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98321A

Flow Column Type Air Gage

FT-5000 SERIES Instruction Manual

NIDEC-SHIMPO CORPORATION

CONTENTS

General

TOHSOKU Flow Type Air Gage FT-5000 Series is a precision comparator utilizing a flow of air and is designed to measure a micro-displacement accurately and quickly without contacting a workpiece.

Of late, air gages have been widely used for continuous measurement, multiple measurement and various applications aiming at precision measurement and labor-saving.

FT-5000 Series has an outstanding advantage in that the number of column units can be easily changed to enable multiple measurement of a workpiece.

. Construction

The construction of Model FT-5000 Series is as follows :

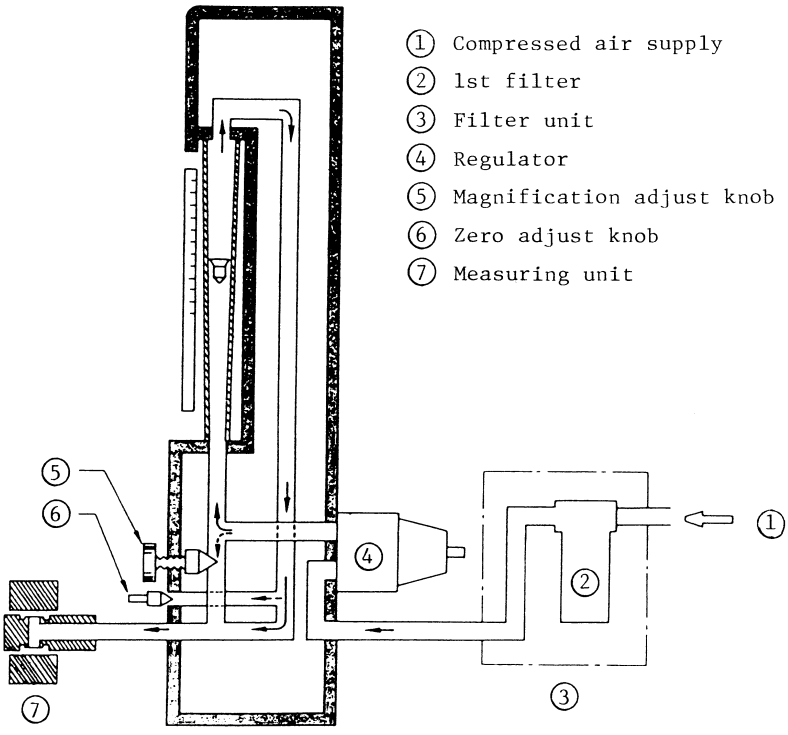


Fig. 1

Compressed air sent from an air supply (air line or air compressor in the factory) is used as a medium for measurement. The filter serves to eliminate dust, oiliness and humidity in the air and also regulate the flow of air, thereby supplying properly stabilized air.
The 1st filter is provided to separate water drops and humidity from the air by centrifugal force and filtrate the air with a filter element.
The 2nd filter is provided to pass the air through the several filter elements so that the air may be thoroughly cleaned and dried.
The pressure of the air so purified is reduced by the regulator to be kept at a constant pressure. The constantly pressurized air which is sent from the bottom of the taper tube of the indication unit passes through the air circuit and jets from the nozzle of the gaging head as shown in Fig. 1.

According as the air flow from the nozzle increases, the float goes up in the taper tube to a position where the clearance between the float and inner surface of the taper tube becomes large, thereby keeping a balance. The float position is indicated by the scale provided on the side surface of the taper tube, so that any change in measurements is represented by a positional change of the float.

The adjustment chamber is provided with a zero adjust knob and a magnification adjust knob.

For zero adjustment, an escape valve is provided in the circuit between the upside of the taper tube and the nozzle, and the float position can be moved up and down by adjusting the amount of air escapement with a knob, independently of the flow of jet air from the nozzle.

For magnification adjustment, a shut-off valve is provided in the circuit between the lower part of the taper tube and the nozzle, and the moving range of the float is controlled by adjusting the by-path flow according to the jet air flow. The magnification (sensitivity) can be easily changed by means of the magnification adjust knob.

The measuring unit is connected to the indicator with a vinyl tube. Usually, direct blow measurement and indirect blow measurement are utilized. So, it is necessary to select a suitable method according to purposes.

The measuring unit should be designed in a most appropriate manner and should also be accurately manufactured. In addition, use of a very accurate master gage is required, as measurement is done by comparison. Usually, a max. master gage and a min. master gage are used for calibrating the indication.

2. Specifications

o Models

Flow type air gages (Model FT-5000 Series) are as follows :

Amplification / Type	1,000 x	2,000 x	5,000 x	10,000 x
Single-column type	FT-5101	FT-5201	FT-5501	FT-5001
Double-column type	FT-5102	FT-5202	FT-5502	FT-5002
Three-column type	FT-5103	FT-5203	FT-5503	FT-5003
⋮	⋮	⋮	⋮	⋮
Six-column type	FT-5106	FT-5206	FT-5506	FT-5006

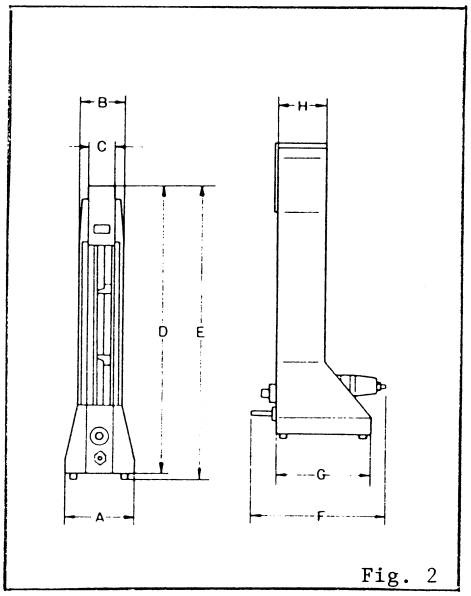


Fig. 2

o Dimensions and Weight of column type air gage

Model / Item	Dimensions (mm)								Weight
	A	B	C	D	E	F	G	H	
FT-5001 Single-column	110	70	40	490	496	Approx. 210	165	80	4.5 kg
FT-5002 Double-column	150	110	80	490	496	Approx. 210	165	80	7.5 kg
FT-5003 Three-column	190	150	120	490	496	Approx. 210	165	80	10.5 kg
FT-5004 Four-column	230	190	160	490	496	Approx. 210	165	80	13.5 kg
FT-5005 Five-column	270	230	200	490	496	Approx. 210	165	80	16.5 kg
FT-5006 Six-column	310	270	240	490	496	Approx. 210	165	80	19.5 kg

