CARVER CENTRIFUGAL self priming PUMPS

NOTE
IF YOUR UNIT CONTAINS PACKING, REFER TO THE PACKING INSERT SHEET, WHICH FOLLOWS THIS COVER PAGE.

OPERATING INSTRUCTIONS AND PARTS LIST FOR:

"KE" CLOSE-COUPLED
AND
"KEF" FRAME MOUNTED PUMPS

Keep this instruction book filed in the field office where it is available to operators responsible for the care and maintenance of this pump.

When writing the factory always GIVE THE MODEL AND SERIAL NUMBER OF YOUR PUMP.

TO USERS OF CARVER PUMPS:

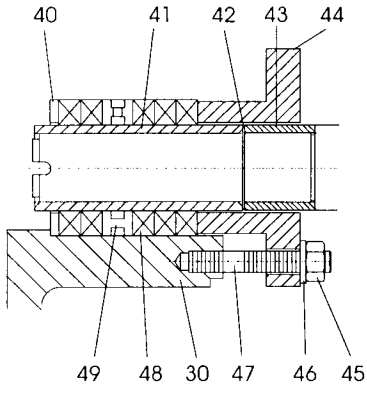
The Carver pump you have received is an efficient pumping unit. It is hydraulically and mechanically correct in design. In its construction only the highest grade materials have been used. When properly installed, it will give you efficient and satisfactory service.

Your pump has been designed for the capacity and head stamped on the nameplate. If the working head is higher, the capacity will be reduced and, if much lower, the capacity will be increased and an overload placed upon the driver.

We, therefore, urge that you observe carefully paragraphs "Size of Pipe" in the following instructions for both suction and discharge piping.

THE CARVER PUMP COMPANY
MUSCATINE, IOWA

Packing Insert Sheet for Self Priming Pump Manual



Legend

30	Volute
40	Throat Bushing
41	Shaft Sleeve
42	O-ring
43	Spacer Sleeve
44	Packing Gland
45	Nut
46	Washer
47	Stud
48	Packing Rings
49	Lantern Ring

View with Packing Assembly

A. Leakage. When first starting the pumping unit, there should be a free leakage at the stuffing box. If there is not a free leakage or if stuffing box begins to smoke, proceed to step 1.

1. Back off nuts (45) until leakage begins.

CAUTION

Do not attempt to shut off all leakage at the stuffing box. There should be a slight leakage at all times. Otherwise, the packing rings (48) will be too tight, causing undue wear of the shaft sleeve (41) and unnecessary consumption of power.

2. After several minutes of operation, gradually apply sufficient pressure on packing rings (48) by tightening nuts (45) so that the leakage is reduced to several drops per minute.
3. When, after a considerable period of operation, the stuffing box leakage cannot be kept to the desired minimum by tightening nuts (45), replace packing rings (48) according to paragraph B of this insert.

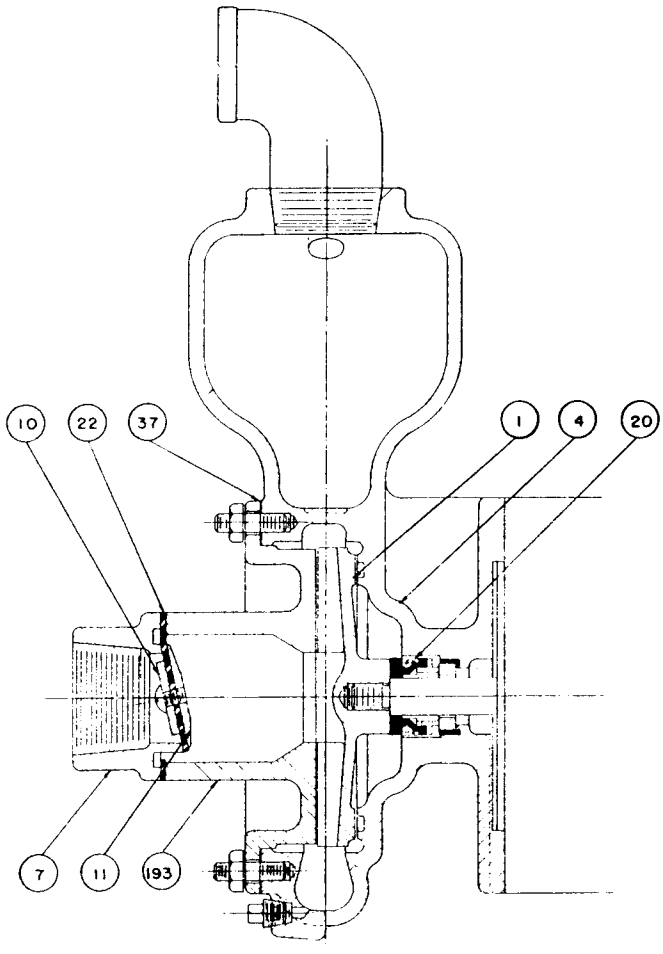
B. Replacement of Packing Rings. To replace packing rings use the following procedure:

1. Shut pumping unit down by partially closing discharge valve.
2. Tag out and lock power to driver according to OSHA Standard 1910.147.
3. Completely close discharge and suction valves.
4. Remove nuts (45) and washers (46) from studs (47). Slide gland (44) out of position.
5. Using a packing hook, remove and discard three packing rings (48).
6. Slide lantern ring (49), if present towards motor end.
7. Using a packing hook, remove and discard additional packing rings (48).

NOTE

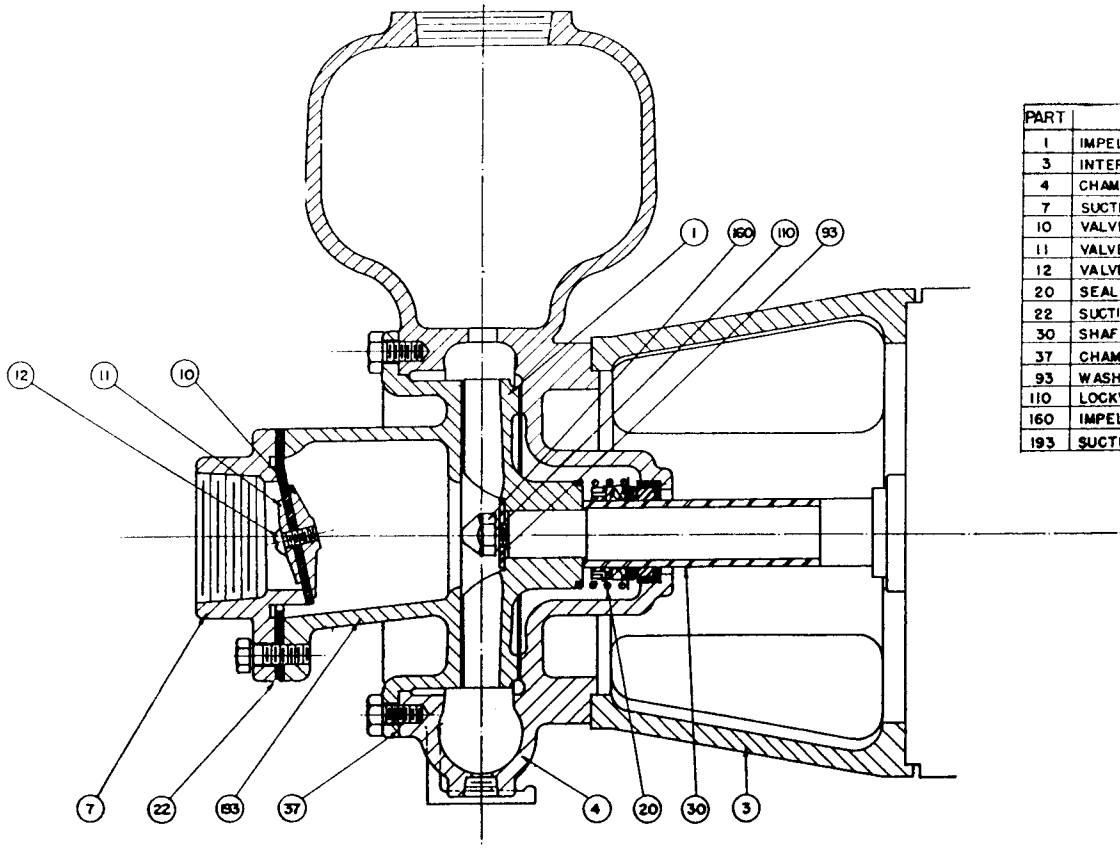
New packing rings (48) are die formed and compressed just enough to slide readily into the stuffing box without being damaged. Pressure with the fingers should be sufficient for pushing new packing rings (48) into place. If pressure from the fingers is not enough, either the packing rings (48) are too large or some obstruction exists.

