



Pump and Lighting Company

ENGINEERED PRODUCTS DIVISION

926 2ND STREET N.E. · P.O. BOX 2504 · HICKORY, N.C. 28601
704/324-9705

OPERATION AND MAINTENANCE MANUAL

PROJECT: Utilities Improvements
Project Number N62470-81-B-1478
LOCATION: Marine Corps Base, Courthouse Bay Area
Camp Lejeune, North Carolina
CONTRACTOR: Wilson Construction Company
Carolina Well and Pump
ENGINEER: L.E. Wooten & Company
SUBJECT: Section 11210 Paragraph 1.2.1.1
Vertical Turbine Pump

DESCRIPTION:

Conditions: 300 GPM @ 131' TDH
Setting: 65' - 7 3/4" To Intake
RPM: 1770

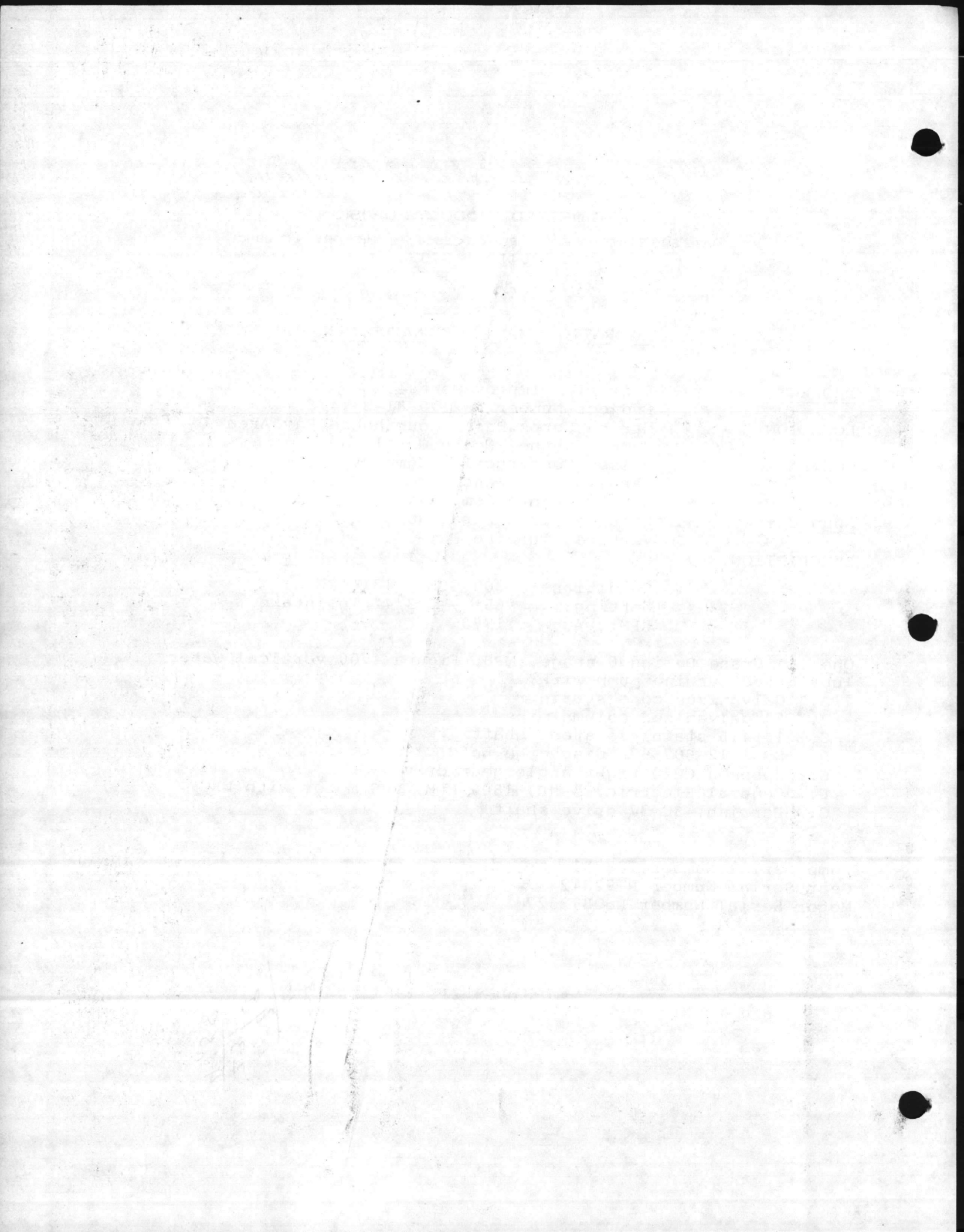
One (1) Crane Deming 6 stage, M-8, Figure 4700 vertical water lubricated turbine pump with:

- A. Galvanized cone strainer
- B. 6" galvanized column pipe
- C. 1" 416 stainless steel shaft
- D. SD66-12-0076678 discharge head
- E. Johnson CH20 right angle gear drive
- F. General Electric 15 HP, 1800 RPM, VHS motor with NRC
- G. Parrish, SC 37 drive shaft

Pump Serial Number T82731
Gear Serial Number R-92842
Motor Serial Number L82873327

October 21, 1985

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18
1848
231
4158

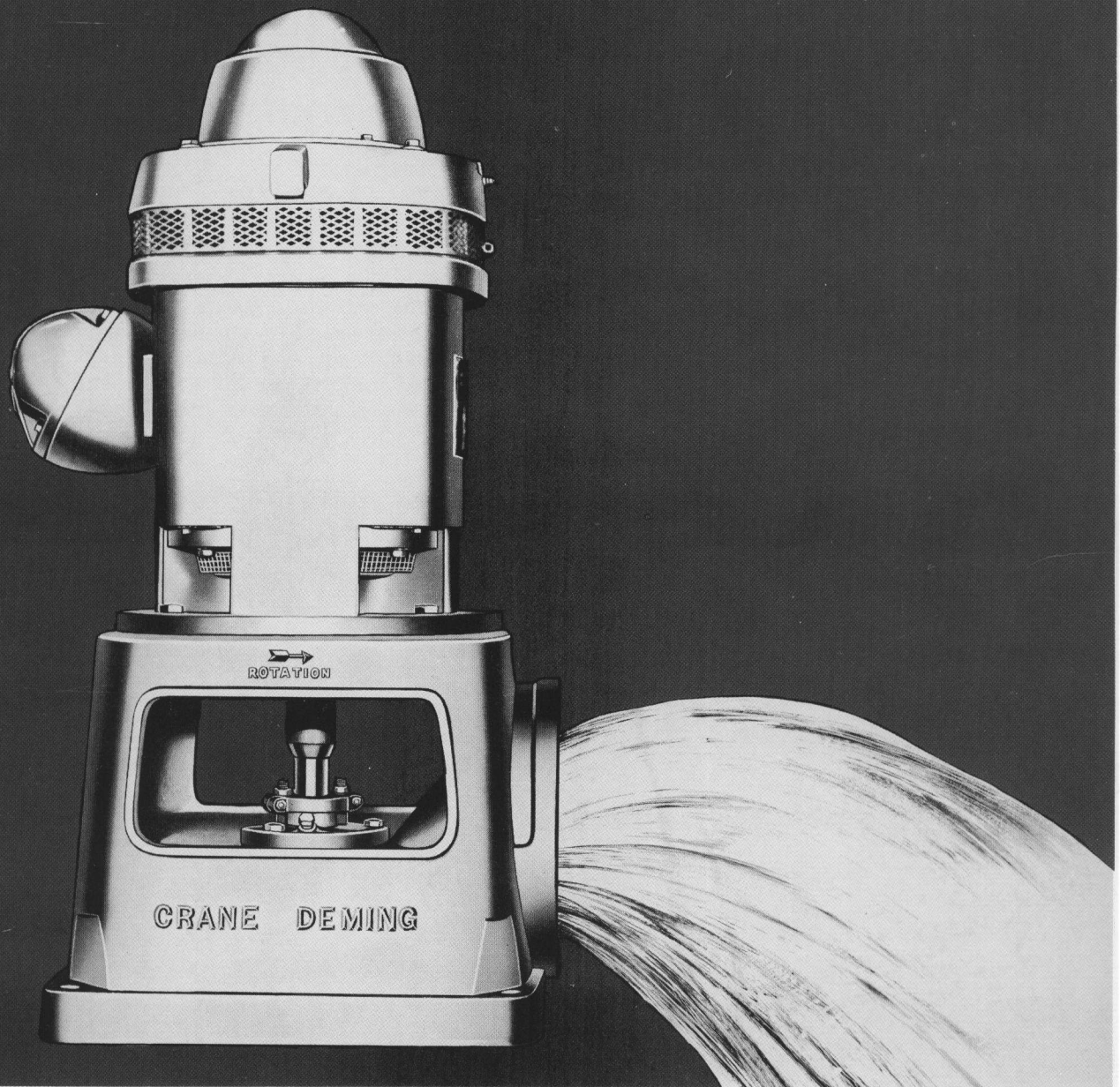


CRANE DEMING

BULLETIN NO. 4700C

Water and Oil Lubricated

VERTICAL TURBINE PUMPS



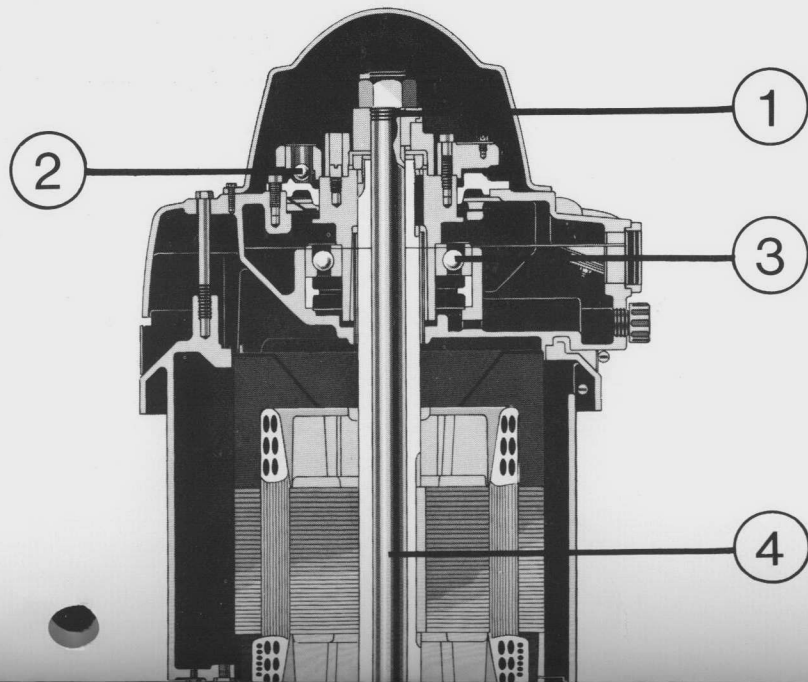
PRECISION ENGINEERED TO FILL EVERY MUNICIPAL, INDUSTRIAL & AGRICULTURAL REQUIREMENT

CRANE DEMING

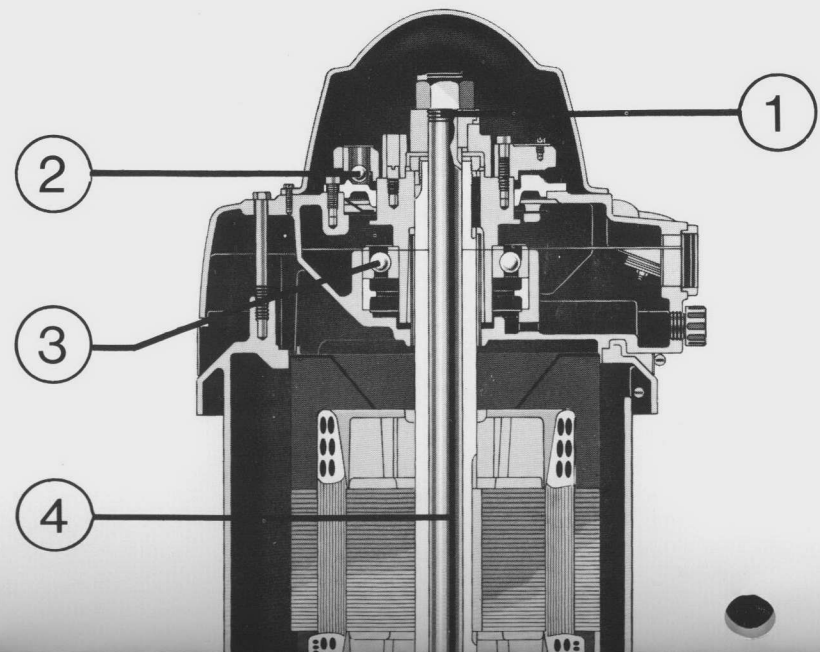
VERTICAL TURBINE PUMPS

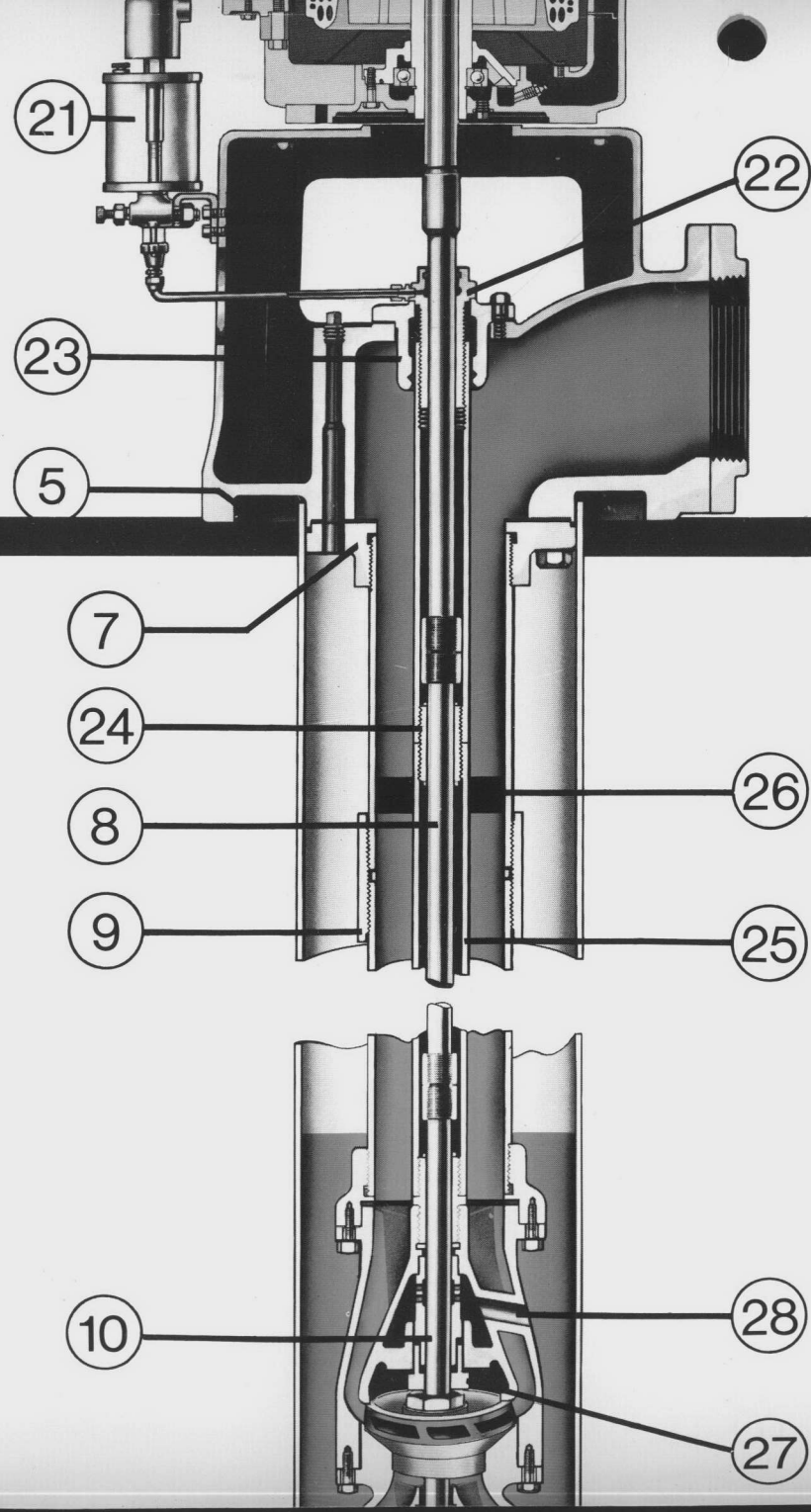
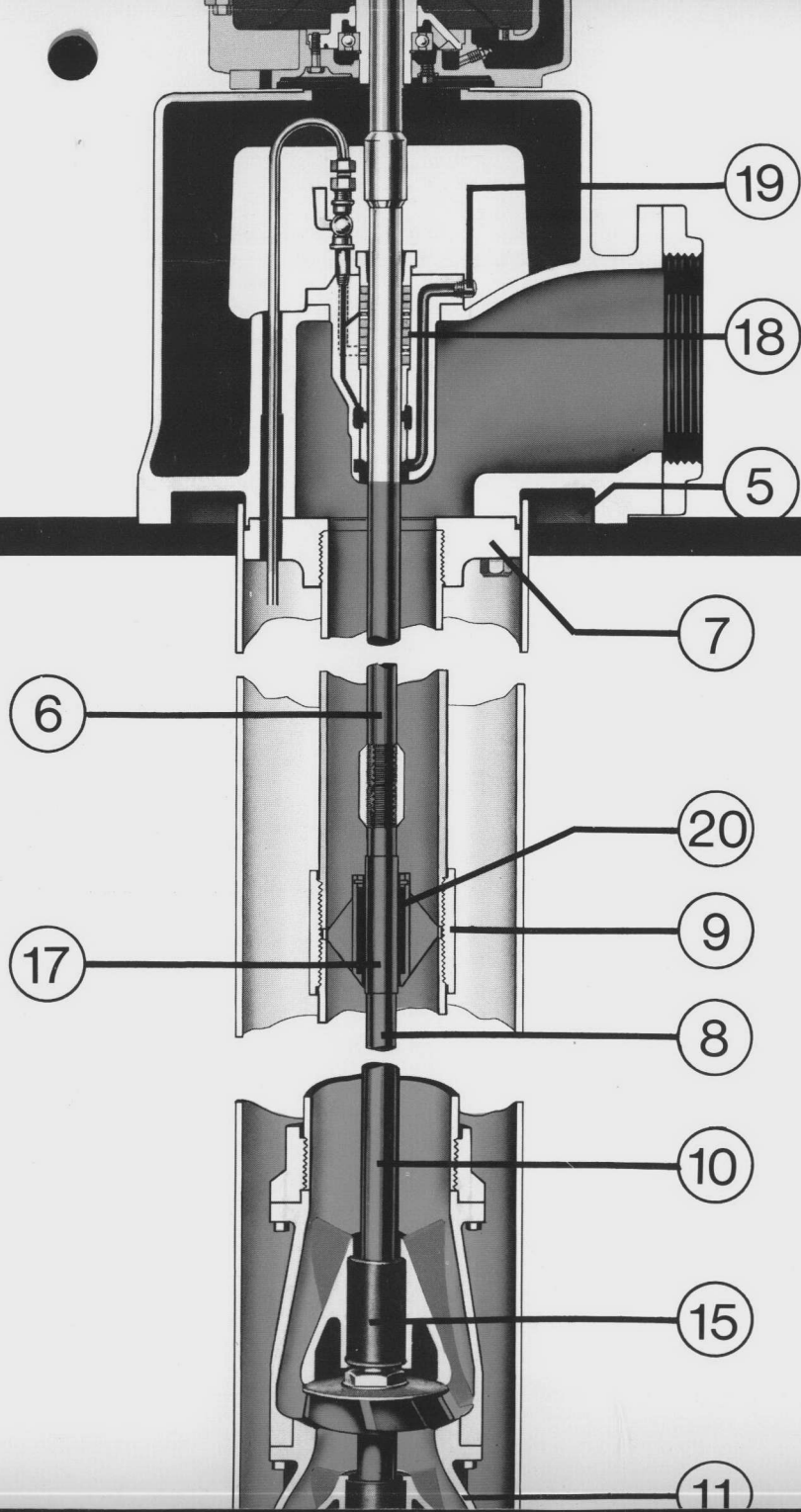
precision engineered to fill every municipal, industrial & agricultural requirement

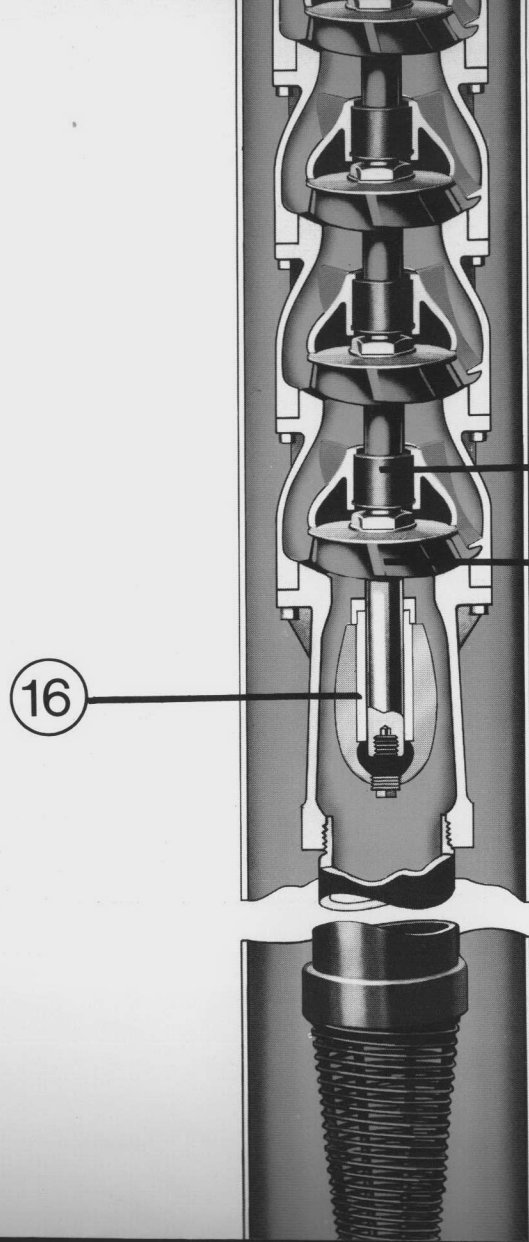
WATER LUBRICATED



OIL LUBRICATED



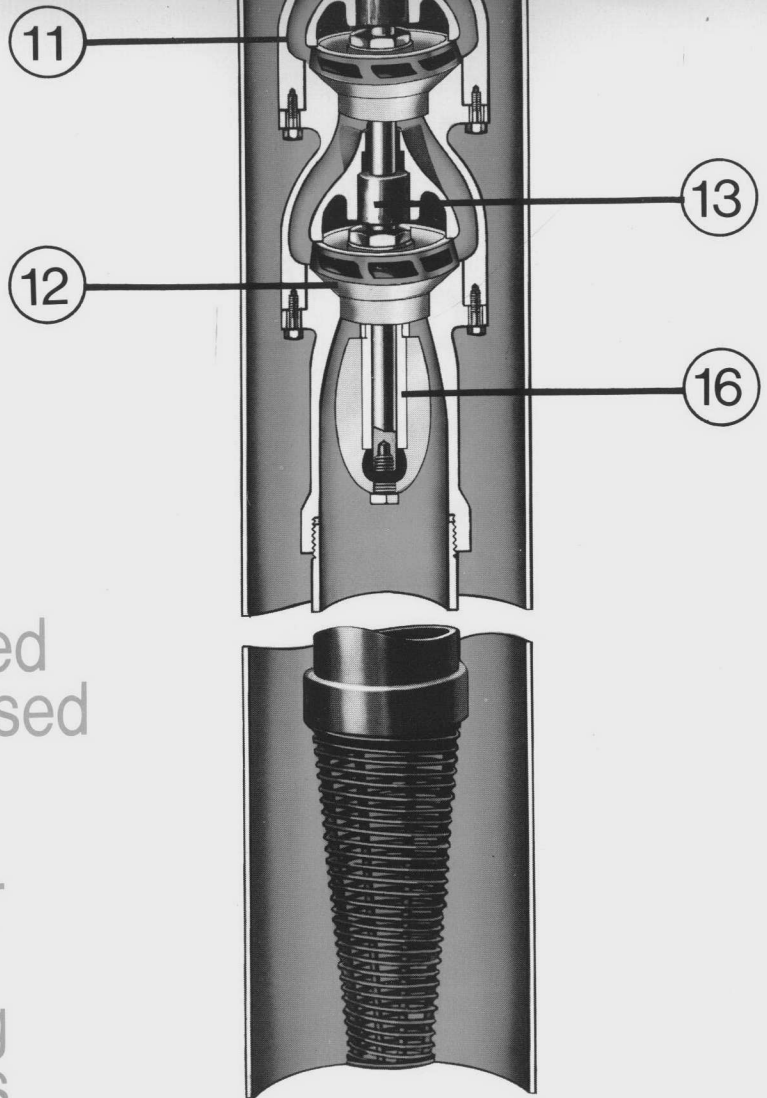




15

14

NOTE: Enclosed or Semi-Enclosed Impellers are available on either Water or Oil Lubricated Crane-Deming Turbine Pumps





Crane Deming quality design features provide longer life...lower operating costs

OIL AND WATER LUBRICATED

1. IMPELLERS EASILY ADJUSTABLE — with adjusting nut located at top of motor.

2. RATCHET PREVENTS BACKSPIN — and avoids damage to pump in case of phase reversal.

3. HEAVY-DUTY THRUST BEARING — cooled by air entering motor.

4. SEPARATE HEADSHAFT — with coupling in pump head facilitates installation. Permits changing drives without raising pump.

5. BASE OF HEAD RECESSED — permits casing or sleeve to extend above foundation as required by many Public Health Departments.

7. FLANGED HEAD CONSTRUCTION — facilitates assembly of column and discharge head. Maintains accurate alignment between motor and column shaft assembly. (Some discharge heads feature threaded column connections. Refer to Factory.)

8. HIGH STRENGTH LINE SHAFT — of heat treated steel, ground and polished — one-third stronger than ordinary shaft.

9. COLUMN COUPLINGS — machined with 8 pitch threads for tight fitting butt joints. (Flanged column available.)

10. STAINLESS STEEL IMPELLER SHAFT — specially heat treated, ground and polished for longer life.

***11. STREAMLINED BOWL PASSAGEWAYS** — enameled to reduce friction and give greater pump efficiency.

12. ENCLOSED BRONZE IMPELLERS — have completely finished surfaces for maximum efficiency.

13. BRONZE BOWL BEARINGS — on all enclosed impeller pumps.

14. SEMI-ENCLOSED BRONZE IMPELLERS — have completely finished surfaces for greater efficiency.

15. RUBBER BOWL BEARINGS — on all semi-enclosed impeller pumps.

†16. ENCLOSED BRONZE BEARING — in suction bowl, protected with sand cap and packed with non-soluble grease.

WATER LUBRICATED ONLY

6. STAINLESS STEEL STUFFING BOX SHAFT — may be inverted to renew wearing surface.

17. STAINLESS STEEL SHAFT SLEEVES — welded to shaft. Specially heat treated, ground and polished for maximum resistance to wear and corrosion. Replaceable in the field.

18. ACCESSIBLE EXTRA-DEEP STUFFING BOX — with controlled lubrication for long packing life.

19. PRE-LUBRICATION CONNECTION — through stuffing box distributes water around shaft for proper lubrication before start up.

20. WATER LUBRICATED SHAFT BEARINGS — fluted, resilient rubber shaft bearings are lubricated by water flowing through the pump. Bearings are held in place by a machined bronze bearing retainer secured between two pipe ends.

OIL LUBRICATED ONLY

21. AUTOMATIC LINE SHAFT LUBRICATOR — on motor driven units — opens when pump starts, closes when it stops.

22. BRONZE TUBING TENSION NUT — is easily accessible for placing tube under proper tension — also provides close fitting bearing in pump head.

23. TUBING HEAD ADAPTER WITH "O" RING — assures water tight seal around shaft enclosing tube.

24. BRONZE LINESHAFT BEARINGS — provide accurate alignment for lineshaft and a coupling for enclosure tube. A spiraling internal oil groove permits uniform bearing lubrication and by-pass of oil to bearings below.

25. HEAVY-DUTY TUBULAR STEEL SHAFT ENCLOSURE TUBE — protects lineshaft. Specially machined for accurate bearing alignment.

26. ENCLOSURE TUBE STABILIZERS — reinforced rubber "spiders" are regularly spaced to maintain enclosure tube alignment.

27. BEARING PROTECTING SLINGER — prolongs bearing life by preventing entrance of sand into top bowl bearing.

28. RELIEF PORTS IN TOP BOWL — prevent water from rising in tube above water level in well.

*Some bowl sizes feature threaded construction. Refer to Factory.

†Semi-enclosed impellers 4" to 10" bowl sizes. Feature open rubber bearing construction.

Specifications subject to change without notice

CRANE DEMING VERTICAL TURBINE PUMPS

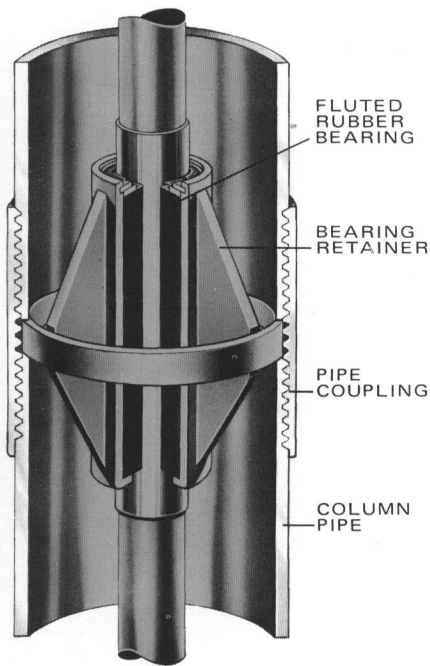
WATER OR OIL LUBRICATED

Crane Deming Vertical Turbine Pumps are available with either oil or water lubrication. The basic difference is in the construction of the lineshaft, its supporting mechanism and the bearings supplied with each. Either type may be furnished with semi-enclosed or enclosed impeller design.

WATER LUBRICATED CONSTRUCTION

Crane Deming water lubricated pumps are lubricated by the water that is being pumped, and require no supplemental lubricants or maintenance.

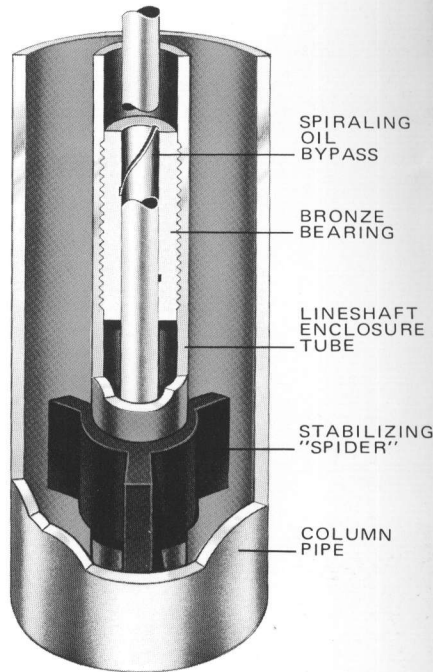
Water lubricated construction includes high strength steel lineshaft and rubber bearings throughout.



Bronze lineshaft bearing retainers are centered in each pipe coupling — tightly secured between the two pipe ends. Retainers are precision cast and machined to house the water lubricated, resilient rubber bearings and assure perfect vertical alignment of pump lineshaft. Rubber bearings are fluted to provide adequate lubrication and permit sand and other abrasive particles to flow through.

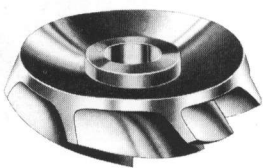
OIL LUBRICATED CONSTRUCTION

Oil lubricated construction has an enclosed lineshaft with bronze bearings used throughout. A heavy-duty steel enclosure tube contains the lubricating oil around the lineshaft and bearings, and shields both from foreign matter and corrosion.

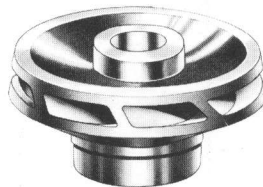


In standard construction, machined bronze bearings are spaced every five feet to assure true pumpshaft alignment and smooth, quiet operation. Bearings are threaded and also serve as a coupling for lineshaft enclosure tubing. A spiraling groove in the bearing inner wall provides uniform oil distribution over the lineshaft surface and permits oil passage through the bearing to each succeeding bearing below. Reinforced rubber "spiders" are spaced at regular intervals to center the enclosure tube in the column pipe.

IMPELLERS



Corrosion-resistant bronze semi-enclosed impellers are easily adjustable at the top of the driver to handle changes in well capacity or ground conditions. Impellers can be temporarily adjusted upward to avoid pump wear when clearing a sandy well. Top pump efficiency can easily be maintained.



Enclosed impellers are high quality corrosion-resistant bronze with completely finished surfaces. The hydraulic design developed from years of engineering experience assures maximum efficiency with minimum operating costs in Crane Deming Vertical Turbine Pumps.

CRANE DEMING

precision engineered

Vertical Turbine Pumps

offer Unequaled Economy, Performance and Dependability... Backed up by over 90 years experience in the development and manufacture of quality pumps.

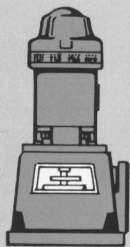
Crane Deming vertical turbine pumps are scientifically engineered and constructed of top quality materials to provide years of dependable service.

Close tolerance machining to increase operating efficiency — precision balancing of moving parts to eliminate vibration — special heat treating to reduce maintenance — using bronze to combat corrosion — stainless steel at critical wear points . . . Crane Deming has expended every effort to design

and build a pump that runs smoother, lasts longer and yet stays in line with competition. The pumps described in this bulletin are the result of this manufacturing philosophy — no short cuts — no sacrificing of quality.

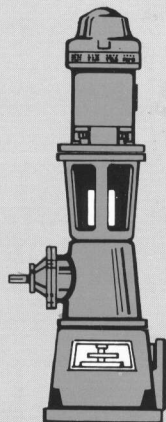
Over 90 years of research, engineering and manufacturing experience stand behind your selection of a Crane Deming Vertical Turbine Pump. It will prove a wise choice.

Top Performance With All Types of Drives



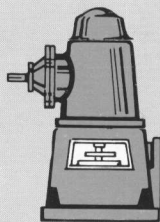
Unit Drive Head

For installations where electric power is available the Unit Drive with hollow shaft motor is compact, quiet and efficient.



Combination Motor — Right Angle Drive

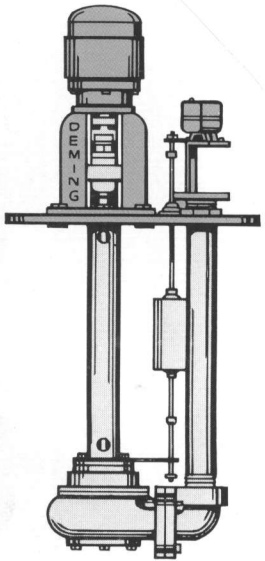
For municipal waterworks and installations where an auxiliary source of power must be available at a moment's notice.



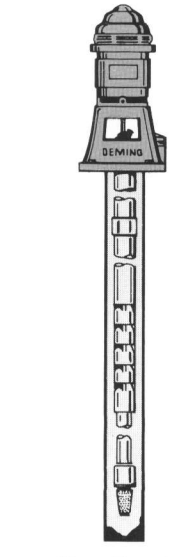
Right Angle Drives

For direct connection to gasoline or diesel power unit. Gear ratio permits unit to operate at the most economical speed.

For Maximum operating efficiency Specify **CRANE** DEMING For all your pumping requirements



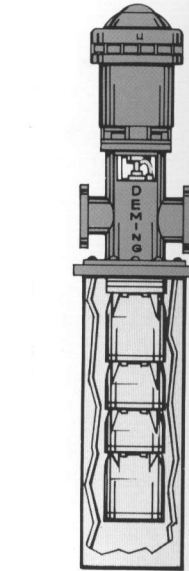
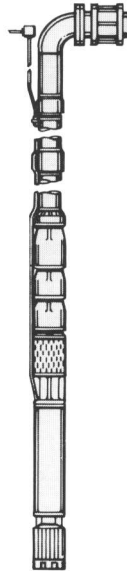
Sewage Pumps and
Cellar Drainers



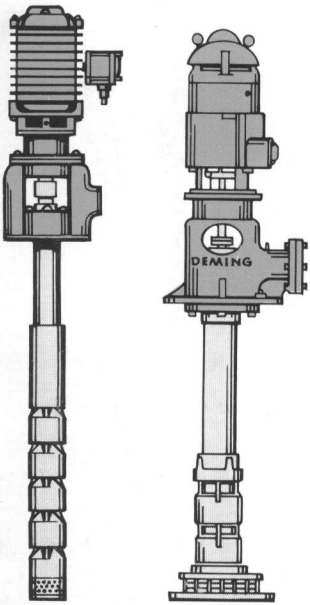
Close-Coupled
Vertical Turbine Pumps



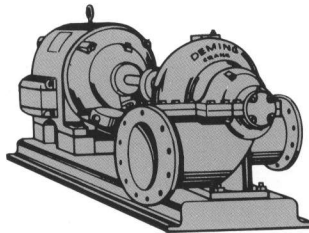
Submersible Pumps



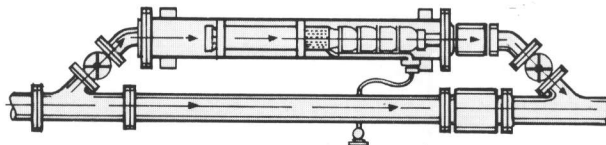
Tee Head Booster Pumps



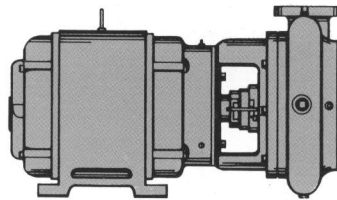
Gasoline, Fuel Oil and
Industrial Solvent Pumps



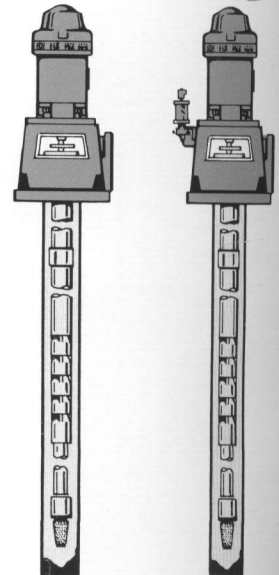
Split Case Centrifugal Pumps



Horizontal Submersible Pumps



Horizontal Motor Mount Pumps



Water Lubricated, Oil Lubricated
Vertical Turbine Pumps

CRANE DEMING PUMPS ARE SOLD AND SERVICED BY:

CRANE

®

VALVES • PUMPS • FITTINGS • WATER TREATMENT • PLUMBING

DEMING PUMPS

CRANE CO. DEMING DIV. • 884 SOUTH BROADWAY • SALEM, OHIO 44460

FOR APPROVAL

FABRICATION PENDING

DEMING PUMP CO.

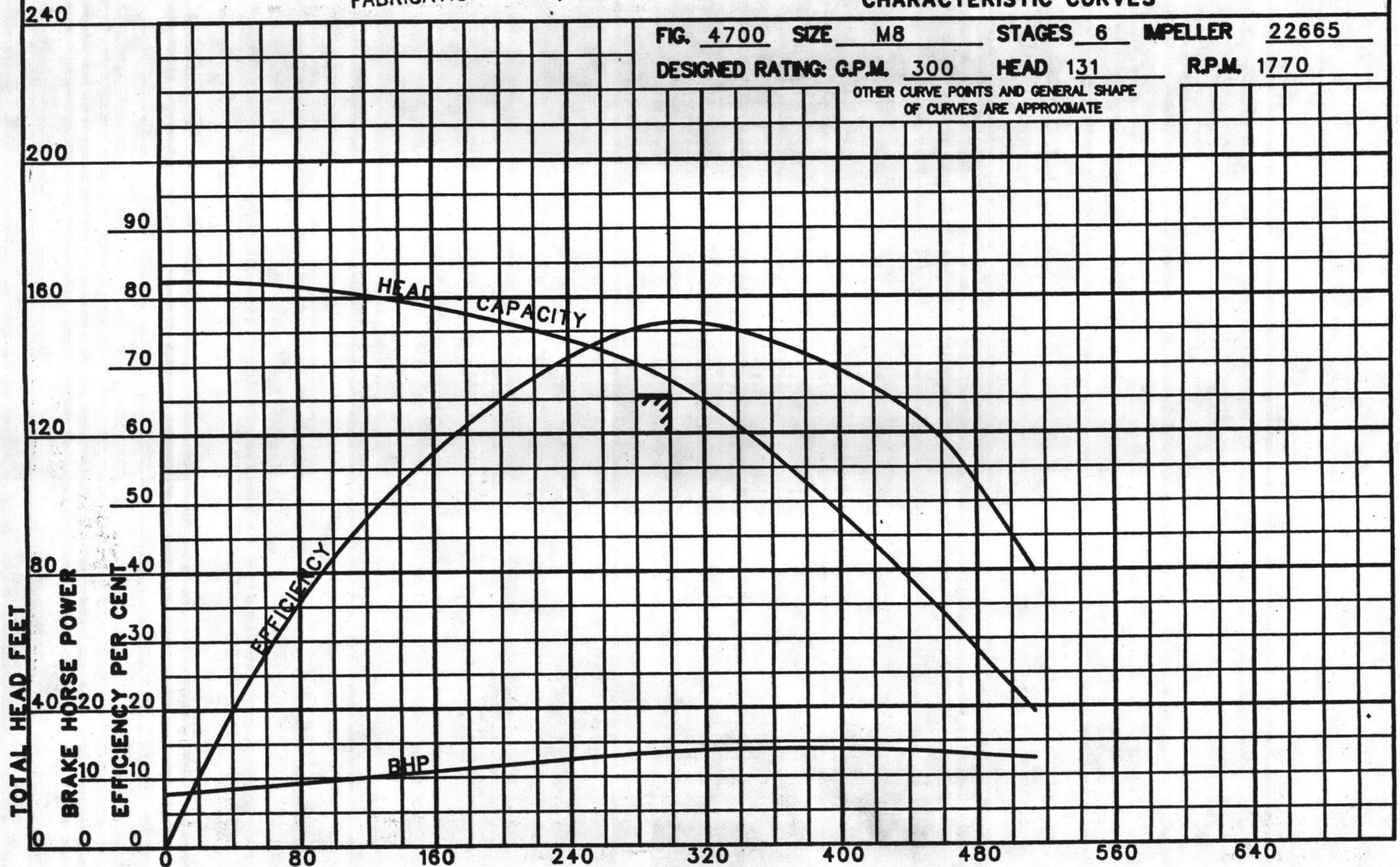
SALEM, OHIO, U.S.A.

