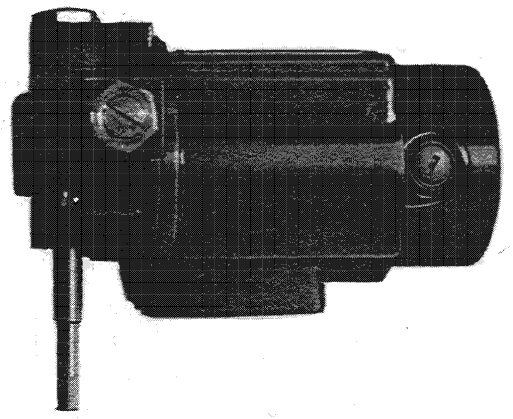
WOODWARD

Product Manual 03026
(Revision R, 5/2010)
Original Instructions



Permanent Magnet Type Synchronizing Motor for UG, PSG, and SG Governors

Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

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Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

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Warnings and Notices

Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Permanent Magnet Synchronizing Motor for UG, PSG, and SG Governors

Description

The permanent-magnet synchronizing motor is used to provide remote speed adjustment for an SG, PSG, or UG governor. The motor allows a switchboard operator to match the frequency of an alternator to that of other alternators or to change load distribution with other units when operating in the droop mode.

The synchronizing motors run only on nominal 24 Vdc power, but models are available with self-contained rectifiers which allow use of 110 Vac and 220 Vac supply. A potentiometer is included in most models. This allows the installer to match the motor with the type of supply available, and to set the motor speed within an adjustable range.

Four different PM motors have been used to adjust the speed setting of the governor. The S40, MM40, and MM4A have been used in the past. The current model is the SMM40. The SMM40 is directly interchangeable with any former speed-setting motor.

The SMM40 permanent-magnet motor operates on a nominal 24-Vdc supply. Rectifiers are included in models built to operate with ac supply. In addition a potentiometer is included with the unit which adjusts dc voltages to an acceptable level. An adjustable speed is achieved when a PM or APM motor control is added to the system.

SMM40 Speed

POWER	RATED SPEED (RPM)	ADJUSTABLE RANGE (RPM)*
24 Vdc	1	0.5 to 1.2
	2	1.2 to 2.5
	4	2.5 to 5
	8	5 to 10
110 Vac/dc	0.5	0.5 to 1
	3	1 to 4
	6	4 to 9
220 Vac/dc	0.5	0.5 to 1
	3	1 to 4
	6	4 to 9

* An adjustable range is available when an APM or PM motor control is used. The adjustment range is only for reference. Exact range depends on the controller used.

Product Specifications

82044 *APM Motor Control*
82499 *Adjustable Voltage Converter for 24 Vdc PM Motor Control*

Adjustment

A friction-type slip clutch between the motor shaft and the governor allows speed adjustment by the regular manual speed-setting method or by the electrically-driven PM motor. If this coupling has too little friction the motor drive will slip. With too great friction the manual speed adjustment will be too hard to turn or set.

The slip clutch also prevents damage to the governor or the speed adjusting motor when a maximum or minimum stop is attained. (The motor can continue to run for a short period after a physical stop has been reached.)

The clutch should be adjusted for about 0.5 N·m (4.5 lb-in) of friction. Individual governor manuals contain instructions on the maintenance and setting of the friction clutch.

Adjustment Procedure

(There are no adjustments on the MM4A.)

1. Unscrew the four round head screws (828, 515, 605) that hold the cover plate (825, 519, 602) on the potentiometer portion of the unit.

2. Loosen the lock nut (866, 511, 603) on the potentiometer, turning it counterclockwise. Turn the potentiometer adjusting shaft (865, 608, 530) clockwise (toward F on the Bakelite board (834, 510, 601) to increase motor speed, or counterclockwise (toward S) to decrease motor speed.

   When the slot in the shaft points toward the white spot on the Bakelite board the potentiometer adjustment will be at about the rated speed.

3. After the adjustment has been satisfactorily completed, lock the nut on the shaft and replace the cover and four round-head screws removed in step 1 of this procedure. (Do not operate the engine for any extended period of time with the potentiometer and wiring exposed.)

