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SERVICE BULLETIN

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SUBJECT:

CONTACT SEAL SERVICE, INSPECTION AND REPAIR GUIDE

CONTACT SEALS SHOULD ONLY BE SERVICED BY EXPERIENCED PERSONNEL.

PURPOSE

This instruction contains servicing information for 17 Series contact seals. Detailed step by step disassembly and reassembly information as well as general information are given in Section I. Section II contains reference drawings, nomenclatures and a speed Service Chart. Item numbers on the drawings in Section II are listed in the speed service chart in the suggested removal order. Refer to Section I for detail and dimensional tolerances.

MACHINES AFFECTED

17M, P, S

GENERAL

Three types of contact seals are used on 17 Series compressors. Figure 4 (Section II) illustrates the most commonly used arrangement. This seal is supplied on all 30 and 40 size compressors.

A 50 or 60 size compressor will seldom be supplied with a contact seal but if it is, it will generally use the type shown in Figure 3 if the application requires.

The 400 Series compressor seal is shown in Figure 5.

TOOLS REQUIRED

A double pin spanner wrench will be required to remove the coupling lock nut. A single pin spanner wrench will be required to remove the shaft seal nut. A set of mechanic's hand tools, including a socket set, dial indicator, prussian blue, feeler gauges and outside snap ring pliers are essential.

PROCEDURE

Determine if the seal is leaking. Seal leakage may be due to a thrust bearing failure. Therefore, plan to inspect the thrust bearing while inspecting or repairing the seal. The contact seal is designed to prevent refrigerant or oil leakage on shutdown and refrigerant leakage during operation. Some seepage of oil through seal during operation is normal.

Shutdown leakage will first be indicated by the oil level rising in the atmospheric chamber (oil return pump chamber). Leakage will be between the contact sleeve and the shaft sleeve or the packing ring (H ring) and the contact sleeve. A leak at the packing housing gasket is possible but not usual. Refrigerant will blow out of the seal after the oil has leaked out of the seal chamber.

If refrigerant leakage is detected but no oil level increase is noted in the atmospheric chamber, refrigerant gas may be leaking between the shaft shoulder and rotating seal ring.

Operating leakage will be indicated by an excessive amount of oil leaking into the atmospheric chamber (oil return pump chamber). Oil leakage is expected and the acceptable amount depends on the application and operating conditions. If the chamber only needs to be pumped back once every eight hours, the leakage is considered normal. If pumping back more than once in a four hour period is required, the seal should be checked at the next shutdown inspection. Slight indications of refrigerant at the seal are normal since the oil which passes through the seal will contain some refrigerant. If excessive refrigerant is blowing from the seal, a seal assembly inspection is warranted to determine the cause of the leakage. Some discretion must be used when determining that refrigerant leakage from the seal is excessive.

Note: A seal can be "run-in" and usually initial leakage will reduce after a run-in period of 24 to 48 hours.

SEAL DISASSEMBLY

Evacuate all pressure from machine and de-energize driver. In order to definitely determine the cause of leakage it will be necessary to disassemble the seal. Disassemble only as far as necessary to repair. Full disassembly is given for general information and is not normally required. Disassembly procedure is as follows:

Disassembly - 30, 40, 50 and 60 Contact Seal (Figures 3 and 4)

1. Remove shaft coupling and spacer.
2. Remove windage baffle, oil collector ring and necessary piping.
3. Loosen seal housing cover carefully and remove. Place on bench with contact seal face downward on a soft cloth over clean cardboard.
   Note: Protect the seal faces at all times.
4. Press downward on seal housing to depress seal spring.
5. Using outside snap ring pliers remove contact sleeve snap ring. Release pressure on housing and spring will force sleeve out of housing. If "H" ring is to be replaced, the new "H" ring can be installed in the housing, light oil applied, and the contact sleeve re-installed into the seal housing. If further inspection of the seal is indicated do not reassemble the seal housing until all parts are inspected.

NOTE: A seriously leaking "H" ring may be caused by the contact sleeve rotating. Placing a dowel pin into the seal housing or packing housing to index onto the snap ring gap will prevent rotation.

