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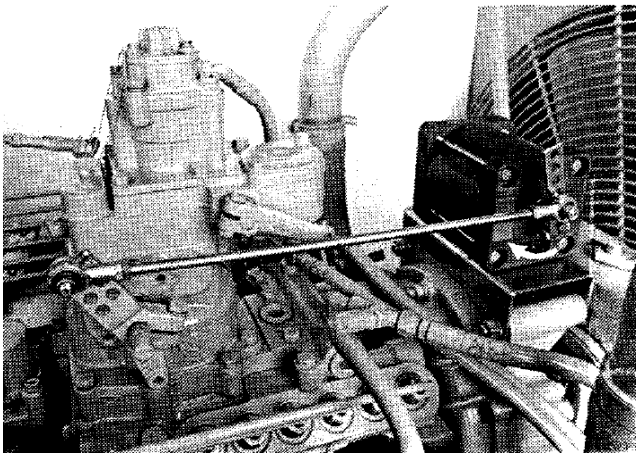

EPG
Electrically Powered Governor

Installation and Control Choices for EPG Actuators

Application Note 50530 (Revision A)

WARNING—DANGER OF DEATH OR PERSONAL INJURY

WARNING—FOLLOW INSTRUCTIONS

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.

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WARNING—OVERSPEED PROTECTION

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—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.

CAUTION—POSSIBLE DAMAGE TO EQUIPMENT OR PROPERTY

CAUTION—BATTERY CHARGING

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.

CAUTION—ELECTROSTATIC DISCHARGE

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.**

IMPORTANT DEFINITIONS

- **A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**
- **A CAUTION indicates a potentially hazardous situation which, if not avoided, could result in damage to equipment or property.**
- **A NOTE provides other helpful information that does not fall under the warning or caution categories.**

Installation and Control Choices for EPG Actuators

General

Connecting an EPG actuator to a diesel engine to provide precise control of speed or load usually presents three choices:

- Removal of the existing governor and connecting the actuator directly to the injector rack or other fuel control
- Leaving the existing governor in place and connecting to the shutdown lever or rod, setting the mechanical-governor speed at maximum
- Connecting to the speed-setting lever on the mechanical governor

Connecting directly to the rack or fuel-metering device is the most desirable, but in many cases the least practical choice, since the mechanical governor is often an integral part of the existing control system. The option of connecting directly to the rack or fuel-metering device should always be the first choice.

Almost all units have a shutdown lever which shuts off fuel to the engine. The movement of the shutdown lever and the flow of fuel is usually proportional, allowing close control. If the shutdown lever is selected for EPG control it should be checked for smooth operation and to be sure that its movement provides a proportional curtailment of fuel.

WARNING—OVERSPEED SHUTDOWN

If the shutdown lever should be selected for the EPG fuel control mechanism, an alternate method of emergency shutdown should be provided. This alternate shutdown method should act totally independent of the EPG system to protect the engine from possible overspeed and resulting property damage, personal injury, and possible death. The EPG system can be set to provide routine shutdown of the engine.

(Some engine-shutdown systems shut off the air supply rather than the fuel supply. The EPG system will not successfully control through this shutdown method. Other engine manufacturers have designed shutdown systems which are adequate for the intended use, but will not stand up to the constant movement associated with close control of speed. If in doubt about the construction of the specific shutdown lever device, contact the engine or fuel system manufacturer. Shutdown systems which are built to trip and “snap” closed are not suitable for operation by the EPG actuator.)

The shutdown rod should have a spring return to minimum fuel as a safety factor, should the linkage between the actuator and the shutdown lever fail. This spring must be weak enough not to cause problems in control. In some cases the spring must be removed, or weakened to gain control through the shutdown lever.

Linkage kit 8924-370 provides a terminal lever for the 1712/24 or 512/24 actuator, two rod ends of the type that should be used with linkage from the governor to the engine, and a 16-inch (406 mm) long piece of threaded rod.

The 4024 actuator requires a larger terminal lever with 0.500-36 serrations. Most 4024 actuators are fitted with an external return spring. These actuators must be ordered with the correct direction of rotation.

