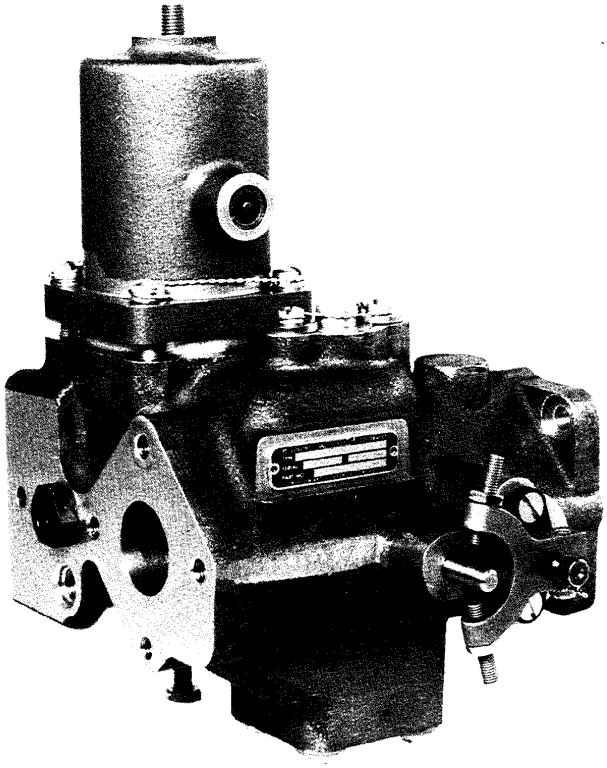
WOODWARD

Product Manual 40100
(Revision A)
Original Instructions



1907 Gaseous Fuel Valve/Limiter

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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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 Out-of-date translations are marked with ⚠.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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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 1907 Gaseous Fuel Valve/Limiter is used in conjunction with a hydraulic actuator. The fuel valve/limiter meters feel to the turbine for starting, acceleration, steady state operation at all normal loads, deceleration, and also limits maximum fuel flow to the engine.

The unit is mechanically linked to the actuator, which determines the fuel flow for any given condition of steady state operation. The limiter sets a maximum fuel limit as a function of CDP, and overrides the input from the actuator during starting and accelerations to prevent the turbine from entering the stall, or unstable, operating region and to avoid over-temperature.

Description

The fuel valve/limiter consists of a fuel metering valve and an acceleration limiter. The fuel valve plunger is held in continuous contact by the plunger loading spring with either the input lever or the adjustable limiter lever. The actuator positions the input lever, and the CDP sensor positions the adjustable limiter lever.

Fuel at inlet pressure enters the valve through the inlet port and is metered by the plunger through metering orifices to the outlet. Fuel flow requirements determine the metering plunger size and shape. The position of either the input lever or limiter lever determines the orifice opening and therefore the amount of fuel delivered to the turbine.

The acceleration limiter section consists of a spring-loaded rolling diaphragm mechanically linked to the fuel limit lever. The diaphragm senses CDP and, acting through the linkage to the fuel limit lever, limits fuel flow during accelerations to prevent the governor from over-fueling the engine. At the end of the acceleration transient, CDP normally increases above the steady-state value for that speed and the governing system assumes control.

IMPORTANT

The 1907 Small Gaseous Fuel Valve may be configured without a CDP acceleration fuel limiter. Without the CDP acceleration limiter option, the input to meter fuel flow during all operating conditions is through the input shaft from the governor/actuator system.

Storage

Storage Material:

Item	Title
Corrosion Preventive Oil	MIL-C-6529, Type 3
Barrier Material	MIL-B-121, Type 1, Grade A,. Class 1
Desiccant	MIL-D-3464, Class 1
Identification Tags	Commercially available

IMPORTANT

Equivalent substitutes may be used for the items listed above.

Short-Term Storage (one year or less)

1. Flush the unit, including the CDP area under the diaphragm, with corrosion preventive oil.
2. Record flushing date and type or name of corrosion preventive oil on two tags. Attach one tag to unit and one to exterior of container.
3. Place protective closures in open ports. Wrap and seal the unit in barrier material.
4. Cushion the unit if necessary and place it in a suitable container.

Long-Term Storage (more than one year)

Perform all steps of Short-Term Storage instructions and, in addition, include a proper amount of desiccant with the unit before wrapping and sealing in barrier material.

IMPORTANT **The unit does not require periodic reflushing.**

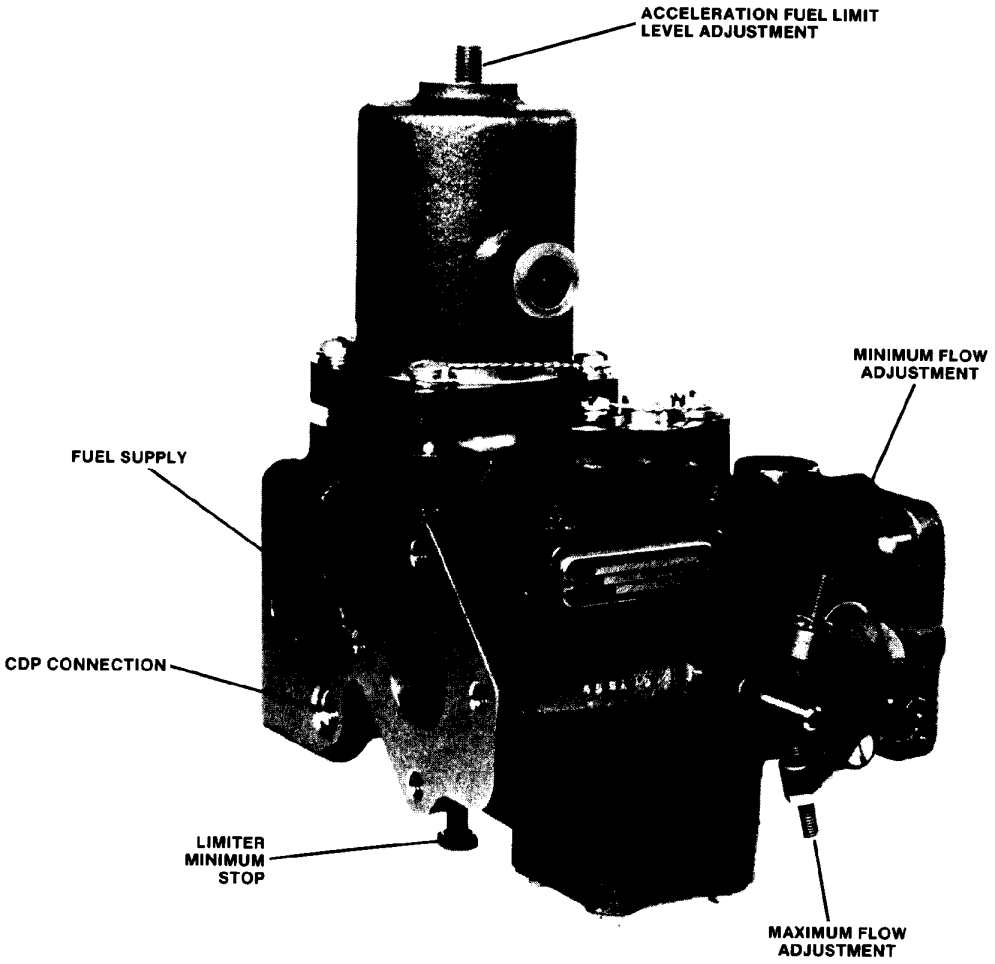

Figure 1-1. 1907 Gaseous Fuel Valve/Limiter

Chapter 2. Installation

Installation

Mount the fuel valve/limiter square with the governor actuator linkage to prevent binding. This unit is calibrated before shipment, and a minimum use of adjustments is recommended. If adjustments are necessary, refer to Figure 2-1 for adjustment locations and effects.

Adjustments

1. The acceleration fuel limit level adjustment screw increases the fuel flow limit for any given CDP value when turned counterclockwise.

2. The limiter minimum stop screw increases the minimum fuel limit (start flow) when turned clockwise.

3. The minimum flow stop screw increases the governor minimum fuel setting when turned clockwise.

4. The maximum flow stop screw increases the governor maximum fuel setting when turned counterclockwise.

5. The adjustable limiter lever (internal adjustment) changes the ratio of fuel flow to CDP proportional to lever length.

