3 Monitor display and operation

4.11.3.1 Default page

Default page is shown during normal operation of the excavator.

Operation

1. Working mode

   Press the key F1 to change working mode to H, S, L or B in a cycle manner.

   H mode - Heavy-duty operation

   S mode - Standard operation

   L mode - Light-duty operation

   B mode - Breaker operation

NOTE: S is the default mode after the machine is powered on.

2. Selecting auto idling

Press the key F2 to disable/enable auto idling function.

When the icon appears above the key F2 , press the key to disable auto idling; when the icon appears above the key F2 , press the key to enable auto idling.

NOTE: When the machine is powered on, auto idling is enabled as default.

- Auto idling is active as default. When all control levers are in neutral position for more than 0.2 seconds, engine speed will drop by 100 rpm immediately and then enter auto idling after another 3 seconds (controller will reduce engine speed to idling) in order to reduce fuel consumption and noise.
- In idling, if the controller detects any maneuver or gear change, engine speed will restore respective level.

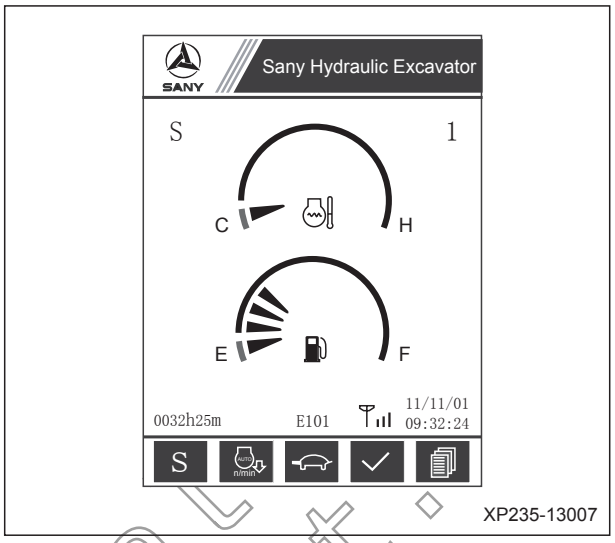


Fig. 4-213

3. Selecting high/low travel speed

Press the key F3 to switch between high and low travel speeds. When the symbol appears above the key F3 , press the key to select high speed travel; when the symbol appears above the key F3 , press the key to select low speed travel.

NOTE: When the machine is powered on, low speed is the default travel speed.

4. Viewing failure information

When alert indicator of the monitor is on, a failure code will appear on bottom line of monitor screen. Meanwhile, a red tick appears above the key F4 . Press the key to see failure information.

5. Viewing system information

Press the key F5 to see system information.

NOTE: To see system information requires password. Please contact your Sany distributor.

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4.11.3.2 Password entry to system information

Press F5 on the default page to enter the password entry to system information. You need to enter the correct password prior to access to System Information.

Key operation

- Press F1 or ⬆ or ⬇ to increase or decrease the number on the digit with the cursor.
- Press F2 or ⬅ or ➡ to move the cursor to the left or right digit.
- Press F3 to enter System Unlock.
- Press F4 to enter Backlight Adjustment.
- Press F5 or ESC to return to the default page.
- Press Enter to check the validity of password. If the password is valid, you have access to the Main Menu.

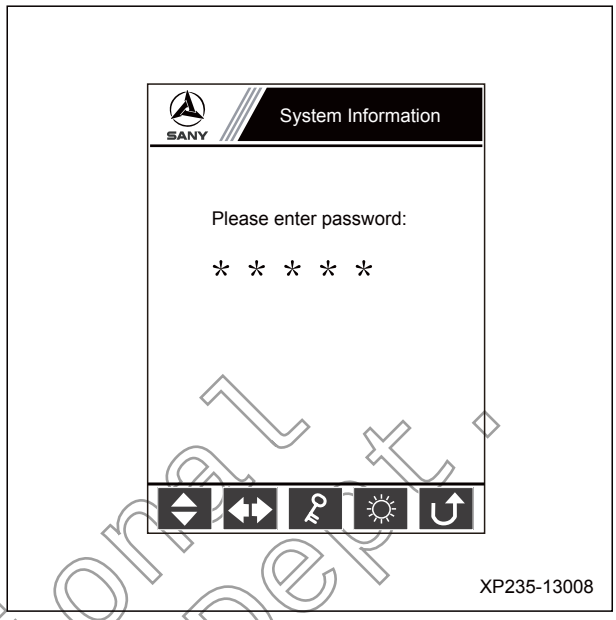


Fig. 4-214

4.11.3.3 Main menu

Key in the correct password and press Enter on the password entry to access System Information.

This page contains a list of system functions. You can pick up an item and enter respective page.

Key operation

- Press F1 or ⬆ or ⬇ to scroll up or down the menu. When you scroll down the menu, the highlight returns to the top item after the bottom one.
- Press F2 or Enter to enter highlighted item.
- Press F4 to go to System Setup.
- Press F5 or ESC to return to the default page.

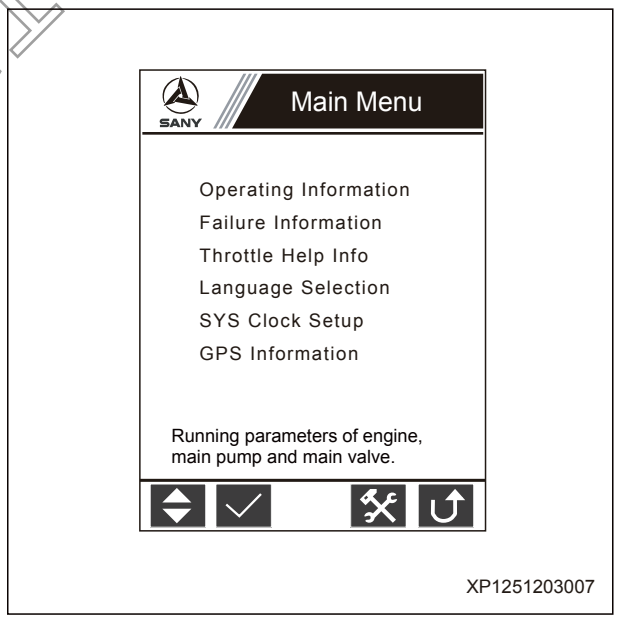


Fig. 4-215

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4.11.3.4 Engine & throttle signals

Select Running information on the Main Menu and press F2 or Enter to see Engine & Throttle Signals.

This page contains operating parameters of engine and throttle signals.

Key operation

- Press F1 to see Pilot Pressure Signals.
- Press F5 or ESC to return to the Main Menu.

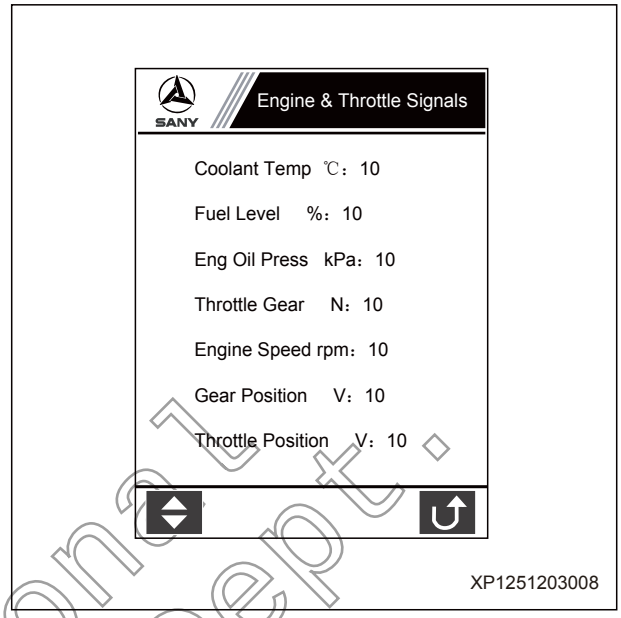


Fig. 4-216

4.11.3.5 Pilot pressure signals

Press F1 on the page of Engine & Throttle Signals to see Pilot Pressure Signals.

This page shows pilot pressure signals.

Key operation

- Press F1 to see Main Pump & Main Valve Signals.
- Press F5 or ESC to return to the Main Menu.

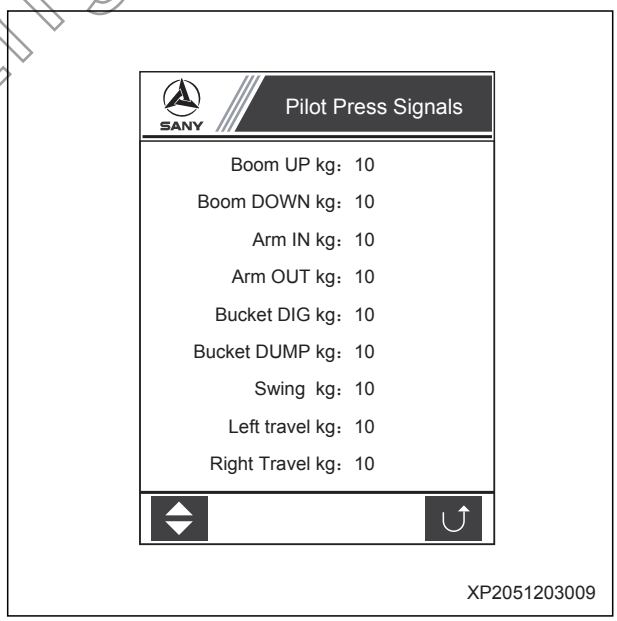


Fig. 4-217

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4.11.3.6 Main pump & main valve signals

Press F1 on the page of Pilot Pressure Signals to see Main Pump & Main Valve Signals.

This page shows main pump and main valve signals.

Key operation

- Press F1 to see Engine & Throttle Signals.
- Press F5 or ESC to return to the Main Menu.

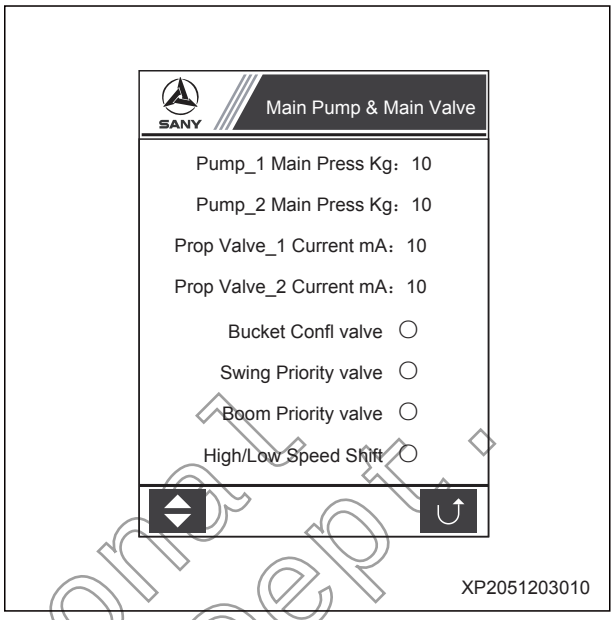


Fig. 4-218

4.11.3.7 Failure codes

Select Failure Codes on the Main Menu and press F2 or Enter to enter the page.

This page contains failure codes and failure information.

Key operation

- Press F1 to see next page of failure codes.
- Press F5 or ESC to return to the Main Menu.

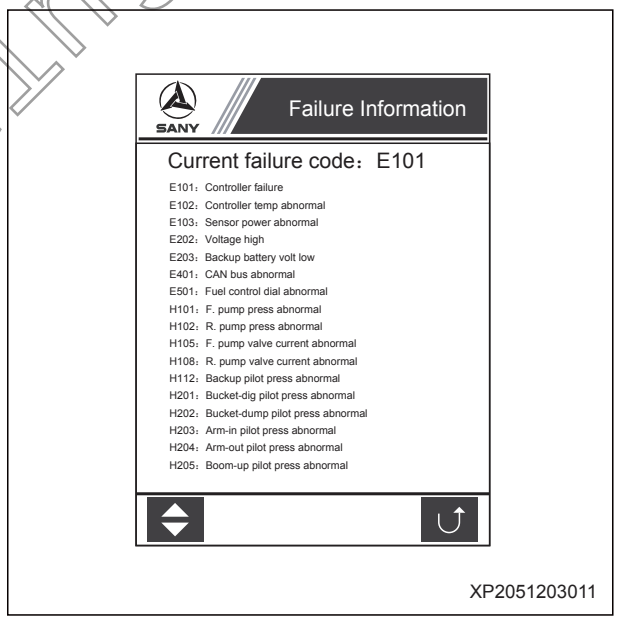


Fig. 4-219

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4.11.3.8 Throttle help information

Select Throttle Help Info on the Main Menu and press F2 or Enter to enter the page.

This page contains help information for throttle installation.

Key operation

- Press F2 to select auto idling or full speed.
- Press F3 to select high or low speed travel.
- When SYFCS controller is used, the icon rpm will appear in blue or red color.
- Press F5 or ESC to return to the Main Menu.

Note: Only a SYFCS controller allows the change of rpm between blue and red colors.

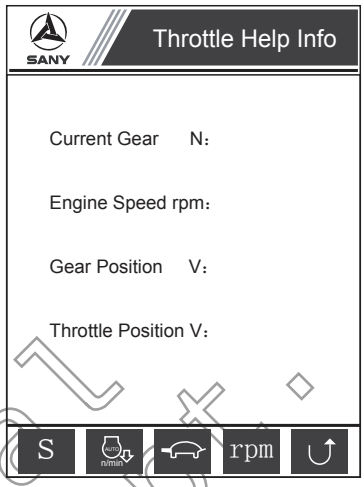


Fig. 4-220

4.11.3.9 Language selection

Select Language Selection on the Main Menu and press F2 or Enter to enter the page.

This page is used to select a language for the system.

Key operation

- Press F2 to select Chinese System (中文系统).
- Press F3 to select English System.
- Press F5 or ESC to return to the Main Menu.
- Press ⬆ or ⬇ to highlight a language up or down the list.



Fig. 4-221

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4.11.3.10 System clock setup

Select System Clock Calibration on the Main Menu and press F2 or Enter to enter the page.

This page is used to set up system clock.

Key operation

- Press ↑ or ↓ to increase or decrease the number on the digit with the cursor.
- Press ← or → to move the cursor to the left or right digit.
- Press F1 or Enter to finish calibration. You will be prompted by "Calibration finished! Please restart your machine."
- Press F5 or ESC to return to the default page.

NOTE: System clock can only be set up once after the machine is powered on. When the machine is powered on, the prompt of successful calibration remains on the screen if you press F1 or the Enter key.

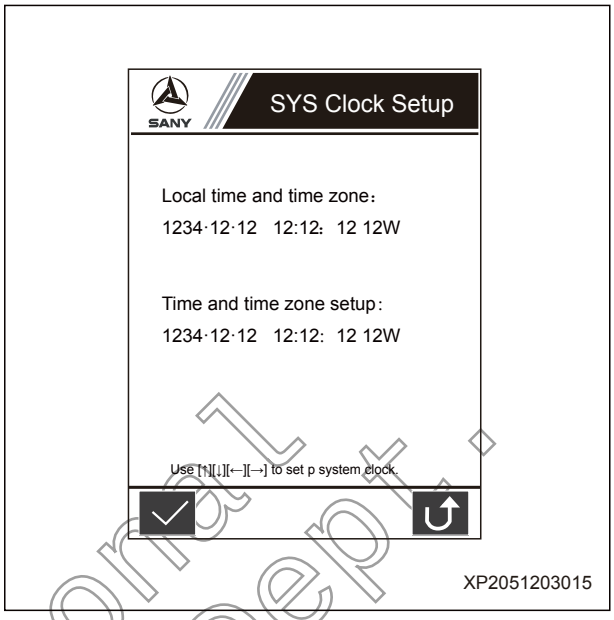


Fig. 4-222

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4.11.3.11 GPS information

Select GPS Information on the Main Menu and press F2 or Enter to enter the page.

This page shows GPS monitoring information.

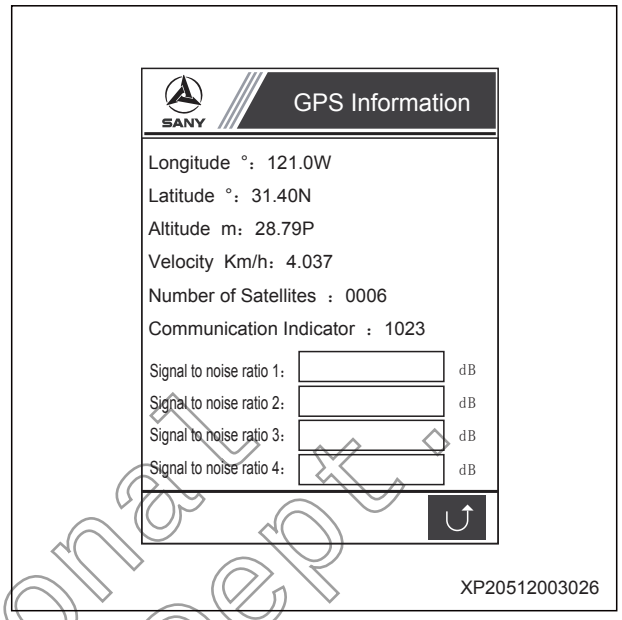


Fig. 4-223

Key operation

Press F5 or ESC to return to the default page.

Note:

1. The letter “E” stands for East Longitude and “W” for West Longitude.
2. The letter “N” stands for North Latitude and “S” for South Latitude.
3. The letter “P” stands for a height above the seal level and “N” for a height below the seal level.
4. The signal-to-noise ratio ranges from 0 to 99, which is indicated by a bar. The value on the right of the bar is real S/N ratio.
5. If the elevation value is not zero and no value is displayed for the longitude and latitude, GPS data are being received but the location has not been precisely defined yet.
6. When the communication signal is 1023, GPRS communication is regular. When it is 615, the GPRS communication is abnormal.
7. When the communication signal changes from 7 to 0, the SIM card or the antenna has a bad connection.
8. When the communication signal changes from 15 to 0, GPRS service is not available, the SIM card has insufficient fund, or GPRS network is abnormal.
9. When the communication signal changes from 31 to 0, the monitoring center is closed.
10. This page is required for remote system locking, remote system unlocking and remote downloading.

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4.11.3.12 System setup

Press the key F4 on the Main Menu to enter System Setup.

This page is used to configure your machine.

Note: Access to System Setup requires entering the password. For method of entering password see **"Password entry to system information" on page 4-202**.

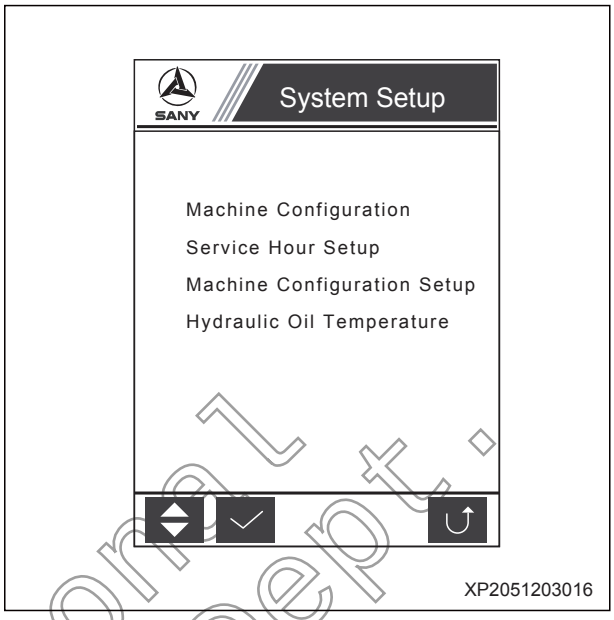


Fig. 4-224

Key operation

- Press F1 or or to scroll up or down the menu. When you scroll down the menu, the highlight returns to the top item after the bottom one.
- Press F2 or Enter to enter highlighted item.
- Press F5 or ESC to return to the Main Menu.

4.11.3.13 Machine configuration

Select Machine Configuration on the Main Menu and press F2 or Enter to enter the page.

This page shows machine configuration information.

Note: Access to System Setup requires entering the password. For method of entering password see **"Password entry to system information" on page 4-202**.

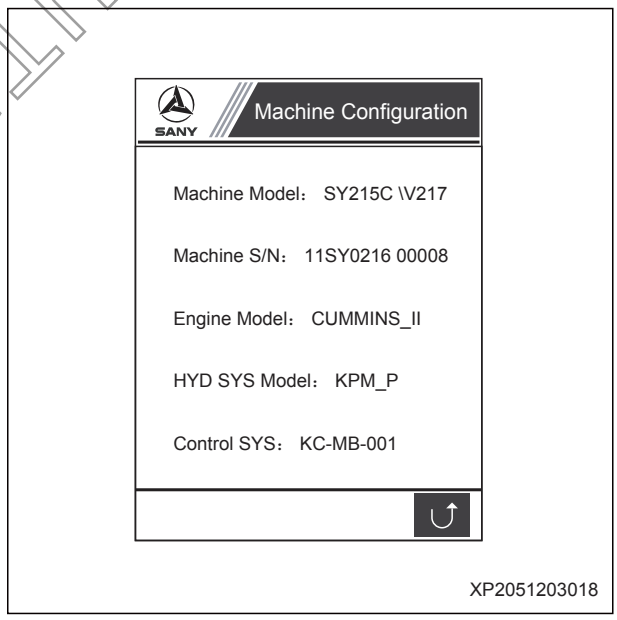


Fig. 4-225

Key operation

- Press F5 or ESC to return to System Setup.

Note: "V217" following machine model is software version.

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4.11.3.14 Service hour setup

Select Service Hour Setup on the page of System Setup and press F2 or Enter to enter the page.

This page is used to set up service hours of the machine.

Note: Access to System Setup requires entering the password. For method of entering password see **"Password entry to system information" on page 4-202**.

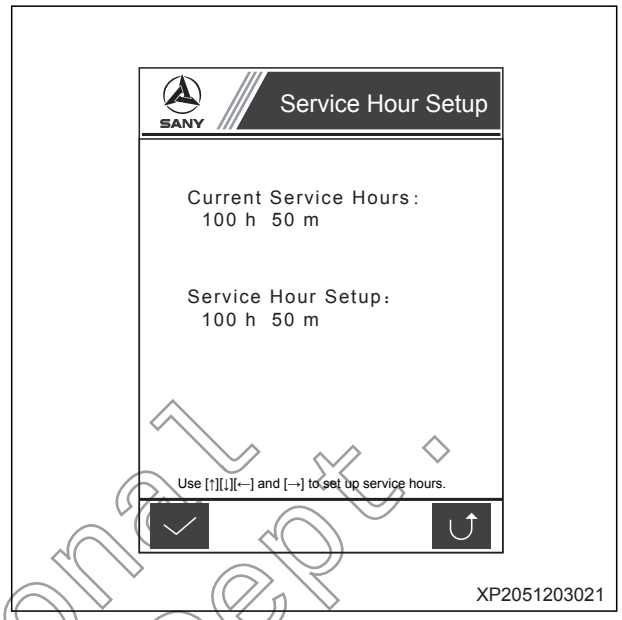


Fig. 4-226

Key operation

- Press F1 or Enter to save the change after calibration. You will see on the screen "Calibration finished! Please restart your machine."
- Press F5 or ESC to return to System Setup.

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4.11.3.15 Machine configuration setup

Select Machine Configuration Setup on the page of System Setup and press F2 or Enter to enter the page.

This page is used to set up machine configuration after monitor installation.

Note: Access to System Setup requires entering the password. For method of entering password see **"Password entry to system information" on page 4-202**.

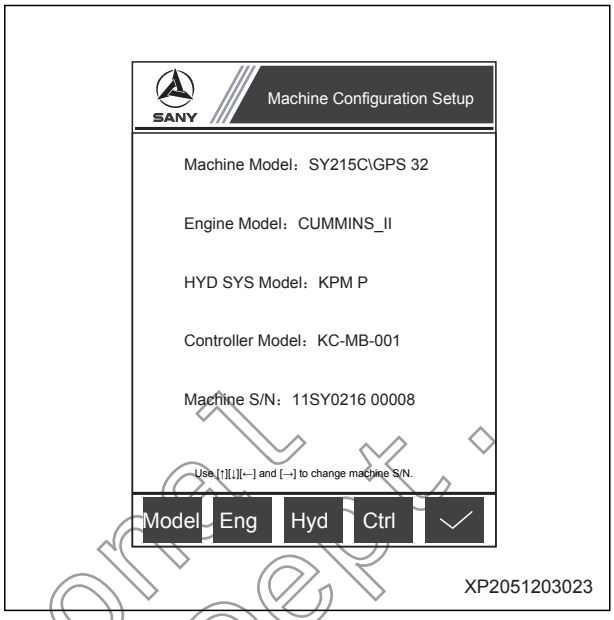


Fig. 4-227

Key operation

- When "215" after machine model is blinking, each pressing of F1 will bring the number up by 10; when "32" after GPS is blinking, each pressing of F1 will bring the number up by 10.
- Press F2 to change Engine Model.
- Press F3 to change Hydraulic System Model.
- Press F4 to change controller model.
- Press F5 to save the change. You will see on the screen "Calibration finished! Please restart your machine."
- Press ↑ or ↓ to increase or decrease the selected machine S/N by 100.
- Press ← or → to increase or decrease the selected machine S/N by 1. Depress the key to increase S/N quickly.
- Press ESC to return to System Setup.
- Each pressing of the key Enter enables the number after machine S/N or model to blink. A blinking number can be modified using the keys.

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4.11.3.16 Hydraulic oil temperature

Select Hydraulic Oil Temp on the page of System Setup and press F2 or Enter to enter the page.

This page shows temperature of hydraulic oil.

Key operation

- Press F5 or ESC to return to System Setup.

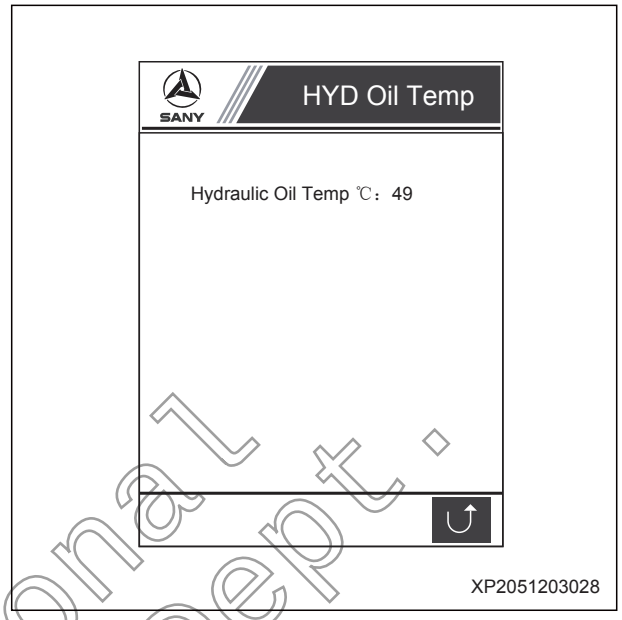


Fig. 4-228

4.11.3.17 Screen brightness setup

Press F4 on the page of password entry to system information to enter the page.

This page is used to adjust backlight brightness of the screen.

Key operation

- Press F1 to dim backlight.
- Press F2 to enhance backlight.
- Press F3 to safe brightness change.
- Press F5 to return to System Information.

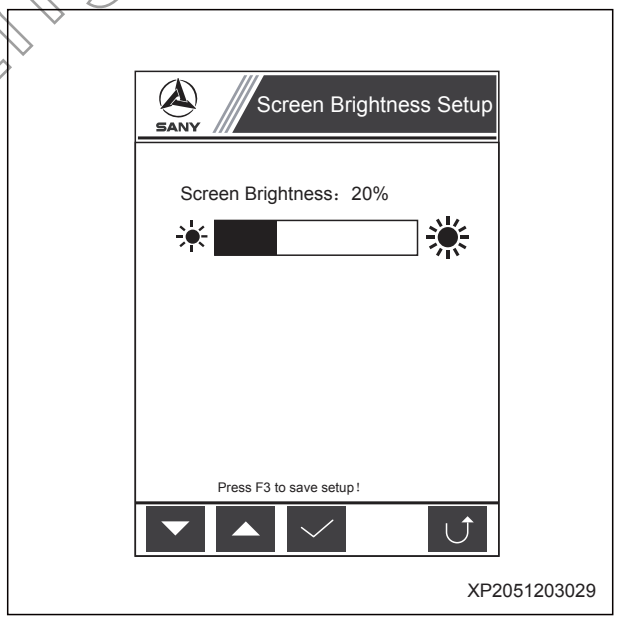


Fig. 4-229

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4.11.3.18 System lockout (level 1)

When this page appear on monitor, it indicates that the excavator is locked out in level 1.

Key operation

- Press F5 to enter the page for unlocking.

NOTE: After 5 seconds according to the command, corresponding state (Level 1 lockout, level 2 lockout or no lockout) will be displayed. (Waiting for 5 seconds performs a function of filtration.)

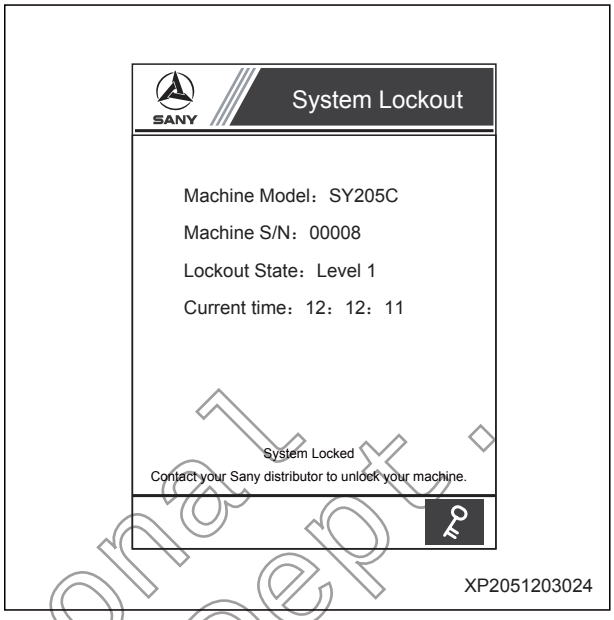


Fig. 4-230

4.11.3.19 System lockout (level 2)

When this page appear on monitor, it indicates that the excavator is locked out in level 2.

Key operation

- Press F5 to enter the page for unlocking.

NOTE: After 5 seconds according to the command, corresponding state (Level 1 lockout, level 2 lockout or no lockout) will be displayed. (Waiting for 5 seconds performs a function of filtration.)



Fig. 4-231

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Standard Values

5 Table of Standard Values

5.1 Standard Values for Engine-Related Parts 5-3
5.2 Standard Values for Chassis-Related Parts 5-4

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5 TABLE OF STANDARD VALUES

5.1 Standard Values for Engine-Related Parts

Applicable Models			SY365(B)H-9	
Engine			ISUZU AA-6HK1-XQP-01	
Item	Measurement condition	Unit	Standard values for new machine	Repair limits
Engine speed	High idling	rpm	2,250 ± 25	2,250 ± 25
	Low idling	rpm	1,050 ± 25	1,050 ± 25
	Rated speed	rpm	2,000	◇ 2,000
Intake pressure (Negative pressure)	Air cleaner outlet location Arm-in relief + max rpm	kPa {mmH_2O}	Min 133 {Min 1,000}	Min 133 {Min 1,000}
Exhaust color	At sudden acceleration	Bosch	Max 25	35
	At high idling	Index	—	—
Valve clearance	Intake valve	mm	0.4	0.3– 0.5
	Exhaust valve	mm	0.4	0.3 – 0.5
Compression pressure	Oil temp：75℃ Engine speed 250 rpm	Mpa {kg/cm^2}	Min 3.0 {31}	2.5 {26}
Blow-by pressure	Coolant temp：working range arm-in relief + max rpm	kPa {mmH_2O}	Max 0.98 {Max 100}	1.96 {200}
Engine oil pressure	High idling	MPa {kg/cm^2}	Min 0.29 {Min 3.0}	0.25 {2.5}
	Low idling	MPa {kg/cm^2}	Min 0.10 {Min 1.0}	0.07 {0.7}
Engine oil temp	Full speed range (in oil pan)	℃	80 – 110	120
Fan belt tension	Between fan belt pulley and alternator belt pulley Deflection when pressed with finger force of 58.8 N {6 kg}	mm	8.5	Min 7，Max 10
A/C compressor belt tension	Between fan belt pulley and compressor belt pulley Deflection when pressed with finger force of 58.8 N {6 kg}	mm	5 – 8	5 – 8

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5.2 Standard Values for Chassis-Related Parts

Applicable Models					SY365(B)H-9	
category	Item	Measurement Condition		Unit	Standard Value for New Machine	Permissible Value
Engine Speed	2 pumps at relief	• Engine coolant temperature: Within operational range • Hydraulic oil temperature: Within operational range • Engine running at high idle • Heavy-load operating mode (H) • Arm-in relief condition		rpm	2,050±50	2,050±50
	2 pumps at relief + boosting (if available)	• Engine coolant temperature: Within operational range • Hydraulic oil temperature: Within operational range • Engine running at high idle • Heavy-load operating mode (H) • Arm-in relief condition + boost switch on		rpm	2,050±50	2,050±50
	Speed when auto deceleration is operated	• Engine running at high idle • Auto idling switch on • All control levers neutral		rpm	1,350±50	1,400±100
Spool Stroke	Boom control valve	• Engine stopped • For measuring points see Control Valve on page 3-10.	Raise	mm	11.5±0.5	11.5±0.5
			Lower	mm	9.5±0.5	9.5±0.5
	Arm control valve		In	mm	11.5±0.5	11.5±0.5
			Out	mm	9.5±0.5	9.5±0.5
	Bucket control valve		Curl/dump	mm	9.5±0.5	9.5±0.5
	Swing control valve		Travel (L&R)	mm	9.5±0.5	9.5±0.5
	Travel control valve		Forward & Reverse	mm	9.5±0.5	9.5±0.5
Travel of Control Lever	Boom control lever	• Engine stopped • Control lever grip at center • Max. reading up to stroke end (except lever play in NEUTRAL position)		mm	85±10	85±10
	Arm control lever			mm	85±10	85±10
	Bucket control lever			mm	85±10	85±10
	Swing control lever			mm	85±10	85±10
	Travel control lever			mm	115±12	115±12
	Play of control lever	• Engine stopped • Slightly push the control lever with your hand. Stop pushing when you feel clear resistance • Max. reading up to stroke end	Work Equipment	mm	Max 15	Max 20
			Travel	mm	Max 20	Max 25

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Applicable Models				SY365(B)H-9	
Category	Item	Measurement Condition	Unit	Standard Value for New Machine	Permissible Value
Operating Force of Control Lever and Pedal	Boom control lever	• Hydraulic oil temp：Within operational range • Engine running at high idle • Control lever grip at center • Pedal at tip • Max reading at stroke end	N {kg}	Max 19.6 {Max 2.0}	Max 24.5 {Max 2.5}
	Arm control lever			Max 19.6 {Max 2.0}	Max 24.5 {Max 2.5}
	Bucket control lever			Max 15.6 {Max 1.6}	Max 21.6 {Max 2.2}
	Swing control lever			Max 15.6 {Max 1.6}	Max 21.6 {Max 2.2}
	Travel control lever			Max 30.4 {Max 3.1}	Max 39.2 {Max 4.0}
	Travel control pedal			Max 93.1 {Max 9.5}	Max 107.6 {Max 11}
Hydraulic Pressure	Unloaded pressure	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode：H • Hydraulic pump output pressure with all control levers in neutral position	MPa {kg/cm^2}	3.5 ± 1.0 {36 ± 10}	3.5 ± 1.0 {36 ± 10}
	Boom relief	• Hydraulic oil temp：Within operational range • Operate corresponding control lever after the engine runs at high idling speed. • Working mode：H • Hydraulic pump output pressure with all measurement circuits relieved		34.3 ± 1.0 {350 ± 10}	33.3 – 35.3 {340 – 360}
	Arm relief			34.8 ± 1.0 {355 ± 10}	33.3 – 36.8 {340 – 375}
	Bucket relief			34.8 ± 1.0 {355 ± 10}	33.3 – 36.8 {340 – 375}
	Swing relief	• Hydraulic oil temp：Within operational range • Operate corresponding control lever after the engine runs at high idling speed. • Working mode：H • Hydraulic pump output pressure with all measurement circuits relieved		25.5 ± 1.0 {261 ± 10}	24.5 — 27.5 {250 — 280}
	Travel relief			33.4 ± 1.0 {342±10}	32.4 – 34.4 {330 – 351}
	Control circuit source pressure	• Hydraulic oil temp：Within operational range • Engine running at high idle • Self pressure reducing valve output pressure with all control levers in NEUTRAL position		3.9±0.2 {40±2}	3.7 – 4.1 {37 – 41}

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Applicable Models					SY365(B)H-9	
Category	Item	Measurement Condition		Unit	Standard Value for New Machine	Permissible Value
Swing	Swing brake angle	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Swing circle misalignment amount when stopping after one turn • For measuring posture see Swing 1 on page 3-10.		degree mm	Max 100 (—)	Max 130 (—)
	Time taken to start swing	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required for passing points 90° and 180° from starting point • For measuring posture see Swing 1 on page 3-10.	90°	sec.	3.1 ± 0.3	Max 3.7
			180°	sec.	4.4 ± 0.4	Max 5.5
	Time taken to swing	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required for 5 turns after making initial one turn • For measuring posture see Swing 1 on page 3-10.		sec.	31^{+4}_{-2}	Max 35
	Hydraulic drift	• Hydraulic oil temp：Within operational range • Engine stopped • Keeping the upper structure transverse on a grade of 15°. For more information see Swing 2 on page 3-10. • Notching a mating mark on inner and outer races of the swing circle • Mating mark misalignment amount during 5 minutes.		mm	0	0
	Motor leakage	• Hydraulic oil temp：Within operational range • Engine running at high idle • Swing lockout switch: ON • Leakage amount for one minute during swing relief		ml/min	Max 5	Max 10
Travel	Travel speed (unloaded)	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required for track shoes to make 5 turns after making one initial turn • For more information on measuring posture see Travel 1 on page 3-11.	Lo	sec.	11.8± 3	8.8-14.8
			Hi		7.6 ± 3	4.6-10.6

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Applicable Models					SY365(B)H-9	
Category	Item	Measurement Condition		Unit	Standard Value for New Machine	Permissible Value
Travel	Travel speed (Actual run)	● Hydraulic oil temp：Within operational range ● Engine running at high idle ● Working mode: H ● Level ground ● Time required for traveling 10 m after 10 m trial run ● For measuring posture see Swing 2 on page 3-10.	Lo	sec.	22 ± 2.5	19.5-24.5
			Hi		14 ± 2.5	11.5-16.5
	Deviation	● Hydraulic oil temp：Within operational range ● Engine running at high idle ● Working mode: H ● Travel Speed: Low ● Hard level ground ● Amount of deviation (x) while traveling 20 m after initial 10 m trial run ● For measuring posture see Travel 2 and 3 on page 3-11.		mm	Max 800	Max 900
	Hydraulic drift	● Hydraulic oil temp：Within operational range ● Engine stopped ● Park the machine on a grade of 12° , with the sprocket in the downhill direction ● Measure the sliding distance for 5 minutes ● For measuring posture see Travel 4 on page 3-12.		mm	0	0
	Leakage amount of travel motor	● Hydraulic oil temp：Within operational range ● Engine running at high idle ● Traveling with the sprocket locked ● Oil leakage amount for one minute with traveling in relief condition		mm	13.6	27.2
Work Equipment	Hydraulic drift — Bucket tips	● Hydraulic oil temp: Within operational range ● Flat and level ground ● Bucket full of earth or with rated load (0.8m^3: 1,440 kg)		mm	Max 600	Max 900
	Hydraulic drift — Boom cylinder	● Boom horizontal, arm fully retracted and bucket cylinder fully extended ● Engine stopped ● Work equipment control lever in neutral position		mm	Max 20	Max 27
	Hydraulic drift — Arm cylinder	● Measure total amount of falling for 15 minutes by measuring the falling every 5 minutes immediately after initial setting ★ Bucket tip lower distance ★ Boom cylinder: Cylinder retracting distance ★ Arm cylinder: cylinder extending distance ★ Bucket cylinder: cylinder retracting distance ● For measuring posture see Work Equipment 1 on page 3-12.		mm	Max 20	Max 20
	Hydraulic drift — Bucket cylinder			mm	Max 35	Max 40

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Applicable Models						SY365(B)H-9	
Category	Item		Measurement Condition		Unit	Standard Value for New Machine	Permissible Value
Work Equipment	Work Equipment Speed	Boom	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required for the bucket to raise from the ground to its stroke end • For measuring posture see Work Equipment 2 on page 3-12.	UP	sec.	3.8 ± 0.3	Max 4.8
		Arm	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required from dumping stroke end to digging stroke end • For measuring posture see Work Equipment 3 on page 3-13.	IN	sec.	3.5 ± 0.3	Max 4.5
				OUT	sec.	3.0± 0.3	Max 3.5
		Bucket	• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Time required from dumping stroke end to digging stroke end • For measuring posture see Work Equipment 4 on page 3-13.	DIG	sec.	3.1 ± 0.3	Max 3.4
				DUMP	sec.	2.0 ± 0.3	Max 2.3

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Applicable Models					SY365(B)H-9	
Category	Item		Measurement Condition	Unit	Standard Value for New Machine	Judgement Criteria
Work Equipment	Time Delay	Boom	• Hydraulic oil temp：Within operational range • Engine running at low idle • Working mode: H • Time required from maneuvering the joystick to the moment that the bucket reaches the ground and begins to push the machine upward, within 50 mm off the ground • For measuring posture see Work Equipment 5 on page 3-13.	sec.	Max 1.0	Max 1.2
		Arm	• Hydraulic oil temp：Within operational range • Engine running at low idle • Working mode: H • Average time required for operating the control lever back and forth till the arm starts to move • For measuring posture see Work Equipment 6 on page 3-14.	sec.	Max 2.0	Max 2.8
		Bucket	• Hydraulic oil temp：Within operational range • Engine running at low idle • Working mode: H • Average time required for operating the control lever back and forth till the arm starts to move • For measuring posture see Work Equipment 7 on page 3-14.	sec.	Max 1.0	Max 3.6
	Internal Leakage	Cylinders	• Hydraulic oil temp：Within operational range • Engine running at high idle • Leakage amount for one (1) minute with cylinder or travel measured at relief condition	ml/min	5	20
		Central Swivel Joint			10	50
Performance in Combined Operations	Amount of deviation in simultaneous operation of work equipment and travel		• Hydraulic oil temp：Within operational range • Engine running at high idle • Working mode: H • Travel Speed: Low • Amount of deviation measured for 20 m after traveling about 10 m on a hard level ground • For measuring posture see Travel 2 and 3 on page 3-11.	mm	Max 200	Max 220

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Machine attitudes applicable to performance test and testing procedure of all machine models

Control valve: Spool stroke

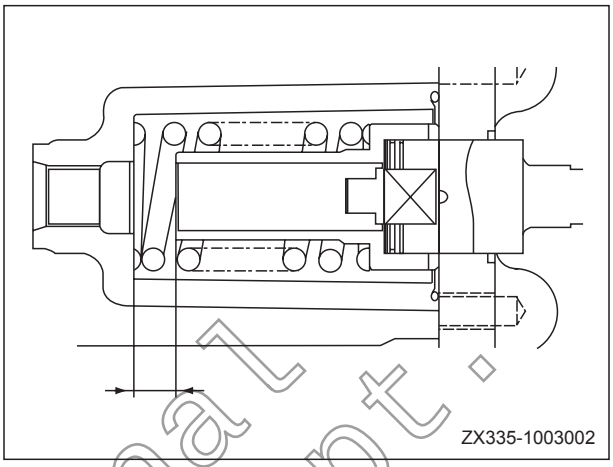


Fig. 5-1

Swing 1: Swing brake angle, time taken to start swing and time taken to swing

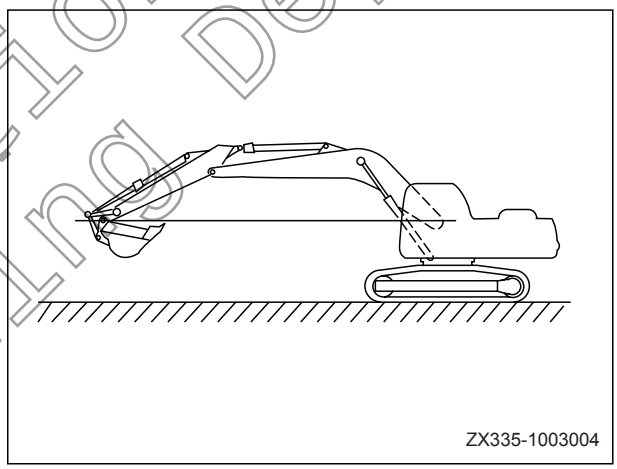


Fig. 5-2

Swing 2: Hydraulic drift of swing

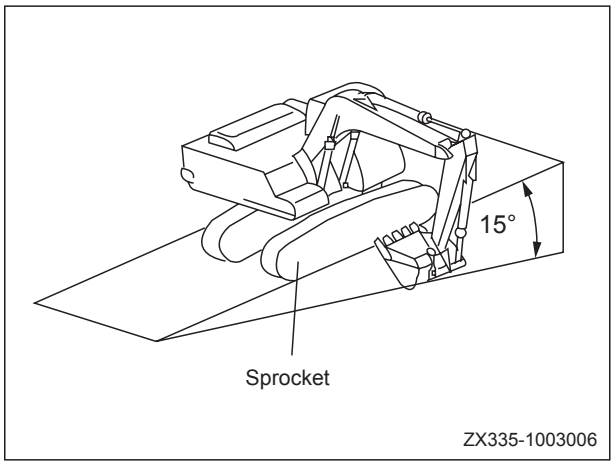


Fig. 5-3

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Travel 1: Travel speed (without load)

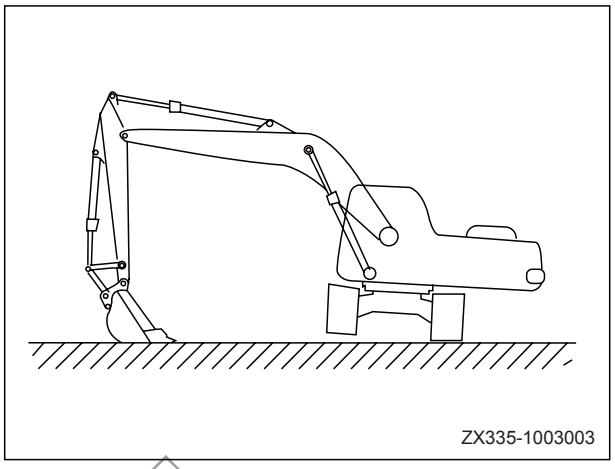


Fig. 5-4

Travel 2: Travel speed (actual run), Travel deviation

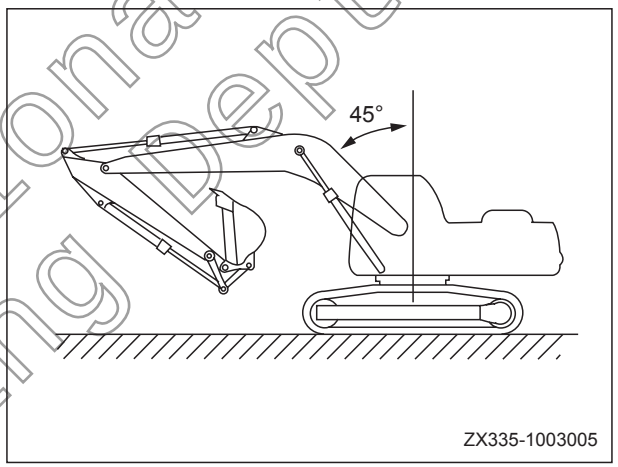


Fig. 5-5

Travel 3: Travel deviation

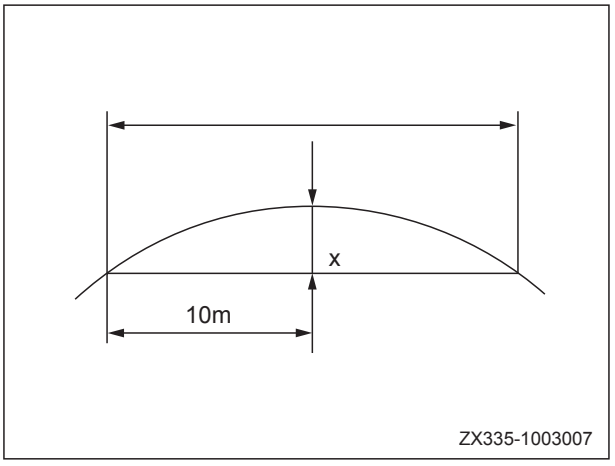


Fig. 5-6

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Travel 4: Hydraulic drift of travel

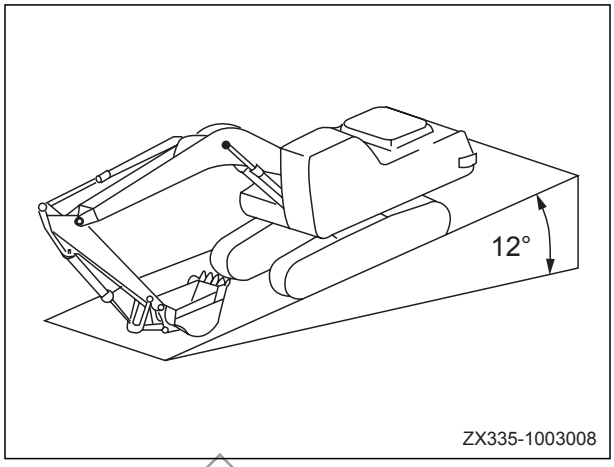


Fig. 5-7

Work equipment 1: Hydraulic drift of work equipment

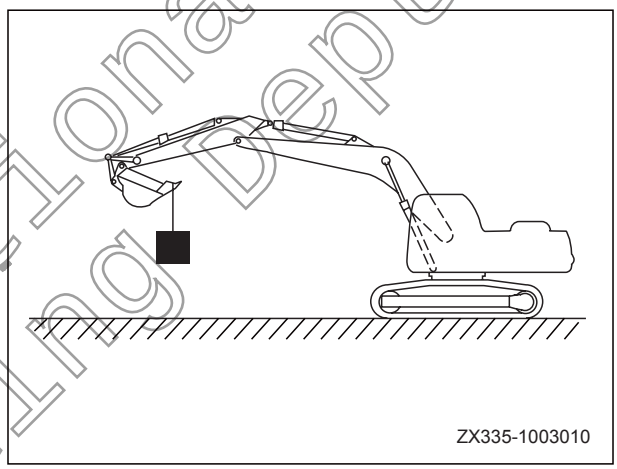


Fig. 5-8

Work equipment 2: Boom speed

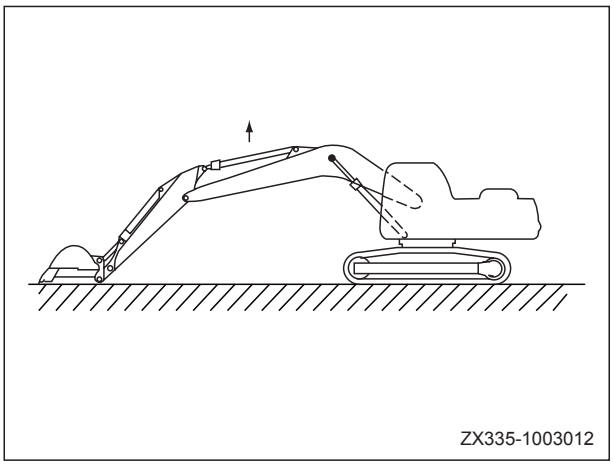


Fig. 5-9

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Work equipment 3: Arm speed

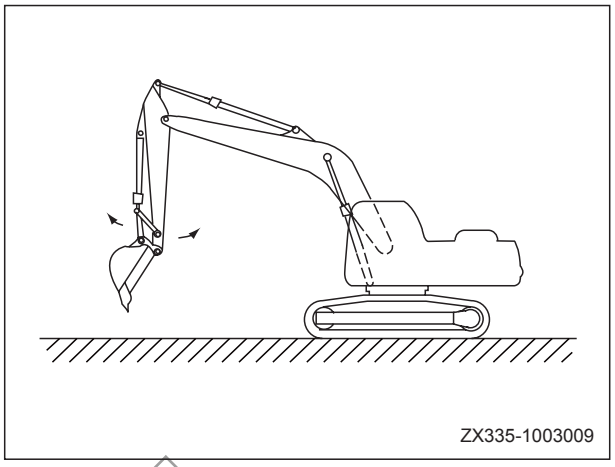


Fig. 5-10

Work equipment 4: Bucket speed

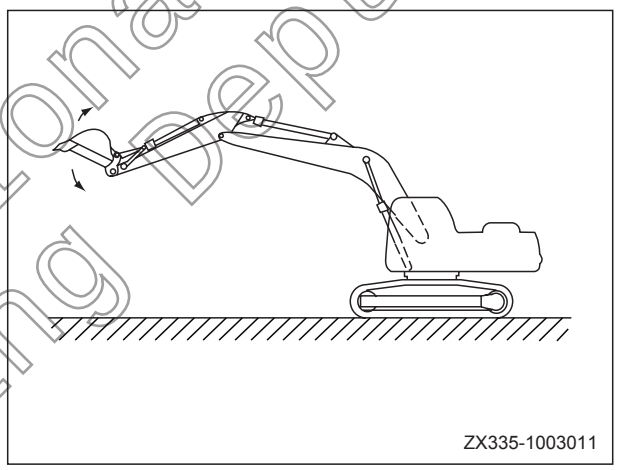


Fig. 5-11

Work equipment 5: Boom delay

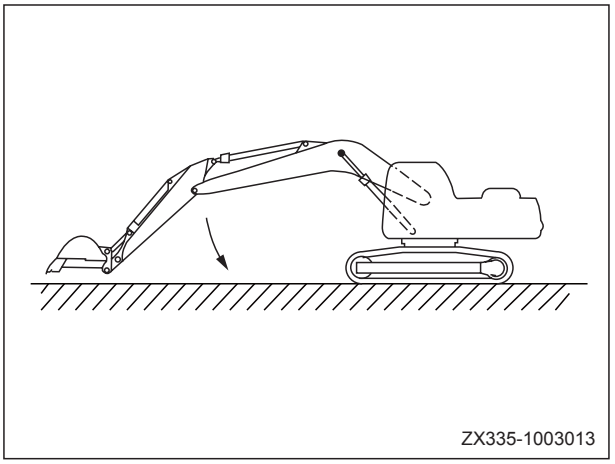


Fig. 5-12

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Work equipment 6: Arm delay

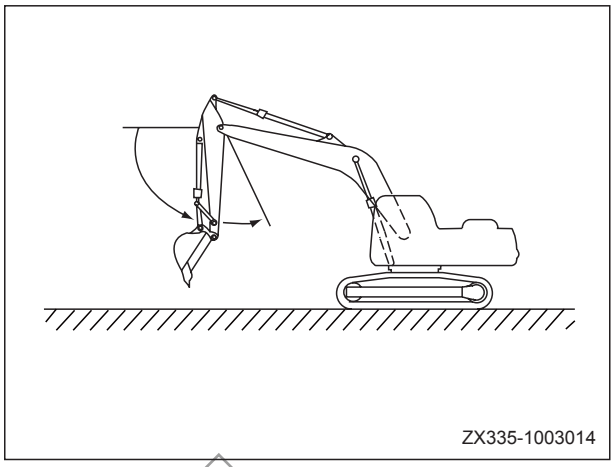


Fig. 5-13

Work equipment 7: Bucket delay

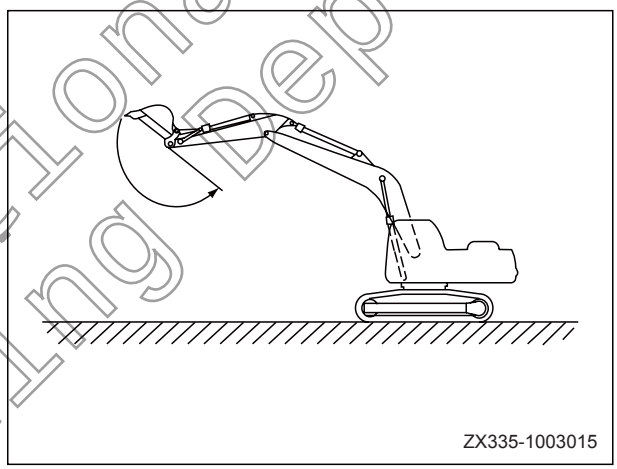


Fig. 5-14

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Testing and Adjusting

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6 Testing and adjusting

6.1 Engine Speed - Test and Adjust 6-3
6.2 Exhaust Gas Color - Test 6-5
6.3 Valve Clearance - Adjust 6-7
6.3.1 Testing 6-8
6.3.2 Adjusting 6-9
6.4 Compression force - Test 6-10
6.5 Fuel Injection Timing - Test and Adjust 6-13
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6 TESTING AND ADJUSTING

6.1 Engine Speed - Test and Adjust

Testing

Start the engine and keep the engine running until coolant temperature enters operational range. Key in the password on the monitor and check if the engine speed is normal in each gear position.

Testing Items:

1. Engine speed at low idle
2. Engine speed at fuel control dial position 11 (H and S modes)
3. Engine speed at relief, with fuel control dial in position 11 (H and S modes)
4. Engine speed at auto deceleration

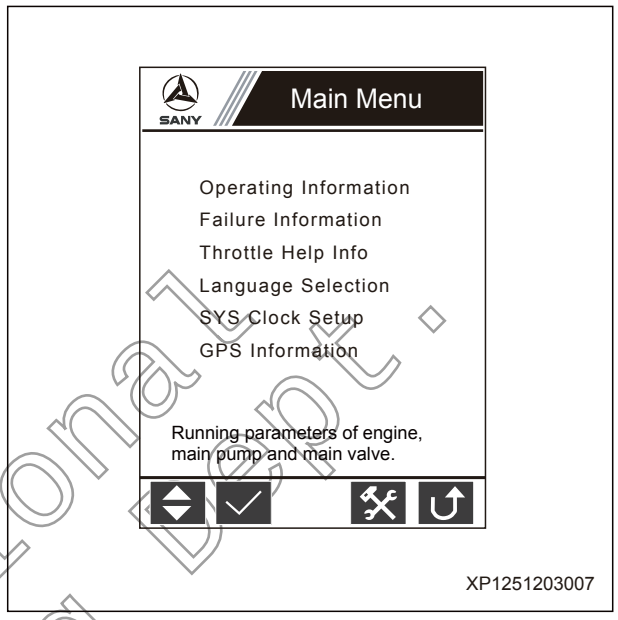


Fig. 6-1

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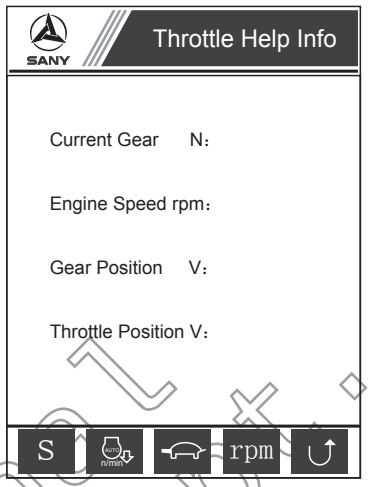
Calibration

1. Preconditions for auto speed calibration:
   A. Start the engine.
   B. Check the throttle position voltage for gear position 1 on the Throttle Help Info page on the monitor. Normal voltage should be 1.3±0.3V under normal speed range of 1050±50. If the voltage is out of the specified range, manually adjust the throttle pull rod. Otherwise abnormality would occur in speed calibration and a red question mark "?" would appear after Engine Speed on the Throttle Help Info page on the monitor.
2. Enter the speed calibration page.

   Press F5 on the default page of monitor and key in the password to access the Main Menu. Choose Throttle Help Info on the Main Menu to enter the page like the figure on the right.
3. Speed calibration

   Press F4 on the Throttle Help Info page to execute speed calibration. The system enters speed calibration (when the icon turns red) and it automatically shifts to full speed (when the icon turns red).
4. Successful calibration

   If the calibration is done successfully, the icon for calibration indication turns blue. The switching to full deceleration requires pressing F2 to switch it manually.



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Fig. 6-2

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6.2 Exhaust Gas Color - Test

- Tools used for testing exhaust gas color

No.	Part Name
1	Smoke meter
2	Opacimeter

⚠ CAUTION

- **Be careful not to touch any hot part when installing or removing a testing equipment.**

1. Testing with smoke meter
   A. Put the filter paper in the smoke meter.
   B. Insert the waste gas intake pipe into the exhaust pipe.
   C. Start the engine and keep the engine running until engine coolant temperature is within the operational range.
   D. When engine speed increases suddenly or is kept at high idle, direct exhaust gas through smoke meter to the filter paper.
   E. Remove the filter paper from the smoke meter. Read the smoke value through the apparatus provided.
   F. Remove the testing tools after testing. Make sure the machine goes back to its normal state.

2. Testing with opacimeter
   A. Mount the opacimeter onto the exhaust pipe by clamping it to the pipe outlet.

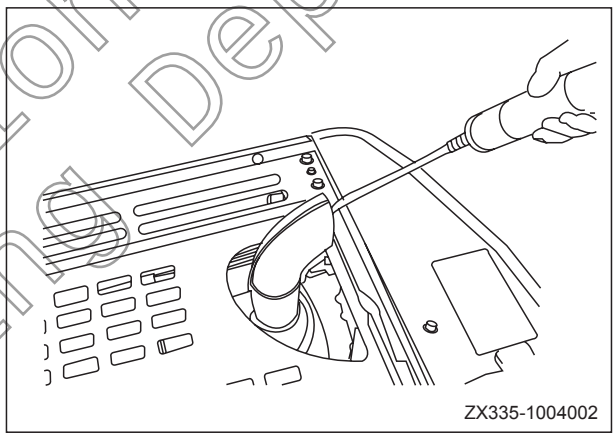


Fig. 6-3

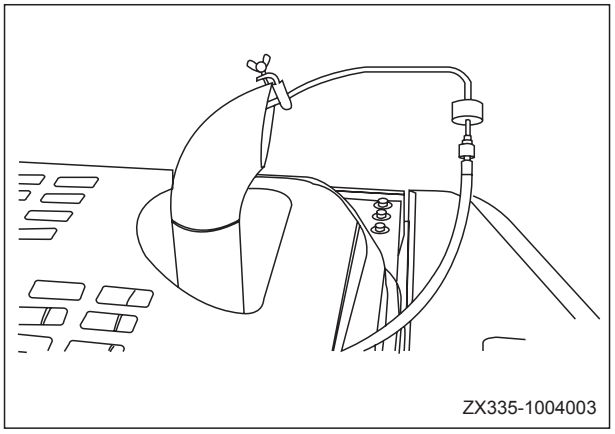


Fig. 6-4

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B. Open the opacimeter and preheat it for about 15 minutes.

C. Start the engine and keep the engine running until engine coolant temperature is within the operational range.

D. When engine speed increases suddenly or is kept at high idle, use the opacimeter to read the smoke value of exhaust gas.

E. Remove the testing tools after testing. Make sure the machine goes back to its normal state.

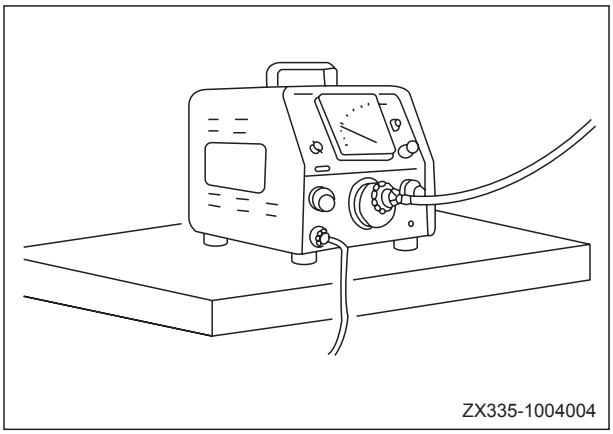


Fig. 6-5

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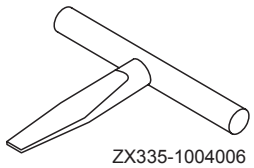
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6.3 Valve Clearance - Adjust

- **Service Standard (Unit: mm)**

Location	Service Item	Standard Value	Limits	Correction method
—	Valve clearance (with engine cold)	0.4	—	Adjust

- **Special tools**

Symbol	Tool name and shape	Part Number	Application
a	Flat-head screwdriver  ZX335-1004006	MH060008	Adjustment of valve clearance (carried on machine)

Check and adjust the valve clearance in cold state as per the following procedure:

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6.3.1 Testing

In cold state, valve clearance is to be checked and adjusted as per the following procedure:

1. Remove the rocker arm cover.
2. Turn the No.1 piston or the No.6 piston to the top dead center (TDC) of compression stroke by following the steps below.
   - Turn the engine until the TDC line on the crankshaft pulley is in line with the timing pointer.
   - Turn the No.1 piston or the No.6 piston to the TDC of compression stroke.

Note: When the rocker arm at the intake side and rocker arm at the exhaust side cannot be turned by hands, it is indicated that the piston has reached the TDC of compression stroke. Turning the engine by one more turn, the TDC of compression stroke of No.1 piston and No.6 piston swaps.

3. When the No.1 piston is at the TDC, adjust the valve clearance in a sequence marked with a black dot (●).

Cylinder	1	2	3	4	5	6
Exhaust	●	○	●	○	●	○
Intake	●	●	○	●	○	○

   A. When a feeler gauge is used for such measurement, resistance to a moving feeler gauge in the clearance should be felt.

   B. If the feeler gauge moves easily in the clearance, it is impossible to obtain accurate result.

4. If the measured value is out of specification, readjustment shall be performed according to the following method.

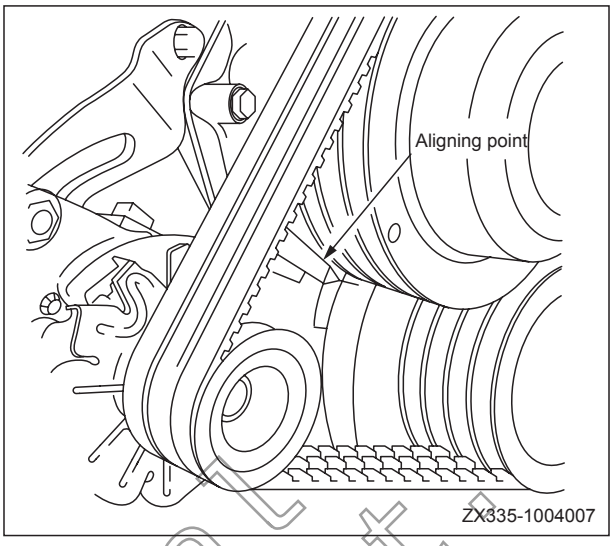


Fig. 6-6

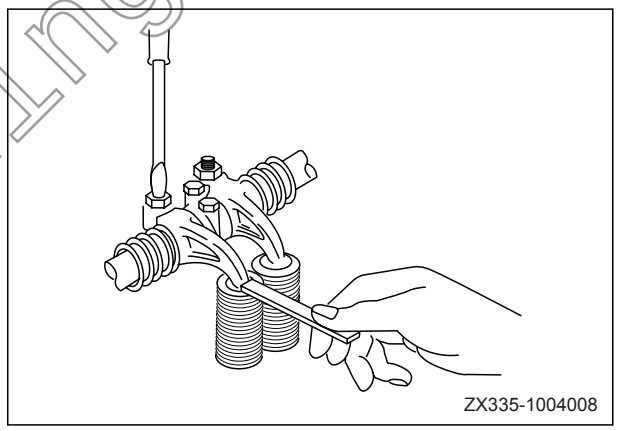


Fig. 6-7

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6.3.2 Adjusting

1. In adjustment of valve clearance, loosen the locknut before adjusting the adjusting screw. A standard clearance is achieved when slight resistance to the feeler gauge is felt when pulling it out from the clearance.
2. After adjustment, hold the adjusting screw with a screwdriver to prevent it from turning, and tighten the locknut.

   Locknut: 21-30 N.m{2.1- 3.1 kgf.m}

3. Go on with the next step until all valve clearances marked with a black dot (●) have been adjusted
4. Recheck the clearances with the feeler gauge. Readjustment should be made if deviation from the standard valve is found.
5. When the engine is carried in vehicle, using Ca to turn the adjusting screw will make the job easy.

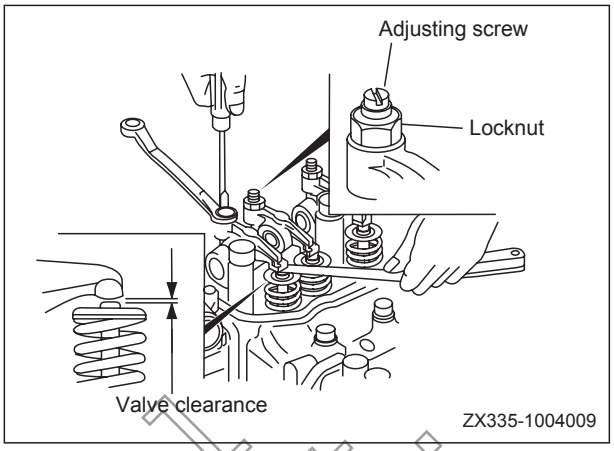


Fig. 6-8

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6.4 Compression force - Test

- **Service standard**

Location	Service Item		Standard value	Limits	Correction method
—	Compression force	Every cylinder (200 rpm/h)	3.0MPa {30.6kgf/cm^2}	2.5MPa {25.5kgf/cm^2}	Check
		Inter-cylinder pressure difference	—	390 kPa { ≤ 4kgf/cm^2 }	Check

- **Special tool**

Symbol	Tool name and shape	Part number	Application
Ca	Pressure gauge connector	5-85317-001-0 (JKM-1015)	Checking the compression force

1. Reduction of compression force can be an indication for engine overhaul.
2. Check the compression force regularly and pay attention to its variation from time to time. Understanding the variation of compression force is helpful for trouble-shooting. In addition, in a new vehicle or when new parts are installed for replacement, the pressure may be higher due to running-in of the piston ring, valve seat, etc. The pressure will become normal as the parts wear.
3. Before testing, make sure that the engine oil, start motor and battery are in normal condition.
4. The vehicle is to meet the following conditions.
   A. Preheat the engine until engine coolant temperature reaches 75~85℃ .
   B. Switch off all lamps and auxiliary devices.
   C. Place the gear lever in a neutral position.

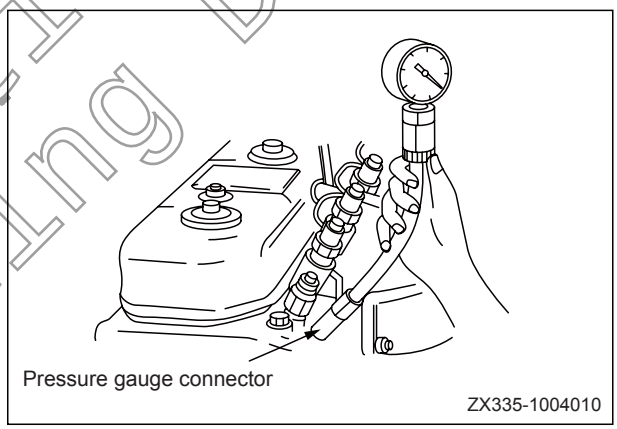


Fig. 6-9

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5. Remove the entire fuel injector.
6. Cover the fuel injector mounting opening with a rag.
7. Activate the start motor in order to run the engine. Check the cloth if it is stuck with foreign substances.
8. According to the substances (engine oil and/or coolant) adhering to the cloth, the following factors might be involved.
   A. When engine oil is found, it might be improper sealing caused by piston ring. Check the piston ring.
   B. When engine oil and coolant are found, it might be cracking of cylinder. Replace the crankcase.
9. Mount the gasket and Ⓐ to the fuel injector mounting hole and fix them with the injector cap. Install the compression force gauge.
10. Start the engine and measure the compression force of each cylinder. Calculate the differential pressure between the cylinders.
11. When the compression force and the differential pressure between cylinders deviate from their limits, inject a small amount of engine oil through the fuel injector mounting hole, and measure the compression force again.
    - If the compression force is higher, it is probably due to worn or damaged piston ring or cylinder inner surface.
    - If the compression force is still low, it is probably due to stuck valve or improper seating, or improperly mounted gasket of cylinder head.

⚠ WARNING

- **When coolant and/or engine oil is found attached to the rag, running the engine may cause the hot coolant and engine oil to squirt out through the mounting hole of the fuel injector. This is very dangerous. Never touch or look into the fuel injector mounting hole when the engine is running.**

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6.5 Fuel Injection Timing - Test and Adjust

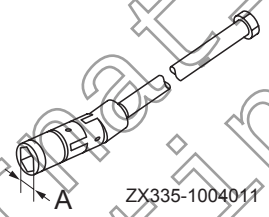
- **Service standard**

Location	Service Item	Standard value	Limits	Correction method
—	Fuel injection timing (BTDC)	8 degrees	7~9 degrees	Adjust

- **Tightening torque (Unit: N·m)**

Symbol	Part tightened	Tightening torque	Remark
—	Body, fuel delivery valve	39~44	—
—	Nut, injection tube	28~32	—

- **Common tool (Unit: N·m)**

Symbol	Tool name and shape	Part number	Application
Ca	Universal connecting rod with extension A: 14  ZX335-1004011	MH061099	Inspection and adjustment of fuel injection timing

NOTICE

- **Take care not let dust or foreign materials get into the fuel injection pump when adjusting the injection timing.**

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6.5.1 Testing

1. Align the TDC mark on the crankshaft pulley with the pointer. Remove the cap of the inspection hole on the timing gear cover in front of the fuel injection pump.

   Check if the pointer on the nut-fixing plate on the gear of fuel injection pump is aligned with the outstanding mark on the gear chamber of fuel injection pump.

   In case of misalignment, turn the crankshaft pulley one more turn and repeat the above steps in order to obtain proper alignment.

   Check if the marking lines are aligned with each other.

   (The marking lines have been aligned properly when assembling the body of fuel injection pump and fixing the flange at factory)

   Now, test the angle of crankshaft at the beginning of fuel injection.

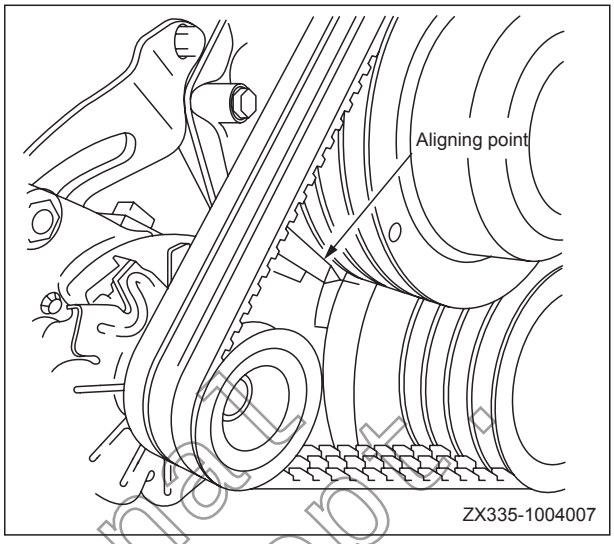


Fig. 6-10

2. Turn the crankshaft pulley counterclockwise approximate 30 degrees.

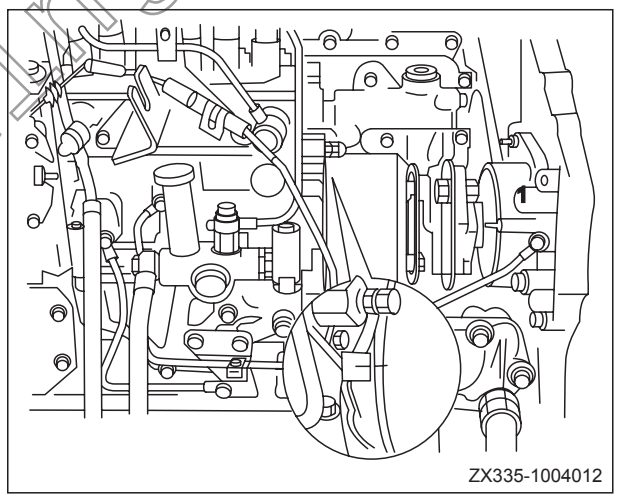


Fig. 6-11

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3. Remove the injection tube from No.1 plunger. This allows you to observe the fuel when it begins to flow out from No.1 plunger.

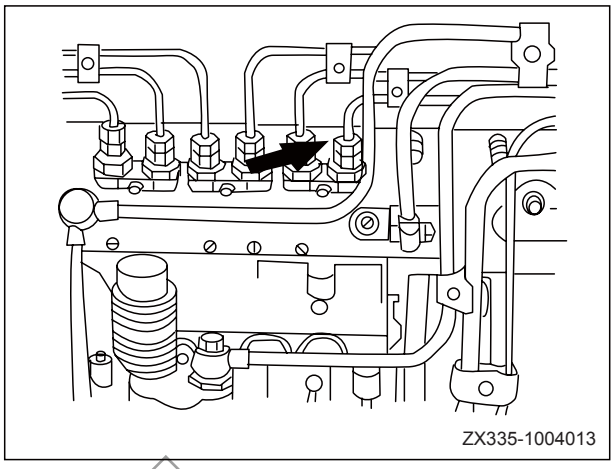


Fig. 6-12

4. Remove from No.1 plunger the valve body ① , seat ② , spring ③ and spool ④ .
5. Reassemble the valve body ① and tighten it to the specific torque. Do no reassemble the spring, seat and spool now. Leave them for later reassembly.

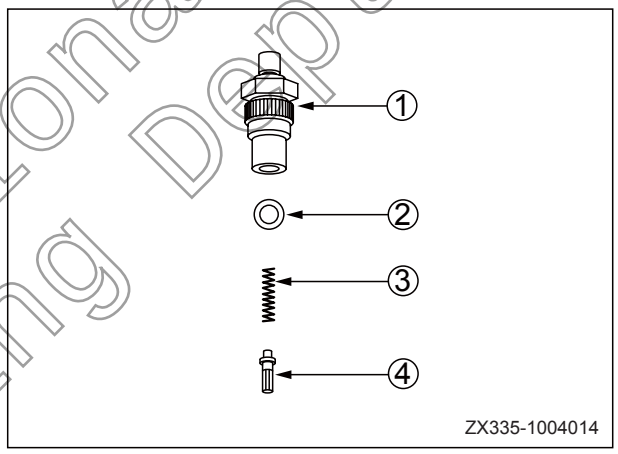


Fig. 6-13

6. Secure the fuel control lever in the fully open position.

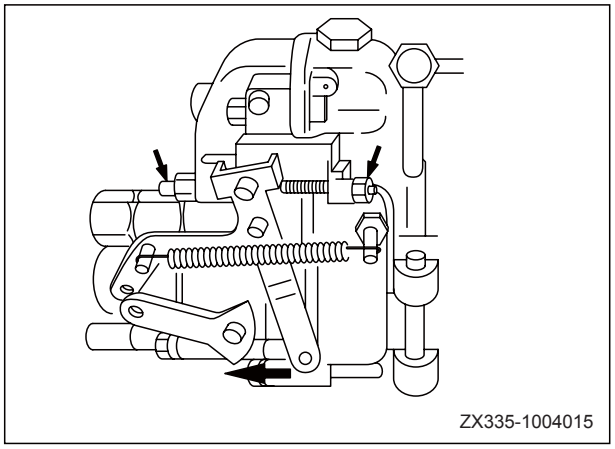


Fig. 6-14

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7. Slowly turn the crankshaft pulley clockwise while operating the hand pump to feed the fuel constantly.

   Stop operating the pump immediately when no fuel is seen coming out of No.1 fuel delivery valve.

   The crankshaft angle is now the engine’s fuel injection beginning angle.

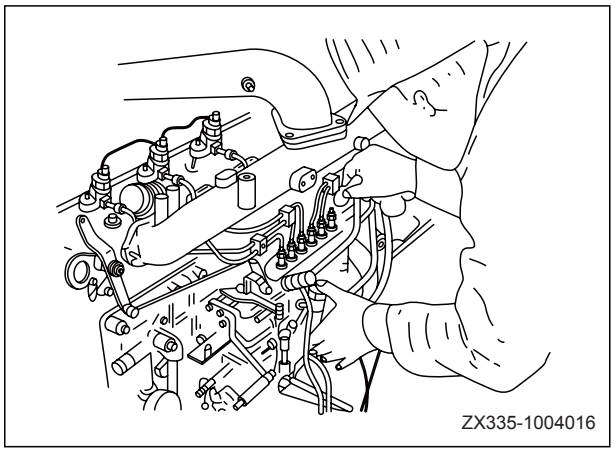


Fig. 6-15

8. Observe and make sure that the mark (of fuel injection beginning angle) on crankshaft pulley is in line with the timing pointer.

   The timing mark is the engine’s fuel injection beginning angle. Discharge the remaining fuel from the body of delivery valve. Make sure that no fuel is delivered from the delivery pump.

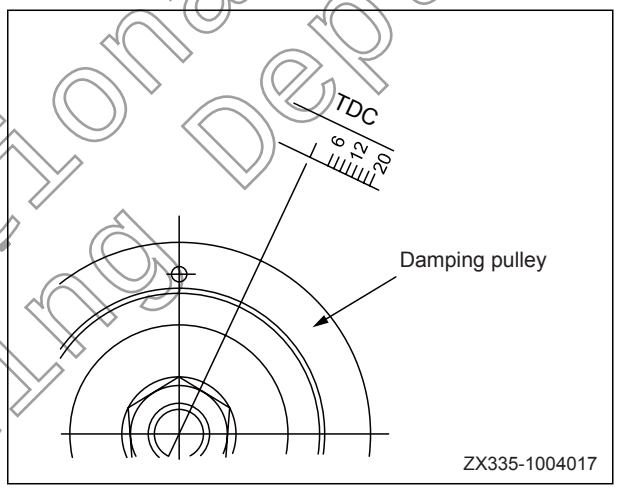


Fig. 6-16

Note: Engines of the same type may have a fuel injection pump that is different in injection timing. To obtain an engine of required specification, please contact machine supplier or local ISUZU engine service station. These specifications are provided by ISUZU or engine manufacturer.

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9. Remove the body of fuel delivery valve from No.1 plunger.
10. Install the internal parts (valve seat, spring and spool) on the body.
11. Reassemble the fuel delivery valve AS on No.1 plunger and tighten it to the specific torque.
12. Install the injection tube to No.1 cylinder and tighten it to the specific torque.

NOTICE

- **Do not tighten the fuel injection pump body more than specified. The pump body is aluminum and it can be deformed by over-tightening, resulting in unfavorable impact on the operation of control rack.**

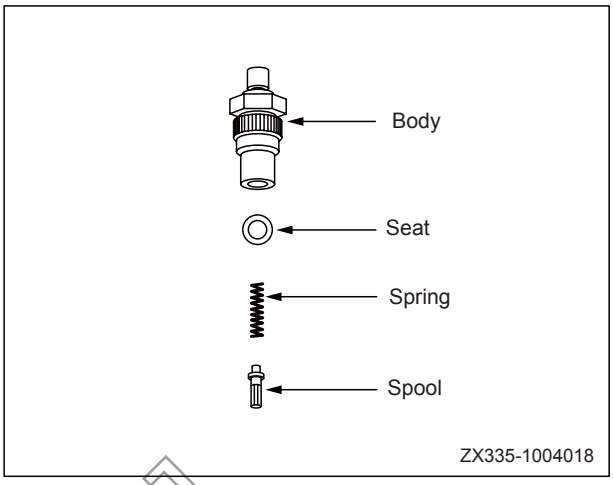


Fig. 6-17

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6.5.2 Adjusting

1. Align the timing pointer with the specific mark on the crankshaft pulley.
2. Perform step 3 through step 6 described in the testing procedure.
3. Loosen the four (4) nuts on the fuel injection pump.
4. Injection timing turns the fuel injection pump in advance along the drive shaft of fuel injection pump in order to make it face outward (getting away from the cylinder block).

   Injection timing turns the fuel injection pump in retard along the drive shaft of fuel injection pump in order to make it face inward (approaching the cylinder block).

   Ref: 1 mm difference between the two marking lines approximates 2º of crankshaft angle.
5. Keep operating the hand pump to transfer the fuel while slowly turning the fuel injection pump. Stop turning the injection pump when no oil is seen coming out of the fuel delivery valve body of No.1 cylinder. Adjustment of fuel injection pump position is now finished.
6. Tighten the four (4) nuts of fuel injection pump.
7. Remove again the fuel delivery valve body and assemble the spool, spring and seat. Tighten the valve assembly to the specific torque.
8. Install the injection tube of No.1 cylinder and tighten it to the specific torque.

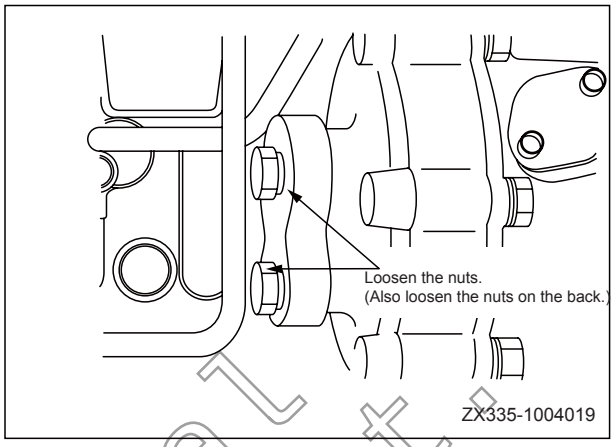


Fig. 6-18

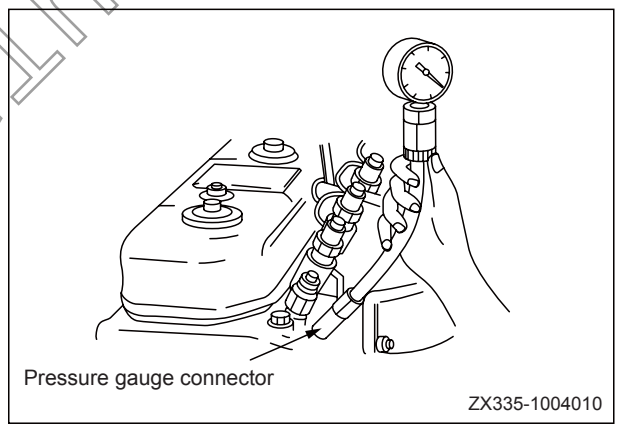


Fig. 6-19

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6.6 A/C Compressor Belt Tension - Test and Adjust

6.6.1 Testing

Press the intermediate point of the belt between the drive pulley and the compressor belt pulley with a finger force of about 58.8 N（6 kgf）, and check the deflection (A) of the belt, which shall be 5~8 mm (0.20 in~0.31 in).

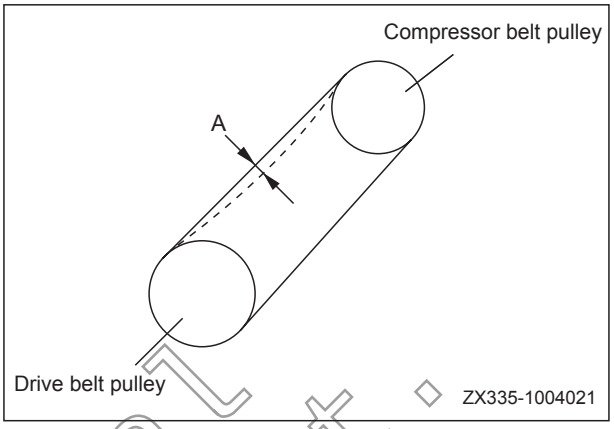


Fig. 6-20

6.6.2 Adjusting

- If the belt deflection is abnormal, adjust it according to the following procedure.

1. Loosen the bolts (1) and (2).
2. Move the compressor (3) and the bracket (4) together to adjust belt tension.
3. After positioning the compressor (3), tighten the bolts (1) and (2).
4. Recheck belt tension after adjustment.

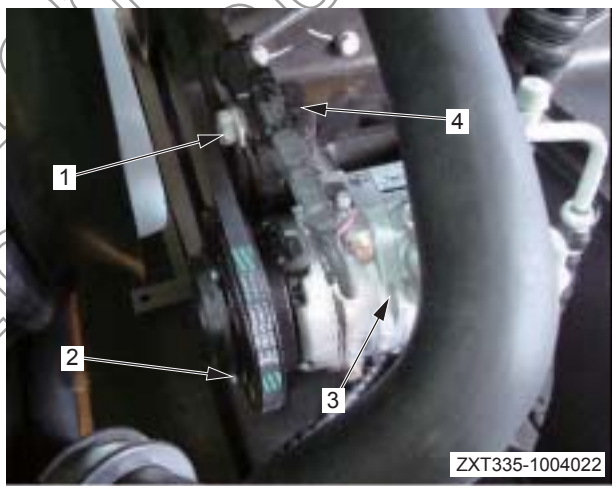


Fig. 6-21

Note:

- Check each belt for damage. Check the V-groove and the V-belt for wear. In addition, it is especially important to keep the V-belt free from friction with bottom of the V-groove.
- Contact local Sany dealer and replace the belt in case of the following conditions.
  - The fan belt has been stretched and little margin is left for adjustment.
  - Cuts or cracks are found in the belt.
  - Abnormal sliding or noise.
- When a new belt is mounted, readjust the belt tension after one hour operation.

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6.7 Swing Bearing Clearance - Test

- Tool used for testing swing bearing clearance

Symbol	Part Number	Part Name
H	60033930	Dial gauge

- The following steps are to be followed when testing the clearance of swing bearing.

⚠ WARNING

- **Park your machine on a level ground. Lower your work equipment to the ground.**
- **Do not put your hands or feet under the undercarriage during testing.**

1. Fix the dial gauge (H) to the track frame and make the pointer point the lower end of the outer race.
2. Place the work equipment to the maximum reach position. Raise the bucket to a height that the bucket tips and the swing frame bottom are on the same level.

   At the moment, the front of upper structure lowers while the rear rises.
3. Reset the dial gauge (H) to zero.
4. Set the arm almost perpendicular to the ground and lower the boom until the front track shoe tilts.

   At the moment, the front of upper structure rises while the rear lowers.
5. Read the dial gauge (H).

   The value indicated by the dial gauge (H) is the clearance of the bearing.
6. Restore the machine to the condition of step 2. Check the dial gauge (H) to see if it reads zero.

   Repeat step 3 through step 5 if the dial gauge (H) reads a value other than zero.

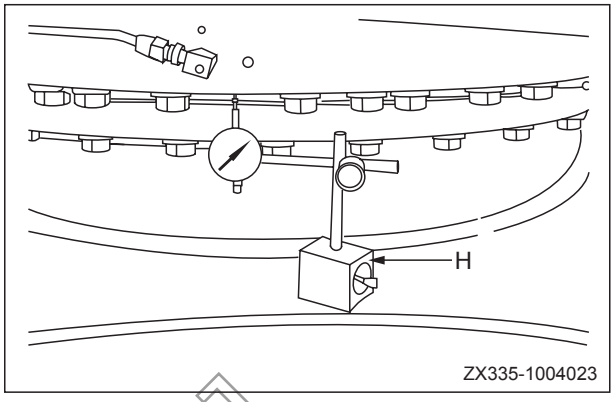


Fig. 6-22

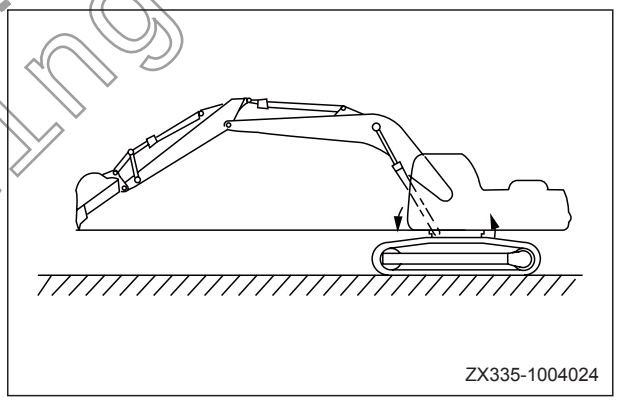


Fig. 6-23

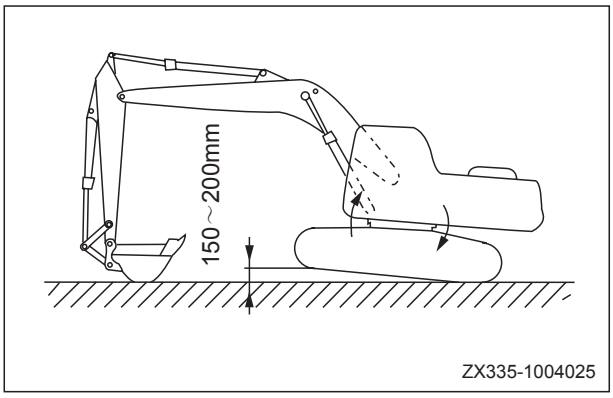


Fig. 6-24

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6.8 Track Tensioner - Test and Adjust

6.8.1 Testing

1. Move your machine forward at a distance that is equal to the length of track on the ground. Keep running the engine at low idle. Park your machine slowly.
2. Place a straight edge on top of the track grousers between the idler (1) and the front carrier roller (2).

   A straight edge of angle steel is recommended for this purpose as angle steel bends little. In addition, an L-shaped beam has good performance against bending.
3. Measure the maximum clearance (a) between the upper surface of track and the bottom of straight edge.

   Max clearance (a): 10~30 mm(0.4~1.2 in)

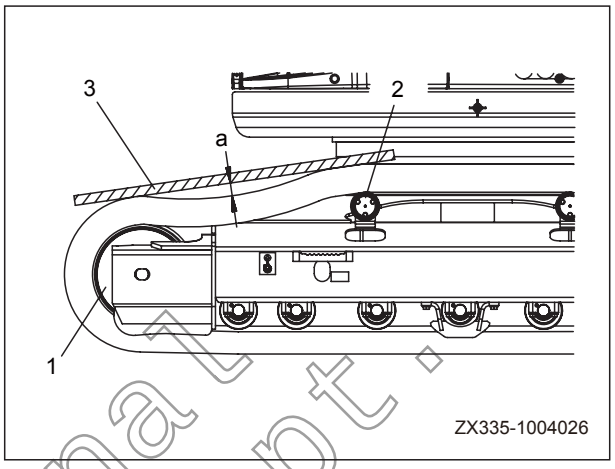


Fig. 6-25

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6.8.2 Adjusting

If the track tension is incorrect, adjustment is to be made in the following way.

1. Decreasing the tension

   A. Loosen the valve (1) to discharge grease. Tighten the valve after discharging.



⚠ WARNING

- **Never loosen the valve over one turn. If the valve is loosened too much, the grease under high pressure may cause the valve to shoot.**

   B. Recheck the track tension as per the above method after adjustment.

2. Increasing the tension

   A. Add grease through the grease fitting (2) with a grease gun.

   B. Recheck the track tension as per the above method after adjustment.

- Add grease until the gap (b) between the idler guide and the track frame end becomes zero. If the tension is till low, it indicates that the pins and bushings are seriously worn. Replace the pins and bushings, or remove one track shoe.

