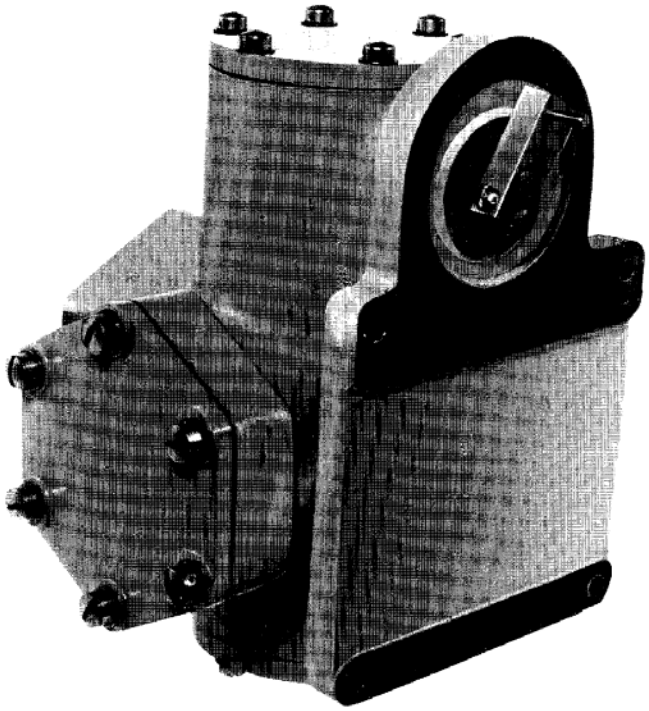
WOODWARD

Product Manual 45001
(Revision A)
Original Instructions



Large Gas Fuel Valve

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 Out-of-date translations are marked with ⚠.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.

Contents

Illustrations and Tables

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.

Chapter 1.
General Information

Introduction

The large gas fuel valve is primarily intended for application to industrial gas turbines, and it is used with a governor and/or an acceleration fuel servo-limiter, depending on the precision of the control required. The gas fuel valve is the basic device used for metering the correct amount of fuel to the turbine as a function of the fuel metering valve plunger position. The position of the plunger is determined by the governor and/or acceleration fuel servo-limiter, and the position determined will schedule the required fuel flows for starting, acceleration, steady state, and deceleration.

The fuel valve is designed for constant gas inlet pressure. It meters fuel as a function of the contoured metering valve plunger and the pressure drop across the valve. It is required that the gas fuel valve inlet pressure be maintained at a constant pressure in order to maintain a predetermined fuel schedule to the turbine.

The gas fuel valve is available in various ranges for different applications. The exact range of each valve is selected to meet the requirements of the installation in which it is used. The valve is capable of metering 500 to 15 000 lb/h (227 to 6804 kg/h). The metering valve plunger has double lands to minimize pressure unbalance.

Specifications

Fuel (gaseous).....Propane, Butane, Natural
  Specific Gravity..... 0.61

Fuel Flow Range (metered gas)
  Minimum ..... 500 lb/h (227 kg/h)
  Maximum ..... 15 000 lb/h (6804 kg/h)

Fuel Pressure (maximum)
  Inlet ..... 335 psi (2310 kPa)
  Outlet ..... 315 psi (2172 kPa)

Porting
  GAS IN.....MS33786-40
  GAS OUT.....MS33786-40

Chapter 2.
Principles of Operation

The gas fuel valve meters fuel as a function of the position of the fuel metering valve plunger. The metering valve plunger is positioned by a governor and/or an acceleration fuel servo-limiter. See Figure 2-1 for a schematic flow diagram of the gas fuel valve.

At a cranking speed high enough to build up the governor oil pressure, the output signal of the governor and/or fuel servo-limiter rotates the fuel control valve control shaft and lifts the metering valve plunger. This movement opens the fuel valve and allows the required fuel flow through the valve to the turbine.

Acceleration fuel to the turbine is scheduled or predetermined by the contour and position of the metering valve plunger for any given gas inlet pressure and outlet pressure; any position of the plunger will result in a specific fuel flow.

