



Meggitt Fuelling Products

Avery-Hardoll
Whittaker Controls

Jet ABLE (Automatic Bottom Loading Equipment)

Installation, operation and maintenance manual

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AMENDMENT RECORD

AMENDMENT NO.	PAGE	DESCRIPTION	DATE

Avery-Hardoll

It is the aim of Avery-Hardoll to maintain a policy of continuous progress and for this reason reserve the right to modify specifications without notice. This manual provides the information required to install, service and overhaul the equipment. Although every effort has been made to ensure absolute accuracy, Avery-Hardoll does not hold itself responsible for any inaccuracies that may be found.

HEALTH AND SAFETY AT WORK ACT 1974

REFERENCE: CHAPTER 37, PART 1, SECTION 6

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- 11 Where applicable, attention should be drawn to dangers resulting from the generation of static electricity in product flow lines. We strongly recommend account is taken of BS5958 parts 1 and 2.x
- 12 This equipment is not suitable for use with Liquid Petroleum Gas (L.P.G).

WARNINGS

IF ANY OF THIS EQUIPMENT IS INVOLVED IN A FIRE THE FOLLOWING WARNINGS SHOULD BE OBSERVED.

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HIGH PRESSURE AIR IS DANGEROUS. HIGH PRESSURE SOURCES MUST NOT BE DIRECTED TOWARDS ANY PART OF THE HUMAN BODY.

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CHAPTER 1

INTRODUCTION

- 1.1 The Jet Automatic Bottom Loading Equipment (Jet ABLE) provides a simple, reliable, low cost method of filling a tank to an accurate, pre-determined level without the use of floats and other moving parts. Jet ABLE is designed for use with light petroleum products, for use with other liquids please consult Meggitt Fuelling Products, Avery-Hardoll.
- 1.2 The system comprises two major components, a foot valve and a jet sensing unit. The foot valve is located at the filling point in the bottom of the tank and the jet sensing unit is installed in the tank at the required fuel cut-off level. Three flexible pipes, forming pressure, return pressure and sensing unit drain lines make up the remaining component parts of the basic system.
- 1.3 The foot valve is operated using supply and spring pressures acting on unequal areas on the top and bottom of a piston, the bottom pressure being controlled by the jet sensing unit, in which the pressure of liquid from an upper jet is sensed by a lower jet and transmitted back to the foot valve.
- 1.4 Jet ABLE consists of:
- (a) A hydraulically actuated foot valve located at the filling point in the bottom of the tank.
 - (b) A liquid level jet sensing unit fitted in the tank at a height determined by the final fluid level required.
 - (c) Three tubes comprising:
 - (i) A sensing unit pressure line
 - (ii) A return pressure line
 - (iii) A sensing unit anti-static drain line
- 1.5 Four types of foot valve of similar basic design are available; each of these is manufactured in 3 in and 4 in bore size. The three valve types are:
- Basic foot valve - Automatic bottom loading with automatic cut-off.
Not used for off-loading. *Continuous jet flow.
- Type 'B' - Automatic bottom loading with automatic cut-off.
Suitable for off-loading with local control.
*Continuous jet flow.
- Type 'BC' - Controlled bottom loading. Suitable for off-loading. Automatic cut-off.
Automatic jet shut-off.
- Type 'V' - Automatic bottom loading with automatic cut-off.
Suitable for off-loading with local control.
Automatic actuation of tank vent.
*Continuous jet flow.
- 1.6 The simplest form of the bottom loading equipment incorporates a basic foot valve. This valve opens almost immediately when line pressure is applied. No control or off-loading features are included in the valve, and the equipment acts as an automatic top level cut-off.

Note: Correct operation of the jet sensing unit is dependent upon the stall pressure of the pump, the initial flow rate and the configuration of the tank upper levels.

*Continuous jet flow - with either the Basic, type 'B', or type 'V' foot valve fitted and with the main valve closed, the flow through the sensing unit pressure line will continue at a rate of 3 gpm until line pressure is shut off.

- 1.7 Type 'B' includes additional facility of an external operating lever. This offers an additional off-loading feature.
- 1.8 The standard Jet ABLE type 'BC' installation includes a standard foot valve which incorporates a control valve, a vacuum valve and off-loading mechanism. With this installation, the main valve remains closed under line pressure until the control valve is operated manually, loading is automatically terminated at the required level, and complete or partial off-loading can be effected as required. With the additional vacuum control feature, selective loading from a multiple loading manifold can be achieved without the danger of off-loading previously loaded compartments by the vacuum created within the manifold.
- 1.9 The type 'V' foot valve has the same functions as the type 'B' with the additional facility for the automatic operation of a vent during loading and off-loading operations through mechanical linkage connected to a hydraulic cylinder on top of the valve.

CHAPTER 2

TECHNICAL DESCRIPTION

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1 GENERAL INFORMATION

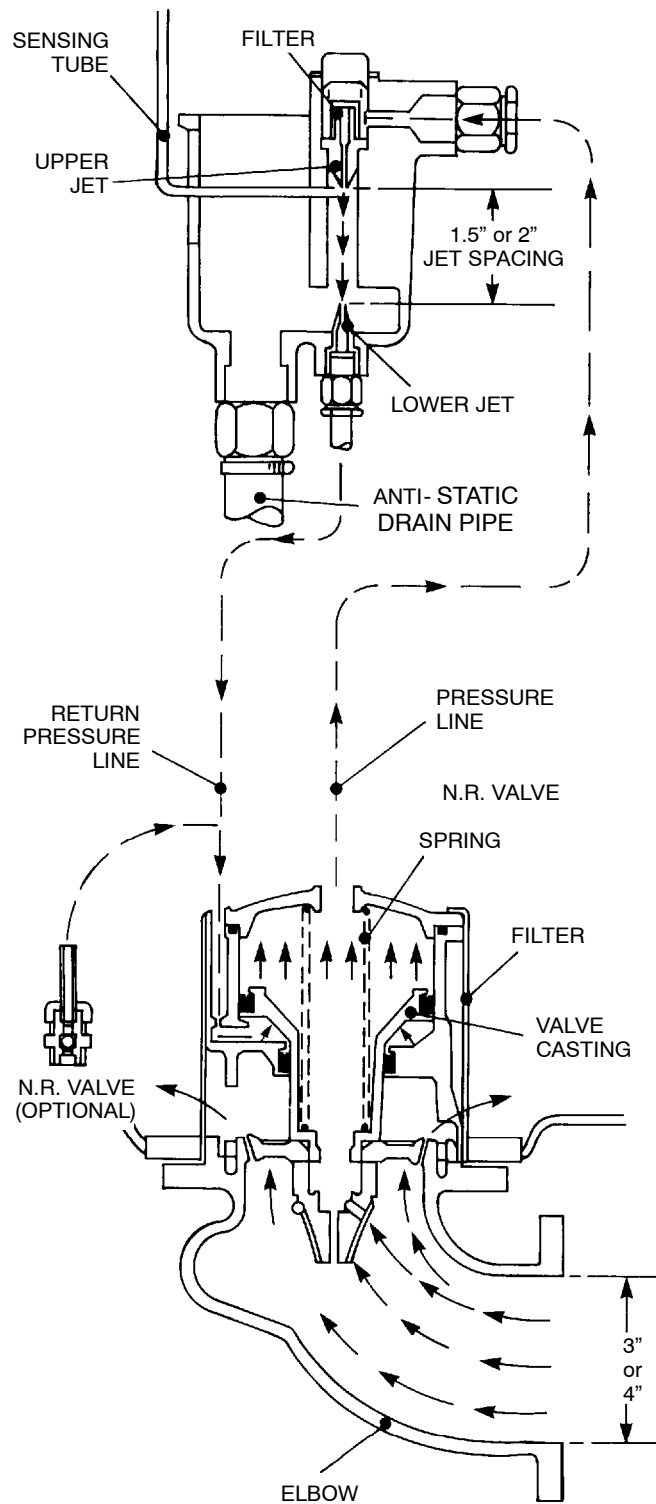
- 1.1 The jet automatic bottom loading equipment comprises one of four variants of foot valve installed, with either a 90 degree or straight inlet connector, in the tank compartment and linked to the fuel level sensing unit, installed at the required fuel cut-off level, by a pressure line and return pressure line. In addition a pre-check valve and deflector plate may be fitted.

Note: The use of Avery Hardoll self sealing couplings is recommended with these foot valves.

2 BASIC FOOT VALVE AND JET SENSING UNIT (Fig. 2.1)

- 2.1 The basic foot valve comprises a cast aluminium alloy valve body into which is fitted a main valve assembly and a spring holding the valve in the closed position. With the application of line pressure to the inlet connector fuel enters the upper chamber of the valve through a passage way in the centre of the valve. The line pressure plus the spring force applied to the relatively larger upper surface area prevents the valve being opened by pressure on the underside of the valve. Almost simultaneously, fuel is forced from the upper chamber of the valve, out through a 1/2" bore pressure line connected to the valve top and discharged from the upper jet of the sensing unit. The jet of fuel, assisted by air drawn through a sensing tube, strikes the aperture of the lower jet located in the base of the sensing unit. Pressure sensed at the lower jet is taken via a return pressure line, to the underside of the valve casting. The application of return pressure overcomes the pressure in the valve upper chamber allowing the main valve to open.
- 2.2 When the level in the tank is such that the fuel enters the sensing unit, the jet will be progressively spoilt. This action will cause a reduction in the return line pressure and create a pressure differential across the main valve causing it to begin to close. When the fuel level reaches the required cut-off level, ingress of air is prevented and the jet dispersed. The complete removal of pressure from the return pressure line permits the main valve to fully close.
- 2.3 Filtration of the fuel flow is achieved by the provision of two strainers one fitted at the foot valve inlet and the other at the sensing unit upper jet inlet. The foot valve discharge ports are also surrounded by a filter screen, to prevent large debris from passing.

Sensing Unit



Standard Foot Valve

Fig 2.1 The Basic Foot Valve and Jet Sensing Unit

3 PRINCIPLE OF OPERATION

- 3.1 On start up of the tank loading operation supply pressure acts on the underside of the main valve which is held shut by valve spring pressure. Supply pressure is also fed, through holes in the off- loading boss and filter assembly to the upper part of the main valve assembly. Initially supply and spring pressure acting on the top of the piston holds the valve shut, but after a very short time pressure is fed through the pressure line to the sensing unit and liquid passes through the filter to the upper jet. The jet of liquid discharged from the upper jet impinges directly onto the lower jet which senses the pressure and transmits it through the return pressure line to the underside of the main valve piston. The combination of supply pressure and return pressure is now enough to overcome the spring and supply pressure acting on top of the piston and the main valve opens.
- 3.2 During the filling operation air is drawn in through the sensing tube, the air sustains the jet in its correct form. When the liquid level reaches the sensing unit body, liquid will enter the body well and, as the well fills, the jet will be partially spoiled by the rising level. The spoiling of the jet is transmitted as a reduced return pressure, the differential pressure across the main valve piston is increased, and the valve will start to close. When the level reaches the top of the sensing tube the jet collapses, the return pressure falls to zero, causing the main valve to fully close.

NOTE

With a basic Type B or Type V foot valve a flow will continue through the pressure line when the main valve is closed, until supply pressure is shut off.

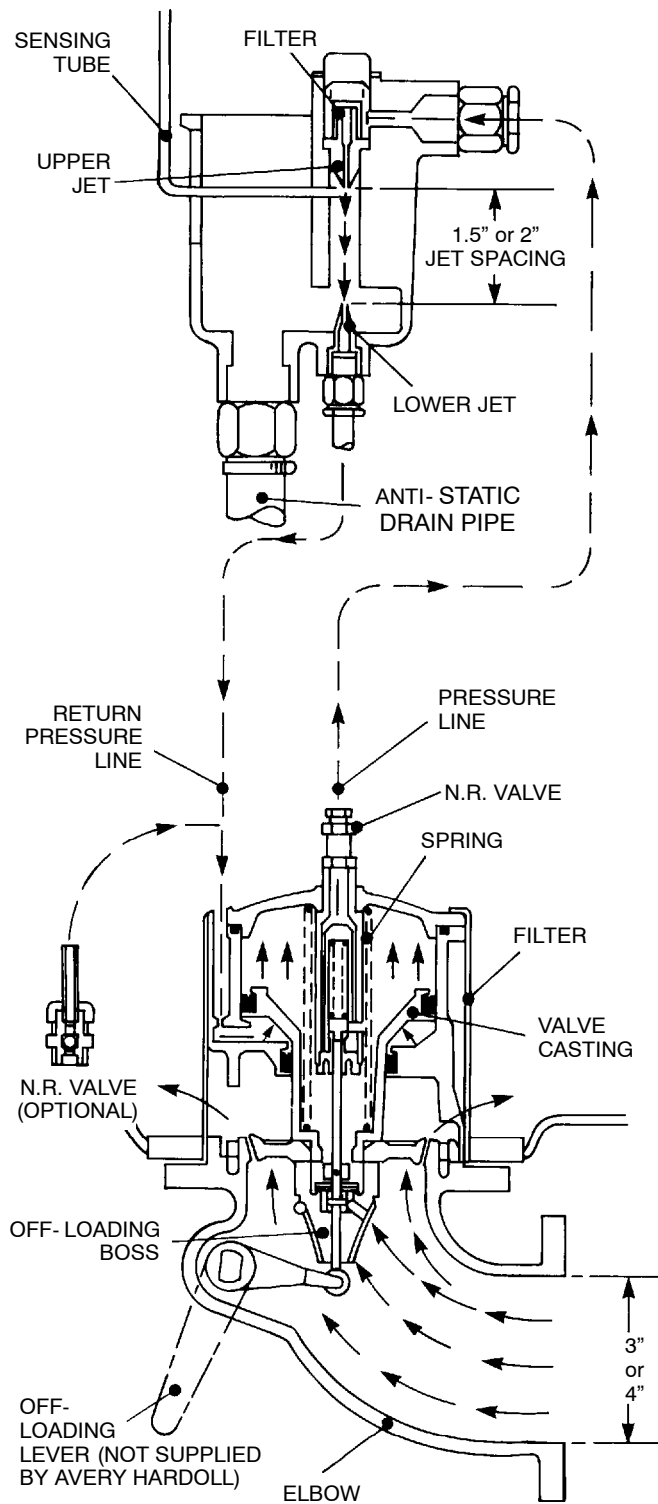
4 TYPE 'B' FOOT VALVES

- 4.1 The type 'B' foot valve is similar in construction and operation to the basic foot valve but with the addition of an externally controlled operating lever, fitted to the inlet connector. The purpose of the lever is to allow the valve to be opened manually for off- loading. The operating lever is secured on a lever shaft which pass through a gland on the connector, an external handle is then secured to the shaft. This handle is supplied by the customer to suit installation requirements.
- 4.2 To set the valve to off- loading the handle is moved to, and held in, the off- loading position, the roller on the operating lever comes in contact with the off loading boss so pushing the main valve assembly to the open position. To overcome the tendency for a vacuum to be created in the valve body and the pressure return line during off loading and to aid in opening the main valve assembly, non return valves are fitted to both lines. If the foot valve is mounted in a horizontal position an alternative non- return valve is fitted in the pressure line and the return pressure non return valve must be repositioned to keep it vertical.

