

## INSTRUCTION MANUAL PLOT OPERATED 2 PORT SOLENOID VALVE

WHL11- 15 A (Normally closed series)  
20  
25

- Prior to using the Product, it is essential to read this INSTRUCTION MANUAL, especially the description of safety-use issue.
- For quick reference whenever necessary, keep this INSTRUCTION MANUAL in a good manner.

## Introduction

Thank you for purchasing the CKD solenoid valve for water "WHL11 Series".

This solenoid valve reduces water hammers with a two-stage speed mechanism that delays the speed just before the valve is closed.

### 1. Description and Intended use

This solenoid valve is used to supply and stop the water supply and miscellaneous water supply (secondary treated water). Do not use for general water (water containing sand or foreign matter, such as river water or ground water).

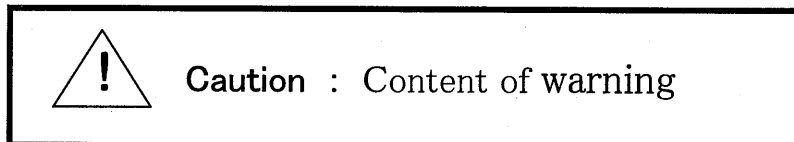
### 2. General precautions

- This operation manual describes the basic matters concerning the handling of the product, including unpacking, installation, use, and maintenance.
- The description about the installation in this manual is intended for qualified technicians and electricians. This should be thoroughly read before designing and installation to ensure the safety of the machine or tool and the proper handling of this product.

### 3. Safety precautions

- Warnings are shown in this manual as required to avoid injury, fire, and damage to your properties. They must be strictly observed.
- Warnings should be shown under different headings, i.e. Danger, Warning, and Caution, according to the degree of risk. However, they are all shown under the heading of Caution in this manual because this product is used as a component of a machine or tool.

Example of warning



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## 1. Unpacking

- (1) Check that the product model and nameplate are the same as those ordered.
- (2) Check that the rated voltage and frequency are the same as those ordered.
- (3) Check the appearance for damage.
- (4) To store the valve, do not unpack the valve to protect it from foreign matter entering its inside. It is recommended to unpack the valve immediately before starting piping work.

## 2. Installation

### 2.1 Installation requirements

#### 2.1.1. Installation attitude

Install the solenoid valve on a horizontal piping with the coil section facing upward. If the solenoid valve must be piped vertically, pipe so that the "IN" port faces downward and the "OUT" port faces upward. (Refer to Fig. 1)

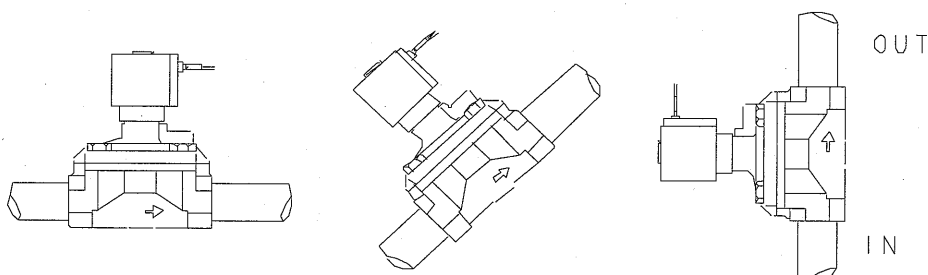
If air enters the piping or solenoid valve, phenomenon such as cavitation or chattering could occur. Make sure that air does not enter.

If a phenomenon such as cavitation occurs, Loosen the four hexagon head bolts slightly, and bleed the air from the top of the diaphragm assembly.



**Caution :** A phenomenon, such as cavitations may occur, causing water to spurt out when the four hexagon bolts are loosened.

#### *Good installation attitude*



#### *Poor installation attitude*

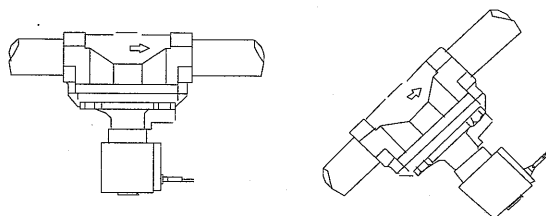


Fig. 1

### 2.1.2 Maintenance space

- (1) By taking safe maintenance and troubleshooting work into consideration, keep adequate spaces around the valve. (Fig. 2)

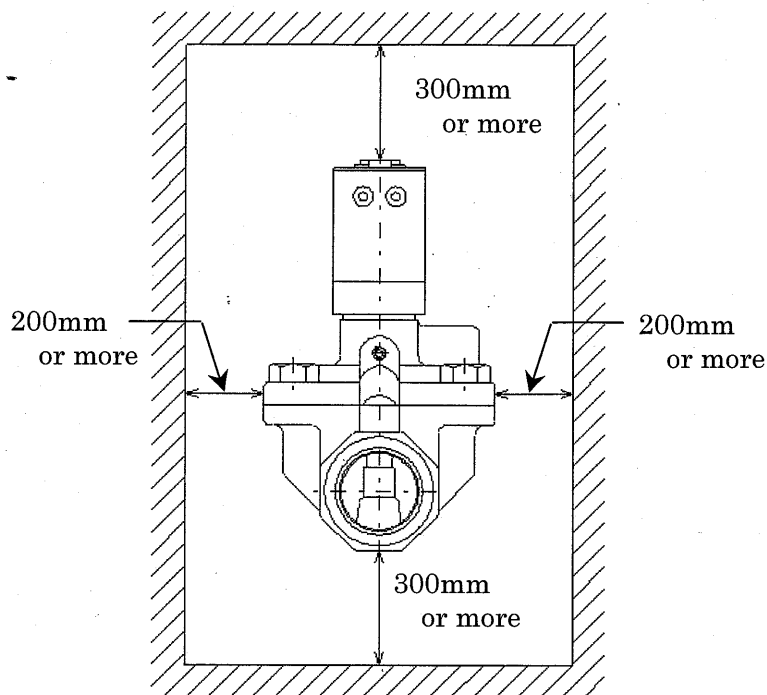



Fig. 2

### 2.1.3 Protection measures

- (1) When using this solenoid valve in cold district, or if the solenoid valve could freeze during the winter, take appropriate anti-freezing measures such as protecting the valve with heat insulating material.

	<p><b>Caution</b> : Do not place heat insulating material, etc. , on the coil section. There is a risk of fire when the coil heats up.</p>
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- (2) Coil option symbol “7A” type can withstand brief submersion in water. However, to prevent corrosion and deterioration in insulation, avoid submerging the valve in water for longer than one month. Make sure that liquid such as water do not get on the coil or terminal box section of the other coil options. Make sure that none of the coil options are subject to direct sunlight.

