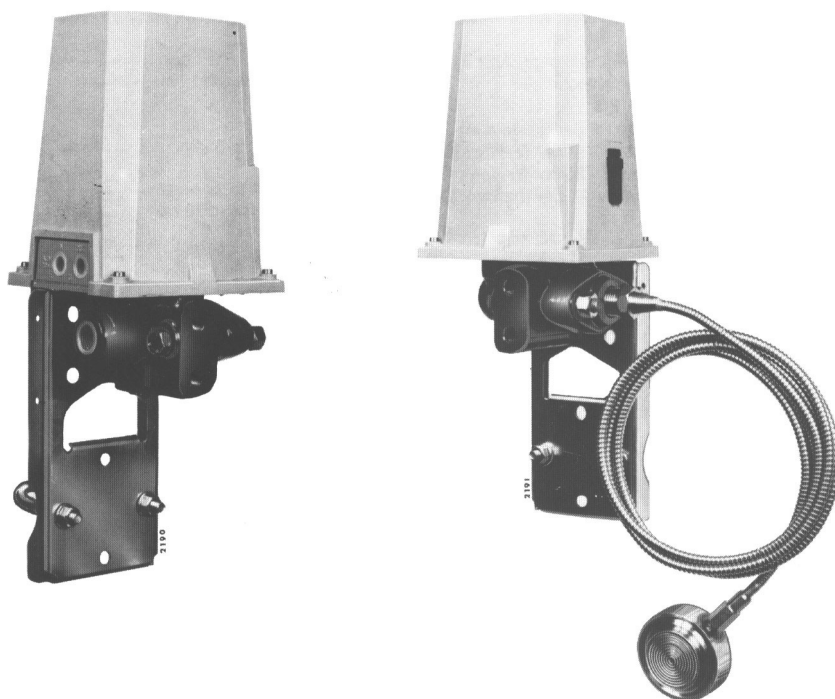


# Models NDA, NDB, NDD Pneumatic differential/gauge pressure transmitters

Deltapi N Series  
A complete range of  
pneumatic pressure transmitters



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## INTRODUCTION

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### General

The Deltapi N series models NDA, NDB, NDC and NDD pneumatic differential pressure transmitters are designed for measuring the pressure, differential pressure or level of liquids, steam, gas or air. The measured value is transmitted as a 0.2 to 1.0 Kg/cm<sup>2</sup> , 3 to 15 lbf/in<sup>2</sup> or 20 to 1.0 bar pneumatic signal to remotely mounted receiving equipment such as recorders, indicators or controllers or combinations of these items.

The relative range are:

#### **NDA - Differential pressure transmitter**

Maximum operating pressure 100 Kg/cm<sup>2</sup> (1500 lbf/in<sup>2</sup>)

Span adjustable from 1.7 to 100 Kg/cm<sup>2</sup> (25 to 1500 lbf/in<sup>2</sup>)

#### **NDB - Pressure transmitter**

Maximum overrange according to the range bellows

Span adjustable from 1.7 to 140 Kg/cm<sup>2</sup> (25 to 2000 lbf/in<sup>2</sup>)

#### **NDC - Absolute pressure transmitter**

Maximum overrange 35 Kg/cm<sup>2</sup> (500 lbf/in<sup>2</sup>)

Span adjustable from 1.7 to 17 Kg/cm<sup>2</sup> (25 to 250 lbf/in<sup>2</sup>)

#### **NDD - Gauge pressure transmitter with separator and capillary**

Maximum overrange according to the range bellows

Span adjustable from 1.7 to 140 Kg/cm<sup>2</sup> (25 to 2000 lbf/in<sup>2</sup>)

The NDA type differential transmitter can measure any set span within the range 1.7 to 100 Kg/cm<sup>2</sup> (25 to 1500 lbf/in<sup>2</sup>). This is achieved in four stages according to the capsule supplied. The exact range for each combination is given in the specification. This type of transmitter is designed to withstand a maximum static pressure of 100 Kg/cm<sup>2</sup> (1500 lbf/in<sup>2</sup>). The NDB and NDD pressure transmitters can measure any set span within the range 1.7 to 140 Kg/cm<sup>2</sup> (25 to 2000 lbf/in<sup>2</sup>) using the same four capsules as for the model NDA, the specifications giving the range limits and the maximum overrange for each capsule.

The NDC absolute pressure transmitter can measure any set span within the range 1.7 to 17 Kg/cm<sup>2</sup> abs. (25 to 250 lbf/in<sup>2</sup> abs) and range limits from 0 to 25 Kg/cm<sup>2</sup> abs. (0 to 350 lbf/in<sup>2</sup> abs.). The maximum overrange is given in the specification. The required measurement span, in accordance with the limitations as set down in the specification can be easily set by a screwdriver adjustment, a scale on the force bar giving an approximate indication of set span refer to the models specification sheets.

# TECHNICAL DESCRIPTION

The Deltapi N series models NDA, NDB, NDC and NAD are basically the same with the exception that different capsules are used for the absolute pressure measurement (mod. NDC) and that the same capsule is connected (mod. NDD) to a diaphragm seal via a capillary pipe forming one all-welded system and properly filled with a separating liquid under vacuum.

The transmission unit is identical for the four types.

## GENERAL DESCRIPTION

For purpose of description the transmitter may be divided into two parts or units: the measuring unit, which detects the measured value and the transmission unit containing the pneumatic transducer.

## Measuring Unit (Fig. 1)

This unit comprises a bellows unit clamped by a flange in the measuring unit body forging, two 'O' rings forming the seal. The movable limb of the bellows unit is connected to the transmission bar by a "C" flexure. The upper end of the transmission bar is clamped to the fulcrum diaphragm seal by the upper portion of the force beam, (the force bar). The periphery of the fulcrum diaphragm is clamped between the measuring unit and the transmission unit to form a flexible pressure-tight fulcrum point for the force beam assembly. The materials used for the measuring unit are selected from the range given in the coding table and are chosen for compatibility with the characteristics of the measured fluid.

A mounting unit bolted to the measuring unit provides mounting facility for the transmitter. The unit comprises a drilled plate and 'U' bolt shackle.