Power Connection

If ac power is used for speed adjustment connect one line from the ac source to terminal "C" on the receptacle (831, 522, 609). The rectifiers (843, 518, 606) may burn out if the unit is incorrectly wired. (Review the wiring diagram on the next page and check against the wiring before applying power to the motor for the first time.)

Terminals "A" and "B" are connected to the respective output poles of the speed-control switch.

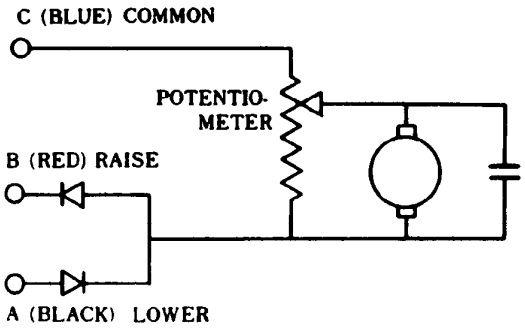
Bearing Lubrication

Ball bearings are permanently packed with a high-quality grease. Repacking or periodic oiling is not required.

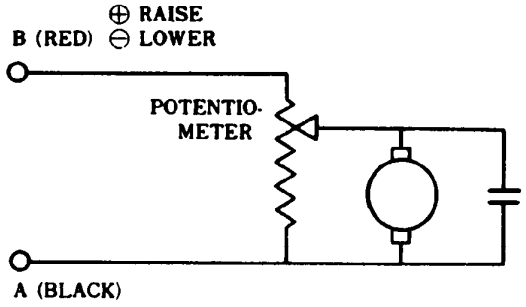
Gear Lubrication

The speed reduction gear housing (846, 528, 640, 733) is filled with enough lubricant to last about two years. Clean out the old grease every two years or as required and refill with Alvania No. 2 grease or its equivalent.

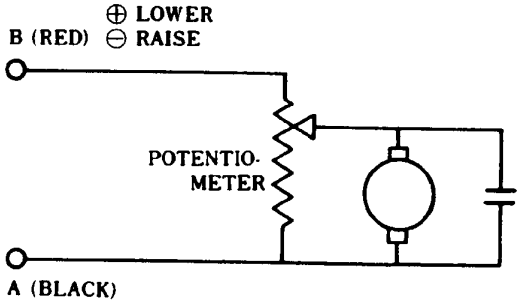
Wiring Diagrams



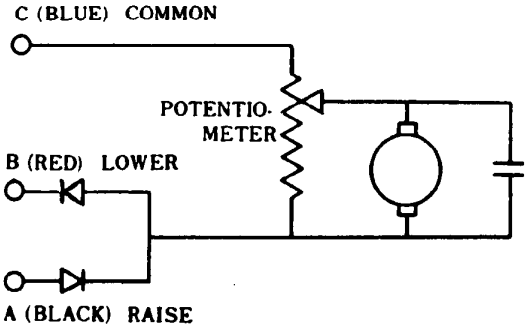
A.C. WIRING DIAGRAM
P.M. MOTOR FOR UG GOVERNOR



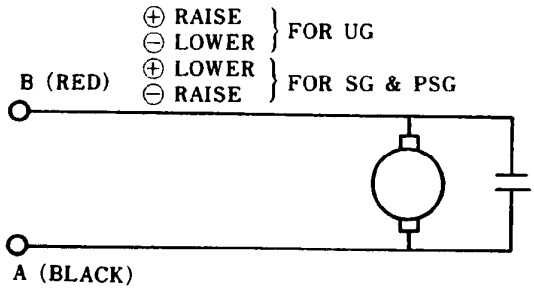
D.C. WIRING DIAGRAM
P.M. MOTOR FOR UG GOVERNOR



D.C. WIRING DIAGRAM
P.M. MOTOR FOR SG & PSG
GOVERNOR



A.C. WIRING DIAGRAM
P.M. MOTOR FOR SG & PSG
GOVERNOR



24V. D.C. WIRING DIAGRAM
P.M. MOTOR FOR SG, PSG & UG
GOVERNOR

Power Connection Diagram

Troubleshooting

The speed setting motor is extremely long lived and reliable. Most problems perceived as caused by the motor are in reality caused by either the power supply to the motor or the friction clutch and speed-setting linkage in the governor.