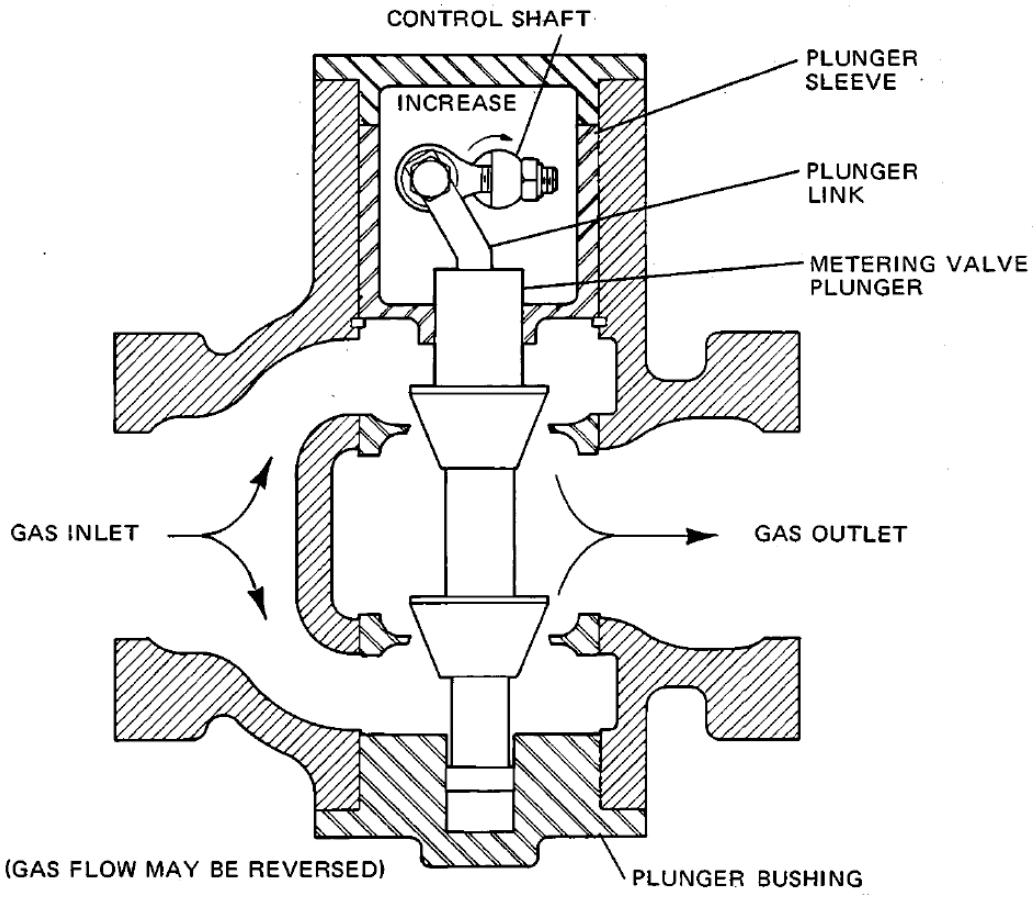


Figure 2-1. Schematic Flow Diagram of Large Gas Fuel Valve

Chapter 3.
Overhaul

Introduction

Over a period of time a gummy deposit from impurities in the fuel may gradually accumulate inside the fuel valve. If this occurs, the valve should be disassembled and cleaned.

Disassembly

Disassemble the valve following the sequence of index numbers assigned to Figure 4-1, giving special attention to the following. Circled index numbers do not require disassembly unless replacement of part is required.

1. To ensure proper alignment of lever (4, Figure 4-1) with the control shaft (22) during reassembly, scribe an “L” or “V” shaped mark from the center of the control shaft (see Figure 3-1) across the lever approximately 1/8 inch (3 mm).

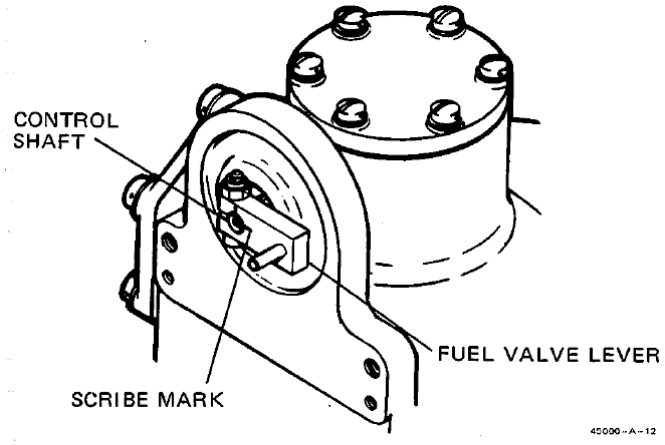


Figure 3-1. Scribe Mark Location for Alignment during Reassembly

2. Measure and record the distance from the flat on the control shaft to the center of the rod end spherical bearing (13). This measurement will eliminate recalibration/readjustment of the rod end during reassembly.

