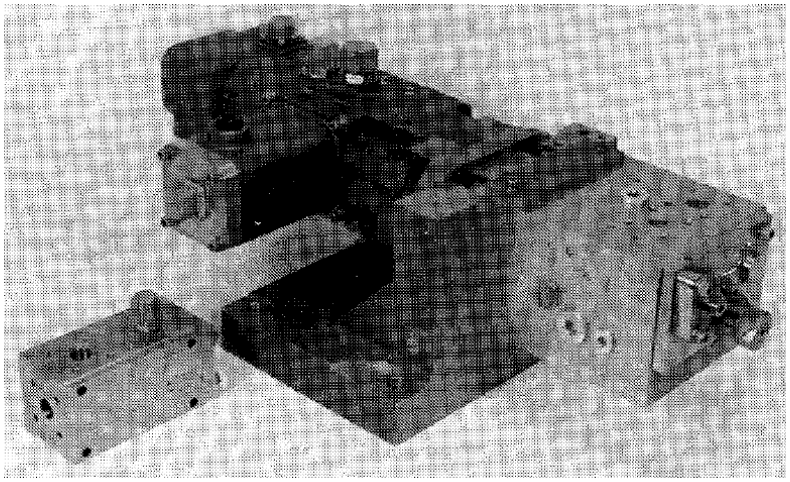
Product Manual 40121
(Revision A)
Original Instructions



3145 Liquid Fuel Valve with Fuel Pressurizing Valve and TM-40LP Actuator

Installation and 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 Out-of-date translations are marked with ⚠.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.**

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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.
Description

The 3145 Liquid Fuel Valve is used with a TM-40 linear-output, proportional actuator which receives position commands from the Woodward electronic control. The valve is capable of metering 300 to 5000 lb/h (136 to 2268 kg/h) of liquid fuel. The linear movement of the metering plunger regulates fuel flow on a precise schedule established by the electronic control system. A constant pressure drop is maintained across the metering port by the delta P regulator acting on the bypass valve to control fuel-supply flow/pressure.

A fuel-pressurizing valve is installed downstream between the fuel-valve output and the fuel nozzle (P_n) to maintain minimum P_2 pressure.

The TM-40 Actuator is a two stage, proportional device using a dry-coil torque motor and hydraulic-supply pressure. The actuator positions the fuel valve in proportion to a 20 to 160 mA signal from the electronic control. The actuator can be configured to operate with a supply pressure of 350 to 750 psig (2413 to 5171 kPa) from either a centrifugal or positive displacement pump. The output force of the actuator is proportional to the pressure of the hydraulic supply.

A torque motor servo valve in the actuator varies the differential pressure applied to the ends of the second-stage spool valve which controls the differential pressure on the servo piston. The servo provides one-half inch (13 mm) of control movement of the attached 3145 fuel-metering valve plunger.

An increase current signal causes the output shaft on the actuator to extend and increase the fuel flow through the attached valve.

Chapter 2. Installation

Receiving

Be careful when handling and installing the valve/actuator. Abuse can damage seals and installation fittings, causing a change in calibration of the unit. Hydraulic, fuel, and electrical connections must be protected by plastic shipping caps or covers whenever the valve/actuator is not connected.

WARNING

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.

The valve/actuator assembly is calibrated and drained of calibration fluid at the factory. It is then placed in a cardboard container filled with urethane foam for protection during delivery. Additional cleaning or calibration is not necessary before installation and operation of the unit.

Storage

The valve/actuator may be stored as received from the factory.

Installation

See the outline drawing, Figure 2-1, for:
- overall dimensions
- installation hole locations
- hydraulic fitting sizes
- output shaft dimensions
- location of adjustments
- electrical connections

The valve/actuator installation attitude does not affect the performance of the unit. The valve-actuator assembly weighs approximately 60 lb (27 kg). The pressurizing valve weighs about 8 lb (3.6 kg). Operation of the assembly does not cause any torsional or shock strains against the installation bracket. The assembly has been designed to withstand US MIL-STD-167, Type 1 vibration.

Hydraulic Connections

Supply pressures for the TM-40LP Actuator can be from either positive-displacement or centrifugal-type pumps. Woodward recommends using a pressure switch to be sure that correct supply pressure is established before start up and during turbine operation.

Proper filtration of the hydraulic fluid is extremely important. A 10 µm (nominal) filter must be installed in the supply line to the actuator. Keep the immediate area and equipment clean and free of dirt while working on or connecting the hydraulic lines. Hydraulic lines must be clean when installed to prevent contamination of filters and possible damage to the actuator upon start-up.

Supply Characteristics for the TM-40LP

Fluid Types	Mineral or synthetic based oils, diesel fuels, kerosenes, gasolines, or light distillate fuels.
Specific Gravity	0.6 to 1.0
Recommended Viscosity	0.6 to 1400 centistokes
External Filter	10 µm nominal
Supply Pressure	±20% of any nominal level between 350 and 750 psig (2413 and 5171 kPa)

Flow Requirements for the TM-40LP

Supply Pressure	Steady State Flow	Maximum Transient Flow	Rated Maximum Work
350 psig	0.3 US gal/min	4.7 US gal/min	11.9 ft-lb
750 psig	0.5 US gal/min	4.9 US gal/min	25.5 ft-lb
2413 kPa	1.1 L/min	17.8 L/min	16.1 J
5171 kPa	1.9 L/min	18.5 L/min	34.6 J

Electrical Characteristics for the TM-40LP

Input Current Range	20 to 160 mA
Coil Resistance	30 Ω maximum at 100 °F (38 °C)
Maximum Coil Current	250 mA

Output Characteristics for the TM-40LP

Linear Stroke	0.500 inches (12.70 mm)
Work Capacity	15.3 ft-lb (20.7 J) at 450 psig (3103 kPa) supply pressure
Output Force	373 lbf (1659 N) maximum at 450 psig (3103 kPa) supply pressure

Electrical Connections

Electrical connections are through a receptacle or a conduit connection. Take care that the plugs are not forced and pins are not bent while making connections. Electrical connections must be made according to the plant wiring diagram supplied with the electronic control.