Do not disassemble the motor until after all other causes have been thoroughly investigated. Make sure that the correct power is being delivered to the motor. Check the connection between the motor and the power source.

Excess load or low supply voltage will slow the speed of the motor. Motor load can be caused in the governor as well as in the sealed gears on the motor. Always check for load in the governor by trying to turn the manual speed setting knob before assuming that excess load is in the motor and attached gears.

Motor heat can be caused by low voltage, excess load, or internal wiring. Always check causes outside of the motor before determining that the motor is at fault.

Applied voltage can cause motor overspeed. Overspeed conditions are seldom caused by the motor itself.

Irregular motor speed can be caused by a slipping clutch, problems in the voltage supply to the motor, of by the motor itself.

Trouble	**Cause**		**Correction**
Motor will not operate	No applied voltage	Power source or motor speed controller incorrect.	Adjust or exchange power source or controller.
		Fuses are blown.	Replace fuse, investigate cause.
		Wiring has intermittent open condition.	Correct wiring.
		Applied voltage time is too short.	Minimum signal time of 0.2 seconds for motor response.
	Current off	Brush spring or wire disconnection.	Replace spring or correct wire.
		Brush incorrectly installed.	Correctly install brush.
	Overload, Overcurrent	Speed-setting gear in governor is locked up.	Inspect and correct governor.
		Excessive wear in speed-setting bearings.	Replace bearings.
		Motor reduction gears.	Adjust or replace reduction gears.
Low rpm (motor speed)	Low Voltage	Power source to motor-speed controller incorrect.	Adjust or exchange power source or speed controller.
	Low Voltage Control	Voltage incorrect.	Correct supply voltage.
	Low Motor Torque	Brush spring disconnecting or shorting.	Replace brush and spring.
		Insulation incorrect.	Clean around brush holder or replace motor windings.
	Overload	Motor shaft has overloaded.	Inspect governor connection and speed setting mechanism.
		Reduction gear box troubles.	Inspect reduction gear box. Replace grease or parts as necessary.
		Bearing wear, lubrication, or adjustment.	Replace bearings, lubricate, and adjust as necessary.

Trouble	Cause		Correction
Low rpm	Low Voltage	Power source or motor speed controller incorrect.	Adjust or exchange power source.
		Voltage incorrect.	Check rated voltage, adjust or exchange power source.
	Low motor torque	Motor fault.	Repair motor or exchange motor.
		Insulation incorrect.	Clean around brush holder and brush spring.
	Overload	Motor shaft has overload.	Inspect governor.
		Reduction gear box problem.	Inspect and repair reduction gear box. Change lubrication in gear box.
		Bearings worn.	Replace bearings.
High rpm	High voltage	Power source or motor speed controller incorrect.	Adjust or replace power source or motor speed controller.
	Voltage incorrect	Check rated voltage.	Provide correct voltage to the motor.
Unstable motor speed	Current is changing	Load is changing.	Inspect governor, inspect gear box.
		Speed controller is not functioning correctly.	Inspect and repair or replace controller.
		Bearing trouble.	Replace or adjust bearings.
		Brush spring disconnecting or shorting.	Replace spring, inspect installation of brush and spring.
		Dirt between brush and commutator.	Inspect brush, clean commutator.
Motor is over-heating	Overcurrent	Overload.	Repair governor, gear box, or bearings.
		Bearing problem.	Replace bearing.
		Excessive bearing thrust.	Adjust bearing thrust.
		Failed brush spring insulation, short.	Replace brush spring, check installation of spring and brush.
		Brush holder shorting.	Clean around brush holder.
	Motor is overheating	High ambient temperature condition.	Improve ventilation, reduce ambient temperature.
		Motor is dirty.	Clean motor to improve heat-exchange capabilities.
Excessive brush wear	Commutation incorrect	Overload.	Repair governor, gear box, or bearing.
		Abrasive gas in atmosphere.	Ventilate with clean air.
		Damaged commutator.	Polish commutator, replace armature assembly.
		Brush spring tension incorrect or brush spring is shorting.	Replace the spring, check the brush installation.
		Excessive vibration.	Improve mounting or reduce governor vibration.
	Brush material incorrect	Brush does not match motor characteristics or installation conditions.	Change brush composition or change operating conditions.
Motor operation is noisy	Excessive vibration	Incorrect motor installation.	Correct installation.
		Motor drive alignment incorrect.	Correct alignment.
		Dirt or debris in the gap between the commutator and the brush.	Clean or repair motor.
Motor operation is noisy cont.	Bearings causing vibration	Lubrication error.	Replace bearing and correct lubrication.
		Damaged bearing surface.	Replace bearing and correct lubrication and adjustment.
		Bearing seizure.	Replace bearing and correct lubrication and adjustment.
	Commutator damaged, causing damage to the brush	Damaged or worn commutator.	Repair commutator or replace armature and winding assembly.
		Abrasive atmosphere.	Improve ventilation or change brush components to match demands of the atmosphere.

