Instruction Manual *for..*

SOUTHERN CROSS

LOW HEAD

CENTRIFUGAL PUMPS

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

SOUTHERN CROSS MACHINERY PTY.LTD.

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1435

INSTALLATION

All unpainted parts of the impeller and body are greased to prevent rusting in storage and, in cases where there would be objection to traces of grease in the initial discharge from the pump, the pump should be flushed out before use.

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: 1in. and 1½in. pumps—1⅛in.; 2in. pumps—1¼in.; 2½in. and 3in. pumps—1½in.; 4in. pumps —2in.

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 washer 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.

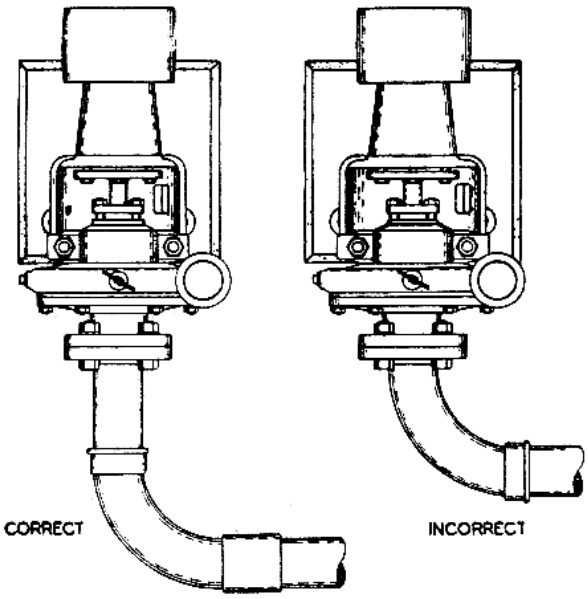
DO—Install Suction Piping to connect to pump without strain.

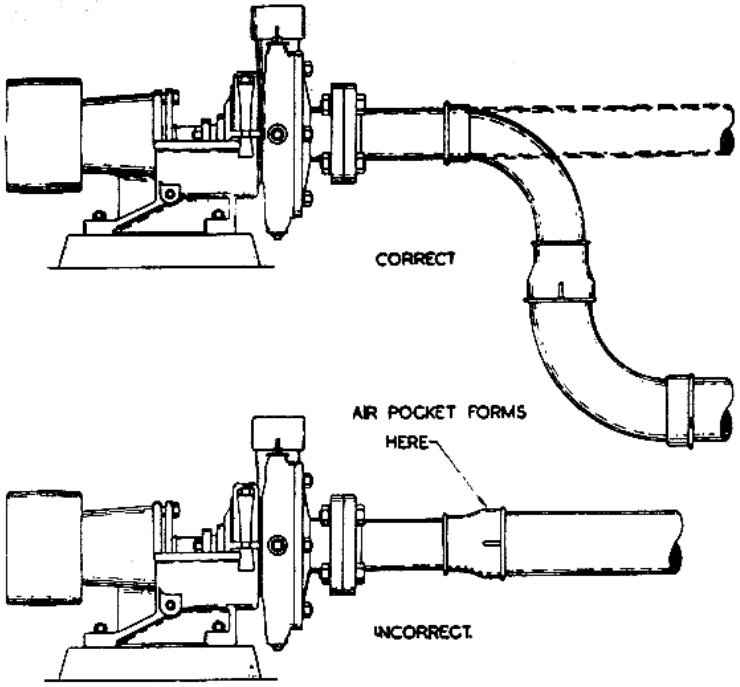
DON'T—Use sharp angle bends or elbows.

