INSTRUCTIONS GEK-28138

HIGH PRESSURE CARBON DIOXIDE FIRE PROTECTION SYSTEM FOR PACKAGE GAS TURBINES

INTRODUCTION

The carbon dioxide (CO_2) fire protection system supplied with package G.E. gas turbines is designed to extinguish fires by reducing the oxygen content of the air in the compartment from an atmospheric normal of 21 percent to less than 15 percent, an insufficient concentration to support combustion for turbine fuel and lubricating oil. The system design is in accord with the requirements of NFPA Pamphlet 12; and, recognizing the reflash potential of combustibles exposed to high temperature metal, it provides an extended discharge to maintain an extinguishing concentration for approximately 40 minutes to minimize the likelihood of reflash condition.

DESCRIPTION

The CO2 is supplied from a bank of high pressure cylinders to a distribution system which conducts the CO2 through pipes to discharge nozzles located in the various compartments of the gas turbine package.

The solenoid pilot valves which open CO2 cylinders and initiate the discharge are located at the cylinder group. These are automatically actuated by an electrical signal from the heat-sensitive fire detectors which are strategically located in the various compartments of the unit. The system may also be manually actuated in the event of an electrical power failure by means of a manual handwheel at the top of each pilot CO2 cylinder. Actuation of the system, either electrically or manually, will trip the turbine. Two spearate systems are used: initial discharge and extended discharge. Within a few seconds after actuation, sufficient CO2 flows from the initial discharge system into the compartment of the machine to rapidly build up an extinguishing concentration. This concentration is maintained for a prolonged period of time by the gradual addition of more CO2 from the extended discharge system.

NOTE

If the CO2 system is to be effective, the compartment panels must be in place and the compartment doors closed. There is sufficient CO2 in the system to compensate for leakage through ventilation openings which are not closed by CO2 operated dampers and unavoidable cracks in the package lagging, but there is not enough to allow for uncontrolled escape of CO2 through open panels or doors.

WARNING

Carbon Dioxide, in a concentration sufficient to extinguish fire, creates an atmosphere that will not support life. It is extremely hazardous to enter the compartments after the CO2 system has been discharged. Anyone rendered unconscious by CO2 should be rescued as quickly as possible and revived immediately with artificial respiration. The extent and type of safeguards and personnel warnings that may be necessary must be designed to meet the particular requirements of each situation. It is recommended that personnel be adequately trained as to the proper action to take in case of such an emergency.

OPERATION

In order to better understand the CO2 system, a brief description of its operation and distinctive features is given in the following paragraphs. Refer to the CO2 system schematic piping diagram (Figure 9).

Should a fire occur in one of the protected compartments of the unit, the solenoid pilot valves 45CR-1 and 45CR-2 (Figure 1), located on each of the two pilot CO2 cylinders in the control compartment, will be energized by one of the heat-sensitive fire detectors, 45FA, 45FT, or 45FG.

When the solenoid pilot valves are energized, pilot cylinder pressure is applied to the pistons of the pilot cylinder discharge heads (Figures 2 and 2A) causing their pistons to move down, thereby opening the pilot cylinder valves (Figure 2A). The cylinder valve is designed to remain open until the cylinders are empty.