8. Install two new packing ring (48) using an "S" twist. When inserting new packing rings (48), make sure the joint in each ring (48) is staggered 90 or 180 degrees.
9. Position lantern rings (49) if present, next to packing rings (48).
10. Install three additional new packing rings (48). When inserting new packing rings (48), make sure the joint in each ring (48) is staggered 90 or 180 degrees.
11. Position gland (44) on studs (47). Install washers (46) and nuts (45).
12. Remove all tags from valves and switches. Open system valves. Reconnect power supply to motor.
13. Fully open the suction valve.
14. Check pump for proper priming and lubrication.
13. Start the pump.
14. Slowly open discharge valve and adjust it to the operating conditions required (see pump nameplate for design point condition).
15. Adjust leakage rate at stuffing box according to paragraph A of this insert.



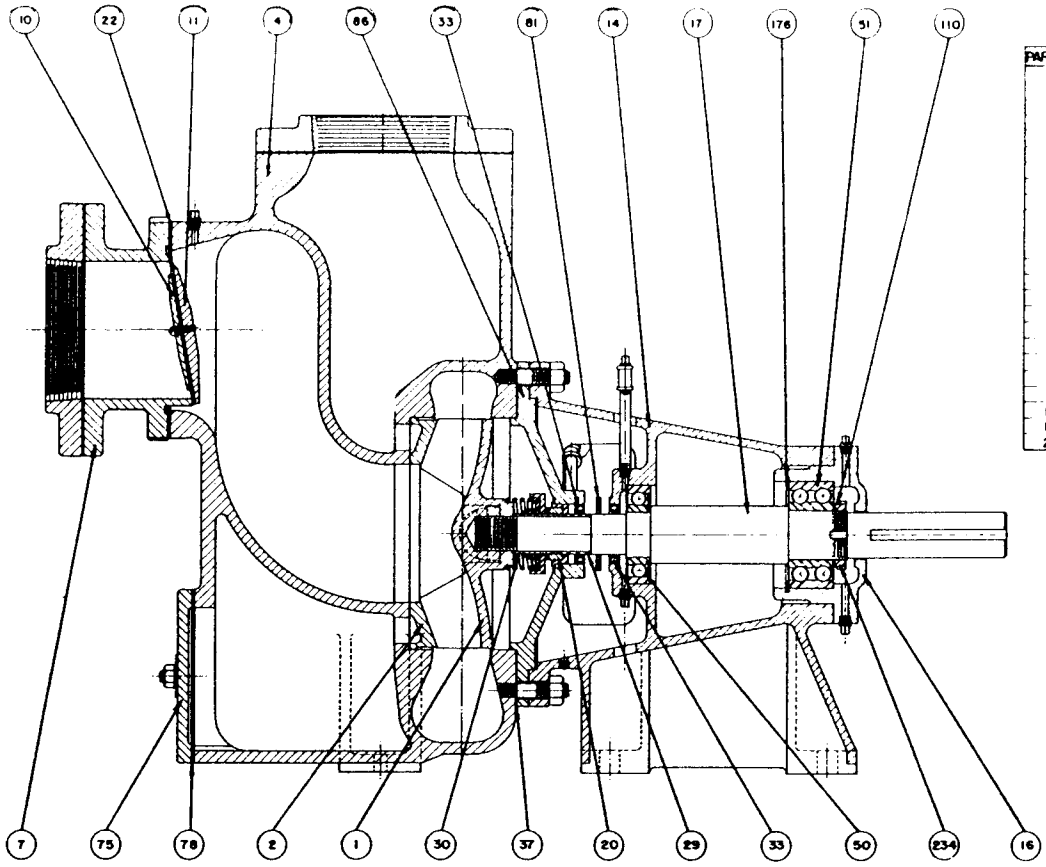
PART NO.	DESCRIPTION
1	IMPELLER
4	CHAMBER
7	SUCTION FLANGE
10	CHECK WEIGHT OUTER
11	CHECK WEIGHT INNER
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
37	CHAMBER GASKET
193	SUCTION HEAD

MODEL: KE100 - KE150



PART	DESCRIPTION
1	IMPELLER
3	INTERMEDIATE
4	CHAMBER
7	SUCTION FLANGE
10	VALVE WEIGHT INNER
11	VALVE WEIGHT OUTER
12	VALVE WEIGHT SCREW
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
30	SHAFT SLEEVE
37	CHAMBER GASKET
93	WASHER
110	LOCKWASHER
160	IMPELLER SCREW
193	SUCTION HEAD

MODELS: KE200 - KE201 - KE300 - KE301 - KE302 - KE303 - KE400 - KE401



PART NO.	DESCRIPTION
1	IMPELLER
2	LINER
4	CHAMBER
7	SUCTION FLANGE
10	VALVE WEIGHT OUTER
11	VALVE WEIGHT INNER
141	BEARING BRACKET
16	BEARING COVER
17	SHAFT
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
29	SHAFT SLEEVE, SHORT
30	SHAFT SLEEVE, LONG
33	GREASE SEAL
37	CHAMBER GASKET
50	BEARING, RADIAL
51	BEARING, THRUST
75	HAND HOLE COVER
78	HAND HOLE COVER GASKET
81	SLINGER
86	BACKHEAD
110	BEARING LOCK WASHER
176	BEARING RETAINER RING
234	BEARING LOCK NUT

(See Disassembled Illustration at Rear of Book)

MODELS: KF6M - KF6H - KF8L - KF10L

INSTALLATION

The suction lift should be kept as low as possible and the suction line as short as possible. Reduction in the capacity of self-priming pumps becomes noticeable at lifts in excess of 15 feet and is very pronounced at 25 feet.

