StartMaster®

Air Starting Systems

Air Starter Service Manual

SERIES SM500

StartMaster
Air Starting Systems
A DIVISION OF MARADYNE CORP.

4540 W. 160th St.
CLEVELAND, OHIO 44135-2629
TELEPHONE: 216-362-0755
FAX: 216-362-0799

P/N 5-22490

TABLE OF CONTENTS

SECTION	TITLE	PAGE NUMBER
I.	INTRODUCTION	1
II.	DISASSEMBLY OF DRIVE GROUP	2
II-1.	SAE #3 TYPE FLANGE	2
II-2.	SPECIAL THREE BOLT TYPE FLANGE	5
II-A.	CLEANING, INSPECTION AND PARTS REPLACEMENT	5
III.	DISASSEMBLY OF AIR MOTOR GROUP	6
III-A.	CLEANING, INSPECTION AND PARTS REPLACEMENT	9
IV.	REASSEMBLY OF AIR MOTOR GROUP	10
V.	REASSEMBLY OF DRIVE GROUP	13
V-1.	SAE #3 TYPE FLANGE	13
V-2.	SPECIAL THREE BOLT TYPE FLANGE	15
VI.	STARTER MODEL CONVERSION AND REPHASING	16
	FOLD-OUT NO. 1	
	FOLD-OUT NO. 2	
	FOLD-OUT NO. 3	

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SECTION II - DISASSEMBLY OF DRIVE GROUP

The Series SM500 drive group (See Figure No. 1.1 and No. 1.2) consists of a drive shaft assembly, a reduction gear set, a gear case and a drive housing.

The drive shaft assembly consists of a Bendix drive unit and drive shaft gear (of the reduction gear set) mounted on the drive shaft. The Bendix unit is mounted to one end of the drive shaft and the drive shaft gear is keyed to the other end.

The drive shaft assembly is supported by two roller bearings (one located in the nose of the drive housing and the other located in the gear case) and a ball bearing mounted in the gear case cover.

The reduction gear set consists of the rotor pinions and drive shaft gear. The rotor pinions are splined to the rotor shafts and retained by the pinion retaining rings. The drive shaft gear is keyed to the drive shaft.

II-1. SAE #3 TYPE FLANGE

Disassemble the drive group in accordance with the parts indexing shown in Fold-Out No. 1 and the following instructions:

1. Install a 1¼" to 2" pipe bushing on StartMaster Tool No. 20099. Insert the tool into the inlet air connection of the SM500 air motor and mount the starter in the vise as shown in Figure No. 2.1.
2. Scribe a reference mark on the drive housing, gear case cover, and gear case, as shown in Figure No. 2.2
3. Loosen and remove the eight drive housing nuts (5) lockwashers (6).
4. Pull the drive housing (4) from the gear case.

