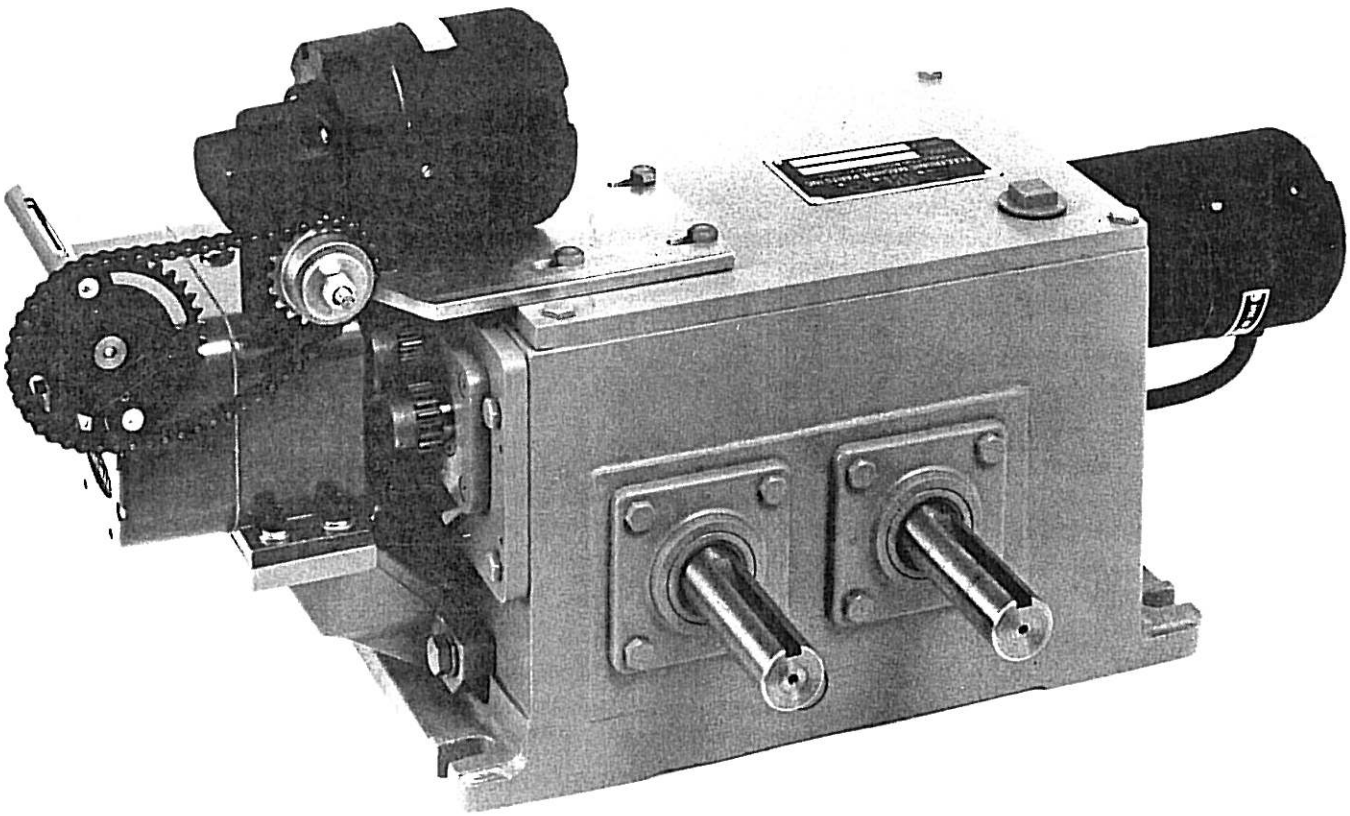
DDT-2

OPERATING & MAINTENANCE MANUAL
WITH PARTS LIST FOR

DDT 2 DOUBLE DIFFERENTIAL MITER GEAR



ELECTRONIC MACHINE PARTS, INC. EMP

OPERATING & MAINTENANCE MANUAL WITH PARTS LIST FOR
DDT 2 DOUBLE DIFFERENTIAL MITER GEAR

1. INTRODUCTION — DOUBLE DIFFERENTIAL TRANSMISSION (DDT).

a. The backbone of the Registration System produced by Electronic Machine Parts Inc. (EMP) is the Double Differential Transmission (DDT). The DDT is unique in that it combines both a Variable Speed Drive and a Phase Shifting Differential into one package.

b. This approach allows us to control and correct simultaneously and independently, an constant length error, or any random phase error that occurs during the processing of the printed web.

c. Registration Systems that cannot correct both the length and random registration errors independently, do not eliminate the error, but only attempt to reduce it.

2. EQUIPMENT PURPOSE, CAPABILITIES.

a. A Packaging Machine with a Fixed Change Gear Station arrangement that delivers a 15.080 inch length of pre-printed web to the knife. If the print repeat length is 15 inches, a .080 inch error exists for every label. If your machine is running 100 RPM, the web will be out of register by 8 inches the first minute. The constant length error of .080 inch is easily corrected by the DDT.

b. Using a standard DDT-2 with a variable speed range of 3.75%, the DDT can be adjusted to deliver a repeat length of 14.515 to 15.080 to the knife. By delivering the exact repeat length, we are able to eliminate the length error.

3. THEORY OF OPERATION.

a. The DDT Transmissions maintain the pre-printed web registration by regulating the speed of the output shaft which controls the machine's draw rollers. The output shaft speed is controlled by two miter gear differentials contained within the transmission housing.

b. The first differential is controlled by the 2089OBCM correction motor which makes momentary corrections. These momentary corrections are required to correct random or phase errors.

c. The second differential is controlled by the variator and makes permanent speed corrections to the output shaft. These permanent corrections are required to compensate for length or tension errors that are constant in the printed web. The variator is automatically controlled by the length motor.

d. The DDT is designed so a "0" setting at the variator makes the DDT's input and output shafts rotate at 1:1 ratio. As the variator is adjusted, the output shaft speed is reduced. Using the DDT-2 as our example again, a setting of "0" will have the input and output shaft rotation at 100 RPM. At it's high setting of 40, the input shaft will rotate at 100 RPM, the output shaft at 96.25 RPM.

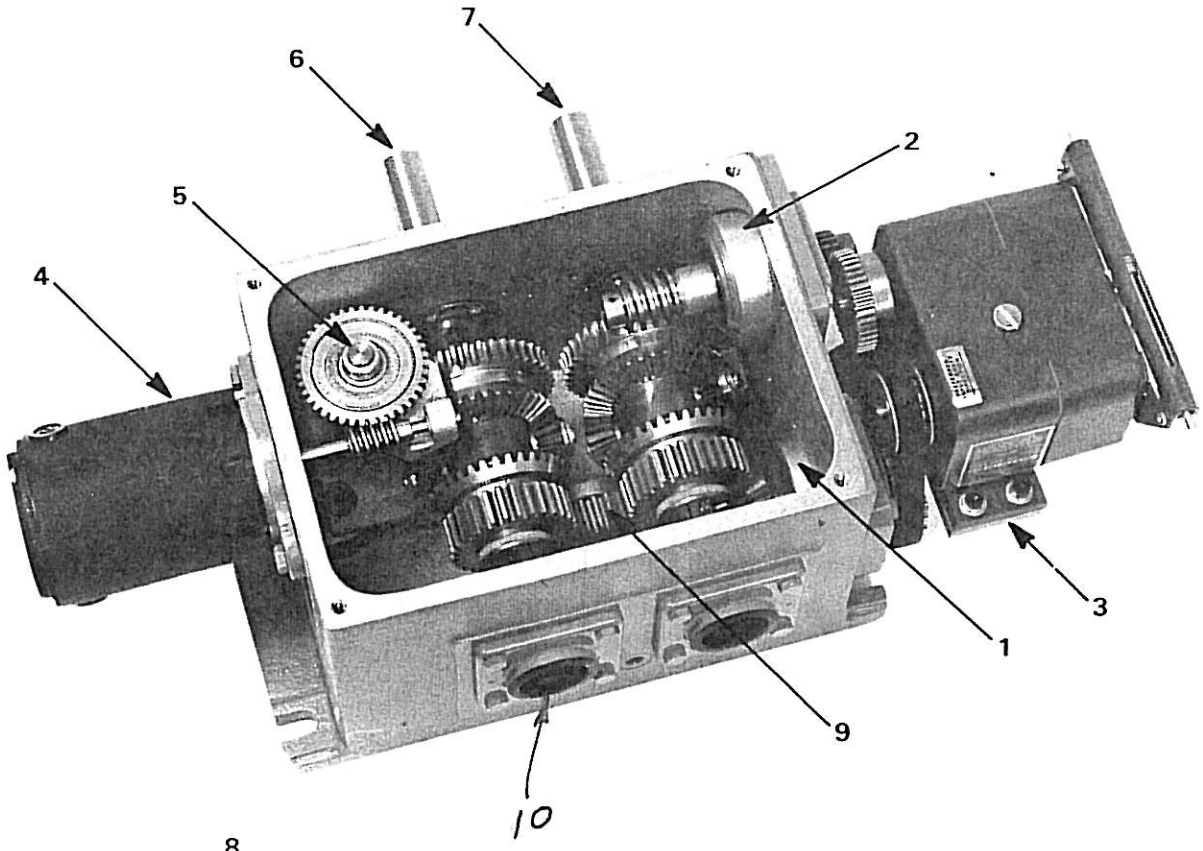
e. The DDT Transmissions when used with the EMP Registration Systems, will have the correction motor and the variator position controlled automatically.

