SECTION 10

INSTALLING THE PACKING

A. The packing container for the 2½ x 3 x 10 and smaller discharge heads is integral with the casting. The packing container for the 4 x 4 x 10C and larger sizes is separate from the casting, and is installed as follows:

1. Slide the packing container gasket (Fig. 8-1a, or b) over the top shaft and into position on the discharge head.

2. Slide the packing container over the top shaft and into position on the gasket.

3. Firmly attach the packing container to the discharge head with the cap screws provided.

B. The arrangement of the packings depends upon the head size, the diameter of the top shaft, and the pressure developed by the pump. Consult Table 10-1 and Fig. 10-1 for the correct arrangement for the particular pump being installed. Note that some pumps require a lantern ring and a compression spring in addition to packing rings.

C. The packing rings must have a gap of 1/16 to 1/8 inch and the ends must be parallel. If the packing is received in coil form, it must be cut into rings before installing. This can be done by tightly wrapping one end of the packing around the top shaft like one coil of a coil spring, and marking the coil with a sharp knife. (See Fig. 10-2.) After cutting on the mark, this length of packing may be used as a template for cutting all the other rings.

D. To install a packing ring in the container, grease the ring on all sides and wrap it around the shaft, just above the container. Start the ring into the container with the fingers. Be sure that the ends of the ring do not butt together or tend to overlap. When the entire ring is worked in approximately flush with the top of the container, use the gland to push it into place. This will ensure that it remains square with the shaft.

E. **NOTE**

Install adjacent packing rings with the gaps 180° apart (on opposite sides of the shaft).

F. In packing arrangements which use springs, be sure not to omit the washer between the spring and the first packing ring. (See Fig. 10-1, Type III.)

G. Place the split gland (Fig. 8-1a, or b) in the packing container. Insert the gland retainer bolts in the slots in the packing container. Place a gland clamp over the end of each gland bolt so that it holds the two halves of the gland together. Install nuts on the gland bolts and turn them finger-tight only.

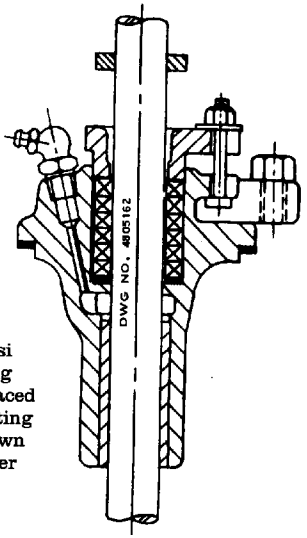
H. On pumps furnished with a pressure-type grease fitting at the packing container, apply grease with a grease gun until grease oozes out around the gland. A list of recommended greases, by brand name and manufacturer, is given in Table 10-2. In addition to its lubrication value, the grease will help to limit the amount of fluid leakage.

J. Final adjustment of the packing gland is done after the pump has been started. This procedure is explained in Section 17.

K. Install the top shaft seal ring ("water slinger", Fig. 8-1a, or b) on the top shaft a short distance above the gland but well below the driver mounting surface of the discharge head.

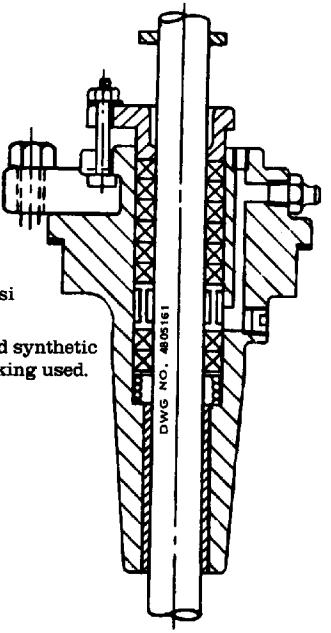
TYPE II
0 to 175 psi
Uses graphited synthetic fiber packing.

For 176 to 400 psi the grease fitting and ell are replaced by a by-pass fitting and line, as shown in Type IV (lower left) and leaded synthetic fiber packing used.



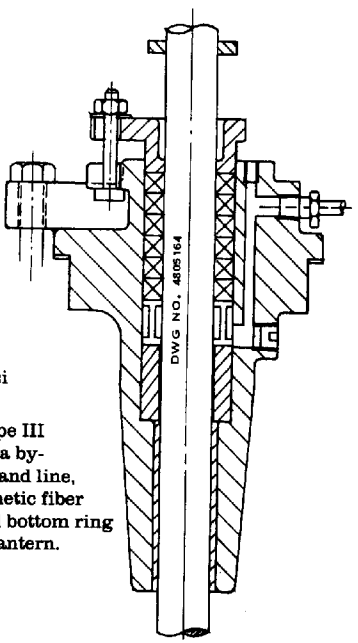
TYPE III
0 to 175 psi

Graphited synthetic fiber packing used.

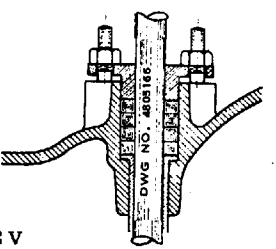


TYPE IV
176 to 400 psi

Same as Type III except with a by-pass fitting and line, leaded synthetic fiber packing and bottom ring below seal lantern.



Container is cast integral with discharge head.



TYPE V
0 to 175 psi
Graphited synthetic fiber packing used.

176 to 300 psi
leaded synthetic fiber packing used.

Fig. 10-1. Packing Arrangements.