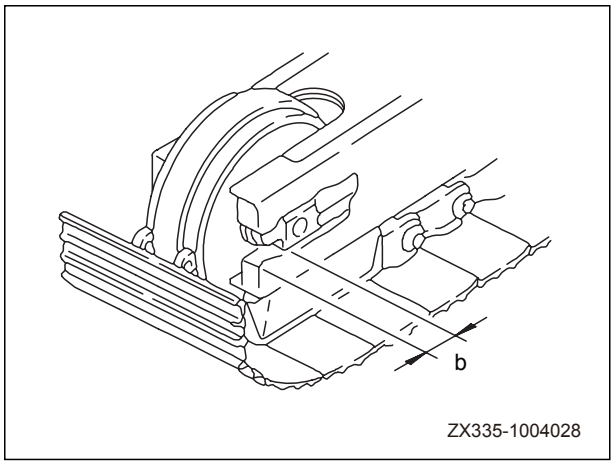


Fig. 6-26

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6.9 Oil in Hydraulic Circuits - Test and Adjust

Tools used for testing and adjusting hydraulic pressure in work equipment, swing and travel circuits

ID	Part Number	Part Name
—	60038932	Hydraulic Tester
	B210770000084	Adaptor

- The hydraulic pressure in work equipment, swing and travel (hydraulic pump output pressure) circuits can be viewed on the monitor.

6.9.1 Testing

1. Preparatory work before measuring

   Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the remaining pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

   A. Remove the plug (1) and plug (2) for testing the hydraulic pressure.

      Plug (1): For oil circuit of back hydraulic pump

      Plug (2): For oil circuit of front hydraulic pump

   B. Install the priming adaptor and connect it to the hydraulic tester.

      Use an oil pressure gauge with a capacity of 40 MPa {408 kg/cm^2}.

   C. Start the engine and keep it running until the hydraulic pressure rises to a point within the operational range.

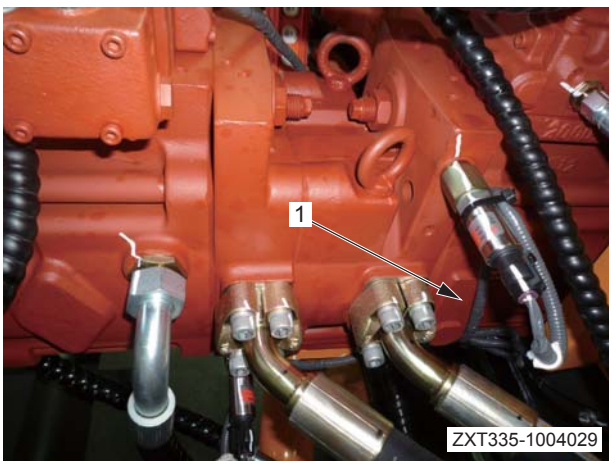


Fig. 6-27

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2. Testing the unloading pressure
   A. Start the engine.
   B. Test the hydraulic pressure when the engine is running at high idle and all control levers are in neutral position.

      The hydraulic pressure indicated is the pressure when the unloading valve unloads.
3. Testing the relief pressure of work equipment
   A. Start the engine and move the cylinder to be measured to its stroke end.
   B. Test the hydraulic pressure when the engine is running at high idle and the cylinder is in relief condition.

      The hydraulic pressure indicated is the pressure when the main relief valve is in relief condition.
4. Testing the swing relief pressure
   A. Start the engine. Reach out the work equipment as far as possible. Lower the work equipment on the ground in order to restrict swinging.
   B. Test the hydraulic pressure when the engine is running at high idle and the swing circuit is in relief condition.

      The hydraulic pressure indicated is the pressure when the swing motor relief valve is in relief condition.

      The relief pressure of swing motor is lower than the main relief pressure.
5. Testing the relief pressure of travel circuit
   A. Start the engine and lock the travel mechanism.

      Place the pin ① between the sprocket and the track frame in order to block the travel mechanism.
   B. Test the hydraulic pressure when the engine is running at high idle and the travel circuit is in relief condition.

      The hydraulic pressure indicated is the pressure when the main relief valve is in relief condition. When the travel circuit is in relief condition, the pressure indicated is always the pressure at high relief.

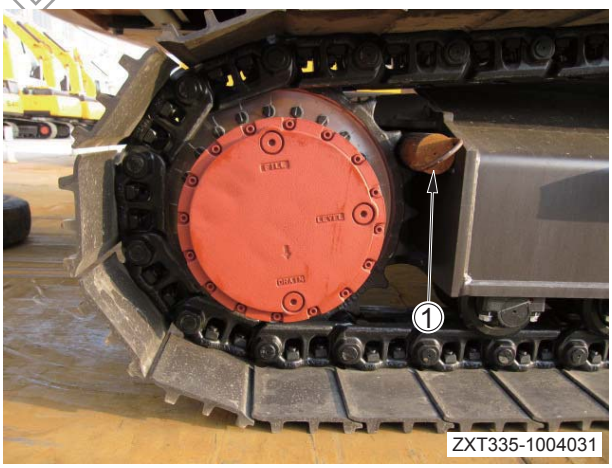


Fig. 6-28

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6.9.2 Adjusting

The unloading valve and safety valve for the boom are not adjustable.

1. Adjusting the main relief pressure (at the high pressure setting side)

   If the high relief pressure in work equipment and travel circuits is abnormal, adjust the high pressure setting side of the main relief valve (3) according to the following procedure.

   A. Disconnect the pilot hose.

   B. Loosen the locknut (4). Turn the adjusting screw (5) to adjust the pressure.

      The pressure increases as the retainer is turned right.

      The pressure decreases as the retainer is turned left.

      Each turn of the retainer approximates: 12.5 MPa {128 kg/cm^2}

      Locknut:

      53.5±4.9 Nm{5.5±0.5 kgm}

   C. Check the pressure again after adjustment. Test the pressure according to the procedure described above.

      Connect the pilot hose before testing the pressure.

      Adjustment of the high pressure setting side will affect the low pressure setting side. The low pressure setting side is, therefore, to be adjusted too.



Fig. 6-29

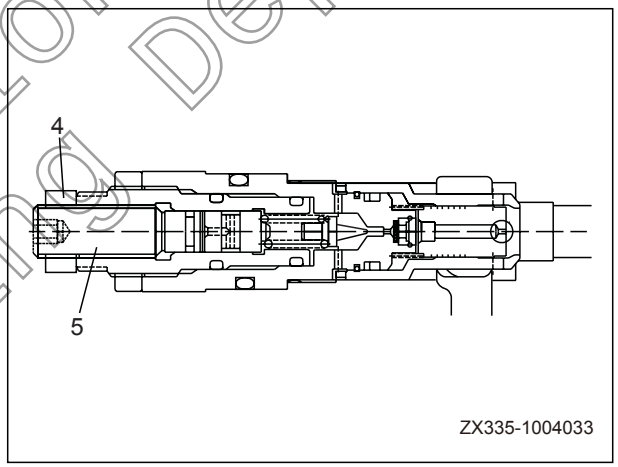


Fig. 6-30

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2. Adjusting the swing relief pressure

   If the swing relief pressure is abnormal, adjust the swing motor relief valve (6) according to the following procedure.

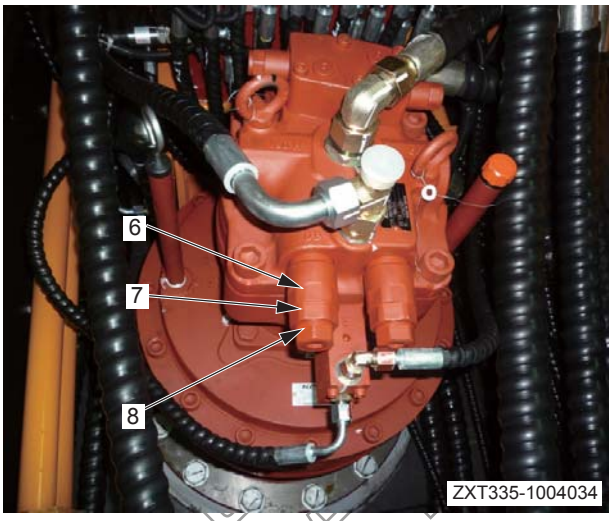


Fig. 6-31

A. Loosen the locknut (7). Turn the adjusting screw (8) to adjust the pressure.

   Pressure increases as the retainer is turned right. The pressure decreases as the retainer is turned left.

   Each turn of the retainer approximates: 6.71 MPa { 68.4 kg/cm^2}

   Locknut:

   78–103 Nm{8.0–10.5 kgm}

B. Check the pressure again after adjustment. Test the pressure according to the procedure described above.

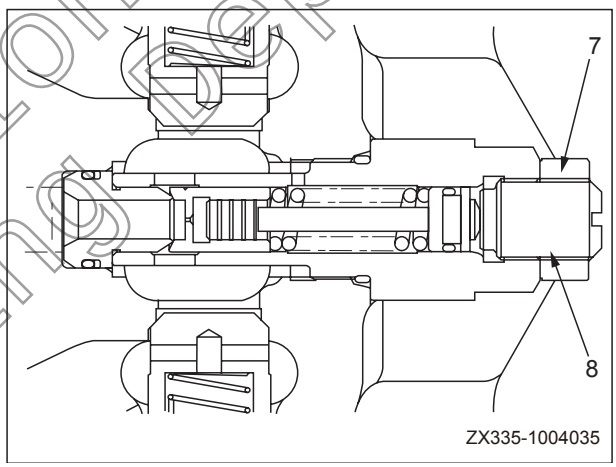


Fig. 6-32

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6.10 Control Oil Circuit Pressure - Test and Adjust

6.10.1 Testing

Tools used for testing and adjusting the pressure in control oil circuit.

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the remaining pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

1. Remove the hydraulic pressure testing plug (1).
2. Install the priming adaptor and connect it to the hydraulic tester.

- Use an oil pressure gauge with a capacity of 6 MPa {61 kg/cm^2}

3. Start the engine and keep it running until the hydraulic pressure rises to the operational range.
4. Test the oil pressure with the engine running at high idle and all control levers in neutral position.

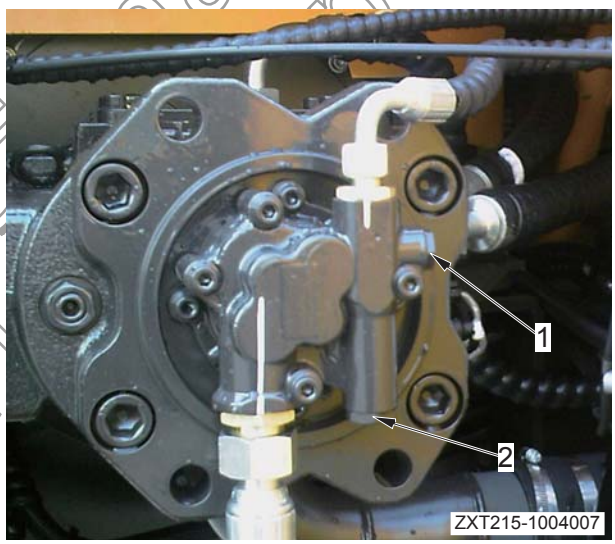


Fig. 6-33

6.10.2 Adjusting

1. If the oil pressure measured is lower than 3.5 MPa {36 kgf/cm^2}, loosen the locknut (2) and screw in the stud (3). Observe pressure change on the gauge at the same time. Tighten the nut (2) when desired pressure is reached.
2. Remove all measuring tools after testing. Make sure that the

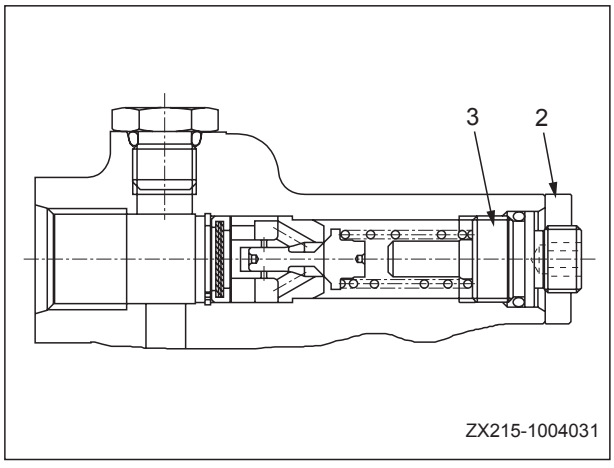


Fig. 6-34

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6.11 Solenoid Valve Output Pressure - Test

Tools used for testing the output pressure of solenoid valve

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

- Make sure that the initial pressure of control oil circuit is normal before testing the output pressure of solenoid valve.

Lower the work equipment to the ground and stop the engine. After the engine is stopped, operate the control levers for several times in order to release the remaining pressure in hydraulic circuits. Open the butterfly nut on the breather valve. Press the relief button to release pressure in the hydraulic tank.

1. Disconnect the hose of solenoid valve in order to test the pressure at the outlet.

No.	Solenoid valve to be tested
1	High travel speed valve
2	Backup proportional valve
3	Backup proportional valve
4	Bucket confluence valve
5	Backup
6	Pilot pressure valve

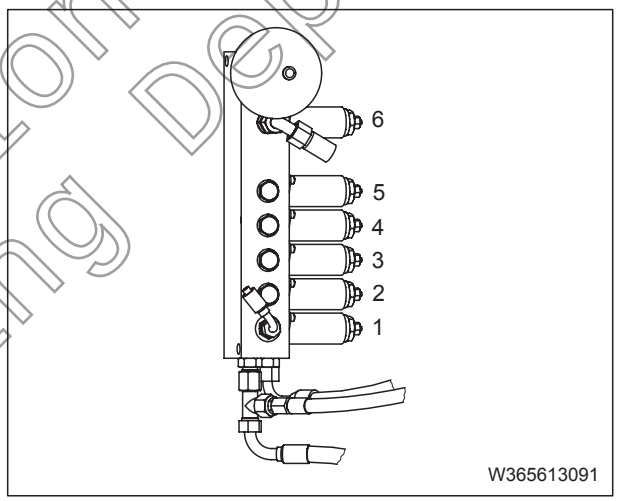


Fig. 6-35

2. Install a tee to location (A) on each solenoid valve and connect the hose.
3. Mount the adaptor onto the tee and connect it to the hydraulic tester.

- Use a hydraulic tester with a capacity of 6 MPa {61 kg/cm^2} .

4. Start the engine and keep it running until the hydraulic oil temperature rises to the operational range.
5. Run the engine at full speed. Operate the control levers to open or close each solenoid valve, and measure the pressure.

- The function of each solenoid valve can be checked through the monitor's monitoring function. (This is a special function of the monitor.)

6. Remove all measuring tools after measurement. Make sure that the machine returns to its normal condition.

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Pilot locking solenoid valve

Functioning state		Function
Hydraulic lockout control	Lock	OFF
	Free	ON

Travel speed shift solenoid valve

<table>
<tr><th colspan="3">Functioning State</th><th>Function</th></tr>
<tr><td colspan="3">When the 2nd level overheat setting is on</td><td rowspan="5">OFF</td></tr>
<tr><td colspan="3">Fuel control dial reads lower than 1500 rpm.</td></tr>
<tr><td colspan="3">When travel speed switch is in Lo position</td></tr>
<tr><td rowspan="3">When travel speed switch is in Hi position</td><td colspan="2">Travel signal OFF</td></tr>
<tr><td rowspan="2">Travel signal ON</td><td>If pressure of both front and back pump is 24.5 MPa {250 kg/cm2}</td></tr>
<tr><td>If pressure of both front and back pump is 15.3 MPa {150 kg/cm2}</td><td>ON</td></tr>
<tr><td colspan="3">Other states</td><td></td></tr>
</table>

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6.12 Pilot Valve Output Pressure - Test

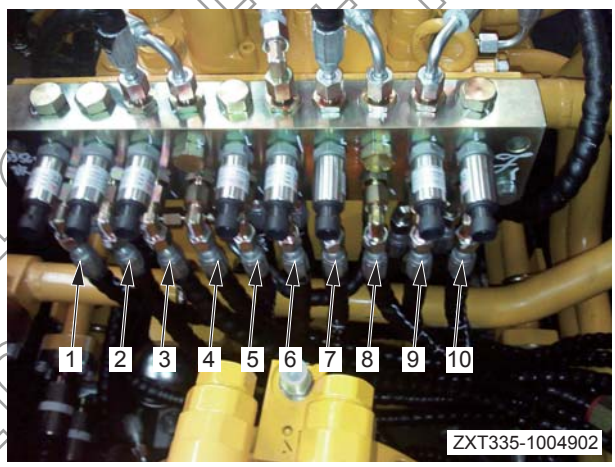
- Tools used for testing the output pressure of pilot valve

ID	Part Number	Part Name
—	21008760	Hydraulic Tester
	B210770000084	Adaptor

- Make sure that the initial pressure of control oil circuit is normal before testing the output pressure of pilot valve.

1. Remove the pilot oil pressure switch or plug.

No.	Oil circuit	No.	Oil circuit
1	Left travel	7	Boom DOWN
2	Right travel	8	Left swing
3	Arm IN	9	Bucket DIG
4	Right swing	10	Arm OUT
5	Bucket DUMP		
6	Boom UP		



2. Install the adaptor and connect it to the hydraulic tester.
- Use a hydraulic tester with a capacity of 6 MPa{61 kg/cm^2}.
3. Start the engine and keep it running until the hydraulic oil temperature rises to the operational range.
4. Measure the output pressure with the engine running at high idle and all control levers of the tested circuit in neutral position.
- When the measured output pressure reads the following values, the pilot valve is normal.
5. Remove all the tools after testing. Make sure that the machine returns to its normal condition.

Control lever	Hydraulic pressure
Neutral position	0{0}
Full stroke	Close to the average initial pressure of oil control circuit (See Table of Standard Values)

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6.13 Work Equipment and Swing Pilot Valves - Adjust

- If the play of work equipment or swing control lever is too big, adjustment can be made through the following steps.

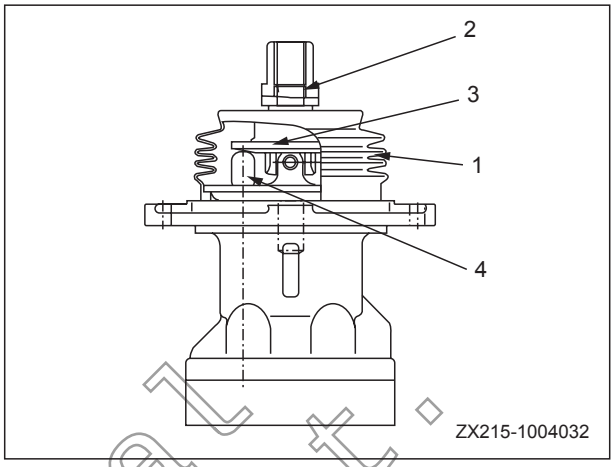
1. Remove the work equipment and swing pilot valve assembly.
2. Remove the bellows (1).
3. Loosen the locknut (2). Screw on the disc (3) until it contacts with the four heads of plunger (4).

- Do not move the plunger.

4. When the disc (3) is fixed, tighten the locknut (2) to the specified torque.

   Locknut: 98~127 Nm {10~13 kgm}

5. Restore the bellows (1).
6. Restore the work equipment and swing pilot valve assembly.



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6.14 Hydraulic Drift of Work Equipment - Test

- If hydraulic drift occurs to the work equipment (cylinder), check it according to the following procedure. It is to determine whether the failure is caused by cylinder seal or control valve.

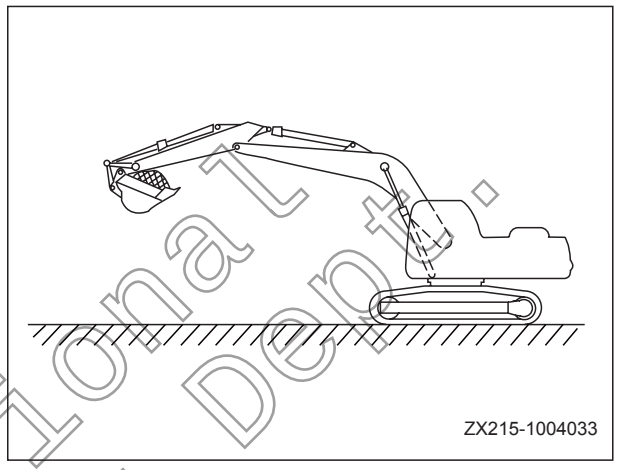
1. Check the boom and bucket cylinders.

   A. Park your machine in an attitude as shown in the illustration on the right, and stop the engine.

   - Load the bucket fully with soil or apply rated load to the bucket.

   B. Operate the control levers in order to keep the boom in the UP position and the bucket in the DIG position.

   - If the lowering speed increases, it is failure of cylinder seal.
   - If nothing changes, it is failure of control valve.
   - Operate the control levers with engine start switch in the ON position.
   - If the pressure in accumulator drops, recharge the accumulator after running the engine for about 10 seconds.

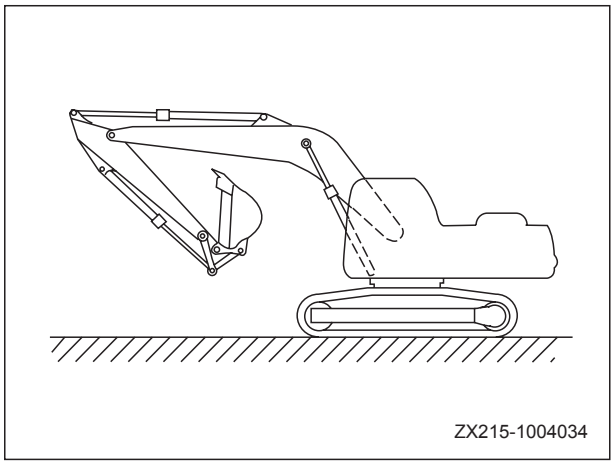

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2. Check the arm cylinder.

   A. Park your machine in an attitude as shown in the illustration on the right. The distance between the arm cylinder and the digging stroke end is 100 mm. Stop the engine.

   B. Operate the control levers in order to place the arm in the DIG position.

   - If the lowering speed increases, it is the failure of cylinder seal.
   - If nothing changes, it is the failure of control valve.
   - Operate the control levers with engine start switch in the ON position.


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- If the pressure in accumulator drops, recharge the accumulator after running the engine for about 10 seconds.

[Ref.] If the hydraulic drift is caused by failure of the cylinder seal, the reason for increase of lowering speed during the above operation is described below:

A. If the machine is set in the above position (where the holding pressure is applied to the head end), the oil leaks from the head end to the rod end. The pressure in the rod end is increased as a result.

B. As the pressure in the rod end decreases, the pressure in the head end increases to keep a balance. This process is repeated until balance is reached at a certain level depending on the amount of leakage.

C. When the pressure is balanced, the lowering speed decreases. If the control levers are operated according to the above procedure, the oil circuit in the rod end opens to the drain circuit (while the head end is closed by a check valve), and the oil flows to the drain circuit from the rod end. As a result, the lowering speed increases.

3. Check the pilot valve.

   Test the hydraulic drift respectively while the accumulator is pressurized and the hydraulic lockout control in the LOCK/FREE position.

- Operate the control levers with engine start switch in the ON position.
- If the pressure in accumulator drops, recharge the accumulator after running the engine for about 10 seconds.
- If there is a difference in hydraulic drift between the LOCK position and the FREE position, it is the failure (internal fault) of the pilot valve.

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6.15 Remaining Pressure in Hydraulic Lines - Relieve

Before disconnecting the lines between the hydraulic cylinders or between the hydraulic motor and the control valve, perform the following steps in order to release the remaining pressure in the hydraulic lines.

Even if there is no pressure remaining in the swing motor line and the travel motor line, they will be influenced by the internal pressure of hydraulic tank. The breather valve must therefore be opened to release pressure prior to operation.

1. Stop the engine, loosen the butterfly nut on the breather valve, and press the release button to release the pressure in hydraulic tank.
2. Turn the engine start switch to the ON position and operate the control levers for several times.
   - The pilot lock valve must be energized. Operate the control levers with the engine start switch in the ON position.
   - Operate the control levers 2 or 3 times to release the pressure in the accumulator.
3. Start the engine and keep the engine running at low idle for about 10 seconds in order to increase the pressure in accumulator. And then stop the engine.
4. Repeat the above step 2 through step 3 several times.

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6.16 Oil Leakage Amount - Test

1. Testing the oil leakage amount of boom cylinder

   A. Start the engine and keep the engine running until the hydraulic oil temperature reaches the operational range. And then fully extend the boom cylinder.

      To release the pressure remaining in the lines see **"Remaining Pressure in Hydraulic Lines - Relieve" on page 6-36.**

   B. Disconnect the hose (1) on the cylinder rod end and plug the hose opening.

      Take care not to disconnect the hose on the cylinder head end.

   C. Start the engine and apply relief pressure to the head end of the cylinder while the engine is running at high idle.

   D. Hold this state for 30 seconds and then test the amount of oil leakage for one minute.

   E. Make sure that the machine returns to its normal condition after testing.

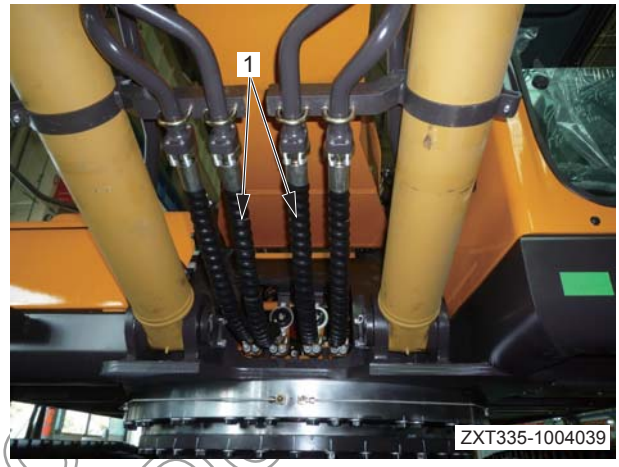


Fig. 6-36

2. Testing the oil leakage amount of arm cylinder

   A. Start the engine and keep the engine running until the hydraulic oil temperature reaches the operational range. And then fully extend the arm cylinder.

      To release the pressure remaining in the lines, **See: Chapter 4 Testing and Adjusting, "Remaining Pressure in Hydraulic Lines - Relieve" on page 6-36**.

   B. Disconnect the hose (2) on the cylinder rod end and plug the hose opening.

      Take care not to disconnect the hose on the cylinder head end.



Fig. 6-37

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C. Start the engine and apply relief pressure to the head end of the cylinder while the engine is running at high idle.

D. Hold this state for 30 seconds. Test the amount of oil leakage for one minute.

E. Make sure that the machine returns to its normal condition after testing.

3. Testing the oil leakage amount of bucket cylinder

A. Start the engine and keep the engine running until the hydraulic oil temperature reaches the operational range. And then fully extend the bucket cylinder.

To release the pressure remaining in the circuits see **“Remaining Pressure in Hydraulic Lines - Relieve” on page 6-36**.

B. Disconnect the hose (3) on the cylinder rod end and plug the hose opening.

Take care not to disconnect the hose on the cylinder head end.

C. Start the engine and apply relief pressure to the head end of the cylinder while the engine is running at high idle.

D. Hold this state for 30 seconds and then test the amount of oil leakage for one minute.

E. Make sure that the machine returns to its normal condition after testing.



Fig. 6-38

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4. Testing the oil leakage amount of swing motor

   A. Fully extend the work equipment. Lower the bucket on the ground and raise the machine slightly. Stop the engine.

   B. Disconnect the drain hoses (4) and (5). Blind the hose ends with caps.

   C. Start the engine and apply swing relief pressure while the engine is running at high idle. Measure the amount of oil leakage under this condition.

      - Hold the state described in step 3) for 30 seconds. Measure the amount of oil leakage for one minute.
      - After the first measurement, swing the upper structure 180° and measure the leakage again in the same way.

   D. Make sure that the machine returns to its normal condition after testing.

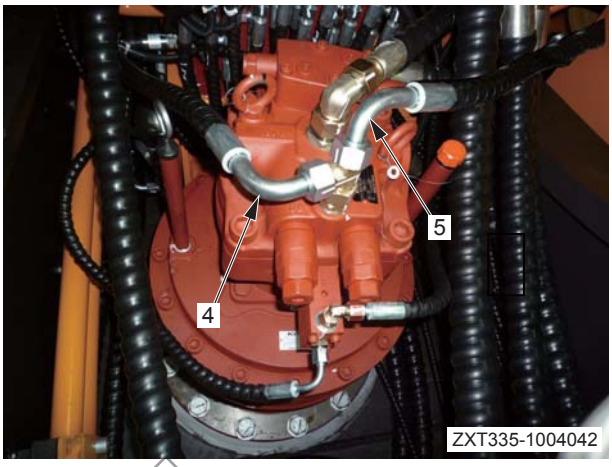


Fig. 6-39

5. Testing the oil leakage amount of the travel motor

   A. Remove the cover of the travel motor.

   B. Start the engine and lock the travel.

      Insert the pin ① between the sprocket and the track frame in order to prevent traveling.

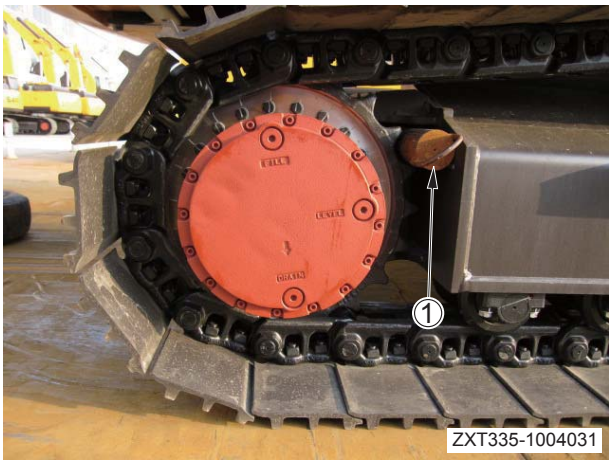


Fig. 6-40

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C. Disconnect the drain hose (6) of the travel motor. Blind the hose end with a cap.

D. Start the engine and apply swing relief pressure while the engine is running at high idle. Measure the amount of oil leakage under this condition.

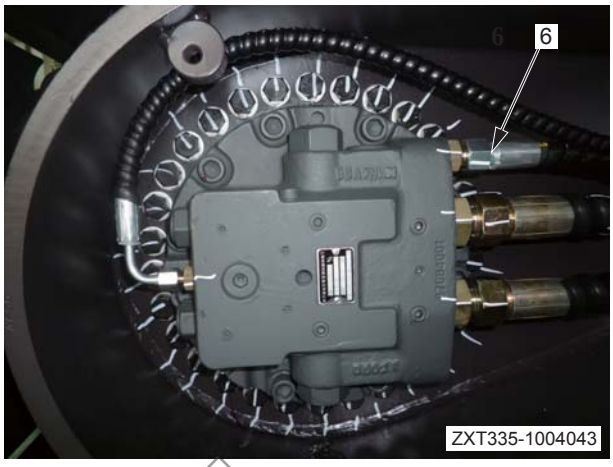


Fig. 6-41

⚠ WARNING

- **During testing, misoperation of the control levers can cause serious accidents. Make sure that all signals are correct.**

  - Hold the condition described in step 4) for 30 seconds. Test the amount of oil leakage for one minute.
  - Rotate the motor slightly. Swap the positions of the oil distributor and the cylinder and of the cylinder and piston. Repeat the testing several times.

E. Make sure that the machine returns to its normal condition after testing.

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6.17 Air in Each Component - Purge

Item to Be Purged / Job Description	Purging Steps					
	1	2	3	4	5	6
	Hydraulic Pump	Engine Starting	Oil Cylinder	Swing Motor	Travel Motor	Operation Starting
• Changing the hydraulic oil • Cleaning the filter element	○ →	○ →	○ →	○ (Note) →	○ (Note) →	○
• Replacing the return filter element		○ →	→	→	→	○
• Repairing/replacing the hydraulic pump • Disassembling the suction hose	○ →	○ →	○ →	→	→	○
• Repairing/replacing the control valve		○ →	○ →	→	→	○
• Replacing the oil cylinder • Disassembling the cylinder piping		○ →	○ →	→	→	○
• Replacing the swing motor • Disassembling the swing motor		○ →	→	○ →	→	○
• Replacing the travel motor • Disassembling the travel motor		○ →	→	→	○ →	○

Note:

Purge air from the swing motor and travel motor only when the oil in the motor cases is drained.

1. Purging air from hydraulic pump

   A. Loosen the plug (1) and make sure that oil leaks through the plug.

   B. If you are sure of the leak, tighten the plug (1).

   Plug: 7.8~9.8 N·m{0.8~1.0 kgf·m}

- Engine starting precaution:

  When engine is started after bleeding the air as described above, run the engine at low idle for 10 minutes.

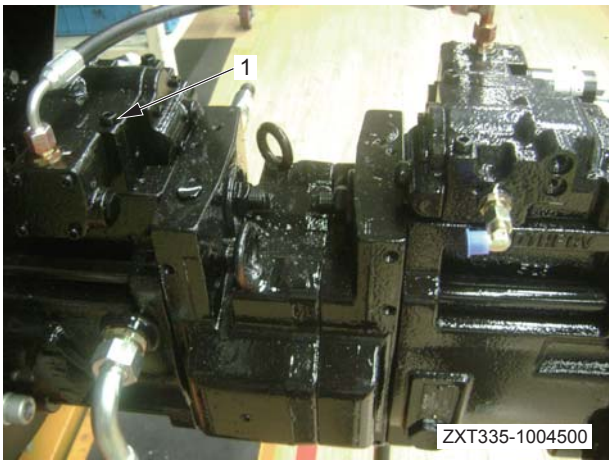


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2. Bleeding air from hydraulic cylinder

   A. Start the engine and keep the engine running at low idle.

   B. Raise and lower the boom 4-5 times with the engine running at low idle.

   - Do not apply relief pressure and stop the piston at about 100 mm to stroke end.

   C. Repeat step 2) with the engine running at high idle.

   D. Apply relief pressure when the piston comes to stroke end with the engine running at low idle.

   E. Purge air from arm cylinder and bucket cylinder. Repeat step 2) through step 4).

   - When a new cylinder is used for replacement, it is recommended to purge air from new cylinder before it is installed to work equipment. Especially the boom cylinder, It must be purged prior to installation because its piston is unable to reach the boom-down side stroke end after installation.
   - For an excavator whose hydraulic oil has been changed or which has been in storage for a long period of time, slowly operate the boom, arm and bucket cylinders in full stroke at low engine speed under zero load in order to purge the air. Immediate pressurization and loaded operation after change of oil should be avoided.

3. Bleeding air from swing motor

   A. Start the engine and run it at low idle.

   B. Bleed air from swing motor by slowly turning the upper structure.

4. Bleeding air from travel motor

   C. Start the engine and run the engine at low idle.

   D. Loosen the bleeder plug (1) and make sure that oil oozes through the plug.

   E. If you are sure of the leak, tighten the plug (1).

   Bleeder plug: 27.5 - 35.3 Nm {2.8 - 3.6 kgm}

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Troubleshooting

7 Troubleshooting

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7 TROUBLESHOOTING

⚠ WARNING

- **Stop the machine on a level ground, and check that lock pins, blocks, and parking brake are effective.**
- **When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.**
- **If the radiator cap is removed when the engine is hot, hot coolant may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.**
- **Be extremely careful not to touch any hot parts or to get caught in any rotating parts.**
- **When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.**
- **When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.**

The aim of troubleshooting is to pinpoint the basic cause of the fault, to carry out repairs swiftly, and to prevent reoccurrence of the fault.

When carrying out troubleshooting, important point is to understand the structure and function.

However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the fault that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components. If components are disassembled immediately any fault occurs:

- Parts that have no connection with the fault or other unnecessary parts will be disassembled.
- It will become impossible to find the cause of the fault.

  It will also cause a waste of man-hours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.

  For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.

2. Points to ask user or operator:

   A. Have any other problems occurred apart from the problem that has been reported?

   B. Was there anything strange about the machine before the fault occurred?

   C. Did the fault occur suddenly, or were there problems with the machine condition before this?

   D. Under what conditions did the fault occur?

   E. Had any repairs been carried out before the fault? When were these repairs carried out?

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F. Has the same kind of fault occurred before?

3. Check before troubleshooting

A. Check the oil level.

B. Check for any external leakage of oil from the piping or hydraulic equipment.

C. Check the travel of the control levers.

D. Check the stroke of the control valve spool.

E. Other maintenance items can be checked externally, so check any item that is considered to be necessary.

4. Confirming fault

Confirm the extent of the fault yourself, and judge whether to handle it as a real fault or as a problem with the method of operation, etc.

When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting

Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of fault, then use the troubleshooting flowchart to locate the position of the fault exactly.

- The basic procedure for troubleshooting is as follows:

A. Start from the simple points.

B. Start from the most likely points.

C. Investigate other related parts or information.

6. Measures to remove root cause of fault

Even if the fault is repaired, if the root cause of the fault is not repaired, the same fault will occur again. To prevent this, always investigate why the problem occurred. Then, remove the root cause.

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7.1 Checks before Troubleshooting

	Item	Criterion	Remedy
Lubricating oil, coolant	1. Check fuel level and type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check hydraulic oil strainer	—	Clean, drain
	5. Check swing drive oil level	—	Add oil
	6. Check engine oil level (in oil pan)	—	Add oil
	7. Check coolant level	—	Add water
	8. Check dust indicator for clogging	—	Clean or replace
	9. Check hydraulic filter	—	Replace
	10. Check final drive oil level	—	Add oil
Electrical equipment	1. Check for looseness, corrosion of battery terminal and wiring	—	Tighten or replace
	2. Check for looseness, corrosion of alternator terminal and wiring	—	Tighten or replace
	3. Check for looseness, corrosion of start motor terminal and wiring	—	Tighten or replace
Hydraulic, mechanical equipment	1. Check for abnormal noise and smell	—	Repair
	2. Check for oil leakage	—	Repair
	3. Bleeding air	—	Bleed air
Electrics, electrical equipment	1. Check battery voltage (with engine stopped)	20-30V	Replace
	2. Check electrolyte level	—	Add or replace
	3. Check for discolored, burnt, exposed wiring	—	Replace
	4. Check for missing wiring clips and hanging wiring	—	Repair
	5. Check for wet wires (esp. wet connectors or terminals)	—	Disconnect connector and dry
	6. Check for blown or corroded fuses		
	7. Check alternator voltage (with engine speed at middle or higher)	—	Replace
	8. Check operating sound of battery relay (when start switch is turned ON or OFF)	After running for several minutes: 27.5~ 29.5V	Replace
		—	Replace

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7.2 Failure Symptoms and Troubleshooting Codes

No.	Symptom	Troubleshooting			
		Code displayed	E mode	H mode	(Engine)
Action to be taken concerning Service Code, Failure code and Failure Code					
1	Display Failure code in monitor panel	According to displayed code			
2	Display Service Code in electrical system after checking failure history				
3	Display Failure Code in mechanical system after checking failure history				
Engine-related failure					
4	Engine does not start up easily. (It always takes some time to start up the engine)				
5	Engine misfires.		E-1		
6	Color of exhaust gas is too dark.(Incomplete combustion)				
7	Engine pickup is poor.				
8	Engine runs rough or is unstable.		E-2		
9	Engine is short of output, or lacks power			H-2	
10	Auto Idle fails.		E-5	H-5	
11	Excessive engine oil consumption, or color of exhaust gas is blue				
12	Premature engine oil contamination				
13	Excessive fuel consumption				
14	Engine cooling water is mixed with engine oil, spurts out or decreases				
15	Engine oil amount increases. (Water or fuel gets in)				
16	Abnormal noises are heard				
17	Excessive vibrations are caused				
Failure related to work equipment, swing and travel					
18	Power supply of machine cannot be cut off.		E-3		
19	There are abnormal noises from around hydraulic pump			H-4	
20	All work equipment, travel and swing do not move			H-3	
21	Speeds of all work equipment, travel and swing are slow			H-1	
22	When Machine Swings and Travels Simultaneously, Travel Speed Lowers Largely			H-13	

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No.	Symptom	Troubleshooting			
		Code displayed	E mode	H mode	(Engine)
Work equipment-related failure					
23	All the equipment do not work		E-7		
24	Cylinder do not work singly			H-9	
25	Drift of cylinder is too large			H-10	
26	Work equipment time lag is too big			H-11	
27	Other work equipment moves, when specific work equipment is relieved			H-12	
28	Boom-up speed or power is low.		E-8	H-6	
29	Arm speed or power is low.		E-9	H-7	
30	Bucket speed or power is low.		E-10	H-8	
Travel-related failure					
31	Travel speed or power is low.		E-11	H-15	
32	Dual Speed Travel Not Functioning		E-14		
33	Machine tends to swerve while in travel			H-14	
34	Machine is difficult to steer, or lacks power			H-16	
35	Travel speed cannot be shifted			H-17	
36	Track shoe does not move (only on one side)			H-18	
Swing-related failure					
37	Machine does not swing			H-19	
38	Swing acceleration is poor, or swing speed is slow			H-20	
39	Upper structure overruns remarkably when stopping swinging			H-21	
40	Large shock is made when stopping swinging			H-22	
41	Large sound is made when stopping swinging			H-23	
42	Hydraulic drift of swing is large			H-24	

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No.	Symptom	Troubleshooting			
		Code displayed	E mode	H mode	(Engine)
Monitor panel-related failure					
43	Monitor display is blank.		E-12		
44	Monitor displays nothing.		E-13		
45	Engine coolant temperature reading is incorrect.		E-15		
46	Fuel level reading is incorrect.		E-16		
47	Arm-in pilot pressure reading is incorrect.		E-18		
48	Arm-out pilot pressure reading is incorrect.		E-19		
49	Boom-up pilot pressure reading is incorrect.		E-20		
50	Boom-down pilot pressure reading is incorrect.		E-21		
51	Bucket-close pilot pressure reading is incorrect.		E-22		
52	Bucket-open pilot pressure reading is incorrect.		E-23		
53	Swing pilot pressure reading is incorrect.		E-24		
54	Left travel pilot pressure reading is incorrect.		E-25		
55	Right travel pilot pressure reading is incorrect.		E-26		
Other failure					
56	Preheat function fails.		E-6		
57	Wiper does not work.		E-17		

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7.3 Connector Location and Electrical Circuit Diagram

Connector No.	Type	Num-ber of pins	Component	Stereo-gram
CN-101M	A	2	Platform lamp	E-5
CN-102M	S	1	Fuel level sensor	F-6
CN-104M	A	2	Boom lamp (L)	E-7
CN-105M	A	2	Boom lamp (R)	E-7
T-117	Terminal	1	High-temp switch	K-7
T-101	Terminal	1	Battery relay coil (+)	M-2
T-102	Terminal	1	Battery relay coil (-)	M-2
T-103	Terminal	1	Battery relay contact (output)	M-2
T-104	Terminal	1	Battery relay contact (input)	M-2
T-105	Terminal	1	Preheater fuse line 21#	M-2
T-106	Terminal	1	Preheater fuse line 16#	M-2
T-118	Terminal	1	Battery ground	M-2
T-500	Terminal	1	Battery ground	M-2
T-107	Terminal	1	Compressor clutch	K-7
T-109	Terminal	1	Engine oil pressure switch	J-7
T-110	Terminal	1	Preheater resistance wire terminal	J-7
T-111	Terminal	1	Start motor terminal B	K-7
T-112	Terminal	1	Alternator terminal B	K-6
T-135	Terminal	1	Start motor terminal S	K-7
T-202	Terminal	1	Chassis ground	W-6
K5	R	5	Horn relay	X-6
K2	R	5	Head lamp relay	X-6
K6	R	5	Work lamp relay	X-6
K4	R	5	Pilot valve relay	X-6
KB	—	5	Battery relay	M-2
K7	R	5	Start relay	X-6
KH	—	5	Preheater relay	Y-6
K3	R	5	Lockout relay	X-6
K9	R	5	Shutdown delay relay	X-6
CN-201F	A	2	Joint connector	W-6
CN-302F	A	3	Intermediate connector	R-6
F-501	Terminal	1	Intermediate connector	R-6
F-502	Terminal	1	Intermediate connector	R-6

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Connector No.	Type	Number of pins	Component	Stereogram
F-503	Terminal	1	Intermediate connector	R-6
F-504	Terminal	1	Intermediate connector	R-6
F-505	Terminal	1	Intermediate connector	R-6
F-506	Terminal	1	Intermediate connector	R-6
F-507	Terminal	1	Intermediate connector	R-6
F-508	Terminal	1	Intermediate connector	R-6
F-509	Terminal	1	Intermediate connector	R-6
CN-502F	D	12	Intermediate connector	R-5
CN-1-110	D	6	Intermediate connector	AD-6
CN-1-112F	3	3	Intermediate connector	W-6
CN-1-111M	S	8	Intermediate connector	W-6
CN-142M	A	35	Monitor	P-5
CN-182P	S	6	Intermediate connector	I-7
CN-155M	S	6	Intermediate connector	J-7
CN-503F	A	2	Intermediate connector	W-6
CN-504F	A	2	Intermediate connector	X-6
CN-505F	A	2	Intermediate connector	X-6
CN-507F	A	2	Intermediate connector	X-6
CN-106M	A	2	Hyd oil temp sensor	I-7
CN-502F	D	8	Intermediate connector	W-6
CN-181M	L	6	Preheater controller	X-6
CN-506F	S	16	Intermediate connector	W-6
CN-180M	S	6	Parking relay	Y-6
CN-140M	DF	3	Front principal pressure sensor	I-7
CN-141M	DF	3	Rear principal pressure sensor	I-7
CN-129M	DF	3	Arm-in pilot sensor	I-6
CN-122M	DF	3	Arm-out pilot sensor	I-6
CN-126M	DF	3	Boom-up pilot sensor	I-6
CN-125M	DF	3	Boom-down pilot sensor	I-6
CN-124M	DF	3	Bucket-dig pilot sensor	I-6
CN-128M	DF	3	Bucket-dump pilot sensor	I-6
CN-123M	DF	3	Swing pilot sensor	I-6
CN-120M	DF	3	Left travel pilot sensor	I-6
CN-121M	DF	3	Right travel pilot sensor	I-6
CN-307M	H	8	Head lamp switch	R-5

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Connector No.	Type	Number of pins	Component	Stereogram
CN-303M	H	8	Work lamp switch	R-6
CN-305M	H	8	Washer switch	R-6
CN-304M	H	8	Wiper switch	R-6
CN-104M	A	2	Horn switch	R-6
CN-003F	S	12	Air conditioner	W-4
CN-150F	AMP	2	Front pump solenoid valve	I-7
CN-151F	AMP	2	Rear pump solenoid valve	I-7
CN-135F	AMP	2	Boom priority 2 solenoid valve	J-6
CN-134F	AMP	2	Bucket confluence solenoid valve	J-6
CN-132F	AMP	2	Boom priority 1 solenoid valve	J-6
CN-136F	AMP	2	Pilot solenoid valve	J-6
CN-131F	AMP	2	High/low travel speed valve	J-6
CN-133F	AMP	2	Swing priority valve	J-6
CN-211M	AMP	2	Washer motor	K-5
F-300	Terminal	1	Coolant temp sensor	K-7
F-101	W	1	Right horn	I-6
F-100	W	1	Left horn	I-6
CN-140M	AMP	35	Controller	W-6
CN-141M	AMP	35	Controller	W-6
CN-800F	S	2	Alternator terminal L/R	K-7
F-103	S	3	Safety relay	X-6
CN-7-707	AMP	2	Cigar lighter	P-4
CN-150M	D	8	Intermediate connector	AE-3
CN-215F	HL	7	Radio	W-6
PF021	_	_	Fuse box	X-4
CN-1-001	AMP	2	Left speaker	AD-7
CN-1-002	AMP	2	Right speaker	AE-6
CN-1-003	AMP	2	Right head lamp	AB-5
CN-1-004	AMP	2	Left head lamp	AB-5
CN-1-005	AMP	2	Cab lamp	AE-7

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Connector No.	Description
S	SWP type, Yazaki
A/AMP	AMP, Japan
D	DT type, made in Japan
H	Hebi
HL	Hulane
L	Ling Xing
DF	Delphi, U.S.
W	AMP, Japan
Terminal	Round

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7.3.1 Connector location layout

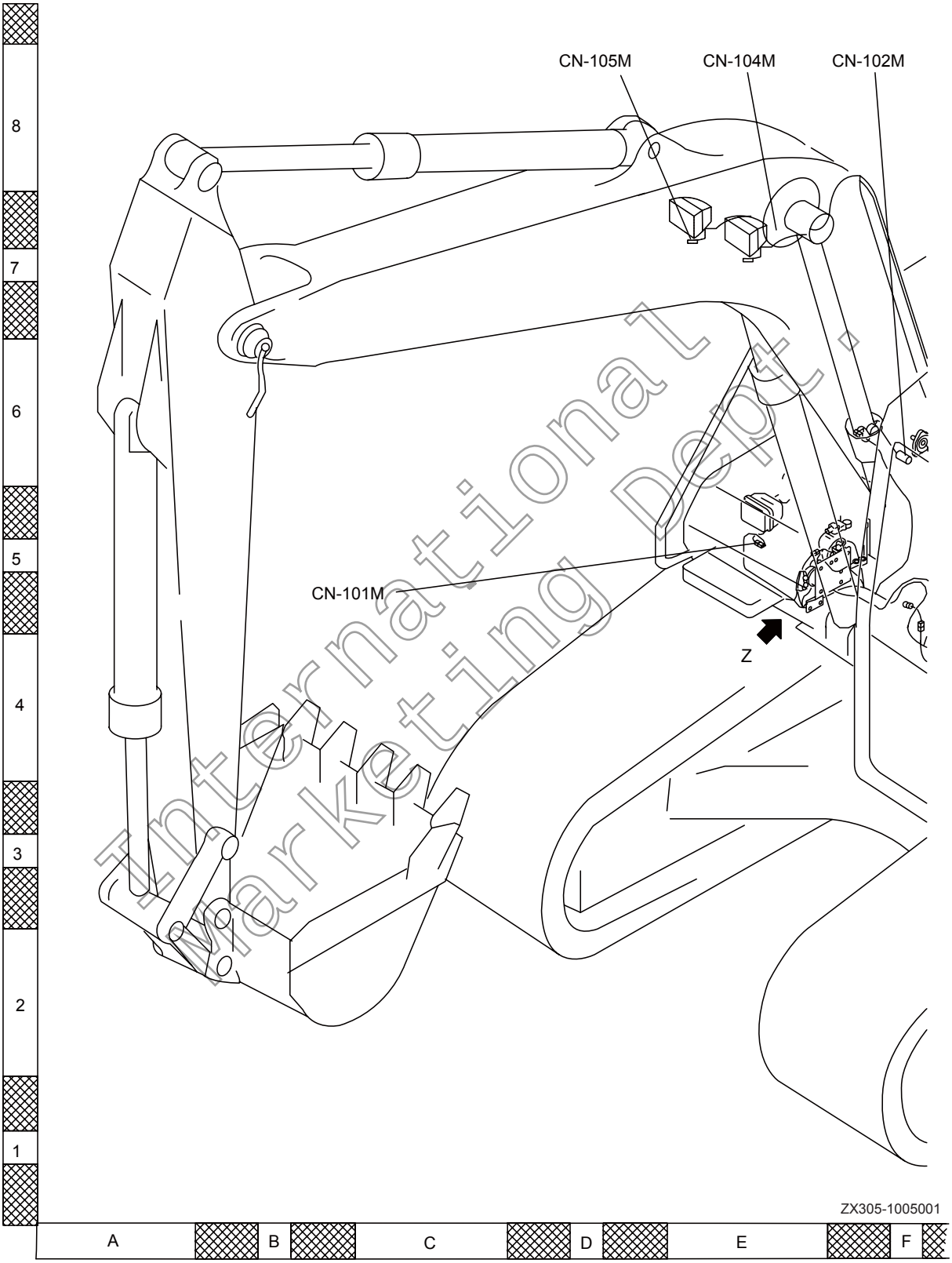
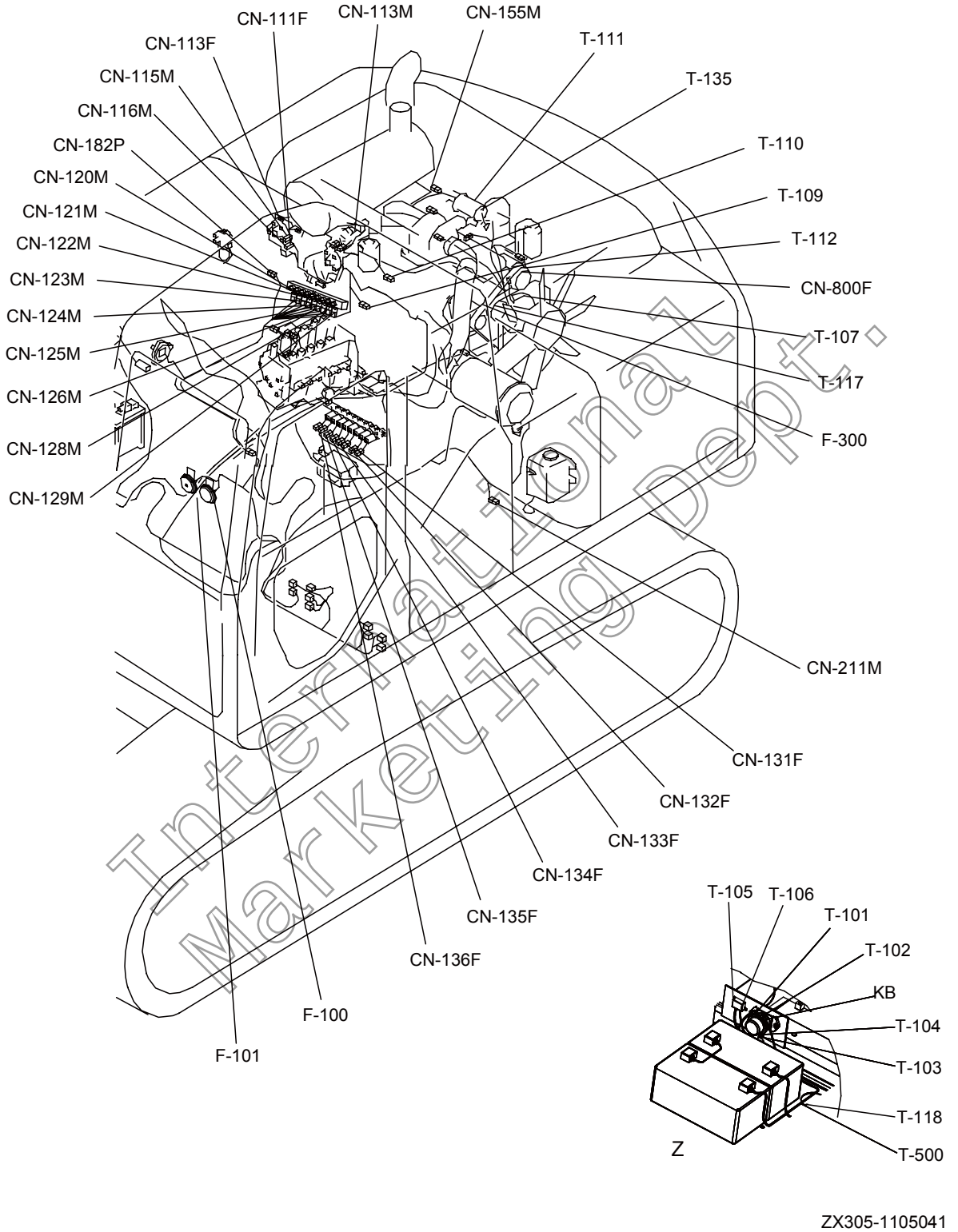


Fig. 7-1

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Fig. 7-2

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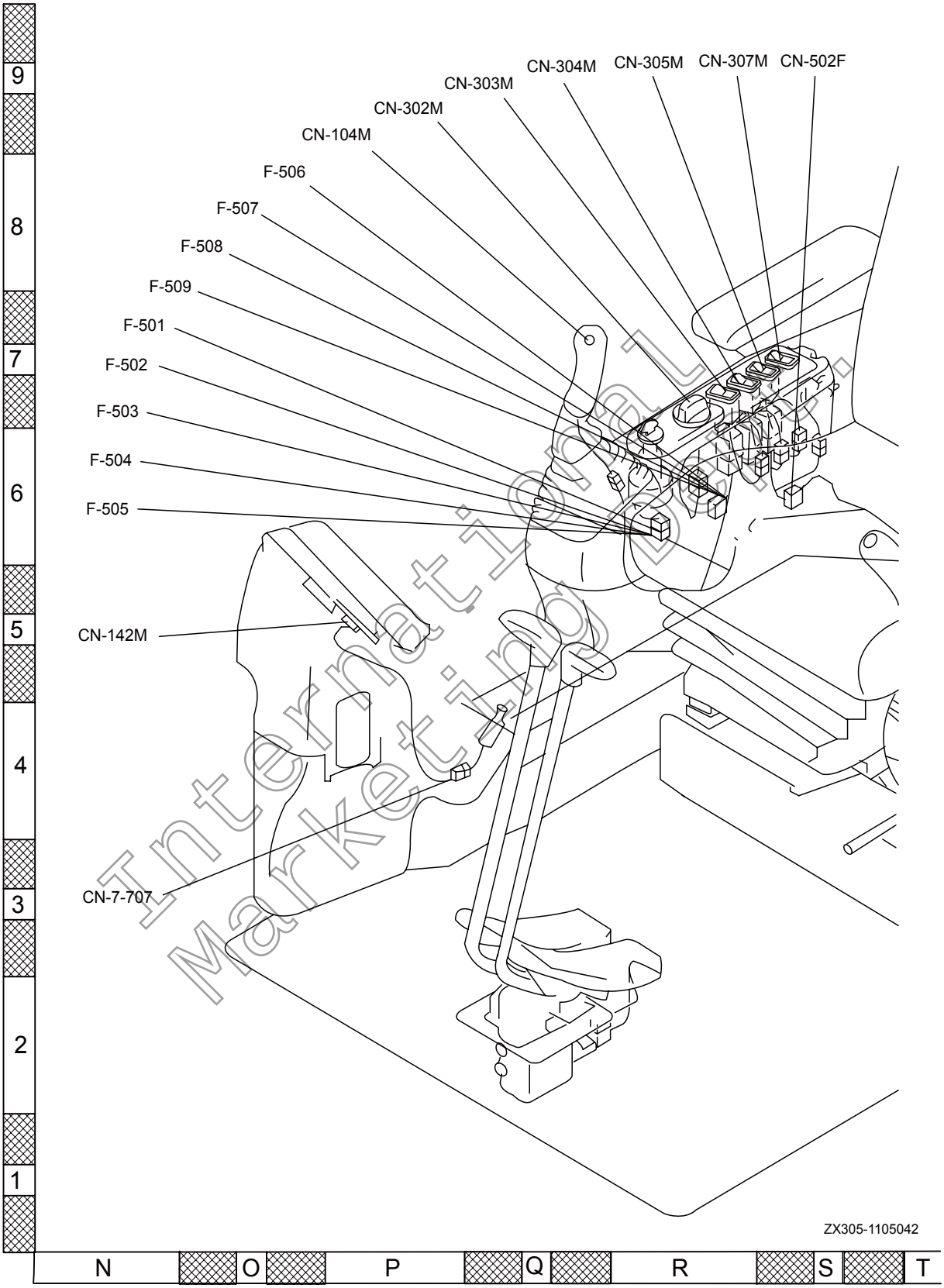
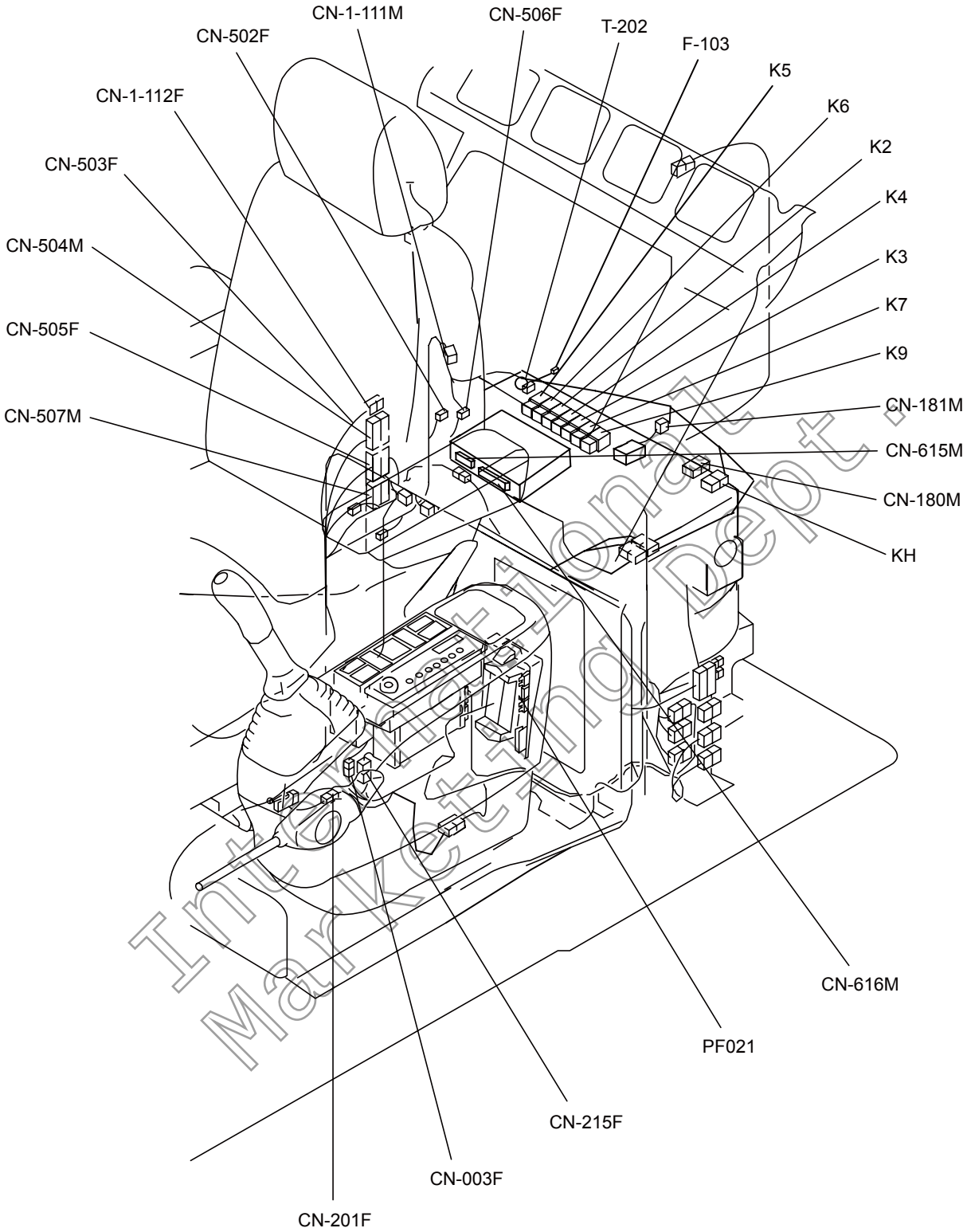


Fig. 7-3

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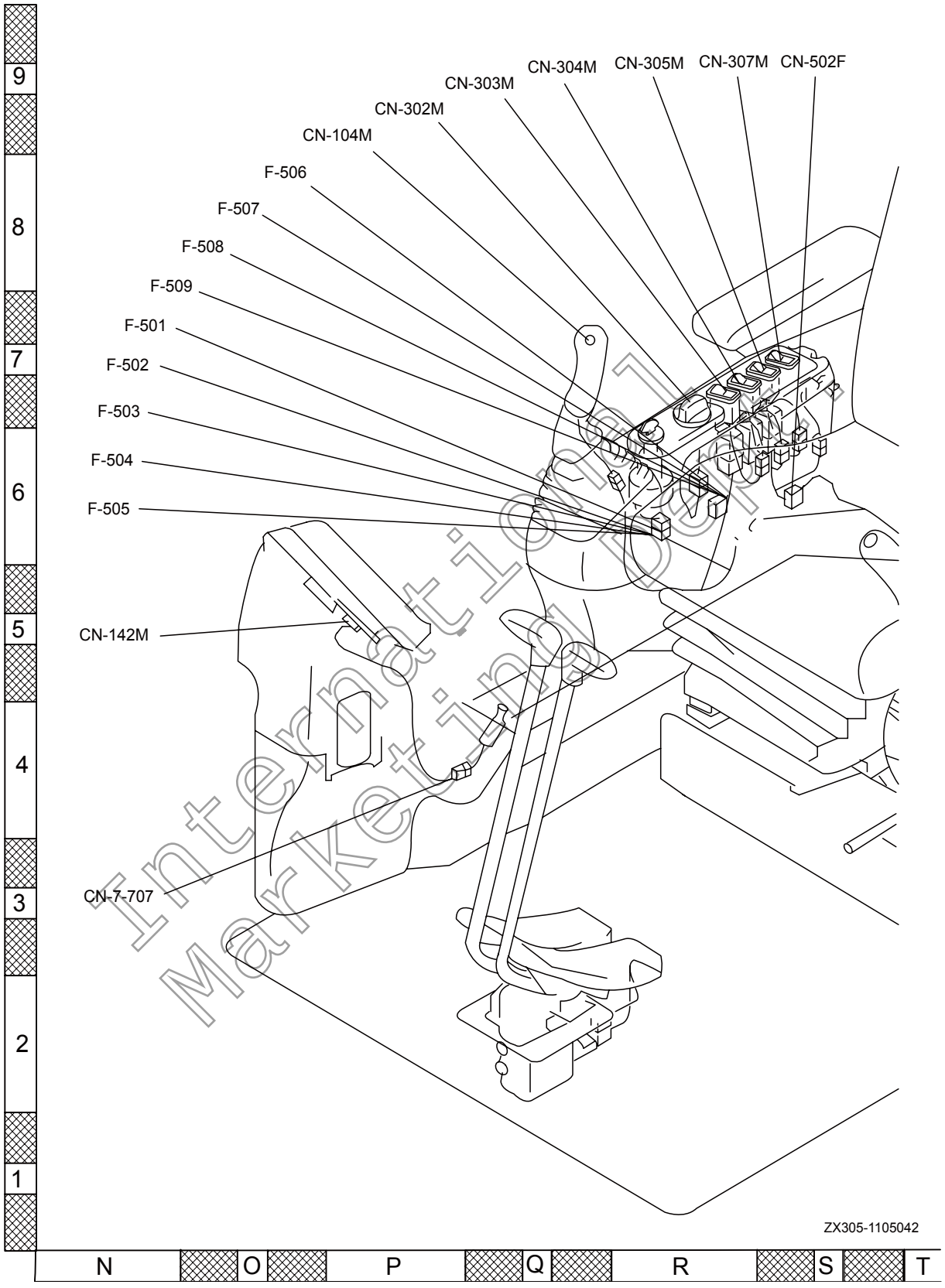
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Fig. 7-4

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Fig. 7-5

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7.3.2 Diagram of system electrical elements

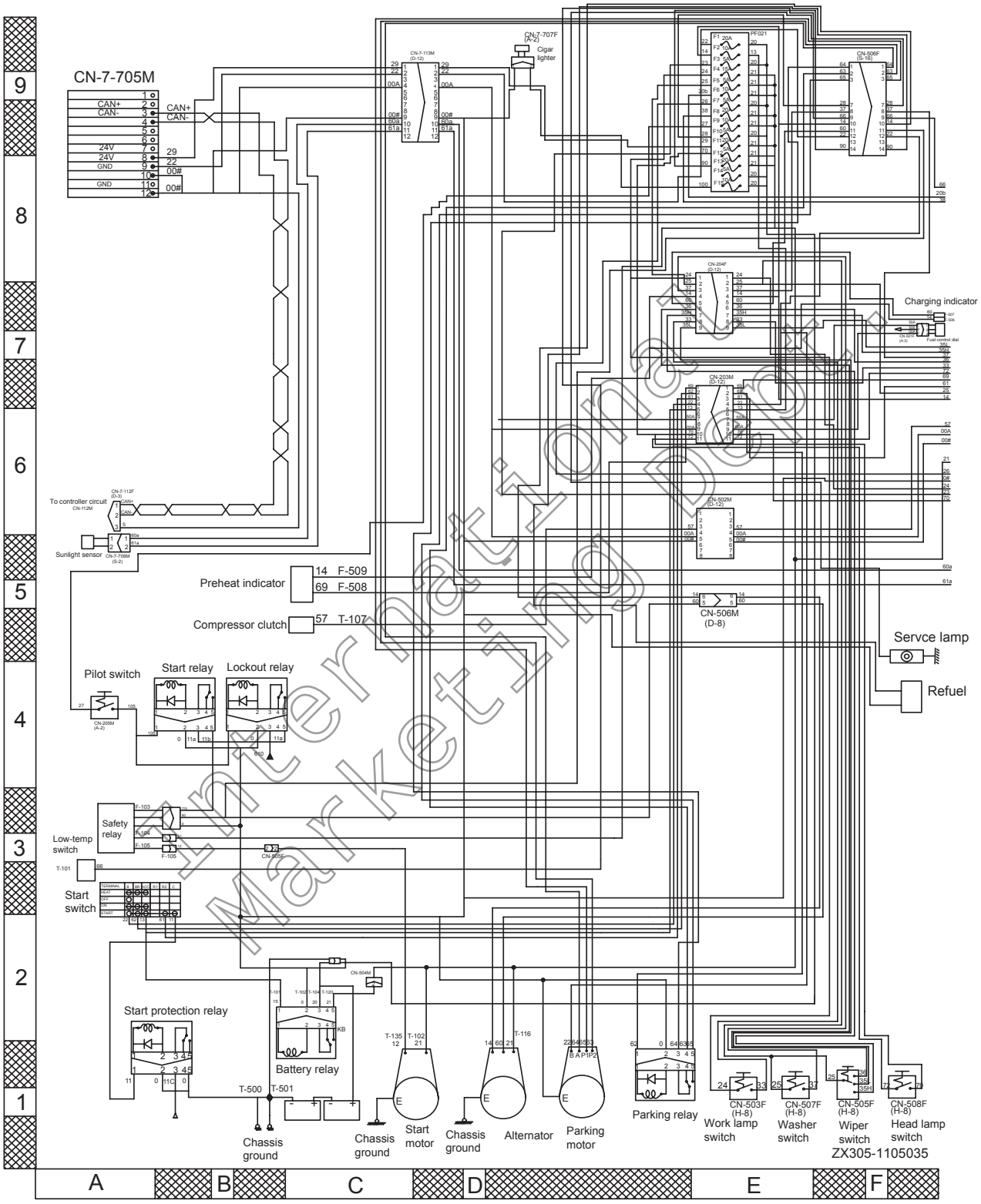


Fig. 7-6

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- This circuit diagram has been compiled by extracting the wiper system and the switch control systems from the general electrical circuit diagram.

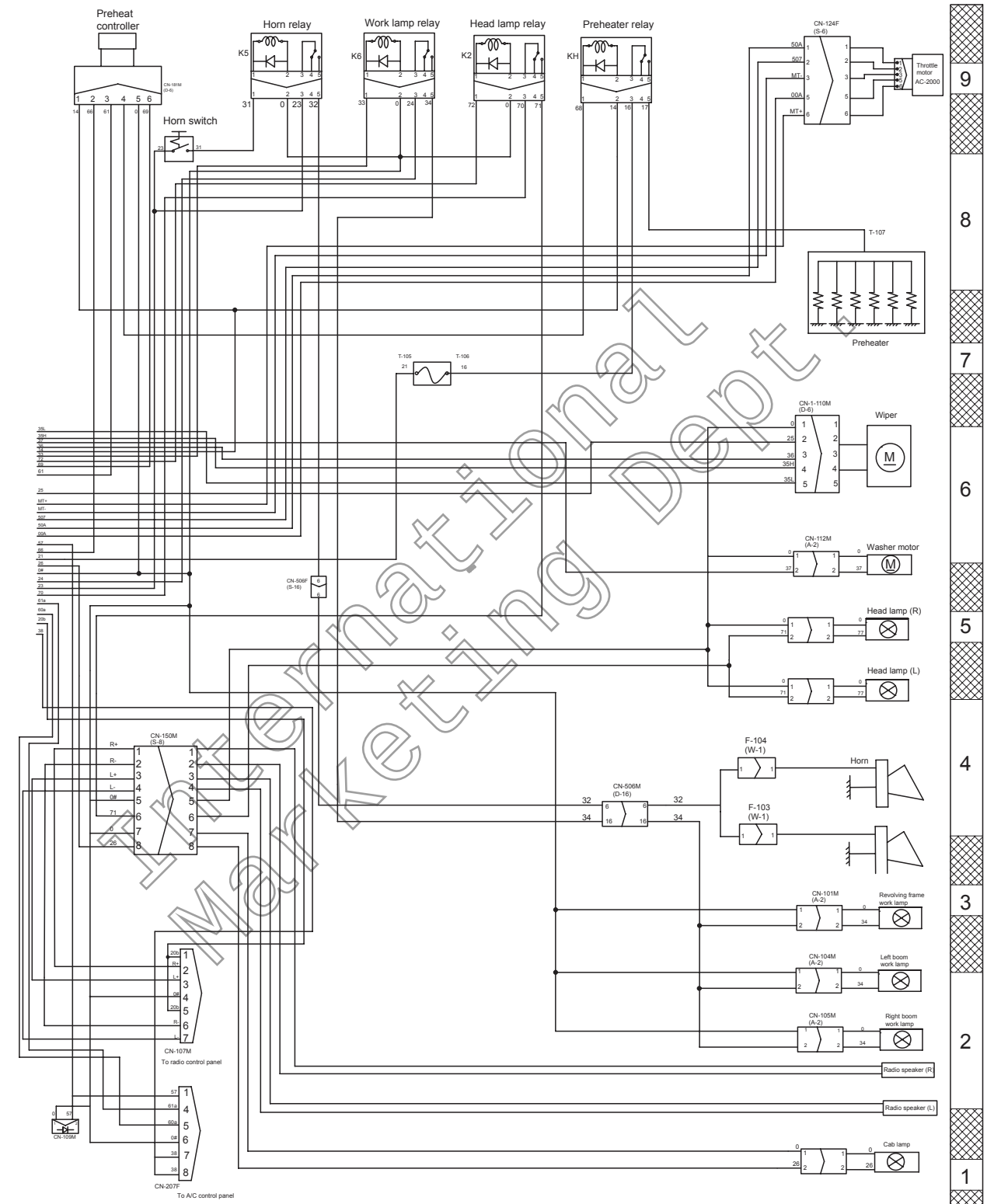
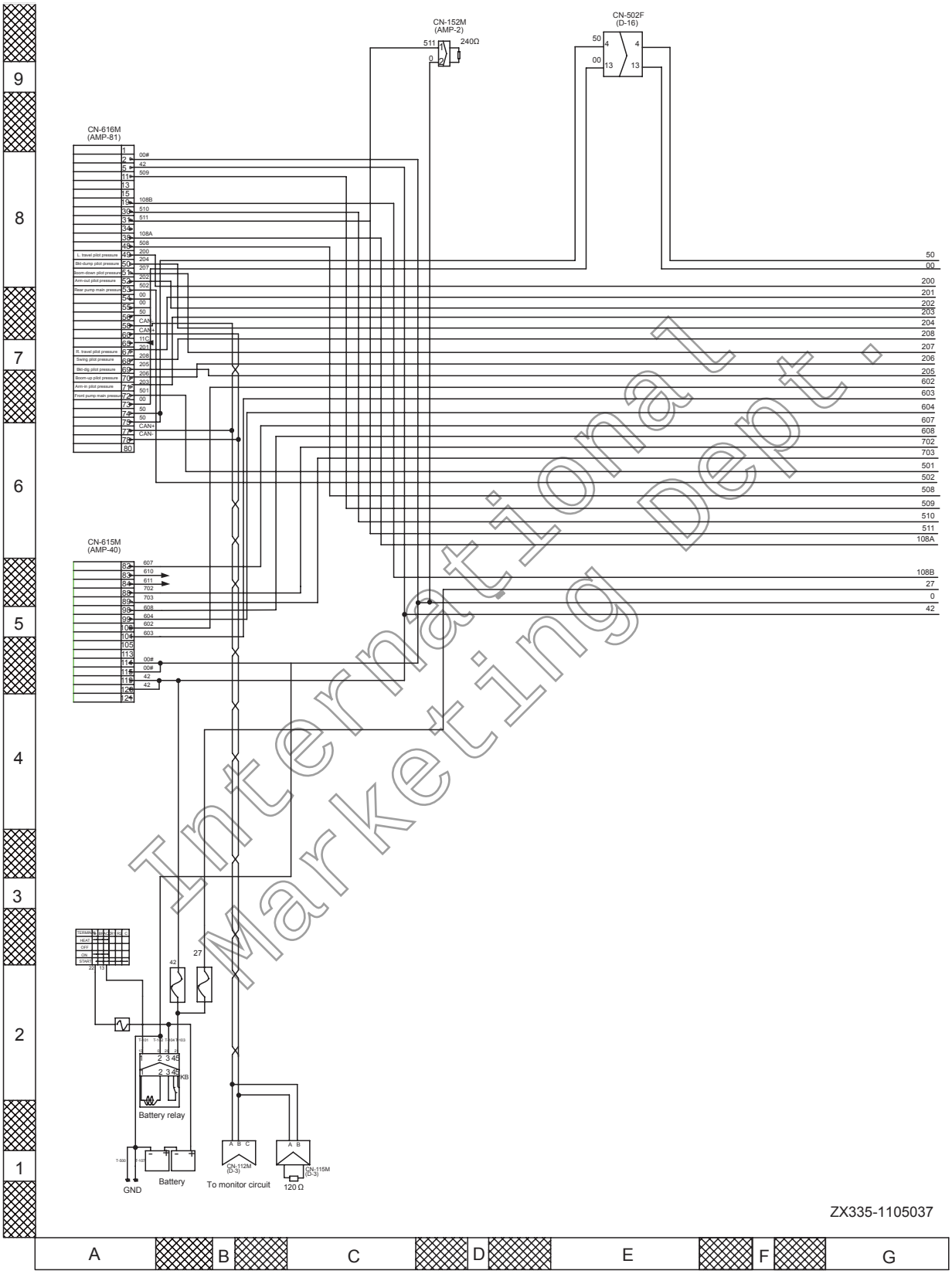


Fig. 7-7

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7.3.3 Diagram of electrical control system



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Fig. 7-8

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- This circuit diagram has been compiled by extracting the pressure collecting system and the solenoid valve control systems from the general electrical circuit diagram.

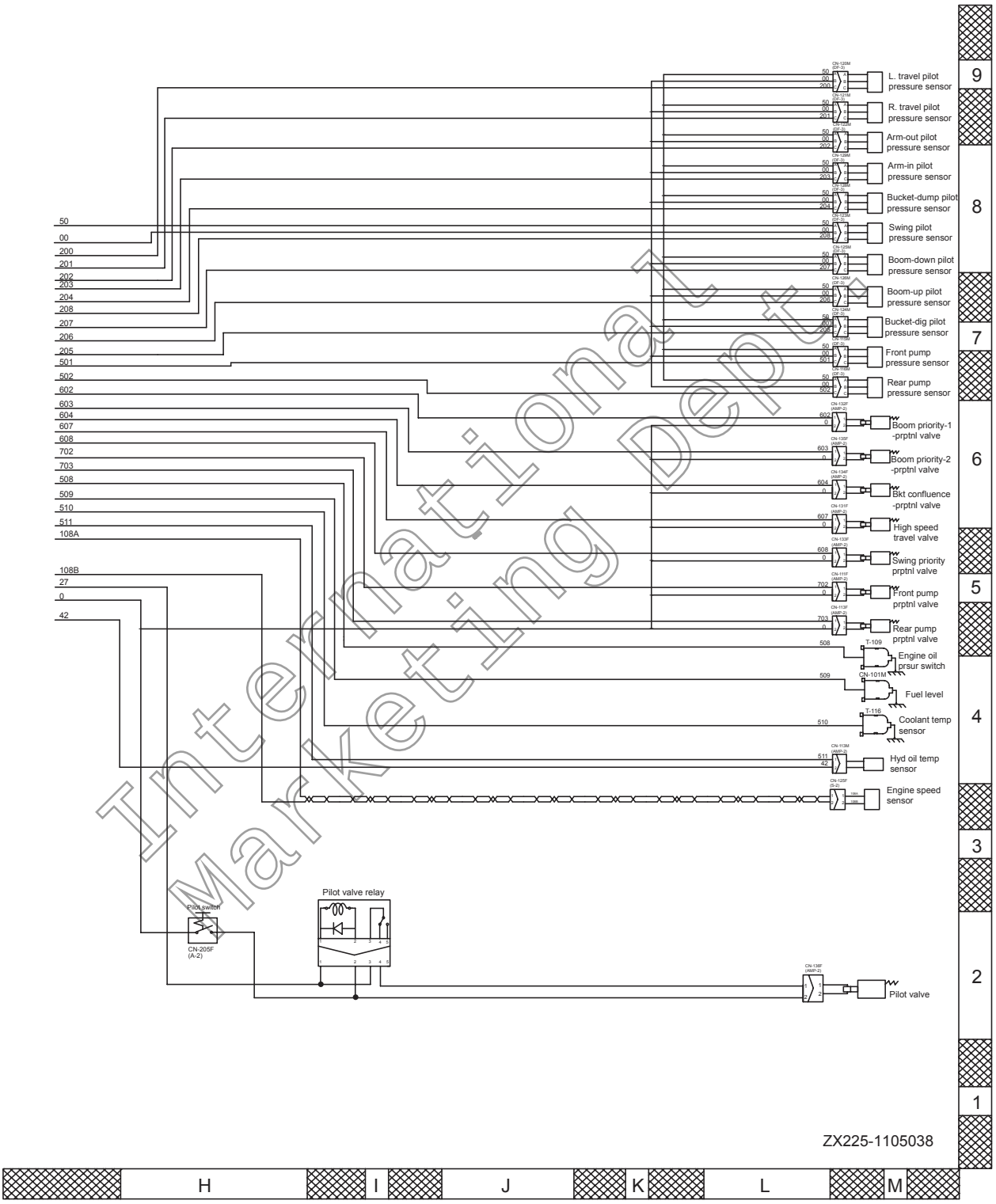
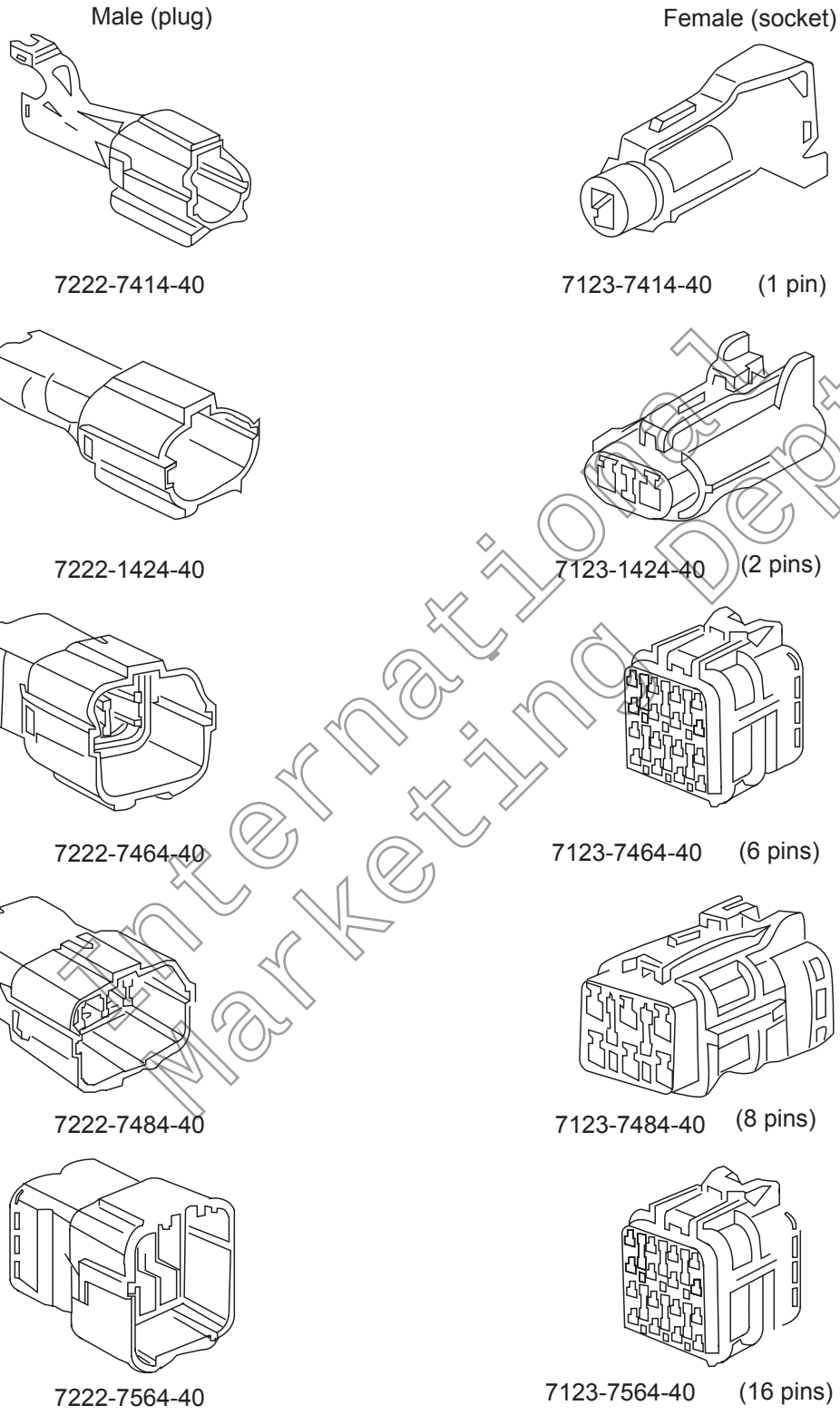


Fig. 7-9

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7.3.4 SWP connectors

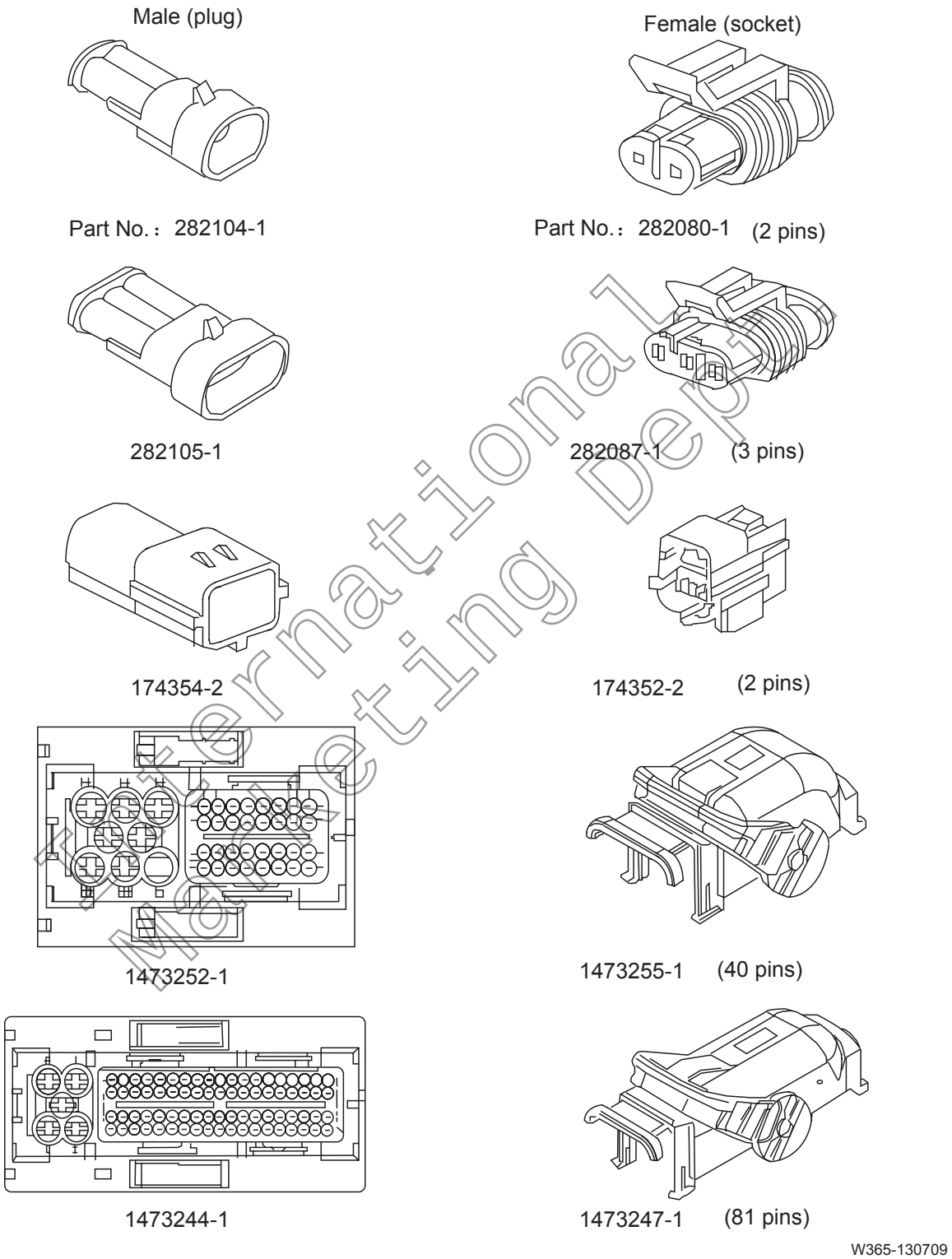


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Fig. 7-10

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7.3.5 A/AMP connectors

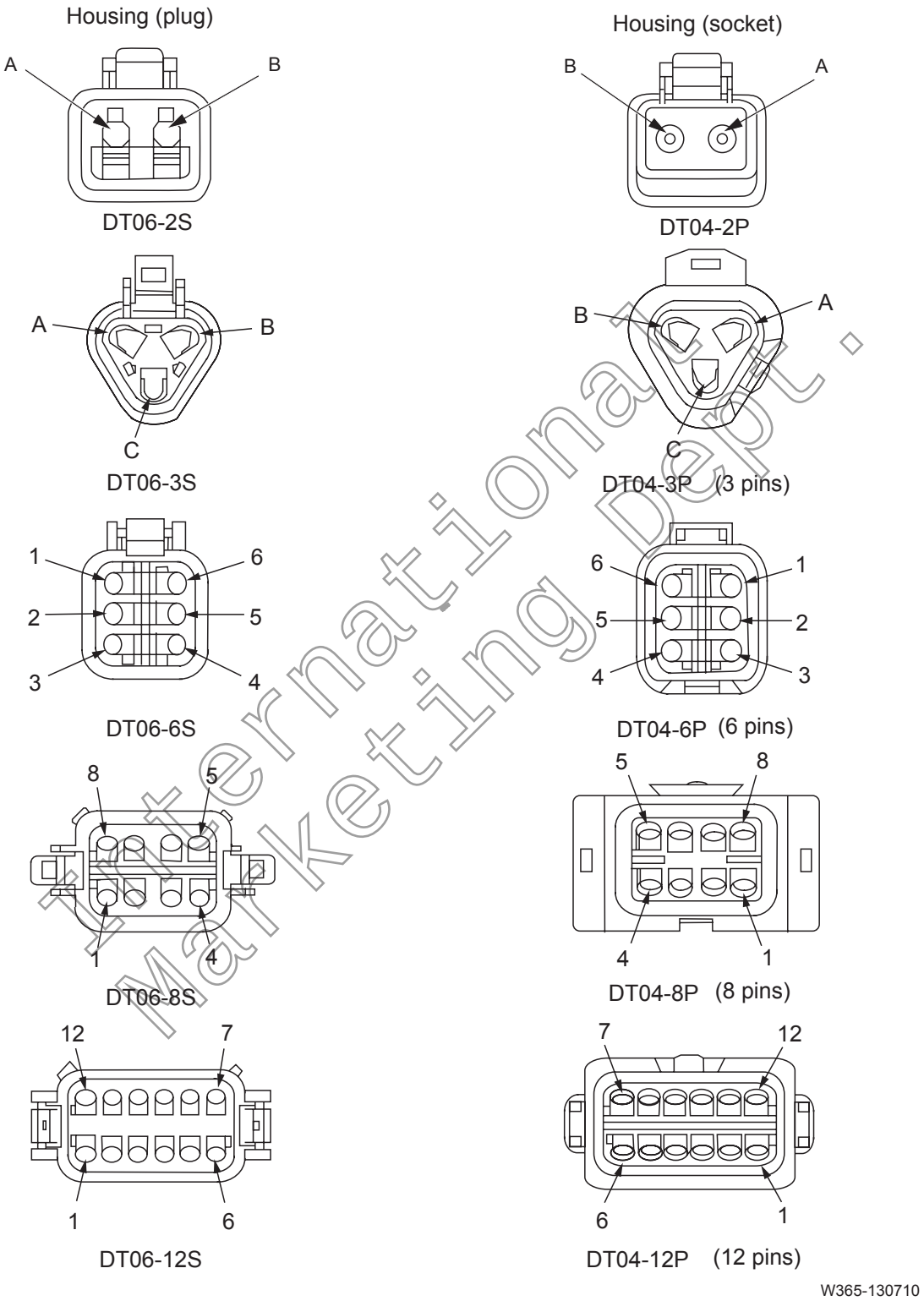


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Fig. 7-11

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7.3.6 DT connectors



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Fig. 7-12

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7.4 Troubleshooting with an Event Code

Information contained in troubleshooting table 7-26
E015 Power voltage abnormal 7-27
E212 Irregular throttle motor current or defective motor connection 7-28
E240 Hydraulic oil temperature abnormal 7-29
E320 Front pump output pressure abnormal 7-30
E321 Rear pump output pressure abnormal 7-31
E322 Bucket-dig pilot pressure abnormal 7-32
E323 Bucket-dump pilot pressure abnormal 7-33
E324 Arm-in pilot pressure abnormal 7-34
E325 Arm-out pilot pressure abnormal 7-35
E326 Boom-up pilot pressure abnormal 7-36
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E328 Left travel pilot pressure abnormal 7-38
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E332 Motor built-in potentiometer irregular 7-41
E434 Front pump proportional solenoid current abnormal (A) 7-42
E435 Rear pump proportional solenoid current abnormal (A) 7-43
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Information contained in troubleshooting table

Failure code	Service Code	Failure symptom	Title of failure shown in failure history
Code displayed	——		
Failure information	Failure is described on the monitor display.		
Controller reaction	When failure is detected, the controller has taken action to protect the affected system or equipment.		
Machine reaction	Symptom that is shown on the machine due to action of controller.		