CHARACTERISTIC CURVES

FIG. 4700 SIZE M8 STAGES 6 IMPELLER 22665

DESIGNED RATING: G.P.M. 300 HEAD 131 R.P.M. 1770

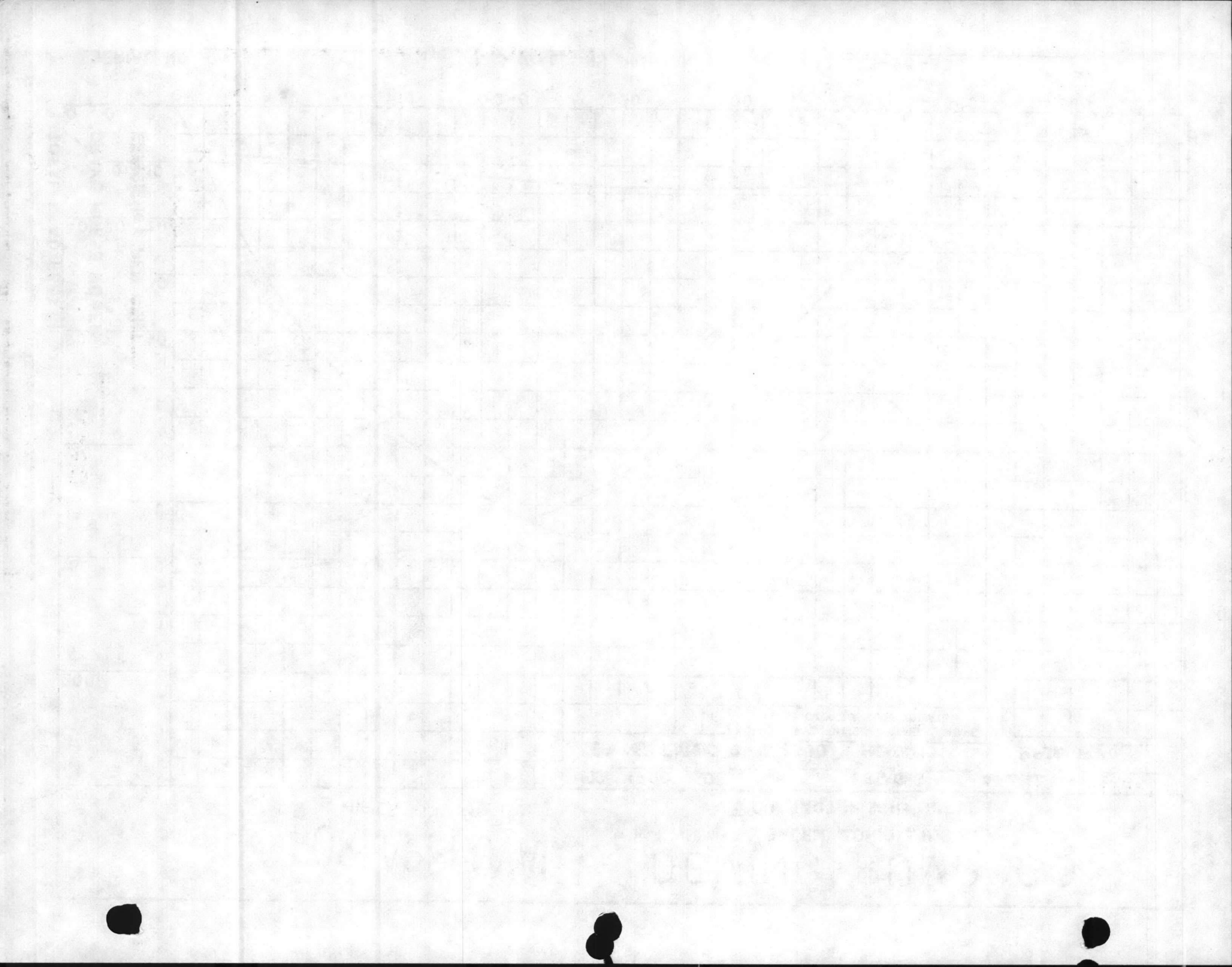
OTHER CURVE POINTS AND GENERAL SHAPE OF CURVES ARE APPROXIMATE



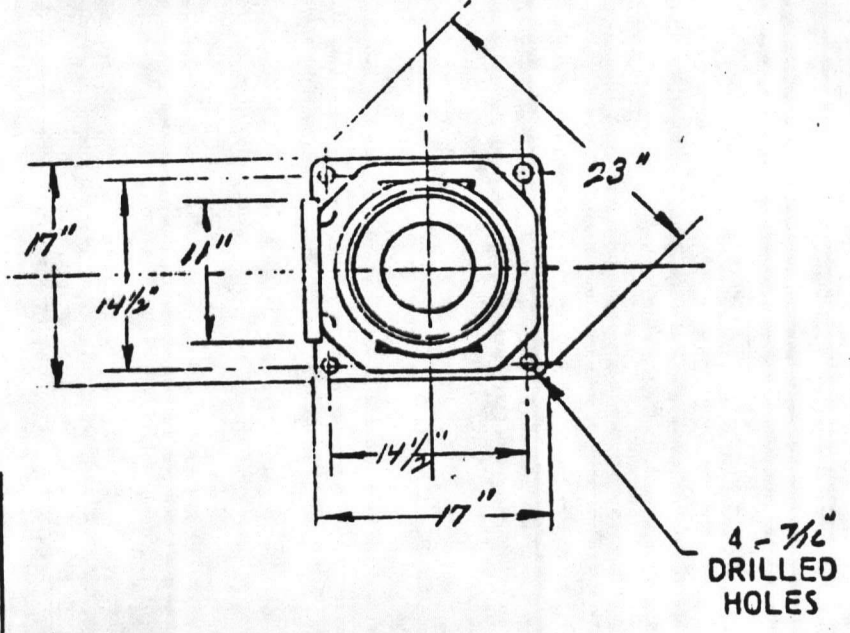
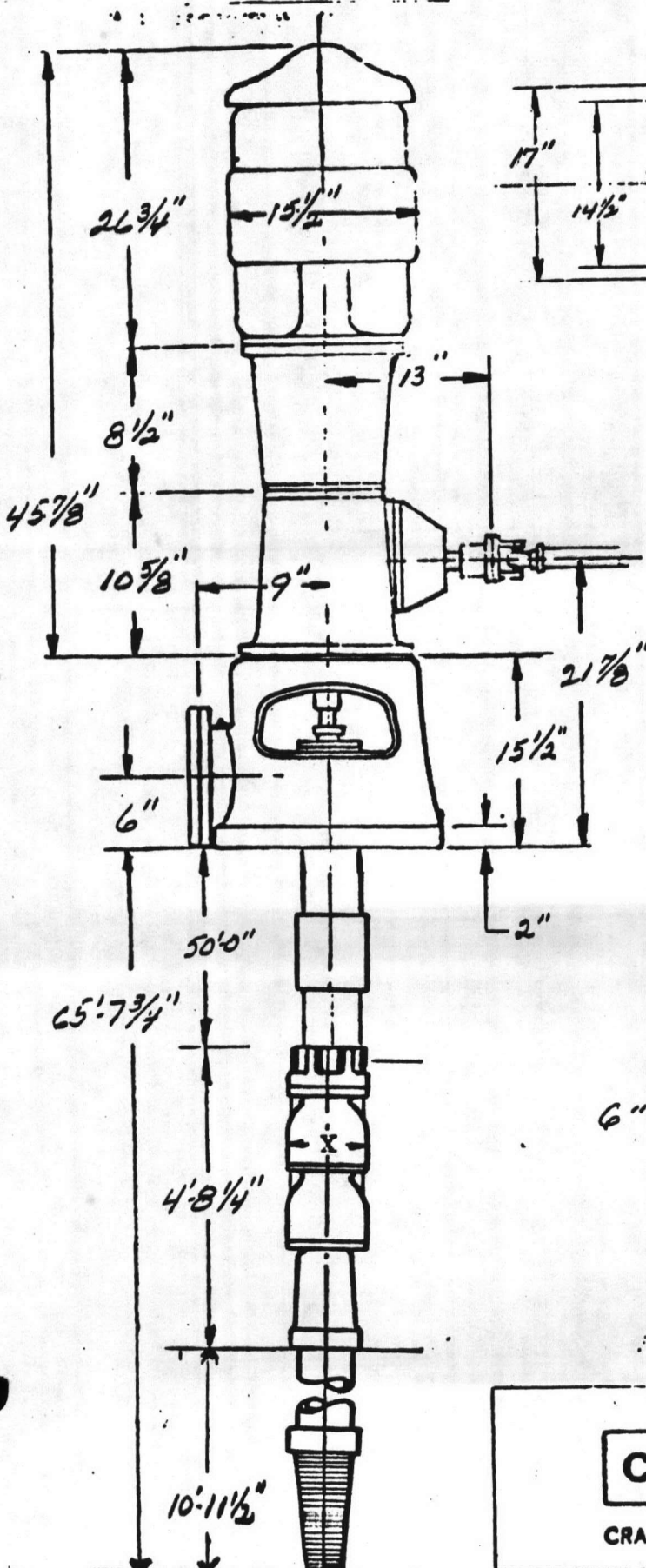
SERIAL NO. ***

U. S. GALLONS PER MINUTE

DATE 3-26-85



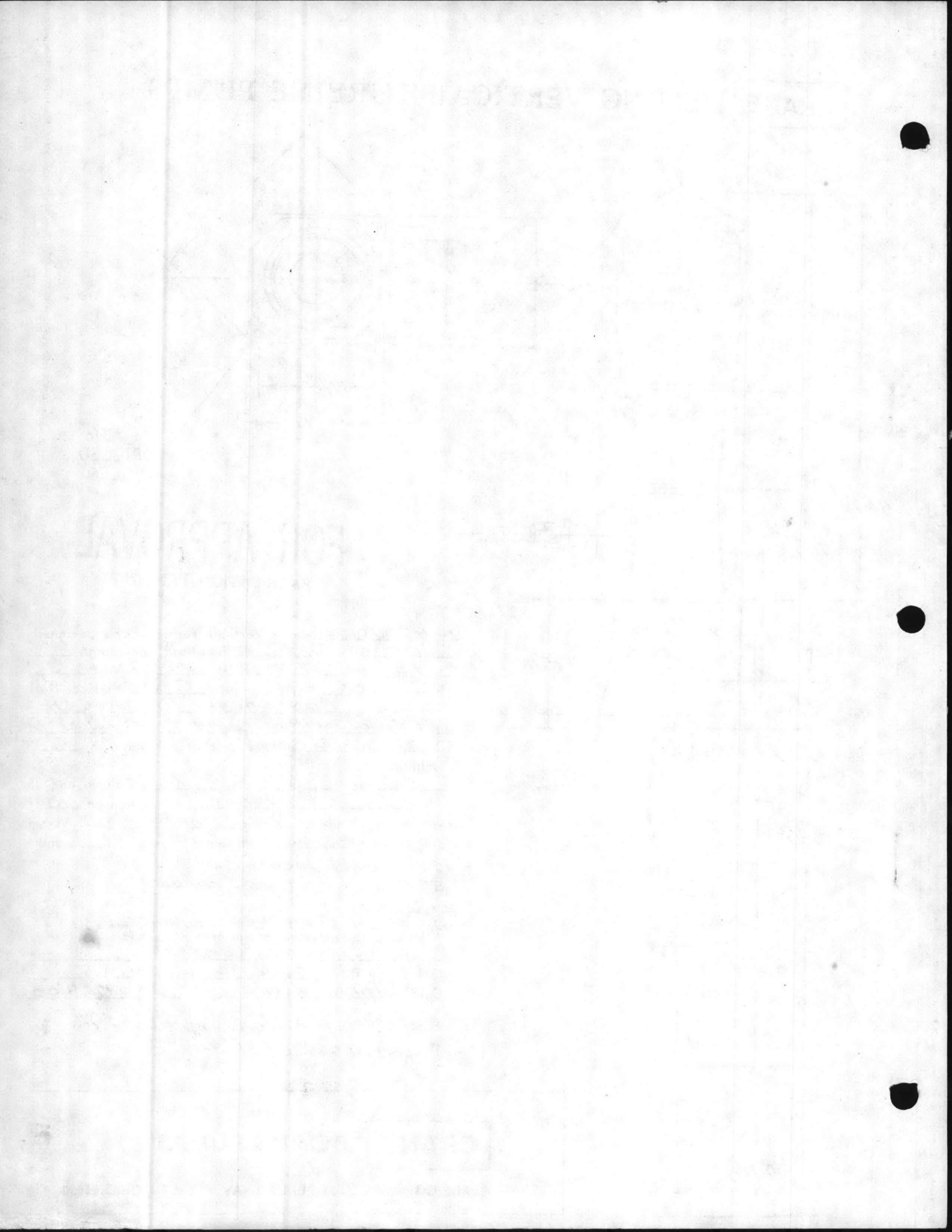
CRANE DEMING VERTICAL TURBINE PUMPS



FOR APPROVAL
FABRICATION PENDING ✓

L-4700 Crane-Deming Vertical Turbine Pump designed
300 GPM at 131 feet head, including:
15 HP 1770 RPM 230/460 Volt 3
 Phase 60 Hertz (1-1-1) G.E. Vertical Hall-
 shaft Motor CUSTOMERS w/ MODEL CH-2
1:1 RATIO JOHNSON COMB. RIGHT ANGLE Dr
 SD 50-66-12 Surface Discharge Head with 6 in
 discharge
50 feet 6 x 1 Column and sh
 with (5) RUBBER Bearings on 10 f
 centers 6 Stage 1 1/8 inch STANDARD Bowl Assem
 using Impeller # 22665 from Curve Page 81 and
10' 5" GALV. SUCTION PIPE
5" GALV. KEYSTONE STRAINER
6" GALV. PIPE
4 1/8" ST. STL. SHAFING W/IMMUEL COLG'S,
 When properly endorsed this print is correct for:
PUMP & LIGHTING COMPANY
 Customer's P.O. 39246-12 Turbine No. T-
 Date 4/14/84 By w. Hahn SP = 03268.00
 For: CAROLINA WELL & PUMP
 PROJECT IN 62470-81-B-1478

CRANE DEMING PUMPS
 CRANE CO • 884 SOUTH BROADWAY • SALEM, OHIO 44460



WILSON CONSTRUCTION COMPANY

GENERAL CONTRACTORS

P. O. BOX 7578

HUNTINGTON, W. VA. 25777

To: Thomas H. Tipton, CQC
Wilson Construction Company
P. O. Box 8446
Camp Lejeune, NC 28542-8446

Date: 10/25/85
 Your Order No. _____
 Our Order No. WC-111
 Job: Utility Improvements
 Location Camp Lejeune, NC

Gentlemen:

We Are Enclosing The Items Listed Below For Action As Indicated:

Copies	Dwg. No.	Title
5		Section 11210 Paragraph 1.2.1.1 - Verticle Turbine Pump Pump & Lighting Company

- Approval
 Final Approval
 Resubmittal In _____ Copies
 See Remarks

Remarks: _____

Yours Very Truly,
 Wilson Construction Co.

By John H. Persun, Jr.
 John H. Persun, Jr., Project Manager

WINDY CONSTRUCTION COMPANY

GENERAL CONTRACTOR

12345 Main Street

TO: Mr. J. B. Smith

1000 Broadway

Order No. 100

FOR YOUR INFORMATION

DATE: 10-15-50

AMOUNT: \$100.00

TERMS: Net 30

PAID TO: Mr. J. B. Smith

BY: J. B. Smith

FOR: Mr. J. B. Smith

12345 Main Street

1000 Broadway

1000 Broadway

12345 Main Street

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

1000 Broadway

CONTRACTOR'S SUBMITTAL TRANSMITTAL

LANTDIV NORFOLK 4-4355/3 (Rev. 11-80)

CONTRACT NO N62170-81-C-1478	TRANSMITTAL NO WC111-438	DATE 11-7-85
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FROM CONTRACTOR
TO Wils on Construction
Vann Marshburn

PROJECT TITLE AND LOCATION
**Utilities Improvements
Marine Corps Base
Courthouse Bay Area**

<p>CONTRACTOR USE ONLY</p> <p><i>*List only one specification division per form.</i></p> <p><i>List only one of the following categories on each transmittal form, and indicate which is being submitted</i></p> <p><input type="checkbox"/> Contractor Approved <input checked="" type="checkbox"/> OICC Approval <input type="checkbox"/> Deviation/Substitution For OICC Approval</p>	<p>REVIEWER USE ONLY</p> <p>**ACTION CODES</p> <p>A-Approved D-Disapproved AN-Approved as noted RA-Receipt acknowledged C-Comments R-Resubmit</p>
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ITEM NO.	PROJ. SPEC. SECT. & PARA. and/or PROJ. DWG. NO. *	ITEM IDENTIFICATION (Type, size, model no., Mfg. name, dwg. or brochure number)	NO. OF COPIES	ACTION CODES **	REVIEWER'S INITIALS CODE AND DATE
1	11210-1.2.1.1.	O&M Manuals - Vertical Turbine Pump Pump & Lighting Company WELL HOUSE	4		

CONTRACTOR'S COMMENTS

Ronald Bailey
CONTRACTOR REPRESENTATIVE (Signature)

COPY OF TRANSMITTAL AND SUBMITTALS TO ROICC

DATE RECEIVED BY REVIEWER FROM (Reviewer) TO

Ronal Bailey

- Submittals are returned with action indicated. Approval of an item does not include approval of any deviation from the contract requirements unless the contractor calls attention to and supports the deviation.
- Submittals are forwarded to LANTDIV with A-E recommendations indicated in REVIEWER USE ONLY Section and in comments below on ONE COPY of the transmittal form.

REVIEWER'S COMMENTS

COPIES TO DATE SIGNATURE

ROICC (2)
LANTDIV (1)
A-E (1)

1875

4700

INSTRUCTIONS

**INSTALLATION
and CARE
of
WATER
LUBRICATED
VERTICAL
TURBINE
PUMPS**

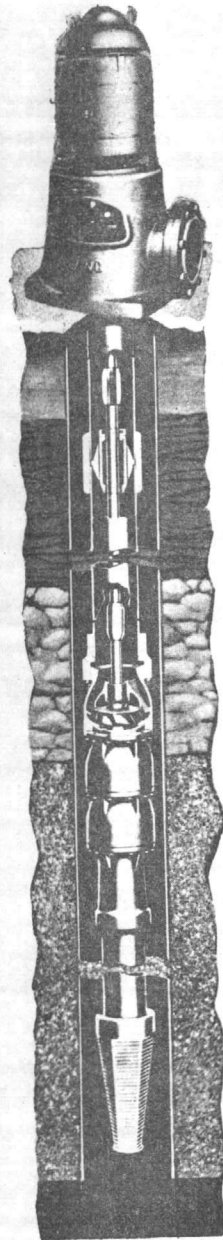


FIG. 4700

CRANE

®

VALVES

PUMPS

FITTINGS

WATER TREATMENT

PLUMBING

DEMING PUMPS

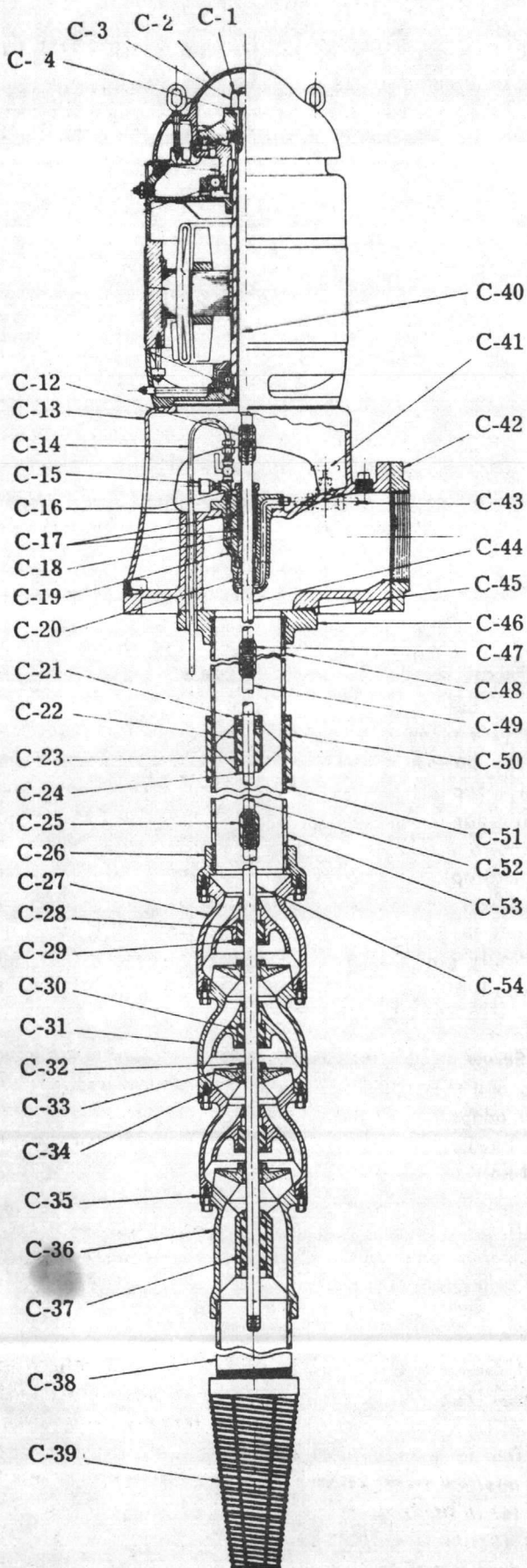
Form 914

CRANE CO. DEMING DIV. • 884 SOUTH BROADWAY • SALEM, OHIO 44460

Printed in U.S.A.

DEMING VERTICAL TURBINE PUMPS

Parts List No. 50 - Fig. 4700 Water Lubricated Pumps



- C- 1 Adjusting Nut Lock Screw
- C- 2 Canopy
- C- 3 Impeller Adjusting Nut
- C- 4 Gib Key
- C-12 Head Shaft Coupling
- C-13 Discharge Head
- C-14 Stuffing Box Relief Assembly
- C-15 Grease Cup
- C-16 Stuffing Box Gland
- C-17 Lantern Rings
- C-18 Stuffing Box Packing
- C-19 Stuffing Box
- C-20 Stuffing Box Bushing
- C-21 Snap Ring & Cover Plate
- C-22 Bearing Housing
- C-23 Column Bearing - Cutless Rubber
- C-24 Shaft Sleeve
- C-25 Impeller Shaft Coupling
- C-26 Column Adapter
- C-27 Discharge or Top Intermediate Bowl
- C-28 Discharge or Intermediate Bowl Bearing
- C-29 Snap Ring and Cover Plate
- C-30 Bowl Bearing
- C-31 Intermediate Bowl
- C-32 Impeller Nut
- C-33 Impeller
- C-34 Impeller Sleeve
- C-35 Bowl Gasket
- C-36 Suction Bowl
- C-37 Suction Bowl Bearing
- C-38 Suction Pipe
- C-39 Strainer
- C-40 Head Shaft
- C-41 Pre-lubricating Valve
- C-42 Discharge Flange
- C-43 Pre-lubricating Pipe
- C-44 Stuffing Box Shaft
- C-45 Top Column Flange Gasket
- C-46 Top Column Flange
- C-47 Shaft Coupling
- C-48 Top Column Pipe
- C-49 Intermediate Shaft
- C-50 Column Coupling
- C-51 Intermediate Column
- C-52 Bottom Shaft
- C-53 Bottom Column
- C-54 Impeller Shaft

NOTE

Specify pump serial number when ordering replacement parts. This will be found on the nameplate attached to the discharge head casting or to the bowl assembly.

WELL

Measure the well to make sure it is of ample size and depth to receive the pump. The well must be sufficiently straight to allow the pump to hang freely with no misalignment.

FOUNDATION

A concrete foundation should be constructed before the pump is installed to permit aligning the pump head with the well while lifting equipment is available. Provide an opening in the foundation large enough for the top column flange with ample clearance. If the well is out of plumb, the pump head must be placed so that the drive shaft will be on the same inclination as the well casing. This is important. The foundation should be large enough to carry the weight of the pump without settling.

TOOLS

The following tools and equipment are required for satisfactory installation:

Derrick, gin pole with chain hoist, winch truck, well rig or similar equipment with at least 12 foot clearance (more for long bowl assemblies) and sufficient capacity to safely handle the weight of the complete unit.

Two pipe clamps or pipe elevators of proper size for pump column.

Two chain pipe tongs (if column has screwed couplings).

Two small pipe wrenches for screwing shaft together.

Small tools including wire brush, three-cornered file, wrenches, can of pipe compound, etc.

PREPARATION

Immediately on receipt of pump check carefully with packing list. Report any loss or damage to transportation company and to factory. Keep all parts in good dry storage. When ready to install, unpack material and lay out on skids or boxes near well.

Place the column pipe with the coupling end toward the well. Check shafts for straightness. Roll on ways if any question as shafts must be almost perfectly straight. Place a shaft inside each length of column with the bearing sleeve toward the well. Screw a shaft coupling on the opposite end.

Note -- Short-coupled turbine pumps are usually shipped assembled except for mounting motor. To install these pumps it is only necessary to raise the pump over the sump or reservoir and lower it on foundation. Then mount motor or drive as explained later.

IMPORTANT NOTES

1. Column pipe threads are right hand; shaft threads are left hand.
2. Protect all parts from dirt; especially column and shaft threads, couplings, and all machined surfaces. Any dirt or foreign material between

ends of shafts or other parts may cause misalignment and unsatisfactory operation.

3. Handle shaft with extreme care to avoid bending.
4. All shaft and column must butt solidly in couplings; otherwise, differences in length may develop during installation. Ends of shafts should be even with small hole in side of shaft coupling.

INSTALLING BOWL ASSEMBLY

If headroom permits, screw strainer on suction pipe and suction pipe into bowl assembly before raising bowl assembly from ground. Where headroom is limited or assembly is long, lower suction pipe into well with strainer attached and hold with clamp. Then if headroom permits, assemble the bottom section of shaft, and column pipe on the top of the bowl assembly. Raise the complete assembly, taking particular care not to place too much strain on the bowls, and screw the bowl assembly on the suction pipe. If necessary to place clamp on bowl assembly, make sure this is located over joint and not on the shell of a bowl.

Loosen clamp on suction pipe and lower assembly into the well until the upper clamp or elevator rests on top of casing or foundation.

INSTALLING COLUMN

Place clamp or elevator under coupling on upper end of the bottom section of column and raise over the well. Support the shaft by hand or with a rope sling, taking particular care not to bend the shaft. On larger pumps a small clamp to fit the shaft or a length of manila rope will assist in supporting the shaft. Carry the lower end of the column or slide it on a plank so as not to damage threads. Make sure all threads are perfectly clean. Paint outside pipe threads with a good thread lubricant. Oil shaft threads and wipe off excess oil.

Screw the bottom shaft into the impeller shaft coupling and tighten. Then screw the column into the column adapter or if the adapter is flanged, bolt it to the top bowl. Lower the complete assembly into the well and hold with clamp.

Place a bearing assembly over the shaft with the snap ring at the top and slip it firmly in place in the column coupling.

Repeat this procedure until all of the column has been installed. Each section must butt rigidly in the couplings. Intermediate column lengths are regularly 10 feet for pumps up to 2200 RPM and 5 feet for pumps to operate over 2200 RPM. Rubber bearing should center in bearing sleeve in each column coupling. The top section of column has a flange for attaching to the discharge head. The top shaft which goes through the stuffing box is regularly of stainless steel, several inches longer than the top pipe.

INSTALLING HEAD ASSEMBLY

Hold the pump with clamps under the upper column coupling. This will support the top column flange several feet above the foundation where it is convenient to attach the discharge head. Remove the stuffing box assembly from the head. It may be necessary to bump it lightly with a wooden block. Place a double chain sling through the head and raise it over the pump. Make sure flange on lower side of head is clean and that studs are not damaged. Clean the top column flange and place paper gasket on it. Line up studs and the opening through the head with holes in top flange and lower the head carefully onto the top flange. Make sure the register fits and tighten stud nuts securely.

Then raise the complete pump assembly and remove the clamps. Rotate the unit until the discharge flange is in the desired direction and lower onto foundation. If the head does not rest evenly on the foundation, lift the unit and place metal shims under each corner. The head must be supported on the foundation so that it is in line with the column and shaft. Never level a pump head on the foundation with a spirit level.

Place paper gasket over stuffing box studs. Make sure the flange is clean and lower the stuffing box over the shaft using care not to damage packing. Tighten stud nuts securely and tighten gland nuts finger tight. Run stuffing box relief tube down through opening in head to return by-pass water to well; or place tube through drain opening in back of head and pipe to drain. If pump is to operate under pressure; leave relief valve partially open to relieve the pressure on the upper packing. Give grease cup several turns to lubricate packing and stuffing box bearing. Screw headshaft coupling on upper end of stuffing box shaft. Place a cloth over coupling to avoid any possibility of dirt or foreign material dropping into it while motor is being mounted.

INSTALLING MOTOR OR DRIVE

Check motor nameplate to make sure it is suitable for the electric current available and the proper speed for the pump. Use eye bolts in top of motor for lifting motor only. Do not use these eye bolts for lifting motor and pump together. Set motor on pump head making sure that base of motor and top of head are clean and that register fits properly. Bolt motor in place with bolts or cap screws furnished. Remove motor canopy and top drive coupling. Lower headshaft through hollowshaft of motor with end of shaft having keyway at the top. Tighten in headshaft coupling. It is important that shafts butt in coupling but do not use excessive force which might cause misalignment.

ALIGNING PUMP

Check alignment of pump head on foundation by noting the clearance around the headshaft at top of motor. If the headshaft stands to one side in hollowshaft, place metal shims between the head and foundation on the opposite side so that the headshaft will stand exactly in the center. The straightness of the headshaft, stuffing box shaft and coupling may be

checked by installing the top drive coupling, raising the impellers and turning the rotating assembly 180°. Then remove the top drive coupling and the shaft should remain in the center of the hollowshaft. Raise the complete pump assembly and without moving the shims, spread a layer of cement on the foundation. Then let the pump down until it rests in exactly the same position as before. Recheck position of top shaft. After cement sets tighten foundation bolts.

CHECKING ROTATION

Have the motor wired and check rotation before installing the top drive coupling. Rotation must be counter-clockwise when looking at top of motor. (See arrow on pump head.) Motors with built-in non-reverse ratchet may be energized momentarily without injury to the ratchet assembly. If rotation is incorrect, reverse two leads on three phase motor. Refer to diagram on single phase motor.

ADJUSTING IMPELLERS

Place top drive coupling over shaft and insert gib key. Tighten adjusting nut until impellers are raised off bowl seats and shaft just turns freely by hand. Then raise approximately one-half turn for each 100 feet of setting. It is better to raise more than necessary for starting and then make closer adjustment gradually. Install lock screw and tighten before starting pump. For maximum performance, impellers should be adjusted so that they run as close as possible and yet do not rub at maximum pressure. If there is any unusual noise or vibration, stop the pump and recheck impeller adjustment. A watt meter or ammeter may be used to obtain very close adjustment. If well may contain sand, raise impellers about twice normal amount when first starting pump and then readjust after well has cleared up. If the well does not produce sufficient water to supply the pump, the capacity of the pump should be reduced by raising the impellers.

PRELUBRICATING AND STARTING PUMP

Before starting deep well pumps the Cutless Rubber bearings above the static water level must be prelubricated with water. Connect pre-lube tank to opening in stuffing box assembly with fittings provided and fill tank with clean water. Allow at least half the tank of water to run down the shaft before starting pump. Then leave valve open and allow pre-lube water to continue to flow until the water from the pump reaches the surface. Allow tank to refill before closing valve. On large pumps with deep static water level refill tank from another source to provide ample prelubrication while the pump is coming up to speed. If such pumps are to be operated manually, it may be more convenient to install a 30 or 50 gallon barrel for prelubrication.

Pumps discharging into pressure systems are normally prelubricated by connecting a line around the check valve and installing the globe valve in this line. A small "V" groove should be filed in the valve seat so that the valve cannot be closed accidentally. Four to five gallons of water per hour is generally sufficient

to keep the bearings moist and in condition for automatic operation. Where pumps operate frequently and the water level is less than 50 feet from the surface, the bearings will normally remain sufficiently moist for smooth starting without prelubrication. Where pumps are started infrequently or the amount of water available for prelubrication is limited or on large installations to be operated automatically an electric solenoid operated valve should be installed in the pre-lube line with a timing relay to delay the starting of the pump until the bearings have been properly lubricated.

A gate valve should be placed in the discharge line. Leave this valve about three quarter closed when the pump is started. After the water reaches the surface, open the valve slowly to avoid over pumping the well and to maintain normal discharge pressure on the pump. Check the stuffing box and tighten gland, if necessary, with a small wrench, until there is only a small trickle of water to keep the packing lubricated.

LUBRICATION

PUMP LINE SHAFT AND BOWL BEARINGS

On Fig. 4700 Water Lubricated Pumps all bearings below ground are lubricated by the water flowing through the pump. Prelubrication during the starting period should be provided where necessary as explained on Page 4.

The water level in the well should be checked occasionally while the pump is in operation. If the water level draws down below the bowls, additional column and shaft should be installed, or the capacity of the pump should be reduced by either raising the impellers or throttling the discharge. The pump must not be allowed to operate if the water level drops to the strainer and the pump breaks suction.

STUFFING BOX

Apply a small amount of a good water resistant lubricant to the grease fitting on the stuffing box each time the pump is started or once a day if the pump is operated continuously. Special turbine stuffing box grease may be obtained from Deming Division, Crane Co. in 1 lb. cans. If necessary, an automotive water pump grease may be used.

MOTOR WITH GREASE LUBRICATED BEARINGS (Lubricated at factory before shipment)

A. Motor with grease fitting and drain plug in each bearing housing.

Once each six months or once a year, depending on operating conditions, the motor should be relubricated as follows:

1. Remove drain plug or grease ejector.
2. Apply pressure gun to grease fitting and inject new grease until all old grease has been forced out of the bearing through the grease drain. If a grease ejector is supplied, assist flushing of old grease by slowly working the

plunger back and forth several times to remove grease from the drain.

3. Run motor for approximately five minutes to relieve bearing of excess grease using ejector immediately upon starting to assist removal of grease from drain.
4. Replace drain plug or ejector.

B. Motor with grease fitting only in each bearing housing.

Once each six months or once a year, depending upon operating conditions, add a small amount of grease. Then remove grease fitting and operate the motor about one-half hour before replacing the fitting to allow any excess grease to be expelled. The bearing may run warm (without injury) until the excess grease has been expelled. An approval motor bearing grease may be obtained from Deming Division, Crane Co., in 1 lb. cans.

MOTOR WITH OIL LUBRICATED BEARINGS, BELT DRIVE OR FLEXIBLE COUPLING DRIVE (Fill with oil before starting)

Oil lubricated motors and drives are shipped without oil and should be filled with proper grade oil before starting. Check oil level once a week with pump idle. Change oil once a year or every 2000 hours operation, whichever occurs first. Change oil more frequently for continuous operation or under dusty conditions. For proper turbine oils refer to table. While special turbine motor oil is preferred, if necessary a SAE10 or SAE20 non-detergent pure paraffin base motor oil may be used temporarily.

MOTOR WITH OIL LUBRICATED TOP BEARING AND GREASE LUBRICATED LOWER BEARING

(Fill top oil reservoir before starting. Lower bearing greased at factory.)

Relubricate according to instructions outlined above.

RIGHT ANGLE DRIVE (Fill before starting)

Refer to manufacturer's instructions which usually recommend changing oil once a year or after 2000 hours of operation, whichever occurs first. Use only an approved turbine oil as recommended by the drive manufacturer; SAE automotive oils are Not satisfactory for Right Angle Drives.

NOTE

See Page 6 for list of recommended oils and greases for motors.

RECOMMENDED OILS AND GREASES FOR MOTORS

<u>Manufacturer</u>	<u>Trade Name of Grease</u>	<u>Trade Name of Oil</u>
Continental Oil Co.	Conoco Race Lube	Conoco Turbine Oil Light
Esso Standard Oil Co.	Andok Lubricant B	Teresso 43
Magnolia Petroleum Co.	Mobilux Grease #2	Mobil DTE 797
Shell Oil Company	Alvania Grease #2	Tellus 27
Socony-Mobil Oil	Mobilux Grease #2	Mobil DTE 797
Standard Oil of California	Chevron Industrial Grease, Medium	Chevron OC Turbine 9
Standard Oil of Ohio	Sohio #78 or Lubtec Grease	Sohivis 43
Sun Oil Company	Sun N-52X	Sunvis 916
The Texas Company	Regal Starfak #2	Regal A (R & O)
Tidewater Oil Co.	Veedol All-Purpose	Tycol Aturbrio 50

CAUTION

Due to the high speed at which the smaller size units may operate, and since most of the pumping unit is underground, extreme care must be used in assembling and installing it and thoroughly checking the entire installation before it is put into operation.

If, after the well has been drilled and cased, it is crooked, the water supply is doubtful, the water level has dropped, or the water contains considerable sand, gravel or gas, the Crane Deming sales office from whom the unit was purchased should be consulted before it is started.

Under no circumstances will the Company guarantee the pump against the effects of corrosion, erosion or electrolytic action, those being entirely beyond the control of the Company.

In case any unusual vibration appears when starting the unit, or if vibration develops later, the unit should not be continued in operation, but Crane-Deming or authorized representative, should be requested to service the installation to place it in proper running condition.

If the above instructions are not followed or if the pump is operated without the proper submergence recommended by the Company, all guarantees are withdrawn and Crane-Deming will not assume any responsibility for the proper operation of the unit or the life of any of its parts.

LIMITED WARRANTY

APPLICABLE ONLY TO CONSUMER SALES

Crane Co., Deming Division gives a limited one-year warranty on the machinery of its own manufacture sold herewith. Crane Co., Deming Division warrants to any buyer or consumer that the machinery shall be free of defects in material and workmanship during normal use and service for a period of one year from the date of shipment.

Under this limited warranty, Crane Co., Deming Division shall, within 45 days from the date of notification, (1) repair the product at the factory or the nearest point of repair OR, (2) replace the product or any parts proven defective in material or workmanship OR, (3) refund the purchase price. The choice of such remedies shall be at the sole discretion of Crane Co., Deming Division.

This written warranty is the only warranty made by Crane Co., Deming Division. IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, IF ANY, ARE LIMITED TO THE SAME TERM AS THIS WRITTEN WARRANTY. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

HOWEVER, SOLELY WITH RESPECT TO A BUYER WHO IS NOT A CONSUMER, THE FOREGOING WARRANTY IS IN LIEU OF ANY AND ALL IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, AND NO OTHER WARRANTY IS MADE OR AUTHORIZED TO BE MADE.

The buyer or consumer must promptly and within the applicable limited warranty period notify the installing dealer or contractor in writing of any defect in the machinery and shall permit Crane Co., Deming Division to inspect the product so that it may determine its obligations under the warranty. The buyer or consumer must pay all labor costs, freight charges to the factory or the nearest point of repair, if any, and any charges for the installation of replacement parts, incurred by the Dealer, Contractor or this Company. Upon settlement of its obligations, if any, under this warranty, Crane Co., Deming Division, at its option, shall be entitled to the return of the defective product or part (s) (transportation prepaid).

This limited warranty does not cover unsatisfactory performance or failure due to misuse or abuse of the product, nor will Crane Co., Deming Division be responsible for unsatisfactory performance or failure due to improper installation, adjustment or repair of the product. The specifications for the machinery are descriptive and are not warranties.

This limited warranty does not cover equipment and accessories manufactured by third parties.

CRANE CO., DEMING DIVISION IS NOT RESPONSIBLE FOR CONSEQUENTIAL, SPECIAL, CONTINGENT, INCIDENTAL OR ANY OTHER DAMAGES WHATSOEVER IN CONNECTION WITH REPLACEMENT, REPAIR OR REFUND AS SET FORTH ABOVE. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

CRANE CO., DEMING DIVISION
884 South Broadway
Salem, Ohio 44460

WARRANTY

**APPLICABLE WHEN THE MACHINERY IS SOLD AND INSTALLED ON
A COMMERCIAL OR INDUSTRIAL APPLICATION, AND NOT AS A
CONSUMER PRODUCT.**

**INDUSTRIAL PUMPS
CRANE CO., DEMING DIVISION
SALEM, OHIO, 44460**

The following warranty, which is not a consumer warranty, is made in lieu of any and all implied or express warranties including, without limitation, implied warranties of merchantability and fitness for a particular purpose and no other warranty is made or authorized to be made.

Service under this warranty is the responsibility of the installing dealer or contractor. In the event service is required, the Buyer should request such service directly from the installing dealer or contractor. If for any reason the installing dealer or contractor is unknown or cannot be located, the Buyer should write Crane., Deming Division for the name and address of the nearest dealer or contractor.

If within one (1) year following date of delivery, any material supplied by Crane Co. hereunder proves defective or fails to meet the agreed specifications, Buyer shall not return it unless requested to do so but shall immediately notify the installing dealer or contractor, stating full particulars in support of his claim and if faulty workmanship or material is involved, or if material fails to meet the agreed specifications, Crane Co. will adjust the matter fairly and promptly. Under no circumstances shall Crane Co. be obligated to allow claims for subsequent or consequential damages or for any labor expense incurred by reason of the use or sale of any material which is defective or fails to meet the agreed specifications. The sole measure of damages shall be the price received therefore by Crane Co.