Replacement Parts

The following pages list replacement parts for the four speed-setting motors included in this manual. The user must be careful that the illustration and parts list correctly matches the motor being serviced. A number of parts are identified in the drawings for information only. These parts are available only through the purchase of larger assemblies, usually the complete motor assembly.

When ordering replacement parts, include the following information:

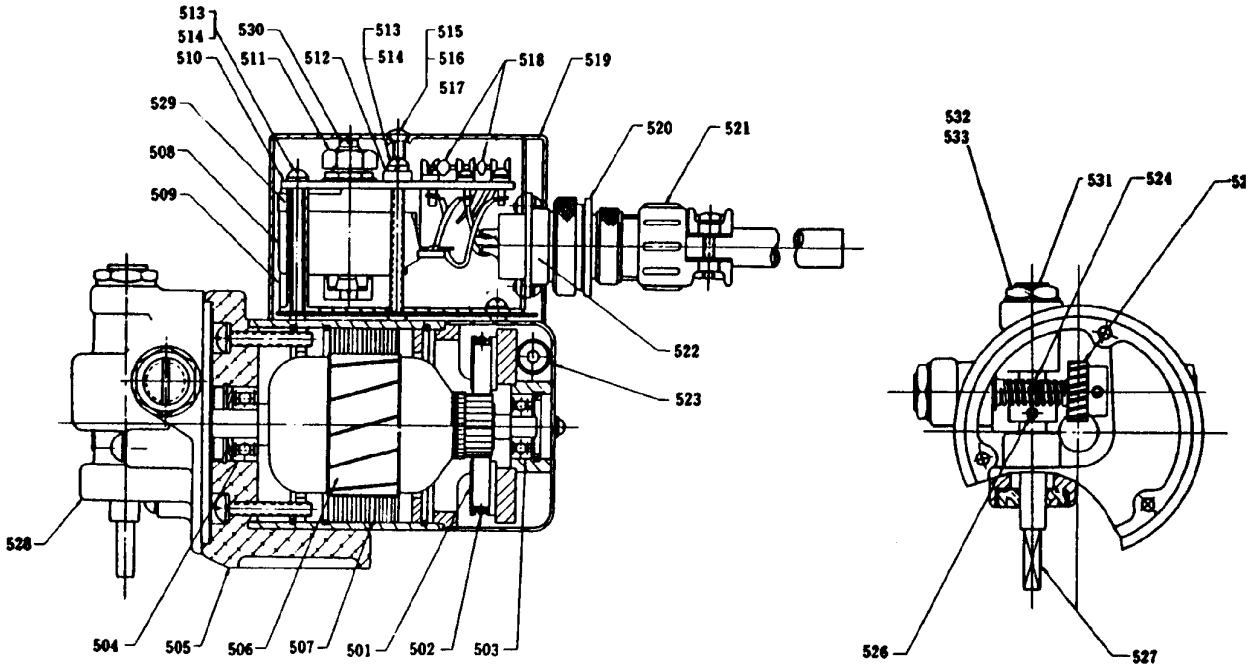
1. Serial number and part number shown on the mane plate.
2. Manual number (this is Manual 03026).
3. Part number from parts list and description or part name.

IMPORTANT

Do not replace the motor until failure of the remote speed-setting adjustment is clearly identified as failure of the motor. Check wiring to the motor and power to the motor before assuming that the motor has failed. If the electrical supply to the motor is determined to be correct, then carefully check the slip-clutch setting to be sure that it has not changed. Check the manual speed-setting gear train to be sure it is not presenting too great a load for the motor to turn.