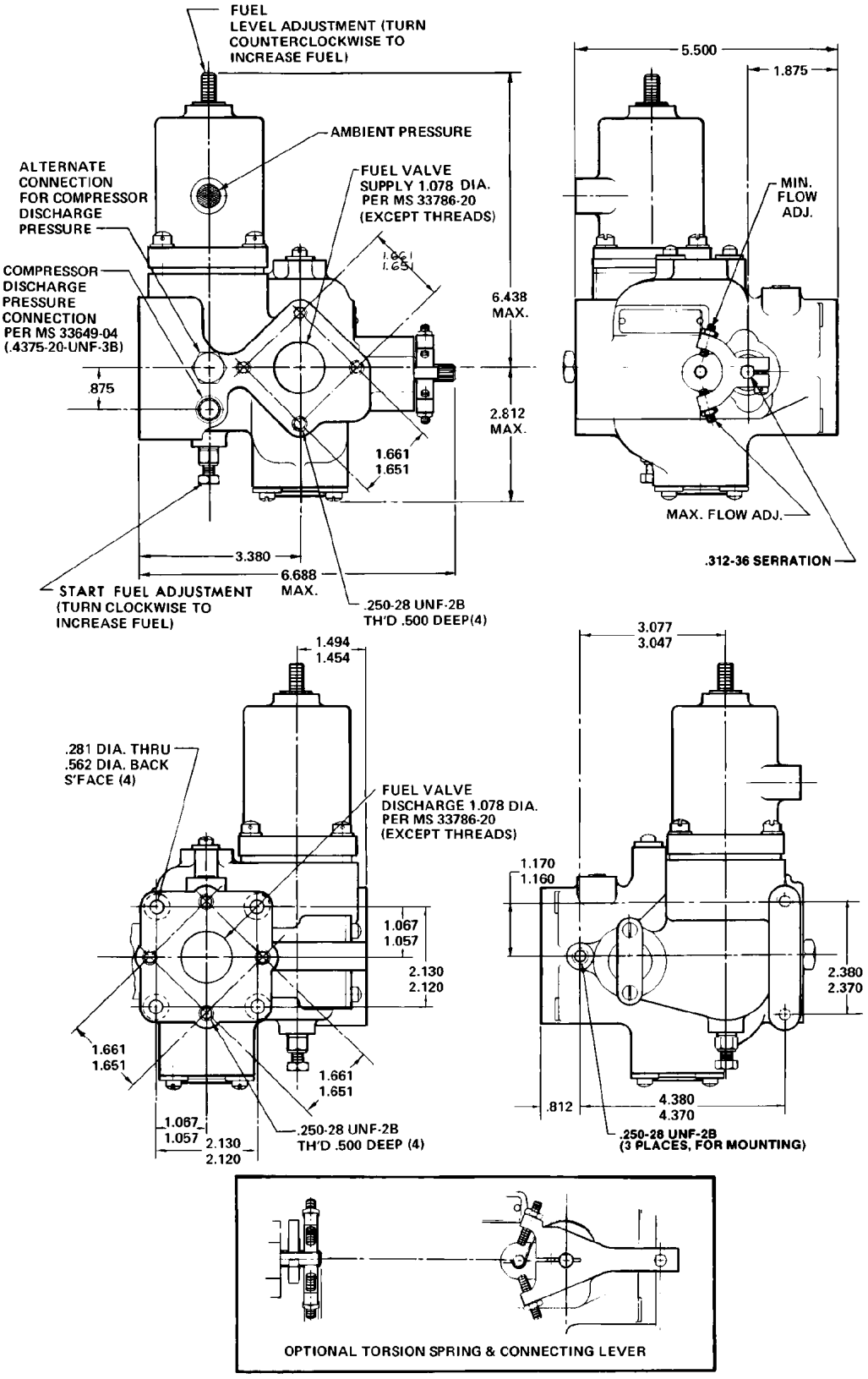

Figure 2-1. Outline Drawing, 1907 Gaseous Fuel Valve Limiter
(Do Not Use for Construction)

Chapter 3.
Principles of Operation

General

Refer to the schematic diagrams, Figures 3-1 and 3-2. The fuel valve/limiter is used in conjunction with a governor/actuator. Fuel is metered to the turbine for starting, acceleration, steady state operation, and deceleration. The limiter section meters fuel flow during acceleration as a function of turbine CDP. Daring steady-state operation, fuel flow is controlled by the governor/actuator through mechanical linkage.

Starting

During starting, the fuel limiter is in the minimum acceleration fuel position with the limiter lever against the minimum limiter stop screw. The input lever is moved to maximum fuel position by the governor, and the adjustable limiter lever determines the position of the metering plunger. Under these conditions, the metering orifices are opened sufficiently to allow the required starting fuel flow.

Acceleration

Following ignition, the turbine accelerates towards the governor speed setting. CDP increases with turbine speed, causing the limiter diaphragm to move away from the minimum limiter stop and rotate the adjustable limiter lever counterclockwise. The plunger loading spring now moves the metering plunger upward, allowing more fuel to flow. This action continues until the turbine reaches the set governor speed.

Steady State

When the turbine has accelerated to the governor preset speed, the actuator rotates the connecting lever counterclockwise to decrease fuel. Fuel flow is then regulated by the governor, which increases or decreases fuel as a function of speed.

Deceleration

During large reductions in load or speed setting, the governing system reduces fuel flow to the turbine. To provide the minimum fuel flow necessary to sustain combustion and prevent flameout, the minimum fuel stop adjustment screw limits the movement of the input shaft in the decrease-fuel direction.

Input Shaft Torsion Spring (optional)

The input shaft torsion spring shown in Figures 2-1 and 5-1 forces the governor connecting link to the minimum fuel stop position if a connecting link should become disconnected or the governor inactivated.

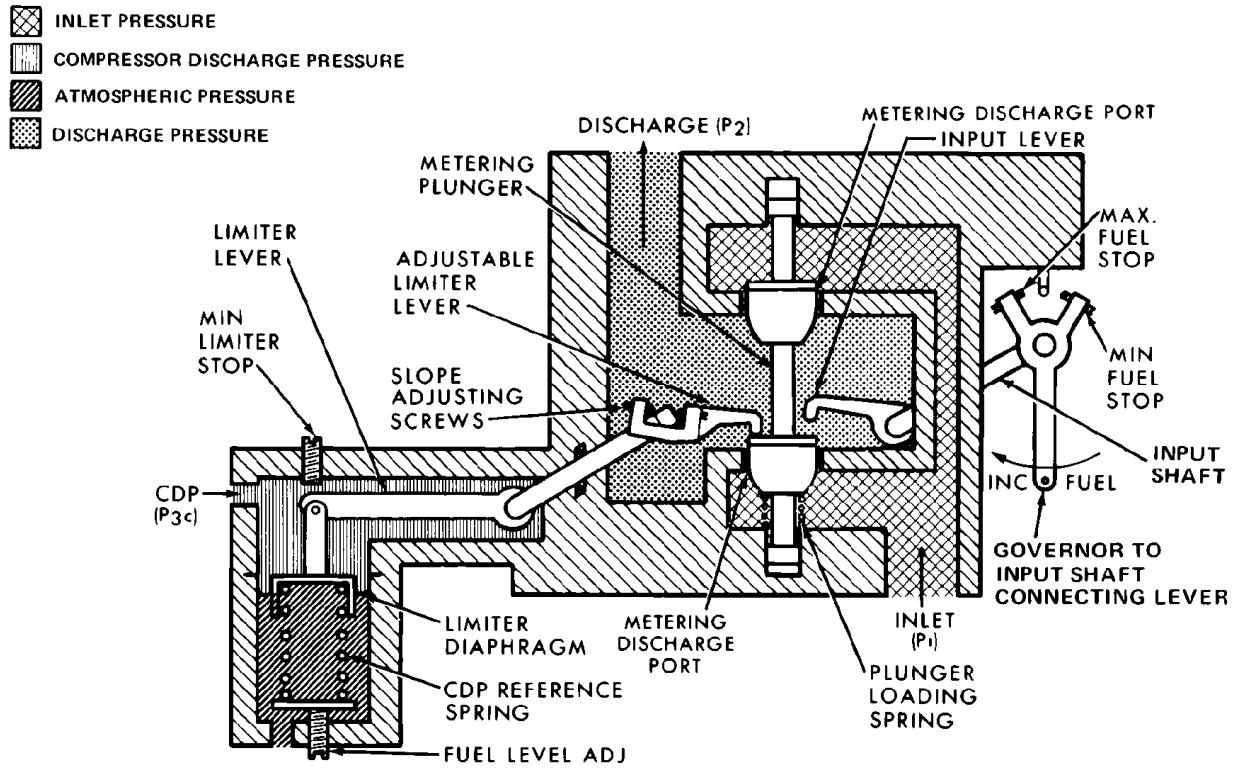

Figure 3-1. Schematic Diagram, 1907 Gas Fuel Valve/Limiter (shown accelerating)