## 2.2 Piping work

- (1) Keep the length of the threads in the piping to an effective thread length. Also, the end of the threaded part should be finished by chamfering to a half pitch. (Fig. 3)

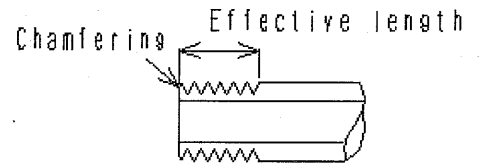


Fig. 3

- (2) Air-flush the pipe to remove any foreign matter or chippings inside the pipe before piping. (Fig. 4)

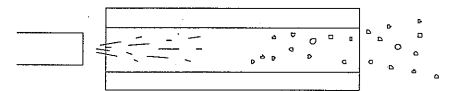


Fig. 4

- (3) If the piping is connected to any other articles, try not to get any seal material or sealing tape inside the piping.

Pay attention to the amount of seal material and the position of application or the position where the sealing tape is wound around the pipe. (Do not place the seal material within 1.5 to 2 threads from the end of the pipe.) (Fig. 5)

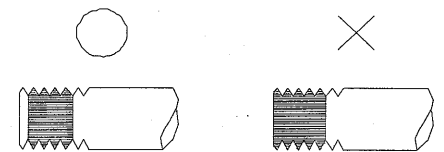


Fig. 5

- (4) Align the fluid flow direction and the direction of the arrow indicated on the solenoid valve when piping. Refer to the tightening torque for piping in the following table. Take care not to strain the valve when piping. Especially take care not to apply external force on the coil section.

Port size	Tightening torque of piping
$Rc \frac{1}{2}$	41 ~ 43 N·m
$Rc \frac{3}{4}$	62 ~ 65 N·m
Rc 1	83 ~ 86 N·m

- (5) When the drainage of water from inside the tank is controlled, if the pipe is placed at the bottom of the tank, accumulated foreign matter may flow into the pipe, causing operational defects in the solenoid valve. The pipe should be placed slightly above the bottom of the tank. (Fig. 6)

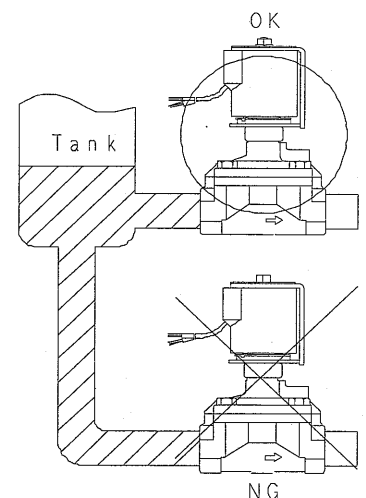


Fig. 6

- (6) Dirt or foreign matter in the water will interfere with the normal operation of the solenoid valve.  
Install an 80 to 120-mesh strainer on the inlet of the solenoid valve according to the water quality. (Fig. 7)

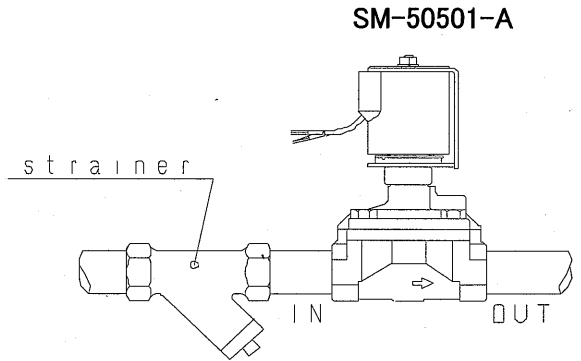


Fig. 7

- (7) Provide a maintenance bypass circuit when laying the pipes. (Fig. 8) The bypass circuit can be omitted when using the optional solenoid valve with manual operation mechanism.

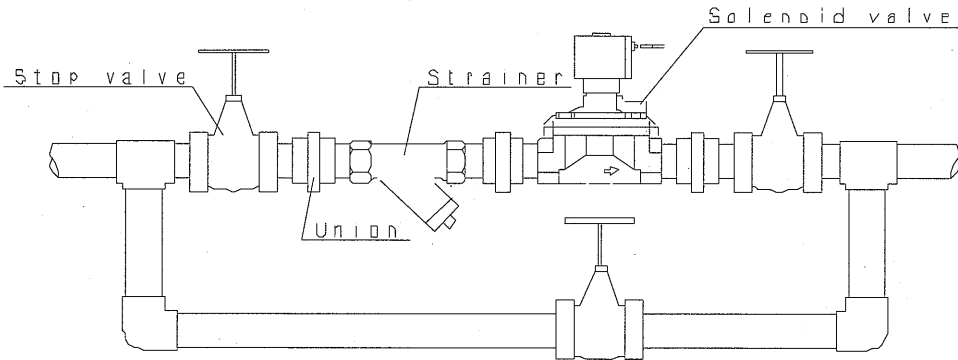


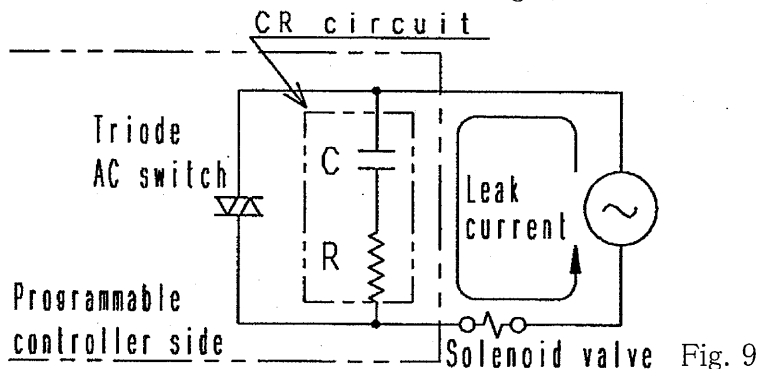
Fig. 8

2.3 Wiring work

- (1) When operating the solenoid valve using a programmable controller, confirm that the leak current level of the output from the programmable controller is within the specified values shown in the following. Failure to observe this could cause malfunctions.

Leak current	Rated voltage	AC100V	AC200V	DC24V	DC12V
	Coil option Symbol				
	2C, 2CS, 2G, 2HS, 2CH, 3T, 3RS	6mA or less	3mA or less	1mA or less	2mA or less
	7A	1.9mA or less	0.7mA or less	4mA or less	—

- (2) Use a surge absorption circuit (CR circuit) to prevent contact chattering. This will extend the life of the solenoid valve. (Fig.9)



- (3) Use a breaker such as a fuse or ground-fault circuit breaker on the control circuit side to protect the electric equipment.
- (4) For the wiring, use electrical wires with a nominal cross-sectional area of 0.5mm<sup>2</sup> or larger.
- (5) The AC and DC coils do not have polarity. (Coil option symbol "7A" type has a built-in rectifier (half wave), and drives the DC coils.) The lead wire and terminal box connections are shown in Fig. 10. to Fig. 12. Connect according to each type.

