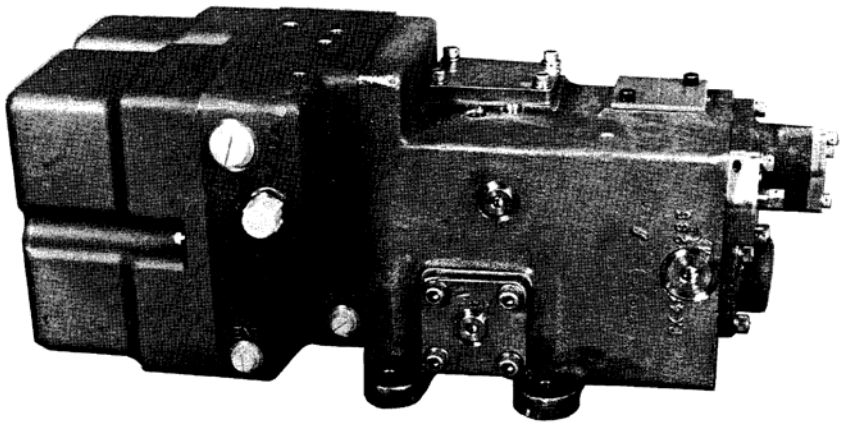
WOODWARD

Product Manual 40122
(Revision NEW)
Original Instructions



3055 Liquid Fuel Metering Valve/ Actuator Assembly

9902-220

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:

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 Out-of-date translations are marked with ⚠.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

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

Contents

Illustrations and Tables

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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.
General Information

The 3055 Fuel Metering Valve/Actuator (FMV/A) assembly consists of a liquid fuel metering valve and an electrohydraulic actuator mounted together. The output shaft of the actuator provides linear movement of the fuel-valve metering plunger. The linear movement of the metering plunger regulates fuel flow on a precise schedule established by an electronic control system. A constant pressure drop is maintained across the metering port by the delta P regulator inside the valve.

The electrohydraulic actuator receives a position command signal from the electronic control and uses oil pressure to position the output shaft. The actuator operates with a supply pressure of 750 psig (5171 kPa) from either a centrifugal or positive-displacement pump.

Two electrical components in the actuator are the torque motor servovalve and the Linear Variable Differential Transformer (LVDT). Redundant coils in the torque motor provide two control channels to the FMV/A. Only one channel in the torque motor is used at a given time. The LVDT also has two coils, yielding redundant position feedback signals which are compared to each other by the electronic control.

The actuator supplies 0.5 inch (12.7 mm) of metering–plunger movement. A current signal to the positive side of the +20 mA null signal causes the output shaft on the actuator to extend and increase the fuel flow through the attached valve. A current signal of less than +20 mA causes the output shaft to retract and decrease fuel flow. In either case, after the actuator moves to the commanded position the current is returned to the null value of +20 mA.

The actuator is designed to provide a rapid initial change of fuel-valve position on a change in control signal, followed by a slower movement to the final new valve position. The rate of position change is controlled by a Jump and Rate Limiter in the actuator portion of the FMV/A.

The FMV/A assembly is calibrated at the factory. The assembly is sealed and should not be adjusted or repaired except at the factory.

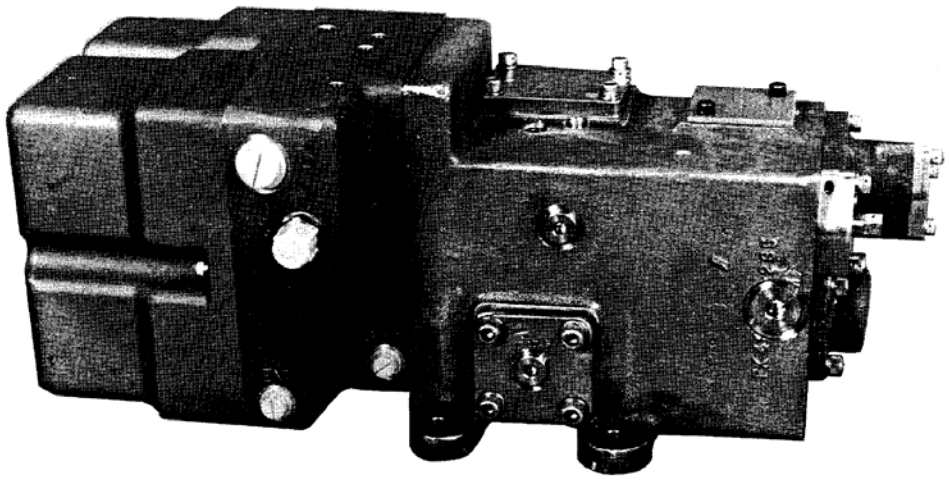

Figure 1-1. Fuel Metering Valve/Actuator Assembly

Chapter 2. Installation

Introduction

Be careful when handling and installing the valve/actuator assembly. 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.

Receiving and Storage

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

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

Installation

See the outline drawing, Figure 2-1, for:

- overall dimension
- mounting flange and hole locations
- hydraulic fitting sizes and locations
- fuel supply fitting sizes and locations
- metered-fuel-port sizes and locations
- electrical connections

The valve/actuator installation attitude does not affect the performance of the unit. The assembly weighs about 95 lb (43 kg). Operation of the assembly does not cause any torsional or shock loads against the installation bracket. The assembly has been designed to withstand US MIL-STD-167, Type 1 vibration.

Hydraulic Filtration

Proper filtration of the hydraulic fluid is extremely important. 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.

Install a 10 µm nominal-rating filter in the oil supply line to the FMV/A.

70 µm filter screens are provided in the supply and control ports of the torque motor servovalve. The entire actuator is protected with a 70 µm (absolute) filter screen installed in the inlet filter fitting. All working parts are stainless steel. The actuator housing and cover are aluminum.

Drain and Vent

An occasional drop of either fuel or hydraulic oil may come from the Overboard Drain port. Connect a hose or pipe to this drain, pointed down to protect the FMV/A assembly from contamination with cleaning fluids. Leave the drain open to monitor against more than an occasional drop of fluid. Any volume of leakage from the drain indicates a leaking seal within the valve/actuator. The assembly should be replaced as soon as convenient should a leak occur.

The vent port must be open to the atmosphere. Again, connect a hose or pipe to the vent port, pointed down to protect the assembly from contamination with cleaning fluids. Leave the vent open to monitor against any fluid coming from the vent. Fluid from the vent indicates leaking seals in the actuator/valve assembly. The assembly should be replaced as soon as convenient should a leak occur.

No back pressure is permissible at either the vent or overboard drain.

Electrical Connections

Two identical 10-contact electrical receptacles are provided on the actuator end of the FMV/A. See Figure 2-1, FMV/A Wiring Diagram, for details on connections to the two connectors. All coils in the FMV/A are redundant and signals to circuit A and circuit B will give identical outputs from the unit. The electrical receptacles are keyed to prevent improper connection. Take care that the plugs are not forced and pins are not bent while making connections. Be sure the securing ring is properly attached before attempting to operate the metering valve. Only one control channel should be used at a given time.

