Model OB-2000

Temperature Regulator

Instruction Manual

Thank you very much for purchasing our temperature regulator. Please read this instruction manual thoroughly before using the temperature regulator, so that you may do so correctly and safely. Please carefully store this manual in a handy place.

——— The following safety symbols are used in this manual. ———

⚠Warning This symbol indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

⚠Caution This symbol indicates a hazardous situation that, if not avoided, may result in minor or moderate injury ("Caution" may also be used to indicate other unsafe practices or risks of property damage.).

Contents

YOSHITAKE

■ PDT-051 ■

Pilot-actuated type temperature regulator features format in which the pilot (small temperature regulating valve) operation is actuated according to the detected temperature, with the main valve then being actuated according to the pressure differential which exists. Compared to direct-acting type, this regulator offers considerably better controllability, and is ideally suited for use with heat exchangers, water heaters, air-conditioning equipment, and chemical processing equipment, as well as many others.

1. Features

(1) Enables you to control a large capacity and excellent durability.
(2) Excellent sealability due to the spherical surface of the main valve.
(3) A wide range of temperature regulation is possible, and the thermal bulb can be mounted in any position.
(4) As the body and thermal bulb (sensor) are easily mounted and removed, it is easy to exchange parts to accommodate changes in temperature specifications.

2. Models

Model	Nominal pressure	Connection	Nominal size
OB-2000	2.0 MPa {20 kgf/cm²}	Screwed	15-50A
	2.0 MPa {20 kgf/cm²}	Flanged	15-100A
	1.0 MPa {10 kgf/cm²}	Flanged	15-100A

3. Specifications

Model		OB-2000		
Application	Heating	Steam		
	Heated	Water, Oil, Liquid		
Max. Pressure	Body	2.0 MPa {20 kgf/cm²G}	2.0 MPa {20 kgf/cm²G}	1.0 MPa {10 kgf/cm²G}
	Bulb	1.0 MPa{10 kgf/cm²G}		
Min. Differential pressure		0.05 MPa {0.5 kgf/cm²}		
Max. Temperature		220 °C		
Set point range		-8 ~ 183 °C		
Valve seat leakage		0.01% or less of rated flow		
Material		Body : Ductile cast iron Pilot body : Bronze Valve, Valve seat(Main and Pilot) : Stainless steel Diaphragm : Stainless steel Bulb : Copper(Nickel chrome plated)		
Capillary tube length		2 m		
Connection		Screwed (JIS Rc)	Flanged (JIS 20K RF)	Flanged (JIS 10K FF)
Body hydraulic test		4.0 MPa {40 kgf/cm²G}		2.0 MPa {20 kgf/cm²G}

- Stainless steel thermal well is available.
- 3m or 5m length capillary tube are also available.
- NPT screwed connection is available.
- Other standard connection are available upon request.

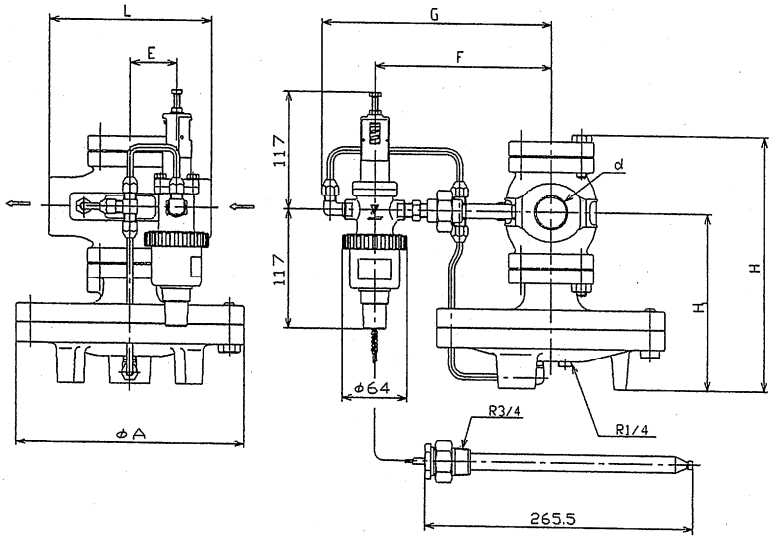
- **Division of set point range**

(°C)

Set point range	Temperature Endurance
-8 ~ 15	35
10 ~ 36	56
30 ~ 62	82
55 ~ 94	114
80 ~ 127	147
115 ~ 183	203

4. Dimensions and Weights

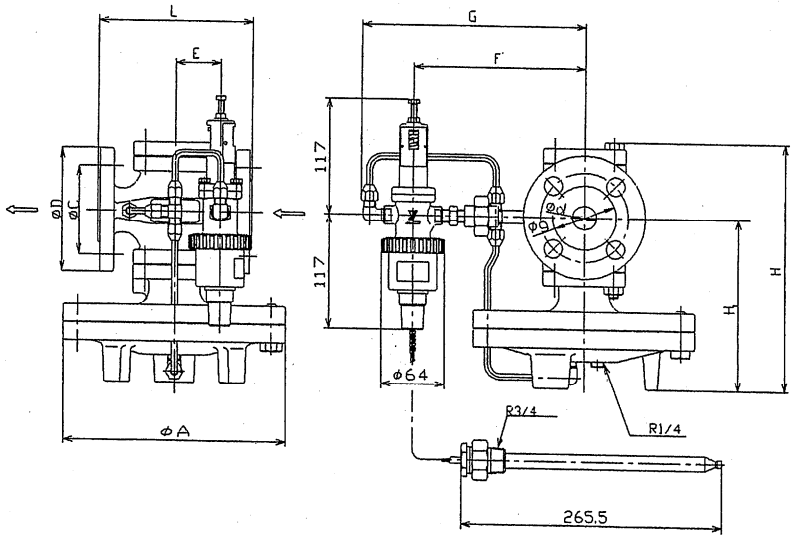
4-1. Screwed type



(mm)

