EO 15-65BB-2

ROYAL CANADIAN AIR FORCE

# DESCRIPTION AND MAINTENANCE INSTRUCTIONS

# AIRBORNE $CO_2$ FIRE EXTINGUISHER SYSTEM

**This EO replaces Interim Publication**



ISSUED ON AUTHORITY OF THE CHIEF OF THE AIR STAFF

RCAF Reprint of
USAF TO 03-45CA-1

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## FOREWORD

Every effort has been made to review the contents of this EO before reproduction to ensure that it meets RCAF Standards so that technicians may derive from it the information necessary to maintain and service this equipment.

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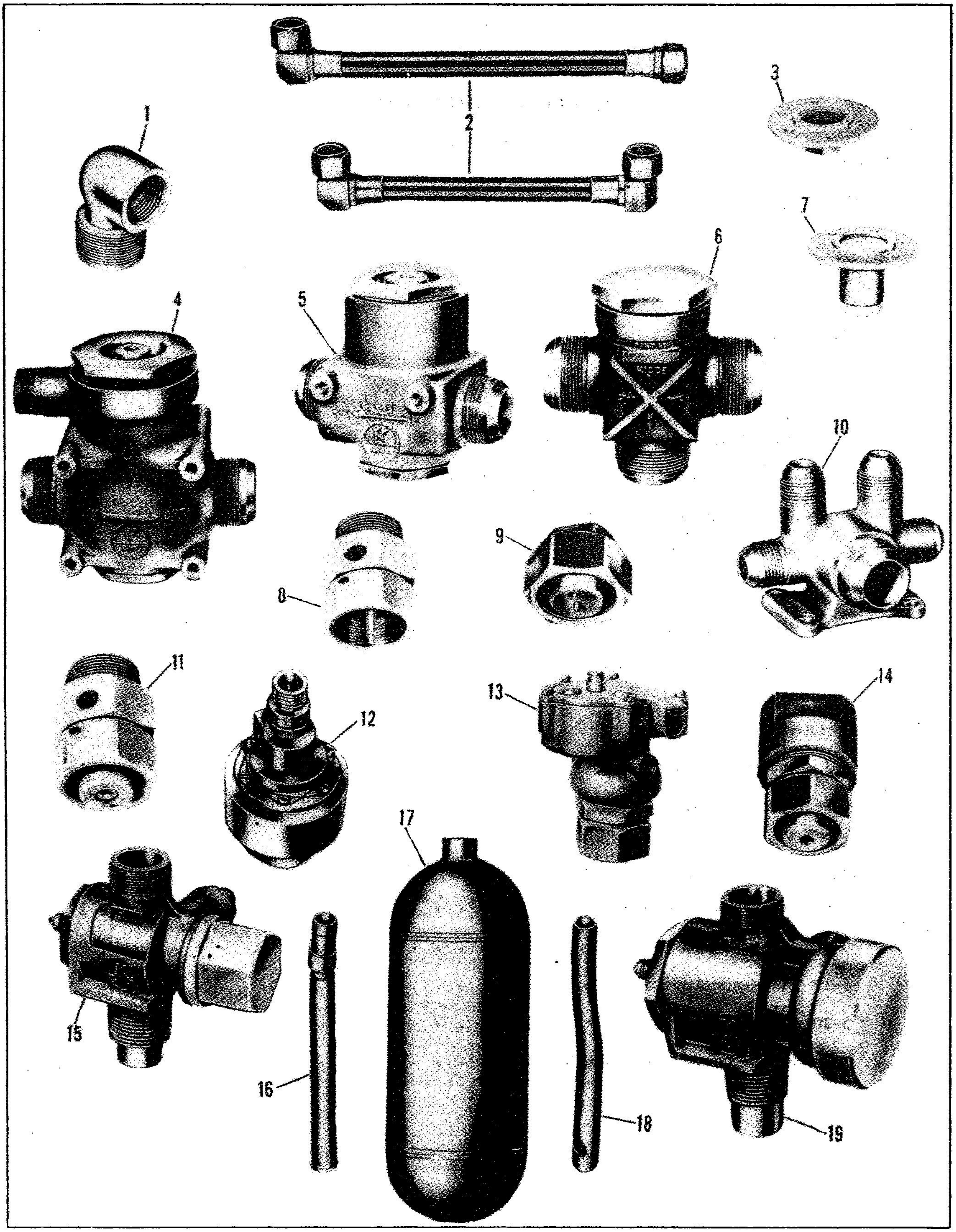
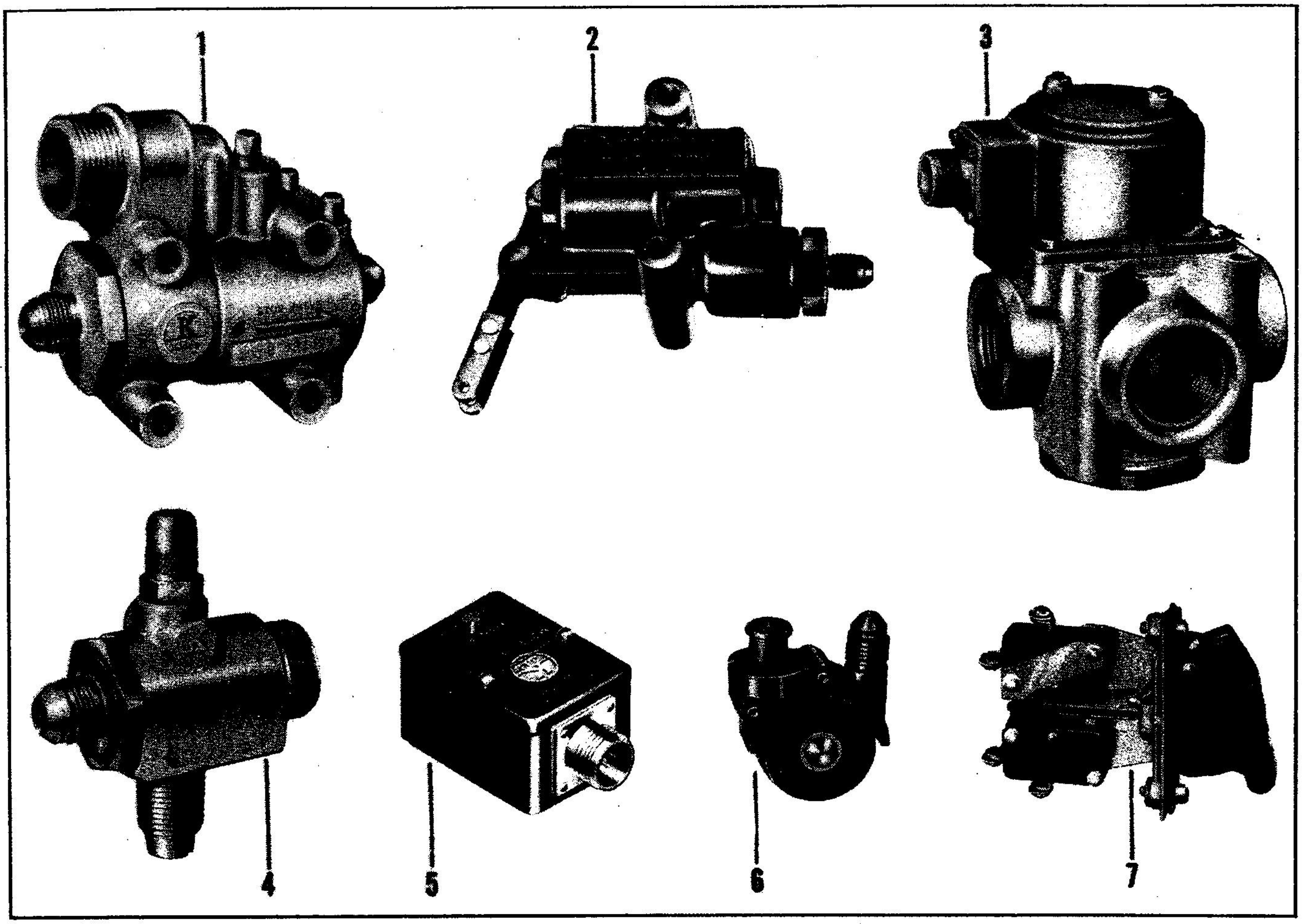



*Figure 1–1—Equipment for Aircraft Carbon Dioxide Fire Extinguishing System Installations*




1. One-Half Inch Stop Valve
2. Pilot Cable Control
3. Two-Way Direction Valve
4. One-Half Inch Flood Valve
5. Pressure Switch
6. Adjustable Swivel Pulley
7. Sequence Switch

***Figure 1–2—Equipment for Aircraft Carbon Dioxide Fire Extinguishing System Installations***

**KEY TO FIGURE 1-1**

1. Elbow
2. Flexible Hose
3. Outboard Discharge Indicator
4. Solenoid Operated Stop Valve
5. Pressure Operated Stop Valve
6. Double Check Tee
7. Inboard Discharge Indicator
8. Interconnector, New Type
9. Pressure Control Head
10. Header
11. Interconnector, Old Type
12. Solenoid Control Head
13. Series Cable Control Head
14. Pressure Piston Control Head
15. Three-Quarter Inch Flood Valve
16. Flexible Syphon Tube
17. Non-Shatterable Carbon Dioxide Cylinder
18. Rigid Syphon Tube
19. One-Inch Flood Valve

# SECTION I
# INTRODUCTION

1–1. IDENTIFICATION. This manual contains descriptive data and instructions on Operation and Maintenance of the Kidde Aircraft Fire Extinguisher, Carbon Dioxide Type, Fixed Installation, ½-inch, ¾-inch, and 1-inch Valve Types, manufactured by the Walter Kidde & Company, Inc., Belleville, New Jersey. The installations referred to are the Single-Shot and the Main and Reserve Systems.

1–2. REFERENCES. The following Technical Orders, containing pertinent data and instructions may be used for reference:

| | |
|---|---|
| T.O. 06-20-3 | $CO_2$ Cylinders—Maintenance and Inspection |
| T.O. 03-45-1 | Fire Extinguishers and Related Equipment—Charging of $CO_2$ Cylinders for Extreme Temperature Operation. |

# SECTION II
# DESCRIPTION

**2–1. GENERAL.** *(See figure 1–1.)*

2–2. The Single-Shot and the Main and Reserve fire extinguishing systems, electrically operated, afford a means of control of fires occurring in engine installations. The system is controlled by an electrical switch mounted in the cabin. Closing the switch for the engine afire causes the solenoids to operate the cylinder flood valves of the "master" or control cylinders and also operates the proper solenoid stop valve installed in the discharge line. The carbon dioxide, under pressure, floods the engine area, cooling and choking out any fire present in the engine or its mounted accessories.

2–3. When the "master" or control cylinders have operated, the released gas pressure from these cylinders is conducted to the pressure control heads on the remaining cylinders, releasing their contents.

2–4. The contents of all the cylinders passes through a master manifold. From this manifold, one or two lines run to each engine. When one line is used, a solenoid operated stop valve is installed in the discharge line between the gas supply and the engine protected. When two lines are used, the solenoid operated stop valve is installed in one line and a pressure operated stop valve, which is operated by the released gas pressure from the solenoid operated stop valve, is installed in the other line. This makes available the full charge of all cylinders to put out a fire in any selected engine.

2–4A. Series cable control heads are used in the manually operated systems. A control handle is attached to a cable leading to the series cable control head. Pulling on the control handle causes the series cable control head to operate the flood valves of the "master" cylinders and release carbon dioxide. The released carbon dioxide operates the pressure control heads of the remaining cylinders and the contents of all the cylinders are released.

2–5. When the pressure of the carbon dioxide becomes excessive due to high temperature a safety disc ruptures in the flood valve affected. The released gas is conveyed by tubing outboard, where a red indicating disc, which is installed in the skin of the airplane, is blown out of its housing, thereby indicating loss of gas. If this occurs, one or more cylinders have been discharged, necessitating replacement.

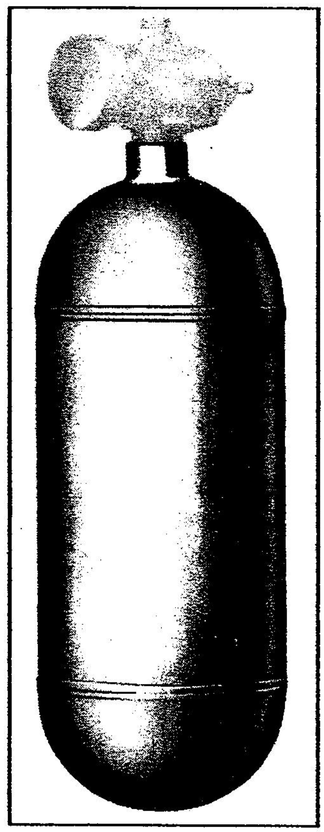


*Figure 2–1—Non-Shatterable Carbon Dioxide Cylinder*

**2–6. DETAILED.**

2–7. CYLINDERS. *(See figure 2–1.)* The cylinders are made of steel and are wire wound to prevent shattering if hit by gunfire or otherwise. All cylinders marked with a yellow dot ¾ inch or more in diameter are charged with 200 psi of nitrogen at 70° F (21.1° C) plus the proper carbon dioxide charge. The purpose of the nitrogen is to force out the liquid carbon dioxide at such extremely low temperatures as may be encountered at high altitudes, when the pressure of the carbon dioxide itself would be too low for efficiency. A syphon tube extends from the flood valve to the bottom of the cylinder.

2–8. FLOOD VALVFS.

2–9. ¾-INCH TYPE. *(See figure 2–3.)* The body of the ¾-inch flood valve is an aluminum forging. The carbon dioxide is retained in the cylinder by the pilot check (1) and the main check (2). When the pilot check is depressed by the solenoid, pressure is conducted through gas passages (3) in the body and piston cap to the head of the piston (4), which opens the main check (2). At the same time, pressure is conducted through the interconnector (figure 2–7), the pressure tubing and the pressure control heads (figure 2–11) to the heads of the pistons of the other flood valves. A pilot check pin (5) is provided to prevent the pilot check (1) from falling out

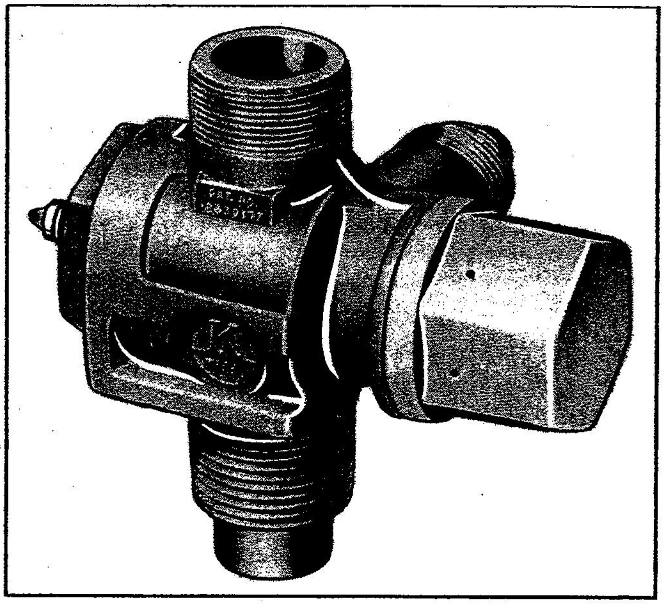
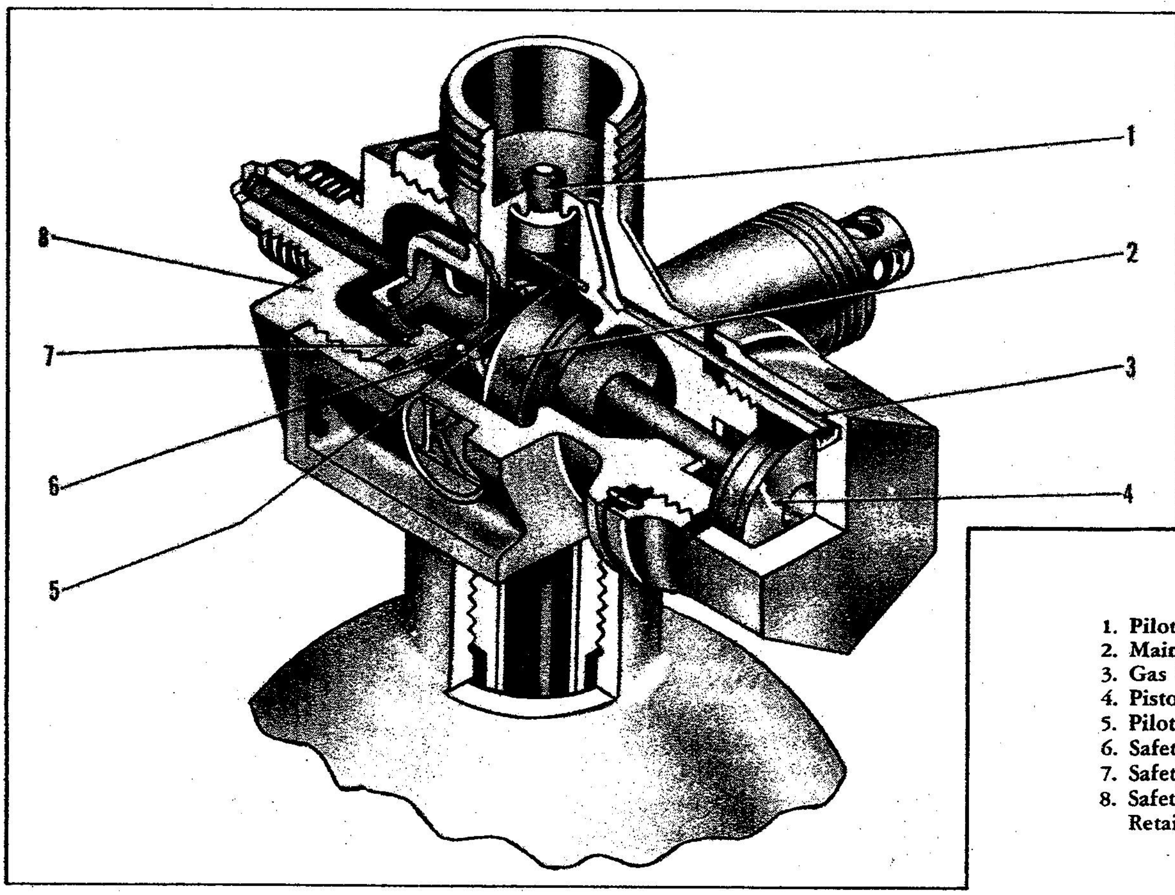


*Figure 2–2—Three-Quarter Inch Flood Valve*




1. Pilot Check
2. Main Check
3. Gas Passages
4. Piston
5. Pilot Check Pin
6. Safety Disc
7. Safety Disc Plug
8. Safety Disc Plug Retainer

*Figure 2–3—Cutaway View, Three-Quarter Inch Flood Valve*

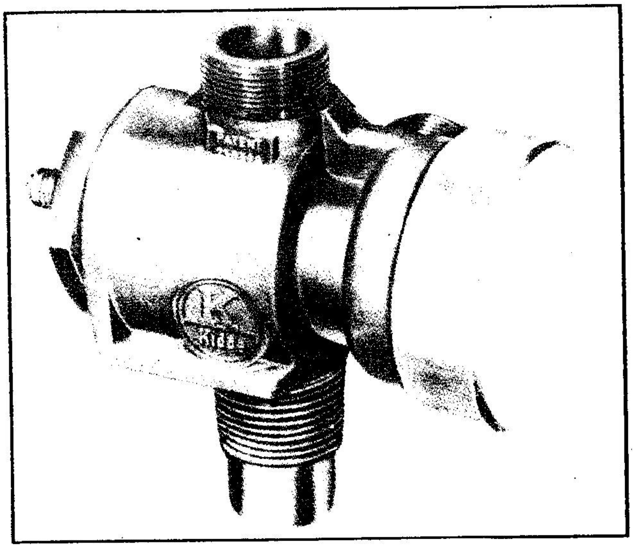
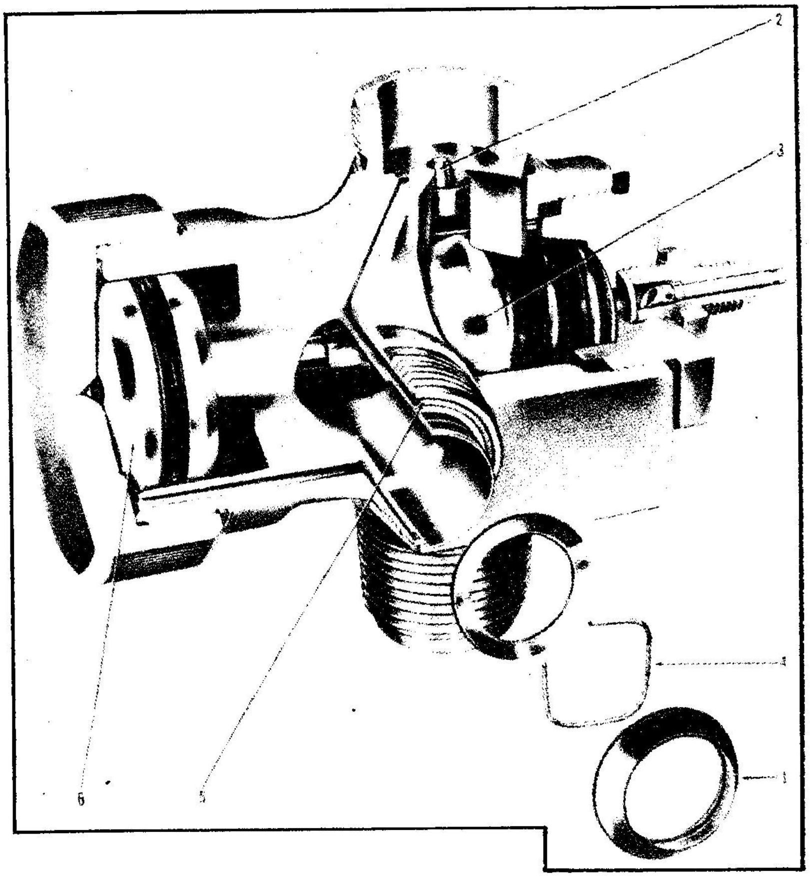


**Figure 2-4—One-Inch Flood Valve**

of position when the cylinder is discharged, or from falling into the cylinder when the valve is disassembled. The flood valve is equipped with a safety disc (6) held in position by a safety disc plug (7). At excessive pressure this disc ruptures, discharging the cylinder's contents through the outboard coupling end of the safety disc plug retainer (8).

