

# USE ES250 INSTRUCTIONS.

**K. COOK. 75 PAGES**

High vacuum pumps, gauges,  
plant and accessories

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## CARE AND MAINTENANCE MANUAL for

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CARE AND MAINTENANCE MANUAL  
for



USER REGISTRATION CARD - PLEASE RETURN TO EDWARDS  
HIGH VACUUM, NO POSTAGE IS REQUIRED IF MAILED IN  
THE U. K.

ROTARY PUMPS CARE AND MAINTENANCE MANUAL  
03825/1

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BLOCK CAPITALS PLEASE


## INTRODUCTION

The mechanical vacuum pump is the basic evacuation unit for production of sub-atmospheric pressures and operates by trapping a quantity of the gas/vapour mixture from the vacuum system which it then compresses and ejects to atmosphere.

The Edwards ES and ED35 to 500 pump models are of the slotted rotor/sliding vane rotary type incorporating the gas ballast feature. Model designation is by the initial letter E for Edwards followed by S for single stage or D for double stage (in series) succeeded by a number denoting the size.

This manual details the tools, jigs, materials, testing equipment and general workshop facilities needed for the repair of the ES/ED35 to 500 range of pumps. Procedure for the dismantling, inspection, rectification and reassembly of each model and its parts is defined and must be observed precisely for satisfactory results. Operation and routine maintenance of pumps is here excluded, as full information appears in the appropriate Working Instructions.

Throughout the manual the same number is used (on drawings, in text and in parts lists) to identify a particular part : for example, a pump pulley is always number 103.

On some drawings parts are annotated  The figure above the horizontal line is the part number whilst that below is the page number on which appears information about that part.

Departures from recommended procedure are expressly the responsibility of the repairer, such as machining or grinding damaged parts to permit re-use. Alterations to one part require complementary alterations to other parts, which may not always be possible. Also, such work immediately produces a non-standard pump for which modified replacements are not available from the makers.

Much thought and investigation has preceded the choice of text and diagrams used to represent the work involved in each operation and success will attend its adoption in most cases. However, the final criterion is the practical achievement of results by discovering those intangibles of, say, feel which cannot be taught in entirety by word-written or spoken.

The Edwards mechanical vacuum pump is a most reliable device and seldom breaks down.

Before starting to dismantle a pump always be certain that the trouble is not caused by system leaks

system contamination

faulty vacuum gauges

misinterpretation of readings given by a particular type of gauge

and so save the time and expense of unnecessary work.

## GENERAL INSTRUCTIONS

Before commencing any repair work on a rotary vacuum pump unit ensure that it is disconnected from the electrical supply to eliminate the possibility of electrical shock or of injury from accidental starting-up.

Consult the section relating to Tools, Fixtures, Jigs, etc. and ensure that all necessary items are available before commencing work.

When the performance of a pump is suspect, conditions of operation and installation should be investigated initially to ensure that it is not these that are at fault. Information about the more common causes - wrong pump or pipeline size, vapour contamination, etc. - is included and indexed.

Work on this range of pumps divides logically into three parts -  
that outside or on the pump case.  
that inside the pump case but outside the pump.  
that inside the pump.

To do work inside a pump involves dismantling but, more importantly, subsequently requires its resetting to obtain the critical running clearances on which satisfactory performance depends. Consequently all possible causes of defects external to the pump proper should be investigated before dismantling it.

With this proviso, and considering the more complex faults which are difficult to diagnose, complete dismantling with careful attention given to all parts will save time and serve as preventive maintenance.

Conventionally, two-stage pumps have the inlet connected to the high vacuum stage with the exhaust connected to the low vacuum stage. Generally the inlet stage is next to the pulley and the exhaust inboard but this is not invariable. To avoid confusion the terminology adopted in this manual is to define one stage as FRONT, being attached to the driving shaft, and the other stage as REAR, being inside the pump away from the drive.

After dismantling a pump, clean all parts thoroughly by washing in white spirit, carbon tetrachloride or similar solvent to remove all oil and grease. Subsequently polish carefully any machined surface which is discoloured, slightly scored or has accumulated deposits of any sort with very fine emery cloth, which should be backed with a truly flat surface when treating any fine machined parts. After use of emery cloth always rewash in solvent to remove abrasive particles and dry with a clean, dry compressed air stream, although wiping with clean lint-free cloth is an acceptable alternative.

It is vital that none of the volatile liquids used to clean pump parts is left in a re-assembled unit for reasons mentioned in the section Operational Notes. To emphasise this, one drop of a volatile liquid at normal temperature and pressure will change into about 5000 litres of vapour at a pressure of 0.1 torr, at which a rotary pump often works. Obviously, even small traces of such liquids produce a heavy load on a pump and take up time which would otherwise be devoted to useful pumping of the device to which it is connected.

When assembling together two metal parts of a pump which move relative to each other all surfaces should first be coated with oil.

After disconnexion of the wiring to a 3 phase motor the direction of rotation must be checked on reconnexion : pump rotation is clockwise viewing pulley end of shaft : if incorrect, the position of any two of the three connecting cables must be reversed.

## USAGE PROBLEMS

Instances occur when normal operating procedure or performance of rotary vacuum pumps does not conform completely to the needs of a specific application.

Information is included for resolution of the more common problems : the Company welcomes operational queries most of which are immediately answerable from records of the less frequent or more obscure problems : the occasional new query may take longer to answer or may require investigational work.

## CONTAMINATION - PUMPING VAPOUR

The common working principle of all mechanical vacuum pumps is the cyclic entrapment and subsequent compression and discharge of a portion of gas/vapour mixture from the volume under evacuation. If the vapour component reaches its saturation pressure before completion of the compression phase, then the produced liquid mixes with the pump oil and subsequently evaporates to fill the entry volume and inhibit pumping : contaminated pump oil may cause internal corrosion, marring the fine finish and small running clearances essential for efficient high vacuum mechanical pumping.

Possible counter-measures are:-

- (i) Passing the vapours through the pump by bleeding gas into the pump during compression to reduce vapour partial pressure and possibility of liquefaction - a procedure known as gas ballasting.
- (ii) Condensation of vapours in a cold trap before the pump inlet.
- (iii) Removal of vapours by adsorption in a trap before the pump inlet.
- (iv) Removal of vapours by chemical absorption in a trap before the pump inlet.
- (v) Entrapment of condensate in a continuously circulating oil system including an oil purifying device external to the pump.

Information as to size of rotary pump required and vapour load involved in pumping water is given in Publication 03700-6.

- (vi) Combinations of the above.

## OIL MIST AT OUTLET OF PUMP

When a rotary vacuum pump is working at high pressures, the large gas throughput carries with it some mist from the pump oil which would pollute the area around the pump if freely discharged : also, the large gas flow creates appreciable noise.

This pollution and noise may be alleviated by:-

- (i) Piping the pump outlet outside the building, the run sloping downwards from the pump to a catchpot, which must be inspected regularly and emptied as required : the external termination of the pipe must have a downward bend, or appropriate cover, to prevent ingress of rain, etc.
- (ii) The fitting of a filter unit. Specifications of appropriate units appear in Publication 03708-1.

## **DUST IN INLET GAS**

Dust particles entering a rotary vacuum pump have an abrasive effect on the finely machined and accurately set interior surfaces causing wear and consequent reduced performance.

The effect can be mitigated by fitting a filter in the inlet pipework, Edwards models stopping particles larger than 15 microns diameter - Publication 03708-2.

## **VIBRATION**

The level of vibration produced by the range is inherently low but reduction can be effected by:-

- (i) Fitting vibration isolators to the baseplate with flexible couplings in pumping, exhaust and electrical lines according to makers' recommendation.
- (ii) Running the rotary pump intermittently in conjunction with a vacuum reservoir : a refinement is the fitting of a solenoid operated isolation valve at the pump inlet opening and closing with the switching on and off of the pump motor : a vacuum switch, with sensing head connected to reservoir and contacts controlling motor/solenoid valve circuit, can be set to cut in and out at predetermined values and give automatic control.

## **PUMP SIZE**

Information as to size of rotary pump for a particular system and process is given in Publication 03700-4.

## **PIPE SIZE**

Information as to size of pipe needed to connect a pump to a system is given in Publication 03700-4 and 03700-5.

## **DATA**

Performance figures for rotary pumps - refer to Working Instructions.





## TOOL SECTION

### WORKSHOP FACILITIES

Hand and power tools and skilled operatives appropriate to a well - equipped mechanical engineering workshop including vices, hand press, vertical drill, centre lathe, surface grinder, compressed air supply (clean and dry).

### TOOLS

Brush -  $\frac{1}{4}$  inch paint type for applying Microlac sealing compound.

Cans, lipped to hold oil -  $\frac{1}{4}$  gallon (1 litre),  $\frac{1}{2}$  gallon (2 litres), 2 gallons (8 litres).

Funnel, for oil filling, with spout less than  $\frac{5}{8}$  inch dia at tip.

Gauges - dial - 0-30 lb/in<sup>2</sup> - pressure.

0-30 inch mercury - vacuum.

- McLeod

- feeler - 0015 inch and 0025 inch thick.

Files - flat, smooth and very smooth.

Oil stones - flat, fine and very fine.

Pencil - soft for marking duo-seal positions.

Pliers - various shapes and sizes will be found useful.

Screwdrivers - flat blade - to fit 4BA, 2BA,  $\frac{1}{4}$ in BSF,  $\frac{1}{2}$ in wide slots.

philips - to fit 2BA,  $\frac{1}{4}$ in BSF.

Set square - about 6in (15 cm) side.

Spanners - box -  $\frac{5}{16}$ in BSF.

- open end, hex. hd. - 4BA, 2BA,  $\frac{1}{4}$ in BSF,  $\frac{5}{16}$ in BSF,  $\frac{3}{8}$ in BSF,  $\frac{1}{2}$ in BSF.

- socket head - 4BA, 2BA,  $\frac{1}{4}$ in BSF,  $\frac{5}{16}$ in BSF,  $\frac{3}{8}$ in BSF ( $\frac{1}{4}$ in BSW ED500).

- torque, 20 lb. ft. - hex. hd.  $\frac{5}{16}$ in BSF or  $\frac{3}{8}$ in BSF : skt. hd.  $\frac{5}{16}$ in BSF or  $\frac{3}{8}$ in BSF.

- adjustable, to take up to 2 inches across flats.

### CONSUMABLE MATERIALS

Stag A sealing compound.

Microlac L28 high solids purple jointing compound.

Shim paper - Melinex - .0006 inch thick.

Pump oil - Edwards No.16

Thick oil

Abrasive paper - emery or carborundum - fine and very fine.

Cleaning solvents - white spirit, benzene, acetone, carbon tetrachloride, trichloroethylene.

Cloth - clean and lint-free.

SPECIAL TOOLS

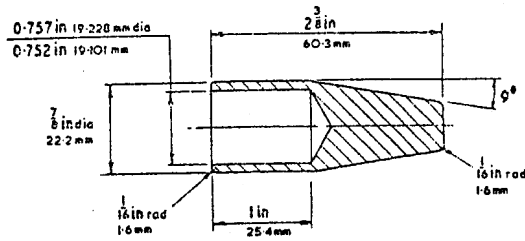
Model	Shaft replacement tool.	bench plate drilling details	C clamp	Modified Key	External setting clamp	Internal setting clamp
ES35	✓ page 10	✓ page 10	✓ page 11			
ED35	✓ page 10	✓ page 10				
ES 75	✓ page 10	✓ page 10	✓ page 11	✓ page 11		
ED75	✓ page 10			✓ page 11		
ES150	✓ page 10				✓ page 11	✓ page 12
ED150	✓ page 10				✓ page 11	✓ page 12
ES250	✓ page 10				✓ page 11	✓ page 12
ED250	✓ page 10				✓ page 11	✓ page 12
ED500	✓ page 10				✓ page 11	✓ page 12

✓ indicates tools required

The manual is based upon usage of these special tools and it is recommended that they be constructed generally in accordance with the leading dimensions given.

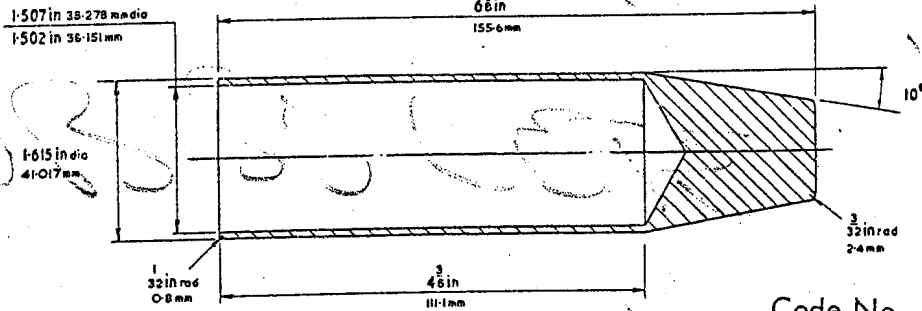
### Shaft replacement tools

ES/ED35/75  
ES/ED150/250



Code No. A001-05-040

ED500

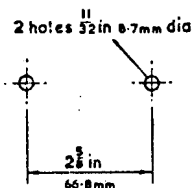


Code No. A086-00-103

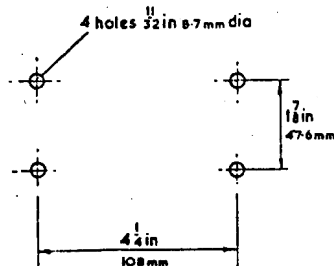
### Bench plate dimension holes

The bench plate may consist of angle iron, drilled on one face to hole dimensions given, with the other face to be held in a vice, or a flat steel sheet to be recessed into bench top with clear space beneath.

ES/ED35

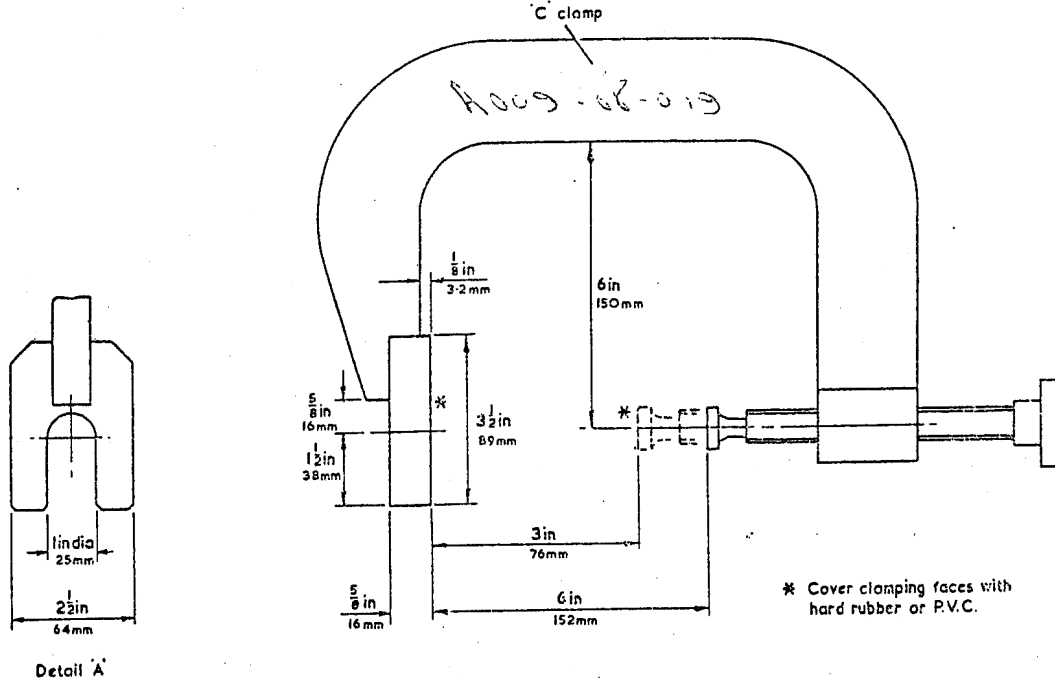


ES75

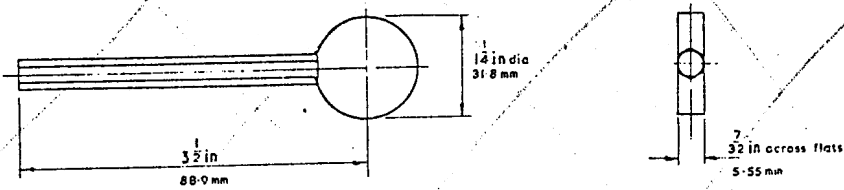


**C clamp**  
**ES35/75**

Obtain a proprietary clamp of robust construction having window size not less than that shown: make up detail A from mild steel and weld, or otherwise securely fix, in position as shown.

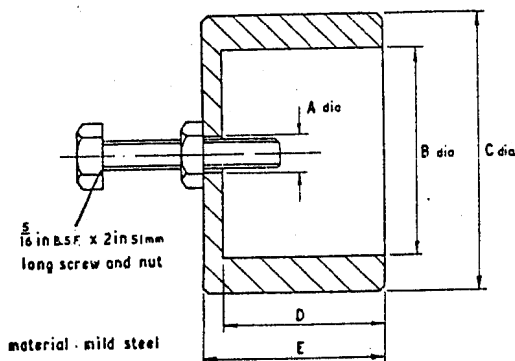


**Modified Key**  
**ES/ED75**



**External setting clamp**  
**ES/ED150/250/500**

*1005-09-004* INTERNAL AND EXTERNAL SET OF TOOLS

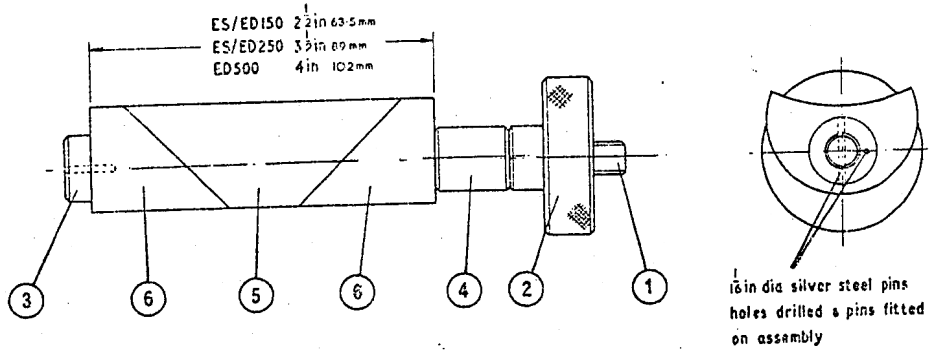


MODEL	A	B	C	D	E	
ES/ED 150/250	in	3/2	2 3/2	1 3/2	5/16	
	mm	10.3	53.2	71.4	41.3	46
ED500	in	3/2	2	3/2	3/14	2 1/8
	mm	10.3	50.8	88.9	44.5	54

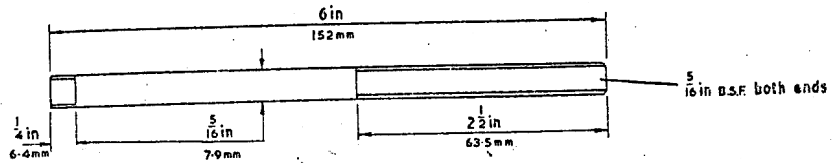
# Internal setting clamp ES/ED150/250/500

Three sizes of internal setting clamp are needed one each for the 150, 250 and 500 models. Basic design parameters are given: within these limits the clamps may be varied considerably in detail.

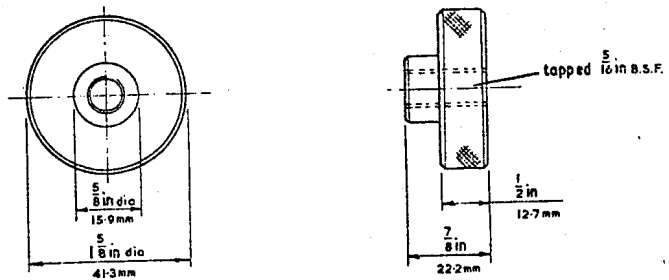
### GENERAL ARRANGEMENT



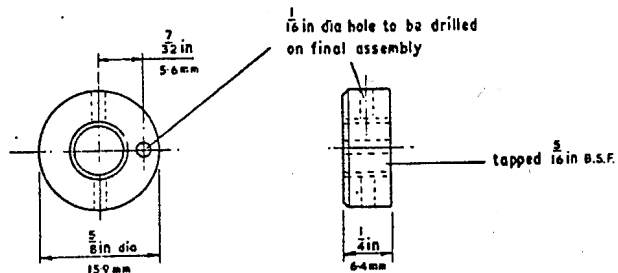
①



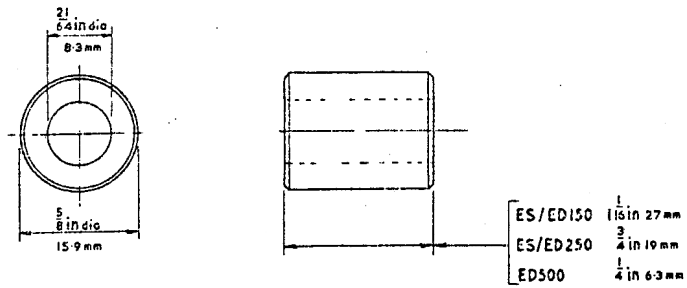
②



③

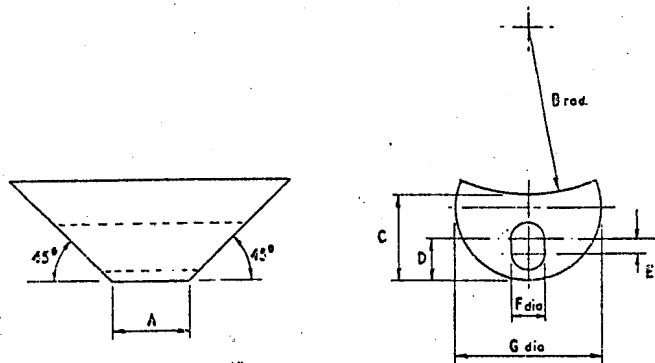


4



material: mild steel

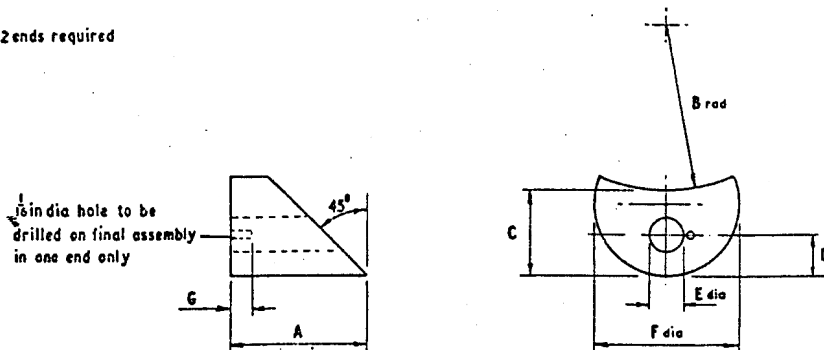
5



material: Tufnol

MODEL		A	B	C	D	E	F	G
ES/ED150	in	1/2	1.625	47/64	3/8			1
	mm	12.7	41.277	18.7	9.5			25.4
ES/ED250	in	3/4	1.672	29/32	7/16	1/8	21/64	1 1/2
	mm	19.1	42.471	23	11.1	3.18	6.3	38.1
ED500	in	3/4	2.312	5/16	5/8			2
	mm	19.1	58.721	33.3	15.9			50.8

6 Zends required



material: Tufnol

MODEL		A	B	C	D	E	F	G
ES/ED150	in	1	1.625	47/64	3/8			1
	mm	25.4	41.277	18.7	9.5			25.4
ES/ED250	in	3/8	1.672	29/32	7/16	21/64	1/2	1/4
	mm	34.9	42.471	23	11.1	8.3	38.1	6.3
ED500	in	5/8	2.312	5/16	5/8			2
	mm	41.3	58.721	33.3	15.9			50.8

# FAULT FINDING

Pumps returned for repair usually arrive without any report of defects. The procedure outlined has evolved from experience but other schemes may better suit different local conditions.