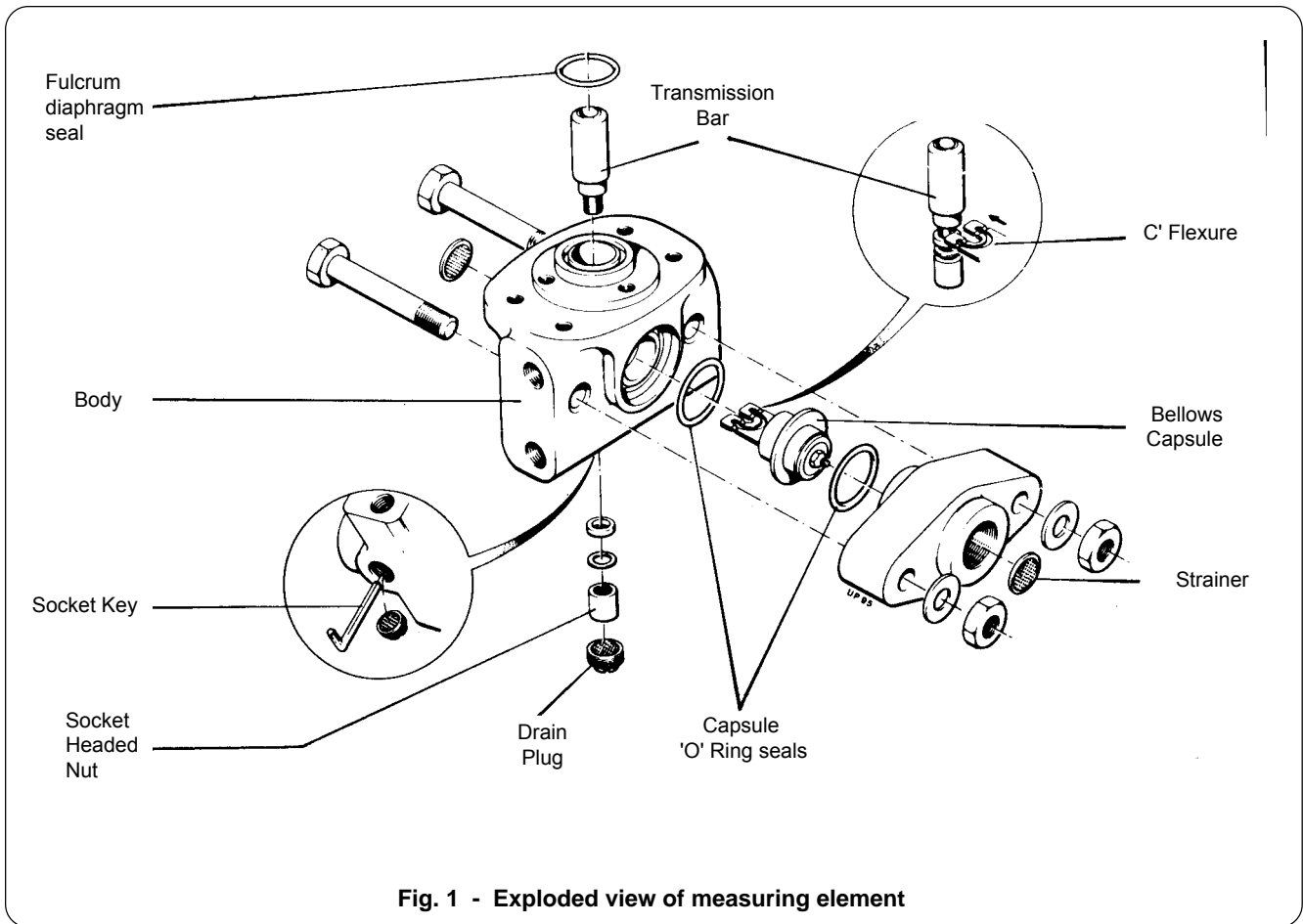


Fig. 1 - Exploded view of measuring element

## ... TECHNICAL DESCRIPTION

### Transmission Unit (Fig. 2)

This unit comprises the following items:

A mounting frame attached directly to the measuring unit body and to which is attached an "A" flexure, flapper, nozzle feedback bellows, span adjustment and zero adjustment mechanisms.

A base plate mounted directly to the measuring unit and on which is mounted the air connection block, air relay and the transmission unit cover.

Beneath the base plate is affixed the data plate.

The force bar is attached at its lower end to the transmission bar (measuring unit) and at its upper end to the 'A' flexure.

Also at the upper end of the force bar is the 'T' strap which actuates the flapper; the flapper adjustment screw is also on this strap.

### OPTIONAL EXTRA ITEMS

#### Input Suppression fig. 3

Comprising a spring, adjustment screw and mounting bracket. The bracket is mounted on the mounting frame and the spring on the force bar. The spring is used in tension.

#### Input Elevation fig. 3

Comprising a spring, adjustment screw and mounting bracket. The bracket is mounted on the mounting frame and the spring on the force bar. The spring is used in compression. The input elevation cannot be obviously used with the NDC absolute pressure transmitter.

#### Body heating

Hollow clamp bolts replace the standard solid bolts for body clamping purposes. The bolts are interlinked by connection piping and provision is made for connection to a steam heating source. Either one or two bolts are used depending on the degree of heating required. A moulded expanded-polystyrene jacket can also be provided to enclose the measuring unit body and reduce heat losses.

