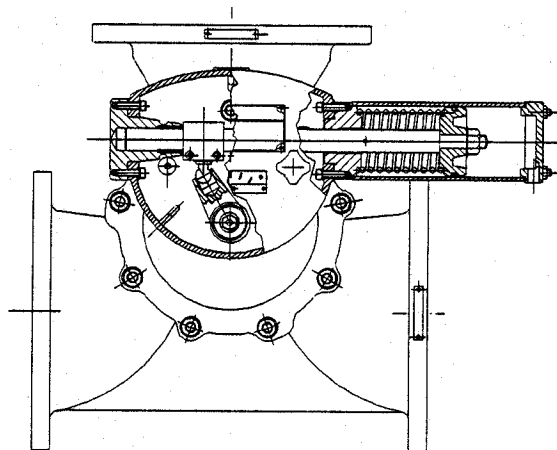


## TEMPERATURE CONTROL SYSTEMS

### Pneumatically Operated (Rotary)



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*The following Walton Instruction Manuals are available:*

Direct Operated (Rotary)	MANUAL\DIRECT01
Direct Operated (25mm Linear)	MANUAL\DIRECT02
Direct Operated (Twin)	MANUAL\DIRECT03
Direct Operated (Rotary) Fail - Safe	MANUAL\DIRECT04
Direct Operated (15-25mm Linear)	MANUAL\DIRECT05
Pneumatically Operated	MANUAL\PNEU01
Electrically Operated (Series 500 Actuator)	MANUAL\ELEC01
Electrically Operated (Series 3000 Actuator)	MANUAL\ELEC02
Electrically Operated (Special Integral Function)	MANUAL\ELEC03
Gas Operated (Rotary)	MANUAL\GAS01
Gas Operated (Linear)	MANUAL\GAS02

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## General Description

The pneumatically operated range of Walton valves is available in bore sizes 25mm (1") - 400mm (16") diameter.

It is a simple matter to convert a valve from direct to pneumatic operation without removing the valve body or modifying the pipework.

The valve may be installed with its axis in any position gravity having no effect on its operation. It can be supplied to any one of six possible handings to suit the piping arrangement.

The principle advantages of pneumatic over direct operated valves are:

1. Increased flexibility in application
2. In sea water circuits the separation of the main operating mechanism from the circulating fluid will eliminate corrosion problems.
3. Increase in power and speed of operation
4. The ability to sense the temperature remote from the valve.

## Manual Control

Provision for manual operation is a standard feature of the Walton pneumatically operated valve.

## 3-Way Valve

The 3-way valve body is of the standard Walton type and interchangeable with the bodies used for the range of direct operated valves.

## Controllers

The options currently available are:

1. Proportional only ('P'). Reverse Action Pressure Controller fitted with a wax filled type sensor as used in the direct operated valves.
2. Proportional and Integral ('P+I'). Mercury in steel sensor housed in stainless steel pocket and connected to the controller measuring unit by a capillary tube.
3. Proportional, Integral and Derivative ('P+I+D'). This system may use a controller having an electro-mechanical transducer which converts an electric input signal of 4-20 mA or 0-20 mA, 1-5V Dc or RT 100 resistance to a pneumatic signal which is then relayed to the valve actuator.

## System Design

It is recommended that the Walton 3-way valve controlling the flow of fluid through or around the cooler is fitted downstream of the cooler to operate as a mixing valve, proportioning the flow between cooler and cooler bypass in response to the pneumatic signal.

The sensor generating the operating signal is mounted in the system at the point where control of the fluid temperature is required.

The system pipework should be as simple and compact as possible. Pressure difference across the 3-way valve, at full flow through either the cooler or cooler bypass should not exceed 0.8 bars.

A degree of flexibility in at least one of the connecting pipes is desirable although, if care is taken on installation, not essential. Mounting of the valve should be such that it is not subjected to excessive vibration under running conditions. Temperature variations, pipe expansion and movement of the ship's hull should be taken into account when designing the piping runs and supports.

Fig. 01 illustrates ways in which the Walton valve may be incorporated in various systems.

### 1. Jacket Cooling Water Systems

Control of the outlet temperature from the engine is generally specified for this system, and the diagram shows the way in which control can be effected. The sensing element is placed in the common outlet pipe from the cylinder heads, whilst the valve is situated downstream of and close to the cooler, with a direct bypass line across the cooler connections as indicated. The sensing element should be placed as close as possible to the engine to reduce time lag to a minimum. The sensing element can be mounted close to the 3-way valve except where the pipe run between the engine and 3-way valve is long, i.e. in excess of 12

### 2. Piston Cooling Water

- a) In the majority of diesel engines the piston cooling water, (or oil if this is the cooling medium), is drained back to a tank before being pumped through the cooler. The diagram shows a system in which the inlet to engine temperature is controlled with the 3-way valve fitted as a mixer.
- b) With the pneumatically operated valve, it is possible to control the outlet temperature of the piston cooling water by installing the sensing element in the common outlet pipe before the water enters the drain tank as shown in diagram 2, while leaving the 3-way valve downstream of the cooler acting as a mixer.

### 3. Lubricating Oil

It is general practice to control the temperature of lub. oil entering the engine as shown.