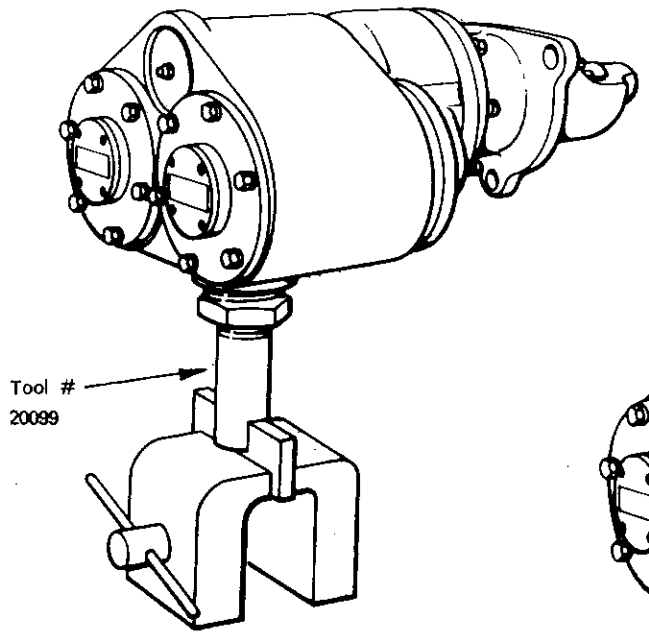


Figure No. 2.1 - Mounting the Starter

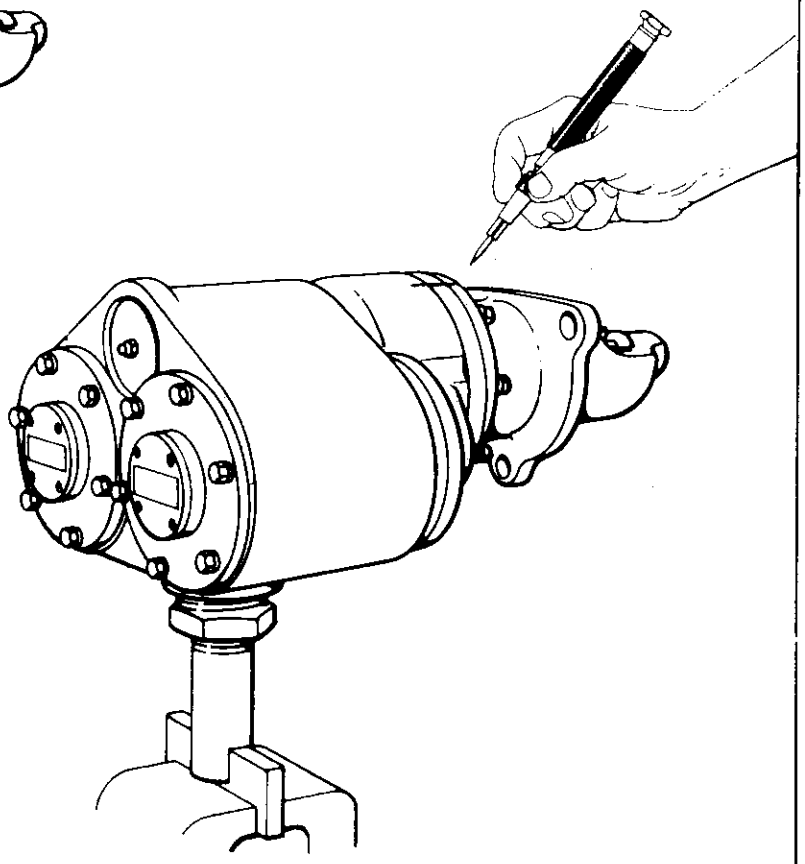


Figure No. 2.2 - Reference Marking

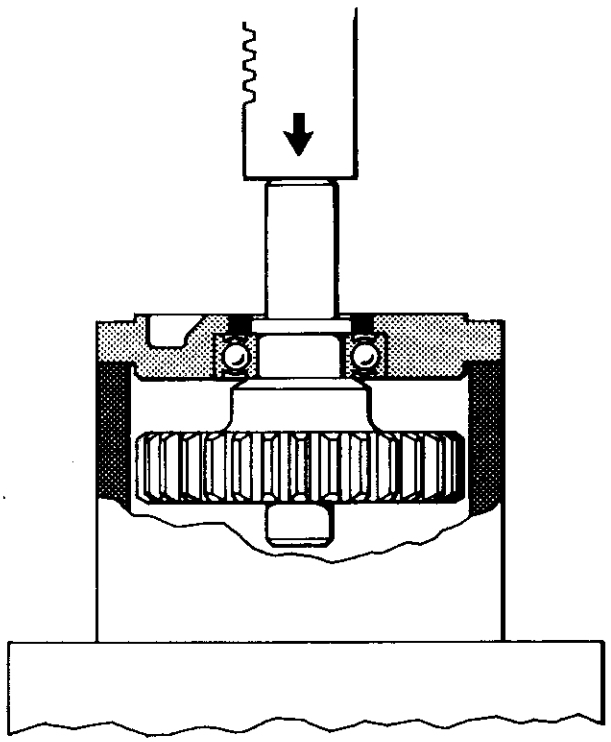


Figure No. 2.6 - Pressing Drive Shaft, Gear, and Bearing from Cover

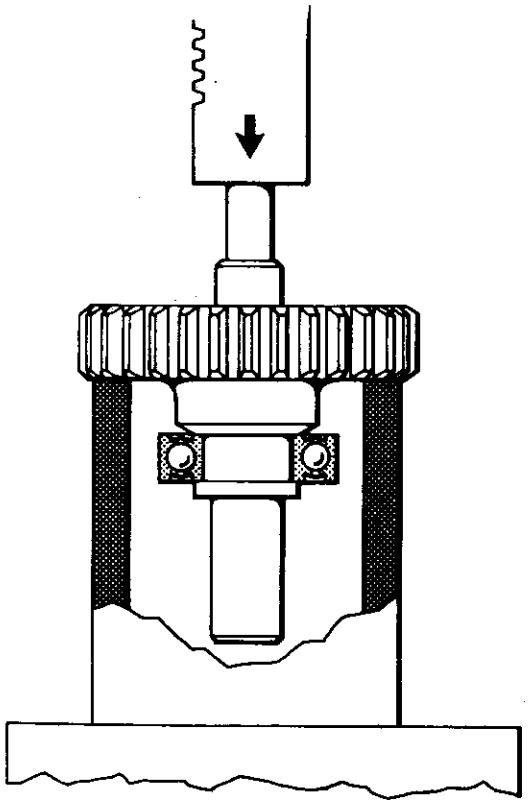


Figure No. 2.7 - Pressing Drive Shaft from Gear

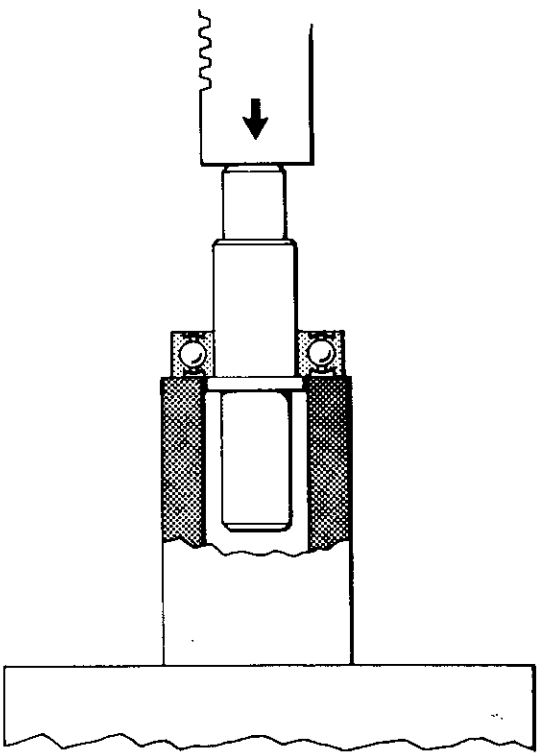


Figure No. 2.8 - Pressing Drive Shaft from Bearing

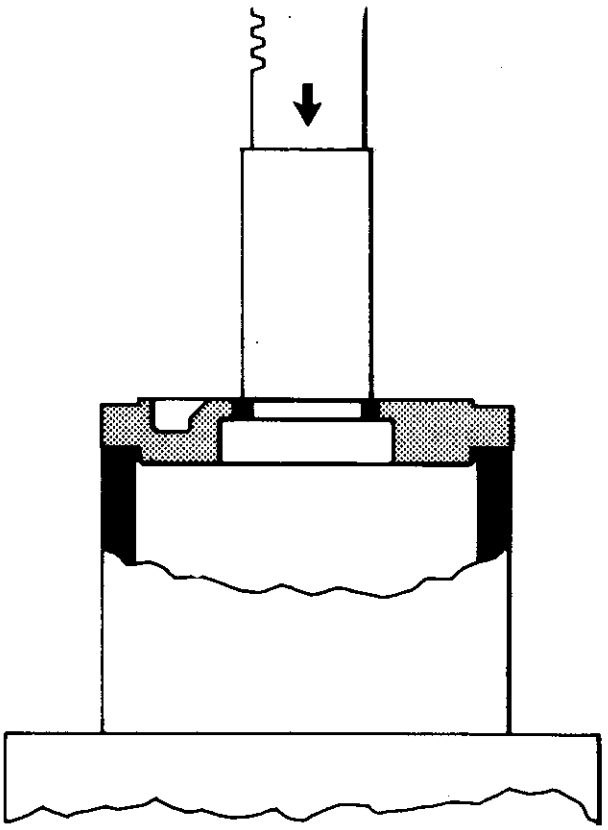


Figure No. 2.9 - Pressing Seal from Cover

SECTION III - DISASSEMBLY OF AIR MOTOR GROUP

The SM500 air motor consists of two sleeve assemblies and two rotors. The sleeve assemblies are mounted to the gear case and endplates, and are surrounded by the air motor casing. Rotation of the air motor is determined by the air flow direction through the sleeve assemblies. Reversing the sleeve assemblies end for end will change direction of air motor rotation. Disassemble the SM500 air motor in accordance with the parts indexing shown in Fold-Out No. 3 and the following instructions:

1. Remove as much grease as possible from the gear case housing (35) to reveal the four gear case screws that are located inside the gear case cover.
2. Remove the screws (36) and washers (37) from the gear case assembly.
3. Remove the gear case assembly from the air motor casing and discard the two gear case gaskets (38).
4. Press the drive shaft roller bearing (34) from the gear case (35), as shown in Figure No. 3.1.
5. Using Tool No. 20044, remove the pinion retaining rings (39) from the rotor shafts. See Figure No. 3.2.
6. Remove the rotor pinions (40) from their shafts.
7. Remove the twelve endplate screws (5) and washers (4) from the rear of the dual air motor assembly.

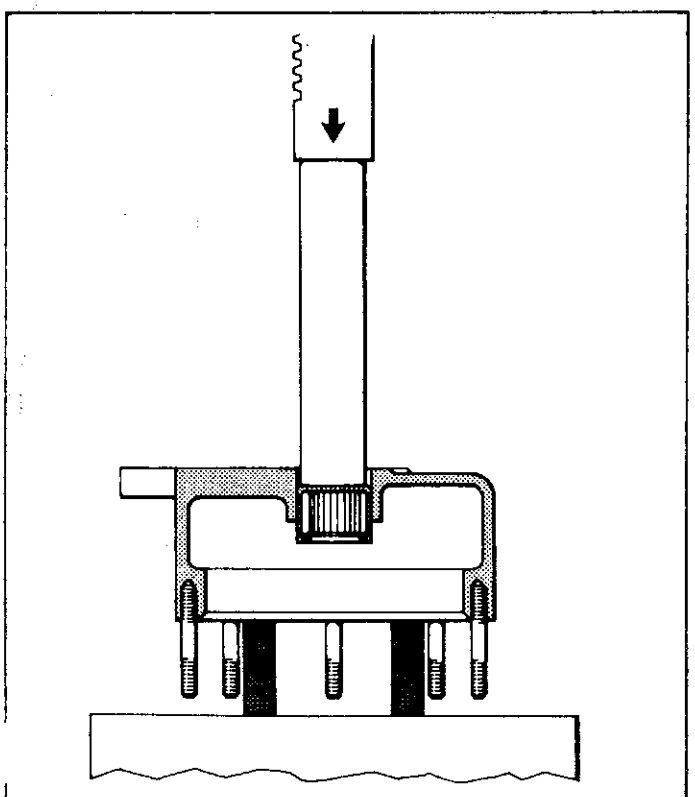


Figure No. 3.1 - Pressing Bearing from Gear Case

NOTE: Some models of the SM500 designed for use with compressed air and all models of the SM500 utilizing natural gas for operation, use an exhaust adaptor. If so equipped, removal of the adaptor is necessary prior to continuing motor disassembly. Proceed as follows: Remove exhaust adaptor mounting screws [22] and remove the adaptor [21] from the rear of the air motor casing. Remove and discard the motor exhaust seal [19] and the four exhaust seal washers [20].

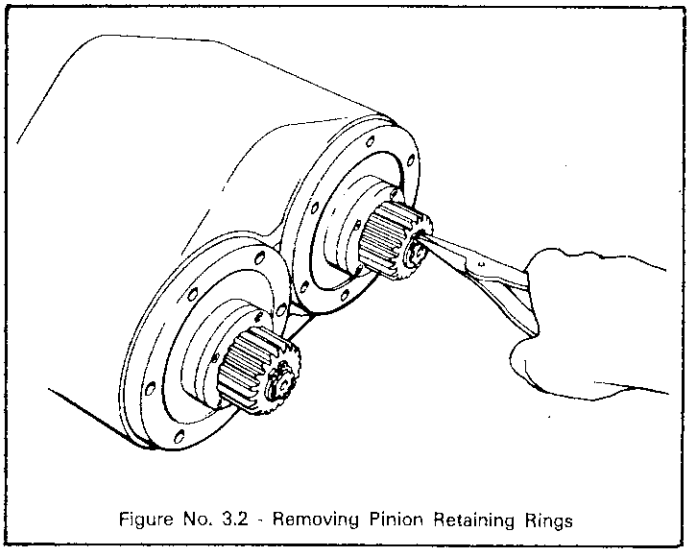


Figure No. 3.2 - Removing Pinion Retaining Rings

8. Grasp the rear endplates (3), and while tapping gently with a hammer, pull the endplates from the rear of the air motor. Discard the endplate seals (2).

NOTE: The rotor shaft bearings [6] are slipfitted to the air motor drive shaft and should come off easily.

9. Tap the front endplate gently with a hammer to loosen the plate from the air motor casing. See Figure No. 3.3
10. Grasp the air motor drive shaft and slide each rotor assembly from the air motor casing, as shown in Figure No. 3.4. Remove the rotor blades (30) and discard the endplate seals (28).
11. Heat the rotor and endplate assemblies to approximately 350 degrees F (177 degrees C) for ½ hour to soften the Loctite on the rotor shafts. Support the rotor and endplate as shown in Figure No. 3.5 and press the rotor assemblies from the endplates.
12. Remove the four bearing retaining screws (23) and washers (24) from each of the endplate bearing retainers (25) and remove retainers.
13. Press the rotor shaft bearings (26) and bearing spacers (41) from each of the two front endplates (27), as shown in Figure No. 3.6.

