YORK®

CENTRIFUGAL COMPRESSORS
YDTL/LTL 108, 120, 126, 131 & 144

SERVICE INSTRUCTION | Supersedes: 160.48-M1 (992) | 493 | FORM 160.48-M1

USED WITH YORK MODELS
YTG1G1E1 THRU YTL6M6F2
CodePak CENTRIFUGAL LIQUID CHILLERS (Style F)

COMPRESSOR MODEL	COMPRESSOR CODE	PART NO.
YDTL108 & LTL108	E1	364-47787-001
YDTL120 & LTL120	E2	364-47787-002
YDTL126 & LTL126	E3	364-47787-003
YDTL131 & LTL131	F1	364-47558-002
YDTL144 & LTL144	F2	364-47558-003

(Also see NOMENCLATURE, page 4)

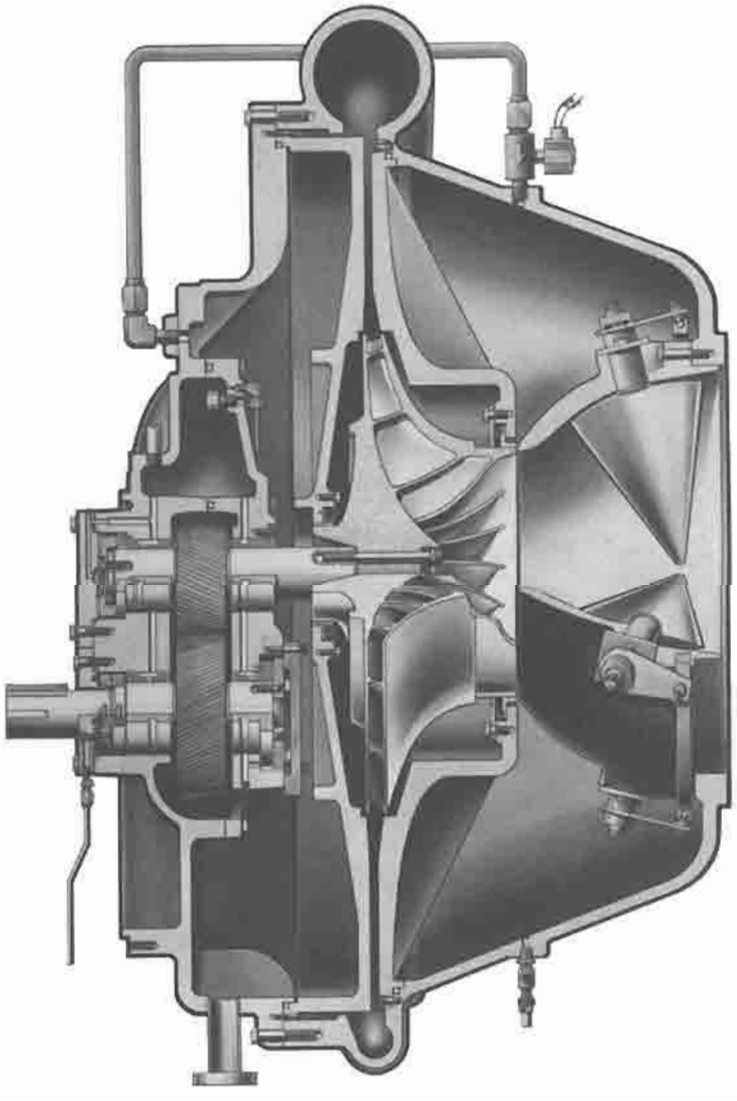


TABLE OF CONTENTS

SECTION 1 - GENERAL

SECTION 2 - COMPRESSOR SERVICE

SECTION 3 - OIL PUMP SERVICE

REFERENCE LITERATURE	
Installation - Unit	160.46-N1
Operation - Unit	160.46-O1
Renewal Parts - Unit	160.46-RP1 (SECT. 1)
Renewal Parts - Compressor	
YDTL/LTL 108, 120, 126	160.48-RP1
YDTL/LTL 131, & 144	160.48-RP2

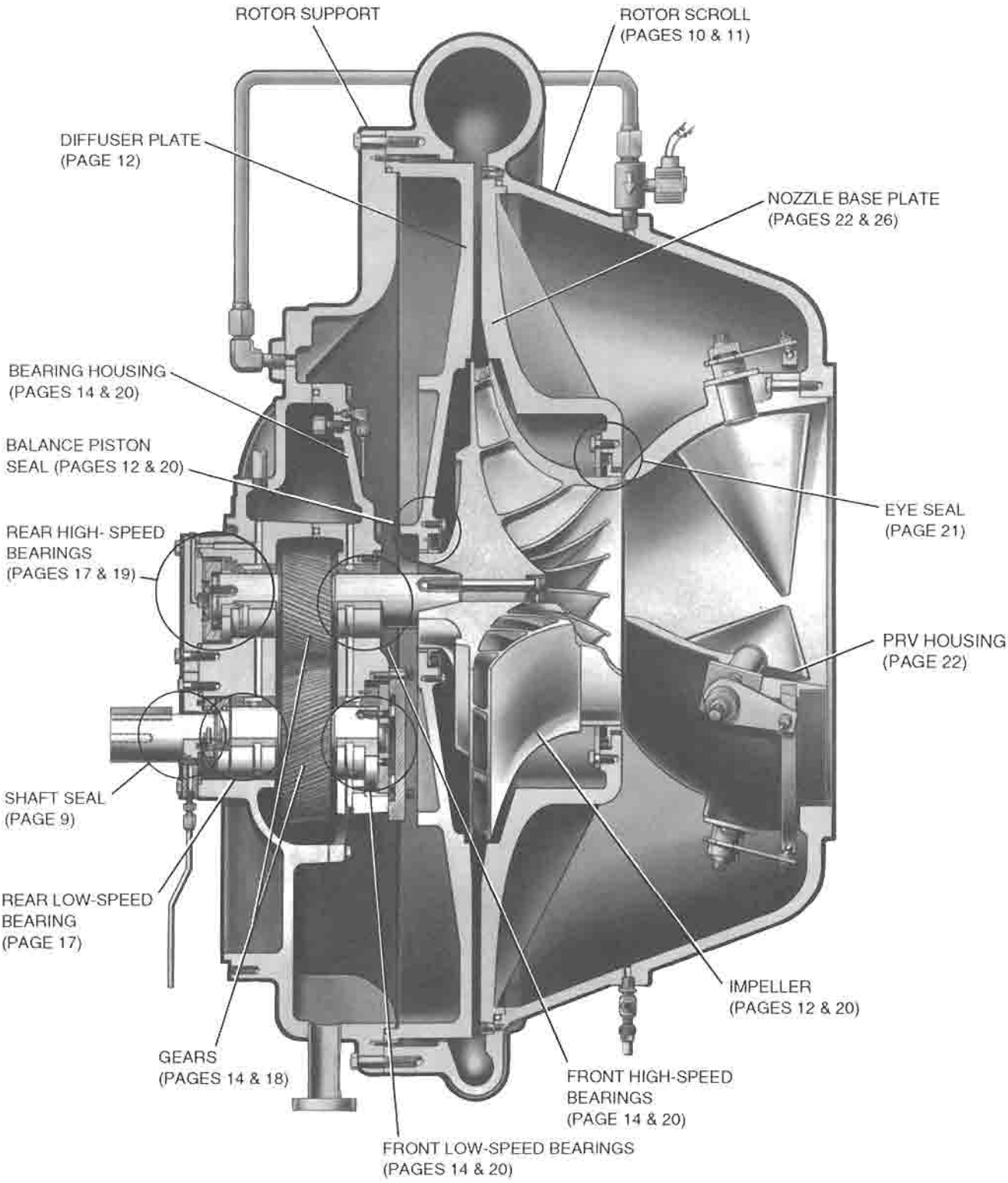


FIG. 1 – COMPRESSOR CUT-A-WAY

SECTION 1
GENERAL

GENERAL DESCRIPTION

These compressors are applied to YORK Model YT CodePak Centrifugal Liquid Chillers listed on front cover.

The compressor is a single-stage centrifugal type powered by an open-drive electric motor. The casing is fully accessible with vertical circular joints and fabricated of close-grain cast iron. The complete operating assembly is removable from the compressor scroll housing. Compressor castings are designed for 300 psig working pressure and hydrostatically pressure tested at 900 psig.

The rotor assembly consists of a heat-treated alloy steel drive shaft with a lightweight, high strength, cast aluminum, fully shrouded impeller. The impeller is designed for balanced thrust and is dynamically balanced and overspeed tested for smooth, vibration free operation.

The insert type journal bearings are fabricated of aluminum alloy and are precision bored and axially grooved. Thrust bearings are of the deflection-pad type design. The specially engineered, single helical gears with crowned teeth are designed so that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Gears are integrally assembled in the compressor rotor support and are film lubricated. Each shaft is individually mounted in its own journal and thrust bearings.

The open-drive compressor shaft seal consists of a spring-loaded, precision carbon ring, high temperature elastomer "O" ring static seal, and a stress-relieved, precision lapped collar. The seal features a small face area and low rubbing speed. It provides an efficient seal under high pressure conditions. The seal is oil-flooded at all times and is pressure-lubricated during compressor operation.

Compressors are available in 5 impeller sizes. (See NOMENCLATURE below).

NOMENCLATURE

COMPRESSOR IDENTIFICATION

Each compressor is identified by nomenclature as shown below. The nomenclature is printed on a data plate which is located on the side of the unit control panel (See Fig. 2). When contacting the factory or ordering renewal parts, include the complete compressor model and serial number. Be sure these numbers are copied accurately.

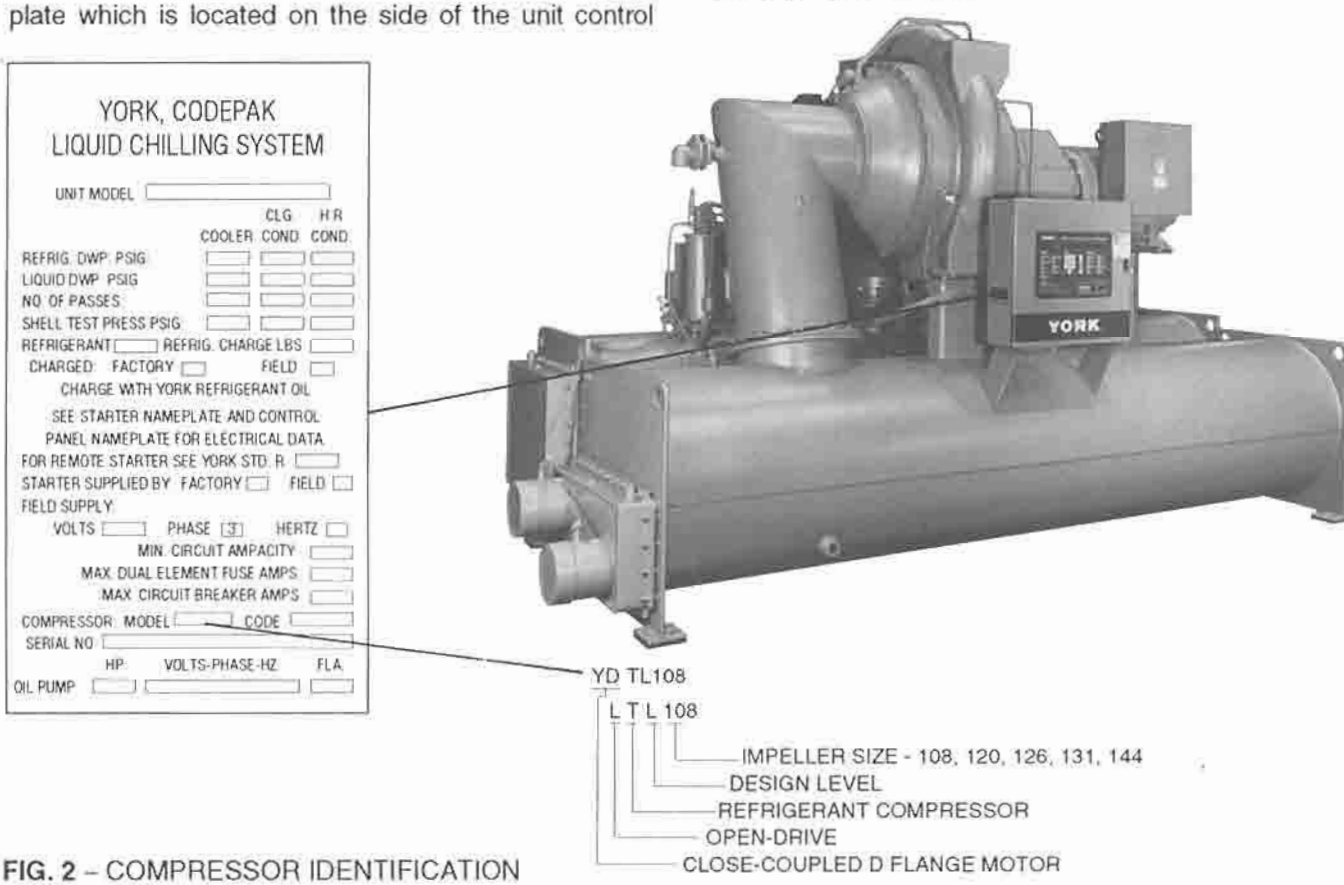


FIG. 2 – COMPRESSOR IDENTIFICATION

SECTION 2
COMPRESSOR SERVICE

The compressor is the heart of the CodePak unit and every effort should be made to maintain and keep it operating at peak efficiency. Being a precision built machine, it is important to check the lubrication system for cleanliness by changing the oil filter as mentioned under Preventive Maintenance in the Operating Instruction.

The compressor should not be dis-assembled for inspection purposes only. However, if the compressor fails to function as outlined in the OPERATING MANUAL, it may be necessary to do so. Individual parts are available for replacement as described in the respective Renewal Parts lists.

SERVICE GUIDELINES

The overhaul and replacement of parts of these compressors, like any other mechanical operation on machinery, is best accomplished by experienced service personnel using tools and measuring instruments to accomplish accuracy in their work.

There are a number of good practices that should be followed in dis-assembly and re-assembly of the compressor; some of these are listed below.

Do Not Mix Parts

Keep parts in some general order when removing them from the compressor. It is suggested that parts be laid out to follow exploded views as shown in the many illustrations outlining the dis-assembly and assembly of the various parts.

Do Not Mix Cap Screws and Washers

Cap screws are suited to the location in which they are used. Too long or too short a cap screw can result in leakage and interference with some interior parts. Washers have been selected for specific screws, etc. It is very important to use correct washers or lockwashers. See the Renewal Parts Manual to order the correct part numbers.

Inspect As Compressor is Dis-assembled

If possible, it is desirable to record shaft and impeller run-outs and thrust clearances before dis-assembly. (See pages 13, 16 & 18) Once compressor parts have been dis-assembled and cleaned, many valuable indications of the compressor condition are lost. Materials found in oil or on burned surfaces can often give an indication as to why a part or parts have failed.

Protect Parts and Surfaces

Do not pile or throw parts indiscriminately. Oil surfaces likely to rust. Tape surfaces subject to scratching or nicking during repair operations. Plug off any passages likely to accumulate dust or abrasives. Do not tape the seals.

Clean Thoroughly

No compressor is completely overhauled if it is not cleaned internally to "new part" condition. Dirty parts cannot be inspected or fitted, and will cause excessive wear when compressor is in operation.

CLEANING AND CHECKING WEARING PARTS

Before re-assembling the compressor, all parts should be thoroughly checked for excessive wear.

Worn parts should be replaced with new and each new part should be thoroughly examined for shipping damage.

While the rotor support is open, carefully clean the interior, using an approved safety solvent and a lint free cloth.

Clean and check all oil passageways and all tubing.

LUBRICATION OF FRICTION SURFACES

Before assembling parts, all friction surfaces should be lightly coated with a molybdenum disulphide lubricant such as "Molykote" or "Molkolube" and oil. Be sure to use new YORK refrigerant Oil, Type C.

NOTE: "Molkolube" is available from:
Dow Corning Corporation
Dept. A0021
P.O. Box 1767
Midland, Michigan

It is also available from YORK (Part No. 364-21508) in 2 oz. cans.

When re-assembling pats, each part should be carefully checked for signs of uneven wear, keeping in mind that a nicely polished surface is not an indication of excessive wear. Sudden, excessive wear on any part of the compressor is not normal, but is usually caused by some other condition which must be determined and corrected to assure long periods of trouble-free operation.

Bearings and seals may be reused if their rubbing surfaces and matching surfaces of their corresponding rotating parts are nicely polished with no sign of uneven wear or gouging.

The impeller should be checked around its outside circumference for evidence of rubbing. If this condition is found, excessive bearing wear is indicated and the impeller may be worn sufficiently to require replacement.

All gaskets and "O" rings should be replaced with new when re-assembling the compressor to assure that all surfaces have a tight seal after re-assembly.

RIGGING THE COMPRESSOR OR MOTOR

When it becomes necessary to remove a compressor or motor from a unit or base, proper rigging methods must be used to avoid damage to the equipment and/or injury to service personnel. Portable cranes must be of adequate capacity and properly positioned and blocked to prevent tipping or slipping while lifting the compressor or motor. Be sure chains are of adequate strength. Compressor weights are shown in Table 1. Motor weights are shown in Table 2.

TABLE 1 – COMPRESSOR WEIGHTS (LBS.) - LESS MOTOR

COMPRESSOR SIZE	COMPLETE COMPRESSOR	ROTOR SUPPORT COMPLETE WITH ALL RUNNING GEAR	SCROLL ASSEMBLY WITH PRV HOUSING
108	4680	2950	1730
120	4680	2950	1730
126	4680	2950	1730
131	5562	3500	2062
144	5562	3500	2062

TABLE 2 – MOTOR WEIGHTS

HERTZ			
60		50	
MOTOR CODE	TYPICAL MOTOR WT. - LBS.	MOTOR CODE	TYPICAL MOTOR WT. - LBS.
CF	960	5CC	960
CG	960	5CD	1335
CH	1335	5CE	1335
CJ	1335	5CF	1335
CK	1335	5CG	1655
CL	1655	5CH	2125
CM	2125	5CI	2125
CN	2125	5CJ	2125
CP	2125	5CK	2200
CR	2200	5CL	2200
CS	2200	5CM	2800
CT	2800	5CN	2800
CU	2800	5CO	3800
CV	3800	5CP	3800
CW	3800	5CQ	4400
CX	4100	5CR	4400
CY	4700	5CS	5000
CZ	4700	5CT	5100
CA	5700	5CU	5100
CB	5700	5CV	5200
–	–	5CW	7200
–	–	5CX	7200

NOTE:

1. Motor weight shown in Table 2 is typical of 200 thru 600 volt motors; high voltage motors may be heavier - contact YORK.

