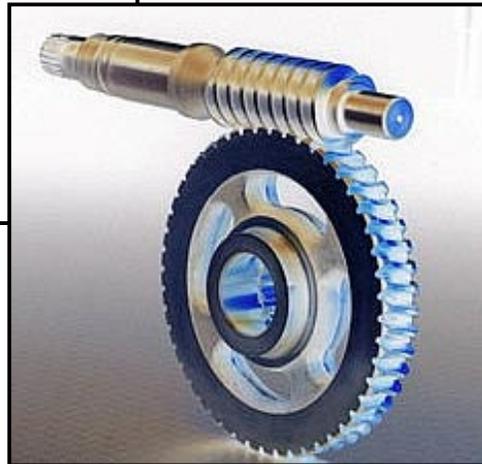
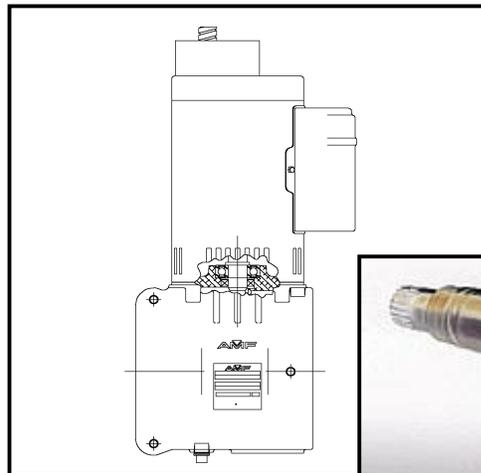




AMF PINSPOTTER **MOTOR AND GEARBOX** **MANUAL**



P/N 400-090-002

Rev. NEW

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DOCUMENT UPDATES

In the interest of continual product and service improvement, AMF reserves the right to revise or update this manual at any time without obligation to notify any person or entity of such revision. The document number and revision date below indicate the edition and printing date of this manual.

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Mechanicsville, Virginia 23111



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400-090-002
Rev. NEW

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CONTENTS

SECTION 1 REPAIR OF THE NEW STYLE FRONT END GEARBOX

1.1	PURPOSE.....	1
1.2	SCOPE.....	1
1.3	PROCEDURES	2
1.3.1	INITIAL SETUP	2
1.3.2	CHANGING THE GEARBOX OIL	3
1.3.3	DETECTING GEARBOX PROBLEMS	4
1.3.4	OIL SEAL REPLACEMENT	5
1.3.4.1	INPUT OIL SEAL.....	5
1.3.4.2	OUTPUT OIL SEAL.....	7
1.3.5	FRONT END GEARBOX DISASSEMBLY.....	8
1.3.6	ASSEMBLING THE FRONT END GEARBOX.....	10
1.3.7	KITS AND ASSEMBLIES	13

PARTS

NEW STYLE FRONT END GEARBOX	15
-----------------------------------	----

SECTION 2 NEW STYLE FRONT END GEARBOX DRIVE MOTOR REPAIR

2.1	PURPOSE.....	16
2.2	SCOPE.....	16
2.3	PROCEDURES	17
2.3.1	REPLACING THE CAPACITOR/RESISTOR ASSEMBLY.....	17
2.3.2	REPLACING THE ROTOR ASSEMBLY.....	18
2.3.3	REPLACING THE THERMAL OVERLOAD DEVICE OR TERMINAL BOARD	19
2.3.4	REPLACING THE SOLID STATE SWITCH	21
2.3.5	REPLACING THE EXTERNAL CONNECTOR ASSEMBLY.....	21
2.3.6	REPLACING THE BRAKE	22
2.3.7	CONFIGURING THE MOTOR FOR 115-VOLT OR 230-VOLT OPERATION.....	23

PARTS

NEW STYLE FRONT END GEARBOX DRIVE MOTOR	25
---	----

SECTION 3 BACK END GEARBOX REPAIR

3.1	PURPOSE.....	26
3.2	SCOPE	26
3.3	PROCEDURES.....	27
3.3.1	INITIAL SETUP.....	27
3.3.2	CHANGING THE GEARBOX OIL	28
3.3.3	DETECTING BACK END GEARBOX PROBLEMS.....	29
3.3.4	OIL SEAL REPLACEMENT	30
3.3.5	BACK END GEARBOX DISASSEMBLY	31
3.3.6	ASSEMBLY OF THE BACK END GEARBOX.....	32
3.3.7	KITS AND ASSEMBLIES.....	33

PARTS

BACK END GEARBOX.....	35
-----------------------	----

SECTION 4 REPAIR OF THE BACK END GEARBOX MOTOR

4.1	PURPOSE.....	36
4.2	SCOPE	36
4.3	PROCEDURES.....	37
4.3.1	REPLACING THE CAPACITOR/RESISTOR ASSEMBLY	37
4.3.2	REPLACING THE ROTOR ASSEMBLY	37
4.3.3	REPLACING THE THERMAL OVERLOAD DEVICE OR TERMINAL BOARD.....	38
4.3.4	REPLACING THE SOLID STATE SWITCH.....	40
4.3.5	CONFIGURING THE MOTOR FOR 115-VOLT OR 230-VOLT OPERATION.....	40

PARTS

BACK END GEARBOX DRIVE MOTOR.....	43
-----------------------------------	----



SECTION 1 REPAIR OF THE NEW STYLE FRONT END GEARBOX

1.1 PURPOSE

This section provides procedures for the repair and maintenance of the pinspotter’s new style front end gearboxes.

1.2 SCOPE

This section contains instructions for performing:

- Initial Setup,
- Periodic Maintenance, and
- Field Repair

of the new style front end gearboxes.

The front end gearbox is a field-serviceable item that is available in two different gear ratios for use with 50 hertz or 60 hertz motors. The procedures for both gearboxes are identical, although the two types have unique worm assemblies. The 50 Hz gearboxes have red nameplate stickers while the 60 Hz gearboxes have black nameplate stickers.

<u>GEARBOX APPLICATION</u>	<u>AMF PART NO.</u>	<u>IDENTIFICATION</u>
50 Hz Front End	090-004-499	Red Name Plate
60 Hz Front End	090-004-500	Black Name Plate

Parts available for gearbox repair are packaged in kits and may be ordered by kit number (see Section 1.3.7). The Gearbox Seal Repair Kit is required for all repairs or any service requiring disassembly and is included with the gear replacement kits. For individual parts, contact AMF for availability.

Special attention must be given to ensure the proper frequency-matched components are used when replacing parts.

1.3 PROCEDURES

1.3.1 INITIAL SETUP

The front end gearboxes are shipped installed on the pinspotter. Before initial operation, it is necessary to verify that the oil level is correct and to replace the solid fill plug with the breather plug and vent extension.

CAUTION! DO NOT OPERATE THE GEARBOX WITH THE SOLID PIPE PLUG INSTALLED IN THE TOP OF THE GEARBOX. DOING SO CAN CAUSE THE GEARBOX TO PRESSURIZE AND LEAK!

Tools Required

1/4-inch Hex Wrench
5/8-inch Wrench
Flashlight

1. Remove the solid pipe plug on top of the gearbox. This was installed for shipping only.
2. Verify that the gearbox oil level is between the top and bottom shelves (see Figure 1). If it is necessary to add oil, add only AMF Gear Lube P/N 715-021-716. Do NOT overfill.
3. Install the vent extension assembly in the threaded opening on top of the gearbox. Tighten securely.
4. Repeat Steps 1 through 3 for the remaining gearboxes.

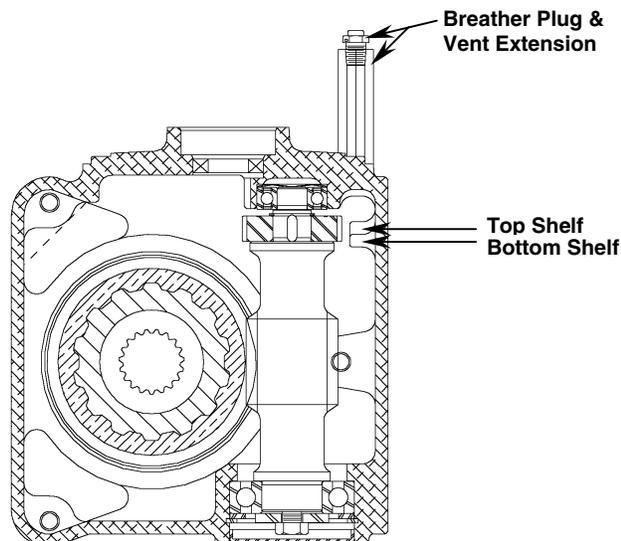


Figure 1, Front End Gearbox Cross Section



1.3.2 CHANGING THE GEARBOX OIL

Replace the gearbox oil following every 2500 hours of pinspotter operation, or every 6 months, whichever occurs first. The amount of oil needed for each front end gearbox is 3.15 pints (1.5 liters). The oil can be drained with the gearbox installed on the pinspotter or removed to a work area. If draining the oil with the gearbox installed in the pinspotter, take adequate precautions to collect the waste oil and prevent it from dripping onto the pinspotter or the lane surface.

Tools Required

3/8-inch Wrench
5/8-inch Wrench
Flashlight

Waste Oil Container
Duct Tape
Funnel

1. Unplug the gearbox motor's electrical connector.
2. Position a funnel between the drip pan and the gearbox drain plug and then insert the small end of the funnel into a waste container.
3. Remove the drain plug from the underside of the gearbox. The oil used in the gearbox is thick and may drain slowly. Removing the vent extension may speed draining. Secure the funnel in place, as needed, while the gearbox is draining. Allow the gearbox to drain completely.
4. Inspect the waste oil for metal filings. Significant quantities indicate excessive gear wear and may warrant further inspection.
5. Clean off and coat the threads of the drain plug with Loctite® #515 Gasket Eliminator.
6. Wipe away any oil from the threads of the drain opening and install the drain plug. Tighten securely. Allow 30 minutes for the thread sealant to cure before filling the gearbox with oil. Failure to do so can result in oil leakage.
7. If not done previously, remove the vent extension.
8. Fill the gearbox with AMF Gear Lube (P/N 715-021-716) to a level between the gearbox's top and bottom shelves (refer to Figure 1).
9. Clean the threads of the vent extension, apply Loctite #515 Gasket Eliminator to the threads, and reinstall the vent extension in the fill opening. Tighten securely.
10. Reconnect the gearbox motor's electrical connector.
11. Dispose of the used oil and any oily rags properly.

CAUTION! OILY RAGS CAN BE A FIRE HAZARD. DISPOSE OF THEM IN AN APPROVED METAL CONTAINER ONLY!



1.3.3 DETECTING GEARBOX PROBLEMS

Inspect the gearboxes at least once every 60 days to identify the need for service or repair. The following symptoms can be detected without any disassembly, and sometimes may indicate the required repair.

➤ **Oil Leakage**

Oil leakage from seals may indicate shaft and/or seal wear. **Whenever replacing a seal, inspect the seal contact area on the shaft for grooving or excessive wear.** Excessive wear can damage the new seal and requires shaft replacement. Leaks from other areas such as threaded fittings may be corrected by the proper use of thread sealant such as Loctite® #515. All threaded connections must be clean and free of oil and grease when they are assembled. Expansion plugs and oil seals that develop leaks must be replaced.

➤ **High Internal Operating Temperature**

The maximum normal operating temperature of a front end gearbox is 50° F (28° C) above ambient temperature. Higher temperatures may be caused by low oil level or internal component failure. As a general rule, higher operating temperatures warrant a more complete examination.

➤ **Shaft End Play and/or Gear Backlash**

Excessive radial or axial gearbox shaft movement (end play) indicates worn bearings, broken retaining rings, incorrect shimming, etc. Excessive backlash (rotational shaft movement without resistance) indicates gear wear.

➤ **Excessive Noise**

A certain amount of noise is inherent in gearbox assemblies and is normal. Excessive noise such as grinding or popping sounds coming from a gearbox indicates internal problems. This unit should be removed from service and repaired.