FOUNDATION

("KF"-"KEF" PUMPS ONLY)

Contrary to general opinion, it is commerically impractical to furnish pumps with bedplaces which, when placed upon an uneven foundation, will not spring, causing misalignment. Misalignment is the cause of many failures and more trouble than all other causes combined. No pump will operate satisfactorily over a long period of time if not properly aligned.

It is desirable that the foundation be from 3" to 6" greater in width and length than the bedplate. The foundation, with its bolts in pipe sleeves, should be of a depth necessary to carry the weight of pump without deflection or vibration and should be brought up to within ½" below the bottom of bedplate.

The top surface should be clean . . . but rough in order to insure proper bond with grout. Grouting should not be done until after pipe connections have been made and alignment has been established.

ALIGNMENT

("KF"-"KEF" PUMPS ONLY)

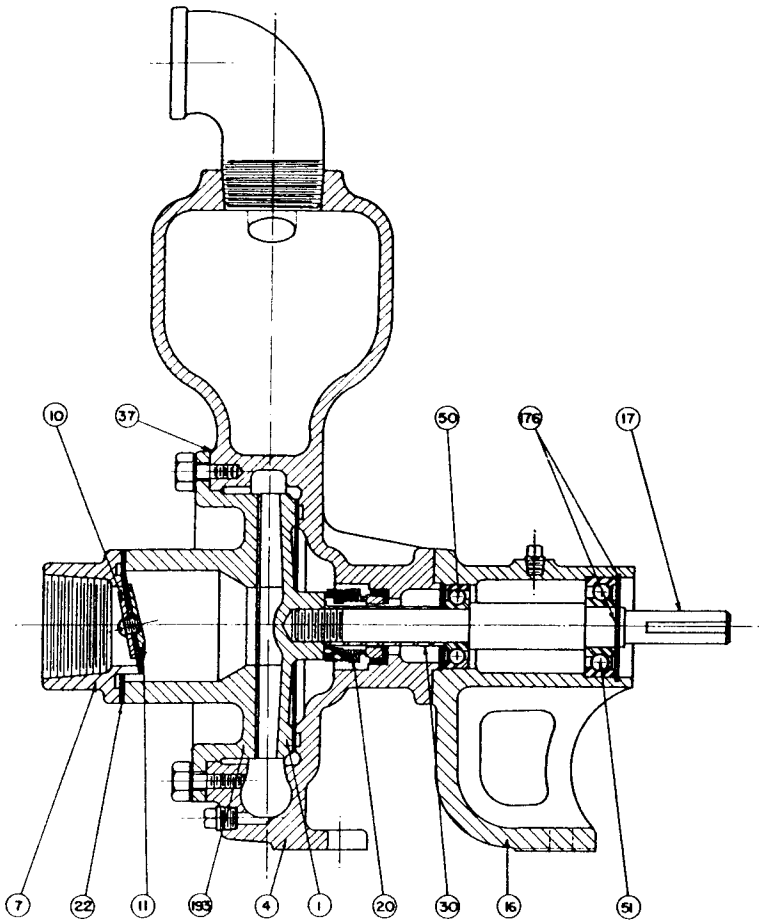
Place the pump upon foundation with bolts in their respective holes. Insert wedges under bedplate nearest foundation bolts.

Check against misalignment by placing a straight edge on the coupling faces at four points . . . 90° apart . . . both sides, top and bottom.

If concentric misalignment (see fig. 1) is found, it is the result of one of the four corners of the bedplate being too high. Withdraw slightly the wedge under the bedplate nearest the "high corner." It is possible also that the motor may have shifted over the hold-down bolt, as a result of shipment or handling. In this case, loosen the hold-down bolts, and move the motor slightly in the required direction . . . necessary to bring its shaft with coupling into perfect alignment with the pump half of coupling.

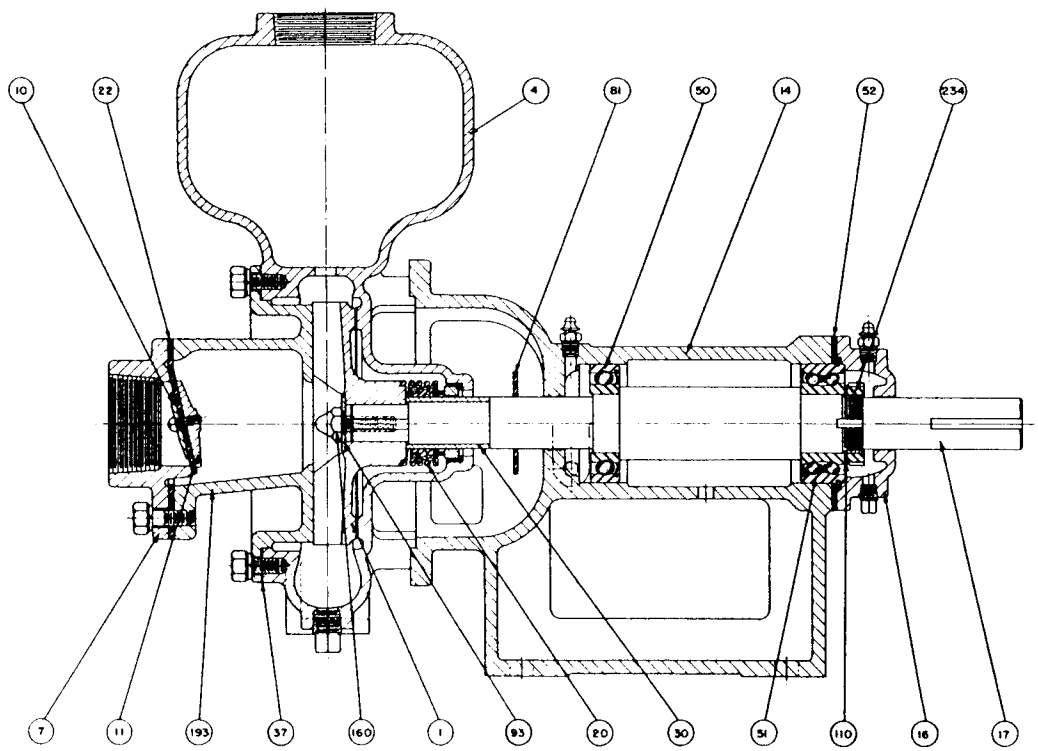
In angular misalignment (refer to fig. 2) is found, it is the result of bedplate not being in a true plane — one or the other end of bedplate being too high, or even too low. This can be corrected by proper adjustment or manipulation of wedges, or with the use of an additional wedge at the proper place. Refer to fig. 5.

Perfect alignment exists only when the coupling faces are parallel and concentric. See figs. 3 and 4.