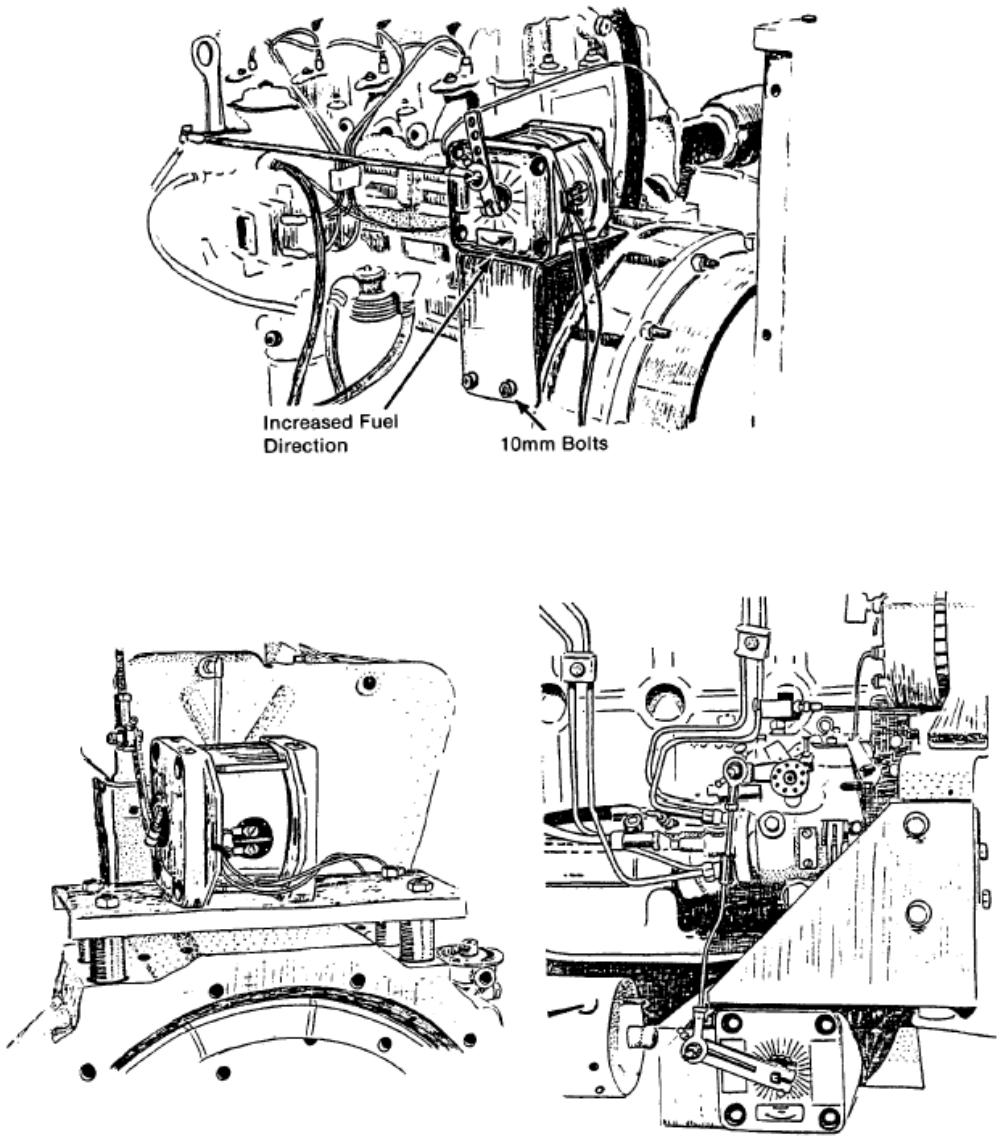

Figure 1. Typical EPG Actuator Installations

A ball-bearing rod end should always be used on the actuator end of the linkage to assure firm movement in both increase and decrease fuel directions. Other types of rod ends may be used on the shutdown lever, rack, or speed-setting lever connections, depending upon the spring load and direction of force. The rod end supplied with the kit is usually the best choice for connection to the fuel control.

In cases where it is not practical to attach directly to the rack or to the shutdown lever, it is possible to provide electronic speed/load control through the speed-setting lever. This option creates additional control problems covered in detail in Application Note 50528, *Linking the EPG to a Mechanical Droop Governor*.

1. Washer .....
2. Nut, 0.312 Elastic.....
3. Screw, 0.250-28 x 1 .....
4. Screw, 0.312-24 x 1 .....
5. Screw, 0.312-24 x 1.5 .....
6. Nut, 0.312-24 Jam .....
7. Nut, 0.250-28 Elastic.....
8. Rod End, Size 5.....
9. Rod, 0.312-24 x 16 .....
10. Lever, 75 mm.....