Size	d	L	H1	H	A	E	F	G	Weight (kg)
15A	Rc 1/2	150	170	244	200	45	169	222	14.1
20A	Rc 3/4	150	170	244	200	45	169	222	14.1
25A	Rc 1	160	175	251	226	46	174	227	18.1
32A	Rc 1-1/4	180	192	282	226	55	182	235	21.6
40A	Rc 1-1/2	180	192	282	226	55	182	235	21.6
50A	Rc 2	230	216	319	276	60	189	242	32.7

4-2. Flanged type



(mm)

Size	L	H1	H	A	E	F	G	Flanged (JIS 20K RF)						Weight (kg)
								d	D	C	g	t	n-φh	
15A	146	170	244	200	45	169	222	15	95	70	51	14	4-15	15.6
20A	146	170	244	200	45	169	222	20	100	75	56	16	4-15	16.1
25A	156	175	251	226	46	174	227	25	125	90	67	16	4-19	21.1
32A	176	192	282	226	55	182	235	32	135	100	76	18	4-19	24.1
40A	196	192	282	226	55	182	235	40	140	105	81	18	4-19	24.6
50A	222	216	319	276	60	189	242	50	155	120	96	18	8-19	35.7
65A	282	251	373	352	75	206	259	65	175	140	116	20	8-19	63.3
80A	302	265	399	352	80	217	270	80	200	160	132	22	8-23	70.3
100A	342	321	488	401	105	234	287	100	225	185	160	24	8-23	110.0

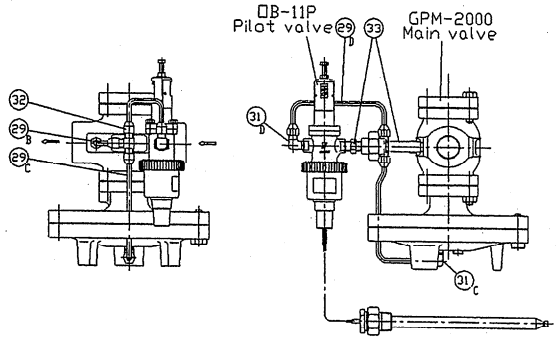
(mm)

Size	L	H1	H	A	E	F	G	Flanged (JIS 10K FF)					Weight (kg)
								d	D	C	t	n-φh	
15A	142	170	244	200	45	169	222	15	95	70	12	4-15	15.4
20A	142	170	244	200	45	169	222	20	100	75	14	4-15	15.9
25A	152	175	251	226	46	174	227	25	125	90	14	4-19	20.7
32A	172	192	282	226	55	182	235	32	135	100	16	4-19	23.7
40A	192	192	282	226	55	182	235	40	140	105	16	4-19	24.2
50A	218	216	319	276	60	189	242	50	155	120	16	4-19	35.5
65A	278	251	373	352	75	206	259	65	175	140	18	4-19	63.0
80A	294	265	399	352	80	217	270	80	185	150	18	8-19	68.1
100A	330	321	488	401	105	234	287	100	210	175	18	8-19	106.4

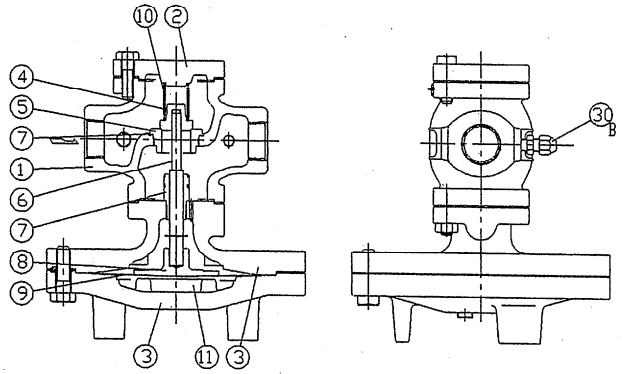
Main parts name

No.	Parts name	No.	Parts name	No.	Parts name
1.	Body	12.	Pilot body	23.	Thermal bellows
2.	Cover	13.	Spring chamber	24.	Capillary tube
3.	Diaphragm case	14.	Pilot valve	25.	Thermal bulb
4.	Main valve	15.	Pilot valve seat	26.	Ring
5.	Main valve seat	16.	Guide	27.	Bushing
6.	Spindle	17.	Seal bellows	28.	Washer of packing
7.	Guide	18.	Bellows plate	29.	Pipe
8.	Retainer	19.	Spring	30.	Joint
9.	Main diaphragm	20.	Adjusting screw	31.	Elbow
10.	Main valve spring	21.	Lock nut	32.	Tee
11.	Main diaphragm chamber	22.	Bellows follower	33.	Nipple

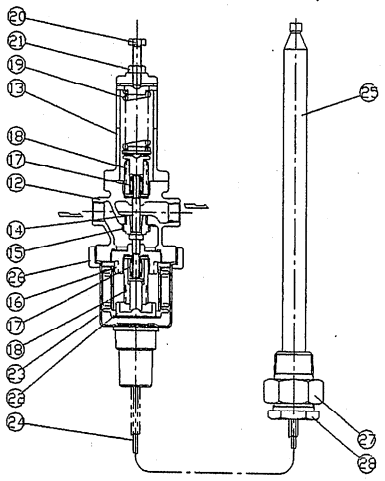
- OB-2000 Temperature regulator



- Main valve (GPM-2000)



- Pilot valve (OB-11P)

