



Imo Delaval Inc.

# **CIG<sup>TM</sup> PUMP**

**INSTRUCTIONAL MANUAL**

## **Series H**

**WARNING**

**READ THIS INSTRUCTION MANUAL AND CIG-1 BEFORE  
INSTALLATION, OPERATION, OR MAINTENANCE**

### **Instructions CIG-H Series (R-1)**

This manual now is  
identified as part no.  
SRM00054

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### **Recommendations for Ordering Parts**

All correspondence pertaining to renewal parts for the equipment must refer to the instruction book number and should be addressed to the nearest IMO Pump Division representative. See addresses of sales offices listed above.

1. Parts should be ordered giving complete pump type and serial number found on pump identification tag.
2. Shaft should be ordered with ball bearing and keys factory installed and fitted.
3. Gear housings, ring gears and pinion gears usually require replacement as sets and should be ordered in matched sets.
4. Lip seals and "O" rings can be ordered as a "seal kit".

## **FOREWORD**

### **CIG-H Series Pumps**

The unique positive-displacement internal gear design of this pump consists of a single shaft that runs through the center of the pump housing and drives a pair of star-shaped gears for each stage, or element of the pump. The design is extremely simple since there are only three moving parts per stage.

Since the pump uses a single shaft that runs through the center of the pump body, it easily lends itself to multi-staging and double pump configurations.

The multi-stage system allows stacking of stages, to desired pressure levels. H series 750 PSI and 1500 PSI units are each of a single-stage design. The 3000 PSI and 4500 PSI units are of a multi-stage design, in which two and three pump stages, respectively, each rated at 1500 PSI, are stacked and working in series. Fluid flows from the outlet of one stage to the inlet of the next stage, and each stage participates equally in producing the eventual outlet pressure. The fact that each stage must only build up 1500 PSI pressure reduces stress on the pump's components and, thus, increases pump life.

In double pump configurations, hydraulically independent pumps are arranged on a common drive shaft, with each pump having a separate inlet and outlet.

## TABLE OF CONTENTS

<b>Title</b>	<b>Page</b>
Foreword .....	iii
Section 1. Disassembly Instructions for Single Stage (N1 &H1) Pumps .....	1
Section 2. Disassembly Instructions for Multiple Stage (H2 & H3) Pumps .....	2
Section 3. Inspection of parts from Failed Pump .....	3
Section 4. Machining Instructions .....	4
Section 5. Assembly Instructions for Single and Multiple Stage (N1, H1, H2 and H3) Pumps .....	5
Section 6. Double Pump Repairs .....	7

## SECTION 1

### Disassembly Instructions for Single Stage (N1 & H1) Pumps (See Figure #1)

**Step 1** — Break and remove tie rods (#1) and seal cover bolts (#6).

**Step 2** — Remove gear assembly (#2) from shaft by simply sliding it back and off shaft while holding front cover (#3). Be careful not to lose anti-rotation pins (#16).

**NOTE:** If Shaft does not turn and gear assembly will not pull out it may be frozen onto shaft. Clamp gear assembly (#2) only in a vice. Remove back cover (#20). Insert brass rod in the hole left by removing the back cover and drive it into pump end of shaft (#4) to try to loosen the gear assembly (#2) from the front cover (#3). Once the gear assembly (#2) is separated enough from the front cover (#3) it can be pried off by inserting a wheel puller between the two castings or by continuing to tap on the end of the shaft.

**NOTE:** If the gear assembly (#2) slides off but the pinion gear (#5) is frozen to the shaft (#4), this gear can be removed by tapping the gear end of the shaft (#4) with a brass hammer. This will move the shaft 1/16" before the key prevents the shaft from going through the front cover sleeve bushing (#9). Now tap the coupling end of the shaft (#4) until the 1/16" space appears between the pinion gear (#5) and front cover face (#3). Put a brass shim in this 1/16" clearance and repeat these steps adding progressively larger shims until a wheel puller can be put between the pinion (#5) and front cover face.