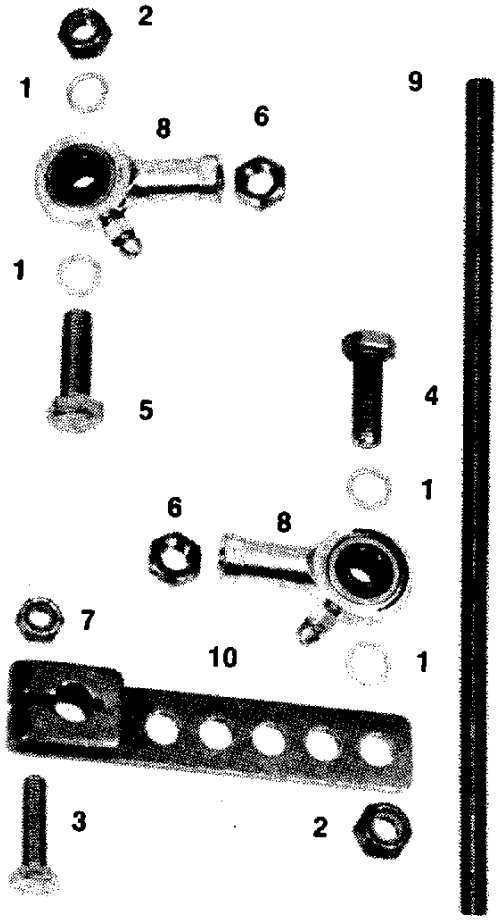

Figure 2. Parts Included with Linkage Kit 8924-370

Required control force is a critical consideration for all installations. Reduced rotation will reduce the total control force. The following table lists control forces for the complete rotation available:

Actuator	Output	Rotation
512	0.7 N·m (0.5 lb-ft)	30°
524	1.0 N·m (0.75 lb-ft)	30°
1712	2.0 N·m (1.5 lb-ft)	35°
1724	2.3 N·m (1.7 lb-ft)	35°
4024	5.4 N·m (4.0 lb-ft)	42°

The actuators are adequate for most small and medium size engines and linkage systems, but the linkage and the control feature being used must be as free of friction as possible. Woodward applications experts can help select the correct size actuator for most engines.

All EPG actuators are available with feedback systems. This provides a "stiffer" actuator and will change some marginal operations into satisfactory or excellent controllers.

Before installing an actuator, check the control feature to be used to be sure that it is within the work output of the actuator and that it operates smoothly, without sticking in a given position and without excessive friction. If in doubt, contact a Woodward Application Engineer for additional details on how to check the work force required and, in some cases, how to overcome friction in the control system.

