

**Instruction Manual** *for..*



**SOUTHERN CROSS**

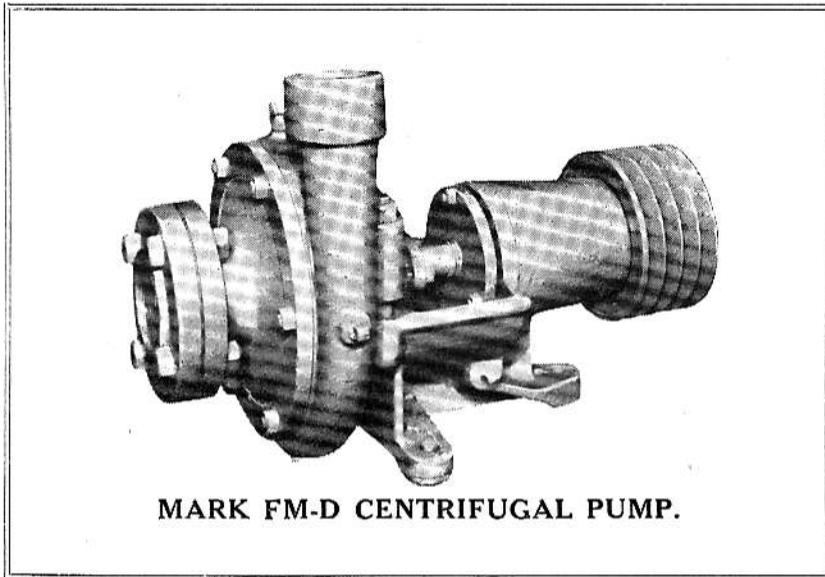
**CENTRIFUGAL PUMPS**

**"FM" Pattern — 1in., 1½in., 2in., 2½in., 3in., 4in.**

**Figs. 3114/3115 Centrifugal Pumping Units**



**INSTALLATION - - OPERATION**  
**AND**  
**MAINTENANCE INSTRUCTIONS**  
**FOR**



*"Southern Cross"*

**"FM" PATTERN**

**CENTRIFUGAL PUMPS**

# INSTALLATION

## Location.

When installing a Centrifugal Pump always remember that the closer the Pump is placed to the source of supply, the better will be its performance. To ensure maximum capacity, select a site permitting the use of the shortest and most direct suction pipe, and smallest possible vertical lift.

Under favourable conditions at or near sea level it is possible to operate a Centrifugal Pump with a suction head of 18 feet including friction in the suction pipe. However, for practical purposes, it is recommended that the pump be kept within 12 feet of the lowest water level, and preferably closer.

The efficiency of a Centrifugal Pump drops off rapidly as the suction lift is increased.

## Foundation.

The Pumping Unit will give the best results if it is set on a firm foundation. A good concrete block is best, but, failing that, a substantial log set well into the ground and free from vibration will do. If the foundation is to be of concrete, then the Unit holding down bolts are to be set in the concrete when the foundation is put down.

The Pump must be supported firmly, independently of the pipe connections, and the spindle must be free to turn by hand after the foundation bolts have been tightened down, and the pipes have been connected.

## To Make Concrete Foundation.

Make a mould of the required shape and height, nailing the boards on firmly so that it will not collapse when filled with concrete.

Sink a hole 12 inches to 18 inches deep in the ground and about 1 foot larger all round than the mould.

Set the mould in position over the hole and lay two pieces of 2 inch by 1 inch timber across the top. Set the pump on these two crosspieces.

Check the position of the pump in relation to the engine or electric motor which has to drive it.

Move the two crosspieces so that they are directly under the foundation bolt holes in the pump feet, and then nail them to the mould. Recheck the position of the pump with the driving machine and then mark the positions of the foundation holes on the timber crosspieces.

At the spots marked, bore holes through the crosspieces to suit the foundation bolts supplied.

Hang the bolts inside the mould from the holes in the timber crosspieces, and screw the nuts on so the top of the bolts will project the following distances above the top of the concrete block—1 and 1½ inch pumps—1 9/16 inch; 2 and 2½ inch pumps—1¼ inch; 3 and 4 inch pumps—2¾ inch.

Check to see that the top of the mould is level by trying a spirit level on it both ways

The mould is now ready to have the concrete poured into it. Mix up a batch of concrete using 4 parts stone or rubble, 2 parts sand and 1 part cement.

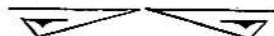
Fill the mould to ground level and if the mould is fairly high a few old bars or bolts should be arranged so that they project into the mould. These will act as reinforcement between the top and bottom portions of the foundation.

Fill the mould and ram well, being sure not to disturb it.

Smooth off the top of the mould with a mixture of 2 parts sand and one part cement.

Allow the concrete to stand for at least 24 hours before removing the mould. Then dampen the block and smooth off the sides with a mixture of 2 parts sand and 1 part cement.

Allow the concrete to stand another 24 hours and then put the pump in position on the block and tighten down the nuts on the foundation bolts. Fit a plain and a spring washer under each nut.



## Suction Piping.

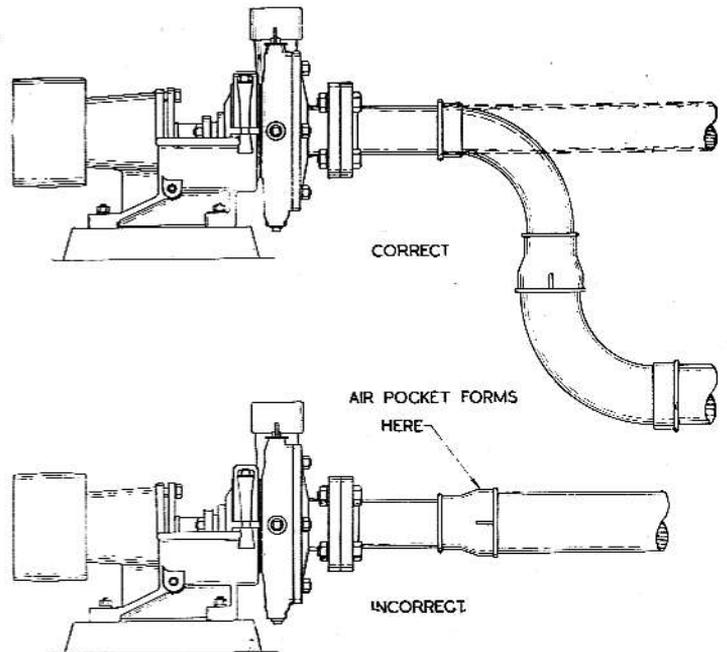
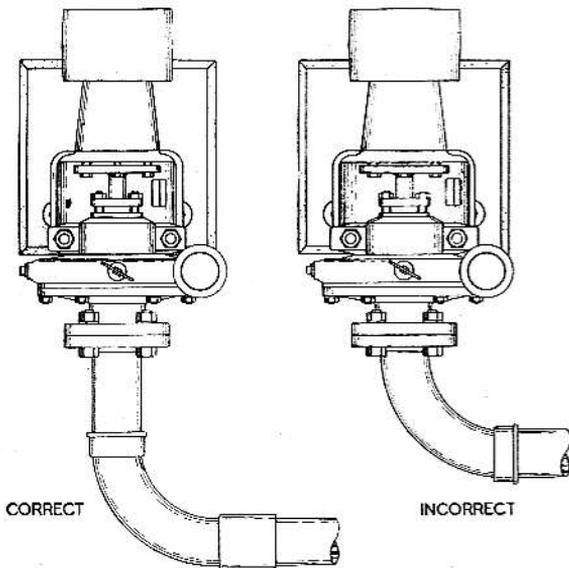
- DO**—Make Suction Piping as short and straight as possible.
- DO**—Keep suction lift as low as possible.
- DO**—Use larger Suction Piping than that for which pump is screwed (if possible).
- DO**—Make certain Suction Piping is perfectly free from air leaks.
- DO**—Install Suction Piping to connect to pump without strain.

**DON'T**—Use sharp angle bends or elbows.

**DON'T**—Try to operate pump with a suction lift of more than 18 feet (including friction).

**DON'T**—Use smaller Suction Piping than recommended.

**DON'T**—Allow Suction Piping to rise above pump unless pump is below the lowest source of supply.



The installation of Suction Piping must be carried out with extreme care, as incorrectly laid Suction Piping will cause endless trouble and inconvenience.

The illustrations on this and the following page show some of the more common installation errors and the best methods of preventing them.