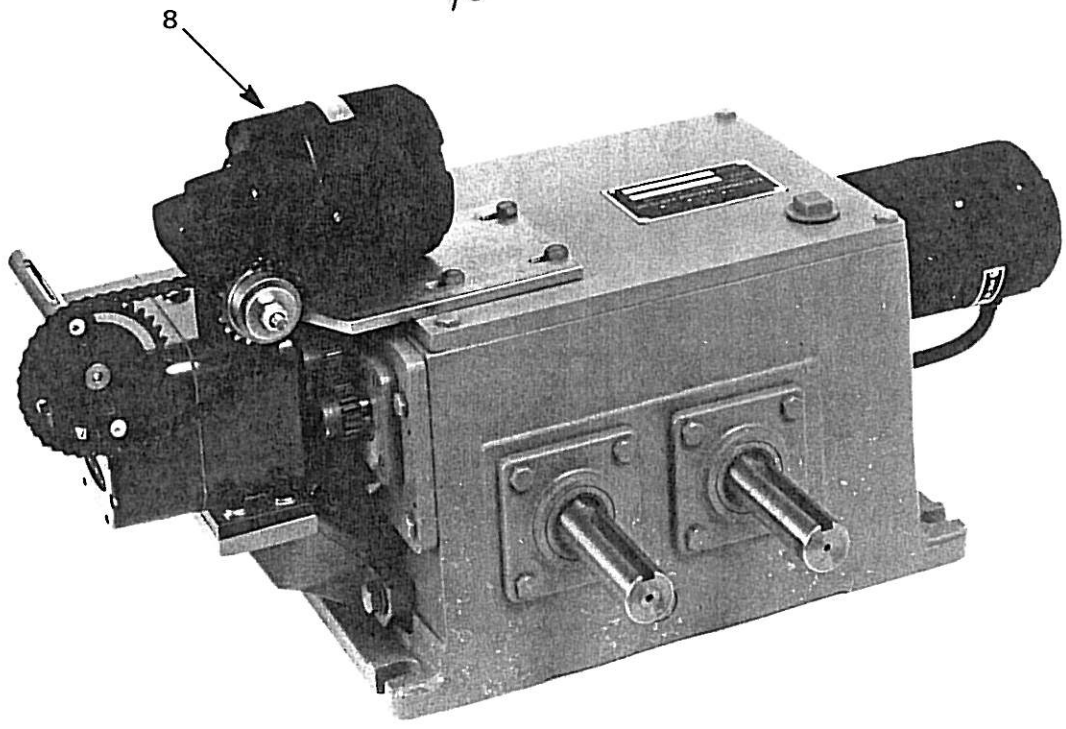
4. LUBRICATION

a. The DDT Transmission is shipped from the factory without oil.

b. An oil access plug is located on top of the DDT. Prior to use, fill the DDT with 2½ quarts of MOBIL GEAR OIL No. 629, or any AGMA 4EP grade oil equivalent.

Figure 1. Double Differential Transmission Assembly, DDT 2





Introduction To The DDT Transmission

At EMP, we understand your needs for a Register Control System that offers you the high quality needed at an affordable price. All EMP Systems are designed with these facts in mind.

The backbone of All EMP Dual Register Motor Systems is the DDT-MVC Transmission. Designed to correct both the random phase error and the constant length error portions of the register error automatically, the DDT-MVC Transmission is recommended for all print to cut registration applications. The DDT-MVC is unique, because it combines both a length compensating differential and a phase shifting differential in one package.

The majority of packaging and converting machinery capable of processing pre-printed webs feature a knife that moves at a constant speed and draw rollers whose speed is determined by a set of change gears. Because the speed of the draw rollers determine the cut size of pre-printed web, the ability to adjust the draw roller speed is necessary for maintaining registration. By adjusting the draw roller speed, we can match the actual print repeat length of the web and the amount of web cut by the knife. This matching of the draw roller speed and print repeat length eliminates the length error portion of the register error.

Features:

- **Designed Specifically for Registration and Motion Control Applications.**
- **Works with All EMP 2 Way Register Control Systems.**
- **Available in 2, 4, and 7 HP Rated Units.**
- **Choice of Brush And Brushless Style Motors for Correcting Length and Phase Errors.**
- **New Higher Speed Version for Today's Faster Operating Speeds.**
- **Choice of Correction Ratios to Meet Your Specific Application.**

Theory of Operation

The DDT Transmission corrects the register error found in the pre-printed web by regulating the speed of the Draw Rollers or Knife. The corrections are made by the transmission's two MITER GEAR Differentials.

The first differential is controlled by a speed variator. For the DDT-2, DDT-25 and DDT-3, a Zero-max unit is used as the speed variator. For DDT-4 and DDT-7, a 1/2 HP PIV style variator is used. The Speed Variable Unit makes permanent speed corrections to the output shaft. This constant correction is necessary to eliminate any length error found in the pre-printed web. This length error represents the difference between the actual repeat length of the pre-printed web and the amount of web cut by the knife. Since this error is constant, it will accumulate as the web is processed. To eliminate this error, a permanent speed adjustment to the Draw Roller is made by changing the Zero Max setting. This correction is made automatically when using the MVC and MVC SS option, and an EMP Dual Motor Register System.

The second miter gear differential is controlled by the Correction Motor. Based on signals received from the EMP Controller, corrections increasing or decreasing the output shaft speed are made momentarily. The momentary adjustments are required to correct Random Phase Errors which will keep the cut-off point of the pre-printed web at it's proper position.

To best illustrate how the DDT-MVC works, we wish to use an example where a pre-printed web with a 15.250 repeat length must be cut in register. This web was printed on a press that used 1/4 inch circular pitch gearing for the required 15.250" length. The secondary machine that is to process the pre-printed web uses 10 diametral pitch gearing. The 10 diametral pitch gears used will delivery 15.394" of web to the knife. The length error of .144 inches (15.394-15.250), will accumulate to 14.4 inches additional alter only 100 register marks. Using a DDT-2MVC with an overall range of 3.75%, the main shaft input to output ratio will be 1:1 with the Zero Max set at "0". As the Zero Max is adjusted, the output shaft will slow down. At the Zero Max's lowest setting of "40", the output shaft will be 3.75% slower than the input shaft. Finishing with our example, when the DDT-2's variator is at it's high setting, the main shafts Ratio will be 1:1 and deliver 15.394" of web to the knife. With the variator setting at it's low point, we will deliver 14.817" of web. The ability to cut anywhere within the 14.817 to 15.394 range allows us to correct the length error. A Register System without this capability can not work effectively at today's high operating speeds.

Selecting Your DDT

The final selection of your DDT will depend greatly on the design of your machine, and the degree of automatic operation desired. While the DDT-MVC Transmission comes with both Phase and Length Motors, the DDT Transmission has only a Phase Motor. The DDT requires a manual adjustment to the variator for length correction, and uses of a Single Motor Controller. EMP recommends the use of the MVC option on the DDT Transmission because the length correction is done automatically.

Selecting Your Overall Speed Reduction

For the DDT-2, DDT-25 and DDT-3 Transmissions, a choice of 3 ratios (3.75%, 5.6% and 2.8%) are available. The DDT-4 and DDT-7 Transmissions also have a choice of 3 ratios (8.2%, 6.3% and 3.2%). Each range has a different maximum input speed limitation which must be considered. When choosing the range, the various jobs to be processed and the available change gears must be considered. For additional assistance, please contact EMP directly.

Correction Motor Option

In the past, EMP has supplied the 20890BCM universal type motor. If a Model 250 or Series 2500 Control System is used, an AC brushless induction motor may be selected.

Length Motor Option

While the 2665 brush type motor has been supplied in most previous applications, EMP customers with Model 250 and Series 2500 Controllers are encouraged to use the MVC SS option. This brushless motor has proven to be more accurate in controlling the variator and has limited torque which prevents damage to the screw control portion of the Zero Max.

DDT-2HP Ordering Information

When ordering, please specify the following information.

1 - Model Number - The Model Number selected will determine the overall input speed and adjustable speed range of the unit.

Model Number	Maximum Speed Of Input Shaft	Overall Speed Reduction Of The Output Shaft
DDT-2	333 RPM	-3.75%
DDT-25	256 RPM	-5.6%
DDT-3	600 RPM	-2.8%

2 - Choice of Correction Motor

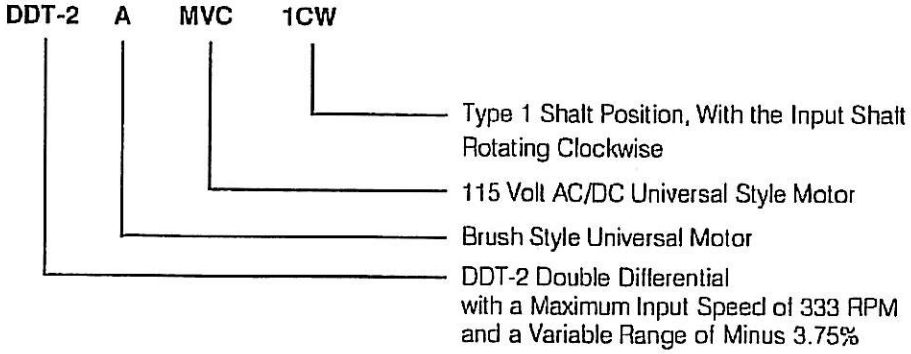
	Style of Motor
A	Brush Style Universal Motor-Standard
B	AC Brushless Induction Motor

3 - Choice of Length Motor (Requires a Dual Motor Controller, If the Length Motor option is not selected a Handwheel for manual adjustments will be supplied).