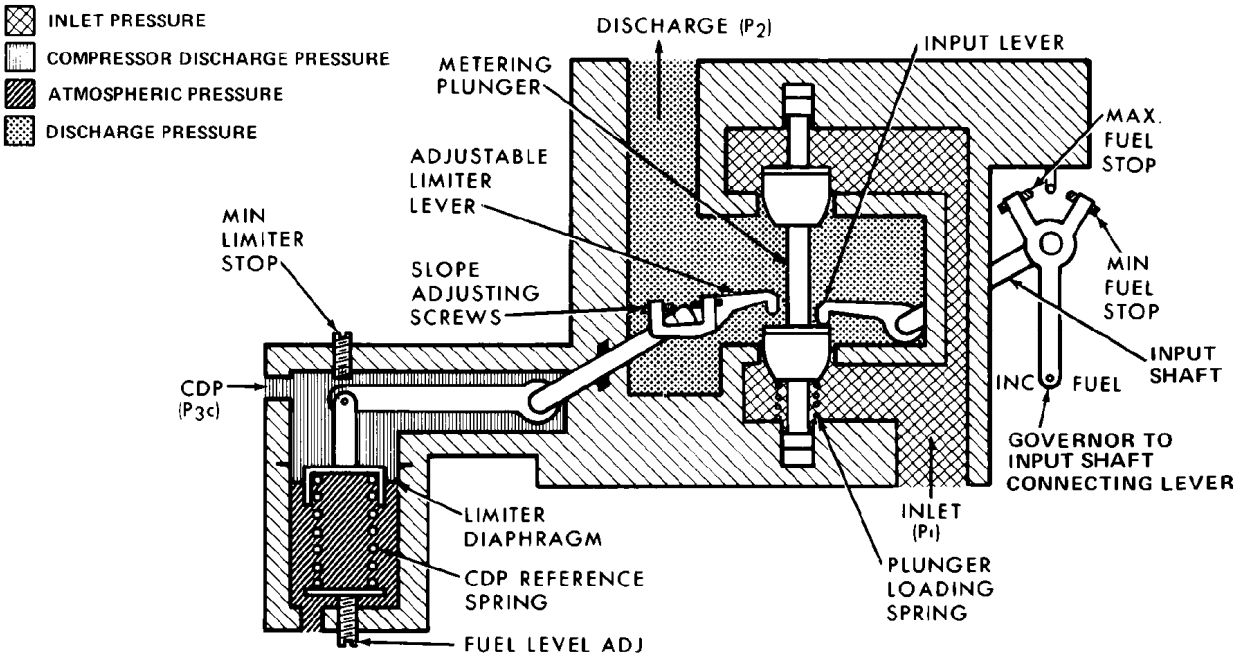

Figure 3-2. Schematic Diagram, 1907 Gas Fuel Valve/Limiter (shown at steady state)

Chapter 4.
Maintenance

Special Tools, Fixtures, and Equipment

Name	Use	Part Number
Test Stand	Required for testing fuel valve/limiter assembly	T-83762
Torque Wrench Adapter	Adapt 5/16-36 serration to 1/2 hex	T-93341
Bearing installation Tool	Install bearing (t4)	T-93025
Bearing installation Tool	Install bearing (39)	T-93668
Orifice Tool	Remove orifice (20)	T-93205
Orifice Tool	Install orifices (18) and (20)	T-92690
Two stage hydraulic power unit	Fuel valve pressure test	Series Y60 Owatonna Tool Co. Owatonna, MN 55060

IMPORTANT **Equivalent substitutes may be used for the items listed above.**

Troubleshooting

If improper speed variations appear, refer no the governor system manuals for assistance in isolating the cause. The following steps relate to the fuel valve/limiter.

IMPORTANT **Refer to Figure 2-1 for location of adjustment screws identified in the following steps.**

1. Check the linkage between the governor/actuator and the fuel valve/limiter to make certain there is no binding or lost motion. Disconnect the actuator linkage and check that the valve input shaft can be rotated between stops without exceeding a torque of 15 lb-in (1.7 N·m).

2. During cranking before reaching ignition speed, the governor/actuator should rotate the valve input shaft to the maximum fuel stop. If this does not occur, check the governing system.

3. If the governor/actuator moves the fuel valve input shaft to the maximum fuel stop during cranking, but ignition does not occur, the starting flow may be too low. To increase, turn the minimum limiter stop screw clockwise.

4. If starting occurs, but acceleration is very slow, the fuel limit level may be too low. To increase, turn the fuel level adjustment screw counterclockwise.

5. If acceleration to rated speed does not occur with the governor speed setting properly adjusted, it may be due to:
   a. Insufficient inlet fuel pressure. Check the line gauge and adjust the fuel inlet pressure regulator.
   b. A CDP signal leak. Check hoses and connections for leaks and tighten all connections.
   c. Maximum fuel flow too low. Full load on engine reduces speed, and maximum fuel adjustment screw may need adjustment.

d. Acceleration fuel slope too low. Acceleration temperature very low and engine may not accelerate. Adjust the CDP level adjustment to increase fuel level.

IMPORTANT **Too high an increase of fuel will cause hot starts.**

e. CDP bellofram failed. If there is an oil or air leak through the air vent, replace the bellofram (see disassembly).
f. Low gas heating value. See part (d) above.

6. If overtemperature occurs during acceleration, the fuel level adjustment may be set too high. If the unit has been disassembled, the adjustable limiter lever may have been set too long.

Disassembly

Disassemble the fuel valve/limiter following the sequence of index numbers assigned in Figure 5-1, giving special attention to the following.

IMPORTANT **Refer to Troubleshooting and establish condition of fuel valve/limiter assembly or most probable cause of malfunction to determine the extent of disassembly required without complete teardown and rebuild.**

NOTICE **Cleanliness and careful handling of all parts is mandatory. Maintenance must be performed in a clean atmosphere since particles of dust or lint can cause malfunctions after assembly. If assembly is not performed within 24 hours, all parts must be protected against corrosion and damage.**

1. Clean the exterior surfaces of the valve/limiter.

2. Remove all lock wires.

3. Discard all gaskets, O-rings, seals, retaining rings, cotter pins, clips, locknuts, etc., removed in process of disassembly.

4. Do not remove press fit components unless replacement is necessary. Removal of these components only for cleaning and inspection may necessitate replacement.

5. Loosen one adjusting screw only to remove fuel limiter lever (see Figure 4-1). The other screw maintains the correct position for reassembly.

   If both adjustment screws are removed, measure “X” dimension (Figure 4-1) to assure that these parts can be replaced in their original positions.

6. Remove screws (1), washers (2), plunger guide (3), and O-ring (4). Rotate input shaft (12) counterclockwise until the minimum flow adjustment screw (6) contacts pin (15). With a depth gauge, measure and record the dimension from the face of the plunger guide boss to the end of metering valve plunger (22). Do not compress the spring (23) any further when making this measurement.

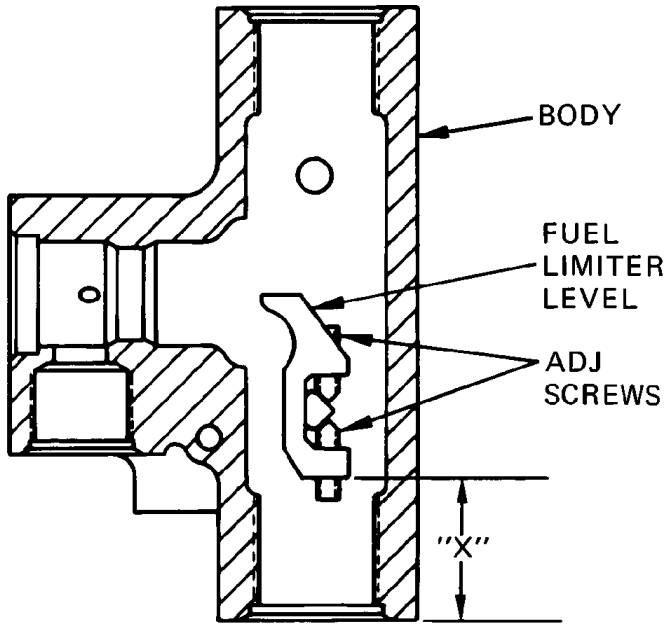

Figure 4-1. Measurement of Fuel Limit Lever Position

7. Rotate input shaft (12) fully clockwise, then rotate it counterclockwise until input lever (16) first comes into contact with the metering valve plunger. Determine this by noting the point at which additional torque is required to compress spring (23). Hold the input shaft in this position. With a thickness gauge, measure and record the gap between the minimum flow adjustment screw (6) and pin (15).