## Physical inspection of pump

Appears well kept - new or clean → Flushout pump and fill with No. 16 oil.  
Check for external oil leaks; Repair.

Appears in poor condition, dirty with contaminated oil, may smell of volatiles

Dismantle completely removing from baseplate if fitted. Clean all parts thoroughly. Inspect parts: repair or replace: re-set: reassemble, fill with oil.

Connect McLeod gauge to pump inlet, arrange pump for electric drive: connect to supply: switch on.

Pump starts  
Pump does not start

Check motor overload 'reset' button, broken motor lead - repair, broken belt - replace, loose belt - retension, defective motor - replace.

Trouble cleared, pump starts  
Motor runs but pump seized

With gas ballast valve closed pump sounds very noisy, puffing indicates leak on inlet tube or in gas ballast assembly: stop pump, locate leak(s), repair as necessary, restart pump.

Open gas ballast valve fully

Loud clacking noise indicates sticking rotor blades or oil starvation: stop pump.

Knocking noise indicates defective valve rubber: Stop: rectify: restart.

Close and open gas ballast valve: noise should decrease and increase with gas no flow/flow at exhaust nozzle. If faulty, stop pump dismantle gas ballast valve repair, reassemble, restart.

Oil mist at gas ballast inlet filter indicates displaced valve plate: Stop: rectify: restart.

Run pump for at least 16 hours with full gas ballast. Measure ultimate pressure at full gas ballast.

Pressure satisfactory

Pressure high: stop pump

Close gas ballast valve. Run pump for at least 2 1/2 hours. Measure ultimate pressure.

Pressure satisfactory

Pressure high

Stop pump.

Fit Bourdon vacuum gauge to inlet.

Run pump for 2 minutes. Stop pump.

No pressure increase over 16 hours. → Return pump into service.

Pressure increase.

immediate and continuing pressure increase indicates leak at pump inlet or gas ballast assembly - examine possible sources of leakage and replace parts or repair as needed to clear fault.

low pressure holds for 1/2 to 3 hours then gradually increases. Defective discharge valve or oil distributor rubbers or dirt between rubber and stator faces preventing sealing is indicated. Dismantle and replace parts as necessary.

low pressure holds for 6 or 7 hours before increasing: pump fills with oil indicating oil seal or stator joints are leaking.

Run pump for 2 minutes: stop: then repeat test.

Test satisfactory (no pressure increase) Pressure increase still showing.

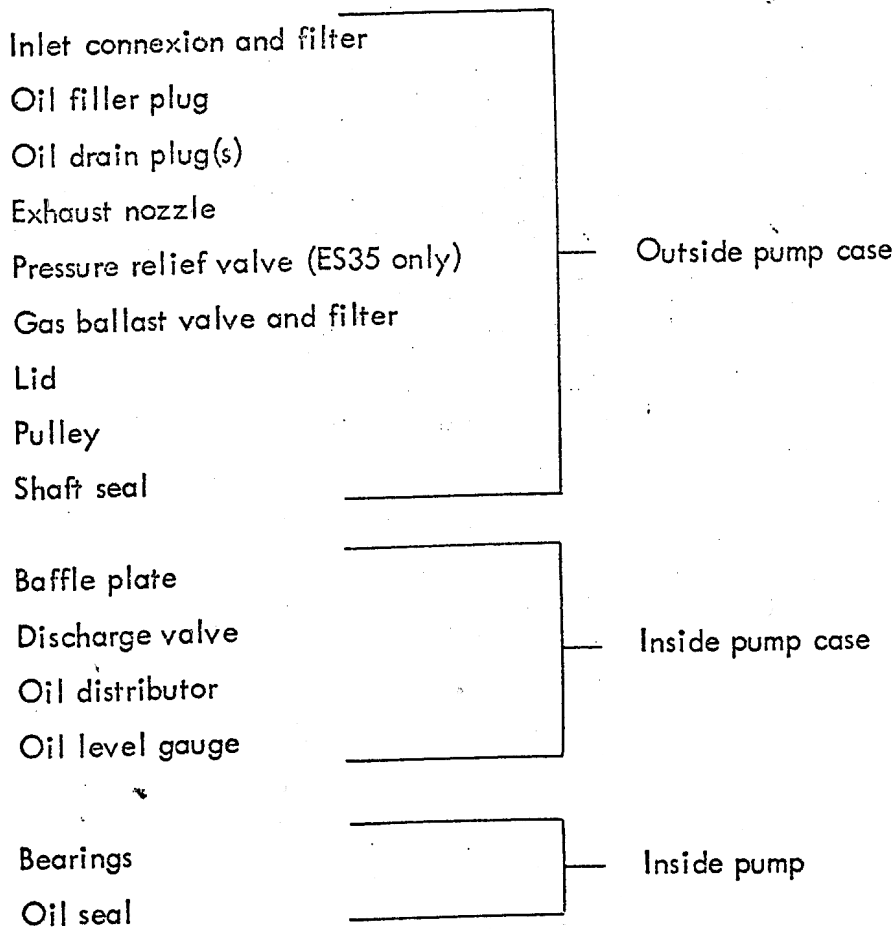
## DISMANTLING AND ASSEMBLY SECTION

Experience has shown a logical sequence for dismantling and for reassembling these pump models. However, this is only a recommendation and repairers may, from their own experience, evolve other sequences appropriate to their particular conditions. Essentially, any method is suitable which produces a satisfactory result in a reasonable time.

The sequences for each pump are included on its exploded drawing but reference must be made, at least initially, to the relative part sections to learn the detail procedure.

Various parts mounted on the surface of the pump are specifically excluded from these sequences since work may be done on any of them without reference to another. Similarly various parts within the pump case are excluded.

### *Parts Not Included in Pump Dismantling and Assembly Sequence*



**Rotor Blades and Oil Pump Blade** - be very careful that none of these drop out unintentionally and become damaged during dismantling.

**Pulley and Shaft Seals** - On each pump start dismantling by removing pulley and shaft seal sub-assemblies (parts 105, 104, 103, 117, 116, 115) and complete reassembly by re-



# PARTS LIST


No.	Part	No.	Part
..	Baffle plate	7.	Oil drain plug
2.	Baffle plate screw and washer	76.	Oil drain plug or pressure relief valve sealing washer
3.	Baffle plate gasket	77.	Oil distributor rubber
4.	Bearing	78.	Oil distributor plate
5.		79.	Oil distributor spring
6.	Blade, front	80.	Oil distributor spring collar
7.	Blade spring, front	81.	Oil distributor gasket
8.	Blade spring support, front	82.	Oil distributor body
9.	Blade, rear	83.	Oil distributor body screw
10.	Blade spring, rear	84.	Oil distributor spacer
11.	Blade spring support, rear	85.	Oil distributor assembly screw and washer
12.		86.	Oil distributor shim
13.	Discharge valve plate, rear	87.	Oil filler plug
14.	Discharge valve rubber, rear	88.	Oil filler plug seal
15.	Discharge valve spacer, rear	89.	Oil filter
16.	Discharge valve screw, rear	90.	Oil filter seal
17.	Discharge valve plate, front	91.	Oil filter screw
18.	Discharge valve rubber, front	92.	
19.	Discharge valve spacer, front	93.	Oil pump blade
20.	Discharge valve screw, front	94.	Oil seal
21.		95.	Oil sight glass
22.	Front cover	96.	Oil sight glass connector
23.	Front cover screw - long, with washer	97.	Oil sight glass connector seal
24.	Front cover screw - short, with washer	98.	Oil sight glass connector locknut and washer
25.		99.	Oil sight glass end cap
26.	Front cover seal	100.	Oil sight transfer MIN
27.	Gas ballast valve assembly	101.	Oil sight transfer MAX
28.	Gas ballast valve body	102.	
29.	Gas ballast valve piston seal	103.	Pulley
30.	Gas ballast valve assembly grub screw	104.	Pulley key
31.	Gas ballast filter	105.	Pulley grub screw
32.	Gas ballast filter spacer	106.	
33.	Gas ballast piston	107.	Rear cover
34.	Gas ballast valve seal	108.	Rear cover screw with washer
35.	Gas ballast valve seal retainer	109.	Rear cover setting screw with washer
36.	Gas ballast valve spring	110.	
37.	Gas ballast valve plate	111.	Rotor, rear
38.	Gas ballast valve plate retainer	112.	Rotor, front
39.	Gas ballast valve spindle	113.	Rotor key
40.	Gas ballast valve spindle knob	114.	
41.	Gas ballast valve spindle knob screw or pin	115.	Shaft seal rubber
42.	Gas ballast valve spindle grub screw	116.	Shaft seal front plate
43.	Gas ballast valve spindle grub screw seal	117.	Shaft seal front plate screw as shakeproof washer
44.	Gas ballast valve spindle grub screw dome nut	118.	Shaft seal taper tool
45.	Gas ballast valve body seal	119.	Stator, front
46.	Gas ballast valve restrictor	120.	Stator, rear
47.		121.	Stator stud
48.		122.	Stator combination
49.	Inlet protective cap	123.	Stator setting screw
50.	Inlet filter	124.	Stator nut
51.	Inlet coupling clip	125.	
52.	Inlet coupling flange	126.	Exhaust nozzle cap
53.	Inlet coupling flange screw and shakeproof washer	127.	Exhaust nozzle
54.	Inlet coupling flange 'O' ring seal	128.	Exhaust nozzle seal
55.	Inlet coupling insert	129.	Pressure relief valve
56.	Inlet union nut	130.	Motor
57.	Inlet union tail piece	131.	Motor fixing bolt
58.	Inlet coupling tube	132.	Motor fixing bolt washer
59.	Inlet union 'O' ring seal	133.	Belt guard
60.		134.	Belt guard gasket
61.	Interstage	135.	Belt guard fixing screw
62.	Interstage screw - long	136.	Belt guard fixing screw washer
63.	Interstage screw - short	137.	Pump fixing bolt
64.		138.	Pump fixing bolt washer
65.	Label	139.	Motor mounting strap
66.	Label screw	140.	Baseplate
67.		141.	Pulley
68.	Oil box	142.	Pulley grub screw
69.	Oil box gasket	143.	Bolt
70.	Oil box screw with washer	144.	Belt adjuster
71.	Lid	145.	Baseplate
72.	Lid gasket	146.	Pulley
73.	Lid screw and washer	147.	Pulley grub screw
74.		148.	Belt

1 phase motor

3 phase motor

## OIL DRAINAGE PROCEDURE

The number, position and size of oil drain points on pumps varies : the following table provides particulars.

Pump model 	ES/ED35	ES/ED75/150/250	ED500
No. of drain plugs	1	2	2
On which oil box face	Left hand face when looking at pulley	Left hand face when looking at pulley	Rear face when looking at pulley
Position on oil box face	At base below oil level gauge.	To left of and just below exhaust nozzle. At base immediately to left to gasket joint.	At top left of oil level gauge. At base below oil level gauge.

### Draining

Disconnect inlet connexion from vacuum system.

To facilitate emptying, extension pipes may be fitted to drain points with drain plugs transferred to outer end.

Place lipped container of adequate size under selected drain point to catch oil.

Remove drain plug.

Gravity or pressure drainage can be used.

Gravity Drainage - use lower drain plug.

Pressure Drainage - start pump motor, partly seal off exhaust nozzle (say, with finger) so creating pressure in pump case and forcing oil out until empty, pour clean oil down pump inlet to flush interior, run until this has drained through, stop pump motor and remove oil container.

Alternative Draining Method - When pump is removed from baseplate use pulley to turn pump by hand for pressure drainage.

**Note** Pressure drainage from the top drain plug depends upon the oil box gasket being undamaged. Drainage is upwards through a channel cast in the stator/front cover joint face : any leakage through this gasket will short-circuit the pressure forcing the oil out of the box.

### WARNING

Do not completely restrict the pump outlet as this may cause excessively high internal pressure build-up with resultant explosive rupture of the pump casing.

## **PUMP REMOVAL AND REPLACEMENT**

Drain oil, according to instructions, (see page 17), before or after removal.

### ***Removal***

Disconnect pump inlet from vacuum system

Loosen and remove belt guard fixing screws (135) with washers (136).

Lift away belt guard (133).

Remove belt guard gasket (134) and examine for defects : if satisfactory retain against reassembly.

Loosen and remove pump securing screws ( 37) with washers (138).

Push pump towards motor to loosen belt for removal of pump pulley.

Pump is now free and can be removed.

### ***Replacement***

Check that replacement pump is correct model and has pulley fitted.

Position pump on baseplate and secure with fixing screws and washers.

Loosen motor bolts and push motor towards pump.

(ED500 - slacken off belt tension adjusters also).

Position belt on pump and motor pulleys, tension belt and align (ED500 - tighten belt tension adjusters).

Tighten motor securing bolts.

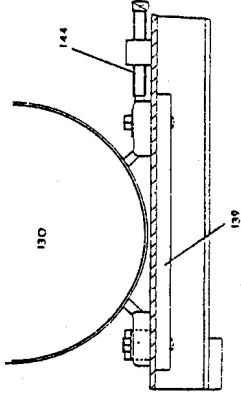
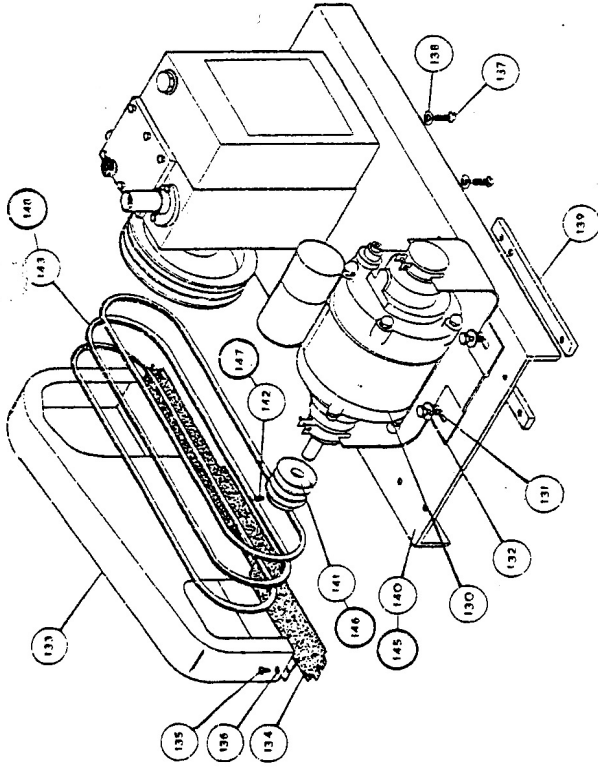
Position belt guard gasket and place belt guard on top.

Place and tighten belt guard fixing screws, with washers.

Connect pump inlet to vacuum system.

For motor removal and replacement details (see page 73)

For Belt Drive tensioning and replacement details (see page 74)



Part No.	Rotary vacuum pump, model	ES35	ED35	ES75	ED75	ES150	ED150	ES250	ED250	ED500
130	Motor, 3-phase Motor, 1-phase									
Refer to, and quote, information on motor nameplate - voltage, frequency, number of phases, horse power, model, catalogue number.										
131	Bolts to fix 3 phase motor - hex. hd. Bolts to fix 1 phase motor - hex. hd.	5/16in BSF 5/16in BSF	5/16in BSF 5/16in BSF	5/16in BSF 5/16in BSF	5/16in BSF 5/16in BSF	5/16in BSF 5/16in BSF	5/16in BSF 5/16in BSF	5/16in BSF 3/8in BSF	5/16in BSF 3/8in BSF	3/8in BSF 3/8in BSF
133	Beltguard	A008-15-002	A008-15-002	A006-14-002	A006-14-002	A006-14-002	A006-14-002	A006-14-002	A006-14-002	A007-01-002
134	Beltguard gasket	A008-12-003	A008-12-003	A006-14-003	A006-14-003	A006-14-003	A006-14-003	A006-14-003	A006-14-003	A007-01-007
135	Beltguard fixing screw	2BA	2BA	2BA	2BA	2BA	2BA	2BA	2BA	5/16in BSF
137	Pump fixing bolts - hex. hd.	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF	5/16in BSF
139	Motor mounting strap	-	-	-	-	-	A8016-6	A8016-6	A990-6	A990-6
140	Baseplate for 1 phase motor	A008-12-001	A008-12-001	A008-15-001	A008-14-001	A002-15-001	A008-16-006	A006-16-006	A099-00-006	A099-00-006
141	Pulley for 1-phase motor	A008-15-004	A008-15-004	A008-15-004	A008-15-005	A006-15-001	A006-14-001	A009-02-007	A099-00-006	A099-00-006
142	Pulley grub screw - socket head	2BA	2BA	2BA	2BA	2BA	2BA	2BA	2BA	5/16in BSW
143	Belt for 1-phase motor	H038-00-024	H038-00-0	H038-00-057	H038-00-057	H038-00-005	H038-00-005	H038-00-055	H038-00-055	H038-00-010
144	Belt adjuster	-	-	-	-	-	-	-	-	Unbrako 3/8in BSF sq. hd.
145	Baseplate for 3-phase motor	A008-12-001	A008-12-001	A002-15-001	A006-14-001	A002-15-001	A006-14-001	A006-14-001	A006-14-001	A099-00-001
146	Pulley for 3-phase motor	A008-15-005	A008-15-005	A008-15-005	A008-15-005	A006-15-001	A006-15-001	A009-02 002	A093-02-002	M003-00-017
147	Pulley grub screw - socket head	2BA	2BA	2BA	2BA	2BA	2BA	2BA	2BA	5/16in BSW
148	Belt for 3-phase motor	H038-00-024	H038-00-024	H038-00-057	H038-00-057	H038-00-005	H038-00-005	H038-00-053	H038-00-053	H038-00-010

Shakeproof washer for motor (132), pump (138) and beltguard (136) fixing

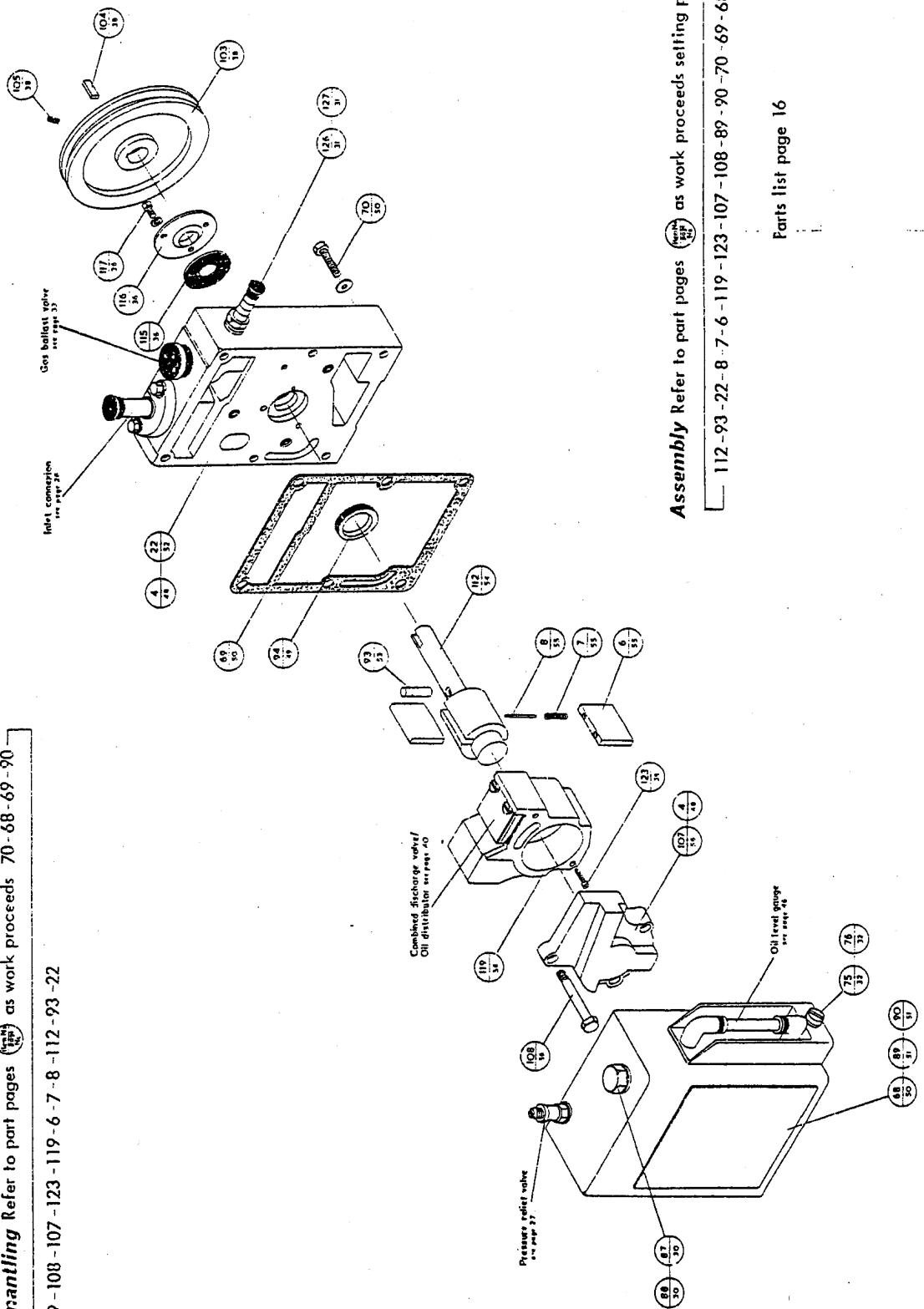
For dimensions, outline plan and elevation, baseplate fixing centres, inlet pipe size and position, exhaust nozzle and position - refer to Publication 03700 et. seq.