5 TYPE 'BC' FOOT VALVES (Fig. 2.2)

- 5.1 The type 'BC' foot valve is similar in construction to the 'B' type valve but with the addition of a control and vacuum valve assembly. The purpose of this assembly is to allow the valve to be used for selective loading and off- loading of an individual tank or tank compartment in a multi- tank system.
- 5.2 The control and vacuum valve assembly comprises a control spindle, with vacuum valve attached and the control valve assembly. The lower end of the control spindle protrudes through the off loading boss and filter assembly and the vacuum valve sits on a seat in the off loading boss. The top section of the control spindle passes up through the main valve assembly and enters the bottom of the control valve assembly.
- 5.3 The control valve assembly comprises an outer housing and inner body in which a spring loaded control valve is housed. Both the housing and body are drilled to form ports, which together with the clearance between housing and body allow liquid to pass when the control valve is opened.

Sensing Unit



Standard 'BC' Foot Valve

Fig 2.2 The 'BC' Foot Valve and Jet Sensing Unit

- 5.4 On loading, the control valve is opened when the control spindle is pushed upwards by the first movement of the operating lever, the ports are then connected and liquid is allowed to flow to the pressure line, initiating full opening of the main valve as described in Section 3. Once the opening action has commenced the operating lever is returned to its 'Valve Closed' position, this allows the main valve to close on completion of loading.
- 5.5 For off- loading the valve is opened by moving and retaining the operating lever in the 'Off Loading' position as described in section 4.
- 5.6 To prevent the accidental opening of the main valve due to the vacuum effect created when another tank in the same system is off- loaded into a common line, the disc type vacuum valve provides a positive seal between the off- loading boss and the control spindle.

6 TYPE 'V' FOOT VALVE

- 6.1 The type 'V' foot valve is similar in operation to the 'B' type foot valve but with the addition of a facility to allow the automatic operation of a tank vent valve during loading or off loading operations. This is achieved by the fitting of an hydraulic piston assembly and a mechanical linkage to the top cover of the valve.
- 6.2 The top cover of the valve is fitted with a hydraulic piston assembly secured to it. The assembly comprises cylinder, piston and piston shaft to which a shackle assembly is attached.
- 6.3 The main valve assembly has a valve cap secured to it into which is screwed a spindle, a special nut screws over the end of the spindle.
- 6.4 The principle of operation of the main valve on loading or off- loading is the same as described in sections 3 and 4. To open the vent valve on loading supply pressure on top of the main valve assembly also leaks around the piston shaft to the underside of the piston causing it to lift. As the main valve opens the spindle comes into contact with the piston shaft further aiding piston lift. With the shackle assembly secured by a suitable linkage to a vent valve the vent valve will also be opened. On off- loading the operating lever contacts the special nut pushing the valve open, the spindle contacts the piston shaft, moving the piston and so opening the vent valve.

7 JET ABLE ANCILLARIES (Fig. 2.3)

PRE-CHECK VALVE

- 7.1 The pre-check valve is a simple ancillary which can be fitted into the pressure line between the foot valve and the sensing unit. This will allow an in-situ functional check of the Jet ABLE system to be carried out. Simply operating this lever during a normal delivery will simulate total jet spoil in the sensing unit, thereby closing the foot valve and stopping the delivery.
- 7.2 This useful device can be fitted in any convenient position around the tank, to suit the customers requirements. The unit should be fitted so that its operating lever is within easy reach of an operator. Once fitted, this valve will allow a functional check of the Jet ABLE system, or allow a load to be terminated at any point during loading, for instance, if a part batch is required.

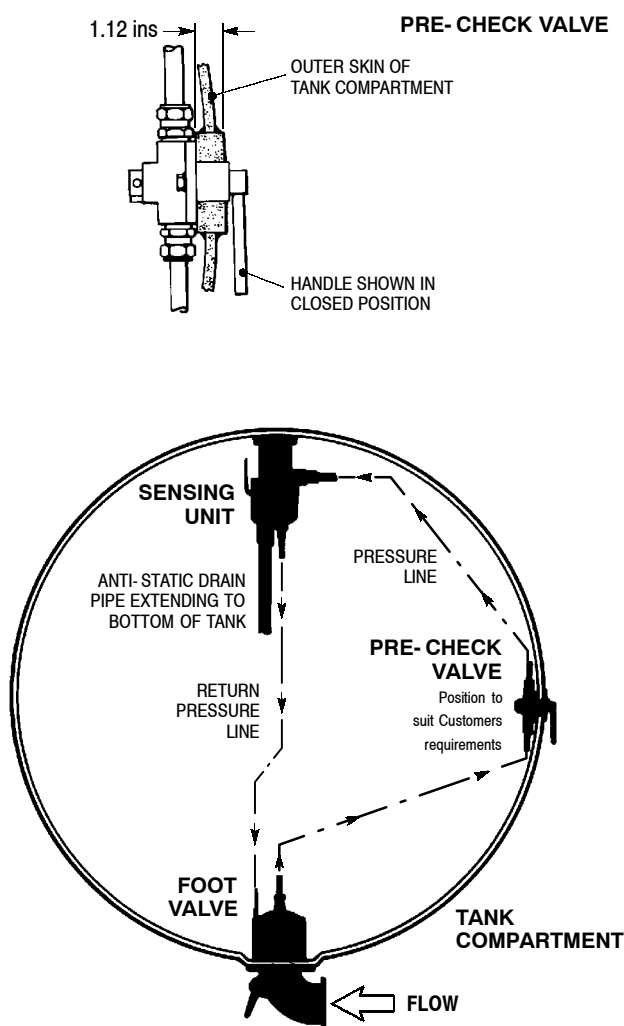


Fig 2.3 Diagram showing positions of units in tank compartment

DEFLECTOR PLATE

- 7.3 A deflector plate can be fitted above the foot valve to prevent the build up of static charge by minimising the turbulence and spray produced when the product is loaded at high flowrates. The deflector is made from two plates joined together in the centre by four thumbscrews, and secured to the valve top cover by four set screws.

SUMMARY OF VALVE VARIANTS

FOOT VALVES

FOOT VALVE	PART NUMBER	FEATURES
Basic 3" 4"	TVMY1400 TVMY1200	Automatic bottom loading with emergency cut-off. Not used for off-loading. *Continuous jet flow.
TYPE 'B' 3" 4"	TVMY1400B TVMY1200B	Automatic bottom loading with emergency cut-off. Suitable for off-loading with local control. *Continuous jet flow.
TYPE 'BC' 3" 4"	TVMY1400BC TVMY1200BC	Controlled bottom loading. Suitable for off-loading. Automatic jet shut-off.
TYPE 'V' 3"	TVMY2530B	Automatic bottom loading with emergency cut-off. Suitable for off-loading with local control. Automatic actuation of tank vent. *Continuous jet flow.

Notes:

1. Type 'BC' valves are designed to comply with Regulation 6 of the UK Road Traffic (carriage of dangerous substances in road tankers and tank containers) regulations 1992.
2. All the above valves are fitted with 90° connectors as standard. For valves with straight connectors, add - 1 to the part number.
3. *Continuous jet flow - with either the Basic, type 'B', or type 'V' foot valve fitted and with the main valve closed, the flow through the sensing unit pressure line will continue at a rate of 3 gpm until line pressure is shut off.

Example: For 3" Type 'BC' valve with straight connector, order TVMY1400BC- 1
When a deflector plate is included in the equipment a further suffix letter 'D' is added.

JET SENSING UNITS

JET SPACING	PART NUMBER	USAGE
2"	TVMY1300	For use where the stall pressure of the pump unit is a minimum of 1.75 kg/cm ² (25 psi)
1 1/2"	TVMY1300- 1	For use where the stall pressure of the pump unit is a minimum of 1 kg/cm ² (15 psi)

Tank geometry/size can also affect the choice

ANCILLARY EQUIPMENT

DESCRIPTION	PART NUMBER	FUNCTION
Deflector plate	TVMY1495	Helps prevent build-up of static at high input flow rates.
Pre-check valve	TVMZ2452	Provides functional check of Foot Valve from outside the tank.

The use of Avery Hardoll dry brake couplings, including CCMY9000 Tank Unit and CCMY9600 Bottom loading coupler, is recommended.

CHAPTER 3

SPECIFICATION

1 STANDARDS

Jet ABLE flanges comply with TTMA RP No. 28

Type 'BC' complies with UK road traffic act (Road transport of dangerous substances)

2 MATERIALS

2.1 The materials used in construction are;

Aluminium alloy.

Zinc plated mild steel.

PTFE.

Static seals - High nitrile.

Dynamic seals - Fluorocarbon.

Nylon Tubing.

3 WEIGHTS

3" foot valve; 5kg (11 lb).

4" foot valve; 7.2kg (16 lb).

Sensing unit; 1.3kg (3 lb).

4 OPERATING PRESSURE

- 4.1 Maximum working pressure, 5.17 bar (75 lb/in²)
- 4.2 The minimum stall pressure of pump required to ensure that the correct cut-off level is reached is as follows:

1 1/2 in jet spacing, 1.03 bar (15 lbf/in)

2 in jet spacing, 1.72 bar (25 lbf/in)

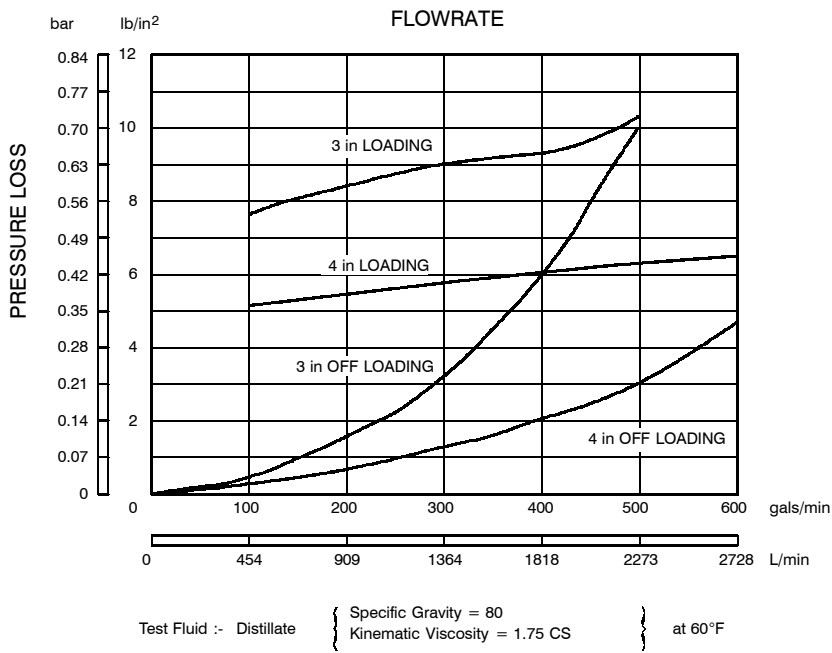


Fig 3.1 Average Pressure Loss Characteristics of 3" & 4" JET ABLE Foot Valves. (Under Loading and Unloading Conditions)

CHAPTER 4

INSTALLATION, OPERATION AND MAINTENANCE

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1 GENERAL

- 1.1 The following installation instructions are applicable to all variants of the system, with the additional requirements for mechanical linkage to be connected to the type 'V' foot valves. Installation details for the pre-check valve are given in figure 4.1.

WARNING

IF EITHER A BASIC OR TYPE 'B' FOOT VALVE IS FITTED AND WITH THE VALVE CLOSED, A FLOW OF 13.6 LTR/MIN (3 GAL/MIN) WILL CONTINUE THROUGH THE PRESSURE LINE TO THE SENSING UNIT UNTIL THE SUPPLY PRESSURE IS SHUT OFF.

2 SENSING UNIT

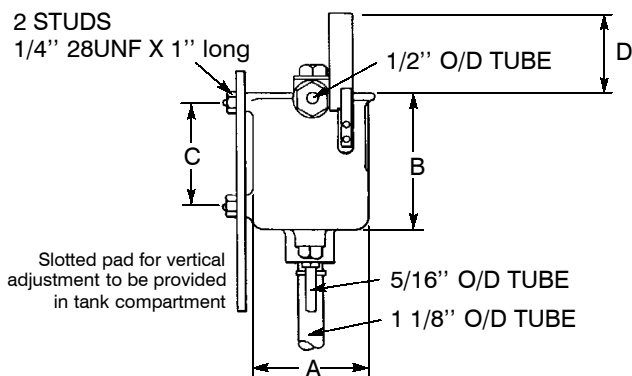
- 2.1 A sensing unit mounting bracket, provided by the customer, is fixed at the approximate final fuel level required. The bracket should contain two vertical slots to accommodate the securing studs of the sensing unit and allow for final adjustment of the cut-off level.
- 2.2 Position the sensing unit onto the mounting bracket with the top of the sensing tube at the required cut- off level. Tighten the securing nuts just sufficiently to hold the unit in place. Final adjustment and tightening is carried out on completion of cut- off level check as described in Chapter 6.

3 FOOT VALVES

- 3.1 It is recommended that the foot valve be situated in the most central position of the compartment in order to minimise any resulting turbulence.
- 3.2 The inlet connector tank pad and flange studs are to be provided and fitted by the customer.
- 3.3 Locate the foot valve elbow/straight connector into position on the studs and secure. From the inside of the tank, ensure a wave spring is located in the groove in the connector flange face and fit the foot valve body onto the connector bayonet fittings.

Sensing Unit

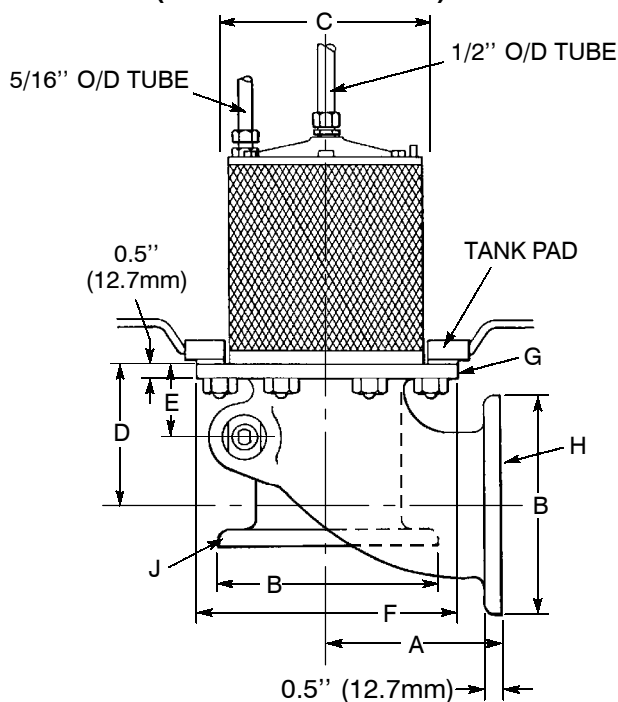
Sensing Unit		
	Ins.	mm.
A	3.80	96.8
B	3.75	95.2
C	2.68	67.5
D	2.36	60.0



Installation Dimensions

Dim.	Foot Valve			
	3"		4"	
	Ins.	mm.	Ins.	mm.
A	4.50	114.3	5.0	127.0
B	5.62	142.7	6.75	171.4
C	4.87	123.7	6.40	162.6
D	3.25	82.5	4.5	114.3
E	2.12	53.9	2.31	57.2
F	7.37	187.3	8.25	209.7

Foot Valve (4 in. Version shown)



Flange Dimensions

Dim.	Valve Size	No. of Holes	Hole Size		P.C.D.	
			Ins.	mm.	Ins.	mm.
G	3"	6	9/16"	14.2	6.25	158.7
	4"	8	9/16"	14.2	7.25	184.0
H	3"	8	7/16"	11.1	4.87	123.7
	4"	8	7/16"	11.1	5.87	149.0
J	3"	8	3/8" UNF Stud		4.87	123.7
	4"	8	7/16"	11.1	5.87	149.0

Flange dimensions are to TTMA TP No. 28

Fig 4.1 Installation Dimensions

4 NON-RETURN VALVES

- 4.1 When non- return valves are fitted in the pressure and pressure return lines it is important that they are installed in a vertical position to ensure correct operation. When a foot valve is fitted horizontally, the non- return valves are to be fitted vertically, with the open end of the valve in the pressure line facing downwards.