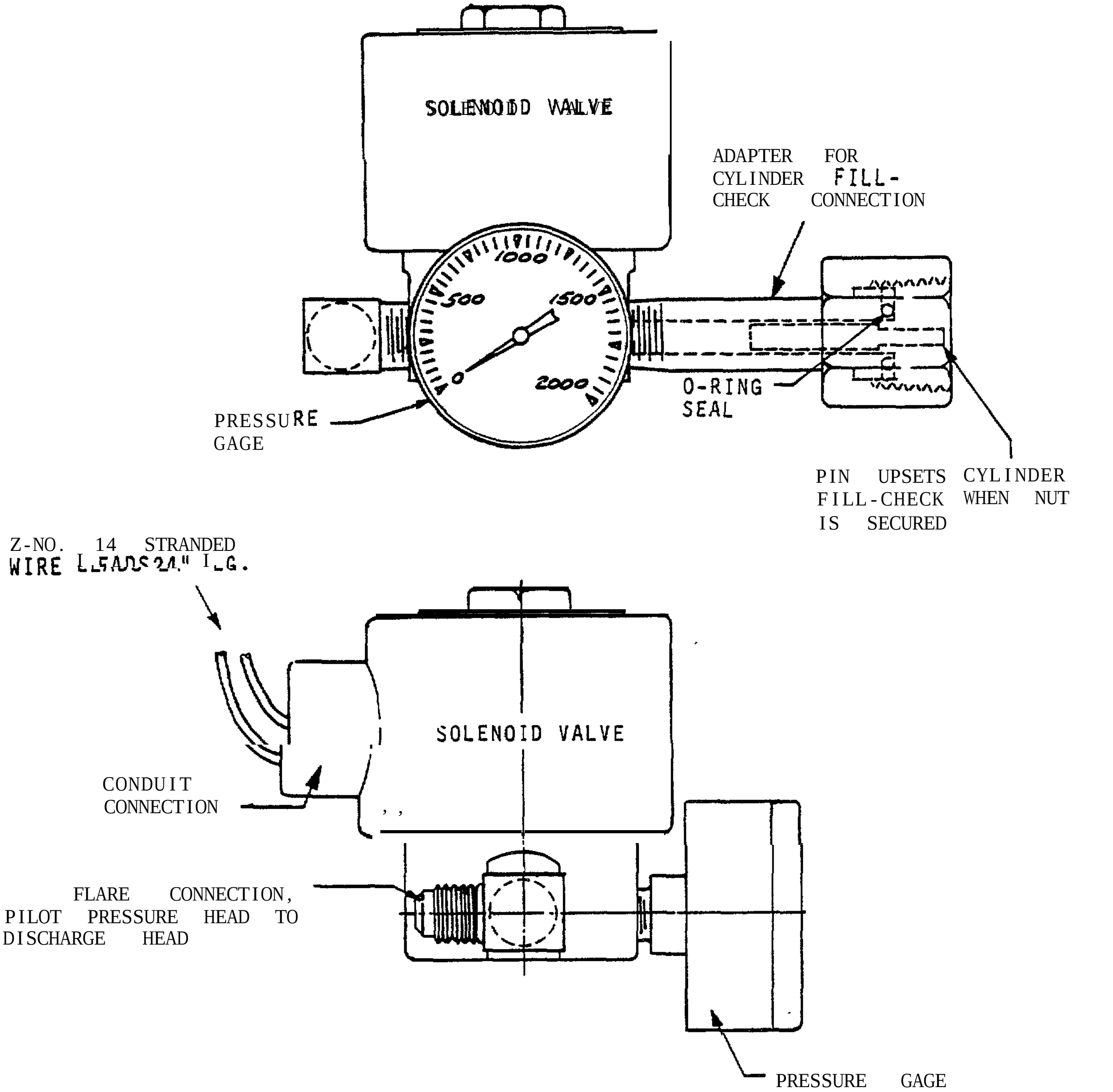


Figure 1. Solenoid Pilot Valves 45CR-1 and 45CR-2.

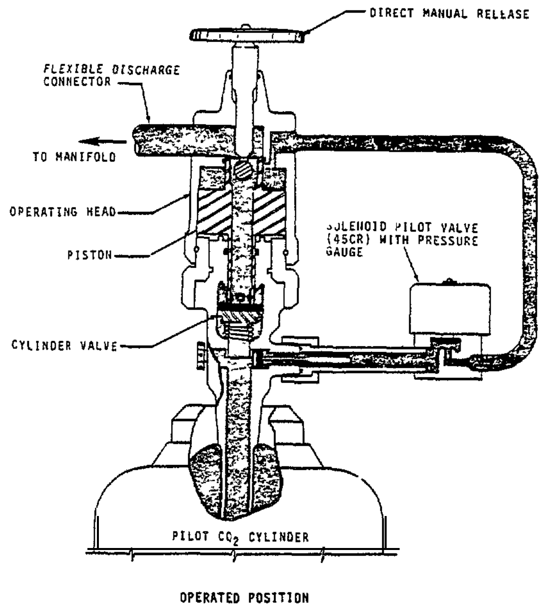


Figure 2. Pilot Cylinder Discharge Heads.

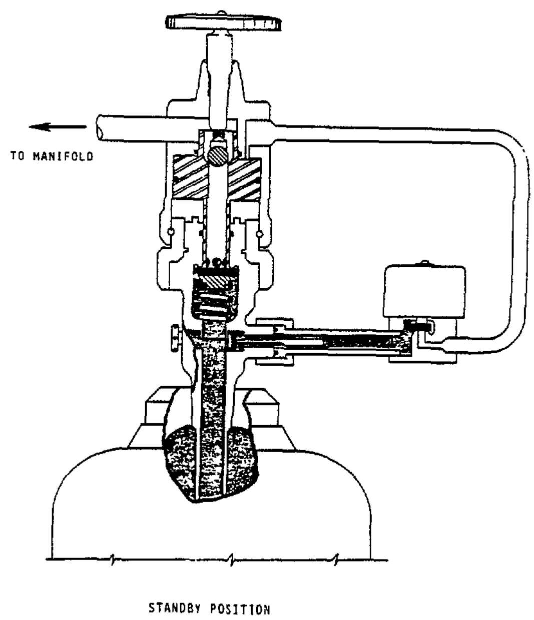


Figure 24. Pilot Cylinder Discharge Heads.

With the pilot cylinder valves open, discharge of their contents passes through the flexible discharge connectors to the cylinder manifold and piping system. The pressure developed in the manifold by the pilot cylinder discharge causes the balance of the primary discharge cylinder valves to open, thereby discharging their contents into the cylinder manifold and primary discharge piping system.

Manifold pressure is also applied through a differential pressure check valve to the extended discharge cylinders causing their valves to open and discharge their contents through the extended discharge piping system.

The differential pressure check valve prevents extended discharge from entering the primary discharge manifold and piping system. A pressure switch (45CP) connected to the manifold, serves to perform alarm and shut-down functions.

The CO2 flow rate is controlled by the size of the orifices in the discharge nozzles in each compartment for the initial and extended discharge system. The orifices for the initial discharge system permit a rapid discharge of CO2 to quickly build up an extinguishing concentration. The orifices for the extended discharge system are smaller and permit a relatively slow discharge rate in order to maintain the extinguishing concentration over a prolonged period of time. By maintaining the extinguishing concentration, the likelihood of a fire reigniting is minimized.

INSTALLATION

ASSEMBLY INSTRUCTIONS

The package power plants are shipped with the CO2 distribution piping and nozzles installed in the compartments. The CO2 release mechanisms, manifold, and wiring are factory assembled and installed in the control compartment. It is only necessary to connect the piping between the control compartment and accessory compartment.

CYLINDER INSTALLATION

The cylinders should be weighed before they are installed on the rack. The weight of each cylinder should be compared to the weight stamped on the cylinder valve body or shown on the weight record tag attached to the cylinder. Any cylinder showing a weight loss in excess of 7.5 pounds for 75 pound cylinders or 10 pounds for 100 pound cylinders should be recharged. Install cylinders in the rack as shown in Figure 3.