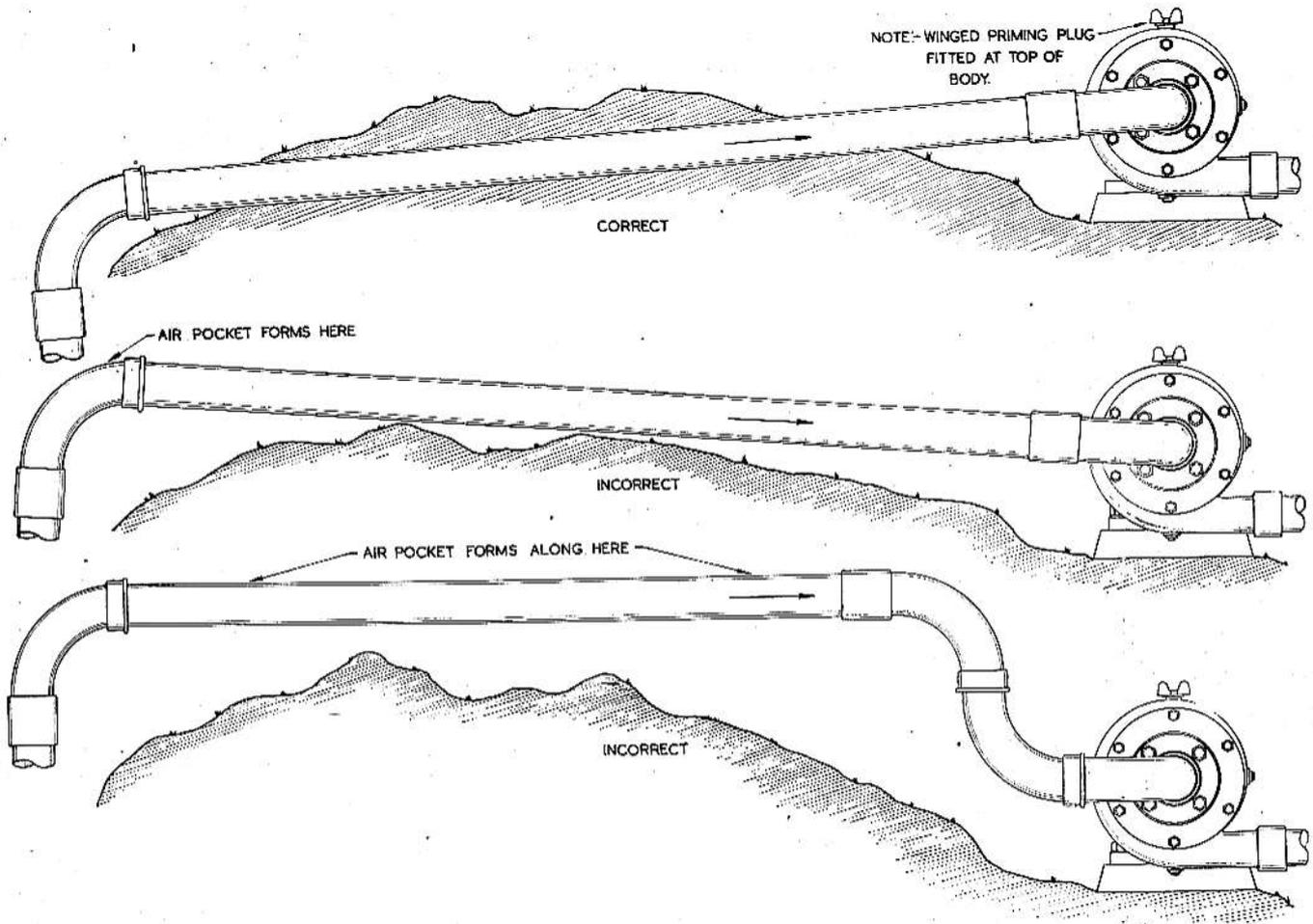
A bend must not be placed directly at the pump suction flange. Fit a straight pipe, at least twice its dia-

meter in length, between the bend and the pump. Where convenient it is recommended that this straight pipe be made 18 inches long.

If reducing sockets are required, fit them in the vertical line.

If the same size pipe, for which the suction flange is screwed, is to be used, it may be installed horizontally.

## Suction Piping—Continued.



Suction Piping should have a continual fall from the pump to the source of supply, when there is a suction lift. The illustrations above show correct and incorrect installations.

A barrel union or flanged joint is necessary in all suction lines to permit the piping to be screwed up tightly and dismantled easily for servicing the pump.

Make sure that all joints, whether flanged or screwed, are absolutely air tight, by using suitable gaskets or jointing compound and bolting or screwing up evenly and tightly.

When there is a suction lift, a good type of footvalve, with a water opening of at least equal area to that of the pipe, is essential.

We recommend the use of the Southern Cross "AF" Pattern Brass Combined Footvalve and Strainer where the suction pipe is 3in. or less, and a Southern Cross Mark HC-H Galvanised Footvalve and Strainer for 4in. suction pipe.

Make sure the footvalve is installed about three feet below the low level of the water to prevent the formation of whirlpools and the consequent entry of air into the suction pipe.

When the pump is below the lowest source of supply, a Fullway Gate Valve should be fitted in the suction line close to the pump. This enables the pump to be serviced without draining the supply reservoir to below pump level. **This Valve must always be fully open unless the pump is being dismantled.**

## Discharge Piping.

Discharge Piping of a size suitable to carry the required discharge from the pump, without excessive friction head, should be selected.

The pipe size for which the discharge flange is screwed is not necessarily the correct size to use.

Always check the friction head of the installation before deciding on the size pipe to be used. As a general rule, one size larger pipe than the discharge flange screwing is recommended. Never, under any circumstances, should a size of pipe smaller than the discharge flange screwing be used.

If the point of discharge is some distance above the pump, the discharge piping should rise continuously to this point. Where the discharge piping is laid over undulating ground with high points where air pockets can form, vent cocks must be placed to expel any accumulation of air which could affect the discharge capacity of the pump.

### GATE VALVE

Install a Fullway Gate Valve in the discharge piping as close as possible to the discharge flange of the pump. It is used chiefly to control the capacity of the pump.

It is always advisable to close the Gate Valve before stopping the pump, so that next time the unit is required to operate, the driving engine or motor may be started free from load.

### BALL BEARINGS

The ball bearings in the pump are packed with grease at the Factory, and do not require further lubrication until the pump is overhauled. At least every two years the pump should be completely dismantled and inspected. To do this, proceed as follows:

1. Disconnect suction and discharge piping from pump at barrel union or flanged joints. Remove belts from pump pulley.
2. Undo nuts holding cover plate to pump body and remove it, taking care not to damage the gasket.
3. Bend back the tab washer and then undo impeller nut. Bend back pulley locknut tab washer and undo locknut. Then bump pulley off shaft, being careful not to lose key.
4. Unscrew the bearing housing, No. 11, on 1 and 1½ inch pumps, and undo nuts holding bearing housing on 2, 2½, 3 and 4 inch pumps.
5. Loosen packing gland. Using a piece of wood to protect the thread, bump shaft through until impeller is clear of pump body. Insert suitable wedges at several points between the impeller and pump body and then bump the shaft back out of the impeller. Remove impeller key from shaft. Examine water passages in the impeller and make sure they are clear.
6. Loosen the two nuts on top of the base and then slide pump body off shaft. Examine the machined lugs on the pump body which fit into the base and a grub-screw will be found in one of them. Screw out this grub-screw. Undo the packing gland and remove the gland, packing rings, lantern ring and the ring of packing fitted under the lantern ring. Clean the lantern ring and using a piece of wire, clean the drilled passages through the body. Refit the grub-

After starting, wait until the unit has gained full speed, then open the Gate Valve **gradually** until the desired quantity of water is being discharged.

A Centrifugal Pump is not harmed whilst operating against a closed discharge valve provided the pump is not left running for more than 10 minutes. If left running for very long, the churning action of the impeller generates sufficient heat to cause seizure and distortion of the pump.

### TO ALTER POSITION OF PUMP DISCHARGE

The discharge branch on all pumps can be easily swivelled to any desired position if the two nuts on top of the base are loosened. After adjusting, press pump body firmly into base before tightening nuts again. Also check to see that the shaft still turns freely.

After swivelling the body it may be found that one of the studs holding the packing gland is inaccessible and in this case the studs should be shifted to the alternative pair of holes provided in the body.

### CONNECTING SUCTION AND DISCHARGE PIPING.

Both Suction and Discharge Pipes must be supported independently of the pump so that no undue strain is placed on the pump casing. These pipes must match up to their respective flanges without pressure being applied to the bolts, to avoid distortion of the pump.