2-10. 1-INCH TYPE. *(See figure 2-5.)* The 1-inch type flood valve is essentially the same as the ¾-inch type. However, on the 1-inch type, if the proper AN tubing has not been securely drawn up to the valve outlet, or if no tubing has been connected to the valve outlet operation of the valve is prevented by a safety feature built into the valve. This safety feature consists of a floating nosepiece (1), a nosepiece spring (4), and a channel (5) at the valve outlet and permits venting to the atmosphere of the released gas pressure from the pilot check (2). This action, by interrupting the gas flow to the piston (6) prevents the functioning of the main check (3) of the valve.




1. Nosepiece
2. Pilot Check
3. Main Check
4. Nosepiece Spring
5. Channel
6. Piston

**Figure 2-5—Cutaway View, One-Inch Flood Valve**

2-10A. ONE-HALF INCH TYPE. *(See figure 2-5B.)* The ½-inch type flood valve can be operated by an electrical, manual, or pressure operated control head. When the control head, which is assembled to the valve, unseats the check and retainer (12), gas pressure behind the valve check (1) is vented to the atmosphere and the valve check is unseated by the gas pressure within the cylinder. When this occurs, the full charge of carbon dioxide is discharged through the valve outlet (6). A safety disc (2) permits the gas to escape from the cylinder when the pressure becomes excessive because of high temperatures.

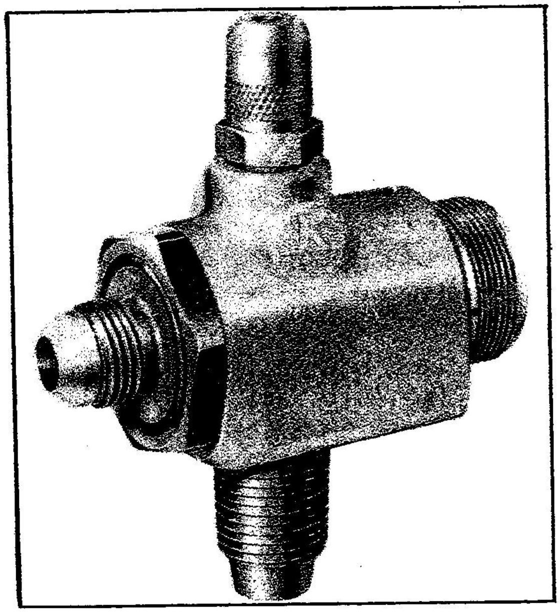
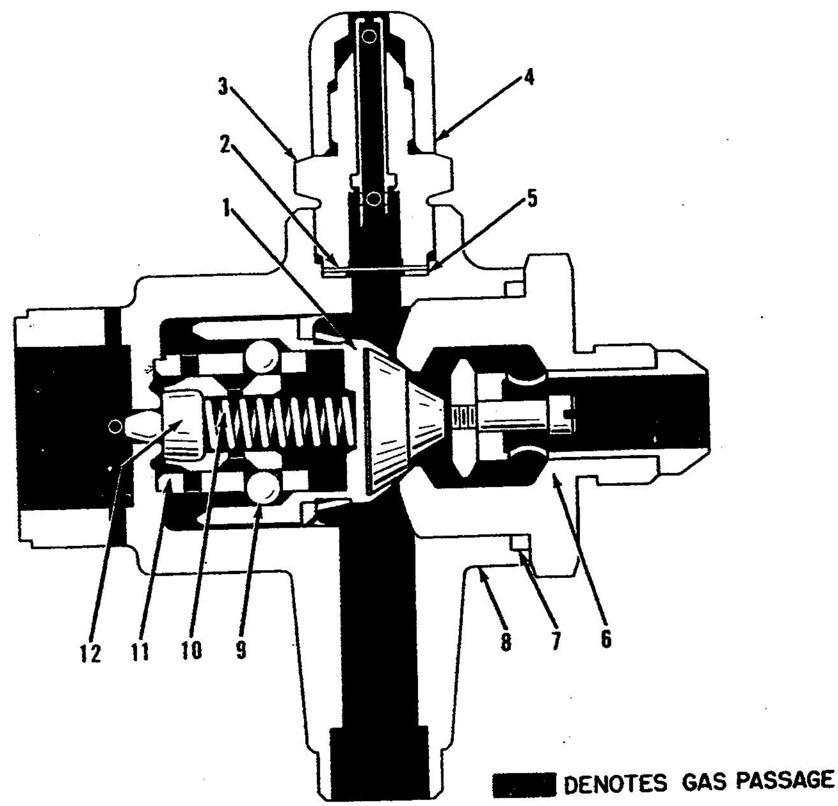


Figure 2-5A—One-Half Inch Flood Valve




1. Valve Check
2. Safety Disc
3. Safety Disc Retainer
4. Cap
5. Safety Disc Washer
6. Outlet
7. Gasket
8. Valve Body
9. Ball
10. Spring
11. Ball Housing
12. Check and Retainer Assembly

Figure 2-5B—One-Half Inch Flood Valve Components

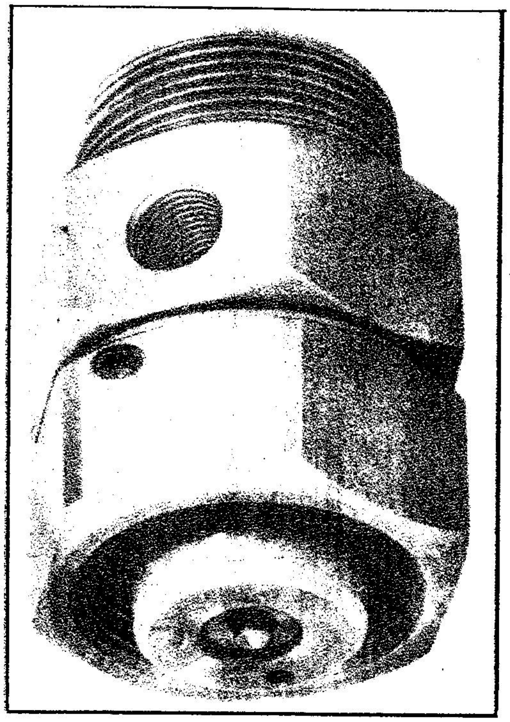


*Figure 2-6—Interconnector, Old Type*

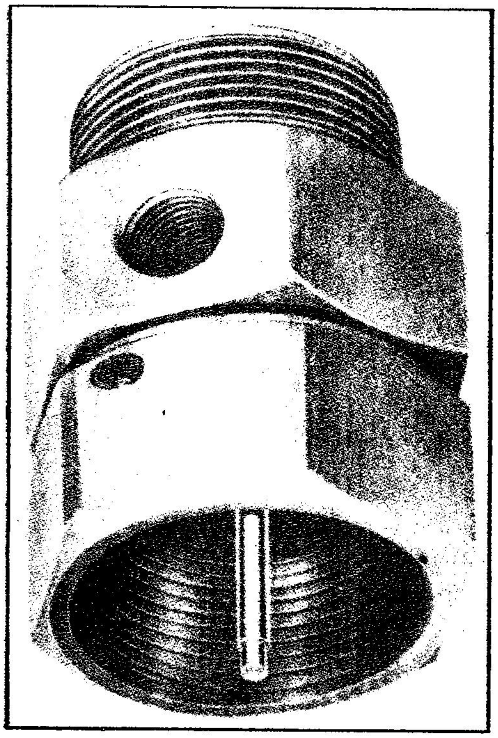
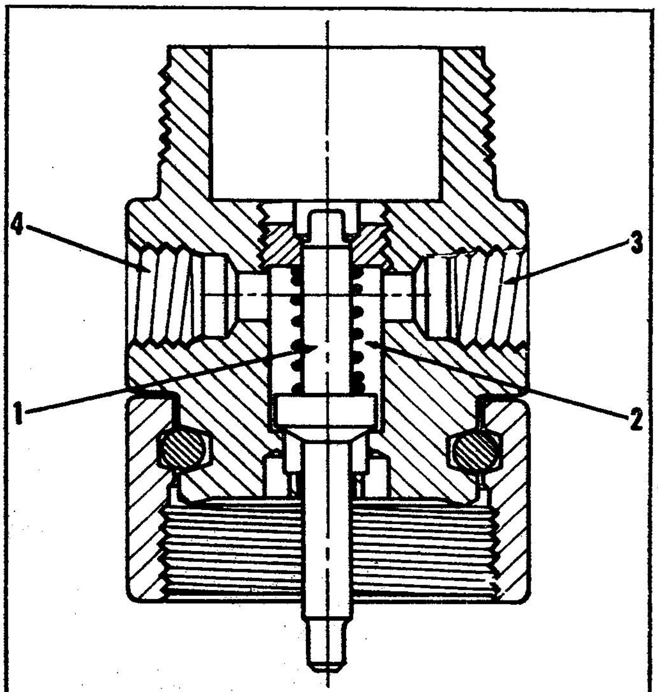


*Figure 2-7—Interconnector, New Type*

2-11. INTERCONNECTORS. *(See figure 2-8.)* The gas interconnector is mounted on the control head outlet of a flood valve and transmits the operation of an electrical or mechanical control head, which is mounted on top of the interconnector. In operation, the plunger within the control head advances, depressing a similar plunger (1) within the interconnector, which, in turn, unseats the pilot check of the flood valve, thus initiating discharge of the carbon dioxide gas. A gas passage (2) in the interconnector conducts gas from the flood valve's control head outlet to a pair of outlet ports (3 and 4). The gas is conveyed by tubing from these ports to the pressure operated cylinders in the bank. The interconnector will also operate the cylinder valve independently of the control head when gas enters either port.




1. Plunger
2. Gas Passage
3. Outlet Port
4. Outlet Port

*Figure 2-8—Cutaway View, Interconnector*

2-12. CONTROL HEADS.

2-13. SOLENOID CONTROL HEAD. *(See figure 2-10.)* The solenoid control head affords a means of electrically operating a flood valve or a stop valve from a remote location. When the solenoid is energized, the solenoid plunger advances and actuates the flood valve. Closing the switch in the airplane cabin energizes the coil (1) of the solenoid, causing a plunger assembly (2) to move forward and depress the pilot check through the plunger of the interconnector. The solenoid control head consists of a machined shell (3). Into this is cemented an electrical coil held in place by a ring assembly (4). The wire from the coil runs to an electrical connector (5), which in turn connects to a plug and line running to the control switch. The plunger assembly consists of a cylindrical steel plunger and a plunger rod. The free end of the rod passes through the central hole in the shell passage (6), then through the packing washer (7) and packing retainer (8) with a soft, molded packing (9) between them. When the coil is energized, the plunger is drawn forward, moving the rod through the packing retainer (8) to actuate the valve or interconnector to which it is attached by its mounting nut (10).

2-13A. SERIES CABLE CONTROL HEAD. *(See figure 2-10B.)* The manually operated series cable control head affords a means of operating the flood valves from a remote position. A sheave (9) at the top of the control head has a cable clamp (6) for attaching the cable which actuates the system. The sheave (9) is pinned to a shaft (7) which extends through it. The lower end of the shaft rests in a hole drilled through the case (4). Secured in the sheave is a friction catch (8) which fits into the depressions inside the cover and serves to lock the sheave in the open or closed position. Rotation of the sheave by the control cable (5) causes

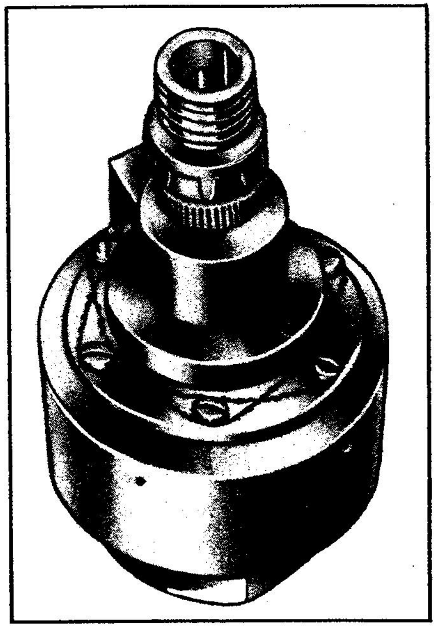


*Figure 2-9—Solenoid Control Head*

1. Coil
2. Plunger Assembly
3. Shell
4. Ring Assembly
5. Electrical Connector
6. Shell Passage
7. Packing Washer
8. Packing Retainer
9. Packing
10. Mounting Nut

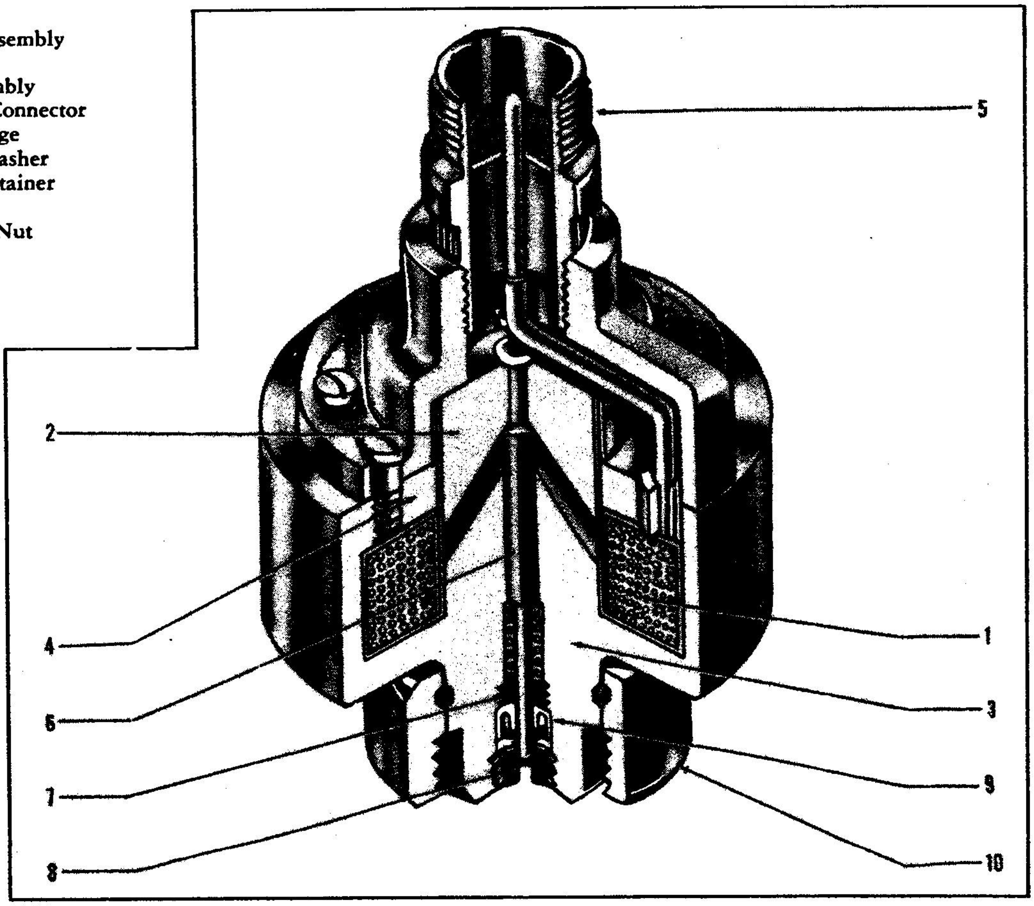



*Figure 2-10—Cutaway View, Solenoid Control Head*

the cam surface to depress the pressure plate (10) and in turn the plunger (3) which forces the piston assembly (12) downwards, and actuates the flood valve of the "master" cylinder permitting discharge of the gas from the valve. At the same time, a portion of the discharged gas escapes around the check of the flood valve to the hollow passage in the piston stem (13). The gas passes through the piston stem and the holes in the piston to the outlet (11) which is connected by means of tubing to the pressure control cylinders. A ball check (2) in the head of the piston prevents the back flow of gas.

2-14. PRESSURE CONTROL HEADS.

2-15. MODELS 30411 and 966679. *(See figure 2-12.)* The pressure type control head assemblies screw on those flood valves not operated by the solenoid control head. They are connected by means of tubing with the interconnectors of the "master" or control cylinders whose released pressure is conducted through the pressure control heads and operates the flood valves to which they have been assembled. A ball check valve prevents loss of the gas if the control head has not been assembled to a flood valve. The unit consists of a plunger (1), an aluminum body (2), a mounting nut (3), and a ball check (4).

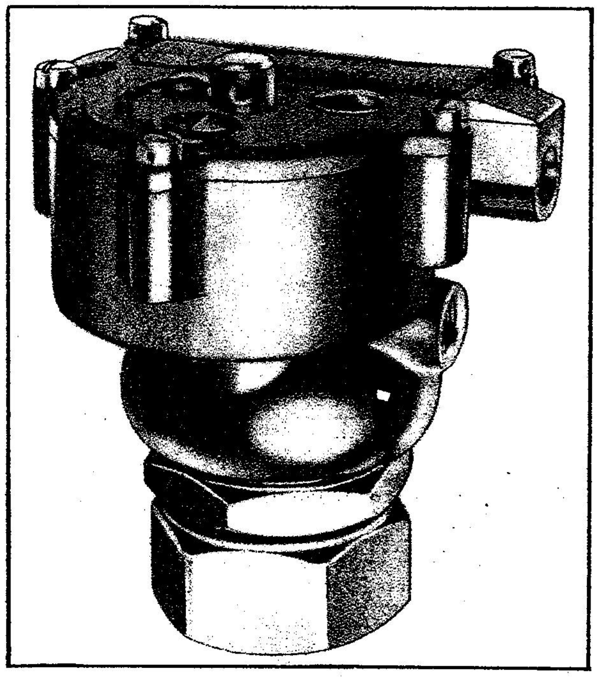
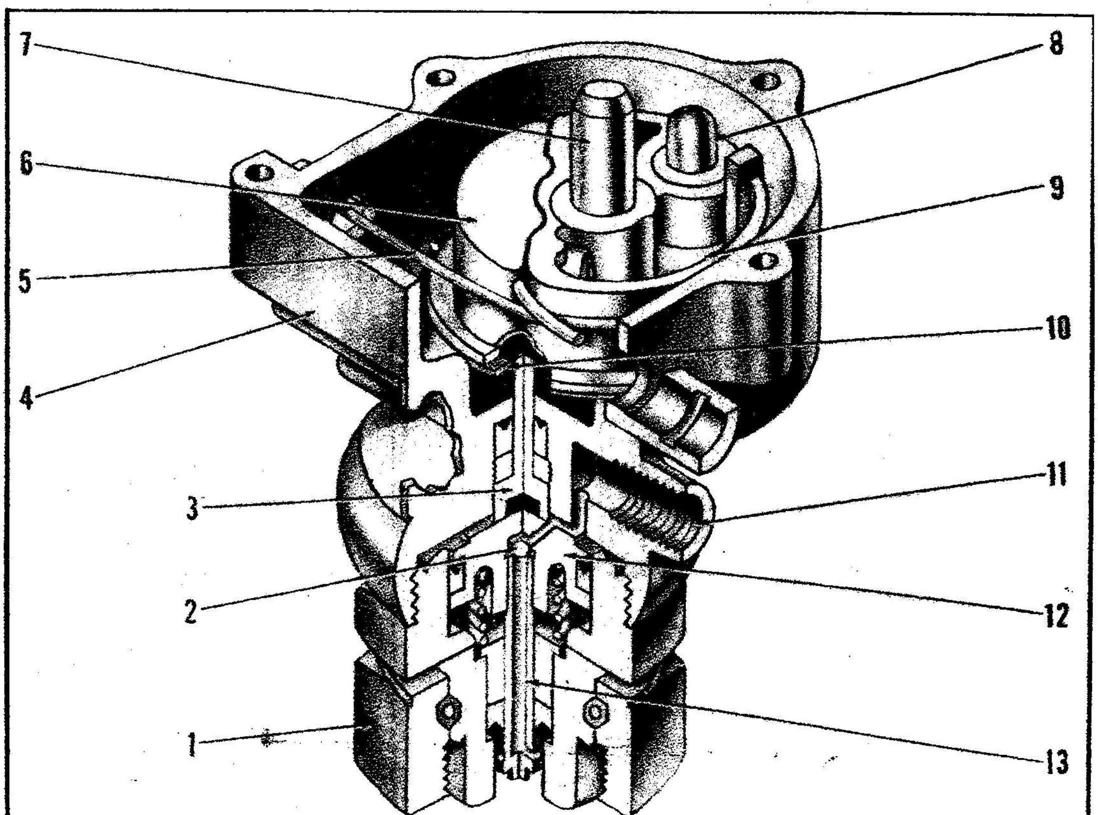