Top Shaft Size	Pack Cont Type	Head Size	No of Pack Rings	Size Square	Depth of Stuffing Box	Diameter of Stuff Box
3/4	V	2½x2½x10 & 2½x3x10	5	3/8	1-7/8	1-17/32
	II	4x4x10C	6	3/8	2-7/16	1-17/32
	II	6x6x12	6	3/8	2-7/16	1-17/32
	II	6x10UG	6	3/8	2-7/16	1-17/32
1	V	2½x2½x10 & 2½x3x10	5	1/4	1-7/8	1-17/32
	II	4x4x10C	6	3/8	2-7/16	1-25/32
	II	6x6x12	6	3/8	2-7/16	1-25/32
	II	6x8x16½	6	3/8	2-7/16	1-25/32
	II	8x8x12	6	3/8	2-7/16	1-25/32
	II	8x8x16½	6	3/8	2-7/16	1-25/32
	II	6x10UG	6	3/8	2-7/16	1-25/32
	II	12x16½UG	6	3/8	2-7/16	1-25/32
1-3/16	II	4x4x10C	6	3/8	2-7/16	1-31/32
	II	6x6x12	6	3/8	2-7/16	1-31/32
	II	6x8x16½	6	3/8	2-7/16	1-31/32
	II	8x8x12	6	3/8	2-7/16	1-31/32
	II	8x8x16½	6	3/8	2-7/16	1-31/32
	II	10x10x16½	6	3/8	2-7/16	1-31/32
	II	10x10x20	6	3/8	2-7/16	1-31/32
	II	12x12x20	6	3/8	2-7/16	1-31/32
	II	14x14x24½	6	3/8	2-7/16	1-31/32
	II	6x10UG	6	3/8	2-7/16	1-31/32
	II	12x16½UG	6	3/8	2-7/16	1-31/32
	II	12x24½UG	6	3/8	2-7/16	1-31/32
1-1/2	II	6x8x16½	6	1/2	3-3/16	2-17/32
	II	8x8x12	6	1/2	3-3/16	2-17/32
	II	8x8x16½	6	1/2	3-3/16	2-17/32
	II	10x10x16½	6	1/2	3-3/16	2-17/32
	II	10x10x20	6	1/2	3-3/16	2-17/32
	II	12x12x20	6	1/2	3-3/16	2-17/32
	II	14x14x24½	6	1/2	3-3/16	2-17/32
	II	12x16½UG	6	1/2	3-3/16	2-17/32
	II	12x24½UG	6	1/2	3-3/16	2-17/32
1-11/16	II	10x10x16½	6	1/2	3-3/16	2-23/32
	II	10x10x20	6	1/2	3-3/16	2-23/32
	II	12x12x20	6	1/2	3-3/16	2-23/32
	II	14x14x24½	6	1/2	3-3/16	2-23/32
	III-IV	16x16x30½	8	1/2	6-1/8	2-23/32
	II	12x24½UG	6	1/2	3-3/16	2-23/32
	III-IV	16x30½UG	8	1/2	6-1/8	2-23/32
1-15/16	II	10x10x16½	6	1/2	3-3/16	2-31/32
	II	10x10x20	6	1/2	3-3/16	2-31/32
	II	12x12x20	6	1/2	3-3/16	2-31/32
	II	14x14x24½	6	1/2	3-3/16	2-31/32
	III-IV	16x16x30½	8	1/2	6-1/8	2-31/32
	II	12x24½UG	6	1/2	3-3/16	2-31/32
	III-IV	16x30½UG	8	1/2	6-1/8	2-31/32
2-3/16	II	12x12x20	6	5/8	3-15/16	3-15/32
	II	14x14x24½	6	5/8	3-15/16	3-15/32
	III-IV	16x16x30½	8	5/8	7-1/4	3-15/32
	II	12x24½UG	6	5/8	3-15/16	3-15/32
	III-IV	16x30½UG	8	5/8	7-1/4	3-15/32
2-7/16	III-IV	16x16x30½	8	5/8	7-1/4	3-23/32
	III-IV	16x30½UG	8	5/8	7-1/4	3-23/32

16x16x30½ and 16x30½UG only

Top of Box to ℄ of Seal Lantern	Seal Lantern Width
3-15/16	7/8
3-15/16	7/8
3-15/16	7/8
3-15/16	7/8
4-13/16	7/8
4-13/16	7/8
4-13/16	7/8
4-13/16	7/8

Fig. 10-2. Marking The Length Of Coil Form Packing Required For One Packing Ring.

TABLE 10-1. Greases for lubrication of lineshaft bearing, suction manifold bearings, and shaft packing. 3600 RPM maximum. -20°F. TO + 120°F.

NOTE: Other products, not listed here but of equal quality, may also be used.

MANUFACTURER	PRODUCT
AMERICAN OIL CO.	AMOCO LITHIUM GREASE ALL–WEATHER
ATLANTIC RICHFIELD CO.	ARCO MULTIPURPOSE GREASE
CATO OIL & GREASE CO.	MYSTIK JT–6
CITIES SERVICE OIL CO.	CITGO H–2
CONTINENTAL OIL CO.	EP CONOLITH NO. 1 (-20° TO + 40° F.) EP CONOLITH NO. 2 (+ 40°F. TO + 120°F.)
GULF OIL CO.	GULF CROWN GREASE NO. 2 OR GULF SUPREME GREASE NO. 2
E. F. HOUGHTON CO.	COSMOLUBE NO. 2
EXXON	LIDOK NO. 2
HYDROTEX	DELUXE NO. M–33 SUPER SHIELD
IMPERIAL OIL & GREASE CO.	MOLUB–ALLOY NO. 1
KEYSTONE DIV., PENNWALT CORP.	80 X LT
MOBIL OIL CORP.	MOBILUX EP NO. 2
THE PENNZOIL CO.	PENNZOIL 705 HDW
PHILLIPS PETROLEUM CO.	PHILUBE IB & RB
SHELL OIL CO.	ALVANIA EP GREASE 2 OR ALVANIA EP GREASE 1 (FOR PROLONGED AMBIENT BELOW 0°F.)
SUN OIL CO.	SUNAPLEX NO. 2 EP PRESTIGE 42
TEXACO, INC.	995 MULTIFAK EP2
UNION OIL CO.	UNOBA EP–2

SECTION 11

INSTALLING THE DRIVER

A typical hollow-shaft driver (motor or gearhead) is shown in Fig. 11-1 coupled to the pump top shaft.

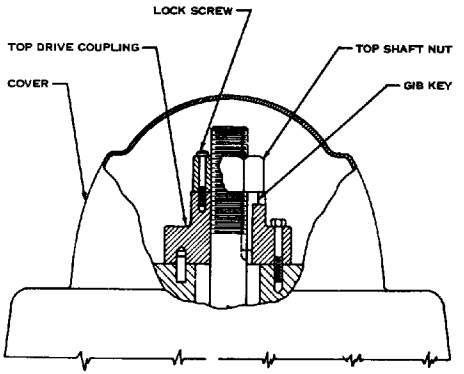


Fig. 11-1. Typical Hollow-Shaft Motor Or Gearhead Coupled To Pump Top Shaft.

A. Remove the driver cover cap screws or nuts and lift off the cover. Remove the top drive coupling. Attach a sling to the lifting lugs on the driver, and hoist it to a convenient working height.

WARNING

Do not work under a heavy suspended object unless there is a positive support under it to stop its fall in event of sling or hoist failure. Disregard of this warning could result in grave personal injury.

Standing to the side of the driver, inspect the mounting surface and register, and clean these surfaces thoroughly. If any burrs are found, support the motor on two parallel supports and remove the burrs with a smooth mill file.

B. Hoist the driver over the discharge head.

CAUTION

When lowering the driver to the pump, take care not to bump or scrape against the top shaft protruding above the discharge head. This could result in bending of the shaft.

Lower the driver slowly, aligning the axial hole with the top shaft so that there will be no bumping or scraping as the shaft enters and passes through the hole.

C. Orient the driver with the conduit box (motor) or the input shaft (gearhead) in the desired position and the mounting holes aligned with the mating tapped holes in the discharge head. Lower the driver until the registers engage and the driver rests firmly on the discharge head. Install the driver-mounting cap screws and tighten them gradually and uniformly.

D. Check to see that the top shaft is concentric with the hollow shaft of the driver, and that the hollow shaft rotates freely when turned by hand. Eccentricity at this point may be due to a bent shaft section or to foreign particles between butting ends of shaft sections. The cause must be found and corrected before proceeding.

E. Some drivers are equipped with an oil-cooling system which is supplied with cooling water from the pump or from an external source. For gearheads, make cooling connections with flexible tubing or rubber hose.

CAUTION

Do not use rigid pipe for this purpose on gearheads. Rigid pipe is susceptible to leaking at the joints in this application, due to vibration.

F. Lubricate the driver per the manufacturer's instructions.

G. Make temporary wiring connections to the motor, if applicable. The motor voltage rating is given on the nameplate. DO NOT USE ANY OTHER VOLTAGE.