(a) Lead wire type

Use a crimp sleeve at the lead wire joint section, and accurately insulate with a waterproof insulation pad (ex. Sumitomo 3M EMS-9091FR).

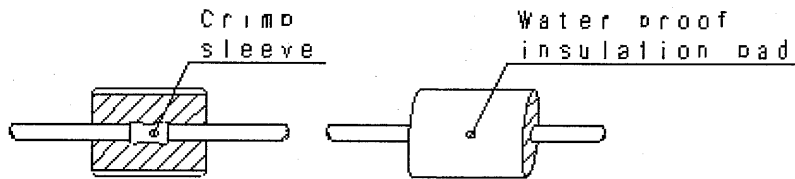


Fig. 10

(b) DIN terminal box (option)

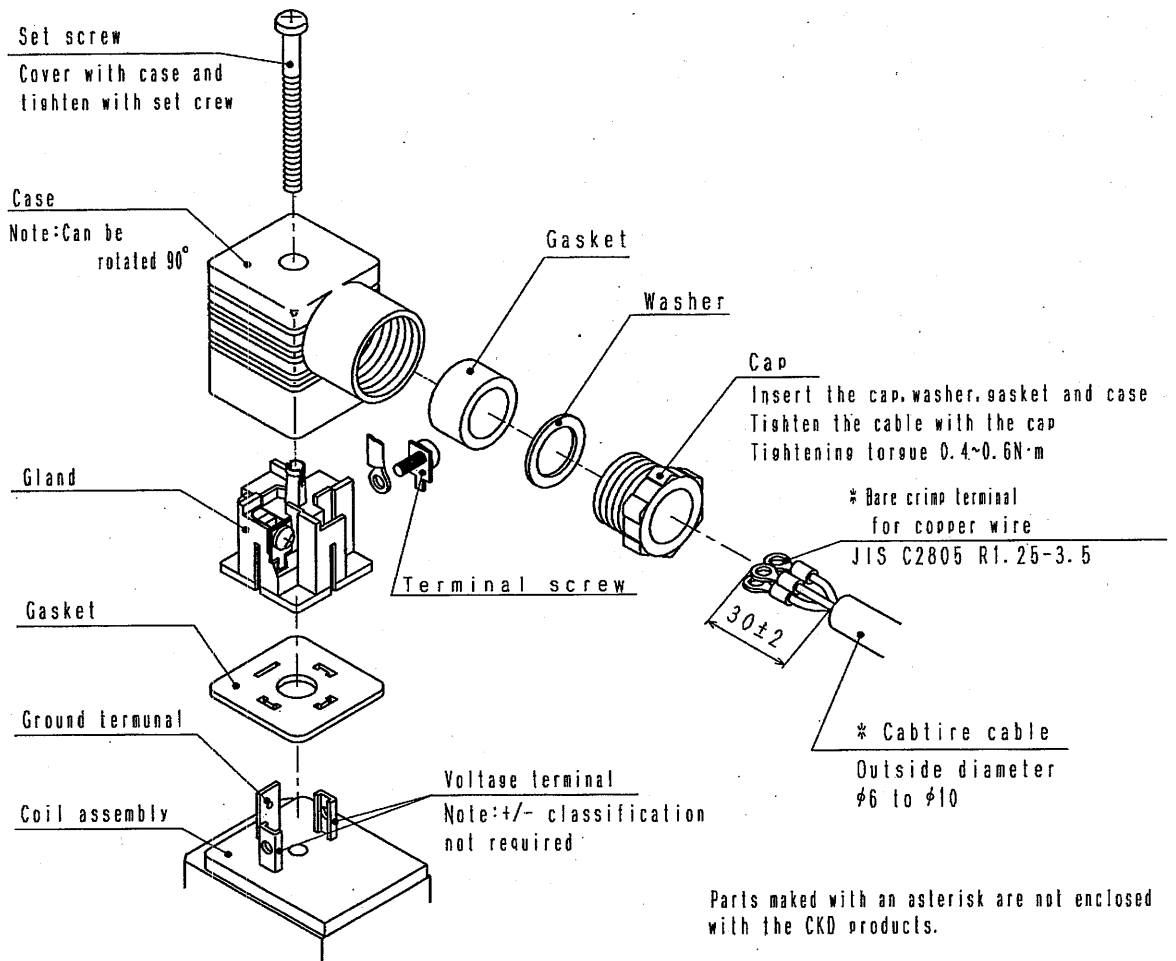


Fig. 11

(c) T type terminal box (option)