### 4. Control on Secondary Fluid

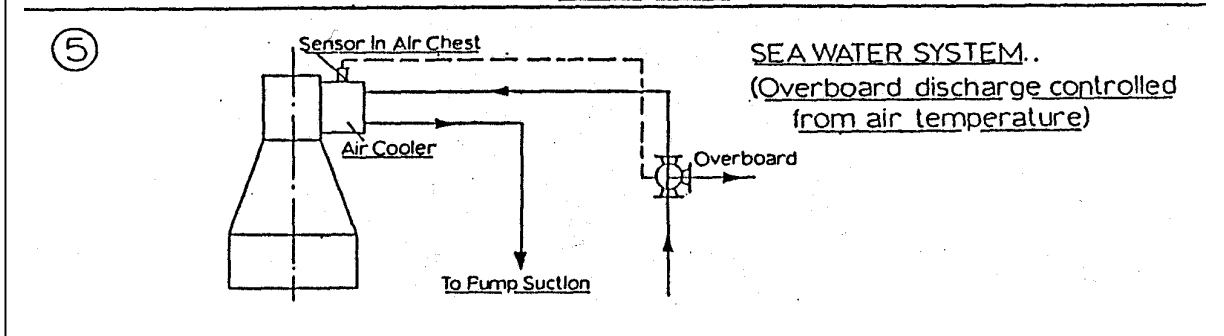
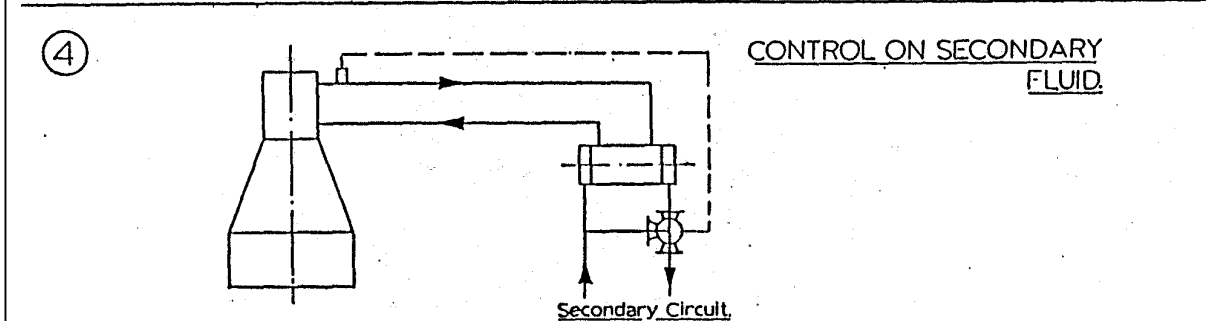
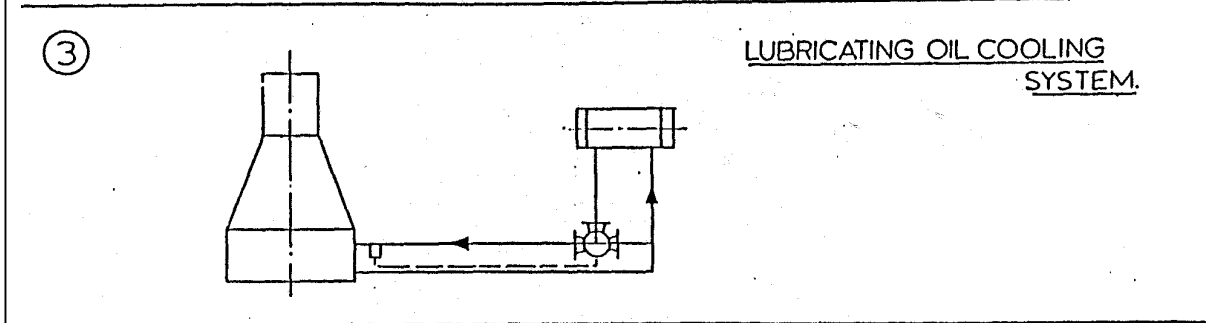
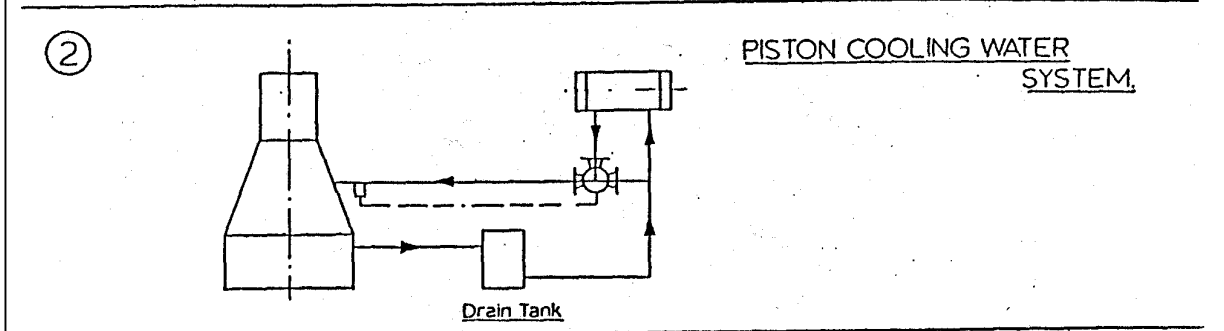
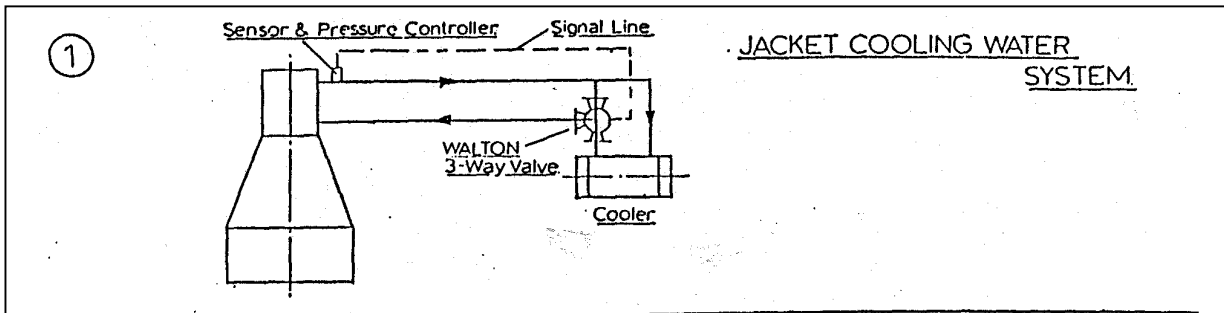
Diagram 4 shows a system in which the temperature of the primary fluid is controlled by varying the flow of secondary fluid (sea water) through the cooler, the full flow of primary fluid being maintained through the cooler at all times. If control of outlet temperature of the primary fluid is required, the temperature sensing element is mounted in the outlet pipe as indicated on the diagram. A similar system can be used to control inlet temperatures by mounting the sensing element in the "inlet to engine" pipe.

## 5. Sea Water System

Control of a sea water system is effected by discharging part of the water flow overboard, allowing cold water to be drawn into the pump suction and so reducing the temperature of circulating water.

The system illustrated is for cooling charge air and is controlled from a sensor placed in the charge air chest downstream of the cooler.

Similar systems can be used for controlling the temperature of sea water flow through the various coolers associated with the main or auxiliary engines.



## WALTON PNEUMATICALLY OPERATED VALVE TYPICAL SYSTEMS

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**FIG.01/Pneu**



## Proportional (P) Controller

Refer to Fig. 02/Pneu and Fig. 03/Pneu

The sensing element used in this design is of the wax filled type, expansion of which on increase of fluid temperature changes the pressure signal generated by a diaphragm type pressure controller.

The operation of the controller is such that increasing temperature produces a reducing signal pressure so that should air pressure be lost, the 3-way valve will move to the 'full open to cooler' safe position.

The varying air signal (3-15 p.s.i.) from the controller is applied and sets the position of a pneumatic actuator. The pneumatic actuator rotates the valve rotor through a ball and sleeve connection. The rotor position and flow proportioning are determined by the temperature of fluid in which the sensing element is immersed.

A small quantity of clean dry air at a pressure of 3 to 7 kg/cm<sup>2</sup> is required.

All control valves are factory tested with their respective controllers before despatch. The setting pressure of the pressure controller is set when the element is cold, i.e. fully retracted. The setting pressure for all valves, excepting those of 350mm diameter fitted with high pressure cylinders is 1.55 bars. For the high pressure cylinder valves, the setting pressure is 2.50 bars.

Deviation from the above setting pressure of more than say .05 bars may result in the 3-way valve not operating over its full travel, so that under "cold" conditions the cooler port may be slightly open whilst if adjusted in the other direction the cooler may not be fully open at the top of the control temperature range.

With air cut off from the system the 3-way valve will be in the maximum cooling position, the valve will go to the "cooler closed" position, and will then retract as the temperature in the system rises into the control range, allowing flow through the cooler.

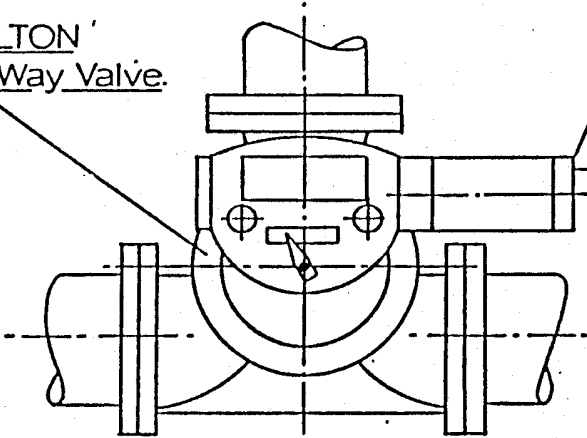
**Failure of air supply during operation will result in the valve moving automatically to the safe "full flow to cooler" position.**

Temperature ranges available are those used for the direct operated valves varying from 08°C to 100 °C. Data Sheet No. 62 details the standard ranges available.

The construction of the ¼" (6mm) pressure controller limits the temperature range of the 3-way valve to the upper two-thirds of the element range.

At the lower limit of the range the cooler will be fully bypassed, and at the higher, all the fluid will pass through the cooler. Provided the cooler has sufficient heat dissipation capacity on equilibrium temperature between the two limits will be maintained.

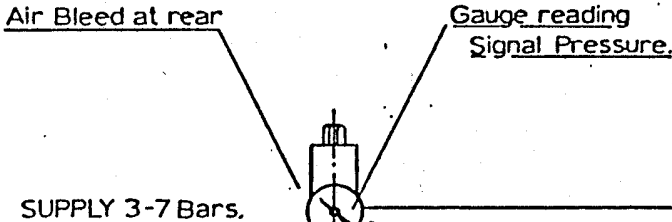
WALTON  
3-Way Valve.



ACTUATOR TAPPING.

40/80mm BORE VALVES -	1/8" BSP
100/150 " "	1/4 " "
175/350 " "	3/8 " "

SIGNAL and SUPPLY AIR LINES  
40/80mm BORE VALVES - 3mm BORE  
100/350 " " " 6mm " "



REVERSE ACTION PRESSURE CONTROLLER.

