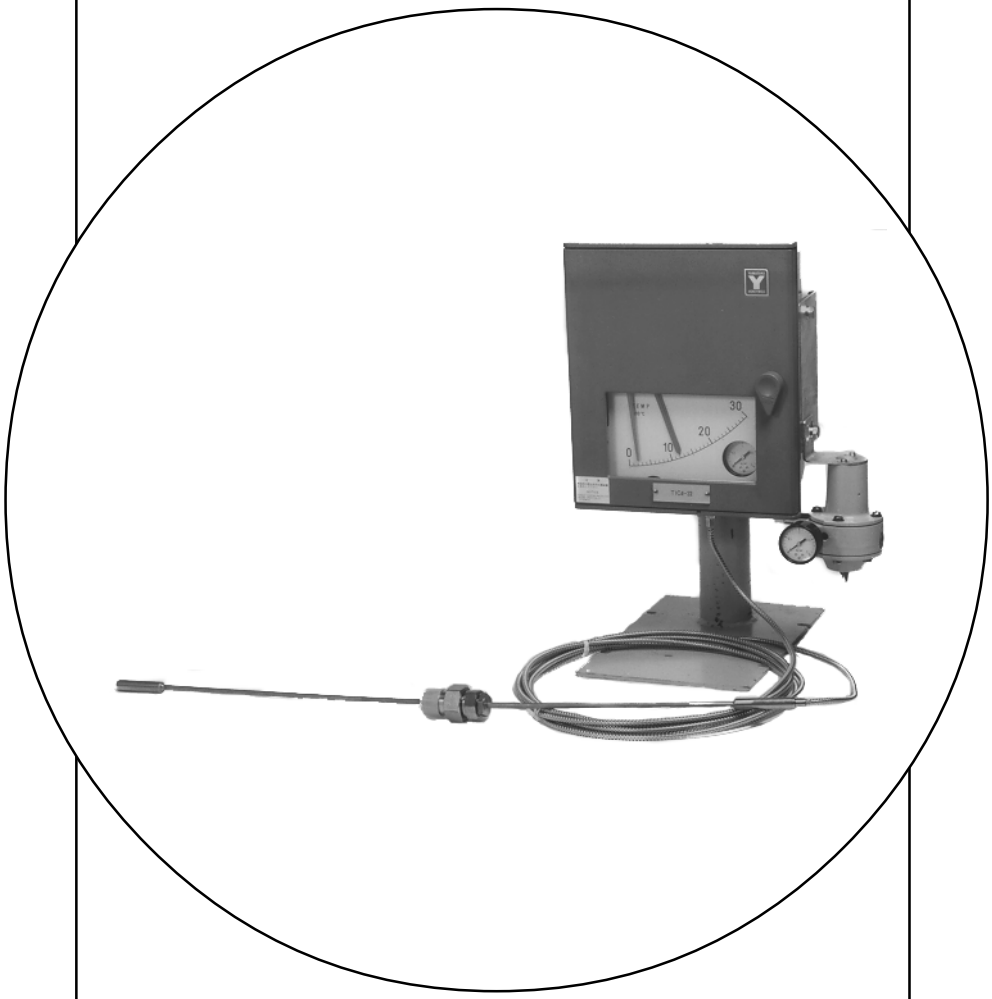
YAMATAKE

OM2-6220-0100

Field Type Pressure / Temperature Indicating Controller Model : KGT

User's Manual



Yamatake Corporation

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1. NOTES AND PRECAUTIONS

1.1 Check of Model Number and Specifications

The model number and specifications of the instrument are indicated on the nameplate posted on the rear door. Check that these items conforms with the ones ordered.

1.2 Standard Accessories

Check that the standard accessories are provided as follows:

(1) For 2-inch pipe mount type:

Two U-shape bolts, four nuts, and four spring washers

(2) For wall mount type:

Four bolts (M6) and four spring washers (for M6)

(3) The instrument is shipped with its controller parameters set as follows:

Action: Reverse action (unless specified otherwise)

Proportional band (P): 100%

Integral time (I): 1 minute

Derivative time (D): 1 minute

PRECAUTIONS: When carrying the instrument, exercise care so that no excessively large force is applied to the armored tube.

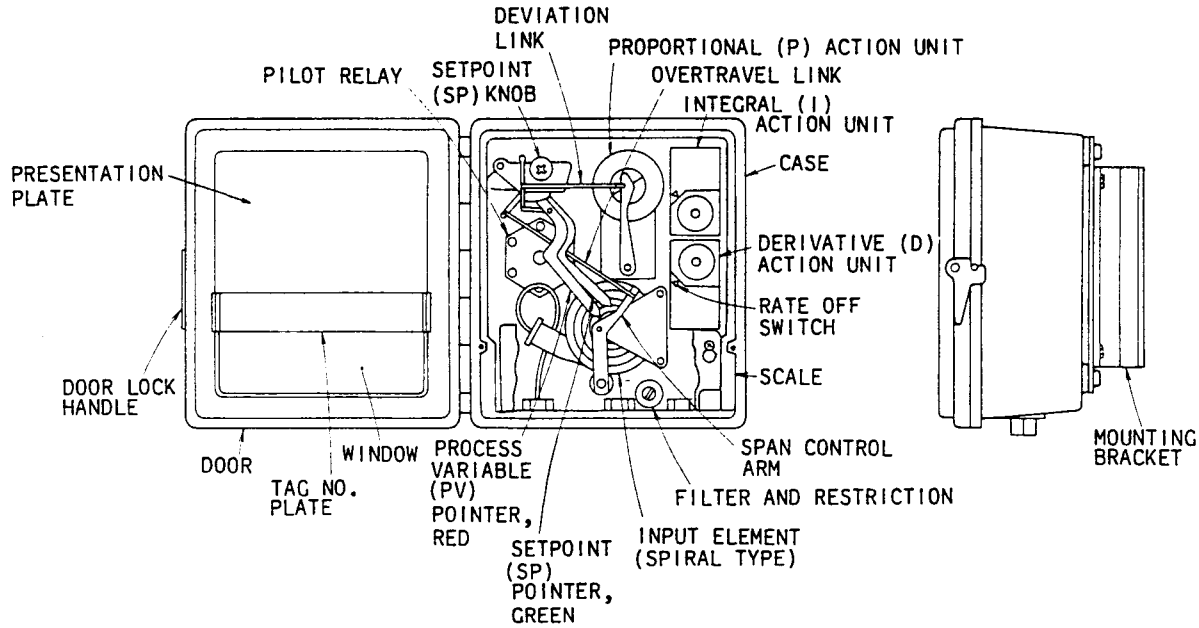
2. GENERAL DESCRIPTION AND COMPONENTS LAYOUT

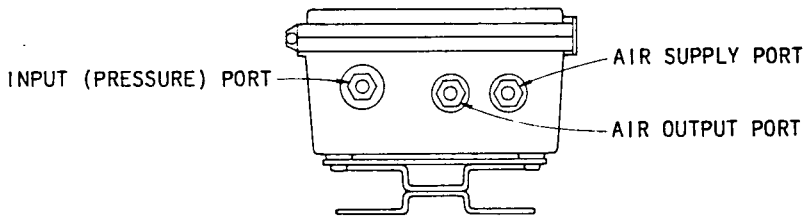
2.1 General Description

The field mounted temperature indicating controller converts the process temperature into mechanical displacement by means of a bellows in response to expansion/contraction of the liquid in the sensor element. The field mounted pressure indicating controller converts the process pressure into mechanical displacement by means of a bellows or a spiral type of pressure sensor element. Each instrument directly indicates the process variable and, at the same time, compares the process variable with the setpoint value and generates a pneumatic control output signal of 20 - 100 kPa {0.2 to 1.0 kgf/cm^2}.

Each instrument consists of a temperature or a pressure sensor element, a deviation detecting mechanism, an indicating mechanism, a controller unit, a pilot relay, a case, and a door.

2.2 Components Layout and Nomenclature





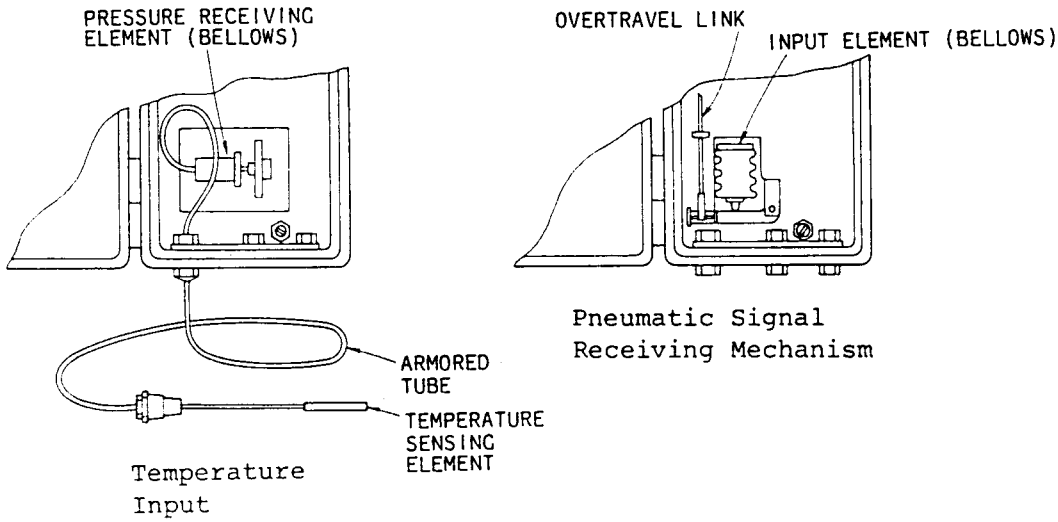


Fig. 2-1

3. SPECIFICATIONS

3.1 Common Specifications

Item		Specification
Performance	Indicating accuracy	± 1.0% FS
	Repeatability	0.5% FS or better
	Dead zone	0.3% FS or less
Indicator section	Indicating Angle	44 degrees
	Scale length	111.3 mm
	Pointers	PV pointer (red) and SP pointer (green)
Setting section	Setting system	With setting knob in case
	Setting range	0 - 100% FS
Controller section	Control actions	PI (Proportional + Integral), or PID (Proportional + Integral + Derivative)
	Adjustable range of control actions	Proportional band (P): 5 - 500% (direct or reverse action) Integral time (I): 0.05 - 30 minutes Derivative time (D): 0.05 - 30 minutes
General specifications	Output	20 - 100 kPa {0.2 - 1.0 kgf/cm^2}
	Minimum load	Inside diameter 4 mm x 3 m + 20 cm^3
	Air supply pressure	140 ± 14 kPa {1.4 ± 0.14 kgf/cm^2}
	Air consumption	5 Nℓ/minute
	Air supply capacity	40 Nℓ/minute
	Air exhaust capacity	40 Nℓ/minute
	Air piping connections	Rc1/4 (PT1/4 internal thread) or 1/4NPT internal thread
	Ambient temperature	-30 to +75°C
	Ambient humidity	10 to 90% RH
	Materials	Case and door: FRP (glass fiber reinforced polyester resin) Internal air piping: Urethane Mounting brackets: Carbon steel with molten zinc plating Mounting bolts, nuts and exposed screws: SUS304
	Applicable standards	o JIS F 8001 Class 3 Splash-proof, NEMA Type 3, IEC IP 54 equivalent o Lloyd Register's Regulations, and Japan Maritime Association Standard equivalent o JIS F 0807 equivalent
	Color of case and door	Dark beige (Munsell 10 RY 4.7/0.5 equivalent)
	Installation	2-inch pipe mount or wall mount
	Weight	Approx. 5 kg (KGPA12-01010A1T-X)