#### Air filter regulator unit

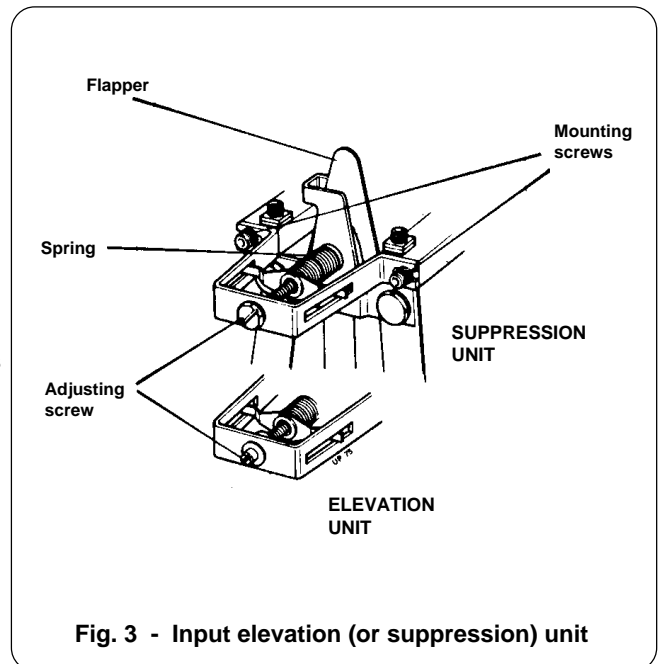
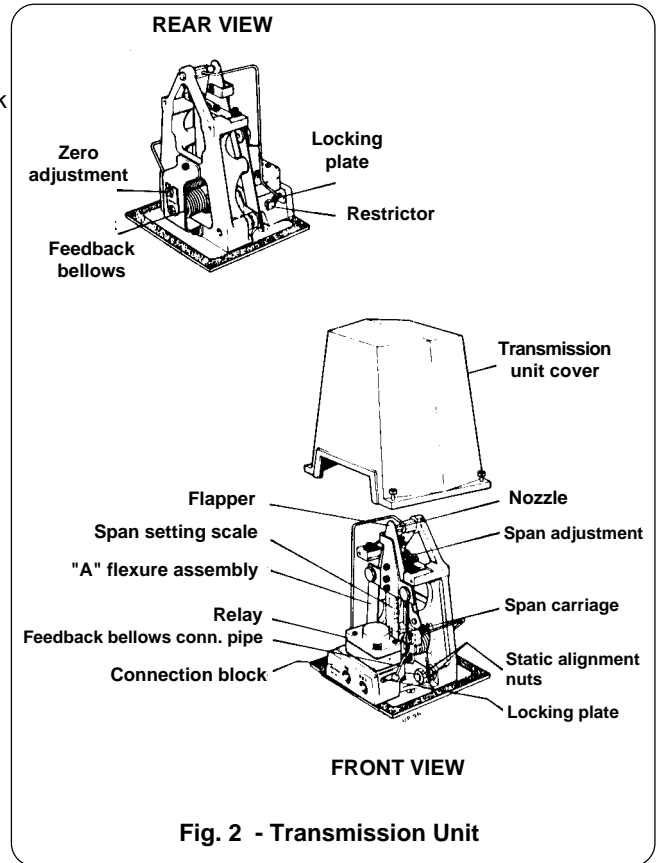
An air filter regulator with a disposable filter element, can be directly mounted on the transmitter, with or without output gauge, and connected with piping and fittings either in stainless steel, aluminium or copper.

#### Principle of operation

The Deltapi N transmitter operates on the force balance principle. The system is depicted schematically in fig. 4. Referring to the diagram, a pressure or a differential pressure is applied across the bellows capsule; this generates a force at the capsule in the direction of the arrow "A", and which is applied to the lower end of the transmission bar. This force produces a moment relative to the fulcrum point (fulcrum diaphragm) and thus a moment of the force beam about the fulcrum. This movement, in the direction of the arrow at "B" varies the distance of the flapper, controlled from the upper end of the force beam, relative to the nozzle.

Air is supplied to the nozzle via a fixed restriction orifice and discharges to the atmosphere through the flapper nozzle gap and variations of this gap determine the back pressure value at the nozzle. The nozzle back pressure is sensed by the relay diaphragm which positions the double valve in the relay to allow supply air into the output system of relay.

The output pressure from the relay is fed to the feedback bellows (and to the receiving equipment) the pressure rising until the bellows force balances that of the bellows capsule;



at this point equilibrium is attained and the output pressure is proportional to and thus representative of the pressure at the measuring unit.

A reduction of the pressure value as sensed by the measuring-unit bellows capsule will initiate a train of events in the opposite direction to that given above. As the pressure falls so the flapper nozzle gap widens because of imbalance of the forces on the force bar. To increase of the flapper nozzle gap causes the output pressure to fall reducing as it does so the bellows feedback force on the force bar until equilibrium is again achieved. The revised output signal will again be proportional to the reduced pressure value.

## ... TECHNICAL DESCRIPTION

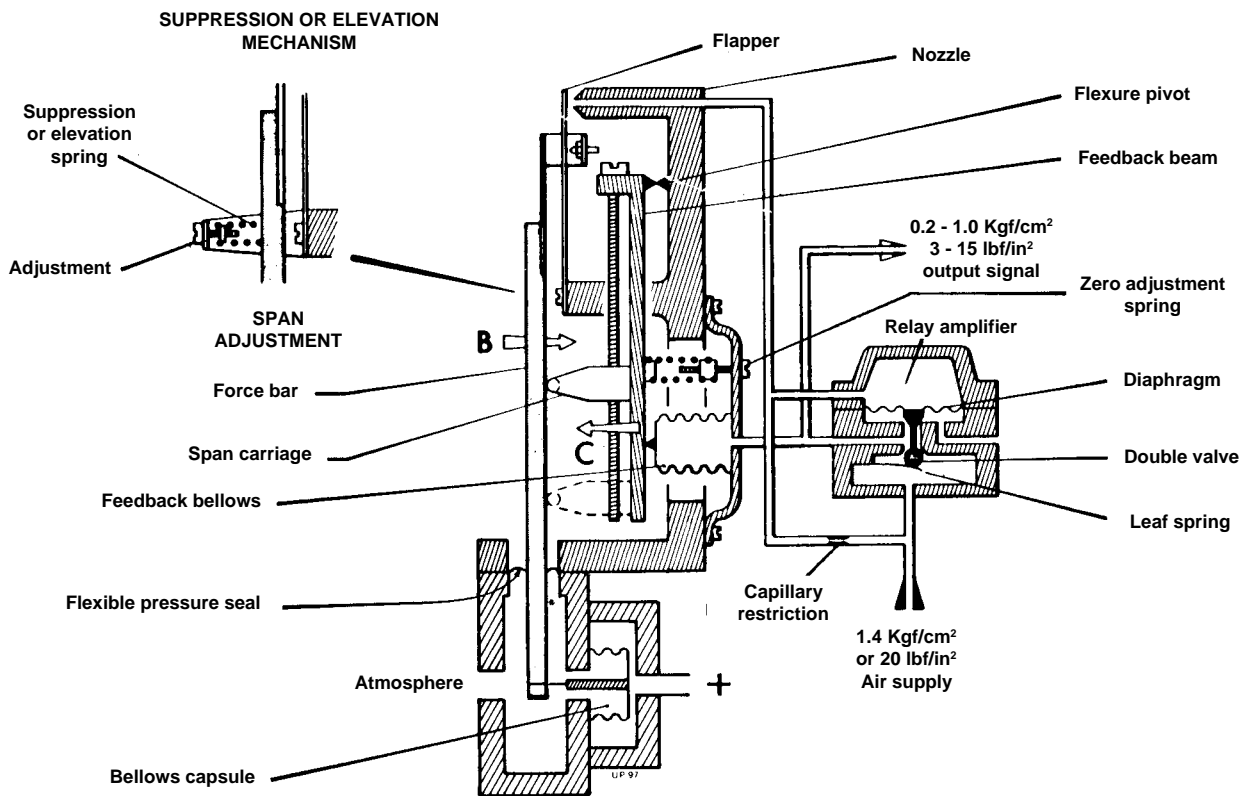


Fig. 4 - Schematic diagram

As the flapper movement necessary to vary the output pressure throughout its ranges is only 0.0003 inches (0.005 mm) the force beam remains in a substantially constant position and thus output varies in proportion to the applied forces and thus to the applied pressure. The measurement span of the transmitter may be varied by positioning the span rider on the feedback beam. This varies the point at which the feedback force is applied to the force bar and thus the feedback movement of the bellows. As the rider is moved away from the fulcrum point to will the effect of the feedback bellows force increase thus the measurement span increases as the span rider is moved upwards along the feedback beam.