6. Remove lubrication header.
7. Remove outer carbon seal ring. Be careful whenever handling seal parts not to touch or damage surfaces. Clean any parts that are to be reused with solvent and coat with light oil. Place in protected area where carbon ring will not be damaged.
8. Using single spanner wrench, remove seal nut. (First loosen set screw in seal nut if it exists.) Do not let spanner wrench hit shaft threads. Do not use punch. Remove shaft sleeve and contact ring key.
9. Carefully remove contact ring. Be sure contact ring does not become cocked or jammed. If jamming should occur, reinstall shaft sleeve and nut (if threads are showing) to free it. Tap shaft sleeve lightly if threads are not showing. Remove inner carbon ring.
10. Remove the diaphragm retaining ring and key for inner carbon ring. Screws must be loosened evenly because of spring pressure exerted by seal guide spring.
11. Remove remaining guide ring and seal guide spring.

NOTE: Exercise caution in handling seal parts. Faces are lapped and any corrosion or scratches will cause seal leakage when the seal is reassembled.

12. If it is desired to replace the felt ring, the seal housing must be removed.

Disassembly - 400 Series Contact Seal (Figure 5)

1. Remove shaft coupling and spacer.
2. Remove windage baffle, oil collector ring and necessary piping.
3. Remove seal housing cover and place on bench for disassembly.
4. Using outside snap ring pliers, remove contact sleeve snap ring.
5. Remove evenly the four (4) lubricating ring bolts.
6. Place contact sleeve in protected area to prevent damage to lapped face. At this point the "O" rings can be replaced. If additional inspection is not required, apply light oil on the "O" ring and mating surface to allow assembly without binding or pinching "O" rings.
7. To inspect or replace remaining seal assembly, remove carbon ring. Carefully handle this ring and place in protected area to prevent damage.
8. Using spanner wrench, remove lock nut. Do not use a punch to remove this nut. Remove seal lock nut set screw if provided.
9. Carefully remove shaft sleeve, contact ring key and rotating contact ring. If contact ring binds it will be necessary to re-install shaft sleeve and tap lightly until contact ring can be removed.

NOTE: An "O" ring is located at the shaft shoulder under the contact ring. Replace "O" ring if damaged or deformed.

10. Remove the inner carbon ring. Handle with care and place in protected area. Seal surface must not be scratched or otherwise damaged.
11. Loosen evenly the bolts holding the retaining ring and remove the inner carbon ring key, retaining ring, diaphragm, guide ring and spring.
12. The external contact seal housing can now be removed.

INSPECTION

The guide ring (22) (Figure 4) was redesigned in 1955 adding several holes to allow passage of oil from the seal housing space to the journal bearing during operation when the inner carbon ring is not in contact with the seal ring. Prior to this change a relief valve (Figure 1) or check valve (Figure 2) arrangement were used to relieve pressure from the seal assembly housing.

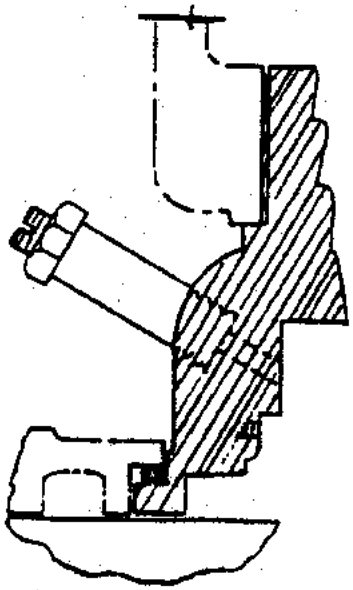

Figure 1
Adjustable Relief Valve

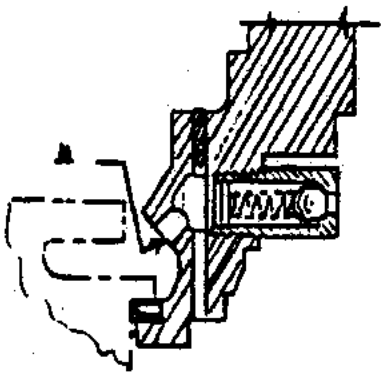

Figure 2
Check Type Relief Valve

If an old style guide ring is replaced, the relief device must be removed and hole plugged to prevent low seal oil pressure. If the adjustable type (Figure 1) is removed plug the 1/2" opening with a 1/2" pipe plug. If the check valve type (Figure 2) is used, tap and plug the 1/8" hole in behind the valve as well as the 1/2" opening. Failure to plug these openings will allow oil to bypass the bearing.

On the 30 Series contact seal housing, a small bleed hold (A Figure 2) was provided until October 1964. If there is adequate seal oil housing pressure and the seal end journal bearing temperature is not excessive, then the bypass hole need not be plugged. However, if oil loss and/or low seal oil housing pressure are experienced, check for a bypass hole and plug.