3.2 Specifications of Pressure Indicating Controller

<table>
<tr><th colspan="2">Item</th><th>Specification</th></tr>
<tr><td rowspan="2">Detector section</td><td>Measuring range, allowable overload, and process connections</td><td>
<table>
<tr><th>Measuring range</th><th>Allowable overload</th><th>Type of element</th><th>Process connections</th></tr>
<tr><td>0 – 300 kPa {3 kgf/cm²}
0 – 500 kPa {5 kgf/cm²}
0 – 1000 kPa {10 kgf/cm²}
0 – 1500 kPa {15 kgf/cm²}
0 – 2000 kPa {20 kgf/cm²}
0 – 3500 kPa {35 kgf/cm²}
0 – 5000 kPa {50 kgf/cm²}
0 – 10 MPa {100 kgf/cm²}</td><td>450 kPa {4.5 kgf/cm²}
750 kPa {7.5 kgf/cm²}
1500 kPa {15.0 kgf/cm²}
2250 kPa {22.5 kgf/cm²}
3000 kPa {30.0 kgf/cm²}
5250 kPa {52.5 kgf/cm²}
7500 kPa {75.0 kgf/cm²}
12 MPa {120.0 kgf/cm²}</td><td>Spiral</td><td>G1/4 (PF1/4) internal thread</td></tr>
<tr><td>Pneumatic signal of 20 – 100 kPa {0.2 – 1.0 kgf/cm²}</td><td>150 kPa or 2250 kPa {1.5 or 22.5 kgf/cm²}</td><td>Bellows</td><td>Rc1/4 (PT1/4 internal thread) or 1/4NPT internal thread</td></tr>
</table>
</td></tr>
<tr><td>Materials of detector elements</td><td>Bellows: Phosphor bronze
Spiral: SUS316</td></tr>
</table>

3.3 Specifications of Temperature indicating Controller

<table>
<tr><th colspan="2">Item</th><th>Specification</th></tr>
<tr><td rowspan="7">Detector section</td><td>Measuring range and Allowable overload</td><td>
<table>
<tr><th>Measuring range</th><th>Allowable overload</th></tr>
<tr><td>0 - 50
0 - 100
0 - 150
0 - 200
0 - 300</td><td>75
120
180
240
360</td></tr>
</table>
Unit: °C
</td></tr>
<tr><td>Length of capillary tube</td><td>5 m</td></tr>
<tr><td>Extension length</td><td>400 mm</td></tr>
<tr><td>Seal liquid</td><td>Kerosene</td></tr>
<tr><td>Type of pressure receiving element</td><td>Bellows</td></tr>
<tr><td>Temperature compensation</td><td>With bimetal</td></tr>
<tr><td>Materials</td><td>Temperature sensor: SUS 304
Pressure receiving element: Phosphor bronze
Capillary tube: SUS 316
Armored tube: SUS 430
Cap nuts and retaining nuts: SUS 304
Packing: Asbestos</td></tr>
</table>

3.4 Options

Item	Specification
(1) "Airset"	Pressure regulator, filter, and pressure gauge (40 mm) Primary pressure: 200 - 990 kPa {2 - 9.9 kgf/cm^2} Secondary pressure: 140 kPa {1.4 kgf/cm^2} Gauge scale: 0 - 200 kPa {0 - 2 kgf/cm^2} Air consumption: 0.95 Nℓ/minute (by Airset as an independent unit) Air connections: Rc1/4 (PT1/4 internal thread) or 1/4NPT internal thread
(2) Output gauge	Scale: 0 - 200 kPa {0 - 2 kgf/cm^2}
(3) Union	Material: SUS 304 Connections: R3/4 (PT3/4), 3/4NPT external thread

3.5 Standard Accessories

(1) For 2-inch pipe mount:

Two U-shape bolts, four nuts, and four spring washers

(2) For wall mount:

Four bolts (M6) and four spring washers (for M6)

4. MODEL NUMBER TABLE

4.1 Indicating Controller

Basic Model No.			Selections					Options	Description
Model	Function	Control actions	Type of detector	Measuring range	Air connection	Pneumatic signal	Installation		
KGP									Pressure indicating controller
KGT									Temperature indicating controller
	A1								Local controller
		2							PI actions
		3							PID actions
			-01			-			Spiral, for pressure
			-03						Bellows (for pneumatic pressure signal reception)
			-08						Liquid (kerosene) seal type, for temperature
				003					0 - 300 kPa {3 kgf/cm²}
				005					0 - 500 kPa {5 kgf/cm²}
				010					0 - 1000 kPa {10 kgf/cm²}
				015					0 - 1500 kPa {15 kgf/cm²}
				020					0 - 2000 kPa {20 kgf/cm²}
				035					0 - 3500 kPa {35 kgf/cm²}
				050					0 - 5000 kPa {50 kgf/cm²}
				100					0 - 10 MPa {100 kgf/cm²}
				821					20 - 100 kPa {0.2 - 1.0 kgf/cm²} pneumatic pressure signal
				050					0 - 50°C
				100					0 - 100°C
				150					0 - 150°C
				200					0 - 200°C
				300					0 - 300°C
					A				Rc, 1/4 (PT1/4) internal thread
					B				1/4NPT internal thread
						1			20 - 100 kPa {0.2 - 1.0 kgf/cm²}
						2			3 - 15 psi
							M		Without mounting brackets (See Note.)
							S		Wall mount
							T		2-inch pipe mount
								-X	No options
								-7	With airset
								-G	With output gauge
								-U1	With union R3/4 (PT3/4) external thread. For KGT only
								-U2	With union 3/4NPT external thread. For KGT only

Note: No Airset can be installed in this case.

4-2 Protecting Tubes

Basic model No.	Selections			Options	Description		
	Model	Connections	Materials				
KFZ1					Protecting tube for temperature sensing element		
	-1				Drilled type		
	-2				Welded pipe type		
		11			Flange type	20A.JIS 10K	
		12			Flange type	25A.JIS 10K	
		13			Flange type	40A.JIS 10K	
		14			Flange type	50A.JIS 10K	
		21			Flange type	20A.JIS 20K	
		22			Flange type	25A.JIS 20K	
		23			Flange type	40A.JIS 20K	
		24			Flange type	50A.JIS 20K	
		31			Flange type	3/4 inch ANSI 150	
		32			Flange type	1 inch ANSI 150	
		33			Flange type	1 1/2 inch ANSI 150	
		34			Flange type	2 inch ANSI 150	
		41			Flange type	3/4 inch ANSI 600	
		42			Flange type	1 inch ANSI 600	
		43			Flange type	1 1/2 inch ANSI 600	
		44			Flange type	2 inch ANSI 600	
		91			Flange type	4/3 inch ANSI 600	
		92			Flange type	1 inch ANSI 600	
		93			Flange type	1 1/2 inch ANSI 600	
		94			Flange type	2 inch ANSI 600	
		51			Threaded type	R3/4 (PT3/4) external thread	
		52			Threaded type	R1 (PT1) external thread	
		61			Threaded type	3/4NPT external thread	
		62			Threaded type	1NPT external thread	
			2		SUS 316		
			7		SUS 304		
			8		SUS 316L		
					Insertion length of protecting tube	Drilled type	Welded pipe type
				-15	150 mm	YES	NO
				-20	200 mm	YES	NO
				-25	250 mm	YES	YES
				-30	300 mm	YES	YES

5. STRUCTURES AND OPERATING PRINCIPLES

5.1 Overall Operating Principles

The process temperature or pressure is converted into mechanical displacement by the sensor element. The mechanical displacement is fed through the overtravel link ① to the deviation detecting mechanism ② which drives the red PV pointer ③ to indicate the process variable. At the same time, the process variable value (PV pointer) is compared with the setpoint value (SP pointer) to detect deviation ⑤.

The displacement which is proportional to the deviation is fed through the deviation link ⑥ to the proportional action unit ⑦ in order to drive the flapper ⑧. The back pressure of the nozzle varies in response to the flapper movement and amplified by the pilot relay ⑨ into a pneumatic control output signal.

Part of the output signal is returned as a feedback pressure signal via the derivative action unit ⑩, a reset pressure is provided by the integral action unit ⑪, and thus the control mechanism is balanced.