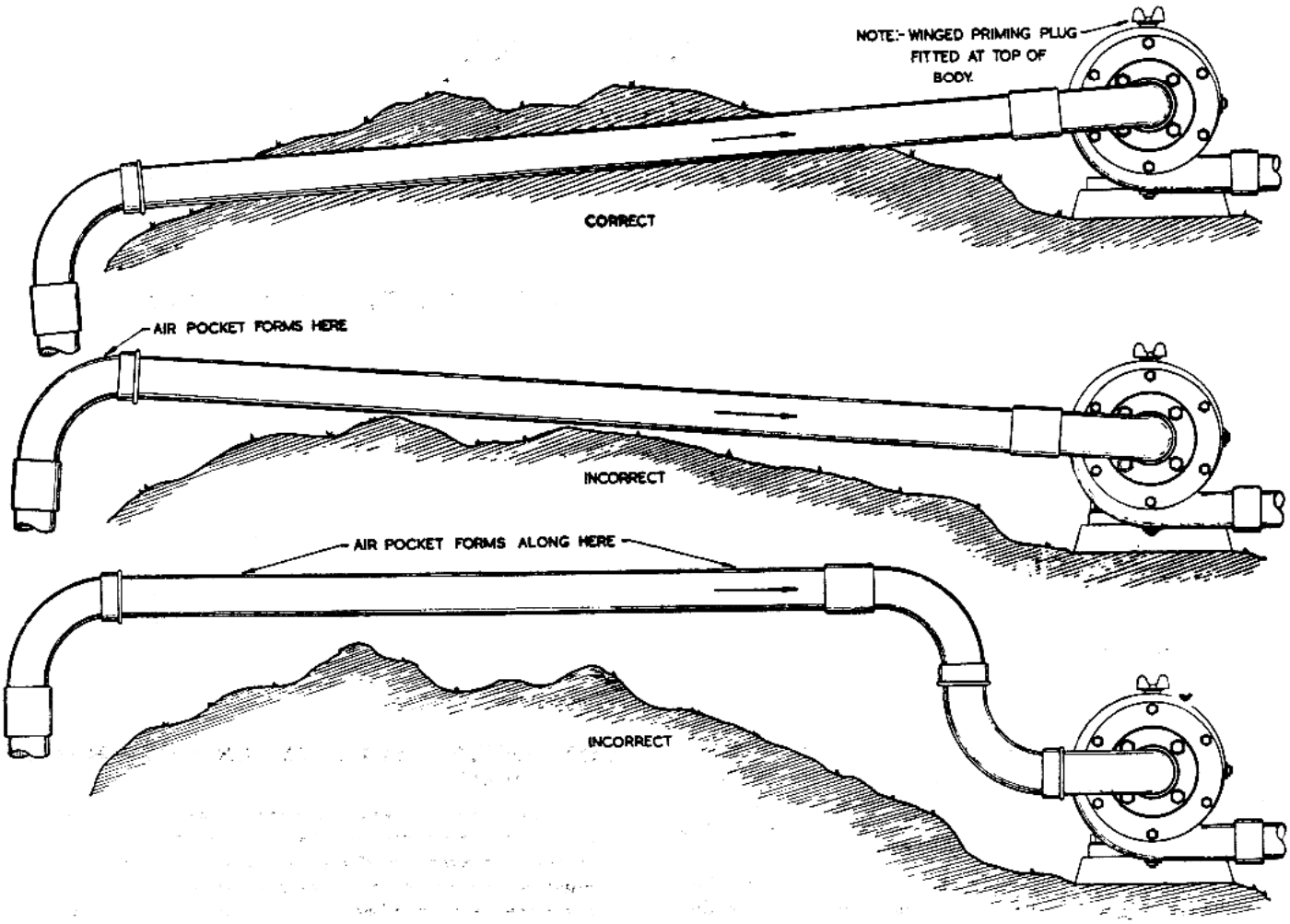
DON'T—Try to operate pump with a suction lift of more than 18 feet (including friction).

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.


CORRECT
INCORRECT


CORRECT
AIR POCKET FORMS HERE
INCORRECT


NOTE:- WINGED PRIMING PLUG FITTED AT TOP OF BODY.
CORRECT
AIR POCKET FORMS HERE
INCORRECT
AIR POCKET FORMS ALONG HERE
INCORRECT

SUCTION PIPING — Continued.

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 Page 3 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 diameter 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 should have a continual fall from the pump to the source of supply, when there is a suction lift. The illustrations on Page 3 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 Galvanised Footvalve and Strainer, Mark HC-H, 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.

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

1in. and 1½in. Pumps:

The discharge can be altered to any one of the four positions, according to the location of the Body on the Base.

2in., 2½in., 3in. and 4in. Pumps:

The discharge branch on all pumps can be easily swivelled to any desired position if the clamps holding the pump body to the base are loosened. After adjusting position of discharge branch, tighten clamps. Also check to see that the shaft still turns freely.

After swivelling the body it may be found that one of the two 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.

GLAND.

1in. and 1¼in. Pumps:

The 1in. and 1¼in. Pumps are fitted with a self-adjusting mechanical seal and this seal requires no attention.

2in., 2½in., 3in. and 4in. Pumps:

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 ½in.

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.