IMPORTANT: Check the shaft float (thrust clearance) to see that it is in the range of .008" - .012". Many contact seals are condemned when actually excessive thrust clearance is the cause of leakage.

Seal oil leakage is usually attributed to the packing ring if excessive float exists. The packing ring is in the form of an "H" cross section or "O" ring (400 Series). One side of the packing grips the contact sleeve and the other side is held against the packing housing. On startup of the compressor, the shaft and seal parts, including the contact sleeve, move toward the thrust end. When the shaft float exceeds .012" the packing ring loses its grip on the contact sleeve and causes a leak at this point. The web of the "H" cross section does not have sufficient flexibility to move with the contact sleeve more than .012". Excessive wear of the "H" ring may be caused by contact sleeve rotation. A dowel indexed between the snap ring opening or a slot in the contact sleeve will prevent movement.

The position of the seal housing cover and seal housing itself must be checked to insure the shaft is operating concentric within them. If the housing cover is not centered (concentric) to the shaft an uneven force will be applied to the contact sleeve tending to cock the sleeve. If the contact sleeve is not aligned perfectly with the carbon ring and rotating contact ring, leakage will result. Normally the maximum run out allowable would be .001". The housing cover should be doweled to the seal housing and the housing doweled to the compressor casing to insure proper alignment. Be sure position of shaft approximates the running position when checks are made. Excessive bearing wear or other journal bearing problems can cause the shaft to lose concentricity with housing. Therefore, check journal bearings prior to adjusting seal housing assembly location.

Most contact seals are designed to exert a total spring pressure of 90# to 120# at operating height. A check of the spring tension is warranted if leakage is reoccuring. Insufficient spring pressure will not keep contact ring forced against carbon ring.

If there has been a failure of the thrust bearings, it will be necessary to check the rotor position to determine if it was possible for the impellers to rub against internal stationary parts of the compressor. To check the rotor position:

1. Force rotor against counterthrust bearing toward drive end.
2. Move the rotor toward the thrust position until the rotor is in the running thrust position.

3. With the rotor in this position, the shaft shoulder against which the contact ring is fitted, should extend 1/2" beyond the flange onto which the seal housing bolts for most of the 30 and 40 series compressors and should be flush with this flange on most of the 50 and 60 series compressors. All shaft shoulders for the contact rings are either extended 1/2" or flush with the flange except on the 400 series compressors. The shaft shoulder on the 400 series compressor will be 1" ± .005" inside from the seal housing flange. (See Figure 5 for locating dimensions).
4. After recording operating position shaft float, remove thrust housing and bearing against force rotor forward against counter thrust bearing. Move rotor toward thrust position (toward suction) until impeller hits against internal part. Record this float. If the dimensions of the operating position float equals the shaft float without the thrust assembly, the possibility exists that impellers have rubbed the internal stationary parts of the compressor. If rubbing is indicated, the upper half of the compressor will have to be removed and the rotor and other internal parts inspected. If counterthrust has failed determine shaft position with rotor against failed counterthrust. Remove counter bearing. If rotor cannot be moved further in direction of counterthrust, then internal parts may have rubbed.

To reset rotor position, the thrust assembly and gasket must be removed. Leave the housing shims in place.

1. Place straight edge against the thrust housing shim.
2. Move rotor toward thrust position until thrust disc (new disc if old one has been damaged) touches the straight edge. The rotor is in its normal operating position.
3. Adjust shims on thrust housing to adjust float of shaft (.008 - .012"). Adjust spacer (shim as required) between thrust disc and thrust shaft to set position of rotor.
4. This rotor position should provide 1/2" between shaft shoulder and seal housing flange at seal end on most 30 and 40 size compressors; flush most 50 and 60 size compressors; and 1" inside on 400 series compressors to determine this location, use a straight edge across compressor casing.

NOTE: Adjust shims behind thrust bearing on 400 series thrust bearing to adjust thrust clearance (.008" - .012").

When any damaged thrust parts have been replaced check shaft float. Shaft float must fall in the .008" - .012" range. After thrust check is finished the seal can be reassembled.

SEAL REASSEMBLY

Before assembling the seal, clean all gasket surfaces. Be sure new gaskets are of correct thickness. Coat with an oil-graphite mixture to prevent sticking. Do not use any other compounds such as pipe dope, leak-loc, etc. Check the oil holes and be sure holes in both the gaskets and flanges line up properly. Prior to assembly, check all seal parts to be sure they are clean. Check "O" rings and replace if damaged or worn.