o Scale plate

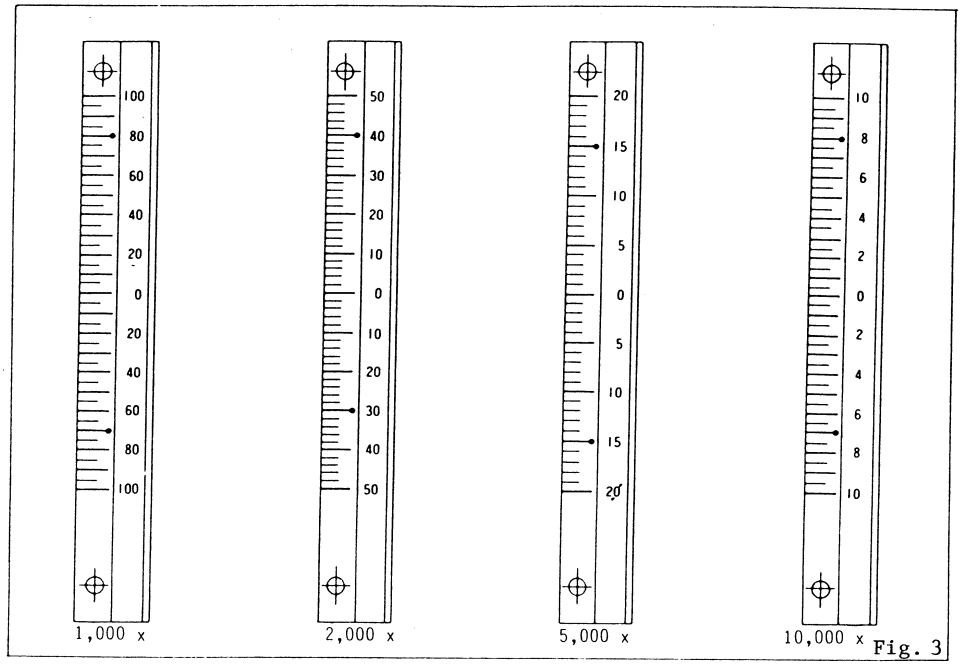


Fig. 3

o Specifications

Item \ Model	FT-5100	FT-5200	FT-5500	FT-5000
Magnification	1,000 x	2,000 x	5,000 x	10,000 x
Full scale (μm)	200	100	40	20
Effective range (μm)	150	70	30	15
Scale interval (μm)	5	2	1	0.5
Range of adjustable magnification	500 x - 13,000 x			

o Performance

Item \ Model	FT-5100	FT-5200	FT-5500	FT-5000
Magnification	1,000 x	2,000 x	5,000 x	10,000 x
Indicating error (μm)	Less than 3.0	Less than 1.5	Less than 0.8	Less than 0.5
Repeatability (μm)	Less than 2.0	Less than 1.0	Less than 0.5	Less than 0.3
Stability (μm)	Less than 2.0	Less than 1.0	Less than 0.5	Less than 0.3
Response time (sec)	Less than 1.5	Less than 1.5	Less than 1.8	Less than 2.0
Indicating variation in multi-column (μm)	Less than 2.0	Less than 1.0	Less than 0.5	Less than 0.3

3. Operation

1) Installation

Install the air micrometer in a place where indications can be easily read, and firmly fix the main unit so that it may not suffer vibration or may not be inclined.

Set the filter unit lower than the main unit.

Arrange the air piping as shown in Fig. 5 as much as practicable.

In this case, use care that moisture does not enter the piping.

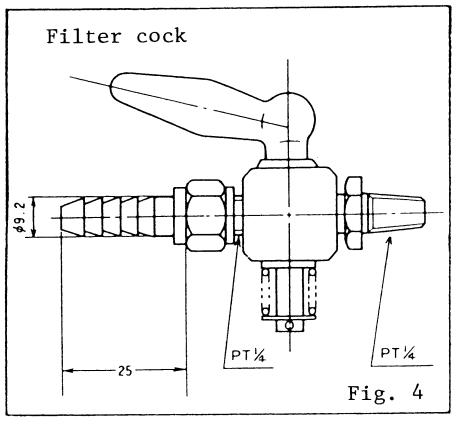


Fig. 4

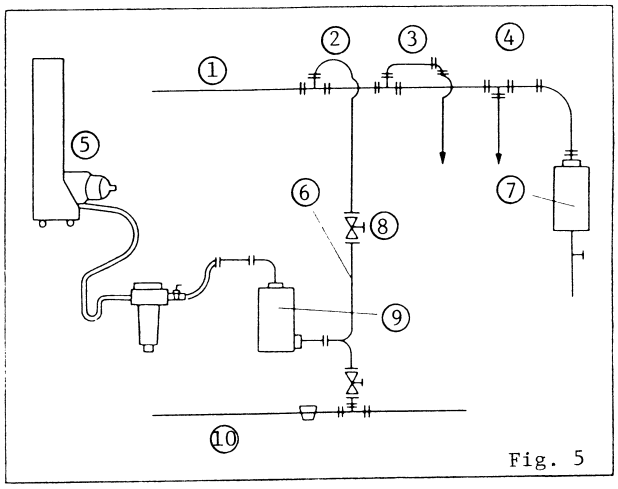


Fig. 5

① Ceiling piping
② Best connection
③ Fair connection
④ Improper connection
⑤ Air gage
⑥ Single-column type : 1/4"φ pipe
Double-column type : 3/8"φ pipe
Multiple-column type : 1/2"φ pipe
⑦ Drain tank
⑧ Cock
⑨ Use of automatic drain trap is recommended. Diameter should be 3-times larger than that of branch pipe.
⑩ On-floor or underground piping

2) Preparation

Connect the cock nipple of the filter to an air line or compressor in the factory with a rubber hose, as shown in Fig. 5. Select a rubber hose with an inner diameter that matches the size of joint shown in Fig. 4.

Then, connect the filter unit to the main unit with the vinyl hose supplied. Each connection should be tightened to prevent any air leakage or disconnection. Thus, connection is completed.