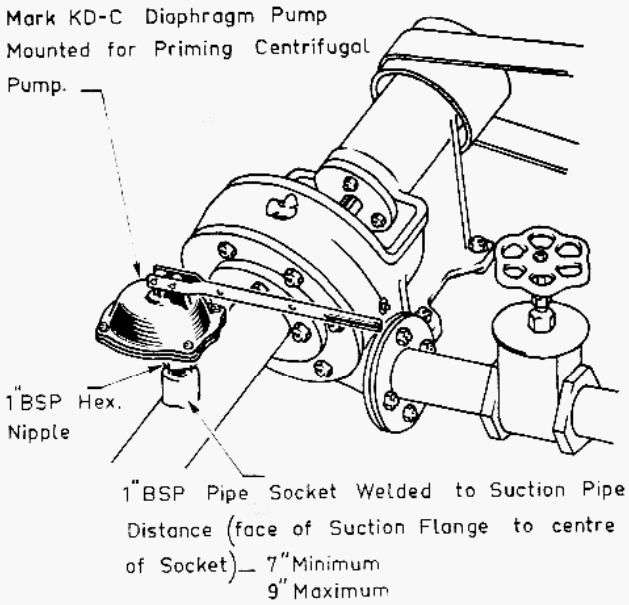
The following methods of priming may be used:—

(a) **Using a Hand Operated Diaphragm Pump** (Refer to Illustration):—
1. Close gate valve on discharge pipe.
2. Operate the diaphragm pump until it discharges water.
3. Start Centrifugal pump.
4. Resume pumping with the diaphragm pump for about another two minutes.
5. Gradually open the discharge gate valve.

(b) 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.

(c) Mount a priming funnel, priming cock and bend from one of the plug holes on the side of the pump body. Open priming cock, remove 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 winged plug, close priming cock, and start pump immediately.

(d) 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.



Diaphragm Pump mounted for priming

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 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.

(e) 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.
6. **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.

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.

LUBRICATION.

The Ball Bearings in the Pumps are packed with grease at the Factory and do not require further lubrication before the Pump is run.

The Bearings should be lubricated with **Southern Cross Grease.** If this grease is not available, any Ball Bearing Grease as recommended by a reputable Oil Company may be used.

For Pumps used on Irrigation Plants: Repack bearings with fresh grease prior to the start of each pumping season.

For other applications: Repack bearings with fresh grease every 6 months.

PUMP OVERHAUL.

When a Pump eventually requires an overhaul, proceed as follows:—

1in. and 1½in. Pumps:

Remove Nuts from Base to Body Studs and lift away the Pump Body. The Base remains in position with the Suction and Discharge Pipes.

1. Unscrew Pulley.
2. Unscrew Impeller Nut.
3. Remove Shaft Bearing Circlip, and drive Shaft and Bearings out.
4. Wash Bearings in petrol (not kerosene), allow to dry, and then inspect. If Bearings are worn or defective, fit new Bearings.
5. Re-pack 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 Bearing.
6. Wipe any old grease or foreign matter out of the Bearing Housing in the Pump Body and reassemble Pump by reversing the dismantling procedure.

2in., 2½in., 3in., 4in. Pumps:

1. Disconnect suction and discharge piping from pump at barrel unions 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. Undo the impeller nut and remove the impeller washer. On 2in. pumps, unscrew the pulley from the pump shaft. On other sizes of pumps, bend back pulley locknut tab washer and undo locknut. Bump pulley off shaft, being careful not to lose the key.
4. **2in. Pump Only:** Remove the impeller from the pump shaft. The plugs in the body can be removed and two screw drivers inserted to lever the impeller off. Be careful not to damage the thread in the plug holes. If the impeller is difficult to remove, hold a piece of brass bar against the impeller end of the shaft and give it several sharp blows with a hammer. **Remove impeller key from shaft.**
   Remove the body clamps, loosen packing gland and slide body from shaft.
   Remove circlip and bearing sealing ring and slide out shaft and bearing.
5. **2½in., 3in., and 4in. Pumps Only:** Remove pump body clamps and bump the body against the back of the impeller to loosen it on the shaft. If necessary, remove plugs from pump body and two screw drivers inserted from opposite sides can be used to free the impeller from the shaft.
   Remove impeller key and then slide pump body off shaft.
   Remove bearing cap and then slide shaft and bearings out of base.
6. Undo the packing gland and remove the gland, packing rings, lantern ring and ring of packing fitted under the lantern ring. Clean the drilled passages through the body with a piece of wire.
7. Reassemble the packing gland leaving it loose. Fit one ring of packing, then the lantern ring, and then the remainder of the packing rings.
   NOTE: It is important to see that the lantern ring and the small by-pass hole coincide.
8. Wash bearings in petrol (not kerosene), allow to dry and then inspect. If bearings are worn or defective, fit new bearings.
9. 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 bearing.
10. Wipe any old grease or foreign matter out of bearing housing in base and then reassemble pump by reversing the dismantling procedure.