MOUNTING FLANGE

1/8" CONTROLLER Din 25 bored x 38mm dia. 1/8" CONTROLLER 1/8" BSP  
1/4" " " " " " " " 1/4" " " " " " " " 1/4" BSP

CONTROLLER BODY TAPPINGS

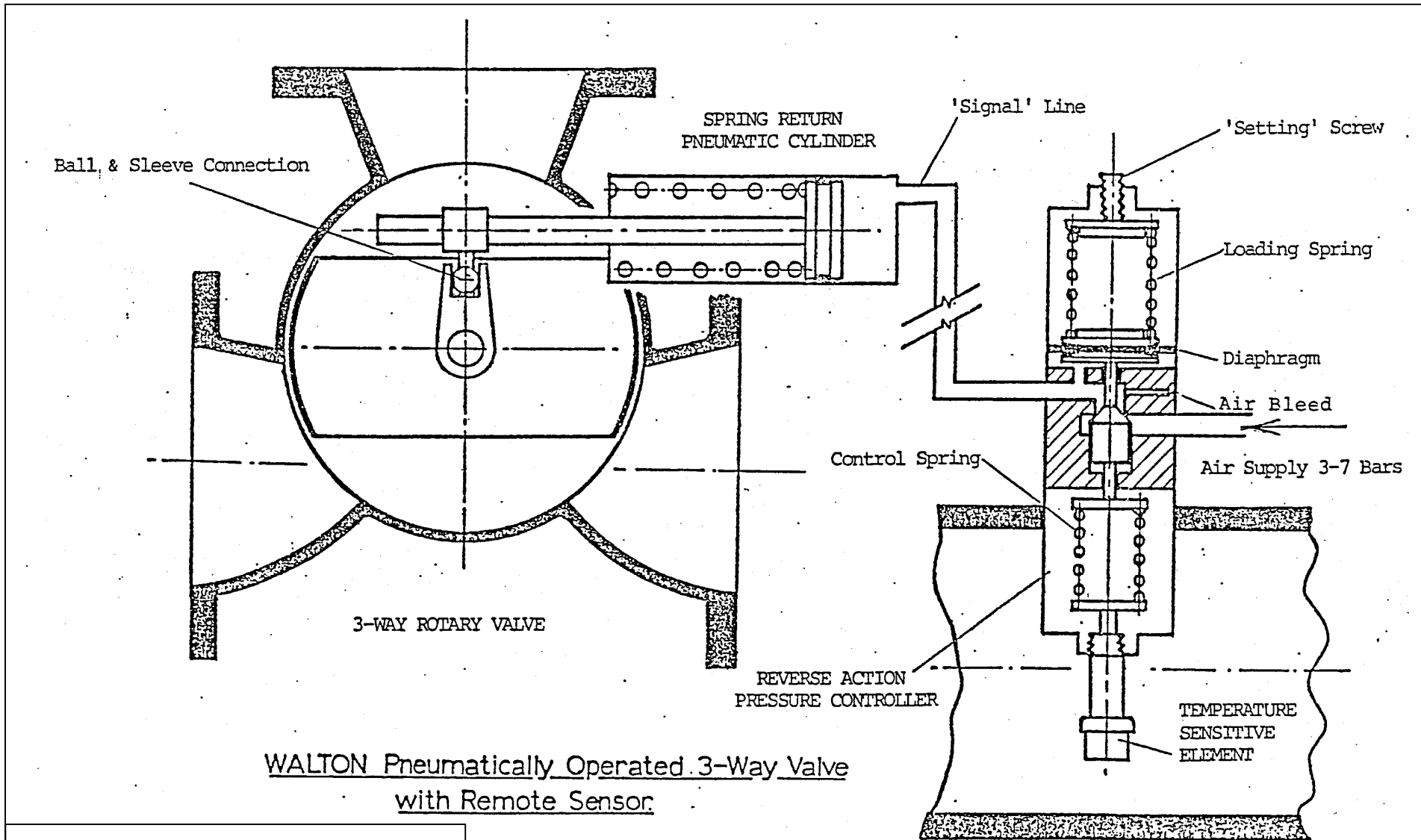
CONTROLLER INSTALLATION DWGS. WE.16082 and WE.15424

## SYSTEM DETAILS PROPORTIONAL CONTROL

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**FIG.02/Pneu**



WALTON Pneumatically Operated 3-Way Valve  
with Remote Sensor.

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Fig.03/Pneu

## Proportional and Integral (P+I) Controller

Refer to Fig. 04/Pneu

### General

This shows the system in which a P+I pneumatic controller is used in conjunction with the 3-way Walton temperature control valve.

The sensing unit is a mercury filled bulb contained in a stainless steel pocket and connected to the controller measuring unit by a capillary tube. The standard length of capillary is 5 metres.

### Operation

A pressure measuring device in the controller operates pneumatic relays to vary the output pressure of the controller according to the requirements of the system. The outlet pressure, which is fed directly to the 3-way valve actuator varies between .21 and 1.05 bar (3-15p.s.i.) international standard. A supply of clean dry air at  $1.38 \pm 0.1$  bar is required for the controller. No other external power is required.

### Range

The standard controller is adjustable for set point temperature over a range of 0-100°C

### Fail-Safe

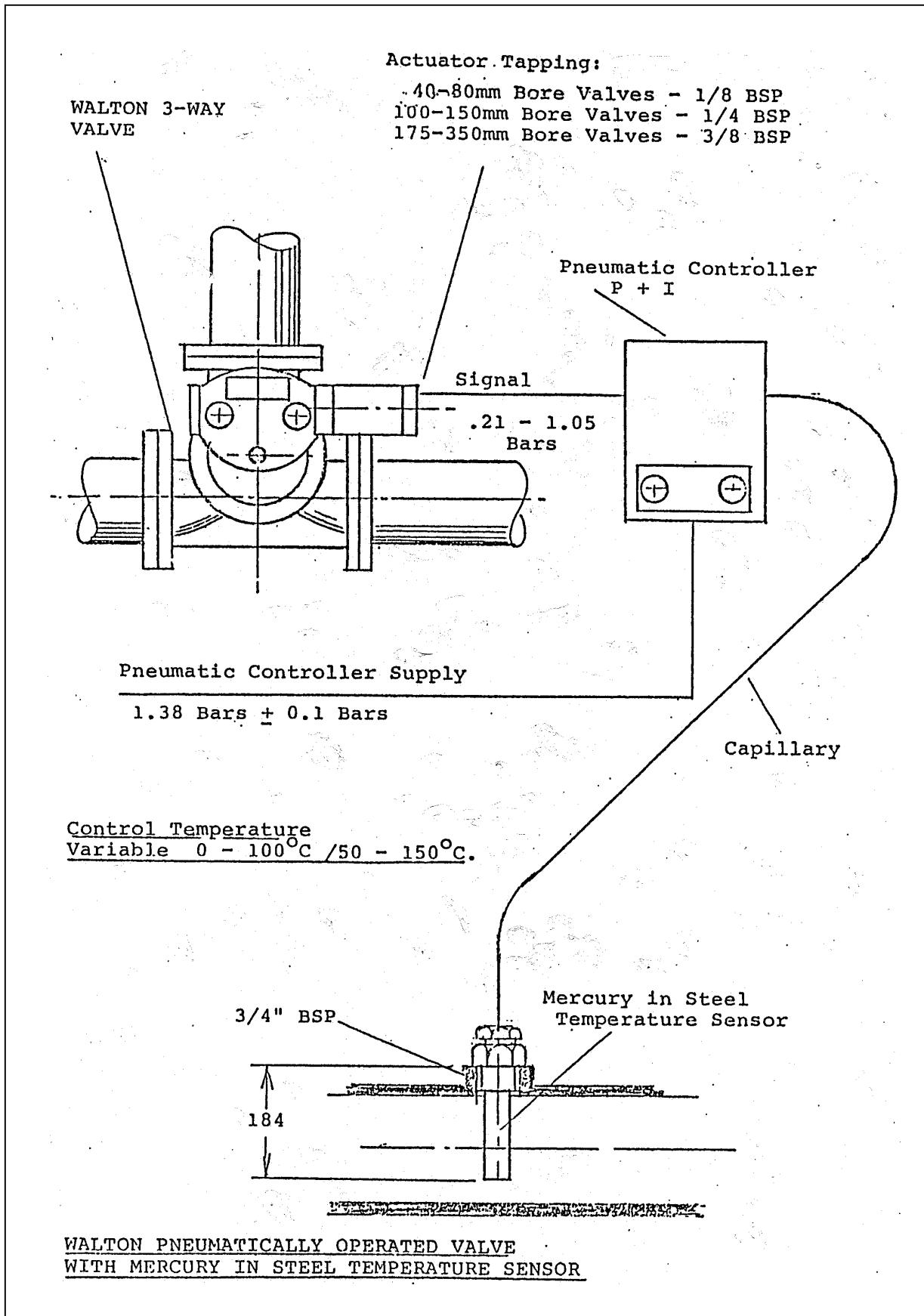
The Walton valve operates "reverse action" so that in the event of air failure the 3-way valve goes into the "full flow to cooler" position.