## Lubrication.

screw and reassemble the packing gland, leaving it loose. **Fit one ring of packing, then the lantern ring and then the remainder of the packing rings.** If the gland is not assembled in this way the lantern ring will be in the wrong position in the gland.

7. Slide shaft and bearings out of base. Wash bearings in petrol (not kerosene), allow to dry and then inspect. If bearings are worn or defective, fit new bearings.
  8. Repack the bearings with fresh grease, using **SOUTHERN CROSS GREASE**, or if this is not available, any Ball Bearing Grease as recommended by a reputable oil company. See that the balls are well covered with grease on both sides of the bearings.
  9. Wipe any old grease or foreign matter out of bearing housing in base, and then slide in shaft and bearings. Refit bearing housing, No. 11, fitting spring washers under nuts on 2, 2½, 3 and 4 inch pumps.
  10. Slide pump body into position in base and tighten two clamping nuts.
  11. Fit impeller key in shaft, and then put impeller, tab washer and impeller nut in position. Make sure that the suction (open) side of the impeller faces outwards. See that pulley key is in position and then fit pulley, tab washer and pulley locknut. Tighten both impeller nut and pulley nut and bend tab washers over to lock nuts.
  12. Put gasket and cover plate in position and fit spring washers and nuts and tighten. Refit belts and connect up suction and discharge piping.
- NOTE: The greasing of the ball bearings at least every two years, as set out above, is the only lubrication which the pump requires.

## Gland.

Pumps are despatched with the gland packed. Temperature changes may cause the packing to swell, and if the shaft cannot be easily turned by hand, reset the packing and screw the gland up lightly. After the pump has been in operation a short time it will be found necessary to tighten up the gland as the packing "beds down." One or two rings of packing should be cut and inserted immediately to restore the packing to its original length. The packing must be inserted into the packing box, one ring at a time, making sure that the joints in successive rings are not together but on opposite sides of the shaft. The packing box should always be kept

filled with sufficient packing so that the gland will not enter the packing box more than approximately  $\frac{1}{16}$  in.

The gland nuts must be screwed up evenly and should be little more than finger tight; a tight gland causes the packing to burn and score the pump shaft. Use only the best quality graphite type packing in the packing gland.

Where special liquids are to be pumped, we will be pleased to advise the type of packing and metals to be used.

## Priming.

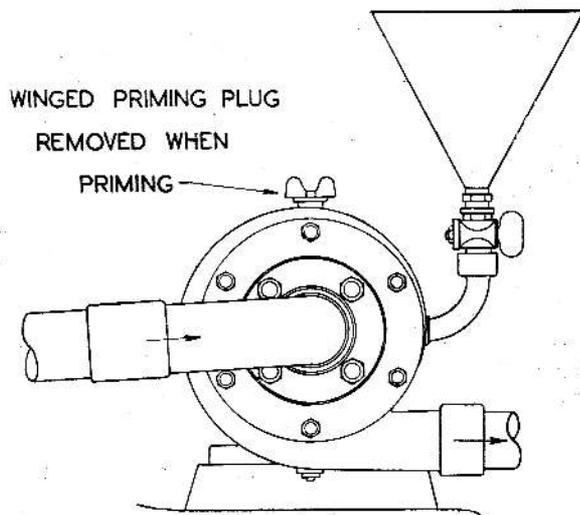
Do not attempt to run the pump when empty. The pump and suction pipe must be filled with water and the air removed from the pump casing (primed) before starting. If run dry, certain interior parts which rely on water for lubrication will be damaged.

After the pump is installed and the discharge piping has been connected, check the position of the winged priming plug on the pump body. It should be fitted at the top of the body. If one of the three gas plugs is at the top, remove it and fit the winged priming plug instead, making sure the sealing washer is in place. The winged priming plug is only screwed up finger tight so that it can be easily unscrewed for priming.

The following methods of priming may be used:

- (a) Where the water is being pumped to a level higher than the pump, the gate valve on the discharge pipe is closed each time just before the pump is stopped. When the pump has to be primed, remove the winged priming plug from the top of the pump and open the gate valve on the discharge pipe. When water, free from air bubbles, flows from the plug hole, close the gate valve and replace the plug. Start pump immediately.
- (b) Fit a priming funnel, priming cock and connection as shown in illustration, "Fitting Priming Funnel." Remove the winged priming plug from the top of the pump and fill the pump and suction pipe by pouring water into the funnel. When water, free from air bubbles, flows from the plug hole, replace plug, shut off priming cock and start pump immediately.
- (c) Place a small tank close to the pump so that the bottom of the tank is higher than the pump. Connect a small branch pipe into the pump discharge pipe between the pump and the gate valve, and run it to the bottom of the tank. Fit a stop cock in this branch pipe.

To prime the pump for the first time, close gate valve on discharge pipe and stop cock on branch pipe. Pour water into tank, remove winged priming plug from pump and open stop cock on branch pipe. The water



*Fitting Priming Funnel*

will flow into the pump and suction pipe, and when it flows from the plug hole, free from air bubbles, close the stop cock on branch pipe, replace plug and start pump immediately.

When the pump is started, open stop cock on branch pipe until tank is full and then close it.

- (d) Where the pump is installed below the lowest source of supply, remove the winged priming plug from the top of the pump, and open the gate valve on the suction pipe, and the water will flow in, thus priming the pump. When water, free from air bubbles, flows from the plug hole, replace the plug and start pump immediately.

In all cases the pump spindle should be turned slowly by hand to expel air trapped in the impeller.

The discharge gate valve must be kept closed until the unit has gained full speed, and then gradually opened.

# OPERATION

## Starting.

Before starting the Unit, check the following points:—

1. **Direction of Rotation:** Make sure that the engine or motor will drive the pump in the direction indicated by the arrow on the pump cover plate.
2. **Gland:** Make sure that the gland is lightly and evenly adjusted and that the pump spindle revolves freely when turned by hand.
3. **Suction Piping:** Make sure that there are no air leaks in the suction piping and that the foot valve does not leak.
4. **Priming:** Prime the pump carefully, as previously explained.
5. **Gate Valve on the Discharge Pipe:** Close the Gate Valve on the Discharge Pipe. This will allow the driving machine to be started free from load.

7. **Alignment:** Recheck alignment of pump and driving machine.

The unit may now be started.

When the pump reaches full speed, open the gate valve on the discharge pipe **gradually** until the desired quantity of water is being delivered. If the pump has lost its prime, stop the pump immediately and reprime the pump.

**As more water is pumped when the gate valve is opened, the load on the engine or electric motor is increased.**

If the layout of the discharge pipe is ever altered and the discharge head is reduced, the pump will deliver a greater quantity of water. This will increase the loading on engine or electric motor, and if necessary the gate valve on the discharge pipe should be partially closed to reduce the loading.

## General.

**DO**—Use correct packing in gland.

**DO**—Inspect pump frequently.

**DON'T**—Run pump for very long with discharge valve closed.

**DON'T**—Tighten packing excessively.

**DON'T**—Run pump in wrong direction, as parts may become loose.

**DON'T**—Use suction valve, if fitted, to control pump capacity. Leave it always fully open, unless pump is being serviced.

## TOTAL HEAD.

This Centrifugal Pump has been supplied to suit the particular conditions of your installation. If the installation is ever altered or the pump is shifted to a different site, the total head and its effect upon the capacity of the pump and horsepower required must be considered.

The total head is the total vertical height from the level of the water being pumped to the point of discharge at the end of the discharge pipe, plus the head due to friction in the pipe lines. Tables showing the heads to be allowed for friction in pipes and pipe fittings are included in the back of the SOUTHERN CROSS Catalogue.

Where the Centrifugal Pump is used for a spray irrigation plant, extra head has to be allowed for the sprays, and added when calculating the total head.

## NOISE.

A centrifugal pump in operation is usually nearly noiseless. Sometimes, however, it will produce a rattling sound, varying in intensity. This is usually caused by the presence of air in the pump and this can be remedied by removing the winged priming plug at the top of the pump body and re-priming the pump.

Noisy operation may also be caused by:

- (a) A foreign body jammed in the impeller or body.
- (b) Pump running in wrong direction. Check with arrow on the pump cover plate.
- (c) Impeller fitted wrong way around after pump has been overhauled.