Supply Characteristics of the FMV/A

Hydraulic Fluid	Mineral or synthetic based oils, diesel fuels, kerosenes, gasolines, or light distillate fuels. 0.6 to 1.0 specific gravity 0.6 to 400 centistokes recommended viscosity 1.5 US gal/min (5.7 L/min) maximum flow
Fuel Data Type	Diesel 0.84 specific gravity 50 psi (345 kPa) nominal delta P
Maximum Fuel Flow	13 544 lb/h (6144 kg/h) nominal
Minimum Fuel Flow	675 lb/h (306 kg/h) nominal

Electrical Characteristics of the FMV/A

Null Current	20 mA nominal
Normal Input Current Range	–57 to +87 mA
LVDT Feedback Signal Ratio	+0.500 V/V at minimum fuel position –0.500 V/V at maximum fuel position

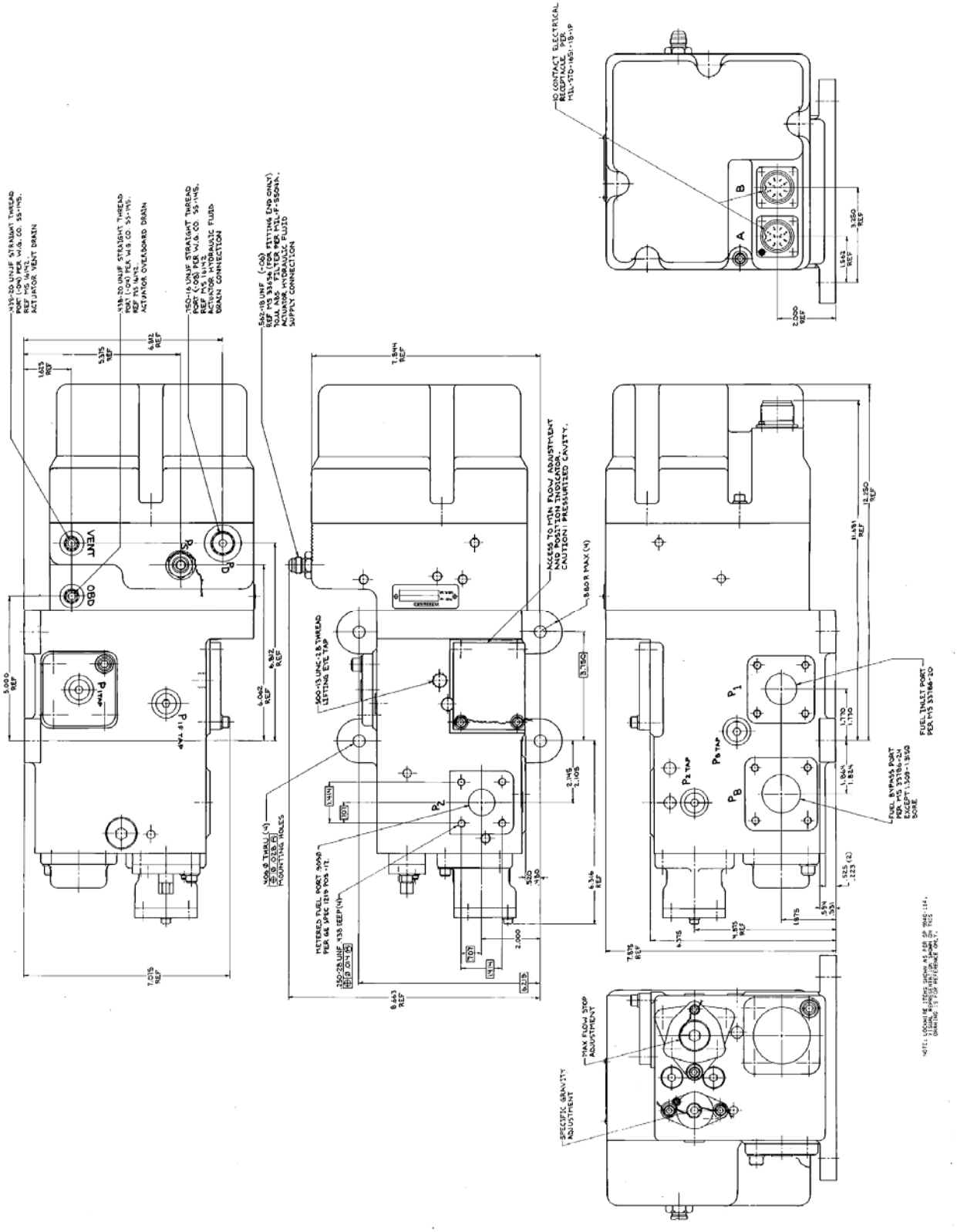

Figure 2-1. Outline Drawing

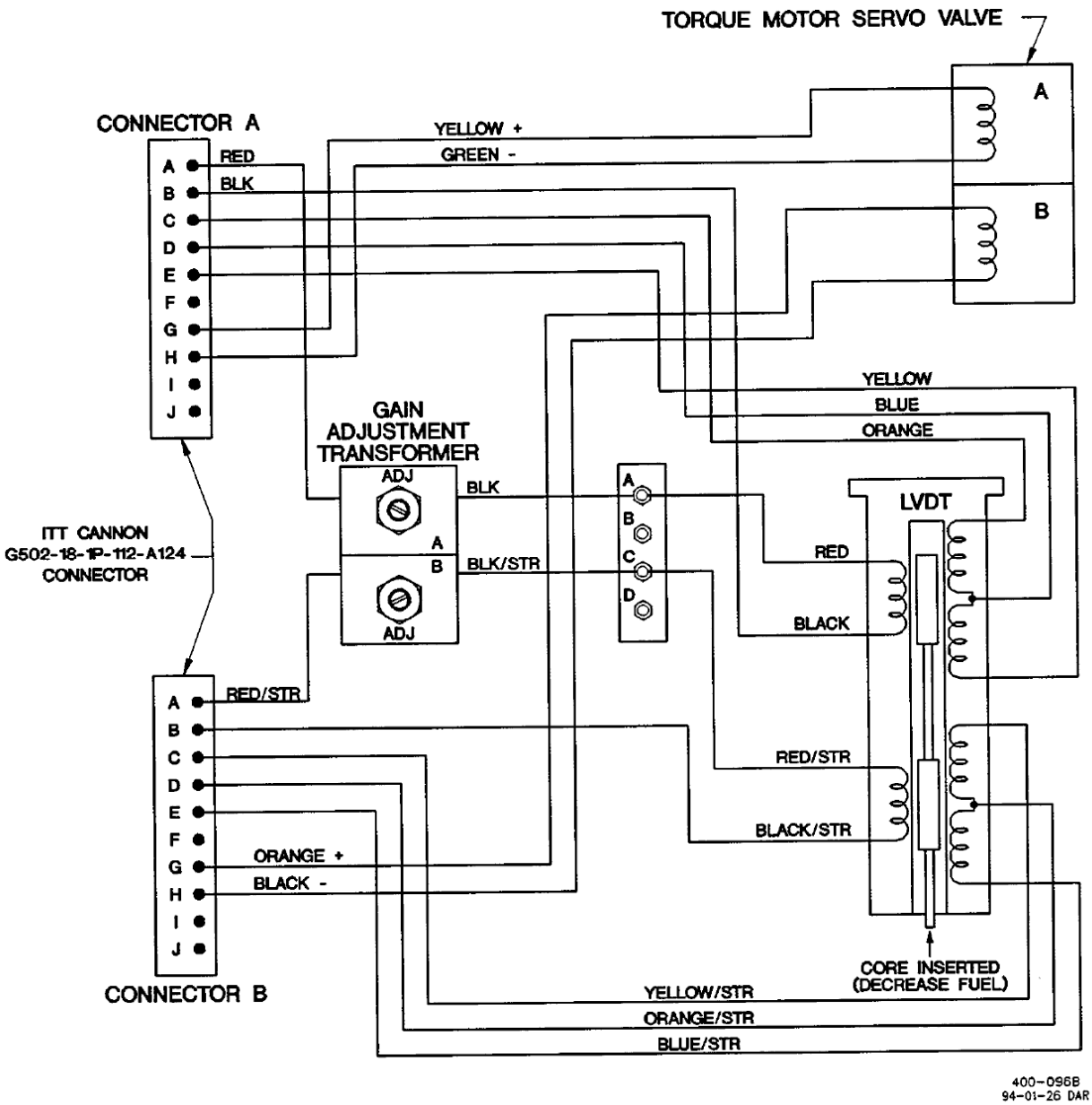

Figure 2-2. FMV/A Wiring Diagram

Chapter 3.
Initial Operation

Initial Operation

Before initial operation, be sure both electrical control channels are secure and correct according to the wiring diagram Figure 2-2. Only one of the control channels will be operational at a given time.

To protect the actuator from contamination be sure the hydraulic filters are properly installed before turning on the hydraulic pump. All hydraulic lines must. be clean before turning on the pump for the first time. All hydraulic fittings must be secure before initial operation.

Trapped air within the hydraulic system may cause temporary erratic behavior of the actuator during initial operation. Therefore, 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.

Before turning on the fuel pump, be sure that the fuel connections at the FMV/A are correct and secure.

NOTICE

The bypass line must be open at all times during fuel valve operation to prevent damage to a bellows within the valve.