PUMP SIZE	GPM		TOTAL HEAD IN FEET											GPM
			20	30	40	50	60	70	80	90	100	110	120	
1" MARK HW-C	10	RPM	1300	1580	1825	2000	2200	2370	2530	2670	2800	2950	3060	10
		BHP	·2	·4	·63	·87	1·1	1·25	1·4	1·63	1·84	2·1	2·2	
	15	RPM	1320	1600	1830	2010	2210	2380	2540	2675	2810	2960	3070	15
		BHP	·2	·45	·7	·9	1·1	1·3	1·5	1·7	1·9	2·15	2·3	
	20	RPM	1350	1625	1850	2030	2220	2400	2550	2680	2825	2970	3080	20
		BHP	·3	·5	·75	1	1·2	1·35	1·6	1·8	2·05	2·25	2·5	
	30	RPM	1500	1730	1930	2100	2280	2450	2600	2740	2860	3000	3100	30
		BHP	·45	·7	·9	1·1	1·3	1·5	1·75	2	2·25	2·5	2·7	
	40	RPM	1700	1880	2160	2230	2400	2550	2680	2800	2950	3050	3150	40
		BHP	·65	·9	1·1	1·3	1·5	1·75	2	2·25	2·5	2·7	2·9	
1 1/2" MARK HW-D	40	RPM	1250	1500	1675	1850	2010	2170	2300	2430	2570	2700	2820	40
		BHP	·57	·8	1·1	1·35	1·6	1·9	2·2	2·7	3·1	3·4	3·7	
	50	RPM	1360	1570	1725	1900	2055	2200	2340	2470	2600	2730	2850	50
		BHP	·75	1	1·3	1·55	1·8	2·1	2·6	3	3·4	3·7	4	
	60	RPM	1475	1650	1810	1975	2110	2255	2390	2510	2650	2775	2875	60
		BHP	·95	1·25	1·5	1·75	2·05	2·5	3	3·3	3·75	4	4·4	
	70	RPM	1610	1775	1930	2060	2190	2325	2440	2570	2700	2800	2905	70
		BHP	1·15	1·45	1·7	2	2·4	2·95	3·3	3·7	4	4·3	4·9	
	80	RPM	1760	1920	2045	2160	2295	2400	2510	2630	2745	2850	2945	80
		BHP	1·4	1·65	1·95	2·35	2·9	3·25	3·6	4	4·4	4·8	5·4	
2" MARK HW-E	80	RPM	1050	1280	1450	1620	1770	1900	2040	2175	2290	2400	2490	80
		BHP	·65	1	1·5	1·9	2·4	2·9	3·5	4·1	4·6	5	5·8	
	100	RPM	1100	1310	1475	1640	1790	1925	2050	2180	2295	2405	2495	100
		BHP	·8	1·25	1·7	2·2	2·75	3·4	4	4·5	5	5·7	6·4	
	125	RPM	1160	1360	1500	1680	1810	1950	2075	2195	2300	2410	2500	125
		BHP	1·05	1·55	2	2·65	3·25	3·95	4·5	5·2	5·75	6·5	7·25	
	150	RPM	1250	1425	1575	1725	1860	1985	2100	2210	2325	2425	2515	150
		BHP	1·4	1·95	2·5	3·1	3·85	4·5	5·25	5·9	6·4	7·25	8	
	175	RPM	1340	1500	1650	1780	1920	2035	2150	2250	2360	2450	2545	175
		BHP	1·75	2·4	3	3·75	4·5	5·25	6	6·75	7·5	8·15	9	
2 1/2" MARK HW-F	175	RPM	1100	1265	1410	1550	1675	1800	1920	2025	2135	2225	2325	175
		BHP	1·5	2·1	2·8	3·7	4·5	5·4	6·5	7·5	8·5	9·6	10·75	
	200	RPM	1160	1310	1450	1575	1700	1825	1940	2050	2150	2245	2340	200
		BHP	1·85	2·5	3·25	4	4·9	6·1	7·1	8·1	9·1	10·2	11·5	
	225	RPM	1230	1375	1500	1625	1740	1865	1975	2075	2175	2270	2365	225
		BHP	2·3	2·9	3·75	4·5	5·6	6·75	7·8	8·8	9·9	11	12	
	250	RPM	1300	1430	1550	1670	1790	1900	2000	2110	2200	2300	2390	250
		BHP	2·75	3·5	4·25	5·1	6·5	7·5	8·3	9·4	10·5	11·75	13	
	275	RPM	1375	1495	1610	1725	1840	1945	2045	2145	2240	2325	2420	275
		BHP	3·25	4	4·9	6·2	7·2	8·1	9	10·2	11·5	12·5	13·75	
3" MARK HW-G	275	RPM	1045	1245	1410	1575	1715	1860	1990	2110	2225	2345	2440	275
		BHP	2·3	3·2	4	5	6·3	7·6	9·1	10·6	11·8	13	14	
	300	RPM	1110	1300	1470	1625	1760	1900	2025	2140	2255	2370	2475	300
		BHP	3	3·9	4·8	6	7·5	8·3	10·9	12·4	14	15·3	16·5	
	325	RPM	1150	1325	1495	1650	1780	1920	2035	2150	2265	2375	2475	325
		BHP	3·25	4·1	5·1	6·5	8	8·75	11·5	13	14·8	16	17·1	
	350	RPM	1210	1360	1510	1670	1800	1930	2050	2165	2280	2385	2490	350
		BHP	3·7	4·4	5·4	6·8	8·3	10	11·7	13·75	15·3	16·75	17·9	
	375	RPM	1250	1400	1550	1690	1825	1950	2075	2180	2295	2400	2500	375
		BHP	3·9	4·75	5·75	7·2	8·8	10·5	12·4	14·4	16	17·6	19	
4" MARK HW-H	375	RPM	1050	1200	1350	1490	1600	1700	1800	1910	2000	2085		375
		BHP	3·8	4·7	5·7	7·25	8·7	10·5	12·1	14·4	15·8	17·4		
	400	RPM	1090	1225	1375	1510	1620	1720	1820	1920	2020	2100		400
		BHP	4·1	5	6	7·5	9·2	11	13	15	16·5	18		
	450	RPM	1160	1300	1440	1555	1660	1760	1850	1950	2040	2130		450
		BHP	4·7	5·9	7·1	8·75	10·5	12·1	14·5	16·3	18	20		
	500	RPM	1250	1370	1500	1610	1710	1800	1910	1990	2075			500
		BHP	5·7	7	8·7	10·1	11·8	13·8	16	17·8	19·8			
	550	RPM	1340	1450	1570	1675	1770	1855	1940	2030	2120			550
		BHP	7·5	9	10·5	11·7	11·3	15·5	17·6	19·7	21·6			

