



502-M2-MS-04

# SERVICE MANUAL

AND

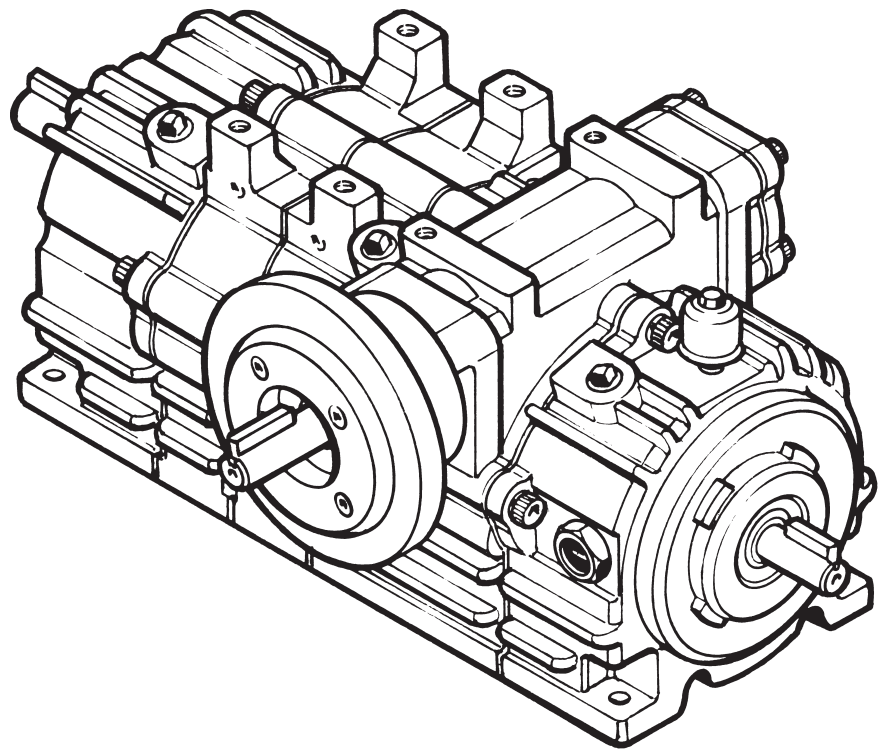
# REPAIR PARTS

FOR

**Model 02 *Posidyne*<sup>®</sup>**

***MULTI-SPEED***

***DRIVES (MSDr)***



**FORCE CONTROL INDUSTRIES, INC.**

**WARNING - Read this manual before any installation, maintenance and operation.**

*MANUFACTURERS OF MECHANICAL AND  
ELECTRICAL POWER TRANSMISSION EQUIPMENT*

## Limited Warranty

**Upon written approval of the application by Force Control Industries, Inc. the standard warranty period will be extended to 24 months from date of shipment.**

Force Control Industries, Inc. ("Force Control") warrants its products to be free from defects in material and workmanship under normal and proper use for a period of one year from the date of shipment. Any products purchased from Force Control that upon inspection at Force Control's factory prove to be defective as a result of normal use during the one year period will be repaired or replaced (at Force Controls' option) without any charge for parts or labor. This limited warranty shall be void in regard to (1) any product or part thereof which has been altered or repaired by a buyer without Force Control's previous written consent or (2) any product or part thereof that has been subjected to unusual electrical, physical or mechanical stress, or upon which the original identification marks have been removed or altered. Transportation charges for shipping any product or part thereof that the buyer claims is covered by this limited warranty shall be paid by the buyer. If Force Control determines that any product or part thereof should be repaired or replaced under the terms of this limited warranty it will pay for shipping the repaired or replaced product or part thereof back to the buyer. EXCEPT FOR THE EXPRESS WARRANTY SET OUT ABOVE, FORCE CONTROL DOES NOT GRANT ANY WARRANTIES EITHER EXPRESSED OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR USE. The warranty obligation set forth above is in lieu of all obligations or liabilities of Force Control for any damages. Force Control specifically shall not be liable for any costs incurred by the buyer in disconnecting or re-installing any product or part thereof repaired or replace under the limited warranty set out above. FORCE CONTROL EXPRESSLY EXCLUDES ALL LIABILITY FOR ANY INDIRECT OR CONSEQUENTIAL DAMAGES THE BUYER MAY SUSTAIN IN CONNECTION WITH THE DELIVERY, USE, OR PERFORMANCE OF FORCE CONTROL PRODUCTS. Under no circumstances shall any liability for which Force Control is held responsible exceed the selling price to the buyer of the Force Control products that are proven to be defective. This limited warranty may be modified only in writing signed by a duly authorized officer of the company. This limited warranty applies exclusively to Force Control products; warranties for motors and gear reducers and other component parts may be provided by their respective manufactures. Any legal action for breach of any Force Control warranty must be commenced within one year of the date on which the breach is or should have been discovered.

A Return Goods Authorization (RGA) number must be obtained from the factory and clearly marked on the outside of the package before any equipment will be accepted for warranty work. Force Control will pay the shipping costs of returning the owner parts that are covered by warranty.

Force Control believes that the information in this document is accurate. The document has been carefully reviewed for technical accuracy. In the event that technical or typographical errors exist, Force Control reserves the right to make changes to subsequent editions of this document without prior notice to holders of this edition. The reader should consult Force Control if errors are suspected. In no event shall Force Control be liable for any damages arising out of or related to this document or the information contained in it.

---

---

# Table of Contents

## Section 1 - DESCRIPTION and OPERATION

|     |  |   |
|-----|--|---|
| 1-1 | UNIT DESCRIPTION (MSDr) .....                | 1 |
| 1-2 | THE OIL SHEAR PRINCIPLE.....                 | 1 |
| 1-3 | DESCRIPTION OF CLUTCH AND BRAKE STACKS ..... | 1 |
| 1-4 | OPERATION .....                              | 1 |

## Section 2 - SPECIFICATIONS

|   |   |
|---|---|
| TABLE 1 - OPERATING SPECIFICATIONS.....   | 3 |
| TABLE 2 - PRESSURE Vs. STATIC TORQUE..... | 3 |

## Section 3 - INSTALLATION

|     |                             |   |
|-----|-----------------------------|---|
| 3-1 | RECEIVING THE DRIVE .....   | 4 |
| 3-2 | MOUNTING THE DRIVE .....    | 4 |
| 3-3 | WIRING SPECIFICATIONS ..... | 5 |
| 3-4 | PNEUMATICS.....             | 5 |
| 3-5 | START UP .....              | 5 |

## Section 4 - LUBRICATION

|     |                              |   |
|-----|------------------------------|---|
| 4-1 | CHECKING THE OIL LEVEL ..... | 6 |
| 4-2 | CHANGING THE OIL.....        | 6 |
| 4-3 | TYPE OF OIL.....             | 6 |

## Section 5 - OPERATIONAL CHECKS

|     |   |   |
|-----|---|---|
| 5-1 | GENERAL SET-UP INSTRUCTIONS .....   | 6 |
| 5-2 | CHECKING CLUTCH AND BRAKE PISTON SEALS AND MOVEMENT.....                              | 6 |
| 5-3 | CHECKING CLUTCH AND BRAKE ENGAGEMENT OR INPUT SHAFT<br>Vs. OUTPUT SHAFT ROTATION..... | 7 |
| 5-4 | DRIVE MOTORS .....  | 7 |
| 5-5 | PNEUMATIC CONTROL.....  | 7 |

## Section 6 - TROUBLESHOOTING

|     |                            |   |
|-----|----------------------------|---|
| 6-1 | TROUBLESHOOTING CHART..... | 8 |
| 6-2 | REMEDIES .....             | 9 |

## Section 7 - DISASSEMBLY

|      |   |    |
|------|---|----|
| 7-1  | GENERAL DISASSEMBLY PROCEDURE.....  | 10 |
| 7-2  | REMOVING C-FACE MOUNTED PRIMARY DRIVE MOTOR.....  | 10 |
| 7-3  | REMOVING C-FACE MOUNTED SECONDARY DRIVE MOTOR.....  | 10 |
| 7-4  | (FAN COOLED UNITS) REMOVING FAN SHROUD AND FAN .....  | 11 |
| 7-5  | SEPARATION AND REMOVAL OF MAJOR SUBASSEMBLIES FOR ACCESS<br>TO CLUTCH AND BRAKE STACKS..... | 11 |
| 7-6  | REMOVING SECONDARY INPUT HOUSING SUBASSEMBLY FROM THE<br>OUTPUT HOUSING SUBASSEMBLY.....    | 11 |
| 7-7  | PRIMARY INPUT HOUSING SUBASSEMBLY (With Male Input Shaft) .....                             | 11 |
| 7-8  | PRIMARY INPUT HOUSING SUBASSEMBLY (With Quill Input Shaft).....                             | 12 |
| 7-9  | PRIMARY PISTON HOUSING.....   | 12 |
| 7-10 | SECONDARY PISTON HOUSING .....  | 12 |
| 7-11 | SECONDARY INPUT HOUSING SUBASSEMBLY (With Male Input Worm Shaft) .....                      | 12 |
| 7-12 | SECONDARY INPUT HOUSING SUBASSEMBLY (With Quill Input Worm Shaft) .....                     | 14 |
| 7-13 | DISASSEMBLY OF SECONDARY INPUT SHAFT SUBASSEMBLY .....                                      | 14 |
| 7-14 | OUTPUT HOUSING SUBASSEMBLY .....  | 14 |

---

---

## Section 8 - CLEANING and INSPECTION

|     |                               |    |
|-----|-------------------------------|----|
| 8-1 | CLEANING AND INSPECTION ..... | 15 |
| 8-2 | REPAIR AND REPLACEMENT.....   | 15 |

## Section 9 - RE-ASSEMBLY

|      |   |    |
|------|---|----|
| 9-1  | GENERAL REASSEMBLY INSTRUCTIONS .....   | 16 |
| 9-2  | INSTALLING BEARINGS AND WEAR SLEEVE ON OUTPUT SHAFT.....                                    | 16 |
| 9-3  | OUTPUT HOUSING SUBASSEMBLY .....  | 16 |
| 9-4  | SECONDARY INPUT SHAFT SUBASSEMBLY (With Male or Quill Input Worm Shaft) .....               | 16 |
| 9-5  | SECONDARY INPUT HOUSING SUB-ASSEMBLY (With Male Input Worm Shaft) .....                     | 17 |
| 9-6  | CHECKING WORM SHAFT END PLAY (Male Input Worm Shaft Only).....                              | 17 |
| 9-7  | SECONDARY INPUT HOUSING SUBASSEMBLY (With Quill Input Worm Shaft) .....                     | 18 |
| 9-8  | PRIMARY AND SECONDARY PISTON HOUSING SUBASSEMBLIES .....                                    | 18 |
| 9-9  | PRIMARY INPUT HOUSING SUBASSEMBLY .....   | 18 |
| 9-10 | ATTACHING OUTPUT HOUSING SUBASSEMBLY TO SECONDARY<br>INPUT HOUSING SUBASSEMBLY .....        | 19 |
| 9-11 | MEASURING AND CONTROLLING STACK HEIGHT DIMENSIONS.....                                      | 19 |
| 9-12 | INSTALLING SECONDARY CLUTCH STACK AND SECONDARY PISTON<br>HOUSING SUB-ASSEMBLY .....        | 20 |
| 9-13 | INSTALLING THE BRAKE STACK AND THE PRIMARY PISTON RETAINER<br>AND HOUSING SUBASSEMBLY ..... | 20 |
| 9-14 | INSTALLING THE PRIMARY CLUTCH STACK AND THE PRIMARY INPUT<br>HOUSING SUBASSEMBLY.....       | 20 |
| 9-15 | FAN AND SHROUD INSTALLATIONS.....   | 20 |
| 9-16 | ATTACHING C-FACE MOUNTED PRIMARY AND SECONDARY DRIVE MOTORS .....                           | 21 |
| 9-17 | INSTALLING BELT DRIVE SHEAVE OR PULLEY .....  | 21 |
| 9-18 | FINAL REASSEMBLY .....  | 21 |

## Section 10 - ORDERING REPAIR PARTS

|      |  |    |
|------|--|----|
| 10-1 | GENERAL INFORMATION .....                        | 22 |
| 10-2 | FACTORY RE-BUILD SERVICE .....                   | 22 |
| 10-3 | DRIVE MOTORS .....                               | 22 |
| 10-4 | ORDERING REPAIR PARTS .....                      | 22 |
| 10-5 | NAME PLATE AND MODEL<br>NUMBER INFORMATION ..... | 23 |

## REPAIR PARTS LISTS

|   |    |
|---|----|
| Parts List for Figure 10.1 .....  | 24 |
| Figure 10.1 - MAJOR SUB-ASSEMBLIES AND CLUTCH/BRAKE STACKS.....         | 25 |
| Parts List for Figures 10.2 & 10.3.....                                 | 26 |
| Figure 10.2 - PRIMARY INPUT HOUSING (Long Coupled C-Face Mounting)..... | 26 |
| Figure 10.3 - PRIMARY INPUT HOUSING .....                               | 27 |
| Parts List for Figure 10.4 .....  | 28 |
| Figure 10.4 - PRIMARY PISTON HOUSING AND SECONDARY PISTON HOUSING.....  | 29 |
| Parts List for Figure 10.5.....   | 30 |
| Figure 10.5 - SECONDARY INPUT HOUSING .....                             | 31 |
| Parts List for Figure 10.6.....   | 32 |
| Figure 10.6 - OUTPUT HOUSING .....                                      | 33 |

# Section 1

## DESCRIPTION and OPERATION

### 1-1 UNIT DESCRIPTION (MSDr)

The **Posidyne® Multi-Speed Drive**, as shown in Figure 1.1, consists of a Primary Input Shaft, Secondary Input Worm Shaft and Output Shaft. Both the Primary Input Shaft and the Secondary Input Shaft can be a Male Shaft or a Quill Shaft. The Male Input Shaft is either belt driven or directly coupled to the Drive Motor. The Quill Input Shaft enables the drive motor to be C-Face Mounted to the Clutch/Brake Unit (Figure 1.1).

### 1-2 THE OIL SHEAR PRINCIPLE

Conventional clutches and brakes depend on friction between solid surfaces operating in air to transmit torque. Friction does the job, but produces a great amount of heat and wear. The MSDr uses the friction surfaces operating in a continually replenished, recirculating supply of oil. The oil molecules tend to cling to each other and to the friction surfaces. As moving and stationary elements are brought together, a thin but positive film of oil is maintained between them, controlled by the clamping pressure and carefully designed grooves in the elements. Torque is transmitted from one element to the other through the viscous shear of the oil film. So long as there is relative motion between the elements, they are protected by the oil, thus greatly reducing wear. The oil also effectively transmits heat away from the friction elements.

### 1-3 DESCRIPTION OF CLUTCH AND BRAKE STACKS

In the MSDr clutch and brake stacks, the friction surfaces consist of alternate carbon steel drive plates and friction discs. The friction discs consist of non-asbestos friction material bonded to steel plates. The friction discs have internal teeth which mate with a spline on the output shaft. The drive plates are keyed to the input shafts in the clutches and to the housing for the brake.

### 1-4 OPERATION

The MSDr Assembly (Figure 1.2) shows the drive in the neutral "off" position. A nominal braking force and brake stack centering force is provided by springs located in the piston housing which move the pistons toward each other engaging the brake stack. The two input shafts can rotate continuously. As either piston is actuated by compressed air to engage its respective clutch, the opposing piston's movement is limited as it contacts the piston retainer. This releases the brake and also allows additional clearance in the opposing clutch stack during times of differential speeds.

When clutch pressure is exhausted, the pistons move back engaging the brake stack and centering it up.

Brake actuation pressure is applied to obtain the additional, desired brake torque.

In the MSDr, the two input shafts normally run in the same direction, but at a different constant speeds. Output shaft speed is determined by the selection of the clutch. With the right MSDr setup, it is possible to have the two input shafts running at two different speeds in the opposite direction.

