BM series bulkmeter capsule

- with calibrating mechanism and register

Maintenance manual and spare parts list

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AMENDMENT RECORD

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TP0003B		Ownership change; Regulatory updates	08-Feb-2016

Liquid Controls

It is the aim of Liquid Controls to maintain a policy of continuous progress and for this reason Liquid Controls reserves 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, Liquid Controls does not hold itself responsible for any inaccuracies that may be found.

PRODUCT SAFETY

In the interest of safety it is strongly recommended by Liquid Controls that the following details receive strict attention.

For the Purpose of Definition, the word PRODUCT applies to any product sold by Liquid Controls.

1 The Product is used only with fluids stated as acceptable by Liquid Controls.

2 The Product, while in service, must not be subjected to pressures greater than the Maximum Working Pressure or tested to pressures greater than the Test Pressure as specified in the manual.

3 The Product must only be coupled/connected to equipment considered acceptable by Liquid Controls.

4 The Product must be handled using the lifting handles where fitted, or in accordance with the manual.

5 The Product must not be misused or handled in any way liable to cause damage.

6 The Product must be inspected for any signs of damage prior to use e.g. cracks, damaged seals, seized or tight operating mechanisms.

7 The Product must be subjected to a regular maintenance program, either in accordance with the manual or as agreed with Liquid Controls.

8 Only technically competent personnel should repair or maintain the Product and only parts supplied by Liquid Controls may be used.

9 Products covered by warranty may not be modified in any way without prior written permission of Liquid Controls.

10 Products not in service, must be stored in a clean area, and should not be subjected to excessive temperature, humidity, sunlight, or strong artificial light. Products should be protected to prevent damage or the ingress of foreign matter.

11 Where applicable, attention should be drawn to dangers resulting from the generation of static electricity in product flow lines.

12 This equipment is not suitable for use with Liquid Petroleum Gas (L.P.G).

WARNINGS

(1) FLUOROCARBON. DO NOT HANDLE O-RINGS/SEALS IF THEIR MATERIAL APPEARS CHARRED, GUMMY OR STICKY. USE TWEEZERS AND WEAR NEOPRENE OR PVC GLOVES. DO NOT TOUCH ADJACENT PARTS WITH UNPROTECTED HANDS. NEUTRALIZE ADJACENT PARTS WITH A SOLUTION OF CALCIUM HYDROXIDE. IF THE DEGRADED MATERIAL OR ADJACENT PARTS TOUCH THE SKIN, DO NOT WASH OFF WITH WATER, SEEK IMMEDIATE MEDICAL AID FOR POSSIBLE CONTAMINATION WITH HYDROFLUORIC ACID. HYDROFLUORIC ACID IN CONTACT WITH SKIN HAS DELAYED SYMPTOMS OF CONTAMINATION. IT IS EXTREMELY TOXIC.

(2) WORK MUST BE CARRIED OUT ONLY BY SUITABLY QUALIFIED PERSONNEL.

(3) PRIOR TO COMMENCING WORK, ENSURE THAT ALL AIRPORT/COMPANY SAFETY PROCEDURES HAVE BEEN COMPLIED WITH.

CONTENTS

Preliminary material

Chapters

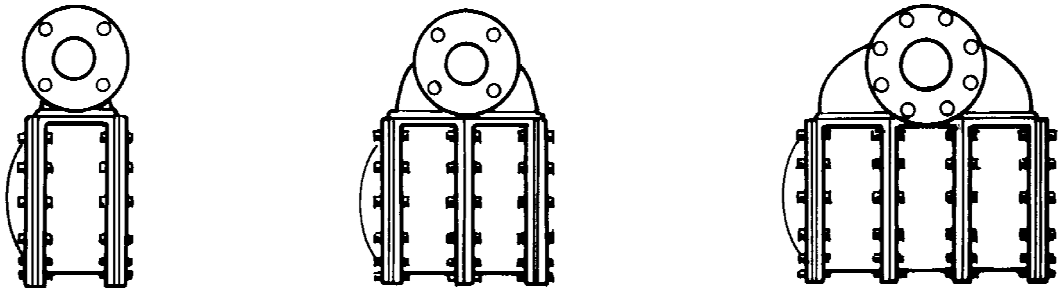
Chapter 1

INTRODUCTION

1 GENERAL INFORMATION

1.1 Avery–Hardoll brand bulkmeters are precision made liquid measuring instruments designed for use with a variety of bulk liquids and maintain accurate metering over long periods of operation. Simplicity of design and construction together with sustained accuracy has led to wide use of the meters by oil companies, government departments, and chemical plants around the world.

1.2 The bulkmeter consists of a body casing containing a rotor assembly with four vanes in opposing pairs, each pair connected by rigid rods. An inlet and outlet manifold is bolted on top of the casing.



SINGLE DOUBLE TRIPLE

FIG 1.1 CAPSULE SIZES

1.3 The basic design of all the series is similar. The higher flow rating for larger meters is achieved by bolting casings together and fitting them with multiple rotor assemblies respectively with larger manifolds to suit. See Fig 1.1.

1.4 The series consists of eight meters for pipeline sizes of 2.5 to 6 inches and are of the positive displacement type as illustrated in Fig 1.2.

1.5 All meters can either be left or right hand discharge and mounted horizontally or vertically.

1.6 The operation of the meter is as follows: Product enters the meter through the inlet side of the manifold and causes the rotor to revolve by pressure on the vanes. The proximity of the rotor to the front and rear of the casing forms an efficient seal, whilst the profile of the casing guides the vanes onto the measuring crescent.

1.7 The manifold and body are constructed separately to avoid pipework stress being transmitted to the metering crescent.

1.8 The meter is not affected by variations in flow up or downstream.

1.9 Accurate readout is possible because:

- The volume contained within the measuring crescent is highly repeatable.
- The dimensions of the measuring chamber are reasonably insensitive to changes of temperature.
- The use of pressure balanced end covers minimises pressure induced distortion within the measuring chamber.
- Meter body materials are chosen for their excellent wear and low frictional properties.

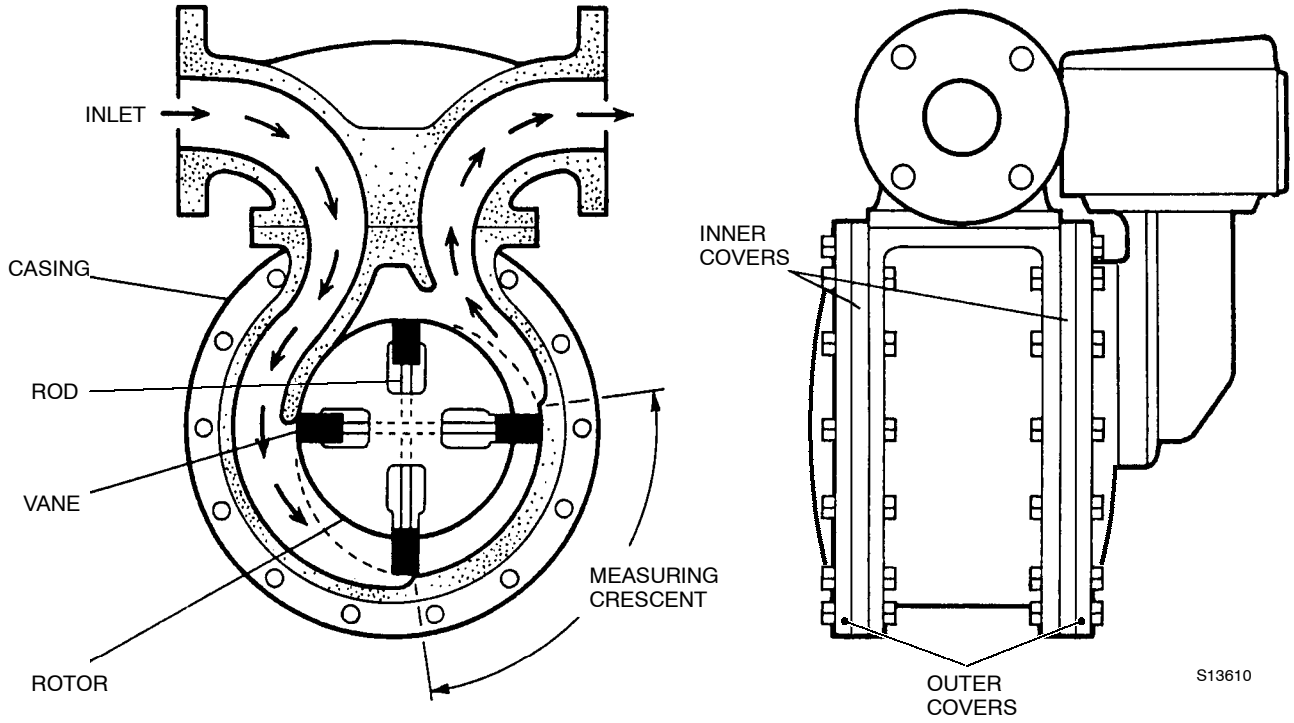


FIG 1.2 METER OPERATION (RIGHT HAND DISCHARGE SHOWN)

1.10 The Bulkmeter produces an output on the rotor shaft proportional to flow. The shaft passes through the end cover without gearing and all moving parts are constantly immersed in fluid.

1.11 There are several ways of using this output:

- A Mechanical Counter driven through a calibrating mechanism to record batch quantity and totaliser.
- A Pulse Transmitter mounted directly to the output to relay flow to an electronic counter and display system, such as Masterload.

1.12 Using a Mechanical Counter, display is available in: Litres, Decalitres, Litres x 10, Imperial gallons, US gallons and Cubic Metres.

1.13 For further information on the Masterload System and other equipment, please refer to Technical Manuals TP0025 (Vehicle) and TP0027 (Gantry).

1.14 Accessories that may be fitted to the Bulkmeters are:

- Mechanical Counters, (also with integral electronic pulser output).
- Mechanical Ticket Printers.
- Mechanical Preset Counter with mechanical and electrical switch output.
- Mechanical Preset Valves.
- Electrically Operated Preset/Control Valves.
- Pulse Transmitter.
- Extended Counter Drive and Swivel.

- Temperature Compensator.
- Volume/Weight Convertor.
- Additive Injection Mechanism.
- Strainer.
- Air Separator.
- Flow Governor.

1.15 Refer to Chapter 2 for further details on accessories.

1.16 Each meter is fully tested and calibrated by Liquid Controls ~~trained staff~~ prior to dispatch and will, when correctly installed and regularly serviced, maintain a high standard of accuracy and repeatability.

1.17 Each meter is suitable for use in Group II Category 2 for Zone 1 operation.

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Chapter 2

TECHNICAL DESCRIPTION

CONTENTS

1 GENERAL INFORMATION

1.1 BM Series Bulkmeters are manufactured in three basic sizes with different ratings identified by a series number. The series numbers, sizes, flow rates and a brief description of each series of meter are shown in Table 1.

TABLE 1 - TYPES OF BULKMETER

SERIES NO	MANIFOLD		FLOW RANGE		GENERAL DESCRIPTION
	ins.	mm	imp. gals.	litres	
BM250	2 1/2	63	25 - 250	115 - 1140	Single capsule meters
BM950	3	76	30 - 300	130 - 1370	
BM450	3	76	45 - 450	200 - 2050	Double capsule meters
BM550	4	102	50 - 500	220 - 2280	
BM350	4	102	55 - 550	250 - 2500	
BM650	4	102	65 - 650	300 - 3000	Triple capsule meters
BM750	6	152	65 - 650	300 - 3000	
BM850	6	152	85 - 850	387 - 3870	Special application only for low viscosity/clean aviation fuel

1.2 The BM series bulkmeters consist of three main assemblies, the manifold, body assembly and rotor assembly, (Figure 2.1). The basic design of all the bulkmeters is similar. The higher rating of the larger meters is achieved by bolting two or three body casings (capsules) together and fitting double or triple rotor assemblies with a larger manifold to suit. A calibrating mechanism and Mechanical Register are also attached to the front end cover. These can be replaced by a front cover incorporating a pulse transmitter when required for electronic systems, such as Masterload.

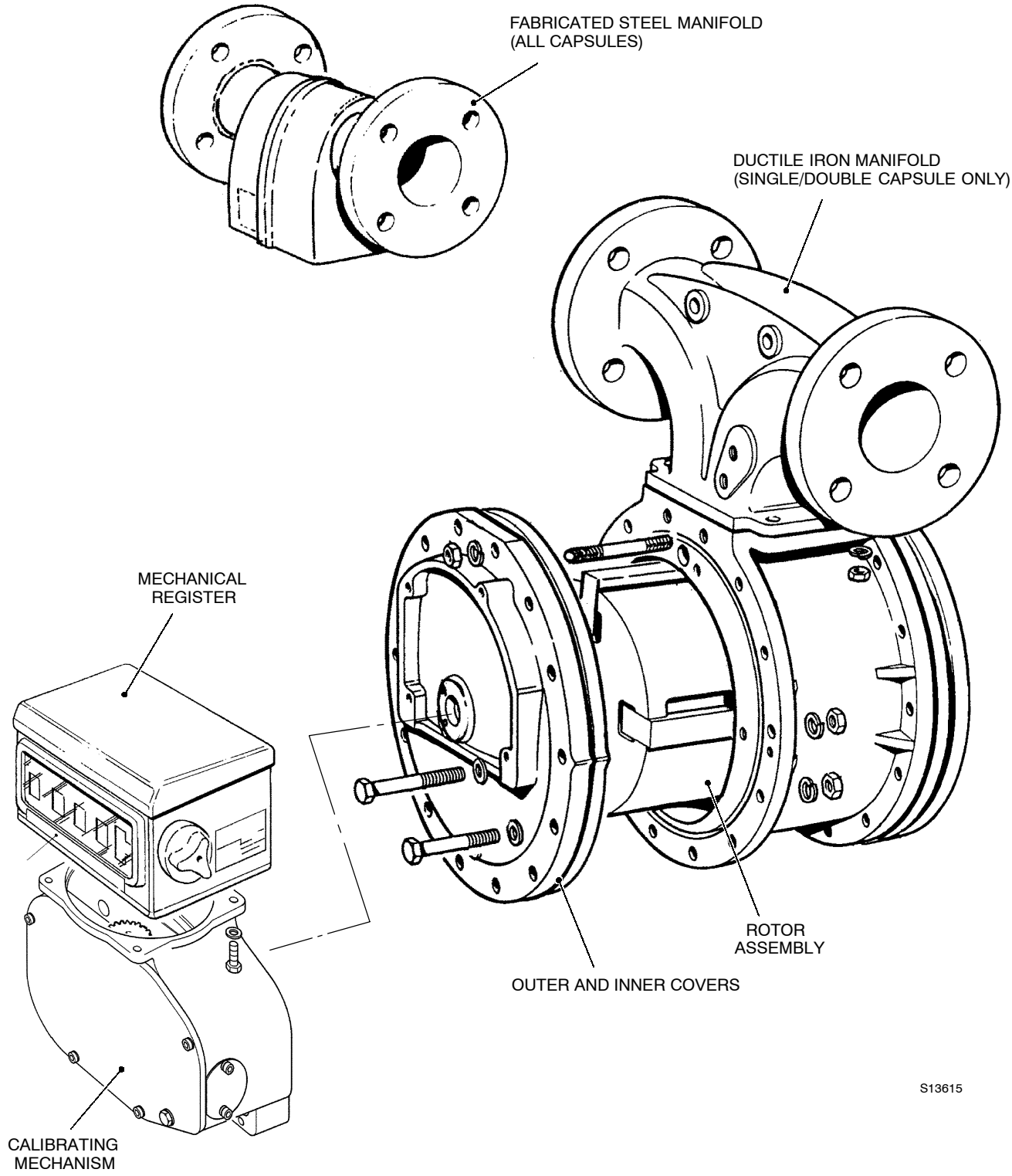


FIG 2.1 BULKMETER MAIN COMPONENTS

2 MANIFOLD

2.1 The manifold is of ductile iron for 2.5” and 3” bores only, or steel fabrication with a bore of either 2.5”, 3”, 4” or 6”, dependant upon the metering capacity (refer to Table 1). The manifold is secured to the body casing by studs, nuts and washers and sealed by an ’O’ ring seal, the center studs are sealed with an ’O’ ring seal and fitted washer. Flanges fitted to the manifold can either be flat or raised face.

3 BODY ASSEMBLY

3.1 The body assembly comprises a body casing with front and rear double end covers. The body casing of NI-resist cast iron forms the metering compartment and is machined internally on two concentric diameters which are joined by blending radii. The larger diameter forms the measuring crescent (Figure 2.2) and the blending radii are machined out to form the inlet and outlet ports.

3.2 The body casing is fitted with pressure balanced inner end covers, the inner covers are of NI-resist cast iron while the standard outer covers are of aluminium, NI-resist cast iron is available as an alternative. The volume between them is fluid filled at line pressure, this ensures that there is no pressure difference across the inner covers of the measuring chamber and therefore, no distortion.

3.3 A bearing is housed within each inner cover to provide support for the rotor assembly. A bearing adjuster, screwed into the front inner cover and a compensating spring between the rear bearing and rear outer cover enables the position of the rotor assembly, within the body, to be adjusted. The front cover is drilled to allow the calibrating drive spindle to pass through, a spindle seal fits in the outer cover. The outer face of the outer front cover is designed to allow the calibrating mechanism to be secured to it. An optional factory fitted cover incorporating a pulse transmitter unit for electronic calibration/metering measuring is also avaiable.

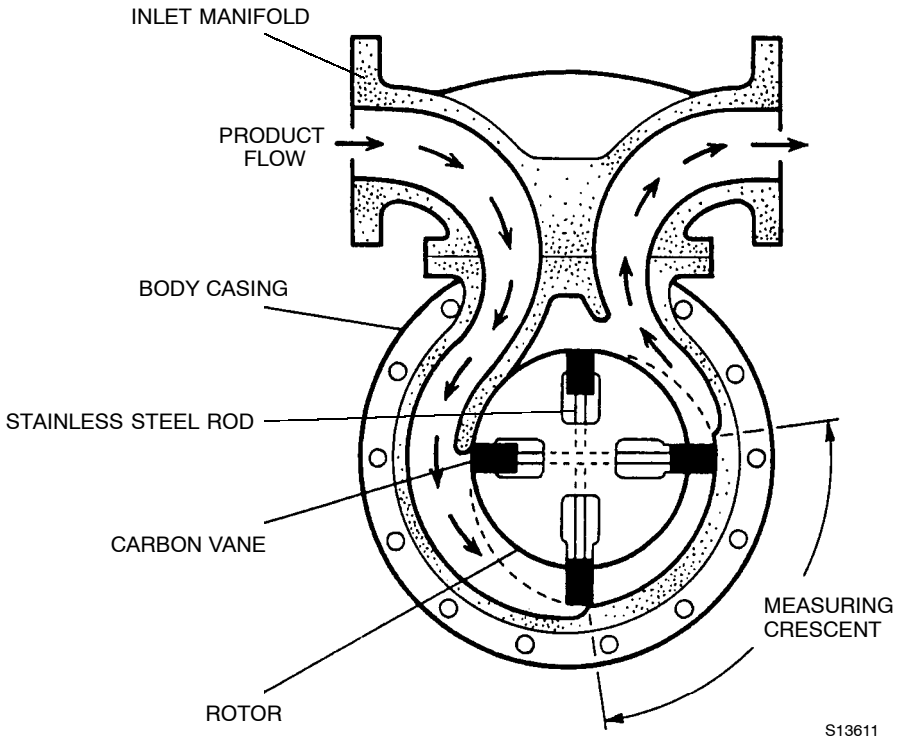


FIG 2.2 BULKMETER OPERATION

4 DYNAMIC SEALS

4.1 A dynamic pressure tight seal is fitted within the front cover. Seal material can be either Nitrile or Fluorocarbon depending on the product in use. See below for a guide to suitable seals:

Products suitable for use with NITRILE SEALS
- Kerosene (without additives)
- Diesel
- Heavy black oils
- Jet A1

Products suitable for use with FLUOROCARBON SEALS
Motor spirit
Aviation gasolines (ie. AVGAS)
Kerosene (with additives)

4.2 The above is only a guide and may not be accurate in every case, especially where extreme temperatures are concerned. If in any doubt about seal selection, please contact our Engineering Department at Liquid Controls.