Model S40

Specify Model S40 when ordering parts from this page. Note that the part numbers are for identification only and are not Woodward part numbers.



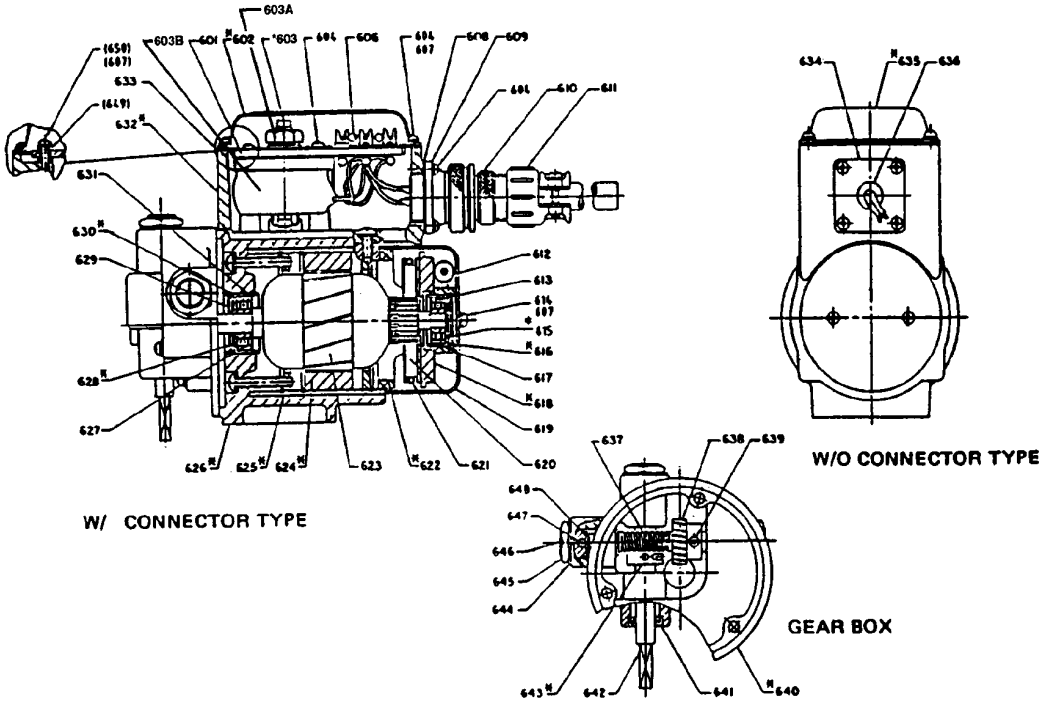
Ref. No.	Part Name	Quantity
03026-501	Motor Brush	2
03026-502	Brush Spring	2
03026-503	Ball Bearing	1
03026-504	Ball Bearing	1
03026-505	End Housing	1
03026-506	Armature	1
03026-507	*Ferrite Magnet	1
03026-508	Potentiometer	1
03026-509	*Frame	1
03026-510	Bakelite Board	1
03026-511	Nut	1
03026-512	Cross Bar	1
03026-513	Spring Washer	4
03026-514	Screw	4
03026-515	Screw	1
03026-516	Stop Ring	1
03026-517	Vinyl Washer	1

Ref. No.	Part Name	Quantity
03026-518	Rectifier	2
03026-519	Enclosing Cover	1
03026-520	Plug	1
03026-521	Cable Clamp	1
03026-522	Receptacle	1
03026-523	Condenser	1
03026-524	Worm Gear Shaft	1
03026-525	Bakelite Gear	1
03026-526	Bronze Gear	1
03026-527	Output Shaft	1
03026-528	*Reduction Gear Box	1
03026-529	Sleeve	2
03026-530	*Adjusting Shaft	1
03026-531	Screw	3
03026-532	Nut	3
03026-533	Washer	3

* Parts available only in connection with larger assembly.

Model MM40

(Speed Setting serial numbers 21105 and after are model MM40. Note that the part numbers are for identification only and are not Woodward part numbers.



