

BULLETIN 295B

TECHNICAL MANUAL

MOTOR UNITS

CONTENTS

**DESCRIPTION AND
PRINCIPLES OF OPERATION**

ADJUSTMENTS

LUBRICATION

PARTS



**TELETYPE[®]
CORPORATION**

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INTRODUCTION

Bulletin 295B is a technical manual that provides descriptive and maintenance information for the Motor Units.

The bulletin is made up of a group of appropriate independent sections. They are separately identified by title and section number. The pages of each section are numbered consecutively, independent of other sections.

The identifying number of a section, a 9-digit number, appears on each page of the section in the upper left corner of left-hand pages and the upper right corner on right-hand pages.

The sections are arranged as shown in the table of contents on a following page. They are in ascending numerical order except where this is contrary to a logical presentation of material.

To locate specific information proceed as follows:

- Find the involved equipment in the first column of the table of contents.
- Find the type of information in the second column.
- The correct 9-digit number can then be found in the third column.
- Turn to Page 1 of the section where its contents can be found.



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MOTOR UNITS

DESCRIPTION AND PRINCIPLES OF OPERATION

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1. GENERAL

1.01 This section is reissued to include miniaturized motor units, and to incorporate the latest engineering information. Because of the general nature of the revision, marginal arrows that indicate changes have been omitted.

1.02 The motor units that provide electro-mechanical rotating motion for operating various teletypewriter apparatus are of two basic types: synchronous and series (governed). Both types are self-contained motor units, with characteristics adaptable for use with standard power sources.

1.03 The synchronous type motor units (Figures 1 and 2) are available in miniature (25 millihorsepower), standard, and heavy duty ratings. These motor units must be operated from a standard, single-phase, regulated power source with specifications as listed in Tables I and II.

1.04 The series (governed) type motor units (Figure 3) are available in standard and heavy duty horsepower ratings and may be operated from regulated or unregulated, standard, single-phase power sources, or dc (direct current). The series (governed) type motor unit is also available for operation with 48 volts dc only. Specifications are given in Table III.

2. DESCRIPTION

2.01 In general, the synchronous motor units consist of a motor and mounting arrangement, and the required starting and protective devices. Variations of this type are described below.

SYNCHRONOUS MOTOR UNITS

A. Miniature Synchronous Motor Units (Figure 1)

2.02 The 25 millihorsepower miniature synchronous motor units consist of a two-pole wound stator and two end shields that support a squirrel cage type rotor. The motor is secured to its bracket-type cradle by means of resilient mounts at each end, which tend to reduce the transmission of vibrations from the motor to the driven apparatus. A starting relay, capacitor and thermostatic cutout switch are mounted under the cradle. The thermostatic cutout switch protects the motor windings from excessive current drawn by the motor. It can be reset manually.

2.03 The variations of the miniature synchronous include 3600 rpm (60 cycle units) and 3000 rpm (50 cycle units) operation; an external fuse instead of the thermostatic cutout switch; single or dual air ducts to improve

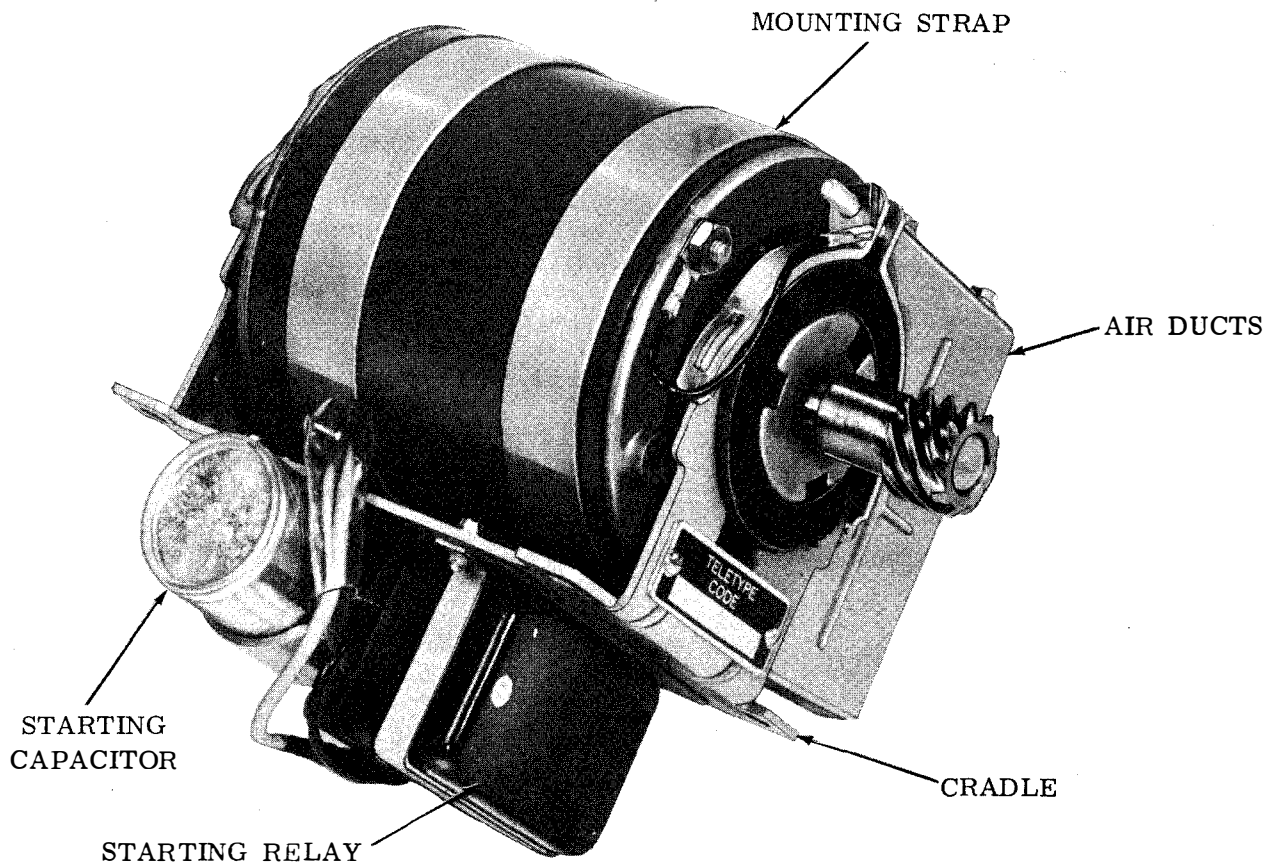


Figure 1 - Typical Miniature Synchronous Motor Unit

ventilation, or an air shield to isolate the incoming cool air from the outgoing heated air; and mounting of control parts on the side of the motor instead of under the cradle.

B. Standard and Heavy Duty Synchronous Motor Units (Figure 2)

2.04 The standard and heavy duty synchronous motor units consist of a two pole wound stator and two end shields that support a ball bearing rotor. A combination hand wheel and fan is mounted on the motor shaft, and two fans are mounted at each end of the rotor within the end shields. The opposite end of the shaft contains a tapped hole for mounting the driving gear. A motor starting relay, starting capacitor, and thermostatic cutout switch are mounted in a compartment of the motor mounting bracket. The thermostatic cutout switch, which is reset manually, protects the motor windings

from excessive current drawn by the motor. The motor is supported by resilient mounts which are part of the end shields and which are held in place by straps attached to the mounting bracket. The resilient mounts tend to reduce the transmission of vibration from the motor to the driven associated apparatus.

2.05 Variations of the standard and heavy duty synchronous motor units include: 3600 rpm (60 cycle units) and 3000 rpm (50 cycle units) operation; 1/20 and 1/12 horsepower ratings; replacement of the fan with a gear to reverse the direction of rotation for such applications as the high speed punch unit; inverted mounting for installation in the Wall Mounted Page Printer Set, for example; re-location of control parts to meet varying installation requirements as in the Multiple KSR and RO Set where the control parts are mounted in a compartment at the rear of the fan.

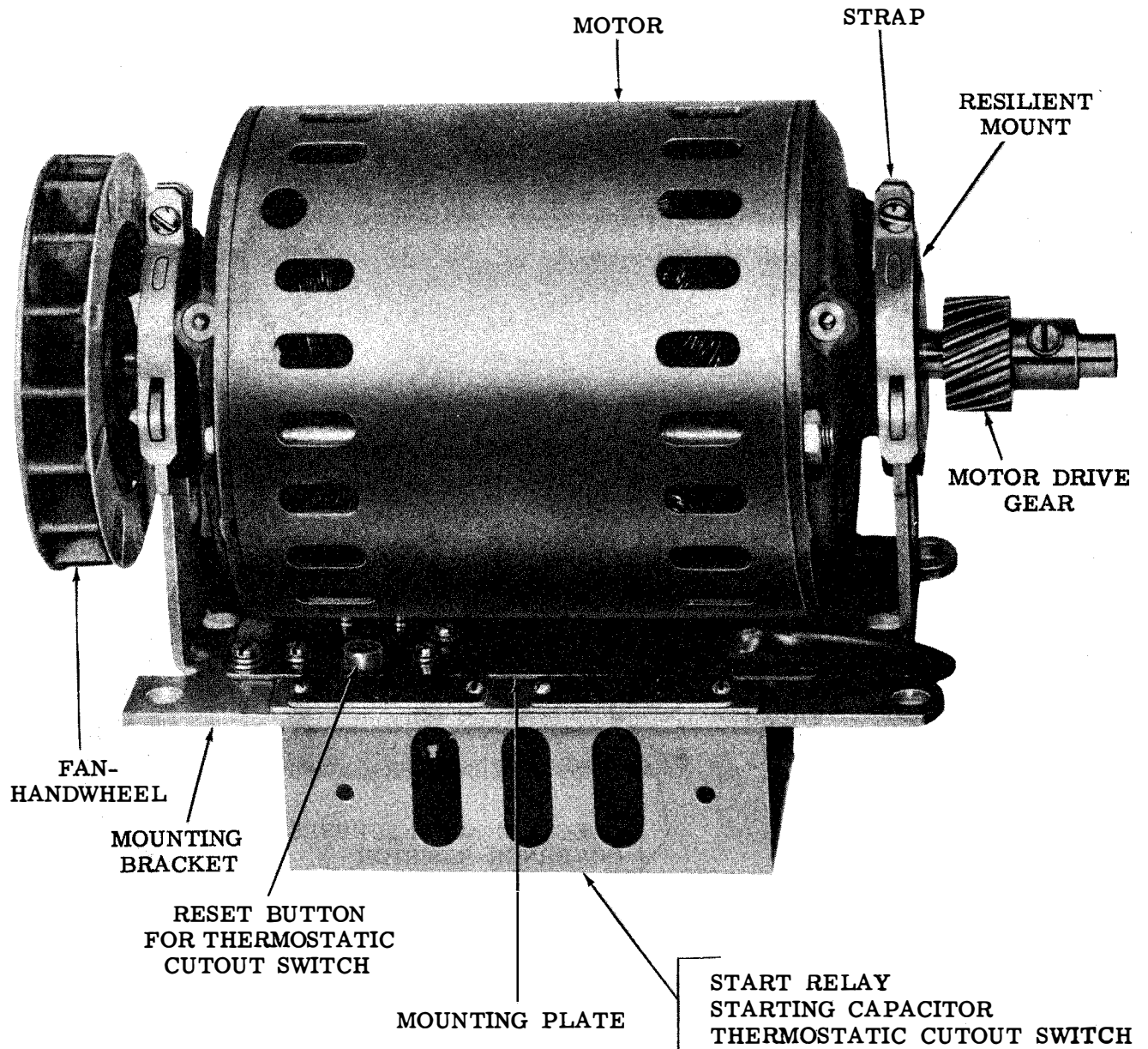


Figure 2 - Typical Standard or Heavy Duty Synchronous Motor Unit

SERIES (GOVERNED) MOTOR UNITS (Fig. 3)

2.06 The series (governed) motor units typically consist of a motor, speed regulator (governor), protective and control devices, and a mounting. Variations of this type are described below.

A. 1/20 Horsepower Motor Units (AC/DC)

2.07 The 1/20 hp series (governed) motor unit consists of a series type motor, speed

governor, motor mounting bracket, and a housing for the governor resistors and spark suppression capacitor. The governor is mounted on an extension of the armature shaft and includes a fan that circulates air through the motor. The opposite end of the shaft contains a tapped hole for mounting the driving gear. Targets for speed checking purposes are provided on the governor cover. The motor is mounted by means of resilient mounts at each end shield that are fastened to the mounting bracket by straps.

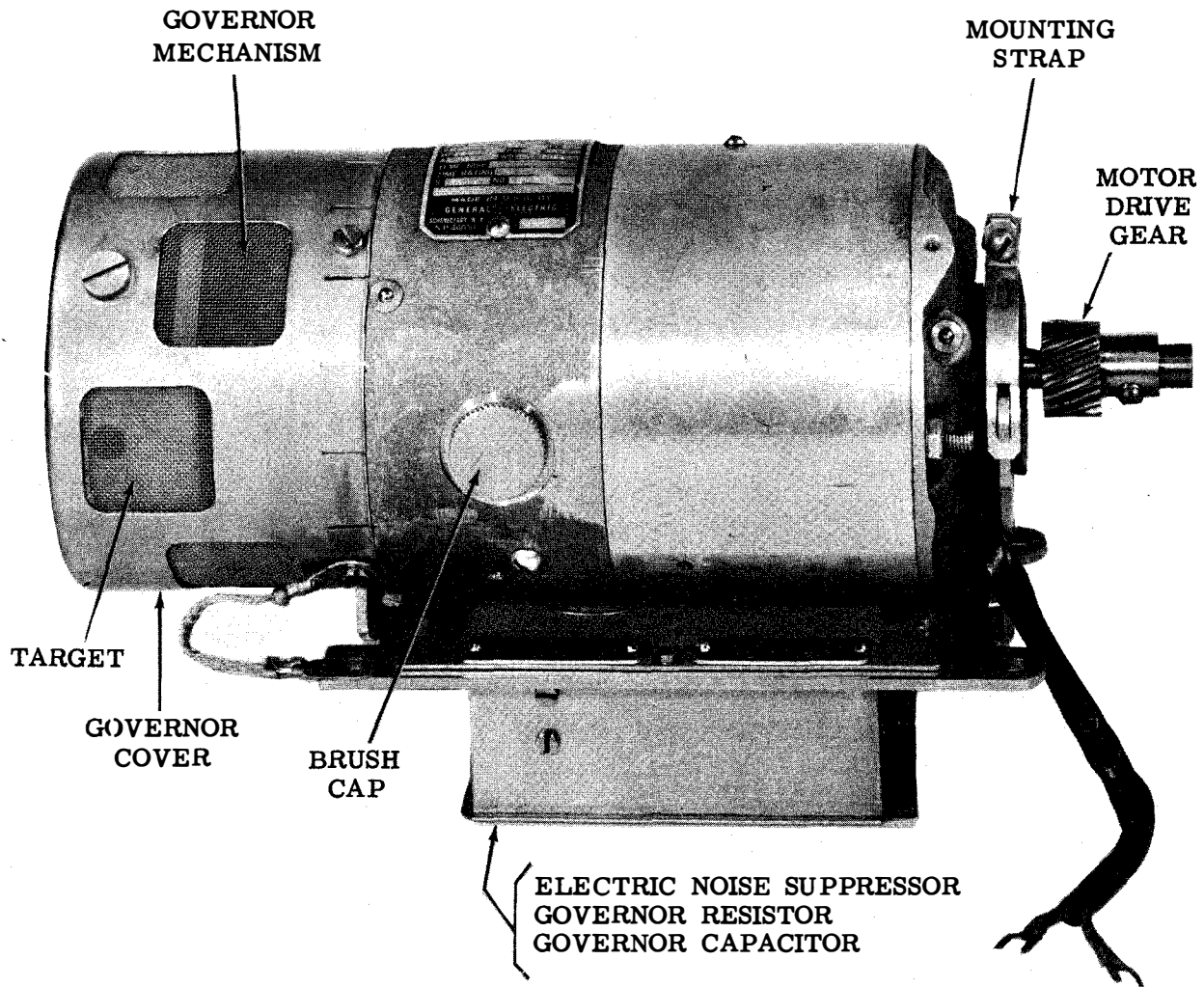


Figure 3 - Typical Series (Governed) Motor Unit

2.08 A variation of the motor unit described in 2.07 is available with electrostatic shielding and radio frequency noise suppression.

B. 1/15 Horsepower Motor Units (AC/DC)

2.09 These motor units are similar to the units described in 2.07, but are equipped with electrostatic shielding and radio frequency

noise suppression. The higher horsepower rating accommodates, for example, the requirements of the Automatic Send-Receive Set.

C. 1/15 Horsepower Motor Units (DC)

2.10 These motor units are designed to operate with 48 volts dc only and are equipped with electrostatic shielding and radio frequency noise suppression.