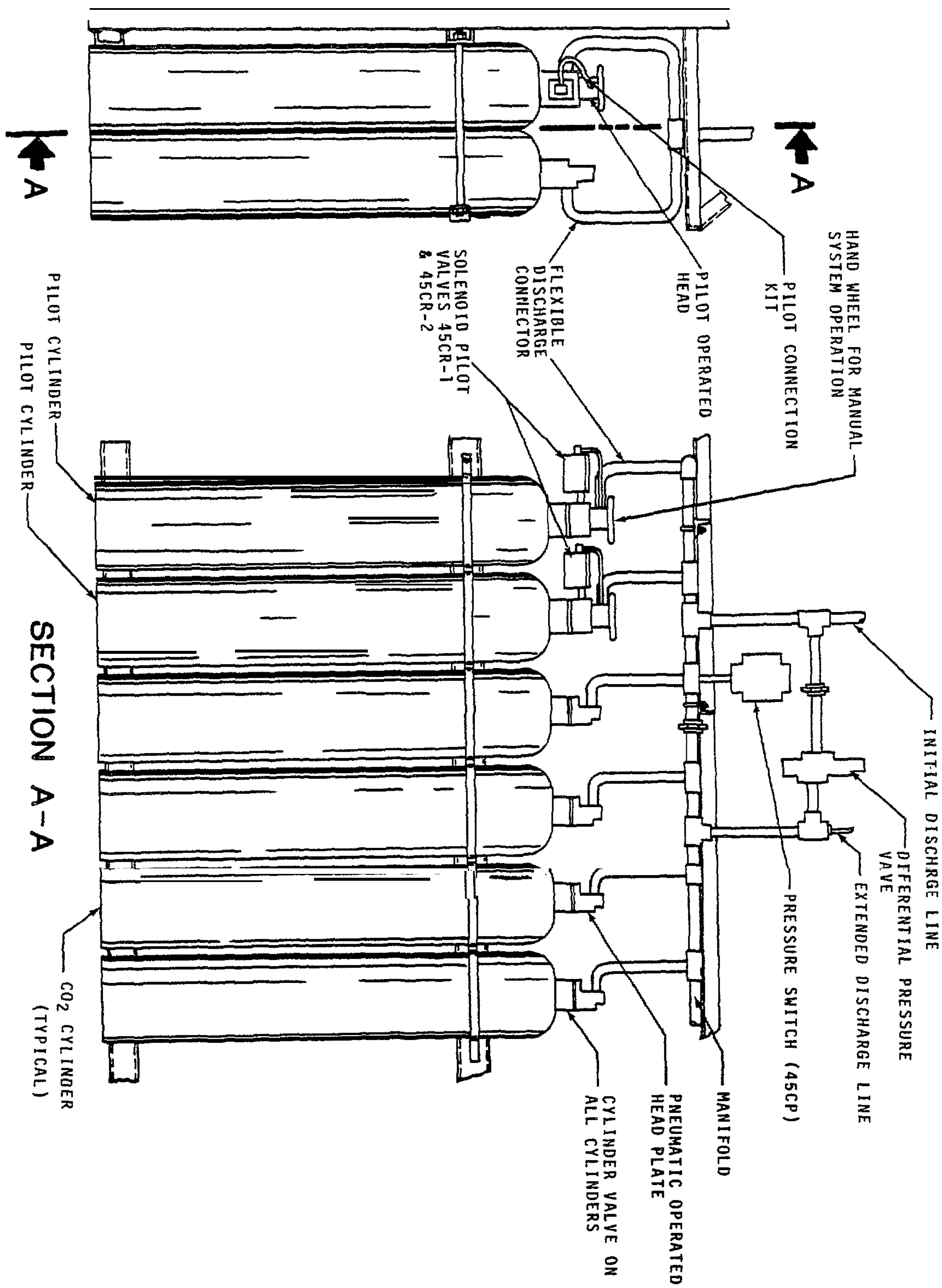


Figure 3. C-2 Cylinders in Rack

DISCHARGE HEAD AND SOLENOID PILOT VALVE INSTALLATION

Since the cylinders cannot be discharged without their discharge heads in place, all connections to the discharge heads must be made with the heads disconnected from the cylinders to avoid accidental discharge during assembly.

Connect the non-union end of the 1/2-inch flexible discharge connectors to the manifold connection points (Figure 3), wrench tight. Connect the union end of the connectors to the discharge outlets of the discharge heads. See Figure 4 for the two pilot operated heads and Figure 5 for the pneumatic operated heads. Make certain that the pilot cylinders receive the pilot discharge heads (handwheel at top).

The pilot connection kit- (Figure 6) includes a 3/16-inch flexible pilot connector and 1/4-inch NPT X 1/4-inch flare elbow. Apply the elbow to the 1/4-inch pilot port of the pilot discharge heads and connect one end of the 3/16-inch pilot connector to the elbow.

Remove the protective caps from the fill check connectors (Figure 7) on the two pilot cylinders valve bodies and connect the solenoid pilot valves by means of the union nut to the connection piece. The connection piece has an internal push-pin which upsets the fill check valve when the union nut is tightly secured. An "O" ring seal inside the union nut is designed to seal the connection before the nut is fully tightened thereby eliminating any blow-by of CO_2 vapor when the fill check is upset. The pressure gauge on the solenoid pilot valve assembly serves to indicate when the fill check has been upset by registering cylinder pressure. The guage should read approximately 840 psi when the cylinder contents are 70 °F. Cylinder pressure will vary with cylinder temperature.