1.3.4 OIL SEAL REPLACEMENT

The gearbox has two oil seals: one where the motor shaft enters the gearbox, and the other where the output hub exits the gearbox (refer to Figure 2). If either of these seals begins to leak, it must be replaced. Whenever replacing seals, inspect the seal contact area on the shaft for signs of grooving or wear. Excessive wear can damage the new seal and requires shaft replacement. To replace an oil seal, proceed as follows:

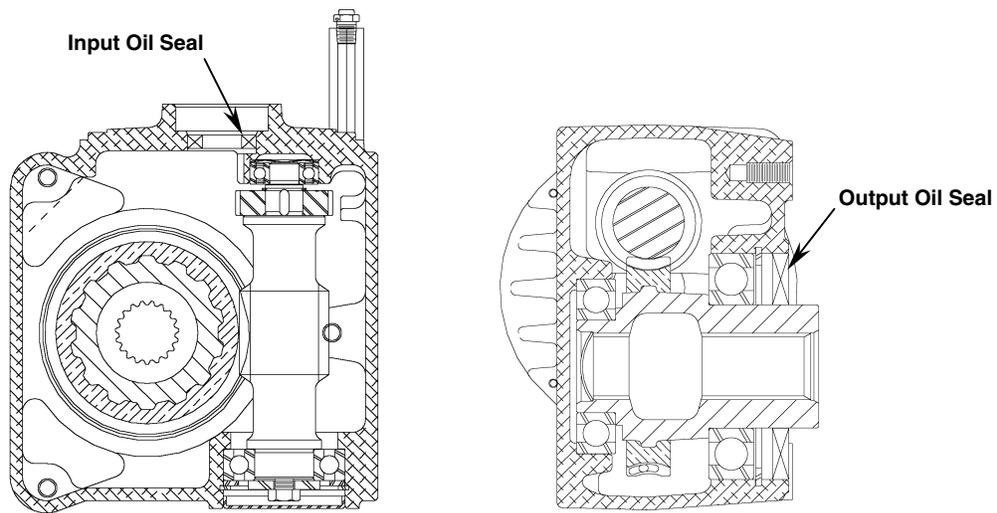


Figure 2, Gearbox Oil Seals

1.3.4.1 INPUT OIL SEAL (UPPER SEAL) REPLACEMENT

Tools Required

Torque Wrench (calibrated in in-lbs.)
1/4-inch Socket

Pliers
Mallet

This repair can either be performed in place, or the gearbox and motor assembly can be removed to the workbench.

CAUTION! SUPPORT THE TABLE OR LOWER THE SWEEP TO THE GUARD POSITION BEFORE REMOVING THE ASSOCIATED GEARBOX!

1. Unplug the gearbox motor's electrical connector.
2. Remove the four long thru-bolts that hold the motor and gearbox together.
3. After removing these bolts, the motor frame should come free of the gearbox. The rotor will either remain with the motor or with the gearbox. Remove the rotor. Save the wave spring (see Figure 3) on the top rotor bearing.

4. Remove the input oil seal. Be careful not to damage the sealing surface on the gearbox housing.
5. Clean any residue from the sealing surfaces on the rotor shaft and the housing bore. **Do not allow any foreign material to fall into the gearbox.**

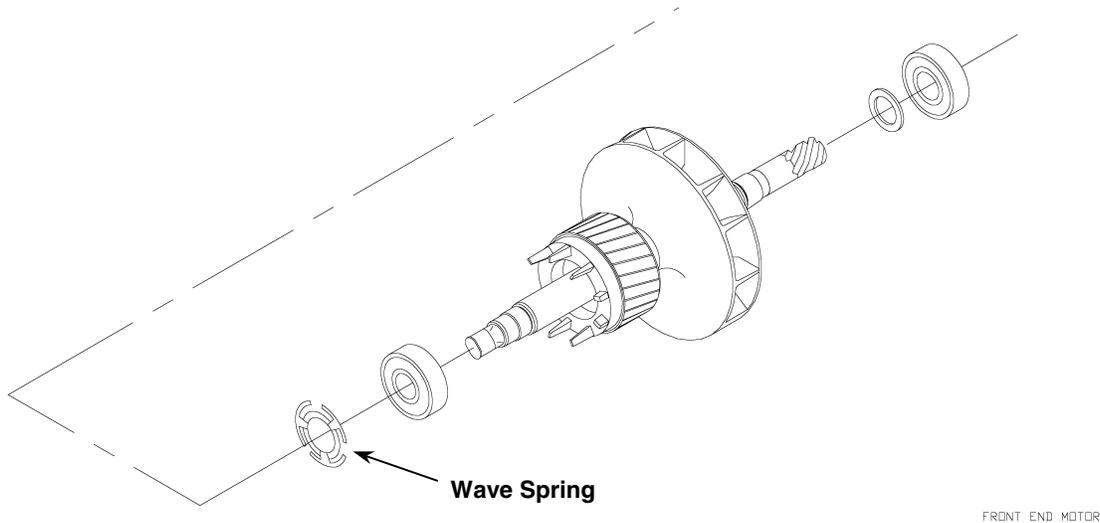


Figure 3, Rotor Assembly

6. Apply Permatex to the housing bore for the input oil seal. Do NOT apply it to the bearing bore surface.
7. Apply a small amount of grease to the seal lips and install the seal slightly below (.06 to .09 inches) the inner edge of the bearing recess so that the rotor bearing does not rub against the seal.
8. Insert the rotor shaft through the oil seal. The rotor's lower bearing fits into a recess in the gearbox housing. The gear teeth on the end of the rotor's shaft must mesh with the gearing inside the gearbox in order for everything to seat properly. Applying a rotating motion to the rotor can facilitate assembly. Be careful not to damage or dislodge the oil seal.
9. Place the wave spring on the rotor's upper bearing, and install the motor's frame over the rotor. Ensure that the wave spring and upper rotor bearing are fully inserted into the recess in the top endplate of the motor. It may be necessary to remove the brake cover and rotate the inner ring of the brake assembly (Figure 9, item 3) so that it aligns with the rotor shaft.
10. Orient the motor's capacitor so that it extends out over the front of the gearbox, and install the four long thru-bolts. Tighten the bolts incrementally in an alternating pattern to a maximum of 20 in-lbs. to prevent the rotor from binding.
11. Reconnect the motor's power cable.



1.3.4.2 OUTPUT OIL SEAL REPLACEMENT

Tools Required

5/8-inch Wrench	Medium Flat-Blade Screwdriver
9/16-inch Wrench	Flashlight
3/8-inch Wrench	Mallet

Refer to Figure 8 for component identification.

1. Unplug the gearbox motor's electrical connector.

CAUTION! SUPPORT THE TABLE OR LOWER THE SWEEP TO THE GUARD POSITION BEFORE REMOVING THE ASSOCIATED GEARBOX!

2. Unbolt the three screws that attach the gearbox to the pinspotter frame and slide the gearbox/motor assembly off the splined drive shaft.
3. Remove the drain plug and drain the oil from the gearbox. Dispose of the oil properly. Do NOT reuse the oil.
4. Puncture the output oil seal with a screwdriver, and pry off the seal. Be careful not to damage the sealing surface of the gearbox housing or any internal components.
5. Clean the sealing surfaces of the housing bore and output hub. Do NOT allow any foreign material to enter the gearbox or output hub bearing.
6. Apply Permatex to the outer circumference of the new oil seal. During installation, do NOT get any on the hub or the bearing.
7. Apply a small amount of grease to the new seal's lips and carefully slide the seal over the output hub. Seat the seal flush with the outer edge of the gearbox housing.
8. Place Loctite #515 on the threads of the drain plug, install it and tighten securely. Allow 30 minutes for the sealant to cure before adding oil to the gearbox.
9. Remove the vent extension from the top of the gearbox housing.
10. On a level surface, fill the gearbox with approximately 3.15 pints (1.5L) of AMF Gear Lube (715-021-716) to a level between the top and bottom shelves (refer to Figure 1).
11. Place Loctite #515 on the threads of the vent extension and install the extension in the fill opening.
12. Coat the splined section of the pinspotter's drive shaft with an antiseize compound such as SAF-T-EZE, and install the gearbox assembly on the pinspotter. Secure the housing to the pinspotter frame with the screws that were removed in Step 2. Do NOT overtighten.
13. Reconnect the motor's power cable.

1.3.5 FRONT END GEARBOX DISASSEMBLY

There are two replaceable oil seals: the input oil seal, which is located where the motor shaft enters the gearbox; and the output oil seal, which surrounds the gearbox's splined output hub (See Figure 4). Both seals must be removed in order to disassemble the gearbox.

There are two expansion plugs, one internal and one external. Only the external expansion plug is serviceable in the field. It must be removed as part of gearbox disassembly. Additionally, there is a worm assembly, a worm gear, bearings, shims, washers, spacers, and retainers that can be accessed and serviced using this disassembly procedure. The worm and worm gear assemblies must be replaced in sets rather than individually. Replacing the oil seals is covered in the previous section. Replacing just the external expansion plug requires draining the oil, but no disassembly of the gearbox.

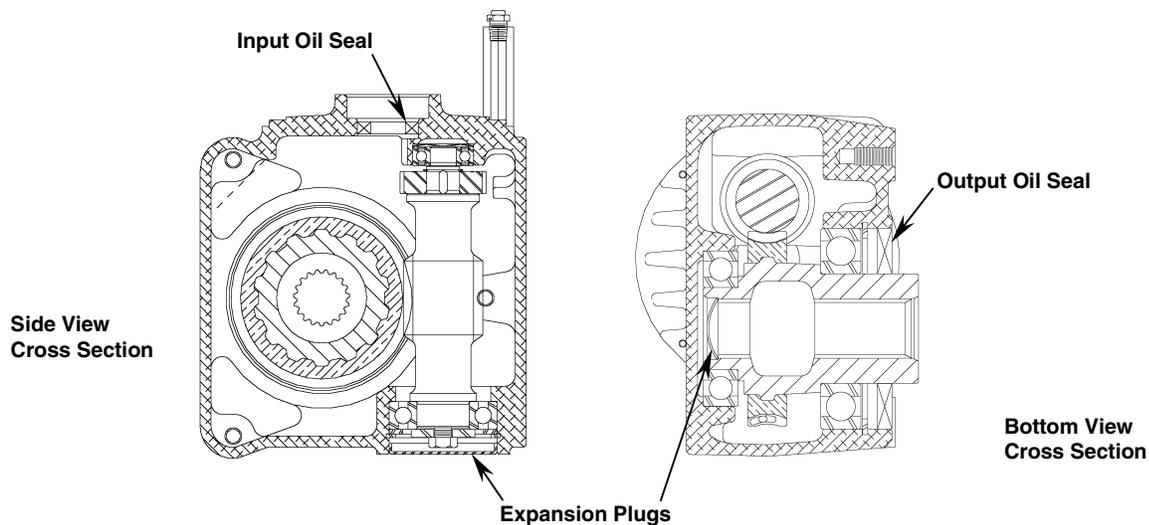


Figure 4, Oil Seals and Expansion Plugs

Tools Required

Medium Flat-Blade Screwdriver
#6 Retaining Ring Pliers
9/16-inch Wrench

3/8-inch Wrench
1/4-inch Wrench

Refer to Figure 8 for component identification.

1. Disconnect the motor's power plug.

CAUTION! SUPPORT THE TABLE OR LOWER THE SWEEP TO THE GUARD POSITION BEFORE REMOVING THE ASSOCIATED GEARBOX!

2. Unbolt the three screws that attach the gearbox to the pinspotter frame and slide the gearbox/motor assembly off the splined drive shaft.
3. Remove the drain plug and drain the oil from the gearbox. Dispose of properly. Do NOT reuse the oil.