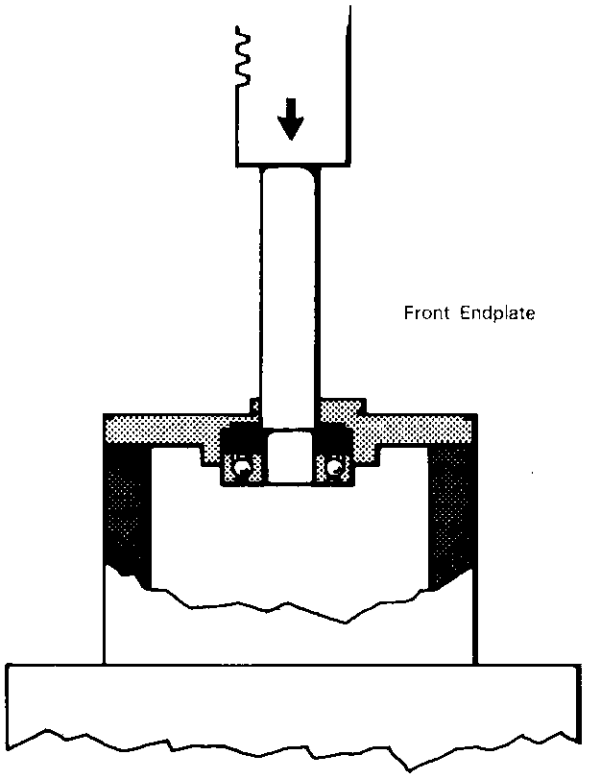
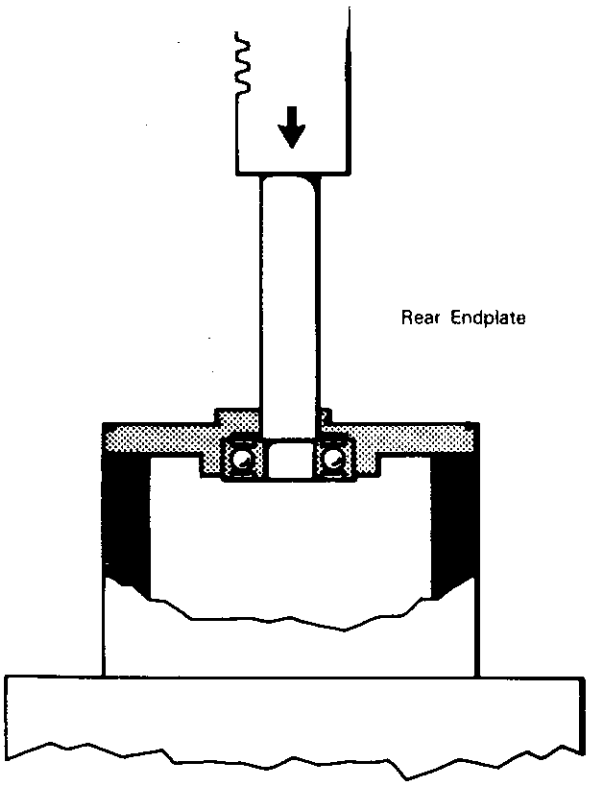


Figure No's. 3.6 and 3.7 - Pressing Rotor Shaft Bearings from Endplates



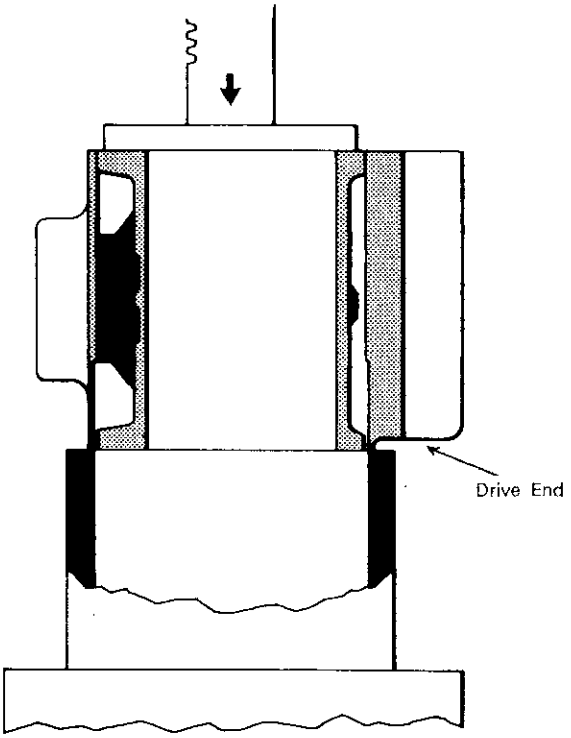


Figure No. 3.8 - Pressing Air Motor Sleeve from Casing

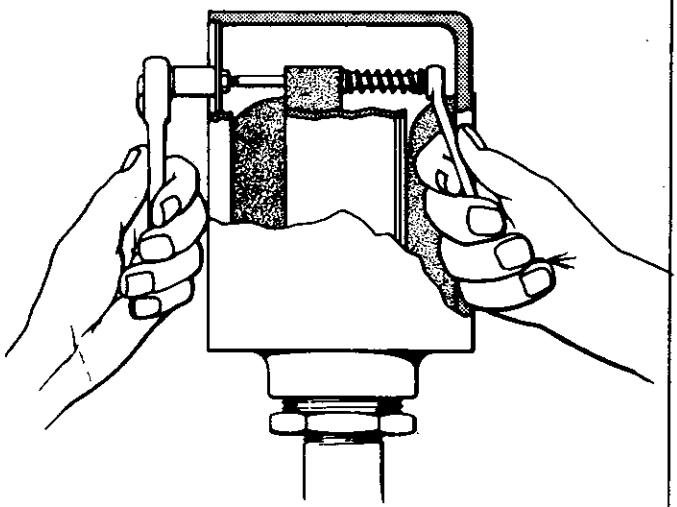


Figure No. 3.9 - Removing Exhaust Valve

SECTION IV - REASSEMBLY OF AIR MOTOR GROUP

Reassembly of the air motor can be accomplished by following the reverse order of disassembly and referring to Fold-Out No. 3. If the air motor is equipped with an exhaust adapter, proceed directly to Step No. 5.

1. If the starter undergoing repair utilizes the exhaust valve assembly, begin by assembling the exhaust valve jam nut (16) to the exhaust valve shaft (15) using the proper thread locking compound and assemble to the dimensions shown in Figure No. 4.1.