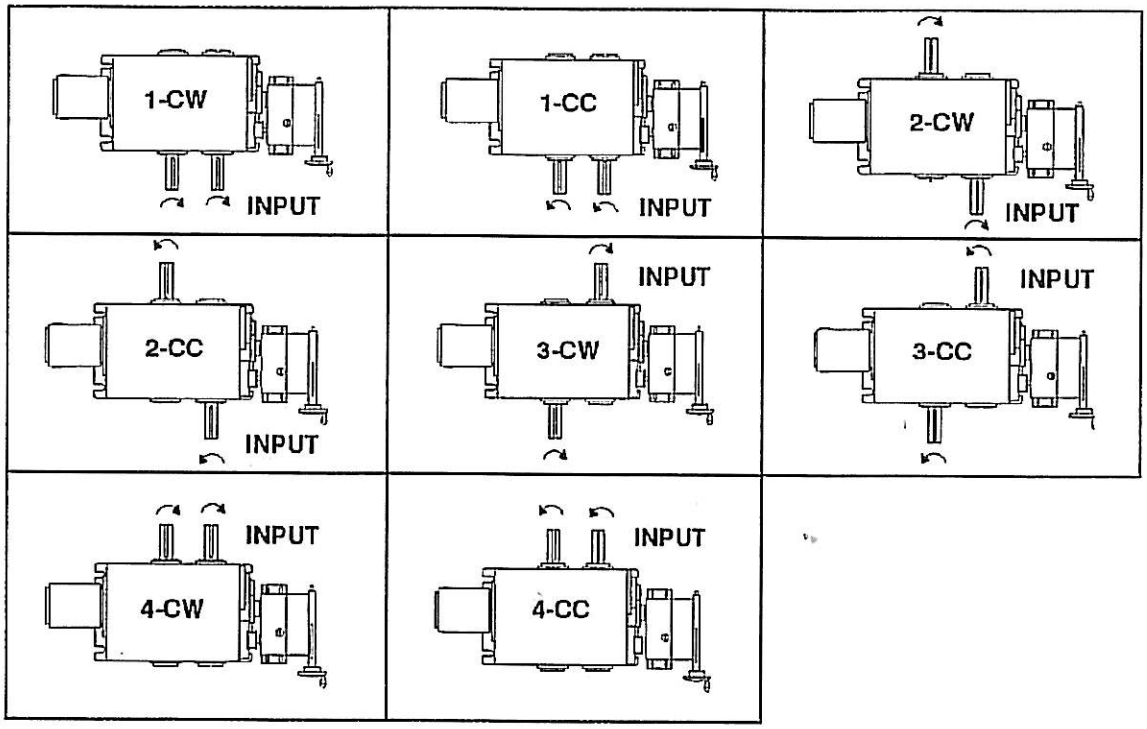
	Style of Motor
MVC	115 Volt AC/DC Universal Style Motor
MVC SS	AC Brushless Synchronous Motor

4 - Shaft Position, and Rotation of Input Shaft (Please review options on page four. Input shaft is always closest to the variator).