TABLE 3 – TORQUE VALUES

Unless otherwise specified all screws must be tightened to the following torque values with lightly oiled threads:

BOLT SIZE INCHES	TORQUE POUND FOOT
.25	10
.375	35
.5	75
.625	155
.75	260

SPECIAL TOOLS

Special tool kits are available as an option to aid in the servicing of the YORK compressors. They are furnished only when ordered. There are (2) different kits available, depending on compressor size. Tables 4 and 5 list the tools along with their application.

TABLE 4 – COMPRESSOR TOOL KIT (364-46557) USED ON MODELS 108, 120 & 126

ITEM NO.	DESCRIPTION	QTY. PER KIT	PART NO.	APPLICATION
1	BAR, RD. 3/8" x 7"	1	064-46402	NOT USED
2	PIN, GUIDE #10 - 24 x 6-1/2"	2	064-46488	H.S. BEARING REMOVAL
3	STUD, 1/2" x 9"	1	064-14500	P.R.V. SHAFT REMOVAL
4	NUT, 1/2" HEX	2	021-00483	P.R.V. SHAFT REMOVAL
5	PIN, GUIDE 3/8" x 7-1/2"	3	064-18716	NOZZLE BASE PLATE REMOVAL
6	BOLT, EYE, 7/8"	1	021-07703	LIFTING ROTOR SUPPORT
8	PUMP, OIL	1	470-10654	OIL CHARGING
9	PIN, GUIDE 1/4" x 8"	2	064-46499	DIFFUSER PLATE REMOVAL
10	NUT, 1/4" HEX	4	021-00450	—
11	BAR	1	064-46611	NOT USED
12	HOOK	2	064-46610	H.S. BEARING REMOVAL
14	BOLT, EYE, 3/4"	1	021-00307	RIGGING
15	BAR, COUPLING	1	064-46251	COUPLING REMOVAL
16	SCREW, 5/8" x 1-3/4"	1	021-01628	COUPLING REMOVAL
17	SCREW, 3/8" x 2"	2	021-01510	COUPLING REMOVAL
18	TOOL, COUPLING	1	064-46743	COUPLING REMOVAL
19	STRAP	1	064-46657	NOT USED
20	SPACER	1	064-46658	COUPLING REMOVAL
21	SCREW, 3/8" x 5/8"	1	021-01463	—
22	NUT, HEX	4	021-00467	—
23	ROD, THREADED	2	021-14842	NOT USED
24	PIN, GUIDE 1/2" x 7-1/2"	2	064-46246	SCROLL/ROTOR SEPARATION
25	BOLT, EYE, 5/8"	1	021-12366	RIGGING
26	BOLT, EYE, 1/2"	3	021-14620	RIGGING
27	BOLT, EYE, 3/8"	3	021-13498	RIGGING
28	TOOL, COUPLING	1	064-47411	COUPLING REMOVAL
29	SCREW,SET 5/8" x 4"	1	021-08199	USED WITH ITEM 28
30	SCREW, CAP 7/16" x 2-1/4"	2	021-16815	USED WITH ITEM 28
31	WASHER, 7/16"	2	021-01275	USED WITH ITEM 28
32	NUT, HEX 7/16"	2	021-00476	USED WITH ITEM 28

TABLE 5 – COMPRESSOR TOOL KIT (464-47047) USED ON MODELS 131 & 144

ITEM NO.	DESCRIPTION	QTY. PER KIT	PART NO.	APPLICATION
1	TOOL, GEAR LOCK	1	064-47029	NOT USED
2	SCREW, 3/8" x 1-3/4"	2	021-01505	NOT USED
3	SCREW, 3/8" x 2-1/2"	2	021-10037	NOT USED
4	NUT, HVY 1/2"	2	021-00483	P.R.V. SHAFT REMOVAL
5	STUD, 1/2" x 9"	1	064-14500	P.R.V. SHAFT REMOVAL
6	BOLT, EYE	2	021-12366	RIGGING
7	BOLT, EYE	2	021-14620	RIGGING
8	SCREW, SET, 3/8"	2	021-00774	NOT USED
9	FILLPIECE, 1/2" x 5/16"	2	064-47030	RIGGING
10	HOOK, TOOL	2	064-46610	H.S. THRUST BEARING REMOVAL
11	PIN, GUIDE, 1/2" x 7-1/2"	2	064-46246	ROTOR SUPPORT TO DIFF. PLATE; DIFF. PLATE TO SCROLL
12	PIN, GUIDE, 3/8" x 7-1/2"	2	064-18716	NOZZLE BASE PLATE
13	PIN, GUIDE, 1/4" x 8"	2	064-46499	L.S. REAR BRG., H.S. BEARING & SEAL REMOVAL
14	NUT, HEX, 1/4"	4	021-00450	SEAL REMOVAL
15	BAR	1	064-47031	SEAL REMOVAL
16	PUMP, OIL	1	470-10654	OIL CHARGING
18	COUPLING PULLER	1	064-47411	COUPLING REMOVAL
19	SCREW, SET 5/8" x 4"	1	021-08199	USED WITH ITEM 18
20	SCREW, 7/16" x 2-1/4"	2	021-16815	USED WITH ITEM 18
21	WASHER, 7/16"	2	021-01275	USED WITH ITEM 18
22	NUT, HVY 7/16"	2	021-00476	USED WITH ITEM 18
23	PIPE 1/4" x 10"	1	023-15508	USED WITH ITEM 24
24	PLATE, TOOL END	1	064-47415	H.S. THRUST BEARING REMOVAL
25	BOLT, EYE 1"	2	021-17218	RIGGING

MOTOR REMOVAL AND REPLACEMENT

> ***WARNING***
>
> *Be sure the main disconnect switch to the compressor motor is open and tagged, then disconnect the electrical leads at the motor terminals and tape the end of each lead. Make sure leads are marked correctly for later identification.*

REMOVAL (MOTOR ONLY)

The following paragraphs outline the procedure for replacing or servicing the motor. Always contact the nearest YORK District Service Office when replacing or servicing the motor.

1. Support the weight of the motor from a hoist using eye-bolts at locations provided in the motor housing.
2. Remove the hex, hd. cap screws that hold the sheet metal covers to the compressor motor adapter. After all screws are removed, remove covers. (See Fig. 3)
3. Remove the internal coupling guard.
4. Remove the bolts holding the coupling hubs to the coupling spool, and the disc pack. Note arrangement of these parts. (See Fig. 4). Remove the coupling spool and disc packs.
5. Taking care to see that the motor is properly supported, remove the bolts that hold the motor to the motor adapter.
6. Remove the bolts, nuts and washers holding the motor to the mounting rails. Note location of any shims.
7. Lift the motor and pull it away from the compressor. Lower motor to floor for servicing. Remove shims from motor mounting rails.

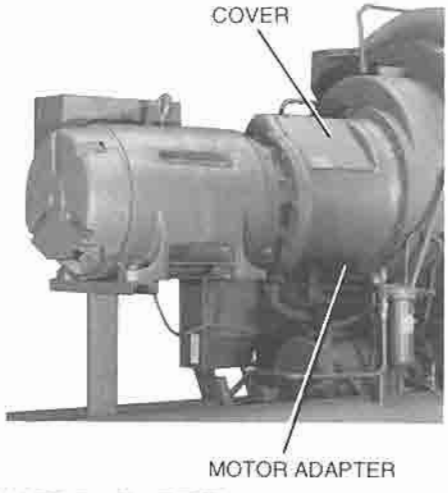
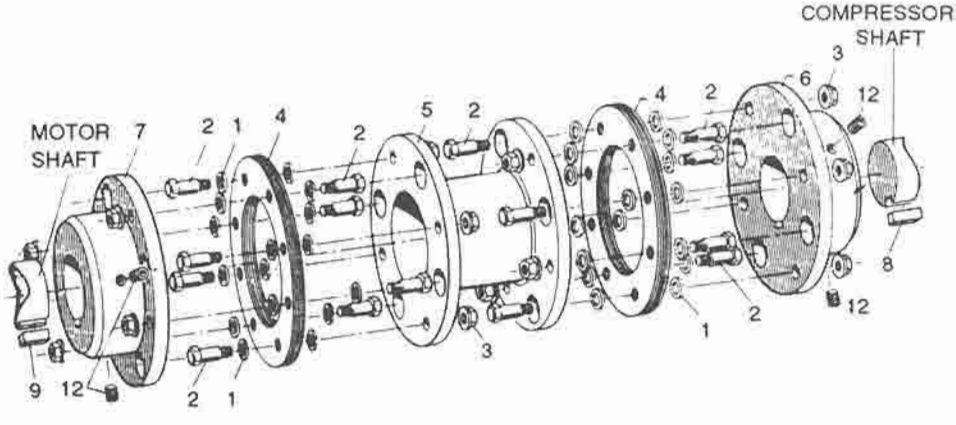


FIG. 3 – MOTOR ADAPTER

INSTALLATION

1. Place the number of shims originally required on each motor mounting rail.
2. Lift motor to the proper location and push motor carefully against the compressor motor adapter.
3. Line up holes in the face of the motor with the holes in the compressor motor adapter. Place the hex hd. cap screws through the compressor motor adapter and screw into the tapped holes on the motor, (but do not fully tighten screws). (Refer to Fig. 3).
4. Place the hex hd. cap screws and washers in holes in motor feet. Make sure the motor is shimmed correctly. Place hex. nuts on screws and tighten and torque.
5. Tighten and torque screws holding motor to motor adapter.



ITEM	DESCRIPTION	QTY. SHOWN
1	Washer, Beveled	32
2	Screw, Shoulder Hex Hd.	16
3	Locknut, Flanged	16
4	Disc, Pack	2
5	Spacer Center Spool	1
6	Hub Coupling (Compressor)	1
7	Hub Coupling (Motor)	1
8	Key (Compressor)	1
9	Key (Motor)	1
12	Set Screws 1/2" - 20 UNF	4

NOTE: Illustration shown above is typical of coupling. Specific details may vary slightly depending on coupling manufacturer.

FIG. 4 – TYPICAL COMPRESSOR COUPLING

6. Assemble the coupling.

7. Re-install sheet metal covers.

> ***WARNING***
>
> *Before opening any part of the compressor, the compressor must be pumped down to atmospheric pressure.*

SHAFT SEAL (SEE FIG. 5)

Removal

To remove/replace the shaft seal, proceed as follows:

1. Remove compressor coupling as described on previous pages under MOTOR REMOVAL AND REPLACEMENT. Also remove the compressor coupling hub from the compressor shaft.

2. Remove the oil drain line from the bottom of the shaft seal cover plate.

3. Remove the (6) cap screws holding the cover plate and remove the cover plate. Use guide pins as shown in Fig. 6 to avoid damaging the carbon seal when removing the cover plate. The stationary carbon seal is attached to the cover plate. Do not touch the carbon seal surface.

4. Using items from the tool kit remove the seal collar from the shaft. (See Fig. 8)

5. Dis-assemble the shaft seal components. (See Fig. 9) Inspect all wearing surfaces and replace parts as necessary. See CLEANING AND CHECKING WEARING PARTS, page 5. Discard all "O" rings and replace with new. Re-assemble the shaft seal components.

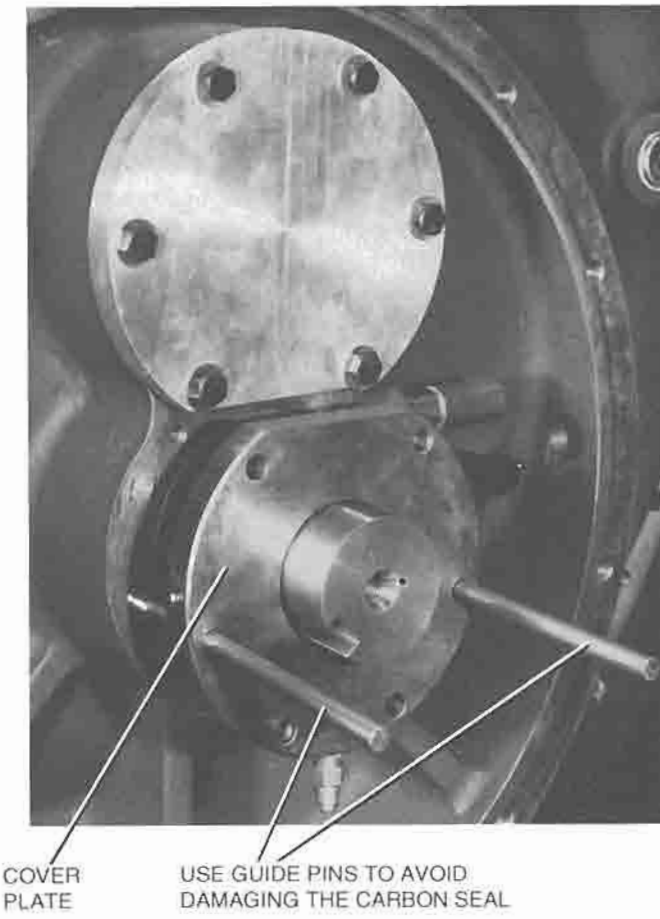


FIG. 6 – REMOVING SEAL COVER PLATE WITH SEAL

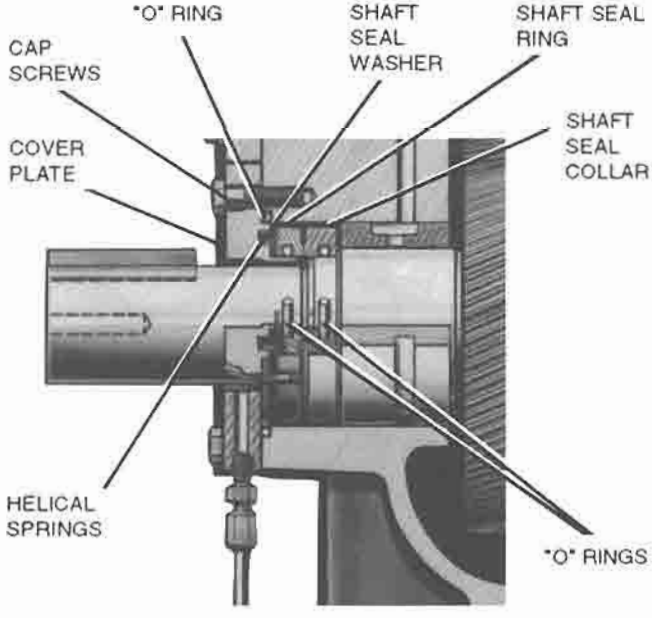


FIG. 5 – SHAFT SEAL CROSS SECTION

FIG. 7 – INSIDE OF SHAFT SEAL COVER PLATE WITH SHAFT SEAL ATTACHED

INSTALLATION

1. Be sure the shaft seal cavity is absolutely clean by cleaning it with an approved safety solvent and blowing it dry with compressed air.

2. Slide the seal collar on to the compressor shaft. Be sure it is positioned with the lapped surface facing out. (See Fig. 8)

3. Re-install the cover plate and seal components. Use guide pins as shown in Fig. 6 to avoid damaging the carbon seal. Insert and tighten the hex head cap screws.

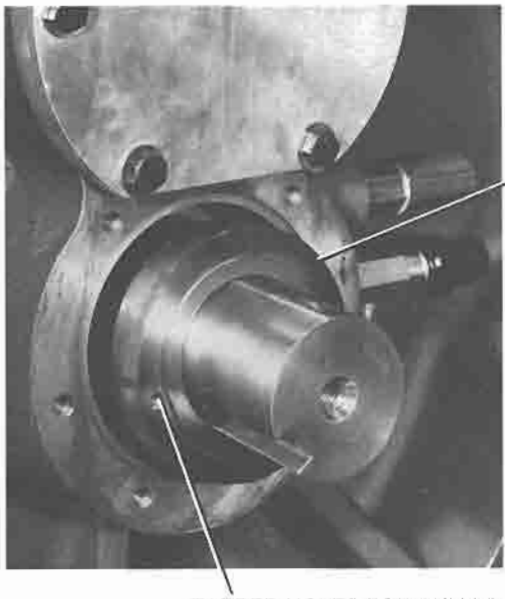


FIG. 8 – SHAFT SEAL COLLAR

4. Re-connect the oil drain line and re-install the compressor coupling if no further service is planned.

DIS-ASSEMBLY OF ROTOR SUPPORT (SEE FIG. 10)

The following paragraphs outline the procedure for separating the rotor support from the rotor scroll if it becomes necessary to service internal parts:

Removing The Rotor Support From Rotor Scroll

> ***NOTE***
>
> *Construction of Models 108, 120 and 126 is different from Models 131 and 144. The main illustration in Fig. 10 shows Models 108, 120 and 126. The insert shows Models 131 and 144. Because of this difference in construction, certain dis-assembly procedures vary. Be sure to follow the correct instruction which follows.*

1. Remove the compressor coupling.

2. Remove all external piping from the rotor support.

3. Taking care that the motor is properly supported, remove the bolts that hold the motor to the motor adapter. DO NOT remove the motor adapter from the compressor.