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**PUMP & LIGHTING CO.
ENGINEERED PRODUCTS DIV.
P. O. BOX 2504
HICKORY, NC 28603**



INSTRUCTIONS

TRI/CLAD[®]

VERTICAL INDUCTION MOTORS

HIGH THRUST, HOLLOW AND SOLID SHAFT, "P" BASE

FRAMES C324-C405, D324-D405, K324-K405

OPEN ENCLOSURES

INTRODUCTION

General Electric standard high-thrust vertical motors (Fig. 1) covered by these instructions are carefully constructed of high-quality materials and are designed to give long periods of trouble-free service when properly installed and maintained. They are of either hollow- or solid-shaft construction, and are generally used to drive pumps. Figure 2 shows a typical hollow-shaft motor. Figure 4 shows the alternate lower end furnished on some hollow-shaft motors. The solid-shaft construction is similar except that the top-half coupling is omitted, and the motor shaft extends out the bottom of the motor. This standard construction is for high continuous down-thrust and is good for momentary up-thrust only in the magnitude of 30 percent of the rated down-thrust.

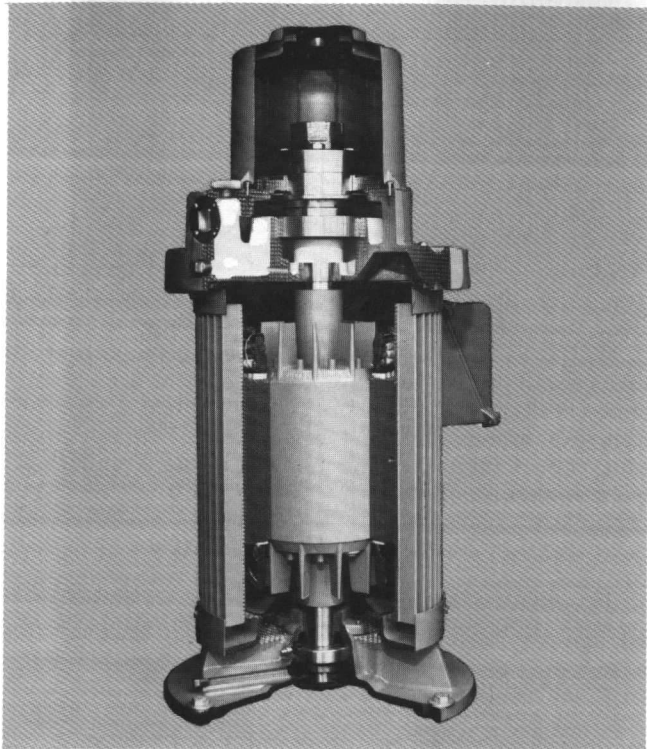


Fig. 1. Typical high-thrust induction motor

These motors may be supplied with bearing arrangements for various external thrust conditions imposed by the pump such as different magnitudes of down-thrust and either momentary or continuous up-thrust. Since overloading greatly reduces bearing life, the amount of thrust applied should not exceed the recommended values.

Motors driving pumps in pressure systems where the pressure is maintained after shutdown should be protected from overspeeding by check valves.

RECEIVING, HANDLING AND STORAGE

Each motor should be carefully examined upon arrival and any damage reported promptly to the carrier and to the nearest office of the General Electric Company.

WARNING: *LIFTING DEVICES ARE NORMALLY INTENDED TO BE USED IN HANDLING THE MOTOR ONLY, AND ARE NOT INTENDED TO LIFT THE COMBINED WEIGHT OF THE MOTOR AND ITS CONNECTED LOAD. HOWEVER, IF A SPREADER BAR IS USED TO PROVIDE PARALLEL LIFTING FORCES IN LINE WITH THE AXIS OF THE MOTOR AND PRECAUTION IS USED TO AVOID SHOCK LOADING, CONNECTED LOADS NOT EXCEEDING 200 PERCENT OF THE MOTOR WEIGHT CAN NORMALLY BE SAFELY HANDLED WITH THE MOTOR LIFTING DEVICES.*

If the motor is not to be installed immediately, it should be stored in a clean, dry location. Precautions should be taken to prevent the entrance of moisture, dust, or dirt during storage and installation. If the storage period is to exceed three months, the reservoirs of oil-lubricated bearing housings should be filled. It is suggested that such oil-filled motors be tagged in a fashion so as to be readily discernible in order to prevent mishandling, which would cause oil spillage and subsequent damage to the internal parts of the motor.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

GENERAL  **ELECTRIC**

SAFETY PRECAUTIONS

WARNING

High voltage and rotating parts can cause serious or fatal injury. The use of electric machinery, like all other utilization of concentrated power and rotating equipment, can be hazardous. Installation, operation, and maintenance of electric machinery should be performed by qualified personnel. Familiarization with NEMA Publication MG2, *Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators*, the National Electrical Code, and sound local practices is recommended.

For equipment covered by this instruction book, it is important to observe safety precautions to protect personnel from possible injury. Among the many considerations, personnel should be instructed to:

- avoid contact with energized circuits or rotating parts,
- avoid by-passing or rendering inoperative any safeguards or protective devices,
- avoid extended exposure in close proximity to machinery with high noise levels, and
- use proper care and procedures in handling, lifting, installing, operating and maintaining the equipment.

Safe maintenance practices with qualified personnel are imperative. Before initiating maintenance procedures, be sure that *all* power sources are disconnected from the machine and accessories to avoid electric shock. High potential insulation test for this equipment is not recommended; however, should it be required, procedures and precautions outlined in NEMA Standards MG-1 should be followed.

Failure to properly ground the frame of this machine may cause serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound local practice.

During storage, windings should be protected from excessive moisture absorption by some safe and reliable method of heating. Space heaters, if supplied, may be used for this purpose. The temperature of the windings should always be maintained a few degrees above the temperature of the surrounding air. It is recommended that motors in storage be inspected, the windings meggered, and a log of insulation resistance and temperature kept. Any significant decrease in insulation resistance should be investigated.

The oil and grease should be replaced at the end of the storage period per the Relubrication instructions on page 7.

If a motor is to be in storage for over one year, it is recommended that competent technical inspection service be contracted for, such as General Electric Installation and Service Engineering Department, to ensure that the storage has been adequate and that the motor is suitable for service.

INSTALLATION

LOCATION AND MOUNTING

WARNING: MOTORS SHOULD BE LOCATED IN A SUITABLE ENCLOSURE TO PREVENT ACCESS TO THE MOTOR BY CHILDREN OR OTHER UN-

AUTHORIZED PERSONNEL IN ORDER TO PREVENT POSSIBLE ACCIDENTS. THIS IS ESPECIALLY IMPORTANT FOR MOTORS THAT ARE REMOTELY OR AUTOMATICALLY CONTROLLED OR HAVE AUTOMATIC RE-SETTING OVERLOAD RELAYS SINCE SUCH MOTORS MAY START UNEXPECTEDLY.

Allow enough space around the motor to permit free flow of ventilating air and to maintain an ambient temperature not over 40°C. Where a choice of locations is possible, install the motor so that it will be subjected to the least amount of dirt, dust, liquid, and other harmful materials. Mount the motor securely on a level, firm foundation, align accurately with the driven equipment, and tighten mounting bolts securely.

COUPLINGS FOR HOLLOW-SHAFT MOTORS

To ensure proper functioning, coupling bolts must be tightened to torque values indicated below:

Bolt Size	Torque
5/16	20 lb ft
3/8	37 lb ft
1/2	90 lb ft
5/8	180 lb ft
3/4	320 lb ft
1	710 lb ft

CAUTION: *IT SHALL BE THE INSTALLER'S RESPONSIBILITY IN ALL CASES TO ASCERTAIN THAT THESE TORQUE VALUES HAVE BEEN ADHERED TO. THIS SHALL INCLUDE THOSE INSTANCES WHEN COUPLING COMES MOUNTED IN MOTOR. FAILURE TO COMPLY MAY RESULT IN COUPLING BOLTS SHEARING AND EXTENSIVE DAMAGE TO EQUIPMENT.*

Vertical hollow-shaft motors are designed for driving deep-well, turbine-type pumps and can be equipped with either self-release, bolted, or non-reverse couplings. The type of coupling is specified by the pump manufacturer. Remove the top cap to gain access to the coupling.

Two slots are provided in the outside rim of the coupling so that a bar can be inserted to keep the assembly from turning while the adjustment of pump impeller clearance is being made. A coupling bolt can be screwed into one of the extra tapped holes in the top end shield to provide a stop for the bar.

Self-release Coupling

Should the motor accidentally operate in the reverse direction, the pump line-shaft joints may unscrew. The self-release coupling (see Fig. 3) acts to limit the amount of this unscrewing. In normal operation, torque from the motor is transmitted by the lower-half coupling through the driving pins to the top-half coupling and thus to the pump shaft. When reversal occurs and the pump shaft starts to unscrew, the self-release top-half coupling disengages from the driving pins, thus uncoupling the pump and motor.

Proper functioning of the self-release coupling depends upon several factors. The pump shaft adjusting nut must be securely attached to the top-half coupling, and the top-half coupling must not bind on the lower half. Otherwise the adjusting nut lock screw may break instead of the coupling halves separating. As a result the motor would continue to drive the pump line shaft, and the joints would continue to unscrew. Serious damage may result to both motor and line shaft. To check the clearance between the coupling halves, place the top-half coupling in position prior to installing the motor. It should drop into place, and rest solidly on the lower-half coupling, without forcing.

Proper alignment of the pump head-shaft within the motor hollow shaft is also important. After the coupling releases, it no longer holds the pump shaft centered. If the alignment is not good, the motor shaft which is still rotating may rub the pump shaft which has stopped, and damage will result.

A third requirement is that the distance between the top of the pump shaft and the inside of the top cap be at least enough to allow the top-half coupling, when it releases, to clear the pins before the shaft hits the cap. Check this clearance after the adjusting nut has been drawn up to its final position. To facilitate making the check, the motor outline print shows a maximum dimension "XH" from the top of the coupling to the top of the shaft. Adhering to this design limit will allow the shaft and coupling to lift in order to clear the pins and still leave a small clearance between the shaft and cap. For standard motors, dimension "XH" is 4 1/2 inches for frames C, D, and K 324-326; and 3 1/2 inches for frames C, D, and K 364-405.

Depending upon the circumstances causing reversal and upon which line-shaft joint unscrews, there may be enough energy stored in the rotating parts, at the time the coupling clears the pins, to cause the pump shaft to continue to rise and strike the top cap. However, if the above conditions are met, damage, even in the most severe cases, should be limited to a broken cap.

It is expected that the self-release coupling will be called upon to operate only at infrequent intervals. Operation from the usual cause, application of single-phase power after an interruption, can be minimized by proper selection of control. When power is removed from the motor, the reverse flow of water through the pumps tends to cause reverse rotation or "back-spin." If single-phase power is applied during the back-spin, the motor will continue to run in the reverse direction. It will drive the pump and tend to unscrew the line-shaft joints. The selection of control which prevents automatic restarting after a power interruption or which employs a back-spin timer to delay restarting until the motor comes to rest will reduce the frequency of such occurrences.

Bolted Coupling

The bolted coupling allows up-thrust from the pump to be taken by the motor bearings. (See END-PLAY ADJUSTMENT under MAINTENANCE.) This coupling is similar to a self-release coupling except that the driving pins are replaced by bolts, which should be securely tightened to hold the two halves of the coupling solidly together. See torque requirements on page 2. This type of coupling does not have the self-release feature.

Non-reverse Coupling

The non-reverse coupling (see Fig. 2) is also a bolted type, and it keeps the pump and motor from

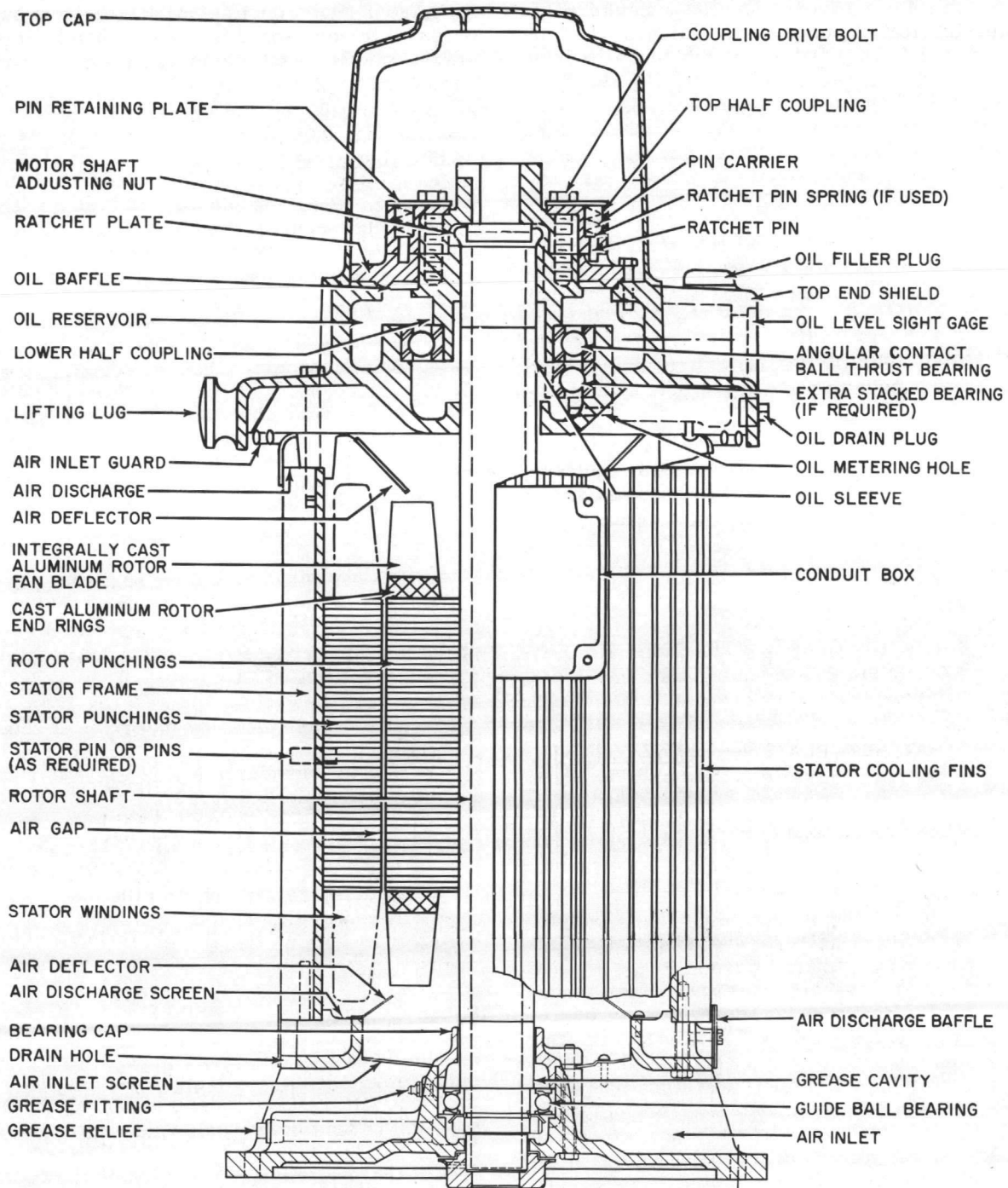


Fig. 2. Typical high-thrust, hollow-shaft motor with non-reverse coupling.

rotating in the reverse direction. Thus, it not only prevents the pump shaft from unscrewing, but it also prevents damage from overspeeding and damage to water-lubricated pump shaft bearings when, on shutdown, the falling water column tends to drive the pump in the reverse direction. In normal operation, motor torque is transmitted to the pump shaft through the two halves of the coupling which are bolted together. The ratchet pins are lifted by the ratchet teeth, and are held clear by centrifugal force and friction as the motor comes up to speed. When power is removed, the speed decreases, and the pins fall. At the instant of reversal, a pin will catch in a ratchet tooth and prevent backward rotation. The number of pins differs from the number of teeth to multiply the number of stopping positions.

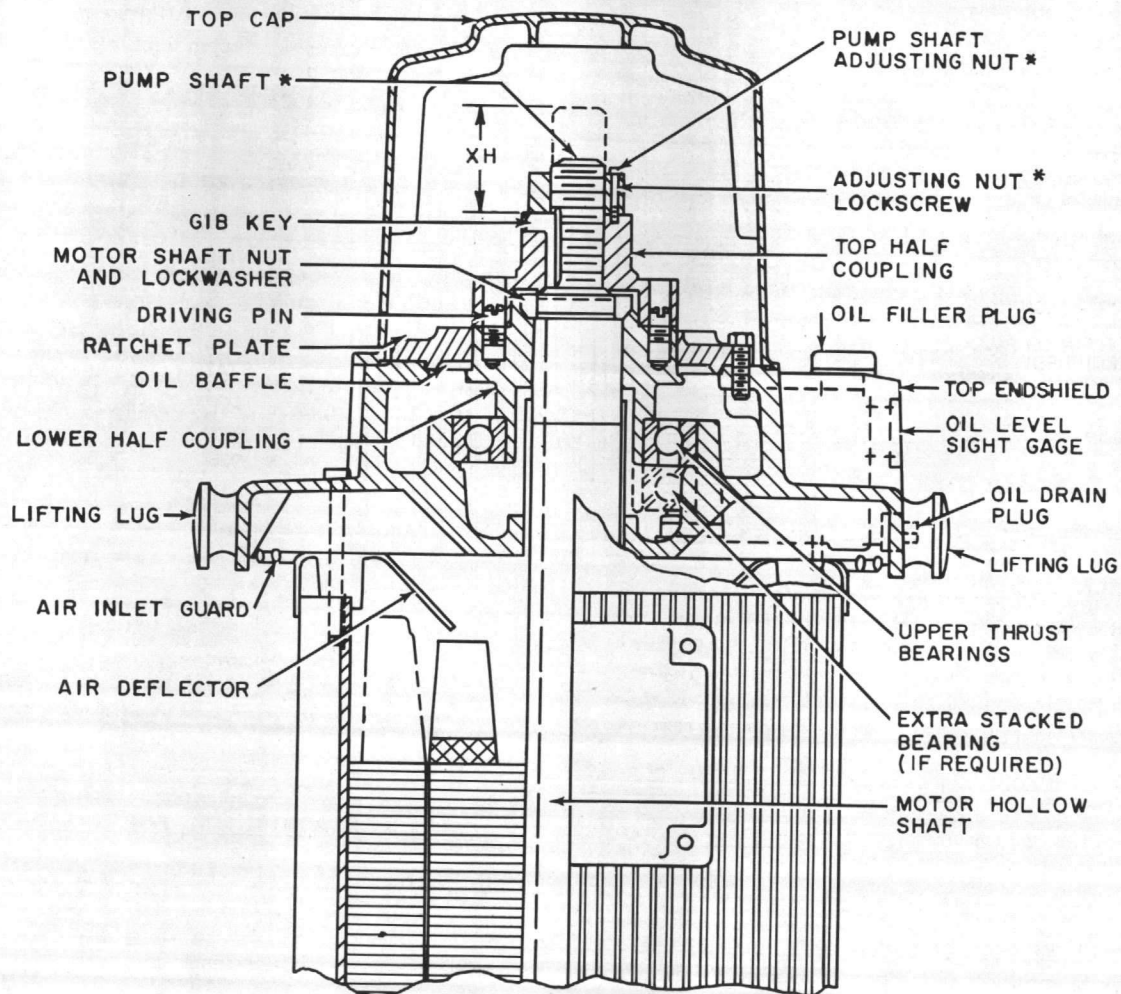
Too rapid a decrease in speed can result in inertia forces great enough to prevent the pins from drop-

ping. This condition is further aggravated when the pins become dirty, and their action sluggish. If the time from shutdown (the instant the stop button is pressed) to zero speed is greater than two seconds, operation will be satisfactory.

To permit operation, where stopping time is less than two seconds, the pins are spring-loaded. For those cases involving cycling (frequent starting and stopping) and stopping times greater than two seconds, the springs should be removed to decrease wear on the ratchet plate.

Pins and springs are made of heat-treated stainless steel.

A complete non-reverse top coupling, as shown in Fig. 2, consists of a self-release coupling plus



* SUPPLIED BY PURCHASER

Fig. 3. Upper end of typical hollow-shaft motor with self-release coupling

GEH-4213, Vertical Induction Motors

a non-reverse assembly, which includes ratchet plate, pin carrier, pins, springs, pin retaining plate, and cap screws. A self-release or a bolted coupling can be converted to a non-reverse coupling without disturbing the adjustment of the pump shaft nut.

To make the conversion, remove the drive pins or bolts from the lower-half coupling. Make sure the ratchet plate is securely bolted in place.

Slide the pin carrier down over the top coupling, insert the pins, and set the pin retaining plate in place. Insert the long cap screws through the plate, pin carrier, and top coupling and into the lower coupling. Tighten them securely.

The retaining plate is secured to the pin carrier with small cap screws. These screws may need to be loosened when this assembly is placed over the top coupling in order to center the plate. Tighten these screws after the three larger bolts are secured.

Motors shipped from stock may have their top couplings and non-reverse assemblies packaged separately. They can be installed as described above.

When installing the non-reverse coupling do not use lubricant. Lubrication will interfere with proper operation. The top half of the coupling should seat solidly on the lower half and the pins should touch the bottom of the pockets between the teeth in the ratchet plate. The clearance between the top-half coupling and the top of the ratchet teeth should be between 1/32 and 1/8 inch.

ELECTRICAL CONNECTIONS

Select and install control equipment and wiring according to National Electrical Code and sound local practice. Check the voltage and frequency with nameplate values. The motor will operate successfully, but with somewhat modified characteristics, when the line voltage is within plus or minus ten percent of nameplate value, the frequency within plus or minus five percent, or the combined variation within plus or minus ten percent (provided the frequency variation does not exceed five percent).

Motors rated 200 volts are designed for use on 208-volt systems.

Operation of a motor rated 230 volts on a 208-volt system is not recommended because utilization voltages are commonly encountered below the minus 10 percent tolerance on the voltage rating for which the motor is designed. Such operation will generally result in excessive overheating and serious reduction in torques. (National Electrical Manufacturers Association.)

LUBRICATION

Motors with oil-lubricated bearings are shipped without oil. Before starting the motor, fill each reservoir to the standstill level shown on the sight gage. Use only the oil specified on the lubrication nameplate or the lubrication instructions supplied with each motor. Exercise care to keep dirt out of the lubricant and bearing housing. When filling for storage, fill to the maximum level shown on the gage. Before operating the motor, drain this oil and refill as instructed above.

All grease-lubricated bearing housings are packed with the proper amount of General Electric grease before leaving the factory and will not require regreasing until they have been in service for a time.

See instructions under MAINTENANCE for re-lubrication recommendations.

OPERATION

Check electrical connections. Be sure that the drain plugs of oil-lubricated bearing housings are tight, and that the reservoirs are filled with oil.

Leave the motor disconnected from the load for the initial start. In the case of hollow-shaft motors, this check should occur before coupling to the pump shaft. First, make sure that the rotor turns freely. Then operate the motor without load for about an hour to test for excessive vibration and for any unusual, localized heating in the bearings and windings.

To reverse the direction of rotation of a three-phase motor, interchange any two line leads; to reverse direction of a two-phase motor, interchange T_1 and T_3 .

Operate the motor under load and check current. Do not exceed steady value of nameplate amperes times service factor.

MAINTENANCE

WARNING: BEFORE INITIATING MAINTENANCE PROCEDURES, DISCONNECT ALL POWER SOURCES TO THE MACHINES AND ACCESSORIES AND COMPLETELY DISCHARGE ALL PARTS AND ACCESSORIES WHICH MAY RETAIN ELECTRIC CHARGE. FAILURE TO COMPLY MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

INSPECTION

A systematic inspection should be made at regular intervals, depending on service and operating conditions.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, oil, and grease. Open motors should be kept dry and, if operating in dirty places, they should be disassembled periodically and thoroughly cleaned.

Motors may be blown out with dry, compressed air of moderate pressure. However, cleaning by suction is preferred due to the possibility of water in the compressed air lines and the danger of blowing metal chips into the insulation with compressed air.

Screens and covers are provided as necessary for protection of the equipment and personnel. All screens must be kept free of dirt and debris to ensure proper ventilation and maintained in place for protection of personnel.

The condition of the non-reverse coupling should be checked periodically by removing the top cap. If dirt has caused the action of the pins to become sluggish, the pin carrier should be removed, disassembled, and thoroughly cleaned with a suitable solvent. The parts should then be dried and reassembled in accordance with the instructions given under INSTALLATION, COUPLINGS. DO NOT LUBRICATE.

Sometimes, after a long period involving frequent stops and starts, the surface of the holes in the pin carrier becomes polished, so that friction forces will no longer hold the pins clear of the ratchet teeth when the motor is running. This condition can be remedied by roughing these surfaces with a piece of emery paper wrapped around a rod.

Whenever the dismantling of couplings is necessary, the use of witness marks will assure a balanced condition when reassembly is complete.

RELUBRICATION

The motors covered by these instructions have oil-lubricated upper (thrust) bearings and grease-lubricated lower (guide) bearings.

Grease-lubricated Bearings

The housings of grease-lubricated bearings are packed at the factory with long-life grease. The oil in this grease will ultimately become depleted, and it will be necessary to regrease at an interval dictated by the severity of service.

Since under normal conditions guide bearings in vertical motors carry relatively light loads, the initial grease pack will usually last for many years. Then a small amount of grease can be added through the fitting located in the lower bearing cap.

Whenever the motor is disassembled for general cleaning and reconditioning, clean the housing of old grease with a suitable solvent and dry thoroughly. Refer to the mixture described under "Insulation Care." Pack the cavity above the bearing with new grease until approximately two-thirds full before reassembling.

For best results use GE long-life grease (No. D6A2C5) and take care to exclude dirt from the bearing housing and lubricant.

Oil-lubricated Bearings

Maintain proper lubrication by checking the oil level periodically and adding oil when necessary. Because of the initial clearing action of the bearing and the expansion of the oil as it comes up to operating temperature, the oil level will be higher after the motor has been in operation for a while than it is with the motor at standstill. The normal level, with the motor stopped and the oil cold, is one-eighth inch below the center of the sight gage. Both the standstill level and operating range are marked on the gage.

Overfilling should be avoided not only because of the possibility that expansion may force the oil over the oil sleeve and into the motor, but also because too high an operating level prevents the bearing from clearing itself of excess oil. The resultant churning can cause extra loss, high temperatures, and oxidized oil. If, during operation, the oil level goes above the maximum shown on the sight gage, drain enough oil to bring the level back within the operating range.

Do not permit the operating level to fall below the minimum shown on the gage. Should it ever become necessary to add excessive amounts of make-up oil, investigate immediately for oil leaks.

Change oil at regular intervals. The time between oil changes depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two changes a year is average, but special conditions such as high ambient temperature may require more frequent changes. Avoid operating motor with oxidized oil.

Select the proper grade of oil from the lubrication nameplate or the special lubrication instructions which accompany each motor. A good grade, oxidation-corrosion inhibited turbine oil having a viscosity of 150 SUS at 100 F and 45 SUS at 210 F is usually

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specified for ball bearings and is covered by GE Specification D6B6A. A tag attached to the motor lists specific recommendations.

Operation in ambient temperatures that are near or below freezing may require preheating the oil or the use of a special oil.

Oil-lubricated bearing housings are provided with a settling chamber in which dust, dirt, and sludge collect. Unless the oil has been permitted to oxidize, the draining of the old oil during regular changes will usually provide sufficient cleaning action.

Whenever the motor is disassembled for general cleaning and reconditioning, the bearing housing may be washed out with a suitable cleaning solvent. Refer to the mixture described under "Insulation Care." Be sure that the oil metering hole is clear, and then dry the housing thoroughly before reassembly.

END-SHIELD ASSEMBLY

Add a thin coating of a non-conducting grease on end-shield rabbet and to threads of end-shield cap screws when assembling end shields to the aluminum frame. (GE Grease D6A2C5 is excellent for this purpose.)

END-PLAY ADJUSTMENT

Standard high-thrust motors are designed to withstand only momentary up-thrust. This up-thrust, which can exist for a few seconds during starting, is taken by the guide bearing. To prevent the thrust bearing from losing radial stability during this time, the motor end-play is limited to a small amount by adjusting the motor shaft nut. This adjustment is made at the factory and need not be disturbed on a new motor. However, should the motor be disassembled for any reason, the adjustment must be made upon reassembly to avoid damaging the bearings. The procedure depends upon the type of thrust bearing.

Refer to Fig. 2. When the motor shaft nut is tightened, the rotor, shaft, and lower bearing are drawn up until the outer ring of the lower bearing bears against its cover. Note that the shoulder on the shaft under the lower-half coupling is purposely located so that the coupling does not seat against it. Further tightening of the nut preloads the bearings.

The best way to position the nut is by trial, using an indicator between the lower-half coupling and top end shield, and lifting the rotor to check the end-play after each setting of the nut until between 0.002 and 0.005 inch is obtained. The nut should then be locked with its lockwasher.

If equipment is not available to use this method, the following procedure may be employed. Tighten the motor shaft nut carefully until all end-play is removed and the rotor just fails to turn freely. Then back the nut off one-sixth turn and lock with its washer. An assembly nameplate giving this information is mounted on the motor.

Motors which must withstand continuous up-thrust have a somewhat different construction. The upper (thrust) bearing is arranged to take this up-thrust, and it consists of angular-contact thrust bearings arranged for face-to-face (DF) mounting. (See Fig. 5.) The inner rings are locked on the lower-half coupling with a nut and the outer rings are clamped in the end shield with a ring.

The shaft shoulder under the lower-half coupling is so located that the coupling seats on it before the lower bearing comes up against its cover. No special adjustment is necessary when reassembling this type of motor, and the motor shaft nut can be pulled down tight and locked. The end-play of motors using DF-mounted bearings will then be very small.

BEARING REPLACEMENT

Replacement bearings should be of the same type and installed in the same relative position as the original bearings.

When removing bearings, apply steady, even pressure parallel to the shaft or lower-half coupling and at a right angle to the bearing. Apply this pressure to the inner race whenever possible. Angular-contact bearings which have failed, and are especially tight on the coupling, will sometimes yield to the following procedure. Separate the bearing by forcing the outer race over the balls. Then with a torch apply quick heat to the inner race while also applying pulling pressure.

Angular-contact bearings which are to be stacked together should have their high points of eccentricity (indicated by a burnished spot on the inner race) lined up. All bearings should be of same manufacture and of the type that permits stacking.

Some motors are supplied with removable spacer rings under the outer race of the thrust bearing so that the thrust capacity can be increased by adding an extra bearing or bearings. When these bearings are installed, the high points of eccentricity should be lined up with the keyway in the lower-half coupling. If the original bearings have been in service, they should be replaced at the time this conversion is made.

INSULATION CARE

Whenever the motor is disassembled, the windings should be given a thorough inspection and the in-

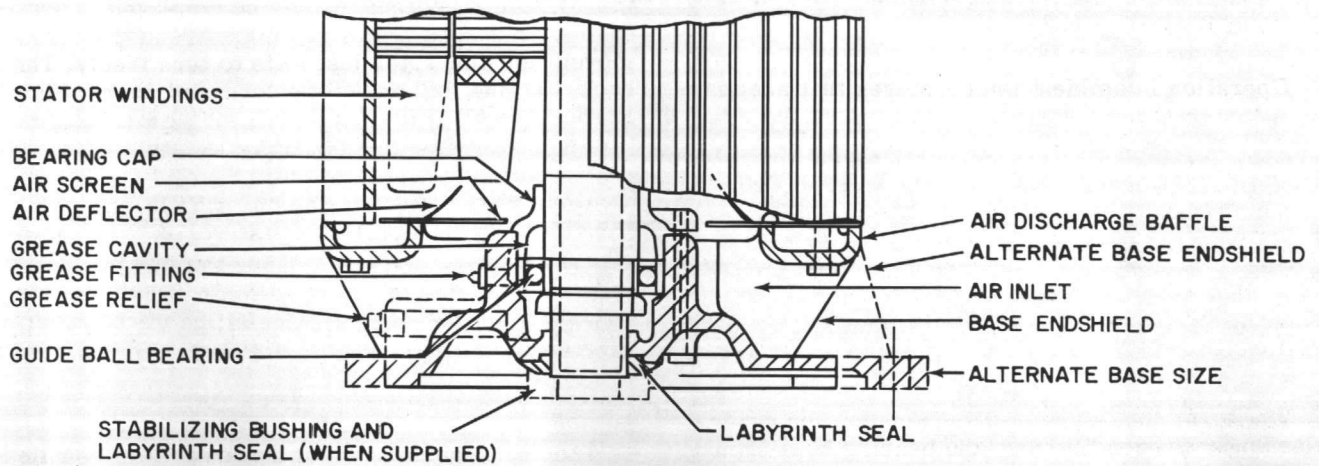


Fig. 4. Alternate lower end on some vertical hollow-shaft motors.

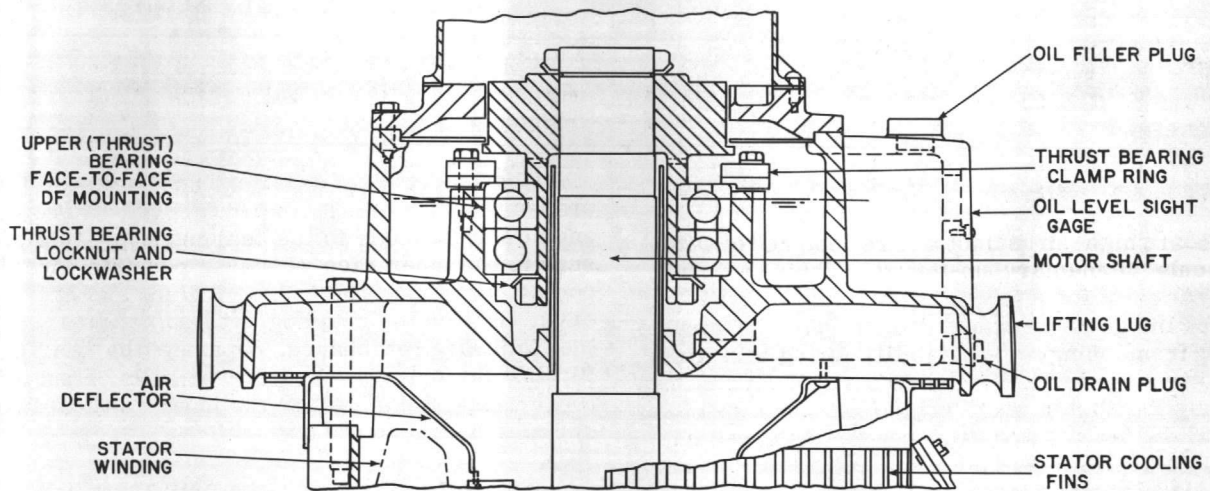


Fig. 5. Upper end of a typical solid-shaft motor which must withstand continuous up-thrust with DF-mounted bearings. Available on 364 frames and above.

sulation cleaned, if necessary, using a cloth or brush wet with a suitable cleaning solvent.

The cleaning fluid used to clean the coils must have grease-dissolving properties, but must not affect the electric insulation or varnish. Many cleaning fluids in common use, which are suitable with respect to the foregoing, may be extremely hazardous because of their toxicity, inflammability, or both. The following mixture is a suitable solvent for cleaning windings, bearings, and the bearing housing:

- 25 percent methylene-chloride (if unavailable, trichlorethylene may be substituted)
- 70 percent Stoddard solvent (petroleum spirits)
- 5 percent perchlorethylene

WARNING: WHEN USING THE ABOVE CLEANING FLUID, THE AREA MUST BE WELL VENTILATED AND SMOKING OR OPEN FLAMES PROHIBITED. FAILURE TO COMPLY CAN RESULT IN PERSONAL INJURY OR DEATH.

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For best results, the windings should then be varnished with an air-drying varnish. More than one coat may be required, depending on the condition of the winding.

The General Electric Company can furnish insulating varnish best suited for definite operating conditions. Consult the nearest General Electric sales office.

REWINDING CAUTION: TO AVOID DAMAGE, THE TEMPERATURE OF THE ALUMINUM FRAME MUST NOT EX-

CEED 200C DURING THE STRIPPING OR BAKING PROCESS. AN OPEN FLAME SHOULD NOT BE USED.

RENEWAL PARTS

When ordering parts, give description and state quantity of parts desired, together with the name-plate rating, model, and serial number of the motor. For couplings, also specify the type, bore, and key-way size.

Requests for additional copies of these instructions or inquiries for specific information should be addressed to the nearest sales office of the General Electric Company.

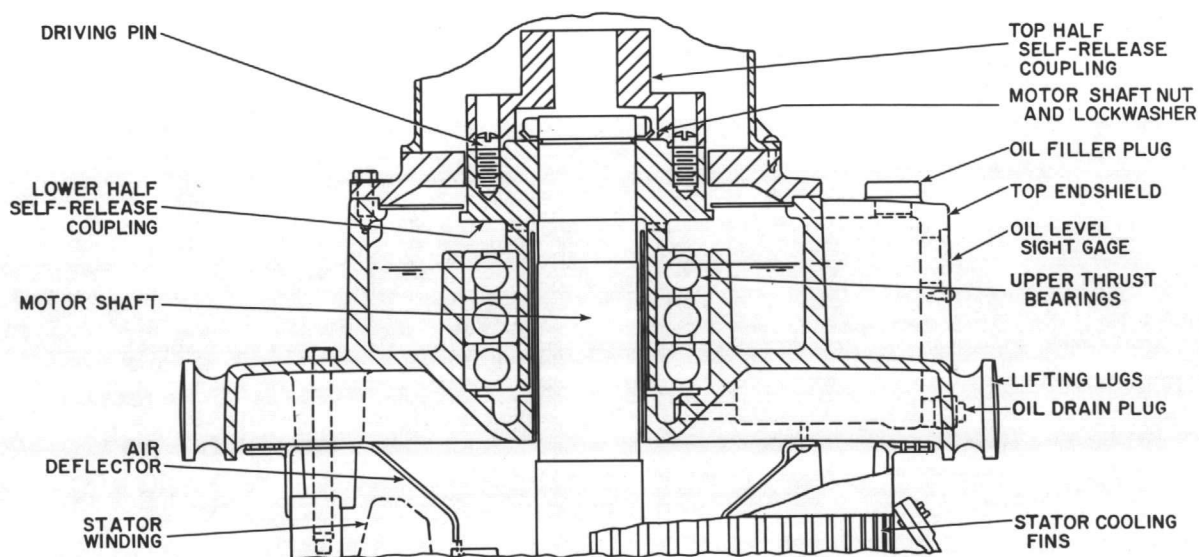
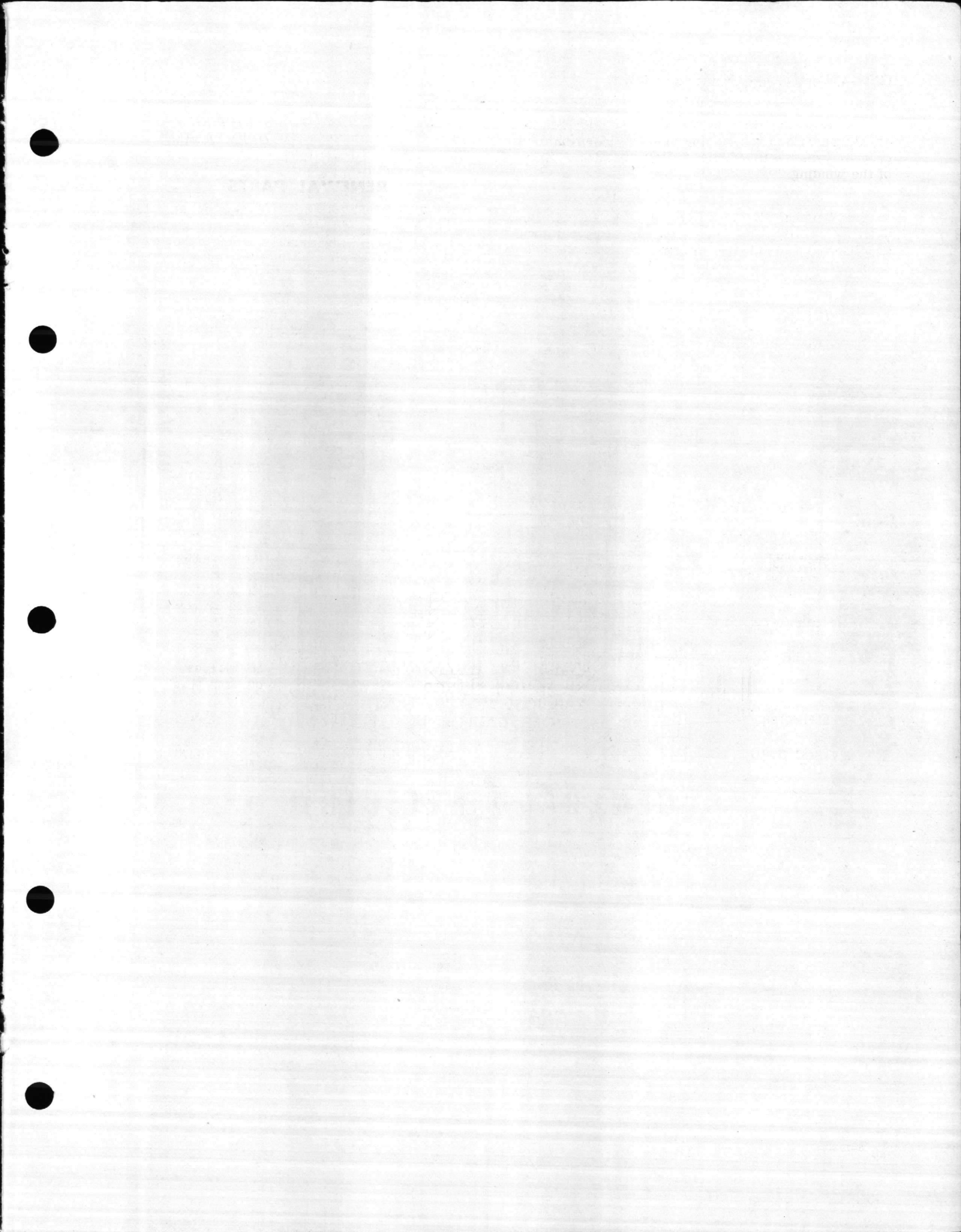


Fig. 6. Alternate end-shield construction for extra-thrust capacity on Frames 364 through 405.