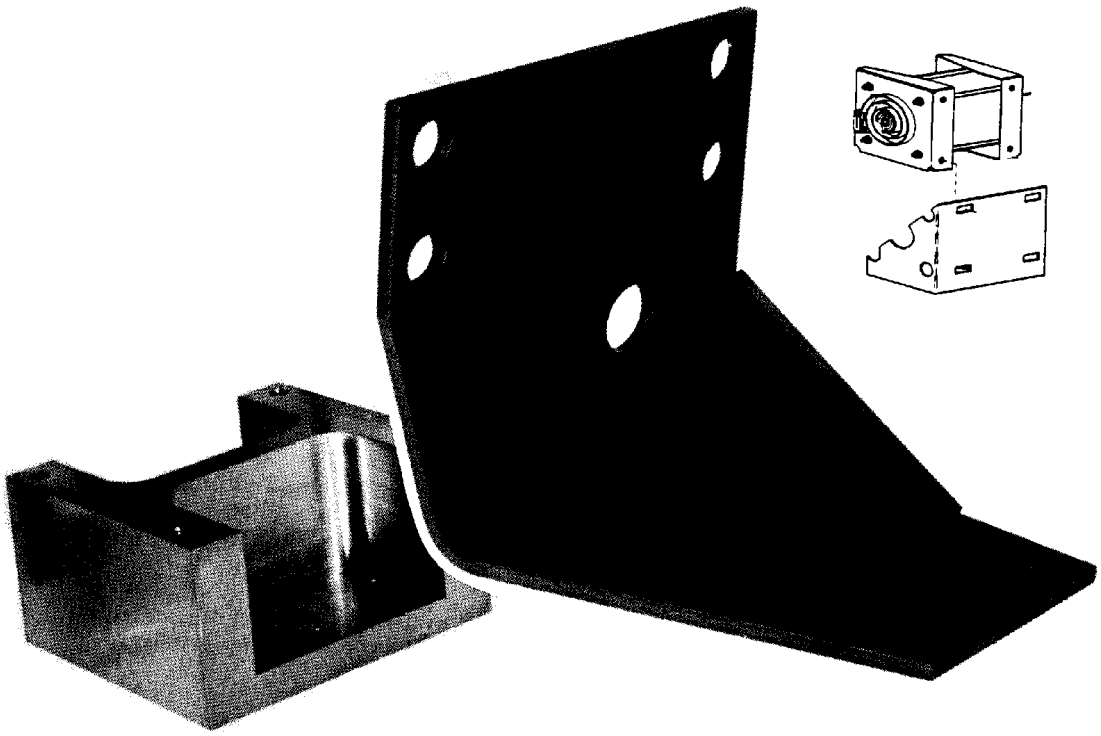

Figure 3. Samples of Actuator Brackets

Installation Bracket

The bracket for an EPG actuator should be designed to provide solid support. The location should be as vibration free as possible. Most Woodward-built brackets are constructed of 10-gauge sheet steel with the edges bent at 90 degrees for stiffness. Steel plate at least 6 mm (1/4 inch) thick is generally heavy enough to support the actuator, although additional bracing is sometimes required if the plate is much larger than the actuator. The 4024 actuator is heavier than the 1712/24 actuator and will generally require a heavier bracket.

The actuator should be protected from excessive heat. The actuator is rated for ambient temperatures from –40 to +93 °C (–40 to +200 °F). The mounting plate should not conduct temperatures in excess of 93 °C/200 °F. to the actuator.

For a 1712/24 or 512/24, drill four 5/16 (0.312), letter "O", or 8 mm holes in the mounting plate and attach the actuator with 0.250-20 grade-5 screws, 0.250 washers, and lock washers. Minimum thread engagement into the actuator should be 8 turns or 0.375 inch. Torque the 0.250-20 bolts into the aluminum actuator case to 2.8 N·m (25 lb-in).

For a 4024, drill four 25/64 (0.390), letter "W", or 10 mm holes in the mounting plate and attach the actuator with 0.375-16 grade-5 screws, 0.375 washers, and lock washers. Minimum thread engagement into the actuator should be 8 turns or 0.500 inch. Torque the 0.375-16 bolts into the aluminum actuator case to 10 N·m (90 lb-in).

Tolerance stack-up in the assembly of actuators indicates that it may be necessary to elongate two of the holes to fit an individual actuator. The use of high-quality rod ends allows the installation to be imperfectly aligned between the actuator lever and the control lever selected on the engine. The alignment should be kept as nearly perpendicular as possible.

Either output shaft of a 1712/24 or 512/24 actuator may be used. 4024 actuators should be ordered with the direction of rotation determined at the factory. Actuators with feedback must be ordered with the direction of rotation determined at the factory.

Installation attitude will not affect governor operation. Install for easy access to the two electrical posts. If possible, position the posts to prevent damage to the terminal during engine maintenance.

The following table shows minimum, maximum, and preferred actuator shaft movement between minimum and maximum fuel. The preferred distance will provide better stability.

Actuator	Min Travel	Max Travel	Preferred Travel
512/24	18°	20°	22°
1712/24	21°	23°	26°
4024	26°	30°	28°

