

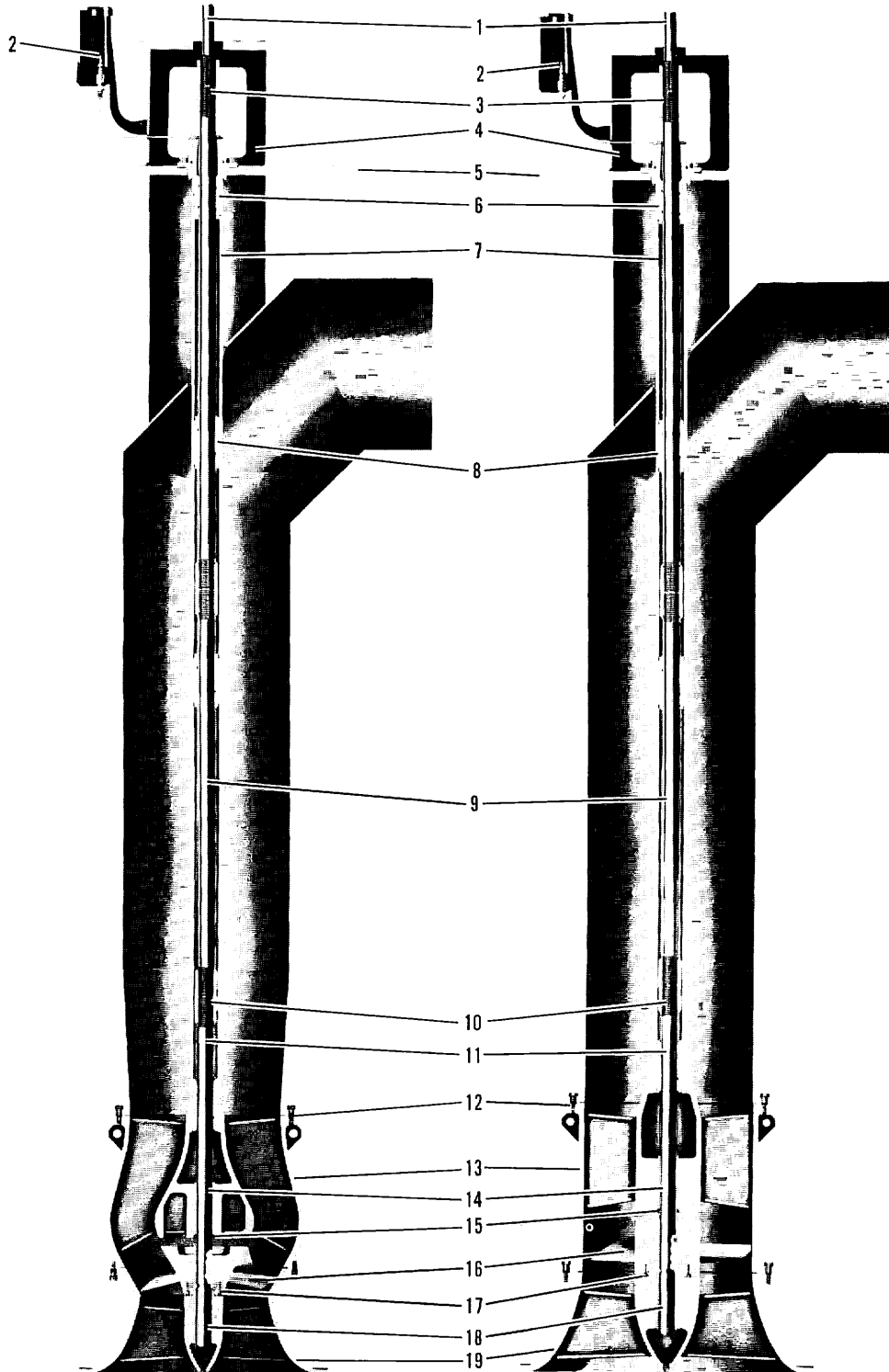
**M-50**  
**INSTALLATION & OPERATING INSTRUCTIONS**

**LOW LIFT TYPE  
PROPELLER AND  
MIXED FLOW  
PUMPS**

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ENCLOSED  
LINE  
SHAFT



- 1. Head Shaft
- 2. Sight-feed Lubricator
- 3. Head Shaft Coupling
- 4. Discharge Head Assembly
- 5. Below Surface Discharge Baseplate

- 6. Tubing Tension Assembly
- 7. Shaft Enclosing Tube
- 8. Line Shaft Bearing
- 9. Line Shaft
- 10. Pump Shaft
- 11. Pump Shaft

- 12. Flanged Joints
- 13. Cast Discharge Case
- 14. Discharge Bowl Bearing
- 15. Shaft Lip Seal (Optional)
- 16. Impeller/Propeller
- 17. Thrust Ring Retainer
- 18. Suction Case Bearing
- 19. Cast Suction Bell

Figure 1

Figure 2



# SECTION 1

## INTRODUCTION

Your Aurora Pump propeller/mixed-flow pump is designed and engineered for dependable and durable service. All components are accurately machined and registered for true and correct alignment. Following these procedures will provide the desired results.

The satisfactory operation of the vertical propeller/mixed-flow pump is dependent upon careful and correct installation and maintenance of the equipment. Because of the variations in installation requirements, the following instructions must of necessity be rather general in tone. The installer and maintenance man must use sound judgement to adapt the methods outlined to the conditions existent for each particular installation.

General assemblies of Aurora Pump vertical propeller/mixed-flow pumps are shown in Figs. 1 and 2 with the individual parts properly identified. This nomenclature will be used as a reference throughout these instructions. It must be understood that these are typical illustrations and may not conform in complete detail to the equipment as furnished. Please refer to any drawings that have been prepared for this specific installation and become thor-

oughly familiar with the construction of the pump furnished before attempting to assemble, install, dismantle, or do repair work on the unit.

This type of equipment is often furnished with optional features to the specifications of the user. Most of the available options will be described in the booklet. Please refer to those sections applicable to the construction of your unit, disregarding those that do not apply.

Close coupled vertical propeller/mixed-flow pumps are usually shipped assembled and proper instructions for the handling of this type of machine will be presented here first. For equipment of a length too inconvenient to ship completely joined, the bowl unit and discharge elbow section are assembled individually at the factory while the extra column parts may be shipped as components for job site assembly as suggested later in the following instructions.

If there is any doubt or question during the process of installation or operation, contact the factory or your nearest Aurora Pump representative at once.

## **SECTION 2**

### **PRELIMINARY PRECAUTION**

Inspect all material and packing for signs of damage in shipment before signing delivery slip. Any damage should be noted on the delivery slip before signing the release and the carrier's claims inspector must be summoned. Otherwise, the signed receipt clears the carrier of any responsibility for the condition of the material as received.

If any parts are protected with permanent coatings, extreme care in handling will be necessary to prevent damage to coating. This might include such precaution as gloves for wrenches, etc. If coating is damaged, it should be repaired before installation is completed.

Examine the installation site carefully before starting work. If pump is to be installed in a sump, be sure sump has been cleared of debris and is equipped with provisions to prevent entrance of any more foreign material. The sump itself, including inflow channel and pump mounting structure, must be of a design adequate for the equipment to be installed. This consideration is the responsibility of the user.

During all steps of installation, care must be used to prevent strains from being imposed upon pump parts which might cause bending or misalignment of column or shafting. This also applies to piping connections. The use of a dresser type coupling is recommended to avoid putting the unit in stress with discharge piping makeup.

## **SECTION 3**

# **PUMP FOUNDATION**

A suitable pump foundation should always be provided, preferably of solid concrete construction. If this is not practical, adequate beams or timbers may be used.

The pump foundation must be built to carry the weight of the entire pump full of liquid and should be of a design to withstand and prevent any undue vibration.

If the pump is mounted on beams, the beams should be heavy enough to prevent spring action between spans, also with lateral bracing to prevent side motion.

Pump foundation or mounting structure is not to be considered part of the pump and will be the responsibility of the user.

## SECTION 4 INSTALLATION EQUIPMENT

Required installation equipment will of course depend upon type and size of pump to be installed. Although portable derricks or tripods are sometimes used, a properly designed pump setting rig or construction crane is recommended. The lifting device must be of sufficient height to allow the load to be raised about two feet higher than total length of unit if it is desired to handle the complete assembly. Depending upon complexity of installation, following miscellaneous tools may be required.

- Wooden friction blocks or steel clamps.
- Steel column lifting elevators of approved type and of proper size for the pump column.
- Cable sling approximately 10 feet long and adequate size for the loads involved.
- Two chain tongs.
- Two medium size pipe wrenches.

- Twelve foot length of 3/4" manila rope.
- Ordinary set of mechanic's tools.
- Wire brush.
- Paint brush.
- A good grade of pipe joint compound.
- Gasoline, distillate or solvent.
- Set of eye bolts.

If equipment is to be oil lubricated, provide at least one gallon of SAE #10 mineral oil with proper additives or a good turbine oil such as Standard Oil O.C. Turbine Oil #9.

If mating stainless steel parts are to be joined, particularly with threads, a lubricant containing Molybdenum disulphide or some equally effective anti-galling compound should be provided and used per manufacturer's directions.



## SECTION 5

# UNLOADING AND PREPARATION FOR INSTALLATION

Uncrate parts and inspect carefully to be sure nothing was damaged in shipment. Check in detail condition of any shafting. If any part of equipment or crating has been damaged or broken in shipment, please report immediately to transportation company involved and to the factory, with full particulars, confirming all verbal understandings by letter. Do not accept shipments showing damage. Be sure to note damage on the freight receipt before signing and request a claims inspector from the delivering carrier. Do not sign for incomplete shipments of material listed on the Bill of Lading.

If pump is shipped assembled, see Section 6. If not, continue with this section.

If pump is shipped unassembled, clean all column flange faces of any slushing compound or foreign particles with wire brush. Keep flange faces clean at all times. Use Permatex No. 2 gasket and thread compound on all flanged pipe connections during installation.

If pump has been shipped in components, lay out column pipe and bowl assembly on suitable timbers or staging to keep all material out of dirt. Clean all threads thoroughly and apply joint compound with paint brush as they are installed. Inner column assembly consisting of shafting and/or tubing with lineshaft bearings will have been preassembled at the factory into proper lengths to match the column pipes. If furnished, tube faces should be inspected to see that they are free from burrs or nicks and are wiped clean. Sections of tubing which have been assembled at factory should be checked for tightness by installer at jobsite.

Examine lineshafting to make sure that it is straight, care being taken not to bend shafts or damage threads. Do not lay shafting lengths on ground or where they may be walked on or run over. **KEEP THEM STRAIGHT.** They must be placed on timbers and all rust preventive oil or slushing compound should be washed off with gasoline, distillate or solvent. Keep threads clean at all times and use care in making up screwed joints to avoid cross threading and damage to threads. Exercise great care in jobsite handling because, due to its length, a shaft can easily be sprung or bent. Any length that is bent should not be used. Keep shaft and tube ends covered until they are ready to be installed.

All other parts should be cleaned and laid out on a clean surface in the order in which they will be used. Check against packing list to be sure that none are missing.

Insert each length of intermediate shafting into the assembled enclosing tubes if furnished or into the column pipe if pump is of open lineshaft construction without tubing. Tube and shaft assembly, if furnished, should similarly be inserted into column pipe sections. Place with projecting lineshaft bearing pointed toward the mounting position (See Figs. 5 and 6).

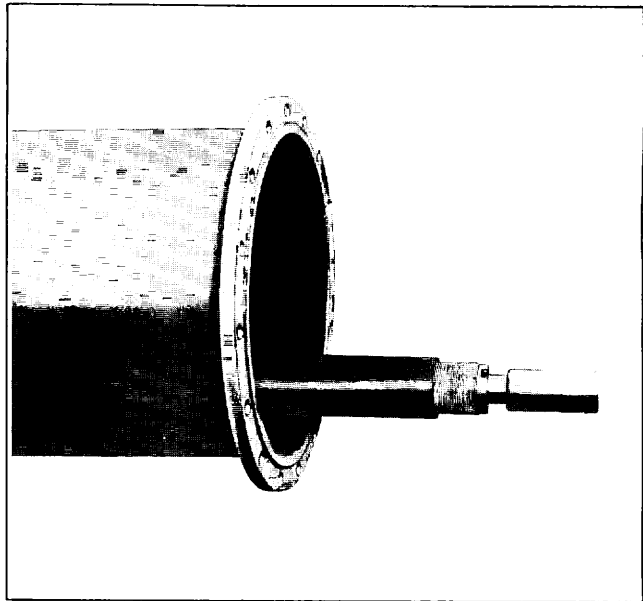


Figure 5

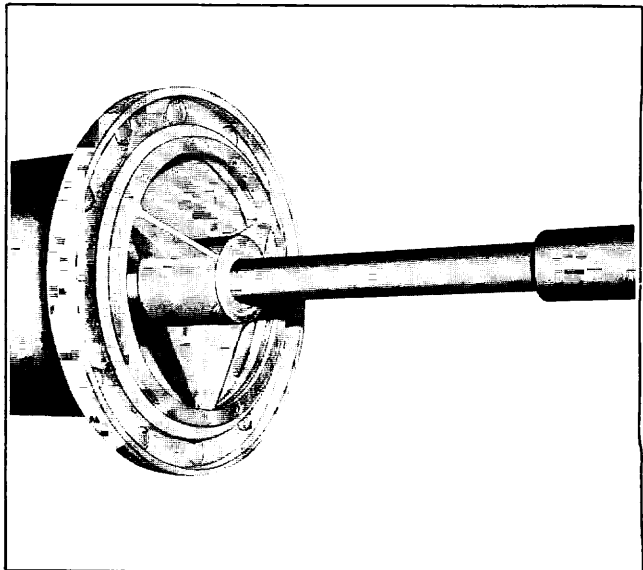


Figure 6

## SECTION 6 INSTALLATION OF FACTORY ASSEMBLED UNITS

Clean mounting structure at pump location. Clean bottom face of elbow/pedestal mounting base plate.

Raise entire unit as shipped to a vertical position, using proper lifting lugs or eye bolts (Fig. 7) taking care not to put strain on column or any exposed shafting. Install assembled unit in a plumb vertical position with full contact base to mounting surface. Assemble base plate mounting bolts and/or nuts.