*Figure 2-10A—Series Cable Control Head*




1. Body assembly
2. Ball check
3. Plunger
4. Case
5. Control cable
6. Cable clamp
7. Shaft
8. Friction catch
9. Sheave
10. Pressure plate
11. Outlet
12. Piston assembly
13. Piston stem

*Figure 2-10B—Cutaway View, Series Cable Control Head*

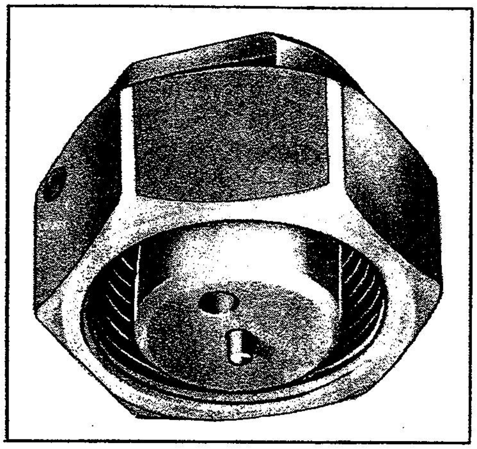


*Figure 2-11—Pressure Control Head, Part No. 966679*

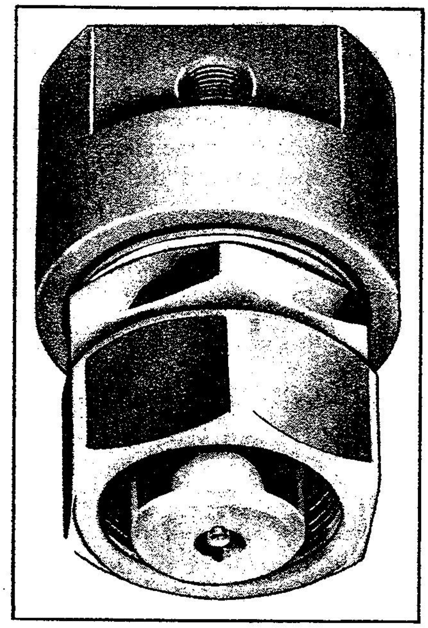


*Figure 2-13—Pressure Piston Control Head*

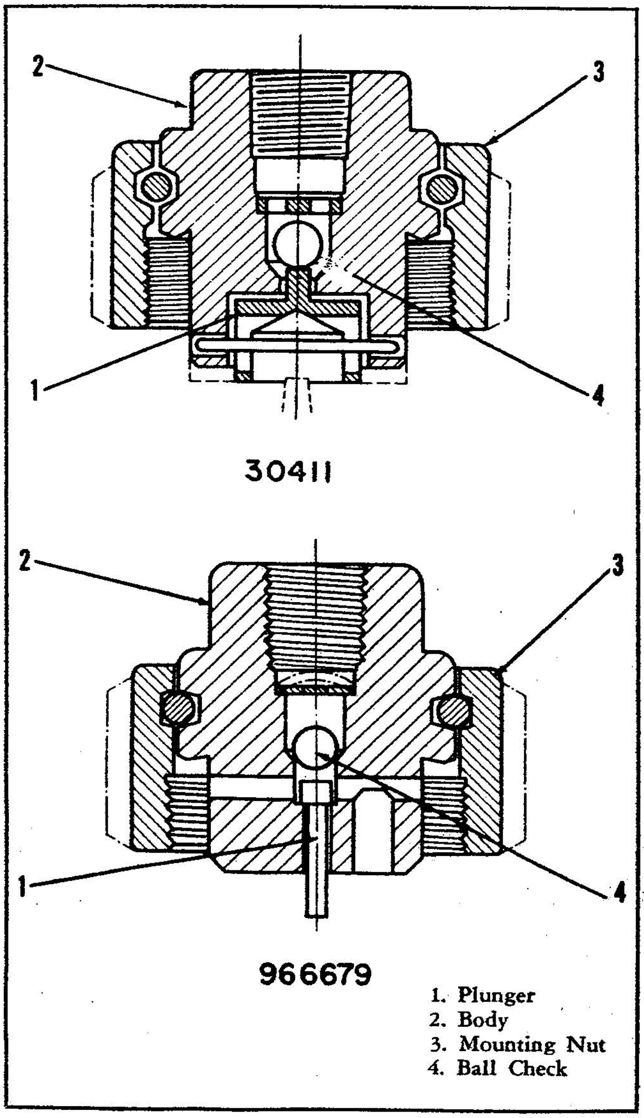



*Figure 2-12—Cutaway Views, Pressure Control Heads, Part Nos. 30411 and 966679*

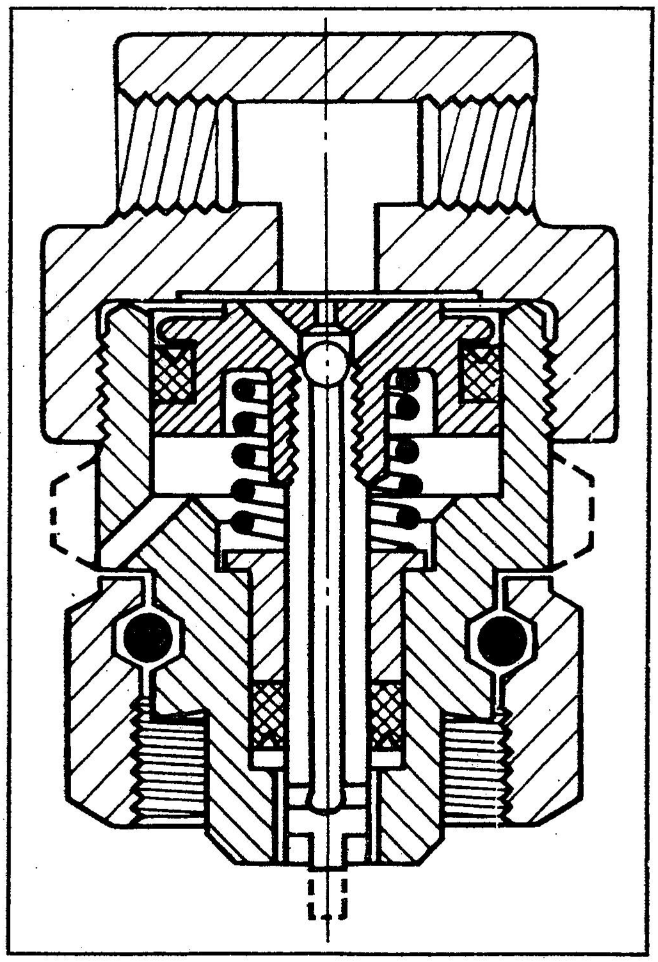


*Figure 2-14—Cutaway View, Pressure Piston Control Head*

2–16. PRESSURE PISTON CONTROL HEAD. *(See figure 2–14.)* This type control head has the same function as the models described in paragraph 2–15. The difference is in the method of operation. With this pressure piston type control head there is no drop in operating pressure from the "master" or control cylinders. The models described in paragraph 2–15 transmit the gas itself to the flood valves.

2–17. STOP VALVES.

2–18. SOLENOID OPERATED STOP VALVE. *(See figure 2–16.)* The solenoid operated stop valve is installed in carbon dioxide discharge lines to control the passage of carbon dioxide to a desired engine or to any other fire hazard in the airplane. On the average installation, one stop valve is installed in the discharge line leading to each engine. The valve is equipped with a solenoid which is attached to the control head outlet of the valve body. A switch in the cabin or any other suitable place in the airplane, controls the solenoid which in turn operates the stop valve. Upon operation of the system, the discharged carbon dioxide fills the supply tubing up to each stop valve. When the desired control head is operated, the check within the valve is unseated, allowing the full discharge of carbon dioxide to pass through the stop valve to the desired engine.

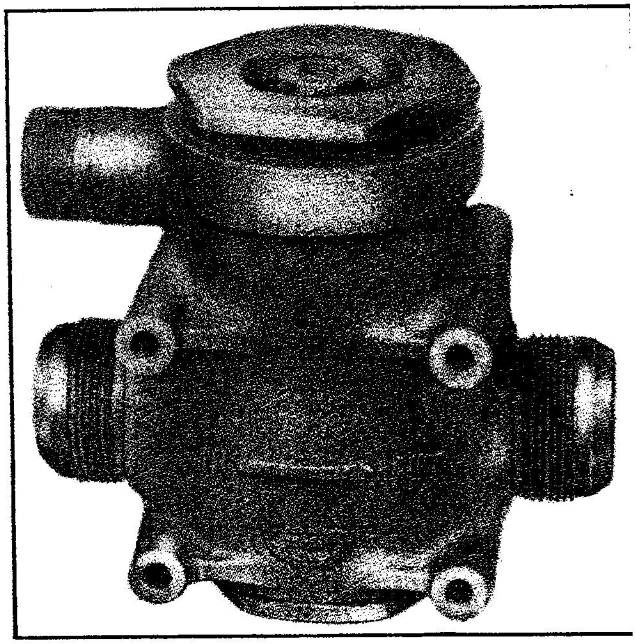


*Figure 2–15—Solenoid Operated Stop Valve*

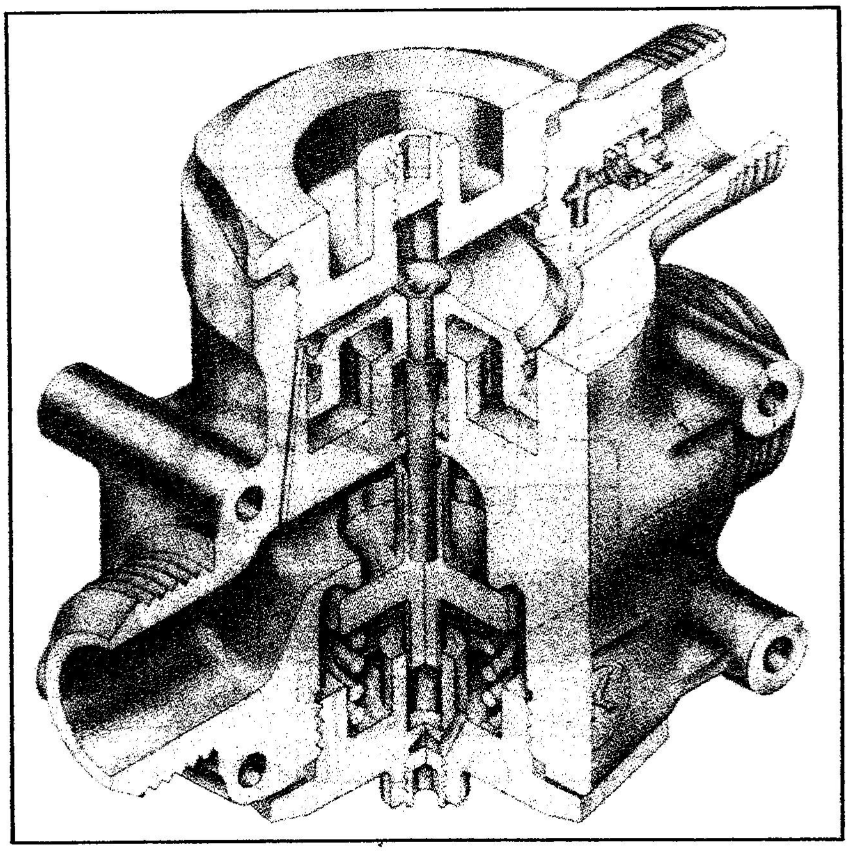


*Figure 2–16—Cutaway View, Solenoid Operated Stop Valve*

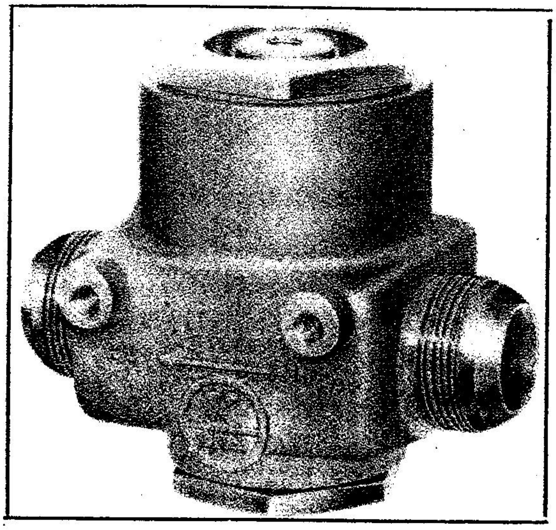


*Figure 2–17—Pressure Operated Stop Valve*

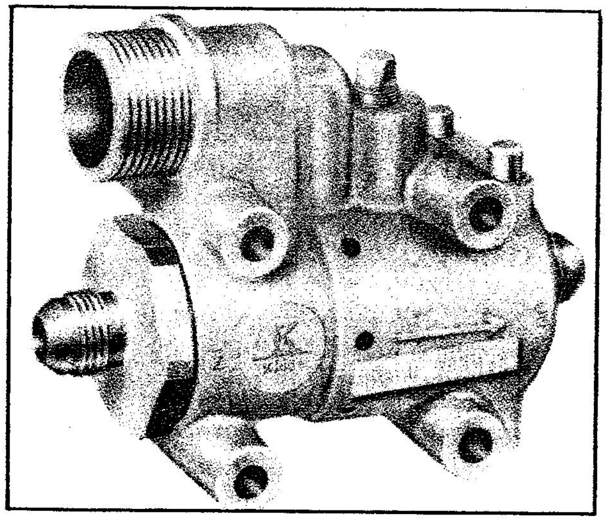


*Figure 2–17A—One-Half Inch Stop Valve*

2–19. PRESSURE OPERATED STOP VALVE. *(See figure 2-17.)* The pressure operated stop valve is similar in construction to the solenoid operated stop valve, except that it differs in methods of operation. For pressure operation, an addititional port is provided on the stop valve body.

2–19A. ONE-HALF INCH STOP VALVE. *(See figure 2-17B.)* This valve may be operated by manual, electrical, or pressure controls and is installed in the carbon dioxide discharge lines to control the passage of carbon dioxide to a hazard. The valve disc (2) can be unseated by the action of a control head, allowing gas to flow from the inlet and through the gas passages to the area behind the piston (6). This pressure moves the piston, which unseats the check assembly (4), allowing carbon dioxide to flow from the inlet past the check assembly (4), through the interior of the piston (6), and out the outlet adapter (8). If the valve is to be pressure-operated, the control head outlet is capped, the plug (1) is removed, and the tubing is connected to the outlet from the pressure line.

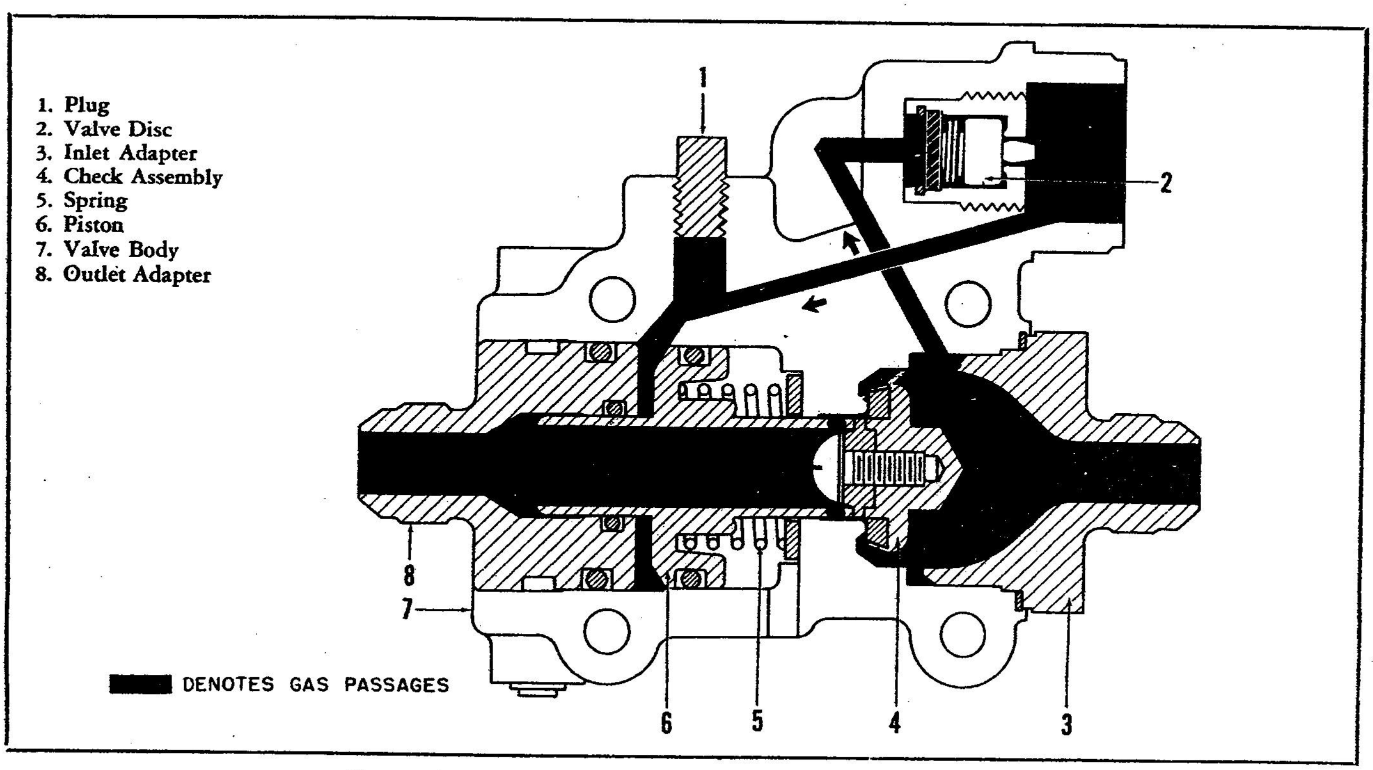



*Figure 2–17B—One-Half Inch Stop Valve Components*

2-19B. TWO-WAY DIRECTION VALVE. *(See figure 2-17D.)* This valve is installed in carbon dioxide discharge lines to control the passage of carbon dioxide to one of two hazards. It is a solenoid-operated unit designed for use at 28 volts d-c, and equipped with an inlet port and two outlet ports, each leading to a hazard. In the normal unoperated position, the valve is open from the inlet port to the outlet port in line with the inlet port, and the seal (4) closes the center port. If the carbon dioxide discharge is to be directed through the center port, actuation of the solenoid (1) rotates the rotor (3), which swings the seal (4) within the valve and thereby directs the discharge to the other hazard.

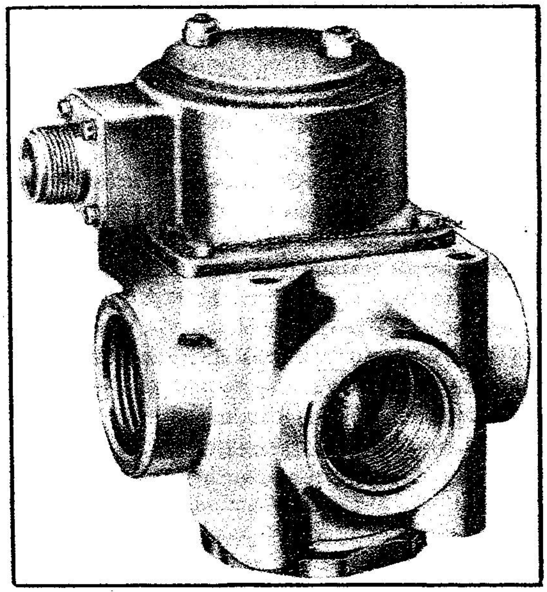
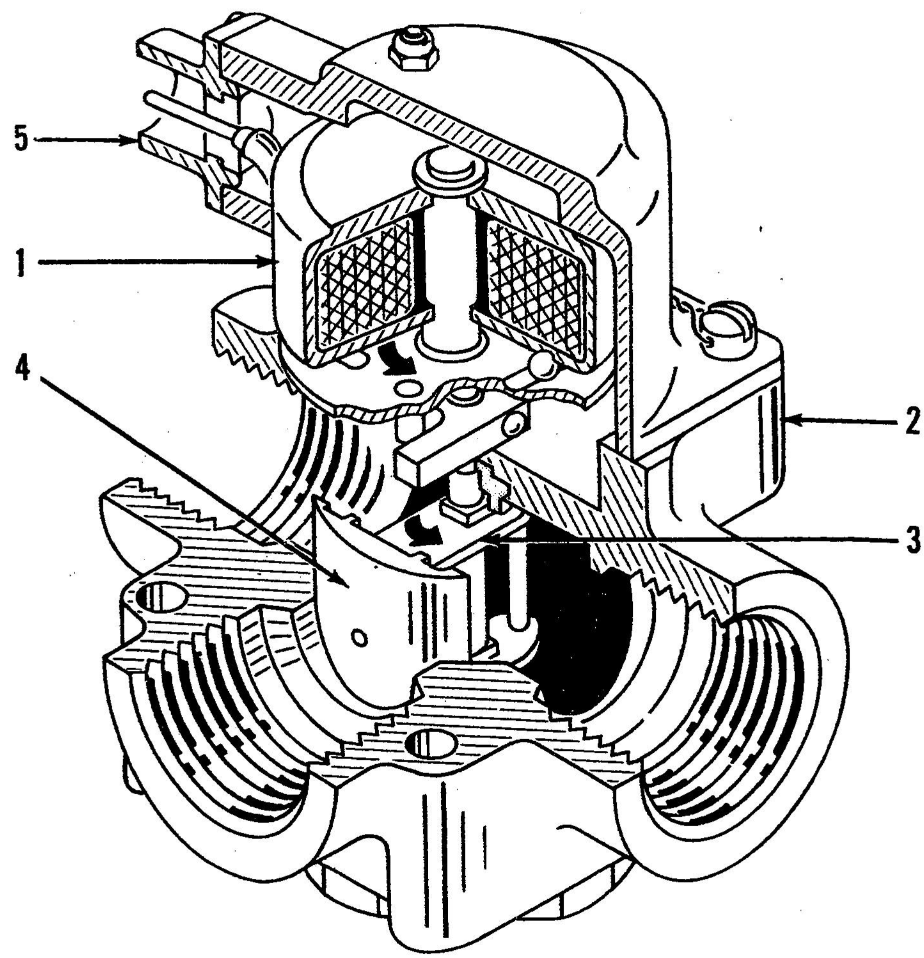


*Figure 2-17C—Two-Way Direction Valve*




1. Solenoid
2. Valve Body
3. Rotor
4. Seal
5. Connector

*Figure 2-17D—Two-Way Direction Valve Components*

2–19C. PILOT CABLE CONTROL. *(See figure 2–17F.)* This unit is a remote cable-operated device for controlling the operation of one or more stop valves in a carbon dioxide discharge line. One pilot cable control, in conjunction with one stop valve, is usually installed for each unit protected by a supply of carbon dioxide. On multi-hazard installations, having a main and a reserve supply of carbon dioxide, the control and stop valves automatically reset themselves after main discharge in order that the reserve discharge can be directed to any hazard. When the lever (14) is pulled, the valve disc (10) is unseated and the gas flows in the inlet (8) through the gas passage, advances the piston (6), and flows through the outlet to the stop valve. When the gas pressure is dissipated, the piston (6) is returned by the action of the spring (7) and the valve is reset to the closed position with lever (14) in normal position.