# MODEL ES35 PUMP

Refer to page 15

**Dismantling** Refer to part pages  as work proceeds 70-68-69-90

89-108-107-123-119-6-7-8-112-93-22



**Assembly** Refer to part pages  as work proceeds setting procedure page 60

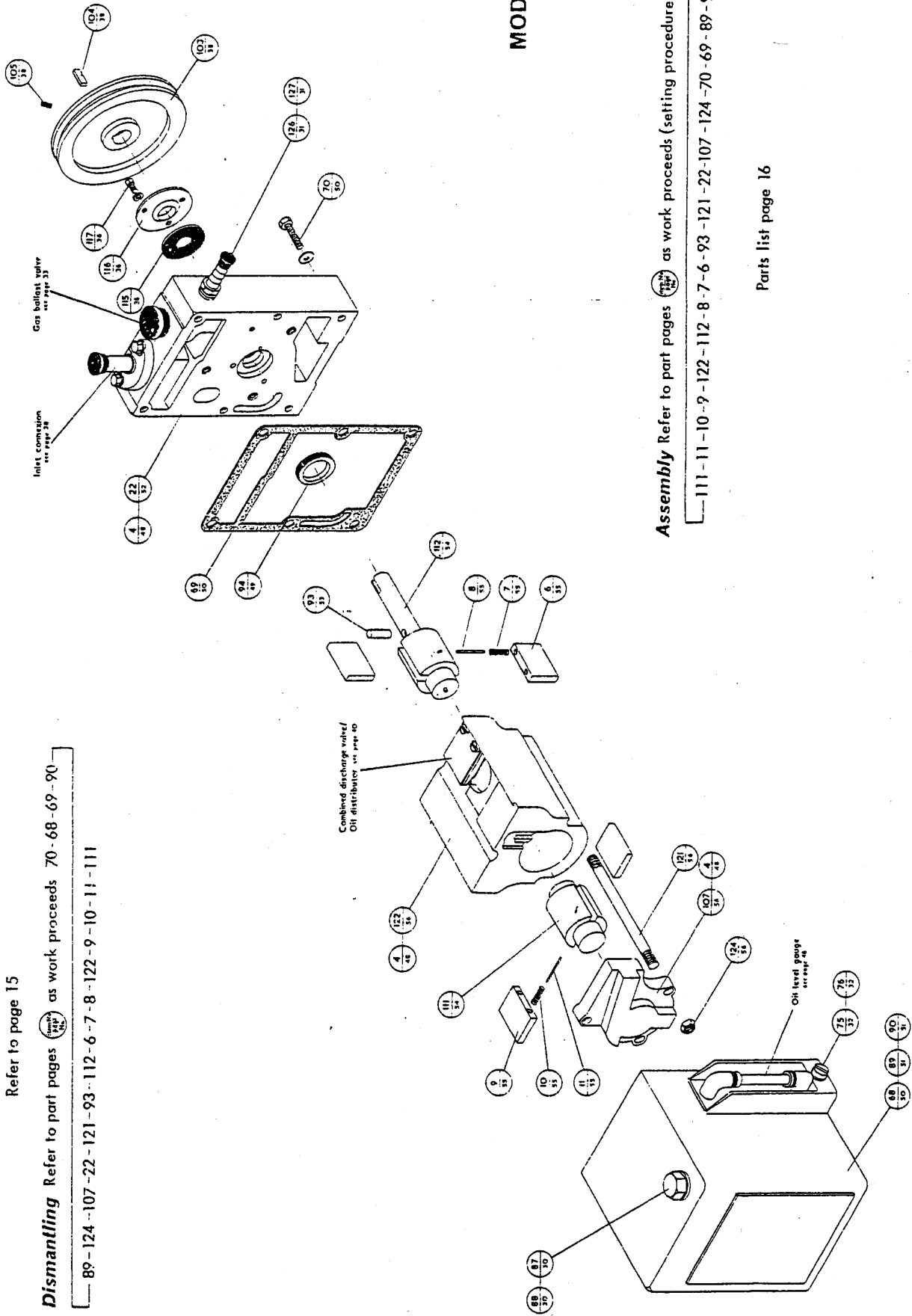
112-93-22-8-7-6-119-123-107-108-89-90-70-69-68

Parts list page 16

# MODEL ED35 PUMP

Refer to page 15

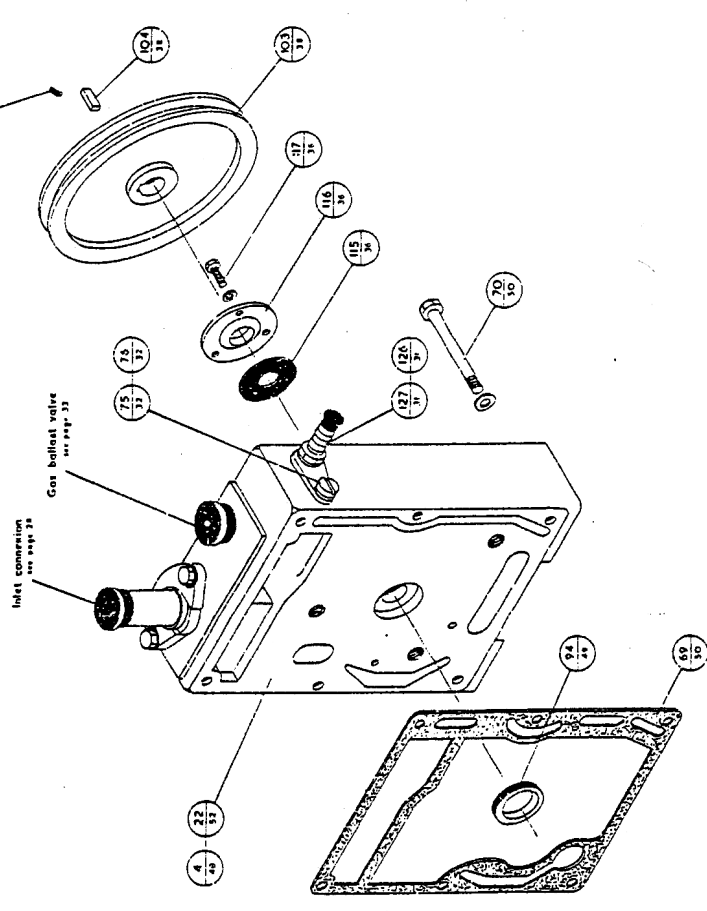
**Dismantling** Refer to part pages (89-124) as work proceeds 70-68-69-90  
89-124-107-22-121-93-112-6-7-8-122-9-10-11-111



**Assembly** Refer to part pages (89-124) as work proceeds (setting procedure page 62)  
111-11-10-9-122-112-8-7-6-93-121-22-107-124-70-69-90-68

Parts list page 16

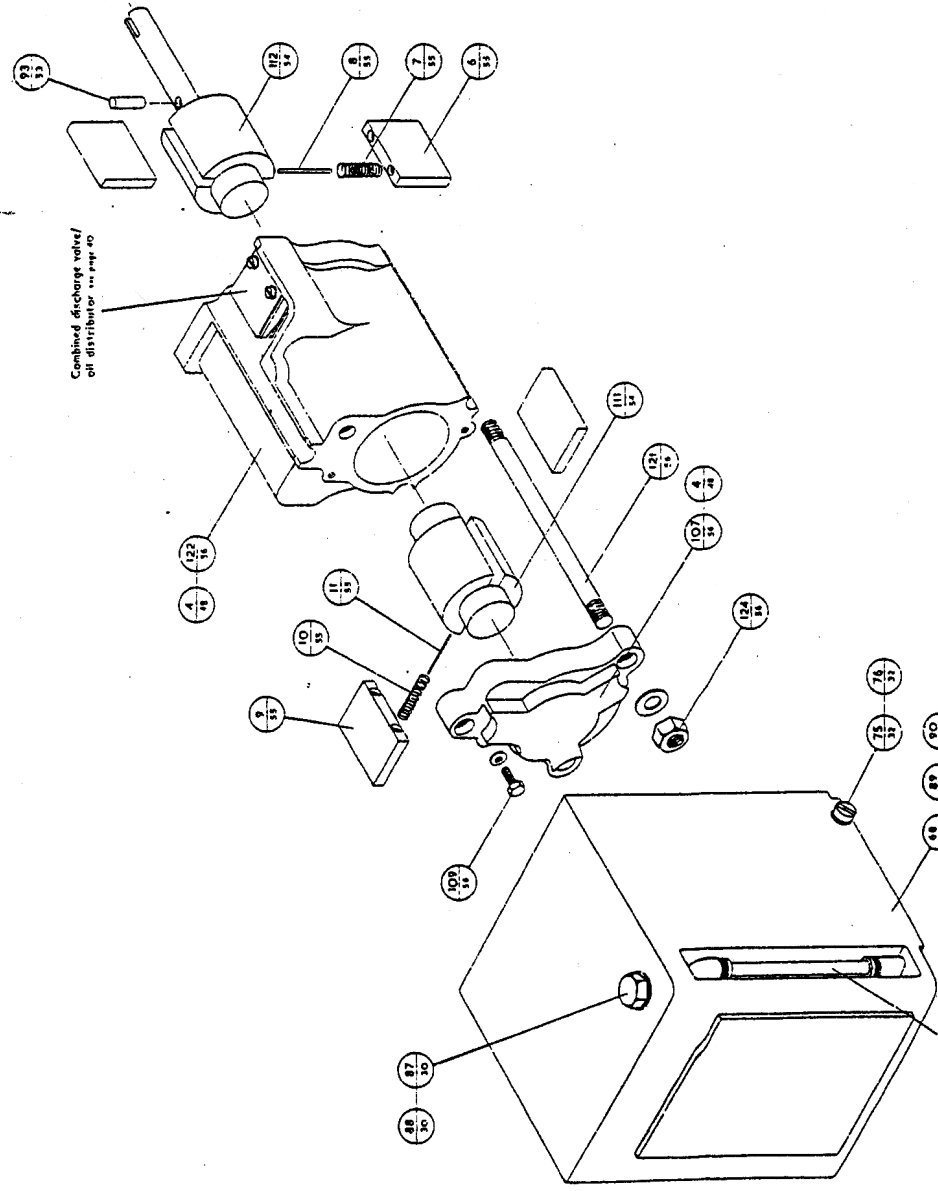




Refer to page 15

**Dismantling** Refer to part pages **69-70** as work proceeds **70-68-69-90-89**

**Assembly** Refer to part pages **111-110-9-122-107-109-107-9-10-11-111-122**



# MODEL ED75 PUMP

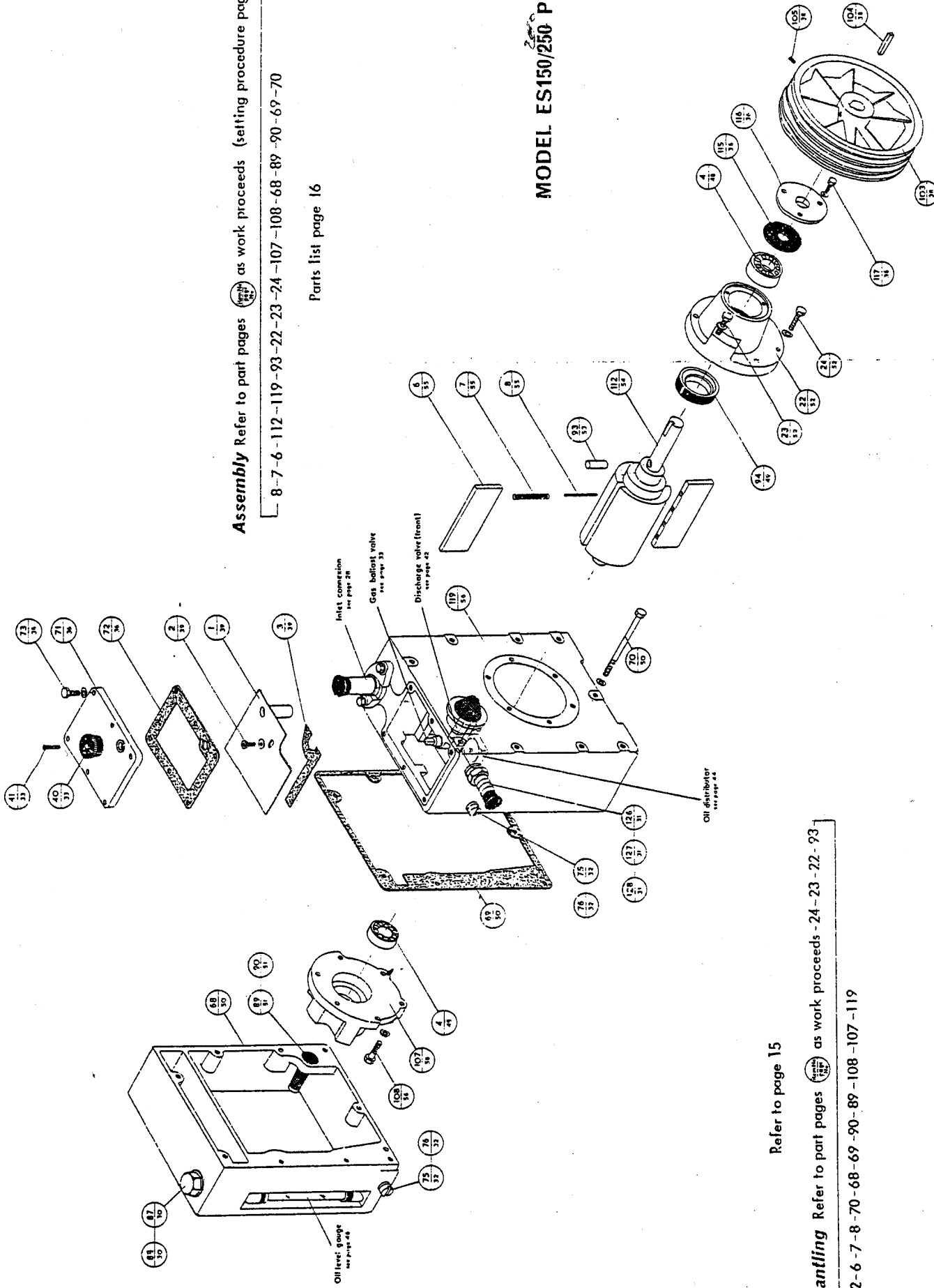
**Assembly** Refer to part pages **69-70** as work proceeds (setting procedure page 64)

**Dismantling** Refer to part pages **111-110-9-122-107-109-8-7-6-112-93-121-22-124-89-90-70**

69-68

Parts list page 16





Assembly Refer to part pages [112-6-7-8-70-68-69-90-108-107-108-68-89-90-69-70](#) as work proceeds (setting procedure page 67)

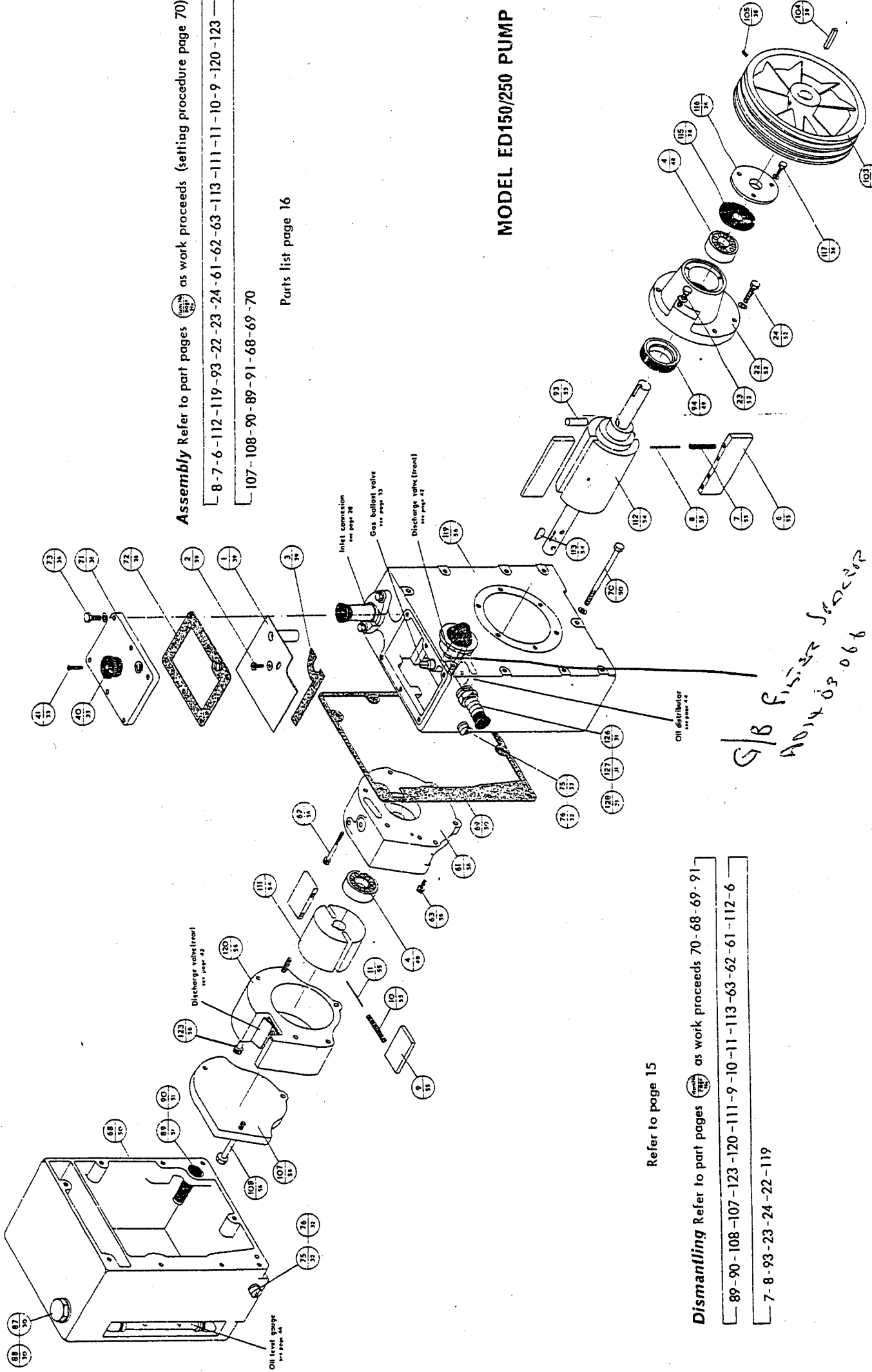
Parts list page 16

MODEL ES150/250 PUMP

Refer to page 15

Dismantling Refer to part pages [112-6-7-8-70-68-69-90-108-107-119](#) as work proceeds - 24 - 23 - 22 - 23

112-6-7-8-70-68-69-90-108-107-119



Assembly Refer to part pages as work proceeds (setting procedure page 70)

8-7-6-112-119-93-22-23-24-61-62-63-113-111-11-10-9-120-123-

107-108-90-89-91-68-69-70

Parts list page 16

MODEL ED150/250 PUMP

Refer to page 15

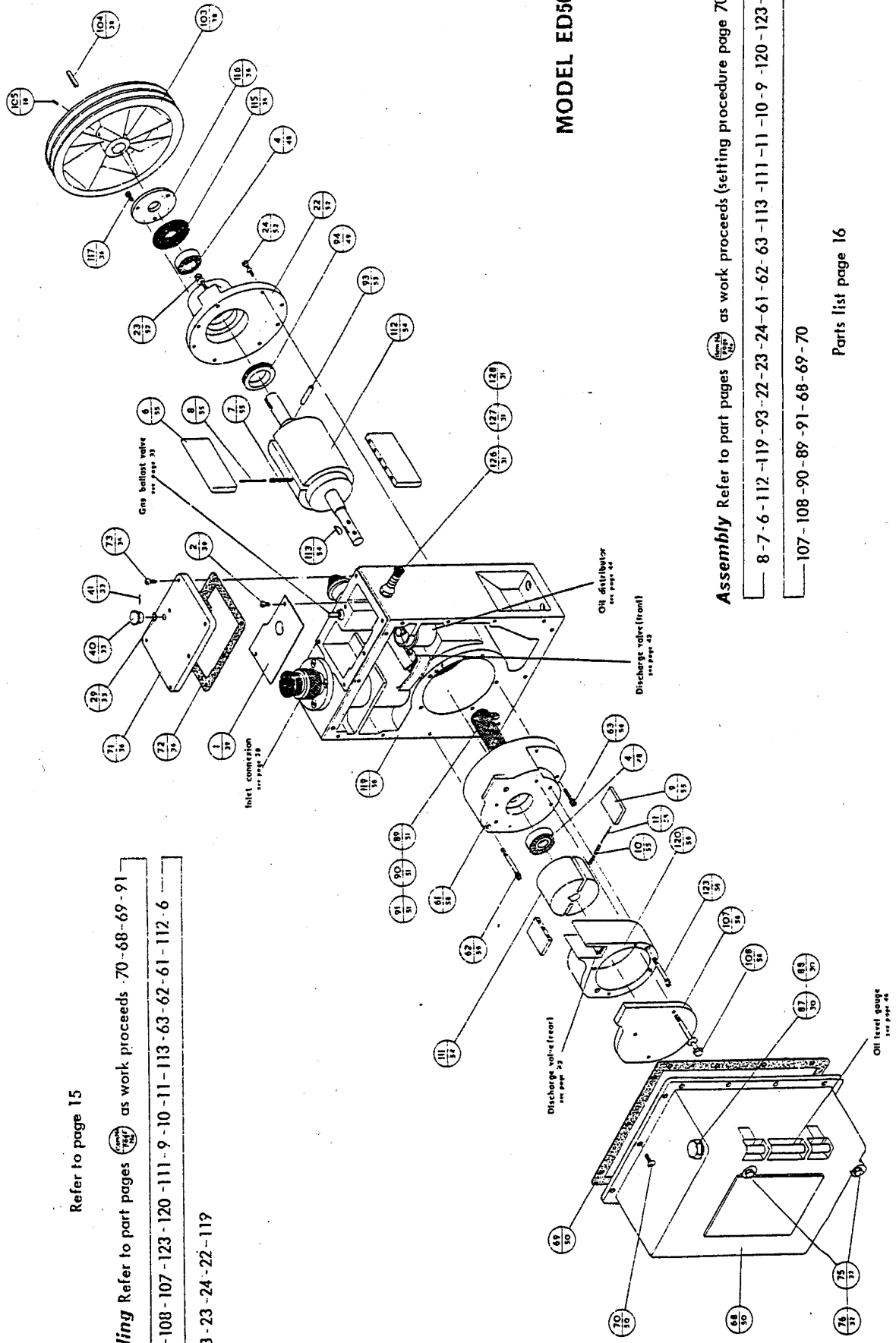
Dismantling Refer to part pages as work proceeds 70-68-69-91

89-90-108-107-123-120-111-9-10-11-113-63-62-61-112-6

7-8-93-23-24-22-119

*G/B F15.27 S.00007  
A014 03 068*

# MODEL ED500 PUMP



Refer to page 15

**Dismantling** Refer to part pages <sup>see page 14</sup> as work proceeds 70-68-69-91

89-90-108-107-123-120-111-9-10-11-113-63-62-61-112-6

7-8-93-23-24-22-119

**Assembly** Refer to part pages <sup>see page 14</sup> as work proceeds (setting procedure page 70)

8-7-6-112-119-93-22-23-24-61-62-63-113-111-11-10-9-120-123

107-108-90-89-91-68-69-70

Parts list page 16

## PRESSURE RELIEF VALVE

### Dismantling

Loosen and turn locknut anticlockwise until it is free of the adjusting screw : unscrew adjusting screw until it is free of body, when spring and stainless steel sealing ball can be removed : unscrew body from case and remove sealing washer from body.