	Cause		Standard values and troubleshooting references
Possible causes and standard values	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	<Inclusion> • Standard value under normal condition can be used to judge possible causes • Reference for passing the above "Good" or "No Good" judgement <Symptom of Wiring Harness Failure> • Open circuit Faulty contact with connector or open circuit in wiring harness • Faulty grounding An ungrounded wiring is grounded. • Short circuit A wiring has mistaken contact with a 24 V electric circuit.
	2		
	3		
	4		
	5		

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Related circuit diagram

This is part of the circuit diagram which shows the portion where the failure occurred.

- Connector No.: A connector number Indicates a connector.
- Arrow: An arrow roughly indicates the installing location.

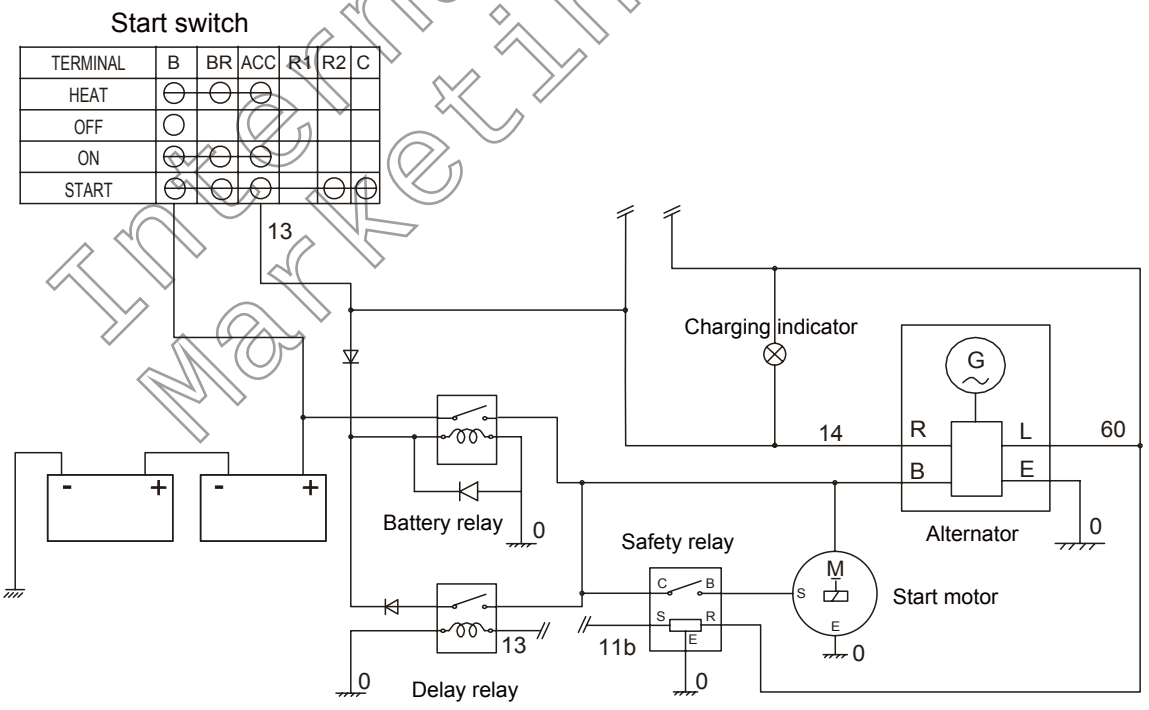
https://truckmanualshub.com/

E015 Power voltage abnormal

Failure code	Failure symptom	Power voltage abnormal
E015		

Failure description	Voltage of power supply is higher than 36V during machine operation.
Controller reaction	Driving of motor and solenoid valve is cut off automatically by the system.
Machine symptom	Engine fails to accelerate and machine moves slowly.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Power failure	★ Turn the start switch to the OFF position and leave it in the position for trouble-shooting.		
			Check battery voltage.	Volt	Under 25 V
	2	Alternator abnormal	★ Turn the start switch to the OFF position before proceeding. Turn the start switch to the START position for trouble shooting.		
			Measure between alternator terminal B and ground.	Volt	Around 28 V
	3				
	4				



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Fig. 7-13

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E212 Irregular throttle motor current or defective motor connection

Failure code	Failure symptom	Throttle motor loading circuit is abnormal and the engine acceleration fails.
E212		
Failure description	Motor feedback voltage is lower than 0.25V or higher than 4.75V	
Controller reaction	The controller stops the motor driving system when this failure is detected.	
Symptom on machine	Engine acceleration fails and the machine acts slowly. .	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of throttle motor coil	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between ③ and ⑥ of CN-124M	Resistance ◇	12.2Ω
	2	Open circuit of harness	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the controller and measure the resistance between the pins 32 and 33.	Resistance	12.2Ω
	3	Short circuit of harness (grounded)	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-124M and measure the resistance between motor ③ (⑥) and the housing.	Resistance	Above 2MΩ
	4	Internal failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of failure.)		
	5				

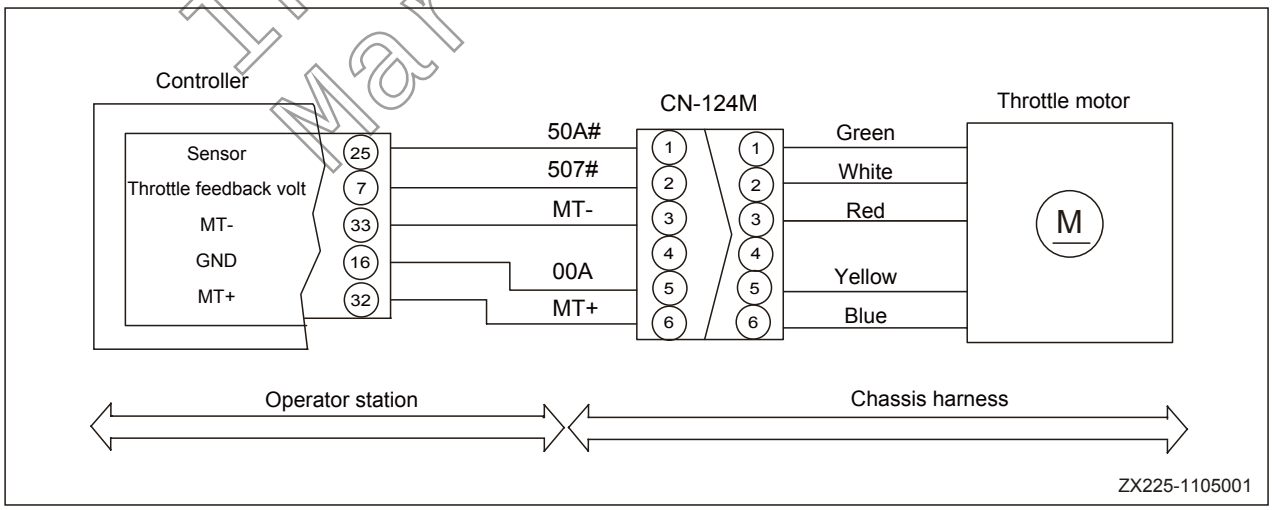


Fig. 7-14

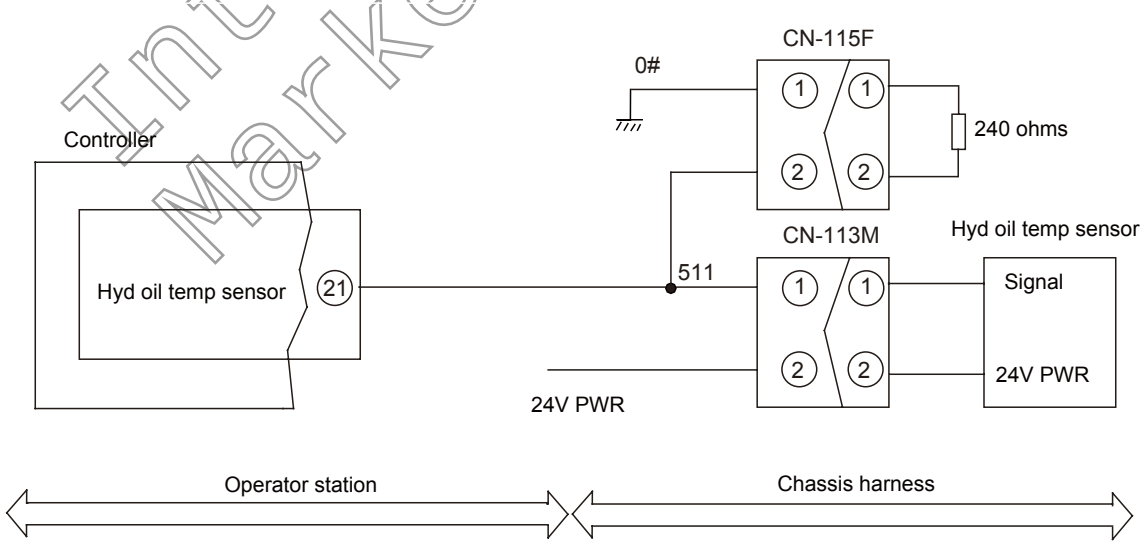
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E240 Hydraulic oil temperature abnormal

Failure code	Failure symptom	Hydraulic oil temperature is abnormal. Only alarm output is effective.
E240		
Failure description	Controller detects a temperature resistance of hydraulic oil that is lower than 10 ohms or higher than 120 ohms and it lasts more than 3s.	
Controller reaction	Only alarm output is effective. The alarm resets automatically when conditions become normal.	
Symptom on machine	——	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of sensor	• Turn the start switch to the OFF position and then keep it in the ON position to perform troubleshooting.		
			Between CN-113M ① and ground	Voltage	0.2-4.75V
	2	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-113M ① and pin 21 of controller	Resistance	Under 1Ω
	3	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-113M ① and ground	Resistance	Above 1MΩ
	4	Failure of 24V power supply	• Turn engine start switch to OFF position. Keep it at ON position to perform troubleshooting.		
			Between CN-113M ② and ground	Voltage	About 24V
	5				



ZX225-1105016

Fig. 7-15

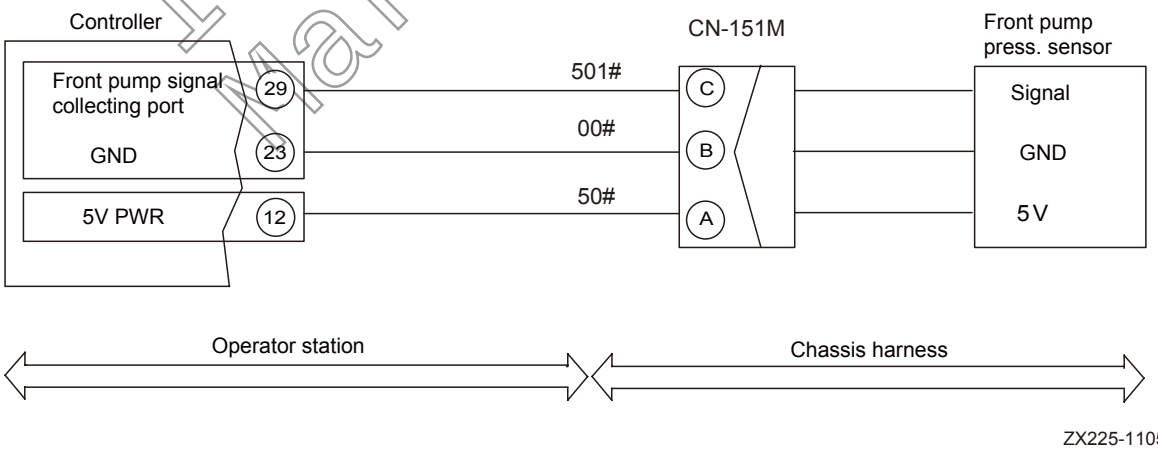
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E320 Front pump output pressure abnormal

Failure code	Failure symptom	Front pump output pressure is abnormal. Only alarm output is effective.
E320		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	——	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the ON position while troubleshooting is performed.		
			Between CN-151M A and B	Voltage	About 5V
	2	Open circuit of signal line	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-151M C and pin 29 of controller	Resistance	Under 1Ω
			Between CN-115M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-151M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	● Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-151M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105003

Fig. 7-16

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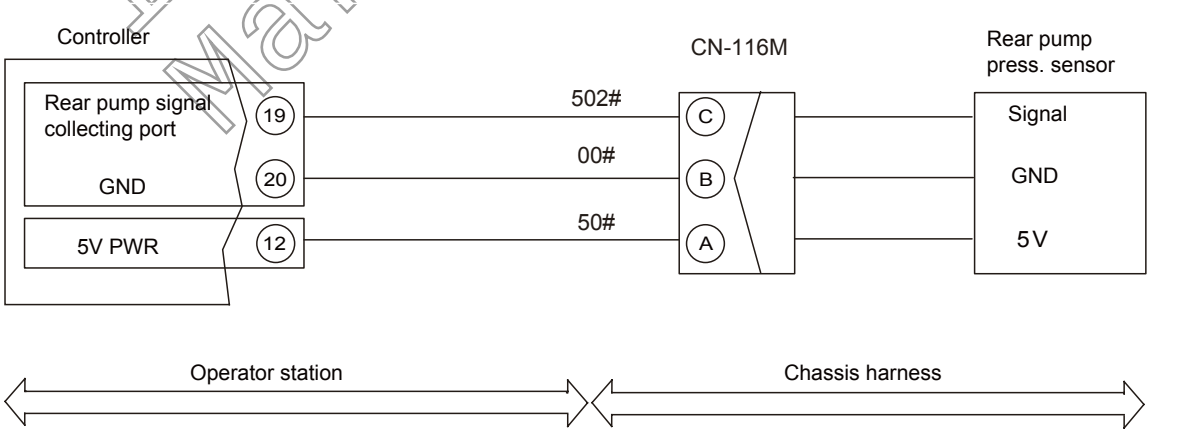
E321 Rear pump output pressure abnormal

- - - -

Failure code	Failure symptom	Reading of rear pump output pressure is abnormal. Only alarm output is effective. .
E321		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	——	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-116M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-116M C and pin 19 of controller	Resistance	Under 1Ω
			Between CN-116M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-116M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-116M C and ground	Voltage	0.5±0.2V
	5				

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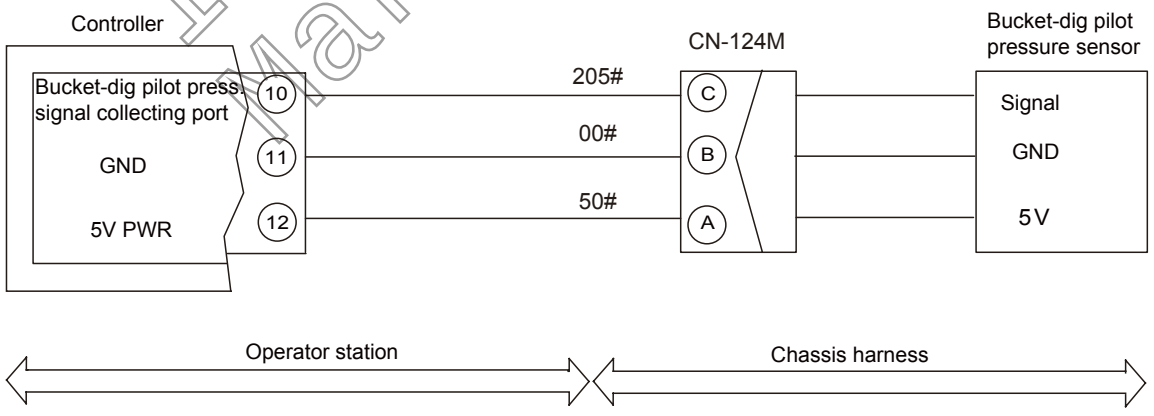
Fig. 7-17

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E322 Bucket-dig pilot pressure abnormal

Failure code	Failure symptom	Bucket-dig pilot pressure is abnormal. Only alarm output is effective. .
E322		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	The bucket-dig motion is slow.	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-124M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-124M C and pin 10 of controller	Resistance	Under 1Ω
			Between CN-124M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-124M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-124M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105005

Fig. 7-18

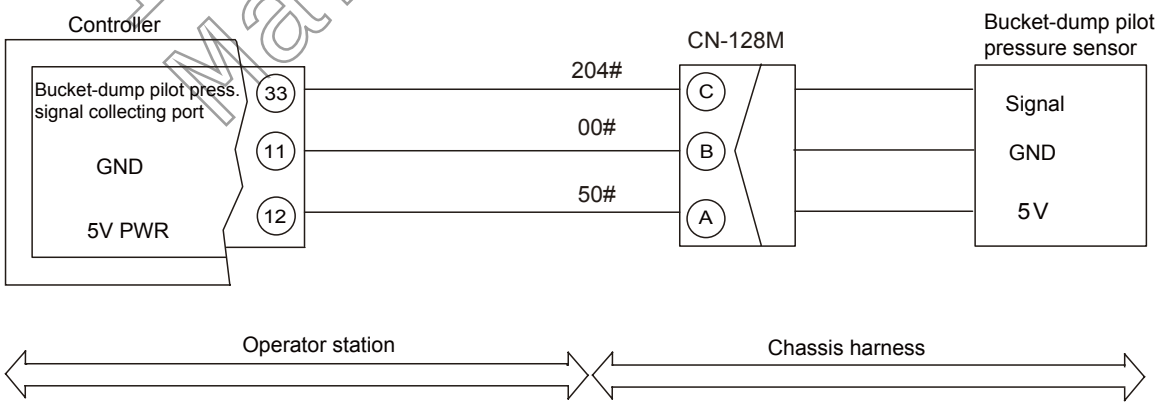
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E323 Bucket-dump pilot pressure abnormal

Failure code	Failure symptom	Reading of bucket-dump pilot pressure is abnormal. Only alarm output is effective.
E323		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Bucket-dump motion is slow.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-128M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-128M C and pin 33 of controller	Resistance	Under 1Ω
			Between CN-128M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed. .		
			Between CN-128M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-128M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105006

Fig. 7-19

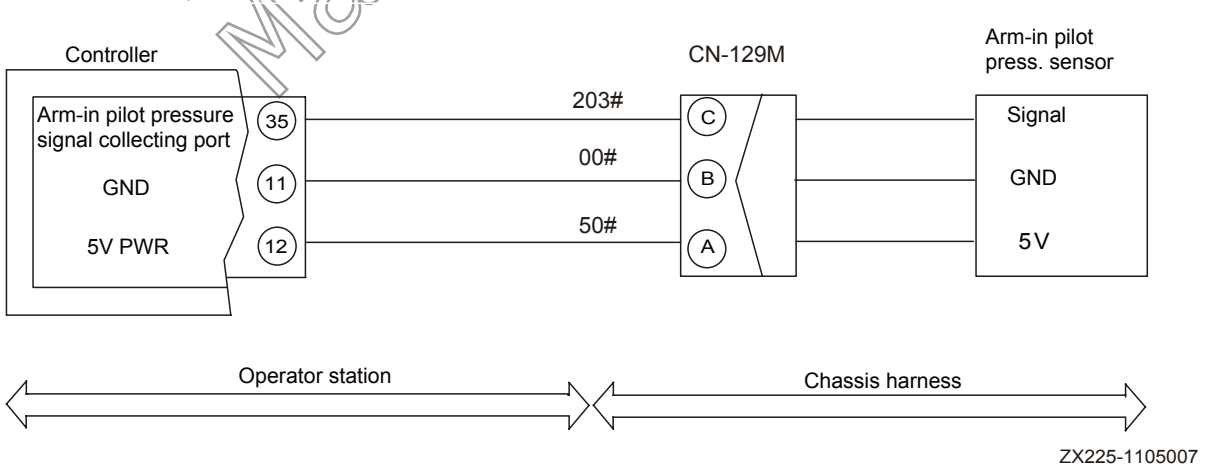
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E324 Arm-in pilot pressure abnormal

Failure code	Failure symptom	Reading of Arm-in pilot pressure is abnormal. Only alarm output is effective. .
E324		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Arm-in motion is slow.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-129M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M C and controller pin 35	Resistance	Under 1Ω
			Between CN-129M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-129M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105007

Fig. 7-20

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E325 Arm-out pilot pressure abnormal

Failure code	Failure symptom	Reading of Arm-out pilot pressure is abnormal. Only alarm output is effective. .
E325		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Arm-out motion is slow.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-122M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M C and pin 22 of controller	Resistance	Under 1Ω
			Between CN-122M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-122M C and ground	Voltage	0.5±0.2V
	5				

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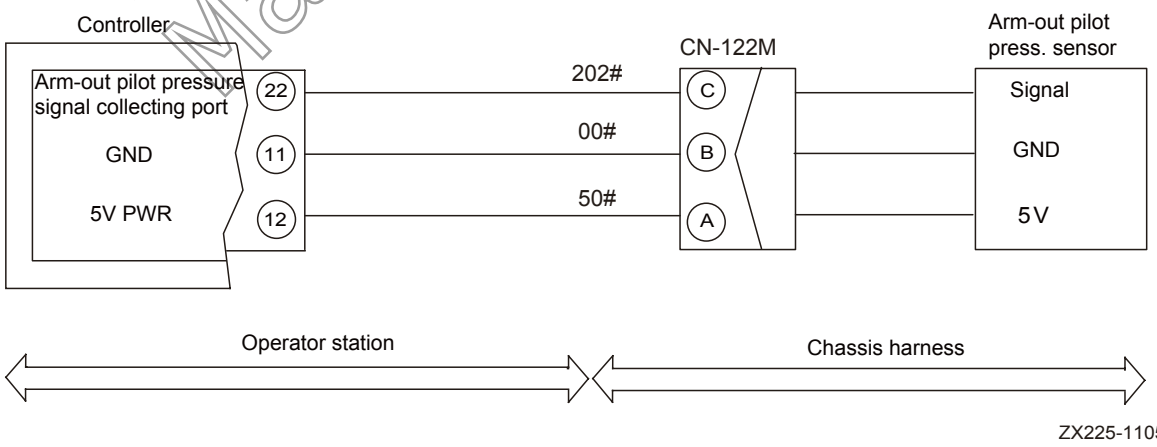


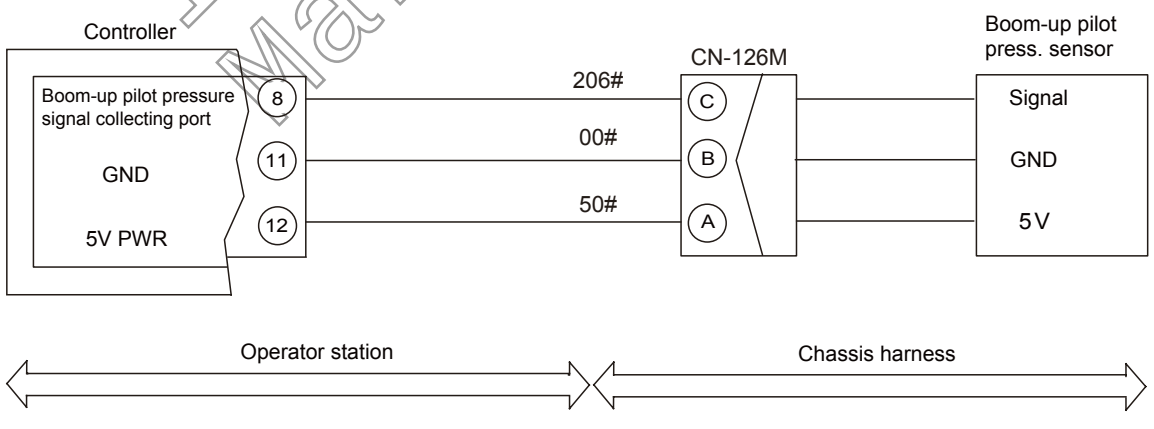
Fig. 7-21

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E326 Boom-up pilot pressure abnormal

Failure code	Failure symptom	Reading of boom-up pilot pressure is abnormal. Only alarm output is effective. .
E326		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Boom-up motion is slow.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-126M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-126M C and controller pin 8.	Resistance	Under 1Ω
			Between CN-126M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-126M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-126M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105009

Fig. 7-22

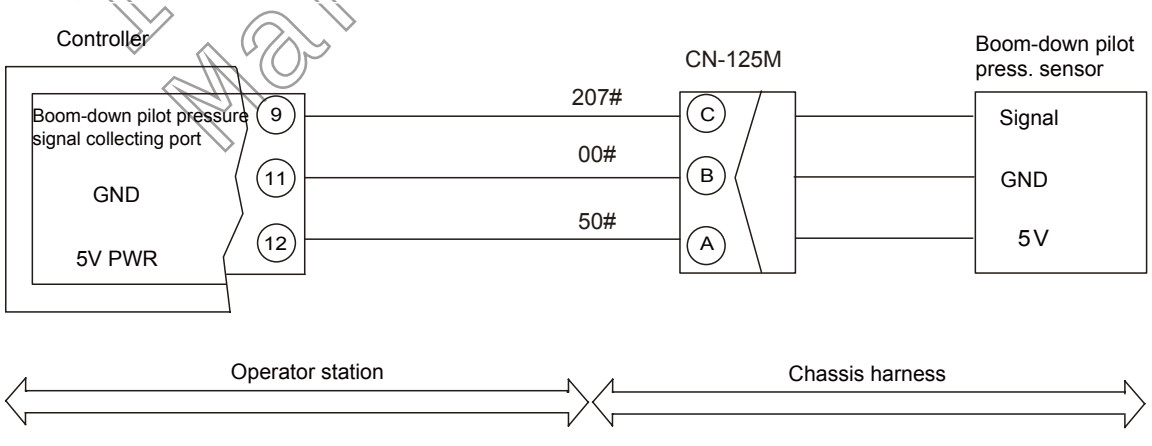
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E327 Boom-down pilot pressure abnormal

Failure code	Failure symptom	Reading of boom-down pilot pressure is abnormal. Only alarm output is effective. .
E327		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Boom-down motion is slow.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-125M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M C and controller pin 9	Resistance	Under 1Ω
			Between CN-125M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-125M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105010

Fig. 7-23

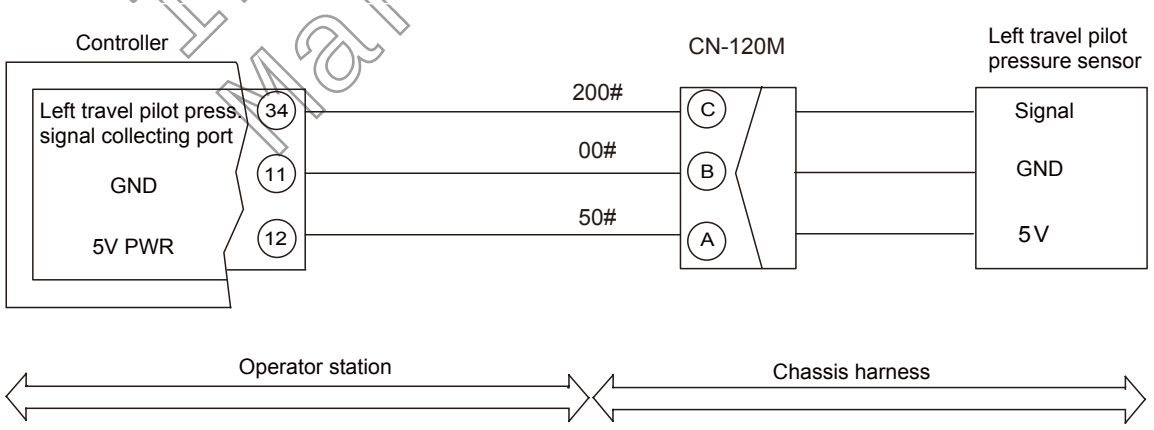
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E328 Left travel pilot pressure abnormal

Failure code	Failure symptom	Reading of left travel pilot pressure is abnormal. Only alarm output is effective. .
E328		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Left travel speed is low. Travel deviates.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-120M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-120M C and pin 34 of controller	Resistance	Under 1Ω
			Between CN-120M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-120M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-120M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105011

Fig. 7-24

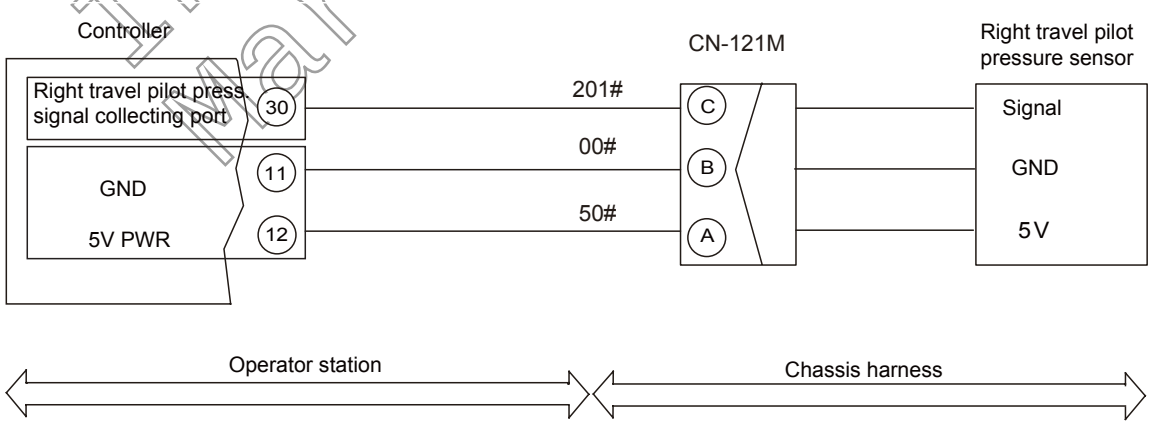
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E329 Right travel pilot pressure abnormal

Failure code	Failure symptom	Reading of right travel pilot pressure is abnormal. Only alarm output is effective. .
E329		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Right travel speed is low. Travel deviates.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-121M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-121M C and pin 30 of controller	Resistance	Under 1Ω
			Between CN-121M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-121M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-121M C and ground	Voltage	0.5±0.2V
	5				



ZX225-1105012

Fig. 7-25

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E330 Swing pilot pressure abnormal

Failure code	Failure symptom	Reading of swing pilot pressure is abnormal. Only alarm output is effective. .
E330		
Failure description	A pressure feedback voltage other than 0.25 – 4.75V keeps more than 200 msec when the power is on.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	Swinging motion is slow.	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-123M A and B	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-123M C and pin 18 of controller	Resistance	Under 1Ω
			Between CN-123M B and ground		Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-123M C and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-123M C and ground	Voltage	0.5±0.2V
	5				

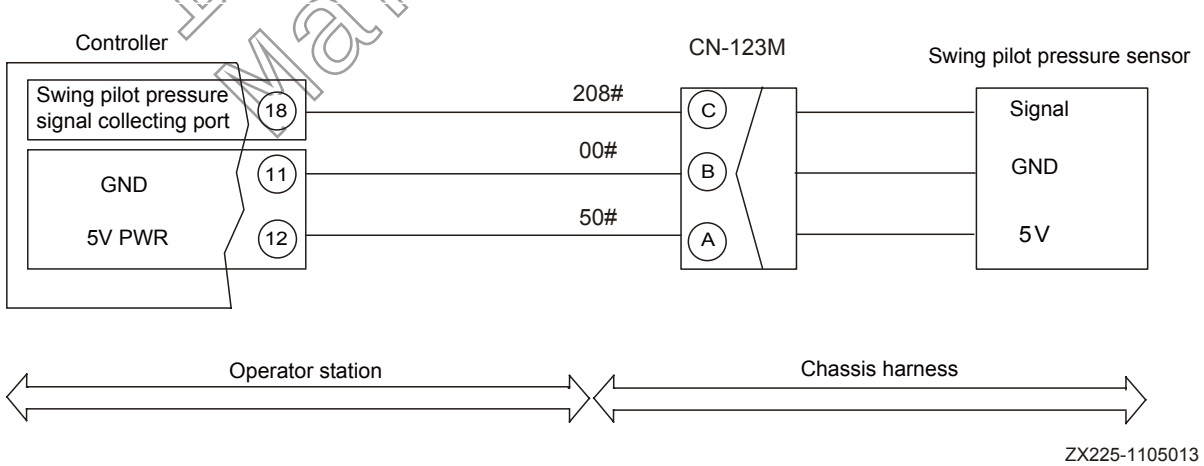


Fig. 7-26

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E332 Motor built-in potentiometer irregular

Failure code	Failure symptom	The potentiometer built in the motor is irregular. It returns to auto deceleration when time point is detected.
E332		
Failure description	When machine power is on, throttle position feedback has a voltage other than 0.25-4.75V lasting more 50 msec.	
Controller reaction	Returns to auto deceleration.	
Symptom on machine	The throttle fails to increase engine speed.	

Possible causes and standard values	Causes		Standard values and troubleshooting references		
	1	Failure of 5V power source	• Turn the start switch to the OFF position and then keep it in the ON position to perform troubleshooting.		
			Between CN-155M ① and ⑤	Volt	About 5V
	2	Open circuit of signal line	• Turn the start switch to the OFF position before troubleshooting. Kee the switch in the OFF position to perform troubleshooting.		
			Between CN-155M ② and the controller port pin 7	Resistance	Under 1Ω
			Between CN-155M ⑤ and ground		Under 1Ω
	3	Short cuit of signal line (grounded)	• Turn the start switch to the OFF position before troubleshooting. Kee the switch in the OFF position to perform troubleshooting.		
			Between CN-155M ② and ground	Resistance	Above 2MΩ

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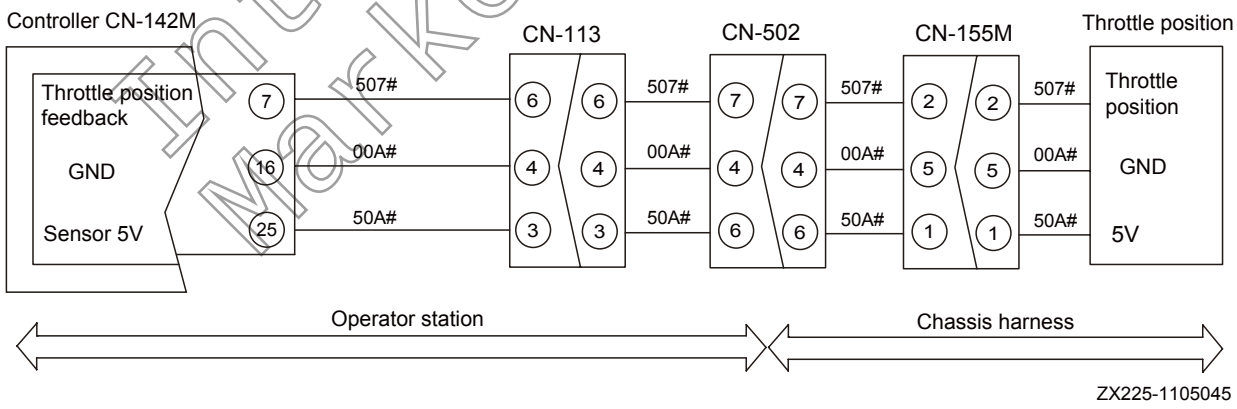


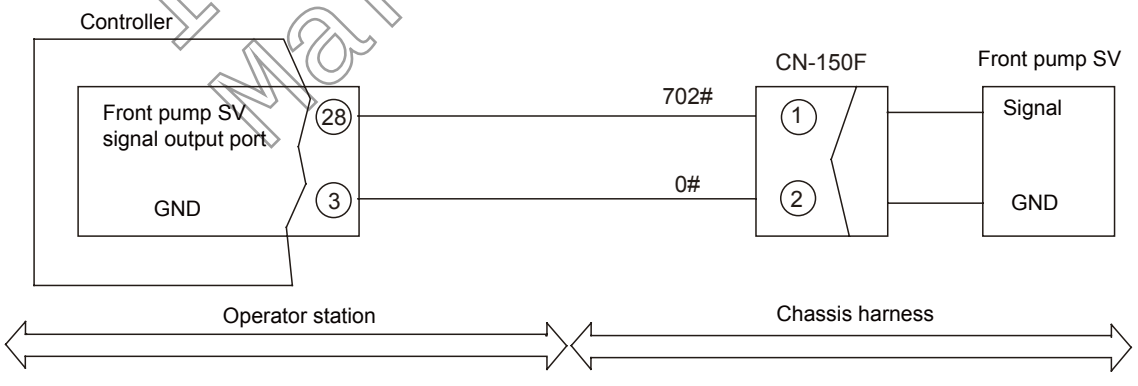
Fig. 7-27

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E434 Front pump proportional solenoid current abnormal (A)

Failure code	Failure symptom	Front pump proportional solenoid current is abnormal. The system operates slowly.
E434		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid. Current which is above 1.3A lasts for 3 second. Differential current occurs in drive protection loop.	
Controller reaction	Stop the solenoid when failure is detected. Power supply must be restored.	
Symptom on machine	System operates slowly.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-111F ① and pin 28 of controller	Resistance	Under 1Ω
			Between CN-111F ② and ground	Resistance	Under 1Ω
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-111F ① and wire 0#	Resistance	Above 1MΩ
	3	Failure of proportional valve coil	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-111F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				



ZX225-1105014

Fig. 7-28

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E435 Rear pump proportional solenoid current abnormal (A)

Failure code	Failure symptom	Rear pump proportional solenoid current is abnormal. The system operates slowly.
E435		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid. Current which is above 1.3A lasts for 3 second. Differential current occurs in drive protection loop.	
Controller reaction	Stop the solenoid when failure is detected. Power supply must be restored.	
Symptom on machine	System operates slowly.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-113F ① and pin 17 of controller	Resistance	Under 1Ω
			Between CN-113F ② and ground		Under 1Ω
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-113F ① and wire 0#	Resistance	Above 1MΩ
	3	Failure of proportional valve coil	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-113F, and measure the resistance between solenoid valve's ① and ② .	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

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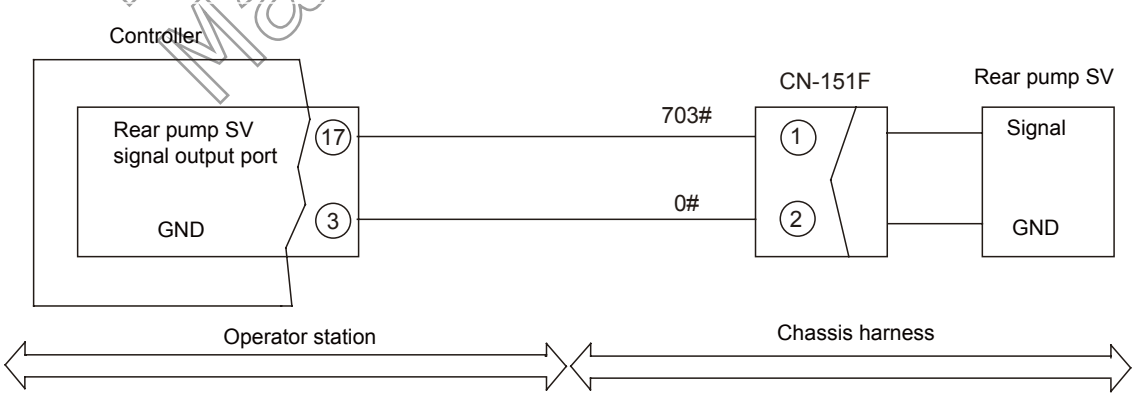


Fig. 7-29

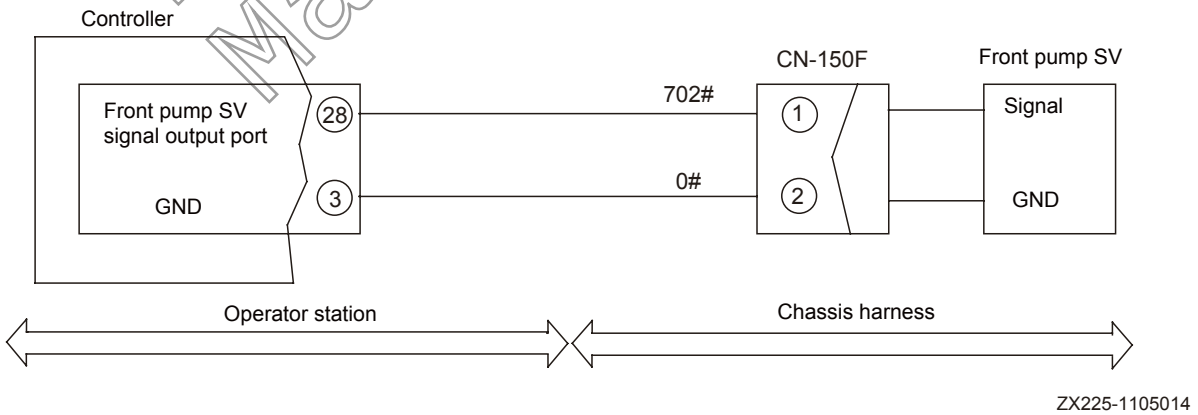
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E436 Front pump proportional solenoid current abnormal (B)

Failure code	Failure symptom	Front pump proportional solenoid current is abnormal. The system operates slowly.
E436		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid. Current which is under 0.2 A lasts for 3 seconds and PWM output is greater than 10V.	
Controller reaction	Stop the solenoid when failure is detected. Power supply must be restored.	
Symptom on machine	System operates slowly.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-150F ① and pin 28 of controller	Resistance	Under 1Ω
			Between CN-150F ② and ground		Under 1Ω
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-150F ① and wire 0#	Resistance	Above 1MΩ
	3	Failure of proportional valve coil	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-150F, and measure the resistance between solenoid valve's ① and ②.	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

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ZX225-1105014

Fig. 7-30

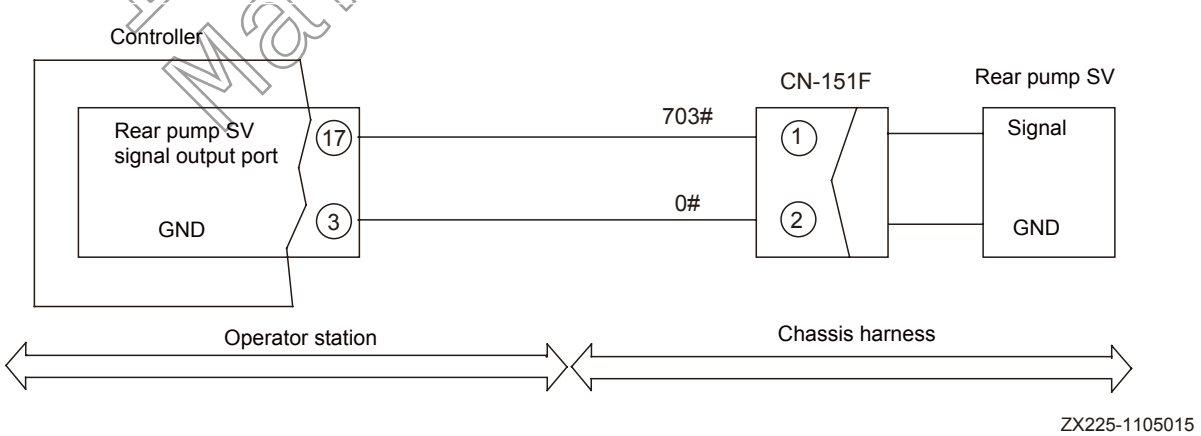
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E437 Rear pump proportional solenoid current abnormal (B)

Failure code	Failure symptom	Rear pump proportional solenoid current is abnormal. The system operates slowly.
E437		
Failure description	Abnormality occurs in loaded circuit of proportional solenoid. Current which is under 0.2 A lasts for 3 seconds and PWM output is greater than 10V.	
Controller reaction	Stop the solenoid when failure is detected. Power supply must be restored.	
Symptom on machine	System operates slowly.	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-151F ① and pin 17of controller	Resistance	Under 1Ω
			Between CN-151F ② and ground		Under 1Ω
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-151F ① and wire 0#	Resistance	Above 1MΩ
	3	Failure of proportional valve coil	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-151F, and measure the resistance between solenoid valve's ① and ②	Resistance	17.5Ω
	4	Failure of controller	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		
	5				

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Fig. 7-31

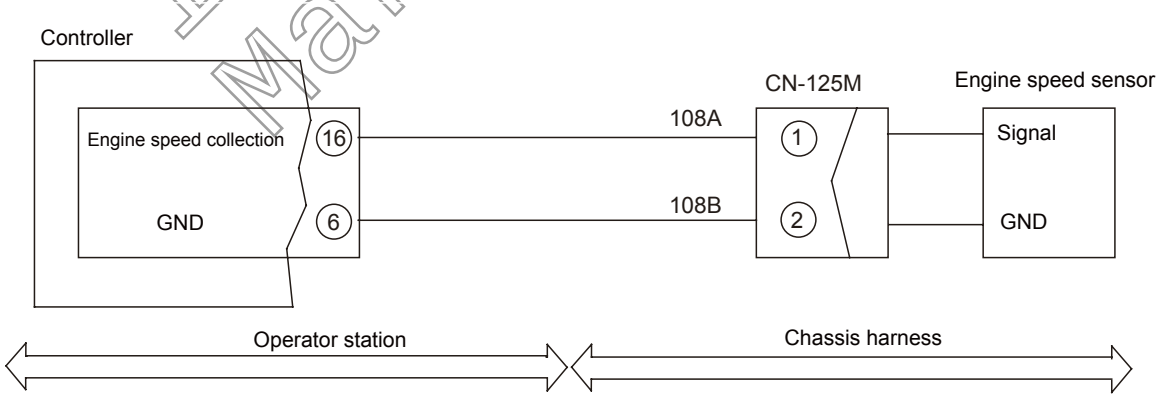
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E543 Engine speed abnormal

Failure code	Failure symptom	Engine speed is abnormal. Only alarm output is effective.
E543		
Failure description	CPU detects out that engine speed is too low (below 100 rpm).	
Controller reaction	Only alarm output is effective. The alarm resets automatically when conditions become normal.	
Symptom on machine	——	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Normal condition	Code 43 will be displayed on the monitor when the engine start switch is turned from the OFF position to the ON position.		
	2	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M ① and pin 16 of controller	Resistance	Under 1Ω
			Between CN-125M ② and pin 6 of controller		Under 1Ω
	3	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M ① and ground	Resistance	Above 1MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector CN-125M, and measure the resistance between ① and ② of the speed sensor.	Resistance	$2.3 \pm 0.2k\Omega$
	5				

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Fig. 7-32

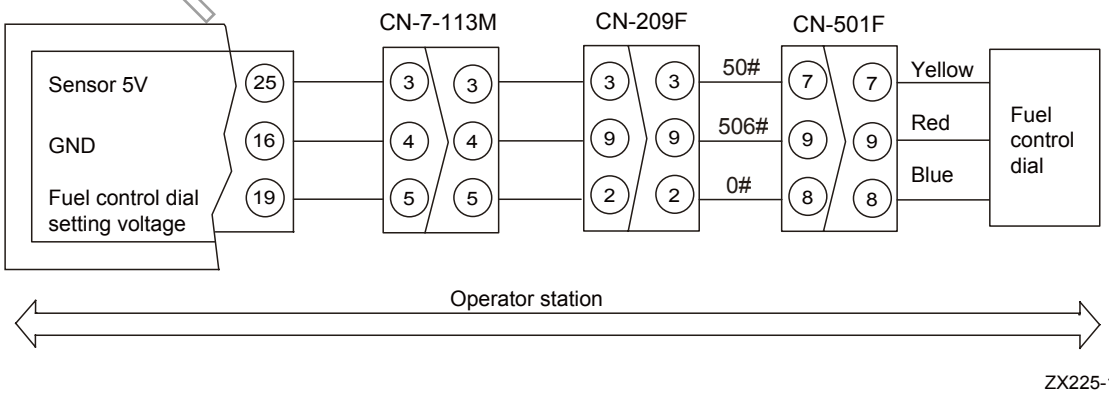
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E244 Fuel control dial setting voltage abnormal

Failure code	Failure symptom	Fuel control dial setting voltage is abnormal and engine returns auto deceleration.
E544		
Failure description	When power is on, voltage of fuel control dial other than 0.25-4.75V lasts for over 200 msec.	
Controller reaction	Throttle is moved to idle position.	
Symptom on machine	Engine returns auto deceleration.	

Possible causes and standard values	Causes		Standard values and troubleshooting references		
	1	5V power failure	• Turn the start switch to the OFF position before troubleshooting. Keep it in the ON position while troubleshooting is performed.		
			CN-501F ⑦ and ⑨	Volt	About 5V
	2	Open circuit of signal line	• Turn the start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			CN-501F ⑧ and controller pin19	Resistance	Under 1Ω
	3	Short circuit of signal line (grounded)	• Turn the start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			CN-501F ⑧ and ground	Resistance	Above 2MΩ
	4	Short circuit of signal line (contact with power supply)	• Turn the start switch to the OFF position before troubleshooting. Keep it in the ON position while troubleshooting is performed.		
			CN-501F ⑧ and ground	Volt	Under 5V
	5	Dial failure	• Turn the start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug connector CN-501F and measure fuel control dial ⑦ and ⑨ .	Resistance	5K±15%Ω

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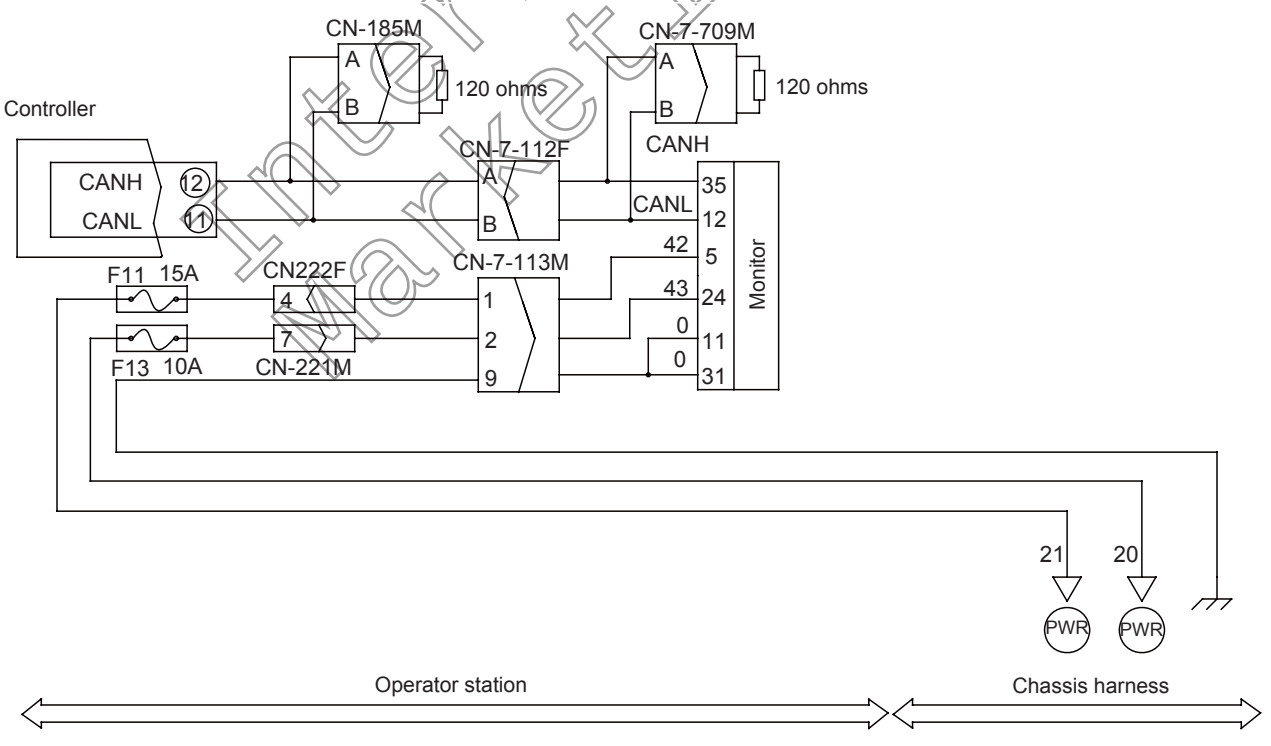
Fig. 7-33

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E145 CAN bus abnormal

Failure code	Failure symptom	Abnormality of CAN bus activates alarm.
E145		
Failure description	Time-out of CAN bus communication lasts for over 3s.	
Controller reaction	Only alarm output is effective.	
Symptom on machine	----	

Possible causes and standard values	Causes		Standard values and troubleshooting references		
	1	CAN resistance failure	• Turn the start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-7-709 A and B	Resistance	60Ω
			Between CN-185 A and B	Resistance	60Ω
	2	Open circuit of Harness	• Turn the start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug controller connector and measure pin 12 and CN-7-112 A.	Resistance	Under 1Ω
			Unplug controller connector and measure pin 11 and CN-7-112 B.		Under 1Ω
	3	Controller internal failure	No troubleshooting can be done for failure occurs in the inner of controller. (Except for the above reasons, the controller must be replaced in case of this failure.)		



ZX335-1005040

Fig. 7-34

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7.5 Troubleshooting Electrical System (E-Mode)

E-1 Engine does not crank 7-51
E-2 Engine runs rough or is unstable 7-54
E-3 Power supply of machine cannot be cut off 7-55
E-4 Throttle motor not working 7-56
E-5 Auto idle not functioning 7-57
E-6 Preheat function fails 7-59
E-7 All components not working 7-60
E-8 Boom-up speed or power is low 7-61
E-9 Arm speed or power is low 7-62
E-10 Bucket speed or power is low 7-63
E-11 Travel speed or power is low 7-65
E-12 Blank monitor display 7-66
E-13 Monitor displays nothing 7-67
E-14 Dual speed travel not functioning 7-68
E-15 Incorrect engine coolant reading 7-69
E-16 Incorrect fuel level reading 7-70
E-17 Wiper does not work 7-71
E-18 Incorrect arm-in pilot pressure reading 7-72
E-19 Incorrect arm-out pilot pressure reading 7-73
E-20 Incorrect boom-up pilot pressure reading 7-74
E-21 Incorrect boom-down pilot pressure reading 7-75
E-22 Incorrect bucket-dig pilot pressure reading 7-76
E-23 Incorrect bucket-dump pilot pressure reading 7-77
E-24 Incorrect swing pilot pressure reading 7-78
E-25 Left travel pilot pressure reading incorrect 7-79
E-26 Right travel pilot pressure reading incorrect 7-80

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Fuse box connection table

- This table gives all power supply units and rated currents of fuse box power supplies.
- If power supply is normal, check the fuse box and fuses when you perform troubleshooting of the electrical system.

Information contained in troubleshooting table

Failure information	Symptom on machine
Related information	Failure occurred and troubleshooting information

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	<Inclusion> ● Standard value under normal condition can be used to judge possible causes ● Reference for passing the above "Good" or "No Good" judgement <Symptom of Wiring Harness Failure> ● Open circuit Faulty contact with connector or open circuit in wiring harness ● Faulty grounding An ungrounded wiring is grounded. ● Short circuit A wiring has mistaken contact with a 24 V electric circuit.

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E-1 Engine does not crank

Trouble	Engine cannot be started.
Related information	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Low battery capacity	★ Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Battery voltage	Voltage	≥ 24V
	2	Internal failure of engine start switch	★ Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			OFF position: between wire 22# and wire 11#	Resistance	≥ 1M Ω
	3	Failure of pilot switch	★ Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Lockout control in unlocked position: between 105 # and 27# wire	Resistance	≤ 1 Ω
			Lockout control in locked position: between wire 105 # and wire 27#		≥ 1 M Ω
	4	Failure of start motor	★ Turn engine start switch to OFF position. Keep the engine running during troubleshooting. (When all power supplies, grounding, signal and engine inputs are normal except engine output, it is the failure of start motor)		
			Engine starting motor	Start switch	Voltage
			Power supply: Terminal B and ground	Start	20—30V
			Between start motor input terminal S and ground		20—30V
	5	Open circuit of harness	★ Turn engine start switch to OFF position before proceeding. Turn it to the ON position to perform troubleshooting.		
			Wire 21# and start motor terminal B	Resistance	≤ 1 Ω
			Wire 12# and start motor terminal S		≤ 1 Ω
			Start relay terminal L and safety relay terminal S		≤ 1 Ω

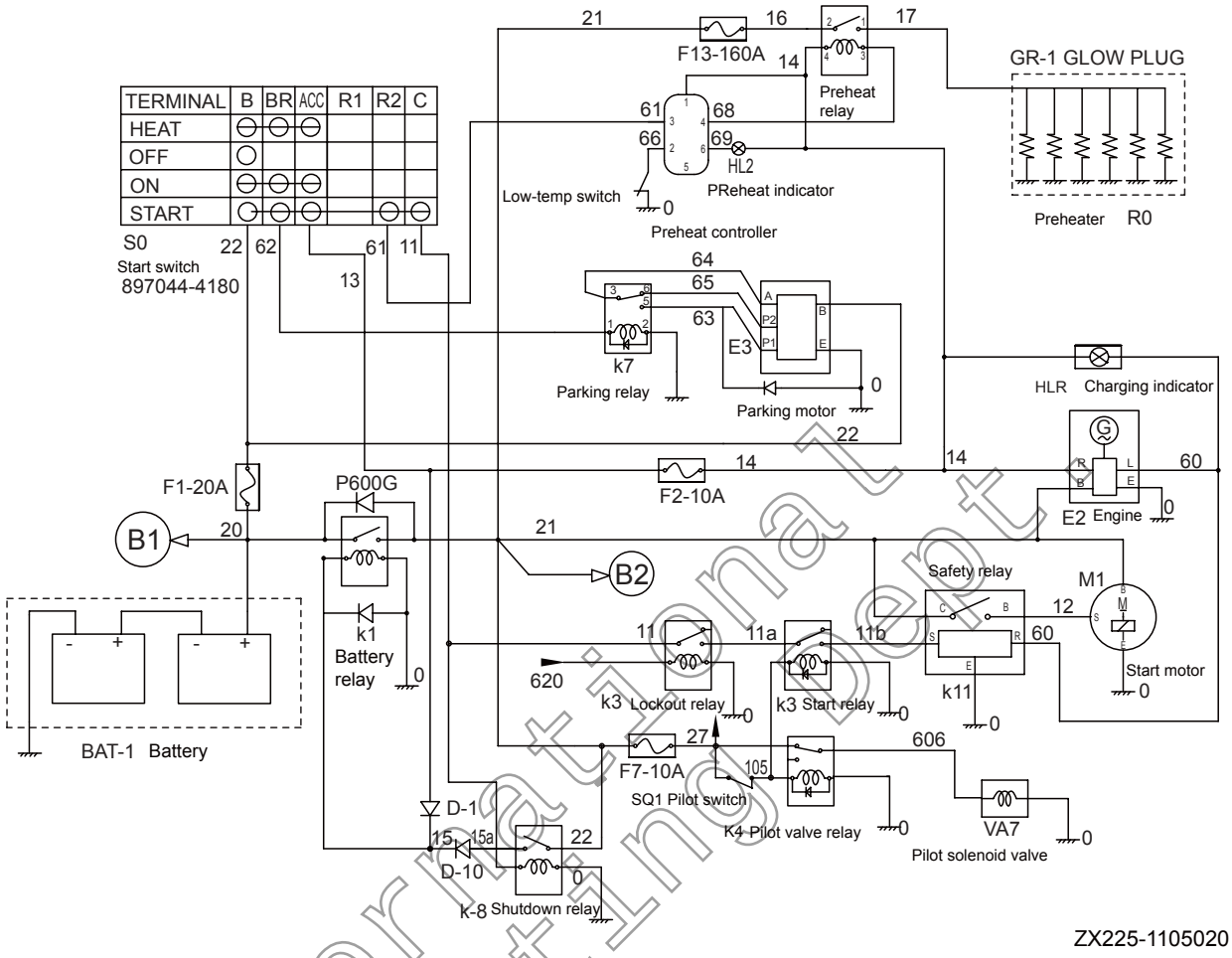
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Possible causes and standard values	Cause		Standard values and troubleshooting references		
	6	Failure of fuse F1	Battery terminal "+" (wire 20#) and control dial wire 22#	Resistance	≤ 1 Ω
	7	Short circuit of harness (grounded)	★ Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Start relay terminal S and ground	Resistance	≥ 1 MΩ
			Start motor input terminal S and ground		≥ 1 MΩ
	8	Internal failure of alternator	★ Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Alternator terminal R and ground	Voltage	≤ 1.5V
	9	Start relay	★ Turn engine start switch to OFF position. Move it to ON position when performing troubleshooting.		
			Between relay coils	Resistance	≥ 300 Ω
			Between start relay terminal B and line 11#		≤ 1 Ω
	10	Failure of parking unit	★ Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Check parking relay	Resistance	—
			Measure resistance of motor coil.		Approx 63 Ω

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Fig. 7-35

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E-2 Engine runs rough or is unstable

Failure information	Engine Runs Rough or Is Unstable
Related information	Engine speed can be read on the monitor.

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Unplug the connector controller, and measure the resistance between pin 16 and pin 7.	Resistance	2.3±0.2 KΩ
	2	Internal failure in sensor	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M A and B	Resistance	2.3±0.2 KΩ
	3	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M A and ground	Resistance	Above 1MΩ
	4	Internal failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		
	5				

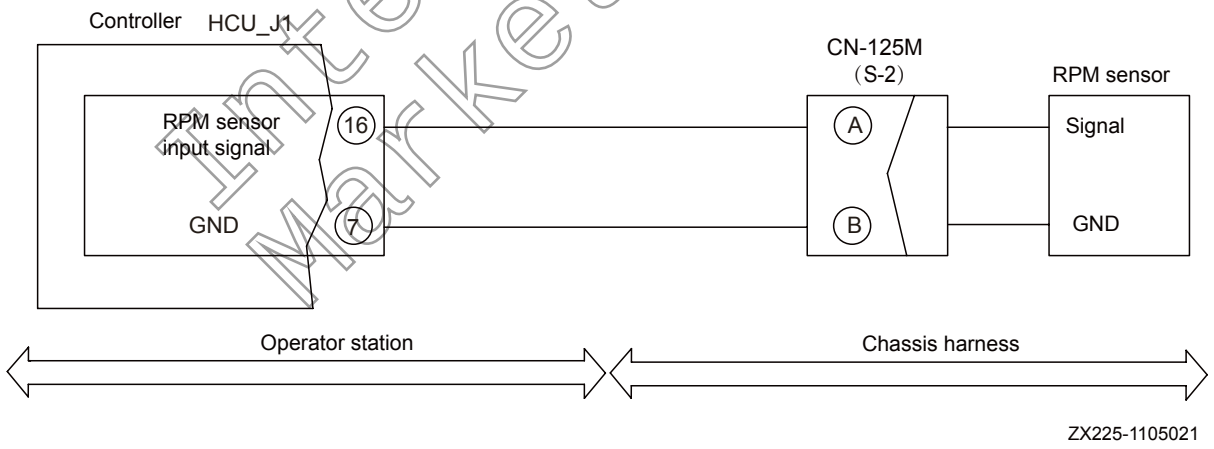


Fig. 7-36

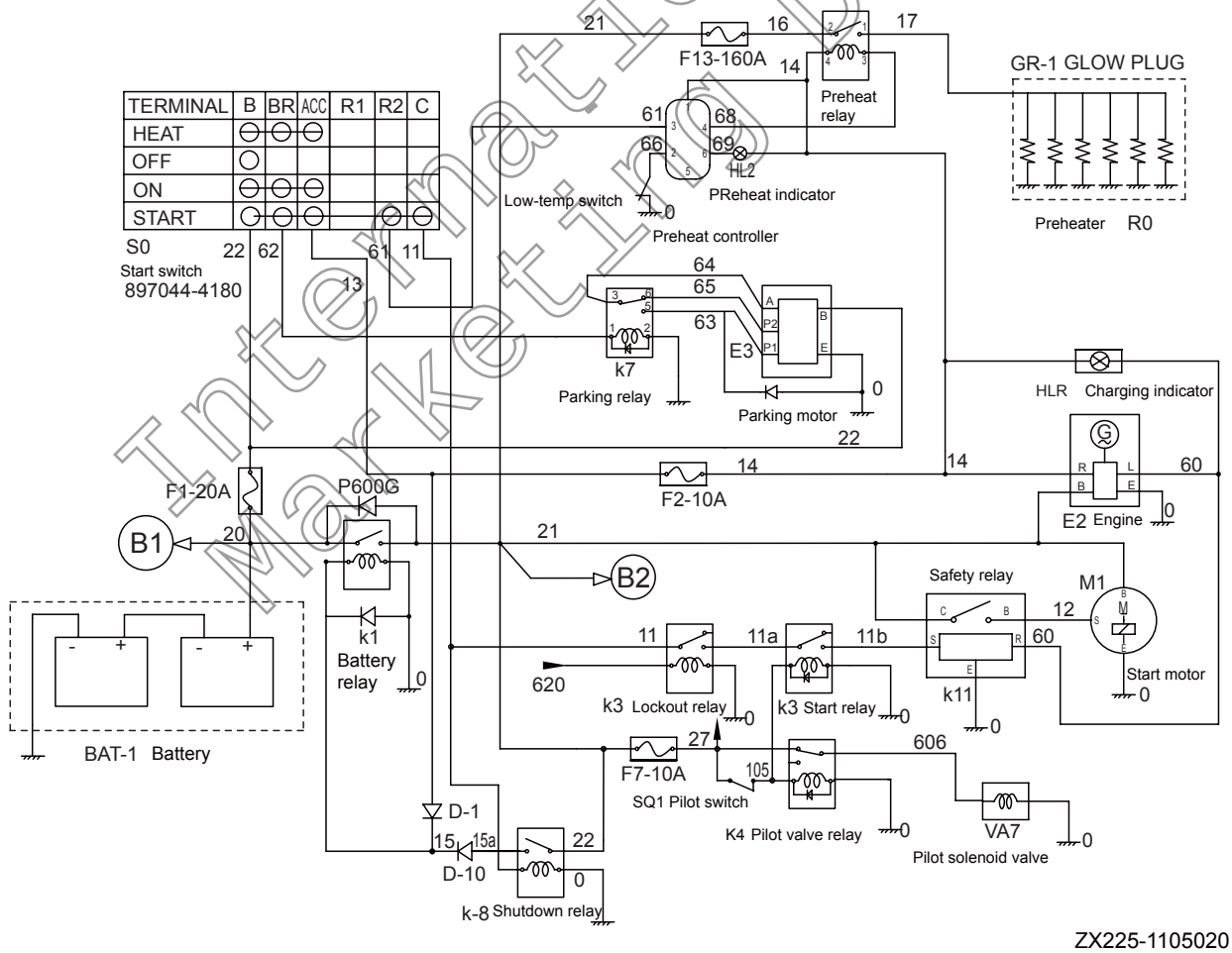
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E-3 Power supply of machine cannot be cut off

Failure information	Engine cannot be stopped.
Related information	Engine stalls when start switch it turned to OFF position. There is no time delay for power cutout.

Possible causes and standard values		Cause	Standard values and troubleshooting references
	1	Failure of battery relay	When the engine start switch is operated, if the operation of battery relay contact is heard, the battery is normal. Turn the start switch OFF→ON→OFF.
	2	Breakdown of surge diode	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed. Between battery relay wire 20# and wire 21# — Resistance — Above 1MΩ
	3		



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Fig. 7-37

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E-4 Throttle motor not working

Failure information	Engine speed does not increase or decrease.
Related information	Turn the fuel control dial but engine speed does not change.

Possible causes and standard values	Causes		Standard values and troubleshooting references		
	1	Preheat fuse failure.	• Turn he start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			The monitor shows failure code 41. Coolant temperature and oil level are normal.		
	2	Sensor power abnormal	• Turn he start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Measure the voltage between motor plug, 50# wire and ground.	Volt	5.0V
	3	Throttle motor failure	Unplug the connector of the harness between throttle motor and chassis.		
			Measure the resistance between the blue and red wires.	Resistance	8~15Ω
			Measure the resistance between the yellow and green wires.		5kΩ ± 10%
	4	Throttle motor failure	• Turn he start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			The monitor shows failure codes 41, 12, 13, 14 and 32.		

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E-5 Auto idle not functioning

Failure information	Auto idle speed do not work
Related information	Engine speed do not decrease wen the mode is auto idle speed and grip keeps still in NEUTRAL position

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Error of boom-up signal	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	2	Error of boom-down signal	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	3	Error of arm-in signal	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	4	Error of arm-out signal	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	5	Error of bucket-dig signal	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG

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Possible causes and standard values	Cause		Standard values and troubleshooting references		
	6	Error of Bucket-dump signal	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	7	Error of swing signal	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	8	Error of travel signal	● urn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	9	Error of attach-ment signal	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, pressure signal transmitted	Pressure	0 KG
			Lever in operation, pressure signal transmitted		0-39 KG
	10	Failure of con-troller	No troubleshooting can be done for it is internal failure. (If it is not caused by one of the factors listed above, it should be the failure of controller.)		

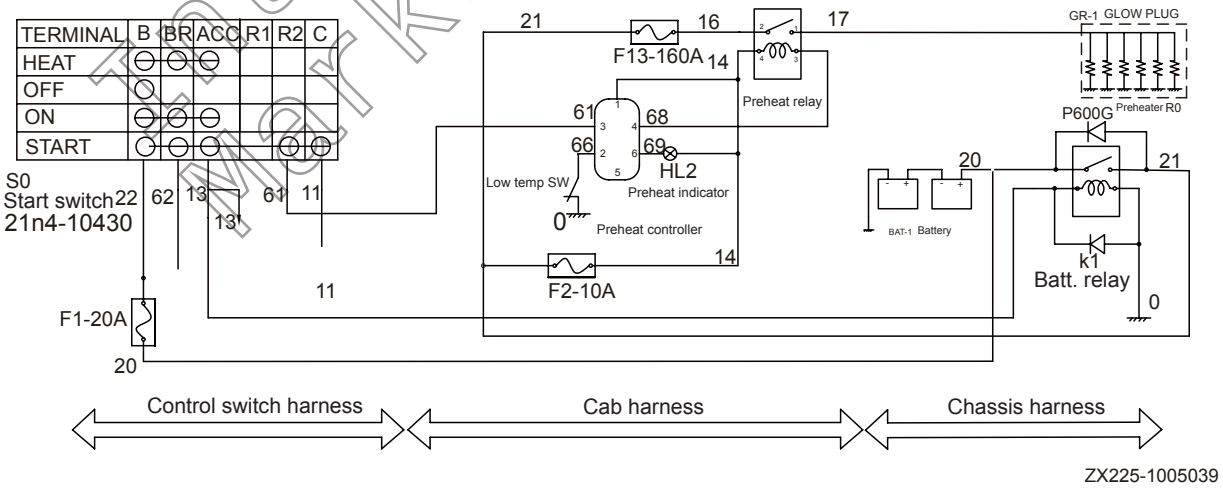
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E-6 Preheat function fails

Failure information	Engine does not preheat.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of preheat fuse	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between wire 21# and preheat relay wire 16#	Resistance	Under 1Ω
	2	Failure of preheat relay	When the preheat function is activated, if operation of the preheat relay contact is heard, the relay is normal. The start switch is to be switched HEAT→OFF→HEAT.		
	3	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
	4	Failure of preheat controller	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between preheat controller pin 3# and start switch wire 61#	Resistance	Under 1Ω
			Between preheat controller pin 4# and preheat relay wire 68#		Under 1Ω
			Between preheat controller pin 1# and preheat relay wire 14#		Under 1Ω
			Between preheat controller pin 2# and low temp switch wire 66#		Under 1Ω



ZX225-1005039

Fig. 7-38

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E-7 All components not working

Failure information	The machine is motionless while operated after starting.
Related information	

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="3">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Failure of lockout switch</td><td colspan="3">• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.</td></tr>
<tr><td>Item</td><td>Lockout control lever</td><td>Resistance</td></tr>
<tr><td>Between wire 105# and wire 27#</td><td>LOCK</td><td>Under 1Ω</td></tr>
<tr><td></td><td></td><td>Between wire 105# and wire 27#</td><td>FREE</td><td>Above 1MΩ</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Short circuit of wire (grounded)</td><td colspan="3">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td>Between 105# and ground</td><td>Resistance</td><td>Above 1MΩ</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Failure of coil inside lockout solenoid valve</td><td colspan="3">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td>Between CN-136F 1 and 2</td><td>Resistance</td><td>About 34Ω</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2"></td><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
</table>

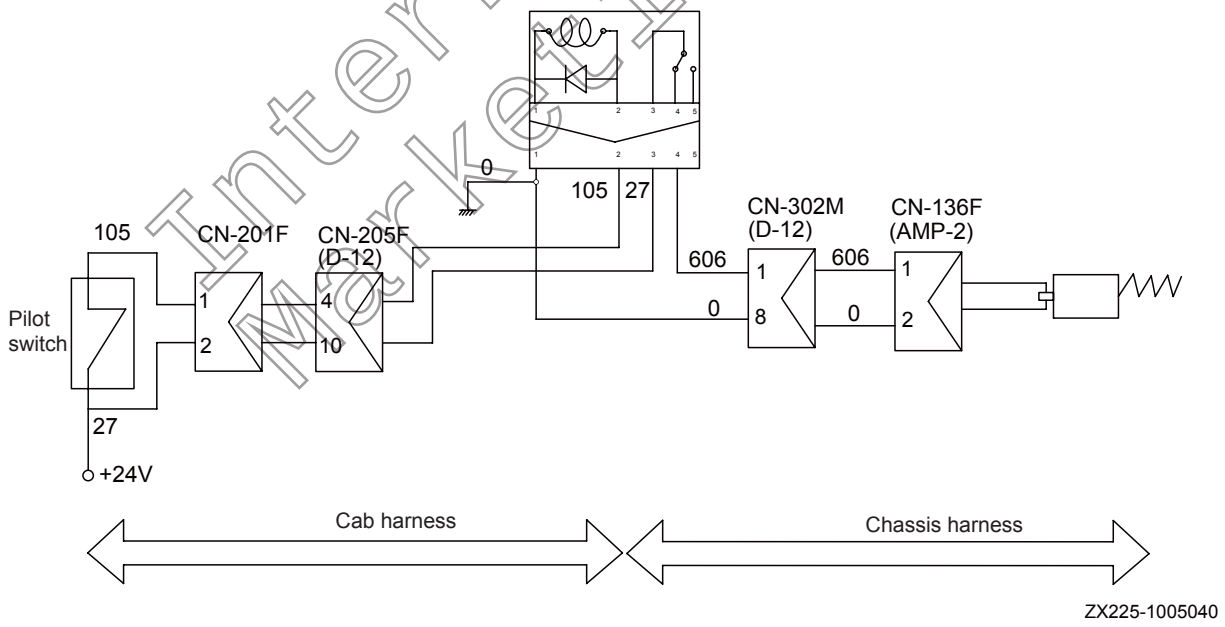


Fig. 7-39

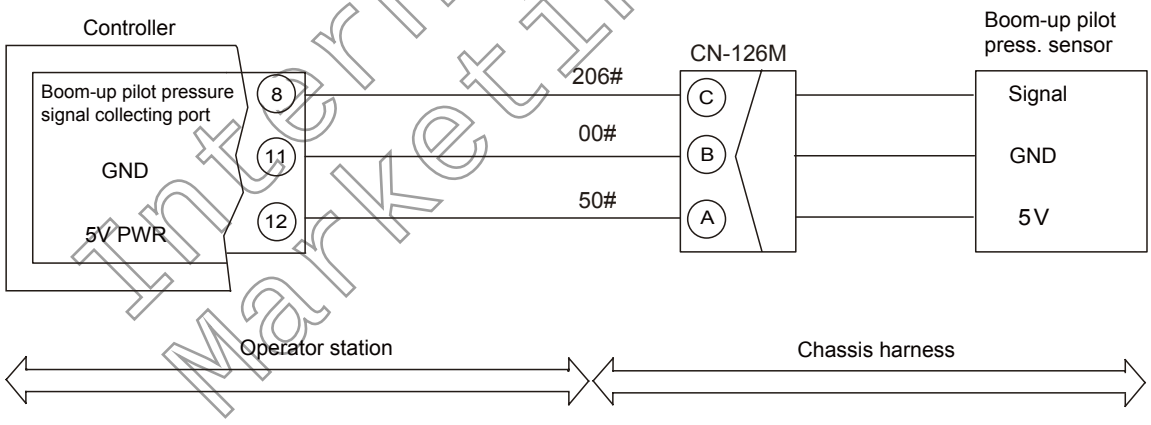
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E-8 Boom-up speed or power is low

Failure information	Boom-up speed or power is low.
Related information	Pilot pressure of the boom in operation can be checked on the monitor.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of sensor	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, boom-up pressure signal	Pressure	0 KG
			Lever in operation, boom-up pressure signal		0-39 KG
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from controller pin 8 to CN-126M A) and ground	Resistance	Above 1MΩ
	3	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between controller pin 11 and CN-126M B	Resistance	Under 1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		



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Fig. 7-40

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E-9 Arm speed or power is low

Failure information	Arm speed or power is low during operation.
Related information	Pilot pressure of the arm in operation can be checked on the monitor.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of sensor	● Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, arm-in and arm-out pressure signals	Pressure	0 KG
			Levers in operation, arm-in and dump pressure signal		0-39 KG
	2	Short circuit of harness (grounded)	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from controller pin 35 to CN-129M A) and ground Between harness (from controller pin 22 to CN-122M A) and ground	Resistance	Above 1MΩ
	3	Open circuit of harness	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between controller pin 11 and CN-129M B Between controller pin 11 and CN-122M B	Resistance	Under 1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		

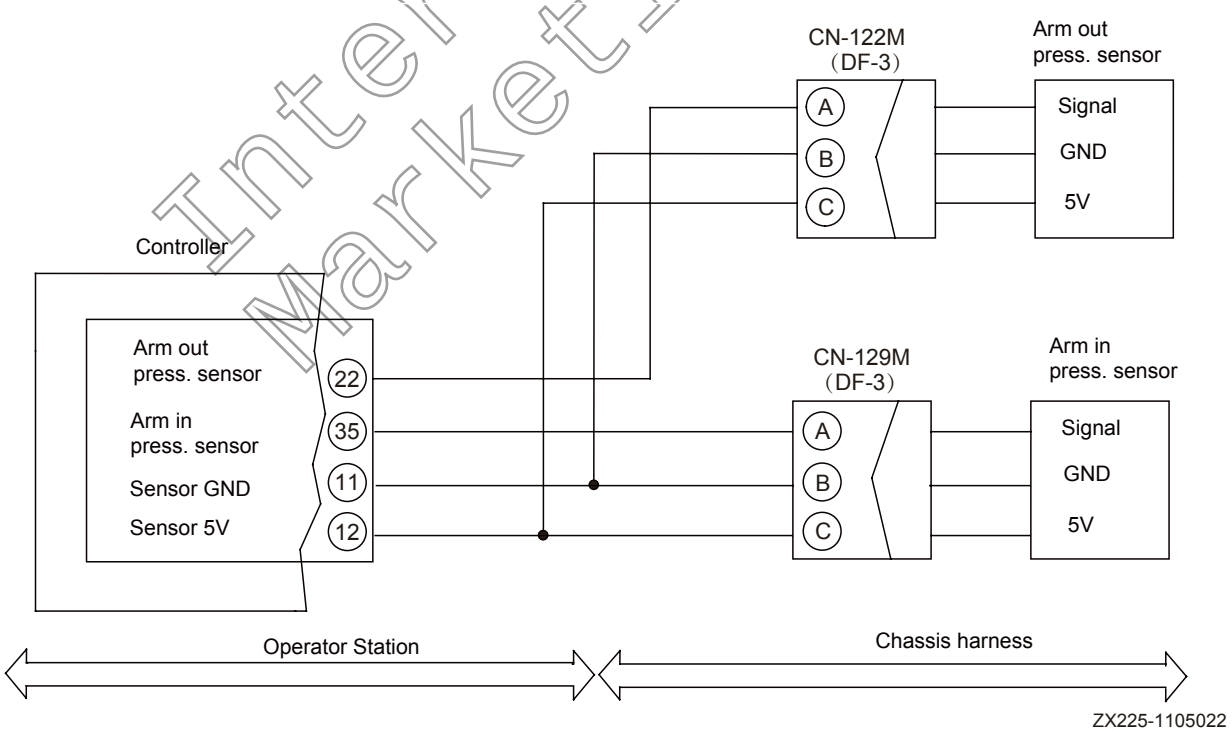


Fig. 7-41

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E-10 Bucket speed or power is low

Failure information	Bucket speed or power is low during operation.
Related information	Pilot pressure of the bucket can be checked on the monitor.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of sensor	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, bucket-dig/dump pressure signals	Pressure	0 KG
			Levers in operation, bucket-dig/dump pressure signals		0-39 KG
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from controller pin 10 to CN-124M A) and ground Between harness (from controller pin 33 to CN-128M A) and ground	Resistance	Above 1MΩ
	3	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between controller pin 11 and CN-124M B Between controller pin 11 and CN-128M B	Resistance	Under 1Ω
	4	Defective bucket confluence solenoid valve	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-134F 1 and 2	Resistance	About 34Ω
	5	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		

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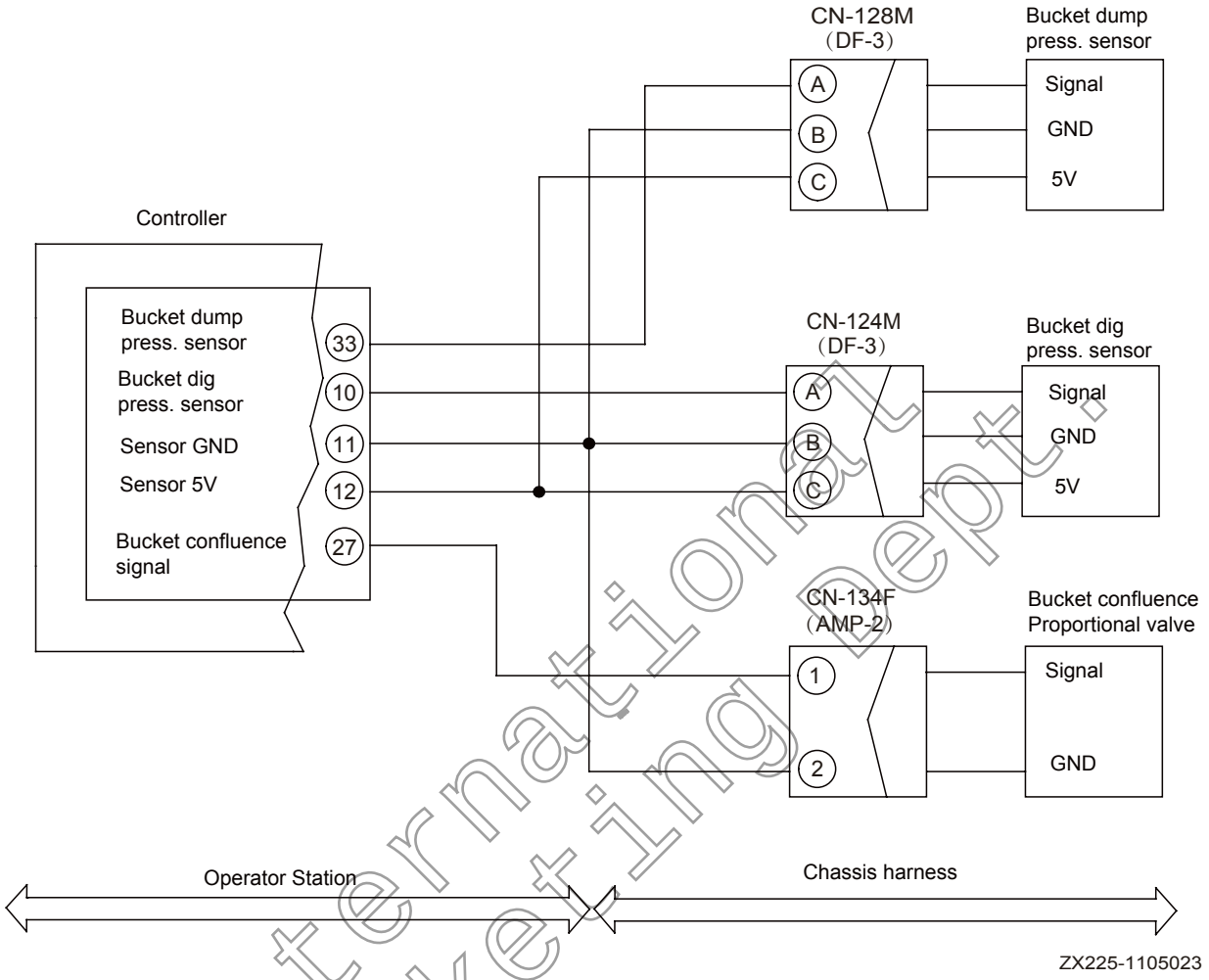


Fig. 7-42

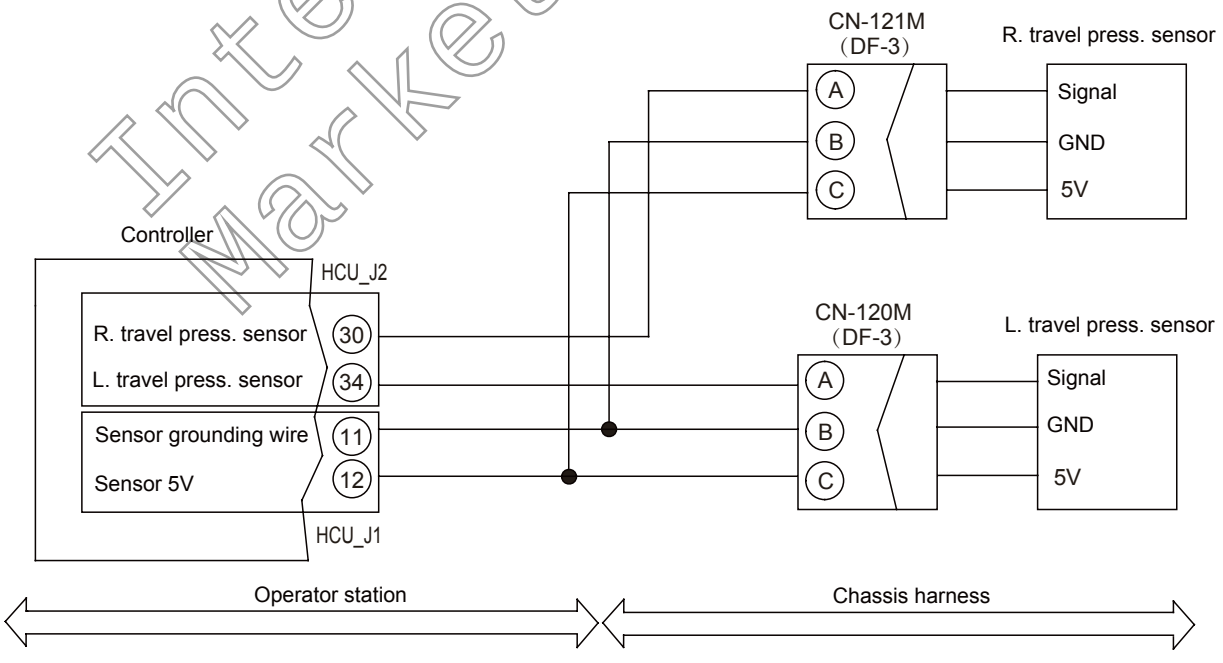
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E-11 Travel speed or power is low

Failure information	Travel speed or power is low during operation.
Related information	Pilot pressure of travel operation can be checked on the monitor.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of sensor	• Turn engine start switch to OFF position. Start the engine and keep it running to perform troubleshooting.		
			Levers in NEUTRAL, left and right travel pressure signals	Pressure	0 KG
			Levers in operation, left and right travel pressure signals		0-39 KG
	2	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from controller pin 34 to CN-120M A) and ground Between harness (from controller pin 30 to CN-121M A) and ground	Resistance	Above 1MΩ
	3	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between controller pin 11 and CN-120M B Between controller pin 11 and CN-121M B	Resistance	Under 1Ω
	4	Failure of controller	No troubleshooting can be done due to internal failure. (Failure lies in the controller if the reasons above are ruled out)		



ZX225-1105024

Fig. 7-43

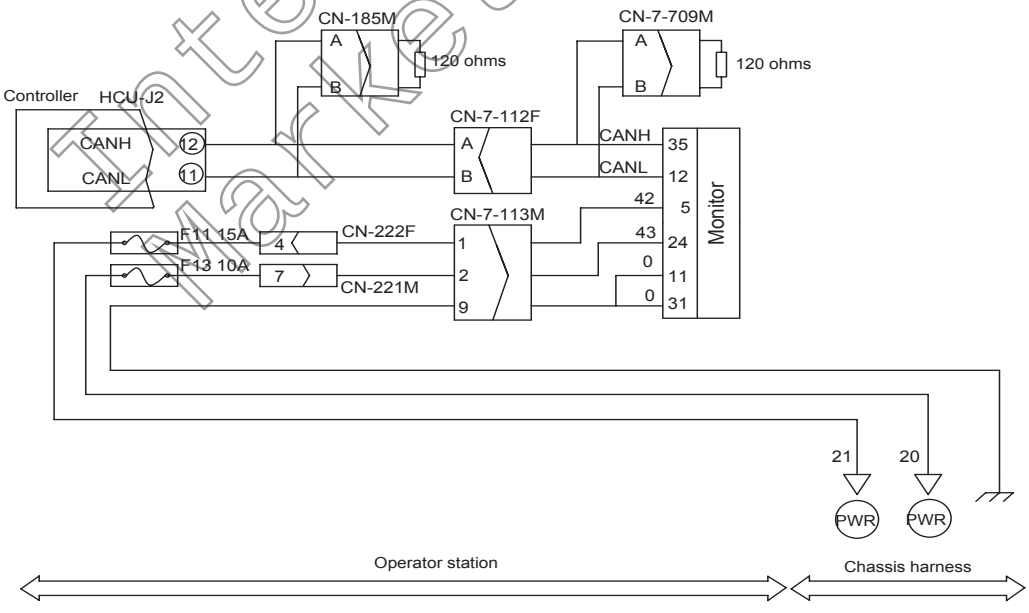
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E-12 Blank monitor display

Failure information	Monitor display is blank after the machine is powered on.
Related information	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of fuse	● Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between wire 42# and ground	Voltage	About 24V
			Between wire 43# and ground		About 24V
	2	Open circuit of harness	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-7-113M pin 1 and CN-222F pin 4	Resistance	Under 1Ω
			Between CN-7-113M pin 2 and CN-222F pin 7		Under 1Ω
			Between CN-7-113M pin 9# and ground		Under 1Ω
	3	Short circuit of harness (grounded)	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from CN-7-113M pin 1 to CN-222F pin 4 and ground	Resistance	Above 1MΩ
			Between harness (from CN-7-113M pin 2 to CN-222F pin 7 and ground		Above 1MΩ
	4	Failure of monitor	No troubleshooting can be done for it is internal failure. (If it is not caused by one of the factors listed above, it should be the failure of monitor.)		



ZX335-1005050

Fig. 7-44

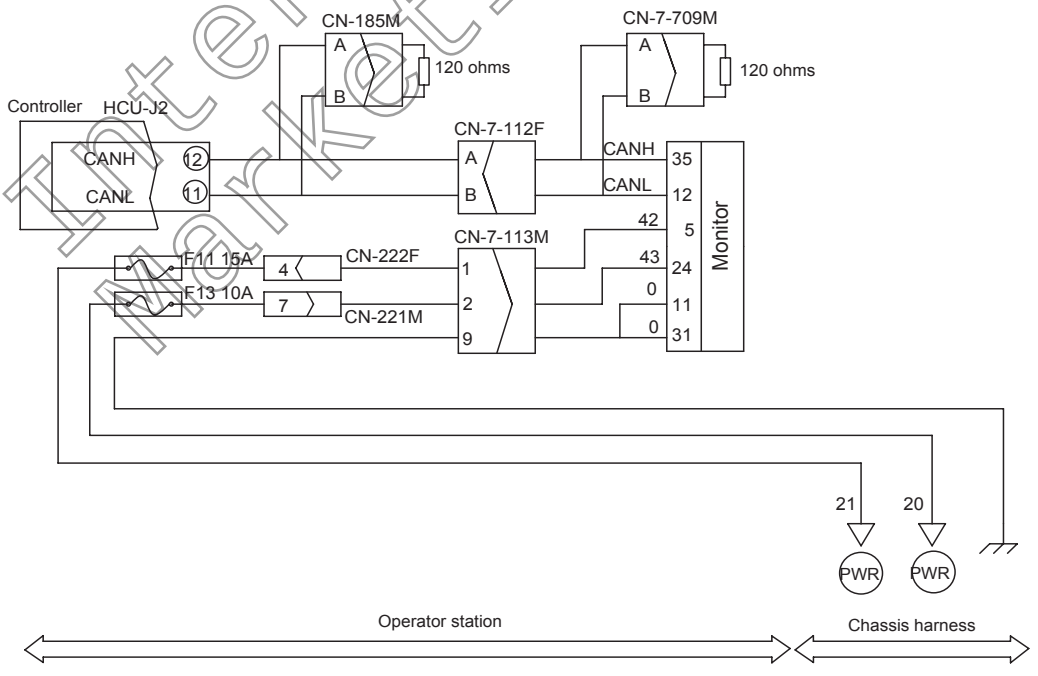
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E-13 Monitor displays nothing

Failure information	Display of monitor is illuminated but no information is shown on the screen after machine is powered on.
Related information	

		Cause	Standard values and troubleshooting references		
Possible causes and standard values	1	Failure of resistance	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-1-185M A and B	Resistance	120 Ω
	2	Open circuit of harness	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-7-112F pin A and controller pin 12	Resistance	Under 1Ω
			Between CN-7-112F pin B and controller pin 11		Under 1Ω
	3	Short circuit of harness (grounded)	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from CN-7-112F pin A to controller pin 12) and ground	Resistance	Above 1MΩ
			Between harness (from CN-7-112F pin B to controller pin 11 and ground		Above 1MΩ
	4	Failure of monitor or controller	No troubleshooting can be done for it is internal failure. (If it is not one of the failures stated above, it should be the failure of monitor or controller.)		



ZX335-1005050

Fig. 7-45

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E-14 Dual speed travel not functioning

Failure information	Only low speed travel is functioning during operation.
Related information	Press the Hi/Lo button on the monitor to change travel speed.