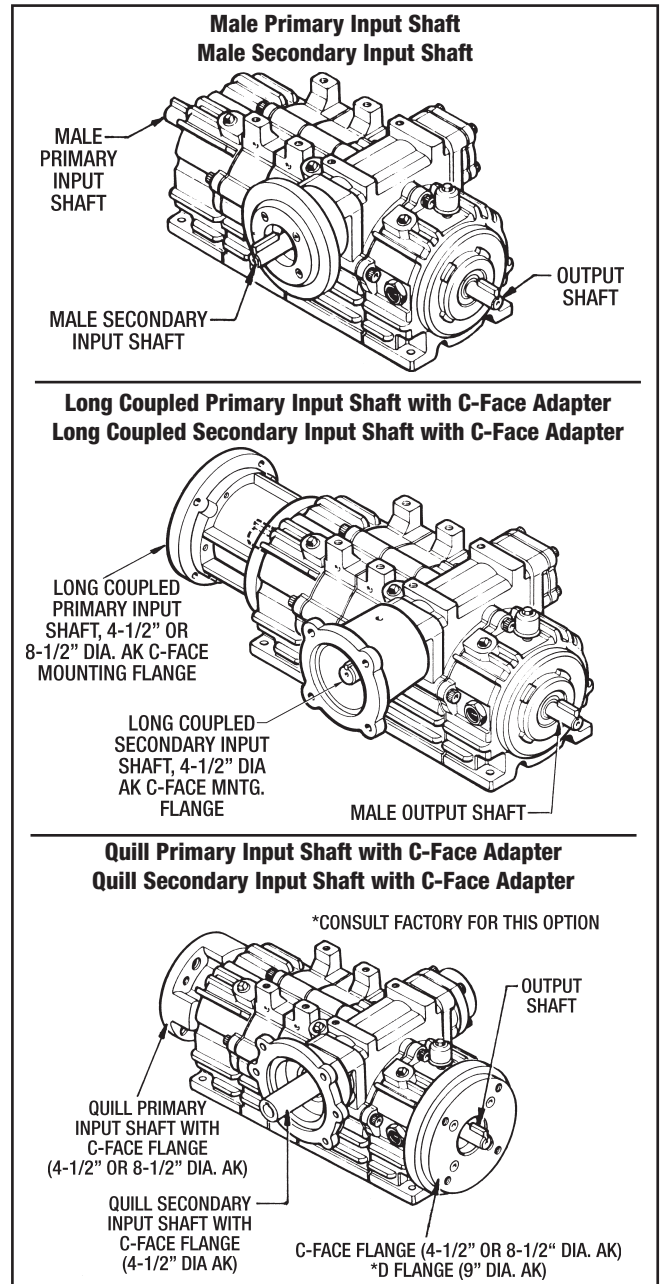


Figure 1.1 - Drive Unit Configurations

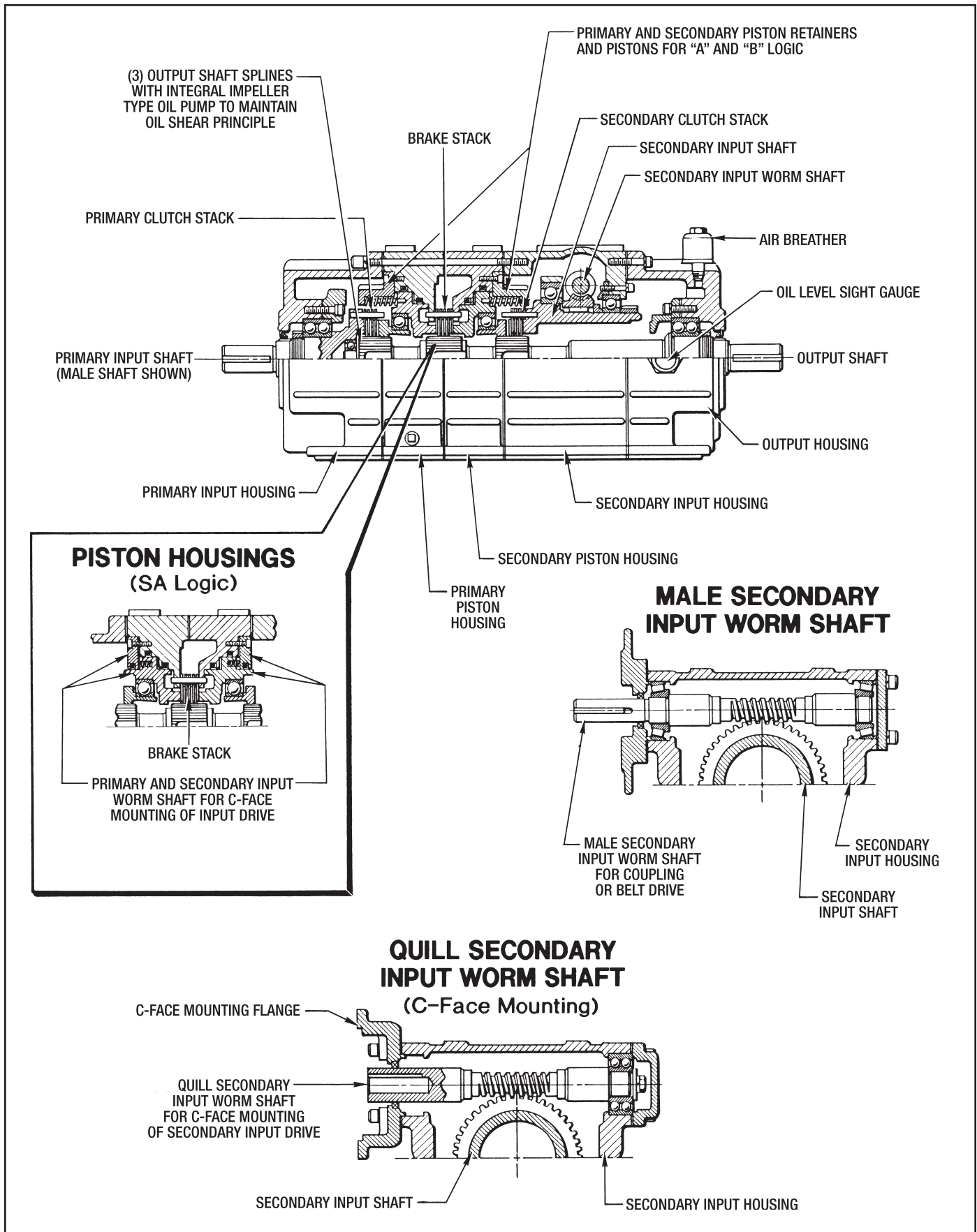


Figure 1.2 - 02 MSDr Assembly

## Section 2

# SPECIFICATIONS

(DUAL CLUTCH *Posidyne*)

### Operating Specifications Chart

| Size | Logic | Clutch Torque<br>(Lb./In.) |                   | Brake Torque<br>(Lb./In.) |         |                        |          | Max<br>RPM | Max<br>KE per<br>Engmt | Average<br>Thermal<br>HP   |      | Air<br>Vol.<br>per<br>Engmt<br><br>(In <sup>3</sup> ) | Oil<br>Cap<br><br>(Qts.) | Inertia<br>of<br>Cyclic<br>Parts<br><br>(Lb./Ft. <sup>2</sup> ) |
|------|-------|----------------------------|-------------------|---------------------------|---------|------------------------|----------|------------|------------------------|----------------------------|------|---|--------------------------|---|
|      |       | Static<br>(PSIG)           | Dynamic<br>(PSIG) | With<br>Springs Only      |         | With<br>Max Air Assist |          |            |                        | Cooling                    |      |   |                          |   |
|      |       |                            |                   | Static                    | Dynamic | Static                 | Dynamic  |            |                        | Basic                      | Fan  |   |                          |   |
|      |       |                            |                   |                           |         |                        |          |            |                        |                            |      |   |                          |   |
| 02   | SA    | 314 @ 70                   | 270 @ 70          | 165                       | 142     | 426 @ 30               | 356 @ 30 | 1800       | 4650                   | Horiz<br> <br>2.00<br>Vert |      | 1   | 4                        | 0.04  |
|      | A     | 424 @ 70                   | 365 @ 70          | 85                        | 73      | ---                    | ---      |            |                        | .80                        | 1.50 |   |                          |   |
|      | B     | 290 @ 70                   | 249 @ 70          | 190                       | 163     | ---                    | ---      |            |                        | .40                        | 1.50 |   |                          |   |

NOTE: Torque Ratings based on 1800 RPM operating speed.

### Pressure vs. Static Torque Chart

| Size | Logic | CLUTCH                                  |  |  |  | BRAKE  |                               |  |  |   |
|------|-------|---|--|--|--|--|-------------------------------|--|--|---|
|      |       | C <sub>M</sub>                          |  | C <sub>E</sub><br>Clutch<br>Engmt<br>Air Pr.<br>Required<br>(PSIG) | C <sub>T</sub><br>Clutch<br>Net<br>Torque<br>(Lb.In./PSIG) | B <sub>0</sub><br>Spring<br>Set Only<br>Without<br>Air Assist<br>(Lb./In.) | B <sub>M</sub>                |  | B <sub>S</sub><br>Max Air<br>Brake<br>Spring<br>Bias<br>(PSIG) | B <sub>T</sub><br>Brake<br>Net<br>Torque<br>(Lb.In./PSIG) |
|      |       | Clutch<br>Static<br>Torque<br>(Lb./In.) | Max Air<br>Actuation<br>Pressure<br>(PSIG) |  |  |  | Static<br>Torque<br>(Lb./In.) | Brake<br>Actuation<br>Pressure<br>(PSIG) |  |   |
|      |       |   |  |  |  |  |                               |  |  |   |
| 02   | SA    | 314                                     | @ 70                                       | 29   | 7.6  | 165  | 426                           | @ 30                                     | 19   | 8.7   |
|      | A     | 424                                     | @ 70                                       | 14   | 7.6  | 85   | ---                           | ---                                      | 10   | ---   |
|      | B     | 290                                     | @ 70                                       | 32   | 7.6  | 190  | ---                           | ---                                      | 22   | ---   |

NOTE: For dynamic torque ratings multiply static ratings above by 0.86.

To find Torque developed at a given Actuation Pressure.

$$\text{Clutch Torque} = (\text{PSI} - C_E) \times C_T$$

$$\text{Brake Torque} = (\text{PSI} + B_S) \times B_T$$

To find Actuation Pressure needed for required Torque.

$$\text{Clutch PSI} = (T_R / C_T) + C_E$$

$$\text{Brake PSI} = (T_R / B_T) - B_S$$

PSI = Air Pressure @ Posidyne Port

T<sub>R</sub> = Required Static Torque

#### CONTROL LOGICS

**SA** Spring Set Brake, Air Assist

**A** Spring Set Brake, 75% clutch/25% brake with 80 PSIG

**B** Spring Set Brake, 50% clutch/50% brake with 80 PSIG

---

---

## Section 3

# INSTALLATION

### IMPORTANT

**The Multi-Speed Drive Units described in this manual must not be installed or operated at any Speeds, Horsepower Loads or Temperatures not specified in this manual. Failure to limit operating conditions of the drive to all specified conditions could damage the Drive Unit and cause damage or malfunction to interconnected equipment**

### WARNING

**Before installation and attempting any repairs to the drive, open the electrical disconnects to both drive motors. Shut off the air supply to the drive and lock them out. Also bleed off any remaining air pressure trapped in the pneumatic lines. These steps must be taken to avoid any possibility of personal injury.**

### 3-1 RECEIVING THE DRIVE

Check the drive for shortage or damage immediately after arrival. Prompt reporting to the carrier's agent, with notations made on the freight bill, will expedite satisfactory adjustment by the carrier. When unloading or handling the drive, keep it upright. All Drives are filled with oil, ready to run, when shipped. However, before placing the unit in service or storage, check the oil level to make sure none has spilled out in transit. Add oil if necessary (refer to Section 4 LUBRICATION). If the drive is not to be installed and operated soon after arrival, store it in a clean, dry place having a slow moderate change in ambient temperature. Actuate pistons and rotate shafts once a month to re-lubricate working surfaces.

### 3-2 MOUNTING THE DRIVE

Installation of the drive should be made in much the same manner, and receive the same care as for a precision gear reducer. Standard drives are designed for horizontal operation. Note the following precautions when mounting the drive.

1. The Drive should be mounted to a firm, level base or foundation.

Use socket head cap screws or SAE grade 5 bolts to bolt the drive securely in place. Before tightening down the bolts, check alignment with the driven machinery, then recheck after tightening.

2. If the Primary Drive Motor Shaft is to be directly coupled, use only a flexible coupling (with horsepower service

factor of 3 to 1) to take care of maximum torque requirements. Make sure that the shafts to be coupled are concentric within the coupling manufacturer's specifications. Check for horizontal, vertical or angular misalignment. Use shims as necessary to correct any misalignment.

### CAUTION

**Do not drive couplings or bushings onto shafts, as this may damage the bearings.**

3. If the Primary Drive Shaft is to be connected through a belt, chain or gear drive, locate the sheave, sprocket or gear as close as possible to the drive housing and the drive motor bearing to minimize overhung loads. Align to run true and adjust belt or chain tension per manufacturer's specifications.

### CAUTION

**Excessive belt or chain tension will damage bearings.**

4. Furnish and install appropriate safety guards for all external rotating drive parts.
5. With "Piggy Back" mounting of the Drive Motors, Force Control furnishes all Drive Motors Mounting Parts and required Belt Guard(s). Drive belts and sheaves are provided as an option as per customer's requirements.

If the motor mounting parts are not furnished by Force Control, then the customer must supply and install all appropriate Safety Guards for all exposed drive rotating parts, as required.

6. The Air Breather (#45) is removed before shipment and a pipe plug put in its place. In most cases this will be a red plastic plug. This is to prevent oil spillage during shipment. This plug must be removed and the Breather (#45) installed to prevent damage to the drive. The Breather (#45) is taped to the drive for shipment.

### CAUTION

**Failure to install this Breather (#45) will result in overheating, which will cause the brake and clutch components to malfunction.**

7. After the drive has been in operation for a few hours, make sure that all mounting bolts are tight and recheck alignment of all driving components.
8. After 40 hours of operation, check mounting bolts and tighten if necessary.



### 3-3 WIRING SPECIFICATIONS

(See Motor Plate for Wiring Specifications)

### 3-4 PNEUMATICS

Note the following when planning and installing the Pneumatic System (See Figure 3.1):

1. Use direct acting solenoid air valves or pilot operated valves to give the response speed required. Locate the valves as close as possible to the air inlets on the drive. The valves may be installed directly on the drive if they are supported.

#### WARNING

**Clutch valving must be interlocked so that both clutches cannot be actuated at the same time. A three-position five-way valve is recommended. Actuating both clutches at the same time will cause damage to the drive.**

Clutch/brake air interlock is not necessary because internal construction of the drive prevents clutch/brake overlap.

2. Be sure to use valves with a minimum Cv factor of .8. Lubricators are not necessary for the MSDr, but they may be used, if needed, for air valve operation.
3. The optional accumulator should be used for quick response, particularly if the air line loss and the nature of the air supply is such that recovery is slow. Size

the accumulator to be at least ten (10) times the air required per engagement. (See Section 2 SPECIFICATIONS)

4. Pressure is proportional to torque. Use only the pressure necessary to drive the machine. This will reduce wear on the unit.
5. A new drive will produce an abundance of torque until it has burnished in. Initial regulator settings should be set at about 80% of charted ratings (See Section 2 "TORQUE Vs ACTUATION PRESSURE"). After using the drive for a few weeks, the acceleration time may increase. Increasing the air pressure will restore the acceleration.

### 3-5 START UP

1. Lock out machine and air pressure. Verify that the Electrical Power is OFF to avoid personal injury.
2. Recheck Air Connections for tightness to see if they are correct as shown in the Pneumatic Schematic (Figure 3.1).
3. Set Air Regulators to 80% of required air pressure. (As charted in Section 2 "TORQUE Vs. ACTUATION PRESSURE"). Actuation pressure may need to be adjusted back up as drive is burnished in.
4. Unlock Main Disconnect.
5. Check out Secondary Drive Speed mode for proper rotation and adjust all limit switches as needed.
6. Check operation of Primary Motor Drive.

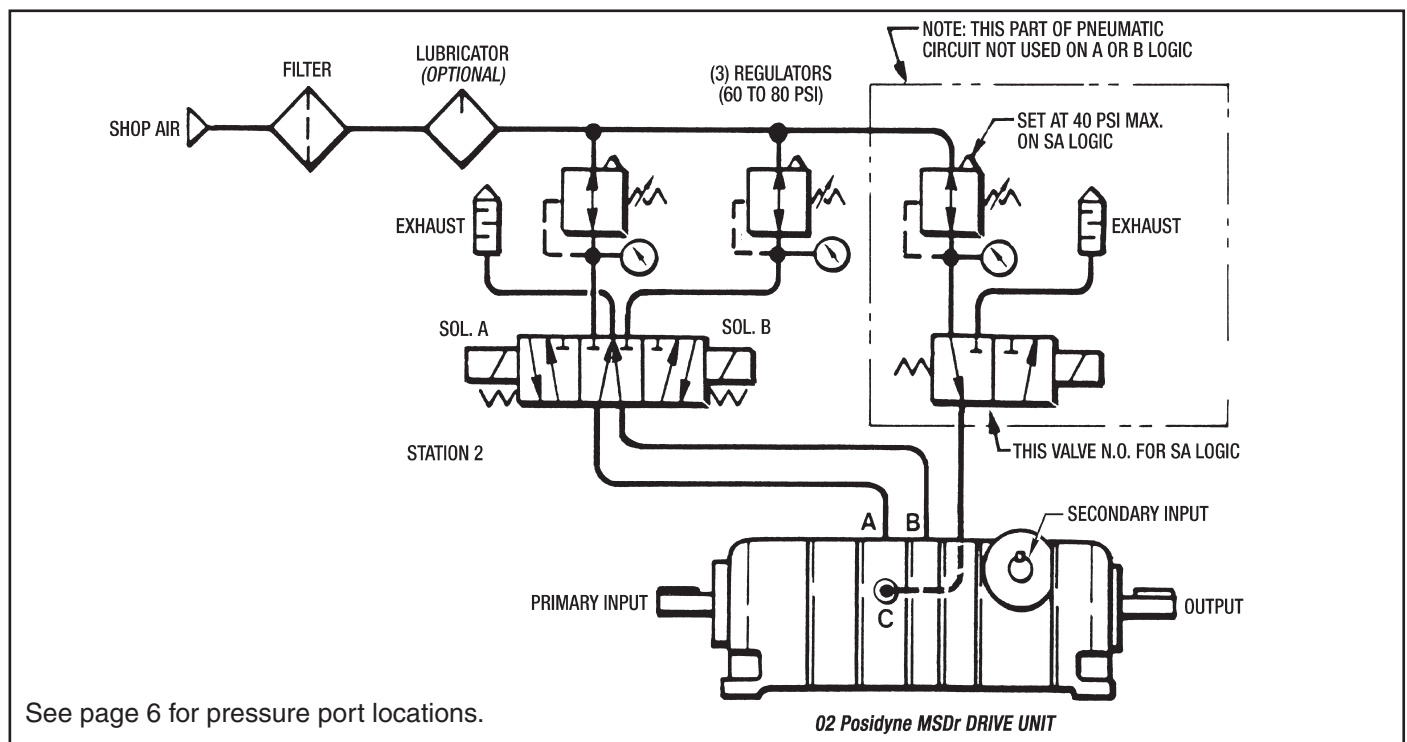


Figure 3.1 - Typical Pneumatic Schematic

## Section 4 LUBRICATION

### 4-1 CHECKING THE OIL LEVEL

When the drive is installed and weekly thereafter, or until experience dictates otherwise, check the oil level. Always check the oil level with the drive at room temperature and while it is not running.

The drive has an oil sight gauge located at the output end of the drive. The oil level is to show at the center of the gauge.

### 4-2 CHANGING THE OIL

#### IMPORTANT

**Open the disconnects to the drive motors before attempting to change the oil.**

After the first 30 days of operation drain the oil from the drive using the drain plugs provided. If the oil sight gauge is dirty, it should be removed and cleaned. Reinstall the drain plugs and refill the drive to the center of the sight gauge with fresh oil.

After the first oil change check the oil level and color of the oil at least once per month. Maintain the oil level to the center of the sight glass by adding additional oil as needed. The oil should be changed after every 12 months of operation or sooner if the oil color darkens. High energy applications will usually darken the oil sooner and require more frequent oil changes. Low energy applications will usually not darken the oil as soon.

#### CAUTION

**Do not overfill the Drive Unit. Excess oil will cause the unit to overheat.**

### 4-3 TYPE OF OIL

Use only **Mobil Automatic Transmission Fluid type ATF-210 type "F"**, or **Mobil Multi-Purpose Automatic Transmission Fluid** for most drives. Other fluids may be specified for special applications. **Always use the type fluid specified on the Name Plate.**

## Section 5 OPERATIONAL CHECKS

These Operational Checks are to be made when the Drive Unit is removed from service for repair. Provisions for manually controlled 60 to 80 PSI air pressure must be made for these Operational Checks.