4. Support the weight of the rotor support using proper rigging methods and an eye-bolt on the top of the rotor support.

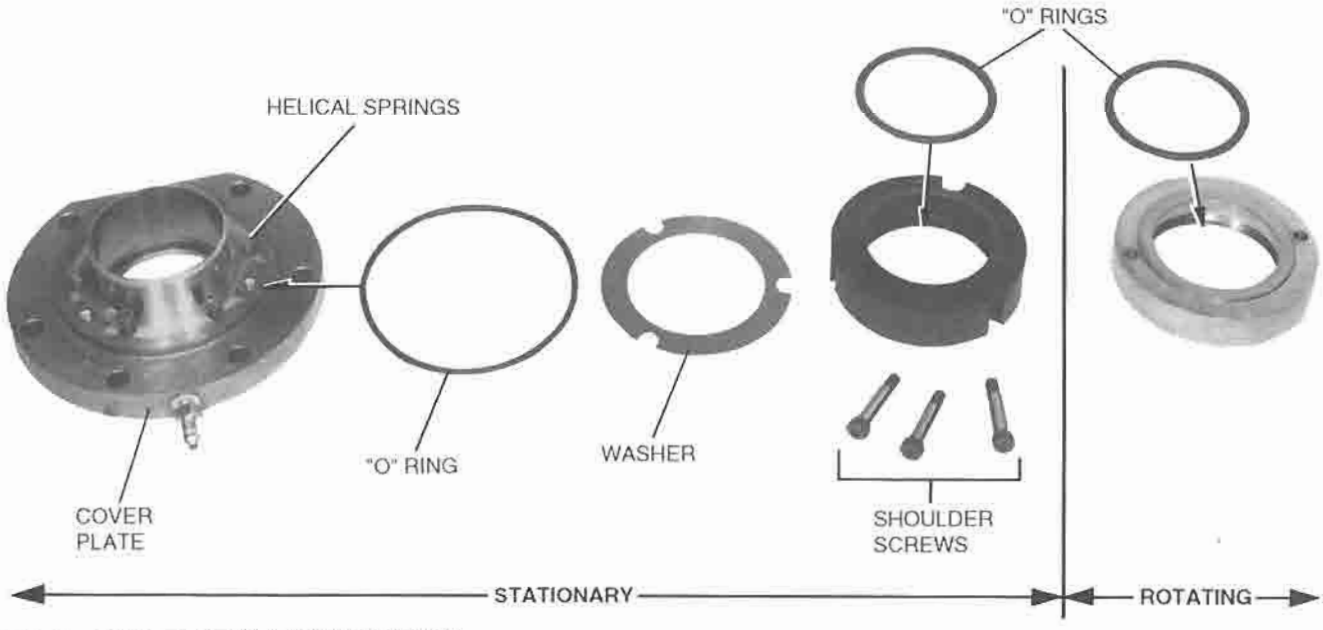
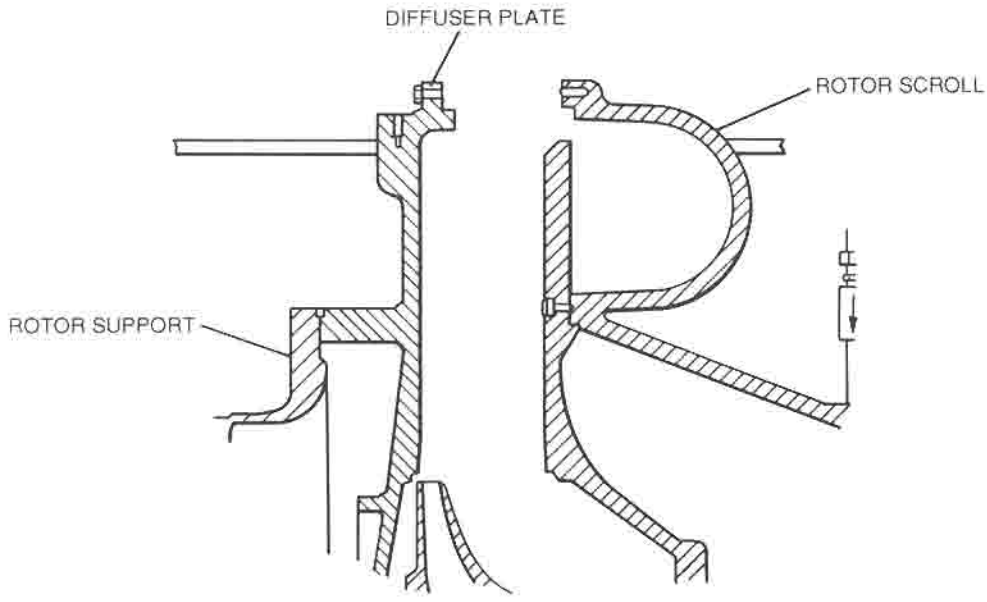
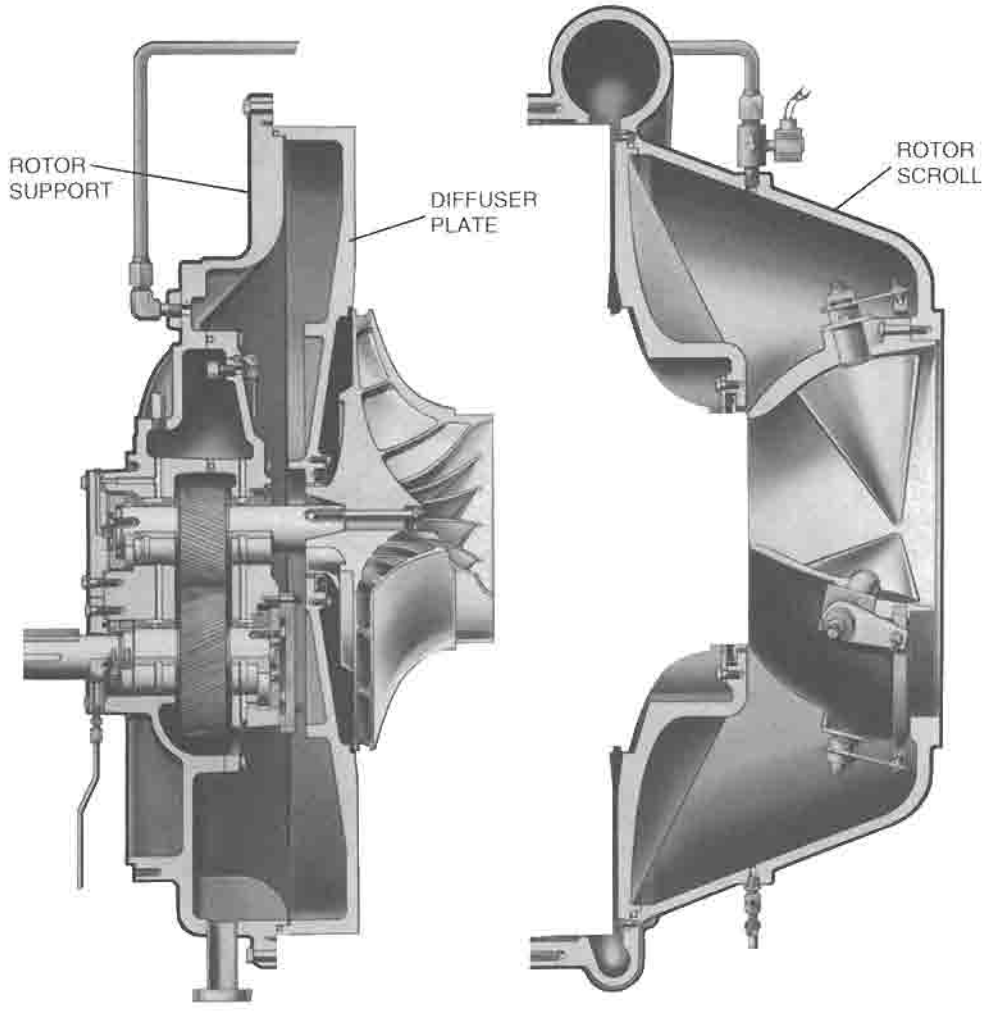


FIG. 9 – SHAFT SEAL COMPONENTS



MODELS 131 & 141



MODELS 108, 120 & 126

FIG. 10 – DISASSEMBLY OF ROTOR SUPPORT FROM ROTOR SCROLL

5. Models 108, 120 and 126:

   Remove (2) of the 12-pt. cap screws holding the rotor support to the rotor scroll. Insert guide pins in place of the (2) cap screws.

5A. Models 131 & 144:

   Remove (2) of the 12-pt. cap screws holding the rotor scroll to the diffuser plate. Insert guide pins in place of the (2) cap screws.

6. Loosen the remaining cap screws.

7. Use (3) of the cap screws as jacking screws in the tapped holes provided to loosen the rotor support from the rotor scroll (Models 108, 120 and 126) or the rotor scroll from the diffuser plate (Models 131 and 144). Carefully separate the (2) sections. Rotate the compressor shaft by hand when removing the rotor support to prevent damage to the impeller inlet seal ring.

REMOVING THE IMPELLER (SEE FIG. 11)

1. Install the gear locking tool on the low-speed shaft. (See Table 4 or 5)

2. Before removing the impeller, measure and record the following. (See Fig. 12)
   - Impeller rim run-out (Detail A)
   - Impeller eye run-out (Detail B)
   - Axial thrust (Detail C)

3. Remove the (7) screws that hold the impeller to the high-speed shaft. (See Fig. 13) Remove the impeller clamping collar and pull the impeller from the high-speed shaft. Use care when removing the impeller so that the balance piston seal is not damaged.

REMOVING BALANCE PISTON SEAL AND DIFFUSER PLATE

1. Remove the (3) socket head cap screws (shoulder bolts) that fasten the balance piston retainer and balance piston seal to the diffuser plate. (See Fig. 14) Remove the balance piston retainer and balance piston seal.

2. Removing The Diffuser Plate

   Models 108, 120 and 126 (See Fig. 15)

   A. Support the weight of the diffuser plate using proper rigging attached to an eye-bolt screwed into the tapped hole on top of the diffuser plate.

   B. Loosen, but do not remove the (3) 1/4" socket head cap screws that hold the diffuser plate to the rotor support.

   C. Remove the (2) lower cap screws and insert guide pins in their place.

   D. Remove the remaining cap screw and remove the diffuser plate from the rotor support. Use care so that the high-speed shaft is not damaged. Remove the "O" ring.

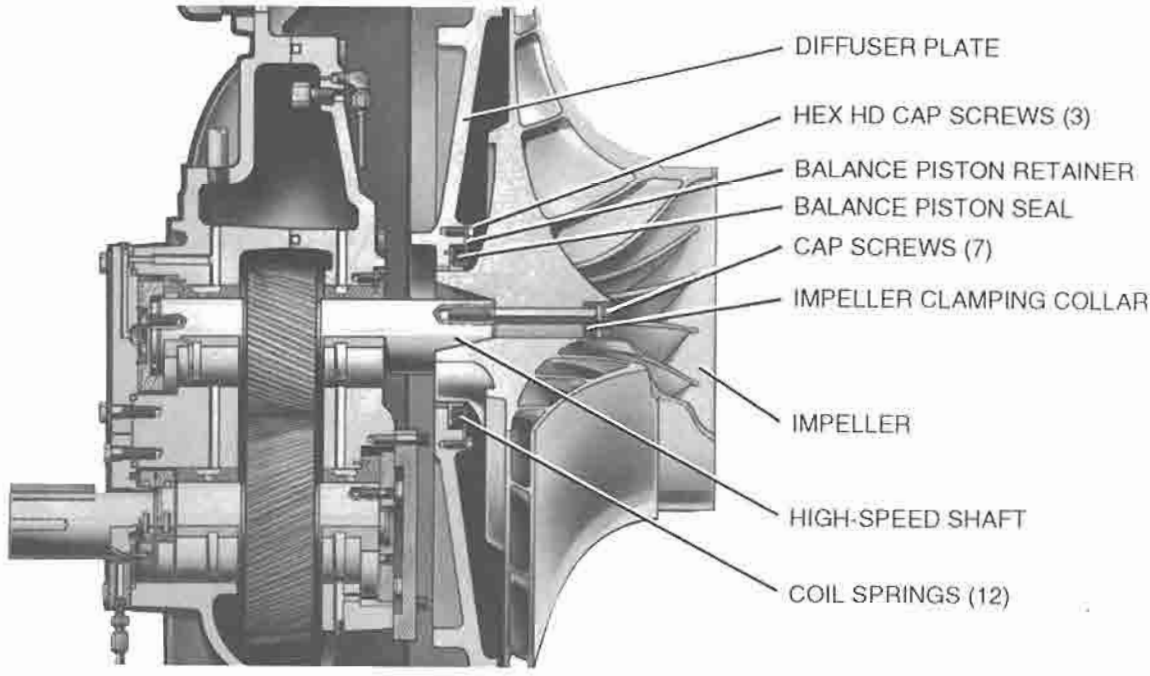
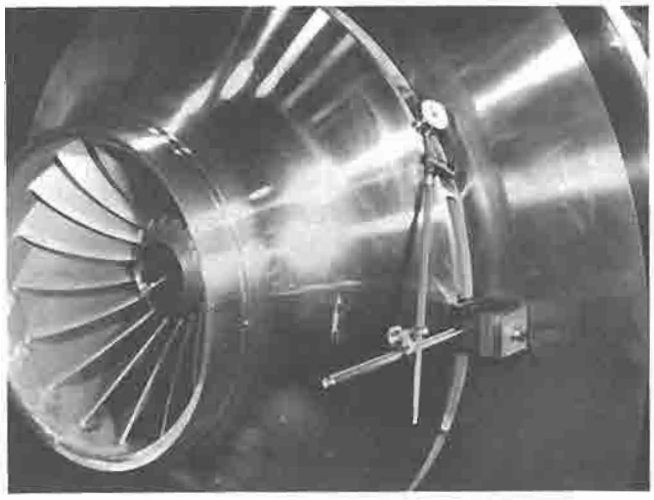
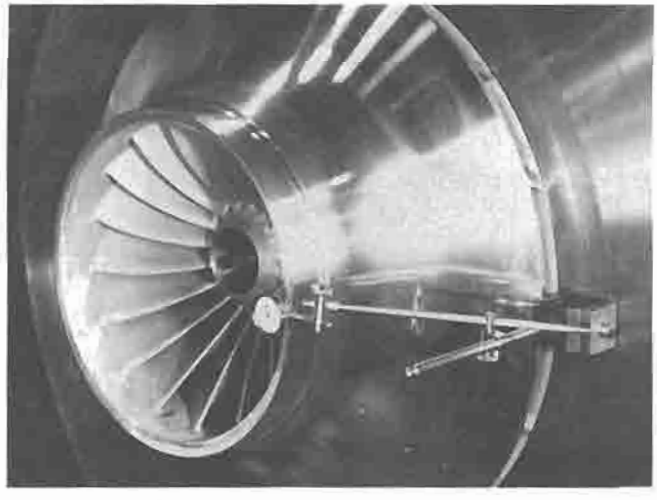


FIG. 11 – IMPELLER AND BALANCE PISTON



DETAIL A - CHECKING RIM RUN-OUT
TOLERANCE: MODELS 108, 120 & 126 = .005"
MODELS 131 & 144 = .006"

DETAIL B - CHECKING EYE RUN-OUT
TOLERANCE: MODELS 108, 120 & 126 = .003"
MODELS 131 & 144 = .004"



DETAIL C - CHECKING AXIAL THRUST
TOLERANCE = .007" TO .014"

FIG. 12 – CHECKING IMPELLER TOLERANCES

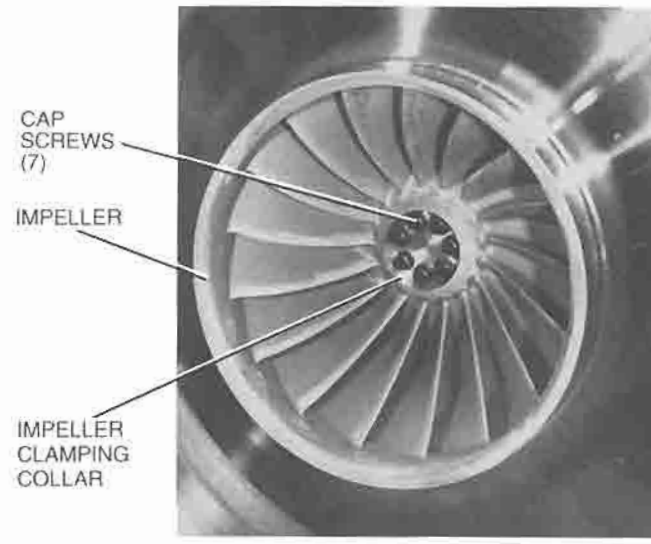
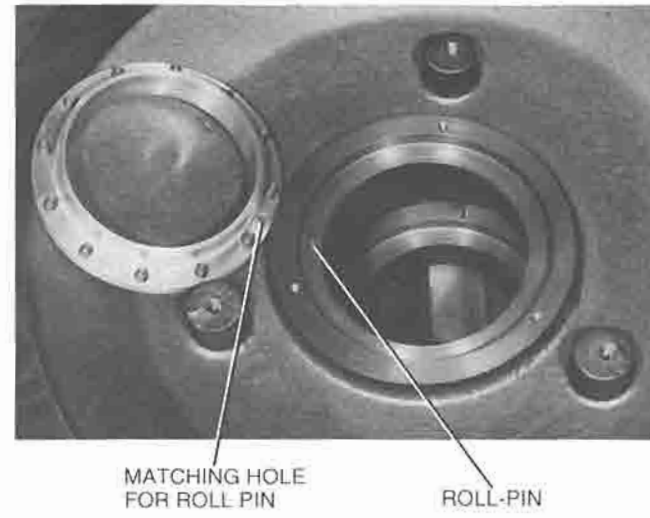