4. Remove the motor's four long thru-bolts. After removing these bolts, the motor frame should come free of the gearbox. The rotor will either remain with the motor or with the gearbox. Remove the rotor. Save the wave spring on the top rotor bearing.
5. Remove the input oil seal. Whenever a seal is removed it must be replaced with a new one.
6. Remove the external expansion plug. The plug can be punctured and then pried off. Be careful not to damage the plug's mating surface on the gearbox housing.
7. Remove the retaining ring (item 2) that was exposed by the removal of the expansion plug, and then remove the worm assembly (item 4 or 5). Rotating the output hub can help force the worm assembly out of the housing. Note the locations and sizes of any shims and spacers at both ends of the worm assembly, and save these parts for reuse. Save the wave spring (item 8) in the housing at the worm assembly's small (inner) bearing.
8. Remove the output oil seal (item 19).
9. Remove the retaining ring (item 18), and then remove the spacer and shims. Note the size and location of shims and spacers.
10. Remove the worm gear and output hub assembly (item 14) and interior shim (item 13).
11. Inspect the gear for excessive wear. Inspect bearings for rough spots. If a gear or bearing is bad, replace the entire gear assembly. Whenever either the worm assembly or worm gear needs to be replaced, both assemblies must be replaced. Different gear ratios are used in 50-hertz and 60-hertz gearboxes. Ensure that the correct replacement parts are used.
12. Clean the inside of the gearbox housing with an approved solvent. Remove any oil or sealant residue from bearing and seal-seating surfaces.

1.3.6 ASSEMBLING THE FRONT END GEARBOX

NOTE: Use the same amount and placement of shims during assembly that was removed during disassembly unless the gear assemblies or bearings have been changed.

Tools Required

Torque Wrench (calibrated in in-lbs.)	1/4-inch Socket
#6 Retaining Ring Pliers	Flashlight
5/8-inch Wrench	Calipers
9/16-inch Wrench	Mallet
3/8-inch Wrench	

Refer to the Figure 8 for component identification.

1. **If reusing the existing components**, reinstall the interior shim (item 13) and large worm gear/hub assembly (item 14) in the gearbox housing. Install the shims, spacer, and the retaining ring (items 15-18) in the order in which they were removed.

2. **If replacing the worm gear assembly**,

a. Use .005-inch shims (included) to obtain a .957 to .962-inch measurement between the gear face and the outside surface of the shim (see Figure 5). Push the bearing toward the gear when making this measurement. Install these components in the housing.

b. Determine the proper shimming to obtain an output hub endplay of .000 to .003 inches. To make this determination, press inward on the bearing's outer ring (evenly so as not to cock the bearing) and **measure the gap** between the ring and the outside edge of the retaining ring groove. Use a sufficient quantity of .003-inch and .005-inch shims, the .030-inch spacer (item 17), and the retaining ring (item 18), to obtain a thickness of .000 to .003 inches **less than** the gap measurement. Always install the .030-inch spacer (item 17) next to the retaining ring. Secure everything in place with the retaining ring.

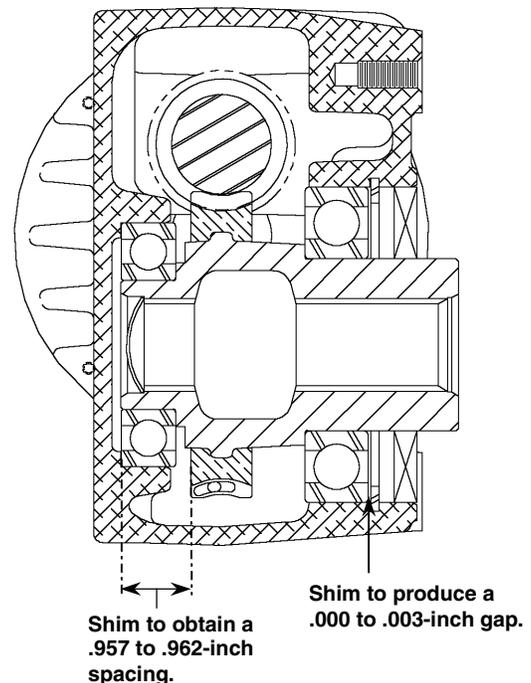


Figure 5, Shim Points

When correctly shimmed, the centerline of the worm gear will align with the centerline of the worm (after its installation). This will promote good tooth contact and even wear.

3. Install the wave spring (8) in the housing bore at the smaller worm bearing recess. Apply a small amount of Nyogel[®] damping grease in the recess.

4. **If reusing existing components**, reinstall the worm assembly. Reinstall the shims, spacer, and retaining ring in the order in which they were removed.

5. If replacing the worm assembly,

- a. **Measure the gap** between the shoulder of the larger worm bearing housing bore and the outside edge of the retaining ring groove (see Figure 6).
- b. Select an estimated quantity of .003-inch and .005-inch shims that when added to the thickness of the large worm bearing, spacer (item 3), and retaining ring (item 2) results in a measurement that is .001 inches to .003 inches **greater than** the gap measurement. This is necessary to ensure that the outer bearing race is clamped tightly between the shoulder of the housing bore and the retaining ring. Push the worm assembly inward to flatten the wave spring, and install the remaining components. Always install the spacer next to the retaining ring.

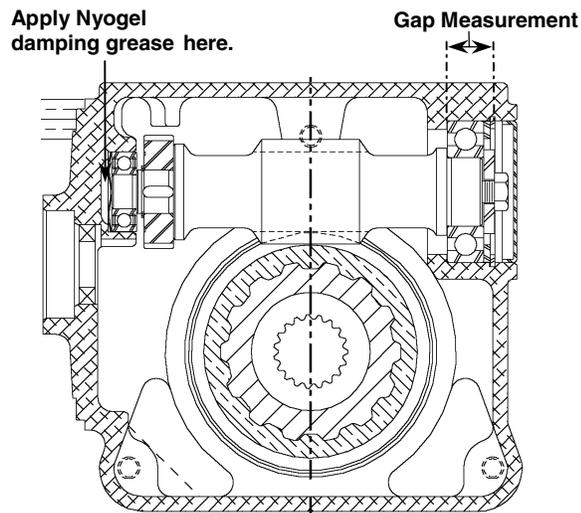


Figure 6, Worm Installation

6. Apply Loctite[®] #515 Gasket Eliminator to the housing bore for the expansion plug and install the expansion plug (item 1). The plug can be seated using a special tool for this purpose (not supplied) or a nonmetallic mallet. Metal tools will damage the housing and the plug. Tap gently around the perimeter of the plug until it is fully seated. Allow 30 minutes for the sealant to cure before filling the gearbox with oil.
7. Apply Permatex to the outer circumference of the new output oil seal. During installation, do NOT get any on the hub or the bearing.
8. Apply a small amount of grease to the new seal's lips and carefully slide the seal over the output hub. Seat the seal flush with the outer edge of the gearbox housing.
9. Apply Permatex to the housing bore for the input oil seal. Do NOT apply it to the bearing bore surface.
10. Apply a small amount of grease to the seal lips and install the seal slightly below (.06 to .09 inches) the inner edge of the bearing recess so that the motor bearing does not rub against the seal.

11. Clean the rotor's shaft below the bearing and insert the rotor shaft through the oil seal. The rotor's lower bearing fits into a recess in the gearbox housing. The shaft's gear teeth must mesh with the gearing inside the gearbox in order for everything to seat properly. Applying a rotating motion to the rotor can facilitate assembly. Be careful not to damage or dislodge the oil seal.
12. Place the wave spring on the rotor's upper bearing, and install the motor's frame over the rotor. Ensure that the wave spring and upper rotor bearing are fully inserted into the recess in the top endplate of the motor. It may be necessary to remove the brake cover and rotate the inner ring of the brake assembly (Figure 9, item 3) so that it aligns with the rotor shaft.
13. Orient the motor's capacitor so that it extends out over the front of the gearbox (see Figure 7), and install the four long thru-bolts. Tighten the bolts incrementally in an alternating pattern to a maximum of 20 in-lbs. to prevent the rotor from binding.
14. Apply Loctite #515 Gasket Eliminator to the drain plug's threads, and reinstall the plug in the drain opening. Torque securely. Allow 30 minutes for the sealant to cure before filling the gearbox with oil.
15. Remove the vent extension, and on a level surface, fill the gearbox with approximately 3.15 pints of AMF Gear Lube (715-021-716) to a point between the top and bottom shelves (refer to Figure 1).
16. Apply Loctite #515 Gasket Eliminator to the threads of the vent extension tube and reinstall the tube in the fill opening.
17. Coat the pinspotter's drive shaft splines with an antiseize compound such as SAF-T-EZE, and reinstall the gearbox and motor assembly on the pinspotter.
18. Reconnect the motor's power cable.

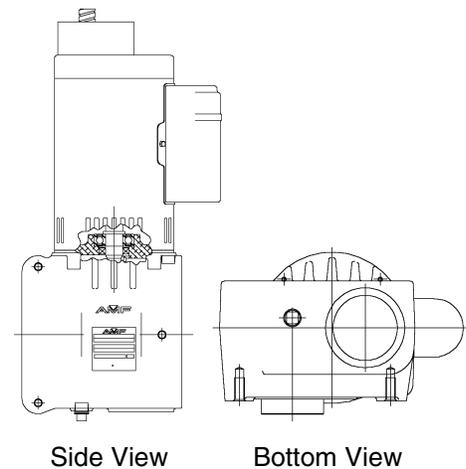


Figure 7, Capacitor Orientation



1.3.7 KITS AND ASSEMBLIES

It is recommended that the worm assembly and worm gear assembly be replaced in sets. This recommendation is based on maximizing the life of the gear teeth.

Refer to Figure 8 for parts identification.

Parts available for gearbox repair are packaged in kits and may be ordered by kit number. The **Gearbox Seal Repair Kit** is required for all seal repairs or for any repair requiring gearbox disassembly. This kit is available separately by ordering the part number shown below, and is included as part of the gear repair kits.

Front End Gear Replacement Kits There are separate kits for the 50-hertz and 60-hertz gearboxes. Each kit consists of a worm/helical gear assembly (Items 4 or 5), the worm gear and output hub assembly (with shims) (Items 13 & 14), damping grease, and a seal repair kit.