Adjustments

All operating adjustments are made to the valve/actuator assembly during factory calibration. Fuel flows have been set according to operating specifications and further adjustments should not be required.

The specific gravity adjustment was set for 0.84 SG at the factory. (See the outline drawing, Figure 2-1, for the location of the this adjustment.) The adjustment has a mark on the end which points to 0.84 on the scale. Should an adjustment be necessary, remove the lockwire on the adjustment and turn the mark to the required specific gravity of the fuel being used.

Chapter 4.
Principles of Operation

Introduction

This chapter describes the operation of the Fuel Metering Valve and Actuator (FMV/A) assembly. The schematic, Figure 4-1, illustrates the working relationships of the various parts.

The actuator requires a flow of hydraulic oil from an outside source. The fuel valve metering plunger is positioned by the actuator and meters fuel to the gas turbine based on the input from an electronic control.

Actuator

A torque motor servo valve in the actuator regulates the flow of hydraulic oil according to the deviation of a control signal from the +20 mA null current. The torque motor has dual coils but only one coil receives a position signal at any given time. The second channel is provided for redundancy which increases the availability of the actuator.

The torque motor positions a flapper between an inlet-pressure nozzle and a drain-pressure nozzle. The position of this flapper determines the actuator control pressure, which is transferred through a jump and rate limiter to position the differential piston.

The differential piston is supplied with inlet pressure on the smaller side and control pressure on the side with greater area. When the flapper in the torque motor is moved toward drain it increases the pressure on the control side of the differential piston, moving the piston toward increase fuel.

The actuator provides one half inch of linear output. Should the control signal fail (0 mA) or the inlet pressure be removed, the actuator will move to the minimum fuel position.

LVDT

The core rod of the two-channel LVDT is connected directly to the differential piston. The LVDT channel in operation is provided with an ac excitation signal from the electronic control. The LVDT supplies an electrical output signal to the electronic control proportional to the position of the actuator piston. The dual LVDT core rod is factory adjusted for location.

Gain adjustment transformers, which can individually calibrate the electrical output of each LVDT channel, are provided inside the actuator cover. These transformers are factory adjusted and do not require further adjustment.

Jump and Rate

The actuator uses a spring-centered piston to provide a jump in the increase-fuel direction when a large increase signal is provided to the torque motor. After the original jump in position, the actuator will continue moving the fuel valve at a slower rate until the commanded position is reached. When a decrease signal is provided to the torque motor, the actuator immediately jumps toward reduced fuel, then continues to move toward reduced fuel at a slower rate until the commanded position is reached.

Metering Valve Connection

The actuator is connected to the metering-valve plunger with an adjustable coupling. This adjustment is set during calibration of the metering valve and actuator and must not be changed.

A visual fuel-metering-valve position indicator is located in the cavity where the actuator connects with the fuel valve. The indicator is concealed beneath a cover. Fuel, at bypass pressure, is present under the cover. The cover to the inspection cavity should not be removed while the turbine is operating.

Metering Valve

The fuel metering valve has been constructed for maximum life and minimum corrosion. All parts are made of corrosion- and wear-resistant materials.

The valve accepts fuel flow from a positive displacement pump and delivers precisely metered amounts to the turbine. Fuel not metered to the turbine is bypassed back to the fuel pump.

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 ports, the bypass valve, and the delta P regulator. The bypass valve is positioned by the servo pressure (P_4) acting on one end, which is spring loaded to close the valve against P_1 on the other end.

P_4 pressure is regulated by sensing P_1, plus spring load, on one side of the bellows assembly and P_2, plus spring load, on the other side 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 discharge (P_2). P_4 is thus regulated to position the bypass valve to maintain a constant delta P across the metering ports.

The 3055 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 minimum-flow orifice allows a flat fuel-flow schedule when the fuel-metering valve is completely closed.

Delta P pressure is set during assembly at the factory. The adjustment 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 shaft seal on the fuel-metering valve or oil leakage past the actuator piston shaft seal. The drain should be dry, or at most show an occasional drop or two of fuel or oil. Any volume of fluid from this drain would indicate a seal failure which should be corrected at the factory.

A vent is provided to drain the area under the large actuator end cover. This should also be dry or have only an occasional drop or two of oil. A volume of hydraulic oil from the vent would indicate an internal seal failure in the actuator which should be corrected at the factory. The vent must always be open to atmosphere.

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

Specific Gravity

The delta P regulator has an adjustment which allows the valve to be used with fuels with different specific gravities. The adjustment is set for 0.811 specific gravity when shipped from the factory. This position is marked and the adjustment is lockwired to prevent accidental change (see Figure 2-1). The specific gravity adjustment operates by changing the regulated delta P across the metering ports.

Fuel Filter

A 60 µm wash-flow filter is located at the fuel inlet to the fuel valve. The filter may be removed and flushed if necessary.

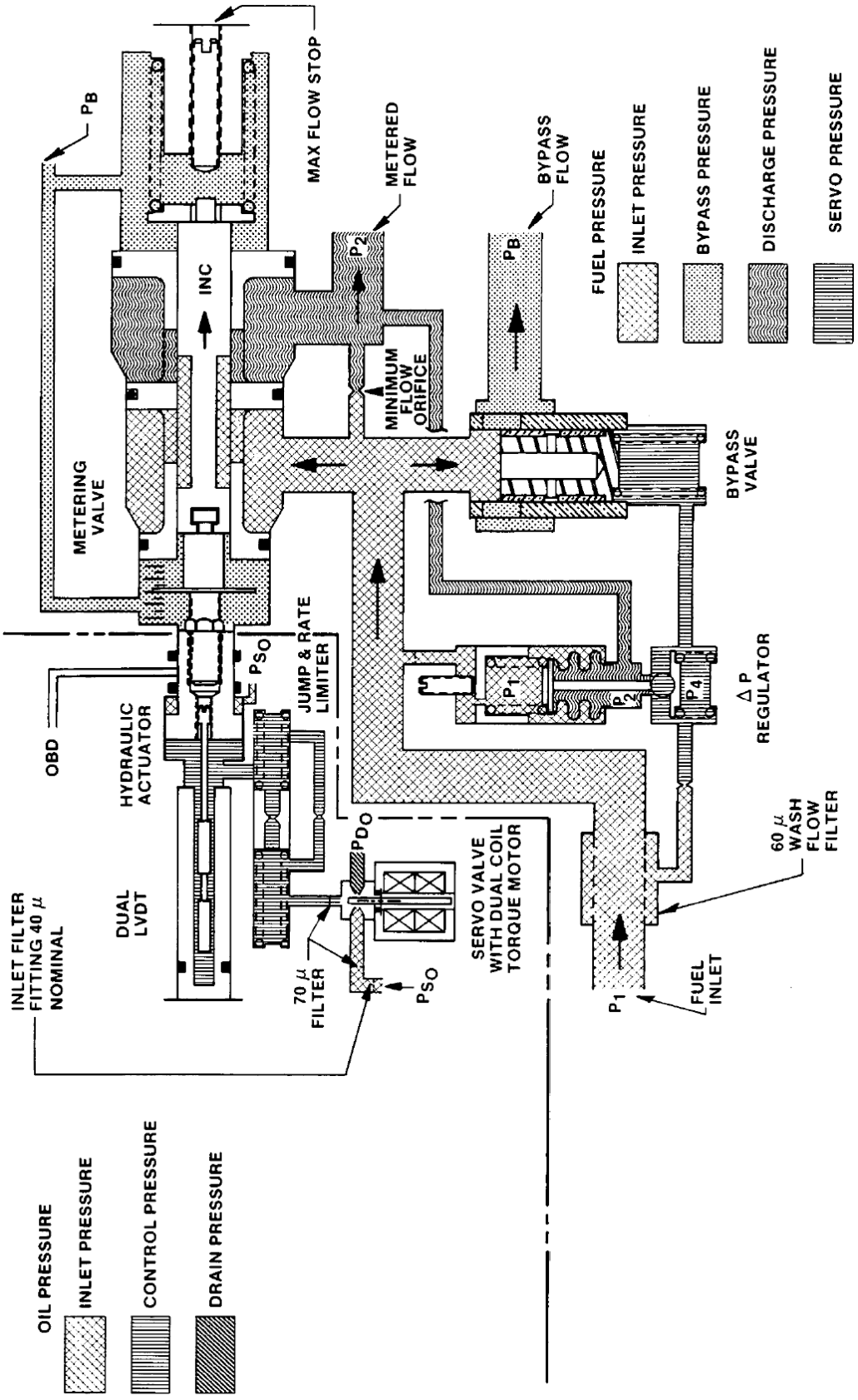

Figure 4-1. FMV/A Assembly Schematic

Chapter 5. Maintenance

Filter Cleaning

The actuator portion of the valve assembly is equipped with a 40 µm nominal, 70 µm absolute 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 164a Figure 6-8) after cleaning the filter (part 164, Figure 6-8).