PART NO.	DESCRIPTION
1	IMPELLER
4	CHAMBER
7	SUCTION FLANGE
10	VALVE WEIGHT OUTER
11	VALVE WEIGHT INNER
16	BEARING BRACKET
17	SHAFT
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
30	SHAFT SLEEVE
37	CHAMBER GASKET
50	BEARING RADIAL
51	BEARING THRUST
176	BEARING RETAINING RING
193	SUCTION HEAD

MODELS: KF150 - KF202



PART NO.	DESCRIPTION
1	IMPELLER
4	CHAMBER
7	SUCTION FLANGE
10	VALVE WEIGHT OUTER
11	VALVE WEIGHT INNER
14	BEARING BRACKET
16	BEARING COVER
17	SHAFT
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
30	SHAFT SLEEVE
37	CHAMBER GASKET
52	SHIM
50	BEARING, RADIAL
51	BEARING, THRUST
81	SLINGER
93	IMPELLER WASHER
110	BEARING LOCKWASHER
160	IMPELLER SCREW
193	SUCTION HEAD
234	BEARING LOCKNUT

(See Disassembled Illustration at Rear of Book)

MODELS: KF200 - KF201 - KF300 - KF301 - KF302 - KF303 - KF400 - KF401

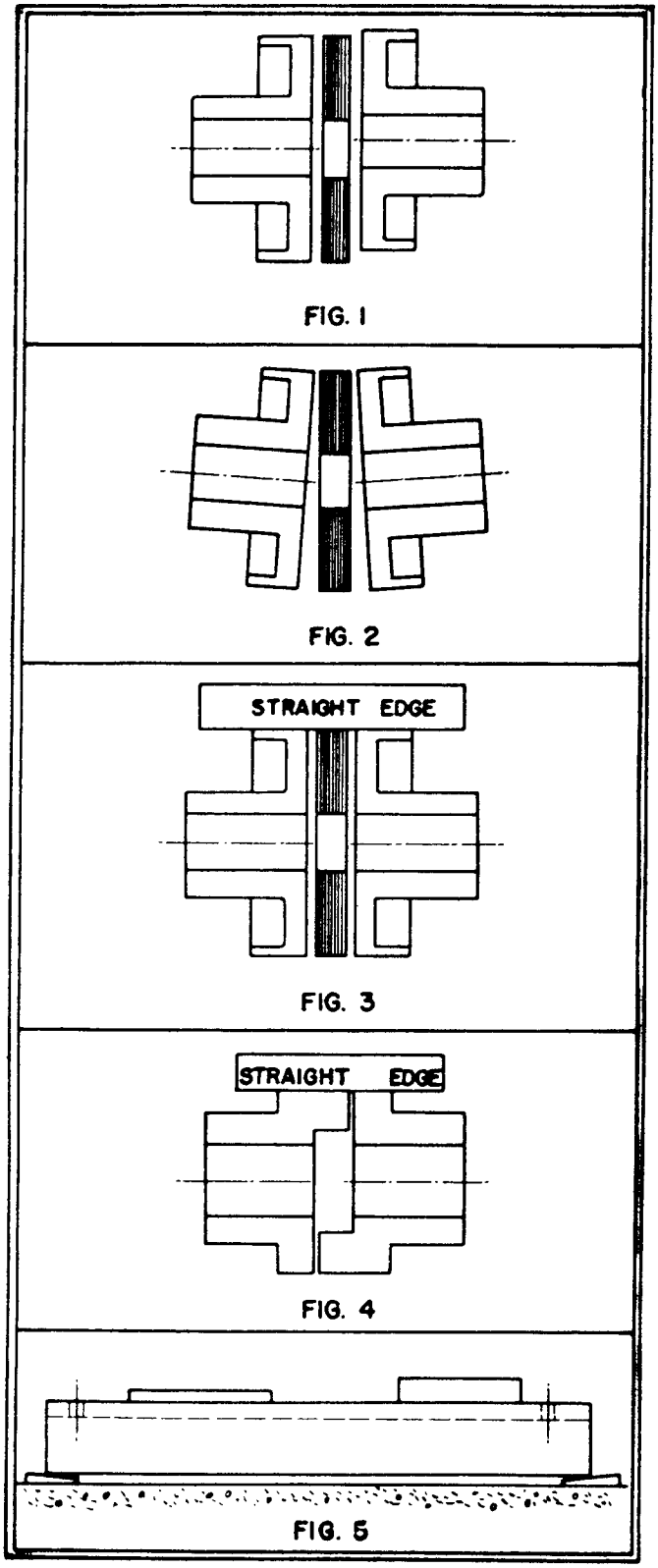


FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

Draw down slightly on foundation bolt nuts. Provide a form or dam around the contour of bedplate. Pour grout through bedplate, in sufficient quantity to reach a level of from ¾" to 1" above the bottom of bedplate. Allow grouting to set before drawing down on foundation bolts.

SUCTION LINE

SIZE OF LINE. The required size depends upon *three factors:* (a) Capacity required; (b) The length of suction line plus the fittings therein when reduced to the equivalent of straight pipe; (c) The actual or static suction lift.

Refer to friction table on back page for frictional loss in pipe and fittings; and select a size of pipe having a sufficient low frictional loss, which, when added to the static head or difference in elevation between pump and source of water supply will not exceed 25 feet.

AIR POCKETS. The highest point in the suction line should be at the pump, and the line should be laid on a *gradual decline* — not even on a level. Avoid high points which will form air pockets. If the pump is operated at a high suction lift you should use extra precaution to see that the hose connections and pipe joints on the suction line are air tight. Even a small air leak in the suction line may cause the pump to fail to prime.

PIPING. Unless the piping is well supported, install a section of hose as close as possible to the pump.

HOSE AND CONNECTIONS. Do not use a suction hose that will collapse. We recommend the use of a wire inserted rubber hose.

In case the pump is operated near the edge of a steep decline, it is advisable to install a 45 or 90 degree elbow on the suction line to prevent a sharp bend in the suction hose. Breaks or air leaks often develop at the point of a sharp bend.

When it is necessary to frequently remove the suction and discharge hose it is advisable to install unions to prevent the pump connections from becoming unduly worn.

The use of white lead on the suction and discharge connections will insure against leaks and prevent the threads from rusting.

FOOT VALVE AND STRAINER. A foot valve is not necessary for the efficient operation of Carver Pumps, but where circumstances require its use a valve with ample free-opening area should be used.

The operator is cautioned to be certain the strainer is well fastened to the hose as it can be easily loosened by vibration.

DISCHARGE LINE

SIZE OF LINE. Friction loss should be given careful consideration. Refer to the table on page 8. If the water is pumped a long distance, a larger pipe will prevent the pipe friction from becoming excessive.

GATE AND CHECK VALVES. The discharge line may be shut off for a short period of time when water is not needed and the water will simply circulate inside the chamber. Never allow it to continue circulating to the point where it is too hot for you to place your hand on the chamber. If the water gets too hot it will damage the seal.

STARTING THE UNIT

CAUTION:

1—Do not start driver without first filling pump with water.

2—Never operate the pump without a strainer on the suction line.

3—Keep grease in the compression grease cup at all times. (Models KF6M - KF6H - KF8L - KF10L only)

4—Do not prime the pump with water containing ice, stones or solids larger than ¼ inch.

5—Read the instructions for the operation of the power unit.

PRIMING

Unless the chamber is completely filled pump will not prime as quickly as it should. If more than five minutes are required to prime the pump, the operator may be reasonably sure there is something mechanically wrong.