### Inspection

Sealing washer (76) must be free of cuts or deformation : sealing ball and seat in body must not be scratched or corroded : spring must be unbroken, uncorroded and compression rate must be unchanged (defect shown by inability to obtain full pressure adjustment).

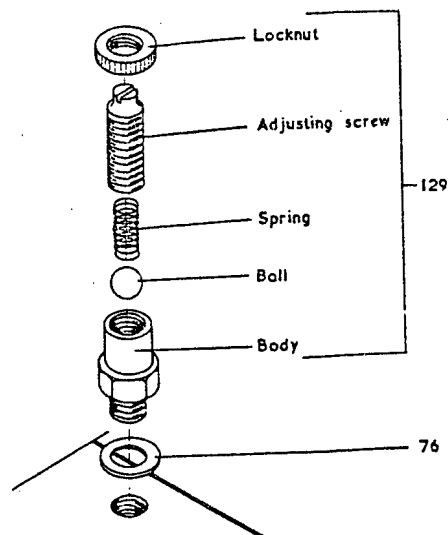
### Assembly

Fit seal (76) over body thread : screw body into pump case (68) : drop ball into body and spring on top of ball : screw adjuster into body : thread locknut onto adjuster. The final assembly is dependant upon relief valve setting.

### Adjustment and Setting

Run pump with inlet open and Bourdon gauge (or alternative) connected to exhaust by length of hose. Within the limits  $2 \text{ lbf/in}^2$  ( $0.14 \text{ kgf/cm}^2$ ) and  $20 \text{ lbf/in}^2$  ( $1.4 \text{ kgf/cm}^2$ ) set relief valve to blow off at required pressure by adjusting screw and locking in position with locknut. To increase pressure relief setting, turn adjusting screw clockwise: after any adjustment wait for steady conditions to be restored before reading pressure corresponding to new setting. Do not exceed  $20 \text{ lbf/in}^2$  or the pressure might blow oil box gasket.

Part No.	Description	Code No.
129	Complete relief valve assembly	A033-01-000
	Adjusting Screw	A023-00-021
	Locknut	A023-00-020
	Spring	A012-00-036
	Ball - stainless steel	$\frac{1}{4}$ dia.
	Body	A023-00-027
76	Sealing washer	Selon mk.3 $\frac{1}{8}$ in BSP



## INLET CONNEXION

### *Dismantling*

For ED500 pump only, undo and remove nut (56) from flange (52).

For other pumps, loosen and remove screws (53) with washers holding flange (52) to pump case (22/119).

All parts on all models are now loose and can be removed.

### *Inspection*

Examine 'O' rings (54) and (59) for cuts or deformation : if defective replace and examine replacement before use.

The filter (50) must be clean and undamaged : dirt will block it and reduce pumping speed : damage may allow material harmful to the pump to penetrate it. Clean filter if dirty : replace filter if damaged. All other parts must be clean and undamaged.

### *Assembly*

Locate filter (50) in pump inlet.

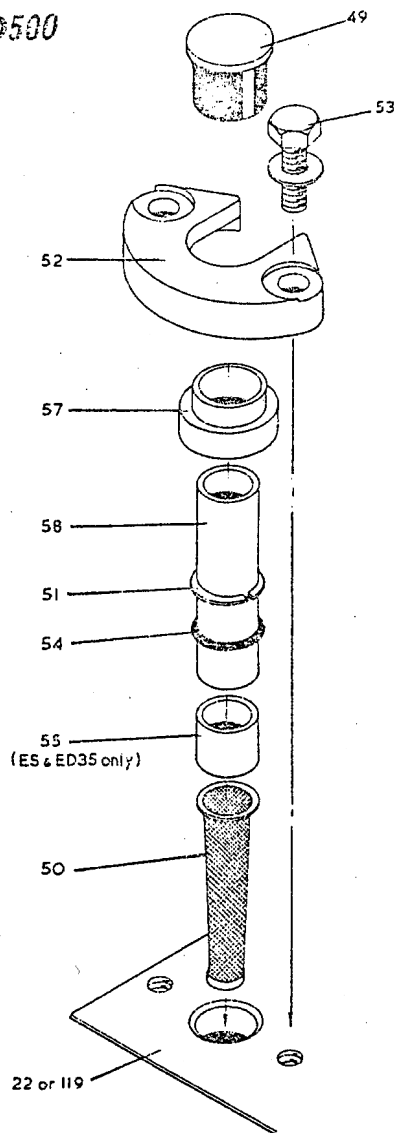
For ED500 pump insert 'O' ring (54) into groove in base of flange (52) : fix latter to pump case (22/119) with screws (53) and washers : place 'O' ring (59) on smaller diameter of coupling tailpiece (57) and set latter into top of flange (52) securing both with nut.

For ES/ED35 pumps push insert (55) down on top of filter (50).

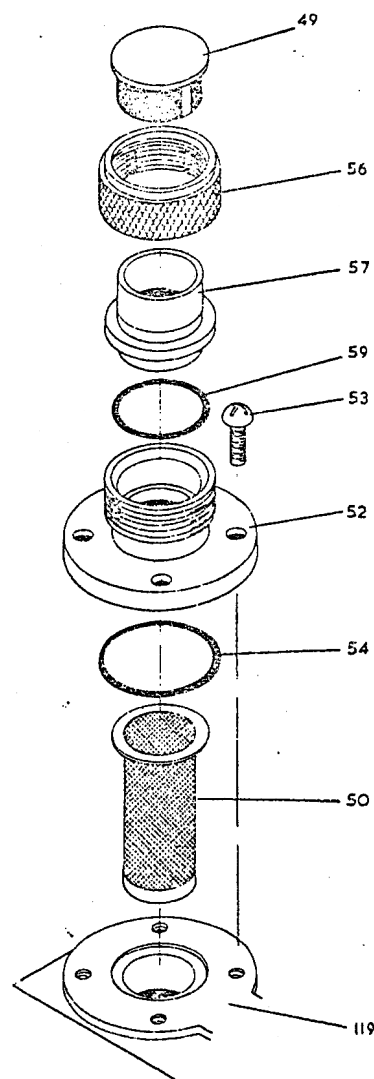
For all pumps except ED500, push 'O' ring (54) onto coupling tube (58) with clip (51) above : set sub-assembly into inlet hole and push down : slide tailpiece (57) over top of coupling tube (58) and fix to pump case with flange (52), screws (53) and washers.

**Note** When pumps are not coupled to plant, protect inlet with rubber cap (49), as originally supplied.

All But ED500



ED500



Part No.	Pump model	ES/ED35	ES/ED75/150/250	ED500
49	Inlet protective cap	A009-06-060	A014-03-090	M006-00-006
50	Filter	A009-06-024	A014-03-026	A098-00-022
51	Coupling clip	C065-00-008	C066-00-008	
52	Flange	C065-00-001	C066-00-001	A098-00-014
53	Screw with Washer	$\frac{1}{4}$ in BSF x $\frac{3}{4}$ in hex. hd. $\frac{1}{4}$ in BSF shakeproof	$\frac{5}{16}$ in BSF x $\frac{7}{8}$ in hex. hd. $\frac{5}{16}$ in BSF shakeproof	$\frac{1}{4}$ in BSF x $\frac{3}{4}$ in Ph. hd. $\frac{1}{4}$ in BSF shakeproof
54	Flange 'O' ring	VOR1119	<del>VOR0215</del> VOR0215	VOR1161
55	Insert	C065-00-002		
56	Union nut			C036-00-020
57	Tailpiece	C065-00-004	C066-00-004	C036-00-020
58	Coupling tube	A009-06-061	A014-03-067	
59	Union 'O' ring			VOR1146

# OIL FILLER PLUG

## Dismantling

The oil filler plug (87), hexagon headed and with a threaded shank on which is a sealing washer (88), is located on the top of the pump case and is removed by unscrewing.

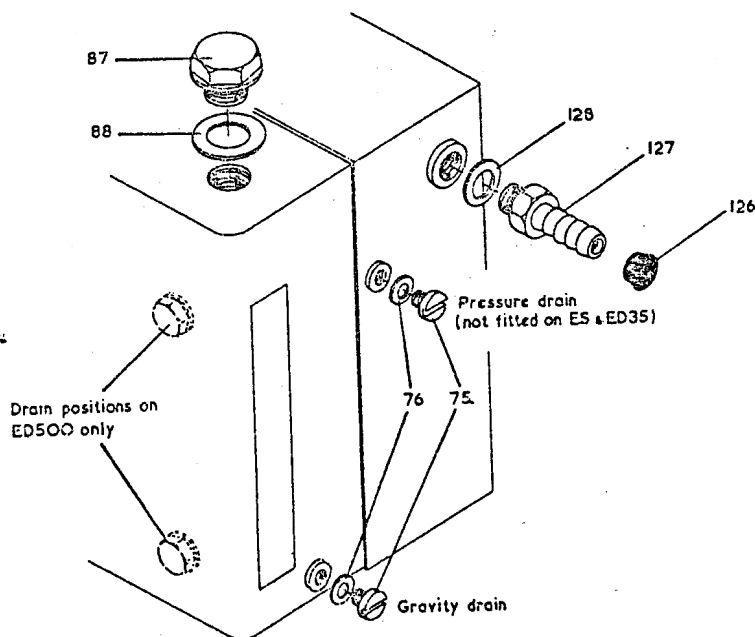
## Inspection

Sealing washer (88) must be free of cuts or distortion, otherwise renew

## Assembly

Take filler plug (87), pass sealing washer (88) up threaded shank and screw thread into tapped hole in top of pump case. Do not tighten excessively or sealing washer will be damaged.

Part No.	Pump model	ES/ED 35/75	ES/ED 150/250/500
87	Oil filler plug	<del>A007-06-065</del> K057-14-012	<del>A098-00-006</del> A005-29-803
88	Sealing washer	A098-00-083	A098-00-078



## EXHAUST NOZZLE

The exhaust nozzle has a threaded shank screwing into the pump case up to a hexagonal section for a spanner followed by a riffled extension. It is located at the top right hand corner of the left side of the pump case when facing the pulley shaft.

### *Dismantling*


Using a spanner on the hexagonal section, unscrew the exhaust nozzle (127) out of the threaded hole in the pump case, with sealing washer (128), if fitted.

### *Inspection*

Nozzle (127) or sealing washer (128) must be free of cuts or distortion, otherwise renew

### *Assembly*

Take nozzle (127), if fitted pass sealing washer (128) over threaded shank up to hexagonal section, and screw nozzle into threaded hole in pump case. Do not tighten excessively or sealing washer or nozzle will be damaged. Cover nozzle end with cap : this cap is on every new pump, should be removed and carefully stored during pump usage and replaced on exhaust nozzle as soon as pump is taken out of service.

Part No.	Pump model 	ES/ED 35/75	ES/ED 150/250	ED500
127	Exhaust nozzle	A021-06-020	A009-00-010	M009-00-013
128	Sealing washer		A014-03-079	A098-00-033
126	Nozzle cap	M006-00-001	M006-00-008	M006-00-003

### **ES/ED35/75 Pumps**

If a sealing washer (A098-00-077) is fitted then exhaust nozzle is M009-00-002 and nozzle cap is M006-00-002.



## OIL DRAIN PLUGS

### *Dismantling*

Using a screwdriver or spanner unscrew drain plug (75) from pump case complete with sealing washer (76). Should extension pipes be fitted, disconnect from pump case after draining.


### *Inspection*

Examine sealing washer (76) for cuts or distortion and renew if damaged.

The upper drain plug is connected to the base of the oil box (68) through a rectangular section passageway having three sides in the casting (22/120) mounting onto the baseplate. The oil box gasket (69) forms the fourth side of this passageway : this gasket must be undamaged, even on its inner edges, or the pump may not empty of oil when pressure drained.

### *Assembly*

Take drain plug (75), pass threaded shank through sealing washer (76) and screw into threaded hole in pump case. Tighten plug with screwdriver or spanner but not excessively or sealing washer will be damaged. Should extension pipes have been fitted, reconnect the pump case and screw drain plug, with washer, into outer end of each.

Part No.	Pump model 	ES 35/75/150/250 ED 35/75/150/250	ED500
75	Oil drain plug Thread on plug	<del>A007-03-033</del> A007-14-012 1/8 inch B.S.P.	A098-00-087 1/4 inch B.S.P.
76	Sealing washer	A014-03-077	A098-00-077

## **GAS BALLAST VALVE**

### ***Dismantling***

#### ***ES/ED35/75***

Remove grub screw (30) retaining valve assembly (27) and lift out latter by knob : turn pump by hand and exhaust pressure so generated will raise valve plate (37), retainer (38), spring (36) and restrictor (46) out of housing for easy removal.

#### ***ES/ED150/250***

Undo screw (41) and remove it and spindle knob (40) : remove lid (71) : lift out spindle (39), piston (33) and seal (29) : screw 2BA bolt into top of body, undo and remove dome nut (44), seal (43) and grub screw (42), lift out body (28) with seal (45) using 2BA bolt to do so : turn pump by hand and pressure generated will lift valve plate (37) out of housing for removal.

#### ***ED500***

Knock out mills pin (41) and lift off knob (40) : remove lid (71) with top seal (29) : slide lower seal (29) upwards off spindle (39) : continue as for ES/ED150/250.

### ***Inspection***

Check all parts for cleanliness.

Check seals (29), (34), (43), (45) for cuts or deformation : renew if damaged.

Check filter (31) for cleanliness and freedom from damage.

Ensure that restrictor (46) hole is not blocked.

Examine spring (36) for corrosion, breakage or loss of tension.

### ***Assembly***

#### ***ES/ED35/75***

Position in stator housing restrictor (46), spring (36) and retainer (38), in that order : above them place seal (34) with retainer (35) : fit filter (31) round spindle of valve assembly (27) : turn assembly (27) with knob downward and place drop of thick oil on bottom face of body : place valve plate (37), with concave side upward - see illustration - on top of oil on body base : turn valve assembly (27) with valve plate (37) downwards, carefully watch valve plate does not drop off, and set down into housing : take set screw (30), immerse in Stag A sealing compound and screw into place until head is flush with outside wall of oil box (68).

#### ***ES/ED150/250***

Fit long 2BA bolt in thread of body (28) : fit body seal (45) : turn upside down : place drop of thick oil on base : place valve plate (37) on base, concave side downward : - see

illustration - turn body with valve plate downwards : carefully watch valve plate does not drop off : slide sub-assembly into position : fit grub screw (42), seal (43) and dome nut (44) : remove 2BA bolt : screw spindle (39) into piston (33) : fit piston seal (29) : place piston in position : replace lid (71) : fit spindle knob (40) with screw (41) : if removed, replace filter (31) with spacer (32).

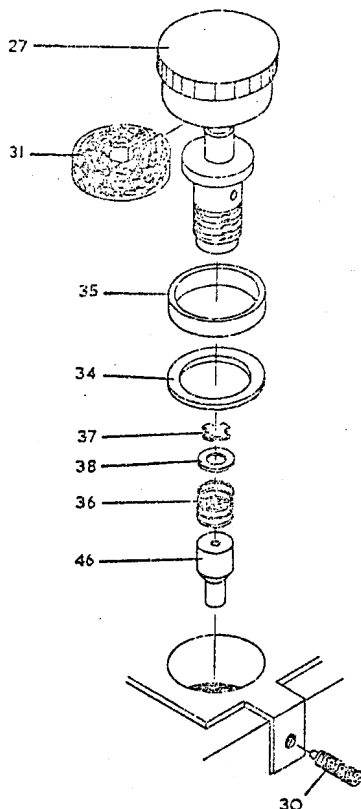
**ED500**

Proceed as for ES/ED150/250 until spindle (39) is screwed into piston (33) : slide lower part of seal (29) over top of spindle shaft and down to top of collar : position piston - spindle sub-assembly on top of body : replace lid (71) : slide upper part of seal (29) over top of spindle shaft and down into recess on top of lid (71) : place knob on top of spindle, align cross hole in knob with that in spindle and press in mills pin to secure knob.

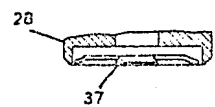
**Note** If the gas ballast valve plate is not correctly positioned either oil mist will be seen to emerge from the gas ballast air inlet filter or the gas ballast air inlet flow will be restricted, indicated by a difference in the pump note.

Part No.	Pump model	ES/ED 35/75	ES/ED 150/250	ED500
27	Valve assembly	A009-06-051		
28	Valve body		A014-03-062 <i>A192-01-011</i>	A098-00-021 -
29	Piston seal		VOR0111 <i>H021-05-011</i>	A098-00-046
30	Assembly grub screw	4BA x 1/2 in skt. hd.	<i>A 980-43 RED A1403-47</i> <i>A 3204-2 SILVER SALES</i>	
31	Filter	A009-06-039	A023-08-040	A098-00-073
32	Filter spacer		A014-03-093	A098-00-038
33	Piston		<del>A014-03-063</del> <i>A192-01-007</i>	A098-00-044 -
34	Valve seal	A009-06-055		
35	Seal retainer	A009-06-056		
36	Spring	A009-06-049		
37	Valve plate	A009-06-038	A014-03-061	A098-00-039
38	Valve plate retainer	A009-06-050		
39	Spindle		<del>A014-03-064</del> <i>A192-01-012</i>	A098-00-045
40	Spindle knob		A014-03-065 <i>A192-01-013</i>	A098-00-047
41	Knob screw/pin		4BA x 5/8 in inst. hd. 21355 2632	Mills pin 1/16 in dia. x 1/2 in
42	Spindle grub screw		2BA x <del>3/8</del> in skt. hd. <i>21225-1157</i>	2BA x 5/8 in skt. hd.
43	Spindle grub screw seat		2BA Selon washer <i>A192-01-012</i>	2BA Selon washer
44	Spindle grub screw dome nut	<i>Now 2BA x 3/8</i>	A014-03-087 <i>21351-1158</i>	<del>A014-03-087</del>
45	Body seal		VOR1114 <i>H021-05-014</i>	VOR0113 <i>H021-05-013</i>
		A009-06-070		

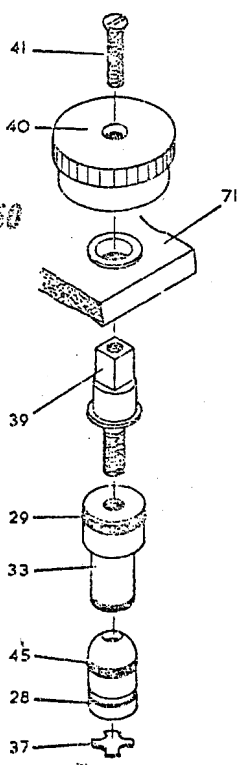
ES/ED35/75



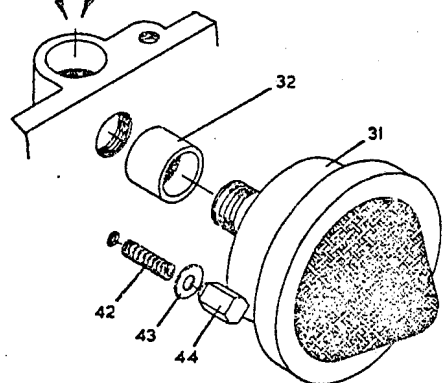
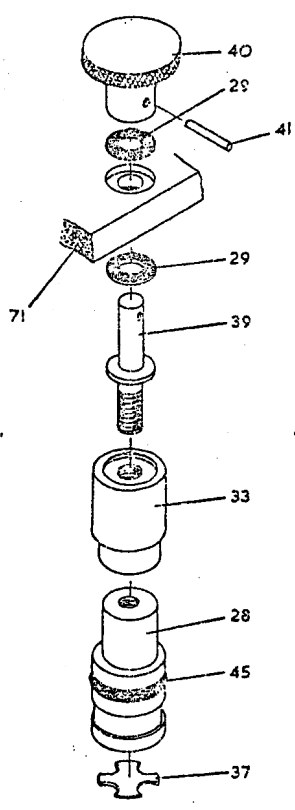
ES/ED150/250/500



ES/ED150/250



ED500



## LID

On the larger pump models the stator casting (119) has a top opening to give access to some components, covered by a lid (71).

### *Dismantling*

Take off gas ballast knob (40) after removing screw or pin (41), loosen screws (73) and take care not to damage gasket (72) when lifting off lid.


### *Inspection*

Check gasket (72) for defects and renew if necessary.

### *Assembly*

Position gasket (72) around top opening in stator casting (119), place lid (71) on top, secure with screws (73) and washers and replace gas ballast valve knob (40), securing with screw or pin (41).

**Note** Do not use jointing compound : it is not necessary.

Part No.	Pump model 	ES/ED150	ES/ED250	ED500
71	Lid	A014-03-089	A092-01-033	A098-00-009
72	Lid gasket	A014-03-025	A092-01-032	A098-00-042
73	Lid screw and washer	2BA x 5/8in long	2BA x 5/8in long	2BA x <del>3</del> 4in long

## SHAFT SEAL

The taper tool (118) is used to fit new shaft seals and should also be employed to remove undamaged seals when dismantling pumps.

Before using the taper tool (118) always:-

examine surface and remove any roughness.

lightly smear surface with pump oil.

### *Dismantling*

Remove pulley.

Undo and remove front plate fixing screws (117) and washers.

Remove front plate (116).

Push taper tool (118) over shaft, to limit of travel, gently pull seal (115) onto and then over and off taper tool (118).

**Inspection**

The seal (115) must be free of imperfections particularly on its inner edges : if damaged renew and inspect replacement before use.