5 ROTOR ASSEMBLY

5.1 The rotor assembly comprises an aluminium or NI-resist cast iron rotor secured by screws to stainless steel stub axles running in bearings mounted in the inner covers. The output spindle is located into the front stub axle and secured by a taper pin.

5.2 Slots in the rotor accept two pairs of horizontally opposed carbon vanes set at 90 degrees to each other and mounted on rigid stainless steel rods. The rods are sealed with special glands where they pass through the rotor.

5.3 In operation, liquid enters the meter through the inlet manifold and causes the rotor to revolve by pressure on the vanes. The proximity of the rotor to the casing forms an efficient seal, whilst the profile of the casing ensures that the vanes are guided through the metering crescent, where the volume of product is accurately measured. Product at line pressure fills the spaces between the inner and outer end covers providing pressure balanced inner end covers free from distortion. The rotor motion is transmitted through an output spindle (which passes through a pressure tight seal in the outer front cover) to the calibrating mechanism which, in turn, drives the mechanical counter.

6 CALIBRATING MECHANISM

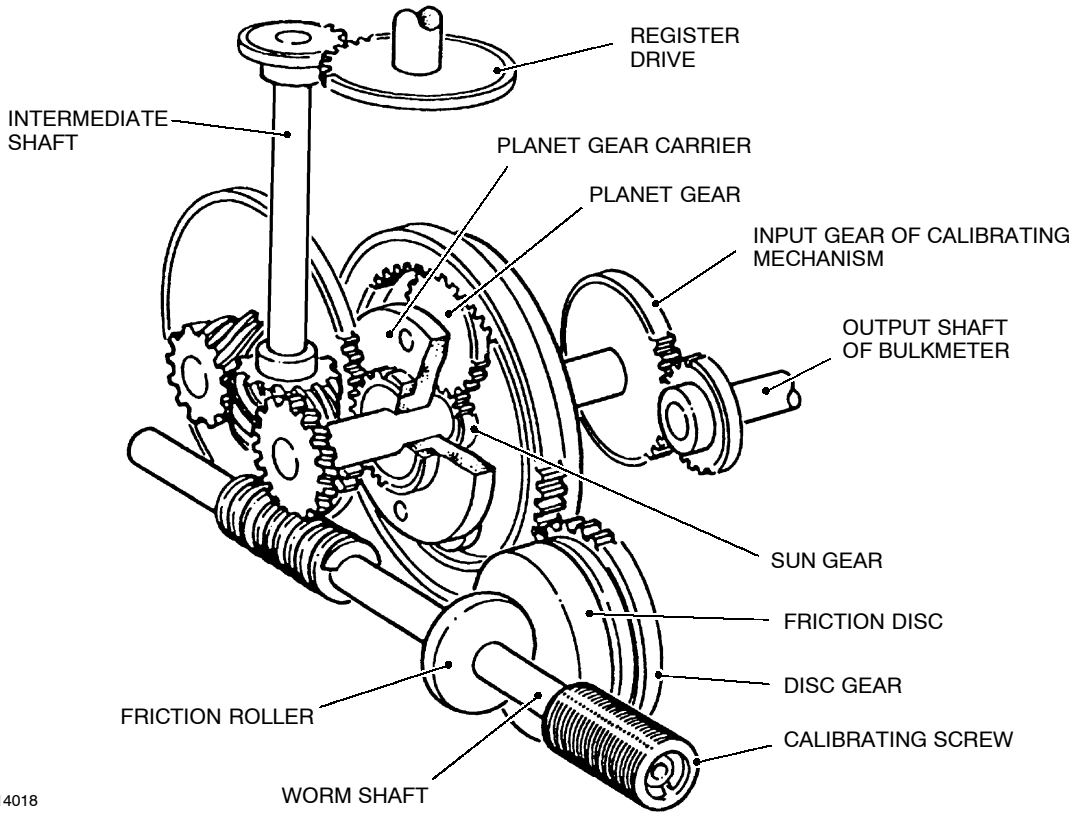


FIG 2.3 calibrating mechanism GEAR ARRANGEMENT

6.1 The calibrating mechanism comprises a gear train with the ability to transmit rotor movement to a mechanical register and allow adjustment of the reading. When tested against a reference meter the adjustment compensates for mechanical losses, wear etc to give the true reading of volume displaced.

6.2 A gear fitted to the Bulkmeter output shaft meshes with the input gear of the calibrating mechanism. The motion is transferred via a driving gear and disc gear to the annulus of the planetary gear. The rotation of the annulus is transferred through a planet gear to a sun gear. The planet gear carrier has secured to it a drive gear which meshes with the spiral gear. Motion is transmitted via sprial gears meshing through the intermediate shaft to the intermediate shaft pinion (register drive).

6.3 The sun gear is connected by a shaft to the worm gear meshed with the worm shaft. A friction roller secured to the worm shaft is in constant contact with a friction disc secured to the disc gear. At the end of the worm shaft is a calibrating screw.

6.4 The arrangement of gears, worm shaft, friction roller and friction disc enables the speed and direction of the planet wheel and thus the spiral driving gear (the effective gear ratio) to be adjusted. The friction roller is moved across the friction disc in either direction by means of the calibrating screw. The range of adjustment available is approximately 6% and is stepless allowing for very precise adjustment.

6.5 The calibrating mechanism is mounted between a base plate and gear bracket; Shafts run in bushes and ball races and the assembly is enclosed by an aluminium alloy cover sealed by a cork gasket and secured to the base by five screws. Access to the calibration screw is gained by removing the cover on the side of the calibrating mechanism casing.

6.6 The version of Calibration Mechanism supplied depends upon:

- Register Readout required i.e. Litres, Imperial Gallons, US Gallons, Decalitres, Litres x 10 and Cubic Metres.
- The size of capsule ordered, single, double or triple.
- Whether discharge required is left or right hand.

6.7 It is important that the above information is stated when ordering replacement parts.

7 MECHANICAL REGISTER

7.1 The Veeder Root counter (Register) fitted to the bulkmeter provides a visible readout on five display wheels of the volume of product delivered through the meter. All counters are reversing but can be made non-reversing by fitting a slipping clutch to the calibrating mechanism.

7.2 The register is mounted on top of the calibrating mechanism. A drive gear on the calibrating mechanism meshes with a gear on the underside of a gear plate secured to the register. The gear plate carries a train of gears that are supplied to give different gear ratios and clockwise or counter - clockwise drive as required. Drive from the gear plate is transferred through bevel gears to a clutch shaft.

7.3 A bevel gear on one end of the clutch shaft drives a transfer shaft which in turn drives a totaliser comprising eight small figure wheels which show the cumulative total irrespective of the number of times the counter is reset to zero. The clutch assembly on the other end of the clutch shaft incorporates a gear wheel which drives the right hand display wheel. On each complete revolution of the right hand display wheel i.e. 0 to 9 a transfer pinion rotates the next display one digit i.e. 0 to 1, 1 to 2 etc so giving a count of delivery. On completion of delivery, the display can be reset to zero by operating the reset knob, a shutter drops across the display while resetting.

7.4 Full details of the operation, installation and servicing of the Veeder Root register are contained in Veeder Root Manual 251325 and Manual 158.

8 METER ACCESSORIES

8.1 A full range of accessories are available for use with all Avery-Hardoll brand bulkmeters. A brief description of each is given in the following sections. Separate manual/data sheets for each accessory are available from Liquid Controls for further information.

9 TICKET PRINTER

9.1 A ticket printer may be fitted above the mechanical counter to provide a printed record of each product delivery through the bulkmeter.

9.2 Two basic types of printer are available, Accumulative and Zero start.

9.3 The accumulative printer records the total amount metered before and after each delivery. The Zero start printer records only the total for each seperate delivery.

10 MECHANICAL PRESET REGISTER AND VALVE

10.1 Presets the quantity to be delivered and shuts off flow, without shock, when the set delivery has passed through the meter. Available in 2.5", 3" and 4" sizes.

11 RATE OF FLOW INDICATOR

11.1 Where indication of flow rate is required so that a definite maximum or minimum flow rate may be maintained.

11.2 The Indicator consists of a calibrated and compensated tachometer incorporated in the front cover of the calibrating unit and driven by a gear train. The Rate of Flow Indicator may be calibrated in Imperial Gallons and Litres, or US Gallons.

12 TEMPERATURE COMPENSATOR

12.1 Designed to operate over a wide temperature range, the Temperature Compensator automatically adjusts the indicated volume on the counter to an equivalent volume at the standard temperature (60° F or 15° C). Dual readout can be provided - one counter showing corrected volume and a second counter showing actual volume.

13 ADDITIVE MECHANISM

13.1 Provides automatic in-line blending of bulkmetered fuel with one or two additive mixtures at pre-determined ratios.

13.2 The Additive Mechanism is mounted on the rear of the bulkmeter which requires a different outer rear cover fitted to allow drive to be taken off the rear stub axle of the rotor. Ideally, the Additive Mechanism should either be ordered with the bulkmeter or the bulkmeter ordered with the provision for an Additive Mechanism to be installed at a later date. In which case the bulkmeter will be delivered with a special rear outer cover factory fitted. The rear drive shaft will be covered by a removable guard. In cases of retro-fitting to an existing bulkmeter, a new rear outer cover will be required and this must only be fitted by a qualified engineer with full workshop facilities. If this is not possible, return the bulkmeter to Liquid Controls for modification.

14 STRAINER

14.1 Essential to protect the meter from damage by pipe scale, dirt etc. Available with 40, 60, 80, 100 and 120 mesh baskets, with either cast or fabricated body. It is recommended that new installations

should be operated with 100 or 120 mesh baskets for an initial period. As a general indication, MINIMUM mesh sizes recommended are:

- Fuel Oil – 40 mesh.
- Gas Oils, Kerosene and Gasolene – 80 mesh.

15 VOLUME/WEIGHT ADAPTOR

15.1 The Volume/Weight Unit is designed to automatically show counter readout in weight, once the specific gravity of the product being metered has been correctly set on the unit.

15.2 The unit, which is self contained, is sandwiched between the calibrating mechanism and the Mechanical Counter. On the front of the unit is a specific gravity indicator dial and setting knob. Total uncorrected volume is recorded on a totaliser which can be reset to zero by a knob on the left hand side of the unit.

16 AIR SEPARATOR

16.1 The Air Separator is designed to prevent air/vapours trapped upstream in the system from reaching the meter.

16.2 The unit consists of a mild steel cylindrical tank mounted horizontally on two flanged support brackets, with an automatic float operated vent valve fitted along its top centreline.

16.3 The Air Separator is available in four bore sizes, 2.5”, 3”, 4” and 6”.

17 FLOW GOVERNOR

17.1 In installations where more than one bulkmeter is supplied from a common pipeline, the rate of flow is liable to exceed the maximum capacity of any individual bulkmeter. When supply is shut off to some of these, the meters remaining in operation may be subjected to excessive flow rates. The Flow Governor protects bulkmeters from possible damage from overload by limiting the maximum rate of flow, irrespective of pressure changes.

18 EXTENDED COUNTER DRIVE AND SWIVEL.

18.1 Designed to raise the level of the mechanical counter to any convenient height up to 3.8 metres (12.5 ft) above the bulkmeter to suit the particular loading installation. The mechanical counter may be bolted to the top of the extension, or a swivel head can be fitted whereby the counter can be turned in any direction to facilitate reading.

19 TROLLEYS

19.1 All Avery–Hardoll brand bulkmeters can be supplied mounted on trolleys for use where space or other operational requirements prevent the use of permanently installed meters.

19.2 Typical applications are:

- Quayside bunkering.
- Loading and offloading rail tank wagons and fuelling diesel locomotives.
- Additive injection between aircraft refueller and aircraft.

19.3 The trolley design is normally of the trailer type, with two, three or four wheels, a chassis of all welded construction with a 2" or 3" diameter eye bolt coupling fitted with over-run and parking brake. The wheels have standard pneumatic tyres and suspension is provided by semi-elliptical springs with centrally mounted rubber bump buffers to provide good handling characteristics on the road, and balance whilst stationary. Two and three wheel trollies are fitted with a tow box which includes a retractable jockey wheel, whilst the four wheel trolley is available with an articulated front axle. All trollies have adjustable chassis jacks fitted for steadying during meter operation.

20 MASTERLOAD

20.1 To enable a direct interface to the Avery-Hardoll brand Masterload Electronic Metering system, an adaptor plate and transmitter assembly are fitted in place of the mechanical calibrating mechanism. This offers the following benefits:

- Precise Electronic Preset Control.
- Improved accuracy due to dynamic calibration.
- Flexible mounting of Display Unit.
- Interface with pump control systems.
- Constant monitoring of Fuelling status.
- Availability of communication link to an Office or SCADA system.

Chapter 3

SPECIFICATIONS

1 MATERIALS

1.1	MANIFOLD:	Ductile Iron (single/double capsule) Fabricated Steel (all builds)
	BODY:	Ni-Resist cast iron
	VANES:	Carbon
	ROTOR:	Aluminium or Ni-Resist cast iron
	OUTER COVERS:	Aluminium or Ni-Resist cast iron
	INNERCOVERS	Ni-Resist cast iron
	BEARINGS:	Stainless steel
	SEALS:	High Nitrile or Fluorocarbon

2 REPEATABILITY

2.1 The Avery–Hardoll brand bulkmeter is repeatable typically to 0.01%. Factory tested to 0.02%.

3 PRESSURES

Maximum working pressure: 150 lbf/in^2 (10.3 bar)

Hydrostatic test pressure: 300 lbf/in^2 (20.7 bar)

Pressure drop: It is recommended that the pressure drop through a bulkmeter should not exceed 15 psi (1 bar), above which the load on the bearings will start to cause wear. Consequently, when using products with viscosities (at operating conditions) above 100 centistrokes, it is necessary to reduce the maximum permitted flowrate. As a guide, it is suggested that the pressure drop through the meter should not exceed 10 psi (0.7 bar) for continuous running at maximum speed, or 15 psi (1 bar) for continuous running at half speed.

4 OPERATING TEMPERATURES

Minimum operating temperature -28 deg C (-18.4 deg F)

Maximum operating temperature 70 deg C (158 deg F)

5 CAPACITIES

5.1 Metered volume per revolution nominal:

Single Meter	2.27 litres
Double Meter	4.54 litres
Triple Meter	6.81 litres

5.2 Calibrating mechanism grease:

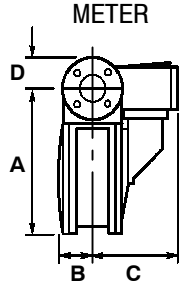
10cc Min.	SHELL ALBIDA RL or equivalent
or	SHELL ALVANIA R1 or equivalent

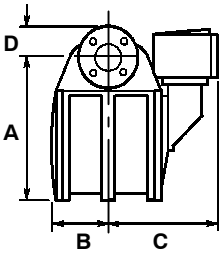
6 STORAGE LIFE

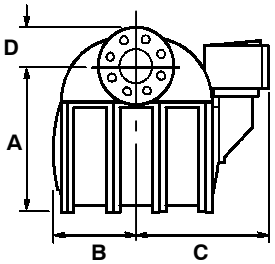
6.1 When stored in cool, dry conditions storage life is limited to two years by deterioration of seals.

7 BM SERIES METERS

FLOW RANGE

SINGLE CAPSULE METER	METER SERIES	PIPELINE SIZE	FLOW RATE			FLANGES	
			Imp Gall	Lpm	m^3/hr	Conform to	Material
	BM 250	2 1/2" (63mm)	25 to 250	115 to 1140	7 to 68	ASA 150 FF	DUCTILE IRON STEEL
	BM 950	3" (76mm)	30 to 300	130 to 1370	8 to 82	ASA 150 FF	DUCTILE IRON STEEL

DOUBLE CAPSULE METER	METER SERIES	PIPELINE SIZE	FLOW RATE			FLANGES	
			Imp Gall	Lpm	m^3/hr	Conform to	Material
	BM 450	3" (76mm)	45 to 450	200 to 2050	12 to 123	ASA 150 FF	DUCTILE IRON STEEL
	BM 550	4" (102mm)	50 to 500	220 to 2280	14 to 136	ASA 150 FF	DUCTILE IRON STEEL
	BM 350	4" (102mm)	55 to 550	250 to 2500	15 to 150	ASA 150 FF	DUCTILE IRON STEEL
			615	2800	168	intermittent use	

TRIPLE CAPSULE METER	METER SERIES	PIPELINE SIZE	FLOW RATE			FLANGES	
			Imp Gall	Lpm	m^3/hr	Conform to	Material
	BM 650	4" (102mm)	65 to 650	300 to 3000	18 to 177	ASA 150 FF	STEEL
	BM 750	6" (152mm)	65 to 650	300 to 3000	18 to 177	ASA 150 FF	STEEL
	BM 850	6" (152mm)	85 to 850	387 to 3870	23 to 232	ASA 150 FF	STEEL
						used on aviation kerosene	

NOTE:

All steel manifolds are available with raised face ~~and~~ 300lb flanges.