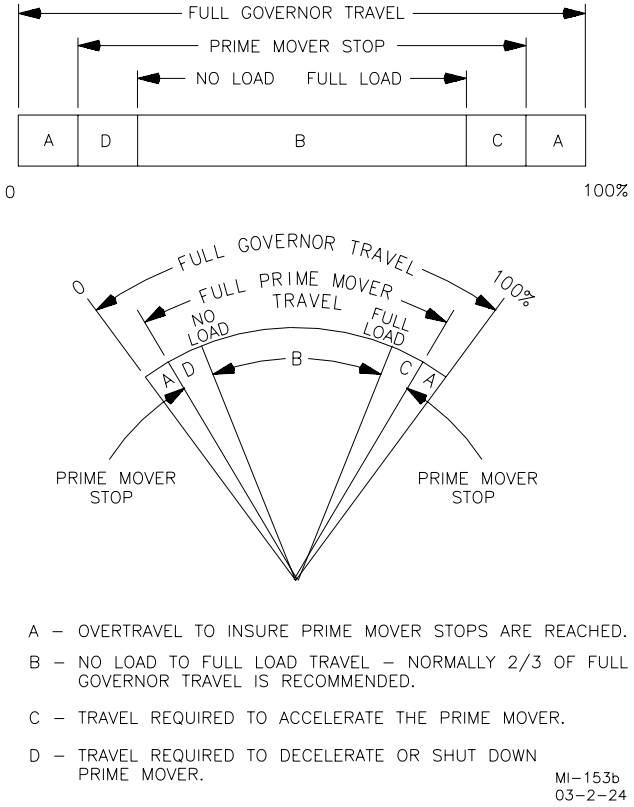

Figure 4. Recommended Terminal Shaft Movement

Using a small amount of actuator travel increases the gain which must be set into the electronic governor system. This will slow the response rate of the governor as it increases the amount of deadband between the electronic signal and the actual output of the actuator. If the gain gets too high, it becomes impossible to stabilize the system with the gain and stability adjustments on the speed control.

If less than recommended rotation of the actuator shaft must be used, locate the lever so the actuator shaft approaches maximum-fuel stop on maximum-fuel signal. Moving the rod end at the actuator closer to the centerline of the shaft (shortening the effective lever length) and/or moving the rod end farther from the centerline of the engine control shaft (lengthening the effective length of this lever) will increase the amount of actuator travel used.

Vibration of the operating rod between the actuator and the engine can quickly cause damage to the rod ends, or to the rod. Long rods are more subject to damage than are short rods. If the rod is over 60 cm (24 inches) long, it should be replaced with a hollow tube to increase speed and accuracy of response by reducing weights and possible bending of the rod. The use of a hollow rod may also eliminated possibly damaging vibration which can build up using long pieces of threaded rod.

When establishing the final length of the threaded link, be sure at least five full threads of the threaded link engage at each end. Do not cause the rod end to bind when tightening the jam nut after establishing the proper length.

WARNING—OVERSPEED

The threaded rod could thread out of the rod end if it is not locked, causing loss of governor control and possible overspeed. It is extremely important that the jam nut on the threaded rod be kept tight.

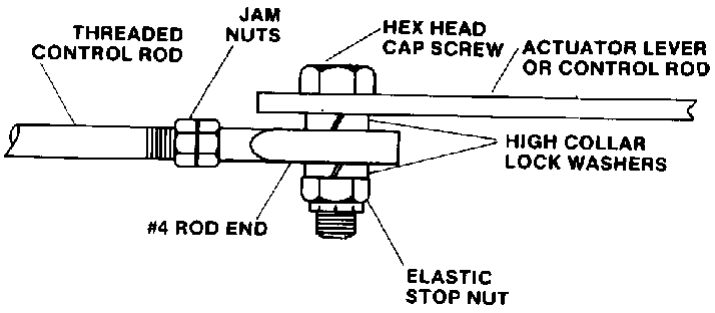

Figure 5. Rod End/Lever Assembly

Wiring Suggestions

If possible use 3 mm² (12 AWG), stranded, insulated wire in the circuit from the battery to the control and from the control to the actuator. Wire of size 2 mm² (14 AWG) can be used, but distances in the circuit must be shortened. Wires from the control to the actuator need not be shielded.

Actuator Type	Length from Battery to Control		Length from Control to Actuator		Total Allowable Wire Length	
	12 Ga.	14 Ga.	12 Ga.	14 Ga.	12 Ga.	14 Ga.
512/1712	35 ft.	10 ft.	25 ft.	10 ft.	60 ft.	20 ft.
524/1724	75 ft.	35 ft.	75 ft.	35 ft.	150 ft.	70 ft.
4024	12 ft.	4 ft.	12 ft.	4 ft.	22 ft.	8 ft.

The wire from the battery to the control must be direct from the battery posts to the control, not through a distribution point.

The wire used must not be kinked, and ties should be of a non-conducting material. Use only new, well insulated, stranded wire in the installation. The wire is not supplied in a mounting kit, but special harnesses are available from Woodward.