Horsepowers Shown are Minimum Required at Pump Shaft

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. Obstruction in suction or discharge line:—
   (a) Valve closed.
   (b) Suction strainer clogged.
   (c) Suction foot valve stuck in closed position.
9. Suction pipe not in water.

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.

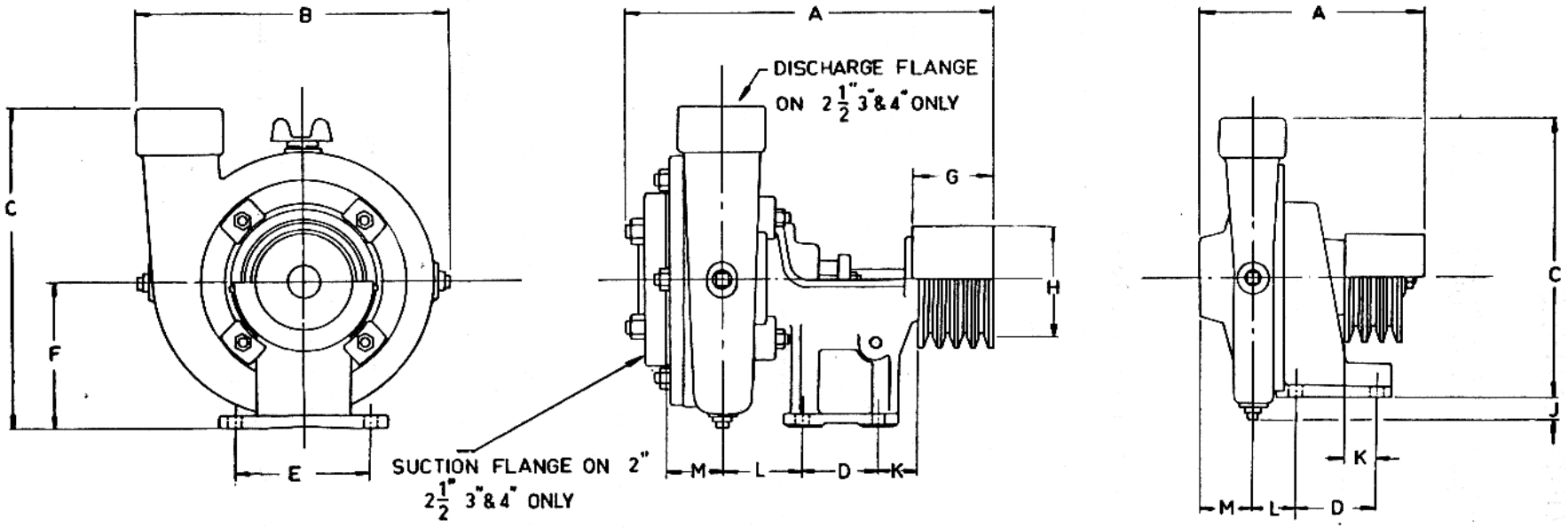
37. Misalignment. When pump or driver becomes hot during operation, check alignment of pump and driving member.
38. Foundation not sufficiently rigid.
39. Impeller partially clogged, causing unbalance.
40. Worn bearings.
41. Casing distorted. (See Nos. 34 and 35).