**Step 3** — Remove shaft key (#7) and "O" Ring (#17).

**Step 4** — Slide or tap shaft (#4) out through mounting end of front cover (#3), seal cover (#14) and ball bearing (#9) will come out with it.

**Step 5** — To remove ball bearing (#9) from shaft (#4) remove snap ring (#10) and bearing spacer (#11) and press off bearing toward coupling end of shaft (#4).

After complete disassembly of the pump, refer to Section 4 for inspection procedures of the parts.

Inspection may show that rework is required on the front cover face and bushing. Refer to Section 5 for rework procedures.

## SECTION 2

### Disassembly Instructions for Multiple Stage (H2 & H3) Pumps (See Figure "2)

**Step 1** — Break and remove tie rods (#1) and seal cover bolts (#6).

**Step 2** — Remove rear cover (#12) being sure not to lose anti-rotation pins (#16).

**Step 3** — Remove "O" Ring (#17) and slide off barrel (#13).

**Step 4** — Slide last stage housing (2a) off shaft, (watch for anti-rotation pin).

**NOTE:** If shaft does not turn and gear assembly will not pull out, it may be frozen onto shaft. Clamp gear assembly (#2) only in a vice. Insert brass rod in the hole left by removing the rear cover and drive it into pump end of shaft (#4) to try to loosen the gear assembly (#2) from the front cover (#3). Once the gear assembly (#2) is separated enough from the front cover (#3) it can be pried off by inserting a wheel puller between the two castings or by continuing to tap on the end of the shaft.

**NOTE:** If the gear assembly (#2) slides off but the pinion gear (#5) is frozen to the shaft (#4), this gear can be removed by tapping the gear end of the shaft (#4) with a brass hammer. This will move the shaft 1/16" before the key prevents the shaft from going through the front cover sleeve busing (#8). Now tap the coupling end of the shaft (#4) until the 1/16" space appears between the pinion gear (#5) and front cover face (#3). Put a brass shim in this 1/16" clearance and repeat these steps adding progressively larger shims until a wheel puller can be put between the pinion (#5) and front cover face.

**Step 5** — Remove key (#7) from shaft before attempting to remove next housing.

**Step 6** — Repeat steps 4 & 5 on the middle housing (2b) and first stage housing (2c).

**Step 7** — Slide or tap shaft (#4) out through mounting end of front cover (#3), seal cover (#14) and ball bearing (#9) will come out with it.

**Step 8** — To remove ball bearing (#9) from shaft (#4), remove snap ring (#10) and bearing spacer (#11) and press off bearing toward coupling end of shaft (#4).

After complete disassembly of the pump, refer to Section 4 for inspection procedures of the parts.

Inspection may show that rework is required on the front cover face and busing. Refer to Section 5 for rework procedures.

## SECTION 3

### Inspection of Parts from Failed Pump

1. **Lip Seals** — Check to see if the seals in the front cover are heavily worn. They should be sharp and firm. If they are flat or spongy they must be replaced. The seal faces should also be checked for any cracks or tears.
2. **Ball Bearing** — Should be free turning and quiet. They should have almost no slop.
3. **Gear Faces** — Some light scratching is acceptable but if there is any scoring the part is scrap. (These faces cannot be lapped down to remove a heavy score mark because their width is critical to the performance of the pump). Lapping more than several ten thousandths of an inch will cause low capacity, also, if the face is not flat, a pump seizure could occur.
4. **Ring Gear OD** — Some light scratches and polishing is acceptable. If scoring is present, then the piece is scrap.
5. **Housing**
  - (a) **Faces** — Same as gear faces above.
  - (b) **Crescent** — This piece should be checked for gouges or scoring. If the marking is severe the housing is scrap.
  - (c) **ID** — If any scoring is present the piece is scrap.
6. **Shaft** — Check areas under sleeve bushings of the pump. Any heavy wear here is a cause for rejection. Also check the edges of the keyways for cracks, chipping or rounding. If this situation exists, the shaft is scrap.
7. **Sleeve Bearing** — If scoring or heavy polishing is present bushing must be pressed out and replaced. See machining Instructions.
8. **Front and Intermediate Covers** — If faces are scored or heavily scratched, they must be machined per machining instructions. Also check ball bearing seating area in front cover on pumps with severe ball bearing failures. If the seating OD is badly scored, deburr it before reassembly.

