

WATEROUS COMPANY  
South St. Paul, Minnesota

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Section 4208

SECTION 4208

OVERHAUL INSTRUCTIONS

FOR

WATEROUS CS SERIES CENTRIFUGAL FIRE PUMPS

March, 1983

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**INTRODUCTION**

This section contains overhaul and repair instructions for Waterous CS Series centrifugal fire pumps, except for the transmissions. Since several types of transmissions are available for these pumps, they are covered in separate sections, beginning with Section 4300. Operation and Maintenance Instructions for these pumps are in Section 2108.

This section gives complete instructions for disassembling a CS Series pump, repairing it, and reassembling it. For minor repairs, use only those steps which apply. Three methods of pump disassembly are outlined. Before proceeding, check each method to determine which is best suited to a specific pump. Since this is written to cover all CS Series pumps, not all of the steps will apply to any one pump.

The Overhaul Instructions are divided into five major topics as follows: PREPARATION, DISASSEMBLING PUMP, INSPECTION AND REPAIR, REASSEMBLING PUMP, and TESTING. Special instructions or information which apply to pump models such as the CSH pump appear at the end of each topic.

**TRANSMISSION TYPE**

The CS pump model designation, which is found on the pump serial plate, will indicate the type of transmission used with the pump. CS pump model descriptions and transmission type are listed below in Table 1.

**REFERENCE NUMBERS**

The text below frequently uses "reference numbers" when discussing specific parts. These numbers

refer to the parts called out in the Service Parts Lists at the end of this section. Since several of these parts lists are attached, be sure to determine which one applies to the pump being repaired.

The letter prefix on each reference number identifies the type of assembly to which the number applies. The letter prefixes and their applications are as follows:

PREFIX	APPLICATION
B	Main Pump Body
L	High Pressure Stage Body (CSH Pump)
S	Impeller Shaft Assembly

The pump serial number and the part reference number must be supplied when replacement parts are ordered from the Waterous Company.

**TOOLING AND EQUIPMENT**

Table 2 lists the items required to overhaul a CS Series pump in accordance with the instructions given below. It supplements the tools and equipment suggested in Section 4100.

**PREPARATION**

The following steps are necessary to prepare a pump for disassembly. They are grouped according to the type of CS Series pump to which they apply.

**CS PUMPS**

1. Disconnect cooling and drain lines, electrical wiring, and similar connections to pump, pump transmission, and accessories.

**TABLE 1**  
**CS PUMP MODEL DESIGNATIONS**

PUMP MODEL	TRANSMISSION TYPE		
CSMB, CSHMB, CSUMB	MB	M Series	Gear Drive
CSMBX, CSHMBX, CSUMBX	MBX	M Series	Gear Drive
CSMC, CSHMC, CSUMC	MC	M Series	Gear Drive
CSMCX, CSHMCX, CSUMCX	MCX	M Series	Gear Drive
CSMBE, CSHMBE	MBE	M Series	Gear Drive
CSMBEX, CSHMBEX	MBEX	M Series	Gear Drive
CSK, CSHK, CSUK	K	K Series	Gear Drive
CSF, CSHF, CSUF	F	F Series	Gear Drive
CSWB, CSHWB	WB	W Series	Chain Drive
CSWBX, CSHWBX	WBX	W Series	Chain Drive
CSYB, CSHYB, CSUYB, CSUHYB	YB	Y Series	Chain Drive
CSYBX, CSHYBX, CSUYBX, CSUHYBX	YBX	Y Series	Chain Drive
CSYC, CSHYC, CSUYC, CSUHYC	YC	Y Series	Chain Drive
CSYCX, CSHYCX, CSUYCX, CSUHYCX	YCX	Y Series	Chain Drive

See Section 4300 for Transmission Overhaul Instructions.

TABLE 2

TOOLS AND EQUIPMENT

ITEM	QUANTITY REQUIRED	APPLICATION
1. Threaded rods, 1/2-13 x 18 in. Hex nuts, 1/2-13 Pipe nipples, 1/2 x 6 in.	1 to 3 3 to 9 1 to 3	Methods 1 and 2
2. Threaded rods, 1/2-13 x 18 in. Hex nuts, 1/2-13	2 6	Method 2
3. Hoist and slings, 1/2-ton capacity	AR	Method 3
4. Saw Horses, capable of supporting center section of pump	2	Method 3
5. Packing installation bushing, similar to Figure 2	1	CSH Pumps
6. Transmission Jack	1	Methods 1 and 2

2. Drain lubricant from pump transmission by removing drain plug.
3. Disconnect drive shaft(s) from transmission.
4. Loosen unbalanced nuts (B15), and remove packing glands (S7) from each end of impeller shaft.
5. Remove bolts (S16) and lock washers (S17). Pull outboard bearing housing (S2) from bore in body using jack screws in tapped holes in bearing housing.