When the filter cock is opened, air jets out from the nozzle. In this case, the float is located at the upper part of the taper tube. When the nozzle hole is closed by hand, the float goes down. If the float fails to move up and down in the taper tube or drifts, check each connection. Now, the instrument is ready for measurement.

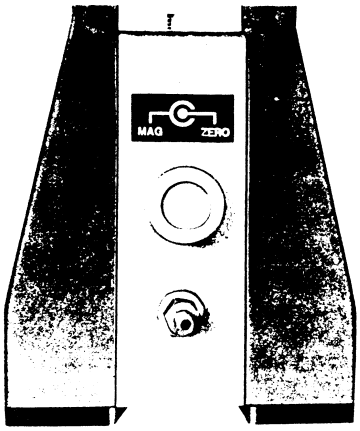
3) Operation of adjust knob (cf. Fig. 6)

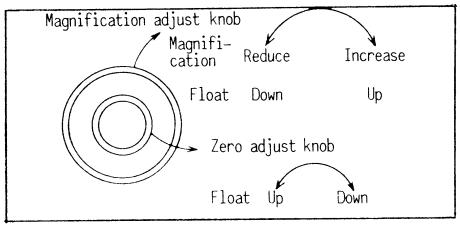
A double adjust knob is provided at the lower position of the main unit. The outer knob is used for magnification adjustment and the inner knob for zero adjustment.

When turning the magnification adjust knob clockwise, magnification is increased, moving up the float. When turning it counterclockwise, magnification is reduced, moving down the float.

When turning the zero adjust knob clockwise, the float moves down, and when turning it counterclockwise, the float moves up.

The indicating position of the float can be calibrated with these adjust knobs.





4) Adjustment

o Adjustment for inner diam. measurement (Figs. 7 and 8)

One of practical examples is given below :

Size of workpiece : $\phi 15 \pm \frac{0.011}{0}$

Max. master gage : D + α = φ15,011

Min. master gage : D = φ15,000

Gaging head : d = φ14,985

Use Model FT-5501 for this adjustment.

① Wipe thoroughly the nozzle and master gage.

② Insert the gaging head into the min. master gage.

③ Make zero adjustment so that the float indicates 11 at the lower position on the scale.

④ Insert the gaging head into the max. master gage.

⑤ Adjust magnification so that the float indicates 0 on the scale. When the float is located lower than 0, turn the magnification adjust knob clockwise, and when the float is located higher than 0, turn it counterclockwise.

⑥ Make zero adjustment again so that it indicates 11 at the lower position on the scale by means of the min. master gage.

⑦ Adjust magnification in the same manner as mentioned in ⑤, so that the float indicates 0 on the scale by means of the max. master gage.

⑧ Repeat the above operations ② - ⑦ until the float indicates correctly 0 and 11 on the scale. Thus, adjustment is completed. It is not strictly required to set the float at 0 - 11 on the scale, for the tolerance of 11μm. For example, the upper 5 is the same as the lower 6. When measuring an inner diameter, the float moves upward in the max. master gage and moves downward in the min. master gage.

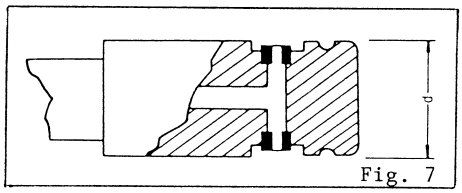


Fig. 7

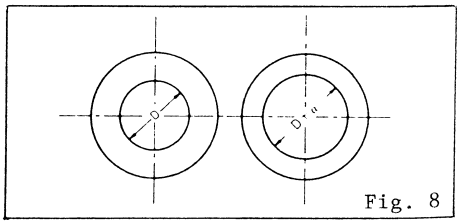


Fig. 8

o Adjustment for outer diam. measurement (cf. Figs. 9 and 10)

The adjustment of outer diam. measurement is explained by the following example :

Size of workpiece : $\phi 15 \, {}^{0}_{-0.008}$

Max. master gage : $d = \phi 15{,}000$

Min. master gage : $d - \beta = \phi 14{,}992$

Gaging head : $D_1 = \phi 15{,}015$

Use Model FT-5501 for this adjustment.

As shown in Fig. 9, the gaging head has 2 jet orifices, and the master plug used consists of a set of max. master and min. master gage. Dimension D_1 of gaging head is larger than the max. master gage by 0.01 - 0.02 mm.

Adjustment is made against the basic magnification by the above setting. Adjustment for outer diameter measurement is the same as of inner diameter adjustment. However, the float moves downward in the max. master gage and moved upward in the min. master gage. The float is set at 0 on the scale by the max. master gage and it is set at the upper 8 on the scale by the min. master gage. Other adjustment is performed in the same procedure as of inner diameter measurement.

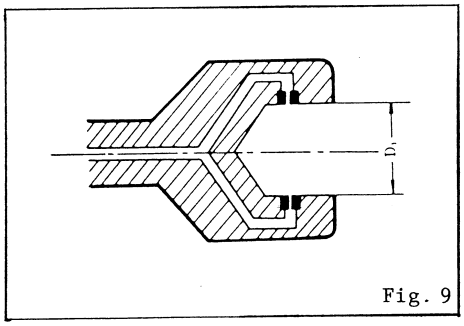


Fig. 9

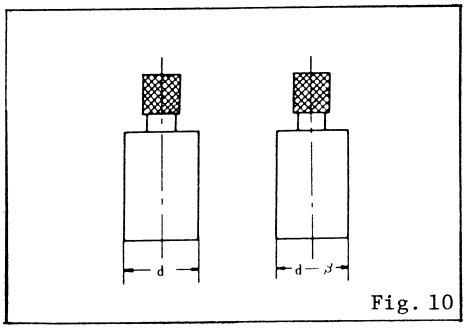


Fig. 10

4. Cautions for operation

1) Keep the air pressure at 3 - 7 kg/cm^2.
2) Drain the filter in the morning and afternoon, and also after operation without fail. When air contains much moisture, check the filter frequently.
3) Be sure to make piping correctly.
4) Do not turn the adjust screw of the regulator, except when confirming whether the regulator is securely locked or not, because it has been adjusted in the manufacture's plant.
5) Use care not to stain or flaw the taper tube.
6) Avoid forcible screwing, violent shaking or bending of the adjust knob.
7) Be sure not to flaw or bend the nozzle of the gaging head and the master gage. Also, apply oil to these parts after operation so as to prevent rusting.
8) Special care should be taken when handling the master gage. Inspect the master gage periodically.
9) Check and clean the groove of the nozzle thoroughly so as to prevent clogging.
10) When operating the Air Gage continuously for a long time, check it with the master gage when starting operation and during operation.