Make electrical connections to the solenoid-pilot valves. Connection should be made with 1/2-inch flexible conduit terminating in a junction box behind the pilot cylinders. The solenoid pilot valves are provided with 24-inch pigtails which must be pulled through 1/2-inch flexible conduit when attaching the flexible conduit to the solenoid valve. Then connect pigtails to the detection circuit wiring.

NOTE

> All of connections described in the preceding section are to be made before the operating heads are attached to the cylinder valves. The solenoid valve test described in the following paragraphs is also to be conducted before the operating heads are attached to the cylinders.

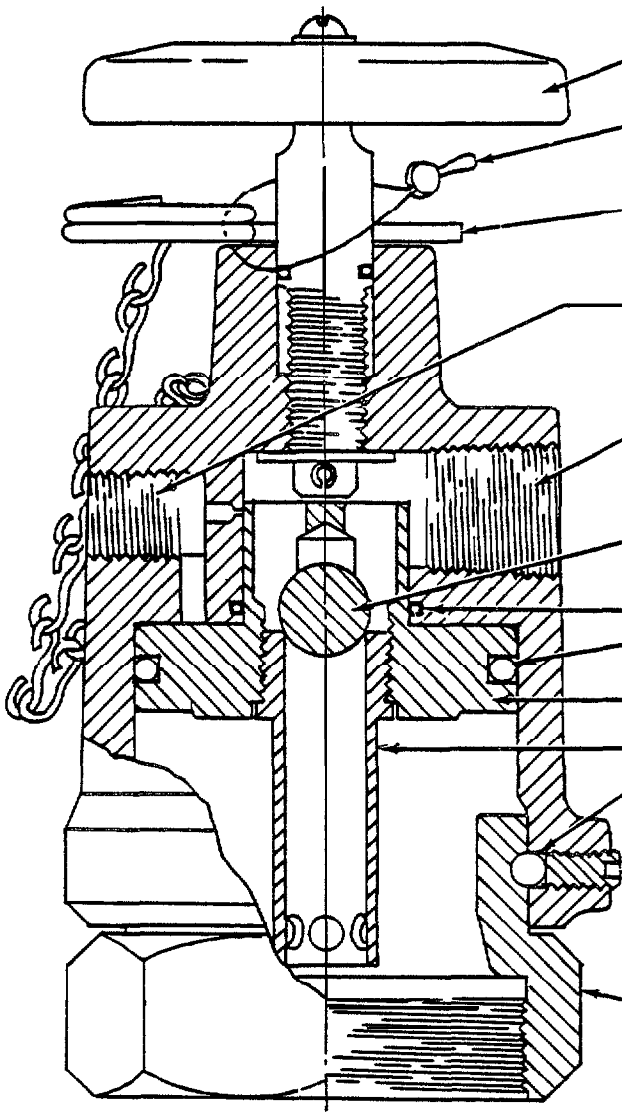


Figure 4. Pilot Operated Heads.