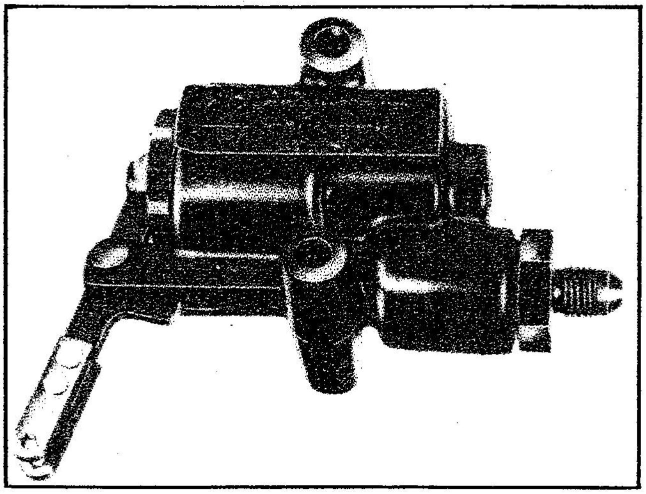


*Figure 2–17E—Pilot Cable Control*

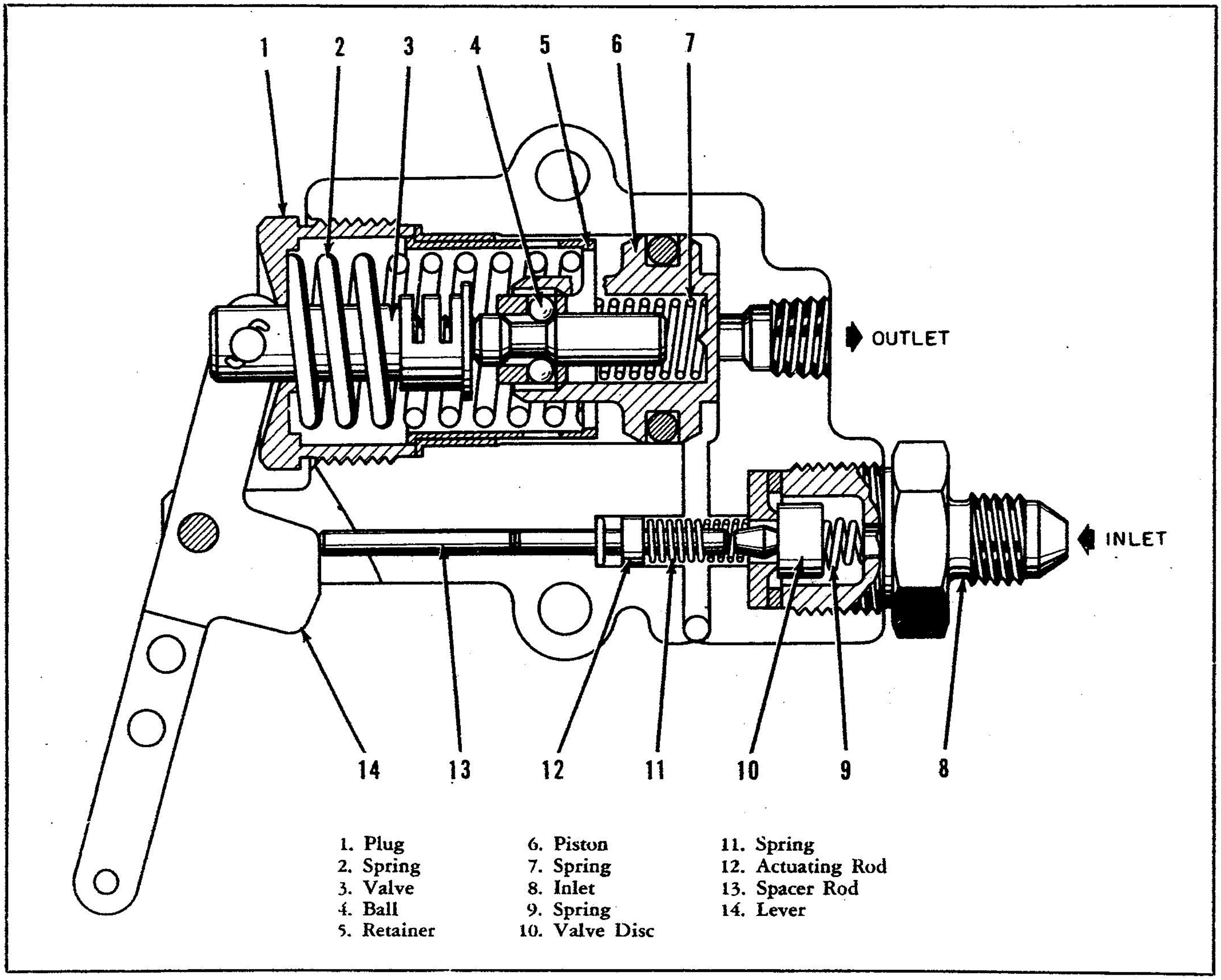



*Figure 2–17F—Pilot Cable Control Components*

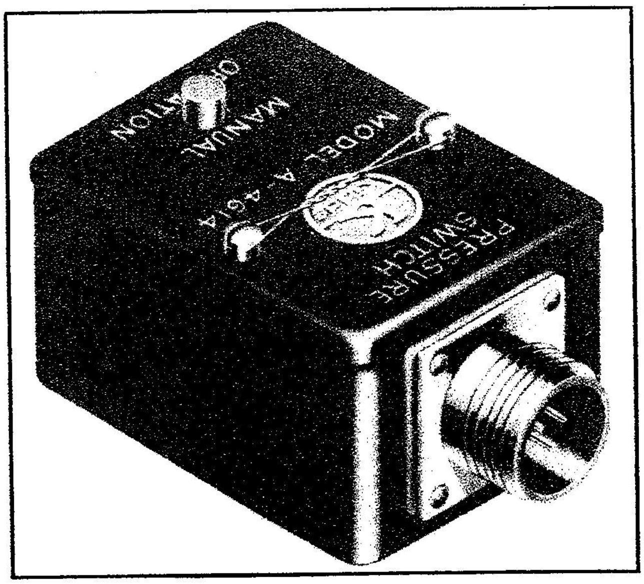
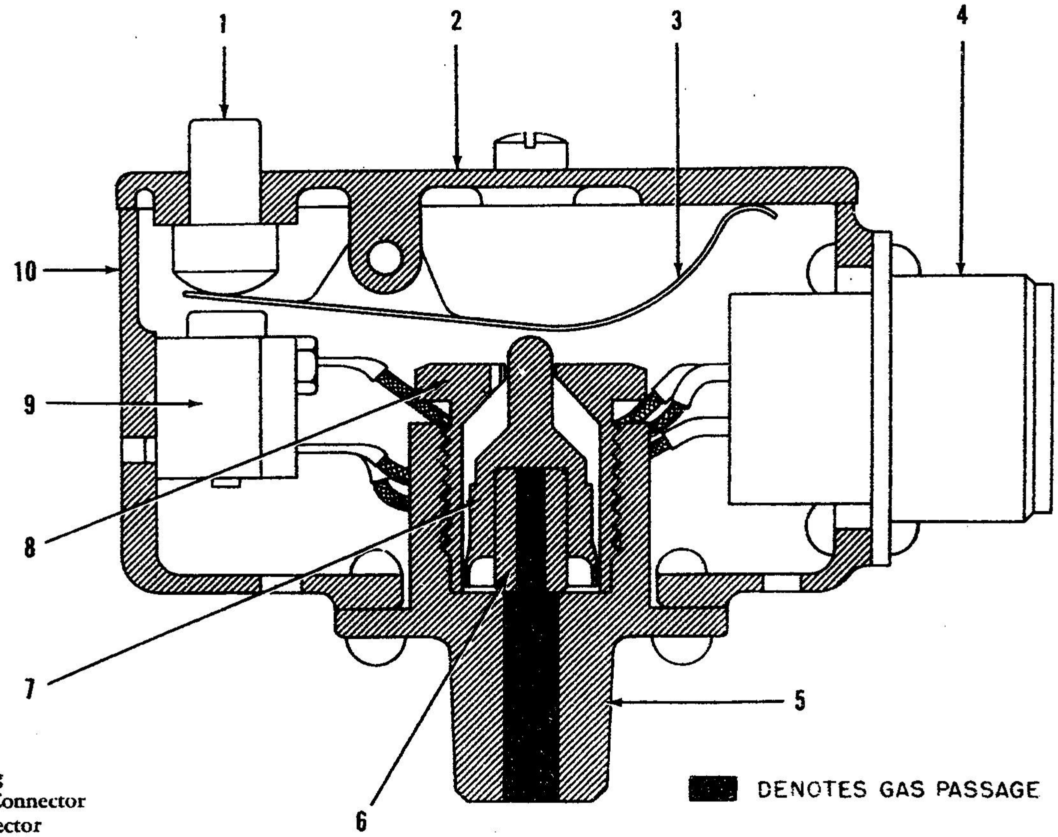


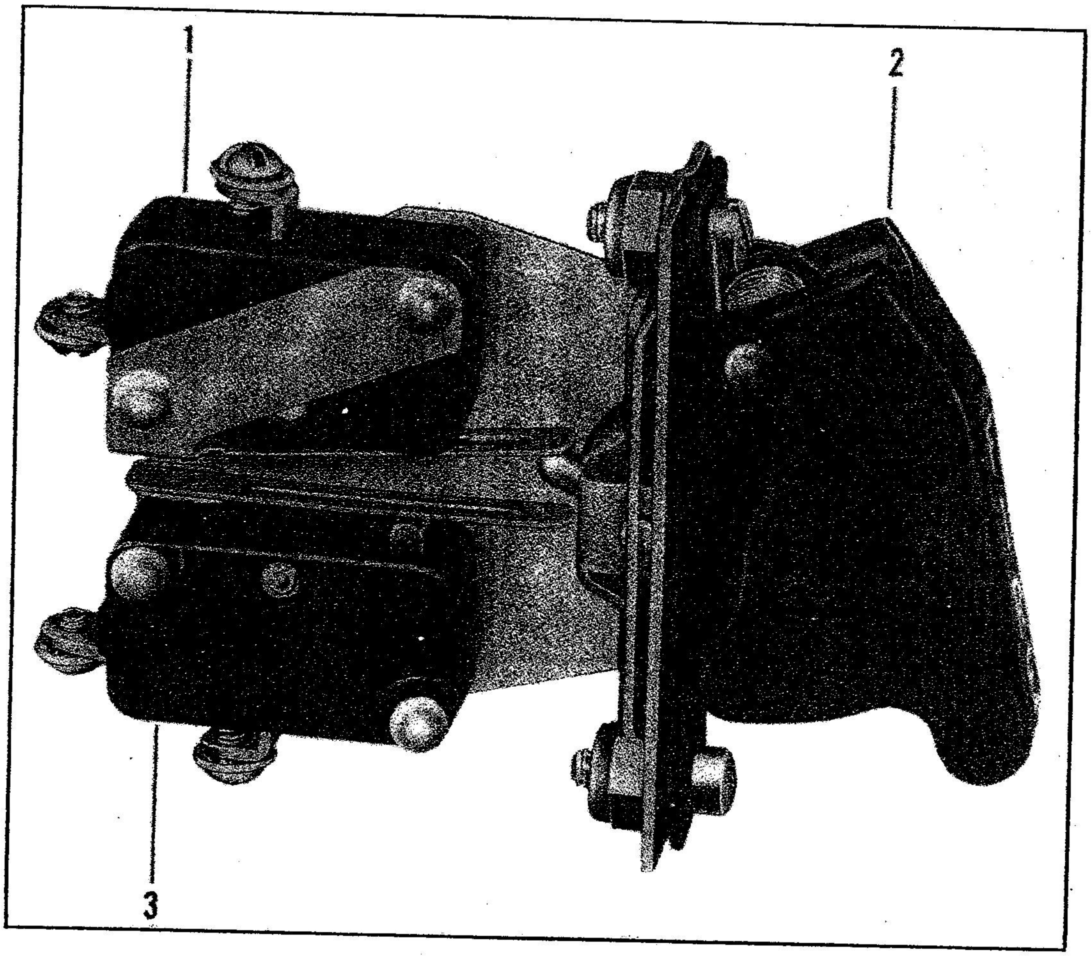

*Figure 2–17G—Pressure Switch*

2–19D. PRESSURE SWITCH. *(See figure 2–17H.)* This switch consists of a pressure-operated plunger (7) and switch (9) in a housing (10) together with a manual button (1) for testing purposes. The pressure switch is installed in the discharge lines and is used to make or break a preselected two- or three-wire circuit. During engine starting, the pilot selects the stop valve in the system for the engine being started by closing the circuit between the pressure switch and the engine stop valve. One pressure switch is used for each stop valve. The ground man attaches a ground supply of carbon dioxide to the external connection of the aircraft. This connection leads to the carbon dioxide manifold within the aircraft. In case of engine fire, the ground man discharges the ground supply which fills the system supply lines up to each stop valve. The pressure in the supply line acting against the plunger (7) actuates the electric switch (9) through the spring (3). The closing of the switch (3) completes the closing of the preselected circuit, thus opening the selected stop valve.




1. Button
2. Cover
3. Trip Spring
4. Electrical Connector
5. Pipe Connector
6. Plunger Pin
7. Plunger
8. Plunge Retainer
9. Switch
10. Housing

*Figure 2–17H—Pressure Switch Components*




1. Switch
2. Guard
3. Switch

*Figure 2–17J—Sequence Switch*

2–19E. SEQUENCE SWITCH. *(See figure 2–17J.)* This switch is designed for installation in a system where it is necessary to operate a direction or stop valve prior to the discharge of the carbon dioxide. This is accomplished by the two switches incorporated in the sequence switch. One switch (1) closes the circuit to the valve when the guard (2) is raised and the other switch (3) causes discharge of the carbon dioxide when the momentary-contact toggle is placed to the "ON" position. The design of the switch is such that it is impossible to discharge the carbon dioxide before the two-way direction valve is open to the hazard. A separate sequence switch is normally installed for each hazard protected by the extinguishing system.

2–19F. ADJUSTABLE SWIVEL PULLEY. *(See figure 2–17K.)* This unit is installed in a cable line between a cable-operated control and a pull handle. The pulley can be set at any angle between 90 and 180 degrees.

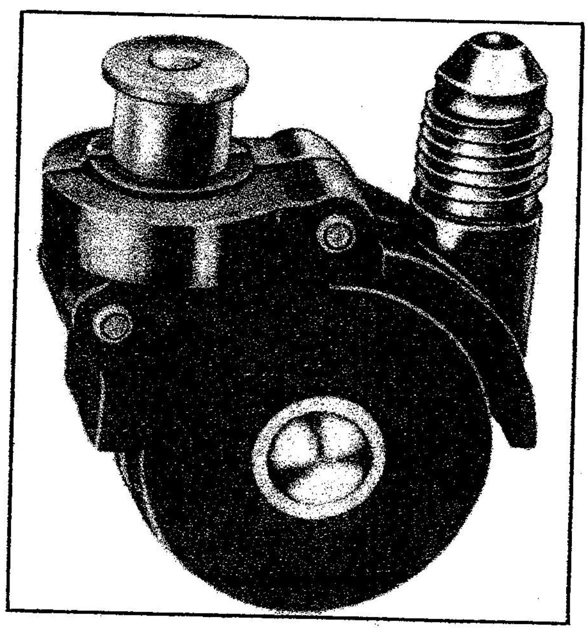


*Figure 2–17K—Adjustable Swivel Pulley.*

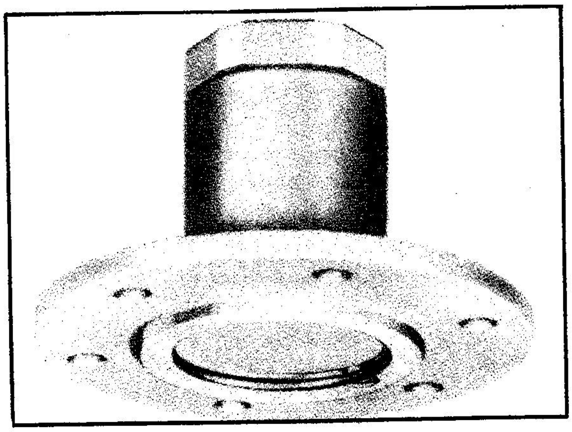


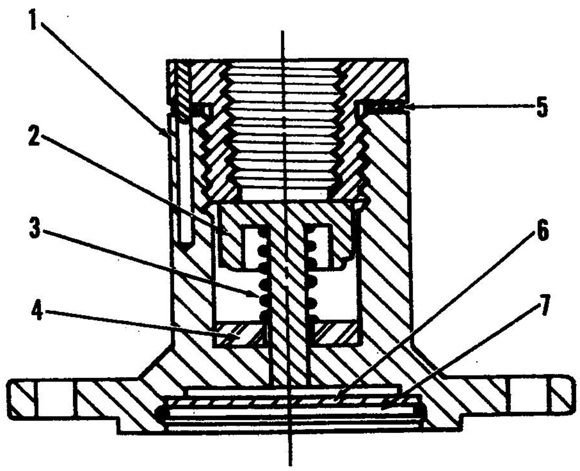
*Figure 2–18—Inboard Discharge Indicator*

## 2–20. DISCHARGE INDICATORS.

2–21. INBOARD DISCHARGE INDICATORS. *(See figure 2–19.)* The inboard discharge indicator is mounted on the pilot's or flight engineer's instrument panel and provides a means of positively determining whether the carbon dioxide gas supply has discharged upon operation of the system. A yellow disc, readily visible in the face of the indicator, is pushed out by a piston stem when the carbon dioxide gas discharges into the distributing line. The unit is composed of an aluminum body (1) in which is located a steel piston (2), a spring (3) to hold the piston fully retracted, washers (4 and 5), a yellow celluloid disc (6) and a retaining ring (7).

2–22. OUTBOARD DISCHARGE INDICATOR. *(See figure 2–20.)* The outboard discharge indicator is mounted on the skin of the airplane in a location that is easily visible from the ground when the airplane is at rest. The unit consists of a body containing a red celluloid disc held in place by a snap ring. This disc covers the discharge end of the safety tubing, which connects to a female ⅛-inch thread on the inner side of the indicator. Discharge of the cylinders through ruptured safety discs blows out the red disc, indicating the discharge of one or more cylinders necessitating replacement.

2–23. DOUBLE CHECK TEES. *(See figure 2–22.)* The double check tees are installed in the supply lines and connect the two separate supplies of carbon dioxide with one common distributing line. The tee consists of a body (1) with two inlet ports (2 and 3), one outlet port (4) and a check assembly (5). The check directs the flow of carbon dioxide from either inlet to a single outlet, as indicated by arrows on the body.




1. Body
2. Piston
3. Spring
4. Washer
5. Washer
6. Disc
7. Retaining Ring

*Figure 2–19—Cutaway View, Inboard Discharge Indicator*

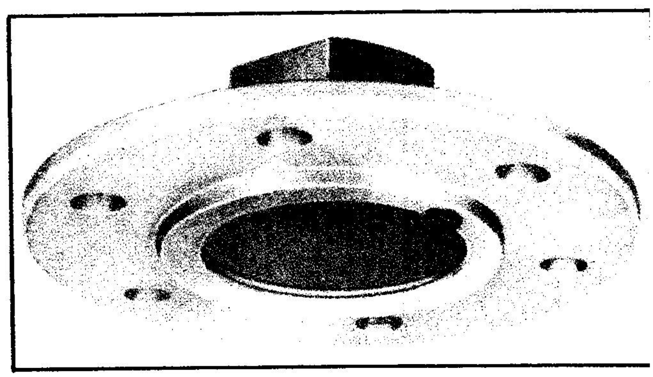


*Figure 2–20—Outboard Discharge Indicator*

2–24. SUPPLEMENTARY EQUIPMENT.

2–25. PRESSURE TUBING. Connections between tl cylinders are made with 1/4-inch pressure tubing equippe with a coupling nut at each end. The tubing is attache to the control heads and gas connector controls by mear of connectors, elbows and tees. Tubing is also used t connect the safety outlet of the cylinder valves with tl outboard discharge indicator.