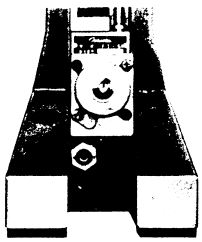
5. Troubleshooting

Trouble	Cause	Countermeasure
The float is caught by the upper buffer.	A) The buffer rod is bent. B) Oil or water sticks to the float. C) The float is flawed. D) The buffer rod end is burred.	A) Inspect the float and correct its position. B) Wash the float with alcohol or thinner. C) Replace the float with a new one. D) Grind the buffer rod end.
The float sticks to the inside wall of the taper tube.	A) Oil or water remains in the taper tube.	A) Remove the moisture and oiliness in the taper tube. (Clean)
The float fluctuates.	A) The air supply pressure is less than 3 kg/cm^2 B) The regulator goes wrong. C) A small quantity of air leaks from the air circuit. D) The float is deformed. E) Oil or dust clogs in the air circuit. F) The nozzle is stained.	A) Raise the air supply pressure to 3 kg/cm^2 or more. B) Repair the regulator. C) Confirm the leak point and retighten the pipe. D) Replace the float with a new one. E) Clean the air circuit. F) Adjust the nozzle.
The magnification or accuracy is inferior.	A) The air supply pressure fluctuates at 3 kg/cm^2 or below. B) Air is not sufficiently supplied. C) The nozzle is worn.	A) Raise the air supply pressure to 3 kg/cm^2 or more. B) Clear up the cause and increase the amount of air supply. C) Replace the nozzle with a new one.

* How to remove the taper tube

1. Loosen the taper tube set screw on the head cover.
   (M6 screw on the upper part)
2. The taper tube is loosened by removing the taper tube set screw.
3. Remove the taper tube from the lower seat by pushing it up.
4. Tilt the taper tube toward you, and thus the taper tube can be removed completely. In this case, use care not to flaw the spring located under the float.

Connection of FT-5000 Series multiple-column type (Rear side)



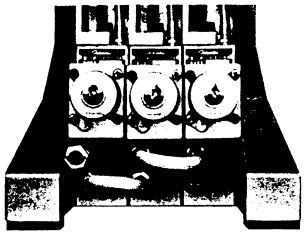


Fig. 11

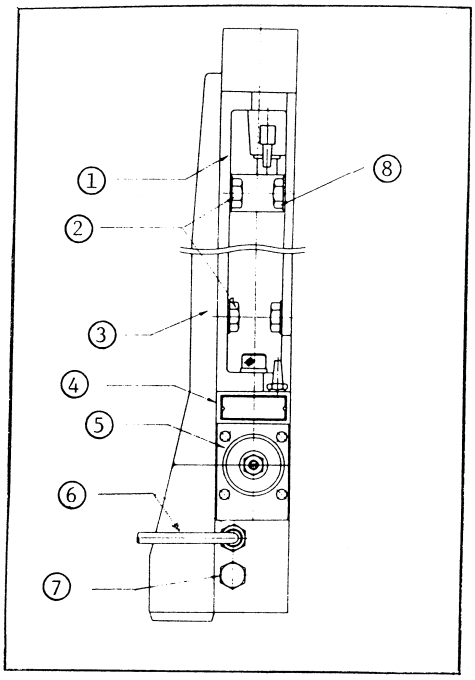
6. How to change the number of columns

When assembling a single column system into a multiple column system or changing a multiple column system into a single column system, follow the procedures below :

[Example] In case of assembling a single column system into a 3-column one, join as shown in Fig. 11.

Prepare 2 columns with manifold block, 4 hexagon bolts (M8 x 16), 4 M8 nuts, 3 joints (C2N-5/16-PT1/8) and 2 vinyl hoses (5/16 x 16 in length)

1) Remove the two hexagon bolts (upper and lower) on the right side that fasten the column to the side cover.
2) Disconnect the vinyl hose of the lower joint on the rear side of the single column.
3) Remove the blind plug on the lower part of the single column.
4) Fasten both upside and lower side of one additional column with the vinyl hose joints, and also fasten the upside of another additional column with the vinyl hose joint and the lower side with the blind plug.
5) Thoroughly join the columns provided with vinyl hose joints on both upside and lower side by means of the hexagon bolt and nut as shown in Fig. 11. In this case, use care that the upside and lower side are parallel.
6) Join and tighten the column provided with the blind plug on the the lower side by means of the hexagon bolt and nut in the same manner as above-mentioned.
7) Firmly tighten the vinyl hose on the rear side in accordance with the 3-column connection as shown in Fig. 11.
8) Fit the side cover and column unit with two bolts.



① Column

② Hexagon bolt (M8 x 16)

③ Side cover

④ Manifold block

⑤ Regulator

⑥ Vinyl hose

⑦ Blind plug

⑧ M8 nut (for multiple-column type)