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.

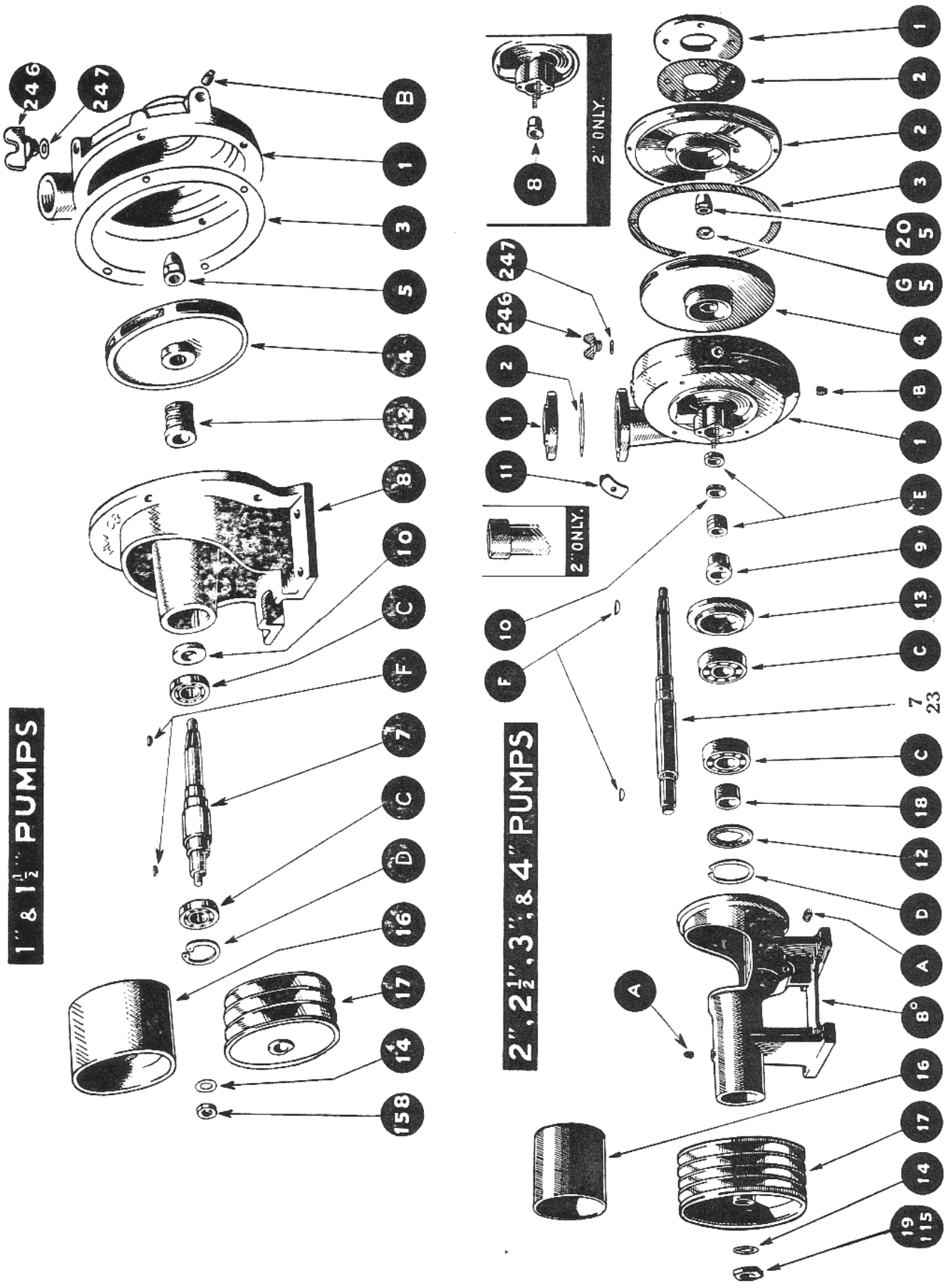
44. Cavitation from air or gases in liquid.
45. Abrasion caused by solid particles.
46. Corrosive action of liquid handled.
47. Unsupported pipes straining pump, causing impeller to bind in body and cover plate.