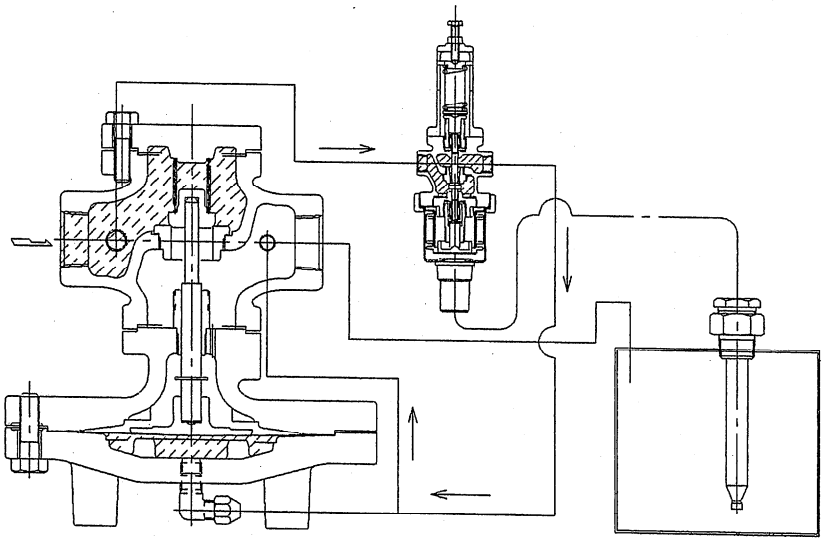


5. Operation

The component Nos. Shown below correspond to those listed in the preceding 'Main parts name' (Page.5).

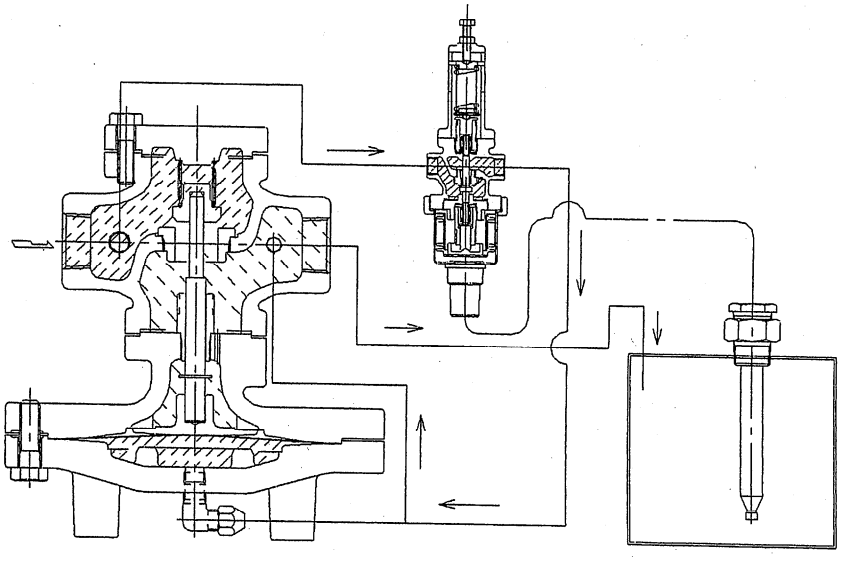
(1) When adjusting screw[20] is turned in the clockwise direction, adjusting spring[19] will be compressed, causing the pilot valve[14] to open (refer to the'8-1 adjustment'). Fluid is introduced by slowly opening the sluice valve at the inlet side. This fluid will then flow to the flowing two areas: To the rear side of main valve[4], and to the pilot valve (via nipple[33]). The fluid which flows through the pilot valve and pilot valve seat[15], will then pass through pipe D[29-D] and pipe C[29-C], and will enter main diaphragm chamber[11]. Meanwhile, a separate fluid to flow will pass through pipe B[29-B] and joint B[30-B], and will be discharged at the outlet side of body[1]. (Fig. 1)

Fig.1



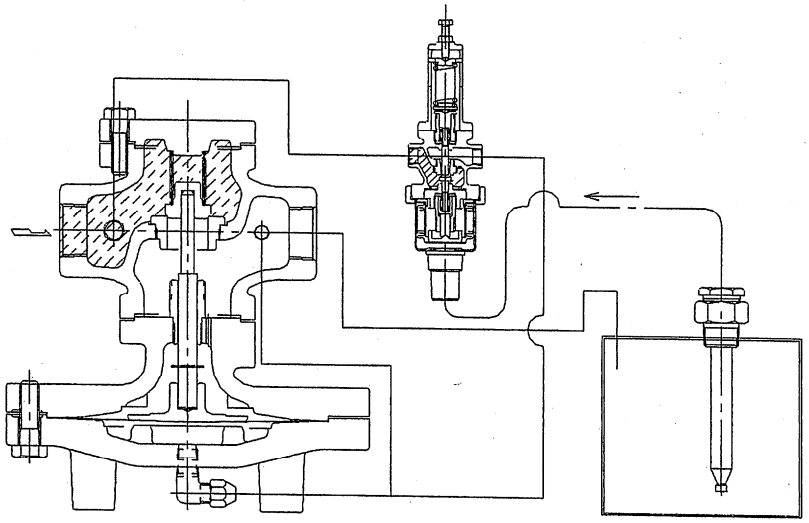
(2) When the pressure in the main diaphragm chamber reaches a given level, it will overcome both the pressure at the rear side of the main valve and the pressure exerted by main valve spring[10], and the main valve will be pushed to open, thereby allowing the fluid to flow to the outlet side. (Fig. 2)