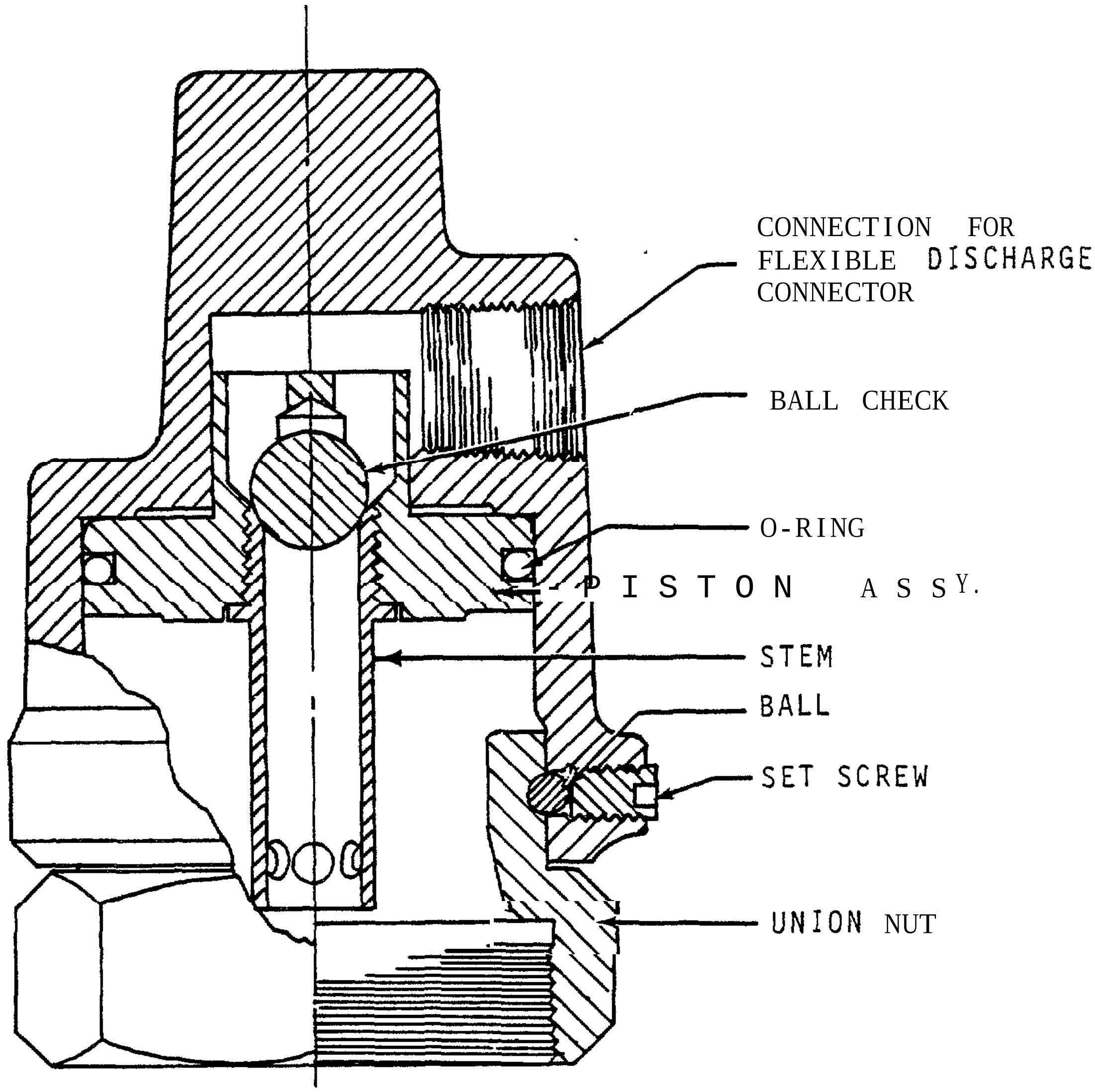
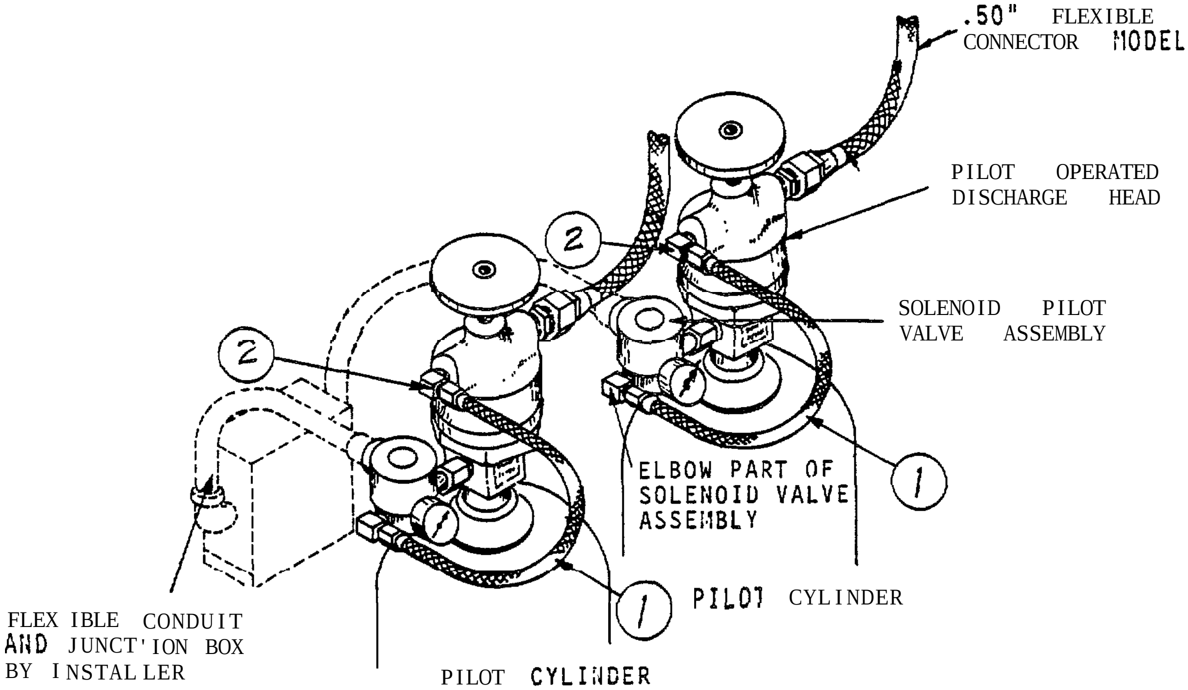


Figure 5. Pneumatic Operated Heads.



ITEM	ITEM QUANTITY KIT 1-26 -0261	KIT 1-26 -0262	DESCRIPTION	ITEM STOCK NUMBER
1	1	1	.18" FLEXIBLE HOSE	1-26-0260
2	1	2	ELBOW, .25" FLARE, .25" MALE NPT	54463

KIT NO. 1-26-0261 FOR SINGLE PILOT CYLINDER
KIT NO. 1-26-0262 FOR TWO PILOT CYLINDERS

Figure 6. Pilot Connection Kit.