## SETTING UP PROCEDURE

1. **Check that thermometer bulb pocket is filled with heat sink compound.**
2. Check all connections and ensure that a supply of clean dry air at 1.38 bar pressure is connected to the controller inlet.
3. Set the proportional band to 100% reverse acting and the integral dial to 10 and bring the temperature of the sensing unit, either while in the system or if this is not possible, by removing and immersing in a hot water container, to approximately 50°C.
4. Adjust the red temperature pointer to coincide with the black pointer.
5. Adjust the red temperature pointer to give a reading of 9 p.s.i.  $\pm$  1 p.s.i. on the controller's output pressure gauge. Hold this pressure for 1 minute, then adjust the integral setting to zero (fully anti-clockwise).
6. Adjust the proportional band to 20% Reverse Acting, and then set the red temperature pointer to coincide with the black pointer. Check that the output pressure reads 9 p.s.i.  $\pm$  1 p.s.i.
7. The controller is now "set-up" and ready for tuning adjustments. The following adjustment procedure is recommended in order to obtain the optimum proportional band and integral settings for the control system.
8. Adjust red pointer to read the desired temperature and allow the system to settle down.
9. If there is no oscillation of the control valve reduce the proportional band to 10%, then reduce in small stages until a degree of oscillation of the valve is noted.

10. Open the integral action valve gradually until oscillation occurs and then turn back slowly until oscillation disappears.
11. After the system has settled down check the stability by altering the setting of the red pointer by, say 5°C. If oscillation then occurs an increase in the proportional band setting will be required and the procedures should go back to stage 8.

The optimum settings will be the narrowest possible proportional band with the highest possible integral action (i.e. largest number of repeats per minute) to give a completely stable system.



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**FIG.04/Pneu**

## **Recommendations/Limitations**

### **Flow Rates**

If good regulation is to be obtained, the flow rates should be within the limits shown on Chart No. 556 (sea water and fresh water) and Chart No. 557 (lubricating oil). These are available upon request.

### **Maximum Pressures**

The standard range valves are suitable for working pressures of up to 7 bar.

### **Differential Temperature**

On mixing valves it is recommended that difference in temperature between the two fluids should be limited to 75°C.

### **Cooler Pressure Loss**

It is recommended that the pressure loss of fluid at full flow through the valve does not exceed 0.7 bar.

## Installation

The light weight and compact design of the WALTON temperature control valve enables installation in the piping system without the necessity of special supporting brackets. The valve, with its deep ports and centre stiffening webs, is very robust. If, however, the valve is to be coupled up to rigid pipes, care must be taken to ensure that the pipes are accurately positioned, and that the final bolting up of the flanges does not distort the valve body.

After finally bolting up the pipe flanges, check that the rotor is free within the body. On valves of 100mm to 250mm bore, it is necessary to remove the top cover of the mechanism box, slacken the clamp block on the piston rod, and move the clamp block back and forth to rotate the valve rotor. After checking that the rotor is free, the block must be securely clamped back in its original position.

During this test the resistance to motion should be negligible. If the rotor appears to bind, check that the body is not being distorted by loads imposed by the piping by releasing each flange in turn and checking for rotor freedom.

Access to the working parts of the 3-way valve is obtained by withdrawing the front cover complete with internal assembly and without breaking the pipe connections. The withdrawal of the internals requires a clear space in front of the valve approximately equal to the length of the valve body.

## Inspection periods

It is recommended that the internals of the 3-way valve be inspected after the first test run to check that they are free of any foreign matter which might have been in the system prior to start up. After this, the valve should, if installed in a fresh water system with adequate attention being paid to the condition of the water, or in a lubricating oil system, be inspected at intervals of approximately 8,000 running hours or one year.

Valves installed in seawater systems, should be inspected at more frequent intervals, say 1,000 hours or as indicated by experience.

If valves in seawater are fitted with sacrificial zinc anodes these require renewing from time to time, the period being dependent on local conditions. Experience suggests replacement of anodes at 6/12 months intervals.

Anodes are mounted into the back cover as shown on Fig. 05/Pneu. If the anode is consumed such that the set bolt is loosened, this will be indicated by leakage under the bolt head and the anodes should be changed at the earliest opportunity.

**It is recommended that a spare set of anodes be carried on board. Failure to replace the anodes could result in corrosion of the internal surface of the valve. These remarks apply to valves in seawater circuits only.**



## Procedure for Dismantling

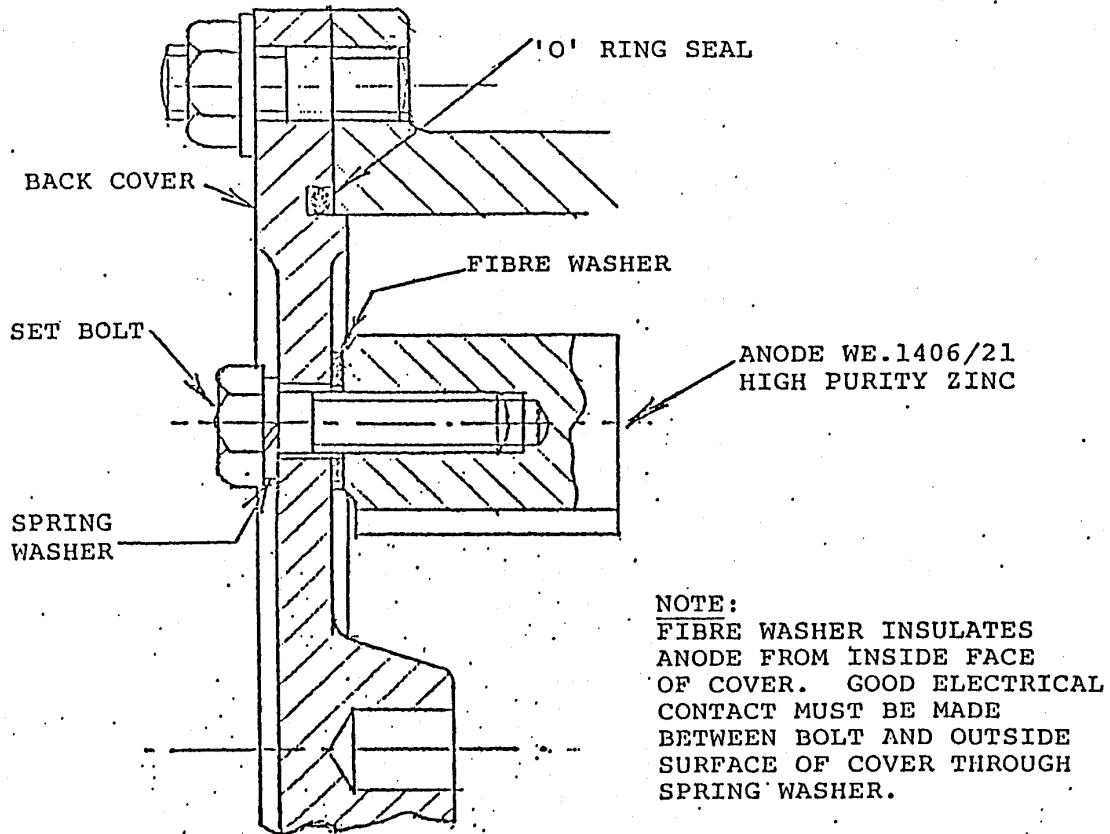
Ensure that the circuit is drained below the valve level or that the valve is fully isolated, then proceed as follows:

Remove valve position indicator (valves up to 250mm bore) or the external lever, etc., (valves 275mm to 350mm bore). Remove hand nuts and mechanism box cover. Slacken bracket clamp screws, disengage spherical ended drive pin from lever and remove lever. Remove cover nuts enclosed by the mechanism box. The mechanism box complete with cylinder(s) can now be removed. On removing the remaining front cover nuts the front cover may be removed together with the shaft and rotor.