5 DEFLECTOR PLATE

- 5.1 When a deflector plate is fitted it must be positioned before the non- return valves and lines are fitted to the foot valve.
- 5.2 The deflector plate should be mounted centrally above the foot valve with a spread diameter of between 14 and 18 inches. Its edge should be a minimum of 10" from the nearest side wall or baffle.

6 TUBE CONNECTIONS

- 6.1 When fitting the pressure and return pressure lines, sufficient length must be allowed for final adjustment on sensing unit height.
- 6.2 Using the adaptors provided, connect the two lines to the foot valve and sensing unit, tighten up on the tube nuts.
- 6.3 The anti- static drain pipe must be installed so that it extends to the bottom of the tank and drops in a vertical line. Secure the drain pipe to the sensing unit using a jubilee clip.

7 PRE- CHECK VALVE

- 7.1 When a pre- check valve is fitted, a boss of suitable dimensions as shown in Fig 4.2 is to be welded into the outer skin of the tank. The pressure line tubing is extended as shown and connected with adaptors and tube nuts.

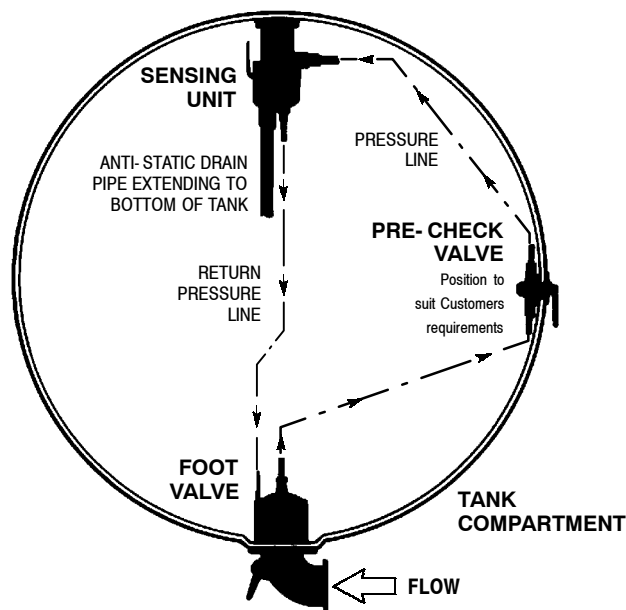
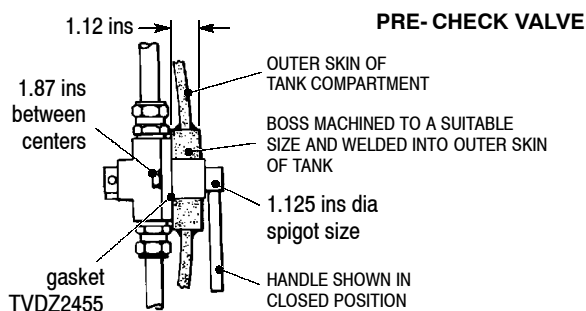




Fig 4.2 Diagram showing positions of units in tank compartment

SET UP

8 JET SPACING

- 8.1 The stall pressure of the pump, the initial flow rate and the configuration of the upper levels of the tank are factors which affect the correct operation of the sensing unit.
- 8.2 Optimum modulation of the flow rate prior to main valve closure is achieved by adjusting the space between upper and lower jets to suit conditions peculiar to the particular installation. The spacing can be set at either 1 1/2in or 2in by fitting the appropriate alternative lower jet.
- 8.3 A 1 1/2in jet spacing is required when a tank, whose horizontal cross-sectional area diminishes only by small degrees near the final fluid level, is loaded at a relatively low pressure. When a tank with a large degree of area reduction is loaded at relatively high pressure, 2in jet spacing is needed to give maximum modulation.
- 8.4 Determination of the correct spacing to suit variation between these extreme conditions may require tests with both lower jets. When any doubt exists concerning the actual operating conditions, it is recommended that an alternative lower jet is ordered. The lower jets are easily interchangeable on site.
- 8.5 Details of minimum pump stall pressures and initial flow rates affecting the choice of lower jets are given opposite.

(a) Minimum stall pressure at pump

	Pump Stall Pressure	Jet Spacing	Sensing Unit Part Number	Lower Jet Part Number
	25 psi (1.75kg/cm ²)	2in	TVMY1300	TVCZ1323
	15 psi (1kg/cm ²)	1 ¹ / ₂ in	TVMY1300- 1	TVCZ1323- 1

These are minimum pressures needed to ensure that the cut-off level (top of sensing tube) is reached.

(b) Minimum initial flow rates

The figures shown are for 2in jet spacing. Jets with 1¹/₂in spacing should be used on installations where flow rates are less than these figures.

Foot Valve	Minimum Initial Flow
3in	225 IGPM (1025 LPM)
4in	325 IGPM (1475 LPM)

9 CUT-OFF LEVEL CHECK

Note: It should be ensured that the tank is adequately vented to avoid a build-up of pressure due to high rate of filling possible with this equipment.

9.1 With the delivery line connected and line pressure applied, commence loading the tank following the instructions indicated in Section 14. When the equipment has completed its function and shut off the main valve, check the liquid level. If this is not correct proceed as follows:

- (1) Off-load the tank until the liquid level is a few inches below the sensing unit.
- (2) Reposition the sensing unit to raise or lower the top of the sensing tube, as required.
- (3) Reload the tank and check the cut-off level again.

9.2 If necessary repeat the procedure until the required level is obtained, then reduce the level, to provide access to the sensing unit, and fully tighten the securing nuts.

10 DURATION OF MAIN VALVE CLOSURE

10.1 The time which the loading valve takes to close is related to the length of the sensing tube, and under normal conditions the standard length should not need alteration. However, when the liquid level areas at the top of a tank are large and the degree of reduction relatively small, it may be considered that the duration of the valve closing is too long. Should this be the case, the length of the sensing tube must be shortened progressively until the time taken is acceptable. This adjustment is attained by trial and error on site, and the procedure is as follows:

- (1) Off-load the tank until the liquid level is a few inches below the sensing unit.
- (2) Unscrew the tube guard retaining screw, remove guard and withdraw the sensing tube.
- (3) Reduce the length of the tube. Replace tube, guard and screw.
- (4) Reload tank, checking the duration of valve closure by reference to a pressure gauge in the filling line.

11 EXTERNAL LEVER (Type 'BC' only)

11.1 When the equipment includes off-loading mechanism, an external lever or remote control linkage must be fitted by the customer. The lever should have a spring return action and the arrangement must ensure that the lever is latched in the off-loading position only. It is recommended that the lever gate is marked to indicate the related valve positions and that a suitable instruction plate is located nearby.

11.2 Three external lever positions are required, ie VALVE CLOSED, LOADING, AND OFF-LOADING. The 'valve closed' position is established when a gap of approximately 0.050in (min) exists between the operating lever roller and the lower end of the control valve spindle. The other two positions are determined by the feel of the valve as the lever is moved. The approximate angles at which the extension lever should be set relative to the vertical are indicated in Fig. 4.3, 4.4, 4.5.

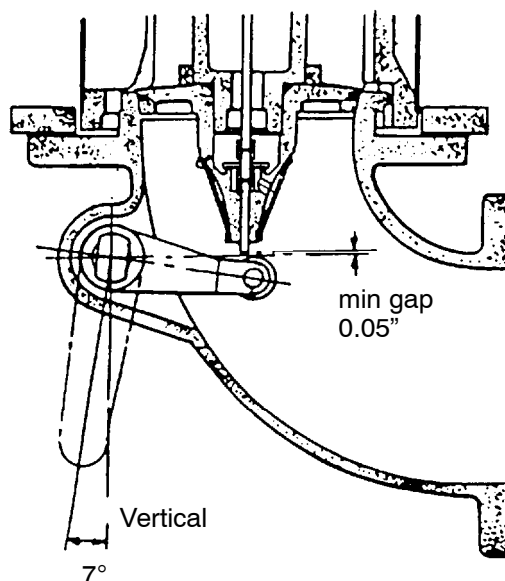


Fig 4.3 Valve Closed

- 11.3 When a type 'V' foot valve is fitted, check that there is sufficient slack in the vent actuating linkage so as to ensure that the vent is fully closed when the foot valve is closed. The vent should be positioned directly above the foot valve.

12 INSTRUCTION PLATE

- 12.1 It is suggested that the instruction plate is worded as shown below:

AUTOMATIC BOTTOM LOADING

TO LOAD

HOLD LEVER AT 'LOADING' POSITION.
WHEN FULL FLOW IS OBTAINED RETURN LEVER TO 'VALVE CLOSED' POSITION.
VALVE WILL CLOSE AUTOMATICALLY WHEN TANK IS FULL.

TO OFF-LOAD

SET LEVER AT 'OFF-LOADING' POSITION AND RETAIN UNTIL OFF-LOADING IS COMPLETED.
RETURN LEVER TO 'VALVE CLOSED' POSITION.

13 POST INSTALLATION TESTING

- 13.1 On completion of installation the Jet ABLE system is to be tested using the relevant procedures described in Chapter 6 TEST PROCEDURES. Particular attention is to be taken to achieving the correct cut-off level. The time taken for the foot valve to close is to be checked and proved to be satisfactory.

14 SYSTEM OPERATION - LOADING

14.1 BASIC, 'B' TYPE AND 'V' TYPE VALVE

The system is set into operation by the application of line pressure to the inlet connector. Filling and valve shut-off is then entirely automatic and controlled by the level sensing unit.

NOTE: With the basic type foot valve fitted and with the main valve closed, the flow through the sensing unit pressure line will continue at a rate of up to 3gpm until line pressure is shut-off.

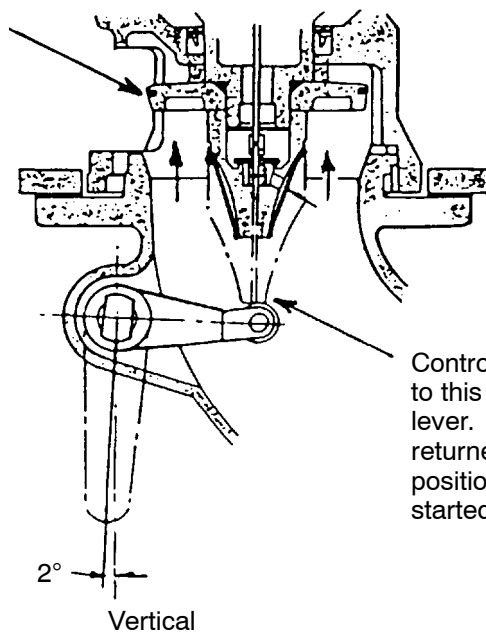
14.2 'BC' TYPE VALVE

The system is set into operation by the application of line pressure and the moving of the external lever to the loading position. Action of the roller pressing against the control spindle (Fig. 4.4) is enough to initiate the loading process, although there is a short delay until full flow is achieved.

NOTE: Do not use force on the lever in an attempt to open the valve quickly.

When full flow is achieved, the lever must be returned to its original position to allow the system to shut down automatically.

When control valve is moved to 'loading open' position. The liquid flow (pressure) will automatically move the main valve to this position



Control valve only moved up to this position by external lever. Lever must be returned to 'valve closed' position when full flow has started.

Fig 4.4 'BC' Type valve

15 SYSTEM OPERATION - OFF-LOADING

- 15.1 Off-loading of the tank is achieved by the operation of the external manual lever to its fullest extent to fully open the foot valve (Fig 4.5).

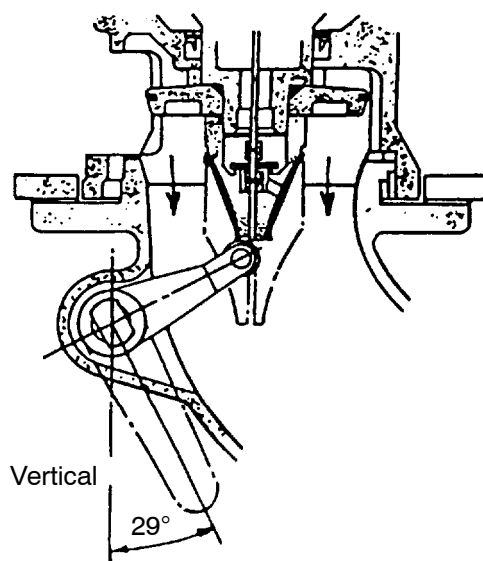


Fig 4.5 Off-loading

16 MAINTENANCE

- 16.1 The periods recommended are a minimum, however, local company instructions must be observed.
- 16.2 **Daily:** Carefully inspect the installation for signs of damage or leaks. Pay particular attention to the area around the inlet connector and external lever. Defects must be rectified immediately.
- 16.3 **Six Monthly:** Carry out a complete operational check.
- 16.4 **Yearly:** Renew all dynamic seals.
- 16.5 **Two yearly:** Renew all static seals. Renew the control valve assembly in type 'C' foot valves.
- 16.6 **Three yearly:** Renew all seals on units in storage.

CHAPTER 5

SERVICING

CONTENTS	SECTION
GENERAL	1
BASIC FOOT VALVE - DISMANTLING	2
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BASIC FOOT VALVE RE-ASSEMBLY	4
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1 GENERAL

- 1.1 It is recommended that the following procedures are carried out by suitably qualified engineers and dismantling is done in a workshop after removal of items from the installation.
- 1.2 The following special tools are recommended to aid in valve dismantling and re-assembly:
 Special tool No. TASZ5100 - Valve Key for use on 3in and 4in valves.
 Special tool No. TAAZ5101 - Lip seal guide for use on 3in valves.
 Special tool No. TAAZ5102 - Lip seal guide for use on 4in valves.

