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DUROFLOW®

D-9-620
1st Edition
Supersedes B0110

SERIES 4500

BLOWERS

SERVICE MANUAL

COOPER

Gardner-Denver
Industrial Machinery

Duroflow®

45 Series Blowers

Table of Contents

SECTION ONE

Introduction

This manual was prepared as a guide for the person involved in the maintenance or overhaul of DuroFlow® 45 Series Blowers utilizing **splined** rotor shafts and timing gears. There are two versions, one of which uses spur gears and the other, helical gears.

The helical gear version is the latest in the evolution of DuroFlow blower technology. It differs from its predecessor, the spur gear version, only in the gear tooth configuration and the addition of a Belleville spring behind one timing gear. On the helical gear blower, rotor timing is accomplished by varying the position of a lock nut moving one timing gear axially against the pressure of the Belleville spring washer. This slight longitudinal movement of the drive gear in relation to the idler gear changes the angular relationship between the two rotors.

In the spur gear version, rotor timing is accomplished by selective assembly. A particular set of gears is matched to a particular set of rotors in order to achieve the proper angular relationship between the two rotors.

This manual is concerned primarily with the helical gear version, which is currently in production. Section Eight covers the differences in teardown and reassembly procedure for the spur gear version.

Each of the four sizes of 45 Series blowers has four configurations designated by the position of the drive shaft as viewed from the drive end. The most common configuration, designated vertical-top (VT), has the drive rotor above the idler rotor and the airbox inlet and discharge ducts are at the sides. In the vertical-bottom (VB) configuration, the drive rotor is mounted below the idler rotor. In the horizontal-left (HL) configuration, the drive rotor is to the left of the idler rotor and the airbox inlet and discharge ducts are at the top and bottom of the unit. In the horizontal-right (HR) configuration, the drive rotor is mounted to the right of the idler rotor.

The VT and HL configurations are identical except for the position of the oil breather and the oil filler plug and a change in the mounting plate in the HL. Likewise, the VB and the HR configurations correspond to each other with the same differences as the VT and HL.

The VT-HL differs from the VB-HR in having a different oil flinger on the drive end which is mounted on the drive shaft in the VB-HR version rather than on the idler shaft as in the VT-HL. Both oil flingers are identical in the VT-HL version, whereas the drive end flinger is more deeply dished than the gear end flinger in the VB-HR versions.

Since the VT version is the most common of the various configurations, the illustrations and the teardown and reassembly procedures in this manual refer to the VT configuration. The person involved in overhauling one of the other versions of the blower should keep in mind the differences noted in the preceding paragraphs.

In addition, if overhauling either the HL or HR versions, it is advisable to use a holding fixture to secure the blower to the workbench. This can be obtained from DuroFlow or it can be fabricated as in Fig. 4.

It is suggested that the appropriate sections of this manual be read and fully comprehended before any specific service operation is attempted. Further, the importance of a clean and adequately outfitted workshop cannot be overemphasized. The success of any major blower service effort depends upon recognition of the fact that virtually every part contained in the assembly is highly precise, and hence, is vulnerable to the damaging effects of dirt, moisture and rough handling.

IMPORTANT NOTICE

In mid-1981, modifications to the 45 Series end plates were made that are not shown in the text of this manual. Blowers now require only one conventional breather cap. This difference will not affect service procedures.

When properly mounted, the air breather ports on modified blowers are always facing downward, and no longer require breather caps. If these vent ports are threaded, a breather vent will be inserted. **DO NOT** PLUG OR OBSTRUCT THESE AIR VENT PASSAGEWAYS!!

The oil sump breathing is now accomplished through the oil fill port. A hexagonal bushing is inserted into the oil fill hole, and the blowers' only breather cap is placed in this bushing to vent the oil sump.

Suggested Equipment and Supplies for a Major Overhaul

A. Sturdy 3' x 6' workbench, equipped with a 5" jaw width, turret type machinist's vise.

B. 10 ton, 2-jaw, 5-1/2" reach puller, such as Snap-On CG-270.

C. Wrenches and pliers.
   1. 12" adjustable ("Crescent" type).
   2. 9/16" six-or twelve-point box/open end combination.
   3. 3/8" or 1/2" square drive socket tools.
      a. Ratchet handle.
      b. 3" to 6" extension bar.
      c. 9/16" six-or twelve-point socket.
      d. Torque wrench, 1 ft-lb graduations to 50 ft-lb [7 mkg], such as Snap-On Nos. TE-50F or TF-51F Torqometers.
   4. 3/4" square drive socket tools.
      a. Ratchet or sliding tee handle.
      b. 1-13/16" six-or twelve-point socket.
      c. Torque wrench, 5 ft-lb graduations to 350 ft-lb [50 mkg], such as Snap-On No. TE-352 Torqometer.

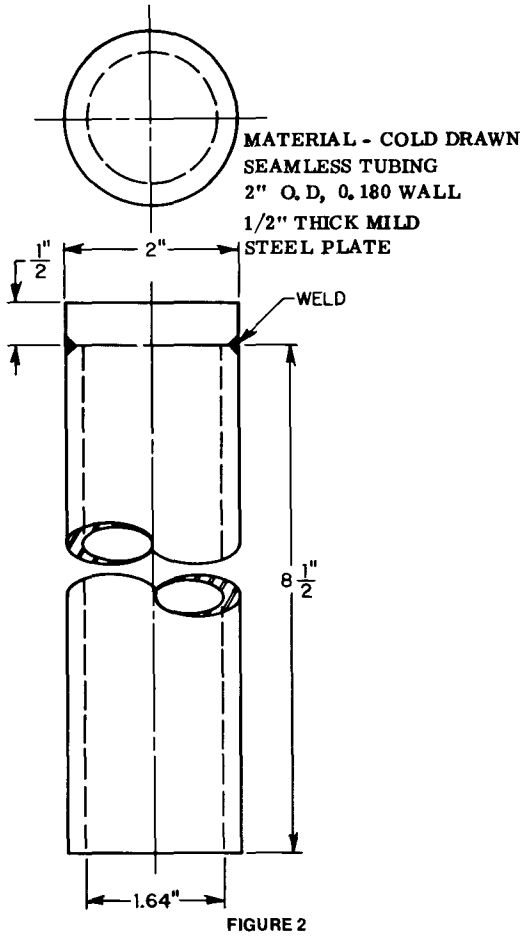


FIGURE 2
BEARING SLEEVE INSTALLATION TOOL

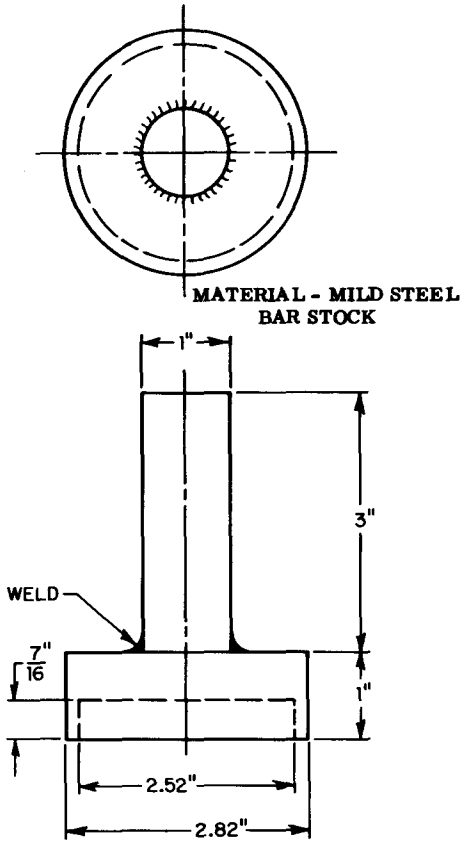


FIGURE 3
OIL SEAL INSTALLATION TOOL

   5. Large internal snap ring pliers, such as Waldes Tru-Arc No. S-6700.

D. Hammers.
   1. 24 ounce ball or cross peen.
   2. 3 pound plastic faced or rawhide mallet.

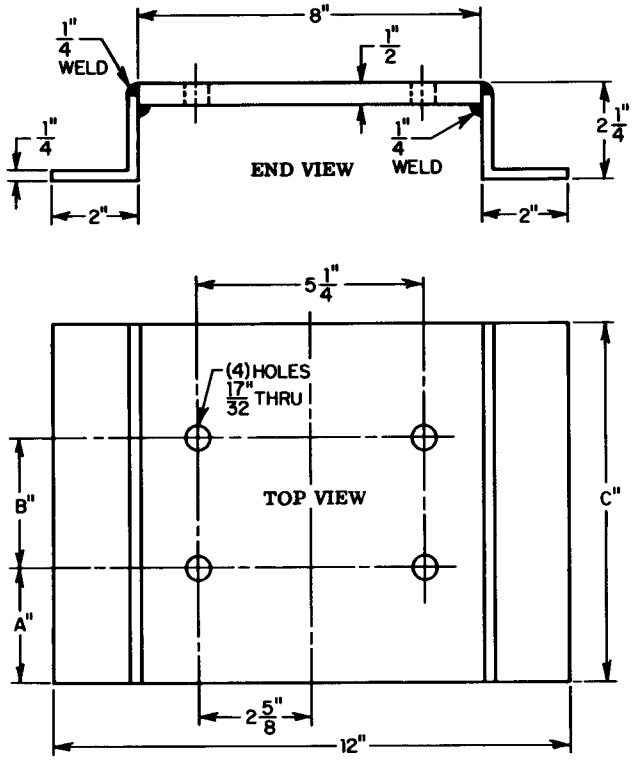
E. Chisels and punches.
   1. 5/8" edge width flat chisel, blunted.
   2. 5/16" shank diameter pin punch.
   3. 1/8" point center punch.

F. Cleaning and deburring tools and supplies.
   1. Degreasing tank of chlorinated solvent, such as perchlorethylene.
   2. 12 clean shop rags.
   3. Stiff, natural bristle scrub brush.
   4. Wire wheel or brush.
   5. 1-1/2" edge width gasket scraper.
   6. 8" half round file, smooth or second cut.
   7. Assorted silicone carbide or aluminum oxide abrasive paper, in 240, 320 and 400 grits.

G. Measuring instruments.
   1. Micrometer caliper, 0" to 1", graduated in 0.001" [0 to 25 mm graduated in 0.01 mm].

2. Depth micrometer, 1" to 2", graduated in 0.001" [25 to 50 mm graduated in 0.01 mm].
3. Dial test indicator (lever contact arm type), graduated in 0.0005" or 0.001" [0.01 or 0.02 mm], and equipped with magnetic base holder.
4. 12" x 1/2" feeler stock, 0.002" to 0.015" in 0.001" increments, [0.04 to 0.40 mm], 2 strips of each, such as Starrett Series 667.

H. Lubricants and compounds.
1. 2 quarts fresh motor oil, conforming to A.P.I. Service Specs CC and SE (See Lubrication Recommendations, Sec. Ten).
2. 1 pound fresh assembly lubricant, such as molybdenum disulfide grease.



MATERIAL - HOT ROLLED STEEL

MODEL	A"	B"	C"
4504	1.75	2.75	6.25
4506	2.63	3.00	8.25
4509	1.13	6.00	8.25
4512	1.13	9.00	11.25

FIGURE 4
HOLDING FIXTURE FOR 4500 SERIES BLOWER

I. Miscellaneous items.
1. 3 wooden blocks, approximately 1-1/2" x 3-1/2" x 10".
2. Two sturdy C-clamps sized appropriately to clamp blower mounting plate to work bench.
3. Wooden block approximately 3" x 6" x 1/2" to 1" thick.
4. Awl.

J. Special tools and fixtures (see sketches).
1. Rotor sleeve installation tool (Figure 2).
2. Oil seal installation tool (Figure 3).
3. Blower holding fixture (Figure 4).
NOTE: Holding fixture is needed only for horizontal blowers. If preferred, this can be purchased from DuroFlow (See Item 40, Section Eleven).
4. Bearing installation tool (Figure 5).