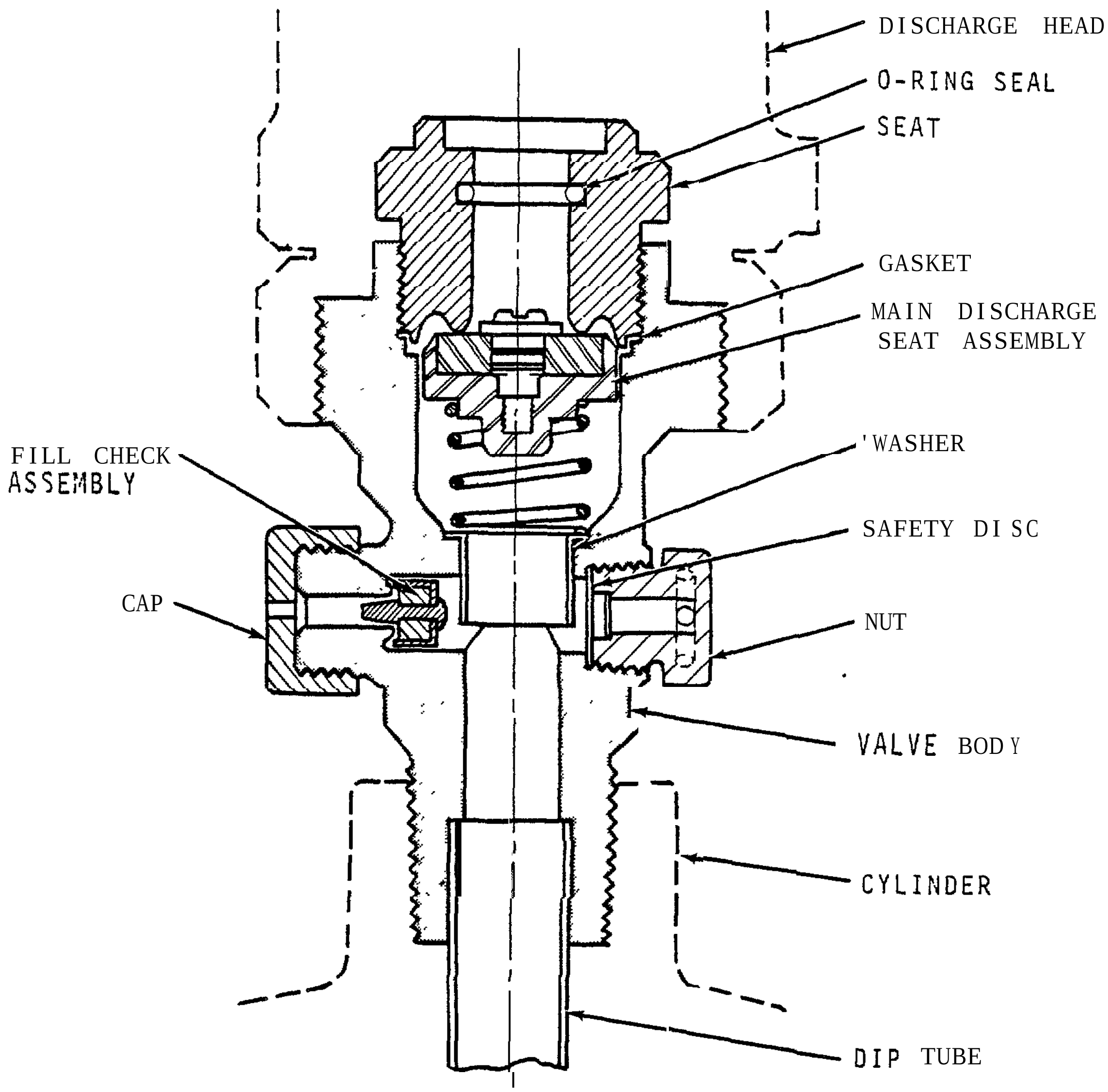


Figure 7. Cylinder Valve and Dip Tube.

TESTING

Two separate tests are necessary to insure that the CO_2 system is ready for operation. These tests are: (1) solenoid pilot valve test and (2) "puff" test.

SOLENOID PILOT VALVE TEST

With control power on the detection circuit, energize the solenoid pilot valves by shorting across the detection circuit to simulate detector actuation. The resulting actuation of the solenoid pilot valves should cause the pilot cylinder pressure to be applied above the pilot discharge head piston which in turn should cause the piston and its associated stem to move down. In the operated position the end of the stem will be about 3/16-inch from the bottom of the discharge head union nut.

De-energize the solenoid valves and push the stem of the discharge head up as far as possible with the thumbs of both hands. In the non-operated position, the end of the stem should be approximately 13/16-inch from the bottom of the discharge head union nut.

CAUTION

> It is important that the stems of the discharge heads are in the retracted (non-operated) position prior to attachment to the cylinder valves to avoid accidental discharge of the cylinder when applying the discharge heads to the cylinders.

PUFF TEST

At this point a "puff" test can be run. This involves discharging two cylinders into the system piping as a final check of the operation of the release devices and to insure that all pressure operated latches and ventilation dampers operate properly. Conduct the "puff" test as follows:

1. Inspect the ventilation dampers in the accessory, turbine and load gear compartments. They should all be latched in the open position with the CO_2 operated latches.

2. Attach the discharge head to one pilot cylinder valve and to one of the non-pilot primary discharge cylinder valves. The balance of the discharge heads are to be disconnected from the cylinders. A check valve arrangement in each will prevent discharge from these unconnected heads when the connected cylinders are discharged.

CAUTION

Be sure that the stems of the discharge heads are in the retracted, non-operated position.

3. Clear all personnel from the compartments and close all compartment doors.

4. Pull the operating pin on the 45CP pressure switch (Figure 8). This action will close the electrical circuit; or as an alternate, short circuit one of the tire detectors

5. When the system starts to discharge, the pressure switch will be actuated to trip the turbine. The fire alarm bell in the accessory compartment should ring, the fire flag on the annunciator should drop, and the 45FTX relay which will trip the turbine should be energized. Some turbines are eauipped with a compartment ventilating fan located under the inlet plenum. This fan should also stop.

6. After CO2 discharge has stopped, reset the pressure switch by pushing the reset plunger in.
When the compartments are clear of C02, inspect to see that all ventilation dampers have operated properly, and after inspection reset the dampers to the OPEN position.

7. Remove the two discharged cylinders, recharge to full capacity, and re-install in the rack.

8. Push stems of all discharge heads to the non-operated position as previously described in step 2.
Then connect all discharge heads to their respective cylinder valves by means of their union nuts - hand tight.