2–26. FLEXIBLE HOSE. *(See figure 2–23.)* The fle: ible hose used to convey the gas to the manifold is mac of synthetic rubber reinforced with a wire braiding. is a high pressure hose, resistant to fuel and oil.

2–27. ELBOWS. *(See figure 2–24.)* The elbow is a AN fitting for 1-inch O.D. tubing.

2–28. HEADER. *(See figure 2–25.)* The header whic serves the purpose of the master manifold is a chamb where all the lines from the cylinders meet and dischar the carbon dioxide into one common discharge lin Lines from the header carry the carbon dioxide to eac stop valve for a particular engine.

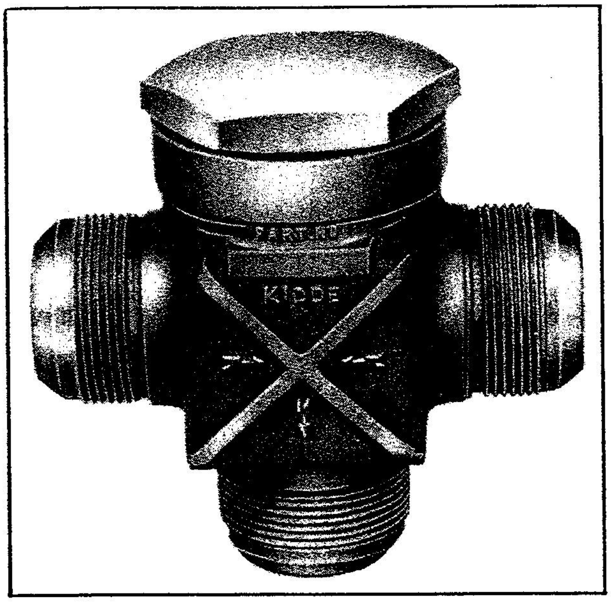



***Figure 2–21—Double Check Tee***

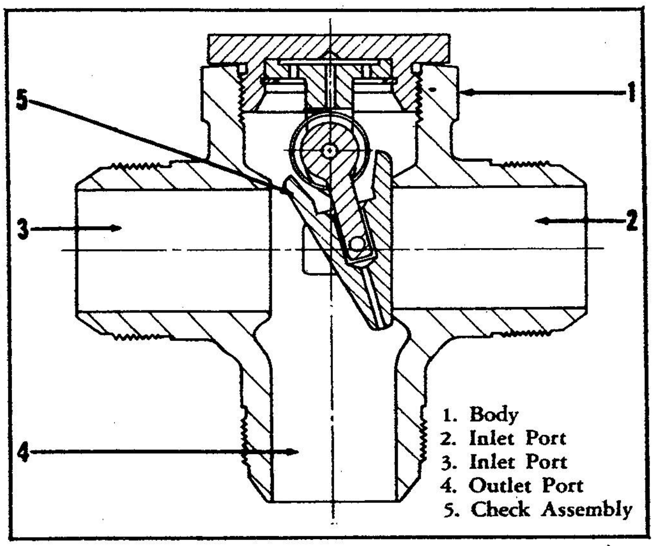



***Figure 2–22—Cutaway View, Double Check Tee***

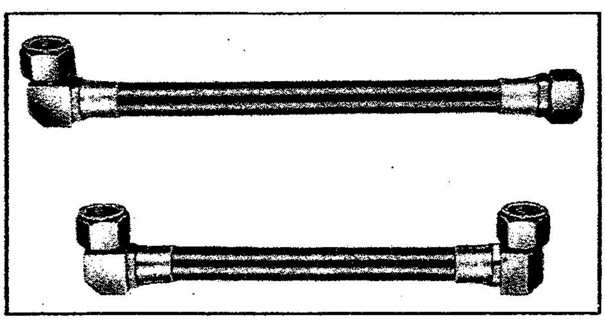


***Figure 2–23—Flexible Hose***

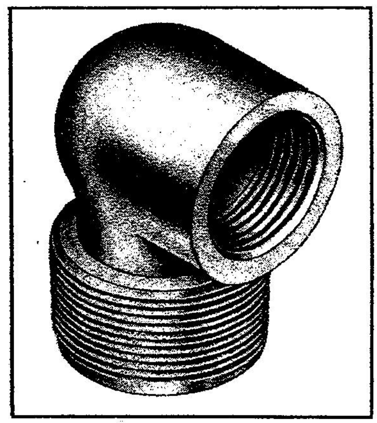


***Figure 2–24—Elbow***

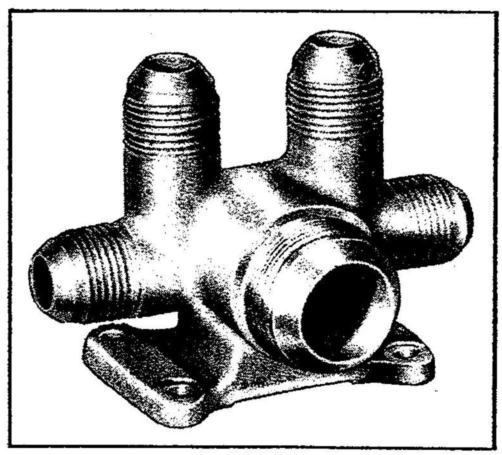


***Figure 2–25—Header***

# SECTION III

# INSTALLATION

## 3-1. GENERAL INSTALLATION INSTRUCTIONS FOR SINGLE-SHOT SYSTEM. *(See figures 3-1, 3-2, and 3-3.)*

3-2. This type of fire extinguisher is designed for installation in multi-engined airplanes. The system is controlled electrically, which allows the cylinders and the flood valves to be set up in the most convenient position in the airplane. The charged cylinders are mounted vertically on brackets in the fuselage or wing and positioned so that connecting tubing and fittings may easily be attached. The "master" or control cylinders have an interconnector and solenoid control head assembled to

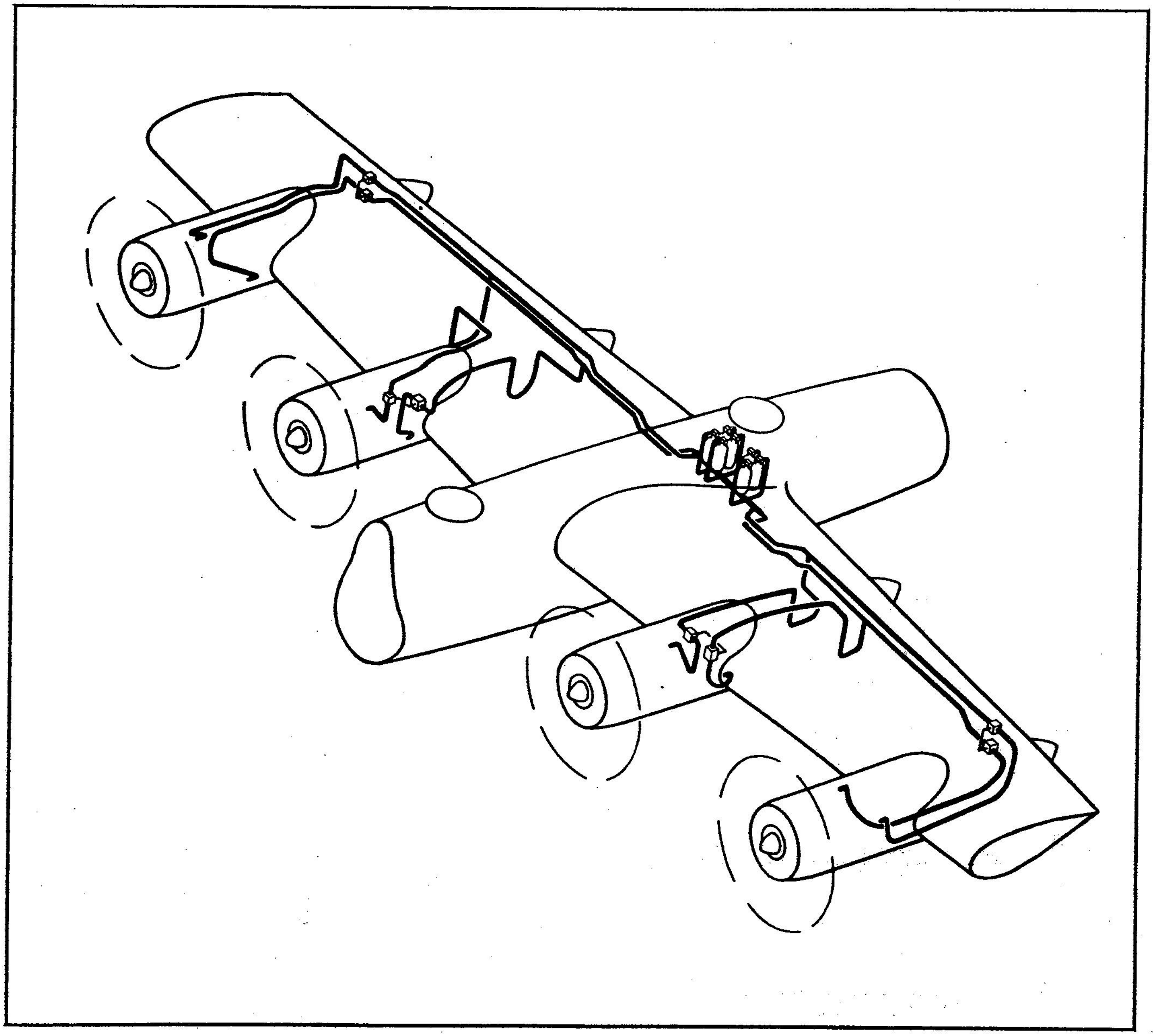


*Figure 3-1—Location of Components in Typical Single-Shot System Installation*

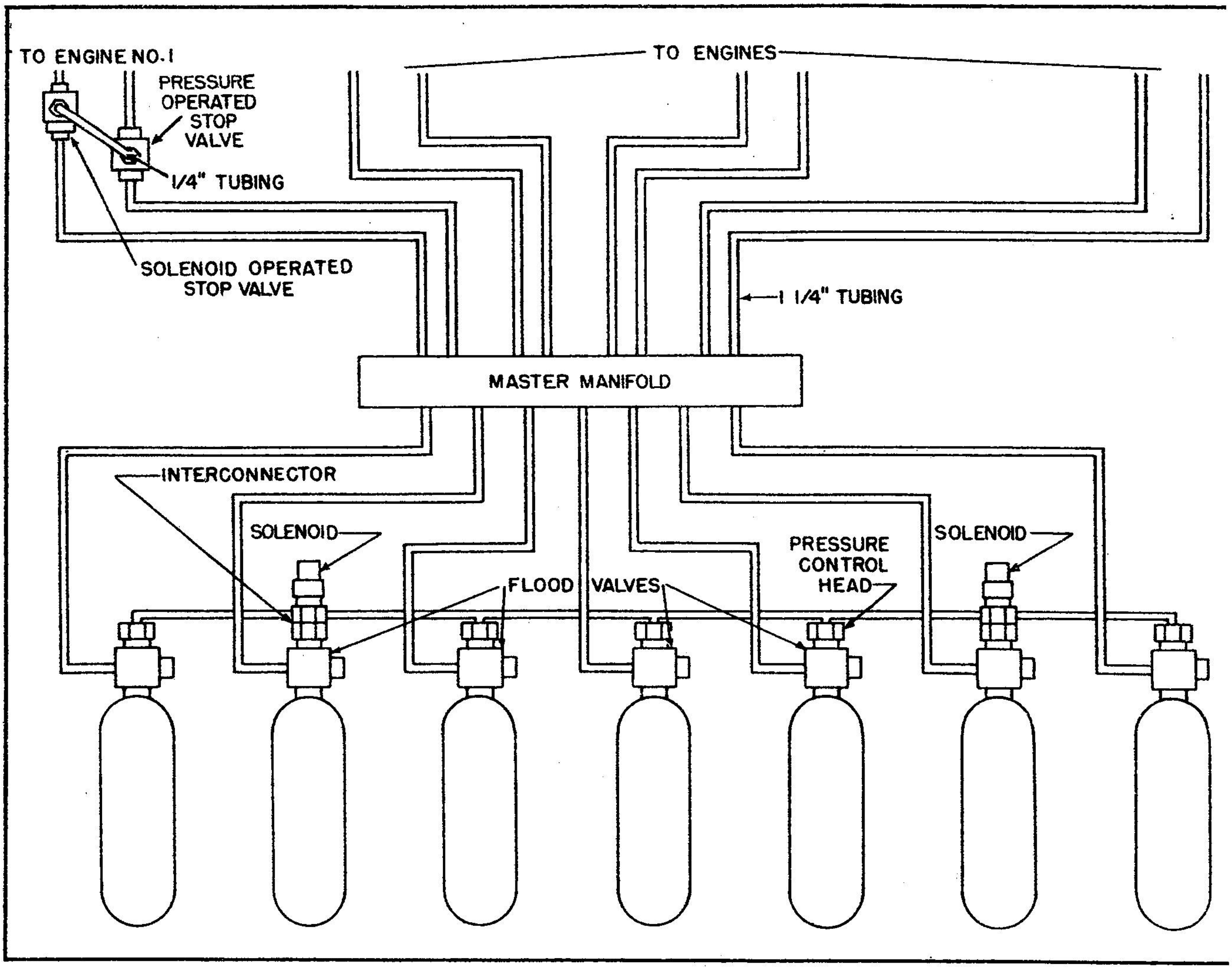



*Figure 3-2—Schematic Diagram of Typical Single-Shot System Installation*

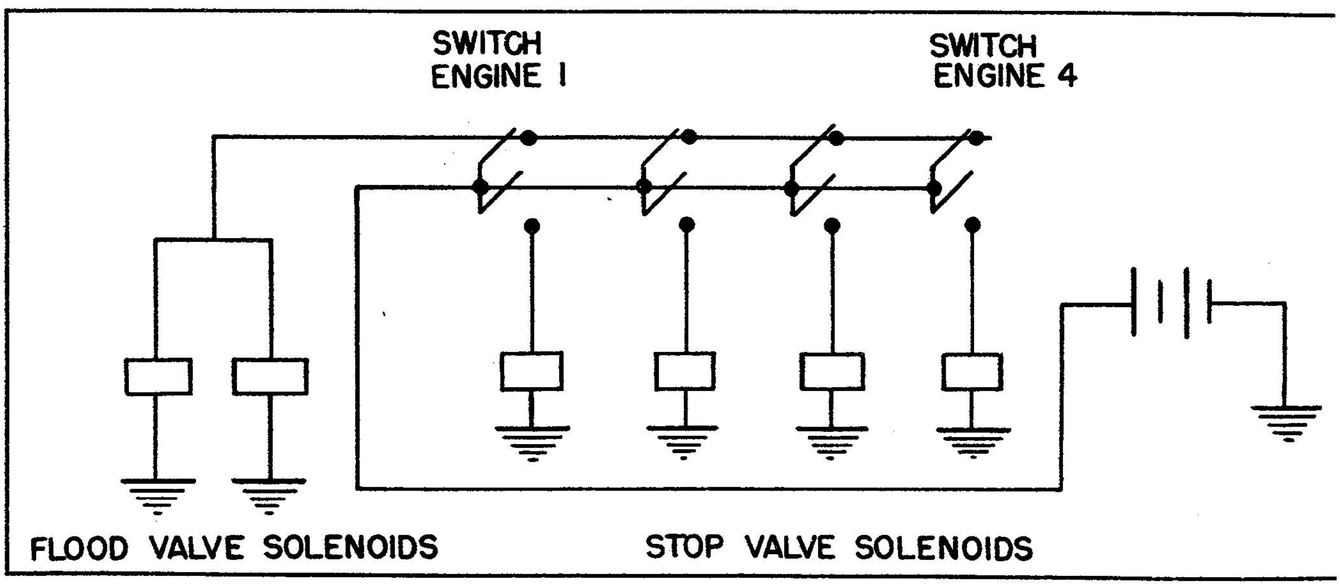



*Figure 3-3—Wiring Diagram of Typical Single-Shot System Installation*

their flood valves. The remaining cylinders each have pressure control heads assembled to their flood valves. Elbow fittings, tee fittings, male connectors and pressure tubing are interconnected between cylinders and the master manifold in the proper relation to give the correct flow of carbon dioxide called for in a particular installation. An outboard discharge indicator is, in most installations, located in a convenient place in the skin of the airplane. All cylinders connect into one line which is connected directly to the outboard discharge indicator. To direct the flow of carbon dioxide to individual engines or fire hazards, stop valves are located between the hazard and the master manifold. The system illustrated contains both solenoid controlled stop valves and pressure controlled stop valves. Pressure tubing connects the stop valves to the master manifold and from the stop valves to the fire hazard.

**3–3. GENERAL INSTALLATION INSTRUCTIONS FOR MAIN AND RESERVE SYSTEM.** *(See figures 3–4, 3–5, and 3–6.)*

3–4. The installation of the main and reserve system is similar to that of the single-shot system except for the number of cylinders installed. The main and reserve system illustrated has four reserve cylinders. These reserve cylinders may be installed either in the engine nacelles, in the fuselage, or in any convenient place in the airplane. Additional tubing plus a double check tee is necessary to connect these reserve cylinders into the main carbon dioxide discharge lines for each engine or fire hazard. Two pressure control heads and two solenoid control heads are connected to the interconnectors on top of the reserve cylinders. In all other respects, with the exception of the necessary additional cabin switch controls, the main and reserve system generally duplicates the single-shot system.

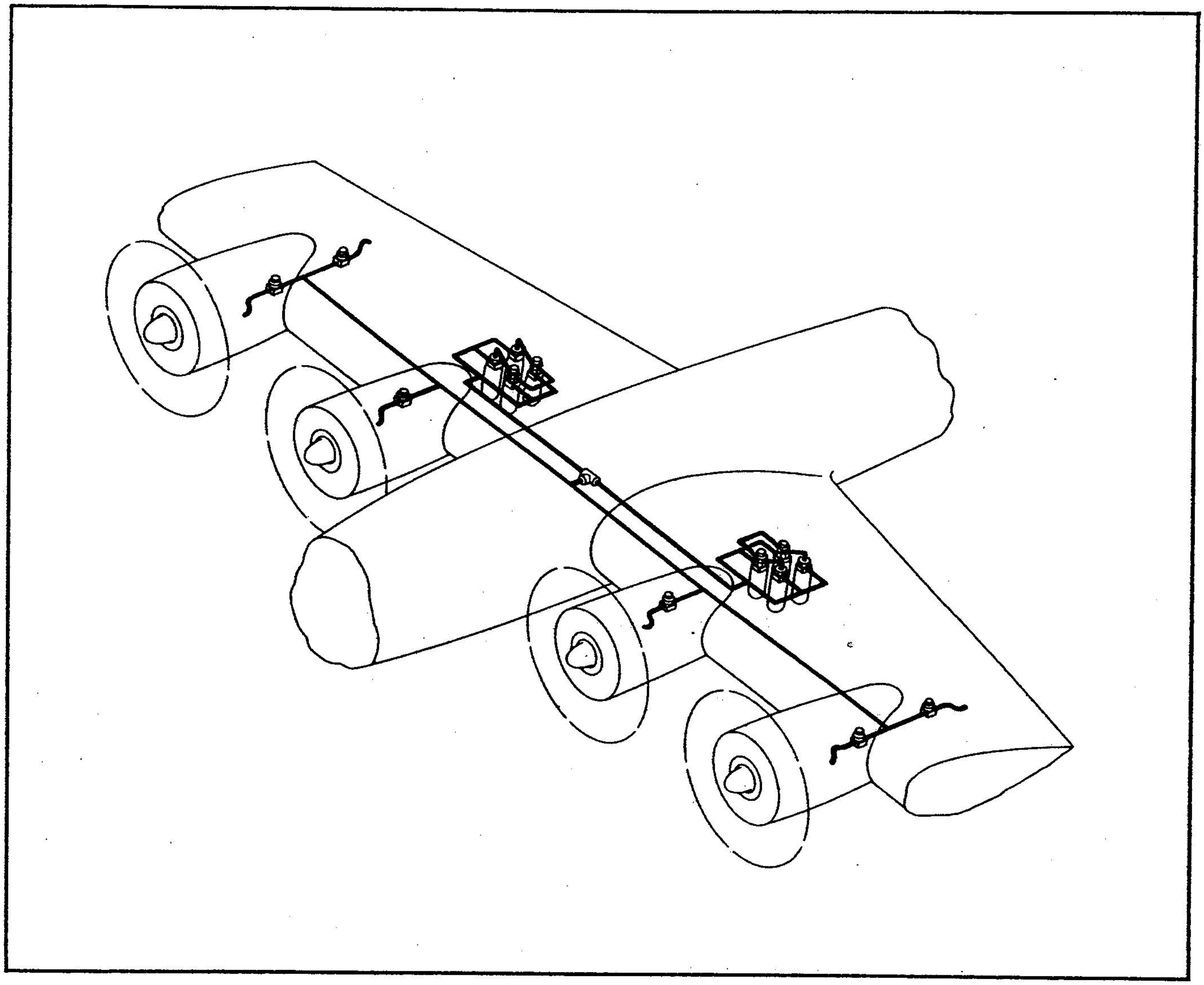


*Figure 3–4—Location of Components in Typical Main and Reserve System Installation*