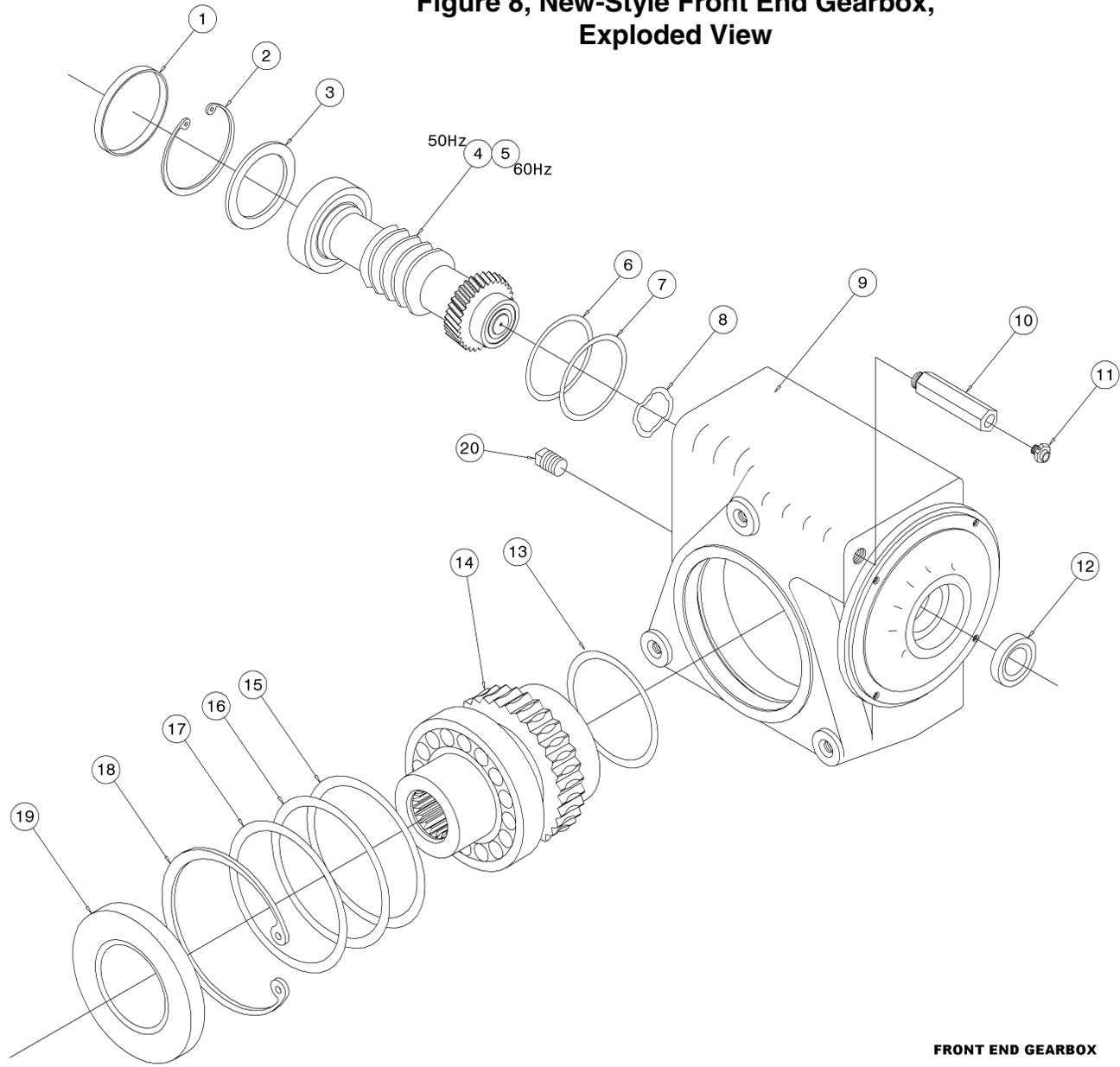
The frequency rating of the kit, the gearbox, and the motor must match the electrical power being supplied to your bowling center for proper pinspotter operation.

- **50-Hz Front End Gearbox Gear Replacement Kit - Part #610-900-061**
 - **60-Hz Front End Gearbox Gear Replacement Kit - Part #610-900-062**
- } Includes Gearbox Seal Repair Kit

Front End Gearbox Seal Repair Kit This kit is for the replacement of gearbox seals that may wear out over time. It consists of an **input oil seal** (item 12), an **output oil seal** (item 19), an external **expansion plug** (item 1), **shims** (items 6, 7, 15, 16, & 17), **retaining rings** (items 2 & 18), and the appropriate **Loctite®** and/or **Permatex®** sealing compounds.

- **Front End Gearbox Seal Repair Kit - Part #785-503-103**

**Figure 8, New-Style Front End Gearbox,
Exploded View**



FRONT END GEARBOX



PARTS LIST

NEW STYLE FRONT END GEARBOX

<u>ITEM #</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY</u>
1	*	EXPANSION PLUG	1
2	*	RETAINING RING	1
3	Ref. Only	SPACER	1
4	§	WORM/HELICAL GEAR ASSEMBLY, 50 HERTZ	1
5	‡	WORM/HELICAL GEAR ASSEMBLY, 60 HERTZ	1
6	*	SHIM, 2-1/8 x 2-7/16 x .003	1
7	*	SHIM, 2-1/8 x 2-7/16 x .005	2
8	*	WAVE SPRING	1
9	Ref. Only	GEARBOX HOUSING	1
10	Ref. Only	VENT EXTENSION	1
11	730-063-088	BREATHER PLUG	1
12	*	SEAL, INPUT SHAFT	1
13	§‡	SHIM, 2-7/8 x 3-5/16 x .005	2
14	§‡	WORM GEAR ASSEMBLY (50Hz & 60 Hz)	1
15	*	SHIM, 2-3/4 x 4-5/16 x .003	2
16	*	SHIM, 2-3/4 x 4-5/16 x .005	2
17	*	SHIM, 2-3/4 x 4-5/16 x .030	1
18	*	RETAINING RING	1
19	*	SEAL, OUTPUT SHAFT	1
20	Ref. Only	PIPE PLUG, 1/4 NPT	1
N/A	610-900-061	GEAR REPLACEMENT KIT, 50Hz	1
N/A	610-900-062	GEAR REPLACEMENT KIT, 60Hz	1
N/A	785-503-103 ^{§‡}	GEARBOX SEAL REPAIR KIT, 50/60 HZ	1

TABLE 1

Ref. Only items are for component identification and are not carried in stock.

* included in Kit 785-503-103

§ included in Kit 610-900-061

‡ included in Kit 610-900-062



SECTION 2 NEW STYLE FRONT END GEARBOX DRIVE MOTOR REPAIR

2.1 PURPOSE

This section describes the procedures for the repair and maintenance of the pinspotter's new style front end gearbox drive motor. This section contains parts lists, drawings, and repair information for these motors.

2.2 SCOPE

The front end motors are field-serviceable items. The motors are dual voltage and are provided in 50 Hz and 60 Hz configurations rated for continuous service. Both models are rated at 1/3 horsepower; however, starting current and instantaneous torque may be 200-300% higher. The AMF part numbers for the different motors are as follows:

<u>APPLICATION</u>	<u>AMF PART NO. (does not include gearbox)</u>
50 Hz Front End	090-004-060 (w/o brake), 090-003-853 (w/brake)
60 Hz Front End	090-004-061 (w/o brake), 090-003-852 (w/brake)

The table and sweep drives use identical new style gearmotor assemblies (090-003-516 for 50 Hz machines and 090-003-517 for 60 Hz machines) consisting of a new style gearbox and an integral new style drive motor. The front end motors have a brake as well as provisions for manual cranking. The new style front end motors are different than the back end motors, and are NOT interchangeable. Also, while the entire front end motor/gearbox assembly is interchangeable with the older motor/gearbox assemblies, neither the motor nor the gearbox is individually interchangeable with the older models.

An exploded view of the new style front end motor is shown in Figure 9 on Page 24. Parts are identified in Table 2 on Page 25.

The following repairs are described in the sections that follow. All other repairs are not considered feasible under field conditions without special tools, and are not covered in this manual.

- Replacing the Capacitor/Resistor Assembly
- Replacing the Rotor Assembly
- Replacing the Thermal Overload Device
- Replacing the Solid State Switch
- Replacing the Terminal Board
- Replacing the External Connector Assembly
- Replacing the Brake
- Configuring the Motor for 115-Volt or 230-Volt Operation

Motor repair parts should be ordered by the part numbers listed in Table 2. Further breakdown of subassemblies is not recommended.



2.3 PROCEDURES

Front end motor repair is relatively simple. The motor is a “partial motor” and is constructed so that the gearbox housing is an integral part of the motor assembly. Separate the two, and the motor comes apart. **NEVER attempt to operate the motor when it has been removed from the gearbox housing!**

Refer to Figure 9 for component identification.

2.3.1 REPLACING THE CAPACITOR/RESISTOR ASSEMBLY

Tools Required

Flat-Blade Screwdriver
Needle Nose Pliers

1. Disconnect the motor’s power cable.
2. Remove the two screws (item 10) from the capacitor cover (item 9) and the lift off the cover.
3. Remove the capacitor/resistor assembly (item 11) from inside the cover.
4. Remove the leads from the capacitor/resistor assembly’s slide-on terminals. Do NOT pull on the wires.
5. Slide the leads onto the terminals of the new capacitor/resistor assembly.
6. Place the new capacitor/resistor assembly into the cover making sure that it is properly seated in the cover; otherwise, the cover will not mount correctly.
7. Reinstall the capacitor cover on the motor frame using the two screws that were removed earlier.
8. Reconnect the motor’s power cable.



2.3.2 REPLACING THE ROTOR ASSEMBLY

Tools Required

Torque Wrench (calibrated in in-lbs.)
1/4-inch Socket

1. Disconnect the motor's power cable.
2. Remove the four long thru-bolts (Item 5) that hold the motor and gearbox together.
3. After removing the thru-bolts, the motor frame should come free of the gearbox. The rotor (items 22 & 23) will either remain with the motor or with the gearbox. Remove the rotor and the wave spring (item 21) at the top rotor bearing.
4. Insert the new rotor's shaft through the oil seal. The rotor's lower bearing fits into a recess in the gearbox housing. The shaft's pinion gear teeth must mesh with the gearing inside the gearbox in order for everything to seat properly. Applying a rotating motion to the rotor can facilitate assembly. Be careful not to damage or dislodge the oil seal.
5. Place the wave spring on the rotor's upper bearing, and install the motor's frame over the rotor. Ensure that the wave spring and upper rotor bearing are fully inserted into the recess in the top endplate of the motor. It may be necessary to remove the brake cover and rotate the inner ring of the brake assembly (Figure 9, item 3) so that it aligns with the rotor shaft.
6. Orient the motor's capacitor so that it extends out over the front of the gearbox, and install the four long thru-bolts that were removed earlier. Tighten the bolts incrementally in an alternating pattern to a maximum of 20 in-lbs. to prevent the rotor from binding.
7. Reconnect the motor's power cable.



2.3.3 REPLACING THE THERMAL OVERLOAD DEVICE OR TERMINAL BOARD

WARNING!

EXERCISE CARE WHEN RESETTING A THERMAL OVERLOAD DEVICE. THE MOTOR CAN START WITHOUT WARNING PRESENTING A POTENTIALLY HAZARDOUS CONDITION.

The thermal overload device protects the motor from a number of faults that can cause the motor's temperature to increase above its designed operating limit. If the device trips, it can be reset by pressing the red reset button on the motor's endplate. If it trips again, check for binding in the gearbox and linkages. If it trips without any apparent cause (manual cranking shows no sticking or binding) or will not reset after an appropriate cool down period, the device must be replaced. Faulty motor windings can also cause the device to trip. If this is the case, replace the motor.

The terminal board accommodates terminations for the motor's various internal wires, and contains no active devices. It should fail only if excessive force is used to remove or reconnect the leads.

Tools Required

Torque Wrench (calibrated in in-lbs.)
1/4-inch Socket
Needle Nose Pliers
Flat-Blade Screwdriver

Soldering Pencil
Rosin Core (nonacid) Solder
Pencil
Mallet

1. Disconnect the motor's power cable.
2. Make an orientation mark on the motor's upper endplate and on the adjacent surface of the motor frame. This will help in achieving proper alignment during reassembly.
3. Remove the four long thru-bolts (Item 5) that hold the motor and gearbox together.
4. After removing the thru-bolts, the motor frame should come free of the gearbox. The rotor will either remain with the motor or with the gearbox. Remove the rotor and the wave spring (item 21) at the top rotor bearing.
5. Loosen the motor's endplate by tapping on it with a mallet, and then pull it away from the motor frame. This allows access to the thermal overload device's retaining screws.
6. **To replace the thermal overload device,**
 - a. Unsolder the wires on the three terminals of the thermal overload device (item 6).
 - b. Remove the two mounting screws (item 7) and then remove the overload device.
 - c. Mount the new thermal overload device using the two screws that were removed in the previous step.



- d. Solder the three wires to the terminals of the new device. The brown wire, to terminal 1; the purple wire, to terminal 2; and the yellow wire, to terminal 3.
7. **To replace the terminal board,**
- a. Remove the two screws (Item 12) that secure the terminal board (item 13) to the endplate.
 - b. Note the color and location of all the leads on the different terminals on both sides of the terminal board. Remove each lead without pulling on the wire and attach it to the new terminal board at the same location. Discard the old board.
 - c. Secure the new terminal board to the endplate using the screws that were removed in step 7a.
8. Align the orientation marks on the endplate and frame and tap the endplate into place. Be careful not to pinch any of the wiring during assembly.
9. Insert the rotor's shaft through the oil seal. The rotor's lower bearing fits into a recess in the gearbox housing. The shaft's pinion gear teeth must mesh with the gearing inside the gearbox in order for everything to seat properly. Applying a rotating motion to the rotor can facilitate assembly. Be careful not to damage or dislodge the oil seal.
10. Place the wave spring on the rotor's upper bearing, and install the motor's frame over the rotor. Ensure that the wave spring and upper rotor bearing are fully inserted into the recess in the top endplate of the motor. It may be necessary to remove the brake cover and rotate the inner ring of the brake assembly (Figure 9, item 3) so that it aligns with the rotor shaft.
11. Orient the motor's capacitor so that it extends out over the front of the gearbox, and install the four long thru-bolts that were removed earlier. Tighten the bolts incrementally in an alternating pattern to a maximum of 20 in-lbs. to prevent the rotor from binding.
12. Reconnect the motor's power cable.



