INSTRUCTIONS

GAS DETECTOR RELAY
MODEL 11, MODEL 11BC, AND MODEL 12

INTRODUCTION

The gas detector relay is a protective device that gives an early indication of faults occurring in oil filled conservator type power transformers. These faults fall into two general classes:

(1) Faults of an incipient or minor nature resulting in a slow evolution of gas. This gas may be generated by local heating, defective insulating structures, improperly brazed joints, loose contacts, grounds, short circuit turns, burning of core steel, or from air in the transformer.

(2) Faults of a major nature that generates a sudden pressure wave. Major faults are usually caused by flashover between parts.

The relay will detect either of these classes of faults.

DESCRIPTION

An outline of the Gas Detector Relay is shown in **Figure 1**.

The relay consists of two sections:

A. A Gas Accumulation Chamber at the top. It consists of:

1. An oil chamber with a gas escape bleeder needle valve having a flame protective screen mounted in a protective recess at the top of the casting. (The Model 12 does not have a flame protective screen)
2. A 75mm magnetic oil gauge with a microswitch.
3. An opening in the bottom of the casing to allow gas to enter from the pressure chamber below.

B. The Pressure Chamber at the bottom. It consists of:

1. An oil chamber at the rear connected to the transformer by a 3/4” pipe in the back of the casing.

NOTE:

A tubular fibre shipping plug is installed to prevent damage to the bellows during handling and transportation. It is to be removed immediately prior to installation but must be reinstalled if the relay is to be moved separately or on the transformer.

2. A test check valve located at the base of the oil chamber.
3. A sensitive brass bellows that separates the oil chamber from, but is part of the pressure operating mechanism.
4. A stop to prevent overtravel of the bellows.
5. A flexible diaphragm.
6. A microswitch.
7. The Model 11 and 11BC Gas Detector Relays have a small leaf spring valve fastened to the diaphragm support. This by-pass valve controls the rate of flow of the air escaping from the bellows side to the front of the diaphragm. The normal setting is indicated by a punch mark on the dial. This gives a rate of pressure rise of approximately 3.5 kPa / 0.5 PSI per second rate of pressure rise, the amount required to actuate the micro switch. Refer to the cross section shown in **Figure 2**.

   For the Model 12, the sensitivity of the pressure chamber is fixed by a small by-pass assembly, which is fastened to the diaphragm support. This by-pass controls the rate of air escaping past the diaphragm from the bellows side to the front of the diaphragm. The sensitivity is approximately 0.7kPa / 1.0 PSI per second rate of pressure rise. The micro-switch is adjusted to close when 17.2 kPa is applied with either little or no air by-passing the diaphragm. Refer to the cross section shown in **Figure 3**.

8. A large silicone rubber diaphragm. This diaphragm is located behind the inspection cover and seals all the air in the front section. It is designed to equalize the internal pressure with that of the external pressure due to changes in ambient temperature and pressure.

INSTALLATION

NOTE:

The design allows for a maximum oil head over the top of the relay of 1.5 metres

1. Mount the relay at the highest point on the transformer cover with the gas escape bleeder valve below the minimum level of the oil in the conservator.
2. Locate the relay within 150mm of the edge of the transformer cover and clear of live parts. The natural frequency of the mounting should not be less than ninety cycles per second.
3. Install a direct connection between the transformer cover and the entrance to the relay to provide a path for the pressure wave.
4. To prevent damage to the bellows through shock in transporting the relay, a removable shipping plug, (18 mm wood doweling for a Model 11 and a foam dowel for a Model 12) is installed in the factory. In order to connect the relay, remove the ¾" pipe plug and remove the shipping plug located immediately behind the pipe plug. The shipping plug must be removed prior to making connections to the relay. The shipping plug must also be replaced whenever the relay is to be transported any distance, either mounted on the transformer or not.
5. Mount the relay as shown in **Figure 4**. The connection should allow all the gas formed in the transformer to gather in the Gas Accumulation Chamber.

WARNING

ALL GAS PIPING TO THE RELAY MUST HAVE POSITIVE SLOPE

The valve in the pipe connection to the relay must be closed while the pressure test for oil leaks on the transformer is made. Sudden application of pressure over 20 kPa and up to 34 kPa to the relay may require that the relay be recalibrated. Sudden pressures over 34 kPa may damage the relay.