Fig.2



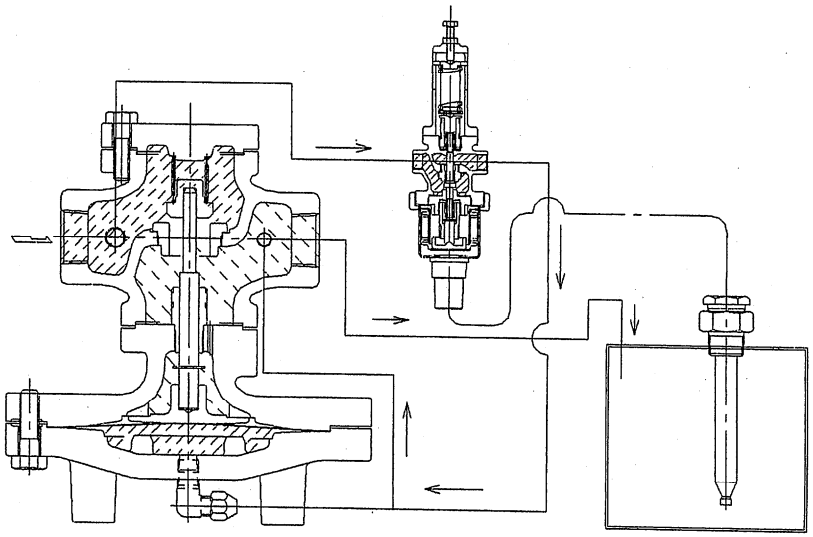
(3) When the fluid is heated, its temperature will be detected by thermal bulb[25], with the thermal bulb's internal pressure rising accordingly. This rising pressure will pass through capillary tube[24] and proceed to thermal bellows[23], causing the thermal bellows to compress and to exert an upward force. When this upward force reaches a give level, it will overcome the adjusting spring load and the pilot valve will open. The pressure in the diaphragm chamber will then drop, and the main valve will be closed, thereby stopping the fluid flow. (Fig. 3)

Fig.3



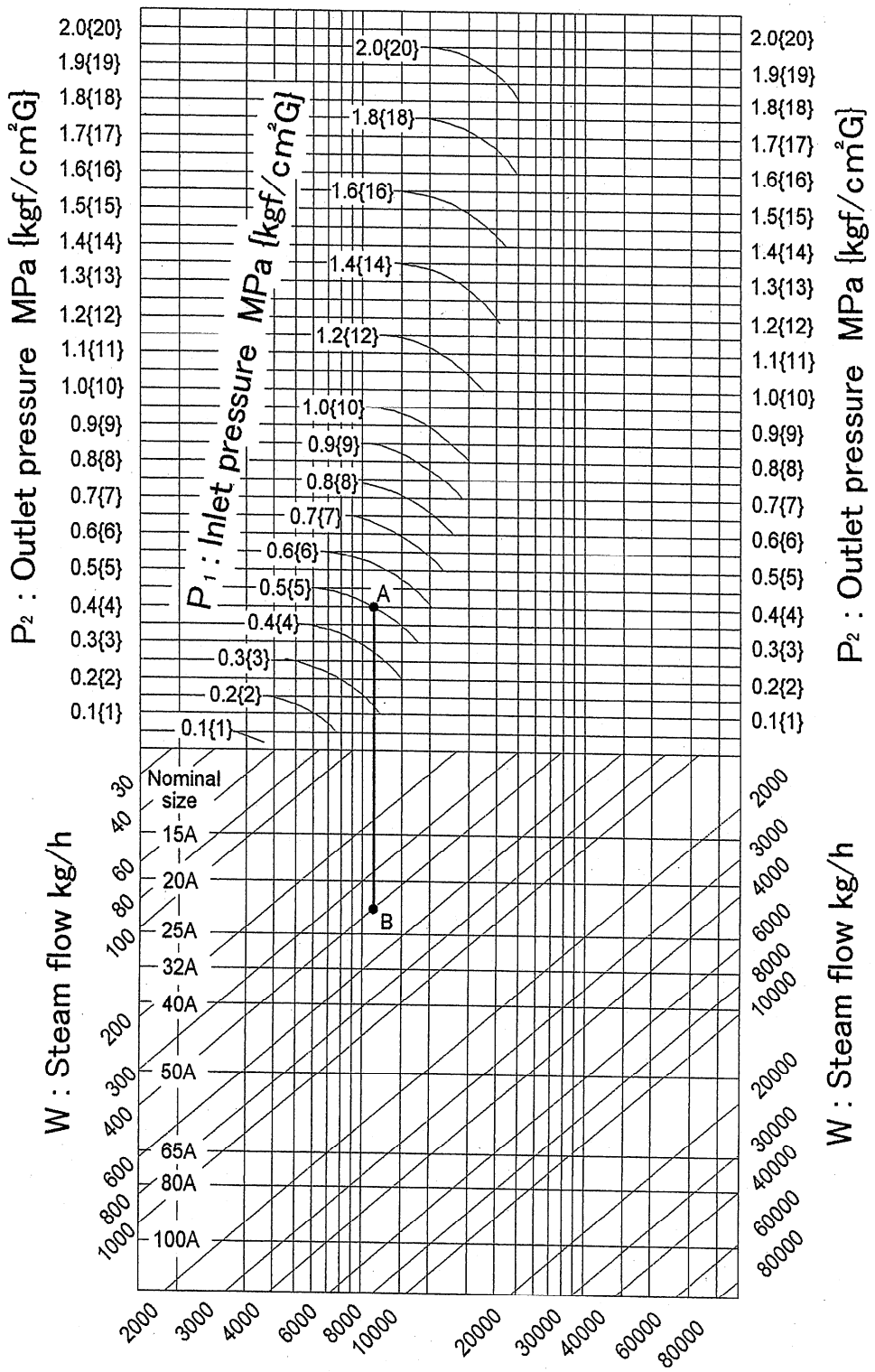
(4) When the fluid temperature decreases, this will be detected by the thermal bulb, and the thermal bulb's internal pressure will drop accordingly, thereby lessening the bellow's internal force. The adjusting spring load will then overcome the force being applied by the bellows, and both the pilot valve and the main valve will open, allowing the fluid to flow to the outlet side. The above operation is repeated as often as necessary in order to maintain a stable temperature. (Fig. 4)