AND DIMENSIONS

FLANGE BOLT HOLES			MANIFOLD OVERALL DIMENSIONS		METER DIMENSIONS								APPROX. WEIGHT OF BASIC METER	
No.	SIZE				A		B		C		D			
Off	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	kg	lbs
4	19	.75	356	14	408	16.1	107	4.2	285	11.2	89	3.5	70	154
4	19	.75	400	15.75	427	16.8	107	4.2	285	11.2	89	3.5		
4	19	.75	356	14	408	16.1	107	4.2	285	11.2	95	3.75	70	154
4	19	.75	400	15.75	427	16.8	107	4.2	285	11.2	95	3.75		

FLANGE BOLT HOLES			MANIFOLD OVERALL DIMENSIONS		METER DIMENSIONS								APPROX. WEIGHT OF BASIC METER	
No.	SIZE				A		B		C		D			
Off	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	kg	lbs
4	19	.75	400	15.75	405	15.9	170	6.7	348	13.7	95	3.75	100	220
4	19	.75	400	15.75	427	16.8	170	6.7	348	13.7	95	3.75		
8	19	.75	400	15.75	420	16.5	170	6.7	348	13.7	115	4.5	112	247
8	19	.75	400	15.75	427	16.8	170	6.7	348	13.7	115	4.5		
ALL DIMENSIONS AS BM 550														

FLANGE BOLT HOLES			MANIFOLD OVERALL DIMENSIONS		METER DIMENSIONS								APPROX. WEIGHT OF BASIC METER	
No.	SIZE				A		B		C		D			
Off	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	kg	lbs
8	19	.75	400	15.75	427	16.8	233	9.2	411	16.2	115	4.5	126	278
8	22	.875	400	15.75	427	16.8	233	9.2	411	16.2	140	5.5	136	300
ALL DIMENSIONS AS BM 750														

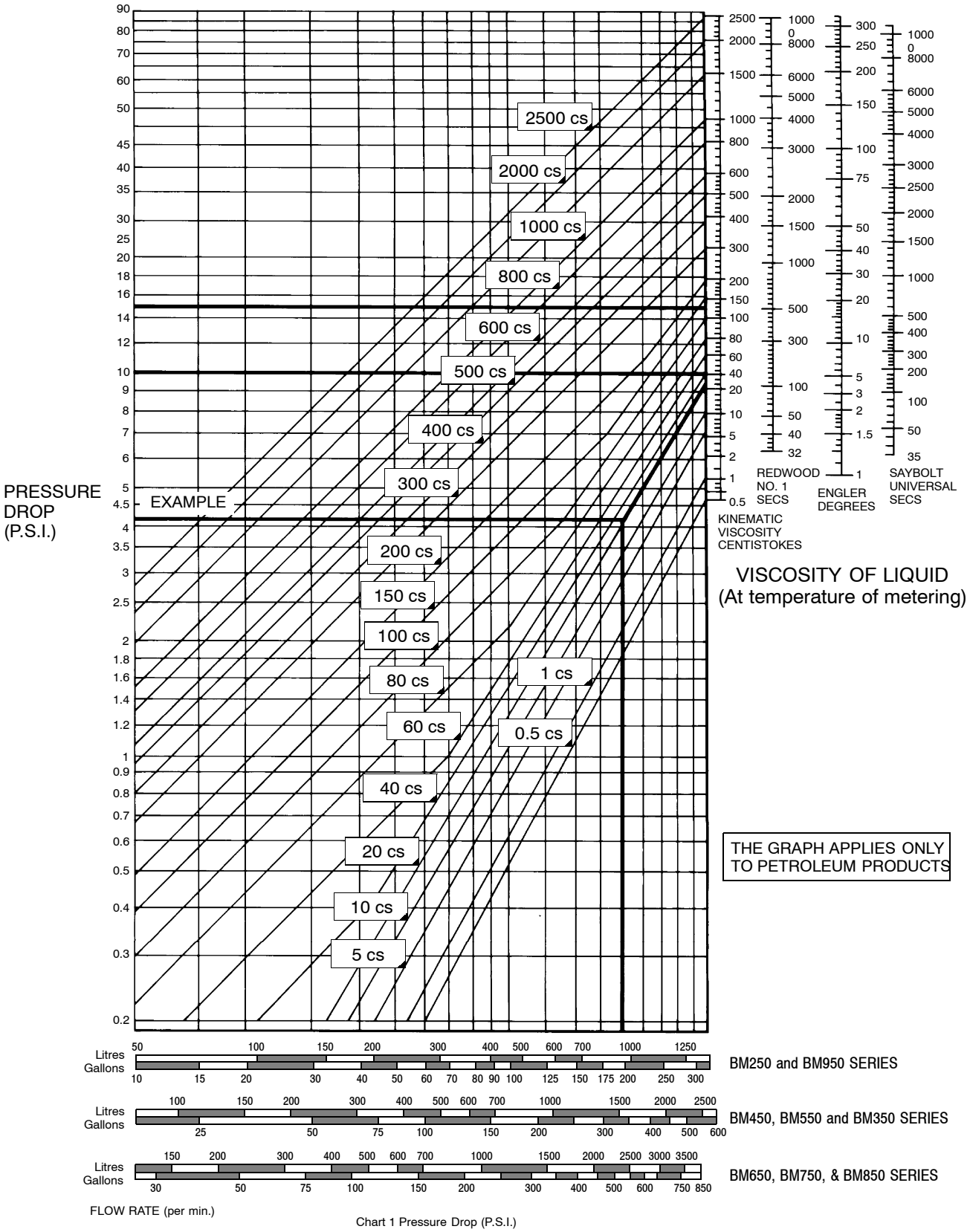


Chart 1 Pressure Drop (P.S.I.)

Chapter 4

INSTALLATION, OPERATION AND MAINTENANCE

CONTENTS

WARNINGS

WORK MUST BE CARRIED OUT ONLY BY SUITABLY QUALIFIED PERSONNEL.

PRIOR TO COMMENCING WORK, ENSURE THAT ALL AIRPORT/COMPANY SAFETY PROCEDURES HAVE BEEN COMPLIED WITH.

1 PRE-INSTALLATION

1.1 Prior to installing a meter carry out the following procedures.

1.2 Flush and drain the body casing.

1.3 Drain the calibrating mechanism by first removing the drain plug and then the cover.

1.4 Thoroughly wash the calibrating mechanism with clean kerosene, refit the cover and drain plug.

1.5 Lubricate the calibrating mechanism with GREASE.

1.6 Refit and wirelock all drain plugs in the body casing.

2 INSTALLATION

2.1 The following notes are for guidance only, installation methods being dependent upon local regulations and conditions.

Note

Plan space around the installed bulkmeter to allow removal of the rotor assembly for servicing.

2.2 Install the bulkmeter by suspending it in the pipeline by the manifold, this ensures that pipeline stresses are not transmitted to the meter body. No attempt is to be made to support the meter body in the installation by any other method.

2.3 When using jointing compound, apply to male threads only to prevent excess compound fouling the meter mechanism.

2.4 Until all air has been eliminated from the system, the control valve must be opened slowly to prevent the meter racing and exceeding its maximum rated speed.

2.5 The Bulkmeter should be installed so that air or vapour cannot pass through it during normal operation. If air or vapour cannot be eliminated from the system under normal operating conditions, an air separator with an adequate vent line should be installed.

2.6 In order to protect the meter from damage due to entrained foreign matter within the system, it is recommended that a suitable strainer is installed in the upstream pipeline, if an air separator is also fitted, this is to be installed between the strainer and the meter.

2.7 It is recommended that until proved on examination that a strainer is capable of dealing with entrained foreign matter, that a pipe spool or bypass is fitted and the system operated with the meter out of circuit.

2.8 In cases where the rate of flow through the system could exceed the maximum rated capacity of the installed meter, it is recommended that a flow control valve is fitted to the system. This should be bolted to the **outlet flange** of the meter.

2.9 Any flow control valve installed is to be fitted in the downstream pipeline.

2.10 To ensure that meters are not subjected to shock pressures appreciably greater than the maximum operating pressure, **Quick Acting Valves MUST NOT be used.**

2.11 The design of all ancillary equipment and pipelines in the installation are to be such that turbulence and pulsations are reduced to a minimum.

3 OPERATION

3.1 There is little for the operator to do once the bulkmeter is installed. The primary task is to reset the register to zero on completion of each delivery. It is important that the register is never reset during a delivery as the reading will be lost and damage may be caused to the register.

4 MAINTENANCE

4.1 The maintenance frequencies recommended are a minimum, however, local company instructions must be observed.

4.2 **Daily:** inspect the meter for signs of damage or leaks. Defects must be rectified immediately or the meter withdrawn from service.

4.3 **Six monthly:** check the meter for accuracy using an Avery-Hardoll brand Master Meter or similar method of testing. Adjust as necessary.

4.4 **Yearly or after 2,500,000 Units:** Clean, inspect and lubricate the Veeder Root counter mechanism as detailed in Veeder Root Manual No. 251325. Lubricate the calibrating mechanism with GREASE.

4.5 For meters in Service: renew dynamic seals yearly and static seals every two years.

4.6 For meters in storage: renew all seals every two years.

5 STORAGE

5.1 If a meter is to be withdrawn from service and stored it is important that the following instructions on cleansing and inhibiting are carried out. A meter stored in a dirty condition is subject to corrosion and subsequent deterioration of performance when re-installed.

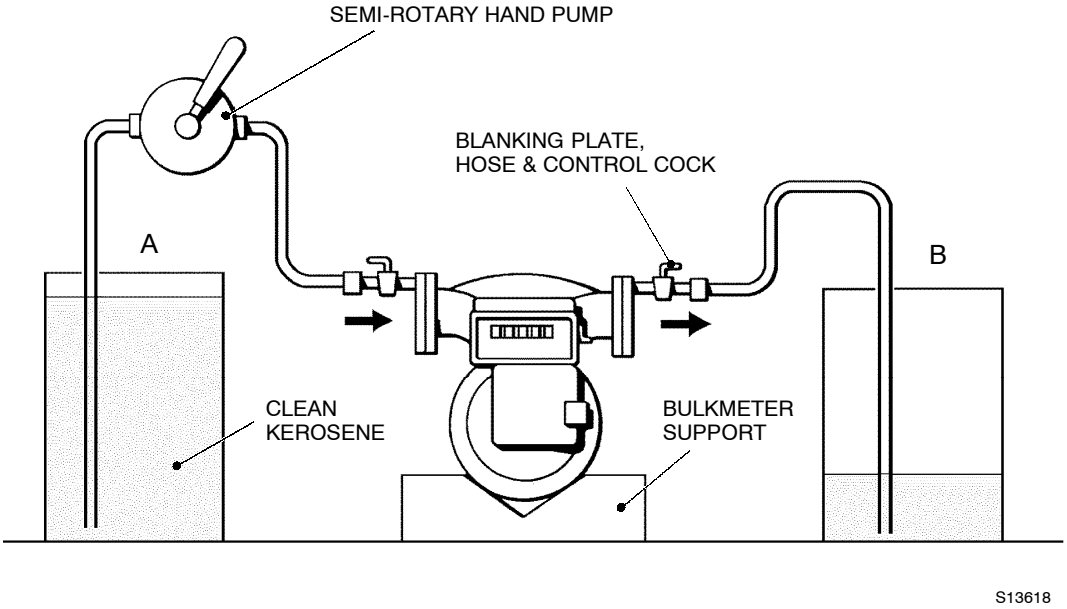


FIG 4.1 CLEANING RIG (RIGHT HAND DISCHARGE METER SHOWN)

5.2 Connect the meter to a rig as shown in Figure 4.1.

5.3 The requirements of the rig are as follows:

- The body of the meter must be supported to prevent rolling.
- Blanking plates complete with control cocks and hose connections should be fitted to the flanges.
- The control cocks are to be fitted above the centre line of the manifold.
- Two suitable containers of approximately five gallons capacity should be provided for the storage of cleansing fluid.

5.4 Fill container 'A' (inlet side) with clean kerosene, open both control cocks.

5.5 Using the semi-rotary pump, circulate kerosene through the meter and into container 'B' (outlet side), repeat the procedure until all residual deposits have been removed from the meter.

5.6 Completely drain the meter and dispose of the contaminated kerosene.

5.7 Using clean kerosene, finally flush the meter.

5.8 Whenever possible a meter in storage should remain in a cleansing rig with the body casing full of clean kerosene, this will allow flushing to be carried out at regular intervals.

5.9 If it is not convenient to retain the meter in the rig during storage it should be filled with clean kerosene or Shell 'Ensis' oil 152 and blanking plates fitted to both flanges.

5.10 During storage, the rotor should be revolved at regular monthly intervals. If the meter is to remain in a cleansing rig, the operation of the semi-rotary pump to circulate kerosene will revolve the rotor.

5.11 In either of the above cases the calibrating mechanism is to be cleaned of grease, the front cover removed and the mechanism washed with clean kerosene. On completion, the cover should be refitted and the mechanism filled with clean kerosene or Shell Ensis Oil 152.

Note:

Stored meters should be kept in a clean dry area and inspected at frequent intervals.

6 STORAGE OF WATER METERS

6.1 A bulkmeter installed into a water system must be kept full of water at all times and never allowed to dry out or the water level to drop. Pockets of air will cause corrosion.

6.2 If the meter is taken out of service for long periods it is advisable to remove the meter from the pipeline, dry it out and flush through with Shell 'Ensis' oil 152.

6.3 Drying may be carried out by blowing through the meter with clean, dry, oil free compressed air or by the use of drying ovens with suitable temperature control.

6.4 After drying, Shell 'Ensis' oil 152, which gives an oily, non drying film is to be applied to all internal surfaces by circulation or flushing through. This procedure will give a medium term protection, estimated at twelve months, under average corrosive conditions. No solvents are required for removal of the oil when the meter is put back in service.

6.5 After treatment of the interior surfaces, fit blanking flanges to the manifold to prevent circulation of air and contamination by dust or moisture.

Chapter 5

SERVICING

CONTENTS

1 GENERAL INFORMATION

1.1 The following procedures are to be carried out by suitably qualified engineers with full workshop facilities available. It is possible to carry out some dismantling with the meter in-situ, i.e. to renew a seal; a clean working area must be maintained at all times during servicing operations.

1.2 If two or more meters are to be overhauled at the same time, it is recommended that they are dismantled and re-assembled separately to avoid any mixing of components.

1.3 Special tools as shown in Fig 5.1 have been designed to assist in dismantling and re-assembling.

Note:

Procedures are described in respect to a single capsule meter (Figs 5.2 and 5.4 refer), double and triple capsule procedures are identical except for extra drain plugs and separation of body casings which is only necessary to renew gaskets.

WARNINGS

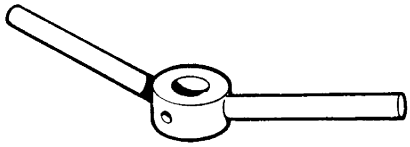
WORK MUST BE CARRIED OUT ONLY BY SUITABLY QUALIFIED PERSONNEL.

PRIOR TO COMMENCING WORK, ENSURE THAT ALL AIRPORT/COMPANY SAFETY PROCEDURES HAVE BEEN COMPLIED WITH.

2 REMOVAL FROM SYSTEM

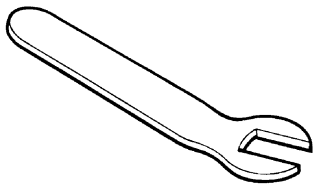
2.1 Ensure all system control valves are closed.

2.2 Refer to Fig 5.2. Remove the drain plug(s) (2) and washer(s) (3) from the body casing. In the case of water meters also remove the drain plugs from the front and rear covers (14). Allow product to drain fully then loosely refit drain plugs and washers.



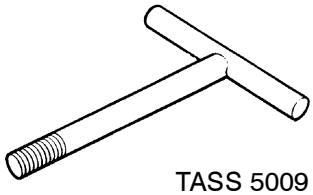
TASS 5006

ROTOR REMOVAL & TURNING TOOL



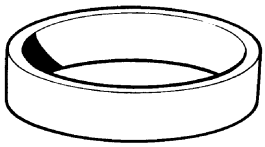
TASS 5008

SPECIAL SPANNER



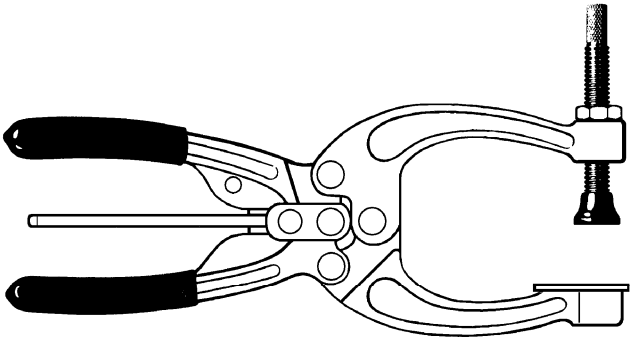
TASS 5009

COVER TOOL (2 REQ'D)



TASS 5010

RING SUPPORT TOOL



TAMS 5072

TOGGLE CLAMP TOOL

TASS 5073

SPRING PLATE

FIG 5.1 SPECIAL TOOLS

2.4 Using suitable lifting equipment support the weight of the meter, remove the nuts, bolts and washers securing each manifold flange to the pipework and withdraw the meter from the system.

2.5 If a replacement meter is not being fitted it is recommended that suitable blanking flanges be fitted to the open pipework.

3 INITIAL DISMANTLING

3.1 To assist in dismantling, the meter should be treated as two main assemblies; body and manifold assembly - calibrating mechanism and register.

3.2 To ensure stability and safety during dismantling place meter in the ring support tool TASS 5010.

3.3 Refer to Fig 5.5. Remove the four screws (13), (53) and washers (14) securing the calibrating mechanism cover (50) to the base (1). Remove the cover and discard the gasket (54).

3.4 Remove the four bolts (3) and spring washers (3A) securing the base to the front cover of the bulkmeter. (Pre-1975 models are fitted with studs and nuts).

3.5 Ease the complete calibrating mechanism, register and spacer off the two dowel pins (2) and place on a clean working surface.

4 INVESTIGATION

4.1 If the meter is being dismantled because a fault is suspected, it is recommended that a preliminary investigation is conducted to determine the general location of the fault.

4.2 Remove the rotor gear (4) and tension pin (5) from the rotor spindle and fit turning tool TASS 5006 in its place. Turn the rotor spindle against the direction of the arrow on the manifold, the rotor should revolve freely, failure to do so will indicate a fault within the body.

4.3 Turn the calibrating mechanism driving gear (8) to ensure that the gear train functions correctly.

4.4 Visually inspect the assembly for obvious faults e.g broken gear teeth, sheared tension pins etc.

4.5 Dismantle the faulty assembly by following the appropriate procedures described in Para 5 or Para 6.

5 BODY ASSEMBLY - Dismantling

WARNING

FLUOROCARBON. THE SPINDLE SEAL, ITEM 12, MAY CONTAIN FLUOROCARBON. REFER TO THE FLUOROCARBON WARNING ON PRELIM PAGE (vii)/(viii) OF THIS PUBLICATION.

5.1 Place the body assembly front face upwards on a bench.

5.2 Note the position of the two sealing bolts (21). Remove the fourteen nuts (25), spring washers (24), twelve bolts (22) with plain washers (23) which secure the front outer cover (14) and inner cover (5) to the body (1).

IMPORTANT

DO NOT ATTEMPT TO REMOVE THE REAR INNER COVER AS THIS IS FACTORY SHIMMED TO THE BODY

5.3 Remove the front outer cover (14) and discard the 'O' ring seal (15).

5.4 **DO NOT REMOVE** the spindle seal (16) from the front cover unless it is defective, shown by product leaking between the cover and the calibrating mechanism base. If replacement is necessary, remove the three countersunk screws (19) and the retaining plate (17). The seal may now be withdrawn.

5.5 Remove the two screws (9) from front inner cover (5). Insert cover tools TASS5009 into the two holes provided in inner cover (5). Screw down evenly on the tools and the inner cover, which is dowelled into position, will be withdrawn. Remove the inner cover and discard the 'O' ring seal (8).

5.6 **IMPORTANT**: Do not remove the bearing adjuster (11) or screw (12) from the hub of the cover unless a new rotor is being fitted. The bearing adjuster has a factory set clearance between the inner front cover and the face of the rotor.

5.7 Fit the rotor tool TASS5006 to the rotor and turn so that two vanes are depressed against the metering crescent. Refer to Fig 2.2.