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Seal Reassembly - 30, 40, 50 and 60 Series

1. If housing has been removed, install new felt ring on seal housing land. Felt ring should be soaked in light oil prior to installation. (17S40 compressor may require adapter ring under felt ring.)
2. Seal guide spring, guide ring, diaphragm, retainer ring and inner carbon ring key can be bench assembled into seal housing.
3. After checking thrust movement, assemble seal housing to machine. Replace 1/16" seal housing gasket as required. Soak gasket in light oil if replaced.

NOTE: Housing can be mounted onto machine prior to installation of parts in Step 2.

4. Guide ring clearance must be between .003" and .006" on the diameter. Use blueing on the seal ring and fit against the shaft shoulder.
5. Place rotating seal ring onto shaft after "blueing" to shaft shoulder. Remove rotating seal ring and check ring contact to shaft shoulder. There must be a 360° continuous contact. Non-continuous contact may allow leakage of refrigerant at shut down. To obtain continuous contact, lap shaft shoulder. Do not lap ring.

NOTE: The rotating seal ring is lapped to maintain parallelism between the two faces. Any mishandling or machining of this piece will lose these close tolerances thus causing seal leakage.

6. Index inner carbon to key and install carefully. Carbon and mating surfaces must be dry and free of oil, dirt, etc.
7. Install previously fitted rotating seal ring. It must be clean and dry.
8. Install shaft key.
9. Install shaft sleeve and blue in to contact ring.
10. Install shaft sleeve nut. Blue it to shaft sleeve. Before and after tightening shaft sleeve nut, check run out of shaft to be sure tightening has not caused shaft bending. If runout is indicated, loosen nut and recheck. Rotating shaft sleeve between nut and rotating ring may eliminate runout condition. Loosen nut and rotate ring 90° and retighten nut. Repeat as required. If over tightening is causing runout, back off on nut slightly and stake with set screw.
11. Install lubricating header, gasket and bolts. Header holes must be clean and clear.
12. Install outer carbon ring. Be careful not to jam carbon ring while sliding over shaft sleeve. Carbon ring must be clean and dry. No oil or lubrication should be used on surfaces during assembly.

NOTE: There should be approximately .010" diameter clearance between carbon ring and shaft sleeve.

13. Replace "H" ring and gaskets as required on seal housing cover. Install spring over seal sleeve and place face (contact surface) down on cloth covered cardboard. Oil "H" ring and contact sleeve. Lift seal housing cover and place onto contact sleeve carefully to be sure "H" ring is not damaged. Press downward on seal housing to compress spring sufficiently to install snap ring over contact sleeve. Install assembly onto machine.

NOTE: Fit of "H" ring on contact sleeve must allow movement of contact sleeve. Spring must be able to seat contact sleeve against carbon at shutdown and follow shaft float when operating. Check movement with dial indicator after servicing to be sure sleeve floats with shaft. Leakage will occur otherwise.

13A. Alternate Method: Install sleeve over shaft against carbon ring. Place spring over sleeve. Install "H" ring into thrust housing cover and replace cover gaskets. Carefully assemble cover over contact seal sleeve. Attach snap ring when cover is secured.

14. Check thrust float of shaft. Snap ring must not hit housing. Floats greater than .012" may cause the "H" ring to unseat and leak. Adjust thrust assembly to regulate shaft float.
15. Contact sleeve should not rotate with shaft or "H" ring will wear. It is recommended that a pin be placed between the snap ring and the packing housing to prevent rotation.
16. Reconnect any previously removed gauges or oil lines.
17. Install shaft end labyrinth.
18. Start auxiliary oil pump. Pressurize machine with refrigerant and pressurize seal with oil. Check for leakage. A contact seal, if leaking, may stop after "run-in" for several hours. Do not disassemble seal unless serious leakage is noted. If leakage continues contact surfaces of seal parts may be cocked or damaged and must be reinspected.
19. If seal appears tight or oil leakage is tolerable reassemble windage baffle onto seal housing cover and install coupling. Lubricate coupling as required.

NOTE: Seal is assembled dry to facilitate proper seating of carbon ring on mating surfaces when rotated.

Seal Reassembly - 400 Series

1. If external contact seal housing has been removed the gasket should be replaced when housing is reinstalled. For proper shaft position allow 1" ± .005" inside between the edge of the shaft shoulder (rotating seal ring) and the face of the flange against which the seal housing is fastened. Failure to maintain this dimension could result in seal leakage and/or excessive seal wear. If clearance is incorrect, adjust thrust back up ring shims as required.
2. Remove housing to work bench. Install guide spring, guide ring and diaphragm. Secure retaining ring when floating seal ring is completely depressed against inner face of seal housing. Install retaining key.