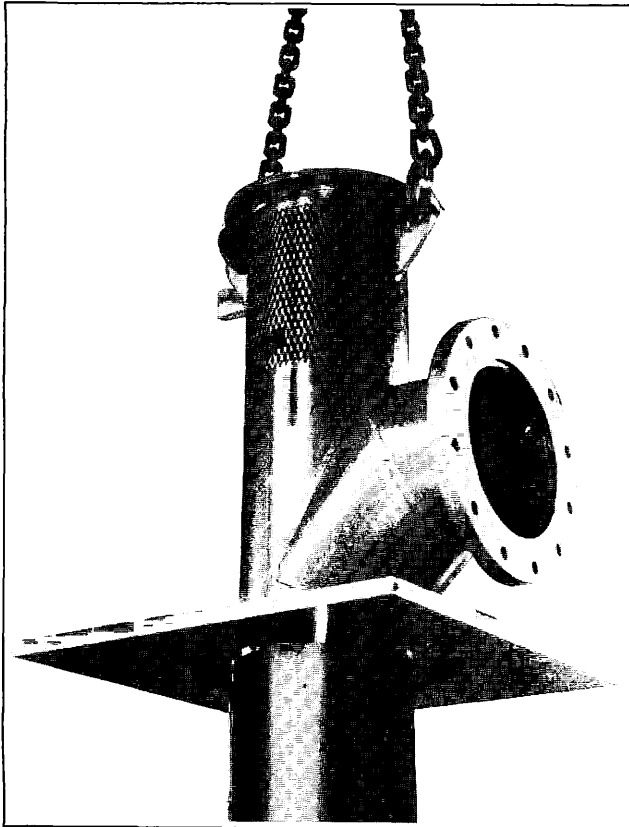


Figure 7

If driver is of vertical solid shaft construction refer to procedures outlined in Section 9. If driver is of vertical hollow shaft construction, continue with this section.

Clean all mounting surfaces and lower driver into position atop its mounting structure, fastening with capscrews as provided. Remove canopy and drive coupling, illustrated in Fig. 8. Check level indicators for amount of oil or grease in driver bearings. Do not add grease without first opening grease relief plugs, as high pressure might damage grease seals. In general, lubrication instructions will be furnished with driver and these instructions should be followed implicitly.

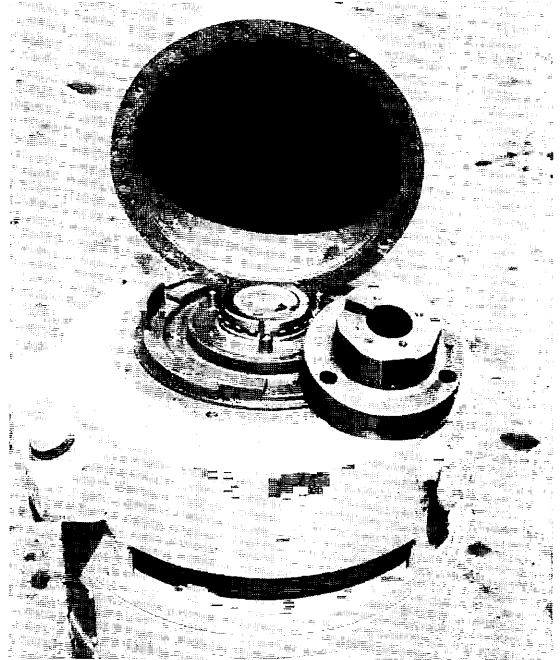


Figure 8

Caution: Do not work on pump, motor, wiring or other components of system without first opening main breaker or pump disconnect switch. Since many electric motors will be furnished as dual voltage machines, it is important that proper connections be made to suit voltage of power source. Therefore, check power source and motor instruction name plate for proper method of connecting motor terminals. On electric motor driven units of hollow shaft construction, connect motor terminals to leads in starter panel.

Energize starter panel and buzz - start motor by switching it very quickly on and off, observing for proper rotation and inspecting to see that it spins freely and is in balance. Motor must run counterclockwise when viewed from the top. If rotation is clockwise, interchange any two motor connections on three phase motors. On single phase motors, follow manufacturer's instructions. After reconnection, again buzz-start the motor to check rotation. Make absolutely sure that it will drive the pump in a counterclockwise direction before making connection to pump shaft. De-energize panel at main breaker or pump disconnect switch before continuing.

Assemble headshaft, sliding it down through driver hollow shaft, snapping it to firm butt against pump shaft. If possible, hold shaft coupling by reaching through coupling access opening in elbow/pedestal. Remember shaft threads are left hand. Make sure headshaft stands in the center of the hollow shaft or that a very slight pressure will center it.

The drive coupling should have a sliding fit and should be firmly seated in its proper position on top of the driver without tendency to hang up as it is lowered into position or rotated. It must sit perfectly flat and without cocking. Try drive key in headshaft keyway and coupling keyway. Make sure that this is also a sliding fit. Reassemble coupling in place on driver and insert key. Do not force key in place. Dress the key NOT THE KEYWAY until a free but not loose fit has been obtained. Top of key must be below adjusting nut seat when in place.

Thread adjusting nut onto headshaft remembering shaft threads are left hand. See Fig. 9. See Section 8 or Section 9C for adjustment procedure which should be followed at this time.



Figure 9

If packing box is furnished, see Section 9A. Lubricate with grease gun through lube fitting on top of box using standard water pump grease. Connect drain lines from top of packing box flange, draining to convenient location.

If pump is of normal oil lubricated design, examine oil reservoir and oil feed line, making sure they are clean. See also Section 9B for details of enclosing tube connection, which will already have been made up at factory. Check to make sure of adequate tension on tube. Connect lubricating system as described in Section 9B. Fill oil reservoir, using oil as described earlier. Adjust lubricator valve to permit oil to drip at a rate of approximately one drop per second. Allow to drip at least 15 minutes before start up.

For solenoid operated lubricators, this adjustment can only be made with solenoid energized, which may

not occur until time of start up. Therefore, it is necessary to remove the plug from the port opposite the oil connection in the tube tension connector so that oil may feed into the connector with an oil can or trigger oiler. Fill the connector slowly to overflow about six times. Replace plug. It is also advisable to apply a few drops of oil at top of tube connector or cap with an oil can. Reservoir and connections are shown in place in Fig. 9.

If any other system of pump lubrication has been furnished, refer to Section 9 for proper procedures or to any special instructions which may have accompanied the shipment of the pump.

Connect discharge pipe to pump without straining or distortion of any kind, follow instruction in Section 8 for propeller or impeller adjustment.

With sufficient submergence over suction or with adequate NPSH available, pump is now ready to start. However, read through these instructions

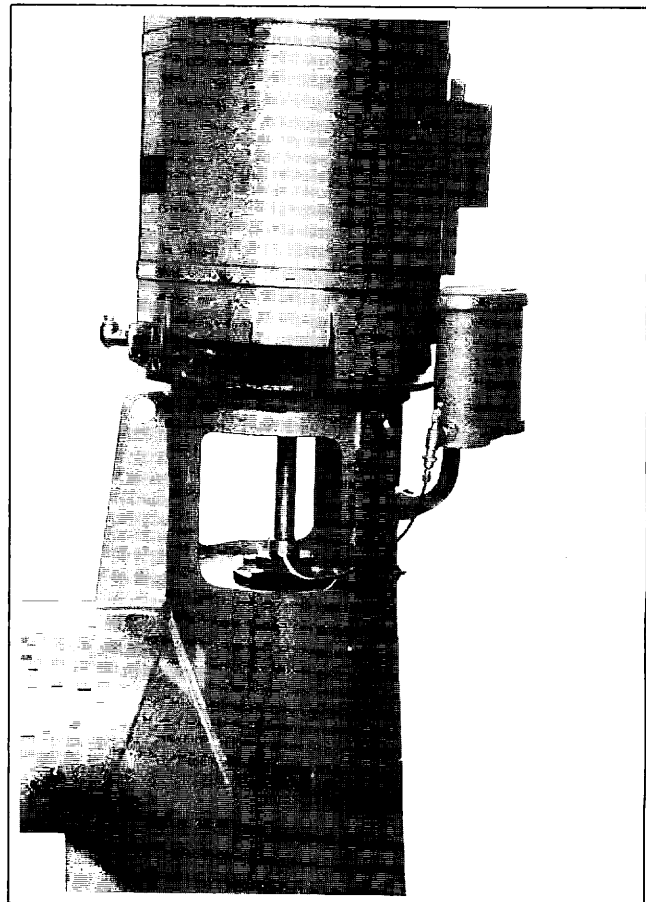


Figure 9A

completely to establish procedure for any optional items before starting pump.

## SECTION 7 INSTALLATION OF UNASSEMBLED UNIT

Propeller/mixed-flow pumps of overall length less than 15 feet are almost invariably assembled complete at the factory less the driver. Equipment of overall length from 15 to 25 feet may or may not be shipped preassembled, depending upon a number of factors. Any unit in excess of 25 feet overall length will invariably be shipped as components for jobsite assembly. The bowl unit and elbow/pedestal section will be assembled individually at the factory. Column components, driver, and other miscellaneous parts will then be shipped as separate items for jobsite assembly as suggested in this section.

If pump mounts on a sealed surface, clean mounting structure and make sure it's level, install gasket. Refer to Section 5 for preparation and location of parts prior to attempting the installation. Refer to Section 4 for suggested installation equipment.

### (a) OPEN LINESHAFT CONSTRUCTION.

Examine bowl assembly carefully. Make sure that bowl assembly discharge bowl flange is clean and register is not marred and that all stage connection bolts have been taken up securely. Inspect bypass port in discharge bowl to make sure that it is properly plugged. Raise bowl assembly as illustrated in Fig. 10, suspend directly over installation position, and lower assembly until upper end may rest and be secured in holding clamp. If a strainer is used it may be assembled onto bellmouth before raising bowl assembly, but care must be taken to prevent damage to strainer while raising to vertical position. Under no circumstance should the bowl assembly be lifted or handled by the pump shaft.

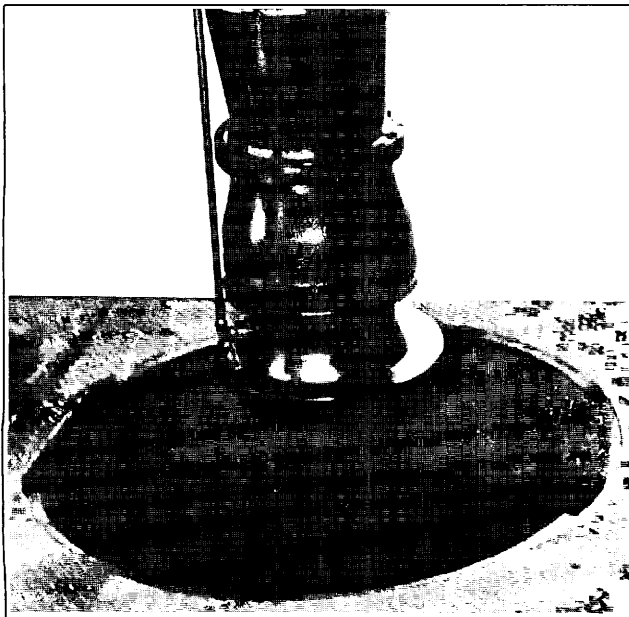


Figure 10

With material positioned as suggested in Section 5, clean all column flanges, centering fits and contact surfaces thoroughly of any slushing compound or foreign particles with wire brush, then wash flange faces clean using distillate or solvent. It's very important that column flange centering fits and contact surfaces are clean and free from burrs, as this could cause misalignment and rough operation. Clean all threads and inspect shaft ends to be sure there are no burrs or dirt adhering to faces. Paint shaft threads with thread lubricant. Inspect and clean shaft coupling and assemble it as described. Before raising column section into place, insert lineshaft into column and using hemp rope, throw timber hitch around pipe about one foot above flange away from mounting position, double half hitch around shaft on top of threads to prevent slipping. This is illustrated in Fig. 11. Although other methods are acceptable, it is preferred that shaft coupling be on length of shafting already assembled as in Fig. 12 so that shaft is lowered into coupling.

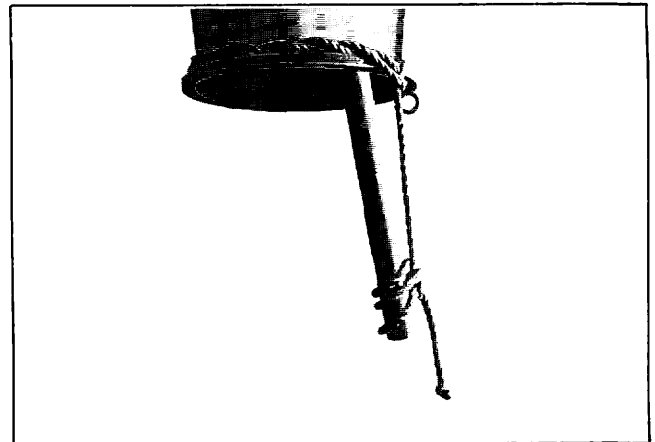


Figure 11

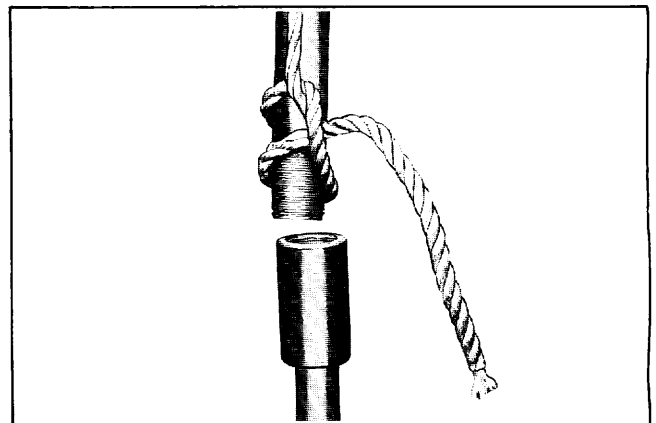


Figure 12

Crown block and load hook must be located exactly above center of installation position so that various components may be lowered and assembled true. Hoist column section in place above bowls as in Fig. 11. It will be necessary that free end of tail rope be held taut to prevent slipping on shaft. A soft board or pipe dolly should be laid out for end of column pipe to slide in on, so that flange will not be damaged as section is being raised. Raise column and shaft into position. Handle very carefully to prevent damaging lineshaft.

Lower column section and couple shaft, remembering that shaft thread is left-hand. Make sure that shaft ends are solidly butted together but do not use undue force in tightening, See Fig. 13. Lock shafts tightly with two small pipe wrenches, using one wrench on shaft coupling and the other on shaft just above threads. Wrench handles should be parallel when final tightening is made to prevent pulling shaft off center. If available, it is even better practice to use a shaft wrench rather than a pipe wrench. Do not allow coupling to ride upon "last scratch" or imperfect thread, as this will tend to cock the coupling and create misalignment. Both shafts should show same amount of threads above and below coupling, indicating that shaft butt is in exact center of coupling. If force is required, look for damaged or dirty threads. Forcing threads may cause misalignment.



Figure 13

It is advisable to stuff sacking into discharge bowl or lower section of column pipe while assembling other parts. This will prevent dropping foreign material, tools or parts into pump. If something is dropped in pump it must be removed before continuing installation. This could require returning everything to surface, and it can thus be seen that some form of cover is indicated. Remove sacking or cover before making up flanged joint.

Clean discharge bowl flange, centering fit and contact surfaces on both discharge bowl and column flanges thoroughly. Lower suspended column section, guide column so that flange slips down over projecting male fit on discharge bowl. Tighten nuts evenly. Use thread lubricant on bolt threads. Bolted joint must be tight enough to support weight of pump assembly and hold liquid pressure.