5.8 Stand over the body and, with a smooth vertical lift, withdraw the rotor assembly, complete with bearings (10) from the body casing.
IMPORTANT: During this operation care must be taken to avoid damaging the vanes.

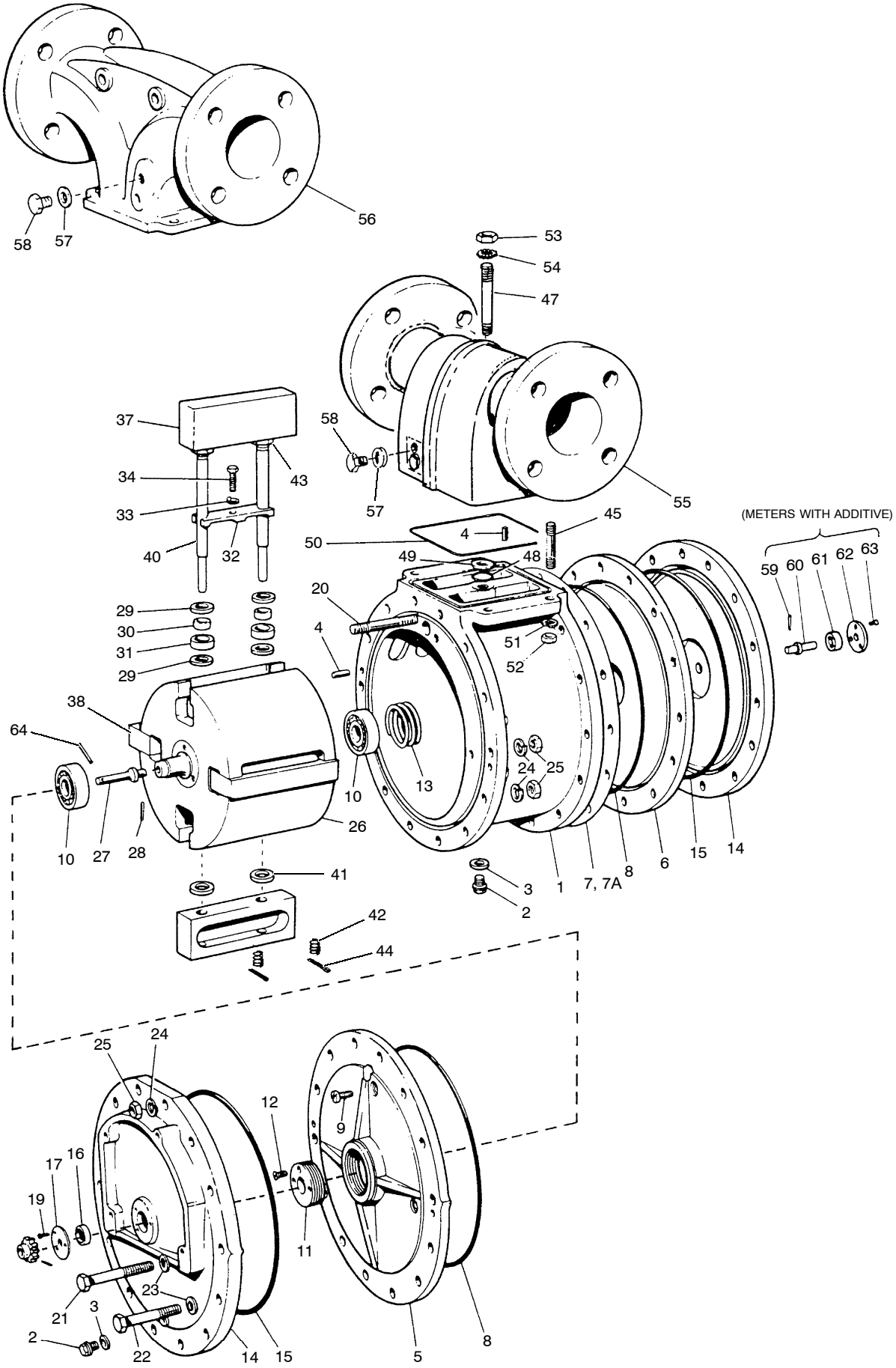


FIG 5.2 BULKMETER COMPONENTS

5.9 Recover the compression spring (13) from the rear inner cover.

5.10 Do not remove the manifold (55) unless defective or to change seals (48) and (50). **UNDER NO CIRCUMSTANCES** attempt to remove the rear inner cover (6).

5.11 Before dismantling the rotor assembly the relative positions of the vanes and recesses should be noted; mark each vane and recess with a pencil or similar medium to assist re-assembly. The vanes, if serviceable, must be re-assembled into their original positions.

5.12 Remove the split pins (44) from each vane rod (40). Place Spring Plate over springs (42). Set the toggle clamp tool to 26mm (1.031 in) and place CENTRALLY in position over vane as shown in Fig. 5.3
Note: Special care must be taken not to damage the vane surface.

5.13 Withdraw vane from the rotor, and remove washers (41).Note the relative positions of the washers (41) which must be refitted in their original positions.

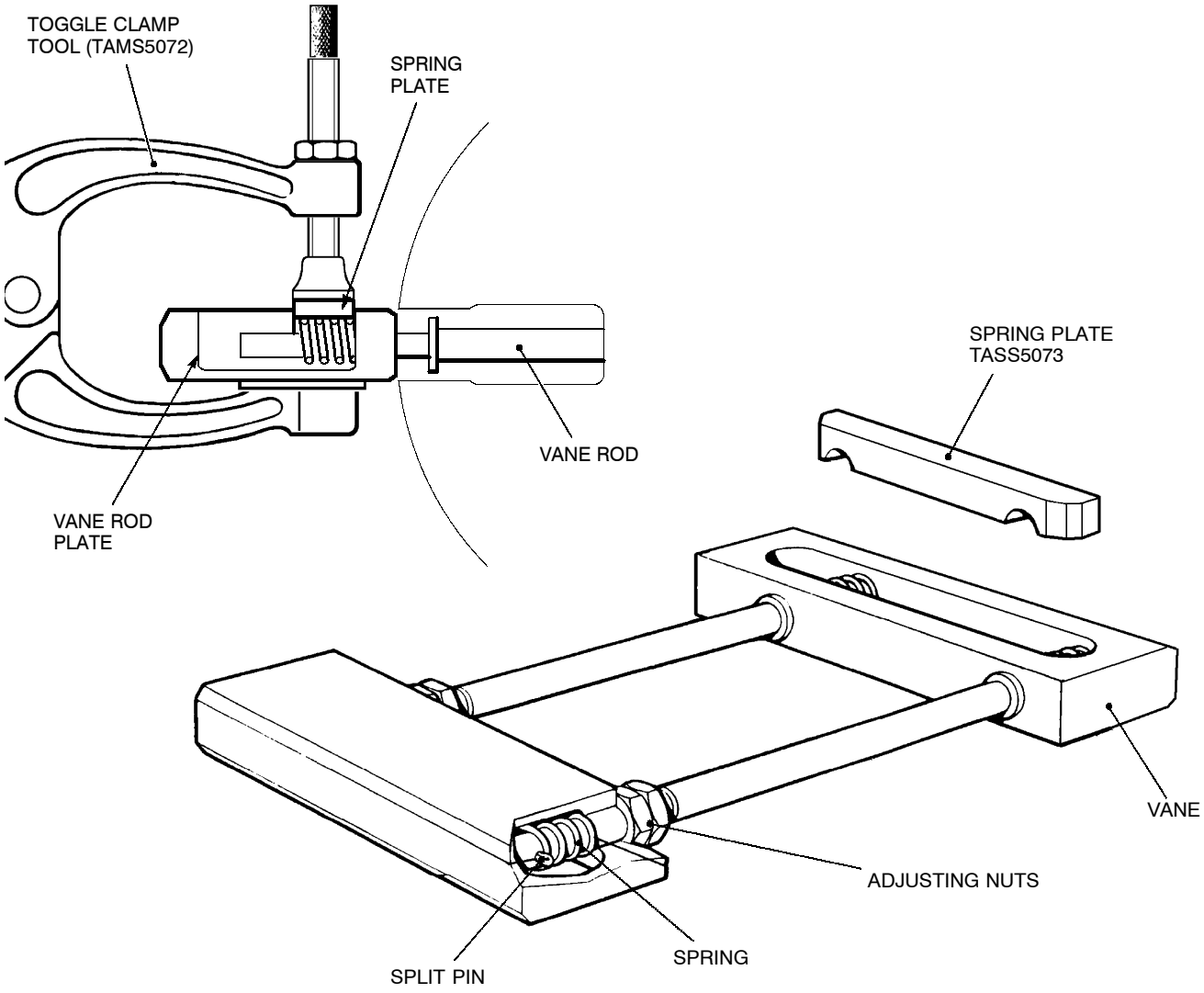


FIG 5.3 USE OF TOGGLE CLAMP TOOL TAMS5072

5.14 Withdraw the remaining vane complete with vane rods, from the rotor (26). Do not remove the vane from the rods unless it is damaged or excessively worn.
IMPORTANT: Do not unscrew the adjusting nuts (43) as their removal will disturb the overall vane clearance on re-assembly.

5.15 After removal,temporarily re-assemble each vane assembly to avoid mixing components.

5.16 The four gland assemblies within the rotor may now be removed. Dismantle each assembly in turn to ensure parts do not become mixed.
IMPORTANT: Gland Assemblies must be refitted in their original positions, it is recommended that each is identified using a suitable marker.

5.17 To dismantle each assembly (refer to Fig.5.4), bend down the tab washer (33), remove the securing screw (34) and clamp plate (32). Stretch a piece of cloth over the rotor recess to collect the parts and turn the rotor upside down and allow the gland assemblies to fall.

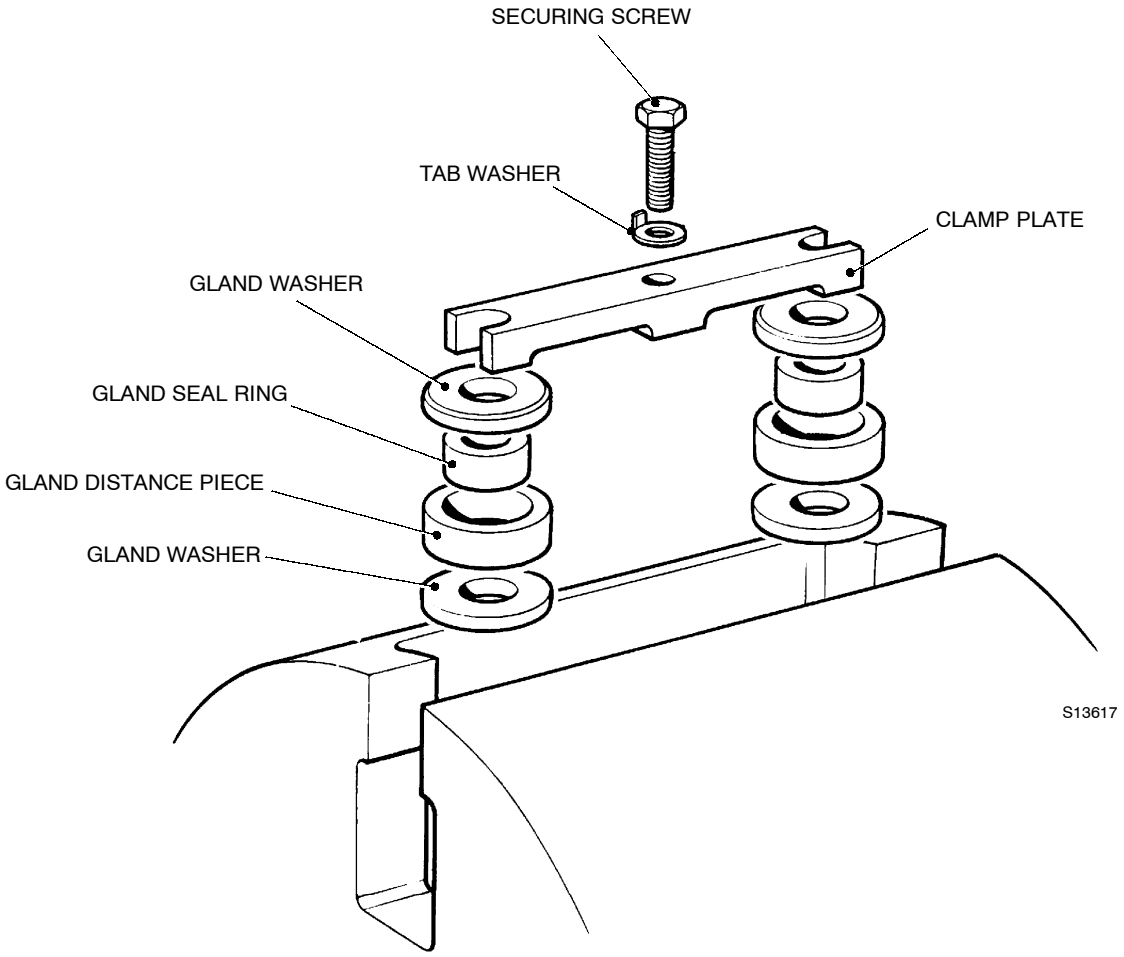


FIG 5.4 GLAND ASSEMBLY

6 CALIBRATING MECHANISM - Dismantling

6.1 Although operational failures of the calibrating mechanism are rare, it is recommended that, if possible, any necessary repairs are carried out without the removal of the calibrating adjustment mechanism. If dismantling is found necessary refer to Fig 5.5.

6.2 Remove the locking wire from the two sealing screws (55) securing the register (58) to the calibrating mechanism base (1). Remove the two remaining screws (56) and washers (57) and lift off the register.

6.2 From the rear of the base, tap out the two dowel pins (15) which locate the calibrating gear bracket (12).

6.3 Lay the calibrating mechanism on its back and remove the three cap head screws (13) and washers (14) securing the gear bracket to the base (1).

6.4 Carefully lift the gear bracket, complete with calibrating adjustment mechanism and gear wheels clear of the base, recover the planet gear (21) and balance weight (22) which are a loose fit in the planet wheel carrier assembly (20).

6.5 Remove the retaining nut (41) from the calibrating screw (40). Slacken the clamping screw (42) fitted to the lug of the gear bracket (12).

6.6 To aid adjustment on re-assembly, note the number of calibrating screw threads (40) protruding through the end lug on the bracket and the angular position of the screwdriver slot. Remove the calibrating screw.

NOTE:

The end of the calibrating screw incorporates the small ball race. If the ball race is unserviceable the calibrating screw and ball race must be replaced.

6.7 Withdraw the worm shaft (37) complete with friction roller (38).

6.8 Further dismantling of components is straight forward, involving the removal of tension pins and screws.

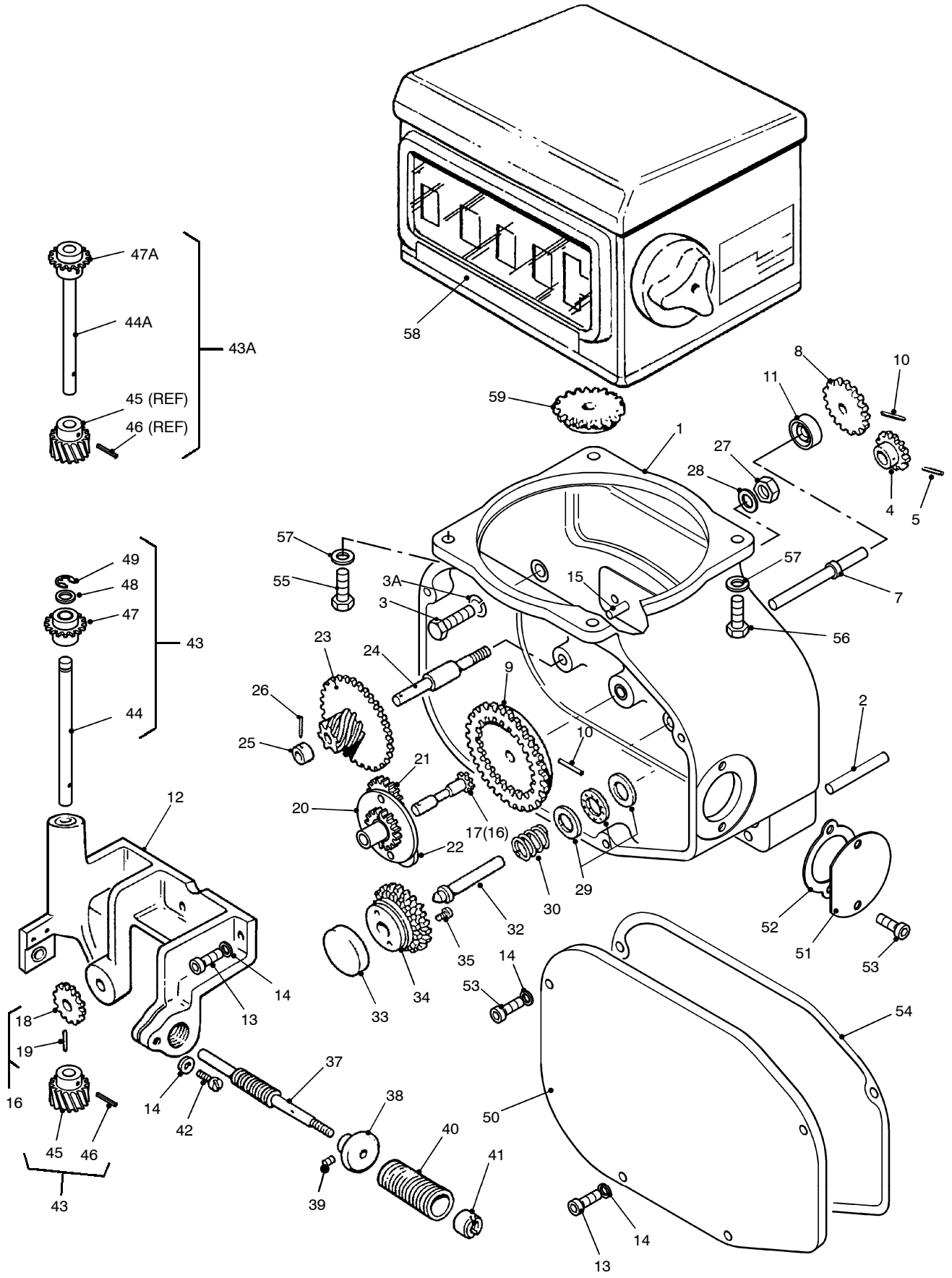


FIG 5.5 CALIBRATING MECHANISM

7 VEEDER ROOT REGISTER - Servicing

7.1 Information on Veeder Root register dismantling, inspection and reassembly is contained in Veeder Root Manuals No. 251325 and 158. If repairs are beyond the scope of local facilities, the register should be returned to Liquid Controls.

8 BULKMETER BODY - Cleaning And Inspection

8.1 Using approved cleaning fluid thoroughly clean all components, pay particular attention to 'O' ring seal recesses, and rotor bores.

8.2 Do not repair damaged components. Any unserviceable component must be renewed.

8.3 Inspect rotor ball races for signs of wear or damage.

8.4 Examine each vane assembly for damage or undue wear. If either is apparent the complete assembly must be renewed.

8.5 Check the overall length of each vane assembly, (Fig 5.6). If incorrect, and accurate measuring instruments are available, the length can be reset by making the necessary adjustment using the adjusting nuts (43).