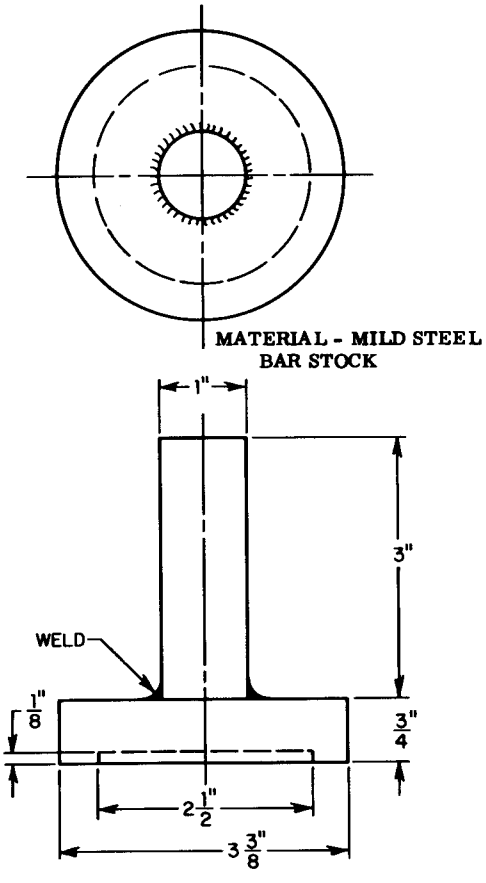


FIGURE 5
BEARING INSTALLATION TOOL

SECTION THREE

Teardown Procedure

A. Preparation.

Before beginning the teardown sequence, the oil should be drained from the unit. It is also suggested that the usual accumulation of sludgy or encrusted material be removed from the exterior. This can best be accomplished by scouring with a stiff bristle brush and soapy water, followed by a pressure rinse with water. An acceptable alternative is steam cleaning, if the equipment is available. Because all salvable parts are made of cast iron (or other ferrous alloy), virtually any heavy duty, chemical cleaning agents—EXCEPT those which are ACIDIC—are acceptable. It should be noted, however, that when water (or steam) is used in the cleaning process, the unit must be disassembled immediately, and blown dry with compressed air to prevent rusting of machined surfaces.

B. Teardown sequence.

NOTE: Numbers in parentheses ( ) refer to key numbers in sectional and exploded assembly drawings on pages 22 and 23.

1. Separation of the unit into basic subassemblies.
   a. Securely fasten the unit to the workbench, gear end facing out, using the mounting or holding fixture and C-clamps (see Fig. 6).

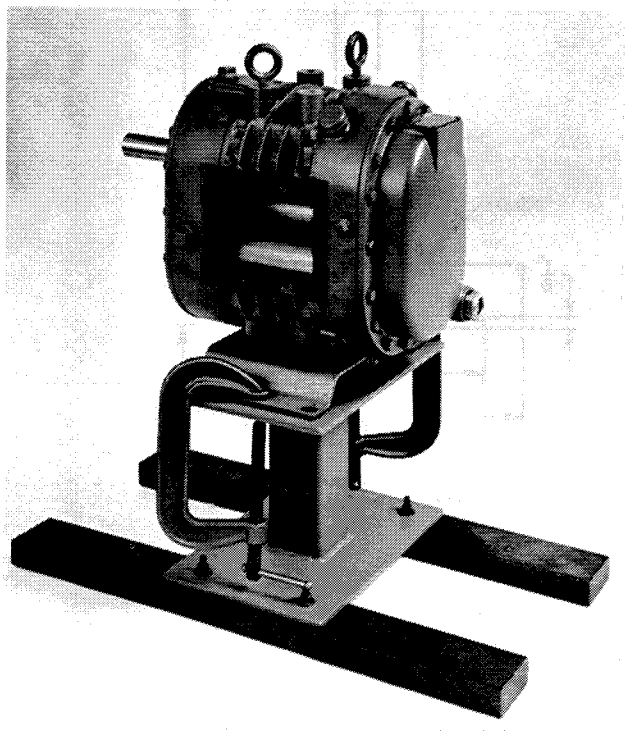


FIGURE 6
BLOWER SECURED TO WORK STAND WITH "C" CLAMPS

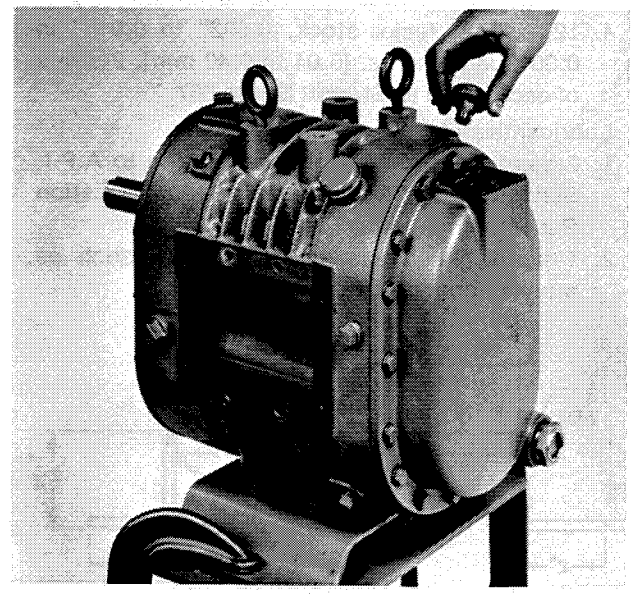


FIGURE 7
REMOVING BREATHER CAPS FROM GEAR END PLATE

NOTE: All screw threads on the blower are standard right-hand threads.

   b. Remove the 2 breather caps from the gear end plate (7) (see Fig. 7).
   c. Remove eight pipe plugs.
   d. Remove the 14 thru-bolts (4) and 2 cap screws (5) from the gear end cover (1).
   e. Remove the gear cover (1) from the gear end plate (7).

NOTE: The gasket used to seal the cover/ end plate seam tends to bond tightly to

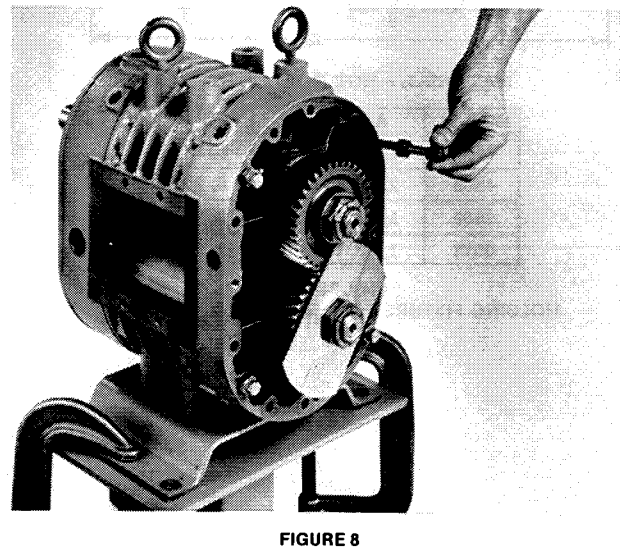


FIGURE 8
FOUR CAPSCREWS WITH SPACERS BEING TEMPORARILY REPLACED IN GEAR END PLATE

both surfaces. After bolt and screw removal, it is usually necessary to drive off the gear cover using the ball peen hammer and blunted chisel.

f. Temporarily replace four of the cap screws (4), two in each housing half, to retain the gear end plate (7) during subsequent operations.

NOTE: Each cap screw must be bushed with a spacer to prevent bottoming in the absence of the gear cover (see Fig. 8).

g. If the timing gears appear to be undamaged, it is advisable to check the gear backlash before removing gears to determine whether they can be reused (see Fig. 9).
   (1) Mount magnetic base dial indicator on gear end plate with arm extending toward drive gear.
   (2) Lock idler rotor stationary by wedging a feeler gage between idler rotor and end plate.
   (3) Place the tip of the indicator arm at approximately the center of the contact surface on a tooth of the drive gear.
   (4) Rock the drive gear by hand and read the total movement to the nearest .0005 in. [.012 mm].
   (5) Rotate the idler rotor 90° and repeat measurement three times.
   (6) Permissable gear backlash is .0025 to .0055 in. [.064 to .141 mm].
   NOTE: If backlash is outside specified limits at this point, it does not necessarily mean gears are unusable because the excessive play could be caused by worn bearings. However, if backlash is within limits and there is no apparent damage, the gears may definitely be reused.

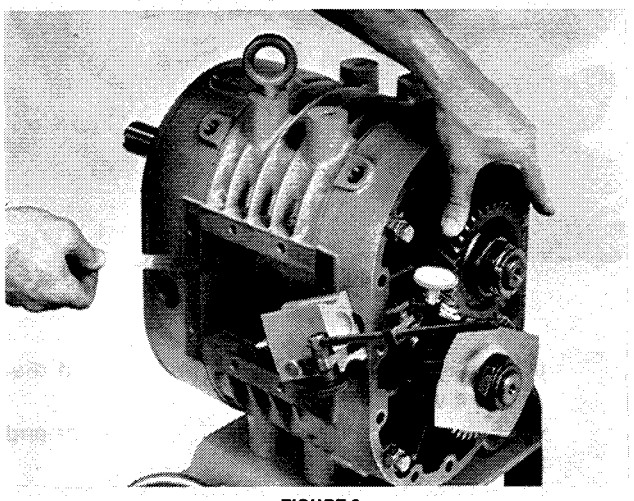


FIGURE 9
CHECKING TIMING GEAR BACKLASH WITH DIAL INDICATOR

h. If the timing gears appear to be reusable, it is advisable to make index marks on the gears to facilitate rotor timing upon reassembly. This can best be done by making small punch marks on the ends of meshing gear teeth with a pin punch and hammer (see Fig. 10).

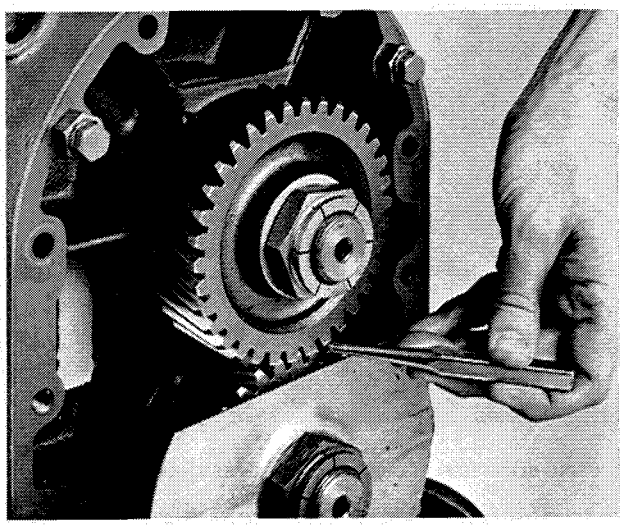


FIGURE 10
INDEX MARKS ON ENDS OF GEAR TEETH

i. Place wood block between idler rotor lobe and edge of inlet-discharge opening to prevent rotor from turning. Loosen but do not remove the flexlock nut from each rotor shaft.

j. Move to drive end of blower. Locate the tang of the spider washer (21) which was bent into slot of lock nut (22). Bend the tang out of the lock nut slot using pin punch and hammer (see Fig. 11).

k. Chock drive rotor with wood block. Using blunted flat chisel and hammer, loosen lock

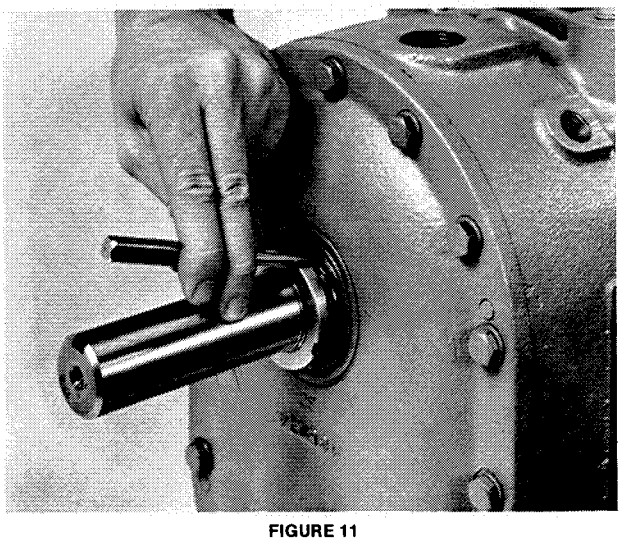


FIGURE 11
BENDING TANG OF SPIDER WASHER OUT OF LOCK NUT SLOT

nut (see Fig. 12). Use caution not to damage rotor shaft with chisel.

l. Remove lock nut and spider washer and discard both as they will not be reused.