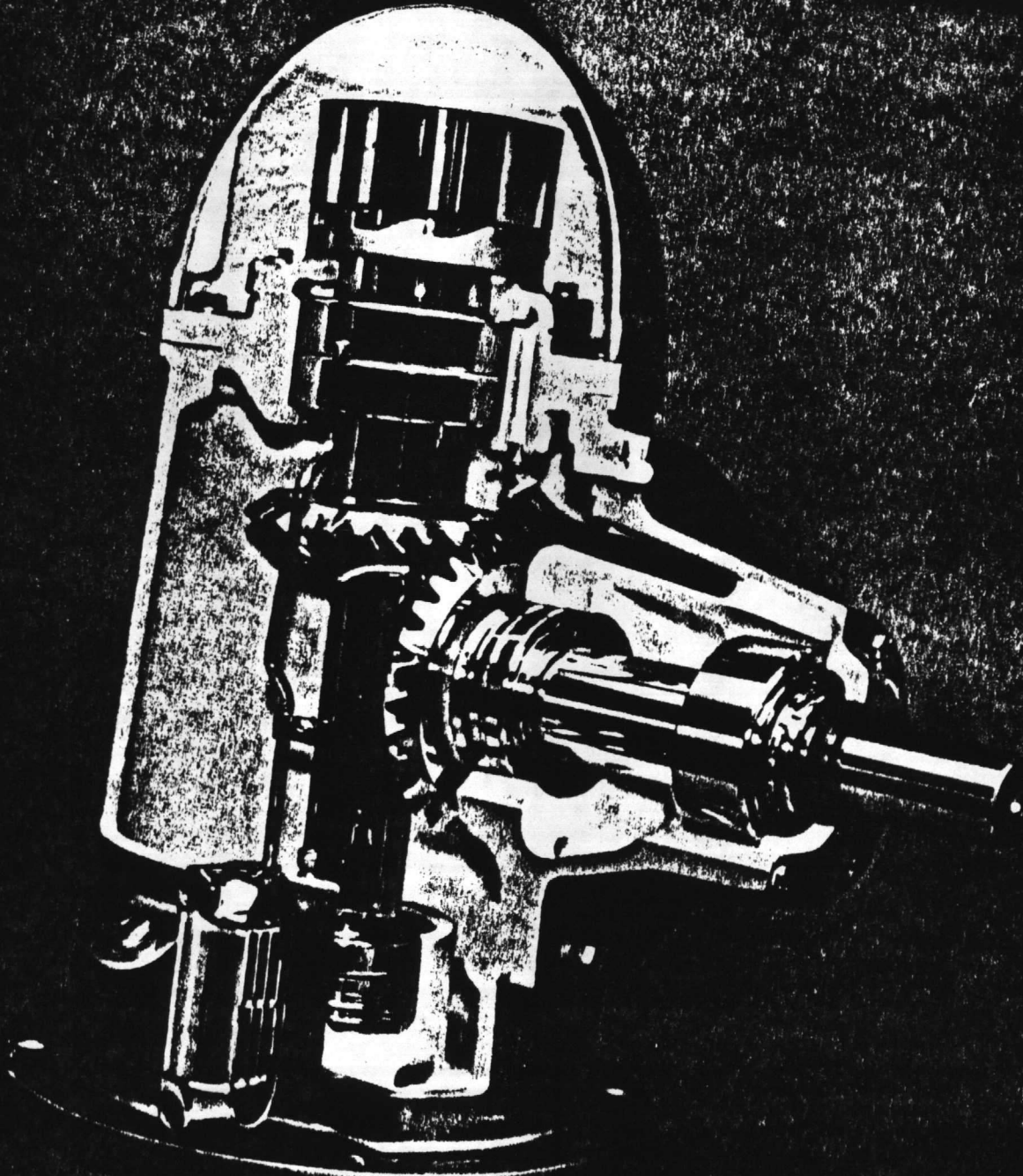


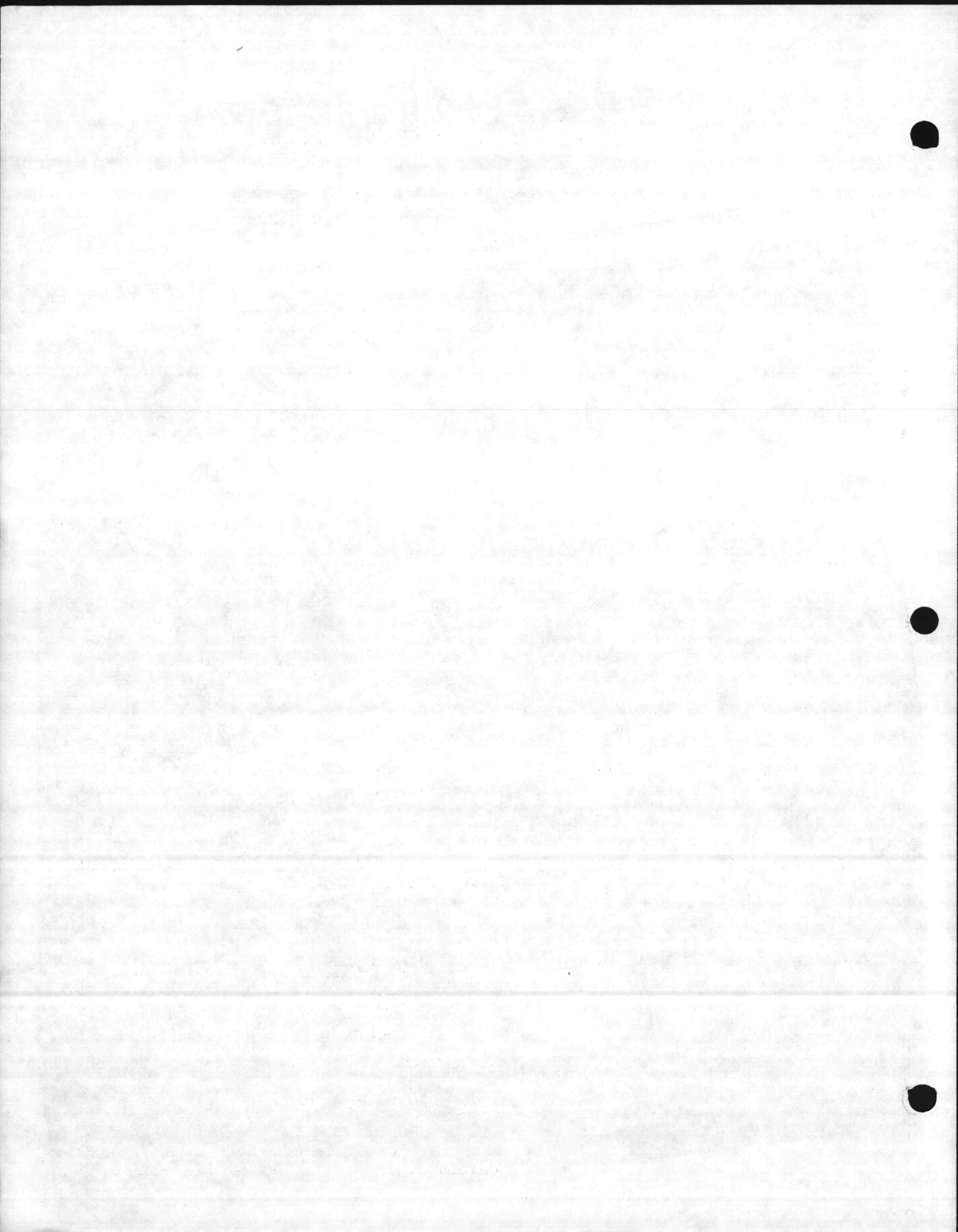
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VERTICAL MOTOR PRODUCTS SECTION
SAN JOSE MOTOR PLANT
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GENERAL  ELECTRIC

JOHNSON GEAR

Right angle drives for irrigation, industrial, and municipal pumping service





Johnson Right Angle Gear Drive

These features mean continuous on-stream performance,
low maintenance and dependability

**NON-REVERSE
COUPLING,**
standard on hollow-
shaft drives

high tensile strength
cast iron **HOUSING**

quick visual inspection
of gear lubrication with
OIL SIGHT WINDOW
(not shown)

**HOLLOW OR SOLID
SHAFT**

externally mounted **OIL
COOLER** with top and
bottom cooling water
connections

weatherproof light weight
COVER

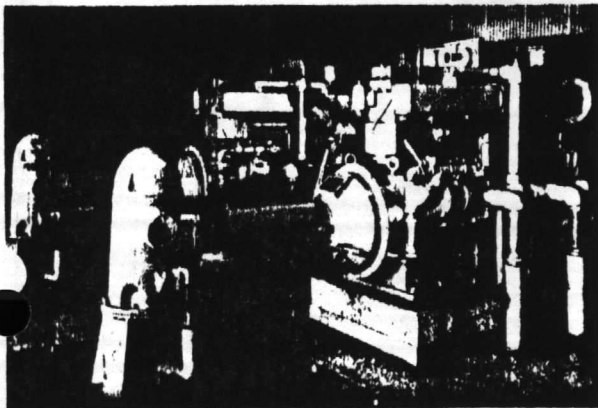
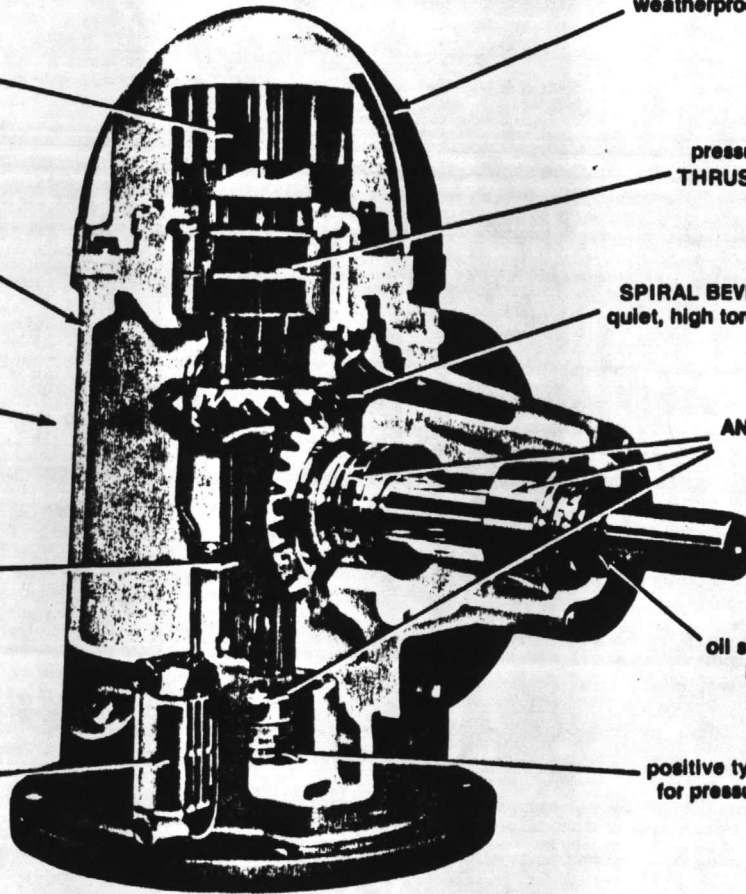
pressure-lubricated
THRUST BEARINGS

SPIRAL BEVEL GEARS for
quiet, high torque operation

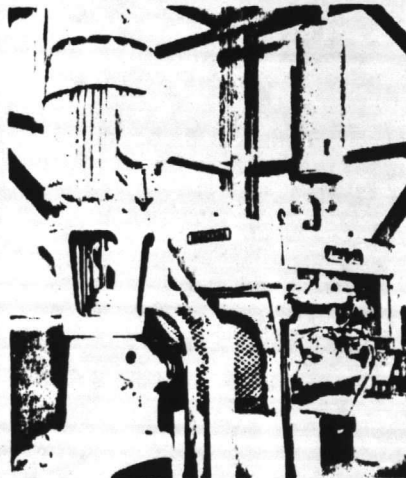
**ANTI-FRICTION
BEARINGS**

oil seal protection
by **SLINGERS**

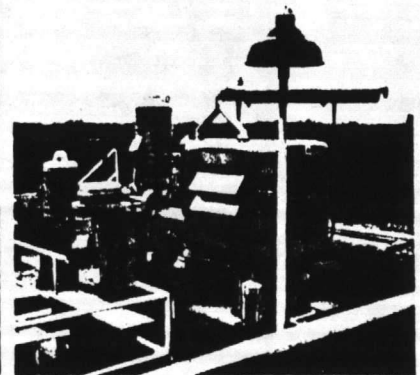
positive type **OIL PUMP**
for pressure lubrication
of bearings



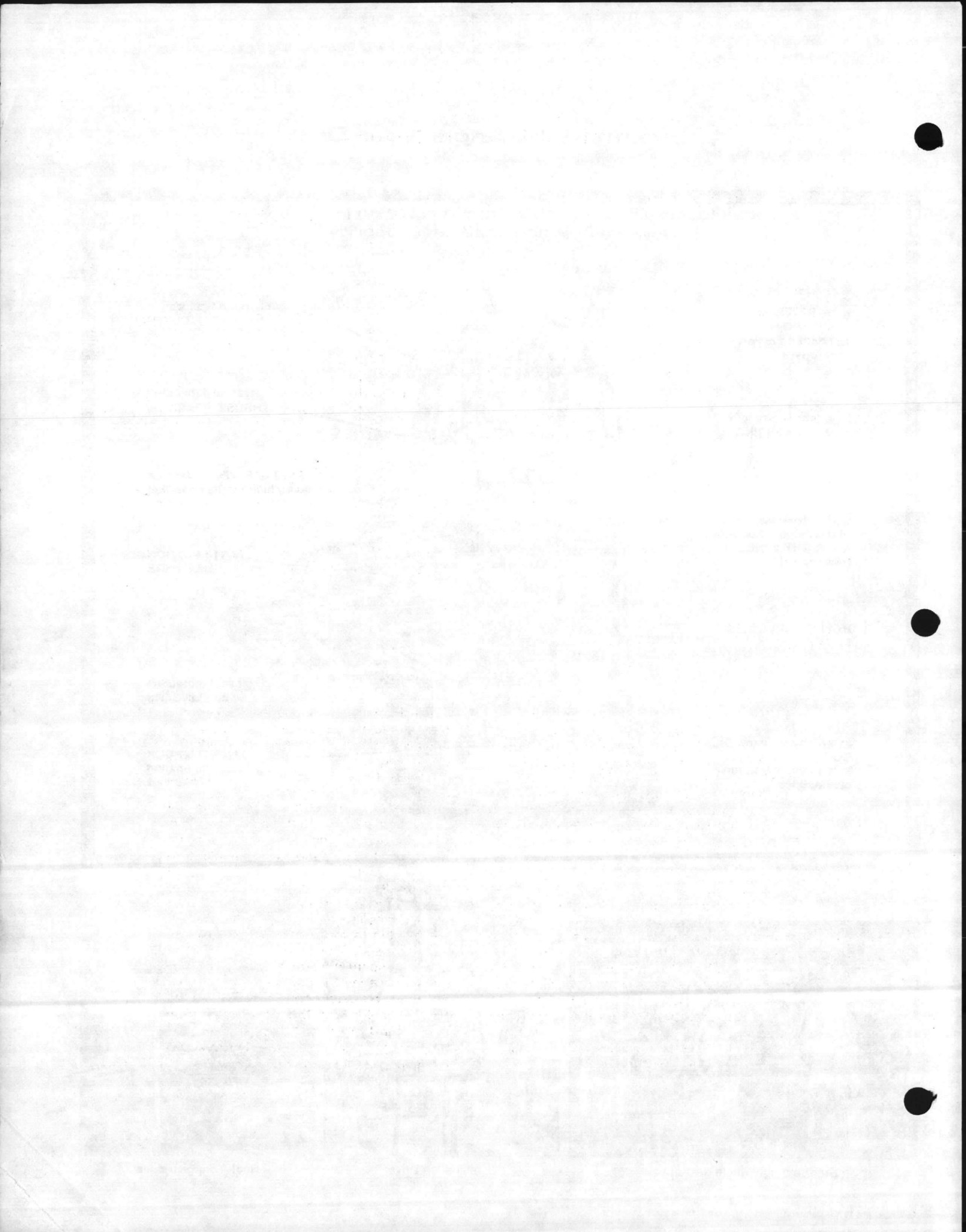
Standard right angle gear drive



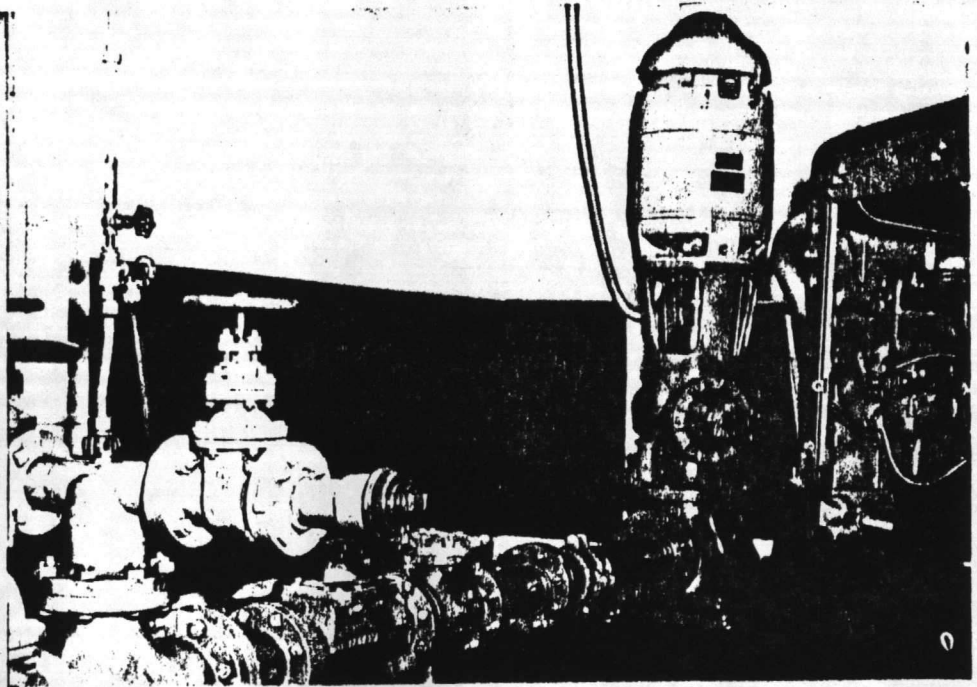
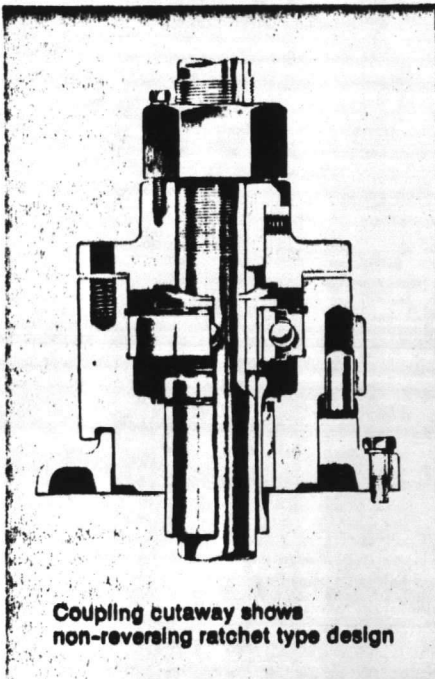
Combination Drive



Redi-Torq gear drive



Combination Drives



Fast changeover prevents costly downtime in emergencies

The Combination Drive—widely preferred by municipalities, waterworks corporations, and those responsible for fire and flood protection—provides pumping assurance when emergencies occur. Either a motor or a mechanical power unit can drive the pump to prevent costly service interruptions. When one of the driving units is down the pump can be operated by the other.

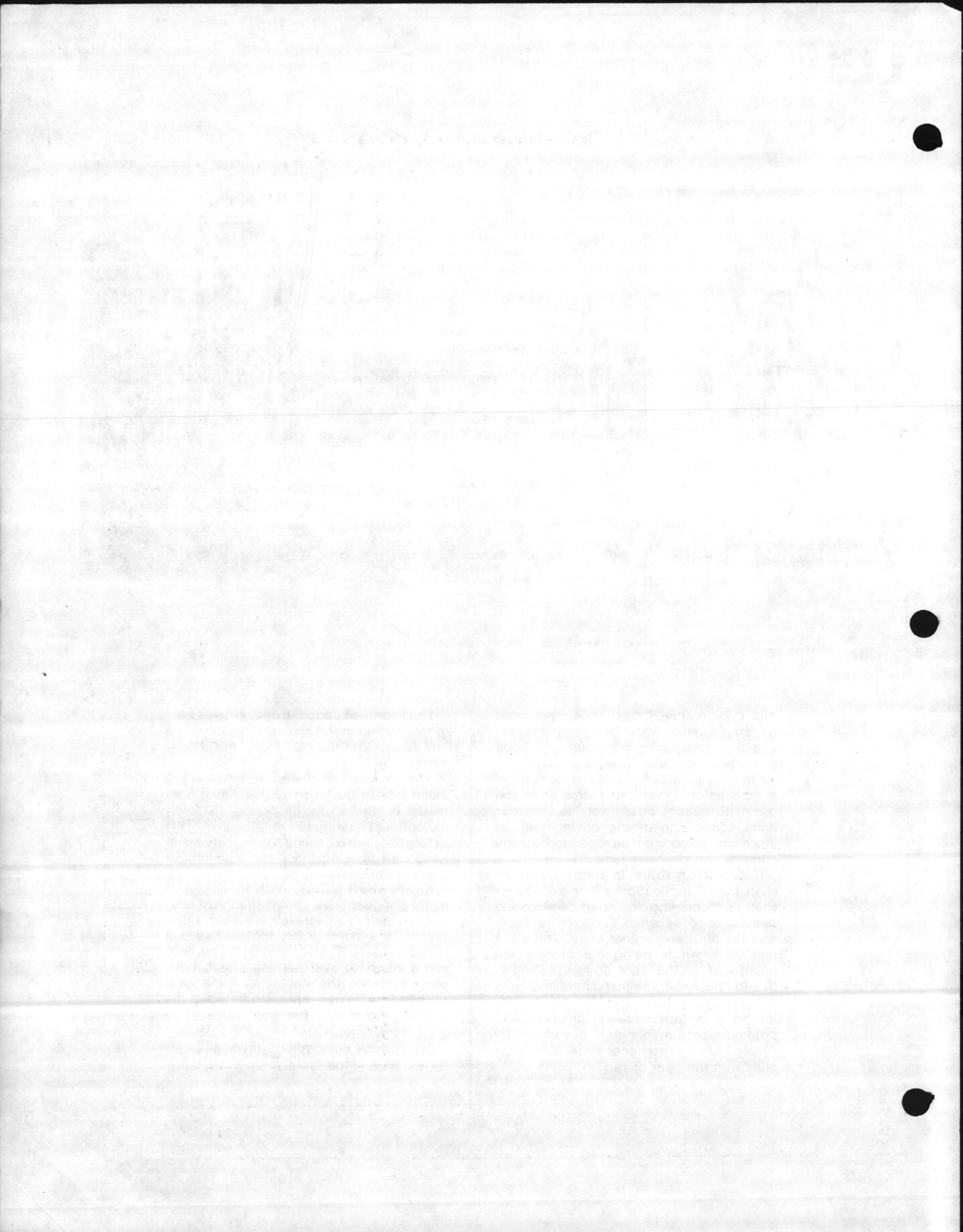
Hollow-Shaft Motor. In a normal hollow-shaft motor application either a through-shaft or a coupling and shaft combination can be used between the electric motor and the right angle gear drive. When the electric motor is doing the driving, the upper half of the gear drive coupling is free to rotate with the pump headshaft and the gears do not revolve. In case of electric motor or power failure the pump can be driven by a mechanical power unit by simply installing stainless steel bolts, supplied with the gear drive.

The improved coupling design gives better protection to the sealed steady bearing and eliminates the possibility of accidental engagement.

Thrust Load Transfer. If the electric motor has to be removed, the thrust load of the pump can be transferred from the motor thrust bearing to the gear drive. This simply requires adjusting a nut on the pump headshaft to bring the pump impellers to the proper setting.

Solid-Shaft Motor. With this type of motor the gear drive carries the thrust load of the pump. The gears revolve when either the electric motor or horizontal drive unit is being used. The recommendation is to use a standard over-running clutch coupling between the engine and the gear drive, and a flexible coupling between the electric motor and the gear drive. (See page 9 for dimensions.)

For various combination drive arrangements consult the factory.



Thrust Capacity

Hollow Shaft Drives

Large capacity thrust bearings are provided to handle a wide range of pump equipment and heads of water. In most instances, the natural thrust of the gears is used to reduce the load on the bearings. This condition necessitates a minimum downthrust requirement to prevent a bearing separation. Unless otherwise specified, Johnson Gear drive units are furnished with a thrust bearing arrangement DT. Ratings shown in the STANDARD column apply.

When there are conditions of sustained upthrust or the minimum downthrust is not available in the installation, other bearing arrangements can be furnished. The TWO-WAY column shows the ratings for bearing arrangement DF. Upthrust and downthrust can be accommodated with this configuration.

When the downthrust exceeds the values of the STANDARD column, select a suitable size from the HEAVY THRUST column. These ratings are for bearing arrangement DT/DT.

The heavy duty model can also be furnished with bearing arrangement of DF/DT. The downthrust ratings are taken from the STANDARD column. The upthrust ratings are taken from the TWO-WAY column.

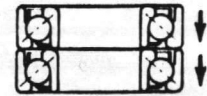
Other Drives

Ratings for Combination, Solid Shaft, and Redi-Torq® drives are taken from the TWO-WAY column. Consult the factory when there are conditions not covered by the following table.

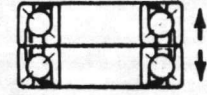
Bearing

Arrangements

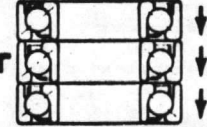
DT



DF



DT/DT



DF/DT

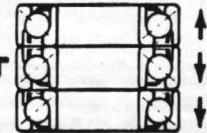


Table 2. THRUST CAPACITY (in pounds)

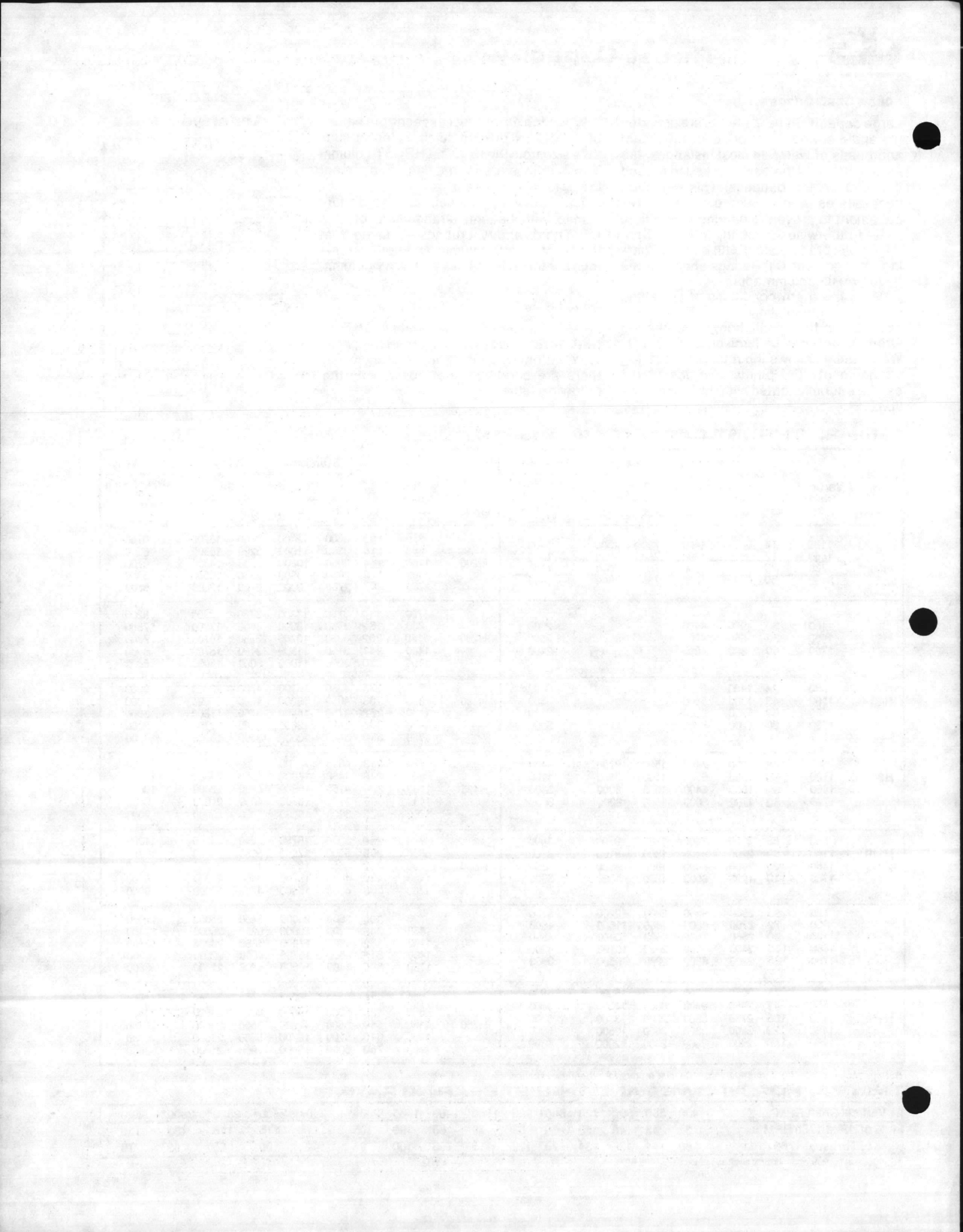
Model	Vertical Shaft RPM	H.P.	Standard		Heavy		Two-Way		Model	Vertical Shaft RPM	H.P.	Standard		Heavy		Two-Way	
			Downthrust Only				Downthrust or Upthrust Max.					Downthrust or Upthrust Max.					
			Min.	Max.	Min.	Max.	Min.	Max.				Min.	Max.	Min.	Max.	Min.	Max.
H20	1160	15		1400	750	2300		1400	H200	720	100	3600	12000	3400	16200		6750
	1460	17		1300	750	2200		1300		860	116	3300	11000	3200	15300		6300
	1760	20		1200	750	2000		1200		1160	144	3050	10200	3000	14300		5700
	3460	30		1000	750	1600		1000		1460	172	2860	9500	2850	13500		5300
									1760	200	2700	9000	2700	13000		5100	
H40	1160	30	900	4400				2600	H280	720	140	3750	13700	3750	18800		8200
	1460	35	850	4200				2500		860	162	3550	13000	3600	17900		7800
	1760	40	800	4000				2400		1160	202	3350	12200	3350	16700		7300
										1460	241	3150	11500	3150	15700		6900
									1760	280	3000	11000	3000	15000		6600	
H60	860	34	1450	6000				3600	H350	720	175	4250	16300	4200	20000		9800
	1160	43	1300	5500				3300		860	203	4050	15500	4000	19000		9300
	1460	52	1250	5200				3100		1160	252	3750	14400	3750	17800		8600
	1760	60	1200	5000				3000		1460	301	3550	13600	3500	16700		8200
									1760	350	3400	13000	3400	16000		7800	
H80	860	46	2050	7400	1500	9700		4400	H425	720	213	4650	18700	4750	25000		11200
	1160	58	1950	6900	1500	9100		4100		860	246	4450	17900	4550	24000		10700
	1460	69	1800	6400	1500	8300		3800		1160	306	4150	16600	4200	22000		10000
	1760	80	1700	6000	1500	8000		3000		1460	366	3900	15700	4000	21000		9400
									1760	425	3800	15000	3800	20000		9000	
H110	860	63	2350	7400	1800	9700		4400	H500	720	250	5250	18700	5250	25000		11200
	1160	80	2200	6900	1800	9100		4100		860	290	5000	17900	5050	24000		10700
	1460	95	2050	6400	1800	8500		3800		1160	360	4650	16600	4600	22000		10000
	1760	110	1900	6000	1800	8000		3000		1460	430	4400	15700	4400	21000		9400
									1760	500	4200	15000	4200	20000		9000	
H125	720	63	2900	8500	2800	12200		5100	H600	720	300	5500	20000	5450	26000		12000
	860	72	2700	8000	2650	11600		4800		860	348	5200	19000	5250	25000		11400
	1160	90	2550	7500	2500	10800		4500		1160	432	4900	17800	4850	23000		10700
	1460	108	2400	7000	2300	10100		4200		1460	516	4600	16700	4600	22000		10000
	1760	125	2200	6500	2200	9500		3900		1760	600	4400	16000	4400	21000		9600
H150	720	75	3050	9800	3150	15000		5900	H750	720	375	6200	20000	6250	26000		12000
	860	87	2950	9400	3000	14300		5600		860	435	5900	19000	6000	25000		11400
	1160	108	2750	8800	2800	13300		5300		1160	540	5500	17800	5500	23000		10700
	1460	129	2600	8300	2600	12500		5000		1460	645	5200	16700	5300	22000		10000
	1760	150	2500	8000	2500	12000		4800		1760	750	5000	16000	5000	21000		9600

Ratings shown are for fig. 1, rotation only. Consult factory for other figure ratings.

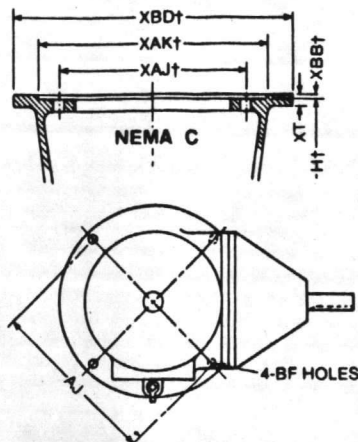
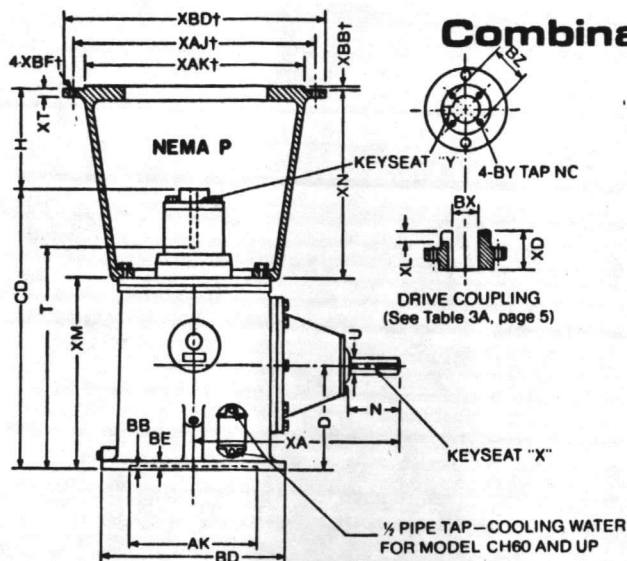
Table 2A. HORSEPOWER AND THRUST BEARING RATINGS

Vertical Shaft RPM	430	580	690	720	860	960	1160	1460	1760	2000*	2200*	2400*	2800*	3000*	3520*
% of HP at 1760 RPM	34	43	48	50	58	63	72	86	100	105	111	116	128	133	150
% of Thrust at 1760 RPM	160	144	136	134	126	122	115	106	100	96	92	90	85	83	79

*Consult factory when vertical shaft speed exceeds 1760 RPM.



Combination Drives - Hollow Shaft



Speed decreasing ratios in Models CH150 and up are subject to change in dimensions: U - XA - N - X. Contact factory for certified print.

Table 4. COMBINATION DRIVE DIMENSIONS (Hollow Shaft) in Inches

Model	CD	D	U	XA	N	XM	H	BE	BD	AJ	AK	BB	BF	Keyseat X
CH20	16	8 3/4	1 1/2	13	2 3/4	11 1/4	7 3/4	3/4	10	9 1/2	8 1/4	3/16	7/16	1/4 x 1/2 x 2 1/4
CH40 (12)	22 1/4	9	1 1/2	16	3 1/2	15 1/4	9	3/4	12	9 1/2	8 1/4	3/16	7/16	3/8 x 7/16 x 2 3/4
CH40	22 1/4	9	1 1/2	16	3 1/2	15 1/4	9	3/4	16 1/2	14 3/4	13 1/2	3/16	11/16	3/8 x 7/16 x 2 3/4
CH60	22 1/4	9	1 1/2	16	3 1/2	15 1/4	9	3/4	16 1/2	14 3/4	13 1/2	3/16	11/16	3/8 x 7/16 x 2 3/4
CH80	22 1/4	9	1 1/2	16 1/2	3 1/2	15 1/4	9	3/4	16 1/2	14 3/4	13 1/2	3/16	11/16	1/2 x 1/4 x 2 3/4
CH110	26 3/4	11 3/4	2	17 1/2	3 1/2	19 3/4	9 3/4	1	16 1/2	14 3/4	13 1/2	3/16	11/16	1/2 x 1/4 x 2 3/4
CH125	26 3/4	11 3/4	2	17 1/2	3 1/2	19 3/4	9 3/4	1	16 1/2	14 3/4	13 1/2	3/16	11/16	1/2 x 1/4 x 2 3/4
CH150	31 3/4	13 3/4	2 7/16	20 1/2	4 3/4	23 1/4	10 3/4	1	20	14 3/4	13 1/2	3/16	11/16	5/8 x 7/16 x 3 3/4
CH200	31 3/4	13 3/4	2 7/16	20 1/2	4 3/4	23 1/4	10 3/4	1	20	14 3/4	13 1/2	3/16	11/16	5/8 x 7/16 x 3 3/4
CH280	36	15	2 3/4	24	5 1/2	26 3/4	12 3/4	1 1/4	20	14 3/4	13 1/2	3/16	11/16	5/8 x 7/16 x 4 3/4
CH350	40 1/2	16 1/2	2 3/4	29	5 1/2	29 3/4	12 3/4	1 1/4	24 1/2	22*	13 1/2	3/8	1 3/16	5/8 x 7/16 x 4 3/4
CH425	41 3/4	16 1/2	3	30	5 3/4	29 3/4	12 3/4	1 1/4	24 1/2	22*	13 1/2	3/8	1 3/16	7/8 x 7/16 x 4 3/4
CH500	41 3/4	16 1/2	3 1/2	31	6 3/4	29 3/4	12 3/4	1 1/4	24 1/2	22*	13 1/2	3/8	1 3/16	7/8 x 7/16 x 5 1/2
CH800	45 3/4	16 1/2	3 3/4	33	7 1/2	31 3/4	10 1/2	1 1/4	24 1/2	22*	13 1/2	3/8	1 3/16	7/8 x 7/16 x 5 1/2
CH750	48	19	4	36	7 1/2	37	12	1 1/2	30 1/2	26	22	3/8	1 3/16	1 x 1/2 x 6 3/4

H as determined using maximum XN
*Also 5/8-11 Tap on 14-3/4 Bolt Circle 1" Deep

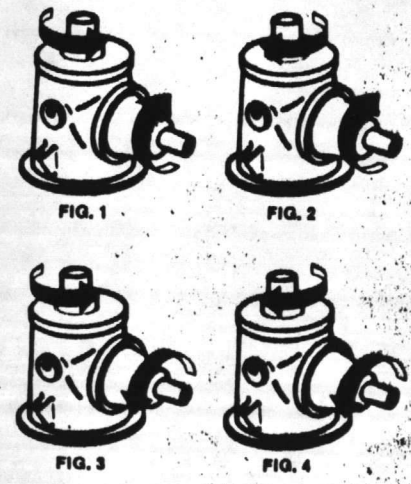
Table 4A. MAX. DRIVE COUPLING BORE SIZE AVAILABLE MOTOR STAND

Model	XD	Max. BX		T	XN Available Motor Stand	XT	Top Flange †	
		Fig. 1 & 4	Fig. 2 & 3					
CH20	1 3/4	1	3/4	13 1/4	8 1/2	10	12 1/2	7/16
CH40	2 3/8	1 1/2	1 1/4	18 3/4	12 1/2	16		3/4
CH60	2 3/8	1 1/2	1 1/4	18 3/4	12 1/2	16		3/4
CH80	2 3/8	1 1/2	1 1/4	18 3/4	12 1/2	16		3/4
CH110	2 3/8	1 1/2	1 1/2	23	12 1/2	17		3/4
CH125	2 3/8	1 1/2	1 1/2	23	12 1/2	17		3/4
CH150	2 3/8	1 1/2	1 3/4	27 1/2	15	19		3/4
CH200	2 3/8	1 1/2	1 3/4	27 1/2	15	19		3/4
CH280	2 3/8	2	2	31 1/2	15	22		3/4
CH350	3 1/8	2 3/16	2 3/16	35 1/2	15	24		1
CH425	3 3/8	2 7/16	2 7/16	35 3/4	15	24		1
CH500	3 3/8	2 7/16	2 7/16	35 3/4	15	24		1
CH600	4	2 1/2	2 1/2	38 1/4	19	24		1
CH750	4	3 3/16	3 3/16	41 3/4	**	24		1 1/4

MACHINED TO SUIT**

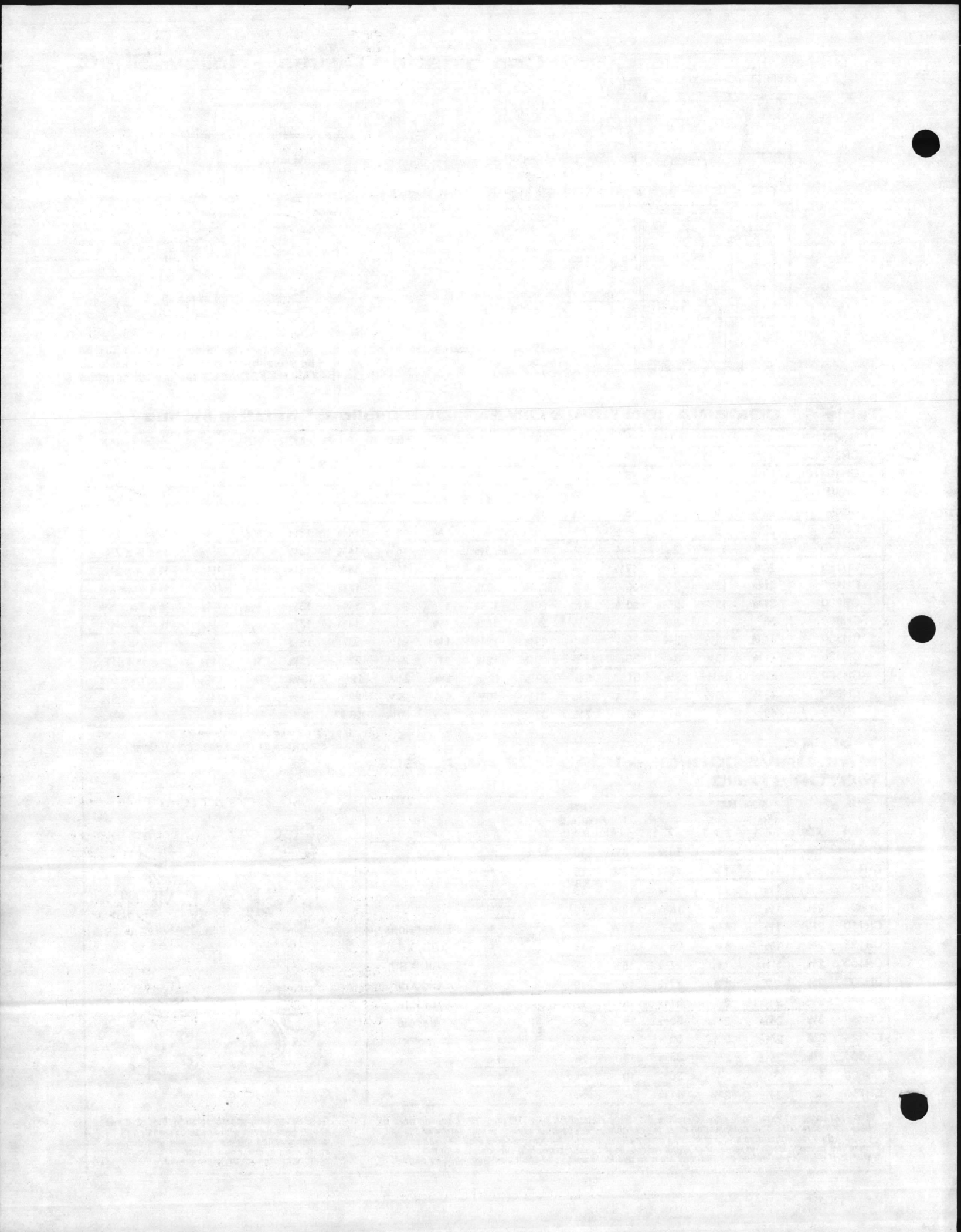
Dimensions XBD, XAJ, XAK, XBB, and XBF to suit electric motor

ROTATION



Gear drives with special rotation (Figs. 2, 3 and 4) and gear drives with speed decreasing of 7:4 or higher ratios are manufactured to order, and such orders are not subject to cancellation without charge for parts processed.