LINE DIMENSIONS OF "HW" PATTERN CENTRIFUGAL PUMPS.

Size Pump	A	B	C	D	E	F	G	H	J	K	L	M	SUCTION SCREWED	DISCHARGE SCREWED	V — PULLEYS		SHAFT DIA. FOR PULLEY
															SYM. No.	GROOVES	
HW-C 1in.	8 3/8in.	9in.	9 1/2in.	3in.	4 3/8in.	4 1/2in.	3in.	4 1/2in.	1/2in.	1 1/4in.	2in.	2in.	1 1/2in. pipe	1in. pipe	HW-C17	3 — "A" 4 1/2in. P.D.	.751in. .752in.
HW-D 1 1/2in.	8 1/2in.	10 5/8in.	10 1/2in.	3in.	4 3/8in.	4 1/2in.	3in.	4 1/2in.	5/8in.	1 1/4in.	1 3/8in.	2in.	2in. pipe	1 1/2in. pipe	HW-C17	4 — "A" 4 1/2in. P.D.	.751in. .752in.
HW-E 2in.	13 1/4in.	11 5/8in.	12in.	2 7/8in.	5in.	5 1/2in.	3in.	4 1/2in.	1/2in.	1 1/4in.	3in.	2 3/8in.	2 1/2in. pipe	2in. pipe	HX-C17	4 — "A" 5in. P.D.	1/2in. B.S.P.
HW-F 2 1/2in.	20 7/8in.	14 1/4in.	13 1/4in.	6 13/16in.	6 1/2in.	6 1/2in.	4 1/2in.	6in.	5/8in.	1 3/8in.	4 1/2in.	2 5/8in.	3in. pipe	2 1/2in. pipe	HX-E17	4 — "B" 6in. P.D.	.875in. .876in.
HW-G 3in.	21 1/2in.	16 1/8in.	13 3/4in.	6 13/16in.	6 1/2in.	6 1/2in.	4 1/2in.	6in.	1in.	1 1/2in.	4 3/4in.	2 7/8in.	4in. pipe	3in. pipe	HX-E17	4 — "B" 6in. P.D.	.875in. .876in.
HW-H 4in.	24 3/8in.	16 7/8in.	14 5/8in.	7 1/8in.	8 1/2in.	7 1/2in.	6in.	6in.	—	1in.	5 3/8in.	2 7/8in.	4in. pipe	4in. pipe	HY-E17	4 — "C" 10in. P.D.	1.250in. 1.251in.

NOTE: Dimensions are approximate only and are not binding.