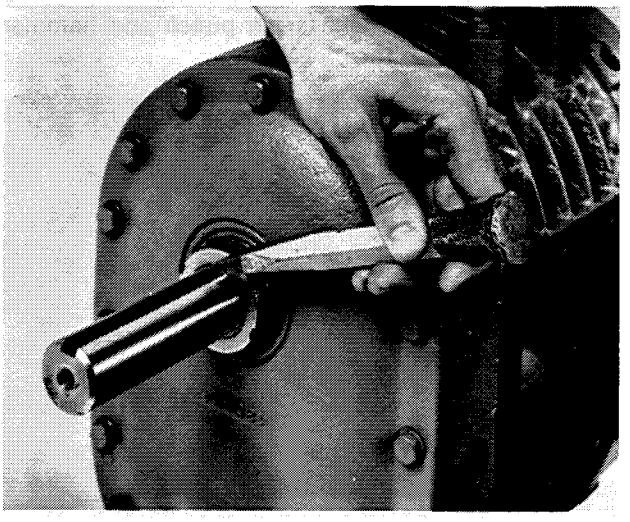


FIGURE 12
USING BLUNTED FLAT CHISEL AND BALL PEEN HAMMER TO LOOSEN LOCK NUT

m. Remove the 14 cap screws (18), 14 lock washers (6), and two cap screw and lock washer assemblies (5) from the drive end cover (30).

n. Remove the drive end cover. It may be necessary to use blunted flat chisel and hammer to loosen cover from end plate.

o. Remove bearing spacer (20) from drive shaft (see Fig. 13).

p. Chock idler rotor with wood block. Remove flexlock nut (27) from drive end of idler shaft.

q. Remove oil flinger (29) and clamp washer (28) from idler rotor shaft.

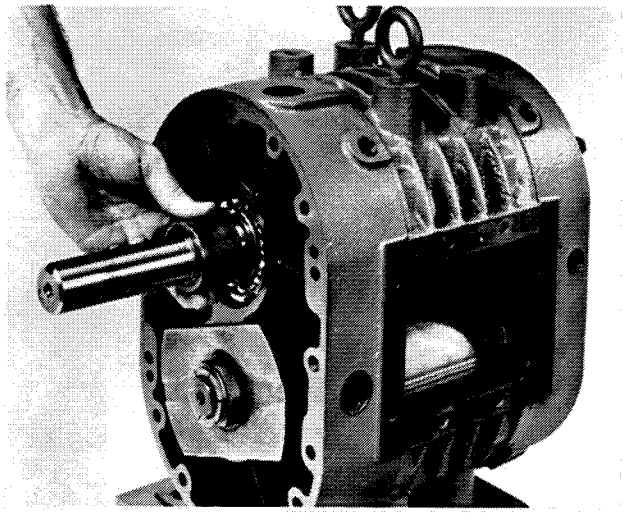


FIGURE 13
REMOVING BEARING SPACER FROM DRIVE SHAFT

r. Remove the drive end plate from the remainder of the assembly using soft faced mallet to loosen end plate from dowel pins in housing halves (see Fig. 14).
CAUTION: The drive end plate weighs about 40 pounds. Use care not to drop it.

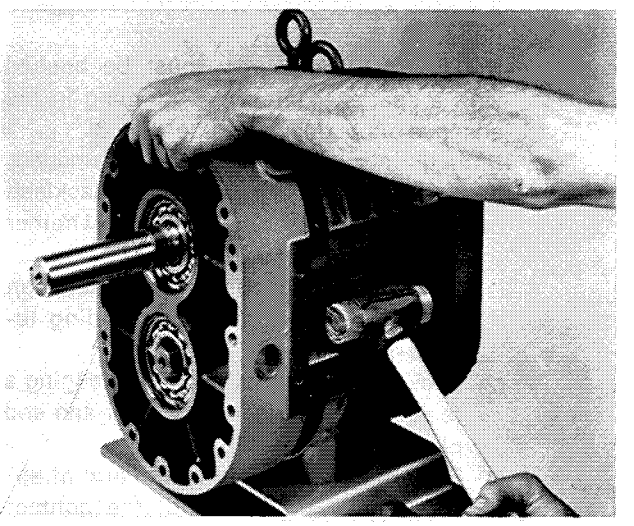


FIGURE 14
USING SOFT FACED MALLET TO LOOSEN DRIVE END PLATE

s. Remove the flexlock nut (44) from the gear end of the drive rotor shaft.

t. Remove the timing gear from the drive rotor using the gear puller (see Fig. 15). Make sure oil flinger (29) is turned so as not to interfere with gear being removed from the drive shaft.

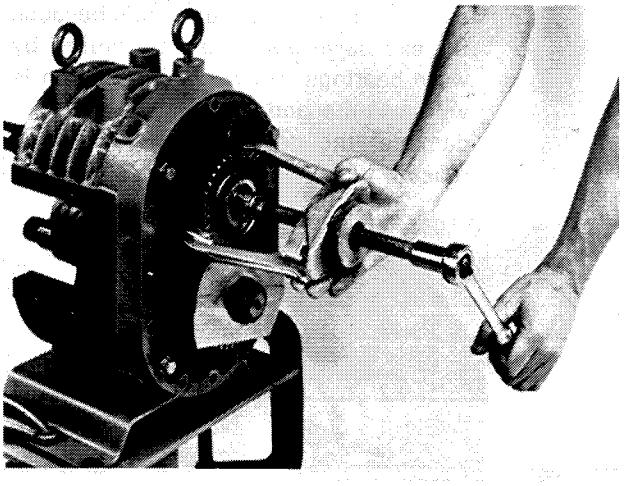


FIGURE 15
USING PULLER TO REMOVE TIMING GEAR

u. Remove the Belleville spring (48) and discard as it will not be reused.

v. Separate the drive rotor from the gear end plate (see Fig. 16).

w. Remove the two cap screws and spacers holding the upper housing half (12) to the

gear end plate and remove the upper housing half.

x. Remove the flexlock nut (44) from the idler rotor shaft.

y. Remove the oil flinger (29).

z. Use gear puller to remove the idler gear (42) from the idler rotor (32).

aa. Remove the idler rotor from the gear end plate.

bb. Remove the two cap screws and spacers holding the gear end plate to the lower housing half (39).

cc. Remove the gear end plate from the lower housing half.

CAUTION: The gear end plate weighs about 35 pounds. Use care not to drop it.

dd. Loosen the C-clamps and invert the lower housing half on the workbench.

ee. Remove the four cap screws (37) and lock washers (38), and separate the mounting plate (40) from the lower housing half.

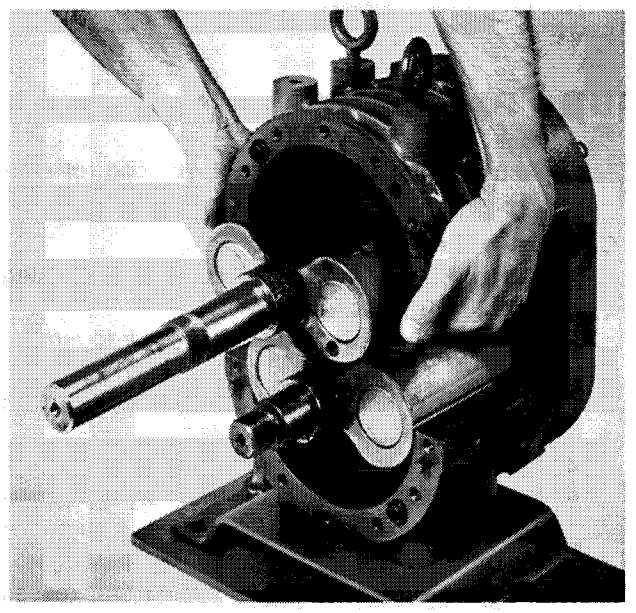


FIGURE 16
REMOVING DRIVE ROTOR FROM GEAR END PLATE

2. Separation of the subassemblies into component parts.

a. Rotor subassembly.

PREFACE: Except in unusual cases, the 4 end plugs in each rotor casting need not be removed or replaced.

Rotor sleeves need only be removed from their respective shafts for the purpose of rotor or sleeve salvage.

The 2 iron seal rings carried in the rotor sleeves should always be removed and replaced as a matter of service policy.

(1) Securely fasten the rotor in the vise, using 2 wood blocks to prevent marring of the contoured surfaces.

(2) Remove the seal ring (13) from the drive end sleeve (14), using the awl to pry apart the interlock, and then break the ring from underneath.

(3) Remove the seal ring (13) from the gear end sleeve (11), as in Step 2.

(4) Remove shims (15) from rotors.

(5) Only as required in accordance with the guidelines given under PREFACE, remove the sleeve(s) from the rotor shaft(s) using the gear puller.

b. End plate subassembly.

PREFACE: Since all seals and bearings should be replaced during overhaul as a matter of service policy, both end plate subassemblies must be completely disassembled internally.

(1) Remove the 2 retaining rings (26) from their respective bearing sockets, using the snap ring pliers.

(2) Invert the end plate on the work bench, and set on 2 oak blocks, so as to provide 3-1/2" clearance between the plate and bench, and to clear the edges of the bearing sockets.

(3) Remove the drive rotor bearing (9) or (17) from its socket, using the ball peen hammer and pin punch.

(4) Remove the drive rotor oil seal (10) from its socket, as in Step 3.

(5) Remove the idler rotor bearing (9) or (17) from its socket, as in Step 3.

(6) Remove the idler rotor oil seal (10) from its socket, as Step 3.

c. Housing half subassembly.

Except in unusual cases, the 4 dowel pins (34) and 2 ferrules (35) in each housing half end surface need not be removed or replaced. However, the 2 "O" rings (36) carried on the ferrules of each housing half should always be replaced as a matter of service policy.

d. Drive end cover.

(1) Place cover on two wood blocks gasket side up. With hammer and punch drive out the seal (25). Discard seal as it will be replaced.

(2) Normally, there is no reason to remove the two dowel pins (34) which are pressed into the cover.

SECTION FOUR

Policy Replacement Items

It is suggested that the following parts be replaced each time the 45 Series blower is disassembled regardless of apparent or measured condition. This merely reflects sound service policy in that the reuse of these parts cannot be justified on the basis of cost savings when possible consequences are considered. *It is not necessary to order these parts individually, as DuroFlow offers a factory service parts kit for the 45 Series, splined shaft blower.*

Item No.	Description	Qty. Per Unit
9	Roller Bearing	2
10	Oil Seal	4
13	Seal Ring	4
15	Shim .002—.003—.005—.007—.010"	As Required
17	Ball Bearing	2
21	Lock Washer	1
22	Lock Nut	1
25	Oil Seal	1
31	Gasket	2
36	O Ring	4
46	Gasket	2
48	Belleville Spring	1

SECTION FIVE

Major Parts Cleanup Procedures

A. Rotors.
1. Dip in degreasing tank agitating and brushing to remove grease and oil.
2. Sandblast or wirebrush as necessary to remove scale from rotor lobes. If sandblasting, mask bearing sleeves, bearing spacers, and shafts with rubber hose or tape to prevent erosion.
3. Lightly wet polish the bearing sleeves, bearing spacers, and rotor shafts with crocus cloth.
4. Any burrs on rotor or shaft should be removed with a file.
5. Dip again in degreasing tank and blow dry with compressed air.
6. If rotor is not to be inspected and reused immediately, dip in oil or rust preventative solution and seal in a clean plastic bag for storage.

B. End plates.
1. Dip in degreasing tank agitating and brushing to remove grease and oil.
2. Sandblast or wirebrush as necessary to remove scale. If sandblasting, place plugs in seal ring bores to prevent erosion during blasting.
3. Lightly wet polish the seal ring bores with 400 grit abrasive paper.
4. Remove burrs with file.
5. Dip in degreasing tank and blow dry with compressed air.
6. If end plate is not to be inspected and reused immediately, dip in oil or rust preventative solution and seal in clean plastic bag for storage.

C. Housing halves.
1. Dip in degreasing tank agitating and brushing to remove grease and oil.
2. Sandblast or wirebrush as necessary to remove scale.
3. Wet polish the machined concave surface with 240 grit abrasive paper.
4. File burrs on machined surfaces.
5. Dip in degreasing tank and blow dry with compressed air. Use particular care to insure that all foreign matter is purged from oil passages.
6. If housing is not to be inspected and reused immediately, dip in oil or rust preventative solution and seal in clean plastic bag for storage.

D. Timing gears.
1. Dip in degreasing tank to remove grease and oil.
2. Wirebrush as necessary to remove scale.
3. Remove nicks and burrs with file.
4. Dip in degreasing tank and blow dry with compressed air.
5. If gears are not to be inspected and reused immediately, dip in oil or rust preventative solution and seal in clean plastic bag for storage.