CAUTION

Motors having spring-loaded spherical roller bearings must not be allowed to run at normal speed without a load. When checking direction of rotation, do not hold the switch closed – just "tap" it.

Momentarily close the circuit to the motor to check the direction of rotation. The correct direction is counterclockwise when viewed from above. If the rotation is not correct, reverse it by changing the wiring connections to the motor. For a three-phase motor, interchange any two of the three leads. If the motor is single-phase, directions for reversing rotation are given on the nameplate. Mark the leads to indicate the correct connections.

H. Make the final electrical connections to the motor, using the lead markings previously designated to ensure correct direction of rotation. If there is any doubt, recheck the rotation MOMENTARILY (see CAUTION above). All connections must be insulated in accordance with the local electrical code.

J. Install the top drive coupling over the top shaft, the holes in the bottom of the coupling engaging the drive pins protruding from the rotor hub or ratchet coupling. Align the keyways in the shaft and in the coupling, and insert the gib key (See Fig. 11-2.) The key must fit snugly against the sides of the keyways but must have a slight clearance with the bottom of each keyway. File the key, if necessary, with a smooth mill file to obtain the proper fit. Apply a thin film of grease to the sides of the key before installing. Install the cap screws holding the top drive coupling to the rotor hub or ratchet coupling.

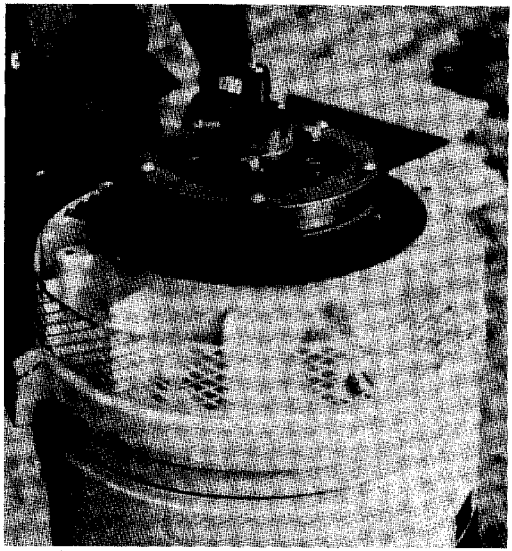


Fig. 11-2. Gib Key Inserted Into Top Shaft And Top Drive Coupling. Head Of Key Will Be Pushed Down Into Slot In Top Of Top Drive Coupling.

NOTE

Some shallow setting pumps (usually less than 50 feet) require upthrust protection. If such is the case, above cap screws must be installed to provide this protection.

K. Place the top shaft nut on the shaft and screw it down manually until it contacts the top drive coupling. Do not tighten the nut at this time. Do not install the lock screws at this time. This will be done after the impeller adjustment has been made (Section 15).

SECTION 12

GROUTING THE DISCHARGE HEAD

NOTE

It is recommended that only non-shrinking grouting material be used for grouting the discharge head to the foundation.

A. Build a frame or dam on the foundation, enclosing an area around the discharge head which includes all of the alignment wedges. The top of the dam should be approximately 1/2 inch above the bottom of the discharge head base. (See Fig. 4-1.)

B. Pour the grouting material into the dammed-in area, and force it between the discharge head and the foundation all around. Level off the grout flush with the top of the dam. Allow the grout to cure at least 48 hours before tightening the foundation bolts or starting the pump.

SECTION 13

INSTALLING THE DISCHARGE PIPING

CAUTION

The discharge piping must be independently supported so that it does not impose a load on the discharge head. If there is a difference in operating temperature between the discharge piping and the head, provision must be made in the installation for differential expansion. Any stress transmitted to the discharge head may cause misalignment and subsequent damage to the pump.

SECTION 14

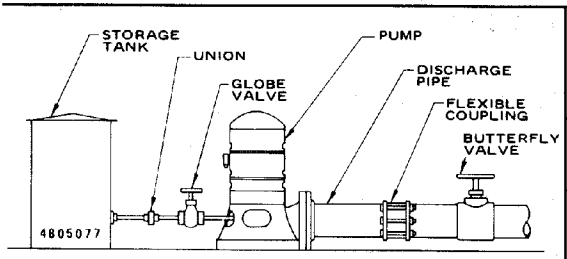
PRE-LUBRICATING THE SHAFT BEARINGS

CAUTION

The lineshaft bearings are lubricated by the water being pumped. If the standing water level is 50 feet or more below the surface, it is essential that the bearings receive prelubrication until the pumped water rises to the top of the column.

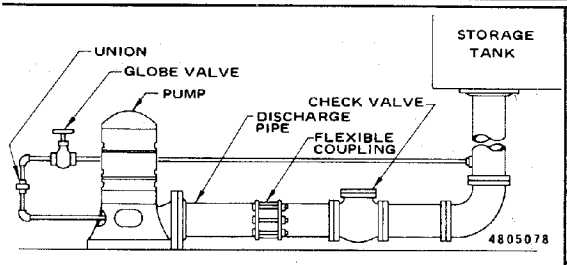
A. Prelubrication is accomplished by connecting an external source of water to the discharge head or by using pump water stored in a tank especially for this purpose. The discharge head is furnished with a pipe tap connection for the necessary piping on the side opposite the outlet. Fig. 14-1 shows four suggested methods of providing for prelubrication.

B. If a tank is used, it must be installed high enough to permit gravity flow to the discharge head.



(a) Manual Control

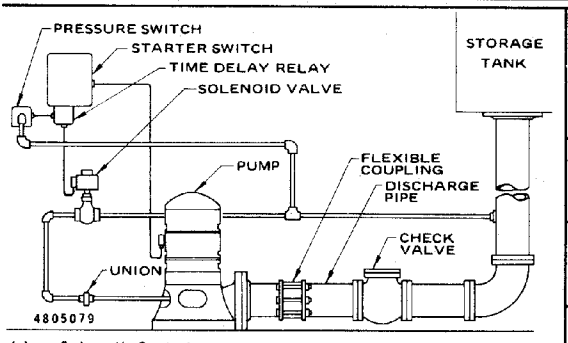
SHAFT DIAMETER	DEPTH TO STANDING WATER LEVEL	TANK CAPACITY GALLONS	PRELUBRICATING PIPE SIZE	PRELUBRICATING VALVE SIZE
3/4-1 1 3/16-1 1/2	100 Ft or less	30	3/4	3/4
	101 to 200 Ft	50	1	1
	201 to 500 Ft	100	1 1/2	1 1/2
1 11/16-1 15/16	100 Ft or less	50	1	1
	101 to 200 Ft	100	1 1/2	1 1/2
	201 to 500 Ft	200	2	2



(b) Manual Control

SHAFT DIAMETER	DEPTH TO STANDING WATER LEVEL	PRELUBRICATING PIPE SIZE	PRELUBRICATING VALVE SIZE
3/4-1 1 3/16-1 1/2	100 Ft or less	3/4	3/4
	101 to 200 Ft	1	1
	201 to 500 Ft	1	1
1 11/16 1 15/16	100 Ft or less	1	1
	101 to 200 Ft	1 1/2	1 1/2
	201 to 500 Ft	1 1/2	1 1/2