TABLE 1. TECHNICAL CHARACTERISTICS OF MINIATURE SYNCHRONOUS MOTOR UNITS

CHARACTERISTICS	LMU19, LMU20, LMU24, LMU26, LMU31, LMU45, MU43 (Bell 28F)	LMU35, LMU40
Rated Horsepower	25 Millihorsepower	25 Millihorsepower
Input Voltage	115 \pm 10% AC	115 \pm 10% AC
Phase	Single	Single
Frequency	60 Cycles, \pm 0.75%	50 Cycles, \pm 1%
Input Current (Full Load - Amperes)		
Starting	4.0-5.0	3.0
Running	1.25	0.47
Power Factor (Full Load)		89%
Watts Input (Full Load)		50
Start Capacitor	88-108UF (130-156UF, MU43 (Bell 28F))	64-77
Run Capacitor	-	7.0
Speed	3600 RPM	3000 RPM
Rotation	Clockwise viewed from pinion end	Clockwise viewed from pinion end
Mounting	Upright	Upright
Other Distinguishing Characteristics	<p>LMU19 - Relay, capacitor, and thermostatic cutout switch mounted on motor bracket.</p> <p>LMU20, LMU26 - Relay, capacitor, and thermostatic cutout switch mounted on motor bracket. LMU20 has single ventilator, LMU26 none.</p> <p>LMU24 - Twin exhaust ducts. Relay and capacitor mounted on motor bracket. No thermostatic cutout switch. Fused externally. Latest design have double shaft.</p> <p>LMU31 - Capacitor and thermostatic cutout switch mounted on motor bracket. Relay mounted on bracket assembly.</p> <p>LMU45, MU43 (Bell 28F) - Relay, thermostatic cutout switch mounted on motor bracket. Capacitor mounted on motor shield. Wiring for external start switch noise suppressor (LMU45 only).</p>	<p>LMU35, LMU40 - Contain no thermostatic cutout device. Fused (0.8A) externally. Relay and capacitors mounted on motor mounting bracket. Equipped with an air shield.</p>

TABLE 2. TECHNICAL CHARACTERISTICS OF STANDARD AND HEAVY DUTY SYNCHRONOUS MOTOR UNITS

CHARACTERISTICS	LMU3 (Bell 28A), LMU15 (Bell 35A), LMU21 (Bell 28LA), LMU30, LMU37, LMU42, LMU46	LMU33, LMU36, LMU38, LMU51, LMU52	LMU11, LMU12 (Bell 28C)	LMU50
Rated Horsepower	1/20	1/20	1/12	1/12
Input Voltage	115 \pm 10%, AC	115 \pm 10%, AC	115 \pm 10%, AC	115 \pm 10%, AC
Phase	Single	Single	Single	Single
Frequency	60 Cycles, \pm 0.75%	50 Cycles, \pm 0.75%	60 Cycles, \pm 0.75%	50 Cycles, \pm 0.75%
Input Current (Amperes)				
Starting	9.0	9.0	12.25	14.5
Running	1.85	2.4	2.8	2.8
Power Factor (Full Load)	30%	35%	44.75%	46.8%
Watts Input (Full Load)	65	107	132.9	150
Heat Dissipation (Watts)	50	70	70.6	63.38
Start Capacitor Rating	43-48 UF	43-48 UF	170-226 UF	161-193 UF
Speed	3600 RPM	3000 RPM	3600 RPM	3000 RPM
Rotation	LMU42 CW, others CCW viewed from fan or short shaft end.	CCW viewed from fan or short shaft end.	CCW viewed from fan end.	CCW viewed from fan end.
Mounting	All upright except LMU27 and LMU30 which are inverted.	All upright except LMU36 which is inverted.	LMU11 - Inverted LMU12 (Bell 28C) - Upright	Upright
Other Distinguishing Characteristics	LMU3 (Bell 28A) - Control parts in compartment under motor. Fan cooled. Thermostatic cut-out switch. Latest design have more compact control parts arrangement.	LMU33 - Similar to LMU3 (Bell 28A). No fan. LMU36 - Similar to LMU3 (Bell 28A) except for inverted mounting with control parts above motor.	LMU11 - Control parts located above motor for inverted mounting. Fan cooled. Thermostatic cut-out switch.	Similar to LMU11 but with control parts in motor mounting cradle. Starting relay is voltage sensitive type.

TABLE 2. TECHNICAL CHARACTERISTICS OF STANDARD AND HEAVY DUTY SYNCHRONOUS MOTOR UNITS - Continued

CHARACTERISTICS	LMU3 (Bell 28A), LMU15 (Bell 35A), LMU21 (Bell 28LA), LMU30, LMU37, LMU42, LMU46	LMU33, LMU36, LMU38, LMU51, LMU52	LMU11, LMU12 (Bell 28C)	LMU50
<p>Other Distinguishing Characteristics - Continued</p>	<p>LMU15 (Bell 35A) - Same as LMU3 (Bell 28A) except no fan. Pinion on short shaft end.</p> <p>LMU21 (Bell 28LA) - Same as LMU3 (Bell 28A) except control parts at rear of fan.</p> <p>LMU30 - Same as LMU3 (Bell 28A) except for inverted mounting with control parts above motor.</p> <p>LMU37 - Same as LMU3 (Bell 28A) except for more compact cradle and mounting arrangement. Control parts on side of motor.</p> <p>LMU42 - Same as LMU3 (Bell 28A) except cradle and mounting arrangement is more compact and control parts are in a bracket on side of motor.</p> <p>LMU46 - Same as LMU3 (Bell 28A) except for wiring for motor start relay arc suppressor.</p> <p>LMU49 - Same as LMU3 (Bell 28A) but with speed sensing device.</p>	<p>LMU38 - Differs from LMU3 (Bell 28A) only in power frequency.</p> <p>LMU51 - Similar to LMU3 (Bell 28A) except for more compact cradle and mounting arrangement. Fan reversed (solid side adjacent to end bell).</p> <p>LMU52 - Similar to LMU3 except control parts mounted at rear of fan.</p>	<p>LMU12 (Bell 28C) - Same as LMU11 but with control parts located in motor mounting cradle and end shields rotated 180° for upright mounting.</p>	

SECTION 570-220-100

TABLE 3. TECHNICAL CHARACTERISTICS OF SERIES (GOVERNED) MOTOR UNITS

CHARACTERISTICS	LMU6 (Bell 28B), LMU28, LMU41	LMU13, LMU32, LMU39	LMU23, LMU29 (Bell 28E)	
Rated Horsepower	1/20	1/15	1/15	
Input Voltage	115 \pm 10%, AC/DC	115 \pm 10%, AC/DC	48 \pm 10%, DC	
Phase	Single	Single	-	
Frequency	25, 50, or 60 cycles, or DC	25, 50, or 60 cycles, or DC	-	
Input Current (Full Load - Amperes)	Cycles			
	<u>25</u> <u>50</u> <u>60</u> <u>DC</u>	<u>25</u> <u>50</u> <u>60</u> <u>DC</u>		
Starting	2.4 2.7 1.9 1.8	4.5 4.0 2.8 3.4	13.5	
Running	1.18 1.34 1.12 0.93	2.1 2.3 1.8 1.7	2.5	
Power Input (Watts)	123 114 92 1.07	235 200 190 195	120	
Power Factor (Full Load)	90% 74% 71% -	96.8% 87% 79% -	-	
Heat Dissipation (Watts)	86 87 55 70	130 97.2 94.2 111	66	
Series Resistor (Ohms)	25 - - 50	12 - - 20	-	
Target Indicator	4, 6, and 35 Spot	4, 6, and 35 Spot	4, 6, and 35 Spot	
Governed Speed	3600 RPM	3600 RPM	3600 RPM	
Rotation	CCW viewed from commutator end	CCW viewed from commutator end	CCW viewed from governor end	
Mounting	Upright	LMU13, LMU32 - Inverted LMU39 - Upright	LMU23 - Inverted LMU29 - Upright	
RF Shielding	LMU28, LMU41	LMU32, LMU39	LMU29 (Bell 28E)	
RF Suppression	LMU28, LMU41	LMU32, LMU39	LMU29 (Bell 28E)	
Other Distinguishing Characteristics	Control parts com- partment rectangular on LMU6 (Bell 28B) and LMU28 and LMU41 governor resistor mounted on heat sink.	LMU39 governor resistor mounted on a heat sink. LMU13, LMU32 cradle com- partments are rectangular.	No screened governor cover on LMU29 (Bell 28E)	

3. PRINCIPLES OF OPERATION

SYNCHRONOUS MOTOR UNITS (Figs. 1, 2, and 4)

3.01 The following description of operation applies to the miniaturized, standard, and heavy duty synchronous motor units.

3.02 The stator of the synchronous motor has two windings: a starting winding and an operating (or run) winding. The starting winding, starting capacitor and the normally-open contacts of the starting relay are connected in series. The coil of the current-operated starting relay is connected in series with the operating winding. When power is applied, the initial current through the operating winding (and also the starting relay coil) energizes the relay, and its contacts close the circuit to the starting

winding. As the speed of the rotor increases, the current in the operating winding decreases and, when the current has decreased to a predetermined magnitude, the starting relay deenergizes. Its contacts open and remove the starting winding from the operating circuit. The rotor continues to accelerate until it reaches the synchronous operating speed. Rotation is in the counterclockwise direction, as viewed from the fan or short-shaft end of the motor.

3.03 The thermostatic cutout switch is connected in series with both stator windings. This temperature operated device opens the circuit to these windings whenever excessive current is drawn, such as may occur if the motor is stalled, thereby preventing overheating and damage to the motor and control parts. The switch may be reset after the unit has cooled by depressing a pushbutton.

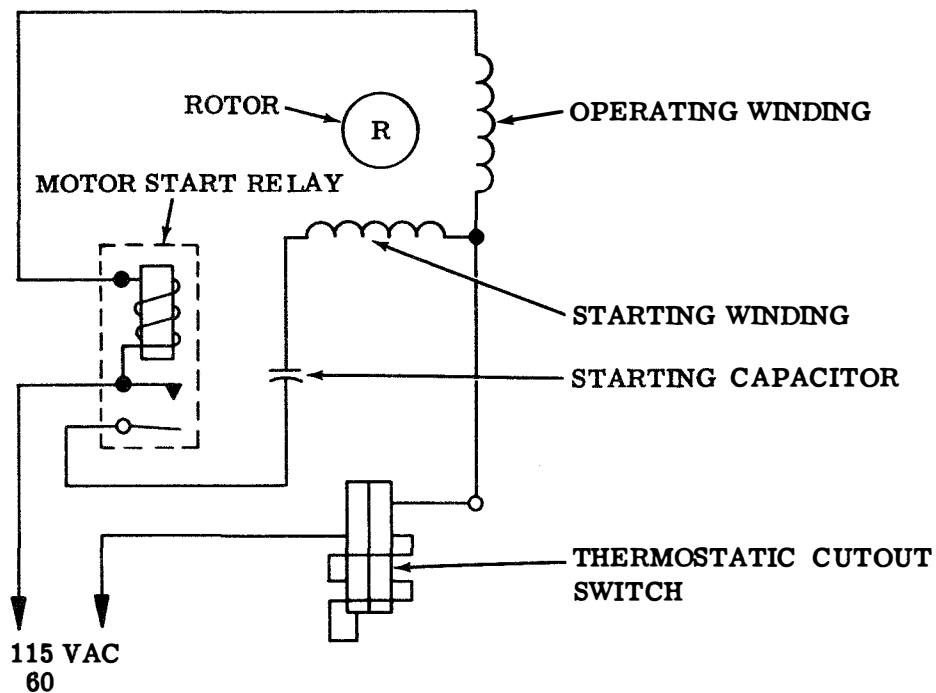


Figure 4 - Typical Synchronous Motor Unit Schematic Diagram

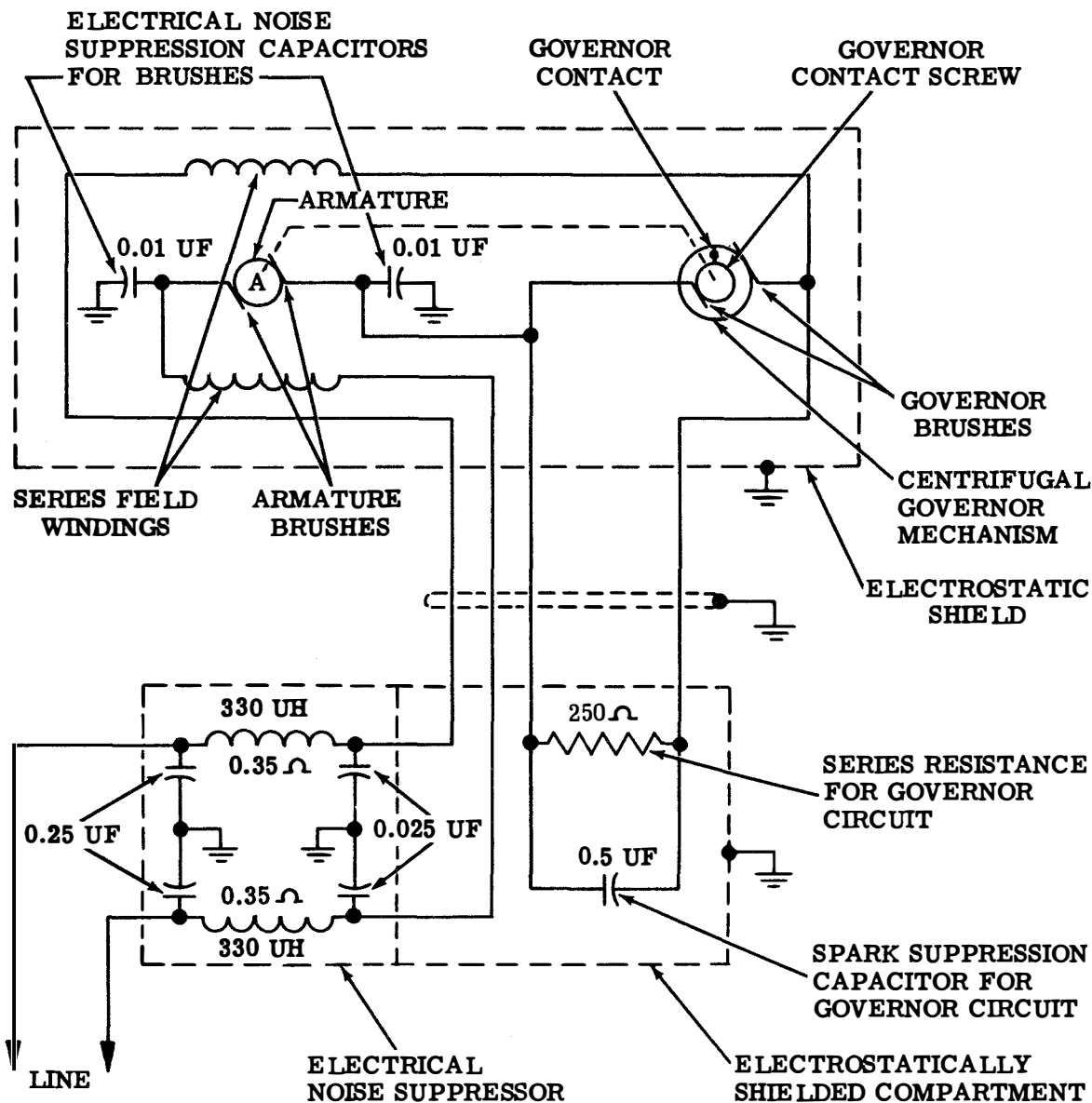


Figure 5 - Typical Series (Governed) Motor Unit Schematic Diagram

SERIES (GOVERNED) MOTOR UNITS (Figs. 3 and 5)

3.04 The following description of operation is applicable to all series (governed) motor units.

3.05 The series wound motor utilizes an electro-mechanical governor for speed regulation. The governor regulates the speed at 3600 rpm, ± 1 percent, by alternately increasing and decreasing the current in the series connected field windings and armature, which are also in series with a governor contact. A

resistor (high-wattage) and capacitor are connected in parallel with the governor contact. The contact is held closed under the tension of a spring which is adjusted to maintain this condition during speeds up to a predetermined rate. With the contact closed, the resistors are shorted out. When the speed of the motor exceeds the predetermined rate, the centrifugal force acting upon the contact momentarily overcomes the spring tension and the contact is opened. This removes the short from the resistors and they then appear in series with the field windings and armature, reducing their current, and consequently reducing the speed of the motor.

3.06 The tension on the contact spring is adjustable to maintain the motor speed at 3600 rpm. To make this adjustment, a target is provided to compare the motor speed with a standard. The outside surface of the governor cover is finished in white with three rows of black spots equally spaced about its periphery. The outer, center, and inner rows contain four, six, and thirty-five spots, respectively. The

four spot row is a target which should remain essentially stable at 3600 rpm, when viewed through the moving shutter of a 120 vibrations per-second tuning fork. The six spot and thirty-five spot rows serve as targets when using an 87.6 vibration-per-second tuning fork. The six spot row is used to approach an on-speed setting and the thirty-five spot row is used to arrive at an accurate setting of 3600 rpm.