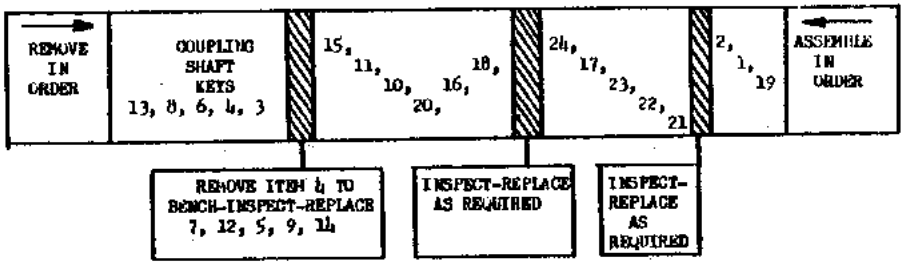
3. Carefully install housing assembly onto compressor. Guide ring must not bind.
4. "Blue" shaft shoulder behind rotating contact ring and install ring. There must be a 360° continuous contact of ring with shaft shoulder.

NOTE: The rotating seal ring is lapped to maintain parallelism between the two faces. Any mishandling or machining of this piece will lose these close tolerances thus causing seal leakage.

5. After "blueing" is satisfactorily completed, install inner carbon ring.
6. Install shaft "O" ring (3-7/16" x 3/32") into groove on shaft. Carefully fit rotating contact ring over shaft into position. Be sure "O" ring is not binding ring and preventing ring from seating against shaft shoulder. Install contact ring shaft key.
7. Install shaft sleeve. "Blue" to rotating contact ring. Any high spots might cause ring to seat improperly resulting in seal leakage.
8. Seal lock nut should be "blued" to shaft sleeve to prevent cocking seal rotating ring. Snug up lock nut. Do not over torque since shaft may "run out" from lock nut overtightness. Check shaft run out after tightening lock nut. Maximum allowable run out is .001". If run out is noted, loosen lock nut until run out disappears. Stake lock nut with set screw if necessary.
9. With seal housing cover face down (windage baffle side down) on bench check fit of contact sleeve (stationary) into seal housing. No binding should be present. There must be at least .003" to .005" diameter clearance. Oil and install "O" ring in seal housing. Excessive "O" ring tightness will result in the sleeve binding and not following shaft movement.
10. Install contact seal spring and retainer ring in position.
11. Place lubricating ring over retainer and press downward to depress contact seal spring. Insert lubricating ring cap screws and evenly tighten.
12. Insert contact sleeve into seal housing cover. Use light oil on "O" ring and sleeve to facilitate assembly. Place snap ring in position to index onto dowel pin. This pin prevents possible rotation of the contact sleeve.
13. Oil "O" ring on lubricating ring and mating surface on external seal housing cover. Be sure seal housing cover "O" ring is in position.
14. Install clean & dry carbon ring. Ring must be free to rotate on shaft sleeve. Contact surfaces must be dry.
15. Assemble complete seal housing cover onto seal housing. Be careful not to pinch "O" ring. Evenly tighten housing bolts. Check shaft float. Contact sleeve must follow float.
16. Start oil pump, rotate shaft by hand and observe for any oil leaking from seal.
17. Pressure test seal with refrigerant gas with seal full of oil. Any refrigerant loss must come between the shaft shoulder and contact ring. If leakage is noted, ring will have to be "blued" to shaft shoulder to minimize leakage.
18. If seal appears tight, reassemble oil collector ring and shaft end baffle.
19. Connect coupling and lubricate as required.

NOTE: Seal is assembled dry to facilitate proper seating of carbon ring to mating surfaces when compressor is rotated.

SPEED SERVICE CHART



HOW TO USE CHART:

1. For disassembly proceed from left to right.
2. Remove in order the items corresponding to the numbered pieces in each box.
3. The darkened area between boxes represents stopping areas. Parts should be inspected. If source of leakage is found, do not go on to next box.
4. To reassemble, proceed from right to left.

NOTE: Refer to Section I for step by step procedure and additional details.