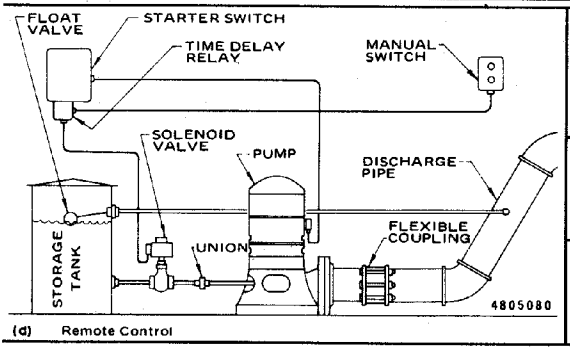
STORAGE TANK CAPACITY SAME AS IN (a) & (d)



(c) Automatic Control

SHAFT DIAMETER	DEPTH TO STANDING WATER LEVEL	ADJUSTABLE TIME DELAY RELAY	PRELUBRICATING PIPE SIZE	SOLENOID VALVE SIZE
3/4-1 1 3/16-1 1/2	100 Ft or less	15 sec to 5 min	3/4	3/4
	101 to 200 Ft		3/4	3/4
	201 to 500 Ft		1	1
1 11/16 1 15/16	100 Ft or less		3/4	3/4
	101 to 200 Ft		3/4	3/4
	201 to 500 Ft		1 1/4	1 1/4

STORAGE TANK CAPACITY SAME AS IN (a) & (d)



(d) Remote Control

SHAFT DIAMETER	DEPTH TO STANDING WATER LEVEL	TANK CAPACITY GALLONS	FLOAT VALVE SIZE	FLOAT VALVE PIPE SIZE	SOLENOID VALVE SIZE	PRELUBRICATING PIPE SIZE	ADJUSTABLE TIME DELAY RELAY
3/4-1 1 3/16 1 1/2	100 Ft. or less	30	1/2	1/2	3/4	3/4	15 sec to 5 min
	101 to 200 Ft.	50	1/2	1/2	1	1	
	201 to 500 Ft	100	1/2	1/2	1 1/2	1 1/2	
1 11/16 1 15/16	100 Ft. or less	50	1/2	1/2	1	1	
	101 to 200 Ft.	100	1/2	1/2	1 1/2	1 1/2	
	201 to 500 Ft.	200	3/4	3/4	2	2	

Fig. 14-1. Four Suggested Methods Of Providing For Prelubrication.

SECTION 15

ADJUSTING THE IMPELLERS

CAUTION

The impellers must be adjusted before any attempt is made to start the pump.

A. A pump operating in a new well should be run with its impellers in the mid-position, which is approximately 3/16 inch above the lateral bowl wear rings. This is to minimize the possibility of damage due to sand in the water. When the water is clear of sand, the impellers should be reset to the most efficient pumping position.

B. When making the impeller adjustment it is necessary to allow for shaft stretch due to the downward hydraulic force on the impellers (hydraulic thrust). For pumps with settings 500 feet or less, this can be determined as explained below. For pumps having settings over 500 feet, additional factors are involved. Consult your Peerless Pump dealer.

1. From Table 15-1 select the value for hydraulic thrust of the pump being installed. This is given in pounds per foot of pumping head. Multiply this value by the height (in feet) of the pumping head to determine the total hydraulic thrust of the impellers.

2. From Table 15-3, under the shaft diameter and across from the previously determined downward force, read the value of the elongation (stretch) per 100 feet of shaft. Elongation values for forces not given in the table may be found by interpolation. This is explained in the example in Part C.

Table 15-1. Hydraulic Thrust And Weight Data

Size	Thrust	②	Size	Thrust	②	Size	Thrust	②	Size	Thrust	②	Size	Thrust	②
4LO	1.6	1½	10LB	4.1	25	14HXB	12.4	32	20HH	48.0	137	30HH-OH	104.0	370
4LE	1.0	1½	10MA	5.5	12	14HH	20.0	44	24MA	46.1	200	32HXB	87.0	470
6LB	1.5	3½	10HH	9.5	35	15LC	6.4	46	24HXB	38.5	135	36MA	83.0	636
6MA	2.8	3	10HXB	5.8	15	15MA	15.0	56	24HH	57.0	190	36HXB	112.0	680
6HXB	2.2	3	11MB	6.2	58	16MC	12.7	50	24HH-OH	57.0	154	36HH	140.0	784
7LB	2.4	5	12LB	6.0	14	16HXB	20.3	35	26HXB	54.3	166	36HH-OH	140.0	679
7HXB	3.4	6	12LD	7.8	22	16HH	30.0	75	26HH	69.0	275	42HXB	152.0	870
8LB	2.6	7	12MB	7.5	21	18MA	22.5	54	26HH-OH	69.0	225	48HXB	208.0	1075
8MA	5.6	7	12HXB	8.5	17	18HXB	24.4	72	27MA	74.5	270	48HH	235.0	1600
8HXB	3.62	7	12HXH	11.0	27	18HH	35.0	151	28HXB	64.2	205	48HH-OH	235.0	1425
9LA	3.9	11	14LD	10.4	38	20MA	30.0	100	30LA	64.0	210	56 HH	338.0	2675
			14MC	10.0	33	20HXB	25.3	120	30HH	104.0	450	56HH-OH	338.0	2467

Thrust in pounds per foot of head, per stage. ② Weight of rotating element in pounds, per stage.

3. To find the elongation (shaft stretch), multiply the elongation per 100 feet by the total length of the shaft, including the top shaft, divided by 100 feet.

C. Here is an example of a shaft stretch calculation.

Problem: Determine the shaft stretch for an 8LB pump which operates against a 350-foot head and is equipped with a total of 250 feet of 1½-inch diameter shaft. The bowl unit consists of 12 stages.

1. From Table 15-1, select 2.6 pounds per foot as the hydraulic thrust of an 8LB pump. Multiply 2.6 by 350 to obtain the total hydraulic thrust of the impellers, 910 pounds.

2. Consulting Table 15-3, we find that 910 pounds is not listed in the DOWNWARD FORCE column. However, values are given for 800 pounds and for 1000 pounds. From these we can find an in-between value for 910 pounds:

$$\frac{.024 - .019}{1000 - 800} = .000025 \text{ in./lb.}$$

elongation at 910 pounds will be:

$$.019 + (910 - 800) \times .000025 = .022 \text{ inches}$$

3. To find the elongation (shaft stretch) for 250 feet of shafting:

$$.022 \times \frac{250}{100} = .055 \text{ inch}$$

D. Before any adjustment is made, the impellers will be resting on the lateral bowl wear rings, and considerable resistance due to friction can be felt when turning the shaft by hand. To set the impellers to mid-position, proceed as follows: Screw down the top shaft nut, while restraining the top shaft from turning, until the impellers just clear the seals and the shaft can be turned freely by hand. Scribe a line on the thread of the top shaft flush with the top of the nut. Continue to turn down the nut until the distance from the scribe line to the top of the nut is 3/16 inch plus the shaft stretch previously determined. Turn the nut an additional few degrees, if necessary, to align two of the holes in the top shaft nut with the tapped holes in the top drive coupling. Install the lockscrews in the top shaft nut. (See Fig. 15-1)

E. To set the impellers to the most efficient position, follow the procedure of Paragraph 1, page 37, if the pump is driven by an electric motor. If the pump is driven by any other device, follow the procedure of Paragraph 2.