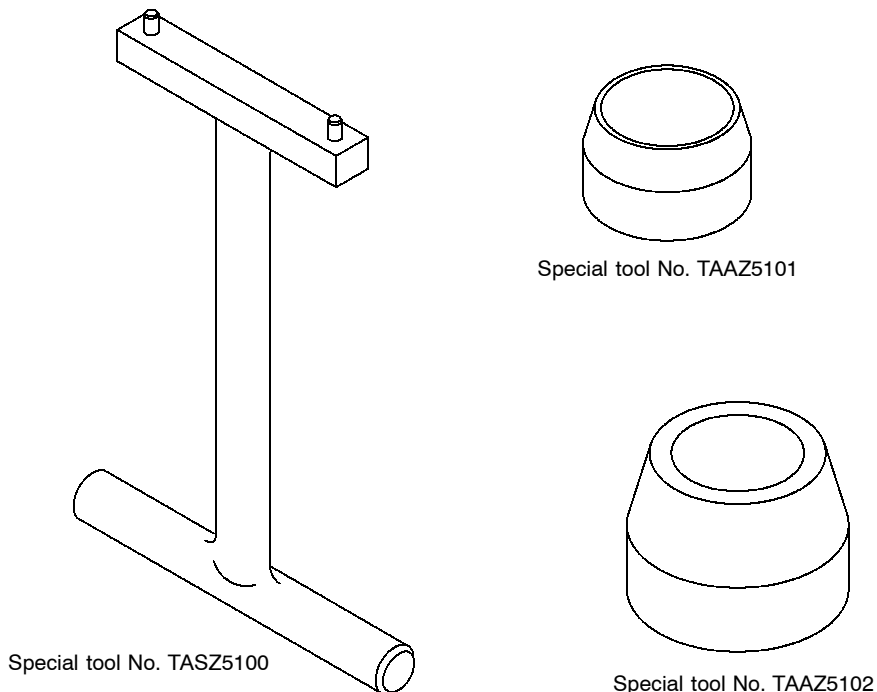


Fig 5.1 Special Tools

- 1.3 Ensure parts are available, listings of recommended stock spares are to be found in Chapter 8.

2 BASIC FOOT VALVE DISMANTLING (Figure 5.2)

- 2.1 With the valve still in position in the tank:

Disconnect and remove the pressure line (11).

Disconnect and remove the return pressure line (12).

Remove the deflector plate (if fitted)

Uncouple the foot valve from the inlet connector (1) or (2) remove and retain the wave spring (5).

- 2.2 With the valve removed to a workshop, remove the three screws (17) and washers (16) securing the mesh filter (21) to the valve body (10), remove the mesh filter from the body.

WARNING

The top cover is spring loaded

- 2.3 Restrain the top cover (22) and carefully unscrew the remaining three screws (17) and washers (16) and remove the top cover (22) and gasket (23) from the valve body (10). Remove the main valve spring (24) from the body.
- 2.4 Remove the grub screw (7) (if fitted). Remove the off loading boss and filter assembly (6/6A), using special tool TAAZ5100 in the top of the main valve (26) to prevent it rotating. Carefully remove the valve head (8). Remove and discard 'O' ring seal (9).
- 2.5 Loosen set screws (29) and remove the valve stop (30).
- 2.6 Withdraw the main valve (26) from the valve body (10). Remove the keep ring (27) and seals (25 and 28).

3 BASIC FOOT VALVE CLEANING AND INSPECTION

Maintenance of this equipment is limited to general inspection for corrosion or damage, cleaning filters, and replacing seals and gaskets as necessary.

- 3.1 Components should not require heavy cleaning, if necessary cleaning is to be carried out using approved methods and materials. Inspect all components ensuring they are undamaged and that all mating surfaces are free from serious defects. Any suspect components must be renewed.

4 BASIC FOOT VALVE RE-ASSEMBLY

- 4.1 When re-assembling fit new 'O' ring seal (9) and seals (25) and (28) to the main valve assembly and body. Fit keep ring (27) to body.
- 4.2 To prevent damage to seals during assembly fit special tool, TAAZ5101 or TAAZ5102 to the threaded portion of the main valve (26). Taking care not to damage or distort seal (25) insert the main valve into the valve body. Remove the special tool.
- 4.3 Fit valve stop (30) to valve head (8).
- 4.4 Fit new 'O' ring seal (9) and position the valve head (8) onto the main valve (26).

- 4.5 Apply sealant LOCTITE 542 to the mating faces of the off-loading boss (6/6A) and the valve head (8). Using special tool TASZ5100, screw the off-loading boss and filter assembly onto the main valve. Secure with the grub screw (7) (if fitted). Remove the special tool.
- 4.6 Making sure the valve stop (30) is in its correct position tighten the three set screws (29).
- 4.7 Locate the main spring (24) into the valve body.
- 4.8 Fit a new gasket (23) onto the valve body and locate the top cover (22) into position, secure with three screws (17) and washers (16).

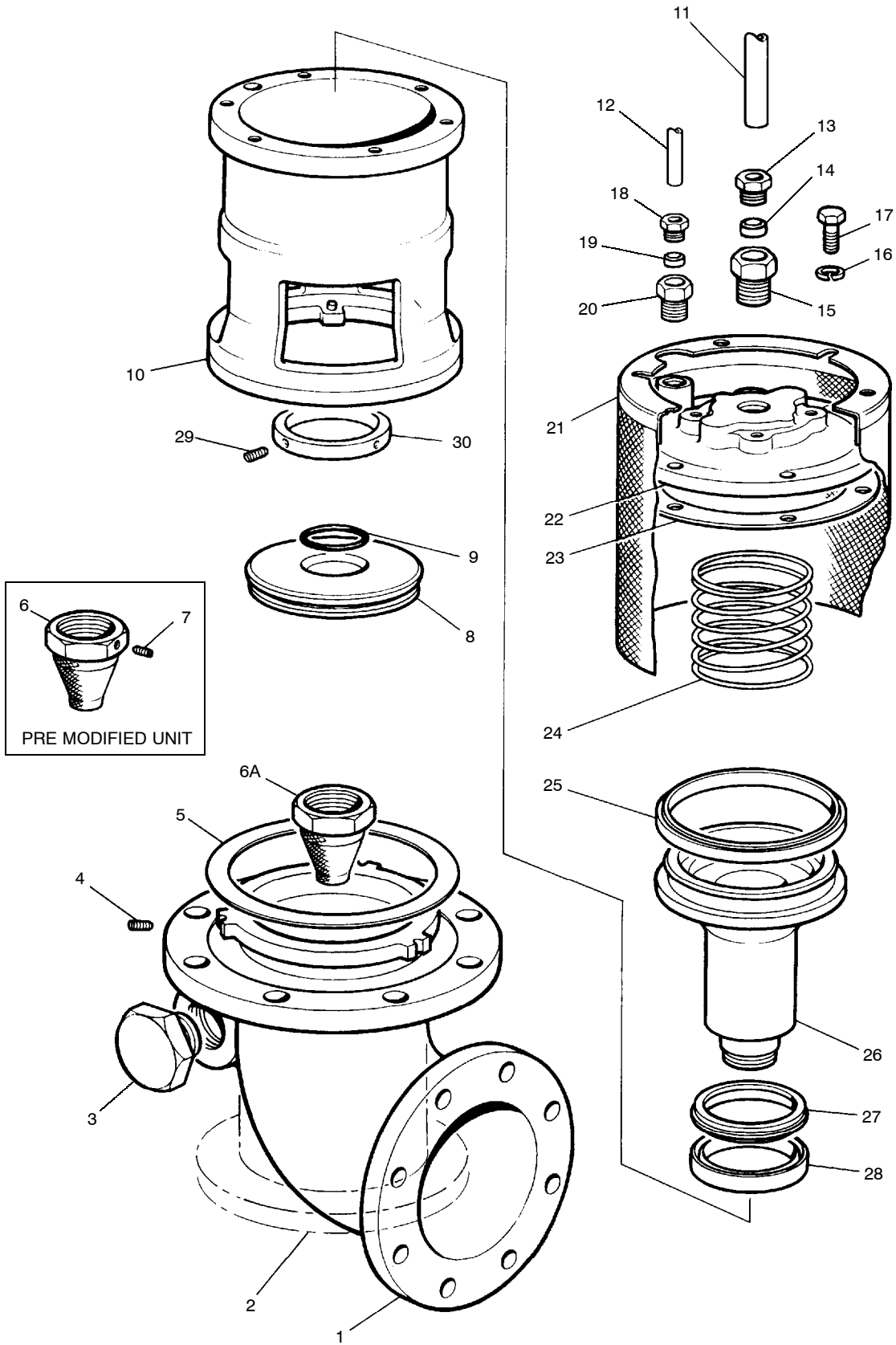


Fig 5.2 Basic Foot Valve

- 4.7 Position the mesh filter (21) over the valve body and secure with the remaining three screws (17) and washers (16).
- 4.8 From the inside of the tank, ensure the wave spring (5) is in position on the connector and re-couple the valve to the inlet connector.
- 4.9 Apply sealant LOCTITE 542 to the threads of adaptors (13) and (18) and refit the pressure (11) and pressure return lines (12).
- 4.10 On completion of re-assembly carry out the appropriate operational check as described in Chapter 6.

5 TYPE 'B' FOOT VALVE (Figure 5.3)

- 5.1 The dismantling, inspection and re-assembly of the type 'B' foot valve is identical to that for the basic valve.
- 5.2 The inlet connector (5 or 6) has the off loading lever assembly fitted to it.
- 5.3 Dismantling of the off-loading lever assembly is straight forward involving removal of the gland nut (7) and withdrawal of the lever shaft (8) and 'O' ring seal (9). The operating lever (2) can then be withdrawn from the connector and the roller (3) removed, if required, by removing the tension pin (4) and pushing out the pin (1).
- 5.4 Having been inspected and renewed as necessary, the off-loading lever assembly is re-assembled in the reverse order to dismantling. Always fit a new 'O' ring seal (9) use Loctite 542 on thread of gland nut (7). This procedure applies to all other valves fitted with lever assembly.

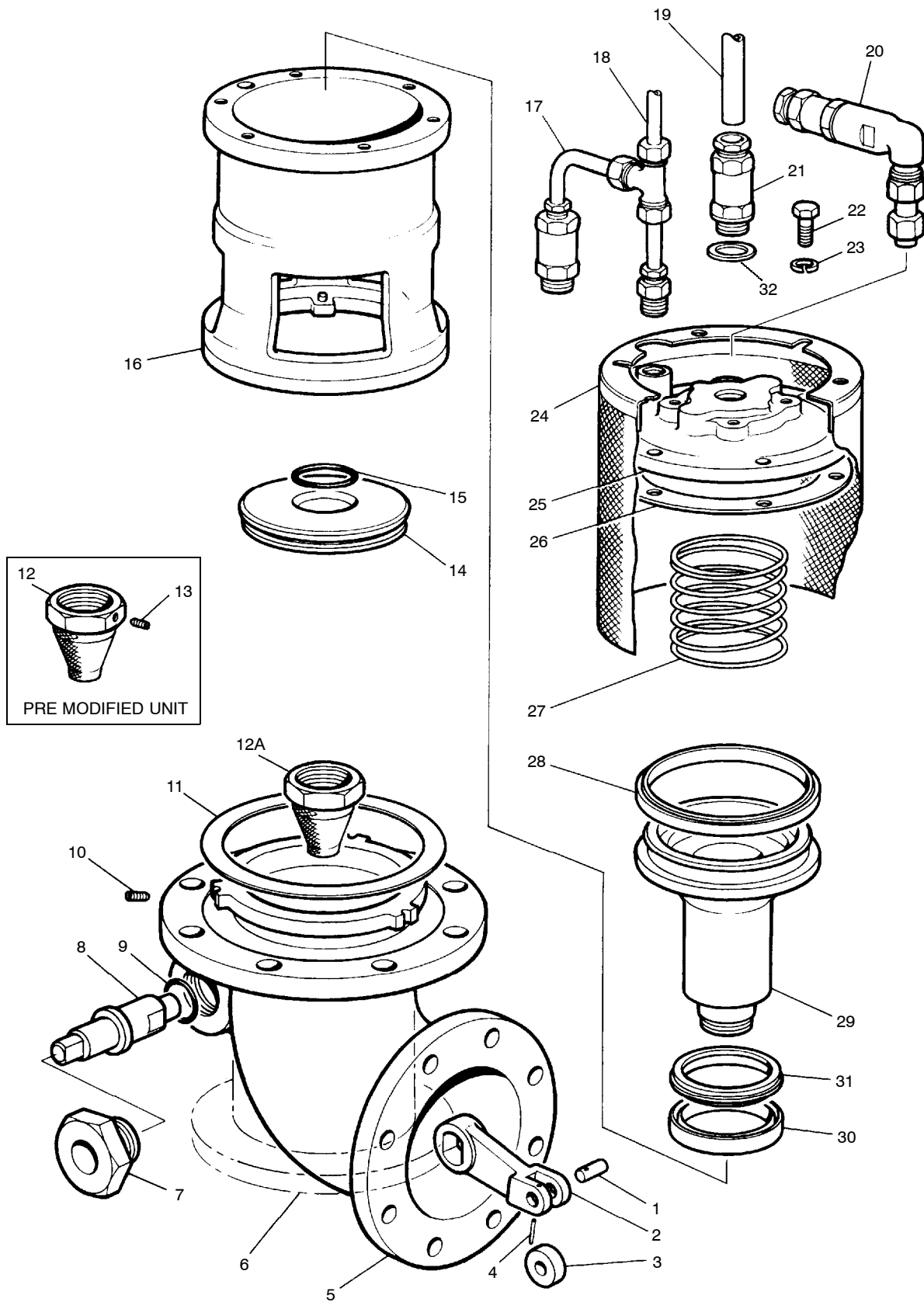


Fig 5.3 'B' Type foot valve

6 TYPE 'BC' FOOT VALVE DISMANTLING (Figure 5.4)

6.1 With the valve still in position in the tank:

Disconnect and remove the pressure line (20).

Disconnect and remove the return pressure line (19).

Uncouple the foot valve from the inlet connector (5 or 6) remove and retain the wave spring (11).

6.2 With the valve removed to a workshop, remove the three screws (23) and washers (24) securing the mesh filter (27) to the valve body (17) and remove the mesh filter from the body.

WARNING

The top cover is spring loaded

6.3 Restrain the top cover (28) and carefully unscrew the remaining three screws (23) and washers (24) and taking care not to damage the control valve assembly spindle (14) remove the top cover (28) complete with control valve assembly (32) and gasket (29) from the valve body (17). Remove the main valve spring (31) from the body.

6.4 Unscrew the locknut (25) from the top cover and remove the control valve assembly (32) and 'O' ring seal (30).

6.5 Remove the grub screw (13) (if fitted). Remove the off loading boss and filter assembly (12/12A), using special tool TASZ5100 in the top of the main valve (34) to prevent it rotating. Carefully remove the valve head (34). Remove and discard 'O' ring seal (16).

6.6 Withdraw the main valve (34) from the valve body (17). Remove the keep ring (35) and seals (33 and 36).

6.7 Dismantle, inspect and reassemble inlet connector as described in Section 5.

7 TYPE 'BC' FOOT VALVE CLEANING AND INSPECTION

7.1 Components should not require heavy cleaning, if necessary cleaning is to be carried out using approved methods and materials. Inspect all components ensuring they are undamaged and that all mating surfaces are free from serious defects. Any suspect components must be renewed.

7.2 The control valve assembly (32) is supplied as a complete assembly and is not to be further dismantled. The assembly should be renewed if suspect and at two year intervals as indicated in Chapter 4 Section 11.

8 TYPE 'BC' FOOT VALVE - RE-ASSEMBLY

8.1 When re-assembling fit new 'O' ring seals (16 and 30) and seals (33 and 36) to the main valve assembly and body. Fit keep ring (35) to body.

8.2 To prevent damage to seals during assembly fit special tool, TAAZ5101 or TAAZ5102 to the threaded portion of the main valve (34). Taking care not to damage or distort seal (33) insert the main valve into the valve body. Remove the special tool.