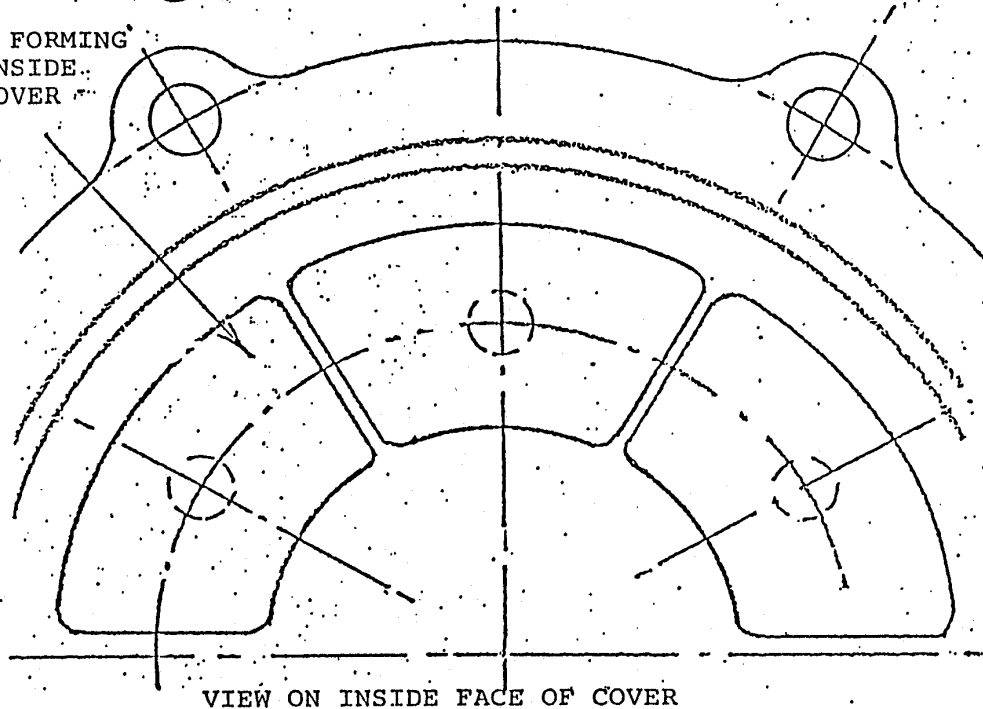
Full inspection of the internal surfaces of the 3-way valve and the internal assembly can now be carried out and the parts cleaned if required.

## Maintenance – Standard Actuator

The 3-way valve actuating mechanism is designed to operate without lubrication, all bearings being of the self-lubricated, low friction, non-metallic type. Lubrication of the piston rod, etc., by a light machine oil on occasions is recommended.



ANODES FORMING  
RING INSIDE  
BACK COVER



## WALTON 3-WAY VALVE IN SEAWATER CIRCUITS SACRIFICIAL ANODE FIXING

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**FIG.05/Pneu**

### 3 – Way Valve and Actuator 25 – 80mm Bore Diameter

#### Refer to Fig. 06/Pneu

A pneumatic signal from the pneumatic controller (separately described) is led to the actuating cylinder (2), acts on the head of the piston (3) and against return spring (4). A high signal pressure (corresponding to low temperature at the control unit), causes the return springs to be compressed, and the rotor (5) working in the bore of the 3-way valve (1) to be so positioned that the cooler port is closed off and the bypass port fully open. As the control temperature increases, the signal pressure decreases, allowing the actuator return springs to extend until the spring force balances the reduced signal pressure.

After equilibrium has been established, any change in control temperature will result in a change in signal pressure, and compensating adjustment of the 3-way valve rotor position, thus maintaining an approximately constant control temperature.

The movement of the actuator is transmitted to the rotor through a ball ended drive pin (6) working in a low friction non-metallic sleeve (7) fitted into an extension of the piston (3).

The actuator piston (3) is provided with a composite low friction piston ring (26), the outer p.t.f.e. ring being held in light contact with the actuator walls by a rubber backing ring.

The valve shaft runs in a low friction non-metallic bearing (10), and is sealed in the front cover by 'O' ring (12). The front cover bearing (10) is made of filled polytetrafluoroethylene (p.t.f.e.), and incorporates the shaft thrust face which rotates against thrust washer (13). The shaft thrust (in the opposite direction) is taken by a low friction thrust washer (14).

The shaft collar (15) is adjusted on assembly to give the specified shaft end float and then locked by grub screw (16). The shaft end is extended to carry lever arm (8) and manual control knob (18). The lever arm is coupled to the manual control knob by two pins (19) and

the control knob fixed to the shaft by a cross pin (20).

Movement of the actuator is transmitted to the valve rotor (5) via the spherically ended drive pin (6), lever (17), sleeve (18) and through cross pin (20) to the shaft (9). The rotor is secured to the shaft by pin (26).

The actuator is mounted in a box casting (27) by studs (28). The box casting is bolted to the 3-way valve by four "long" studs (29), and provided with a cover (31) secured by screws (32). A raised segment indicates the valve position against a pointer provided by the cross pin.

The mechanism box is symmetrical, and by reversing the piston and fitting the return spring at the opposite end of tube, a valve with the opposite handing is obtained.

#### Manual Operation

The valve can easily be positioned manually.

To hand control:

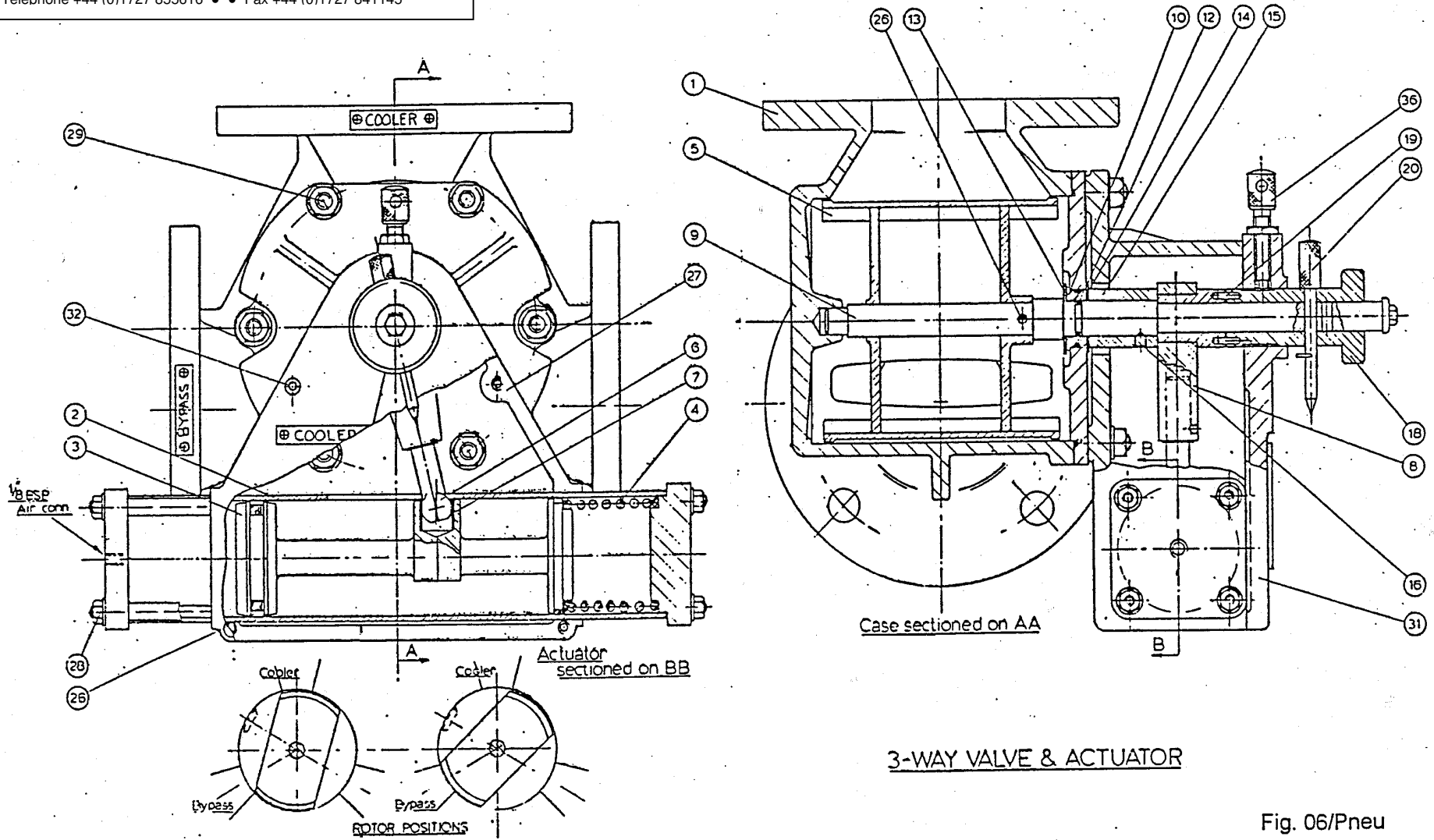
1. Remove cross pin.(20)
2. Pull knob (18) back to stop.
3. Re-insert cross pin through knob and shaft. The knob is now disconnected from the actuator and directly connected to the shaft and rotor.
4. Position knob to give desired level of temperature control and secure by tightening screw (36).
5. Adjust lever position as necessary to maintain required circuit temperature.