WARNING

The driver cover must be in place when the pump is in operation. Rotating parts below this cover could cause grave personal injury if exposed.

Table 15-3. Shaft Elongation.

Inches Per 100 Feet Of Shaft

DOWNWARD FORCE	SHAFT DIAMETER													
	3/4	1	1-3/16	1-1/2	1-11/16	1-15/16	2-3/16	2-7/16	2-11/16	2-15/16	3-3/16	3-7/16	3-11/16	3-15/16
500	.047	.026	.018	.012	.009	.007								
600	.056	.032	.022	.014	.011	.008	.006							
800	.075	.042	.030	.019	.015	.011	.009							
1000	.094	.053	.037	.024	.019	.014	.011	.009						
1200	.112	.063	.045	.028	.022	.017	.013	.011						
1400	.131	.074	.052	.033	.026	.020	.015	.012	.010					
1600	.150	.084	.060	.038	.030	.022	.018	.014	.012					
1800	.169	.095	.067	.042	.033	.025	.020	.016	.013	.011				
2000	.187	.105	.075	.047	.037	.028	.022	.018	.015	.012				
2400	.225	.127	.090	.056	.044	.034	.026	.021	.018	.015	.012			
2800	.262	.148	.105	.066	.052	.039	.030	.025	.020	.017	.015			
3200		.169	.119	.075	.059	.045	.035	.028	.023	.020	.017	.014		
3600		.190	.135	.085	.067	.051	.040	.032	.026	.022	.019	.016		
4000		.211	.150	.094	.074	.056	.044	.036	.029	.025	.021	.018	.016	
4400		.240	.164	.103	.081	.062	.048	.039	.032	.027	.024	.020	.017	
4800		.253	.179	.113	.089	.067	.053	.043	.035	.029	.025	.021	.019	.016
5200		.274	.194	.122	.096	.073	.057	.046	.038	.032	.027	.023	.020	.018
5600			.209	.131	.107	.079	.062	.050	.041	.034	.029	.025	.022	.019
6000			.224	.141	.111	.084	.066	.053	.044	.037	.031	.027	.023	.020
6500			.243	.153	.120	.091	.071	.058	.047	.040	.034	.029	.025	.022
7000			.260	.164	.129	.098	.077	.062	.051	.043	.036	.031	.027	.024
7500				.176	.139	.105	.082	.067	.055	.046	.039	.033	.029	.026
8000				.188	.148	.112	.088	.071	.058	.049	.042	.036	.031	.027
9000				.211	.167	.126	.098	.080	.066	.055	.047	.040	.035	.031
10,000				.234	.185	.140	.110	.089	.073	.061	.052	.045	.039	.034
12,000				.281	.222	.168	.132	.106	.088	.073	.062	.054	.047	.041
14,000					.259	.196	.154	.124	.102	.086	.073	.062	.055	.048
16,000					.296	.224	.176	.142	.117	.098	.083	.071	.062	.054
18,000						.252	.198	.160	.131	.110	.093	.080	.070	.061
20,000						.280	.220	.176	.146	.122	.104	.089	.078	.068
22,000							.242	.195	.160	.134	.114	.098	.086	.074
24,000							.264	.213	.175	.147	.124	.107	.094	.082
26,000							.286	.230	.190	.159	.135	.116	.102	.088
28,000								.248	.204	.171	.145	.125	.109	.095
30,000								.266	.219	.183	.156	.134	.117	.104
32,000								.283	.233	.196	.166	.143	.125	.109
34,000									.248	.208	.176	.152	.133	.116
36,000									.262	.220	.187	.160	.140	.122
38,000									.277	.232	.197	.170	.148	.129
40,000									.292	.245	.207	.178	.156	.136

$$e = \frac{L \times 12 \times F}{E \times G.S.A.}$$

e = Elongation (in inches)

L = Shaft Length (feet)

E = Modulus of Elasticity (29,000,000)

F = Total Downward Force (pounds)

G.S.A. = Gross Shaft Area (sq. inches)

Downward Force due to the hydraulic thrust of the pump causes the shaft to stretch after the pump is in operation. Unless the impellers are raised off the bottom of the bowls enough to allow for this stretch plus some running clearance, the impellers will rub, causing the pump to wear and increase the horsepower required.

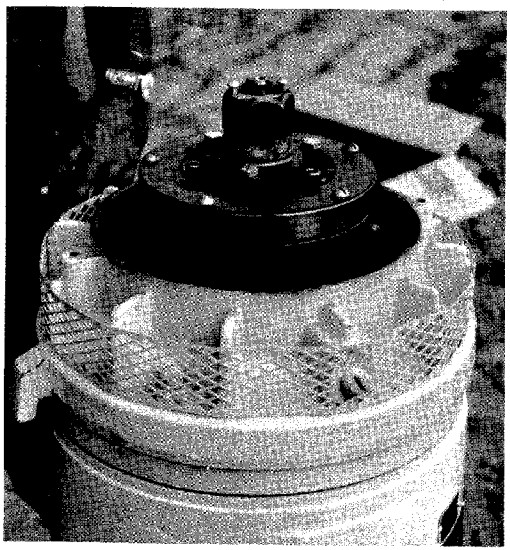


Fig. 15-1. Impeller Adjustment Completed. Lock Screws Shown In Position But Not Yet Tightened.

1. An accurate check for the most efficient impeller setting may be made by observing the electric power meter or, if more convenient, an ammeter connected to the power input to the motor. Operate the pump and watch the meter. When the impellers are rubbing on the wear rings, more electrical power will be consumed. As the impellers are adjusted to just clear the wear rings there will be a definite decrease in power consumption. Set the impellers at a height slightly above where this definite decrease occurs. Install the lock screws in the top shaft nut.

2. When the driver is a device other than an electric motor, the impeller adjustment is made with the pump stopped. The most efficient impeller clearance (minimum clearance when the pump is running) is given in Table 15-4 for every pump size. Select the value for the pump being installed and add to this the calculated shaft stretch (Part B). Adjust the impellers to obtain this total clearance above the point where the impellers just clear the wear rings. Install the lock screws in the top shaft nut.

Table 15-4. Most Efficient Impeller Clearance

Pump Size	Impeller Number	Clearance
6LB	2616324	1/32
	2618292	1/8
	2616318	1/8
6MA	V850B	1/32
6HXB	2607800	1/8
7LB	2626207	1/8
	2626208	1/8
7HXB	2607926	1/8
	2607921	1/8
8LB	2616464	1/4
	2616465	1/8
8MA	T84229	3/16
	T84234	1/8
8HXB	2616348	1/16
9LA	T84391	1/8
	T84323	1/8
10LB	2625032	1/8
	2625033	1/8
10MA	T84363	1/8
	2624288	1/16
10HXB	T82337	3/16
	T82366	3/16
10HH	2622864	1/16
	2626818	1/16
11MB	2622504	1/16
12LB	2623849	1/32
	2616025	1/8
	2616011	1/16
12LD	2634820	1/16
12MB	2624331	1/32
	2626936	1/16
	2624332	3/16
12HXB	2608100	1/16
	2608379	1/8
	2608368	1/16
12HXH	2629933	1/8
14LC	2625105	1/16
14LD	2634704	1/16
14MC	2626082	1/16
	2626083	1/16
14HXB	V4399C	1/8
	V4400C	1/8
14HH	2621973	1/16
	2621959	1/16
15LC	2625920	1/8
15MA	2617049	1/8
	2617046	1/8
16MC	2626756	1/8
	2626757	1/16
16HXB	2617216	1/8
	2617215	1/8
16HH	2621593	1/32
	2620735	1/16

Dimensions shown are subject to change without notice.