MOTOR UNITS

ADJUSTMENTS

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Capacitor position	4		
Motor gear	2	1. GENERAL	
Motor positioning	2	1.01 This section is reissued to include ad- justments formerly given in other sec- tions, to include the latest engineering informa- tion, and to change the title. Since this revision is of a general nature, marginal arrows which indicate changes have been omitted.	
Motor shield	3	1.02 The adjustment information given in this section and the section covering general teletypewriter requirements and adjustments provide the information necessary for mainte- nance of the motor unit.	
3. STANDARD AND HEAVY DUTY SYNCHRONOUS MOTOR UNITS	5	1.03 The illustrations in this section show the adjusting tolerances, positions of moving parts, and spring tensions.	
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2. MINIATURIZED SYNCHRONOUS MOTOR UNITS

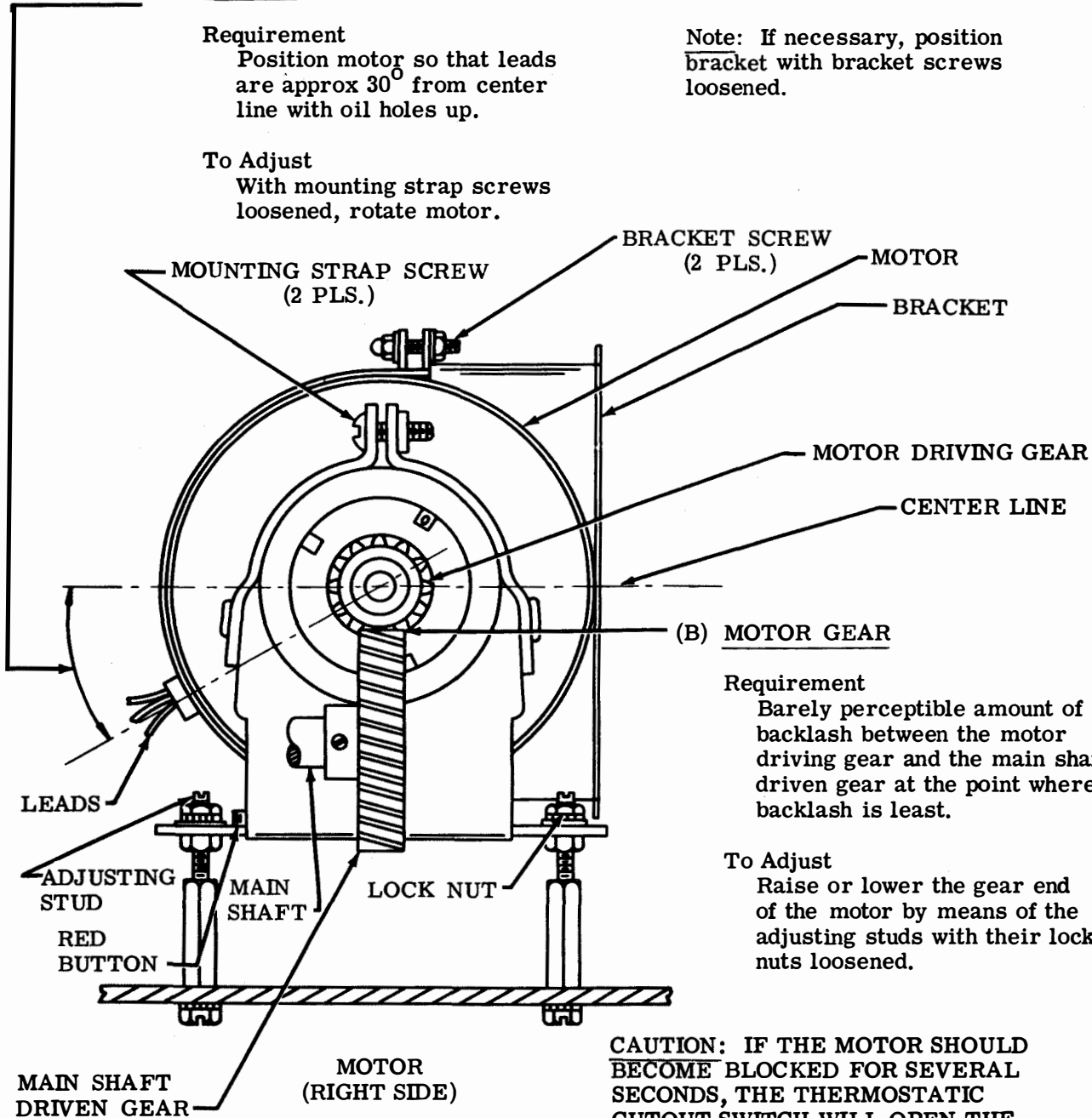
2.01 Motor Positioning

(A) MOTOR POSITIONING

Requirement
Position motor so that leads are approx 30° from center line with oil holes up.

Note: If necessary, position bracket with bracket screws loosened.

To Adjust
With mounting strap screws loosened, rotate motor.

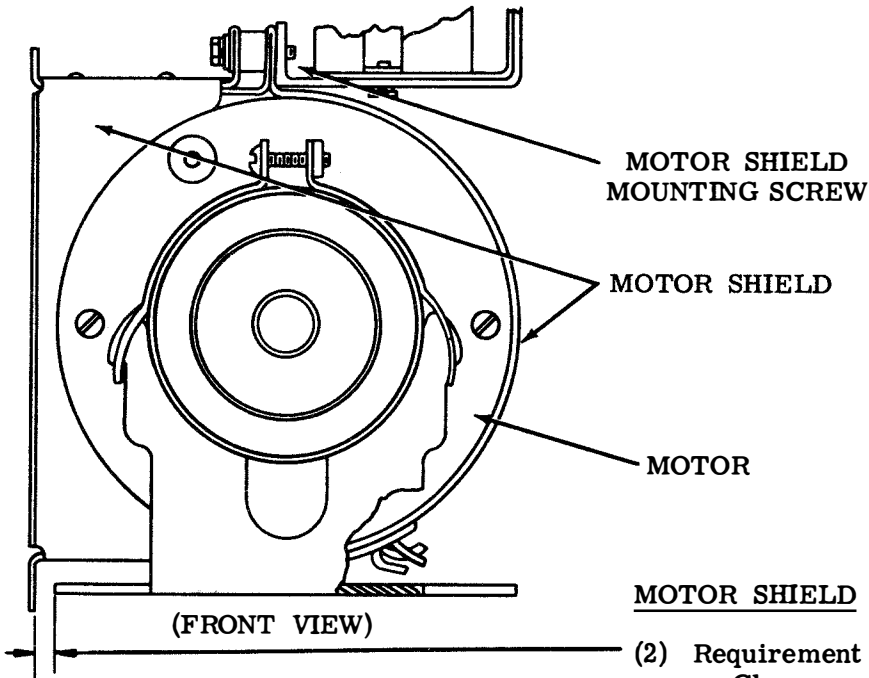


Requirement
Barely perceptible amount of backlash between the motor driving gear and the main shaft driven gear at the point where backlash is least.

To Adjust
Raise or lower the gear end of the motor by means of the adjusting studs with their lock nuts loosened.

CAUTION: IF THE MOTOR SHOULD BECOME BLOCKED FOR SEVERAL SECONDS, THE THERMOSTATIC CUTOUT SWITCH WILL OPEN THE CIRCUIT. SHOULD THIS HAPPEN, ALLOW MOTOR TO COOL AT LEAST 5 MINUTES BEFORE MANUALLY RESETTING THE SWITCH BY DEPRESSING THE RED BUTTON. AVOID REPEATED RESETTING.

2.02 Motor Shield



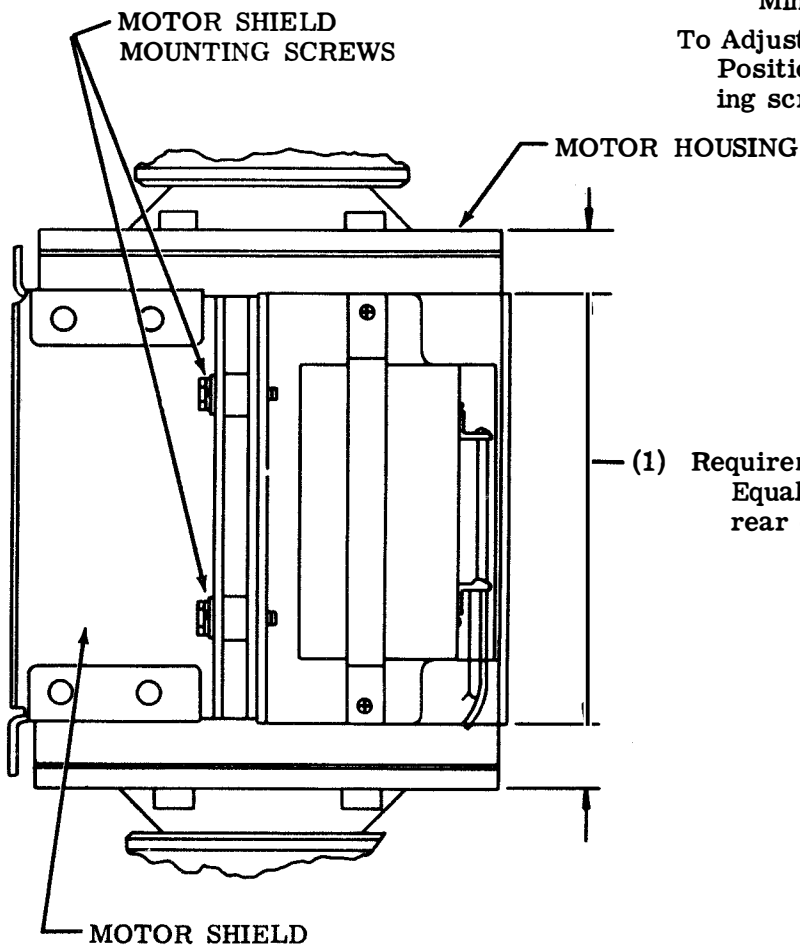
MOTOR SHIELD (IF SO EQUIPPED)

(2) Requirement

Clearance between motor shield and motor mounting bracket should be
Min 0.062 inch

To Adjust

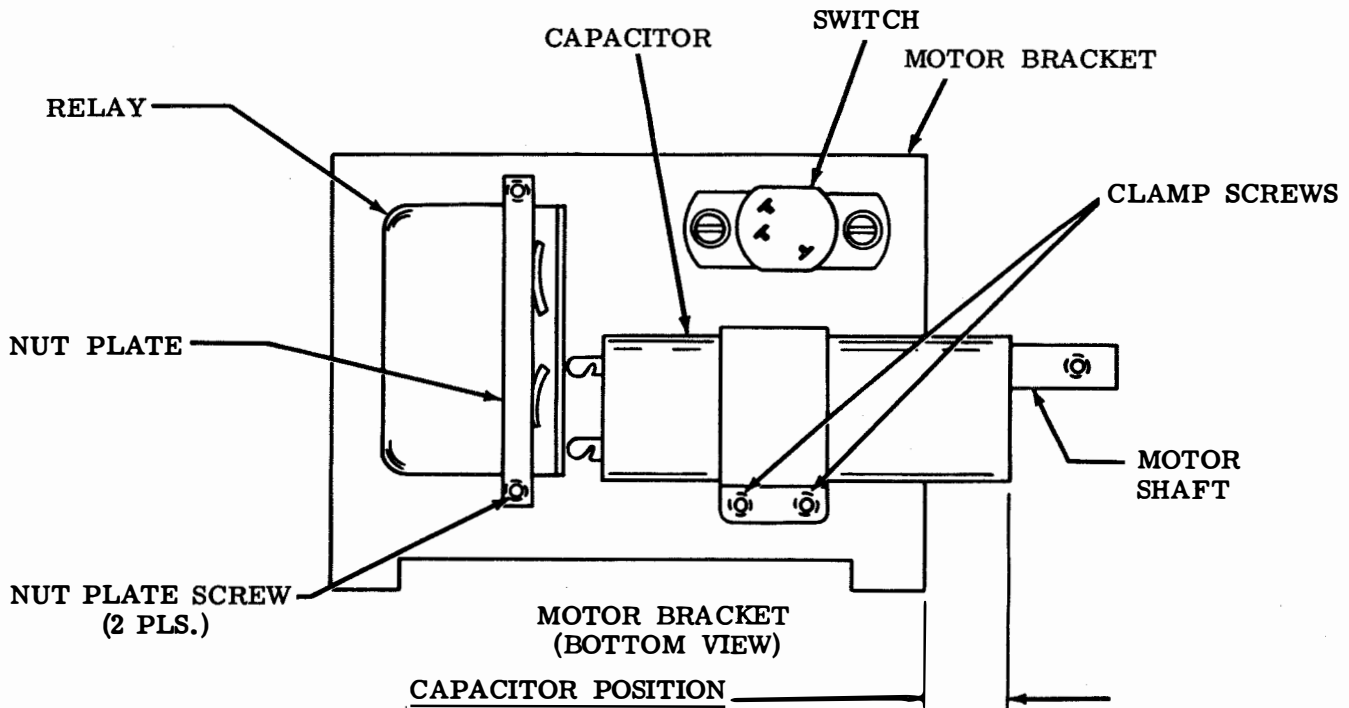
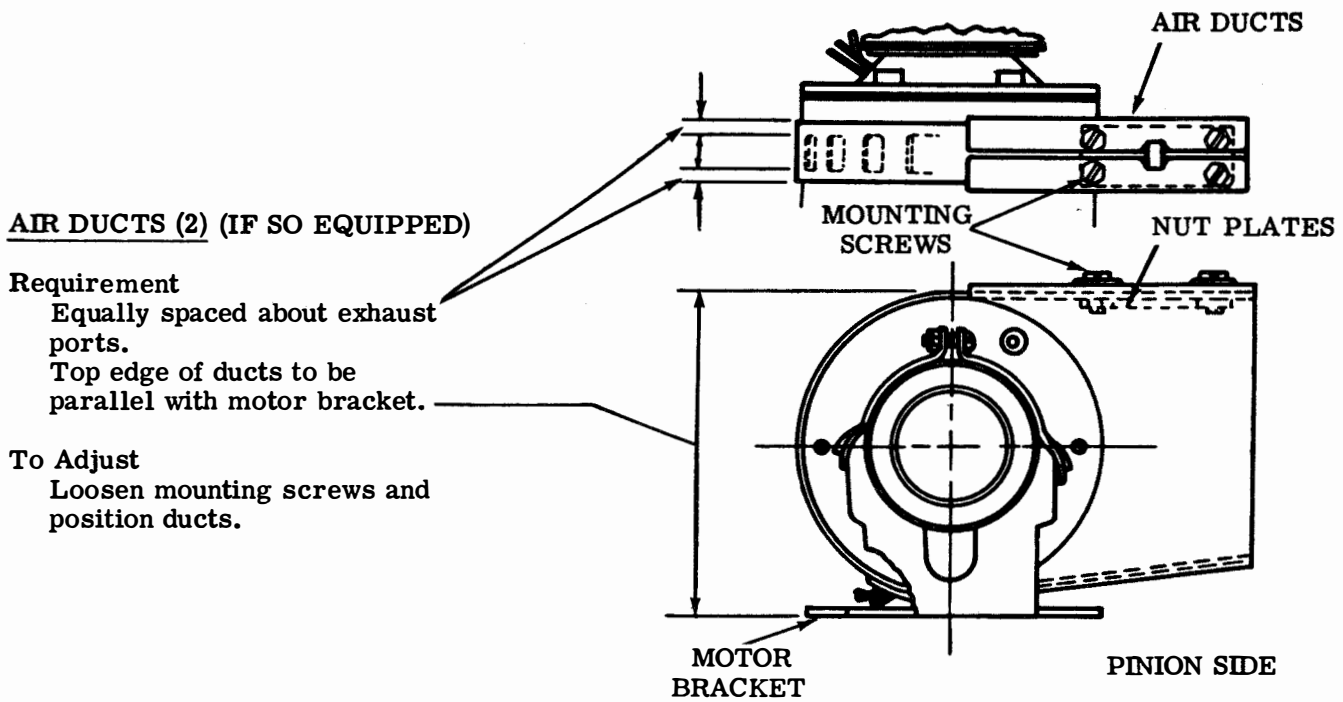
Position motor shield with its mounting screws loosened.



(1) Requirement

Equal clearance between front and rear ends of motor and motor shield.

2.03 Air Ducts and Capacitor Position

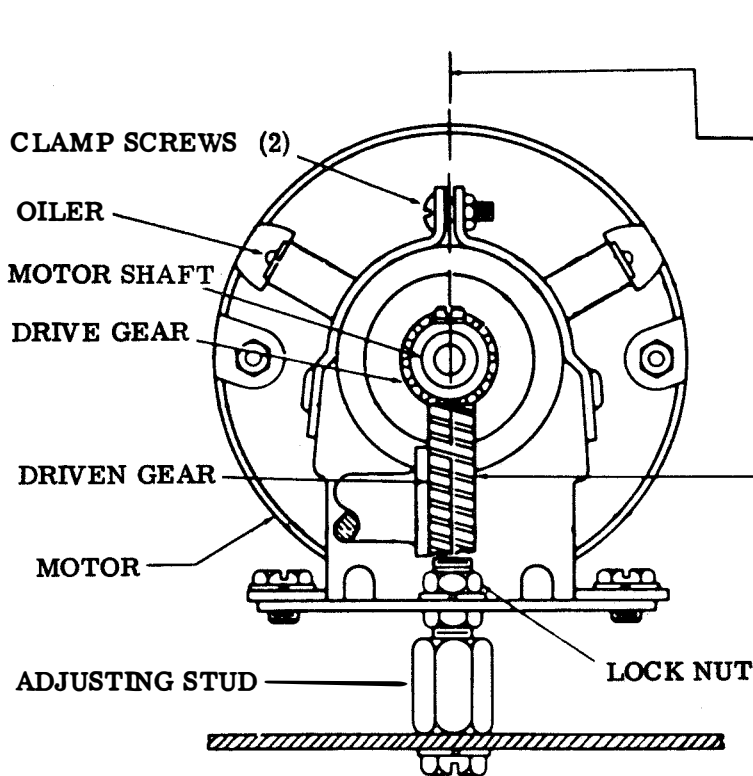


Requirement
Max 1/2 inch between motor bracket and end of capacitor.

To Adjust
Position relay and capacitor with motor removed from motor bracket and nut plate and clamp screws loosened.