E. Covers.
1. Dip in degreasing tank agitating and brushing to remove grease and oil.

2. Scrape gasket surface to remove any remaining pieces of gasket.
3. File any burrs on gasket surface.
4. Dip in degreasing tank and blow dry with compressed air.
5. If covers are not to be inspected and reused immediately, dip in oil or rust preventative solution and seal in clean plastic bag.

F. Mounting plate, flingers, and external hardware.
1. Dip in degreasing tank to remove grease and oil.
2. File burrs from mounting surfaces of mounting plate.
3. If parts are not to be reused immediately, store in clean plastic bag.

SECTION SIX

Major Parts Inspection Procedures

A. Rotors.

The rotors are usually salvable if no significant degeneration of the contoured or end surfaces has occurred.

Occasionally, a hard object accidentally passes through the blower causing localized gouging of the lobes. This is not necessarily grounds for immediate rejection unless the gouging takes place on the tip sealing vanes. Rotor end surfaces should be checked for uniformity and smoothness and should be free of burrs, eruptions, and other irregularities. If there is evidence of rotor contact with end plates, housings, or with each other, the rotor lobe length and width should be measured.

The following table gives lengths and widths for the various 45 series models (If specifications outside these limits, contact factory for advice):

Models	Length	Width
4504	3.982 - 3.986 in. [101.14 - 101.24 mm]	7.372 - 7.374 in. [187.25 - 187.30 mm]
4506	5.978 - 5.982 in. [151.84 - 151.94 mm]	7.372 - 7.374 in. [187.25 - 187.30 mm]
4509	8.976 - 8.982 in. [228.00 - 228.14 mm]	7.372 - 7.374 in. [187.25 - 187.30 mm]
4512	11.971 - 11.977 in. [304.07 - 304.22 mm]	7.372 - 7.374 in. [187.25 - 187.30 mm]

B. End plates.

The end plates are usually salvable if the planar air box and seal ring bore surfaces appear undamaged. As with the rotors, moderate localized gouging of the air box surface is allowable but is not usually found without more extensive damage to surrounding areas. Ring bore condition, however, is critical. No visible evidence of surface finish disturbance is allowable. If seizure of the rotor group had occurred during operation, the end plates should be checked for cracks.

C. Housing halves.

The housing halves are usually salvable if the cylindrical air box surfaces appear undamaged. As with the end plates, the housing halves should be checked for cracks if seizure had occurred during operation.

D. Timing gears.

The timing gears are usually salvable if the meshing teeth show no evidence of profile degeneration. The gear teeth are cut with a slight spherical crown so that small errors in axial rotor alignment can be tolerated. This produces a tooth contact pattern that is characteristically elliptical and somewhat more polished than that of the surrounding tooth surface. To determine whether gear tooth wear has gone beyond acceptable limits, it is necessary to check the backlash when the pump is reassembled.

E. Covers.

The gear end and drive end covers are nearly always salvable provided there are no cracks since there are no wearing surfaces. The seal bore of the drive end cover should be examined for smoothness.

F. Mounting plate and external hardware.

The mounting plate is nearly always salvable provided it is not cracked or severely bent. If it is bent, but can be straightened so that the mounting holes line up, it may be reused. External hardware can be reused provided the threads are good and the heads of screws and plugs are not too severely deformed. Exceptions to this are the spider type lock washer and external lock nut on the drive shaft which should always be replaced as a matter of service policy. The oil gage plug and breather filters should also be replaced.

G. Flingers.

Usually salvageable, but if **any** cracks or surface damage around the center hole exists they should be replaced.

SECTION SEVEN

Assembly Procedure

A. Preparation.
All metallic parts should be rinsed in clean mineral spirits to remove any residual traces of dirt or filings from deburring operations. It is also suggested that all tools to be used in the reassembly operation also undergo a solvent wash, so as to eliminate yet another source of contamination.

Following solvent wash, the parts and tools should be blown dry with clean compressed air.

The elastic rotor shaft seals (10) and (25) should be immersed in fresh motor oil of the type used in the blower for a period of at least two (2) hours prior to installation in the end plates. This will allow the elastomers to absorb sufficient oil to prevent accelerated early wear.

B. Reassembly sequence.
1. Rebuilding component parts into basic subassemblies.
   a. Rotor subassembly.
      If the sleeves were removed as described in Section III, proceed as follows:
      (1) Lightly coat the gear end rotor shaft and the bearing sleeve (11) bore with assembly lubricant.
      (2) Install the bearing sleeve (11) on the gear end rotor shaft, using the rotor sleeve installation tool and ball peen hammer to drive the sleeve tightly onto its seat.
      NOTE: The face of the seal ring end of the sleeve is notched out in two places to provide clearance for tips of the mating rotor lobes. Therefore, the sleeve must be installed in such a position that the valley sections of its rotor are both totally encompassed by a notch on both sides.
      (3) Lightly coat the drive end rotor shaft and the bearing spacer (14) bore with assembly lubricant.
      (4) Install the bearing spacer (14) on the drive end rotor shaft, as in Step (2) above.
      If sleeves were not removed, or after reinstalling them:
      (5) Coat the seal ring groove with assembly lubricant. Install and couple the seal ring (13) on the bearing sleeve (11).
      (6) Install and couple the seal ring (13) on the bearing spacer (14), as in Step (5) above.
   b. End plate subassembly.
      (1) Place one presoaked oil seal (10) on the oil seal installation tool and install the seal in the idler socket of one end plate (7) or (33), metal side down, using the ball peen hammer to drive the seal securely onto its seat.
      (2) Install another presoaked oil seal in the drive socket of the end plate, as in Step (1) above.
      (3) Install the idler bearing (9) or (17) in the idler socket of the end plate using the bearing installation tool and ball peen hammer to drive the bearing tightly onto its seat.
      NOTE: Install roller bearings in gear end plate and ball bearings in drive end plate (drive end plate is thicker).
      (4) Install the drive bearing (9) or (17) in the drive socket of the end plate, as in Step (3) above.
      (5) Install the 2 retaining rings (26) in their respective bearing sockets, **bevelled side out,** using the snap pliers (see Fig. 17). Make certain the snap rings are properly seated in their grooves.

FIGURE 17
INSTALLING RETAINING RING

   c. Housing half subassembly.
      Assuming that the 4 dowel pins (34) and 2 ferrules (35) were not removed, install the 2 "O" rings (36) on the ferrules (35).
   d. Drive end cover (30).

Invert cover and place on wood blocks gasket side down. Wipe excess oil from O.D. of presoaked seal (25). Place seal in its bore with metal face up and tap with plastic mallet to seat securely.

FIGURE 17A
MEASURING FROM AIRBOX SURFACE TO INNER RACE OF BALL BEARING

2. Final assembly.
   a. Place lower housing half assembly (39) on bench with cylindrical air box surface down. Place mounting plate (40) on housing half, align holes, and secure with four cap screws (37) and four lock washers (38). Torque cap screws to 50 to 60 ft-lb [7.0 to 8.3 mkg].

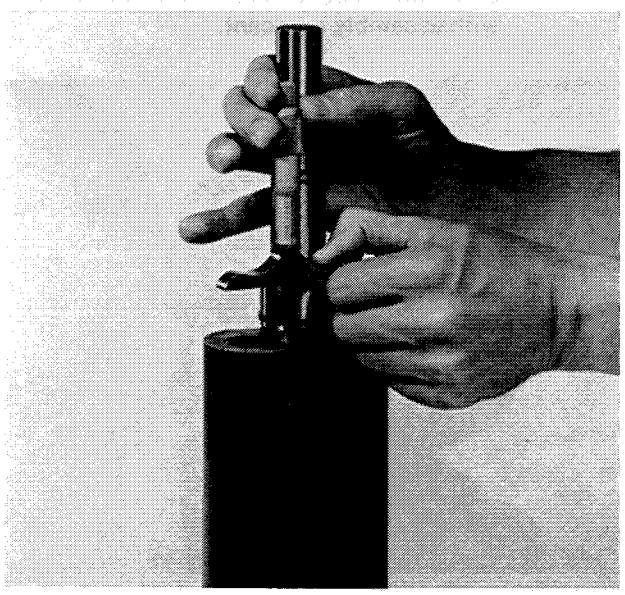


FIGURE 17B
MEASURING FROM END OF BEARING SPACER TO END OF ROTOR LOBE

NOTE: The lower housing half differs from the upper housing half in that the lower half has **one** through hole from end to end while the upper half has **two** through holes.

   b. Invert assembly and secure mounting plate to workbench with "C" clamps.
   c. The clearance between the air box surface of the drive end plate and the drive end of the rotors is controlled by placing shims of the required number and thickness on the drive end of each rotor between the bearing spacer and the inner race of the ball bearing. The procedure for determining the shim thickness required for each shaft is as follows. Using depth micrometer, measure the distance from the planar air box surface to the inner race of the double row ball bearing reading to the nearest .0005 in. (see Fig. 17A). For the corresponding shaft, measure from the outer end of the bearing spacer to end of the rotor lobe reading to the nearest .0005 in. (see Fig. 17B). The first measurement minus the second measurement plus the appropriate drive end clearance specified in the table below is the total shim thickness required. (If specifications are outside these limits, contact factory.)

Model	Drive End Minimum Clearance	Gear End Minimum Clearance
4504	.005 in. [.127 mm]	.006 in. [.152 mm]
4506	.005 in. [.127 mm]	.010 in. [.254 mm]
4509	.007 in. [.178 mm]	.014 in. [.356 mm]
4512	.007 in. [.178 mm]	.016 in. [.406 mm]

   d. Assemble the required shim stacks, reading the micrometer caliper to the nearest 0.0005" across the total lamination of shims to be used, so as to reduce additive error.

NOTE: Always use the least number of shims necessary to obtain the required

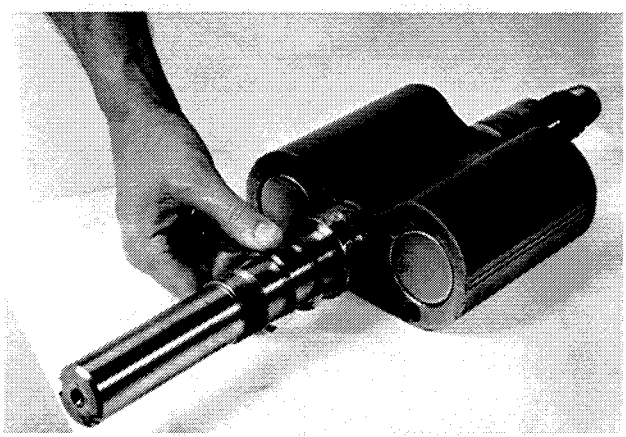


FIGURE 18
ASSEMBLING SHIMS TO DRIVE END OF DRIVE ROTOR SHAFT

stack thickness, as this reduces the apparent loss later produced by retaining nut compression.

e. Install the assembled shim stacks (15) on their respective drive end rotor shafts (see Fig. 18).

f. Install the drive end plate to the lower housing half with two cap screws (18) using a 1/2-13 nut spacer under the head of each cap screw (see Fig. 19).

Torque cap screws to approximately 30 ft-lb [3.9 mkg].

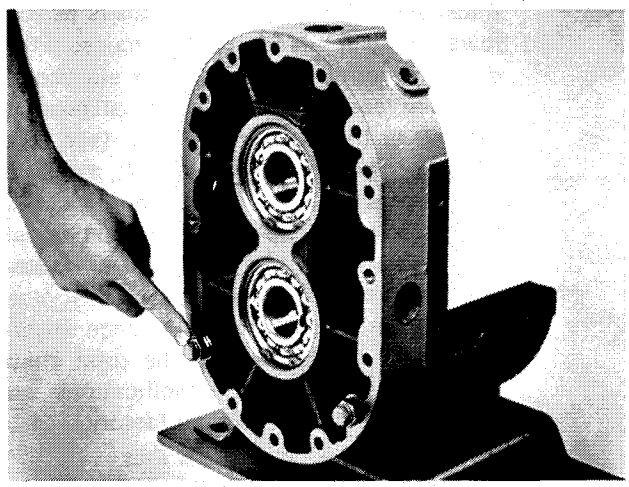


FIGURE 19
TWO CAPSCREWS WITH SPACERS USED TO TEMPORARILY FASTEN DRIVE END PLATE TO LOWER HOUSING HALF.

g. Brush the bearing spacers on the drive ends of both rotors with assembly lubricant.

h. Install the idler rotor to the drive end plate. Use extreme care in starting the seal ring in the bore as the ring can easily be broken.

i. Assemble the drive rotor to the end plate (see Fig. 20).