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of dual speed travel solenoid valve	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-131F A and B	Resistance	About 34Ω
	2	Open circuit of harness	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-131F pin A and controller pin 7	Resistance	Under 1Ω
			Between CN-131F pin B and controller pin 3		Under 1Ω
	3	Short circuit of harness (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between harness (from CN-131F pin A to controller pin 7) and ground	Resistance	Above 1MΩ
	4				

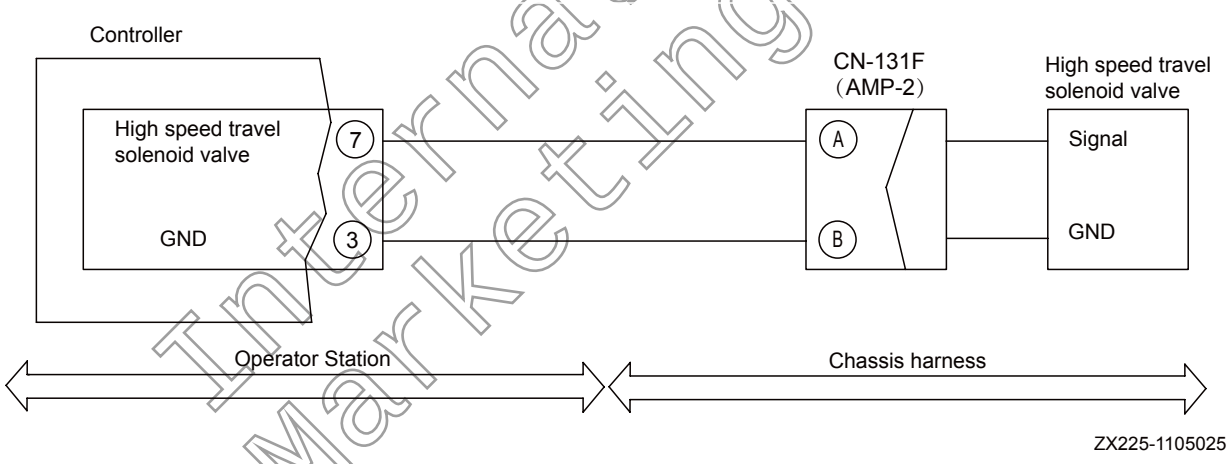


Fig. 7-46

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https://truckmanualshub.com/

E-15 Incorrect engine coolant reading

Failure information	Engine coolant temperature sensor cannot correctly reflect current coolant temperature.
Related information	Coolant temperature can be checked on the monitor.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="3">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Failure of coolant temperature sensor</td><td colspan="3">Standard values for engine coolant temperature sensor</td></tr>
<tr><td colspan="2">50℃</td><td>130Ω</td></tr>
<tr><td colspan="2">80℃</td><td>48.5±4.2Ω</td></tr>
<tr><td colspan="2">100℃</td><td>26.7±2.5Ω</td></tr>
<tr><td colspan="2">110℃</td><td>20Ω</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Open circuit of lead</td><td colspan="3">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td>Between wire 510# and controller pin 32</td><td>Resistance</td><td>Under 1Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Short circuit of lead (grounded)</td><td colspan="3">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td>Between wire 510# and ground</td><td>Resistance</td><td>Above 1MΩ</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Lead short to 24V circuit</td><td colspan="3">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the ON position while troubleshooting is performed.</td></tr>
<tr><td>Wire 510# to ground</td><td>Voltage</td><td>Under 1V</td></tr>
</table>

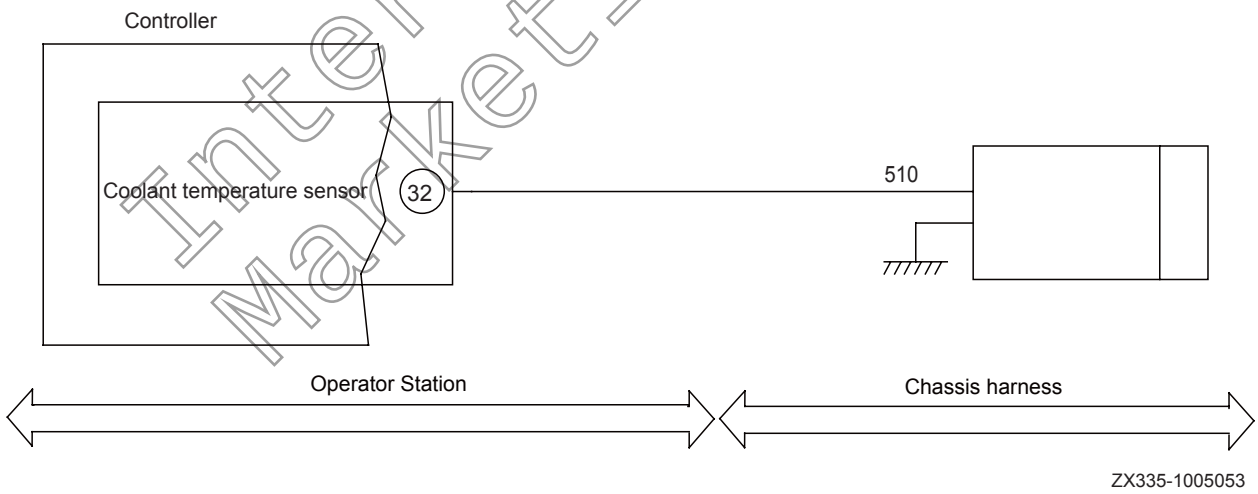


Fig. 7-47

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E-16 Incorrect fuel level reading

Failure information	Engine fuel level sensor cannot correctly reflect current fuel level.
Related information	Fuel level can be checked on the monitor.

<table>
<tr><td rowspan="10">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="4">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Fuel level sensor error</td><td colspan="4">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td>Pin</td><td colspan="2">Fuel level</td><td>Resistance</td></tr>
<tr><td rowspan="2">Between wire 509# and ground</td><td colspan="2">FULL (Upper limit)</td><td>Approx. 10 Ω</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Open circuit of lead</td><td colspan="2">EMPTY (Lower limit)</td><td>85-95Ω</td></tr>
<tr><td colspan="4">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Short circuit of lead (grounded)</td><td>Between wire 509# and controller pin 17</td><td>Resistance</td><td>Under 1Ω</td></tr>
<tr><td colspan="4">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Lead short to 24V</td><td>Between wire 509# and ground</td><td>Resistance</td><td>Above 1MΩ</td></tr>
<tr><td colspan="4">• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.</td></tr>
<tr><td colspan="2"></td><td>Wire 509# grounded</td><td>Voltage</td><td>Under 1V</td></tr>
</table>

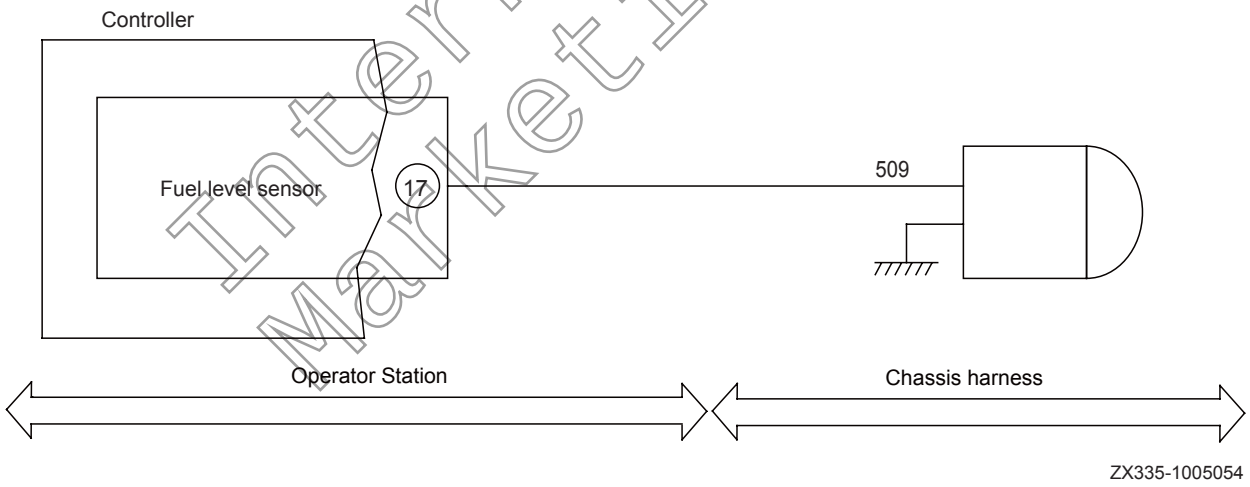


Fig. 7-48

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E-17 Wiper does not work

Failure information	Wiper does not work.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Internal Failure of wiper motor	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between wiper wire 25# and ground	Resistance	＞10Ω
	2	Open circuit of lead	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-403F 1 and CN-1-110 2	Resistance	Under 1Ω
			Between wiper switch wire 35L# and CN-1-110M 5		Under 1Ω
			Between wiper switch wire 35L# and CN-1-110M 4		Under 1Ω
	3	Short circuit of lead (grounded)	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Harness from CN-403F 1 to CN-1-110M 2 short to ground	Resistance	Above 1MΩ
	4				

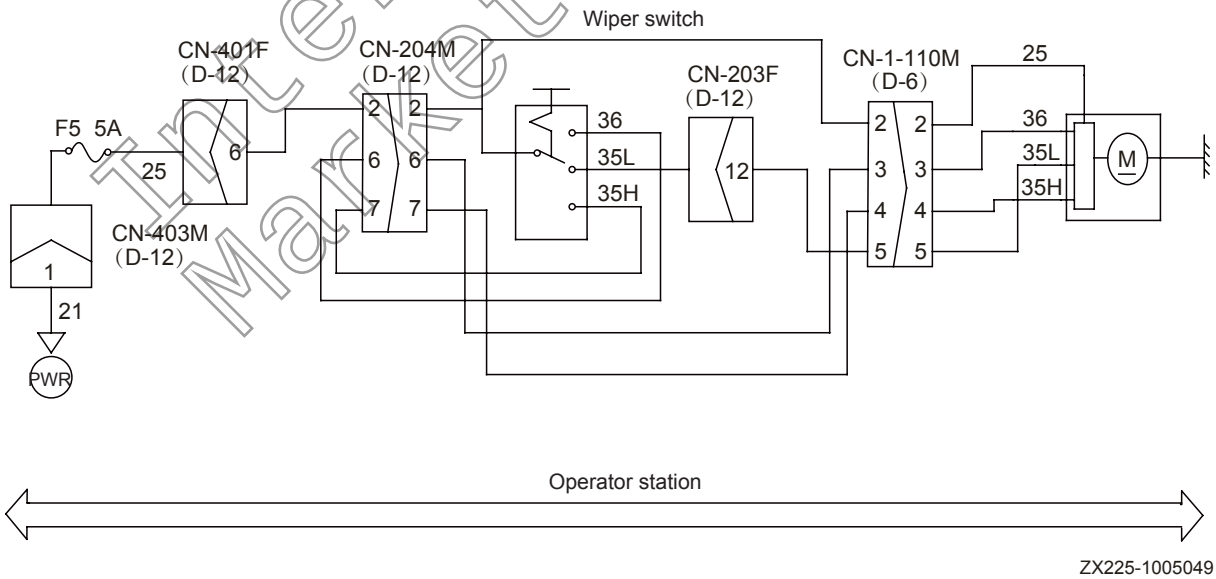


Fig. 7-49

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E-18 Incorrect arm-in pilot pressure reading

Failure information	Reading of arm-in pilot pressure is incorrect.
Related information	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M ① and ③	Voltage	Approx. 5V
	2	Open circuit of signal line	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M ② and controller pin 35	Resistance	Under 1Ω
	3	Short circuit of signal line	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-129M ② and ground	Voltage	0.5V- 4.5V
	5				

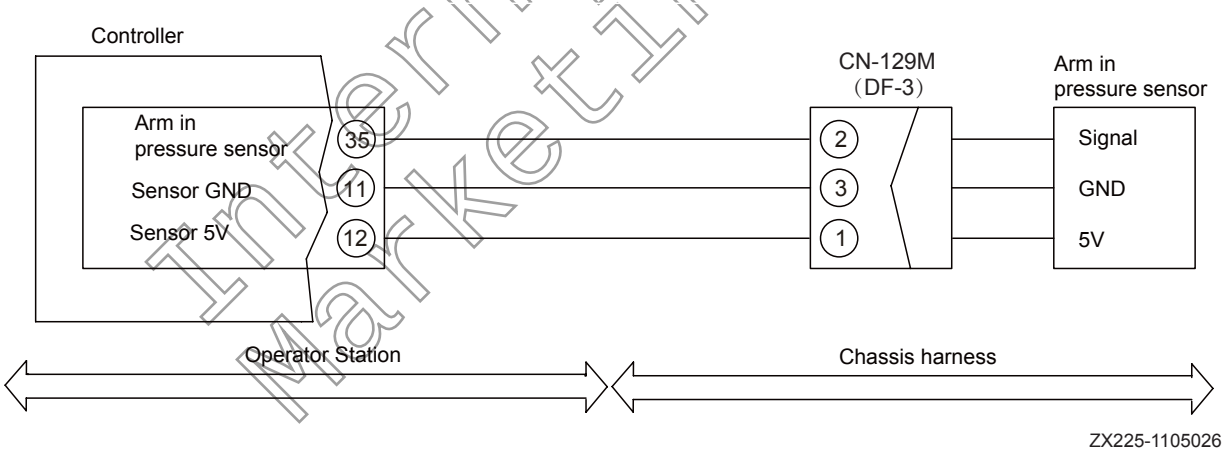


Fig. 7-50

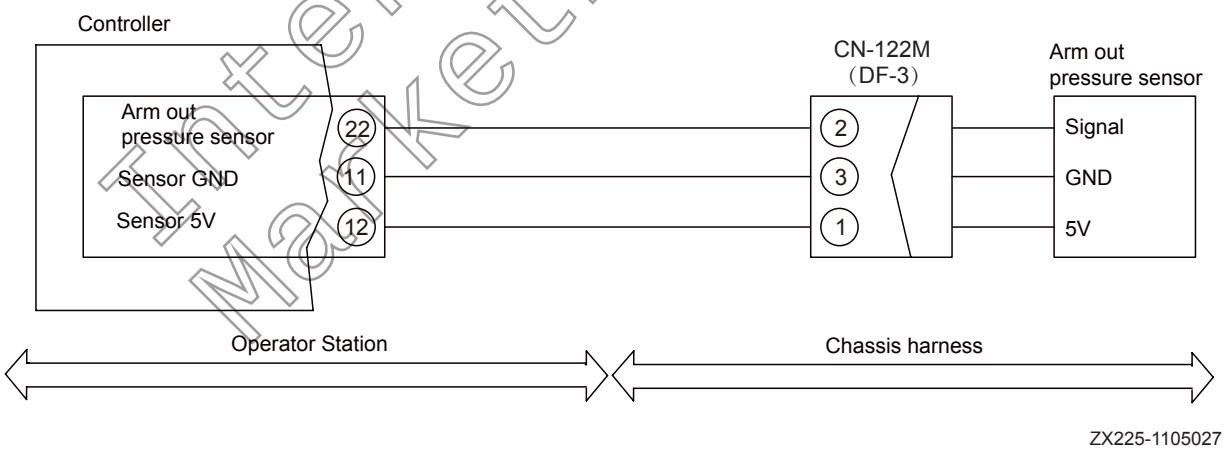
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E-19 Incorrect arm-out pilot pressure reading

Failure information	Reading of arm-out pilot pressure is incorrect.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M ② and controller pin 22	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-122M ② and ground	Voltage	0.5V- 4.5V
	5				



ZX225-1105027

Fig. 7-51

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E-20 Incorrect boom-up pilot pressure reading

Failure information	Incorrect Boom-up Pilot Pressure Reading
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-126M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-126M ② and controller pin 8	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-126M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-126M ② and ground	Voltage	0.5V- 4.5V
	5				

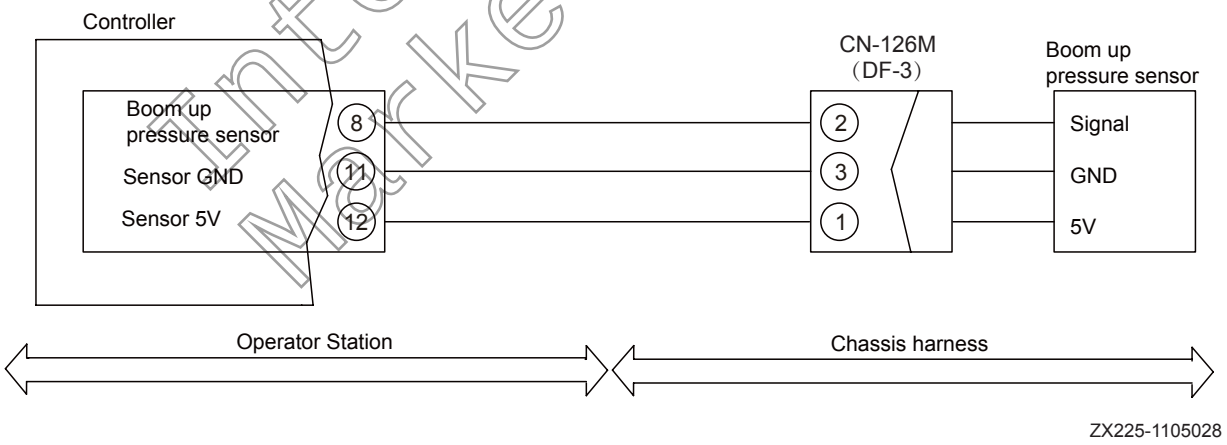


Fig. 7-52

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E-21 Incorrect boom-down pilot pressure reading

Failure information	Boom-down pilot pressure reading is incorrect.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	● Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-125M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M ② and controller pin 9	Resistance	Under 1Ω
	3	Short circuit of signal line	● Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-125M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	● Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-125M ② and ground	Voltage	0.5V- 4.5V
	5				

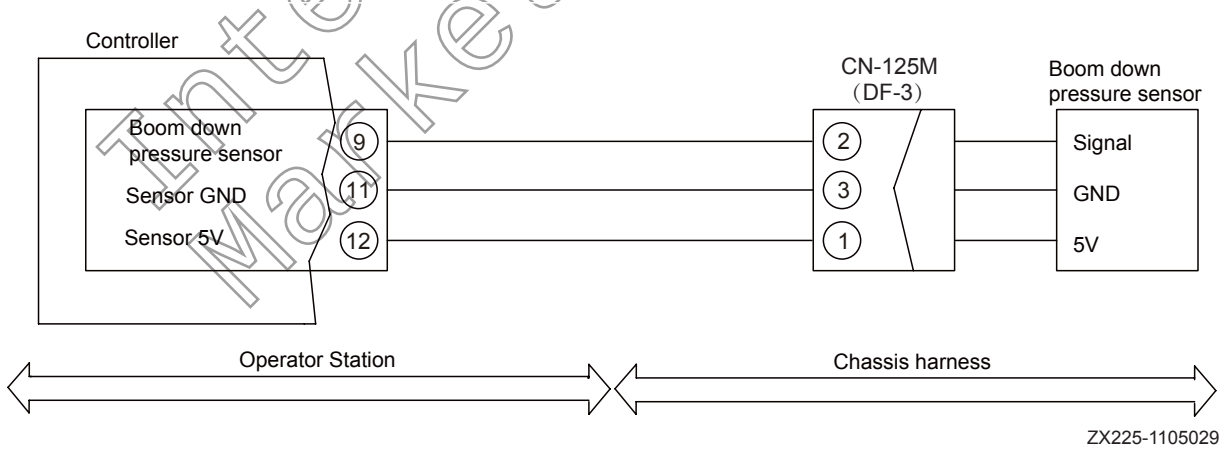


Fig. 7-53

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E-22 Incorrect bucket-dig pilot pressure reading

Failure information	Bucket-dig pilot pressure reading is incorrect.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-124M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-124M ② and controller pin 10	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-124M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to OFF position. Then, keep it at OFF position to perform troubleshooting.		
			Between CN-124M ② and ground	Voltage	0.5V- 4.5V
	5				

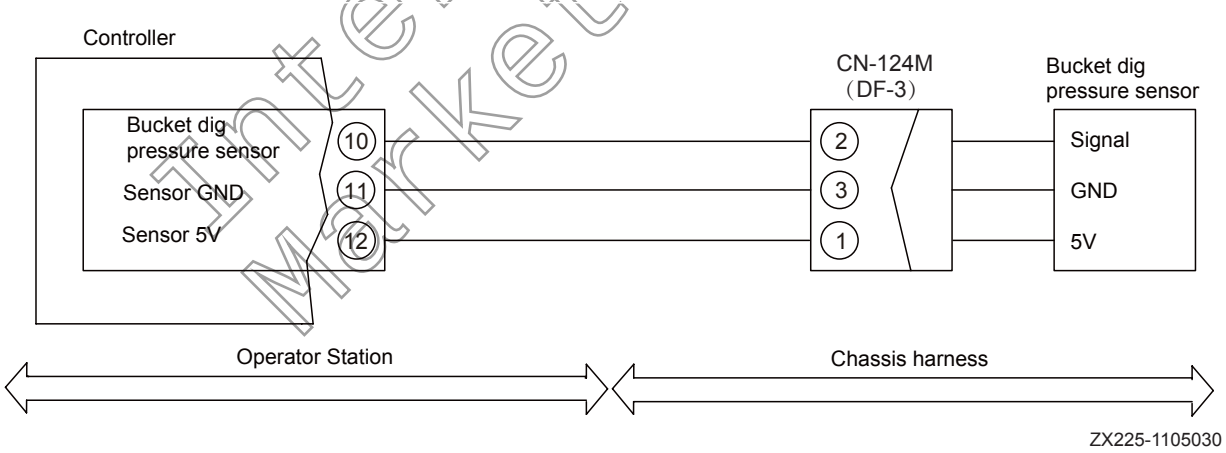


Fig. 7-54

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E-23 Incorrect bucket-dump pilot pressure reading

Failure information	Bucket-dump pilot pressure reading is incorrect.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-128M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-128M ② and controller pin 33	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-128M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-128M ② and ground	Voltage	0.5V- 4.5V
	5				

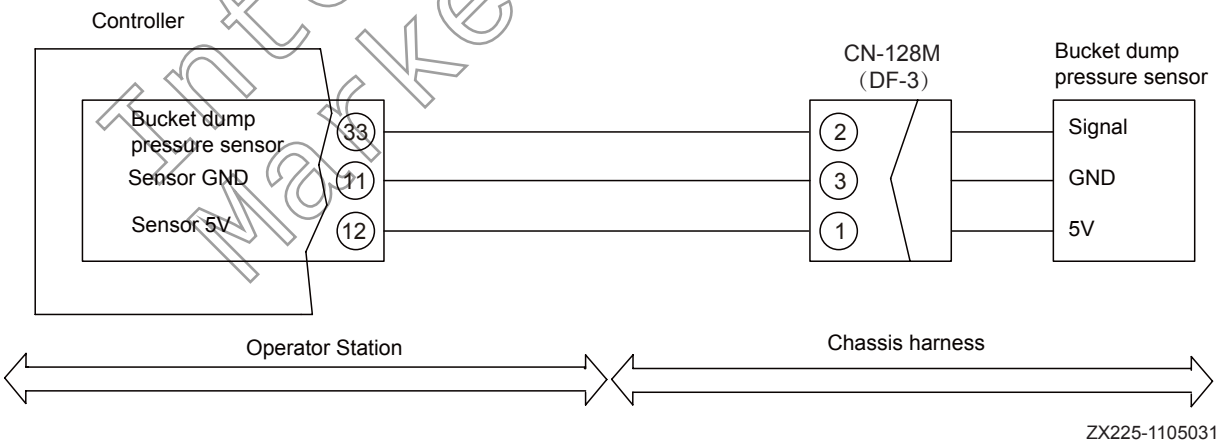


Fig. 7-55

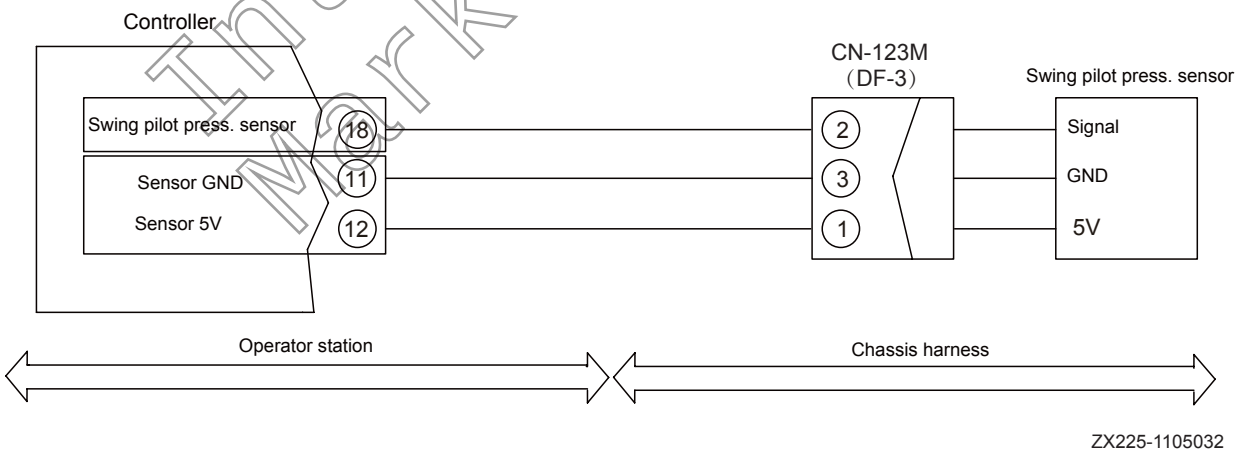
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E-24 Incorrect swing pilot pressure reading

Failure information	Swing pilot pressure reading is incorrect.
Related information	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-123M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-123M ② and controller pin 18	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-123M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-123M ② and ground	Voltage	0.5V- 4.5V
	5				



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Fig. 7-56

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E-25 Left travel pilot pressure reading incorrect

Failure information	Left Travel Pilot Pressure Reading is incorrect.
Related information	

Possible causes and standard values	Cause		Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-120M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-120M ② and controller pin 34	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-120M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-120M ② and ground	Voltage	0.5V- 4.5V
	5				

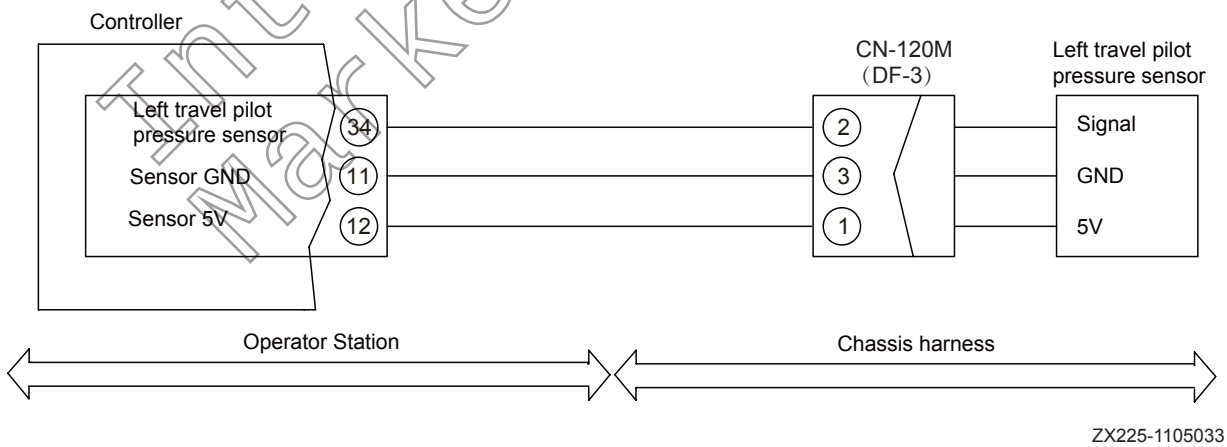


Fig. 7-57

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E-26 Right travel pilot pressure reading incorrect

Failure information	Right travel pilot pressure reading is incorrect.
Related information	

Possible causes and standard values		Cause	Standard values and troubleshooting references		
	1	Failure of 5V power supply	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-121M ① and ③	Voltage	About 5V
	2	Open circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-121M ② and controller pin 30	Resistance	Under 1Ω
	3	Short circuit of signal line	• Turn engine start switch to the OFF position before troubleshooting. Keep it in the OFF position while troubleshooting is performed.		
			Between CN-121M ② and ground	Resistance	Above 2MΩ
	4	Failure of sensor	• Turn engine start switch to the OFF position before troubleshooting. Turn the start switch to the ON position and keep it in the ON position while troubleshooting is performed.		
			Between CN-121M ② and ground	Voltage	0.5V- 4.5V
	5				

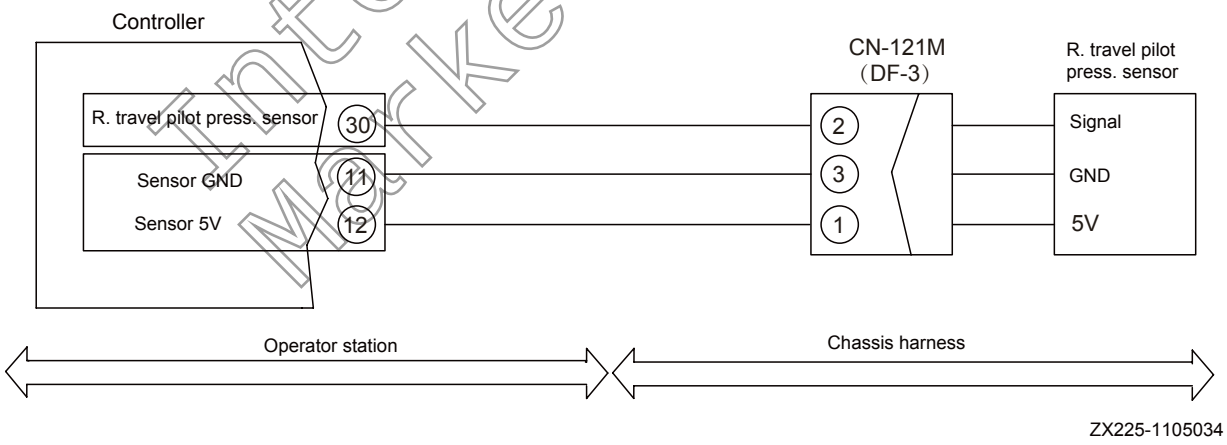


Fig. 7-58

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7.6 Troubleshooting Hydraulic and Mechanical Systems (H-mode)

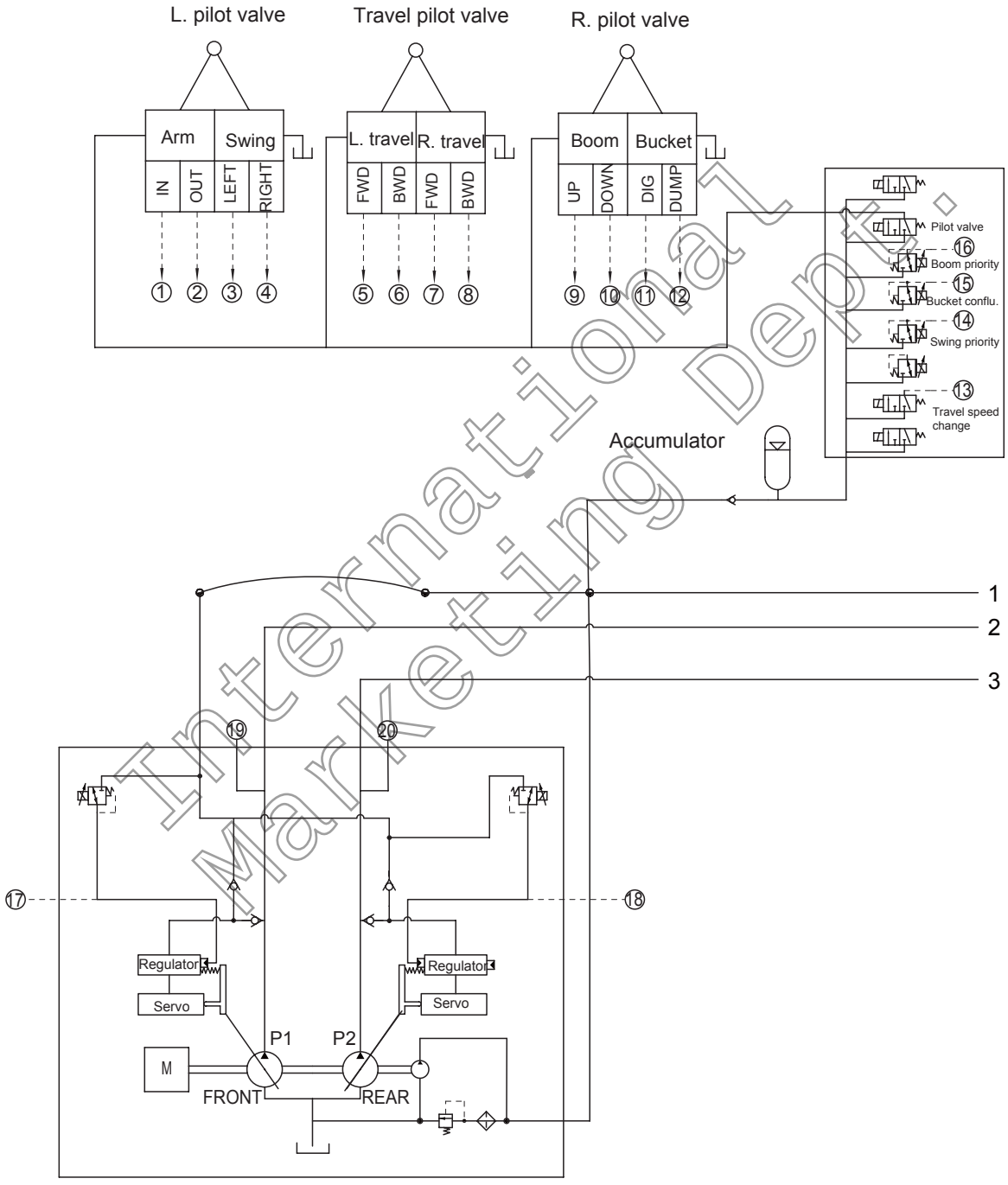
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H-24 Swing drift excessive 7-110

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A schematic of hydraulic and mechanical systems

This diagram is a simplification of the diagram of the whole hydraulic system and can be referred to in troubleshooting the hydraulic and mechanical systems.

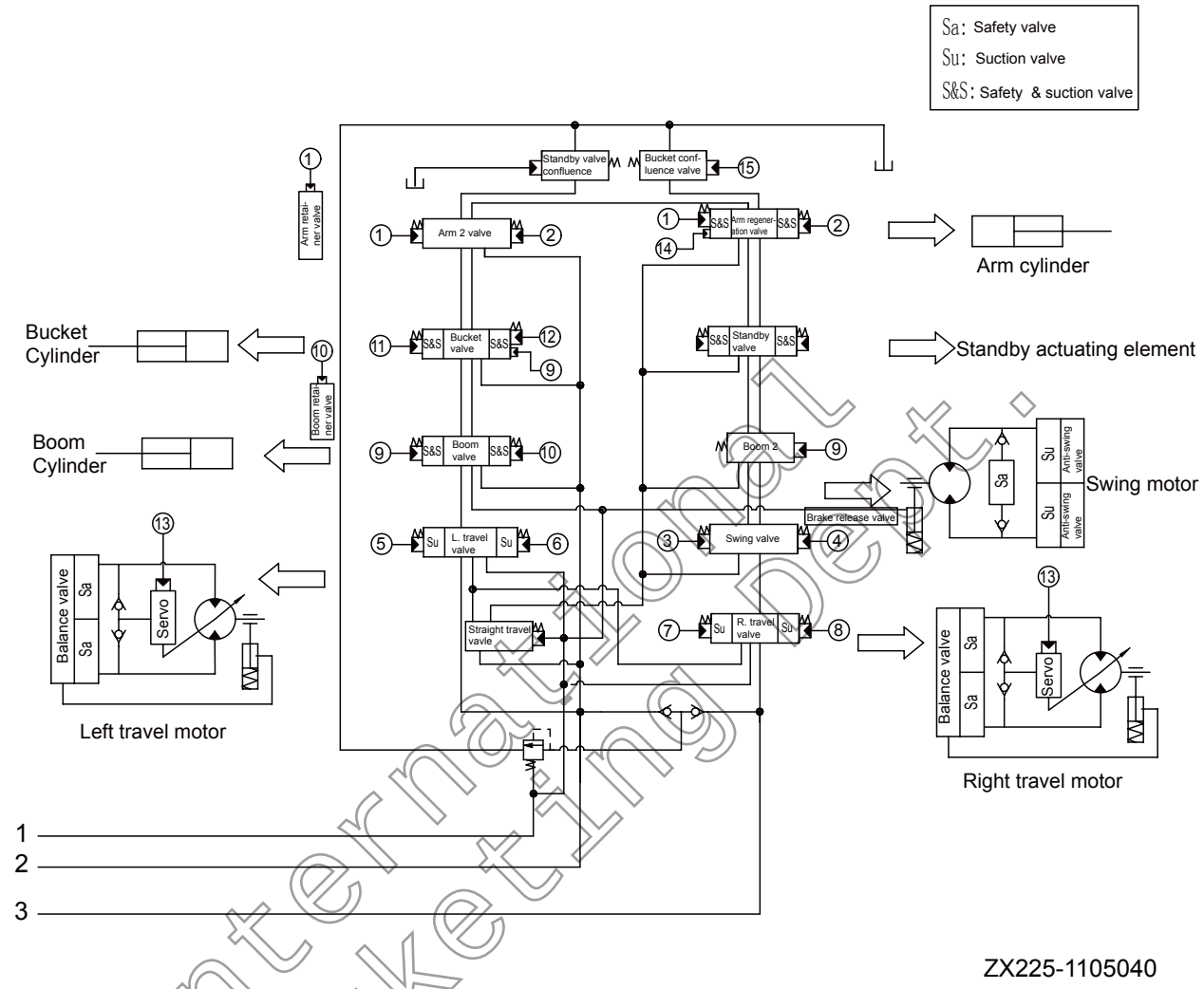


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Fig. 7-59

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Fig. 7-60

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Information contained in troubleshooting table

- The following information is contained in the troubleshooting table and related electric circuit diagrams. Fully understand these information before carrying out troubleshooting.

Failure information	Trouble which occurs on the machine
Related information	Information related to detected trouble or troubleshooting

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Possible causes of trouble (Given numbers are reference numbers, which do not indicate priority)	• < Description > • Standard value in normal state, which is used to judge possible causes that might be OK or N/G. • A reference value is used to determine OK or N/G.
	2		
	3		
	4		
	5		

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H-1 Work equipment speed slow, or swing and travel speeds slow

Failure information	● Work equipment speed is slow or the travel and swing speeds are slow.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="6">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective adjustment or malfunction of main relief valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Main relief pressure</td></tr>
<tr><td>Arm IN</td><td>33~34.3 MPa
{337~350 kg/cm^2}</td></tr>
<tr><td colspan="4">If normal pressure cannot be restored after adjustment, it is possible the failure of main relief valve or internal defect. Check the valve directly.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Malfunction of pilot relief valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control levers</td><td>Pilot control pressure</td></tr>
<tr><td>All levers in NEUTRAL</td><td>3.9~4.1 MPa
{40~42 kg/cm^2}</td></tr>
<tr><td>3</td><td>Malfunction of regulator</td><td colspan="2">The regulator possibly fails. Check the servo mechanism of the regulator.</td></tr>
<tr><td>4</td><td>Malfunction of main pump</td><td colspan="2">If the trouble is caused by other factors, it might be the main pump that has performance deterioration, malfunction or internal defect.</td></tr>
</table>

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H-2 Engine speed drops sharply or engine stalls

Failure information	• Engine speed drops sharply or engine stalls.
Related information	• Information concerned

		Cause	Standard values and troubleshooting references
Possible causes and standard values	1	Failure of injection pump	Injection pump may be defective. Check it directly.
	2	Malfunction of regulator	Regulator may have malfunction. Check its servo mechanism.
	3	Clogging of oil filter element	Oil filter element may be clogged. Check the element directly.
	4	Carbon buildup at fuel injection nozzle	Carbon built up at fuel injection nozzle. Check it directly.
	5	Clogging of air cleaner	Air cleaner may be clogged. Check it directly.
	6	Abnormal wear of engine	Engine may be worn abnormally. Check it directly.
	7	Failure of oil pump	Oil pump may be defective. Check it directly.

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H-3 Work equipment, swing, and travel systems do not work

Failure information	● Whole work equipment, swing, and travel systems do not work.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of pilot relief solenoid valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Pilot lockout control lever</td><td>Pilot relief pressure</td></tr>
<tr><td>LOCKED</td><td>0 {0}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Failure of relief valve (pilot pump)</td><td>FREE</td><td>3.9~4.1 MPa
{40~42 kg/cm^2}</td></tr>
<tr><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control lever</td><td>Pilot relief pressure</td></tr>
<tr><td>3</td><td>Failure of hydraulic pump</td><td>All levers in NEUTRAL</td><td>3.9~4.1 MPa
{40~42 kg/cm^2}</td></tr>
<tr><td>3</td><td>Failure of hydraulic pump</td><td colspan="2">The main pump may have malfunction or internal defect. Check it by following method.
● Remove the oil pressure measurement plug and start the engine. If oil flows out of the opening, the piston pump is in good condition.</td></tr>
<tr><td>4</td><td>Failure of coupling</td><td colspan="2">Internal failure of the coupling can stop rotation of the pump shaft. Check the coupling.
● Loosen the oil delivery line of the pilot pump. If no oil is seen, it is probably the failure of coupling.</td></tr>
</table>

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H-4 Abnormal noise in hydraulic pump

Failure information	● Abnormal noise is produced from the hydraulic pump
Related information	—

Possible causes and standard values		Cause	Standard values and troubleshooting references
	1	Low level of hydraulic oil	Make a visual check.
	2	Inferior hydraulic oil	Hydraulic oil probably contains air. Make a visual check.
	3	Clogging of vent on top of hydraulic tank	It is probably the clogging of the vent on top of the hydraulic tank that causes negative pressure in the hydraulic tank. Press the release button of the breather valve to eliminate air. Check again if the noise disappears.
	4	Clogging of hydraulic tank strainer	It is probably the clogging of hydraulic tank strainer that causes negative pressure in the oil suction line. Make a visual check.
	5	Failure of main pump	The main pump may have internal defect. Check the main pump.

H-5 Auto deceleration not functioning

Failure information	● Auto-deceleration is not functioning.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values	Cause		Standard values and troubleshooting references	
	1	Sensor failure	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Control levers	Pilot valve output pressure
			NEUTRAL	0 {0}
			Operation	3.5~4.1MPa {36~42 kg/cm2}
	2	Failure of pilot valve	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Control levers	Pilot valve output pressure
			NEUTRAL	0 {0}
			Operation	3.5~4.1MPa {36~42 kg/cm^2}
	3	Controller failure	Controller may be defective. Check it directly.	

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H-6 Boom speed slow

Failure information	• The boom moves slowly.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of right pilot valve (boom circuit)</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Boom control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Boom UP
Boom DOWN</td><td>≥ 3.5MPa
{36 kg/cm2}</td></tr>
<tr><td>2</td><td>Malfunction of boom control valve (spool)</td><td colspan="2">Spool of boom control valve may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Press sensor failure</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the sensor by replacing it with a new one.</td></tr>
<tr><td>4</td><td>Malfunction of boom control valve (retaining valve)</td><td colspan="2">Retaining valve of boom control valve may have malfunction. Check the valve directly.</td></tr>
<tr><td>5</td><td>Malfunction or defective seal of boom control valve
(Relief valve and makeup valve)</td><td colspan="2">The relief valve and makeup valve in boom control valve may have malfunction or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Failure of boom cylinder</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure see "Hydraulic Drift of Work Equipment - Test" on page 6-34.</td></tr>
</table>

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H-7 Arm speed slow

Failure information	• The arm moves slowly.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of left pilot valve (arm circuit)</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Arm control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Arm IN or Arm OUT</td><td>≥ 3.5MPa
{36 kg/cm^2}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Press sensor failure</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of arm control valve (spool)</td><td colspan="2">Spool of arm control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction of arm control valve (re-generation valve)</td><td colspan="2">Regeneration valve of arm control valve may have malfunction.
Check it directly.</td></tr>
<tr><td>5</td><td>Malfunction or de-fective seal of arm control valve (Relief valve and makeup valve)</td><td colspan="2">The relief valve or makeup valve inside the arm control valve may have malfunction or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Failure of arm cylin-der</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Cut off the oil passage to the high-pressure side of the cylinder. Discon-nect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure see **"Hydraulic Drift of Work Equipment - Test" on page 6-34.**</td></tr>
</table>

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H-8 Bucket speed slow

Failure information	● The bucket moves slowly.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of right pilot valve (bucket circuit)</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Bucket control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Bucket DIG or Bucket DUMP</td><td>≥ 3.5MPa
{36 kg/cm^2}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Press sensor failure</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of bucket control valve (spool)</td><td colspan="2">Spool of bucket control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction or defective seal of bucket control valve (relief valve and makeup valve)</td><td colspan="2">Relief valve and makeup valve in bucket control valve may have malfunction or defective seal. Check the valves directly.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Failure of bucket cylinder</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure see "Hydraulic Drift of Work Equipment - Test" on page 6-34.</td></tr>
</table>

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H-9 Work equipment cylinders no response in separate operation

Failure information	● Boom cylinder gives no response in separate operation. ● Arm cylinder gives no response in separate operation. ● Bucket cylinder gives no response in separate operation.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="7">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of pilot valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Work equipment control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>DIG or DUMP</td><td>≥3.5MPa
{36 kg/cm^2}</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Press sensor failure</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Check the sensor by replacing it with a new one.</td></tr>
<tr><td>3</td><td>Malfunction of control valve (spool)</td><td colspan="2">Spool of control valve may have malfunction. Check it directly.</td></tr>
</table>

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H-10 Work equipment drifts excessively

Failure information **(1)**	• The boom drifts at excessive speed.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values	Cause		Standard values and troubleshooting references
			• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.
	1	Failure of boom cylinder	Charge the bucket with a load of approximate 1260 kg. Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure see **"Hydraulic Drift of Work Equipment - Test" on page 6-34.**
	2	Failure of boom retaining valve	Boom retaining valve or pilot valve may be worn or sluggish. Check the valves.
	3	Malfunction or defective seal of boom control valve (relief valve and makeup valve)	The relief valve and the makeup valve in the boom control valve may have a defective seal. Check the seals.
	4	Failure of boom valve spool	Spool of boom valve may be worn excessively. Check the spool.

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Failure information **(2)**	● The arm drifts excessively.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Failure of arm cylinder	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.
			Cut off the oil passage to the high-pressure side of the cylinder. Disconnect the cylinder from the main valve. Measure the displacement of piston for 15 minutes after the cylinder becomes stable. If the measured value is greater than 10 mm, it is deemed that cylinder has a defective seal. For more information on the measuring procedure see **"Hydraulic Drift of Work Equipment - Test" on page 6-34.**
	2	Malfunction or defective seal of arm control valve (relief valve and makeup valve)	Relief valve or makeup valve of the arm control valve may be defective. Check the valves directly. ★ The performance of seal can be judged by replacing it with another relief valve or makeup valve.(Never replace it with the boom-down relief valve or makeup valve as their pressures are set differently.)
	3	Failure of arm retaining valve	Arm retaining valve or pilot valve may be worn or sluggish. Check the valves.
	4	Failure of arm valve (spool)	Arm valve (spool) may be worn excessively. Check it directly.

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Failure information **(3)**	● The bucket drifts excessively.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values	Cause		Standard values and troubleshooting references	
	1	Failure of bucket cylinder	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Bucket control levers	Leakage from bucket cylinder
			Bucket-dig relief	20 ml/min
	2	Defective seal of bucket control valve (relief valve and makeup valve)	Seal of relief valve or makeup valve of bucket control valve may be defective. Check it directly. ★ The performance of seal can be judged by replacing it with another relief valve or makeup valve. (Never replace it with the boom-down relief valve or makeup valve as their pressures are set differently.)	
	3	Defective seal of bucket control valve (spool)	Seal of bucket control valve spool may be defective. Check it directly.	

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H-11 Work equipment moves sluggishly

Failure information	• Work equipment moves sluggishly.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values		Cause	Standard values and troubleshooting references
	1	Malfunction of arm regeneration valve	Regeneration valve of arm may have malfunction. Check it directly.
	2	Malfunction of control valve (relief valve and makeup valve)	Relief valve or makeup valve of control valve may have malfunction. Check it directly. • For arm and boom, whether a valve has malfunction can be judged by replacing it with another relief valve or makeup valve. (Never replace it with the boom-down relief valve or makeup valve as their pressures are set differently.)

H-12 Other work equipment moves while single oil circuit is relieved

Failure information	• Other work equipment moves while single oil circuit of certain work equipment is relieved.
Related information	• Set the working mode to S to perform troubleshooting.

Possible causes and standard values		Cause	Standard values and troubleshooting references
	1	Defective seal of control valve	Seal of control valve may be defective. Check it directly.

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H-13 Travel speed drops considerably while swinging and travelling

Failure information	● Travel speed drops considerably in swinging plus travelling operation.
Related information	● If the travel speed is low in only travelling operation, check first according to H-15.

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Failure of straight travel valve	The straight travel valve gives no response. Check the spool and the logic oil circuit drain port.

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H-14 Machine deviates during travel

Failure information	● Machine deviates during travel.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="20">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="3">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of travel pilot valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td colspan="2">Pilot valve output pressure</td></tr>
<tr><td>Forward
Reverse</td><td colspan="2">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>Difference occurs between left and right output</td><td colspan="2">0.4 MPa {4 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Malfunction of pilot relief valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control lever</td><td colspan="2">Control circuit source pressure</td></tr>
<tr><td>All levers in NEUTRAL</td><td colspan="2">3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>3</td><td>Failure of regulator</td><td colspan="3">Check the regulator by swapping the front and back regulators.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Sluggishness of proportional solenoid valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td colspan="2">Proportional valve output pressure</td></tr>
<tr><td>Operate both control levers</td><td colspan="2">≤ 0.1 MPa</td></tr>
<tr><td>5</td><td>Sluggishness of travel control valve (spool)</td><td colspan="3">Check the valve spool to see whether it works well.</td></tr>
<tr><td>6</td><td>Internal leakage of central swivel joint</td><td colspan="3">Check it by swapping the lines.</td></tr>
<tr><td rowspan="3">7</td><td rowspan="3">Malfunction of travel motor</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td colspan="2">Leakage of travel motor</td></tr>
<tr><td>Travel relief</td><td colspan="2">27.2 ml/min</td></tr>
<tr><td>8</td><td>Failure of final drive</td><td colspan="3">Final drive may have internal defect. Check it directly.
● Internal defect of the final drive can be determined through abnormal noise, abnormal heat, and metal powder or debris contained in the oil drained.</td></tr>
<tr><td rowspan="4">9</td><td rowspan="4">Failure of travel pilot pressure sensor</td><td>Travel control levers</td><td colspan="2">Pilot valve output pressure</td></tr>
<tr><td>Forward or backward</td><td colspan="2">The monitor reads:
3.5~3.9MPa
{ 36~40 kgf/cm^2}</td></tr>
<tr><td>Output difference between the left and the right</td><td colspan="2">0.4 MPa {4 kgf/cm^2}</td></tr>
<tr><td colspan="3">Check it by swapping.</td></tr>
</table>

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H-15 Travel speed low

Failure information	● Machine travel speed is low.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="15">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="3">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of travel pilot valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Travel control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td colspan="2">Forward or reverse</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td colspan="2">Difference occurs between front output and rear output</td><td>≤ 0.4 MPa
≤{4 kg/cm^2}</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Malfunction of pilot relief valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Control lever</td><td>Control circuit source pressure</td></tr>
<tr><td colspan="2">All levers in NEUTRAL</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Sensor failure</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel speed</td><td>Travel control</td><td></td></tr>
<tr><td>Low</td><td>Operation</td><td>3.5~3.9 MPa
{ 36~40 kgf/cm^2}</td></tr>
<tr><td>High</td><td>Operation</td><td>3.5~3.9 MPa
{ 36~40 kgf/cm^2}</td></tr>
<tr><td>4</td><td>Malfunction of travel control valve (spool)</td><td colspan="3">Check it by replacement.
Spool of travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>5</td><td>Malfunction of travel control valve (makeup valve)</td><td colspan="3">The makeup valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Failure of travel motor</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td colspan="2">Travel control lever</td><td>Oil leakage of travel motor</td></tr>
<tr><td colspan="2">Travel relief</td><td>27.2 ml/min</td></tr>
<tr><td>7</td><td>Failure of final drive</td><td colspan="3">Final drive may have internal defect. Check it directly.
● Internal defect of the final drive can be determined through abnormal noise, abnormal heat, and metal powder or debris contained in the oil drained.</td></tr>
</table>

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H-16 Machine not steered easily or steering power low

Failure information	● Machine is not steered well or steering power is low
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of travel pilot valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>Both sides in NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Either side operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Failure of travel pilot pressure sensor</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>Both sides operated</td><td>3.5~3.9 MPa
{ 36~40 kgf/cm^2}</td></tr>
<tr><td>Either side operated</td><td>3.5~3.9 MPa
{ 36~40 kg/cm^2}</td></tr>
<tr><td>3</td><td>Malfunction of travel control valve (spool)</td><td colspan="2">Spool of travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>4</td><td>Malfunction of travel control valve (makeup valve)</td><td colspan="2">The makeup valve in travel control valve may have malfunction. Check it directly.</td></tr>
<tr><td>5</td><td>Failure of travel motor (relief valve)</td><td colspan="2">Seal of relief valve in travel motor may be defective. Check it directly.
● The failure of seal can be determined by swapping the front and back motors or the left and right motors.</td></tr>
<tr><td>6</td><td>Failure of travel motor (check valve)</td><td colspan="2">Seal of check valve in travel motor may be defective. Check it directly.
● The failure of seal can be determined by swapping the front and back motors or the left and right motors.</td></tr>
</table>

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H-17 Travel speed cannot be shifted

Failure information	● Travel speed cannot be shifted.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="5">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="3">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of travel speed shifting solenoid valve</td><td colspan="3">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Travel speed</td><td>Travel control lever</td><td>Solenoid valve output pressure</td></tr>
<tr><td>Lo</td><td>Operated</td><td>0 {0}</td></tr>
<tr><td>2</td><td>Failure of travel motor (in speed change)</td><td>Hi</td><td>Operated</td><td>3.5~3.9 MPa { 36~40 kg/cm^2}</td></tr>
<tr><td colspan="2">Speed shifting assembly of travel motor may have malfunction. Check it directly.</td><td colspan="3"></td></tr>
</table>

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H-18 Travel system fails (only at one side)

Failure information	● One side of the tracks cannot make a turn.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

	Cause		Standard values and troubleshooting references	
Possible causes and standard values	1	Defective seat of travel control valve (makeup valve)	Seat of makeup valve in travel control valve may have malfunction. Check it directly.	
	2	Defective seat of travel motor (relief valve)	Seat of relief valve in travel control valve may have malfunction. Check it directly.	
	3	Defective seat of travel motor valve (makeup valve)	Seat of check valve in travel motor valve may have malfunction. Check it directly.	
	4	Speed of travel motor drops.	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Leakage from travel motor
			Travel relief	27.2 ml/min
	5	Failure of final drive	Final drive may have internal defect. Check it directly. ● Internal defect of final drive can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.	
	6	Failure of pilot pressure sensor	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Travel control lever	Pilot valve output pressure
			Forward or backward	The monitor read: 3.5~3.9 MPa { 36~40 kgf/cm^2}
			Output difference between the left and the right	0.4 MPa {4 kgf/cm^2}
			Check it by swapping.	

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H-19 Swing operation fails

Failure information (1)	● Upper structure fails to swing in either direction.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td>1</td><td>Malfunction of swing motor (parking brake)</td><td colspan="2">Parking brake of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Improper adjustment or malfunction of swing motor (relief valve)</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Swing relief pressure</td></tr>
<tr><td>Swing relief</td><td>25.5~28.5 MPa
{260~291 kg/cm^2}</td></tr>
<tr><td colspan="2">If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Failure of swing motor</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Leakage from swing motor</td></tr>
<tr><td>Swing relief</td><td>≥ 10 ml/min</td></tr>
<tr><td>4</td><td>Failure of swing mechanism</td><td colspan="2">Swing mechanism may have internal defect. Check it directly.
● Internal defect of swing mechanism can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.</td></tr>
</table>

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Trouble (2)	● Upper structure only fails to swing in one direction.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

Possible causes and standard values	Cause		Standard values and troubleshooting references	
	1	Malfunction of pilot valve	● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.	
			Left control lever	Pilot valve output pressure
			NEUTRAL	0 {0}
			Swing	≥ 3.5MPa { ≥ 36 kg/cm^2}
	2	Malfunction of swing control valve (spool)	Spool of swing control valve may have malfunction. Check it directly.	
	3	Defective seal of swing motor (makeup valve)	Seal of makeup valve in swing motor may have defect. Check it directly. ● Failure of the seal can be determined by swapping the right and left makeup valves and check for any changes.	

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H-20 Swing acceleration poor or swing speed low

Failure information (1)	• Swing acceleration is poor, or swing speed is low.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="9">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td>1</td><td>Malfunction of swing motor (parking brake)</td><td colspan="2">Parking brake of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Improper adjustment or malfunction of swing motor (relief valve)</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Swing relief valve</td></tr>
<tr><td>Swing relief</td><td>25.5~28.5 MPa
{260~291 kg/cm^2}</td></tr>
<tr><td colspan="2">If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Failure of swing motor</td><td colspan="2">• Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Leakage from swing motor</td></tr>
<tr><td>Swing relief</td><td>≤ 10 ml/min</td></tr>
<tr><td>4</td><td>Clogging of brake control lines</td><td colspan="2">Disassemble, clean and check.</td></tr>
</table>

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Failure information (2)	● Swing acceleration is only poor on one side, or swing speed is low.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of pilot valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>≥ 3.5MPa { ≥ 36 kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunction of swing motor (pressure compensation valve)</td><td colspan="2">Pressure compensation valve of swing motor may have malfunction. Check it directly.</td></tr>
<tr><td>3</td><td>Defective seal of swing motor (makeup valve)</td><td colspan="2">Seal of makeup valve in swing motor may have defect. Check it directly.
● Swap the left and right makeup valves and observe the result to determine whether the seal fails.</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">One-side leakage of swing pilot pressure sensor (shuttle valve)</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>3.5~3.9MPa {36~40 kg/cm^2}</td></tr>
</table>

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H-21 Upper structure overrunning remarkably

Failure information (1)	● Upper structure overruns remarkably when it stops swinging in both directions.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="6">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Improper adjustment or malfunction of swing motor (relief valve)</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Swing relief pressure</td></tr>
<tr><td>Swing relief</td><td>25.5~28.5 MPa
{260~291 kg/cm^2}</td></tr>
<tr><td colspan="2">If oil pressure does not become normal after adjustment, swing motor relief valve may have malfunction or internal defect. Check the relief valve directly.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Failure of swing motor</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Control lever</td><td>Leakage from swing motor</td></tr>
<tr><td>Swing relief</td><td>≤ 10 ml/min</td></tr>
</table>

Failure information (2)	● Swing acceleration is only poor on one side, or swing speed is low.
Related information	● Set the working mode at gear (10) of power mode (S) to perform troubleshooting.

<table>
<tr><td rowspan="5">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Malfunction of pilot valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>2 3.5MPa { ≥ 36 kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunction of swing control valve (spool)</td><td colspan="2">Spool of swing control valve may have malfunction. Check it directly.</td></tr>
<tr><td>3</td><td>Defective seal of swing motor (makeup valve)</td><td colspan="2">Seal of makeup valve in swing motor may be defective. Check it directly.
● Swap the left and right makeup valves and observe the result to determine whether the seal fails.</td></tr>
</table>

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H-22 Large shock produced upon swing stoppage

Failure information	● Large shock is produced when upper structure stops swinging.
Related information	● Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

<table>
<tr><td rowspan="6">Possible causes and standard values</td><td colspan="2">Cause</td><td colspan="2">Standard values and troubleshooting references</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunction of swing pilot valve</td><td colspan="2">● Stop the engine before troubleshooting. Perform troubleshooting while the engine is running at high idle.</td></tr>
<tr><td>Swing control lever</td><td>Pilot valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Left swing
Right swing</td><td>≥ 3.5MPa {≥ 36 kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunction of swing reverse prevention valve</td><td colspan="2">Reverse prevention valve of swing motor may have malfunction. Check it directly.
● Replace the valve with a new on to determine whether the valve fails.</td></tr>
<tr><td>3</td><td>Malfunction of swing relief valve</td><td colspan="2">Swing relief valve may be worn or sluggish.</td></tr>
</table>

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H-23 High noise produced upon swing stoppage

Failure information	• High noise is produced when upper structure stops swinging.
Related information	• Set working mode to S and fuel control dial at position 10 to carry out troubleshooting.

	Cause		Standard values and troubleshooting references
Possible causes and standard values	1	Malfunction of back pressure valve	Back pressure valve may have malfunction. Check it directly.
	2	Malfunction of swing motor (relief valve)	Relief valve of swing motor may have malfunction. Check it directly.
	3	Malfunction of swing motor (makeup valve)	Seal of makeup valve in swing motor may have malfunction. Check it directly. • Swap the left and right makeup valves and observe the result to determine whether the seal fails. .
	4	Failure of swing mechanism	The swing mechanism is suspected of an internal failure. Check the inside of the machinery itself. • Internal defect of swing mechanism can be determined with abnormal noise, overheat, and metal powder or debris contained in the oil drained.

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H-24 Swing drift excessive

Failure information (1)	● Hydraulic drift of swing is large (when swing holding brake is applied).
Related information	● When swing lock switch is turned ON or when swing holding brake release switch is in normal position, swing holding brake operates and upper structure is fixed with disc brake.

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Failure of swing holding brake control lines	Swing holding brake control lines and holding brake pilot valve may be defective. Check them directly.
	2	Malfunction of swing motor (parking brake)	Parking brake of swing motor may have malfunction. Check it directly.

Failure information (2)	● Hydraulic drift of swing is large (when swing holding brake is released).
Related information	● When swing holding brake release switch is in release position, swing holding brake is released and upper structure is secured by only hydraulic pressure.

Possible causes and standard values	Cause		Standard values and troubleshooting references
	1	Malfunction or defective seal of swing control valve (spool)	Swing control valve spool may have malfunction or defective seal. Check it directly.
	2	Failure of swing motor (relief valve)	Seal of relief valve in swing motor may be defective. Check it directly.
	3	Failure of swing motor (makeup valve)	Seal of makeup valve in swing motor may be defective. Check it directly.

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Disassembly and Assembly

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8 Disassembly and Assembly

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8 DISASSEMBLY AND ASSEMBLY

8.1 How to Read This Manual

8.1.1 Removing and installing an assembly

Special tools

- Special tools for parts removal and installation are listed.
- Necessary characteristics of the tools are noted in the list of special tools.
  - ■ : Special tools that cannot be substituted and must be used.
  - ● : Very important tools, which can be substituted with commercially available ones.

Removal of parts

- The "Removal" section contains procedure, precautions and the amount of oil or coolant to be discharged.
- The symbols used the in the "Removal" section are described below:


This symbol indicates that safety-related precautions must be observed when doing the job.


This symbol is followed by instructions or precautions when performing a procedure.


This symbol indicates related rules and precautions that must be obeyed when installing the pats.


This symbol indicates the amount of oil or coolant to be discharged.

Installation of parts

- Unless specified otherwise, installation of a part is to be performed in a reverse order of removing the part.
- The mark  used in the "Installation" section indicates the rules and precautions related to parts installation.
- Symbols used in the "Installation" sections are shown below:


This symbol indicates that safety-related precautions must be observed when doing the job.


This symbol is followed by instructions or precautions when performing a procedure.


This symbol indicates that specific coating agent must be used.


This symbol indicates the lubricant required.


This symbol indicates a torque specified.


This symbol indicates the amount of oil or coolant to be added.

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8.2 Operating Precautions

Observe the following precautions before removing or installing (disassembling or assembling) a component.

1. Precautions to be observed prior to removal operation
   - Dispose the engine coolant properly if antifreeze is used in the engine coolant.
   - After disconnecting a hose or tube, seal the openings to prevent invasion of dirt or dust.
   - Use a suitable container to contain oil drained.
   - Matching mark must be made at where is necessary before removing a part in order to avoid mistake during reinstallation.
   - Do not pull the wire and avoid the wire coming off its contact. To avoid excessive force imposing on the wire, hold the connector when disconnecting a wire.
   - Tag the wires and the hoses in order to ensure their connecting positions. By doing so, mistakes can be avoided during reinstallation.
   - Count and check the number and thickness of the shims, and keep them in a safe place.
   - When raising or lifting a component, be sure to use a proper lifting equipment of ample strength.
   - When forcing screws are used to remove any components, tighten the screws evenly in turn.
   - The surrounding area must be cleaned before removing a component. Cover the component after removal in order to prevent invasion of dirt or dust.

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- Precautions to be observed when disassembling the lines

  The lines disassembled must be blinded with plugs.

A. Thread-connected hoses

Inner Diameter (mm)	Code	Description
Light Thread Connection		
6	B210780001189	Plug
8	B210780001190	Plug
10	B210780000077	Plug
12	B210780000078	Plug
15	B210780000883	Plug
20	B210780000079	Plug
22	60056667	Plug
Heavy Thread Connection		
12	B210780001142	Plug
16	60002397	Plug
20	B210780000080	Plug
25	B210780000081	Plug

B. Thread-connected adaptors (plug and nut used in combination)

Inner Dia.(mm)	Code	Description	Code	Description
Light Thread Connection				
6	B210780000903	Cone Plug	23002925	Nut
8	B210780001146	Plug	B210770000011	Nut
10	B210780000088	Plug	B210334000011	Nut
12	B210780000089	Plug	B210334000012	Nut
15	B210780000882	Plug	B210334000004	Nut
20	B210780000090	Plug	B210334000010	Nut
22	B210780000091	Plug	B210780000112	Nut
Heavy Thread Connection				
12	B210780001143	Plug	B210780000406	Nut
16	A820205001523	Plug	B210780000405	Nut
20	B210780000902	Plug	B210780000904	Nut
25	B210780001172	Plug	B210334000006	Nut

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2. Precautions to be observed prior to installation
   - Tighten all the screws and nuts (sleeve nuts) to specified torques.
   - Install the hoses without twisting or interference.
   - Replace the gaskets, O-rings, cotter pins and lock plates with new ones.
   - Bend the cotter pin or lock plate securely.
   - Before applying the adhesive, clean the parts of oil and dust. Apply 2 or 3 drops of adhesive to the threaded portion.
   - Before applying the sealant to the gasket, clean the gasket surface of oil and dust. Check the gasket for contamination or damage. Apply the gasket sealant evenly.
   - Clean all parts, and correct any damage, dents, burrs, or rust.
   - Apply engine oil to the moving parts.
   - Before installing a snap ring, make sure that the snap ring is mounted properly in the circular groove.
   - Before connecting the wiring connector, clean the wiring connector of oil, dirt or water. Make sure that the wiring connector is connected securely.
   - Before using an eyebolt, check the eyebolt for deformation or deterioration. Screw on the eyebolt as far as possible and align it to the direction of the hook.
   - Before tightening the half flanges, tighten it evenly in turn in order to prevent over tightening on one side.

- After reassembling the hydraulic cylinder, main pump or other hydraulic equipment that has been disassembled and repaired, it is necessary to purge the air from the hydraulic cylinder prior to initial operation of the cylinder. The purging procedure is performed as the following:

  (1) Start the engine and run the engine at low idle.

  (2) Operate the work equipment control lever in order to cycle the movement of the hydraulic cylinder 4 or 5 times. Hold the cylinder at where it is 100 mm from its stroke end.

  (3) Go on operating the hydraulic cylinder 3 or 4 times to its stroke end.

  (4) You can run the engine at normal speed after this operation.

- This procedure is to be performed before using your machine for the first time after repair or long storage.

3. Precautions to be observed upon completion of the operations
   - Completely discharge the engine coolant, tighten the drain valve, and add coolant to the specified level. Run the engine to circulate the coolant through the system. Check the coolant level again.
   - Add hydraulic oil to the specified level after disassembly and reinstallation of a hydraulic unit. Run the engine to circulate the hydraulic oil through the system. Check the oil level again.
   - Purge the air from the system after removing and repairing the lines or hydraulic unit and reassembling the parts.
   - To purge the air, see related information in “Testing and Adjusting”.
   - Add the specified amount of grease (MoS_2) to the work equipment related parts.

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8.3 Start Motor AS

8.3.1 Removal

NOTICE

- **Before removing the start motor assembly, disconnect the cable from the negative post (-) of the battery. Insulate the cable and negative post (-) with tape.**

1. Open the engine hood.
2. Disconnect the Cables (2), (3) and (4).
3. Remove the start motor fixing bolt (1) in order to remove the start motor.

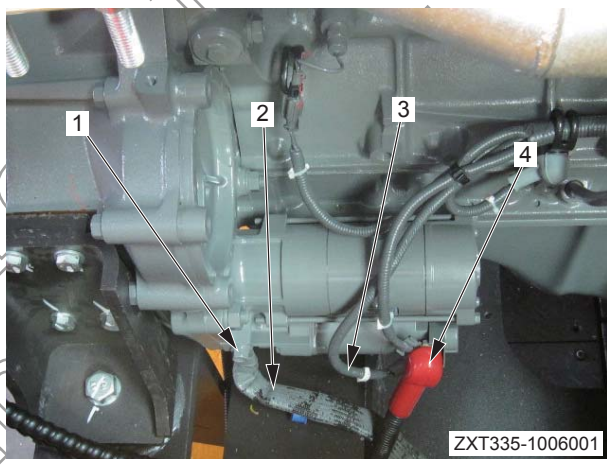


Fig. 8-1

8.3.2 Installation

- Installation is performed in the reverse procedure of removal.

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8.4 Fuel Injection Pump AS

8.4.1 Removal

NOTICE

- **Disconnect the negative (-) post of battery.**

1. Open the engine hood.



Fig. 8-2

2. Disconnect the air hoses (1) and (2) of the crankcase.



Fig. 8-3

3. Remove the fuel return line (3), fuel delivery line (4), fuel supply line (5) and lubrication line (7).
   - After disconnecting the hoses, cork them to prevent fuel leak.

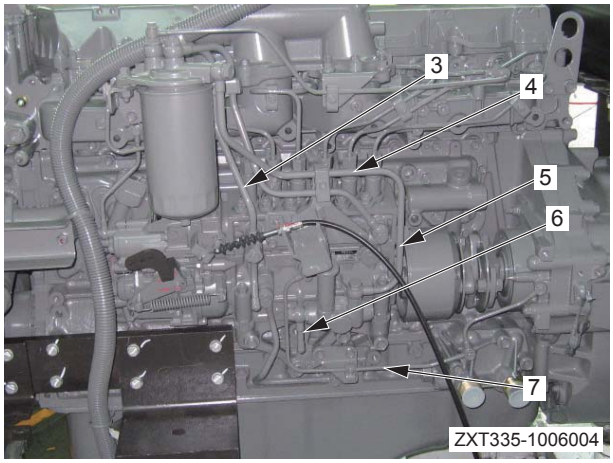


Fig. 8-4

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4. Remove the six (6) fuel delivery lines (8)

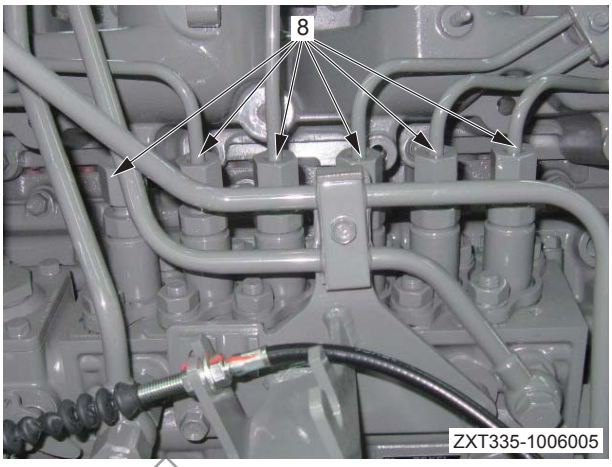


Fig. 8-5

5. Remove the air hose (9).
6. Remove the bolt (10) fixing the electronic shutdown device and the bolt (11) of governor motor.
7. Remove the fuel injection pump mounting nut in order to remove the fuel injection pump assembly.

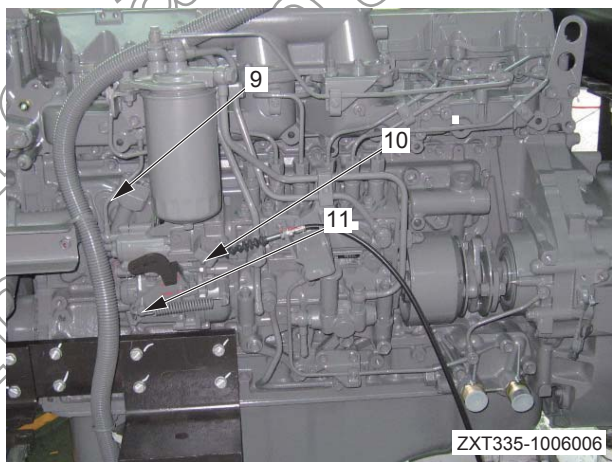


Fig. 8-6

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8.4.2 Installation

- Installation is performed in the reverse procedure of removal.

  Torques for:

  Fuel supply line connector bolt: 28-46 N•m

  Fuel return line nut: 28-46N•m

  Fuel delivery line nut: 28-32N•m

  Engine oil line nut: 16-25N•m

- Install the fuel injection pump as the following:

  A. Check the fuel injection timing.

  See **“Fuel Injection Timing - Test and Adjust” on page 6-13**.

  B. Assemble the fuel injection pump assembly and tighten the nuts.

  Nut: 9.8±2 Nm {10±0.2 kgm}

- Purge the air.

  Purge the air from the fuel injection system.

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8.5 Engine Front Oil Seal

8.5.1 Removal

1. Remove the radiator assembly. See **“Radiator AS” on page 8-20.**
2. Remove the engine fan (1), belt (2) and pulley (3).
3. Remove the bolt (4) and then the crankshaft belt pulley (5).
4. Remove the front oil seal (6).

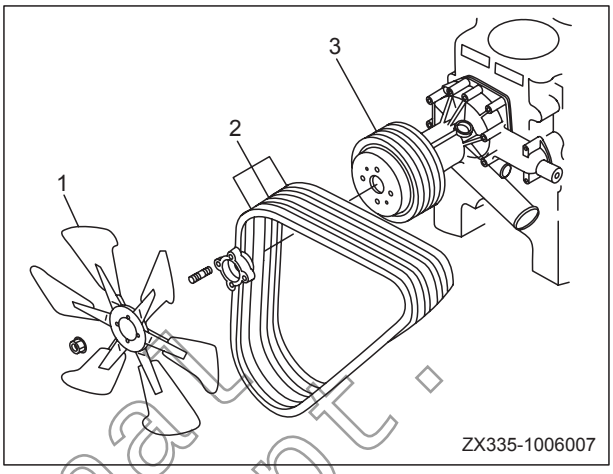


Fig. 8-7

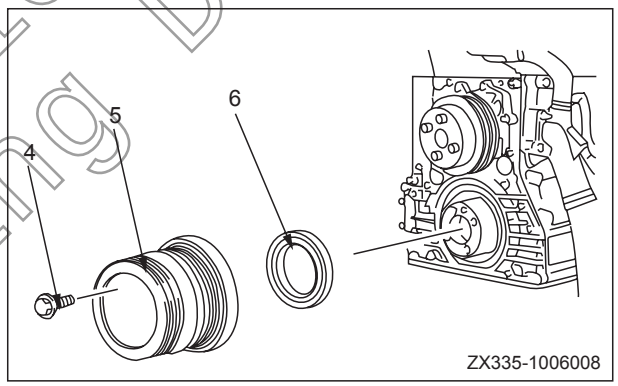


Fig. 8-8

8.5.2 Installation

- Installation is performed in the reverse procedure of removal.

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8.6 Engine Rear Oil Seal

8.6.1 Removal

1. Remove the hydraulic pump assembly. See **“Hydraulic Pump AS” on page 8-80.**
2. Remove the flywheel (1).
3. Remove the rear oil seal (2).

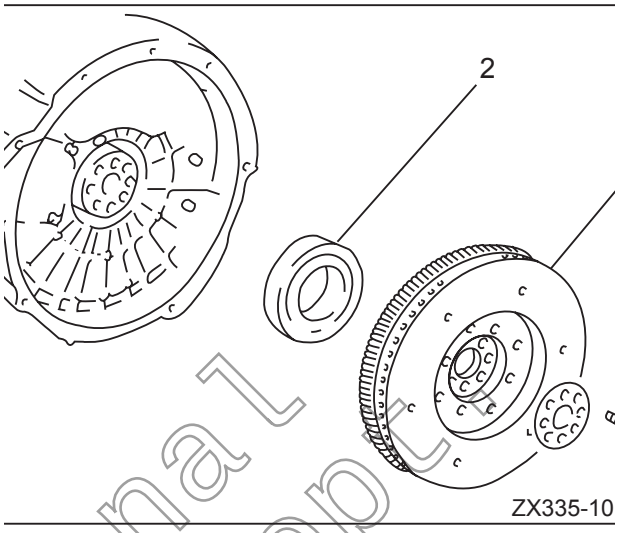


Fig. 8-9

8.6.2 Installation

- Installation is performed in the reverse procedure of removal.
- Install the rear oil seal as the following:
  - A. Apply engine oil to the lip of rear oil seal.
  - B. Clean the seal surface.
  - C. Apply sealant along the sealing line continuously and uniformly.

    Sealant (Tianshan 1596)
  - D. Installation is to be performed within three (3) minutes after application of sealant. It is important to keep the applied sealant in proper area.

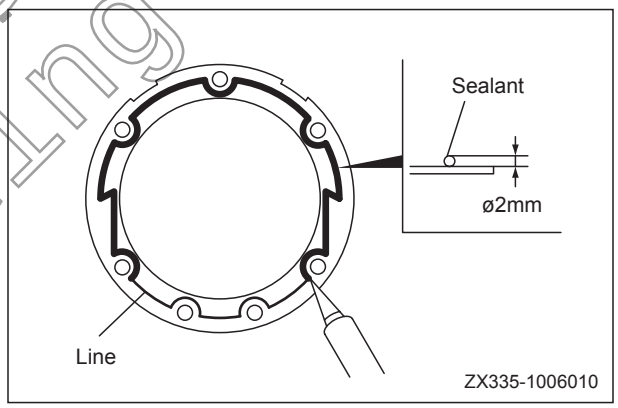


Fig. 8-10

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8.7 Cylinder Head AS

8.7.1 Removal

NOTICE

- **Disconnect the cable from the negative post (-) of the battery.**

1. Drain coolant from the engine.
   Coolant: 26 L
2. Open the engine hood.



Fig. 8-11

3. Remove the air intake hose (1).



Fig. 8-12

4. Disconnect the lines (2) and (3) between the fuel filter and the fuel injection pump.
5. Remove the fuel filter bracket (4) and the fuel filter assembly (5).



Fig. 8-13

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6. Disconnect the six (6) fuel delivery lines (6).

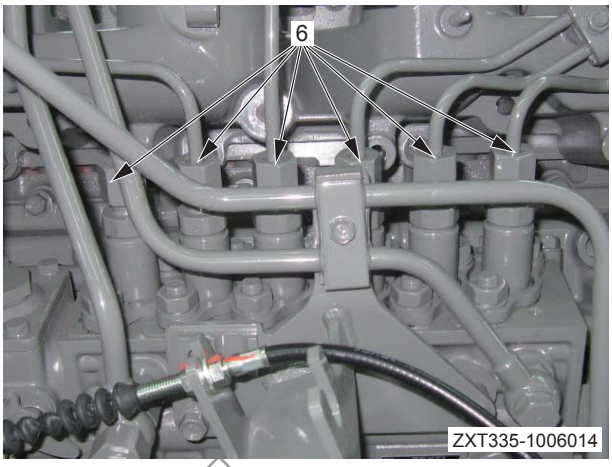


Fig. 8-14

7. Remove the cover (7) of exhaust muffler connector.
8. Disconnect the air intake hose (8).
9. Disconnect the air intake hose (9) and the crankcase breathing hose (10) between turbocharger and intercooler.

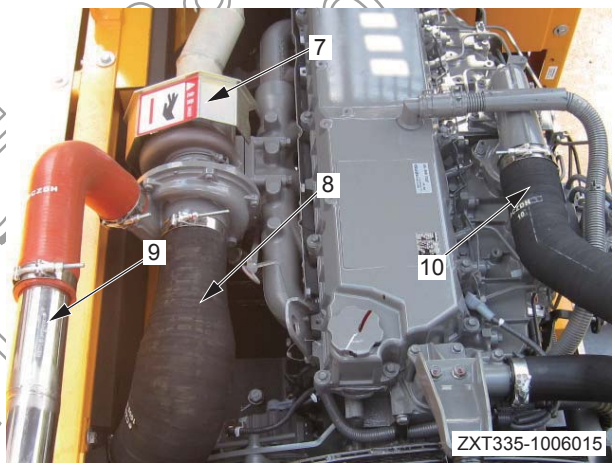
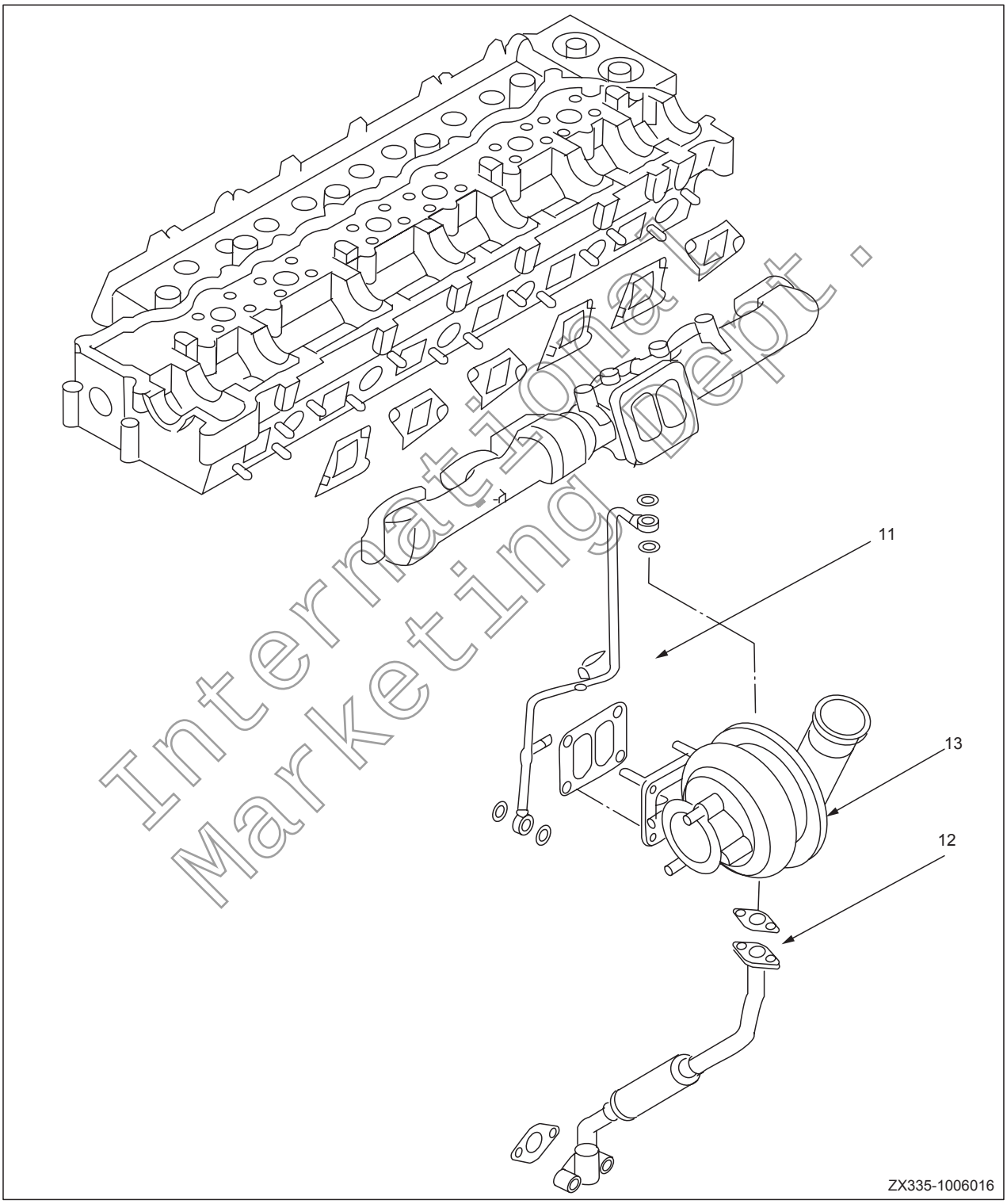


Fig. 8-15

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10. Disconnect the oil delivery line (11) and the oil return line (12).
11. Remove the turbocharger system assembly.
12. Remove the exhaust manifold (13).



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Fig. 8-16

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13. Remove the radiator inlet hose (14) and outlet hose (15).

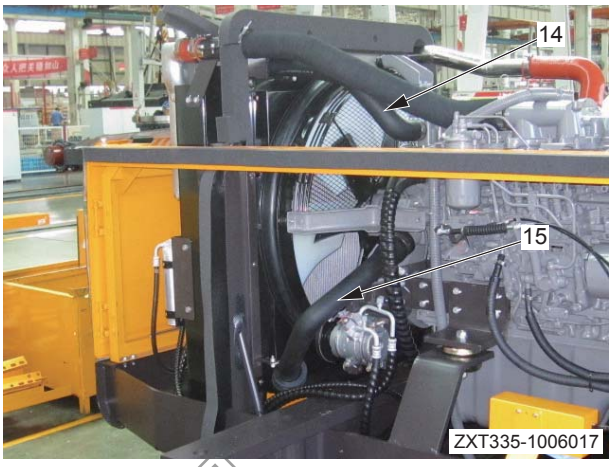


Fig. 8-17

14. Remove the six (6) nozzle seats (16).

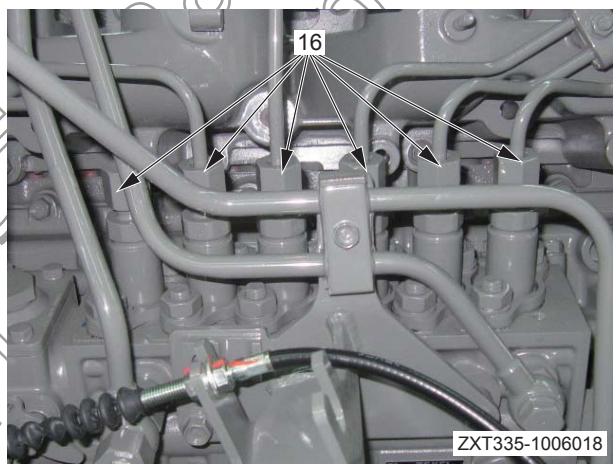


Fig. 8-18

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15. Remove the rocker arm cover (17).
16. Remove the camshaft assembly (18).
17. Remove the rocker arm assembly (19).
18. Remove the bolts of cylinder head and lift the cylinder head assembly in order to disassemble it.
19. Remove the cylinder head gasket (21).

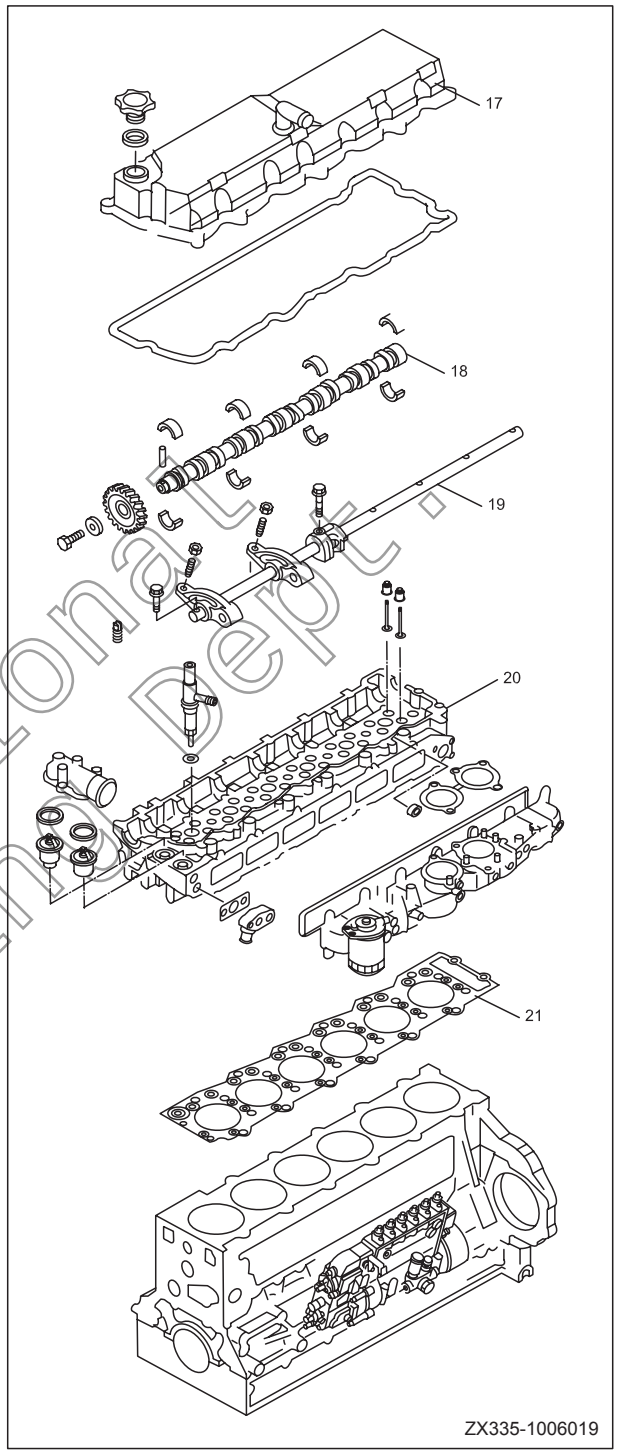


Fig. 8-19

8.7.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Rocker cover bolt:
7.8-9.8N.m{0.8-1.0kgf.m}

Cylinder head bolt:
88N.m{9.0 kgf.m }+90°

※2

a Cylinder head bolt threads: engine oil

a Camshaft flange surface: engine oil

a Camshaft journal circumference: engine oil

- Adjusting valve clearance
  - **See “Valve Clearance - Adjust” on page 6-7.**
- Adding coolant

  Add engine coolant to the specific level. Start the engine to circulate coolant in order to eliminate all foams. Check the coolant level again.

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8.8 Radiator AS

8.8.1 Removal

1. Open the engine hood
2. Open the pressure cap (1). Drain engine coolant via the drain valve beneath the coolant tank.

   Coolant: Approx. 26 L



Fig. 8-20

3. Disconnect the pipes from the hydraulic oil cooler delivery port (2) and supply port (3). Seal the ports in order to prevent the leakage of hydraulic oil in the hydraulic system.
4. Drain hydraulic oil from the cooler and from radiator.

   Hydraulic oil radiator: Approx. 8 L

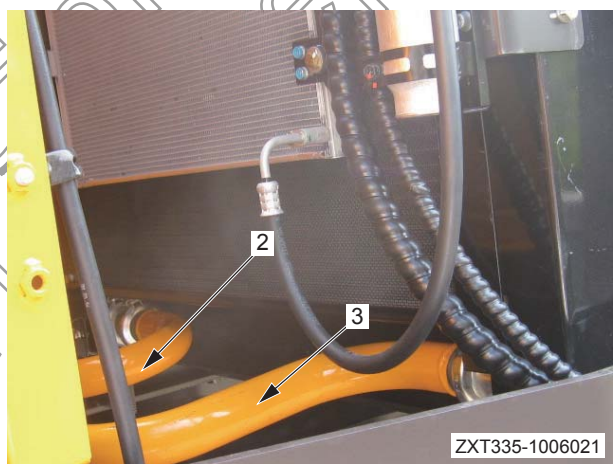


Fig. 8-21

5. Remove hose (4) of coolant tank.



Fig. 8-22

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6. Remove the inlet and outlet houses (5) and (6) of the water cooler.

   Hydraulic oil radiator: Approx. 5.6 L

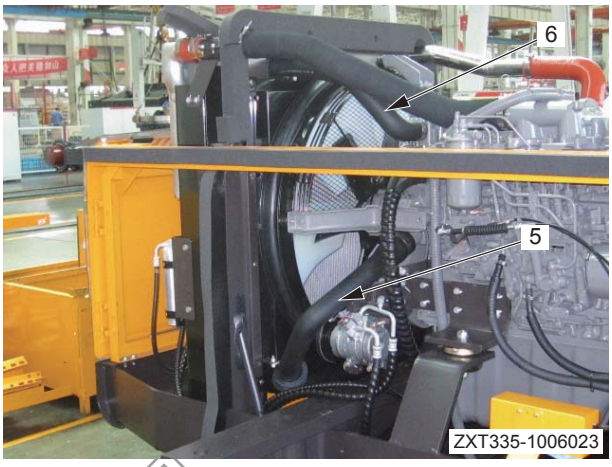


Fig. 8-23

7. Remove the inlet and outlet air hoses (7) and (8) of the intercooler.

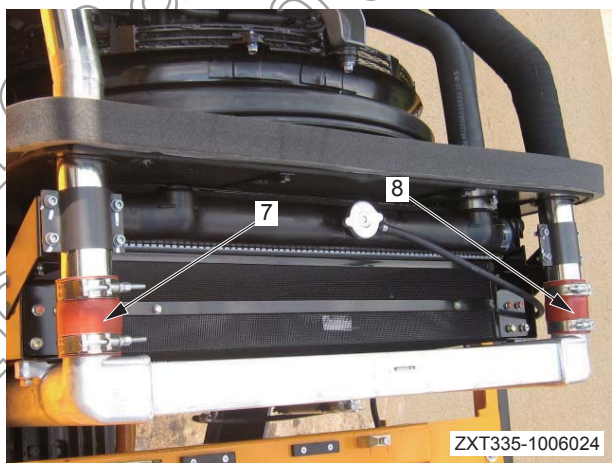


Fig. 8-24

8. Remove the four bolts (9) of the A/C radiator. Remove the A/C radiator and put it in a suitable place.

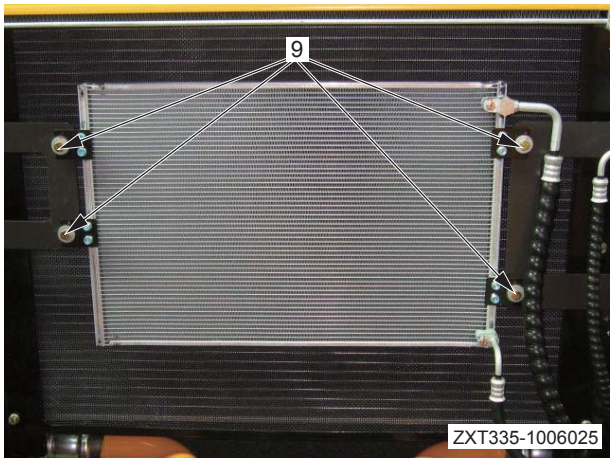


Fig. 8-25

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9. Remove the radiator fan guard (10).