The transmitter is designed to give a positive output signal pressure ( $0.2 \text{ Kg/cm}^2$  or  $3 \text{ lbf/in}^2$ ) for the measured zero; to achieve this the feedback bellows is counter balanced by an adjustable spring and adjustment.

Of this spring by a screw anchor is the means of zeroing the transmitter.

A further adjustable bias spring acting on the top of the force bar as shown in the inset, fig. 4 is used when included, as a means of either suppressing or elevating the set input span in relation to the output signal.

For elevation of the span a spring in compression is used and for suppression a spring in tension.

The two facilities are not interchangeable, a separate set of parts is required for each function.

### Stainless Steel bolts

For the models NDA, NDB and NDC the transmitter body bolts and nuts, in case of a particularly aggressive atmosphere, can be supplied in stainless steel AISI 316 or 17-4-PH.

For the NDB model the rating will be reduced to  $100 \text{ Kg/cm}^2$  ( $1500 \text{ lbf/in}^2$ ).

## LOCATION AND INSTALLATION

### Location

Before selecting a location and installing the transmitter all relevant sections of this manual must be read and the requirements of all associated equipments considered. Select a location as close as possible to the pressure tap, where the ambient temperature will not exceed the limits  $-40$  to  $+120^{\circ}\text{C}$ . The location should also be as free as possible from vibration.

Sufficient space must be allowed above the transmitter to permit removal of the cover, the specification sheet gives the minimum space required for this purpose.

### Mounting the transmitter

The transmitter is fitted with a mounting unit comprising a mounting plate and "U" bolt shackle. It is suitable for mounting on a 2" I.D. (2.375" or 60 mm O.D.) pipe which may be either vertical or horizontal. The mounting plate bolts to the transmitter body as shown in the specification sheet. If necessary the plate may be inverted or mounted on the opposite side of the body.

### Pressure connection and pipework (Fig. 5)

Both body ports are screwed 1/2" NPT Female. Connection is made at the flanged port (except when a reversed output signal is required in which case the port marked (-) is used). The unused port must always be left open to atmosphere. The piping between the tapping point and the transmitter should be 1/2 inch nominal bore.

It is recommended that a suitable shut-off valve be fitted at the tapping point and also that a valve to release the pressure for zero setting purposes be fitted. Adequate protection must be given to prevent the freezing of water filled pipes when exposed to the weather.

For installation where the fluid is subject to variations in temperature, an expansion loop must be included in the connection pipe to eliminate any zero error due to stresses on the transmitter body caused by these temperature changes. Before connecting the pressure pipe to the transmitter the valve (s) in the pipework must be opened and the pipework blown through to clear out any foreign matter. In the case of steam measurement the pipe should be flushed out with water. For the model NDD the diaphragm seal will be mounted directly on the process line to prevent the process fluid to reach the measurement capsule. The two inches wafer type diaphragm seal is normally fixed by means of a blind flange 1 1/2" ASA 150 RF or UNI DN 25/32 PN10/40 whereas the one inch extended diaphragm seal brings with it a flange drilled according to ASA 1500 ND 1" or 1-1/2" as special for sch. 100 extra strong pipe. Special seals can be provided and in this case special fitting would be required.

Fig. 10 gives details of the standard arrangement.

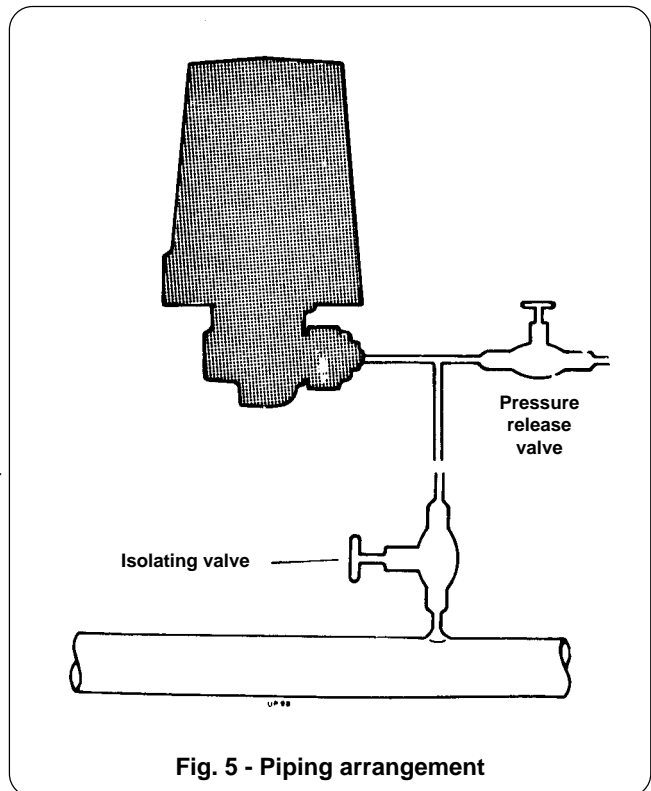


Fig. 5 - Piping arrangement

### Pneumatic transmission supply and connections (Fig. 6a, b and c)

The air supply and output signal ports are tapped 1/4" NPT female and are identified 'IN' and 'OUT' respectively. A clean, dry and regulated air supply of 1/4 Kg/cm<sup>2</sup> or 20 lbf/in<sup>2</sup> is required for the transmitter and it is recommended that this be supplied via a filter regulator unit mounted as close to the transmitter as possible.

Both the supply and transmission piping for the transmitter should be at least 3/16" nominal bore copper or plastics pipe and the pipes should terminate in connections suitable for the 1/4" NPT female ports at the transmitter.

If the pipe run between transmitter and receiver is less than 4 metres (13 feet) the transmitter output signal may become unstable; it is recommended therefore that a reservoir with a capacity of about 500 cm<sup>3</sup> be included in the transmission line (fig. 6b). If the length of the transmission line exceed 200 metres (650 feet) a booster relay (1:1) should be included in the line (fig. 6c). This information, however, is given as a reference only. The final choice will mainly depend upon the dynamic characteristics of the control loop. To simplify checking and signal monitoring at the transmitter it is recommended that two suitable pressure gauges be included in the pneumatic piping: one in the supply line and the other in the output line. Alternatively a tapping point should be included in each line for gauging purposes.