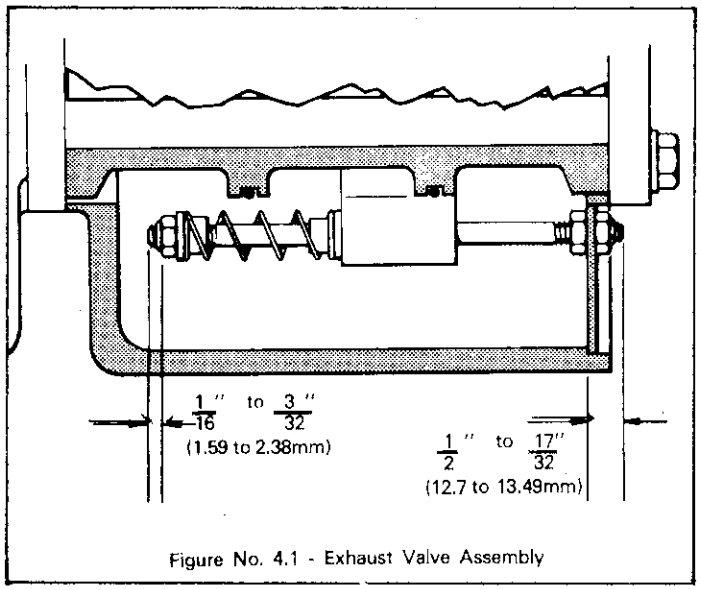


Figure No. 4.1 - Exhaust Valve Assembly

NOTE: Curing of the thread locking compound will require considerable time. This step may be completed prior to total reassembly of the starter.

2. Install the exhaust valve plate (17) and exhaust valve nut (18) and tighten securely.
3. Install the shaft assembly through the valve shaft bore in the air motor housing. See Figure No. 4.1.
4. Assemble the exhaust valve spring (13), guides (12 and 14), and nut (11) in Figure No. 4.1.

NOTE: The exhaust valve spring nut should be tightened to the shaft until 1/16" to 3/32" of the threaded end of the exhaust valve shaft is protruding beyond the nut. Access to the exhaust port area may be obtained through the exhaust cutout in the front of the air motor casing.

5. Press the rotor shaft bearings (26) and bearing spacer (41) into the front motor endplates (27), as shown in Figure No. 4.2.

NOTE: It is imperative that when pressing the drive shaft bearing into the cover and drive shaft into its bearing, the assembly forces are not transmitted through the balls in the bearing or damage will result.

6. Heat each endplate and bearing assembly to approximately 350 degrees F (177 degrees C) for ½ hour to expand the inner race of the endplate bearing. Support each endplate assembly as shown in Figure No. 4.3 and place .002" (.05mm) feeler gauges on the endplates. Apply a small amount of #35 Loctite retaining compound to the rotor shaft bearing diameter. Press the rotor assembly into the upper endplate bearing until it bottoms against feelers and hold in position for approximately 30 seconds while the bearing cools to grip the rotor shaft.

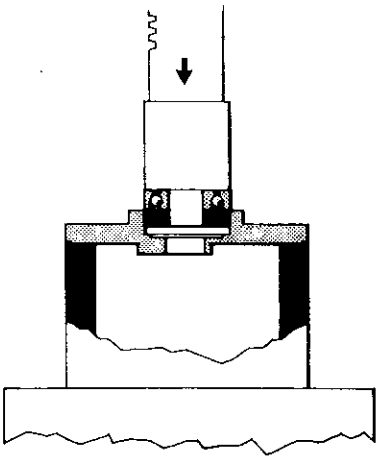


Figure No. 4.2 - Pressing Bearing into Front Endplate

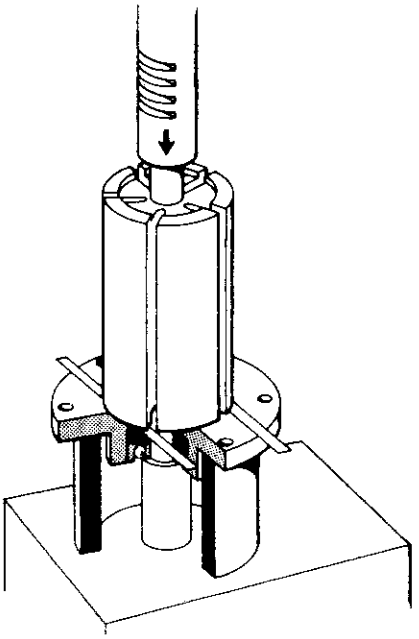


Figure No. 4.3 - Pressing Rotor Assembly into Front Endplate

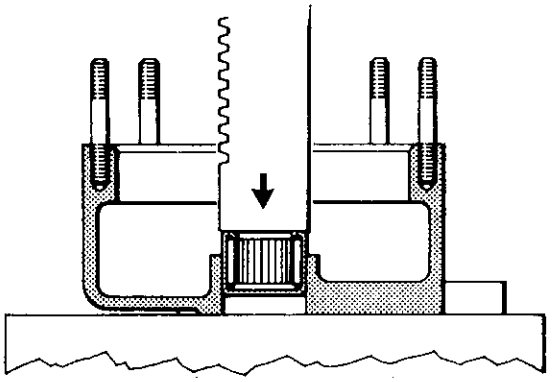


Figure No. 4.7 - Pressing Roller Bearing into Gear Case

17. Assemble the gear case (35) to the air motor assembly using twelve screws (36) and lockwashers (37). (On gas operated starters, the twelve lockwashers are replaced by seal washers).

NOTE: It may be necessary to rotate the air motor sleeves in either direction to properly align the bolt holes in the sleeve with those in the gear case cover. This can be done by inserting two cap screws 180 degrees apart in the rear of the sleeves and turning the sleeves by use of a screwdriver between the two cap screws.

18. Torque the twelve gear case cap screws (36) to 150 - 165 in.-lbs. (16.9 to 18.6Nm)
19. Press the single row rotor shaft bearings (6) into the rear endplates (3) as shown in Figure No. 4.8.