8.3 Fit new 'O' ring seal (16) and position the valve head (15) onto the main valve (34).

8.4 Locate the vacuum control valve assembly spindle (14) and spring (37) into position in the main valve assembly.

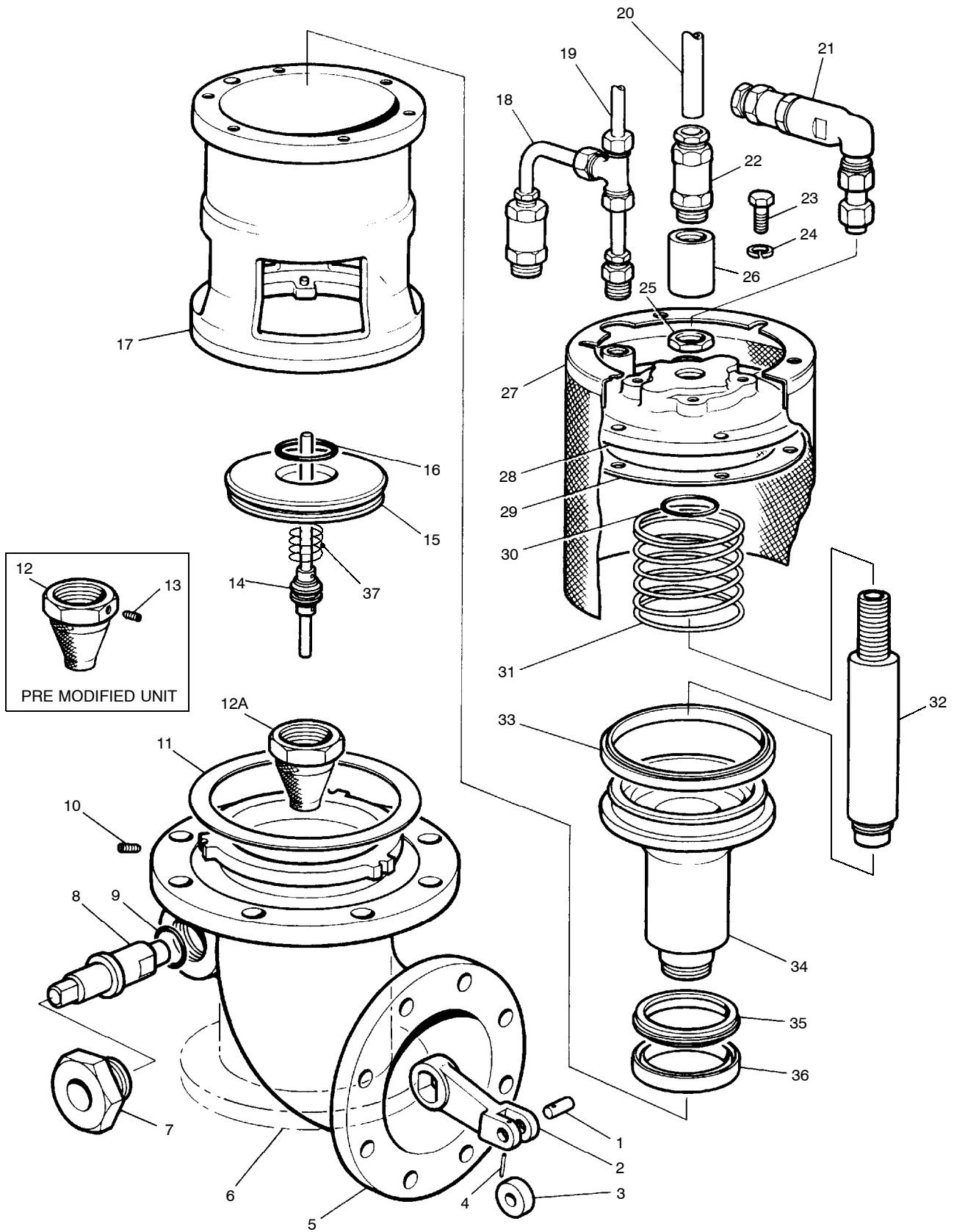


Fig 5.4 'BC' Type foot valve

- 8.5 Apply sealant LOCTITE 542 to the mating surfaces of the off-loading boss (12/12A) and valve head (15). ensure the bottom end of the spindle (14) locates through the boss and screw the off-loading boss and filter assembly onto the casting using special tool TASZ5100 to prevent valve casting from rotating. Secure with grub screw (13) if fitted. Remove the special tool.
- 8.6 Locate the main valve spring (31) into the valve body.
- 8.7 Refit the control valve assembly (32) to the top cover (28), screw the locknut (25), finger tight, onto the assembly.
- 8.8 Fit a new gasket (29) onto the valve body and carefully locate the top cover into position. Ensure the spindle (14) enters the bottom of the control valve (32). Secure with three screws (23) and washers (24).
- 8.9 Ensuring a wave spring (11) is fitted, couple the foot valve to the inlet connector (5 or 6). This action positions the valve correctly on the seat.
- 8.10 Check that there is 0.75mm (0.03in) free travel on the vacuum control valve spindle (14), this ensures the valve in the control valve assembly (32) is fully closed when the main valve is closed. Adjustment to give this travel is made by screwing in or out on the control valve assembly. On completion of adjustment tighten the locknut (25) and uncouple the valve from the inlet connector.
- 8.11 Position the mesh filter (27) over the valve body and secure with the remaining three screws (23) and washers (24).
- 8.12 Apply sealant LOCTITE 542 to the threads of the adaptor (26) and screw into place on the control valve assembly (not fitted if valve is mounted horizontally).
- 8.13 Apply sealant LOCTITE 542 to the threads of the non return valve assemblies (18 and 22 or 21) and refit to the top cover, ensure valves are fitted so they are vertical with open end downwards when re-installed in the tank.
- 8.14 From the inside of the tank, ensure the wave spring (11) is in position on the connector and re-couple the valve to the inlet connector.
- 8.15 Refit the pressure (20) and pressure return (19) lines.
- 8.16 On completion of reassembly carry out the appropriate operational check as described in Chapter 6.

9 TYPE 'V' FOOT VALVE DISMANTLING (Figure 5.5)

- 9.1 With the valve still in position in the tank:
 - Disconnect and remove the pressure line (30).
 - Disconnect and remove the return pressure line (43).
 - Disconnect the vent control linkage from the shackle (39).
 - Remove the set screw (23) and uncouple the foot valve from the inlet connector (1 or 2).
 - 9.2 With the valve removed to a workshop, remove the three screws (32) and washers (31) securing the mesh filter (24) to the valve body (16), remove the mesh filter from the body.
- WARNING**
- The top cover is spring loaded
- 9.3 Restrain the top cover (26) and carefully unscrew the remaining three screws (32) and washers (31) and, taking care not to damage the actuating rod (21), remove the top cover (26) complete with hydraulic assembly and gasket (25) from the body. Remove the valve spring (22).

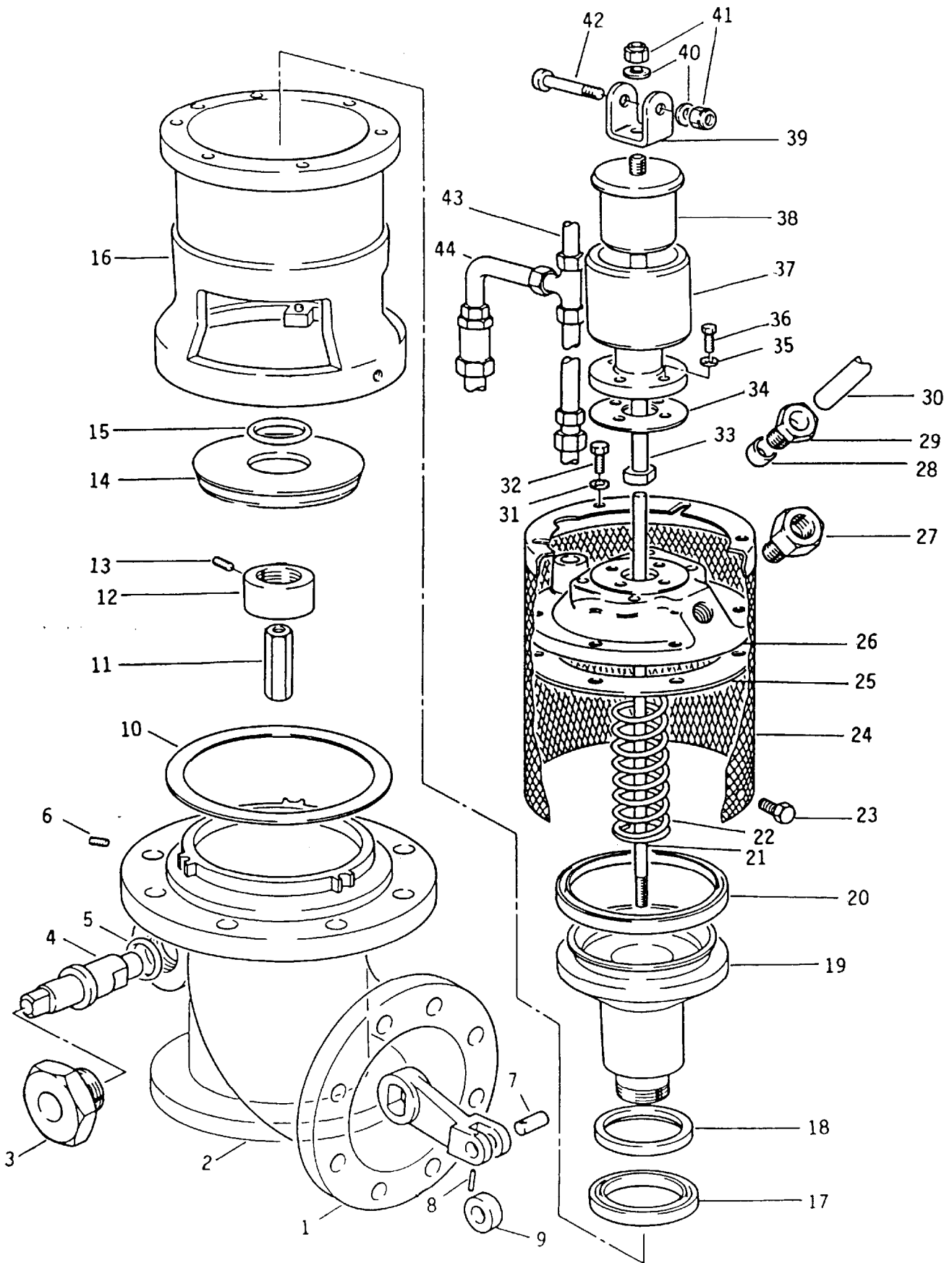


Fig 5.5 'V' Type foot valve

- 9.4 Remove the special nut (11) from the actuating rod (21) and withdraw the actuating rod from the valve cap (12).
- 9.5 Remove the grub screw (13), fit special tool TASZ5100 into the top of the valve piston casting (19) to prevent it rotating and taking care not to damage the main valve head (14), unscrew the valve cap (12). Withdraw the valve head from the casting, remove 'O' ring seal (15). Remove special tool.
- 9.6 Remove the four screws (36) and washers (35) and, taking care not to damage the piston rod (33), remove the complete hydraulic assembly from the top cover. Remove gasket (34).
- 9.7 Remove the nut (41) and washer (40) from the piston rod (33) and withdraw the piston rod from the piston (38) and cylinder (37).
- 9.8 Remove the piston (38) from the cylinder (37).
- 9.9 Dismantle, inspect and reassemble inlet connector as described in Section 5.

10 TYPE 'V' FOOT VALVE CLEANING AND INSPECTION

- 10.1 Maintenance of this equipment is limited to general inspection for corrosion or damage, cleaning filters, and replacing seals and gaskets as necessary.
- 10.2 Components should not require heavy cleaning, if necessary cleaning is to be carried out using approved methods and materials. Inspect all components ensuring they are undamaged and that all mating surfaces are free from serious defects.
- 10.3 Inspect the bore of the cylinder and the piston, if badly worn renew the complete hydraulic assembly.

11 TYPE 'V' FOOT VALVE RE-ASSEMBLY

- 11.1 When re-assembling fit new 'O' ring seal (15) and seals (17 and 20) to the main valve assembly and body. Fit keep ring (18) to body.
- 11.2 Fit the piston (38) into cylinder (37), locate the piston rod (33) through the piston, fit the shackle (39), washer (40) and nut (41). With the piston fully bottomed in the cylinder, adjust the piston rod so that it protrudes 25.4mm (1in) from the cylinder base as shown in Figure 5.5.

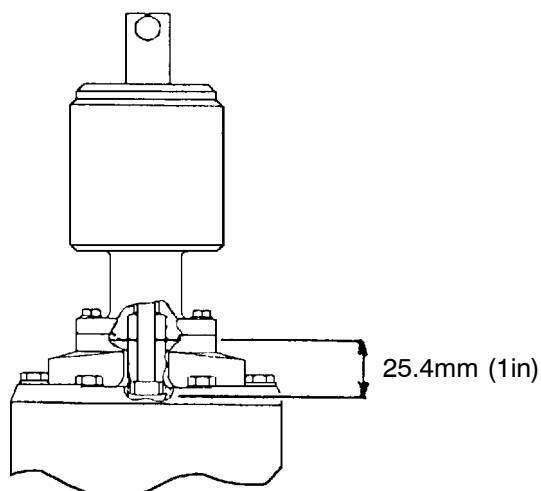


Fig 5.6 Shaft setting

- 11.3 To prevent damage to seals fit special tool TAAZ5101 to the threaded portion of the valve piston casting (19). Taking care not to damage or distort seal (20) locate the casting into the valve body. Remove the special tool.
- 11.4 Fit 'O' ring seal (15) to the casting and position the valve head (14) onto the casting.
- 11.5 Fit special tool TASZ5100 to the piston casting to prevent it rotating. Screw the end cap (12) onto the casting and secure with the grub screw (13). Remove the special tool.
- 11.6 From the inside of the body screw the actuating rod (21) into the end cap (12), fit the special nut (11), finger tight onto the rod.
- 11.7 Position a new gasket (25) onto the body, position the main spring (22) in the body. Taking care not to damage the actuating rod, fit the top cover (26) to the body and secure with three screws (32) and washers (31).
- 11.8 With the main valve assembly pushed to the fully open position, adjust the actuating rod so that the top of the rod is flush with the top face of the cover as shown in figure 5.6. On completion of adjustment tighten the special nut (11).

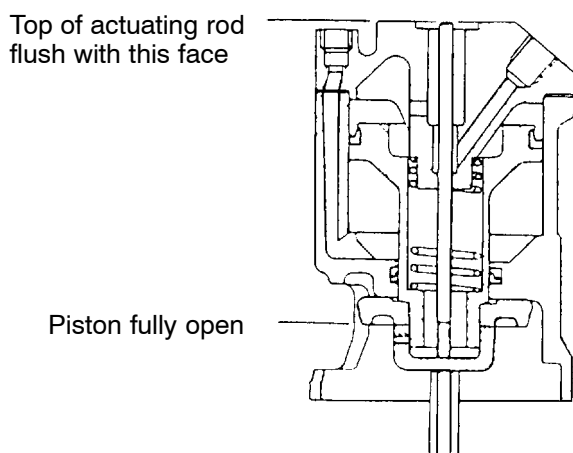


Fig 5.7 Actuating rod setting

- 11.9 Position a new gasket (34) on the top cover and, taking care not to damage the piston rod secure the hydraulic cylinder assembly to the top cover with screws (36) and washers (35).
- 11.10 Position the mesh filter (24) over the valve body and secure with the remaining three screws (32) and washers (31).
- 11.11 Refit the inlet connector to the tank pad, secure with nuts and washers.
- 11.12 Apply sealant LOCTITE 542 to the threads of the non-return valve assembly (44) and refit to the top cover, ensure the valve is fitted so that is vertical, with open end downwards, when re-installed in the tank.
- 11.13 From the inside of the tank, ensure the wave spring (10) is in position on the connector and re-couple the valve to the inlet connector.
- 11.14 Refit the pressure (30) and pressure return (43) lines.
- 11.15 On completion of re-assembly carry out the appropriate operational check as described in Chapter 6.