### 5-1 GENERAL SETUP INSTRUCTIONS

(See Figure 5.1)

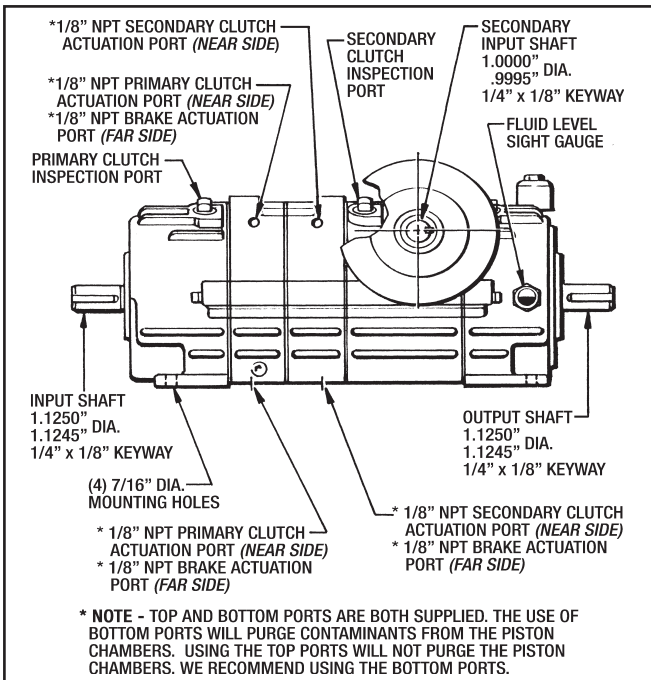


Figure 5.1 - Set-Up for Operational Checks

The setup shown in Figure 5.1 is only an example. The basic requirement is that the air supply have a quick acting shut-off action. Lever type shut-off valves suitable for air operation would be another option.

1. Install the 60 to 80 PSI air supply to the Drive Unit and remove the (3) Inspection Plugs as shown in Figure 5.1.

#### CAUTION

**Do not remove these Inspection Plugs while the Drive is running.**

### 5-2 CHECKING CLUTCH AND BRAKE PISTON SEALS AND MOVEMENT

1. Manually apply air pressure to the "Primary Clutch" Port. With the aid of a flashlight, observe the Clutch Piston to see if it actuates quickly and smoothly. Internal damage may be indicated if the piston action is irregular or if it sticks or binds.

Also listen for air leaks and look for air bubbles in the oil that would indicate damage to the piston seals.

2. Exhaust the air pressure from Primary Clutch Port and observe to see that the Clutch Piston moves back smoothly to the normal "Braking Position".
3. Apply air pressure to the Secondary Clutch Port and repeat steps 1 and 2 to check the Secondary Piston seals and movement.

- Apply air pressure to the "Brake" port. The Brake is spring loaded so there will not be any observable piston movement when air is applied. Check for leakage and air bubbles in the oil to see if the piston seals are functioning properly.
- Replace Inspection Plugs.

### 5-3 CHECKING CLUTCH AND BRAKE ENGAGEMENT OR INPUT SHAFT Vs. OUTPUT SHAFT ROTATION.

(WITH MALE INPUT SHAFTS)

- When applying air pressure to the desired Clutch Port, simply rotate the proper Input Shaft by hand and observe the rotation of the Output Shaft. Likewise, when the air pressure is not applied to the clutch port or when air pressure is applied to the "Air Assist" brake port, the Output Shaft should be locked in the braking position and should not rotate.

(WITH C-FACE MOUNTED DRIVE MOTORS)

If the C-Face mounted Drive Motors are still attached, then the Input Shafts are not accessible to be manually rotated to check clutch/brake engagement and Input Shaft vs. Output Shaft rotation.

- Temporarily hookup Drive Motors and "Bump" them to check the Clutch or Brake Operating Modes and Output Shaft rotation.

### CAUTION

**Do not attempt to run motors with the Inspection Plugs removed. They must first be replaced.**

### 5-4 DRIVE MOTORS

Check wiring connections against the wiring diagram on the Name Plate. "Bump" the motor and check direction of rotation. Check all connections for tightness.

### 5-5 PNEUMATIC CONTROL

The Pneumatic Control Operational Checks are to be made with Pneumatic Control valves hooked up.

- Shut off air supply, lock it out, and bleed off any trapped air in the system.
- Insert Diagnostic Pressure Gauges in the air supply between the control valves and the drive. (See Figure 5.2) Turn air supply back on.
- Activate Solenoid Control Valves for desired function. (See Pneumatic Control Logic Diagram on Figure 5.2.)
  - Primary Drive
  - Secondary Drive
  - Brake "Air Assist"
- Check air pressure with installed diagnostic pressure gauges for each function.
- Check all electrical connections and solenoid operation per manufacturer's specifications.

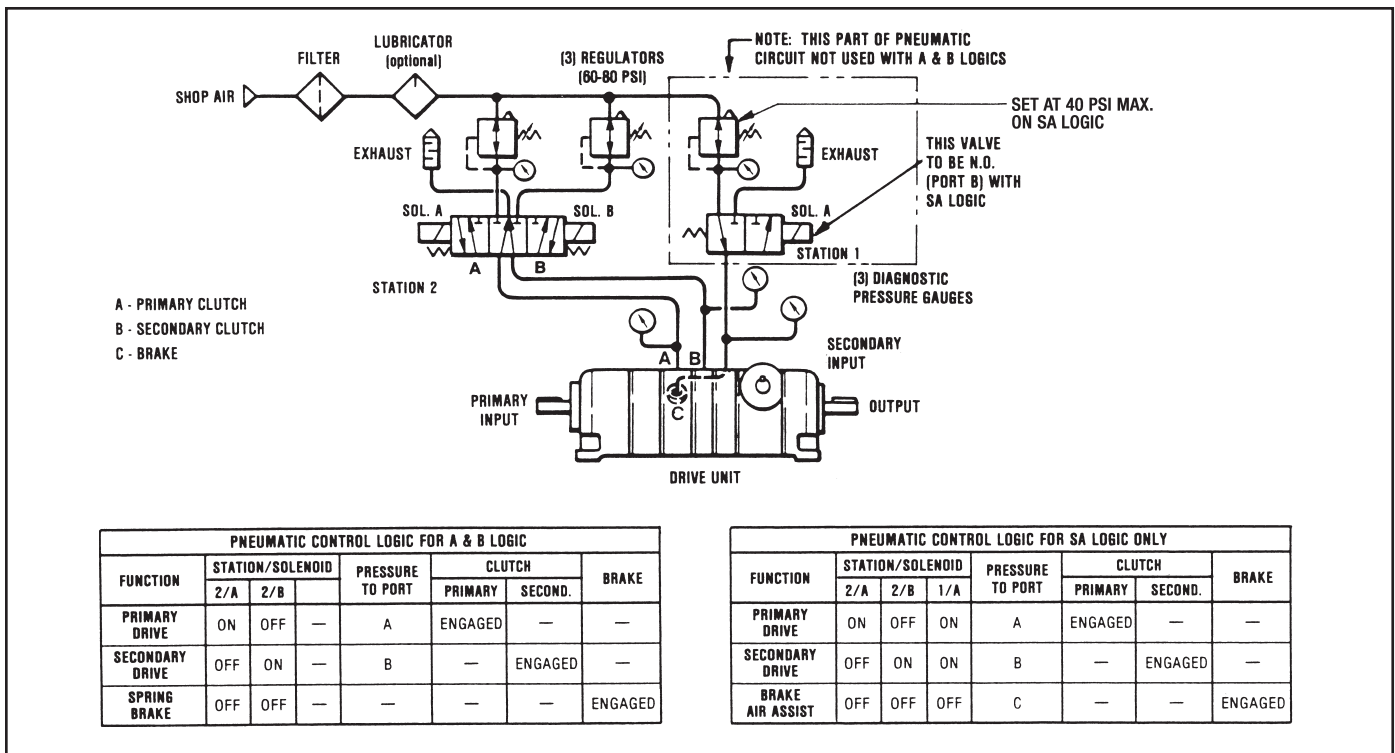


Figure 5.2 - Pneumatic Control Diagram

## Section 6

# TROUBLESHOOTING

**CAUTION**  
**Open disconnect to prime movers and lock it out while making repairs or checking machinery to avoid personal injury.**

### 2-1 TROUBLESHOOTING CHART

| SYMPTOM  | POSSIBLE CAUSE  | REMEDY           |
|--|---|------------------|
| A. Either clutches or brake fail to engage properly    | <ol style="list-style-type: none"> <li>1. Loss of air supply</li> <li>2. Loss of electrical signal</li> <li>3. Worn friction surfaces</li> <li>4. Stuck or damaged piston</li> </ol>                                    | a<br>b<br>c<br>d |
| B. Picks up load too quickly                           | <ol style="list-style-type: none"> <li>1. Air pressure too high</li> </ol>  | e                |
| C. Either clutches or brake fail to disengage properly | <ol style="list-style-type: none"> <li>1. Valve malfunction</li> <li>2. Electrical signal error</li> <li>3. Stuck or damaged piston</li> </ol>  | a,f<br>b<br>d    |
| D. Clutch fails to engage                              | <ol style="list-style-type: none"> <li>1. See A-1,2,3 &amp; 4 above</li> <li>2. Broken return springs</li> </ol>  | a,b,c,d<br>g     |
| E. Noise and vibrations                                | <ol style="list-style-type: none"> <li>1. Mounted on poor foundation</li> <li>2. Misaligned couplings</li> <li>3. Damaged bearings</li> </ol>   | h<br>i<br>j      |
| F. Drive overheats (oil temp over 225° F)              | <ol style="list-style-type: none"> <li>1. Improper oil level</li> <li>2. Cooling media not functioning properly</li> <li>3. Clutch or brake fails to engage or disengage properly causing excessive slippage</li> </ol> | l<br>m<br>a,k    |
| G. Oil leakage out of breather                         | <ol style="list-style-type: none"> <li>1. Oil level too high</li> <li>2. Damaged piston seals</li> </ol>  | l<br>n           |
| H. Clutch or brake does not repeat                     | <ol style="list-style-type: none"> <li>1. Air pressure change</li> <li>2. Oil temperature change</li> <li>3. Resistance in machine changed</li> </ol>   | a<br>o<br>k      |

---

---

## 6-2 REMEDIES

When checking pneumatics, shut off air supply, lock it out, and bleed off any trapped air in the system. Insert “diagnostic pressure gauges” in the air supply between the valves and drive or in the extra ports in the drive.

- a. Set up “diagnostic pressure gauges” as noted above. Manually activate the valves and check the gauges for proper pressure and sequence.
- b. Set up “diagnostic pressure gauges” as noted above. Actuate the valves and check gauges for proper sequence.
- c. Remove the proper inspection port plug. Actuate the proper clutch or brake. Use a screwdriver to check to see if the plates and discs are clamped up tight. Use a flashlight to check plates for signs of excessive heat.
- d. Remove the proper inspection port plug. Actuate the proper piston . Use a flashlight to visually inspect piston movement. Check that it actuates quickly and smoothly. If the piston action is irregular or if it tends to stick or bind, internal damage may be indicated.
- e. Adjust air pressure. Check “Torque vs. Actuation Pressure” chart in Section 2.
- f. Follow the valve manufacturer’s specs and check out the air valves.
- g. Disassemble to the extent necessary and inspect for damaged parts. See Section 7 and follow instructions through the piston removal procedure.
- h. Check mounting bolts. Check installation.
- i. Check couplings and alignment.
- j. Check bearings. Disconnect couplings and rotate each shaft by hand. If bearings feel “rough or sticks in spots”, replace them. Always check bearings when any unusual noise or vibration develops in the drive.
- k. A change in the driven machinery’s resistance will cause the drive to overheat or lose its repeatability. Check out machinery for the problem.
- l. Check oil level. See Section 4.
- m. On fan cooled drives, check for air restrictions around fan or shroud.
- n. Remove the proper inspection port plug. Actuate the proper piston. Use a flashlight to visually inspect for air bubbles in the oil indicating a leak. Listen for air leaks above oil level.
- o. For installations requiring precise starting and stopping, operating temperature is important. Operating temperatures between 116 degrees and 165 degrees F are recommended. If the oil is allowed to drop to ambient temperatures overnight, the clutch input shafts should be run for approximately 1/2 hour before operating machinery.

## Section 7

# DISASSEMBLY

### WARNING:

**Before attempting any repairs to the Drive Unit, open disconnect to the prime mover, shut off air supply and lock them out to avoid any possibility of personal injury.**

### 7-1 GENERAL DISASSEMBLY PROCEDURE

1. Disconnect the Drive and move it to a suitable work area.

#### NOTE:

On Belt Drive or Direct Coupled Units, remove all necessary safety guards, sheaves and couplings.

2. Disconnect all necessary pneumatic piping.
3. Remove drain plug at the bottom of the Drive Unit and drain all of the oil into a suitable container and either save for reuse or discard as the condition of the oil warrants.

#### NOTE:

An overhead crane and soft sling is also recommended, if necessary, to remove heavy castings and parts.

#### IMPORTANT:

**Unless the drive is to be completely overhauled, it should only be disassembled to the extent necessary to gain access to the worn or damaged parts.**

4. It is also recommended that the Primary Input Housing, Primary Piston Housing and the Secondary Piston Housing be "Matched Marked" for proper Reassembly. A suitable punch can be used.  
(See Figure 7.1)

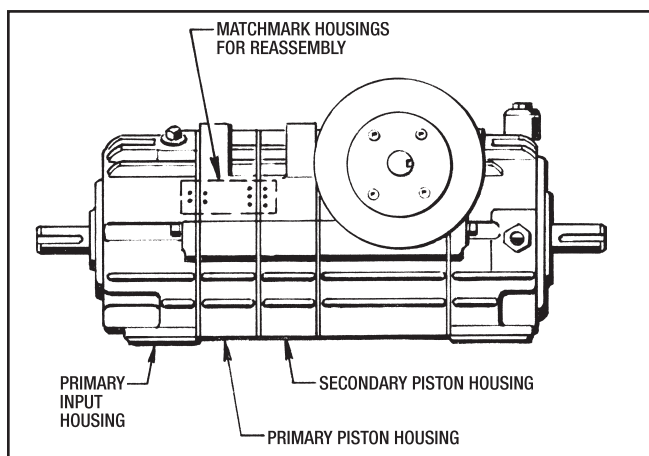


Figure 7.1 - Match Marking Housings

The MSDr Unit is comprised of (5) basic subassemblies and can be disassembled as complete subassemblies and for easy access to the Clutch or Brake Stacks, as shown in the following exploded views.

1. MAJOR Subassemblies AND CLUTCH/BRAKE STACKS (See Figure 10.1)
2. PRIMARY INPUT HOUSING SUBASSEMBLY
  - a. Long Coupled C-Face Mounting (See Figure 10.2)
  - b. With Male Input shaft (See Figure 10.3)
  - c. With C-Face Adapter and Quill Shaft (See Figure 10.3)
3. OPTIONAL FAN COOLING (See Figure 10.3)
4. PRIMARY PISTON HOUSING SUBASSEMBLY (See Figure 10.4)
5. SECONDARY PISTON HOUSING SUBASSEMBLY (See Figure 10.4)
6. SECONDARY INPUT HOUSING SUBASSEMBLY
  - a. Long Coupled C-Face Mounting (See Figure 10.5)
  - b. With Male Input shaft (See Figure 10.5)
  - c. With C-Face Adapter and Quill Shaft (See Figure 10.5)
7. OUTPUT HOUSING SUBASSEMBLY (See Figure 10.6)

### 7-2 REMOVING C-FACE MOUNTED PRIMARY DRIVE MOTOR

(See Figure 10.2 and 10.3)

1. Attach appropriate sling or lifting hook to the Drive Motor for support and removal.
2. Remove motor mounting screws and washers from C-Face Adapter (#155).
3. Slide motor shaft out of the Quill Input Shaft (#2).

### 7-3 REMOVING C-FACE MOUNTED SECONDARY DRIVE MOTOR

(See Figure 10.5)

1. Attach appropriate sling or lifting hook to the Drive Motor for support and removal.

---

---

### (With Quill Input Shaft)

2. Remove motor mounting screws and washers from the C-Face Adapter (#155).
3. Slide Motor Shaft out of the Quill Input Shaft (#153).

### (With Long Coupled Input Shaft)

2. Loosen Set Screws in the Drive Coupling.
3. Remove Motor Mounting Screws and Washers from the C-Face Adapter (#155) and slide the Drive Motor and Coupling away from the C-Face Adapter.

## 7-4 (FAN COOLED UNITS) REMOVING FAN SHROUD AND FAN

(See Figure 10.3)

1. Remove Fan Shroud Screws (#66) and remove Fan Shroud (#24) from the Primary Input Housing (#8).
2. Loosen Set Screw (#70) and pull the Fan (#25) off of Primary Input Shaft (#2).

## 7-5 SEPARATION AND REMOVAL OF MAJOR SUBASSEMBLIES FOR ACCESS TO CLUTCH AND BRAKE STACKS

(See Figure 10.1)

### NOTES:

Jackscrew holes are provided to aid in separation of main housings from each other.

Do not attempt to reuse Gaskets (#51), (#53) and (#54). They must be replaced with new ones at reassemble.

When removing the CLUTCH or BRAKE STACKS, always keep the Drive Plates (#13), Friction Discs (#12) and Shim (#983), if used, in the same order as they were removed.

### (PRIMARY CLUTCH STACK)

1. Remove Allen Nuts (#152) and Lockwashers (#127) from the input end of the Primary Input Housing SUBASSEMBLY.
2. Using jackscrews, separate and lift the Primary Input Housing SUBASSEMBLY away from the Drive Unit.
3. Remove and discard Gasket (#53).
4. The PRIMARY CLUTCH STACK can now be removed from the output shaft spline.

### (BRAKE STACK)

5. Separate and remove the Primary Piston Housing Subassembly from the remaining Drive Unit.
6. Remove and discard Gasket (#54).
7. Remove the BRAKE STACK from the output shaft spline.

### (SECONDARY CLUTCH STACK)

8. Separate and remove the Secondary Piston Housing Subassemblies from the unit.
9. Remove and discard Gasket (#51).
10. Remove the remaining SECONDARY CLUTCH STACK from the output shaft spline.

### IMPORTANT REMINDER:

**When removing the CLUTCH/BRAKE STACKS, always keep the Drive Plates (#13), Friction Discs (#12) and Shim (#983), if used, in the same order as they were removed.**

If repair or replacement of the CLUTCH or BRAKE STACKS is the only repair to be done, then proceed to Section 8, CLEANING AND INSPECTION.

## 7-6 REMOVING SECONDARY INPUT HOUSING SUBASSEMBLY FROM THE OUTPUT HOUSING SUBASSEMBLY

(See Figure 10.1)

1. Place Drive Unit in a horizontal position for access to attaching screws.
2. Remove (5) Screws (#61) and (5) Lockwashers (#127) from the output end of the Output Housing Subassembly.
3. With the aid of jackscrews, separate the Output Housing Subassembly from the Secondary Input Housing Subassembly.
4. With care, slide the Output Shaft (#1) out of the Secondary Input Housing Subassembly.
5. Remove and discard Gasket (#53).

## DISASSEMBLY OF MAJOR SUBASSEMBLIES

### 7-7 PRIMARY INPUT HOUSING SUBASSEMBLY (WITH MALE INPUT SHAFT)

(See Figure 10.3)

1. If the Key (#180) is still intact in the Primary Input Shaft (#2), remove it at this time.
2. Remove Screws (#17) or (#176) and Washers (#127) from the Bearing Retainer (#16).
3. Carefully slide the Primary Input Shaft SUBASSEMBLY out of the Primary Input Housing (#8). Be careful not to damage the lip of the Oil Seal (#31) which is still pressed into the Primary Input Housing.
4. Check the Oil Seal (#31) and replace if necessary.
5. Check Bearing (#26) or (#38) and if it needs to be replaced, remove the Locknut (#15) or (#34) from the Primary Input Shaft (#2).