The suction check valve hangs at a vertical angle to prevent dirt from lodging on the seat of the inlet. If the check valve is not seating properly, water will run out of the chamber and down the suction line, thus making it impossible to prime.

OPERATION

FREEZING TEMPERATURE. When operating the unit in a freezing temperature, the use of warm water in the chamber will thaw possible ice films on the impeller and seal and will prevent possible damage.

When not in use, drain the pump because freezing will burst the chamber. The pump is easily drained by removing the drain plug at the bottom of the chamber.

GRITTY WATER. Pumping of excessively sandy water may cause the impeller to become unbalanced thus causing the pump to vibrate. Avoid possible damage to the shaft by having the impeller balanced.

When extremely muddy or sandy water is being pumped the chamber should be drained frequently to prevent sediment from filling up the chamber.

ROTATION

The required rotation is indicated by arrow on pump. If unit is operated by 2 or 3 phase motors, it is of the utmost importance to cautiously turn on power for seconds only to determine if rotation is correct. The pumping unit may be *seriously damaged* if rotation is incorrect. If the motor, when started, operates in the wrong direction, then, for two-phase motors, merely interchange two leads of one phase. Do not change the leads of both phases. For motors of three-phase, interchange any two lead wires and the opposite rotation will result.

LUBRICATION FOR THE MECHANICAL SEAL

Models KF6M, KF6H, KF8L and KF10L are furnished with a mechanical water seal which requires grease lubrication in the grease cup.

Use a good, especially soft, grade of lime base (waterproof) grease equal to Socony Vacuum Gargoyle AA-1 for winter and AA-2 for summer. DO NOT USE COMMON SODA-SOAP GREASE, which is not waterproof and will emulsify in water. ONCE THIS GREASE IS IN THE SEAL IT CANNOT EASILY BE REMOVED. The automatic pressure grease cup will not operate satisfactorily with stiff greases, especially in cold temperatures.

All other models do not require grease lubrication for the mechanical seal — as the liquid being pumped is the lubricator.

TROUBLES AND THEIR CAUSES

FAILURE TO PRIME.

(1) Plugged priming hole.
(2) Air leak in the suction line caused by:
  (a) Defective seal.
  (b) Loose hose connections.
  (c) Pin holes in hose.
  (d) Lining of hose collapsed.

  Note: Test the suction by removing the suction line to see if a strong suction forms at the inlet. If there is a strong suction the trouble is in the suction line. If there is not a strong suction, examine the check valve to see that it is free from obstruction then examine the impeller to see if it is broken.
(3) End of suction line or strainer may be clogged.
(4) Chamber may not have been completely filled.
(5) The impeller may be clogged, worn out or broken.
(6) Lining of hose collapsed.

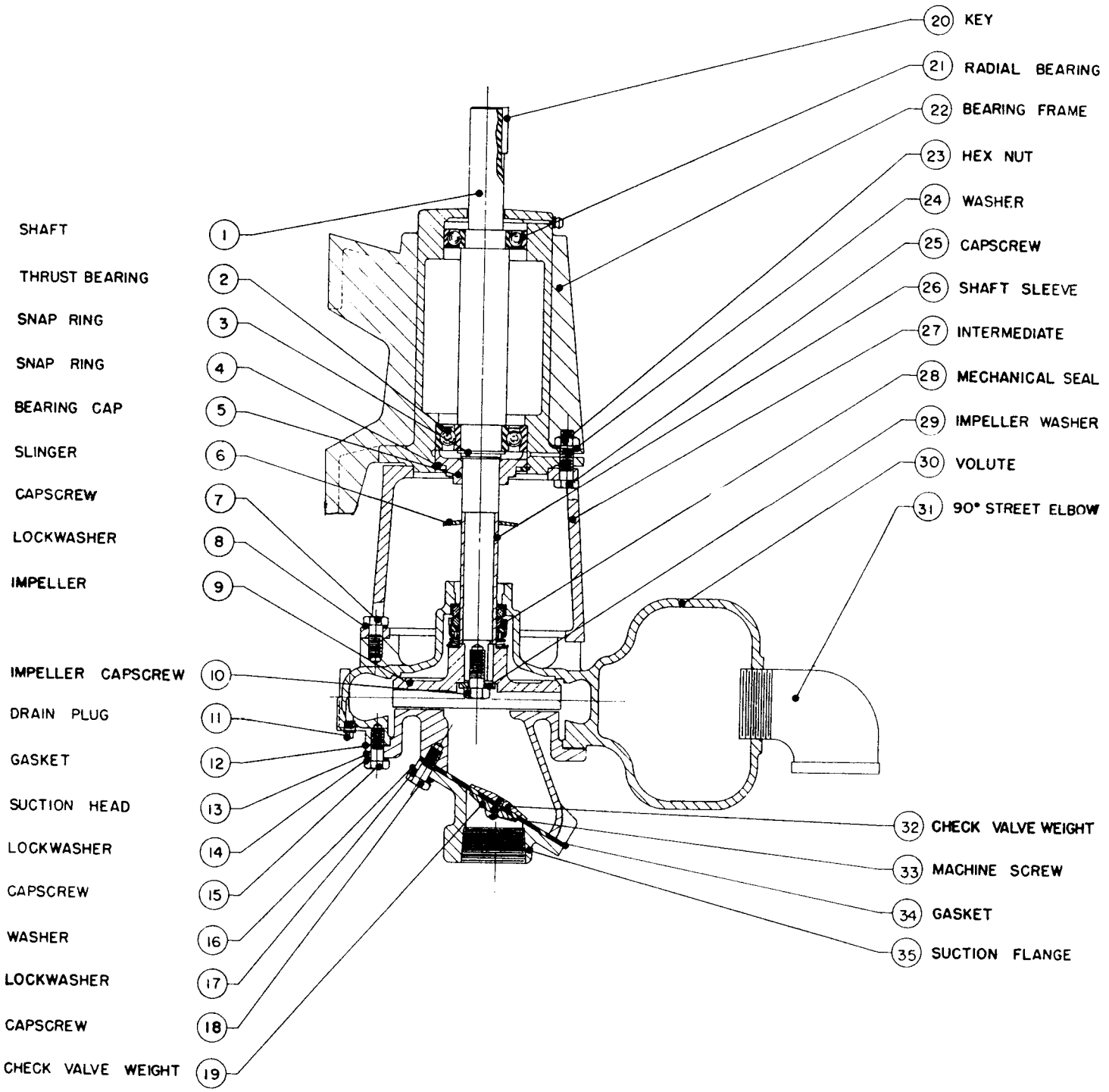
FAILURE TO PUMP.

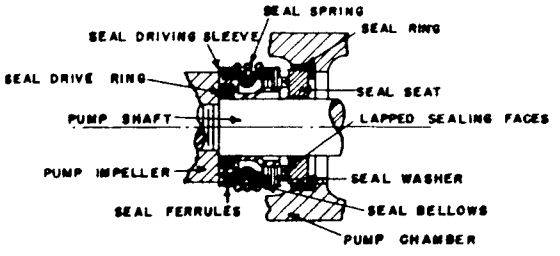
(1) Pump not properly primed.
(2) Speed too low.
(3) Total head too high.
(4) Lining of hose collapsed.

INSUFFICIENT CAPACITY.