Tolerances: Shaft Extensions plus .000 minus .001; Base Rabbet AK plus .002 plus .005; Coupling Bore BX plus .0005 plus .0015. The combination drive is desirable where 24-hour service is mandatory and is preferred by municipalities and waterworks corporations. Electric motor or engine may be used to drive the pump, permitting removal of either for repairs without interrupting service. As with the standard drive, combination applications are also available with solid shaft construction. See page 6.

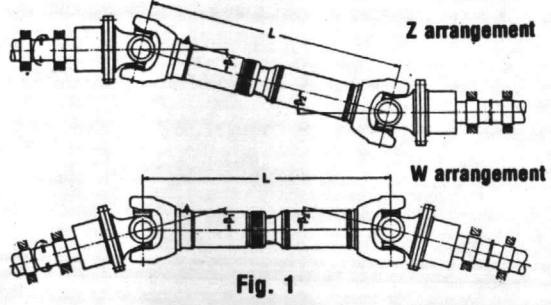


INSTALLATION and MAINTENANCE INSTRUCTIONS

For Parrish Universal Joint/Intermediate Industrial Shafting

PRE-INSTALLATION INSPECTION

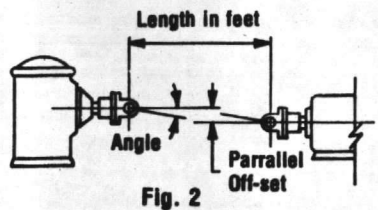
- Even though drive shafts have the unique capability of accepting both axial and offset movements, the following precautions must be taken:
 1. WORKING ANGLES (B₁ and B₂) of both the driver and driven equipment MUST BE EQUAL to one another within plus or minus 1 degree.



An offset of 1/8 to 3/16 of an inch per foot or a working angle of 1 degree is preferred to provide needle bearing rolling action. Use Table 1 to approximate offset and/or working angle. NOTE: Working angle MUST BE HELD to within 8° on standard shafting, 5° on short coupled shafting. Where working angle exceeds these recommendations, contact Parrish Engineering.

	1°	2°	3°	4°	5°	6°	7°	8°
	OFFSET IN INCHES							
1	.209	.419	.625	.839	1.049	1.261	1.473	1.686
2	.418	.838	1.250	1.678	2.098	2.522	2.946	3.372
3	.627	1.257	1.875	2.517	3.147	3.783	4.419	5.058
4	.836	1.676	2.500	3.356	4.196	5.044	5.892	6.744
5	1.045	2.095	3.125	4.195	5.245	6.305	7.365	8.430
6	1.254	2.514	3.750	5.034	6.294	7.566	8.838	10.116
7	1.463	2.933	4.375	5.873	7.343	8.827	10.311	11.802
8	1.672	3.352	5.000	6.712	8.392	10.088	11.784	13.488
9	1.881	3.771	5.625	7.551	9.441	11.349	13.257	15.174
10	2.090	4.190	6.250	8.390	10.490	12.610	14.730	16.860

Table 1



2. Check flange bores and shaft diameters for PROPER FIT.

3. SUPPORTING STRUCTURES:

- a) FOUNDATIONS for all installations must be adequate since most power units will vibrate to some extent. Proper steel beams or concrete foundation, with hold down bolts, are necessary to maintain alignment and to eliminate damaging vibrations. INADEQUATE foundations will VOID the Parrish warranty.

- b) STEADY BEARING SUPPORTS must have enough rigidity to avoid vibrations. It is recommended that the following suggestions be observed:

1. Keep SPANS as short as possible.
2. Make end CONNECTIONS rigid.
3. Use rigid beams and install so that the principle section modulus OPPOSES the horizontal forces.
4. Beam selection should be sized so that the horizontal and vertical NATURAL FREQUENCY of the beam is 4 times the maximum system RPM.

TRANSPORTATION and STORAGE

- Drive shafts which have been stored for a long period of time, should be re-greased in working position prior to start up. See LUBRICATION section.
- Generally, drive shafts should be transported in a HORIZONTAL position. Fig. 3

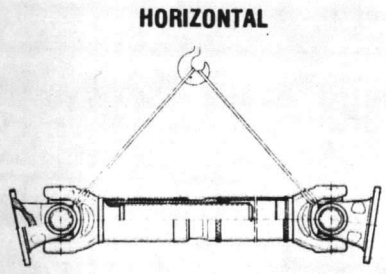


Fig. 3

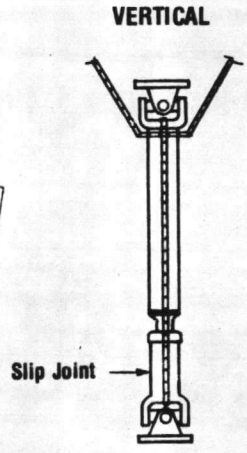


Fig. 4

- For VERTICAL INSTALLATIONS additional protection must be provided in order to eliminate the possibility of drive shaft from coming apart at the Spline connection (SLIP JOINT). Fig. 4 CAUTION: The dust cap and spline seal could be damaged by incorrectly hanging the drive shaft in a vertical position.

- SHOCKS, BUMPS, and MISHANDLING must be avoided to assure proper performance. Abuse could result in bending the drive shaft causing WHIPPING and UNBALANCE problems. Damage of this nature will VOID the warranty.

- Damage to cartons or crates during shipping becomes the responsibility of the freight carrier and consignee and must be noted or reported at time of receipt of shipment.

COMPANION FLANGE INSTALLATION

- STOCK BORED flanges are bored with a plus .001 minus .000 tolerance and should be a slip fit over the mating shaft. Align keyways in both the flange and shaft and gently tap flange on.
- INTERFERENCE or SHRINK FITS require heating the flange uniformly (preferably submerged in oil not exceeding 350°F) to expand the bore. Align the keyways in both the shaft and flange, slide flange onto shaft and allow to cool. CAUTION: DO NOT attempt to hammer an undersize flange on without heat.

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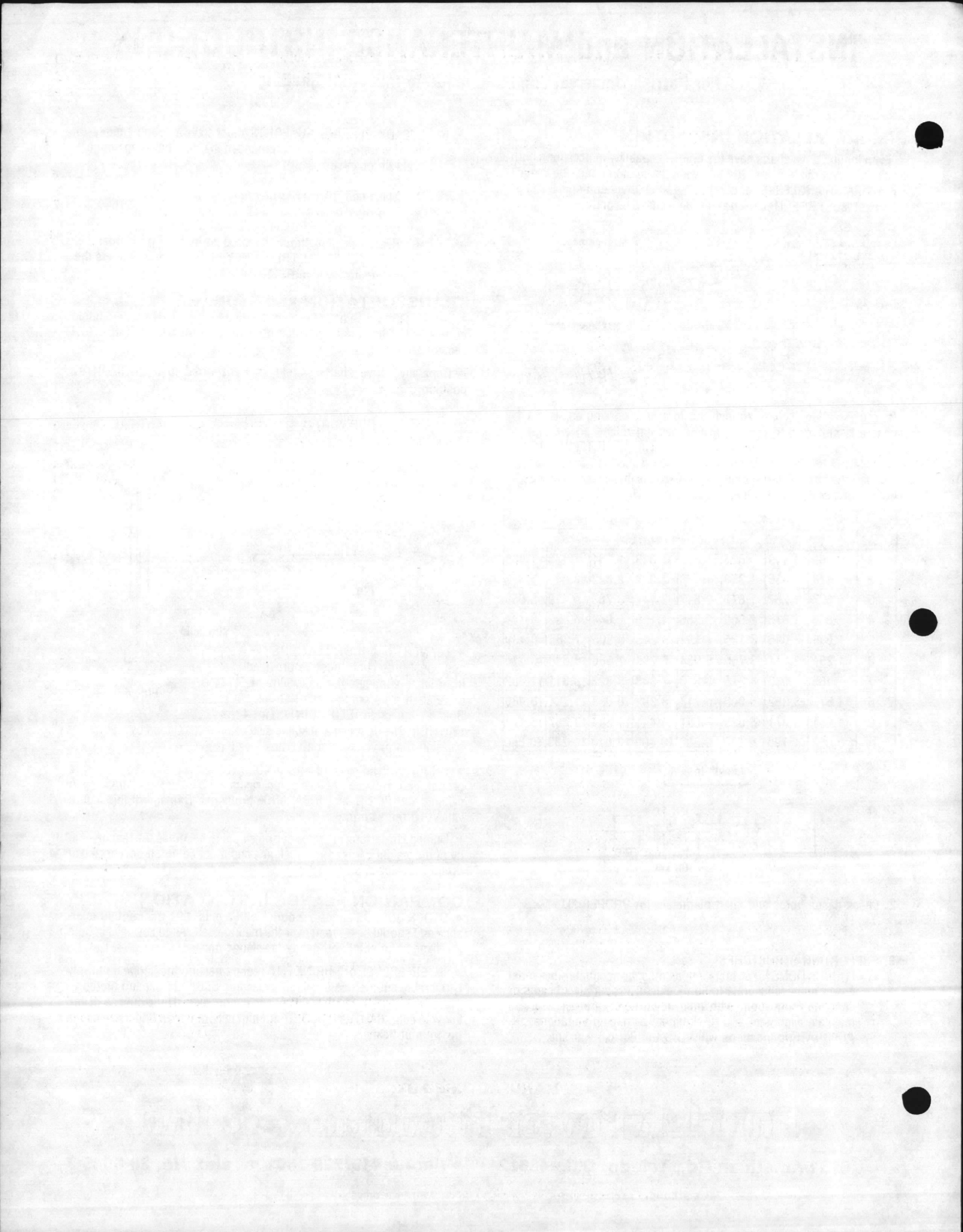
Parrish Power Products Inc.



6151 American Rd., Toledo, Ohio 43612

• Phone 419/729-1601 • Telex No. 28-6045

WE STRONGLY RECOMMEND THE USE OF SHAFT GUARDS WITH ALL DRIVE SHAFTS.



- **TAPER BORED** flanges require great care to insure proper interference fit between shaft and bore. GRAPH 1 shows the amount the flange has to be advanced to maintain a given interference (use dial indicator to measure advancement).

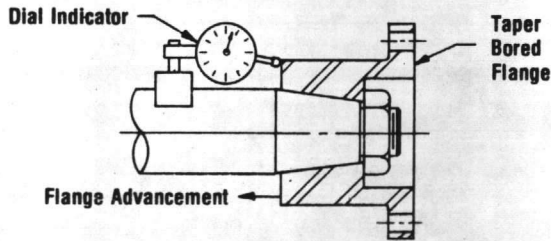
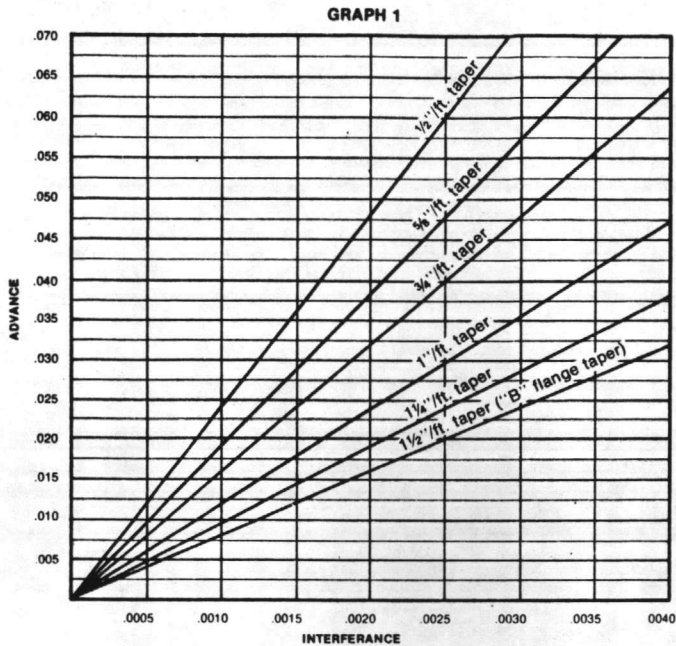


Fig. 5

NOTE: To facilitate installation and future removal, it is recommended that a light grease be used on shaft and threads. Install tapered flange onto shaft. Tighten retaining nut until firmly seated against flange and flange is firmly seated against shaft. Attach dial indicator (Fig. 5) to shaft and begin tightening nut until proper advancement is obtained.

REFERENCE: All Parrish "B" Flanges are SAE TAPERS (1 1/2" / ft) and require an interference fit of .001 to .002 for light or medium duty shafting and .002 to .004 for heavy duty shafting.

- In **VERTICAL** applications, most of the shafting weight is supported from the upper companion flange. We **RECOMMEND** that when a drive shaft or multiple section drive shaft installation weighs over 150 lbs., it should be supported in one of the following ways:

1. Ordering flanges with an **EXTRA SET SCREW** 90° from the keyway (DO NOT use with drive shafts weighing over 300 lbs.).
2. Ordering special bored flanges with the bore machined **UNDER-SIZED** for a **SHRINK FIT** (refer to above for proper installation of shrink fits).
3. Ordering flanges with a **COUNTER BORE** for a split ring adapter.
4. Ordering flanges with a **TAPER BORE** (consult with motor manufacturer).

- After installing companion flange, check runout of companion flange pilot (.003 T.I.R. maximum permissible).
- There are four types of flanges as shown in Fig. 6

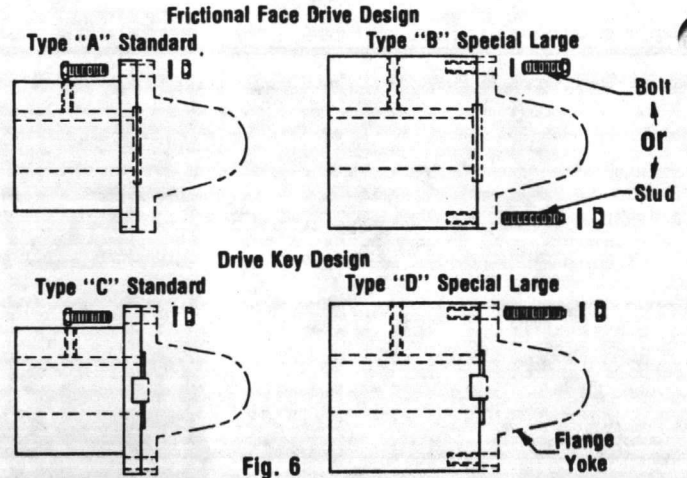


Fig. 6

Types A, C and some B utilize bolt, nut, and lockwasher which are installed after positioning drive shaft.

Type D and some B utilize a special stud, nut, and lockwasher which must be installed before positioning drive shaft. Insert **SQUARE** end of **STUD** through hole in flange yoke. Slide lockwasher over **STUD** and thread **NUT** onto **STUD** until the square portion of stud is showing.

Install drive shaft (see drive shaft installation section).

Screw **STUD** into **COMPANION FLANGE** until firmly seated. Tighten nut to specified torque indicated in Table 2.

INSTALLATION OF DRIVE SHAFT

- **HORIZONTAL APPLICATION** (single section).

Lower drive shaft into position and extend ends so that the pilot is seated firmly into mating companion flange and bolt holes are lined up. Insert bolts or studs, nut, and lockwashers and tighten to specified torque indicated in Table 2.

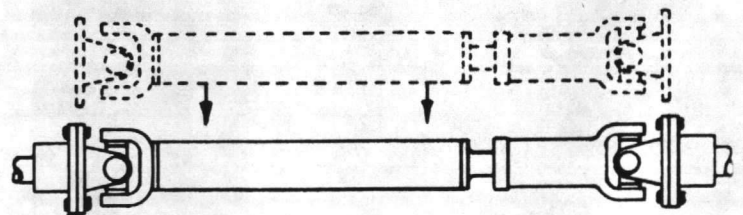
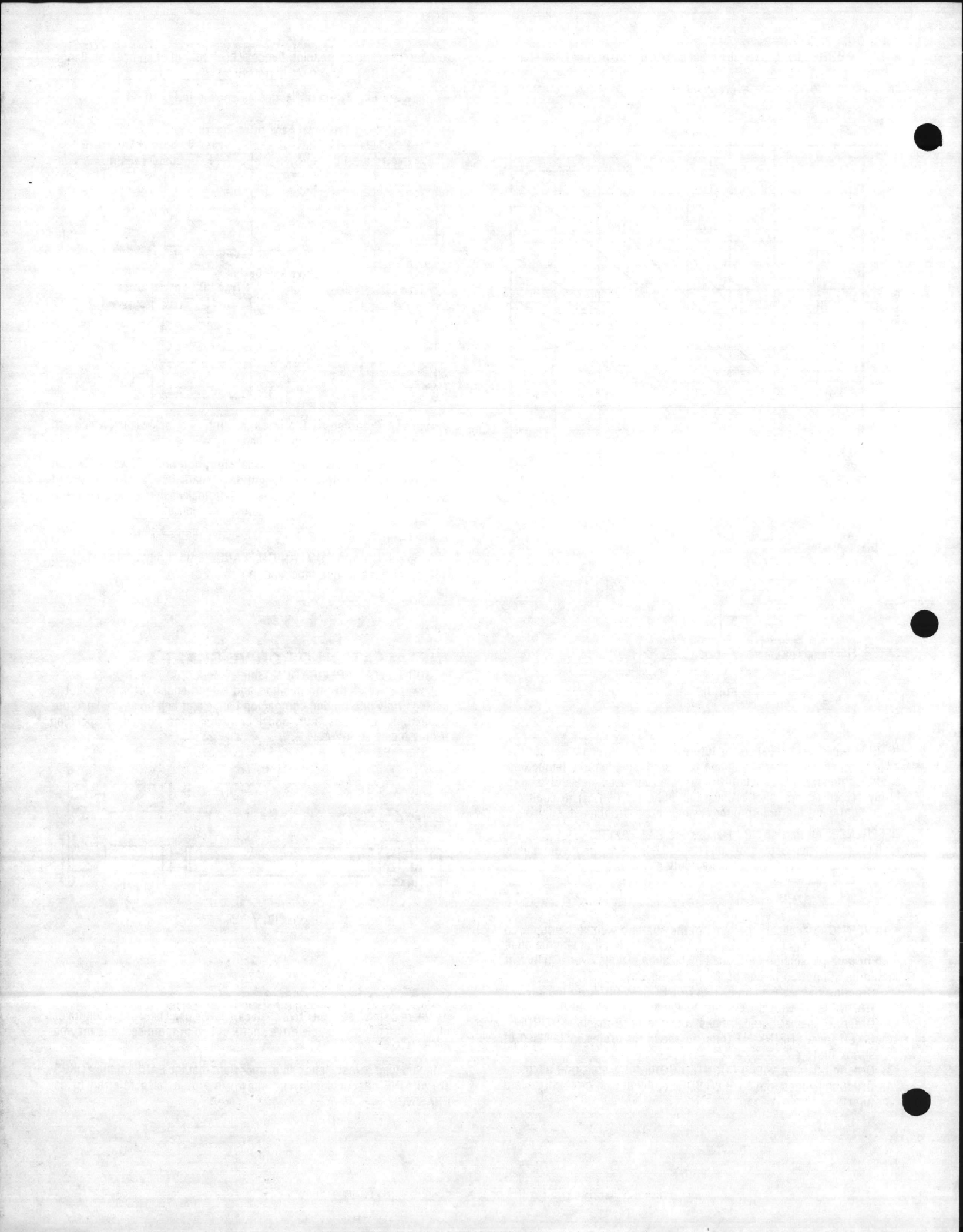


Fig. 7

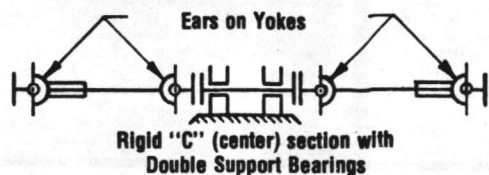
- **HORIZONTAL APPLICATION** (multiple sections).

Where a single section drive shaft can not be used because of length or other restrictions, multiple drive shafts of two or more sections may be used.

In this type of installation, it is important that the **EARS** on the **YOKES** are in **LINE** after assembly as shown in Fig. 8 (also referred to as **PHASING**).



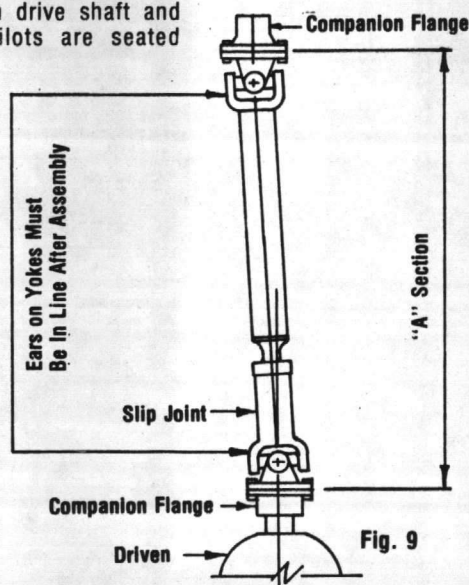
Basic Horizontal Arrangements



Lower drive shafts into position and extend ends so that the pilots are seated firmly into mating companion flanges and bolt holes are lined up. Insert bolts or studs, nut, and lockwashers and tighten to specified torque indicated in Table 2.

• VERTICAL APPLICATION (single section).

Raise drive shaft into a vertical position (CAUTION: Make sure that slip joint is secured to drive shaft — see TRANSPORTATION SECTION). Position drive shaft and extend ends so that pilots are seated firmly into mating companion flange and bolt holes are lined up. Insert bolts or studs, nuts, and lockwashers and tighten to specified torque indicated in Table 2.



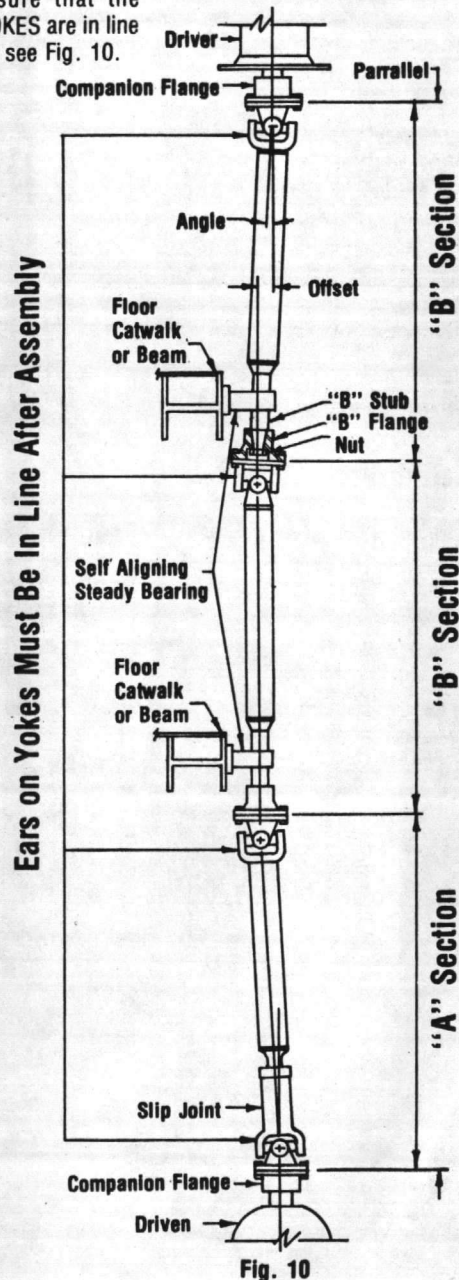
• VERTICAL APPLICATION (multiple sections).

In multiple section installations, start with the upper most "B" section of shafting:

1. Laying the "B" section out on the floor, slide steady bearing over neck of the "B" stub followed by the TAPERED "B" FLANGE, NUT, AND COTTER PIN. NOTE: NUT must be tightened so that there is approximately .001 to .004 diametral interference between bore and shaft — refer to TAPER BORE FLANGE section on page 2.
2. Attach universal end of shafting to upper companion flange so that pilot is seated firmly and holes are lined up. Insert bolts or studs, nuts, and lockwashers and tighten to specified torque indicated in Table 2.

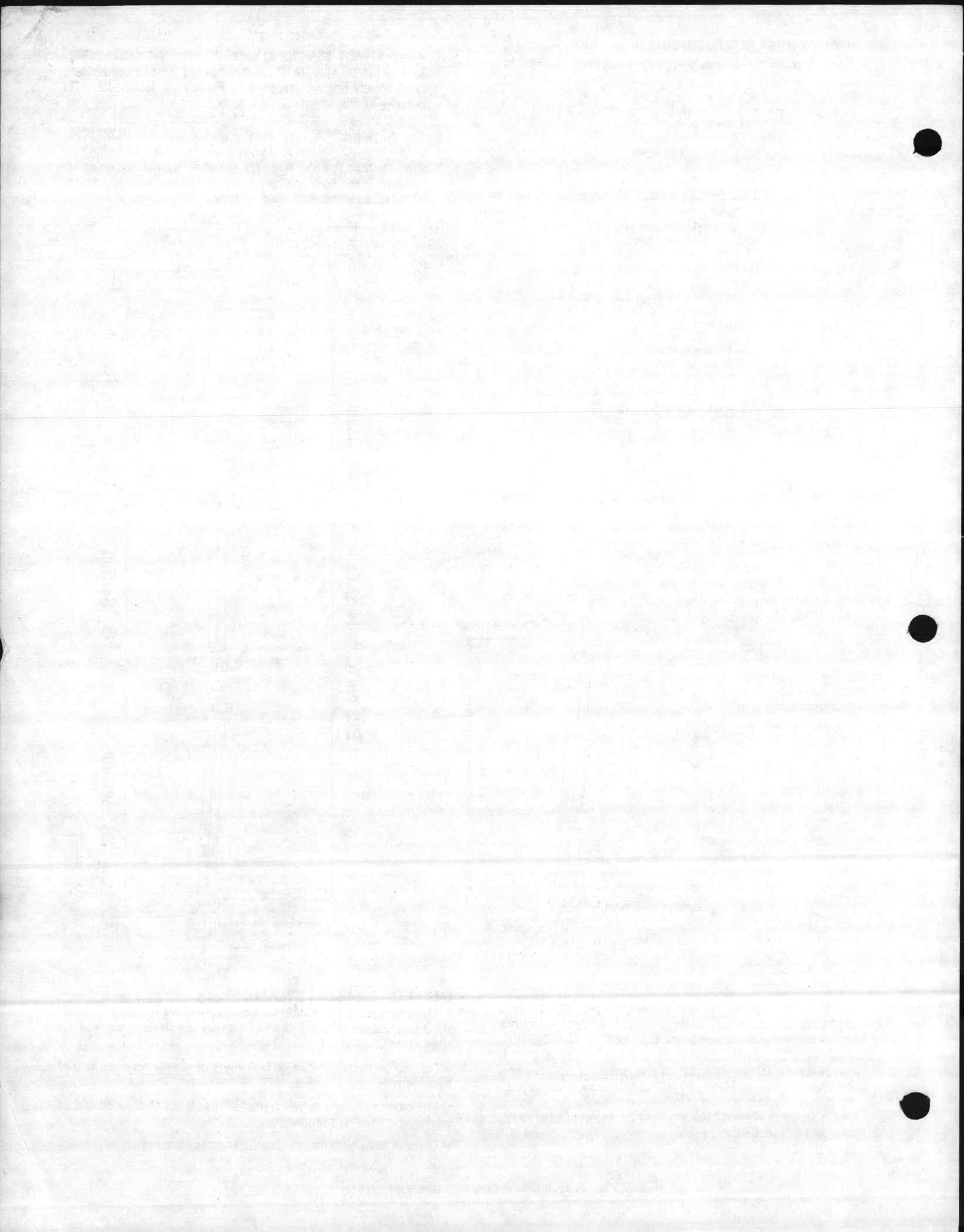
3. Attach STEADY BEARING to support beams and secure steady bearing to "B" stub. NOTE: Steady bearing must be self-aligning type. Steady bearings supplied by Parrish are designed for 1½ degrees misalignment. Shim if necessary.
4. Repeat Steps 1 thru 3 for each "B" Section.
5. The bottom or "A" Section is installed with the SLIP JOINT mounted to COMPANION FLANGE on the driven unit. Position drive shaft so that the pilots are seated firmly and bolt holes are lined up. Insert bolts or studs, nuts, and lockwashers and tighten to specified torque indicated in Table 2.

NOTE: Make sure that the EARS on the YOKES are in line after assembly, see Fig. 10.



GENERAL MAINTENANCE

- Maintenance and lubrication should be carried out at regular intervals and it is advisable to coordinate this with the maintenance work of the other machine parts.
- Lubrication cycles should be 500 hours of normal service and 200 hours of continuous service.
- Noise testing — any deviation from normal levels of noise should be located and corrected immediately.
- Check of bolts for tightness should be carried out at regular intervals.



LUBRICATION

• Cross and bearing and sliding splines contain only enough grease to provide protection during storage. It is necessary to completely lubricate them prior to start-up to avoid premature failure.

• Points of lubrication:

1. Cross and bearing (Point "A" - Fig. 11) and steady bearing — lubricate with a good quality lithium soap base or equivalent E.P. grease for speeds over 500 RPM or SAE 140 to 250 oil for speeds under 500 RPM. NOTE: Lubricant MUST APPEAR at all four bearing seals to assure removal of dirt and contaminants. It may be necessary to move drive shaft from side to side while applying gun pressure to allow greater clearance on the thrust end of bearing that is not purging.
- 1A. Cross and bearing lubrication for Series 200, 201, 211, 221, 231, 241, 251, 261, and 271. To lubricate, rotate drive shaft so that the oil plug is at a 45° position, Fig. 12. Remove oil plug and fill with SAE 140 GEAR OIL.

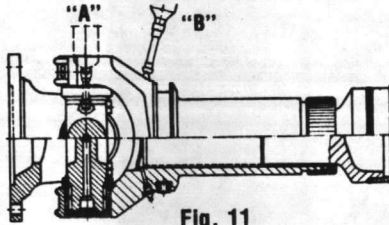


Fig. 11

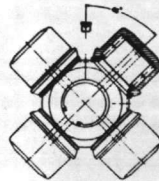


Fig. 12.

2. Sliding splines in slip joint - lubricate with only good grade of long fiber grease ("B" Fig. 11).

• Greases having acceptable properties: Cross and bearing: Shell Alvania EP2, Molyvis ST-200 grease, or Texaco PASR #629 oil or equal. Sliding splines: Texaco Marfac "O" EP or equal.

BOLT SPECIFICATIONS

Bolt Size	Series Used In	Wrench Torque Grade
3/8 - 24	27, 31, 61, 71	31' # 5
7/16 - 20	37, 41, 81	49' # 5
1/2 - 20	48, 55	78' # 5
5/8 - 18	88, 91	213' # 8
3/4 - 16	95	375' # 8

METRIC BOLT SPECIFICATIONS

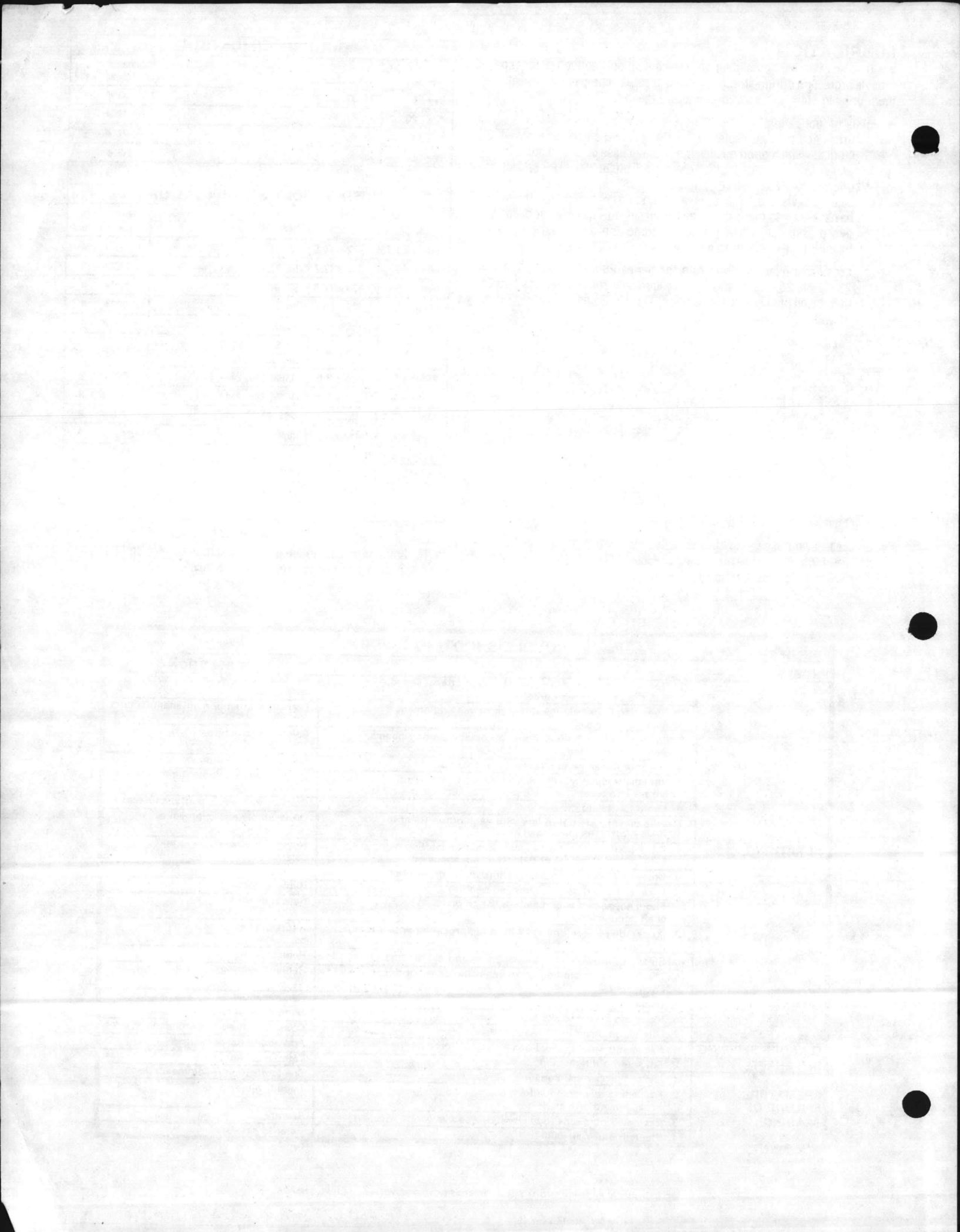
Metric Size	Inch	Series Used In	Wrench Torque Grade
12mm x 1.75	.472 x 14.5	92, 93	83' # 8
14mm x 2	.551 x 12.7	87, 94, 96	132' # 8
16mm x 2	.630 x 12.7	97, 98, 101, 200	205' # 8
18mm x 2.5	.709 x 10.2	99, 101S, 115, 201	283' # 8
20mm x 2.5	.787 x 10.2	115S, 125, 211	401' # 8
22mm x 2.5	.866 x 10.2	125S, 135, 135S, 145, 221, 231	545' # 8
24mm x 3	.945 x 8.5	145S, 155, 241	693' # 8
27mm x 3	1.063 x 8.5	155S, 165, 251	1013' # 8
30mm x 3.5	1.181 x 7.2	261, 271	1376' # 8
36mm x 4	1.417 x 6.2	308, 408	2465' # 8
48mm x 3	1.890 x 8.5	318	6300' # 8
56mm x 4	2.205 x 6.2	428	9800' # 8
64mm x 4	2.520 x 6.4	338, 358	14,325' # 8
72mm x 4	2.835 x 6.4	348, 368	21,275' # 8

Table 2.

NOTE: Bolts must be tightened in a crisscross pattern and tightened to specified torque to insure proper mating face contact.

TROUBLE SHOOTING GUIDE

PROBLEM	CAUSE	SOLUTION
VIBRATIONS	1. Operating in or near the critical or half-critical speed. Refer to critical speed graphs.	Reduce speed or rework using special tubing.
	2. Operating in or near the driver or driven equipment natural frequency.	Consult with equipment manufacturer.
	3. Inadequate foundations, floors, or steady bearing beams. Refer to supporting structure section.	Reinforce structure.
	4. Driver or driven components out of balance.	Consult with equipment manufacturer.
	5. Variable frequency controller inducing torsional surges into system.	Consult with equipment manufacturer.
	6. Pump Cavitating.	Consult with equipment manufacturer.
	7. Ears on yoke are not in line with each other. Refer to drive shaft installation section.	Disassemble and align yokes.
	8. Drive shaft may be out of balance due to shafting being bent during shipment or balancing not specified.	Return for straightening and balancing.
	9. Cross and bearing, steady bearing, or spline wore out.	Replace defective components.
	10. U-joints are stiff due to damaged bearing.	Replace bearing.
	11. Pilots not seated at companion flange or "B" shaft connections.	Reseat flanges.
	12. If operating in conjunction with a reciprocating engine, a torsional problem may exist.	A torsional analysis should be performed.
	13. Steady bearings are not self-aligning and are binding.	Replace.
	14. Thrust bearings binding up in either the driver or driven equipment.	Replace bearings.
	15. Exceeding recommended angular misalignments.	Reduce angle.
	16. Input and output shafts are not parallel.	Shim if necessary.
	17. Runout on driver or driven shafts.	Consult with equipment manufacturer.
FLANGES SLIPPING OFF SHAFT	1. Exceeding weight limitations for stock bored flanges. 2. Set screw not tightened.	Add additional set screw. Tighten set screw.
PREMATURE FAILURE OF BEARING	1. Lack of proper maintenance.	See lubrication recommendations.
	2. Exceeding recommended angular misalignment or Max. RPM.	Reduce either or both.
	3. Excessive vibrations (See vibrations sec. above).	See above.
	4. Shafting under specified.	Refer to catalog.

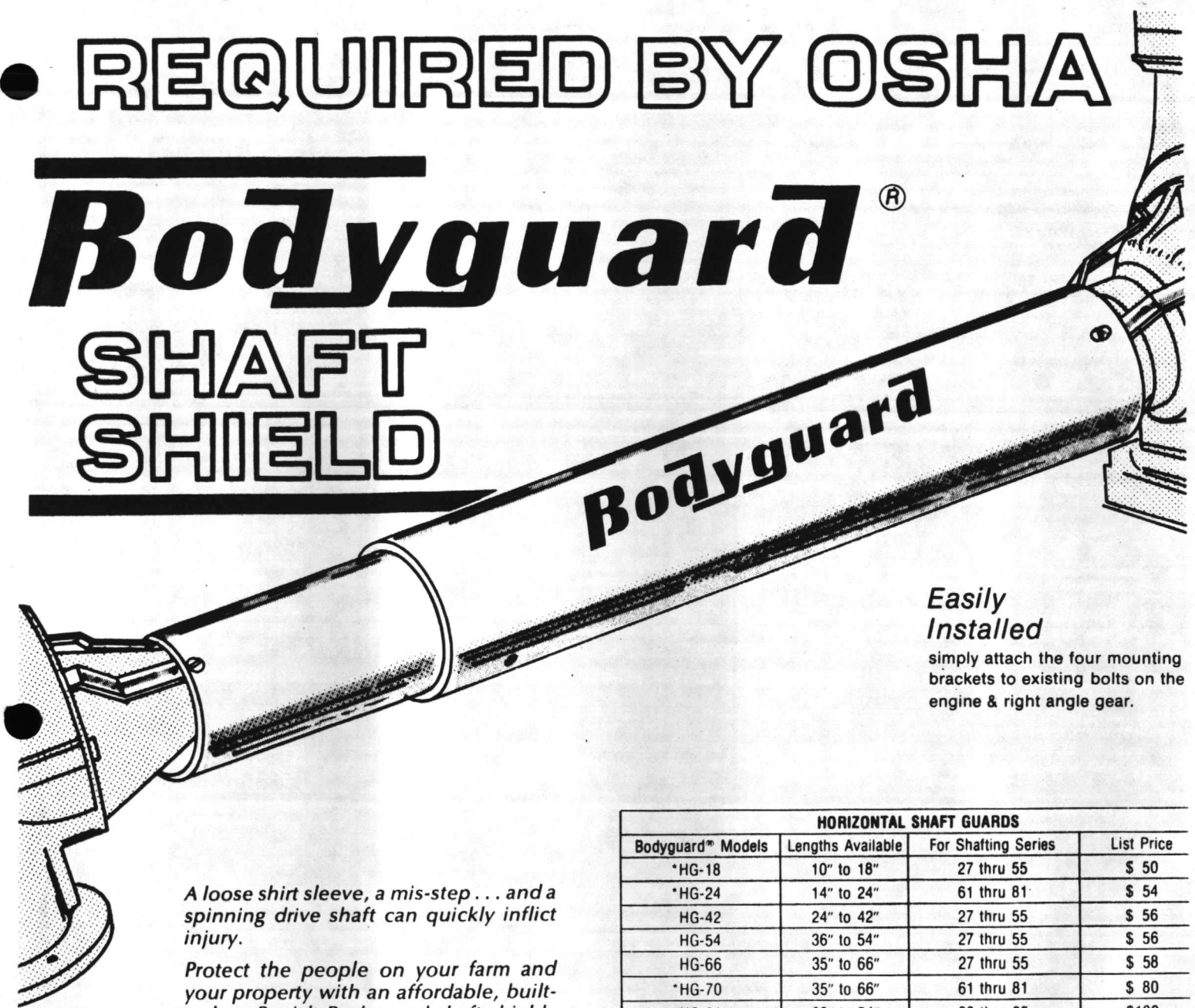


Helps prevent drive shaft injuries and liability!