6. Using a standard Arbor Press, press the Bearing Retainer (#16) and the Bearing (#26) or (#38) off of the Primary Input Shaft (#2).
7. Check Wear Sleeve (#4) or (#195) and replace if necessary.

### **7-8 PRIMARY INPUT HOUSING SUBASSEMBLY (With Quill Input Shaft)**

(See Figures 10.2 and 10.3)

1. Remove the (6) Screws (#201) and Washers (#202) and remove the C-Face Adapter (#200) from the Input Housing.
2. Remove Screws (#17) and Washers (#127) from the Bearing Retainer (#16).
3. Carefully slide the Primary Input Shaft Subassembly out of the Primary Input Housing (#8). Be careful not to damage the lip of the Oil Seal (#31) which is still pressed into the Primary Input Housing.
4. Check the Oil Seal (#31) and replace if necessary.
5. Check Bearing (#26) or (#38) and if it needs to be replaced, remove the Locknut (#15) from the Primary Input Shaft (#2).
6. Using a standard Arbor Press, press the Bearing Retainer (#16) and the Bearing (#26) or (#38) off of the Primary Input Shaft (#2).
7. Check Wear Sleeve (#4) and replace if necessary.

### **7-9 PRIMARY PISTON HOUSING** (See Figure 10.3)

**(SA, A and B Logics)**

1. Evenly back out (6) Screws (#58) and remove the Piston Retainer (#191) from the Piston Housing (#10).

#### **CAUTION:**

**This Piston Retainer is under spring pressure and care must be taken to avoid personal injury when removing the screws.**

**(SA with Air Boost Only)**

2. Remove the Gasket (#57), O-Ring (#39) and Liner (#42) from the Piston Retainer (#191).

**(SA, A and B Logics)**

3. Remove the Springs (#36) from the Piston (#3).

#### **NOTE:**

The quantity of springs are predetermined at the factory for your torque requirements. When removing these springs, if all of the holes are not used, make a freehand sketch locating the position of the springs. This will help you at reassembly.

4. Pull the Piston Subassembly, which consists of Thrust Plate (#5), Bearing (#27) and Piston (#3), out of the Piston Housing (#10).

5. The O-Rings (#39) and (#40), Liners (#42) and (#43) can now be removed from the Piston Housing (#10) for inspection and replacement.
6. Remove the Thrust Plate (#5) and the Bearing (#27) from the Piston (#3) with an Arbor Press.

#### **IMPORTANT:**

**Only remove this Thrust Plate and Bearing if replacement of either part is necessary.**

### **7-10 SECONDARY PISTON HOUSING**

(See Figure 10.4)

**(SA, A and B Logics)**

1. Evenly back out (6) Screws (#58) and remove the Piston Retainer (#11) from the Piston Housing (#190).

#### **CAUTION:**

**This Piston Retainer is under spring pressure and care must be taken to avoid personal injury when removing the screws.**

**(SA with Air Boost Only)**

2. Remove the Gasket (#57), O-Ring (#39) and Liner (#42) from the Piston Retainer.

**(SA, A and B Logics)**

3. Remove the Springs (#36) from the Piston (#3).

#### **NOTE:**

The quantity of springs are predetermined at the factory for your torque requirements. When removing these springs, if all of the holes are not used, make a freehand sketch locating the position of the springs. This will help you at reassembly.

4. Pull the Piston Subassembly, which consists of Thrust Plate (#5), Bearing (#27) and Piston (#3), out of the Piston Housing (#10).
5. The O-Rings (#39) and (#40), Liners (#42) and (#43) can now be removed from the Piston Housing (#190) for inspection and replacement.
6. Remove the Thrust Plate (#5) and the Bearing (#27) from the Piston (#3) with an Arbor Press.

#### **IMPORTANT:**

**Only remove this Thrust Plate and Bearing if replacement of either part is necessary.**

### **7-11 SECONDARY INPUT HOUSING SUBASSEMBLY (With Male Input Worm Shaft)**

(See Figure 10.5)

Remove any remaining belt guards, belts, sleeves or pulleys connected to the Input Shaft or Housing. (See Figure 7.2) for removal of Input Sheave or Pulley.



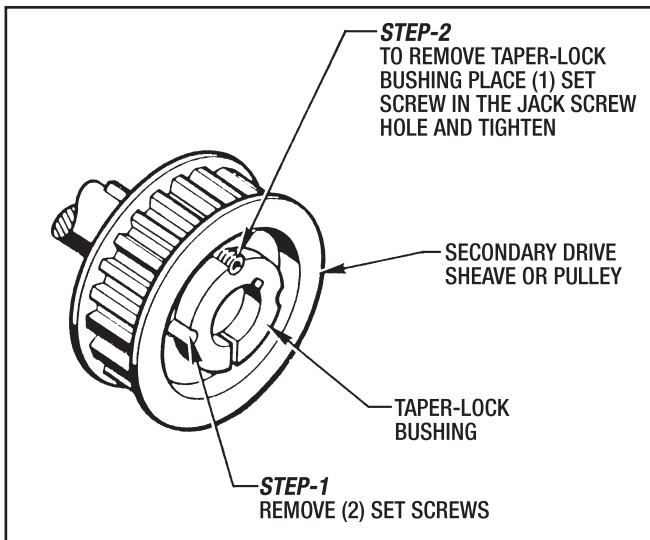


Figure 7.2 - Removing Drive Sheave or Pulley

1. Remove Key (#166) from the Worm Shaft (#153). Tape keyway on the worm shaft so the lip of the Oil Seal (#158) will not be damaged when removed.

**(With Coupling Drive)**

2. On the drive side remove (4) Screws (#264) and (4) Lockwashers (#175) and Slide Bearing Retainer (#151) off of the worm shaft carefully so Oil Seal (#158) will not be damaged.

**(With Long Coupled C-Face Adapter)**

2. On the drive side remove (4) Screws (#199) and (4) Lockwashers (#202) and slide the C-Face Adapter (#155) off of the worm shaft carefully so Oil Seal (#158) will not be damaged.

**(With Male Input Worm Shaft)**

3. Check Oil Seal (#158) and remove it from the Bearing Retainer (#151) or C-Face Adapter (#155) if replacement is necessary.
4. Remove Shims (#917) and save for reassembly.
5. On the opposite side, remove (4) Screws (#159) and (4) Lockwashers (#175).

Remove the Bearing Retainer (#156), Shim Gasket (#913) and Spacer (#171). Save the Shims for Re-Assembly.

6. Turn the Secondary Input Housing on it's side with the drive end of the Worm Shaft (#153) in the "Up" position and place in an Arbor Press.

Press the Worm Shaft out of the housing. (See Figure 7.3)

**NOTE:**

The Rear Bearing Cup (#167) and Rear Bearing Cone (#168) will be pushed out with the Worm Shaft. The Drive side Bearing Cup (#167) and Bearing Cone (#168) will remain in the housing bore.

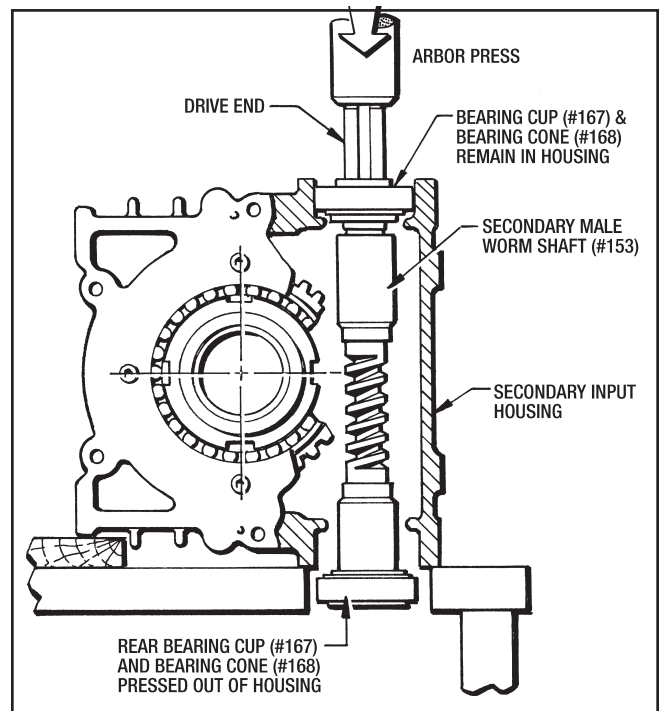


Figure 7.3 - Removing Male Worm Shaft

7. Remove the remaining Bearing Cup (#167) and Bearing Cone (#168) from the housing bore.
8. Use a Jaw-Type Bearing Puller to remove the Roller Bearing Cones (#168) from the worm shaft, if replacement is necessary.
9. Remove (5) Screws (#278) and (5) Washers (#128) from the housing.

The whole Secondary Input Housing Subassembly can now be removed from the housing. (See Figure 7.4)

**NOTE:**

If any parts have to be replaced on this Secondary Input Shaft Subassembly, refer to Section 7-13

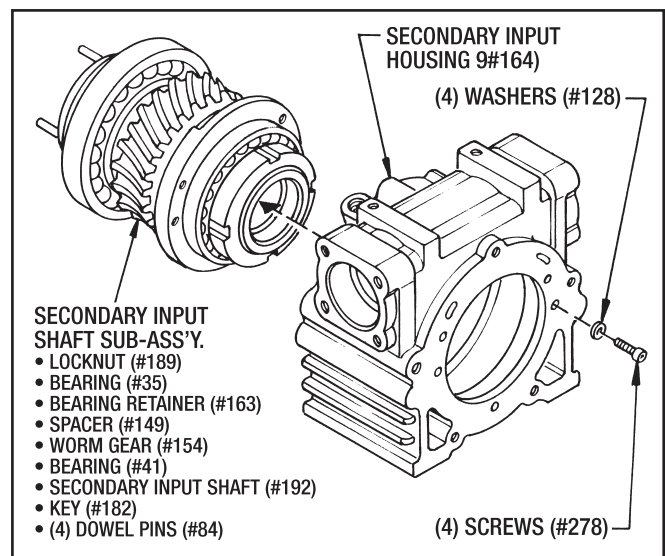


Figure 7.4 - Removing Secondary Input Shaft Sub-Assembly

## 7-12 SECONDARY INPUT HOUSING SUB-ASSEMBLY

(With Quill Input Shaft)

(See Figure 10.5)

1. On the drive side, remove (4) Screws (#264) and (4) Washers (#175). Slide the C-Face Adapter (#155) off of the Quill Input Shaft (#153) being careful not to damage the lip of the Oil Seal (#158).
2. Check the lip of the Oil Seal (#158) for damage, and remove it from the C-Face Adapter if necessary.
3. Remove and discard Gasket (#161).
4. On the opposite side of the drive side remove (4) Screws (#198) and (4) Lockwashers (#175). Remove the Bearing Retainer (#156) and the Gasket (#161). Discard the gasket when removed.
5. Unscrew Hex Hd. Screw (#263) and remove along with the Lockwasher (#226) and the Bearing Retainer Washer (#165).
6. Partially push the Worm Shaft (#153) out of the Housing (#164) until the bearing (#157) is freed from the bearing bore. The Worm Shaft (#153) can now be completely removed by just unthreading it from the Worm Gear (#154) as shown in Figure 7.5.
7. Unscrew and remove (5) Screws (#278) and (5) Lockwashers (#128). The Bearing Retainer (#163) can be loosened from the housing (#164).
8. Slide the Secondary Input Shaft Sub-Assembly out of the Housing (#164) as shown in Figure 7.4.

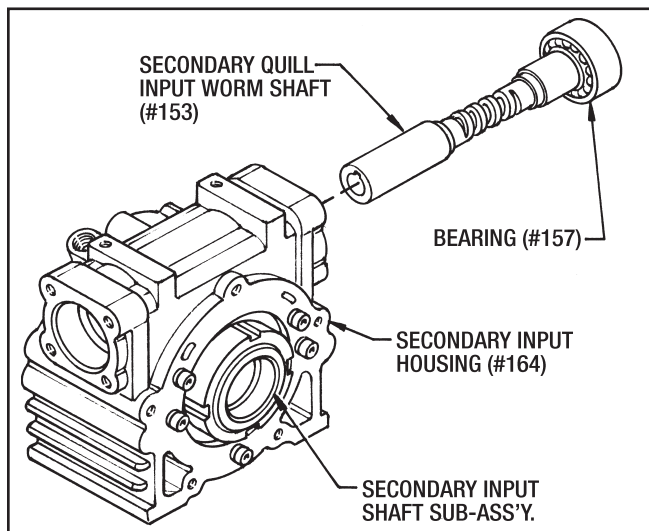


Figure 7.5 - Removing Quill Worm Shaft

9. See Section 7-13 "DISASSEMBLY OF SECONDARY INPUT SHAFT SUBASSEMBLY" if Bearings (#35) or (#41) need to be replaced.
10. Use a standard Jaw-Type Bearing Puller if Bearing (#157) needs to be removed from the Worm Shaft (#153)

## 7-13 DISASSEMBLY OF SECONDARY INPUT SHAFT SUBASSEMBLY

(See Figures 10.5 and 7.6)

### NOTE:

Do not attempt to disassemble this Secondary Input Shaft Sub-Assembly unless Bearings (#35), (#41) or the Gear (#154) has to be replaced.

1. Remove the Locknut (#189) from the Input Shaft.
2. Place the Secondary Input Shaft Sub-Assembly into an Arbor Press as shown in Figure 7.5 and press all parts off of the Input Shaft.

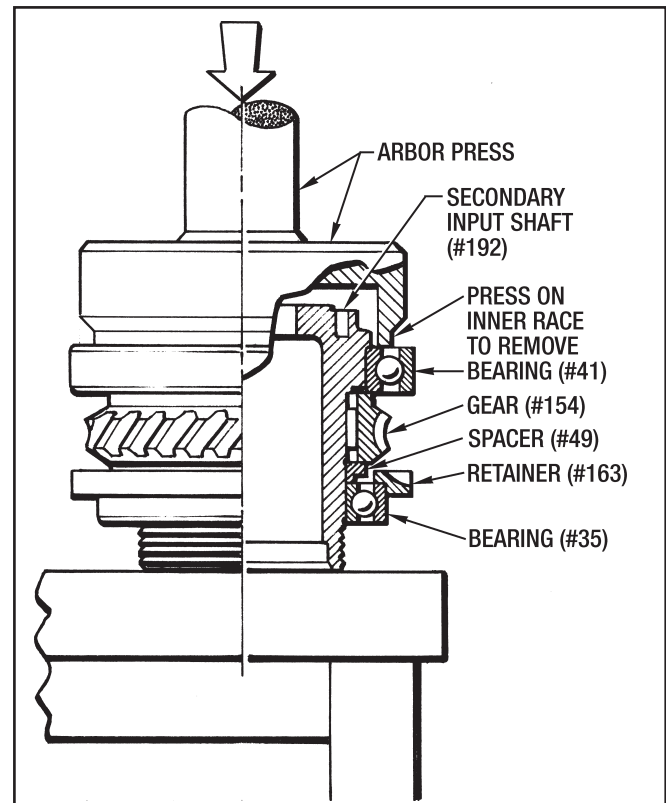


Figure 7.6 - Disassembly of Secondary Input Shaft

## 7-14 OUTPUT HOUSING SUBASSEMBLY

(See Figure 10.6)

1. Remove the Key (#181) from the Output Shaft (#1) and place tape over the Keyway.
2. Remove (4) Screws (#63) and (4) Washers (#127) from the Bearing Retainer (#7)  
  
Pull the Bearing Retainer (#7) out of the housing and over the output shaft.
3. Carefully pull the Output Shaft (#1) out of the Output Housing (#9) as not to damage the Oil Seal (#31), which is still in the Output Housing.
4. Inspect and remove the Oil Seal (#31), if necessary, from the Output Housing.

5. Unscrew the Locknut (#15) from the Output Shaft if the Bearing (#26) or (#38) has to be replaced. Using a standard Bearing Puller remove the Bearing.
6. Also use a Bearing Puller to remove the Pilot Bearing (#28) from the end of the Output Shaft.
7. Procedure to remove the Wear Sleeve (#4) from the Output Shaft (#1). (See Figure 7.7)

**NOTE:**

Only remove this Wear Sleeve if damage is indicated and replacement is necessary.

With a chisel the same width as the Wear Sleeve, make about 5 or 6 notches in the sleeve parallel to the shaft. It can now be removed from the Output Shaft by hand.

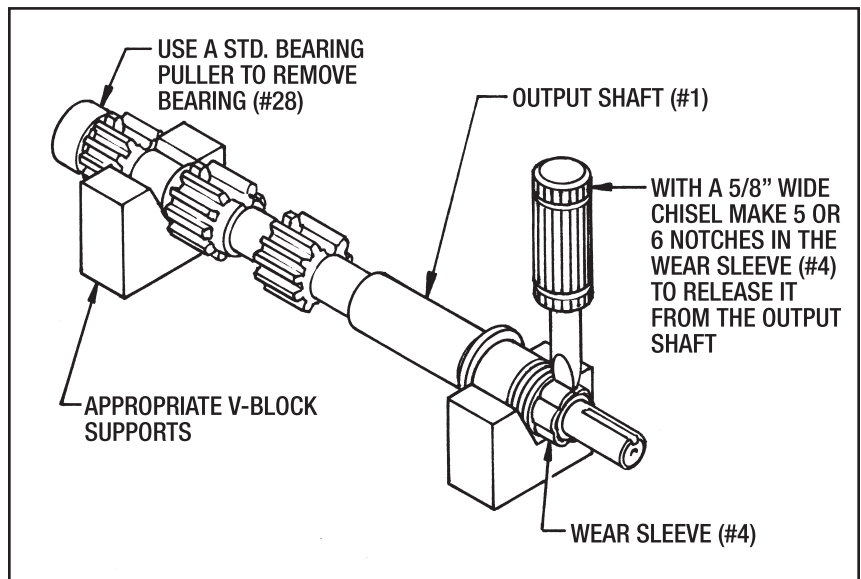


Figure 7.7 - Removing Wear sleeve (#4) from the Output shaft

**THIS COMPLETES THE DISASSEMBLY PROCEDURE FOR THE 02 MULTI-SPEED DRIVE (MSDr).**

## Section 8 CLEANING and INSPECTION

### 8-1 CLEANING AND INSPECTION

**WARNING - Petroleum based cleaning solvents are flammable and open flames or smoking by personnel in the vicinity of these solvents is extremely hazardous and must not be permitted.**

Clean metal parts in a suitable solvent and dry in a stream of low pressure compressed air. The Clutch and Brake Drive Plates (#13) can be cleaned in a solvent, but DO NOT clean the Clutch and Brake Friction Discs (#12) in solvent. Use only a clean, dry and lint-free rag to clean these Friction Discs. (Solvent will damage the resilient paper-based friction material used on the Friction Discs). Keep the Drive Plates and Friction Discs in the same order as they were removed. After cleaning, inspect parts for cracks, distortion, scoring, nicks, burrs or other damage would affect serviceability. Pay particular attention to the following:

1. Check the disc wear surfaces for scoring, galling or evidence of uneven wear.
2. Check the clutch and brake plates for scoring or galling. Make sure they are flat. If a perceptible ridge is worn in any of the drive plates, replace all of the drive plates and friction discs as a complete set.