#### Fail-Safe

In the event of air failure the valve will automatically "fail-safe" to the cooler position to prevent the possibility of the system over-heating.

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3-WAY VALVE & ACTUATOR

Fig. 06/Pneu

### 3-Way Valve and Actuator 100-150mm Bore Diameter

#### Refer to Fig. 07/Pneu

This shows the 3-way valve with actuator which is fitted in the piping system to automatically control the flow diversion through or around the cooler.

The signal from the pneumatic controller (separately described) is led to the actuating cylinder (2), and acts on the head of the piston (3) and against return spring (4). A high signal pressure, corresponding to low temperature at the control unit causes the return spring to be fully compressed, the actuator rod to be fully extended, and the rotor (5) working in the bore of the 3-way valve (1) to be positioned such that the cooler port is closed off and the bypass port fully open. As the control temperature increases, the signal pressure reduces. The reduced air pressure acting on the piston head allows the actuator return spring to extend until the spring force balances the reduced signal pressure.

After equilibrium has been established any changes in control temperature will result in a change in signal pressure, and a compensating adjustment of the 3-way valve rotor position, so maintaining the control temperature approximately constant.

The movement of the actuator is transmitted to the rotor through a ball ended drive pin (6) working in a low friction non-metallic sleeve (7) pressed into a lever arm (8) directly connected to the valve shaft (9).

The actuator piston (3) is provided with a composite low sealing piston comprising an outer ring of p.t.f.e. with a synthetic rubber backing ring.

The valve shaft (9) runs in low friction non-metallic bearings (10 and 11). The shaft is sealed by 'O' ring (12). An extension of the shaft (13) carries a pointer (14) giving a direct indication of the valve rotor position and flow through the control ports. The mechanism is enclosed within a box casting (15) with a cover (16) secured by hand nuts (17). The box casting

(15) is symmetrical about the section line AA, and actuator and cover (18) may be interchanged to change the "handing" of the valve.

The valve body (1) is exactly as used for direct operated valves and the front covers (22) and back cover (23) where fitted similar except for the shaft bearing arrangement. The front cover is provided with a cast stop (25) which positively prevents the rotor cutting off the inlet/outlet port under any circumstance.

The front and back covers are sealed by 'O' rings (24). The mechanism box is secured to the front cover by using some of the cover studs. By removing the box securing nuts of these studs, and the lever (8), the box casting (15) together with the actuator, etc, may be removed from the valve. By removing the remaining front cover nuts, the front cover complete with shaft and rotor can be withdrawn leaving the valve body in-situ and without disturbing the associated piping.

### **Manual Override**

The valve can easily be positioned manually.

To hand control:

1. Remove pointer (14)
2. Release hand nuts (17)
3. Remove cover (16)
4. Slacken clamp (21)
5. Slide block (19) along piston rod (20) to position which controls temperature at desired level.
6. Tighten clamp (21)

### **Fail-Safe**

In event of air failure the valve will automatically “fail-safe” to the cooler position to prevent the possibility of the system overheating.

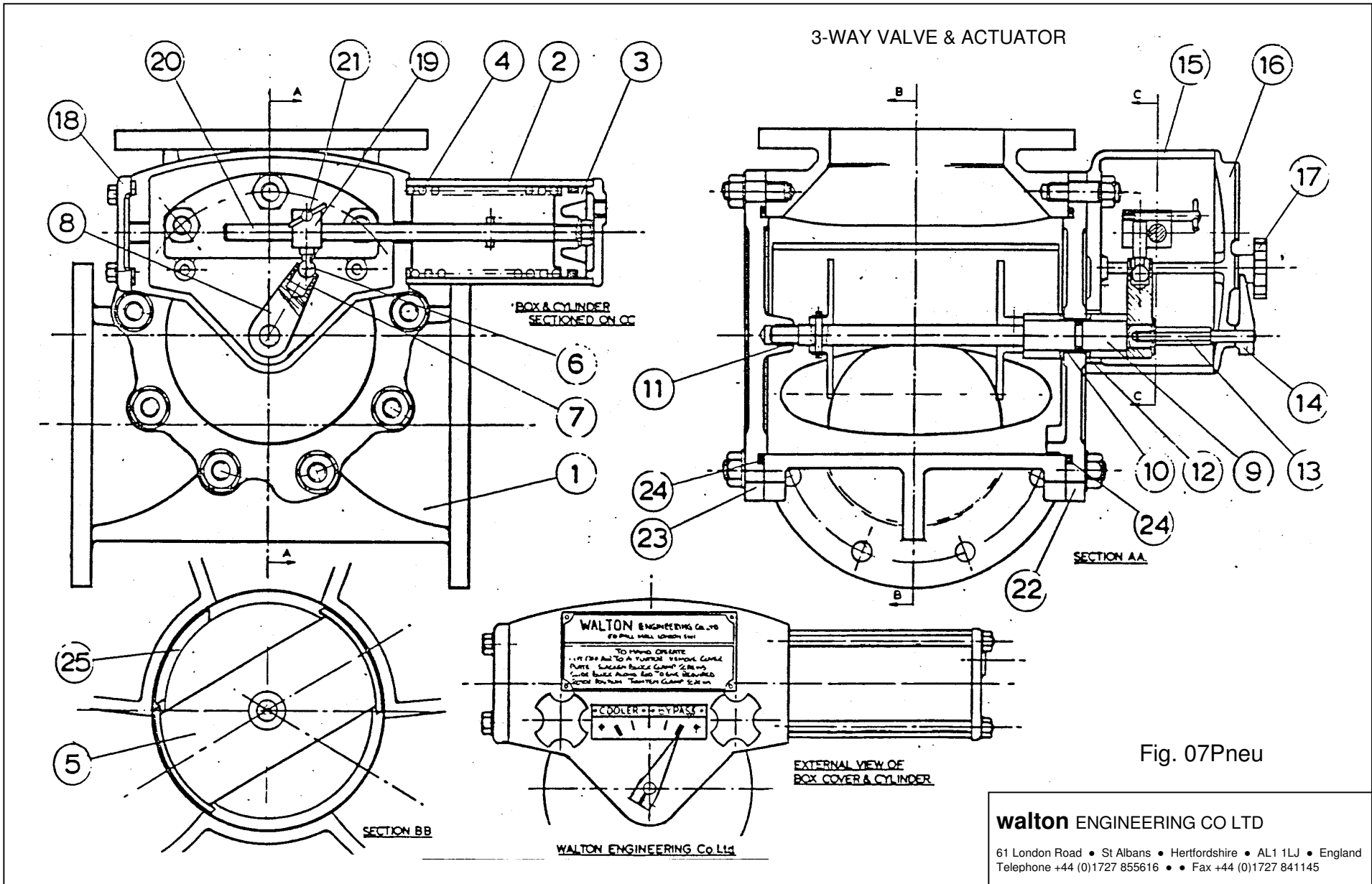


Fig. 07Pneu

PNEUMATICALLY OPERATED TYPE

### 3-Way valve and Actuator 175mm – 250mm Bore Diameter

#### Refer to Fig. 08/Pneu

This shows the 3-way valve with actuator which is fitted in the piping system to automatically control the flow diversion through or around the cooler.

The signal from the pneumatic controller (separately described) is led to the actuating cylinder (2), and acts on the head of the piston (3) and against return spring (4). A high signal pressure, corresponding to low temperature at the control unit causes the return spring to be fully compressed, the actuator rod to be fully extended, and the rotor (5) working in the bore of the 3-way valve (1) to be positioned such that the cooler port is closed off and the bypass port fully open.

As the control temperature increases, the signal pressure reduces. The reduced air pressure acting on the piston head allows the actuator return spring to extend until the spring force balances the reduced signal pressure.