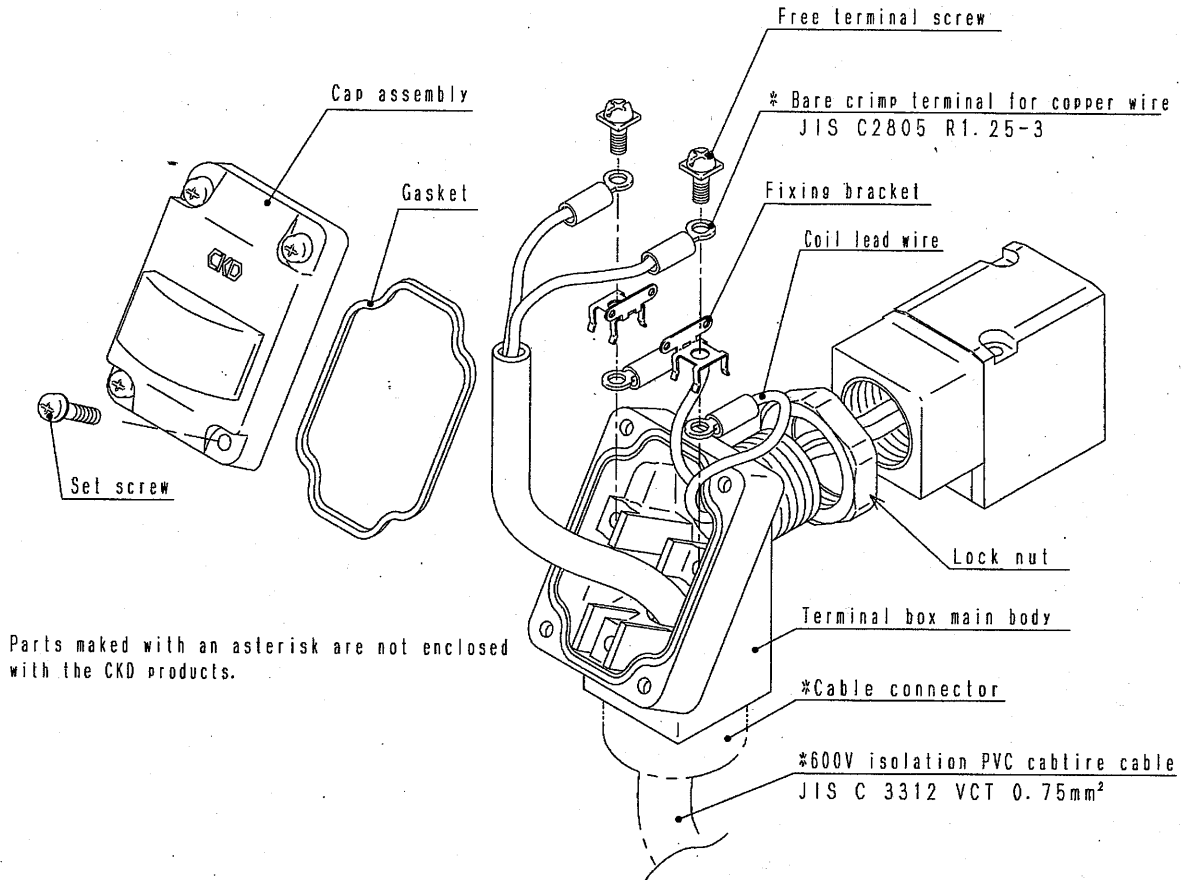


Fig. 12

- (6) The solenoid valve can be used in the continuous power ON state. If the power is turned ON for a long time, the coil surface temperature will rise to approx. 40to70°C, and will become very hot. Make sure that combustible matters do not come in contact, and provide sufficient heat dissipation with ventilation, etc.

### 3. Check items before starting operation (Check items after installation)

#### 3.1 Appearance check



**Caution** : Turn OFF the power.  
: Stop the fluid flow.  
(Turn the water off at the main.)

- (1) Press the piping connection by hand to check that solenoid valve is correctly secured to the piping.
- (2) Check that all the bolts and screws are securely tightened.

#### 3.2 Leak check

- (1) Confirm that the liquid does not leak from the connection section or to the solenoid valve's "OUT" side when applied within the working pressure range. (If there is air in the piping or solenoid valve, water will flow temporarily to the solenoid valve's "OUT" side immediately after the pressure is applied. This is not a leak.)

#### 3.3 Electrical check



**Caution** : Turn OFF the power.

- (1) Measure the insulation resistance between the metal section, such as the solenoid valve's body or screw parts, and the charged section, such as the lead wire. The state is correct if the resistance is  $10\text{M}\Omega$  or more.
- (2) Power supply voltage check  
The power supply voltage variation shall be in a range of  $-10\sim+10\%$  of the rated voltage.

## 4. Proper operating procedure



**Caution** : When using the solenoid valve is used in the continuous power ON state, the coil surface temperature will rise to approx. 40to70°C, and will become very hot.

Do not touch the coil with bare hands while the power is ON or immediately after turning the power OFF.

: Do not touch the electrical wiring connection sections (bare exposed sections) while the solenoid valve is energized with hands or body parts. (Note that if the solenoid valve is wet, this includes the water and solenoid valve.) There is a risk of electric shock.

: If electric cables are loose and directly placed on the work place floor, this may cause stumbling hazards. Protect the electric cables with appropriate measures, such as wire conduits.

: Do not use in an atmosphere that contains corrosive or flammable gases. There is a risk of accidents.

- (1) Use this solenoid valve for industrial water. Avoid using with agricultural water, contaminated water, sea water or water containing foreign matter, etc.
- (2) Always stay within the specified range for the temperature of the ambient air and the water that passes through the valve.
- (3) Use within the specified pressure range. Note that the inlet and outlet valve pressure difference must be 0.03MPa when the valve is open. (Refer to Fig. 13.)

$$\text{Differential pressure } \Delta P = P_1 - P_2 > 0.03\text{MPa}$$

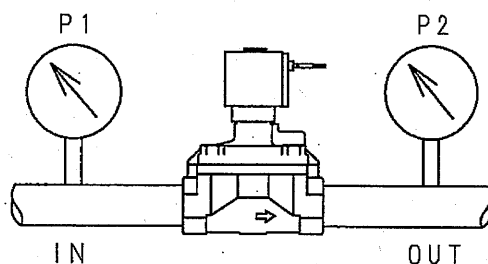


Fig. 13

- (4) When the solenoid valve has not been used for six months or more, operation faults or leakage faults could occur due to changes in the water quality. Disassemble and clean the valve in this case. Refer to the "5. Disassembly, Cleaning, assembly".
- (5) Strictly follow the valve activation frequency.

Activation frequency [activations/min]
6 or less

## 5. Disassembly, Cleaning, Assembly

For details on disassembly and assembly, refer to the disassembly figures in Fig. 17 and 18 according to the coil option symbol.

### 5.1 Disassembly procedure



**Caution** : Turn the water off at the main.  
: Discharge the fluid in the solenoid valve.  
: Turn OFF the power.

(1) For coil option symbols 2C, 2CS, 2G, 2HS, 2CG, 2CH, 3T and 3RS

When the clip ⑭ is removed, the parts will come off in the order of ⑬, ⑫ and ⑪.  
Refer to Fig. 14 for details on removing the clip.

For coil option symbol 7A: When the hexagon nut ⑲ is removed, the parts will come off in the order of ⑱, ⑰, ⑭, ⑬, ⑫ and ⑪.

(2) When the core assembly ⑩ is removed, the parts will come off in the order of ⑨, ⑧ and ⑦. When removing the core assembly, fix the stuffing ⑤, and turn the core assembly ⑩ counterclockwise while holding the lock nut section. Never hold the pipe section of the core assembly ⑩.

(3) Remove the Hexagon head bolt ⑥ and then remove the parts in the order of ⑤, ④, ③, ②.

(4) When using the type with manual operation mechanism (option), insert a coin or flat-tip screwdriver into the slot on the manual operation needle ⑩, and turn counterclockwise to remove.

<Removing the clip> (Excluding coil option symbol 7A)

Insert a flat-tip screwdriver between the core assembly and clip knob, and turn in the direct of the arrow to remove the clip.