8.6 If test equipment is available check spring loads (Table 2 items 8 and 9).

8.7 Check that the gland seal ring (30) is a free fit in the gland distance piece (31). Renew components as necessary.

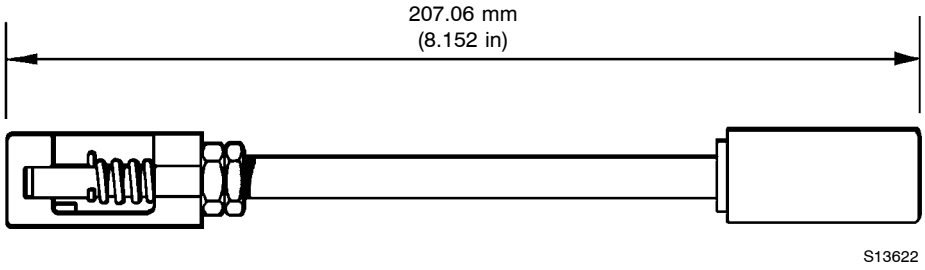


FIG 5.6 VANE LENGTH

9 CALIBRATING MECHANISM - Cleaning And Inspection

9.1 Thoroughly clean all components using clean kerosene.

9.2 Examine all gears for excessive wear, under cutting of teeth and security of fixture to spindles.

9.3 If the mechanism has not been completely dismantled, examine all gears for free meshing.

9.4 Inspect ball races for signs of wear or damage.

9.5 Inspect all bracket bushes for wear. If these bushes are unduly worn, the complete bracket must be renewed. Bushes cannot be supplied separately.

10 BULKMETER BODY - Re-assembly

10.1 On re-assembly always use new 'O' ring seals, bonded washers and split pins. It is most important to maintain the cleanliness of components during re-assembly.

10.2 If a new rotor is being fitted, the clearance between the inner covers and rotor face must be checked. If rotor is not being renewed continue with paragraph 10.6.

10.3 Fit rotor into body without compression spring (13).

10.4 Place a straight-edge across body of meter and using feeler gauges measure the clearance between rotor face and underside of straight-edge. See Table 1 – Fits and Clearances.

10.5 If the measured clearance is outside the figures stated then the meter and new rotor should be returned to Liquid Controls for re-shimming, re-calibration and test.

10.6 Place the compression spring (13) in position in the inner rear cover boss, fit rotor (26), complete with bearings (10) into the body (1).

10.7 Locate the inner front cover (5) into position over the dowels (4) and secure to the body with the two screws (9) and a minimum of four equally spaced cover bolts (22).

10.8 Mark a permanent line “X” (See Fig 5.7) approximately 6mm (0.25”) long from near the edge of the adjuster.

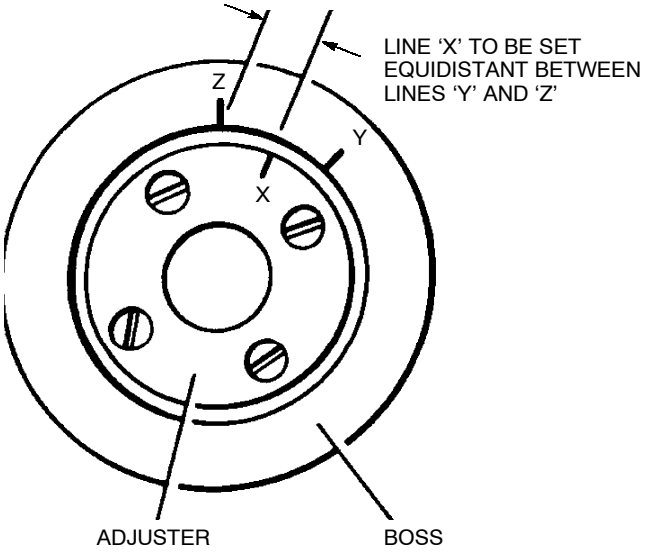


FIG 5.7 BEARING ADJUSTER CLEARANCE

10.9 Spin the rotor and screw the adjuster inwards until the rotor is heard to touch the inner REAR cover (6). Mark the boss of the inner front cover in pencil with a line “Y” coinciding with line “X” on the adjuster.

10.10 Spin the rotor and unscrew the adjuster until the rotor is heard to touch the inner FRONT cover. Mark the boss, in pencil with a line “Z” coinciding with line “X” on the adjuster.

10.11 Identify the inner front cover, with adjuster fitted, with its particular rotor and body and remove the cover. With a scriber make the lines “Y” and “Z” on the cover boss permanent. Check that the angle between the two lines is between 45 deg and 57 deg for BM250 and BM900 meters, 62 deg and 76 deg for BM450 and BM550 meters and 76 deg and 95 deg for BM650 and BM750 meters.

10.12 Reset the bearing adjuster (11) by screwing the adjuster inwards to bring line “X” (Figure 5.7) equidistant between lines “Z” and “Y”. Lock the adjuster with the counter sunk screw (12).

10.13 Withdraw the rotor from the body.

10.14 Assemble each gland as shown in Fig 5.4 (the chamfered edges of the lower gland washers (29) face downwards). Ensure that each gland assembly is located in its correct rotor recess.

Table 1 - Fits and Clearances

ITEM	DESCRIPTION			CLEARANCE OR DIMENSION
1	Overall clearance between rotor & inner covers.			
	Single Capsule			0.10 mm to 0.15 mm (0.004 in. to 0.006 in.)
	Double Capsule			0.15 mm to 0.20 mm (0.006 in. to 0.008 in.)
	Triple Capsule			0.20 mm to 0.25 mm (0.008 in. to 0.010 in.)
2	Clearance between tip of vane and bore of body.			0.15 mm to 0.25 mm (0.006 in. to 0.010 in.)
3	Clearance between rotor and bore of body. See Fig 5.8 Position A –Upper position B –Lower	BM250, BM950	A	0.03 mm to 0.04 mm (0.0015 in. to 0.0017 in.)
			B	0.09 mm to 0.11 mm (0.0035 in. to 0.0043 in.)
		BM450, BM550	A	0.17 mm to 0.22 mm (0.007 in. to 0.009 in.
			B	0.10 mm to 0.13 mm (0.004 in. to 0.005 in.)
		BM650, BM750	A	0.07 mm to 0.13 mm (0.003 in. to 0.005 in.)
			B	0.11 mm to 0.14 mm (0.0043 in. to 0.0055 in.)
4	Overall length of vane assembly from vane tip to vane tip.			207.06 mm (8.152 in.)
5	Internal diameter of gland seal ring.			9.34 mm to 9.36 mm (0.3678 in. to 0.3686 in.)
6	Outside diameter of vane rod.			9.27 mm to 9.29 mm (0.3650 in. to 0.3658 in.)
7	Clearance between gland seal ring.			0.05 mm to 0.90 mm (0.0020 in. to 0.0036 in.)
8	Rotor Compression Spring			To give load of 6.3 to 7.2 kg at 15.87 mm (14 to 16 lbf at 0.625 in.)
9	Vane Compression Spring			To give load of 3.2 to 3.4 kg at 6.86 mm (7 to 7.5 lbf at 0.27 in.)

10.15 Position the clamp plate (32), fit a new tab washer (33) to the securing screw (34).
CAUTION: DO NOT over-tighten the screw and check that the clamp plate will not foul the vane rods during operation. Secure the clamp plate.

10.16 Ensure that each gland seal ring (30) is a free fit within the gland distance piece (31).

10.17 Locate vane and rods into their correct slot in the rotor, ensuring the recessed face of the vane is towards the stepped face of the rotor slot.

10.18 Refit the vane washers (41) on the correct rods and refit the opposite vane by repeating paragraphs 10.18 to 10.21. Ensure the vane is seated on the washers by lightly tapping with a rubber mallet.

10.19 Repeat the above procedures for the second vane assembly. Ensure that the assemblies are a free fit within the rotor by slowly revolving the rotor by hand and allowing each assembly to fall slowly under its own weight.

10.20 Fit rotor tool TASS 5006 and turn the rotor to fully depress two adjacent vanes against the metering crescent (smaller radius in body) to aid correct final positioning. The rear ball race should seat evenly in the rear inner cover and when finally positioned the rotor should revolve freely.

10.21 In the position shown in Fig 5.8 check the clearance between the tip of the vane and the bore of the body (Table 1 Item 2). The clearance should be equal at each end of the vane to within .05mm (.002in). If the clearance is incorrect, reset the vanes by the adjusting nuts using special spanner TASZ 5008.

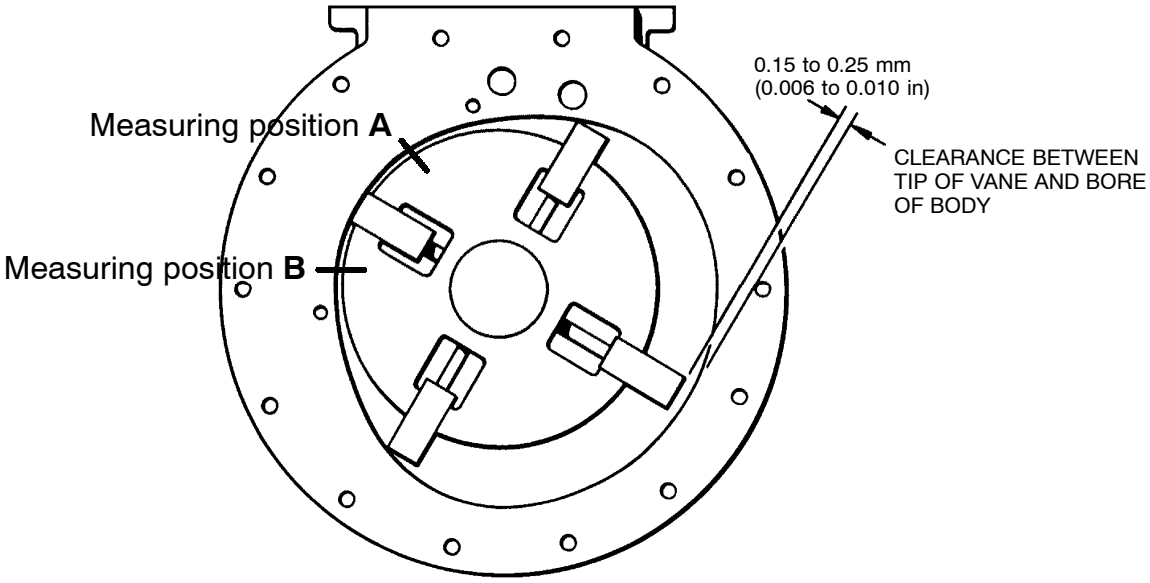


FIG 5.8 VANE CLEARANCE

10.22 Remove rotor assembly and locate compression spring (13) into the rear inner cover. Refit rotor assembly.

10.23 Remove rotor tool and fit a new 'O' ring seal (8) to the body and locate the front inner cover into position over the dowels (4), secure with two screws (9).

10.24 If the spindle seal (16) has been removed, press the new seal into the front outer cover (14) with the spring towards the rotor. Refit the backing washer (17) and seal retaining plate (18), secure with three screws (19).

10.25 Fit a new 'O' ring seal (15) to the front outer cover. Locate the cover into position. Ensure the two sealing bolts (21) are correctly located, secure the front cover with bolts (21 and 22), nuts (25) and washers (24).

11 CALIBRATING MECHANISM - Reassembly

11.1 Refer to Fig 5.5. Re-assemble components dismantled at Para 6.

11.2 Locate worm shaft (37) complete with friction roller (38) into gear bracket (12).

11.3 Locate calibrating screw (40) and ball race into gear bracket, screw in until the number of threads protruding equal to that noted in Paragraph 6.7. The position of the friction roller (38) on the friction disc (33) will be indicated by a circular mark on the ground face of the disc.

11.4 Tighten the clamping screw (42) and install the worm shaft retaining nut (41).

11.5 Align the planetary gear assembly, locate the gear bracket (12) into position and loosely secure it to the base (1) with three screws (13) and washers (14).

11.6 Fit the two dowel pins (15) into the rear of the base, ensure that they locate into the holes in the gear bracket.

11.7 Tighten the three bracket securing screws.

11.8 Ensure the gears correctly mesh and refit the register (58) to the base (1), secure with the four screws (55), (56) and washers (57).

12 FINAL REASSEMBLY

12.1 Locate the calibrating mechanism assembly, complete with register, onto the front outer cover of the meter, taking care not to damage the dowels (2). Secure in place with four bolts (3) and spring washers (3A).

12.2 Position the calibrating mechanism cover (50), complete with a new gasket (54) and secure with screws (13), (53) and washers (14).

12.3 Prior to re-installing or storage carry out the appropriate actions as detailed in Chapter 4.

12.4 Renew all sealing washers, sealing wires and lead seals.

13 METER TESTING

13.1 On completion of overhaul, bulkmeters may be tested ~~on a special rig~~ with suitable proving tanks. Alternatively, an Avery-Hardoll brand Master Meter may be used.

13.2 ~~Instructions for operating the Master Meter and carrying out testing are contained in a separate manual, Liquid Controls Publication No. E1/351.~~

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Chapter 6

FAULT FINDING

1 GENERAL

1.1 Because of the simple robust design of the bulkmeter, in most instances fault finding is limited to the location and rectification of leaks. The following table lists faults that may be more difficult to diagnose, their possible cause(s) and remedy.

1.2 In cases where the accuracy of the meter is in doubt, testing and calibration as in Chapter 5 Para 13 is to be carried out. If such calibration proves ineffective the bulkmeter should be removed from service and returned to Liquid Controls for overhaul and repair. If this is not practical, the appropriate procedures described in Chapter 5 may be carried out by a suitably qualified person providing full workshop facilities are available.

1.3 It must be remembered that the fault 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.

TABLE 1 - FAULT FINDING

FAULT	POSSIBLE CAUSE(S)	REMEDY
No flow	Zero line pressure	Investigate system and rectify.
	Control valve closed	Open control valve.
	Seized Bulkmeter rotor	Refer to Chapter 5, dismantle clean, inspect and renew components as necessary. Reassemble and test.
Reduced/Erratic Flow	Fluctuating line pressure	Investigate system and rectify.
	Control valve not fully open	Open control valve.
	Partially seized rotor	Refer to Chapter 5, dismantle clean, inspect and renew components as necessary. Reassemble and test.
Overspeeding	System not bled free of air/vapour	Bleed system. If fault persists consider fitting air separator upstream of meter.
Rate of flow indicator contaminated	Ingress of water to calibrating mechanism	Locate and cure the leak.
	Calibrating mechanism overfilled with oil	Lubricate calibration mechanism with GREASE (see Chapter 4).
		Renew Rate of flow indicator.

TABLE 1 - FAULT FINDING (continued)

FAULT	POSSIBLE CAUSE(S)	REMEDY
EXTERNAL LEAKS AT:		
Manifold/Pipeline Flanges	Loose flange nuts Defective gasket(s)	Check tighten nuts. Renew gaskets, check condition of flange faces.
Meter Body/Manifold Seal	Loose nuts Defective seal	Check tighten nuts. Renew seal, check seal seating.
Front Cover/Meter Body	Loose nuts Defective seal(s)	Check tighten nuts. Refer to Chapter 5, renew cover seal(s).
Front Cover/Calibrating mechanism	Faulty spindle seal Drive spindle not concentric	Refer to Chapter 5, renew spindle seal. Use a clock gauge and check concentricity is within 0.076 mm (0.003 in.) total clock reading,
Rear Cover/Meter Body	Loose nuts Defective seal(s)	Check tighten nuts. Return meter to Liquid Controls. DO NOT ATTEMPT REAR COVER REMOVAL
Rear cover spindle seal (additive adaption only)	Faulty spindle seal Spindle not concentric	Refer to Chapter 5.
General Leakage	Seal(s) incompatible with product	Verify seal compatibility.
Failure to adjust calibration within limits	Internal wear of Calibration Mechanism and/or Meter	Refer to Chapter 5, dismantle clean, inspect and renew defective components of calibrating mechanism/meter. Reassemble and test.
Register reading erratic or failing to read	Calibration mechanism drive or gear train faulty Lack of, or poor, lubrication Faulty register	Refer to Chapter 5 and dismantle, clean and inspect, renew components as necessary. Reassemble and test. Check lubrication. Renew register.
Measurement problems	Meter not calibrated for the product being measured	Calibrate with Master Meter

Chapter 7

SPARE PARTS

CONTENTS

When ordering spare parts please quote the following information.