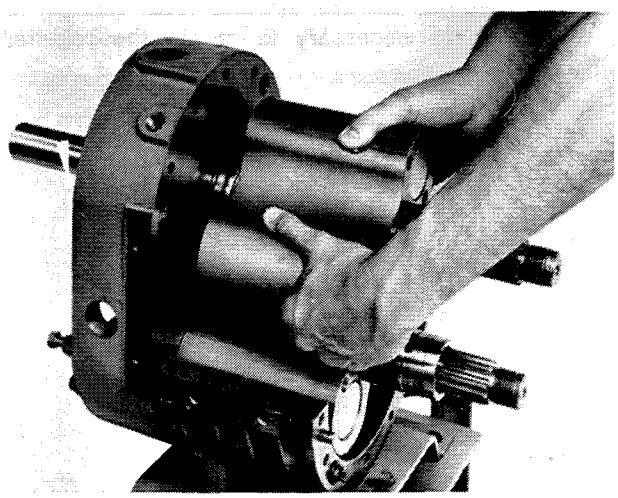


FIGURE 20
ASSEMBLING DRIVE ROTOR TO DRIVE END PLATE

j. Install the upper housing half to the drive end plate. Ferrule with "O" ring must mate with counterbored hole in end plate. Secure with two cap screws (18) using a 1/2-13 nut spacer under the head of each cap screw (see Fig. 21). Torque cap screws to approximately 30 ft-lb [3.9 mkg].

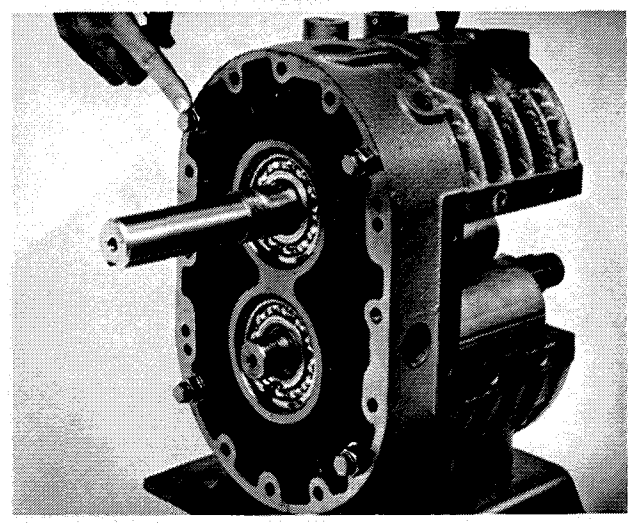


FIGURE 21
TWO CAPSCREWS WITH SPACERS USED TO TEMPORARILY FASTEN UPPER HOUSING HALF TO DRIVE END PLATE

k. Brush the bearing sleeves on the gear ends of both rotors with assembly lubricant. Install gear end plate using care to avoid damage to the seal rings during assembly. Secure end plate to housings using six cap screws with 1/2-13 nut spacers (see Fig. 22). Torque screws to approximately 30 ft-lb [3.9 mkg].

l. Lubricate threads on drive end of each shaft with assembly lubricant.

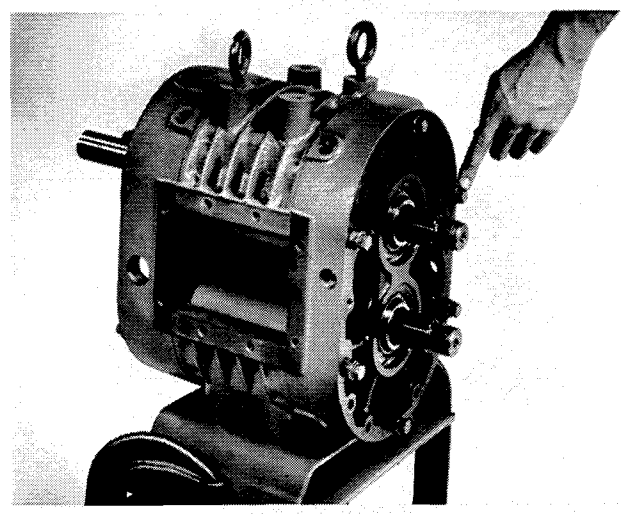


FIGURE 22
SIX CAPSCREWS WITH SPACERS USED TO TEMPORARILY FASTEN GEAR END PLATE TO UPPER AND LOWER HOUSING HALVES

m. Assemble clamp washer (28) and oil flinger (29) to drive end of idler shaft (see Fig. 23). Be sure that oil flinger is assembled concave side out.

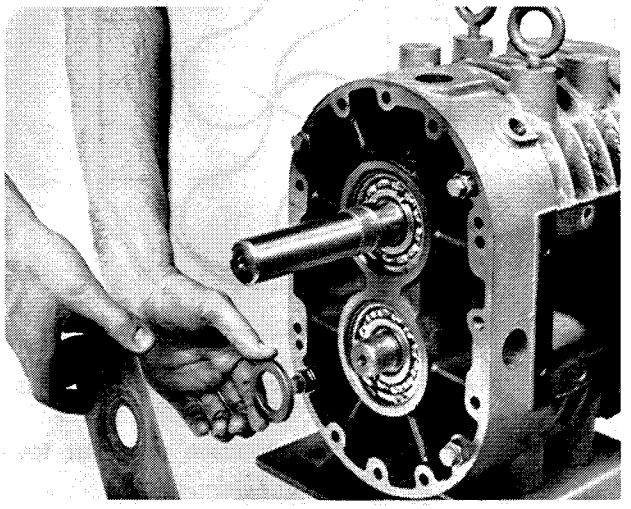


FIGURE 23
ASSEMBLING CLAMP WASHER AND OIL FLINGER TO DRIVE END OF IDLER SHAFT

n. Assemble flexlock nut (27) to drive end of idler shaft. Place wood block between idler rotor lobe and inlet or discharge duct to prevent rotor from turning. Torque nut to 300 ft-lb [42 mkg] (see Fig. 24).
o. Assemble bearing spacer (20) to drive end of drive shaft.
p. Assemble lock nut (22) to drive end of drive shaft with chamfer facing toward pump body. Using hammer and blunted flat punch, tighten lock nut sufficiently to compress shim stack (see Fig. 25).

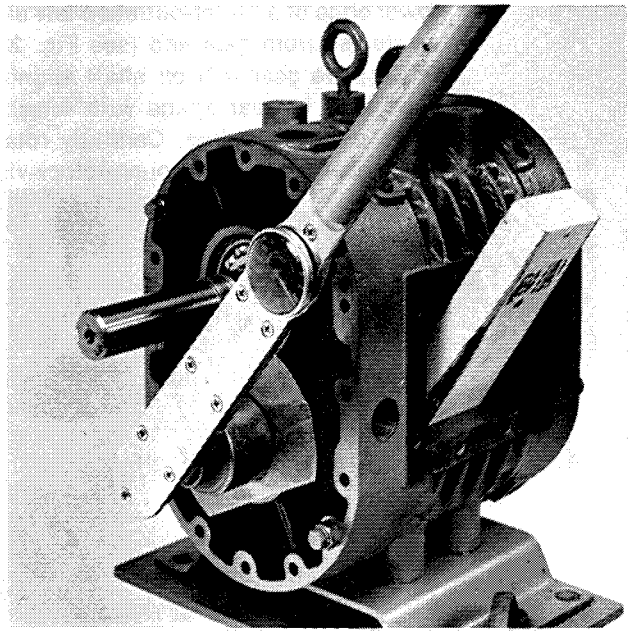


FIGURE 24
TIGHTENING LOCK NUTS WITH TORQUE WRENCH

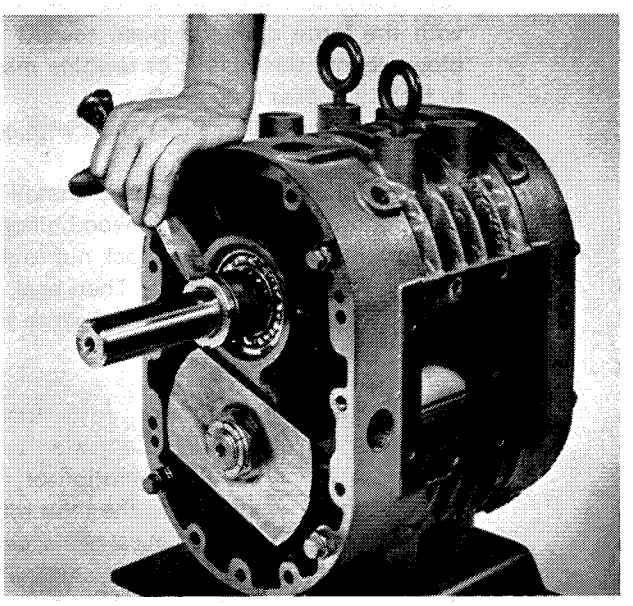


FIGURE 25
TIGHTENING LOCK NUT TO CHECK DRIVE END CLEARANCE

q. Check drive end plate to rotor lobe clearance for each rotor with feeler gages (see Fig. 26). (Drive end clearance for each model is specified in table following Step c of Final Assembly procedure on page 12). If clearance is not within specified limits for each rotor, remove the drive end plate and add or remove shims as necessary to adjust clearance. Reassemble and recheck clearance.
r. When drive end clearance is correct, temporarily remove the snap rings (26) retaining the drive end bearings.
CAUTION: Failure to remove these rings may result in damage to the double-row ball bearings during installation of the timing gears.

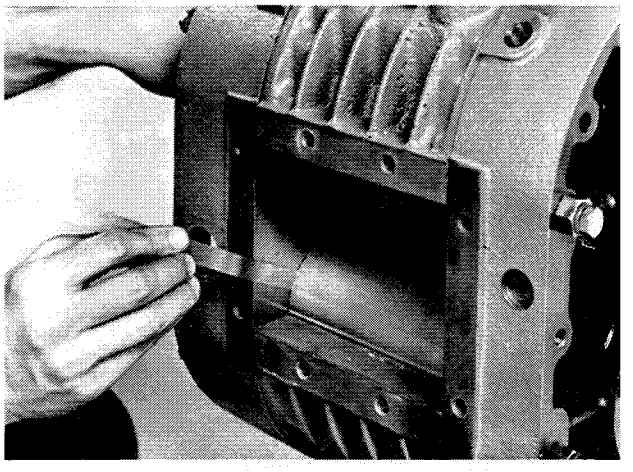


FIGURE 26
CHECKING DRIVE END CLEARANCE WITH FEELER GAGE

s. Brush the gear end splines and threads of both shafts with assembly lubricant. Assemble the idler gear (42) to the idler shaft with the large diameter boss toward the blower body. Use plastic or rawhide mallet to start idler gear onto shaft.

t. Place oil flinger (20) on idler shaft with concave side in toward gear.

u. Lubricate flexlock nut (44) and install on idler shaft. Chock rotor with wood block to prevent its turning. Tighten lock nut to seat gear against bearing sleeve. Then back off lock nut enough to permit oil flinger to turn freely.

v. Rotor timing procedure.
On the helical gear blower, rotor timing (rotor to rotor clearance) is adjusted by a system in which rotational motion of the drive rotor is transferred to the idler rotor by means of two meshed helical gears, each splined to its respective rotor shaft. The axial position of the **idler** gear is **fixed** as the gear face butts against the bearing sleeve and is held there by a lock nut. The axial position of the **drive** gear is slightly **adjustable** as the drive gear is clamped between a conical spring washer (Belleville spring) and a lock nut. Axial movement of the drive gear, accomplished by tightening the lock nut against spring pressure, changes the angular relationship between the two rotors thereby changing their timing.
(1) In order to time the rotors, it is first necessary to start the gears on their rotor shafts in proper relationship to each other.
(2) Place Belleville Spring (48) on the drive rotor shaft, concave side out toward gear (see Fig. 27).