# SELECTION TABLE for CENTRIFUGAL PUMPS

G.P.M.	TOTAL FEET HEAD																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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10	R.P.M. 1020 B.H.P. .13	1220 .19	1430 .26	1600 .33	1750 .41	1880 .45	2010 .50	2130 .55	2250 .60	2370 .69	2460 .75	2570 .81	2660 .87	2770 .92	2850 .97	3025 1.07	3190 1.13	3330 1.19	3460 1.25	3640 1.32	3800 1.38	3975 1.45	4040 1.50	4200 1.57	4380 1.63	4500 1.68	4650 1.75	4800 1.81	4950 1.87	5100 1.93	5250 1.99	5400 2.05	5550 2.11	5700 2.17	5850 2.23	6000 2.29	6150 2.35	6300 2.41	6450 2.47	6600 2.53	6750 2.59	6900 2.65	7050 2.71	7200 2.77	7350 2.83	7500 2.89	7650 2.95	7800 3.01	7950 3.07	8100 3.13	8250 3.19	8400 3.25	8550 3.31	8700 3.37	8850 3.43	9000 3.49	9150 3.55	9300 3.61	9450 3.67	9600 3.73	9750 3.79	9900 3.85	10050 3.91	10200 3.97	10350 4.03	10500 4.09	10650 4.15	10800 4.21	10950 4.27	11100 4.33	11250 4.39	11400 4.45	11550 4.51	11700 4.57	11850 4.63	12000 4.69	12150 4.75	12300 4.81	12450 4.87	12600 4.93	12750 4.99	12900 5.05	13050 5.11	13200 5.17	13350 5.23	13500 5.29	13650 5.35	13800 5.41	13950 5.47	14100 5.53	14250 5.59	14400 5.65	14550 5.71	14700 5.77	14850 5.83	15000 5.89	15150 5.95	15300 6.01	15450 6.07	15600 6.13	15750 6.19	15900 6.25	16050 6.31	16200 6.37	16350 6.43	16500 6.49	16650 6.55	16800 6.61	16950 6.67	17100 6.73	17250 6.79	17400 6.85	17550 6.91	17700 6.97	17850 7.03	18000 7.09	18150 7.15	18300 7.21	18450 7.27	18600 7.33	18750 7.39	18900 7.45	19050 7.51	19200 7.57	19350 7.63	19500 7.69	19650 7.75	19800 7.81	19950 7.87	20100 7.93	20250 7.99	20400 8.05	20550 8.11	20700 8.17	20850 8.23	21000 8.29	21150 8.35	21300 8.41	21450 8.47	21600 8.53	21750 8.59	21900 8.65	22050 8.71	22200 8.77	22350 8.83	22500 8.89	22650 8.95	22800 9.01	22950 9.07	23100 9.13	23250 9.19	23400 9.25	23550 9.31	23700 9.37	23850 9.43	24000 9.49	24150 9.55	24300 9.61	24450 9.67	24600 9.73	24750 9.79	24900 9.85	25050 9.91	25200 9.97	25350 10.03	25500 10.09	25650 10.15	25800 10.21	25950 10.27	26100 10.33	26250 10.39	26400 10.45	26550 10.51	26700 10.57	26850 10.63	27000 10.69	27150 10.75	27300 10.81	27450 10.87	27600 10.93	27750 10.99	27900 11.05	28050 11.11	28200 11.17	28350 11.23	28500 11.29	28650 11.35	28800 11.41	28950 11.47	29100 11.53	29250 11.59	29400 11.65	29550 11.71	29700 11.77	29850 11.83	30000 11.89	30150 11.95	30300 12.01	30450 12.07	30600 12.13	30750 12.19	30900 12.25	31050 12.31	31200 12.37	31350 12.43	31500 12.49	31650 12.55	31800 12.61	31950 12.67	32100 12.73	32250 12.79	32400 12.85	32550 12.91	32700 12.97	32850 13.03	33000 13.09	33150 13.15	33300 13.21	33450 13.27	33600 13.33	33750 13.39	33900 13.45	34050 13.51	34200 13.57	34350 13.63	34500 13.69	34650 13.75	34800 13.81	34950 13.87	35100 13.93	35250 13.99	35400 14.05	35550 14.11	35700 14.17	35850 14.23	36000 14.29	36150 14.35	36300 14.41	36450 14.47	36600 14.53	36750 14.59	36900 14.65	37050 14.71	37200 14.77	37350 14.83	37500 14.89	37650 14.95	37800 15.01	37950 15.07	38100 15.13	38250 15.19	38400 15.25	38550 15.31	38700 15.37	38850 15.43	39000 15.49	39150 15.55	39300 15.61	39450 15.67	39600 15.73	39750 15.79	39900 15.85	40050 15.91	40200 15.97	40350 16.03	40500 16.09	40650 16.15	40800 16.21	40950 16.27	41100 16.33	41250 16.39	41400 16.45	41550 16.51	41700 16.57	41850 16.63	42000 16.69	42150 16.75	42300 16.81	42450 16.87	42600 16.93	42750 16.99	42900 17.05	43050 17.11	43200 17.17	43350 17.23	43500 17.29	43650 17.35	43800 17.41	43950 17.47	44100 17.53	44250 17.59	44400 17.65	44550 17.71	44700 17.77	44850 17.83	45000 17.89	45150 17.95	45300 18.01	45450 18.07	45600 18.13	45750 18.19	45900 18.25	46050 18.31	46200 18.37	46350 18.43	46500 18.49	46650 18.55	46800 18.61	46950 18.67	47100 18.73	47250 18.79	47400 18.85	47550 18.91	47700 18.97	47850 19.03	48000 19.09	48150 19.15	48300 19.21	48450 19.27	48600 19.33	48750 19.39	48900 19.45	49050 19.51	49200 19.57	49350 19.63	49500 19.69	49650 19.75	49800 19.81	49950 19.87	50100 19.93	50250 19.99	50400 20.05	50550 20.11	50700 20.17	50850 20.23	51000 20.29	51150 20.35	51300 20.41	51450 20.47	51600 20.53	51750 20.59	51900 20.65	52050 20.71	52200 20.77	52350 20.83	52500 20.89	52650 20.95	52800 21.01	52950 21.07	53100 21.13	53250 21.19	53400 21.25	53550 21.31	53700 21.37	53850 21.43	54000 21.49	54150 21.55	54300 21.61	54450 21.67	54600 21.73	54750 21.79	54900 21.85	55050 21.91	55200 21.97	55350 22.03	55500 22.09	55650 22.15	55800 22.21	55950 22.27	56100 22.33	56250 22.39	56400 22.45	56550 22.51	56700 22.57	56850 22.63	57000 22.69	57150 22.75	57300 22.81	57450 22.87	57600 22.93	57750 22.99	57900 23.05	58050 23.11	58200 23.17	58350 23.23	58500 23.29	58650 23.35	58800 23.41	58950 23.47	59100 23.53	59250 23.59	59400 23.65	59550 23.71	59700 23.77	59850 23.83	60000 23.89	60150 23.95	60300 24.01	60450 24.07	60600 24.13	60750 24.19	60900 24.25	61050 24.31	61200 24.37	61350 24.43	61500 24.49	61650 24.55	61800 24.61	61950 24.67	62100 24.73	62250 24.79	62400 24.85	62550 24.91	62700 24.97	62850 25.03	63000 25.09	63150 25.15	63300 25.21	63450 25.27	63600 25.33	63750 25.39	63900 25.45	64050 25.51	64200 25.57	64350 25.63	64500 25.69	64650 25.75	64800 25.81	64950 25.87	65100 25.93	65250 25.99	65400 26.05	65550 26.11	65700 26.17	65850 26.23	66000 26.29	66150 26.35	66300 26.41	66450 26.47	66600 26.53	66750 26.59	66900 26.65	67050 26.71	67200 26.77	67350 26.83	67500 26.89	67650 26.95	67800 27.01	67950 27.07	68100 27.13	68250 27.19	68400 27.25	68550 27.31	68700 27.37	68850 27.43	69000 27.49	69150 27.55	69300 27.61	69450 27.67	69600 27.73	69750 27.79	69900 27.85	70050 27.91	70200 27.97	70350 28.03	70500 28.09	70650 28.15	70800 28.21	70950 28.27	71100 28.33	71250 28.39	71400 28.45	71550 28.51	71700 28.57	71850 28.63	72000 28.69	72150 28.75	72300 28.81	72450 28.87	72600 28.93	72750 28.99	72900 29.05	73050 29.11	73200 29.17	73350 29.23	73500 29.29	73650 29.35	73800 29.41	73950 29.47	74100 29.53	74250 29.59	74400 29.65	74550 29.71	74700 29.77	74850 29.83	75000 29.89	75150 29.95	75300 30.01	75450 30.07	75600 30.13	75750 30.19	75900 30.25	76050 30.31	76200 30.37	76350 30.43	76500 30.49	76650 30.55	76800 30.61	76950 30.67	77100 30.73	77250 30.79	77400 30.85	77550 30.91	77700 30.97	77850 31.03	78000 31.09	78150 31.15	78300 31.21	78450 31.27	78600 31.33	78750 31.39	78900 31.45	79050 31.51	79200 31.57	79350 31.63	79500 31.69	79650 31.75	79800 31.81	79950 31.87	80100 31.93	80250 31.99	80400 32.05	80550 32.11	80700 32.17	80850 32.23	81000 32.29	81150 32.35	81300 32.41	81450 32.47	81600 32.53	81750 32.59	81900 32.65	82050 32.71	82200 32.77	82350 32.83	82500 32.89	82650 32.95	82800 33.01	82950 33.07	83100 33.13	83250 33.19	83400 33.25	83550 33.31	83700 33.37	83850 33.43	84000 33.49	84150 33.55	84300 33.61	84450 33.67	84600 33.73	84750 33.79	84900 33.85	85050 33.91	85200 33.97	85350 34.03	85500 34.09	85650 34.15	85800 34.21	85950 34.27	86100 34.33	86250 34.39	86400 34.45	86550 34.51	86700 34.57	86850 34.63	87000 34.69	87150 34.75	87300 34.81	87450 34.87	87600 34.93	87750 34.99	87900 35.05	88050 35.11	88200 35.17	88350 35.23	88500 35.29	88650 35.35	88800 35.41	88950 35.47	89100 35.53	89250 35.59	89400 35.65	89550 35.71	89700 35.77	89850 35.83	90000 35.89	90150 35.95	90300 36.01	90450 36.07	90600 36.13	90750 36.19	90900 36.25	91050 36.31	91200 36.37	91350 36.43	91500 36.49	91650 36.55	91800 36.61	91950 36.67	92100 36.73	92250 36.79	92400 36.85	92550 36.91	92700 36.97	92850 37.03	93000 37.09	93150 37.15	93300 37.21	93450 37.27	93600 37.33	93750 37.39	93900 37.45	94050 37.51	94200 37.57	94350 37.63	94500 37.69	94650 37.75	94800 37.81	94950 37.87	95100 37.93	95250 37.99	95400 38.05	95550 38.11	95700 38.17	95850 38.23	96000 38.29	96150 38.35	96300 38.41	96450 38.47	96600 38.53	96750 38.59	96900 38.65	97050 38.71	97200 38.77	97350 38.83	97500 38.89	97650 38.95	97800 39.01	97950 39.07	98100 39.13	98250 39.19	98400 39.25	98550 39.31	98700 39.37	98850 39.43	99000 39.49	99150 39.55	99300 39.61	99450 39.67	99600 39.73	99750 39.79	99900 39.85	100050 39.91	100200 39.97	100350 40.03	100500 40.09	100650 40.15	100800 40.21	100950 40.27	101100 40.33	101250 40.39	101400 40.45	101550 40.51	101700 40.57	101850 40.63	102000 40.69	102150 40.75