8. With input shaft (12) rotated fully clockwise, mark a point on the face of input shaft stop (7). Use this as the reference position of a protractor and rotate the shaft counterclockwise until the maximum flow adjustment screw contacts pin (15). Using the protractor, measure and record the number of degrees of rotation from maximum to minimum flow position. When the input shaft stop is removed, do not looses the adjustment screws unless necessary to replace them.

9. Use a felt tip pen or scribe line to mark the end of input shaft (12) with a line parallel to the slot in input shaft stop (7) so that the stop can be reassembled in the same position. Loosen screw (8) and remove the stop.

IMPORTANT

If removal of one or both adjustment screws (6) is necessary, measure and record the distance from the point end of the screw to the arm of the stop so that the screw(s) can be reassembled in the same position(s).

10. Remove input shaft retaining ring (10) and bearing retaining ring (9).

11. Use a small diameter punch and drive roll pin (17) out of input lever (16) and remove the input lever.

12. Remove input shaft (12), bearing (11), and O-ring (13).

13. Remove 2 screws (35) and washers (36).

14. Take out bearing retainer (38) and O-ring (37).

IMPORTANT

Do not remove bearings (39 and 45), as they must be bored out. These bearings normally do not wear out since there is very little load on the bearings.

15. Loosen one screw (46) which is accessible through the fuel outlet port, and pull out shaft (41) and key (40).

IMPORTANT

Measure the depth of lever (47) from the surface of the housing, and record for reference when reassembling.

18. Remove adjustable fuel limiter lever (47). Do not change the position of the other screw (46) in the adjustable lever. If it must be replaced or removed, before moving the screw, measure and record the distance the pointed end extends inside the arm of the lever.

17. Remove screws (48), washers (49), and lift off cover assembly (50).

18. Disassemble diaphragm unit from cover, removing CDP spring (52), steel ball (54), CDP spring seat (53), diaphragm retainer (56), and diaphragm assembly.

19. Remove minimum limiter stop screw (51).

IMPORTANT

It is not necessary to remove this screw for overhaul. If it is removed, measure the screw height above its boss in the cover and reset to the same height at reassembly.

20. Remove the diaphragm adapter bushing (59) and O-ring (60) from the valve housing.

IMPORTANT

When the fuel valve has a large diaphragm, the adapter bushing (59) and O-ring (60) are omitted from the valve.

21. Remove lock nut (55) and separate link (63), seal (62), diaphragm clamp plate (61), rolling diaphragm (58), and piston (57). Remove cotter pin (64), washer (66), pin (65), and separate CDP lever (67) from link (63).

22. Remove spacer (42),O-ring (43), and channel seal (44).

23. Remove screws (27), washers (26), plunger guide (24), O-ring (25), spring assembly (23), and fuel metering plunger (22).

IMPORTANT

When the valve is equipped with the optional plunger guide (28) and minimum plunger screw (30), record the distance screw (30) is seated below the surface of plunger guide (28). This is for ease in reassembling the screw.

24. Use a number 3 Truarc pliers and remove retaining ring (21).

25. Insert tool T93205 into orifice cup (20), expand the tool, and pull out the orifice cup.

IMPORTANT **Remove retaining ring (19) and orifice (18) only if it is damaged. Normally this orifice will not need removed.**

26. Remove plug (63) and O-ring (69).

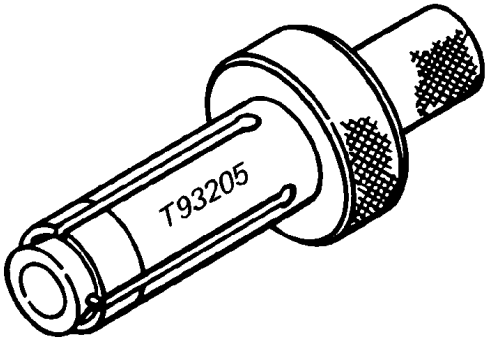

Figure 4-2. Orifice Cup Removal Tool

27. Remove bearing (14) by taping it down into the larger cavity.

IMPORTANT **Removal is not necessary for overhaul unless bearing is damaged.**

28. Removal of plug (74) is not required for overhaul unless adjustment of the fuel limiter lever is necessary.

29. Minimum limiter stop screw (70) does not need removed. However, if it is removed, measure its height above the boss so it can be replaced at the same depth.

Parts Check

General

1. Check all parts for wear, corrosion, nicks, cracks, or other damage. Mating or rubbing surfaces must be particularly examined for nicks, burrs, scores, or other roughness, and evidence of wear.

2. Check threads and thread inserts for stripping, cross-threading, or other deformation. Check inserts for proper retention in holes.

3. Check aluminum parts for abrasion, scratches, nicks, or other damage which expose bare metal.

4. Check for mis-match of serrations or other tooth damage.

Metering Valve Plunger (22)

1. Sharp corners on plunger lands must not be rounded off, nicked, scored or otherwise damaged.

Input Lever (16) And Fuel Limiter Lever (47)
1. Toes on levers must not be perceptibly flat–spotted.

Bearings
1. Check bearings (45) and rotate needles so shaft rides on new area.

Link (63) and CDP Lever (67)
1. Check for perceptible elongation of pin holes.

Plunger Loading Spring (23) and CDP Reference Spring (52)
Normally, these springs do not wear out, although they may need to be replaced due to breakage. Each particular spring must compress to a certain length under a specific load. If tests are desired, spring compression data is available from Woodward.

Cleaning

Cleaning Materials

Item	Description
Stoddard Solvent	PD-680
Lint free wipers	Commercially available
Plastic bags, 3 x 4”	Commercially available

IMPORTANT **Equivalent substitutes may be used for items listed above.**

Cleaning Procedures
1. Immerse all parts in solvent and wash ultrasonically or by agitation.
2. Dry parts with clean wipers or blow dry with a jet of clean, dry air.
3. Place fuel meter plunger (22), bearing retainer (38), plunger guide (3) and (24) in individual bags to prevent damage to the parts.

Repair

Repair Materials

Item	Availability
Abrasive paper or cloth 600 grit	Commercially available
Iridite 14-2, MIL-C-5541	Commercially available
Hard Arkansas Stone	Commercially available
Light machine oil	Commercially available

IMPORTANT **Equivalent substitutes may be used for items listed above.**

General
1. Replace parts that do not meet requirements and cannot be reconditioned.
2. Chase damaged threads.
3. Replace loose or damaged thread inserts.
4. Polish slightly corroded areas using a fine grit abrasive cloth or paper and oil.

5. Treat areas on aluminum parts where bare metal is exposed to restore corrosion resistant surface film using Iridite 14-2.

6. Replace all O-rings, seal (62), thread seal (73), roll pin (17), diaphragm (58), nut (55), and cotter pin (64).

Input Lever (16) and Fuel Limit Lever (47)

Polish toes of levers to remove flat spots using a hard stone and oil.

Assembly

Assembly Materials

Item	Availability
Petrolatum, VV-P-236	Commercially available
Lubricating oil MIL-L-23699 Grade 1010	Commercially available
Molykote lubricant G	Alpha Molykote Corp., Stanford, Connecticut

IMPORTANT **Equivalent substitutes may be used for items listed above.**

Assembly Procedures

IMPORTANT **Refer to specific figures mentioned for assembly or Figure 5-2, the exploded view.**

1. Count all parts and divide into convenient group sizes.

2. All parts must be clean and free from nicks and scratches.

3. Identification numbers on bearings must face out unless otherwise specified.

4. Locate the sharp edge of all retaining rings toward the side of the groove that the pressure is against.

5. Lubricate O-rings and seals (62 and 73 Figure 5-1) with petrolatum or lubricating oil prior to installation.

NOTICE **Install new O-rings and seals carefully. Do not use pointed or sharp-edged tools.**

6. Lubricate rolling diaphragm (58 Figure 5-1) with Molykote lubricant prior to installation.

7. Lubricate metal parts lightly with lubricating oil prior to assembly.

8. Place O-rings on plunger guide (3 and 24), bearing retainer (38), plug (68), and input shaft (12). See Figure 4-3.

9. Use tool T93025 and press in new bearing (14) to a depth of 1.340 inches (34.04 mm) from face of housing bore to bearing.