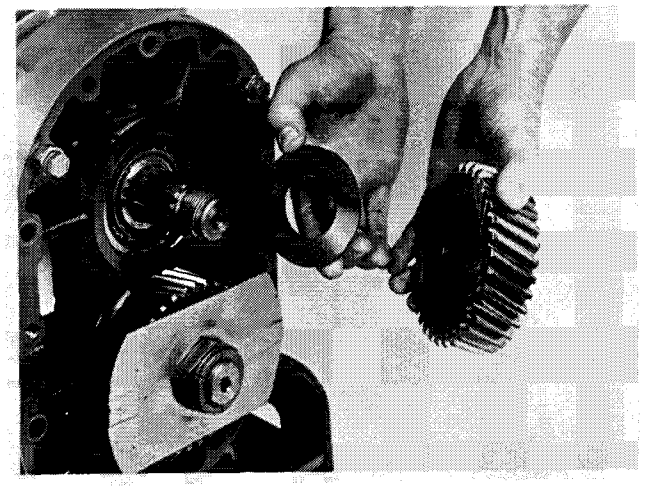


FIGURE 27
POSITIONING BELLEVILLE SPRING AND DRIVE GEAR BEFORE ASSEMBLING TO DRIVE ROTOR SHAFT

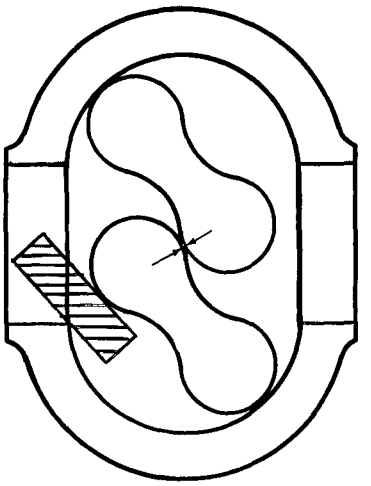


FIGURE 28
ROTOR AND SPACER BLOCK POSITION FOR INDEXING GEARS (AS VIEWED FROM GEAR END)

(3a) If gears are being reused, align the index marks made on the gears during teardown. Make sure that the wide land in the drive gear spline is aligned with the missing tooth on the drive rotor shaft. Start drive gear on rotor shaft using plastic or rawhide faced mallet far enough to engage flexlock nut two turns by hand.

(3b) If new gears are used, align rotors parallel to each other in approximately the ten o'clock-four o'clock position as viewed from the gear end. Place 1/2" to 1" thick block between idler rotor lobe and lower edge of air inlet-outlet on left side as viewed from gear end (see Fig. 28). Place drive gear (47) on shaft aligning wide land in gear spline with missing tooth on shaft spline. Carefully rotate drive gear and rotor counterclockwise

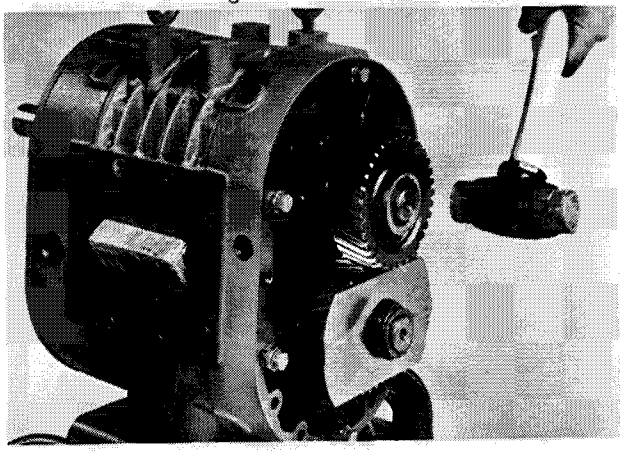


FIGURE 29
STARTING DRIVE GEAR ONTO SHAFT WITH SOFT FACED MALLET

approximately 15° (1-1/2 teeth) while idler gear and rotor remain stationary. Push drive gear onto shaft meshing it with idler gear. Use mallet to move gear onto shaft far enough to engage flexlock nut two turns by hand (see Fig. 29).

(4) The two drive end snap rings (26) temporarily removed on page 14 should now be replaced.

(5) Drive gear onto shaft by turning flexlock nut. When the inner faces of gears are aligned, check rotor-to-rotor clearance at arrows in Fig. 28. If clearance is greater than .016″ continue turning nut until .016″ is obtained. Rotors should then turn freely.

(6) If tightening drive gear lock nut does not free rotors, the gears have been improperly meshed. Remove drive gear, fit a new Belleville spring, and repeat gear indexing procedure (Item 3b above).

(7) Before making final timing adjustments, torque idler gear lock nut to 300 ft-lb [42 mkg].

(8) When rotors turn freely, it is still necessary to adjust rotor clearances to be equal on both sides. Refer to diagram in Fig. 30. Use feeler gages placed between the rotor lobes at position A-A and B-B to check clearance. Adjust clearance by tightening flexlock nut on drive rotor shaft. One-sixth of a turn of the nut will change the clearance by .005 in. [.13 mm]. Adjust so that clearance at A-A is equal to B-B within + .001 in. [.025 mm]. Clearance must be checked on both sides of each rotor lobe near each end.

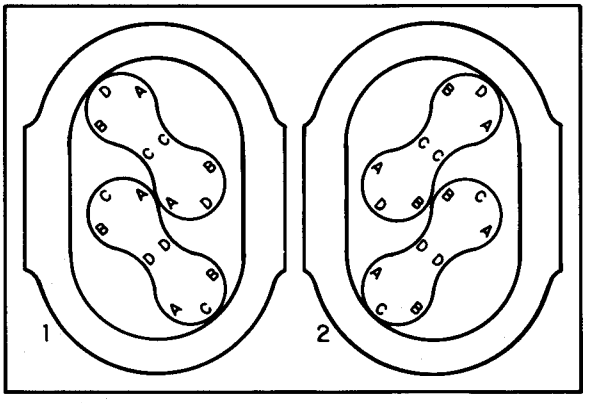


FIGURE 30
POSITIONS OF ROTORS FOR CHECKING TIMING

w. When correct rotor timing has been established, the other interior rotor and air box clearances should be checked with feeler gages (see Fig. 31).

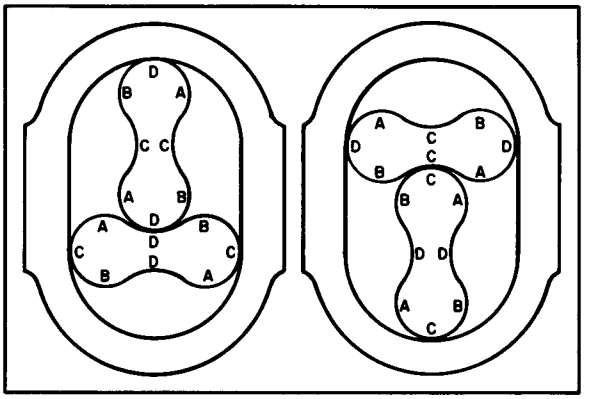


FIGURE 31
POSITIONS OF ROTORS FOR CHECKING INTERNAL CLEARANCE

(1) Clearance between tip of one rotor lobe and valley of other rotor (C-C and D-D) should be a minimum of .0040 in. [.102 mm]. This is measured with the rotors perpendicular to each other. It should be checked several places along the length of the rotor for each of the four lobe tip to valley positions.

(2) Clearance between the rotor tips and the housing halves should be a minimum of .0040 in. [.102 mm]. It should be measured at several places along the length of each of the four rotor lobes.

(3) Gear end rotor to end plate clearance is measured between the end of each rotor lobe and the gear end plate. The gear end clearance for each model is specified in the table on page 12. If the gear end clearance is not within limits, recheck the drive end clearance (refer back to Item q.), as gear end and drive end clearance are interdependent.

CAUTION: These rotor-to-rotor and rotor-to-air box clearances are extremely critical. Even though the blower may turn freely by hand when cold; under operating conditions, the parts expand, and the rotors are subject to slight deflection. If the clearances are not sufficient, the rotors may contact each other or the housing with destructive results. If the clearances are too great, the

blower may not develop the pressure or airflow that is required to perform its function.

x. Check gear backlash four places at 90° intervals as described in the Teardown Sequence (Section III, Item B., 1., g.).
NOTE: If any of the four readings are not within the specified limits, do not proceed further with assembly. If a new set of gears does not solve the problem then consider returning the unit to DuroFlow for credit towards a remanufactured blower.

y. After correct gear backlash has been established, remove the six cap screws and spacers used to temporarily secure the gear end plate to the housing halves.

z. Assemble gasket (31) to gear end cover (1).

aa. Assemble gasket and cover to gear end plate with 14 cap screws (4), 14 lock washers (6) and 2 cap screw and lock washer assemblies (5). Torque all cap screws to 28 to 32 ft-lb [3.9 to 4.4 mkg] (see Fig. 32).

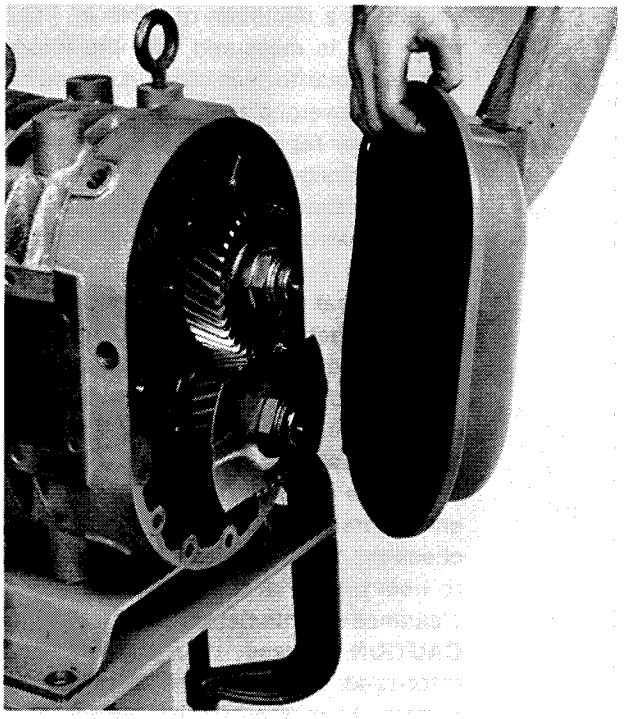


FIGURE 32
ASSEMBLING GEAR END COVER AND GASKET TO END PLATE

bb. Move back to drive end of blower.

cc. Remove lock nut (22) from drive rotor temporarily.

dd. Remove 4 cap screws (18) holding drive end plate to upper and lower housing halves.

ee. Assemble gasket (31) to drive end cover (30).

ff. Assemble gasket and cover to drive end plate.

gg. Insert 14 cap screws (18) and lock washers (6) and two cap screw and lock washer assemblies (5) through holes in cover and end plate. Torque all cap screws to 28 to 32 ft-lb [3.9 to 4.4 mkg].

hh. Assemble lock washer (21) to drive end of drive shaft with tangs outward toward end of shaft (see Fig. 33).

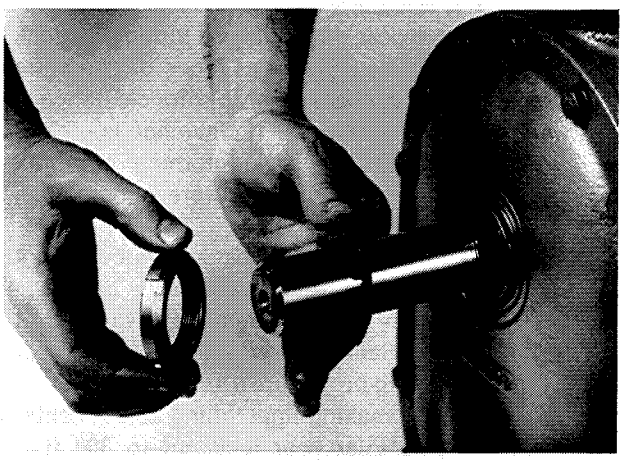


FIGURE 33
ASSEMBLING SPIDER WASHER AND LOCK NUT TO DRIVE SHAFT

ii. Reassemble lock nut (22) to drive shaft with chamfer toward blower body. Tighten lock nut securely with hammer and punch (see Fig. 34).
NOTE: If blower rebuilding is to be performed on a regular basis, a special tool for the drive rotor lock nut is suggested. A detailed drawing for the fabrication of this tool is available from DuroFlow upon request. If the special tool is used, torque lock nut to 300 ft-lb [42 mkg].

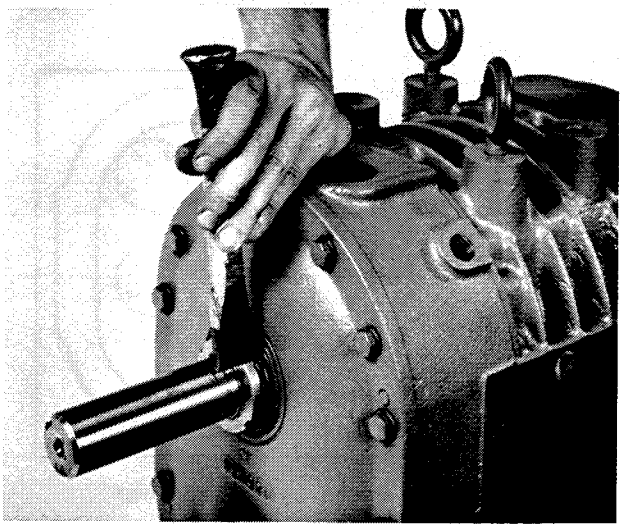


FIGURE 34
TIGHTENING DRIVE SHAFT LOCK NUT SECURELY WITH BLUNTED CHISEL AND BALL PEEN HAMMER

jj. Choose the lock washer tang that best aligns with a slot in the lock nut (22). Bend the tang into the lock nut to prevent lock nut from backing off (see Fig. 35).

kk. Install oil gage plug (43) in gear end cover.

ll. Install two oil breather caps (8) in gear end cover.

mm. Install the other eight pipe plugs.

nn. If the unit is not to be installed immediately cover the air inlet and outlet openings to prevent the entry of foreign material.