3. Carefully check the piston and bore surfaces for nicks, scratches, scoring or other damage which would affect operation or cause leakage.
4. Pay particular attention to Wear Sleeve (#4) and shafts in the area of rotary seals. Check for nicks, scratches which would cause leakage. Replace any damaged parts.
5. It is not necessary to remove the ball bearings to check their operation. Slowly rotate the free race of each bearing by hand checking to see if it turns freely without rough or flat spots.

### 8-2 REPAIR AND REPLACEMENT

A fine stone or crocus cloth may be used to remove minor surface defects from parts so long as the operating or sealing action of the part is not affected. The use of coarser abrasives or other machining methods should not be attempted. Otherwise, damaged parts should be replaced.

Replacement is recommended also for the following, as applicable:

1. Replace all O-Rings, liners, gaskets and oil seals removed during the course of disassembly.
2. Replace clutch or brake discs and drive plates in complete sets only.

## Section 9

# REASSEMBLY

### 9-1 GENERAL REASSEMBLY INSTRUCTIONS

1. Lubricate O-Rings and the lips of all Oil Seals with the same oil as used in the drive unit immediately before reassembly and installation of any mating parts.
2. The installation of press fit parts can be eased by heating the outside parts in an oven. Heat bearings to 250° F max.

#### CAUTION:

**Wear suitable gloves when handling heated parts.**

3. Apply Gasket Sealant (Permatex #3D), or equivalent, to all flat gaskets

(Apply sealant to gaskets and mating surfaces immediately before assembly.)

4. Use Cap screw Adhesive (Loctite #271), or equivalent, on studs (#283) shown on Figure 10.1. Apply adhesive only on the ends that screw into the Secondary Input Housing. Use sparingly and clean any excess off with (Loctite Cleaner #755).

Also apply (Loctite #271) to all Locknuts.

5. Place a light coating of Gasket Sealant (Permatex #3D) in the bore for all Oil Seals immediately before pressing oil seals into the bore.

### REASSEMBLY OF MAJOR PARTS

Basically, the Reassembly Procedure is just a reverse order of the Disassembly Procedure.

### 9-2 INSTALLING BEARINGS AND WEAR SLEEVE ON OUTPUT SHAFT

1. Press Bearing (#26 or #38) onto Output Shaft (#1) using an Arbor Press.

#### IMPORTANT:

**Outboard Bearing (#26 or #38) must be installed with the Loading Slots towards the output end of the shaft.** (See Figure 9.1)

2. Press Bearing (#28) onto the other end of the Output Shaft (#1)
3. Screw Locknut (#15) onto the shaft. Use (Loctite #271) on threads.
4. Press the Wear Sleeve (#4) onto the shaft.

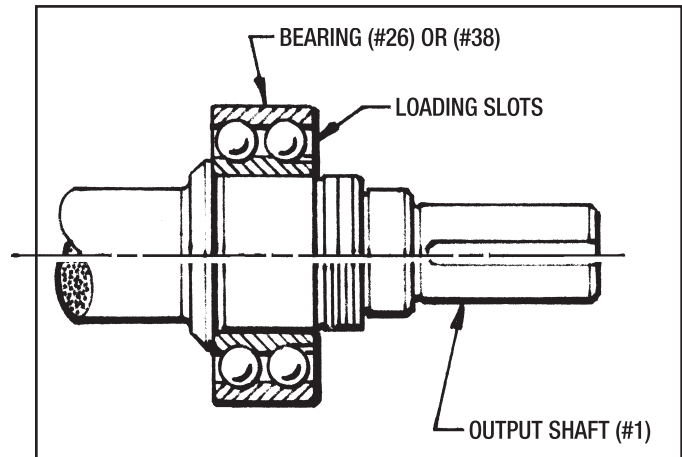


Figure 9.1 - Installing Outboard Bearing (#26 or #38)

### 9-3 OUTPUT HOUSING SUBASSEMBLY

1. Press the Oil Seal (#31) into the Output Housing (#9). Use (Permatex #3D) or equivalent.
2. Lubricate the oil seal lip and the wear sleeve with ATF 210 Type F and carefully guide the Output Shaft Sub-Assembly into the Output Housing until the Bearing (#26 or #38) seats in the Bearing Bore.
3. Slide the Bearing Retainer (#7) over the output shaft. Attach with (4) Screws (#63) and (4) Lockwashers (#127).
4. Replace the Air Breather (#45), Sight Glass (#46) and any other plugs or fittings removed at disassembly.
5. Install Key (#181) into the output shaft keyway.

### 9-4 SECONDARY INPUT SHAFT SUBASSEMBLY (With Male Input Worm Shaft)

(See Figure 10.5)

#### (With Quill Input Worm Shaft)

(See Figure 10.5)

1. Press the Bearing (#41) onto the Input Shaft (#192), making sure that it seats on the Input Shaft shoulder.
2. Install (1) Key (#182), (2) Worm Gear (#154), (3) Spacer (#49), in this order, onto the Input Shaft. (The Worm Gear (#154) will have to be pressed onto the Input Shaft.) Slide Bearing Retainer (#163) over Input Shaft before installing Bearing (#35).
3. Press Bearing (#35) onto the Input Shaft.
4. Using (Loctite #271) adhesive sparingly on the threads, install the Locknut (#189).

## 9-5 SECONDARY INPUT HOUSING SUBASSEMBLY

### (With Male Input Worm Shaft)

(See Figure 10.5)

1. Insert the assembled Secondary Input Shaft into the housing and attach the Bearing Retainer (#163) with Screws (#278) and Washers (#128). See Figure 9.2.

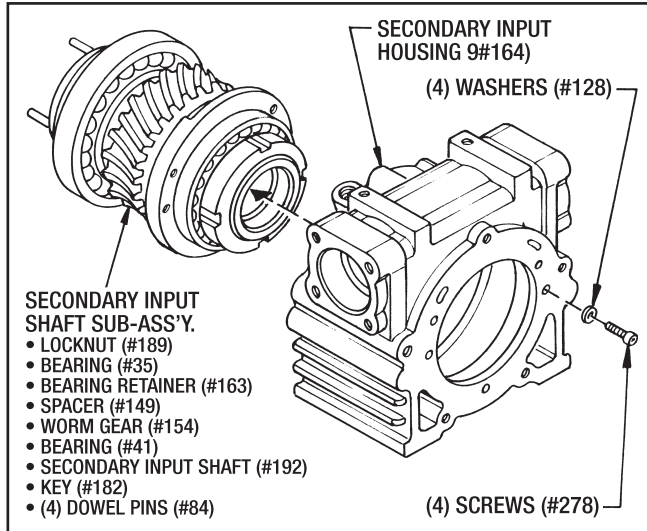


Figure 9.2 - Installing Secondary Input Shaft Sub-Assembly

2. Press (1) Bearing Cone (#168) onto the opposite end of the drive end of the Worm Shaft (#153).
3. Insert the Worm Shaft (#153) and the Bearing Cone (#168) into the Housing (#164).
4. Place Housing and Worm Shaft into an Arbor Press and press the drive side Bearing Cone (#168) onto the Worm Shaft. (See Figure 9.3).

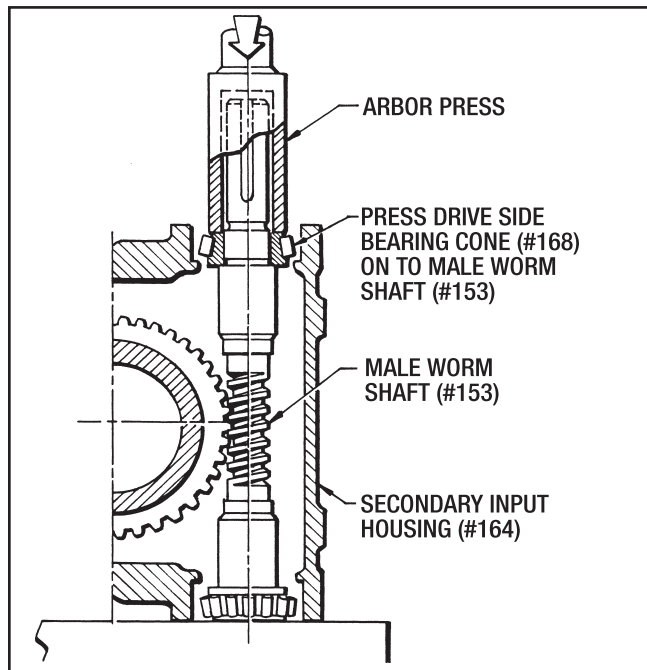


Figure 9.3 - Installing Drive Side Bearing Cone (#168) onto Male Worm Shaft

**FORCE CONTROL INDUSTRIES, INC.**

5. Insert the (2) Bearing Cups (#167) into both bearing bores of the housing.
6. Apply thin coat of (Permatex #3D) in the oil seal bore of the Bearing Retainer (#151) or C-Face Flange (#155) and press the Oil Seal (#158) into the bore. (Be careful not to damage the lip of the oil seal.)
7. Replace Shims (#917) on to the pilot of the Bearing Retainer or C-Face Flange.
8. Lubricate the lip of the Oil Seal (#158) and slide the Bearing Retainer (#151) or C-Face Flange (#155) over the end of the Worm Shaft (#153) being careful not to damage the oil seal lip on the keyway.
9. Bolt the Bearing Retainer (#151) to the Housing with (4) Screws (#264) and (4) Lockwashers (#175) or the C-Face Flange (#155) with (4) Screws (#199) and (4) Lockwashers (#202).
10. On the opposite side, replace Spacer (#171), Shims (#913) and bolt the Bearing Retainer (#156) to the housing with (4) Screws (#159) and (4) Lockwashers (#175).
11. Replace Key (#166) and all pipe plugs removed.

## 9-6 CHECKING WORM SHAFT END PLAY

### (Male Secondary Input Worm Shaft Only)

**(WORM SHAFT END PLAY - .003" TO .005" MAX.)**

1. Install a Dial Indicator with a magnetic mount to the drive side of the Secondary Input Housing Sub-Assembly, as shown in Figure 9.4. Manually push the worm shaft in and out while rotating it. Add or subtract Shims (#917) on the drive side to get correct end play of .003" to .005".

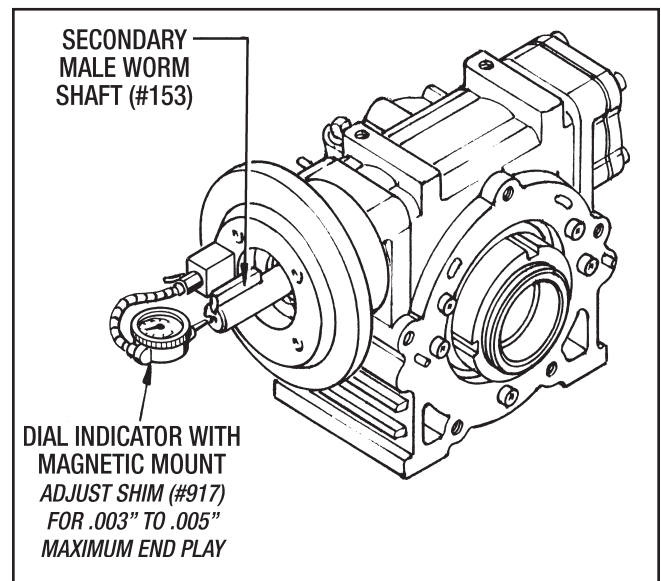


Figure 9.4 - Checking the Worm Shaft End Play

## 9-7 SECONDARY INPUT HOUSING SUBASSEMBLY

### (With Quill Input Worm Shaft)

(See Figure 10.5)

1. Insert the Secondary Input Shaft Sub-Assembly into the Housing (#164). Attach Bearing Retainer (#163) with Screws (#278) and Lockwashers (#128). (See Figure 9.2)
2. Press the Ball Bearing (#157) onto the Worm Shaft (#153). Attach Bearing Washer (#165) with Lockwasher (#226) and Hex Hd. Screw (#263) to the end of the Worm Shaft.
3. Using (Permatex #3D), install Gasket (#161) to the drive side of the housing.
4. Slide the Worm Shaft (#153) into the housing. When contact is made with the Worm Gear (#154) rotate the worm shaft to thread it into the mating teeth of the worm gear. Slide the Bearing (#157) all the way into the bearing bore.
5. Install the Gasket (#161) to the housing using (Permatex #3D) gasket sealant.
6. Bolt the Bearing Retainer (#156) to the housing using (4) Screws (#198) and (4) Lockwashers (#175).
7. Press the Oil Seal (#158) into the C-Face Adapter (#155) after applying a thin coat of (Permatex #3D) in the oil seal bore.
8. Lubricate the lip of the Oil Seal first, then slide the C-Face Adapter (#155) over the end of the worm shaft, being careful not to damage the oil seal lip.
9. Bolt the C-Face Adapter (#155) to the housing using (4) Screws (#264) and (4) Lockwashers (#175).

## 9-8 PRIMARY AND SECONDARY PISTON HOUSING SUBASSEMBLIES

(See Figure 10.4)

1. Install O-Rings (#39), (#40) and Liners (#42), (#43) into Piston Housings. Lubricate O-Rings before installation.

### **IMPORTANT:**

**Before applying (Loctite #620) to the Bearing (#27) I.D. and O.D. clean it well with (Loctite #755) cleaning solvent or equivalent.**

2. Apply (Loctite #620) to the I.D. of Bearing (#27) and press it onto the Thrust Plate (#5). Make sure that the bearing is firmly seated on the thrust plate shoulder.
3. Apply (Loctite #620) to the O.D. of Bearing (#27) and press the bearing and thrust plate into the Piston (#3). Again, Make sure that the bearing is firmly seated against the piston shoulder.

4. Insert the Piston Sub-Assembly into the Piston Housing. Be very careful not to damage the Teflon Liners (#42) and (#43) in the housing.

### **(A and B Logic)**

5. Set the Piston Housing upon end with the Piston Pins (#74) and Thrust Plate (#5) pointing upwards.
6. Replace Springs (#36) back over the appropriate pins.
7. Attach the Piston Retainer (#191) or (#11) with Screws (#58).

### **IMPORTANT:**

**Tighten down the Screws (#58) evenly to compress the Springs (#36) correctly.**

### **(SA Logic)**

5. Set the Piston Housing upon end with the Thrust Plate (#5) pointing upwards.
6. Replace Springs (#36) back into holes in piston.
7. Replace O-Ring (#39) and Liner (#42) into the Piston Retainer (#191) or (#11). (Lubricate O-Ring before installing.)
8. Install Gasket (#57) with (Permatex #3D) onto the housing mating surface.
9. Apply (Permatex #3D) to the mating surface of the Piston Retainer (#191) or (#11). Wipe off any excess sealant.
10. Attach Piston Retainer (#191) or (#11) to the Housing with Screws (#58).

### **IMPORTANT:**

**Tighten down the Screws (#58) evenly to compress the Springs (#36) correctly.**

## 9-9 PRIMARY INPUT HOUSING SUBASSEMBLY

(See Figures 10.2 and 10.3)

1. Slip Primary Input Shaft (#2) into Bearing Retainer (#16).
2. Press Bearing (#26) or (#38) onto the Primary Input Shaft (#2) (See Figure 9.5 for position of "Loading Slots"). Only press on the inner race of the bearing until it bottoms out on the Input Shaft shoulder.
3. Install Locknut (#15) or (#134) onto the Input Shaft, using (Loctite #271) on threads.
4. Press Wear Sleeve (#4) or (#195) onto the Input Shaft.
5. Press the Oil Seal (#31) into the housing bore. Lubricate the lip of the Oil Seal.
6. Insert this Input Shaft Subassembly into the Input Housing being careful not to damage the lip of the Oil Seal (#31). (See Figure 9.6)

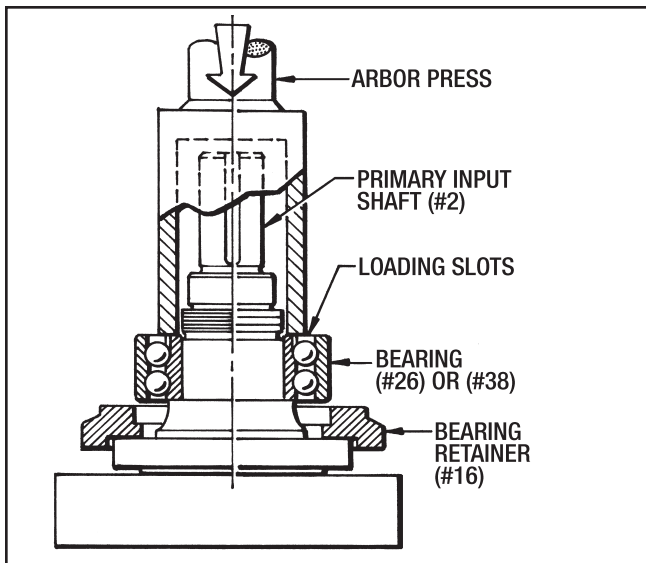


Figure 9.5 - Installing Outboard Bearing on Input Shaft

Attach this assembly with Screws (#17) and Lockwashers (#127).

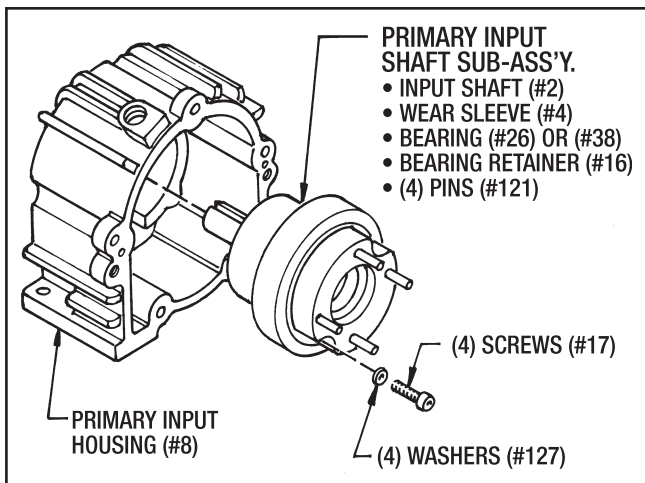


Figure 9.6 - Installing Input Shaft Sub-Assembly

### REASSEMBLY OF MAJOR SUBASSEMBLIES AND CLUTCH/BRAKE STACKS

#### 9-10 ATTACHING OUTPUT HOUSING SUBASSEMBLY TO SECONDARY INPUT HOUSING SUBASSEMBLY

(See Figure 10.1)

1. Install Gasket (#53) to the rear of the Output Housing. Apply (Permatex #3D) sealant to both sides of the Gasket. Clean off any excess sealant.
2. Slide the Output Housing into the Secondary Input Housing Sub-Assembly.
3. Attach the Output Housing to the Secondary Input Housing with (5) Screws (#61) and (5) Lockwashers (#127).