Fig. 8-26

10. Remove the four bolts (11) from the bottom of radiator.

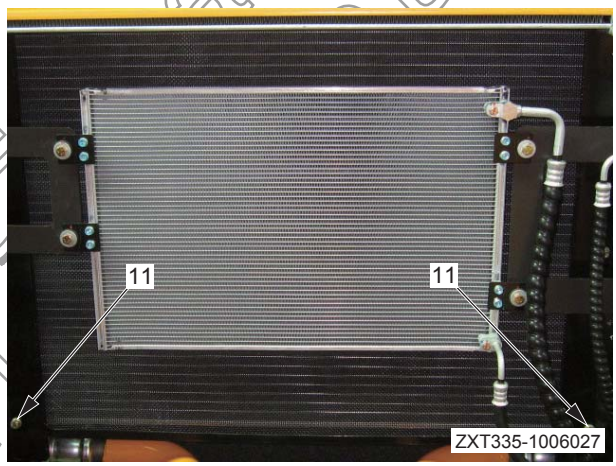


Fig. 8-27

11. Remove the bolts (12) and (13) of both left and right brackets.



Fig. 8-28

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12. Install eyebolts (14) on both sides of the radiator and lift the radiator assembly.

- Before lifting the radiator assembly, move the radiator assembly in axial direction until the fan is free from the fan guard.

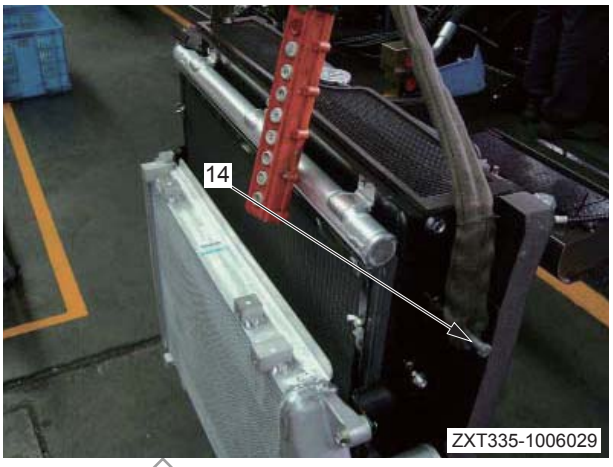


Fig. 8-29

8.8.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

- Adjust the clearance (a) between the fan and guard so that the clearance is uniform around the fan.
- The clearance (a) should read as the following on the left, right, top and bottom points.
  - Standard clearance (a) (around the fan): 10 mm
  - Fan dia. (b): ø830 mm
  - Guard inner dia. (c): ø850 mm

- Refilling engine coolant and hydraulic oil

  Refill engine coolant and hydraulic oil to the specific levels. Start the engine to circulate the coolant and oil. Check the coolant level and oil level again.

  Engine coolant: Approx. 26 L.

  Hyd oil radiator: Approx. 8 L.

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8.9 Engine and Hydraulic Pump AS

8.9.1 Removal

Lower the work equipment to the ground in order to ensure safety. Stop the engine. Disconnect the cable from the battery negative (-) post.

Loosen the butterfly nut on the breather valve and press the relief button to release internal pressure.

- Mark the lines to avoid mistakes during re-installation.

1. Remove the hydraulic tank suction filter and block the opening.
2. Discharge engine coolant.

   Coolant: About 22.9 L
3. Open the engine hood.

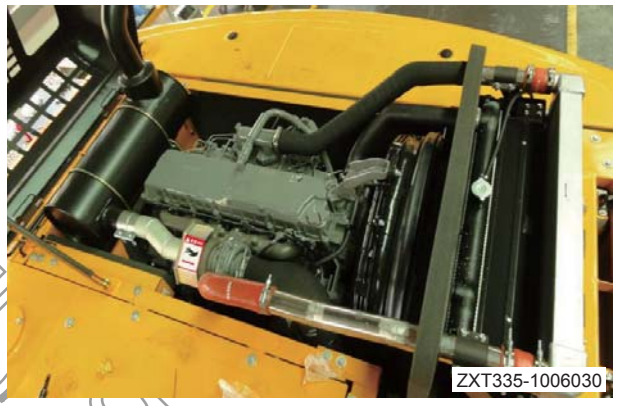


Fig. 8-30

4. Disconnect lines (1), (2) and (3).

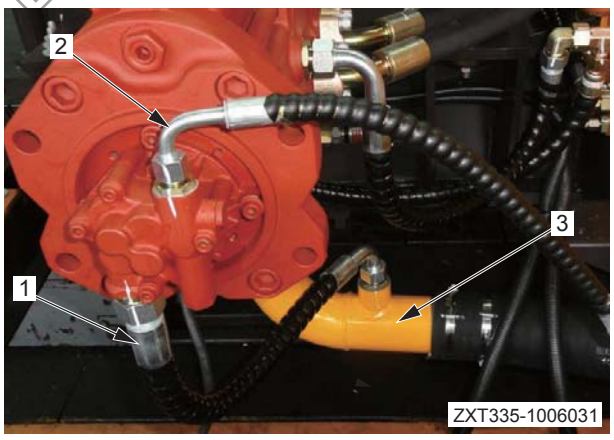


Fig. 8-31

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5. Disconnect hoses (4), (6) and (7). Disconnect the cables (5) and (8) of main pump pressure sensors.

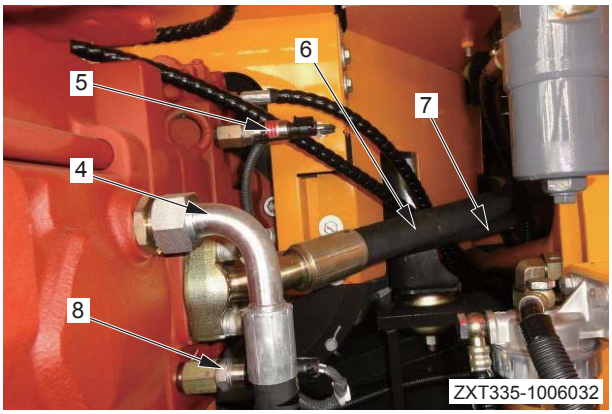


Fig. 8-32

6. Remove the hose (9) and the clamps (10).

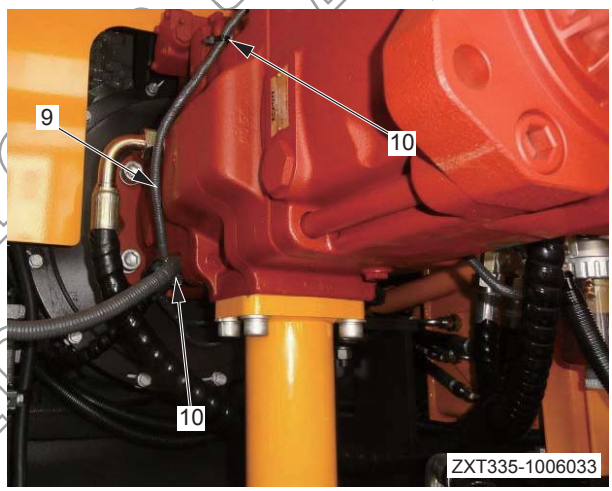


Fig. 8-33

7. Remove the main pump negative feedback hoses (11) and (12).



Fig. 8-34

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8. Remove the main pump PSV hose (13), clamp (14) and cable (15).

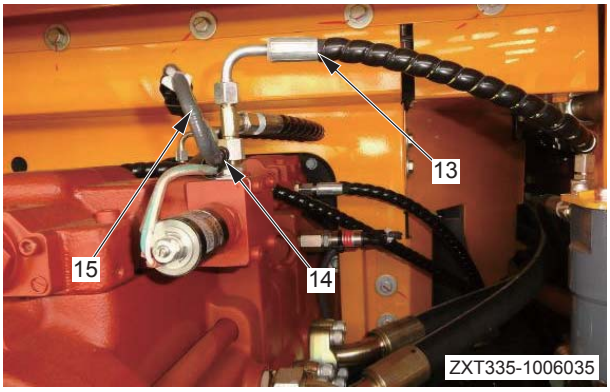


Fig. 8-35

9. Disconnect the engine fuel hoses (16) and (17) and the engine oil hoses (18) and (19).
10. Disconnect the engine speed sensor cables (20) and (21) as well as the clamp (22).

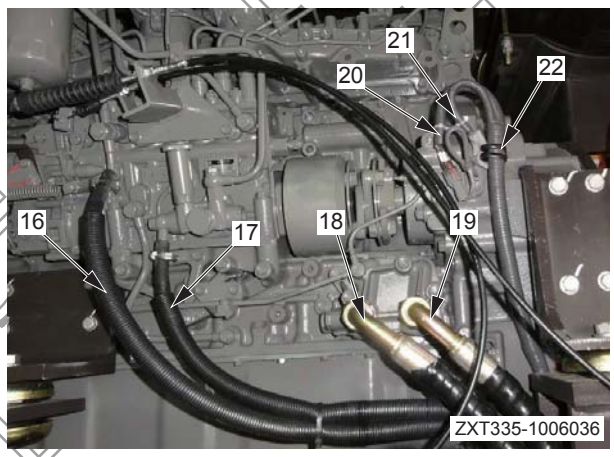


Fig. 8-36

11. Unscrew the throttle guy connecting bolt (23) and the electronic shutdown device connecting bolt (24).

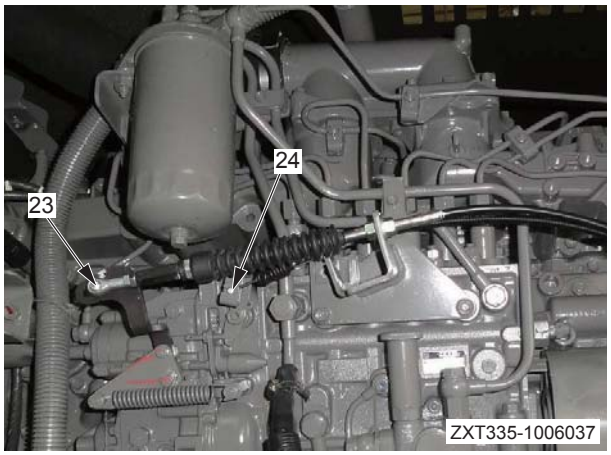


Fig. 8-37

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12. Remove the coolant temperature sensor, high temperature switch external cables (25) and (26) as well as the hose clamps (27).



Fig. 8-38

13. Disconnect the compressor cables (28) and (29) as well as the hoses (30) and (31).

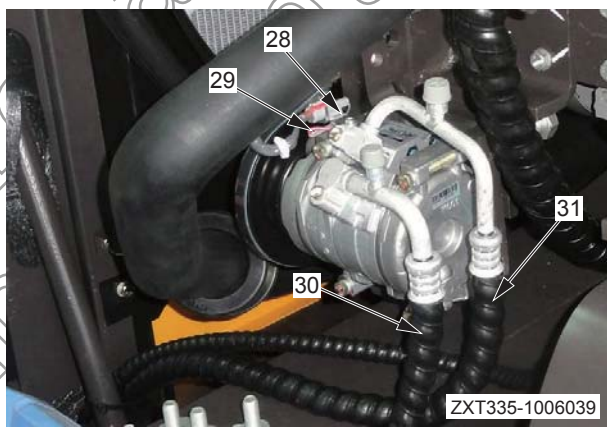


Fig. 8-39

14. Disconnect the external cable (32) of engine oil pressure sensor and the cable (33) of engine oil pressure sensor.
15. Remove the clamps (34).
16. Remove the starter main cable (35).
17. Disconnect the alternator cable (36).

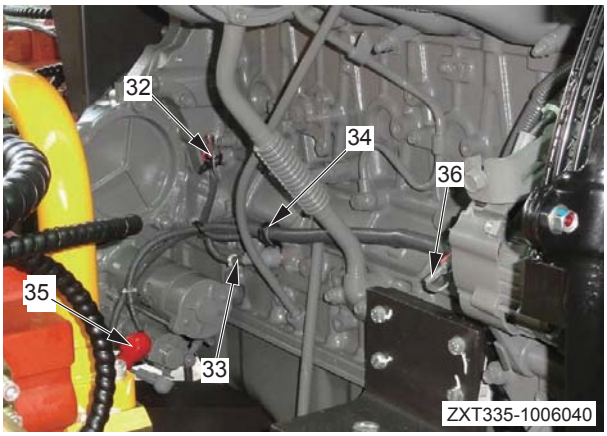


Fig. 8-40

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18. Remove the hose clamp (37).



Fig. 8-41

19. Disconnect the hoses (38), (39) and (40) between the engine and the radiator.
20. Disconnect the air intake hose (41).



Fig. 8-42

21. Disconnect the hose (42) between the engine and the radiator.

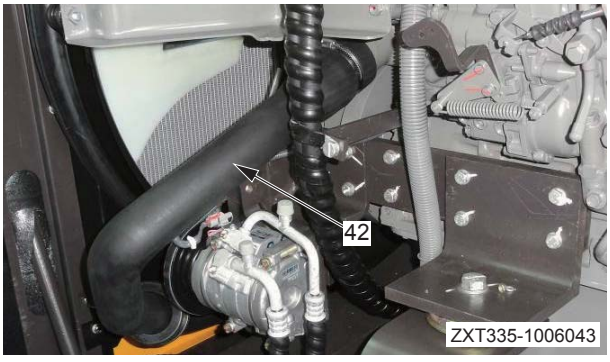


Fig. 8-43

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22. Disconnect the radiator fan guard (43).

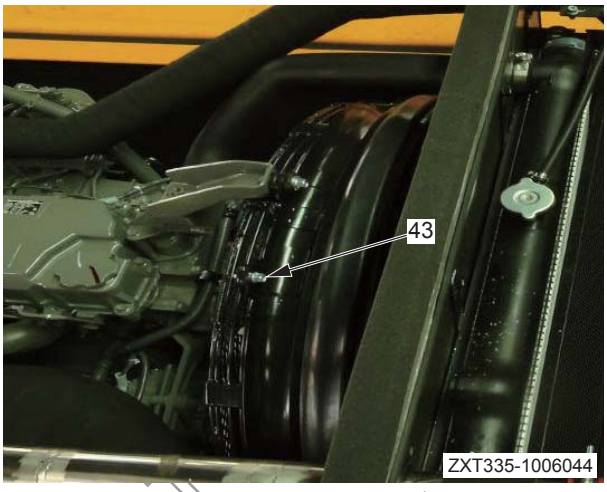


Fig. 8-44

23. Remove the fixing bolt (44) on each of the four (4) mounting plates of the damper. Lift the engine and main pump assembly.

Engine and hydraulic pump AS: 836 kg

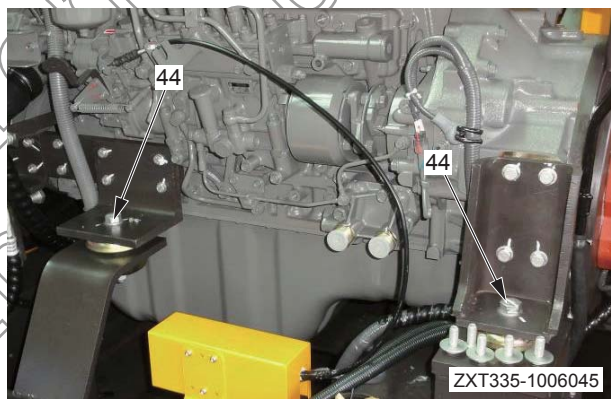


Fig. 8-45

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8.9.2 Installation

- Installation is performed in the reverse procedure of removal.
- Open the radiator tank cap to refill coolant. Add coolant to the coolant tank.

   Engine coolant:Approx. 26 L

- Refill the hydraulic tank with hydraulic oil.

   Hydraulic tank: Approx. 380 L

- Start the engine to circulate the coolant in order release the foams, and check the coolant level again.
- Start the engine to circulate the hydraulic oil in the hydraulic system, and check the oil level again.
- Purging the air.

  See **“Air in Each Component - Purge” on page 6-41.**

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8.10 Final Drive AS

8.10.1 Removal

1. Remove the sprocket. See **“Sprocket” on page 8-58.**

⚠ WARNING

- **Lower the work equipment to the ground in order to ensure safety. Stop the engine. Operate the breather valve to release internal pressure.**

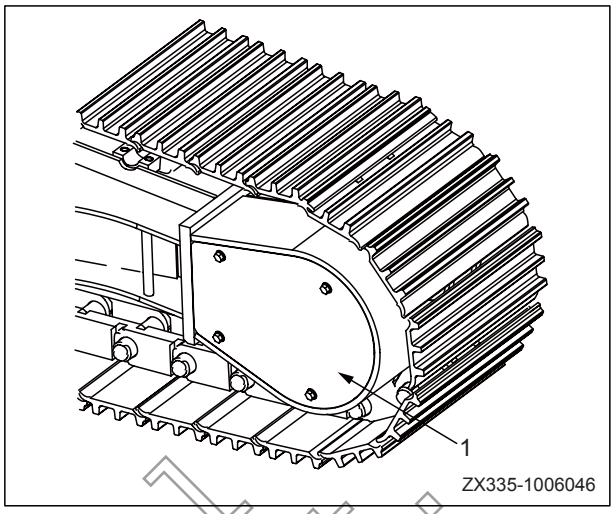


Fig. 8-46

2. Remove the motor cover plate (1).
3. Disconnect the four hoses (2) of the travel motor and the corresponding hose connectors.
4. Remove the 24 mounting bolts (3) connecting the final drive assembly with the sprocket. And the remove the sprocket.
5. Remove the bolts (4) connecting the final drive with the track frame. Lift the final drive (5) in order to disassemble it.
   - Take care not to damage the surface of mounting seal installed on the hose base.
   - Never use the threaded holes to lift the cover when lifting the final drive.



Fig. 8-47

	SY365(B)H-9
Number of Bolts	18
Travel motor plus reducer	389 kg

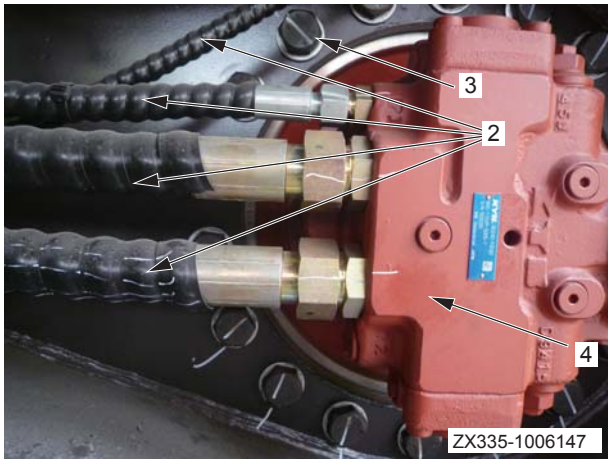


Fig. 8-48

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8.10.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Mounting bolts (final drive AS): 245~309 Nm {25~31 kgm}

- Refilling hydraulic oil.

  Add hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Purging the air.

  See **“Air in Each Component - Purge” on page 6-41.**

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8.11 Final Drive AS

8.11.1 Disassembly

1. Discharging the oil

   Open the drain plug to discharge oil from the final drive tank.

   Final drive tank: About 4.0 L

2. Cover

   Unscrew the mounting bolts. Remove the cover (1) with the help of eyebolts ① .

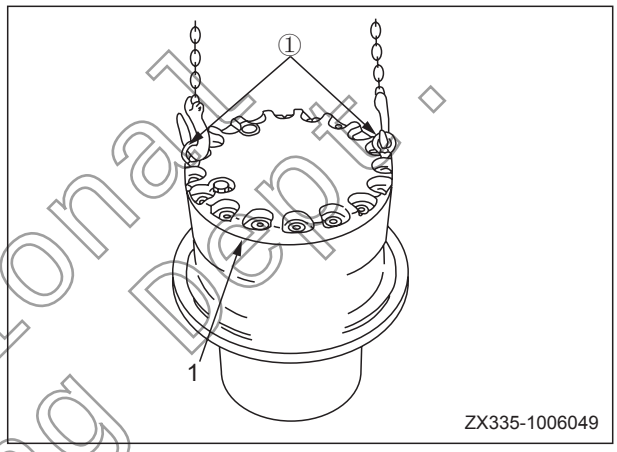


Fig. 8-49

3. Spacer

   Remove the spacer (2).

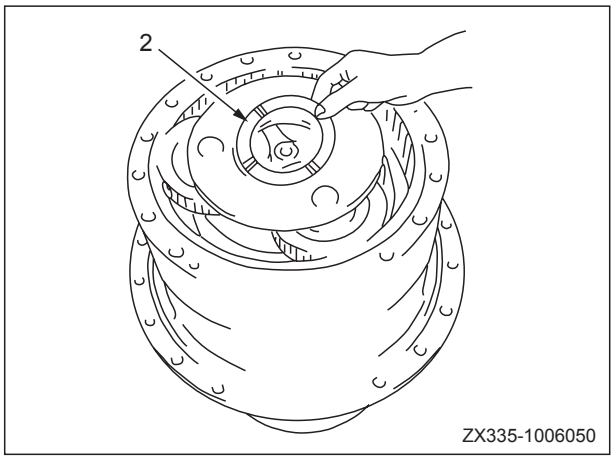


Fig. 8-50

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4. No. 1 planetary carrier assembly

   A. Remove No.1 planetary carrier assembly (3).

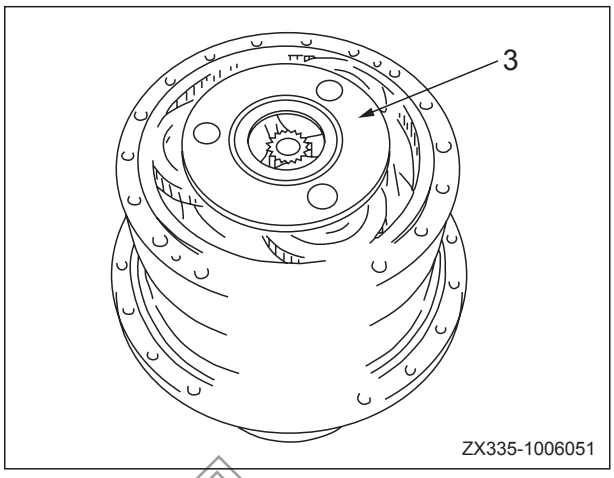


Fig. 8-51

   B. Disassembling No.1 planetary carrier assembly.

      a. Remove the screw (4). Remove the coverplate (5) from the planetary carrier (6).

      b. Remove the thrust washer (7), gear (8), bearing (9), bearing inner race (10) and thrust washer (11).

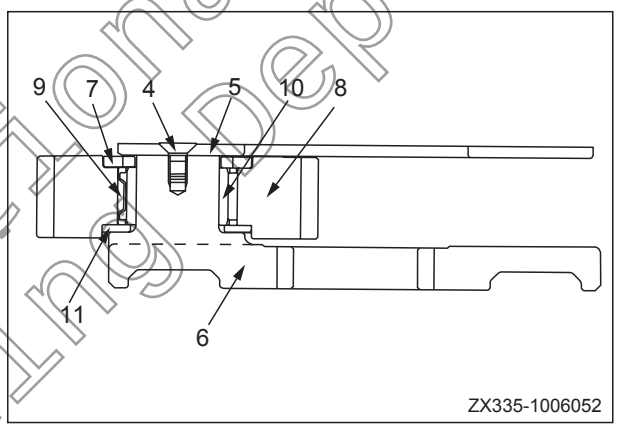


Fig. 8-52

5. No.1 sun gear shaft

   Remove No.1 sun gear shaft (12).

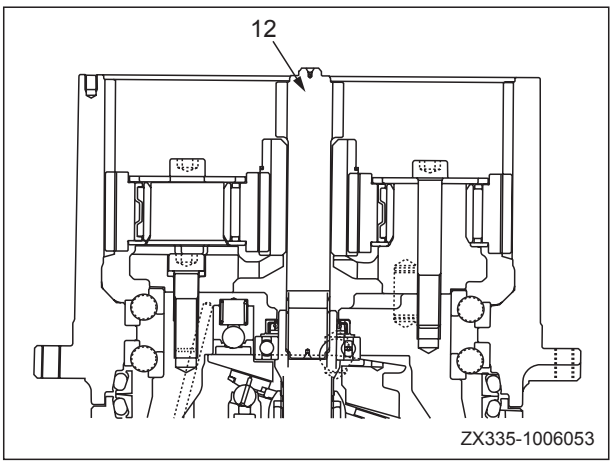


Fig. 8-53

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6. Thrust washer.

   Remove the thrust washer (13).

7. No.2 sun gear

   Remove No.2 sun gear (14).

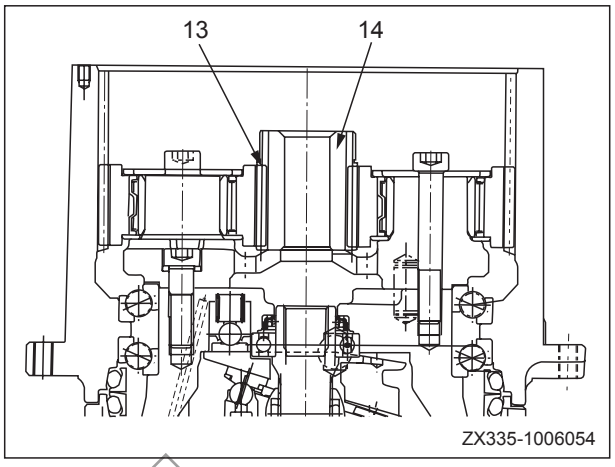


Fig. 8-54

8. Disassembling No.2 planetary carrier assembly

   A. Remove the screw (15). Remove the plate (16) and the planetary gear (17) from the carrier (22).

   B. Remove the bearing inner race (19) and outer race (18). Remove the plate (20).

   C. Remove the screw (21) in order to take down the planetary carrier (22) and shims (23) from the body.

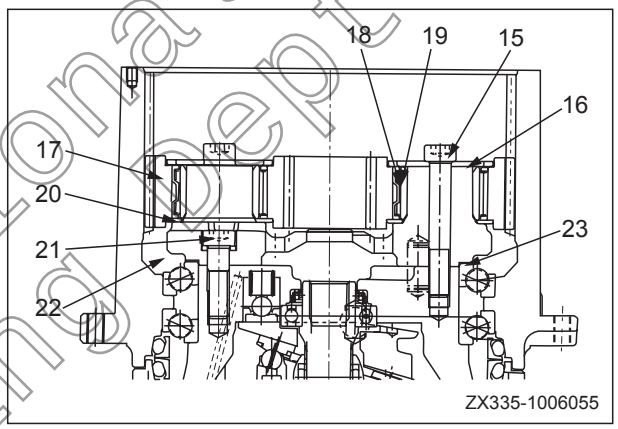


Fig. 8-55

9. Boss assembly

   A. Remove the boss assembly (24) from the travel motor with the help eyebolts ② .

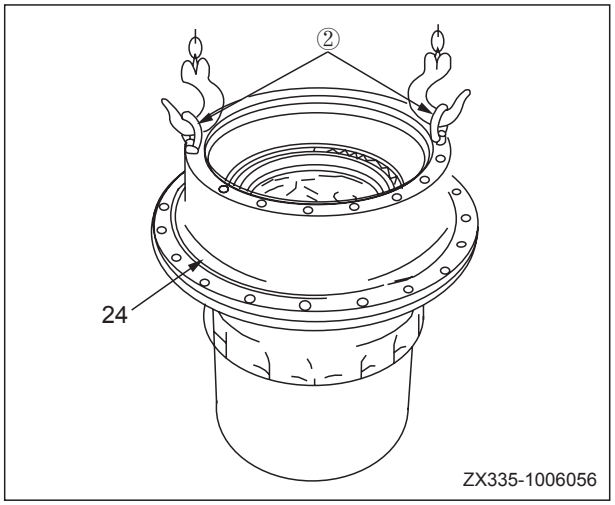


Fig. 8-56

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B. Disassemble the boss assembly as the following.

a. Remove the floating seal (25).

b. Remove the bearings (26) and (27) from the boss (28).

- Take care not to damage the bearing retainer while disassembling the bearing (26).

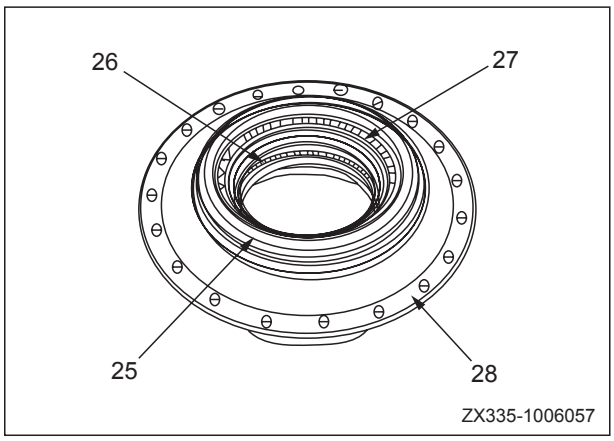


Fig. 8-57

C. Remove the floating seal (29) from the travel motor (30).

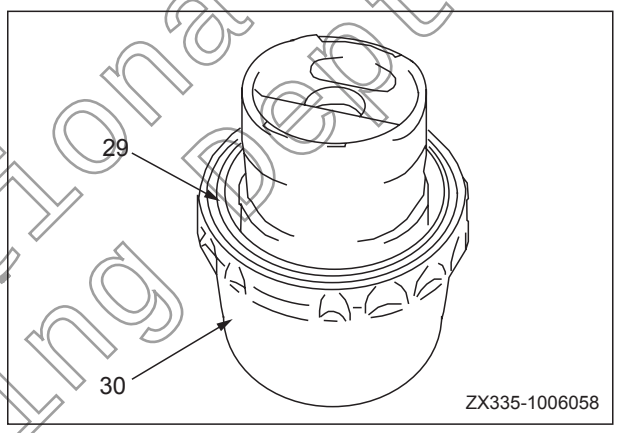


Fig. 8-58

8.11.2 Assembly

- Clean all the parts. Make sure that these parts are free from contamination or damage. Apply some engine oil to the sliding surfaces prior to installation.

1. Boss assembly

A. Install the bearings (26) and (27) by pressing them onto the boss (28).

B. Install the floating seals (25).

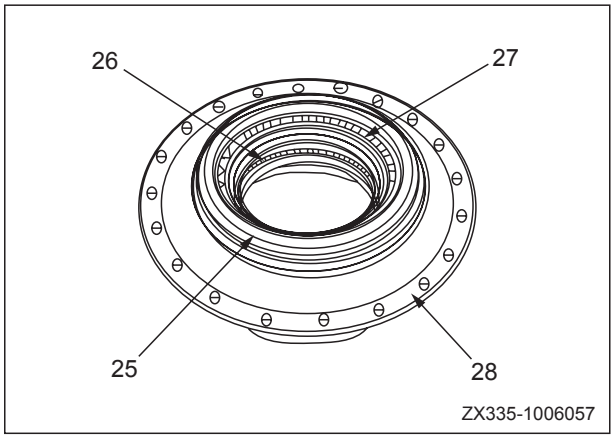


Fig. 8-59

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- Remove any oil or dust from the O-ring or O-ring contact surfaces. Dry the parts before installing the floating seals.
- After installing the floating seal, make sure that the angle of floating seal is within 1 mm.
- Apply a thin layer of engine oil to the sliding surface after the floating seal has been installed.

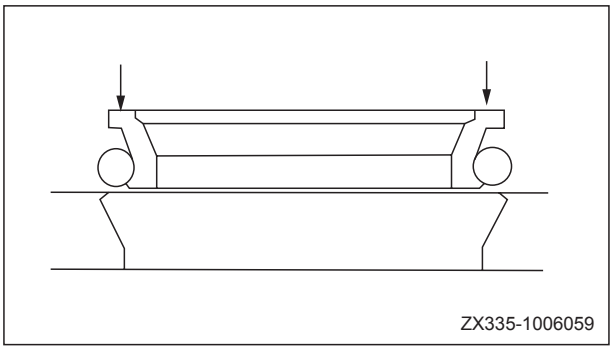


Fig. 8-60

C. Install the floating seal (29) on the travel motor (30).
   - See the above step 2 for the installation procedure.

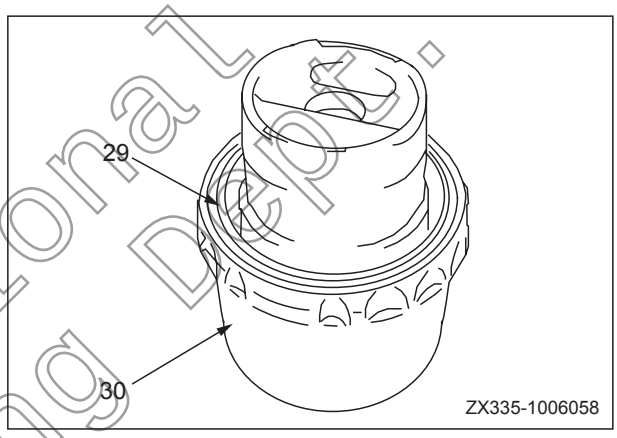


Fig. 8-61

D. Place the boss assembly (24) on the travel motor with the help of eyebolts ② . Carefully tap the bearing to press-fit it.

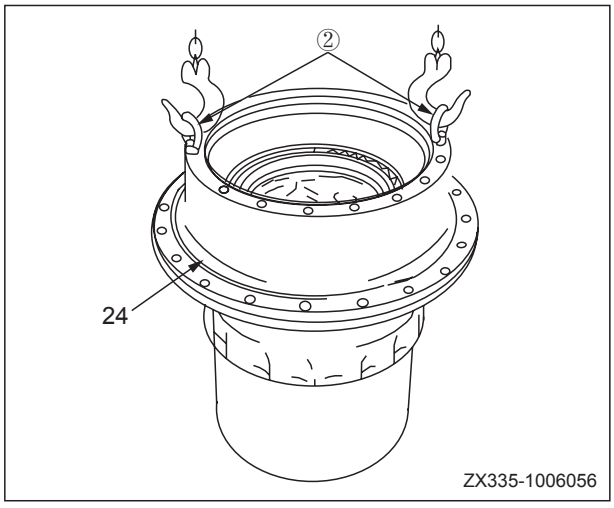


Fig. 8-62

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2. Calculation of shim thickness

   A. Measure the thickness (H) of the raised part of No.2 planetary carrier (22).

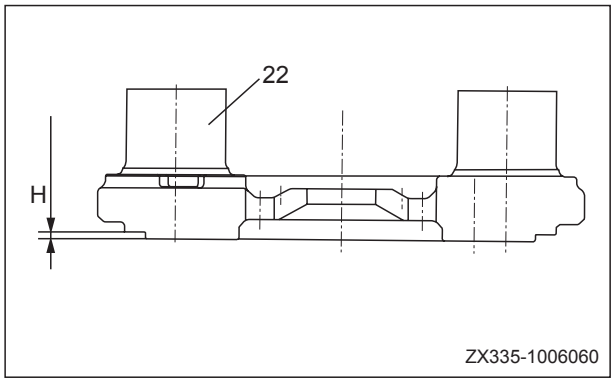


Fig. 8-63

   B. Measurement of raised thickness

      Apply 3000 Kg load to the bearing and measure the value (H) of the raised part of bearing.

   - Turn the boss 2-3 times before applying a pushing force.
   - Do not use a spray gun to cushion the bearing.
   - Do not push or strike the retaining valve.

   C. Shim thickness calculation: C=H-h.

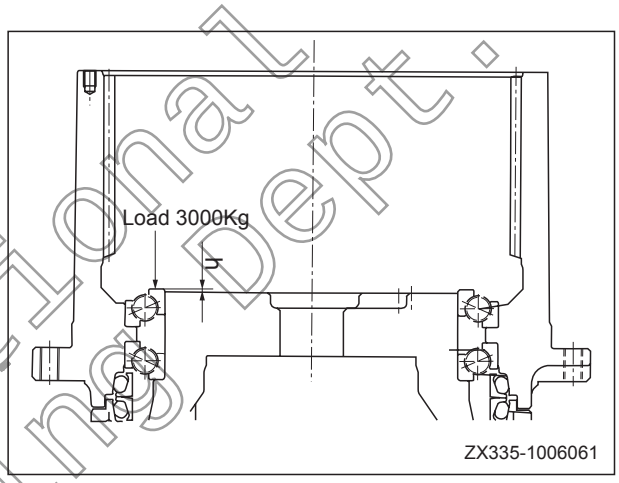


Fig. 8-64

   D. Place the shims on the body and insert the dowel pin. Press the carrier assembly onto the dowel pin and tighten it with screw (21). Apply locking adhesive to the threads.

      Screw-locking adhesive:

      (Kesaixin 1277)

      Screw (21):

      539±28 Nm {55±2.9 kgm}

   - Use a tensiometer to measure the tangential force of boss to motor case rotation.

     Tangential force: Max. 294N {30 kg}

     Maximum tangential force occurs at the beginning of direction change.

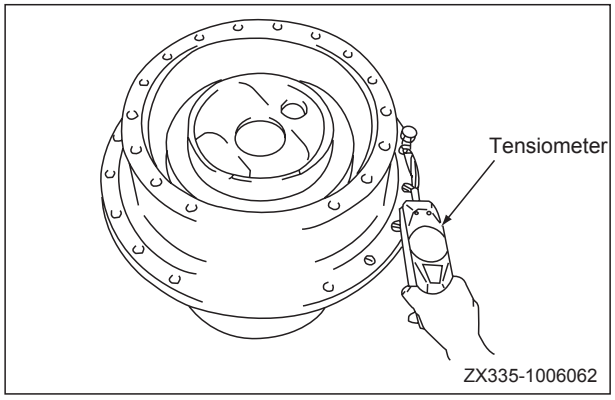


Fig. 8-65

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3. Assembly of No.2 planetary carrier assembly

   Assemble the No.2 planetary carrier assembly through to the following steps.

   - Replace the plates (20) and (16) with new ones.

   A. Assemble the bearings (18) and (19) on the gear (17). Assemble the top and bottom plates (16) and (20), and place the gear assembly into the planetary carrier (22).

   B. Lock it with screw (15).

   Screw (15):

   539±28 Nm {55±2.9 kgm}

   - Check the flexibility of gear (17) after assembling the planetary carrier assembly.

4. Thrust washer

   Install the thrust washer (13).

5. No.2 sun gear

   Install No.2 sun gear (14).

6. No.1 sun gear shaft

   Install No.1 sun gear shaft (12).

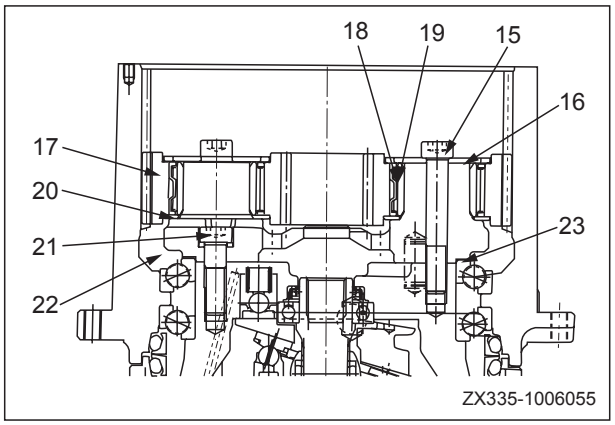


Fig. 8-66

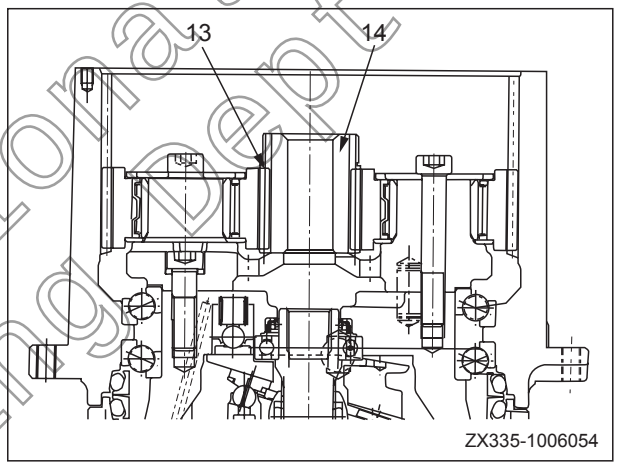


Fig. 8-67

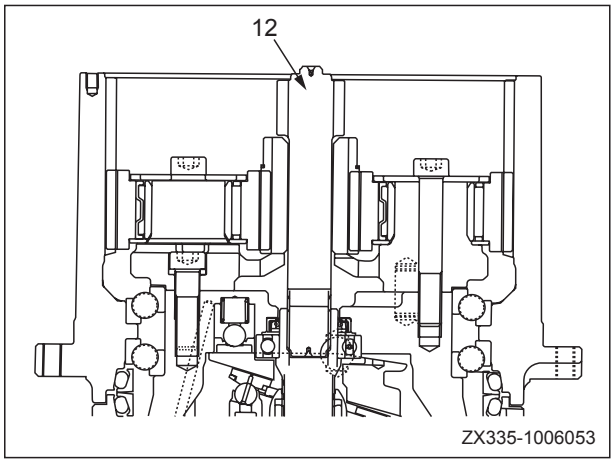


Fig. 8-68

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7. No.1 planetary carrier assembly

   A. Install No.1 planetary carrier assembly as the following.

   - Replace the thrust washers (7) and (11) with new ones.

     a. Assemble bearings (9,10) on gear (8). Assemble the top washer (7) and the bottom washer (11). Place the gear assembly in the carrier assembly (6).

     b. Secure the coverplate (5) to the planetary carrier (6) with screw (4).

   B. Install No.1 planetary carrier assembly (3).

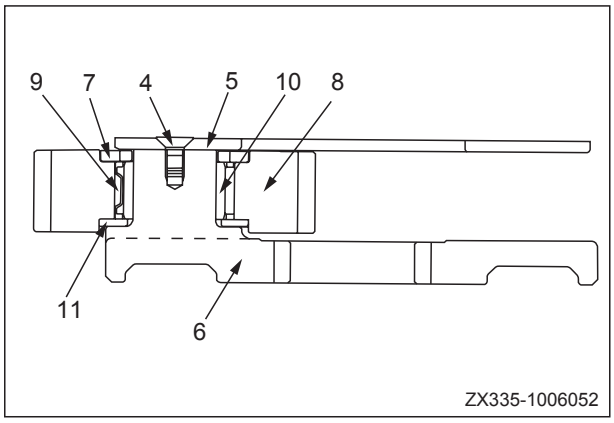


Fig. 8-69

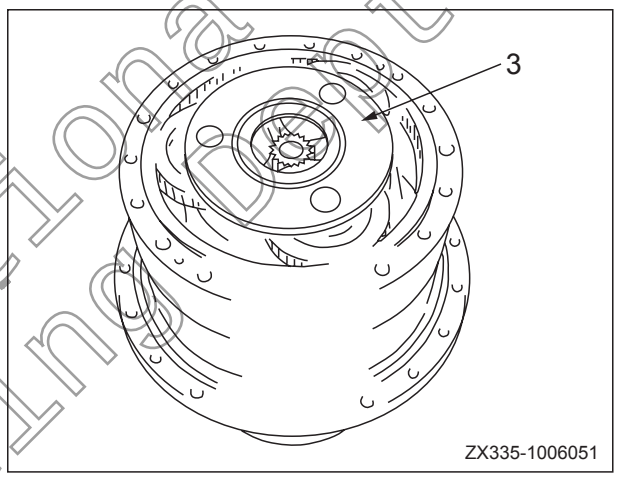


Fig. 8-70

8. Spacer

   Install the spacer (2).

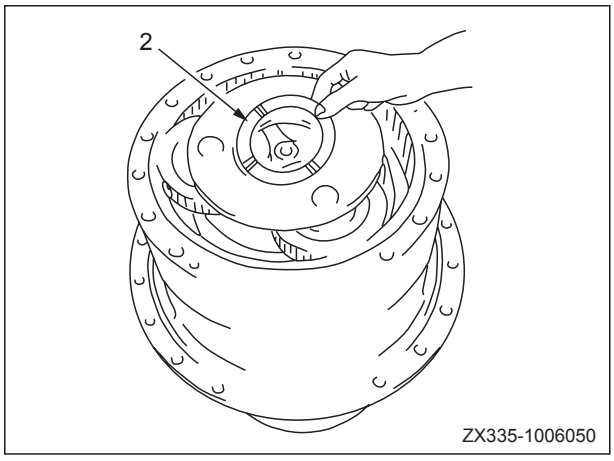


Fig. 8-71

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9. Cover

Assemble the cover (1) with the help of eyebolts ①. Use a torque wrench to tighten the bolts.

Bolts:

73.4±3.63 Nm {7.5±0.4 kgm}

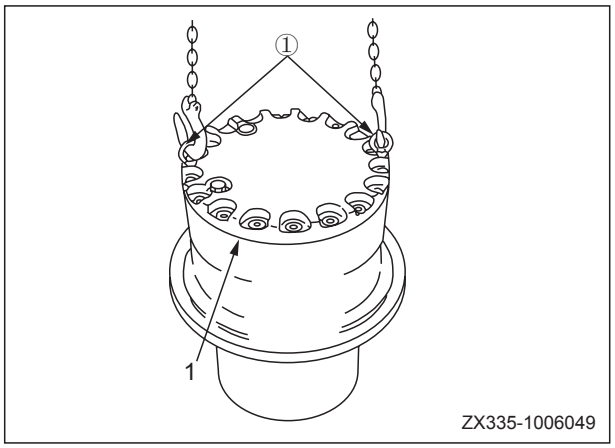


Fig. 8-72

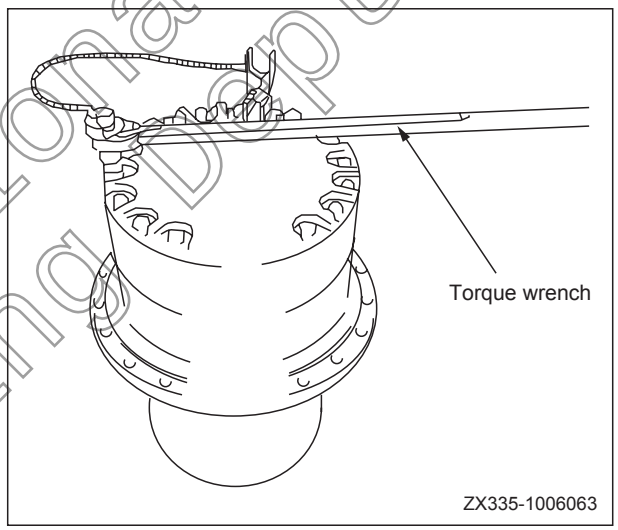


Fig. 8-73

10. Refilling the oil

Tighten the drain plug and refill engine oil through a filler.

Final drive case: About 4.7 L

- After the final drive has been successfully installed to the chassis, check the oil to see if it has reached the specified level.

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8.12 Swing Motor and Swing Drive AS

8.12.1 Removal

Release the remaining pressure in the hydraulic return circuit. See **“Remaining Pressure in Hydraulic Lines - Relieve” on page 6-36**.

Lower the work equipment to the ground in order to ensure safety. Stop the engine. Press the release button of the breather valve to release remaining pressure in the hydraulic tank. Place the hydraulic lockout control in the locked position.

1. Disconnect the hose (1) through the hose (9).
   (1): Between oil tank and swing motor (port Dr)
   (2): Between central swivel joint and swing motor (port Dr)
   (3): Between swing motor and main valve (port M)
   (4): Between swing motor and main valve port Px (port A)
   (5): Between swing motor and main valve (port B)
   (6): Between swing motor and main valve port Px (port SH)
   (7): Between swing motor and solenoid valve block (port PG)
2. Remove the 14 fixing bolts (8).
3. Lift the swing motor and swing mechanism assembly (9) in order to disassemble it.
   Slowly lift the swing motor and swing mechanism assembly in order to avoid damaging the hoses and other parts.
   Swing motor and swing drive AS: 425.5 kg

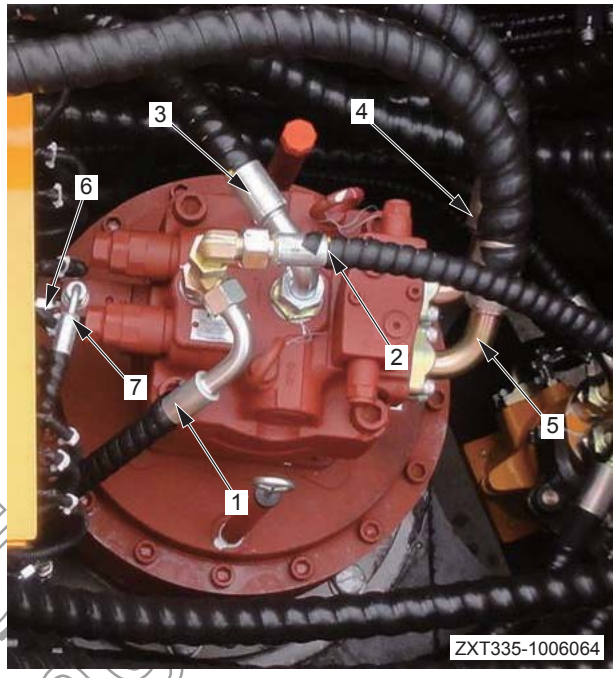


Fig. 8-74

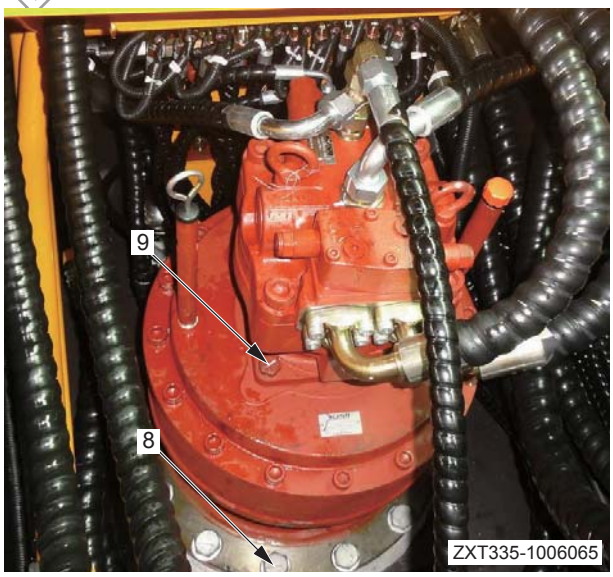


Fig. 8-75

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8.12.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Mounting bolts (swing motor and swing mechanism AS):

490~608 Nm {50~62 kgm}

- Refilling of hydraulic oil

  Refill hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Purging of air

  See **“Air in Each Component - Purge” on page 6-41**.

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8.13 Swing Motor and Swing Drive AS

8.13.1 Disassembly

1. Draining of oil

   Open the drain plug to drain the oil from the swing mechanism.

   Swing drive case: Approx. 10.5 L

2. Swing motor assembly

   A. Place the swing motor and swing mechanism assembly on a suitable cribbing. Take care not to damage the drive gear or let it contact the ground.

   B. Unscrew the four(4) bolts (1) in order to remove the swing motor assembly (2).

   Swing motor assembly: 67.5 kg

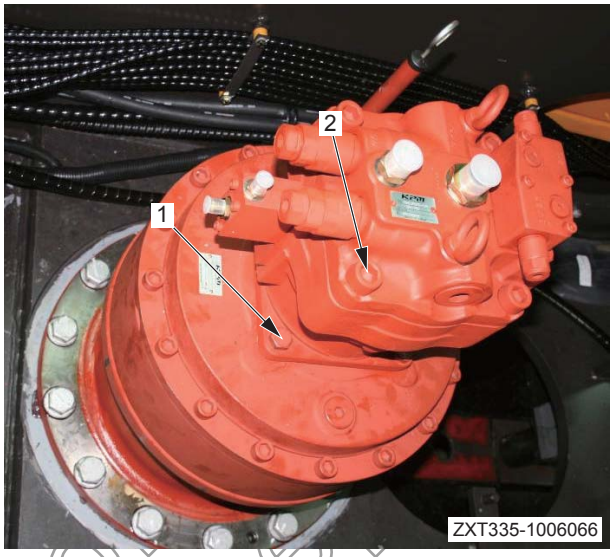


Fig. 8-76

3. No.1 sun gear

   Remove No.1 sun gear (2).

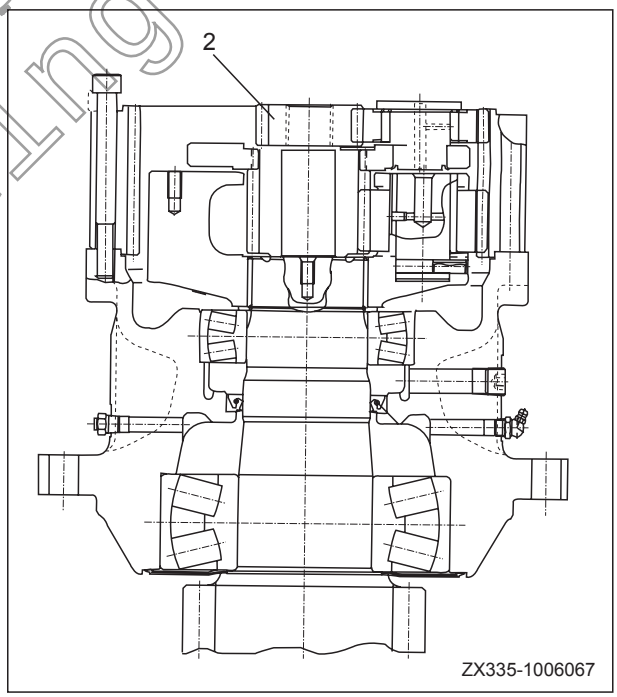


Fig. 8-77

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4. No.1 planetary carrier assembly

   A. Remove No.1 carrier assembly (3) and the plate (4).

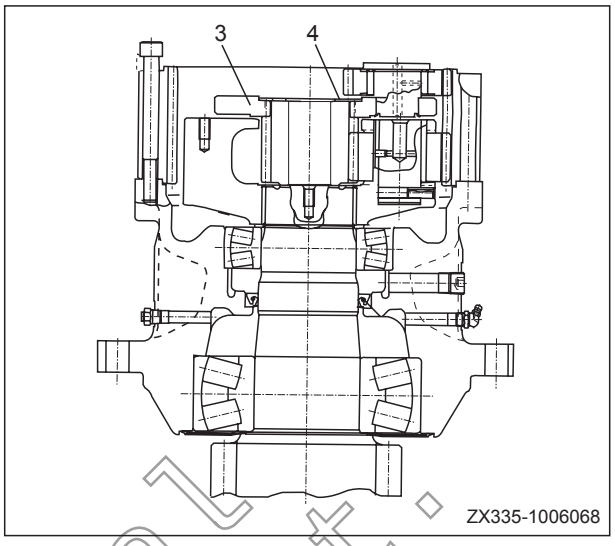


Fig. 8-78

   B. Disassemble No.1 carrier assembly.

   Cut the rivets on the shaft (8) to remove the shaft (8), and remove in turn the gear (6), bearing (9) and plate (7).

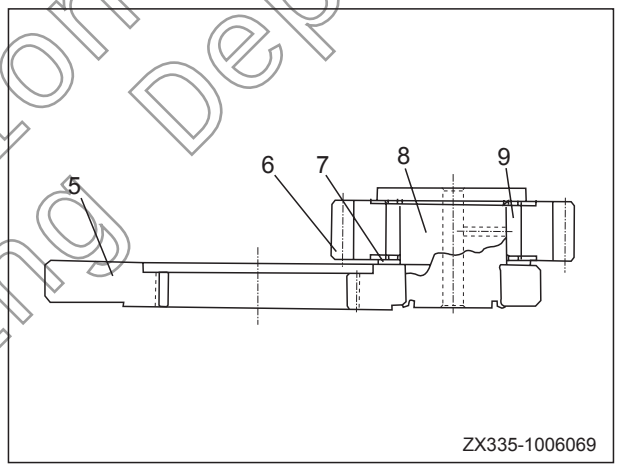


Fig. 8-79

5. Gear ring

   Unscrew the mounting bolts to remove the gear ring (10).

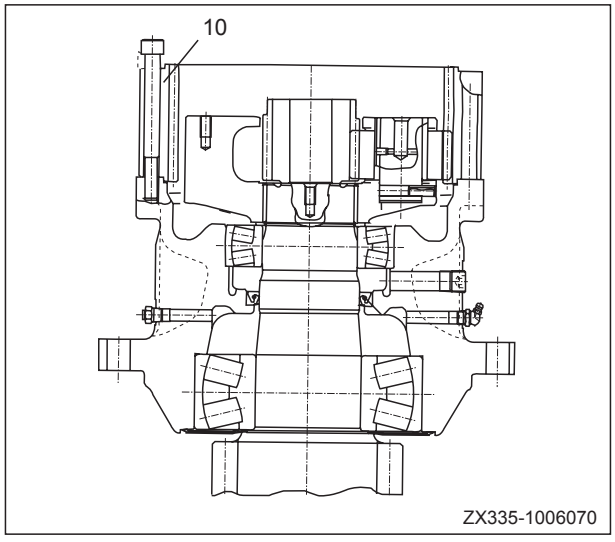


Fig. 8-80

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6. No.2 sun gear

   Remove No.2 sun gear (11).

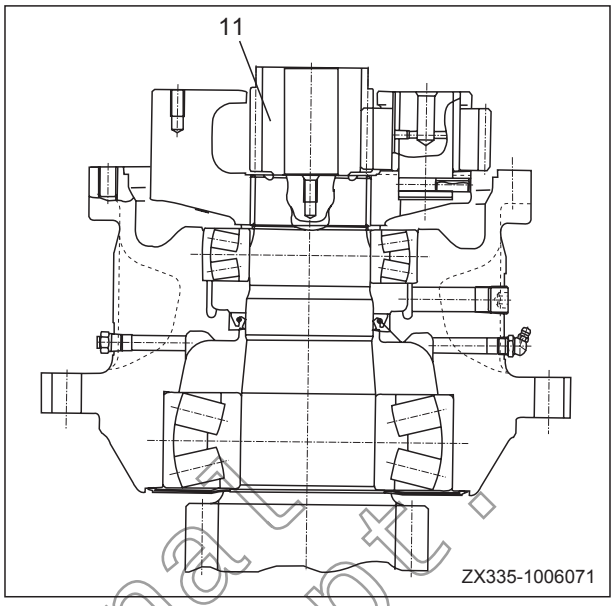


Fig. 8-81

7. No.2 planetary carrier assembly

   A. Remove No.2 carrier assembly (12).

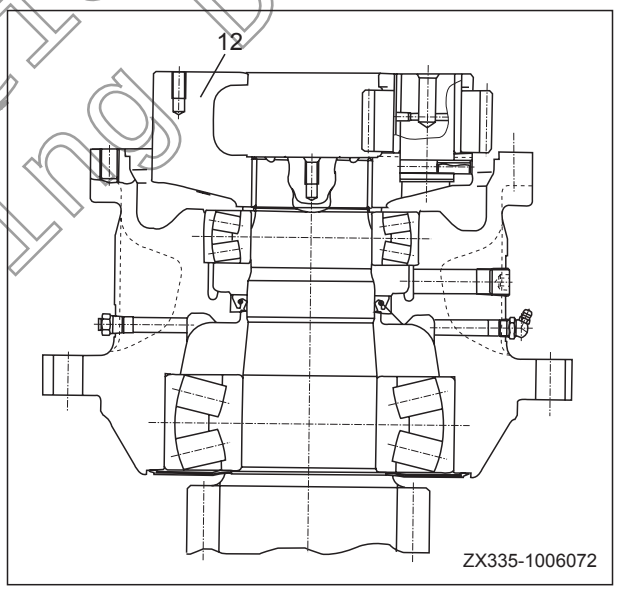


Fig. 8-82

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B. Disassemble No.2 carrier assembly with hands through the following steps.

a. Hammer the pin (13) in the shaft (14) in order to push the shaft (14) out of the carrier assembly (19).

- Hammer out the pin (13) after removing the shaft.

b. Remove the thrust washer (16) and gear (17).

c. Insert the pin (15) to remove the bearing (18) from the shaft. Remove the pin (15).

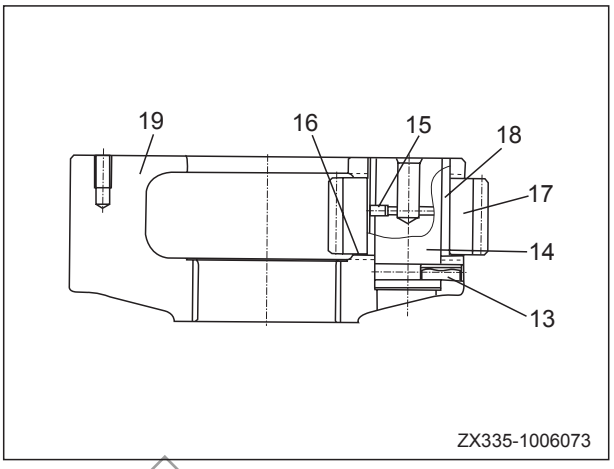


Fig. 8-83

8. Snap ring

Remove the snap ring (20).

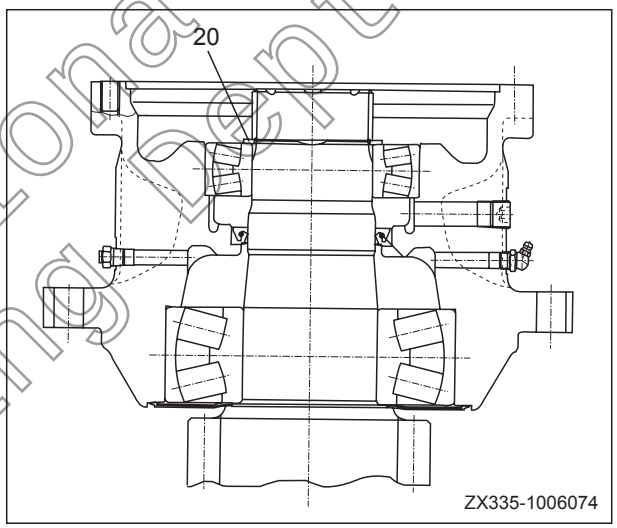


Fig. 8-84

9. Disassembling the main shaft

A. Place the shaft housing assembly on a press and push the shaft assembly (21) out of the shaft housing assembly (22).

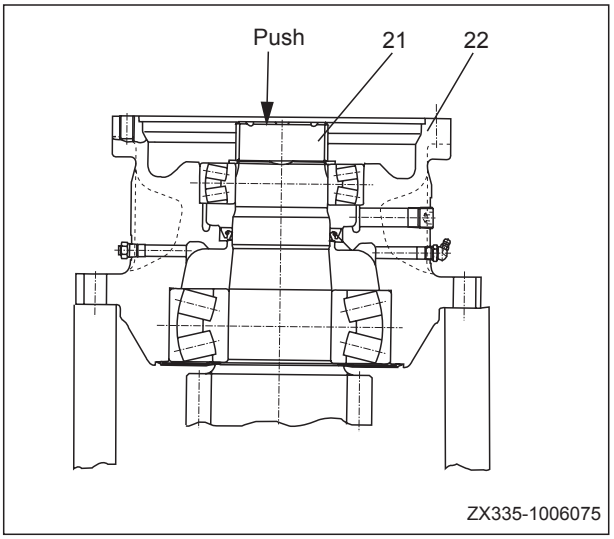


Fig. 8-85

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B. Disassemble the shaft assembly in the following procedure.

Remove the bearing (23) from the shaft (24).

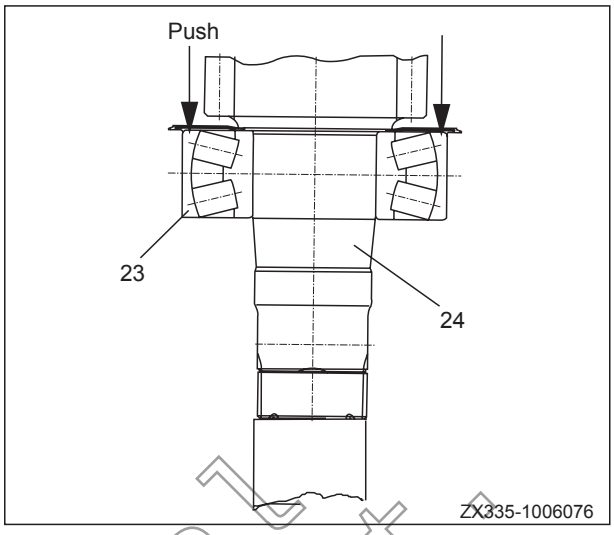


Fig. 8-86

10. Bearing

Remove the bearing (25) and the oil seal (26) from the housing (27).

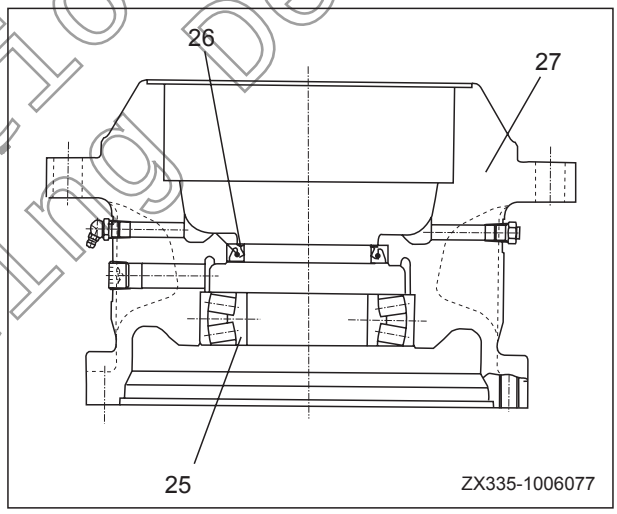


Fig. 8-87

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8.13.2 Assembly

- Clean all the parts and check for any contamination or damage. Apply engine oil to the sliding surfaces of the parts.

1. Bearing

   Press the bearing (23) into the housing (27).

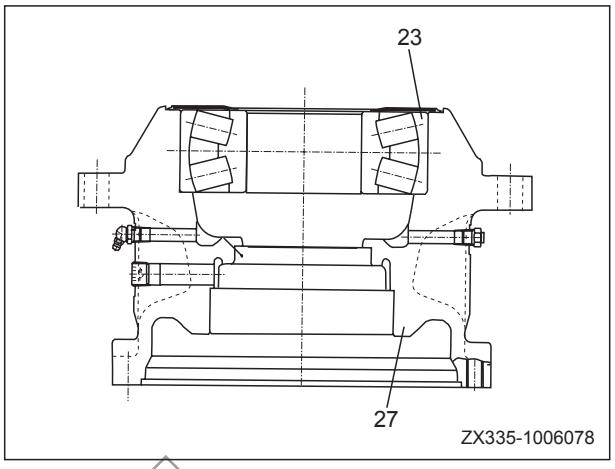


Fig. 8-88

2. Oil seal

   Press the oil seal (26) into the housing (27).

   Oil seal mounting surface: gasket sealant (Loctite 515)

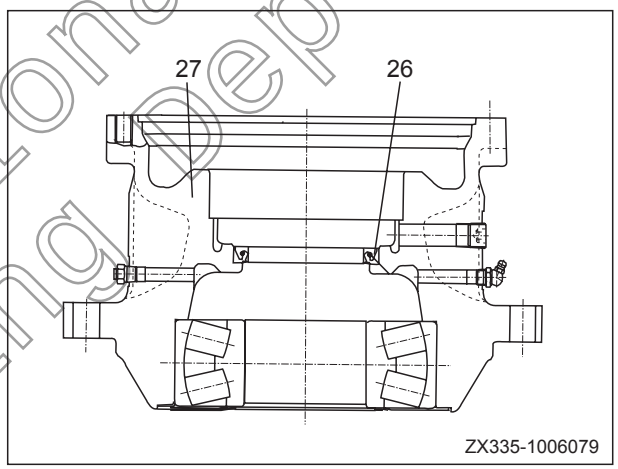


Fig. 8-89

3. Housing assembly

   A. Position the plate (28) on the shaft (24).

   B. Position the housing assembly (22) on the shaft (24). Press to fit the bearing.

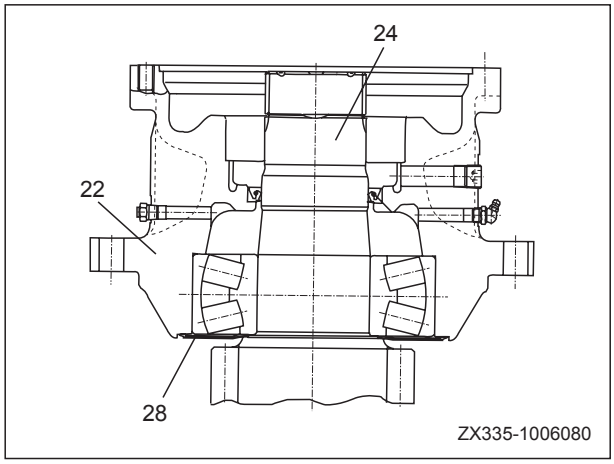


Fig. 8-90

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4. Bearing

   Press to fit the bearing (25).

   - When press-fitting the bearing, press the bearing inner race and outer race simultaneously. Never press only the inner race.
   - After assembling the bearing, check if the housing rotates freely.

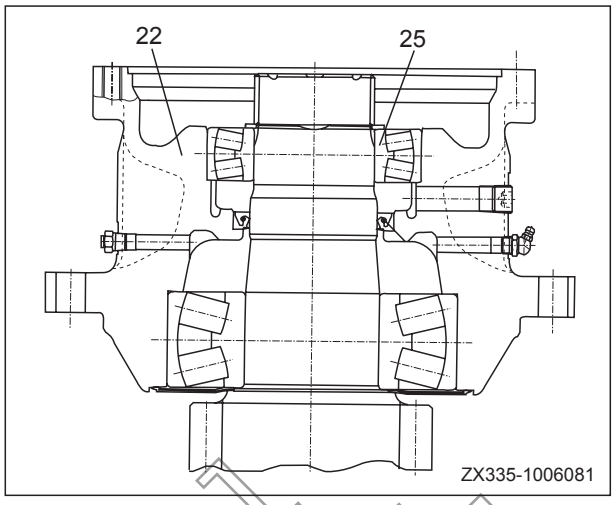


Fig. 8-91

5. No.2 Planetary carrier assembly

   Reassemble No.2 carrier assembly through the following steps.

   A. Assemble the plate (16) in the carrier assembly (19).

   B. Assemble the gear (17) in the carrier assembly (19). Put the bearing (18) on the shaft (14). Slightly tap the pin (15) into the bore after alignment. Use a rubber hammer to tap the pin. Make sure that the pin (15) must not be higher than the bearing (18).

   C. Push the shaft assembly into the carrier assembly (19). Be careful not to damage the gear and the plate. Align the pin hole of the shaft with that of the carrier assembly, and install the pin (13). Carefully tap the pin with a rubber hammer during installation.

   - Installation of the shaft requires rotating the planetary gear. Take care not to damage the thrust washer.

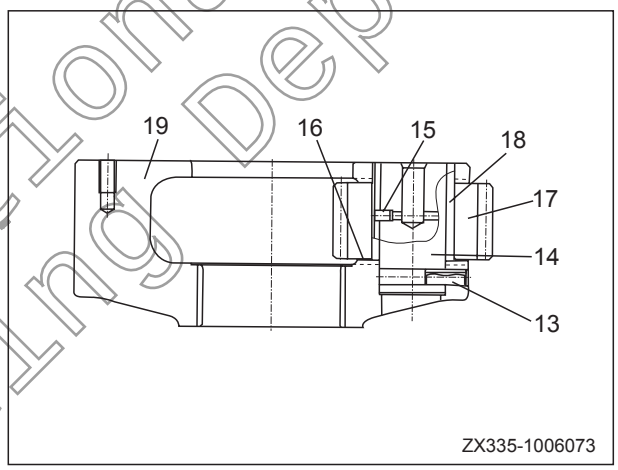


Fig. 8-92

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6. Assemble in turn the snap ring (20), No.2 carrier assembly and No.2 sun gear (11).

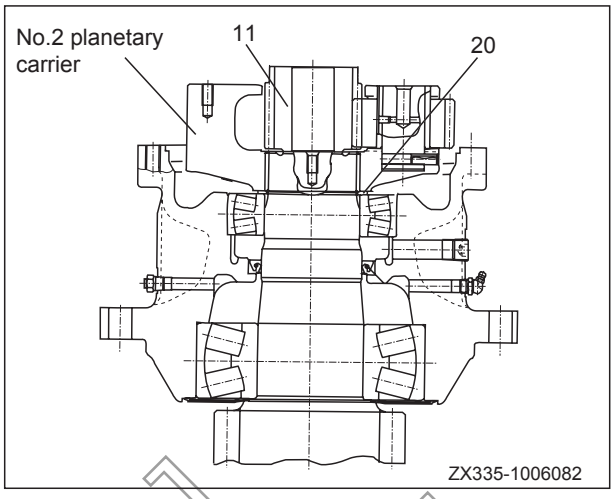


Fig. 8-93

7. Installation of gear ring

   Apply sealant on the mating surface indicated by (C) and tighten it with screws. Never get the sealant onto the gear ring (10).

   Mating surface: Sealant (Loctite 515)

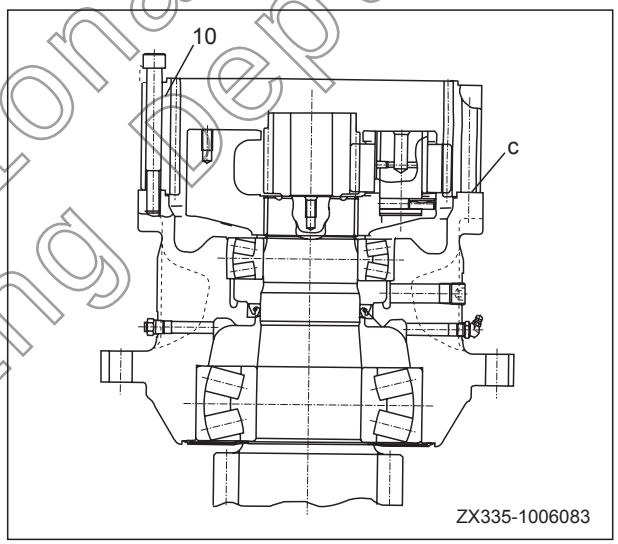


Fig. 8-94

8. No.1 planetary carrier assembly

   A. No.1 carrier assembly is assembled as the following.

      a. Install the plate (7) on the carrier assembly (5).

      b. Install the gear (6) onto the plate after installing the bearing (9) into the gear.

      c. Press the shaft (8) into the gear (6) and the carrier assembly (5). Rivet one end of the shaft.

      - Check if the gear rotates freely.

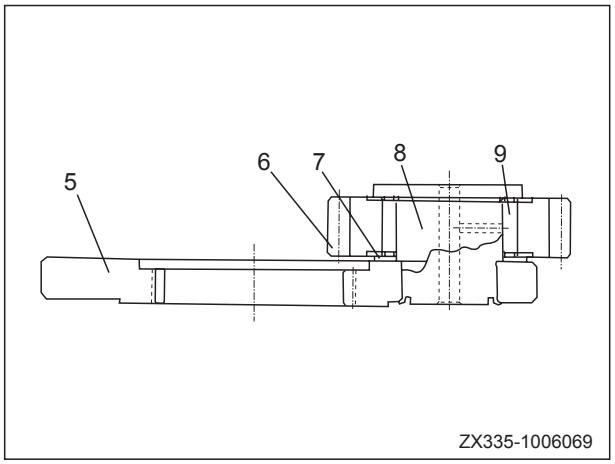


Fig. 8-95

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B. Install No.1 carrier assembly (3) and the plate (4).

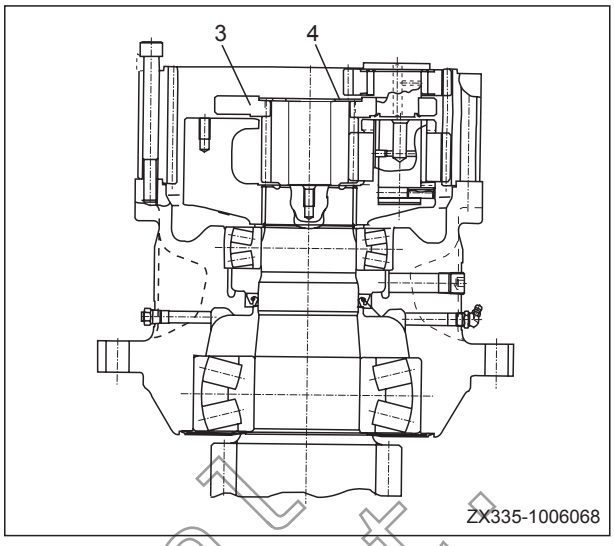


Fig. 8-96

9. No.1 sun gear assembly

   Install No.1 sun gear (2).

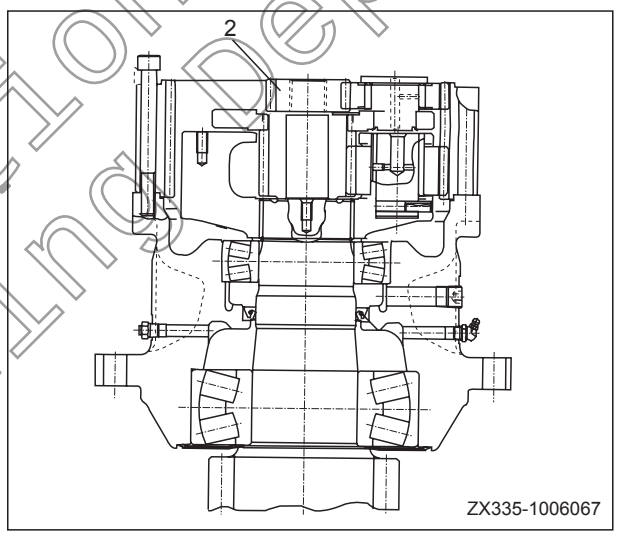


Fig. 8-97

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10. Installation of swing motor assembly

Install the swing motor assembly after applying sealant to the mating surfaces of the gear ring and the motor cover.

Mating surface: sealant (Loctite 515)

Swing motor assembly: 55 kg

Mounting bolts (swing motor):

156±5 Nm {16±0.5 kg}

- The 14 bolt holes of the swing motor and swing drive assembly are distributed nonuniform. The mating direction of each hole is exclusive, as shown in the illustration on the right. The installation of swing motor requires proper alignment of the bolt holes in order to ensure the installation orientation.

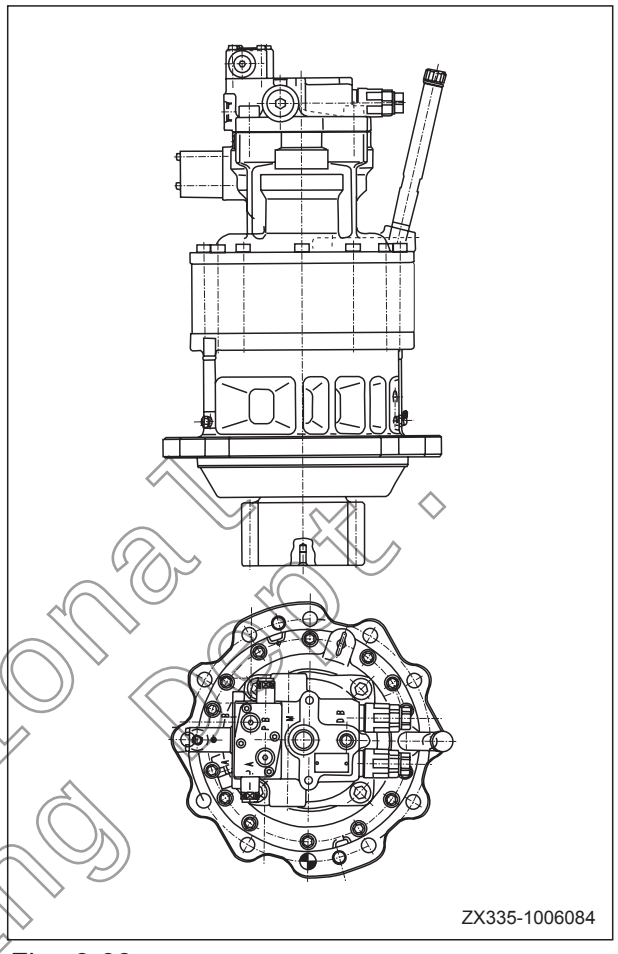


Fig. 8-98

11. Refilling of lubricant

Screw on the drain plug and refill lubricant through the filler to the specified level (the upper mark of oil stick).

Swing drive case: About 4 L

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8.14 Idler AS

8.14.1 Disassembly

1. Remove the dowel pin (1) and the support (2).
2. Remove the floating seals (3) from the support (2) and the idler (4).
3. Remove the O-ring (11). Remove the idler (4) from the shaft (5) and the support assembly (7).
   - The idler contains 80 ml oil, which should be drained completely before disassembling. Spread a cloth on the floor to prevent smearing of the floor by the oil.

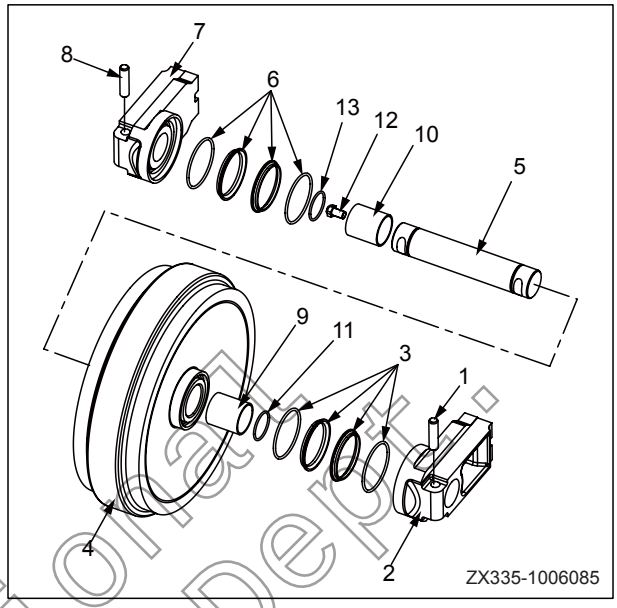


Fig. 8-99

4. Remove the floating seals (6) on the other side from the idler (4), shaft (5) and support assembly (7).

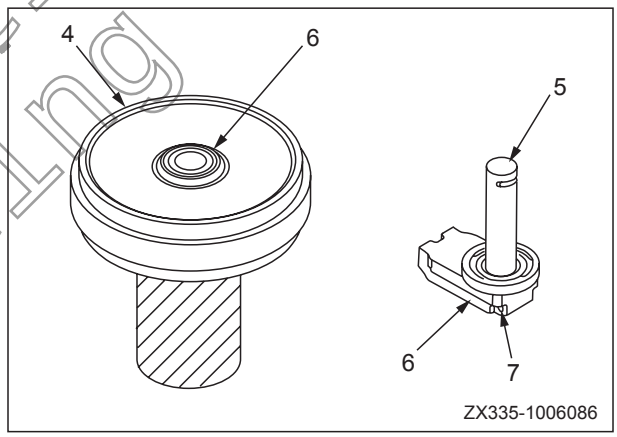


Fig. 8-100

5. Remove the dowel pin (8) in order to remove the support (7) from the shaft (5).
6. Remove the bushings (9) and (10) from the idler (4).

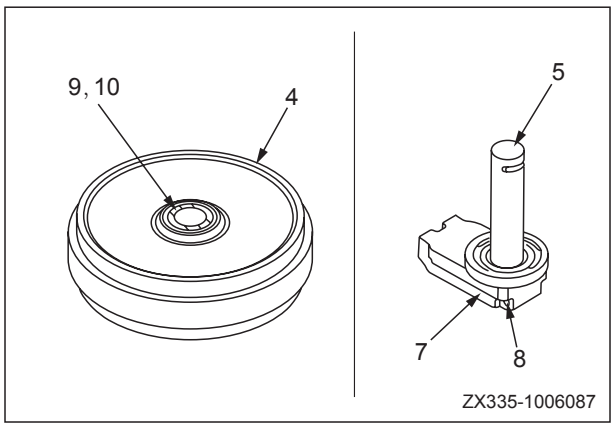


Fig. 8-101

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8.14.2 Assembly

1. Install the bushings (9) and (10) in the idler (4).

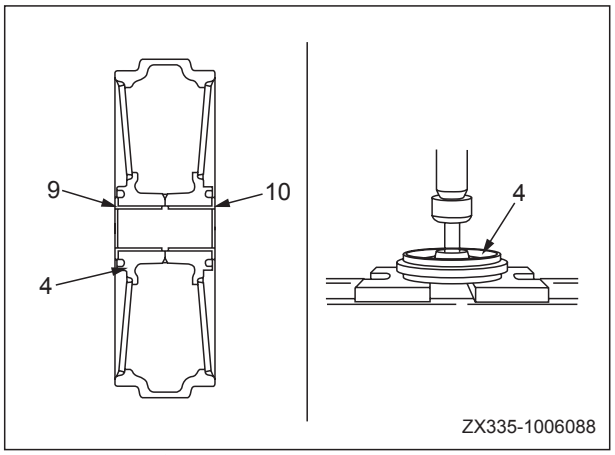


Fig. 8-102

2. Assemble the O-ring. Use the dowel pin (8) to install the support (7) on the shaft (5).

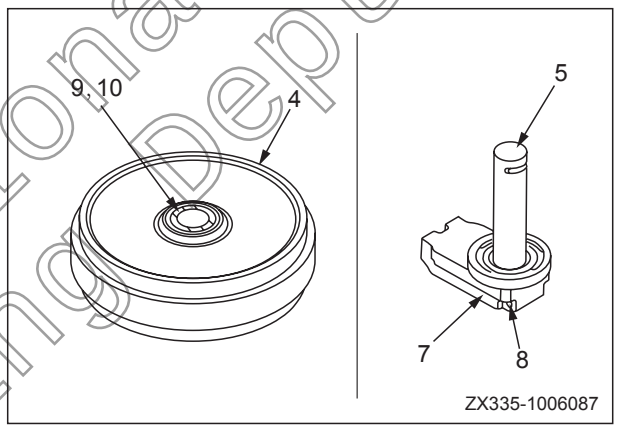


Fig. 8-103

3. Install the floating seals (6) on the idler (4), shaft (5) and support (7) assembly.
   - Floating seals

     Completely remove the grease from the contact surfaces (hatched area in the illustration on the right) of O-ring and floating seal before installing the floating seal. In addition, care must be taken to keep the contact surface of floating seal free from dust.

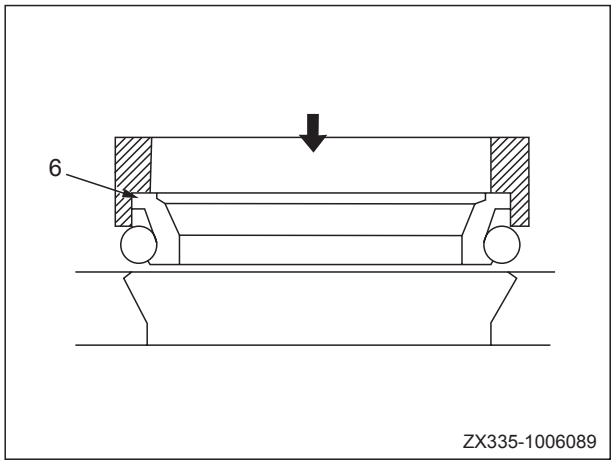


Fig. 8-104

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- After installation of the floating seals, check that the sealing inclination should be less than 1 mm and the seal protrusion be within a range of 5-7 mm.

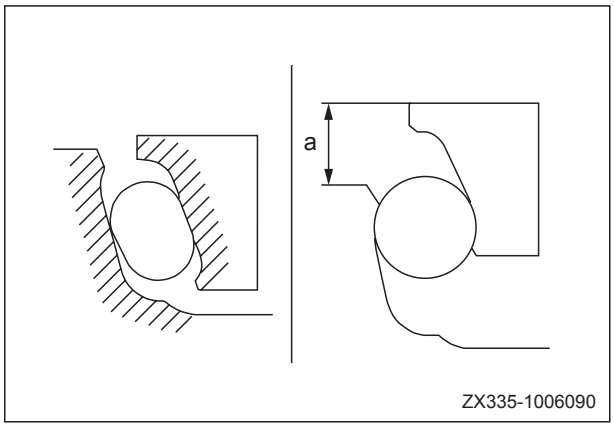


Fig. 8-105

4. Install the shaft (5) and support (7) assembly to the idler (4).

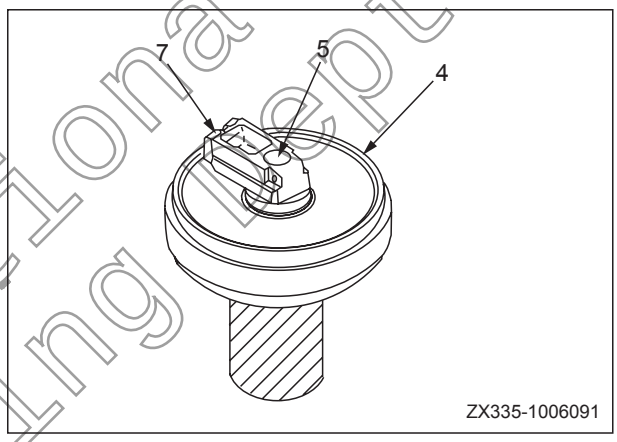


Fig. 8-106

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5. Install the floating seal (3) to the idler (4) and support (2).
   - Apply oil to the sliding surface of floating seal. Care must be taken to keep the sliding surface from any contaminants or dust.
   - Remove the oil and dust from the contact surfaces of the O-ring and floating seal.

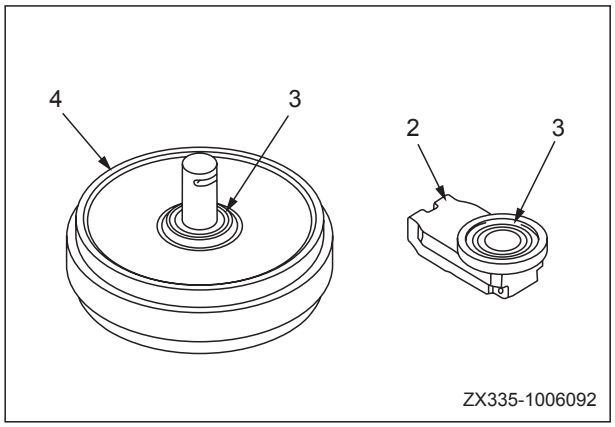


Fig. 8-107

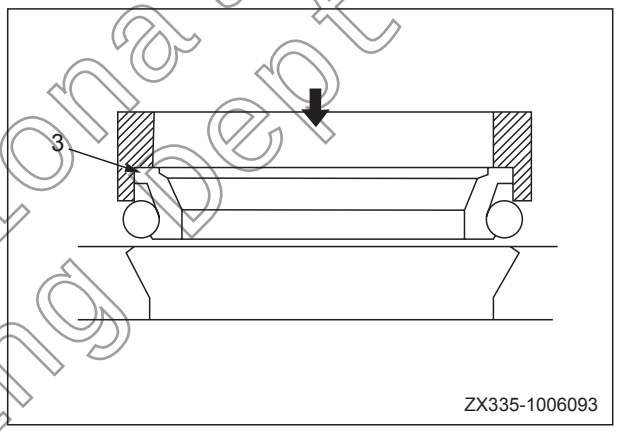


Fig. 8-108

6. Install the O-ring. Use the dowel pin (1) to install the support (2).
7. Refill oil and screw on the plug.

   Oil: About 80 ml (No.18 hyperbola gear oil)

   Plug: 205.8±49 Nm {21±5 kgm}

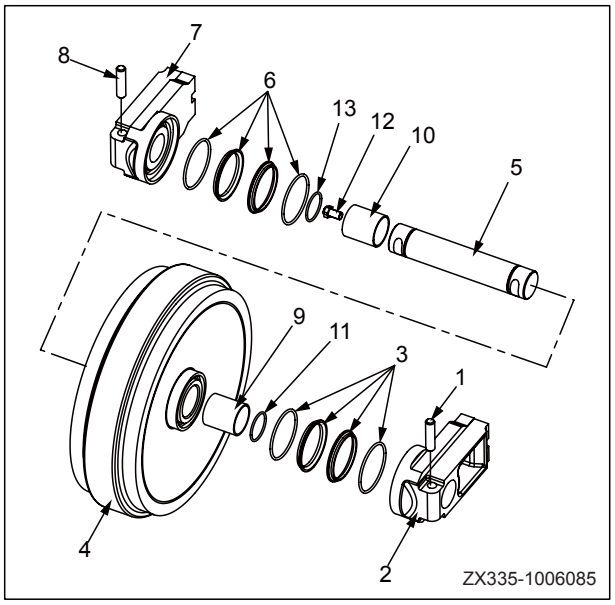


Fig. 8-109

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8.15 Sprocket

8.15.1 Removal

1. Remove the track assembly. For more information see **“Track AS” on page 8-59**.
2. Swing the work equipment 90° and lift the chassis with the help of the work equipment. Place a block ① between the track frame and the track shoe.
3. Remove the sprocket (1).

   Sprocket: 98.4 kg

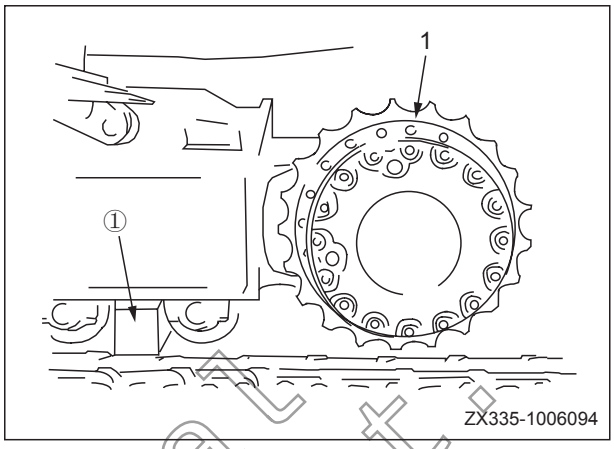


Fig. 8-110

8.15.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Threads (bolt - sprocket):

Thread sealant (Kesaixin 1277).

Bolts (sprocket):

927±103 N·m {94.6±10.5 kgf·m}

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8.16 Track AS

Special tools

Mark	Part Name	Necessity	Qty
M	Manual/electric hydraulic track removing/installing machine	●	1

8.16.1 Removal

1. Choose a place that has enough space to spread the track. Park the machine when the master pin is between the idler and the carrier roller.
2. Lower the work equipment. Loosen the grease fitting (1) and release the track tension.



Fig. 8-111

WARNING

- **The adjustment cylinder is under extremely high pressure. Never loosen the grease fitting by more than one turn. Move the machine back and forth if no grease is seen.**

3. Pull out the master pin (2) with the tool (M).

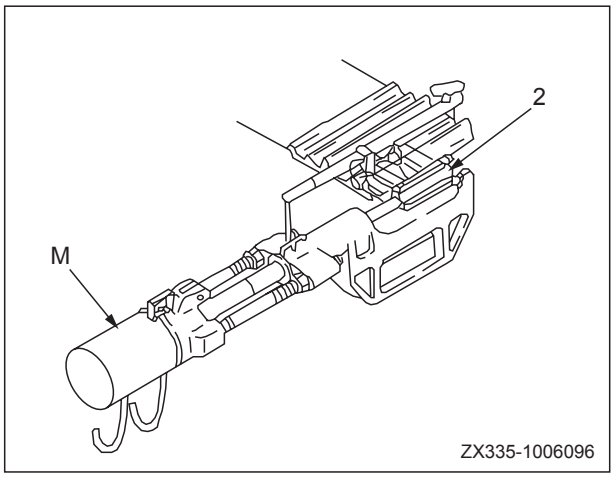


Fig. 8-112

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4. Remove the tool (M). Move the machine forward so that the temporary pin ② is in front of the idler. Place the block ① .
5. Remove the temporary pin ② and the dust seal. Move the machine backward to spread the track (3).