SECTION 16

STARTING THE PUMP

A. Before attempting to start the pump, check the water level in the well to be sure that the first impeller of the pump is submerged.

CAUTION

Do not operate the pump if the first impeller is above the standing water level. In this condition the pump cannot be expected to pump water. Severe damage to the pump may result.

B. Before attempting to start the pump, check the readiness of the following items:

Prelubrication piping – essential for pumps over 50 feet long
Grease fitting at packing (if applicable)
Lubrication of the driver
Oil-cooling connections for the driver (if applicable)
Wiring of electric motor (if applicable)
Impeller adjustment
Discharge piping connection
Shut-off valve in discharge pipe – must be open

CAUTION

If the standing water level is 50 feet or more below the surface, never start the pump without prelubricating the lineshaft bearings. Prelubrication is necessary even if the pump is started after a short shut-down.

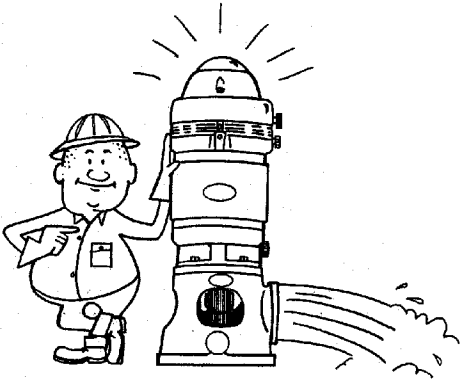
C. If a manually controlled storage tank is used for prelubrication, close the tank-to-pump valve and fill the tank with clean water.

D. Before starting the pump, allow 75% of the water in the tank to drain into the pump column. If an external water supply is used for prelubrication, allow water to pour into the column for several minutes before starting the pump.

E. Start the pump. The remainder of the water in the prelubrication tank will lubricate the bearings until the column fills. IF THERE IS EXCESSIVE VIBRATION OR IF THE DRIVER OVERHEATS, STOP THE PUMP. Determine the cause and correct the problem before restarting.

F. Leave the tank-to-pump valve open. When the pump fills the discharge head, water will flow back into the tank. Shut off the valve when the tank is filled to the required level. Prelubrication will then be available for the next time the pump is started.

G. If the pressure at the discharge head is not sufficient to raise water to the required level in the prelubrication tank, obstruct the pump discharge line to increase the pressure until the tank is adequately filled.



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SECTION 17

ADJUSTING THE PACKING GLAND

CAUTION

Too tight an adjustment of the packing gland can wear out the packing in only a few minutes of operation and may seriously damage the shaft.

A. With the pump in operation there will be some leakage at the top shaft packing. The packing gland must now be adjusted to allow a controlled amount of leakage while maintaining the required pressure at the discharge head. The correct leakage rate is approximately one drop per second. This amount of water passing through the packing will act as a lubricant and will carry off excessive heat of friction.

B. Turn down the gland nut only one-sixth to one-quarter turn at a time. After each adjustment, allow the packing to equalize against the increased pressure and the leakage to gradually reduce to a steady rate before making the next adjustment.

C. The amount of adjusting required will vary with the pressure developed by the pump at the discharge head. Never rush the break-in of the packing, even if it requires several days of attention to accomplish.

D. On models furnished with a grease fitting for lubrication of the packing, use a light-weight grease which will not tend to harden when in contact with water. A list of acceptable greases, by brand name and manufacturer, is given in Table 10-2. In addition to its lubrication value, the grease will act as a water barrier; thus less packing pressure will be required.

SECTION 18

DISASSEMBLING THE PUMP

WARNING

Do not attempt to lift the entire pump by the lifting lugs of the driver. These lugs and the bolts attaching the driver to the pump cannot support the weight of the entire pump.

WARNING

There are definite load limitations for the eyebolts or lifting lugs of cast discharge heads. See Table 8-1. Exceeding these loads may result in failure of the discharge head, serious damage to other parts of the pump and grave injury to nearby personnel.

WARNING

Do not work under a heavy suspended object unless there is a positive support under it to stop its fall in event of sling failure. Disregard of this warning could result in grave personal injury.

A. Clear a large area adjacent to the pump as a storage space for pump parts as they are disassembled. Arrange parallel timbers on the ground in the cleared area to support the pump column and shaft sections horizontally.

B. Disconnect the discharge piping from the discharge head. If the driver is equipped with an oil-cooling system, remove the external tubing or piping used for this purpose. On pumps equipped with an air-pressure water-level testing system, remove the gage and disconnect the tubing connection inside the discharge head. Some pumps have this connection below the base, in which case the tubing will be disconnected later.

C. On pumps which are driven through a gearhead, remove the coupling or drive shaft between the gearhead and the prime mover. If the driver is an electric motor, remove the electrical connection at the conduit box.

WARNING

Before opening the conduit box of an electric motor, be certain that the current to the motor is shut off. An electrical shock from contact with live motors leads can be fatal.

Remove the driver from the discharge head in the following manner. (See Fig. 11-1.) Remove the driver cover. Remove the lock screws, the top shaft nut, the gib key, and the top drive coupling. Remove the driver mounting screws. Attach the hoist sling to the lifting lugs of the driver and lift it off the discharge head. Place the driver on clean wooden blocks in the storage area.

D. Remove the top shaft seal ring (Fig. 8-1) from the pump shaft by sliding it up over the top.

E. Disassemble the packing. (See Fig. 8-1.) Remove the gland retaining bolts or nuts and the two gland clamps. Lift off the split gland. Pull out the packing rings, using a special packing removal tool or a hooked pointed wire. If the packing assembly includes a lantern ring or a compression spring and a washer, or a bushing, remove these. Be sure to remove any packing rings that might be below the lantern ring. If the packing container is a separate casting (not integral with the discharge head), remove the cap screws in the packing container flange, and lift off the packing container. Remove the gasket.

F. Remove the cap screws or nuts holding the discharge head to the sole plate or to the foundation. Attach the sling to the lifting ears of the discharge head, and hoist the entire pump straight upward to bring the discharge head base to a comfortable working height. If the pump has an air line with a connection point below the base, disconnect the line at this time.

G. The procedure for removing the discharge head and the top column section varies, depending on the size of the discharge head. The size is indicated in raised letters on the upper surface of the discharge head base.