## Troubles and Their Causes.

### Failure to Deliver Water.

1. Pump not properly primed.
2. Speed too low:—
  - (a) If motor driven, check speed and line voltage.
  - (b) If engine driven, check governor setting and engine speed.
  - (c) If driven from line shaft, check shaft speed and pulley sizes.
3. Discharge head beyond pump's rating. Check both suction and discharge heads with gauges.
4. Excessive suction lift.
5. Incorrect direction of rotation.
6. Long suction and short delivery.  
A minimum discharge head of approximately 5ft. will help to eliminate this trouble.
7. Impeller clogged.
8. Impeller fitted wrong way about in pump.
9. Obstruction in suction or discharge line:—
  - (a) Valve closed.
  - (b) Suction strainer clogged.
  - (c) Suction foot valve stuck in closed position.

### Pump Delivers a Little Water and Then Fails to Deliver More.

10. Air not all out of pump.
11. Leaking suction pipe, joints, or gland.
12. Suction lift too great.

### Too Low Pressure or Too Small Quantity of Liquid Discharged.

13. Footvalve too small or restricted by rubbish or insufficiently submerged.
14. Slight air leaks in suction piping or joints.
15. Air leaks at packing gland.
16. Excessive suction lift.
17. Impeller partially or fully clogged.
18. Speed too low. (See No. 2.)
19. Suction or discharge piping and strainers partially stopped up. (See No. 9.)
20. Suction head too high when pumping hot or volatile liquids.
21. Discharge head too high.
22. Impeller damaged.
23. Wrong impeller in pump. Check diameter and clearances.
24. Sealing rings badly worn, giving excessive clearance.
25. Air or gases in liquid handled.

### Pump Discharges at Surface but Fails to Deliver at Higher Discharge Point.

26. Pump speed too low.
27. Head not calculated correctly.

### Hot Bearings.

28. Belt too tight or out of line.
29. Too much grease in ball bearings.
30. Unsupported pipes straining the pump.  
A temperature uncomfortably hot to the hand is not necessarily injurious to the pump; any sudden rise in temperature, however, should be investigated.

### Power Consumption Too High.

31. Total head is lower than estimated causing too much water to be pumped.  
Throttle back capacity by means of gate valve on delivery side.
32. Pump speed too high.
33. Density of liquid greater than water.
34. Bent shaft.
35. Unsupported pipes straining pump causing impeller to bind in body and cover plate. Remove belts and turn spindle by hand to check if it is free.
36. Packing gland too tight.

### Excessive Vibration.

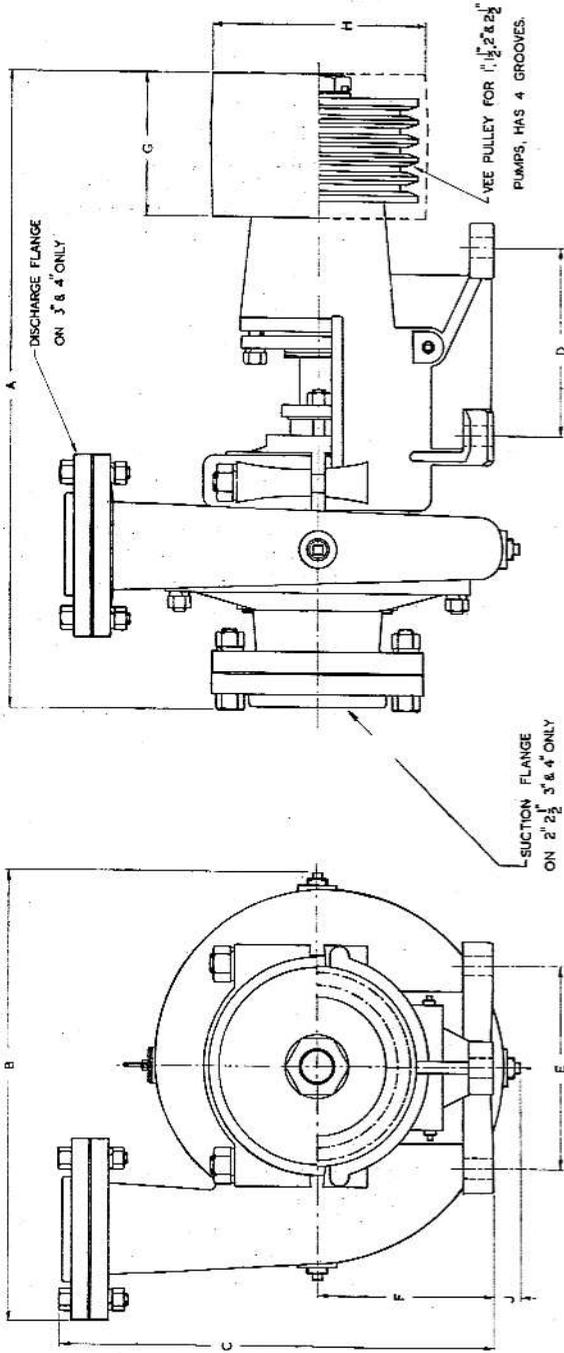
37. Misalignment. When pump or driver becomes hot during operation, check alignment of pump and driving member.
38. Foundation not sufficiently rigid.
39. Impeller partially clogged, causing unbalance.
40. Worn bearings.
41. Casing distorted. (See Nos. 34 and 35).

### Too Much Leakage Around Shaft.

42. Insufficient packing.
43. Packing loose on worn shaft. Replace packing, or, if shaft badly worn, replace shaft.

### Excessive Internal Wear of Pump.

44. Cavitation from air or gases in liquid.
45. Abrasion caused by solid particles.
46. Corrosive action of liquid handled.
47. Unsupported pipes straining pump, causing impeller to bind in body and cover plate.