Exploded View of Pump Showing Parts and Their Numbers

PARTS LIST

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

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

1in.	1½in.	2in.	2½in.	3in.	4in.	No.	
Mark HW-C	Mark HW-D	Mark HW-E	Mark HW-F	Mark HW-G	Mark HW-H	Off	Name of Part
HW-C 1	HW-D 1	HW-E 1	HW-F 1	HW-G 1	HW-H 1	1	Body.
		GW-F 1	GW-G 1	GW-H 1	GW-H 1	1	Suction Flange.
			GW-F 1	GW-G 1	GW-H 1	1	Discharge Flange.
		GW-F 2	GW-G 2	GW-H 2	GW-H 2	1	Suction Flange Gasket.
			GW-F 2	GW-G 2	GW-H 2	1	Discharge Flange Gasket.
		HW-E 2	HW-F 2	HW-H 2	HW-H 2	1	Cover Plate.
HW-C 3	HW-C 3					1	Body to Base Gasket.
		HW-E 3	HW-F 3	HW-H 3	HW-H 3	1	Cover Plate Gasket.
HW-C 4	HW-D 4	HW-E 4	HW-F 4	HW-G 4	HW-H 4	1	Impeller.
FM-B 5	FM-B 5	FM-B 5	FM-B 5	FM-B 5		1	Impeller Nut.
					HY-E 5B	1	Impeller Washer.
HW-C 7	HW-C 7	HX-C 7C	HX-E 7C	HX-E 7C	HY-E 7B	1	Shaft (Mild Steel).
HW-C 8	HW-C 8	HX-C 8	HX-E 8	HX-E 8	HY-E 8	1	Base.
		FM-B 8				1	Neck Bush.
		HX-C 9	HX-E 9	HX-E 9	HY-E 9	1	Packing Gland.
HW-C 10	HW-C 10					1	Water Slinger.
		FM-B 10	HX-E 10	HX-E 10	FM-D 10	1	Lantern Ring.
		HX-C 11	HY-E 11	HY-E 11	HY-E 11	4	Body Clamp.
HW-C 12	HW-C 12	HX-C 12	HX-E 12	HX-E 12	HY-E 12	1	Bearing Seal.
			HX-E 13	HX-E 13	HY-E 13	1	Bearing Cap.
HW-C 14	HW-C 14		FM-B 14	FM-B 14	FM-D 14	1	Pulley Locknut Lock Washer.
FM-B 15	FM-B 15	FM-B 15	FM-B 15	FM-B 15	FM-B 15	1	Priming Funnel (as ordered).
HW-C 16	HW-C 16	HX-C 16	HX-E 16	HX-E 16	HY-E 16	1	Flat Belt Pulley (as ordered).
HW-C 17	HW-C 17	HX-C 17	HX-E 17	HX-E 17	HY-E 17	1	Vee Belt Pulley (as ordered).
			HX-E 18	HX-E 18	HY-E 18	1	Pulley Spacer.
					ET-B 19	1	Pulley Locknut.
					HY-E 20	1	Impeller Nut.
		HX-C 23	HX-E 23	HX-E 23	HY-E 23	1	Shaft (Stainless Steel).
			AW-D115	AW-D115		1	Pulley Locknut.
PC158	PC158					1	Pulley Locknut.
YC246	YC246	YC246	YC246	YC246	YC246	1	Winged Priming Plug.
YC247	YC247	YC247	YC247	YC247	YC247	1	Winged Priming Plug Washer.
			1¼in. x 5/16in.	1¼in. x 5/16in.	1¼in. x 5/16in.	3	Bearing Cap to Base Stud.
		1⅛in. x ⅜in.	1⅛in. x ⅜in.	1⅛in. x ⅜in.	1⅛in. x ⅜in.	6	Cover Plate to Body Stud.
		1⅞in. x ⅜in.	1⅞in. x ⅜in.	1⅞in. x ⅜in.	2in. x 7/16in.	2	Packing Gland Stud (not illus.).
		2¼in. x ⅜in.	2¼in. x ⅜in.	2¼in. x ⅜in.	2¼in. x ⅜in.	4	Suction Flange to Cover Plate Stud.
1¼in. x 5/16in.	1¼in. x 5/16in.					4	Base to Body Stud.
		1⅛in. x ⅜in.	2⅛in. x ⅜in.	2⅛in. x ⅜in.	2⅛in. x ⅜in.	4	Body Clamp Stud.
6in. x ⅜in.	6in. x ⅜in.	6in. x 7/16in.	7in. x ⅜in.	7in. x ⅜in.	8in. x ⅜in.	4	Foundation Bolt.
			2⅛in. x ⅜in.	2⅛in. x ⅜in.	2⅛in. x ⅜in.	4	Discharge Flange Bolt.
S.K.F. 6205Z (2 off)	S.K.F. 6205Z (2 off)	S.K.F. 6305 (1 off)	S.K.F. 6305 (2 off)	S.K.F. 6305 (2 off)	S.K.F. 6307 (2 off)		C—Shaft Bearing.
52 mm. Bore	52 mm. Bore	62 mm. Bore	62 mm. Bore	62 mm. Bore	80 mm. Bore	1	D—Shaft Bearing Circlip.
		⅛in. x ⅛in. x ⅛in.	⅛in. x ⅛in. x ⅛in.	⅛in. x ⅛in. x ⅛in.		1	G—Impeller Nut Washer (Spring).
B.S. 505	B.S. 505		B.S. 606	B.S. 606	B.S. 808	1	F—Pulley Key.
B.S. 505	B.S. 505	B.S. 505	B.S. 606	B.S. 606	B.S. 1008	1	F—Impeller Key.
⅜in. B.S.P.	⅜in. B.S.P.	⅜in. B.S.P.	⅜in. B.S.P.	⅜in. B.S.P.	⅜in. B.S.P.	3	B—Priming Plug.
		¼in. B.S.P.	¼in. B.S.P.	¼in. B.S.P.	¼in. B.S.P.	2	A—Base Drain Plug.
⅛in. B.S.P.	⅛in. B.S.P.		¼in. B.S.P.	¼in. B.S.P.	¼in. B.S.P.	1	A—Base Lubricator Plug.
⅜in.	⅜in.	⅜in.	⅜in.	⅜in.	⅜in.	1	Priming Cock (M. & F. Gas Main Cock—as ordered).
⅜in.	⅜in.	⅜in.	⅜in.	⅜in.	⅜in.	1	Priming Funnel Connection (M. & F. Bend—as ordered).
		5/16in. Sq.	5/16in. Sq.	5/16in. Sq.	5/16in. Sq.	1	E—Gland Packing (Graphited Packing).