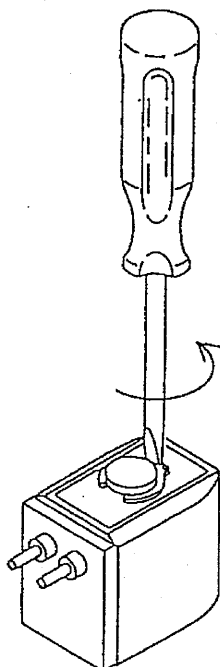


Fig. 14

## 5. 2 Cleaning

Wash the disassembled parts with water or a neutral detergent.

Note that contamination on the coil should be wiped off, and the coil must not be washed.

Do not use organic solvent as it could cause the rubber parts to expand

## 5. 3 Assembly procedure

- (1) To re-assembly, follow the instructions for "5.1 disassembly" in reverse order, and make sure not to forget any of the parts. Refer to Fig. 15 for details on assembling the clip ⑭ (excluding coil option symbol 7A).
- (2) Tighten the hexagon head bolts ⑥ diagonally so that they are uniform. Tighten the hexagon head bolts with a torque of 13 to 18N.m.
- (3) To prevent the outer spring ⑨ (⑧ for coil option symbol 7A) from biting, temporarily tighten the core assembly ⑩ until it contacts the O-ring ⑦, and then tighten with a torque of 16 to 24N.m.
- (4) Apply the fluid pressure, and confirm that the fluid does not leak out.
- (5) Turn the power ON so that the fluid circuit can be used.

<Assembling the clip> (Excluding coil option symbol 7A)

Place a flat-tip screwdriver on the clip knob as shown below, and press in the direction of the arrow.

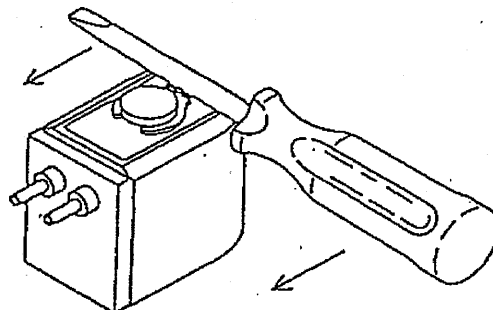


Fig. 15

## 6. Maintenance

### 6. 1 Maintenance and inspection

- (1) Periodically inspect the valve once 6 months to keep its optimal operating status.
- (2) Refer to section "5.1 Disassembly procedures", disassemble the part and inspect.
  - (a) Check that there is no foreign matter such as contaminant in the valve or rust in the piping, and check that no highly viscous matter is adhered. If any abnormality is found, disassemble and clean the part.
  - (b) Check that the plunger and the diaphragm assembly is not damaged or abnormally worn. Replace the part if any abnormality is found.
  - (c) Clean the No. 1 and No. 2 orifice of the body with a 0.4mm or thinner wire, etc. (0.5mm or thinner for WHL11-20A and WHL11-25A).

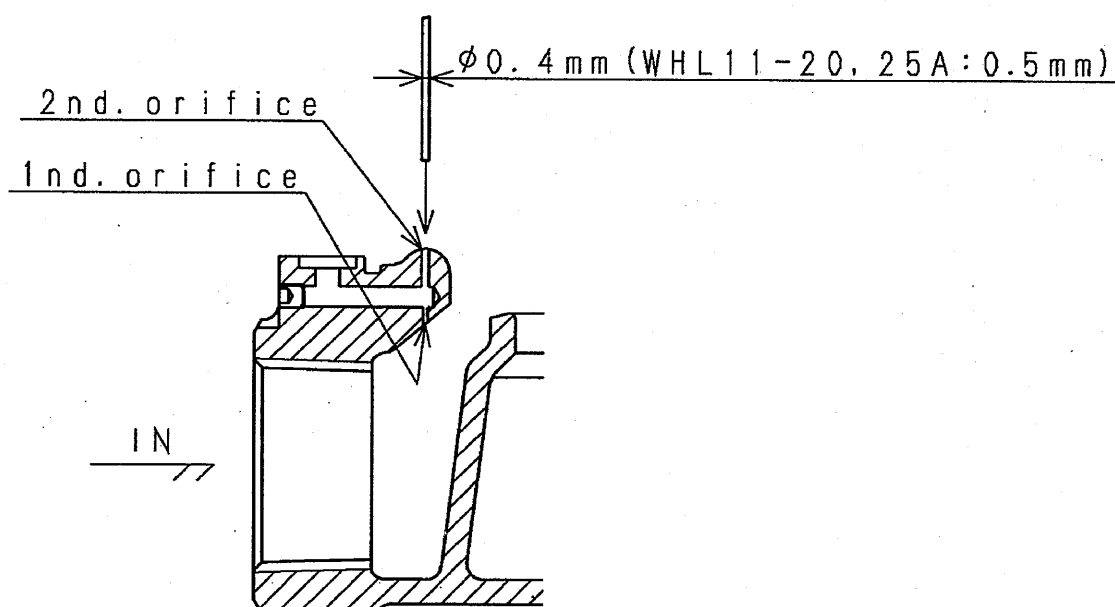


Fig. 16

### 6. 2 Spare parts

- (1) The following maintenance parts are available as a kit. If any abnormality is found in the parts, replace the part immediately. (Refer to the disassembly drawings in Fig. 17.)

Kit name	Parts	Number in disassembly drawing
Diaphragm ass'y kit	Diaphragm ass'y	③
Core ass'y kit	Core ass'y	⑩
Plunger ass'y kit	Spring	⑨
	Plunger ass'y	⑧
	O-ring	⑦
Coil kit	Clip	⑭
	Coil	⑫
	Wave washer	⑪

Note. Contact your dealer for the coil option symbol 7A.