CSH PUMPS

1. Disconnect cooling and drain lines, electrical wiring and similar connections to pump, pump transmission, and accessories.
2. Drain lubricant from pump transmission by removing drain plug.
3. Disconnect drive shaft(s) from transmission.
4. Loosen unbalanced nuts, and remove packing glands from each of the three stuffing boxes.
5. Disconnect high pressure-stage discharge piping from pump.
6. Remove drain and vent assembly from high pressure-stage pump.
7. Remove cap screws (L20), and pull flange (L2) away from pump head. Turn elbow (L29 or L31) as necessary to move hose (L15) and flange away from pump. Discard gasket (L1).

NOTE

Lack of space between pump and chassis may prevent removing high pressure-stage body. If this condition exists, remove hose and attaching parts as outlined in steps 6 and 7, but wait until impeller shaft assembly is removed from the pump to disassemble high pressure-stage.

8. Remove cap screws (L19) and copper washers (L25), and carefully pull off pump head (L7). Discard gasket (L5). (See Fig. 1.)
9. (See Fig. 1.) Remove cotter pin (S19). Unscrew impeller nut (S18), and pull impeller (S21) from end of shaft (S11). Do not lose impeller spacer (S25) which may come off with impeller.

NOTE

If no suitable puller is available, use high pressure-stage body to remove impeller. When doing so, be sure to pull evenly on body.

10. Disconnect hose (L14). Remove bolts (L37) and lock washers (L24), and carefully slide high pressure-stage body (L8) from impeller shaft.

DISASSEMBLING PUMP

This portion contains three methods of disassembling a CS Series pump into its major components, except for the transmission. Briefly, these methods are as follows:

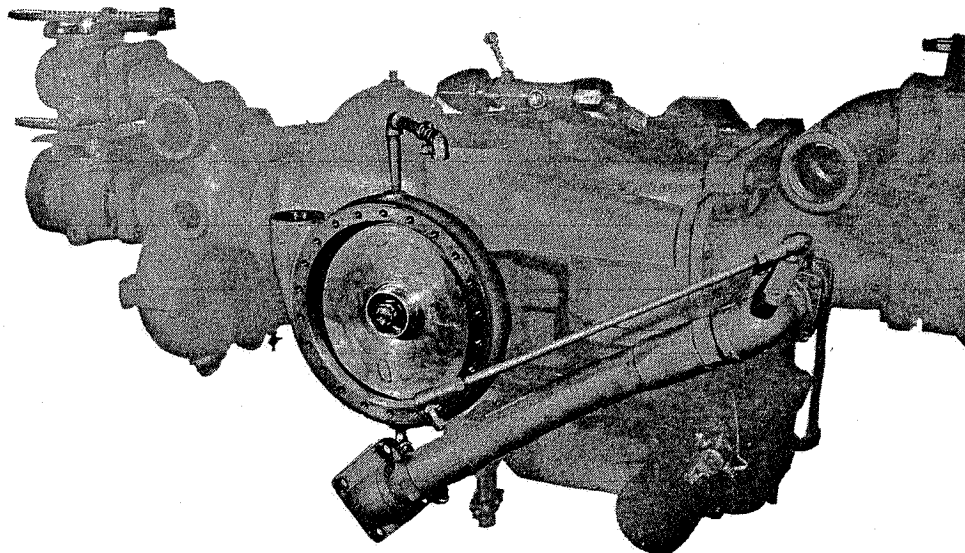


Fig. 1 CSH Pump with High Pressure-Stage Head Removed

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METHOD 1 consists basically of removing the transmission and volute cover separately to expose the impeller shaft assembly. Threaded rods or a transmission jack are used to lower the transmission, as well as the volute cover with the assembled impeller shaft resting on the cover. Although the entire procedure may seem longer than the others, it may simplify pump re-assembly.

METHOD 2 is essentially the same as Method 1, except that the transmission remains attached to the volute cover. This method speeds up disassembly, and if balance is maintained, it will also speed up reassembly. With this method, separating the volute cover from the body is easier than in Method 1. This method might prove more practical with transmissions in the F, K, and W Series.

METHOD 3 consists basically of removing the transmission, separating the assembled pump body from its suction adapters, and raising or lowering it clear of the chassis. This method is practical only if the construction of the truck body permits free access to the top and sides of the pump.