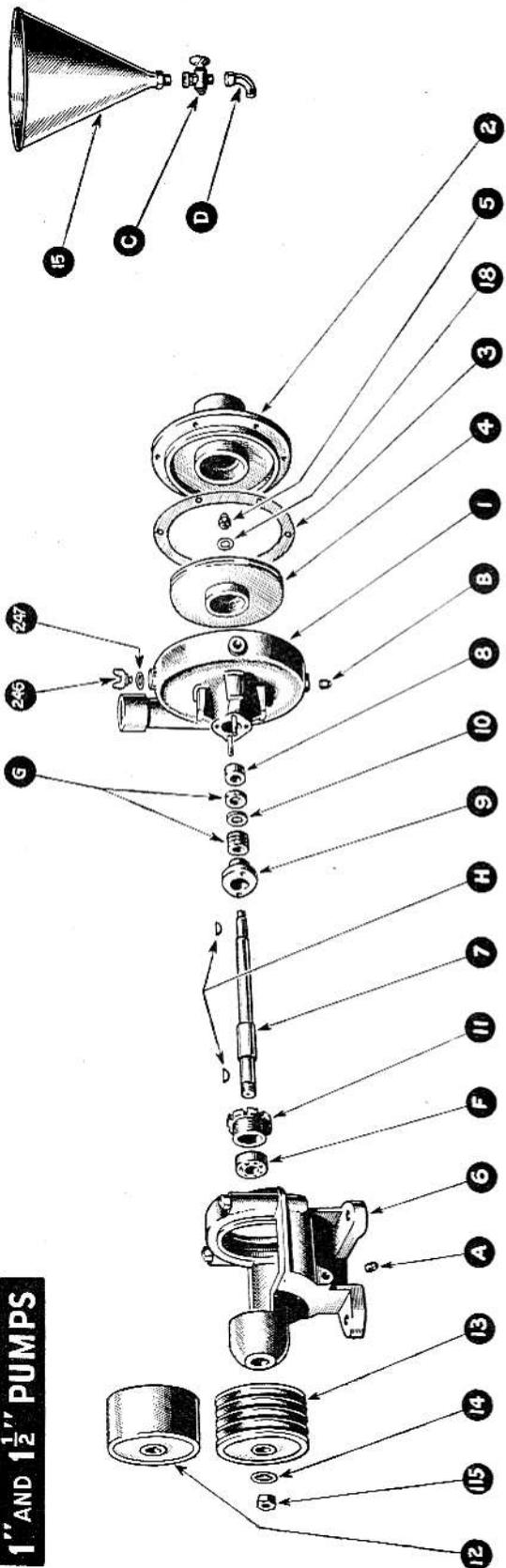


LINE DIMENSIONS OF FM PATTERN CENTRIFUGAL PUMPS.

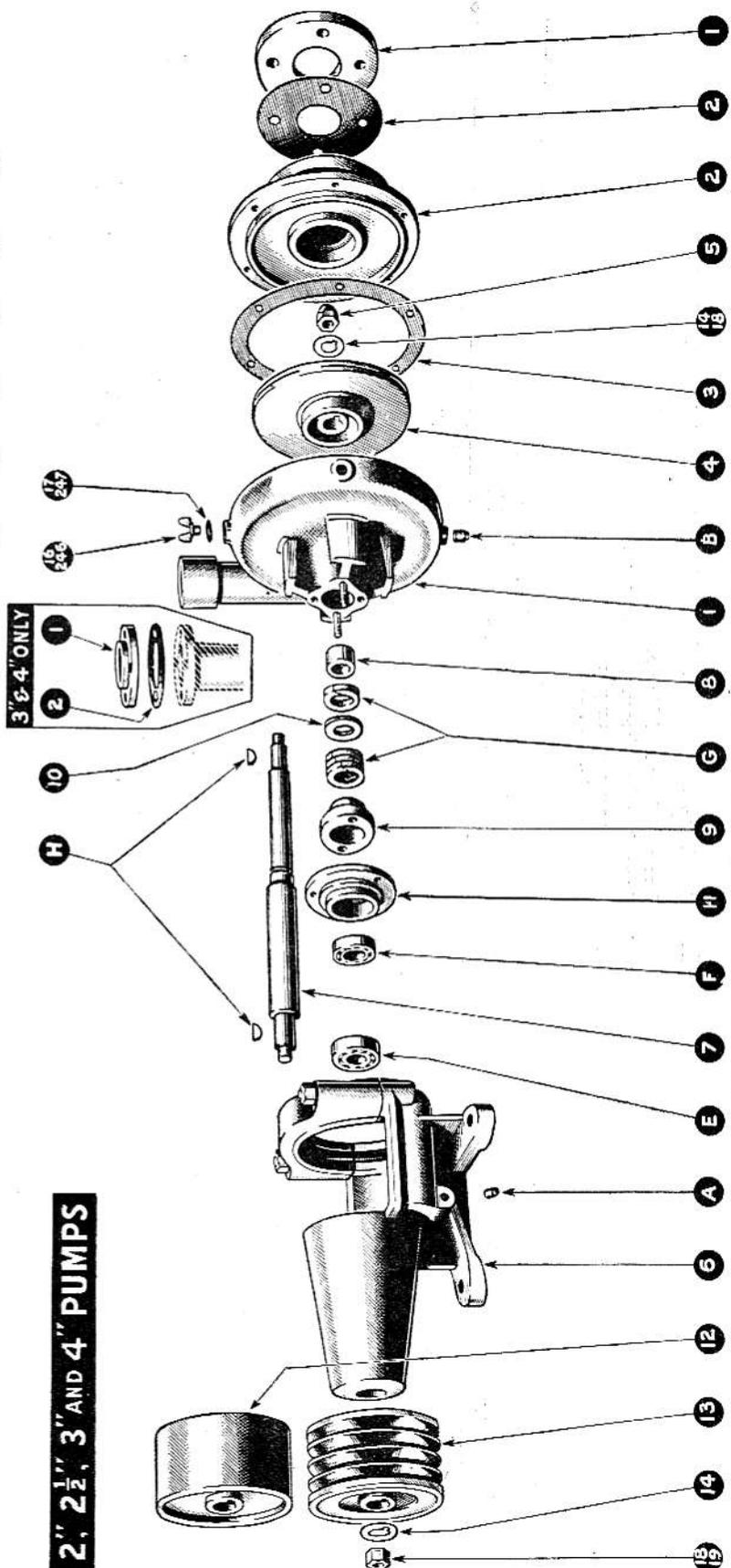
Size Pump	A	B	C	D	E	F	G	H	J	SUCTION SCREWED	DISCHARGE SCREWED	V - PULLEYS		SHAFT DIA. FOR PULLEY
												SYM. No.	GROOVES	
FM-B 1in.	18 $\frac{3}{4}$ in.	9 $\frac{3}{4}$ in.	10 $\frac{3}{4}$ in.	4 $\frac{3}{4}$ in.	6in.	5 $\frac{3}{4}$ in.	3in.	6 $\frac{1}{2}$ in.		1 $\frac{1}{2}$ in. pipe	1in. pipe	FM-B 13	4 - "A" 5in. P.D.	.875in. .874in.
FM-C 1 $\frac{1}{2}$ in.	18 $\frac{3}{4}$ in.	10 $\frac{3}{4}$ in.	11 $\frac{1}{2}$ in.	4 $\frac{3}{4}$ in.	6in.	5 $\frac{3}{4}$ in.	3in.	6 $\frac{1}{2}$ in.		2in. pipe	1 $\frac{1}{2}$ in. pipe	FM-B 13	4 - "A" 5in. P.D.	.875in. .874in.
FM-D 2in.	21 $\frac{1}{2}$ in.	12 $\frac{3}{4}$ in.	13 $\frac{3}{4}$ in.	7 $\frac{1}{4}$ in.	7 $\frac{1}{2}$ in.	6in.	4 $\frac{1}{2}$ in.	6 $\frac{3}{4}$ in.	9/16in.	2 $\frac{1}{2}$ in. pipe	2in. pipe	FM-D 13	4 - "B" 6in. P.D.	1.250in. 1.249in.
FM-E 2 $\frac{1}{2}$ in.	22in.	13 $\frac{3}{4}$ in.	14 $\frac{3}{4}$ in.	7 $\frac{1}{4}$ in.	7 $\frac{1}{2}$ in.	6in.	4 $\frac{1}{2}$ in.	6 $\frac{3}{4}$ in.	$\frac{3}{4}$ in.	3in. pipe	2 $\frac{1}{2}$ in. pipe	FM-D 13	4 - "B" 6in. P.D.	1.250in. 1.249in.
FM-F 3in.	25 $\frac{1}{4}$ in.	17 $\frac{3}{4}$ in.	17 $\frac{7}{16}$ in.	7 $\frac{1}{2}$ in.	8in.	7in.	5 $\frac{1}{2}$ in.	8 $\frac{3}{4}$ in.	1 $\frac{1}{4}$ in.	4in. pipe	3in. pipe	FM-F 13	5 - "B" 7 $\frac{1}{2}$ in. P.D.	1.625in. 1.624in.
FM-G 4in.	25 $\frac{3}{4}$ in.	17 $\frac{3}{4}$ in.	17 $\frac{9}{16}$ in.	7 $\frac{1}{4}$ in.	8in.	7in.	5 $\frac{1}{2}$ in.	8 $\frac{3}{4}$ in.	$\frac{3}{4}$ in.	4in. pipe	4in. pipe	FM-F 13	5 - "B" 7 $\frac{1}{2}$ in. P.D.	1.625in. 1.624in.