NOMENCLATURE (FIG. 3)

ITEM	DESCRIPTION
1.	Seal Housing Gasket
2.	Seal Housing
3.	Seal Housing Cover Gasket
4.	Seal Housing Cover
5.	Packing Ring ("H" Ring)
6.	Gasket (Oil Collector Ring)
7.	Contact Sleeve
8.	Oil Collector Ring
9.	Spring Seat
10.	Shaft Sleeve
11.	Shaft Nut
12.	Snap Ring
13.	Shaft End Baffle
14.	Spring (Outer)
15.	Outer Carbon Seal Ring
16.	Contact Ring
17.	Retaining Ring
18.	Inner Carbon Seal Ring
19.	Felt Ring
20.	Shaft Key (Seal End)
21.	Spring (Inner)
22.	Guide Ring
23.	Diaphragm
24.	Key (Inner Carbon Ring)

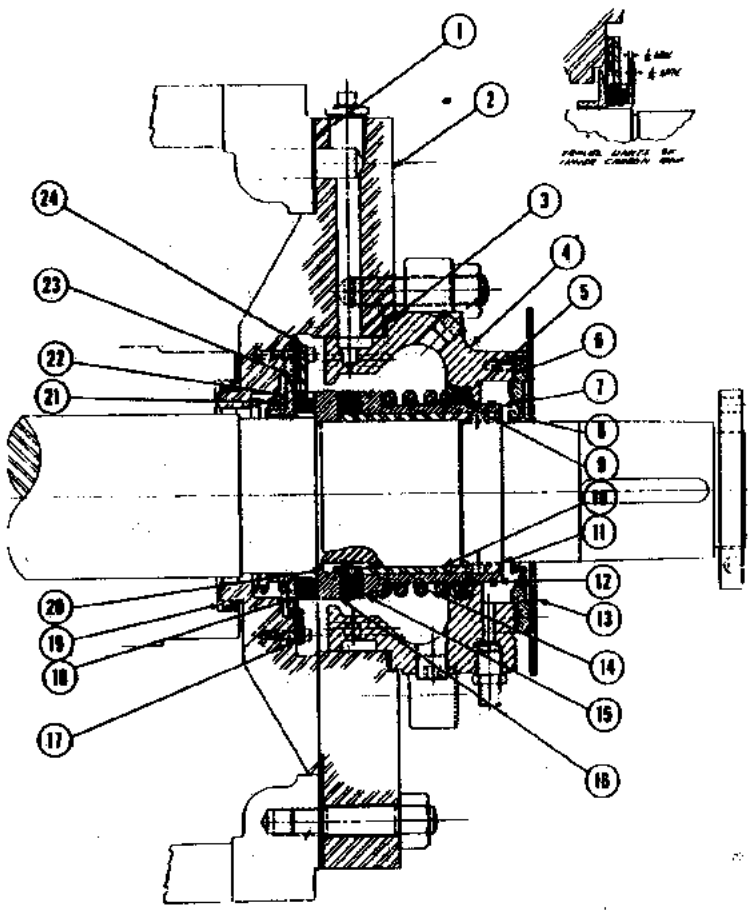
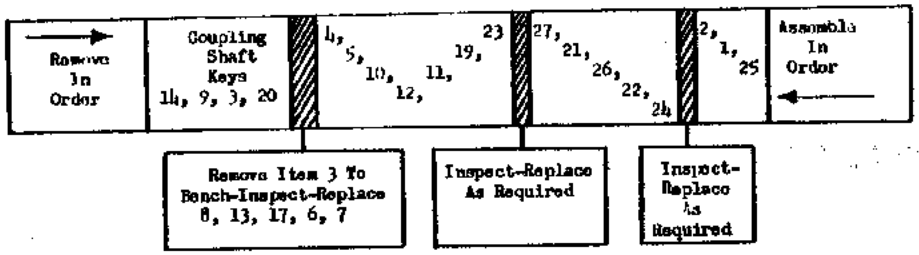


FIGURE 3 - CONTACT SEAL ASSEMBLY
(USED ON SIZE 17H, F&O AND 60 SIZE COMPRESSORS)

SECTION II
CONTACT SEAL

SPEED SERVICE CHART



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3. The darkened area between boxes represents stopping areas. Parts should be inspected. If source of leakage is found, do not go on to next box.
4. To reassemble, proceed from right to left.

NOTE: Refer to Section I for step by step procedure and additional details.

