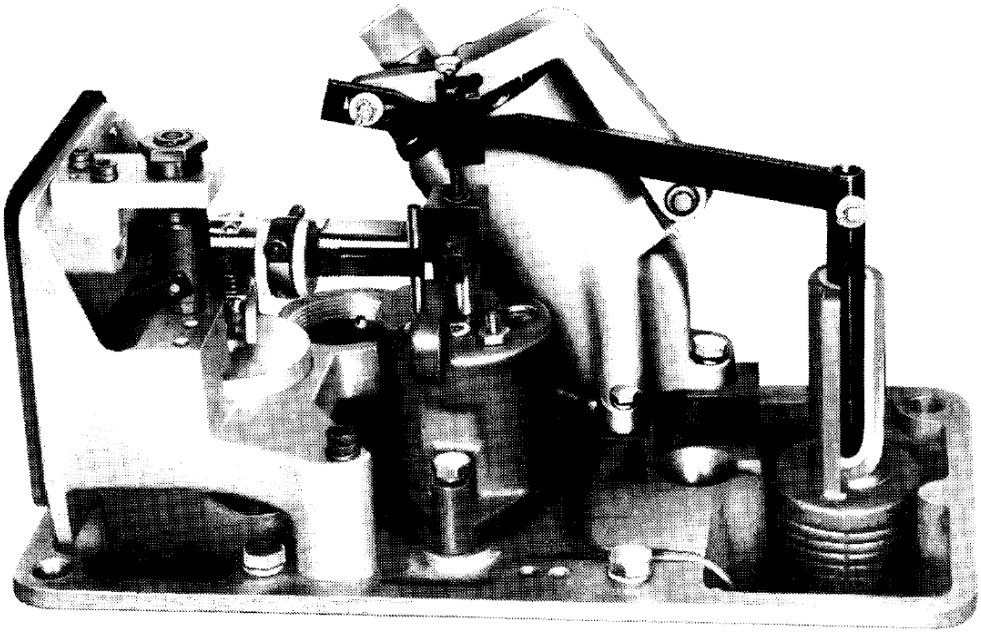
WOODWARD

Product Manual 36661
(Revision A)
Original Instructions



Manifold Gauge Pressure Fuel Limiter for PG 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:

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

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

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

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.

Manifold Gauge Pressure Fuel Limiter for PG Governors

Several types of fuel (or load) limiters are available for use in Woodward PG governors. One simple device provides a fixed maximum fuel limit without regard to the many variables which affect engine speed and load. Another arrangement varies the maximum fuel allowed the engine as a function of engine speed at any instant. Still another limits fuel as a function of governor speed setting. Some governors have more than one fuel limiter built within them. In such units, the different limiters operate independently, and fuel is limited by whichever limiter reaches its limiting value first.

The fuel limit curve for turbo-supercharged engines is often biased (shifted) as a function of supercharger discharge (manifold charging air) pressure. Some units bias the fuel limit curve as a function of absolute manifold charging air pressure. This bulletin describes the components of a system which biases the limit curve as the manifold charging air gauge pressure varies.

The normal lag of the turbo-supercharger speed to the engine speed makes it possible during periods of acceleration or on large increase in load, to supply more fuel to the engine than can be burned with the air available from the supercharger. The resulting imbalance of fuel and air leads to poor combustion and excessive smoke, and often retards the ability of the engine to return to normal speed after a load change. Restricting the governor power piston in the opening direction—and hence, limiting engine fuel - as a function of manifold charging air pressure insures that sufficient air available for proper combustion is maintained.

The fuel limiter consists essentially of a pressure sensor, a cam, and a connecting beam. They are shown schematically in Figure 1 as they relate to the PG governor basic elements.

One end of the connecting beam is attached to the tailrod of the governor power piston; the other end is positioned as a function of the cam position. The beam passes under the shutdown block so that, if the beam is raised sufficiently far, it will raise the shutdown block and with it the shutdown rod. The shutdown rod is an extension of governor pilot valve plunger. Thus, lifting the shutdown rod lifts the pilot valve plunger.

The governor power piston can move up—increasing fuel as it does so—only when the pilot valve plunger is below its centered position. Thus, fuel can be increased only until the upward movement of the power piston causes the connecting beam to return the pilot valve plunger to its centered position. The cam position establishes the height to which the power piston may rise before the connecting beam lifts the pilot valve plunger. Thus, the cam position determines the maximum fuel allowed the engine at any instant.

The cam is mounted on a hydraulically operated sensor piston which is connected to a force-balance system to take a position proportional to manifold charging air gauge pressure.

Manifold charging air is brought into the bellows and tends to push the cone valve up off its seat. This force is opposed at the cone valve by the force of the spring between the cone valve and sensor piston.

The unrestricted flow of pressure oil applies constant pressure to the upper-side of the sensor piston. A series of orifices restricts the flow of pressure oil to the underside of the piston. Except while changes are occurring in the manifold charging air pressure, the bellows force tending to push the cone valve up is balanced or equaled by the spring force from the opposite direction. Thus, the cone valve normally “floats” just off its seat and continually by-passes to sump the oil admitted through the orifice stack to the under-side of the piston. (This accounts for continuous “bubbling” of oil from the top of the sensor when it is operating.) If the bellows force is greater than the opposing spring force, the cone valve is forced upward, and oil flows out from under the piston at an increased rate. The pressure oil above the piston forces it down, compressing the spring until the spring force again equals the bellows force. If the manifold charging air pressure is decreased, the bellows output force is reduced, and the spring pushes the cone valve onto its seat. The oil pressure under the piston will move the piston up and reduce the spring load on the cone valve until the opposing forces are again equal.