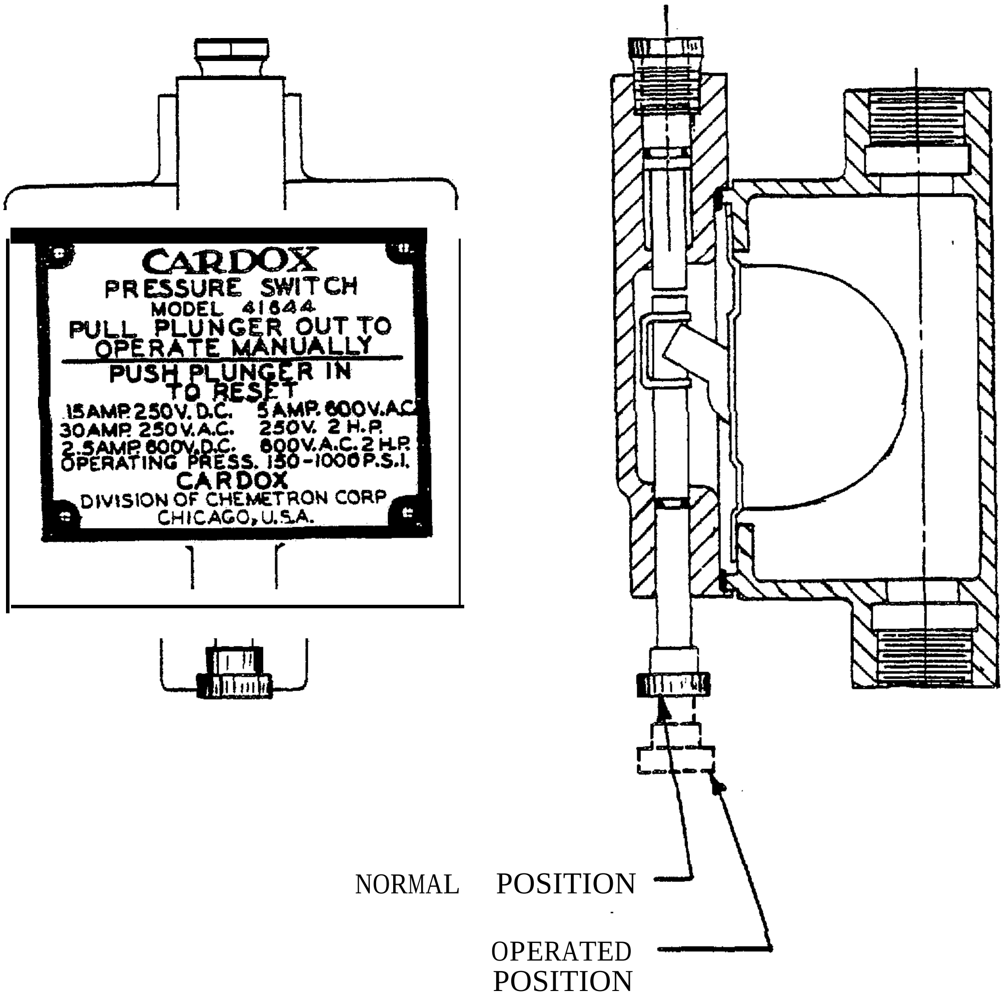


Figure 8. Pressure Switch 45CP.

NOTE

It may be necessary to loosen the union nut of the 1/2-inch flexible discharge connectors in order to ease any strain on the connectors once the heads are installed. If so, make sure the union nuts are all tightened after adjustments have been made.

MAINTENANCE

CYLINDERS

Only Cardox 75 pound (B50410-2) or 100 pound (B50410-3) cylinders (as the case may be) can be used in the fire protection system. Commercial CO2 cylinders other than those referenced above are not compatible with the discharge heads used in the CO2 systems. In cases where cylinders are not furnished with the turbines, they may be ordered from Cardox Division of Chemetron Corporation, 111 East Wacker Drive Chicago , Illinois.

NOTE

The CO2 fire protection system maintenance and inspection procedures discussed in the following paragraphs comply with the requirements contained in National Fire Protection Association Standard 12, Carbon Dioxide Entinguishing Systems, and are the minimum considered necessary to provide for a reliable system in good working order.

In some cases, fire insurance company inspectors, local fire departments and municipal codes may require additional or more frequent inspections and test

Maintenance of the CO2 system may be broken down into four phases of tests and inspections which must be conducted at regular intervals. These phases are as follows:

Phase I - Weigh storage cylinders and test solenoid pilot valves semi-annually

Phase II - System test - annually

Phase III - Inspect and repair package lagging - annually

Phase IV - Visual inspection - monthly

Phase I: Weigh storage cylinders and test solenoid pilot valves - annually

At least semi-anually disconnect the discharge heads from all cylinders and disconnect the solenoid pilot valve assemblies from the pilot cylinders and weigh each cylinder. If at any time a cylinder shows a loss in net weight of more than 10 percent, it should be re-filled or replaced.

The empty and full weights of all cylinders are permanently stamped on the cylinder valve bodies. Each time the cylinders are weighed, the date of weighing and the net weight should be recorded on a tag attached to the cylinder.

At least semi-annually perform the solenoid pilot valve test described on page 12 to ascertain that the piloting system is in good working order.

Phase II - System Tests - annually

Fire protection system tests are relatively simple to make and any deficiencies are easily corrected. Before any tests are conducted the person making the tests should review and thoroughly understand the schematic piping diagram, elementary wiring diagram, andall the information contained in these instructions.

At least annually the puff test described on page 12 of this instruction should be conducted. This test will demonstrate that the CO2 system, the compartment ventilating dampers, and other devices associated with the CO2 system and described under the puff-test instructions are operating properly. Electrical continuity of the fire detection circuit should also be tested at this time.