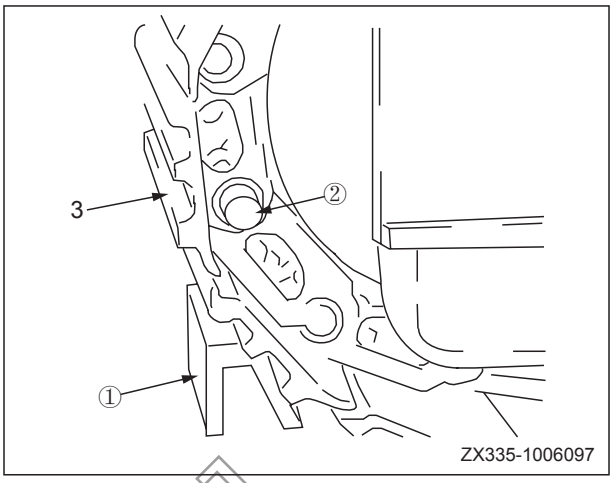


Fig. 8-113

8.16.2 Installation

- Installation is performed in the reverse procedure of removal.

See **“Track Tensioner - Test and Adjust” on page 6-21**.

- Installation procedure of track shoe bolts and nuts

  A. Bring the R side of the track shoe nut (1) to the link seat surface. Both seat surfaces should be in close contact when assembling the track shoe.

  - If the track shoe bolts are installed from the other side, the corner of nut will interfere with the link seat surface, causing the nut to raise and the bolt to loosen.

  B. Tighten the bolts of track shoe to the torque below.

  Track shoe bolts:

  1029±60 Nm {105±6 kgm}

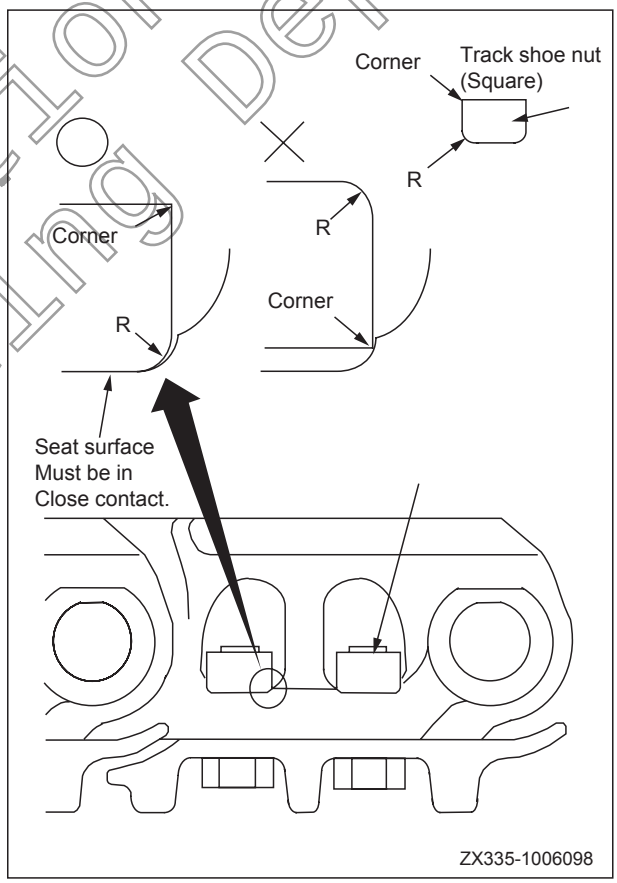


Fig. 8-114

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- Use the tool (M) to press the master pin. Make sure that the protrusion of master pin meets the size (a).

  Master pin protrusion (a): 4.2±2mm

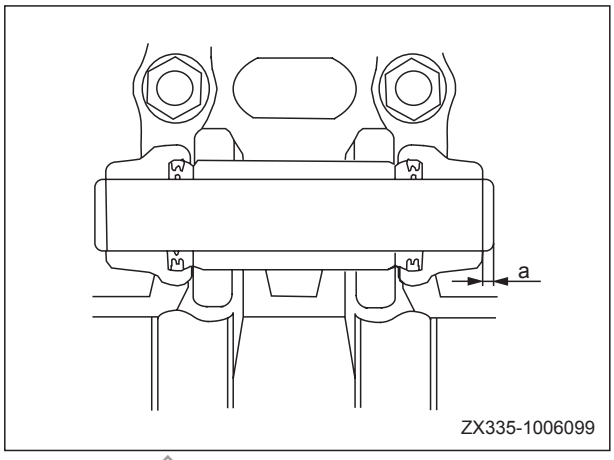


Fig. 8-115

- Before installing the dust seal, apply grease (G2-LI) to its contact surface with the bushing.

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8.17 Swing Bearing AS

8.17.1 Removal

1. Remove the swing frame assembly. For more information See **“Swing frame AS” on page 8-64**.
2. Remove the 36 bolts (1) in order to take off the swing bearing assembly. ※1
3. Lift the swing bearing assembly (2). ※2



Fig. 8-116

Swing bearing assembly; 526 kg

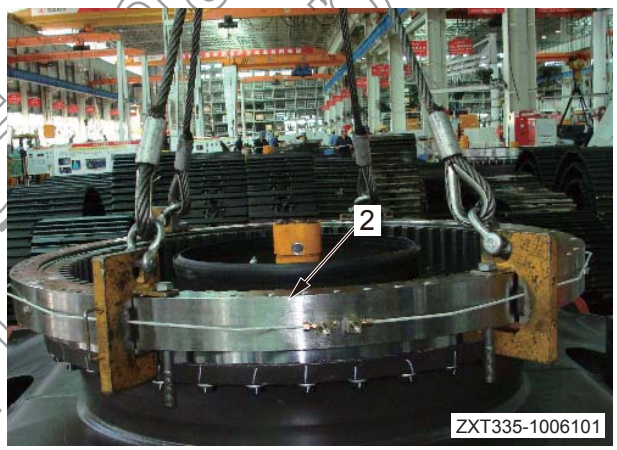


Fig. 8-117

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8.17.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Threads (bolt - swing bearing):

Thread adhesive (Tianshan 1277)

Mounting bolts (swing bearing):

Step 1:

Use a pneumatic spanner to tighten the bolts.

Step 2:

Tightened to:

927±103 Nm {94.6±10.5 kgm}

A. When a torque wrench is used to tighten the bolts, tighten first the four corners and then mark them.

B. Other bolts will be tightened clockwise or counterclockwise. After one bolt is tightened, tighten the next one on the diagonal position and make a mark.

C. Tighten the rest bolts in the same way.

※2

- Let the S mark in the soft zone of the inner race of the inner ring face the right side, as shown in the photo, and install the swing bearing to the track frame.
- Apply grease to the inside of the gear ring of the swing bearing.

  All gear teeth must be covered by grease .

  Swing bearing:

  Grease(MoS_2 G2-LI):15 L

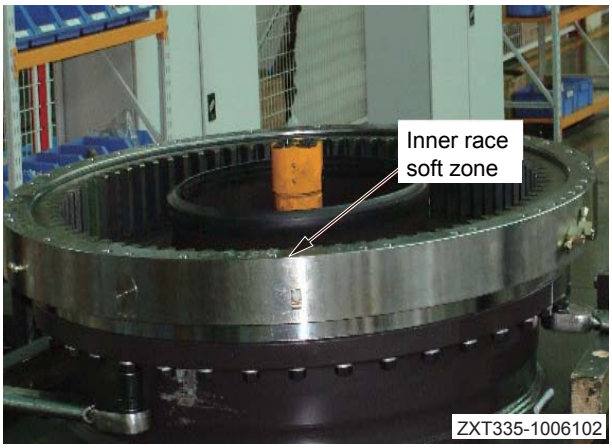


Fig. 8-118

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8.18 Swing frame AS

8.18.1 Removal

Fully extend the arm and the bucket. Lower the work equipment to the ground and engage the hydraulic lockout control.

1. Disassemble the work equipment assembly. See **"Work Equipment AS" on page 8-97**.
2. Remove the counterweight assembly. See **"Counterweight AS" on page 8-104**.
3. Remove the four (4) hoses (1) of boom cylinder.

   Cork the hoses to stop oil flowing out.
4. Lift the boom cylinder assembly (2).

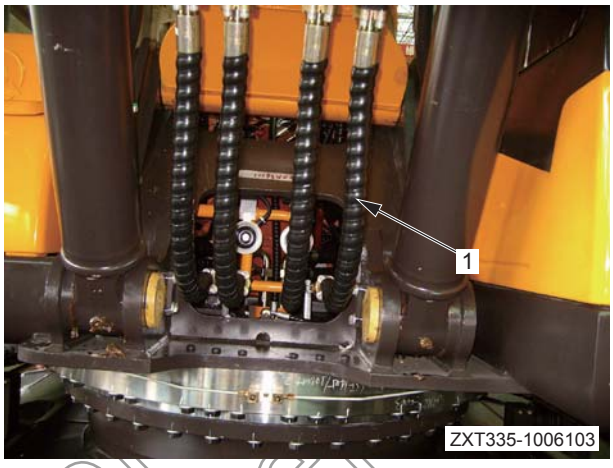


Fig. 8-119

5. Remove the plate (3) and the pin (4). Lift



Fig. 8-120

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the boom cylinder assembly (2) in order to disassemble it.

Remove the boom cylinder assembly on the other side in the same way.

Boom cylinder AS: 264 kg

6. Remove the plate (5), air intake hose (6) and fan guard (7). ※1

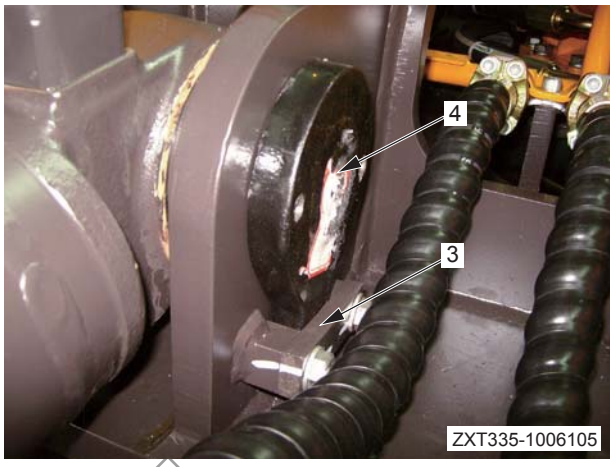


Fig. 8-121

Removal of the swing frame requires removing other parts that interfere with the lifting of swing frame.

7. Disconnect the six (6) hoses over the rotary joint assembly on the side of swivel joint.

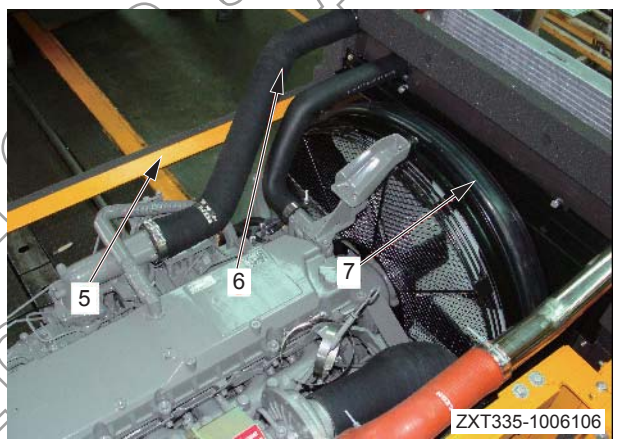


Fig. 8-122

(8): Central swivel joint (port A)-Left travel control valve (port BTL)

(9): Central swivel joint (port C)-Left travel control valve (port ATL)

(10): Central swivel joint (port F)-Solenoid valve

(11): Central swivel joint (port G)-Swing motor (port T)

(12): Central swivel joint (port D)-Right travel control valve (port ATR)

(13): Central swivel joint (port B)-Right travel control valve (port BTR)

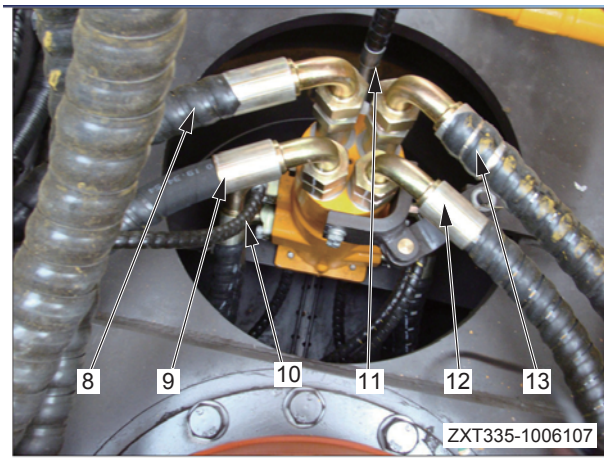


Fig. 8-123

8. Remove the bolt (14).

9. Unscrew the 32 swing frame mounting

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bolts in order to remove the swing frame assembly (15). Lift the swing frame assembly off the machine.

- Remove the front and rear mounting bolts of the platform. Use a lever block to adjust the swing frame so that the platform can reach a balance both longitudinally and laterally. Remove the last two bolts finally.

⚠ Take care not to damage the central swivel joint assembly while removing the swing frame assembly.

Swing frame assembly:

Model	Assembly (kg)	Only swing frame (kg)
SY365(B)H-9	14,755	3,040



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8.18.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Clamping screws (air intake hose): 5.4~6.4 Nm {0.55~0.65 kgm}

※2

Mating surface (swing bearing): Flat surface sealant (Tianshan 1596)

Threads (bolt - swing frame): Thread adhesive: (Tianshan 1277)

Mounting bolts (swing frame):

Step 1: Tighten the bolts with a pneumatic spanner.

Step 2: tighten them again. 490~608 Nm {50~62 kgm}

- Refilling of hydraulic oil

  Refill through the filler opening the hydraulic oil to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- Purging the air

  Purge the air from the travel motor. See **“Air in Each Component - Purge” on page 6-41.**

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8.19 Swivel Joint AS

8.19.1 Removal

Release remaining pressure in the hydraulic return circuit. See **“Remaining Pressure in Hydraulic Lines - Relieve” on page 6-36**.

- Tag each line so as to ensure correct reinstallation.

1. Disconnect the hoses (1) through (8) on the central swivel joint of the travel motor.

(1): Central swivel joint (port T) - Left travel motor (port T)

(2): Central swivel joint (port T) - Right travel motor (port T)

(3): Central swivel joint (port B) - Left travel motor (port PA)

(4): Central swivel joint (port D) - Right travel motor (port PB)

(5): Central swivel joint (port A) - Left travel motor (port PB)

(6): Central swivel joint (port C) - Right travel motor (port PA)

(7): Central swivel joint (port E)- Left travel motor (port X)

(8): Central swivel joint (port E) - Right travel motor (port X)

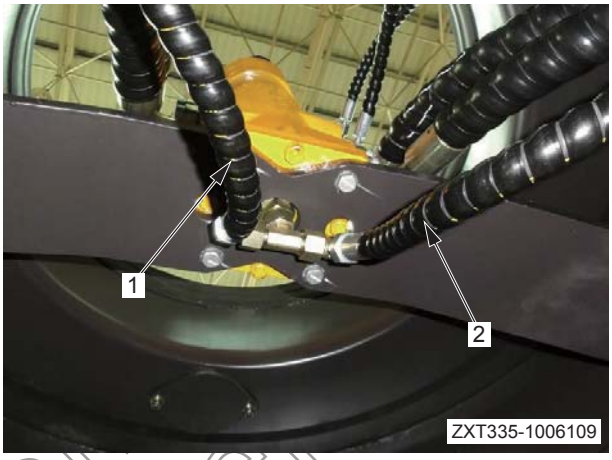


Fig. 8-124

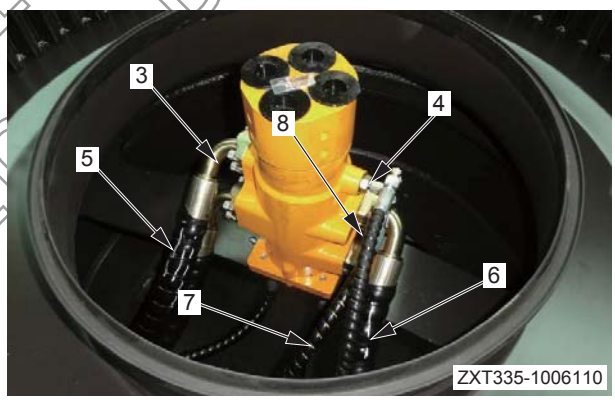


Fig. 8-125

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2. Disconnect the hoses (7) through (12) between:

(9): Central swivel joint (port T) - Swing motor (port Dr)

(10): Central swivel joint (port E) - Solenoid valve (port PT)

(11): Central swivel joint (port C) - Left travel control valve (port BTL)

(12): Central swivel joint (port A) - Right travel control valve (port ATL)

(13): Central swivel joint (port D) - Left travel control valve (port BTR)

(14) Central swivel joint (port B) - Right travel control valve (port ATR)

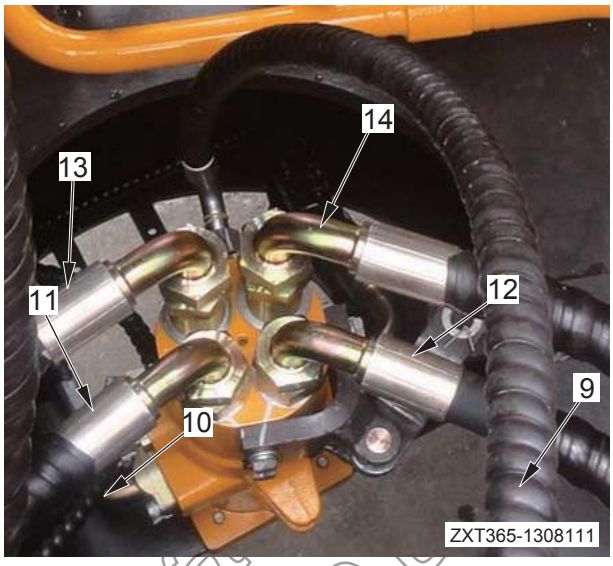


Fig. 8-126

3. Remove the two(2) pin rolls (16) in order to remove the plate (15).
4. Remove the four bolts (a) in order to remove the plate (b).

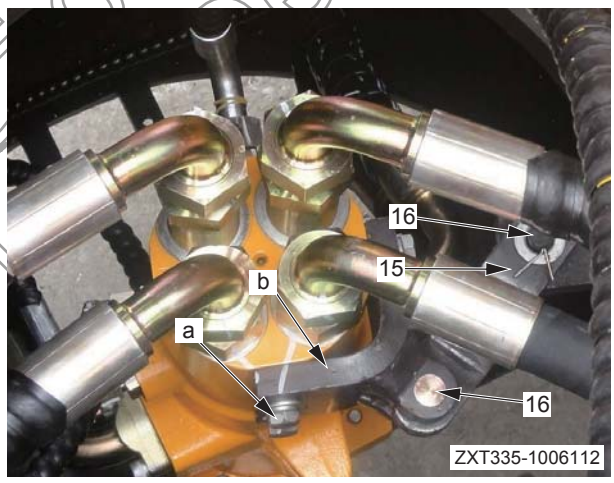


Fig. 8-127

5. Remove the four mounting bolts (17).

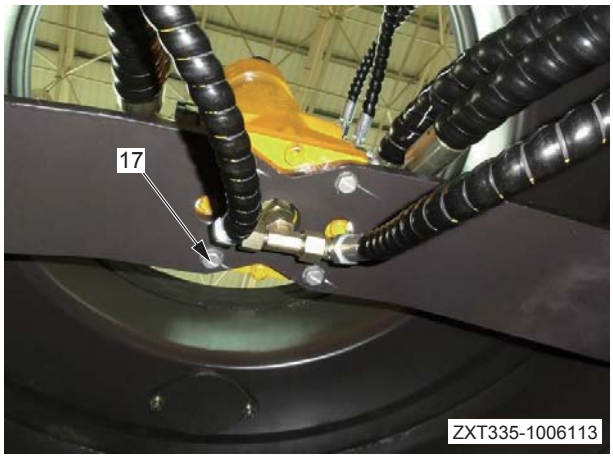


Fig. 8-128

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6. Remove the swivel joint assembly (18). ※1

   Central swivel joint: 45 kg

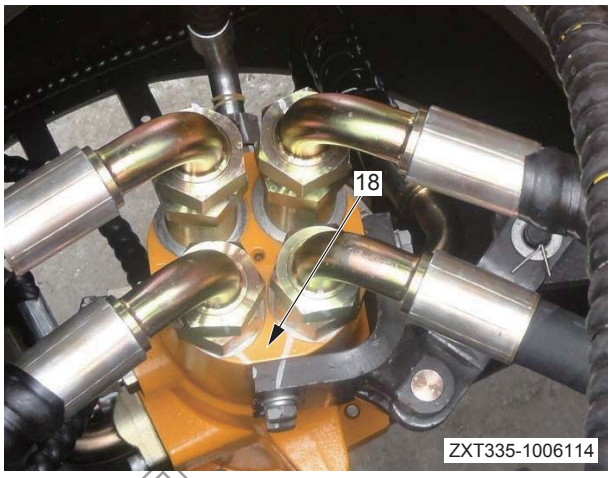


Fig. 8-129

8.19.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Install the central swivel joint facing the direction indicated in the illustration.

(In the illustration, the machine is viewed from the above.)

- **Refilling of oil (hydraulic tank)**

  Refill through the filler opening the hydraulic oil to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- **Purging the air**

  Purge the air from the travel motor. See **"Air in Each Component - Purge" on page 6-41.**

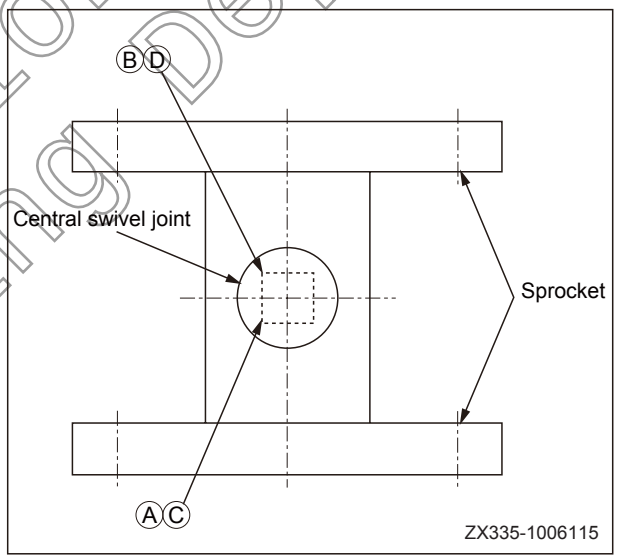


Fig. 8-130

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8.20 Central Swivel Joint AS

8.20.1 Disassembly

1. Remove the fixing bolt (1).
2. Remove the cover (2).
3. Remove the rotor (12) from the housing (6).
   - Take care not to damage the sliding surface of the seal of the rotor (12).
4. Remove the O-ring (3), oil seal (8) and retainer (7) from the housing (6).
5. Remove the rotary seal (9) and O-ring (10) from the housing (6).
6. Remove the oil seal (11) from the rotor (12).

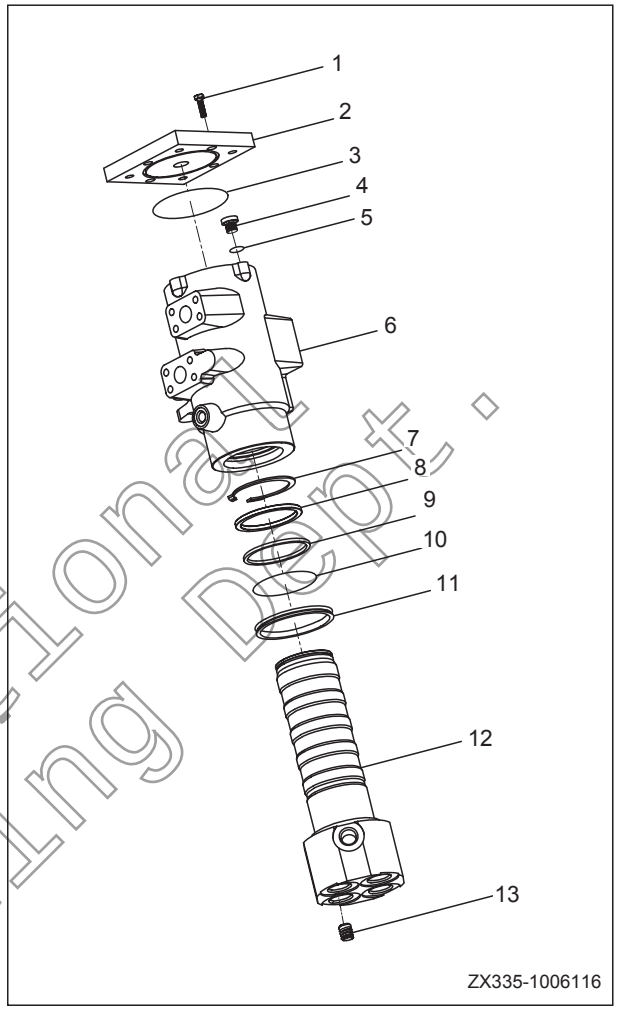


Fig. 8-131

8.20.2 Assembly

1. Install the oil seal (11) on the rotor (12).
   - Let the lip face the dust ring of housing.
2. Install the O-ring (10), rotary seal (9) in the housing (6).
3. Fix the rotor (12) on a work bench. Install the housing (6) on the rotor (12).

   The clearance between the housing (6) and the rotor (12) approximates 0.1 mm, so the rotor must be inserted slowly in the axial direction. Take care not to damage the rotary seal and the O-ring.
4. Use a rubber hammer to tap the housing (6) in order to match the rotor (12) properly.
5. Install the O-ring (3) and retainer (7) on the rotor (12).
6. Install the cover (2) and tighten the bolts (1).

   Fixing bolts: 49 Nm {5 kgm}

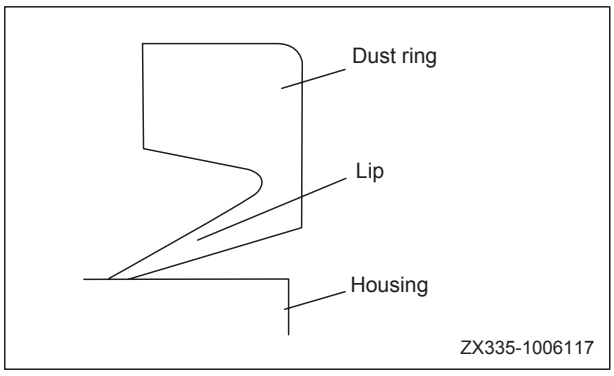


Fig. 8-132

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8.21 Hydraulic Tank AS

8.21.1 Removal

1. Drain oil from the hydraulic tank. ※1
   Hydraulic oil: About 260 L
2. Open the engine hood.
3. Remove the engine hood (1), beam (2) and control valve cover (3).

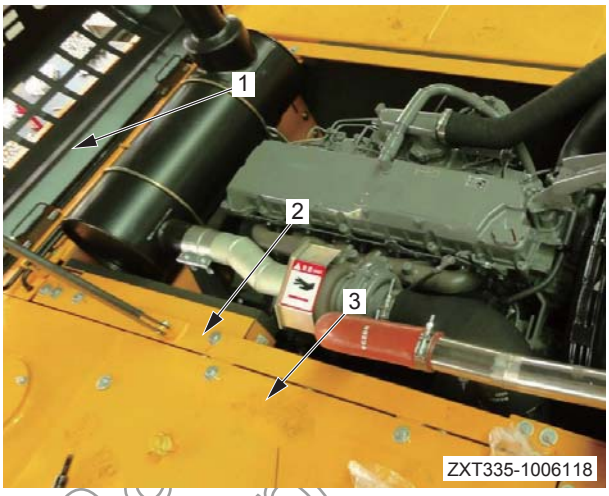


Fig. 8-133

4. Remove the covering (4) and the main pump partition (5).
5. Remove the engine partition (6) and the bracket (7) at the hydraulic tank side.

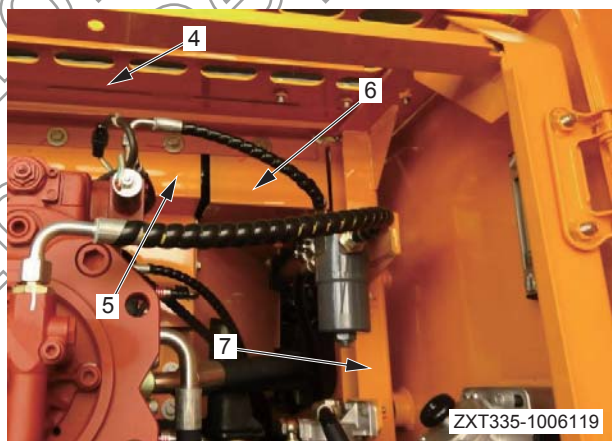


Fig. 8-134

6. Remove the two(2) oil return tubes (8) and (9) of the hydraulic tank.

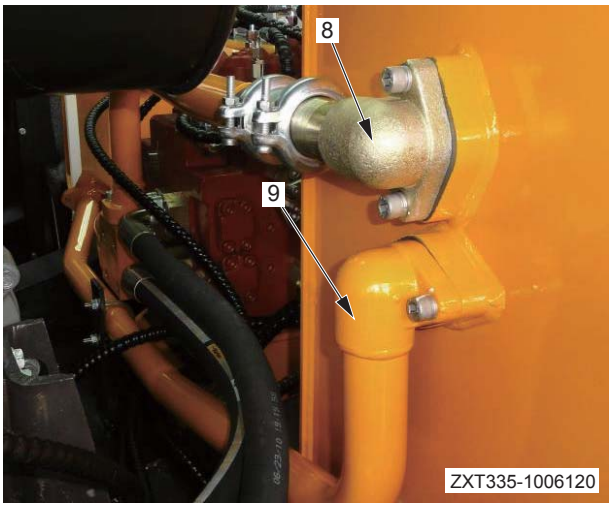


Fig. 8-135

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7. Remove the six hoses. ※2

   (10): Oil return (T-block, pilot)

   (11): Oil return D2 (main valve)

   (12) & (13): Oil return (leak of main pump)

   (14): Oil return (solenoid valve)

   (15): Oil return D1/D3 (main valve)

   (16): Oil return (swing motor)

   - Tag the hoses for identification.
   - Use socket nuts to protect the hose connectors and cone seals against damage.

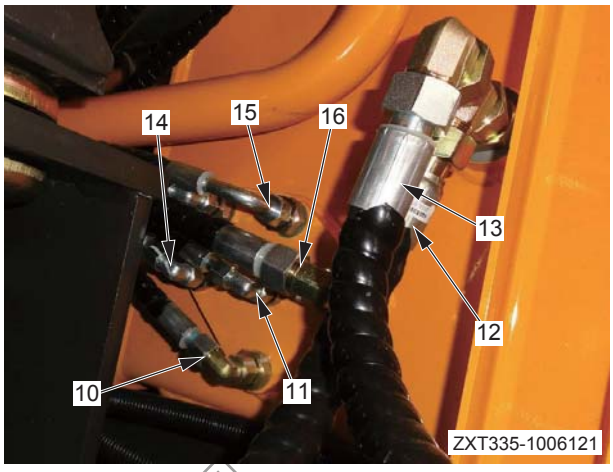


Fig. 8-136

8. Disconnect the oil suction tube (17) from the bottom of hydraulic tank and the oil suction hose (18) connected with the oil suction tube of the main pump.
9. Remove the six (6) mounting bolts (19) from the bottom of hydraulic tank. Lift the hydraulic tank assembly. ※3
10. Move the hydraulic tank assembly away in order to disassemble it.

    Hydraulic tank AS: 234 kg

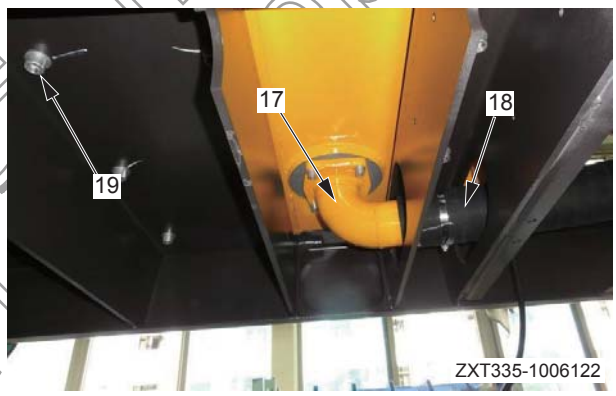


Fig. 8-137

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8.21.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Drain plug (hydraulic tank):
58.8~78.5 Nm {6.0~8.0 kgm}

※2

- After tightening the hose clamping screw, check that the screw should be in the range indicated in the illustration.

Screw (hose clamp):
8.8±0.5 Nm {0.9±0.05 kgm}

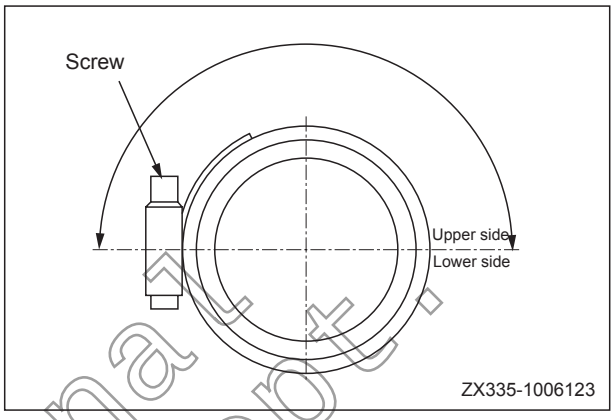


Fig. 8-138

- Install the hose clamp and tighten the screw according to the illustration on the right.

※3

Bolt:
245.2~308.9 Nm {25~31.5 kgm}

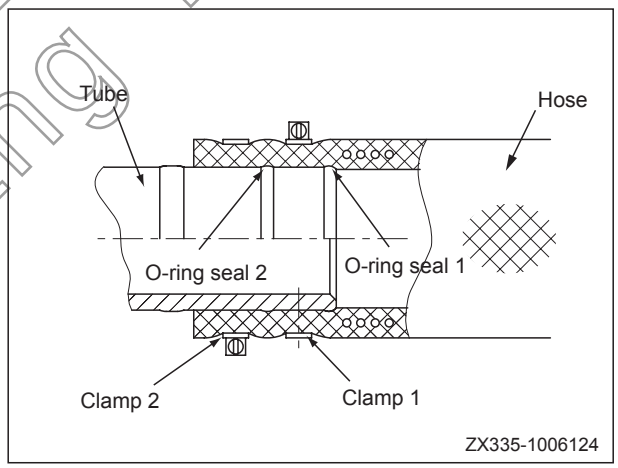


Fig. 8-139

- **Refilling the oil (to hydraulic tank)**

  Refill hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

- **Purging the air**

  See **"Air in Each Component - Purge" on page 6-41.**

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8.22 Control Valve AS

8.22.1 Removal

Lower the work equipment to the ground in order to ensure safety. Stop the engine. Power on the machine and relieve system pressure. Use the breather valve to release the pressure in the hydraulic tank. Place the hydraulic lock-out control in the LOCK position.

- Tag each line so as to ensure correction reinstallation.

1. Remove the engine hood (1).
2. Remove the coverplate (2) on the control valve.

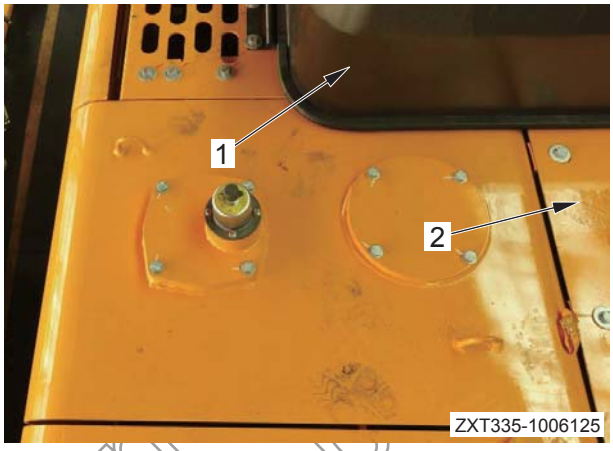


Fig. 8-140

3. Remove the engine partition (3).

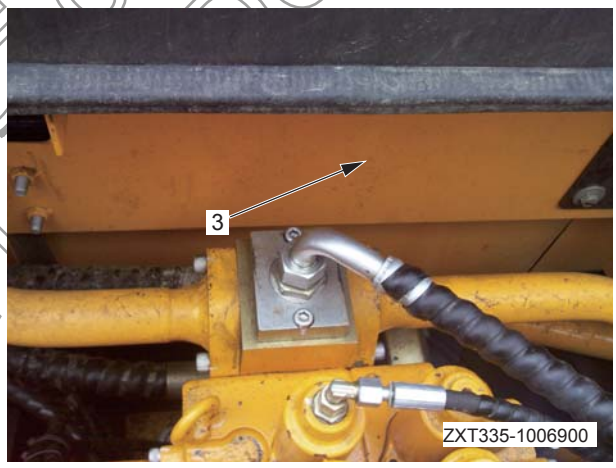


Fig. 8-141

4. Remove the pressure sensor guard (4).

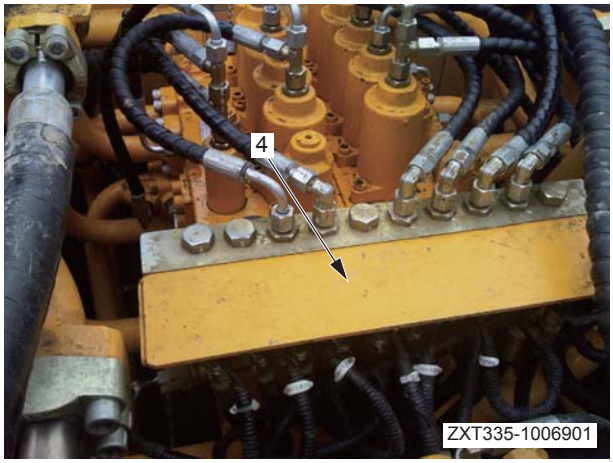


Fig. 8-142

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5. Remove the ten (10) pilot hoses (from left to right) and tag them properly. The hoses are for:

   (5) Left travel

   (6) Right travel

   (7) Arm OUT

   (8) Left swing

   (9) Bucket DIG

   (10) Boom DOWN

   (11) Boom UP

   (12) Right swing

   (13) Bucket DUMP

   (14) Arm IN

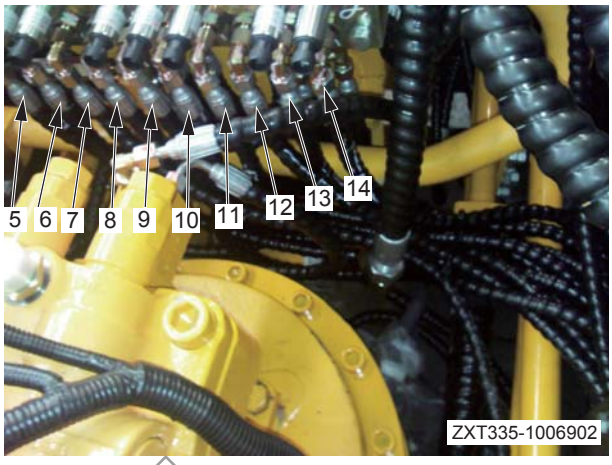


Fig. 8-143

6. Remove the two(2) pilot hoses on the control valve and tag them properly. The hoses for:

   (15): Right travel forward

   (16): Left travel forward

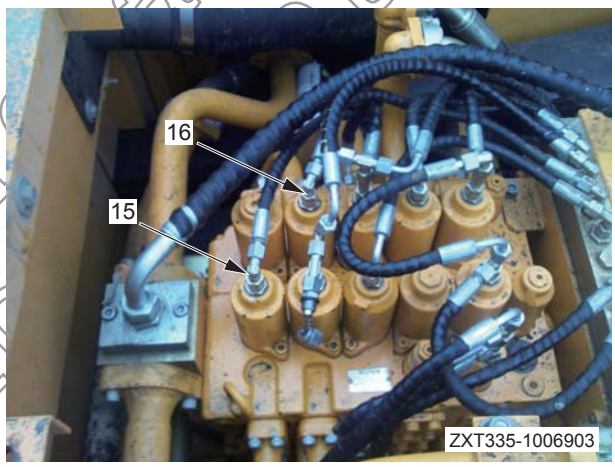


Fig. 8-144

7. Remove the pressure sensor harness (17).

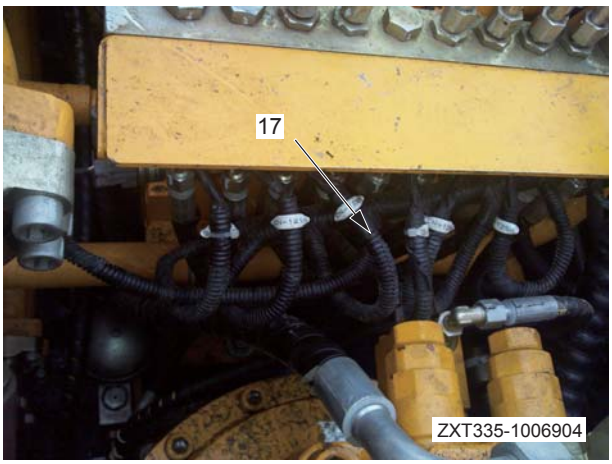


Fig. 8-145

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8. Remove the clamp (18) fixing the harness of solenoid valve.

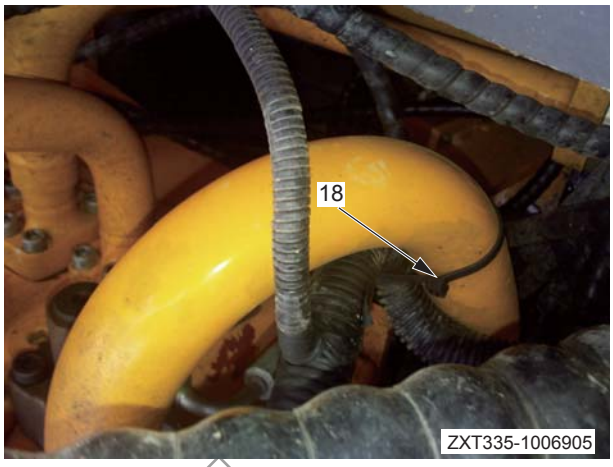


Fig. 8-146

9. Disconnect the hoses (19) and (20) from the check valve block to the pilot pump and swing motor port (PG).

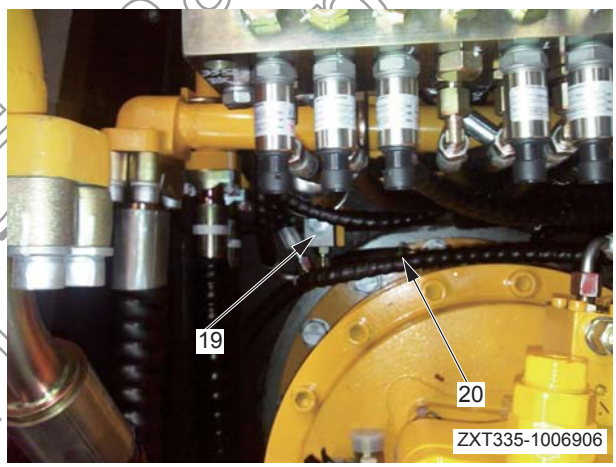


Fig. 8-147

10. Remove the boom tube clamp (21) on the main valve.
11. Remove the tubes (22) and (23) from the main valve to boom cylinder. Seal the ports properly.

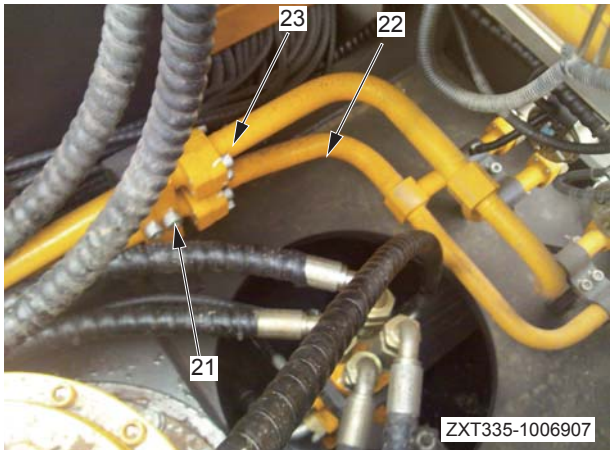


Fig. 8-148

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12. Disconnect the bucket hoses (24) and (25). Seal the ports properly.
13. Disconnect the arm hoses (26) and (27). Seal the ports properly.

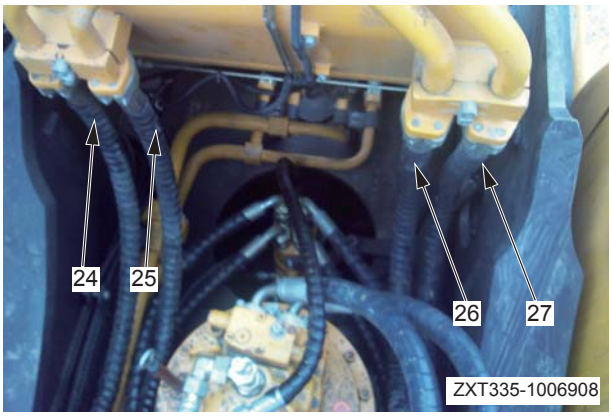


Fig. 8-149

14. Disconnect the hoses (28), (29), (30) and (31) between the central swivel joint and the main valve. Seal the ports properly.
15. Disconnect the swing motor hoses (32) and (33). Seal the ports properly.
16. Disconnect the hose (34) between control valve and swing motor port (M) and the hose (35) between control valve and swivel joint.

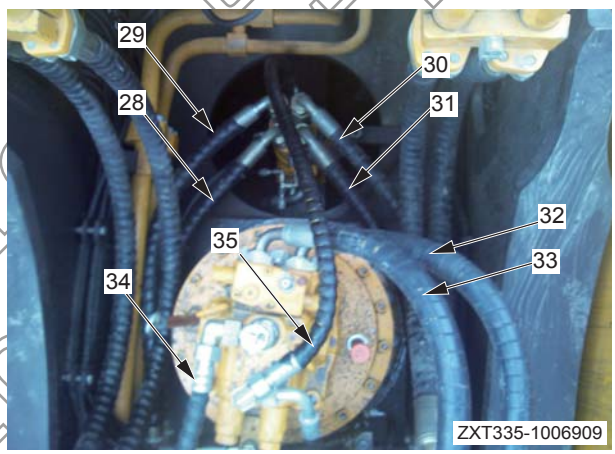


Fig. 8-150

17. Disconnect the tube or hose (36) of radiator and the oil return tube (37) of hydraulic tank. Seal the ports properly.

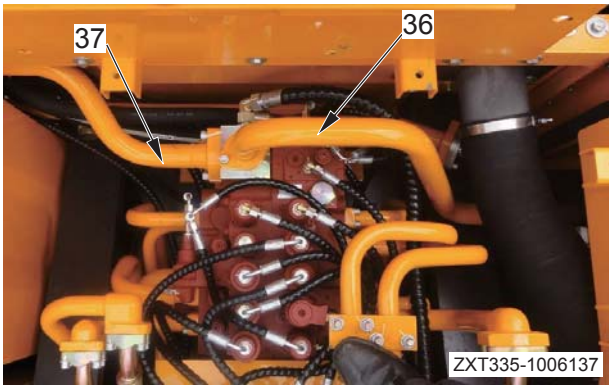


Fig. 8-151

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18. Disconnect the hydraulic pump hoses (38) and (39).

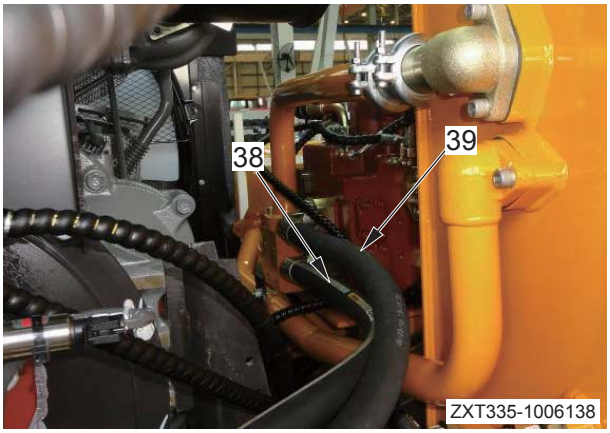


Fig. 8-152

19. Remove the two pilot hoses under the control valve and tag them properly.

    (40) Right travel backward

    (41) Left travel backward

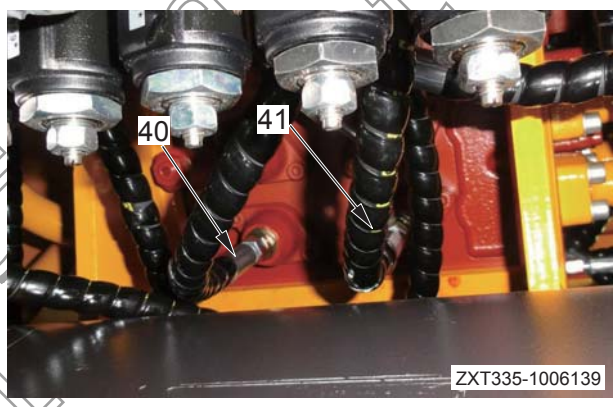


Fig. 8-153

20. Remove the harness and hoses of the solenoid valve and tag them properly.

    (42) Oil return hose

    (43) Harness

    (44) Negative feedback hose from solenoid valve to front pump

    (45) Negative feedback hose from solenoid valve to rear pump

    (46) Oil feed hose from solenoid valve to PT block

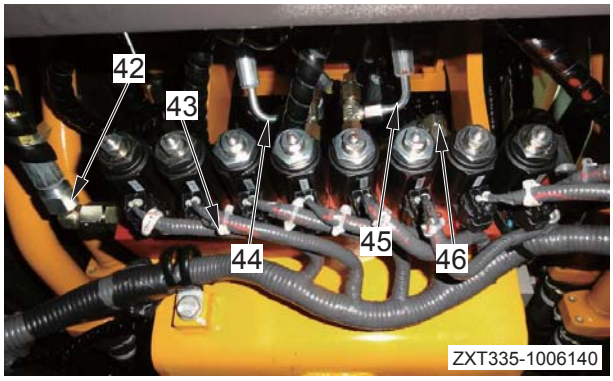


Fig. 8-154

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21. Remove the bolts (48) of the control valve assembly. Lift the control valve assembly in order to dissemble it.

    Control valve AS: 380 kg

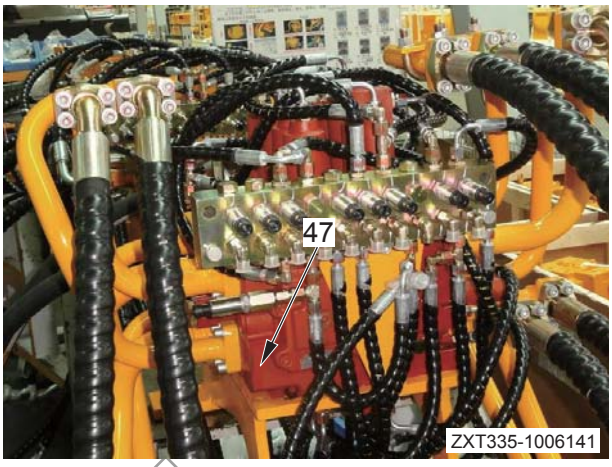


Fig. 8-155

8.22.2 Installation

- Installation is performed in the reverse procedure of removal.
- **Refilling the oil (to hydraulic tank)**

  Refill hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.
- **Purging the air**

  See **"Air in Each Component - Purge" on page 6-41**.

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8.23 Hydraulic Pump AS

8.23.1 Removal

Lower the work equipment to the ground in order to ensure safety. Stop the engine. Press the release button of the breather valve to release remaining pressure in the hydraulic tank.

Disconnect the cable from the negative (-) post of the battery before performing the job.

- Tag each line so as to ensure correction reinstallation.

1. Remove the oil inlet filter element from the hydraulic tank and stop oil outflow with an oil stopper.

   If no oil stopper is used, remove the drain plug and drain the oil from the hydraulic tank and the lines.

   Hydraulic oil tank: About 340 L

2. Remove the engine hood (1)

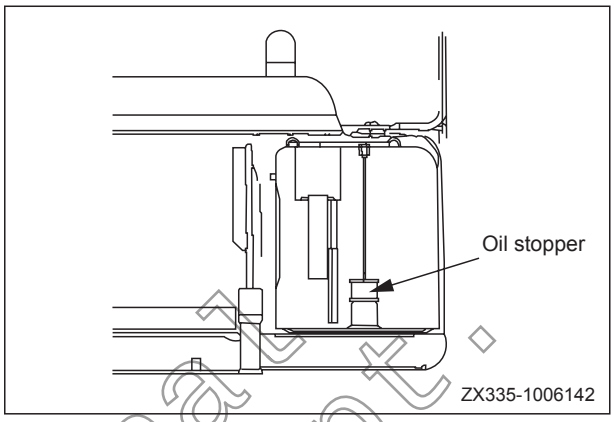


Fig. 8-156

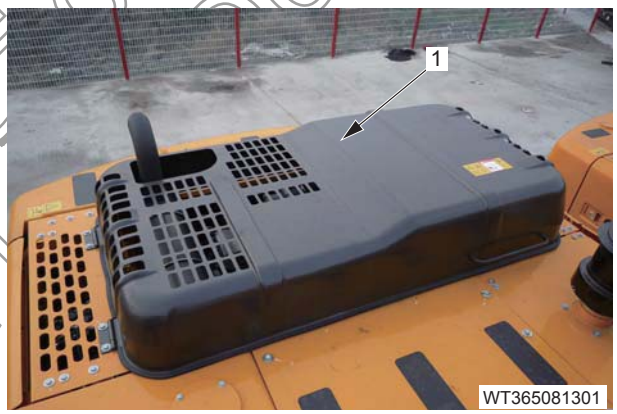


Fig. 8-157

3. Remove the rod (2) and bolts (3). Lift the engine hood.



Fig. 8-158

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4. Remove the upper right coverplate (4).



Fig. 8-159

5. Disconnect the hose (5) supplying oil to the lower proportional valve and the hose (6) delivering oil from the pilot pump. Seal the ports properly.

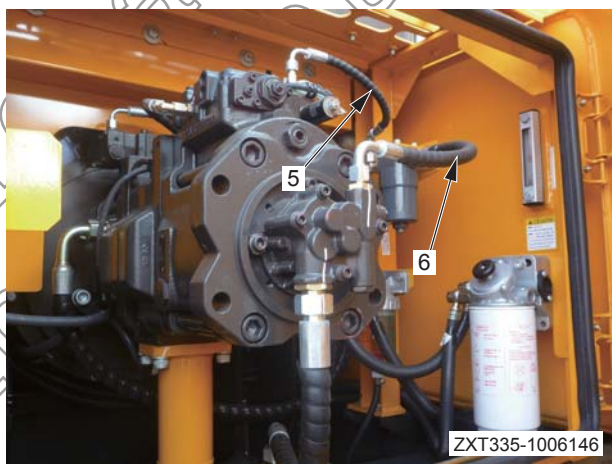


Fig. 8-160

6. Remove the shutdown device line (7).



Fig. 8-161

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7. Remove the right door (8).
8. Remove the hydraulic pump cover (9).



Fig. 8-162

9. Disconnect the oil drain hose (10) and seal the ports properly.
10. Disconnect the high-pressure hoses (11) and (12) connected to the control valve, and seal the port properly.
11. Disconnect the harness (13) of the pressure transducer.
12. Disconnect the pilot pump oil suction hose (14) and seal the port properly.
13. Disconnect the hydraulic pump oil suction tube (15) and seal the port properly. ※1

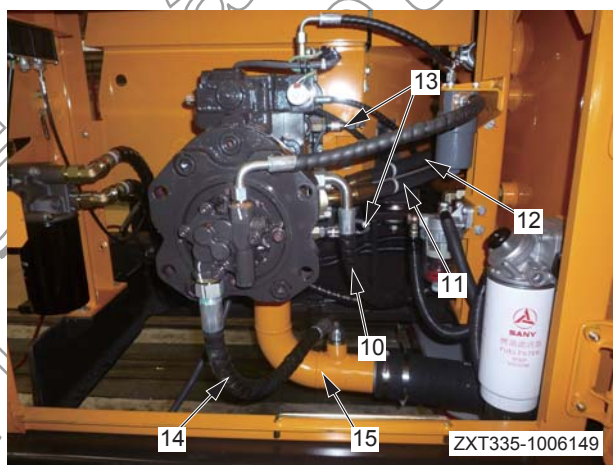


Fig. 8-163

14. Disconnect the solenoid valve harnesses (16) and (17).

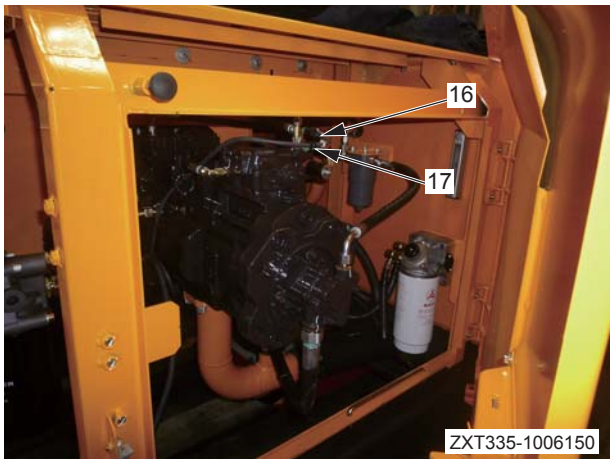


Fig. 8-164

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15. Remove the four bolts (18) of the hydraulic pump. Lift the hydraulic pump assembly (19) in order to disassemble it. ※2

Hydraulic pump assembly: 186 kg

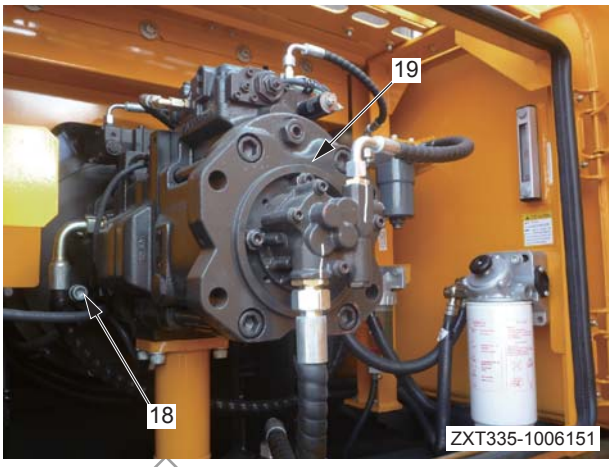


Fig. 8-165

8.23.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

- After tightening the hose clamping screw, check that the screw should be in the range indicated on the right illustration.

Screw (suction hose clamp):
10~13 N·m {1.0~1.3 kgf·m}

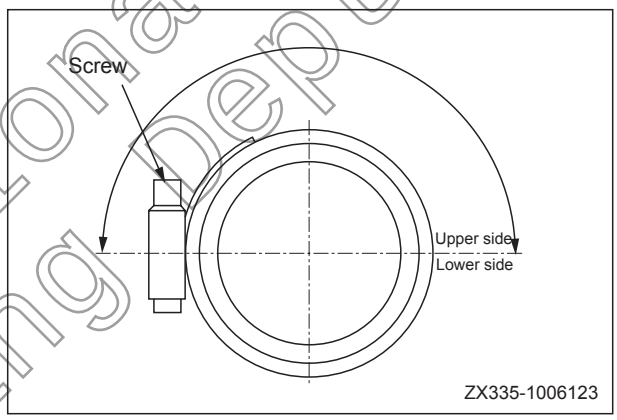


Fig. 8-166

- Install the hose clamp and tighten the screw according to the illustration on the right.

※2

Mating surface (hydraulic pump housing):
Gasket sealant: (Loctite 515)

- **Refilling the oil (to hydraulic tank)**

  Refill hydraulic oil through the filler opening to the specified level. Start the engine to circulate oil in the hydraulic system, and check the oil level again.

Hydraulic tank: About 340 L

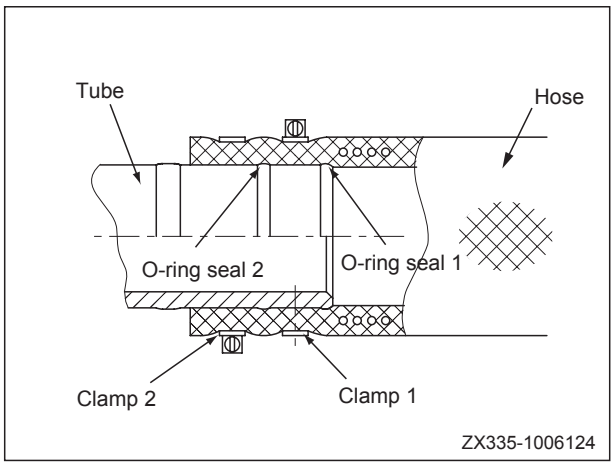


Fig. 8-167

- **Purging the air**

  See **"Air in Each Component - Purge" on page 6-41.**

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8.24 Middle Oil Seal (Hydraulic Pump Input Shaft)

8.24.1 Removal

1. Remove the hydraulic pump assembly (1). See **“Hydraulic Pump AS” on page 8-80.**
2. Remove the screw (2). Remove the bearing cover (3).
3. Pry the oil seal (4) out with a screwdriver.

※1

- Take care not to damage the shaft while prying the oil seal.

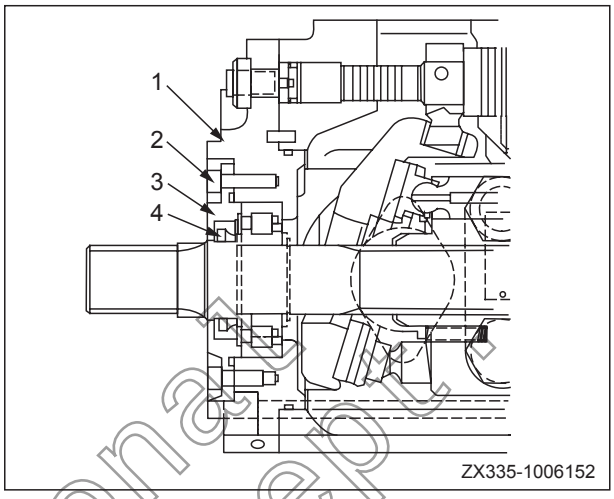


Fig. 8-168

8.24.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Seal lip: grease (No.1 Calcium base grease)

Seal circumference: grease (No.1 Calcium base grease)

- Apply a thin layer of grease to the oil seal circumference.

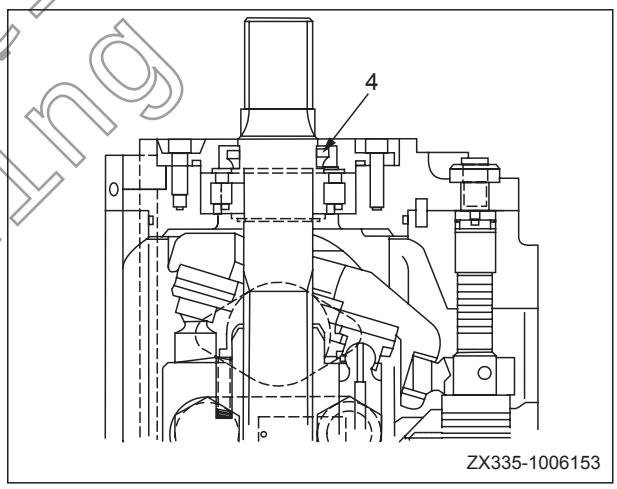


Fig. 8-169

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8.25 Pilot Valve AS (Work Equipment)

- This section discusses only the precautions when reassembling the work equipment pilot valve assembly.



Fig. 8-170

- Reassembly of the work equipment pilot valve assembly

1. Install the plate (9) in the valve body (8) with O-ring seal. Tighten the socket-headed screw (10).

   Screw (socket head): 25~33 Nm {2.55~3.36 kgm}

2. Insert the spring (7) into the spool hole in the valve body (8). Put the spool (6) in the spring. Install the plug (5) on the spool. Push the plug (5) to the spool hole.
3. Install the plate (4) on the plug (5). Tighten the U-joint (3).
4. Install the plate (2). Align the position of the plate (2) and tighten the nut (1).

   Nut: 98~133 Nm {10~13.5 kgm}

   - Location of each oil port is stamped on the bottom of valve body.

   Plug (5) circumference: Grease (No.1 Calcium base grease)

   U-joint working surface: Grease (No.1 Calcium base grease)

   Threads in valve body: Thread adhesive (Tianshan 1277)

   Apply the thread adhesive (Tianshan 1277) to two points on the inner threads, as indicated in the illustration on the right. The amount of application is approximately 0.02 g.

   U-joint (3): 98~133 Nm {10~13.5 kgm}

   - Tightening is to be made to the specified torque.

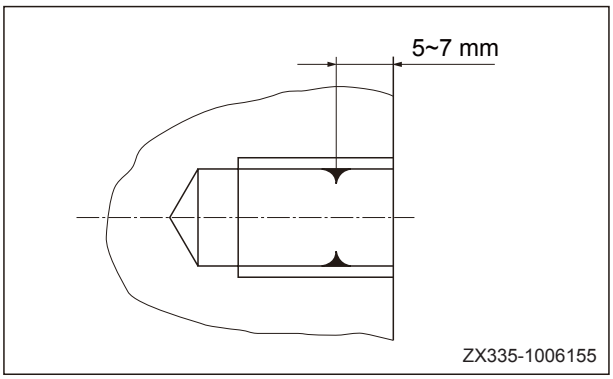


Fig. 8-171

Contact surface between plug (5) and plate (2): Grease 0.3~0.8cc (G2-L1)

- After assembling plate (2) see **"Work Equipment and Swing Pilot Valves - Adjust" on page 6-33**.

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8.26 Travel Pilot Valve AS

- This section discusses only the precautions when reassembling the travel pilot valve assembly.

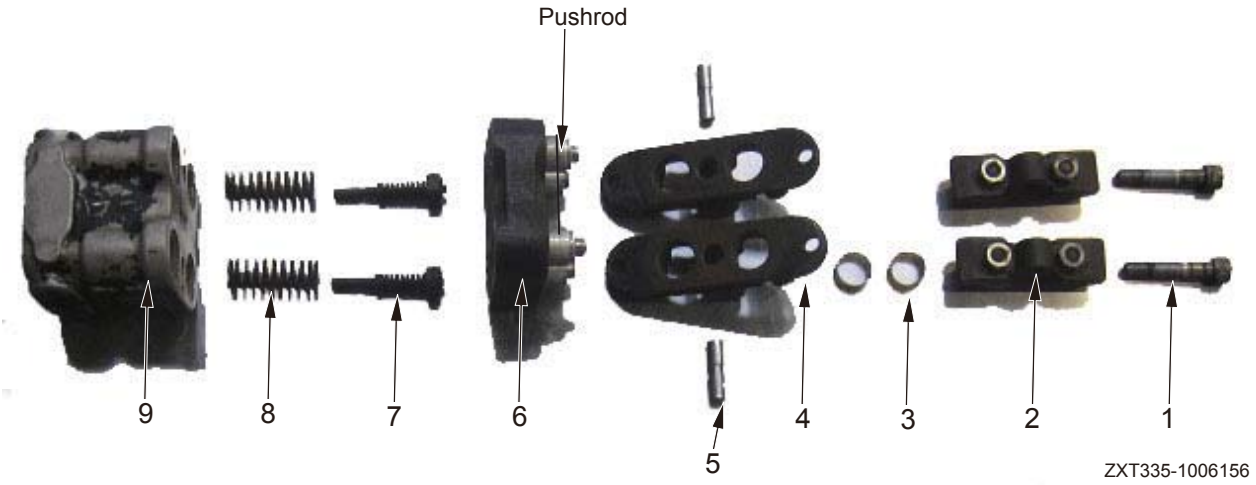


Fig. 8-172

- Reassembly of pedal pilot valve assembly

1. Install the spring (8) into the spool installation hole in the body assembly (9). Install the spool (7). Place the cover assembly (6) on the spool and press the cover assembly (6) with a hand.
2. Install the cover (4) after aligning the holes. Tighten the socket-headed bolts (1).

   Bolt (socket head): 98~114 Nm {10~11.6 kgm}
3. Install the dust ring (3) on the plug. Install the cover (2) and fix the cover (2) with the camshaft (5).

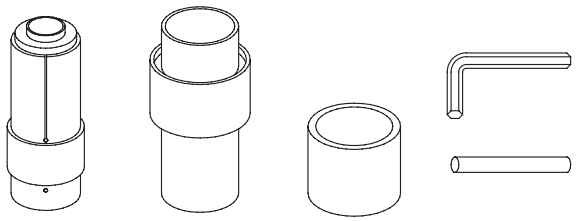
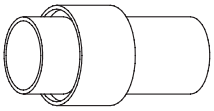
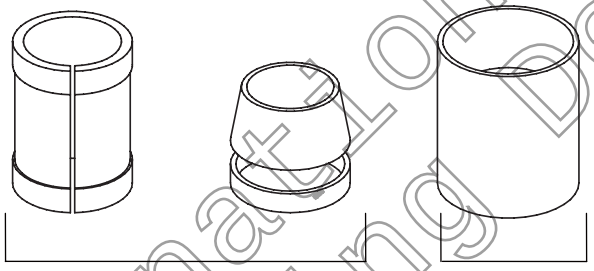
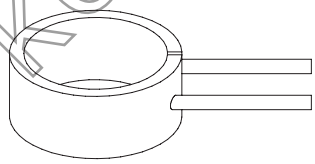
   Contact surface between the plug and the dust ring (3): Grease (No.1 Calcium base grease)

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8.27 Hydraulic Cylinder AS

Special tools

Tool Description	Sketches	Necessity	Quantity
For pulling out/ pushing in the bushing		■	1
For press fitting the dust ring		■	1
For O-ring seal correction		■	1
For inserting the cylinder head		■	1
For inserting the piston		■	1

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8.27.1 Disassembly

1. Drain the oil and remove the tubing.
2. Fix the cylinder.
   - Fix the cylinder in a vertical or level manner. A vertically fixed cylinder can be disassembled and assembled easily.
   - The pin hole in the head end can be used for fixing of the cylinder. The pin roll can prevent the cylinder from turning.
   - Remove the tubing in case of tubing interference while fixing the cylinder.

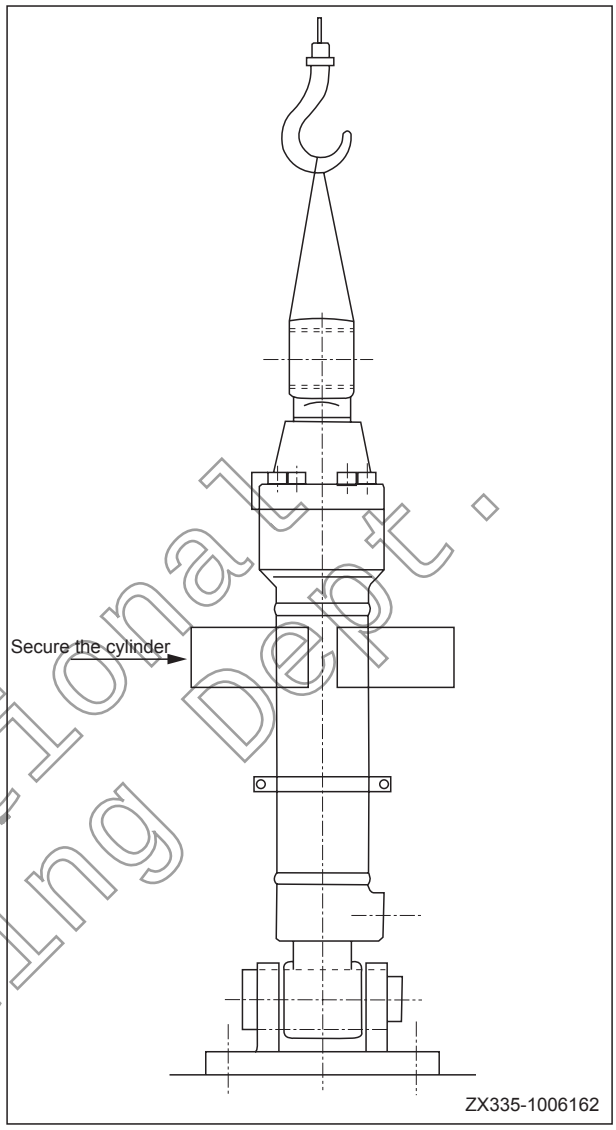


Fig. 8-173

3. Removal of cylinder head
   - Unscrew the bolts with Allen Wrench.
   - Using an extension rod, as shown in the illustration on the right, will make the work easy.

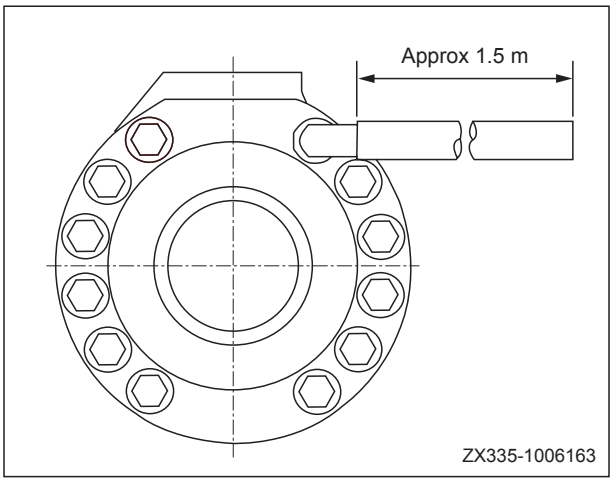


Fig. 8-174

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4. Pulling out the piston rod
   - Be sure to have removed the tubing cover.
   - Prepare a suitable container to collect oil coming out of the oil port.
   - After pulling out the piston rod (1) to its limit, slowly loosen the cylinder head and pull it out.
   - Remove piston rod (1) with cylinder head (2) and place them on a wooden sleeper.

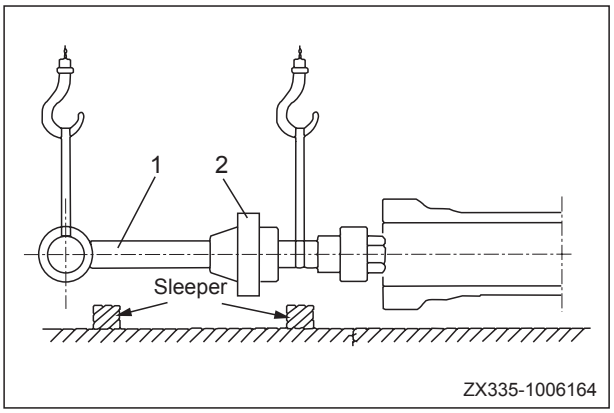


Fig. 8-175

5. Securing the piston rod
   - Pin hole on the rod end or the flat part of the ear can be used to fix the piston rod and prevent it from turning.

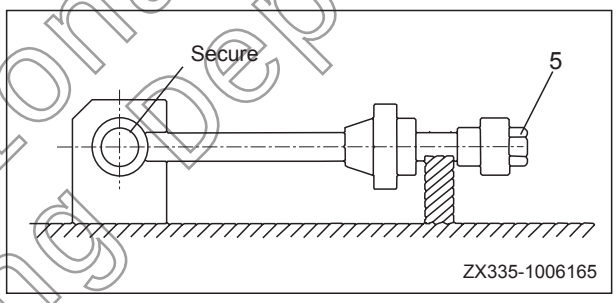


Fig. 8-176

6. Remove of piston nut (5)
   A. Remove the fixing screw (3) from the piston nut (5).
   - Around the fixing screw there are two points that have been punched against loosening. After removing the riveted part with a hand drill, loosen and remove the fixing screw (3).

   B. Remove the steel ball (4) inside the fixing screw.

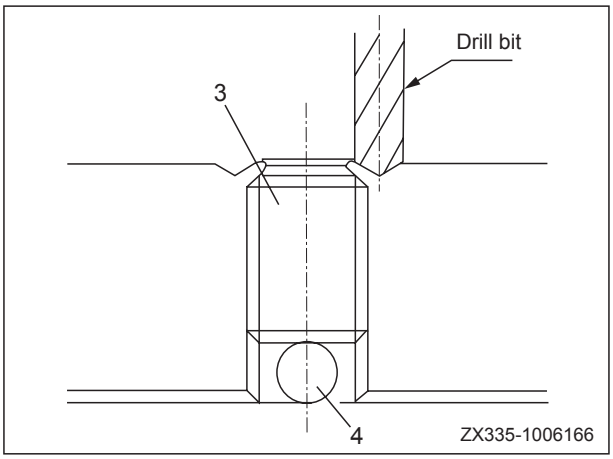


Fig. 8-177

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C. Remove the piston nut (5).

- The piston nut (5) is very tight. To loosen the piston nut (5), prepare a hydraulic jack or a spanner powered by hydraulic cylinder. An extension rod should be ready when removing the piston nut (5) manually.

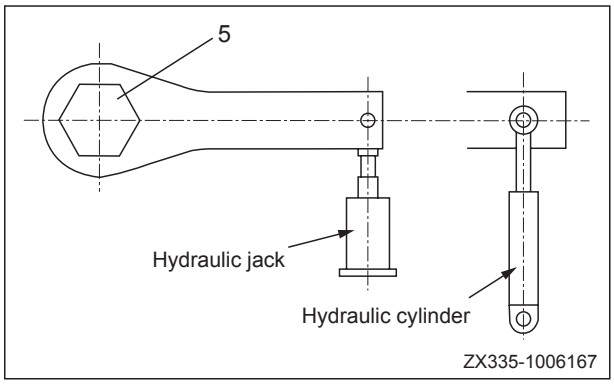


Fig. 8-178

7. Removal of piston assembly

Remove in turn the piston (7), buffer sleeve (6) and cylinder head (2).

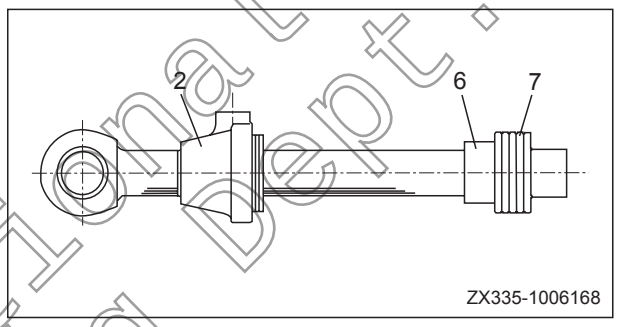


Fig. 8-179

8. Removal of the buffer sleeve (8) on the head end

A. Remove first the piston nut (5).

B. Use a tool like rubber hammer to tap the piston nut (5) slightly in order to remove it. The piston rod and the buffer sleeve (8) should be kept intact. Remove the elastic retainer (9).

C. Slide the buffer sleeve (8) toward the piston threads in order to remove the two-piece stopper ring.

D. Remove the buffer sleeve (8).

E. There is an opening in the buffer seal (10). Take advantage of this opening to remove the buffer seal (10).

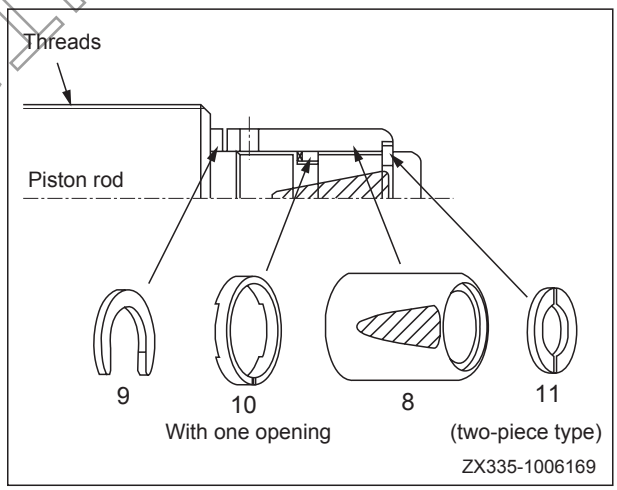


Fig. 8-180

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9. Removal of piston seal

   A. The slide ring (12) and the guard ring (13) can be simply removed with hands.

   B. The seal (14) can be removed with a hammer and a flat-head screwdriver.

   C. Remove the O-ring seal (15) with a pry bar.

   - The removed seals should not be re-used.

10. Removal of buffer ring (16)

    - The buffer ring (16) is installed in the inner groove in the cylinder head. Use a tool with sharp end to pry it out and remove it with a scraper.

11. Removal of the U-ring (17) and the dust ring (18).

    A. Remove the U-ring (17) with a tool such as screwdriver.

    B. Press a tool (such as a screwdriver) against the dust ring (18) and hammer the screwdriver to remove the dust ring (18).

    - The removed seals should not be re-used.

12. Removal of bushing (19)

    A. Remove the elastic ring (20) from the cylinder head (2) with a screwdriver.

    B. Push the bushing (19) out with the help of clamps and press.

13. Removal of pin bushing (21)

    A. Remove the dust ring (22) on the side of cylinder barrel and piston rod with a tool such as screwdriver.

    B. Remove the bushing (21) with the help of a suitable cushion block.

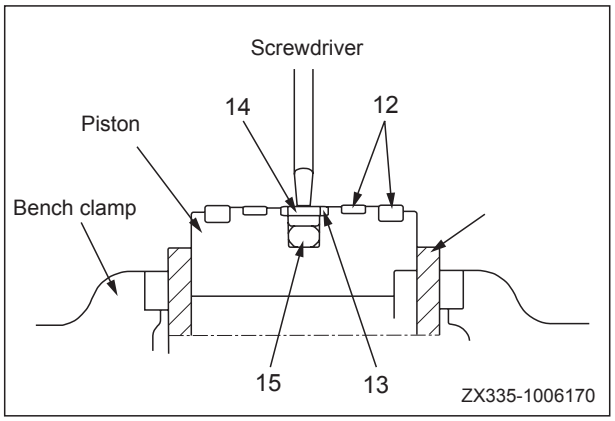


Fig. 8-181

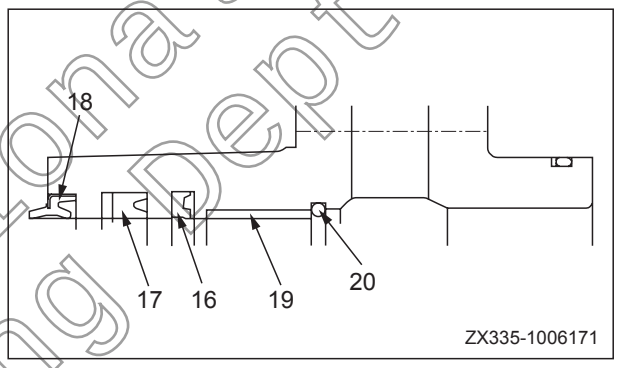


Fig. 8-182

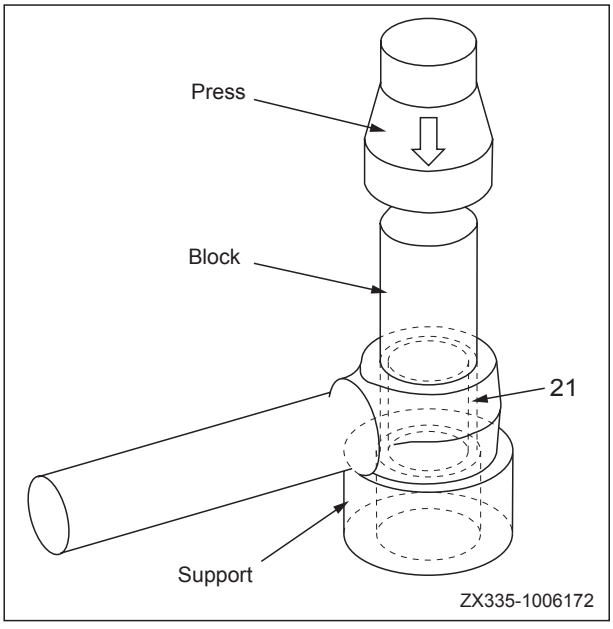


Fig. 8-183

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8.27.2 Assembly

1. Installation of bushing (21)

   A. Use an installation tool to press the bushing (21) into the bushing (lubricated with hydraulic oil) on the side of piston rod and cylinder barrel.

   B. Install the dust ring (22) with the help of a suitable cushion block.

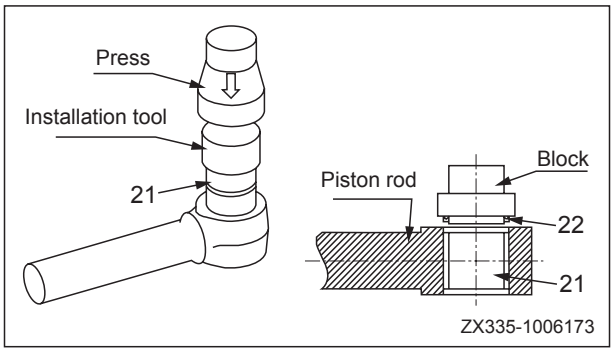


Fig. 8-184

2. Assembly of cylinder head (2)

   A. Use the press to push in the bushing (19).

   - Apply hydraulic oil to the inside of cylinder head in advance. Make sure that the bushing (19) pushed in is free from a raised shoulder.

   B. Use the press to push in the dust ring (18).

   C. Install the guard ring and the U-ring (17) sequentially in the U-groove.

   - Install the U-ring (17) in correct direction. Make sure that the U-ring is intact before installation.
   - Inverse installation will cause leak of oil.
   - Make sure that the U-ring is free from any corrugation or permanent deformation after installation.

   D. Installation of buffer ring (16)

   - Make sure that the seal is installed in correct direction. Inverse installation can cause high pressure between the buffer ring (16) and the U-ring (17), which may lead to deformation or breakage of oil cylinder.

   E. Install the elastic ring (20) to prevent the fall of the bushing (19).

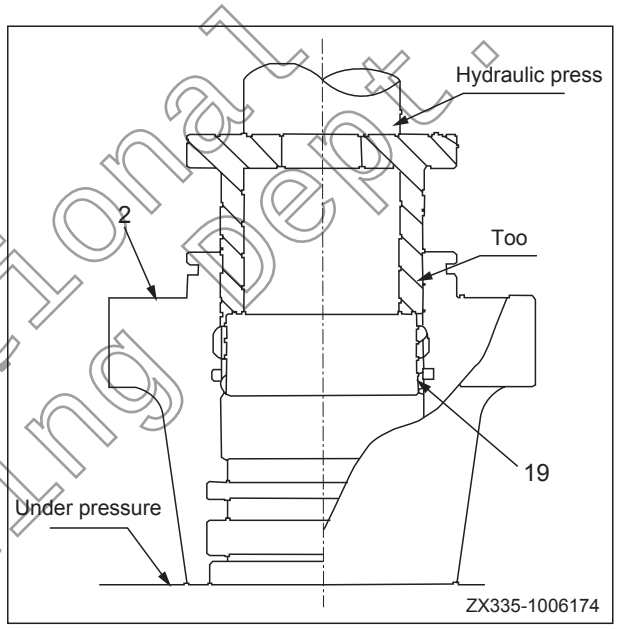


Fig. 8-185

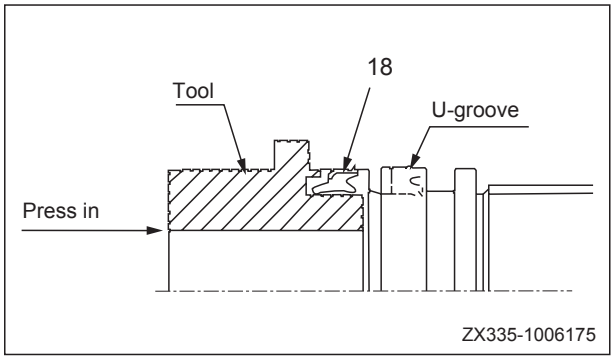


Fig. 8-186

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3. Assembling the piston assembly

   A. Installation of seal (14).

   - Install first the O-ring seal and the one-side guard ring (13) on the piston. Place the piston on the press. As shown in the illustration on the right, the seal (14) is installed with the tools indicated.

   B. Correction of seal (14)

   - Install the seal (14) and the guard ring (13) on the other side. In order to prevent the expansion of the seal (14), a corrector must be used to correct the seal (14) which has been stretched during installation. The piston rod may not be able to go in the cylinder barrel if the seal (14) is not corrected timely.

   C. Installation of slide ring (12)

   - Slightly open the slide ring (12) and install it axially. Excessive opening of the slide ring (12) can fail installation.

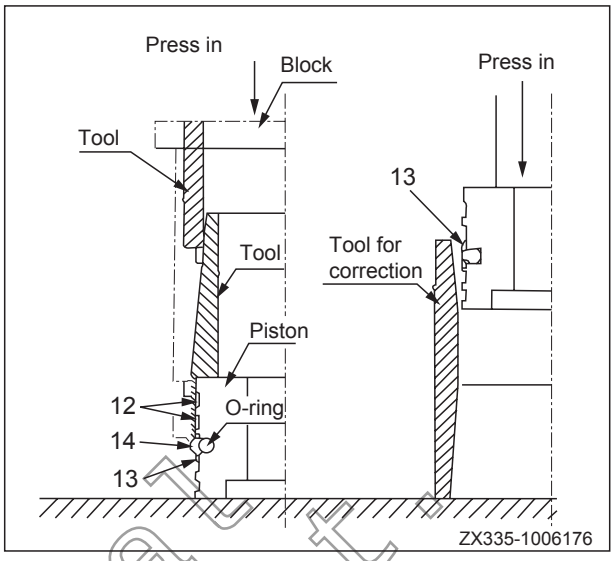


Fig. 8-187

4. Assembling the piston rod assembly

   A. Fix the piston rod (1).

   B. Install the cylinder (2) on the piston rod.

   - Make sure that the dust ring lip or the U-ring lip is not stopped by the shoulder of any part. Install the cylinder head and the piston rod with the tools.

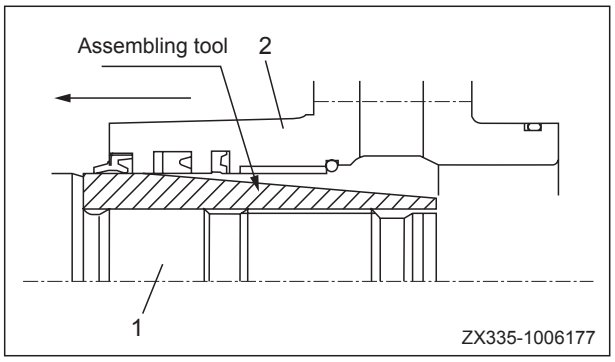


Fig. 8-188

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C. If the bottom side of cylinder contains a buffer (not for bucket cylinder), install the buffer bearing and the buffer seal in the following order.

   a. Let the notched side of the buffer seal (10) face the piston while installing the buffer seal (10) in the groove.

   b. Install the buffer sleeve (8) according to the indication in the illustration on the right.

   c. Install the stopper ring (11) in the groove. Install the elastic ring after the buffer sleeve (8) is pushed to the bottom. A rubber hammer should be used for the tapping job in order to avoid damaging the piston rod and the buffer bearing.

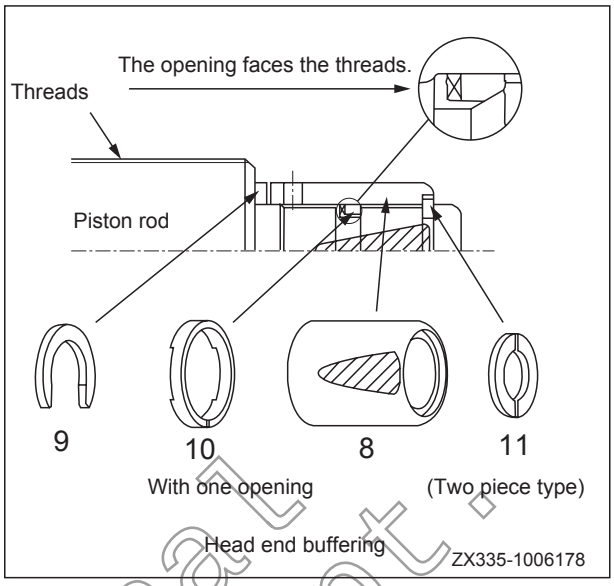


Fig. 8-189

D. If the head side of cylinder contains a buffer, install the buffer sleeve (6) and the buffer seal (23) according to the following order.

   a. The piston nut must be installed after installation of the buffer bearing.

   b. The buffer seal (23) must be installed in the groove, with its notches facing the piston.

   c. The buffer sleeve (6) must be installed according to the illustration on the right.

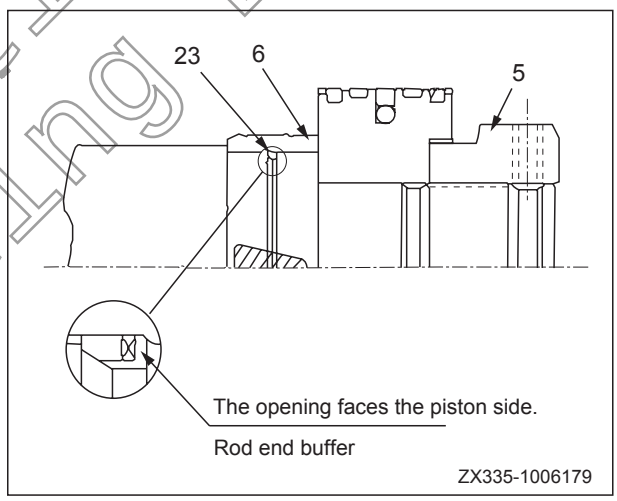


Fig. 8-190

E. Tighten the piston nut (5).

Piston nut (arm):

9600 Nm {979.6 kgm}

Piston nut (boom and bucket):

6200 Nm {632.6 kgm}

- Insufficient tightening can cause oil leakage, loose nut and thread breakage. In addition, excessive tightening can cause expansion of the buffer shaft on the extending side or deformation of

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piston on the contact side.

- Thoroughly clean and grease (with banana oil) the threaded portions of the piston, nuts and piston rod before tightening the nuts.

F. Treatment of the piston against loosening

- After the piston nut (5) is tightened, put in the steel ball (4), tighten the setscrew (3) and punch to rivet the two peripheral points.