7. Examples of measurement

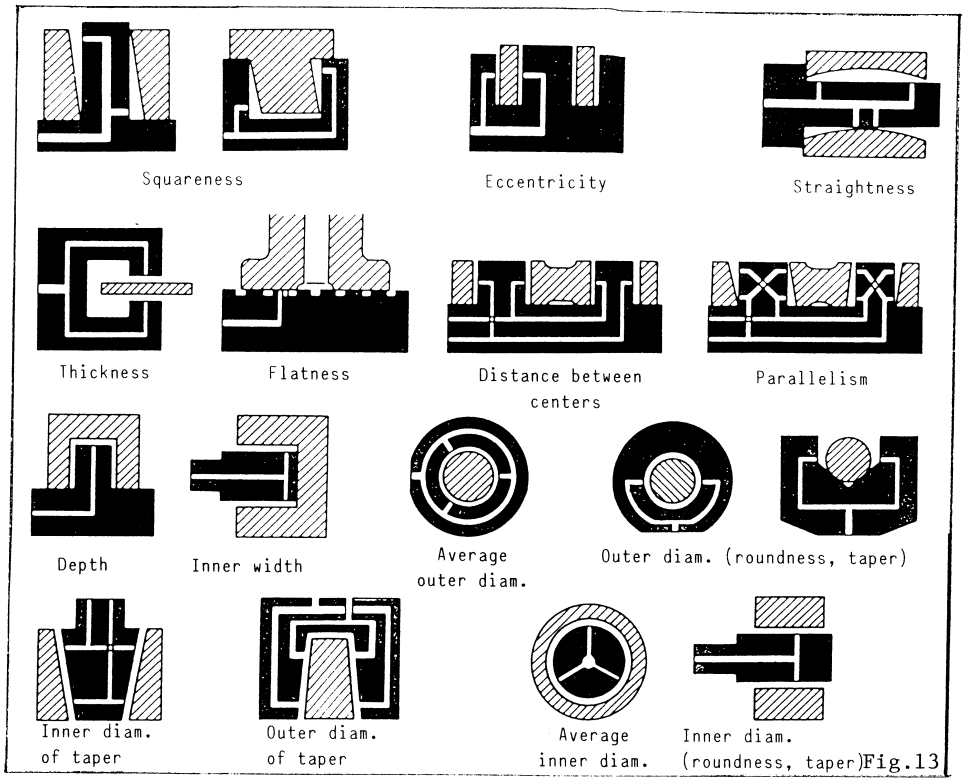
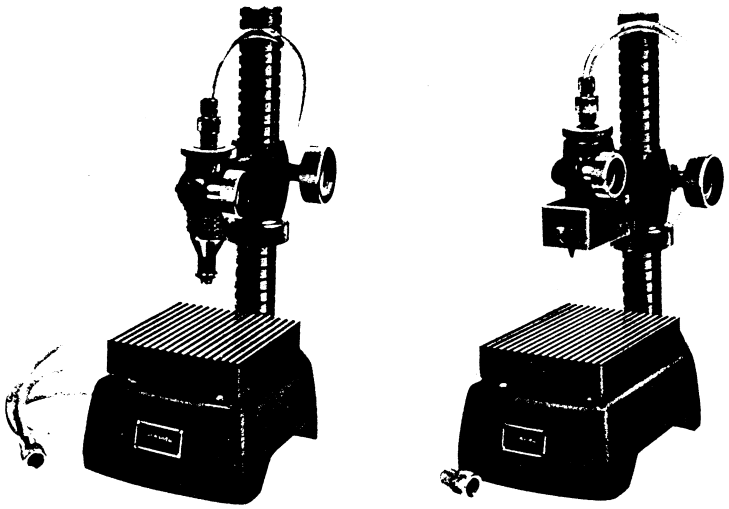


Fig.13

Direct type stand ADS-200 Indirect type stand ACD-200

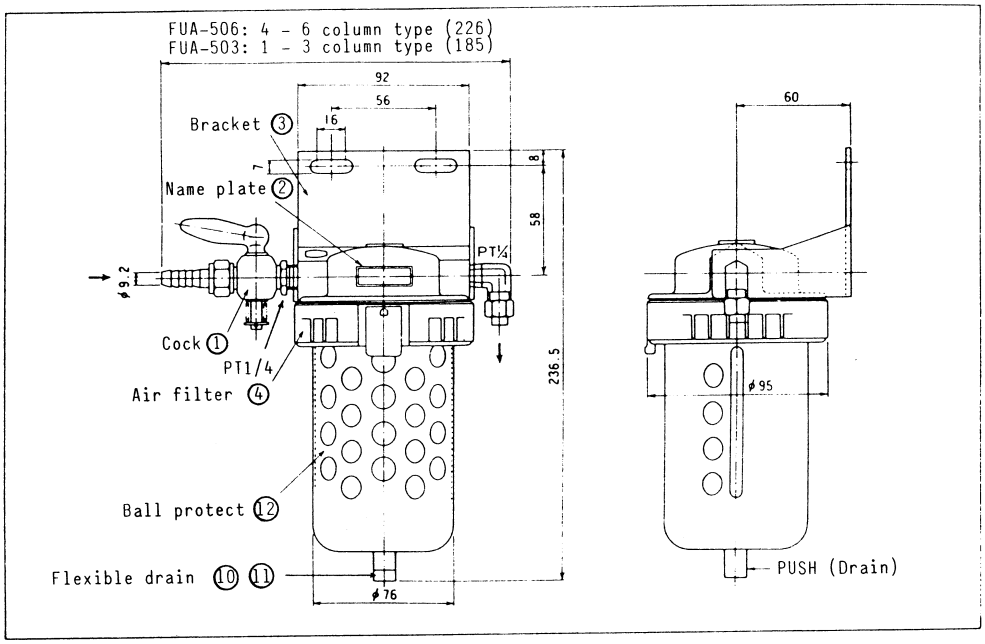


8. Filter unit

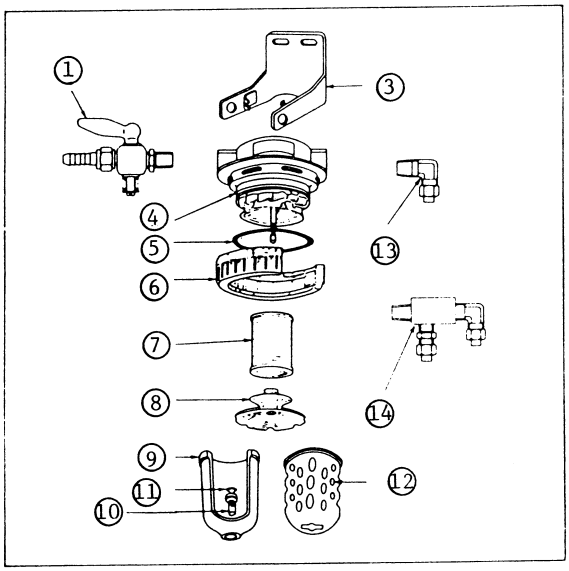
Model FUA-503 : For FT-1 - 3 column type

Model FUA-506 : For more than 3-column type

External drawing



Component parts



① Cock (SV-2A)
② Name plate
③ Bracket
④ Air filter
⑤ O-ring
⑥ Clamp ring
⑦ Y element
⑧ Baffle
⑨ Ball
⑩ Valve
⑪ Drain sheet
⑫ Ball protect
⑬ Nipple
(FUA-503 for FT-1 - 3 column type)
⑭ Nipple
(FUA-506 for FT-4 - 6 column type)