Fig.4



6. Nominal Size Selection Chart

For example, take a temperature regulator whose inlet pressure(P_1) is 0.5 MPa{5 kgf/cm²G}, outlet pressure(P_2) 0.4 MPa{4 kgf/cm²G}, flow rate 400 kg/h. When determining the nominal size, find the point of intersection(A) of inlet pressure 0.5 MPa{5 kgf/cm²G} and outlet pressure 0.4 MPa{4 kgf/cm²G}. Vertically proceed from point(A) to come across the flow rate 400 kg/h, and regard this point as (B). Point(B) is between nominal sizes 20A and 25A. Select the larger nominal size (in this example, nominal size 25A).



7. Precautions before Operation

When installing the temperature regulator, observe the precautions below.

7-1. When installing the temperature regulator

⚠Caution

(1) Do not disassemble the valve unreasonably.

* Disassembling the valve at your discretion may affect the original performance.

(2) Remove foreign matter and scales from the lines before connecting the valve.

* Failure to do so may prevent the valve from functioning correctly.

(3) Install the valve so that the arrow on the valve body coincides with the direction of the fluid flow.

* Failure to do so may prevent the valve from functioning.

(4) Install the valve perpendicularly to horizontal lines with the diaphragm chamber located at the bottom.

* Failure to do so may affect the original performance.

(5) Be extremely careful not to damage the copper pipe.

* Damage to the copper pipe may prevent the valve from functioning correctly.

(6) Do not apply excessive load, torque or vibration to the valve.

* Doing so may result in drastically shortened service life or operational failure.

7-2. When installing the thermal bulb.

⚠Caution

(1) Although the thermal bulb can be mounted in any posture, be sure that the mount position allows at least 3/4 of its total length to be immersed in the fluid to be monitored.

* Failure to do so may affect the original performance.

(2) Screw on bushing[27] first, then use washer of packing[28] to secure thermal bulb[25].

* Failure to do so may prevent the valve from functioning.

(3) The bend radius of the capillary tube should never be less than 40mm. Avoid abrupt bend in the tube, and never twist or pull it with force. Furthermore, it should be secured in a manner which prevents it from touching the steam piping, etc..

* Damage to the capillary tube may prevent the valve from functioning correctly.

(4) Install the thermometer in a position close to the thermal bulb.

* Failure to do so may affect correct adjusting and the original performance.

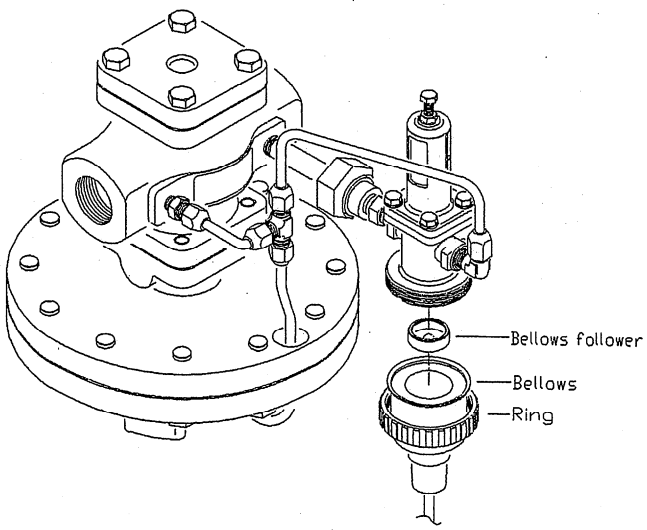
(5) If temperature detection is to be executed with the thermal bulb inserted into the piping, it should be installed at a point where the circulation is best.

* Failure to do so may prevent the setting temperature.

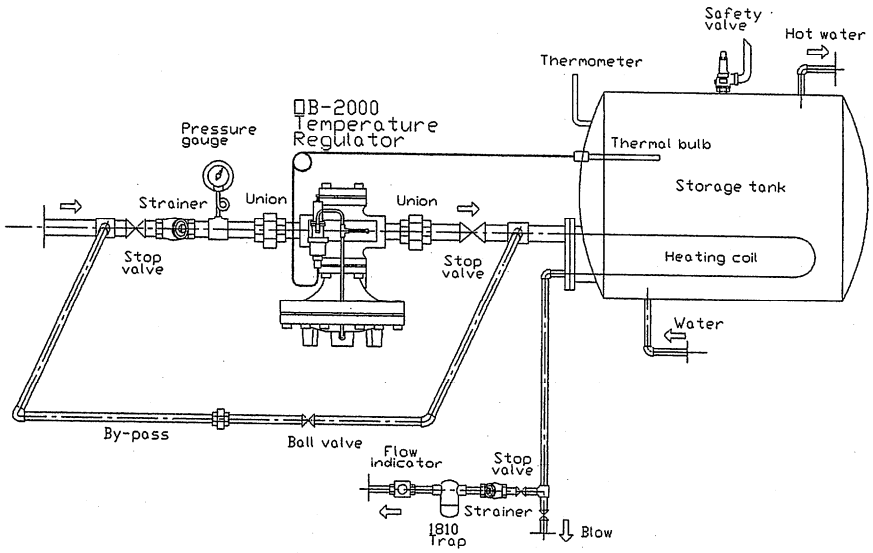
7-3. Assembly pilot valve and thermal bulb

Install bellows follower[22] into the thermal bellows with its flat surface facing downward, then use the fastener ring to screw the thermal bellows assembly to the body.