NOTE: Dimensions are approximate only and are not binding.

**1" AND 1 1/2" PUMPS**



**2", 2 1/2", 3" AND 4" PUMPS**



Exploded View of Pump Showing Parts and Their Numbers

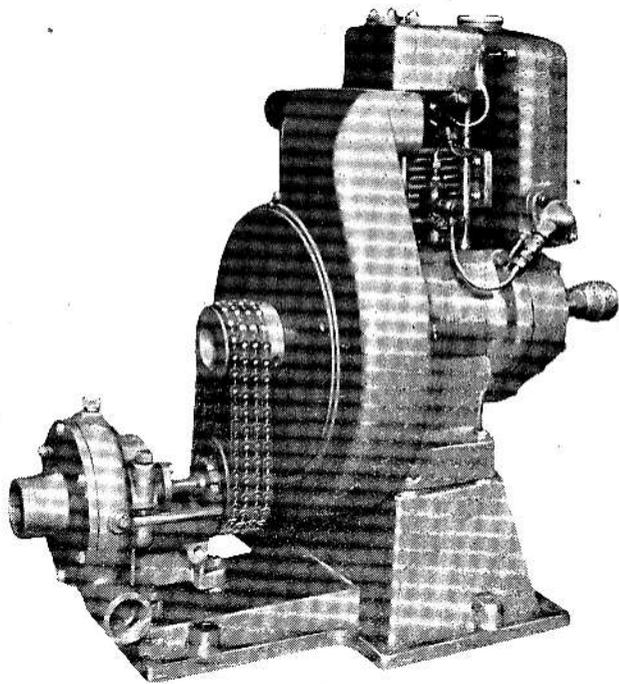
# PARTS LIST

Note: It is important when ordering a part for a pump to give the following information:

- (1) Size and Mark of Pump.
- (2) Pump Number shown on Nameplate.
- (3) Date Pump was supplied.
- (4) Name and Number of Part.

1in. Mark FM-B	1 1/2in. Mark FM-C	2in. Mark FM-D	2 1/2in. Mark FM-E	3in. Mark FM-F	4in. Mark FM-G	No. Off.	Name of Part.
FM-B 1	FM-C 1	FM-D 1 GW-F 1	FM-E 1 GW-G 1	FM-F 1 GW-H 1 GW-G 1	FM-G 1 GW-H 1 GW-H 1	1 1 1	Body Suction Flange Discharge Flange Cover Plate
FM-B 2	FM-C 2	FM-D 2 GW-F 2	FM-E 2 GW-G 2	FM-F 2 GW-H 2 GW-G 2	FM-G 2 GW-H 2 GW-H 2	1 1 1	Suction Flange Gasket Discharge Flange Gasket Cover Plate Gasket.
FM-B 3	FM-C 3	FM-D 3	FM-E 3	FM-F 3	FM-G 3	1	Impeller.
FM-B 4B	FM-C 4B	FM-D 4B	FM-E 4B	FM-F 4	FM-G 4	1	Impeller Nut
FM-B 5	FM-C 5	FM-D 5	FM-E 5	FM-F 5	FM-G 5	1	Base
FM-B 6	FM-C 6	FM-D 6	FM-E 6	FM-F 6	FM-G 6	1	Shaft
FM-B 7	FM-C 7	FM-D 7	FM-E 7	FM-F 7	FM-G 7	1	Neck Bush
FM-B 8	FM-C 8	FM-D 8	FM-E 8	FM-F 8	FM-G 8	1	Packing Gland
FM-B 9	FM-C 9	FM-D 9	FM-E 9	FM-F 9	FM-G 9	1	Lantern Ring
FM-B 10	FM-C 10	FM-D 10	FM-E 10	FM-F 10	FM-G 10	1	Bearing Housing
FM-B 11	FM-C 11	FM-D 11	FM-E 11	FM-F 11	FM-G 11	1	Flat Belt Pulley
FM-B 12	FM-C 12	FM-D 12	FM-E 12	FM-F 12	FM-G 12	1	Vee Belt Pulley
FM-B 13	FM-C 13	FM-D 13	FM-E 13	FM-F 13	FM-G 13	1	Impeller Nut Tab Washer
FM-B 14	FM-C 14	FM-D 14	FM-E 14	FM-F 14	FM-G 14	1	Pulley Locknut Tab Washer
FM-B 15	FM-C 15	FM-D 15	FM-E 15	FM-F 15	FM-G 15	1	Priming Funnel
FM-B 18	FM-C 18	FM-D 18	FM-E 18	FM-F 18	ET-B 18	1	Winged Priming Plug Washer
AW-D115	AW-D115	FM-D 18 ET-B 19	FM-D 18 ET-B 19	FM-F 17 ET-B 18	ET-B 17 ET-B 18	1	Pulley Locknut
Y-C246	Y-C246	Y-C246	Y-C246	Y-C247	Y-C247	1	Impeller Nut Tab Washer
Y-C247	Y-C247	Y-C247	Y-C247	Y-C247	Y-C247	1	Pulley Locknut
7 x 3/8	7 x 3/8	2 1/2 x 3/8	2 1/2 x 3/8	2 1/2 x 3/8	2 1/2 x 3/8	1	Pulley Locknut
4 x 1/2	4 x 1/2	5 x 3/8	5 x 3/8	6 x 3/8	8 x 3/8	1	Winged Priming Plug
1 3/4 x 3/8	1 3/4 x 3/8	2 x 7/16	2 x 7/16	2 1/2 x 7/16	2 1/2 x 7/8	3	Foundation Bolts
1 1/2 x 5/16	1 1/2 x 5/16	1 1/2 x 7/16	1 1/2 x 7/16	1 1/2 x 7/16	1 1/2 x 7/8	4	Suction Flange Bolt
3 x 3/8	3 x 3/8	3 x 3/8	3 x 3/8	3 x 3/8	3 x 3/8	4	Discharge Flange Bolt
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	2	Pump Body Clamping Stud
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	2	Packing Gland Stud
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	6	Cover Plate Stud
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	3	Bearing Housing Stud
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	3	By-pass Grubscrew
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	2	A—Base Drain Plug
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	2	B—Priming Plug
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	3	C—Priming Cock (Gas Main Cock).
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1	D—Priming Funnel Conn. (M & F Bend)
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1	E—Bearing for Pulley End
1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1 1/2 x 3/8	1	F—Bearing for Pump End
SKF 6205	SKF 6205	SKF 6307	SKF 6307	SKF 6309	SKF 6309	1	G—Gland Packing (Graphited Packing)
1ft. 6in. x 5/16 sq.	1ft. 6in. x 5/16 sq.	2ft. x 5/16in. sq.	2ft. x 5/16in. sq.	2ft. x 3/8in. sq.	2ft. x 3/8in. sq.	1	H—Pulley Key (Woodruff)
SAE 90	SAE 90	SAE 155	SAE 155	SAE 215	SAE 215	1	H—Impeller Key (Woodruff)
SAE 90	SAE 90	SAE 155	SAE 155	SAE 215	SAE 215	1	

# FIGS. 3114/3115 CENTRIFUGAL PUMPING UNITS



The Fig. 3114 Unit consists of a Mark ET-B Diesel Engine driving either a Mark FM-B (1 inch) or Mark FM-C (1½ inch) Centrifugal Pump. The Fig. 3115 Unit consists of a Mark ET-C Diesel Engine driving either a Mark FM-B (1 inch) or Mark FM-C (1½ inch) Centrifugal Pump. In each case the pump is driven by four "A" Type Brammer Belts, and both pump and engine are mounted on a Mark EV-G Cast Iron Base.