Signal wires from the MPU (magnetic pickup) to the control and from the control to and from the position feedback device on the actuator (if used) are normally run in 0.8 mm² (18 AWG) shielded conductors. The shield is grounded at one end only. See the manual for the particular system being installed for detailed wiring instructions.

Wiring Terminal Fittings

Attach AMP 52941 or AMP 52961 crimp-on number 6, slotted, insulated terminals, or equivalent, on the control-box end of 3 mm² (12 AWG) wires from the actuator and the battery. If 2 mm² (14 AWG) wire is used, attach AMP 35935 or AMP 52955 crimp-on, slotted, number 6, insulated terminals or equivalent.

The actuator end of the wires should be fitted with a number 8 ring terminal, AMP 35108 or equivalent, for 3 mm² (12 AWG) wire or AMP 32236, or equivalent, for 2 mm² (14 AWG) wire.

Polarity of actuator connections is not important, and the wires can be interchanged. Polarity of other connections is important.

Protect the actuator electrical connections from accidental damage while servicing the engine.

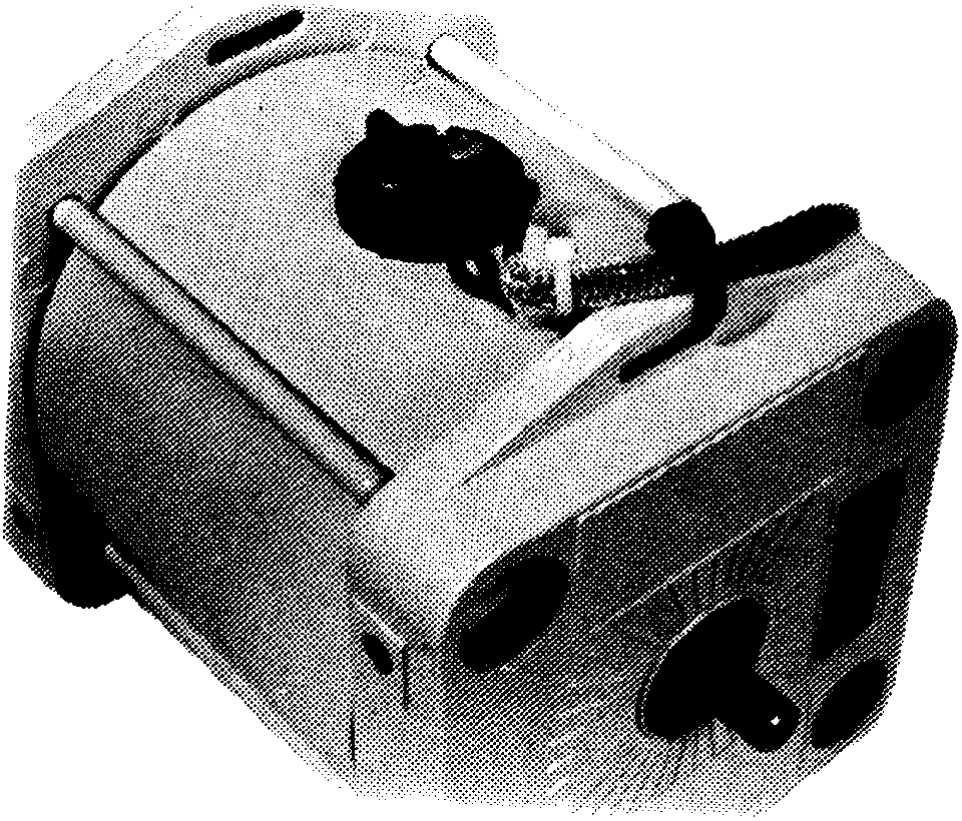

Figure 6. Actuator with Wiring Attached
(Note tie of the actuator wire to the actuator to prevent damage due to vibration.)

References

Pub.
Number Title
Manuals—
82493 *EPG 512/524 & 1712/1724 (Isochronous)*
82327 *EPG 512/24 & 1712/24, Single Phase Droop*
82354 *EPG with Position Feedback*
82042 *4024 Electrically Powered Governor 8256-060/080/081*

Product Specifications—
82043 *4024 All Electric Governor System*
04106 *EPG Electrical Powered Governor Systems*

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WOODWARD

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

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