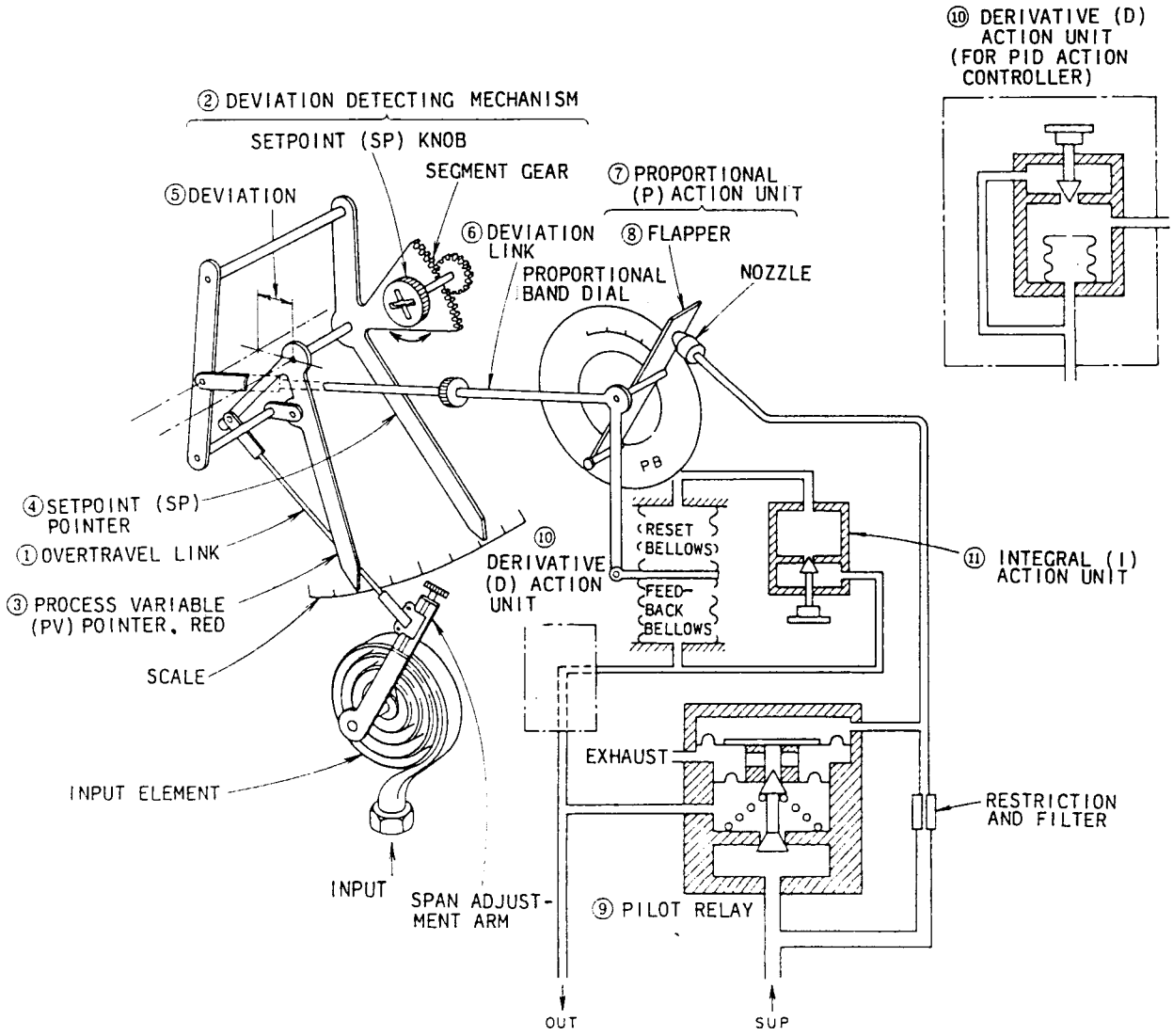


Fig. 5-1

5.2 Deviation Mechanism

The deviation mechanism is comprised of the deviation detecting mechanism ② and the indicating mechanism. It detects the deviation of the process variable (PV pointer) ③ from the setpoint (SP pointer) ④ and dictates the positional relationship between the nozzle and the flapper of the proportional action until ⑦ via the deviation link ⑥. It drives the PV pointer (process variable value) and the SP pointer (setpoint value).

5.3 Controller Units

The controller units are for the proportional action (P unit), integral action (I unit), or derivative action (D unit).

(1) Proportional (P) Action Unit

This unit is comprised of the nozzle/flapper mechanism and feedback mechanism (feedback chamber and reset chamber). Movement of the deviation link is fed to the nozzle/flapper mechanism via the flapper pin which is connected to the feedback link, in such manner that the gap between the nozzle and the flapper is returned to the original state and the pneumatic control output signal is balanced at a value proportional to the magnitude of deviation.

Setting of a proportional band is accomplished by rotation the proportional band dial, thereby varying the angle made between the flapper and the deviation link (feedback link).

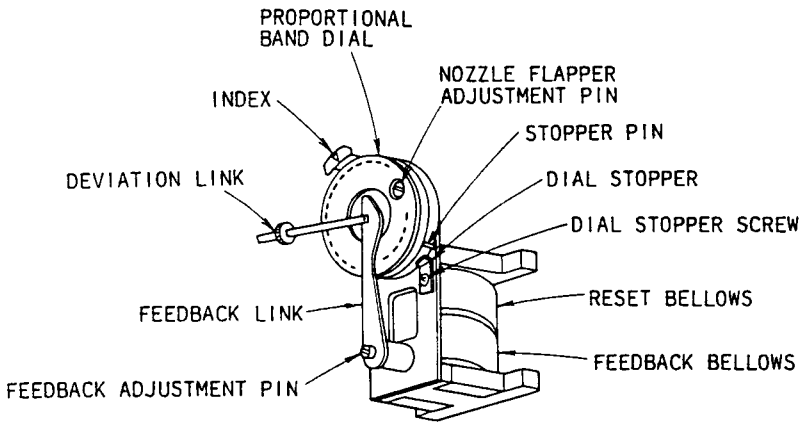


Fig. 5-2. Controller Unit

(2) Integral (I) Action Unit

This unit provides a reset pressure by acting with its restriction and capacity chamber on the feedback pressure of the proportional action unit (Pilot relay).

(3) Derivative Action Unit

This unit as a rate bellows in its chamber. Part of the pilot relay output is fed to the bellows to provide a rate amplitude.

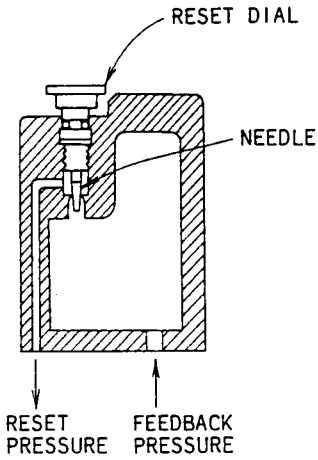


Fig. 5-3. Integral Action Unit

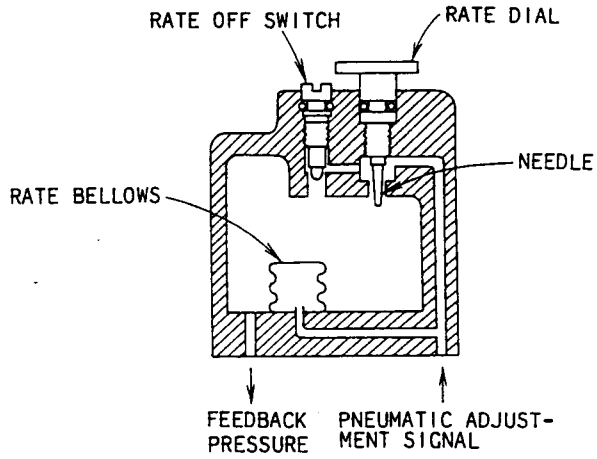


Fig. 5-4. Derivative Action Unit

6. INSTALLATION

6.1 Place of Installation

The place of instrument installation should allow ready access for inspection and maintenance and should meet the following requirements:

(1) Ambient temperature should be within -30 to +75 degrees C and should not change largely or sharply. The instrument should be located sufficiently apart from any source of heat. (When measuring a liquid in a cold season or area, provide appropriate means to prevent freezing which may cause damage to the instrument.)

(2) The place of installation should be reasonably free from high humidity and mechanical vibration.

6.2 Installation Method

Install the instrument on a wall or on a 2-inch pipe stanchion, employing the mounting brackets, U-bolts, and hexhead bolts. The instrument must be positioned vertically.

The instrument may be directly installed on a wall with four bolts (M6 x 1), without using the mounting brackets and U-bolts. In this case, tighten the bolts uniformly. Note that excessive stresses may be applied to the chassis if the bolts are tightened ununiformly. Refer to the installation dimension drawings at the end of this manual.

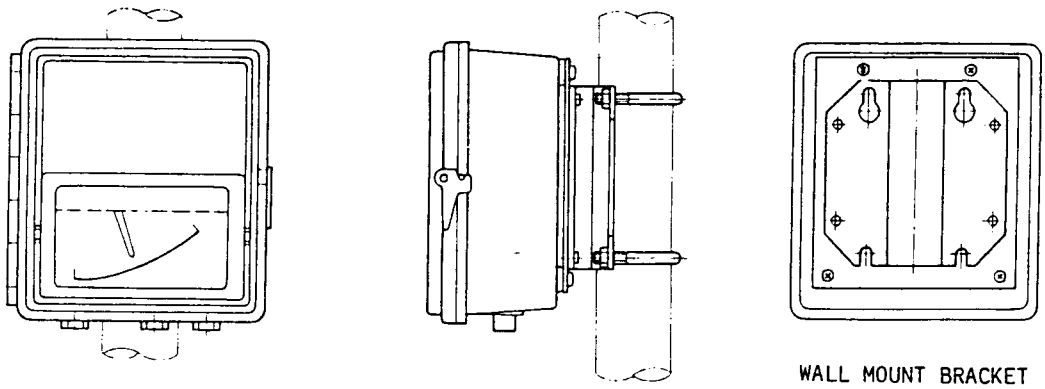


Fig. 6-1. Pipe Mount or Wall Mount (with Brackets)

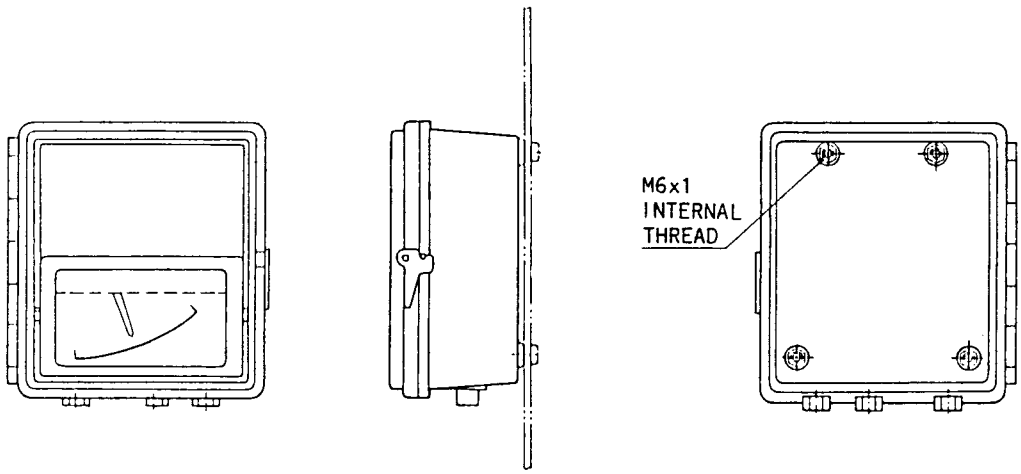


Fig. 6-2. Wall Mount (Direct)

6.3 Piping for Pressure Indicating Controller (Refer to Fig. 7-1 - Fig. 7-4.)

(1) For pressure connection piping, use pipes of ID 6 - 10 mm. Provide tee-joints and stop-valves in the piping in order that adjustment and service can be made without shutting down the process.

(2) When the measured process medium is gas or steam, tap the pressure at the top or side of the process pipe or tank. When the measured process medium is liquid, tap the pressure at a side position.