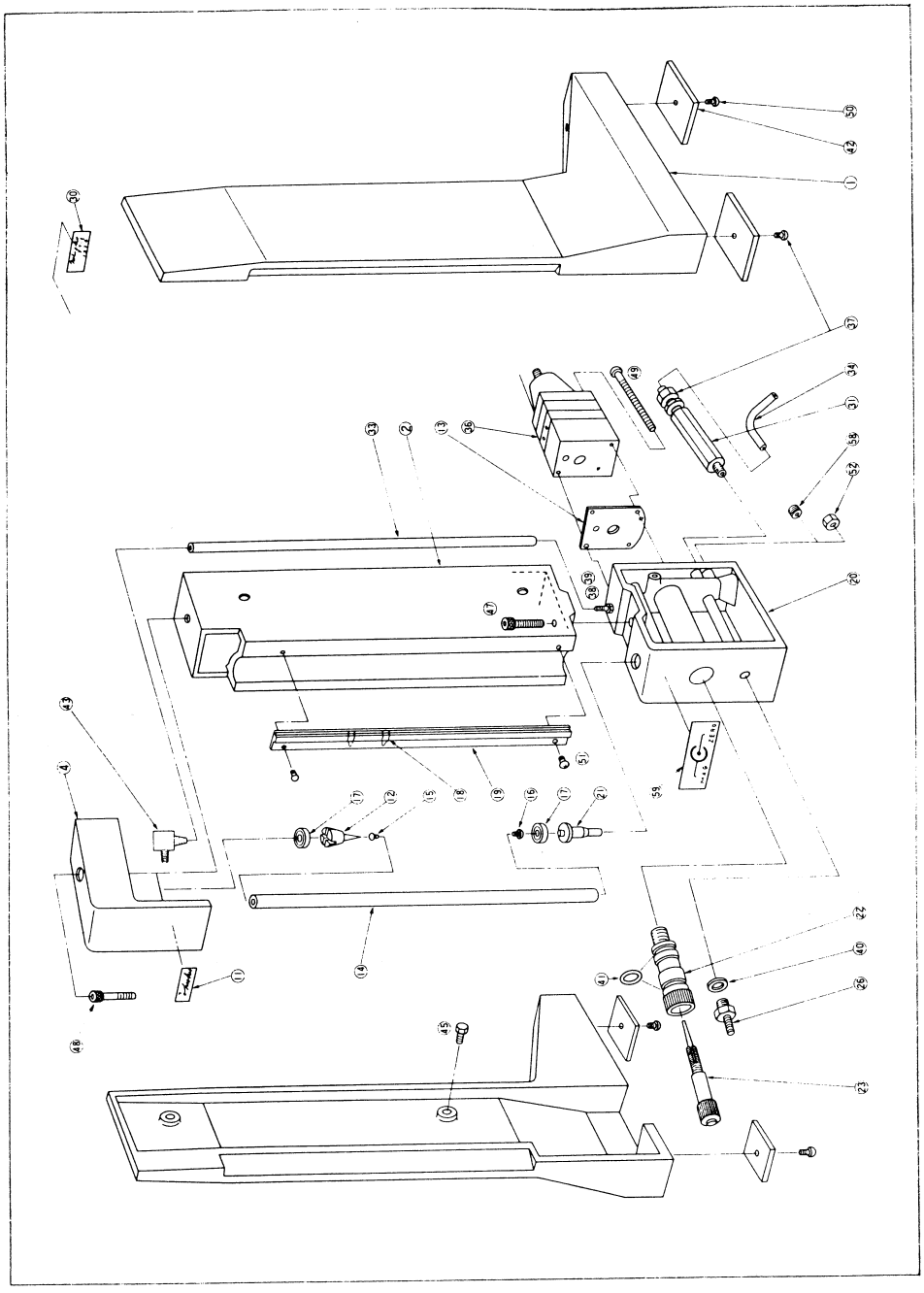
Specifications

Max. operating pressure	9.5 kg/cm^2
Resisting pressure	15 kg/cm^2
Operating temperature range	5 ∿ 65°C
Efficienty of filtration	0.3 μm
Removing of tar or carbon	99 %
Max. flow rate	0.5 Nm^3/min (Input : 7 kg/cm^2, Pressure drop:0.1 kg/cm^2)
Nipple diam.	PT 1/4
Weight	1.6 kg

o Flexible drain ..... The filter unit can be manually drained by pushing the adaptor sideways.

o Normally, pressure drop is less than 0.1 kg/cm^2 at an early stage. When it reaches 0.7 kg/cm^2, the filter element is used up. So, it is necessary to replace the filter element with a new one.

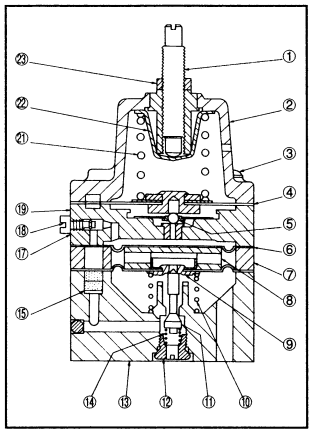
9. General drawing



10. Parts List of FT Column Type Air Gage

No.	Part name	Q'ty	Remarks	No.	Part name	Q'ty	Remarks
1	Side cover	2 pcs.		33	Vinyl tube	1 pc.	
2	Column	1 pc.		34	Supply tube	(1) pc.	For 2 columns or more
4	Head cover	1 pc.	⑪ included	36	Miniature regulator	1 pc.	
12	Buffer	1 pc.	(Upper)	37	Connector	1 pc.	C2N-5/16-PT 1/8
13	Gasket	1 pc.		38	Joint	1 pc.	M6
14	Taper tube	1 pc.		39	Packing for joint	1 pc.	M6
15	Float	1 pc.		40	Packing for joint	1 pc.	M10
16	Buffer spring	1 pc.	(Lower)	41	O-ring	2 pcs.	KS 12
17	Packing for taper tube	2 pcs.		42	Rubber pad	4 pcs.	
18	Cursor	2 pcs.		43	L type nipple	1 pc.	
19	Scale plate	1 pc.	By magnification	45	Hexagon bolt	4 pcs.	M8 x 16
20	Manifold block	1 pc.	⑲ included	47	Hexagon socket head cap screw	1 pc.	M8 x 25
21	Throttle	1 pc.		48	Hexagon socket head cap screw	1 pc.	M6 x 35
22	Magnification adjust knob	1 pc.		49	Cross-recessed head screw	2 pcs.	M4 x 57
23	Zero adjust knob	1 pc.		50	Cross-recessed head screw	4 pcs.	M4 x 8
26	Hose joint	1 pc.		51	Cross-recessed head screw	2 pcs.	M3 x 4
30	Manufacture No. plate	1 pc.		52	Nut for supply blind	1 pc.	Special accessory
31	Supply connector	1 pc.		58	Blind plug	1 pc.	PT 1/8