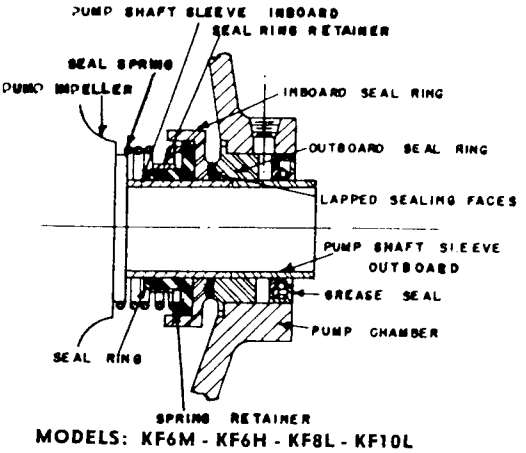
(1) Air leak in suction line or water seal.
(2) Speed too low.
(3) Suction lift too high or total lift more than that for which the pump is intended.

FRAME MOUNTED MODELS EQUIPPED WITH 10P, 20P, OR 30P POWER FRAMES

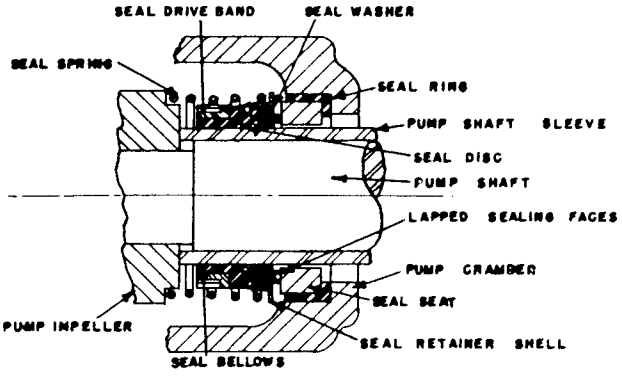




MODELS: KE100 - KE150 - KF150 - KF202



MODELS: KF6M - KF6H - KF8L - KF10L



SEAL ASSEMBLIES

MODELS: KF200 - KF201 - KF300 - KF301 - KF302 - KF303 - KF400 - KF401
KE200 - KE201 - KE300 - KE301 - KE302 - KE303 - KE400 - KE401

(4) Impeller partially clogged.
(5) Lining of hose collapsed.

INSUFFICIENT PRESSURE.

(1) Speed too low.
(2) Air in the water.
(3) Mechanical defects.

BALL BEARINGS

The motor bearings are properly grease-lubricated at time of shipment. The frequency of re-lubrication depends upon operating conditions.

Generally speaking, re-lubrication is required every 1,000 hours of operation, based upon eight hours operation per day. At least twice per year the bearing housings should be cleaned or flushed with carbon tetrachloride, gasoline or kerosene, and re-lubricated. Do not use more grease than necessary to fill the bearing housings to one-fourth or one-third full. DO NOT OVER-LUBRICATE. As much damage can be caused by over-lubrication as by lack of lubrication.

If the bearings are removed from the housings for cleaning, use extreme care to see that they are thoroughly dried before being re-installed. Water or moisture is the Nemesis of all ball bearings.

While the brand of grease is unimportant, the following brands — suggested for use under room temperature of from 32°F. to 150°F. — represent those most easily obtainable.

Atlantic Refining Co.'s	P. S. Lubricant
Master Lubricants Co.'s	Lubrico
New York & New Jersey Lubricant Co.'s	A-29
Socony Mobil Oil Co.'s	MOBIL GREASE MP
Standard Oil Co. of Indiana's	Superla 2X
Texas Co.'s	REGAL STARFAK Special Grease
Union Oil Co.'s	Ballroll Medium

TEMPERATURE OF BEARINGS

Under usual conditions, ball bearings will reach a temperature of from 10°F. to 55°F. above the surrounding temperature. Unless the temperature reaches 125°F. or more above room temperature, there is no cause for alarm.

PUMP MAINTENANCE

(Numbers in parenthesis refer to illustrations)

TO REPLACE THE IMPELLER.

1—Remove bolt assembly that fastens the suction head (193) to chamber (4). Remove suction head (193) carefully breaking joint at chamber gasket (37).

On models KF6M, KF6H, KF8L and KF10L remove bolt assembly that fastens bearing bracket (14) to chamber (4) and remove chamber (4) after chamber (4) leg bolts are removed.

2—On models that have impeller screw (160) remove this screw and washer (93). Impeller may now be pulled from motor shaft or pump shaft (17) as it is keyed to this shaft.

2A—On models that have threaded impellers (1) the thread is right hand. To loosen the impeller, place a block of wood on the edge of one of the impeller (1) vanes and tap with a hammer until it is loose. Unscrew by hand.

3—Use the reverse procedure for assembly of the impeller (1).

4—Care must be exercised to insure the mechanical seal is installed as shown in seal assembly sketches.

5—It is of utmost importance to obtain the correct thickness of chamber gasket (37) which spaces the impeller (1) vanes relative to the suction head (193) or liner (2). The correct spacing is .005" to .010".

6—Units KF200, KF201, KF300, KF301, KF302, KF303, KF400, KF401 are equipped with shims (52) for adjusting the impeller (1) vanes relative to the suction head (193). As impeller vanes (1) are worn, remove shims (52) to adjust for this wear, so as to maintain the correct spacing with the suction head (193).

TO REPLACE THE SUCTION HEAD: (All models except KF6M, KF6H, KF8L and KF10L).

1—Remove suction flange (7) and check valve (22) as outlined in the following paragraphs "To Replace The Suction Check Valve."

2—Remove suction head (193) from chamber (4) carefully breaking joint at chamber gasket (37).

3—Reverse procedure for assembly, installing the check valve (22) and suction flange (7) in accordance with paragraphs "To Replace The Suction Check Valve."

TO REPLACE THE LINER: (Models KF6M, KF6H, KF8L and KF10L only).

1—Remove chamber (4) and hand hole cover (75) and reach through the opening to liner nuts located on either side of the suction tube in the chamber.

2—The liner should slip out by hand. If rusted tight, tap loose with a hammer.

3—Use the reversed procedure for the assembly.

TO REPLACE THE SUCTION CHECK VALVE:

1—Remove bolts that fasten the suction flange (7) to the suction head (193). Also remove check valve rubber (22) and weights (10-11).

2—Take off check valve weights (10-11) by removing cap screw (12).

3—Assemble the weights (10-11) with the flat edge next to the hinged part of the check valve rubber (22).

4—Replace the check valve rubber (22) with hinge on top and reassemble unit.

TO REPLACE THE MECHANICAL SEAL AND SHAFT SLEEVES:

1—Disassemble unit as per "To Replace Impeller."

2—Remove seal assembly (20) and clean the seal housing and coat the seal housing with white lead. Replace shaft sleeves (30) if necessary.

3—Utmost care must be exercised in the reassembly. Caution: Read instruction sheet with seal before attempting the installation. The new mechanical seal may then be installed in the seal housing as shown in the seal sketches. Install shaft sleeves (30) as per these sketches.