Be sure to provide a slight gradient for a horizontal pressure connection pipe for liquid drain vent.

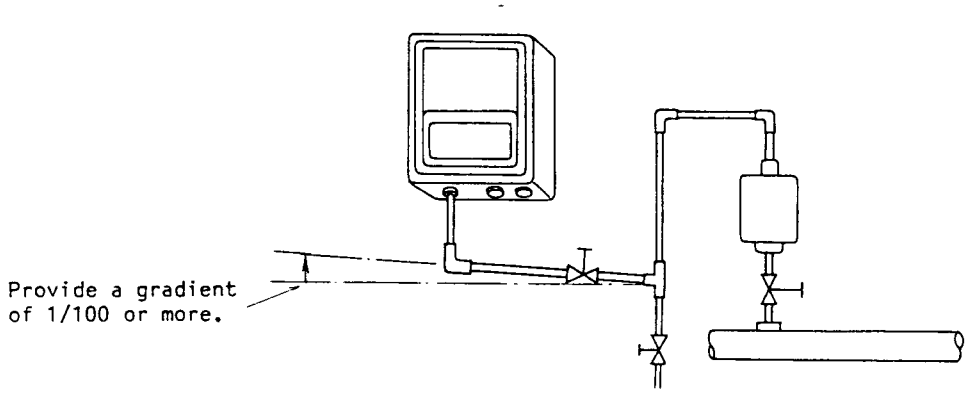


Fig. 6-3

(3) Compensation for Installation Height

(a) Compensation for the head pressure is necessary when the pressure medium is liquid, the measuring pressure range is low, and the pressure indicating controller is located higher or lower than the process pressure tap position.

When the instrument is located higher than the tap position, the instrument indicates a value lower than the process pressure by the amount of the head pressure; when the instrument is located lower than the tap position, the instrument indicates a value higher than the process pressure by the amount of the head pressure.

(b) Unless the instrument is compensated for the liquid head pressure, errors will be introduced as above. Compensation for the errors caused by the head pressure can be made by adjusting the zero point of the instrument.

(4) When connecting a pressure connection pipe to the instrument, hold the case connection section with a wrench. (See Fig. 6-4)

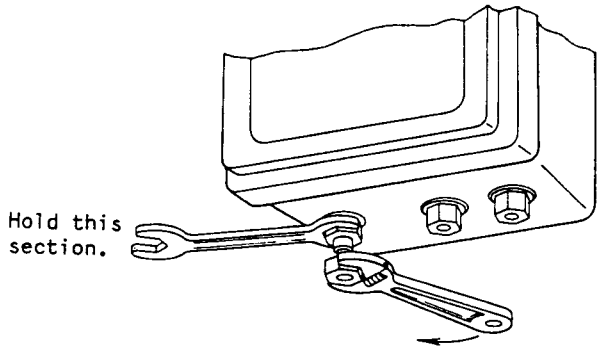


Fig. 6-4

(5) The temperature of the process fluid fed to the spiral pressure sensor element must not be higher than 75 degrees C.

(6) When the process pressure pulsates, provide a damper.

6.4 Installation of Sensor of Temperature Indicating Controller

Install the temperature sensor in a union type (without any protecting tube), a screw thread type (with a protecting tube), or in a flange type (with a protecting tube) depending on the conditions of the measured medium and its pipe or vessel.

(1) Provide a sufficient distance from the temperature sensing position to the instrument.

(2) The bending radius of the capillary tube and its protective armored tube must not be less than 60 mm.

(3) When measuring the temperature of fluid in a pipe, it is most recommendable to install the temperature sensing portion of the sensor in the center of the pipe along the flow of the medium in the pipe.

(4) Temperature compensation for ambient temperature change of the temperature sensor is made with a bimetal in the instrument. Note, however, that no temperature compensation is made for the armored tube section. Pay attention so that the armored tube section is not subjected to large ambient temperature change.

Fix the armored tube section at an appropriate position so that it does not swing.

(5) When installing a temperature sensor, in order to minimize measuring errors, select a protecting tube length (L) so that the effective insertion length (distance from the inside wall of the process to the end of the sensing element) becomes 1.5 times or more of the temperature sensing section length (ℓ).

(6) Pay attention to the strength of the protecting tube when the process fluid flow speed is fast, when the process fluid viscosity is high, or when there is a possibility of Karman's cortex flow.

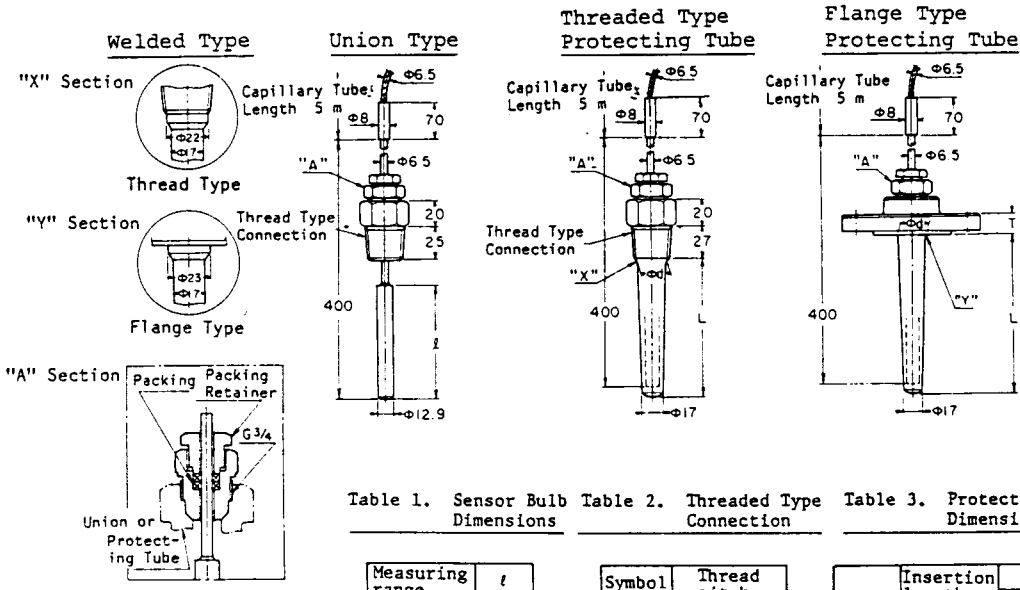


Table 1. Sensor Bulb Dimensions

Measuring range	ℓ
0 ~ 50℃	145
0 ~ 100℃	83
0 ~ 150℃	63
0 ~ 200℃	45
0 ~ 300℃	35

Table 2. Threaded Type Connection

Symbol	Thread pitch
51	R3/4 External thread
52	R1 External thread
61	3/4 NPT External thread
62	1 NPT External thread

Table 3. Protecting Tube Dimensions

Symbol	Insertion length L (mm)	φd Welded type	φd Drilled type
-15	150	—	18
-20	200	—	19
-25	250	17	20
-30	300	17	21

Fig. 6-5

6.5 Air Supply

The air supply must be a clean air filtered with a filter of mesh 5 mm or finer, must not contain oil mist, and must be with a dew point lower by 10 degrees C or more than the minimum temperature anticipated at the place of installation of the instrument.

When an Airset which has integrally a pressure regulator and a filter is provided, pay attention to oil mist and its dew point.

6.6 Air Connection Ports

The air connection ports are located at the bottom of the instrument: "IN" for the air supply and "OUT" for the pneumatic control output pressure.

The thread is Rc1/4 (PT1/4 internal thread) or 1/4NPT internal thread.

When an Airset is provided, connect the air supply to the "IN" port (Rc1/4 or 1/4NPT internal thread) of the Airset.

Note: When connecting a pressure connection pipe to the instrument, hold the case connection section with a wrench. (Refer to Section 6.3 (4).)

7. OPERATION METHOD

Confirm that the indicating controller is properly installed and piping is correctly done.

(1) Select the desired type of control action (direct action or reverse action) and set the controller parameters as follows:

Proportional band (P): Maximum ("PROP BAND" 500%)

Integral time (I): Maximum ("RESET" 30 minutes)

Derivative time (D): Minimum ("RATE" 0.05 minutes)

(2) Set the SP pointer (green) at the desired value by means of the SP setting dial.

(3) Feed the air supply. Set the P, I and D control actions to suit the process.

(4) When the instrument has a derivative action unit but no derivative control action is necessary, turn the RATE OFF switch to the fully counterclockwise position. This rate-off provision may be utilized when adjusting the control mechanism.

(5) Setting the Controller Parameters

Set the proportional band at the maximum (500%), the integral time at the maximum (30 minutes), and the derivative time at the minimum (the RATE OFF switch set in the off state). Operate the process under these conditions.

(a) Setting the Proportional Band

Gradually reduce the proportional band until the PV value oscillates with a certain amplitude and mark the PB value when in this state.

Next, set the PB at a value double of the value marked in the above.

(b) Setting the Integral Time

After the procedure of (a) above is over, gradually reduce the integral time until the PV value oscillates with a certain amplitude and mark the integral time when in this state.

Next, set the integral time at a value approximately double of the value marked in the above.

(c) Setting the Derivative Time

After the procedure of (b) above is over, turn on the RATE OFF switch and gradually increase the derivative time until the PV value oscillates with a certain amplitude and mark the derivative time when in this state. Next, set the derivative time at a value approximately a half of the value marked in the above.

(6) Of the pressure indicating controller, the operating sequence differs by the type of the pressure medium and by the location of the instrument with respect to the pressure tap position. (See Fig. 7-1 - Fig. 7-4.)

(A) Liquid or gas

(a) Close the block valve ①, open the bleed valve ③, and then open the stop valve ② to blow away foreign matter from inside of the pressure connection pipe.

(b) After the inside of the pressure connection pipe is cleaned, close the bleed valve.
After waiting until the pressure connection pipe is cooled off if the temperature of the pressure medium is high, open the block valve and then start operating the instrument.

(B) Steam

(a) Close the block valve ①, open the bleed valve ③, and then open the stop valve ② to blow away foreign matter from inside of the pressure connection pipe.

(b) Close the bleed valve. Condense steam and fill the pressure connection pipe and siphon with water. Open the block valve and then start operating the instrument.