Fuel Valve Connections

Locate the fuel pressurizing valve between the fuel valve and the turbine. Fitting sizes are shown in the outline drawings. All lines should be non-corrosive with a minimum-burst-pressure-test level of 3000 psig (20 685 kPa). To avoid a possible heat problem the fuel- pump capacity should not greatly exceed the maximum fuel demands of the turbine.

Positive Displacement Fuel Valve Application

Maximum Metered Flow	5000 lb/h (2268 kg/h)
Minimum Metered Flow	300 lb/h (136 kg/h)
Maximum Bypass Flow	7000 lb/h (3175 kg/h)
Nominal Delta P	50 psi (345 kPa)
Delta P Adjustment	±10%
Linear Input	0.5 inch (13 mm) stroke
Flow vs Position Accuracy	5% of point
Proof Pressure Test Level	2000 psig (13 790 kPa)
Burst Pressure Test Level	3000 psig (20 685 kPa)
Minimum Discharge Pressure	100 psig (690 kPa) above bypass pressure
Metering Valve Return Spring Force	8 to 17.5 lbf (36 to 78 N)

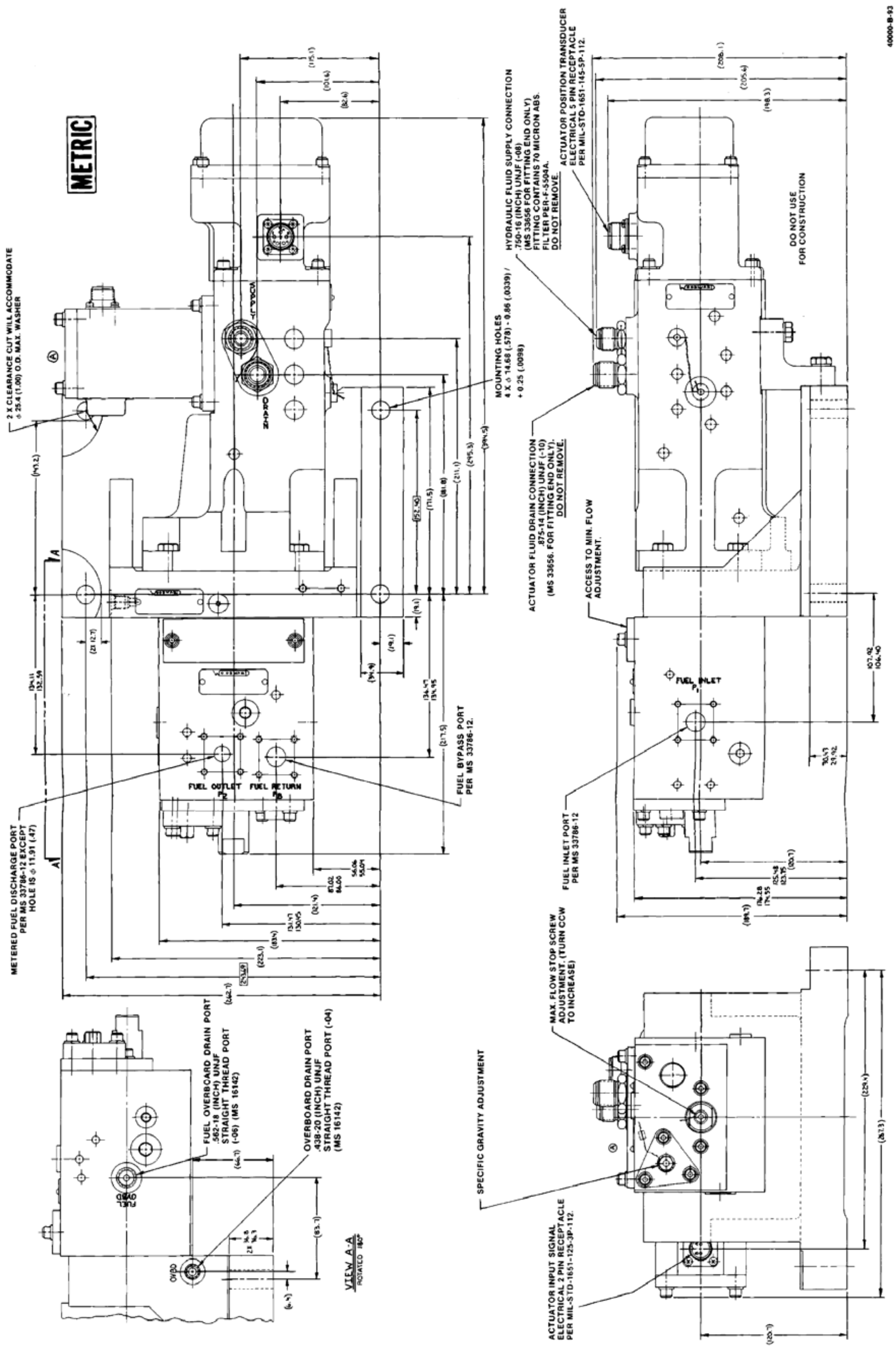

Figure 2-1. Outline Drawing of TM-40–3145 Liquid Fuel Valve

Chapter 3.
Initial Operation

Initial Operation

Before initial operation be sure the electrical connections between the actuator and the control are secure and correct according to the plant-wiring diagram included with the control. The LVDT feedback wiring should also be checked for a secure connection and for correct wiring.