After equilibrium has been established any change in control temperature will result in a change in signal pressure, and a compensating adjustment of the 3-way valve rotor position, so maintaining the control temperature approximately constant.

The movement of the actuator is transmitted to the rotor through a ball ended drive (6) working in a low friction non-metallic sleeve (7) pressed into a lever arm (8) directly connected to the valve shaft (9). The actuator piston (3) is provided with a composite p.t.f.e. sealing ring. The valve shaft runs in low friction non-metallic bearings, (10 and 11). The shaft is sealed by 'O' (12). An extension of the shaft (13) carries a pointer (14) giving a direct indication of the valve rotor position and flow through the control ports. The mechanism is enclosed within a box casting (15) with cover (16) secured by hand nuts (17). The box casting (15) is symmetrical about the section line AA, and actuator and cover (18) may be interchanged to change the "handing" of the valve.

The valve body (1) is exactly as used for direct operated valves and the front cover (22) and back cover (23) similar except for the shaft bearing arrangement. The covers are provided with a cast stop (25) which positively prevents the rotor cutting off the inlet/outlet port under any circumstance.

The front and back covers are sealed by 'O' rings (24). The box casting is secured to the front cover by using three of the cover studs and by removing the three nuts of these studs, and the lever (8) secured by drive pin, the box casting (5) together with the actuator, may be removed from the valve. By removing the remaining front cover nuts, the front cover complete with shaft and rotor may be withdrawn, leaving the valve body in place and without disturbing any of the associated piping.

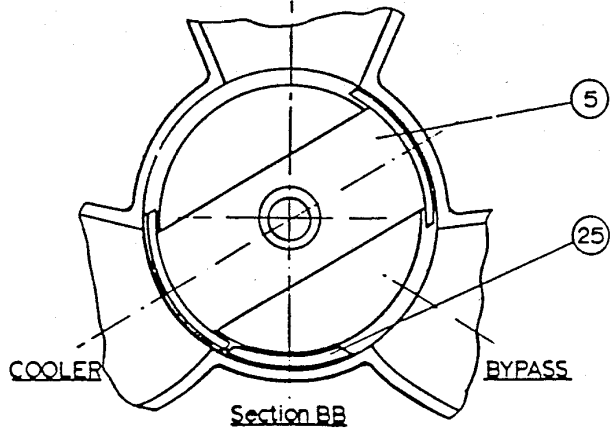
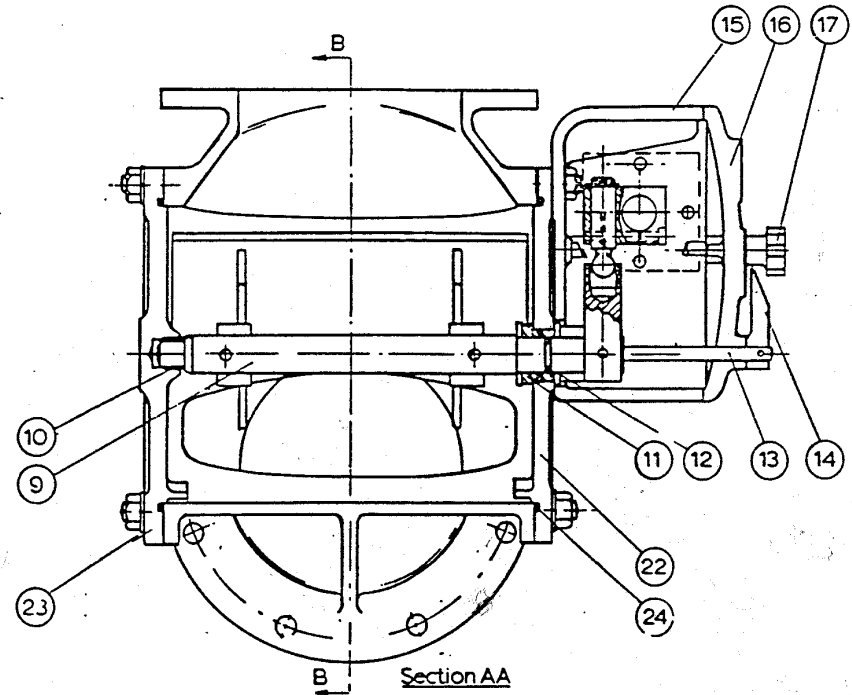
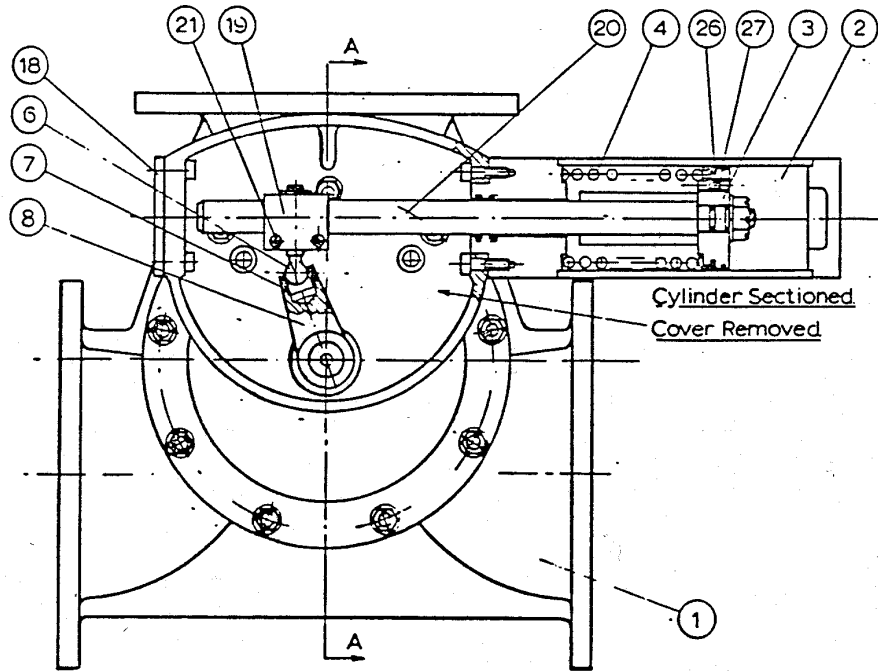
#### Manual Override

The valve can be readily positioned manually.

To hand control:

1. Remove drive pin from pointer (14)
2. Remove hand nuts (17)
3. Remove cover (16)
4. Slacken socket head screws (21)
5. Slide block (19) along piston rod (20) to position which controls temperature at desired level.
6. Tighten socket head screws (21)





3-WAY VALVE & ACTUATOR. Mk.II.

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Fig. 08/Pneu

### 3 – Way Valve and Actuator 275mm – 350mm Bore Diameter

Refer to Fig. 09/Pneu and Fig. 10/Pneu

The signal from the pneumatic controller (separately described) is led to the actuating cylinders (2), and acts on the head of the pistons (3) and against return springs (4). A high signal pressure (corresponding to low temperature at the control unit), causes the return springs to be fully extended, and the rotor (5) working in the bore of the 3-way valve (1) to be so positioned that the cooler port is closed off and the bypass port fully open. As the control temperature increases, the signal pressure decreases, allowing the actuator return springs to extend until the spring forces balance the reduced signal pressure acting on the piston heads.

A mid-range control temperature will give an approximate mid-position of the actuator piston, and an equal division of flow through cooler and bypass. After equilibrium has been established, any change in control temperature will result in a change in signal pressure, and a compensating adjustment of the 3-way valve rotor position, thus maintaining an approximately constant control temperature.

The movement of the actuators is transmitted to the rotors through a ball ended drive pin (6) working in a low friction non-metallic sleeve (7) pressed into a lever arm (8) directly connected to the valve shaft (9).

The actuator pistons (3) are provided with a composite low friction piston ring (26), the outer p.t.f.e. ring being held in light contact with the actuator walls by a rubber 'O' ring.

The valve shaft runs in low friction non-metallic bearings (10 and 11), and is sealed in the front cover by 'O' ring (12).

The front cover bearing (11) is made of filled polytetrafluorethylene (p.t.f.e.), and incorporates the shaft thrust face which rotates against thrust washer (13). The shaft thrust (in the opposite direction) is taken by a low friction thrust washer (14) acting against the shaft nut (15). The shaft nut is adjusted on assembly to give the specified shaft end float

(0.75/1.00mm), and then locked by grub screw (16). The shaft end is extended to carry lever arm (8) and manual handle (18).