REQUIRED BY OSHA

Bodyguard®

**SHAFT
SHIELD**



**Easily
Installed**

simply attach the four mounting brackets to existing bolts on the engine & right angle gear.

A loose shirt sleeve, a mis-step... and a spinning drive shaft can quickly inflict injury.

Protect the people on your farm and your property with an affordable, built-to-last, Parrish Bodyguard shaft shield.

It's an ideal way to complete any irrigation pumping installation.

- Rugged construction of heavy-gauge galvanized steel.
- Easy to lubricate u-joint via underside opening.
- Complete shaft coverage via telescoping construction.
- All mounting hardware included.

HORIZONTAL SHAFT GUARDS

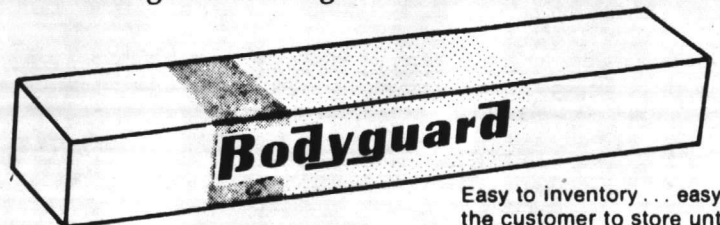
Bodyguard® Models	Lengths Available	For Shafting Series	List Price
*HG-18	10" to 18"	27 thru 55	\$ 50
*HG-24	14" to 24"	61 thru 81	\$ 54
HG-42	24" to 42"	27 thru 55	\$ 56
HG-54	36" to 54"	27 thru 55	\$ 56
HG-66	35" to 66"	27 thru 55	\$ 58
*HG-70	35" to 66"	61 thru 81	\$ 80
*HG-91	28" to 54"	88 thru 95	\$180

All Parrish Horizontal Bodyguards® are 7" in diameter except the HG-24 & 70 which are 12" in diameter and the HG-91 which is 15" in diameter, of telescoping construction in 1" increments. All Nuts and Bolts necessary for installation are furnished together with complete instructions.

•Special lengths and diameter guards

Consumer Boxed Complete

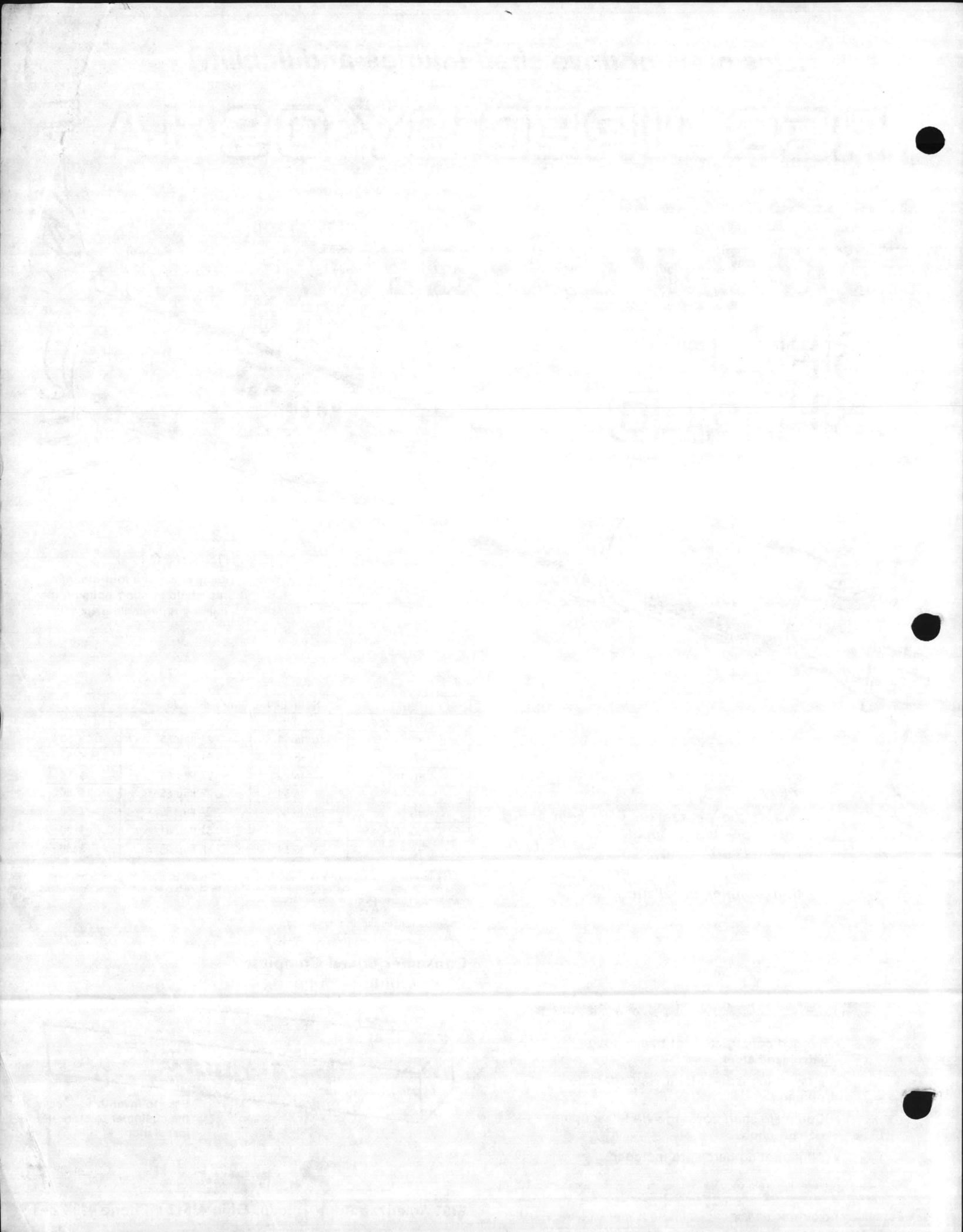
...including all mounting hardware



Easy to inventory... easy the customer to store until installation.

Parrish

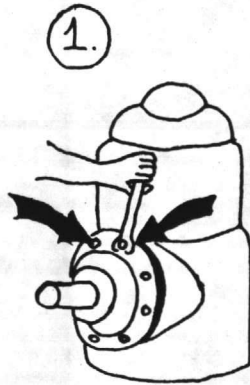
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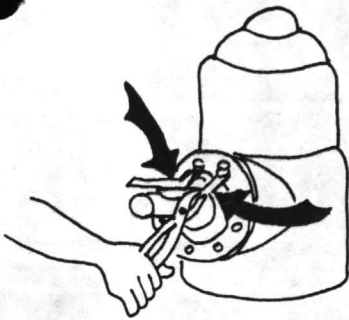
1. Remove indicated bolts from the gear head.



2. Install the brackets, using the bolts removed in Step No. 1.

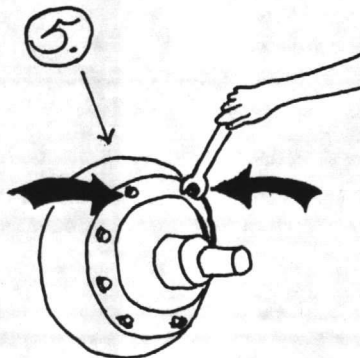


3. Form the brackets to fit the housing.

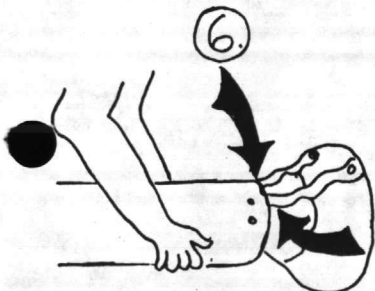


4. With a pair of pliers, bend the outer end of the brackets so that the guard will be centered around the shaft.

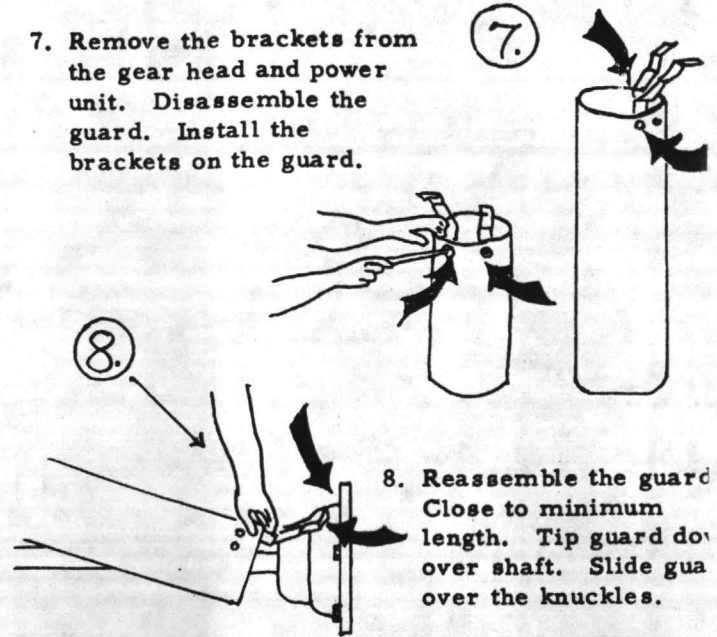
5. Remove indicated bolts from the power unit. Repeat Steps 2 through 4.



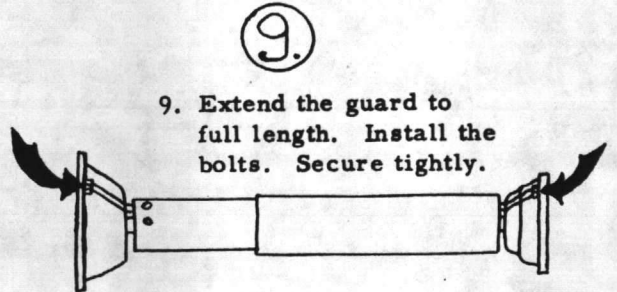
6. Check each end of guard for fit as indicated.



7. Remove the brackets from the gear head and power unit. Disassemble the guard. Install the brackets on the guard.

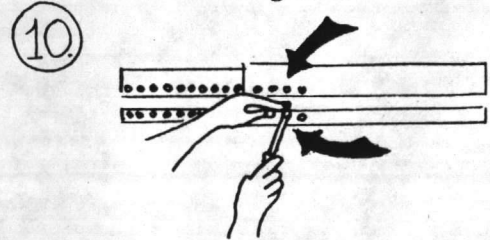


8. Reassemble the guard. Close to minimum length. Tip guard down over shaft. Slide guard over the knuckles.

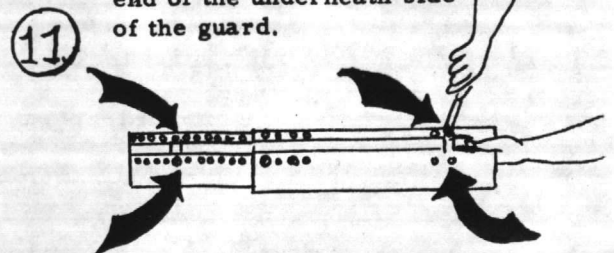


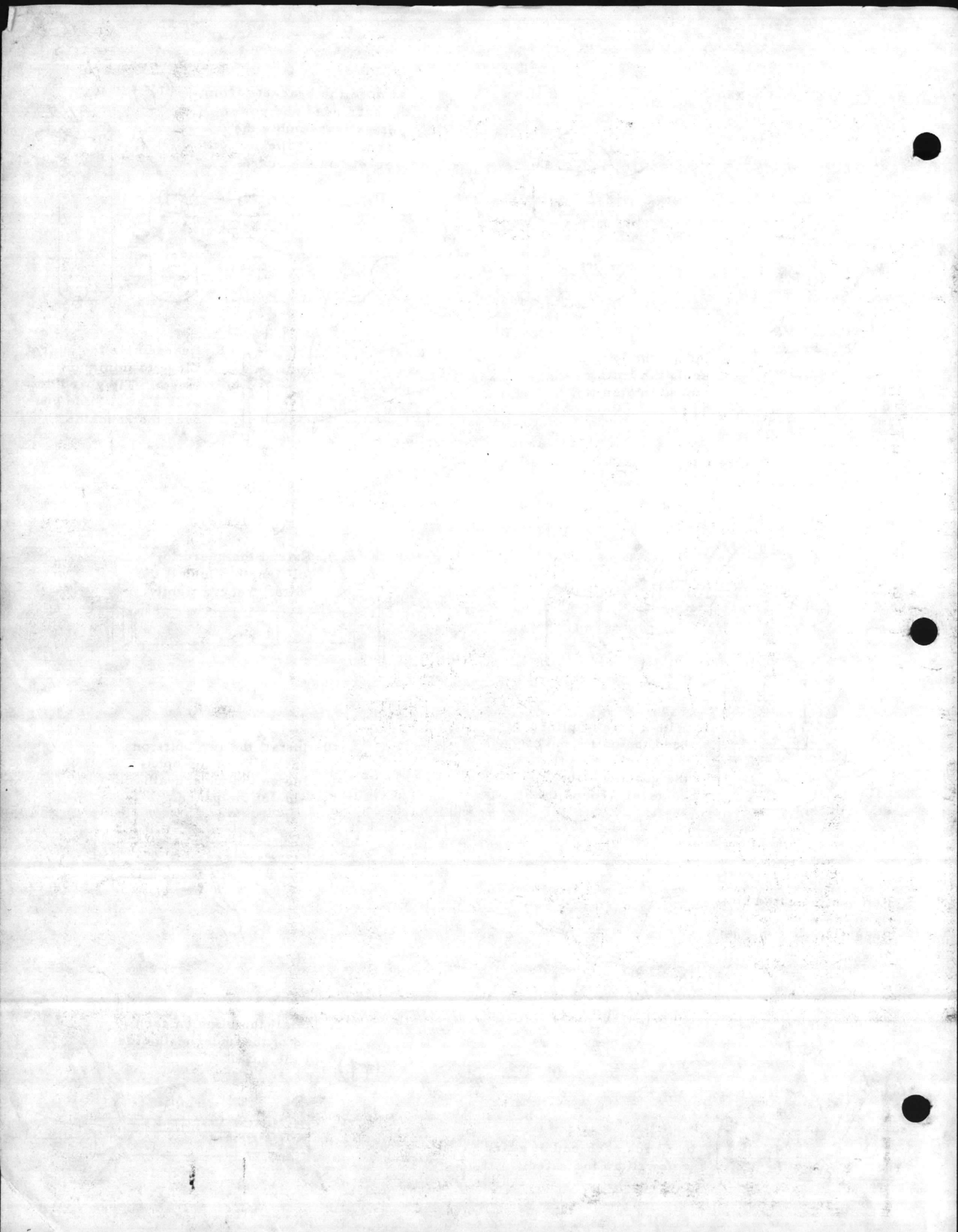
9. Extend the guard to full length. Install the bolts. Secure tightly.

10. Install the two bolts on each side of the opening on the underneath side of the guard.

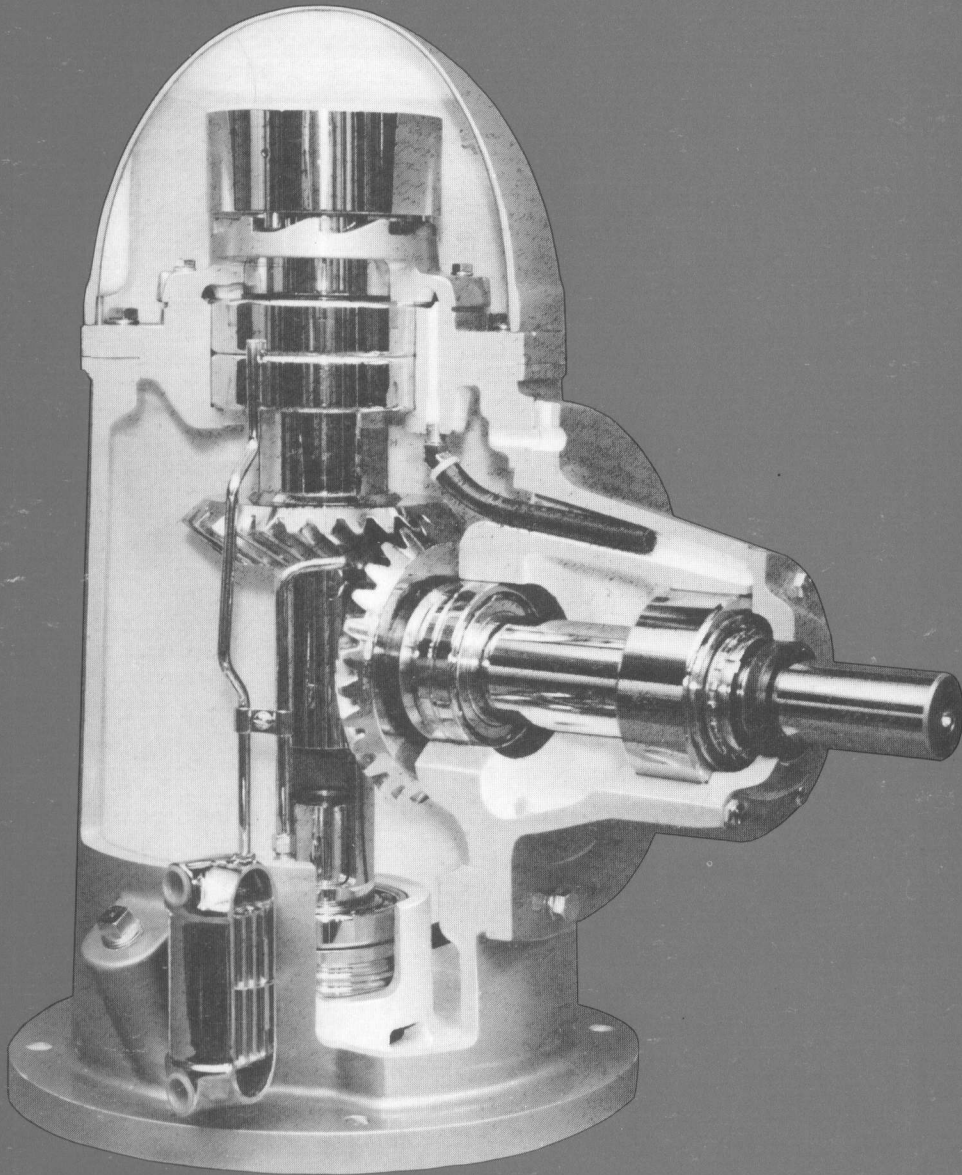


11. Install the clips on each end of the underneath side of the guard.





OPERATOR'S MANUAL FOR THE JOHNSON GEAR RIGHT ANGLE DRIVE



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FOUNDATION

A *solid level* foundation is necessary to prevent vibration and misalignment, both of which are detrimental to your gear drive. Width and length of the base will be governed by size of gear drive, size of engine, and specifications of the pump head.

SHORT COUPLED INSTALLATIONS BETWEEN GEAR DRIVE AND ENGINE SHOULD HAVE A COMMON FOUNDATION.

The depth of the foundation should extend down to a solid footing, if possible, and will depend on the type of soil, total weight of the installation, and the climate. Where freezing temperatures occur, the foundation should extend below the frost line.

INSTALLATION

The base of every Johnson Right Angle Gear Drive is provided with a machined rabbet to insure centering on the pump head. Therefore, it is essential that the pump shaft be in the exact center of the corresponding rabbet in the pump base.

Since a faulty headshaft will cause vibration and ultimately destroy the bearings and gears, it must be thoroughly checked for straightness and alignment. The procedure for checking the headshaft, which is outlined below, requires removal of the dome cover from the drive. *While the dome is off, care must be taken to protect against grit and dirt as even a small amount might cause damage to the bearing located in the top of the drive.*

Checking the Headshaft

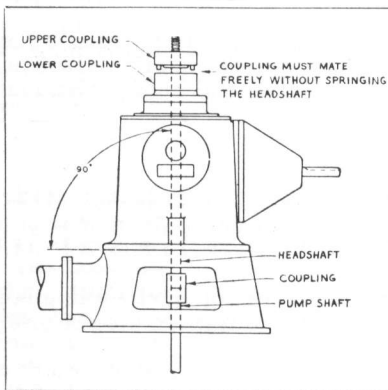


Figure 1

Before an alignment check can be made, it is necessary to ascertain that the headshaft is true to size, that diameters are concentric if shaft changes in diameter, and that it is absolutely straight throughout its length.

Combination drives are furnished with a steady bearing to prevent whipping of the headshaft under electric motor operation. The headshaft of such drives must therefore be tested for fit in the steady bearing.

Steady bearings are of the sealed ball bearing type and are mounted on adaptor sleeves through which the head shaft *must be a sliding fit* but not a press fit.

Headshafts are sometimes made with the pump coupling end larger than the hole in the hollow shaft of the gear drive. This makes it necessary to lower the drive on the pump head with the headshaft coupled in place. Particular care must be taken in such cases to avoid bending the headshaft or damaging the oil seal tube.

Mounting the Drive

After the headshaft has been thoroughly checked, inspect the machine fit of both gear drive and pump head for burrs or obstructions. Install the drive on the pump head and bolt in place, tightening thoroughly and evenly.

With the headshaft in place, slip on the upper coupling and lower it carefully into position. **WHEN THE UPPER COUPLING POSITIONS ON THE LOWER COUPLING WITHOUT SPRINGING THE HEADSHAFT, IT INDICATES THAT THE UNIT IS CORRECTLY ALIGNED.** Correct the alignment if upper and lower couplings do not meet properly.

With the gear drive and headshaft correctly aligned, install the ratchet pins and gib head key in the upper coupling. This key should be a slide fit, permitting adjustment of the headshaft by means of the adjusting nut. Tighten the nut as directed by the pump manufacturer, and lock with screw provided for this purpose. **DO NOT OIL THE RATCHET PINS.**

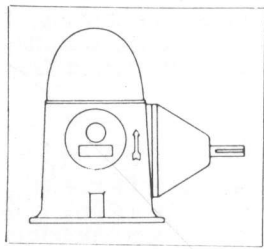


Figure 2

Checking the Rotation

Check the rotation of the power unit and pump in relation to that of the drive, as shown by the arrow on the case. **DO NOT OPERATE IN THE REVERSE DIRECTION OF THE ARROW**, as the lubrication system will not function and the destruction of the drive will result. Rotate the drive by hand before applying the power as a precaution against a bound or locked installation. Figure 2 shows drive with standard rotation.

Oil Cooler Connection

Models H-60 and larger are supplied with counter-flow oil coolers with water connections taped for 1/2" standard pipe. These connections are arranged vertically, the top connection for the inlet and the bottom connection for the outlet. Use rubber hose or copper tubing for water supply. **DO NOT MAKE A RIGID PIPE CONNECTION.** A moderate amount of cold water should flow through the cooler when the drive is operating, and provision should be made in the piping to permit draining the cooler in localities subject to freezing weather conditions.

Under normal conditions with 70°F water available, requirements are approximately 1 to 3 gal/min (4 to 12 liters/min) for models H60 thru H200 and 4 to 6 gal/min (15 to 23 liters/min) for models H280 and above. Maximum allowable water pressure 75 psi.

Filling with Oil

Correct lubrication of your Johnson Right Angle Gear Drive is a **MUST** for satisfactory operation. As the operator of this equipment, it is your responsibility to **KEEP THE OIL RESERVOIR FILLED AT ALL TIMES.**

Fill the oil reservoir until the oil is level with the top of the filling hole or the line on the gauge marked "Full." Be sure to tighten plug securely after filling or draining.

Look in the section on "Lubrication" for information about grades of oil, frequency of oil changes, and other data on the lubrication of the gear drive.

Oil reservoir capacities are as listed below:

Models	Gallons—U.S.	Liters
H20-H30	1/2	2
H40 (12)	3/4	3
H40-H60-H80	1	4
H110-H125	1 1/2	6
H150-H200	3	12
H280	4	15
H350-H425-H500-H600	6	23

OUR WARRANTY DOES NOT PROTECT YOU IN THE EVENT OF FAILURE FROM NEGLIGENCE IN MAINTAINING SUFFICIENT OIL OF RECOMMENDED GRADE IN THE GEAR DRIVE.

CONNECTING THE POWER UNIT

Coupling Installation

Care should be taken in selecting the proper type and size of coupling. The great majority of installations will require a Universal joint of standard length, as this type is capable of absorbing the misalignment which may occur due to installation errors or settling of earth around the well. Installation should be preferably made as nearly in line as possible and it is extremely important that the center line of the engine be parallel to the center line of the drive shaft within 2 or 3 degrees. This precaution will prevent an unbalanced condition which would result in vibration and be detrimental to the gear drive bearings and drive shaft.

Certain types of flanged flexible couplings are suitable for close coupled drives, providing pump head and power unit are on the SAME RIGID FOUNDATION. Such couplings should be mounted and maintained according to the manufacturer's instructions. NEVER USE A RIGID FLANGED COUPLING.

IN FITTING THE UNIVERSAL JOINT OR FLEXIBLE COUPLING FLANGE TO THE DRIVE, IT SHOULD BE MACHINED FOR A PUSH FIT WITHOUT THE USE OF EXCESS POWER, AS HAMMERING ON THE DRIVE SHAFT WILL DAMAGE THE BEARINGS AND DESTROY THE ADJUSTMENT OF THE GEARS.

LUBRICATION

General Information

Careful attention to the lubrication requirements and use of the correct grade of oil is essential to continued and satisfactory operation of your Johnson Right Angle Gear Drive. *Gear drives should not be operated at speeds 15% above or below the nameplate RPM without consulting the Factory.* The operating speed of your drive is shown on the nameplate.

Changing Oil

Proper lubrication requires that the oil be changed at least once every six months or after 2500 hours of operation, whichever occurs first. Should extreme changes of temperature or humidity cause condensation in the reservoir, the oil should be changed more frequently. Drain the oil when hot, inspecting for water. Be sure to change the oil at the end of the operating season to remove any moisture which would otherwise rust the bearings and other finely machined parts.

Oil changing at the recommended time interval aids in restricting the amount of acid which may form in oils under high temperature and pressure conditions. Acids are injurious impurities in lubricating oils, since they attack the machine parts.

Keep the "Lubrication Record" as a guide for making these oil changes at the proper intervals.

Cold Weather

Close attention should be given the drive when starting under freezing conditions. The oil becomes very thick at low temperatures, which may result in flooding the thrust bearing (as evidenced by oil leak at top of drive). In such cases, providing the leak does not cease as the drive warms up, stop the drive and allow the oil to drain and then restart. Removal of dome on standard drives is required for above observations. CAUTION: *Be sure to check oil flow to gears* when starting under low temperature conditions.

Recommended Oil

The high-grade oils approved for the Johnson Right Angle Gear Drives are less susceptible to emulsification (mixing with water) and oxidation than other oils.

RECOMMENDED OILS

Ambient Temp °F	15-60	50-125
A.G.M.A. Grade	2	3
Visc. S.S.U. @ 100°F	284-347	417-510
I.S.O. Visc. (cSt) @ 40°C	68	100
Amoco	Ind. Oil 68	Ind. Oil 100
Cato Oil	AW/AL 20	AW/AL 30
Chevron—USA	A.W. Mach 68	A.W. Mach 100
Citgo	Pacemaker 68	Pacemaker 100
Exxon—USA	Teresstic 68	Teresstic 100
Getty—USA	Skelvis—MP 20	Skelvis—MP 30
Gulf—USA	Harmony 68	Harmony 90
Mobil Oil	Mobil Gear 626	Mobil Gear 627
Pacer	Thermal T315	Thermal T465
Phillips	Magnus 68	Magnus 100
Shell—USA	Turbo 68	Turbo 100
Sun Oil	Sunvis 931	Sunvis 951
Texaco	Regal R & O 68	Regal R & O 100
U.S. Navy		Mil-L-17335-F

S.A.E. Automotive oils are NOT satisfactory and *must not be used* in the gear drive. USE OF AUTOMOTIVE OILS WILL VOID OUR WARRANTY.

OPERATION

The following operating recommendations are made to aid you in keeping your gear drive in the best possible condition. Careful attention to these details will prolong the useful life of your equipment.

Starting

Always check the oil level in the housing of the gear drive and add oil if needed. Inspection when starting and regular checks during the operating period will prevent failure of the gear drive due to poor oil circulation. Should the circulation appear to be lagging, check the oil level and the age of the oil in the drive. Oil tends to thicken with use and old oils will not circulate properly in the gear drive oiling system.

Turn by hand the drive shaft between pump and engine to check whether pump turns freely. (When the engine has no clutch, as in fire pump drives, it will be necessary to uncouple the shaft.)

When the drive is furnished with a non-reverse clutch, check to see that ratchet pins are clean and drop readily. Do not oil pins.

Before applying power replace dome and all covers and guards.

Apply power to drive gradually, but do not idle at low speed for a long period.

Observe carefully the entire installation during the starting period and do not leave until satisfied that all units are functioning properly.

Operating Temperatures

A standard drive operating at 1750 RPM pump speed under rated load and normal atmospheric conditions will reach a temperature of approximately 130-170°F depending on whether the unit is air or water cooled and local conditions peculiar to the installation. It is not possible to hold one's hand on the gear drive case except momentarily when temperatures exceed 135°F.

Increased speed, high loads, or lack of air circulation will cause the temperature to rise, but the oil temperature should not at any time exceed 200°F. A thermometer may be used at the oil filling hole of the drive to obtain actual temperatures if unusual conditions exist. When starting the drive at temperatures below 10°F, the oil should first be checked to see whether it is above the pour point. The drive must not be operated if the oil does not flow, which limiting condition exists at approximately 10°F.

Shutdown Periods

When the installation is to be inoperative for a considerable time, such as after the completion of an irrigation period, the gear drive should be drained while hot and then replenished with new oil.

Occasional brief operation during extended shutdown periods will help prevent damage from condensation and will benefit the bearings by changing the position of the balls and races. This procedure is of equal benefit to the engine, as it spreads an oil film on the cylinder walls, rings, bearings, etc.

In localities where freezing conditions prevail, drain the water from the oil coolers of drives so equipped.

Long Term Storage

1. Fill with oil in appropriate amount for storage period only. Replace oil when put into regular duty.
2. Spray exposed machined parts (i.e., base, shaft end, upper coupling) with rust-retarding oil.
3. Operate gear drive every month long enough to oil bearings and gears to prevent condensation and rusting.
4. Store in heated building if at all possible.
5. Cover with tarpaulin or other dust shield.

General Precautions

The bearings furnished are of high quality and have been approved by the manufacturer for the rated loads and speeds of the gear drives in which they are used. Bearing life is directly affected by the care given in operating the equipment and adherence to the instructions given in this manual. Usually a bearing will become noisy and give adequate warning of impending failure. Do not operate the gear drive with noisy bearings as destruction of the gears will result if the bearing should fail.

Changes sometimes occur in the water level, or alterations may be made to the pump subsequent to selection and installation of the gear drive. Such changes will usually affect the operating conditions of the gear drive and should be thoroughly investigated.

As mentioned repeatedly in this manual, lubrication is the most important factor affecting the life of the drive, which, given ordinary care and properly operated, will give exceptionally trouble-free service.

Special Instructions

Johnson Right Angle Hollow Shaft Gear Drives used for Factory Mutual and NPFA fire pump installations are not permitted to omit or disable the non-reverse ratcheted coupling. Nor is the use of disconnecting couplings or clutches permitted between the engine and gear drive, or to reset the engine from its pre-set speed.

COMBINATION DRIVES

All the preceding operating instructions are applicable to the combination drive. There are also special instructions which must be followed according to the particular application.

Standard Combination

In most installations, the gear drive and engine are required for standby service only. The installation is therefore made so that the electric motor drives the pump and also carries the thrust load. The coupling at the top of the gear drive is free to turn when the electric motor is driving the pump, running clearance being maintained by a compressible spacer. (Figures 3 & 4)

When pump operation by the engine through the gear drive is required the stainless steel bolts are used to fasten the coupling halves together (Figure 4). This procedure permits transmission of power through the right angle gear drive, but does not alter the setting of the pump. The pump thrust load is still carried by the electric motor.

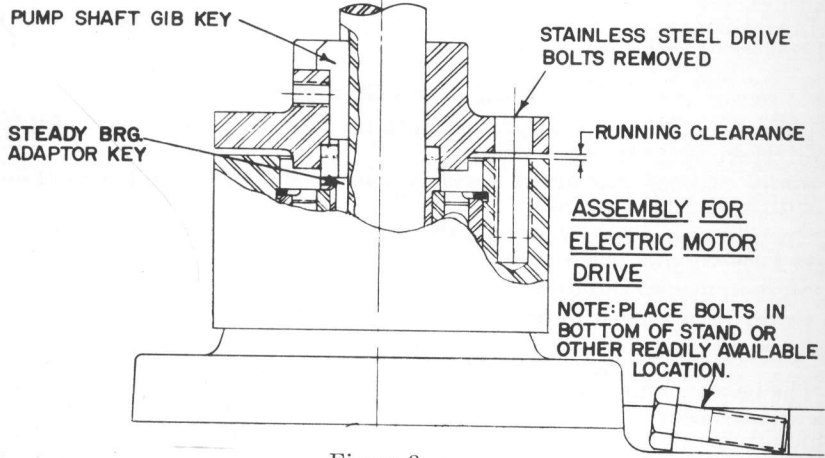


Figure 3

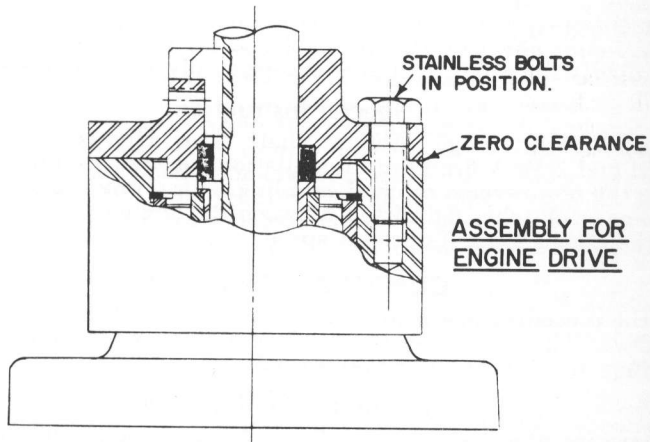


Figure 4

Redi-Torq®

The Johnson Redi-Torq® Gear Drive is manufactured specifically for automatic installations and permits the use of standard flexible shafting between the gear drive and engine. If your gear drive is a Redi-Torq® you must read and comply with the supplementary instructions accompanying this manual. Contact the factory prior to making the installation if the pamphlet is missing.

Solid Shaft

This type of drive is used with solid shaft electric motors. The gear drive and electric motor are connected together by a flexible coupling. Most installations using this drive are of dry pit design and flexible shafting is used between the pump and gear drive.

With solid shaft combination drives, the electric motor revolves when the engine is driving. Means of disconnecting the gear drive and engine must be provided.

MAINTENANCE

General

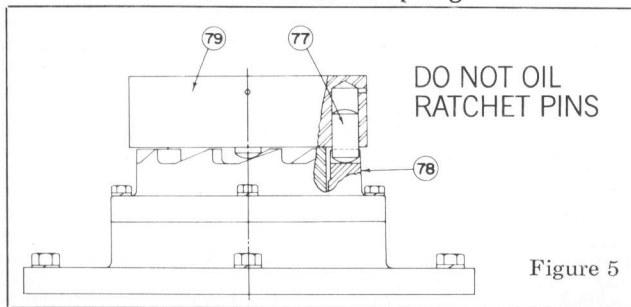
A Johnson Right Angle Gear Drive which has been properly installed and operated according to instructions furnished will give years of dependable service with a minimum of maintenance. Instructions included in this manual are to inform you of correct maintenance procedure.

Repairs should only be undertaken by a skilled mechanic, fully capable of doing the work; and when for any reason extensive maintenance beyond the scope of this manual is required, the drive should be returned to our factory with transportation charges prepaid. This allows our trained mechanics, aided by specialized tools and equipment, to reassemble and test your gear drive under controlled conditions. Factory reconditioning, wherein all worn parts which in our judgement require renewal are replaced, has the additional advantage of carrying a new drive warranty. No allowance is made for parts removed, and such parts are returned on request.

Alterations or repairs made outside the factory without our approval are at buyer's risk and void the warranty. We suggest that you read the terms of our warranty before undertaking any repair work on the drive. (See back cover.)

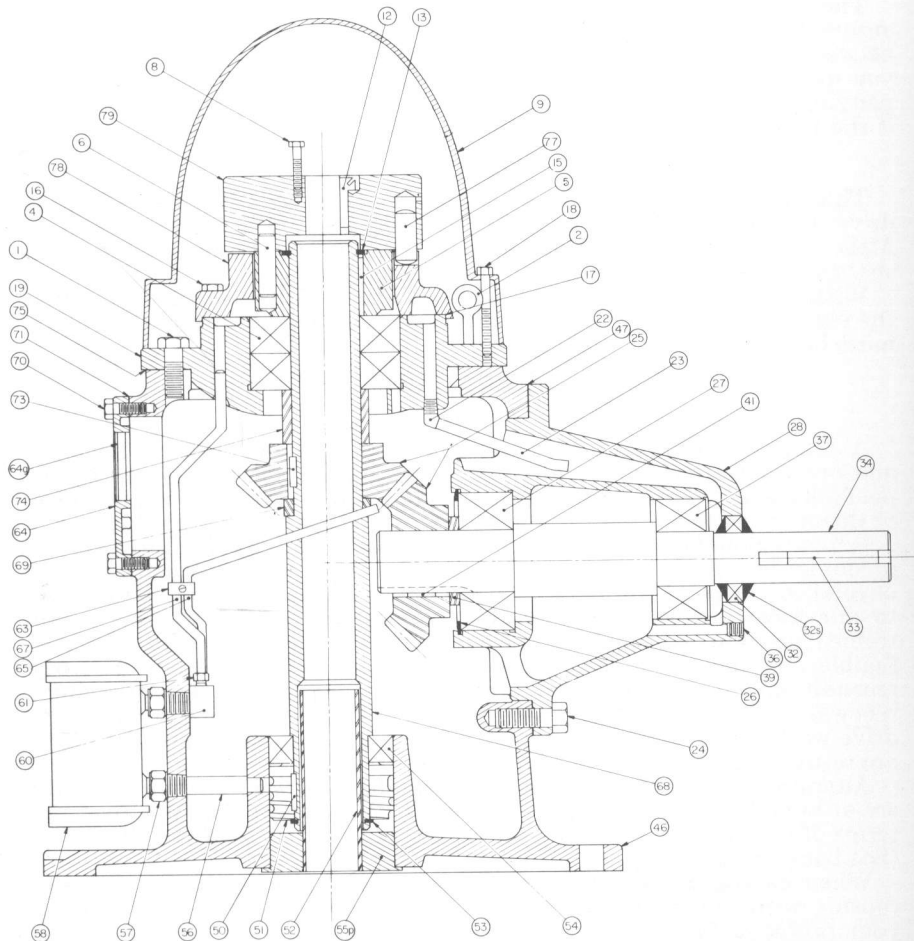
When conditions do not permit return of the drive to the factory, consult with our Engineering Department, giving full information on your problem. Make your data as complete as possible, and be sure to include the serial number of the drive and approximate length of service.

Non-Reverse Coupling



The operation of a Johnson Non-Reverse Coupling is extremely simple and requires a minimum of maintenance. The ratchet pins must operate freely, and will therefore require an occasional cleaning. They must never be oiled as this would result in formation of a gummy film, preventing their dropping freely into position as forward rotation slows down.