- Model number and mark
- Publication number and issue
- Figure number
- Figure reference number
- Part number
- Description
- Serial number of Meter

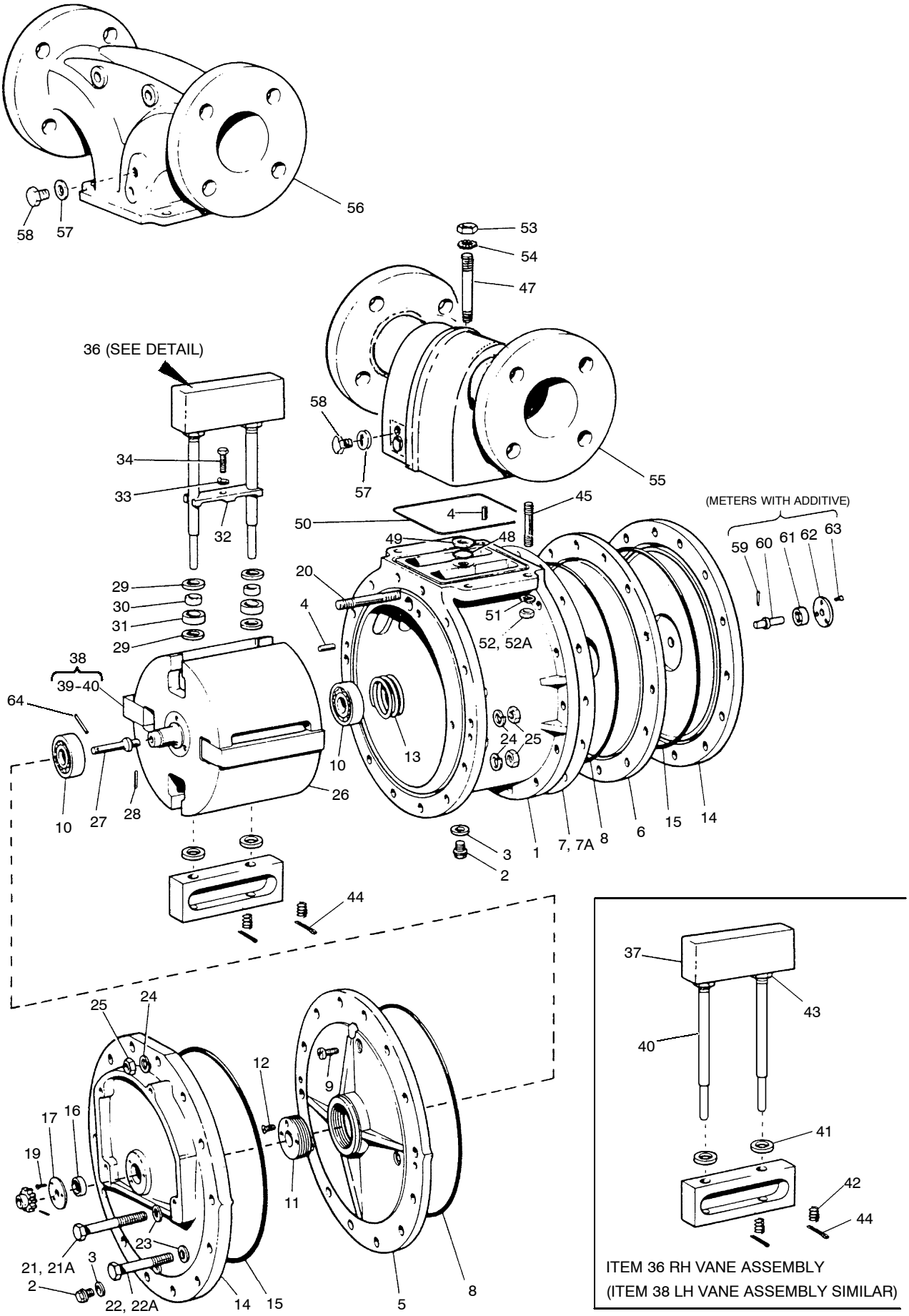


FIG 7.1 BULKMETER COMPONENTS

Fig/ Item No.	Part No.	Description	Qty Req'd (Iron Manifold in brackets)		
			SINGLE	DOUBLE	TRIPLE
7.1-1	NOT SPARED	BODY	Ref	Ref	Ref
2	ZASZ0017-3	DRAIN PLUG	2	3	4
3	ZMMZ0135-4	SEALING WASHER	2	3	4
4	ZASZ0104-2	DOWEL PIN 1/4" X 3/4"	4	4	4
5	NOT SPARED	FRONT COVER INNER	Ref	Ref	Ref
6	NOT SPARED	BACK COVER INNER	Ref	Ref	Ref
7	SEE TABLE 2	BODY GASKET (RING)	-	-	-
7A	SEE TABLE 2	BODY GASKET (CRESCENT)	-	-	-
*8	Z022E272139A	'O' RING	2	2	2
*9	ZS4025E1010A	SCREW 5/16" UNF X 5/8"	4	4	4
*10	BMSZ1627	BEARING 5/8"	2	2	-
	BMSZ1628	BEARING 7/8" (also used with highflow double)	-	-	2
11	SEE TABLE 5	BEARING ADJUSTER	1	1	1
12	ZS3223E0606A	SCREW	1	1	1
13	BMSZ1613	COMPRESSION SPRING	1	1	-
	BMSZ1614	COMPRESSION SPRING (also used with highflow double)	-	-	1
14	SEE TABLE 3	OUTER COVER: FRONT	1	1	1
	SEE TABLE 4	OUTER COVER: REAR	1	1	1
15	ZARZ0041-31	'O' RING	2	2	2
*16	BMRZ36 OR	SPINDLE SEAL, NITRILE	1	1	1
	BMRZ36-1	SPINDLE SEAL, FLUOROCARBON (FROM ISSUE 8 - YELLOW DOT ON OUTER SURFACE)	1	1	1
*17	BMCZ32894 OR	SEAL RETAINER (FOR NITRILE SEAL)	1	1	1
	BMCZ32894-1	(FOR FLUOROCARBON SEAL)	1	1	1
19	ZS2201A0406A	SCREW 4BA X 5/16"	3	3	3
20	BMSZ1648	STUD	4	4	4
21	BMSZ120	SEALING BOLT SPECIAL	4	4	4
21A	BMSZ120A	SEALING BOLT SPECIAL	-	2	4
22	ZS3226E1232A	BOLT 3/8" UNF X 2"	20	20	20
22A	ZS3226E1228A	BOLT 3/8" UNF X 1 3/4"	-	10	20
23	ZW2201G12A	WASHER 3/8" PLAIN	24	24	24
24	ZW8207G12A	WASHER, SPRING	28	52	72
25	ZN2201E12A	NUT 3/8" UNF	28	40	48
26	SEE TABLE 6 & 7	ROTOR ASSEMBLY	1	1	1
*27	BMSZ26151	ROTOR SPINDLE	1	1	1

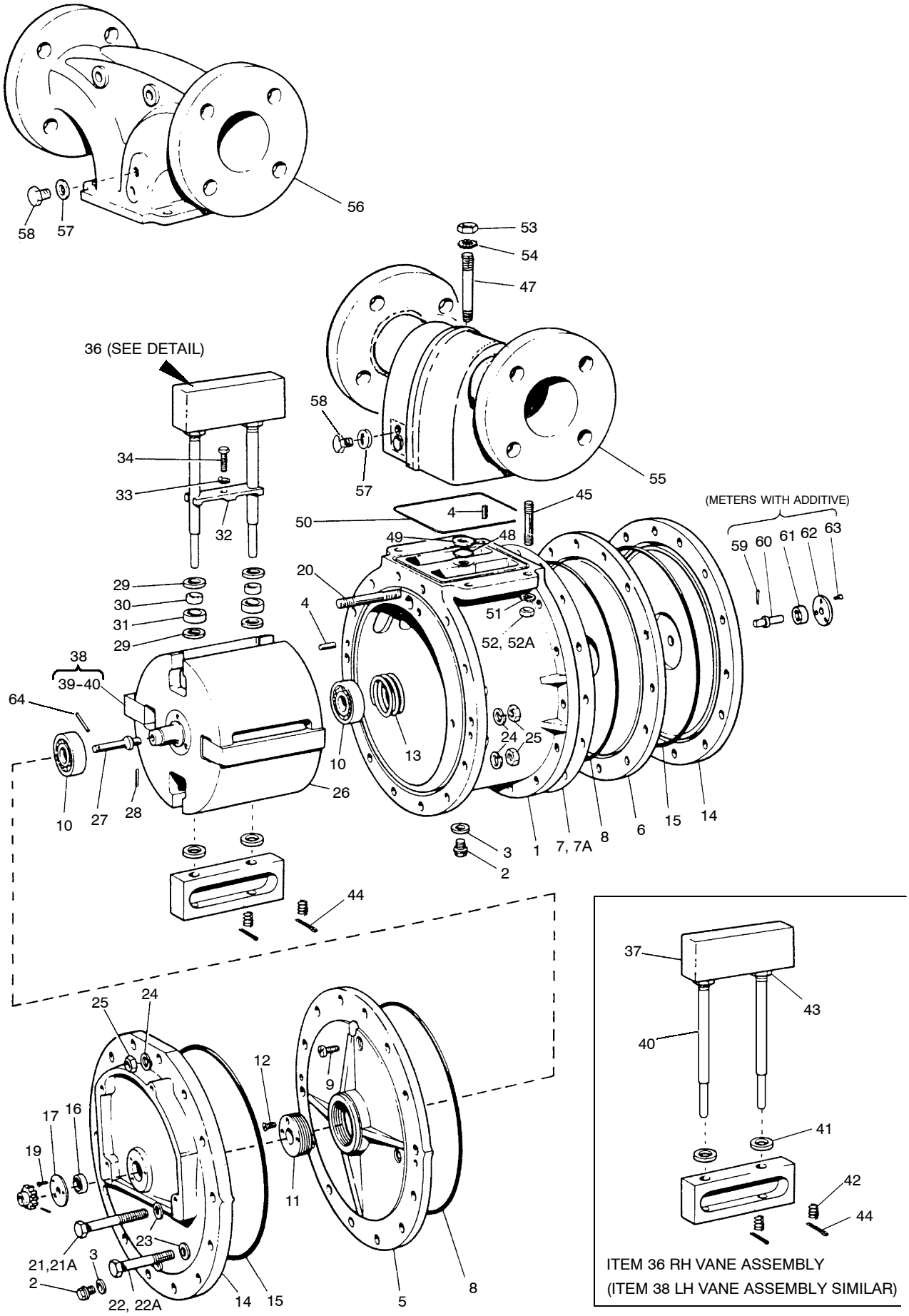


FIG 7.1 BULKMETER COMPONENTS

Fig/ Item No.	Part No.	Description	Qty Req'd (Iron Manifold in brackets)		
			SINGLE	DOUBLE	TRIPLE
28	ZT8001E0410A	TENSION PIN	1	1	1
29	BMSZ7634	GLAND WASHER	16	32	48
30	BMYZ7633	GLAND SEAL RING	8	16	24
31	BMSZ7635	GLAND DISTANCE PIECE	8	16	24
32	BMSZ13724	GLAND CLAMP STEEL	4	8	12
33	BMSZ7642	GLAND CLAMP TAB WASHER	4	8	12
34	ZS4028M05016A	GLAND CLAMP SCREW	4	8	12
*36 +	BMMZ17711	VANE ASSEMBLY R/H (comprising Items 37, 40-44)	1	2	3
*38	BMMZ17712	VANE ASSEMBLY L/H (comprising Items 39-44)	1	2	3
*44	ZT4006E0208A	PIN, SPLIT, ST.ST. 1/16" DIA X 1/2" LG	8	16	24
45	SEE TABLE 8	MANIFOLD STUD	4	8	12
46 +	SEE TABLE 9	MANIFOLD STUD, CENTRE (LONG)	-	-	1
47	SEE TABLE 9	MANIFOLD STUD, CENTRE	1	2	2
48	Z022E015070A	'O' RING SEAL	1	2	3
49	BMSZ17502	SEALING RING	1	2	3
50	BMRZ114	'O' RING SEAL	1	2	3
51	ZW8207G12A	WASHER, SPRING	4(8)	8	12
52	ZN2201E12A	NUT 3/8" UNF	4	8	12
52A	BMSZ3016-1	NUT 3/8" UNC (Iron Manifold)	8	-	-
53	ZN2201D14A	NUT	1	2	3
54	ZMMZ0135-8	SEALING WASHER 7/16''	1	2	3
55	NOT SPARED	MANIFOLD STEEL	REF	REF	REF
56	NOT SPARED	MANIFOLD DUCTILE IRON	REF	REF	REF
*57	ZMMZ0135-6	SEAL	A/R	A/R	A/R
58	BMSZ7668	PLUG	A/R	A/R	A/R
59	ZT8001E0410A	TENSION PIN	1	1	1
60	BMSZ2104	SPINDLE 3/8"	1	1	1
61	ZAMZ0091-2	SEAL	1	1	1
*62	BMCZ4457	SEAL RETAINER	1	1	1
63	ZS2201A0406A	SCREW	3	3	3
64	ZT8001E0310A	TENSION PIN	1	1	1

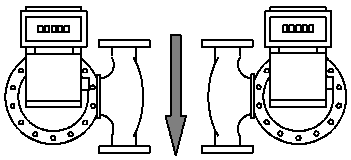
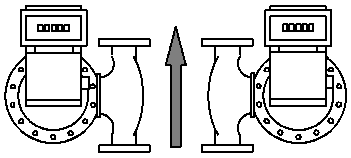
* = SUGGESTED SPARE PART

TABLE 2 - BODY GASKETS (Items 7, 7A) FOR ALL METERS

FIG. 7.1 ITEM 7		
THICKNESS	DESCRIPTION	PART NUMBER
.002”	BODY GASKET (RING)	BMJZ107-2
.005”	BODY GASKET (RING)	BMJZ107-5
FIG. 7.1 ITEM 7A		
THICKNESS	DESCRIPTION	PART NUMBER
.002”	BODY GASKET (CRESCENT)	BMJZ2332-2
.005”	BODY GASKET (CRESCENT)	BMJZ2332-5

The gaskets are used in matched pairs ie: BMJZ107-2 and BMJZ2332-2

TABLE 3 - OUTER COVER - FRONT (Item 14)

STANDARD METERS	PART NUMBER	TYPE
(ALUMINIUM ROTOR)	BMAZ1600	R/H (Standard cover)
	BMAZ1601	L/H (Standard cover)
	BMAZ1600-1	R/H (with drain plug)
	BMAZ1601-1	L/H (with drain plug)
	BMAZ2328	L/H EP.DP. - FOR WATER METER
	BMAZ2329	R/H EP.DP. - FOR WATER METER
	BMAZ19417	VERTICAL - FLOW DOWN (R/H & L/H)
	BMAZ25829	VERTICAL - FLOW UP (R/H & L/H)
	BMAZ1601	L/H MASTERLOAD Mk2
	BMAZ1600	R/H MASTERLOAD Mk2
NI-RESIST METER	BMBZ12470	L/H
	BMBZ12471	R/H
	BMBZ12470-1	L/H (with drain plug)
	BMBZ12471-1	R/H (with drain plug)
	BMBZ12470	L/H MASTERLOAD Mk2
	BMBZ12471	R/H MASTERLOAD Mk2
	BMBZ19434	VERTICAL

EP. - EPINAMEL
DP. - TAPPED FOR DRAIN PLUG

TABLE 4 - OUTER COVER - REAR (Item 14)

STANDARD METERS	PART NUMBER	TYPE
(ALUMINIUM ROTOR)	BMAZ1602	RH & LH (Standard cover)
	BMAZ1602-1	R/H (with drain plug)
	BMAZ1602-2	L/H (with drain plug)
	BMAZ2330	EP.DP. - FOR WATER METER R/H
	BMAZ3290	EP.DP. - FOR WATER METER L/H
NI-RESIST METER	BMBZ25062	RH & LH (Standard cover)
	BMBZ25062-1	RH & LH (with drain plug)
	BMBZ13757	ADDITIVE R/H
	BMBZ13758	ADDITIVE L/H
	BMBZ13757-1	ADDITIVE R/H (with drain plug)
	BMBZ13758-1	ADDITIVE L/H (with drain plug)

EP. - EPINAMEL
DP. TAPPED FOR DRAIN PLUG

TABLE 5 - BEARING ADJUSTER AND SCREW (Items 11 & 12)

DESCRIPTION	PART NUMBER	SINGLE/DOUBLE	HIGHFLOW DOUBLE/TRIPLE
STANDARD METER (ALUM ROTOR)	BMAZ19223	1	
	BMAZ19224		1
NI-RESIST METER	BMSZ19225	1	
	BMSZ19226		1

ALL PARTS MUST BE ACCOMPANIED WITH LOCKING SCREW - Item 12
PART NO. ZS3223E0606A - 1 OFF

TABLE 6 - ALUMINIUM ROTOR ASSEMBLIES (Item 26)

NOTE:

Rotor assemblies are only supplied as follows:

WITH ROTOR SPINDLE	Includes all parts required of the following Item Nos. 26, 27, 28.		
	SINGLE	DOUBLE	TRIPLE
R/H	BMMZ26154	BMMZ26166	BMMZ26178
L/H	BMMZ26153	BMMZ26165	BMMZ26177

WITH SPINDLE, VANES & BEARINGS	Includes all parts required of the following Item Nos. 10, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35		
	SINGLE	DOUBLE	TRIPLE
R/H	BMMZ14073	BMMZ14075	BMMZ14077
L/H	BMMZ14072	BMMZ14074	BMMZ14076

WITH VANES, BEARINGS, ROTOR SPINDLE & ADDITIVE SPINDLE	Includes all parts required of the following Item Nos. 10, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 59, 60		
	SINGLE	DOUBLE	TRIPLE
R/H	BMMZ13729	BMMZ13731	BMMZ13733
L/H	BMMZ13730	BMMZ13732	BMMZ13734

WITH ROTOR & ADDITIVE SPINDLE	Includes all parts required of the following Item Nos. 26, 27, 28, 59, 60		
	SINGLE	DOUBLE	TRIPLE
R/H	BMMZ26158	BMMZ26170	BMMZ26182
L/H	BMMZ26157	BMMZ26169	BMMZ26181

For highflow double rotor assemblies please contact Liquid Controls.

TABLE 7 - NI-RESIST ROTOR ASSEMBLIES

	SINGLE	DOUBLE	TRIPLE
WITH ROTOR SPINDLE			
R/H	BMMZ26191	BMMZ26204	BMMZ26216
L/H	BMMZ26190	BMMZ26203	BMMZ26217
ROTOR SPINDLE VANES & BEARINGS			
R/H	BMMZ24807	BMMZ24809	BMMZ24811
L/H	BMMZ24806	BMMZ24808	BMMZ24810

TABLE 8 - MANIFOLD STUD (FIG 7.1 ITEM 45)

MANIFOLD MATERIAL	BULKMETER CAPSULE		
	SINGLE	DOUBLE	TRIPLE
DUCTILE IRON	BMSZ3016-1	BMSZ103	-
STEEL	BMSZ103	BMSZ103	BMSZ103

TABLE 9 - MANIFOLD STUD (FIG 7.1 ITEM 47)

MANIFOLD MATERIAL	STUD PART NO.	QTY		
		SINGLE	DOUBLE	TRIPLE
DUCTILE IRON	ZASZ0028-5	1	-	-
	ZASZ0028-15	-	2	-
STEEL (to 1997)	ZASZ0028-18	1	2	2
(from 1998)	ZASZ0028-30	1	-	-
	ZASZ0028-19	-	-	1 (CENTRAL)

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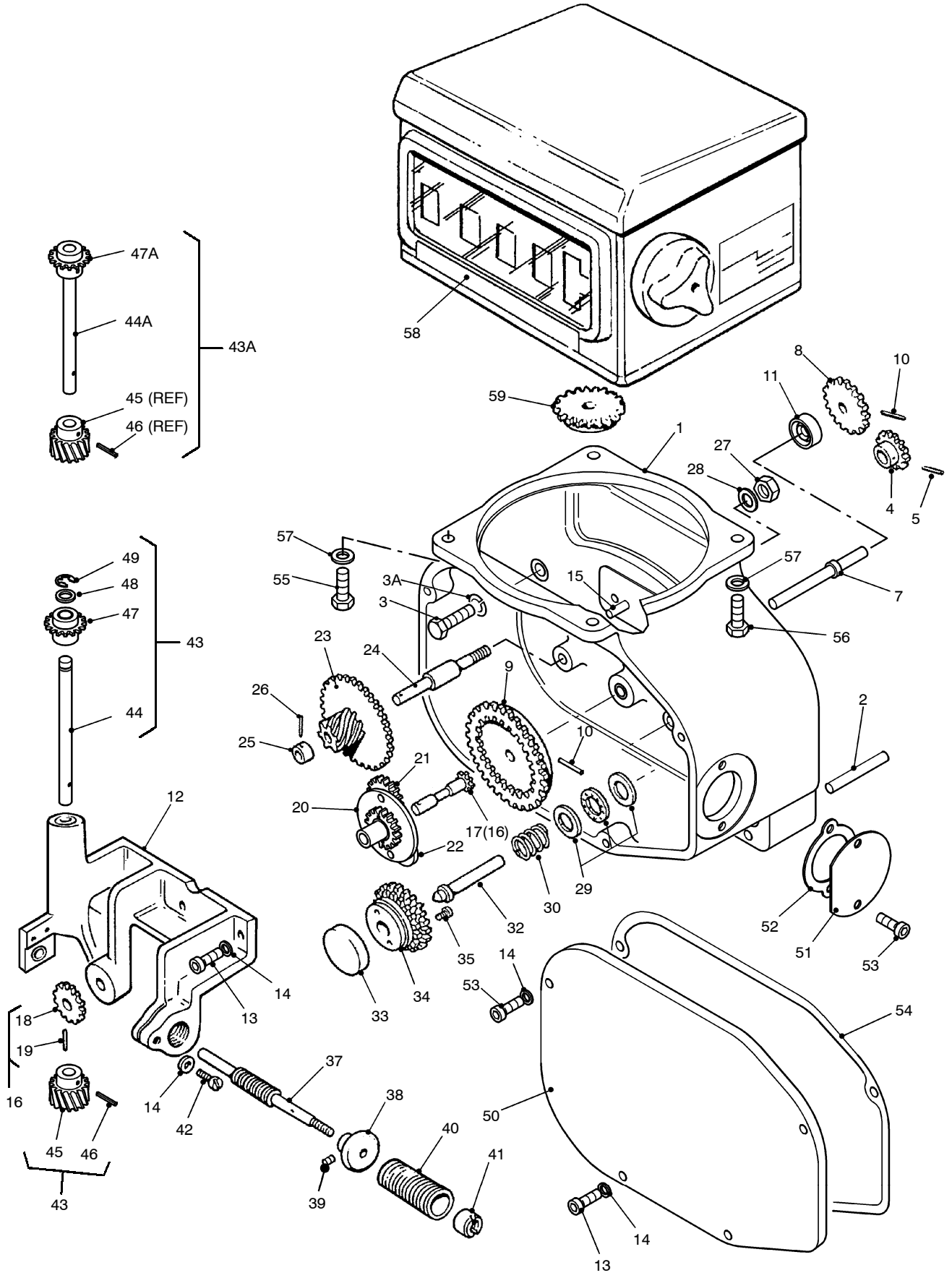