TO REPLACE PUMP BEARINGS:

("KF" Models only)

1—Remove pump end from bearing bracket (14) and remove cap screws that fasten the bearing cover (16) to the bearing bracket (14). On models KF150 and KF202 bearing retainer ring (176) must be removed in place of the bearing cover (16). The entire pump shaft (17) may now be removed with the bearing (50-51) assembled to it from the coupling (pulley) end.

2—Remove bearing locknut (183) and bearing lockwasher (182) from pump shaft (17). On models KF150 and KF202 remove bearing retainer ring (176-1). The bearing (50-51) may now be pressed off the pump shaft (17).

3—Clean shaft (17) and bearing bracket (14) of all dirt and assemble new bearings (50-51) to the shaft (17) as shown in illustrations.

4—Reverse the above procedure for reassembly, following the paragraphs under "To Replace The Impeller" and "To Replace The Mechanical Seal."

ELECTRIC MOTORS COMMUTATOR AND BRUSH CARE

With single-phase and D.C. motors, make certain that the brushes are free to move within the brush-holders and that proper contact is maintained between the brushes and commutator surface.

The commutator surface should maintain a polished condition. If the commutator surface blackens at irregular intervals the indications are that the commutator has become rough or eccentric. DO NOT USE LUBRICANT ON THE COMMUTATOR OR BRUSHES.

Under normal operating conditions the commutator will not require much attention other than to be occasionally wiped off with a piece of dry canvas, or other non-linting material. Should commutator blackening appear and consistently become worse, the cause should be determined and corrected. This condition usually results from overloads causing a current to flow at all times through the brushes of single-phase motors, which ordinarily do not carry a current after the motor has

come up to speed; and in the case of direct current motors, blackening of the comutator is also usually due to excess current resulting from overload.

When considered necessary to do so, single-phase and direct current motor commutators may be smoothed with OO sandpaper, while the motor is running. DO NOT USE EMERY CLOTH ON THE COMMUTATOR.

GENERAL MAINTENANCE

Dirt or grease should not be permitted to accumulate on the windings. Any dirt or dust accumulation should be removed at regular intervals. Clean, dry air under a pressure not in excess of 20 lbs. is recommended for cleaning windings.

TROUBLES

If mechanical, make certain that all bolts and nuts are properly tightened and that bearings are in good condition so that shaft turns freely.

If electrical, (1) check all protective devices and all electrical connections; (2) take voltage reading on all phases; (3) have load reading taken as a check against the possibility of overload.

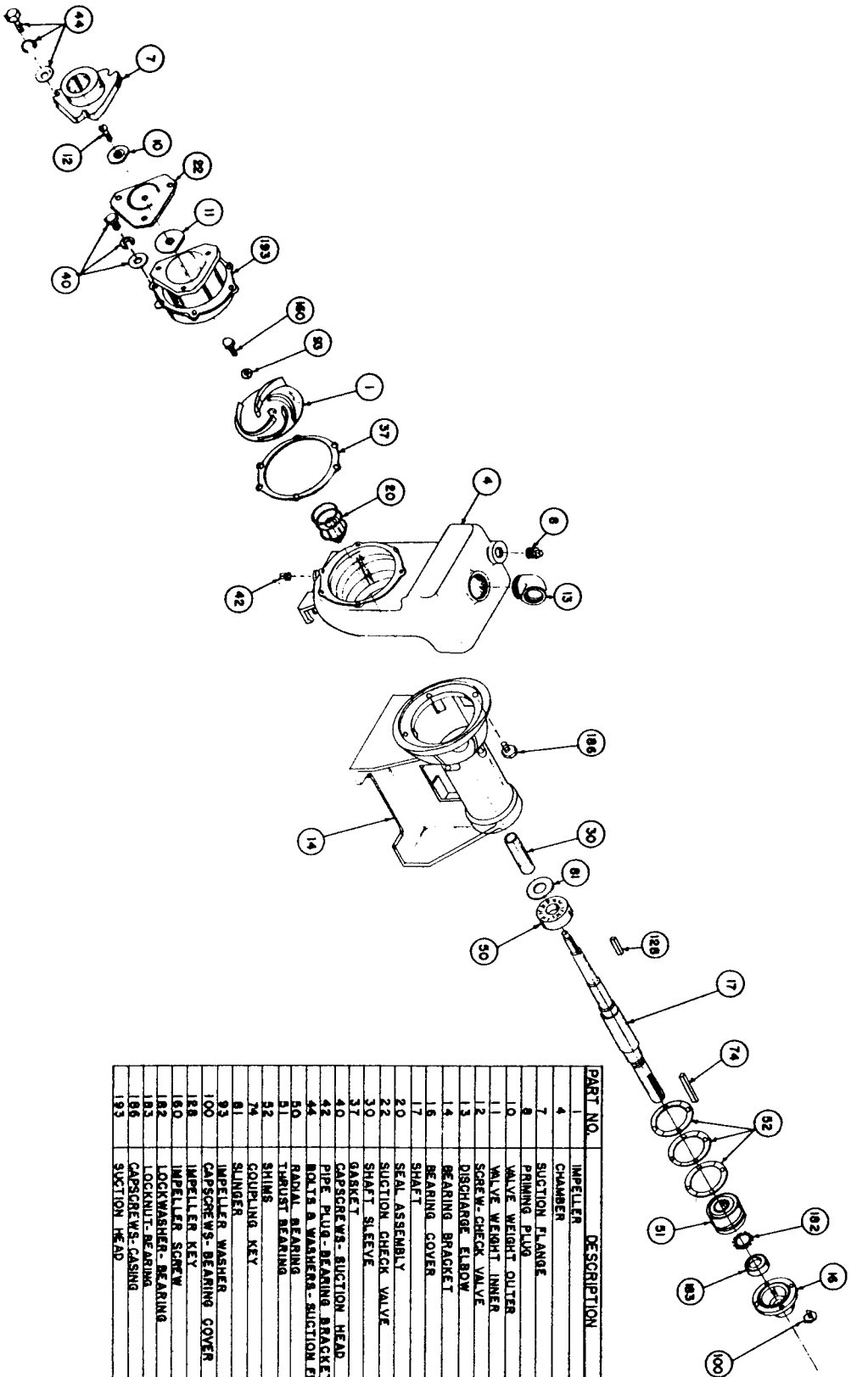
Before making connections, check the nameplate data against the characteristics of current to be used. In case of any doubt as to the characteristics of power available, consult the local power company.