To protect the actuator from contamination check that the hydraulic filters are properly installed before turning on the hydraulic pressure. All hydraulic lines must be clean before turning on the hydraulic source for the first time. All hydraulic fittings must be secure and the hydraulic supply must be in operation before initial operation.

Trapped air within the hydraulic system can be expected to cause erratic behavior of the actuator during initial operation. If possible start the actuator before running the turbine, vary the electronic signal to the actuator between 20 and 140 mA several times to work the air out of the actuator. If this pre-run actuator exercise is not possible be sure to follow requirements of the following warning.

⚠WARNING	**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.**

Adjustments

All operating adjustments are made to the valve/actuator assembly during factory calibration. Fuel flows have been set according to operating specification and further adjustments should not be required. Do not attempt adjustments to the assembly unless thoroughly familiar with the proper procedures.

Electrical Connections

Electrical connections must be made according to individual plant-wiring diagrams to assure safe operation.

Chapter 4.
Principles of Operation

TM-40 Linear-Proportional Actuator

The actuator consists of three basic sections:
- A torque-motor servo valve
- A spring-centered, four-land spool valve
- A double-sided, equal-area servo piston with a linear- output shaft

The torque motor in the actuator locates a flapper between two nozzles to regulate the hydraulic pressure at the ends of the second-stage spool valve. During steady-state operation the flapper is centered between the nozzles and the two pressures, Pc1 and Pc2, are equal. When the pressures are equal the spool valve is centered and no oil is flowing to or from the servo piston.

When input current increases, the limited movement of the flapper toward increase restricts hydraulic flow from one nozzle while flow from the other nozzle increases. The resulting differential pressure is applied to the ends of the spool valve, moving it from its spring-centered position.

When moved, the spool valve directs supply pressure to one side of the servo piston and, at the same time, vents the other side to drain. The servo piston then moves the output shaft toward increase. When the servo shaft moves it increases the compression of the feedback spring, returning the flapper to a centered position and returning the actuator to a steady-state condition at the new fuel setting.

The orifices in the torque motor servo valve are small. Keep contamination of hydraulic fluid to a minimum to prevent plugging these orifices. The orifices are contained within the torque motor servo valve assembly and are not available for repair or service.

LVDT

The LVDT is located at the end of the actuator. The operating rod connects directly to the output shaft, passing through the center of the level adjustment screw. The LVDT is used to supply a frequency modified in proportion to actuator position. The modified frequency is used by the electronic control for position indication and trimming.

3145 Liquid Fuel Valve

(See Figure 4-1, Schematic Drawing.)

Fuel metering within the valve is accomplished as pump-discharge pressure (P_1) enters the unit through the inlet port and is directed to the metering port, the bypass valve, the delta P regulator, and to the bypass-valve servo. The bypass valve is positioned by the servo pressure (P_4) acting on the large area, which is spring loaded to close the valve against P_1 on the small area.

P_4 pressure is regulated by sensing P_1, plus spring load, on the inside of the bellows assembly and P_2, plus spring load, on the outside of the bellows assembly. The position of the bellows assembly controls a bleed valve to bleed P_1 supply to the P_4 area to valve bypass (P_b). P_4 is thus regulates to position the bypass valve to maintain a constant delta P across the metering port.

Stability orifices are required in the P_1 and P_4 supply to the bypass-servo areas. The orifice in the line is built into a lightly-loaded check valve to permit free flow in the decrease fuel direction, and prevent any lag in the bypass valve on throttle chop.

The 3145 Liquid Fuel Valve provides a consistent fuel-flow schedule through the metering sleeve because of control of the difference in pressure (delta P) from the fuel-inlet pressure to the valve-discharge pressure. A fuel-pressurizing valve, located remotely from the valve, prevents loss of delta P control and maintains control stability.

A minimum-flow orifice allows a flat fuel-flow schedule when the fuel-metering valve is completely closed. An optional minimum- flow switch is available to signal when the fuel-metering valve is closed and fuel supply is coming through the minimum-flow orifice.

Fine-mesh filters are built into the valve to protect both sides of the delta P regulator. The filters cannot be removed for cleaning.

Delta P pressure is set during assembly at the factory. The adjustment is lockwired and should not be changed.

Maximum flow is adjusted during assembly at the factory. The adjustment is lockwired and should not be changed.

Two drains are built into the actuator/valve assembly. The overboard drain provides for fuel leakage past the primary seal on the fuel-metering valve. The drain should be dry or at most show an occasional drop or two of fuel. Any volume of fuel from this drain would indicate a seal leak which should be corrected at the factory. A second seal on the metering valve will allow limited use of the valve until a replacement can be installed.