Ref. No.	Part Name	Quantity
03026-601	Bakelite Board	1
03026-602	Pot Cover	1
03026-603	Potentiometer	1
03026-604	Rd Hd Screw	12
03026-605	Spring Washer	14
03026-606	Rectifier	2
03026-607	Flat Washer	6
03026-608	Gasket	1
03026-609	Receptacle	1
03026-610	Plug	1
03026-611	Cable Clamp	1
03026-612	Condenser	1
03026-613	Ball Bearing	1
03026-614	Rd Hd Screw	2
03026-615	Alum. Washer	1
03026-616	Retaining Ring	1
03026-617	Bearing Retainer	1
03026-618	Brush Holder Board	1
03026-619	End Cover	1
03026-620	Motor Brush	2
03036-620A	Brush Holder Assy	1
03026-621	Brush Spring	2
03026-622	*Bracket	1
03026-623	Armature Assy	1
03026-624	*Ferrite Magnet	1
03026-625	*Stator Assy	1

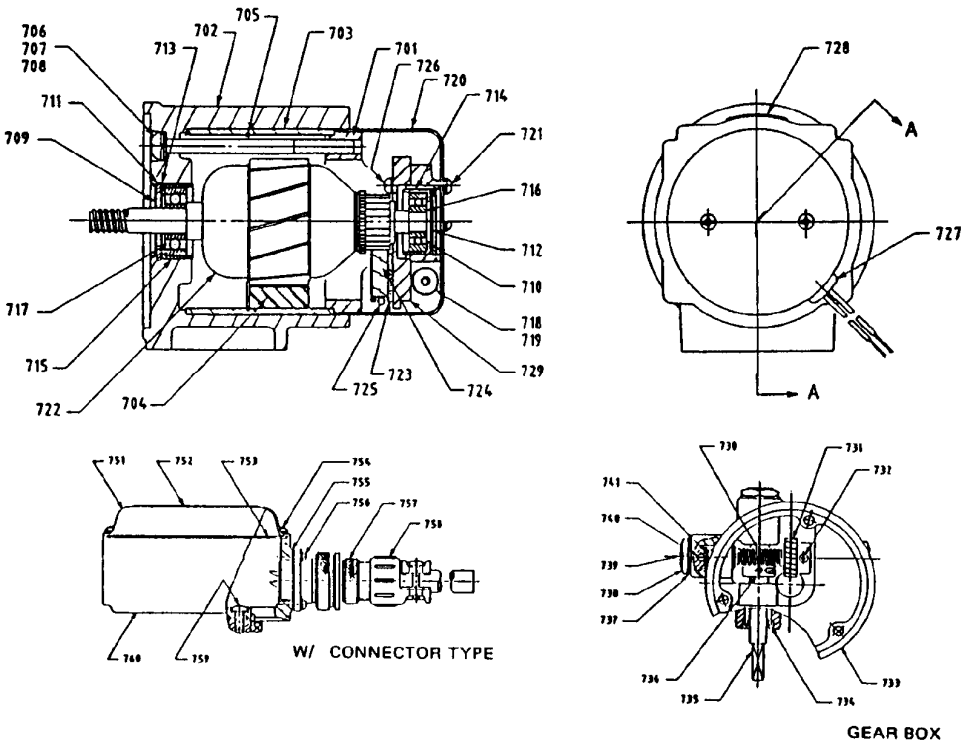
Ref. No.	Part Name	Quantity
03026-626	*Body	1
03026-627	Ball Bearing	1
03026-628	Alum Washer	1
03026-629	Bearing Cap	1
03026-630	Retaining Ring	1
03026-631	Bearing Retaining Ring	1
03026-632	*Pot. Box	1
03026-633	Gasket	1
03026-634	Plate	1
03026-635	Name Plate	1
03026-636	Grommet	1
03026-637	Worm Shaft	1
03026-638	Helical Gear	1
03026-639	Rd Hd Screw	
03026-640	*Gear Housing	1
03026-641	Oil Seal	1
03026-642	Output Shaft	1
03026-643	Helical Gear	1
03026-644	Fiber Washer	3
03026-645	Lock Nut	3
03026-646	Adjusting Plug	3
03026-647	Ball	3
03026-648	Ball Seat	1
03026-649	Damping Bushing	1
03026-650	Rd Hd Screw	4

NOTE—Units with the Damping Rubber Bushing use 8 parts 604 and 10 parts 607.

* Parts available only in connection with larger assembly.