3. STANDARD AND HEAVY DUTY SYNCHRONOUS MOTOR UNITS

3.01 Motor Positioning



MOTOR POSITIONING

- (1) Requirement (Upright Mounted Motors)
Oilers should be upward and approximately equidistant from a vertical line through motor shaft.
- (2) Requirement (Inverted Mounted Motors)
Oilers should be downward and approximately equidistant from a vertical line through motor shaft.

To Adjust
Position motor with clamp screws (2) loosened.

MOTOR ADJUSTING STUD (IF SO EQUIPPED)

Requirement
Barely perceptible backlash between drive gear and driven gear at point where backlash is least.

To Adjust
With lock nut loosened, position adjusting stud. Tighten nut while holding stud in position.

CAUTION: IF MOTOR BECOMES BLOCKED FOR SEVERAL SECONDS, THERMOSTATIC CUTOUT SWITCH (ON UNITS SO EQUIPPED) WILL BREAK CIRCUIT. SHOULD THIS HAPPEN, ALLOW MOTOR TO COOL AT LEAST 5 MINUTES BEFORE DEPRESSING RED RESET BUTTON. AVOID REPEATED RESETTING.

4. SERIES GOVERNED MOTOR UNITS

4.01 Motor Positioning and Governor

MOTOR POSITIONING (NOT ILLUSTRATED)

Requirement

Motor should be centrally positioned in its rubber mounts so as to provide at least 0.020 clearance between the motor housing and the cradle at the governor end. The cable should also clear the grommet in the screen by at least 0.030 inch.

(A) GOVERNOR CONTACT BACKSTOP

Requirement

Clearance between the movable contact arm and its eccentric backstop.

Min 0.020 inch---Max 0.040 inch

To Adjust

Rotate the eccentric backstop with clamping screw loosened.

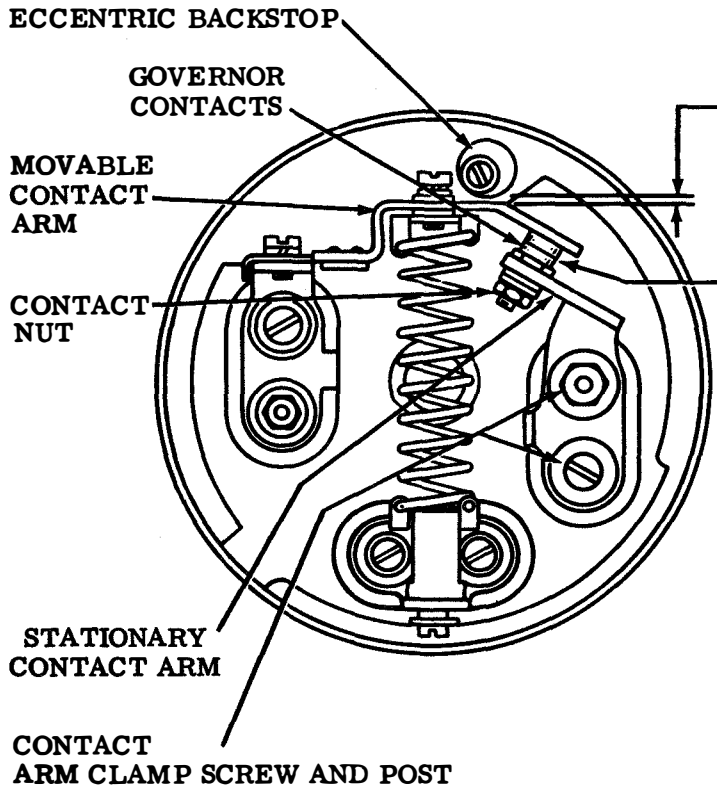
(B) GOVERNOR CONTACT

Requirement

The contacts should meet squarely and not overlap more than 0.010 inch.

To Adjust

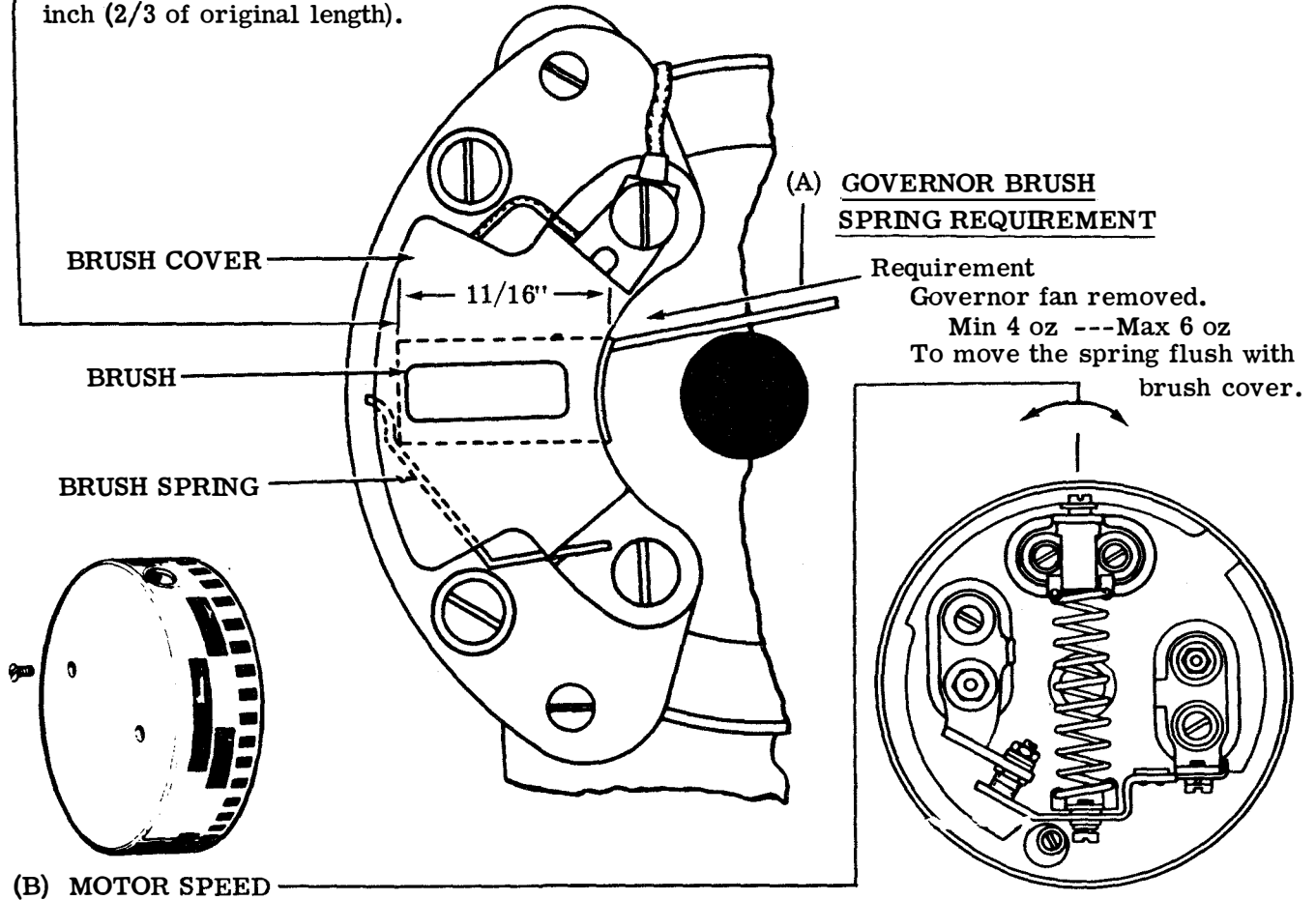
Position the stationary contact and contact arm with the clamp screw and post loosened.



**CAUTION: EXCESSIVE PRESSURE
AGAINST GOVERNOR COVER
ASSEMBLY DURING REMOVAL
MAY DAMAGE SCREENED WINDOW.**

4.02 Motor Governor

Note: Replace governor brushes that have worn to a length of approximately 15/32 inch (2/3 of original length).



Requirement

With target illuminated and viewed through the vibrating shutters of a 120 vps turning fork the spots on the 4-spot target should appear stationary while rotating. With target illuminated and viewed through the vibrating shutters of an 87.6 vps tuning fork the spots on the 6-spot target should appear stationary while rotating and with speed slightly increased the spots on the 35 spot target should appear stationary.

To Adjust

Stop the motor and turn the adjusting screw as indicated on governor cover. For units with screened governor covers, stop the motor, remove the TP152035 plug from cover. Turn adjusting screw as indicated on periphery of target.

Note: It is possible to adjust the motor at some multiple of the correct speed. To check motor speed when used with a page printer, return typebox carriage to left margin, set up any character in selector and manually trip typebox clutch trip lever. Printing should occur as follows:

WPM	PRINTED CHARACTERS	REQUIRED TIME
60	70	10 seconds
75	44	5 seconds
100	57	5 seconds



MOTOR UNITS

LUBRICATION

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1. GENERAL

1.01 This section has been generally revised to include information on recent motor units. Because this issue is a general revision, marginal arrows that indicate changes have been omitted.

1.02 For complete lubrication instructions refer also to the section covering teletypewriter apparatus general lubrication.

1.03 The motor should be lubricated initially, before being placed in service, as specified in the section covering the preparation of teletypewriter apparatus for installation. In the case of a new motor, the information supplied with it pertaining to the amount of lubricant should be used as a guide for further lubrication.

1.04 The suggested lubrication interval is given in the table below. However, because of varying conditions of application, the motor should be lubricated as often as specified by local instructions.

1.05 Before lubricating the motor, carefully and thoroughly clean the outer surfaces of the ball oilers with a clean cloth (KS2423) dampened with petroleum spirits (KS7860). Avoid depressing the ball oilers so that grit, dirty grease, or contaminated petroleum spirits do not get into the motor bearings.

1.06 Whenever the motor is disassembled the bearings should be repacked with Beacon 325 grease or equivalent.

1.07 The exposed motor shaft should be covered with a thin film of grease to prevent rust.

1.08 Use KS7470 oil where oil is specified.

CAUTION: DO NOT USE A GREASE GUN ON ANY MOTOR UNIT.

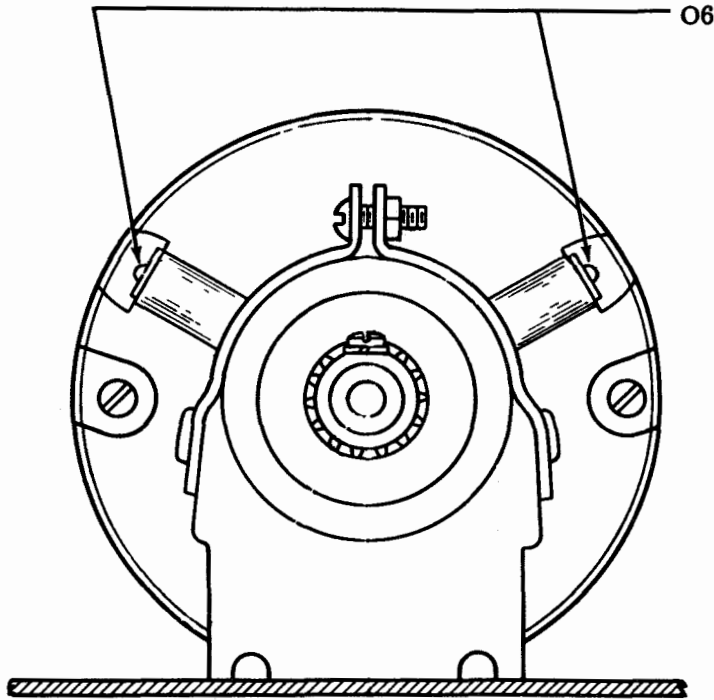
LUBRICATION INTERVAL

Motor Unit	Interval
Standard and heavy duty units	1500 consecutive operating hours or 6 months, whichever occurs first.
Miniature units	750 consecutive operating hours or 3 months, whichever occurs first.

SECTION 570-220-701

2. LUBRICATION

2.01 Motor Bearings



O6
**One Oiler
at Each End
(Depress Oiler
With Metal
Object)**

Motor Bearings

MOTOR UNIT (LMU)

PARTS

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5	Relay and Capacitor Mounting (Synchronous)	7
6	Synchronous Motor Assemblies (Miniature)	8
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MOTOR UNIT APPLICATION CHART

Units Covered		Operating Characteristics	General Usage	ASR Set	RT Set	High Speed Punch	High Speed Reader	Miniature Trans-Dist	Miniature-Reperf.	Compact Rec. Selector	(Ticker) Tape Printer	Multiple Mounted Units	Variable Speed	Stack Mounted
Teletype Code	Bell System Code													
LMU3	28A	AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM	X											
LMU4		Series, 1/20 HP, 115V/60 cycle/3600 RPM, RF Sup.	X											
LMU6	28B	Series, 1/20 HP, 115V/60 cycle/3600 RPM	X											
*LMU10		Series, 1/20 HP, 115V/60 cycle/3600 RPM, RF Sup.										X		
LMU11		AC Synchronous, 1/12 HP, 115V/60 cycle/3600 RPM			X									
LMU12	28C	AC Synchronous, 1/12 HP, 115V/60 cycle/3600 RPM		X							X			
LMU13		Series, 1/15 HP, 115V/60 cycle/3600 RPM			X									
LMU14	28D	Series, 1/15 HP, 115V/60 cycle/3600 RPM, RF Sup.		X							X			
LMU15	35A	AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM	X											
LMU19		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM					X							
LMU20		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM						X						
LMU21	28LA	AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM											X	
LMU23		DC Series, 1/15 HP, 48V/3600 RPM			X									
LMU24		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM						X						
LMU26		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM						X						
LMU28		Series, 1/20 HP, 115V/60 cycle/3600 RPM										X		
LMU29	28E	DC Series, 1/15 HP, 115V/3600 RPM	X											
LMU30		AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM			X									
LMU31		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM						X						
LMU32		Series, 1/15 HP, 115V/60 cycle/3600 RPM, RF Sup.			X									
LMU33		AC Synchronous, 1/20 HP, 115V/50 cycle/3000 RPM				X								
LMU35		AC Synchronous, 25 MPH, 115V/50 cycle/3000 RPM					X							
LMU36		AC Synchronous, 1/20 HP, 115V/50 cycle/3000RPM			X									
LMU37		AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM						X						
LMU38		AC Synchronous, 1/20 HP, 115V/50 cycle/3000 RPM	X											
LMU39		Series, 1/15 HP, 115V/60 cycle/3600 RPM, RF Sup.		X							X			
LMU41		Series, 1/20 HP, 115V/60 cycle/3600 RPM, RF Sup.	X											
LMU42		AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM								X				
MU43	28F	AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM					X							
LMU45		AC Synchronous, 25 MHP, 115V/60 cycle/3600 RPM				X								
LMU46		AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM			X									
*LMU47		Series, 1/20 HP, 115V/60 cycle/3600 RPM, RF Sup.										X		
LMU49		AC Synchronous, 1/20 HP, 115V/60 cycle/3600 RPM	X											
LMU51		AC Synchronous, 1/20 HP, 115V/50 cycle/3000 RPM						X						
LMU52		AC Synchronous, 1/20 HP, 115V/50 cycle/3000 RPM											X	

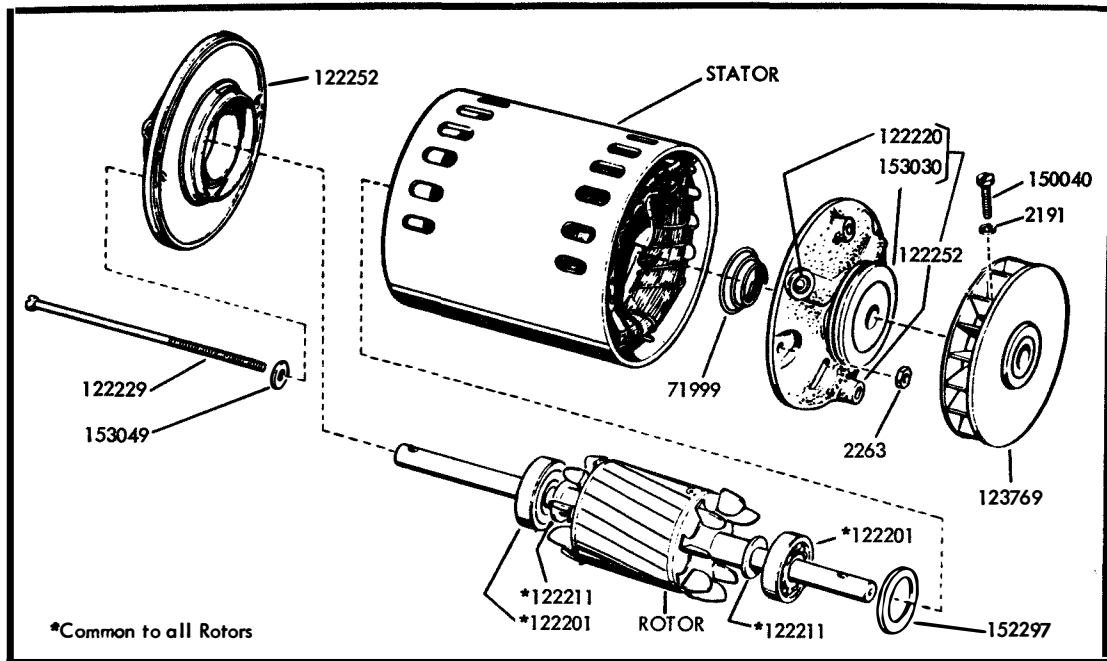
*Requires 173518 Mod. Kit for special Variable speed application BSP Section 573-116-800/Parts Bulletin 1149B, Page 1-27