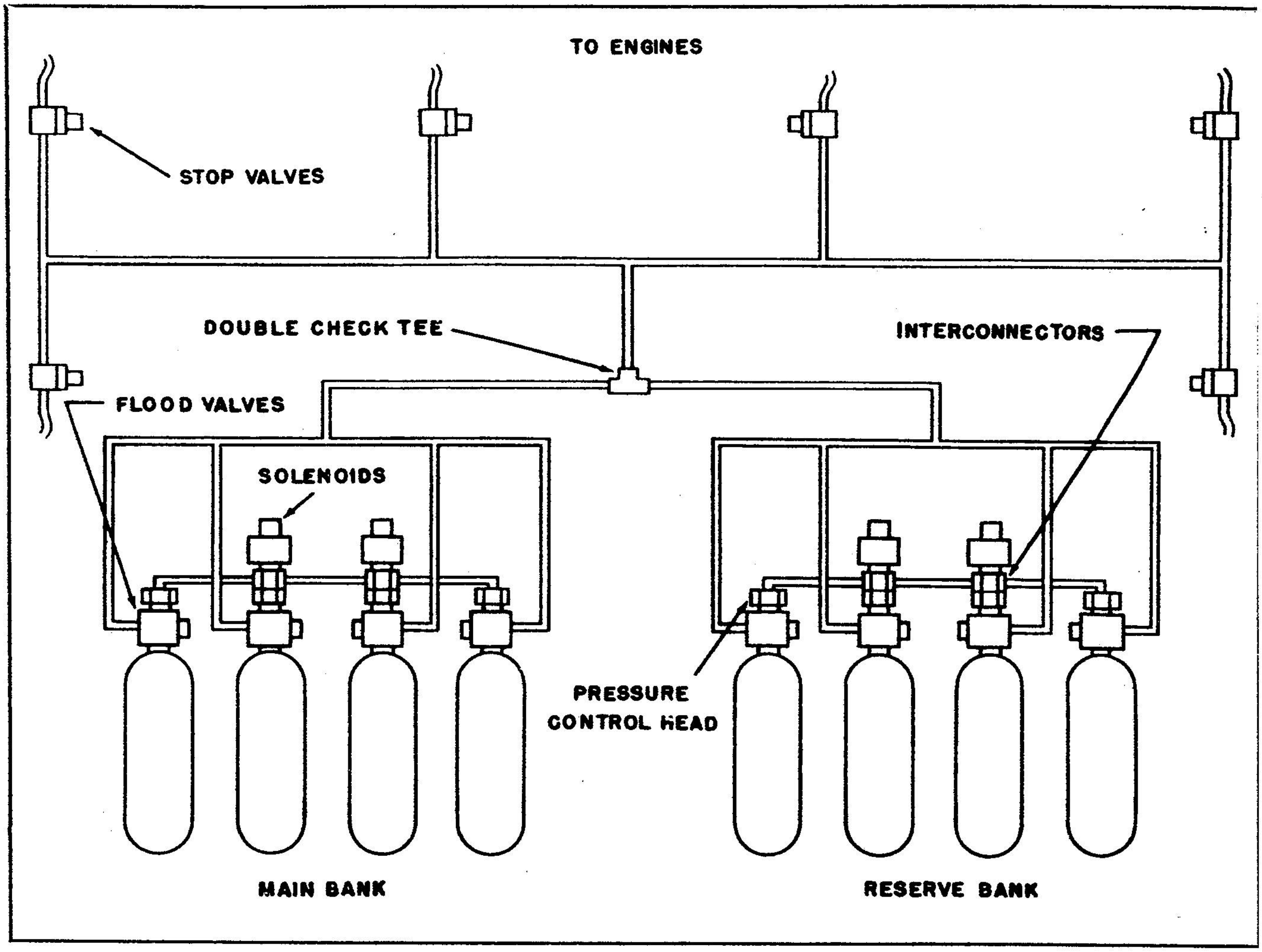



*Figure 3-5—Schematic Diagram of Typical Main and Reserve System Installation*

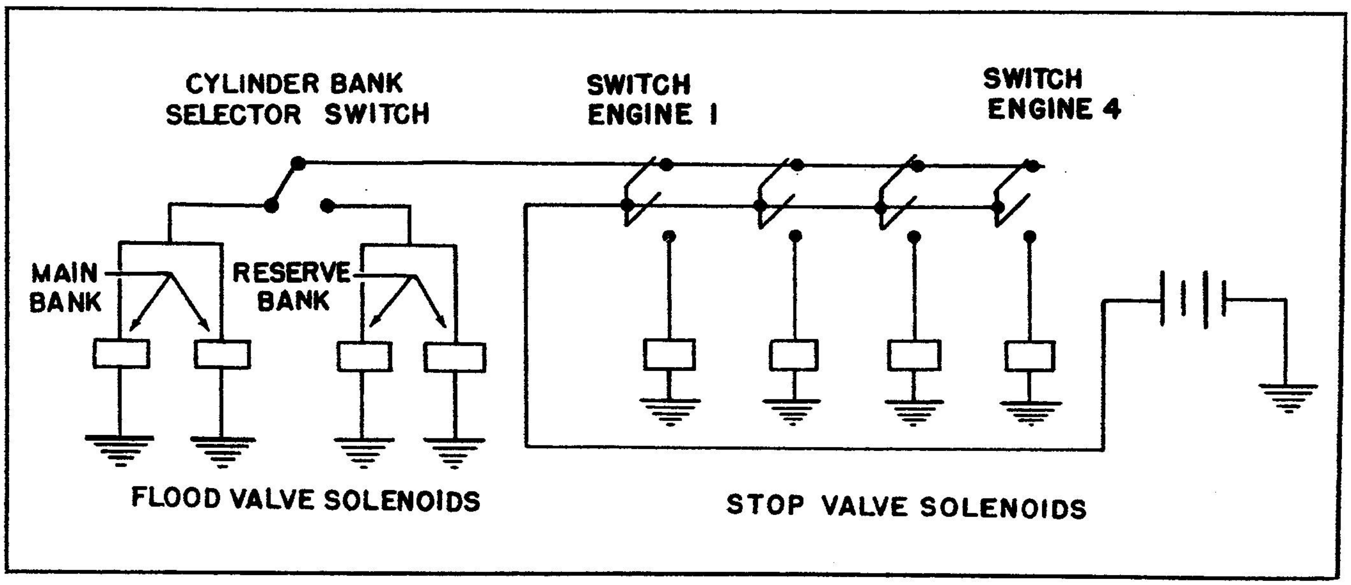



*Figure 3-6—Wiring Diagram of Typical Main and Reserve System Installation*

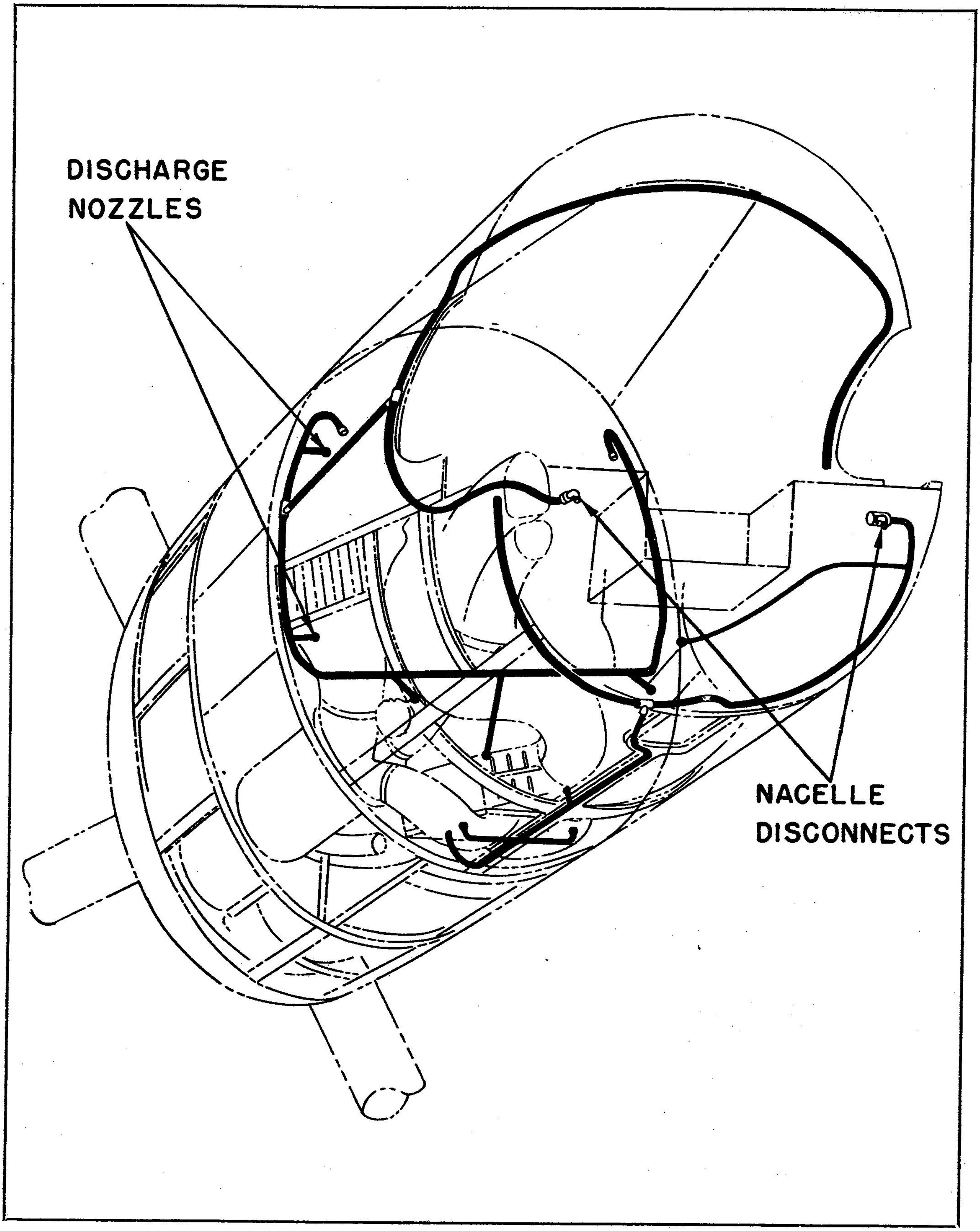



*Figure 3-7—Typical Nacelle Installation*

### 3–4A. SERIES CABLE CONTROL HEAD.

3–4B. The following procedure should be used when installing the series cable control heads:

a. The control cable line should be kept as short and direct as possible in order to minimize the pull required for operation of the system.

b. To prevent accidental pulling of the cable, it is recommended that it be enclosed in ¼-inch outside diameter by .032 inch or .035 inch wall, 52SO aluminum tubing.

c. Under no circumstances are bends or offsets to be made in the control cable line. Use adjustable corner pulleys at all bends.

d. The control handle rests in a socket mounted in the cabin. Drill a 21/32-inch diameter hole through the mounting board. Install the socket and fasten it securely with a palnut.

e. Flare the end of the ¼-inch control-cable tubing and connect it to the pull-handle socket.

f. Apply a thin coating of graphite (Specification AN-G-6-2) to the cable and feed it through the front of the control handle socket and through the control cable tubing. Pull the free end of the cable taut so that the control handle rests snugly in the control handle socket.

g. Remove the cover of the series cable control head and lift the sheave from the control head. Loosen the screws holding the cable clamp and wrap the cable around the sheave as shown in figure 3-7A. Tighten the clamp and clip the end of the cable as close to the clamp as possible. The cable end should be tinned to prevent unravelling.

h. Plug the unused opening in the control head with the small aluminum disc supplied.

i. Provisions are provided to extend the cable through the control head and connect it to a second series control head, if the operation of two series cable control heads in tandem is required.

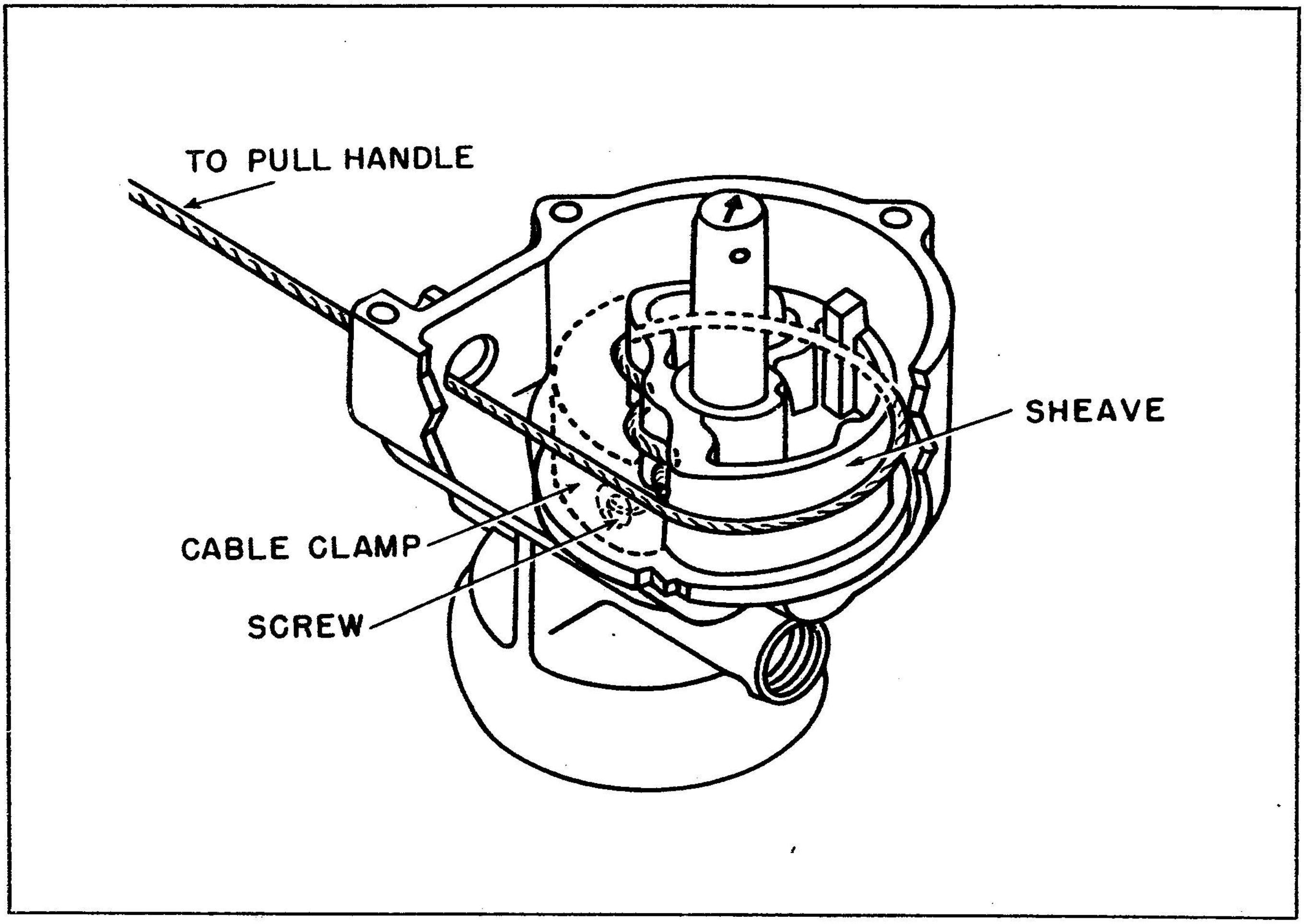



*Figure 3–7A—Cable Attachment*

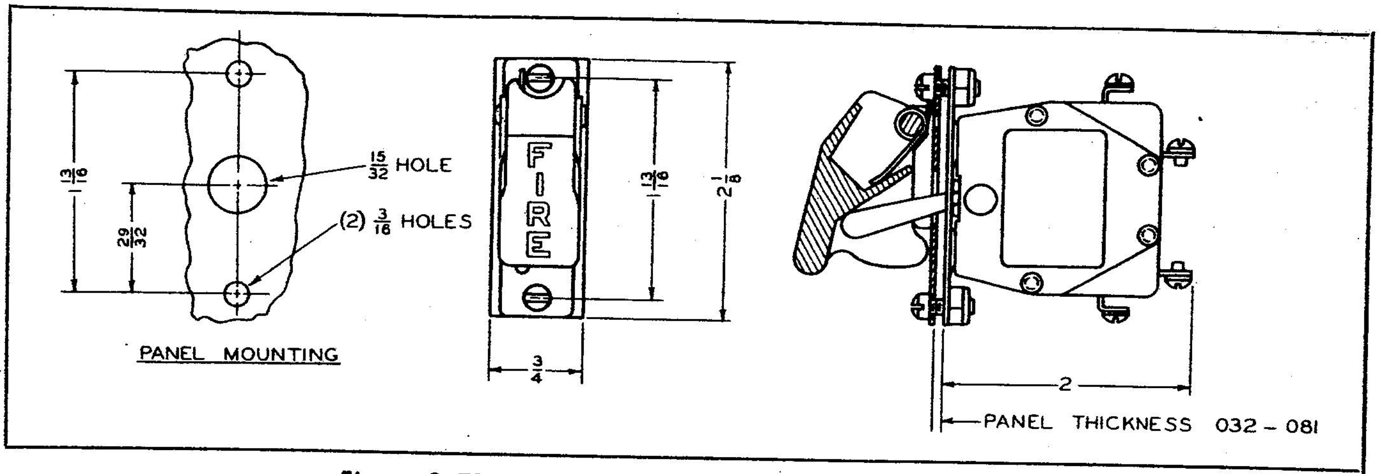



*Figure 3–7B—Installation Dimensions, Sequence Switch*

**3–4C. SEQUENCE SWITCH.** *(See figure 3–7B.)*

3–4D. Figure 3–7B shows the dimension required for the panel mounting of the switch.

**3–4E. PRESSURE SWITCH.** *(See figure 3–7C.)*

3–4F. Figure 3–7C gives the installation dimensions for this unit, while figure 3–7D shows the internal wiring of the switch.