1. For discharge heads 4 x 4 x 10C or smaller:

a. Raise the pump until the uppermost column coupling is about three feet above the foundation. Attach an elevator clamp to the column about two feet below the coupling. Place two short lengths of timber on the foundation, one on either side of the well casing, directly below the the ears of the elevator clamp; then lower the pump until the elevator clamp rests on the timbers. Remove the sling from the discharge head.

b. If an air line was installed with the pump, cut the wires attaching it to the column. When the air line is tubing, form the tubing into a coil as each column section is removed. If pipe was used, remove each pipe section before the corresponding column section is uncoupled.

c. Unscrew the top column section from the coupling, using chain tongs or a capstan drive and rope (cat head and cat line). Attach the sling to the discharge head lifting ears and lift the top column about two feet, exposing the lineshaft inside the column. Place over the column coupling a specially made wood or metal apron which covers the opening and fits closely around the shaft. Wrap a clean rag tightly around the shaft, over the apron. (See Fig. 7-7.) This will prevent entry of foreign matter into the bearing and pump. Unscrew the top shaft section from the shaft coupling, using a pair of pipe wrenches.

NOTE

The shaft threads are left hand.

CAUTION

Do not strike the coupling with a hammer to assist in loosening the joint. This creates local stresses which may cause cracking of the coupling when torque is applied during subsequent pump operation.

CAUTION

When the shaft is completely unthreaded from the coupling, let it rest on top of the coupling. Do not permit the shaft to move laterally off the coupling, as it will fall into the pump column.

Using a special clamping tool or a suitable tail rope, fasten the lower end of the shaft section to lower end of the column section. (Section 7, Part C.) Lift the discharge head, column and shaft as an assembly. The lower end should be guided by a dragline which is pulled by the hoist. (See Section 7, Part D and Fig. 7-5 and 7-6.) If a power-operated dragline is not available, the lower end must be guided manually. Move the assembly away from the pump and lower it into the cleared storage area, placing it across the parallel timbers.

2. For discharge heads 6 x 6 x 12 or larger:

a. Fasten an elevator clamp to the pump column, about two feet below the top column flange (See Fig. 8-1b.). Place two short lengths of timber on either side of the well casing, directly below the ears of the elevator clamp. Lower the pump until the elevator clamp rests on the timbers. Remove the nuts holding the top column flange to the discharge head. Lift the discharge head from the pump and place it on clean wooden blocks in the storage area. Attach the sling to the elevator clamp and raise the pump until the uppermost column coupling is about three feet above the foundation. Fasten a second elevator clamp to the column about two feet below the column coupling. Lower the pump until the elevator clamp rests on the timbers, and remove the sling.

b. If the air line was installed with the pump, remove it per Part G, Paragraph 1.b, above.

c. Remove the top column and top shaft sections as explained in Part G, Paragraph 1.c, above, except that the sling will be attached to the elevator clamp near the top of the column instead of to the discharge head, which has already been removed.

H. The next step is to remove the bearing retainer. Unscrew the shaft coupling above the bearing retainer, using a pair of pipe wrenches.

NOTE

The coupling threads are left hand.

CAUTION

Do not strike the coupling with a hammer to assist in loosening the joint.

File smoothly any burrs which may have been raised on the shaft and wipe off all metal chips with a clean rag. The apron and rag protecting the pump may now be removed. Remove the bearing retainer by sliding it up over the top of the shaft.

J. Remove all of the remaining column sections, shaft sections, and bearing retainers in the same manner.

K. Pull the bowl unit from the well, using the elevator clamp and the hoist in the same manner as for column sections. Certain extra-long relatively small-diameter bowl units are susceptible to damage by bending and must be treated with special care. These units were originally shipped from the factory attached to special skids, which should have been retained for use in removing the unit from the well. With the bowl unit in a vertical position over the well, encase the unit in the special skid before moving it to the storage area. When placing this type of unit on the parallel timbers, add two or three additional supporting timbers to prevent sagging.

L. Pull out the suction pipe, using the elevator clamp and the hoist. A very short suction pipe may be left connected to the bowl unit, if desired, and the two removed as an assembly. Take care not to damage the strainer which, on some pumps, is attached to the bottom of the suction pipe.

SECTION 19

INSTALLING AND OPERATING THE WATER LEVEL TESTING SYSTEM

A. The air line may be 1/4 inch galvanized pipe or 1/4 inch OD copper or plastic tubing. It is tied to the pump column at regular intervals during the pump installation, as explained in Sections 7 and 8.

B. Assemble the water level gage and the air valve on the tee and bracket assembly. Attach the bracket to the side of the discharge head, using the cap screws, nuts, and lock washers provided. (See Fig. 19-1 or 19-2 and 19-3).

C. The connection from the air line to the gage is made with the short length of 1/4 OD copper tubing furnished. If the pump has a discharge head 2½ x 3 x 10 or 2½ x 2½ x 10, this tube has already been attached to the air line. Connect the upper end of the tube to the tee at the gage, using a compression fitting (1/4 tube x 1/4 NPT). (See Fig. 19-1.) If the discharge head is a 4 x 4 x 10C, the air line has been attached to the bottom of the head. Install the 1/4 elbow type tube fitting in the 1/4 NPT hole located just above the bottom flange of the head (see Fig. 8-2c). Attach one end of the 1/4 OD tubing to this elbow and the other end to the tee at the gage, using a 1/4 tube fitting. In the case of a 6 x 6 x 12 or larger discharge head, the air line was terminated with a compression fitting at the top of the discharge head base. Attach one end of the short tube to this fitting and the other to the tee at the gage, using another compression fitting. (See Fig. 19-2.)

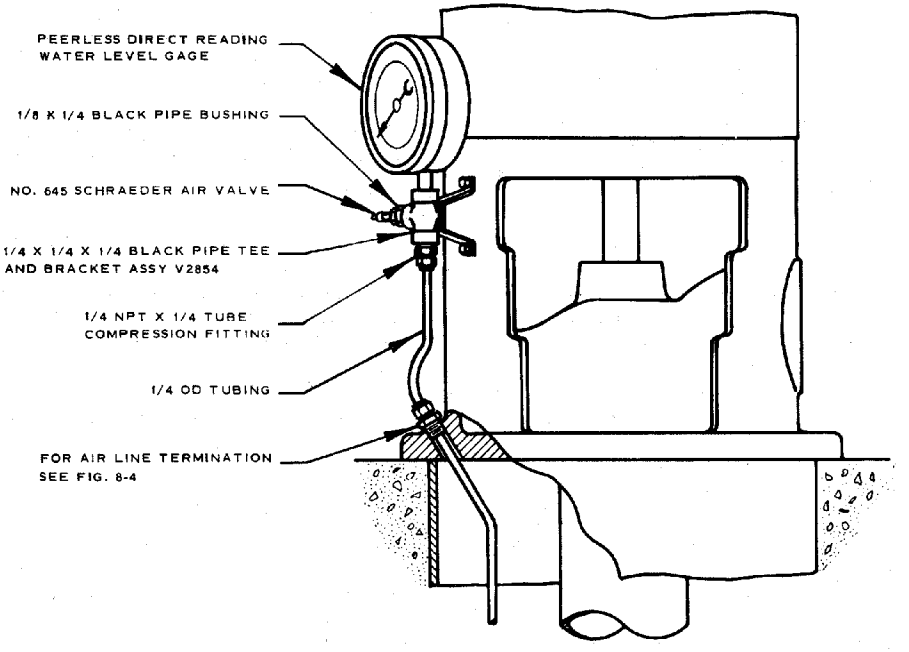

Fig. 19-1. Gage Installation – 2½x3x10 or 2½x2½x10 Discharge Heads

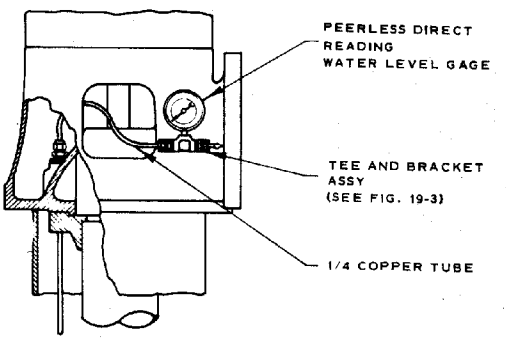

Fig. 19-2. Gage Installation – 6x6x12 Or Larger Discharge Head.