2.3.4 REPLACING THE SOLID STATE SWITCH

The motor contains a switch that removes the capacitor and starting winding from the electrical circuit when the motor reaches a predetermined speed. The capacitor provides additional starting torque, but must be removed from the circuit for proper motor operation. The switch can be replaced without removing and completely disassembling the motor.

Tools Required

Flat-Blade Screwdriver
Needle Nose Pliers

1. Disconnect the motor's power cable.
2. Remove the electrical cover plate attachment screws (item 4) and remove the cover plate assembly (Item 18) from the top of the motor.
3. Remove the switch mounting screw (Item 17) and the start switch (Item 15 or 16).
4. Remove the three leads from the switch's slide-on terminals. Discard the old switch.
5. Connect the leads to the new switch. The gray lead, to terminal 1; the red lead, to terminal 2; and the pink lead, to terminal 3.
6. Position the switch in the endplate, and secure it with the mounting screw. Ensure that the leads do not interfere with the rotating parts of the motor.
7. Replace the electrical cover plate assembly and secure it using the three screws that were removed in Step 2.
8. Reconnect the motor's power cable.

2.3.5 REPLACING THE EXTERNAL CONNECTOR ASSEMBLY

The electrical cover plate assembly (Item 18) can be replaced as a complete unit (preferred), or as a partial replacement consisting of the connector and wire assembly (Item 19).

Tools Required

Flat-Blade Screwdriver	Wire Cutters
Needle Nose Pliers	Wiring labels
Electrical Tape	Paper & Pencil
Gray (Small) Wire Nuts	

1. Disconnect the motor's power cable.
2. Remove the electrical cover plate assembly (Item 18) from the top of the motor.
3. Record how the wiring is connected. If necessary, mark the wires using tape, wire labels, etc.



4. Undo any wire nuts, and cut any crimped leads at the crimp. Disconnect the ground lead from the motor, and remove the remaining connector leads from the terminal board.
5. If only the connector (item 19) is being replaced, remove the four mounting screws (item 20), replace the old connector with a new one, and secure it with the screws.
6. Connect the wires of the new connector assembly to the corresponding motor wires. Use gray wire nuts for the leads that were originally crimped, and tape the wire and wire nut combination with electrical tape. Connect the other leads to the terminal board exactly as before.
7. Connect the ground lead to the motor.
8. Push the extra lead lengths back into the conduit cavity, and reinstall the electrical cover plate assembly. Secure it with the three screws that were removed in Step 2
9. Reconnect the motor's power cable.

2.3.6 REPLACING THE BRAKE

The brake is an independent auxiliary device that should require little or no service other than cleaning. If the brake fails, it should be replaced.

Tools Required

#1 Phillips Screwdriver
Needle Nose Pliers

1. To remove the brake (item 3), remove the retaining plate (Item 2) and lift out the cylindrical brake assembly.
2. Drop a new brake assembly, pin end up, into the brake housing and over the motor shaft. Rotate the brake until the slots in the side of the brake align with the pins in the bottom of the brake housing, and push the brake downward until it bottoms out. When correctly seated, the top surface of the brake should be approximately 3/4 inch below the top surface of the brake housing.
3. Reinstall the retaining plate.



2.3.7 CONFIGURING THE MOTOR FOR 115-VOLT OR 230-VOLT OPERATION

Front end motors are shipped from the factory wired for 230-volt operation. (There is a sticker on the motor indicating the voltage for which the motor is wired.) Some bowling centers run their pinspotters on 115-volt circuits. It is relatively easy to reconfigure the motors for 115-volt operation. Simply wire the motor for low voltage (115V) as shown below. Refer to the wiring diagram on the motor.

Tools Required

Small Flat-Blade Screwdriver
Needle Nose Pliers

1. Disconnect the motor’s power cable.
2. Remove the electrical cover plate (item 18) from the top endplate of the motor.
3. Rewire the motor’s terminal board according to the applicable voltage category as follows:

HIGH VOLTAGE (230V)

<u>Terminal</u>	<u>Color</u>
L1	
3	Blue
4	
5	Violet
L2	

LOW VOLTAGE (115V)

<u>Terminal</u>	<u>Color</u>
L1	
3	Violet
4	
5	
L2	Blue

The change to 115-volt operation consists of moving the BLUE wire from terminal 3 to L2 and the VIOLET wire from terminal 5 to terminal 3.

4. Reinstall the electrical cover plate.
5. After wiring for 115-volt operation, remove the “Motor Connected 230 Volts” sticker from the motor.
6. Reconnect the motor’s power cable.

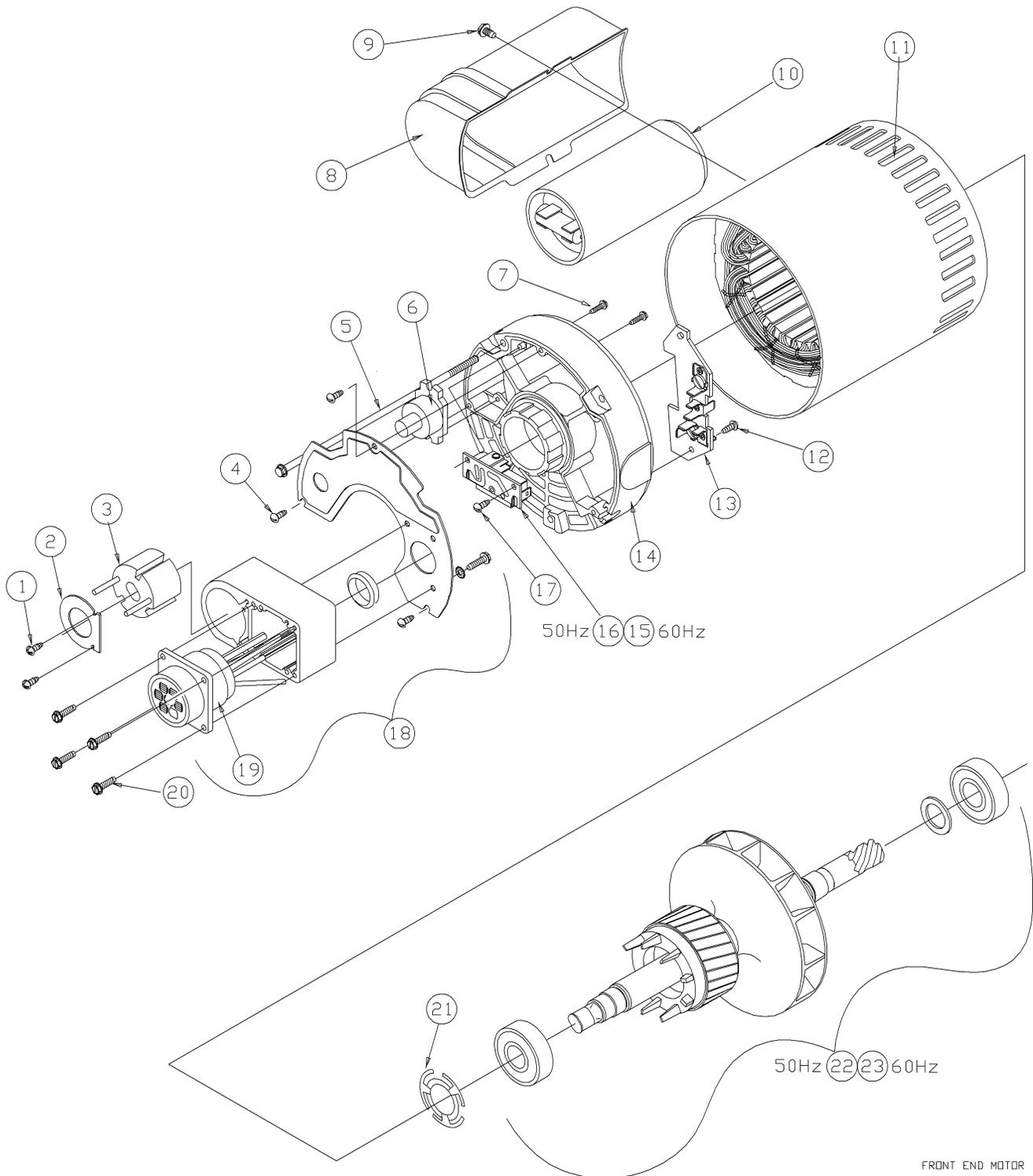


Figure 9, Front End Gearbox Motor - Exploded View



PARTS LIST

NEW STYLE FRONT END GEARBOX DRIVE MOTOR

<u>ITEM #</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY</u>
1	822-626-042	SCREW, #6 X 1/4, SELF-TAPPING	2
2	Ref. Only	RETAINING PLATE	1
3	090-004-516	DRAG BRAKE	1
4	Ref. Only	SCREW, TRUSS, 10-32 X 3/8, HEX WASHER HEAD	3
5	Ref. Only	THRU-BOLT	4
6	090-003-630	THERMAL OVERLOAD (MANUAL RESET)	1
7	Ref. Only	SCREW, ROUND HEAD, SELF-TAPPING	2
8	Ref. Only	CAPACITOR COVER	1
9	Ref. Only	SCREW, TRUSS, 10-32 X 5/16, HEX, WASHER HEAD	2
10	090-003-634	CAPACITOR/RESISTOR ASSEMBLY	1
11	Ref. Only	MOTOR FRAME	1
12	Ref. Only	SCREW, 10-32 X 3/8, ROUND HEAD, SELF-TAPPING	2
13	090-003-629	TERMINAL BOARD ASSEMBLY	1
14	Ref. Only	END PLATE	1
15	090-004-560	START SWITCH, 60 HZ	1
16	090-004-550	START SWITCH, 50 HZ	1
17	Ref. Only	SCREW, 10-32 X 3/8, ROUND HEAD, SELF-TAPPING	2
18	090-004-524	MOTOR RECEPTACLE ASSEMBLY	1
19	755-050-773	RECEPTACLE PLUG, 7-PIN WITH WIRES	1
20	Ref. Only	SCREW, 6-32 X 1/2	4
21	*	WAVE SPRING	1
22	090-004-578	ROTOR ASSEMBLY (50 HZ)	1
23	090-004-579	ROTOR ASSEMBLY (60 HZ)	1

TABLE #2

Ref. Only items are for component identification and are not carried in stock.

* included with items 22 & 23 (rotor assemblies)



SECTION 3 BACK END GEARBOX REPAIR

3.1 PURPOSE

This section describes the procedures for the repair and maintenance of the pinspotter's back end gearbox, including parts lists, drawings, and repair kit information.

3.2 SCOPE

The back end gearbox is a field-serviceable item that comes in two different gear ratios for 50-hertz and 60-hertz applications. It is also made in left hand and right hand versions for each gear ratio for a total of 4 different models. The repair procedures for all models are identical, but when replacing gears, special attention must be given to ensure the proper gear ratios are installed.

A back end gearbox is shown in an exploded view in Figure 10 on Page 34. The corresponding parts are identified in Table 3 on Page 35. The 50-hertz gearboxes can be identified by red nameplate stickers, while the 60-hertz gearboxes have black nameplate stickers. The frequency rating is indicated on the stickers.

APPLICATION

AMF PART NO.