The pneumatic piping and connections between transmitter and receiving equipment should be completely leak-free and should be checked in accordance with "Leak Checking the Transmission Line" section.

# SERVICE

## Preparation for service

Before the transmitter is put into service it must be mounted and connected in accordance with the foregoing instructions. If not already included a gauge should be connected into the transmission line.

Remove the transmitter top cover which is secured by four captive screws, one at each corner. Dirt and dust must not be allowed to enter the mechanism while the cover is off.

## Leak checking the transmission line

No leaks can be tolerated in the transmission line and for this reason all pipeworks and connections must be checked with a soap and water solution with the transmitter at maximum output and all leaks eliminated before zero is checked or the transmitter put into service.

To obtain maximum output pressure switch on the supply air and adjust the pressure to 1.4 Kg/cm<sup>2</sup> (20 lbf/in<sup>2</sup>). Lightly hold the flapper against the nozzle (no force must be used for this) and the output pressure will rise to maximum. Retain it at this pressure and check all joints and connections in the transmission line between transmitter and receiving equipment with the soap solution and eliminate any leaks found.

Replace the transmitter cover.

## Zero adjustment

When it is ensured that the pneumatic system is completely leak-free check and, if necessary, adjust the zero as follows:

Open the pressure release valve in the pipework (if fitted) or open the pressure connection at the transmitter so that pressure on both sides of the bellows is atmospheric.

Ensure that the supply air is switched on and set the pressure to 1.4 Kg/cm<sup>2</sup> (20 lbf/in<sup>2</sup>). The output pressure gauge should now indicate 0.2 Kg/cm<sup>2</sup> or 3 lbf/in<sup>2</sup>. If not rotate the zero adjuster flap in the transmitter cover to one side and with a screwdriver rotate the adjustment screw, visible through the hole in the cover, in the appropriate direction until the output is correct. Ensure that the receiving equipment is also indicating zero; if not adjust in accordance with its own instructions.

## PUTTING INTO SERVICE

Ensure that all pipeworks are correctly made and that all associated equipment is correctly commissioned in accordance with the manufacturers instructions.

Ensure that the pressure connection pipe is filled with the measured liquid (water in the case of steam) or gas. Close any pressure release valve fitted. Open the isolating valve (s) between tapping point and transmitter.

In the case of liquid or steam measurement, carefully crack open the pressure connection at the transmitter to expel any air and then re-secure the connection. When zero has been checked and adjusted as described above, disconnect the test instrument, replace the top and housing covers firmly. The transmitter is now operational.

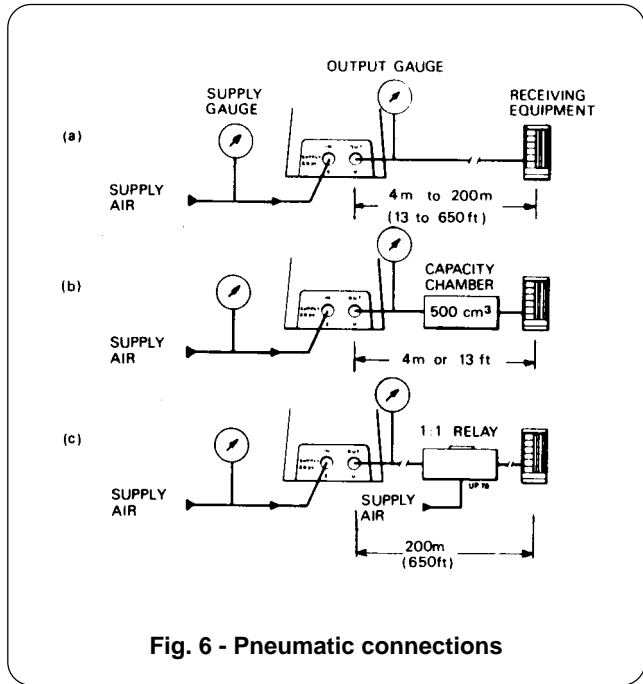


Fig. 6 - Pneumatic connections

## TAKING OUT OF SERVICE

If the transmitter is part of a control circuit ensure that it is safe to take the transmitter out of service and if necessary that other means of control are in action.

Close the isolating valve between the transmitter and tapping point.

Release any pressure trapped in the transmitter body to atmosphere by opening the pressure release valve.

Switch off the supply air to the transmitter.

# MAINTENANCE

## General

If the transmitter forms part of a control loop the plant must be placed under local manual or by-pass control while the transmitter is examined, or taken out of service for maintenance of other reasons.

It is recommended that any servicing which involves the dismantling of the transmitter be carried out under workshop conditions. If service is to be carried out in the field all precautions must be taken to prevent the ingress of dirt, dust water or other foreign matter into the mechanism.

## ROUTINE MAINTENANCE

Under normal working conditions no routine maintenance is required apart from ensuring that the air supply filter is drained periodically in accordance with its own instructions.

## POSSIBLE FAULTS

When operating under adverse conditions or after some considerable time under normal conditions the slow accumulation of dirt and deposit may cause faults in the following items which should be cleaned as described.

## Flapper nozzle assembly

Under adverse conditions dirt and deposit can build up around the nozzle and flapper in which case the assembly may be cleaned as follows. Great care must be taken not to damage the nozzle in any way or distort or bend the flapper.

- Shut off the supply air and isolate the process connection.
- Remove the transmitter cover.
- Loosen the locking plate screw on the relay block (fig. 2) and swing the plate side-ways to release the nozzle supply pipe connection.
- Hold the pipe entry hexagon at the nozzle steady with a spanner (10 mm AF) and with an 8 mm AF spanner remove the nozzle securing screw. Nozzle and pipe assembly may now be removed.
- With a clean, lint free, rag moistened in a suitable solvent such as carbon tetrachloride carefully clean all dirt and deposit from the flapper.
- Rinse the nozzle assembly in solvent and if necessary probe the nozzle with a non-ferrous wire not exceeding 1 mm diameter. Blow out the assembly with clean compressed air and thoroughly dry. Finally examine the "O" ring on the connection and if necessary replace with a new one.
- Replace the pipe assembly, holding the nozzle end with a spanner while tightening the set screw so that the pipe is not distorted. If necessary use a smear of silicone grease on the "O" ring to facilitate entry into the block. Swing the locking plate round to secure the pipe connection and tighten the screw.