#### METHOD 1, PROCEDURE

This method consists of removing the transmission and volute cover separately to expose the impeller shaft assembly. It is especially effective with the M and Y Series transmissions.

1. Remove transmission as directed in transmission overhaul instructions. (Sections 4301 thru 4306.) The M or Y series transmission cap is left attached to the pump impeller shaft. (See Fig. 2.)

2. Remove one cap screw (B18) from each corner near dowel-pin locations, and install 1/2-in. threaded rods, hex nuts, plain washers, and pipe nipples (see Fig. 4), or use transmission jack to support cover (B13) (see Fig. 3). Remove all cap screws (B10, B18, and B14), and copper washers (B38) which attach volute cover (B13) to body (B5). Use two of the removed cap screws inserted into the threaded holes next to the dowel pins to jack the cover away from the body.

3. Turn upper hex nuts on threaded rods down evenly to lower the volute cover (B13), or lower the transmission jack. Impeller shaft assembly will come down with cover. (See Fig. 3 and 4.) BALANCE MUST BE MAINTAINED.

4. Carefully remove impeller shaft assembly from volute cover.

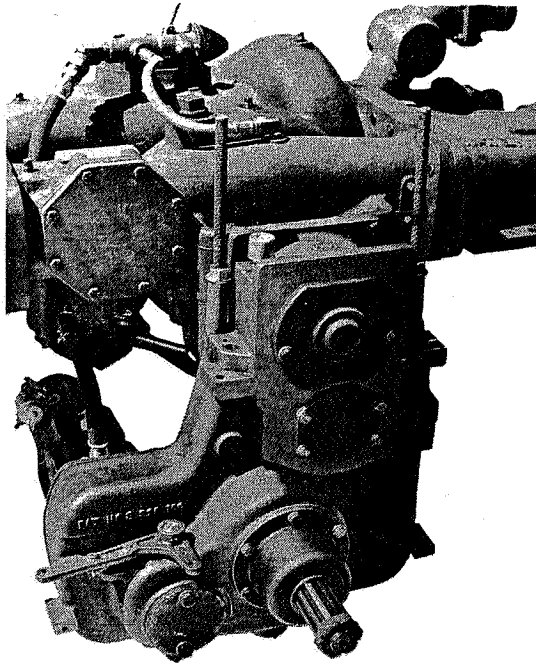


Fig. 2 Threaded Rods Installed for Removing M Series Transmission

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METHOD 2, PROCEDURE

This method is essentially the same as Method 1, except that the transmission remains attached to the volute cover. This method should be used with the F, K, or W Series transmission. Method 2 will make this type of transmission more accessible for removal and disassembly when the volute cover and transmission are removed from the chassis. This method speeds up disassembly, and if balance is maintained, it will also speed up reassembly. Parts of this method may be combined with Method 1 to speed up disassembly.

1. Remove two upper bolts and nuts attaching transmission to body.
2. Remove one cap screw (B18) from each corner near dowel pin locations, and one screw from other corner on transmission end of pump. Install 1/2-in. threaded rods, hex nuts, plain washers, and pipe nipples in these holes as shown in Fig. 4, or use a transmission jack as shown in Fig. 3. Remove all cap screws (B10, B18, and B14), and copper washers (B38) which attach volute cover (B13) to body (B5). Use two of the removed cap screws inserted into the threaded holes next to the dowel pins to jack the cover away from the body.
3. Turn upper hex nuts on threaded rods down evenly to lower the volute cover (B13), assembled impeller shaft, and transmission. A transmission jack

may also be used to lower the cover and transmission. BALANCE MUST BE MAINTAINED.

4. Remove transmission assembly as directed in Section 4300.
5. Carefully remove impeller shaft assembly from volute cover.

METHOD 3, PROCEDURE

This method consists of removing the transmission, separating the assembled pump body from the suction adapters, and raising or lowering it clear of the chassis. It is usable only if space directly above or below the pump permits it to be removed.

1. Remove transmission as directed in transmission overhaul instructions.
2. Loosen, but do not remove, all parts attaching pump to chassis.
3. Attach a suitable sling to pump and a hoist, and take up all slack in sling.
4. Remove all cap screws (B22), and (B23), attaching assembled pump body to suction adapters (B8 and B21). If possible, move one suction adapter away from body about 1/8 in. Raise or lower pump clear of truck.