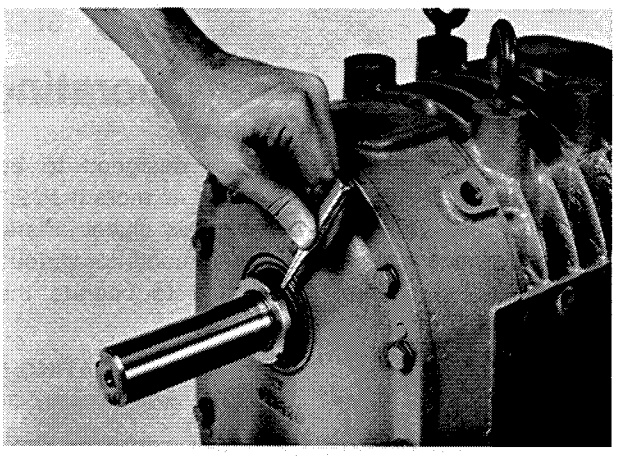


FIGURE 35
BENDING SPIDER WASHER TANG INTO LOCK NUT SLOT

SECTION EIGHT

Spur Gear Blowers

As mentioned in Section I, the former blower design utilized spur tooth timing gears rather than helical tooth gears in the current design. The only change (besides the gears) from the former model to the current model is the addition of a Belleville spring washer behind the drive rotor timing gear. Therefore, when overhauling a blower with a reusable set of spur gears and rotors, it is optional whether the spur gears are reused or replaced with a set of helical gears and Belleville spring. If it is desired to reuse the spur gears, some steps in the teardown and reassembly procedures will differ from those for the helical gear type.

Rotor timing with the spur gears is controlled by selective assembly (matching a particular rotor to a particular gear). Therefore, it is essential each gear be replaced on the shaft from which it was taken. After checking the gear backlash and marking the ends of the gear teeth for proper indexing as in Section III, Item B., 1.,g. and h.; it is also necessary to mark the drive gear and idler gear in some way so that they can be differentiated upon reassembly. This can be done with the center punch and hammer or with an etching tool.

The reassembly procedure for a spur gear blower is identical to that for the helical gear blower except for the gear assembly and timing. With the spur gears, assemble the idler gear as in Section VII, Item B., 2., s. Assemble the drive gear to the drive shaft aligning the gear idex marks which were made prior to removing the timing gears. Chock the rotors with a wood block and torque both flexlock nuts to 300 ft-lb [42 mkg]. Check rotor timing with feeler gages as in Section VII, Item B., 2., v., (7). With spur gears the rotor timing is not adjustable. If the timing is not within limits, remove the spur gears and replace with a new set of helical gears and Belleville spring.

SECTION NINE

Operating Limitations

DuroFlow 45 Series blowers are designed to be operated at 4000 RPM maximum and no more than 2:1 pressure ratio. The table below gives characteristic inlet airflow and horsepower requirements for various speeds and pressures. Attempting to operate the blower at speeds and pressures above the rated maximum will cause premature bearing and seal wear and will void the warranty.

CAUTION: Outlet temperatures should not exceed 350°F.

OPERATING CHARACTERISTICS

(Data based on standard air at inlet (14.7 psi @ 60°F)

		SPEED (RPM)									
		2000		2500		3000		3500		4000	
MODEL	PSI	CFM	HP	CFM	HP	CFM	HP	CFM	HP	CFM	HP
4504	2	165	2.5	225	3	280	3.5	335	4.5	390	5.5
	5	145	5	205	6.5	260	8	315	9	370	11
	8	130	8	185	10	240	12	295	14	351	16.5
	10	120	9.5	175	12.5	230	15	287	17.5	337	20.5
	12	110	11.5	162	15	215	18.5	270	22	325	26
	15			150	18	203	23	255	27	308	31.5
4506	2	260	4	340	5	430	6	513	6.5	600	8
	5	235	8	320	10	400	12.5	485	14.5	565	16.5
	8	215	12	295	16	380	19	460	22.5	540	26
	10	200	14.5	285	19	365	23.5	445	28	530	32.5
	12	185	17.5	265	23	350	28.5	435	33.5	515	39
	15			250	28	349	35	415	41	495	48
4509	2	395	6	525	8	650	9.5	775	11.5	900	13.5
	5	360	12.5	480	16	615	19	735	23	855	26
	8	330	19	450	24	575	29	700	34	820	39
	10	315	23.5	435	29.5	555	36	680	42	800	48
	12	290	27	420	35	540	42	660	50	780	57
	15			385	43	510	52	630	61	755	70
4512	2	540	8	705	10	870	12	1040	14	1205	16.5
	5	480	16	650	20	820	25	980	30	1150	34
	8	445	23	610	30	775	37	935	44	1100	51
	10	420	28	580	37	745	45	905	54	1065	62
	12	400	34	560	44	720	54	880	64	1040	74
	15			520	54	680	66	845	78	1010	90

SECTION TEN

Lubrication Recommendations

The blower gears and bearings are splash lubricated. Proper oil level must be constantly maintained to prevent overheating and damage to internal parts.

After installation of the blower, add oil through the oil fill plug on top of the drive end plate. Fill only until oil reaches the level midway in the oil gage plug sight glass in the gear end cover. Approximate oil capacities are given below.

Vertical-30 oz. [0.9L]
Horizontal-56 oz. [1.7L]

Oil level should be checked daily. Wait three minutes after shutdown to allow oil to drain down before reading level at sight glass. Top up if necessary through oil fill plug. Every 500 hours of operation (or 6 months whichever occurs first) the oil should be changed.

Oil used in DuroFlow blowers must meet or exceed the requirements of SAE specifications SE and CC. The viscosity used depends upon ambient air temperature and severity of application, i.e., pressure ratio, as in the following table.

		AMBIENT AIR TEMPERATURE	
		−65°F to 40°F −54°C to 4°C	40°F to 110°F 4°C to 43°C
PRESSURE	1.0 to 1.7 P.R. 0 to 10 psig pressure 0 to 10 in.Hg vacuum	SAE 10W	SAE 20
RATIO	1.7 to 2.0 P.R. 10 to 15 psig pressure 10 to 15 in. Hg vacuum	SAE 20W	SAE 40

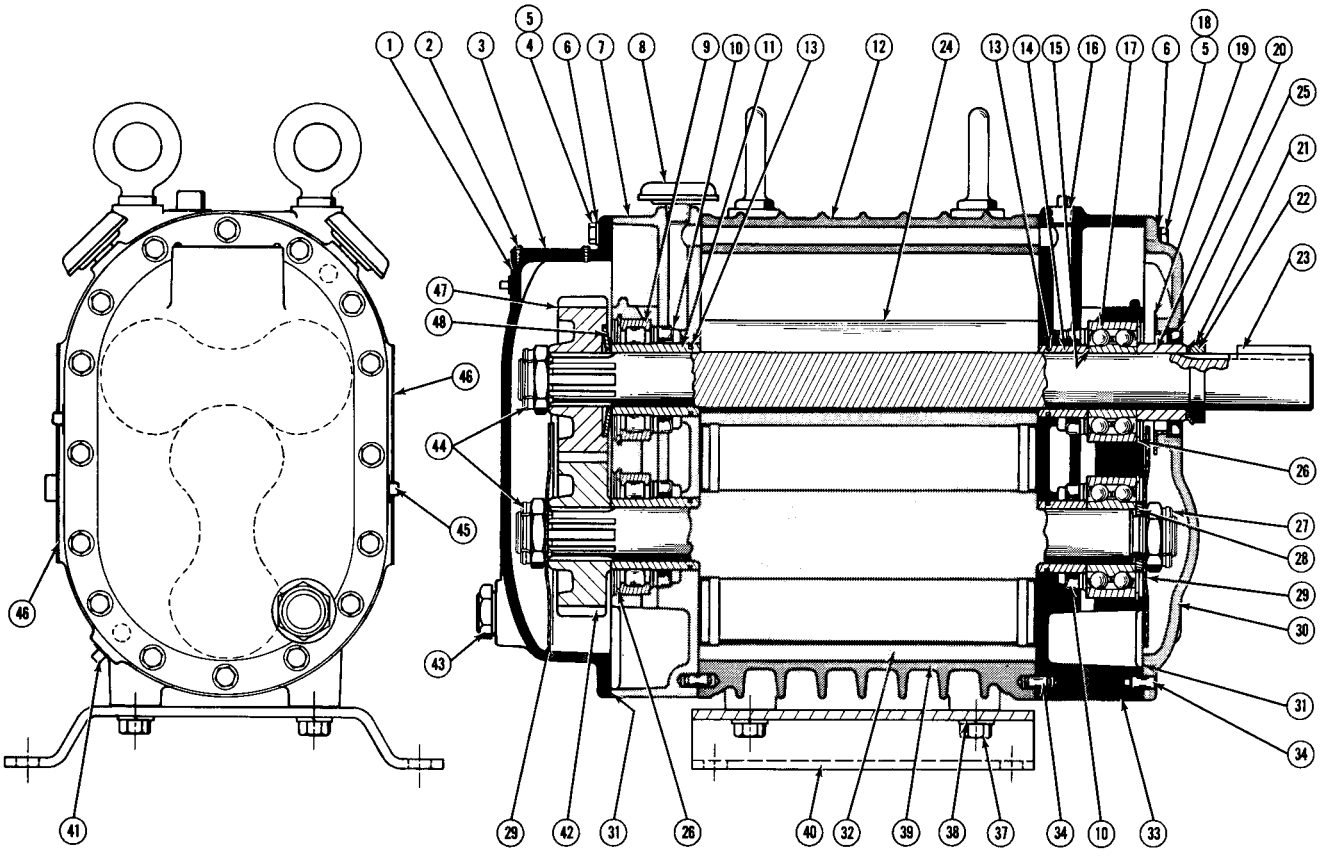
For applications outside these limits, consult DuroFlow. Oils of different brands or types should not be mixed.

10W40 or 15W40 multigrade oil is recommended for all ordinary operating conditions.