## Restriction orifice (Fig. 7)

- Remove the restrictor by loosening the locking plate screw in the relay block and rotating the plate to one side. The restrictor may now be pulled straight out from the relay block. Remove the "O" rings.
- Clean by probing with a non-ferrous wire of less than 0.15 mm (0.005 inch) diameter and wash in solvent. Examine the "O" rings and if necessary replace with new ones.
- Replace the "O" rings on the restrictor and smear them with silicone grease.
- Replace the restrictor and lock with the plate and screw.
- Check zero and adjust as necessary.

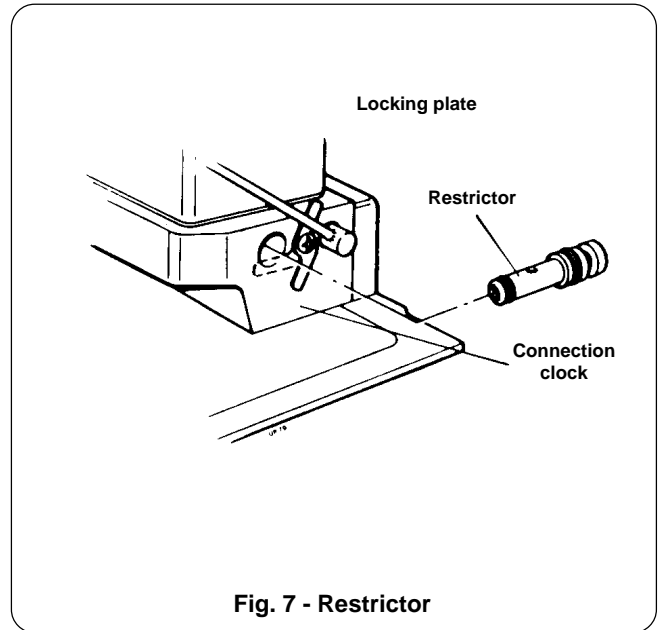


Fig. 7 - Restrictor

## Relay (Fig. 8)

- Detach the relay to connection block (3), by removing the two mounting screws (1) and (2) taking care not to damage the gasket (4).
- Remove the two screws (5) and (6) and separate both halves of the relay taking care not to damage sphere (7) and spacer tube (8) within relay body (9).
- With solvent such as carbon tetrachloride clean the interior of the relay and dry thoroughly.
- Examine: the gaskets (10-11), the diaphragm (12) and the metal foil (13). Replace with new ones if damaged.
- Reassembled the relay ensuring that both halves are correctly oriented with regards to each other and that the gasket (4) is correctly placed.



# CALIBRATION AND ACCURATE SPAN SETTING (Fig. 9)

The instrument is dispatched with the span, as specified, accurately set and no further adjustment is normally required. The span may be set approximately to a new value by adjusting the position of the span carriage: this is done by rotating the span adjustment screw in the appropriate direction until the red pointer indicates the desired span value on the force-bar mounted scale. For more accurate setting or for checking calibration the following procedure must be used and for this purpose the following equipment is required.

Transmission air supply:

- 1 - Mercurial manometer or standard test gauge (accuracy 0.25% FS) to cover the output range 0.2 to 1.0 kgf/cm<sup>2</sup> or 3 to 15 lbf/in<sup>2</sup>.
- 1 - Capacity chamber 500 cm<sup>3</sup>.
- 1 - Clean, dry, filtered air supply at 1.4 kgf/cm<sup>2</sup> or 20 lbf/in<sup>2</sup>.

Measuring unit supply:

- 1 - Pressure regulator.
- 1 - Mercurial manometer or standard test gauge ( ±0.25% accuracy) sealed to cover the measured value span of the transmitter.
- 1 - Clean filtered air supply.
- 2 - Needle valves.

Pipework and connections.

**\*** Note - If the transmitter is fitted with input elevation or suppression mechanism it must be removed as follows before calibration (fig. 3).

**Suppression mechanism.** Unscrew and remove the adjusting screws (3 mm AF socket key) and spring washers and lift away the bracket. The elevation spring may be left in place during calibration.

**Elevation mechanism.** Remove both bracket mounting screws (3 mm AF socket key) and spring washers and lift away the bracket. The spring and adjustment mechanism can remain in position during calibration.

- a) Connect the above equipment and transmitter as shown in fig. 9.
  - b) Set the span-carriage pointer to the desired span on the force bar scale.
  - c) Switch on the transmission air supply. Set the measuring-unit supply regulator to zero and switch on the air supply. Close valve D. Open valve C and adjust zero, if necessary, via the zero screw. The signal should now equal 0.2 Kgf/cm<sup>2</sup> or 3 lbf/in<sup>2</sup> at manometer (or gauge) "A".
  - d) Close valve C, open valve D and supply the required maximum pressure to the measuring unit, via the regulator, on the manometer "B". The output at "A" should now be 1.0 kgf/cm<sup>2</sup> or 15 lbf/in<sup>2</sup>. If it is not adjust the span carriage, via its adjustment screw, in the appropriate direction.
  - e) Return the pressure at manometer 'B' to zero and open the vent valve C. The signal pressure at manometer "A" should be 0.2 kgf/cm<sup>2</sup> or 3 lbf/in<sup>2</sup> if not adjust the transmitter zero screw until it is.
  - f) Repeat stages d) and e) until the transmitter is correct at both extremes of the desired span.
  - g) Check the transmitter at some mid-point of the span with a rising and a falling pressure to ensure that the transmitter is mechanically free.
- If the transmitter is fitted with elevation or suppression mechanism which was removed for calibration, this should be refitted and set in accordance with either "input elevation" sub section or "input suppression" sub section.
- h) Disconnect the test rig and return the transmitter to service in accordance with "service" section.