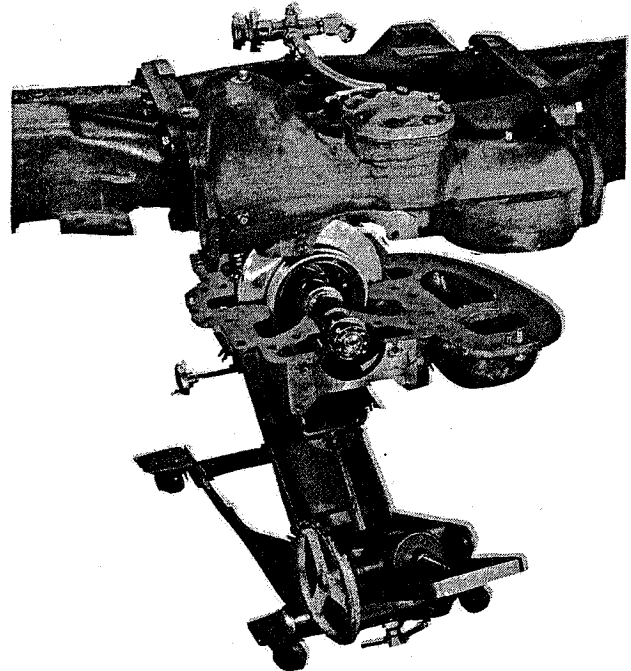


Fig. 3 Lowering Volute Cover with Transmission Jack

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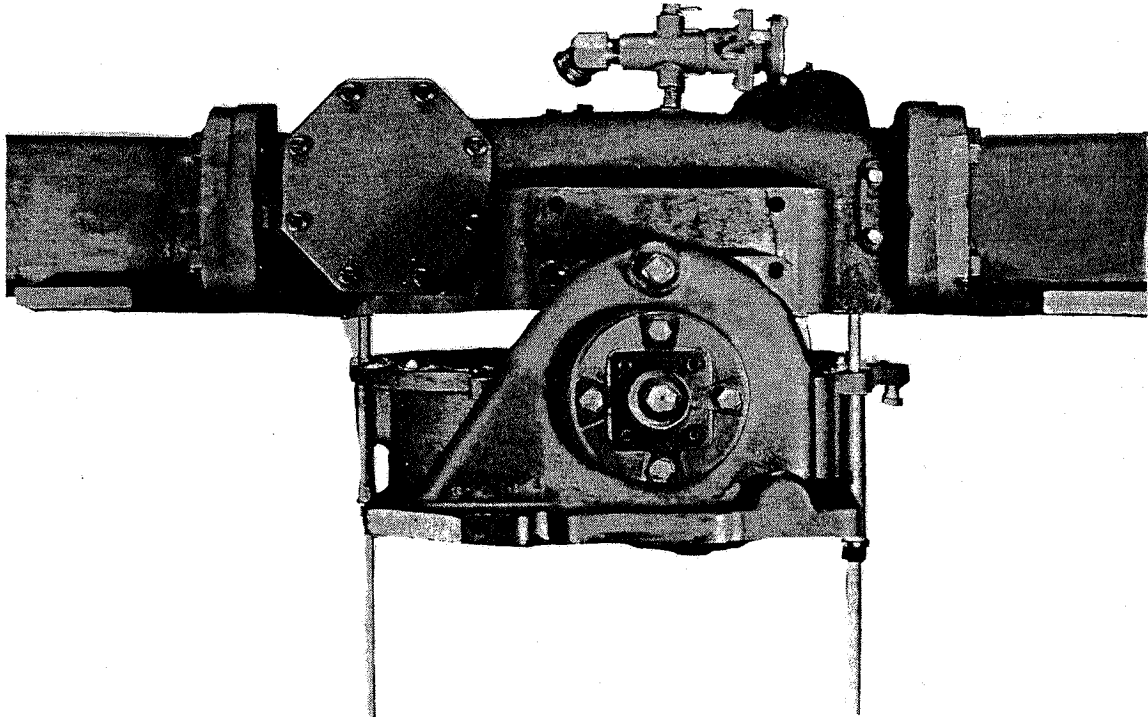


Fig. 4 Volute Cover and Impeller Shaft Assembly Suspended from Threaded Rods with W Series Transmission Cap

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5. Rest pump on horses with cover up. Remove all cap screws (B10, B18, B14), and copper washers (B38). Carefully lift volute cover from body to expose impeller shaft assembly.

point, place a piece of brass or similar soft material between puller and shaft to protect shaft center. Brace inside of transmission cap as shown in Fig. 5. (Does not apply to W series transmission.)

**DISASSEMBLING IMPELLER SHAFT ASSEMBLY**

This gives the steps necessary to disassemble completely an impeller shaft assembly. Removal of the driven gear or sprocket and its associated parts (Step 1), applies only to pumps with M and Y series transmissions, and is unnecessary unless some of these parts are damaged or defective. Refer to Sections 4301 thru 4306 for transmission removal procedures.