3. Discard all gaskets, O-rings, seals, retaining rings, etc., removed in the process of disassembly.

Cleaning

Wash all parts ultrasonically or by agitation while immersed in cleaning solvent. Do not permit contoured surfaces of metering valve plunger to contact other parts, Use a non-metallic brush or jet of compressed air to clean slots, holes, or apertures. Dry all parts with a jet of clean, dry compressed air. Store parts in a moisture-proof container until reassembled.

Inspection

Visually inspect all parts for damage or wear, paying particular attention to the following.

- Mating surfaces must be free of nicks, burrs, scratches, cracks or other damage.
- Screws and thread inserts must be free of corrosion, cracks, burred slots, rounded wrench flats, or damaged threads.
- All threaded surfaces, apertures, and passages must be free of foreign matter.
- Inspect rod end bearing for detectable roughness.

Repair or Replacement

Repair of small parts of this assembly is impractical and should generally be limited to removal of nicks and burrs from mating surfaces and to light burnishing of mating parts.

NOTICE **Handle critical parts with care so that mating edges and surfaces will not be damaged. Sharp edges must be maintained.**

1. Replace damaged thread inserts in accordance with standard procedure.

2. Polish slightly corroded areas in mating surfaces using a fine grit (600 grit) abrasive cloth or paper and oil.

3. Touch up defects in painted surfaces using oil resistant epoxy paint. Apply the paint in accordance with manufacturer's instructions. Complete repainting of valve should be accomplished where defects are numerous and widespread, where the surface has been severely eroded or weathered or where the paint is loose.

Lubrication

At the time of reassembly, lubricate all parts with No. 10 lubricating oil. Lubricate O-rings and seals with petrolatum before installation.

Reassembly

Reassemble the gas fuel valve in reverse order of the index numbers assigned to Figure 4-1, following the special instructions given below.

IMPORTANT **Reassembly should be performed in a dust-free work area.**

1. When installing O-rings over threaded surfaces, use an appropriate size thimble or tape the threaded area to prevent damage to O-rings.

2. Obtain new gaskets, O-rings, seals, retaining rings or clips, etc., to replace those discarded during disassembly.

NOTICE

Count out only the required number of small parts such as screws, washers, retaining rings or clips, etc., before proceeding with the operation at hand. When a sufficient number of parts is not available, the missing part must be located before performing the next operation. If the part or parts cannot be located, it is essential to disassemble the unit to such a point as is necessary to ensure that the missing part has not fallen into an internal cavity. Any parts in the assembly which are not properly secured or in place can readily cause jamming and render the unit inoperative.

3. Retaining rings must be installed with their sharp edge in the direction of the applied force.

4. Install rod end spherical bearing (13, Figure 4-1) in control shaft (22) and secure at dimension recorded in step 2, under disassembly.

5. Align the scribe marks on the control lever (4) with those on the control shaft (22) and secure in position with screw (2) and nut (1).

Test and Adjustment

Test of the gas fuel valve shall be accomplished in accordance with procedures outlined in the Woodward Servo Limiter manual 45000.

The only adjustment applicable to the gas fuel valve is rod end spherical bearing adjustment. Rotating the rod end within the control shaft moves the pivot point of the pivot link. This small movement permits fine adjustment of the acceleration fuel schedule slope.

Leakage Check

1. Locally manufacture 2 leak test adapters in accordance with Figure 3-2.

2. Install adapters on the GAS IN and GAS OUT pads using gasket and six 1/4-28 x 7/8 inch screws and flat washers.

3. The test medium should be calibrating fluid (US MIL-F-7024 or similar).

4. Connect a suitable hand pump and 0–1500 psi (0–10 342 kPa) pressure gauge to the adapter on the GAS IN pad. Operate the hand pump to fill the valve with fluid, allowing air to bleed from valve through the open fitting on the GAS OUT adapter. When a clear stream of fluid with no air bubbles flows from the fitting, cap off fitting.

5. Increase pressure to 1500 psig (10 342 kPa) and check the valve for leaks. No leakage is permissible. If leakage occurs, disassemble valve as necessary and inspect for damage to sealing surfaces, presence of foreign material, or damaged O-rings. Repair or replace any damaged parts, reassemble the valve, and repeat the leak test.