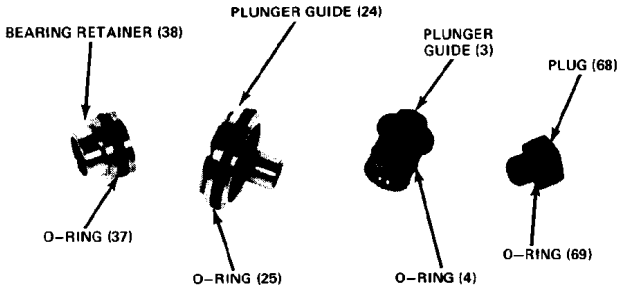

Figure 4-3. O-ring Assembly

10. Press in bearing (11) until it stops on the machined shoulder. Secure with retaining ring (9).

11. If bearing (45) was previously removed, replace it. Seat the bearing on the machined shoulder in the housing.

12. Insert channel seal (44), O-ring (43), and spacer (42). See Figure 5-1.

13. Use tool T92890 (Figure 4-4) (small diameter end) and replace orifice cup (18) if previously removed. Secure with retaining ring (19). See Figure 4-5.

NOTICE **Do not damage hard coat on orifice.**

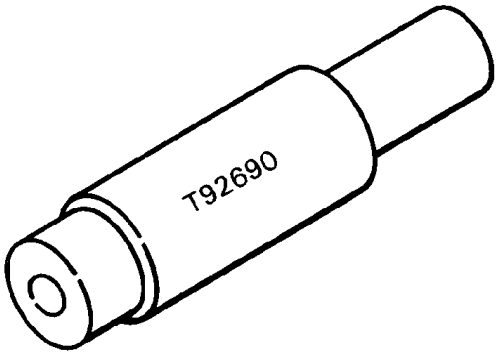

Figure 4.4. Orifice Cup Replacement Tool

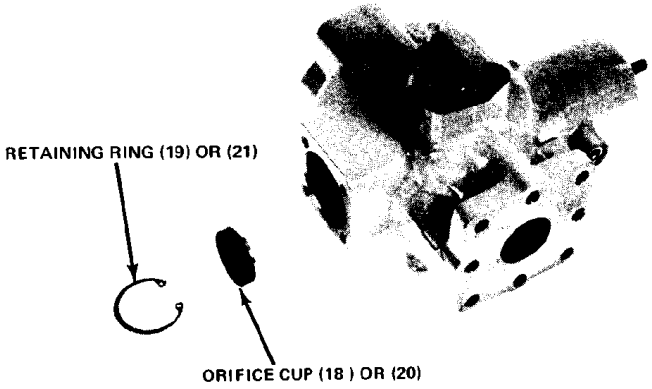

Figure 4-5. Orifice Cup Assembly

14. Use large diameter end of tool T92690 and replace orifice cup (20). Secure with retaining ring (21). See Figure 4-5.

15. Assemble link (63), seal (62), plate (61), rolling diaphragm (58), piston (57), and nut (55). See Figure 4-6.

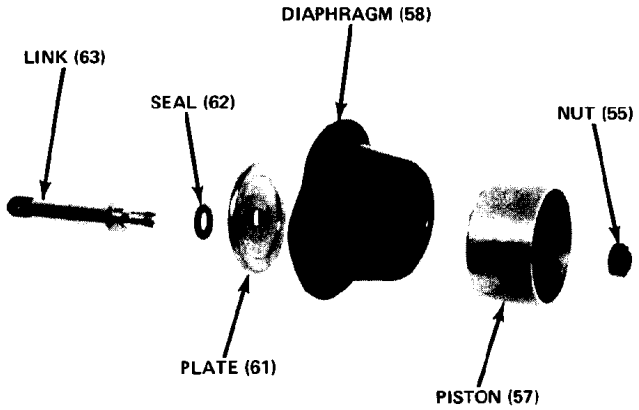

Figure 4-6. Diaphragm and Linkage Assembly

16. Assemble lever (67) to link (63) with pin (65), washer (66), and cotter pin (64). See Figure 4-7.

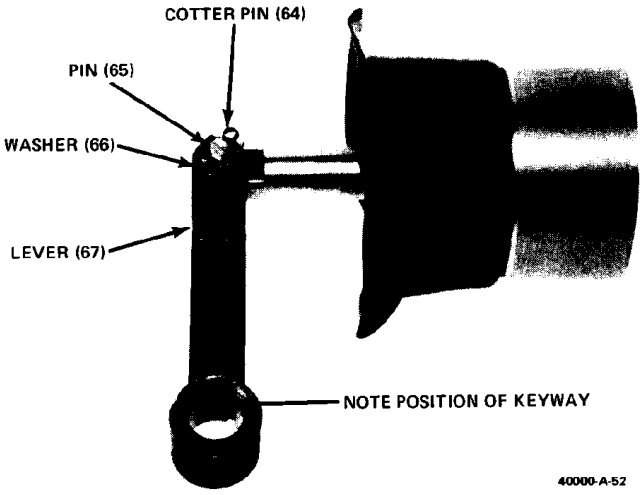

Figure 4-7. Lever to Link Assembly

17. Lubricate rolling diaphragm with Molykote and roll the diaphragm over the piston. Reverse roll the diaphragm (Figure 4-8) and place the diaphragm retainer (56) over the diaphragm (58) with the diaphragm lip flush with the retainer lip. Slide the retainer back and forth on the piston a couple of times, checking the diaphragm to be sure it is not crimped or creased.

18. Place O-ring (60) on diaphragm adapter bushing (59) and install the housing.

19. Refer to Figure 4-7 and insert the rolling diaphragm assembly, noting the position of the keyway for proper assembly.

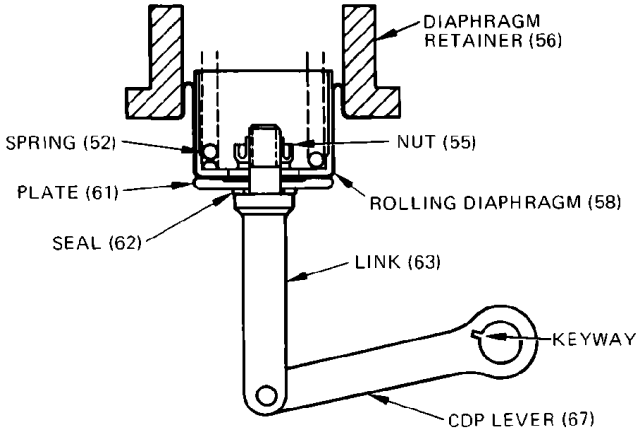

Figure 4-8. CDP Diaphragm Assembly

20. Insert shaft (41), with key (40) in place on the shaft, into the housing. Keyed shaft fits into lever (67).

21. Assemble spring (52), spring seat (53), and steel ball (54). Place them and cover assembly (50) on the diaphragm. Secure the cover with screws (48) and washers (49).

22. Replace set screw (51) if previously removed. Reset to the same height above the cover.

23. Use tool T93668 to seat bearing (39) into retainer (38) until the tool shoulder contacts the retainer shoulder. Seat the bearing with the numbers to the outside. See Figure 4-9.

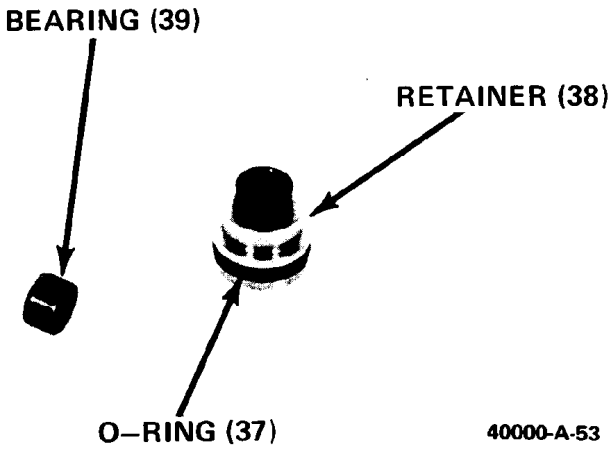

Figure 4-9. Bearing to Retainer Assembly

24. Install bearing retainer (38), O-ring (37), and bearing (39). Secure with two screws (35) and washers (36).

25. Install lever (47) complete with adjustment screws on the end of shaft (41). Secure with set screw (46).

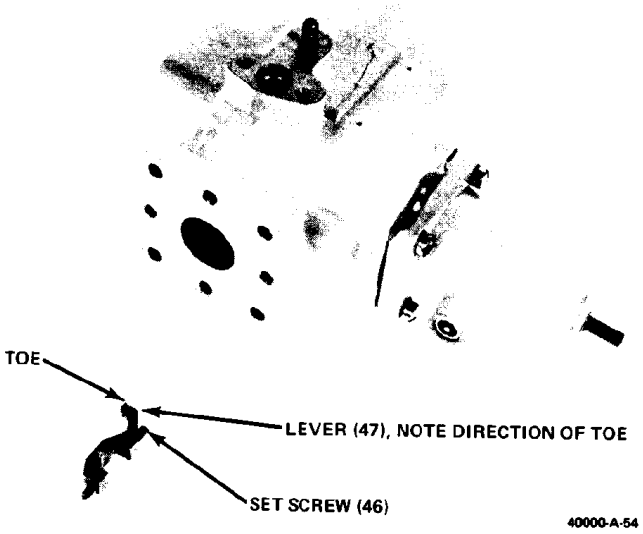

Figure 4-10. Assembly of Adjustable Limiter Lever

IMPORTANT **Insert toe of lever (47) with toe pointing downward, when the valve is setting with the diaphragm on top as shown in Figures 4-10 and 5-1.**

26. Start roll pin (17) into input lever (16). Insert input shaft (12) into housing and at the same time place the input lever (16) into the housing, assembling it on the end of the input shaft. Secure the input shaft with retaining ring (10).