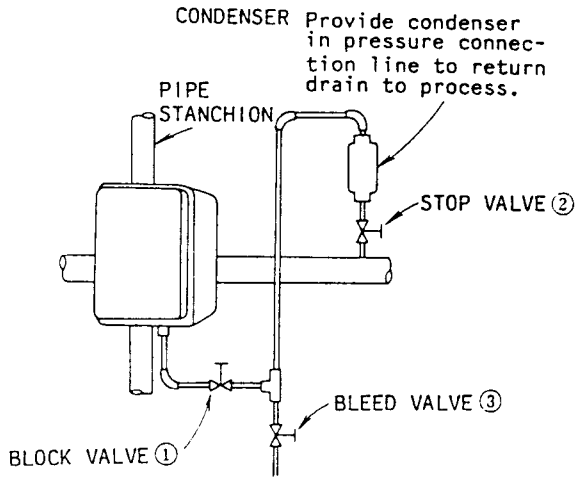


Fig. 7-1. Piping for Wet Gas Pressure Measurement

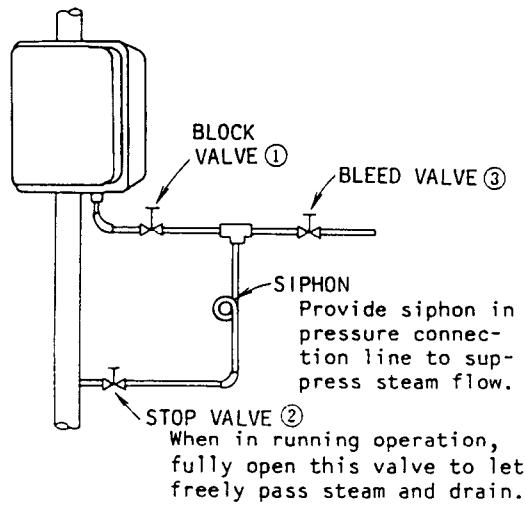


Fig. 7-2. Piping for Stem Pressure Measurement

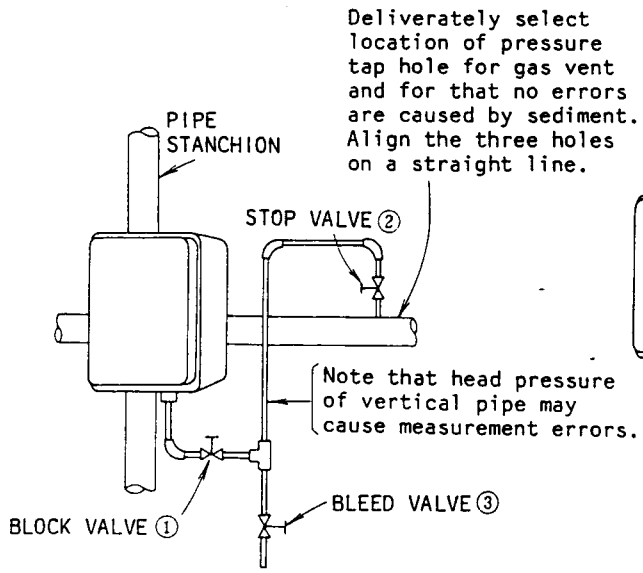


Fig. 7-3. Piping for Liquid Pressure Measurement

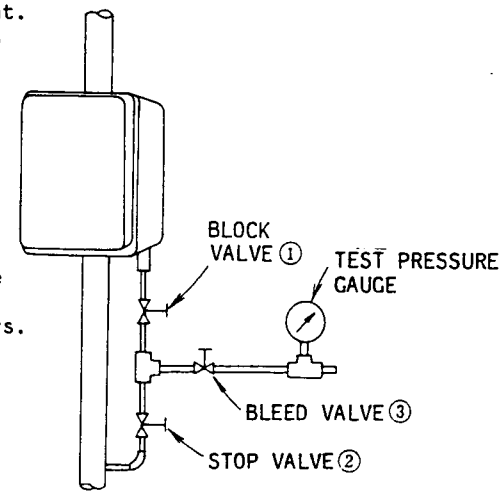


Fig. 7-4. Piping for Dry Gas Pressure Measurement

8. CALIBRATION AND ADJUSTMENT

8.1 Deviation Mechanism (See Fig. 8-1)

Align together the ends of the red PV pointer ① and green SP pointer ② as follows:

(1) Set the PV pointer at the 50% FS position by disengaging the overtravel link or by applying a corresponding input signal.

(2) Set the SP pointer also at the 50% FS position by turning the SP setting dial ③.

(3) Confirm that the three adjustment holes are on a straight line as viewed from the instrument front.

(4) If the end of the SP pointer is not accurately aligned with that of the PV pointer, adjust it with the SP POINTER ADJ screw ④. If adjustment is heavy, loosen once the SP pointer clamping-screw ⑤, align the SP pointer with the PV pointer, and then securely tighten the SP pointer clamping-screw.

(5) Connect an air supply to the AIR SUPPLY port and a mercury column (133.3 kPa {1000 mmHg}) to the AIR OUTPUT port.

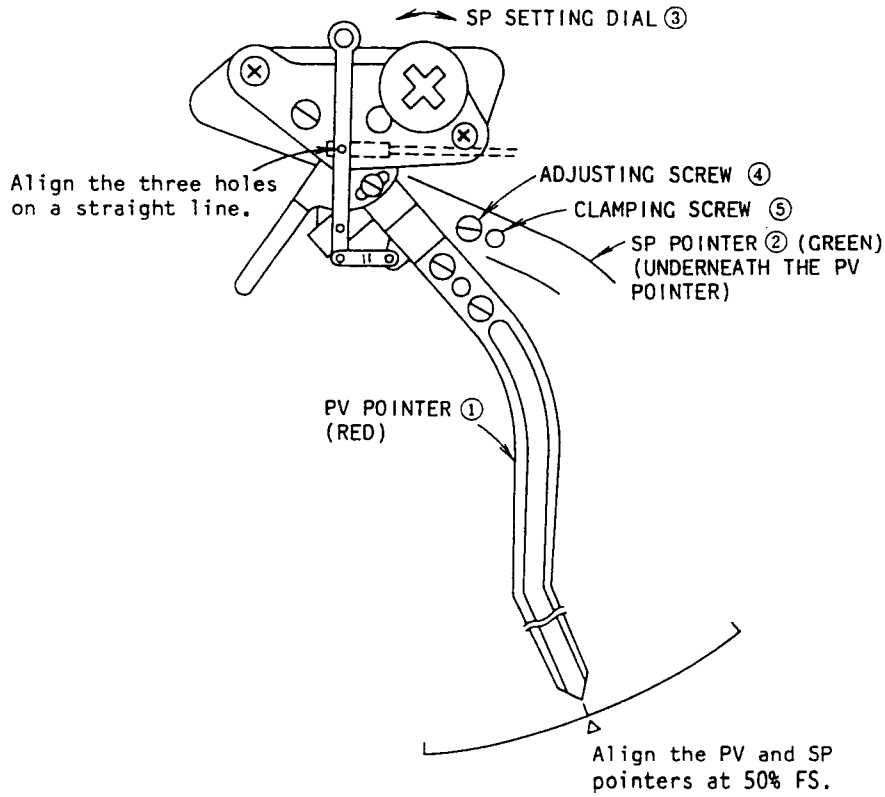
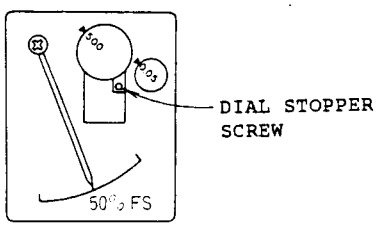


Fig. 8-1

8.2 Balancing Adjustment of Proportional Action Unit

Check at first that air supply is 140 ± 14 kPa {1.4 ± 0.14 kgf/cm^2}. Set the proportional action in the direct action (INC MES INC OUT) mode. (See the Note of Item (5) of this section.)

(1)

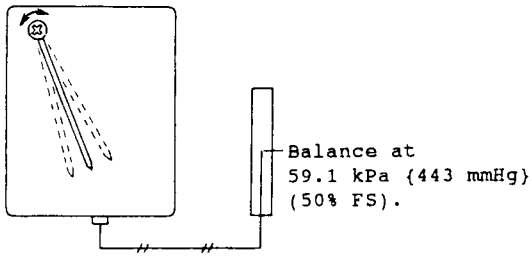


(1) o Loosen the dial stopper screw.

o Set the PB SETTING dial at 500% PB.

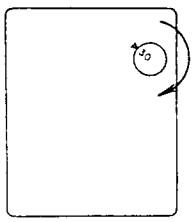
o Set both PV and SP pointer at 50% FS.

(2)

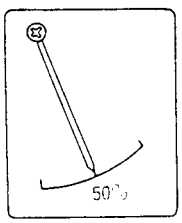


(2) Set the integral time at the minimum (RESET dial 0.05 minutes). Adjust the SP pointer so that the pneumatic control output signal becomes 59.1 kPa {443 mmHg} (50% FS).

(3)



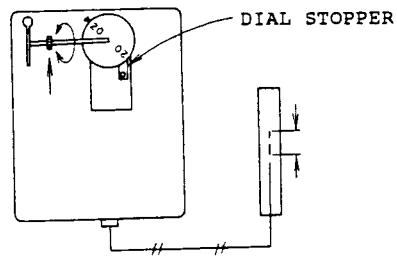
(4)



(3) After the pneumatic control output signal is balanced and stabilized, set the integral time to the maximum (RESET dial 30 minutes) and align again both pointers at 50% FS.

Note: A pneumatic pressure of 60 kPa {0.6 kgf/cm^2} (50% FS) is sealed in the reset chamber. As time elapses, the pressure may vary. Rapidly accomplish the above procedure.

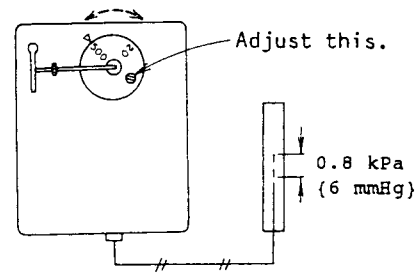
(5)



(5) Adjust the length of the deviation link so that change in the pneumatic control output signal becomes less than 0.8 kPa {6 mmHg} (1.0% FS) when the PB SETTING dial is changed from direct action (INC MEAS INC OUT) 20% PB to reverse action (INC MEAS DEC OUT) 20% PB.

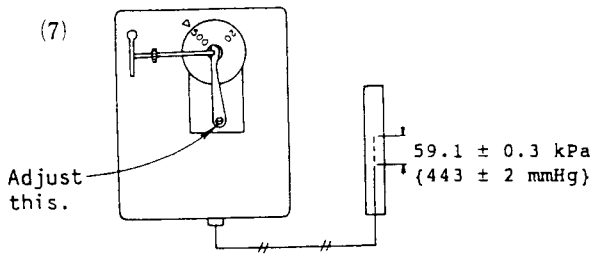
Note: For change between the direct and reverse actions, let the dial stopper hang down by loosening the screw, let it pass the stopper pin, and then fix the dial stopper in the original state.