NOMENCLATURE (FIG. 4)

ITEM	DESCRIPTION
1.	Seal Housing Gasket
2.	Seal Housing
3.	Seal Housing Cover
4.	Oil Spray Ring
5.	Outer Carbon Seal Ring
6.	Spring Seat
7.	Packing Ring ("U" Ring)
8.	Snap Ring
9.	Oil Collector Ring
10.	Shaft Nut
11.	Shaft Key (Seal End)
12.	Shaft Sleeve
13.	Contact Sleeve
14.	Shaft End Baffle (Windage Baffle)
15.	Packing Ring Housing
16.	Oil Collector Ring Gasket
17.	Spring (Outer)
18.	Packing Ring Housing Gasket
19.	Contact Ring
20.	Seal Housing Cover Gasket
21.	Retainer Ring
22.	Guide Ring
23.	Inner Carbon Seal Ring
24.	Spring (Inner)
25.	Felt Ring
26.	Diaphragm
27.	Key (Inner Carbon Ring)
28.	Spray Ring Gasket

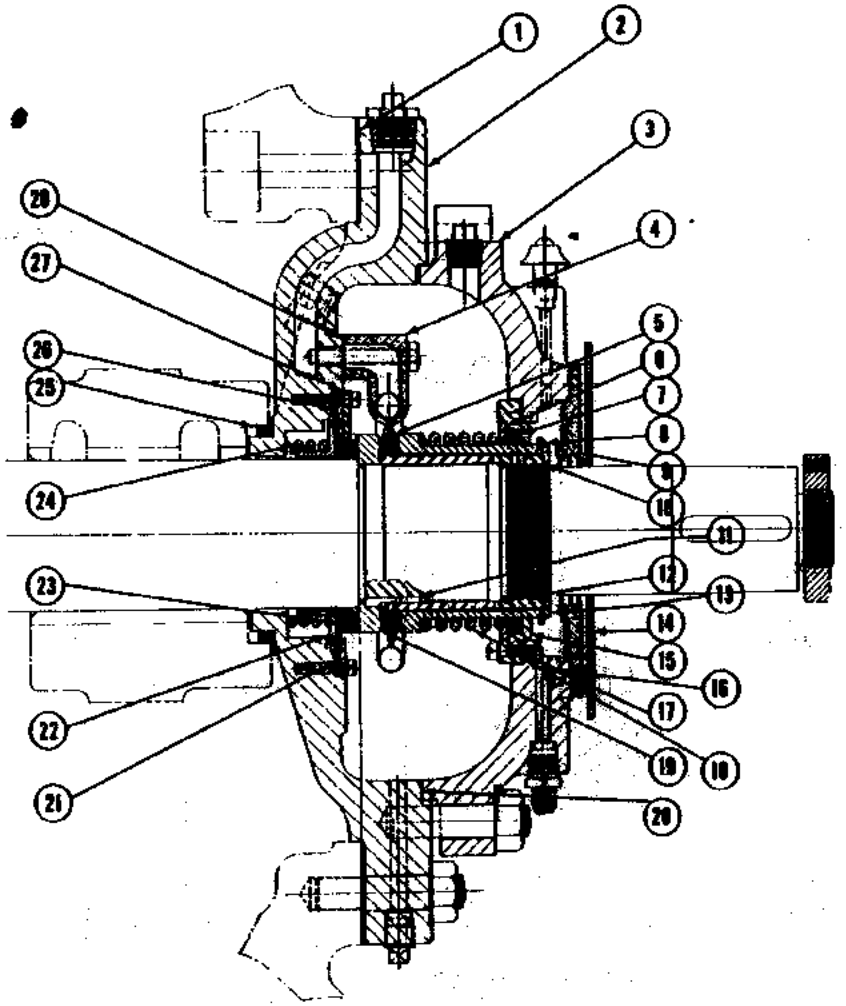
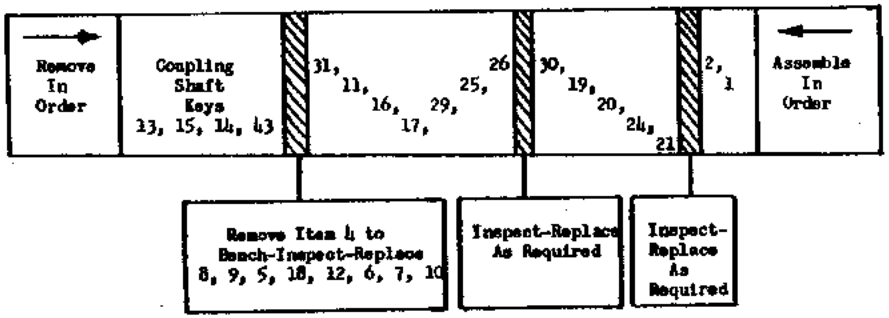


FIGURE 4 - CONTACT SEAL ASSEMBLY
(STANDARD ARRANGEMENT USED ON 17M,P,S 30 AND 40 SIZE COMPRESSORS)

SECTION II

STANDARD CONTACT SEAL

SPEED SERVICE CHART



HOW TO USE CHART:

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2. Remove in order the items corresponding to the numbered pieces in each box.
3. The darkened area between boxes represents stopping areas. Parts should be inspected. If source of leakage is found, do not go on to next box.
4. To reassemble, proceed from right to left.