A vent is provided between the actuator and the fuel valve. This should also be dry or have only an occasional drop or two. A volume of hydraulic oil from the vent would indicate an internal seal leak in the actuator. A volume of fuel from the vent would indicate a leak in the internal seal of the valve portion. Any fluid from the vent is likely to be a mixture of hydraulic fluid and fuel and should be discarded.

The metering plunger is spring-loaded closed against the actuator-opening force.

Fuel Pressurizing Valve Assembly

The fuel pressurizing valve is used to maintain minimum P_2 pressure. P_2 pressure is maintained at a minimum of 150 psi (1034 kPa) so the bypass-valve servo has the required dynamic response. The valve also maintains a pressure level high enough to ensure that bypass flow requirements can be met at low metered flows and low back pressures (P_n). The pressurizing-valve plunger is spring- loaded closed to create back pressure. As pressure P_2 reaches 150 psi (1034 kPa) minimum, the plunger moves against the spring, opening the port in the pressurizing valve, allowing fuel to flow to the turbine.

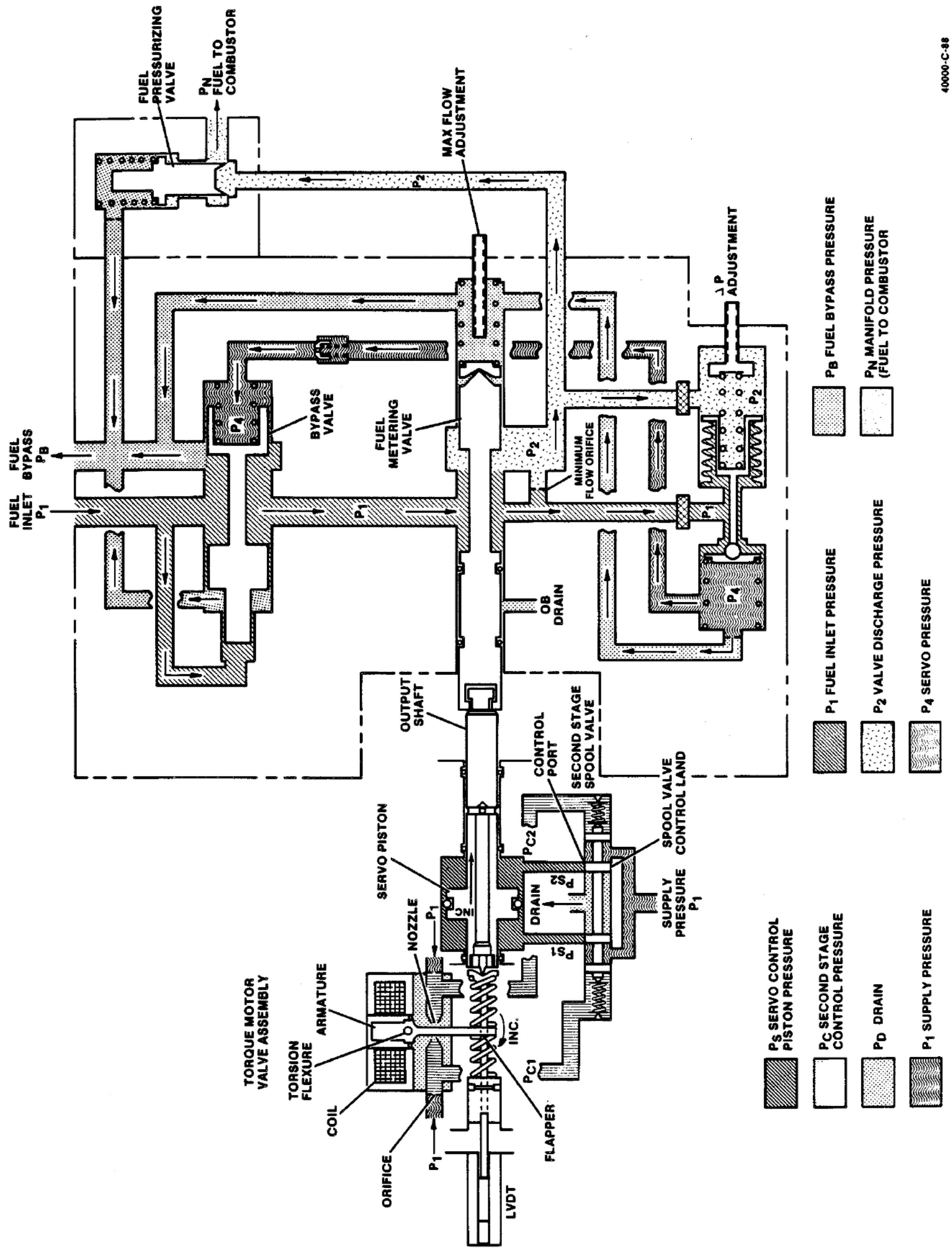

Figure 4-1. Schematic of TM Actuator and 3145 Liquid Fuel Valve

Chapter 5. Maintenance

Filter Cleaning

The actuator portion of the valve assembly is equipped with a 40- micron filter fitting at the supply connection. See the outline drawing, Figure 2-1, for the location of the fitting. If the filter becomes clogged, as evidenced by sluggish response of the actuator, it may be removed, cleaned ultrasonically, and back-flushed with a light solvent. Be prepared to replace the O-ring, (part 116, Figure 6-2) after cleaning the filter (part 115, Figure 6-2).