*Be sure the bellows follower is not lost when unpacking the unit.



7-4. Examples of piping



8. Precautions for Temperature Regulator Operation

Follow the steps in 8-1 Adjustment, and slowly turn the adjusting screw to control pressure.

* Incorrect adjustment may cause hunting, water hammer, etc., resulting in damage to the valve and other equipment.

⚠Warning

(1) Do not touch the valve directly with bare hands.

* Doing so may result in burns.

⚠Caution

(1) Close the stop valves located at front and rear of the temperature regulator, and remove all foreign matter and scales via the by-pass line before operation.

* Failure to do so may prevent the valve from functioning correctly.

(2) Remove condensation completely from the line, and close the stop valves located at front and rear of the valve when not using it for long periods of times.

* Rust generated in the valves and lines may cause malfunction. Incorrect adjustment of the valve may cause problems due to scales, hunting, water hammer, etc., resulting in drastically damaged trim.

8-1. Adjustment

(1) Close the stop valves located at the front and rear of the temperature regulator and pass fluid (introduced into the system at the by-pass) through the piping until all foreign matter has been evacuated. After this operation, be sure to close the by-pass line. When passing the fluid through the piping, be sure that the fluid temperature does not exceed the prescribed temperature endurance.

(2) Turn the adjusting screw until the scale's indicator reading is at the desired position. Turn the screw to the right to increase the temperature, and to the left to decrease the temperature.

(3) Slowly open the inlet side of stop valve to its full open position, then little by little, open the outlet side of stop valve to its full open position.

(4) Re-adjust as necessary while referring to the thermometer reading (allow enough time for the thermometer to register the temperature).

(5) The scale values and approximate corresponding temperatures are shown in the table below. These values may vary somewhat according to the operating conditions.

Unit:℃

Scale Value	Temp. Regulating Range					
	-8～15℃	10～36℃	30～62℃	55～94℃	80～127℃	115～183℃
0.5	-11	4	22	45	68	101
1.0	-2	15	37	61	89	130
1.5	6	25	49	76	107	153
2.0	14	34	58	91	125	178

9. Troubleshooting

Most temperature regulator problems are the result if scaling caused by foreign particles such as sand and dust, etc., inside the piping. Therefore, be sure that the piping has been thoroughly cleaned out. Problems caused by faulty pressure gauges, failure to close the by-pass valve, clogged strainers, etc., are often mistakenly thought to be temperature regulator malfunctions. To avoid such a mistake, verify that all equipment is functioning properly before resorting to the troubleshooting instructions given below.

Problem	Cause	Solution
Temperature fails to rise.	1. Adjustment is incorrect.	1. Re-adjusting according to the adjustment procedure.
	2. The nominal size is too small for these specifications.	2. Replace with the correct nominal size item.
	3. The sensor being used in improper for the temperature which is desired.	3. Check the ravel, and replace the sensor if necessary.
	4.The ambient temperature is higher than the setting temperature.	4. Install a ventilation fan and/or windows to lower the ambient temperature.
	5. The traps of the heat exchanger, etc., cannot be drained of sediment.	5. Open the trap's by-pass valve and check its condition.
	6. Main diaphragm[9] is damaged.	6. Remove pipe C[29-C] and open the by-pass valve. If fluid is discharged from elbow C[31-C], replace main diaphragm[9].
	7. Joint C[30-C]'s orifice is clogged.	7. Remove the joint and clean out the orifice
	8. Joint B[30-B] has no orifice.	8. Replace with the correct joint.
Temperature rises excessively.	1. Adjustment is incorrect.	1. Re-adjust according to the adjustment procedure.
	2. Either foreign matter is embedded in the main valve[4] or main valve seat[5], or else scratches exist.	2. Free (no-load) the adjusting spring [19], then disconnect pipe D[29-D]. Next, supply fluid to the inlet side of the temperature regulator. If a fluid discharge occurs at tee[32] at this time, disassemble the unit and clean out the foreign matter. If scratches exist, polish them away.
	3. Either foreign matter is embedded in the pilot valve[14] or pilot valve seat[15], or else scratches exist.	3. With the thermal bulb exposed to a temperature which exceeds the setting temperature, remove pipe D[29-D]. Next, supply fluid to the inlet side of the temperature regulator. If a fluid discharge occurs at elbow D[31-D], disassemble the unit and clean out the foreign matter. If scratches exist, polish them away.
	4. Joint B [30-B]'s orifice is clogged.	4. Remove and clean it.
	5. The thermal bulb[25] and/or thermal bellows [23] is damaged.	5. Replace the sensor.
	6. The by-pass pipe is leaking.	6. Repair, or replace it.
Temperature error is large.	1. Either the thermal bulb is mounted incorrectly, or the thermometer position is unsuitable.	1. Install the thermal bulb and thermometer where circulation is good.
	2. Inlet pressure is excessively high.	2. If steam consumption is low, lowering the inlet pressure will improve control.
	3. Spindle[6] and guide[7], or pilot valve[14] and guide[16] movement is not smooth.	3. Disassemble and clean, or replace if necessary.
External leakage.	1. Gasket has leakage.	1. Tighten bolt, or replace the gasket.
	2. Seal bellows[17] is damaged.	2. Replace the bellows.

10. Precautions During Disassembly, Inspection, and Assembly

10-1. Precautions during disassembly and inspection

⚠Warning

The temperature regulator shall be disassembled and inspected by qualified persons, observing the following.

(1) Cool the valve down to a level where you can touch it with bare hands before disassembly and inspection.

* Failure to do so may result in burns.

(2) Completely discharge internal pressure from the valves, lines, and equipment before disassembly and inspection.

* Failure to do so may result in injury or burns due to residual pressure or spillage around the valve.