Use some type of pipe elevators, steel channels with through bolts or wooden clamp blocks. Take care to avoid chafing sling on flange or creating pull-off forces.

With column joint made up, raise entire unit sufficiently to remove holding clamp, lower assembly until upper end may rest and be secured in holding clamp.

Intermediate flanged column joints are made up in same manner except that bearing retainer is installed in centering fit at each joint when removable type is furnished.

Clean centering fits, contact faces and bearing retainer rim thoroughly before assembling. Wipe upper end of shaft down beyond journal point free of oil or grease.

Before lowering bearing retainer into place, make sure shaft stands in center of pipe or that very slight pressure will center it. Bearing retainer is now placed over projecting end of lineshaft and into annular centering recess in column flange as illustrated in Fig. 14. Retainer forms a centering ring for column pipe flanges and also forms a gasket for flanged joint. Shaft should now stand freely in center of bearing retainer without binding against side.

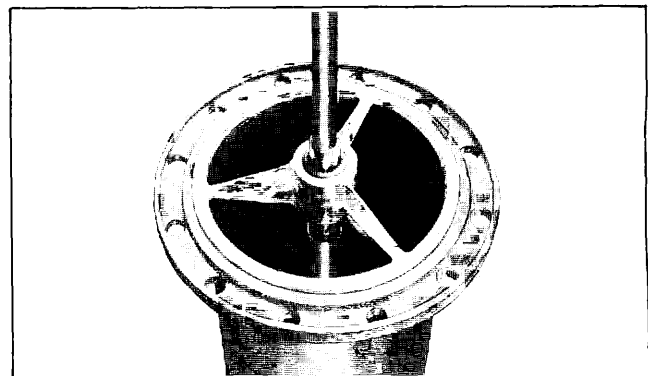


Figure 14

Do not force shaft to center with bearing retainer. If shaft bears heavily to one side and bearing retainer is properly seated, column and shaft should be pulled up again, removed, and inspected for misalignment. Never continue with installation if shaft does not center freely at bearing retainer. This indicates a misaligned column section or bent shaft which will eventually cause trouble.

If all parts are centered properly at this time, proceed with installation of next column/elbow section. Repeat this installation procedure with all additional sections, remembering that shafts must butt solidly in center of each joint.

Lower next section of flanged column, with its length of drive shaft supported inside by a rope hitch, onto projecting half of retainer rim after shaft make up, or this may be a flange register if retainer is fabricated in the column section as illustrated in Fig. 15.

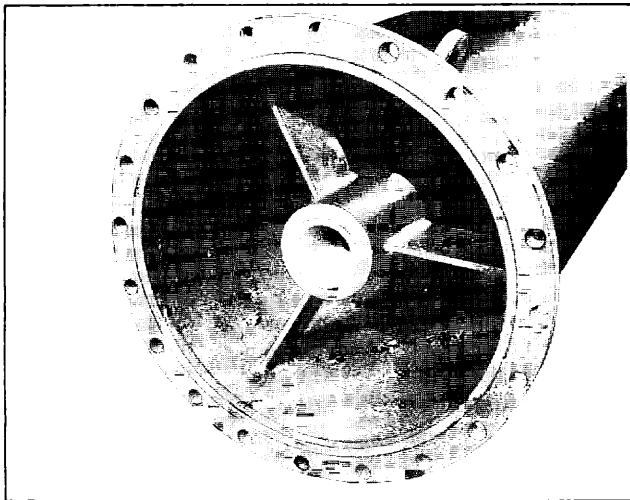


Figure 15

Tighten nuts evenly all around, first lightly setting up opposite bolts, then applying greater torque all around until all bolts are tightened evenly. If available, use a torque wrench which indicates amount of foot-pounds torque applied to each bolt.

If lineshaft is furnished with sleeves at journal points, inspect to see that sleeve journal falls properly within the bearing location. Any attaching collet or projecting part must clear bearing retainer by approximately one inch minimum so that, when shaft is raised for propeller or impeller adjustment, no interference occurs at journal points. In applying thread lubricant to shaft threads, prevent lubricant from contact with rubber bearing in bearing retainer.

Top column section with driver pedestal or mounting plate is generally shipped with packing box assembly in place. Packing box assembly should be removed to permit installation of the pedestal/elbow. The packing box may then be slipped carefully down over

the top line shaft into position. Since this section will normally be different than intermediate joints, it is difficult to be assembled in other than its proper location.

Clean bottom face of base plate including all machined surfaces.

Lower top section carefully into position on top of flange, after shaft make-up, making sure centering registers are fully engaged and that flange face seats firmly, evenly, and with no cocking. Install bolting and tighten nuts uniformly, making a solid flange connection.

See Section 9A for details of normal packing box for any other options, see other portions of Section 9 or other special instructions furnished with the equipment.

Lower entire unit carefully to final installed position. Be sure unit is in a plumb vertical position with full contact at base to mounting surface. Assemble base plate mounting bolts and/or nuts.

Proceed at surface from this point as described in Section 6.

#### (b) ENCLOSED LINESHAFT CONSTRUCTION

Enclosed lineshaft parts are assembled in a manner similar to that used for open lineshaft construction, except that there will also be enclosing tube to handle. Again examine bowl assembly carefully to make sure discharge bowl flange is clean and register is not marred and that all stage connecting bolts have been taken up securely. Inspect bypass port in discharge bowl to make sure that it is properly open and not plugged in any way. Remove shaft protecting pipe by unscrewing from bowl assembly tube adaptor. See Fig. 16 for illustration for bowl assembly.

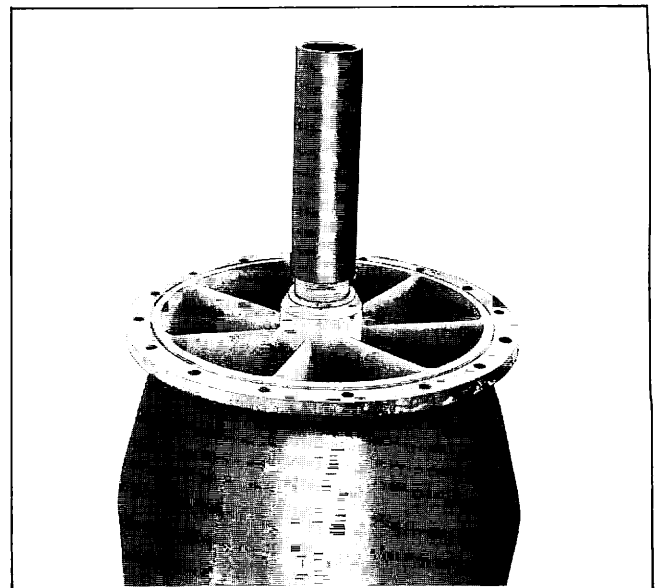


Figure 16

Position bowl assembly as described for open line-shaft construction with material arranged as suggested in Section 5. Before raising flanged column pipe into position, lineshaft and enclosing tube should be placed into column, use hemp rope to throw timber hitch around pipe one foot above lower flange then apply double half hitch around tubing section and double half hitch around shaft on top of threads to prevent slipping. This is illustrated in Fig. 17.

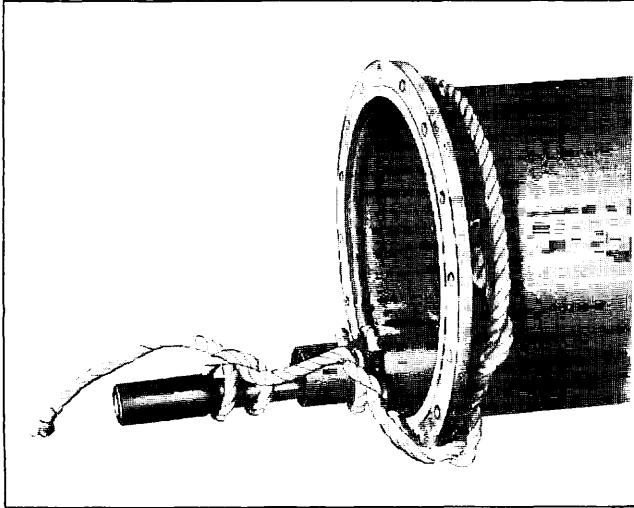


Figure 17

As described earlier, hoist column section into place above mounting position. Handle very carefully to prevent damaging enclosing tube and lineshaft. It will be necessary that free end of rope be held taut to prevent slipping on shaft. A soft board or pipe dolly should be laid out for end of column section to slide on so that flange does not become damaged during raising of section.

Clean and inspect all shaft ends and enclosing tube faces to be sure that there are no burrs or dirt adhering to faces. Paint shaft and tube threads with thread lubricant. Inspect and clean shaft coupling, which will usually be found in boxed parts, and assemble it as described.

Lower column assembly and couple shaft, remembering that shaft thread is left hand. Make sure that shaft ends are solidly butted together but do not use undue force in tightening. See Fig. 18. Lock shafts tightly with two small pipe wrenches, using one wrench on shaft coupling and the other on shaft just above threads. Wrench handles should be parallel when final tightening is made to prevent pulling shaft off center. If available, it is even better practice to use a shaft wrench rather than a pipe wrench. Do not allow coupling to ride up on "last scratch" on imperfect thread as this will tend to cock the coupling. Both shafts should show same amount of threads above and below coupling, indicating that the shaft butt is exact center of coupling. If force is required, look for damaged or dirty threads. Forcing threads may cause misalignment.

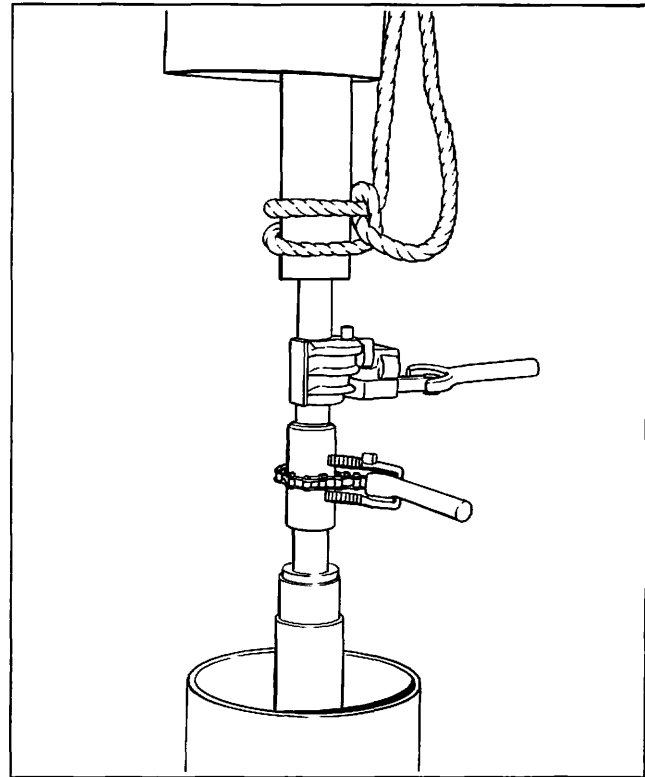


Figure 18

Carefully lower enclosing tube and engage threads of tube adapter at top of bowl assembly, tightening it with pipe wrench or small chain tong. These are right hand threads. On following tube sections, two wrenches or small chain tongs should be used, one holding lower tube stationary and the other to tighten upper section into place onto projecting lineshaft bearing. In all cases, wrenches must be held parallel for final tightening.

It is advisable to stuff sacking into discharge bowl or lower section of column pipe while assembling shaft and tubing. This will prevent dropping foreign material, tools, or parts into pump. If anything is dropped into pump, it must be removed before continuing installation. This could require returning everything to surface and it can thus be seen that some form of cover is indicated. Remove sacking or cover before making up column joint.

With tube and shaft properly made up, clean discharge bowl flange, centering fit and contact surfaces as well as column flange thoroughly. Lower suspended column pipe, guiding column so that flange slips down over projecting male fit on discharge bowl. Tighten nuts evenly. Use thread lubricant on bolt threads. Bolted flanges must be tight enough to support weight of pump assembly and hold liquid pressure.

Use some type of pipe elevators, steel channels with through bolts or wooden clamp blocks. Take care to avoid chafing sling on flange or create pull-off forces.

Raise entire unit sufficiently to remove holding clamps. Lower assembly until upper end may rest and be secured in holding clamp. Remove lineshaft bearing from projecting oil tube and pour into tube not more than one half pint turbine oil described earlier. Replace lineshaft bearing using half the bearing threads, allowing half the lineshaft bearing to project out of tube to connect with next joint. At this time, also check alignment of shaft in tubing and position of tubing and column pipe, being sure all members are centered. If all parts are centered properly, proceed with installation of next column section. Repeat procedure on all additional sections.

Intermediate flange column sections are made up in same manner. Clean centering fits and contact surfaces on both intermediate column flanges thoroughly. Lower next section of flange column, with its length of enclosing tube and lineshaft supported inside by a rope hitch and after inner column makeup guide column so that the flange slips over projecting male fit on lower column flange. Tighten nuts evenly all around, first lightly setting up opposite bolts, then applying greater torque all around until all bolts are tightened evenly. If available, use a torque wrench which indicates amount of foot-pounds torque applied to each bolt.

Top column section with driver pedestal or mounting plate is generally shipped with the tube tension assembly in place. The tension assembly must be removed, if assembled, to permit positioning of top tube. Enclosing tube to be assembled in top column section will usually consist of sections, one of which is a standard 5 foot joint and the other may be a shorter length of tube. Length of tube connector at

top of this section has been established to provide about 2 inches of adjustment at tension nut location, far more than usually required with short setting pumps.

Top lineshaft may also be of different length than standard 10 foot joints. It will be designed to terminate at a predetermined point with respect to top mounting plate. Make up top section and handle similar to intermediate assembly. The long tube connector should be assembled to the top tubing joint before the top section is lowered. See Section 9B. This is to permit use of back up tongs on tube while making up a tight joint connector.

Clean bottom face of base plate including all machined surfaces.

Lower top section carefully into position on foundation, making sure centering registers are fully engaged and that outer flange face seats firmly, evenly and with no cocking.

See Section 9B for details of normal enclosing tube connection. For any other optional features see other applicable portions of Section 9 or other special instructions furnished with equipment.

Lower entire unit carefully to final installed position. Be sure unit is in a plumb vertical position with full contact at base to mounting surface. Assemble base plate mounting bolts and/or nuts.

Proceed at surface from this point as described in Section 6.



## SECTION 8

# PUMP ADJUSTMENT PROCEDURE

### (a) Propeller pump

Propeller, shown in Fig. 19, is designed to operate best approximately half way between its upper and lower limits of travel in the cylindrical section of the discharge or intermediate bowl.