NOTICE

Do not run the valve assembly with the inlet filter fitting or the in-line filter removed or bypassed as extensive repairs can be made necessary by only momentary exposure of the interior of the torque motor to contaminants.

Troubleshooting

Malfunctions of the governing system are usually revealed as speed variations of the prime mover, but it does not necessarily mean that such speed variations indicate governing system problems. When improper speed variations appear, inspect all components, including the turbine, for proper operation.

Most internal parts of the actuator and fuel valve are of stainless steel. The housings are aluminum. All parts have been carefully selected to provide long life and maximum resistance to corrosion.

The torque motor in the actuator portion of the assembly can be contaminated without constant filter protection. Should the small orifices in the torque motor be clogged with dirt due to improper filtration of the hydraulic oil, the torque motor must be replaced. The actuator/valve assembly must be returned to Woodward Governor Company for repair.

To Troubleshoot the Actuator/Valve Assembly:

1. If the actuator does not respond to electric- control input, make sure the actuator-pressure supply and supply filter are normal.

2. If the actuator still does not respond to electric input, attach a power supply and milliammeter. Increase current to the actuator and output should follow smoothly with increasing current. Do not exceed 160 mA.

3. Contamination of either the valve or actuator can require factory disassembly and parts replacement. The assembly cannot be repaired in the field as individual calibration is possible only on special purpose test stands.

When requesting information or service from Woodward or your authorized dealer or distributor, include the part number and serial number of the fuel valve/actuator in your communications.

Chapter 6.
Replacement Parts

When ordering parts, give the following information:

- The fuel valve/actuator type, serial number, and part number (shown on the nameplate)
- Manual number (this is manual 40121)
- Part reference number given in the parts list and part name or description

- Figure 6-1 illustrates parts for the 3145 Liquid Fuel Valve.
- Figure 6-2 illustrates parts for the TM-40LP Actuator.
- Figure 6-3 illustrates parts for the pressurizing valve.

⚠CAUTION	**Injury may result if compressed springs are released suddenly. Use the proper equipment to remove springs and spring covers.**

Parts List for the 3145 Liquid Fuel Valve

Ref. No.	Part Name	Quantity
40121-1	Drive Screw	2
40121-2	Nameplate	1
40121-3	Plug, 0.750-16	1
40121-4	O-ring, 0.644 x 0.087	1
40121-5	Check Valve Spacer	1
40121-6	Retaining Ring	1
40121-7	Spring Seat	1
40121-8	Check Valve Spring	1
40121-9	Check Valve Orifice	1
40121-10	O-ring, 0.489 x 0.070	1
40121-11	Check Valve Bushing	1
40121-12	Pipe Plug	1
40121-13	Screw, 6-32 x 0.375	2
40121-14	Washer, No. 6	2
40121-15	Position Scale	1
40121-16	Access Cover	1
40121-17	Screw, 0.250-20 x 1.000	5
40121-18	Washer, 0.250	8
40121-19	O-ring, 1.989 x 0.070	1
40121-20	O-ring, 0.468 x 0.078	3
40121-21	Plug, 0.562-18 UNF	1
40121-22	Case	1
40121-23	Orifice Plug	1
40121-24	Plug, 0.562-18 UNF	2
40121-25	NOT USED	
40121-26	NOT USED	
40121-27	NOT USED	
40121-28	Loading Spring	1
40121-29	O-ring, 0.989 x 0.070	14
40121-30	Bypass Valve Sleeve	1
40121-31	Bypass Valve Piston	1
40121-32	Loading Spring	1
40121-33	Bypass Valve Cap	1
40121-34	Metering Valve Plunger	1
40121-35	O-ring, 0.301 x 0.70	2
40121-36	Glyd Ring Seal, 0.500	2
40121-37	Metering Valve Sleeve	1
40121-38	Loading Spring	1
40121-39	Spring Seat	1
40121-40	Loading Spring	1
40121-41	Retaining Ring	1
40121-42	Orifice Plug	1
40121-43	O-ring, 0.551 x 0.70	1
40121-44	Loading Spring	1
40121-45	Spring Seat	1
40121-46	Bellows	1
40121-47	O-ring, 0.739 x 0.070	1
40121-48	O-ring, 0.676 x 0.070	1
40121-49	O-ring, 0.614 x 0.070	1
40121-50	Spring	1
40121-51	Valve Sleeve	1
40121-52	Filter Plug	1
40121-53	Inline Filter	1
40121-54	Flange Filter	1
40121-55	Filter Plug	1
40121-56	O-ring, 0.755 x 0.097	1
40121-57	Plug, 0.875-14 UNF	1
40121-58	O-ring, 1.114 x 0.070	1
40121-59	Valve Cap	1
40121-60	Cover Plate	1
40121-61	Wire Seal	1
40121-62	Lock Wire	1
40121-63	O-ring, 0.364 x 0.070	1
40121-64	Stop Screw	1
40121-65	Screw, 0.250-20 x 0.875	2
40121-66	Cover	1
40121-67	Adjuster	1
40121-68	Screw, 10-32 x 0.875	2
40121-69	Expansion Plug	1
40121-70	Screw, 0.250-20 x 1.5	1
40121-71	Detent	1
40121-72	Roll Pin, 0.062 dia. x 0.312	1
40121-73	Detent Spring	1
40121-74	Seal Block	1
40121-75	O-ring, 0.239 x 0.070	1
40121-76	Spring Seat	1

Not Shown—The large angle plate and attaching screws and washers that connect the TM-40LP to the 3145 Liquid Fuel Valve are not shown.