A wash-flow filter is located in about the center of the fuel valve portion of the FMV/A. This filter may be removed and cleaned routinely. See Figure 6-4, part 64 for the location of the wash and flow filter.

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

If it is suspected that the FMV/A assembly is at fault, the assembly must be returned to Woodward or your authorized dealer/distributor for repair.

To troubleshoot the actuator/valve assembly:

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

2. Check LVDT outputs according to the plant wiring diagram, Figure 2-3, and the electric control signal to the actuator.

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, include the part number and serial number of the Fuel Metering 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 40122)
- Part reference number given in the parts list and part name or description

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

Parts List for Figure 6-1

Ref. No.	Part Name	Quantity
40122-1	Metering Valve Body	1
40122-2	Sleeve	1
40122-2A	O-ring, 0.801 x 0.070	1
40122-2B	O-ring, 0.864 x 0.070	1
40122-3	Spring	1
40122-3A	Seat Assembly	1
40122-4	Bellows	1
40122-4A	O-ring, 0.618 x 0.070	1
40122-4B	O-ring, 0.801 x 0.070	1
40122-5	Spring	1
40122-6	Spacer	1
40122-6A	O-ring, 1.051 x 0.070	1
40122-7	Seat	1
40122-8	Cap	1
40122-8A	Seal, Outside, 1.049 x 0.103	1
40122-8B	Seal, Inside, 0.239 x 0.070	1
40122-9	Pin	1
40122-10	Spring	1
40122-11	Clamp	1
40122-11A	Pin	1
40122-12	Detent	1
40122-13	Adjuster	1
40122-13A	O-ring, 0.364 x 0.070.	1
40122-14	Screw, 10-32 x 0.750 (adj)	1
40122-15	Retainer	1
40122-16	Plate	1
40122-17	Washer, Flat, No. 4 x 0.032	2
40122-18	Washer, No. 4 Lock	2
40122-19	Screw, 4-40 x 0.375	2
40122-20	Plug, Expansion	1
40122-21	Washer, 0.250 Lock	2
40122-22	Screw, 0.250-20 x 0.750	2
40122-23	Scale	1
40122-24	Screw, No. 10 x 0.375	2
40122-25	Packing, 4.237 x 0.030	1
40122-26	Cover	1
40122-27	Washer, 0.250 lock	4
40122-28	Screw, 0.250-20 x 0.750	4

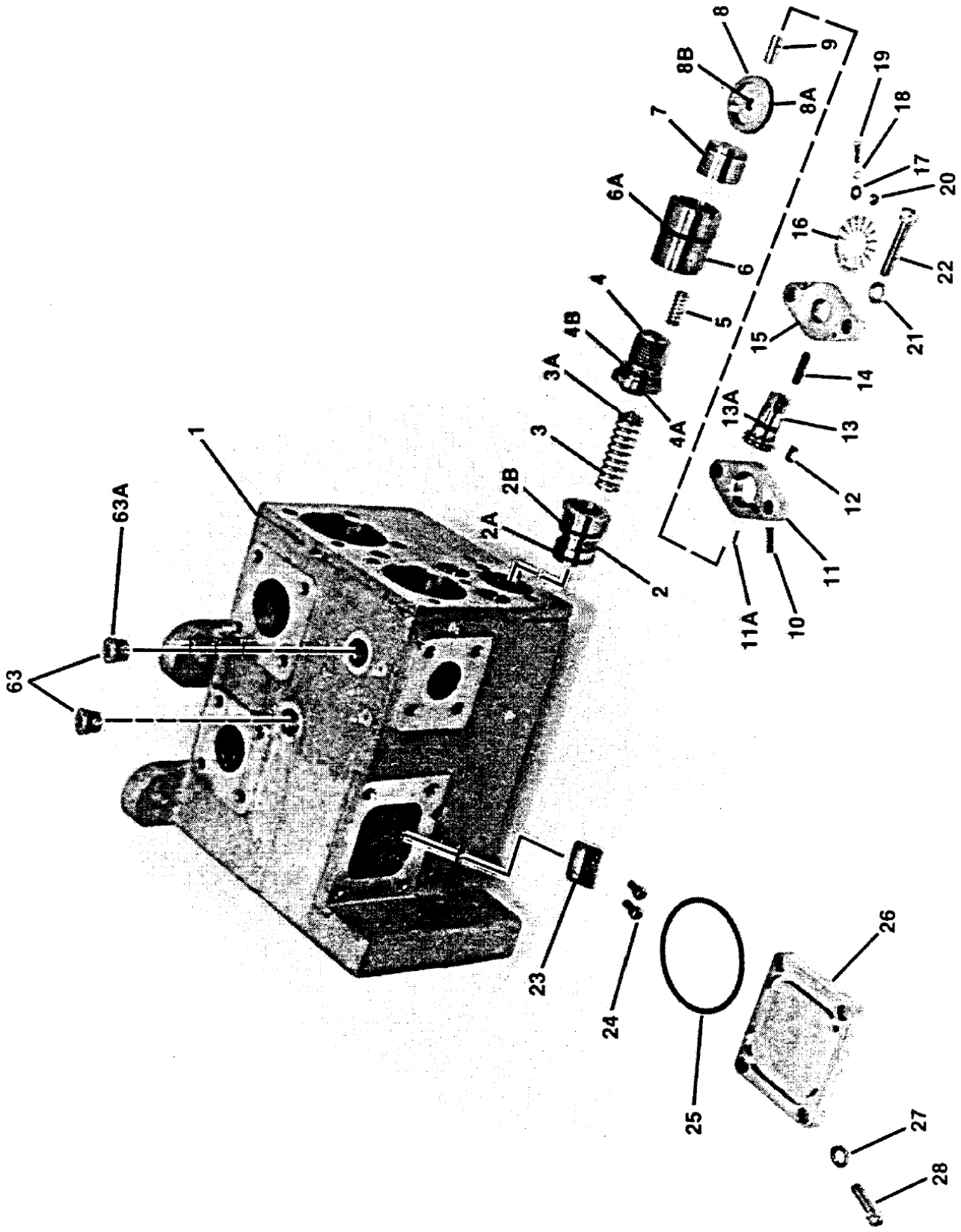

Figure 6-1. Bellows and Specific Gravity Parts

Parts List for Figure 6-2

Ref. No.	Part Name	Quantity
40122-29	Sleeve	1
40122-29A	O-ring, 1.612 x 0.103	1
40122-29B	O-ring, 1.549 x 0.103	1
40122-29C	O-ring, 1.487 x 0.103	1
40122-30	Spacer	1
40122-31	Plunger	1
40122-32	Not Used	
40122-33	Seat	1
40122-34	Spring	1
40122-35	Housing	1
40122-35A	O-ring, 1.674 x 0.103	1
40122-36	Washer, 0.250 Lock	3
40122-37	Screw, 0.250-20 x 1.000	3
40122-38	Seat	1
40122-38A	O-ring, 1.174 x 0.103	1
40122-39	Not Used	
40122-40	Nut	1
40122-41	Screw, Set, 0.250-28 x 1.000	1
40122-42	Plug, 0.875-14 (-10)	1
40122-42A	O-ring, 0.755 x 0.097	1
40122-43	Not Used	
40122-44	Washer, No. 10 Lock	3
40122-45	Screw, 10-214 x 0.750	3