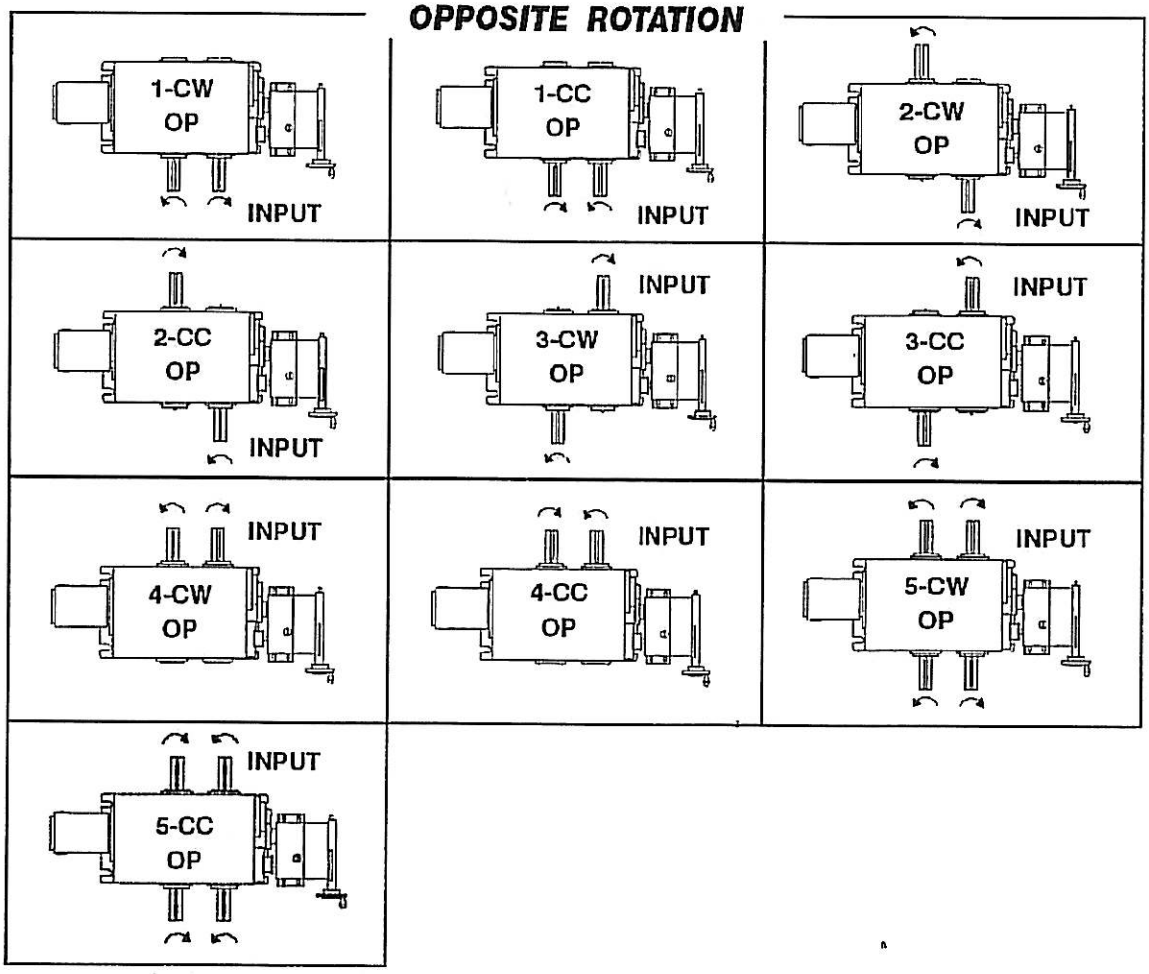
5 - Example Of A DDT- Part Number



SAME DIRECTION ROTATION



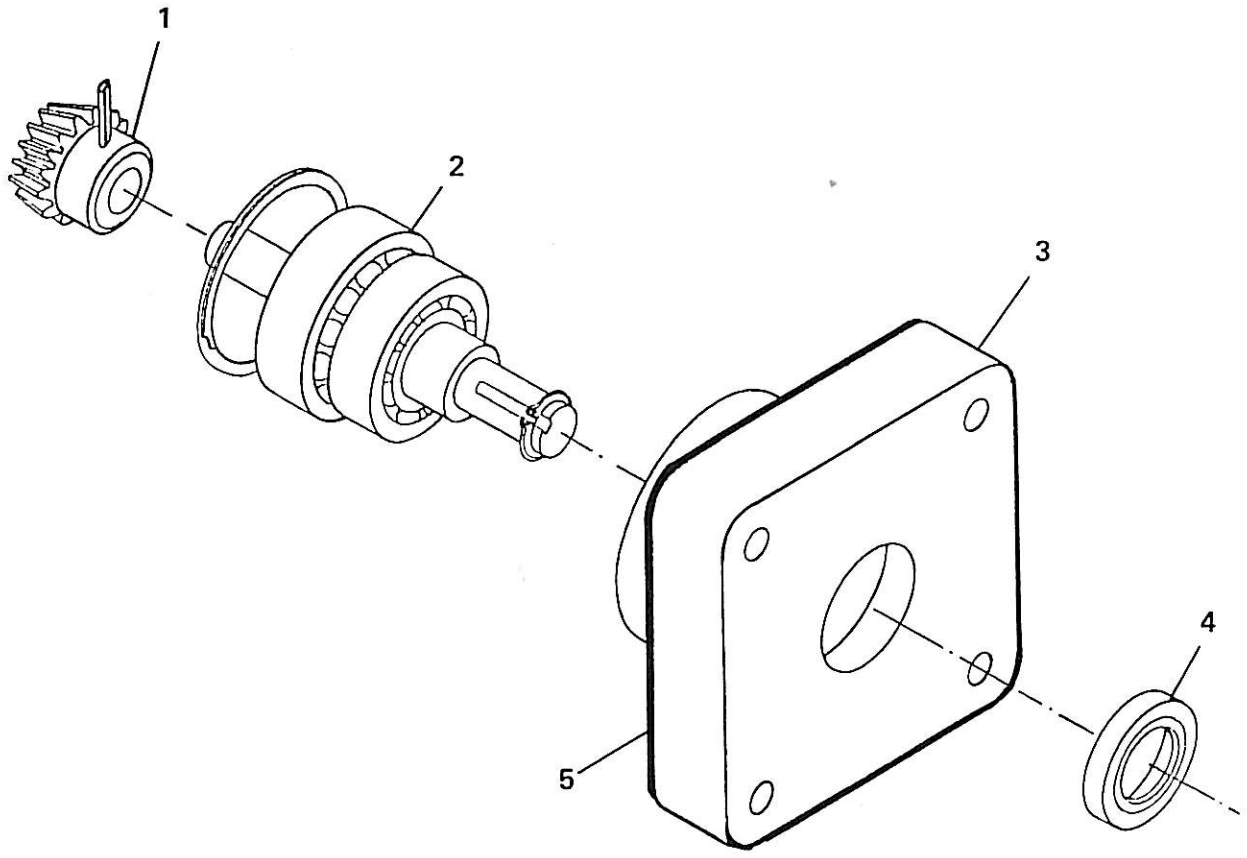
OPPOSITE ROTATION



UNIT
DOUBLE DIFFERENTIAL
TRANSMISSION ASSEMBLY, DDT 2

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
1 –	DDT-2	Double Differential Transmission Assembly	Ref
– 1	B259	Variator Input Assembly (See Figure 2 for Breakdown)	1
– 2	C934	Variator Output Assembly (See Figure 3 for Breakdown)	1
– 3	JK41 JK42	Zero Max, CCW (See Figure 4 for Breakdown) Zero Max, CW (See Figure 4 for Breakdown)	1 1
– 4	20890BCM	Correction Motor Assembly (See Figure 5 for Breakdown)	1
– 5	C1413	Reduction Bracket Assembly (See Figure 6 for Breakdown)	1
– 6	C1508 C1510	Main Output Shaft Assembly (See Figure 7 for Breakdown)	1
– 7	C1507 C1509	Main Input Shaft Assembly (See Figure 7 for Breakdown)	1
– 8	C1195	Length Motor/Limit Switch Assembly (Optional) (See Figure 8 for Breakdown)	1
– 9	C1497	IDLER Gear Assembly See Figure 7 For Breakdown	

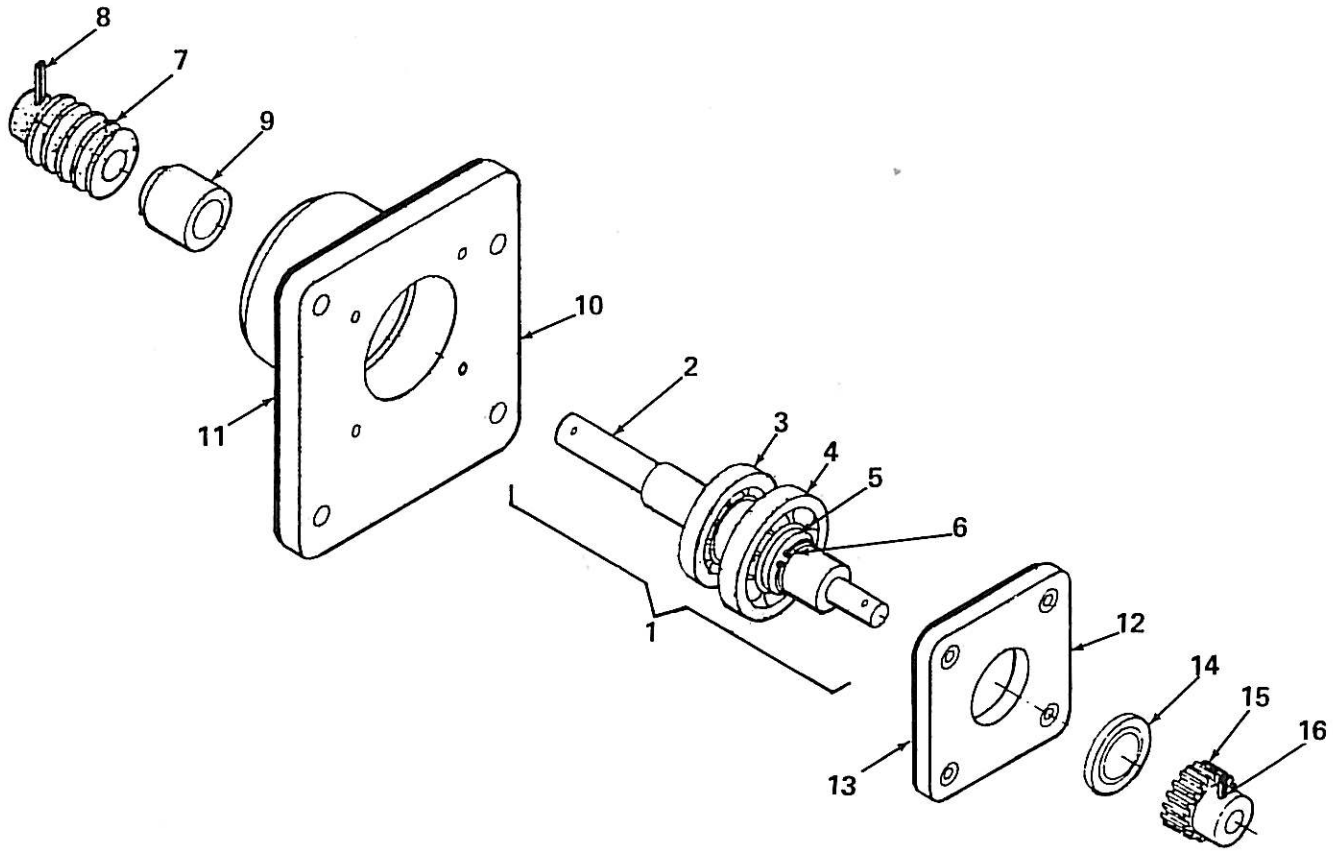
Figure 2. Variator Input Assembly



UNIT
VARIATOR INPUT ASSEMBLY

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
2 –	B259	Variator Input Assembly	Ref
– 1	B262	Gear, Bevel, Pinion	1
	A254-30	Pin, Spring 1/8 D x 3/4 L	1
– 2	B2204	Shaft Assy, Pinion	1
	A107	Ring, Retaining	1
	A147	Bearing, Ball	1
	A146	Bearing, Ball	1
	A109	Ring, Retaining	1
	A252-20	Key, Square 1/8 x 1/8 x 13/16	1
	B284	Shaft, Pinion	1
– 3	B260	Cap, Bearing	1
– 4	A129	Seal, Oil	1
– 5	D357-1	Gasket B276	1