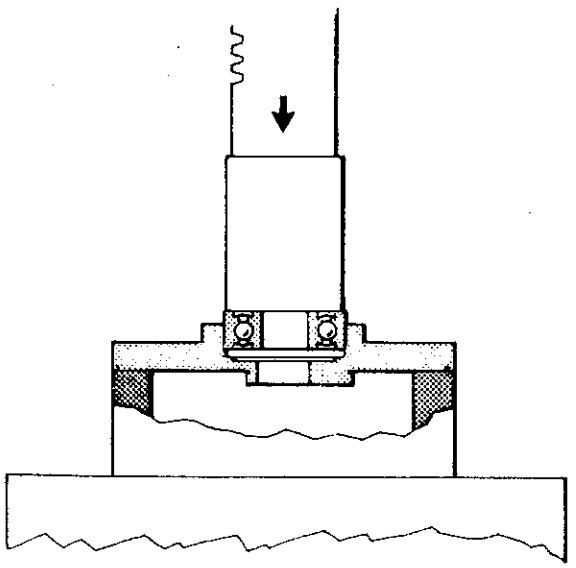


Figure No. 4.8 - Pressing Bearing into Rear Endplate

20. Install new endplate seals (2) on the rotor endplates (3).
21. Stand the air motor and gear case assembly on the gear case end.
22. Insert five new rotor blades (30) into each air motor (29).

NOTE: The rotor blades must stand squarely on end to permit assembly of the positive blade displacement cam which is part of the rear endplate.

23. Assemble the rear endplates (3) to the air motor assembly using six endplate screws (5) and lockwashers (4). (On gas operated starters, the lockwashers are replaced by seal washers and all mounting screws should be coated with Loctite #277).

NOTE: If the starter is equipped with an exhaust adapter, assemble the endplates and adapter to the air motor assembly using four exhaust adapter screws [22] with seal washers [*] and seals [20], and one exhaust adapter seal [19] as depicted in Fold-Out No. 3.

24. Torque the twelve endplate screws on the rear of the air motor to 150 - 165 in.-lbs. (16.9 to 18.6Nm).
25. Install a new bearing cover gasket (7) on each rear endplate (3).
26. Assemble the bearing covers (8) to the motor endplate with four cap screws (10) and lockwashers (9).
27. Torque the screws to 25 - 30 in.-lbs. (2.8 to 3.4 Nm).
28. Rotate each air motor by its pinion to insure that it is free and that the blades do not bind.

NOTE: Reassembly of the air motor group is now complete.

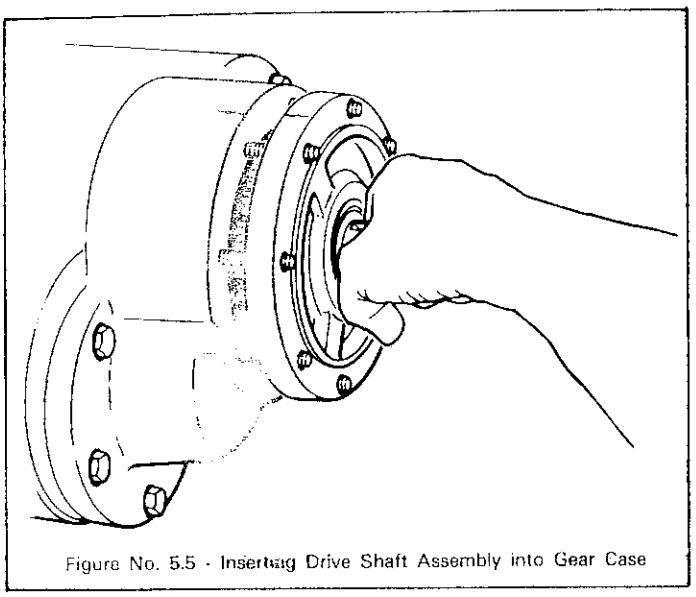


Figure No. 5.5 - Inserting Drive Shaft Assembly into Gear Case

9. Insert the thrust spring (8) into the drive shaft end of the Bendix drive unit (7).
10. Insert the drive unit keys (10) into the output end of the drive shaft (9).
11. Align the drive unit keyway with the drive shaft keys and slide the unit onto the drive shaft.
12. Turn the locking screw in until it bottoms in the drilled hole in the output drive shaft. Back the screw out sufficiently to orient the slot in the screw perpendicular to the drive shaft centerline.
13. Using needle nose pliers or a screwdriver, place the retaining snap ring over the drive shaft locking screw so that the retaining ring lies in the screwdriver slot.
14. Stand the drive housing (4) on the outboard bearing end in an arbor press and press the inside seal (3) into the outboard bearing bore, as shown in Figure No. 5.6.

NOTE: This seal must be pressed in so that it is flush to .010" [.25mm] below the machined surface on the inside of the drive housing.

15. Stand the drive housing on the flange end, as shown in Figure No. 5.7 and press in a new outboard drive bearing (2).
16. Press in the outside drive housing seal (1).
17. Lubricate the interior of the outboard drive bearing (2) with Lithium Based general purpose grease.
18. Locate the scribe marks previously placed on the drive housing and orient the mark with those previously aligned on the gear case and cover.
19. Assemble the drive housing over the drive assembly by simultaneously aligning the outboard shaft and bearing and the eight drive housing mounting studs.
20. Assemble the eight drive housing nuts (5) and washers (6) to secure the drive housing assembly to the gear case cover. Torque the nuts to 150 - 165 in.-lbs. (16.9 to 18.6Nm).
21. Rotate the drive unit to insure that the drive assembly, gear case assembly and air motors are free.