60 Hz, Back End, Right Hand	090-004-501
60 Hz, Back End, Left Hand	090-004-502
50 Hz, Back End, Right Hand	090-004-506
50 Hz, Back End, Left Hand	090-004-507

Parts available for gearbox repair are packaged in kits and can be ordered by kit number. **The back end gearbox packing kit is required for all back end gearbox repair or any service requiring disassembly.** For individual parts, contact AMF for availability.



3.3 PROCEDURES

3.3.1 INITIAL SETUP

Back end gearboxes are shipped installed on the pinspotter. Before initial operation, it is necessary to verify that the oil level is correct and replace the solid fill plug with a vented plug.

Replace the oil (1.8 quarts [1.7 liters]) in the gearbox following every 2500 hours of pinspotter operation, or every 6 months, whichever occurs first.

Refer to Figure 10 for component identification.

CAUTION! DO NOT OPERATE THE GEARBOX WITH THE SOLID PIPE PLUG INSTALLED ON THE TOP OF THE GEARBOX. DOING SO CAN CAUSE THE GEARBOX TO PRESSURIZE AND LEAK!

1. Remove the solid pipe plug from the top of the gearbox. This was installed for shipping only.
2. Remove the oil level plug (item 30) in the side of the gearbox near the top and verify that the oil level is at the fill opening. Add AMF Gear Lube, P/N 715-021-716, if necessary.
3. Coat the threads of the oil level plug with Loctite® # 515 Gasket Eliminator and reinstall the plug in the side of the gearbox.
4. Coat the threads of the breather plug assembly (items 3 & 4) with Loctite® # 515 Gasket Eliminator and install the assembly in the threaded opening on the top of the gearbox.



3.3.2 CHANGING THE GEARBOX OIL

Replace the gearbox oil following every 2500 hours of pinspotter operation, or every 6 months, whichever occurs first. The amount of oil needed for each back end gearbox is 1.8 quarts (1.7 liters). When draining the oil from the gearbox, take adequate precautions to collect the waste oil and prevent it from dripping onto the work area.

Tools Required

1/4-inch Hex Wrench	Waste Oil Container
9/16-inch Wrench	Duct Tape
5/8-inch Wrench	Funnel

1. Unplug the gearbox motor's electrical connector.
2. Disconnect the distributor drive shaft and remove the belts from the gearbox pulleys.
3. Unbolt the gearbox (four bolts) from the mounting plate and remove the gearbox from the machine.
4. Position a funnel below the gearbox drain plug and then place the small end of the funnel into a waste container.
5. Remove the drain plug from the gearbox. The oil used in the gearbox is thick and may drain slowly. Removing the breather plug may speed draining. Secure the funnel in place, as needed, while the gearbox is draining. Allow the gearbox to drain completely.
6. Inspect the waste oil for metal filings. Significant quantities indicate excessive gear wear and may warrant further inspection.
7. Clean off and coat the threads of the drain plug with Loctite® #515 Gasket Eliminator.
8. Wipe away any oil from the threads of the drain opening and install the drain plug. Tighten to 10 - 12 ft-lbs. Allow 30 minutes for the thread sealant to cure before filling the gearbox with oil. Failure to do so can result in oil leakage.
9. Fill the gearbox with 1.8 quarts (1.7 liters) of AMF Gear Lube (P/N 715-021-716).
10. Clean off and coat the threads of the breather plug with Loctite® #515 Gasket Eliminator, and reinstall the plug in the fill opening. Tighten securely.
11. Reinstall the gearbox in the pinspotter. Install the drive belts and distributor drive shaft, and reconnect the gearbox motor's electrical connector.
12. Dispose of the used oil and any oily rags properly.

CAUTION! OILY RAGS CAN BE A FIRE HAZARD. DISPOSE OF THEM IN AN APPROVED METAL CONTAINER ONLY!



3.3.3 DETECTING BACK END GEARBOX PROBLEMS

Inspect the gearboxes at least once every 60 days to identify the need for service or repair. The following symptoms can be detected without any disassembly, and sometimes may indicate the required repair.

➤ **Oil Leakage**

The gearbox's input (motor-end) flange contains a groove that acts as a telltale drain to indicate input seal leakage. Oil leakage from seals may indicate shaft and/or seal wear. **Whenever replacing a seal, inspect the seal contact area on the shaft for grooving or excessive wear.** Excessive wear can damage the new seal and requires shaft replacement. Leaks from any other areas, such as case covers, plugs, etc., may be corrected by replacing o-rings and through the proper use of thread sealant such as Loctite[®]. All threads must be clean and free of oil and grease when they are reassembled.

➤ **High Internal Operating Temperature**

The maximum normal operating temperature of a back end gearbox is 50 °F (28 °C) above ambient. Higher temperatures may be caused by low oil level or internal component failure. As a general rule, higher operating temperatures warrant a complete examination.

➤ **Shaft End Play and/or Gear Backlash**

Excessive radial or axial gearbox shaft movement (end play) indicates worn bearings, broken retaining rings, incorrect shimming, etc. Excessive backlash (rotational shaft movement without resistance) indicates gear wear.

➤ **Excessive Noise**

A certain amount of noise is inherent in gearbox assemblies and is normal. Excessive noise such as grinding or popping sounds coming from a gearbox indicates internal problems. This unit should be removed from service and repaired.



3.3.4 OIL SEAL REPLACEMENT

Prior to removing an oil seal, drain the oil from the gearbox in accordance with Section 3.3.2, Steps 1-6. Following seal replacement, fill the gearbox in accordance with Section 3.3.2, Steps 7-12. Refer to Figure 10 for component identification.

1. **To remove the distributor shaft seal** (item 12), remove the cap screws (Item 10) from the distributor drive port cap (Item 27), and remove the cap, the o-ring (item 26), and the shims (items 28 & 29). Remove and discard the oil seal.
2. **To remove the carpet shaft seal** (also Item 12), remove the cap screws (Item 10) from the carpet drive port cap (Item 11), and remove the cap, the o-ring (item 7), and the shims (items 8 & 9). Remove and discard the oil seal.
3. **To remove the input shaft oil seal,**
 - a. Remove the expansion plug (item 18).
 - b. Remove the bolt (item 17) and washer (item 16) from the worm assembly shaft.
 - c. Remove the worm assembly (item 1 or 2) and oil seal (item 32) through the housing's seal opening. Rotating the carpet drive and/or worm shafts can help force the worm assembly out of the housing. Remove and discard the oil seal.
4. **To install a new input shaft oil seal** (item 32),
 - a. Clean the shaft and seal-seating areas.
 - b. Reinstall the worm assembly in the gearbox housing. Rotating the carpet drive and/or worm shafts can facilitate reassembly.
 - c. Apply blue Loctite[®] to the bolt threads, and install the washer and bolt in the end of the worm assembly. Continue to rotate the carpet drive shaft to seat the worm shaft against the bearing, and tighten the bolt to 120 in.-lbs.
 - d. Apply Permatex[®] sealant on the outer circumference of the new expansion plug, and install the plug in the housing opening at the bolt end of the worm assembly. Ensure that the housing bore is clean and free of any leftover sealant.
 - e. Apply lubricant to the shaft and the inner seal lip and apply Permatex[®] to the outside circumference of the seal. Slide the oil seal onto the shaft and gently tap it into place just below (.08 in.) the outer edge of the seal bore.
5. **To replace either the distributor drive shaft oil seal or the carpet drive shaft oil seal,**
 - a. Clean the shaft and seal-seating areas.
 - b. Reinstall the shims, the o-ring, and the port cap. Apply a light coating of grease to the o-ring before installation.
 - c. Apply Loctite[®] to the cap screws and torque them to 50 in.-lbs.
 - d. Apply lubricant to the shaft and the inner seal lip and apply Permatex[®] to the outside circumference of the seal. Slide the oil seal onto the shaft and gently tap it into place flush with the outside surface of the port cap.



6. **To replace the pin elevator drive shaft oil seal** (item 19),
 - a. Clean the shaft and seal-seating areas.
 - b. Apply lubricant to the shaft and the inner seal lip and apply Permatex[®] to the outside circumference of the seal. Slide the oil seal onto the shaft and gently tap it into place flush with the outside surface of the gearbox housing.

3.3.5 BACK END GEARBOX DISASSEMBLY

Remove components as described. This procedure does not cover the removal of gears or bearings from shafts.

1. Remove the motor and gearbox assembly from the machine and separate the gearbox from the motor.
2. Remove the pulleys, distributor drive housing, and keys from the drive shafts. Save these parts for reuse.
3. Remove the breather plug (Item 3) and the lower pipe plug (drain plug, Item 30). Drain the oil from the gearbox and discard properly. Do NOT reuse the oil.
4. Remove the pin elevator shaft oil seal (item 19).
5. Remove the retaining ring (item 20) and shim (item 21), if one is present.
6. Remove the pin elevator drive shaft assembly (item 22). Note the shim (item 21) between the interior bearing and gearbox housing.
7. Remove the distributor drive support cap (item 27), the o-ring (item 26), and the shim(s) (items 28 & 29).
8. Remove the distributor drive shaft assembly (item 25) from the gearbox.
9. Remove the expansion plug (Item 18), and remove the bolt (Item 17) and washer (Item 16) from the end of the worm shaft.
10. Remove the worm assembly (item 1 or 2) and input oil seal (item 32) through the housing's seal opening. Rotating the carpet drive and/or worm shafts can help in removing the worm assembly.
11. Remove the retaining ring (Item 15) and bearing (Item 14) from the gearbox housing. Note the shim (item 13) between the bearing and the housing.
12. Remove the carpet drive port cap (Item 11). Remove and save the o-ring (item 7) and shim(s) (items 8 & 9). Remove the carpet drive shaft (item 5 or 6) through the opening.



3.3.6 ASSEMBLY OF THE BACK END GEARBOX

1. Degrease and clean all serviceable components selected for reuse. Use new components as determined by analysis and visual observation. Replace all seals and shims.
2. Install the shim (Item 13) and the bearing (Item 14) inside the gearbox housing. Secure the bearing using the retaining ring (Item 15) ensuring that there is no end play in the bearing.
3. Install the distributor drive shaft assembly (Item 25). Coat the o-ring (item 26) with a small amount of grease and install it on the end cap (item 27). Add shims (Items 28 & 29) between the cap and housing to eliminate end play. Apply Loctite[®] to the threads of the cap screws (item 10), and torque them to 50 in.-lbs.
4. Install the pin elevator drive shaft assembly (Item 22). Shim (Item 21) in front of the first bearing to adjust the bevel gear engagement depth by moving the pin elevator shaft output gear away from the mating gear. The backlash between the two gears should be .002" to .005". Shim (Item 21) between the second bearing and the retaining ring (item 20) to take up the rest of the shaft end play. The gear pair should rotate freely with minimal shaft end play. Secure in place with the retaining ring.
5. Install the carpet drive shaft assembly (item 5 or 6). Coat the o-ring (item 7) with a small amount of grease and install it on the end cap (item 11). Add shims (items 8 & 9) between the cap and the housing to eliminate end play. Apply Loctite[®] to the threads of the cap screws (item 10), and torque them to 50 in.-lbs.
6. Insert the worm assembly (Item 1 or 2) into the housing. Rotating the worm and/or carpet drive shafts can facilitate assembly.
7. Apply blue Loctite[®] to the bolt threads and install the washer (item 16) and bolt (item 17) in the end of the worm assembly. Continue to rotate the carpet drive shaft to seat the worm shaft against the bearing, and tighten the bolt to 120 in.-lbs.
8. Apply Permatex[®] sealant to the outside circumference of the expansion plug (Item 18) and install the plug in the gearbox housing opening at the end of the worm. Ensure that the bore in the housing is clean and free of any leftover sealant.
9. Apply Permatex[®] sealant to the outside circumference of the new oil seals, and install the seals with the lip of each seal facing inward. Recess the input oil seal .08 inches.
10. Clean and coat the threads of the drain plug (item 30) with Loctite[®] thread sealant, and reinstall in the housing. Tighten to 10 - 12 ft.-lbs. Allow 30 minutes for the thread sealant to cure before filling the gearbox with oil. Failure to do so can result in leakage.
11. Fill the gearbox with 1.8 quarts (1.7 liters) of AMF Gear Lube (Part No. 715-021-716). Do not overfill the gearbox.
12. Clean and coat the threads of the breather plug (item 3) with Loctite[®] thread sealant and reinstall the plug in the housing.