FIG. 13 – REMOVING IMPELLER



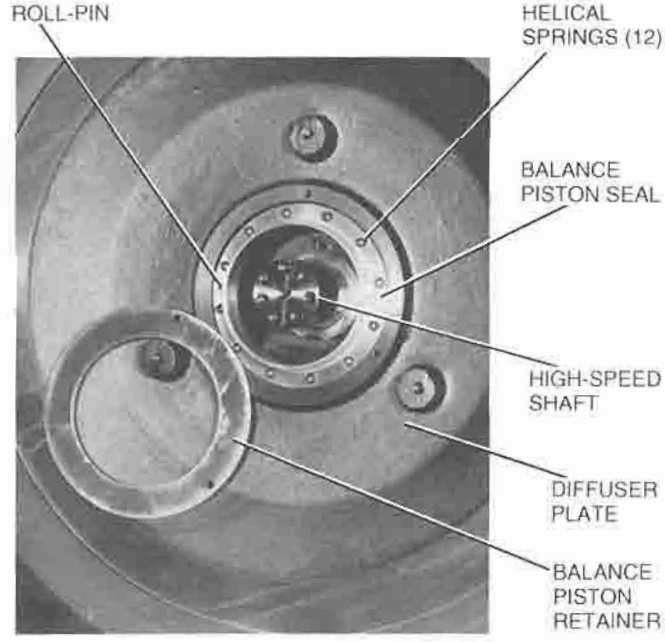


FIG. 14 – BALANCE PISTON

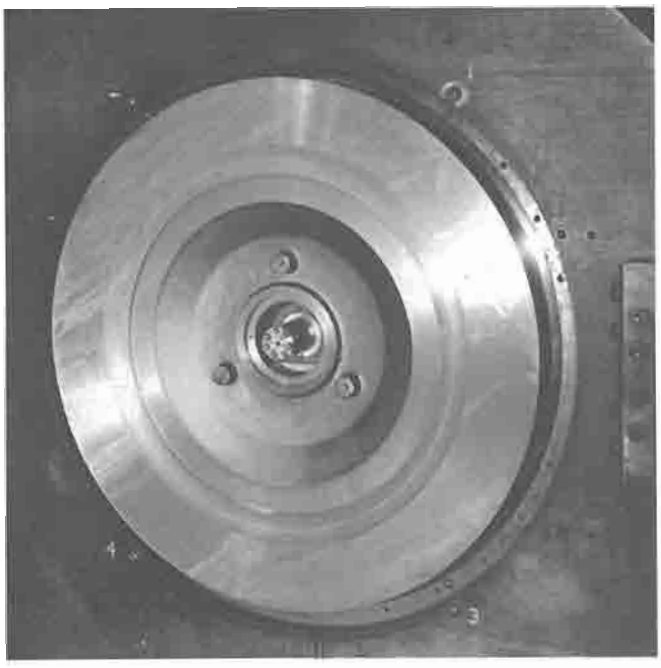


FIG. 15 – DIFFUSER PLATE
(MODELS 108, 120 & 126)

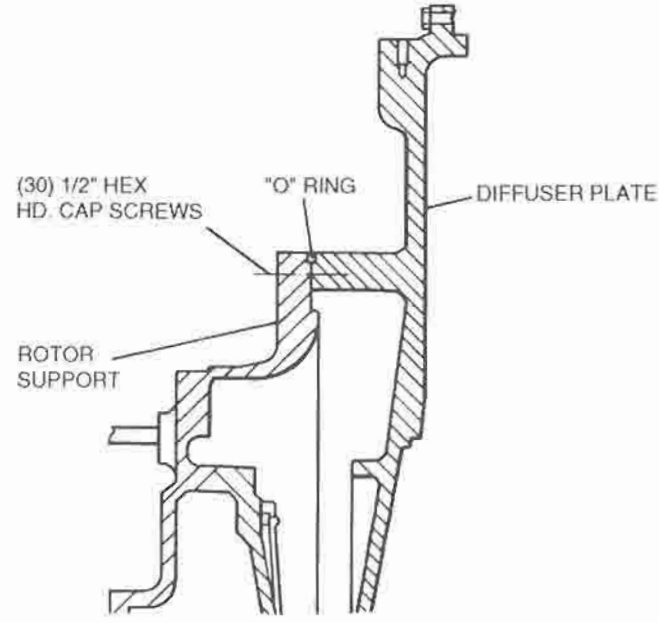


FIG. 16 – DIFFUSER PLATE
(MODELS 131 & 144)

Models 131 and 144 (See Fig. 16)

A. Support the weight of the diffuser plate using proper rigging attached to an eye-bolt screwed into the tapped hole on top of the diffuser plate.

B. Loosen, but do not remove the (30) 1/2" hex head cap screws holding the diffuser plate to the rotor scroll.

C. Remove (2) of the cap screws and insert guide pins in their place.

D. Remove the rest of the cap screws and remove the diffuser plate from the rotor support. Use care so that the high-speed shaft is not damaged. Remove the "O" ring.

REMOVING FRONT LOW-SPEED BEARINGS (SEE FIG. 17)

1. Remove the (6) socket head cap screws that hold the low-speed thrust bearing to the bearing housing, and using (2) guide pins, remove the thrust bearing. Be sure not to damage the bearing pads. (See Fig. 18 and 19)

2. Before removing the low-speed thrust collar, mount an indicator as shown in Fig. 20 and check the run-out of the thrust collar. Maximum run-out should not exceed .001" T.I.R. (It will be necessary to remove the shaft locking tool in order to take this measurement.)

3. Re-install the shaft locking tool. Remove the socket head cap screws that hold the low-speed thrust collar to the low-speed shaft, and remove the thrust collar. (See Fig. 21). Use care when handling so that surfaces are not damaged.

4. To remove the low-speed bearing, use (2) hook tools and carefully pull the bearing out of the bearing housing. Note position of roll-pin. (See Fig. 22)

REMOVING FRONT HIGH-SPEED BEARING (SEE FIG. 17)

1. Remove the cap screw and retainer clip. (See Fig. 22)

2. Using (2) 1/4" puller rods, pull the high-speed bearing out of the bearing housing.

REMOVING BEARING HOUSING AND GEARS

Bearing Housing

1. Remove (4) of the cap screws that hold the bearing housing to the rotor support and insert (4) 3/8" guide pins as shown in Fig. 23. Also insert (3) 3/8" eye-bolts in the tapped holes.

2. Attach proper rigging, remove the remaining cap screws.

3. Remove the bearing housing, using care so that the compressor is not damaged, and that no injury occurs to service personnel.

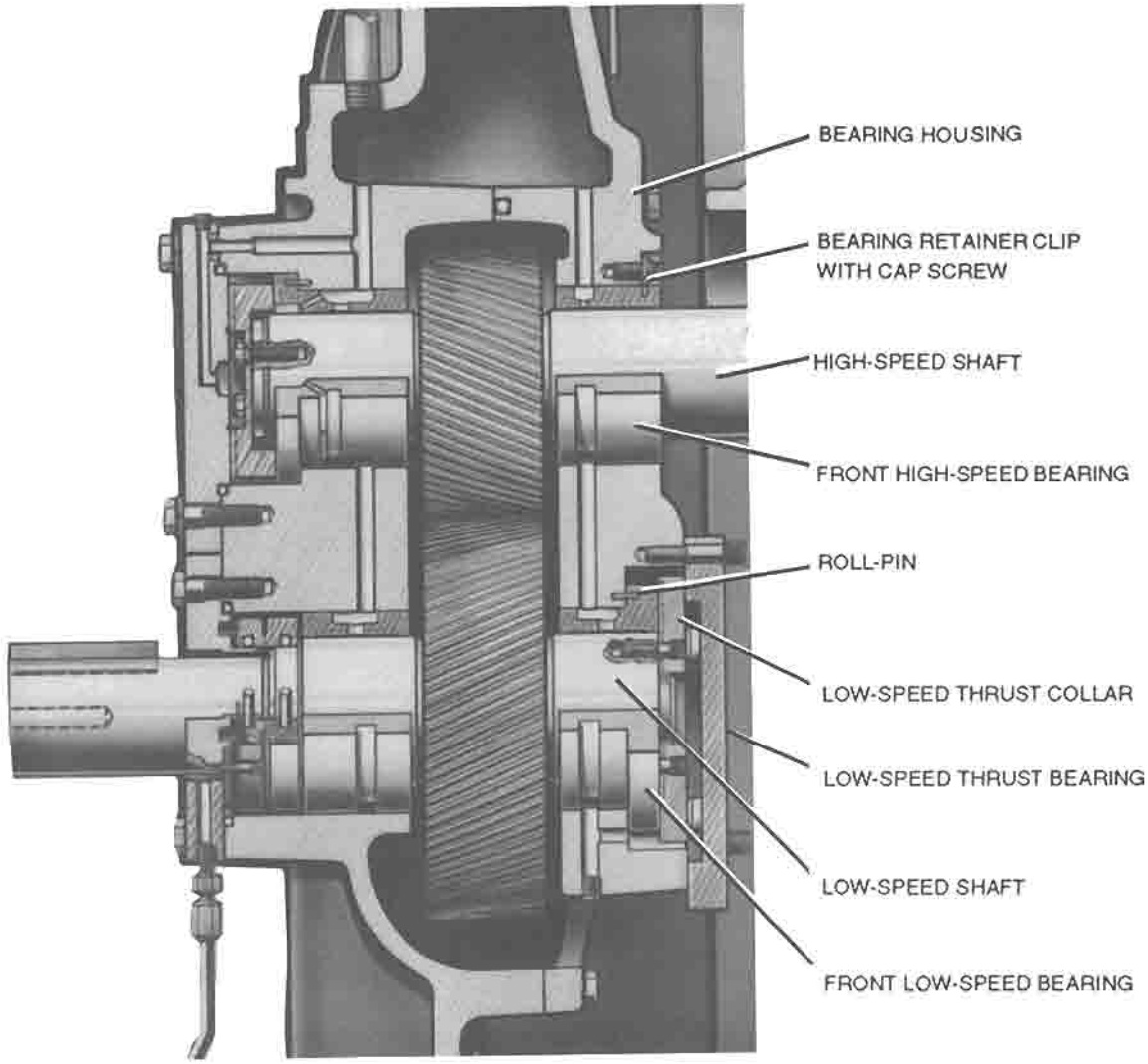


FIG. 17 – FRONT BEARING COMPONENTS

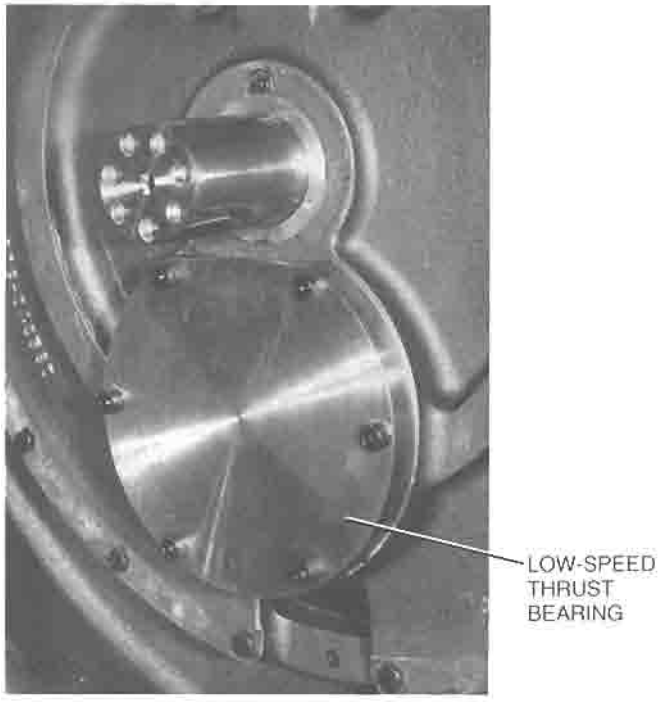


FIG. 18 – LOW-SPEED THRUST BEARING
YORK APPLIED SYSTEMS

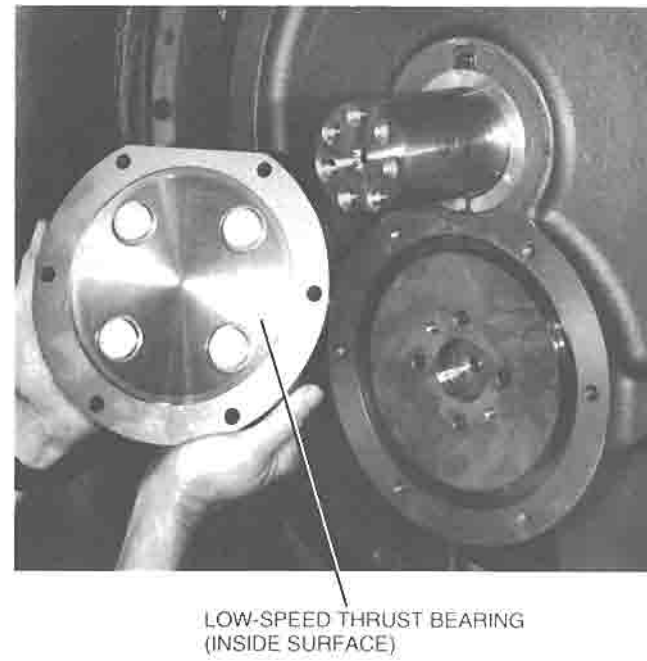


FIG. 19 – LOW-SPEED THRUST BEARING REMOVED

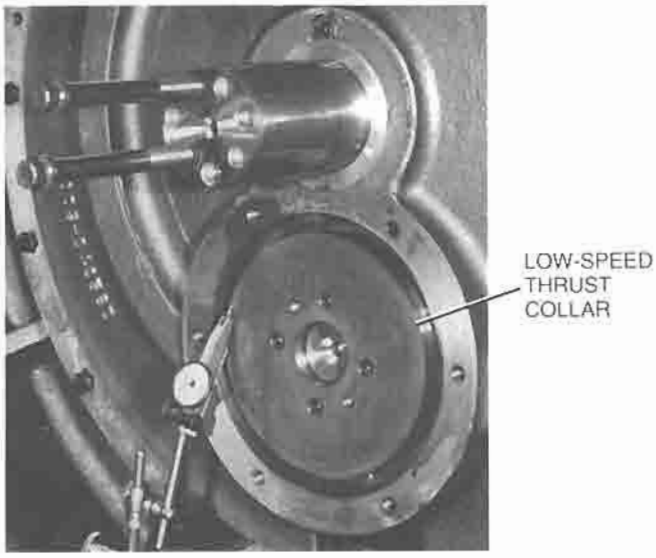


FIG. 20 – CHECKING LOW-SPEED THRUST RUN-OUT - MAX. RUN-OUT = .001" T.I.R.

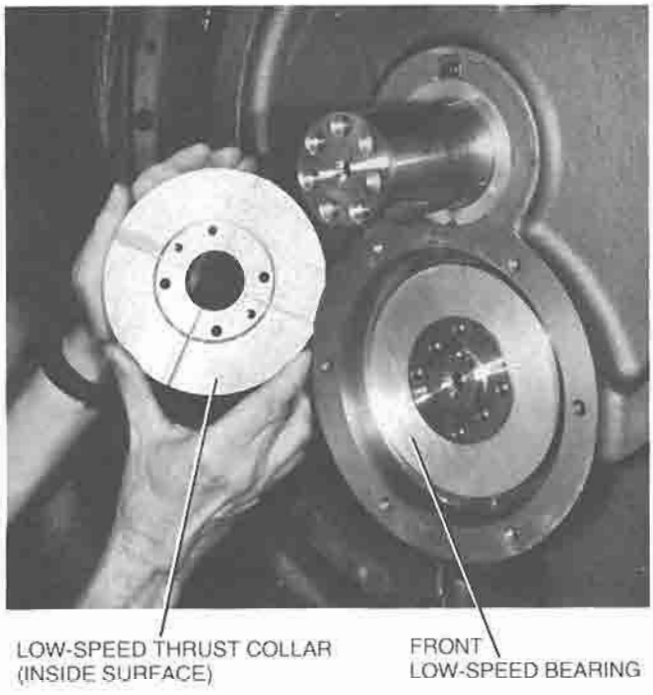


FIG. 21 – LOW-SPEED THRUST COLLAR REMOVED

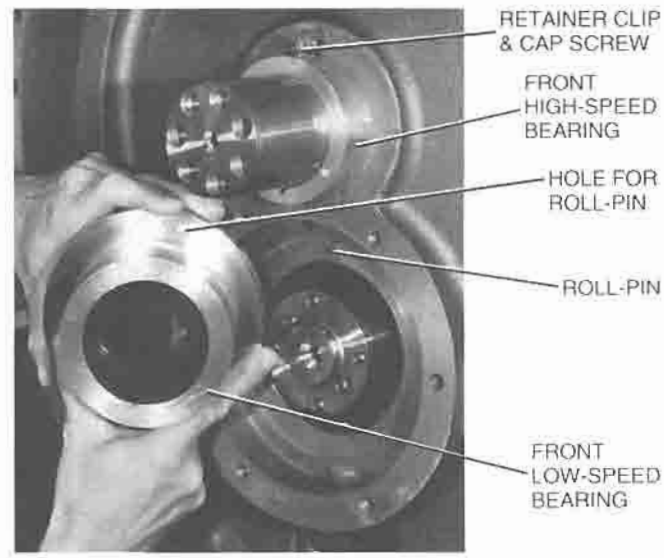


FIG. 22 – FRONT LOW-SPEED AND HIGH-SPEED BEARINGS

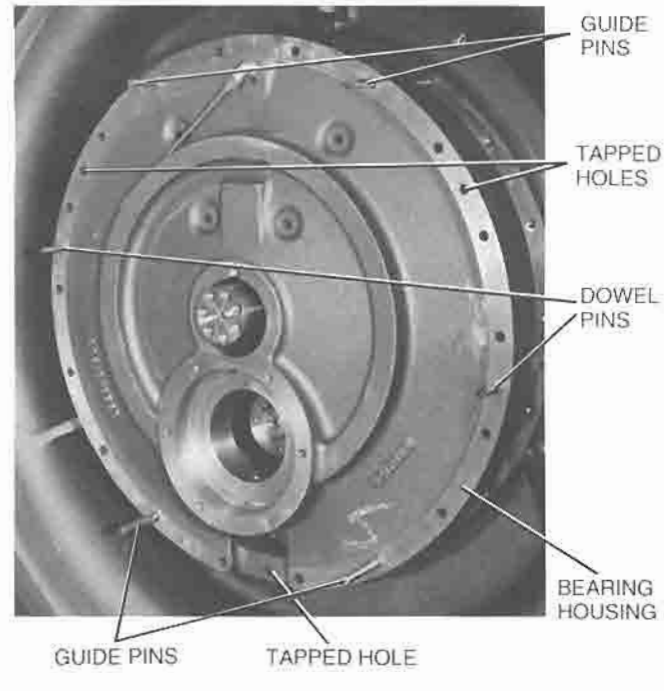


FIG. 23 – REMOVING BEARING HOUSING

Gears

1. Before removing the gears it is necessary to remove the high-speed thrust cover and the high-speed thrust collar. DO NOT remove the rear high-speed bearing. (See page 17)

2. Remove the shaft locking tool.

3. Remove the compressor shaft seal. (See page 9) DO NOT remove the rear low-speed bearing. (See page 17)

4. Rotate the high-speed gear as necessary to free the gear teeth while pulling the gear from the rotor support.

5. To remove the low-speed gear use a 1/2" - 13 eyebolt in the end of the shaft and pull the gear out of the rotor support.