Parts for Miniature Regulator



No.	Part name	Q'ty
1	Adjusting screw	1 pc.
2	Top housing	1 pc.
3a	Bolt SSH-M4 x 0.7 x 35	2 pcs.
3b	Spring washer WAP-4	2 pcs.
4	Top diaphragm assy'	1 pc.
5	Leaf spring assy'	1 pc.
6	Diaphragm	1 pc.
7	Exhaust ring	1 pc.
8	Spacer	1 pc.
9	Exhaust diaphragm assy'	1 pc.
10	Spring (8678-6)	1 pc.
11	Pilot plunger	1 pc.
12	Seal screw	1 pc.
13	Pilot base	1 pc.
14	Plunger spring	1 pc.
15	Filter (felt)	2 pcs.
17	O-ring SM720 Nitrile rubber	1 pc.
18	Throttle plug assy'	1 pc.
19	Pilot ring	1 pc.
21	Spring (8678-7)	1 pc.
22	Spring sheet	1 pc.
23	Locknut	1 pc.

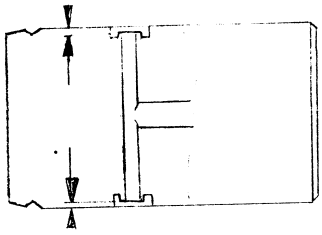
11. Handling Instruction of Gaging Heads and Measuring Tools for Air Micrometer

11-1 Regard gaging heads (including measuring tools) as expendables
Take into consideration that the gaging head is bound to wear because it is designed to touch part of the workpiece.
If the gaging head is considered as a permanently usable part and is used for long time, it will wear to cause indication errors.
Consequently, the good parts may be judged as the bad and vice versa.

11-2 What phenometa occur when gaging head wears.
Measurement is made by bringing the workpiece to the gaging head or the latter to the former. In either case, the gaging head is not always in contact with the workpiece at the same point. Therefore, they cannot be uniformly worn out.
If the jet wears unevenly as shown in Fig. 14, the amount of difference in level on the upper part differs from that on the lower part. Accordingly, air flow is out of balance, causing indications to vary widely and deteriorating repetitional accuracy.

Amount of difference in level (Large)

Fig. 14



Amount of difference in level (small)

Even when the upper part and lower part are worn out uniformly to the same amount of difference in level, air receives resistance in case of flowing out and thus indications vary widely, because such amount of difference in level becomes smaller than that in the early stage due to wear.
If this instrument is used in this state, the indicated position will vary each time the indication is set with a master gage.
The greater the variation, the greater the indication error, causing more rejects.

11-3 Service life and limit of wear

The service life and limit of wear vary according to daily frequncy in use, usage and handling.

Several hints on the service life and limit of wear are as follows :

(1) More frequent usage will fasten wear and shorten the service life.

(2) The service life varies according to usage.

For an example of measurement after honing, the service life varies largely according to whether or not the workpiece is cleaned after honing.

If the workpiece is not cleaned after honing, rubbish will stick to it to lap the gaging head, fastening the wear.

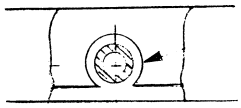
On the other hand, cleaning the workpiece after honing will lessen the wear and lengthen the service life.

(3) The service life varies according to handling.

The air jet of a gaging head is a vital part.

Any of flaws, dents or rust occurred in the part shown in Fig. 15 will make the gaging head unusable.

Fig. 15



No flaw, dent, rust, etc. should occur on this part.

Never throw, drop or hit the gaging head or never leave as it is for long time.

Make it a rule to apply rust preventing oil or clean it after use. This precaution should also apply to the reference surfaces for measurement other than the air jet.

Careful handling will lead to the long service life.

11-4 The master gage should be handled as an important accessory of the gaging head

Since the air micrometer is designed to make relative measurement using a master gage, strict care should be taken to the handling of the master gage.

Rust, flaws, dents, etc. will change the actual measurements, thus causing indication errors.

Even a slightest amount of rust, dents or flaws will change the actual measurements, because the master gage is manufactured with close tolerance in microns. In addition, it will be worn out as long time use, and thus the size will be changed.

Therefore, check the actual measurements periodically.

11-5 The master gage should be carefully kept.
The best method is to prepare a case for keeping the master gage and put it in the case. A wooden case is preferable.
When the case is not prepared owing to circumstances, lay a soft mat on the master gage or place it keeping away from the workpiece.
Avoid locating it on a metal or near the workpiece, otherwise it may be flawed or dented.

11-6 Simple way of inspection
The gaging head can be easily inspected by the operator using a master gage without asking an inspection division or measuring tools maintenance division to do so.
As shown in Fig. 16, inspection is performed by pushing the master gage to the right, left, top and bottom of the gaging head.