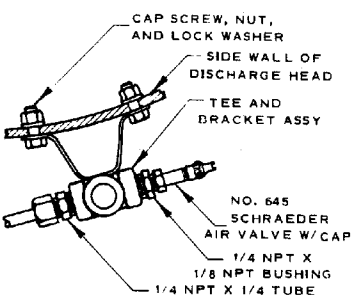

Fig. 19-3. Detail Of Tee And Bracket Assembly Attachment To Discharge Head Wall.

D. Determine the exact height from the center of the discharge outlet to the lower end of the air line. Mark this height to the nearest foot in the square provided on the gage dial.

E. Loosen the three dial lock screws on the face of the gage, and rotate the movable dial until the graduation corresponding to the pre-determined height is in line with the pointer. Re-tighten the screws and check the dial position to be sure that it has not shifted.

F. Connect a suitable source of air pressure to the air line at the tee. A hand pump, as shown in Fig. 19-4, is satisfactory.

G. Pressurize the system and determine that all joints are air-tight and the air line is not plugged.

H. Standing (static) water level readings are taken before starting the pump or after a shut-down period long enough to allow the water level in the well to normalize. Drawdown (pumping level) readings are taken after the pump has operated against normal head for a period sufficient to draw the water level down to the maximum depth. (See Fig. 19-4.)

J. To obtain the required readings, increase the pressure in the system (operate the hand pump) until the gage pointer ceases to rise. Note the gage reading. This reading is the depth of the water level below the center of the discharge outlet.

K. For a complete history of the well's performance through the seasons, keep a record by date of all readings taken.

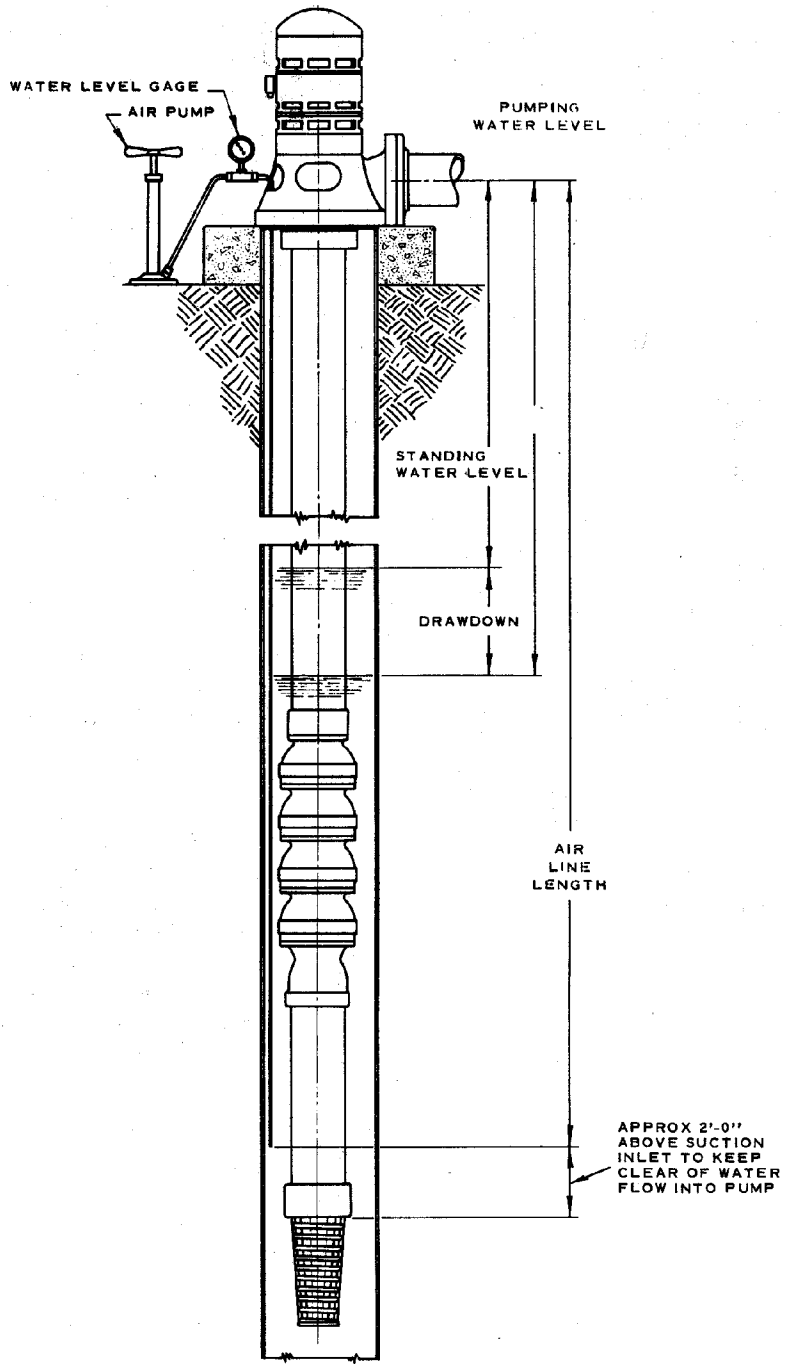

Fig. 19-4. Air Pressure Water Level Testing System.

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Vertical Pumps

Deep Well Types

Flows to 150,000 gpm
Heads to 2,300 ft.
Settings to 1,500 ft.
Horsepower to 5,000 hp
Pressure to 1,000 psi
Brochure B-100

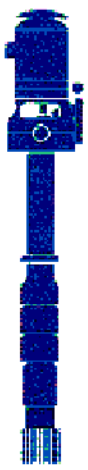
For water supply from drilled wells.

Flows:
- **Verticals to 5,000 gpm**
- **Horizontals to 5,000 gpm**
- **In-Lines to 500 gpm**
- **End Suctions to 500 gpm**

Heads:
- **Verticals to 1,176 ft.**
- **Horizontals to 630 ft.**
- **In-Lines to 406 ft.**
- **End Suctions to 340 ft.**

Pressures:
- **Verticals to 510 psi**
- **Horizontals to 640 psi**
- **In-Lines to 175 psi**
- **End Suctions to 147 psi**

Horsepowers to 800 hp



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