SIZE OF WIRE AND FUSES

The following sizes of wire and fuses are recommended for motors of standard electrical characteristics:

B & S GAUGE — RUBBER COVERED WIRE

Horsepower Motor	Type RA Single Phase		Type PA 2 or 3 Phase		Type DM Direct Current	
	Volts		Volts		Volts	
	115	230	220	440	115	230
1/4—1/3	14	14	14	14	14	14
1/2	14	14	14	14	14	14
3/4	14	14	14	14	14	14
1	12	14	14	14	14	14
1 1/2	10	14	14	14	12	14
2	8	12	14	14	12	14
3	6	10	14	14	8	14
5	4	8	12	14	6	10
7 1/2	—	—	10	14	4	8
10	—	—	8	12	1	6
15	—	—	6	10	—	—
20	—	—	4	8	—	—
25	—	—	3	6	—	—
30	—	—	1	6	—	—
40	—	—	0	4	—	—
50	—	—	000	3	—	—
FUSE SIZES for 1725 RPM — AC — 60 CYCLE & D.C.						
1/4	6	3	3	3	3	3
1/3	10	6	3	3	6	3
1/2	10	6	3	3	6	3
3/4	15	10	3	3	10	6
1	20	10	6	3	10	6
1 1/2	25	15	10	6	15	10
2	35	20	10	6	20	10
3	40	20	10	6	30	15
5	70	35	20	10	50	25
FUSE SIZES for 3450 RPM — AC — 60 CYCLE & D.C.						
1/4	6	3	3	3	3	3
1/3	6	3	3	3	6	3
1/2	10	6	3	3	6	3
3/4	10	6	3	3	10	6
1	15	6	3	3	10	6
1 1/2	20	10	6	3	15	10
2	25	15	6	3	20	10
3	40	20	10	6	30	15
5	50	25	15	10	40	20
7 1/2	70	35	—	—	60	30
10	—	—	—	—	80	40



PART NO.	DESCRIPTION
1	IMPELLER
4	CHAMBER
7	SUCTION FLANGE
8	PRIMING PLUG
10	VALVE WEIGHT OUTER
11	VALVE WEIGHT INNER
12	SCREW-CHECK VALVE
13	DISCHARGE ELBOW
14	BEARING BRACKET
16	BEARING COVER
17	SHAFT
20	SEAL ASSEMBLY
22	SUCTION CHECK VALVE
30	SHAFT SLEEVE
37	GASKET
40	CAPSCREWS- SUCTION HEAD
42	PIPE PLUG- BEARING BRACKET
44	BOLTS & WASHERS- SUCTION FLANGE
50	RADIAL BEARING
51	THRUST BEARING
52	SHIMS
74	COUPLING KEY
81	SLINGER
93	IMPELLER WASHER
100	CAPSCREWS- BEARING COVER
128	IMPELLER KEY
160	IMPELLER SCREW
182	LOCKWASHER- BEARING
183	LOCKNUT- BEARING
186	CAPSCREWS- CASING
193	SUCTION HEAD

FRICTION TABLE

FRICTION OF WATER IN PIPES

Loss of Head in Feet Due to Friction, per 100 Feet of 15-Year-Old Smooth Iron Pipe

G.P.M.	1 Inch	1¼ Inch	1½ Inch	2 Inch	2½ Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch	10 Inch	12 Inch	G.P.M.
5	3.25	0.84	0.40										5
10	11.7	3.05	1.43	0.50	0.17	0.07							10
15	25.0	6.50	3.0	1.08	0.36	0.15							15
20	42.0	11.1	5.2	1.82	0.61	0.25							20
25	64.0	16.6	7.8	2.73	0.92	0.38							25
30	89.0	23.5	11.0	3.84	1.29	0.54							30
35	119.0	31.2	14.7	5.1	1.72	0.71							35
40	152.0	40.0	18.8	6.6	2.20	0.91	0.22						40
45		50	23.2	8.2	2.80	1.15	0.28						45
50		60	28.4	9.9	3.32	1.38	0.34						50
70		113	53.0	18.4	6.21	2.57	0.63	0.21					70
75			60.0	20.9	7.1	3.05	0.73	0.24					75
100			102	35.8	12.0	4.96	1.22	0.41	0.14				100
120			143	50.0	16.8	7.0	1.71	0.58	0.25				120
125				54	18.2	7.6	1.86	0.64	0.28				125
150				76	25.5	10.5	2.55	0.88	0.32				150
175				102	33.8	14.0	3.44	1.18	0.48				175
200				129	43.1	17.8	4.40	1.48	0.62				200
225					54.3	22.3	5.45	1.86	0.74				225
250					66	27.2	6.72	2.24	0.92	0.22			250
270						31.3	7.70	2.60	1.13	0.25			270
275						32.5	7.99	2.72	1.15	0.27			275
300						38.0	9.30	3.14	1.29	0.32			300
350							12.32	4.19	1.75	0.42			350
400							16.00	5.40	2.21	0.54			400
450							19.80	6.70	2.65	0.68	0.21		450
470							22.40	7.22	2.90	0.75	0.24		470
475							22.96	7.42	2.95	0.76	0.25		475
500							24.00	8.12	3.30	0.82	0.28	0.11	500
550								9.60	3.93	0.97	0.33	0.14	550
600								11.30	4.70	1.14	0.39	0.15	600
650								13.20	5.40	1.34	0.46	0.19	650
700								15.10	6.20	1.54	0.52	0.22	700
750								17.20	7.00	1.74	0.59	0.24	750
800									8.00	1.97	0.67	0.27	800
850									8.95	2.28	0.75	0.31	850
900									10.11	2.46	0.83	0.34	900
950									10.80	2.87	0.91	0.38	950
1000									12.04	3.02	1.01	0.41	1000
1050									13.30	3.21	1.00	0.44	1050
1100									14.31	3.51	1.20	0.49	1100
1150									15.60	3.84	1.34	0.53	1150
1200									16.69	4.15	1.46	0.57	1200
1250									18.50	4.45	1.51	0.62	1250
1500										6.27	2.09	0.85	1500
2000										10.71	3.65	1.43	2000
2500											5.33	2.28	2500
3000											7.80	3.15	3000
3500											10.08	4.10	3500
4000												5.32	4000
4200												6.00	4200
4500												6.90	4500
5000												8.40	5000

Velocity of water—in feet per second—through any given size pipe equals gallons per minute x .404 divided by the square of the diameter of pipe.

FRICTION IN FITTINGS*—Reduced to equivalent feet of straight pipe

	NOMINAL SIZE IN INCHES											
	1 Inch	1¼ Inch	1½ Inch	2 Inch	2½ Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch	10 Inch	12 Inch
90° Elbow	2.8	3.7	4.3	5.5	6.4	8.2	11.0	13.5	16.0	21.0	26.0	32.0
45° Elbow	1.3	1.7	2.0	2.6	3.0	3.8	5.0	6.2	7.5	10.0	13.0	15.0
Tee-Side Outlet	5.6	7.5	9.1	12.0	13.5	17.0	22.0	27.5	33.0	43.5	55.0	66.0
Close Return Bend	6.3	8.4	10.2	13.0	15.0	18.5	24.0	31.0	37.0	49.0	62.0	73.0
Gate Valve	.6	.8	.9	1.2	1.4	1.7	2.3	2.9	3.5	4.5	5.7	6.8
Globe Valve	27.0	37.0	43.0	55.0	66.0	82.0	115.0	135.0	165.0	215.0.	280.0	335.0
Check Valve	10.5	13.2	15.8	21.1	26.4	31.7	42.3	52.8	63.4	81.0	105.0	125.0
Foot Valve	24.0	33.0	38.0	46.0	55.0	64.0	75.0	76.0	76.0	76.0	76.0	76.0

*Loss of head resulting in pipe fittings must be included when calculating frictional loss in a pipe line. The above table furnishes the approximate head losses for various fittings and are based upon the most accurate information available. Exact losses cannot be determined owing to variation in constructional details.

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