4. Install (2) Studs (#283) into the rear of the Secondary Input Housing to act as a guide in the Re-Assembly of the other Major Sub-Assemblies.

#### NOTE:

Install these (2) studs opposite each other and with the slotted end exposed. Do not apply any screw adhesive to the studs at this time. They have to be removed at a later time.

#### 9-11 MEASURING AND CONTROLLING STACK HEIGHT DIMENSIONS

To assure correct piston travel, the following steps must be taken when replacing the Clutch and Brake Stacks.

1. Based on the Stack Arrangement shown on page 24, place the correct number of Friction Discs (#12) and Drive Plates (#13) or (#102) in an arbor press. Clamp and measure each stack height as shown in Figure 9.7.

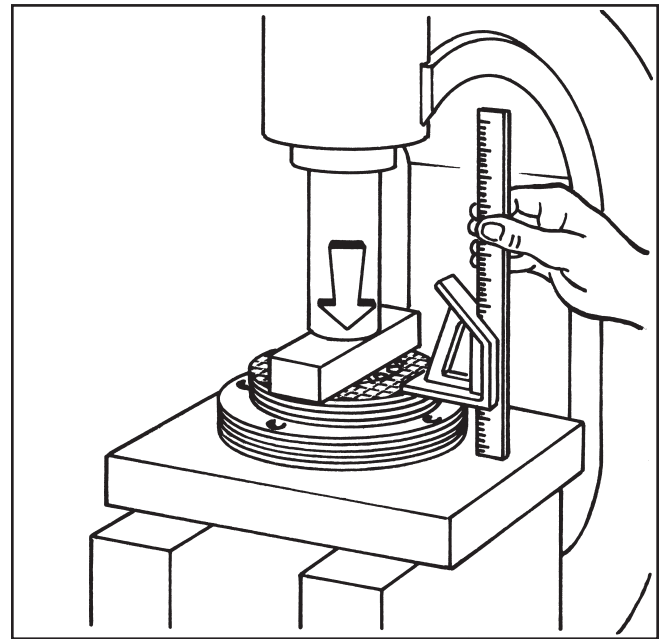


Figure 9.7 - Measuring Stack Height

#### a. Primary Clutch Stack -

(4) Friction Discs (#12) and (4) Drive Plates (#13) or (#102).

**Minimum Stack Height = .560"**

#### b. Secondary Clutch Stack -

(4) Friction Discs (#12) and (4) Drive Plates (#13).

**Minimum Stack Height = .560"**

#### c. Brake Stack -

(4) Friction Discs (#12) and (5) Drive Plates (#13).

**Minimum Stack Height = .609"**

2. If the Stack Height is at the Minimum or less, a Shim (#983) will be required for that stack.

## IMPORTANT

**When using a Shim (#983), it must never be installed to contact a Friction Disc (#12) but always installed to contact a Drive Plate (#13).**

### 9-12 INSTALLING SECONDARY CLUTCH STACK AND SECONDARY PISTON HOUSING SUBASSEMBLY

(See Figure 10.1)

For ease in Reassembly, place the assembled unit in a vertical position with the splines of the output shaft in an up position.

1. Install the Secondary Clutch Stack onto the Output Shaft Spline starting with a Shim (#983), if required, then a Drive Plate (#13) and then a Friction Disc (#12), ending with a Friction Disc. Align the holes in the Drive Plate and Shim with the pins on the Secondary Input Shaft and the internal teeth in the Friction Disc with the Output Shaft Spline.
2. Install Gasket (#51) to the rear of the Secondary Input Housing. Apply (Permatex #30) to both sides of the gasket. Lower the Secondary Piston Housing Sub-Assembly over the extended studs onto the assembled unit.

### 9-13 INSTALLING THE BRAKE STACK AND THE PRIMARY PISTON HOUSING SUBASSEMBLY

(See Figure 10.1)

1. Install the Brake Stack onto the Output Shaft Spline starting with a Drive Plate (#13) and then a Friction Disc (#12), ending with a Drive Plate. [If a Shim (#983) is required it can be installed first or last.] Align the holes in the Drive Plate and Shim with the pins on the Secondary Piston Housing and the internal teeth in the Friction Disc with the Output Shaft Spline.
2. Install Gasket (#54) using gasket sealant (Permatex #3D) on mating surfaces. Clean off any excess sealant.
3. Lower the Primary Piston Housing Sub-Assembly over the extended studs onto the assembled unit.

### 9-14 INSTALLING THE PRIMARY CLUTCH STACK AND THE PRIMARY INPUT HOUSING SUBASSEMBLY

(See Figure 10.1)

1. Install the Primary Clutch Stack onto the Output Shaft Spline starting with a Friction Disc (#12) and then a Drive Plate (#13) or (#102), ending with a Drive Plate. [If a Shim is required, install it after the last Drive Plate.] Align all the holes in the Drive Plates and Shim with each other and the internal teeth in the Friction Disc with the Output Shaft Spline.

**NOTE** - Drive Plate (#13) and Shim (#983) is used with 1/4" Driver Pins. Drive Plate (#102) and Shim (#983) is used with 3/8" Driver Pins.

2. Install Gasket (#53). Apply gasket sealant (Permatex #3D) to both mating surfaces. Clean off any excess sealant.
3. Lower the Primary Input Housing Subassembly over the (2) extended studs. Turn the Primary Input Shaft by hand to align the Pins with the mating holes in the Drive Plates.

#### CAUTION:

**Do not force the Primary Input Subassembly down into the Clutch Stack. This could bend and damage the Drive Plates.**

4. Remove the (2) studs previously installed. Install all of the studs (#283), one at a time, with the following procedure:
  - a. Apply (Loctite #271) sparingly, only to the end of the stud being inserted.
  - b. Insert the stud into the housing. Using the slots in the exposed end of the stud, adjust it so 1/2" of thread is exposed beyond the Input Housing flange.

#### NOTE:

It is **IMPORTANT** that this procedure be completed for each stud, one at a time, so the Loctite Adhesive does not have time to set, making the 1/2" adjustment impossible.

5. After all of the studs have been properly adjusted to the right height, replace the Allen Nuts (#152) and Lockwashers (#127).
6. If your Drive Unit has a Male Primary Input Shaft and is not equipped with Fan Cooling, then replace Key (#180) into the shaft.

This completes the Re-Assembly Procedure for the Major Subassemblies. Before proceeding any further, an OPERATIONAL CHECK of the Clutch and Brake Piston Movement should be made. Apply 60 to 80 PSI to the clutch and brake ports, as indicated in Section 5 - OPERATION CHECKS, and observe the piston movement through the inspection ports.

### 9-15 FAN AND SHROUD INSTALLATION

(See Figure 10.3)

1. Install Key (#37).
2. Place Fan (#25) on the Input Shaft and tighten Set Screw (#70).
3. Place the Fan Shroud (#24) into place and attach with (2) Screws (#66) in the Shroud.
4. Install Key (#180).



## 9-16 ATTACHING C-FACE MOUNTED PRIMARY AND SECONDARY DRIVE MOTORS

1. First attach the C-Face Adapter (#200) to the Primary Input Housing with (4) Screws (#201) and (4) Washers (#202). (See Figures 10.2 and 10.3.)
2. Attach an appropriate soft sling or lifting hook to the drive motors and, with care, slide the motor shafts into the Quill Input Shafts, making sure the key on the motor shaft aligns with the keyway in the input shaft.

### CAUTION:

**Be very careful not to bump the Input Shafts. This could damage the bearings and the lip of the oil seals.**

3. Attach the Primary Drive Motor and Secondary Drive Motor with appropriate Screws and Lockwashers.

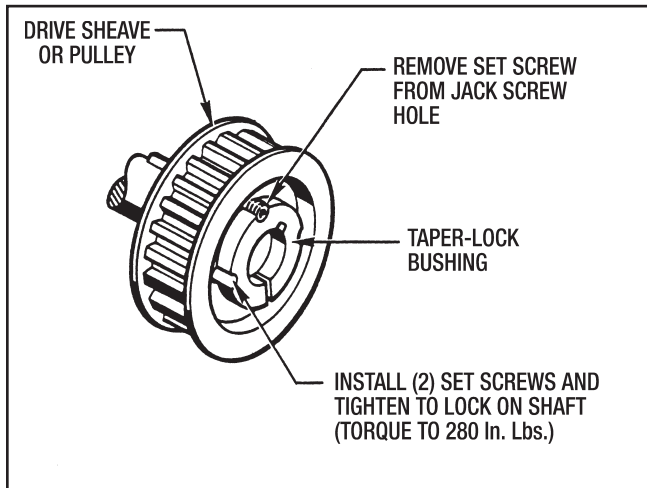


Figure 9.8 - Installing Drive Sheave or Pulley with Taper-Lock Bushing

## 9-17 INSTALLING BELT DRIVE SHEAVE OR PULLEY (WITH MALE INPUT SHAFT ONLY)

1. Install guard back plate if necessary.
2. Assemble the Taper-Lock Bushing and the Drive Sheave or Pulley with the (2) Set Screws placed in the (2) Locking Holes.
3. Place Assembled Drive Sheave or Pulley onto the Male Input Shaft as close as possible to the drive unit to minimize overhang shaft deflection. Tighten (2) Set Screws to lock it on the Input Shaft (See Figure 9.8).

## 9-18 FINAL REASSEMBLY

1. Replace all pipe plugs and fittings removed for inspection or disassembly.
2. Fill the Drive Unit to the center of the sight gauge with Mobil Automatic Transmission Fluid ATF-210 - Type "F", unless otherwise specified on the unit nameplate. See Section 4 LUBRICATION.
3. Replace all external motor drive parts, safety guards, sheaves, pulleys, belts and couplings on belt drive units.
4. Before placing the Drive Unit back into service completely check out the Operation as described in Section 5 OPERATION CHECKS.

**REASSEMBLY IS NOW COMPLETE AND THE DRIVE UNIT IS READY FOR SERVICE.**

---

---

## **Section 10**

# **ORDERING REPAIR PARTS**

### **10-1 GENERAL INFORMATION**

This section illustrates, lists and describes all available Repair Parts for the Force Control Multi-Speed Drive (MSDr). Exploded views with numbers are used to identify the various parts in the Drive Units. These numbers are listed in the parts list along with the part name and quantity used.

### **10-2 FACTORY REBUILD SERVICE**

Reconditioning service is offered by Force Control Industries at the factory. Before returning a unit for this service, be sure to first contact the Force Control Industries Service Sales Dept. for authorization and shipping instructions. Force Control Industries cannot be responsible for units returned to the factory without prior notice or authorization.

Care must be given to the packaging of returned drives. Always protect mounting feet by attaching to a skid. Shipment-damaged drives always delay repairs. When possible, describe the problem experienced on your shipping papers.

#### **SHIPPING ADDRESS:**

Force Control Industries, Inc.  
3660 Dixie Highway  
Fairfield, OH 45014

Telephone: (513) 868-0900  
Fax: (513) 868-2105  
E-Mail: [info@forcecontrol.com](mailto:info@forcecontrol.com)

### **10-3 DRIVE MOTORS**

The motors used with these Drive Units are standard and may be repaired or replaced by any qualified motor rebuild facility or supplier.


### **10-4 ORDERING REPAIR PARTS**

When ordering replacement parts, please specify all of the following information:

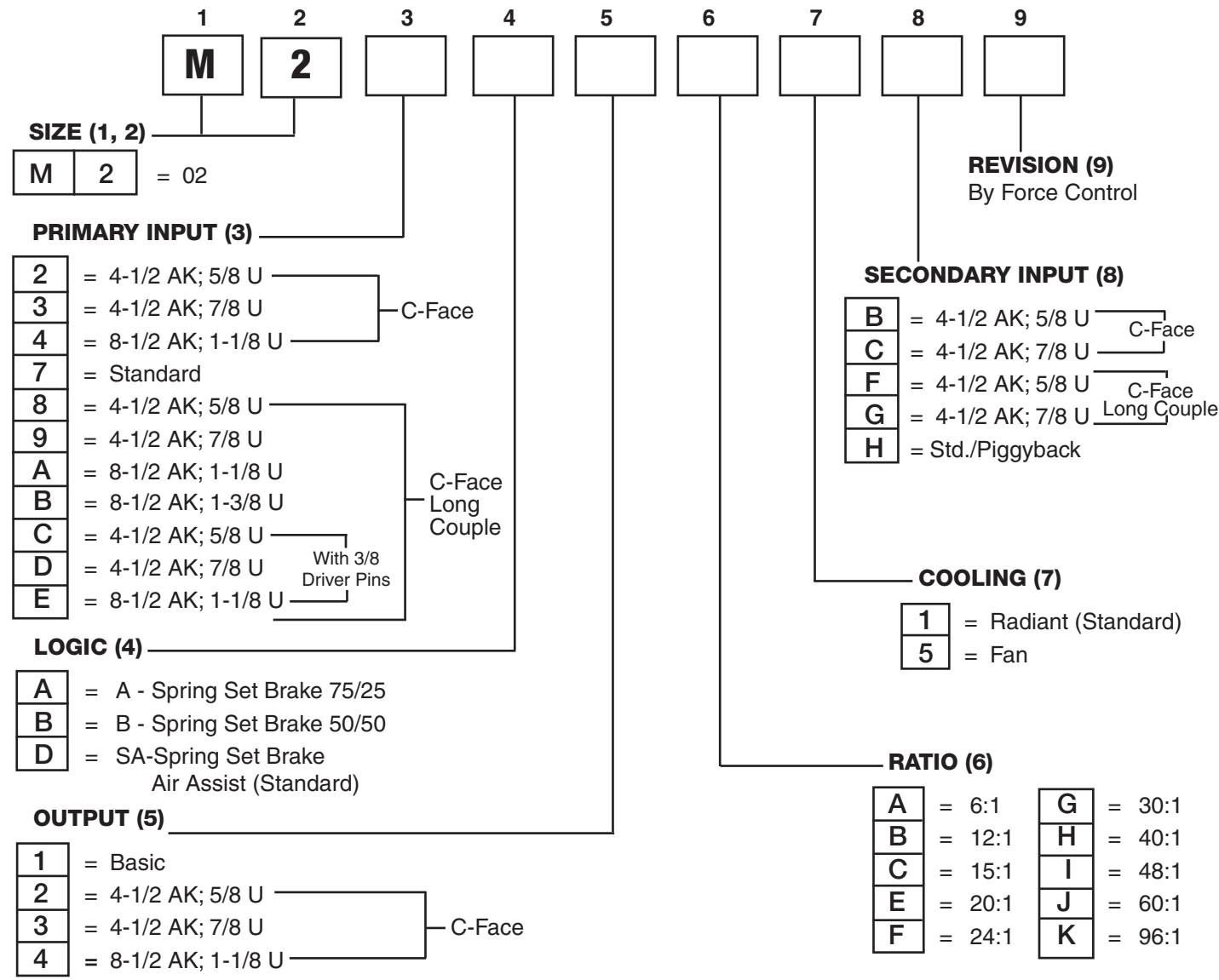
1. Drive Model Number (On the Nameplate.)
2. Drive Serial Number (On the Nameplate.)
3. Part Reference Number (On Figure & Parts List.)
4. Part Name (On Parts List.)
5. Quantity (On Parts List.)
6. Complete Shipping Information

Failure to include information for items 1 through 5 will only delay your parts order. Unless another method is specified for item 6, parts less than 70 pounds will be shipped United Parcel Service, parts over 70 pounds will be shipped motor freight. Air freight and other transportation services are available, but only if specified on your order.

# 10-5 NAME PLATE AND MODEL NUMBER INFORMATION

|   |                                    |
|---|------------------------------------|
| <b>MSDr</b>   | MULTI-SPEED DRIVE                  |
|   | MODEL No. <b>M 2 7 D 1 C 5 H B</b> |
| SERIAL No.  |                                    |
|  FORCE CONTROL INDUSTRIES, INC.<br>Fairfield, Ohio |                                    |
| USE MOBIL ATF - 210   | <input type="checkbox"/>           |
| MOBIL ATF - 220   | <input type="checkbox"/>           |

## (MSDr) MULTI-SPEED DRIVE MODEL NUMBERS



Consult factory for 9" AK D-Flange.

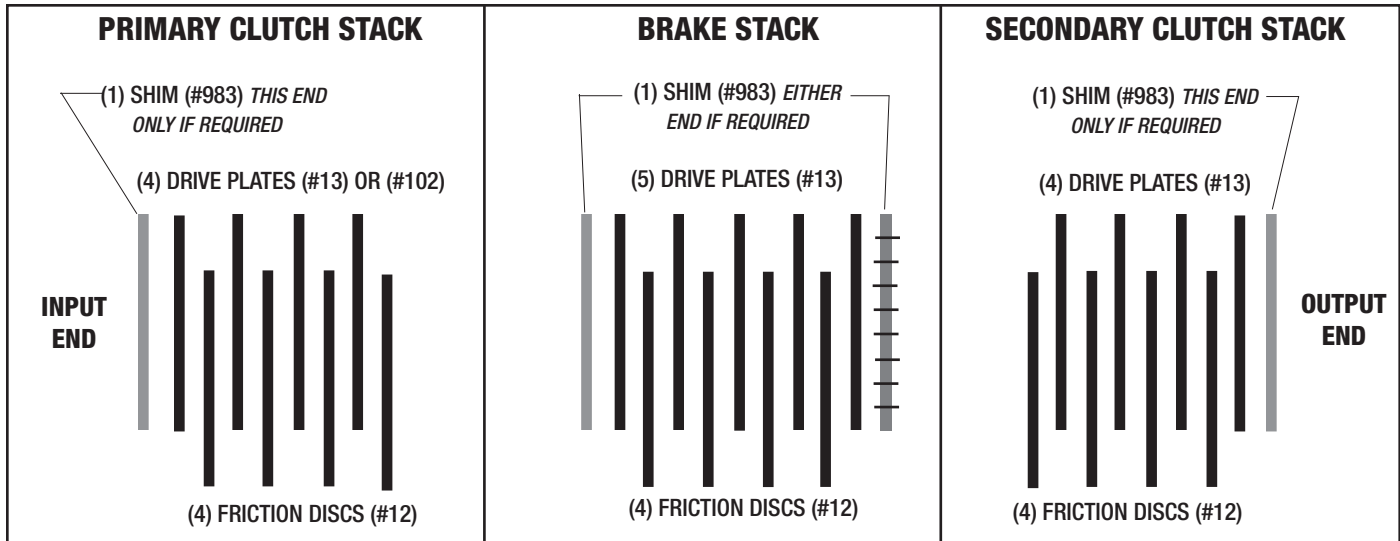
# REPAIR PARTS LISTS

## MAJOR SUBASSEMBLIES and CLUTCH/BRAKE STACKS (FIGURE 10.1)

| REF. No. | PART NAME  | QTY. | REF. No. | PART NAME                                | QTY. |
|----------|--|------|----------|--|------|
| *12      | Friction Disc .....  | 12   | 61       | Soc. Hd. Cap Screw.....                  | 5    |
| *13      | Drive Plate (With 1/4" Driver Holes)<br>With 1/4" Driver Pins..... | 13   | *102     | Drive Plate (With 3/8" Driver Holes).... | 4    |
|          | With 3/8" Driver Pins.....   | 9    | 127      | Lockwasher.....                          | 10   |
| *51      | Gasket .....   | 1    | 152      | Allen Nut .....                          | 5    |
| *53      | Gasket .....   | 2    | 283      | Threaded Stud.....                       | 5    |
| *54      | Gasket .....   | 1    | *983     | Shim Plate (See Below).....              | 3    |

\* - Indicates parts in Minor Overhaul Kit.