The section of shaft mating with the seal must be smooth : any slight roughness should be removed using fine emery/ carborundum paper : scoring of the shaft can only be treated by renewal.

**Assembly**

Push taper tool (118) over shaft (112) to limit of travel.

Push centre hole of seal (115) over smaller, outer end of taper tool (118) and along it onto shaft (112).

Remove taper tool.

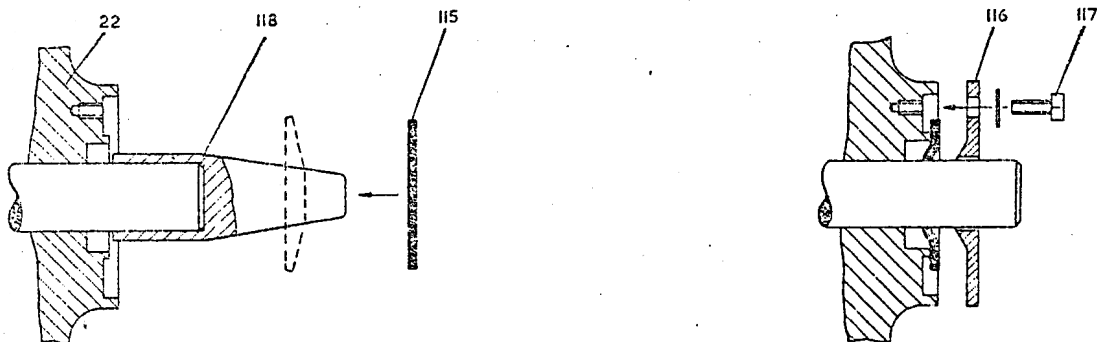
Pass front plate (116) over shaft (112) up to seal (115) with plain face outward.

Loosely fix front plate (116) in position with screws (117) and washers to front cover (22/119).

Set front plate (116) to have uniform annular gap round shaft (112).

Uniformly tighten screws (117).

**UNEVEN TIGHTENING OF SCREWS WILL PRODUCE A DEFECTIVE SEAL.**



Part No.	Pump model	ES/ED 35/75	ES/ED 150/250	ED500
115	Shaft seal rubber	<del>A007-06-028</del> H 2109-29	A014-03-056	A098-00-043
116	Front plate	<del>A009-06-029</del> R 001-05L 008	A014-03-057	A098-00-010
117	Screw	4BA x 1/2 in hex. hd.	2BA x 1/2 in hex. hd.	2BA x 5/8 in ch. hd.
	Washer	4BA shakeproof	2BA shakeproof	2BA shakeproof
118	Taper tool	A001-05-040	A001-05-040	A086-00-103

## PULLEY WHEEL

### *Dismantling*

Loosen grub screw (105) in pulley (103) with socket wrench.

Slide pulley (103) off shaft (112) : do not loose key (104).

Should pulley be tight on shaft remove by use of a drawing off tool : do not attempt to knock pulley off shaft as this will cause serious damage to pump interior .

### *Inspection*

Check shaft surface, pulley bore, key (104) and keyways for roughness : dress off as required with smooth file, carborundum stone or paper, etc.


### *Assembly*

Slide pulley (103) onto shaft (112) but do not force : if there is resistance, find what is binding and obviate it.

Check that shaft and pulley keyways coincide and insert key (104).

Check that outer surfaces of shaft and pulley centre are in plane.

Tighten grub screw (105) hard down on key (104) with socket wrench.

Part No.	Pump model 	ES35 ED35	ES75 ED75	ES150 ED150	ES250 ED250	ED500
103	Pulley	A009-06-072 A003-07-042		A005-08-017	A092-01-036	A077-02-027
104	Key	A009-06-069		A014-03-084		A077-00-046
105	Grub screw (skt. hd).	2BA x 5/16in				1/4inBSW x 3/8in

### BAFFLE PLATE

In all models a baffle plate (1) is interposed between the discharge valve and the exhaust nozzle to prevent emission of oil spray when large quantities of gas are being pumped. The device itself does not need maintenance but on some pump models has to be removed and replaced to reach other components.

#### **ES/ED35/75**

The baffle is an integral part of the oil box (68).

#### **ES/ED150/250/500**

Part of the baffle plate is integral with the oil box (68) and part is a plate (1) with gasket (3) situated below the lid, held in position by one or two screws (2), according to pump model.

#### **Dismantling**

Remove lid (71), loosen screws (2) and slide out sideways baffle plate (1) with gasket (3).

#### **Inspection**

Examine gasket (3) and renew if damaged.

#### **Assembly**

Locate gasket (3), place baffle plate (1) on top, insert fixing screw (2), refix oil box, push baffle plate against web (fixed part of plate) in oil box, tighten screw(s) (2).

Part No.	Pump model	ES/ED35/75	ES/ED150	ES/ED250	ED500
1	Baffle plate	-	A014-03-044	A092-01-029	A098-00-012
2	Screw washer	-	2BA x 3/8in skt. hd.	2BA x 1/2in ch. hd.	
3	Gasket	-	A005-08-020	A098-01-010	-



## **COMBINED DISCHARGE VALVE/OIL DISTRIBUTOR**

***For ES/ED35/75***

### ***Dismantling***

On ES/ED35 remove assembly screw (85) : on ES/ED75 remove screw (85) and spacer (84) : lift away spring steel shim (79) and oil distributor rubber (77) : remove body screw (83) then lift away oil distributor body (82) and discharge valve rubber (18).

### ***Inspection***

All parts must be clean : check oil holes/passages in body (82) are not blocked : rubbers (77) and (18) must be free of any cracking or scoring : spring (79) must not be deformed or have lost its elasticity.

### ***Assembly***

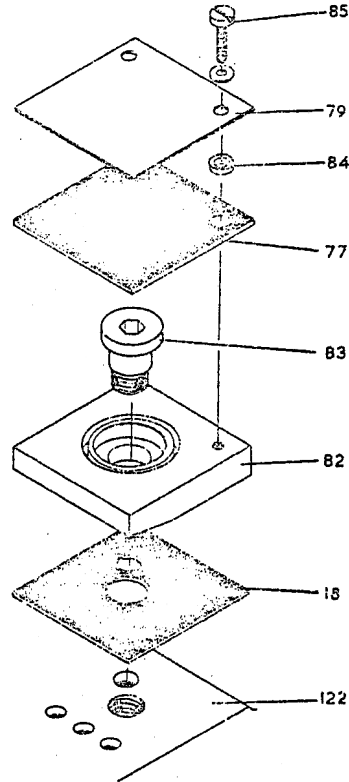
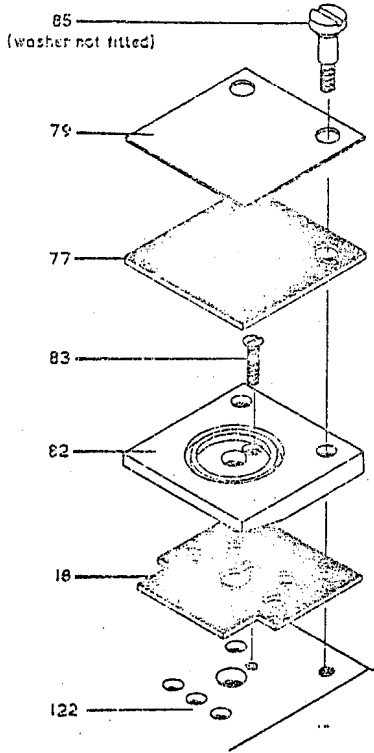
Inject oil into pump through discharge valve holes (3 squirts) : position discharge valve rubber (18) on stator (119/122) and place body (82) on top, securing both with screw (83) having Microlac on its thread.

**Note** ES/ED35 screw (83) must be very tight - suggest use of large screwdriver with end ground down for 4BA head : ES/ED75 screw (83) must not be overtight - use special tool (see special tools section) or short arm of socket wrench to tighten : departure from this procedure will cause suck back.

Oil centre oil way (4 squirts) : locate oil distributor rubber (77) with spring steel shim (79) on top and fix with assembly screw (85) or washer for ES/ED35 and assembly screw (85) and spacer (84) for ES/ED75.

ES/ED35

ES/ED75



Part No.	Pump model	ES/ED35	ES/ED75
18	Discharge valve rubber	<del>A009-08-012</del>	A003-08-016
77	Oil distributor rubber	A009-06-021 <del>A009-06-023/014/015</del>	A003-08-003
79	Spring	A009-08-015	A003-08-004
82	Body	A009-06-020	A003-07-010
83	Body screw	4BA x 3/8 in cks. hd. <del>2134/2428</del>	A003-07-011
84	Spacer		A003-07-012
85	Assembly Screw and Washer	A009-06-023	4BA x 3/8 in ch. hd.

77 A009-06-021 now A009-06-014  
 AND A009-08-012  
 (and plug (10e))  
 A009-06-020 and A009-06-021  
 with hub

VERIF RUG. A009-08-012

## **DISCHARGE VALVE**

*For ES/ED150/250/500*

### ***Dismantling***

The discharge valve of the single stage pumps and the front discharge valve of the two stage pumps is located below the oil box lid and baffle plate. The rear discharge valve of the two stage pumps is on the stator end remote from the pulley.

In both cases loosen and remove screws (16) or (20) when the respective plate (13) or (17), rubber (14) or (18) and spacer (15) or (19) becomes free and can be lifted off.

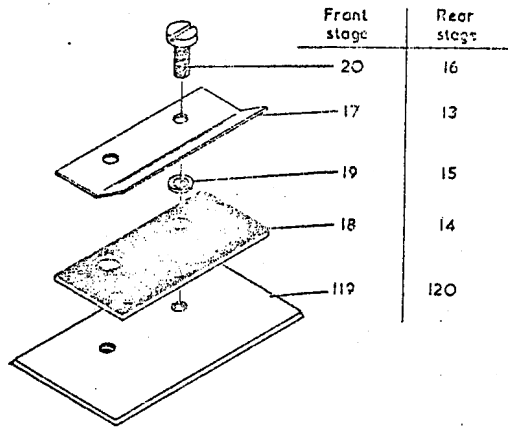
### ***Inspection***

All parts, including stator valve face, must be clean.

Check rubber (14) or (18) for cracks or deformation.

### ***Assembly***

Inject oil into pump through exhaust holes : position rubber (14) or (18) with spacer (15) or (19) in each fixing hole : place plate (13) or (17) on top and secure with screws (16) or (20).



**Discharge Valves Front**

Part No.	Pump model	ES/ED150	ES/ED250	ED500
17	Plate	<del>A204-47-001</del> A014-03-053	<del>A092-01-028</del> <del>A092-02-005</del>	A098-00-019
18	Rubber	<del>A014-05-003</del> <del>A014-03-053</del>	<del>A092-01-027</del> <del>A092-02-004</del>	A098-00-020
19	Spacer	A014-03-009	A014-03-009	A098-00-071
20	Screw	4BA x 5/16in ch. hd.	4BA x 5/16in ch. hd.	1/4in BSF x 1/2in ch. hd.

**Discharge Valves Rear**

Part No.	Pump model	ED150	ED250	ED500
13	Plate	A014-03-052	A092-01-023	A098-00-075
14	Rubber	A014-03-050	A092-01-022	<del>A098-00-018</del>
15	Spacer	A014-03-009	A014-03-009	A014-03-009
16	Screw	4BA x 5/16in ch. hd.	4BA x 5/16in ch. hd.	4BA x 1/4in ch. hd.

## **OIL DISTRIBUTOR**

**For ES/ED150/250/500**

### ***Dismantling***

The oil distributor is located on the stator top below the oil baffle plate and lid. Loosen and remove assembly screw (85) : all other parts of oil distributor can now be lifted off : body (82) and gasket (81) may need slight forcing as they are stuck one to the other and then to the stator.

### ***Inspection***

All parts must be clean : gasket (81) and rubber (77) must be free from defect : elasticity of spring (79) must be unimpaired.

### ***Assembly***

Paint stator face with Microlac : position gasket (81) aligning its holes with those in stator : paint upper face of gasket (81) with Microlac and place body (82) in position on gasket with pin fixed in body underside passing through gasket and locating in hole in stator face : press parts together to obtain good Microlac joint by tightening assembly screw (85).

### ***ES/ED150/250***

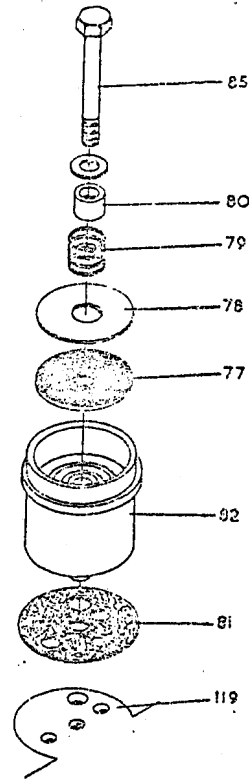
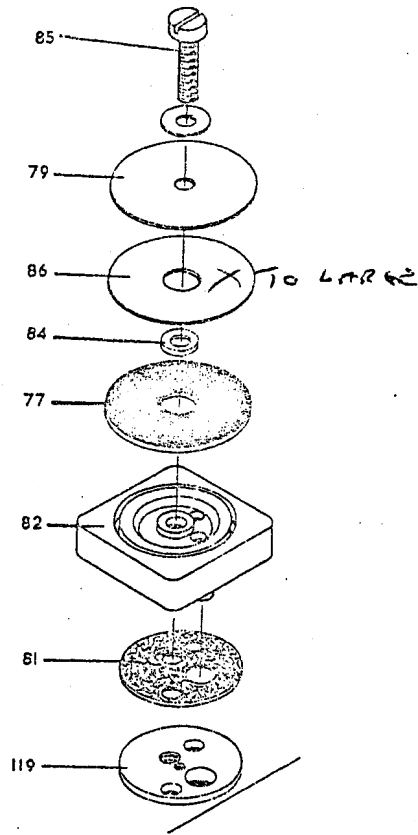
Remove assembly screw (85) : insert spacer in centre of rubber (77) and place on top of body : place shim (86) and spring (79) on top of rubber (77) and secure all with assembly screw (85). Make sure that the body (82) or rubber (77) is not fouling the casting wall.

### ***ED500***

Remove assembly screw (85) : position rubber (77), spring collar (80), place (78) and spring (79) in that order on top of body (82) and secure with assembly screw (85).

ES/ED150/250

ED500



Part No.	Pump model	ES/ED150/250	ED500
77	Rubber	A014-03-041	A098-00-084
78	Plate		A031-00-014
79	Spring	A005-09-008	M012-00-034
80	Spring Collar		A081-00-020
81	Gasket	A014-03-060	A098-00-070
82	Body	A014-03-076	A098-00-013
84	Spacer	A014-03-078	
85	Assembly Screw and Washer	2BA x $\frac{3}{8}$ in ch. hd. 5/16 in BSF x 2 1/8 in hex. hd.	
86	Shim	A005-09-019	

## OIL LEVEL GAUGE

### *Dismantling*

#### *All But ED500*

Inside oil box (68) loosen and remove locknuts (98) and lock washers.

Outside oil box withdraw sight glass sub-assembly.

Separate sub-assembly into connectors (96) connector seals (97) end caps (99) and sight glass (95).

#### *ED500*

Unscrew and remove oil filler cap (87) with washer (88).

With screwdriver through oil filler hole unscrew connector (96).

Remove connector (96), end caps (99) and sight glass (95) through oil filler hole.

### *Inspection*

Sight glass (95) must be clean, free from cracks and not chipped at ends.

End caps (99) must be free from cuts or deformations and not perished (cracks).

Connector seals (97) must be free from cuts and not deformed.

Renew damaged parts: inspect new parts before use.

### *Assembly*

All parts must be clean and free from oil.

Sight glass must be turned to have clean part to front and blue coloured line at rear towards connector threaded ends.

#### *All But ED500*

Push connector seal (97) over threaded end of each connector (96).

Push end cap (99) over each end of sight glass (95) and connectors (96) over end caps.

Take this sub-assembly and carefully feed connector threaded ends through holes in oil box, connector labelled MIN being towards box base and that labelled MAX towards lid.

Inside oil box place lockwasher over each connector threaded end and then screw on locknut (98).

Check alignment of connectors with sight glass, then tighten locknuts carefully.

#### *ED500*

Place end cap (99) on each end of sight glass (95).

Pass sight glass and end caps down through oil filler hole into position.

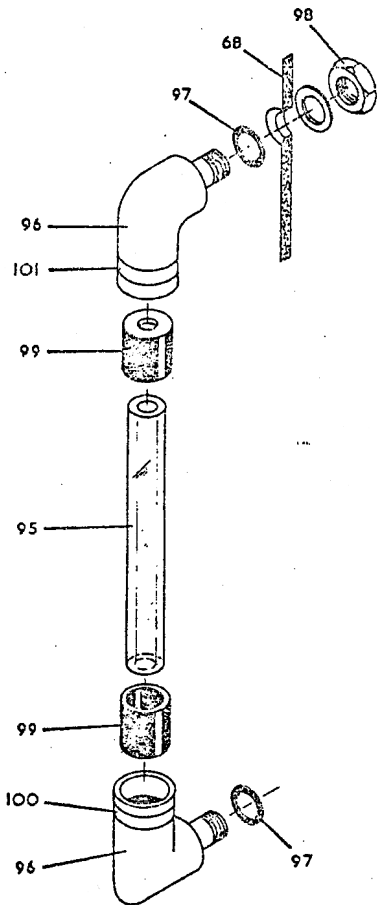
Take connector (96), smear thread with Microlac, pass down through filter hole and screw into position, on top of sight glass, with screwdriver.

Do not tighten excessively or end caps and/or sight glass will be damaged.

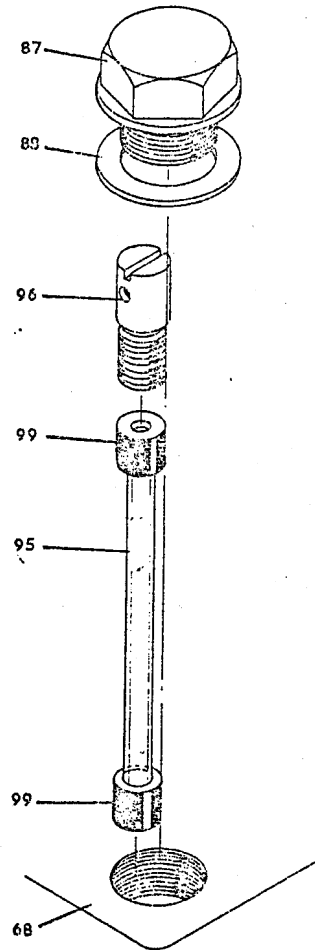
### Oil Level Marks

In the unlikely event of renewal being required, those for the ED500 are transfers stuck on the oil box whilst those for the other models are flexible sleeves located on the connector elbows using a Helleman sleeve expander.

All but ED500



ED500



Part No.	Pump model	ES/ED35	ES/ED75	ES/ED150/250	ED500
95	Sight glass	A009-06-059	A003-07-027	A014-03-032	A098-00-065
96	Connector		A009-06-053		A098-00-067
97	Connector seal		VOR0011	4021.25.003	
98	Locknut and washer		5/16in BSF		
99	End cap		A009-06-058		A098-00-066
100	Transfer MIN		A014-03-082		A098-00-069
101	Transfer MAX		A014-03-083		A098-00-069



**BEARINGS**

Pump model		ES35/75	ED35/75	ES150/250	ED150/250	ED500
Bearing position and code number	Front cover 22	Sleeve	Sleeve	Roller Hoffman RL8E A014-03-072	Roller Hoffman RL8E A014-03-072	Roller Hoffman RL10E A098-00-058
	Interstage 61 or 122	-	Sleeve	-	Roller Hoffman RL8E A014-03-072	Roller Hoffman RL10E A098-00-058
	Rear cover 107	Sleeve	Sleeve	Roller Hoffman RL8E A014-03-072	-	-

The bearings (4) are in recesses in the front cover (22), rear cover (107), interstage (61) or stator combinations (122).

The sleeve bearings are machined parts of these components so any bearing wear involves replacement of the component.

The outer housing of the roller bearing is a press fit into its recess, requiring an extractor tool to remove and a simple press to replace. The inner housing of the roller bearing is removed from the rotor shaft by a drawing tool.

There are many proprietary brands of bearing housing extractor/withdrawal tools available and little difficulty should be experienced in most parts of the world in obtaining sizes appropriate to the inner and outer races of the two bearing models fitted.

To test for wear in sleeve bearings, attempt to move rotor shaft sideways in sleeve : if there is any perceptible movement examine both parts carefully to detect which is worn and replace either or both according to findings.

With rotor shaft in position try roller bearings for lateral movement and replace if wear is evident.

Do not interchange parts of roller bearings.

Before pressing roller bearing housing into position make sure that all surfaces are clean : press squarely into recess.

Take great care not to damage surrounding precision machined surfaces when working on bearings.

### OIL SEAL

The oil seal (94) is a push fit into a recess machined in the rear face of the front cover (22) and the rotor shaft (112) passes through it.

#### *Dismantling*

Do not remove seal from recess in front cover unless suspect as it cannot be re-used.  
Remove oil seal from rear of front cover (22) with extractor.

#### *Inspection*

If seal is removed from front cover, renew: taper edge of seal must be free from cuts, irregularities or deformations: spring encircling seal must not have lost its tension.

Running surface on shaft (112) must be smooth: slight roughness must be smoothed off with (say) carborundum paper: a scored shaft must be renewed.

Before reassembly ensure that shaft surface, including end, is free of all roughness which would otherwise damage taper edge of seal on passing shaft through it: also, oil shaft before assembly.

#### *Assembly*

Coat outside diameter of seal with Microlac: press seal into recess in rear face of front cover.

Part No.	Pump model	ES/ED35	ES/ED75	ES/ED150/250	ED500
94	Oil seal	<del>A009-06-016</del>	<del>A003-07-024</del>	<del>A014-03-078</del>	A098-00-059

*H021-09-001 H003-07-034 H021-09-009*

*NOW  
H021 09 037  
SPRING SEAL  
+  
H021 09 038  
SEAL HOUSING.*

### OIL BOX

The oil box (68) is a single casting, with integral oil baffle, and is fixed to the pump front cover (22/119) with gasket (69) by screws (70) with washers.

#### Dismantling

Undo fixing screw (70) and remove oil box (68) carefully to avoid damage to gasket (69).

#### Inspection

Examine gasket for damage: renew if defective. Inspect oil box flange and mating face on front cover: dress off any roughness and clean.

#### Assembly

Hold gasket in position on ends of fixing screws, bring up box to screws and tighten uniformly: do not use jointing compound. Refer to NOTE at bottom of page 17.