12 SENSING UNIT DISMANTLING (Figure 5.8)

- 12.1 Servicing of the sensing unit should, under normal operation, be restricted to the cleaning or renewal of the filter (3). However if further dismantling is considered to be needed the following procedures are to be carried out.
- 12.2 With the unit still mounted in the tank:
- Disconnect the pressure line from connector (12).
 - Disconnect the return pressure line from connector (9).
 - Loosen the jubilee clip (18) and remove the drain pipe (17).
- To aid in refitting mark the position of the unit on the bracket. Support the weight of the unit and remove the two nuts (24) and washers (25) from the studs (23) and lift the unit clear of the mounting bracket.
- 12.3 With the unit removed to the workshop, remove the plug (6) and washer (5). Withdraw the spring (4), filter (3) from the housing (1), taking care not to damage or lose the flow straightener withdraw the top jet (2).
- 12.4 Remove the connector (9) and withdraw the washer (5) and lower jet (7) from the housing.
- 12.5 If required remove the screw (21) and remove the sensing tube guard (20). Remove the connector (12).

13 SENSING UNIT CLEANING AND INSPECTION

- 13.1 Components should not require heavy cleaning, if necessary cleaning is to be carried out using approved methods and materials. Inspect all components ensuring they are undamaged and that all mating surfaces are free from serious defects.
- 13.2 The housing (1) and the jet assemblies (2) and (7) are manufactured and fitted as a matched set. Any wear or damage to any one of these components means the whole unit is to be renewed.

14 SENSING UNIT RE-ASSEMBLY

- 14.1 When re-assembling the threads of the adaptors (9 and 12) are to be coated with sealant, LOCTITE 542
- 14.2 Locate the lower jet (7) into the housing (1), secure with the connector (9) fitted with washer (8). Fit the connector (12).
- 14.3 Locate the upper jet (2) into the housing, position the filter (3) and spring (4) over the jet and secure with the plug (6) and washer (5).
- 14.4 Secure the sensing tube guard (20) with screw (21).
- 14.5 if required test check the unit on a test rig as detailed in Chapter 6.
- 14.6 Using the marks made on removal, position the unit onto the mounting bracket and secure with two nuts (24) and washers (25).
- 14.7 Refit the drain pipe (17), pressure and pressure return lines.
- 14.8 On completion of re-assembly carry out the appropriate operational check as described in Chapter 6

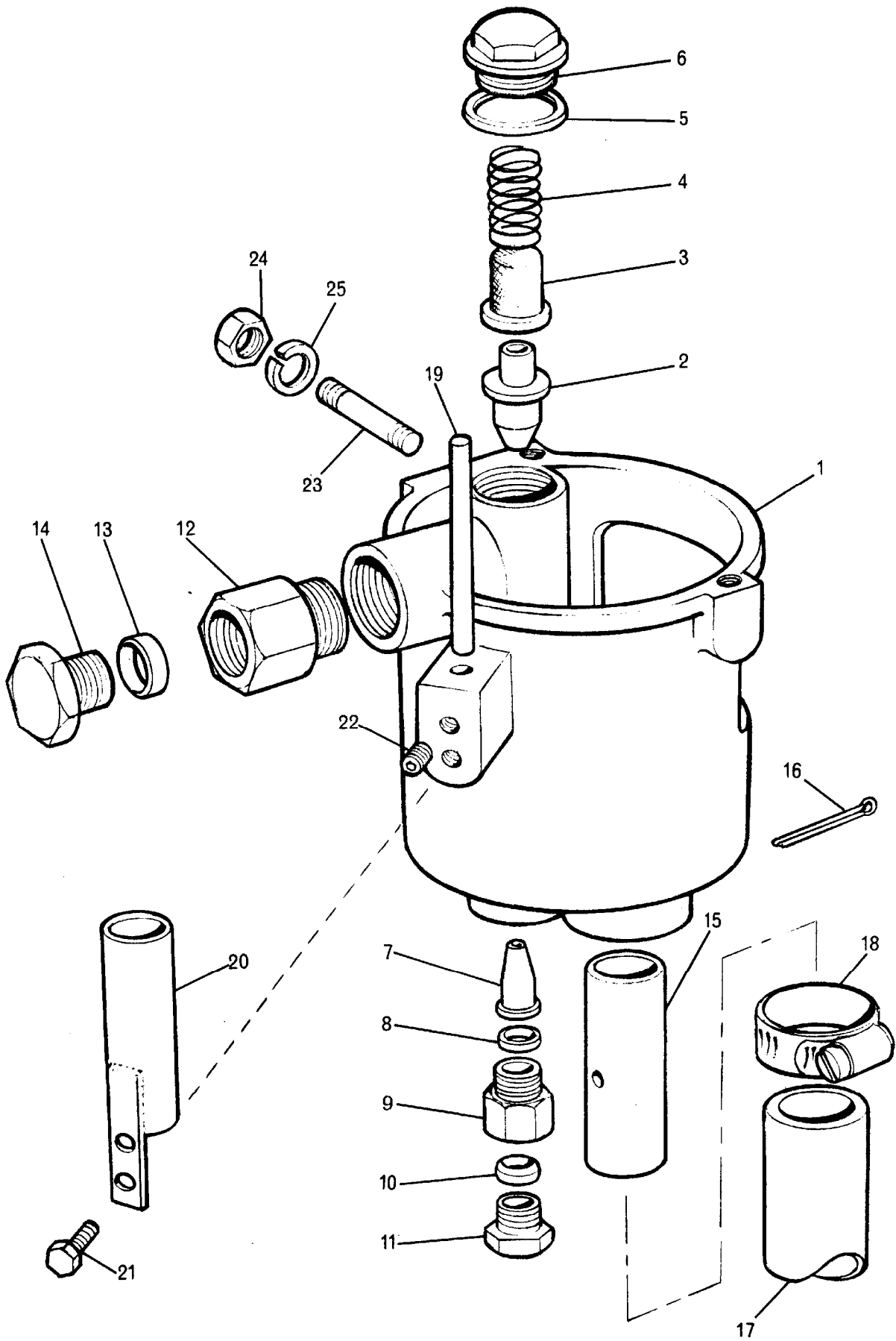


Fig 5.8 Sensing unit

15 PRE-CHECK VALVE

- 15.1 Servicing of the pre-check valve should normally be restricted to the replacement of valve seals which can be carried out without removal of the valve from the tank.
- 15.2 To change the seals, remove the operating handle, circlip and thrust washer from the outside of the valve. From the inside of the tank withdraw the valve spindle and renew the seals.
- 15.3 Reassemble the valve reversing the above procedure.
- 15.4 Removal and replacement of the complete valve is straightforward and only requires disconnecting the pressure lines and removal of the mounting screws securing the valve to the tank boss. On refitting always use a new gasket between the valve and the boss.

CHAPTER 6

TEST PROCEDURES

CONTENTS	SECTION
GENERAL	1
BASIC, B, AND V TYPE FOOT VALVES, OPERATIONAL CHECK	2
'BC' TYPE FOOT VALVES, OPERATIONAL CHECK	3
SENSING UNIT, OPERATIONAL CHECK	4

1 GENERAL

- 1.1 The following operational tests as applicable are to be carried out on completion of overhaul/repair of Jet ABLE components and at the intervals laid down in Chapter 4

WARNING

DUE TO THE HIGH RATE OF FILLING POSSIBLE WITH JET ABLE. CARE MUST BE TAKEN THAT THE TANK/COMPARTMENT IS FITTED WITH SUFFICIENT VENTING ARRANGEMENTS TO AVOID A BUILD UP OF PRESSURE.

2 BASIC, 'B', AND 'V' TYPE FOOT VALVES OPERATION CHECK

- 2.1 The initial check is to be carried out using a supply pressure of 4.14 bar (60 lbf/in) at a flow rate of 2272 ltr/min (500 gal/min), if the system operates at a lower rating than this, the maximum achievable pressure and flow rate is to be used.
- 2.2 Open up supply pressure to the foot valve. The valve should immediately start to open, opening should be progressive and filling commence.
- 2.3 When checking a type 'V' valve ensure the tank vent fully opens.
- 2.4 As the maximum level is approached the valve should close progressively, without shock. Should closure be too fast the condition of the seals in the foot valve are to be checked. Indication of valve closure can be ascertained by a pressure gauge, fitted at the loading point. As the valve closes a progressive increase in pressure will be indicated.
- 2.5 Immediately the foot valve is closed, shut off the supply pressure, if supply pressure is not shut off, flow will continue, through the sensing unit upper jet, at a rate of 13.6 ltr/min (3 gal/min).
- 2.6 Check that the final level is within 1.6mm (1/16in) of the top of the air sensing tube. Ensure that the sensing unit is finally tightened in position.
- 2.7 Partially drain the tank and repeat the check at a flow rate of 454 ltr/min (100 gal/min).

3 'BC' TYPE FOOT VALVES, OPERATIONAL CHECK

- 3.1 The initial check is to be carried out using a supply pressure of 4.14 bar (60lbf/in) at a flow rate of 2272 ltr/min (500 gal/min). If the system operates at a lower rating than this the maximum achievable pressure and flowrate is to be used.
- 3.2 Open up supply pressure to the foot valve. The foot valve should remain closed.

Note On the first operation air in the sense tube may cause the jet to spoil and the valve to close, re-establish flow by repeating 3.3.

- 3.3 Move the external operating handle to the 'LOADING' position. Hold in position until the main valve opens, release the handle. Tank fill should continue.
- 3.4 As the maximum level is approached the valve should close progressively, without shock. Should closure be too fast the condition of the seals in the foot valve are to be checked. Indication of valve closure can be ascertained by a pressure gauge, fitted at the loading point. As the valve closes a progressive increase in pressure will be indicated.
- 3.5 With the main valve completely closed, check the sensing unit and ensure that the jet flow has stopped.
- 3.6 Check that the final level is within 1.6mm (1/16in) of the top of the air sensing tube. Ensure that the sensing unit is finally tightened in position.
- 3.7 Set the external operating handle to the 'OFF LOADING' position and partially drain the tank. If, when the tank is full, with the level above the lower jet, excessive force is required to move the handle, the non-return valve in the return pressure line is probably defective, investigate and rectify.
- 3.8 Repeat the check at a flow rate of 454 ltrs/min (100 gal/min).

4 SENSING UNIT, OPERATIONAL CHECK

WARNING

DURING THIS CHECK SPILLAGE COULD OCCUR. ALL RELEVANT SAFETY PRECAUTIONS AND PROCEDURES ARE TO BE OBSERVED.

- 4.1 This check may be carried out with the sensing unit mounted in the tank or on a suitable test rig.
- 4.2 The test consists of applying liquid pressure to the sensing unit top jet and measuring the resultant pressure at the lower jet outlet.
- 4.3 If installed in the tank, disconnect the pressure line and return pressure line from the foot valve.
- 4.4 Apply a constant pressure of 3.45 bar (50 lbf/in) to the top jet (this will give a flow rate of 13.6 ltr/min, 3 gal/min).
- 4.5 With a suitable gauge, measure the resultant pressure in the return line. The pressure measured should be at least 80% of the inlet pressure.
- 4.6 If the required 80% or above is not achieved in the return pressure line, rotate the upper jet 1/4 of a turn and repeat the check. Should the pressure still not be achieved the complete sensing unit is to be renewed.

Chapter 7

FAULT FINDING**1 GENERAL**

- 1.1 Faults to the system will in many cases be easily identified as mechanical failure due to damage, leakage of seals or jamming of moving parts.
- 1.2 The following table is a guide only and may not cover all possible faults. Operation and maintenance procedures correctly carried out should keep faults to a minimum. If the fault cannot be traced and rectified, consult Meggitt Fuelling Products, Avery Hardoll for advice.

TABLE 7.1 - FAULT FINDING -

COMMISSIONING FAULTS

FAULT	CAUSE	REMEDY
Foot valve fails to open or to open fully during loading operation	Insufficient return pressure from the jet sensing unit Foot valve jammed	Check position of pre check valve (if fitted) Check filter in top of sensing unit Check condition of jets Carryout operational check of sensing unit Check for obstruction in foot valve and condition of piston seals
Foot valve fails to close	Foot valve jammed	Check for obstruction in foot valve and condition of piston seals
Foot valve closes too fast	Seals worn or damaged	Replace seals in foot valve
Foot valve opens too quickly (with a surge)	Air present in the sense line	Make another delivery and verify that the air has been removed
Foot valve opens too quickly (with a surge)Foot valve closes before the compartment is full	Air present in the sense line	Make another delivery and verify that the air has been removed

Chapter 8

SPARE PARTS CATALOGUE

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1 GENERAL

1.1 When ordering spare parts please quote the following information:

- (a) Publication number and issue
- (b) Fig/Item number
- (c) Part number and description
- (d) Quantity

2 The following tables of spare parts also contain the relevant attaching parts, i.e. screws, washers, nuts, etc, which may fail as a result of repeated removal and insertion.