(3) Remove condensation before disassembling the diaphragm case at the bottom of the valve.

* Failure to do so may allow the condensation to splash out, resulting in burns or spillage around the valve.

10-2. Disassembly

Refer to "**11. Disassembly drawing**" and observe the steps below.

(1) **Pilot valve**

1. Be sure that the thermal bulb is not exposed to a temperature which exceeds the prescribed temperature endurance.
2. Slightly loosen lock nut[21] and turn adjusting screw[20] counterclockwise to release spring[19] (no compression).
3. Remove bolt of spring chamber [13] and remove the spring chamber and remove spring[19], and etc..
4. Remove bellows plate[18] and seal bellows[17].
5. Loosen ring[26], and remove the thermal bellows[23]. Be sure not to lose the bellows follower[22] at this time.
6. Remove guide[16] and pilot valve[14].
7. Remove bellows plate[18] and seal bellows[17].

(2) **Main valve**

1. Remove bolt of cover [2]. Dismount the cover from the body [1]. And remove main valve spring [10] and main valve [4].
2. Special tools are required when removing main valve seat [5], due to dimensions unique to Yoshitake.

(3) **Main diaphragm**

1. Remove pipe C [29] at tee [32] and elbow C[31-C].
2. Remove bolt of bottom dia. case [3]. Dismount the bottom dia. case, main diaphragm [9], retainer [8], and spindle [6].

10-3. Precautions during assembly

⚠Caution

(1) Check that there is no damage on the main valve, main valve seat, pilot valve, and pilot valve seat.

* Any damage on the sealing surfaces of these may cause leakage.

(2) Move the sliding section (pilot valve, main spindle, etc.) two to three times and confirm they move smoothly.

* If they do not move smoothly, original performance may be affected.

(3) After the main valve, spring, and cover are assembled correctly, mount the main diaphragm.

* Incorrect assembly may affect the original performance.

(4) Replace gaskets with new ones when disassembling.

* Using old gaskets may cause steam leakage, resulting in burns.

(5) Tighten the nuts evenly.

* Tightening insufficiently may cause steam leakage, resulting in burns.

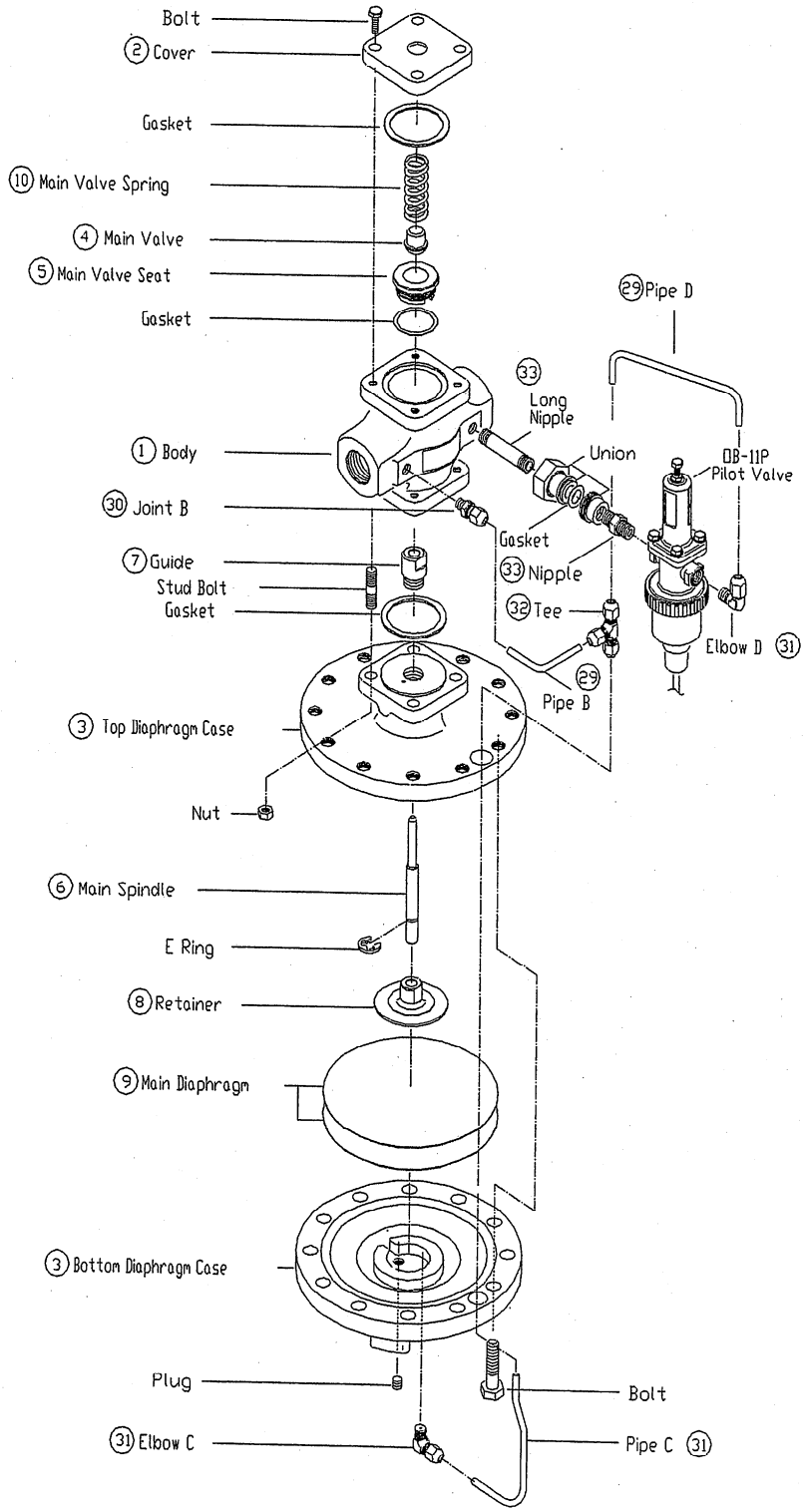
10-4. Assembly

Assemble in the reverse order of "**11. Disassembly drawing**".