Part No.	Pump model	ES35	ED35	ES75	ED75
68	Oil box	<i>A007 14 002</i>	A009-06-031	A001-08-004	A003-07-007
69	Gasket	A009-06-030		A003-07-009	
70	Screw and Washer	$\frac{1}{2}$ in BSF x $2\frac{1}{2}$ in long hex. hd.		$\frac{1}{4}$ in BSF x $2\frac{3}{4}$ in long hex. hd.	

Part No.	Pump model	ES150	ED150	ES250	ED250	ED500
68	Oil box	A005-08-011	A014-03-021	A089-01-007	A092-01-025	A098-00-005
69	Gasket	A014-03-022		A092-01-024		A098-00-041
70	Screw and Washer	$\frac{5}{16}$ in BSF x $3\frac{1}{2}$ in long		$\frac{5}{16}$ in BSF x $4\frac{3}{4}$ in long		2BA x $\frac{5}{8}$ in long

### LABEL

The label is fixed to the side of the pump case opposite the pulley by four self tapping screws and gives brief working instructions.

Pump model	ES35	ED35	ES/ED75/150/250/500
Label	A007-08-006	A009-06-033	A098-00-051 <i>A 250. 01. 015</i>
Fixing screws	4 - self tapping U2 x $\frac{1}{8}$ in slotted head		

## OIL FILTER

### *Dismantling*

The oil filter (89) is located beneath the pump overhand in the oil box (68).

Withdraw seal (90) and filter (89) from recess in oil box (with ED500, remove screws (91) and then withdraw filter (89)).

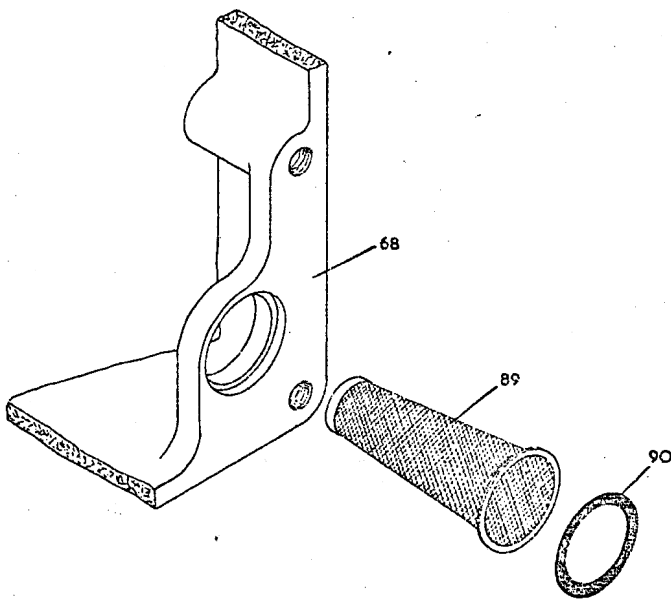
### *Inspection*

Examine filter gauze (89) and seal (90) for damage: clean if dirty, renew if defective.

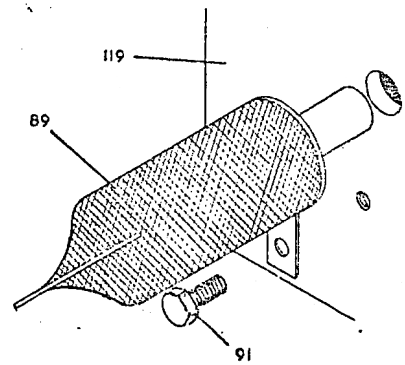
### *Assembly*


Push closed end of filter through hole in base of oil box until flange is in recess: push in ring seal (90) and refit oil box to pump. For ED500, position filter as above then fix with screw: there is no seal.

### *All But ED500*



### *ED500*



Part No.	Pump model 	ES/ED35	ES/ED75/150/250	ED500
89	Oil filter	A009-06-024	A014-03-026	A098-00-079
90	Seal	A009-06-042	A014-03-030	
91	Screw			2BA x 5/16in

## FRONT COVER

The front cover (22) is that part of the pump case through which the rotor shaft (112) passes, is immediately behind the pulley and has alternate forms in the ES/ED range of pumps.

For the ES/ED35/75 models it comprises the front box section whereas for the other models it is a separate casting bolted to the front box section. In both cases the front cover houses the oil seal (94), oil pump (93), front bearing (4) and shaft seal assembly (115/116/117).

### Dismantling

#### ES/ED35/75

Removal of the various parts attached to it, according to the instructions given in the appropriate sections, leaves the front cover (22) alone.

#### ES/ED150/250

Remove pulley and shaft seal according to instructions, loosen and remove front cover fixing screws (23/24), fit two front cover fixing screws in threaded holes at approximately 2 o'clock and 8 o'clock positions and screw in the break joint adhesion: remove front cover (22), watching for oil pump blade (93) which may drop out: remove joint breaking screws. There is now access to oil pump (93), oil seal (94) and bearing (4).

### Inspection

Scoring or corrosion of face forming end of stator enclosure may occur: if very slight it may be polished out with very fine emery paper, otherwise replace. Clean joint faces.

### Assembly

Proceed according to setting instructions for particular pump.

Part No.	Pump model	ES/ED35		1250 ED150/250	ED500
22	Front cover	A009-06-003	A003-07-001	A005-08-014A014-03-035	A098-00-004
23	Fixing screw - long	-	-	5/16in BSF x 2in long	3/8 BSF x 2 LNS 21463 2774
24	Fixing screw - short	-	-	5/16in BSF x 1in long	3/8 in BSF
	Washer	-	-	5/16in BSF plain	x 1 in 21463 2770

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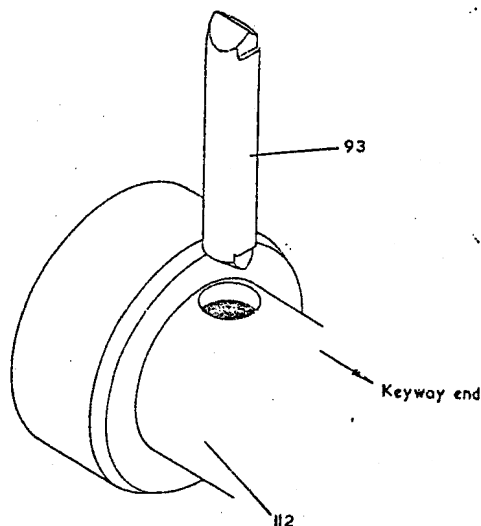
### OIL PUMP

The oil pump consists of a blade (93) situated in a cross hole in the rotor shaft (112) immediately in front of the oil seal (94) and rotating in a recess in the front cover (22).

When assembling, the flat on the blade must face towards the pulley (103) end of the shaft and the blade position in the cross hole must agree with the front cover recess on entry.

This part is not likely to require maintenance but is dismantled and reassembled in dealing with other components.

Part No.	Pump model	ES/DD35/75	ES/ED150/250	ED500
93	Oil pump blade	A009-06-044	A014-03-031	A098-00-040



**Note** Lubrication and sealing in the rotary vacuum pump depends upon successful operation of this component.

Always coat parts with oil when assembling, squirt oil down oil distributor delivery hole and pour oil down inlet connexion when filling oil box.

## ROTOR

In the single stage, ES model pumps, the rotor (112) is a single unit integral with the driving shaft.

In the two stage, ED model pumps, the rotor assembly is in two parts (111/112), coupled by pins or a key (113).

For the ED150/250/500 pumps one end face of the rear rotor (111) (non driving shaft section) is marked F and must be towards the pulley.

If the circumference of a rotor section is scored but not so deeply that it may be removed by grinding to produce a reduction of the radius by not more than .005 inch, then such an alteration can be accommodated in the setting adjustment, except for the ED35/75 where no adjustment is provided. Deeper scoring or damage to ends, shaft etc. can only be repaired by part replacement as machining would involve corresponding alteration to the stator, blades, etc. proving complex and expensive and making the pump entirely non-standard for subsequent overhaul.

Part No.	ES Pump series	35	75	150	250
112	Rotor (front) with driving shaft	A007-08-009	A003-07-023	A005-08-002	A089-01-002

Part No.	ED Pump series	35	75	150	250	500
111	Rotor (rear)	A009-06-009	A003-07-025	A014-03-017	A092-01-013	A098-00-008
112	Rotor (front) with driving shaft	<del>A009-06-005</del> A009-08-023	A003-07-040	A014-03-003	A092-01-003	A098-00-007
113	Key			A014-03-085	A014-03-085	A098-00-061

## BLADES

### Dismantling

As blades are slid out of rotor slot, hold each pair together to prevent springs flinging them apart and probably damaging them.

Keep blades in pairs, matched to their rotor slot.

Do not mark blades by stamping which causes local distortion and probable subsequent pump seizure.

### Inspection

It is good practice to renew blade springs whenever a pump is dismantled.

Renew spring supports if they show any sign of wear or corrosion.

Renew blades if any surfaces are scored: slight high spots or local roughness should be polished off with a very fine oil stone or very fine emery cloth on a truly flat surface.

Check blade pairs slide smoothly in their particular rotor slot.

### Assembly

Coat all parts with pump oil.

Fit springs and spring supports between each pair of blades.

Blades having a grooved surface must have that surface towards the direction of rotation.

Slide sub-assembly into rotor slot.

Part No.	Near pulley (Front)			Remote from pulley (Rear)		
	6	7	8	9	10	11
Model No. ↓	Blade	Blade Spring	Blade Spring Support	Blade	Blade Spring	Blade Spring Support
ES35	A009-06-079	A009-06-077	A007-03-019			
ES75	A003-07-048	A003-07-046	A077 02			
ES150	A014-03-038	A014-03-047	040			
ES250	A092-01-046	A089 02 005	A092-01-019			
ED35	A009-06-013	A009-06-077	A007-03-019	A009-06-075	A009 06 077	A007-03-019
ED75	A003-07-048	A003-07-046	A077 02 040	A003-07-044	A003 07 046	A077 02 040
ED150	A014-03-092	A005-09-009	A077 02 040	A014-03-051	A014 05 004	A014-03-049
ED250	A092-01-016	A089 02 005	A092-01-019	A092-01-039	A014-03-047	A092-01-019
ED500	A097-01-011	M012-00-013	A077-02-040	A098-00-089	A098-00-016	A098-00-015



## STATOR-INTERSTAGE-REAR COVER

The stator sections (119/120), interstage (61) and rear cover (107) are interdependent so are not dealt with in separate sections.

Single stage pumps comprise one stator section closed off front and rear by covers.

Two stage pumps have a double section stator closed by front and rear covers with the two sections separated by an interstage (61), providing mechanical connexion between the front and the rear.

In the ED35/75 models the interstage is included with the two stator sections into a single casting (122) : for the large two stage models the interstage is a separate unit providing relative adjustment of the two sections at the central junction.

### *Dismantling*

**All** Loosen rear fixing screws (108) or nuts (124) and remove rear cover (107).

**ES35/75** - loosen and remove stator setting screws (123) then slide stator (119) off rotor-blade (112/6/7/8) assembly, holding in blades before removal is complete : remove rotor sub-assembly, sliding shaft out of bearing in front cover (22) : ES75 only - remove studs (121) from front cover.

**ES150/250** - slide rotor-blade sub-assembly (112/6/7/8) out of stator (119), holding in blades before removal is complete.

**ED35/75** ED75 and ED35 from serial No. 4000 - remove rear setting screws (109) to release rear cover (107) slide complete rotor-stator sub-assembly away from front cover (22) : remove front rotor (112) and blades (6/7/8) from stator (122), holding in blades before removal is complete : remove rear rotor (111) and blades (9/10/11) from stator (122), holding in blades before removal is complete : remove studs (121) from front cover (22).

**ED150/250/500** - remove rear stator setting screws (123) : slide off rear stator (120), holding rear rotor blades (9/10/11) before removal is complete : slide off rear rotor (111) and remove key (113) : loosen and remove interstage fixing screws (62/63) : remove interstage (61) : slide out front rotor (112) from front stator (119), holding in rotor blades (6/7/8) before removal is complete.

### *Inspection*

Any stator section, interstage or end cover badly scored, corroded or otherwise damaged should be renewed as regrinding of any of these parts is not a practical proposition except for the ED150/500 rear covers where the working surface is flat and can be refaced.

### *Assembly*

Refer to setting instructions for the particular pump and proceed accordingly.

**Single Stage Pumps**

Part No.	Pump model	ES35	ES75	ES150	ES250
107	Rear cover	A007-08-003	A001-08-005	A005-08-013	A089-01-005
108	Fixing screw and washer	5/16in BSF x 2½in	-	5/16in BSF x 1 1/8in	5/16in BSF x 1in
119	Stator	A007-08-010	A001-08-007	A005-09-001	A089-01-001
121	Studs	-	A001-08-007	-	-
123	Setting screw	4BA x 7/8in S/H	2BA x 2in S/H	-	-
124	Nut and washer	-	½in BSF hex.	-	-

Two stage pumps over page



Two Stage Pumps

Part No.	Pump model	ED35	ED75	ED150	ED250	ED500
61	Interstage	-	-	A014-03-014	A092-01-009	A098-00-002
62	Fixing screw-long S/H	-	-	5/16in BSF x 2in	5/16in BSF x 2in	3/8in BSF x 2 1/2in
63	Fixing screw-short S/H	-	-	5/16in BSF x 1in	5/16in BSF x 1in	3/8in BSF x 1 3/8in
107	Rear cover	A009-06-017	A003-07-005	A014-03-019	A092-01-020	A098-00-006
108	Fixing screw hex. hd. and washer			5/16in BSF x 2 1/2in	5/16in BSF x 3in	5/16in BSF x 3in
109	Rear cover setting screw hex. hd. and washer		1/2in BSF x 1/2in	-	-	-
119	Front stator			<del>A014-03-011</del> A014-03-011	A092-01-001	A098-00-001
120	Rear stator		-	A014-03-016	A092-01-011	A098-00-003
121	Studs	A009-06-078	A003-07-032			
122	Stator-combination	A009-06-001	A003-07-003			
123	Setting screw S/H	-	-	<del>5/16in BSF x 3 1/2in</del> 5/16in BSF x 3 1/2in	5/16in BSF x 3 7/8in	1/2in BSF x 2in
124	Nut and washer	5/16in BSF	1/2in BSF hex	-	-	-

STATOR-INTERSTAGE-REAR COVER

## SETTING ES35/75

Secure front cover (22) to bench plate.

ES75 - insert studs (121) in front face and tighten.

Mark position of duo-seal on rear face of stator (119).

Coat front face of stator (119) with Microlac, outside oil holes and inside screw holes.

Cover rotor (112) with layer of oil and position oil blade (93).

Ensure rotor shaft is oily and push into sleeve bearing in front cover (22).

Oil the blades (6), springs (7) and pins (8), assemble together and slide into rotor slot which must be horizontal.

Nip blades (9) together into rotor slot and slide stator (119) over them up to front cover, positioning setting screws (123) and entering thread in stator holes.

Clamp rotor (112) to front cover, using C clamp.

Press stator (119) down onto rotor (112), rock gently to find central position, tighten setting screws (123) and try gap between rotor and stator with .0015 inch feeler which must not enter duo-seal and should show a uniform gap each side : adjust rotor - stator positioning until these conditions are met, tighten setting screws (123), recheck with feeler.

Remove rotor setting clamp.

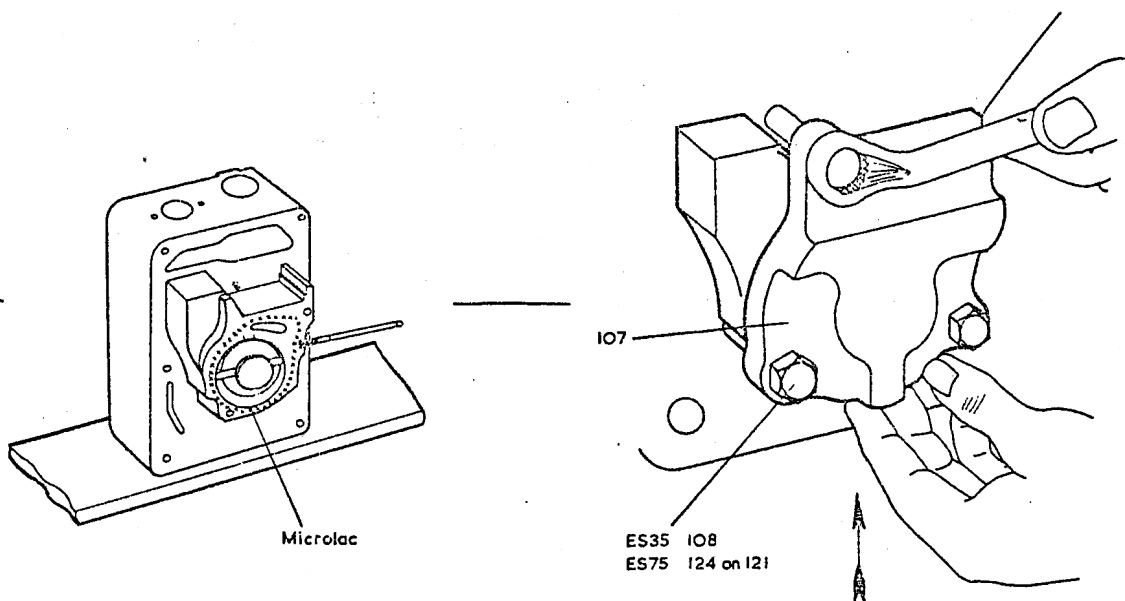
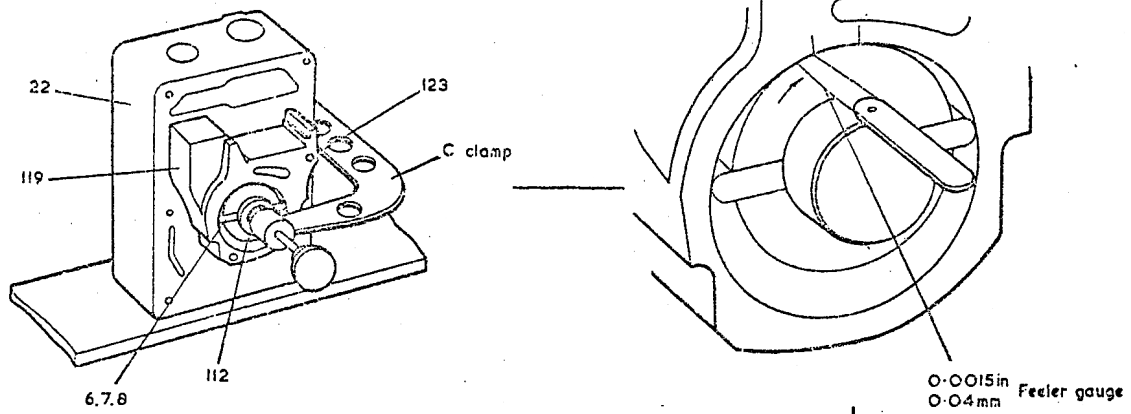
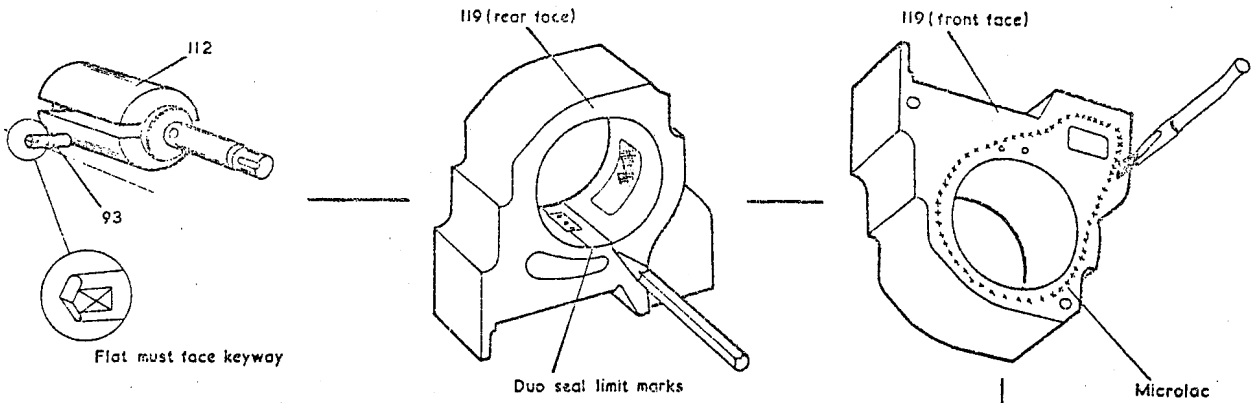
Coat rear face of stator with Microlac, outside oil holes and inside screw holes.

Oil bearing in rear cover (107).

Locate rear cover (107) and hold in position with fixing bolts (108) - (ES75 - fit nuts (124) to stud ends (121) - loosely.

Rock rear cover (107) to find central position, gently push upwards towards duo-seal to pre-load bearing and tighten bolts (108) evenly (ES75 - tighten nuts (124) on studs (121).

Fit pulley to shaft, use it to rotate pump slowly by hand and check for possible tight spots : if any are found, reset pump applying decreased pressure from rear cover edge towards duo-seal.



## SETTING EDGE

Note Pumps with a serial number of 4000 and above include setting screws in the rear stator section and may be set in the same manner as the Model ED75.

Fix front cover (22) to bench plate.

Mark duo-seal on each end surface of stator combination (122).

Take stator combination (122) and oil centre bearing.

Select stator combination front face, next exhaust port, and place that face downwards onto bench.

Oil rotor rear section (111), without drive shaft, fit blades (9), springs (10) and pins (11), press blades into rotor slot and place sub-assembly within stator rear section with plain rotor stub faced upwards, with one blade located centrally within the marked duo-seal lines.

Turn stator assembly upside down.

Oil rotor front section (112), with shaft, fit blades (6), springs (7) and pins (8), press blades into rotor slot and place sub-assembly within stator front section with rotor shaft pointing towards, with line of blades at right angles to diameter through duo-seal and twist slightly relative to other half to engage coupling pins with holes.

Microloc upward face of stator outside all holes and ports:

Oil rotor shaft (112), oil and position oil pump blade (93).

Take complete stator/rotor assembly and pass rotor shaft through bearing in front cover (22), with exhaust port upward, until pressing on front cover : Microloc rear face of stator outside all ports and holes whilst holding it in position.

Press rear rotor (111) hard towards front cover (22).