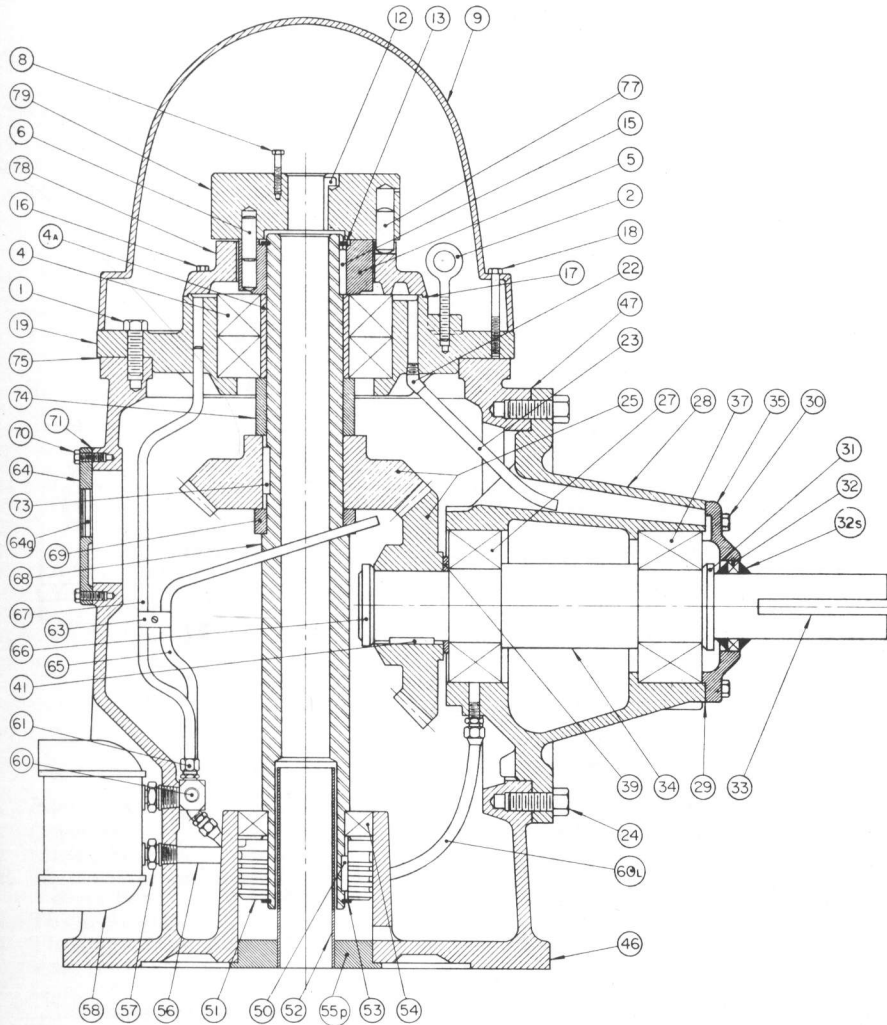
TYPICAL MODEL H-20 - H-60



No.	Part Name	No.	Part Name	No.	Part Name
1	Capscrew—Thrust Cage	33	Key	67	Oil Tube to Thrust Bearing
* 2	Lifting Eyebolt	34	Driveshaft	68	Hollow Shaft
4	Thrust Bearing	36	Drain Plug-Set Screw	*69	Lower Hollow Shaft Spacer
5	Lower Coupling	37	Outer Bearing	70	Capscrew—Insp. Plate
6	Coupling Pin	39	Horizontal M.D. Spacer	71	Gasket—Insp. Plate
8	Capscrew	41	Key—Drive Gear	73	Key—Driven Gear
9	Dome	46	Main Housing	74	Vertical M.D. Spacer
12	Gib Key	47	Shim—Horiz. Hsg.	75	Shim—Thrust Bearing Cage
13	External Snap Ring	50	Key—Pump Runner	77	Ratchet Pins
15	Key—Lower Coupling	51	Pump Runner	78	Thrust Bearing Cover
16	Capscrew—Thrust Cover	52	Seal Tube	79	Upper Clutch
17	Gasket—Thrust Cover	53	External Snap Ring		
18	Capscrew—Dome	54	Pump Bearing		
19	Thrust Bearing Cage	55P	Seal Plug		
*22	Flexible Tube Fitting	*56	Oil Tube From Pump		
*23	Flexible Tube	*57	Cooler Flexible Fittings		
24	Capscrew—Horiz. Hsg.	*58	Oil Cooler (H60 Only)		
25	Gears	60	Oil Distributor		
26	Internal Snap Ring	61	Compression Fitting		
27	Inner Bearing	63	Oil Tube Clamp		
28	Horizontal Housing	64	Inspection Plate		
32	Oil Seal	*64G	Oil Sight Glass		
* 32S	Slingers	65	Oil Tube to Gears		

* These parts are not universal and are omitted in certain ratios and models.

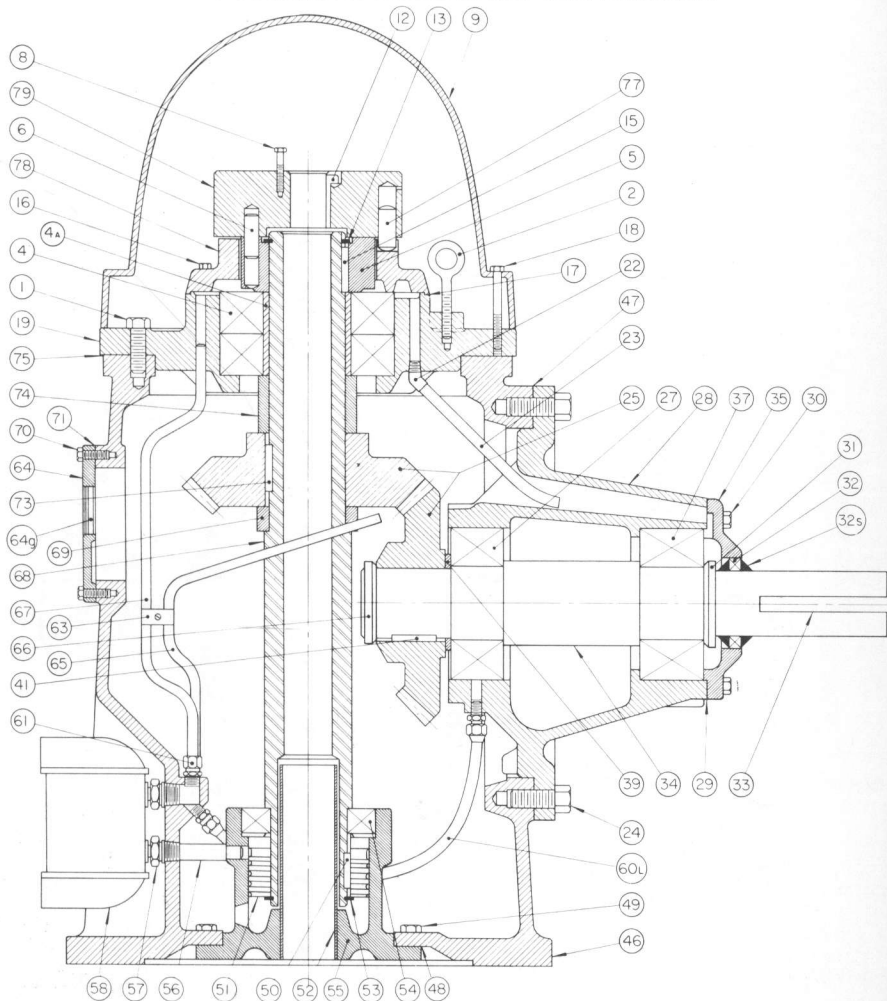
TYPICAL MODEL H-80 - H-200



No.	Part Name	No.	Part Name	No.	Part Name
1	Capscrew—Thrust Cage	29	Gasket—Horiz. Hsg. Cover	56	Oil Tube From Pump
2	Lifting Eyebolt	30	Capscrew—Horiz. Hsg. Cover	57	Cooler Flexible Fittings
4	Thrust Bearing	*31	Locknut & Washer	58	Oil Cooler
*4A	Thrust Bearing Sleeve	32	Oil Seal	60	Oil Distributor
5	Lower Coupling	*32S	Slings	60L	Oil Tube to Inner Bearings
6	Coupling Pin	33	Key	61	Compression Fittings
8	Capscrew	34	Driveshaft	63	Oil Tube Clamp
9	Dome	35	Horizontal Housing Cover	64	Inspection Plate
12	Gib Key	37	Outer Bearing	*64G	Oil Sight Glass
13	External Snap Ring	39	Horizontal M.D. Spacer	65	Oil Tube to Gears
15	Key—Lower Coupling	41	Key—Drive Gear	*66	Locknut & Washer
16	Capscrew—Thrust Cover	46	Main Housing	67	Oil Tube to Thrust Bearing
17	Gasket—Thrust Cover	47	Shim—Horiz. Hsg.	68	Hollow Shaft
18	Capscrew—Dome	50	Key—Pump Runner	*69	Lower Hollow Shaft Spacer
19	Thrust Bearing Cage	51	Pump Runner	70	Capscrew Insp. Plate
*22	Flexible Tube Fitting	52	Seal Tube	71	Gasket—Insp. Plate
*23	Flexible Tube	53	External Snap Ring	73	Key—Driven Gear
24	Capscrew—Horiz. Hsg.	54	Pump Bearing	74	Vertical M.D. Spacer
25	Gears	55P	Seal Plug	75	Shim—Thrust Bearing Cage
27	Inner Bearing			77	Ratchet Pins
28	Horizontal Housing			78	Thrust Bearing Cover
				79	Upper Clutch

* These parts are not universal and are omitted in certain ratios and models.

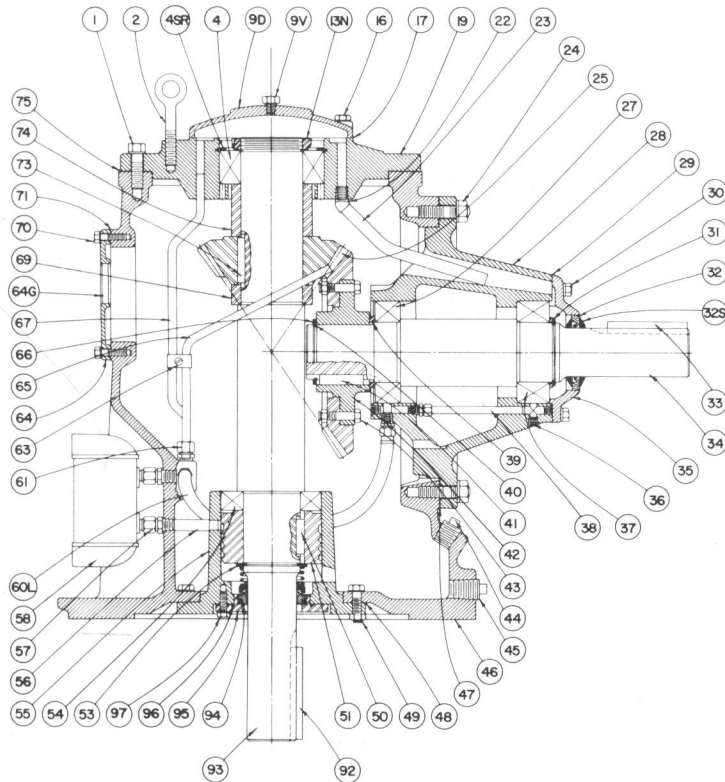
TYPICAL MODEL H-280 and LARGER



No.	Part Name	No.	Part Name	No.	Part Name
1	Capscrew—Thrust Cage	30	Capscrew—Horiz. Hsg. Cover	56	Oil Tube From Pump
2	Lifting Eyebolt			57	Cooler Flexible Fittings
4	Thrust Bearing	*31	Locknut & Washer	58	Oil Cooler
4A	Thrust Bearing Sleeve	32	Oil Seal	60L	Oil Tube to Inner Bearings
5	Lower Coupling	*32S	Slings	61	Compression Fittings
6	Coupling Pin	33	Key	63	Oil Tube Clamp
8	Capscrew	34	Driveshaft	64	Inspection Plate
9	Dome	35	Horizontal Housing Cover	*64G	Oil Sight Glass
12	Gib Key	37	Outer Bearings	65	Oil Tube to Gears
13	External Snap Ring	39	Horizontal M.D. Spacer	*66	Locknut & Washer
15	Key—Lower Coupling	41	Key—Drive Gear	67	Oil Tube to Thrust Bearing
16	Capscrew—Thrust Cover	46	Main Housing	68	Hollow Shaft
17	Gasket—Thrust Cover	47	Shim—Horizontal Housing	*69	Lower Hollow Shaft Spacer
18	Capscrew—Dome	48	Gasket—Pump Housing	70	Capscrew—Insp. Plate
19	Thrust Bearing Cage	49	Capscrew—Pump Housing	71	Gasket—Insp. Plate
22	Flexible Tube Fitting	50	Key—Pump Runner	73	Key—Driven Gear
23	Flexible Tube	51	Pump Runner	74	Vertical M.D. Spacer
24	Capscrew—Horiz. Hsg. Gears	52	Seal tube	75	Shim—Thrust Bearing Cage
27	Inner Bearing	53	External Snap Ring	77	Ratchet Pins
28	Horizontal Housing	54	Pump Bearing	78	Thrust Bearing Cover
29	Gasket—Horizontal Housing Cover	55	Pump Housing	79	Upper Clutch

* These parts are not universal and are omitted in certain ratios and models.

TYPICAL SOLID SHAFT

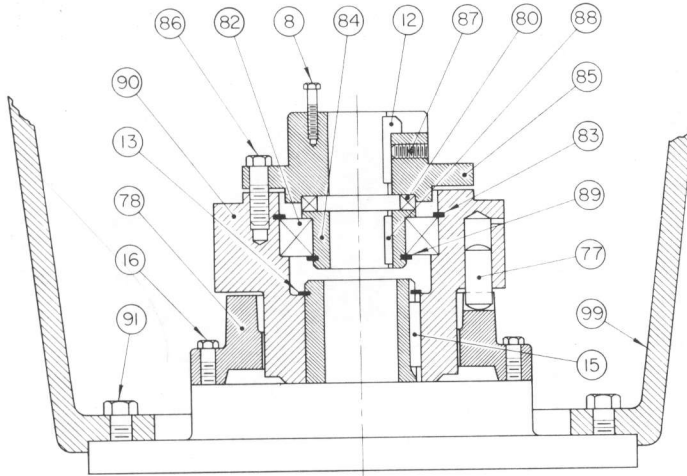


No.	Part Name	No.	Part Name	No.	Part Name
1	Capscrew	35	Horizontal Housing Cover	*57	Cooler Flexible Fittings
2	Lifting Eyebolts	36	Pipe Plugs—Hollow Head	*58	Oil Cooler
*4SR	Thrust Bearing Internal Snap Ring	37	Outer Bearing	*60L	Oil Tube to Inner Bearing
4	Thrust Bearing	*38	Oil Tube to Outer Bearing	*61	Compression Fittings
D	Thrust Bearing Dome	*39	Gear Spacer	*63	Clamp Assembly (Oil Tubes)
9V	Vent Plug	40	Shim	64	Inspection Plate
13N	Locknut and Lockwasher	*41	Key	*64G	Oil Sight Glass
16	Capscrew	*42	Drive Gear Hub	65	Oil Tube to Gears
17	Gasket—Thrust Bearing Dome	*43	Capscrew	66	External Snap Ring or Locknut & Washer
19	Thrust Bearing Cage	44	Pipe Plug	67	Oil Tube to Thrust Bearing
*22	Flexible Tube Fitting	45	Pipe Plug	*69	Driven Gear Spacer
*23	Flexible Tube	46	Main Housing	70	Capscrew
24	Capscrew	47	Shim—Horizontal Housing	71	Gasket—Inspection Plate
25	Gears	48	Gasket—Pump Housing	73	Key
27	Inner Bearing	49	Capscrew	74	Pinion Spacer
28	Horizontal Housing	50	Key	75	Shim—Thrust Bearing Cage
29	Gasket—Horizontal Housing Cover	51	Pump Runner	92	Key
30	Capscrew	53	External Snap Ring	93	Vertical Shaft
31	Snap Ring and Washer	54	Pump Bearing	94	Mechanical Seal
32	Oil Seal	*54W	Pump Bearing Spacer (Fig. 2 or 3)	95	Seal Cage
*32S	Slinger	*55	Pump Housing	*96	"O" Ring
33	Key	*56	Oil Tube from Pump	*97	Capscrew
34	Driveshaft				

*These parts not universal and are omitted in certain ratios and models. Lock washers furnished when fastening is not self-locking.

When ordering parts, the serial number, ratio, and size of drive stamped on the nameplate **MUST** be furnished.

COMBINATION



COMBINATION NON-REVERSE

<i>No. Part Name</i>	<i>No. Part Name</i>
8 Capscrew	84 Steady Bearing Adaptor
12 Gib Key	85 Upper Coupling Combination
13 External Snap Ring	86 Stainless Steel Capscrews
15 Key (Lower Coupling)	87 Set Screw
16 Capscrew	88 Key (Steady Bearing Adaptor)
77 Ratchet Pins	89 External Snap Ring
78 Thrust Bearing Cover	90 Lower Coupling Combination Non Reverse
80 Wave Spring	91 Capscrew
82 Steady Bearing	99 Motor Stand
83 Internal Snap Ring	

LUBRICATION RECORD

Date	Estimated Hrs. Operation	Oil Changed	Oil Added	Trade Name

USE ONLY APPROVED OILS

Serial No. _____

Model _____

Ratio _____

___BHP at ___RPM of vertical shaft

This manual contains information which will assist you to obtain the maximum service. Keep it readily available for reference in the event any question arises as to the proper care of your right angle gear drive.

Communications with your dealer or the manufacturer having reference to your gear drive, should state the SERIAL NUMBER and approximately how long the drive has been operated.

Filed under the SERIAL NUMBER, Johnson Right Angle Gear Drive keeps complete data on every gear drive manufactured. This service is maintained for the customer so that replacement parts can be furnished by the factory to fit each individual drive, once the serial number is known. The SERIAL NUMBER and rating of each drive is stamped on the nameplate fastened to the inspection hole coverplate. If the nameplate is missing or illegible remove the inspection coverplate and gasket. The SERIAL NUMBER is stamped on the machined surface of the inspection opening of the main housing.

WARRANTY

1. The Johnson Right Angle Gear Drive is warranted to be free from defects in material and workmanship under normal use and service for a period of one year from the date of factory shipment by us for the original purchaser and then only when operated within the rated capacity for which it was sold and in accordance with recognized usage and practice. Our obligation under this warranty is limited to the replacement of any part or parts which shall be returned to us with transportation charges prepaid, within one year after shipment for the original purchaser; and, which it is determined by the company, to have proven defective under normal and proper use. This warranty shall not apply to any drive which shall have been altered or repaired outside our factory without our written consent and approval, nor any drive which has been subject to misuse, neglect, accident, improper oiling or mounted on foundations which are not vibration proof.

2. We make no warranty of any kind

whatever, express or implied, in regard to bearings, trade accessories, machinery, or other articles of merchandise not manufactured by us. The bearings which we have selected for the thrust position will cover most installations, but there are many cases which will require special treatment.

3. No warranty or guarantee is binding upon the company and no asserted breach thereof can be claimed against the company unless the company has been notified in detail and in writing of any alleged defect within seven (7) days after the discovery thereof.

4. The express warranties and guarantees contained herein are exclusive and are made in lieu of any other representation by the company or its agents, and any implied warranty of Merchantability or Fitness for a Particular Purpose are hereby expressly disclaimed. It is agreed that the language contained herein shall be the final and exclusive expression of the agreement with respect to sale of equipment by the company.



JOHNSON

RIGHT ANGLE GEAR DRIVE

A Division of Arrow Gear Company

Sales Office and Manufacturing Plant:
1401 West Bond Circle, Lincoln, NE 68521 U.S.A.
Phone: (402) 474-5285 Telex: 48 4307



PARRISH INTERMEDIATE DRIVE SHAFTS

PARTS LIST AND PRICES

PARTS DIAGRAMS

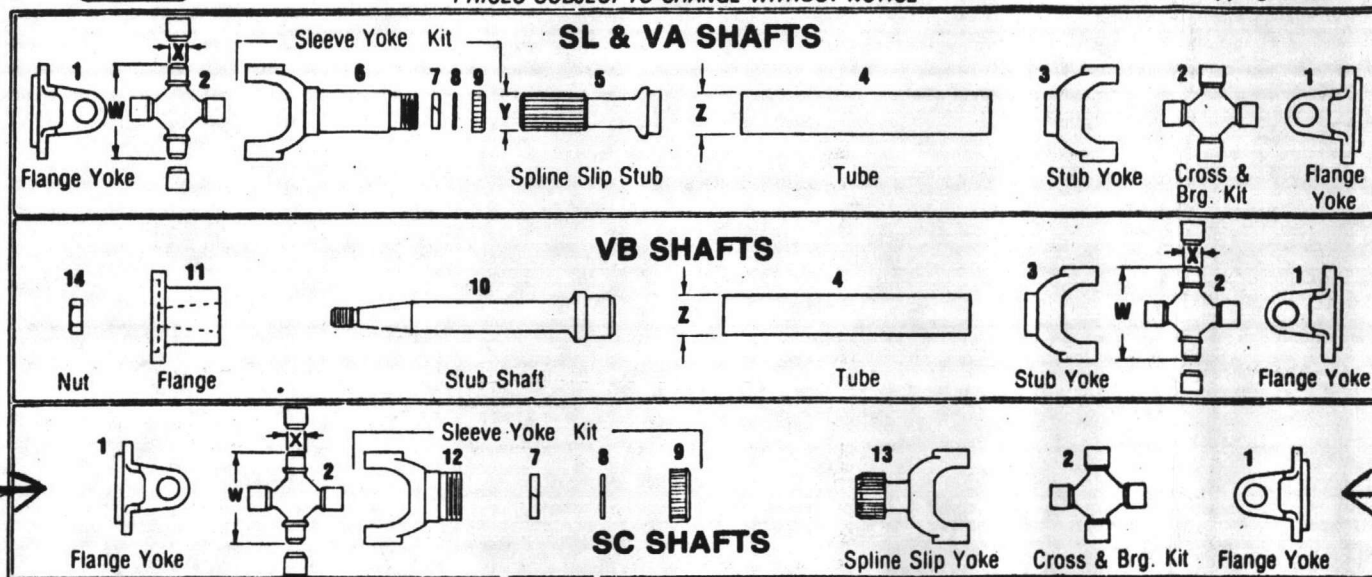
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

PRICE LIST PL-579

Dated May 1, 1979

Supersedes PL-875

F.O.B. Shipping Point



IDENTIFYING DIMENSIONS

Dimen.	27	31	37	41	48	55	61	71	81	88	91	95
W†	2 ³¹ / ₃₂	2 ³¹ / ₃₂	3 ³ / ₈	3 ¹⁵ / ₁₆	3 ⁷ / ₈	4 ²¹ / ₃₂	5	5 ²⁵ / ₃₂	7 ¹ / ₄	7 ¹⁹ / ₃₂	8	9 ⁵ / ₃₂
X†	1 ⁹ / ₃₂	2 ¹ / ₃₂	4 ⁹ / ₆₄	4 ⁹ / ₆₄	5 ⁷ / ₆₄	5 ⁷ / ₆₄	1 ⁹ / ₃₂	1 ⁵ / ₁₆	1 ¹⁹ / ₆₄	1 ³ / ₈	1 ¹ / ₄	2
Y**	1 ¹ / ₂ "-16	1 ¹ / ₂ "-16	1 ¹ / ₂ "-16	1 ¹ / ₂ "-16	1 ⁹ / ₁₆ "-16	1 ³ / ₄ "-16	2"-16	2 ¹ / ₂ "-16	3-16	3-16	3 ⁵ / ₃₂ -36	4 ⁵ / ₃₂ -24
Z Std.	2 ¹ / ₂	2 ¹ / ₂	3	3 ¹ / ₂	3 ¹ / ₂	3 ¹ / ₂	3 ¹ / ₂	4	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	6
Z Spec.	3 ¹ / ₂	3 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	—	—	—	—	—	—

† Dimensions "W" and "X" are without bearings assembled to cross.

** Dimension "Y" is spline diameter and number of splines.

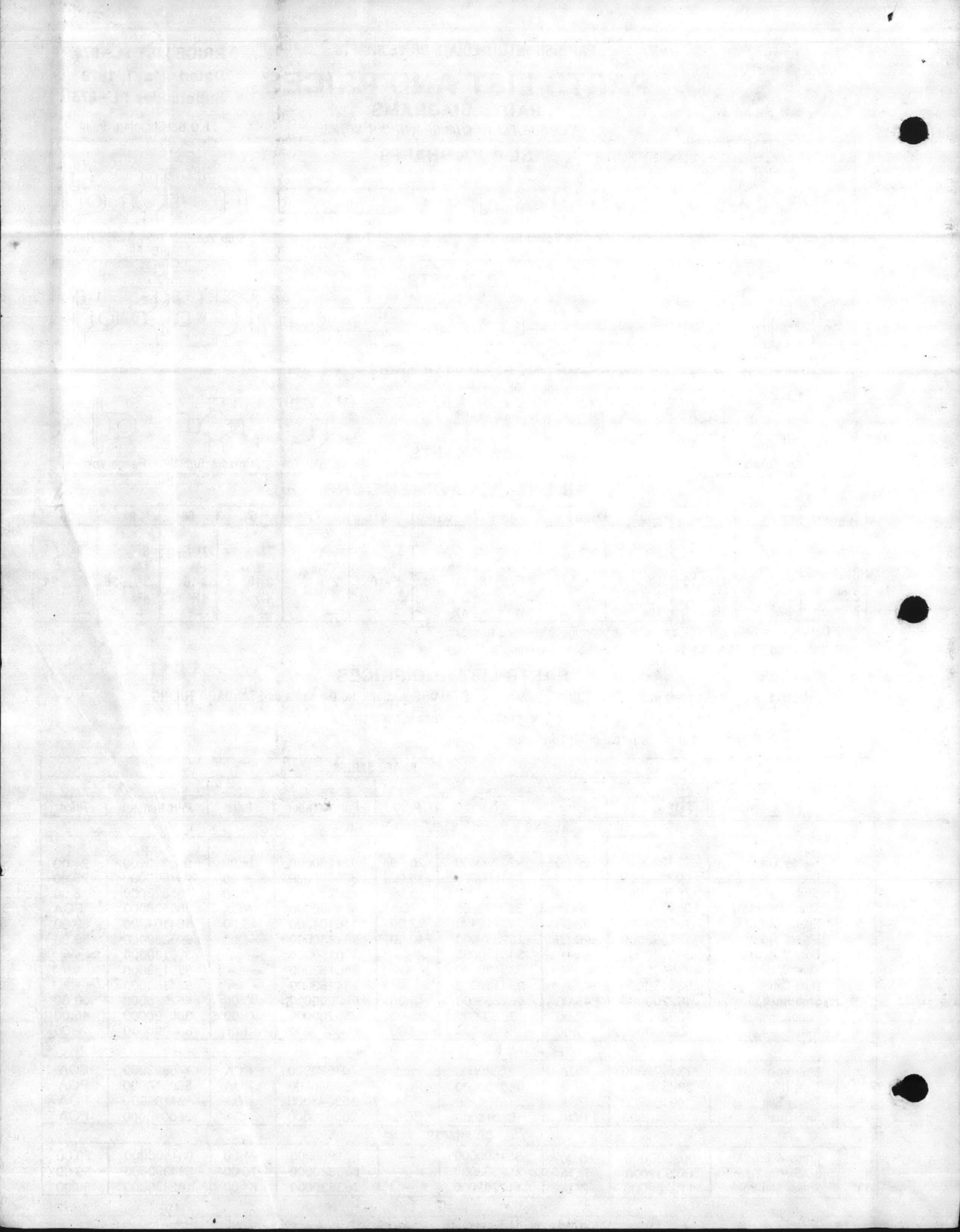
PARTS LIST AND PRICES

Note 1. Items not shown in SPECIAL TUBING sections or SC SHAFTS sections are the same as STANDARD TUBING.

Note 2. When ordering tubing, Item 4, specify length required. Price is per inch.

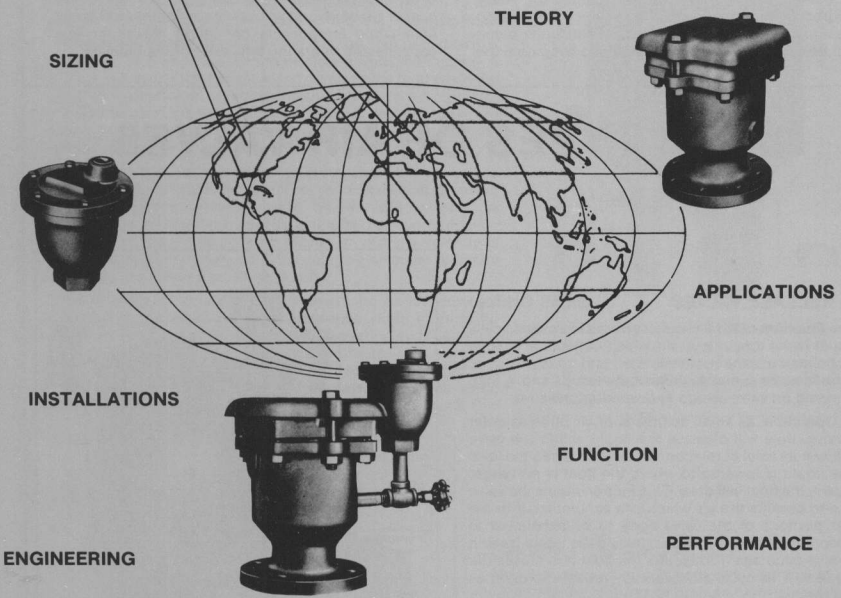
Note 3. Parts 7, 8 & 9 are available in Kit Form only.

No.	Description	SHAFT SERIES							
		27		31		37		41	
		Part Number	Price	Part Number	Price	Part Number	Price	Part Number	Price
SL AND V SHAFTS STANDARD TUBING									
1	Flange Yoke	923220000	20.00	923220000	20.00	911230000	24.00	951230000	24.00
2	Cross & Brg. Kit	002500000	16.00	351500000	18.00	871500000	21.00	061500000	23.00
3	Stub Yoke	763822000	18.00	763822000	18.00	758230000	15.00	755823000	18.00
4	Tube (Per Inch)	380520000	POA	380520000	POA	380300000	POA	380530000	POA
5	Spline Slip Stub	117104200	32.00	117104200	32.00	116104300	46.00	194104300	69.00
6	Sleeve Yoke	122532000	40.00	122532000	40.00	884330000	44.00	805330000	59.00
7	Cork Washer	346130000	See Note 3	346130000	See Note 3	356130000	See Note 3	356130000	See Note 3
8	Steel Washer	335130000	See Note 3	335130000	See Note 3	355153000	See Note 3	355153000	See Note 3
9	Dust Cap	934139000	See Note 3	934139000	See Note 3	934153000	See Note 3	934153000	See Note 3
10	Stub Shaft	462200000	45.00	462200000	45.00	562200000	55.00	662200000	108.00
11	Flange	130200000	33.00	130200000	33.00	230200000	41.00	330200000	45.00
14	Nut	580000000	1.00	580000000	1.00	580000000	1.00	860000000	2.00
SL AND V SHAFTS SPECIAL TUBING									
3	Stub Yoke	724822000	POA	724822000	POA	704823000	POA	775823000	POA
4	Tube (Per Inch)	380530000	POA	380530000	POA	590540000	POA	590540000	POA
5	Spline Slip Stub	149104200	POA	149104200	POA	153043000	POA	194104300	POA
10	Stub Shaft	160010000	POA	160010000	POA	260010000	POA	360010000	POA
SC SHAFTS									
2	Cross & Brg. Kit	002500000	16.00	351500000	—	871500000	21.00	061500000	23.00
12	SC Sleeve Yoke	159332000	POA	159332000	—	883330000	75.00	864330000	59.00
13	Spline Slip Yoke	112282000	POA	112282000	—	162830000	61.00	182830000	56.00





Empire AUTOMATIC AIR VALVES



DISTRIBUTED LOCALLY BY:

NEW WELL HOUSE

PUBLICATION E852M



Empire

Air Release Valves (Small Orifice)



WHY USE AIR VALVES?

Water contains approximately 2% dissolved air by volume under normal conditions and since flowing water is constantly subjected to changing pressures and velocities it is obvious that air is continually coming out of solution. Without air valves this free air will accumulate in pockets at system high points constricting pipeline area. Flow capacity can easily be reduced 5 to 10% due to air pocket build up. These air pockets not only rob line capacity but they also steal expensive electrical energy because the pump will be operating at increased head to overcome the

constricted flow. The elimination of these air pockets through the installation of inexpensive Air Valves greatly improves the pipeline efficiency and decreases overall system operating costs.

Air Valves are of simple construction and are relatively inexpensive to buy and install. The overall cost of air valves is usually less than $\frac{1}{2}$ of 1% of the overall cost of a system and will easily pay for themselves by eliminating air pockets permitting maximum flow capacity and operating efficiency of the pipeline.

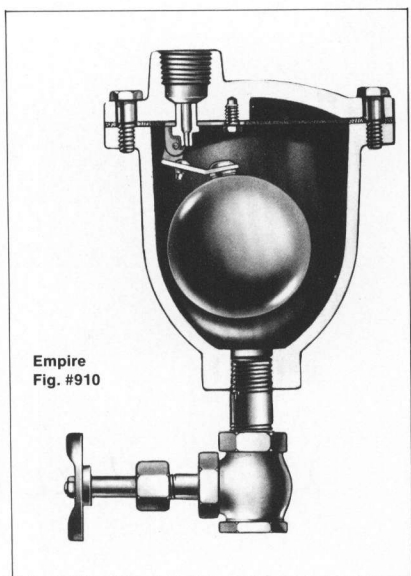
BASIC TYPES OF AIR VALVES

AIR RELEASE VALVES (Small Orifice)

The **Function** of Air Release Valves is to automatically exhaust small amounts of air which collects at system high points once the system is filled and up to pressure. The orifice size generally varies between $\frac{1}{16}$ and $\frac{3}{16}$ inch depending on valve design and working pressure.

In **Operation**, as small quantities of air bubbles enter the valve, they will displace the liquid within the valve and lower its level in relation to the float. When the level of the liquid is lowered to where the float is no longer buoyant, the float will drop. This motion opens the valve seat and permits the air which has accumulated in the upper portions of the valve body to be exhausted to atmosphere. When this air is released the liquid level in the valve once again rises, lifts the float and closes the valve seat. This cycle automatically repeats as often as necessary.

In **Theory** these valves have a very small orifice and either a weighted float or a leverage mechanism connected to the float which multiplies its weight. This force must be greater than system pressure times (X) the orifice area in square inches (in^2) which tries to keep the valve closed. This is why for any particular size valve, the smaller the orifice the higher the pressure rating.



Empire
Fig. #910



Empire

Air and Vacuum Valves (Large Orifice)



AIR/VACUUM VALVES

(Large Orifice)

The **Function** of air/vacuum valves is to automatically exhaust large volumes of air from the system when it is being filled and also to allow air to re-enter the pipe line when being emptied. The orifice size is most generally approximately the same size as the valve inlet.

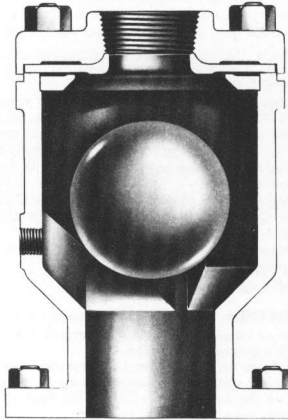
In **Operation** the rate at which air escapes is a direct function of the pressure across the valve orifice. The incoming fluid compresses the air until it reaches a pressure sufficient to develop an exhausting velocity equal to that of the incoming fluid.

When the system is filled, the fluid lifts the float until it closes the orifice. The orifice will remain closed until the system is emptied. Air may enter the valve and displace the fluid while the system is in operation, however, internal pressure will continue to hold the valve closed. The valve will not re-open until the system pressure drops to near atmospheric pressure and the float is no longer buoyed.

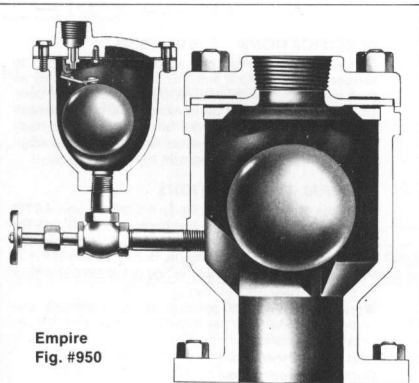
In **Theory** the linear velocity of air exhausted from the orifice of an Air Release Valve increases as the differential pressure across the orifice increases until "Super Critical Flow" is reached. Maximum inflow velocity is reached at approximately - 7 P.S.I. (Gage Pressure) and Maximum outflow velocity is reached at approximately 13 P.S.I. (Gage Pressure). Velocity **can not** be increased past these points.

The quantity of air exhausted through the orifice however continues to increase indefinitely because while there is no further increase in the velocity of the exhausting air it becomes progressively denser and represents a greater volume when expressed in cubic feet at atmosphere. *It should be noted that an outflow of approximately 13 P.S.I. also produces sonic velocity and a noise level somewhat similar to a jet engine.*

Empire Fig. #930



Utilizing Kinetic Air Valves and designing your pipeline to fill at a higher pressure lessens the potential water hammer and surge when the valve closes.



Empire
Fig. #950

COMBINATION AIR VALVES

The **Function** of a "Combination Air Valve" is to incorporate the features of both an "Air Release Valve" and an Air/Vacuum Valve into one body.

The comments which were made on operation and Theory for the individual valves apply to this valve also.

Kinetic Valves Are Specifically Designed Not To Blow Closed — Our Engineering Department has tested our Kinetic design in various sizes at pressures in excess of 200 PSI and the valve remained open until the float was buoyed closed by the water level.



Empire

Air Release Valves (Small Orifice)



AIR RELEASE VALVES (Small Orifice)

The **Function** of Air Release Valves is to automatically exhaust small amounts of air which collects at system high points once the system is filled and up to pressure. The orifice size generally varies between $\frac{1}{16}$ and $\frac{3}{8}$ inch depending on valve design and working pressure.

GENERAL SPECIFICATIONS

Materials of Construction: Body & Cover = iron ASTM A48, Float & Leverage Mechanism = St. St. ASTM A240, Orifice Button = Buna-N Std. & viton optional, Cover Gasket = Composition, Bolts = Steel 1035 H.T.

Pressure Rating: Valve body to 300 psi W.O.G. and float rated to 1000 psi

Working Pressure: 150 psi with standard $\frac{3}{32}$ dia. orifice. Optionally 75 psi with $\frac{1}{8}$ " orifice and 300 psi with $\frac{1}{16}$ " orifice.

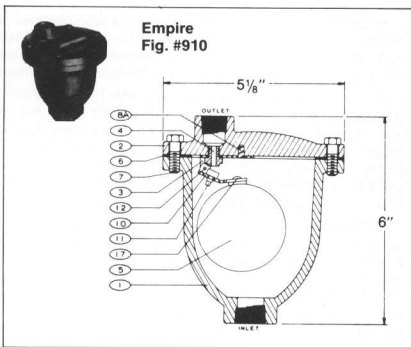
Inlet Pipe Connection: $\frac{1}{2}$ ", $\frac{3}{4}$ " or 1" N.P.T.

Outlet Pipe Connection: $\frac{3}{8}$ " N.P.T.

Weight: 8 pounds

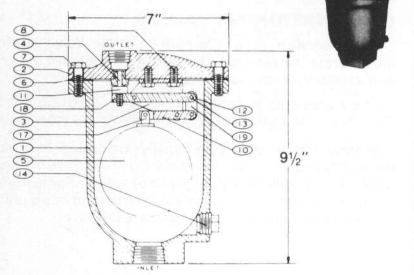
OPERATION (910 or 920)

1. The air release valve orifice is normally held closed by the buoyant force of the float.
2. As the air accumulates in the air release valve body, the float will lower expelling the air to the atmosphere. When the air is expelled, the float will once again cause the orifice to be closed.



1 Body	7 Cover Bolts	13 Retaining Ring
2 Cover	8 Retaining Screws	14 Pipe Plug
3 Leverage Frame	8A Locating Pin	17 Float Retainer
4 Seat	10 Float Arm	18 Orifice Button Arm
5 Float	11 Orifice Button	19 Link
6 Gasket	12 Pivot Pin	

Empire Fig. #920



SPECIFICATIONS (910 or 920)

The **air release valve** shall automatically function to release to atmosphere small amounts of entrained air that may accumulate in a pipeline, chamber or tank. Once the accumulated air is exhausted, the valve shall seat tightly to prevent water leakage. The valve body and cover shall be of semi-steel; float of stainless steel; levers of stainless steel, and with resilient seat.

GENERAL SPECIFICATIONS

Materials of Construction: Body & Cover = iron ASTM A48, Float & Leverage Mechanism = St. St. ASTM A240, Orifice Button = Buna-N Std. & viton optional, Cover Gasket = Composition, Bolts = Steel 1035 H.T.

Pressure Rating: Valve body to 300 psi W.O.G. and float rated to 1000 psi

Working Pressure: 150 psi with standard $\frac{3}{16}$ dia. orifice. Optionally 75 psi with $\frac{5}{16}$ orifice and 300 psi with $\frac{3}{32}$ orifice.

Inlet Pipe Connection: 1", $1\frac{1}{2}$ ", & 2" N.P.T.

Outlet Pipe Connection: $\frac{1}{2}$ " N.P.T.

Weight: 24 pounds

NOTE: All Air Release Valves are available with an Optional Vacuum Check to prevent air from re-entering the system on negative pressure.



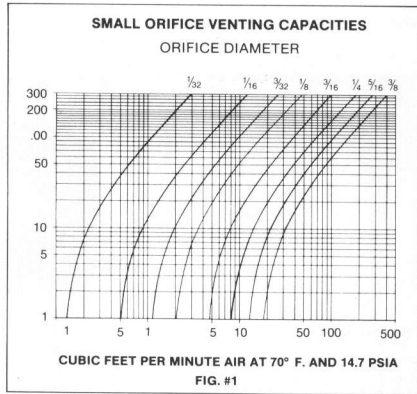
Empire

Air Release Valve Sizing



I. Where specific venting capacity is required.

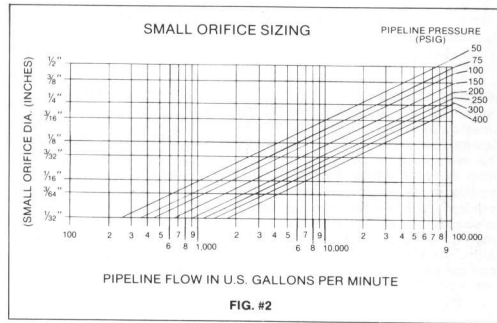
- Enter system pressure and venting capacity onto graph Fig. #1 and select nearest larger orifice diameter.
- Consult available Air Release Valve orifice diameters in Fig. #3 and select Valve with correct orifice diameter and pressure rating.
- Useful Information**
 1 ft³/min. = 7.48 Gal./min.
 1 Gal./min. = .134 ft³/min.



II. Where valve is to be selected on the basis of maximum system flow.

(This graph assumes that water contains 2% dissolved air by volume and therefore will select an orifice diameter that will exhaust approximately 2% of the Volume.)