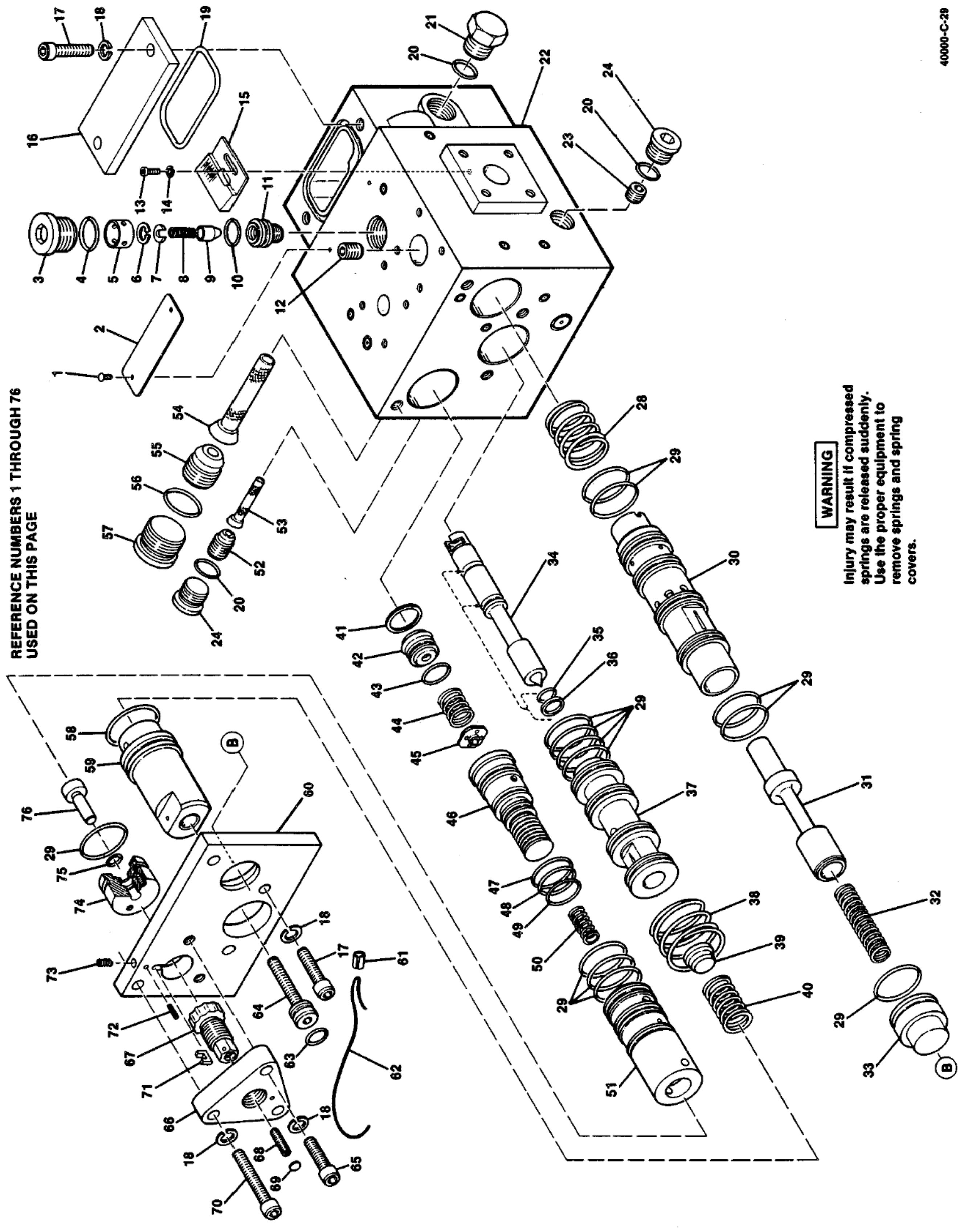

Figure 6-1. Parts for the 3145 Liquid Fuel Valve

Parts List for the TM-40 Actuator

Ref. No.	Part Name	Quantity
40121-101	Connector, Electrical	1
40121-102	Screw, 6-32 x 0.375	8
40121-103	Lock Washer, No. 6	8
40121-104	Gasket, Connector	1
40121-105	Cover, Torque Motor	1
40121-106	Screw, 0.250-28 x 875	12
40121-107	Washer, 0.250 splitlock	20
40121-108	Housing Assembly	1
40121-109	Screw, 0.250-28 x 1.000	8
40121-110	Plug, 0.500-14	1

Not Shown—Two 1606-787 terminal feed-throughs and two 1012-783 tab-type lock washers. Use 18 AWG (0.8 mm²) wire and shrink tubing as required.