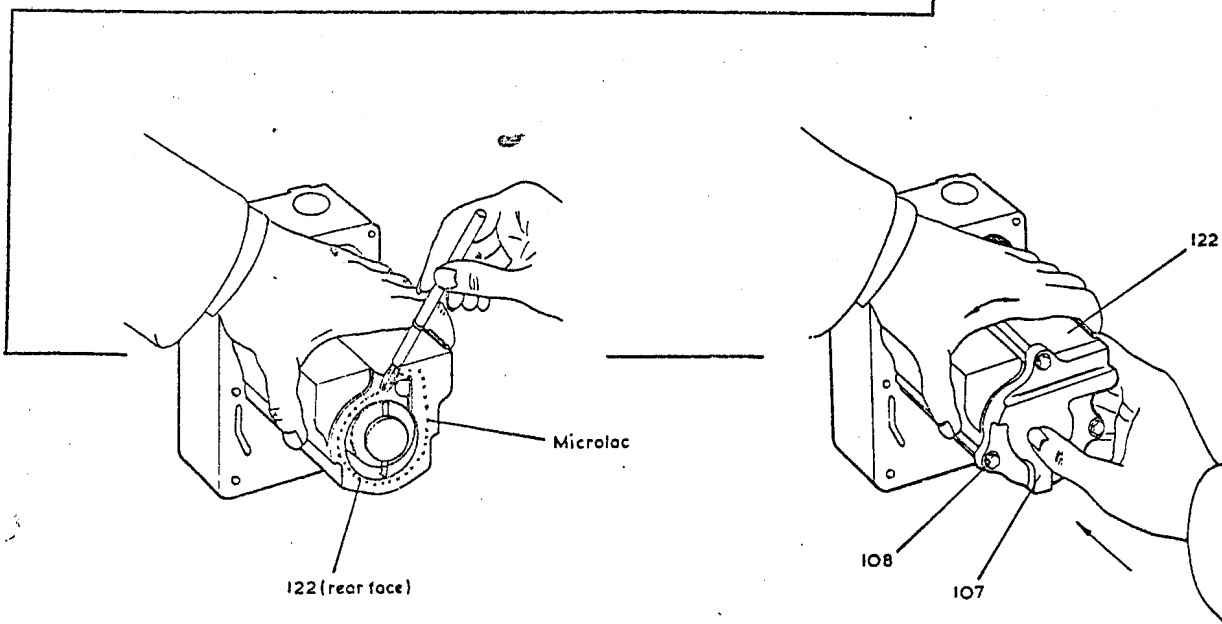
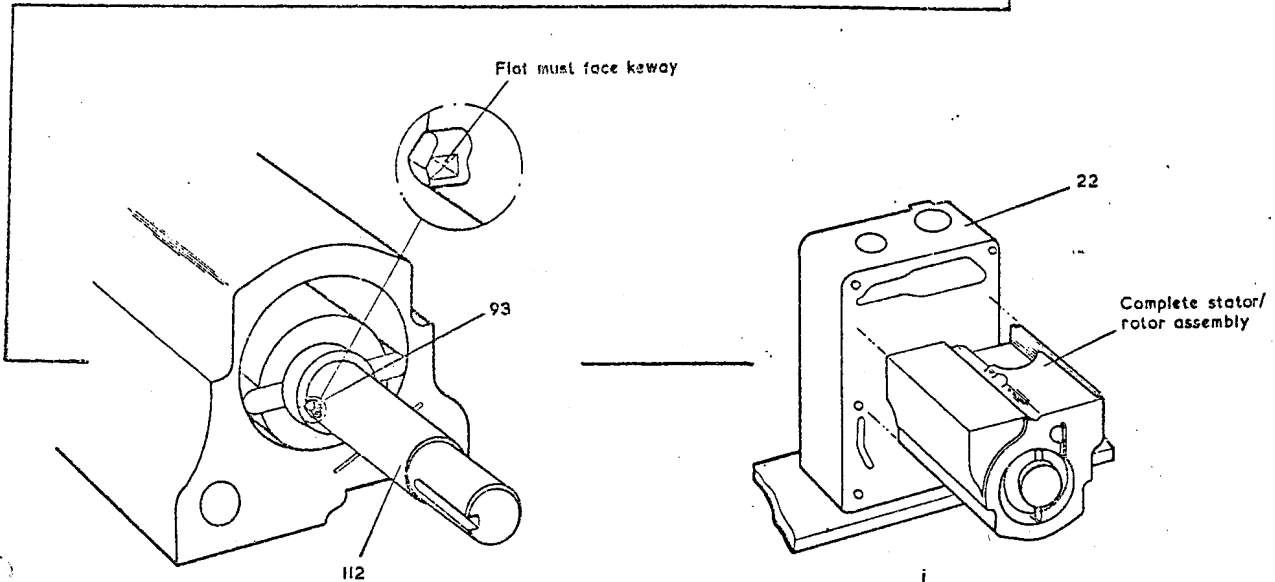
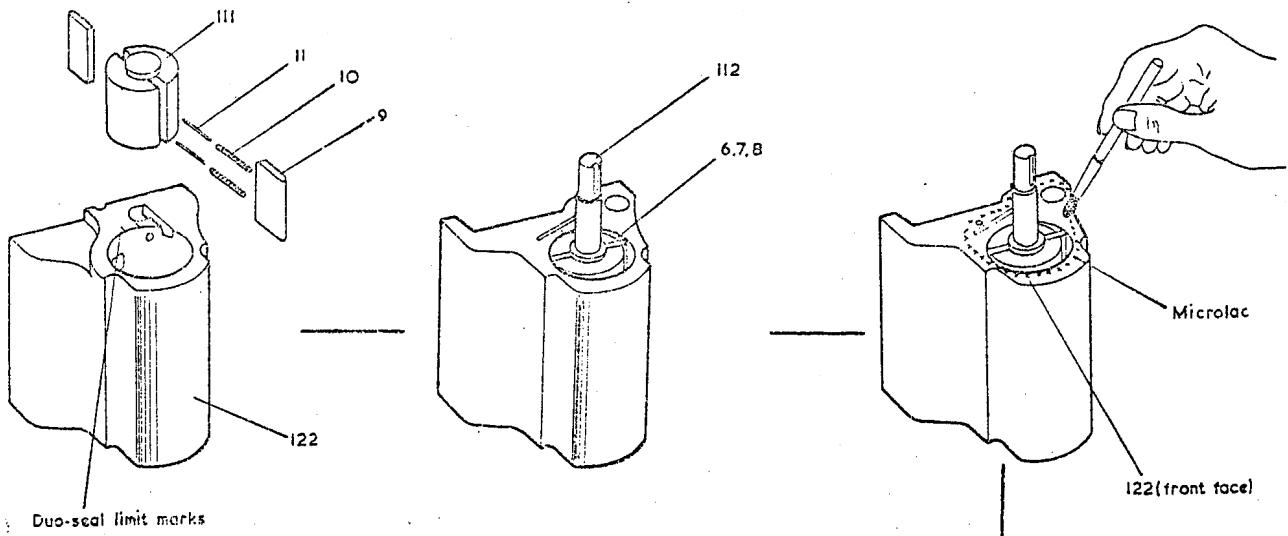
Oil rear cover (107) and position rock gently to centralise without disturbing rotor (111).

Locate fixing screws (108) and washers.

Press rear cover (107) hard towards front cover (22) whilst rocking stator (122) gently and feeling for midway position.

Tighten screws (108) evenly.

Fit pulley to shaft, turn pulley slowly by hand to rotate pump and check for possible tight spots : if any are found, reset pump.



## SETTING ED75

Fit studs (121) to front cover (22) and true up, using a set square from rear face of front cover checking vertical of each stud in two planes at right angles to each other.

Place front cover studs upward, on blocks, with clearance beneath cover for rotor shaft.

Take stator (122), mark duo-seal on each end face and oil centre bearing.

Place exhaust port end of stator face down on bench.

Oil and assemble blades (9), springs (10) and pins (11) to rear rotor section, (without driving shaft (111)).

Press blades into rotor slot and lower sub-assembly into stator (122) with rotor plain stub upwards and one blade central in duo-seal.

Coat upward stator face with Microlac inside threaded holes and outside plain holes.

Press rotor (111) hard down into stator (122).

Take rear cover (107), oil bearing and gently lower onto rotor stub without moving rotor, line up three fixing holes around edge with slots along stator surface, position setting screws (109) complete with washers, and tighten uniformly.

Set stator on side with exhaust port downwards.

Take front rotor section (112), with shaft but without blades, fit into open end of stator, mating drive pins with other stator section and fit pulley to rotor shaft.

Press shafted rotor section (112) onto duo-seal, turn pulley and check for tight spots in already assembled rear rotor/stator section : if tight, reset rear section.

Remove front rotor section (112) from stator, oil and fit blades (6), springs (7), pins (8) and oil pump blade (93), then fit sub-assembly to front cover (22), turning rotor until blade line is parallel with cover sides, which positions oil pump blade.

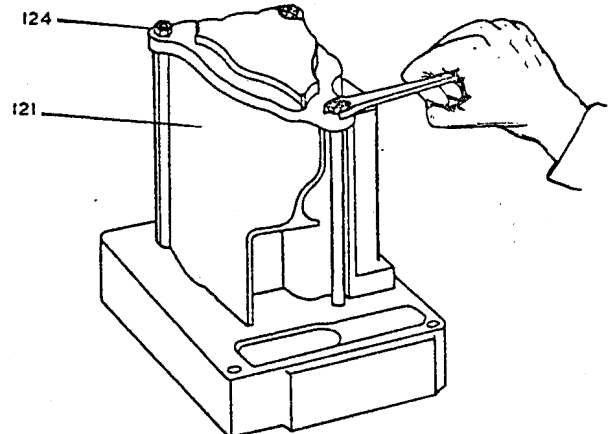
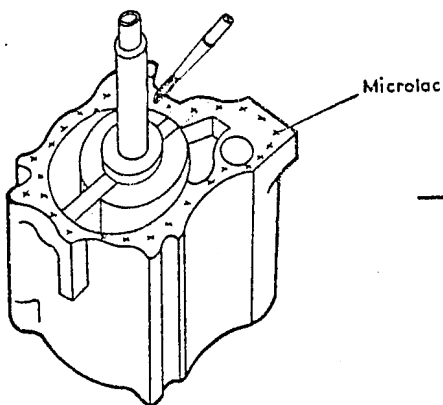
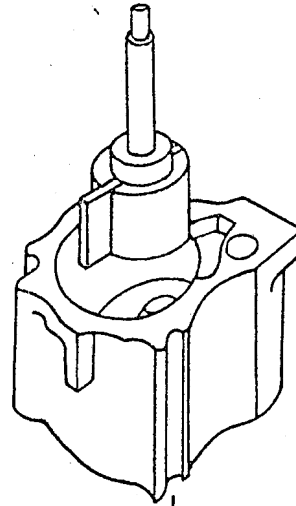
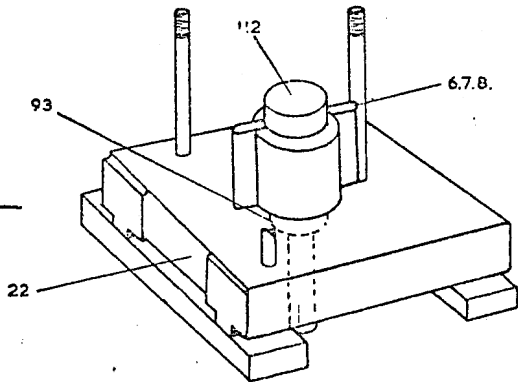
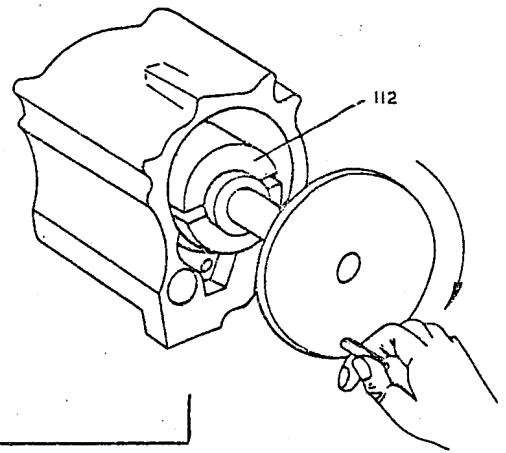
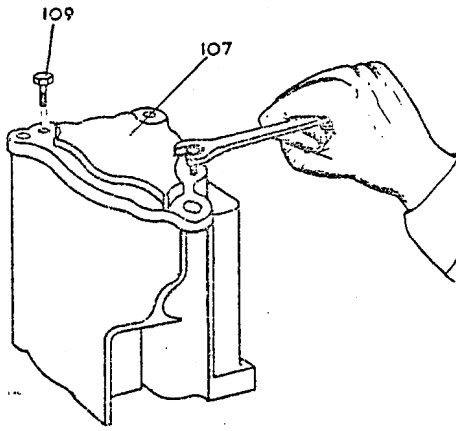
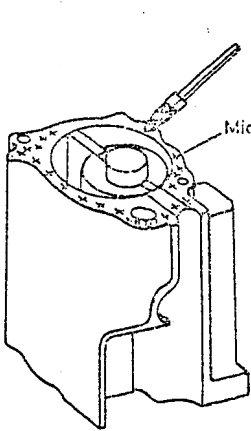
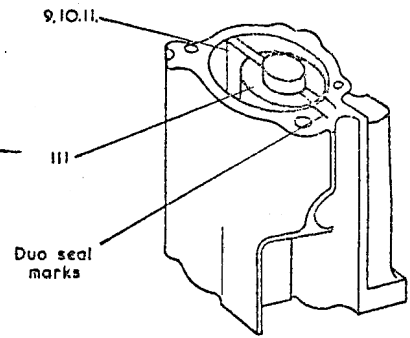
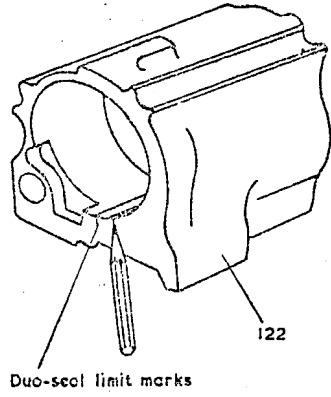
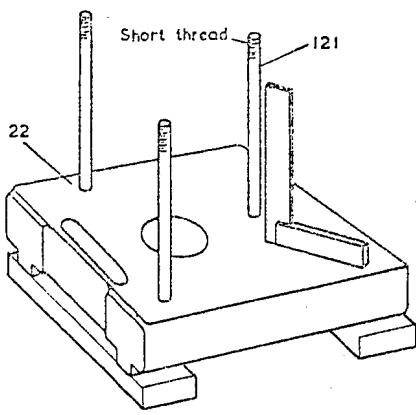
Carefully lift the front rotor section sub-assembly from the front cover, holding the blades in and with the shaft vertically downwards.

With the oil pump blade centre line as axis, turn the front rotor sub-assembly upside down with shaft vertically upwards and position it in the front stator with blade central in duo-seal. Take care that the oil pump blade does not move.

Coat upward face of stator with Microlac outside all holes and grooves and oil rotor shaft.







Lift complete stator assembly and turn upside down, again using centre line of oil pump blade as axis, taking care that oil pump blade does not move and holding rotor front section to stop it dropping out of stator.

Offer rotor/stator assembly to front cover and lower so that studs locate in grooves and shaft enters bearing sleeve: lower until stator front face mates with front cover face and studs pass through rear cover holes. The earlier procedure ensures that the oil pump blade is correctly positioned to enter the recess in the front cover plate.

Assemble nuts and washers on studs, push down hard on stator, rocking from side to side to centralise, and then tighten nuts without moving stator.

Turn pump upright, fit pulley to shaft and rotate by hand to test for tight spots: if tight, repeat setting procedure until a satisfactory condition is obtained.

## SETTING ES100/250

Press roller bearings (4) into recesses in front (22) and rear cover (107), if removed.

Check that inlet connexion, gas ballast valve, lid, etc. have been dismantled from stator (119).

Place stator (119) upside down on bench and mark duo-seal position on front and rear faces.

Oil inside surface of stator, particularly the duo-seal. Place a piece of .006 inch thick shim paper, approximately 1/8 inch wide by 1/2 inch long, across each end of duo-seal.

Oil and assemble in rotor (112), blades (6), springs (7), pins (8) and oil pump blade (93).

With slot horizontal, press in blades and place rotor assembly into stator to rest on paper shims.

Fix rotor in position with setting clamp.

Try gap each side of duo-seal with .0025 inch feeler, which must not pass marks and must show a uniform gap each side : adjust until these requirements are met.

Microlac front face of stator (119) inside threaded holes and outside plain holes.

Take front cover (22), oil inside surface, thread rotor shaft (112) through bearing (4), bring cover and stator together, rock cover gently to centralise without disturbing rotor, insert fixing screws (23/24) and washers, press down gently towards duo-seal on cover edge and tighten screws, subsequently using torque spanner to set tightness to 20 lb. ft.

Remove internal setting clamp.

Position external setting clamp over rotor shaft, fix by central screw into end of rotor shaft and tighten by nut. Where on earlier pumps the rotor shaft end is not drilled and tapped, omit fitting of external setting clamp but follow subsequent procedure : be particularly careful not to move rotor when positioning rear cover.

Microlac rear face of stator (119) outside plain holes and inside threaded holes.

Oil bearing (4) in rear cover (107) and position over end of rotor (112).



Rock rear cover gently to centralise, do not disturb rotor, position screws (108) and washers, push gently downwards on edge of cover towards duo-seal and tighten screws.

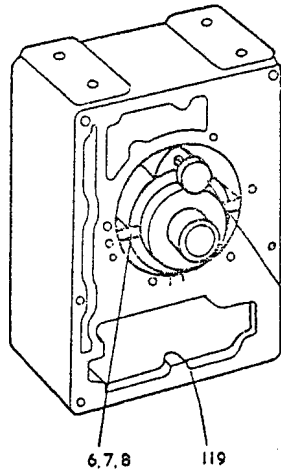
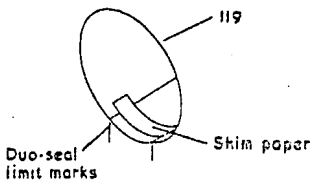
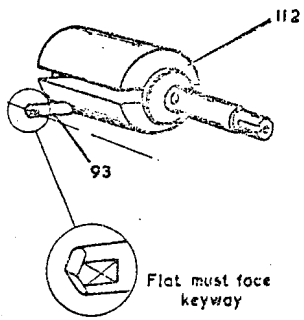
Fit pulley to shaft, turn pulley slowly by hand to rotate pump and check for possible tight spots : if any are found, reset pump applying less pressure on front and rear cover edges towards duo-seal.

When setting is satisfactory use a torque spanner set to 20 lb. ft. on all front and rear cover fixing screws.

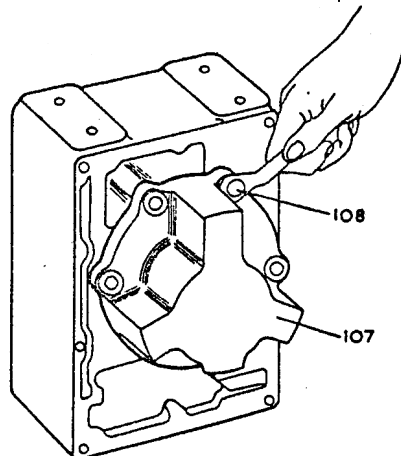
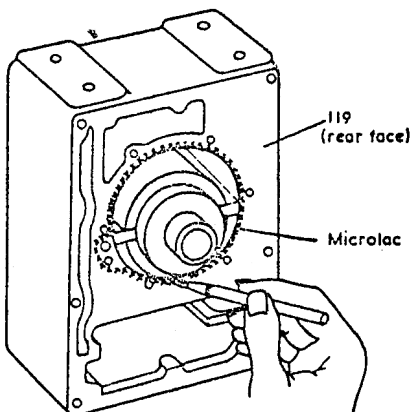
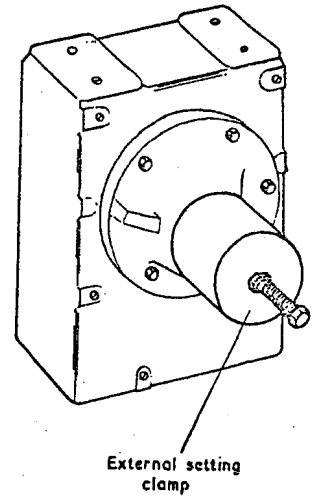
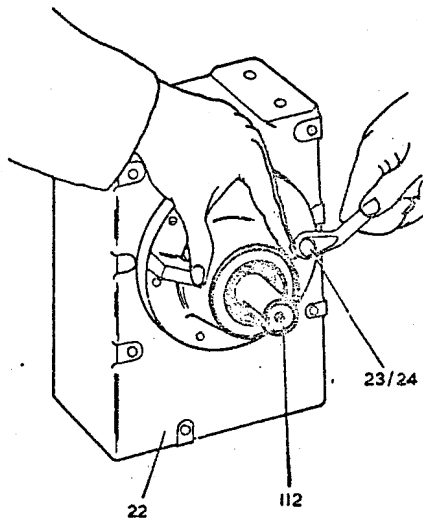
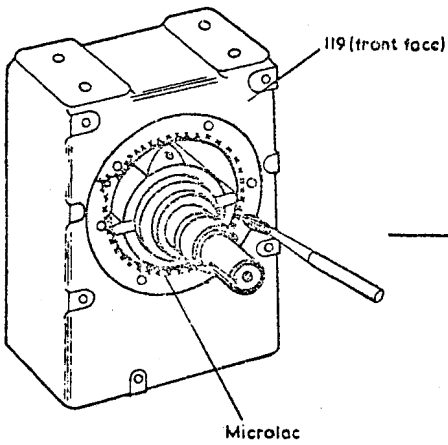
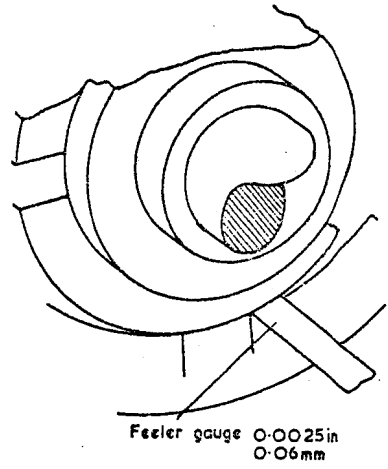
*Note* Shim paper used in setting is left in pump to be ejected during running.

***Important***

Shaft ends were not internally threaded on earlier production, to use recommended setting jigs and procedure, drill shaft centrally down centre line with  $17/64$  in dia. drill for  $5/8$  in minimum and then tap  $5/16$  in BSF for  $1/2$  in depth.



Internal setting clamp



## SETTING ED150/250/500

Commence according to procedure for ES150/250 and continue until rear face of front stator section (119) is coated with Microlac. Then, take interstage (61) oil bearing (4), push up to stator over rotor (112) end, rock gently to centralise, position bolts (62/63) and washers, push gently downwards on top of interstage (61) and tighten bolts (62/63) subsequently setting them to 20 lb. ft. with a torque spanner.