27. Insert fuel metering plunger (22), plunger spring (23), plunger guide (24), and O-ring (25) into the housing. Secure in place with screws (27) and washers (26).

IMPORTANT **Install optional plunger guide (28) and O-ring (29), and secure with screws (27) and washers (26). Insert plunger adjustment screw (30) and O-ring (31) into plunger guide if previously removed (to its previous depth).**

28. Assemble on the governor connecting lever (7), set screws (6), nuts (5), and screw (8) if previously disassembled.

29. Secure governor connecting lever (7) onto input shaft (12) with screw (8).

30. Insert plunger guide (3) and O-ring (4), and secure with screws (1) and washers (2).

31. If previously removed, assemble minimum limiter stop screw (70), seal (73), washer (72), and nut (71), and install to its original position.

32. Install plug (68) and O-ring (69).

33. Install plug (74), if previously removed.

Testing

Test Equipment and Materials

Equipment/Material	Description
Test Fluid (calibrating)	Air
Test Stand	See Special Tools, Fixtures, and Equipment, above
Torque Adapter Wrench	See Special Tools, Fixtures, and Equipment, above
Graph Paper	10 x 10 x 1/2-inch
Lock Wire	MS9226-03
Plastic Protractor	Slotted for 5/16-inch diameter shaft
Hydraulic Power Unit	See Special Tools, Fixtures, and Equipment above

IMPORTANT

Equivalent substitutes may be used for items listed above.

Test Setup

1. Connect the fuel valve/limiter to a test stand as shown in Figure 4-11.

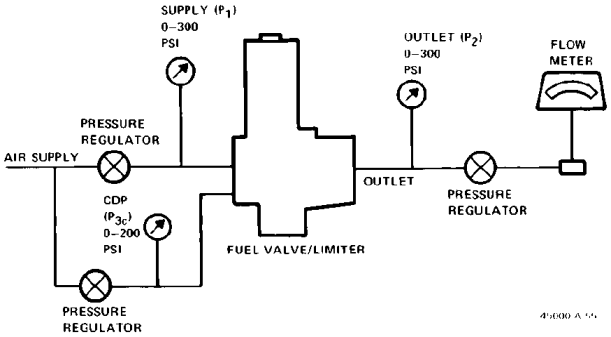

Figure 4-11. Test Hookup for Gaseous Fuel Valve/Limiter

2. Refer to the calibration schedule for the particular valve. Construct a graph using the specified minimum, nominal, and maximum flow rates versus P_{3c} (CDP) similar to that shown in Figure 4-12. This provides a representation of the unit's performance when the actual flow rates are plotted and assists in determining any adjustments which may be required.

IMPORTANT

Calibration schedules are available from Woodward.

3. Make the following preliminary adjustments to the fuel valve/limiter.

IMPORTANT

Omit this step if the unit has not undergone a complete overhaul and leakage check, and if verification of the previous adjustments only is required.

   a. Back out the minimum and maximum fuel adjustment screws 18 (Figure 5-1) to prevent any possibility of interference during adjustment and calibration of limiter section of unit
   b. Back out the limiter minimum stop (start flow) fuel adjustment screw (70) until the shank protrudes approximately 1-1/4 inches (32 mm).

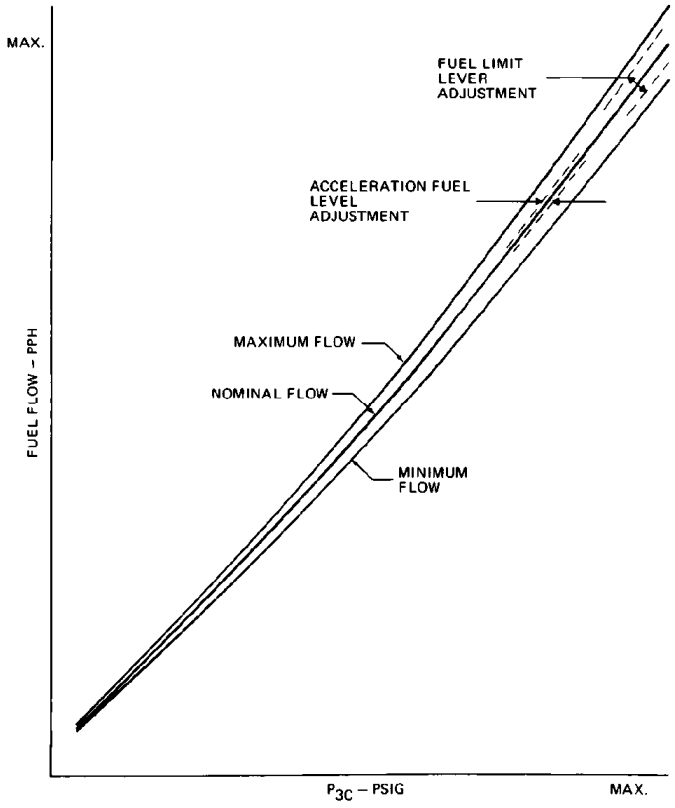

Figure 4-12. Typical Outlet Flow Schedule Graph Showing Effects of the Various Adjustments

Perform the second step of the Adjustment and Calibration Procedures to determine the exact condition or malfunction and extent of repair necessary. All variances from the flow tolerances should be noted for future reference during subsequent testing.

c. If the previous setting (protrusion) of acceleration fuel limit lever adjustment screw (51) was disturbed or is unknown, adjust the screw so that it protrudes approximately 1/2 inch (13 mm).

IMPORTANT **The flow meter must be calibrated for the air with which the test is to be conducted.**

4. Maintain air temperature at 60 °F (16 °C).

Adjustments and Calibration Procedures

WARNING **Take proper safety measures before conducting the test to prevent possible injury.**

IMPORTANT **The position of the throttle shaft during the test is unimportant; however, the shaft must be allowed to move freely.**

1. Check and adjust the outlet flow schedule as follows:
   a. Set the P_{3c} pressure, inlet pressure, and outlet pressure (P_2) specified for the first (low) point given in the calibration schedule.
   b. Adjust acceleration fuel lever adjustment screw (51) as required to obtain the specified nominal outlet flow. Turn the fuel lever adjustment screw counterclockwise to increase outlet flow.
   c. Set the parameters specified for the last (high) point given in the calibration schedule. The outlet flow must be within the specified tolerance range.
   d. If adjustment is necessary, shut down the test stand, and disconnect the inlet line. Remove test fitting from INLET port and plug (74) to gain access to adjustment screws (46) which attach fuel limit lever (47) to shaft (41). Move lever inward (alternately loosening and tightening adjustment screws as required) to increase flow, or outward to decrease flow. This changes the arm of the lever so a greater or lesser movement of the fuel metering plunger (22) occurs for a given angular position of the CDP shaft. This increases or decreases outlet fuel flow accordingly. Replace the plug, reconnect the inlet line, and repeat step (c) above after each adjustment.
   e. Recheck the previous setting, step (a) above. Repeat steps (a) through (d) until no further adjustment is required.

2. Refer to the calibration schedule and run the complete outlet flow schedule, successively regulating P_{3c}, inlet pressure, and P_2 to the specified settings. The in the table below are used as reference only. During actual tests, use the specific calibration schedule for the fuel valve. Plot the actual outlet flow obtained at each setting on the graph and draw a line connecting the points. The line should be near (or on) and reasonably parallel to the previously plotted nominal flow schedule. If further adjustment is necessary or desired, repeat step (1) of Adjustment and Calibration Procedures, then repeat the entire schedule. The fuel limit lever adjustment causes non-linear changes in the outlet flow. In effect, they add or subtract more fuel at the high end of the schedule than at the low end. This will be seen as a change in slope when the flows are plotted on the graph. The acceleration fuel level adjustment causes a linear increase or decrease in fuel flow, the slope remaining basically unchanged.