(6)



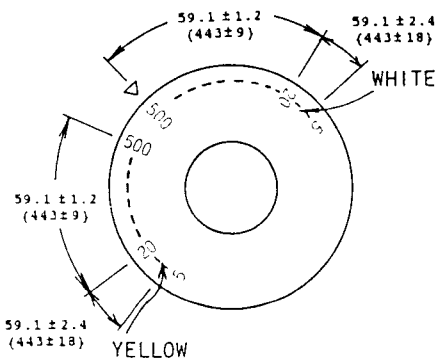
(6) Adjust the nozzle/flapper adjustment pin so that change in the pneumatic control output signal becomes less than 0.8 kPa {6 mmHg} (1.0% FS) when the PB SETTING DIAL is changed from 20$ PB to 500% PB. (If the output when 500% PB is larger than that with 20% PB, turn the pin clockwise.)

(7)



(7) Adjust the feedback link adjustment pin so that the pneumatic control output signal becomes 59.1 ± 0.3 kPa {443 ± 2 mmHg} with the PB SETTING dial set at 500% PB. (The output signal increases as the pin is turned clockwise.)

(8)

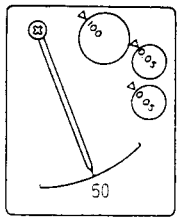


(8) Repeat the procedure of (6) through (8) so that the output signal becomes 59.1 ± 1.2 kPa {443 ± 9 mmHg} (50 ± 1.5% FS) within a range of PB SETTING dial 20% PB - 500% PB (for both direct and reverse actions) and that the output signal becomes 59.1 ± 2.4 kPa {443 ± 18 mmHg} (50 ± 3.0% FS) at other ranges.

8.3 Calibration of Integral (Reset) Action Unit

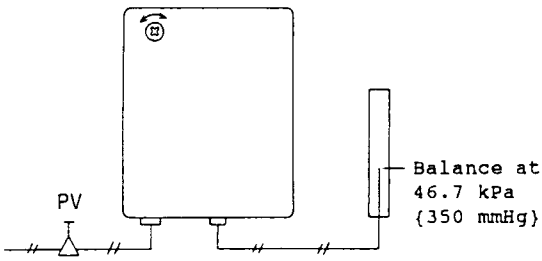
Be extremely careful when handling the reset restriction because even a slight damage to the needle valve or the seat may largely affect the instrument performance. In order to maintain the accuracy, the reset restriction and dial base are securely fixed.

To calibrate the reset action unit, proceed as follows:

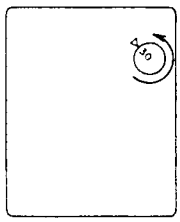


Set the PV pointer at 50% FS and the PB SETTING dial at direct action 100% PB.

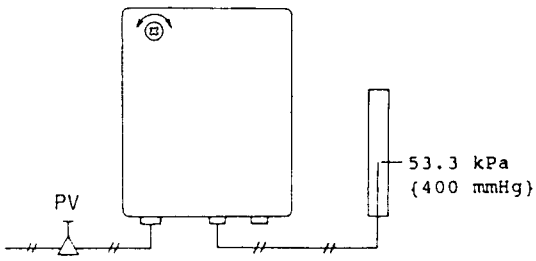
Note: Set the reset time at the minimum (RESET dial 0.05 minutes). If a derivative unit also is provided, set the RATE OFF switch in the OFF state.



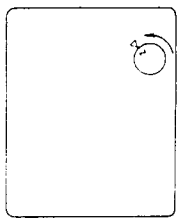
Let the pneumatic control output signal balanced at 46.7 kPa {350 mmHg} by adjusting the SP SETTING dial.



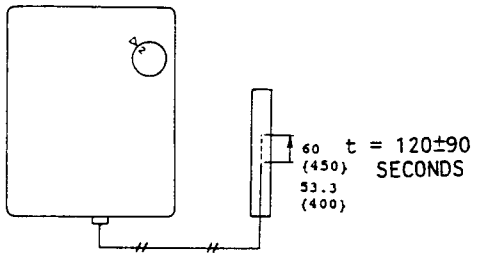
Set the reset time at the maximum (RESET dial at 30 minutes).



Adjust the pneumatic control output signal to 53.3 kPa {400 mmHg} by adjusting the SP SETTING dial.



Set the reset time at 2 min.

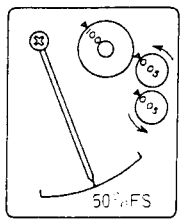


Check that it takes 120 ± 90 seconds for the pneumatic control output signal to change from 53.3 kPa {400 mmHg} to 60 kPa {450 mmHg}.
If necessary, adjust the dial position of the integral action unit by loosening the setscrew.

8.4 Calibration of Derivative (Rate) Action Unit

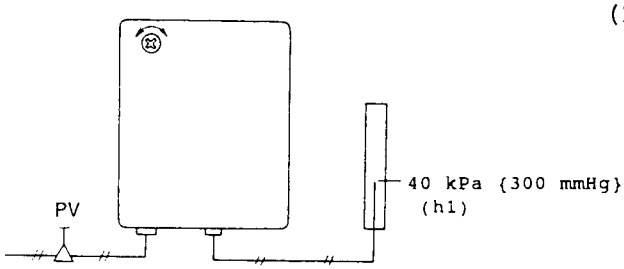
Exercise great care when handling the rate restriction as is the case when handling the reset restriction.

To calibrate the unit, proceed as follows:

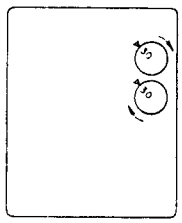


(1) Set the PV pointer at 50% FS and the PB SETTING dial at 100% PB, direct action.

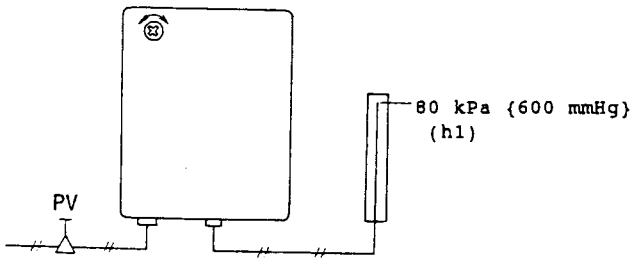
Note: Set the rate time at the minimum (the RATE dial at 0.05 minutes and the reset time also at the minimum (the RESET dial at 0.05 minutes).



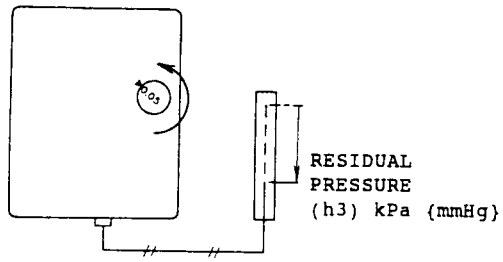
(2) Set the pneumatic control output signal at 40 kPa {300 mmHg} by adjusting the SP SETTING dial. (Denote the output signal value by "h1".)



(3) Set both rate time and reset time at the maximum (30 minutes).

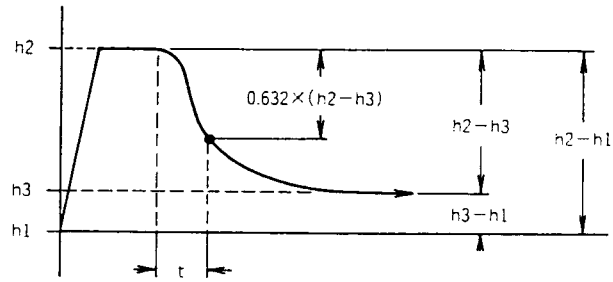


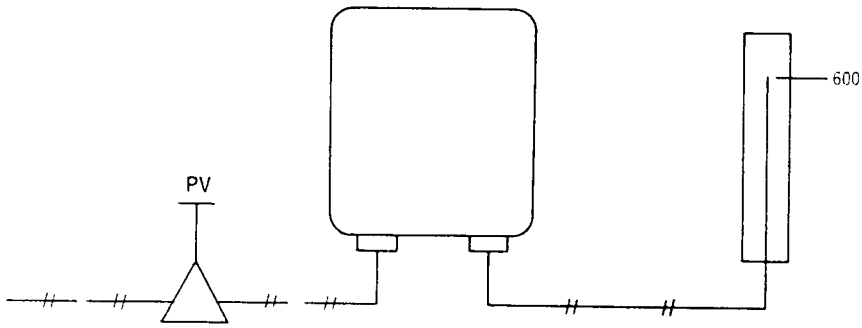
(4) Set the pneumatic control output signal at 80 kPa {600 mmHg} by adjusting that SP SETTING dial. (Denote the output signal value by "h2".)



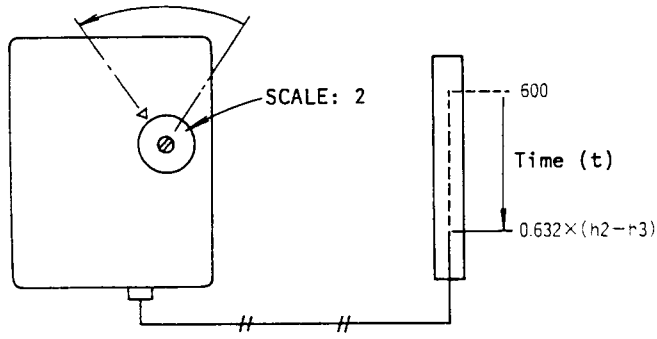
(5) Set the rate time at the minimum (0.05 minutes). Measure the residual pressure and denote it by "h3". Calculate the rate amplitude employing the formula shown below.

$$\text{RATE AMPLITUDE } (W) = \frac{h_2 - h_1}{h_3 - h_1}$$





(6) Repeat the procedure of (2) to (5) and set the pneumatic control output signal at 80 kPa {600 mmHg}.



(7) Rapidly change the rate time to 2 minutes and determine time "t" taken by the pneumatic control output signal for changing to 63.2% of (h2 - h3). Check that the time (t x W) is within 120 ± 90 seconds.

If necessary, adjust the dial position of the derivative action unit by loosening the setscrew.

8.5 Calibration and Adjustment of Indicating Mechanism (Sensors)

Before starting calibration or adjustment of a sensor, confirm that the deviation mechanism of the instrument has been properly adjusted.

Set the proportional band at 100% PB, the reset time and derivative time at the minimum, and both pointers at 50% FS. Move the SP pointer so that the pneumatic control output signal becomes 59.1 kPa {443 mmHg} (50% FS), and (See Fig. 8-2).

(A) For Pressure Sensor Element (See Fig. 8-2)

Prepare a calibration pressure signal source corresponding to the measured pressure range and apply the pressure input to the INPUT port of the instrument.

(a) Zero Adjustment

Adjust the ZERO ADJ knob of the overtravel link so that the PV pointer indicates the 0% FS position when the input pressure is set at 0% FS.
The zero point becomes higher as you turn the knob clockwise.