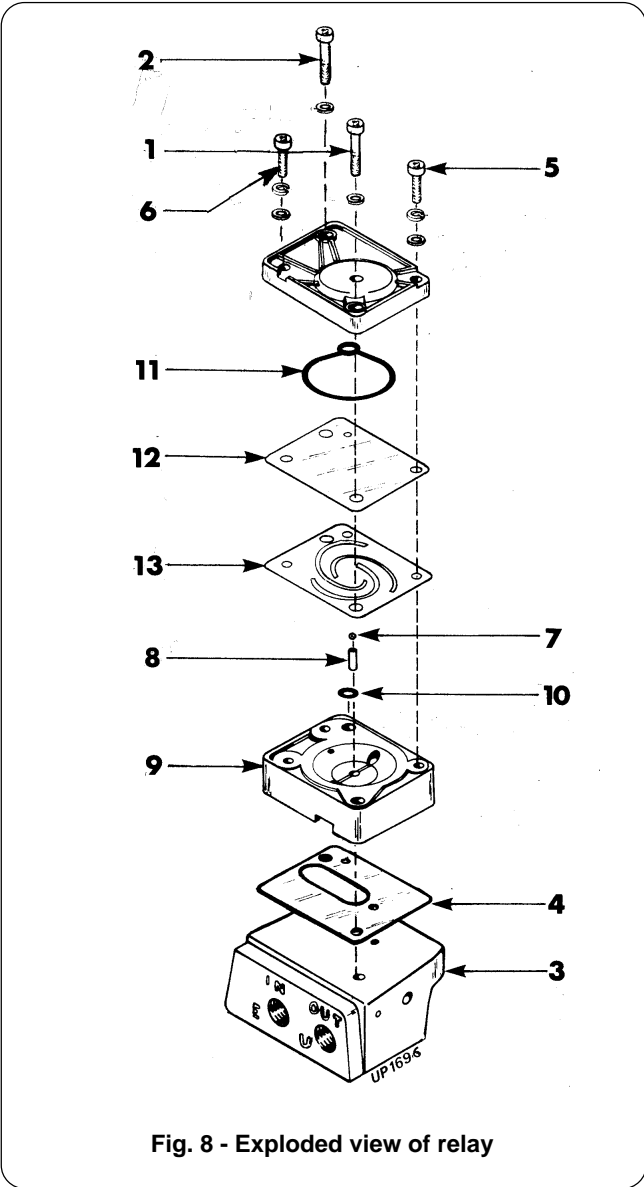


Fig. 8 - Exploded view of relay

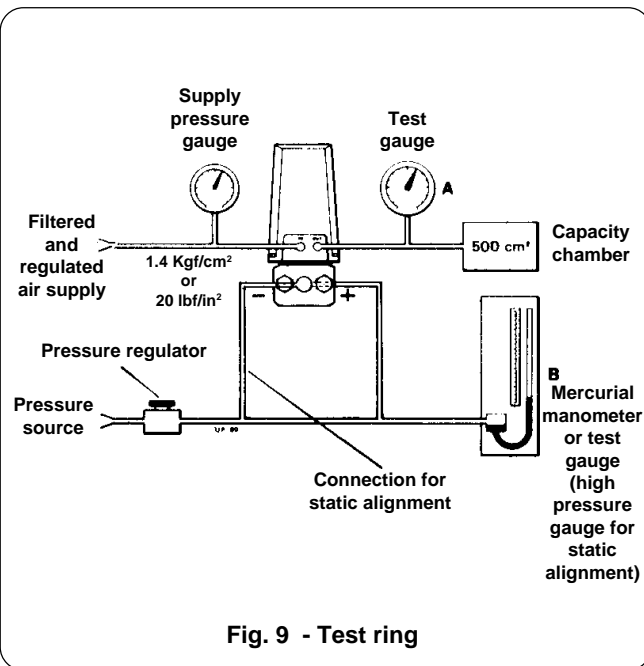


Fig. 9 - Test ring

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## INPUT SUPPRESSION (if included) fig. 3

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When dispatched the degree of suppression as specified on ordering is accurately set and no further adjustment is normally required. If a new suppression value is required or if the suppression mechanism has been fitted subsequent to installing the transmitter, the following setting procedure should be adopted.

- a) Set up the transmitter and connect to the test rig (fig. 9). Remove the suppression spring and bracket and check calibration in accordance with "calibration and accurate span setting" sub section.
- b) Refit the suppression mechanism and apply the required suppression pressure value to the transmitter.



Note - The suppressed value plus the maximum desired span value of the transmitter must not exceed the maximum span range value of the transmitter e.g. the suppression which may be applied to a transmitter with a maximum span range value of 17 Kg/cm<sup>2</sup> and which is calibrated to say 10 Kg/cm<sup>2</sup> must not exceed 7 Kg/cm<sup>2</sup> (10 + 7 = 17 Kg/cm<sup>2</sup>).

- c) Adjust the suppression screw until the output signal is 0.2 Kg/cm<sup>2</sup> or 3 lbf/in<sup>2</sup>.
- d) Apply the maximum suppressed span pressure to the transmitter (maximum span plus suppression). Output should now be 1.0 Kg/cm<sup>2</sup> or 15 lbf/in<sup>2</sup>. If not, adjust via the span adjustment in small increments rechecking after each adjustment until correct calibration has been achieved.
- e) Return the transmitter to service in accordance with "service" section.

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## INPUT ELEVATION (if included) fig. 3

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When dispatched the degree of elevation as specified on ordering is accurately set and no further adjustment is normally required. If a new elevation value is required or if the elevation mechanism has been fitted subsequent to installing the transmitter, the following setting procedure should be adopted.

- a) Set up the transmitter, connect to the test rig (fig. 9) and check calibration as described in "calibration and accurate span setting" section. For this check the elevation bracket and spring must be removed.
- b) Refit the elevation spring and bracket. Adjust the spring until it is in its most relaxed condition and apply the maximum elevation span pressure to the transmitter (maximum required span value minus required elevation value). Adjust the elevation screw until the output signal equals 1.0 kgf/cm<sup>2</sup> or 15 lbf/in<sup>2</sup>.
- c) Check the minimum required span value by reversing the pressure connection to the measuring unit (connect to negative chamber) and applying the elevation value on manometer 'B'. Output on manometer 'A' should be 0.2 Kg/cm<sup>2</sup> or 3 lbf/in<sup>2</sup>.
- d) If an error exists adjustment should be made to span in small increments checking and adjusting in accordance with (b) and (c) above after each adjustment. The pressure connection must be reversed as appropriate after each check.
- e) When calibration is correct return the transmitter to service in accordance with "service" section.

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## OUTPUT SIGNAL REVERSAL (Fig. 3)

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Output signal reversal i.e. 1.0 kgf/cm<sup>2</sup> or 15 lbf/in<sup>2</sup> output at minimum input span value and 0.2 kgf/cm<sup>2</sup> or 3 lbf/in<sup>2</sup> at maximum input span value may be obtained by using the input elevation mechanism and reversing the process connections to the transmitter.

Reversal is obtained as follows:

- a) Connect the transmitter to the test rig (fig. 9) and remove the elevation spring and bracket from the transmitter. Calibrate in accordance with "calibration and accurate span setting" sub-section to direct output valves.
- b) Refit the elevation mechanism and reverse the pressure connection to the measuring unit (connect the pressure to the negative chamber).
- c) Apply the maximum desired span pressure to the transmitter and adjust the elevation spring screw until the output signal is 0.2 kgf/cm<sup>2</sup> or 3 lbf/in<sup>2</sup>.
- d) Reduce the pressure to zero and open the negative vent valve. The output signal should now be 1.0 Kg/cm<sup>2</sup> or 15 lbf/in<sup>2</sup>.
- e) If an error exists adjust the span in small increments checking the span after each adjustment in accordance with c) and d) above until the calibration is correct.
- f) Return the transmitter to service in accordance with "service" section but with the process connections to the transmitter reversed.