2. Carefully remove ball bearing (S3 or S23) and flinger rings (S8 or S22). On CSH pumps, be sure to remove snap ring (S24), before removing bearing (S23). Slide packing (S6), stuffing box ends (S5), and wear rings (S13) from each end of shaft.

1. Remove impeller shaft nut and lock washer. With a suitable puller, remove transmission cap, driven gear, spacers, and bearings. Remove cap screws attaching oil seal housing to cap, and discard gasket and oil seal.

NOTE

Mark wear rings or keep them with the side of impeller from which they were removed to permit checking impeller-hub clearance later on.

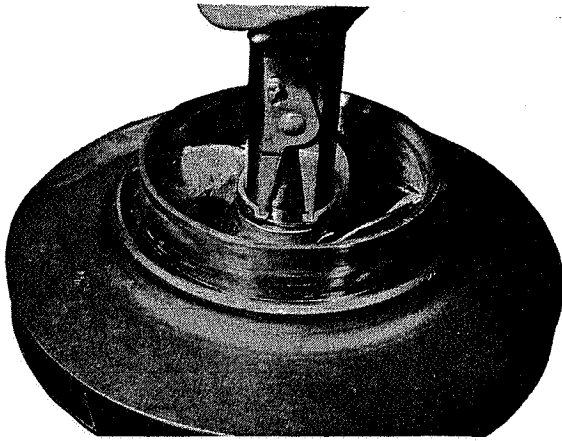
CAUTION

When removing bearing housing or transmission cap, driven gear, and related parts, be sure to use a puller or press which will apply force to cap on side opposite puller. If necessary, make a steel plate, notched for impeller shaft, and attach puller to plate. If puller does not have a center

3. Remove snapring (S12) on each side of impeller hub (see Fig. 6). Place impeller and shaft assembly in an arbor press so that impeller is adequately supported by wear ring hub. Apply force to upper end of shaft (S11) until impeller is free. (See Fig. 7.)

NOTE

If driven gear or sprocket and related parts were left on impeller shaft, the impeller may be removed from outboard end of shaft.



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Fig. 6 Removing Impeller Snap Ring

#### INSPECTION AND REPAIR

The following points cover inspection and repair of the major components of the CS Series fire pumps. Check parts not covered here in accordance with standard automotive shop practice. If the slightest doubt exists about the actual condition of any part, replacing it during overhaul is much better than taking a chance on its malfunctioning during future operations.

1. IMPELLER - Check wear rings and impeller hubs for deep grooves or scratches. Position each wear ring on impeller hub on which it was used, hold wear ring firmly against one side of hub, and measure total clearance on opposite side (original factory clearance is from 0.007 to 0.014 in.). If clearance is excessive, turn the impeller hubs, and install undersize wear rings as directed below. (See Table 3.)

If replacing the impeller is necessary, be sure to install new, standard size wear rings. Examine snap rings, lock nuts, washers, and keys for corrosion and other damage, and replace if condition is doubtful.

2. STUFFING BOX ENDS - These parts seldom need replacing if handled properly during pump disassembly and reassembly. If the total clearance between the stuffing box end and the impeller shaft is much greater than 0.011 in., then replacing the stuffing box end may be desirable.

#### INSTALLING UNDERSIZE WEAR RINGS

If inspection shows that the wear ring clearances are excessive, or the impeller hubs are scored or grooved, turn impeller hubs in a lathe to an acceptable rework dimension at which they will clean up, and install undersize wear rings during reassembly. These repair rings are available in 0.025, 0.050, and 0.075 inch undersize, except for the high pres-