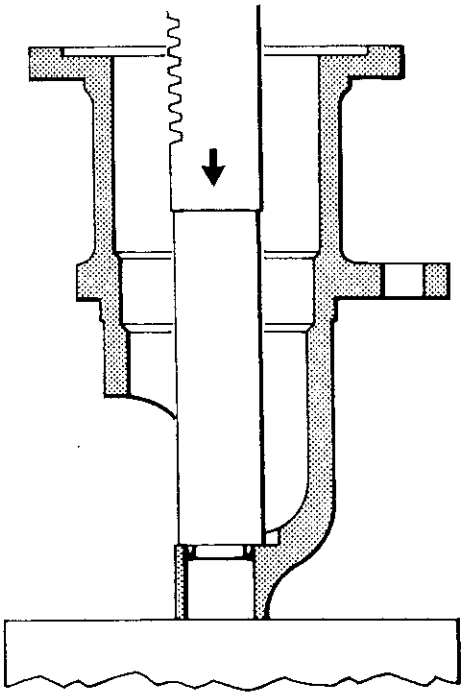


Figure No. 5.6 - Pressing Inside Seal into Outboard Bearing Bore

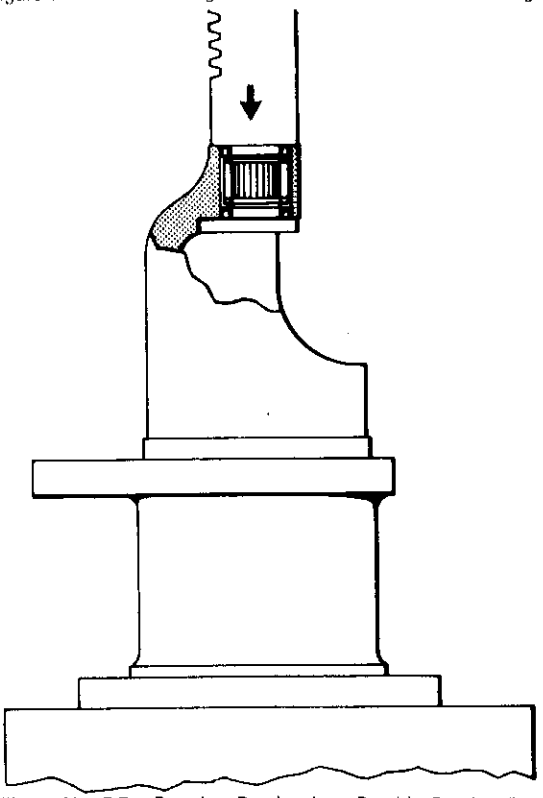


Figure No. 5.7 - Pressing Bearing into Outside Bearing Bore

SECTION VI - STARTER MODEL CONVERSION AND REPHASING

The SM500 Series of air starters contains several different models. Each is designated by a particular part number and conversions from one model to another may be made by interchanging or replacing various parts. Consult the latest specification sheet to determine which parts should be substituted or if any housing position changes are necessary.

MOTOR ROTATION

Air motor rotation may be determined by viewing the inlet position of the air motor sleeves, as seen through the air inlet port in the motor casing. If the sleeves are installed so as to duct the inlet air to the right as viewed from the rear of the air motor (See Figure No. 6.1), the air motors will rotate clockwise. Right-hand rotation of the pinion will result due to the reduction gears changing rotational direction in the gear case assembly.

To reverse direction of the SM500, it will be necessary to completely disassemble the starter and reinsert the sleeves to change direction of the inlet air flow. In addition, the Bendix drive unit must also be changed to one with the opposite rotation.

Follow the instructions set forth in Sections II through V to achieve reversal of starter rotation.