### Recommendations for Ordering Parts

1. Parts should be ordered giving complete pump type and serial number found on pump identification tag.
2. Shaft should be ordered with ball bearing and keys factory installed and fitted.
3. Gear housings, ring gears and pinion gears usually require replacement as sets and should be ordered in matched sets.
4. Lip seals and "O" rings can be ordered as a "seal kit".

## SECTION 4

### Machining Instructions

The front cover on single pumps and the front and intermediate covers on double pumps can usually be restored to serviceable condition by machining of the damaged faces. Sleeve bearings usually require replacement and must be remachined to size after installation.

Refer to Figure 3, 4, and 5 for remainder of discussion.

To repair damage to face area A and to replace sleeve bearing C, proceed as follows:

1. Press out and replace bushing (C) in front cover making sure that the bushing slit is facing as shown in Figure 3.
2. Chuck the cover in a lathe and indicate true with respect to the face (A) and counter bore (B) within .0008" TIR.
3. Machine the face (A) deep enough to remove any scored material. Be sure this face is flat within .0008" TIR with a 32 finish. Because of the interrupted cut at its center, caused by kidney ports (D) and hardening of this face from scoring, the center is sometimes raised after machining.

#### CAUTION

**Out-of Flatness in excess of .0008"  
can cause a pump failure.**

**NOTE:** If more than .015" is removed from face (A), the same amount should be removed from (G) and (F).

4. In the same chucking operation, machine the bushing (C) to the dimensions given for the pump fram size. (Figure 4) Surface finish should be a 32, and the total bronze surface should "clean up". If bushing does not clean-up, then cover may be distorted and unusable.

For replacement of sleeve bearing only, follow Step 1 and 4.

**NOTE:** Rework other than light stoning or cleaning of the gears or gear housings is not recommended. New gear housings are provided with the sleeve bearing factory installed.



## SECTION 5

### Assembly Instructions for Single and Multiple Stage (N1, H1, H2 and H3) Pumps. (See Figure 1 & 2)

Before beginning any erecting, clean all the parts thoroughly. Remove the gears from their housing deburr and stone both the housing and gear. Pay particular attention to kidney port chamfers on housing and the faces of the ring and pinion gears (Do not break edges on OD of ring gear.) When replacing gears in housings be sure that gears are below housing face.

**Step 1** – With the shaft key (#12) removed from the shaft, press ball bearing (#9) on power rotor shaft (#4) then install spacer (#11) and snap ring (#10) holding bearings. Be sure bearing turns freely.

**Step 2** – Press (2) lip seals (#15) into housing cover back to back, i.e., with raised letters on seals facing one another. Seals must be pressed in one at a time. Be sure the gap between the seals is uniform all around (use old seal to press in). Pack grease on lips of seal.

**Step 3** – With all keys removed from the shaft, slide the shaft into the front cover (#3) until the bearing seats.

**Step 4** – Install “O” Ring (#18) on seal cover. Install the seal cover (#14) and bolt in snugly.

**NOTE:** Use a clean fluid to coat all mating parts to aid in assembly.

**Step 5** – Install key (#7) *Bevel edge up*, into first stage keyway tapping with screwdriver if tight.

**Step 6** – Place pinion gear (#5) on shaft and keyway. It should slide freely on key and shaft. If not, check to see if key is seated for burrs or if key height is correct. Once the pinion is checked to be free on the shaft, remove and install as an assembly in Step 7.