   Before re-assembly, be sure the compressor housing is absolutely clean by cleaning it with an approved safety solvent and blowing it dry with compressed air. Inspect all wearing surfaces and replace parts as

necessary. See CLEANING AND CHECKING WEARING PARTS, page 5. Discard all "O" rings and replace with new.

REAR LOW-SPEED BEARING (SEE FIG. 24)

Removal

To remove/replace the rear low-speed bearing proceed as follows:

1. Remove the compressor coupling spool as described on previous pages under MOTOR REMOVAL AND REPLACEMENT. Also remove the compressor coupling hub from the compressor shaft.

2. Remove the compressor shaft seal as described on previous pages.

3. Remove the bearing locking bolt from the side of the bearing housing.

4. Using the (2) 1/4" dia. puller rods, remove the bearing from the compressor.

5. Inspect the bearing. See CLEANING AND CHECKING WEARING PARTS, page 5. Replace with new bearing if necessary.

Installation

1. Apply a light coating of oil and Molykote to the inside and outside surfaces of the the bearing.

2. Carefully slide the bearing into position. Be sure it is turned so that the hole for the locking bolt is in the proper location.

3. Re-install the bearing locking bolt with new "O" ring.

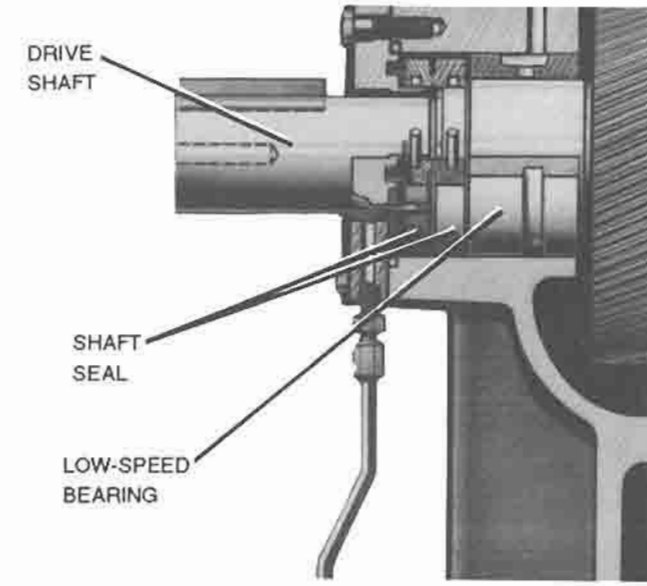
REAR HIGH-SPEED BEARING COMPONENTS (SEE FIG. 25)

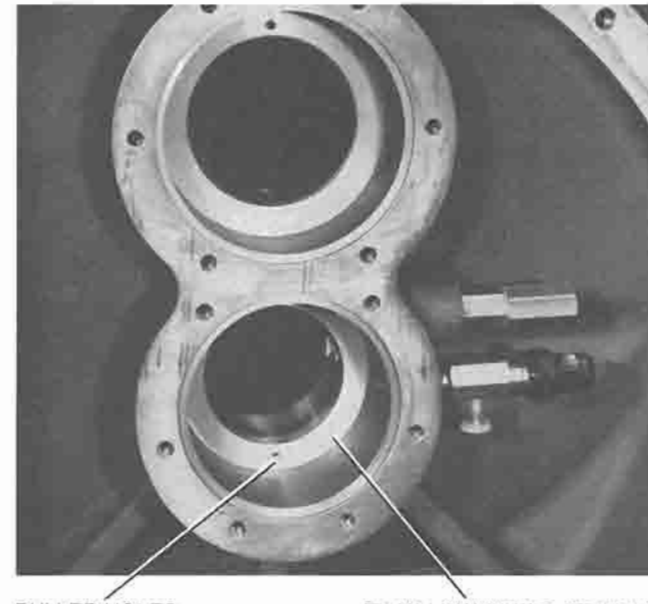
Removal

To remove/replace any of the components shown in Fig. 25, proceed as follows:

1. Remove the cap screws holding the high-speed thrust cover and remove the high-speed thrust cover. (See Fig. 26) Note alignment of oil passages. Also note "O" ring at oil passage on cover.

2. Before removing the high-speed thrust collar it is advisable to measure the run-out. Mount a dial indicator as shown in Fig. 27 and rotate the compressor shafts. Maximum allowable run-out is .001".





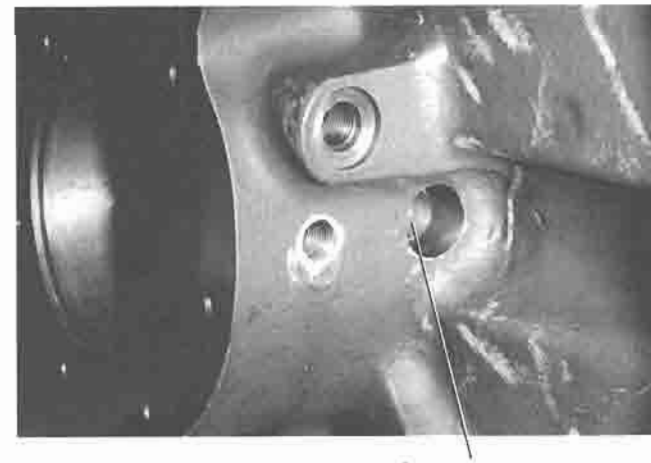


FIG. 24 – REAR LOW-SPEED BEARING

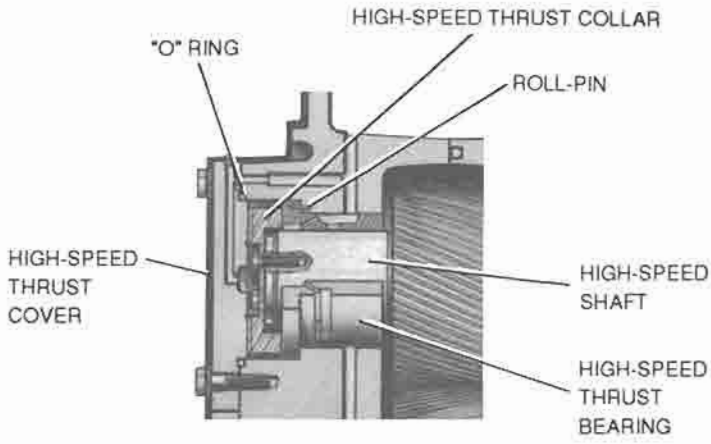


FIG. 25 – REAR HIGH-SPEED BEARING

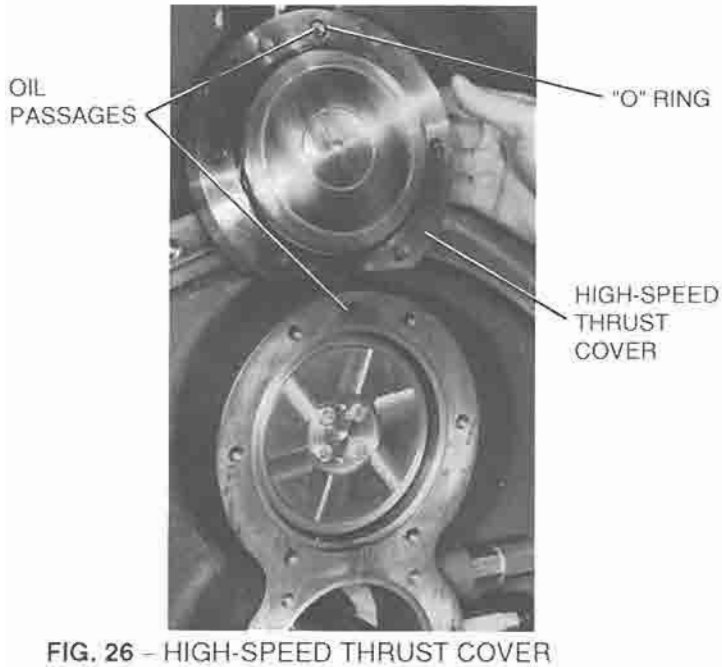


FIG. 26 – HIGH-SPEED THRUST COVER

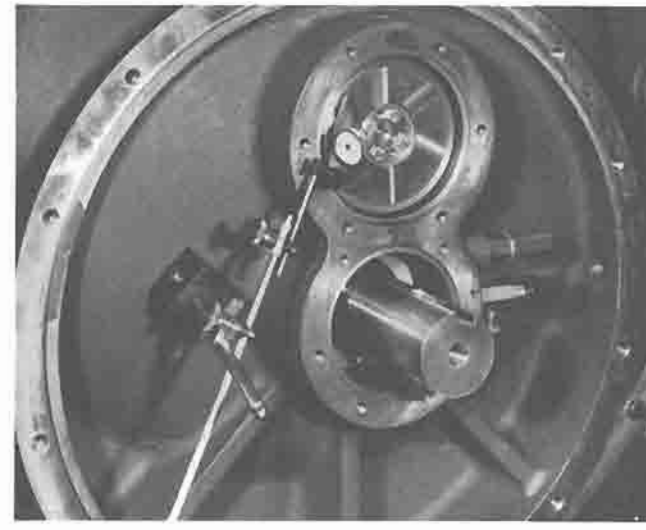


FIG. 27 – CHECKING HIGH-SPEED THRUST COLLAR RUN-OUT. MAX = .001" T.I.R.

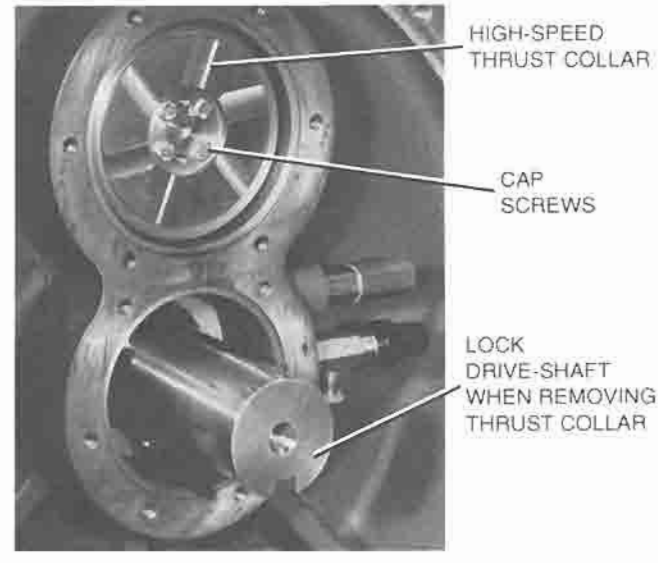


FIG. 28 – REMOVING HIGH-SPEED THRUST COLLAR

3. To remove the high-speed thrust collar it is necessary to lock the shafts to prevent rotation. Use the gear locking tool from the tool kit.

4. Remove the cap screws that hold the high-speed thrust collar to the high-speed shaft. (See Fig. 28) and remove the thrust collar. (1/4" - 20 puller holes are provided for convenience.)

5. Using hook tools found in the tool kit, pull the high-speed thrust bearing from the compressor. (See Fig. 29)

6. Inspect all parts removed above. See CLEANING AND CHECKING PARTS, page 5. Replace with new parts as necessary.

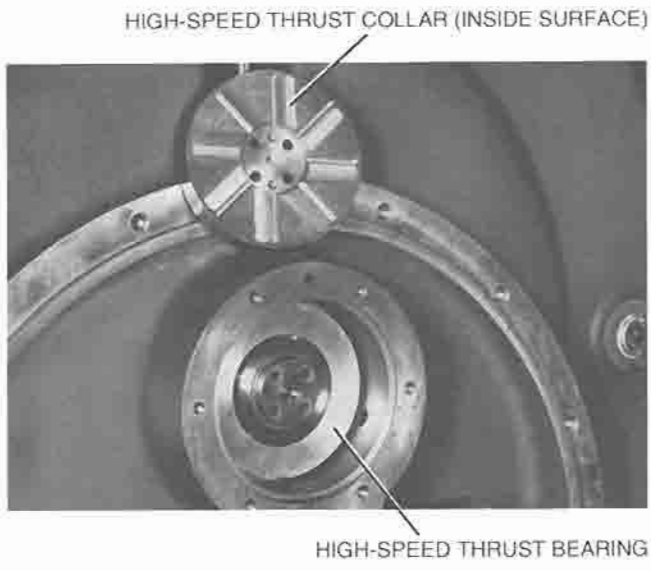
Installation

1. Apply a light coating of oil and Molykote to the inside and outside surfaces of the high-speed thrust bearing.

2. Carefully slide the high-speed thrust bearing into position, taking care that the hole in the flange engages the roll-pin in the compressor casing.

INSTALLING GEARS

1. Before installing the gears it will be necessary to hold the high-speed thrust bearing in position to keep it from being pushed out of the compressor when the high-speed shaft is inserted. (See Fig. 30 for a suggested method)



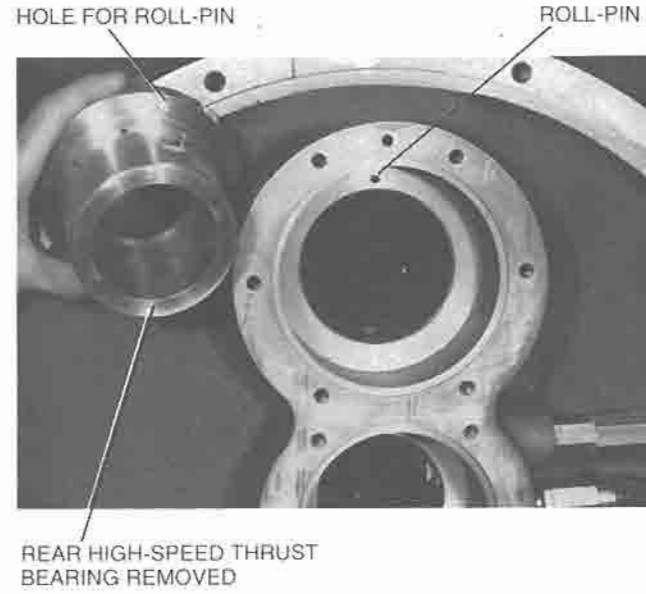


FIG. 29 – REAR HIGH-SPEED THRUST BEARING

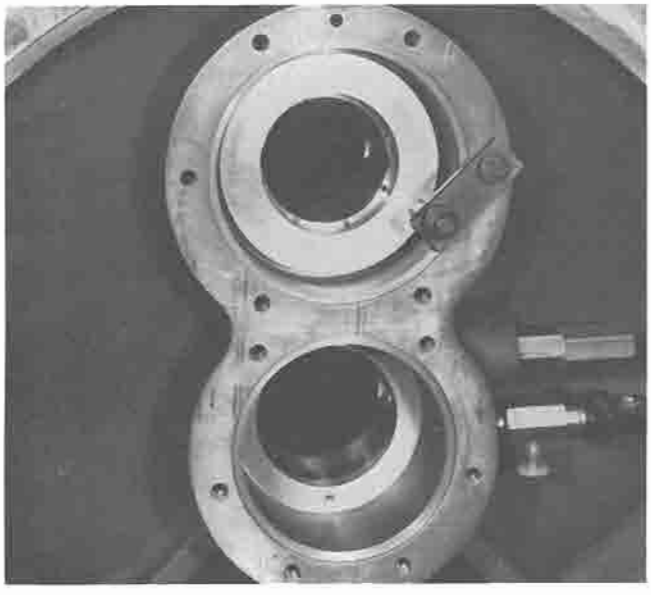


FIG. 30 – HOLDING HIGH-SPEED THRUST BEARING IN POSITION

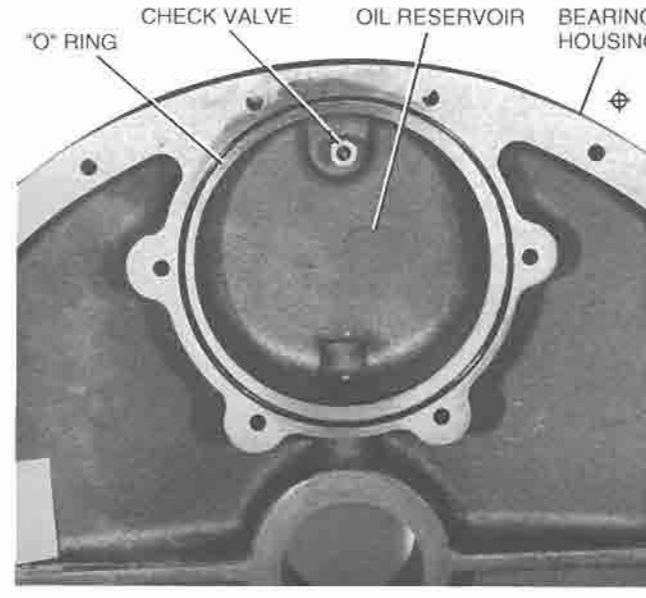


FIG. 31 – OIL RESERVOIR (BEARING HOUSING)

2. Oil the bearing surface on the drive end of the low-speed gear, and carefully insert the low-speed gear into the rear bearing.

3. Oil the rear bearing surface of the high-speed shaft, and insert it into the rear bearing. Mesh the high-speed and low-speed gear teeth and rotate the gears as the gear is installed.

INSTALLING HIGH-SPEED THRUST COLLAR AND THRUST COVER

1. To install the high-speed thrust collar it is necessary to lock the shafts to prevent rotation. Use the gear locking tool from the tool kit.