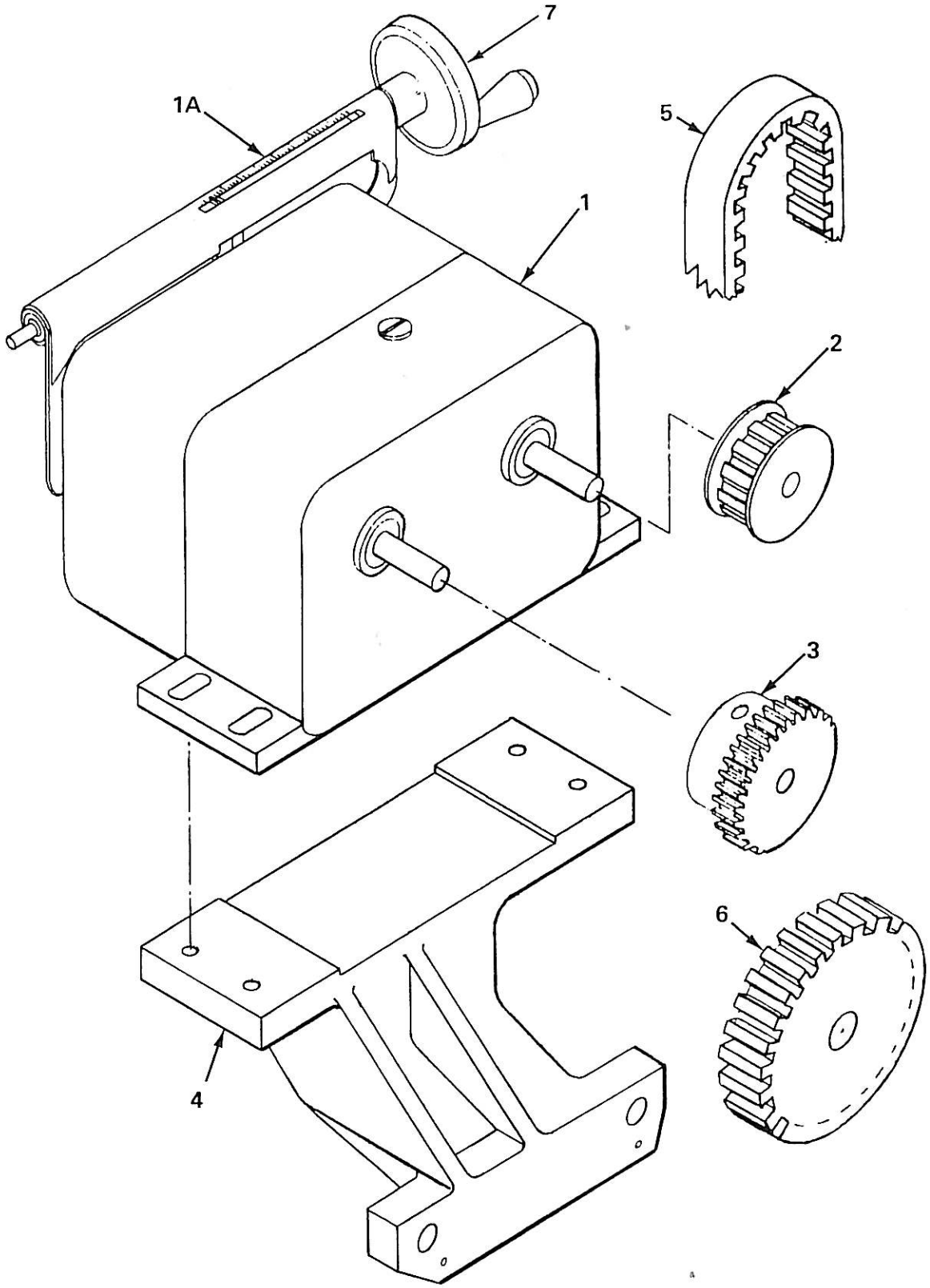
Figure 3. Variator Output Assembly



UNIT
VARIATOR OUTPUT ASSEMBLY

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
3 –	C934	Variator Output Assembly	Ref
– 1	C1444	Shaft Assembly	Ref
– 2	B1359	Shaft, Worm	1
– 3	A142	Bearing, Ball	1
– 4	A141	Bearing, Ball	1
– 5	B674	Washer, Thrust	1
– 6	A111	Ring, Retaining	1
– 7	B268	Gear, Worm	1
– 8	A254-50	Pin, Spring, 5/32" Dia x 3/4" Lg	1
– 9	B282	Spacer, Worm Shaft	1
– 10	C196	Cap, Bearing, Worm Drive	1
– 11	D358-2	Gasket (C196)	1
– 12	B285	Cap, Oil, Seal	1
– 13	D358-4	Gasket (B285)	1
– 14	A129	Seal, Oil	1
– 15	B463	Gear, Spur, 20 Tooth For 3.75% Ratio (See Figure 10 For 5.6% Ratio)	1
– 16	A254-30	Pin, Spring, 1/8" Dia x 3/4" Lg	1

Figure 4. Zero Max Variator

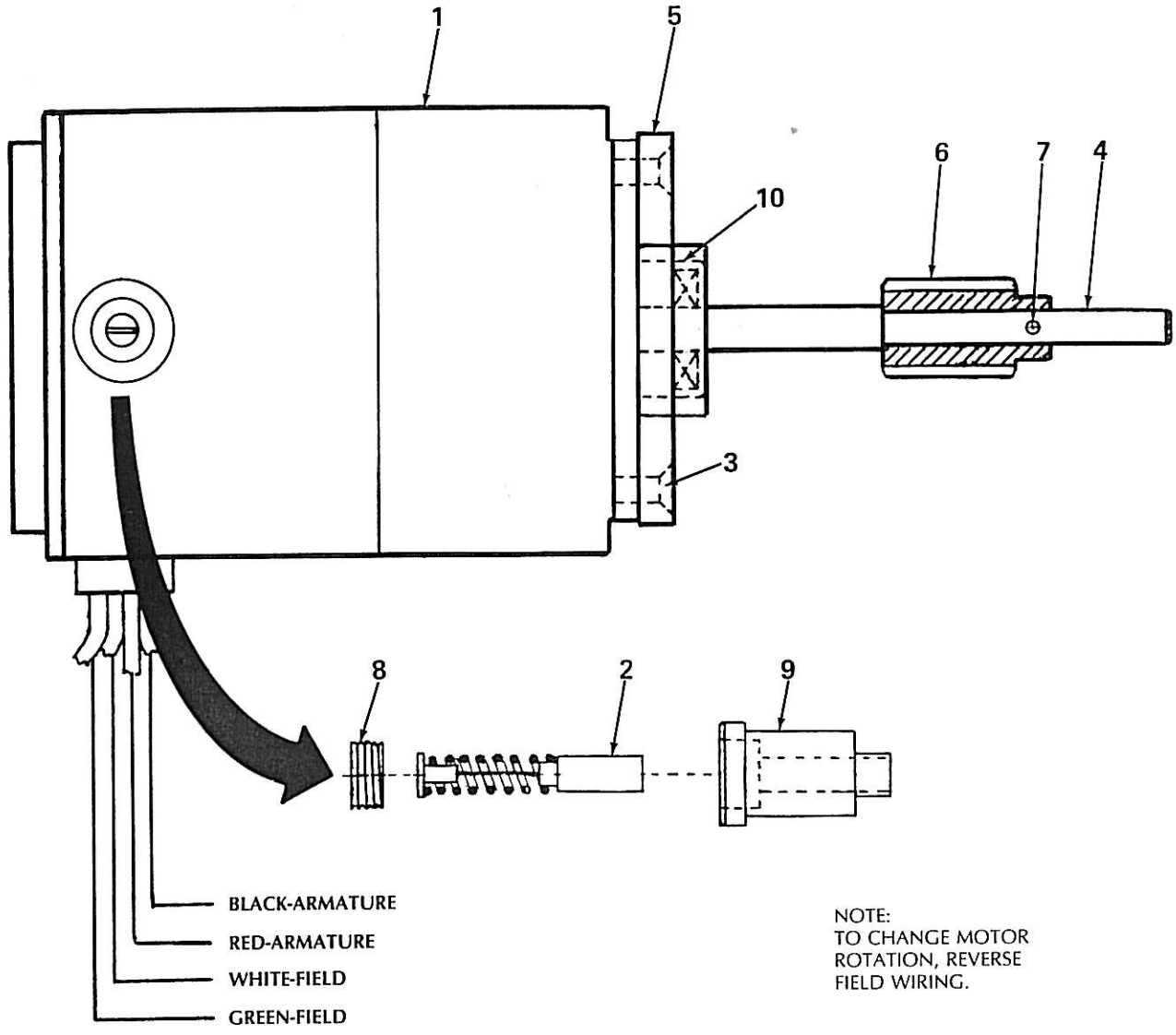


UNIT
ZERO MAX VARIATOR

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
4 –	C1414	Zero Max Variator, CCW (JK41) Assembly	Ref
4 –	C1414-1	Zero Max Variator, CW (JK42) Assembly	Ref
– 1	JK41	Zero Max, CCW with Screw Control and Knob	1
– 1	JK42	Zero Max, CW with Screw Control and Knob	1
– 1A	E-JK	Screw Control with A298 Adjustment Knob	1
– 2	B275	Pulley, Driven, 12 Tooth	1
– 3	B464	Gear, Spur, 40 Tooth	1
– 4	D125	Bracket, Mounting	1
– 5	A201	Belt, Timing	1
– 6	B274	Pulley, Driver, 24 Tooth	
– 7	A298	Variator Adjustment Knob	

Figure 5. Correction Motor Assembly

SPECIFICATIONS - 115 VOLT AC-DC
SERIES WOUND MOTOR
INTERMITTENT DUTY
1/20 HP
5000 RPM
20 INCH-OZ 1.2 AMPS
4 LEAD REVERSIBLE