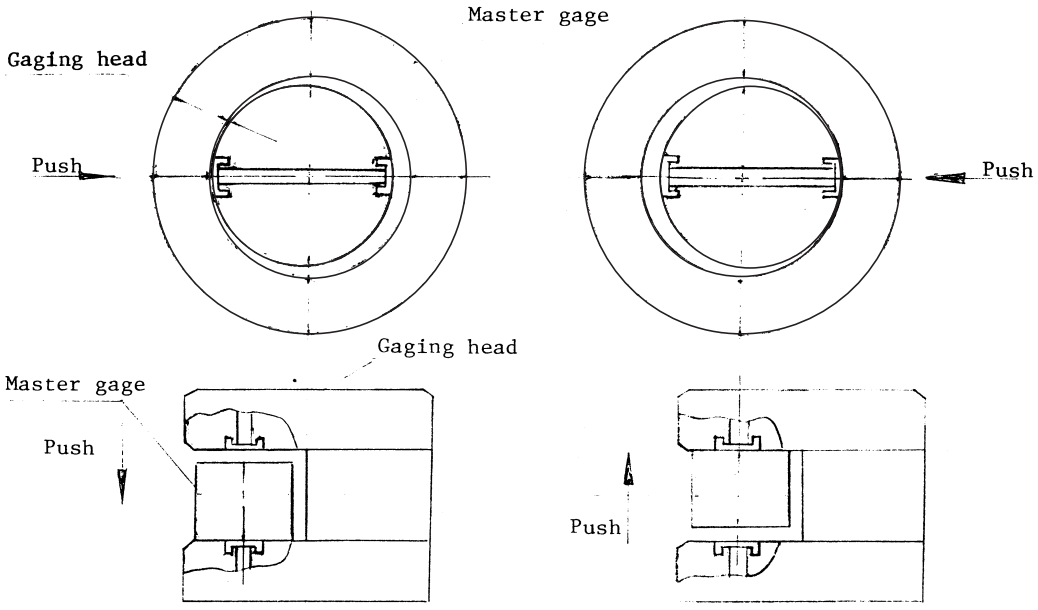
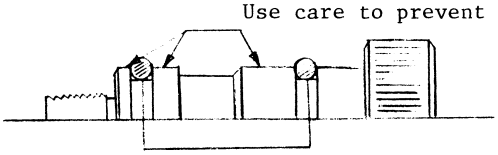


Fig. 16

Our inspection standard for the variation of indications differs to some degree according to the size of workpieces. However, it is usually set at 1 to 1.5 graduation in each magnification.
Since greater wear will lead to greater variation, it is desirable to determine a certain limit of the variation of indications in advance to make clear the limit of use.

12. Operating Instructions for Flow Type Air Gage

12-1 Magnification adjust knob

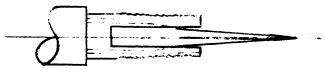


Use care to prevent Vaseline from swelling out. Otherwise, Vaseline clogs air circuit joint, adversely affecting accuracy.

Apply Vaseline to bottom surface.

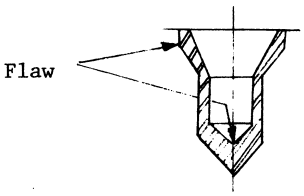
If this unit is left as it is for long, Vaseline will be dried up to immobilize the O-ring, so that the adjust knob cannot be rotated any more. To avoid such a trouble, apply Vaseline periodically.

12-2 Zero adjust knob



If the adjust knob is loose, expand the slit with a screw driver.
If the adjust knob is tight, cover the screw with a cloth etc. and narrow the slit with pliers etc.
Use strict care to prevent damage to the screw, otherwise it badly fits to the magnification adjust knob, and thus this knob becomes very tight.

12-3 Float



When the float is used for long time, it may be deformed and the periphery of inside bottom is flawed, adversely affecting the accuracy. In such a case, replace with a new one.
Since the end of the upper float receiving buffer hits on the bottom of the float each time of measurement, if the inside bottom is flawed, the flaw will become larger with long time use and thus deteriorate accuracy due to unbalance with the taper tube.
When the taper tube is soiled, the float sticks to the taper tube. If the float is used for long in this state, it will be worn out, presenting a phenomenon just like a flaw.

Special care must be taken not to drop or press it, otherwise it will be easily deformed as it has a very thin wall.

12-4 Taper tube

If oil or water adheres to the inside of the taper tube, the float will stick to the taper tube, thus being immobilized or stopped halfway. In such a case, remove the taper tube immediately and clean the inside with degreasing agents such as Freon, trichloroethane, alcohol, etc.

After cleaning, wipe off with a gauze and remove flocks of the gauze using an air gun. If any flocks of the gauze remain on it, the movement of the float will change on this part, adversely affecting the accuracy.

Also, use care to prevent damage or flaw to the inside surface, otherwise the accuracy will be badly affected.

12-5 Regulator

When the regulator is used for long time with the inside immersed with water or oil, the diaphragm will be deteriorated to choke the throttle. As a result, stable air pressure cannot be applied, leading to inaccuracy.

Since supplied air contains a slight amount of oil or water in most cases, disassemble the regulator for replacing the diaphragm and cleaning the inner parts.

After assembling, adjust pressure as shown below :

1. Install the regulator in a fixed position on the rear side of the body.
2. Screw the magnification adjust knob to such a degree that the O-ring on the knurling side cannot be seen.
3. Screw the zero adjust knob deep until it stops.
4. Connect the gaging head joint on the front with a hose, and connect a pressure gage with another end of the hose.
5. Send air
6. Set pressure at 0.75 kg/cm^2 with the adjusting screw of the regulator while seeing the pressure gage.
7. Lock it with a nut.
8. Apply soapy water to the outside surface of the regulator with a writing brush to check for air leakage.
9. Put a finger to the bleed hole to check for excessive air flow.

Assemble the regulator with the adjusting screw loosened (pressure setting is 0).

12-6 Filter and auxiliary filter

Check the felt for dirt.

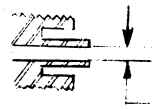
An extremely dirty felt is incapable of filtering, causing to drop the pressure.

If the filter loses its filtering function, air enters the regulator taper tube etc., thereby deteriorating the diaphragm and float to cause defective operation and inaccuracy. In such a case, replace with a new one.

Note) Be sure to drain the filter when starting and ending the operation. The filter element and felt can be easily replaced. After completion of overhaul, firmly tighten it to prevent looseness.

If any loose part is found in the filter, unclean air enters the regulator taper tube directly without passing through the filter element.

12-7 Joint and hose



Larger than usual hose inner diameter

The joint connecting from the auxiliary filter to the body is thickened in its inner and outer diameters due to change in pressure applied, as compared with the usual joint.

Therefore, the hose inner diameter becomes larger than the usual one. The new hose is colored yellow since April, 1979, and the old one milk white.

The new hoses are sticked with a certificate on the reverse of the body.

12-8 Others

While this gage is used in the manufacture line, the vinyl hose and packing are deteriorated with oil or unclean air in the factory, causing air leakage. So, replace them periodically.

12-9 Stock of parts

According to circumstances, quick delivery of parts may not be performed. So, it is recommended that you stock the following spare parts beforehand :

Taper tube, float, diaphragm, filter element and felt