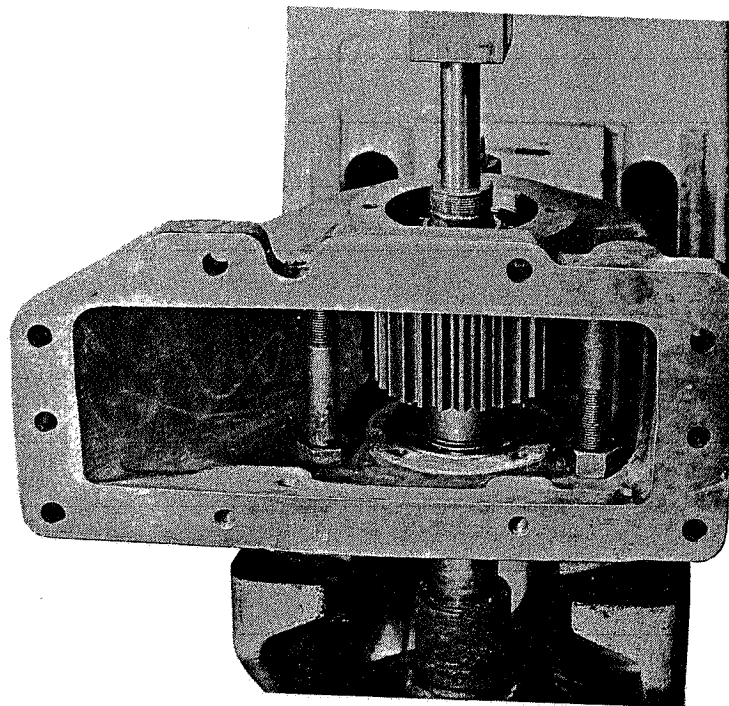


Fig. 5 Transmission Cap Braced for Removal

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sure-stage on CSH pumps, for which no undersize wear rings are available. Table 3 gives the original hub dimensions for the impeller and the rework dimensions for each degree of under size.

REASSEMBLING PUMP

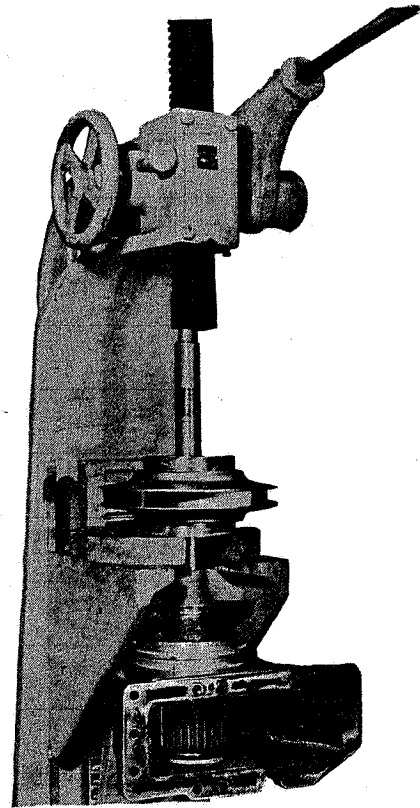
REASSEMBLING IMPELLER SHAFT ASSEMBLY

Reassembly procedure is essentially the reverse of disassembly. Be sure the snap rings are seated securely at the impeller hubs. Also, be sure that impeller has a tight fit on shaft. If undersize wear rings are required, install them at this time. If a new impeller is needed, also install new standard size wear rings for it.

INSTALLING IMPELLER SHAFT AND COVER

Reassembling the pump is essentially the reverse of disassembly. Be sure to observe the following points regardless of the method of reassembly used.

1. When installing impeller shaft assembly, be sure that wear rings (S13), and stuffing box ends (S5) fit into their respective slots in body (B5) and volute cover (B13). THESE SLOTS MUST BE CLEAN BEFORE REASSEMBLY TO PREVENT POSSIBLE INTERFERENCE. (Figure 9 shows correct positioning of a wear ring and stuffing box end in volute body.) The stuffing box end may be equipped with two alignment pins which are located 180 degrees from each other. Therefore the stuffing box ends must be installed so that the fin of the stuffing box end will extend into the volute cover on reassembly.



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Fig. 7 Removing Impeller on an Arbor Press

TABLE 3  
IMPELLER AND WEAR RING REPAIR DIMENSIONS

Impeller No.	Original Hub Dia.	Original Wear Ring No.	Reworked Hub Dia.	Undersize Wear Ring No.
71799 71799T	5.501/5.498 5.5015/5.4965	71800	5.476/5.473 5.451/5.448 5.426/5.423	71800-25 71800-50 71800-75
71610 71610T	5.501/5.500 5.5015/5.4965	62058	5.476/5.473 5.451/5.448 5.426/5.423	62058-25 62058-50 62058-75
71517	6.121/6.119	61826	6.096/6.091 6.071/6.066 6.046/6.041	61826-25 61826-50 61826-75
71548	A 6.121/6.116 B 6.171/6.166	61826	A 6.096/6.091 B 6.146/6.141 A 6.071/6.066 B 6.121/6.116 A 6.046/6.041 B 6.096/6.091	61826-25  61826-50 61826-75
71651T	A 6.375/6.370 B 6.425/6.420	62119	A 6.350/6.345 B 6.400/6.395 A 6.325/6.320 B 6.375/6.370 A 6.330/6.295 B 6.350/6.345	62119-25  62119-50 62119-75