SYNCHRONOUS MOTOR UNITS

Teletype Code	Motor Assembly	Cradle	Mounting Plate	Thermostatic Switch	Fixed Capacitor	Capacitor Clamp	Relay	Relay Insulator	Relay Clamp	Cable Assembly	Wire
LMU3	151795	150976	151920	122249	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
LMU11	155595	150976	160298	160304	160299	160300	160303	160301	160302	151927	96264R (5" Ig. Red)
LMU12	159739	150976	160298	160304	160299	160300	160303	160301	160302	151927	96264R (5" Ig. Red)
LMU15	170764	150976	151920	122249	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
LMU19	161984	142589		174471	162072	151922	173425	162196	151925	161099	96264R (5" Ig. Red)
LMU20	161984	142589		174471	162072	151922	173425	162910	160302	162911	96264R (5" Ig. Red)
LMU21	151795	164612		122249	122245	151922	151923	164603	151925	151927	96264R (5" Ig. Red)
LMU24	161984	142589		fused	162072	151922	173425	162196	151925		176137 (9-1/4" Ig. Black w/151626 Terminal) 151819 (3" Ig. Black w/151626 Terminal) 96264R (5" Ig. Red)
LMU26	161984	142589		174471	162072	151922	173425	162910	160302	162911	96264R (5" Ig. Red)
LMU30	178500	150976	151920	122249	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
LMU31	161984	142589		174471	162072	151922	173425	162196	151925	179016	156656 (2-3/4" Ig. Black W/107398 and 82474 Terminals)
LMU33	170764	150976	151920	*193781	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
+LMU35	194924	171749		fused	*195172	171702	*195173	171704	171703	195178	96264R (5" Ig. Red)
LMU36	178500	150976	151920	*193781	122245	151922	151923	151924	171703	151927	96264R (5" Ig. Red)
LMU37	151795	194897		122249	122245	151922	151923	194898	151925	194899	96264R (5" Ig. Red)
LMU38	151795	150976	151920	*193781	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
LMU42	196830	196839		122249	122245	151922	151923	164603	151925	151927	96264R (5" Ig. Red)
MU43	161984	171749		174471	162072	171702	173425	171704	171703	171810	96264R (5" Ig. Red)
LMU45	161984	171749		174471	162072	171702	173425	171704	171703	193181	96264R (5" Ig. Red)
LMU46	151795	150976	151920	122249	122245	151922	151923	151924	151925	193236	96264R (5" Ig. Red)
LMU49	170764	172795	151920	122249	122245	151922	151923	151924	151925	151927	96264R (5" Ig. Red)
LMU51	151795	194897		*193781	122245	151922	151923	194898	151925	194899	96264R (5" Ig. Red)
LMU52	151795	164612	151920	*193781	122245	151922	151923	164603	151925	151927	96264R (5" Ig. Red)

*For use with Motor Unit operating on 50 Cycle Current
+See Page 10 for Parts peculiar to LMU35

FIGURE 1. SYNCHRONOUS MOTOR CROSS-REFERENCE CHART



SYNCHRONOUS MOTOR ASSEMBLY - STANDARD OR HEAVY DUTY

SYNCHRONOUS MOTORS - Standard or Heavy Duty				
DUTY	MOTOR ASSEMBLY	STATOR	ROTOR	MOTOR DATA
Standard	151795	122251	128874	AC Synchronous, 1/20 HP, 115V: 50/60 Cycle, 3600RPM
Heavy	155595	#160306	160305	AC Synchronous, 1/12 HP, 115V: 60 Cycle, 3600 RPM
Heavy	159739	160306	160305	AC Synchronous, 1/12 HP, 115V: 60 Cycle, 3600 RPM
Standard	+170764	122251	128874	AC Synchronous, 1/20 HP, 115V: 50/60 Cycle, 3600RPM
Standard	178500	#122251	128874	AC Synchronous, 1/20 HP, 115V: 60 Cycle, 3600 RPM
Standard	**196830	196837	128874	AC Synchronous, 1/20 HP, 115V: 60 Cycle, 3600 RPM

+Without Fan
 **CW Rotation (All others CCW Rotation)
 #Arranged for Inverted Mounting

FIGURE 2. SYNCHRONOUS MOTOR ASSEMBLIES (STANDARD OR HEAVY DUTY)

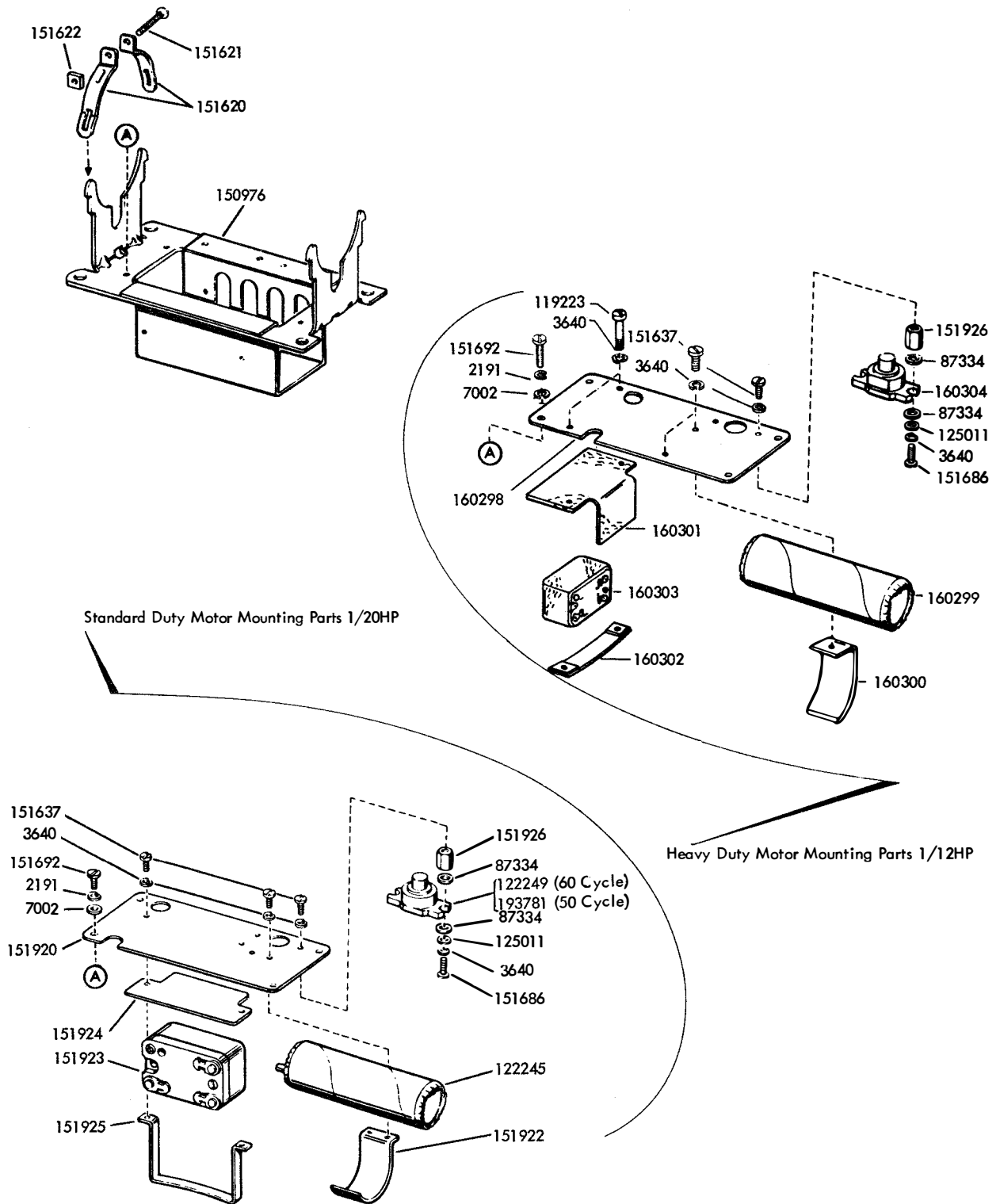


FIGURE 3. RELAY AND CAPACITOR MOUNTINGS (SYNCHRONOUS)

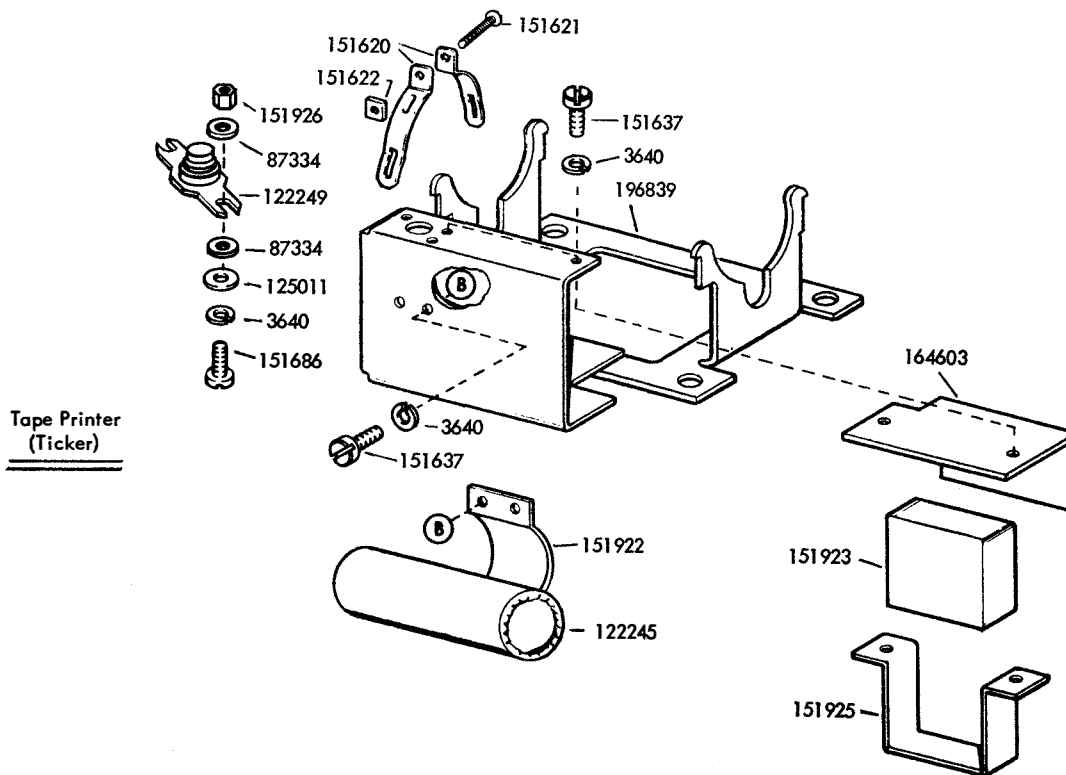
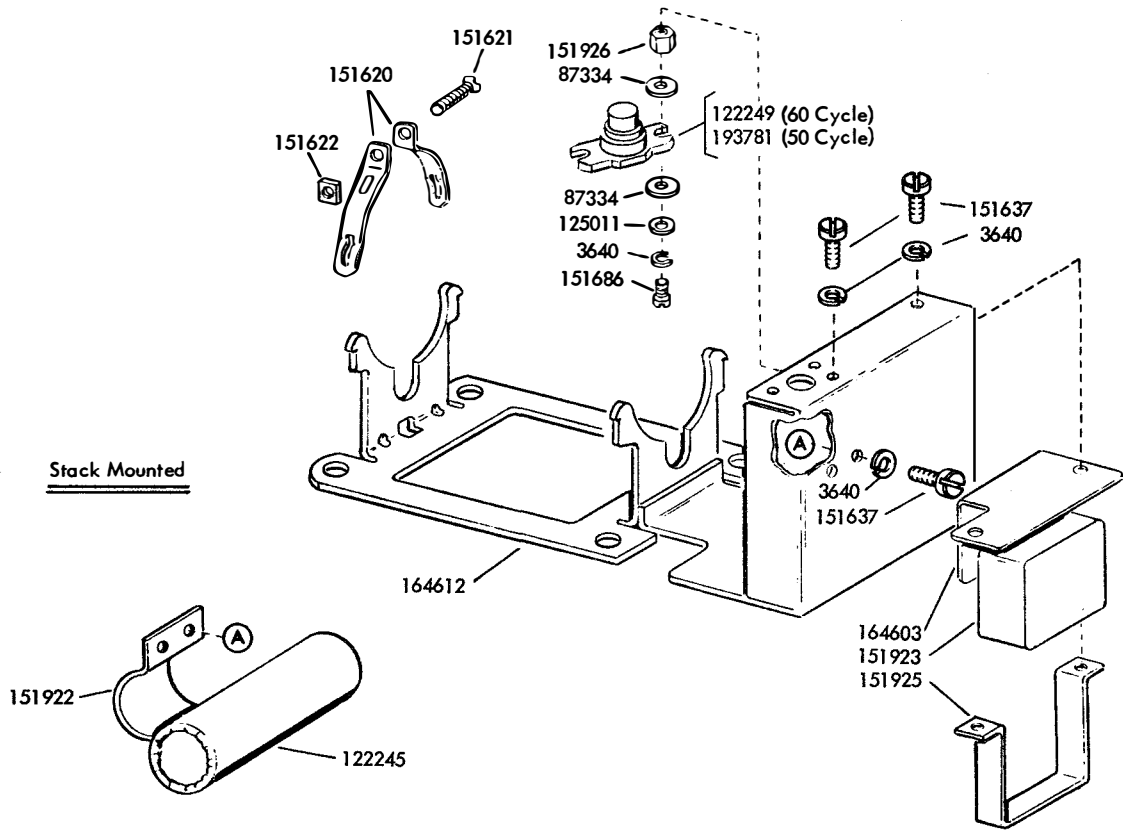
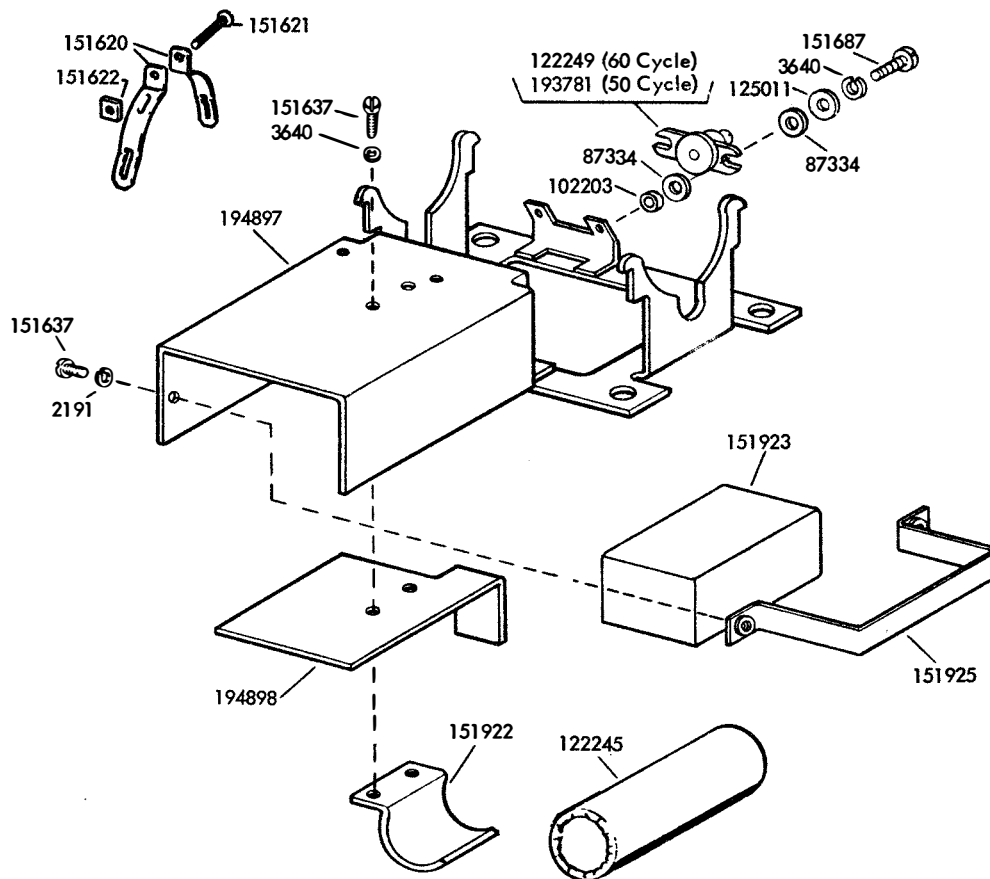
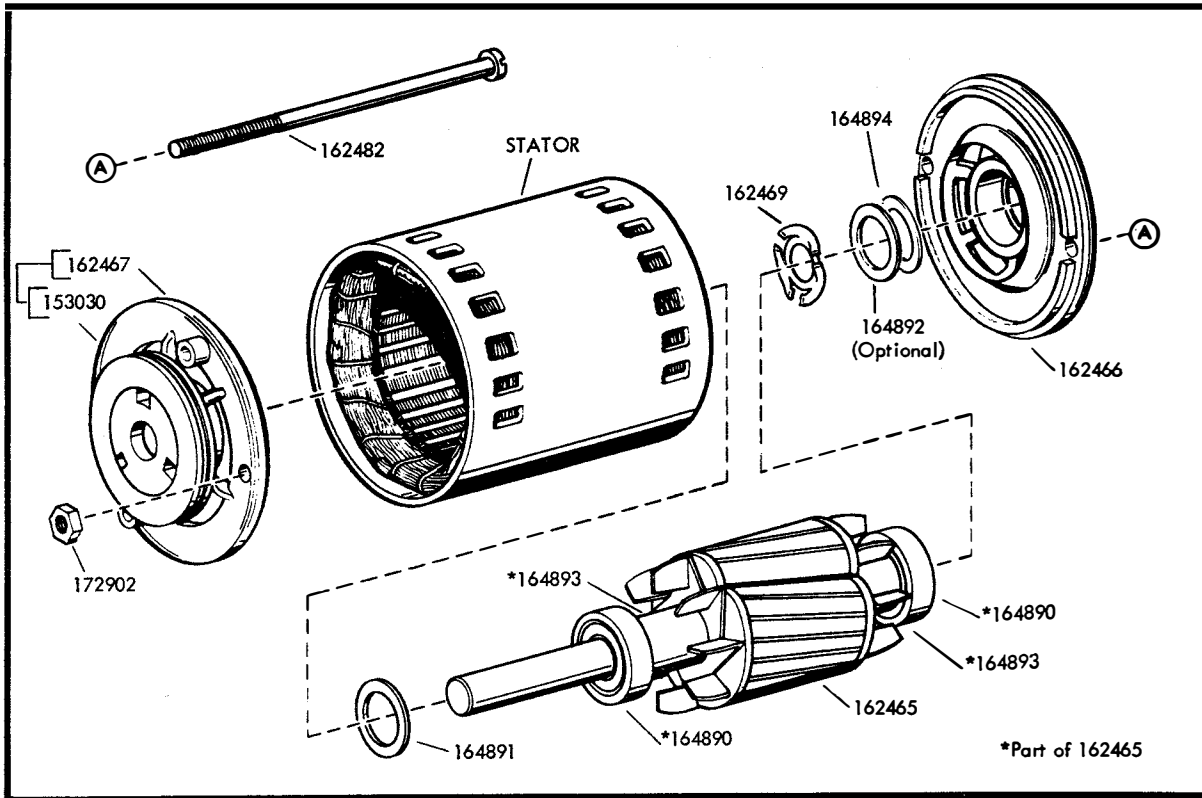