When a hollowshaft driver is furnished, adjust pump by turning nut on the left hand threads so that propeller just breaks free from the extreme low position. This is break-free point and should be marked, nut to drive coupling. Then, by continuing to turn adjusting nut, raise shaft until propeller contacts top of propeller cavity in bowl. Do not use undue force against any resistance. Upper limit of propeller adjustment is thus established and should be marked, again nut to drive coupling. Number of turns of adjusting nut between the two marks should be recorded and nut backed off from its upper position half the total number of turns recorded above.

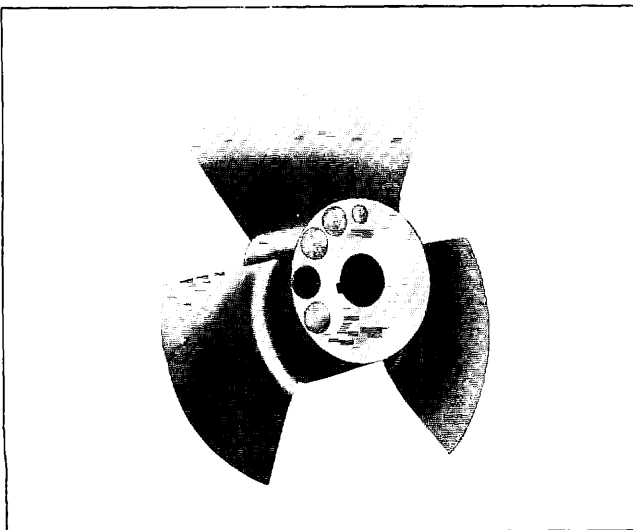


Figure 19

When a solidshaft driver is furnished, see Section 9C for adjustment.

### (b) Mixed-Flow Impeller Pump

Impeller, shown in Fig. 20, is designed to operate close to the taper bowl seat in intermediate bowl or bellmouth for best performance.

With a hollowshaft driver, adjust by turning adjusting nut on the left hand shaft threads so that the impeller just breaks free from the seat. This is break-free point and should be marked, nut to drive coupling. Then continue to turn adjusting nut until impeller clears seat approximately 1/4 turn of adjusting nut. Rotate the shaft to make sure it will turn freely. On settings beyond 20 feet in length increase this clearance 1/4 turn of the adjusting nut for each additional 20 feet of column length.

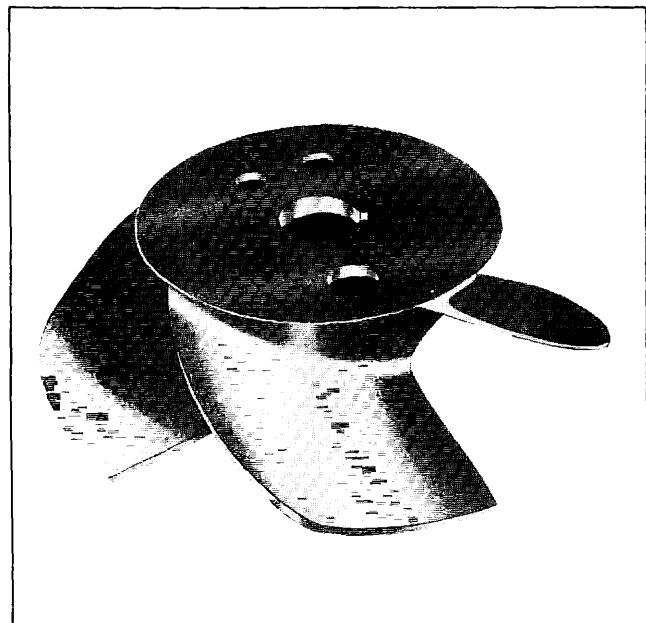


Figure 20

With solidshaft drivers, see Adjustment Procedure, Section 9C. It should be noted that hydraulic down thrust increases with any increase in operating pressure. While shaft elongation on close coupled and very short pumps is minimal, it must be remembered that some deflection will occur, however minor. Pumps that must be subjected to varying operating heads should be adjusted with respect to the highest head to avoid excessive dragging of impellers under these conditions.

## SECTION 9

# OPTIONAL FEATURES AND SPECIAL INSTRUCTIONS

Examine this section as outlined in the table of contents for those features applicable to the equipment in question. Also check shipment for any special instructions and/or drawings that have been included to cover items not described in this booklet.

### (a) Packing Box

If a packing box has been furnished, as is the normal case with short coupled open lineshaft equipment, it will usually be shipped assembled in its proper position in the elbow or driver pedestal. Normal packing box assembly will usually include packing container Item 111-15, at extreme lower end of which is a bushing or throttle sleeve item 111-18. Immediately above this are assembled a given number of packing rings Item 111-20. Then a lantern ring Item 111-17 positioned so as to allow leakage into proper drain port, then more packing rings and at the top, a two piece gland Item 111-16 which can be removed without disturbing shaft. A gasket Item 115 seals housing flange to seat. Housing Item 111-15 is secured in position with capscrews Item 114. See Fig. 21.

If it is ever necessary to install packing box, packing gland nuts Item 111-21 should be loosened so that shaft threads will not drag excessively on packing

rings as packing box is lowered over end of shaft into place. After completion of assembly, packing gland nuts should be tightened initially only finger tight.

Lube fitting Item 111-19 should be greased with standard water pump grease. A small amount should be forced down into bushing area before starting pump. Periodic injection of grease will add life to journal area and packing.

Drain lines from drain port Item 111-24 and flange lip are to be connected and routed to some convenient drainage location.

At time of first operation, start pump and run for 10 to 15 minutes. Let pump packing leak at least 100 drops per minute during first operation. If leakage slows down, loosen gland nuts to keep leak rate constant. Gland temperature should level off and then drop slightly toward the end of 15 minute operation. Gland nuts may then be drawn up about 1/6 turn every five minutes until leaking is minimized. If, during this operation, gland heats up so that it will vaporize water, back off gland nuts and repeat run-in procedure as described until temperature stays down after gland nuts are retightened. Gland nuts must always be rotated evenly to avoid cocking gland.

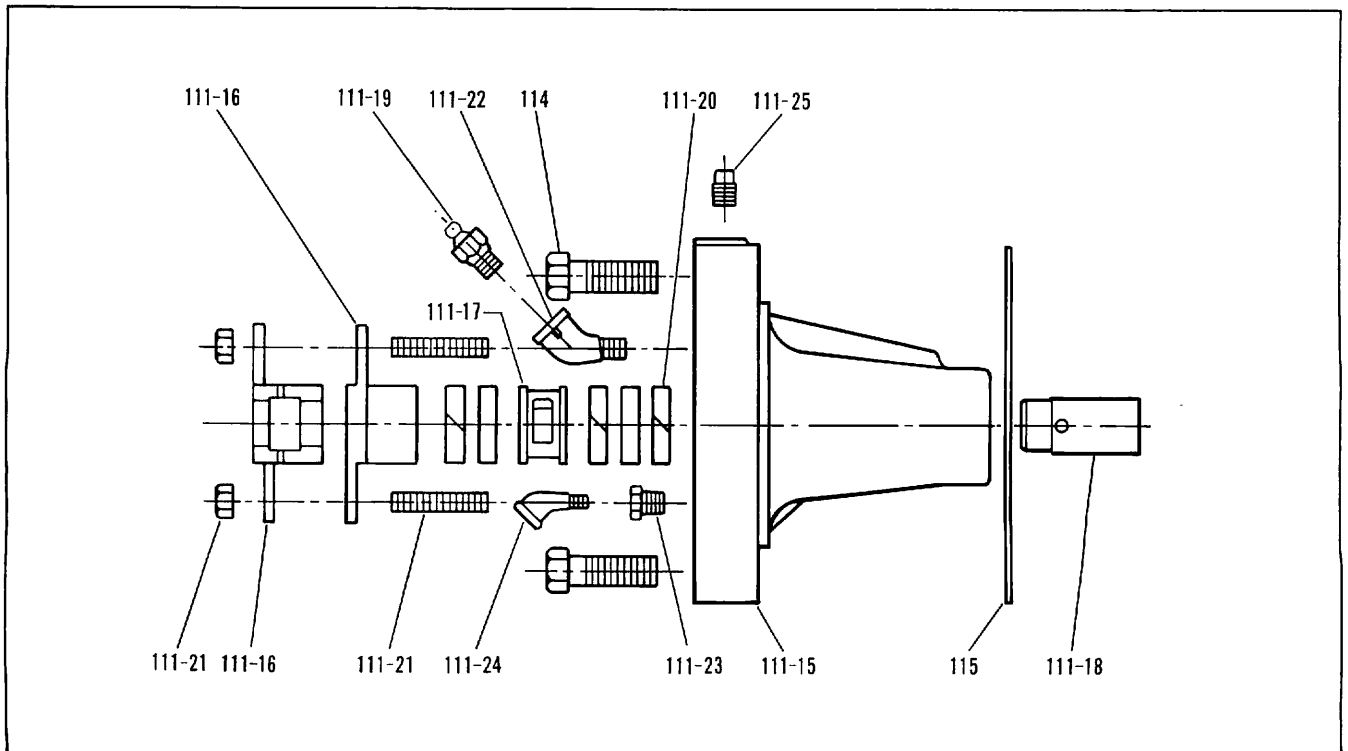


Figure 21

During first four or five hours of operation, packing gland should be gradually tightened as packing becomes broken in and formed to completely fill chamber. If it can be tolerated, a small trickle allowed to come through box during this breaking in period will result in a better packed box. During this time frequent checks should be made to insure that box is not overheating. Should box become overheated, slackening off on the gland nuts may be all that is needed as described above. Should overheating continue, check to be sure bypass is open and fluid is passing through it.

In repeated tightening of gland nuts as packing wears, packing will also be compressed in packing chamber, lowering gland into chamber. Additional rings may be installed as required to compensate, but not more than two additional rings of packing should be inserted above lantern ring, as otherwise drain port will be blocked. After adding any rings, check drain port to see that it has not become plugged.

To repack, old packing must be removed by means of packing hooks, cleaning out chamber thoroughly. Lantern ring Item 111-17 is provided with two #10-32 tapped holes at 180° apart in the upper face. Thus, it may be lifted from box by means of two #10-32 x 3-1/2" or longer machine screws or similar means. Gland Item 111-16 may be removed completely because of its split design and lantern ring may be held up out of the way during repacking lower portion by means of string tied around shaft or tape.

At time of repacking, check shaft alignment and surface finish. Finish should be smooth, without burrs or scratches. Avoid shaft run-outs over .005". Packing may be butt or diagonal cut, with the latter preferred. It is recommended that die formed rings be used for repacking, naturally of same size as original parts. If rings are cut and fit at jobsite, length of rings should be such that ends just meet when packing is wrapped tight around shaft. Joint in rings should be staggered or located 90° to 180° from joints in rings immediately above and below it in box. Packing rings may be flattened slightly to aid starting in box.

In packing a new pump before driver is assembled, a short piece of pipe passed over line shaft can be used to press individual rings down into box and tamp them firmly into place. This expedient is not possible after driver has been installed, however, although a split tube may be used in a similar manner.

Insert three rings of packing into bottom of packing chamber, or whatever number is required to bring top of packing up to bottom of drain port. Install these rings in individually. (Repeat). Before reinstalling lantern ring, check to see that drain port through box has not been plugged by packing or other material. This can be done by means of wire run through drain port into packing chamber.

Lantern ring may now be placed above first set of packing rings Item 111-20. It is by means of this lantern cage that pressure is relieved from top rings of packing, any fluid seepage being returned to atmosphere or suction through drain port and drain line tubing.

Install necessary additional rings of packing one by one above lantern cage as required to obtain proper location of gland. Gland may now be reinstalled and gland nuts be reassembled on studs but they should not be tightened at this time. Follow run-in procedure as described earlier in this section.

A packing box assembly properly adjusted is a most suitable and practical sealing device, requiring only nominal skills and instruction to maintain. It should be packed quite loosely when first starting pump, with fairly free leakage. Gland nuts may then be taken up evenly and gradually, preferably with fingers, until proper control of leakage rate is obtained. It should be emphasized that packing should never be run too tight or without minor leakage since it is possible otherwise to generate extreme heat, consume excess power, wear or score journals, and destroy packing itself. Grease should be injected regularly through the lube fitting. A regular maintenance program will insure trouble free service with a properly designed unit.

#### (b) Enclosing Tube Head Connection.

If pump is shipped assembled, enclosing tube connection is already complete except for oil reservoir connection. Read the following paragraphs to reach a description of oil line connection.

If pump is of enclosed lineshaft construction, parts for connecting enclosing tube and lubrication system at upper elbow section or driver pedestal will usually be shipped assembled in this component. Before making up top inner column assembly, remove these parts, which are illustrated in Fig. 22, from their assembly position and lay them out separately on a clean surface. After making up lengths of tubing that comprise top inner column assembly, together with any shafting to be assembled therein, the long tube connector Item 111-1 should be made up as an additional joint at top end. Use back up tongs on tubing while making a tight joint with connector.

After top section is completely assembled as described before and installed, the job is completed to this point according to the instructions in Section 7B. With complete unit in place and pump resting properly on its foundation, the long threaded tube connector should project up through and in the exact center of the hole provided in the mounting pedestal for this purpose. Examine and clean threads, bore, and faces of tube tension nut, Item 111-2. Apply thread lubricant. Thread tube tension nut down over connector and into position. It may be necessary to remove pipe bushing and plug Items 111-5 and 111-9 from ports at top of tube connector to accomplish this.