2. Note that the high-speed thrust collar has 6 tapered lands on one side and 8 tapered lands on the other side. It **MUST** be installed with the **6** tapered lands facing **OUTWARD** as shown in Fig. 28.

3. Apply a light coating of oil and Molykote to both surfaces of the thrust collar, using care that no damage occurs. Place the thrust collar into position on the end of the high-speed shaft (See step 2 above) insert cap screws and tighten to the proper torque. (See Table 3)

4. Remove the gear locking tool. Mount a dial indicator as shown in Fig. 27 and rotate the shafts to measure the run-out on the thrust collar. Maximum allowable run-out = .001".

5. Apply a light coating of oil and Molykote to the inside surface of the high-speed thrust cover. Re-install the thrust cover using a new "O" ring. (See Fig. 25)

INSTALLING BEARING HOUSING

1. Install a new "O" ring in the groove around the oil reservoir cavity. (See Fig. 31) Coat the "O" ring with Vaseline to hold it in the groove.

2. Insert guide pins apart into the rotor support. (See Fig. 23)

3. Lift the bearing housing and carefully push in place over the guide pins. Note location of dowel pins. Be careful not to damage any of the machined surfaces on either the high-speed or low-speed shafts. Leave the guide pins in position to help support the bearing housing.

4. Install the cap screws and dowel pins. Remove the guide pins and tighten the cap screws to proper torque. (See Table 3).

INSTALLING FRONT HIGH-SPEED BEARINGS (SEE FIG. 22)

1. Apply oil and Molykote to the bearing surface of the high-speed shaft.

2. Apply oil and Molykote to the inside and outside surfaces of the high-speed bearing.

3. Carefully slide the high-speed bearing into place over the shaft and into the cavity in the bearing housing. Install the retainer clip and cap screw.

INSTALLING FRONT LOW-SPEED BEARINGS

1. Apply oil and Molykote to the bearing surface of the high-speed shaft.

2. Apply oil and Molykote to the inside and outside surfaces of the low-speed bearing.

3. Carefully slide the low-speed bearing into place over the shaft and into the cavity in the bearing housing. Be sure hole in bearing flange engages roll-pin in bearing housing. (See Fig. 22)

4. Re-install the shaft locking tool.

5. Apply oil and Molykote to the lapped surfaces of the low-speed thrust collar; using care that no damage occurs. Place the thrust collar into position on the end of the low-speed shaft, insert cap screws, and tighten to the proper torque. (See Table 3 and Fig. 21)

6. Mount a dial indicator as shown in Fig. 20 and check the run-out of the thrust collar. (It will be necessary to remove the shaft locking tool in order to take this measurement.) Maximum run-out should not exceed .001" T.I.R.. If run-out exceeds .001" T.I.R. DO NOT proceed with further assembly; contact the YORK Factory Service Dept. for assistance.

7. Re-install the shaft locking tool.

8. Apply a coating of oil and Molykote to the bearing pads of the low-speed thrust bearing and to the low-speed thrust collar. Install the low-speed thrust bearing. (See Fig. 18 and 19)

INSTALLING BALANCE PISTON AND DIFFUSER PLATE

1. Install a new "O" ring on the diffuser plate.

2. Insert guide pins into the rotor support.

3. Using proper rigging methods, slide the diffuser plate over the guide pins and into position against the rotor support. (See Fig. 15 or 16)

4. Insert (4) of the bolts before removing rigging and guide pins; then insert remaining bolts and tighten.

5 Install the (8) helical springs, large end first, into the balance piston seal. Rotate each spring to lock it into place. (See Fig. 14)

6. Apply Loctite and insert the (3) cap screws (shoulder bolts) and fasten the balance piston seal and balance piston retainer to the diffuser plate.

7. After tightening the (3) cap screws, check that the balance piston is free to "float".

INSTALLING THE IMPELLER

1. Apply a light coating of oil and Molykote to the inside diameter of the balance piston seal.

2. Slide the impeller into position on the high-speed shaft using care not to damage the balance piston seal.

3. Install the impeller clamping collar and the 7 cap screws.

4. Torque cap screws as follows:

   a. Apply the torque of 120 ft. lbs. in 2 equal steps. Refer to Fig. 32 for sequence of tightening screws.

   b. Indicate impeller (See Fig. 12). If T.I.R. deviates from Fig. 12, increase torque to 150 ft. lbs. max.

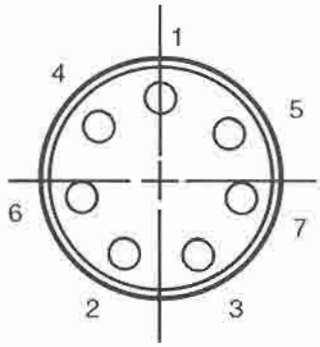


FIG. 32 – IMPELLER MOUNTING SCREWS TIGHTENING SEQUENCE

to the bolts opposite to the high side. Repeat as necessary until allowable T.I.R. is achieved.

5. Re-install compressor shaft seal and coupling following procedures outlined previously.

REMOVING THE IMPELLER EYE SEAL

NOTE: There are (4) different eye seal arrangements used on these compressors. Dis-assembly/re-assembly procedures vary slightly but are similar. Refer to Fig. 33 for eye seal arrangement.

1. Remove the (3) or (6) cap screws that hold the eye seal retainer to the nozzle base plate.

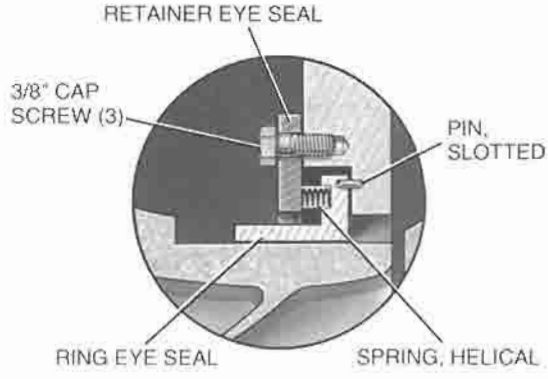
2. Remove the eye seal retainer, eye seal ring (and eye seal plate if applicable) from the nozzle base plate. Note position of the slotted pin.

> ***NOTE***
>
> *The Pre-Rotation Vane (PRV) Assembly cannot be removed from the suction connection side of the compressor. It must be removed from the inside of the rotor scroll housing AFTER the rotor scroll is dis-assembled. If dis-assembly of the PRV housing is anticipated proceed to DIS-ASSEMBLY OF THE ROTOR SCROLL, page 22. Otherwise proceed with re-assembly of the compressor as follows.*

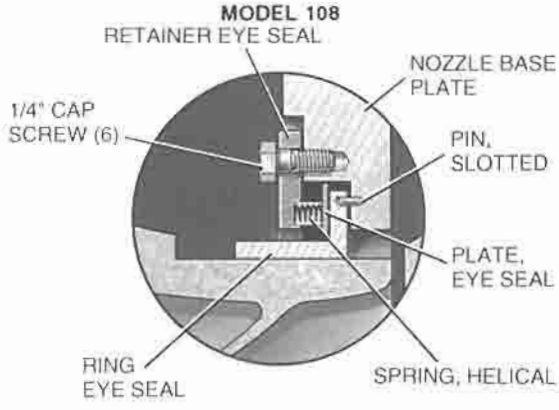
RE-ASSEMBLY OF EYE SEAL

1. Inspect all parts before re-assembly. See CLEANING AND CHECKING WEARING PARTS, page 5. Replace with new parts as necessary.

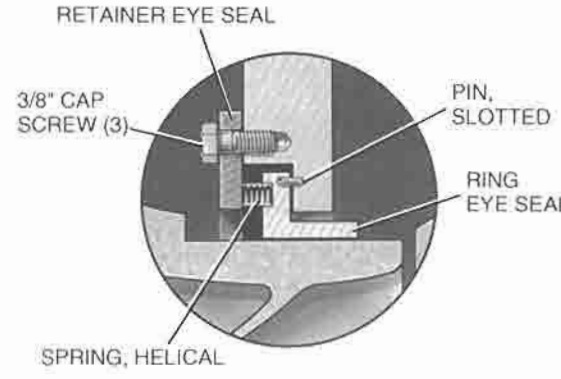
2. Be sure the helical springs are securely locked in pockets. Give each spring a clockwise twist to lock it into place.



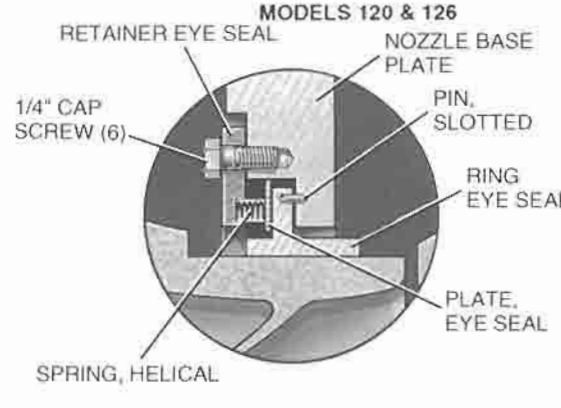
MODEL 108



MODEL 131



MODELS 120 & 126



MODEL 144

FIG. 33 – IMPELLER EYE SEAL ARRANGEMENTS

3. Place the eye seal ring and retainer (and eye seal plate if applicable) into position on the nozzle base plate. Be sure the hole in eye seal ring fits over roll-pin in nozzle base plate. Insert cap screws and tighten. Check that the seal ring is free to "float".

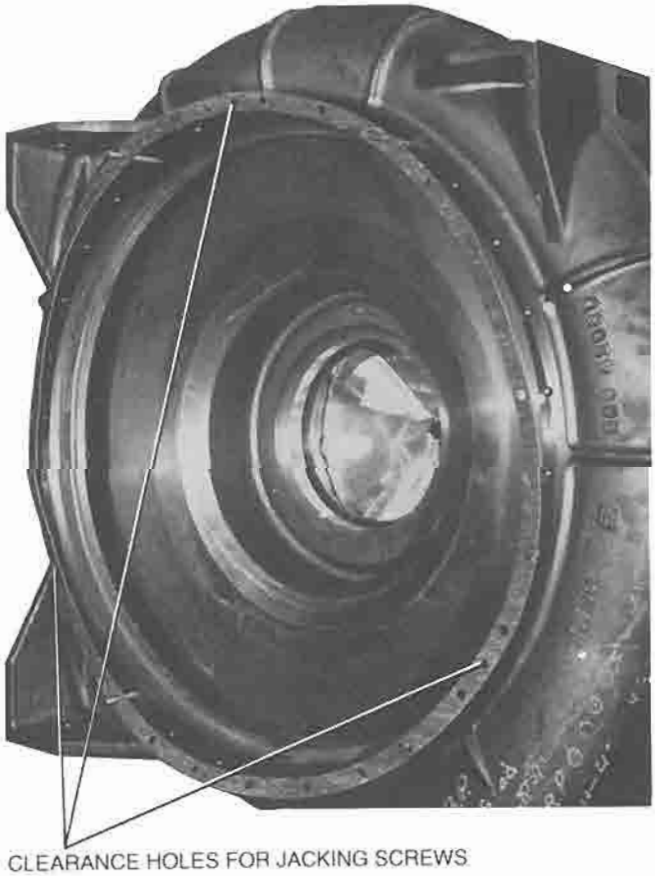
RE-ASSEMBLY OF SCROLL HOUSING TO ROTOR SUPPORT

1. Using proper rigging methods lift scroll housing assembly into place on unit base. Be sure vibration isolators are installed under scroll housing.

2. Using new gaskets, re-connect suction and discharge piping.

3. Insert guide pins into the scroll housing and install a new gasket. Note that the gasket contains 3 holes to clear the jacking screws in the rotor support. Be sure gasket is installed correctly. (See Fig. 34) Coat gasket with a mixture of oil and graphite.

4. Apply a light coating of oil and Molykote to the impeller where it enters the eye seal ring.



CLEARANCE HOLES FOR JACKING SCREWS

FIG. 34 – SCROLL HOUSING READY FOR RE-ASSEMBLY OF ROTOR SUPPORT

5. Using proper rigging methods raise the rotor support with motor adapter, into proper position and slide it into place over the guide pins.

6. Carefully slide the rotor support into place against the scroll housing. Use care that the impeller is not damaged as it enters the eye seal ring.

7. Insert the cap screws and tighten to the proper torque. (See TABLE 3)

8. Re-install the shaft seal and compressor coupling following procedures outlined previously.

9. Bolt the motor to the motor adapter.

10. Re-connect all external piping.

DIS-ASSEMBLY OF ROTOR SCROLL

> ***NOTE***
>
> *It is necessary to dis-assemble the rotor scroll ONLY if the Pre-Rotation Vane Assembly (PRV) is to be removed.*

1. Remove the cap screws then fasten the suction connection and the discharge connection to the scroll housing.

2. Remove all other external piping from the rotor scroll.

3. Support the rotor scroll by proper rigging methods; then remove the bolts holding the rotor scroll to the unit.

4. Carefully remove the rotor scroll from the unit base and rest it on the end of the suction housing. Do not lose any parts of isolators that were beneath the compressor feet. Be sure the rotor scroll is resting solidly - block if necessary. (See Fig. 35).

REMOVING THE NOZZLE BASE PLATE

1. To prevent damage, remove the impeller eye seal from the nozzle base plate. (See page 21)

2. Remove the (3) socket head cap screws that hold the nozzle base plate to the rotor scroll.

3. Using eye-bolts and proper rigging methods lift the nozzle base plate from the rotor scroll.

NOTE: On Models 108, 120 and 126 use the (3) 3/8" tapped holes from which the impeller eye seal was removed. On Models 131 and 144 use the (3) 1/2" tapped holes provided for rigging purposes.

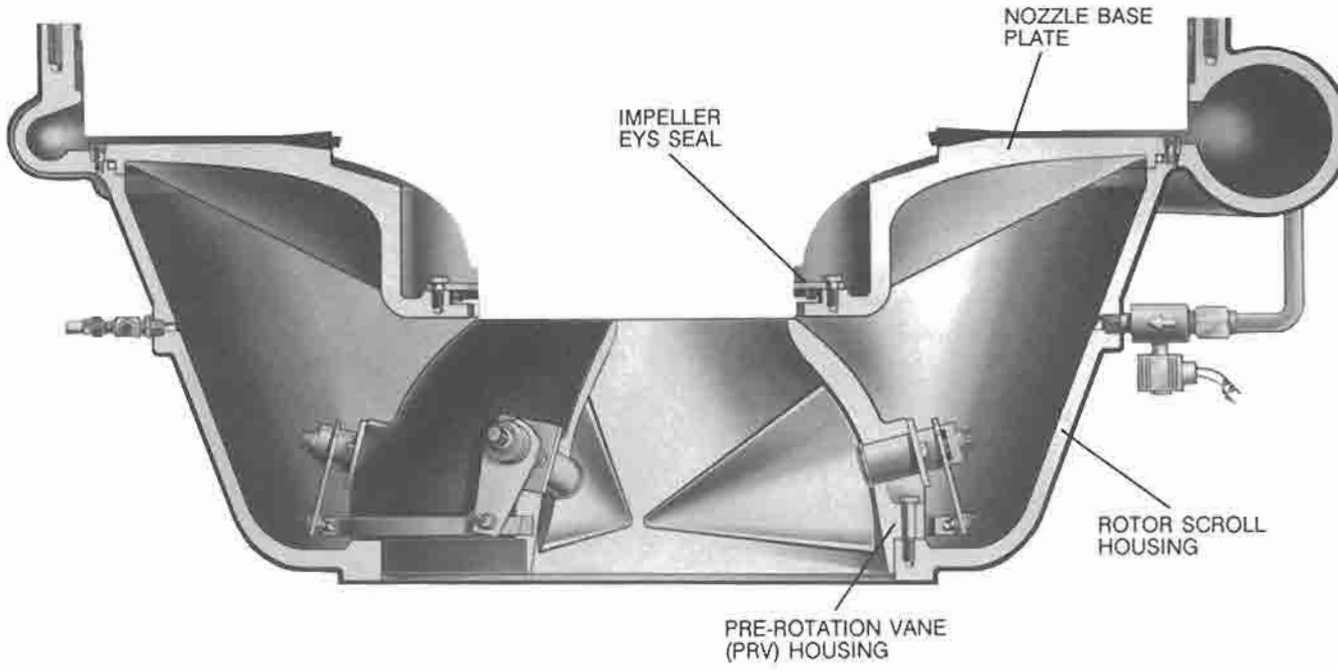


FIG. 35 – ROTOR SCROLL

REMOVING THE PRE-ROTATION VANE HOUSING

The Pre-rotation Vane Assembly cannot be removed from the suction side of the compressor.

1. Remove the 12 pt. hd. cap screw and fillpiece to disconnect the adjustable bearing rod from the vane driving ring. (Refer to Fig. 36).
2. Remove 2 hex hd. cap screws at approximately 180° apart. Replace these screws with 2 guide pins from the tool kit. Then remove the remaining screws from around the perimeter of the PRV Assembly. Carefully pull the PRV assembly about half way on the guide studs. Hook a lifting device to the assembly. Pull it off the guide studs and place on a bench to replace any parts.
3. The PRV vanes are actuated by a rotating vane driving ring through individual vane arms to each vane. Individual vanes may be removed by (a) unscrewing the cap screw which secures the vane arm to the vane; (b) lifting off the vane arm; (c) lifting off the two special washers and pulling the vane out toward the inside of the vane housing. (Refer to Fig. 37).
4. If any of the individual vanes were removed or replaced, refer to Fig's. 37 and 38. The vane cap screw must be tightened to the torque as indicated in TABLE 3.
5. Re-assemble the pre-rotation assembly and the nozzle base plate together in reverse order. Torque all screws in accordance with TABLE 3.