## STACK ARRANGEMENTS



# MAJOR SUBASSEMBLIES AND CLUTCH/BRAKE STACKS

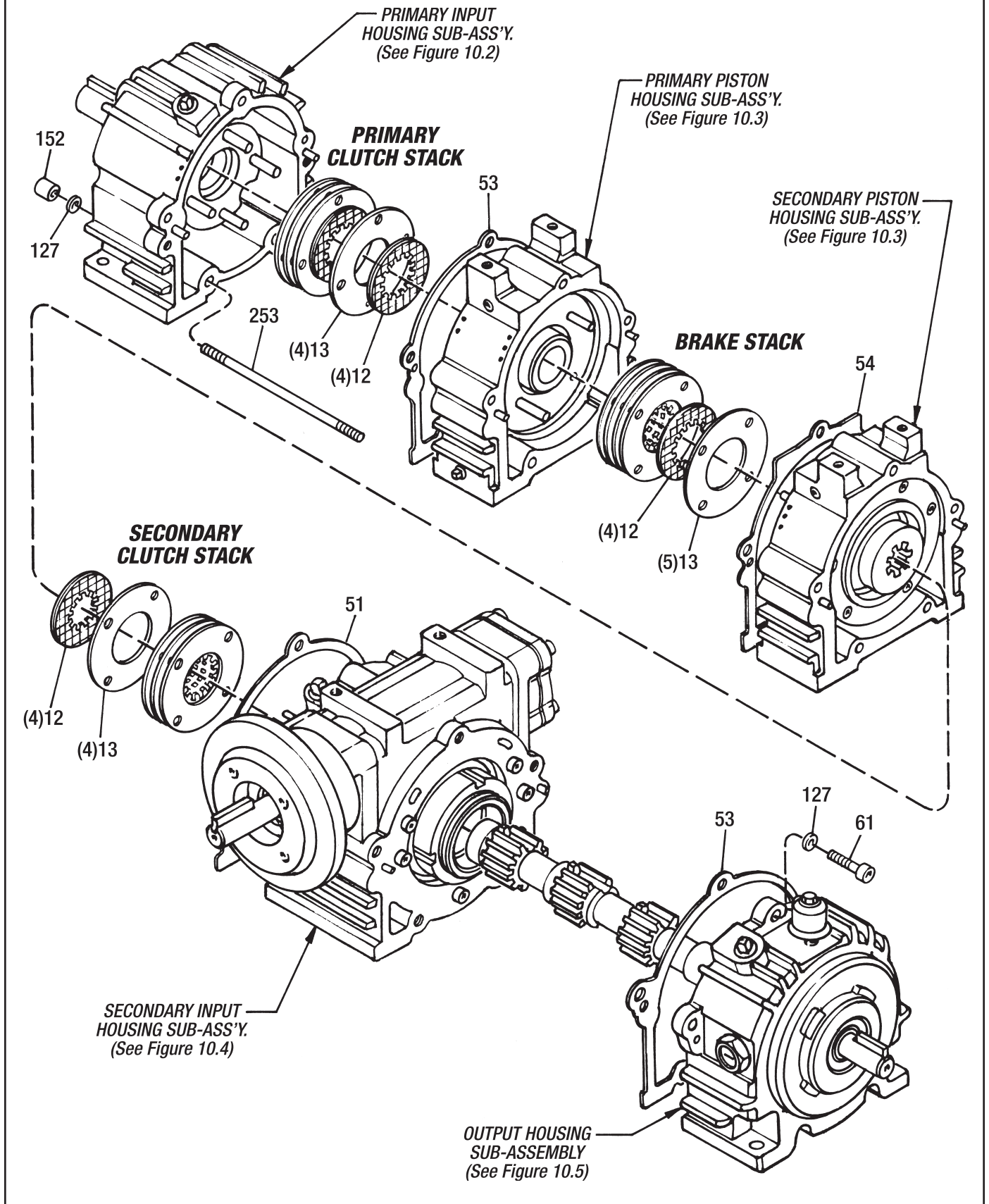


Figure 10.1 - Major Sub-Assemblies and Clutch/Brake Stacks

**PRIMARY INPUT HOUSING**  
**FIGURE 10.2 and 10.3**

| REF. No. | PART NAME                  | QTY. | REF. No. | PART NAME                      | QTY. |
|----------|----------------------------|------|----------|--------------------------------|------|
| 2        | Primary Input Shaft.....   | 1    | 65       | Flat Hd. Screw.....            | 6    |
| *4       | Wear Sleeve .....          | 1    | 66       | Screw .....                    | 2    |
| 8        | Primary Input Housing..... | 1    | 68       | Dowel Pin.....                 | 2    |
| 14       | Pipe Plug .....            | 1    | 70       | Set Screw.....                 | 1    |
| **15     | Locknut .....              | 1    | 76       | Cap Screw .....                | 4    |
| 16       | Bearing Retainer.....      | 1    | 121      | Dowel Pin.....                 | 4    |
| 17       | Cap Screw .....            | 4    | 125      | C-Face Adapter, 8-1/2" AK..... | 1    |
| 24       | Fan Shroud .....           | 1    | 127      | Lockwasher.....                | 4    |
| 25       | Fan.....                   | 1    | 180      | Key .....                      | 1    |
| *26      | Ball Bearing .....         | 1    | *195     | Wear Sleeve.....               | 1    |
| *31      | Ball Bearing .....         | 1    | 200      | C-Face Adapter.....            | 1    |
| **34     | Locknut .....              | 1    | 201      | Hex. Hd. Screw.....            | 6    |
| 37       | Key.....                   | 1    | 202      | Lockwasher.....                | 6    |
| *38      | Ball Bearing .....         | 1    |          |                                |      |

\* - Indicates parts in Minor Overhaul Kit.

\*\* - Indicates parts in Major Overhaul Kit. (Includes all parts in Minor Overhaul Kit.)

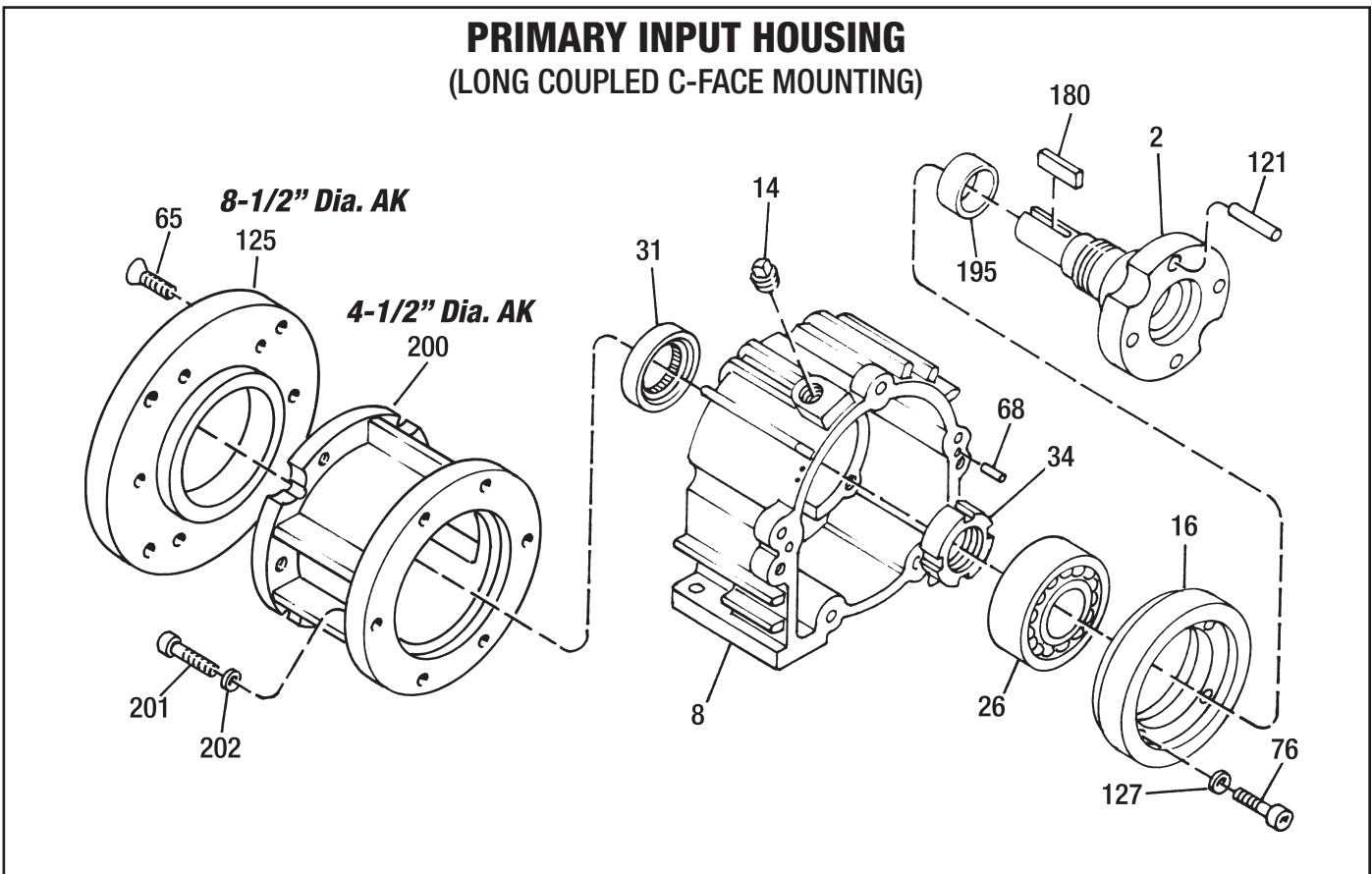
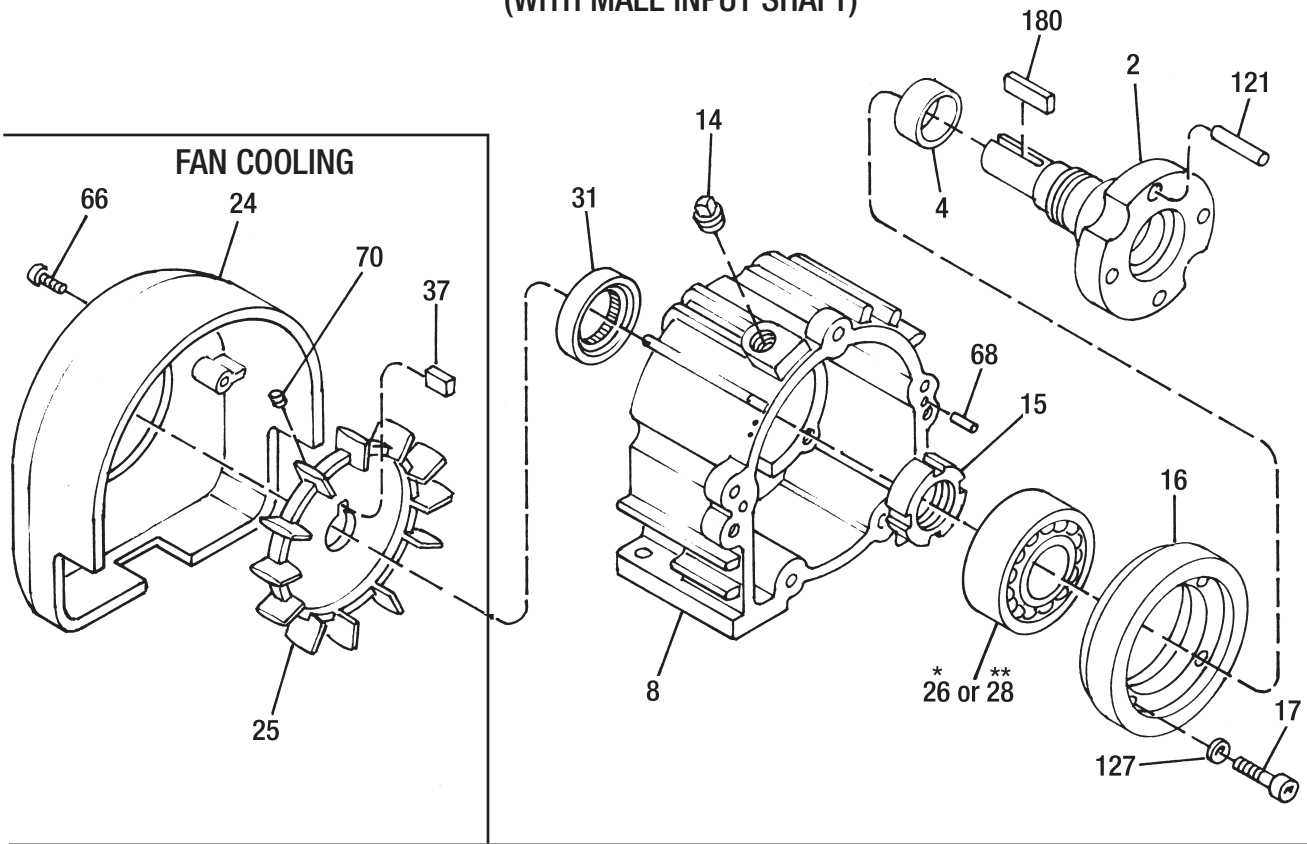


Figure 10.2 - Long Coupled C-Face Primary Input Housing

## PRIMARY INPUT HOUSING (WITH MALE INPUT SHAFT)



## (WITH C-FACE ADAPTER AND QUILL INPUT SHAFT)

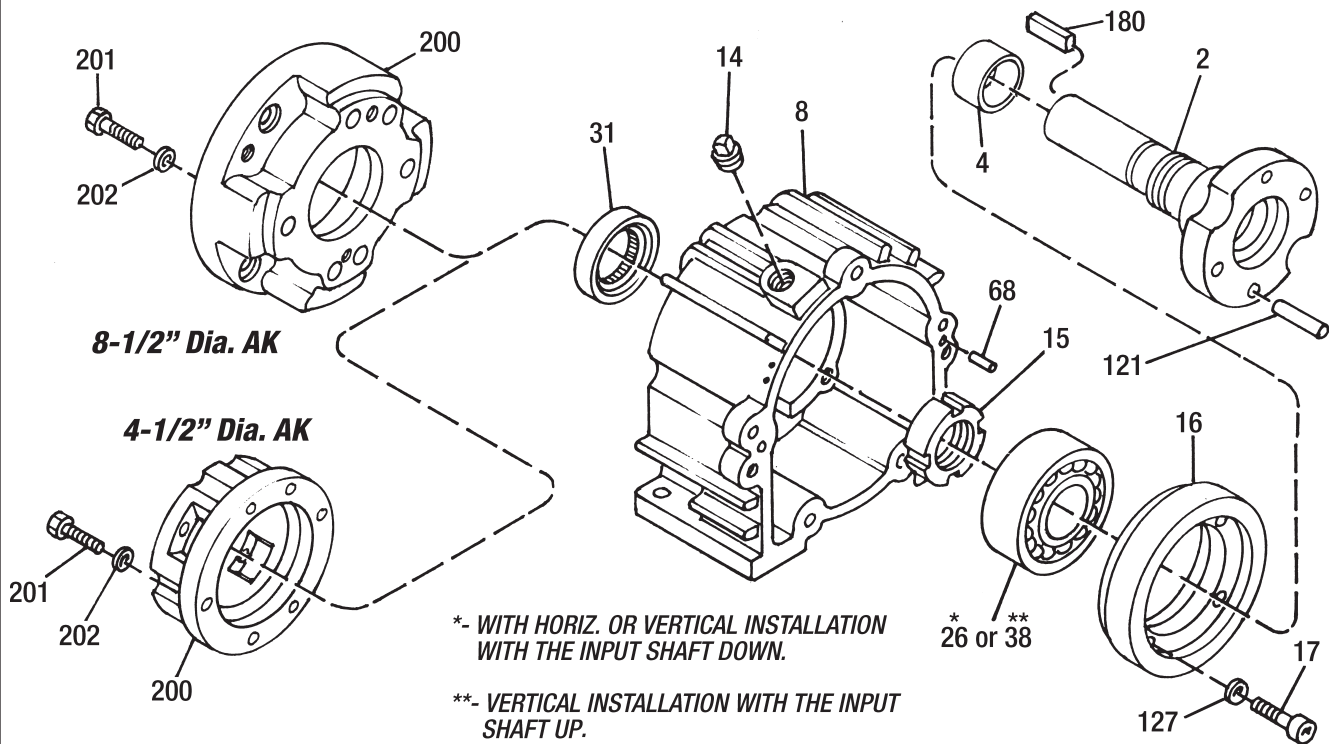


Figure 10.3 - Primary Input Housing

**PRIMARY PISTON HOUSING**  
**SECONDARY PISTON HOUSING**  
(Figure 10.4)

| REF. No. | PART NAME                    | QTY. | REF. No. | PART NAME                     | QTY. |
|----------|------------------------------|------|----------|-------------------------------|------|
| 3        | Piston .....                 | 2    | *43      | Teflon Liner.....             | 2    |
| **5      | Clutch Thrust Plate .....    | 1    | *57      | Gasket (SA Logic only) .....  | 2    |
| 10       | Primary Piston Housing ..... | 1    | 58       | Cap Screw.....                | 6    |
| *27      | Ball Bearing .....           | 2    | 64       | Dowel Pin .....               | 4    |
| *36      | Spring                       |      | 68       | Dowel Pin .....               | 4    |
|          | A Logic.....                 | 8    | 73       | Pipe Plug.....                | 2    |
|          | B Logic.....                 | 18   | 74       | Dowel Pin                     |      |
|          | SA Logic.....                | 48   |          | A Logic .....                 | 8    |
| *39      | O-Ring                       |      |          | B Logic .....                 | 18   |
|          | A and B Logic.....           | 2    | 131      | Pipe Plug.....                | 9    |
|          | SA Logic.....                | 4    | 190      | Secondary Piston Housing..... | 1    |
| *40      | O-Ring.....                  | 2    | 191      | Primary Piston Housing .....  | 1    |
| *42      | Teflon Liner                 |      |          |                               |      |
|          | A and B Logic.....           | 2    |          |                               |      |
|          | SA Logic.....                | 4    |          |                               |      |

\* - Indicates parts in Minor Overhaul Kit.