FIG 7.2 CALIBRATING MECHANISM

Fig/ Item No.	Part No.	Description	Qty
7-2			
1	NOT SPARED	CALIBRATING MECHANISM BASE SUB ASSEMBLY	REF
2	ZASZ0029-2	DOWEL PIN, 1/4" X 1 1/2"	2
3	ZS3226E0832A	BOLT, HEX HD, 1/4" UNF X 2"	4
3A	ZW8207G08A	WASHER 1/4" SINGLE COIL	4
4	SEE TABLE 10	ROTOR GEAR	1
5	ZT8001E0308A	TENSION PIN 3/32" X 1/2"	1
6 +	SEE TABLE 10	DRIVING GEAR SUB ASSEMBLY comprising:	1
7		. DRIVING SPINDLE	REF
8		. DRIVING GEAR	REF
9		. INTERMEDIATE GEAR	REF
10		. TENSION PIN (2)	REF
11	BMRZ36	SPINDLE SEAL	1
12	NOT SPARED	CALIBRATING GEAR BRACKET SUB ASSEMBLY	REF
13	ZS3225M05016A	SCREW M5 X 16mm SKT.HD.	5
14	ZW2201M05A	WASHER M5 PLAIN	8
15	ZASZ0104-5	DOWEL PIN, 3/16" X 1/2", SILV STL	2
16	BMMS66	SUN GEAR SUB ASSEMBLY comprising:	1
17		. SUN GEAR, 12T	REF
18		. WORM GEAR, 28T	REF
19		. TENSION PIN, 3/32" X 7/16", SP STL	REF
20	BMMS4021	PLANET WHEEL CARRIER SUB ASSEMBLY comprising:	1
		. CARRIER, PLANET WHEEL	REF
		. GEAR, 34T	REF
		. PIN	REF
		. TENSION PIN, 1/16" X 5/16", SP STL	REF
21	BMCZ10340	PLANET GEAR	1
22	BMCZ10339	BALANCE WEIGHT	1
23	SEE TABLE 11	SPIRAL GEAR SUB-ASSEMBLY	1
24	BMSZ53	SPIRAL GEAR STUD	1
25	BMSZ54	COLLAR	1
26	ZT8001E0308A	TENSION PIN 3/32" X 1/2"	1
27	ZN2201B08A	NUT 1/4" BSF	1
28	ZW8207G08A	WASHER 1/4" SINGLE COIL	1
29	ZAMZ0077-2	BALL BEARING/THRUST WASHERS	1
30	BMSZ90	FRICTION DISC SPRING	1

* = SUGGESTED SPARE PART + = NOT ILLUSTRATED

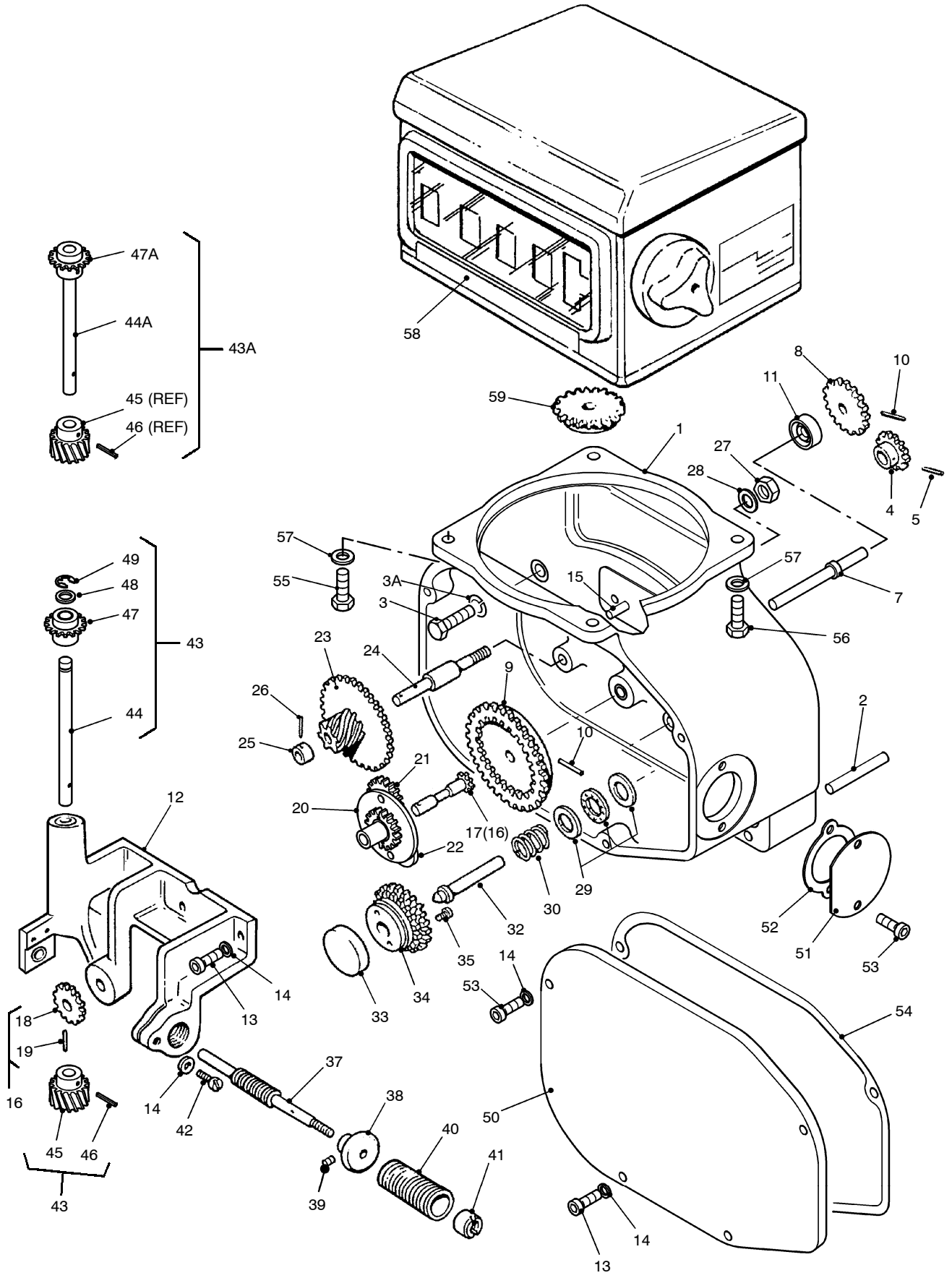

FIG 7.2 CALIBRATING MECHANISM

Fig/ Item No.		Part No.	Description	Qty
7-2				
31	+	BMMS17228	DISC GEAR SUB ASSEMBLY comprising:	1
32		BMSZ70	. SPINDLE, FRICTION DISC	1
33		BMSZ73	. DISC, FRICTION DRIVE	1
34		BMMZ17248	. SHELL/DISC GEARS ASSEMBLY	1
35		ZS2203A0504A	. SCREW, 5BA X 1/4", CH.HD.	2
36	+	BMMS77	CALIBRATOR WORM SHAFT SUB ASSEMBLY comprising:	1
37			. CALIBRATOR, WORM SHAFT	1
38			. FRICTION ROLLER	1
39			. SKT GRUB SCREW, CUP POINT, HTS, M5 X 6MM	1
40		BMMS80	CALIBRATING SCREW SUB ASSEMBLY	1
41		BMCZ78	NUT, SPECIAL	1
42		ZS2203A0210A	SCREW CH.HD. 2BA X 5/8"	1
43		SEE TABLE 12	INTERMEDIATE SHAFT SUB ASSEMBLY (WITH CLUTCH) incorporating ITEMS 44 TO 49	1
43A		SEE TABLE 12	INTERMEDIATE SHAFT SUB ASSEMBLY (WITHOUT CLUTCH) incorporating ITEMS 44A, 45, 46 AND 47A	1
47		SEE TABLE 13	DRIVE GEAR	1
48		ZASZ0035-17	SHIM WASHER	1
49		ZASZ0058-4	CIRCLIP	1
50		BMAS33225 BMAS33225M	CALIBRATING MECHANISM COVER, NO RATE OF FLOW CALIBRATING MECHANISM COVER, FOR RATE OF FLOW	1
51		BMSZ32988	FLAT PLATE	1
52		BMDZ109	GASKET	1
53		ZMSZ0111-16	SEALING SCREW M5 X 16mm	2
* 54		BMDZ33226	GASKET, CALIBRATING MECHANISM COVER	1
55		BMSZ2362	SCREW SPECIAL SEALING	2
56		ZS3228E0812A	SCREW 1/4" UNF x 3/4"	2
57		ZW8205G08A	WASHER 1/4" EXT. SHAKEPROOF	4
58		INFORMATION ONLY	REGISTER	-
59		SEE TABLE 14	REGISTER DRIVING GEAR	-

* = SUGGESTED SPARE PART + = NOT ILLUSTRATED

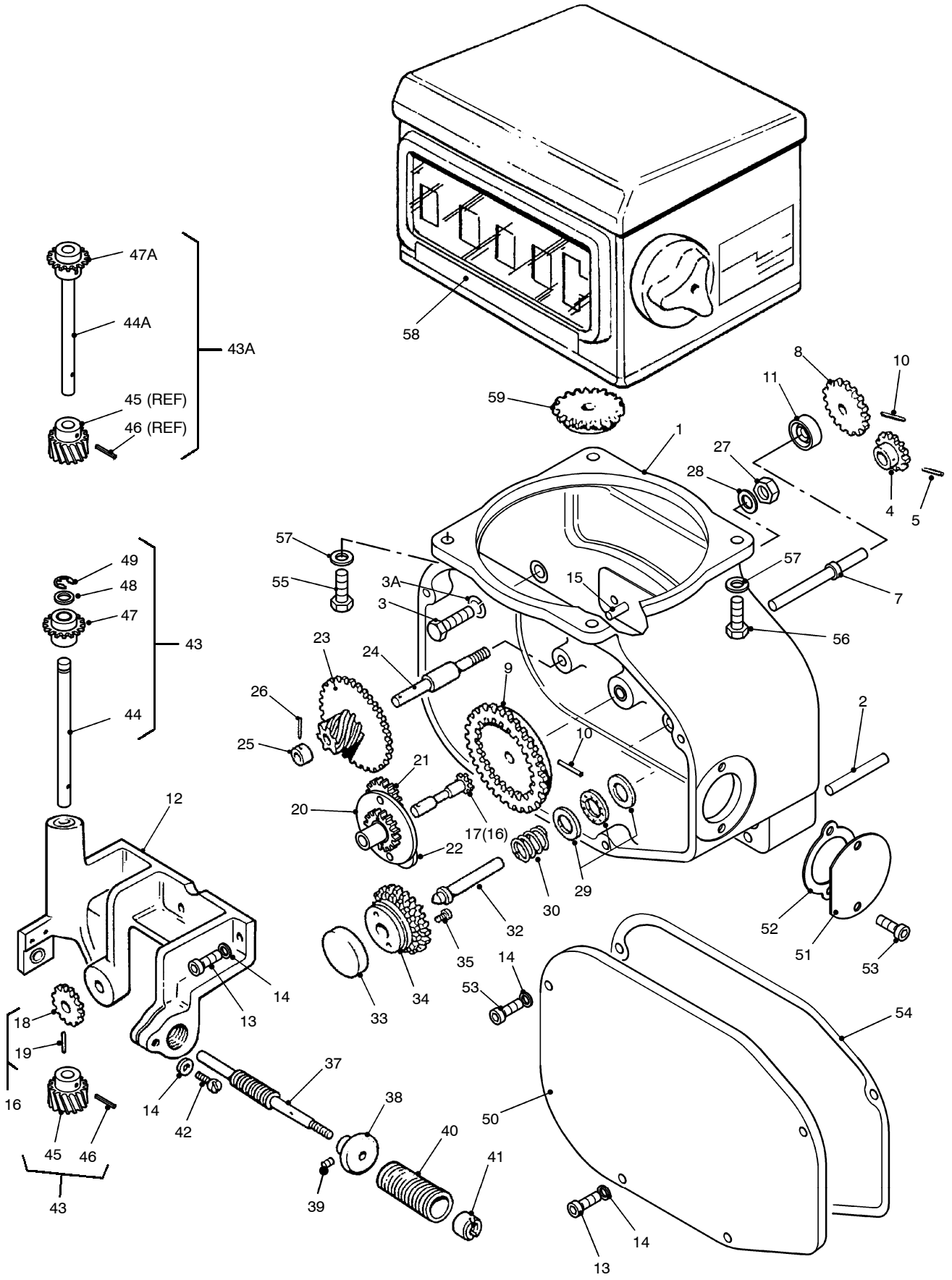

FIG 7.2 CALIBRATING MECHANISM

TABLE 10 - ROTOR & DRIVING GEARS (FIG 7.2, ITEMS 4 & 6)

				DECALITRE ONLY		
	SINGLE	DOUBLE	TRIPLE	SINGLE	DOUBLE	TRIPLE
ITEM 5	BMSZ33	BMSZ134	BMSZ47	BMSZ33	BMSZ33	BMSZ130
ITEM 7	BMMS1862	BMMS2324	BMMS2322	BMMS1862	BMMS1862	BMMS2325

TABLE 11 - SPIRAL GEAR SUB-ASSEMBLY (FIG 7.2, ITEM 23)

METER TYPE		PART NUMBER			
		LITRES	DECALITRES	US GALLONS	IMP. GALLONS
L/H	SINGLE	BMMZ44	BMMZ3275	BMMZ44	BMMZ44
	DOUBLE	BMMZ44	BMMZ44	BMMZ44	BMMZ44
	TRIPLE	BMMZ44	BMMZ44	BMMZ44	BMMZ44
R/H	SINGLE	BMMZ45	BMMZ3276	BMMZ45	BMMZ45
	DOUBLE	BMMZ45	BMMZ45	BMMZ45	BMMZ45
	TRIPLE	BMMZ45	BMMZ45	BMMZ45	BMMZ45

TABLE 12 - INTERMEDIATE SHAFT SUB-ASSEMBLY

FIG 7.2, ITEM 43 (WITH CLUTCH)

METER TYPE		PART NUMBER			
		LITRES	DECALITRES	US GALLONS	IMP. GALLONS
L/H	SINGLE	BMMS31479	BMMS31481	BMMS31479	BMMS31479
	DOUBLE	BMMS31479	BMMS31479	BMMS31479	BMMS31479
	TRIPLE	-	BMMS31479	BMMS31479	BMMS31479
R/H	SINGLE	BMMS31480	BMMS31482	BMMS31480	BMMS31480
	DOUBLE	BMMS31480	BMMS31480	BMMS31480	BMMS31480
	TRIPLE	-	BMMS31480	BMMS31480	BMMS31480

FIG 7.2, ITEM 43A (WITHOUT CLUTCH)

METER TYPE		PART NUMBER			
		LITRES	DECALITRES	US GALLONS	IMP. GALLONS
L/H	SINGLE	BMMS105	BMMS3400	BMMS192	BMMS86
	DOUBLE	BMMS105	BMMS1622	BMMS192	BMMS86
	TRIPLE	BMMS105	BMMS1622	BMMS192	BMMS86
R/H	SINGLE	BMMS104	BMMS3401	BMMS193	BMMS88
	DOUBLE	BMMS104	BMMS1623	BMMS193	BMMS88
	TRIPLE	BMMS104	BMMS1623	BMMS193	BMMS88

TABLE 13 - DRIVE GEAR (FIG 7.2, ITEM 47) (WITH CLUTCH)

LITRES	DECALITRES	US GALLONS	IMP. GALLONS
BMMS31470D	BMMS31470A	BMMS31470B	BMMS31470C

TABLE 14 - REGISTER DRIVING GEAR (FIG 7.2, ITEM 59)

LITRES	DECALITRES	US GALLONS	IMP. GALLONS
BMCS101	BMCS1620	BMCZ190	BMCZ87

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Appendix to Chapter 7

CALIBRATING MECHANISM Mk.IIA FITTED TO METERS MADE BEFORE 1998

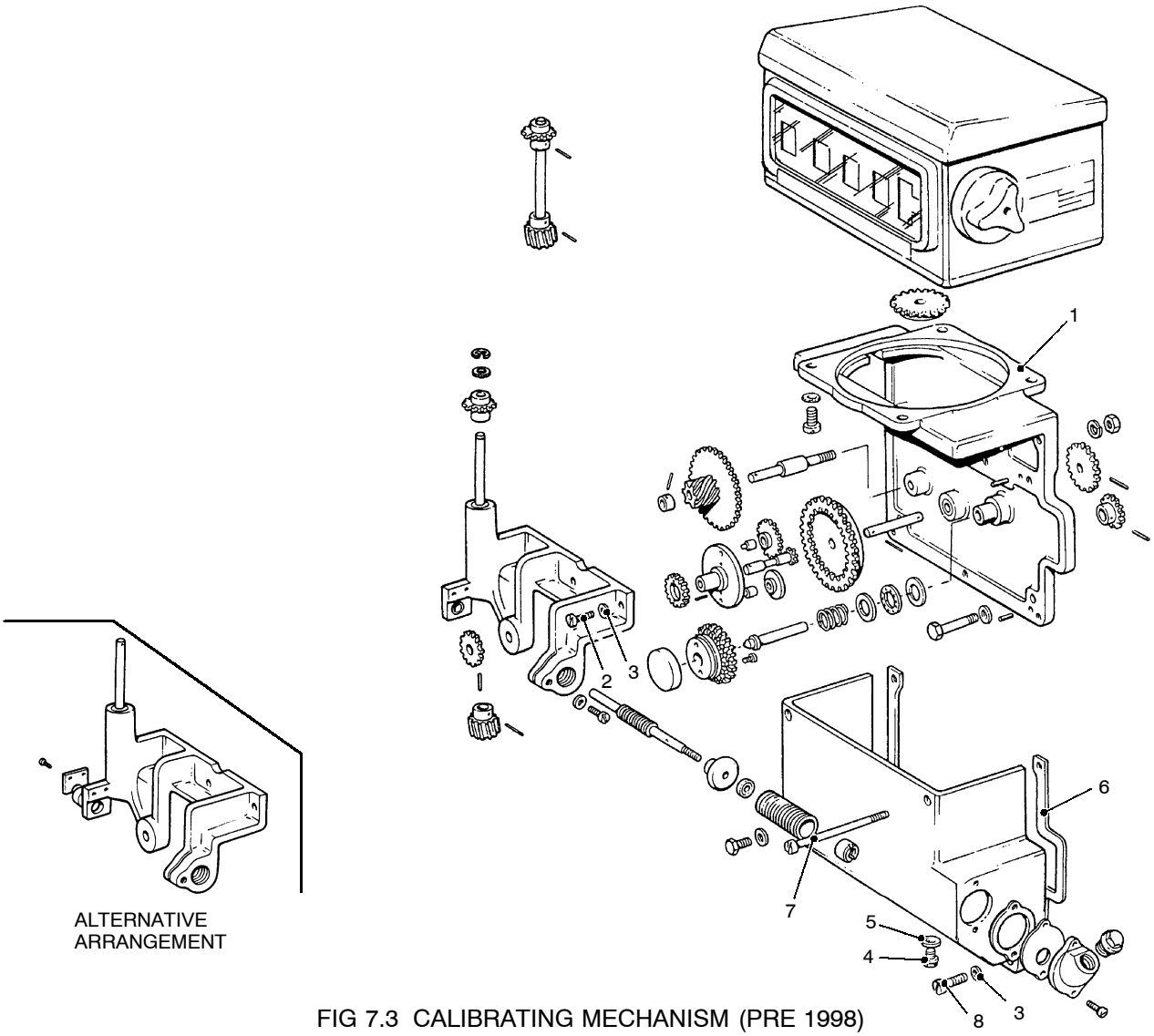

FIG 7.3 CALIBRATING MECHANISM (PRE 1998)

Fig/ Item No.	Part No.	Description	Qty
7-2			
1	BMMS19282	COUNTER DRIVE MECHANISM BASE SUB ASSEMBLY	1
2	ZS3203A0210A	SCREW 2BA X 5/8'' CH. HD.	3
3	ZW2201A02A	WASHER 2BA PLAIN	6
4	ZACZ0017-2	DRAIN PLUG	1
5	ZMMZ0135-4	WASHER	1
6	BMDZ106	GASKET, CALIBRATING MECHANISM COVER	1
7	BMSZ121	SCREW SPECIAL	2
8	ZS2203A0210A	SCREW 2BA X 5/8'' CH. HD. MS.	3

* = SUGGESTED SPARE PART

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Chapter 8

RATE OF FLOW INDICATOR

CONTENTS

1 INTRODUCTION

1.1 Where indication of the rate-of-flow of product through a bulkmeter is required, an Avery-Hardoll brand Rate-of-Flow Indicator can be fitted.