Ref. No.	Part Name	Quantity
40121-111	Torque Motor–Servo Valve	1
40121-112	O-ring	3
40121-113	O-ring	1
40121-114	Body Assembly	1
40121-115	Fitting for 0.500 40 µm filter	1
40121-116	O-ring, 0.644 id x 0.087	1
40121-117	Connector Assembly, 0.625 x 0.875-14	1
40121-118	O-ring, 0.755 id x 0.097	1
40121-119	Plug, 0.438-20 Socket Head	2
40121-120	O-ring, 0.351 id x 0.072	2
40121-121	Spring Support Assembly	2
40121-122	O-ring, 0.737 id x 0.103	2
40121-123	Spring Seat	4
40121-124	Spring, PV Centering	2
40121-125	Plunger Bushing Retainer Assembly	1
40121-126	Plunger, Pilot Valve	1
40121-127	Pilot Valve Bushing	1
40121-128	O-rings, 0.551 id x 0.070	6

Ref. No.	Part Name	Quantity
40121-129	Seat Assembly, Trim Spring	1
40121-130	TM-40 LP Trim Spring	1
40121-131	TM-40 LP Feedback Spring	1
40121-132	Glyd Ring Seal	2
40121-133	O-ring, 0.676 id x 0.070	2
40121-134	O-ring, 1.487 id x 0.103	1
40121-135	Bearing, Bronze	1
40121-136	Piston Sleeve	1
40121-137	Rod, LVDT Extension	1
40121-138	Seal, 1.250 OD Glyd Ring	1
40121-139	O-ring, 1.051 id x 0.070	1
40121-140	TM-40 Piston Assembly	1
40121-141	O-ring, 1.612 id x 0.103	1
40121-142	Cover Assembly	1
40121-143	Seal, Rod	1
40121-144	O-ring, 0.674 id x 0.103	1
40121-145	Seal Retainer	1
40121-146	Int. Retaining Ring, 1.111 Free Dia	1
40121-147	Screw, 0.375-24 x 1.250	4
40121-148	Washer, 0.375 Split Lock	4
40121-149	O-ring, 0.864 id x 0.070	2
40121-150	Sleeve, O-ring Seal	1
40121-151	O-ring, 0.739 id x 0.070	1
40121-152	Nut, Size 10 Bulkhead Lock	1
40121-153	Transducer, LVDT Position	1
40121-154	Strap, Wire Bundle	2
40121-155	Anchor, Nylon Tie	1
40121-156	Screw, 6-32x 0.250	1
40121-157	Gasket, Connector	1
40121-158	Receptacle, Spin	1
40121-159	Housing Assembly	1
40121-160	TM-40 LVDT Cover	1