Calibration Schedule

IMPORTANT **This schedule is for reference only and does not apply to any particular fuel valve.**

P_{3c} (CDP) PSIG (±0.01)	INLET PRESSURE PSIA P_1 (±1.0)	OUTLET PRESSURE (P_2) PSIG (±1.0)	AIR FLOW PPH			NOMINAL GAS FLOW
			MINIMUM	NOMINAL	MAXIMUM	
0	185	16.0	282	352	422	354
10	185	31.2	1671	1759	1847	1770
15	185	41.4	2202	2318	2434	2333
20	185	51.5	2757	2902	3047	2920
25	185	63.2	3398	3576	3755	3599
30	185	78.0	4022	4233	4445	4260
35	185	94.0	4725	4974	5222	5005
40	185	112.0	5391	5675	5959	5750
0 minimum plunger(optional)	185	18.0	561	581	601	585
10 minimum lever	185	19.7	581	601	621	605
0 start	185	19.7	581	601	621	605
45 maximum	185	101.0	5204	5254	5304	5295

Optional Step

Adjust minimum plunger fuel flow as follows:

a. Reduce CDP (P_{3c}) to 0 psig (0 kPa) (ambient).
b. Regulate inlet pressure to (185 psia/1276 kPa) that shown on the calibration schedule.
c. Adjust P_2 to (18 psig/124 kPa) that shown on the calibration schedule.
d. Turn the minimum plunger screw (30 Figure 5-1) clockwise until an outlet flow of (581 ±20 lb/h / 264 ±9 kg/h) that shown on the calibration schedule is obtained. Readjust P_2 as necessary.

3. Adjust minimum acceleration (starting) fuel flow as follows:
   a. Reduce P_{3c} to 0 psig (0 kPa) (ambient).
   b. Regulate inlet pressure to (185 psia/1276 kPa) that shown on the calibration schedule.
   c. Adjust P_2 to (19.7 psig/136 kPa) the outlet pressure for start-up.
   d. Turn the minimum acceleration fuel adjustment screw (70 Figure 5-1) clockwise until a nominal outlet flow (601 ±20 lb/h / 273 ±9 kg/h) per the calibration schedule is obtained. Readjust P_2 as necessary. Lock the screw in the final position with nut (71).

4. Adjust minimum (deceleration) fuel flow as follows:
   a. Increase P_{3c} to 10 psig (69 kPa).
   b. Regulate minimum lever inlet pressure (185 psia/1276 kPa).
   c. Adjust P_2 (to 19.7 psig/136 kPa) per the calibration schedule.
   d. Rotate the throttle shaft towards the decrease fuel direction (counterclockwise facing the shaft) until a flow of 601 ±20 lb/h (273 ±9 kg/h) is obtained. Readjust P_2 as necessary.
   e. Adjust minimum fuel adjustment screw (6) until it just contacts stop pin (15). Lock the screw in the final position with nut (5).

IMPORTANT

If input shaft stop (7) is improperly located so that the minimum fuel flow cannot be obtained or if excessive adjustment of the screw is necessary, reposition the stop on the shaft one or more serrations as required.

5. Adjust maximum fuel flow as follows:
   a. Increase P_{3c} (to 45 psig/310 kPa) to 5 psig (34 kPa) greater than the value shown on the calibration schedule.
   b. Verify that inlet pressure is (185 psia/1276 kPa) per the calibration schedule.
   c. Adjust P_2 (to 101 psig/696 kPa) per the calibration schedule.
   d. Rotate throttle shaft as required to obtain a flow (of 5245 ±50 lb/h / 2379 ±23 kg/h) per the calibration schedule. Readjust P_2 as necessary.
   e. Adjust the maximum fuel adjustment screw (6) until it just contacts the stop pin with 1.7 lb-ft (2.3 N·m) torque applied to throttle shaft using a torque wrench adapter (see Test Equipment and Materials above). Lock the screw in position with nut (5).

6. Check for external leakage as follows:
   a. Fully close back pressure valve.
   b. Regulate P_{3c} (CDP) to 50 psig (345 kPa).
   c. Pressure test the fuel section at 150 psig (1034 kPa) and correct any leaks.
   d. Pressure test the CDP section at 50 psig (345 kPa) for one minute (2 psi/min [14 kPa/min], maximum leakage).
   e. Check that no external leakage occurs. If leakage occurs, shut down the test stand and remove the unit. Disassemble to the extent necessary to determine the cause of the leakage, make any necessary repair or replacement, and retest.

7. Shut down the test stand and remove the fuel valve/limiter assembly.

8, Determine and record the protrusion of the acceleration fuel level and minimum acceleration fuel adjustment screws for future field reference.

9. Lock wire the minimum and maximum fuel adjustment screws (6) to the arm of input shaft stop (7).

Chapter 5.
Replacement Parts

Introduction

When ordering replacement parts, it is essential to include the following information:

- Fuel Valve/Limiter serial number and model number shown on nameplate
- Manual number (this is manual 40100)
- Parts reference number in parts list and description of part or part name

The illustrated parts breakdown (Figure 5-1) Illustrates and lists all the replaceable parts for the 1907 Gaseous Fuel Valve/Limiter. The numbers assigned are used as reference numbers and are not specific Woodward part numbers. Woodward will determine the exact part number for your particular fuel valve/limiter.

Ref. No.	Part Name	Quantity
40100-1	Fil. hd. dr. screw 10-32 x 5.00	2
40100-2	Washer 0.600 OD	2
40100-3	Plunger guide	1
40100-4	O-ring 0.103 x 0.693 OD	1
40100-5	Gas valve lever	1
40100-6	Fil. hd. dr. screw 10-32 x 0.750	1
40100-7	Governor connecting lever	1
40100-8	Fil. hd. screw	1
40100-9	Retaining ring	1
40100-10	Retaining ring 0.339 OD	1
40100-11	Bearing	1
40100-12	Input shaft	1
40100-13	O-ring 0.070 x 0.629 OD	1
40100-14	Needle bearing	1
40100-15	Straight pin 0.2515 x 1.000	1
40100-16	Input lever	1
40100-17	Roll pin 0.094 dia. x 0.500	1
40100-18	Orifice cup	1
40100-19	Beveled retaining ring 1.413 OD	1
40100-20	Orifice cup	1
40100-21	Retaining ring	1
40100-22	Metering valve plunger	1
40100-23	Plunger loading spring assembly	1
40100-24	Plunger guide	1
40100-25	O-ring 0.103 x 1.505 OD	1
40100-26	Washer 0.600 OD	4
40100-27	Fil. hd. dr. screw 10-32 x 0.500	4
40100-28	Plunger guide (optional)	1
40100-29	O-ring 0.103 x 1.505 OD (optional)	1
40100-30	Screw (optional)	1
40100-31	O-ring 0070 x 0.441 OD (optional)	1
40100-32	Gas valve housing assembly	1
40100-33	Dr. screw #0 x 0.187	2
40100-34	Nameplate	1
40100-35	Fil. hd. dr. screw 10-32 x 0.500	2
40100-36	Washer 0.600 OD	2
40100-37	O-ring 0.103 x 0.737 ID	1
40100-38	Bearing retainer	1
40100-39	Needle bearing	1
40100-40	Woodruff key	1
40100-41	Shaft	1
40100-42	Spacer	1
40100-43	O-ring 0.103 x 0.568 OD	1
40100-44	Channel seal	1
40100-45	Needle bearing	1
40100-46	Slope adjustment screws	2
40100-47	Adjustable fuel limiter lever	1
40100-48	Fil. hd. dr. screw 0.250-28 x 1.00	4
40100-49	Washer	4
40100-50	CDP spring cover assembly	1
40100-51	Accel. fuel lim. adj. screw, 0.312-24	1
40100-52	CDP spring	1
40100-53	CDP spring seat	1
40100-54	Steel ball 5/16 inch	1
40100-55	Kaylock nut 0.250-28	1
40100-56	Diaphragm retainer	1
40100-57	Piston	1
40100-58	Rolling diaphragm	1
40100-59	Diaphragm adapter bushing	1
40100-60	O-ring 0.103 x 1.755 OD	1
40100-61	Diaphragm clamp plate	1
40100-62	Statoseal seal 0.245 ID	1
40100-63	Link	1
40100-64	Cotter pin 1/16 x 0.375	1
40100-65	Headed pin	1
40100-66	Washer 0360 OD x 0.215 ID x 0.031	1
40100-67	CDP lever	1
40100-68	#4 DL plug	1
40100-68	O-ring	1
40100-70	Limiter min. stop adjustment screw	1
40100-71	Hex head nut	1
40100-72	Washer 0.500 OD	1
40100-73	Seal	1
40100-74	Pipe plug 1/8	1
40100-75	Torsion spring (optional)	1
40100-76	Spring seat collar (optional)	1
40100-77	Plunger loading spring assy. (opt.)	1