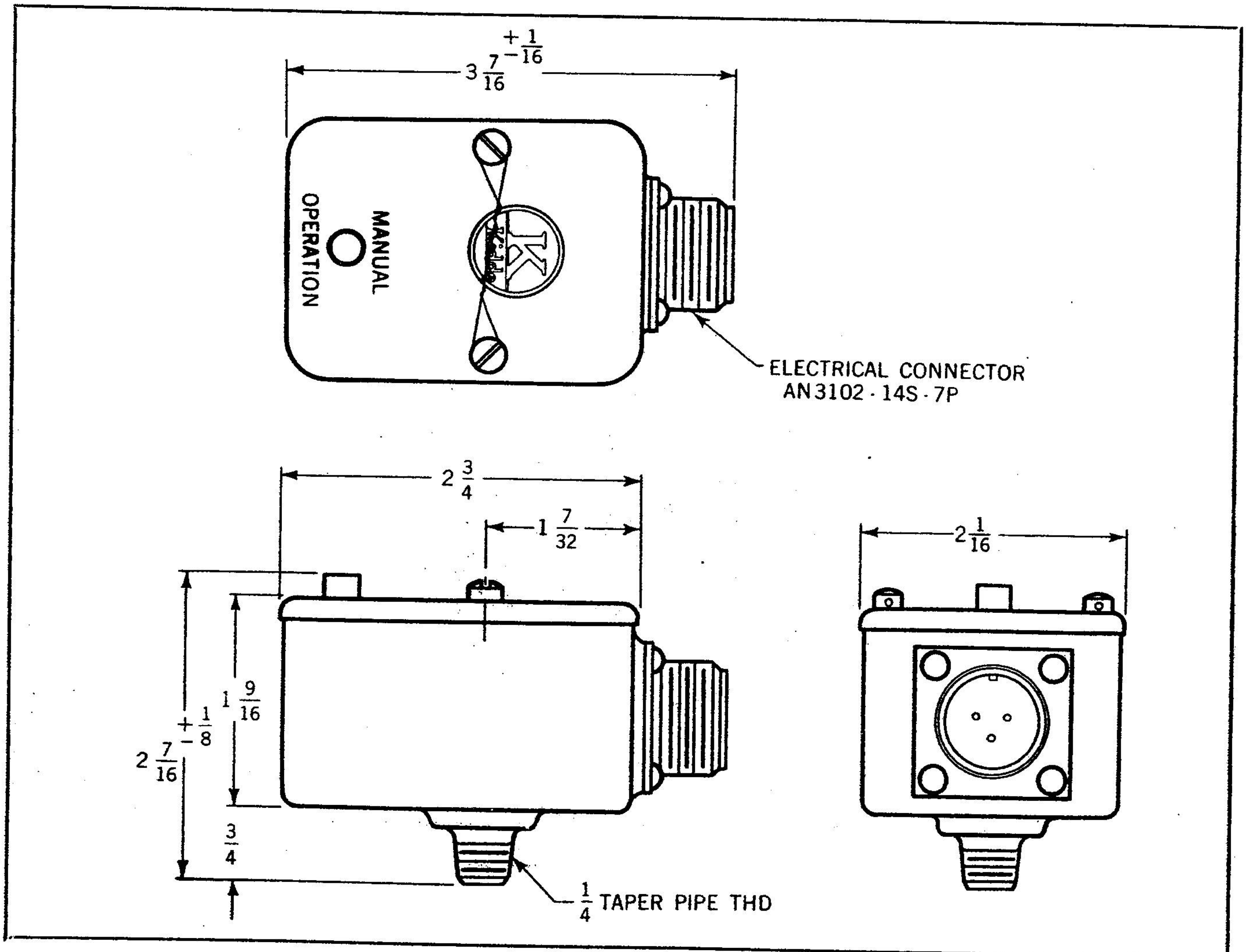



*Figure 3–7C—Installation Dimensions, Pressure Switch*

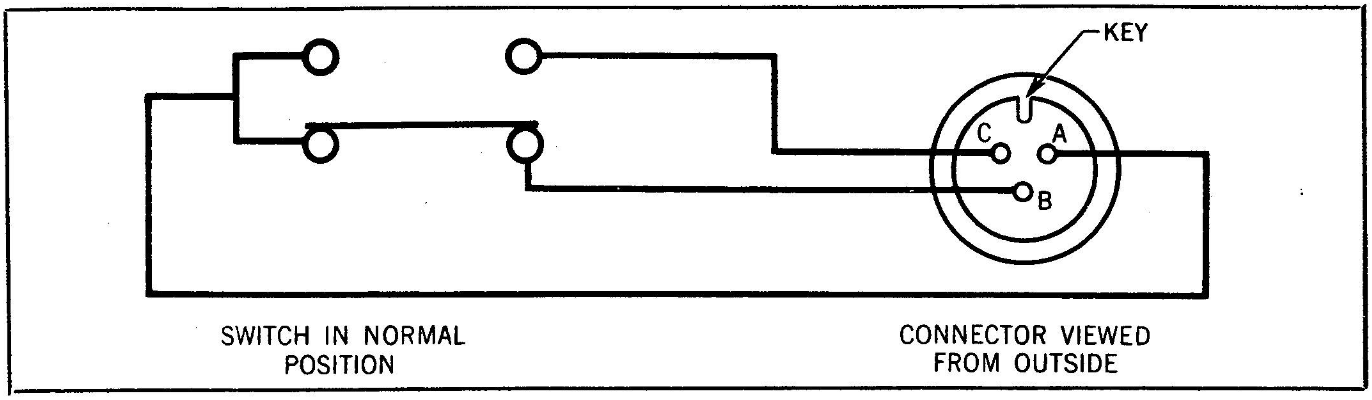



***Figure 3–7D—Wiring Diagram, Pressure Switch***

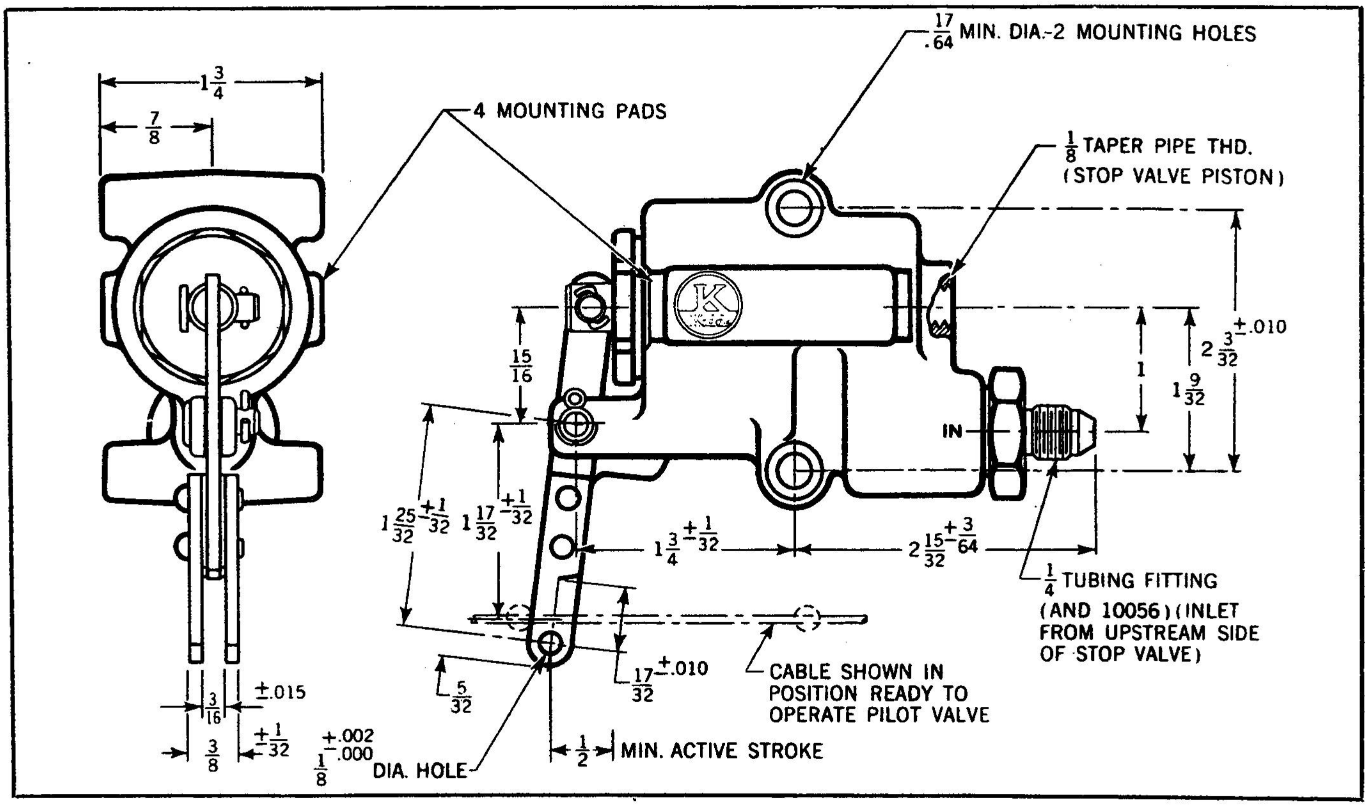



***Figure 3–7E—Installation Dimensions, Pilot Cable Control***

**3–4G. PILOT CABLE CONTROL.** *(See figure 3–7E.)*

3–4H. Installation dimensions for this control are shown in figure 3–7E.

**3–4J. ADJUSTABLE SWIVEL PULLEY.** *(See figure 3–7F.)*

3–4K. Clearance dimensions for the pulley are shown in figure 3–7F.

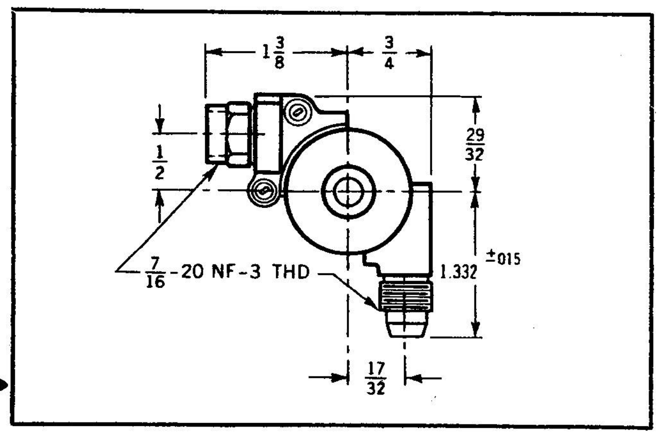



***Figure 3–7F—Clearance Dimensions, Adjustable Swivel Pulley***

# SECTION IV

# OPERATION

## 4-1. PRINCIPLES OF OPERATION.

4-2. Major aircraft fires occur chiefly around engine installations. Removing oxygen from the flames and cooling the fuel and heated metal below their ignition points are the best ways to handle such fires. This can be done by flooding the engine area with carbon dioxide. The carbon dioxide is stored as a liquid under pressure together with nitrogen in light steel cylinders located in each nacelle. The flood valves retain the gas within each cylinder. A remote switch opens these valves to release the carbon dioxide when a fire occurs.

4-3. OPERATION OF FLOOD VALVES.

4-4. 3/4-INCH TYPE. *(See figure 4-1.)* Solenoid control heads, together with gas connector controls are assembled to the "master" or control cylinders. Energizing the solenoid by closing the switch operates the plunger (1) solenoid head. This in turn depresses the plunger (2) of the interconnector which unseats the pilot check

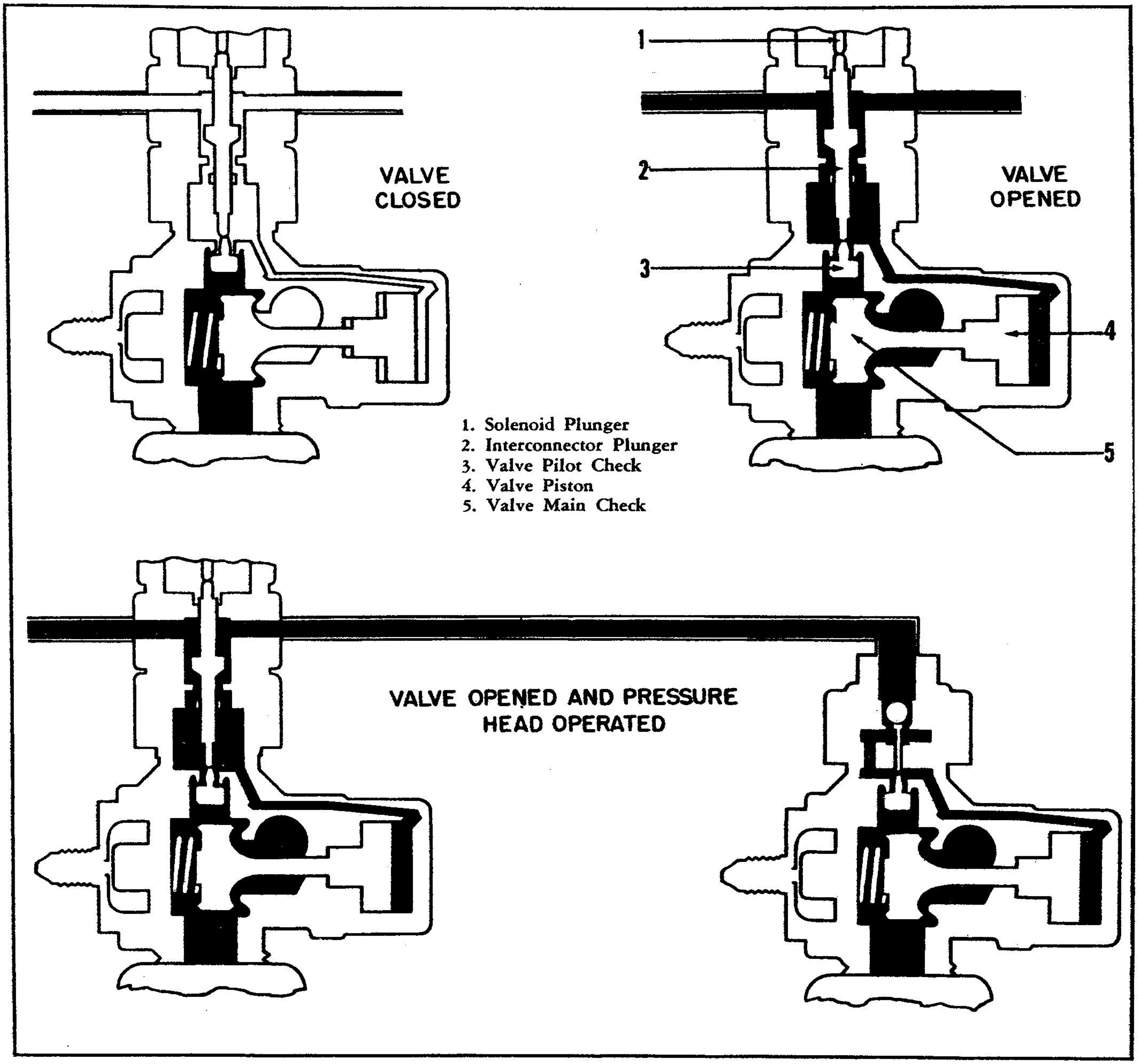



*Figure 4-1—Operation of Three-Quarter-Inch Flood Valve*

(3) of the "master" flood valve. Unseating the pilot check permits a small volume of gas to pass around the pilot check and through the gas passage in the valve body and piston cap, operating the piston (4) which opens the main check (5) and discharges the cylinder. When the carbon dioxide passes around the pilot check of the "master" flood valve, some of the gas flows up through the drilled gas passages in the interconnector and out through the tubing to the pressure control heads of the other cylinders. In passing through the pressure control heads, the gas acts on the pistons, unseating the main checks in these valves.

4-5. 1-INCH TYPE. *(See figure 4-2.)* The operation of the 1-inch flood valve is identical to the operation of the ¾-inch flood valve except that it is designed to prevent discharge of the cylinder when the discharge port is disconnected and leakage occurs in the valve. In the case of the ¾-inch valve leakage when the discharge port is disconnected would cause complete discharge. Here it is avoided by having the gas flow through a channel at the circumference of the discharge port before it gets to the discharge piston. When the discharge port is disconnected the action of the nosepiece (figure 2-5, reference 1) keeps the circular channel (figure 2-5, reference 5) open thus permitting the free exit of the leaking gas without actuating the discharge piston. In normal operation, when the discharge tubing is tightly connected to the valve outlet, the channel becomes enclosed thus creating a path for the flow of gas to the operating piston.

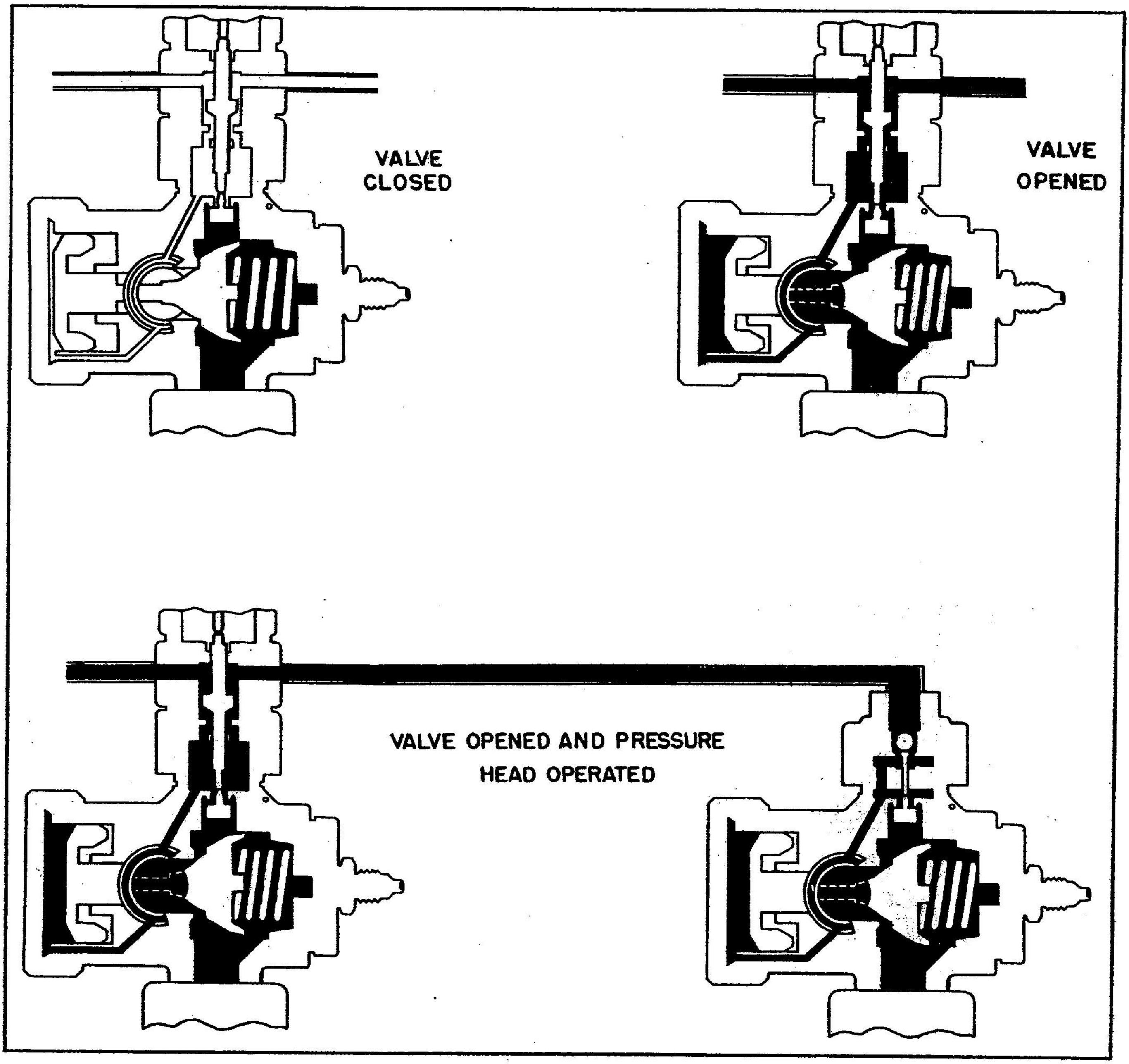



***Figure 4-2—Operation of One-Inch Flood Valve***

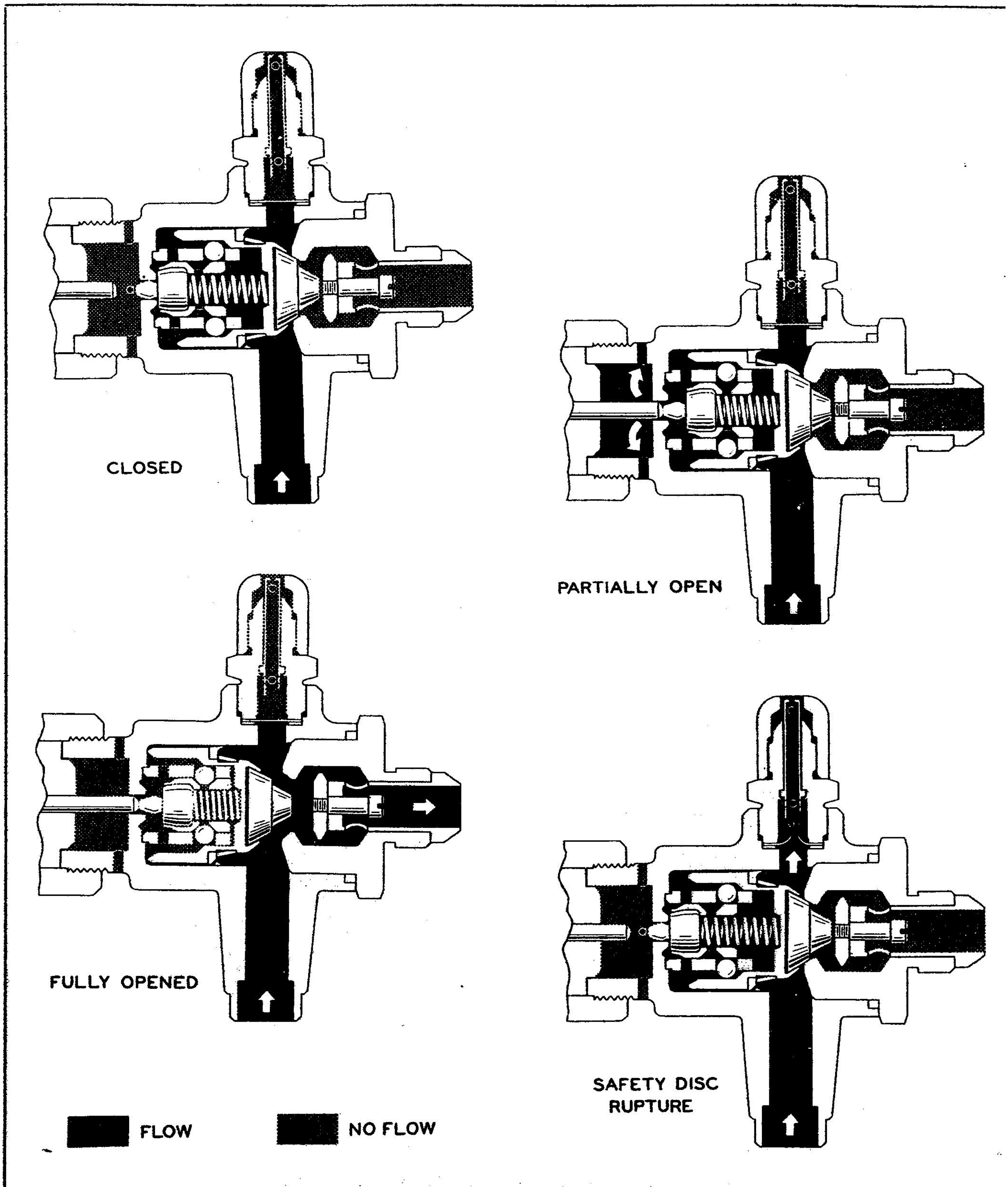



*Figure 4–2A—Operation of One-Half-Inch Flood Valve*

4–5A. ONE-HALF-INCH TYPE. *(See figure 4–2A.)* Operation of the control head unseats the pilot check, allowing the gas pressure behind the main check to escape. The gas pressure within the cylinder unseats th main check and the full charge of carbon dioxide is dis charged through the valve outlet.

4–5B. OPERATION OF SERIES CABLE CONTROL HEAD. *(See figure 4–2B.)* Series cable control heads are assembled to the "master" or "control" cylinders. Rotation of the sheave, by the control cable depresses the plunger and in turn the piston, which unseats the pilot check of the master cylinder valve. Unseating the pilot check permits a small volume of gas to pass around the pilot check and through the valve gas passage to the pressure side of the piston. This pressure moves the piston and unseats the main check, permitting carbon dioxide to be released into the system. When the carbon dioxide passes around the pilot check of the master cylinder valve, some of the gas simultaneously flows upward through the passage in the piston assembly of the series cable control head. From the control head it is conducted by tubing to the pressure control heads on the remaining cylinders. This gas pressure then unseats the main checks of the pressure operated cylinders.