1.2 Rate-of-flow indicators are accurate to within +/- 5% FSD.

1.3 The dial of the indicator can be calibrated in:

Imperial gallons and litres/minute; or

US gallons/minute.

2 DESCRIPTION

2.1 The indicator consists of a calibrated and compensated tachometer, fitted to the front cover of the calibrating mechanism, and is driven by a compound gear train taken off the calibrating mechanism friction disc gear.

2.2 The indicator sub-assembly and mounting plate are fitted to the front cover of the calibrating mechanism, secured by three screws assembled from inside the cover.

2.3 The gear train consists of a compound gear which takes the drive from the friction disc assembly, and transmits it to a drive pinion on the indicator.

2.4 Right hand (RH) discharge meters have an idler gear interposed between the friction drive gear and the compound gear. This alters the direction of rotation of the calibrating mechanism gears which rotate in the opposite direction to Left Hand (LH) discharge meters.

3 INSTALLATION

3.1 Rate of Flow Indicators are assembled to the calibrating mechanism at bulkmeter build, but are available as a modification kit, containing the parts in Fig 8.1.

3.2 For removal and re-assembly refer to Paragraph 5.

4 MAINTENANCE

4.1 The maintenance frequencies recommended are a minimum, however, local company instructions must be observed.

4.2 Daily

Carefully inspect the Rate of Flow Indicator for security and signs of damage. Defects should be rectified immediately.

4.3 Six Monthly

Check the Indicator for accuracy. Adjust the control valves to a given rate of flow, as displayed on the indicator, and compare it with the quantity registered on the counter over one minute.

NOTES

1. Rate of flow indicators should only be removed from the bulkmeter for maintenance if the variation in accuracy falls below acceptable limits viz. +/- 5% FSD.

2. It is recommended that no 'on-site' dismantling or overhaul of the actual instrument is attempted, and that faulty indicators be replaced.

5 SERVICING

WARNING

THE RATE OF FLOW IS A DELICATE INSTRUMENT AND CARE MUST BE TAKEN TO ENSURE THAT THE INDICATOR SHAFT IS NOT PUSHED INTO THE CASE WHEN FITTING THE GEARS

The only servicing procedures necessary are those required to change a defective instrument.

5.1 **Removal**

For Mk. 2 calibrating mechanisms proceed as follows:

5.1.1 Refer to Fig 7.2 Remove the screws and release the front cover (51), taking care to ensure clean disengagement of the gears. Discard the cover gasket (57).

5.1.2 Refer to Fig 8.1 Slacken the gear bracket clamping screw (2), remove the gear bracket and gear assembly from the rear of the indicator (1).

5.1.3 Remove the serial number plate.

5.2 **Assembly**

5.2.1 Fit the serial number plate.

5.2.2 Refer to Fig 8.1. Fit the gear bracket and gear assembly to the rear of the indicator and 'nip' the gear bracket clamping screw (2) - do not fully tighten at this stage.

5.2.3 Refer to Fig 7.2. Fit a new cover gasket (57) and assemble the front cover (51) to the calibrating mechanism, ensuring clean engagement of the gears.

5.3 **Adjustment**

5.3.1 With the Veeder Root counter removed, slacken the gear bracket clamping screw (2). Move the gear bracket (3) along the barrel of the indicator to position the compound gear (7) centrally on the calibrating mechanism friction disc gear, and rotate the gear bracket to ensure correct meshing.

5.3.2 Finally, fully tighten the gear bracket clamping screw (2).

5.3.3 Refit the Veeder Root counter assembly.

Note:

1. When re-assembly has been satisfactorily completed, lubricate the calibrating mechanism with GREASE.

2. Old units may have a separate indicator and cover, these are no longer supplied separately as the new unit is a combined plastic moulding.

6 SPARES

When ordering spare parts, please supply the following information

Calibrating mechanism type and Mk. number

Manual number, issue and date

Page number

Figure and reference number

Part name

Part number

Quantity

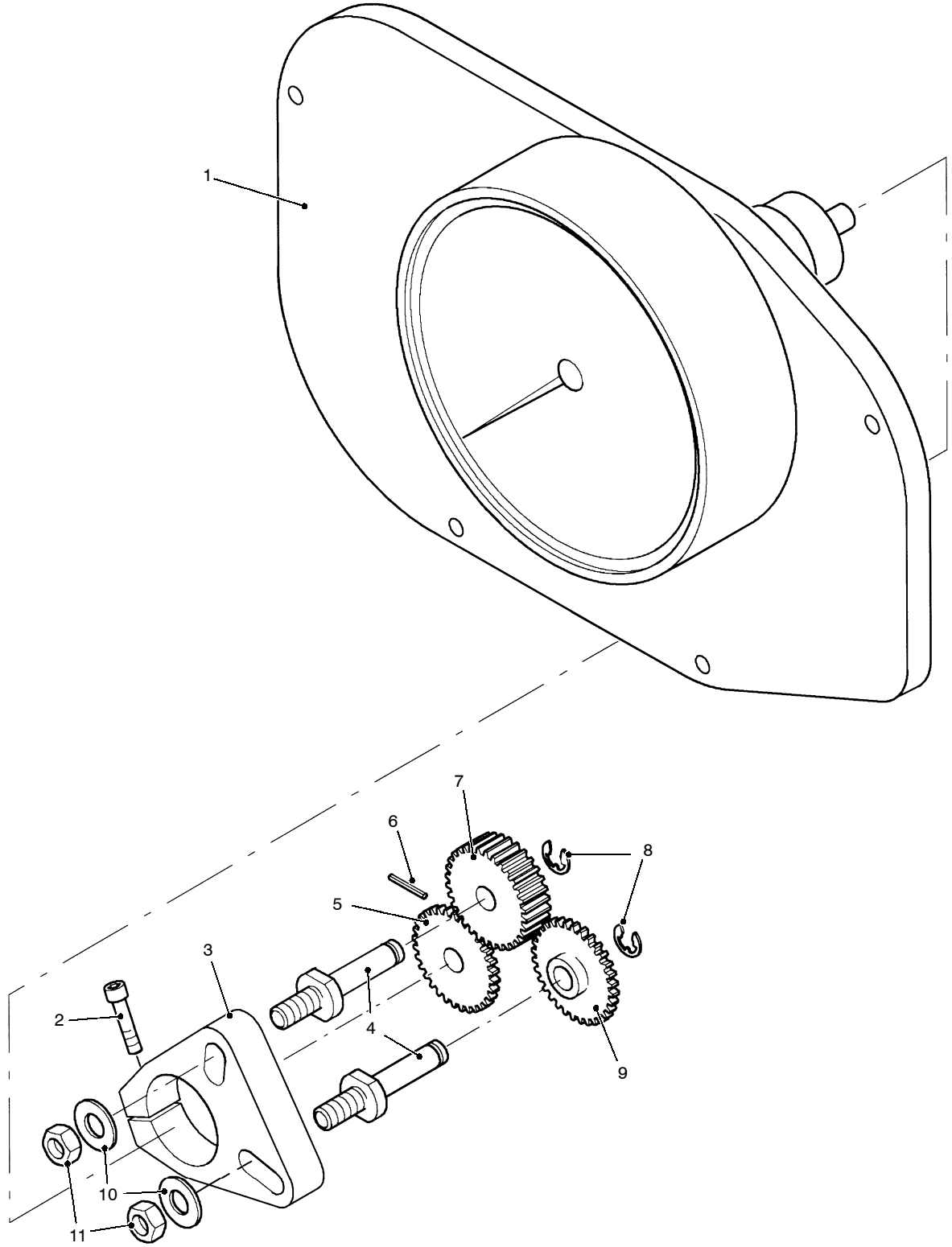

FIG 8.1 RATE OF FLOW INDICATOR AND COVER ASSEMBLY

Fig/ Item No.	Part No.	Description	(Qty)
8.1-			
1	BMMZ33284	RATE OF FLOW INDICATOR AND COVER ASSEMBLY	1
2	ZS3225M04016A	CLAMPING SCREW	1
3	BMAZ33220	GEAR BRACKET	1
4	BMSZ33222	STUD	1(LH) 2(RH)
5	SEE TABLE 1	DRIVING PINION	1
6	ZT8001E0207A	TENSION PIN 1/16 IN DIA.	1
7	SEE TABLE 1	COMPOUND GEAR	1
8	ZASZ0058-3	CIRCLIP TYPE 1500-147E	1(LH) 2(RH)
9	ZACZ0003-75	IDLER GEAR	0(LH) 1(RH)
10	ZW2203A02A	WASHER 2BA	1(LH) 2(RH)
11	ZN2201E06A	NUT 10-32 UNF	1(LH) 2(RH)

* = SUGGESTED SPARE PART

TABLE 1

FIG 8.1 - RATE OF FLOW INDICATOR AND COVER ASSEMBLY (Including all items shown in Fig 8.1)

METER TYPE		GALLONS	US GALLONS	LITRES / DECALITRES
LH	SINGLE	BMMS33227-GSL	BMMS33227-USL	BMMS33227-GSL
	DOUBLE	BMMS33227-GDL	BMMS33227-UDL	BMMS33227-DDL
	TRIPLE	BMMS33227-GTL	BMMS33227-UTL	BMMS33227-DTL
RH	SINGLE	BMMS33227-GSR	BMMS33227-USR	BMMS33227-GSR
	DOUBLE	BMMS33227-GDR	BMMS33227-UDR	BMMS33227-DDR
	TRIPLE	BMMS33227-GTR	BMMS33227-UTR	BMMS33227-DTR

TABLE 1 Contnd.

FIG 8.1, ITEM 1 - INDICATOR

METER TYPE	LITRES/GALLONS	US GALLONS	LITRESx10 / DECALITRES
SINGLE	BMMZ33284-GS	BMMZ33284-US	BMMZ33284-GS
DOUBLE	BMMZ33284-GD	BMMZ33284-UD	BMMZ33284-DD
TRIPLE	BMMZ33284-GT	BMMZ33284-UT	BMMZ33284-DT

FIG 8.1, ITEM 5 - DRIVING PINION

METER TYPE	LITRES/GALLONS	US GALLONS	LITRESx10 / DECALITRES
SINGLE	ZACS0003-25	ZACS0003-25	ZACS0003-25
DOUBLE	ZACS0003-25	ZACS0003-25	BMCS1664
TRIPLE	BMCS1675	BMCS1675	BMCS1678

FIG 8.1, ITEM 7 - COMPOUND GEAR

METER TYPE	LITRES/GALLONS	US GALLONS	LITRESx10 / DECALITRES
SINGLE	BMCZ1663	BMCZ1663	BMCZ1663
DOUBLE	BMCZ17833	BMCZ17833	BMCZ1663
TRIPLE	BMMZ17721	BMMZ17721	BMMZ17250

Appendix to Chapter 8

1 RATE OF FLOW INDICATORS FITTED TO OLDER (MK IIA) CALIBRATION MECHANISM

1.1 To replace the rate of flow indicators on meters manufactured before 1997 it is necessary to replace the rate of flow and cover assembly, since the rate of flow style changed at this time. Kits of parts to do this are shown in Fig 8A.1. If in doubt quote the meter serial number to Liquid Controls spares dept.

2 FITTING INSTRUCTIONS

2.1 Remove the Calmech cover (4 screws). Remove the ROF Indicator from the cover.

2.2 Units from LH discharge meters have 2 gears, those from RH discharge meters have 3. Transfer the gears to the new assembly. Secure the gears using the circlips (9) and tension pin (6).

2.3 Adjust the gears in their slots to achieve the correct mesh. Tighten the nuts (11).

2.4 Bolt the ROF Unit into the Calmech cover using the new gasket (2), screws (3) and washers (4). Fit the cover to the Calmech assembly.

2.5 Remove the Veeder Root Register (69). Slacken the clamp screw (5) and rotate the gear clamp (1) to achieve the correct mesh between the Calmech gear and the ROF gear.

2.6 Refit the Veeder Root Register and replace the sealing wire and lead seals as necessary.

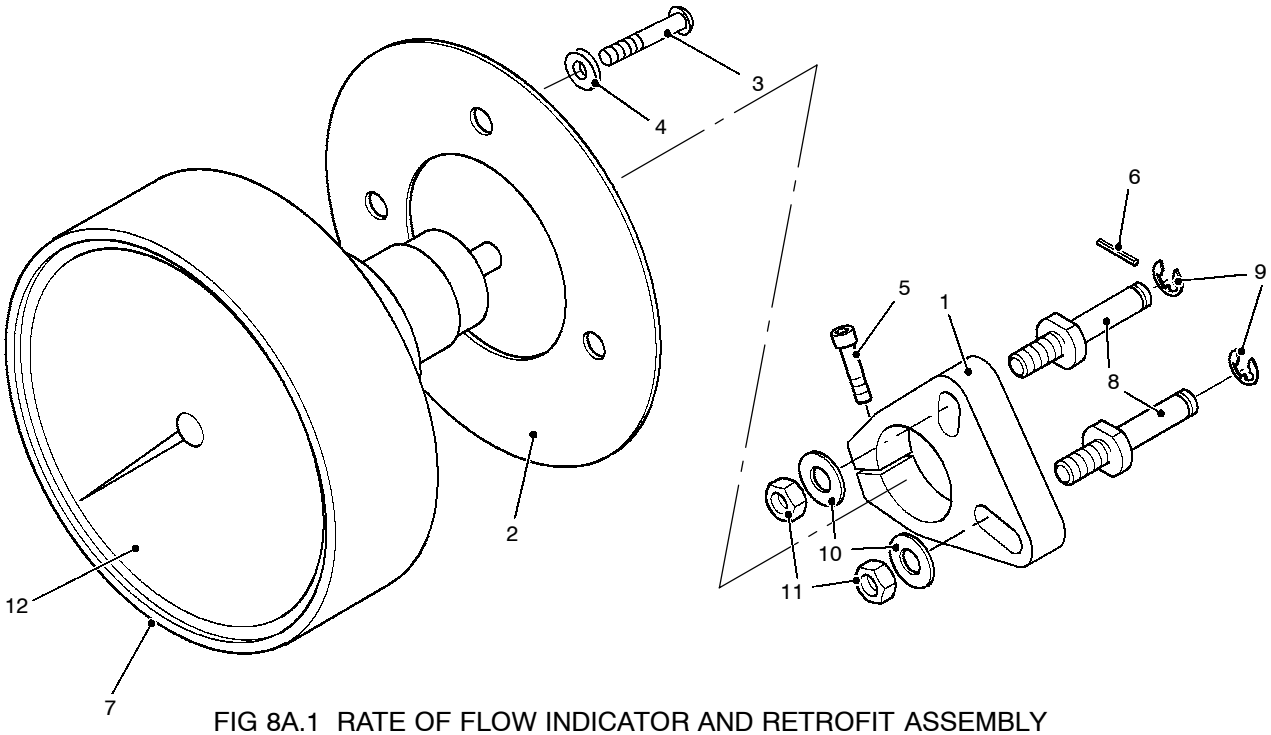

FIG 8A.1 RATE OF FLOW INDICATOR AND RETROFIT ASSEMBLY

Fig/ Item No.	Part No.	Description	(Qty)
8A.1-			
1	BMAZ33220	GEAR BRACKET	1
2	BMDZ5178	GASKET	1
3	ZS2203M03035A	SCREW	3
4	ZW8206M03A	WASHER	3
5	ZS3225M04016A	CLAMPING SCREW	1
6	ZT8001E0207A	TENSION PIN 1/16 IN DIA.	1
7	SEE TABLE 1	INDICATOR	1
8	BMSZ33222	STUD	2
9	ZASZ0058-3	CIRCLIP TYPE 1500-147E	2
10	ZW2203A02A	WASHER 2BA	2
11	ZN2201E06A	NUT 10-32 UNF	2
12	BMMS33253	GLASS (REPAIR KIT)	1

TABLE 1

FIG 8A.1, RATE OF FLOW INDICATOR RETROFIT TO MK2A CALMECHS.

METER TYPE	GALLONS / LTRS	US GALLONS
SINGLE	BMMS33261-GS	BMMS33261-US
DOUBLE	BMMS33261-GD	BMMS33261-UD
TRIPLE	BMMS33261-GT	BMMS33261-UT

FIG 8A.1 - ITEM 7 - INDICATOR

METER TYPE	LITRES/GALLONS	US GALLONS
SINGLE	BMMZ33285-GS	BMMZ33285-US
DOUBLE	BMMZ33285-GD	BMMZ33285-UD
TRIPLE	BMMZ33285-GT	BMMZ33285-UT