(b) Span Adjustment

Adjust the SPAN ADJ knob so that the PV pointer indicates 100% FS when the measured pressure is set at 100% FS.
The span becomes wider as the knob is turned clockwise.
For a large span change, change connecting positions of the overtravel link and SPAN ADJ knob hole.
The span becomes wider as the connecting position is farther from the center of the element.

(c) Linearity Adjustment

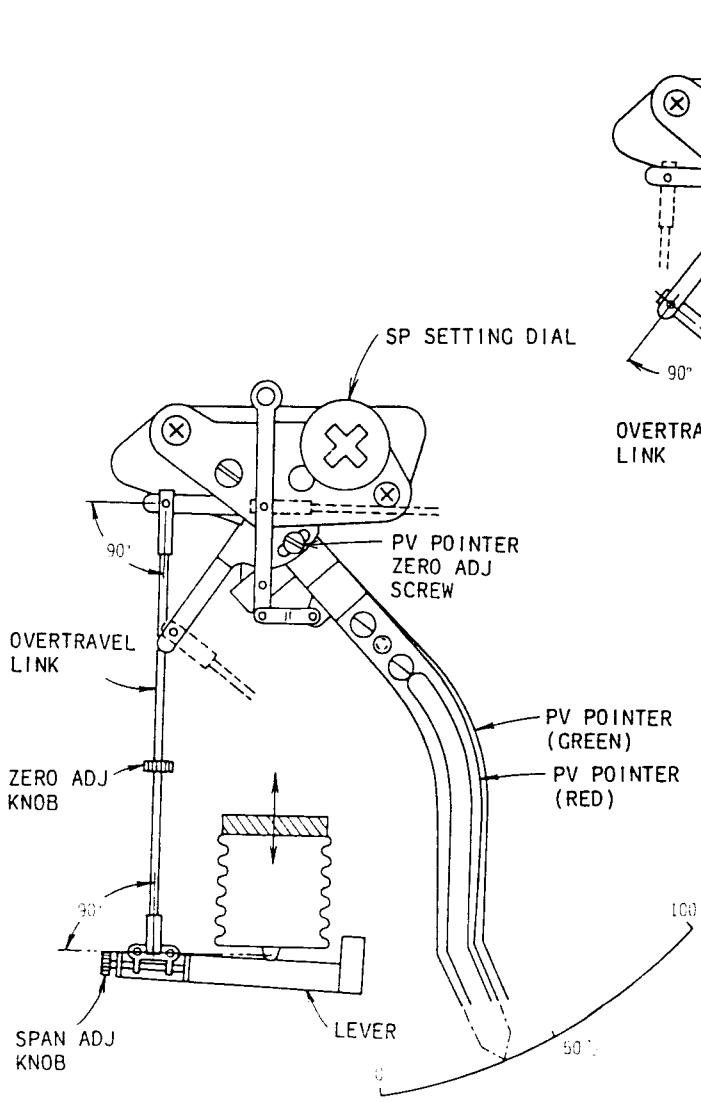
(1) Check the linearity at the point of 50% FS.

(2) If errors are greater than 1% FS, adjust the length by turning the ZERO ADJ knob of the overtravel link.
If errors are in the positive direction, make the overtravel link shorter (turn the knob counterclockwise as viewed from the sensor element side).

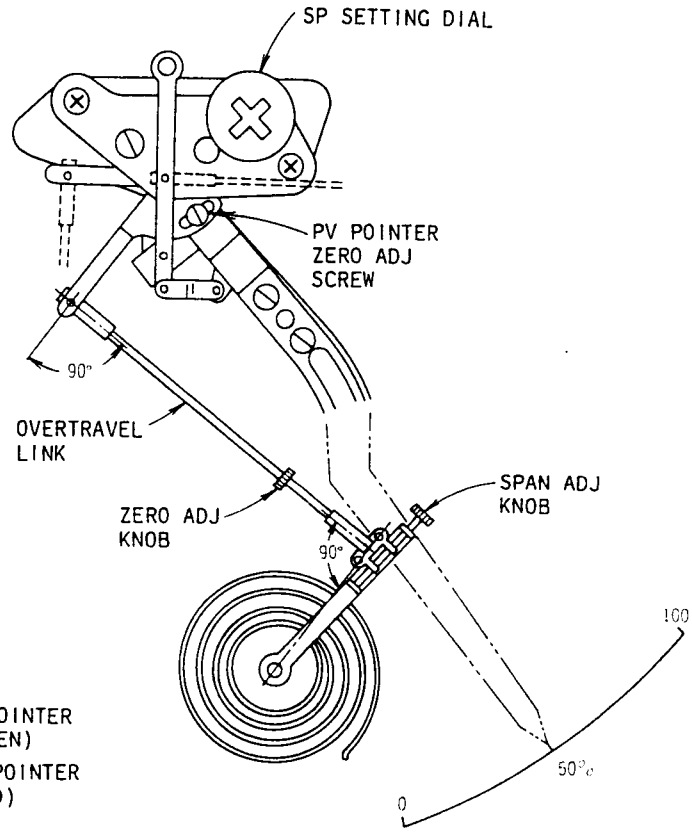
(3) As the overtravel link length is varied, the zero point also may vary. Loosen the ZERO ADJ screw, align the PV pointer, and then tighten the screw.

(4) Check again the zero point and the 100% FS point in the method mentioned in the above.

(5) As required, accuracy can be checked at any point within the measuring range in the same method as above.



(Bellow Type)



(Spiral Type)

Fig. 8-2

(B) For Temperature Sensor Element (See Fig. 8-3)

The calibration and adjustment procedure of the temperature sensor element is identical with that for the pressure sensor element. Prepare a constant-temperature calibration bath corresponding to the measured range.
Fully immerse the heat sensing section in the bath and wait until the PV pointer is stabilized.
Note that the sensor which has a protecting tube which has a large heat capacity will take a longer time before stabilization.

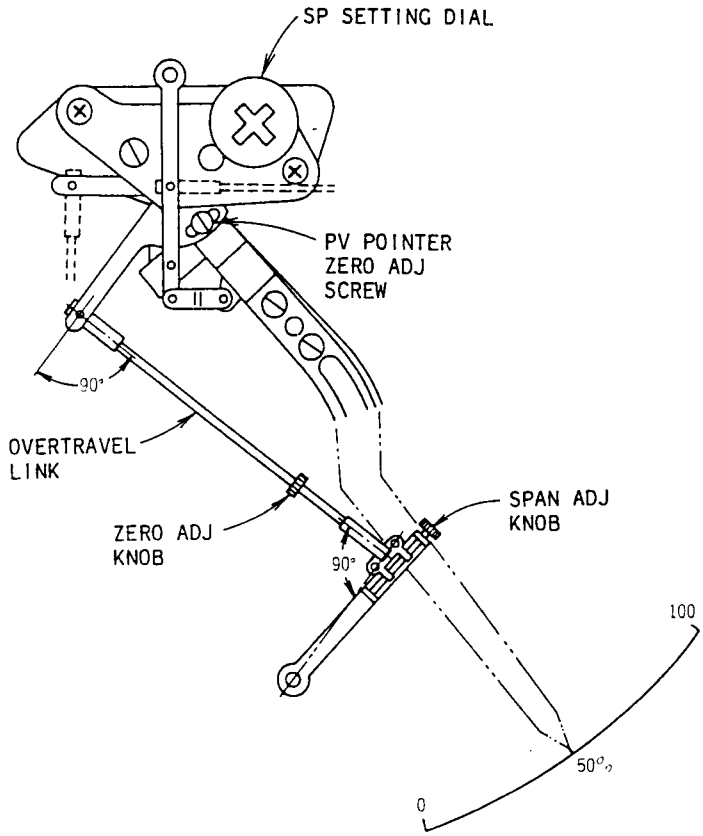


Fig. 8-3

(C) Check of Adjustment

When the mechanism is correctly adjusted, the angles indicated as "90°" in the illustrations of (A) and (B) will be of the right angle (90 degrees).
This fact may be employed as a criterion when adjusting the mechanism.

9. MAINTENANCE

9.1 Periodical Inspection

(1) Check the air piping and connection for air leak.

(2) Drain liquids from the air supply line and Airset.

(3) Check that the filter and restrictions are not dirty. Replace the filter if it is dirty. Clean the dirty restrictions using a steel wire of 0.12 mm outer diameter.

9.2 Proportional Action Unit

(1) Disconnect the air supply and disengaged the deviation link.

(2) Take to the proportional action unit by undoing the four screws which clamp the unit to the base, and clean the nozzle.

(3) Install the proportional action unit in the reverse order of removing it, and then adjust it.

Note: Confirm that the O-ring is provided and that the unit is securely fixed with the four screws for no air leak. Replace the O-ring with a fresh one as required.

9.3 Pilot Relay

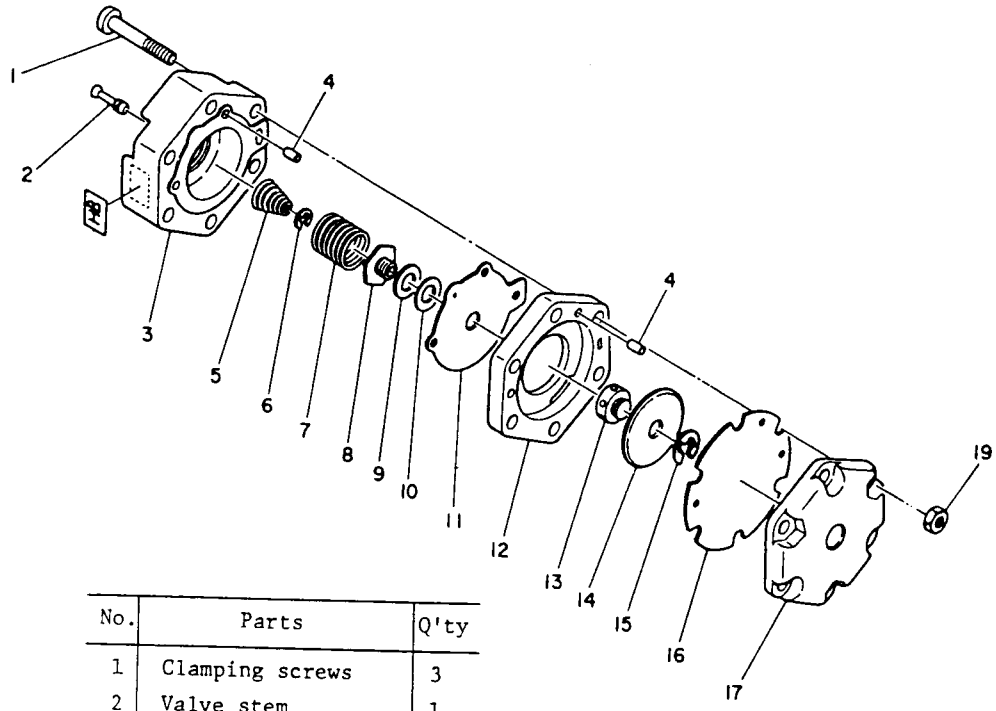
(1) Remove the pilot relay from the base by removing the three mounting-screws, lock washers, and gasket from the base. The removal can be made easier by moving the SP pointer (green) toward the 0% position by turning the SP SETTING dial and the PV pointer also toward the 0% position by disengaging the over-travel link.