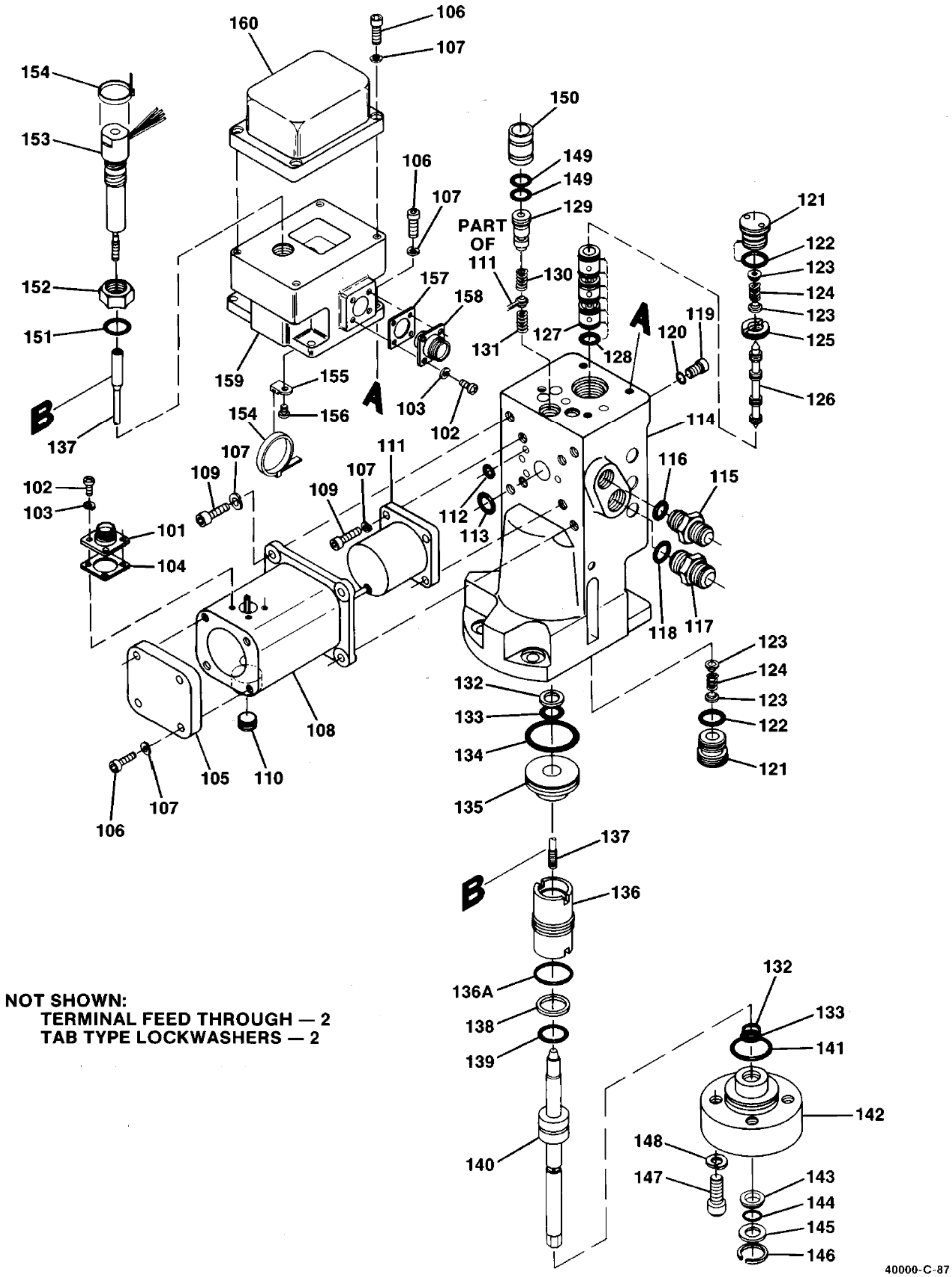

Figure 6-2. Parts for the TM-40 Actuator

Parts List for the Fuel Pressurizing Valve

Ref. No.	Part Name	Quantity
40121-201	Nameplate	1
40121-202	Drive Screw, No. 2 x 0.188	2
40121-203	O-ring, 0.426 x 0.070	1
40121-204	Pressurizing Valve Orifice	1
40121-205	Lockwire	1
40121-206	Valve Body	1
40121-207	O-ring, 0.864 x 0.070	1
40121-208	O-ring, 1.364 x 0.070	1
40121-209	Valve Sleeve	1
40121-210	Valve Plunger	1
40121-211	Spring	1
40121-212	O-ring, 1.489 x 0.070	1
40121-213	Cap	1
40121-214	Washer, 0.250	4
40121-215	Screw, 0.250-20 x 0.875	4

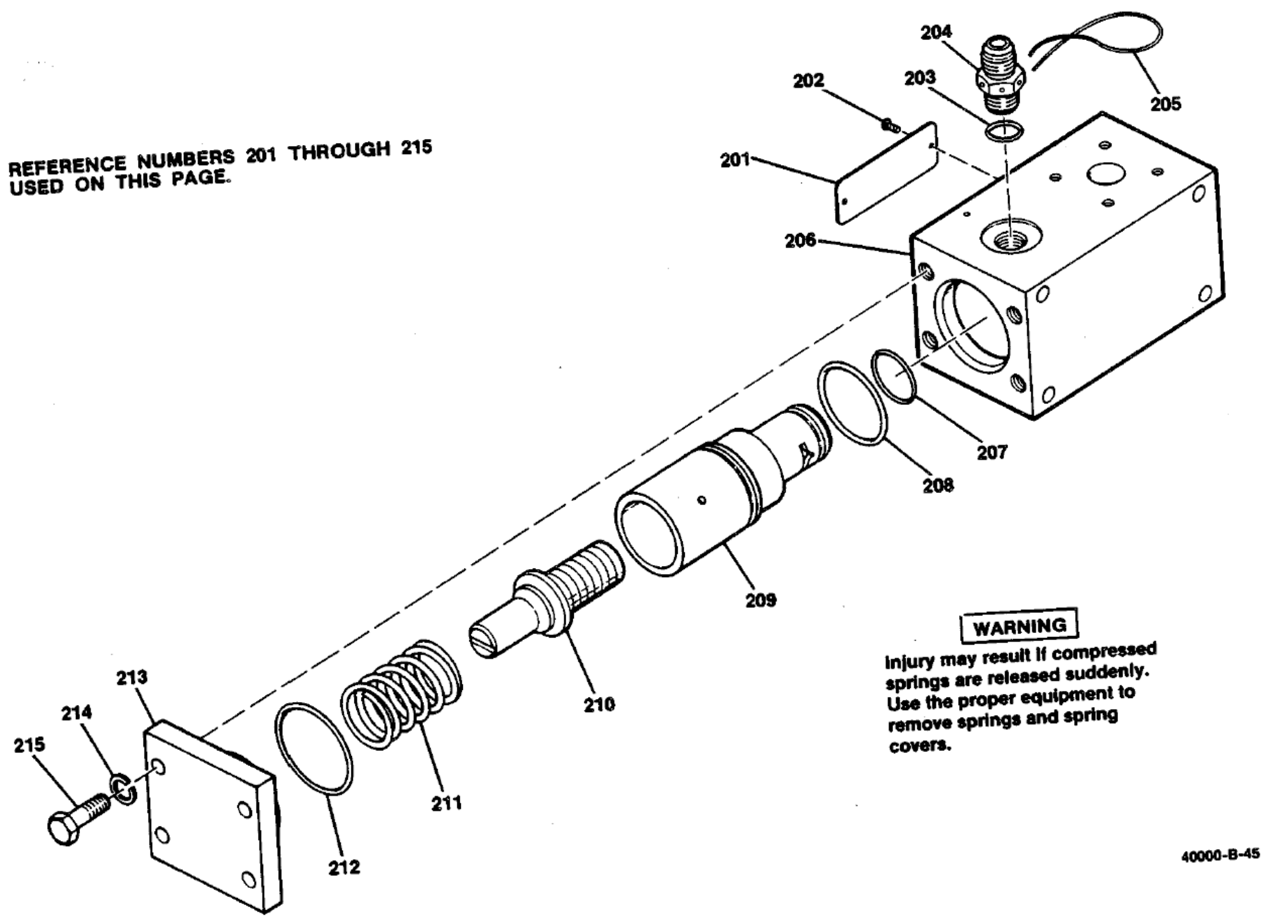

Figure 6-3. Parts for the Fuel Pressurizing Valve

Chapter 7.
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 40121A.

B40121:A

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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.

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