\*\* - Indicates parts in Major Overhaul Kit. (Includes all parts in Minor Overhaul Kit.)



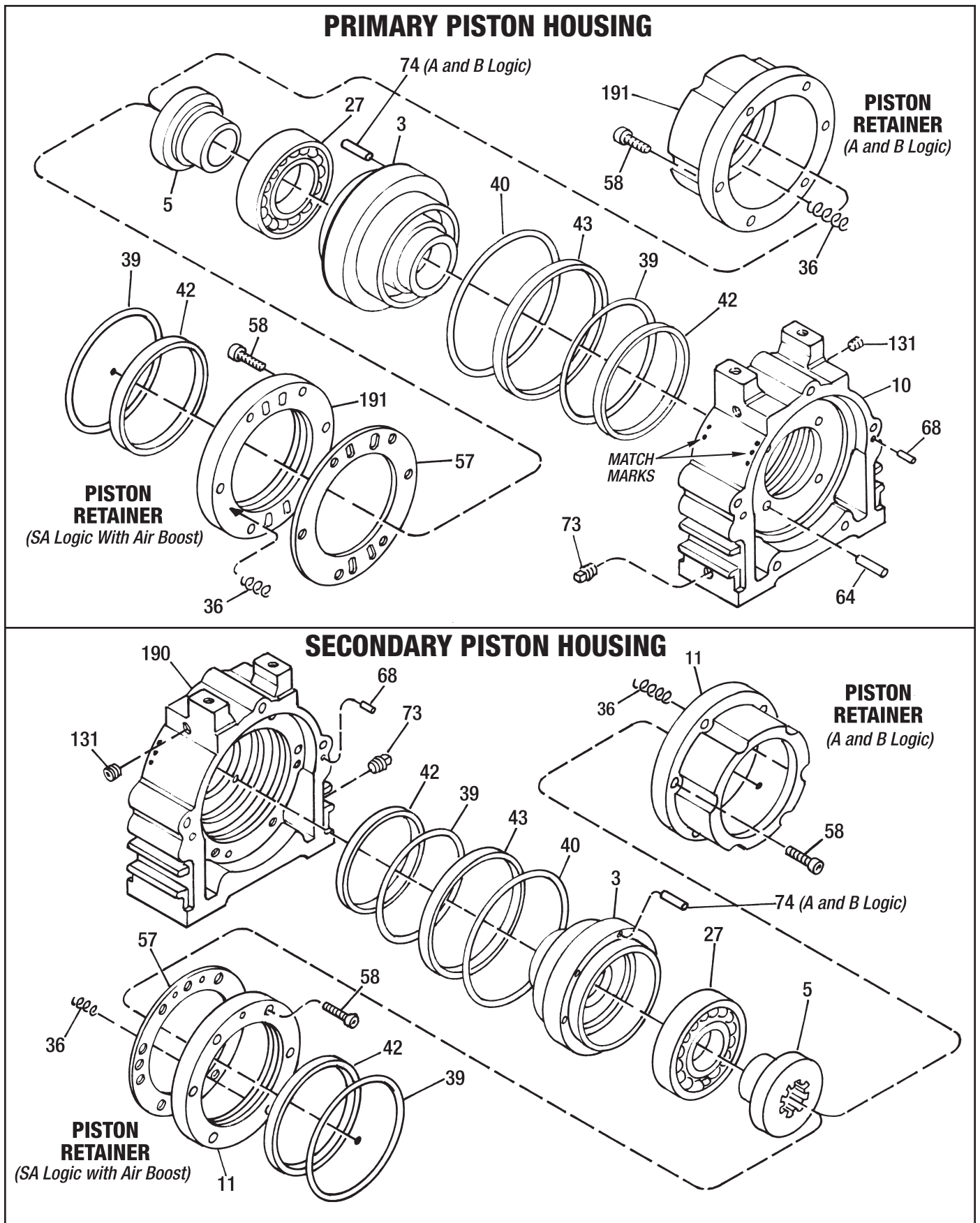


Figure 10.4 - Primary Piston Housing and Secondary Piston Housing

## SECONDARY INPUT HOUSING (FIGURE 10.5)

| REF. No. | PART NAME                        | QTY. | REF. No. | PART NAME                   | QTY. |
|----------|----------------------------------|------|----------|-----------------------------|------|
| 14       | Pipe Plug .....                  | 1    | 165      | Bearing Washer .....        | 1    |
| *35      | Ball Bearing .....               | 1    | 166      | Key .....                   | 1    |
| *41      | Ball Bearing .....               | 1    | *167     | Bearing Cup .....           | 2    |
| 49       | Spacer .....                     | 1    | *168     | Bearing Cone .....          | 2    |
| 68       | Dowel Pin .....                  | 2    | 171      | Bearing Spacer .....        | 1    |
| 84       | Dowel Pin .....                  | 4    | 175      | Lockwasher .....            | 8    |
| 128      | Lockwasher .....                 | 5    | 182      | Key .....                   | 1    |
| 151      | Bearing Retainer .....           | 1    | **189    | Locknut .....               | 1    |
| 153      | Secondary Input Worm Shaft ..... | 1    | 192      | Secondary Input Shaft ..... | 1    |
| 154      | Worm Gear .....                  | 1    | 198      | Cap Screw .....             | 4    |
| 155      | C-Face Flange .....              | 1    | 199      | Cap Screw .....             | 4    |
| 156      | Bearing Retainer .....           | 1    | 202      | Lockwasher .....            | 4    |
| *157     | Ball Bearing .....               | 1    | 226      | Lockwasher .....            | 1    |
| *158     | Oil Seal .....                   | 1    | 263      | Cap Screw .....             | 1    |
| 159      | Cap Screw .....                  | 4    | 264      | Cap Screw .....             | 4    |
| *161     | Gasket .....                     | 2    | 278      | Cap Screw .....             | 5    |
| 163      | Bearing Retainer .....           | 1    | *913     | Shim Gasket .....           | AR   |
| 164      | Secondary Input Housing .....    | 1    | *917     | Shim .....                  | AR   |

\* - Indicates parts in Minor Overhaul Kit.

\*\* - Indicates parts in Major Overhaul Kit. (Includes all parts in Minor Overhaul Kit.)

AR - As Required

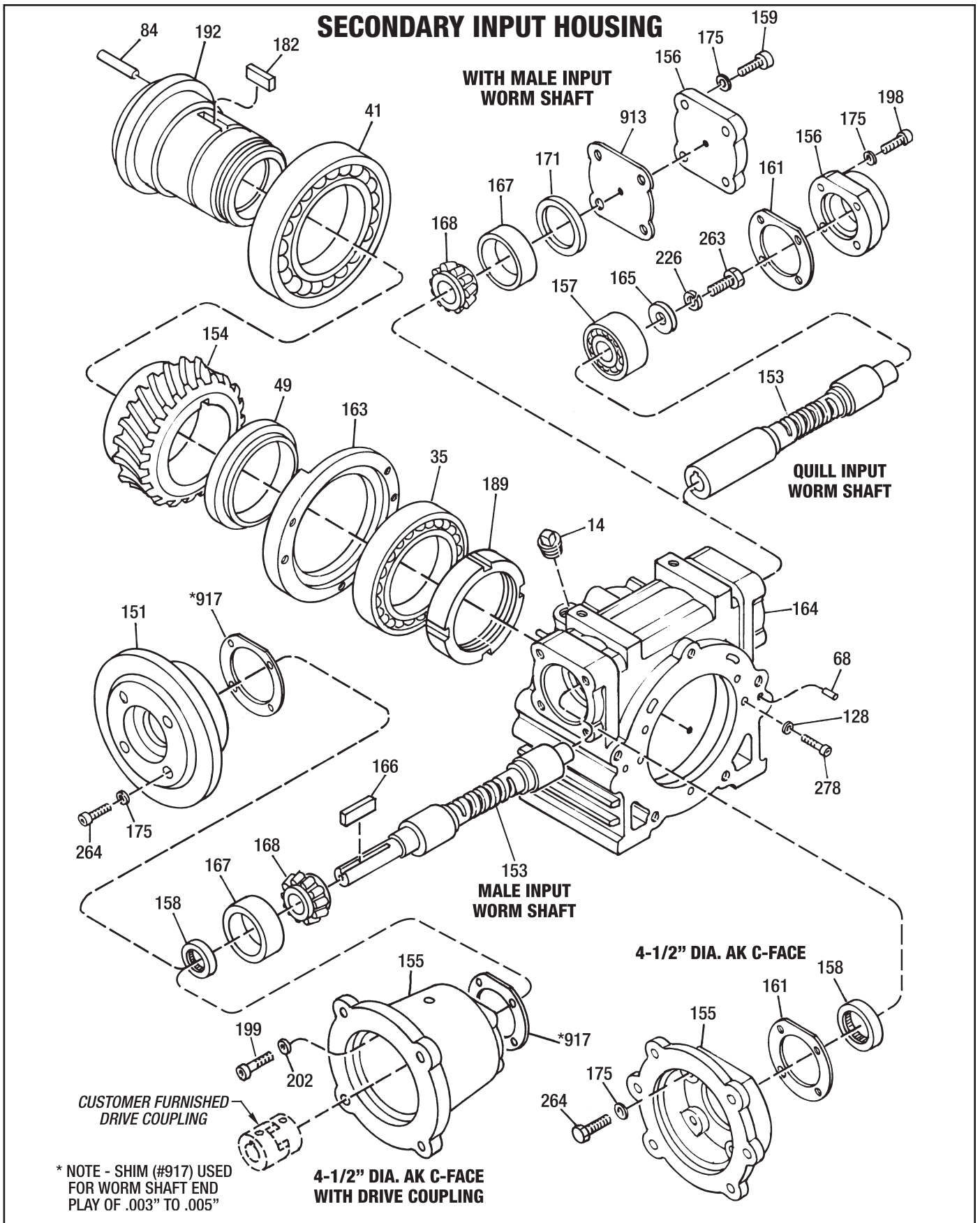


Figure 10.5 - Secondary Input Housing

## OUTPUT HOUSING

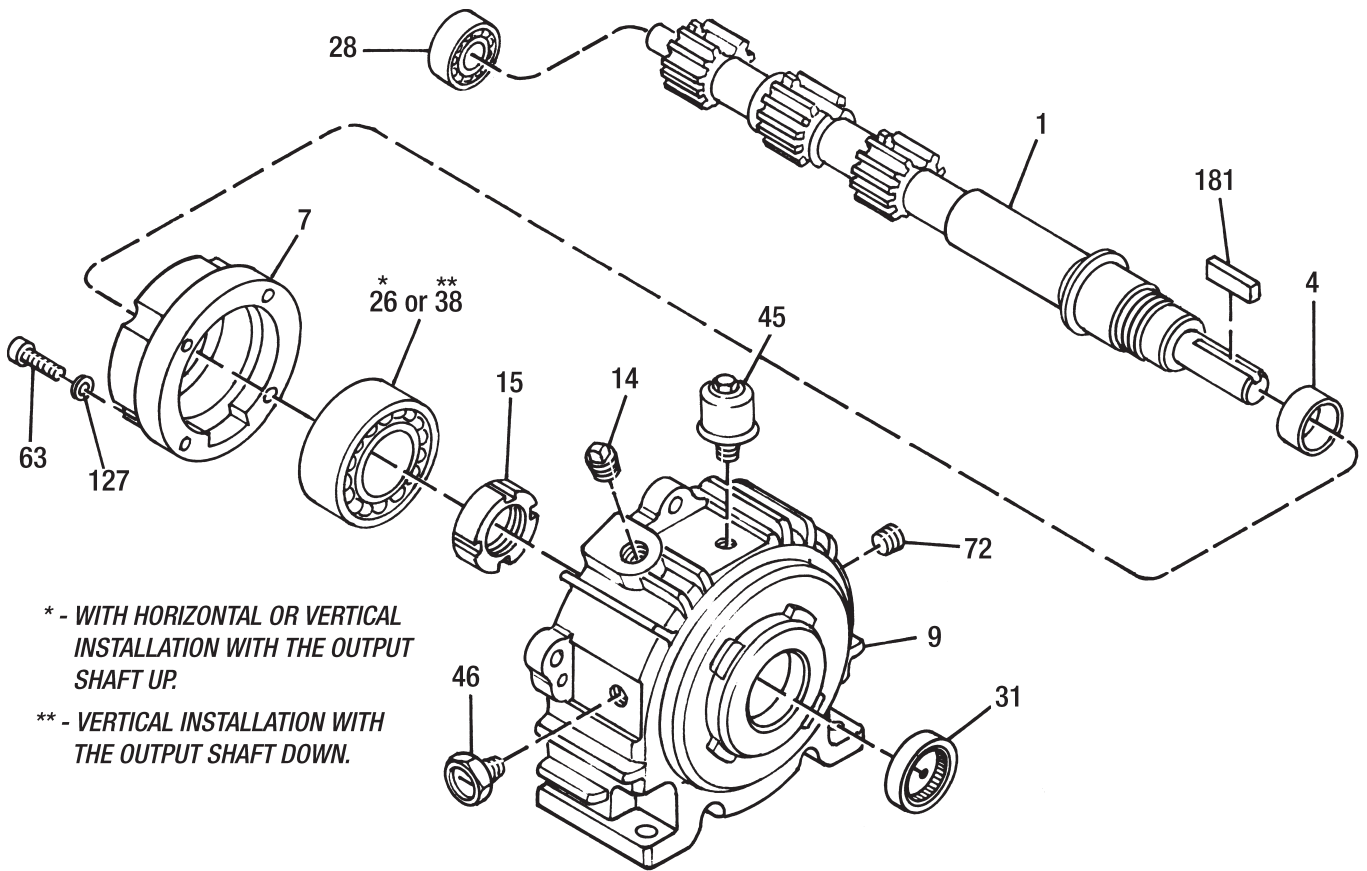
(FIGURE 10.6)

| REF. No. | PART NAME             | QTY. | REF. No. | PART NAME               | QTY. |
|----------|-----------------------|------|----------|-------------------------|------|
| 1        | Output Shaft.....     | 1    | **46     | Oil Sight Gauge .....   | 1    |
| *4       | Wear Sleeve .....     | 1    | 63       | Cap Screw .....         | 4    |
| 7        | Bearing Retainer..... | 1    | 72       | Pipe Plug .....         | 1    |
| 9        | Output Housing.....   | 1    | 127      | Lockwasher.....         | 4    |
| 14       | Pipe Plug .....       | 1    | 181      | Key.....                | 1    |
| **15     | Locknut .....         | 1    | 203      | Mounting Flange.....    | 1    |
| *26      | Ball Bearing .....    | 1    | 204      | Cap Screw .....         | 4    |
| *28      | Ball Bearing .....    | 1    | 205      | Lockwasher.....         | 4    |
| *31      | Oil Seal .....        | 1    | 225      | Lockwasher.....         | 2    |
| *38      | Ball Bearing .....    | 1    | 226      | Hex. Hd. Cap Screw..... | 2    |
| **45     | Breather .....        | 1    |          |                         |      |

\* - Indicates parts in Minor Overhaul Kit.

\*\* - Indicates parts in Major Overhaul Kit. (Includes all parts in Minor Overhaul Kit.)

# OUTPUT HOUSING



## (C-FACE ADAPTER and D-FLANGE ADAPTER)

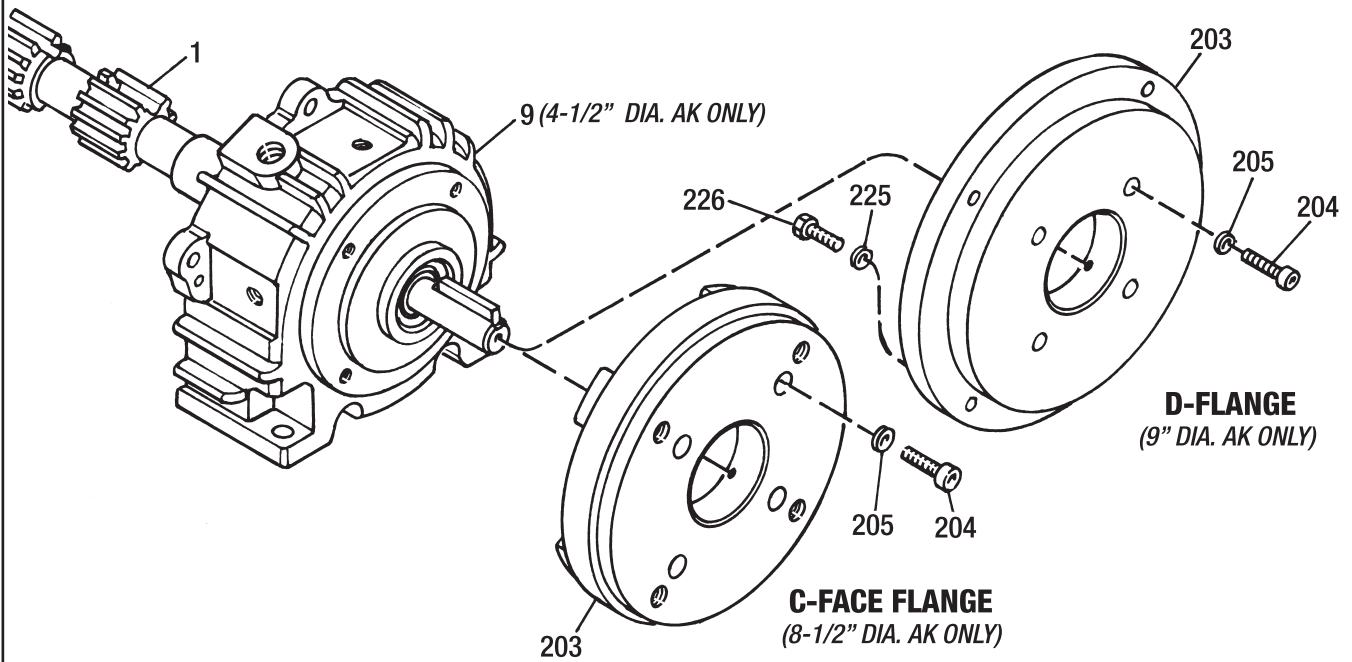


Figure 10.6 - Output Housing

# **FORCE CONTROL INDUSTRIES, INC.**

## ***Worldwide Leader in Oil Shear Technology***

Providing today's industries  
with Oil Shear Clutch and  
Brake Drives that deliver . . .

- Flexibility
- Efficiency
- Endurance
- Performance
- and • Dependability.

---

---

**" Built to Last - Guaranteed to Perform"**

---

---



### **FORCE CONTROL INDUSTRIES, INC.**

3660 Dixie Highway  
Fairfield, Ohio 45014

Tel: (513)868-0900  
Fax: (513)868-2105

E-Mail: [info@forcecontrol.com](mailto:info@forcecontrol.com)  
Web Site: [www.forcecontrol.com](http://www.forcecontrol.com)