NOTE: Refer to Section I for step by step procedure and additional details.

NOMENCLATURE (FIG. 5)

ITEM	DESCRIPTION
1.	Seal Housing Gasket
2.	Seal Housing
3.	"O" Ring (9" x 8½" x ¼")
4.	Seal Housing Cover
5.	Lubricating Ring
6.	Retainer Ring
7.	Spring (Outer)
8.	Anti-Rotation Pin
9.	Snap Ring
10.	"O" Ring (4 3/8" x 4 3/4" x 3/16")
11.	Shaft Nut
12.	Contact Sleeve
13.	Shaft End Baffle
14.	Oil Collector Ring Gasket
15.	Oil Collector Ring
16.	Shaft Sleeve
17.	Shaft Key (Seal End)
18.	"O" Ring (7 1/4" x 6 3/4" x 1/4")
19.	Retainer Ring
20.	Diaphragm
21.	Spring (Inner)
22.	Labyrinth
23.	Journal Bearing
24.	Guide Ring
25.	"O" Ring (3 7/16" x 3 1/4" x 3/32")
26.	Inner Carbon Seal Ring
27.	Windage Baffle
28.	Wiper Labyrinth
29.	Contact Ring
30.	Key (Inner Carbon Ring)
31.	Outer Carbon Seal Ring

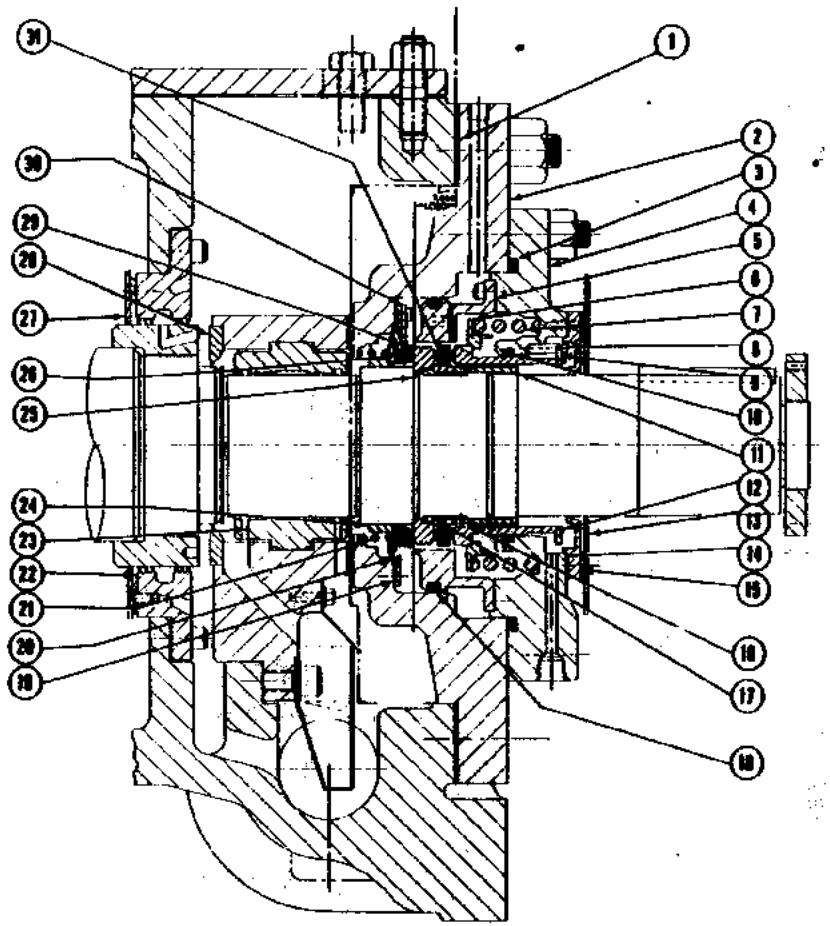

FIGURE 5—CONTACT SEAL ASSEMBLY
(USED ON 17H, P 400 COMPRESSORS)

SECTION II
400 SERIES CONTACT SEAL