Setscrew (3):

66.9 Nm {6.8 kgm}

5. Install the piston into the cylinder barrel.

A. Fix the barrel in a vertical or level manner.

B. Install the piston rod into the cylinder barrel.

- If fixed in a vertical manner, the piston rod falls into the barrel under its gravity.
- Make sure that the slide ring does not fall while the piston is inserted into the barrel.

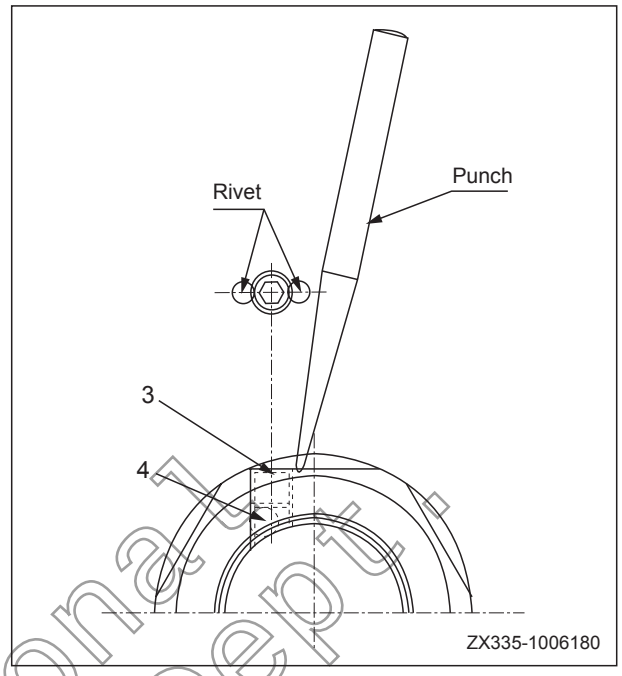


Fig. 8-191

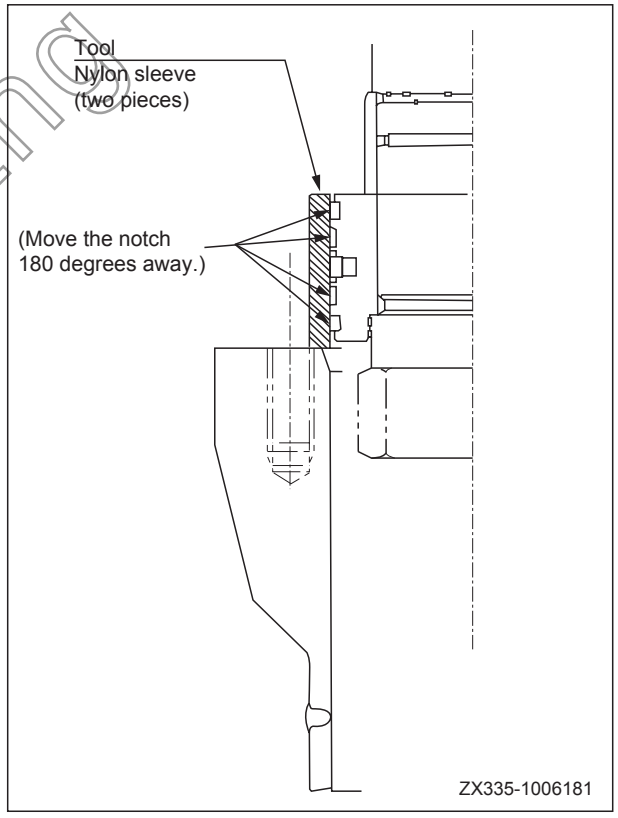


Fig. 8-192

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6. Tightening of cylinder head

   Tighten the bolts following the sequence shown in the illustration on the right.

   Bolt: 267 Nm {27.2 kgm}

7. Install the tubing.

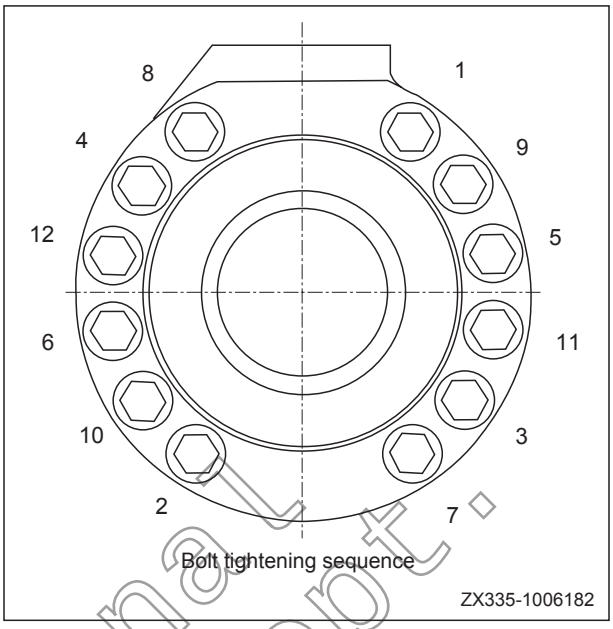


Fig. 8-193

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8.28 Work Equipment AS

8.28.1 Removal

Fully extend the arm and the bucket. Lower the work equipment to the ground. Move the hydraulic lockout control to the LOCK position.

Release remaining pressure in the hydraulic circuit. See **“Remaining Pressure in Hydraulic Lines - Relieve” on page 6-36**.

1. Disconnect the grease hose (1).
2. Lift the boom cylinder assembly (2). Remove the lockbolt (3).
3. Remove the plate (4) and then the pin roll (5). ※1
   - There are shims installed. Count the shims and check the thickness. Place the shims in a safe place.
4. Start the engine and retract the piston rod.
   - Secure the piston rod with a wire rope in order to prevent the piston from slipping out. Place the cylinder on a bench or support. The grease fitting on the bottom side must be removed in the later case.
   - Remove the other boom cylinder in the same way.
5. Remove the two hoses (6) of bucket cylinder and the two hoses (7) of the arm cylinder.
   - Cork the hoses to prevent outflow of oil. Tie the hoses to the valve side
6. Remove the mid-connector (8) used for work lamp.

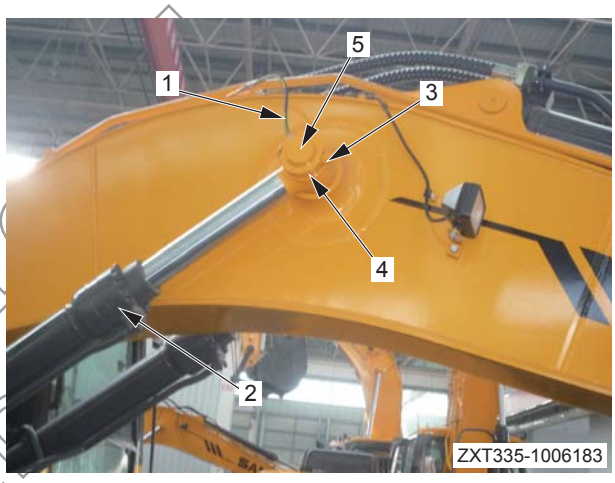


Fig. 8-194



Fig. 8-195

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7. Lift the work equipment and remove the plate (9). Remove the bottom pin roll (10).

   ※2

   There are shims installed. Count the shims and mark their locations.

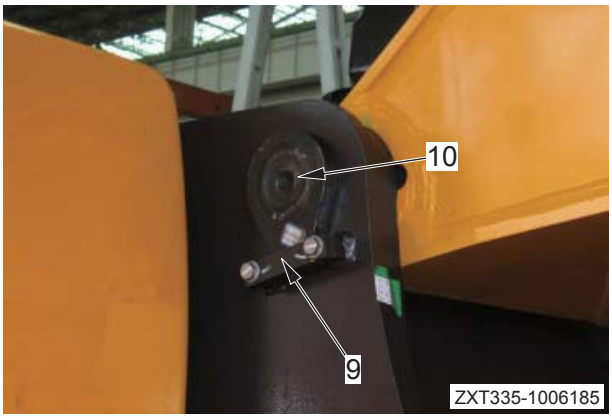


Fig. 8-196

8. Lift the work equipment assembly (11) in order to disassemble it.

   Work equipment assembly:

Model	Weight
SY365H-9	5,652 kg
SY365BH-9	7,102 kg



Fig. 8-197

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8.28.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

A clearance (a: 0.5 - 1.5 mm) should be left between the plate and the nut when tightening the locknut.

Greasing after assembling the pin:

Grease (MoS_2 G2-L1)

⚠ WARNING

- **Never use your finger to align the pin holes.**

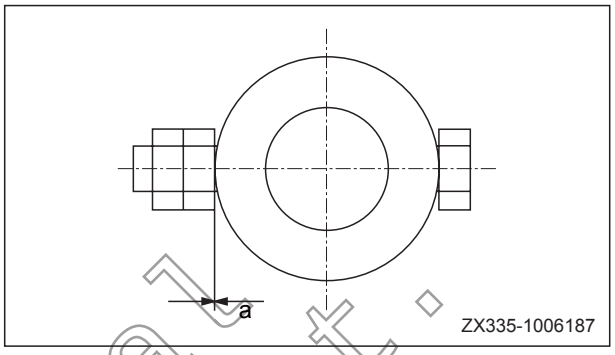


Fig. 8-198

- Adjust the shim thickness in order to have a desired clearance (a: 0.5 < a < 1 mm) between the piston end (12) and the plate (4).
- Standard shim thickness: 1.0 mm and 2.0 mm.

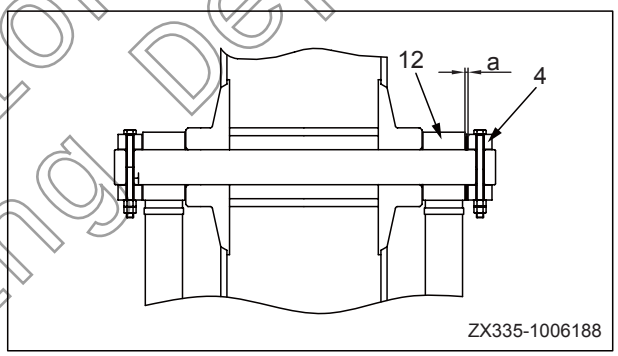


Fig. 8-199

※2

Greasing after assembling the pin:

Grease (MoS_2 G2-LI)

⚠ WARNING

- **Never use your finger to align the pin holes.**

- Refilling the hydraulic oil

  Refill hydraulic oil to the specified level. Start the engine to circulate the oil in the hydraulic system, and check the oil level again. Add more hydraulic oil if necessary.

- Purging the air

  Purge the air from travel motor. See **"Air in Each Component - Purge" on page 6-41.**

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8.29 Air Conditioner AS

Special tools

ID	Part Name	Model	Necessity	Qty
S	Refrigerant refiller	-	●	1

8.29.1 Removal

NOTICE

- **Always disconnect the cable from negative post of the battery before you proceed.**

1. Drain the coolant.

   Coolant: Approx 22.5 L

2. Recover refrigerant from the air-conditioning system with the tool (S).
3. Remove the pad on the bottom cover (1).



Fig. 8-200



Fig. 8-201

4. Use the start key to open the left rear cover of the cab. Remove the external air filter element (2).



Fig. 8-202

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5. Remove the monitor lower covers (3) and (4).

   Disconnect the wire (M19) of the cigar lighter before removing the cover (3).

6. Remove the air duct (5) on the right side.



Fig. 8-203

7. Remove the back cover (6).



Fig. 8-204

8. Remove the back air duct (7).
9. Remove the left air duct (8).
10. Remove the baffle (9).
11. Remove the right air duct (10).

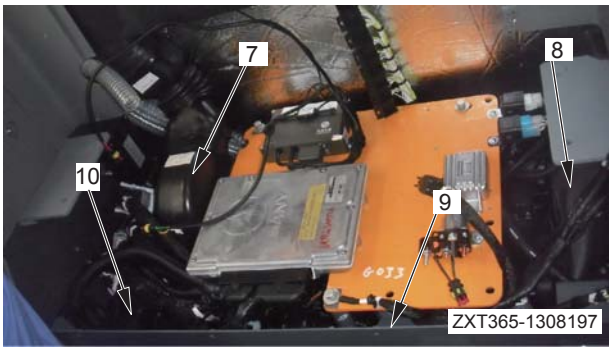


Fig. 8-205

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12. Remove the cover (11).
13. Remove the cab's center connector (12).
14. Remove the radio antenna(13).

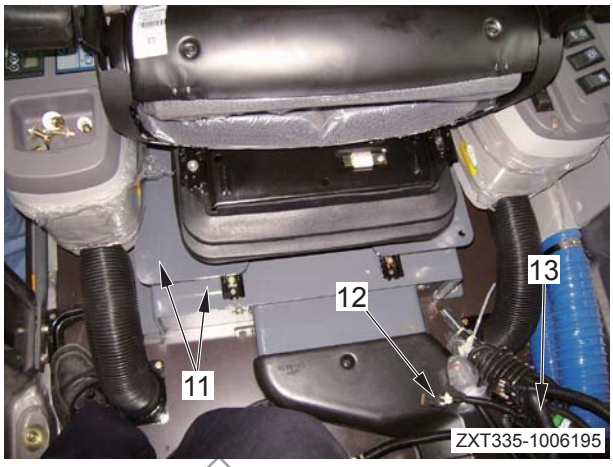


Fig. 8-206

15. Remove the air duct (14) and the controller wiring connector (15). Disconnect the wiring connector (16). Remove the air conditioner relay (17). Remove the three (3) mounting bolts (18) and then the board (19).

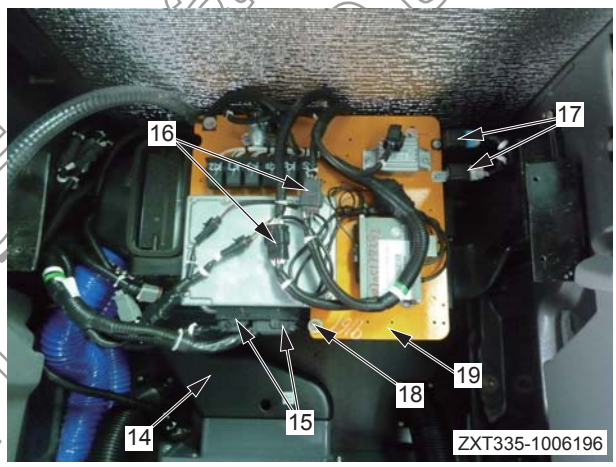


Fig. 8-207

16. Remove the air conditioner water pipes (20) and (21) as well as the dripping tube (22) under the bottom cover.

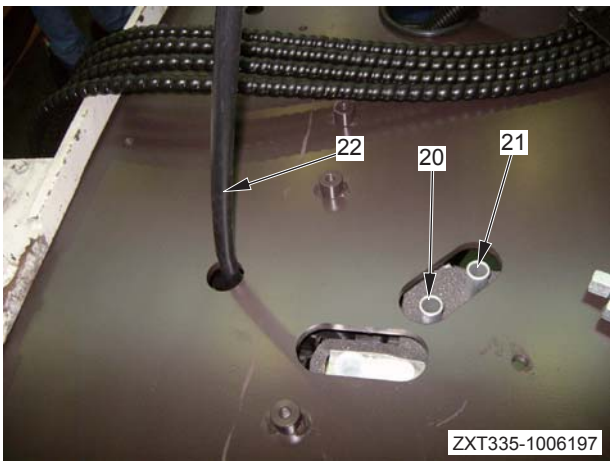


Fig. 8-208

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17. Remove the air conditioner unit (23).

    Also disconnect the two hoses connecting to the bottom of the air conditioner when removing the air conditioner unit.

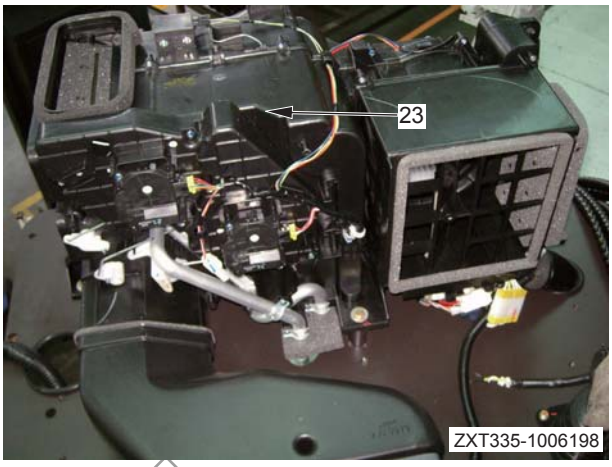


Fig. 8-209

8.29.2 Installation

- Installation is performed in the reverse procedure of removal.

  Keep the hoses free from contamination by dirt, dust or water while installing the return hose of the air conditioner.

  Make sure that the O-ring seal is present in the connection before connecting a hose of the air conditioner.

  Make sure that the O-ring seals are free from any damage or deformation.

※1

- Apply compressor oil (ND8#) to the threads of the parts connected with the refrigerant lines. Tighten the line connections with a double-end spanner.

  Screw (hose clamp):

  8.83~14.7 Nm {0.9~1.5 kgm}

  Bolt (pressure plate):

  13.5±1.2 Nm {1.38±0.12 kgm}

- Refilling refrigerant

  Refill refrigerant (HFC-134a) into the air conditioner circuit with the tool (S).

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8.30 Counterweight AS

8.30.1 Removal

1. Install lift pin (1) in lift eye of counterweight. Slowly tighten the wire rope (2) with lifting equipment to hold the counterweight.

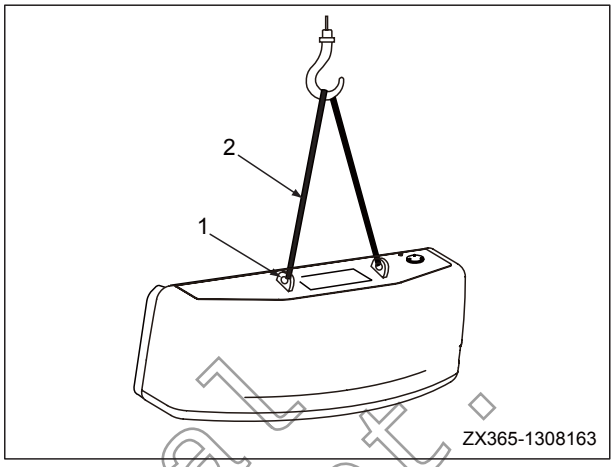
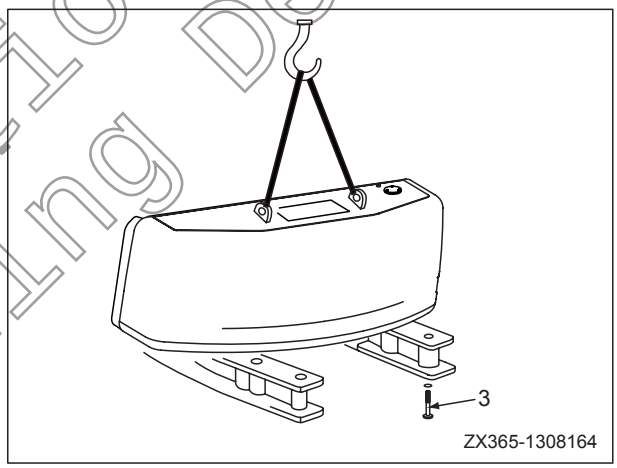


Fig. 8-210

2. Remove the four mounting bolts (2) and washers. ※1
3. Lift the counterweight with lifting equipment. ※2

   Take care not to damage the engine, radiator and cooler.

   Counterweight AS: 6800 kg



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8.30.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Threads (mounting bolt - counterweight):

Thread adhesive (Tianshan 1277)

Mounting bolt (counterweight):

2,295±200 N·m {214~255 kgf·m}

※2

- Counterweight Installation and adjustment

A. Lift the counterweight with a crane to a suitable position over the frame.

B. Push the counterweight and install the bolts. Adjustment is to be made according to the following specification.

- Clearance with swivel:

10±5 mm(L&R)

- Clearance with bodywork door:

10±5 mm(L&R)

- Step difference from swing frame in left to right direction

b: max. 5 mm

- Step difference from bodywork door in left to right direction

a: 10±4

- Step difference from bodywork top cover in upper to lower direction

c: max. 5 mm

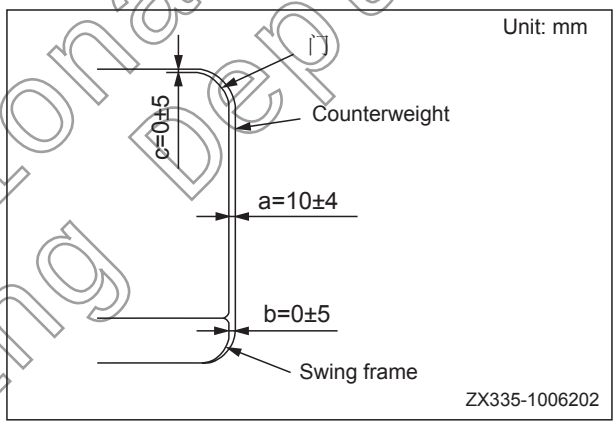


Fig. 8-211

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8.31 Cab AS

8.31.1 Removal

NOTICE

- **Always disconnect the cable from negative post of the battery before you proceed.**

1. Remove the floor mat (1).



Fig. 8-212

2. Remove the back covers (2) and (3).

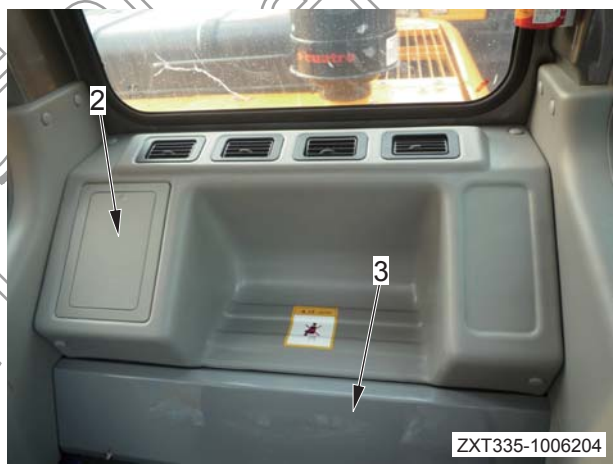


Fig. 8-213

3. Disconnect the left harness (4), the monitor harness connector (5) and the window washer harness (6).
4. Remove the right air duct (7).

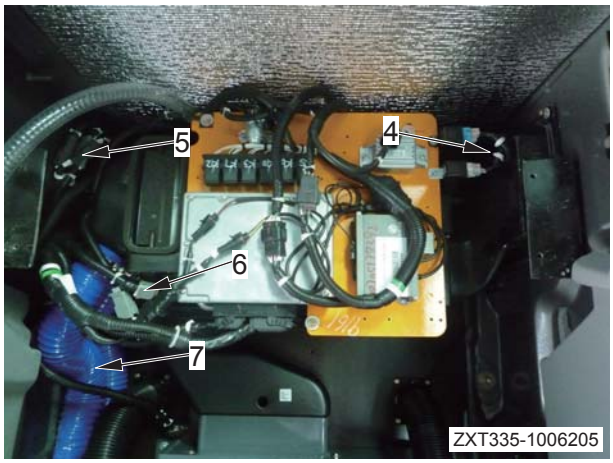


Fig. 8-214

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5. Remove the fresh air filter element (8).



Fig. 8-215

6. Remove the fresh air duct (9).



Fig. 8-216

7. Remove the storage box (10) of console.



Fig. 8-217

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8. Disconnect the radio connector (11).
9. Disconnect the radio harness (12).

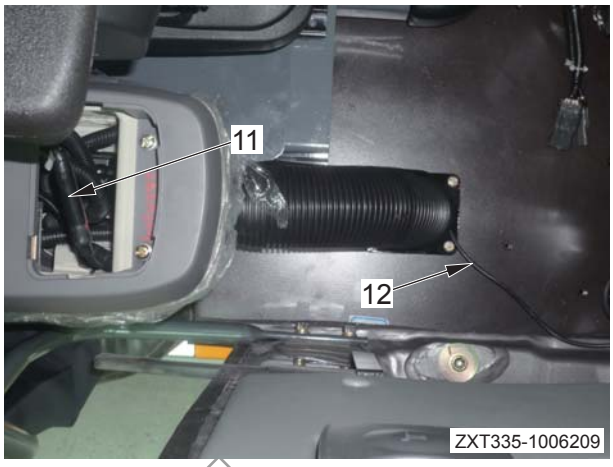


Fig. 8-218

10. Remove the window washer fluid reservoir (13).

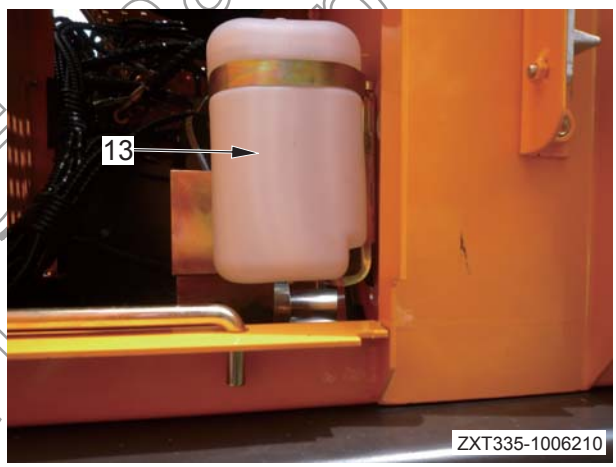


Fig. 8-219

11. Remove the window washer hose (14).



Fig. 8-220

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12. Remove the decorative cap (15).



Fig. 8-221

13. Remove the five (5) bolts (16) and the four(4) nuts (17). ※1
    - Check the length of bolt before removal.

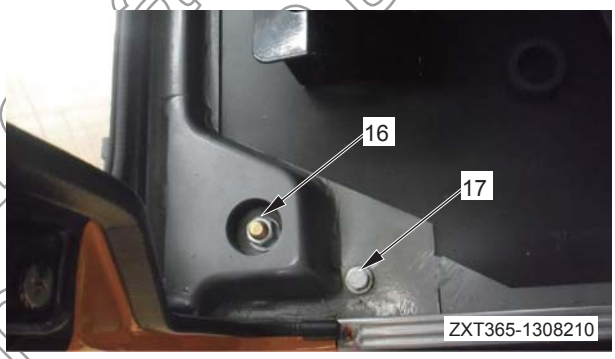


Fig. 8-222

14. Lift the cab assembly (18) in order to remove it.

    Cab AS: 105 kg



Fig. 8-223

8.31.2 Installation

- Installation is performed in the reverse procedure of removal.

※1

Bolt: 200 Nm {20.4 kgm}

Nut: 210 Nm {21.4 kgm}

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8.32 Cab Window Glass

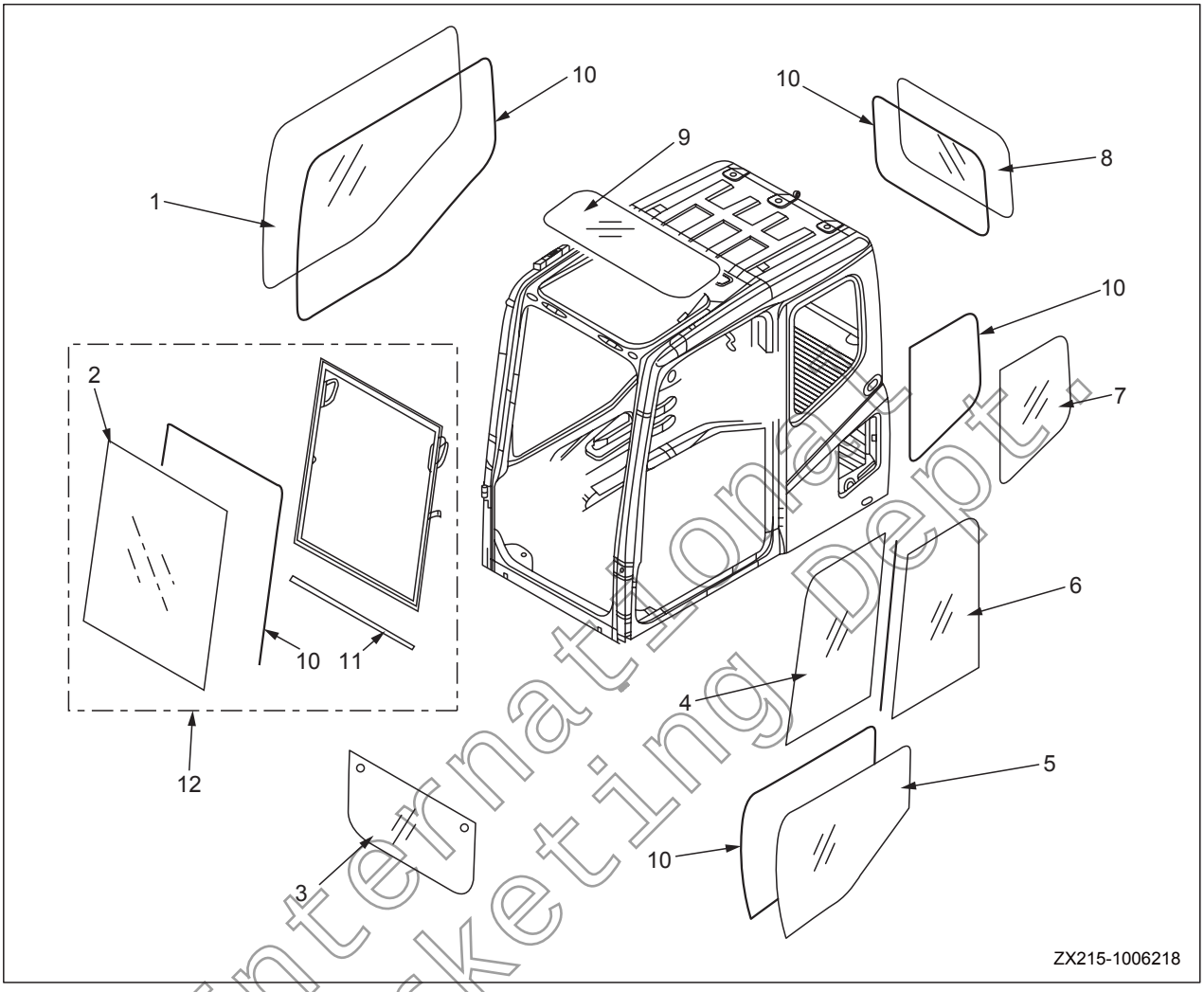


Fig. 8-224

(1) Right window glass
(2) Front window glass
(3) Lower front glass
(4) Cab door window glass (upper)
(5) Cab door window glass (lower)
(6) Cab door window glass (upper)
(7) Left side rear window glass
(8) Rear window glass
(9) Roof window glass
(10) Rubber sealing strip
(11) Center adjusting seal
(12) Front window assembly (Glass and frame)

- Cab window glasses (1), (2), (5), (7) and (9) are adhered to the window frame.
- When replacing front window glass (2), disassemble front window assembly (12). (If the cab is install with a front window assembly, do not only replace the front window glass.)
- For detailed information, See **"Front Window AS" on page 8-126.**

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8.32.1 Removal

⚠ CAUTION

- **Be careful with sharp edges that may cut your fingers when handling broken or cracked window glasses. Put a piece of adhesive film (or adhesive tapes) onto the broken or cracked window glass to prevent possible personal injury before you proceed. Remove all glass fragments.**

1. Removal of glass (3)

   Glass (3) is hold in place by sealing strips. Pull it upward carefully to remove it.

2. Removal of glass (4) and (6)

   A. Remove the sealing strip from the frame of the cab door.

   B. Push the glass outward carefully from inside of the cab and remove glass (4) and (6) together with the frame.

   C. Remove glass (4) and (6) from the frame with a screw driver.

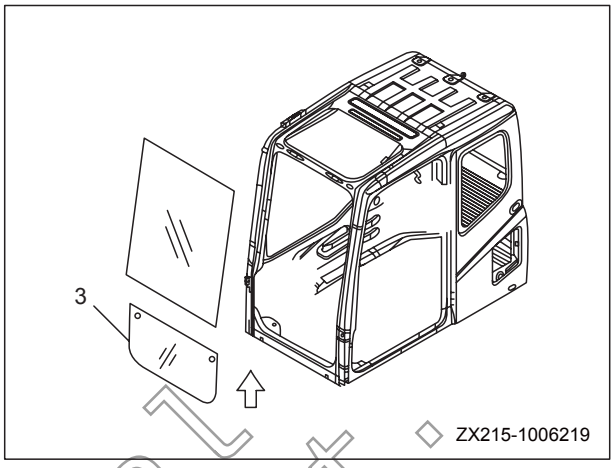


Fig. 8-225

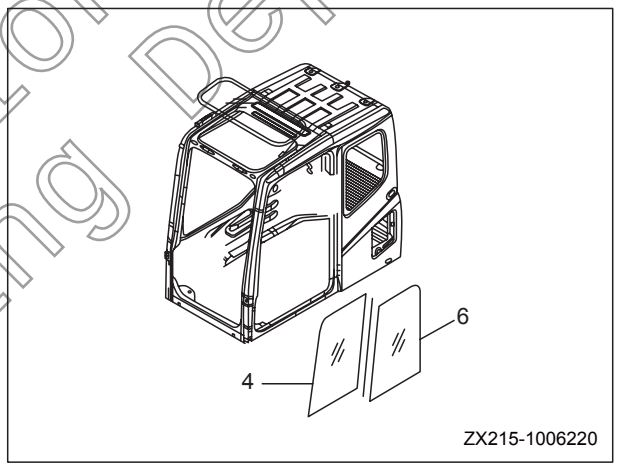


Fig. 8-226

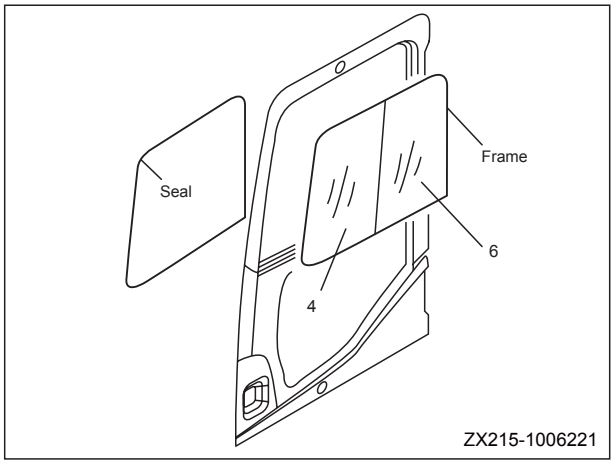


Fig. 8-227

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3. Removal of glass (8)

   A. Remove the retainer from the groove on the rubber with an ordinary screw driver.

   B. Put a thin bamboo chip inside part A of the retaining rubber and detach the retainer along the edge.

   C. Pat the glass from inside of the cab and remove it. This job requires two people.

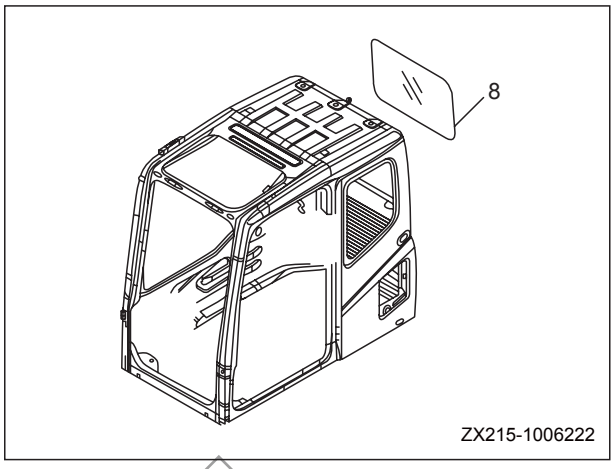


Fig. 8-228

4. Removal of glass (1), (2), (5), (7) and (9)

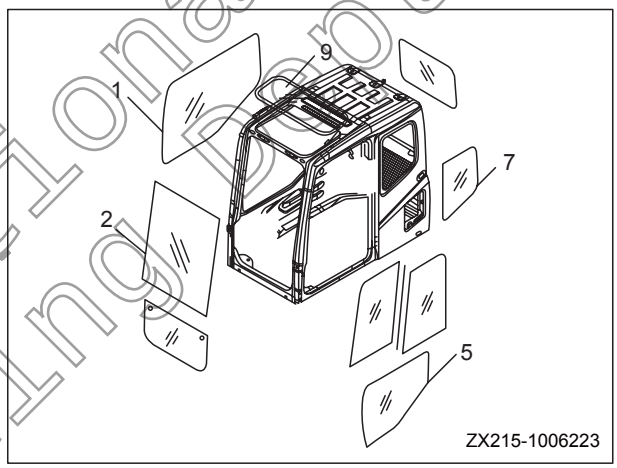


Fig. 8-229

   A. Remove the resin board, decor strip and retainer along the edge of the glass.

   B. Punch a hole through the adhesive with a drill (or a cutter) as illustrated.

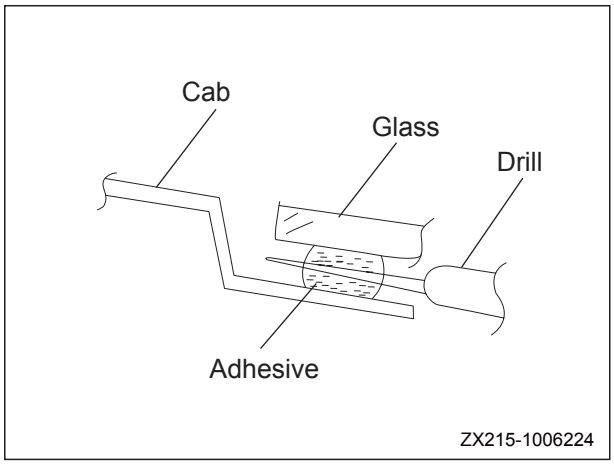


Fig. 8-230

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C. Pull a piece of piano string (or steel wire) through the hole as illustrated.

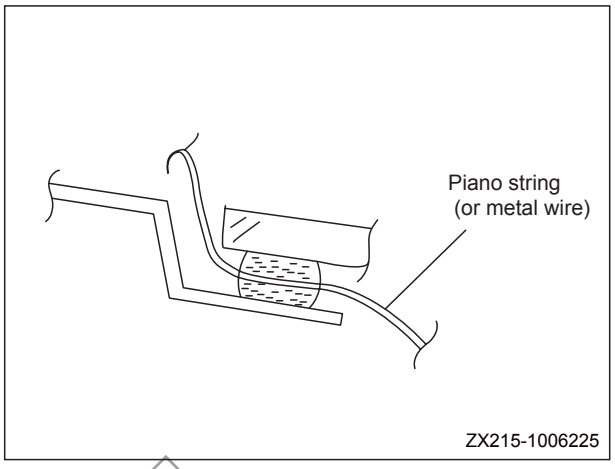


Fig. 8-231

D. Fix both ends of the piano string onto two screw drivers. Pull the wire back and forth in order to cut the adhesive and detach the glass from the cab. This job requires 2-3 people.

Run the string along the center of the adhesive. The string may break when it becomes very hot. Use different sections of the string while cutting the adhesive.

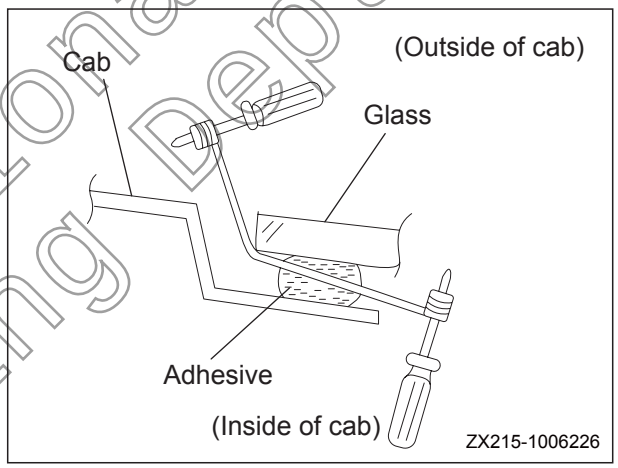


Fig. 8-232

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8.32.2 Installation

1. Clean the remaining adhesive and rubber on cab frame (contact surface) with a knife or scraper (5).
   - Remove the remaining adhesive and rubber so that they will not affect the application of new adhesive. Do not scrape the original paint on the surface. (Scraping of paint reduces the performance of the adhesive.)



Fig. 8-233

2. Clean the grease, dust and dirt on the cab (8) and the glass (9) with unleaded gasoline.
   - Contaminant on the contact surface reduces the performance of adhesive.
   - Clean the black part on the back of the glass.
   - After cleaning, dry the glass for at least 5 minutes.



Fig. 8-234



Fig. 8-235

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3. Priming coat (10)
   - Priming paint expires four (4) months after production. Do not use expired paint.
   - Use the paint within two (2) hours after it is unsealed.
   - Use the paint within 24 hours even if it is sealed again immediately unsealing. (Dispose the paint 24 hours after it is unsealed)

   A. Make sure the adhesive paint and glass priming paint are well agitated before application.
      - If the priming paint is stored in a refrigerator, keep it under ambient temperature for at least half a day before agitation.

        (If the paint is unsealed immediately after it is taken out of a refrigerator, water will condense on it.)

   B. Always wash a used brush (11) with unleaded gasoline before using it.
      - Check the brush for contaminants after it has been washed.
      - Prepare two brushes for priming paint, one for painted surface and the other for glass surface.

   C. Apply priming paint (for painted surface) evenly onto the surface where sealing rubber is to be adhered and where adhesive agent is to be applied (on the cab (8)).

      Priming paint (for painted surface): Sunrise MSI Primer 24
      - Do not apply primer more than twice; otherwise, the performance of the primer will be reduced.
      - Applying location: Cover the whole area of (a)
        - Dimension of (a): 25mm

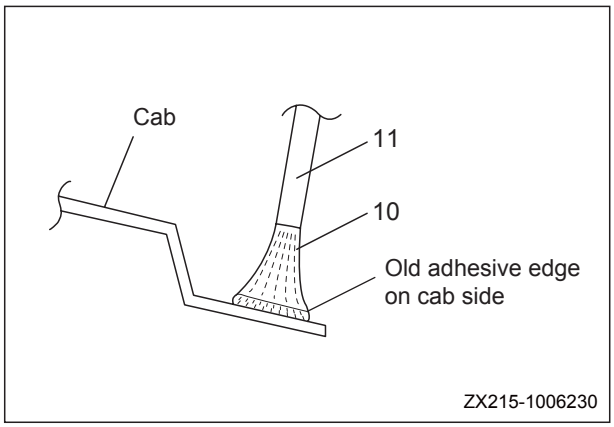


Fig. 8-236

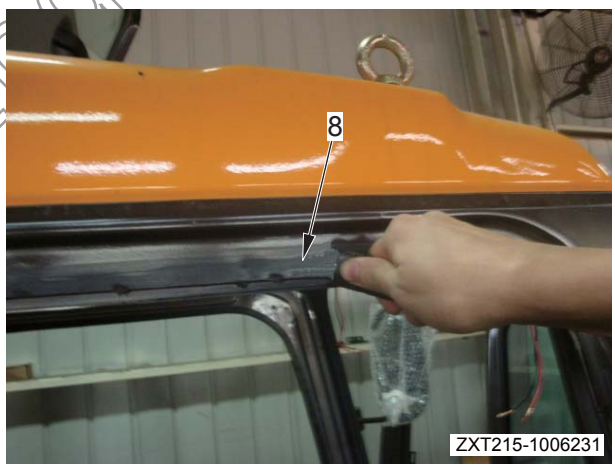


Fig. 8-237

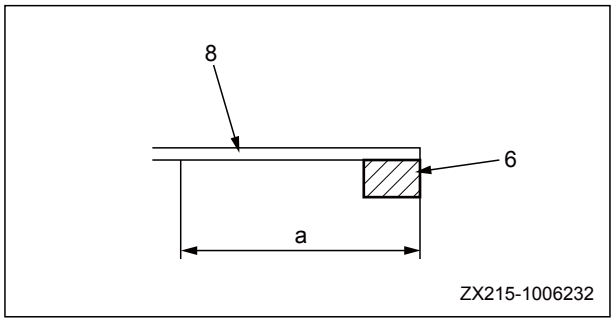


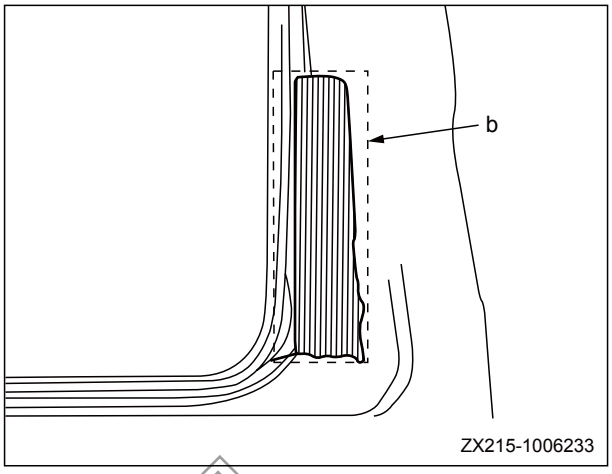
Fig. 8-238

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- Besides the above locations, apply primer also onto the right window glass and the cab door lower window glass.
  - Additional priming area on the right window glass: (b)
  - Additional priming area on the cab door lower window glass: (c)
- Dry the primer for at least 5 minutes (within 8 hours).
- Do not use wrong priming paint.

  If, for example, glass primer is mistakenly used, wash it with unleaded gasoline.



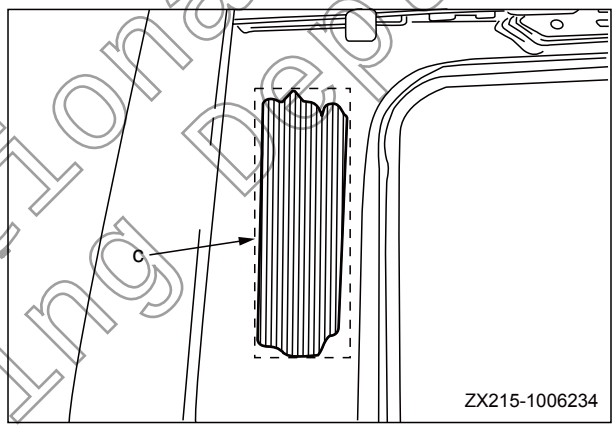


Fig. 8-239

D. Apply priming paint (for glass surface) onto the contact surface of window glass (9).

Glass primer:

Sunrise MSI Primer 35

- Do not apply the primer more than twice; otherwise, the performance of the primer will be reduced.

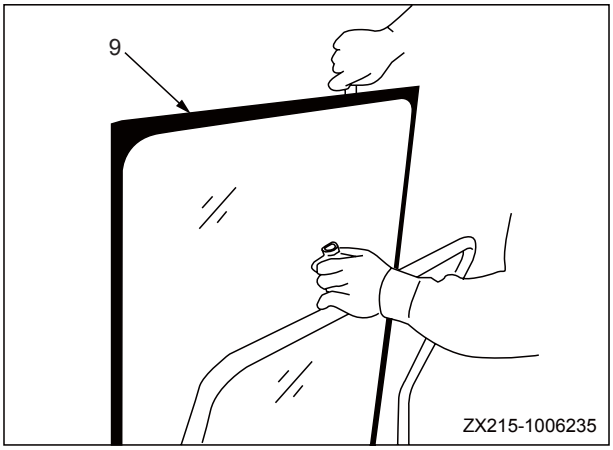


Fig. 8-240

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- Priming area: Apply the priming paint on the contact surface of glass (9) (rubber seal (6)adhering location) and along cab frame (8).
- Leave a 5 mm margin uncoated along the black strip adjacent to the clear area of the glass.
- When priming paint has been coated, dry it for at least 5 minutes (within 8 hours).
- Do not use wrong primer.

  If wrong glass primer is used, wash it with unleaded gasoline.

4. Adhere rubber seal (6) (with adhesive tape on both sides) along the inner edge of the contact surface of the glass.
   - Do not detach the waxed paper on the rubber seal before the window glass is installed.
   - Do not touch the cleaned area on the glass before rubber seal is adhered.
   - Be careful not to allow the rubber seal on the corners to peel off.
   - When sticking rubber seal (6) along the window frame, do not overlap the two ends of the seal. A 5 mm gap (e) between the two ends of the seal is recommended.

   A. Stick rubber seal (6) onto the right cab window frame as illustrated.

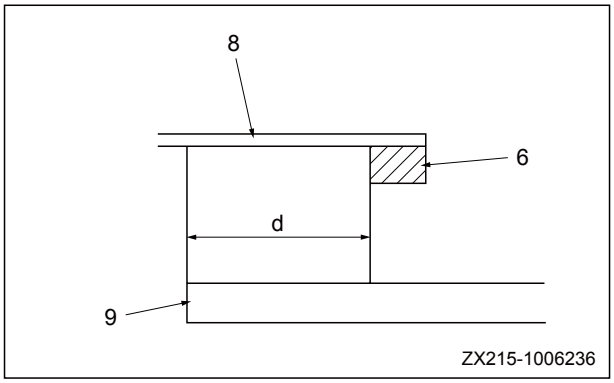


Fig. 8-241



Fig. 8-242



Fig. 8-243

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- Adhere additional rubber seal (6a) onto the right cab window

  Position of the additional rubber seal:

  (f): 50 mm

  (f): 90 mm

  (h): 250 mm

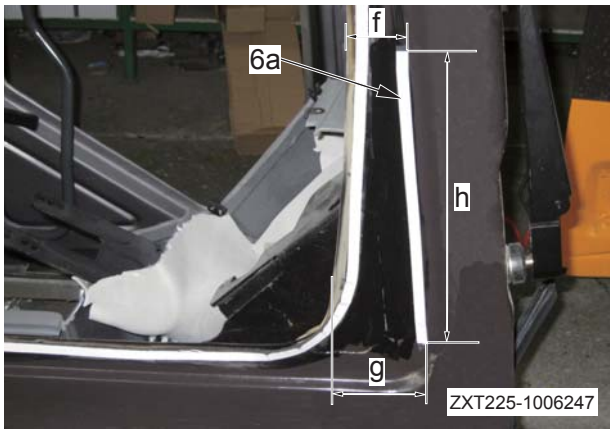


Fig. 8-244

B. Adhere rubber seal (6) on the left cab window as illustrated.



Fig. 8-245

C. Adhere rubber seal (6) onto the lower cab door window as illustrated.



Fig. 8-246

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- Adhere additional rubber seal (6b) onto the lower cab door window frame as illustrated.

  Position of additional rubber seal:

  (j): 110 mm

  (k): 90 mm

  (m): 200 mm

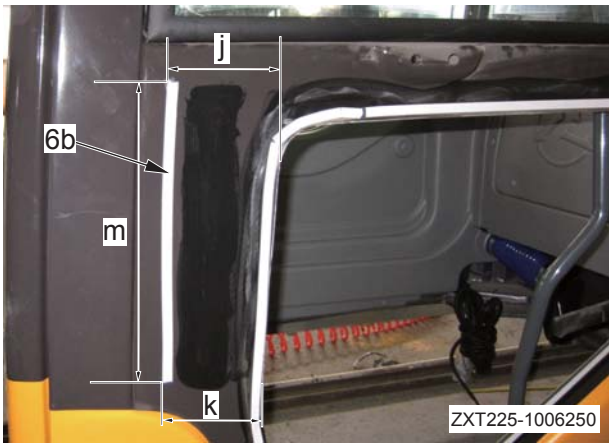


Fig. 8-247

D. Adhere rubber seal (6) onto the front window glass as illustrated.

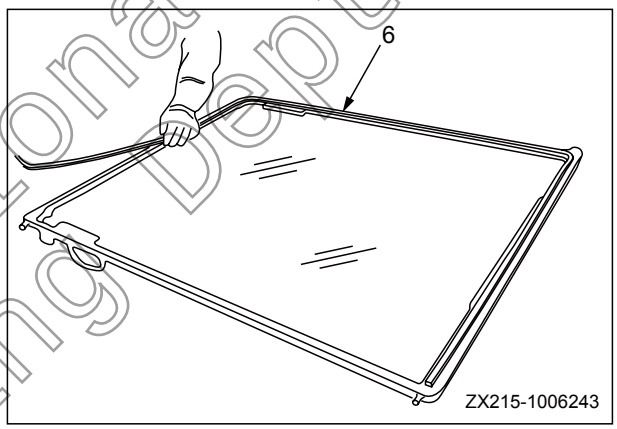


Fig. 8-248

- Different from the rubber seal (6) on other window, rubber seal (6c) on the bottom of the front window shall be adhered onto the external edge of the lower part of the front window frame. (If it is adhered along the inner edge, the rubber seal will be seen through the clear part of the glass.)

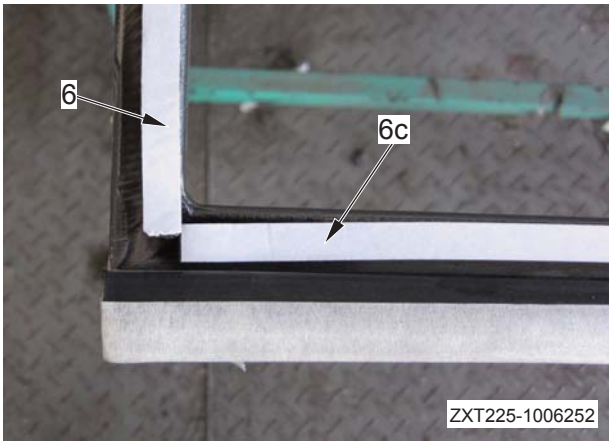


Fig. 8-249

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5. Positioning of new window glass

   A. Check the clearance between the edge of glass and the cab in 4 directions, and position the glass. Make sure the clearance is even.

   B. Put a tape [6] across the glass (9) and cab (8) and draw a line (n) on it for alignment.

      Adhere tape [6] at 3 points as illustrated for precise alignment of right window glass, left rear window glass and cab door lower window glass.

   C. Cut the tapes across the glass (9) and the cab (8) and remove the glass.

      - Do not remove the tape on the left side of the glass until the glass is installed.



Fig. 8-250

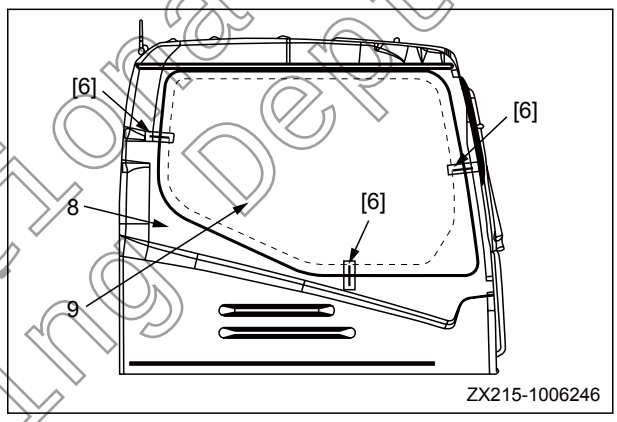


Fig. 8-251

      - When positioning front window glass (4), cover it across the width of the window frame in the horizontal direction.

        Set the clearance (p) between the top edge of the glass and the upper frame at 3 mm when positioning it in the vertical direction.

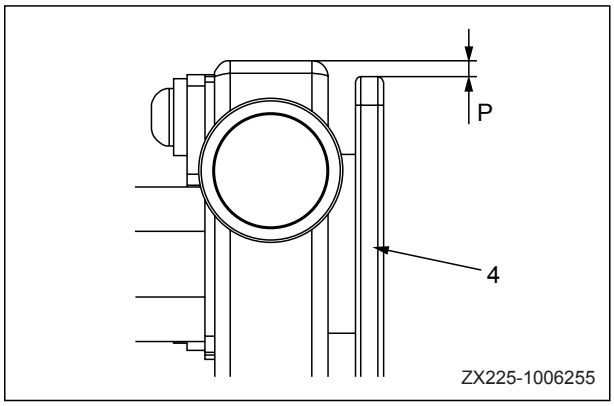


Fig. 8-252

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6. Adhesive

- Store adhesion agent in dark places where temperature is blow 25℃ .
- Do not heat the adhesive to above 30℃ .
- Before using adhesive that has been unsealed, remove the hardened part at the nozzle.

A. Open the aluminum seal (13) on the head of the cylinder (12) and install the nozzle.

Adhesive:

Sunrise MSI SR sealant U90 4463876

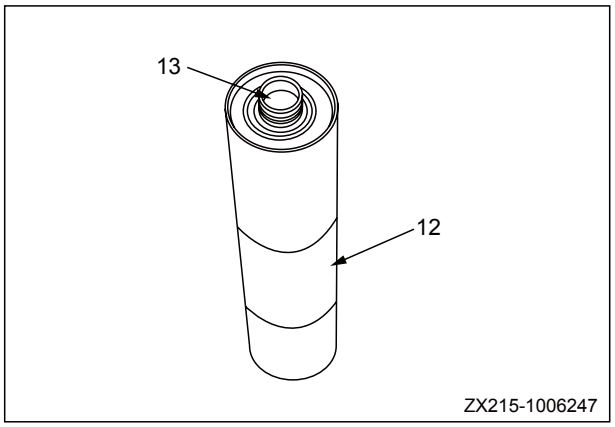


Fig. 8-253

B. Cut the tip of nozzle as illustrated. Dimension of the cut:

(q): 10 mm

(r): 5 mm

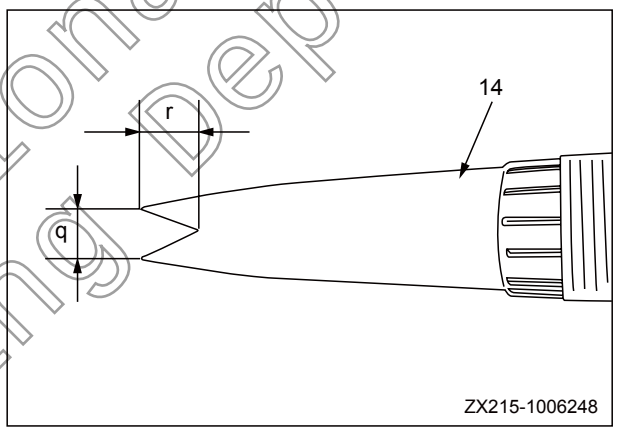


Fig. 8-254

C. Set the cylinder (12) in the gun [7].

An electrical caulking gun is more efficient.

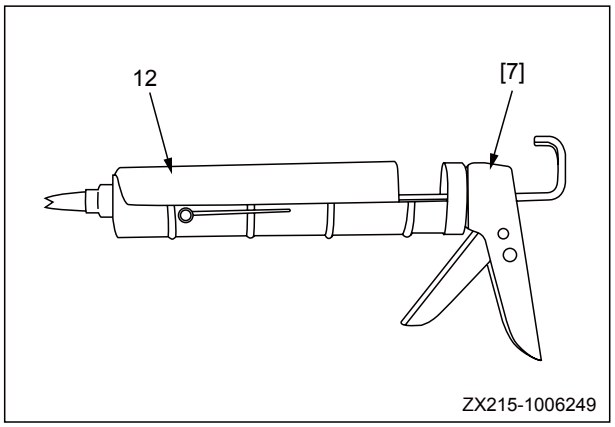


Fig. 8-255

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4) Remove the waxed paper of the rubber seal on the surface where adhesive is to be applied.

5) Apply adhesive (15) along the external edge of the rubber seal (6).

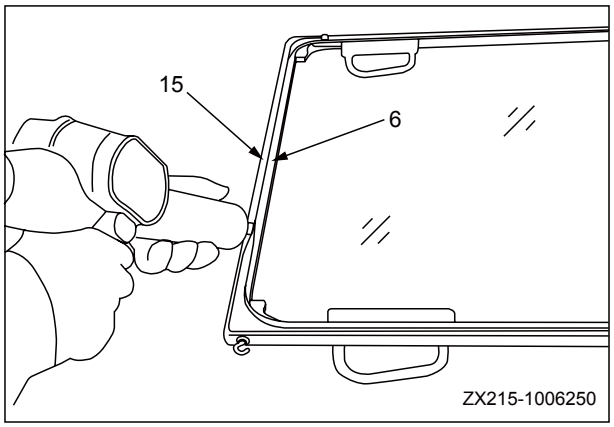


Fig. 8-256

- Adhesive (15) for rubber seal (6) on cab (8) shall be applied as illustrated:

  Dimension of (s): 10 mm

  Dimension of (t): 15 mm

- Adhesive (15) shall be thicker that the rubber seal (6).
- Apply adhesive of the same thickness evenly.

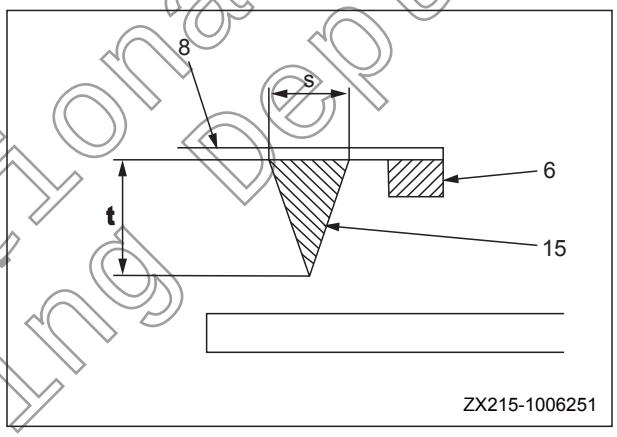


Fig. 8-257

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- Apply adhesive (15) onto the additional rubber seal of the right window (6a) and additional rubber seal of the cab door lower window (6b).

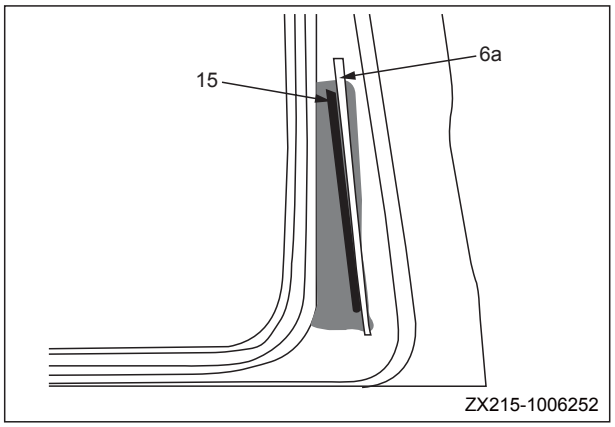


Fig. 8-258

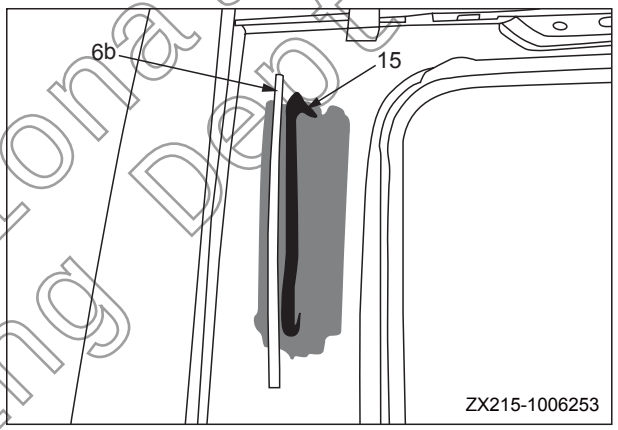


Fig. 8-259

7. Install window glass
   A. Install window glass (9) and align it with the mark on the cab. (See step 5)
   - Since the glass can not be remove once installed, be very careful when performing this task.
   - Install the glass properly within 5 minutes after adhesive has been applied.

   B. Press the perimeter of the glass (9) after is has been put in place until it is securely stuck to the rubber seal.
   - Press the corners of the glass hard.



Fig. 8-260

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- After the front window glass has been installed, fill the clearance between the glass on area (s) and the center adjusting seal (16) to the dimension of (t) and (u). Coat primer onto glass (4) on section A-A and apply the adhesive as fillers.
  - Dimension of (t): 2 mm
  - Dimension of (u): 5 mm
- Use a rubber spatula to cover the edge of the glass and trim the adhesive.
- Remove surplus adhesive.

Glass primer：

Sunrise MSI Primer 35

Adhesive：

Sunrise MSI SR Sealant U90 4463876

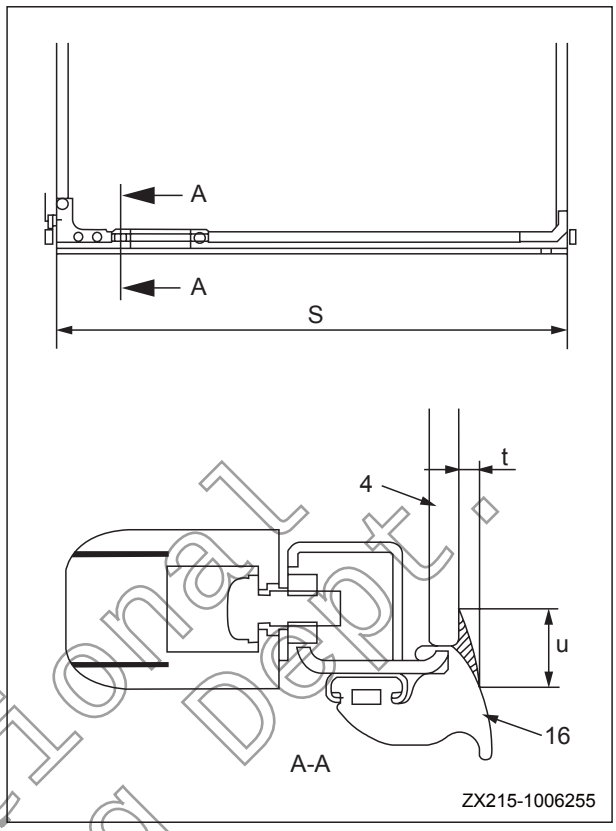
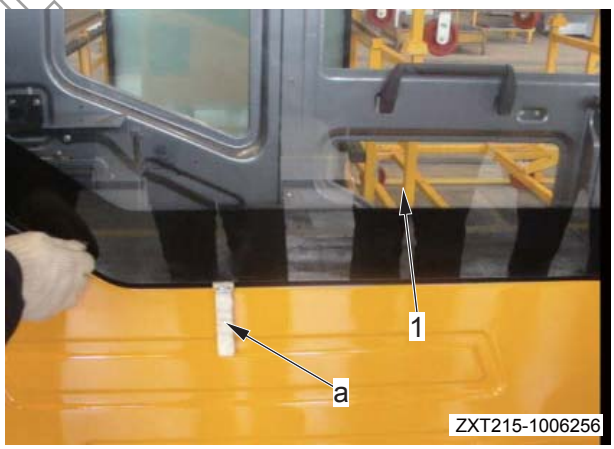


Fig. 8-261

8. Fix the glass

   A. After the right window glass (1) has been adhered to the cab, put positioning chips (a) (1 or 2 pcs) beneath the glass in order to fix it.



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B. Use foam polystyrene blocks [9] and rubber band [10] to fix the glass and the rubber seal as illustrated.

9. After the glass has been fixed, remove all the remaining primer and adhesive on the cab and on the glass.
   - Clean the adhesive with unleaded gasoline before it is hardened.
   - Do not apply impacting force onto the glass when cleaning it.
10. Protection of fixed window glass
    A. Remove the positioning chips, foam polystyrene blocks and the rubber band after 10 hours.

       (Condition: Temperature: 20; humidity: 60%)

    B. Wait for another 14 hours after the removal of positioning chips, foam polystyrene blocks and rubber band before operating the machine.

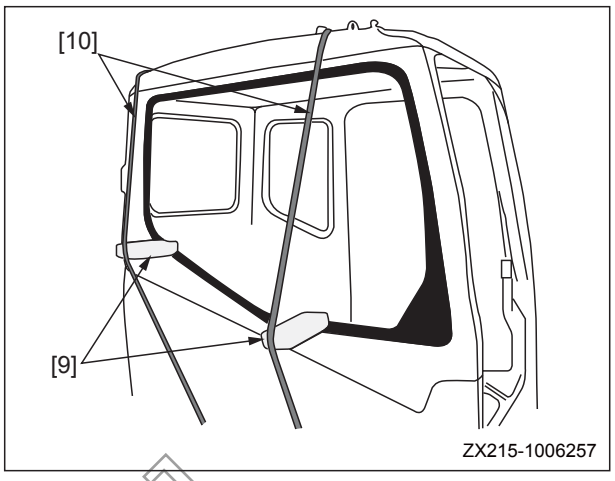


Fig. 8-262

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8.33 Front Window AS

Lower the work equipment onto the ground and shut down the engine.

- The front window assembly must be removed from the cab in order to replace the front window glass. Disassembling and assembling method of front window assembly (frame and glass) is illustrated in the following part.

8.33.1 Disassembly

1. Raise the front window assembly to the roof and secure it with the rear locks (at both sides).
2. Remove left corner plate (1) and right corner plate (2). ※1
   - Mounting bolt (4) and washer (3) of the left corner plate will be used in Step 6 to hang the pull rod.

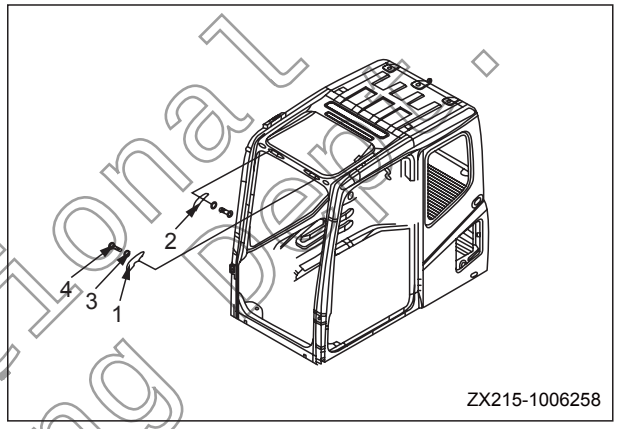


Fig. 8-263

3. Release the rear lock of the cab.
4. Lower the front window assembly carefully a bit. Take out and hold the rollers (5) and (6) at the bottom of the front window from the removed parts in Step 2.
5. Remove roller (5) and (6) from both sides of the bottom of the front window.

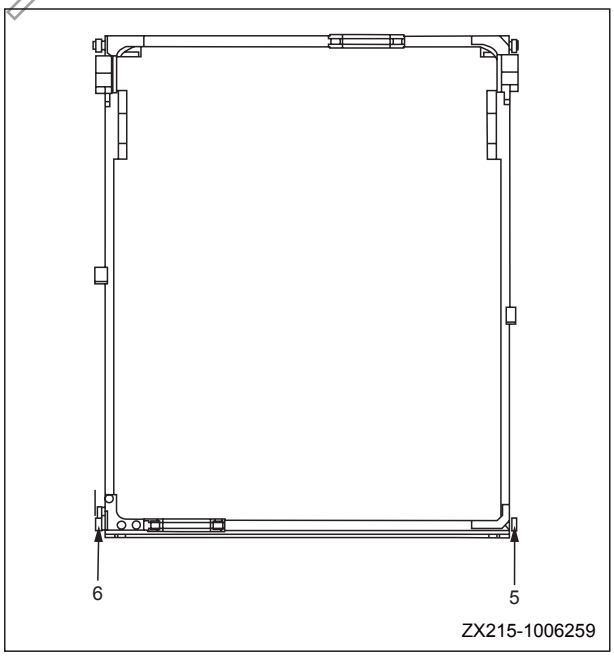


Fig. 8-264

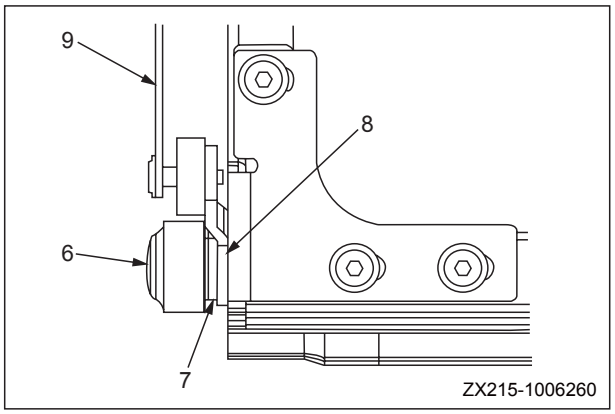
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6. Remove pin (7) at the lower left side. ※2
   - Plate (8) at the end of the pull rod (9) will come out by removing of pin (7).
   - Hang plate (8) onto the mounting bolt of left corner plate (using the washer) and fix it.

NOTICE

- **A return load of 58.8 N {6 kg}is applied onto the rear of the cab. Be very careful when removing pin (7) to disconnect pull rod (9).**



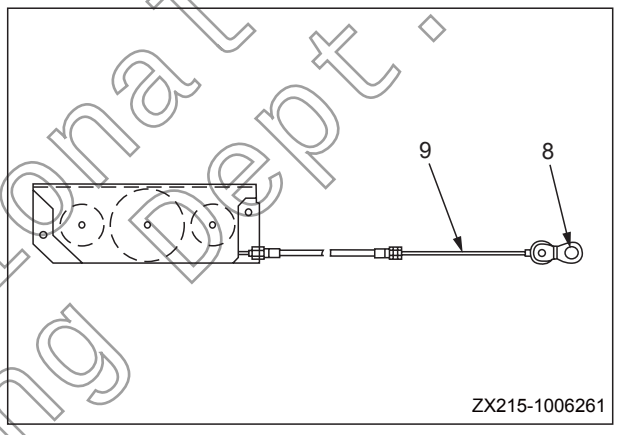


Fig. 8-265

7. Pull out the front window assembly (10) from the opened part of the guide rail and lower the assembly gradually.

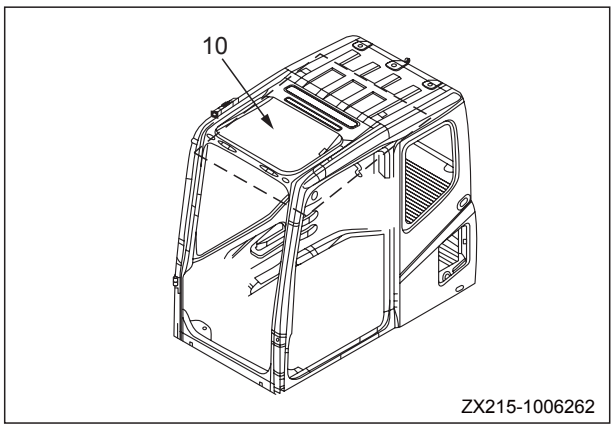


Fig. 8-266

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8. Lower the front window assembly (10) completely.
   - Be careful not to allow the front window assembly to damage the machine monitor.

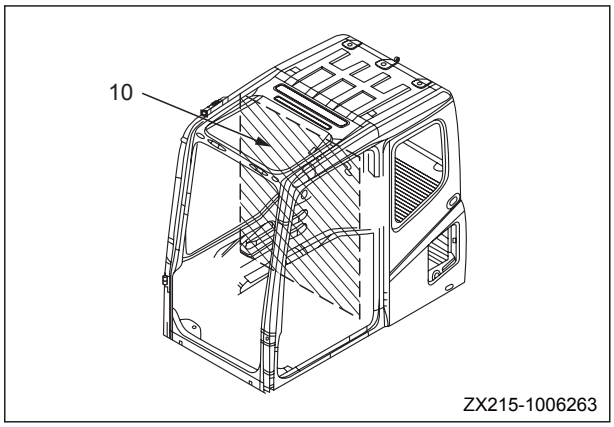


Fig. 8-267

9. Move the front window assembly (10) to the right and the left and remove the two upper rollers (11) and (12) from the guide rail. Then, remove the front window assembly (10).

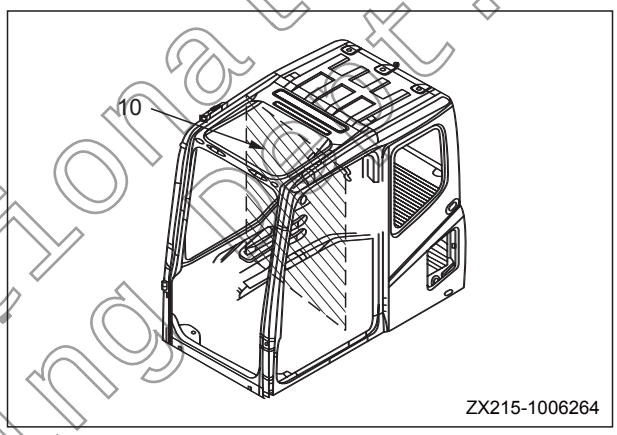


Fig. 8-268

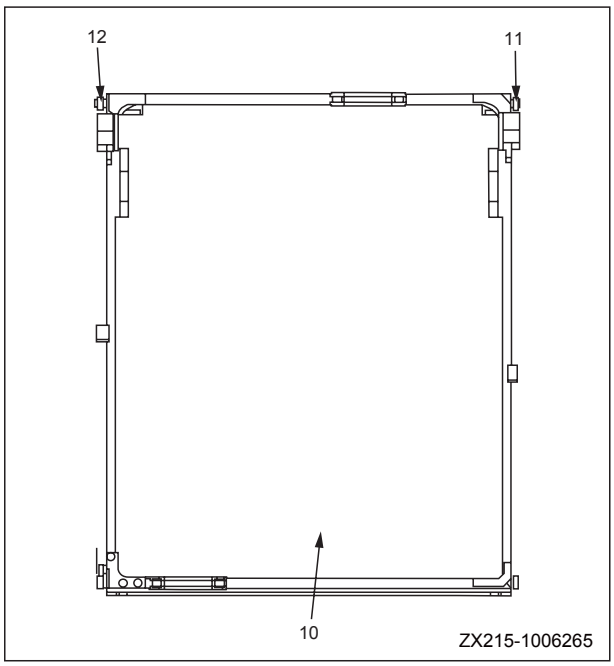


Fig. 8-269

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8.33.2 Assembly

- Reverse the disassembling sequence.

※1

- Adjust the opening and closing of the front window assembly as per the following instruction.

1. Open and close the front window assembly and check if it interferes with the guide rail. Check if the roller is jammed.
2. If the front window can not be opened or closed properly, loosen the mounting bolt of the roller adjusting bracket (13) and adjust the condition of the front window. Tighten the mounting bolt after adjusting.
   - Make sure bracket (13) is installed without an angle.

   Mounting bolt：34.3 N·m {3.5 kgf·m}
3. Raise the front window assemble and fix it with rear locks (at both sides).
   - Check if the locks at the rear of the cab are securely fixed.
4. Install the right corner plate (2).
   - After the "locked" position is adjusted in Step 6, tighten the corner plate.
   - Install the right corner plate. Clearance (a) between the guide rail and the right corner plate (2) is 0 – 2.0 mm.
   - Install the right corner plate. Keep the surface (R) of the roller without a level error.

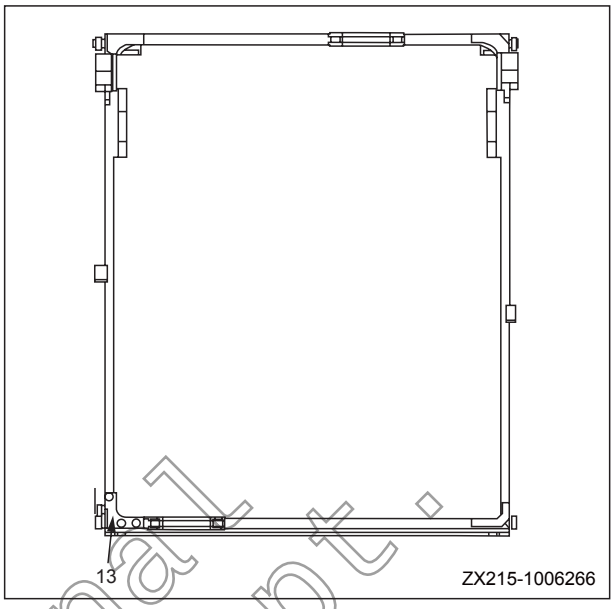


Fig. 8-270

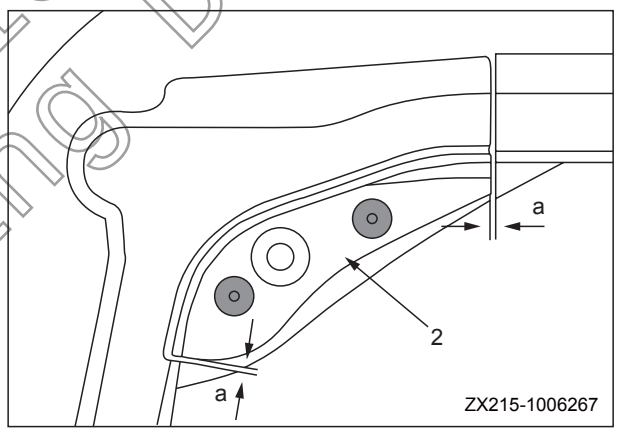


Fig. 8-271

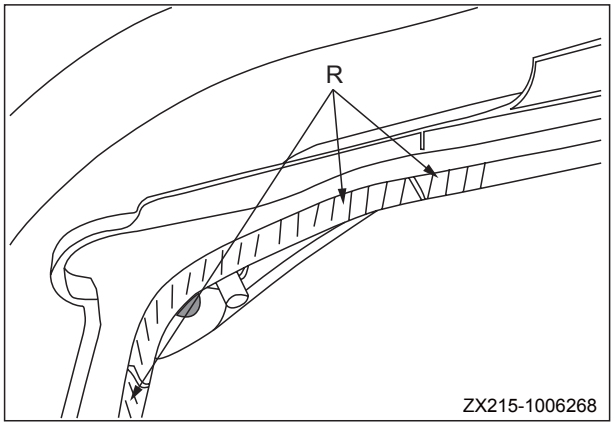


Fig. 8-272

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5. Install left corner plate (1)
   - After the "locked" position is adjusted in Step 6, tighten the corner plate.
   - Install left corner plate. Clearance (b) between the guide rail and the left corner plate (1) is 0 – 2.0 mm.
   - Install left corner plate and keep the surface (R) of the roller without a level error. (See the previous illustration).

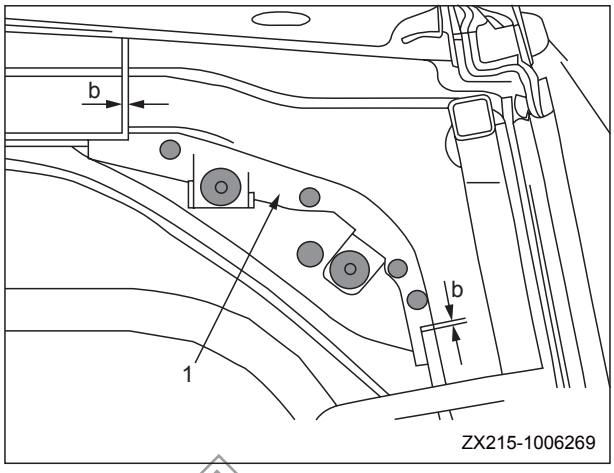


Fig. 8-273

6. Adjust the "locked" position of the lock of front window assembly as per the following instruction.
   A. Tighten the left corner plate (1) and the right corner plate (2) in a nearly correct position so that front window glass (14) is pressed closely against the adjusting seal (19) on the cab.

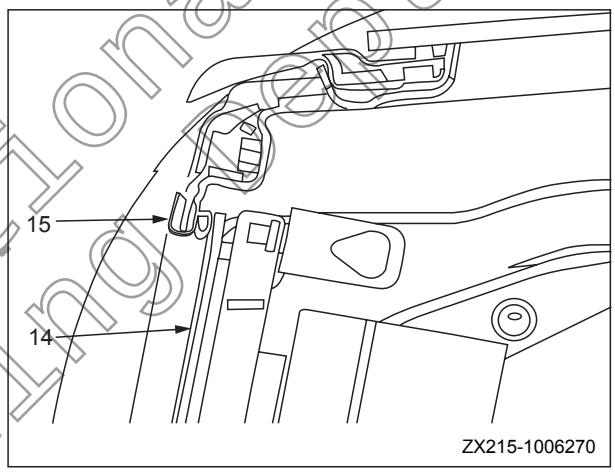


Fig. 8-274

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B. Open and close the front window assembly and check the working condition of left lock (16) and right lock (17).

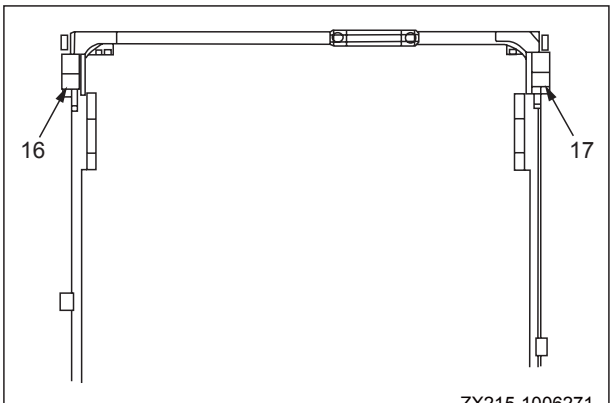
- If left lock (16) and right lock (17) do not work properly,

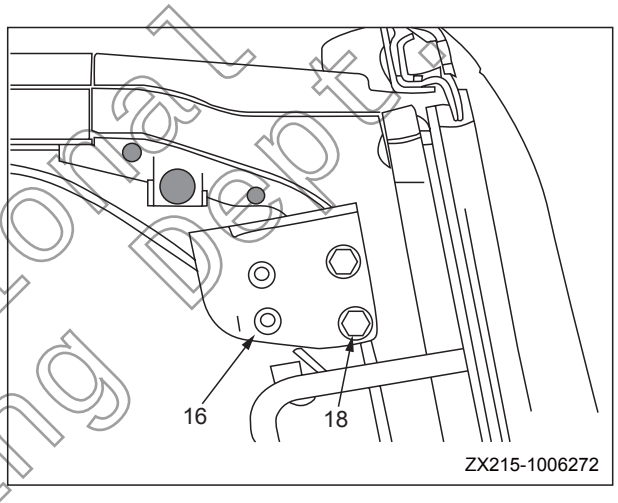
a. Loosen the mounting bolt (18) of the lock and move the lock (16) forward. Tighten the bolt after that.

Adjust the right lock with the same method.

b. Check again the adaptability between the front window assembly (14) and the adjusting seal (15) on the cab. (Checked in Step 1)

Repeat Step a) and Step b) until the condition of front window glass and lock (16) and (17) is satisfactory. Tighten the mounting bolts of the left and right corner plates.





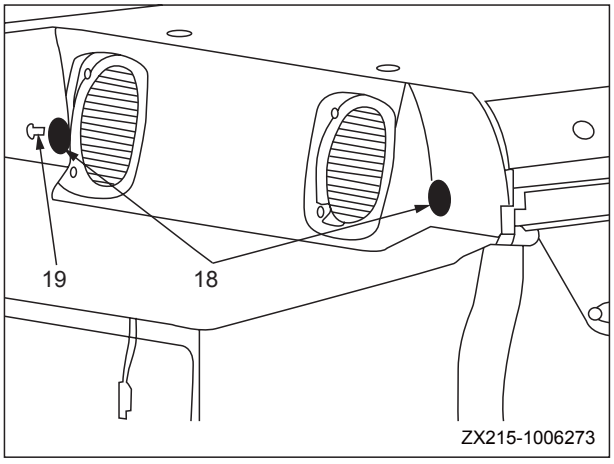
7. After adjustment is finished, flush the front window glass with abundant water and check if any water penetrates into the cab.

8. Adjust the "locked" position of the lock of front window assembly

A. After the "locked" position of the lock of front window assembly is adjusted in Step 6 and Step 7, raise the assembly to the roof.

B. Set the locks of the front window assembly at the rear of the cab at the "locked" position, and check the following items:

- Check the conditions of left lock (16) and right lock (17).
- The front window assembly must contact the left and right rubber stopper (18), and the rubber stoppers must be pushed backward by 1.5 – 3.0 mm.
- The front window assembly shall push the limit switch 4 – 7mm backward.



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C. Close the front window assembly (10).

D. Loosen the retaining nut (20) at the left and right side of rubber stopper (18), and pull the two rubber stoppers (18) inward so that they can not contact the "unlocked" front window assembly.

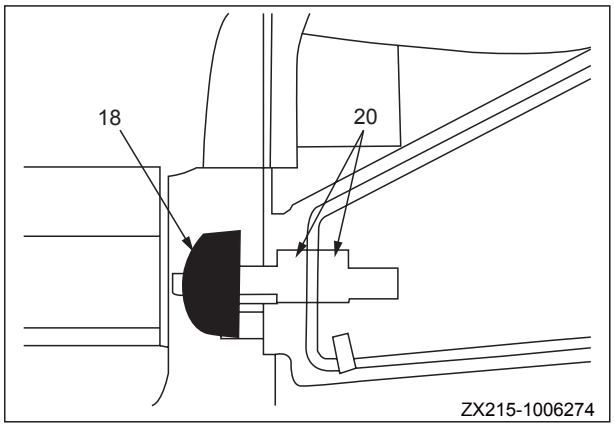


Fig. 8-275

E. Adjust the position of latch bolt (21).

Latch bolt(21): M10, Inner diameter of plate (23): ø14.5 mm

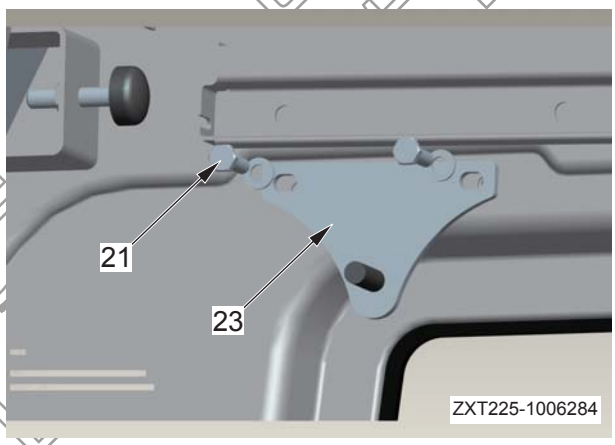


Fig. 8-276

F. Adjustment of left and right rubber stopper (18)

a. Allow front window assembly (10) to contact the left and right rubber stopper (18). (when the lock is "unlocked")

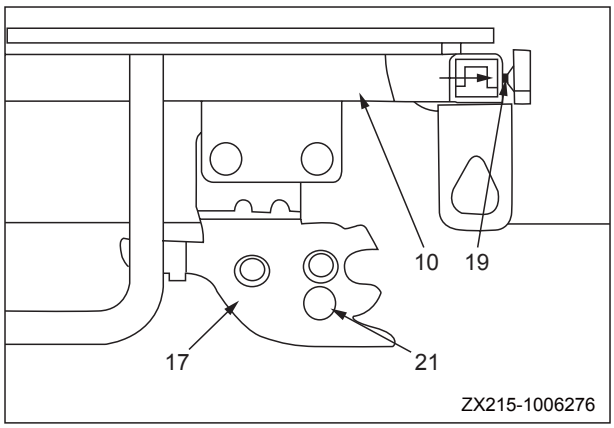


Fig. 8-277

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b. Lock front window assembly (10).

c. Turn the left/right rubber stopper (18) to the left by one and a half round.

- Turning the rubber stopper (18) leftward for one round is equivalent to pressing it by 1.5 mm.
- When front window assembly is “unlocked”, it must move the left/right rubber stopper (18) by 1.5 – 3.0 mm.

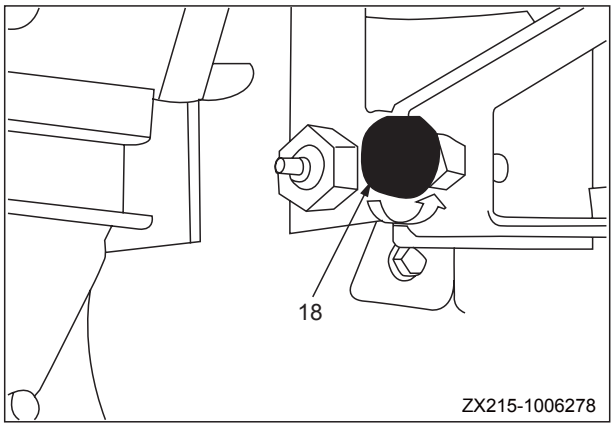


Fig. 8-278

d. Tighten the retaining nuts (20) at both sides of the rubber stopper (18).

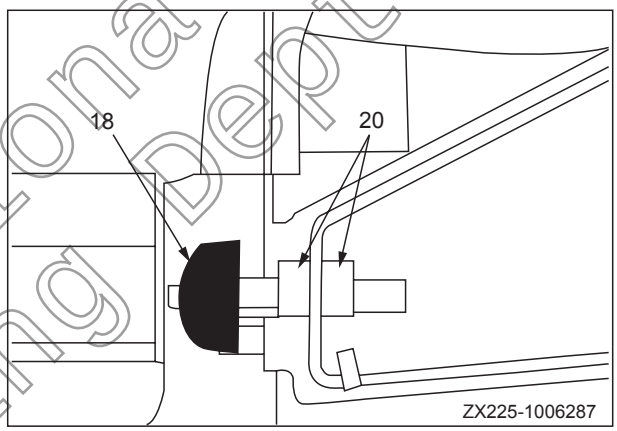


Fig. 8-279

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9. Adjust the front window assembly retainer (24).

   A. Adjust and lock both sides of the retainer (24) so that surface (d) of stopper (D) of front window assembly contacts surface (c) of retainer (24) when front window assembly is raised.

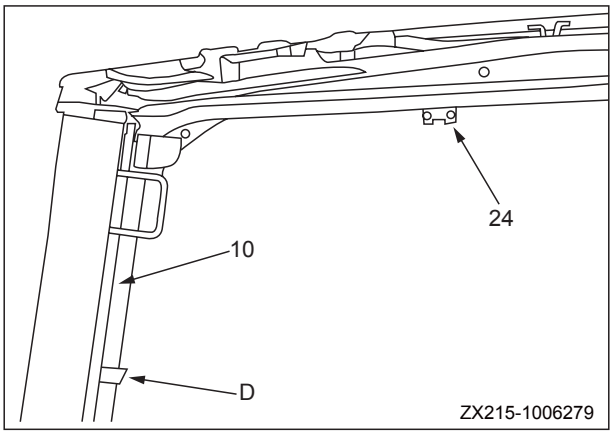


Fig. 8-280

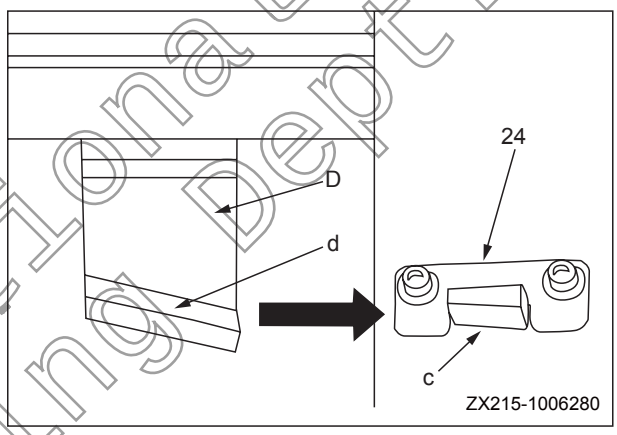


Fig. 8-281

10. Check the locking ability of front window assembly.

   A. After the adjustment from Step 6 to Step 9 is finished, check the locking force of left lock (16) and right lock (17).