- Enter total maximum system flow at the bottom of graph Fig. #2, draw a vertical line upward until you reach the line indicating maximum pressure. Draw a line horizontal left until you read minimum required orifice diameter.
- Consult available Air Release Valve orifice diameter in Fig. #3 and select Valve with correct orifice diameter and pressure rating.



NOTE: It is more efficient to install a greater quantity of air release valves at strategic locations with smaller orifice than a lesser quantity with larger orifice.

III. Available Air Release Valve Orifice Diameters and Operating Pressure Ratings.

Operating Pressure Rating is that pressure below which the valve will function automatically to exhaust air from system high points.

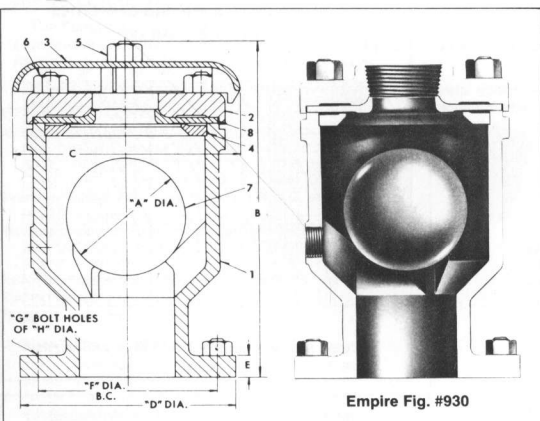
Valve Figure Number	Inlet Size	Outlet Size	AVAILABLE ORIFICE DIAMETERS		
			Opt. Orifice Dia. Max. Working Pres.	Std. Orifice Dia. Max. Working Pres.	Opt. Orifice Dia. Max. Working Pres.
910	1/2" N.P.T.	3/8" N.P.T.	1/8"	3/32"	1/16"
	3/4" N.P.T.		50 PSI	150 PSI	300 PSI
	1" N.P.T.				
920	1" N.P.T.	1/2" N.P.T.	5/16"	3/16"	3/32"
	1 1/2" N.P.T.		50 PSI	150 PSI	300 PSI
	2" N.P.T.				

NOTE: For orifice diameters other than shown, consult factory.



Empire

Air and Vacuum Valves (Large Orifice - Kinetic Type)



FEATURES
 Only one moving part
 Non-corrosive, non-collapsible float
 Drop tight closure
 Highest discharge capacity
 Kinetic design-prevents blowing shut

NOTES:
 1. 2" & 3" size valve available with screwed (N.P.T.) or flanged ends on inlet.
 2. Sizes to 4" are available with screwed (N.P.T.) outlet and throttle devices for deep well pump service.

PARTS LIST			
No.	Item	No.	Item
1	Body	5	Cowl Bolts
2	Cover	6	Cover Bolts
3	Cowl	7	Ball
4	Joint Support Ring	8	Seat Ring

SPECIFICATIONS
 The Air Release Valve shall employ the Kinetic operating principle with one moving part, a stainless steel buoyball. The valve shall be designed such that when the large orifice is open, the ball remains in the throat area without the possibility of the valve blowing shut or collapsing the ball. The valve shall close when water rises in the valve to lift the ball to the orifice seat. The valve body shall be cast iron.

GENERAL DIMENSIONS

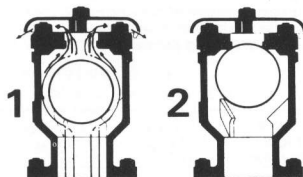
Valve Size	A Ball Dia.	B Height	C Width	D Fig. Od.	E Fig. Thk.	F Bolt Circle	G No. Holes	H Hole Dia.
1"	2"	8"	6 1/2"	Available Scr. End Only				
2"	3"	10 1/2"	7 1/2"	6"	5/8"	4 3/4"	4"	3/4"
3"	3 3/8"	11 1/4"	9 3/4"	7 1/2"	3/4"	6"	4"	3/4"
4"	5"	14 1/4"	12 1/8"	9"	15/16"	7 1/2"	8"	3/4"
6"	8"	19 1/4"	17"	11"	1"	9 1/2"	8"	7/8"
8"	23"	20"	13 1/4"	1 1/8"	1 1/4"	11 3/4"	8"	7/8"

NOTE: Flange dimensions shown are for 125# ANSI B16.1

KINETIC OPERATING PRINCIPLE

In the development of the Kinetic air release valve, hydrodynamic principles have been applied to produce a unique patented feature. One moving part, the Buoy ball (float) seals the orifice but positively remains open during the exhausting of air. This valve is immediately closed when water rises in the valve to lift the ball to the orifice seat for a drop tight closure.

The Kinetic air release valve is designed so that when the large orifice is open the ball remains in the throat area. Here the escaping air stream flows around the ball in such a manner that a resultant pressure on the ball is downward and increases as the exhausting air velocity increases. Thus, air at any velocity can be discharged without the possibility of the valve blowing shut or collapsing the ball (float) — even when the air is moving at its critical velocity.



1. During the exhausting sequence, the air flowing around the Buoy ball produces a resultant downward force which maintains the ball in the open position.
2. The buoyant force of the ball will seal the exhaust orifice when water reaches the ball.



Empire

Air/Vacuum Valve Sizing



1. To exhaust Air when filling pipe line.

A. Size valve to exhaust air at a rate equal to the pumping rate or the design pipe fill rate.

B. Convert system liquid flow in G.P.M. (Gallons per minute) to air flow terminology which is shown in S.C.F.M. (Standard Cubic Foot per minute)

$$SCFM = \frac{Q}{7.5} \quad Q = \text{Flow in G.P.M.}$$

SCFM = Flow in Cubic Foot per minute

C. Enter Air discharge into graph Fig. #4 at desired pressure differential (ΔP) to get correct valve size.

1. Use a ΔP of 5 PSI for Kinetic Air Valves, Kinetic valves can be vented at virtually any ΔP without blowing shut, however it should be noted that ΔP 's in excess of 10 PSI could cause excessive noise levels.

2. Use a ΔP of 2 PSI for conventional valves. (at pressures in excess of 2 PSI conventional air valves will blow shut causing internal damage to the valve)

NOTE: A kinetic type air valve is capable of exhausting a greater volume of air than a conventional air valve because it is specifically designed not to blow shut and therefore can be operated at higher differential pressures.

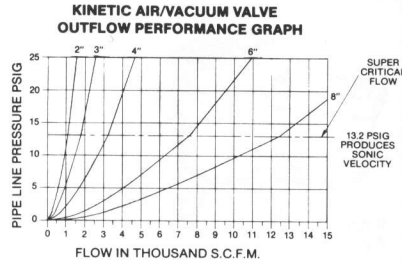


FIG. #4

KINETIC AIR/VACUUM VALVE INFLOW PERFORMANCE GRAPH

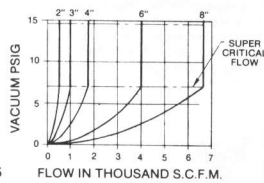


FIG. #5

II. To Admit Air into the System When Draining (Or for Line-Break Protection)

A. Size vacuum valve to admit air at a rate equal to flow generated due to gravity. Use an inflow ΔP of 5 PSI or lower if pipe will not stand that much negative pressure. (See "D" below)

$$\text{Flow Due to Gravity} = 5 \times \sqrt{SD^3}$$

(Cubic Feet/Minute)

S = Pipe Slope in Ft. Per Ft.

D = Pipe Diameter (inches)

B. Insert into graph Fig. #5 to determine Correct Valve Size.

OR

C. Solve for A & B above directly by using graph Fig. #6 by simply inserting pipe slope to get flow created by gravity. Enter answer into graph Fig. #5 to find the Correct Size Valve.

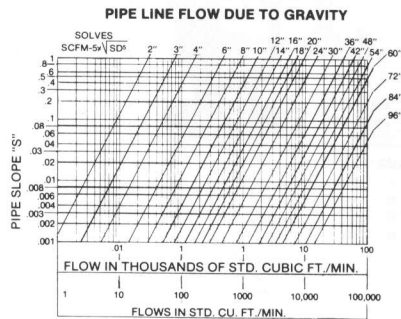
D. If there is a risk of pipe collapse due to the vacuum created when draining or from line break the maximum tolerable differential pressure must be determined using the following formula:

$$P = 13,000,000 \left(\frac{T}{D} \right)$$

P = Collapse pressure (PSI)

T = Wall thickness of Pipe (inches)

D = Pipe Diameter (inches)



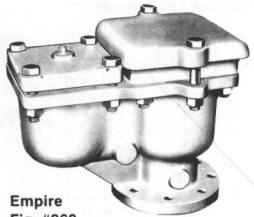
NOTE: PIPE SLOPES "S" = RATIO OF HEAD (FEET) CAUSING FLOW TO LENGTH OF PIPE (FEET).

FIG. #6



Empire

Combination Air Release Air/Vacuum Valves

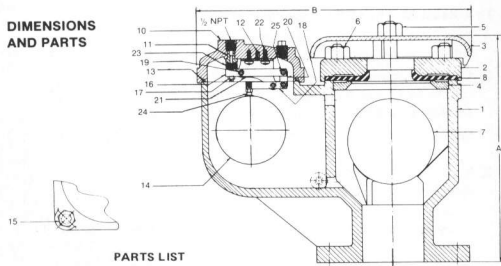


Empire
Fig. #960

SPECIFICATIONS

The Combination Valve shall be a combination of small and large orifice units employing the unique Kinetic operating principle. The only moving parts shall be the stainless balls which will remain in the throat area when discharging air without blowing shut or collapsing the ball. In the closed position, resulting from water filled line, the valve shall prevent leakage. The large orifice seat shall be of composition material and replaceable. The body shall be cast iron.

DIMENSIONS AND PARTS



PARTS LIST

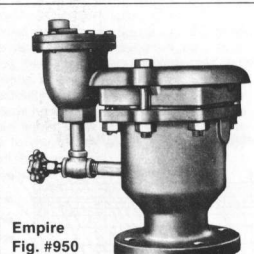
No.	Part	No.	Part
1	Body	14	Small Orifice Ball
2	Cover	15	Small Orifice Cover Bolts
3	Cowl	16	Lever Arm
4	Joint Support Ring	17	Nut
5	Cowl Bolts	18	Float Arm
6	Cover Bolts	19	Pins
7	Large Orifice Ball	20	Link
8	Seat Ring	21	Lever Bracket
10	Small Orifice Cover	22	Bracket Screws
11	Small Orifice	23	Orifice Button
12	Centering Pin	24	Float Retainer
13	Cover O-Ring	25	Retaining Ring

NOTES

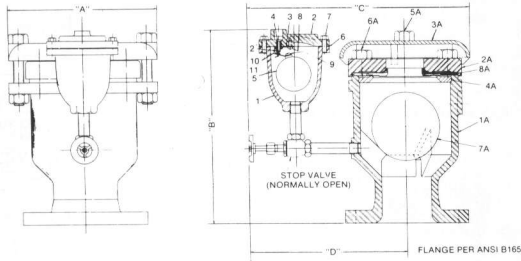
- 2" size valve available with screwed (N.P.T.) or flanged ends on inlet.
- Sizes to 4" are available with screwed (N.P.T.) outlet and throttle devices for Deep-Well Pump Service.

	DIMENSIONS				
	2"	3"	4"	6"	8"
A	11	11	14	19	22 1/2
B	14	14	16	25	35
C	8	9	11	17	19

NOTE: Large Orifice Valve Section is also available with threaded outlet.



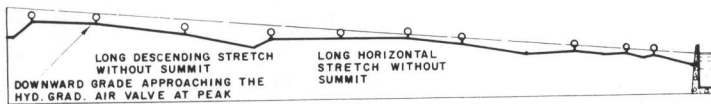
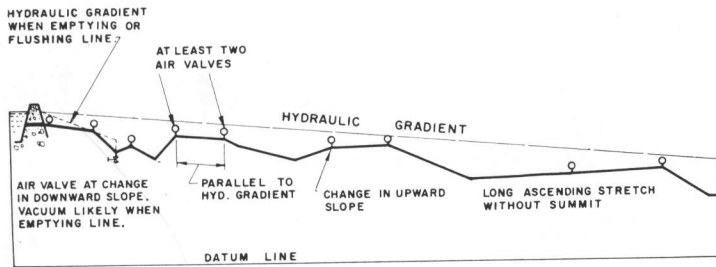
Empire
Fig. #950



SIZE	1"	2"	3"	4"	6"
A	6 1/4"	7 3/4"	8 3/4"	10 3/4"	17"
B	11 1/2"	13 1/4"	13 3/4"	14 1/4"	19 1/4"
C	13"	14 1/4"	15 1/4"	16 1/4"	24"
D	9 3/8"	10 1/2"	11"	11 1/2"	15 1/2"

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Body	7	Cover Bolts	1A	Body
2	Cover	8	Locating Screw	2A	Cover
3	Leverage Bracket	9	Float Retainer	3A	Cowl
4	Seat	10	Float Arm	4A	Joint Support Ring
5	Float	11	Orifice Button		AIR RELEASE AND VACUUM VALVE
6	Gasket	12	Pivot Pin		

HIGH PRESSURE AIR RELEASE VALVE



SUGGESTED AIR RELEASE VALVE LOCATIONS TYPICAL PIPELINE

1. **Peaks** — Install Combination Air Valves. This is the foremost place where air valves are required. A peak is located by reference to the hydraulic gradient and not to a horizontal datum line.
A section of the pipeline that is above the hydraulic gradient is under negative pressure and generally requires the use of a check to prevent air from being drawn into the pipe line.
2. **Increased Down Slope** — Install an air-release valve. If vacuum protection is required, install a combination air valve.
3. **Decrease In Upward Slope** — Same as #2.
4. **Long Ascents** — Install Air/Vacuum Valves @ $\frac{1}{4}$ - $\frac{1}{2}$ mile intervals.
5. **Long Decents** — Install Combination Air Valves @ $\frac{1}{4}$ - $\frac{1}{2}$ mile intervals.
6. **Long Horizontals** — Install Combination Air Valves @ $\frac{1}{4}$ - $\frac{1}{2}$ mile intervals.
7. **Pumps** — Install Air Release on discharge as close as possible to check valve.
8. **Large Valve, Operating Cylinders & Piping Loops** — Install Air Release Valves.



Empire

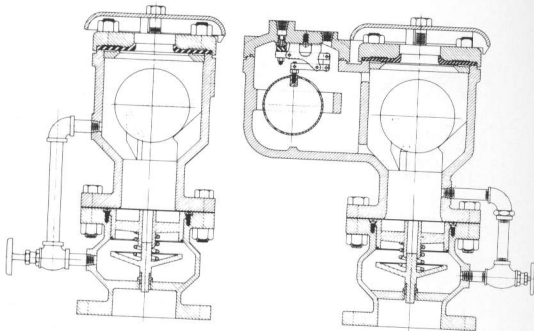
Special Purpose Air Valves



Shhockless Air and Vacuum Valves With Regulated Closure

(Sometimes referred to as
Slow-Closing Air Valves)

This valve provides pipelines with all the protection of a standard air and vacuum valve plus the additional feature of a Shhock-Less regulated closure device which prevents the air and vacuum valve from being slammed shut during critical operation. This is achieved by means of throttling the flow of water through the Shhock-Less device to a degree that allows the air and vacuum valve to fill at a slower rate. A damaging shock or water hammer is prevented from occurring within the valve and a rapid closure of the valve is prevented.



Empire Fig. #970

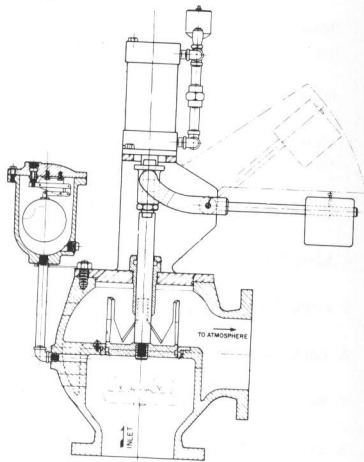
Hydraulically Controlled — Combination Air Valves (An Air Valve that Provides Surge Protection)

The "Hydraulically Controlled" - Combination Air Valve functions the same as a conventional combination air valve except that it has one additional feature.

These valves are normally open and close at an adjustable, controlled rate spilling a regulated volume of water to prevent a pressure surge.

This valve will provide excellent pipeline protection against surge pressures which normally occur when filling or draining a pipeline.

A small orifice type Air Release Valve is also included to vent small quantities of accumulated air at normal operating pressures.





Empire

"Air Like Water, Is A Fluid"

by Ruth Wolfe



DANIEL BERNOULLI (1700-1782) was one of a Swiss family of which at least eight members became distinguished in the history of science and mathematics. The family originated in Antwerp, and later settled in Switzerland. Daniel, a philosopher, mathematician and physician, advanced the kinetic theory of gases and fluids in his most important work, the *Hydrodynamica*, devoted to a theoretical and practical exploration of the equilibrium, pressure reaction and velocities of fluids. He won or shared some ten prizes offered by the Academy of Sciences of Paris and devoted the rest of his life to study of probabilities.

DANIEL BERNOULLI



A crow can fly from tree to tree quite well without understanding the principles of flight. A pilot doesn't have to know what holds a plane up in order to fly it. But right there is where the pilot has the advantage over the crow. Man has not learned to fly, but he knows *why* he can fly.

Daniel Bernoulli (ber-NEW-ye) was the scientist who helped us to understand one of the main secrets of flight. Bernoulli lived in the eighteenth century. He never saw an airplane. In fact, Bernoulli didn't even work with air in figuring out his valuable principle. Bernoulli worked with water. His theorem deals with fluids. Air, like water, is a fluid. Bernoulli's theorem helps to explain one of the four major forces in flight. That force is lift. The other three are gravity, thrust, and drag.

Bernoulli was concerned with the flow of water through pipes. He discovered that if the speed of a moving fluid is increased at any point, the pressure is decreased. It is not hard to find examples of Bernoulli's theorem around you. You can see Bernoulli's theorem at work in many ways.

- (1) Try blowing between two thin sheets of paper. The moving air between the sheets will have less pressure than the atmospheric pressure. They will be forced together.
- (2) Place a card over the end of a spool. Hold it there with a pin to keep it from slipping sideways. The harder you blow, the tighter the card will stick.
- (3) A ball or balloon will balance in a stream of compressed air. The velocity of the moving air is greater than the surrounding air, but its pressure is less.
- (4) The moving air passing through the throat of an atomizer has less pressure than the atmospheric pressure acting on the surface of the liquid.

Now how does Bernoulli's principle apply to the airplane? First, let's take a look at the shape of an airplane wing. The shape is called an airfoil. The airfoil is slightly curved on the top and nearly flat on the bottom. As it moves through the air, the stream of air is divided. The air which flows over the top has farther to go. Consequently, it travels faster than the air moving along the underside. Remember our principle. When the speed increases, the pressure decreases. If the air is moving faster over the top of the wing than it is below the wing, then the pressure above the wing must be less. The air below the wing will try to rise into the high pressure area. It pushes the wing up with it, providing lift.

Greater lift is produced with greater speed. The design of the wing will also determine the amount of lift.

There does not have to be a great amount of difference in pressure between the two areas to provide enough lift for a plane to fly. You will remember that at sea level, air has a

pressure of 14.7 pounds per square inch. Let us suppose that the air beneath the wing has 14.7 lbs. of pressure and the air moving above the wing has 14.5 lbs. of pressure per square inch.

The difference of .2 lb. does not seem very great. We know that there are 144 square inches in a square foot. By multiplying 144 by .2, we find that there would be a difference of 28.8 lbs. per square foot between the pressure below the wing and the pressure above the wing.

If an airplane has a wing area of 200 square feet, then there would be (200 x 28.8) a force of 5,760 lbs. lifting the plane. That's nearly three tons of lift!

Bernoulli's theorem accounts for the way a wing gets about three fourths of its total lift. There are other factors to be considered. The wing must meet the air stream at the proper angle. This angle is called the angle of attack.

This article can give only the briefest explanation of lift.

Every plane in flight is acted upon by four forces — lift, gravity, thrust, and drag. We have seen how lift is provided. For our purposes, we can say that *gravity* is the weight of the plane. Before a plane can take off, the lift must be greater than the weight.

Thrust is provided by the propeller, which is in itself an airfoil. As it turns, the propeller bites into the air, pulling the plane forward. It also sends a current of air back over the wing.

Drag is the resistance of the plane to the air. You have met drag on a windy day when you tried to run against the wind. Before a plane can increase in speed, thrust must be greater than drag. In level flight, lift is equal to gravity; the thrust is equal to the drag.

Lift is the force that makes an airplane differ from other vehicles. Cars, trains, and bicycles all have thrust, gravity, and drag. Only aircraft have the fourth force of lift.



Bernoulli's principle in action!
This theory, worked out with fluids not air, explains to man the principle of lift in aircraft flight.



Empire

Air Release Valves

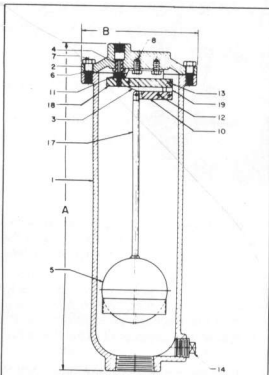


SPECIFICATIONS

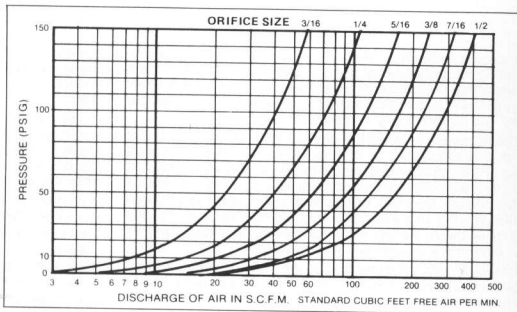
The Air Release Valve shall automatically function at full line pressure to release to atmosphere small amounts of entrained air that may accumulate in a pipeline, chamber or tank. Once the accumulated air is exhausted, the valve shall shut tightly to prevent waste water leakage. The valve body and cover shall be of semi-steel, with vitron resilient seat, and stainless steel float and linkage.

OPTIONAL:

Flush-Out accessories shall be furnished and assembled to the valve consisting of an inlet shutoff valve, blowoff valve, clear water inlet valve, rubber hose and quick disconnect couplings.



Wastewater Air Release Valves are designed to release air and gases which accumulate at high points in sewage handling systems such as sewage force mains, treatment plants and pumping stations during their operation



GENERAL DIMENSIONS

FIGURE NUMBER	INLET SIZE		OUTLET SIZE		WORKING PRESSURE		ORIFICE SIZE		A		B		SHIPPING WEIGHT		MODEL
	IN	MM	IN	MM	PSI	Kg Sq CM	IN	MM	IN	MM	IN	MM	LBS	KG	
2 - SAR - 3	2	50.8	1/2	12.7	0	.07	3	16	20	521	7	178	48	22	A S V A L V E
3 - SAR - 3	3	76.2			50	23									
4 - SAR - 3	4	101.6			150	10.5							4.76	52	
2 - SAR - 5	2	50.8	1/2	12.7	0	.07	5	16	12	305	7	178	48	22	S B H O D R T
3 - SAR - 5	3	76.2			50	23									
4 - SAR - 5	4	101.6			75	5.25							7.94	52	
2 - SARS - 3	2	50.8	1	25.4	0	.07	7	16	20	521	9	242	44	20	L H C I G P A C I T Y
3 - SARS - 3	3	76.2			46	21									
4 - SARS - 3	4	101.6			150	10.5							4.76	48	
2 - SARS - 5	2	50.8	1	25.4	0	.07	7	16	20	521	9	242	44	20	L H C I G P A C I T Y
3 - SARS - 5	3	76.2			46	21									
4 - SARS - 5	4	101.6			75	5.25							7.94	48	
2 - SAR - 7	2	50.8	1	25.4	0	.07	7	16	20	521	9	242	80	37	L H C I G P A C I T Y
3 - SAR - 7	3	76.2			83	38									
4 - SAR - 7	4	101.6			150	10.5							11.11	85	
2 - SAR - 8	2	50.8	1	25.4	0	.07	1	2	20	521	9	242	80	37	L H C I G P A C I T Y
3 - SAR - 8	3	76.2			83	38									
4 - SAR - 8	4	101.6			75	5.25							12.7	85	

Note: For sizes under 2" (50.8MM) reducer bushings will be provided. Sizes up to 3" furnished with screwed ends.

Sizes 4" and up furnished std. flanged. All flanges per 125# ANSI B-16.1 specs. Contact Home Office for higher pressures and other orifice sizes.

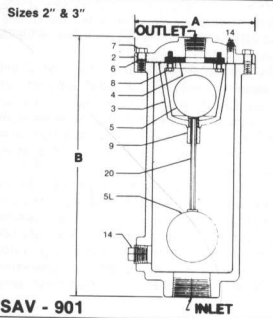
Ordering Data:

Size _____ Figure No. _____ Quantity _____ Operating Pressure _____ Fluid _____



Empire

Air and Vacuum Valves



SAV - 901

SPECIFICATIONS

The Air and Vacuum Valve shall automatically function to release to atmosphere large amounts of air found in pipe lines, tanks or chambers during their filling cycle. Once the air is exhausted, the valve shall seat tightly to prevent leakage. The valve shall also function to admit air into a line, tank or chamber under emergency conditions or when it is being drained. The valve body and cover shall be of semi-steel; float of stainless steel; with resilient seat.

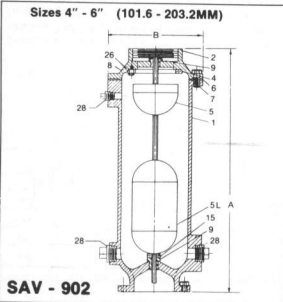
OPTIONAL—A Flushing attachment shall be furnished and assembled to the valve, consisting of an inlet shutoff valve, clear water inlet valve, rubber supply hose and quick connect couplings.

MATERIALS OF CONSTRUCTION

PART	MATERIAL SPECIFICATIONS
Body & Cover	Cast Iron - ASTM A 48
Internal Parts	Stainless Steel - ASTM A-240
Seat	Rubber - Viton
Cover Gasket	Composition

LIST OF PARTS

1. Body	6. Gasket	20. Guide Shaft
2. Cover	7. Cover Bolts	23. Hood
3. Baffle	8. Retaining Screws	24. Hood Ret. Screws
4. Seat	9. Guide Bushings	25. Washer
5. Float	14. Pipe Plug	26. Seat Ret Screws
5L. Lower Float	15. Cushion	28. Pipe Plug

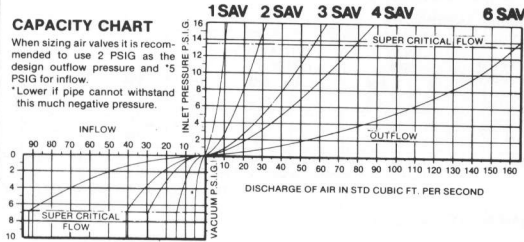


SAV - 902

CAPACITY CHART

When sizing air valves it is recommended to use 2 PSIG as the design outflow pressure and 15 PSIG for inflow.

*Lower if pipe cannot withstand this much negative pressure.



NOTE: All flanged valves conform to 125# ANSI B 16.1 specs.
For extra heavy service flanged valves conform to 250# ANSI B 16.1 specs.

Wastewater - Fig. SAV - Air/Vacuum Valves provide pipeline efficiency and protection by releasing a large volume of air when a system is being filled and allowing a large volume of air to re-enter the system when draining.

GENERAL DIMENSIONS

FIGURE NUMBERS	INLET SIZE		OUTLET SIZE		MAX. WORKING PRESSURE		A		B		SHIPPING WEIGHT	
	IN	MM	IN	MM	PSI	Kg Sq C M	IN	MM	IN	MM	LB	KG
2 SAV	2	50.8	1	25.4	150	10.5	7	178	20 1/2	521	48	22
2 SAV-2	2	50.8	2	50.8			9 1/2	242			83	38
3 SAV	3	76.2	3	76.2			9 1/2	242	21	534	87	40
4 SAV	4	101.6	4	101.6			12	305	37	940	290	132
6 SAV	6	152.4	6	152.4			14	356	38	966	350	159

Note: Sizes up to 3" Furnished Standard Screwed End. Sizes 4" and up Furnished Standard Flanged. All Flanges per 125# ANSI B-16.1 specs.

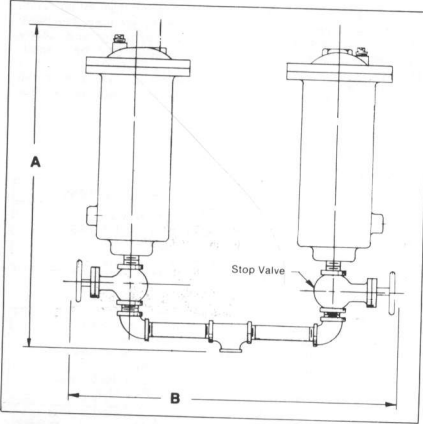


Empire

Sewage Combination Air Valves



Fig. Number SCAV



SPECIFICATIONS

The Combination Sewage Air Valve shall consist of one Sewage Air Release Valve and one Sewage Air Vacuum Valve piped into a compact assembly.

The Air Release Valve shall automatically function at full line pressure to release to atmosphere small amounts of entrained air that may accumulate in a pipeline, chamber or tank. Once the accumulated air is exhausted, the valve shall seat tightly to prevent waste water leakage. The valve body and cover shall be of semi-steel. Float and levers of stainless steel and with viton resilient seat.

The Air/Vacuum Valve shall automatically release to atmosphere large amounts of air found in pipelines, tanks or chambers during their filling cycle. Once the air is exhausted the valve shall seat tightly to prevent leakage. The valve shall also function to admit air into a line, tank or chamber under emergency conditions when it is being drained. The valve body and cover shall be of semi-steel. Float of stainless; with resilient seat.

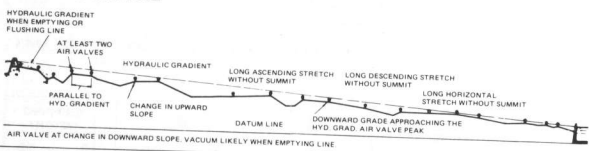
OPTIONAL—"Flush out Attachment" shall be furnished and assembled to the valves, consisting of two inlet shutoff valves, two blowoff valves, two clear water inlet valves, rubber hose and quick disconnect couplings.

GENERAL DIMENSIONS

FIGURE NUMBERS	INLET SIZE		OUTLET SIZE		A		B		DEPTH		SHIPPING WEIGHT	
	IN	MM	IN	MM	IN	MM	IN	MM	IN	MM	LB	KG
2-SCAV	2	50.8	2	50.8	26	660	21	533	10	254	140	64
3-SCAV	3	76	3	76	28	711	22	559	10	254	150	68
4-SCAV	4	102	4	102	37	940	26	660	12	305	275	125

Notes: 2" and 3" Furnished Standard with screwed ends. Many other combinations of Sewage Air Release and Air/Vacuum valves are available.
 4" Furnished Standard flanged 125# per ANSI B16.1. For larger sizes consult factory.

WHERE TO INSTALL



NOTE:

The dimensions shown in this catalog are for estimating purposes only and are not guaranteed. Certified dimensional drawings are available with your order when requested.

WHY INSTALL?

Air is known to be the cause of serious problems in a water main working under pressure or in the process of filling, such as: delay in filling, throttling and reduction of discharge capacity, initiation of water hammer, and increased tendency towards corrosion of inner pipe services. Since a main cannot be emptied unless the water is replaced by air, means of ventilation are necessary, emptying of the line. The large orifice of the combination valve is designed to exhaust or intake air while the line is being filled or emptied, while the small orifice serves to release air that may accumulate in the main working under pressure. The

combination valve is advantageous in situations where multiple contingencies exist. **LOST EFFICIENCY/ADDED EXPENSE** may be the result of air binding particularly in a pressure line where the pump is forced to operate at an increased head with decreased efficiency. **EVERY ENGINEER** must protect his line against trapped or entrained air to assure maximum flow capacity and ultimate operating efficiency. **YOUR BEST BUY** — Air Release and Air/Vacuum Valves are engineered to protect your system from air binding and assure maximum flow capacity.

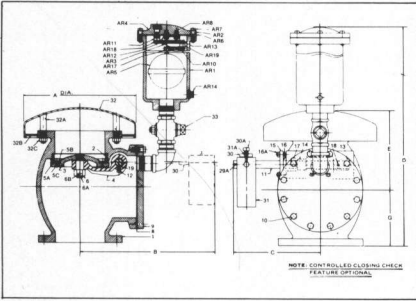


Empire

High Capacity Sewage Air and Vacuum Valves



Fig. Number HCARV



SPECIFICATION:

Function

The function of the High Capacity Vacuum breaking and Small Orifice Air Release Valve is to open at a specified negative pressure within the pipeline and admit air in large volumes. Once in the pipeline, the air must be vented by way of a small orifice automatic air release valve.

Construction

The vacuum breaking portion of the valve assembly shall be comprised of a rubber seated swing check valve with a stainless steel screened shroud over the inlet port. The opening set point shall be by way of an adjustable counterweight factory set for minus one PSIG.

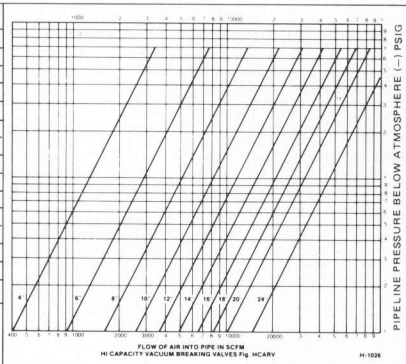
The small orifice shall vent air anytime air accumulates under working pressure conditions.

The valve bodies shall be cast iron ASTM A126-B. The vacuum valve hinge shaft shall be stainless steel as shall be the interior parts of the small orifice air release valve.

GENERAL DIMENSIONS

VALVE SIZE	IN	3	4	6	8	10	12	14	16
A	MM	76.2	101.6	152.4	203.2	254	304.8	355.6	406.4
B	IN	12	12	14	18	24	28	32	36
C	MM	305	305	356	458	610	712	813	915
D	IN	9	10	14	15	28	29	29	29
E	MM	229	254	356	381	712	737	737	737
F	IN	10	11	12	14	15	17	20	24
G	MM	254	280	305	356	381	432	508	610
H	IN	39	40	42	42	44	48	50	51
I	MM	990	1016	1067	1067	1118	1220	1270	1296
J	IN	9	9	12	13	15	18	22	25
K	MM	229	229	305	330	381	457	559	635
L	IN	6	7	9	9	12	14	17	18
M	MM	153	178	229	229	305	356	432	458
N	LB	120	164	250	355	520	1000	1580	1950
O	KG	54	74	113	161	236	454	727	885

SIZE SELECTION CHART



Notes:
Flanges Per 125# ANSI B16.1. For larger sizes consult factory.

LIST OF PARTS

1 Globe Body	9 Cover	31A Counterweight Set Screw
2 Seat	10 Cover Bolts	32 Dished Head
3 Disc	11 Shaft	32A Dished Head Studs
4 Disc Arm	12 Disc Arm Set Screws	32B Screen
5A Renewable Seat Washer	15 Gland	32C Nuts
5B Seat Ring Follower	16 Gland Studs	33 Stop Cock
5C Seat Ring Screws	16A Gland Nuts	29A Key
6 Disc Nut	19 Key Not Used on 2" & 3"	13 Inner Bushing
6A Disc Pin	30 Counter Weight Arm	14 Outer Bushing
6B Disc Nut Pin	30A Counterweight Arm Screw	17 Gland Packing
8 Cover Gasket	31 Counterweight	18 Shaft Lock Pin

Kinetic Air Valves (They Really are Something Special)

Basic Principle of Bernoulli's Theory

$$\text{"P" Pressure Head} + \text{"V" Velocity Head} + \text{"Z" Elevation Head} = \text{"C" Constant}$$

THE VALVE

The "Kinetic" form of air valve for water mains overcomes the risk, and subsequent inconveniences, of orthodox large orifice air valve balls being suddenly caught up in the escaping air stream and closing the valve during the filling of water mains at high rates. In the "Kinetic" valve, this difficulty is obviated by controlling the movement of the valve ball in such a way that the valve cannot be blown shut prematurely by discharging air, or even by a mixture of air and water spray, however high the emergent air velocity, but is positively closed by rising solid water.

THE DEVELOPMENT

In the development of the "Kinetic" valve, hydro-dynamic principles have been applied to produce the novel feature through which the ball-sealed orifice always remains open while air is exhausting, and is immediately closed when solid water rises in the valve to lift the ball and seal the orifice.

Conventional large orifice air valves usually have recesses or pockets, sheltered from escaping air, for the ball to drop into when the valve is open. From experience, however, it has been found that turbulent air can circulate in such cavities, and cause the ball to be thrown into the discharging air stream, thus blowing the valve shut. As only slight pressure will hold the ball against the orifice, the valve is liable to remain closed until the ball is manually forced off the orifice.

THE THEORY

When fluid escapes through an orifice in a plate with a disk placed closely over the orifice it issues on all sides in a radiating film but does not displace the disk. A similar phenomenon is produced when the plate and disk are replaced by a cone and ball.

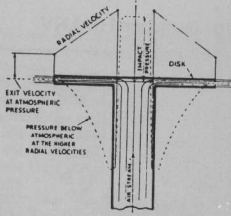
The principle of this action can be easily shown, using a table tennis ball and a small funnel. If the ball is placed in the funnel and air is blown through the stem, the ball will remain poised in the neck. And if the funnel is inverted and air is blown down the stem, the ball will be supported by the air flow against gravitational pull.

The forces acting on the ball, independent of gravitational forces, are the impact of the air stream, acting over an area equal to that of the pipe section and tending to blow it away, and a suction force acting over a large annular area and tending to hold it in place. Therefore, if the impact force is less than the suction force, the ball will be held down, and if the opposite condition exists, the ball will be blown out.

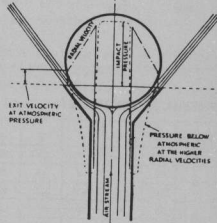
THE DESIGN

For practical purposes, since the diameter of ball which will be blown off by air can be ascertained and a larger ball will be displaced by water than by air, it is possible to determine the ratio of ball size to stream size that will result in the ball being blown out by a stream of water, but held down by a stream of air. From laboratory investigations, the ratio, which, together with a convenient angle of cone, conforms to this principle has been obtained and embodied in the design of the "Kinetic" air valve.

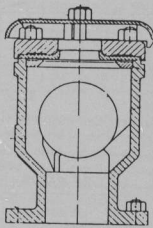
Although the foregoing applies in principle to an open cone and ball, only minor modifications — including the provision of suitable limit stops to prevent the ball blocking inflow by falling into the bottom of the cone, and thus impairing the function of a large orifice air relief valve to induce as well as exhaust air — are needed when a ball is contained in a housing with an orificed cover. With this arrangement, the impinging air stream creates a greater suction force, which causes a downward pressure on the ball, that increases as the emergent air velocity increases. Consequently, air at any velocity, even its critical velocity, can be discharged without the possibility of the valve blowing shut prematurely.



ADHERENT DISK



CONE AND BALL



Empire SPECIALTY CO., INC.
GENERAL AUTOMATIC VALVES
P.O. BOX 907 • CLAY AVENUE EXTENSION • MARS, PA 16048
412-625-3541

WARRANTY

Warranty Empire Specialty Co., Inc. (Seller) warrants, to the original Buyer only, that all products delivered hereunder shall be free from defects in manufacture for a period of one year from the date of delivery, provided that such products are installed, used, operated, adjusted and serviced only in a proper and appropriate manner and in strict accordance with any instructions relating thereto furnished to Buyer by Seller. In no event shall the foregoing warranty extend to any products in any way caused or allowed to be, or installed, operated or used in such a manner as to be, subject or exposed to conditions of misuse, abuse or accident.

Products not manufactured by Seller shall be warranted only to the extent of warranty to Seller.

The foregoing warranty is exclusive and lieu of any and all other warranties, express or implied. No warranty of merchantability, no implied warranty of fitness for any particular purpose, and no implied warranty arising by usage of trade, course of dealing or course of performance is given by Seller or shall arise by or in connection with this sale and/or the Seller's and/or Buyer's conduct in relation thereto or to each other, and in no event shall Seller be liable on any such warranty with respect to any product.

Liability of the Seller under or in connection with this sale and/or the foregoing warranty shall be limited, at the sole option of the Seller, to one of repair or, replacement of, or a refund of the purchase price of any products or part thereof with respect to which Seller receives. Promptly after Buyer's discovery of any alleged defect and prior to the expiration of the one-year warranty period as provided above, notice, in writing, from Buyer of Buyer's claim of defect, and which shall be returned to Seller by Buyer, as provided herein, promptly after Buyer's discovery of such alleged defect and which shall be determined by the Seller to have proved

defective within the one-year warranty period provided above, failure by Buyer so to notify Seller and return such products to Seller after Buyer's discovery of such alleged defect shall constitute a waiver by Buyer of any and all claims of any kind with respect thereto. Any products returned by Buyer to Seller under the foregoing terms shall be returned to Seller's place of business freight prepaid, accompanied or preceded by Buyer's particularized statement of the claimed defect. The risk of loss and freight charges to and from Seller in connection with any returned products shall be borne by Buyer; but Seller shall bear such additional freight charges arising in connection with any returned products ultimately determined by Seller to be defective under the terms of the foregoing warranty, the cost of repair or replacement (if any) of such products, and the risk of loss or damage while such products are in Seller's possession at its place of business. The foregoing remedy shall constitute the sale and exclusive remedy of the Buyer under or in connection with this sale and/or warranty of the Seller. Except as specifically provided herein, Seller shall not be responsible or liable for any costs, expenses or damages of Buyer in connection with any removal, repair or replacement (including any attempts or actions relating thereto) of any allegedly defective products, and no charge or setoff of any kind of Buyer relating thereto shall be made against the Seller without prior and specific written approval of Seller.

In no event shall Seller be responsible or liable for any special, indirect, incidental or consequential damages arising in any way in connection with any products or this sale.

The agreement of Seller to sell its products is expressly conditioned upon the Buyer's assent to, and Seller agrees to sell its products only upon, all terms and conditions set forth above and on the face hereof. Buyer's acceptance of any products provided under this sale constitutes such assent.

CUSTOMER ORDER NO. 52404-8

SERIAL NO. E85146



Empire SPECIALTY CO., INC.
GENERAL AUTOMATIC VALVES
P.O. BOX 807 • CLAY AVENUE EXTENSION • MARS, PA 16048
412-625-3541