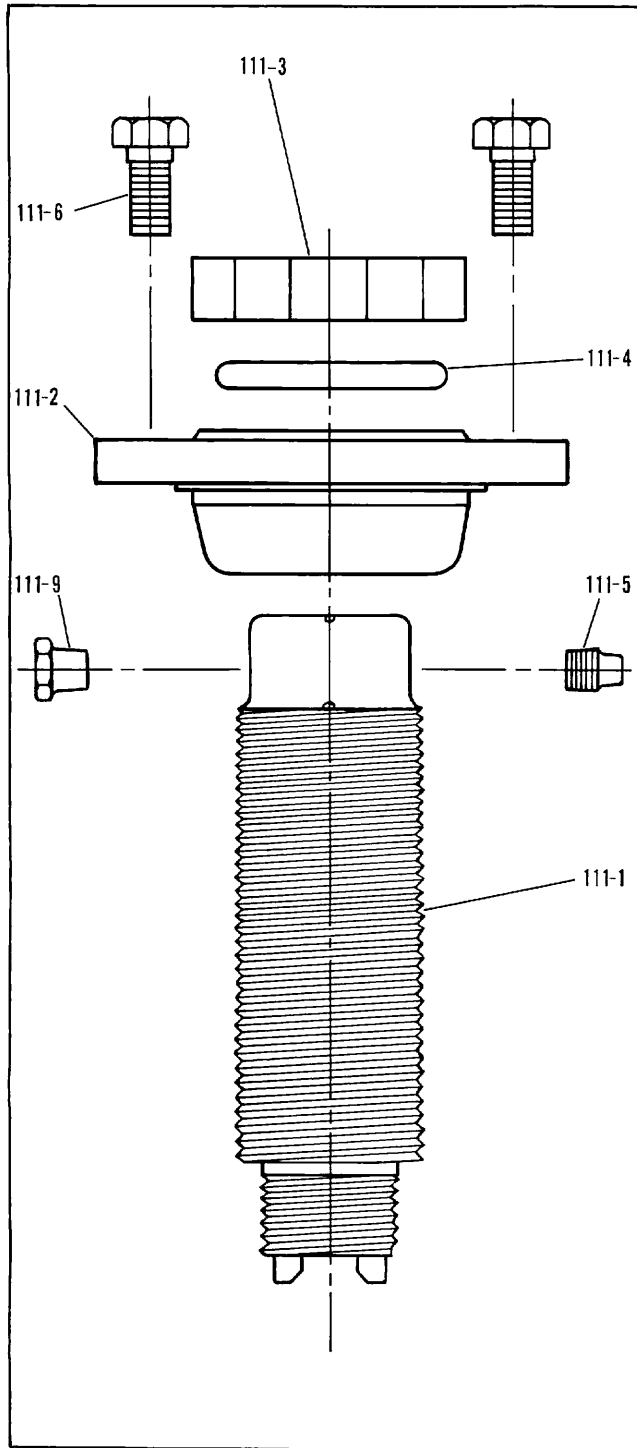


Figure 22

It should be possible to run tube tension nut down until it is seated against mating face in elbow/pedestal by hand. Inspect to see that centering register is properly engaged. Tighten tension nut with a tube tension nut wrench until weight of tube is well supported. With all tubing joints solidly butted and with tension nut seated firmly in place, apply additional tension by rotating tension nut to next matching hole in flange. Tension nut flange must seat firmly in its

location in elbow/pedestal in order to prevent leakage through top of elbow. Put thread lubricant on cap screws Item 111-6. Place them in tension nut flange and thread them firmly in position in the assembly.

Packing ring Item 111-4 may now be laid in place in chamfered top of tension nut around connector. Care must be taken to see that ring remains properly seated as tubing lock nut Item 111-3 is assembled and tightened with chamfered face down. Tightening locknut for last two or three turns may be accomplished with a spanner wrench or by tapping nut around using a block of wood and hammer. Never tap nut around with a metallic object. Tubing joints are now complete and pipe bushing and plug may be reassembled in ports in position most convenient for oil line from reservoir.

Examine oil reservoir and oil feed line making sure that they are clean. Fig. 23 shows parts involved. Attach bracket Item 124-2 to driver pedestal using capscrews 124-7, placing dampener gasket 124-8 between bracket and mounting surface. Reservoir Item 124-1 will slide on wedge end of bracket. Bushing 124-10 must be located on that side of reservoir most convenient to bring out oil line to tube connector. It may be necessary to interchange bushing and plug Item 124-9 to accomplish this.

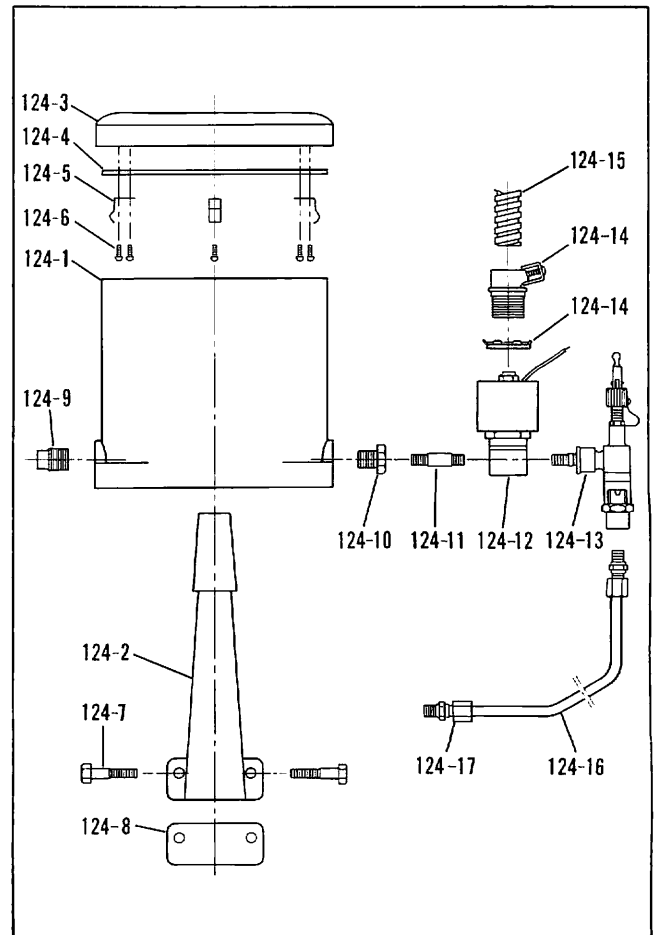


Figure 23

If lubricator is automatic, assemble pipe nipple Item 124-11, solenoid operated valve Item 124-12 in relative position shown. If lubricator is not automatic, pipe nipple and solenoid operated valve will not be furnished; manual feed regulator is then assembled directly onto bushing Item 124-10. Keep cover assembly Item 124-3 on reservoir at all times to keep foreign material out of container.

Connect lubricating system as illustrated in Fig. 24, using tube Item 124-16 and fittings Item 124-17. Fill oil reservoir using oil as described earlier. Adjust lubricator valve 124-13 to permit oil to drip at a rate of approximately one drop per second. With solenoid operated lubricators, complete electrical connection to valve. Remove pipe plug at top of tubing connector and fill upper cavity with oil just before first start. See Page 10. This will insure an adequate supply of oil at each bearing for first start.

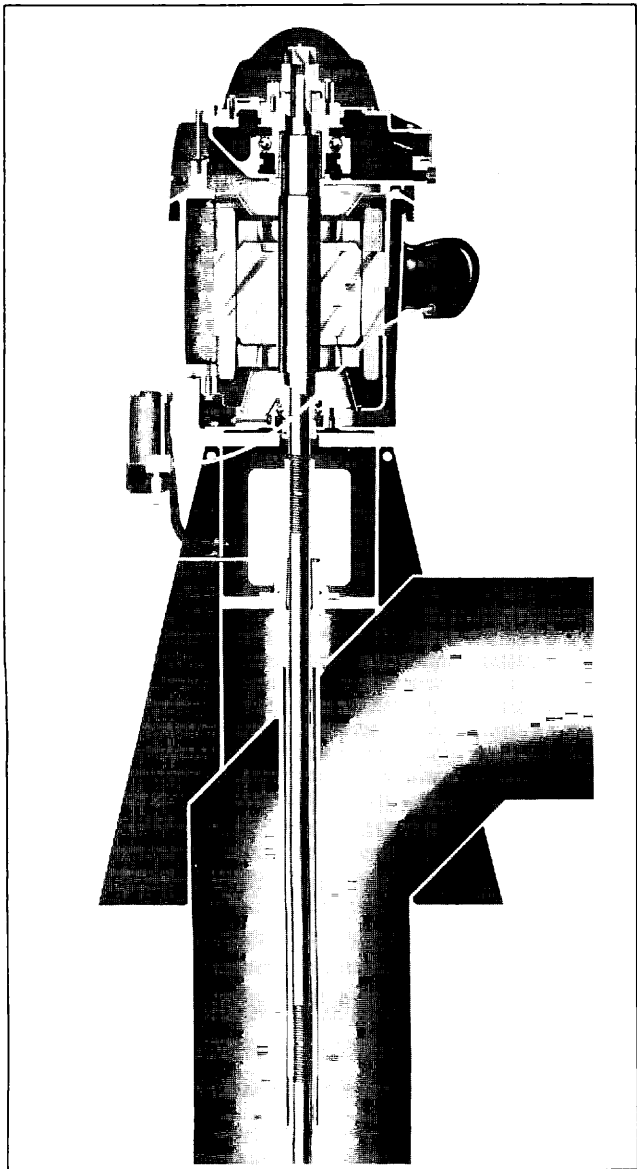


Figure 24

Before first start, verify that oil reservoir is full and lubricant can flow freely into enclosing tube. Then start pump. Be sure oil continues to flow into pump during running time. It may be found necessary to apply a small amount of oil from an oil can at point where shaft emerges from tubing in pedestal. This should only be necessary during first few minutes of initial operation.

After logging about 1/2 hour running time, adjust flow on manual lubricator to allow 30 drops per minute and operate at this flow rate for first 20 operating hours. Unless solenoid control is furnished, shut off manual lubricator during idle periods. After running about 20 hours, reduce oil flow rate to an amount between 8 and 10 drops per minute for permanent operation.

(c) Flanged Adjustable Coupling.

After installation of all pump components through driver pedestal, assembly of flanged shaft coupling must be commenced before setting driver in place. Check and clean all coupling parts before attempting assembly. Flange mating faces must be flat and free from burrs, nicks, dents, defects or foreign material. If parts are matchmarked, assemble accordingly. Refer to Fig. 25 which illustrates flanged adjustable coupling.

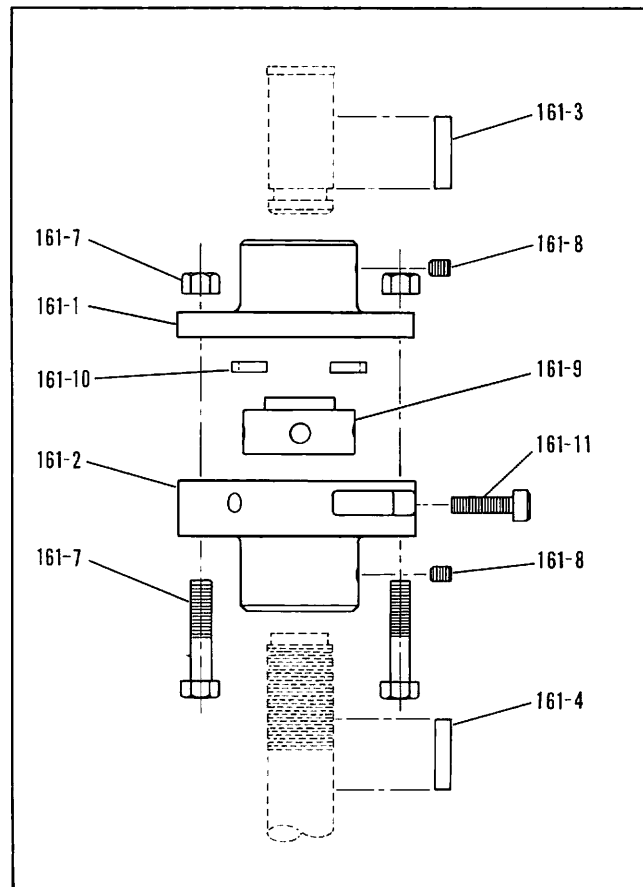


Figure 25

Inspect and clean pump shaft threads, painting lightly with good thread lubricant. Insert key Item 161-4 in pump shaft keyway and slide pump shaft coupling Item 161-2 well down over shaft, flange face up, leaving shaft threads projecting above coupling. Thread adjusting nut Item 161-9 onto pump shaft with rimmed end up, turning counterclockwise until pump shaft protrudes through threaded portion of nut by at least two threads.

Set driver on beams or blocks on pedestal with ample clearance between driver shaft and pump shaft. Secure driver firmly against torque with chain or cable restraints.

Insert key Item 161-3 in driver shaft keyway and slide driver shaft coupling Item 161-1 up onto driver shaft, flange face down. With flange above driver shaft ring groove, insert both halves of thrust collar Item 161-10 into groove and slide coupling down on shaft until it rests firmly on thrust collar halves, these collar halves being retained in coupling recess. (If necessary, dress keys to a sliding but not loose fit. Do not file keyways.) Assemble and tighten setscrew Item 161-8 securely. Remove blocks and lower driver onto its mounting flange, seating it firmly. Assemble fasteners loosely but do not tighten. (Connect motor and energize to check rotation, which must be counterclockwise when viewed from top. See Section 6. Stop motor.)

For mixed flow pumps only, and with impellers firmly seated in bowls, thread adjusting nut 161-9 up on pump shaft by turning clockwise until its outer shoulder is spaced approximately .030 inches to .060 inches below face of driver coupling flange. Pull pump coupling up and insert flange bolts item 161-7 through both coupling flanges. Assemble nuts item 161-7 and run up by hand until they are snug, using a light machine oil on the bolt threads. CAUTION: Use only bolts and nuts furnished with pump.

For propeller pumps only and with shaft in bottomed position, thread adjusting nut onto pump shaft by turning counterclockwise until its outer shoulder is spaced approximately X inches below face of driver coupling flange.

For number 8 thru number 12 pumps	X = 1/4
For number 14 thru number 16 pumps	X = 3/8
For number 20 and above	X = 1/2

Insert flange bolts through both coupling flanges. Assemble nuts and pull coupling flanges together by tightening nuts on bolts securely. Use a light machine oil on threads. CAUTION: Use only bolts and nuts furnished with pump.

With all nuts drawn up and with flanges meeting evenly both at faces and at outer circumference, tighten all bolts under uniform tension, using torque wrench if available. Five hundred inch pounds will be sufficient torque; i.e., a 50 pound pull on a 10 inch wrench, etc. Make sure pump shaft key is flush with coupling hub and tighten setscrew Item 161-8 securely.

Coupling is now completely assembled and locked. Tighten motor fasteners firmly. See that pump turns freely by hand. Follow motor lubrication instructions before operating.

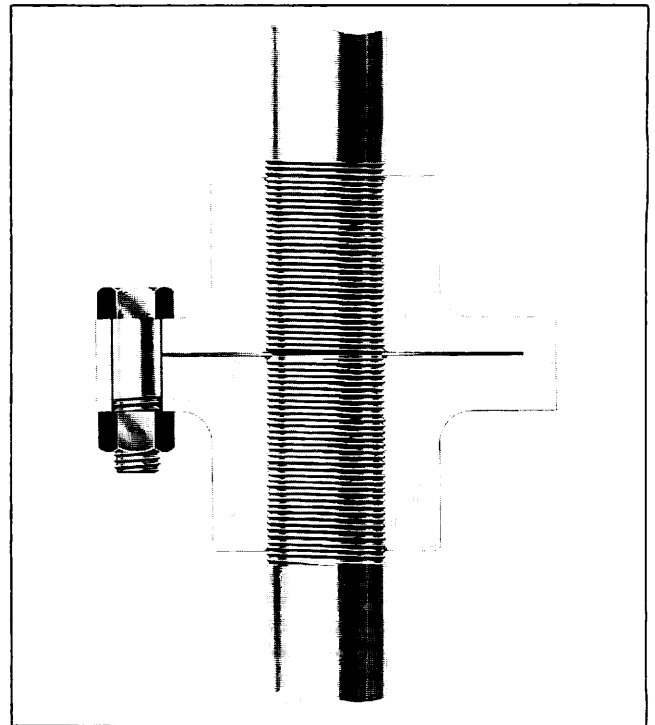


Figure 26

Pump may be readjusted as necessary by removing setscrew and turning nut with a bar through slots in lower coupling half.