Model MM4A

This model does not include built in rectifiers or a voltage adjustment potentiometer. Note that the part numbers are for identification only and are not Woodward part numbers.



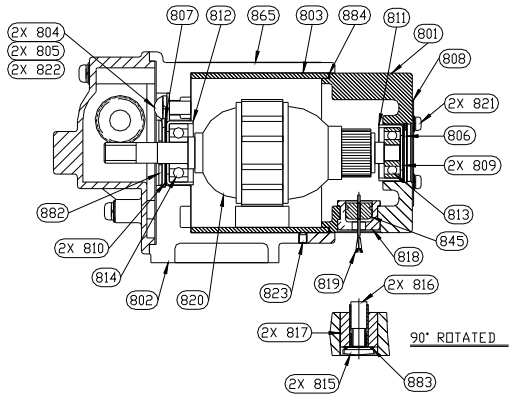
Ref. No.	Part Name ..... Quantity	Ref. No.	Part Name ..... Quantity
03026-701	*Front Housing 1	03026-727	*Grommet 1
03026-702	*Body 1	03026-728	Name Plate 1
03026-703	*Stator Assembly 1	03026-729	Brush Holder Board 1
03026-704	*Ferrite Magnet 1	03026-730	Worm Shaft 1
03026-705	*Retaining Ring 1	03026-731	Helical Gear 1
03026-706	*Rd Hd Screw 2	03026-732	Rd Hd Screw 1
03026-707	*Spring Washer 2	03026-733	Gear Housing 1
03026-708	*Flat Washer 2	03026-734	Oil Seal 1
03026-709	Bearing Cap 1	03026-735	Output Shaft 1
03026-710	Retaining Ring 1	03026-736	Helical Gear 1
03026-711	Alum Washer 1	03026-737	Fiber Washer 3
03026-713	Alum Washer 2	03026-738	Lock Nut 3
03026-714	Bearing Retainer 1	03026-739	Adjusting Plug 3
03026-715	Bearing Retainer 1	03026-740	Ball 3
03026-716	Ball Bearing 1	03026-741	Ball Seat 3
03026-717	Ball Bearing 1	03026-742	*Cover 1
03026-718	Condenser 1	03026-752	*Name Plate 1
03026-719	*Insulator 1	03026-753	*Plate 1
03026-720	*Motor Cover 1	03026-754	Rd Hd Screw 4
03026-721	*Rd Hd Screw 2	03026-755	Gasket 1
03026-722	*Armature 1	03026-756	Rd Hd Screw 4
03026-723	Brush Holder Assy 1	03026-757	Plug 1
03026-724	Motor Brush 2	03026-758	Cable Clamp 1
03026-725	Brush Spring 2	03026-759	Screw 4
03026-726	*Rd Hd Screw 2	03026-760	*Box 1

* Parts available only in connection with larger assembly.

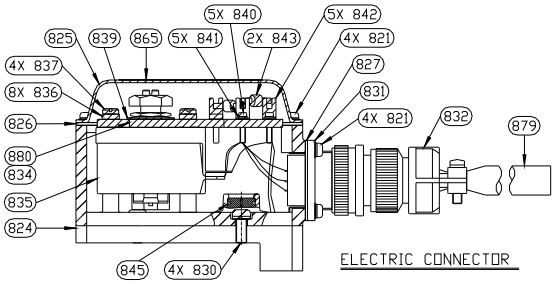
Model SMM40

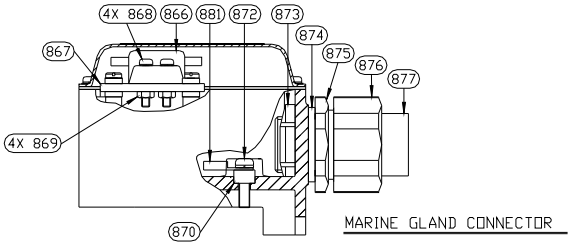
This motor will replace any other speed-setting motor. Most parts, however, are not interchangeable. Note that the part numbers are for identification only and are not Woodward part numbers. Housing is IP44.