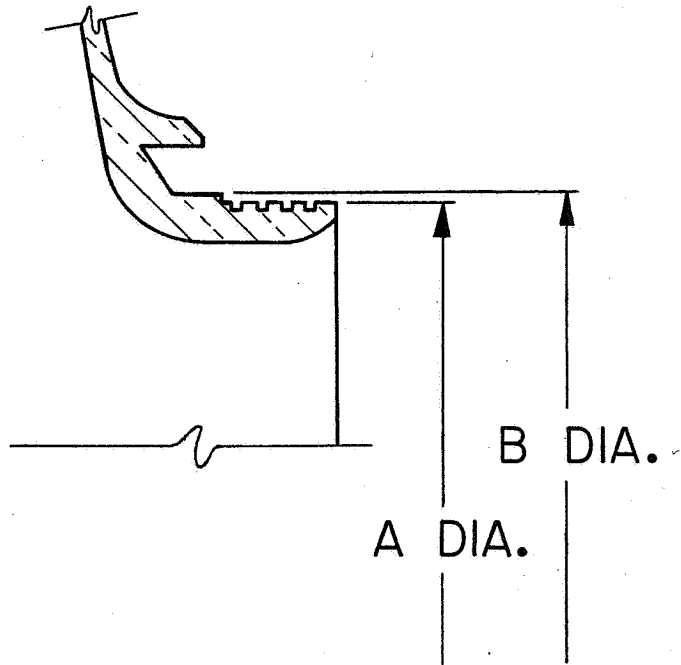


Fig. 8 Impeller Hub Repair Dimensions

NOTE

Only impellers 71548 and 71651T use the stepped impeller hub as shown in Figure 8.

NOTE

If high pressure-stage body and impeller were removed with the impeller shaft assembly, then install them on volute cover (B13) before proceeding.

2. An effective guide can be made for installing the volute cover by cutting the heads off two 1/2-13-NC x 3 in. long bolts. Screw these studs into the pump body (B5) near the dowel pin (B11) locations.

3. Whether using the threaded rods or a transmission jack, be sure to raise the volute cover and transmission case evenly, or the impeller shaft parts may not enter the body properly or engage the aligning studs.

4. Install packing as directed in Section 2108, Packing Adjustment.

NOTE

Installing the packing before mounting the transmission or volute cover is easier than waiting until the transmission or volute cover is installed.

FINAL ASSEMBLY

CS PUMPS

1. Install outboard bearing housing (S2) in body bore, and secure with bolts (S16), and lock wash-

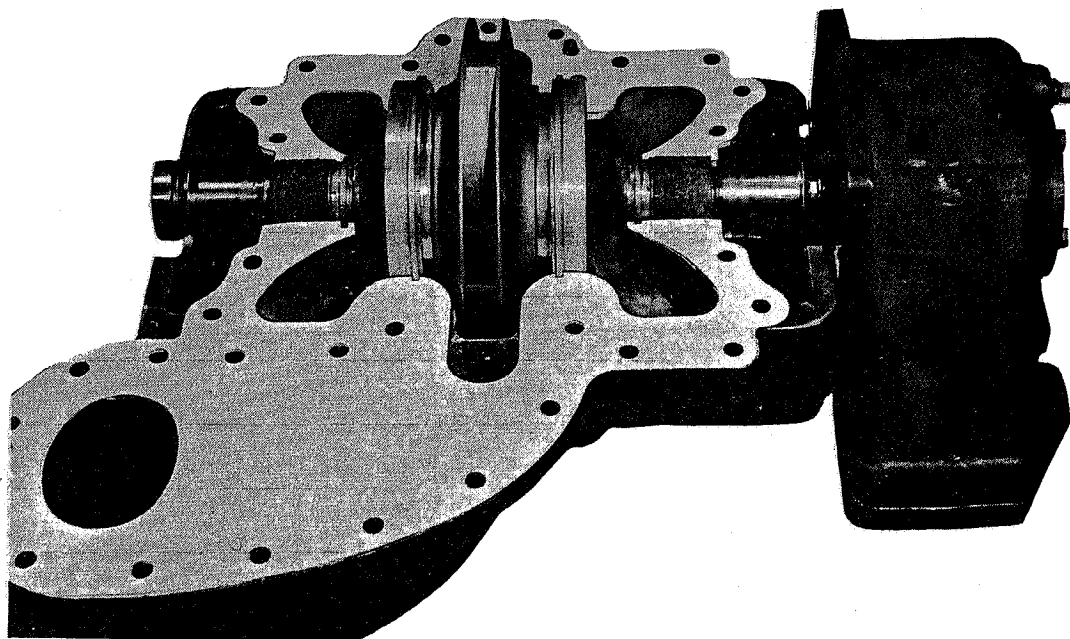
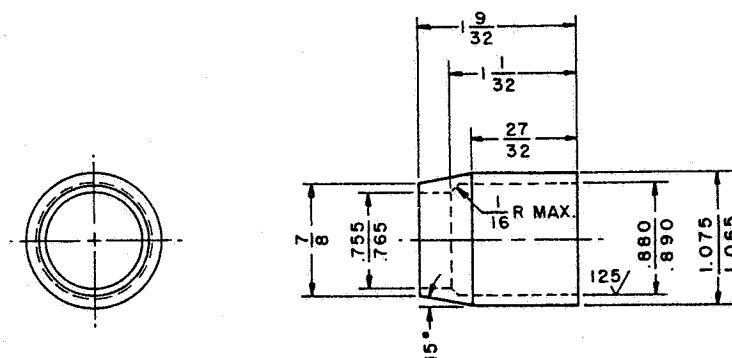