FIGURE 4. RELAY AND CAPACITOR MOUNTINGS (SYNCHRONOUS)



Compact Page Printer

FIGURE 5. RELAY AND CAPACITOR MOUNTINGS (SYNCHRONOUS)



MINIATURE MOTOR ASSEMBLY

SYNCHRONOUS MOTORS - Miniature		
MOTOR ASSEMBLY	STATOR	MOTOR DATA
161984	162464	AC Synchronous, 25 MHP, 115V: 60 Cycle, 3600 RPM
194924	195214	AC Synchronous, 25 MHP, 115V: 50 Cycle, 3000 RPM

FIGURE 6. SYNCHRONOUS MOTOR ASSEMBLIES (MINIATURE)

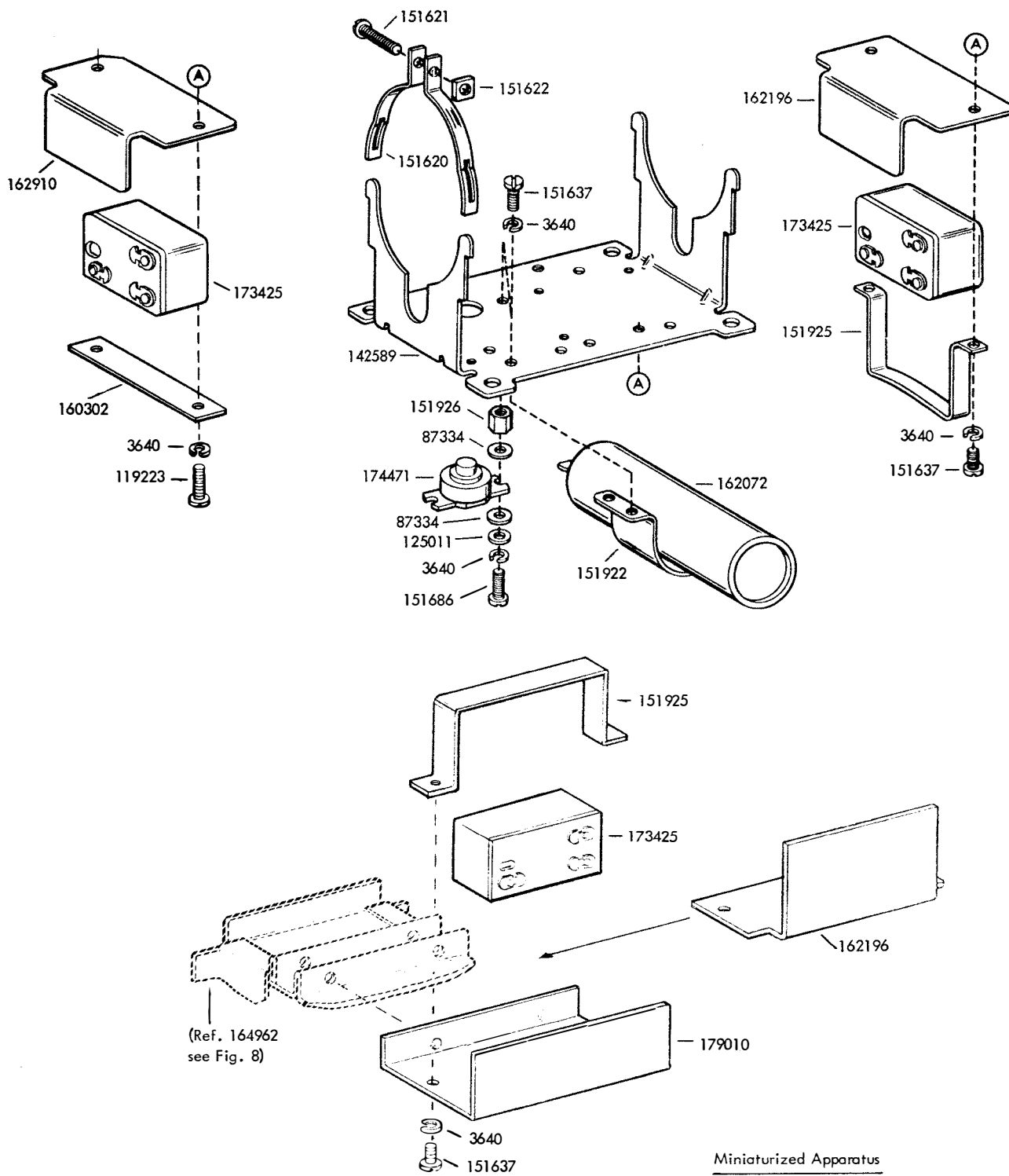


FIGURE 7. RELAY AND CAPACITOR MOUNTINGS (SYNCHRONOUS)

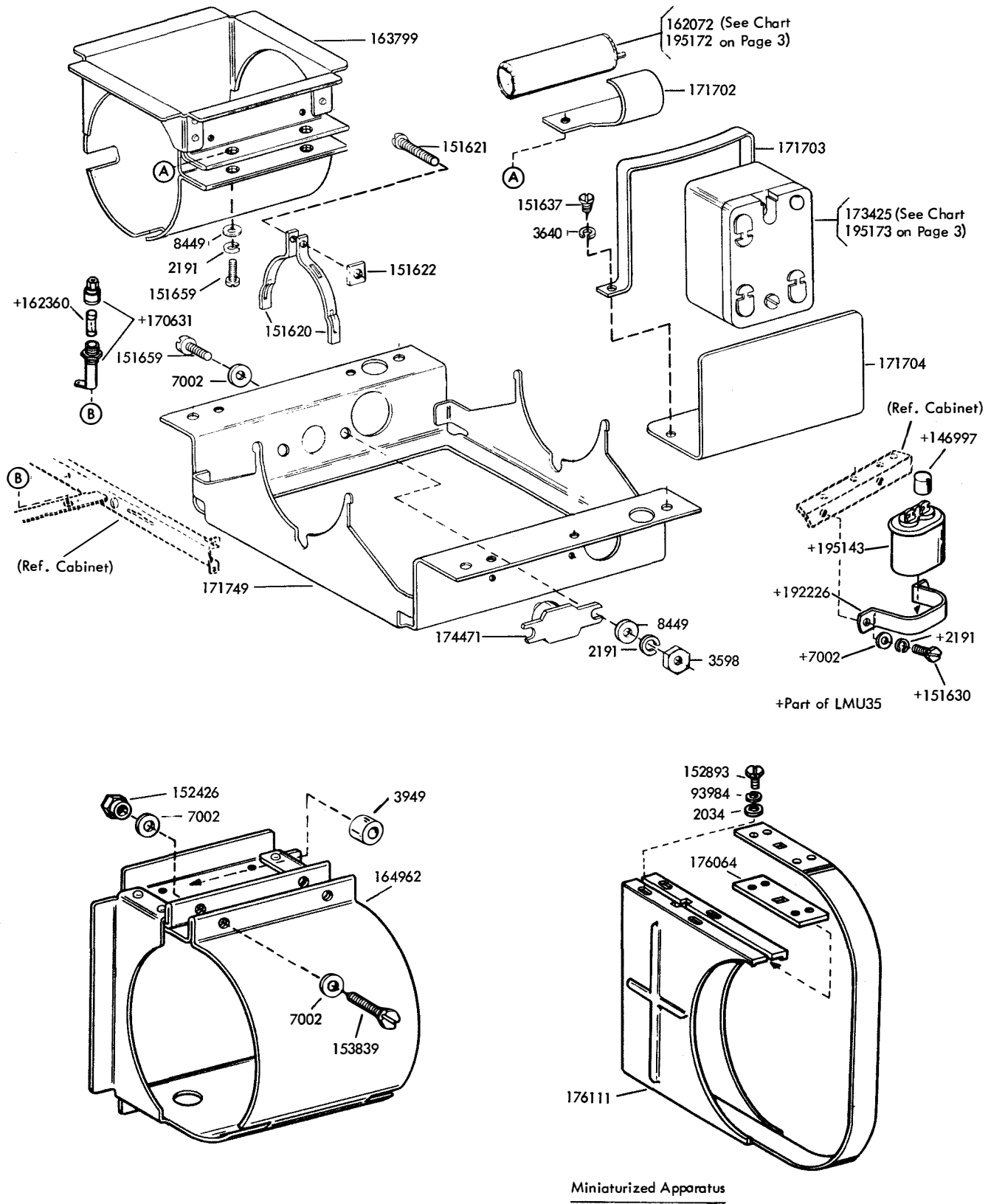
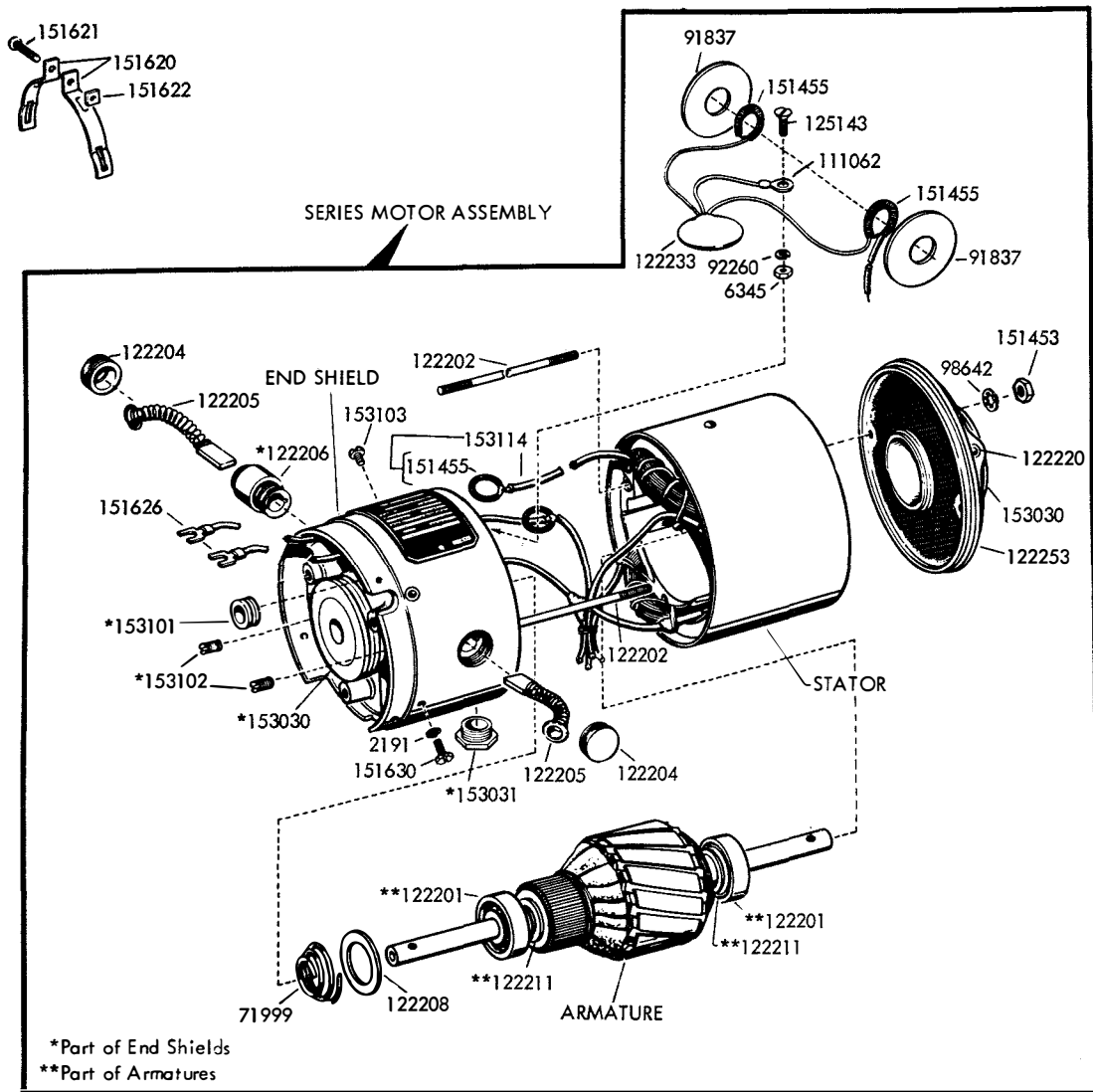


FIGURE 8. RELAY, CAPACITOR MOUNTING AND BRACKET (SYNCHRONOUS)

SERIES MOTOR UNITS

Teletype Code	Motor Assembly	Motor Bracket	Container	Lid	Nipple	Capacitor	Resistor	Electrical Noise Suppressor	Cable Assembly	Wire
LMU4	150701	152046	152039	152040	152067	161579	161580	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals) 162684 (2-3/4" lg. w/164479 Terminal) 162685 (4" lg. w/164479 Terminal)
LMU6	150701	150976				161579	161580			91228 (2-1/2" lg. w/107398 and 125139 Terminals) 162684 (2-3/4" lg. w/164479 Terminal) 163268 (6-1/2" lg. White w/164479 Terminal) 163269 (2" lg. w/164479 Terminal)
LMU10	150701	152046	152039	152040	152067	161579	161580	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals) 162684 (2-3/4" lg. w/164479 Terminal) 162685 (4" lg. w/164479 Terminal)
LMU13	163272	150976				161579	161580			91228 (2-1/2" lg. w/107398 and 125139 Terminals) 162684 (2-3/4" lg. w/164479 Terminal) 163268 (6-1/2" lg. White w/164479 Terminal) 163269 (2" lg. w/164479 Terminal)
LMU14	161577	152046	152039	152040	152067	161579	161580	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals) 162684 (2-3/4" lg. w/164479 Terminal) 162685 (4" lg. w/164479 Terminal)
LMU23	164758	173751				173003	173004			91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU28	179100	152046	179105	179106	179282	161579	179103	161578	179283	91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU29	179190	152046	179420	179424	152067	179421	173004	179422	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU32	194060	152046	194057	179424	194063	161579	179103	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU39	161577	152046	179420	179424	152067	161579	179103	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU41	150701	152046	179420	179424	152067	161579	179103	161578	152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals)
LMU47	150701	152046	179420	179424	152067	161579	179103		152059	91228 (2-1/2" lg. w/107398 and 125139 Terminals)