   - Check the locking force at the "locked" side (front of cab) and the "unlocked" side (rear of cab).

※2

Left lower pin:

27 – 34 N·m {2.75 – 3.47 kgf·m}

Mounting bolt：adhesive(LT-2)

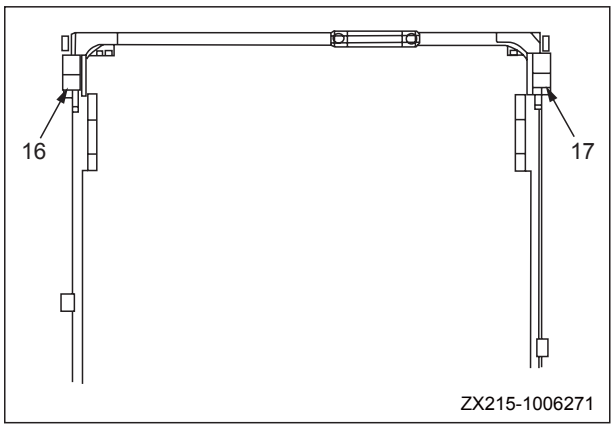


Fig. 8-282

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8.34 Monitor - Remove and Install

8.34.1 Removal

NOTICE

- **Always disconnect the cable from negative post of the battery before you proceed.**

1. Unscrew the three (3) bolts (4). Remove the mounting plate and the monitor assembly from the bracket (3).
2. Remove the nut (1) and the gasket (2) to separate the monitor (5) from the mounting plate.

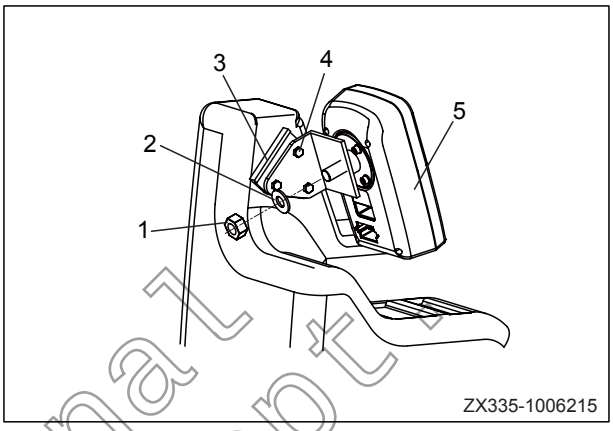


Fig. 8-283

8.34.2 Installation

- Installation is to be performed in the reverse order of removal.

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8.35 Controller AS

8.35.1 Removal

NOTICE

- **Always disconnect the cable from negative post of the battery before you proceed.**

1. Remove the back plates (1) and (2).
2. Remove the controller wiring connectors (3) and (4).
3. Remove the two(2) bolts. Remove the controller assembly (5).



Fig. 8-284

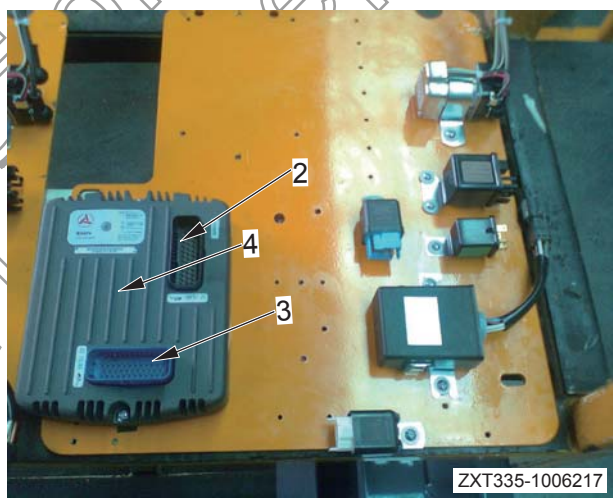


Fig. 8-285

8.35.2 Installation

- Installation is to be performed in the reverse order of removal.

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8.36 Radio

8.36.1 Structure

1. Main structure

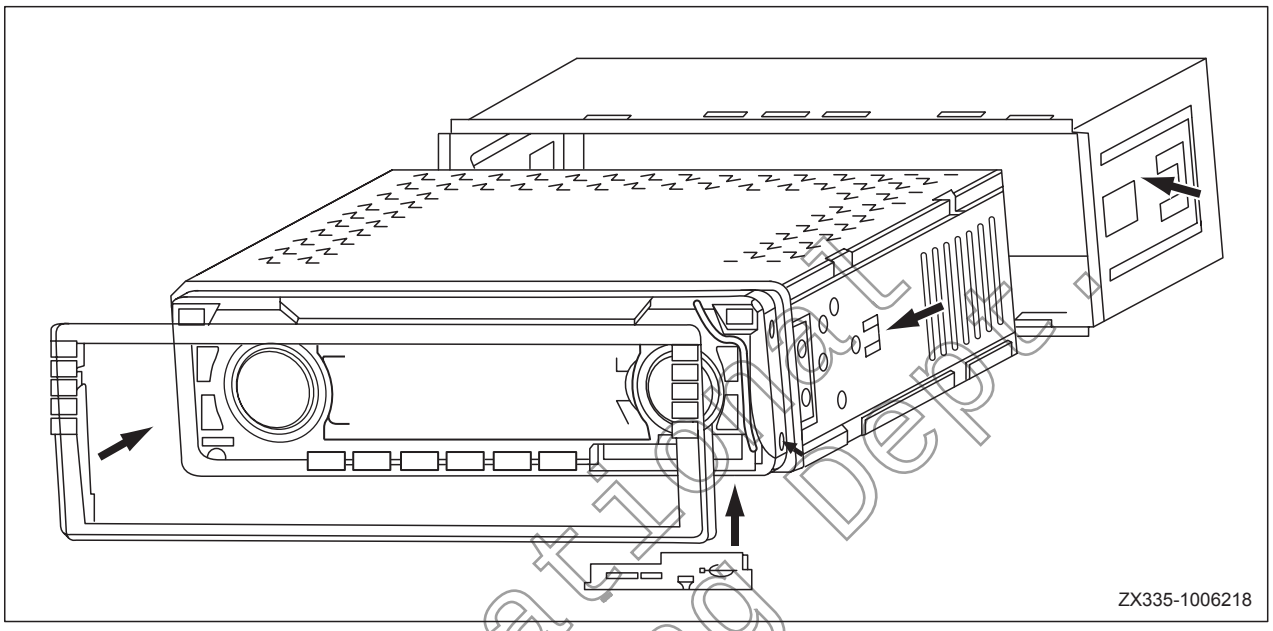


Fig. 8-286

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2. Wiring

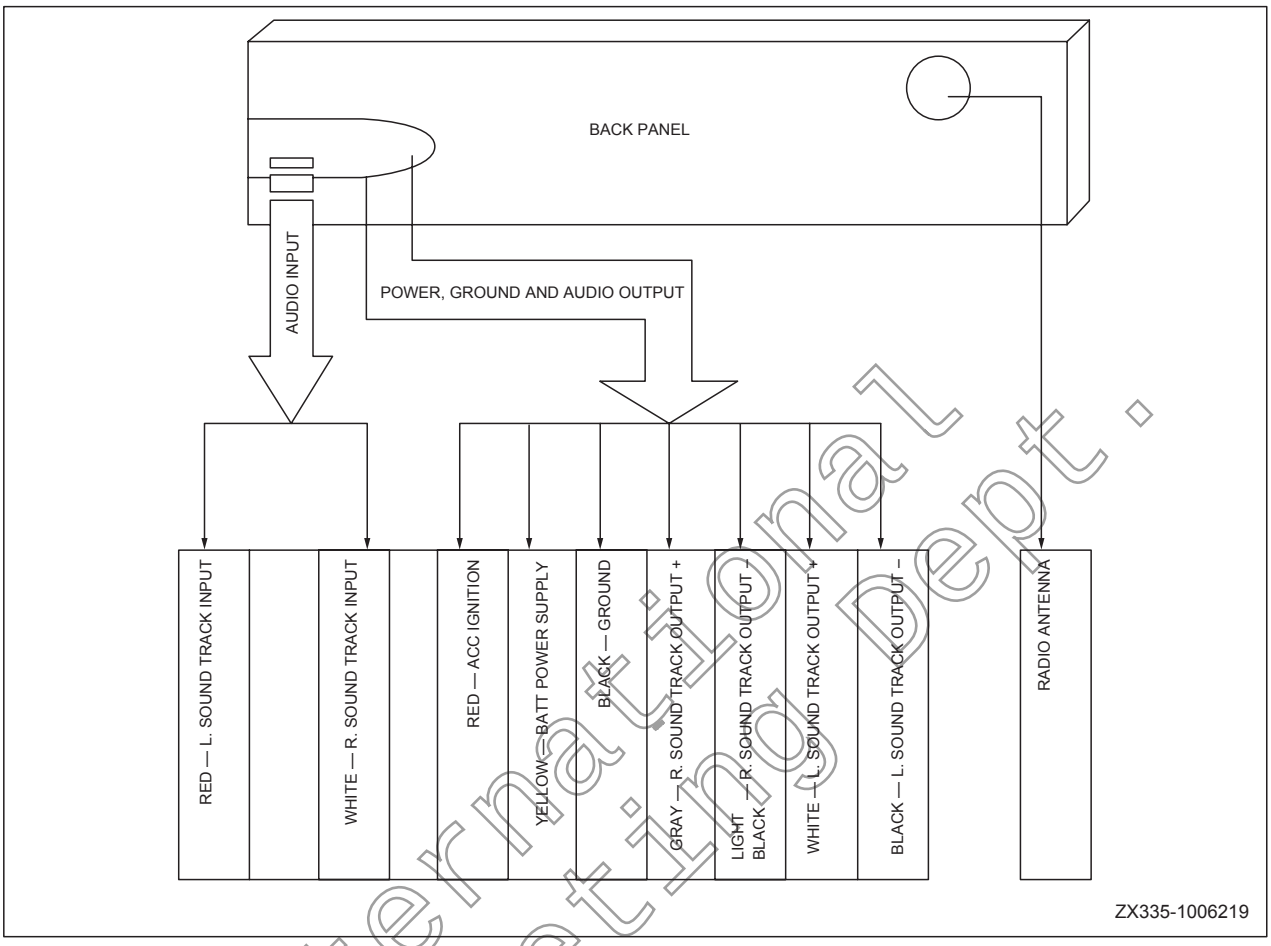


Fig. 8-287

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8.36.2 Removal and installation

Removal

1. Remove the console cover (1).

NOTICE

- **The power must be turned off before removal.**

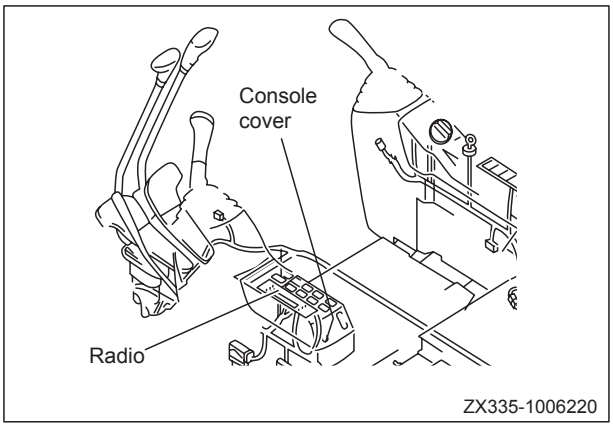


Fig. 8-288

2. Remove the radio connector CN-003F.

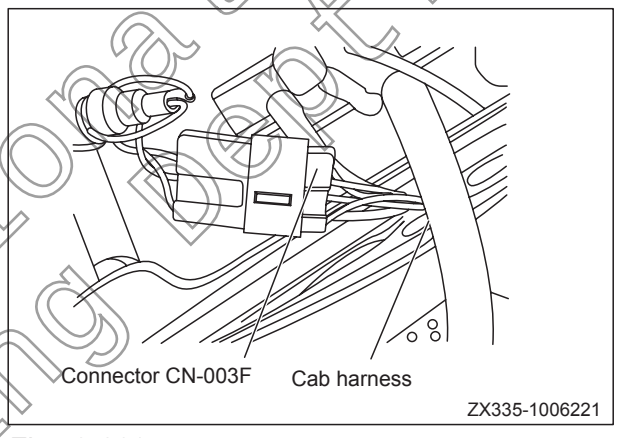


Fig. 8-289

3. Remove the four(4) screws and the washers in order to remove the radio and the radio mounting brackets from the console cover.
4. Remove the four(4) screws and the washers in order to remove the radio from the radio mounting brackets.

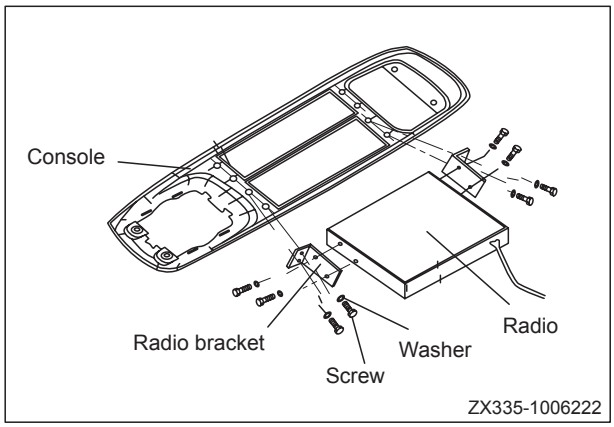


Fig. 8-290

Installation

- Installation is to be performed in the reverse order of removal.

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8.36.3 Connector model and wiring

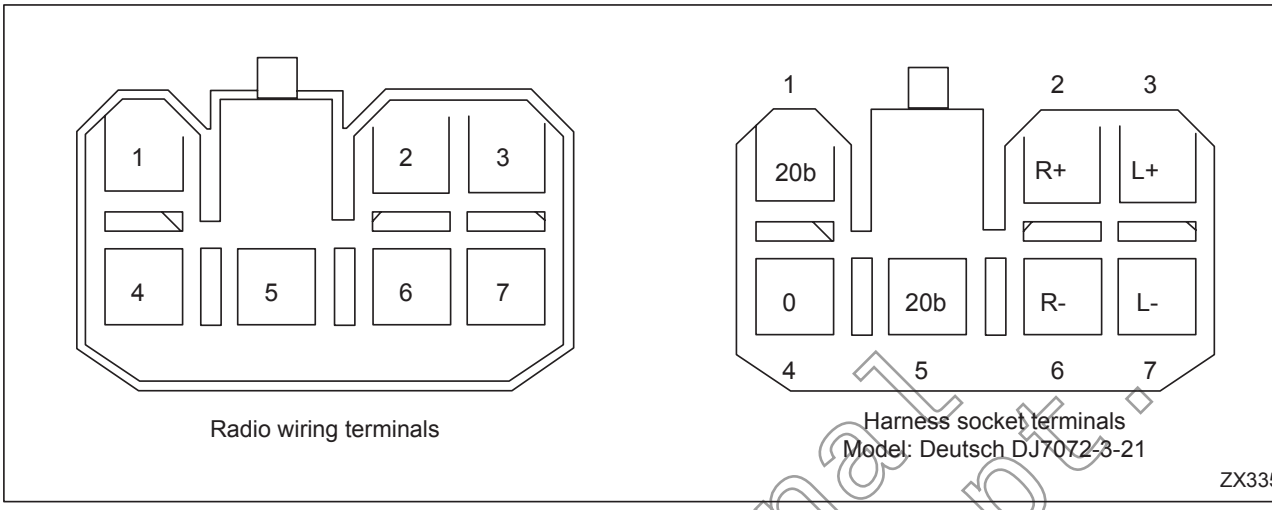


Fig. 8-291

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8.37 Battery

8.37.1 Structure

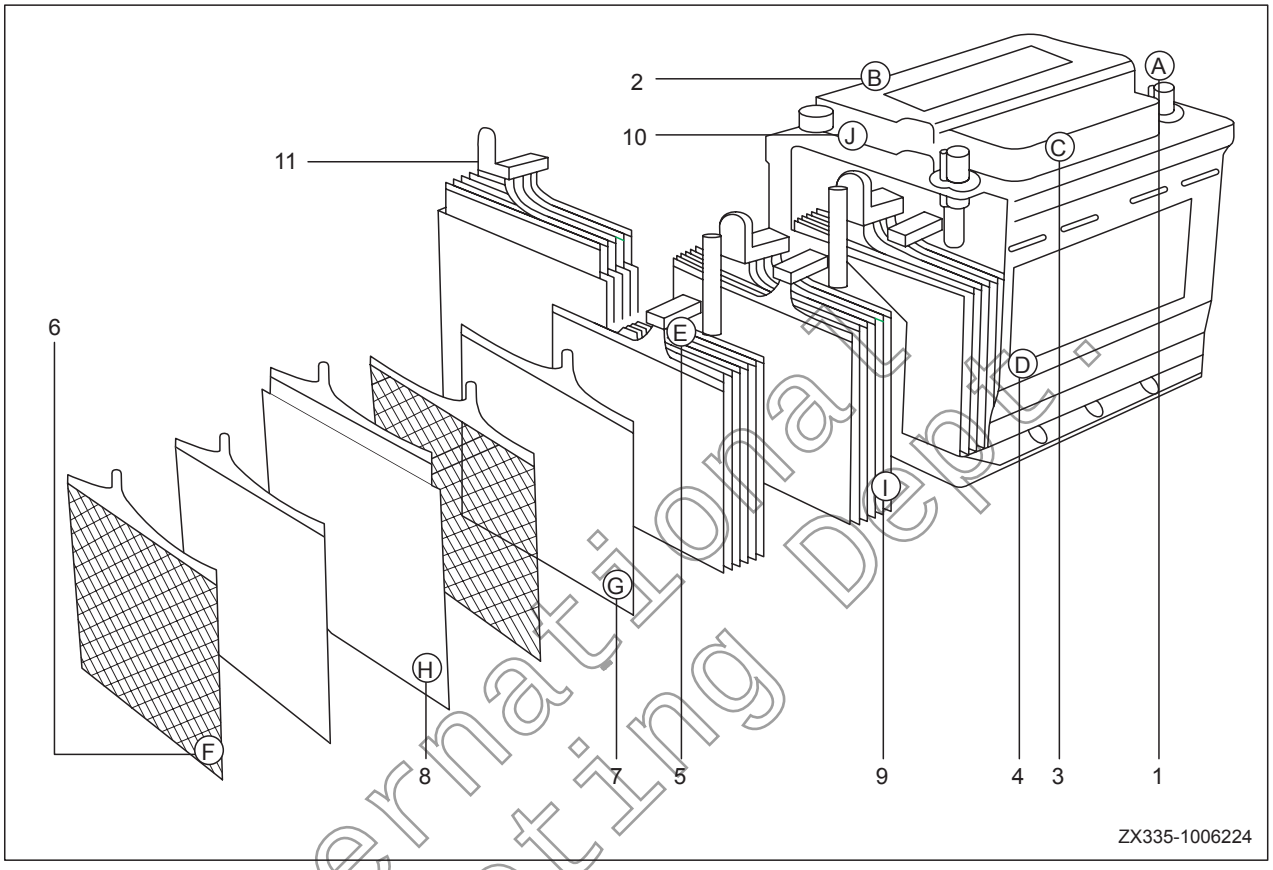


Fig. 8-292

(1) Spinning post
(2) Charge densimeter
(3) Heat-sealing cover
(4) PP casing
(5) Central polar ear
(6) Forged grid
(7) Paste (active material)
(8) "Bag-type" screen
(9) Polar group
(10) Liquid-gas separator
(11) Central busbar

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8.37.2 Removal and installation

NOTICE

- **Turn the start switch to the OFF position before removal.**
- **Do not remove the charge densimeter. Tighten the densimeter clockwise, if it is loosened, with a suitable tool.**

Removal

3. Removal of battery grounding wire

- Open the tarpaulin, unscrew the bolt, and remove the terminal from the battery wiring post.

⚠ CAUTION

- **Battery gas can cause explosion. No sparks or flames are allowed near the battery.**

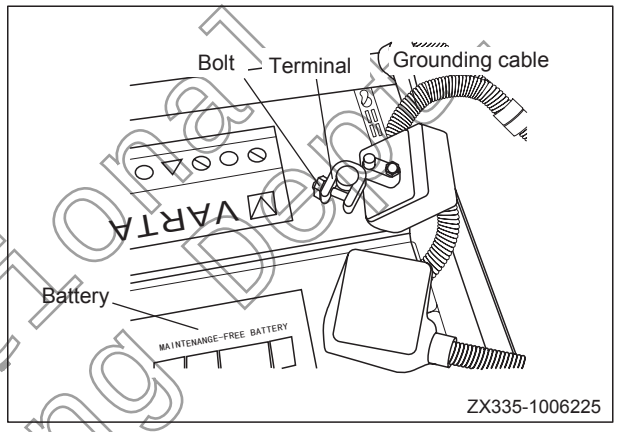


Fig. 8-293

2. Disconnect the battery wiring cable and the battery breaker cable.

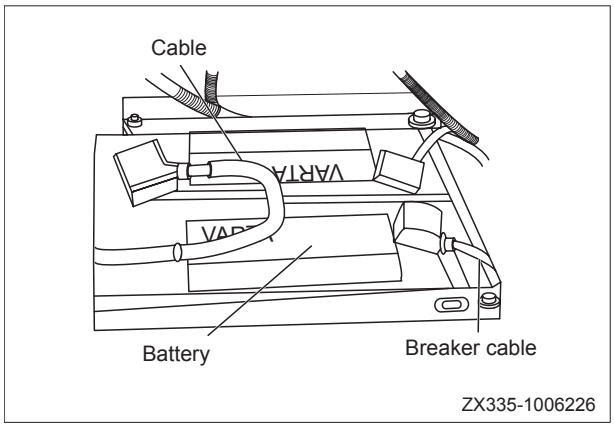


Fig. 8-294

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3. Remove the four(4) bolts and washers. Remove the battery assembly from the bottom plate. Remove the battery.

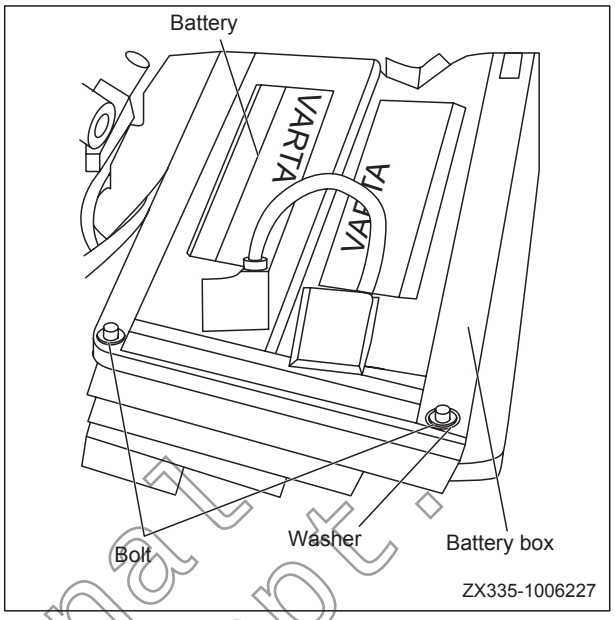


Fig. 8-295

Installation

- Installation is to be performed in the reverse order of removal.

8.37.3 Replacement

There are two 12V batteries with grounding negative (-) posts in the machine. If one battery fails in the 24V system, it must be replaced with one of the same type. Batteries of different types are probably charged at different speeds, which may cause one of them to fail due to overloading.

NOTICE

- **Apply Vaseline, when required during installation, to battery terminals to prevent corrosion.**

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8.38 Start Switch

8.38.1 Structure

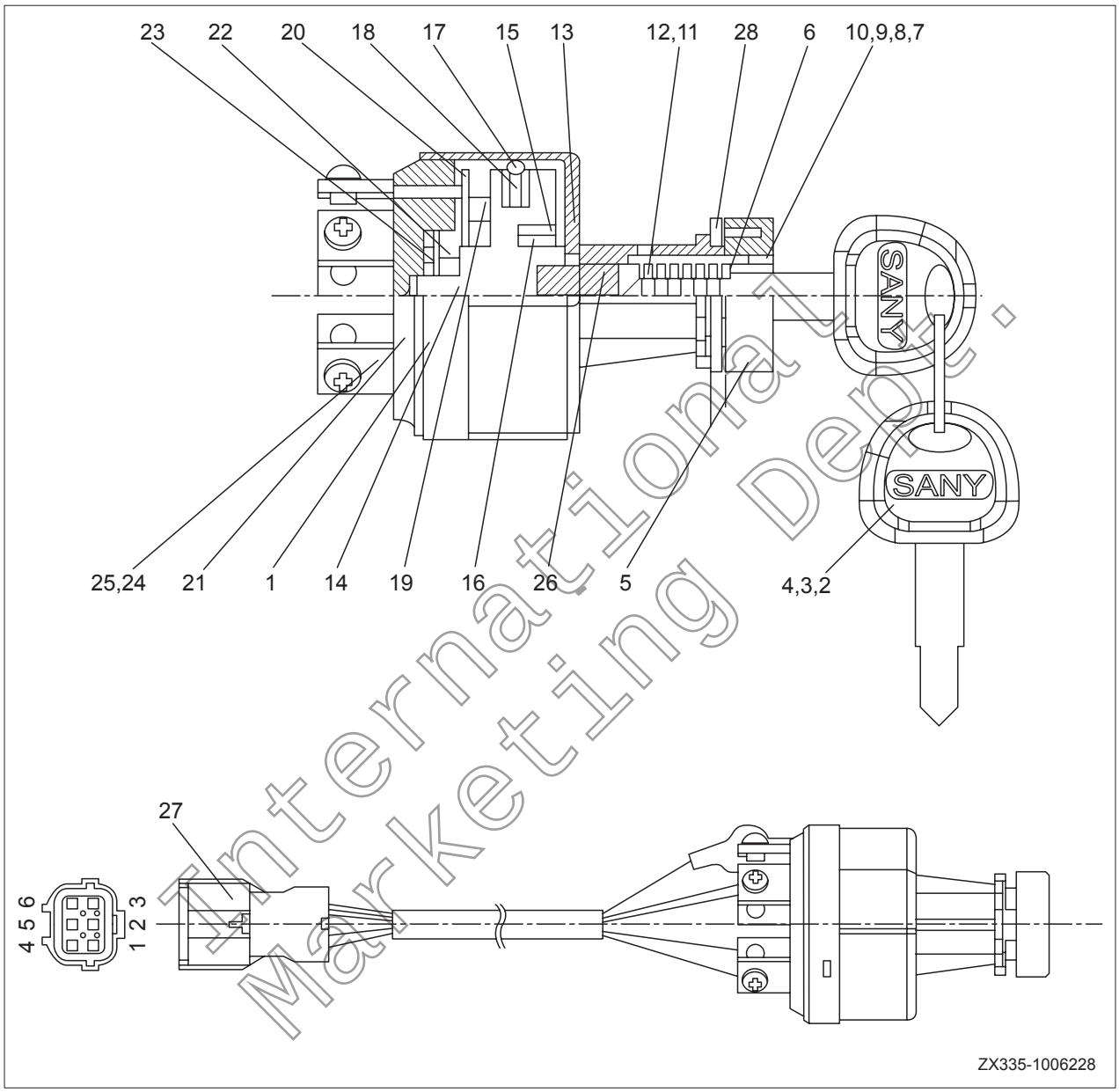


Fig. 8-296

(1) Housing
(2) Key
(3) Ring
(4) Dial
(5) Nut
(6) Cylinder
(7) Cap
(8) Shield
(9) Pin
(10) Spring
(11) Disc
(12) Spring
(13) Plug
(14) Rotor
(15) Cover
(16) Spring
(17) Ball
(18) Spring
(19) Contact SPR-B
(20) Contact A
(21) Seat
(22) Contact SPR-A
(23) Contact B
(24) Terminal
(25) Bolt
(26) O-ring seal
(27) Harness AS
(28) Washer

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8.38.2 Removal

1. Unscrew the setscrew to remove the console cover.

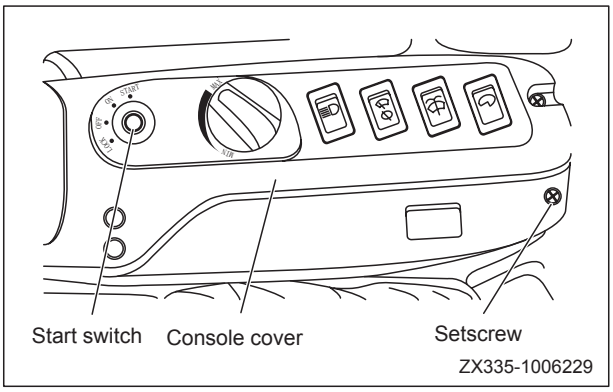


Fig. 8-297

2. Remove both setscrews in order to remove the mounting plate and the start switch from the console cover.

NOTICE

- **Disconnect the power supply of the start switch before removal.**

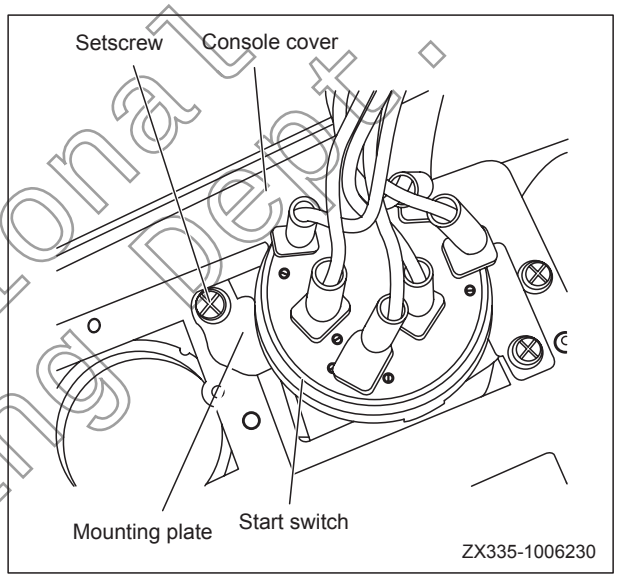


Fig. 8-298

3. Remove the nut so as to remove the start switch from its mounting plate.

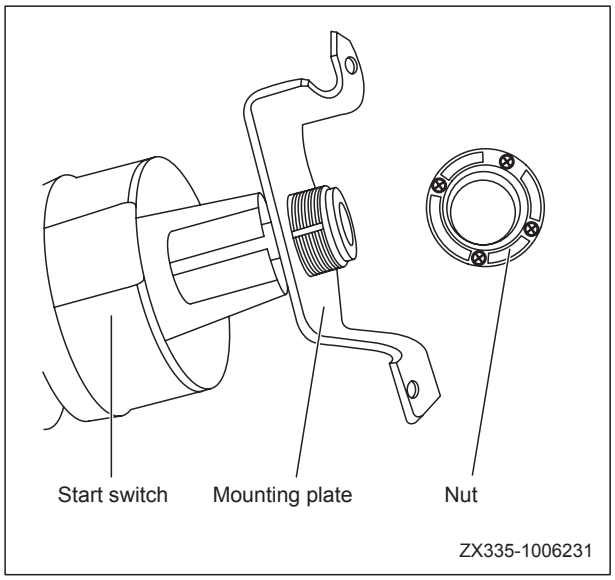


Fig. 8-299

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8.38.3 Working principle

Gear position	On/off status					
	Battery (B)	Battery relay (BR)	Accessory (ACC)	Preheat plug (R1)	Preheat plug (R2)	Start relay (C)
3B	○	○	○	○		
OFF	○					
1B	○	○	○			
2B	○	○	○		○	○

ZX335-1006232

Fig. 8-300

8.38.4 Wiring

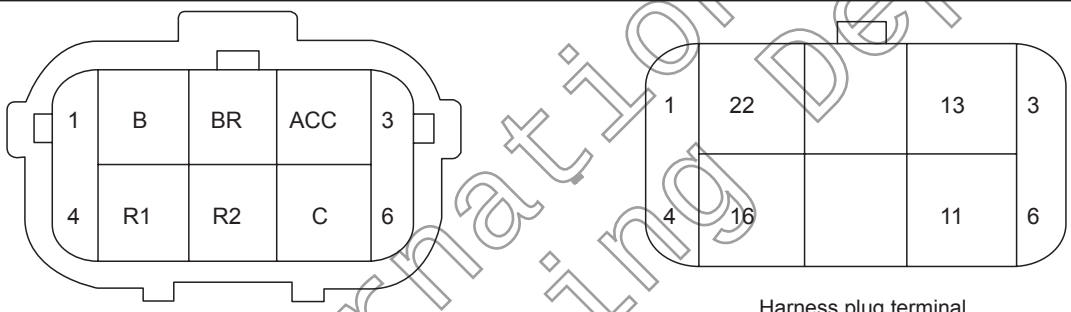


Fig. 8-301

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8.39 Fuse Box

Removal

1. Remove the cover.

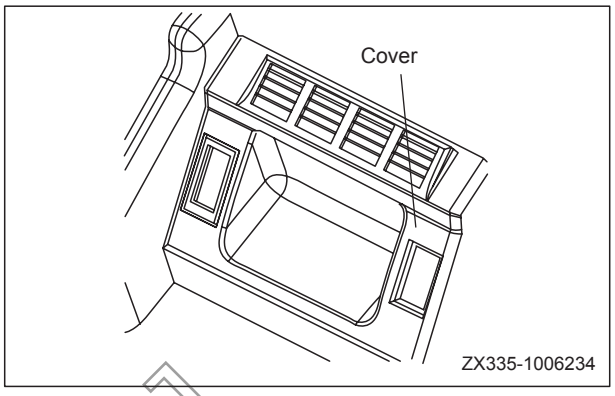


Fig. 8-302

2. Remove the bolts and take off the back cover along with the fuse box.

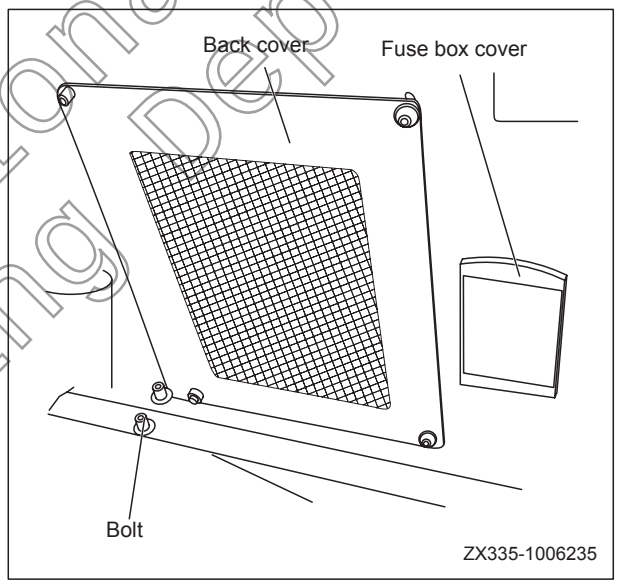


Fig. 8-303

3. Remove the bolts so as to separate the fuse box and harness from the back cover.

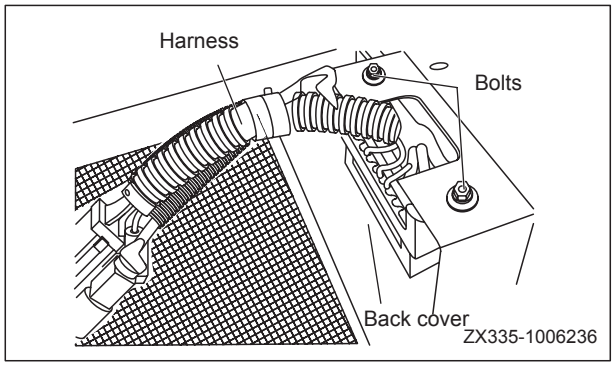


Fig. 8-304

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8.40 Wiper

8.40.1 Structure

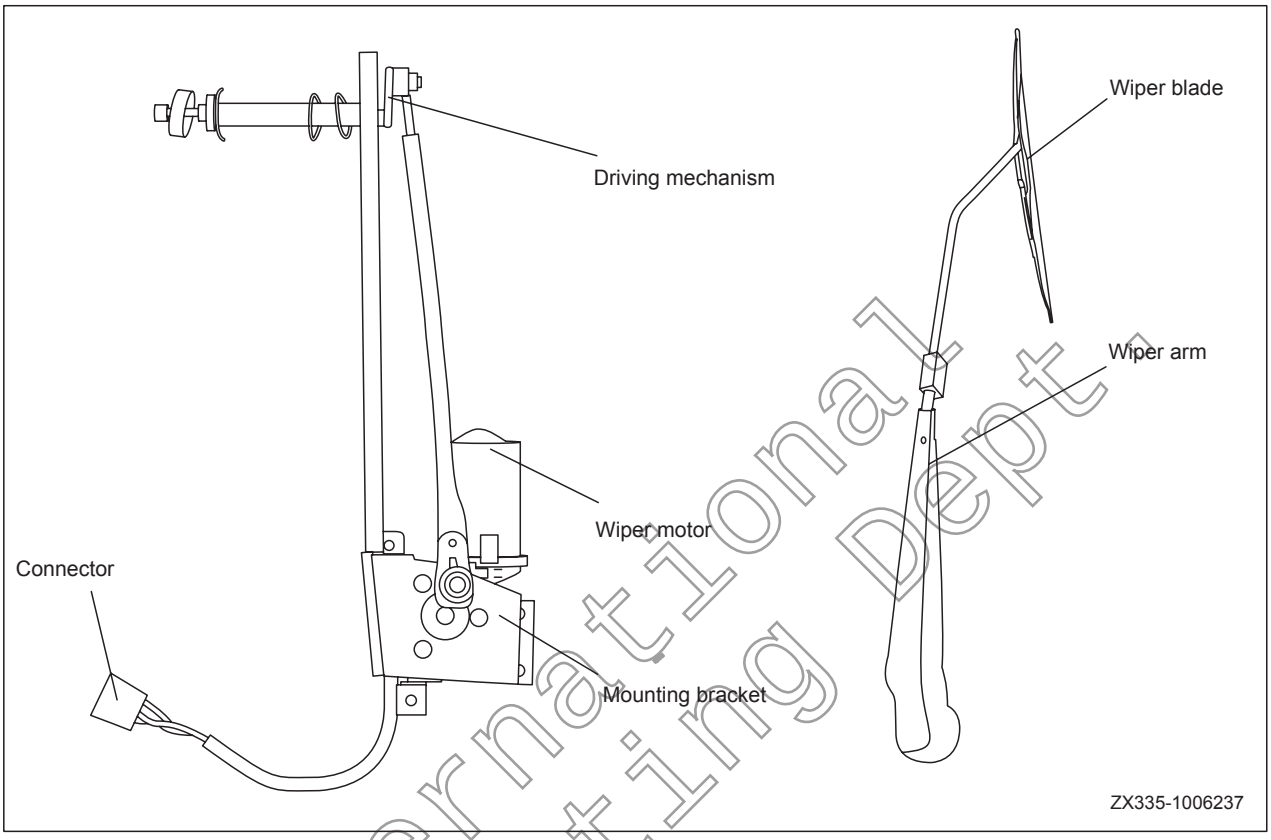


Fig. 8-305

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8.40.2 Working principle

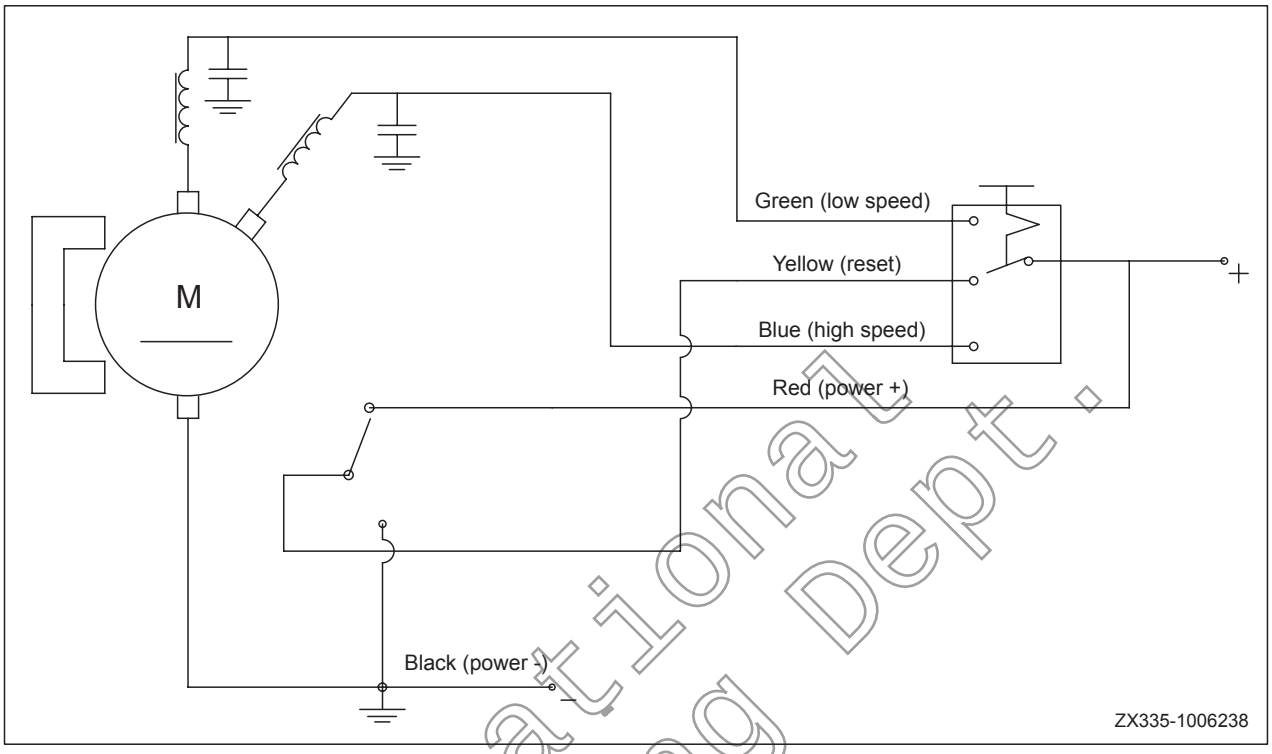


Fig. 8-306

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8.40.3 Removal

1. Remove the decorative button in order to remove the interior decoration.

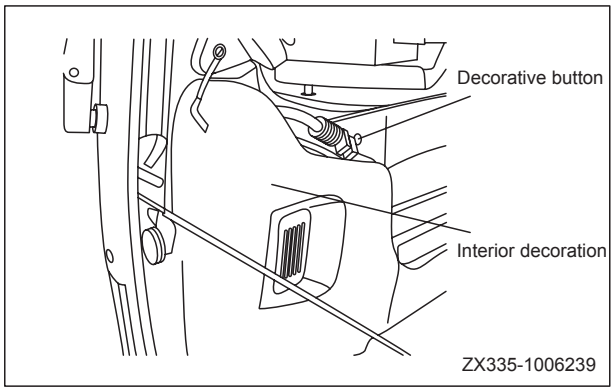


Fig. 8-307

2. Remove the moving mechanism and the motor.
   - Unscrew the bolts to remove the wiper motor and moving mechanism from the cab.

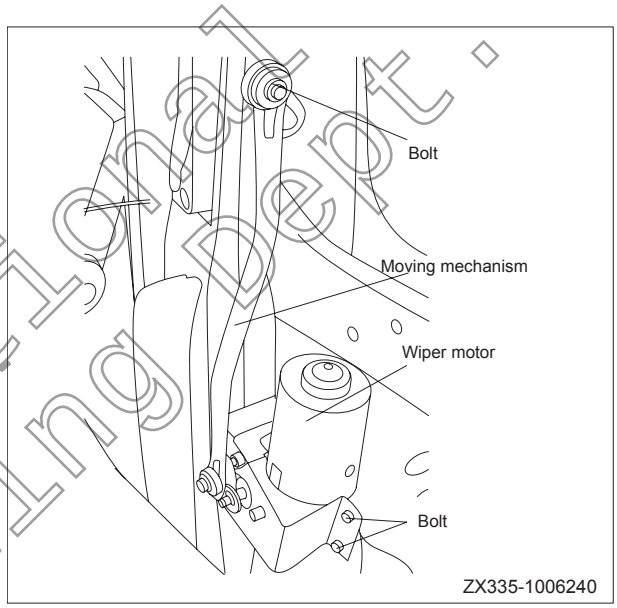


Fig. 8-308

3. Remove the arm and the blade.
   - Unscrew the nut to remove the wiper arm and blade from the cab.

8.40.4 Installation

- Installation is to be performed in the reverse order of removal.

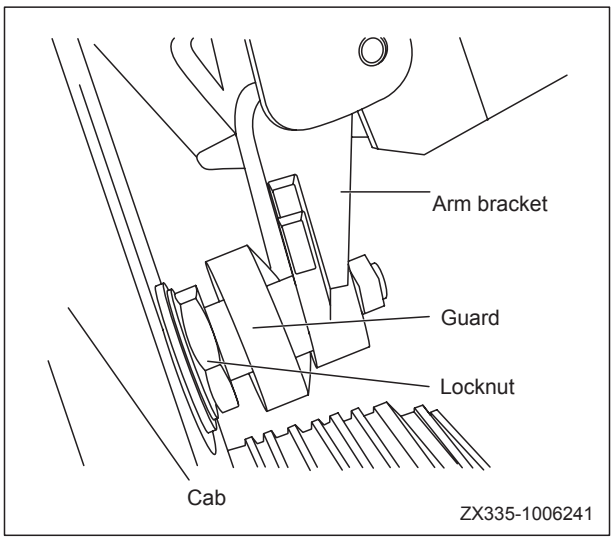


Fig. 8-309

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8.40.5 Angle adjustment of wiper arm

- The arm should stops moving when the blade reaches the stopper.
- If the arm is still working when the blade reaches the stopper or the arm already stops working before the blade reaches the stopper, the moving angle of wiper should be adjusted to prevent breakdown of the wiper.
- Adjust the wiper in such a way. Loosen the locknut; adjust the arm working angle according to actual condition. Make sure that the wiper motor stops working at the moment that the blade reaches the mechanical stopper.

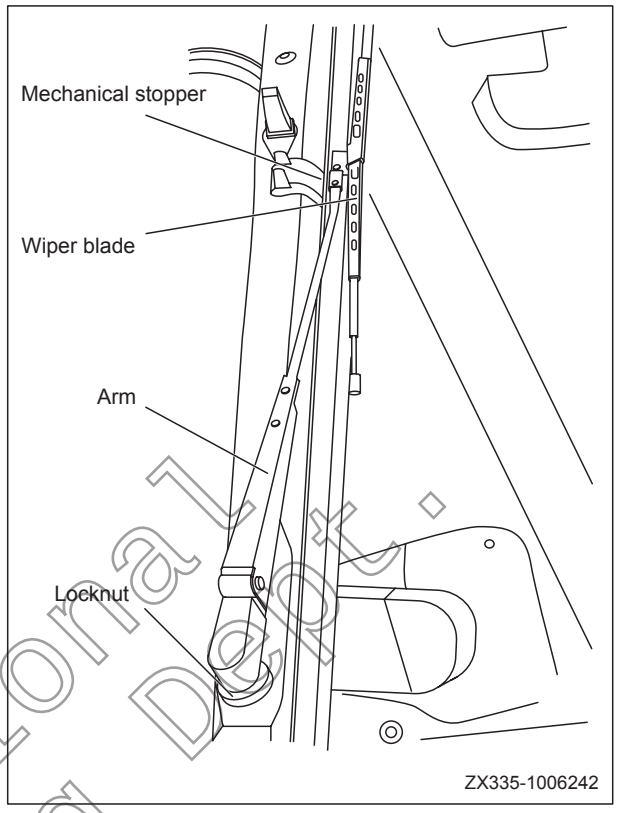


Fig. 8-310

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8.41 Relays

8.41.1 Engine relays

1. Starter relay - check

- Check the conduction and action. Replace the relay in case of any failure.

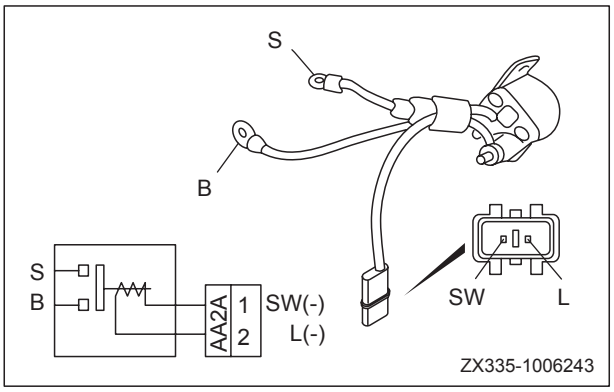


Fig. 8-311

2. Mains relay - check

- Check the conduction and action. Replace the relay in case of any failure.

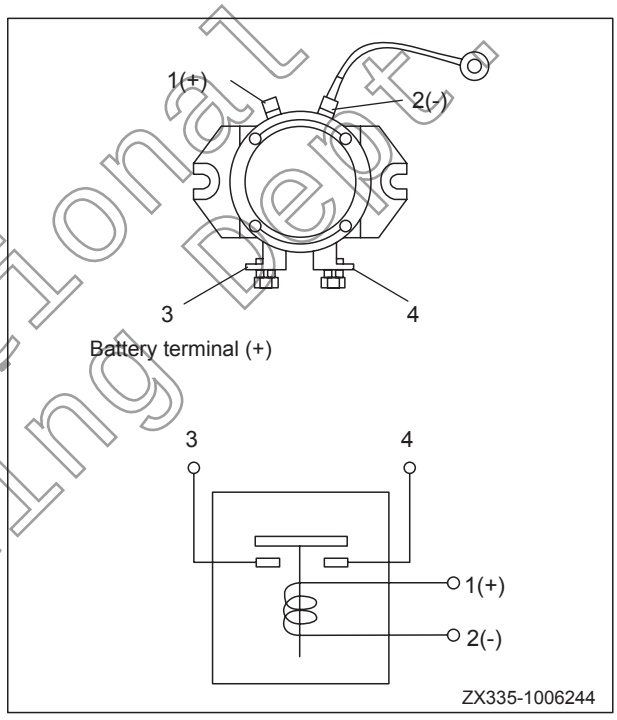


Fig. 8-312

3. Heater relay

- Check the conduction and action. Replace the relay in case of any failure.

4. Safety relay

- Measure the resistance between terminal 2 and terminal 3.

Standard Value	Approx. 200W

- Check the conduction and action. Replace the relay in case of any failure.

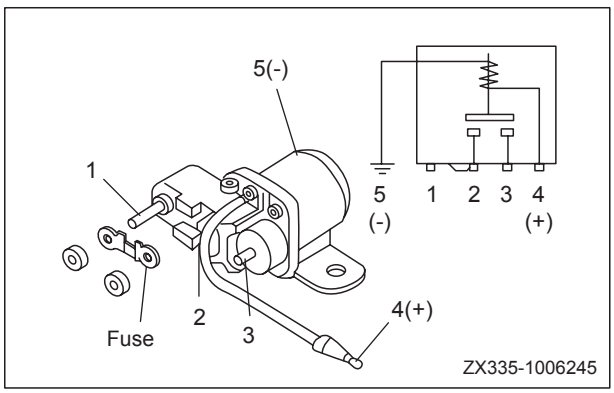


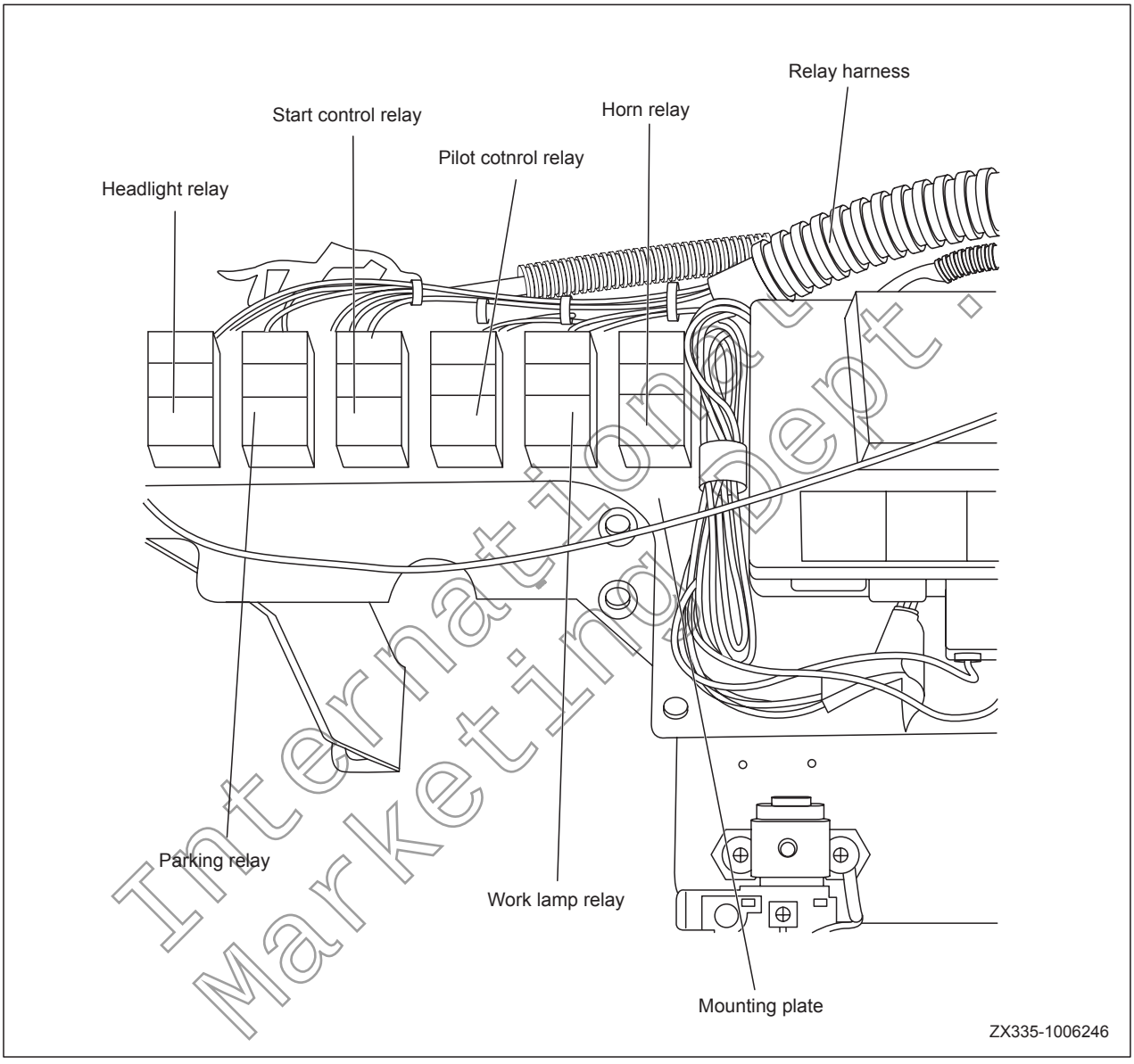
Fig. 8-313

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8.41.2 Other relays

Function and location



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Fig. 8-314

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8.41.3 Removal and installation

Removal

1. Remove relay from its seat.
2. Remove the screw in order to remove the relay seat and harness from the mounting plate.

Installation

- Installation is to be performed in the reverse order of removal.

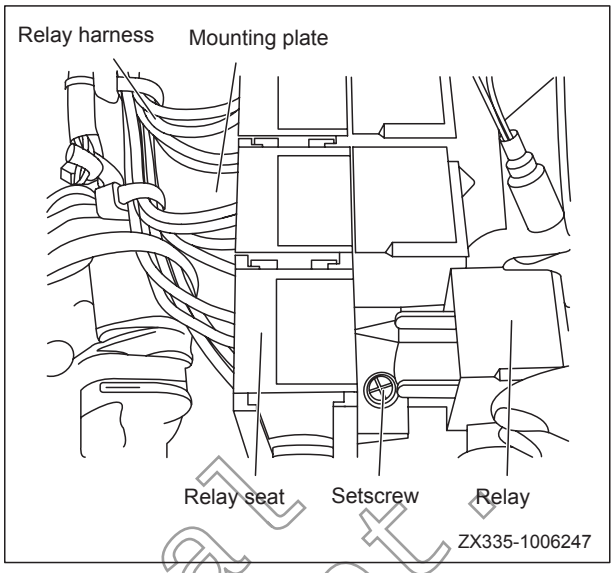


Fig. 8-315

8.41.4 Relay connector and wiring

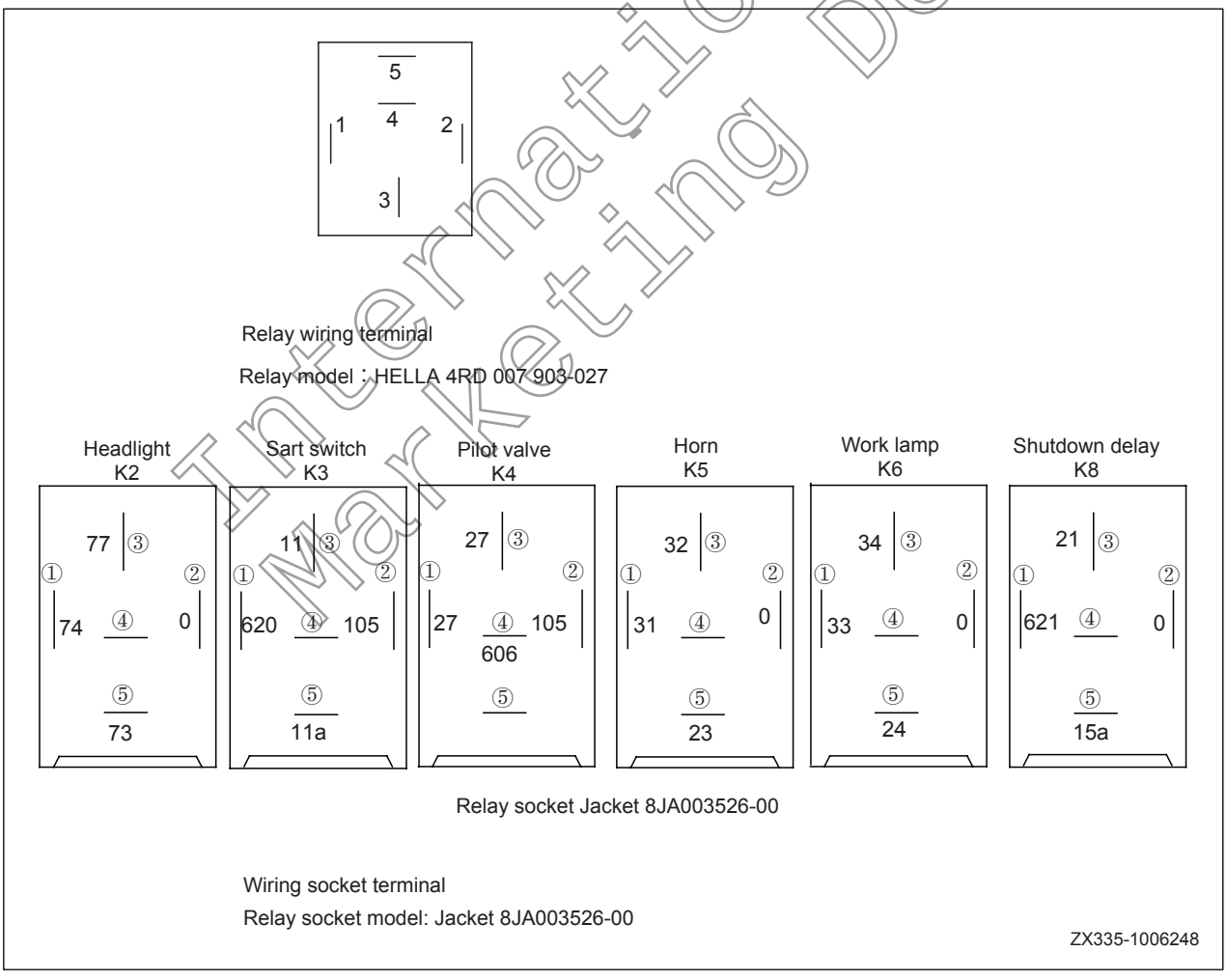


Fig. 8-316

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8.42 Sensors

1. Water temperature sensor - check

- Put the sensor into a vessel containing engine oil.
- Heat the oil to the specified temperature. Stir the oil at the same time.
- Measure the resistance value between the terminal 1 and the sensor body at different temperatures.

Standard Value	50±0.2℃	80±10Ω
	60℃	56.3Ω (ref.)
	80℃	29.5Ω (ref.)
	100℃	16.5Ω (ref.)
	106±0.3℃	14.3±1.0Ω
	120℃	10Ω (ref.)

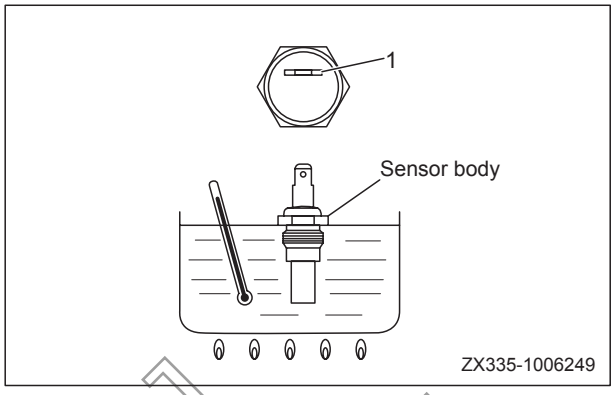


Fig. 8-317

- Replace the sensor if the measured value exceeds the standard one.

2. Engine speed sensor - check

- Measure the resistance between terminal 1 and terminal 2.

Std. Value(25℃)	2.3±0.2kΩ

- Replace the sensor if the measured value exceeds the standard one.

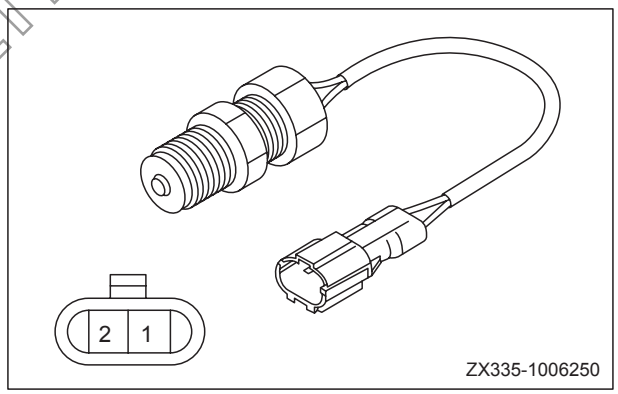


Fig. 8-318

NOTICE

- **Insufficient tightening of the engine speed sensor may cause signal output failure. Tighten the sensor to specified torque.**

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3. Pressure sensor - check

- Input volt: 4.75~5.25 VDC
- Output volt: 0.5~4.5 V
- Pressure range: 0~50 BAR

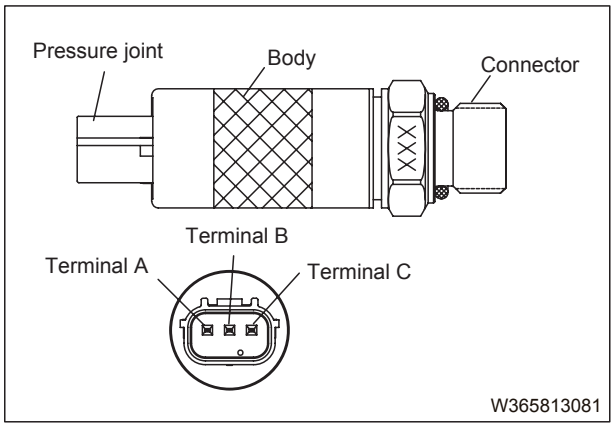


Fig. 8-319

4. Fuel level sensor - check

- Swing the float up and down in order to measure the effective angle of radial swing, i.e. the line through the float and the turning point will swing 105° .
- Swing the float up and down. The vertical distance between the upper limit and the lower limit of the float should be 500 mm.
- Move the float to its upper limit. Measure the resistance between the sensor terminal R and ground with a multimeter. The measured resistance should be Ru ≧ 9.6Ω.
- Move the float to its lower limit. Measure the resistance between the sensor terminal R and ground with a multimeter. The measured resistance should be Rd ≧ 86Ω.

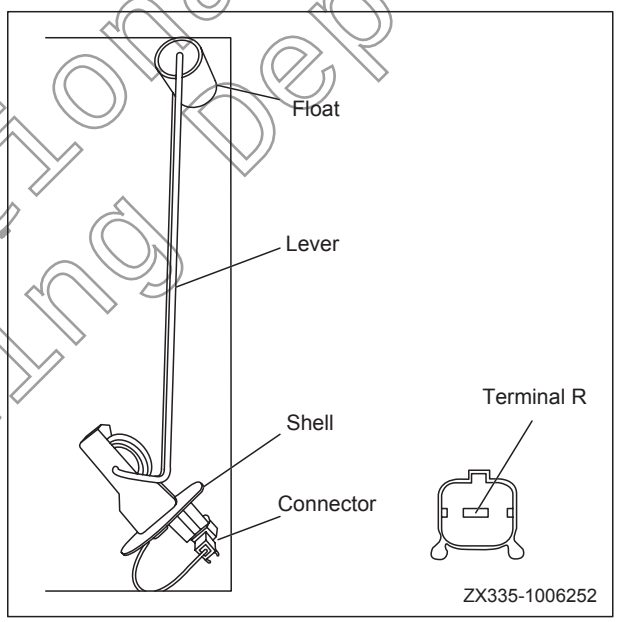


Fig. 8-320

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8.43 Connector Terminals

8.43.1 Insertion

1. Hold tightly a wire terminal at a distance of about 25 mm from its end.

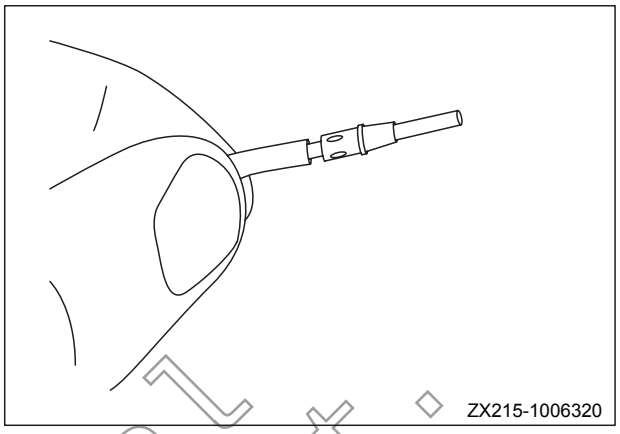


Fig. 8-321

2. Hold the connector. Let the rear seal face you.

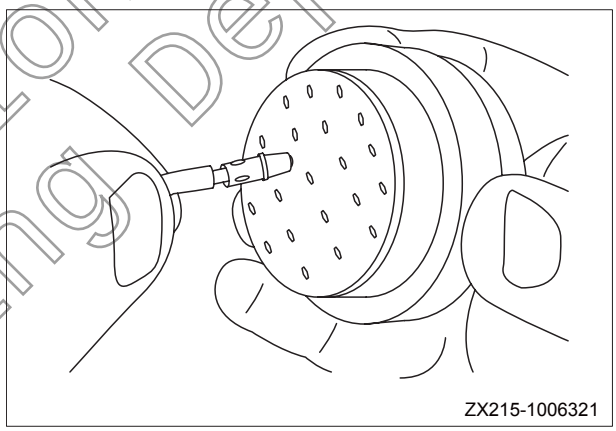


Fig. 8-322

3. Align the terminal with a hole on the seal and push it perpendicularly to the bottom. Slightly pull back the wire in order to ensure that the terminal is locked in place.

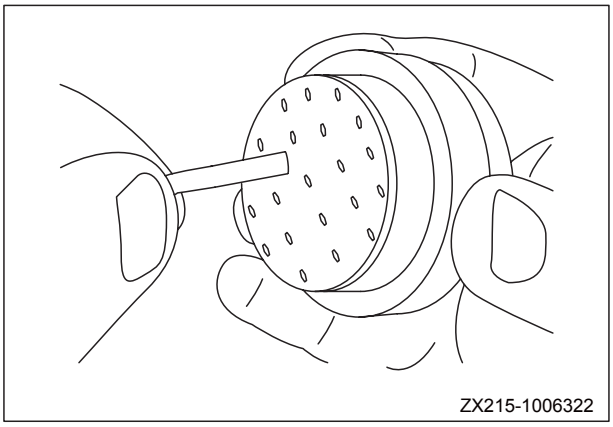


Fig. 8-323

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8.43.2 Removal

1. Hold the connector, with its back end facing you. Select a suitable tool and clip on the wire.

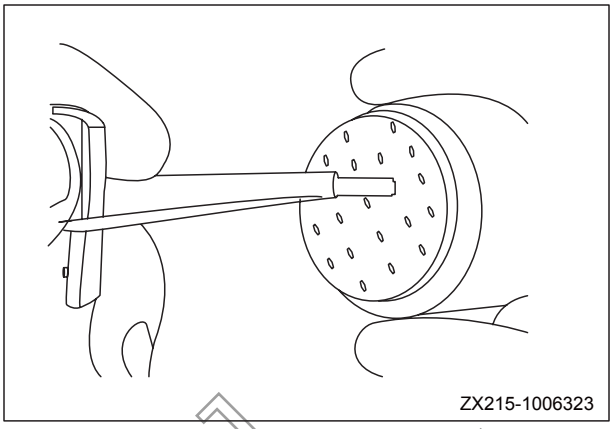


Fig. 8-324

2. Push the tool along the wire into the connector so that the tool can expand the terminal lock shoulder and reach its flanged part.

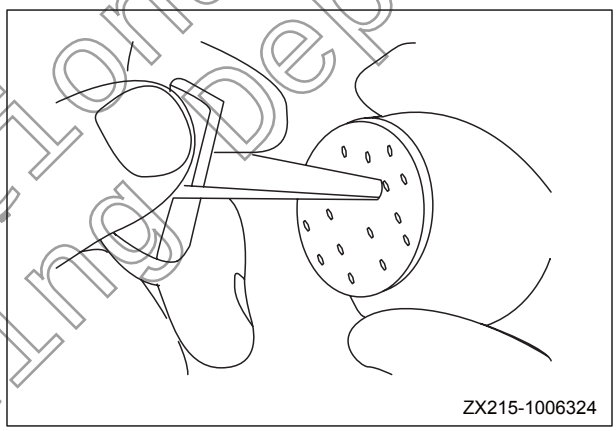


Fig. 8-325

3. Pull out the tool to remove the wire with terminal.

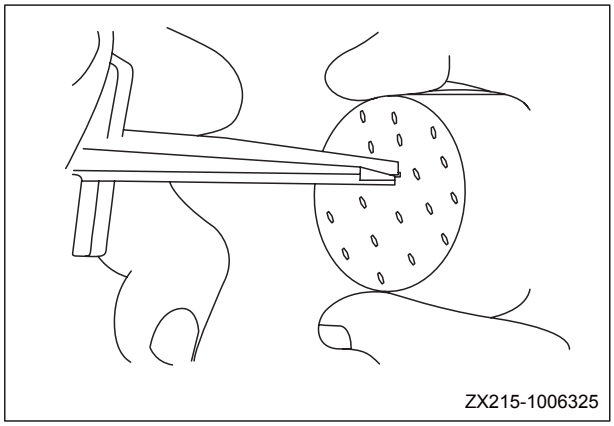


Fig. 8-326

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System Schematics

9 System Schematics

9.1 Diagram of Hydraulic Lines 9-3
9.2 Electrical diagram of chassis 9-4
9.3 Electrical diagram of control switches 9-5
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9.5 Electrical diagram of air conditioner 9-7
9.6 Electrical diagram of monitor 9-8

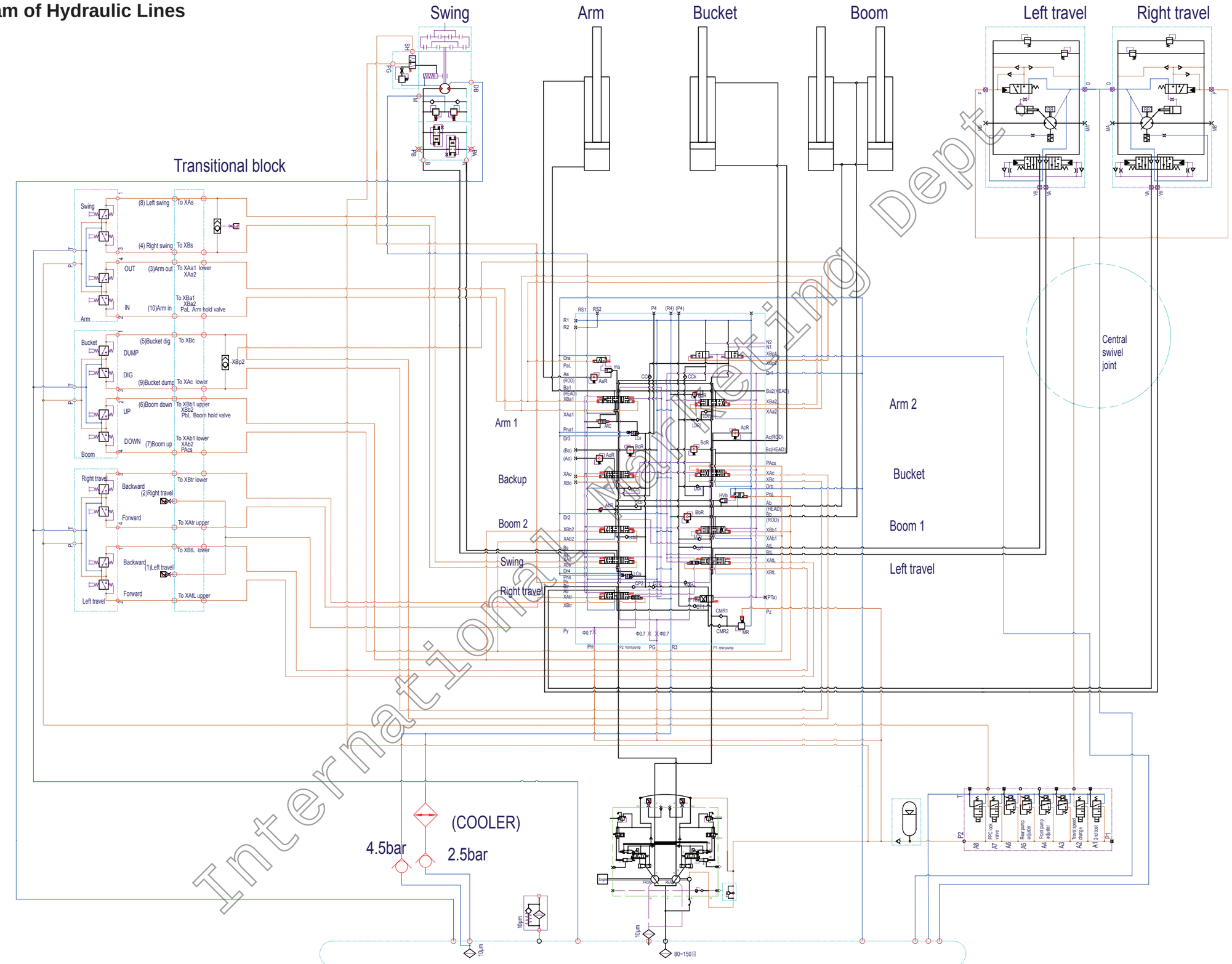
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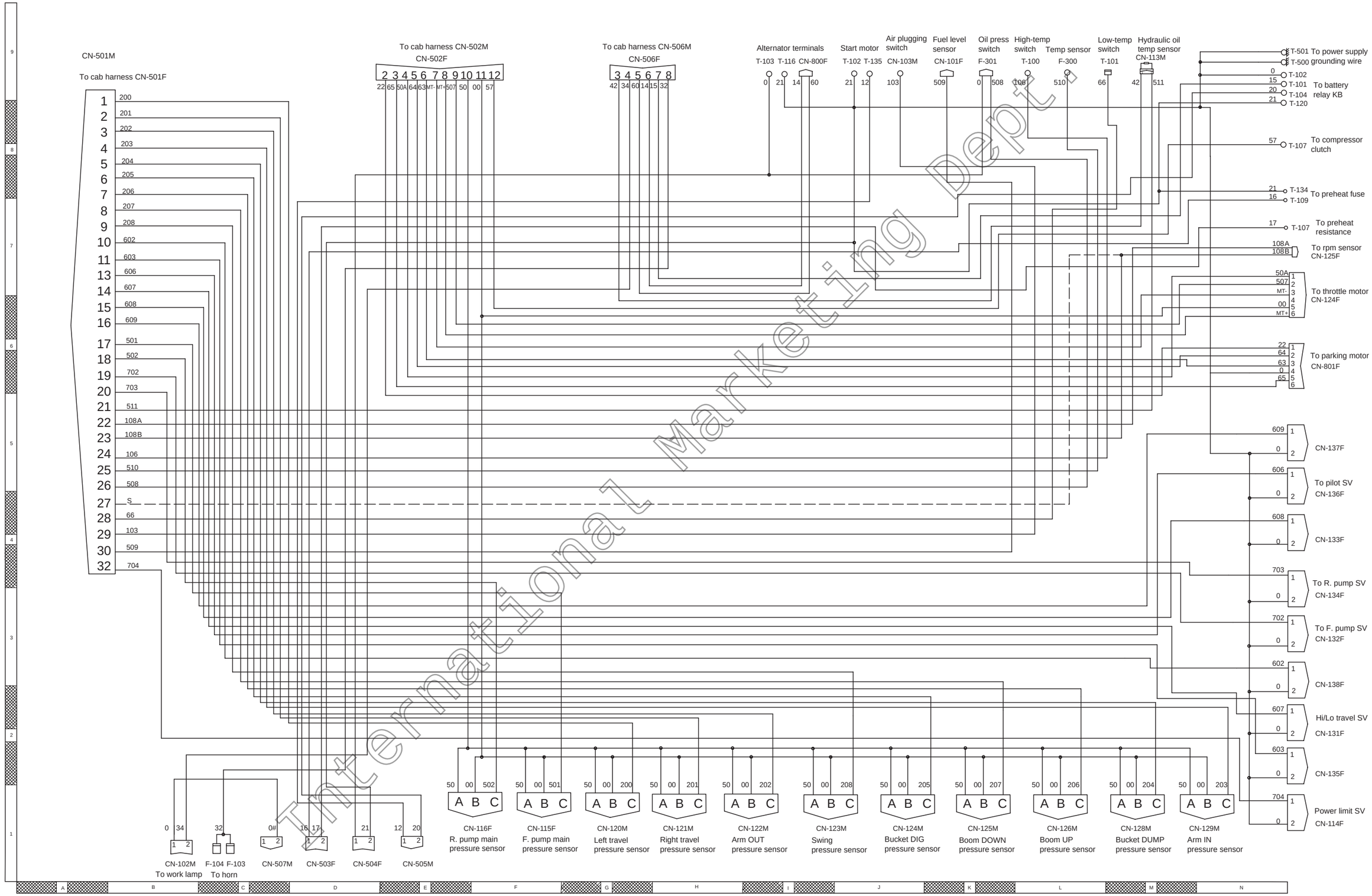
9.1 Diagram of Hydraulic Lines



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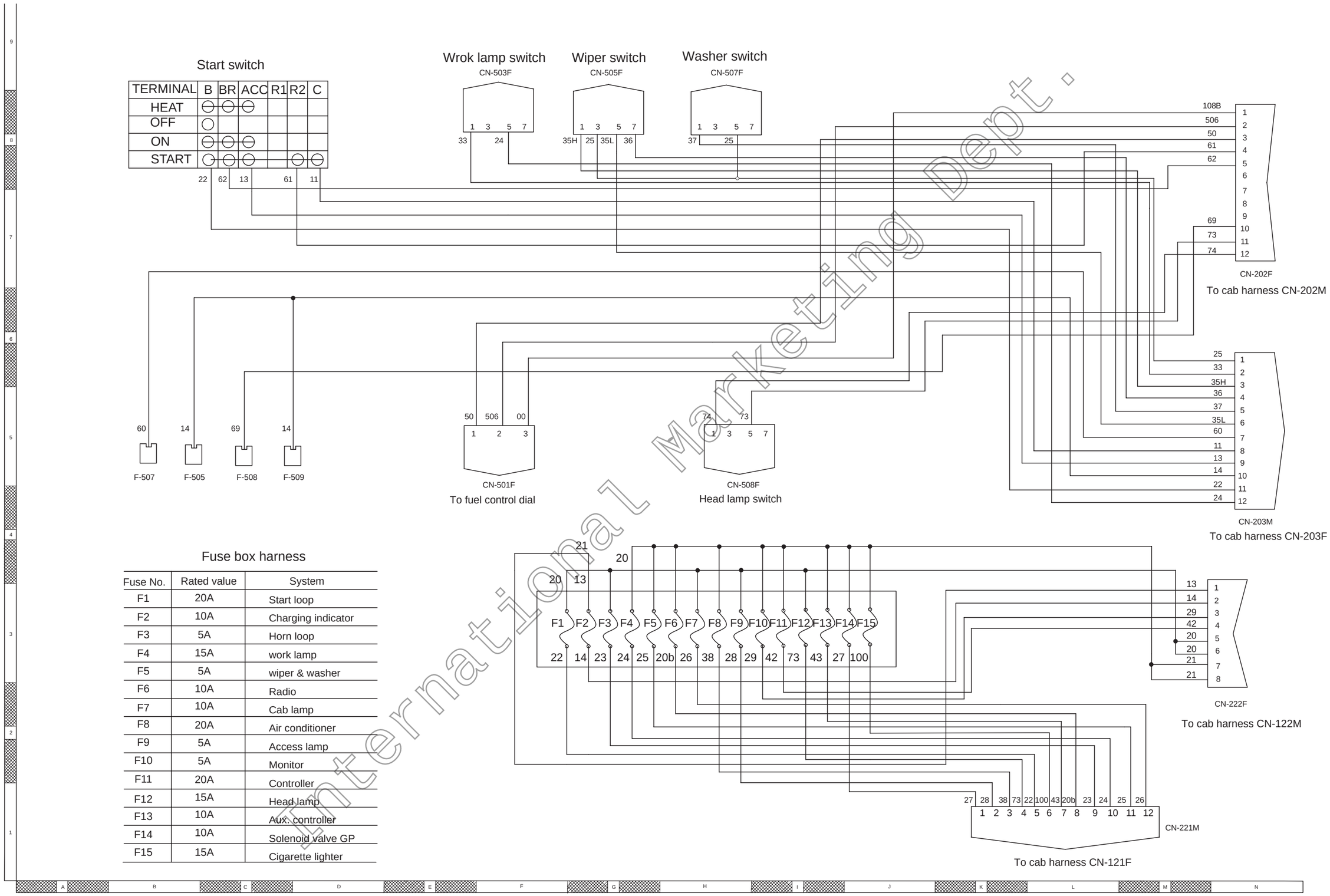
9.2 Electrical diagram of chassis



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9.3 Electrical diagram of control switches



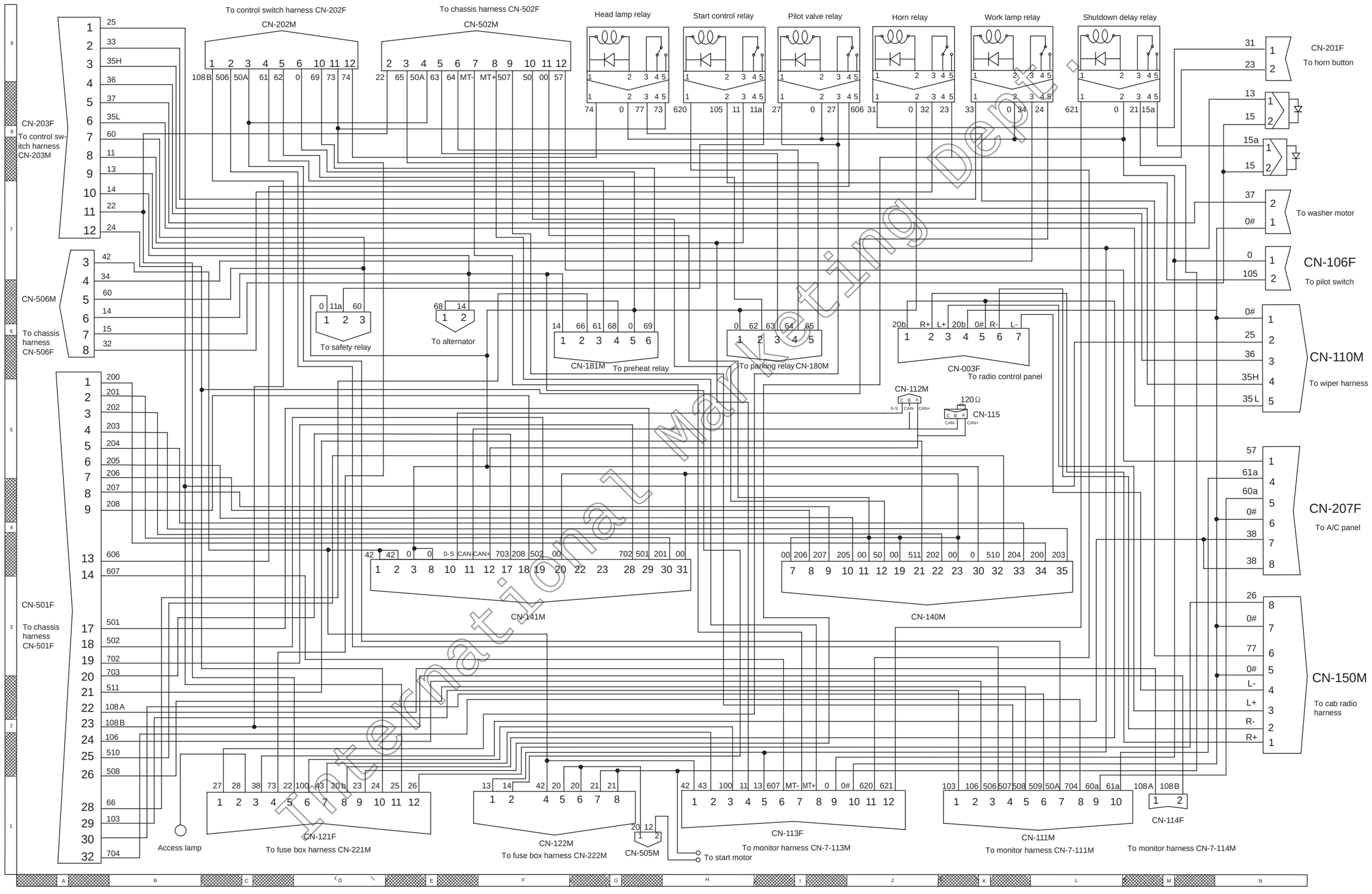
Fuse box harness

Fuse No.	Rated value	System
F1	20A	Start loop
F2	10A	Charging indicator
F3	5A	Horn loop
F4	15A	work lamp
F5	5A	wiper & washer
F6	10A	Radio
F7	10A	Cab lamp
F8	20A	Air conditioner
F9	5A	Access lamp
F10	5A	Monitor
F11	20A	Controller
F12	15A	Head lamp
F13	10A	Aux. controller
F14	10A	Solenoid valve GP
F15	15A	Cigarette lighter

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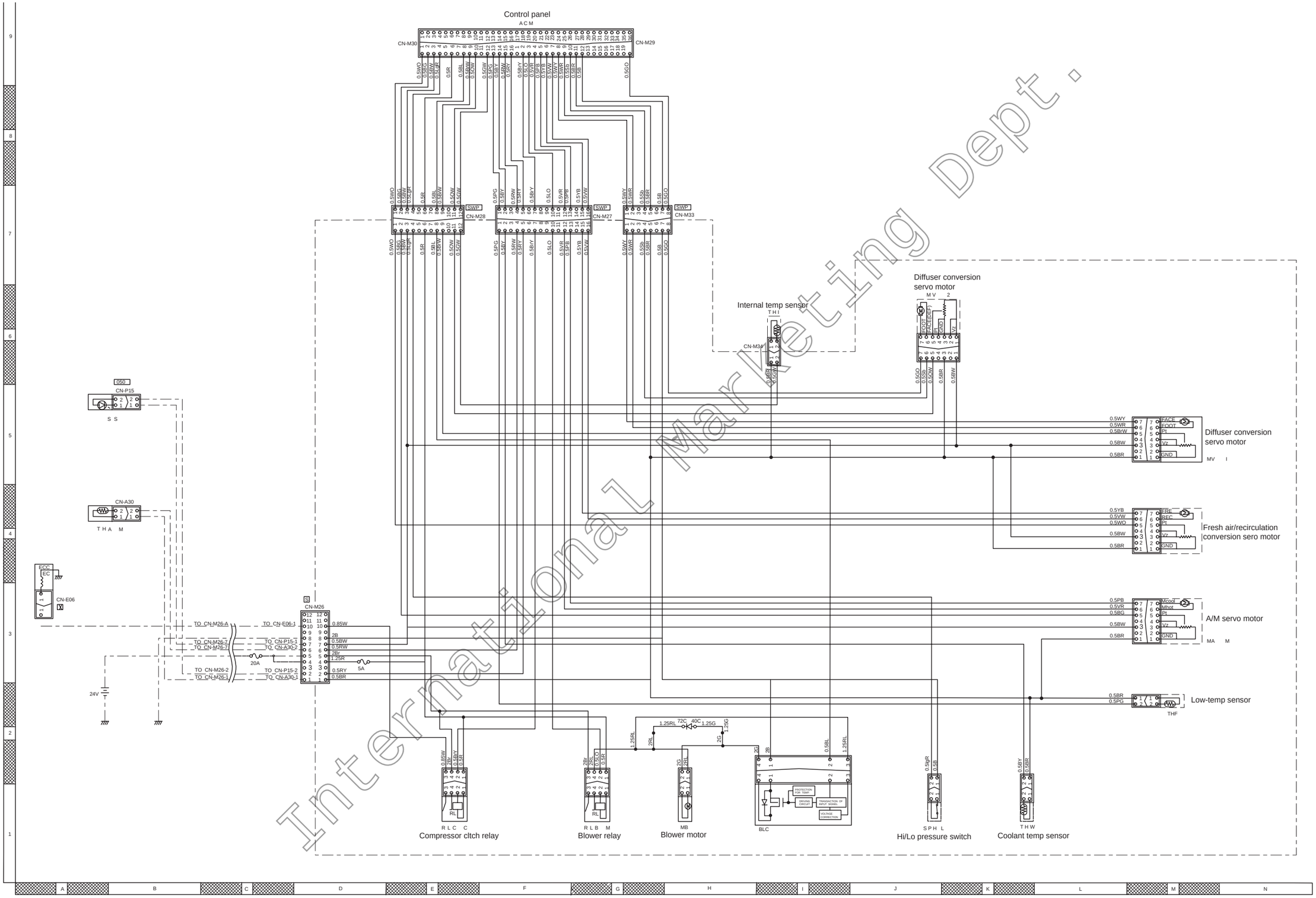
9.4 Electrical diagram of operator station



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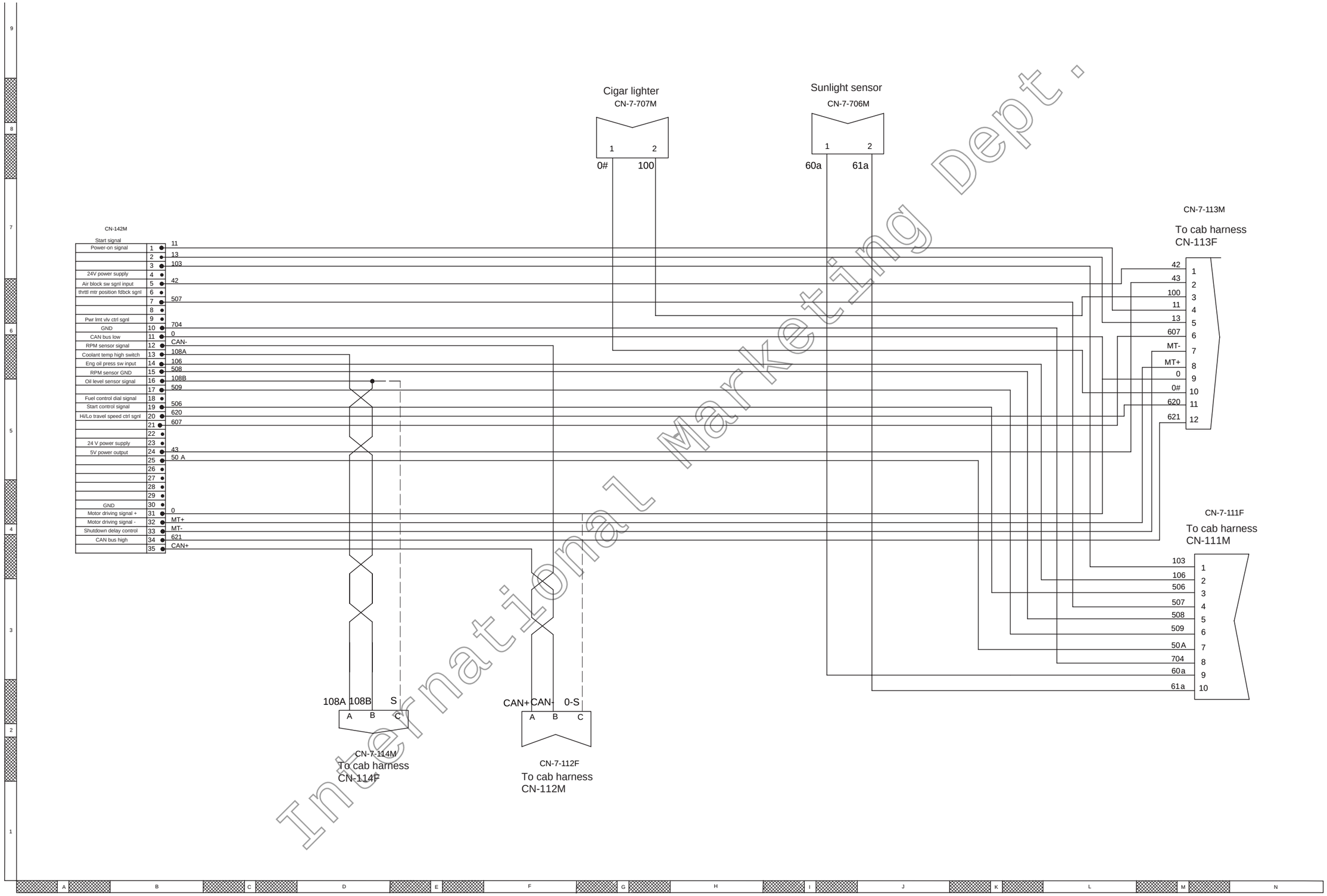
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9.5 Electrical diagram of air conditioner



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9.6 Electrical diagram of monitor



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