SECTION VIEW

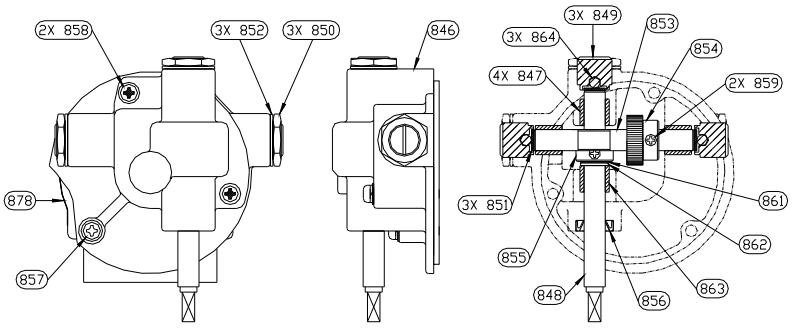


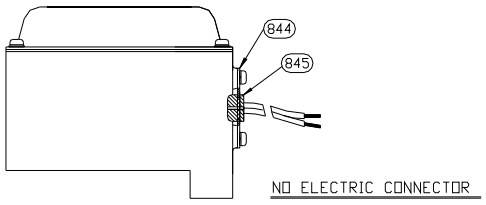
POTENTIOMETER BOX





GEAR HOUSING





030-346
(Sawamura drawing)
2010-1-11

Ref. No.	Part Name	Quantity	Ref. No.	Part Name	Quantity
03026-801	*Front Housing	1	03026-843	Diode Rectifier	2
03026-802	*Body	1	03026-844	Plate	1
03026-803	*Stator Assy	1	03026-845	*Grommet	1
03026-804	PH Hd Screw	2	03026-846	*Gear Housing	1
03026-805	Spring Washer	2	03026-847	Bushing	4
03026-806	Retaining Ring	1	03026-848	Motor Shaft	1
03026-807	Retaining Ring	1	03026-849	Ball Seat	3
03026-808	Cap	1	03026-850	Hex Nut	3
03026-809	Alum Washer	2	03026-851	Shim	3
03026-810	Alum Washer	2	03026-852	Fiber Washer	3
03026-811	Bearing Retainer	1	03026-853	Worm Gear Shaft	1
03026-812	Bearing Retainer	1	03026-854	Helical Gear	1
03026-813	Ball Bearing	1	03026-855	Helical Gear	1
03026-814	Ball Bearing	1	03026-856	Oil Seal	2
03026-815	Holder Cap	2	03026-857	Screw	1
03026-816	Brush Assy	2	03026-858	Screw	2
03026-817	*Brush Holder	2	03026-859	Screw	2
03026-818	*Grommet	1	03026-860	Washer	3
03026-819	Lead Wire	AR	03026-861	Spacer	1
03026-820	Armature	1	03026-862	Spacer	1
03026-821	PH Hd Screw	max 10	03026-863	Retainer	1
03026-822	Flat Washer	2	03026-864	Ball	3
03026-823	Set Screw	1	03026-865	Nameplate	1
03026-824	*Potentiometer Box	1	03026-866	Terminal Block	1
03026-825	Potentiometer Cover	1	03026-867	Bakelite Board	1
03026-826	Gasket	1	03026-868	PH Hd Screw	4
03026-827	Gasket	1	03026-869	Hex Nut	4
03026-828	Removed		03026-870	Sleeve	1
03026-829	Removed		03026-871	Removed	
03026-830	PH Hd Screw	3 or 4	03026-872	PH Hd Screw	1
03026-831	Receptacle	1	03026-873	Gland Lock Nut	1
03026-832	Plug & Cable Clamp	1	03026-874	Gland Packing	1
03026-833	Removed		03026-875	Gland Lock Union	1
03026-834	Bakelite Board	1	03026-876	Gland Nut	1
03026-835	Potentiometer	1	03026-877	Gland Lock Joint	1
03026-836	Damping Bushing	8	03026-878	Motor Label	1
03026-837	Slotted Hd Screw	4	03026-879	Cable Clamp Bushing	1
03026-838	Insulated Terminal	2	03026-880	Board	1
03026-839	Spring Washer	1	03026-881	Insulated Terminal	1
03026-840	Pan Hd Screw	5	03026-882	Bearing Cap	1
03026-841	Spring Lock Washer	5	03026-883	O-ring	1
03026-842	Terminal	5	03026-884	Gasket	1

* Parts available only in connection with larger assembly.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 03026R.

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