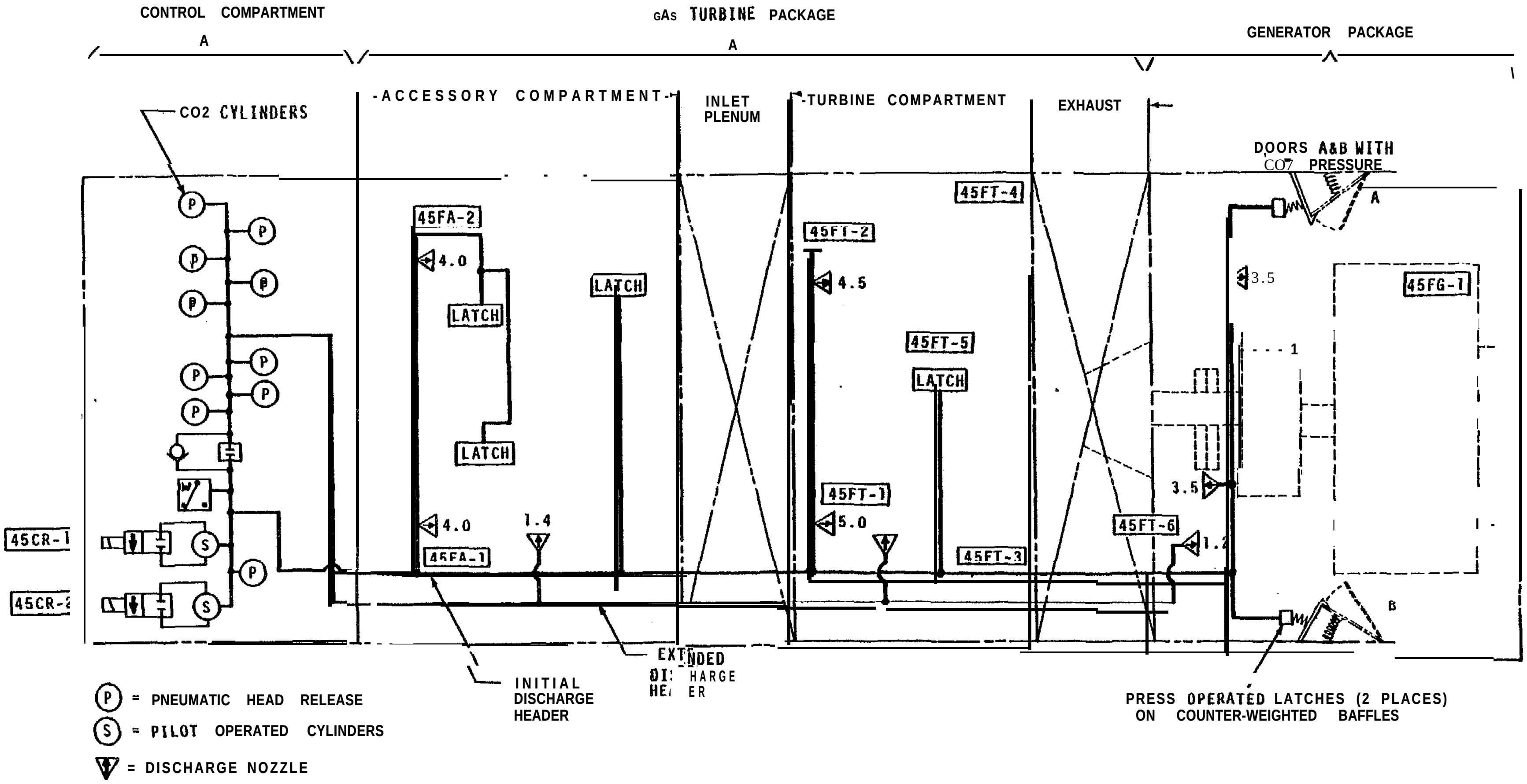
Each fire detector should also be tested for proper operation by heating it in an oil bath or with a heat lamp. Do not use a propane torch to heat the detector because the high flame temperature of the torch may destroy calibration of the detector. The temperature setting of the detector is stamped on its identification plate. It is not possible to accurately check the calibration of the detector by heating it in an oil bath or with a heat lamp because the set point of the detector is sensitive to the rate of heating which cannot be easily determined without specialized equipment. If it is suspected that a detector is out of calibration it should be replaced.

Phase III:- Inspect and repair package lagging - annually

Once each year, the joints in the lagging panels, roof, doors, and base should be inspected to be sure they are tight. If the joints are not tight the loss of CO_2 will be greater than can be supplied and the concentration of CO2 will not build up inside the compartments to the required value. The easiest way to make the inspection is to stand inside each compartment on a bright? sunny day with the compartment lights off. No light should be visible through the joints. Particular attention should be paid to all doors, the joint between the generator compartment and the back side of the exhaust plenum, and the joint between the generator and turbine bases. In general, joints which are not tight should be re-gasketed. Doors frequently can be tightened up by adjusting the striker plates.

Phase IV: - Visual system inspection - monthly

Once every month the CO2 system should be visually inspected to see that it is in proper working order. The pressure gauges on the pilot-operated cylinders should be read in order to be sure that the cylinders are at the proper pressure. The pressure is dependant on the cylinder temperature. At a temperature of 50 °F the pressure should be about 650 psig, at 70 °F the pressure should be about 840 psig, and at 105 °F the pressure should be about 1250 psig. The ventilation dampers should be examined to see that they are unobstructed and latched in their proper position.



SCHEMATIC DIAGRAM OF HIGH PRESSURE CO2 FIRE PROTECTION SYSTEM FOR PACKAGE POWER PLANTS.

FIGURE 9