13. Coat the end of the motor shaft with an antiseize compound such as SAF-T-EZE, and attach the gearbox to the drive motor using a new key (Item 31). Apply Loctite® to the screws and torque them to 120 in.-lbs.
14. Reinstall the distributor drive housing and drive pulleys that were removed earlier.
15. Reinstall the motor/gearbox assembly in the pinspotter.

3.3.7 KITS AND ASSEMBLIES

It is recommended that the worm assembly and worm gear assembly be replaced in sets. This recommendation is based on maximizing the life of the mating teeth.

Refer to Figure 10 for component identification.

Some gearbox components have been grouped into replaceable subassemblies that are available as kits, as listed below.

The Gear Drive Packing Kit is required for all repairs or any service requiring disassembly. Individual parts in this kit are generally not available.

Distributor Drive Replacement Kit Part #610-900-100 - Consists of a distributor drive shaft assembly (item 25).

Back End Worm Gear Replacement Kit - Different kits for 50-hertz and 60-hertz gearboxes. The kit consists of a worm assembly (Item 1 or 2) and a carpet drive shaft assembly (Item 5 or 6).

The frequency rating of the kit, the gearbox, and the motor, must match the electrical power being supplied to your bowling center for proper pinspotter operation.

- **50 Hz kit - Part #610-900-085**
- **60 Hz kit - Part #610-900-090**

Pin Elevator Wheel Drive Replacement Kit Part #610-900-105 - Consists of a pin elevator wheel drive shaft assembly (item 22).

Back End Gear Drive Packaging Kit Part #610-900-051 - includes disposable maintenance items (Items 7, 8, 9, 12, 13, 14, 15, 16, 18, 19, 20, 21, 26, 28, 29, 31, and 32). Also included is Loctite® 242 Sealant, Seal Grease NLG1 Class 0 or 1, and Permatex® Gasket Sealant – Aviation Form-A-Gasket #2.

BACK END GEARBOX - EXPLODED VIEW AMF 82-90XL PINSPOTTER

The back end gearbox comes in left-hand and right-hand versions that are mirror images of each other. The left-hand version is shown below.

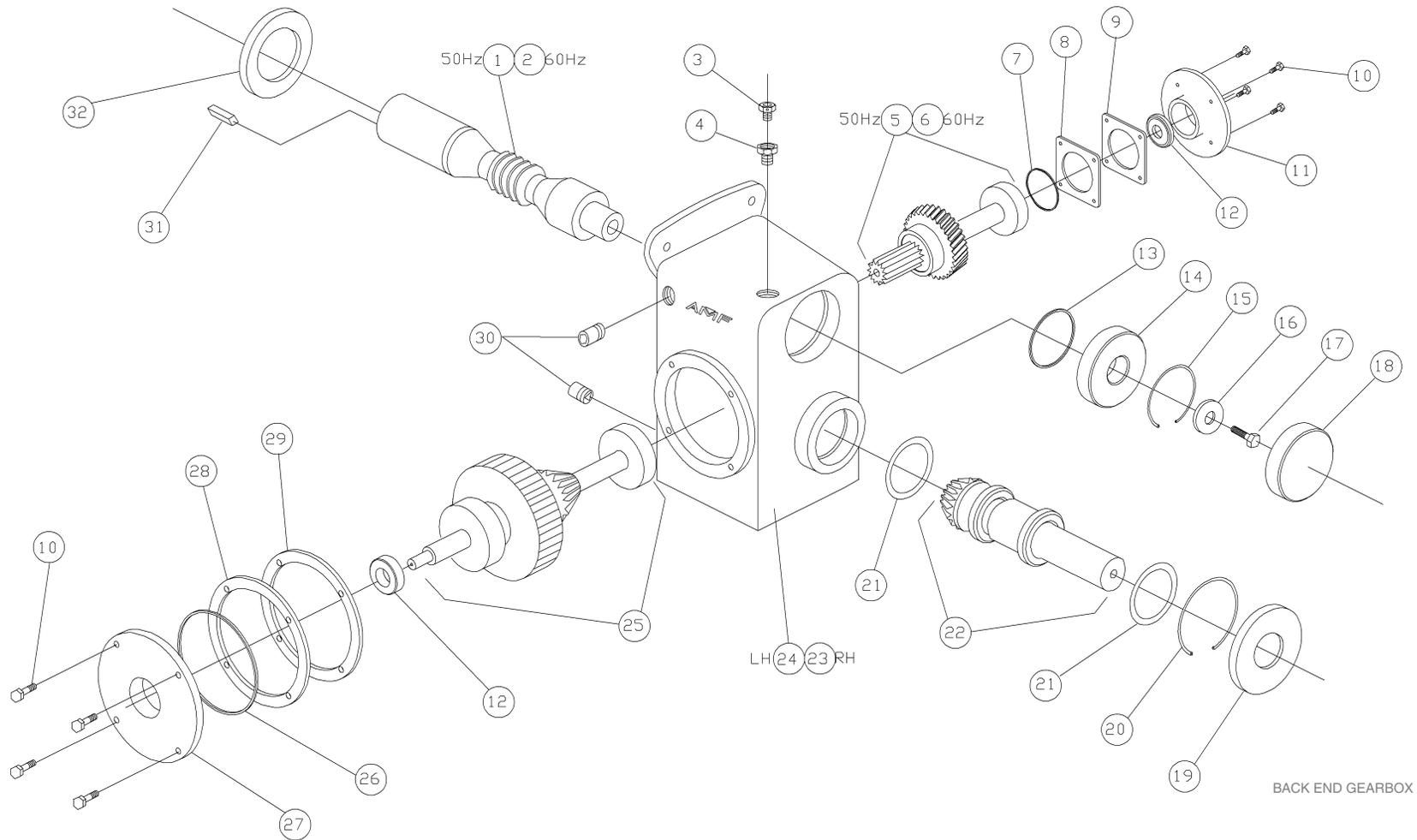


Figure 10, Back End Gearbox, Exploded View



**PARTS LIST – BACK END GEARBOX
AMF 82-90XL PINSPOTTER**

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY</u>
1	785-503-029*	WORM, 50 Hz	1
2	785-503-030**	WORM, 60 Hz	1
3	730-063-088	BREATHER PLUG	1
4	718-803-003	BUSHING, 1/4 X 1/8 NPT	1
5	610-900-085	WORM GEAR REPLACEMENT KIT, 50 Hz	1
6	610-900-090	WORM GEAR REPLACEMENT KIT, 60 Hz	1
7	919-102-000	O-RING, (CARPET DRIVE CAP)	1
8	785-503-035	SHIM, .002, RED	3
9	785-503-036	SHIM, .005, BLUE	2
10	Ref. Only	SCREW, HEX, 1/4 NC x 3/4	8
11	785-503-045	GEARBOX COVER (CAP, CARPET DRIVE PORT)	1
12	785-503-072	OIL SEAL, DISTRIBUTOR AND CARPET SHAFTS	2
13	785-503-040	SHIM, 1-1/2 x 1-13/16 x .002	6
14	701-000-034	BALL BEARING	1
15	Ref. Only	RETAINING RING	1
16	Ref. Only	WASHER, 3/8 x 1 x 1/8	1
17	Ref. Only	SCREW, HEX, GRADE 5, 5/16 NC x 3/4	1
18	785-503-043	EXPANSION PLUG	1
19	785-503-071	SEAL, PIN ELEVATOR WHEEL SHAFT	1
20	919-001-400	RETAINING RING	1
21	785-503-039	SHIM, 2-1/4 x 2-7/16 x .002	4
22	610-900-105	PIN ELEVATOR DRIVE REPLACEMENT KIT	1
23	Ref. Only	HOUSING, R.H.	1
24	Ref. Only	HOUSING, L.H.	1
25	610-900-100	DISTRIBUTOR DRIVE REPLACEMENT KIT	1
26	Ref. Only	O-RING, DISTRIBUTOR SHAFT FLANGE	1
27	Ref. Only	CAP, DISTRIBUTOR DRIVE PORT	1
28	785-503-037	SHIM, .002, RED	1
29	785-503-038	SHIM, .005, BLUE	2
30	718-507-023	PLUG, PIPE SOCKET, 1/4 x 1/8 NPT	2
31	907-202-500	KEY, 3/16 x 3/16 x 1-3/8	1
32	785-503-104	OIL SEAL, VITON®, INPUT SHAFT	1

Table 3

Ref. Only items are for component identification and are not carried in stock.

* included in the Worm Gear Replacement Kit, 50 Hz - 610-900-085 (item 5)

** Included in the Worm Gear Replacement Kit, 60 Hz - 610-900-090 (item 6)



SECTION 4 REPAIR OF THE BACK END GEARBOX MOTOR

4.1 PURPOSE

This section describes the procedure for the repair and maintenance of the back end gearbox drive motor. It contains parts lists, drawings, and repair information.

4.2 SCOPE

The back end motors are field-serviceable items. The motors are dual voltage and are provided in 50 Hz and 60 Hz configurations rated for continuous service. Both motors are rated at 1/3 horsepower. The AMF numbers for the different motors are as follows:

<u>APPLICATION</u>	<u>AMF PART NO</u>
50 Hz Back End	090-007-310 (flat plug)
60 Hz Back End	090-003-766 (flat plug)

Motors are shipped configured for 230 volts, and the procedure for configuring the back end motor for 115 volts is covered later in this section. When replacing a drive motor, ensure that the model used matches the frequency and voltage of the electrical power that is being supplied to the pinspotter. The same model of back end motor is used for both left hand and right hand gearboxes.

An exploded view of the back end motor is shown in Figure 11 on Page 42. Parts are identified in Table 4 on Page 43.

The following service and repairs are described in the sections that follow. All other repairs are not considered feasible under field conditions without special tools and are not covered in this manual.

- Replacing the Capacitor/Resistor Assembly
- Replacing the Rotor Assembly
- Replacing the Thermal Overload Device
- Replacing the Solid State Switch
- Replacing the Terminal Board
- Configuring the Motor for either 115-Volt or 230-Volt Operation

Motor repair parts should be ordered by the part numbers listed in Table 4. Further breakdown of listed subassemblies is not recommended.



4.3 PROCEDURES

Front end motor repair is covered in another section of this manual. Use this section only for the repair of the back end pinspotter motor.

4.3.1 REPLACING THE CAPACITOR/RESISTOR ASSEMBLY

Tools Required

Flat-Blade Screwdriver
Needle Nose Pliers

1. Disconnect the motor's power cable.
2. Remove the two capacitor cover screws (Item 6) and the cover (Item 5).
3. Remove the capacitor/resistor assembly (Item 7 or 8) from the cover.
4. Remove the leads from the capacitor/resistor assembly's slide-on terminals. **DO NOT PULL ON THE WIRES.**
5. Place the leads on the terminals of the new capacitor/resistor assembly.
6. Place the new capacitor/resistor assembly into the cover making sure that it is properly seated in the cover; otherwise, the cover will not mount correctly.
7. Reinstall the capacitor cover on the motor using the screws that were removed earlier.
8. Reconnect the motor's power cable.

4.3.2 REPLACING THE ROTOR ASSEMBLY

Tools Required

Torque Wrench (calibrated in in-lbs.)	9/16-inch Wrenches (2)
1/4-inch Socket	Mallet
Pencil	

1. Disconnect the motor's power cable.
2. Unbolt the motor from the gearbox housing and remove the motor.
3. Note the location of the orientation indicator on the flanged endplate. This triangle-shaped indicator, which is cast into the endplate near one of the bolt holes, must be oriented opposite the capacitor during reassembly.
4. Mark a line on the circular endplate (item 12) and on the adjacent part of the motor frame (item 9). This will help in reassembly.