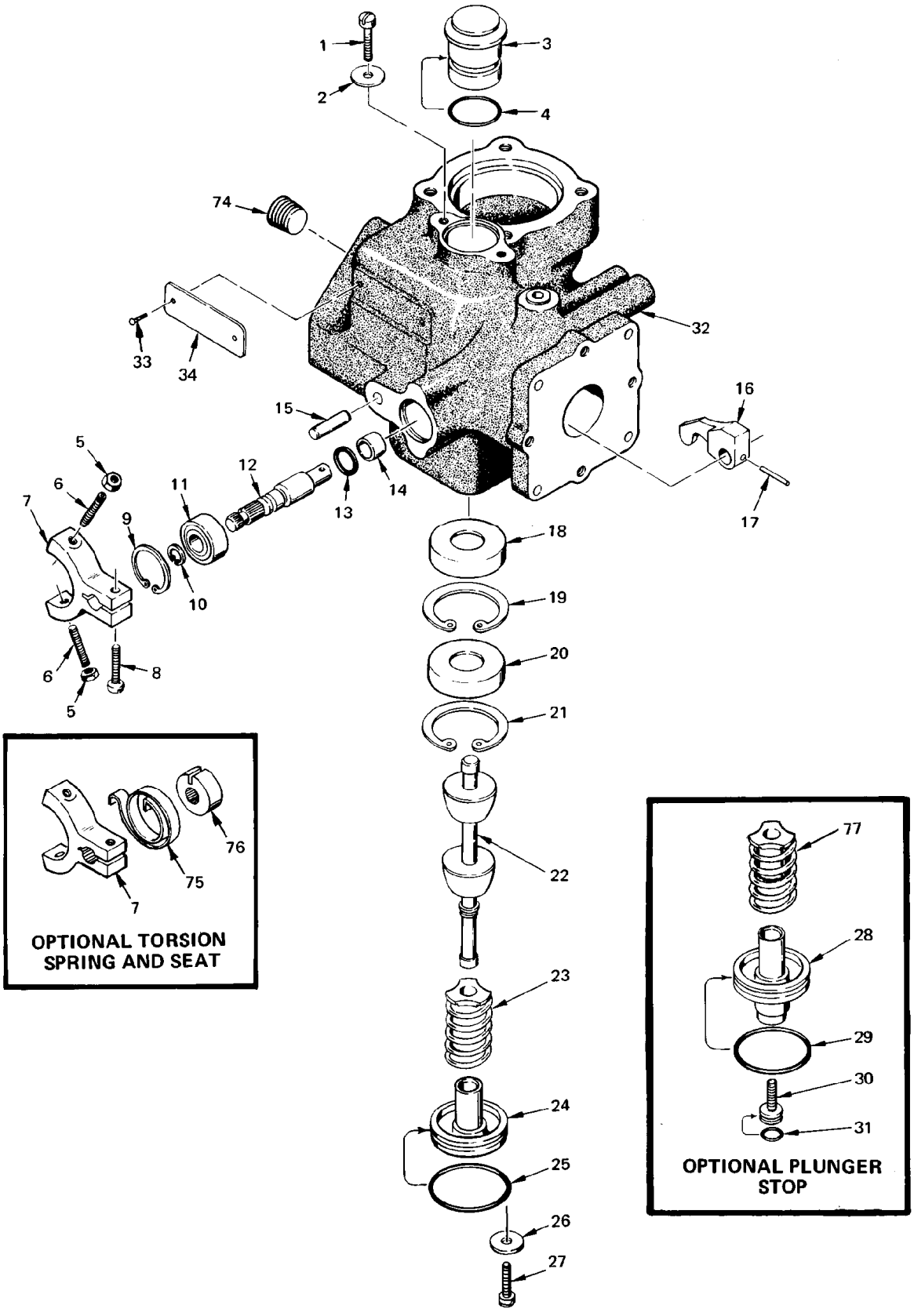

Figure 5-1a. Exploded View of Gaseous Fuel Valve/Limiter (sheet 1 of 2)

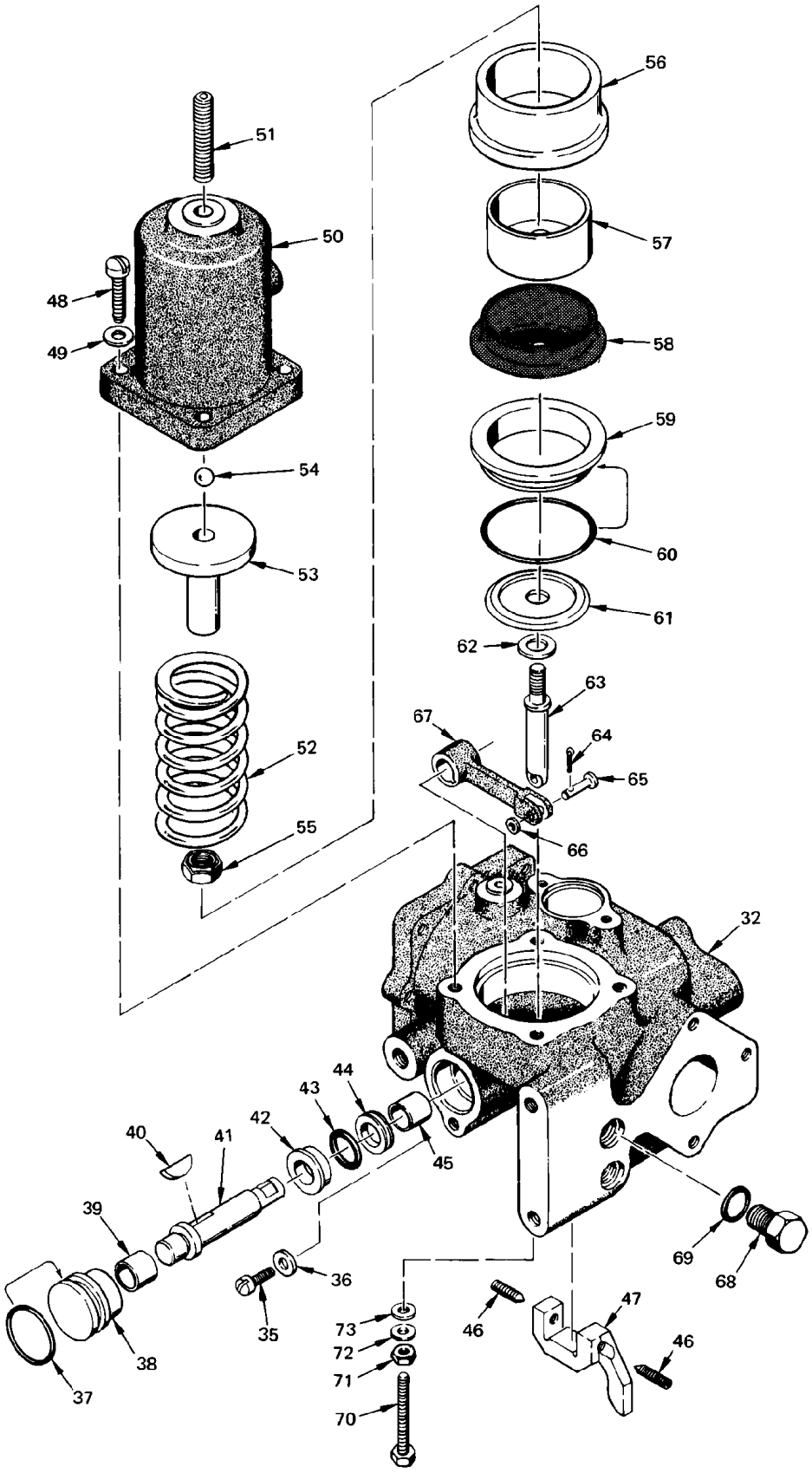

Figure 5-1b. Exploded View of Gaseous Fuel Valve/Limiter (sheet 2 of 2)

Chapter 6.
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 40100A.

B40100:A

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Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

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

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

2013/1/Colorado