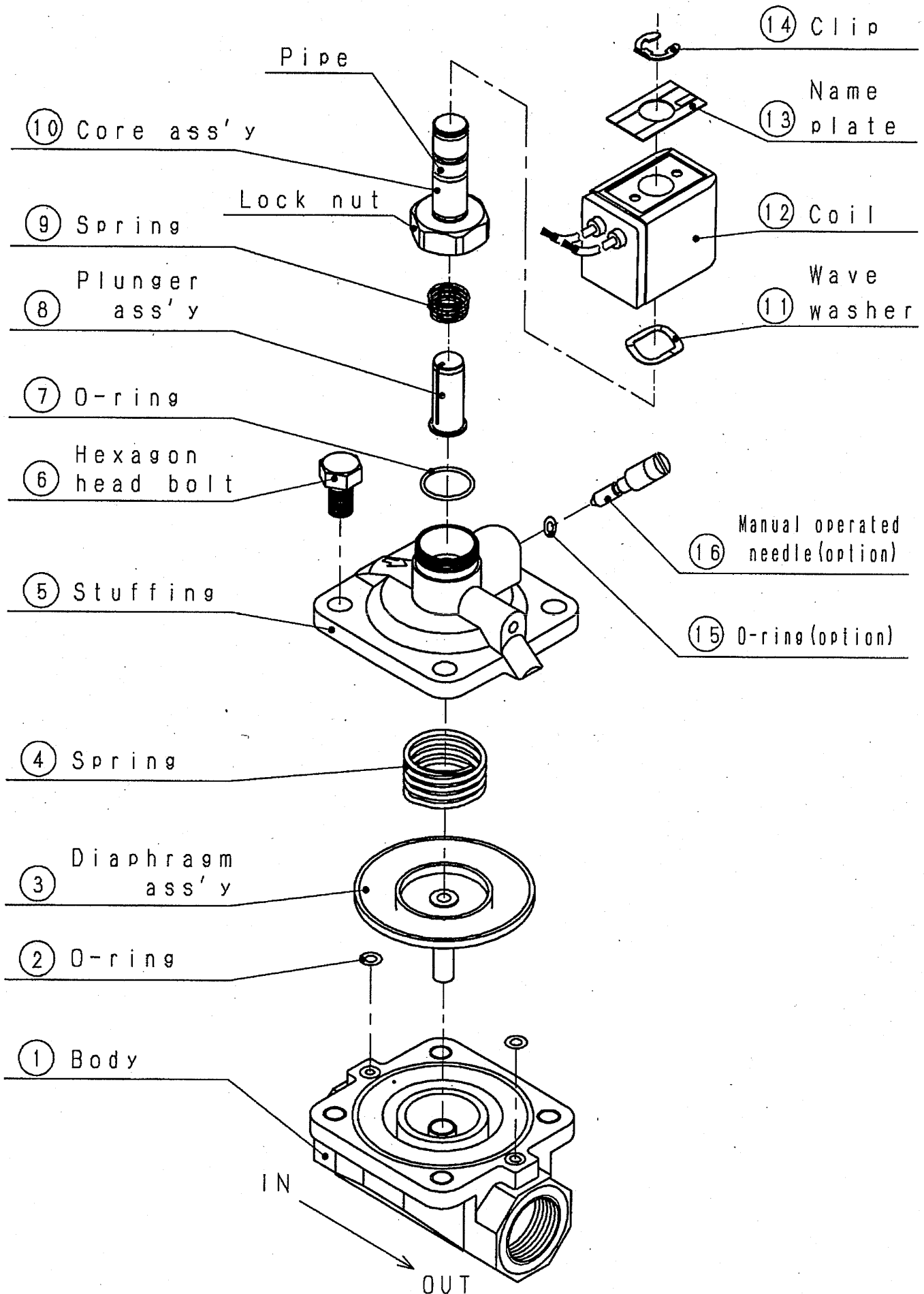


Fig.17 Disassembly drawing (Coil option symbol: 2C)

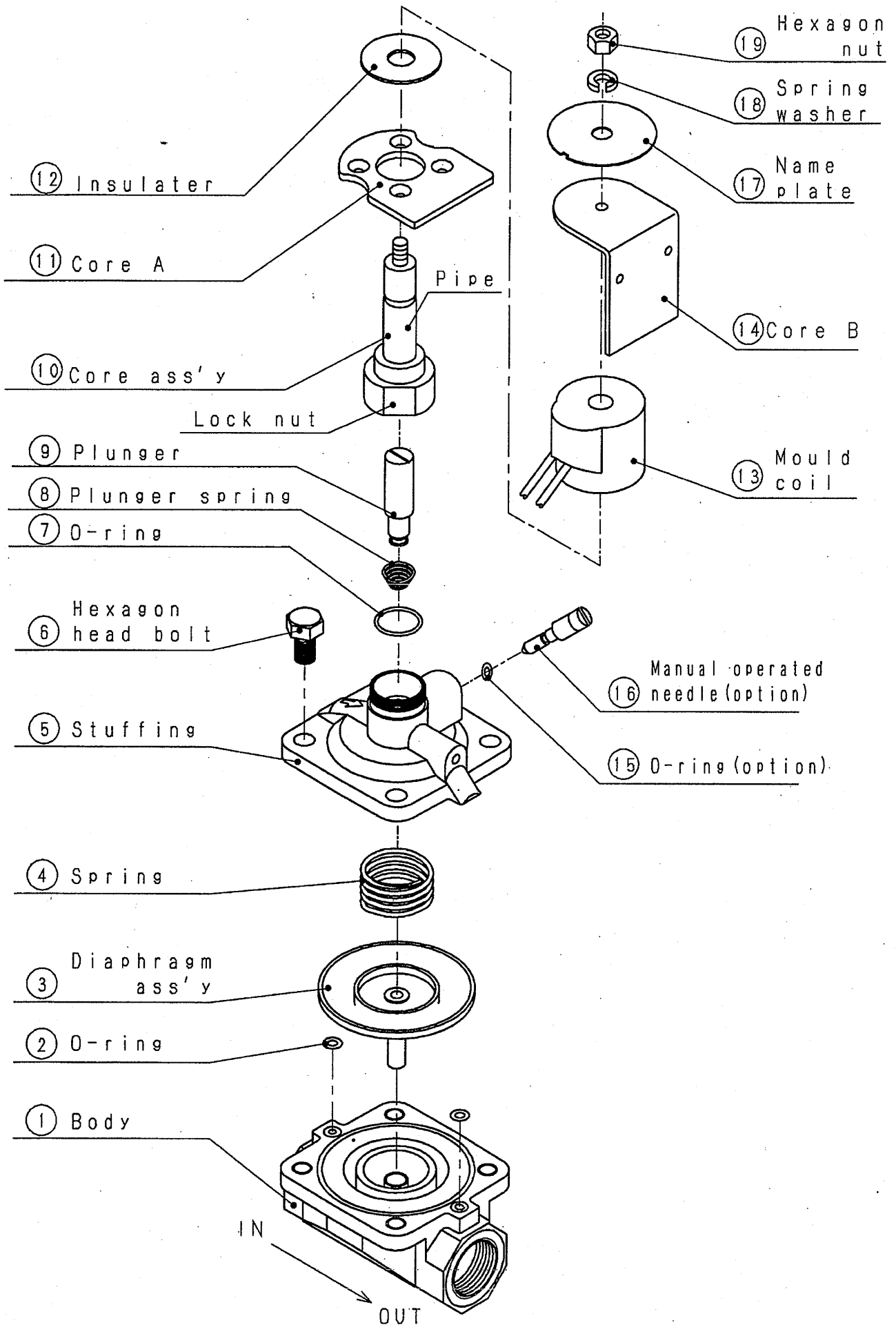


Fig.18.Disassembly drawing (Coil option symbol: 7A)

## 7. Troubleshooting

(1) If the solenoid valve does not operate as intended, refer to the following table and inspect.