NOTES

- (1) '+' in the Fig/Item column indicates Item is not illustrated.
- (2) 'REF' in the Qty column indicates Item is for reference purposes only and is **not available** as a spare.
- (3) '**' in the Fig/Item column indicates Item is recommended as a spare part

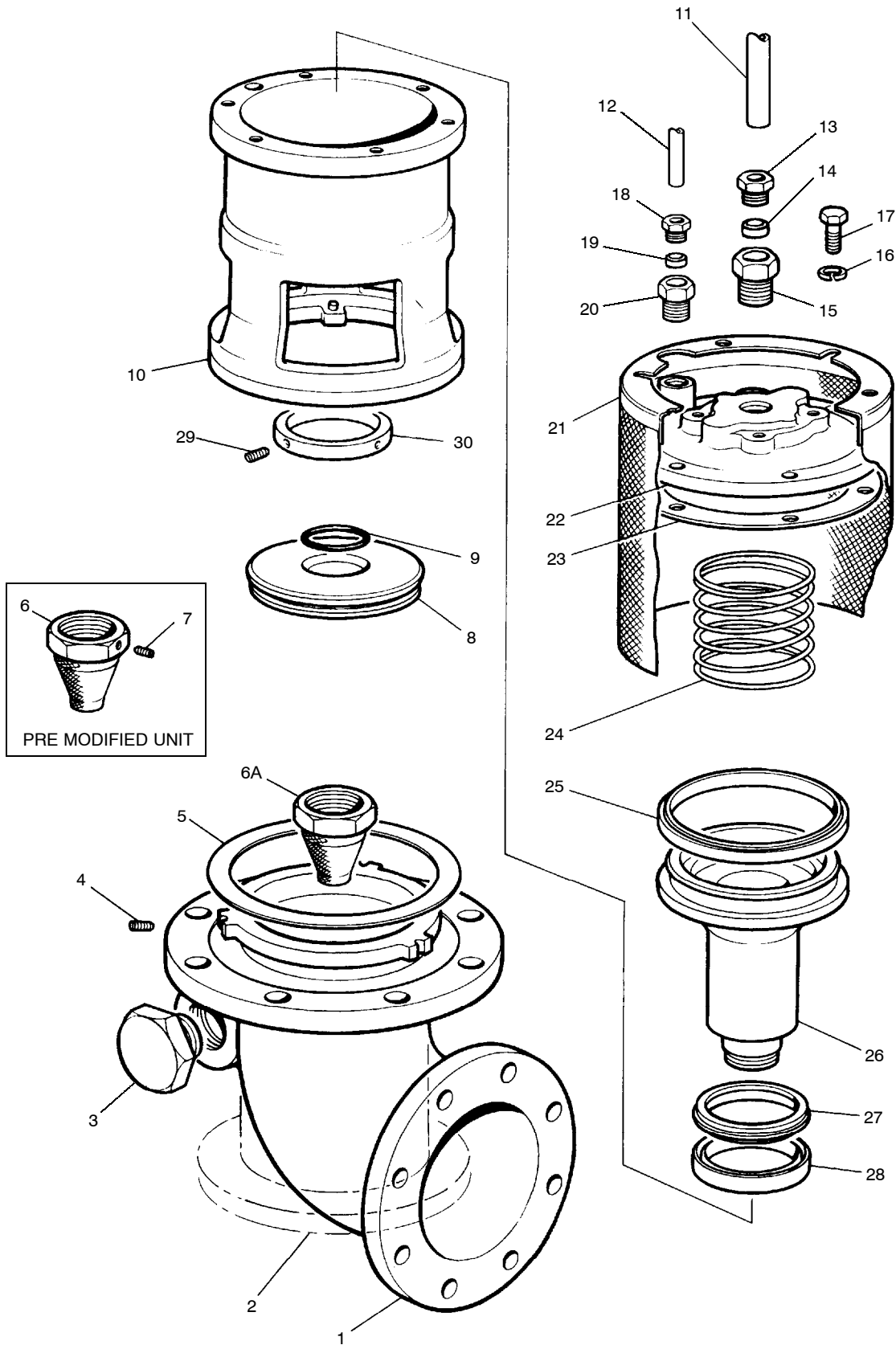


Fig 8.1 Basic Foot Valve

BASIC FOOT VALVE

Fig/ Item No.	Part No.	Description Assy	Qty
8.1	TVMY1400 3" VALVE	TVMY1200 4" VALVE	Basic foot valve Ref
1	TVMS1725	TVMS1726	90 degree elbow inlet connector including items 3, 4, 5
2	TVMS1727	TVMS1728	Straight inlet connector including items 3, 4, 5
3	TVCZ426	TVCZ426	Blanking plug
4	TVSZ1493	TVSZ1493	Stop screw
5	TVSZ1492	TVSZ1264	Wave spring
6	Superseded by 6A		Off-loading boss and filter assembly
6A	TVMZ2475	TVMZ2475	Off-loading boss and filter assembly
7	Deleted		Grub screw
* 8	TVMZ1476	TVMZ1284	Valve head - Viton
* 9	Z022E218139A	Z022E219139A	'O' Ring seal
10	Not spared		Valve body assembly
11	RMPR849	RMPR849	Nylon tube 1/2" OD
12	RMPR850	RMPR850	Nylon tube 5/16" OD
13	TVCZ1540	TVCZ1540	Tubing nut
14	ZACZ0023-2	ZACZ0023-2	Tubing sleeve
	ZACZ0023-3	ZACZ0023-3	
15	TVCZ1538	TVCZ1538	Male adaptor
16	ZW8207G08A	ZW8207G10A	Washer
17	ZS32286E0812A	ZS3228D1012A	Screw
18	TVCZ1539	TVCZ1539	Tubing nut
19	TVCZ1541	TVCZ1541	Tubing sleeve
20	TVCZ1537	TVCZ1537	Male adaptor
21	TVCZ1533	TVCZ1239	Filter screen
22	TVAZ1481	TVAZ1250	Valve body cover
*23	TVFZ1480	TVFZ1240	Gasket - valve body cover
24	TVSZ1478	TVSZ1241	Main valve spring
*25	TVRZ2447	ZARZ0097-7	External distributor seal
26	TVAZ1477	TVAZ1237	Main valve
27	TVPZ2446	TVPZ2411	Keep ring
*28	ZARZ0097-5	TVRZ2454	Internal distributor seal
29		ZS3031A0404A	Set Screw 4BA x 1/4"Lg
30		TVSZ1585	Valve Stop

* = Suggested spare part

Ref = Reference only

+ = Item not illustrated

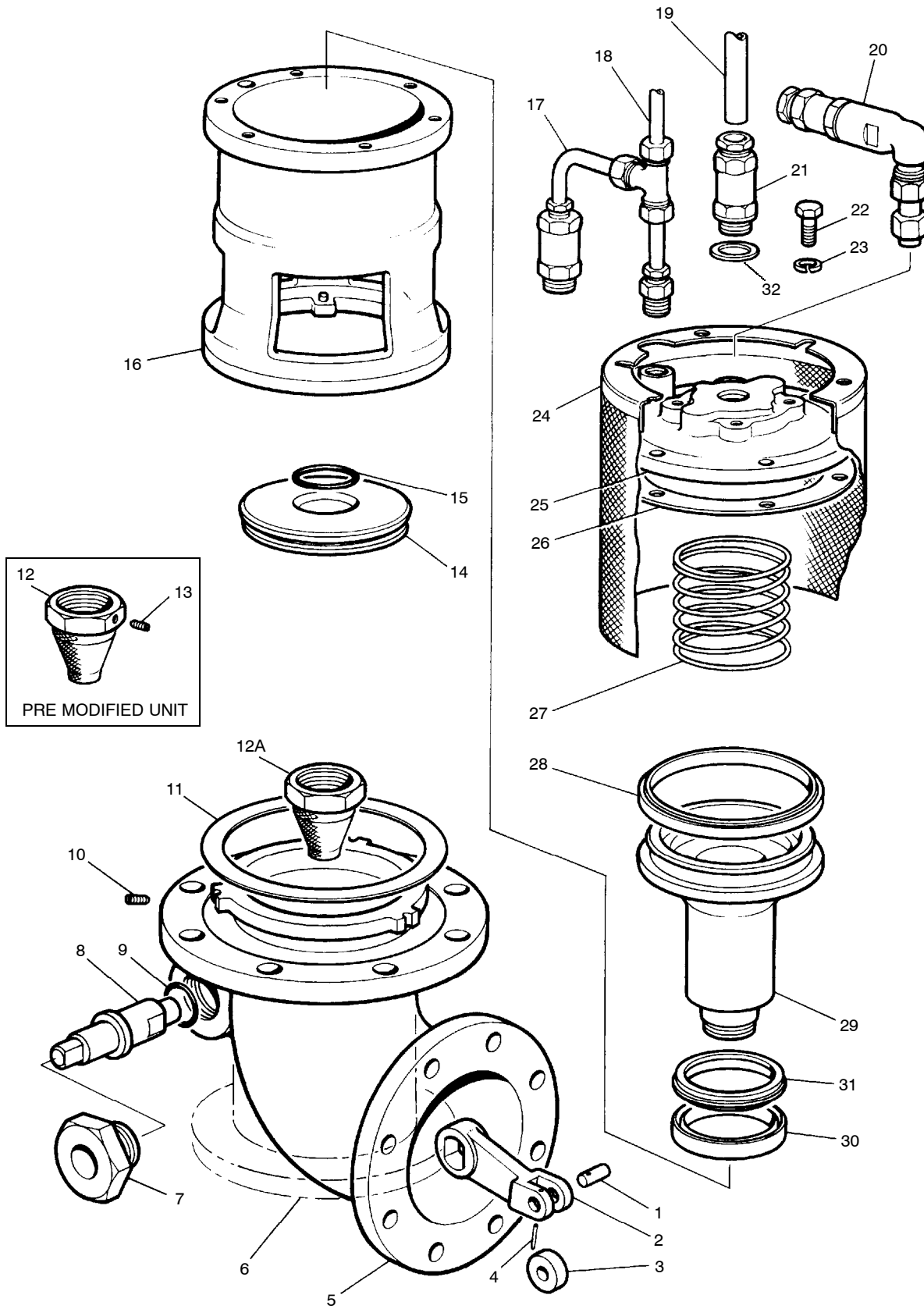


Fig 8.2 'B' Type foot valve

'B' TYPE FOOT VALVE

Fig/ Item No.	Part No.	Description Assy	Qty
8.2	TVMY1400B 3" VALVE	TVMY1200B 4" VALVE	'B' type foot valve Ref
+	TVMZ1430	TVMZ1224	90 degree elbow inlet connector assembly (items 1, 2, 3, 4, 5, 7, 8, 9 and 10) Ref
+	TVMZ1430-1	TVMZ1224-1	Straight inlet connector assembly (items 1, 2, 3, 4, 6, 7, 8, 9 and 10) Ref
+	TVMS1729	TVMS1730	Operating lever sub assembly (items 1, 2, 3 and 4) Ref
1	TVSZ33	TVSZ1068	Operating lever pin 1
2	TVCZ146	TVCZ1222	Operating lever 1
3	TVCZ135	TVCZ1223	Roller 1
4	ZT8001E0208A	n/a	Tension pin 1/16" dia 1
5	Not spared		90 degree elbow inlet connector 1
6	Not spared		Straight inlet connector 1
7	TVCZ1154	TVCZ1154	Gland nut 1
8	TVSZ61	TVSZ61	Operating lever shaft 1
* 9	Z032E211139A	Z032E211139A	'O' ring seal 1
10	TVSZ1493	TVSZ1493	Stop screw 1
11	TVSZ1492	TVSZ1264	Wave spring 1
12	Superseded by 12A	Off-loading boss and filter assembly	
12A	TVMS2475	TVMS2475	Off-loading boss and filter assembly 1
13	Deleted		Grub screw
*14	TVMZ1476	TVMZ1284	Valve head - Viton 1
*15	Z022E218139A	Z022E219139A	'O' ring seal 1
16	Not spared		Valve body assembly 1
17	TVMZ1590	TVMZ1590	Non-return valve assembly 1
18	RMPR850	RMPR850	Nylon tube 5/16" OD as reqd
19	RMPR849	RMPR849	Nylon tube 1/2" OD as reqd
20	TVMZ2413	TVMZ2413	Non-return valve assy - horz mounted 1
21	TVCZ2416	TVCZ2416	Non-return valve assy - vert mounted 1
22	ZS3228E0812A	ZS3228D1012A	Screw 6
23	ZW8207G08A	ZW8207G10A	Washer 6
24	TVCZ1533	TVCZ1239	Filter screen 1
25	TVAZ1481	TVAZ1250	Valve body cover 1
*26	TVFZ1480	TVFZ1240	Gasket - valve body cover 1
27	TVSZ1478	TVSZ1241	Main valve spring 1
*28	TVRZ2447	ZARZ0097-7	External distributor seal 1
29	TVAZ1477	TVAZ1237	Main valve 1
*30	ZARZ0097-5	TVRZ2454	Internal distributor seal 1
31	TVPZ2446	TVPZ2411	Keep ring 1
32	ZAFZ0010-16	ZAFZ0010-16	Fibre washer (red) 1