**Step 7** – Install ring and pinion gear in gear housing (coat lightly with fluid).

**NOTE:** If the gears were previously run be sure the same side of the teeth that was loaded previously is again on the loaded side.

**NOTE:** If ring gear is stepped be sure that the stepped gear face is the loaded gear face.

**Step 8** – Install dowel pin (#16) in front casting.

**NOTE:** Before putting gear housing (#2) into front cover (#3) be sure that dowel pin position is such that the gear housing discharge port is in the correct position.

**Step 9** – Install assembled (#2) gear housing onto shaft and slide up shaft until key on shaft engages with keyway in pinion gear. Then turn gear housing until dowel pin and hole line up. Push on snugly.

**Step 10** – Install “O” Ring (#17) into front casting over barrel. Grease lightly to hold “O” Ring in place.

**NOTE:** If another stage is required, repeat above steps 5 through 8.

**Step 11** – Lubricate pump barrel thoroughly and slide over gear housing with one turning, pushing motion.

**Step 12** – Install back “O” Ring onto barrel “step” with grease.

**Step 13** – Install rear dowel pins. (#16).

**NOTE:** Install rear cover with 4 tee rods (#1) and washers (#18) supplied. Bevel on washers should face bolt head for uniform loading.

**Step 14** – Snug tie rods evenly by hand and check to see that shaft turns smoothly.

**Step 15** – Torque bolts to one-half specified value at opposite corners, then torque to full specified value. See Figure 5 for torque values.

**NOTE:** The required tie-rod torques are critical on all pumps as it may affect the internal leakages and the hydrodynamic lubrication on the pump and, therefore, proper operation.

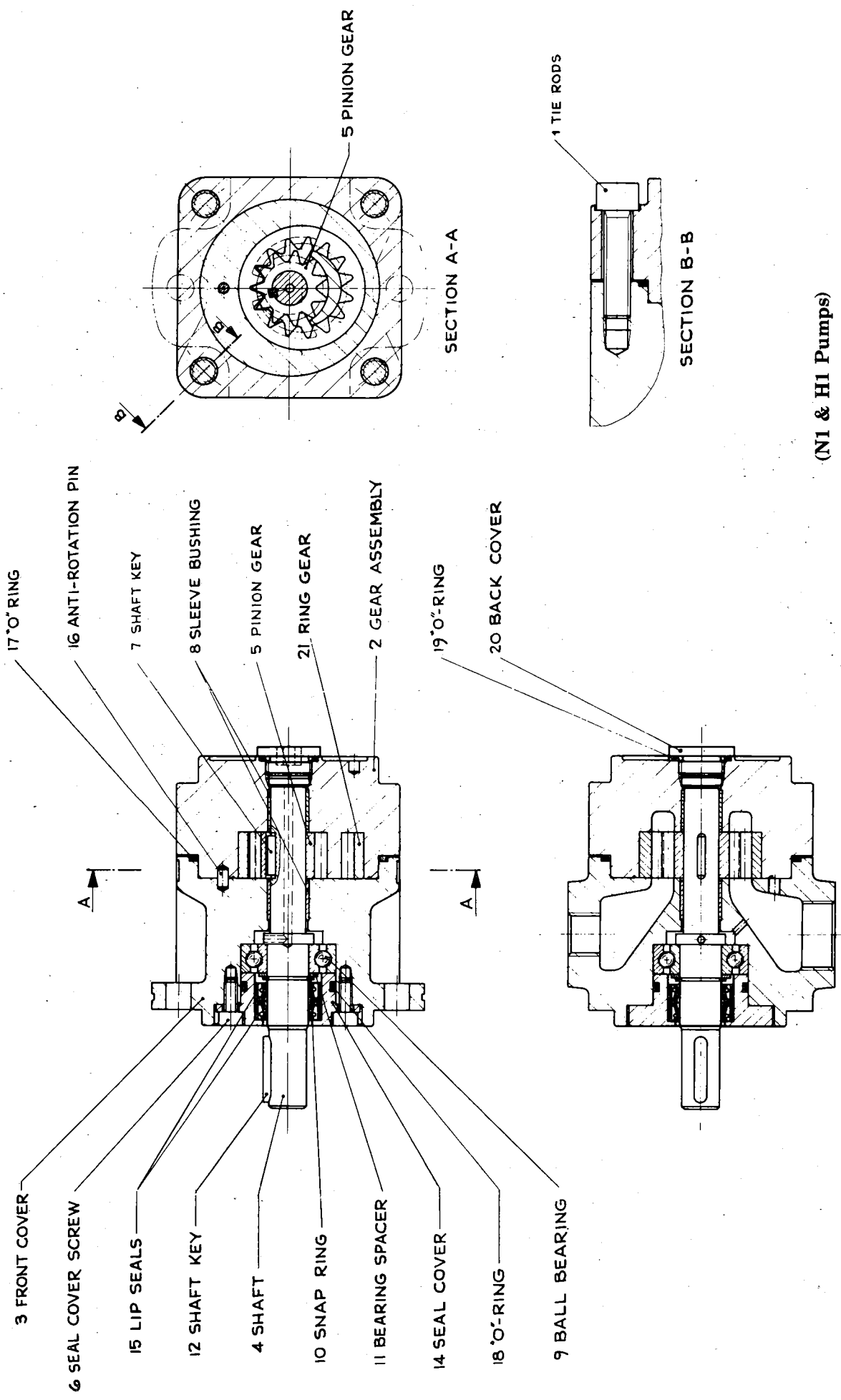
**NOTE:** Check to see if shaft turns smoothly. If shaft does not turn smoothly, disassemble and check the dowel pin length to be sure pins are not bottoming out and holding housings apart. Check key length to be sure it is less than gear width. Also check that there is clearance between the gear faces and housing faces. (Dirt or a burr can be lodged between the gear faces and the housings thus removing necessary clearance.)