SECTION ELEVEN

Parts Lists, Sectional and Exploded Views

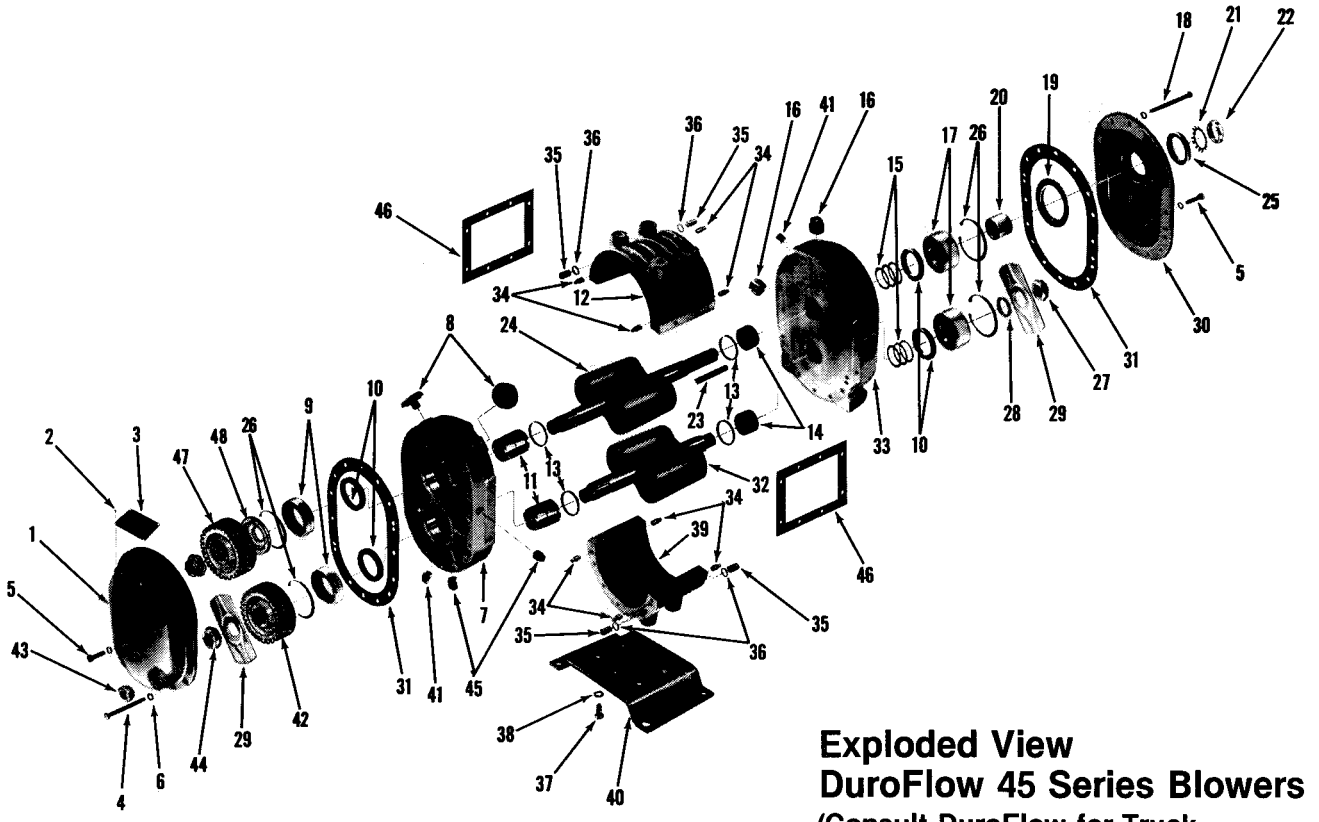
A list of current part numbers is available upon written request from DuroFlow. Alternatively, replacement parts may be ordered by part number from the Parts List.



Sectional View
DuroFlow 45 Series Blowers

VARIABLE PARTS LIST

ITEM NO.	NAME OF PART	4512	4509	4506	4504
12	Top Housing	135069	135431	135437	141534
23	Shaft Key	135729	135720	135720	141562
24	Drive Rotor	180929	180928	180927	180926
32	Idler Rotor	180933	180932	180931	180930
39	Bottom Housing	135070	135432	135438	141535
40	Mounting Plate	135405	135436	135442	141541
46	Gasket	135716	135717	135718	141539



Exploded View
DuroFlow 45 Series Blowers
(Consult DuroFlow for Truck Mounted Blowers)

PARTS LIST

Item No.	Name of Part	Part Number	Quantity Per Blower
1	Cover-Gear End	135075	1
2	Self Tapping Screw	129309	4
3	Name Plate	143606	1
4	Capscrew	134674	14
5	Capscrew & L.W. Assy.	132579	4
6	Lockwasher	2917	28
7*	End Plate-Gear End (137430)	180672	(1) 1
8*	Breather Filter	140867	(2) 1
9	Roller Bearing	138113	2
10	Oil Seal	181200	4
11	Bearing Sleeve	138100	2
12	Housing Half-Top	Variable	1
13	Seal Ring	139986	4
14	Bearing Spacer	134662	2
15	Shim 135726-7-8 and	159076-7	As Required
16*	Pipe Plug (1") (158285)	186545	(2) 2
17	Ball Bearing	138116	2
18	Capscrew	134675	14
19	Oil Deflector	139466	1
20	Bearing Spacer	134671	1
21	Lockwasher	138257	1
22	Locknut	128040	1
23	Key	Variable	1
24	Rotor-Drive	Variable	1
25	Oil Seal	134670	1
26	Snap Ring	125606	4
27	Flexlock Nut	124793	1
28	Clamp Washer	135766	1
29**	Flinger	See Below	**
30	Cover-Drive End	135074	1
31	Gasket	135715	2
32	Rotor-Idler	Variable	1
33*	End Plate-Drive End (137429)	180673	(1) 1
34	Dowel	121880	10
35	Ferrule	119034	4
36	"O" Ring	119058	4
37	Cap Screw	100963	4
38	Lockwasher	2675	4
39	Housing Half-Bottom	Variable	1
40	Mounting Plate (Vertical)	Variable	1
41*	Pipe Plug (3/8")	21360	(2) 2 or 0
42	Gear Idler L.H.	181377	1
43	Oil Gage Plug	137799	1
44	Flexlock Nut	124793	2
45*	Pipe Plug (1/2")	9620	(4) 0 or 2
46	Gasket	Variable	2
47	Gear Drive R.H.	181378	1
48	Belleville Spring	181069	1

* Note – Part Number and/or quantity needed with **old** style end plates are in parenthesis.

** Flingers – For VT/HL shaft configurations use 2-134652.
For VB/HR shaft configurations use 1-134652 and 1-143095.

Troubleshooting Guide— DuroFlow Positive Displacement Rotary Blowers

Problem or Complaint	Probable Causes	Usual Reasons or Sources
Noisiness	Rotor-to-Rotor Contact	- Rotors Out of Time - Excessive Pressure Ratio - Failed Bearing(s) - Failed Gears
	Failing Bearing(s)	- Faulty Installation - Nonspec Oil - Contaminated Oil - Insufficient Oil - Oversized Belt Drive - Improperly Mounted Sheave - Overtightened Belts - Misaligned Direct Coupling
	Failing Gears	- Insufficient Backlash - Nonspec Oil - Contaminated Oil - Insufficient Oil - Severe Torsional Vibration
	Failing Lubricated Coupling or Joint	- Nonspec Grease - Contaminated Grease - Insufficient Grease
	Loose Attached Hardware	- Belt Guard - Pump Mounting Bracket - Frame Members - In/Out Ducting Supports
	Air Leakage	- Improper Relief Valve Setting - Blown Gaskets - Loose Ducting Joints
	Belt Flutter	- Insufficient Static Tension - Long Span (Center-to-Center) Distance - Sheave Misalignment - Severe Torsional Vibration
Poor Performance	Restricted Inlet	- Clogged Filter Element - Undersized Filtration Unit - Undersized Inlet Pipe or Tubing - Excessive Inlet Duct Length - Collapsed Inlet Hose
	Down Stream Restriction	- Clogged Silo Vent Filter Element - Undersized Silo Vent Filter - Undersized Outlet Pipe or Tubing - Excessive Outlet Ducting Length - Clogged Diffusion Pads (on Pneumatic Trailers)
	Excessive Air-to-Product Ratio	- Material Bridging in Feed Hopper - Insufficient Feeder Speed - Material Caking at Inlet Nozzle - Material Caking at Inlet Nozzle or Funnel

	Erroneous Pressure or Vacuum Indication	- Loose Gauge Connection - Gauge Movement Damaged - Gauge Miscalibrated - Gauge Tap Too Far from Unit Outlet Port
	Air Leakage	- Improper Relief Valve Setting - Blown Gaskets - Loose Ducting Joints
	Insufficient Rotor Speed	- Wrong Sheave Set - Wrong Motor Speed - Slipping Belts - Insufficient Engine Speed
	Excessive Rotor Clearances	- Abrasive Wear of Rotor Surfaces - Rotors "Lag" Timed
	Change in Conveyed Material	- Material More Difficult to Fluidize - Material of Higher Density - Moisture Content of Material Too High
Leaking Oil	Failed Oil Seals	- Foreign Material in Seal Bores - Faulty Installation - Nonspec Oil - Contaminated Oil - Overheated Rotor Shafts
	End Cover Seams Not Tight	- Through Bolts Loose - Gaskets Torn
	Oil Foaming	- Nonspec Oil - Oil Cavities Overfilled
Chronic Fuse Blowing or Circuit Breaking	Excessive Motor Amperage	- Excessive Pressure Ratio - Excessive Pump Speed - Line Voltage Droop - Air Density Increase - Loose Electrical Connections - Foreign Material in Air Box
	Underrated Fuses	
	Premature Heater Strip Actuation	- Unusually High Ambient Temperature - Underrated Heater Strips
Overheating	Excessive Pressure Ratio	- Clogged Filter Element - Undersized Filtration Unit - Undersized Inlet Pipe or Tubing - Excessive Inlet Duct Length - Collapsed Inlet Hose - Clogged Silo Vent Filter Element - Undersized Silo Vent Filtration Element - Undersized Outlet Pipe or Tubing - Excessive Outlet Ducting Length - Clogged Diffusion Pads (on Pneumatic Trailers)
	Insufficient Rotor Speed	- Wrong Sheave Set - Wrong Motor Speed - Slipping Belts - Insufficient Engine Speed

WARRANTY

GARDNER-DENVER INDUSTRIAL MACHINERY
1800 GARDNER EXPRESSWAY
QUINCY, IL 62305-4024
TEL: (217) 222-5400 · FAX: (217) 223-5897

DUROFLOW BLOWERS

GENERAL PROVISIONS AND LIMITATIONS

Industrial Machinery (the "Company") warrants to each original retail purchaser ("Purchaser") of its new products from the Company or its authorized distributor that such products are, at the time of delivery to the Purchaser, made with good material and workmanship. No warranty is made with respect to:

1. Any product which has been repaired or altered in such a way, in the Company's judgment, as to affect the product adversely.
2. Any product which has, in the Company's judgment been subject to negligence, accident, improper storage, or improper installation or application.
3. Any product which has not been operated or maintained in accordance with normal practice and with the recommendations of the Company.
4. Components or accessories manufactured, warranted and serviced by others.
5. Any reconditioned or prior owned product.

Claims for items described in (4) above should be submitted directly to the manufacturer.

WARRANTY PERIOD

The Company's obligation under this warranty is limited to repairing or, at its option, replacing, during normal business hours at an authorized service facility of the Company, any part which in its judgment proved not to be as warranted within the applicable Warranty Period as follows.

BARE BLOWERS

Basic bare blowers, consisting of all parts within, are warranted for 12 months from date of initial use or 18 months from date of shipment to the first purchaser, whichever occurs first.

Any disassembly or partial disassembly of the blower, or failure to return the "unopened" blower per Company instructions, will be cause for denial of warranty.

OTHER COMPONENTS

All other components are warranted for 12 months from date of initial use or 18 months from date of shipment to first purchaser, whichever comes first.

LABOR TRANSPORATION AND INSPECTION

The Company will provide labor, by Company representative or authorized service personnel, for repair or replacement of any product or part thereof which in the Company's judgment is proved not to be as warranted. Labor shall be limited to the amount specified in the Company's labor rate schedule.

Labor costs in excess of the Company rate schedule amounts or labor provided by unauthorized service personnel is not provided for by this warranty.

All costs of transportation of product, labor or parts claimed not to be as warranted and, of repaired or replacement parts to or from such service facilities shall be borne by the Purchaser. The Company may require the return of any part claimed not to be as warranted to one of its facilities as designated by Company, transportation prepaid by Purchaser, to establish a claim under this warranty.

Replacement parts provided under the terms of the warranty are warranted for the remainder of the Warranty Period of the product upon which installed to the same extent as if such parts were original components thereof.

DISCLAIMER

THE FOREGOING WARRANTY IS EXCLUSIVE AND IT IS EXPRESSLY AGREED THAT, EXCEPT AS TO TITLE, THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY.

THE REMEDY PROVIDED UNDER THIS WARRANTY SHALL BE THE SOLE, EXCLUSIVE AND ONLY REMEDY AVAILABLE TO PURCHASER AND IN NO CASE SHALL THE COMPANY BE SUBJECT TO ANY OTHER OBLIGATIONS OR LIABILITIES. UNDER NO CIRCUMSTANCES SHALL THE COMPANY BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOSSES OR DELAYS HOWSOEVER CAUSED.

No statement, representation, agreement, or understanding, oral or written, made by any agent, distributor, representative, or employee of the Company which is not contained in this Warranty will be binding upon the Company unless made in writing and executed by an officer of the Company.

This warranty shall not be effective as to any claim which is not presented within 30 days after the date upon which the product is claimed not to have been as warranted. Any action for breach of this warranty must be commenced within one year after the date upon which the cause of action occurred.

Any adjustment made pursuant to this warranty shall not be construed as an admission by the Company that any product was not as warranted.

Gardner-Denver
Industrial Machinery

For additional information, contact Gardner-Denver Industrial Machinery Division, 1800 Gardner Expressway, Quincy, Illinois 62305-4024
Telephone (217) 224-8800 FAX 217-224-7814 Telex 404332.

Specifications subject to change without notice.
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