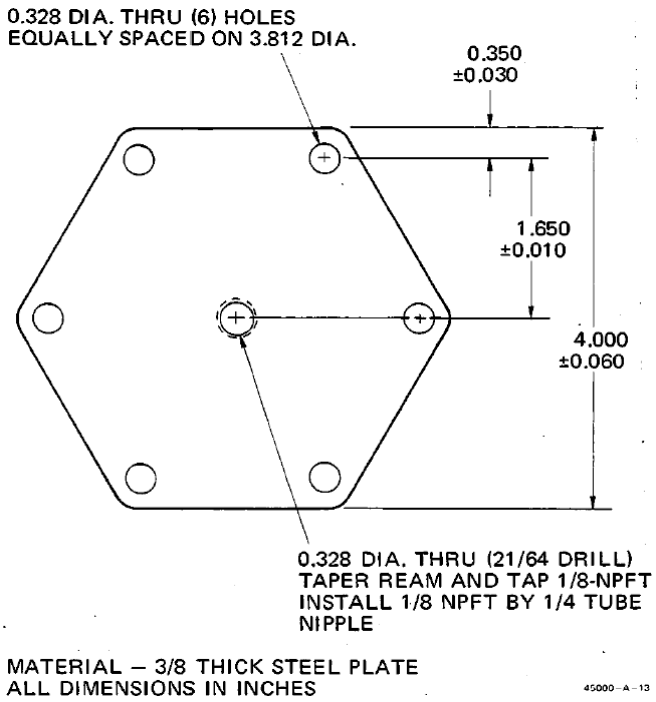


Figure 3-2. Gas Fuel Valve Test Adapter

Chapter 4.
Parts Replacement

When ordering replacement parts, it is essential that the following information be given:

- The gas fuel valve type, serial number, and part number (shown on nameplate). If the valve does not have a nameplate, include the controlling device (servo-limiter or governor) type, part number, and serial number (shown on nameplate).
- Manual number (this manual is 45001).
- Part reference number given in parts list and part name or description.

The illustrated parts breakdown (Figure 4-1) shows all parts of the large gas fuel valve assembly. Index numbers are assigned in disassembly sequence. Circled index numbers indicate items which do not require further disassembly unless repair or replacement of the part is required.

Ref. No.	Part Name	No. Required
45001-1	Nut, hex, 10-32	1
45001-2	Screw, fil. hd. cap, 10-32 x 7/8	1
45001-3	Fuel valve lever pin	1
45001-4	Fuel valve lever	1
45001-5	Screw, fil. hd. cap, 1/4-20 x 7/8	6
45001-6	Washer (AN960-416L)	6
45001-7	Gas valve cap	1
45001-8	O-ring, 2.625 OD (NAS1593-229)	1
45001-9	Nut, hex, 1/4-28	1
45001-10	Screw, hex. hd. cap, 1/4-28 x 7/8	1
45001-11	Washer, plain (AN960-416L)	1
45001-12	Nut, hex, 1/4-28	1
45001-13	Rod end spherical bearing	1
45001-14	Not used	
45001-15	Not used	
45001-16	Not used	
45001-17	Not used	
45001-18	Not used	
45001-19	Not used	
45001-20	Not used	
45001-21	Not used	
45001-22	Not used	
45001-23	Plunger sleeve	1
45001-24	Retaining ring	1
45001-25	Metering valve plunger	1
45001-26	Plunger link pin	1
45001-27	Plunger link	1
45001-28	Lever pivot	1
45001-29	Screw, fil. hd. cap, 1/4-20 x 7/8	6
45001-30	Washer (AN960-416L)	6
45001-31	Plunger bushing	1
45001-32	O-ring, 2.625 OD (NAS1593-229)	1
45001-33	O-ring, 2.750 OD (NAS1593-038)	1
45001-34	O-ring, 2.750 OD (NAS1593-.038)	1
45001-35	Screw, fil. hd., 5/16-18 x 1 (AN503-516-16)	6
45001-36	Washer, 0.562 OD	6
45001-37	Port cap	1
45001-38	O-ring, 1.982 OD (NAS1593-226)	1
45001-39	Pipe plug for linear schedules or orifice for non-linear schedules	1
45001-40	Gas valve housing assembly	1
45001-41	Spacer	4
45001-42	Control shaft	1
45001-43	Bearing	2
45001-44	O-ring, .364 ID x .070	2
45001-45	Control shaft bushing	1
45001-46	O-ring, 0.862 ID x .103	2
45001-47	Retaining ring, .339 ID	1
45001-48	Shaft retainer	1
45001-49	Retaining ring	1