The lever arm is coupled to the manual handle by three pins (19) and fixed to the shaft by a cross pin (20), and knurled nut (21). Movement of the actuator piston rods (35) is transmitted to the valve rotor (5) via the spherically ended drive pin (6), lever (17), handle (18) and through cross pin (20) to the shaft (9). The rotor is secured to the shaft by pins (26). The actuators are mounted on a box casting (27) by set screws (28). The box casting is bolted to the 3-way valve by three "long" studs (29), and provided with a cover (31) secured by handwheels (32).

A scale (33) indicates the valve position against a pointer provided on the manual handle.

The mechanism box is symmetrical, and by interchanging the actuators (2) and the covers (34), a valve with the opposite hand is obtained.

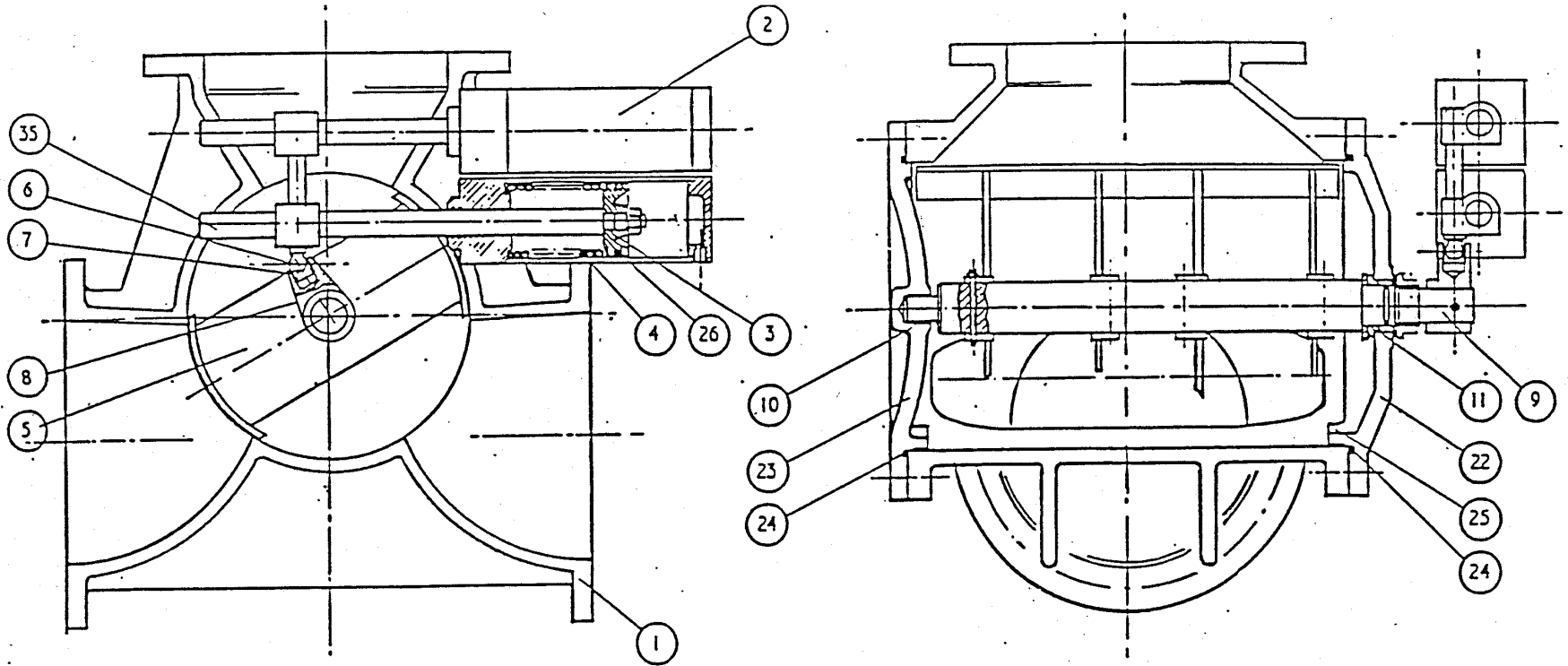
## **Manual Operation**

### **Refer to Fig. 10/Pneu**

The valve can be positioned manually.

To hand control:

1. Run knurled nut (21) back to stop nut (35)
2. Remove cross pin (20)
3. Pull handle (18) back to knurled nut. Handle is now disconnected from the actuators and directly connected to the shaft and rotor.
4. Position handle to obtain desired level of temperature control and secure by locking screw (36)
5. Adjust lever position as necessary to maintain required circuit temperature.



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Fig. 09/Pneu

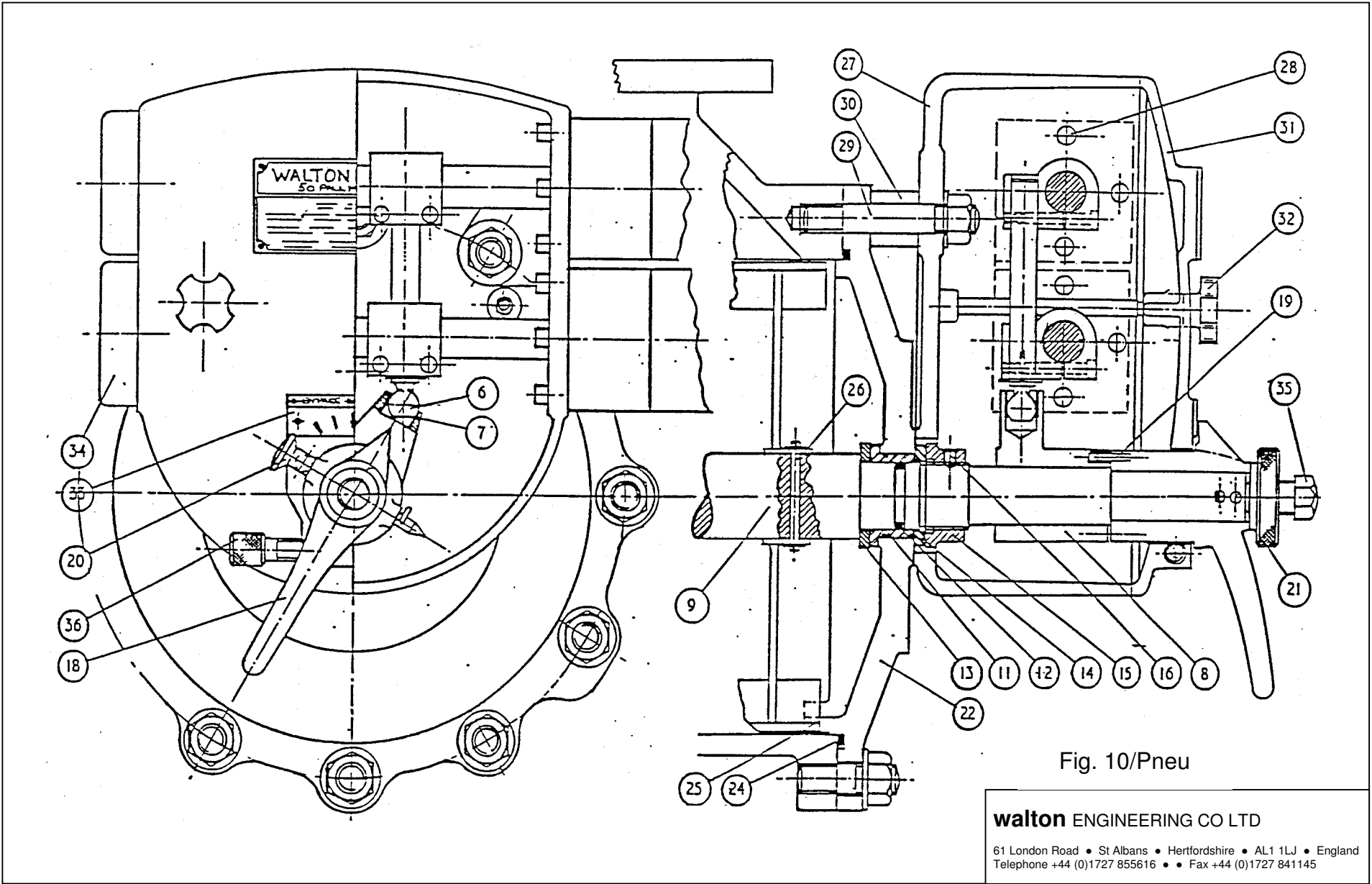


Fig. 10/Pneu

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