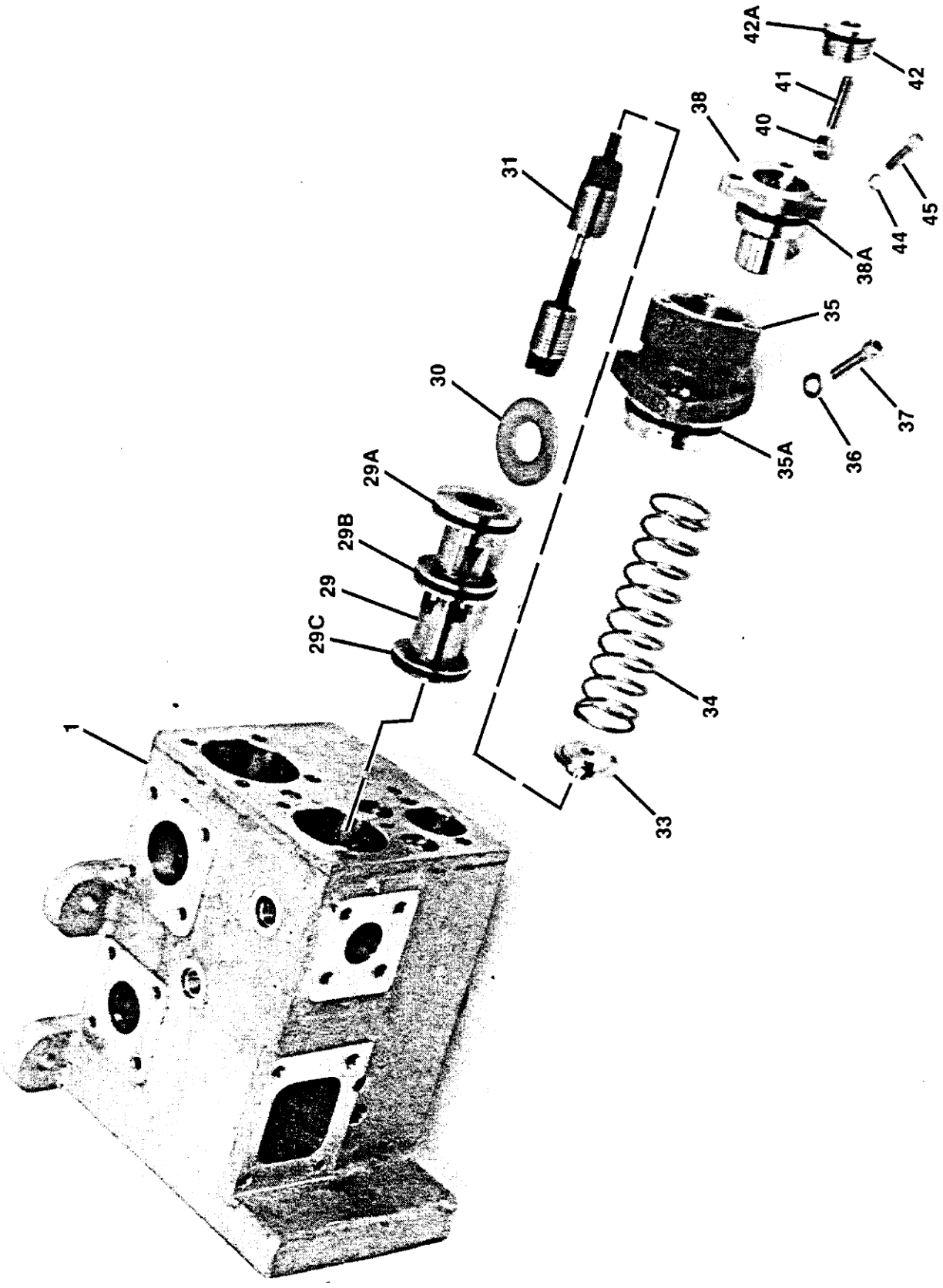

Figure 6-2. Metering Valve Parts

Parts List for Figure 6-3

Ref. No.	Part Name	Quantity
40122-46	Spacer	1
40122-47	Filter	1
40122-48	Plug, 0.438-20 Filter Lock	1
40122-49	Plug, 0.562-18 (-06)	2
40122-49A	O-ring, 0.468 x 0.078	2
40122-50	Not Used	
40122-51	Orifice	1
40122-51A	O-ring, 0.239 x 0.064	1
40122-52	Not Used	
40122-53	Not Used	

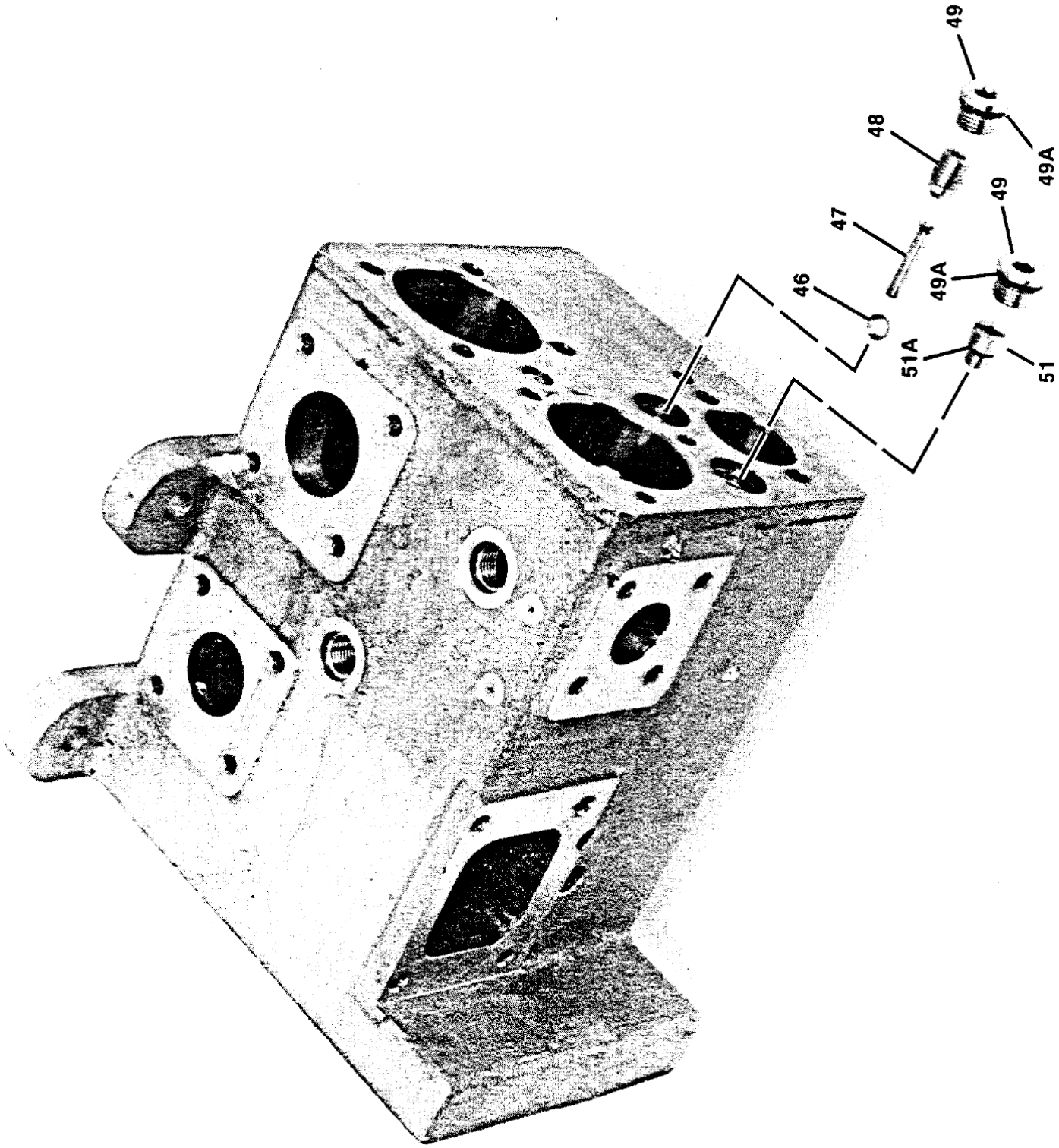

Figure 6-3. Filter Fittings

Parts List for Figure 6-4

Ref. No.	Part Name	Quantity
40122-54	Not Used	1
40122-55	Sleeve	1
40122-55A	O-ring, 1.674 x 0.103	1
40122-55B	O-ring, 1.737 x 0.103	1
40122-56	Piston	1
40122-57	Spring	1
40122-58	Seat	1
40122-59	Cover	1
40122-59A	O-ring, 1.799 x 0.103	1
40122-60	Washer, 0.312 Lock	4
40122-61	Screw, 0.250-18 x 1.000	4
40122-62	Not Used	
40122-63	Plug, 0.562-18 (-06)	5
40122-63A	O-ring, 0.068 x 0.072	5
40122-64	Filter	1
40122-64A	O-ring, 1.549 x 0.103	1
40122-64B	O-ring, 1.612 x 0.103	1
40122-65	Screen	1
40122-66	Ring	1
40122-67	Cover	1
40122-67A	O-ring, 1.674 x 0.103	1
40122-68	Not Used	
40122-69	Washer, 0.312 Lock	4
40122-70	Screw, 0.312-18 x 1.000	4
40122-71	Pin	1