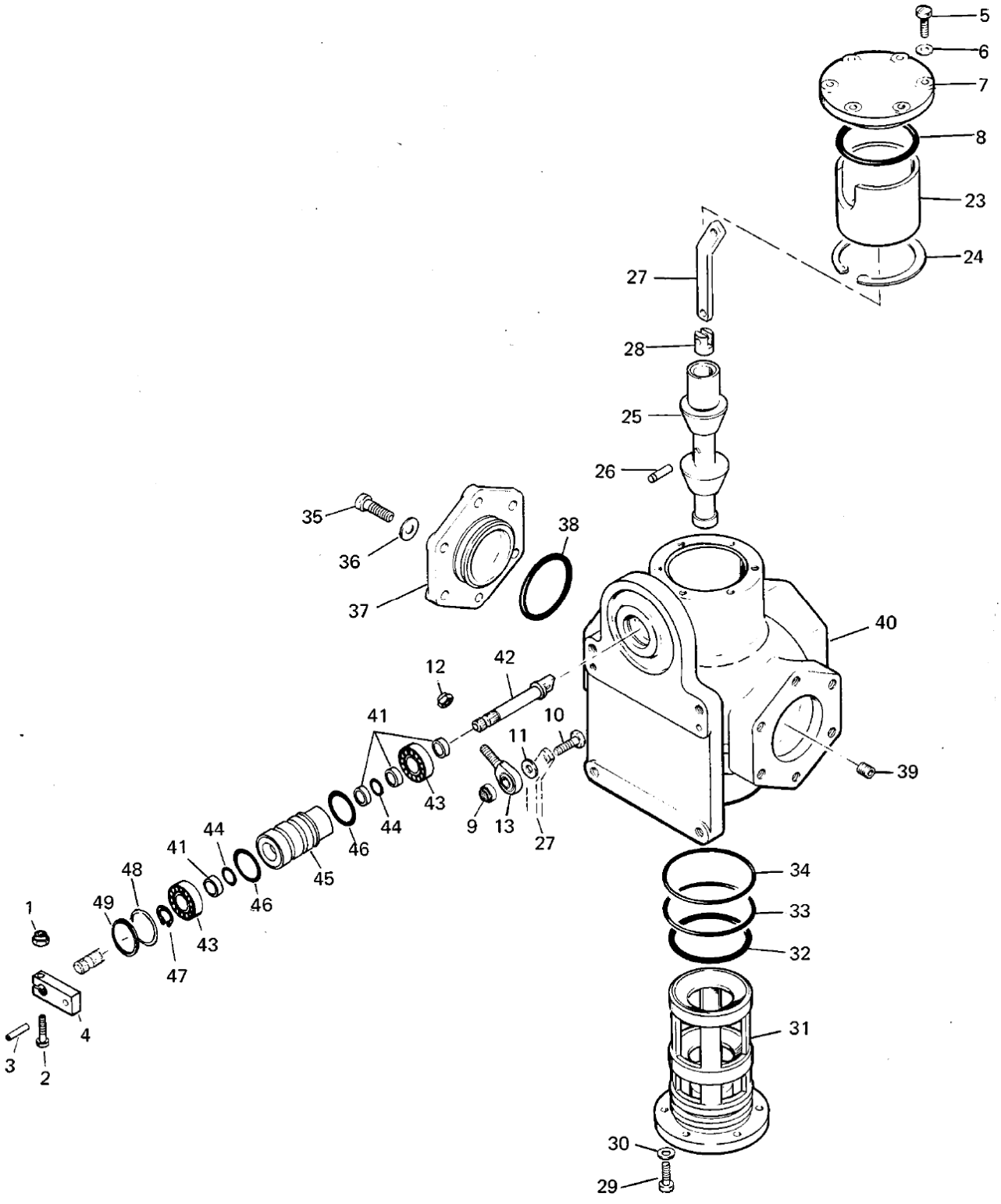


Figure 4-1. Large Gas Fuel Valve Exploded View

Chapter 5.
Service Options

Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

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*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 45001A.

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Email and Website—www.woodward.com

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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.

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