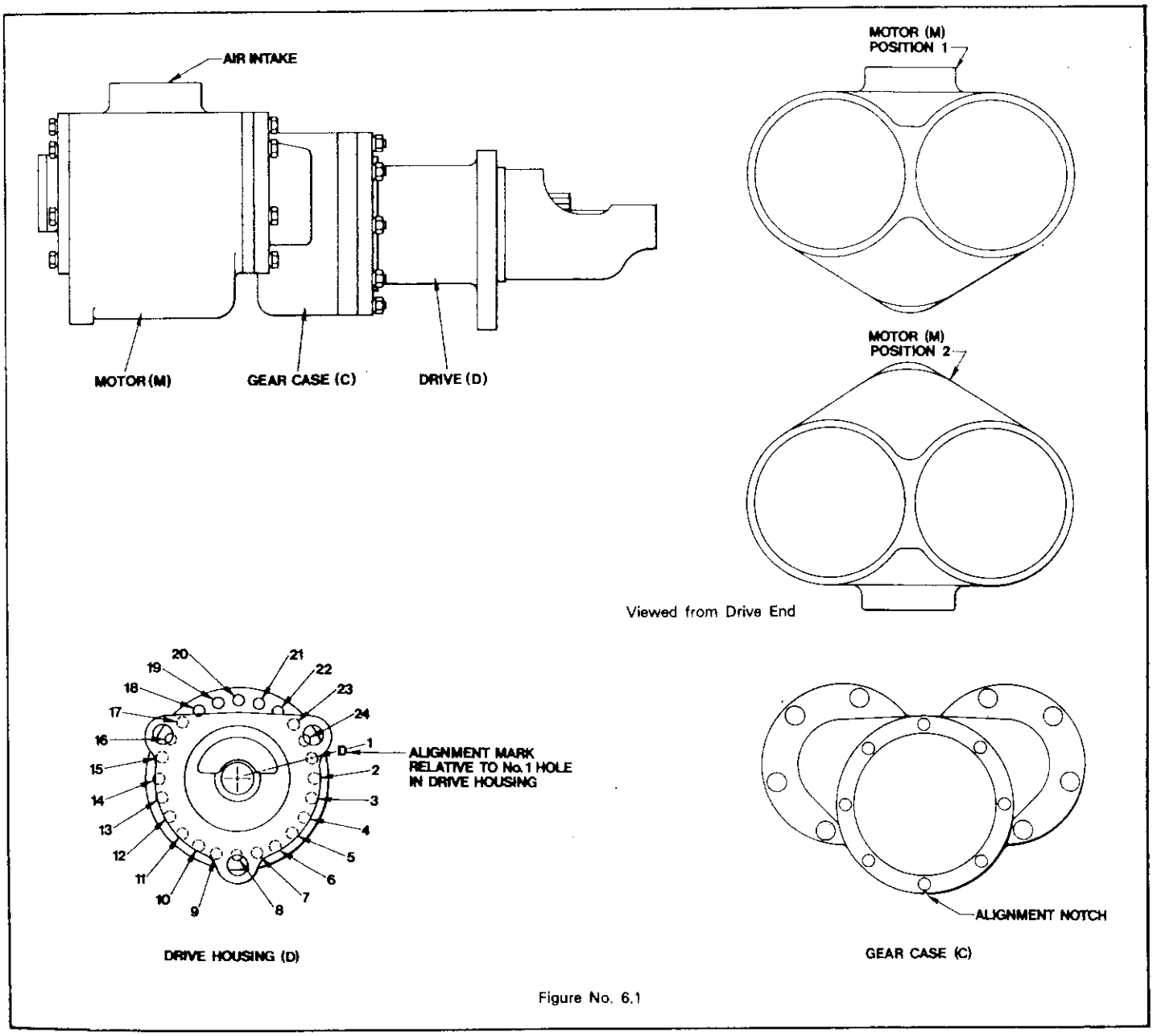
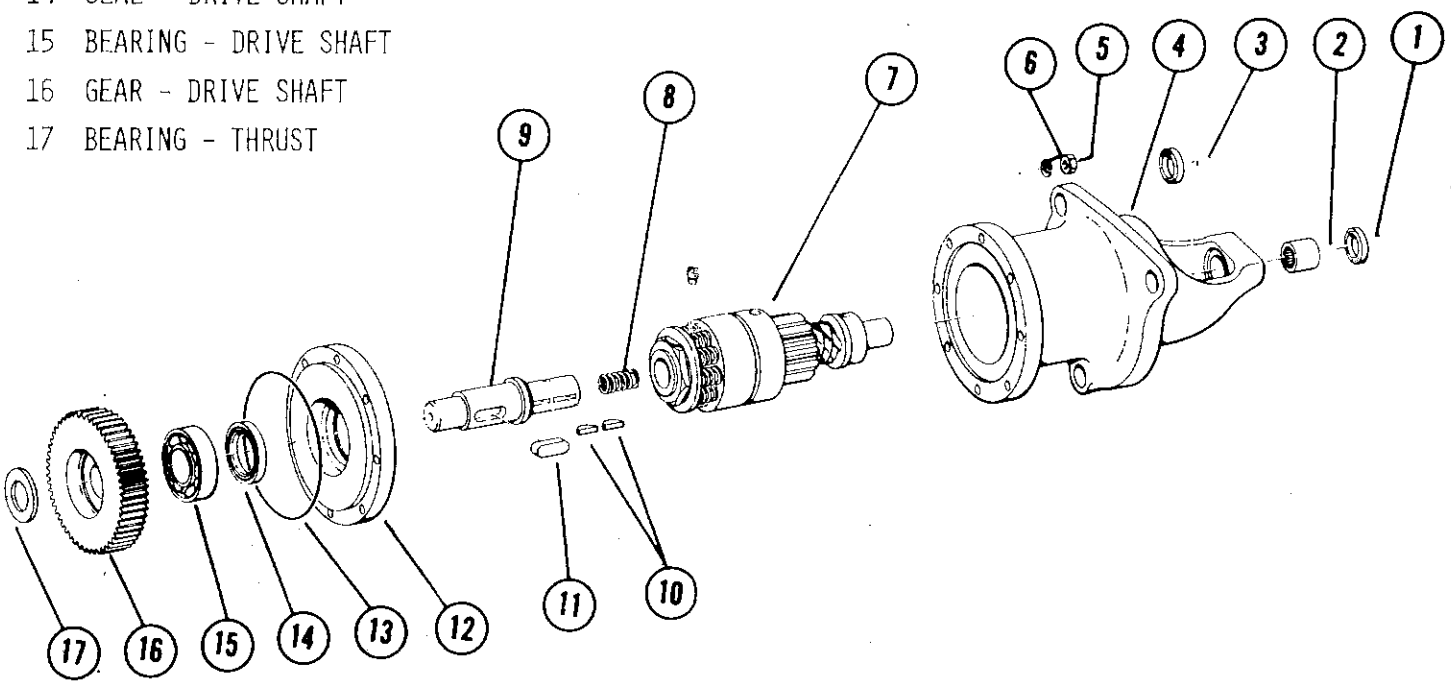


Figure No. 6.1

FOLD-OUT NO. 1 - KEY SHEET

1 SEAL - DRIVE HOUSING
2 BEARING - DRIVE UNIT
3 SEAL - DRIVE HOUSING
4 HOUSING - DRIVE
5 NUT - DRIVE HOUSING
6 WASHER - DRIVE HOUSING
7 DRIVE UNIT - BENDIX
8 SPRING - DRIVE UNIT
9 SHAFT - DRIVE
10 KEY - DRIVE SHAFT
11 KEY - GEAR
12 COVER - GEAR CASE
13 SEAL - GEAR CASE
14 SEAL - DRIVE SHAFT
15 BEARING - DRIVE SHAFT
16 GEAR - DRIVE SHAFT
17 BEARING - THRUST



FOLD-OUT NO. 3 - KEY SHEET

1 CASING - AIR MOTOR
2 SEAL - ENDPLATE
3 PLATE - END
4 LOCKWASHER
5 SCREW - ENDPLATE
6 BEARING - ROTOR SHAFT
7 SEAL - BEARING COVER
8 COVER - BEARING
9 LOCKWASHER - BEARING RETAINING
10 SCREW - BEARING RETAINING
11 NUT - EXHAUST VALVE
12 GUIDE - EXHAUST VALVE SPRING
13 SPRING - EXHAUST VALVE
14 GUIDE - EXHAUST VALVE SPRING
15 SHAFT - EXHAUST VALVE
16 NUT - EXHAUST VALVE JAM
17 PLATE - EXHAUST VALVE
18 NUT - EXHAUST VALVE
19 SEAL - EXHAUST ADAPTER
20 SEAL - EXHAUST ADAPTER
21 ADAPTER - EXHAUST
22 SCREW - EXHAUST ADAPTER
23 SCREW - BEARING RETAINING
24 LOCKWASHER - BEARING RETAINING
25 RETAINER - BEARING
26 BEARING - ROTOR SHAFT
27 PLATE - END
28 SEAL - ENDPLATE
29 ROTOR ASSEMBLY
30 BLADE - ROTOR
31 ADAPTER - SLEEVE
32 SLEEVE ASSEMBLY - AIR MOTOR
33 SEAL - SLEEVE ADAPTER
34 BEARING - DRIVE SHAFT
35 CASE ASSEMBLY - GEAR
36 SCREW - GEAR CASE
37 LOCKWASHER
38 GASKET - GEAR CASE
39 RING - PINION RETAINING
40 PINION - ROTOR
41 SPACER - BEARING