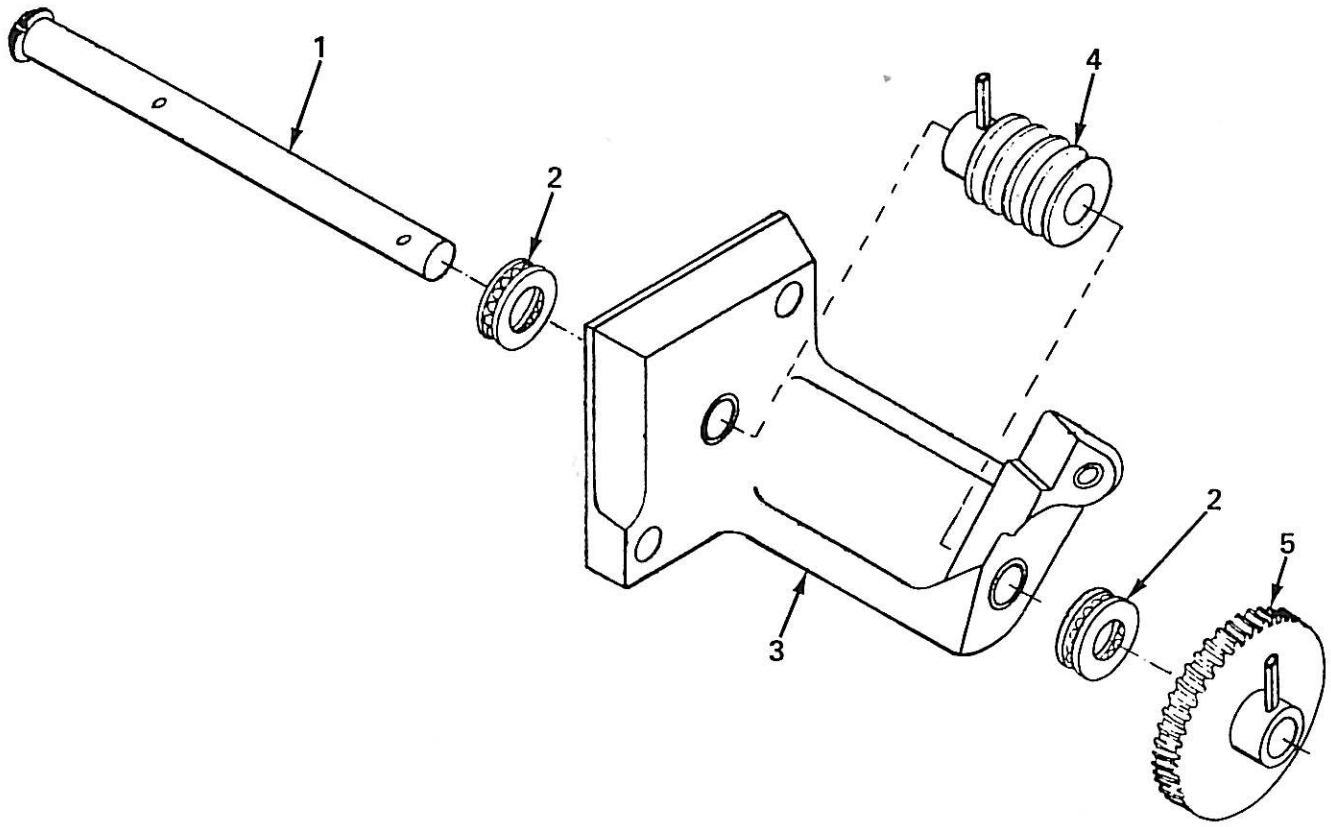


NOTE:
TO CHANGE MOTOR
ROTATION, REVERSE
FIELD WIRING.

UNIT
CORRECTION MOTOR ASSEMBLY

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
5 –	20890BCM	Correction Motor Assy	Ref
– 1	B2020	Motor	1
– 2	A217	Brushes	2
– 3	A239-60	Screw, Flat Hd, 10-32 x 5/8	4
– 4	B1819	Armature with Bearings	1
– 5	B1256	Mount Plate	1
– 6	B267	Worm, Single Thread, RH	1
– 7	A254-10	Pin, Spring, 3/32" Dia x 1/2" Lg	1
– 8	A232	Cap	2
– 9	A231	Brush Holder	2
– 10	A128	Oil Seal	1

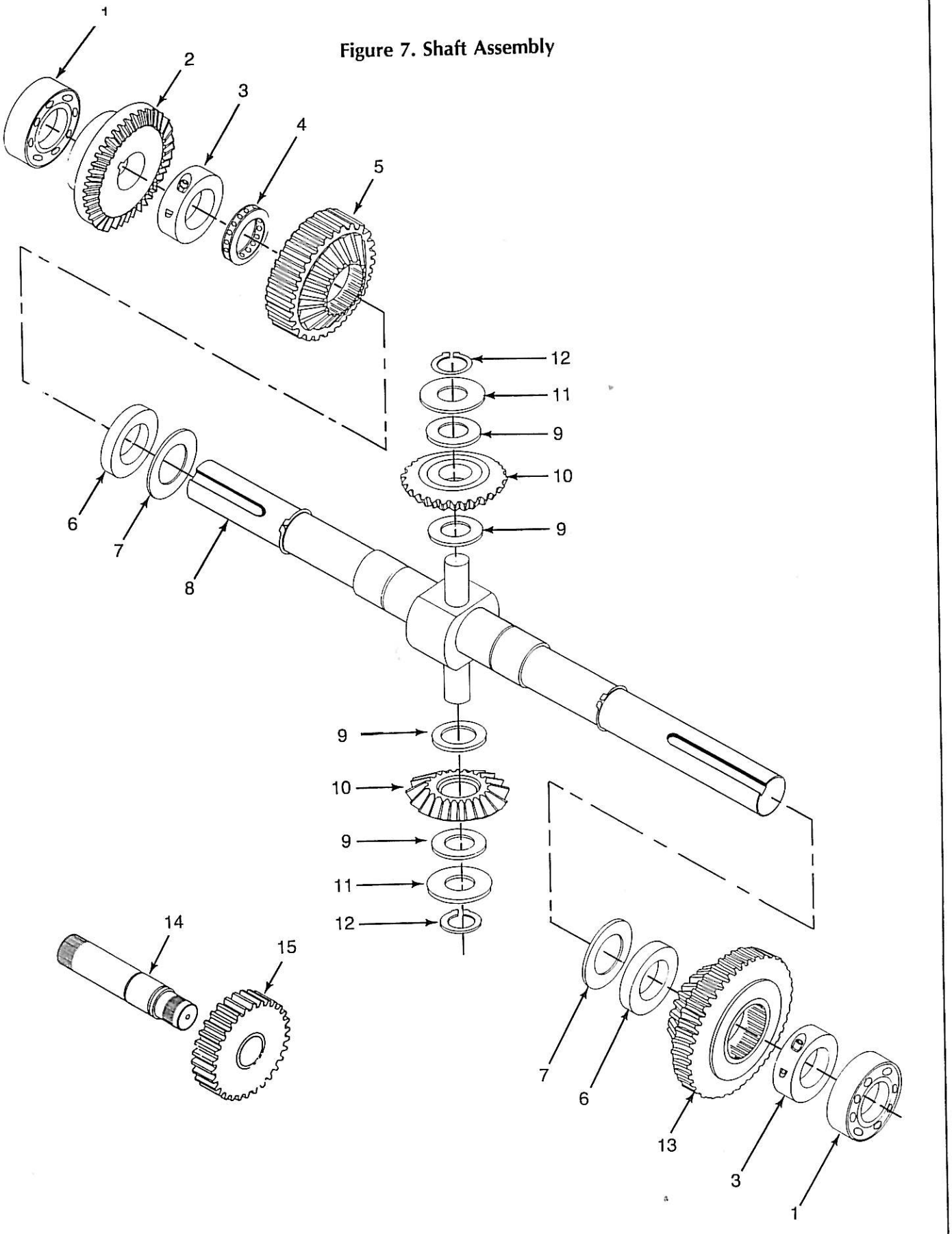
Figure 6. Reduction Bracket Assembly



UNIT
REDUCTION BRACKET ASSEMBLY

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
6 –	C1413	Reduction Bracket Assy	Ref
– 1	B279	Shaft, Reduction	1
	A109	Ring, Retaining	1
– 2	A179	Bearing, Ball, Thrust	2
– 3	D124	Bracket, Reduction	1
	A191	Bushing, Bronze	2
	A186	Bushing, Bronze	1
– 4	B268	Gear, Worm	1
	A254-50	Pin, Spring, 5/32 Dia x 3/4 Lg	1
– 5	B266	Gear, Worm Gear	1
	A254-50	Pin, Spring, 5/32 Dia x 3/4 Lg	1

Figure 7. Shaft Assembly



UNIT
SHAFT ASSEMBLY

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
7 –	C1510	Main Shaft Assembly Output (Type 2 & 4)	Ref
7 –	C1509	Main Shaft Assembly Input (Type 3 & 4)	Ref
7 –	C1507	Main Shaft Assembly Input (Type 1 & 2)	Ref
7 –	C1508	Main Shaft Assembly Output (Type 1 & 3)	Ref
7 –	C1511	Main Shaft Assembly Input (Type 5)	Ref
7 –	C1512	Main Shaft Assembly Output (Type 5)	Ref
– 1	A137	Bearing, Ball	2
– 2	B261	Gear, Bevel (Input Shaft Only)	1
– 3	A279	Lock, Collar	2
– 4	A178	Bearing, Thrust	2
– 5	C1503	Gear Assembly — Miter — Spur with A311 Needle Bearing	1
– 6	B2299	Spacer, Main Shaft	
– 7	A315	Shim Kit Main Shaft	1
– 8	B2313-1	Main Shaft Subassembly Input (Type 1 & 2)	1
	B2313-2	Main Shaft Subassembly — Output (Type 2 & 4)	
	B2313-3	Main Shaft Subassembly Output (Type 1 & 3)	1
	B2313-4	Main Shaft Subassembly Input (Type 3 & 4)	1
– 9	A313	Spacer, Pinion	4
– 10	C1514	Gear — Spider Assembly with A309 Cup Bearing and A308 Cone Bearing	2
– 11	A314	Shim Kit Pinion Shaft	1
– 12	A312	Ring, Retainer	2
– 13	C1501	Gear Assembly, Miter — Worm With A311 Needle Bearing	1
– 14	C1497	Gear, Idler	1
– 15	B281	Shaft, Idler With Retainer Ring	1
– 5	C1505	Gear Assembly, Miter Spur used in place of C1503 when DDT is opposite rotation style	1

Figure 8. Length Motor/Limit Switch Assembly (Optional Equipment)