	Cause of malfunction	Measures
When solenoid valve does not open.	The power is not ON.	Check the power.
	The coil or the lead wire is disconnected.	Replace the coil.
	The specified rated voltage is not applied on the coil end (lead wire).	Correct to within the specified rated voltage range.
	The "IN" side pressure specifications are not within.	Correct the specifications into the range.
	The pressure difference between the "IN" side and "OUT" side is not within the specified pressure difference range.	Correct to within the specified pressure difference range.
	Foreign matter, etc., is caught in the "OUT" side valve seat and pilot hole of the coil section.	Remove the foreign matter.
	The plunger is biting foreign matter.	Remove the foreign matter.
	The diaphragm assembly is damaged.	Replace the diaphragm assembly.
When solenoid valve does not close.	The power is not OFF.	Check the power.
	Water is leaking out side of the solenoid valve.	Tighten the bolts, etc.
	Foreign matter is engaged between the diaphragm assembly and valve seat.	Remove the foreign matter.
	The fluid flow direction and solenoid valve installation direction do not match.	Correct the installation direction.
	The pressure difference of the "IN" side and "OUT" side valves is not within the specified pressure difference range.	Correct to within the specified pressure difference range.
	Foreign matter is caught in the No. 1 and No. 2 orifice. (Refer to section "6.1 Maintenance and inspection (2) (c)".	Remove the foreign matter.
	The plunger is stuck because of foreign matter, etc.	Remove the foreign matter.
	Plunger valve seat is damaged.	Replace the plunger ass'y.

8. Internal structure drawing

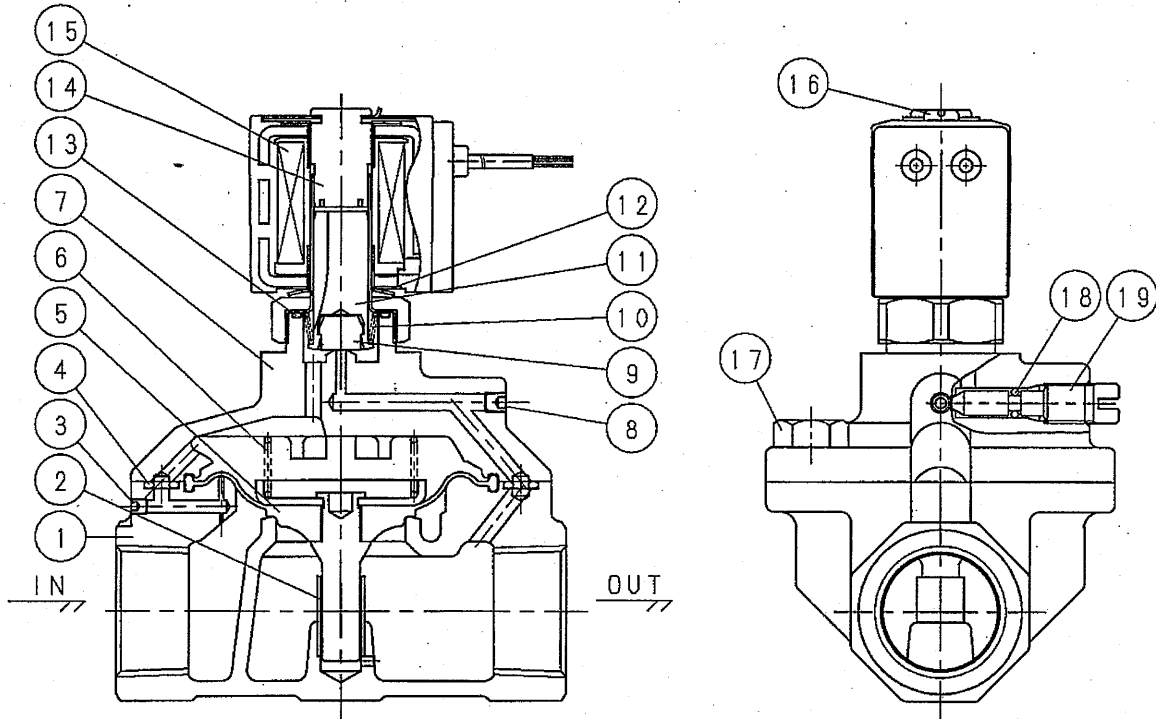


Fig. 19

Part No.	Part name	Q'ty	Part No.	Part name	Q'ty
①	Body	1	⑩	Plunger	1
②	Guide pipe	•2	⑪	Wave washer	1
③	Hexagon socket headed plug bolt	1	⑫	O-ring	1
④	O-ring	2	⑬	Core ass'y	1
⑤	Diaphragm ass'y	1	⑭	Mold coil	1
⑥	Spring	1	⑮	Clip	1
⑦	Stuffing	1	⑯	Hexagon head bolt	4
⑧	Hexagon socket headed plug bolt	1	⑰	O-ring	•1 1
⑨	Valve seat B	1	⑱	Manual operated needle.	•1 1
⑩	Plunger spring	1			

Note

- 1 Part numbers ⑰ and ⑱ are optional parts used only with the type with manual operation mechanism.
- 2 Part number ② is used only with the WHL11-20A and WHL11-25A. This part is not used with WHL11-15A.

## 9. Activation description

### 9.1 Open activation

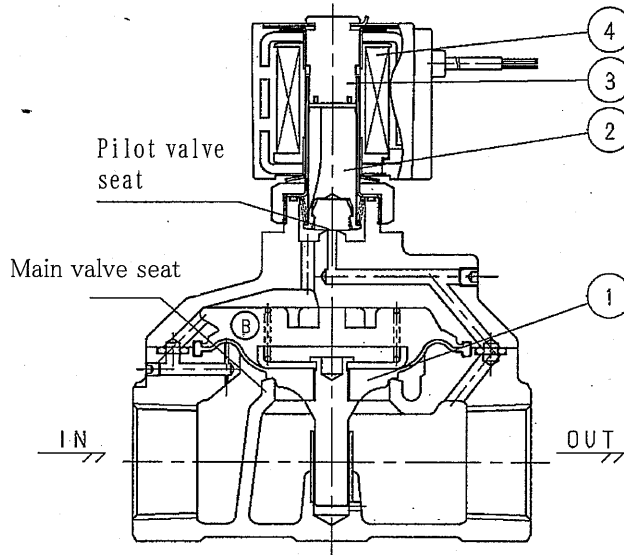


Fig. 20

When the coil ④ is energized, the plunger ② is attracted to the core assembly ③. The liquid in the upper ⑤ chamber of the diaphragm assembly passes through the pilot valve seat, and flows to the "OUT" side. At this moment, the ⑤ chamber pressure drops below the "IN" side pressure, creating a pressure difference. The diaphragm assembly ① rises with this pressure difference, and allows the water to pass. (Refer to Fig.20)