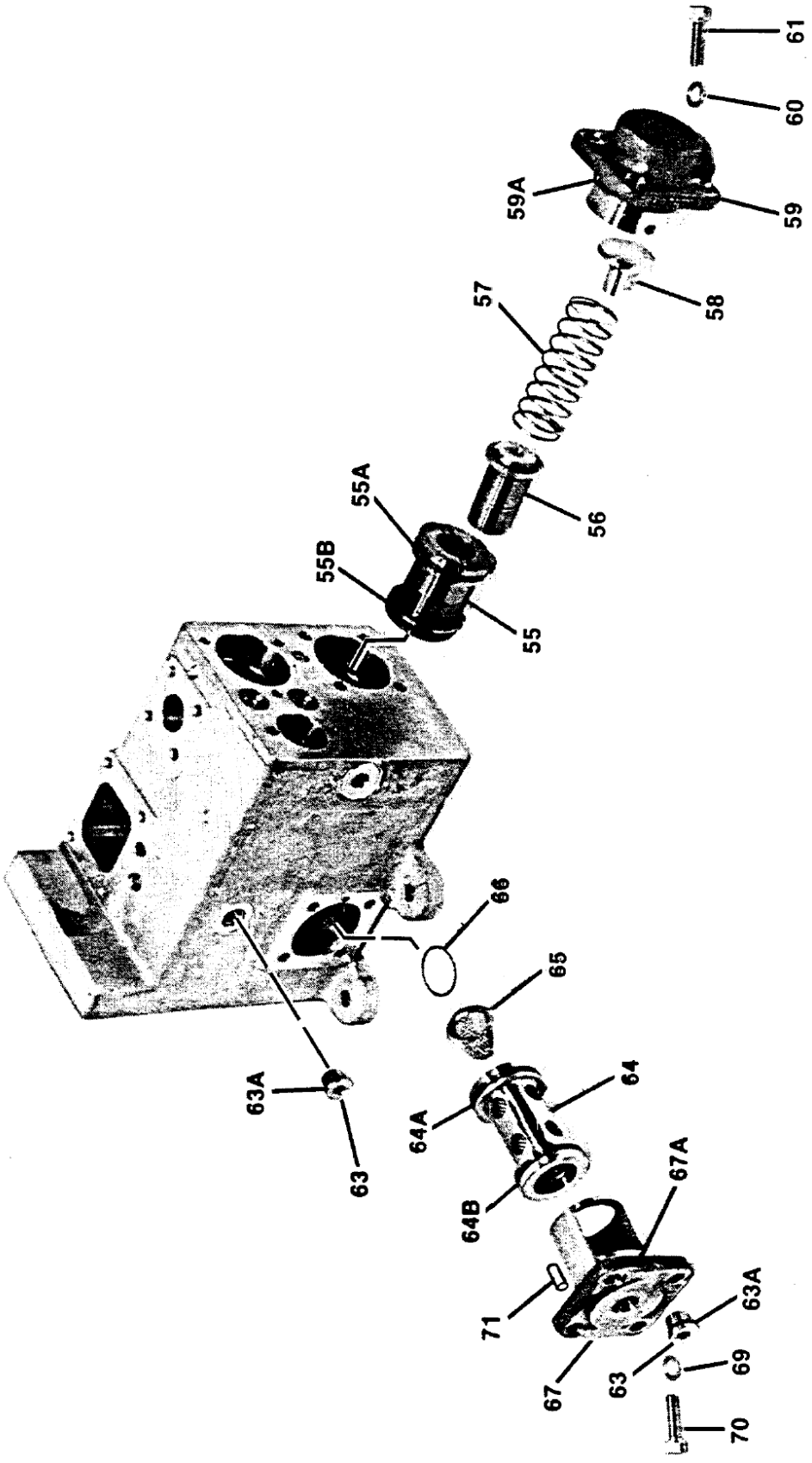

Figure 6-4. Bypass Valve and Filter

Parts List for Figure 6-5

Ref. No.	Part Name	Quantity
40122-101	Actuator Body	1
40122-102	Torque Motor	1
40122-103	O-ring, 0.426 x 0.070	2
40122-104	O-ring, 0.614 x 0.070	1
40122-105	Washer, No. 10 Lock	4
40122-106	Screw, 10-32 x 1.250	4
40122-107	Bushing	1
40122-107A	O-ring, 1.1424 x 0.103	1
40122-107B	O-ring, 1.362 x 0.103	1
40122-107C	O-ring, 1.299 x 0.103	1
40122-107D	O-ring, 1.237 x 0.103	1
40122-107E	O-ring, 0.862 x 0.103	1
40122-107F	Internal Seal (not shown)	2
40122-107G	Internal O-ring (not shown) 0.676 x 0.070	2
40122-108	Not Used	
40122-109	Not Used	
40122-110	Not Used	
40122-111	Not Used	
40122-112	Not Used	
40122-113	Indicator	1
40122-114	Nut	1
40122-115	Coupling	1
40122-116	Piston	1
40122-117	LVDT Assembly	1
40122-117A	O-ring, 0.6114 x 0.070	1
40122-118	Block	1
40122-118A	O-ring, 0.6714 x 0.103	1
40122-119	Not Used	
40122-120	Screw, 10-32 x 1.250	4
40122-121	Washer, No. 10, Lock	4