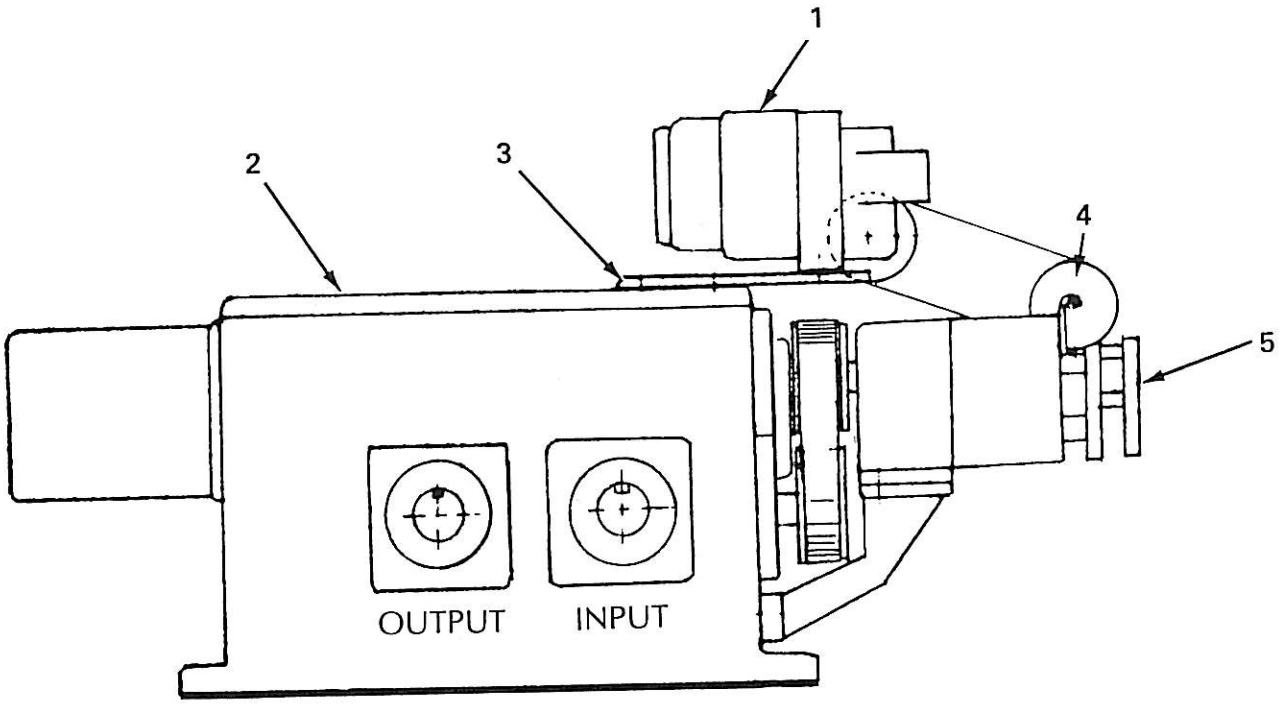
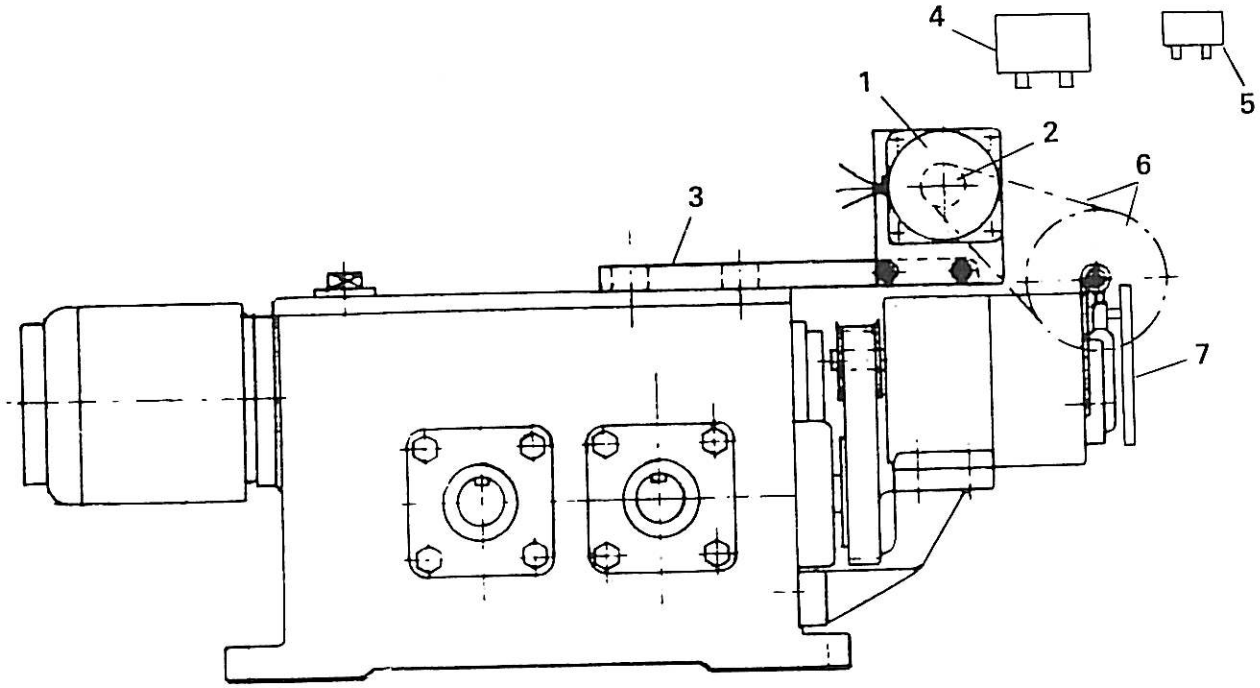


Figure 8A. Brushless Stepping Length Motor/Limit Switch Assembly



UNIT
LENGTH MOTOR/LIMIT SWITCH ASSEMBLY
(OPTIONAL EQUIPMENT)

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
8 –	C1195	Length Motor/Limit Switch Assembly	Ref
– 1	2665	Length Motor Assembly	1
– 2	C988	Plate, Cover DDT	1
– 3	B695	Plate, Mounting, Length Motor A211 A212	1
– 4	C1199	Sprocket, Chain & Link Assembly	1
– 5	C1200	Limit Switch Assembly (See Figure 10 for Breakdown)	1
8A –	C1354	Brushless Stepping Length Motor Assy	1
– 1	B1992	Brushless Stepping Motor 115V AC, 60HZ, 72R	1
– 2	B1991	Sprocket w/ 8/32 x 3/16 Set Screw	1
– 3	B1989	Mounting Bracket	1
– 4	01-20	Capacitor, 0.75 MFD, 330V	1
– 5	02-31	Resistor, 50 Ohms, 5 Watts	1
– 6	C1199	Sprocket, Chain, Link	1
– 7	C1200	Limit Switch Assembly (See Figure 10 for Breakdown)	1

UNIT
2665 LENGTH MOTOR

FIG & ITEM NO.	PART NO.	DESCRIPTION	QTY REQ'D
9 –	2665	Length Motor Assembly	1
– 1	B-238	Motor Gearhead (2665)	1
– 2	B696-1	Bushing	1
– 3	B696-2	Sprocket	1
– 4	A-247-10	Washer, Spring	5
– 5	B698	Spacer	1
– 6	A-263-20	Nut, Hex, Self Locking 1/4-28	1
– 7	A-263-10	Nut, Hex, Self Locking 1/4-20	1
– 8	A-254-10	Pin, Spring, 3/32 x 1/2	1

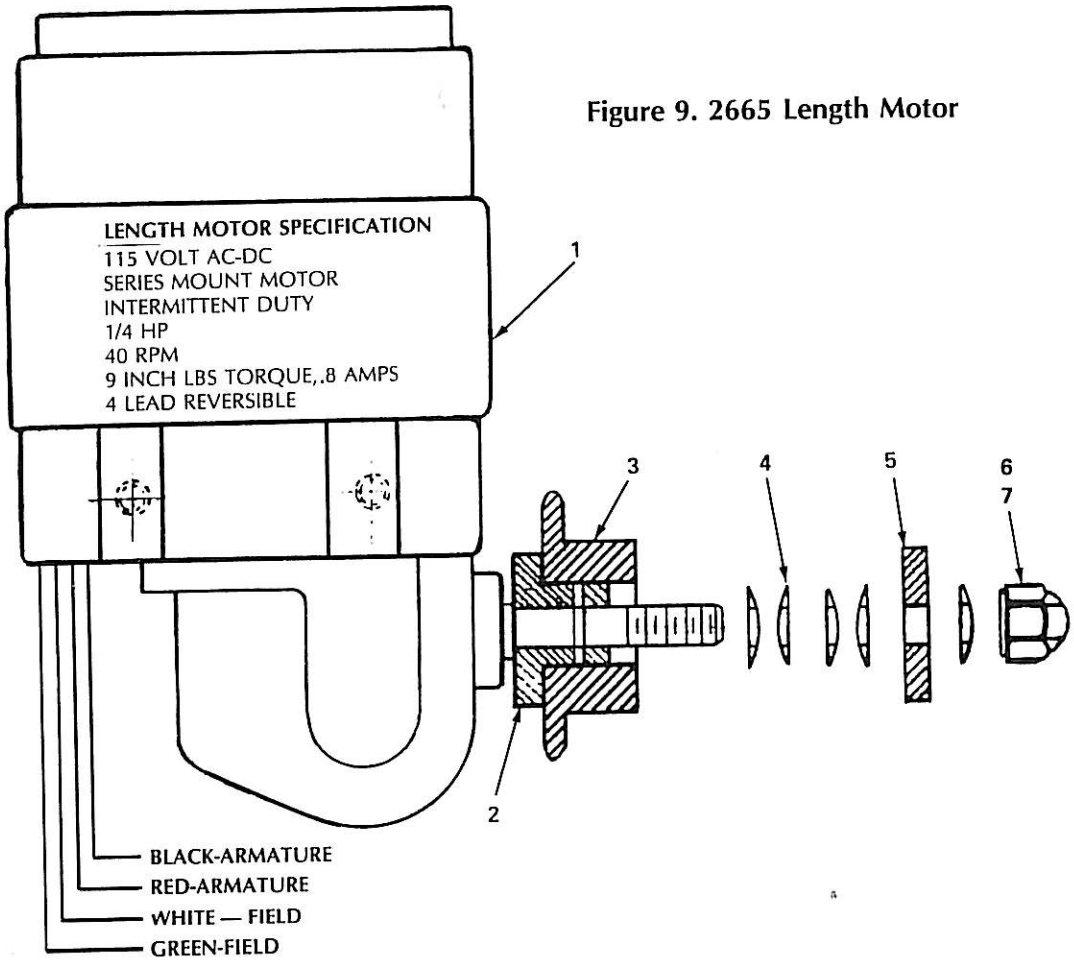


Figure 9. 2665 Length Motor

UNIT
CONVERSION KIT FOR
-5.6 CORRECTION(OPTIONAL)