### 9.2 Close activation

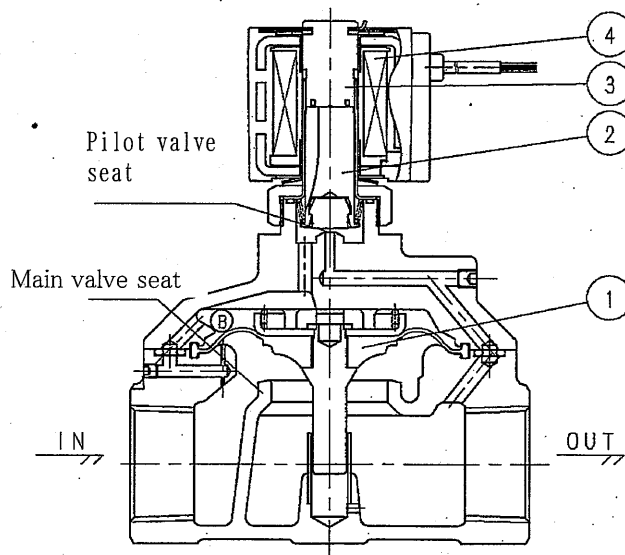


Fig. 21

When the power to the coil ④ is stopped, the plunger ② separates from the core assembly ③ by the spring force, and the pilot valve seat closes, then the valve will start to close. Immediately after the closing operation starts (refer to Fig. 22), the water from the inlet will flow as shown with the arrow. At this time, the water flows through the No. 1 and No. 2 orifices into the ⑤ chamber, so the diaphragm assembly ① will quickly move toward the valve closing direction. When the valve closing degree becomes relatively small (refer to Fig. 23), the diaphragm assembly ① will plug the No. 2 orifice, and the water will

pass through the No. 1 orifice into the ③ chamber. Thus, the valve closing movement of the diaphragm assembly ① will slow down, and the main valve seat will close while suppressing the water hammer. The flow of water from inlet to outlet direction will stop. The valve opening time is shortened by this series of valve closing operations (fast to slow).

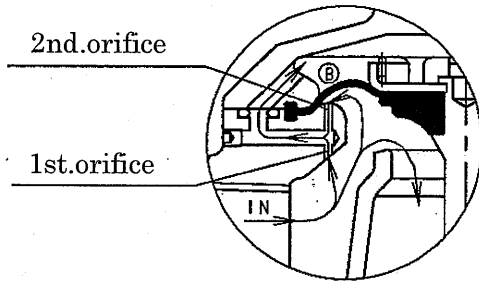


Fig. 22

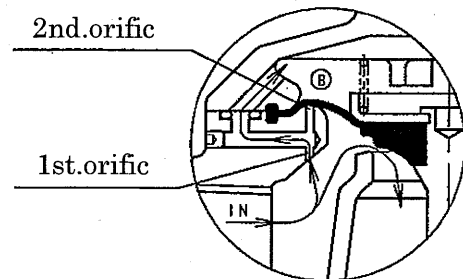



Fig. 23

### 9.3 Opening/closing with manual operations



**Caution :** When opening the valve, if the manual operation needle is turned too far, the water will spray externally. Turn the manual operation needle 3 to 5 times within the pressure range 0.03 to 0.1MPa, or 0.5 to 3 turns at a pressure exceeding 0.1MPa.

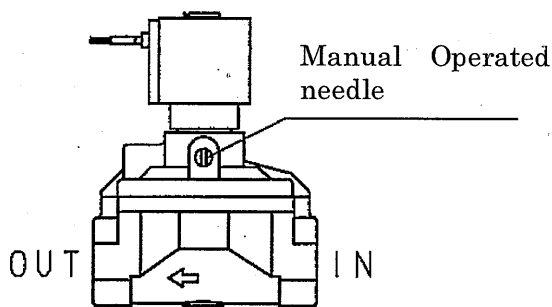


Fig. 24

The manual operation is a mechanism to open and close the solenoid valve when the power to the coil is stopped. (Refer to Fig. 24)

When a coin or flat-tip screwdriver is inserted into the manual operation needle's slot and turned counterclockwise, the solenoid valve will open.

To close the solenoid valve, turn the manual operation needle clockwise and tighten the manual operation needle.

## 10. Product specification

## 10.1 Product number explanation

**WHL11-20A-2C A-Voltage**

① ② ③ ④

① Piping size	
Mark	Screw type
15A	Rc <sup>1/2</sup>
20A	Rc <sup>3/4</sup>
25A	Rc1

② Coil option		
Symbol	Descriptions	
STD	2C	Grommet with lead wire
Option	2CS	Grommet with lead wire surge suppressor
	2G	DIN terminal box(Pg11)
	2HS	DIN terminal box indicator light/surge suppressor(Pg11)
	2CG	Conduit (CTC19)
	2CH	Conduit (G <sup>1/2</sup> )
	3T	T type terminal box(G <sup>1/2</sup> )
	3RS	T type terminal box with indicator light & surge suppressor(G <sup>1/2</sup> )
	7A	Open frame coil

Note : When coil option is 2CS, a surge suppressor is incorporated in the coil , while 2HS, 3RS, in the terminal box.

③ Manual operation		
Symbol	Descriptions	
STD	Blank	No
Option	A	Yes

\*: Marked with an asterisk are in case of coil option "7A" type.

④ Voltage	
AC100V	*AC100V
AC200V	*AC200V
DC12V	*AC24V
DC24V	*DC24V

## 10.2.Product specifications

	WHL11-15A	WHL11-20A	WHL11-25A
Working Fluid	Industrial water		
With standing pressure (water) MPa	1.75		
Working pressure differential range MPa	0.03~0.7		
Fluid temperature °C	4~60		
Ambient temperature °C	-10~60		
Ambient humidity %RH	90 or less		
Rated voltage	AC100V, AC200V, DC12V, DC24V (* AC100V, AC200V, AC24V, DC24V)		
Allowable voltage fluctuation	-10 to +10 %		
Power consumption W	AC:4/3.2 ( 50/60Hz ), DC:6 (* AC:2.5,DC:3 )		
Insulation class	Class B		
Coil temperature rise °C	70 (* 30)		
Cv flow factor	5.2	9.7	13.3
Mass kg	1	1.4	1.5

\* : Marked with an asterisk are in case of coil option "7A" type.