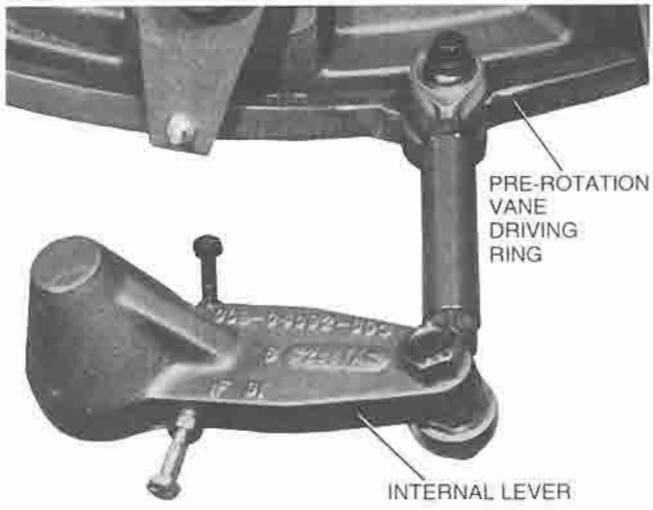


FIG. 36 – INTERNAL PARTS - PRE-ROTATION VANE ASSEMBLY

REPLACING CONTROL SHAFT ASSEMBLY

The external and internal levers are secured to the control shaft by means of a single 12 pt. hd. cap screw threaded into the internal lever. (Refer to Fig. 50).

Adjustable stops are provided in the internal lever arm. These stops ARE NOT to be used to stop the vanes in the extreme positions of normal travel, but are supplied as protection should some external force be applied to

the linkage. The stops are set about 1/32" away from the rotor scroll casting walls when the vanes are in their extreme position, and will prevent overtravel from damaging the internal vane mechanism. A friction producing compound (Thread Locker 242, YORK Part No. 013-01678) is used on the threads when the stops are initially positioned to prevent any change in position. The compound should again be used if the stops are ever removed.

If it becomes necessary to replace the control shafts on these compressors, only the following parts are required:

To replace control shafts refer to Fig. 39 and proceed as follows:

1. Reduce the system pressure to slightly above atmospheric pressure.

2. Disconnect the linkage from the external level. (Refer to Fig. 39, Detail A).

3. Loosen and remove the 12 pt. hd. cap screw and washer. (Fig. 39, Detail A).

4. Insert the special stud (See TABLE 4 or 5 - Special Tools) through the hole in the external lever and control shaft and screw the stud into the internal lever. Be sure to put a nut on the outside end of the special stud. (Refer to Fig. 39, Detail B).

5. Using a hammer and block of hard wood, tap the outside end of the stud to loosen the internal lever. DO NOT REMOVE THE SPECIAL STUD.

6. Remove the cover plate cap screws.

7. Slide the external lever from the control shaft and cover plate from the control shaft.

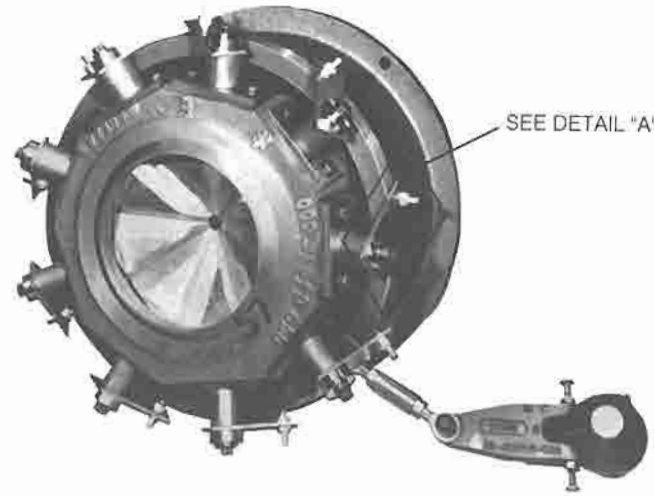
8. Remove the external lever and the control shaft cover from the control shaft.

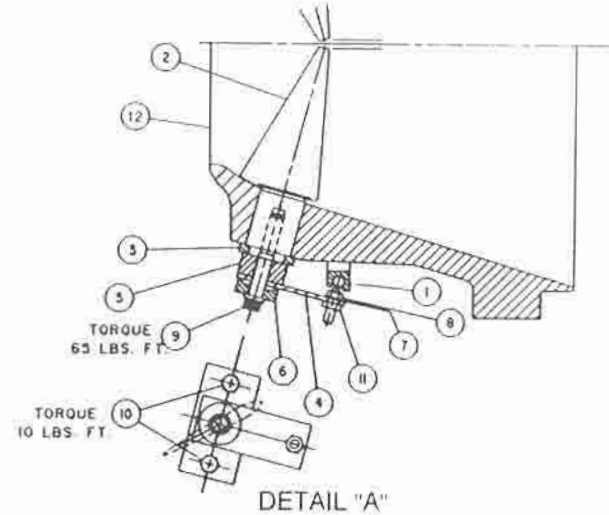
9. Replace the existing gasket with a new one.

10. Install the two new "O" rings and one "O" ring in their respective grooves in the new control shaft - small ring in groove in taper. Liberally coat the control shaft ("O" rings and neoprene sleeve) and the inside of the cover plate with YORK Valve Stem Lubricant. Do not lubricate the tapered surfaces of the shaft.

11. Slide the new shaft with "O" rings into position over the special stud.

12. Install the cover plate but do not tighten the cap screws at this time.





DETAIL "A"

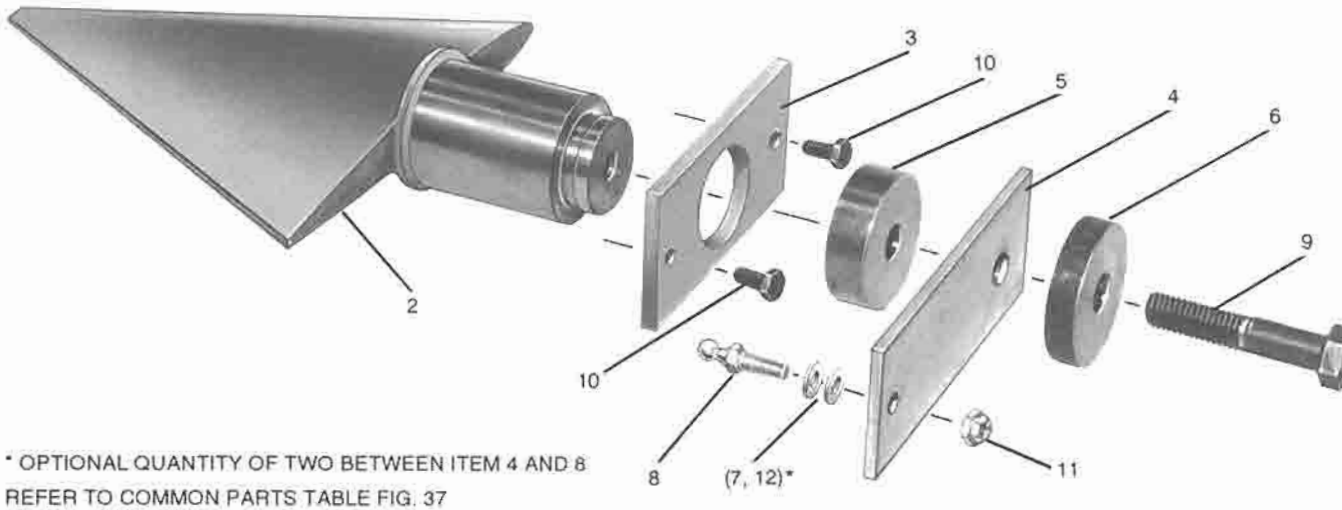
ITEM NO.	DESCRIPTION	QTY.	ITEM NO.	DESCRIPTION	QTY.
1	Ring, Driving	1	7	Washer	10
2	Vane	9	8	Stud, Ball	9
3	Retainer	9	9	Screw - 12 PT	9
4	Arm, Vane	9	10	Screw - Hex HD	18
5	Spacer, Arm	9	11	Nut, Self Locking	9
6	Washer	9	12	Housing	1

FIG. 37 – PRE-ROTATION VANE HOUSING ASSEMBLY

13. Tighten the nut on the outside end of the stud against the end of the control shaft to pull the internal lever hard up on the taper of the shaft.

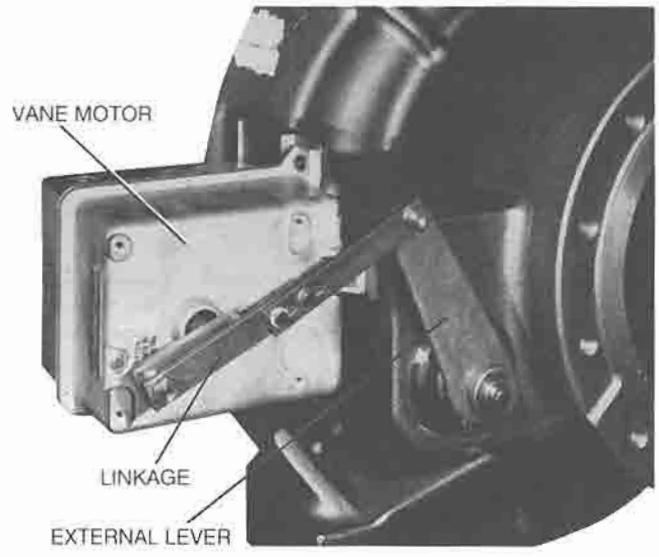
14. With the cover plate loosely installed, close the vanes by turning the nut on outside end of the stud. Position the external lever on the control shaft so that the indicator pin on the lever aligns with the closed "C" mark on the housing. Push external lever arm slightly to seat on taper.

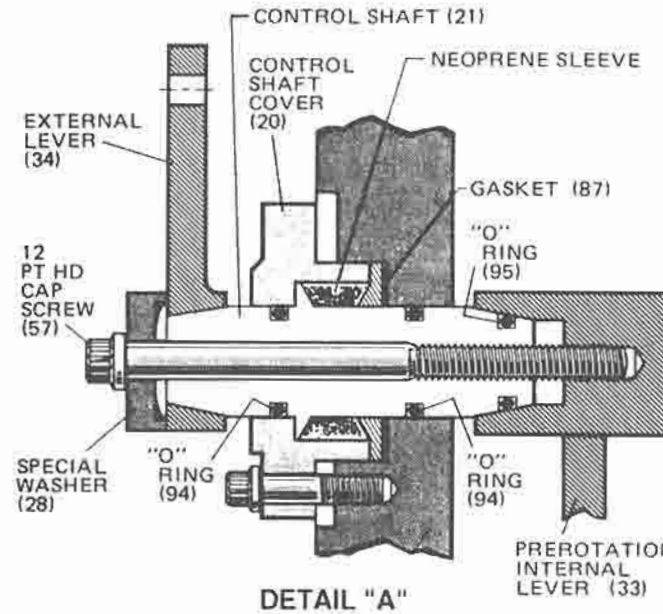
15. Remove the nut and stud.



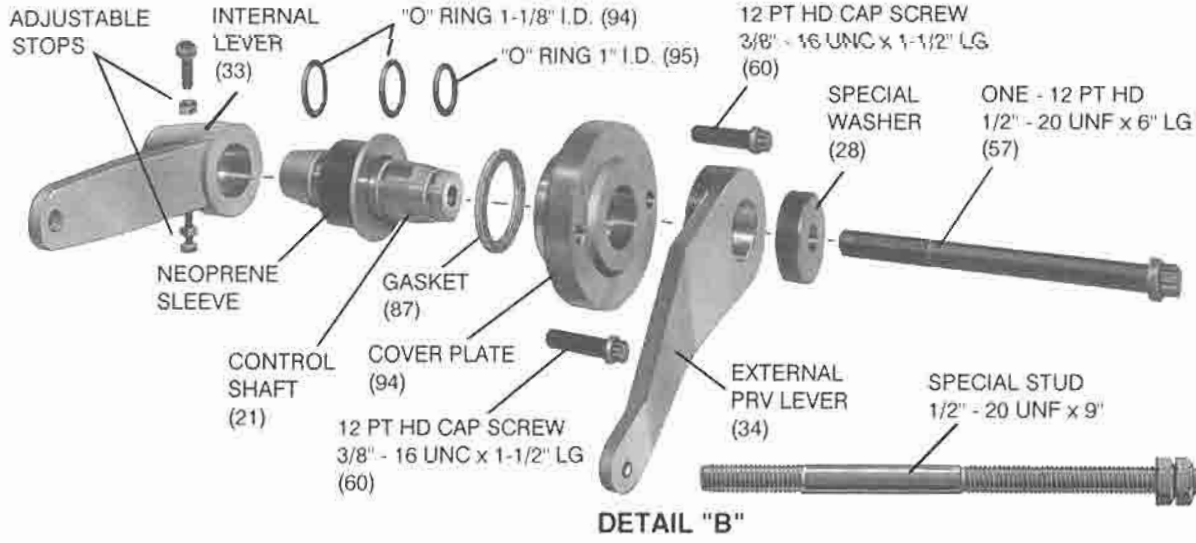
* OPTIONAL QUANTITY OF TWO BETWEEN ITEM 4 AND 6
REFER TO COMMON PARTS TABLE FIG. 37

FIG. 38 – PRE-ROTATION VANE ASSEMBLY





DETAIL "A"



DETAIL "B"

FIG. 39 – REPLACING CONTROL SHAFT ASSEMBLY

16. Install the 6" cap screw and washer. Draw the cap screw tight. Move the external lever to the "open" and "closed" positions, to check the indicator points on the cover plate. Readjust the external lever position, if necessary.

17. Using a torque wrench, tighten the bolt to a torque of 75 ft. lbs.

18. Move the external lever to its mid position (vanes half open) and tighten the cover plate cap screw to a torque of 35 ft. lbs. THIS IS IMPORTANT AND ASSURES THAT THE SLEEVE WILL TWIST EQUALLY WHEN THE VANES ARE MOVED TO EITHER THE WIDE OPEN OR THE FULLY CLOSED POSITION.

19. Connect the linkage to the external lever.

20. Tighten the nut on the outside end of the stud against the end of the control shaft to pull the internal lever hard up on the taper of the shaft.

21. With cover plate loosely installed, close the vanes by turning the nut on outside end of the stud. Position the external lever on the control shaft so that the indicator pin on the lever aligns with the closed "C" mark on the housing. Push external lever arm slightly to seat on taper.

22. Remove the nut and stud.

23. Install the 6" cap screw and washer. Draw the cap screw tight. Move the external lever to the "open" and "closed" positions, to check the indicator points on the cover plate. Readjust the external lever position, if necessary.

24. Using a torque wrench, tighten the bolt to a torque of 75 ft. lbs.

25. Move the external lever to its mid position (vanes half open) and tighten the cover plate cap screws to a torque of 35 ft. lbs. THIS IS IMPORTANT AND ASSURES THAT THE SLEEVE WILL TWIST EQUALLY WHEN THE VANES ARE MOVED TO EITHER THE WIDE OPEN OR THE FULLY CLOSED POSITION.

26. Connect the linkage to the external lever.

NOTE: Store the special stud for use in removing and re-installing subsequent control shaft assemblies.

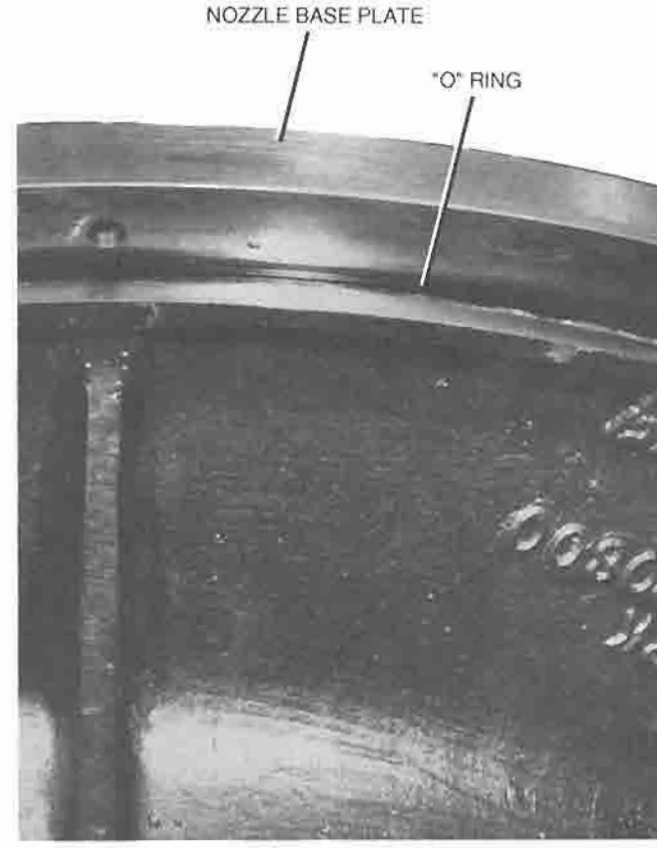


FIG. 40 – NOZZLE BASE PLATE

RE-ASSEMBLY OF NOZZLE BASE PLATE

1. Install a new "O" ring on the nozzle base plate. (See Fig. 40)

2. Insert guide pins into 2 of the holes in the scroll housing.

3. Using proper rigging methods, lower the nozzle base plate over the guide pins, into position in the scroll housing. Remove eye-bolts and guide pins; insert cap screws and tighten.

4. Re-install the impeller eye seal following instructions on page 21.

5. Re-assemble the scroll housing to the rotor support. (See page 22)

SECTION 3
OIL PUMP SERVICE

OIL PUMP

The oil pump furnishes oil to the compressor's rotating components prior to start-up, during compressor operation and during coastdown. If it is necessary to service the oil pump use the following procedures.

REMOVING OIL PUMP FROM THE OIL SUMP

1. De-energize the power supply to the oil pump and oil sump heater. Remove electrical leads from fusite connections and transducers.

2. Drain oil from oil sump through drain valve in cover plate.

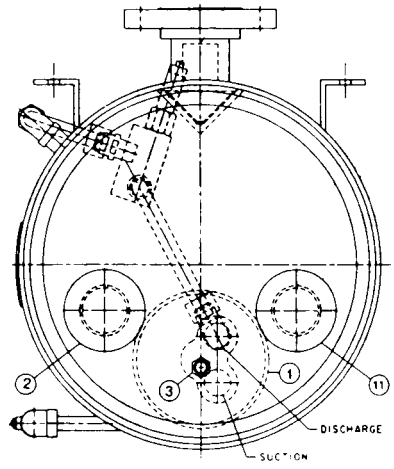
3. Remove the hex nuts from the oil sump cover. (See Fig. 41)

4. After all nuts are removed, pull the oil sump cover loose and remove the cover and oil pump assembly. (See Fig. 41)

DIS-ASSEMBLING THE OIL PUMP

IMPORTANT

Before dis-assembling the pump, notice the location of the match marks on the pump cover and housing. The match marks must line up when re-assembling the pump.