FIGURE 9. SERIES MOTOR CROSS-REFERENCE CHART

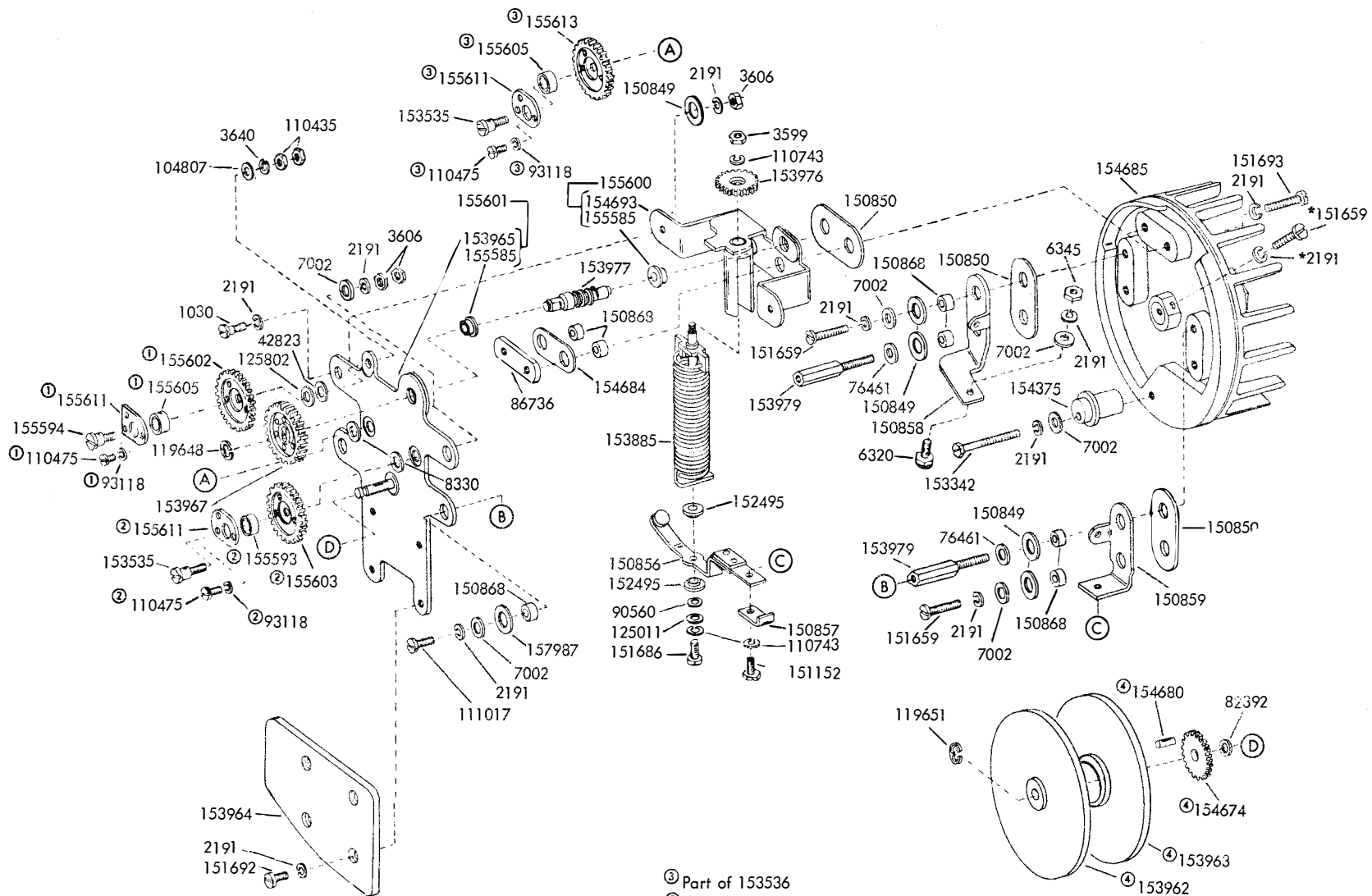


SERIES MOTORS STANDARD OR HEAVY DUTY					MOTOR DATA
	MOTOR ASSEMBLY	STATOR	ARMATURE	END SHIELD	
Standard	150701	122221	122210	122200	Series, 1/20 HP, 115V: 60 Cycle, 3600 RPM
Heavy	161577	161576	161575	122200	Series, 1/15 HP, 115V: 60 Cycle, 3600 RPM
Heavy	+163272	161576	161575	163273	Series, 1/15 HP, 115V: 60 Cycle, 3600 RPM
Heavy	+164758	164756	164757	163273	DC Series, 1/15 HP, 48V: 3600 RPM
Standard	179100	122221	122210	179101	Series, 1/20 HP, 115V: 60 Cycle, 3600 RPM
Heavy	179190	164756	164757	122200	DC Series, 1/15 HP, 48V: 3600 RPM
Heavy	+194060	161576	161575	194062	Series, 1/15 HP, 115V: 60 Cycle, 3600 RPM

+Arranged for Inverted Mounting

FIGURE 10. SERIES MOTOR ASSEMBLIES

FIGURE 13. 154628 GOVERNOR ASSEMBLY



- (A) Part of 153536
- (B) Part of 153966
- (C) Part of 153968
- (D) Part of 154676
- *Not part of 154628

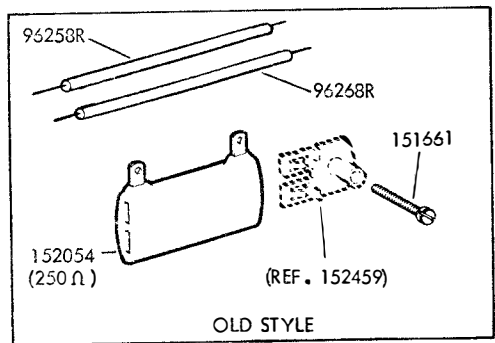
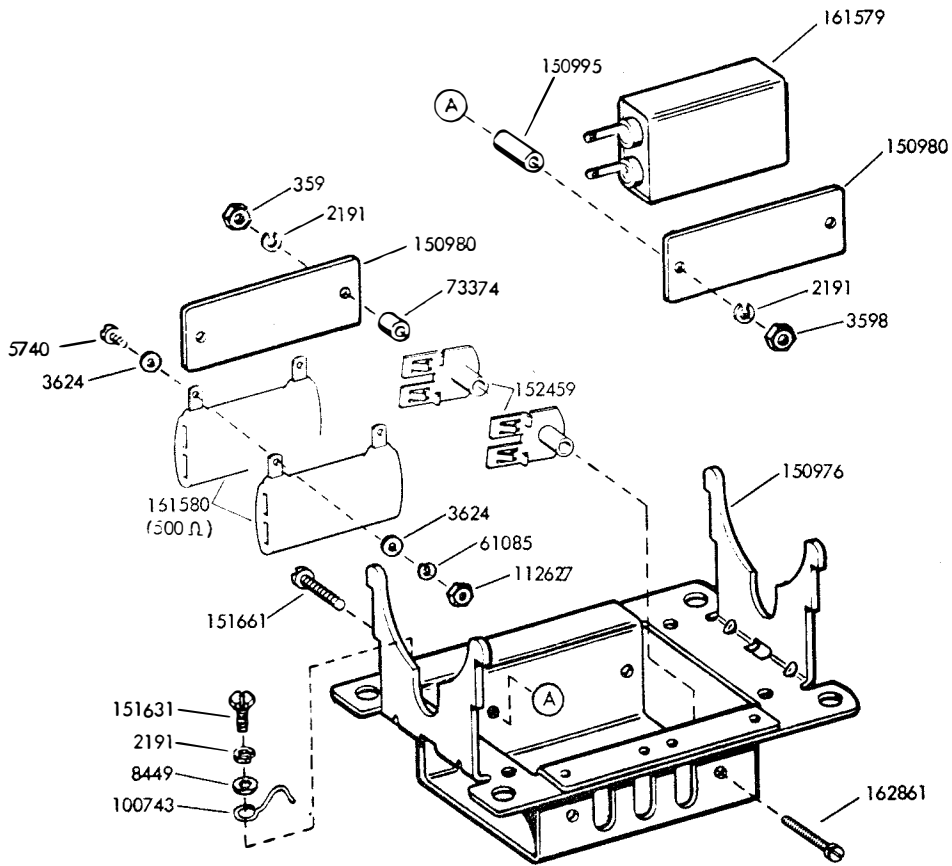
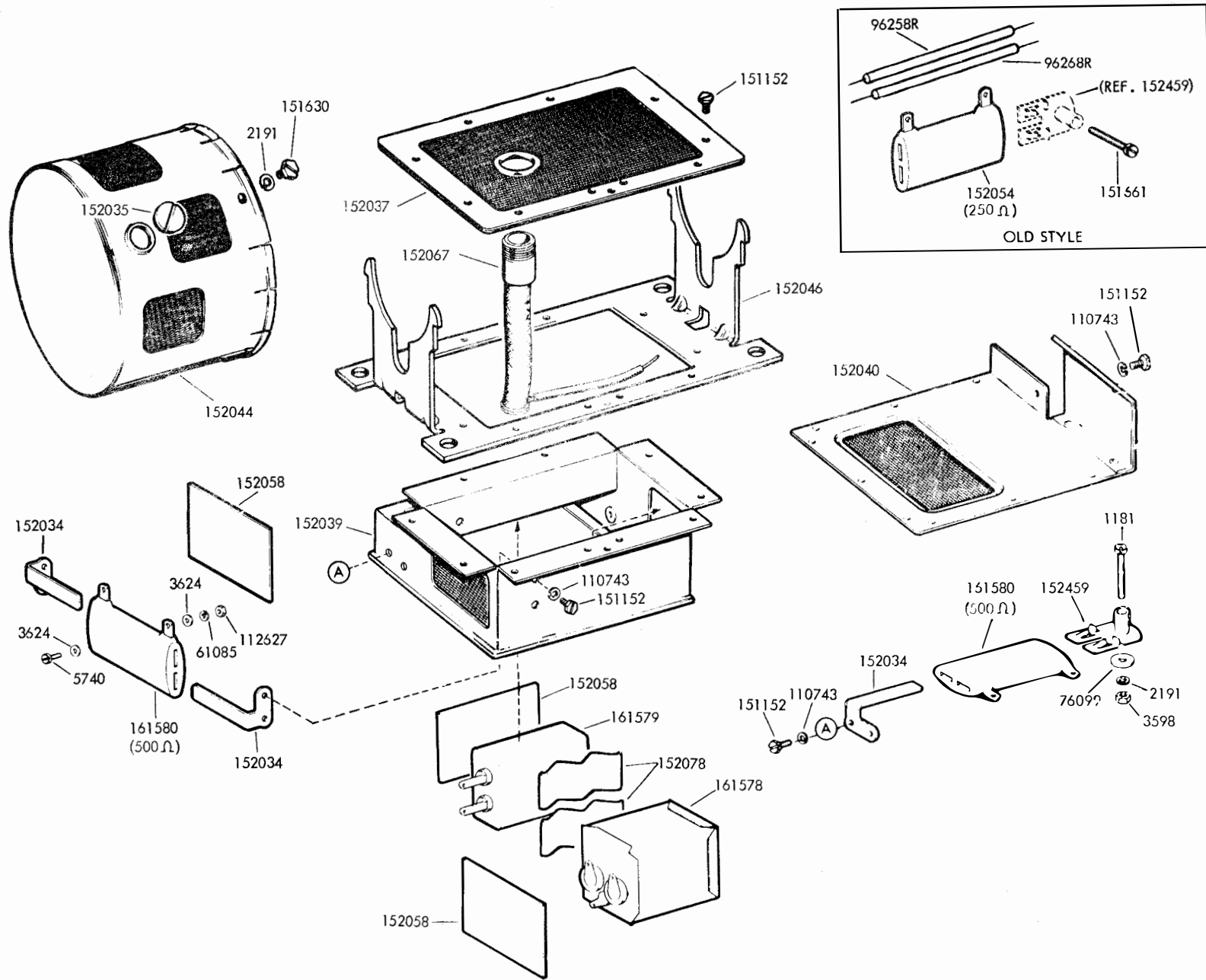