The preload on the spring within the bellows assembly determines the charging air pressure below which a constant maximum fuel limit is held (line RS in Figure 2). Preload is adjusted by means of the adjusting screw in the end of the bellows case and is factory set. The contour of the cam determines the slope of line ST (Figure 2).

Since the fuel limiter is effective at idle speed, the fuel limit must be set high enough to give sufficient fuel for starting.

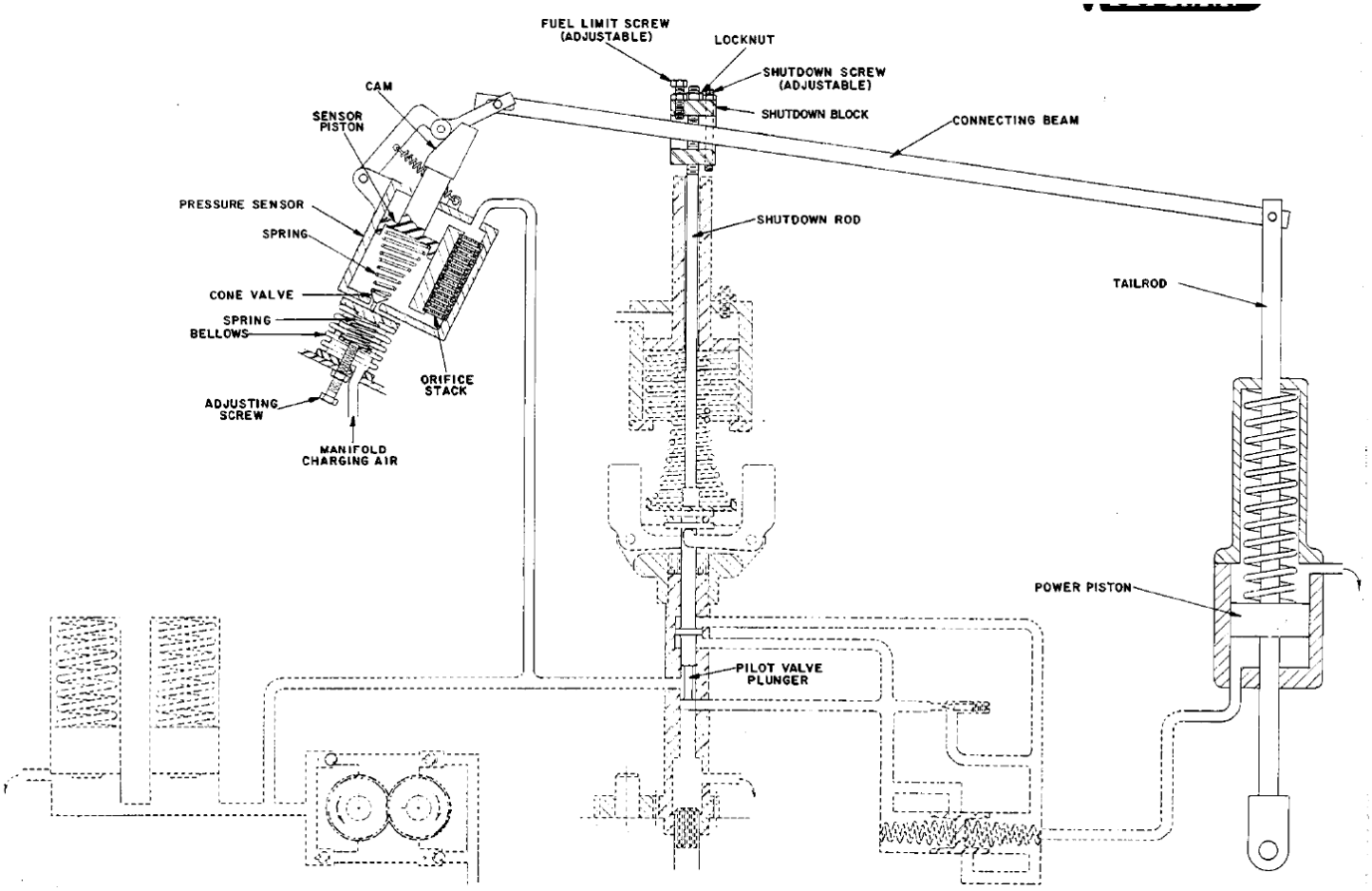


Figure 1. Manifold Gauge Pressure Fuel Limiter

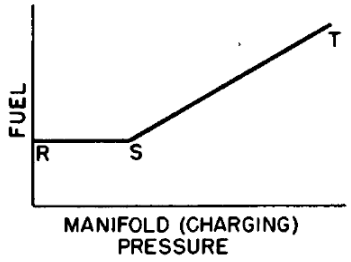


Figure 2. Fuel vs Manifold Pressure

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 36661A.

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

Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

2012/11/Colorado