Fig. 9 Wear Ring and Stuffing Box End Installed in Volute Cover



NOTE: FINISH ALL OVER  $\frac{63}{100}$   
BREAK ALL SHARP CORNERS

Fig. 10 Packing Installation Bushing (CSH Pumps only)

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ers (S17). Lubricate outboard bearing (S3) on re-assembly.

2. Install drive shaft(s).
3. Connect all cooling and drain lines, electrical wiring, and similar connection to the pump transmission, pump and accessories.

CSH PUMPS

1. Install and adjust packing in main pump as directed in Section 2108.
2. The high pressure-stage packing may be installed in high pressure-stage stuffing box of pump body (L8) before or after body is attached to pump. Care must be taken during installation to prevent damage to packing. Figure 10 illustrates a special bushing which can be made for installing the high pressure-stage body with its packing already in place in the stuffing box. Although the pump can be reassembled without the bushing, its use will speed reassembly. The bushing prevents the impeller shaft threads from tearing or dislodging the packing during reassembly. The method of using it will be explained below.

3. If special bushing (Fig. 10) is used, install packing in high pressure-stage body as directed in Section 2108 before mounting, but tighten gland nuts just enough to hold gland in place. If the special bushing is not used, tape can be placed over the shaft shoulder and the splines where the bushing would fit. Grease the inside diameter of the packing before installing the high pressure-stage body.

Slide bushing on end of impeller shaft, and then install high pressure-stage body. Remove bushing, or tape, and install impeller, pump head, hoses, and related parts.

NOTE

Packing may be installed after the second stage body is attached to the pump.

4. Install impeller, pump head, hoses, and related parts.
5. Install high pressure-stage discharge piping.
6. Install propeller or drive shaft(s).
7. Connect all cooling and drainlines, electrical wiring, and similar connections to pump transmission, pump and accessories

LUBRICATION

After pump is assembled, lubricate it and its transmission according to instructions in Section 2108 for details on pump lubrication and to sections beginning with number 2200 for information on transmission lubrication.

TESTING

Before a pump is returned to service, it is advisable to give it both hydrostatic and operational tests to check it for leaks and to make sure the pump operates properly. The operational tests may be combined with the packing adjustment described in Section 2108.

HYDROSTATIC TESTING

1. Connect pump to a hydrant or other pressurized water supply.
2. Close all drain lines, and open discharge and priming valve.
3. On CSH pumps, open control valve to admit water to high pressure-stage body.

4. Open hydrant until water runs out through discharge valves and discharge pipe in priming pump. Close all valves. **BE SURE ALL AIR IS EVACUATED FROM PUMP.**

5. Apply hydrant pressure to pump for 15 minutes. With a portable light, check pump for leaks. If leaks are discovered, tighten connections or attaching parts as necessary. If necessary to tighten packing, be sure to loosen and readjust packing as described in Section 2108.

6. After all leaks are eliminated, shut hydrant valve, drain pump completely, and disconnect suction hose.

#### OPERATIONAL TESTING

If desired, this test may be combined with the packing adjustment described in Section 2108.

1. Operate pump at its maximum intended service pressure. Do not exceed 400 psi for CS pumps or 500 psi for CSH pumps.

2. With a portable light, check pump for water leaks. If leaks are discovered, stop pump, and tighten connections or attaching parts as necessary. Repeat until all leaks are eliminated.

3. While pump is running, check for unusual noises, oil leaks, overheated bearings, etc. If anything unusual is discovered, stop pump immediately, and determine the cause.