5. Remove the four long thru-bolts (Item 18 or 19) that hold the motor together. After removing the motor's four long bolts, the motor can be taken apart.
6. Tap the endplate lightly with a mallet to dislodge it from the frame. Remove the endplate and rotor assembly.
7. Place the new rotor assembly (Item 20 or 21) into the frame. Ensure the wave spring is in place.
8. Orient the mark on the circular endplate with the mark on the frame, and place the orientation indicator on the flanged endplate on the side opposite the capacitor. Ensure wires and leads are not in the way of rotating parts, and bring the assembly together.
9. Install the four long thru-bolts that were removed earlier. Tighten them to a maximum of 20 in-lbs.
10. Install a new key (907-202-500) in the motor shaft keyway.
11. Coat the motor shaft with an antiseize compound such as SAF-T-EZE, and install the motor onto the gearbox. Tighten the bolts to 120 in.-lbs.

4.3.3 REPLACING THE THERMAL OVERLOAD DEVICE OR TERMINAL BOARD

WARNING!

EXERCISE CARE WHEN RESETTING A THERMAL OVERLOAD DEVICE. THE MOTOR CAN START WITHOUT WARNING PRESENTING A POTENTIALLY HAZARDOUS CONDITION.

The thermal overload device protects the motor from a number of faults that can cause the motor's temperature to rise above its designed operating limit. If the device trips, it can be reset by pressing the red reset button on the motor's endplate. If it trips again, check for binding in the gearbox, driven components, and linkages. If it trips without any apparent cause or will not reset after an appropriate cool down period, the device must be replaced. Faulty motor windings can also cause the device to trip. If this is the case, replace the motor.

The terminal board accommodates terminations for the motor's various internal wires and contains no active devices. It should fail only if excessive force is used to remove or reconnect the leads. Disassembly of the motor is required for the replacement of these parts.

Tools Required

Torque Wrench (calibrated in in-lbs.)
1/4-inch Socket
9/16-inch Wrenches (2)
Needle Nose Pliers

Flat-Blade Screwdriver
Rosin Core (nonacid) Solder
Soldering Pencil
Pencil

1. Disconnect the motor's power cable.



2. Unbolt the motor from the gearbox housing and remove the motor.
3. Mark a line on the circular endplate (item 12) and on the adjacent part of the motor frame (item 9). This will help in reassembly.
4. Note the location of the orientation indicator on the motor's flanged endplate. This triangle-shaped indicator, which is cast into the endplate near one of the bolt holes, must be oriented on the side opposite the capacitor during reassembly.
5. Remove the four long thru-bolts (Item 18 or 19) that hold the motor together. After removing the motor's four long bolts, the motor can be taken apart.
6. Loosen the circular endplate and pull it away from the motor allowing access to the screws that retain the thermal overload device.
7. **To replace the thermal overload device,**
 - a. Unsolder the terminals on the thermal overload device (Item 2 or 3).
 - b. Remove the two screws (Item 4) and take out the overload device.
 - c. Position the new overload device and secure it with the two screws that were removed in the previous step.
 - d. Solder the three leads to the terminals of the new overload device. The brown lead connects to terminal 1; the purple, to terminal 2; and the yellow, to terminal 3.
8. **To replace the terminal board,**
 - a. Remove the two screws (Item 10) that secure the terminal board (item 11) to the endplate.
 - b. Make a note of the color and location of all the leads on the different terminals on both sides of the terminal board. Remove each lead without pulling on the wire and attach it to the new terminal board at the same location. Discard the old board.
 - c. Secure the new terminal board to the endplate with the screws removed in step 8a.
9. Orient the mark on the circular endplate with the mark on the frame, and place the orientation indicator on the flanged endplate on the side opposite the capacitor. Ensure wires and leads are not in the way of rotating parts, and bring the assembly together
10. Install the four long thru-bolts that were removed earlier. Tighten them to a maximum of 20 in-lbs.
11. Install a new key (907-202-500) in the motor shaft keyway.
12. Coat the motor shaft with an antiseize compound such as SAF-T-EZE, and install the motor onto the gearbox. Tighten the bolts to 120 in.-lbs.



4.3.4 REPLACING THE SOLID STATE SWITCH

Tools Required

Needle Nose Pliers
Small Flat-Blade Screwdriver

1. Remove the three screws (Item 17) that secure the electrical cover plate (Item 1) to the endplate. Remove the cover plate.
2. Remove the mounting screw (Item 16) and dislodge the start switch (Item 14 or 15).
3. Remove the three leads from the switch, and discard the old switch.
4. Connect the leads to the new switch. The gray lead goes to terminal 1; the red, to terminal 2; and the pink, to terminal 3.
5. Place the switch into the endplate positioning one of the holes in the switch assembly's circuit board over the pin on the endplate, and reinstall the mounting screw. Ensure that the leads do not interfere with the rotating parts of the motor.
6. Replace electrical cover plate and screws, and tighten them securely.

4.3.5 CONFIGURING THE MOTOR FOR 115-VOLT OR 230-VOLT OPERATION

Back end motors are shipped from the factory wired for 230-volt operation. (There is a sticker on the motor indicating the voltage for which the motor is wired.) Some bowling centers run their pinspotters on 115-volt circuits. It is relatively easy to reconfigure the motor for 115-volt operation. Simply wire the motor for low voltage (115V) as shown below. Follow the wiring diagram on the motor if it differs from what is shown below.

Tools Required

Needle Nose Pliers
Small Flat-Blade Screwdriver

1. Disconnect the motor's power cable.
2. Remove the electrical cover plate from the endplate of the motor.
3. Rewire the motor according to the applicable voltage category as follows:

HIGH VOLTAGE (230V)

<u>Terminal</u>	<u>Color</u>
L1	
3	Blue
4	
5	Violet
L2	

LOW VOLTAGE (115V)

<u>Terminal</u>	<u>Color</u>
L1	
3	Violet
4	
5	
L2	Blue



The change to 115-volt operation consists of moving the BLUE wire from terminal 3 to L2 and the VIOLET wire from terminal 5 to terminal 3.

4. Reinstall the electrical cover plate.
5. After wiring for 115-volt operation, remove the “Motor Connected 230 Volts” sticker.
6. Reconnect the motor’s power cable.

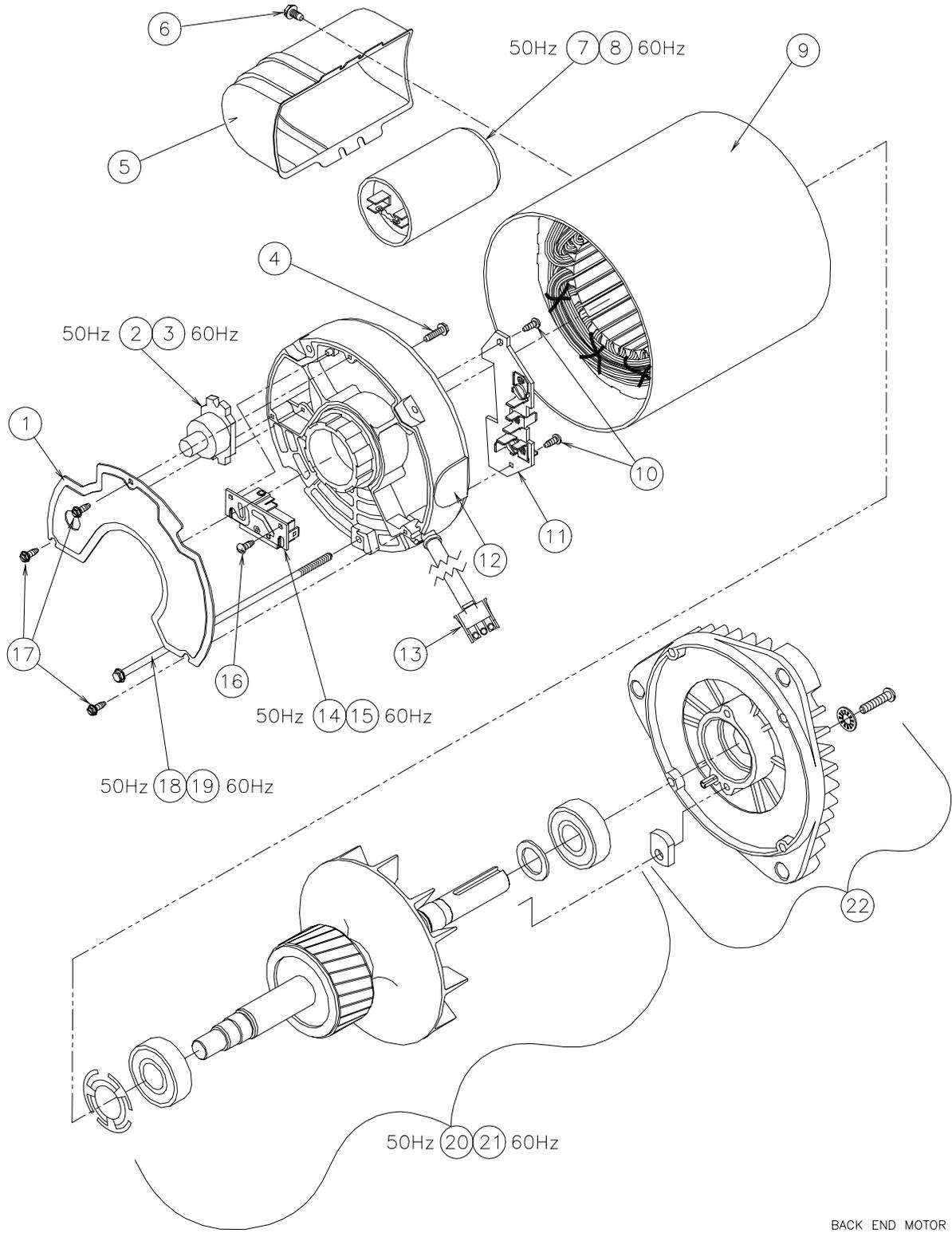


Figure 11, Back End Drive Motor, Exploded View



**PARTS LIST
BACK END DRIVE MOTOR**

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QTY</u>
1	Ref. Only	COVER ASSEMBLY, CONDUIT CAVITY	1
2	090-003-665	OVERLOAD, THERMAL w/RESET (50 HZ)	1
3	090-003-630	OVERLOAD, THERMAL w/RESET (60 HZ)	1
4	Ref. Only	SCREW, SELF-TAPPING ROUND HEAD	2
5	Ref. Only	COVER, CAPACITOR	1
6	Ref. Only	SCREW, TRUSS WASHER HD,10-32 X 5/16	2
7	090-003-666	CAPACITOR/RESISTOR ASSEMBLY (50 HZ)	1
8	090-003-634	CAPACITOR/RESISTOR ASSEMBLY (60 HZ)	1
9	Ref. Only	FRAME ASSEMBLY	1
10	Ref. Only	SCREW, SELF-TAPPING, RD HD, 10-32 x 3/8	2
11	090-003-629	TERMINAL BOARD ASSEMBLY	1
12	Ref. Only	ENDPLATE	1
13	Ref. Only	RECEPTACLE, 3-PIN	1
14	090-004-558	SWITCH, SOLID STATE (50 Hz)	1
15	090-004-560	SWITCH, SOLID STATE (60 Hz)	1
16	Ref. Only	SCREW, SELF-TAPPING RD HD, 10-32 x 3/8	1
17	Ref. Only	SCREW, TRUSS, WASHER HD, 10-32 x 3/8	3
18	709-013-071	THRU-BOLT (50 Hz)	4
19	709-013-056	THRU-BOLT (60 Hz)	4
20	090-004-559	ROTOR ASSEMBLY (50 Hz)	1
21	090-004-556	ROTOR ASSEMBLY (60 Hz)	1
22	090-004-557	ENDBELL ASSEMBLY	1

Table 4

Ref. Only items are for component identification and are not carried in stock.