(2) Remove the three clamping-screws (1) and nuts (19).

(3) Remove the parts (3) through (17) in the due order. Unless parts are required to be replaced, the pin washer (6) is not required to be removed from the valve stem (2).

(4) Clean the metallic parts by using naphtha, chlorothane, or other detergent of a similar type.

PRECAUTION: Do not apply detergent to the diaphragm.



No.	Parts	Q'ty
1	Clamping screws	3
2	Valve stem	1
3	Housing	1
4	Guide pins	6
5	Conical spring	1
6	Pin washer	1
7	Spring	1
8	Nozzle	1
9	Washer	1
10	Seal	1
11	Diaphragm (Bottom)	1
12	Exhaust ring (Outer)	1
13	Exhaust ring (Inner)	1
14	Area plate	1
15	Pin washer	1
16	Diaphragm (Top)	1
17	Cover	1
19	Nuts	3

Fig. 9-1

9.4 Troubleshooting

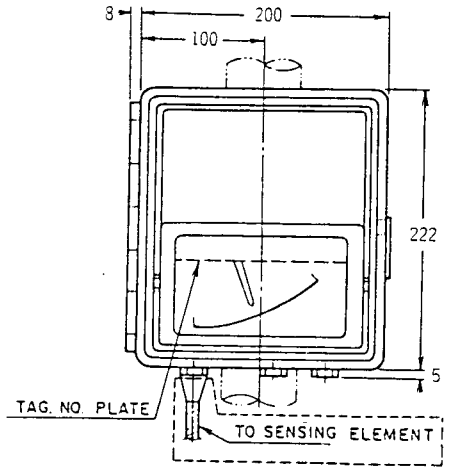
Basic troubleshooting procedures are given in the following table. For adjustment of the instrument, refer to the preceding chapters.

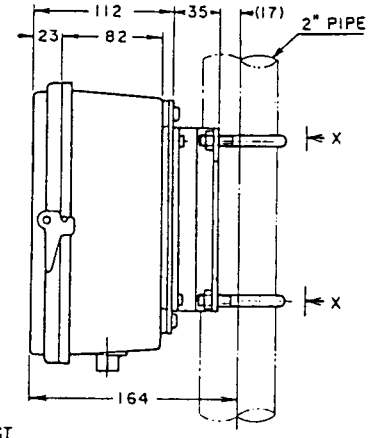
Symptom	Probable cause	Remedy
The pilot relay whines.	The seat (port) of valve stem is stained.	Remove the pilot relay and clean the seat.
No pneumatic control output signal is delivered or the signal pressure is very low.	No air supply is provided or the supply pressure is lower than 140 kPa {1.4 kgf/cm^2}.	Provide an air supply of the correct pressure.
	The restriction is clogged.	Take out the restriction and clean it.
	The filter is heavily stained.	Replace the filter.
	There is air leak from the indicating controller section. No O-ring is correctly installed.	Correctly install the O-ring. Securely fix the restriction and other components.
	There is air leak from the pilot relay diaphragm.	Take out the pilot relay and inspect the diaphragm for leak. If leak is found, replace the diaphragm.
The pneumatic control output signal pressure is too high.	The nozzle of the indicating controller section is clogged.	Clean the nozzle.
	The restriction screw of the indicating controller section is not perfectly seated on the seat.	Tighten the restriction screw so that its seating surface is brought into contact with the manifold.
	The valve seat of the pilot relay is stained.	Take out the pilot relay and clean the valve seat.
Large input offset is indicated.	The SP or PV pointer is shifted.	Adjust the deviation mechanism.
	The controller mechanism is not properly adjusted. (Balancing of the PB mechanism is imperfect.)	Adjust balancing of the controller mechanism.
Balancing of PB is poor.	Clamping-screws of the indicating mechanism or controller mechanism are loose.	Tighten the screws and adjust the mechanism.

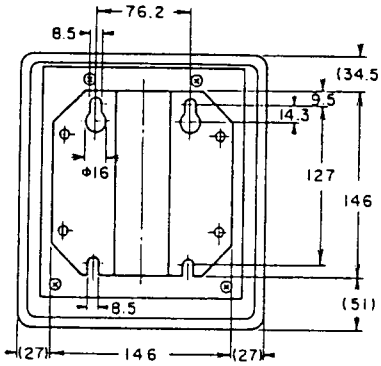
(to be cont'd)

Symptom	Probable cause	Remedy
PB is shifted.	The fixing screws of the dial is loose.	Set the dial in the correct position and securely tighten the screw.
Integral time or derivative time is shifted or ineffective.	The needle or seat is damaged.	Replace the needle assembly.
	The fixing screw of the dial is loose.	Set the dial is the correct position and securely tighten the screw.
	There is air leak from the gasket section.	Securely tighten the mechanism to the base.
The output is unstable or pulsates.	Air leak	Check the air piping and gaskets, and tighten them as required.
	Improper assembly of nozzle and flapper.	Properly assemble the nozzle.
	Stained pilot relay.	Take out the pilot relay and clean it. Replace it as required.
	The actual load is less than the minimum load capacity requirement.	Add load.

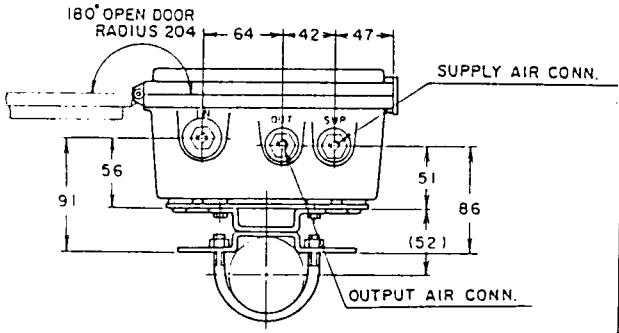
10. INSTALLATION DIMENSIONS

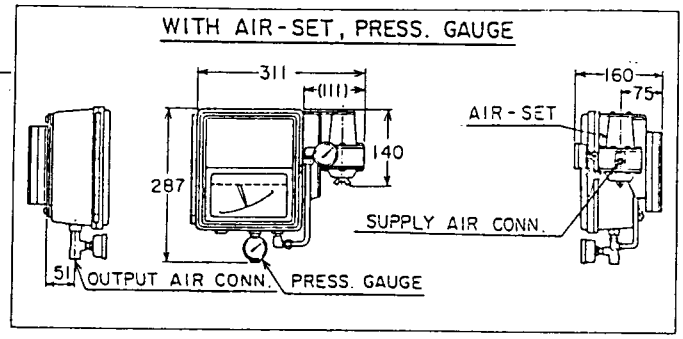


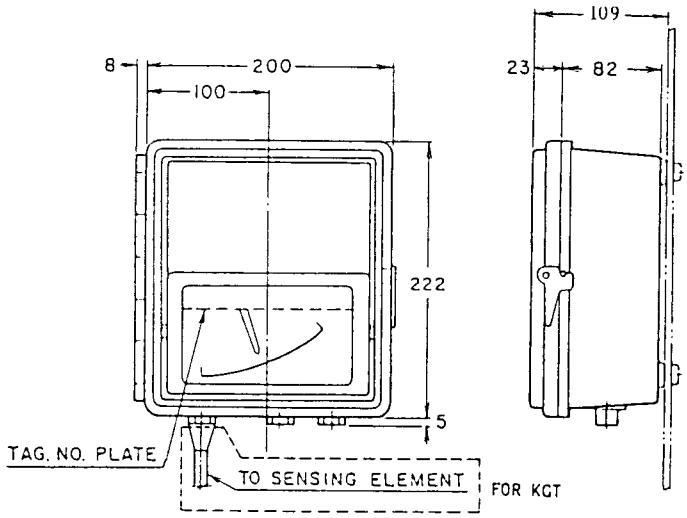


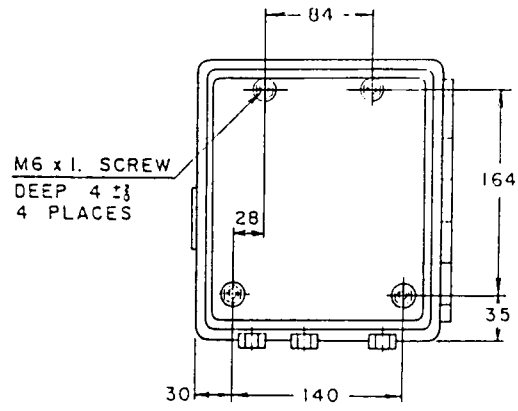


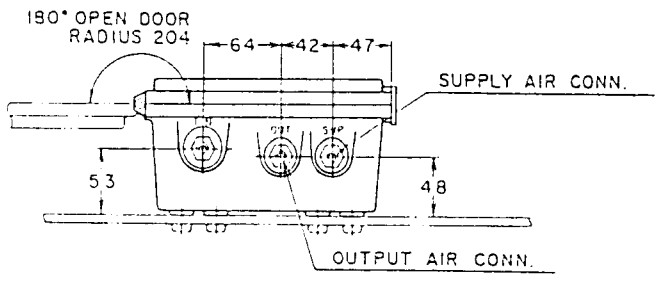
SURFACE MOUNTING (VIEW X - X)
DETAILS OF BRACKET (A)

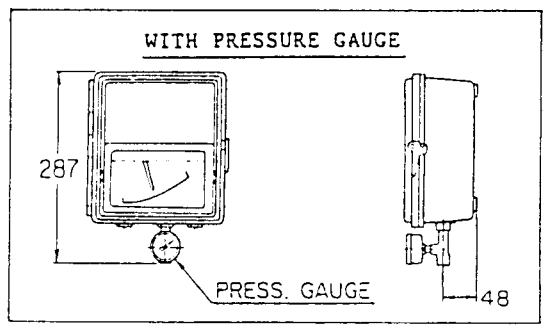












Document Number :	OM2-6220-0100
Document Name :	Field Type Pressure / Temperature Indicating Controller Model : KGT
Date :	Jan., 1986 July, 1998 Rev.3
Issued / Edited by :	Yamatake Corporation

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