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## REMOVING AND REFITTING THE DIAPHRAGM CAPSULE (Fig. 1)

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Although the bellows capsule may be replaced with the transmitter in situ, it is recommended that this operation be carried out under workshop conditions.

If this operation is to be carried out in situ it should be born in mind that some considerable force is required to loosen and then subsequently correctly retighten the two clamping bolts and nuts. Care should therefore be taken not to over-strain the mounting whilst this being done.

### Removal of the Capsule

- a) Isolate the transmitter from its receiving equipment and also from the process tapping point. If the transmitter forms part of control loop, place the controller under MANUAL control where appropriate or use an alternative method of control.
- b) Release any pressure from the transmitter by opening the pressure release valve.
- c) Disconnect the pressure pipe from the transmitter. If it is intended to continue the capsule removal and replacement procedure in the workshop, the transmitter should be removed from its mounting.
- d) If the transmitter is fitted with range elevation or suppression mechanism remove the mechanism as described in "calibration and accurate span setting" section.
- e) Through the drain plug hole slacken, but do not remove, the socket headed nut securing the transmission bar to the capsule flexure (6 mm AF socket key).
- f) Release both nuts and bolts securing the clamp flange to the body and remove the flange and 'O' ring.
- g) Withdraw the capsule from the body.

## ... REMOVING AND REFITTING THE DIAPHRAGM CAPSULE (Fig. 1)

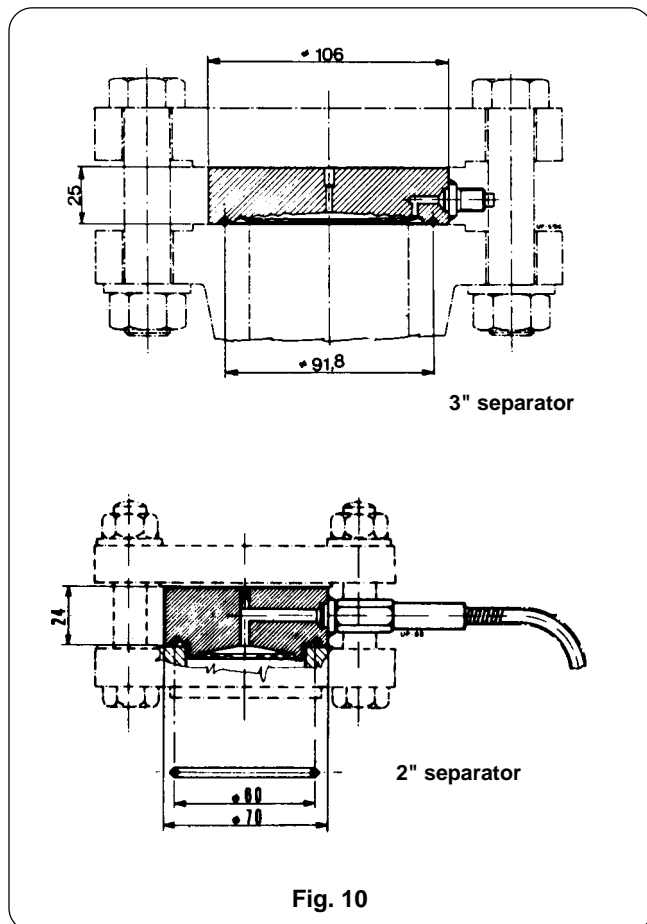
### Refitting the capsule (Fig. 1)

When reassembling the transmitter it is recommended that new capsule "O" ring seals be used.

- To reassemble the measuring unit place an "O" ring seal in position in the annular slot in the body capsule recess, slide the capsule into the recess engaging the 'C' flexure between the upper washer and the shoulder of the transmission bar (both washers must be below the flexure) ensuring that the flexure is aligned at 90° to the beam axis.
- Place an "O" ring in the recess in the flange face and position the flange over the bellows capsule and both clamp bolts.
- Tighten the clamp nuts and bolts in small increments finally using a torque wrench set to 3.5 Kg/M. Replace the two support bracket bolts and firmly secure.
- Connect the transmitter to a suitable supply pressure and set the zero screw to 3 lbf/in<sup>2</sup>.
- Through the drain plug hole carefully tighten the transmission bar socket nut (6 mm AF socket key). Check the output signal, which should not have varied by more than 0.06 lbf/in<sup>2</sup>. If it has, slaken and retighten the nut until the required result is obtained. Replace the drain plug.
- If a new capsule has been fitted, calibrate in accordance with the instructions given in "calibration and accurate span setting" section before returning the transmitter to service.
- If the original capsule is refitted, the transmitter may be returned to service in accordance with the instructions given in "service" section; no recalibration is required. When range suppression or zero elevation is included the mechanism should be refitted, taking care to maintain the original setting, before returning the transmitter to service.

### Static Alignment Procedure (for model NDA only)

- Set up the transmitter, connect to the testing (Fig. 9) in the previous sections and disconnect the capsule as described.
- Set the maximum span through the span adjustment screw.
- Screw in completely the internal nuts (fig. 2) and lightly lock the external nuts.
- Set the force bar parallel to the feedback arm by means of the zero adjusting screw.
- Position the flapper screw to a distance of 0.6 mm ± 0.1 mm from the flapper then supply the transmitter with a reduced pressure of 10 lbf/in<sup>2</sup> and set zero output to 3 lbf/in<sup>2</sup> via the zero adjustment screw.
- Tight socket-headed nut on the capsule without altering the parallelism already found: the output pressure should not change more than ± 0.2 lbf/in<sup>2</sup>. Increase the supply pressure to 20 lbf/in<sup>2</sup> and adjust the output at 3 lbf/in<sup>2</sup>.
- Loose the external nuts (fig. 2) and move internal nuts anticlockwise by one turn and then lock the external nuts again adjusting the output at 3 lbf/in<sup>2</sup>.
- Apply on both sides of the capsule a pressure equal to 35% of the maximum; if the output variations exceed the specified limits proceed as follows:
  - Shut off the static pressure, repeat the operation g) moving the internal nut:
    - anticlockwise in case of positive error
    - clockwise in case of negative error
 Repeat the operation described under b) until the error falls within the specified limits.



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