(d) Flanged Non-adjustable Shaft Coupling (V.H.S. Drive)

Two piece flanged coupling may be installed after assembly of pedestal and packing box component parts. See Fig. 26 for coupling design.

Clean headshaft and headshaft coupling threads thoroughly and paint with a good thread lubricant. Clean coupling flange face and thread coupling onto headshaft, with flange face up. Shaft face must not project beyond flange face.

After cleaning driver shaft threads, clean driver shaft coupling threads and flange face. Paint driver shaft and coupling thread with thread lubricant. Thread coupling onto driver shaft, flange face down. Shaft face must never project beyond flange face.

Raise motor, insert driver shaft into driver hollow shaft with driver coupling flange facing down. Thread on driver shaft adjusting nut to lock shaft in position in motor while lowering motor onto mounting flange. Lower driver onto mounting flange and fasten in place.

Insert flange bolts and thread on hex nuts by hand until snug against flange, using a light oil on machine bolt threads. After all nuts are drawn up and flange coupling meets evenly, put all machine bolts under uniform tension, using a torque wrench if available. Check to be sure shaft ends butt.

(e) Flanged Non-Adjustable Shaft Coupling (Two-Piece Flanged Coupling for Combination Gear Drive)

Two-piece flanged coupling may be installed after assembly of pedestal packing box component parts and headshaft. Lower gear drive and yoke onto mounting flange and fasten into place. See Fig. 27 for coupling design.

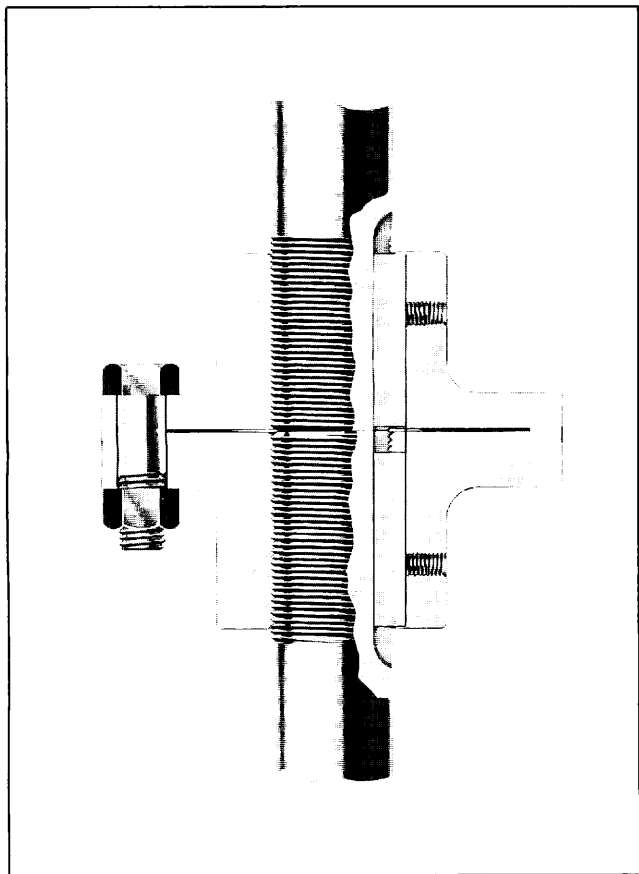


Figure 27

Clean headshaft and headshaft coupling threads thoroughly and paint with a good thread lubricant. Clean coupling flange face and screw coupling onto head shaft, flange face up. Shaft face may be .005 to .100 below flange face but must not project beyond flange face. Line up keyways, insert key and tighten set screw firmly.

After cleaning driver shaft threads, clean driver shaft coupling threads and flange face. Paint driver shaft and coupling threads with thread lubricant. Screw coupling onto driver shaft, flange face down. Shaft face may be recessed .005 to .100 into coupling but must never project beyond flange face. Line up keyways, insert drive key and tighten set screw firmly.

Raise motor, insert driver shaft into driver hollow shaft with driver coupling flange facing down. Thread on driver shaft adjusting nut to lock shaft in position in motor while lowering motor onto gear drive yoke. Lower driver onto gear drive yoke and fasten into place.

Insert bolts and screw on hex nuts by hand until snug against flange, using a light oil on machine bolt threads. After all nuts are drawn up and flange coupling meets evenly, put all machine bolts under uniform tension, using a torque wrench if available.

Installation of adjusting nut, adjustment of propeller or impellers, etc., can be completed as suggested in previous operating instructions, using applicable sections.

#### (f) External Source of Pressure Lubrication

Refer to Fig. 28 and to any assembly drawing which is included with these instructions to become thoroughly familiar with the construction before assembling the tube tension/packing head assembly.

Installation and assembly of tube connector, tubing tension nut, and tubing locknut is the same as described in Section 9B with additional instruction as follows:

After installation of tube connector and component parts, place lantern ring into bottom of packing chamber. It is positioned to allow inlet of fresh water or other lubricant to enter chamber for lubrication of lineshaft bearings. Assemble the given number of packing rings above the lantern ring and then insert the two piece gland. Refer to Section 9A for first operation & repacking procedures.

Prelubricate system before operating pump. Connect prelubrication line to one of the two ports in connector bearing. Remove plug from other port on opposite side of connector bearing. Prelubricate system using lubricant supply with port open to allow any air to escape from system while lubricating all bearing journals in inner column. Replace plug after lubricant emerges clear without air. Continue lubrication system while pump is in operation.

For most installations, 3 to 5 GPM at 40 to 50 PSIG is ample supply of fresh water for lubricating lineshaft bearings, as long as bowl assembly bypass ports are open. If ports are plugged, lubricating water must be admitted to tubing under heads greater than that generated in the bowl assembly. Higher pressures will of course necessitate more frequent maintenance of packing.

Do not exceed 200 PSIG injection pressures with design pictured here. Over this amount, a different arrangement will be furnished.

#### (g) Fresh Water Flush System

When pumping fluids containing abrasive particles, it is often advisable to inject clean liquid directly into journal areas to provide lubrication and to prevent entrance of abrasive particles into bearing zones. One method by which this can be accomplished is to flush bearings continuously during operation with clean or filtered water.

In the case of the bowl assembly, refer to Fig. 29 and 30. The bellmouth is provided with a pipe tap

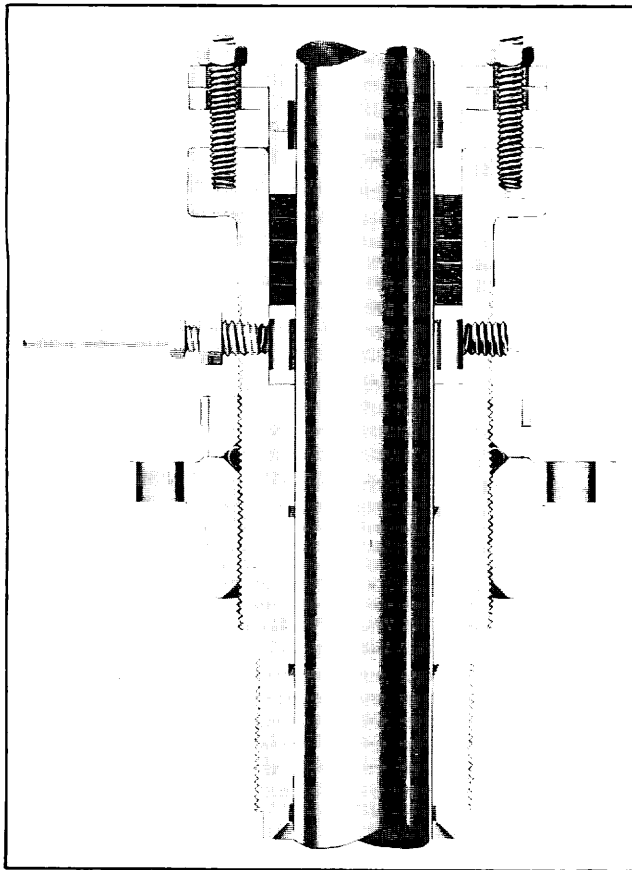


Figure 28

in bottom hub or with port leading through a vane from outside into bearing area and lubricating fluid may be injected here. Bowls themselves may be cast with a port leading through a vane from outside into bearing area so that lubricating fluid may be admitted. At discharge bowl, fluid is often injected into the bypass port. Bowl assemblies must be ordered from factory in this condition so that porting will be available. Piping is usually installed at jobsite, connecting each port either individually or from a common line to surface where user must furnish a source of proper fluid. However, short pumps are occasionally shipped with piping in place, ready for user's connections. In handling pumps with external piping, take care to avoid damage to piping or tubing. Pinching or perforating a line could render the lubrication system inoperative.

The lubricating liquid must be free from abrasives and other foreign particles, must have sufficient lubricating properties for the bearings involved and should not be allowed to increase above 85°F in temperature. It must be injected at a pressure in excess of that existing across the journal area in question, which usually means something greater than total discharge head on pump.

Open lineshaft bearings, if necessary, may be lubricated in much the same way as illustrated in Fig. 31. Again, piping is connected as shown and run from surface source of supply. It must be injected into bearing at a pressure in excess of that existing in column pipe at that point.

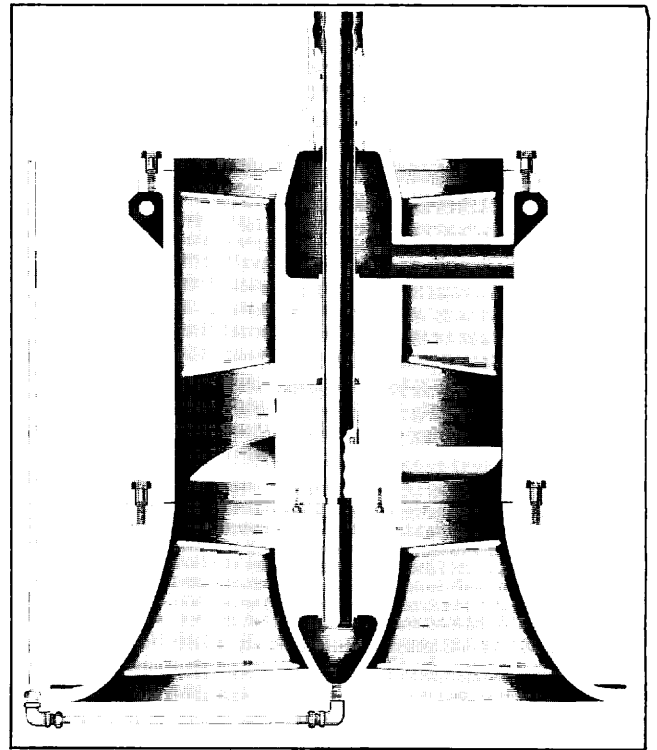


Figure 29

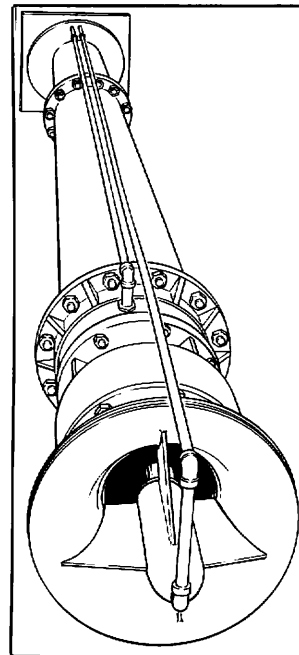


Figure 30

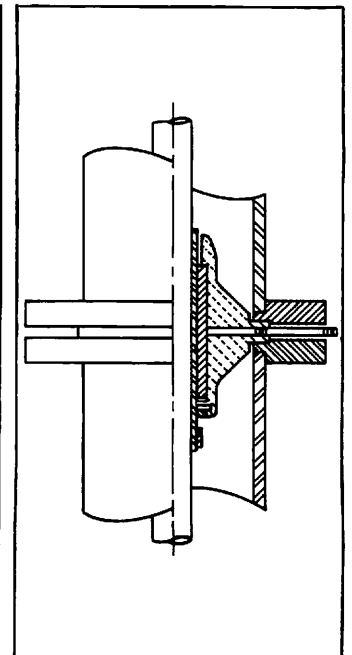


Figure 31

Flushing at packing box may be accomplished in a manner as illustrated in Fig. 32.

Occasionally, a water flush arrangement is used in connection with tube enclosed construction and may be accomplished as described in Section 9G.

Although subject option is referred to as a fresh water flush system, any suitable lubricant that is compatible with pumped liquid may be used so long



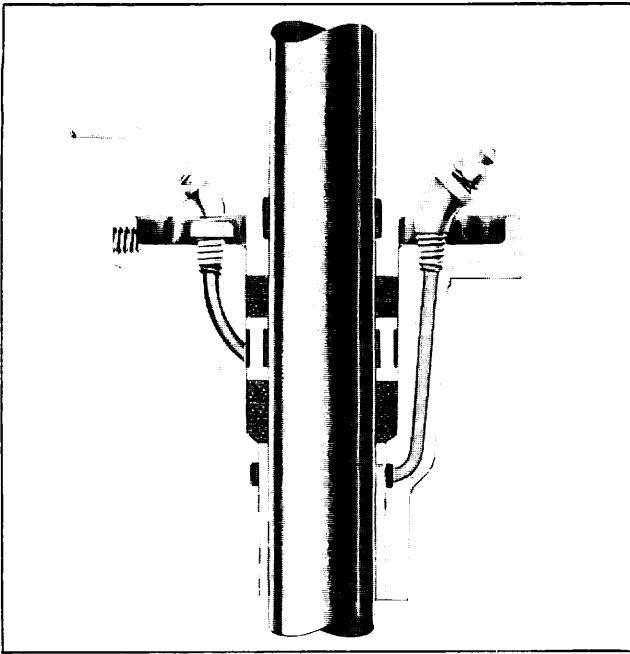


Figure 32

as conditions of flow and pressure permit. In general, capacity of a water flush system must be approximately 1 GPM for each journal to be served, up to 1 inch shaft; 2 GPM for each journal, up to 2 inch shaft; 5 GPM each journal up to 3 inch. For diameters in excess of 3 inches, consult factory.