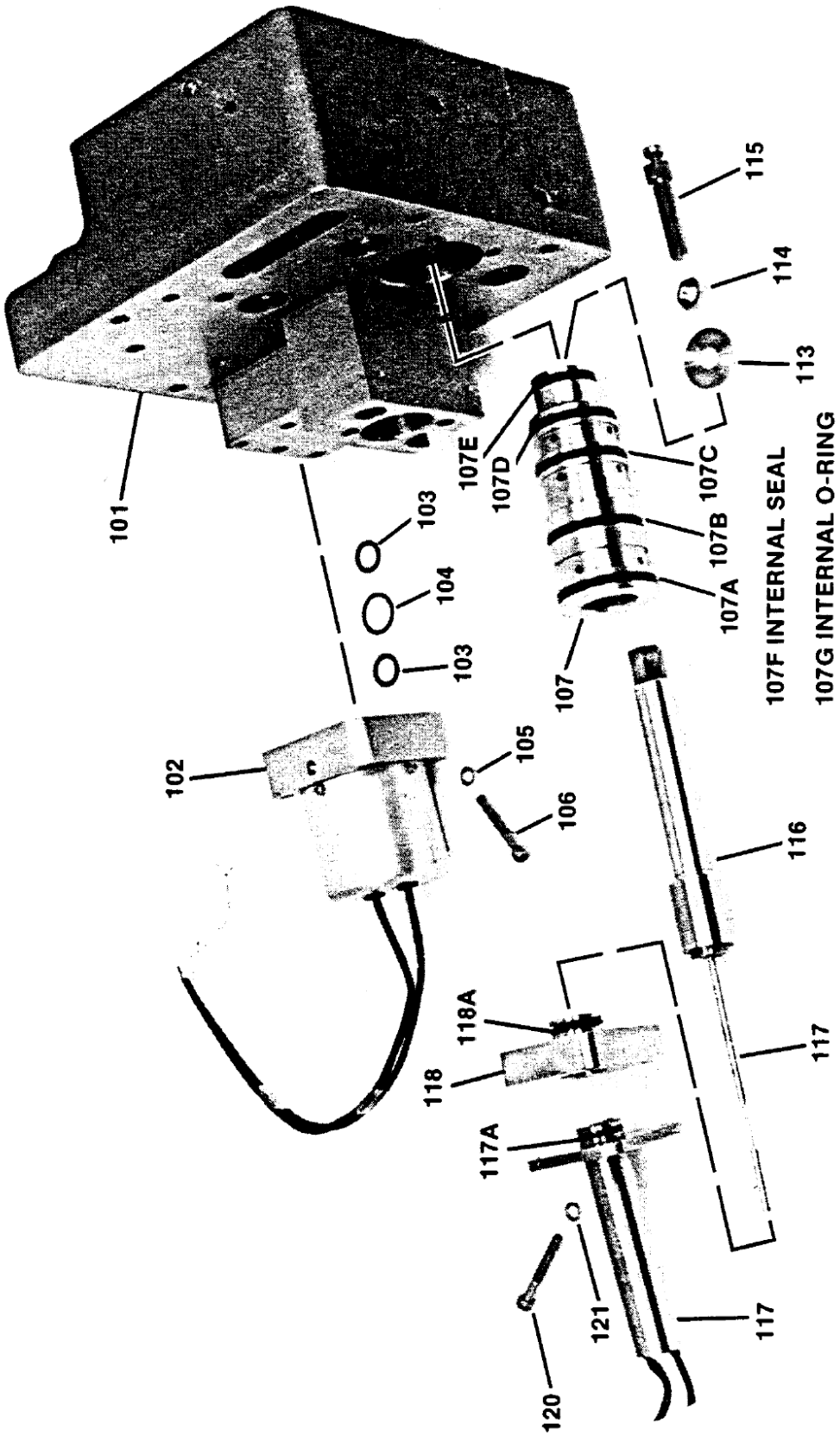

Figure 6-5. FMV/A Actuator and LVDT

Parts List for Figure 6-6

Ref. No.	Part Name	Quantity
40122-122	Seat	1
40122-123	Spring	2
40122-124	Bushing, Assembly, includes piston	1
40122-124A	O-ring, 0.799 x 0.103	1
40122-124B	O-ring, 0.862 x 0.103	1
40122-124C	O-ring, 0.989 x 0.070	1
40122-124D	O-ring, 0.997 x 0.103	1
40122-125	Not Used	
40122-126	Not Used	
40122-127	Not Used	
40122-128	Not Used	
40122-129	Jump and Rate Piston, part of 40122-124	1
40122-130	Orifice	1
40122-131	Part of Orifice, 40122-130	1
40122-132	Not Used	
40122-133	Seat	1
40122-134	O-ring, 0.362 x 0.103	1
40122-135	Strap	1
40122-136	Washer, 0.250 Lock	2
40122-137	Screw, 0.250-20 x 1.250	2
40122-138	Lee Plug	1
40122-139	Part of Lee Plug 40122-138	1
40122-140	Plug, 0.312-24 (-02)	1
40122-140A	O-ring, 0.239 x 0.064	1

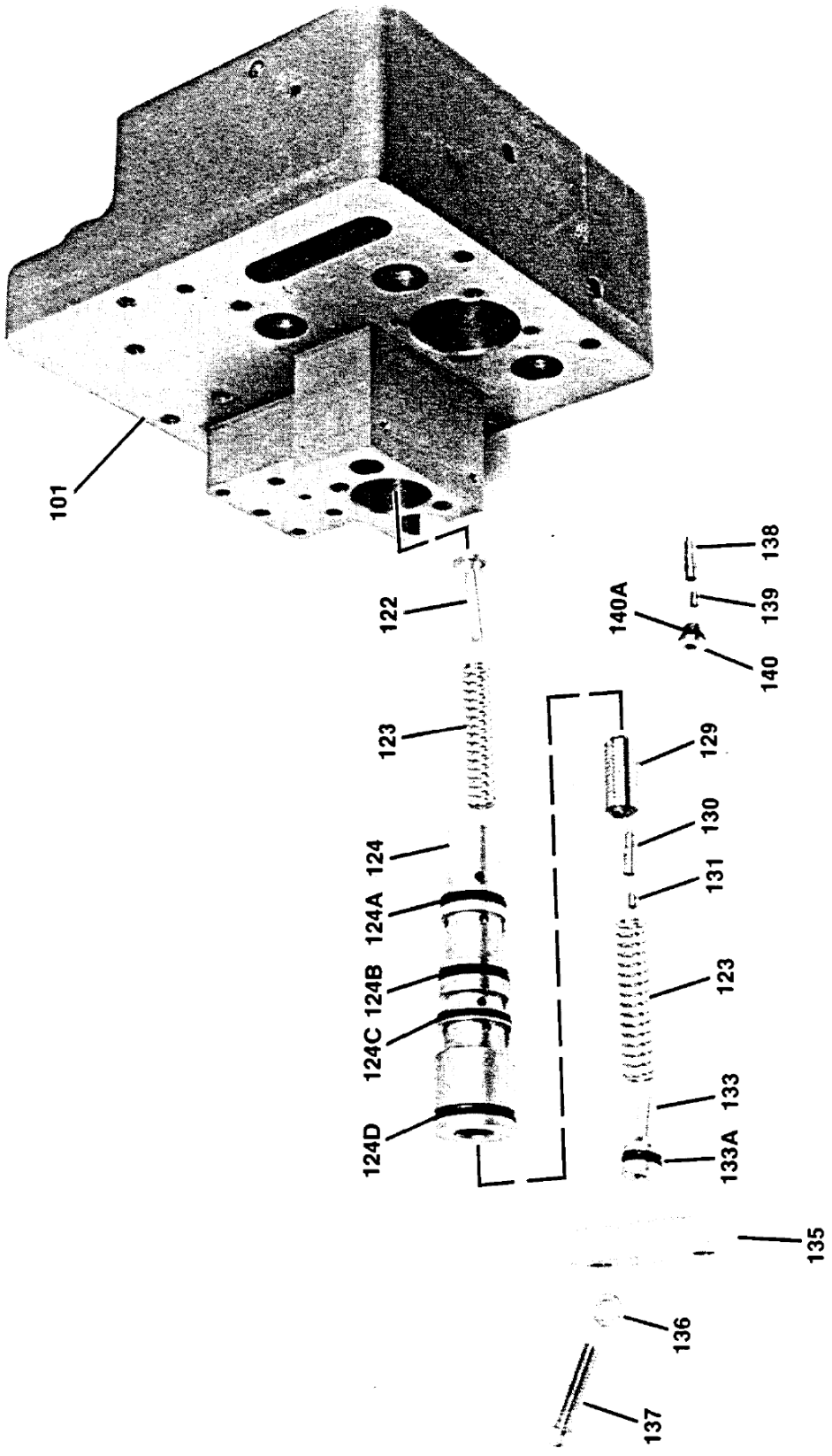

Figure 6-6. Actuator Jump and Rate

Parts List for Figure 6-7

Ref. No.	Part Name	Quantity
40122-141	O-ring, 0.549 x 0.103	4
40122-142	Washer, 0.375 Lock	4
40122-143	Screw, 0.375-16 x 1.250	4
40122-144	Gasket	1
40122-145	Clamp	1
40122-146	Screw, 6-32 x 0.250	1
40122-147	Screw, 0.250-20 x 1.250	5
40122-148	Washer, 0.250 Lock	5
40122-149	Not Used	
40122-150	Electrical Connector	2
40122-150A	Gasket	2
40122-151	Washer, No. 4 Lock	8
40122-152	Screw, 4-40 x 0.375	8
40122-153	Cover	1