**NOTE:** Install port plugs and shaft coupling key (#12).

## **SECTION 6**

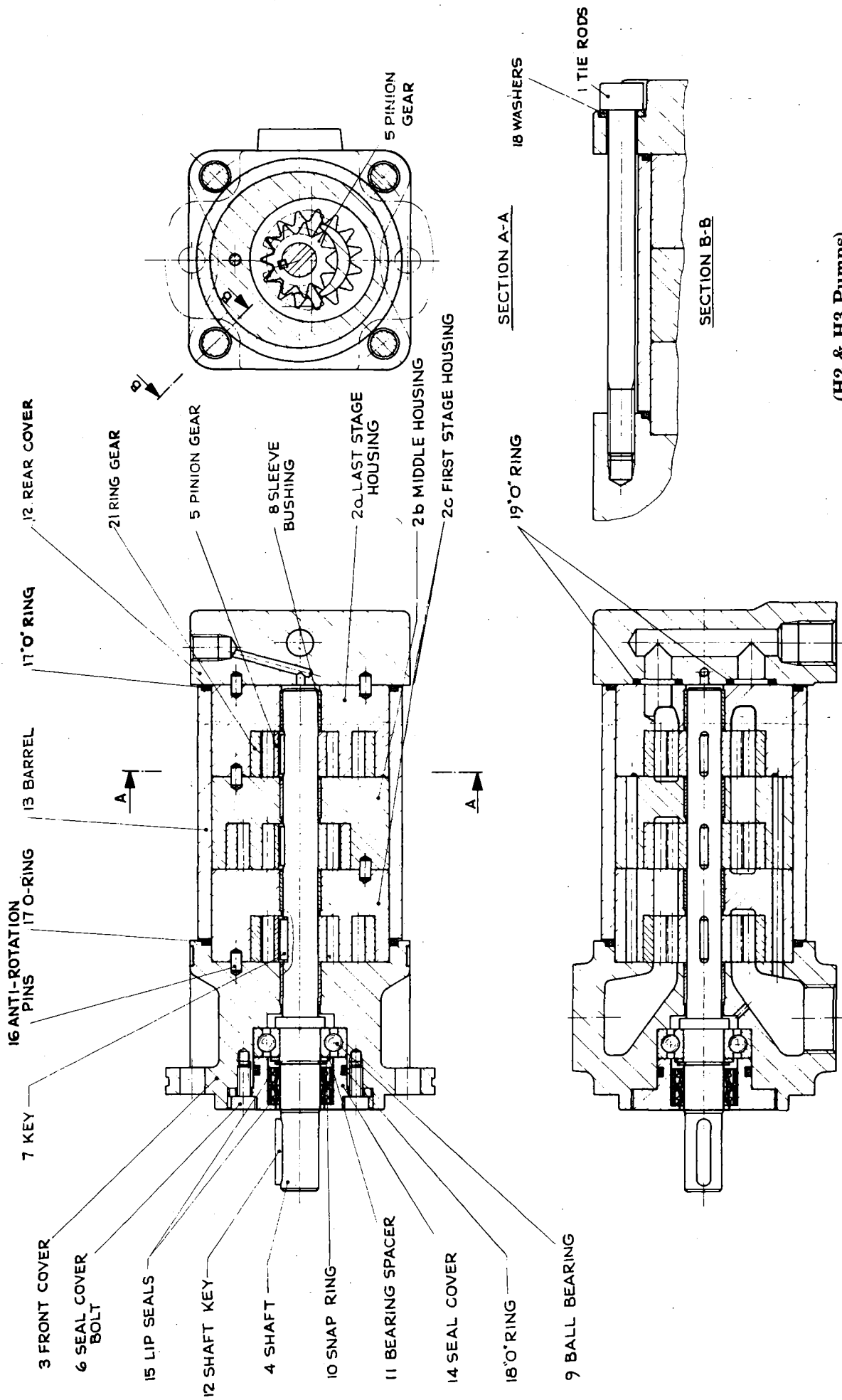
### **Double Pump Repairs**

When repairing double pumps, the same instructions as described in Sections 1 through 6 apply. In addition, extra care must be taken on assembly when torquing the pumps' bolts to keep the sleeve bushing aligned. To accomplish this, when Pump #1, the pump nearest the coupling end of the pump, is built, its bolts should only be snugged hand-tight. Pump #2 should be assembled and its bolts torqued to their full value. Only then should the bolts on Pump #1 be tightened to their full value.



(N1 & H1 Pumps)

Figure 1



(H2 & H3 Pumps)