* = Suggested spare part

Ref = Reference only + = Item not illustrated

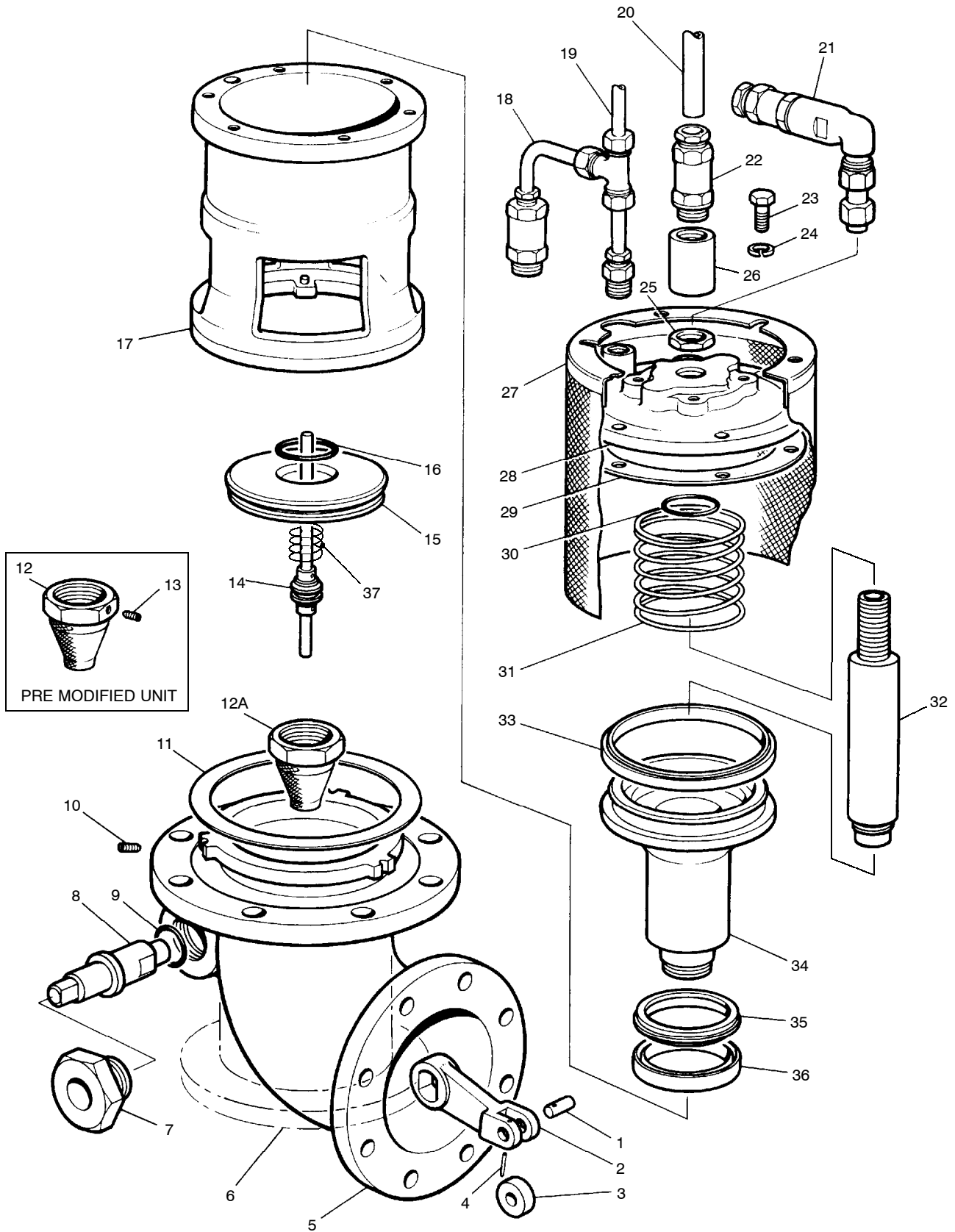


Fig 8.3 'BC' Type foot valve

'BC' TYPE FOOT VALVE

Fig/ Item No.	Part No.	Description Assy	Qty	
8.3	TVMY1400BC 3" VALVE	TVMY1200BC 4" VALVE	'BC' type foot valve	Ref
+	TVMZ1430	TVMZ1224	90 degree elbow inlet connector assembly (items 1, 2, 3, 4, 5, 7, 8, 9 and 10)	Ref
+	TVMZ1430-1	TVMZ1224-1	Straight inlet connector assembly (items 1, 2, 3, 4, 6, 7, 8, 9 and 10)	Ref
+	TVMS1729	TVMS1730	Operating lever sub assembly (items 1, 2, 3 and 4)	Ref
1	TVSZ33	TVSZ1068	Operating lever pin	1
2	TVCZ146	TVCZ1222	Operating lever	1
3	TVCZ135	TVCZ1223	Roller	1
4	ZT8001E0208A	n/a	Tension pin 1/16" dia	1
5	Not spared		90 degree elbow inlet connector	1
6	Not spared		Straight inlet connector	1
7	TVCZ1154	TVCZ1154	Gland nut	1
8	TVSZ61	TVSZ61	Operating lever shaft	1
* 9	Z032E211139A	Z032E211139A	'O' ring seal	1
10	TVSZ1493	TVSZ1493	Stop screw	1
11	TVSZ1492	TVSZ1264	Wave spring	1
12	Superseded by 12A		Off-loading boss and filter assembly	
12A	TVMS2475	TVMS2475	Off-loading boss and filter assembly	1
13	Deleted		Grub screw	
14	TVMS1719	TVMS1720	Vacuum control spindle assembly	1
*15	TVMZ1476	TVMZ1284	Valve head - Viton	1
*16	Z022E218139A	Z022E219139A	'O' ring seal	1
17	Not spared		Valve body assembly	1
18	TVMZ1590	TVMZ1590	Non-return valve assembly	1
19	RMPR850	RMPR850	Nylon tube 5/16" OD	as reqd
20	RMPR849	RMPR849	Nylon tube 1/2" OD	as reqd
21	TVMZ2414	TVMZ2414	Non-return valve assy - horz mounted	1
22	TVCZ2416	TVCZ2416	Non-return valve assy - vert mounted	1
23	ZS3228E0812A	ZS3228D1012A	Screw	6
24	ZW8207G08A	ZW8207G10A	Washer	6
25	TVCZ1550	TVCZ1550	Locknut	1
26	TVCZ2421	TVCZ2421	Adaptor	1
27	TVCZ1533	TVCZ1239	Filter screen	1
28	TVAZ1481	TVAZ1250	Valve body cover	1
*29	TVFZ1480	TVFZ1240	Gasket - valve body cover	1
*30	ZARZ0041-28	Z022E218139A	'O' ring seal	1
31	TVSZ1478	TVSZ1241	Main valve spring	1
*32	TVMS2467	TVMS2468	Control valve assembly	1
*33	TVRZ2447	ZARZ0097-7	External distributor seal - Viton	1
34	TVAZ1477	TVAZ1237	Main valve	1
35	TVPZ2446	TVPZ2411	Keep ring	1
*36	ZARZ0097-5	TVRZ2454	Internal distributor seal - Viton	1
37	TVSZ2473	TVSZ2473	Spring	1

* = Suggested spare part

Ref = Reference only + = Item not illustrated

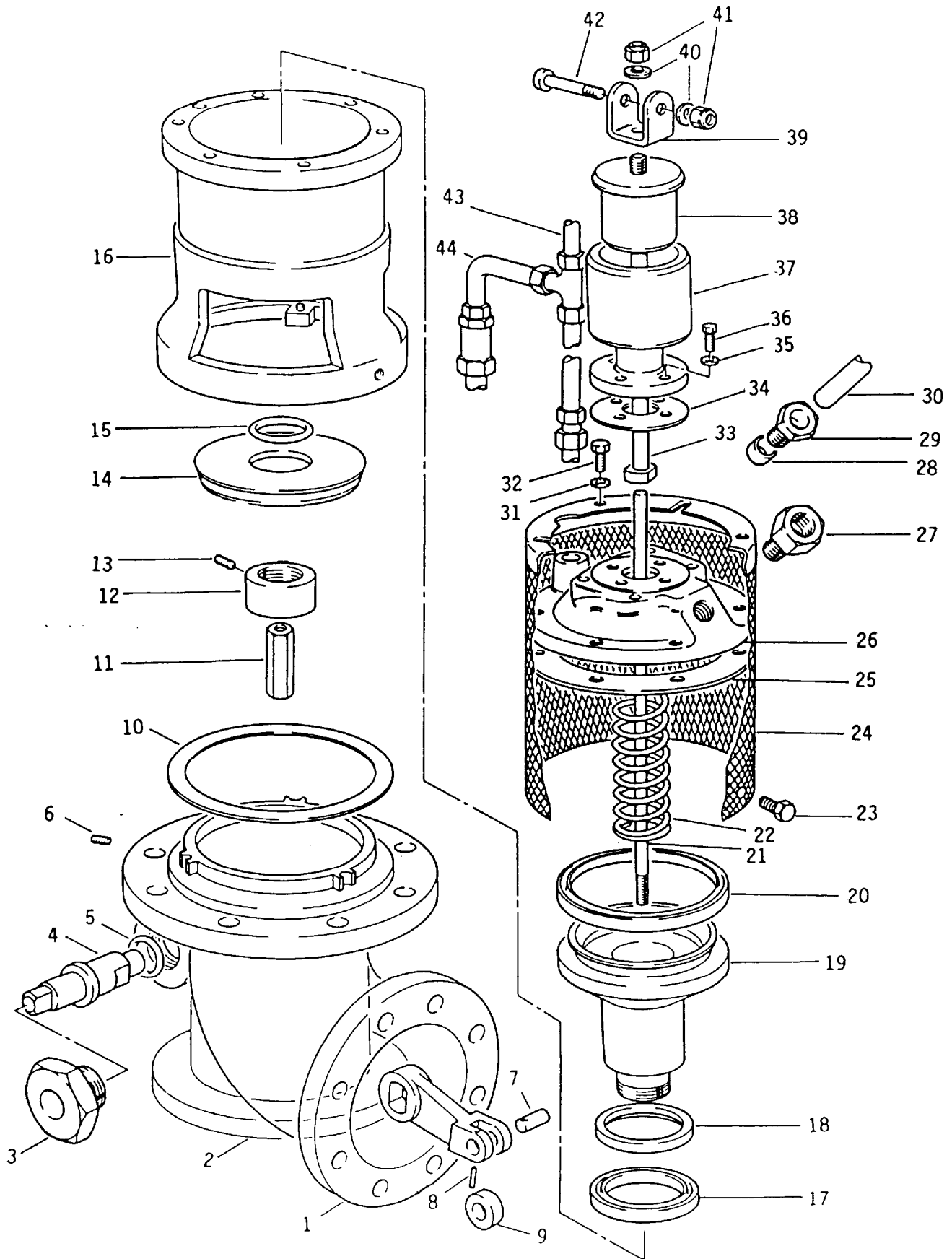


Fig 8.4 'V' Type foot valve

'V' TYPE FOOT VALVE

Fig/ Item No.	Part No.	Description Assy	Qty
8.4	TVMY1400V 3" VALVE	'V' type foot valve	Ref
+	TVMZ1430	90 degree inlet connector assembly (items 1, 3, 4, 5, 6, 7, 8, and 9)	Ref
+	TVMZ1430-1	Straight inlet connector assembly (items 2, 3, 4, 5, 6, 7, 8, and 9)	Ref
1	Not spared	90 degree inlet connector	1
2	Not spared	Straight inlet connector	1
3	TVCZ1154	Gland nut	1
4	TVSZ61	Operating lever shaft	1
*5	Z032E211139A	'O' ring seal	1
6	TVSZ1493	Stop screw	1
7	TVSZ33	Operating lever pin	1
8	ZT8001E0208A	Tension pin 1/16" dia	1
9	TVCZ135	Roller	1
10	TVSZ1492	Wave spring	1
11	TVSZ2462	Special nut	1
12	TVCZ2457	Cap	1
13	ZS3531D0404L	Grub screw	1
*14	TVMZ1476	Valve head - viton	1
*15	Z022E218139A	'O' ring seal	1
16	Not spared	Valve body assembly	1
*17	ZARZ0097-5	Internal distributor seal D1162	1
18	TVPZ2446	Keep ring	1
19	TVAZ1477	Main valve	1
*20	TVRZ2447	External distributor seal SH91	1
21	TVSZ2461	Actuating rod	1
22	TVSZ1536	Main valve spring	1
23	ZS4028D0606A	Screw 10-24 UNC x 3/8"	1
24	TVCZ1533	Filter screen	1
*25	TVFZ1480	Gasket - valve body cover	1
26	TVAZ1535	Top cover	1
27	TVCZ1545	Male adaptor	1
28	TVCZ1542	Tubing sleeve	1
29	TVCZ1540	Tubing nut	1
30	RMPR849	Nylon tube 1/2" od	as reqd
31	ZW8207G08A	Washer	6
32	ZS3226E0812A	Bolt 1/4" UNF	6
33	TVSZ2460	Shaft	1
*34	TVDZ1513	Gasket	1
35	ZW8207G06A	Washer	4
36	ZS2228E0610A	Screw 10-32 UNF	4
37	TVAZ2458	Cylinder body	1
38	TVCZ2459	Piston	1
39	TVSZ1522	Shackle fork	1
40	ZW2201G10A	Washer	1
41	ZW2201G08A	Washer	1
42	ZASZ0070-19	Nut	1
43	ZS3226E0826A	Bolt 1/4"	1
44	RMPR850	Nylon tube 5/16" od	as reqd
45	TVCZ2416	Non return valve assembly	1
46	ZASZ0070-11	Nut	1

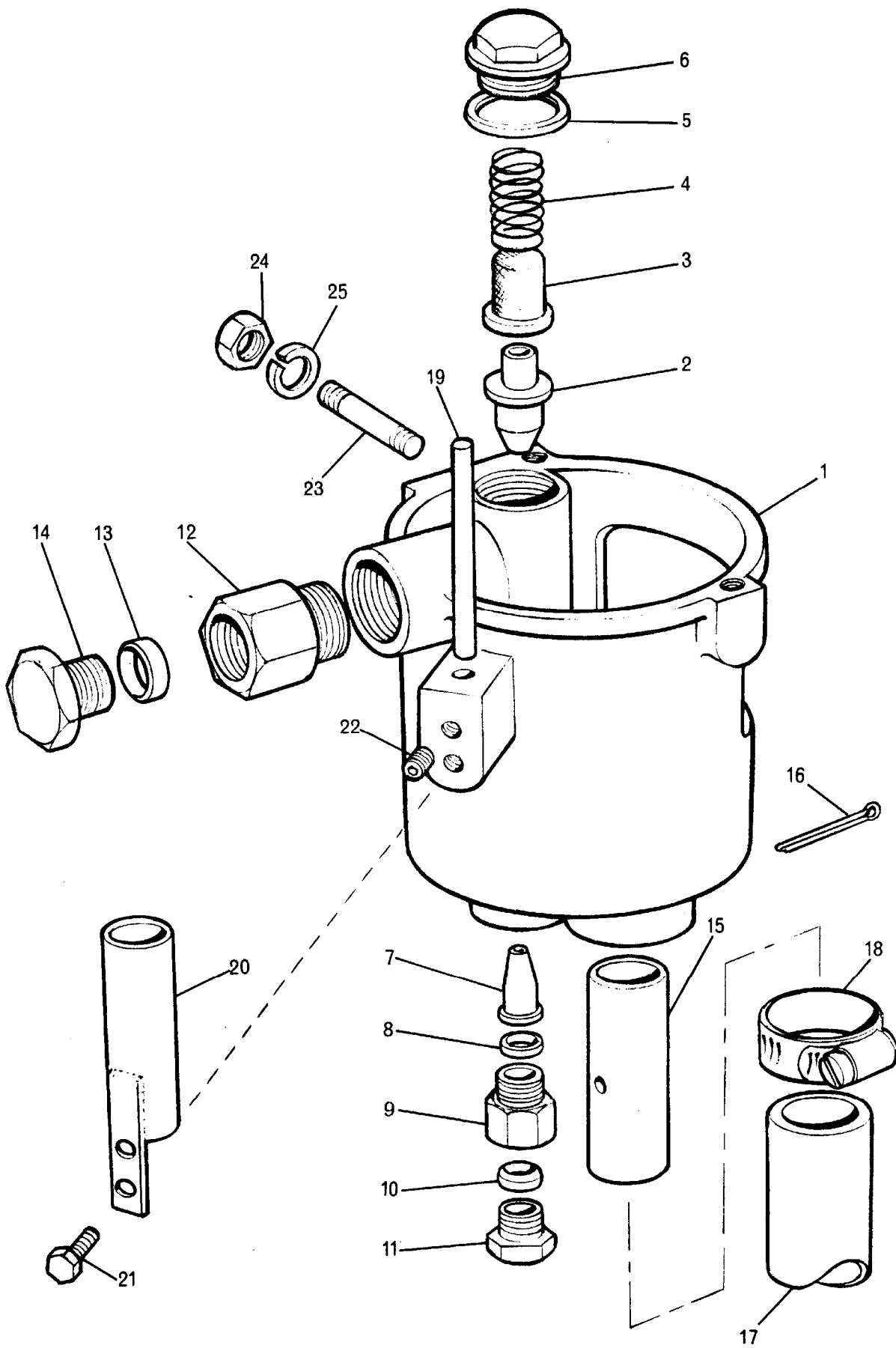


Fig 8.5 Sensing unit

SENSING UNIT

Fig/ Item No.	Part No.	Description Assy	Qty
8.5	TVMY1300	2" Sensing unit	Ref
	TVMY1300-1	1 1/2" Sensing unit	Ref
1	Not spared	Jet housing casting	1
2	Not spared	Top jet assembly	1
3	TVCZ1322	Filter	1
4	ZASZ0001-16	Spring	1
5	TVCZ1326	Washer	1
6	TVCZ1325	Top jet plug	1
7	TVCZ1323 (fitted on TVMY1300)	Lower jet (2")	1
	TVCZ1323-1 (fitted on TVMY1300-1)	Lower jet (1 1/2")	1
8	ZAAZ0035-18	Washer 17/64" id x7/16" od	2
9	ZACZ0303-3	Male adaptor	1
10	ZACZ0023-2	Tubing sleeve	1
11	TVCZ1539	Tubing nut	1
12	TVCZ1538	Male adaptor	1
13	ZACZ0023-3	Tubing sleeve	1
14	TVCZ1540	Tubing nut	1
15	TVAZ1588	Connecting tube	1
16	ZT2206E0428A	Split pin - 1/8" dia	1
17	TVRZ1589	'Nitrile' rubber tubing - 7/8" id	as reqd
18	ZASZ0075-7	Jubilee clip No. 1A	1
19	TVCZ1331	Sensing tube	1
20	TVCZ1330	Sensing tube guard	1
21	ZS2228E0606A	Screw 10-32 UNF x 3/8" lg	1
22	ZS3331E0804A	Grub screw 1/4" - 28 UNF x 1/4" lg	1
23	ZASZ0028-22	Stud 1/4" - 28 UNF x 1" lg	2
24	ZN2201E08A	Nut 1/4" - 28 UNF	2
25	ZW8207G08A	Washer 1/4" S/Coil spring	2

* = Suggested spare part

Ref = Reference only + = Item not illustrated