## FOUNDATION FOR UNIT

To obtain the best results from this unit, install it on a firm foundation. A large concrete block with the foundation bolts set into it, makes a suitable foundation.

## TO MAKE CONCRETE BLOCK

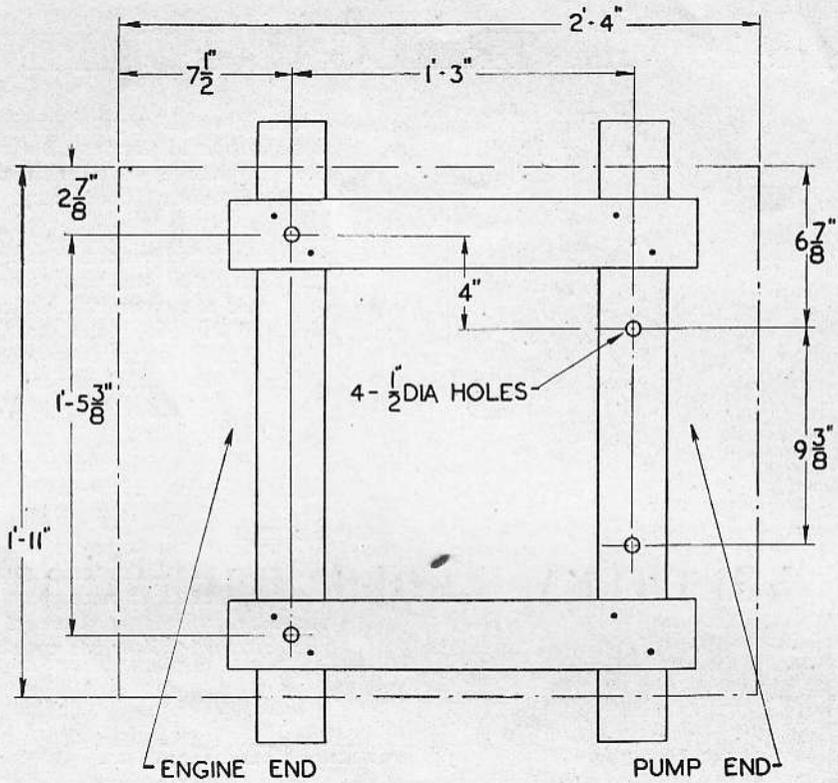
1. After deciding where the unit is to be installed, sink a hole in the ground 1 ft. to 1 ft. 6 in. deep, and to the sizes shown on the "Bolt Template" illustration on Page 14.
2. Make a wooden template to hold the foundation bolts in their positions while the concrete is being poured. (Refer illustration "Bolt Template" on Page 14). Slide the base on the template and mark the positions for the foundation bolts. Remove the base and bore ½ inch holes through the template.
3. Place template in position over the hole in the ground. Take the foundation bolts supplied in the engine case, put large washers on them and then hang them from the template so the tops will project 3 inches above the concrete when the template is removed.

4. Drive in small pegs around the ends of the cross-boards to hold the template in position. Check that the template is level with a spirit level and pack under the ends if necessary.
5. Mix a batch of concrete using 4 parts sharp stone, 2 parts sand and one part cement. See that the stone and sand are clean and do not contain any clay or dirt. If they do, wash carefully before mixing. A block 1 ft. 6 inches deep will require approximately 2½ bags of cement, ¼ yard of sand and ½ yard of stone.
6. Fill the hole with concrete, and at the same time place old bars and bolts in for reinforcements.
7. Allow the concrete to set for 2 to 3 hours, and then carefully lift off the template, taking care not to disturb the bolts. If necessary, smooth off the top of the block with a mixture of 2 parts sand and one part cement. Allow the concrete to set for a day.

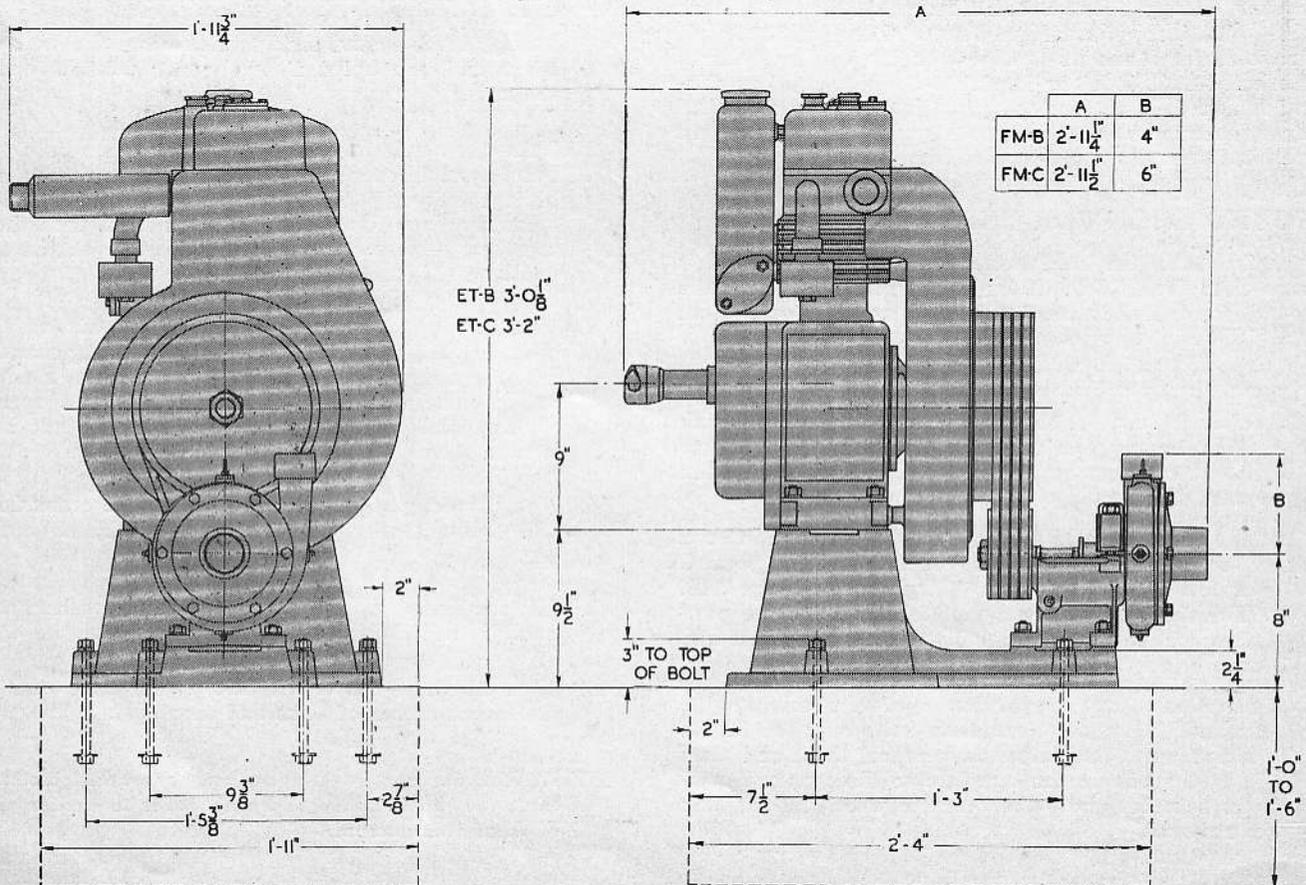
## ASSEMBLING UNIT

1. Lift the base into position on the concrete block and with a spirit level, check that the base is level. Where necessary, place pieces of tin under the edge of the base to level it, and then tighten down the nuts on the foundation bolts, fitting spring washers under the nuts.
2. Take the studs supplied and screw them into the base, short threaded end first. The three short studs are for the pump. To tighten the studs into the base, screw two nuts on to each stud in turn, lock them together, tighten stud using the spanner on the top nut, and then unlock nuts.
3. Unscrew the cylinder head cover nut, lift off the cylinder head cover and screw on the lifting shackle. Lift the engine on to the base, remove the shackle and replace the cover and cover nut. Fit spring washers and nuts on the holding down studs and tighten them.
4. Screw the engine pulley on to the engine crankshaft and tighten, using the starting handle as a tommy bar.
5. Lift the pump on to the base, fit spring washers and nuts on the holding down studs and tighten.
6. Then fit the belts. Each belt should have exactly the same number of links and should be tight.

**NOTE:** For further installation and operation instructions for the Centrifugal Pump, refer to earlier sections of this manual.



Bolt Template for Figs. 3114/3115 Centrifugal Pumping Units



General Arrangement of Figs. 3114/3115 Centrifugal Pumping Units