Available capacity could be reduced slightly when oil is used as a lubricant. If grease is used, it is only necessary to keep lines full under adequate pressure. Grease lines on completely assembled pumps

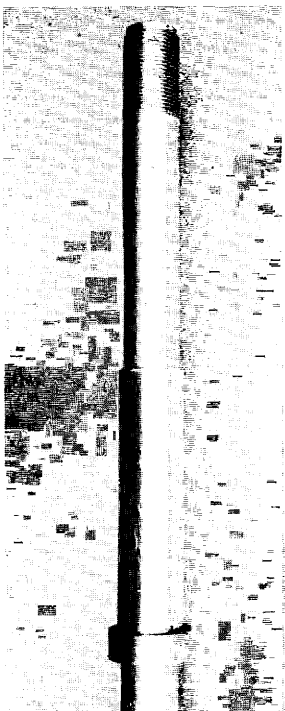


Figure 33

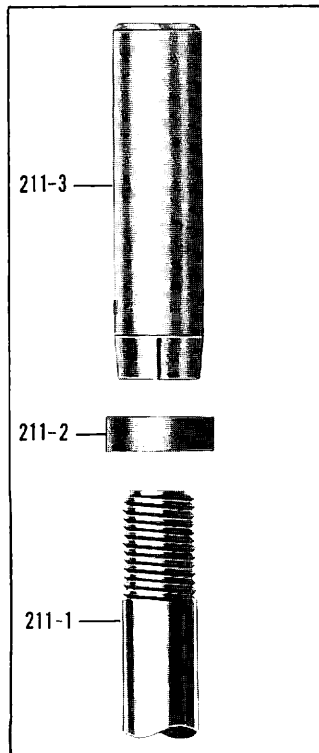


Figure 34

will be filled with grease at factory.

(h) OPEN LINESHAFT REPLACEABLE SLEEVE

Lineshafting may be furnished with a sleeve at journal points, using several different designs. Fig. 33 depicts a collet attached field replaceable sleeve arrangement often used in open lineshaft construction. Individual parts are identified in Fig. 34.

If it is necessary to remove sleeve in field for repair or relocation, this may be accomplished by driving collet down off sleeve taper as shown in Fig. 35. Collet is driven in either direction by a two piece collet driver as illustrated in Fig. 36. Thus, the tool may be used both for assembly and removal of journal sleeve.

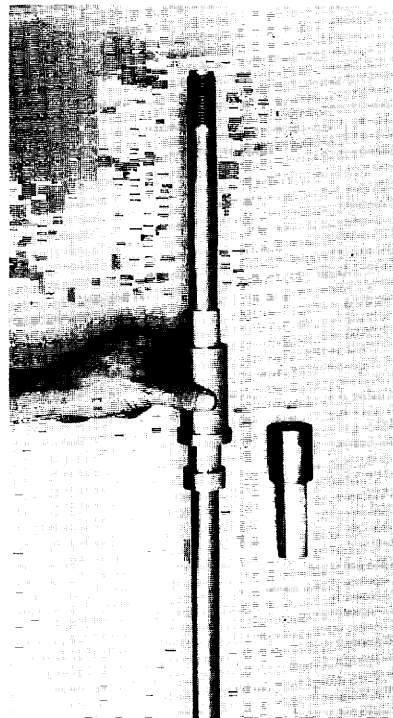


Figure 35

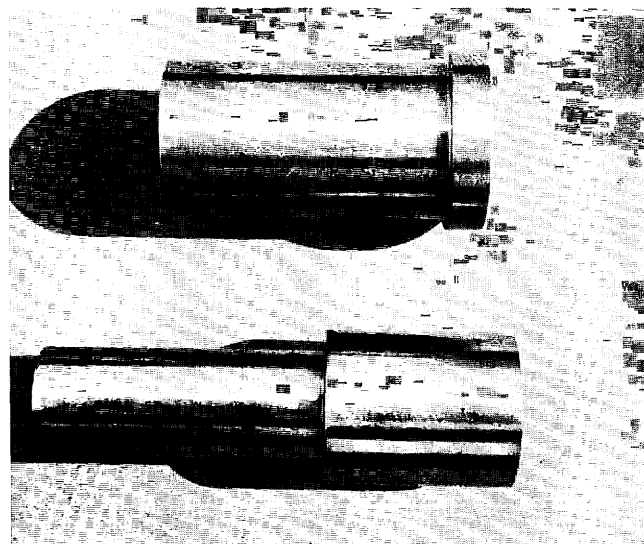


Figure 36

To replace sleeve at jobsite, coat shaft with an epoxy adhesive such as Loc-Tite or, failing that, a filler material based on shellac. Slip collet item 211-2 over shaft item 211-1 with open end of taper away from threads. It must be moved away from threads to a point beyond eventual sleeve location. Slide sleeve item 211-3 onto shaft with tapered end away from threads to a point at which it will run in bearing and so that collet will not interfere with

bearing after pump is adjusted. It is imperative that journal point be properly located and this may be done by reference to position of bearing. Having established sleeve in proper location, it is advisable to construct a stop for end of shaft and also end of sleeve so that the latter will not move with respect to shaft. Collet may then be driven on sleeve taper firmly with collet driver, working as indicated in Fig. 37.

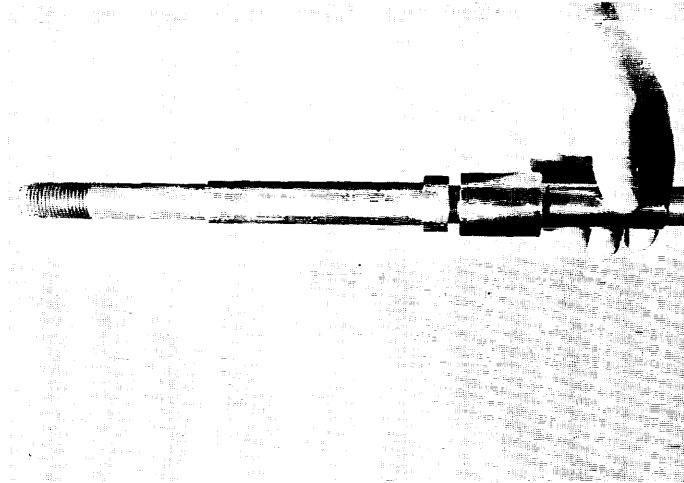


Figure 37

## SECTION 10

# BOWL ASSEMBLY SERVICING

Bowl assemblies are furnished as a component whether shipped separately or connected to the column elbow section. Should dismantle be required, the following tools will be needed:

- Set end or box wrenches for bolts, nuts and cap screws.
- Set allen set screw wrenches for thrust collar retainer.
- Strap or pipe wrenches for shaft and tube adapter.
- Hardwood block to move propeller on shaft.
- Hammer and screw driver.

In a dry sump, the propeller may be removed with the pump unit in place, if necessary. Remove the bellmouth, lowering it carefully to the sump floor. With allen set screw wrenches, remove the 4 set screws holding the thrust collar retainer and lower the retainer off the shaft. Move the propeller up slightly on the shaft to relieve the thrust rings and remove these rings. Care must be exercised to be sure to support the propeller, or it may drop and cause injury. The propeller may now be lowered off the propeller shaft.

To remove the discharge bowl, it will be necessary to disconnect the drive shaft above as well as the tube tension nut, if tube enclosed. Unbolt the discharge bowl flange making provisions to support the bowl and lower to a position where the tube and shaft may be disconnected. Support the drive shaft and tubing, then the discharge bowl and propeller shaft may be removed. If the bowl clearance is not sufficient, the whole unit may have to be lifted and blocked, or possibly it might be better under these circumstances to remove the complete unit.

For the two stage unit, the intermediate bowl would be removed and proceed with the upper propeller in the same manner as the lower one. A two or more stage mixed-flow should not be disassembled in the sump, since the upper impeller positions are adjustable as in Fig. 39.

With the unit removed and in a horizontal position, the bowl assembly should be blocked and proceed to remove the bellmouth. Disconnect from the column section, tube and shaft. The shaft may be removed with the propeller intact. On two stage units, it will be necessary to follow the procedure outlined for the removal of the lower propeller. With the intermediate bowl removed, then the shaft may be taken out of the assembly with the upper propeller in place, if so desired.

On multi-stage mixed flow, disconnect column section, tube and shaft and separate from the column section. Remove the discharge bowl, take out the allen set screw from the thrust collar retainer and unthread the retainer. Thrust collar may now be removed and the impeller can now be slid off the impeller shaft. Remove the impeller drive key and the

intermediate bowl may be unbolted and removed. Follow this procedure for all intermediate stages.

The lower impeller may be removed with the shaft, if desired. To remove the first or lower impeller, the thrust collar at the lower side of the impeller must be disassembled. Remove the four set screws from the thrust collar retainer which will allow the retainer to be removed. Shift the impeller slightly to relieve the thrust collar and take the split collar from the shaft groove. The impeller may now be removed from the shaft.

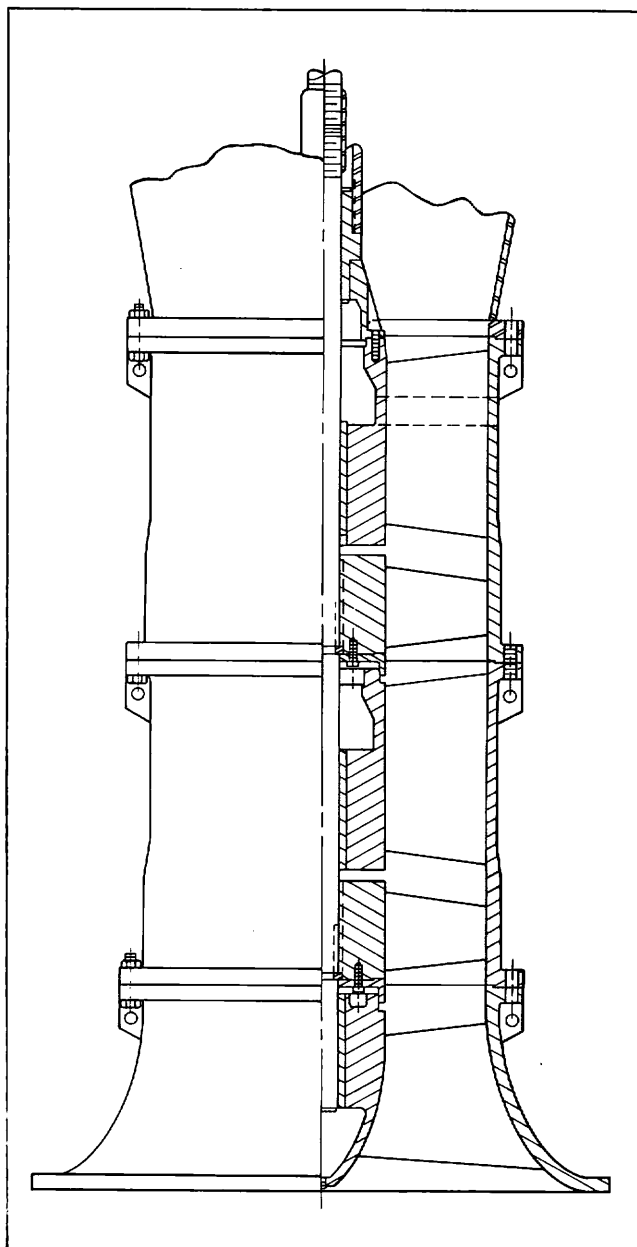


Figure 38

Reassembly would be the reverse of the dismantle procedure. In each case, the propellers must be set in position on the thrust collar prior to installing the retainer.

The shaft at bearing positions should be coated with a mixture of white lead and light oil just prior to positioning. All parts should be cleaned and free from dirt and grit, and the shaft should turn without drag as each bowl flange is positioned and tightened.

The two stage mixed flow assembly follows a somewhat different procedure. The lower impeller is installed on the shaft, and positioned in the bellmouth. This is illustrated in Fig. 39. Use a hold down bolt through the grease plug hole in the suction hub to secure the shaft and impeller on the bowl seat. Install the intermediate bowl and secure in place. Install

the impeller drive key and position the upper impeller (lower retainer secured to the impeller, no thrust collar at this position). With the upper impeller on its seat, install the thrust collar, upper end. Thread thrust collar retainer until it contacts thrust collar being sure not to lift the impeller from its seat. Turn the retainer, right or left, to the nearest set screw holes and install allen set screw. Continue with the same procedure on additional stages.

Release hold down bolt from the shaft end and check for free rotation of the shaft assembly. Assemble the discharge bowl and if threading of the shaft is full size, tape the threads to avoid cutting the optional seal surface (lower end of bearing pocket) as it passes over the threads. Secure in position and again check for shaft assembly freedom. Fill suction hub with a water proof grease and force shaft to its lowest position before installing grease pipe plug.

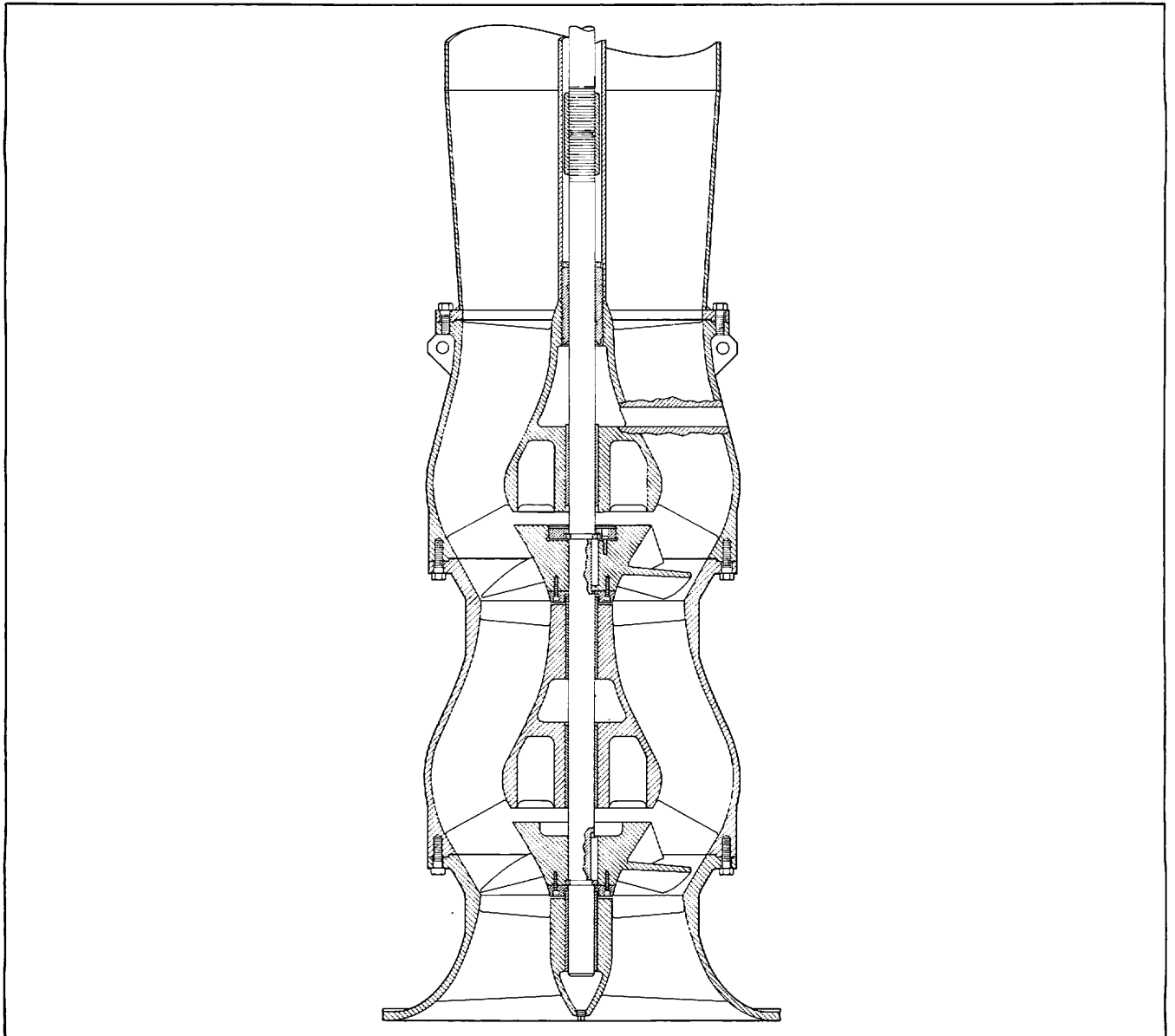


Figure 39

## SECTION 11

### DON'T

DON'T pull discharge piping to pump discharge flange with bolts or cap screws. Install pipe line so that fasteners are used to prevent leakage only.