FIG. & ITEM NO	PART NO.	1 2 3 4 DESCRIPTION	QTY REQ'D
11–	C1278	Conversion Kit For –5.6% Correction	Ref
–1	B1874	Spur Gear, Driven, 18 Teeth	1
–2	B1875	Change Gear, Driver, 42 Teeth	1
–3	B1878	Pulley, Driven, 10 Teeth	1
–4	B1879	Pulley, Driver, 26 Teeth	1
–5	D125-1	Bracket, Mount	1

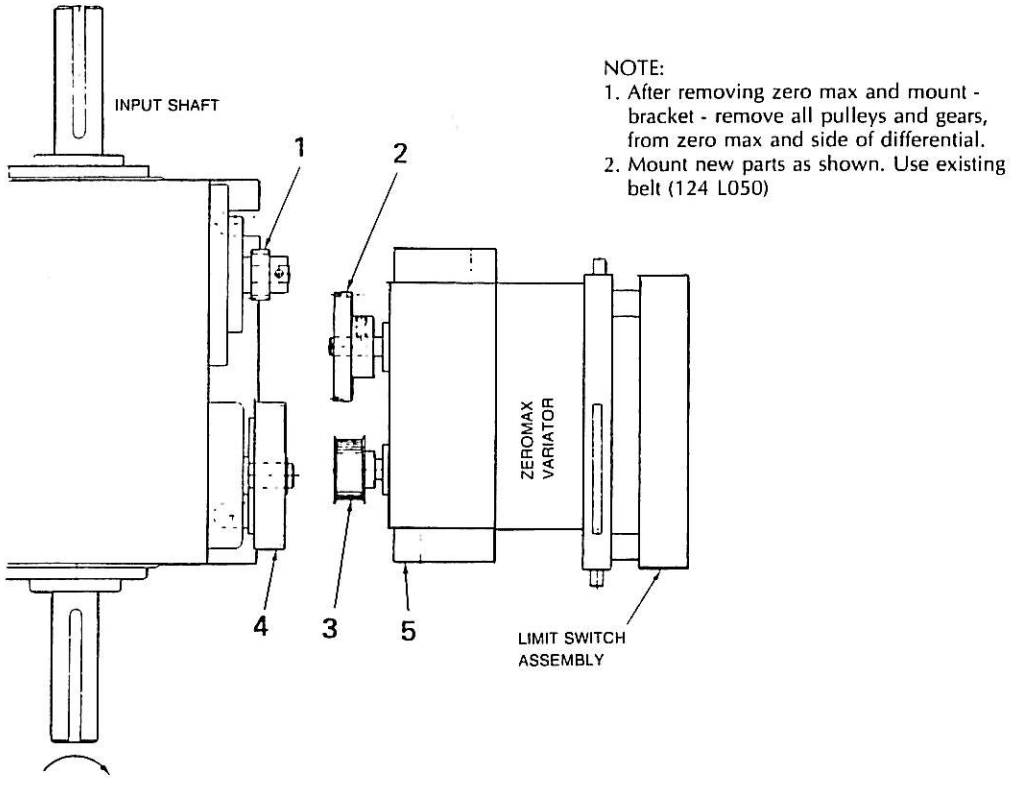
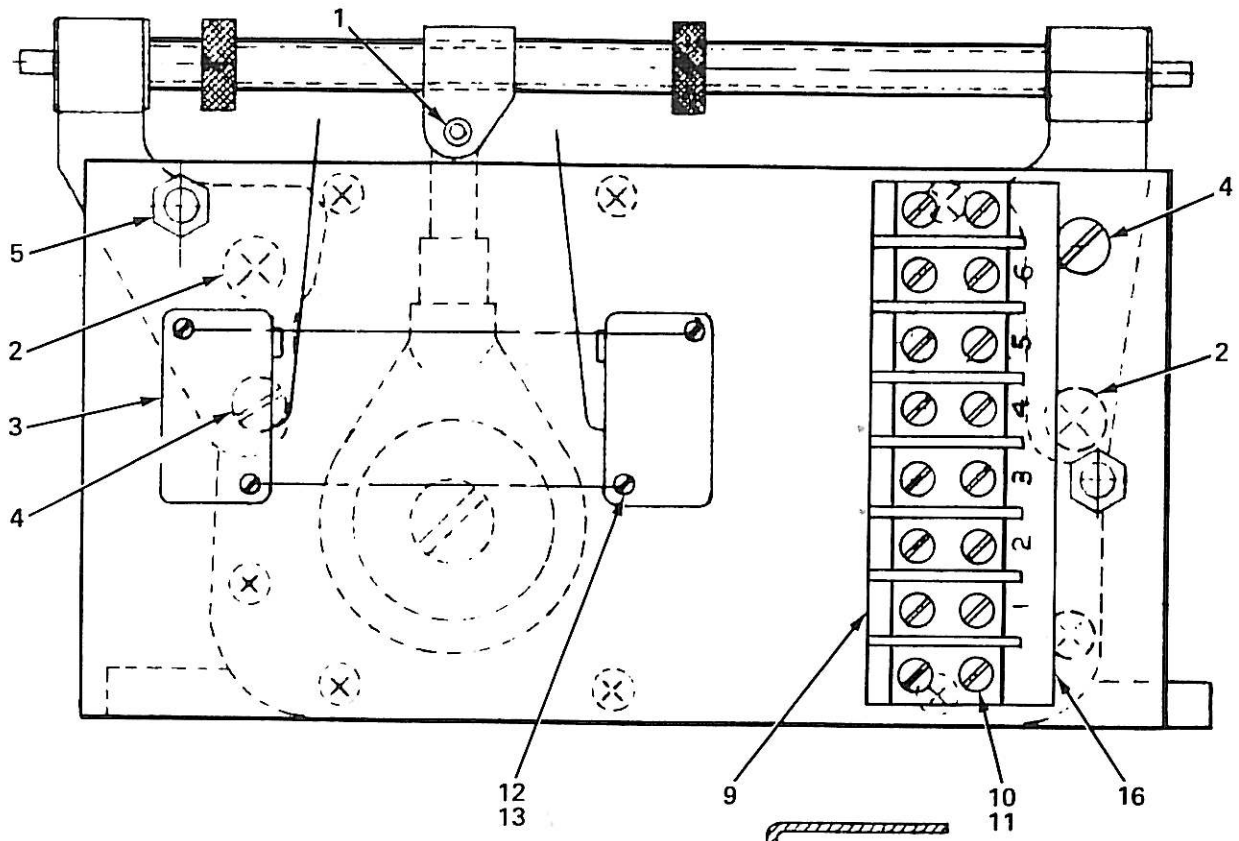
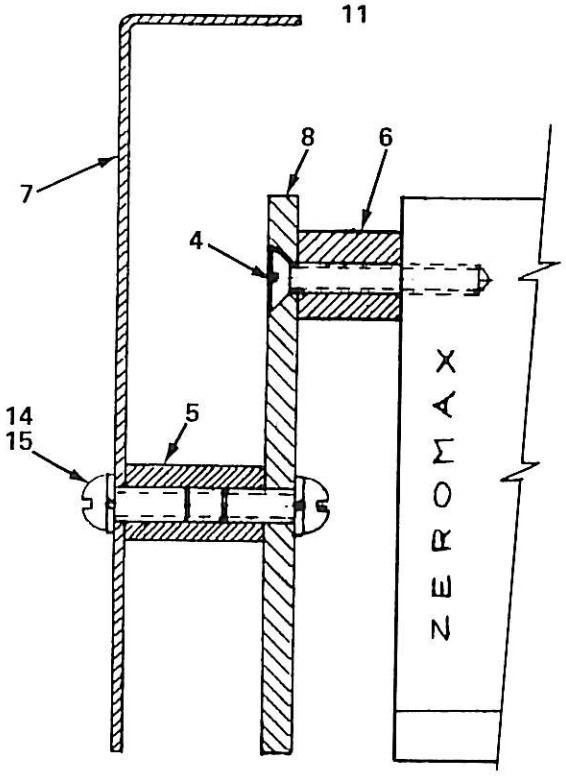


Figure 11. Conversion Kit for –5.6% Correction (Optional Equipment)

Figure 10. Limit Switch Assembly C1200





1. Remove screw control (4 screws, Items 2 & 4). Replace with new screw control kit (supplied with pin) using only two screws (Item 2).
2. Mount mounting plate (Item 8) to zeromax using two flat HD machine screws (Item 4) and spacers (Item 6).
3. Adjust limit switches to desired position.
4. Secure guard cover (Item 7) to threaded spacers (Item 5).