ITEM NO.	DESCRIPTION	QTY.
1	OIL PUMP WITH MOTOR	1
2	HEATER	1
3	SENSOR, TEMP.	1
4	VALVE, RELIEF	1
5	VALVE, STOP ANGLE, 3/8"	2
6	BOX, ELECTRICAL	1
7	COVER, ELECTRICAL BOX	1
8	SIGHTGLASS	2
9	GASKET, COVER PLATE	1
10	VALVE, STOP ANGLE, 1/4"	1
11	HEATER	1

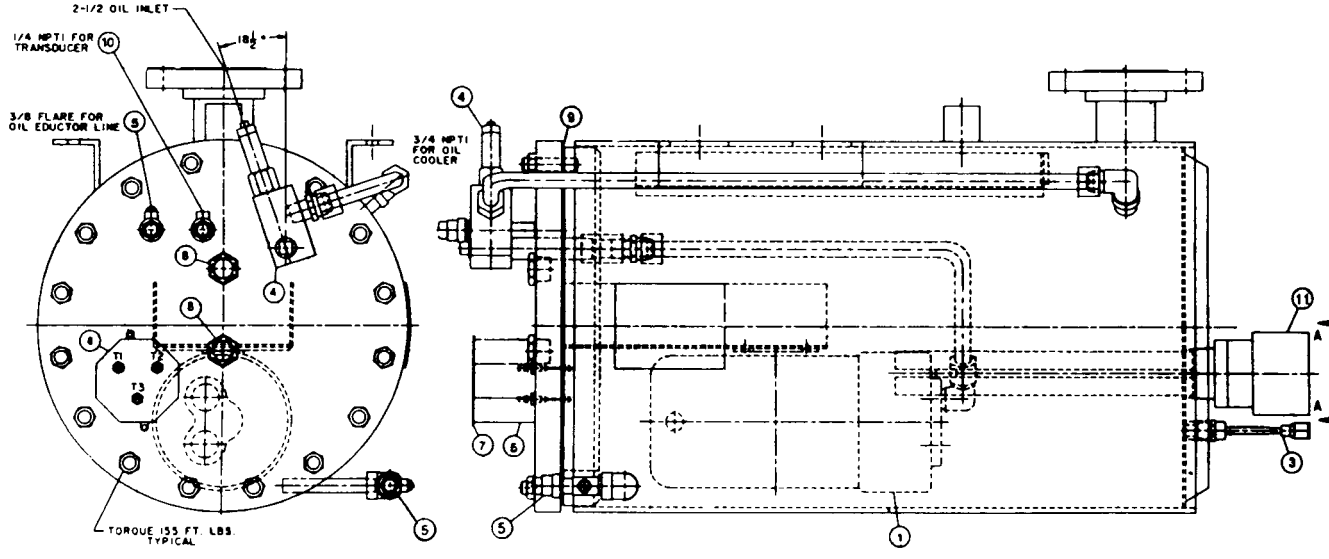


FIG. 41 - OIL RESERVOIR ASSEMBLY

To remove the oil pump proceed as follows:

1. Remove the eight cap screws (four long screws marked "X" and four short screws marked "Y") from the face of the oil pump cover. Refer to Fig. 42.

2. Remove the drive gear assembly by screwing the inner pump gear puller screw (10-24 UNC x 1-1/2 lg.), supplied with the pump kit, into the tapped hole in the drive gear. (Refer to Figs. 42 and 43). After the screw is in place hold screw and gently pull the gear from the key and the shaft.

3. Remove the key from the shaft. (Refer to Fig. 44 - Detail B).

   NOTE: No seal in this pump.

4. To remove the pump housing pull lose from the motor and slide over the motor shaft.

RE-ASSEMBLY OF OIL PUMP

1. Clean all parts of pump with approved safety solvent, use great care to eliminate all dirt. Lubricate all parts with clean YORK refrigerant oil. To re-assemble proceed as follows:

2. Lubricate the motor shaft with refrigerant oil. Position housing in place over the motor shaft and against the motor housing. The pump housing match mark must be on one side of the motor. Line the pump housing screw holes up with the screw holes in the motor housing.

3. Lubricate the shaft key and place it in the keyway on the shaft.

4. Lubricate the drive gear. Slide the gear over the shaft, line up the keyway with the key and drive gear. Push the drive gear in place.

5. Lubricate the drive gear and place it into the cavity of the oil pump housing.

6. Lubricate the face and the teflon coated shaft bearing of the cover assembly. Locate the cover as shown in Fig. 45 and gently slide onto the end of the shaft. Line up holes and place "X" long screws and "Y" short screws in their proper holes according to Fig. 42. Tighten the "X" long screws in a 1, 3, 2, 4 sequence. Tighten the "Y" short screws in a 5, 7, 6, 8 sequence. Torque screws to 15 foot lbs. using the alternating tightening method.

RE-ASSEMBLING OIL PUMP ASSEMBLY INTO OIL SUMP (REFER TO FIG. 51)

Before assembling oil pump into oil sump pump clean the oil sump with approved solvent using the utmost care to eliminate all dirt.

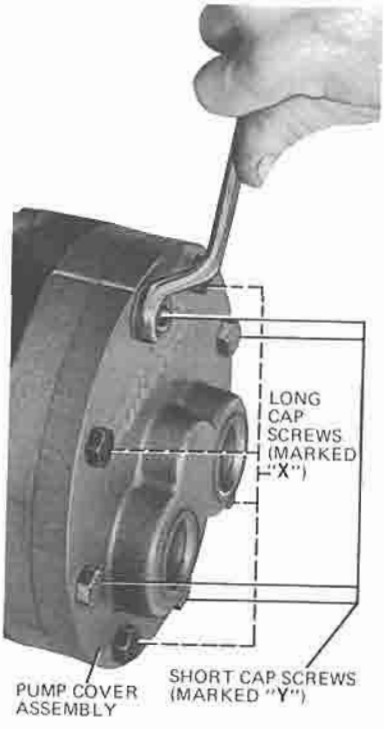


FIG. 42 – REMOVING OR REPLACING PUMP COVER CAP SCREWS

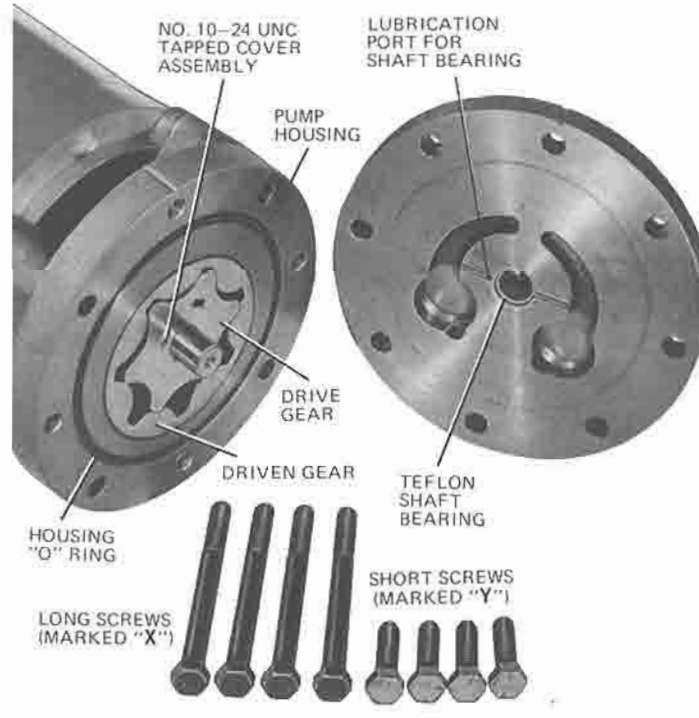
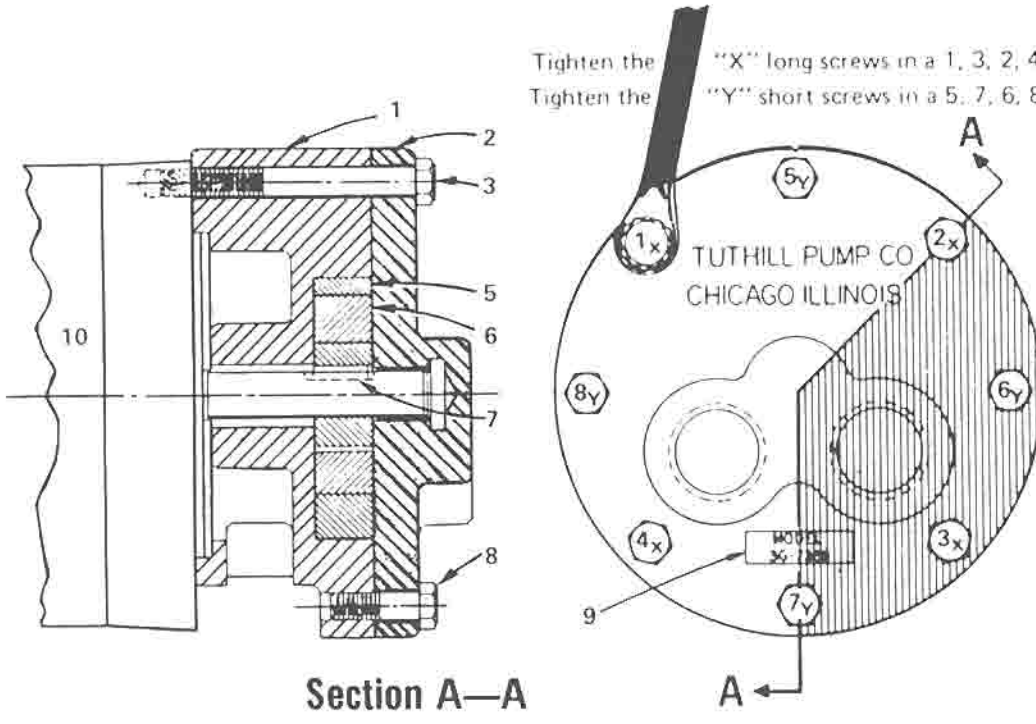
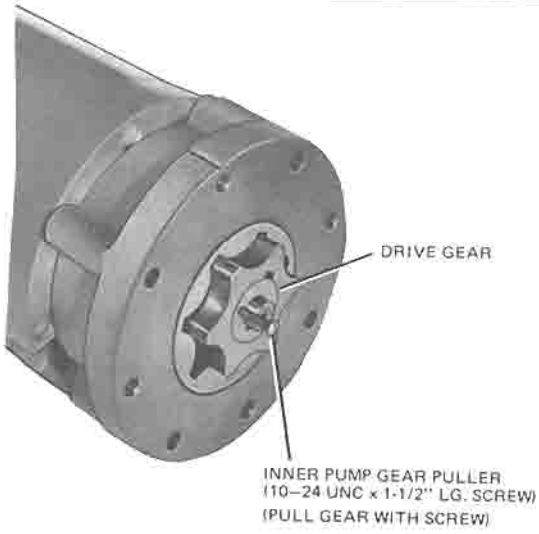


FIG. 43 – SCREWS AND COVER ASSEMBLY

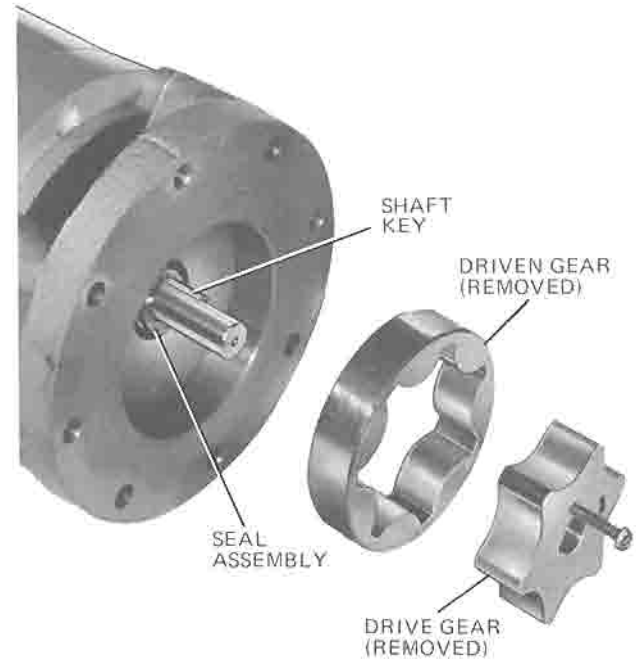


Section A—A

NO.	DESCRIPTION	NO. PER UNIT
1	Housing	1
2	Cover Assembly	1
3	Hex Hd. Cap Screw	4
4	—	—
5	Driven Gear	1
6	Drive Gear	1
7	Square Key	1
8	Hex Hd. Cap Screw	4
9	Model Number Identification	1
10	Motor	1



DETAIL "A"



DETAIL "B"

FIG. 44 – REMOVING THE DRIVE GEAR (DETAIL "A")

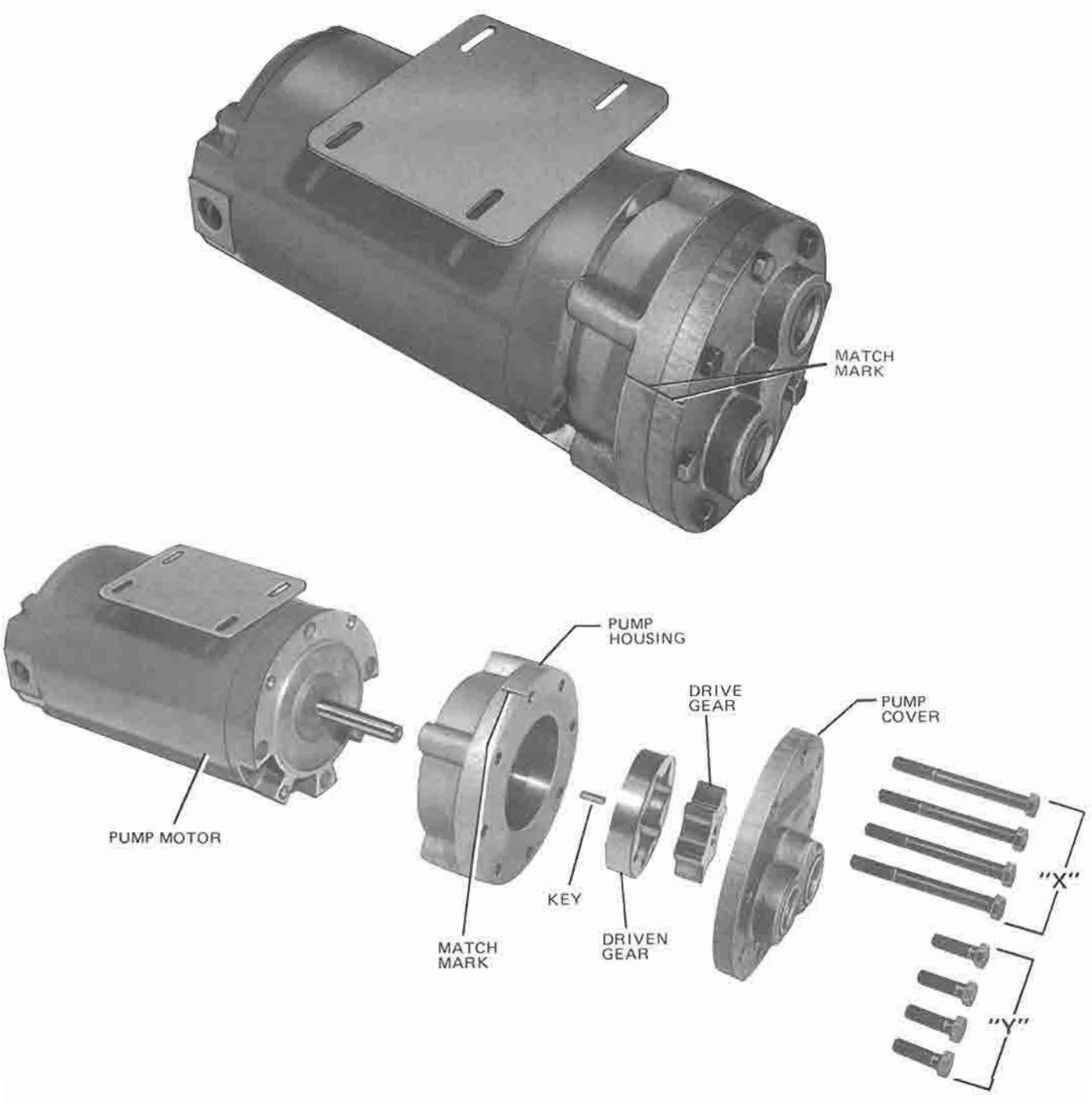


FIG. 45 – COMPLETE PUMP AND MOTOR ASSEMBLY

1. Replace oil sump cover gasket with a new one. Lubricate gasket with YORK refrigerant oil and graphite.

2. Assemble the gasket and the oil pump and sump cover assembly to oil sump using the (16) 5/8" hex nuts. Tighten nuts using the alternating tightening method. Torque to 155 ft. lbs.

3. Reconnect all electrical leads to fusite connection on sump cover. Reconnect oil lines. Reconnect transducers.

4. Charge oil into oil sump. See OPERATING INSTRUCTION, FORM 160.49-O1. Be sure oil is compatible with refrigerant being used.

5. Make sure there are no leaks around the cover and connections.

MAINTENANCE RECORD

SERVICE PERFORMED	DATE	BY

Official Sponsor
of the 1992
U.S. Olympic Team

36USC380

P.O. Box 1592, York, Pennsylvania USA 17405-1592

FORM 160.48-M1 (493)
SUPERSEDES: 160.48-M1 (992)

SHU 3M 593 1.60
CODE: SJ4A