DON'T hang weight of discharge line and fittings on discharge elbow alone. Support pipe line by blocking or concrete saddles according to best piping practice. Use dresser-type couplings wherever possible to eliminate piping strains imposed on pump.

DON'T start pump while it is rotating in reverse direction after having shut down. It is advisable to install a delay relay on electric drives to prevent this. Non-reverse protection in driver could also be a solution.

DON'T put heavier than recommended heaters in starter if pump load begins to trip those furnished originally. These are protective devices. Contact your Aurora Pump representative for assistance.

DON'T add oil to driver while running. DON'T add grease to grease lubricated driver without removing relief plug.

DON'T drop parts into pump during installation or disassembly. DON'T drop parts into motor when canopy has been removed and top is open. Parts must be removed before next operation.

DON'T tighten shaft packing where provided except in increments, I.E., tighten gland nuts part of a turn and let pump run 5 to 10 minutes before tightening further. If leakage water is too hot to put on hand, back gland nuts off a little until water cools, then

tighten again. Gland nuts must be adjusted evenly so as to prevent cocking gland, forcing it against shaft.

DON'T forget that this equipment contains rotating parts. Use CAUTION when working near such parts to avoid injury. DON'T neglect to replace all guards, covers, and shields before start-up.

DON'T run pump backward. Clockwise operation (looking down on pump) under power can unscrew threaded joints. Power requirements of impellers can increase when driven backward and can thus create undesirable overloads. These problems do not apply to pumps coasting backward due to return flow of water from system; overspeed is the circumstance to guard against then.

DON'T throttle the suction of the pump or operate with restricted suction since power will increase and delivery will be reduced.

DON'T change pump speed without checking effect on power, internal pressure and other conditions.

DON'T allow oil, grease, or thread lubricant to contact rubber bearing.

DON'T work on pump, wiring, or any system components without opening energizing circuits such as at main breaker or pump disconnect switch. This will prevent "surprise" starts that may occur due to automatic control systems. It will also prevent other possibility of personal injury.

## SECTION 12

# MAINTENANCE HINTS

For pump lubrication, use light turbine oil equivalent to Standard Oil O.C. Turbine Oil #9 or good grade of mineral oil with proper additives having viscosity equal to S.A.E. #10.

Remove old oil from driver once a year, flush with solvent and refill. Follow manufacturer's instructions carefully as to method and type of lubricant. Replace self-lubricated driver ball bearings in about 5 years. It is generally less expensive to replace these bearings before they fail.

Replace all shaft packing on open lineshaft pumps after maintenance has required addition of two rings. Always let packing box leak slightly at top to add life to packing.

Be aware of changing conditions in the system. Any change from original conditions or any variation in the system can create an undesirable reaction in pump as the energizer of the system. Refer to vertical turbine pump association environmental data brochure for some of the system variable conditions that might occur or for recommendations due to a system change, consult your Aurora Pump representative.

Don't attempt to remove or to repair your pump without consulting a company representative. If it becomes necessary to attempt any repair work on your equipment, be sure to review all instructions for operation and maintenance of the unit.

## SECTION 13

# OPERATION AT OR NEAR SHUT OFF HEADS

Normally the operating of Aurora Pump Propeller/Mixed-Flow pumps is not recommended at or near shut off or static flow heads. Operation should be limited to the highest head shown on pump curve or field curve that has been submitted. At no time should the driver be overloaded beyond normal service factor unless approval has been given and the duration for a short period only. The maximum head operating condition should include the following considerations.

A. Thrust bearing capacity must be adequate.

B. If prolonged operation at no flow or restricted delivery is contemplated, the problem of heat dissipation may become acute. Much of the power un-

der such conditions is converted to heat in the available fluid.

C. Propeller and mixed flow impellers have critical horsepower characteristics at low flows. Shut off power requirements will in most cases result in driver overload.

D. It must be kept in mind that open line shaft units depend upon pumped fluid for lubrication. Fluid temperatures, if raised excessively due to lack of flow, may impair lubrication efficiency.

Full operating range should be known and considered in the original pump and driver selection. In the event of a change in conditions, contact your Aurora Pump representative for recommendations.





## TERMS AND CONDITIONS OF SALE

NOT INTENDED FOR SALE OR USE FOR PERSONAL, FAMILY, OR HOUSEHOLD PURPOSES.

1-79 Printed in U.S.A.

All orders shall be made out to Aurora Pump at North Aurora, Illinois, and shall be subject to acceptance by us at North Aurora.

**1. CONSTRUCTION AND LEGAL EFFECT.** Our sale to you will be solely upon the terms and conditions set forth herein. They supersede and reject any conflicting terms and conditions of yours, any statement in yours to the contrary notwithstanding. Exceptions to any of our terms and conditions must be contained in a written or typed (not printed) statement received from you; we shall not be deemed to have waived any of our terms and conditions or to have assented to any modification or alteration of such terms and conditions unless such waiver or assent is in writing and signed by an authorized officer. No representation of any kind has been made by us except as set forth herein; this agreement conclusively supersedes all prior writings and negotiations with respect thereto and we will furnish only the quantities and items specifically listed on the face hereof; we assume no responsibility for furnishing other equipment or material shown in any plans and/or specifications for a project to which the goods ordered herein pertain. Any action for breach of contract must be commenced within one year after the cause of action has accrued. Our published or quoted prices, discounts, terms and conditions are subject to change without notice.

**2. PRICES.** Unless otherwise noted on the face hereof, prices are net F.O.B. our producing factory, and include standard catalogue literature only. Service time of a factory-trained service man is not included and may be charged extra. The amount of any applicable present or future tax or other government charge upon the production, sale, shipment or use of goods ordered or sold will be added to billing unless you provide us with an appropriate exemption certificate. We may adjust prices to our prices in effect at time of shipment. Purchased equipment such as motors, controls, gasoline engines, etc., will be invoiced at prices in effect at time of shipment in accordance with pricing policy of manufacturer.

**3. DEFECTIVE EQUIPMENT.** Providing Purchaser notifies us promptly, if within one year from date of shipment equipment or parts manufactured by us fail to function properly under normal, proper and rated use and service because of defects in material or workmanship demonstrated to our satisfaction to have existed at the time of delivery, the Company reserving the right to either inspect them in your hands or request their return to us will at our option repair or replace at our expense F.O.B. our producing factory, or give you proper credit for such equipment or parts determined by us to be defective, if returned transportation prepaid by Purchaser. The foregoing shall not apply to equipment that shall have been altered or repaired after shipment to you by anyone except our authorized employees, and the Company will not be liable in any event for alterations or repair except those made with its written consent. Purchaser shall be solely responsible for determining suitability for use and the Company shall in no event be liable in this respect. The equipment or parts manufactured by others but furnished by us will be repaired or replaced only to the extent of the original manufacturer's guarantee. Our obligations and liabilities hereunder shall not be enforceable until such equipment has been fully paid for. Purchaser agrees that if the products sold hereunder are resold by purchaser, he will include in the contract for resale, provisions which limit recoveries against us in accordance with this section. In case of our failure to fulfill any performance representation, it is agreed that we may at our option remove and reclaim the equipment covered by this agreement at our own expense and discharge all liability by repayment to the purchaser of all sums received on account of the purchase price. (THE FOREGOING OBLIGATIONS ARE IN LIEU OF ALL OTHER OBLIGATIONS AND LIABILITIES INCLUDING NEGLIGENCE AND ALL WARRANTIES, OF MERCHANTABILITY OR OTHERWISE, EXPRESS OR IMPLIED BY FACT OR BY LAW, AND STATE OUR ENTIRE AND EXCLUSIVE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR ANY CLAIM OF DAMAGES IN CONNECTION WITH THE SALE OR FURNISHING OF GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION OR OPERATION.) WE WILL IN NO EVENT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES OR DELAY RESULTING FROM ANY DEFECT WHATSOEVER, AND OUR LIABILITY UNDER NO CIRCUMSTANCES WILL EXCEED THE CONTRACT PRICE FOR THE GOODS FOR WHICH LIABILITY IS CLAIMED.

**4. DELIVERY.** Delivery, shipment and installation dates are estimated dates only, and unless otherwise specified, are figured from date of receipt of complete technical data and approved drawings as such may be necessary. In estimating such dates, no allowance has been made, nor shall we be liable directly or indirectly for, delays of carriers or delays from labor difficulties, shortages, strikes or stoppages of any sort, fires, accidents, failure or delay in obtaining materials or manufacturing facilities, acts of government affecting us directly or indirectly, bad weather, or any causes beyond our control or causes designated Acts of God or force majeure by any court of law, and the estimated delivery date shall be extended accordingly. We will not be liable for any damages or penalties whatsoever, whether direct, indirect, special or consequential, resulting from our failure to perform or delay in performing unless otherwise agreed in writing by an authorized officer.

**5. OPERATING CONDITIONS AND ACCEPTANCE.** Recommendations and quotations are made upon the basis of operating conditions specified by the Purchaser. If actual conditions are different than those specified and performance of the equipment is adversely affected thereby, Purchaser will be responsible for the cost of all changes in the equipment required to accommodate such conditions, and we reserve the right to cancel this order and Purchaser shall reimburse us for all costs and expenses incurred in, and reasonable profit for, performance hereunder. We reserve the right to refuse any order based upon a quotation containing an error. The provisions in any specification or chart are descriptive only and are not warranties or representations; we will certify to a rated capacity in any particular product upon request. Capacity, head and efficiency certifications are based on shop tests and when handling clear, fresh water at a temperature of not over 85°F. Certifications are at this specified rating only and do not cover sustained performance over any period of time nor under conditions varying from these.

**6. SHIPPING.** Unless you specify otherwise in writing, (a) goods will be boxed or crated as we may deem proper for protection against normal handling, and extra charge will be made for preservation, waterproofing, export boxing and similar added protection of goods; (b) routing and manner of shipment will be at our discretion, and may be insured at your expense, value to be stated at order price. On all shipments F.O.B. our producing factory, delivery of goods to the initial carrier will constitute delivery to you and all goods will be shipped at your risk. A claim for loss or damage in transit must be entered with the carrier and prosecuted by you. Acceptance of material from a common carrier constitutes a waiver of any claims against us for delay or damage or loss.

**7. PATENT INFRINGEMENT.** We will not be liable for any claim of infringement unless due to infringement by goods manufactured by us in the form in which we supply such goods to you and without regard to their use by you. If you notify us promptly of any such claim of infringement and, if we so request, authorize us to defend or settle any suit or controversy involving such claim, we will indemnify you against the reasonable expenses of any such suit and will satisfy any judgment or settlement in which we acquiesce, but only to an amount not exceeding the price paid to us for the allegedly infringing goods. If an injunction is issued against the further use of allegedly infringing goods we shall have the option of procuring for you the right to use the goods, or replacing them with non-infringing goods, or modifying them so that they become non-infringing, or of removing them and refunding the purchase price. The foregoing expresses our entire and exclusive warranty and liability as to patents, and we will not be liable for any damages whatsoever, suffered by reason of any infringement claimed, except as provided herein. You will hold us harmless and indemnified against any and all claims, demands, liabilities, damages, costs and expenses resulting from or connected with any claim of patent infringement arising out of the manufacture by us of goods in accordance with a design or specifications which you furnish us.

**8. CANCELLATION AND RETURNED EQUIPMENT.** Orders may be cancelled only with our written consent and upon payment of reasonable and proper cancellation charges. Goods may be returned only when specifically authorized and you will be charged for placing returned goods in saleable condition, any sales expenses then incurred by us, plus a restocking charge and any outgoing and incoming transportation costs which we pay.

**9. CREDIT AND PAYMENT.** Payment for products shall be 30 days net. Pro-rata payments shall become due with partial shipments. A late charge of 1½ percent per month or the maximum permitted by law, whichever is less, will be imposed on all pastdue invoices. We reserve the right at any time to alter, suspend, credit, or to change credit terms provided herein, when in its sole opinion your financial condition so warrants. In such a case, in addition to any other remedies herein or by law provided, cash payment or satisfactory security from you may be required by us before shipment; or, the due date of payment by you under this contract may be accelerated by us. Failure to pay invoices at maturity date at our election makes all subsequent invoices immediately due and payable irrespective of terms, and we may withhold all subsequent deliveries until the full account is settled, and we may terminate this agreement. Acceptance by us of less than full payment shall not be a waiver of any of our rights. You represent by sending each purchase order to us that you are not insolvent as that term is defined in applicable state or federal statutes. In the event you become insolvent before delivery of any products purchased hereunder, you will notify us in writing. A failure to notify us of insolvency at the time of delivery shall be construed as a reaffirmation of your solvency at that time. Irrespective of whether the products purchased hereunder are delivered directly to you, or to a customer of yours, and irrespective of the size of the shipment, we shall have the right to stop delivery of the goods by a bailee if you become insolvent, repudiate, or fail to make a payment due before delivery, or if for any other reason we have a right to withhold or reclaim goods under the applicable state and federal statutes. Where you are responsible for any delay in shipment the date of completion of goods may be treated by us as the date of shipment for purposes of payment. Completed goods shall be held at your cost and risk and we shall have the right to bill you for reasonable storage and insurance expenses.

**10. SPECIAL JIGS, FIXTURES AND PATTERNS.** Any jigs, fixtures, patterns and like items which may be included in an order will remain our property without credit to you. We will assume the maintenance and replacement expenses of such items, but shall have the right to discard and scrap them after they have been inactive for one year without credit to you.

**11. INSPECTION.** Inspection of goods in our plant by you or your representative will be permitted insofar as this does not unduly interfere with our production workflow, provided that complete details of the inspection you desire are submitted to us in writing in advance.

**12. RECORDS, AUDITS AND PROPRIETARY DATA.** Unless otherwise specifically agreed in writing signed by an authorized officer, neither you nor any representative of yours, nor any other person, shall have any right to examine or audit our cost accounts, books or records of any kind or on any matter, or be entitled to, or have control over, any engineering or production prints, drawings or technical data which we, in our sole discretion, may consider in whole or in part proprietary to ourselves.