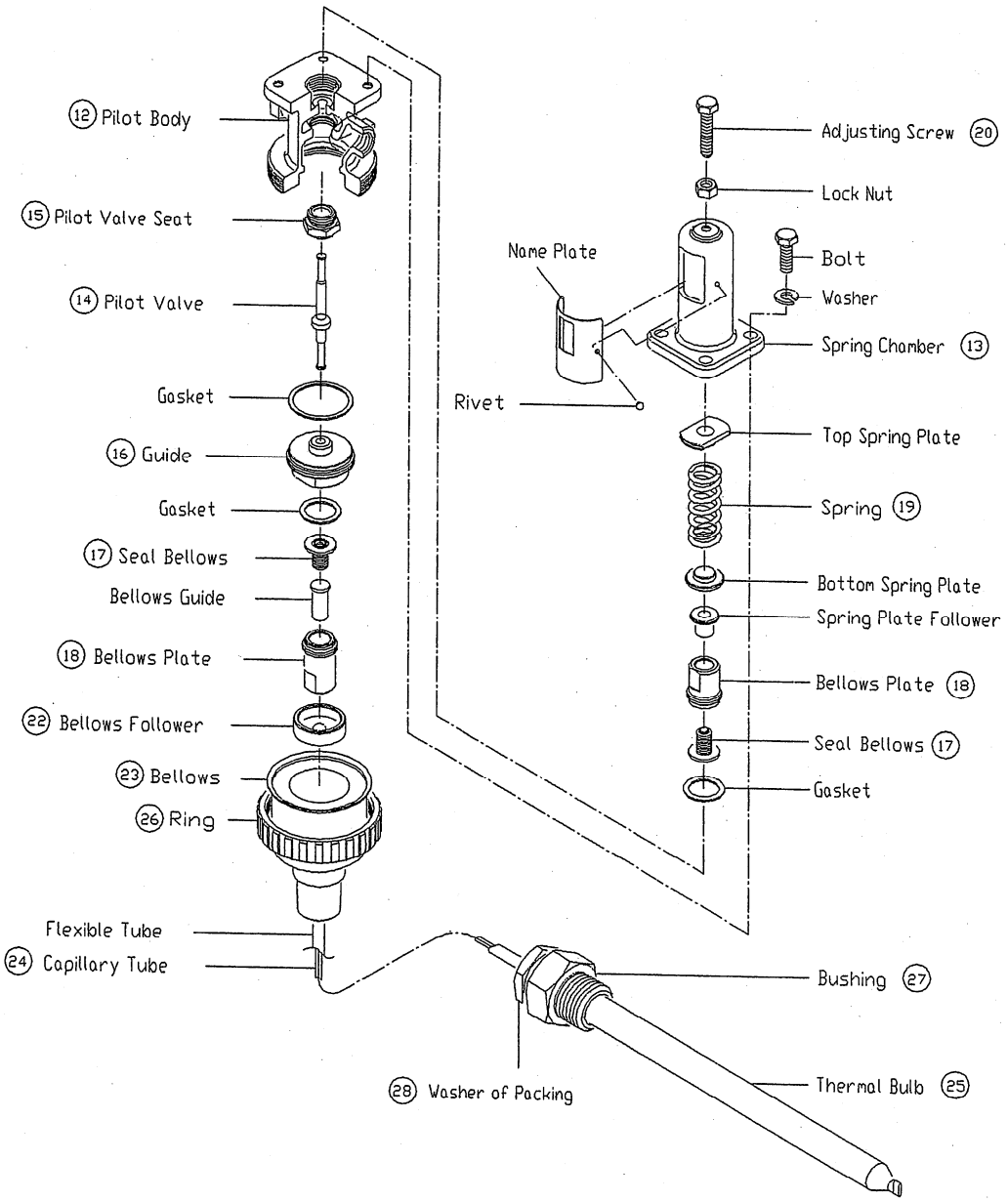
Further, apply a fluid sealant (heat and steam resistant) to the top and bottom sealing surfaces of the main diaphragm.

11. Disassembly Drawing

- **OB-2000**



- **OB-11P Pilot valve**



Warranty Information

1. Limited warranty

   This product has been manufactured using highly-advanced techniques and subjected to strict quality control. Please be sure to use the product in accordance with instructions on the manual and the label attached to it.

   Yoshitake warrants the product to be free from any defects in material and workmanship under normal usage for a period of one year from the date of receipt by the original user, but no longer than 24 months from the date of shipment from Yoshitake's factory.

2. Parts supply after product discontinuation

   This product may be subject to discontinuation or change for improvement without any prior notice. After the discontinuation of the product, Yoshitake supplies the repair parts for 5 years otherwise individually agreed.

3. This warranty does not cover the damage due to any of below:
   (1) Valve seat leakage or malfunction caused by foreign substances inside piping.
   (2) Improper handling or misuse.
   (3) Improper supply conditions such as abnormal water pressure/quality.
   (4) Water scale or freezing.
   (5) Trouble with power/air supply.
   (6) Any alteration made by other than Yoshitake.
   (7) Use under severe conditions deviating from the design specifications
   (e.g. in case of corrosion due to outdoor use).
   (8) Fire, flood, earthquake, thunder and other natural disasters.
   (9) Consumable parts such as O-ring, gasket, diaphragm and etc.

   Yoshitake is not liable for any damage or loss caused by malfunction or defect of the product.

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