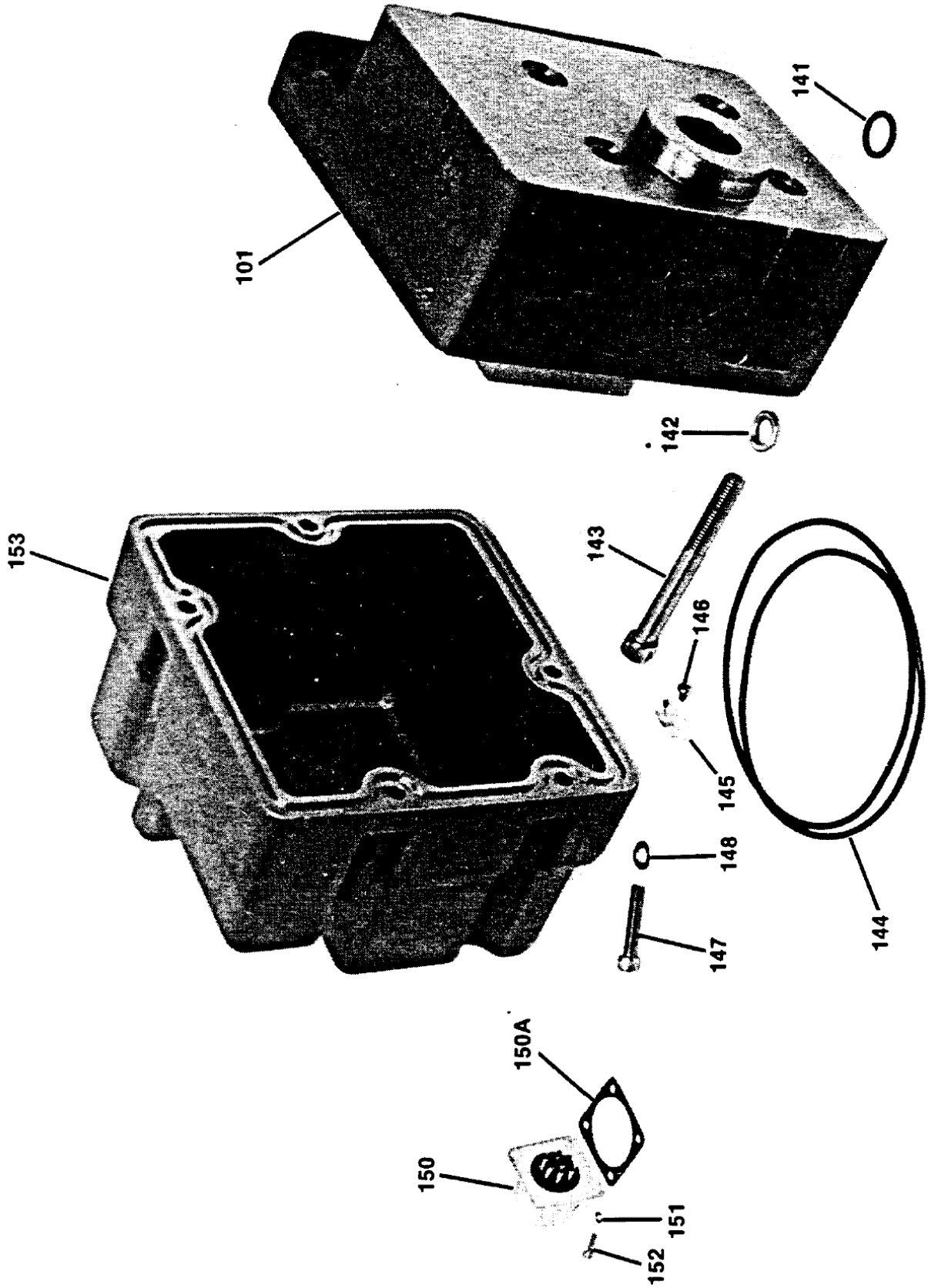

Figure 6-7. Actuator Cover

Parts List for Figure 6-8

Ref. No.	Part Name	Quantity
40122-154	Bracket	1
40122-155	LVDT Transformer	1
40122-156	Washer, No. 10 Lock	4
40122-157	Screw, 8-32 x 0.312	4
40122-158	Screw, 0.250-20 x 0.875	3
40122-159	Washer, 0.250 Lock	3
40122-160	Terminal	2
40122-161	Anchor	2
40122-162	Screw, 10-32 x 2.000	2
40122-163	Strap	2
40122-164	Fitting	1
40122-164A	O-ring, 0.468 x 0.078	1

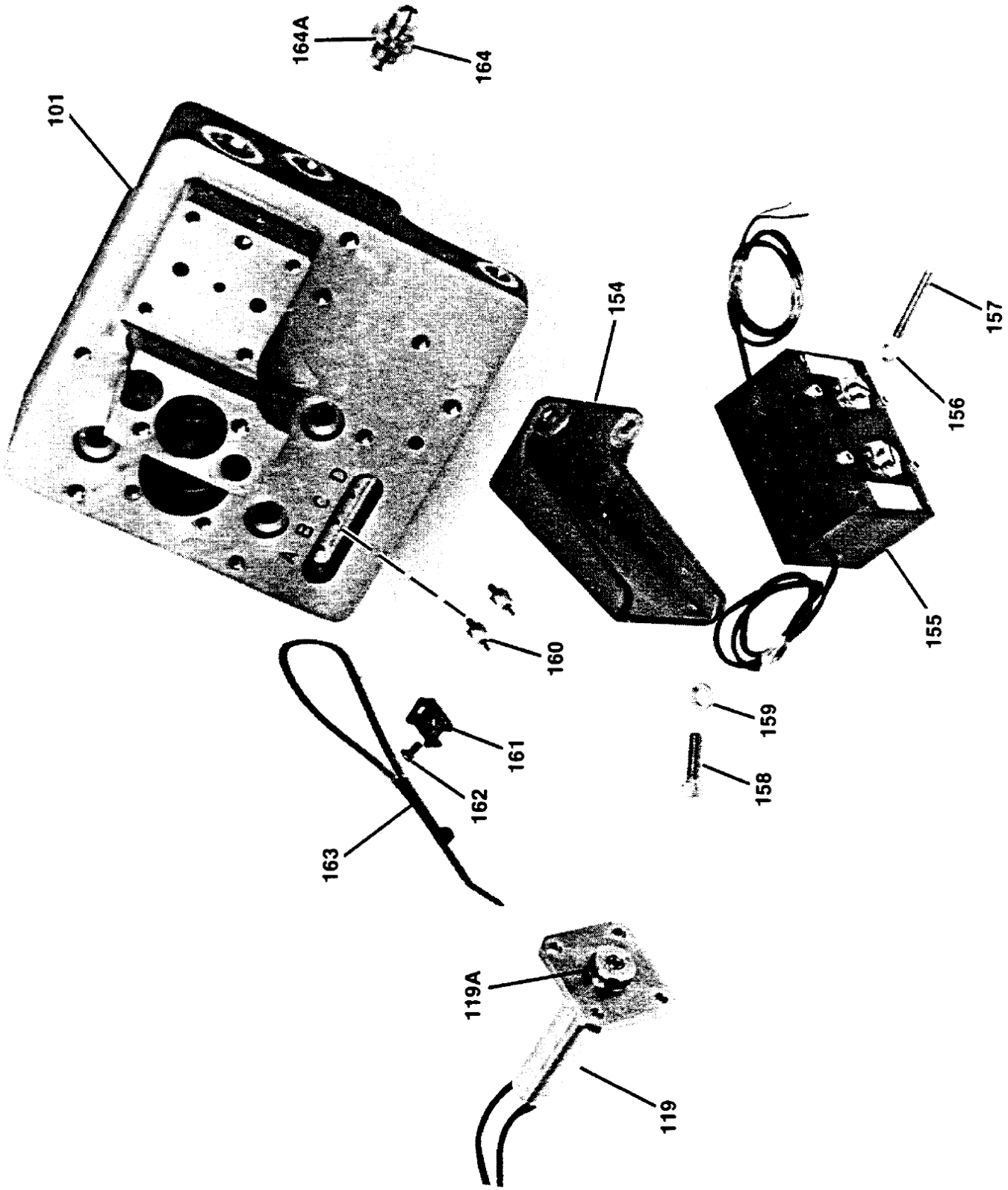

Figure 6-8. Transformer

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 40122.

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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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