FIGURE 14. SERIES MOTOR MOUNTING PARTS

FIGURE 15. SERIES MOTOR MOUNTING PARTS WITH RF SUPPRESSION



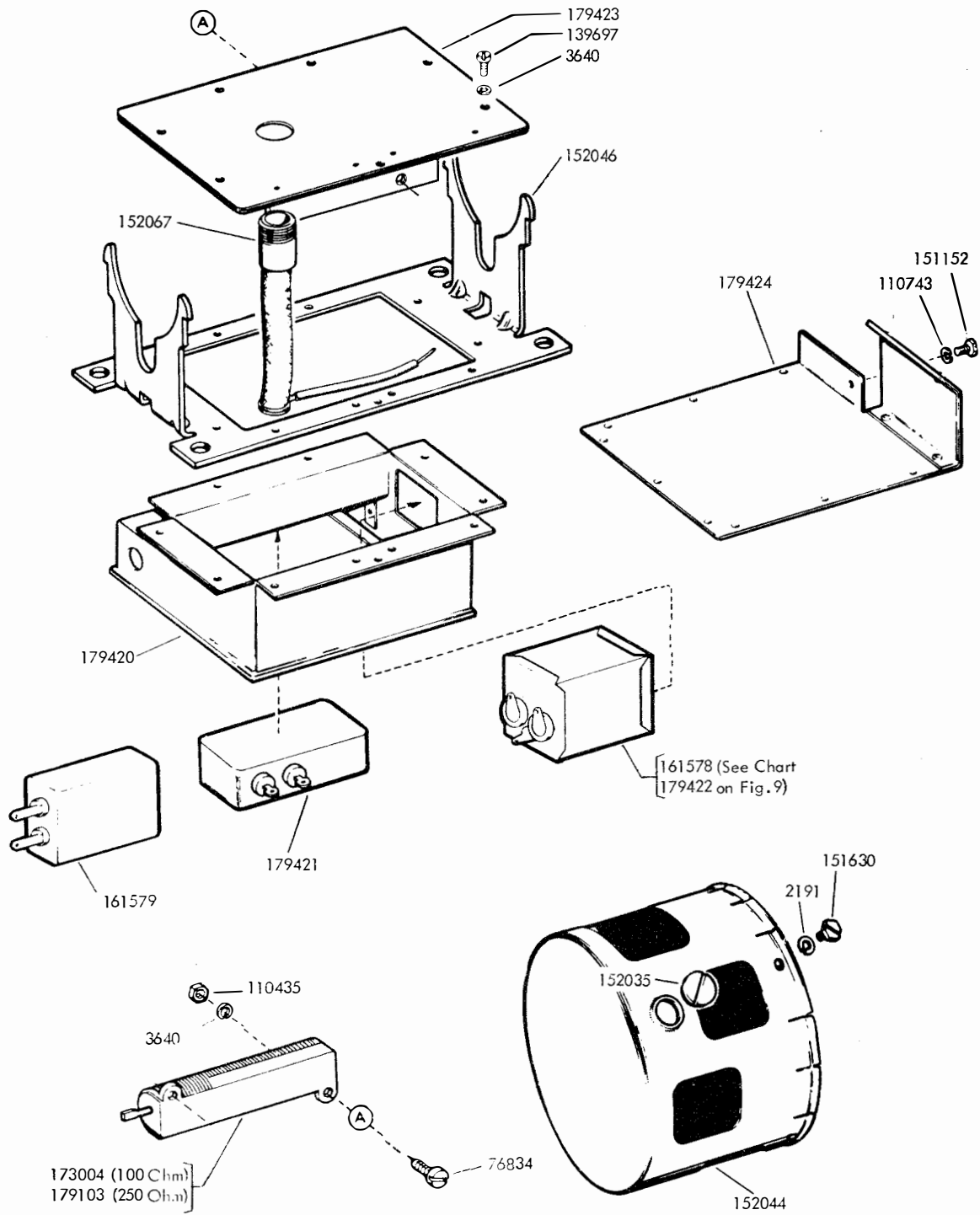


FIGURE 16. SERIES MOTOR MOUNTING PARTS WITH RF SUPPRESSION

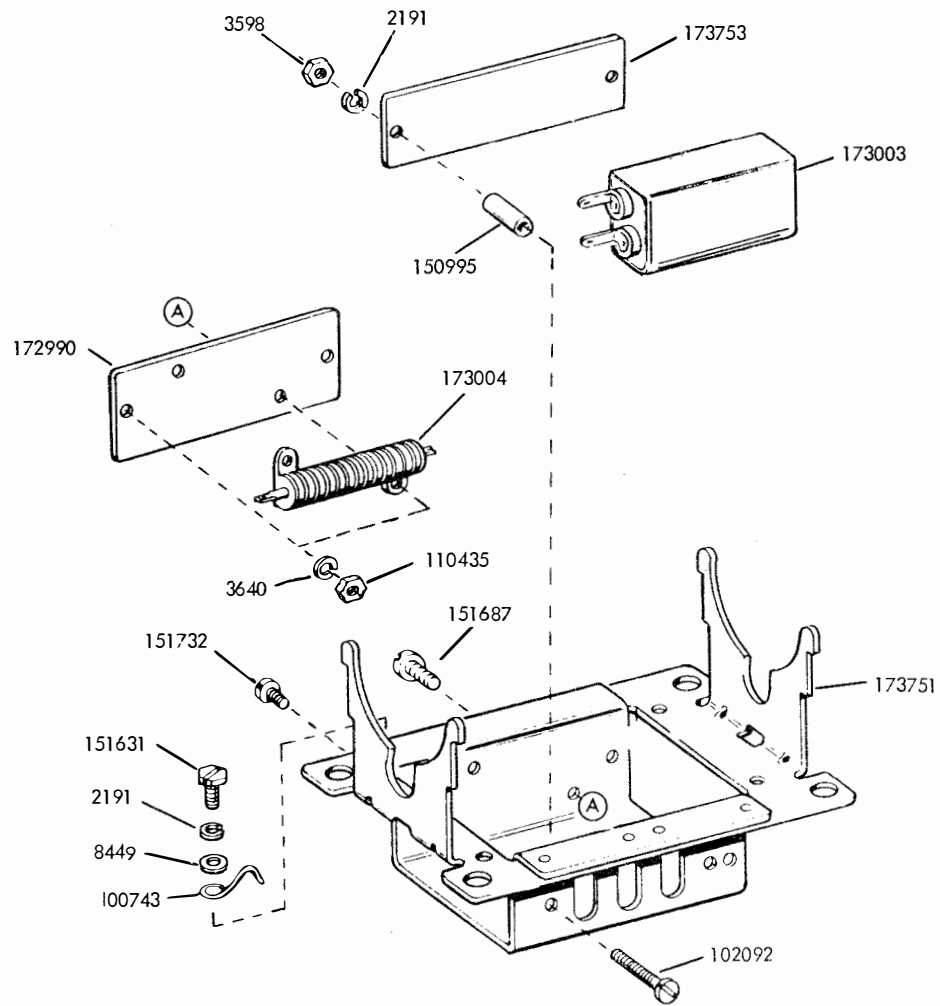
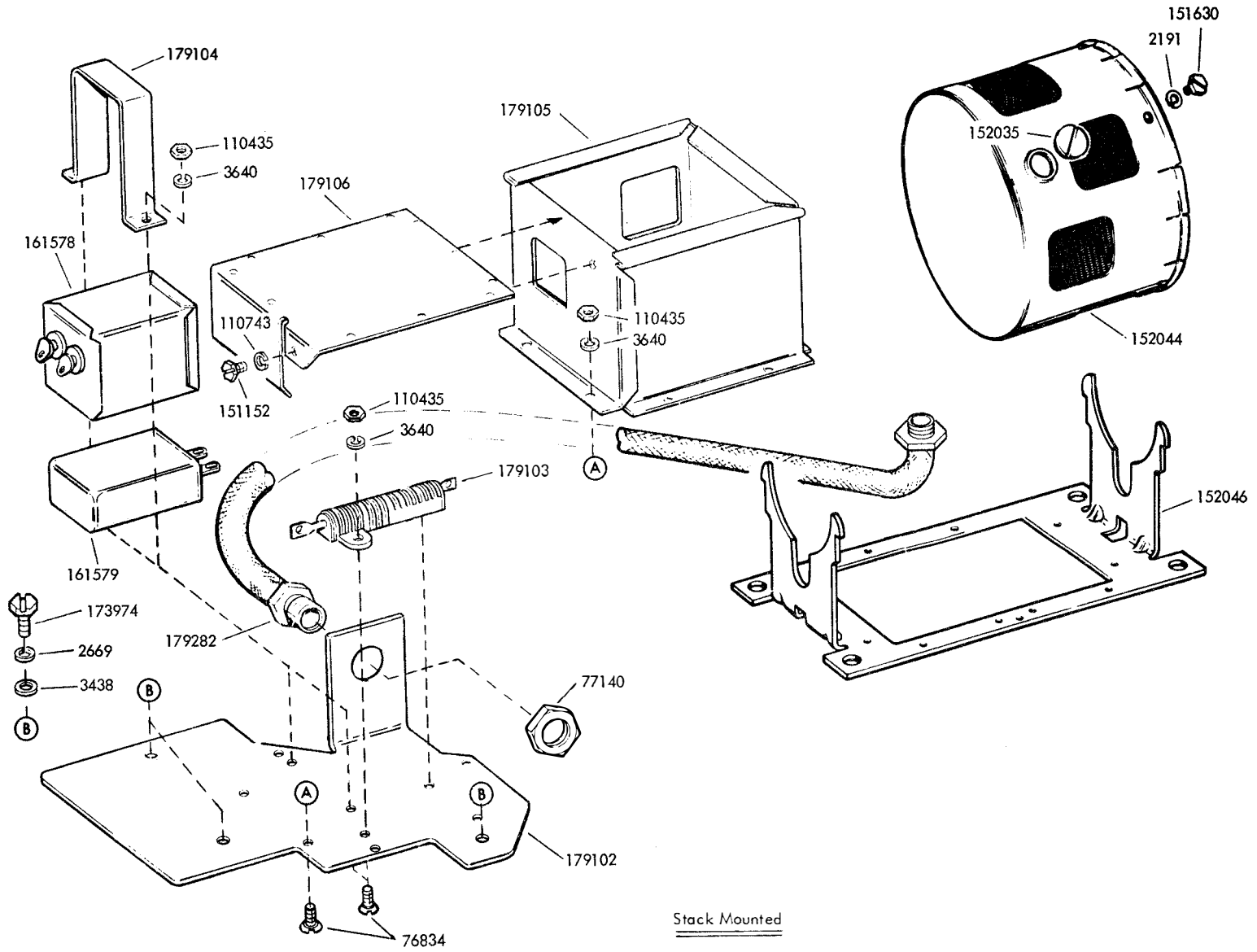


FIGURE 17. SERIES MOTOR MOUNTING PARTS

FIGURE 18. SERIES MOTOR MOUNTING PARTS WITH RF SUPPRESSION



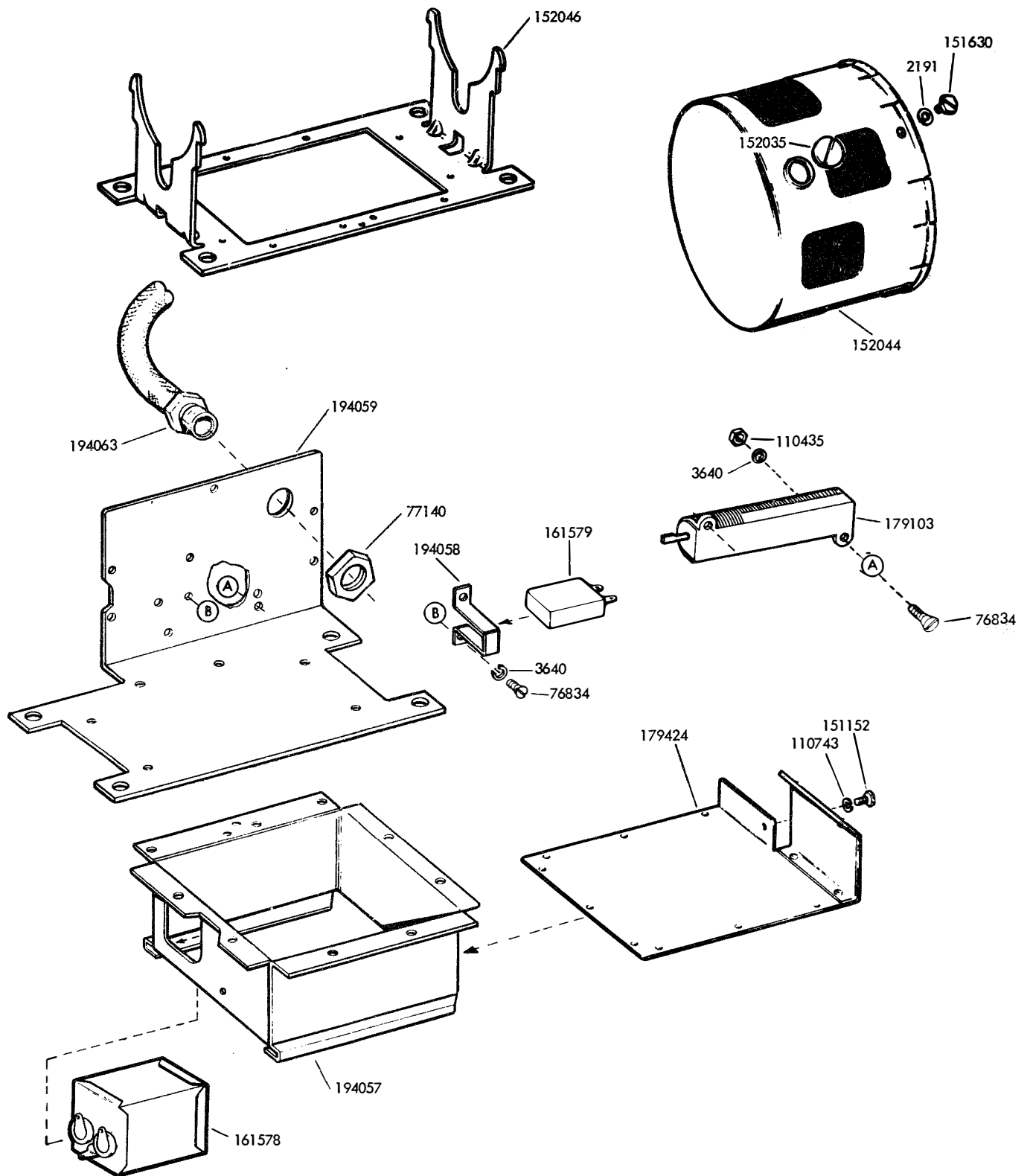
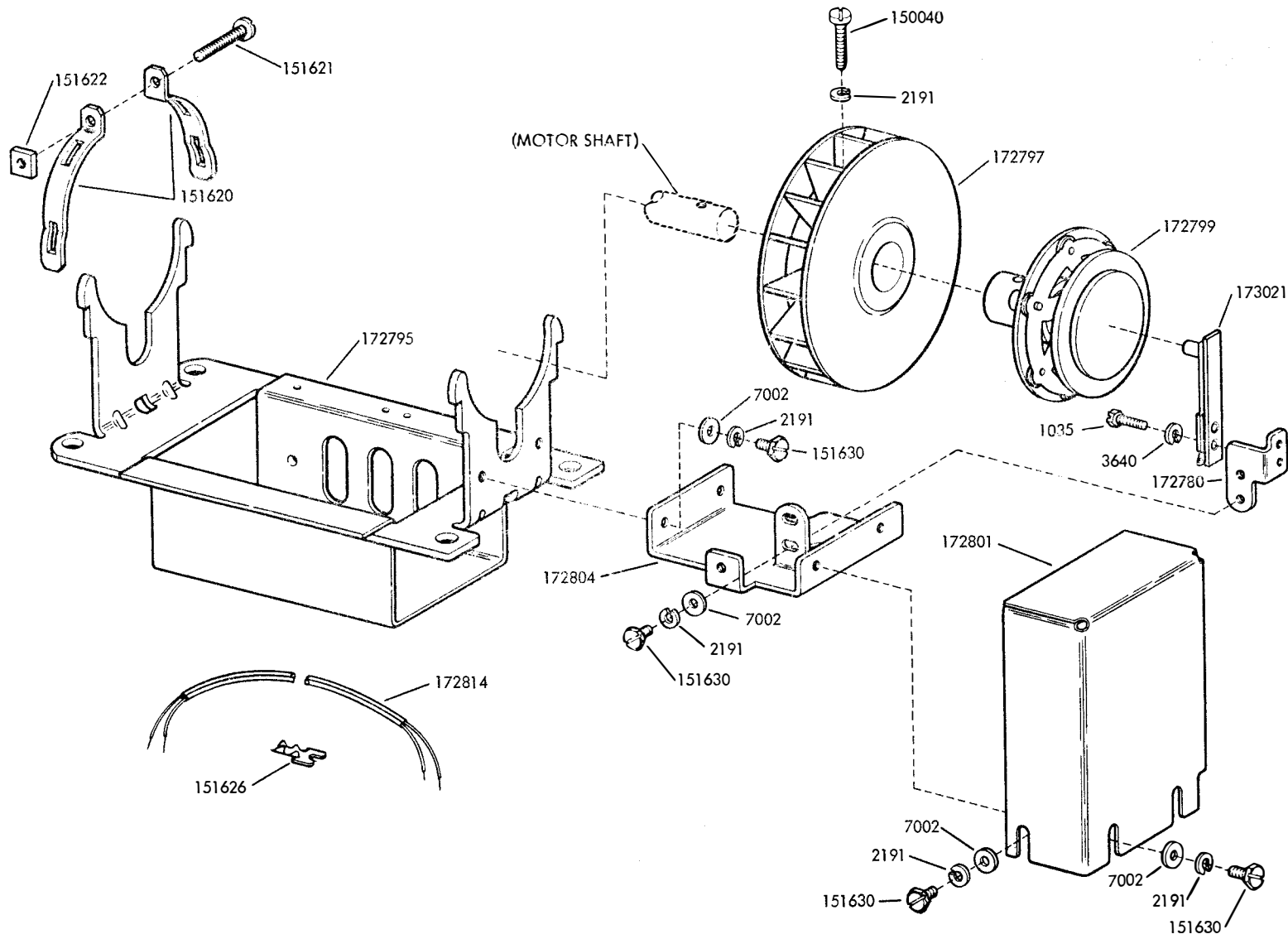


FIGURE 19. SERIES MOTOR MOUNTING PARTS WITH RF SUPPRESSION

FIGURE 20. SYNCHRONOUS MOTOR UNIT WITH CENTRIFUGAL SWITCH ASSEMBLY



NUMERICAL INDEX

Part Number	Description and Page Number	Part Number	Description and Page Number	Part Number	Description and Page Number
1030	Screw, Shoulder (6-40) 15	122210	Armature, Motor 12	151658	Screw (6-40 x 5/16 Fil) 13
1035	Screw (4-40 x 3/8 Hex) 22	122211	Washer, Pull 4,12	151659	Screw (6-40 x 1/2 Fil) 10,14,15
1181	Screw (6-40 x 11/16 Fil) 17	122220	Oiler, Ball 4,12	151661	Screw (6-40 x 1" Fil) 13,14,16,17
2034	Washer, Flat 10	122221	Stator 12	151686	Screw (4-40 x 3/8 Fil) 5,6,9,15
2191	Washer, Lock 4,5,7,10,12 to 22	122229	Bolt (8-32 x 4 11/16 Fil) 4	151687	Screw (4-40 x 7/16 Fil) 7,19
2263	Nut (8-32 Hex) 4	122233	Capacitor Assembly 12	151692	Screw (6-40 x 3/16 Fil) 5,15
2669	Washer, Lock 20	122245	Capacitor (43 to 48 Mfd) 3,5,6,7	151693	Screw (6-40 x 9/16 Fil) 15
3438	Washer, Flat 20	122249	Switch, Thermostatic 3,5,6,7	151732	Screw (4-40 x 11/32 Fil) 19
3598	Nut (6-40 Hex) 10,16,17,19	122251	Stator 4	151795	Motor, Synchronous 3,4
3599	Nut (4-40 Hex) 15	122252	Shield Assembly, End 4	151819	Jumper (3" Black) 3
3606	Nut (6-40 Hex) 15	122253	Shield Assembly, End 12	151920	Plate, Mounting 3,5
3624	Washer, Flat 16,17	123769	Fan, Motor 4	151922	Clamp 3,5,6,7,9
3640	Washer, Lock 5,6,7,9,10,15,18 To 22	125011	Washer, Flat 5,6,7,9,14,15	151923	Relay, Motor 3,5,6,7
3949	Spacer (.160") 10	125139	Screw (4-40 x 1/8 Fil) 11	151924	Insulator 3,5
5740	Screw (2-56 x 1/4 Fil) 16,17	125143	Screw (6-32 x 3/8 Flat) 12	151925	Clamp 3,5,6,7,9
6320	Screw, Contact (6-32) 14,15	125802	Washer, Flat 15	151926	Nut (4-40 Spl.) 5,6,9
6345	Nut (6-32 Hex) 12, 14, 15	128874	Rotor, Motor 4	151927	Cable w/Terminals 3
7002	Washer, Flat 5,10,13,14,15,22	139697	Screw (4-40 x 9/32 Fil) 18	152034	Bracket, Resistor 17
8330	Washer, Flat 15	142589	Bracket, Motor 3,9	152035	Plug 17,18,20,21
8449	Spacer (.094") 10,16,19	146997	Cap 10	152037	Cover 17
42823	Washer, Flat 15	150040	Screw (6-40 x 5/8 Fil) 4,22	152039	Container 11,17
61085	Washer, Lock 16,17	150701	Motor 115V. A.C. Series 11,12	152040	Lid 11, 17
71999	Spring 4,12	150845	Governor Assembly 14	152044	Cover 17,18,20,21
73374	Spacer (.250") 16	150849	Washer, Insulating 14,15	152046	Bracket, Motor 11,17,18,20,21
76099	Washer, Flat 17	150850	Insulator (.031") 14,15	152054	Resistor (250 Ohm) 16,17
76461	Washer, Flat 15	150856	Arm, Contact 14,15	152058	Separator 17
76834	Screw (4-40 x 3/8 Flat) 18,20,21	150857	Clamp 14,15	152059	Cable w/Terminals 11
77140	Nut, Lock (9/16 - 32 Hex) 20,21	150858	Bracket, Contact 14,15	152067	Nipple 11,17,18
82392	Shim (.004") 15	150859	Bracket, Mounting 14,15	152078	Spring 17
82474	Terminal 3	150865	Screw, Clamping (4-40) 14	152297	Washer, Flat 4
86736	Plate, Clamping 15	150866	Clamp 14	152426	Nut, Self-Locking (6-40 Hex) 10
87334	Washer, Insulating 5,6,7,9	150868	Bushing, Insulating 14,15	152459	Bracket, Mounting 16,17
90560	Washer, Flat 15	150869	Spring 14	152495	Bushing 14,15
91228	Strap (2-1/2" Braided) 11	150872	Stud 14	152893	Screw (4-40 x 1/4 Hex) 10
91837	Washer, Insulating 12	150873	Collar 13	153030	Mount, Vibration 4,8,12
92260	Washer, Lock 12	150877	Bracket 14	153031	Bushing, Lead 12
93118	Washer, Lock 15	150879	Cover, Governor 14	153049	Washer, Fiber 4
93984	Washer, Lock 10	150880	Spring, Governor Brush 13	153101	Grommet, Rubber 12
96258R	Jumper (3" Red) 16,17	150881	Spring, Governor Brush 13	153102	Screw, Set (8-32) 12
96264R	Jumper (5" Red) 3	150882	Brush 13	153103	Screw, Self-Tapping (4-40) 12
96268R	Jumper (7" Red) 16,17	150884	Mounting, Brush 13	153114	Jumper (8-1/2" Black) 12
98642	Washer, Lock 12	150885	Plate, Brush 13	153342	Screw (6-40 x 15/16 Hex) 15
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