Figure 2

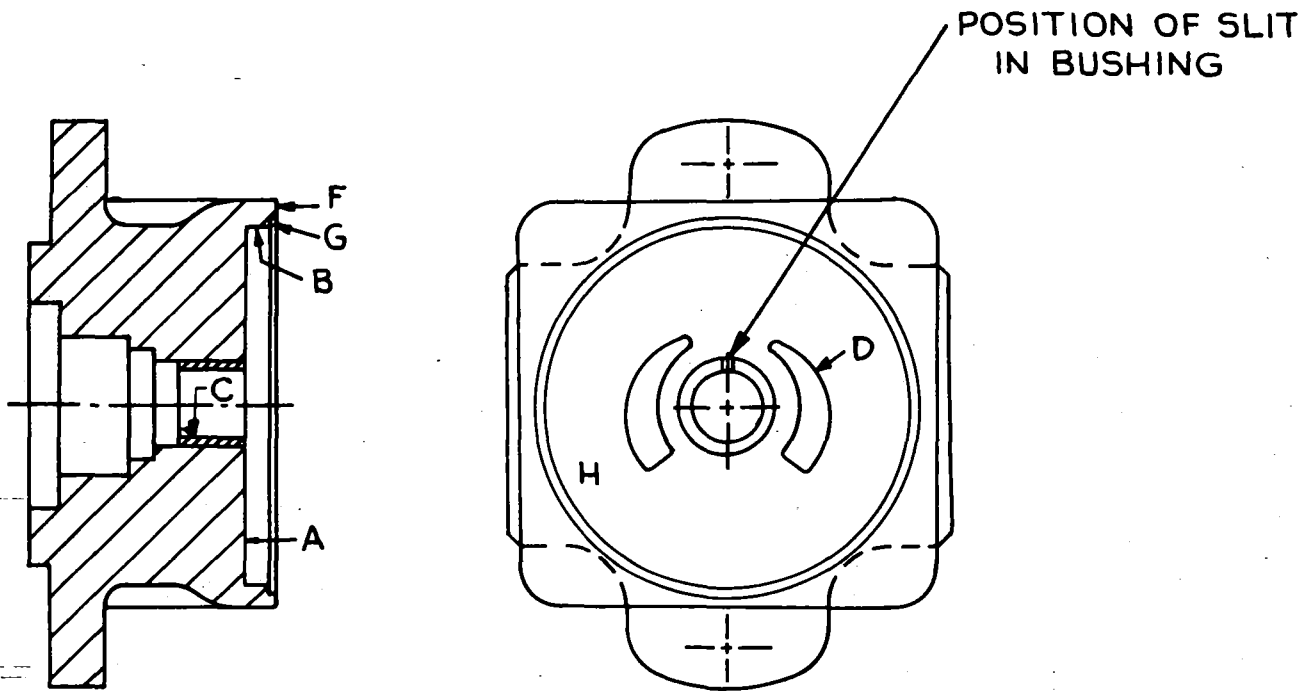


Figure 3. H-Series Front Cover

PUMP SIZE	BEARING DIAMETER	
	MINIMUM	MAXIMUM
2	.5124 in.	.5128 in.
3	.6307 in.	.6311 in.
4	.8671 in.	.8677 in.
5	1.1037 in.	1.1043 in.
6	1.3403 in.	1.3409 in.
8	1.7346 in.	1.7354 in.

Figure 4. Sleeve Bushing Finished Dimensions

PUMP SIZE	*BOLT SIZE	SOCKET SIZE	TORQUE	
	mm		mm	kg-m
8H3	M30	22	135	975
8H2	M30	22	100	700
8H1	M30	22	70	505
8N1	M30	22	70	505
6H3	M24	19	80	580
6H1	M24	19	60	435
6H1	M24	19	40	290
6N1	M24	19	40	290
5H3	M30	17	40	290
5H2	M20	17	30	220
5H1	M20	17	20	145
5N1	M20	17	20	145
4H3	M16	14	20	145
4H2	M16	14	20	145
4H1	M16	14	10	72
4N1	M16	14	10	72
3H3	M12	10	10	72
3H2	M12	10	10	72
3H1	M12	10	5	36
3N1	M12	10	5	36
2H3	M10	8	6	43.4
2H2	M10	8	6	43.5
2H1	M10	8	3	21.5
2N1	M10	8	3	21.5

\*If old bolts are not re-usable, be sure to buy high stress (12.9) bolts.

Figure 5. "H" Series Bolt Torques

The instructions given herein cover generally the operation and maintenance of subject equipment. Should any questions arise which may not be answered specifically by these instructions, they should be referred to the IMO Pump Division for further detailed information and technical assistance.

This manual cannot possibly cover every situation connected with the operation, adjustment, inspection, test, overhaul and maintenance of the equipment furnished. Every effort is made to prepare the text of the manual so that engineering and design data is transformed into the most easily understood wording. The IMO Pump Division, in furnishing this equipment and this manual, must presume that the operating and maintenance personnel assigned thereto have sufficient technical knowledge and experience to apply sound safety and operational practices which may not be otherwise covered herein.

In applications where the IMO Pump Division furnished equipment is to be integrated with a process or other machinery, these instructions should be thoroughly reviewed to determine the proper integration of the equipment into the overall plant operational procedures.