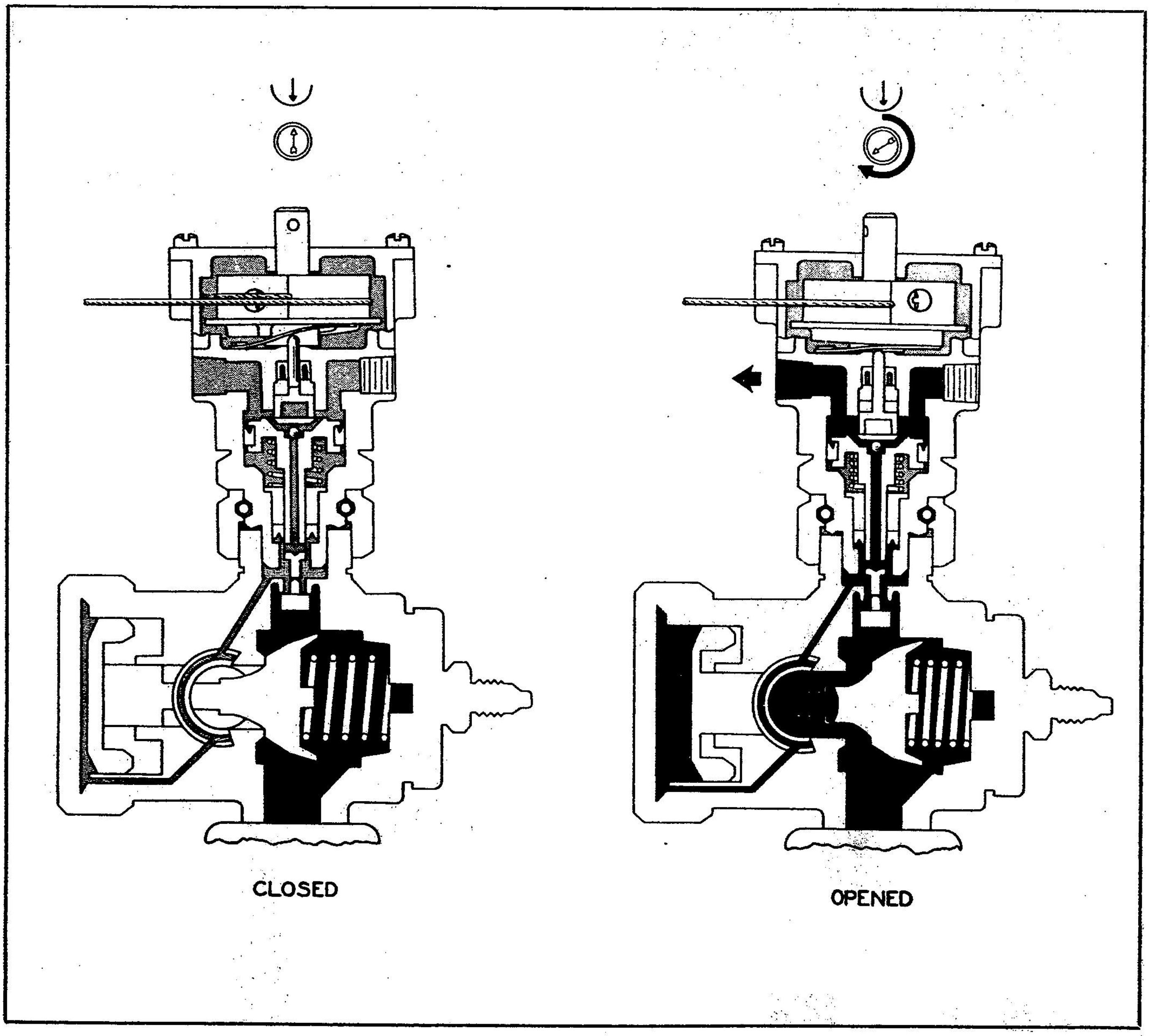
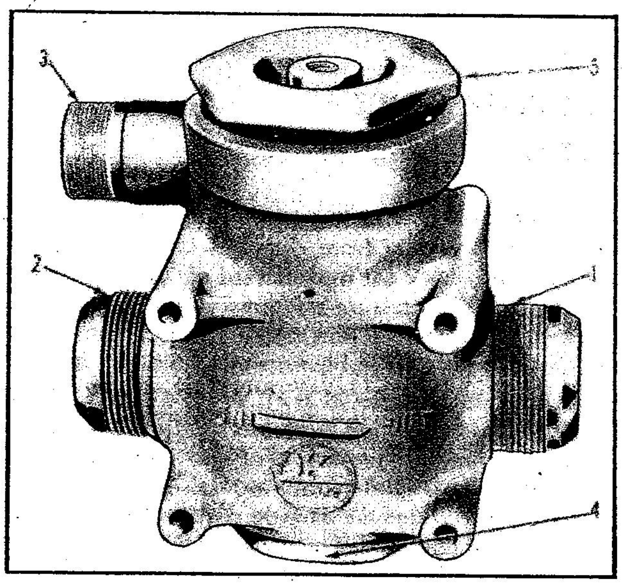



**Figure 4–2B—Operation of Series Cable Control Head**




1. Tubing Connection
2. Tubing Connection
3. Solenoid Connection
4. Plug
5. Cap

*Figure 4-3—Solenoid Operated Stop Valve*

4-6. OPERATION OF THE SINGLE-SHOT SYSTEM. *(See figure 3-2.)*

4-7. The released carbon dioxide is conducted through a flexible hose to a master manifold or header. All the cylinders are connected to the one manifold. From the manifold, eight 1-1/4-inch lines carry the carbon dioxide to the four engines. The two lines going to each engine have connected into them respectively, one solenoid operated stop valve and one pressure operated stop valve. The lines are connected to each valve by two 1-1/4-inch fittings. One valve is operated by a solenoid control head. The other valve, which is connected by tubing to the pressure chamber of the solenoid operated stop valve, is operated by carbon dioxide pressure from the solenoid operated stop valve.

4-8. The body of the solenoid operated stop valve consists of a machined casting with five main openings, two externally threaded connections (figure 4-3, references 1 and 2) to fit the connections of tubing, another (3) to fit the solenoid control head, and two internally threaded openings in the body, of which one takes a plug (4) and the other a cap (5) with tapped hole.

4-9. When the solenoid is energized, its plunger operates and unseats the pilot check which is held closed by the gas pressure from the manifold coming through a gas passage from the main inlet. Unseating the check permits gas to pass through a drilled passage to the center of the stop valve. There it operates a plunger and stem assembly whose stem passes through the center of the stop valve ending just above the main check valve. When the plunger moves, the stem presses against and unseats the main check valve, releasing the gas discharge from the manifold to the engine afire. The main check valve is held closed by a steel spring, and also by gas pressure when the flood valves are open. Gas leakage around the stem and plunger assembly is prevented by a molded composition packing around the plunger and another around the stem. A hole is drilled through the side of the valve body into the dead air space under the stem and plunger assembly in both valves. This is to prevent trapped air blocking the movement of the plunger.

4-10. When the solenoid stop valve operates, released gas is conducted through tubing to the operating piston of the pressure operated valve, unseating the main check valve and releasing the gas. The action of both stop valves follows closely the action of the cylinder flood valves, similarly solenoid and pressure operated.

4-11. The total charge of carbon dioxide is then conducted through the two tubes leading from the stop valves to the engine. There it enters another manifold, from which tubing, spray nozzles and perforated tubing effectively distribute the gas.

4-12. Every cylinder valve is equipped with a safety disc which ruptures when gas pressure within the cylinder becomes excessive due to increased cylinder temperature. Maximum safe storage temperature is 54.4°C (130°F) for non-winterized cylinders, and 71.1°C (160°F) for winterized cylinders, after which the safety disc ruptures. When the disc ruptures, the gas discharges through the outboard discharge tubing to which the safety outlets of all the cylinders are connected. The escaping gas blows out the red celluloid indicator disc at the end of the line, and discharges outside the plane. In the Single-Shot system after the switches have been operated to discharge the cylinders the system cannot be operated again. The cylinders completely discharge the entire carbon dioxide supply.

4-13. OPERATION OF THE MAIN AND RESERVE SYSTEM. *(See figure 3-5.)* The main and reserve system differs from the Single-Shot system in that it is comprised of one main bank and one reserve bank of cylinders which operate independently of each other. In addition, these banks of cylinders are discharged through a double check tee directly into the main discharge line leading to the engine nacelles instead of being discharged into a master manifold or header as in the one-shot system.

**4-14. OPERATION INSTRUCTIONS.**

4-15. In a typical installation there are four electrical switches in the cabin, corresponding to the four engines. When closed, these switches energize and operate the solenoids with the 24-volt DC power of the airplane. In case of fire, proceed as follows:

a. Cut engine by moving mixture control to "IDLE CUT-OFF."

b. Close propeller feathering switch.

c. Close fuel and oil shutoff valves.

d. Operate cowl flap control to open position.

e. AFTER PROPELLER HAS STOPPED ROTATING, turn off ignition switch for engine afire.

f. THEN, close the fire-control switch for the engine fire.

g. Do not attempt to restart engine unless it is absolutely necessary.

# SECTION V
# SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION

## 5–1. SERVICE TOOLS REQUIRED.

5–2. No special tools are required for the maintenance of the Kidde Aircraft Fire Extinguisher, Carbon Dioxide Type, Fixed Installation ½-, ¾-, and 1-inch Valve Types.

## 5–3. SERVICE INSPECTION.

### COLUMN NO. 43—AIRPLANE GENERAL.

5–4. PREFLIGHT INSPECTION. Examine the outboard discharge indicator to make certain the red celluloid disc is intact. If a disc is blown out, one or more cylinders has been discharged through the safety discharge tube. The discharged cylinders must be removed, their cylinder valve safety discs replaced, and the cylinders recharged immediately. Replace red celluloid indicator discs.

5–5. DAILY OR POST FLIGHT INSPECTION. Check $CO_2$ Cylinder Installation date(s), AF Form 41-B.

5–6. 50-HOUR OR INTERMEDIATE INSPECTION. Check $CO_2$ cylinder(s), distribution lines, valves, control heads, solenoids, discharge indicators, fittings, connections, brackets, and wiring or control cables, when applicable, for condition and security of mounting or attachment. Make physical check of $CO_2$ cylinder installation date(s) and correct AF Form 41-B, if necessary.

5–7. SPECIAL INSPECTION. At the first complete 50-hour or intermediate inspection of the airplane following installation of the engine $CO_2$ fire extinguishing system cylinder(s), remove and weigh the cylinder(s). If loss of weight does not exceed five percent (5%) of the initial $CO_2$ charge stencilled on the cylinder(s), the cylinder(s) will be reinstalled in the airplane. However, if weight loss exceeds five percent (5%) of the initial charge, cylinder(s) must be replaced with fully charged cylinder(s) with date or recharge and installation date stencilled thereon.

5–8. 100-HOUR OR MAJOR INSPECTION.

a. Test Fire Extinguishing System Controls.

b. *Electrically operated systems:* Remove solenoids from $CO_2$ cylinder(s), operate switches controlling engine selector valve and $CO_2$ release to determine if solenoids are working properly.

c. *Cable operated systems:* Disconnect the control cable from the $CO_2$ release valve on the cylinder(s), apply approximately five pounds (5 lbs.) tension on the cable and operate back and forth a few times in the housing to make sure cable does not seize or bind. Return release handle to holder and reconnect control cable.

d. Check $CO_2$ distribution tubing, perforations and nozzles for freedom from dirt and foreign matter. Use air hose and check for unrestricted air flow. On systems employing $CO_2$ pressure operated heads, be sure to disconnect $CO_2$ pressure line to the pressure head, and reconnect after system is blown out with air.

5–9. 500-600 HOUR OR 6-MONTH OPERATIONAL TEST. This inspection and test will be accomplished at the first major inspection of the airplane after the accumulation of 500-600 flying hours or at the expiration of 6 calendar months following date of installation, whichever comes first. Actual release of the $CO_2$ through the distribution tubing is necessary to determine condition of the system and will be accomplished as follows:

a. Open engine cowling sufficiently to observe perforated distribution tubing or discharge nozzles.

b. Set the engine selector (switch or mechanical control) to the desired engine.

c. Release system and observe for efficient distribution of $CO_2$ about the engine selected. On multi-engine aircraft, two (2) engines will be tested if a two-shot system is provided. Maintain a record of the engine(s) tested and alternate engine(s) on succeeding tests. Because of the sudden sharp cooling, frost will form on the nozzles, and around the perforations. Those without frost or with noticeably lighter coatings of frost should be checked for stoppages. Upon satisfactory completion of the tests(s) recharge the empty $CO_2$ cylinder(s) and restore the system to its operating condition.

5–10. AFTER EXTINGUISHING FIRE. Inspect the entire system in the area covered by the fires for possible damage to component parts and attaching supports and replace as necessary. Make certain the openings in the spray nozzles or perforated tubing are free from dirt and foreign matter. Make sure switches are "OFF," reinstall fully charged $CO_2$ cylinder(s) and restore the system to an operating condition.

## 5–11. MAINTENANCE.

5–12. REMOVAL OF CYLINDERS.

**WARNING**

Follow the instructions closely when removing cylinders for weighing or recharging. Loss of gas and injury to personnel may result from carelessness. Always remove control heads first and replace last.

a. Disconnect the pressure control heads and the interconnectors with attached solenoid control heads, by turning the mounting nuts counterclockwise. Support each unit above its cylinder until all the cylinders are free. Then keeping the units and their connecting tubing in their normal relationship, lift them entirely free of the cylinders.

b. Remove the discharge hose from the cylinder valve main outlet. Disconnect the safety discharge tubing from the outboard coupling of each cylinder valve. Support all this tubing in its normal position as much as possible.

c. Unscrew the bolts holding the cylinder bracket closed and remove the cylinders.

5-13. REINSTALLATION OF CYLINDERS.

a. Set the cylinders in the brackets and tighten the bolts sufficiently to hold them loosely in place for any adjusting required in connecting the tubing.

b. Connect the safety discharge tubing to the outboard couplings. Connect the flexible hose to the cylinder valve main discharge outlets.

c. Check the solenoid control heads by closing the switches and making certain the plunger of the interconnector operates as the switch is closed. Return switch to "OFF" position.

d. Check the operation of the series cable control heads and then reset the controls by placing a pin in the shaft and turning counterclockwise until the arrows on the shafts line up with the arrows on the covers.

e. Place the solenoid control heads or the series cable control heads, with attached interconnectors and the pressure control heads, in place on the cylinder valves. Tighten the mounting nuts.

5-14. RECHARGING THE CYLINDERS.

**WARNING**

Cylinders must be charged with completely dry carbon dioxide and, where winterization is required, with completely dry nitrogen. Any moisture will freeze in the tubes and valves at the extreme cold of high altitude, possibly rendering the extinguisher inoperative.

5-15. The control head should be detached from the cylinder valve. If the cylinder was discharged by rupture of the cylinder valve safety disc, be sure this has been replaced. Make certain the cylinder is empty by weighing it and seeing that its weight agrees with the empty weight specified on the cylinder and valve body.

a. Assemble the recharging adapter, part number 933537, to the control head outlet of the ¾- and 1-inch flood valves. Recharging adapter, part number 200009, is connected to the valve outlet of the ½-inch flood valve.

**Note**

If winterization is *not* required, disregard steps b. and c.

b. Connect a line from a nitrogen supply cylinder to the adapter.

c. Open the nitrogen valve, allowing the nitrogen to flow in until the pressure reaches 200 psi (±10 psi) measured at room temperature 21.1°C (70°F). The force of the spring holding the main check in position in the ½-inch flood valve is approximately five pounds. When winterizing with nitrogen, an additional pressure of five psi should be maintained in the nitrogen line to overcome the force of the spring. Compensate for variation in temperature by charging according to the following table:

| GAS TEMPERATURE | | FILLING PRESSURE |
|---|---|---|
| *Deg. Fahr.* | *Deg. Cent.* | *Pounds per square inch* |
| 30 | -1.1 | 185 |
| 40 | 4.4 | 188 |
| 50 | 10.0 | 192 |
| 60 | 15.6 | 196 |
| 70 | 21.1 | 200 |
| 80 | 26.7 | 204 |
| 90 | 32.2 | 207 |
| 100 | 37.8 | 211 |
| 110 | 43.0 | 215 |
| 120 | 49.0 | 219 |

d. When the desired nitrogen pressure has been reached, charge the cylinder immediately with the proper weight of carbon dioxide as follows:

| *Cylinder Volume (cu. in.)* | *Normal $CO_2$ Charge (lbs)* | *Winterized $CO_2$ Charge (lbs)* | *Total Weight of Charge ($CO_2 + N_2$) (lbs)* |
|---|---|---|---|
| 57 | 1.4 | 1.03 | 1.07 |
| 96 | 2.36 | 1.73 | 1.79 |
| 205 | 5. | 3.70 | 3.83 |
| 295 | 7.25 | * | 7.25 |
| 514 | 12.6 | 9.28 | 9.61 |
| 646 | 15. | 11.66 | 12.07 |
| 853 | 20. | 15.40 | 15.95 |

* Nonwinterized cylinder

e. Connect the carbon dioxide charging line to the adapter. Then open the valve in the charging line. The pressure of the gas will automatically open the cylinder valve.

f. When the proper gas charge is reached, close the valve in the charging line. Sudden release of pressure in the charging line will enable the pilot check to seat, closing the valve. If the gas charge is excessive, reduce it to the proper amount by using a blow-off fixture. This consists of a freely vented handwheel which depresses the pilot check. Remove the recharging adapter and replace with the blow-off fixture. Turn the handwheel until the fixture pin contacts the pilot check. Further rotation will depress check allowing carbon dioxide to escape through holes in fixture. When blowing down to desired weight, make certain weight of fixture is considered.

5-16. TESTING. Test the cylinder and valve for leakage as follows:

**WARNING**

Water trapped in the control head will freeze at high altitudes and possibly prevent the proper functioning of the extinguisher.

5-17. ¾-INCH FLOOD VALVE.

a. Place valve outlet *only* into a small cup of water.

b. After testing valve outlet for leakage, tilt cylinder so that side hole in control head outlet is above center hole (pilot check stem hole). Place enough water in control head outlet to cover center hole only.

**CAUTION**

Do not allow any water to enter side hole.

c. If any bubbles are detected, they may be the result of trapped air, not leakage of valve. Release these bubbles and retest.

d. Remove water from control head outlet; then remove all traces of water by wiping dry with a suitable absorbent material.

5-18. 1-INCH FLOOD VALVE.

a. With the cylinder in a horizontal position and the discharge outlet up, test the main check for leakage by pouring water into the valve, filling the discharge outlet almost to the top. Be careful that no water spills over the top of the outlet (between the outlet and the floating nosepiece) as it may enter the passages under the nosepiece and possibly prevent operation of the valve. Empty the water from the valve and clean with an air hose.

b. Place the valve cover *only* (including the safety disc retainer) into a small cup of water.

c. Tilt the cylinder so that the side hole in the control head outlet is above the center hole (pilot check stem hole). Place enough water in the control head outlet to cover the center hole only. If any bubbles are detected, they may be the result of trapped air, not leakage of valve. Release these bubbles and retest.

**CAUTION**

Do not allow any water to enter side hole.

d. Remove all water, wiping dry with suitable absorbent material, and stencil the required date on the cylinder.

e. Fill in the date and weight record table on the tag attached to the cylinder (applicable only to cylinders installed in an inaccessible location).

5-18A. ½-INCH FLOOD VALVE.

a. Test for leakage by immersing the cylinder and valve in water.

b. Drain all water from the valve. To facilitate drainage from the main check, hold floating nose piece flat against the valve outlet. Blow clear with compressed air.

5-19. To charge cylinders with nitrogen that are already charged with carbon dioxide proceed as follows:

a. Attach a blow-off fixture as described in paragraph 5-15.f. of this section. With the cylinder on a scale reduce the charge of carbon dioxide to the proper carbon dioxide charge. See the preceding table.

b. Attach the recharging adapter and nitrogen line to the cylinder valve.

c. Take a pressure reading of the clyinder. Then open the nitrogen valve slowly and carefully until the cylinder shows pressure increase of 200 psi or the corresponding pressure according to the preceding table.

d. Weigh the cylinder for the total combined charge of carbon dioxide and nitrogen. (See table.)

**5-20. LUBRICATION.**

5-21. No lubrication in any part of the system is required.

**5-22. SERVICE TROUBLES AND REMEDIES.**

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| DISCHARGE FROM SAFETY OUTLET DURING CHARGING | Blown safety disc. | Replace safety disc. |
| LEAKAGE AT CYLINDER PILOT CHECK VALVE | Foreign matter or nick in pilot check seat. | Renew pilot check or reface seat with proper reseating tool. |
| LEAKAGE AT VALVE OUTLET | Foreign matter or nick in main check seat. | Renew main check or reface seat with proper reseating tool. |
| LEAKAGE AT SAFETY DISCHARGE OUTLET | Loose safety disc plug retainer. | Tighten securely. |
| NON-OPERATION OF SOLENOID CONTROL HEADS | Defective wiring from switch to valves, defective coil or insulation in solenoid, defective plunger, bushings or molded packing. | Check wiring with high voltage tester. Check insulation with same. Check action of plunger in solenoid; replace any necessary parts. |

| TROUBLE | PROBABLE CAUSE | REMEDY |
|---|---|---|
| NON-OPERATION OF VALVE (¾- and 1-inch) | Empty cylinder. | Recharge. |
| | Loose piston cap. | Retighten securely. |
| | Large piston packing cut. | Replace packing. |
| NON-OPERATION OF VALVE (1-inch only) | Gas leakage at tube nut. | Tighten tube nut securely. |
| SERIES CABLE CONTROL HEAD INOPERATIVE | Cable fouled or broken. | Check cable and routing. |
| PRESSURE SWITCH INOPERATIVE | Defective wiring. | Check wiring. |
| | Defective switch. | Replace switch. |
| TWO-WAY DIRECTION VALVE INOPERATIVE | Defective wiring. | Check wiring. |
| | Defective solenoid. | Replace. |