Fit pulley to shaft, rotate pump stage slowly checking for possible tight spots : if found, reset with reduced downward pressure on interstage.

Turn pump upright, turn front rotor shaft until key slot is at top.

Fit key (113) and slide rear rotor (111) along overkey up to interstage with rotor face marked F towards pulley.

Oil and assemble blades (9), springs (10) and pins (11) in rear rotor slots, ensuring that springs and pins pass through holes in slot base and in shaft.

Microlac front face and rear stator section (120), inside bolt holes but outside pumping passage.

Press blades back into slot and slide rear stator section (120) over rotor (111).

Position setting screws (123).

Rock stator (120) to centralise, press down to rotor (111) and handtighten screws (123).

Try gap each side of rotor-stator contact point with 0.0015 inch feeler, which must not pass across top of gap. If necessary, adjust to obtain this setting, then tighten screws (123).

Microlac rear face of stator (120) within screw holes.

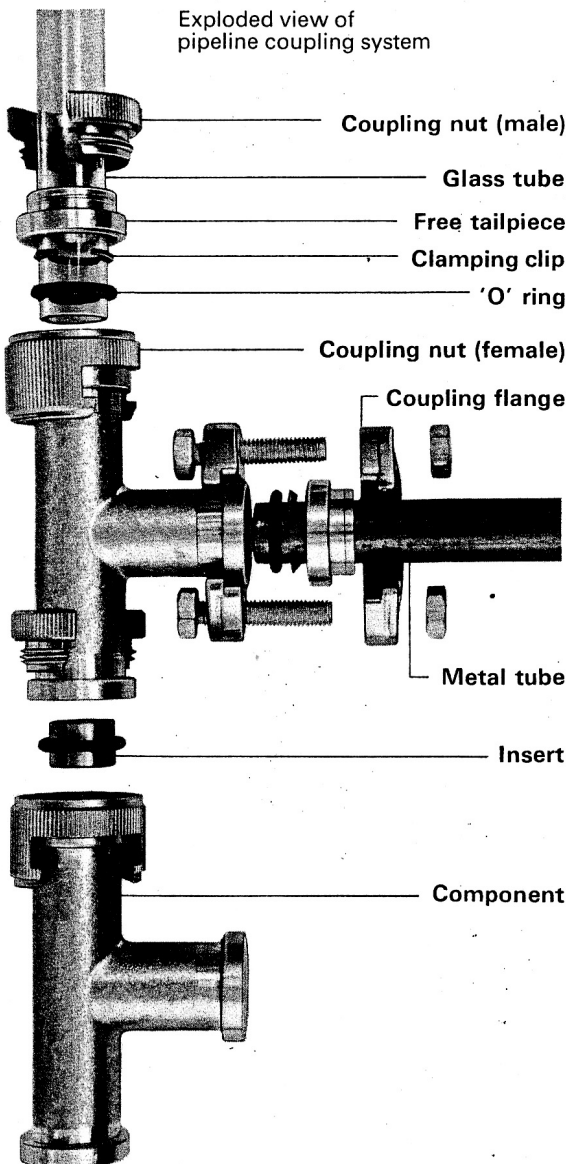
Position rear cover (107), insert fixing bolts (108), centralise cover, tighten bolts : fit pulley to shaft and turn to test for tight spots : if there are any, reset with reduced pressure of stator towards rotor.

**Note** Shim paper used in setting is left in pump to be ejected during running.

**Pipeline coupling components**—a comprehensive range of rigid, solderless, vacuum couplings for  $\frac{1}{2}$ in (12.7mm) and 1in (25.4mm) systems.

**Features**

- Strong and rigid.
- Choice of two easily assembled solderless joints—flange clamped or hand tightened.
- Designed for the stringent leak-tightness standards of vacuum work.
- Wide range of components available.
- Simple direct component to component joints—no intermediate tubes required.
- Equally suitable for metal or glass tube to component joints.
- Complete interchangeability of tees, elbows, crosses.
- Each part can be used again and again.
- Constructed in mercury—resistant light alloy and stainless steel.
- Neat clean design—no projecting wing nuts.
- Can be fitted close to walls or bench backs.
- No orientation difficulties.
- Comprehensive range of adapters—no need to modify existing equipment.
- If required, components can be hard-soldered or brazed for system pressures up to 200 lbf/in<sup>2</sup>.



Many accessories such as Speedivalves, magnetic valves, air admittance valves and flexible couplings terminate in coupling fittings for incorporation in vacuum pumping systems. Edwards pipeline coupling components ensure exceptionally easy and time-saving fitting of these accessories.

Edwards solderless couplings enable perfectly engineered leak-free pipeline systems to be built without workshop facilities. Basically the joint is an 'O' ring sealed muff coupling designed to meet the stringent leak-tightness requirements of modern vacuum practice.

The coupling can be secured by one of two methods according to preference. Flange clamped—requiring only a spanner and intended for the inexpensive semi-permanent joint. Hand tightened—with two specially designed knurled locking rings for the frequently dismantled joint.

The system is available in two nominal ranges,  $\frac{1}{2}$ in and 1in, for use with preferred standard tubing of  $\frac{5}{8}$ in or 16mm external diameter and  $1\frac{1}{8}$ in external diameter respectively. However, it can also be used with  $\frac{1}{2}$ in bore  $\times$  0.596in \* external diameter and 1in bore  $\times$  1.112in \* external diameter tubing, the fittings for the latter being equally suitable for 28mm external diameter tubing.

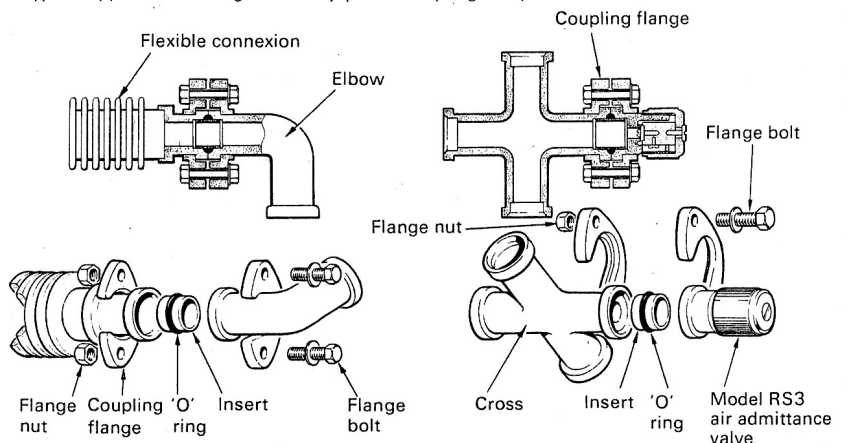
**Wide range of adapters**

Special purpose adapters are available to exploit the advantages of these couplings using Edwards pumps and equipment. These adapters enable the couplings to be attached to rotary pumps, vapour pumps, valves, unions and flanges. There is absolutely no need to modify any Edwards pumping equipment when introducing variations or extensions to installations or when building new systems with previously purchased pumps.

In addition to the basic joints, a range of components is available which will cover every normal requirement of system construction. The components are die cast in mercury—resistant light alloy and comprise elbows, tees and crosses, all of which are made to a module ensuring complete interchangeability. The design enables tube to component and component to component joints to be made with ease, the latter making possible the construction of small, compact, high vacuum pumping units without the use of tubing.

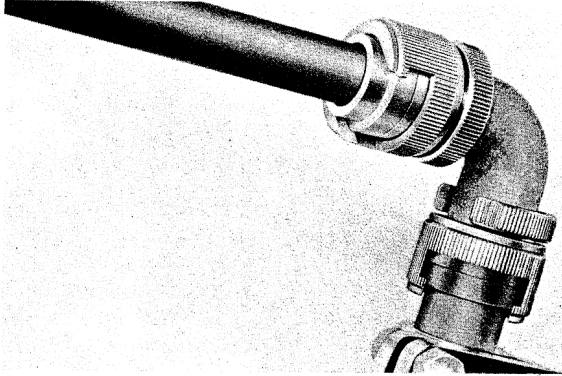
Clamping clips are recommended for use with a free tailpiece when fitting gauge heads to a system to prevent leakage at the joint due to vibration. They are recommended if pipeline joints are to be subjected to pressures greater than 1 atmosphere. For normal vacuum use, the clamping clips are optional.  
\* BS659.

Typical applications using Edwards pipeline coupling components

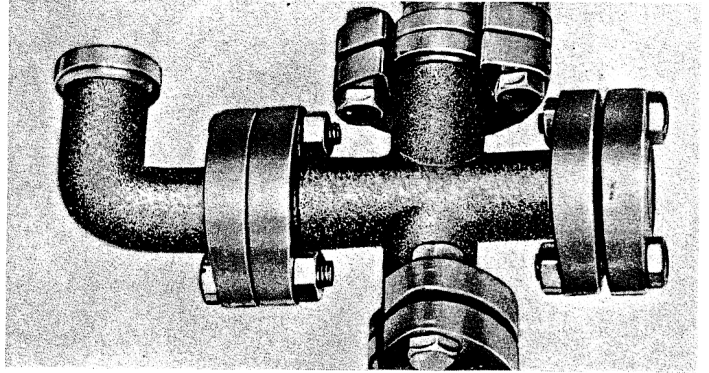


# General vacuum accessories

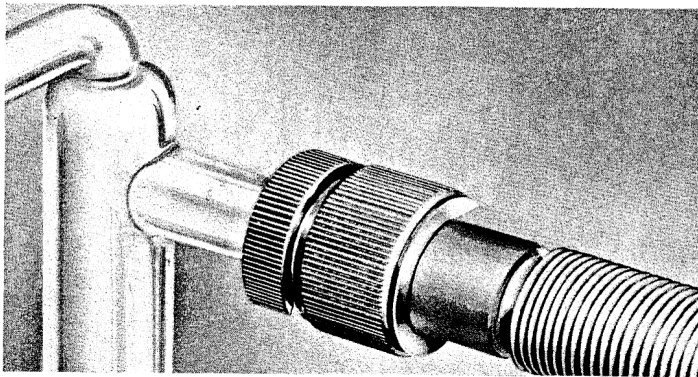
Some of the applications for Edwards pipeline coupling components



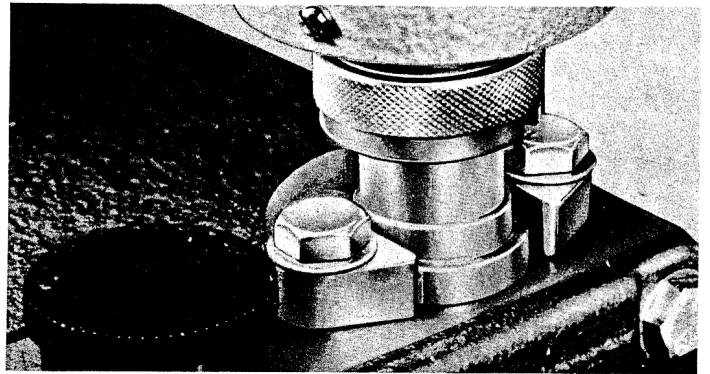
*Metal tube to component*



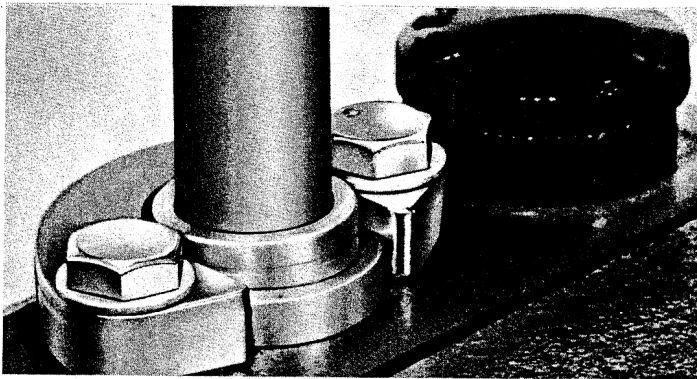
*Component to component*



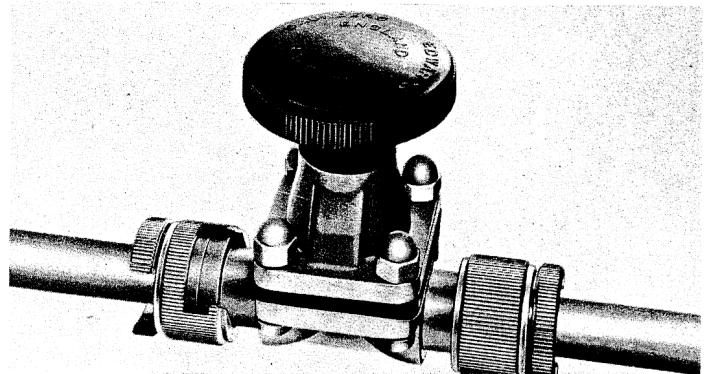
*Glass tube to component (flexible tube)*



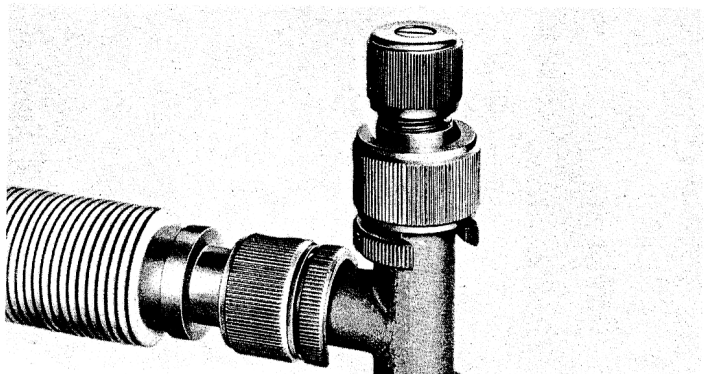
*Component to flat surface*



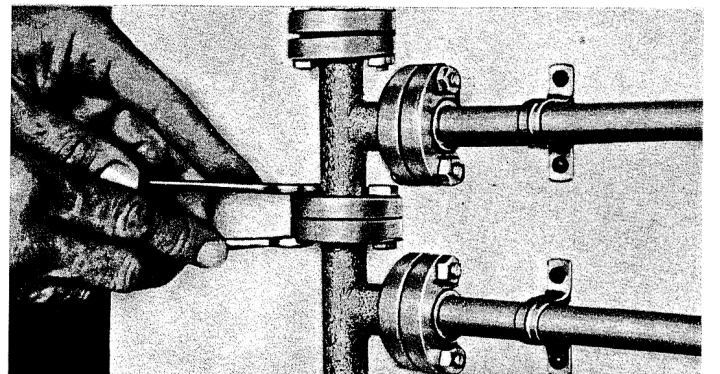
*Tube to flat surface*



*Speedivalve to tube*



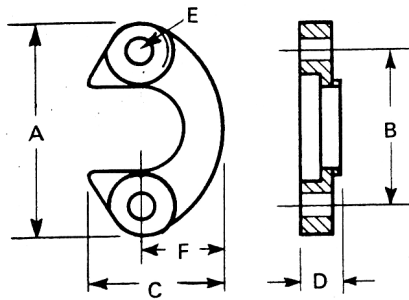
*Component to flexible tube and air admittance valve*



*Easy fitting close to bench backs*

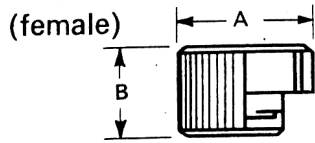


Coupling flange (nickel plated brass)

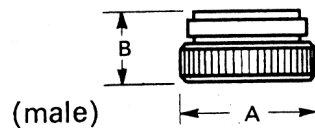


Size	A	B	C	D	E	F	G	H	Pkts of	Ordering number
in	$2\frac{1}{16}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{8}$	$\frac{17}{64}$	$\frac{1}{8}$	—	—	10	08-C065-02-001
$\frac{1}{2}$ in	mm	52	38	32	9.5	6.7	20.6	—		
in	$2\frac{3}{4}$	$2\frac{1}{8}$	$1\frac{13}{32}$	$\frac{1}{2}$	$\frac{11}{32}$	1	—	—	10	08-C066-02-001
1 in	mm	70	54	40.5	13	8.7	25.4	—		

Coupling nuts (nickel plated brass)

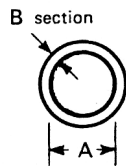


Note: The coupling nuts are only available in pairs. (Male and female.)



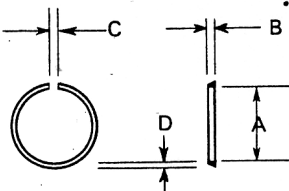
in	$1\frac{1}{4}$	$\frac{1}{8}$	—	—	—	—	—	—	2 pairs	08-C065-02-007
$\frac{1}{2}$ in	mm	32	21	—	—	—	—	—		
in	$1\frac{1}{4}$	$\frac{5}{8}$	—	—	—	—	—	—	1 pair	08-C066-02-007
$\frac{1}{2}$ in	mm	32	16	—	—	—	—	—		
in	$1\frac{13}{16}$	$\frac{7}{8}$	—	—	—	—	—	—	1 pair	08-C066-02-007
1 in	mm	46	22	—	—	—	—	—		
in	$1\frac{13}{16}$	$\frac{5}{8}$	—	—	—	—	—	—	1 pair	08-C066-02-007
1 in	mm	46	16	—	—	—	—	—		

O ring (Nitrile or Viton)



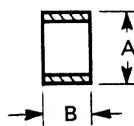
in	0.594	0.103	—	—	—	—	VOR 1119 or VIT 1119	10	08-H021-05-119
$\frac{1}{2}$ in	mm	15.09	2.6	—	—	—	—	5	08-H021-06-119
in	1.046	0.139	—	—	—	—	VOR 0215 or VIT 0215	10	08-H021-05-025
1 in	mm	26.57	3.59	—	—	—	—	5	08-H021-06-025

Clamping clip for use with free tailpiece (brass)



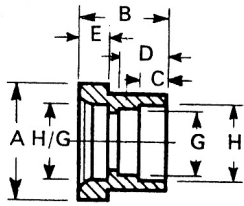
in	$\frac{5}{8}$	0.062	$\frac{11}{16}$	0.04	—	—	—	—	10	08-C065-02-008
$\frac{1}{2}$ in	mm	16	1.6	4.4	1	—	—	—		
in	$1\frac{1}{8}$	0.093	$\frac{11}{16}$	0.052	—	—	—	—	10	08-C066-02-008
1 in	mm	28.6	2.4	4.4	1.3	—	—	—		

Insert (stainless steel)



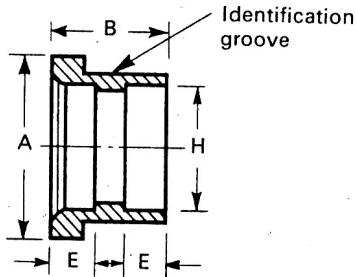
in	$\frac{5}{8}$	$\frac{7}{16}$	—	—	—	—	—	—	10	08-C065-02-002
$\frac{1}{2}$ in	mm	16	11	—	—	—	—	—		
in	$1\frac{1}{8}$	$\frac{3}{32}$	—	—	—	—	—	—	10	08-C066-02-002
1 in	mm	28.6	17	—	—	—	—	—		

Universal fixed tailpiece (brass)



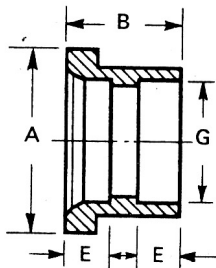
Size	Suitable for tube								Pkt of	Ordering number
	A	B	C	D	E	F	G	H		
in	$1\frac{1}{64}$	$\frac{3}{4}$	$\frac{7}{32}$	$\frac{13}{32}$	$\frac{1}{4}$	—	$\frac{1}{2}$ (nom)	$\frac{5}{8}$	5	08-C065-02-025
$\frac{1}{2}$ in								or		
mm	25.8	19	5	10	6	—	15.2	16		

Fixed tailpiece type A (brass)



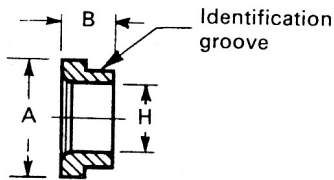
in	$1\frac{37}{64}$	1	—	—	$\frac{3}{8}$	—	—	$1\frac{1}{8}$	5	08-C066-02-003
1 in										
mm	40.1	25.4	—	—	9.5	—	—	28.5		

Fixed tailpiece type B (brass)



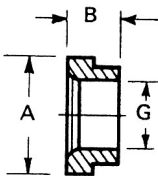
in	$1\frac{37}{64}$	1	—	—	$\frac{3}{8}$	—	1 (nom)	—	5	08-C066-02-010
1 in							or			
mm	40.1	25.4	—	—	9.5	—	28	—		

Free tailpiece type A (dural)



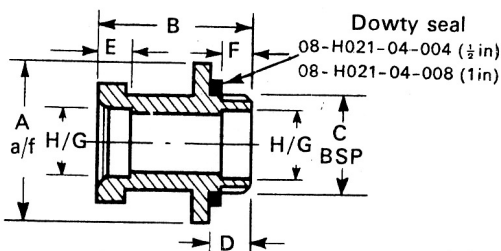
in	$1\frac{1}{64}$	$\frac{7}{16}$	—	—	—	—	—	$\frac{5}{8}$	10	08-C065-02-004
$\frac{1}{2}$ in								or		
mm	25.8	11	—	—	—	—	—	16		
in	$1\frac{37}{64}$	$\frac{13}{32}$	—	—	—	—	—	$1\frac{1}{8}$	5	08-C066-02-004
1 in										
mm	40.1	15	—	—	—	—	—	28.5		

Free tailpiece type B (dural)



in	$1\frac{1}{64}$	$\frac{7}{16}$	—	—	—	—	$\frac{1}{2}$ (nom)	—	10	08-C065-02-012
$\frac{1}{2}$ in										
mm	25.8	11	—	—	—	—	15.2	—		
in	$1\frac{37}{64}$	$\frac{13}{32}$	—	—	—	—	1 (nom)	—	5	08-C066-02-012
1 in							or			
mm	40.1	15	—	—	—	—	28	—		

Screwed tailpiece (nickel plated brass)



in	$1\frac{13}{64}$	$1\frac{11}{32}$	$\frac{1}{2}$ (BSP)	$\frac{3}{8}$	$\frac{1}{4}$	—	—	$\frac{5}{8}$	2	08-C065-02-026
$\frac{1}{2}$ in								or		
mm	30.6	34.1	—	9.5	6.4	—	—	16		
in	$1\frac{5}{8}$	$1\frac{25}{32}$	1 (BSP)	$\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{4}$	1 (nom)	$1\frac{1}{8}$	1	08-C066-02-026
1 in							or			
mm	41	45.2	—	12.7	9.5	6.4	28	28.5		