OPERATION

Gas Accumulation

The presence of gas in the relay indicates the possibility of a fault in the transformer. If the gas is flammable, decomposition gases are present and the transformer should be disconnected until the fault has been located and cleared. If the gas is not flammable, the unit should be left in service. The gas should be let out through the bleeder valve until oil emerges and the time and rate of gas accumulation should be noted. The air could be coming from a leak in a forced oil system or could be released from the oil itself after the transformer is placed in service.

The rate of accumulation of gas is more important than the total volume produced. Record of either time intervals between alarm or alarm chamber pointer positions against time, will indicate the degree of urgency of de-energization. A slow, uniform gas accumulation does not indicate immediate need for disconnection. However, accumulation at an accelerating rate does indicate that the transformer should be de-energized as soon as possible for examination and correction. Proceed as follows:

1. Take a syringe sample of the gas.
2. Take a syringe sample of the oil from the transformer.
3. Have both samples analyzed for types and quantities of gas present.

Check with transformer manufacturer for further instructions.

WARNING

DO NOT TEST FOR GAS FLAMMABILITY WITH AN OPEN FLAME AT THE BLEEDER VALVE

To prevent false tripping of the relay due to "water" hammer when the gas is being bled from the relay, follow this procedure:

1. Open gas escape bleeder valve one-half turn to clear oil from the small orifice.
2. Close valve one quarter turn.

3. Allow to bleed until oil appears.
4. Close valve.

WARNING

DO NOT REMOVE THE VALVE STEM COMPLETELY WHEN THE TRIP CIRCUIT IS ENERGIZED

Trip

An arc from a major fault within a transformer causes a rapid evolution of gas in the oil. This in turn produces a pressure wave. The pressure wave enters the relay through the ¾" pipe and compresses the flexible bellows. The air inside the bellows itself is compressed. It forces the flexible diaphragm forward. The button at the centre of the diaphragm pushes the operating pin of the microswitch closing its contacts. This actuates the equipment that disconnects the transformer from the line.

When a transformer has been tripped by the pressure mechanism of a gas detector relay, the fault that caused the incident should be located and corrected before the unit is re-energized.

Action of a forced oil cooling system may cause a false trip of a relay with a sensitive setting. Note that the Model 11 relay is more sensitive than the Model 12 or 11BC. A Model 12 relay may be better suited for transformers with pumped oil.

Electrical Relay System

1. The micro switch for the gas accumulation mechanism is located in the oil gauge. It is not replaceable. Leads from the switch are brought from the gauge into the front section of the pressure mechanism.
2. The microswitch for the pressure mechanism is located in the front section of the trip chamber.
3. The lead from the relay is a 4-conductor cable.
4. The switch ratings are given in **Table 1**.

Checking Operation

1. Check that the connection to the transformer tank is open.
2. Attach an air supply to the test check valve and force air in slowly. The air that displaces the oil will rise to the top of the accumulation chamber. The float will fall and the gauge will indicate the presence of gas.
3. Inject air rapidly. The pressure mechanism should operate. . Do not apply excessive pressure as the diaphragm and/or the micro switch will be damaged. See Testing – Trip Operation

   Note

   The pressure applied should not exceed 34 kPa/5 psi.
4. Remove the air from the relay by opening the gas escape bleeder valve in the manner described under "Gas Accumulation".

Characteristic Curve

The "Characteristic Curve" depicts the results of sensitivity tests made at both high and low rates of pressure rise. The curve shows the time and pressure of which the relay will operate for a wide range of rates of pressure increase. The relay will operate at the pressure rise condition above the curve, but will not operate at any pressure rise condition under the curve.

For example:

Model 11, Graph 1

A rate of pressure rise of 70 kPa/10 PSI per second will operate the relay in 0.052 seconds at 3.60 kPa/0.51 PSI.

The **Model 11 BC** relay has been desensitized for seismic regions and calibrated to meet the following specifications:

The sudden pressure element will operate when a rate of pressure rise of 34 kPa (5 psi) per second is injected into the relay.

The sudden pressure element will not operate when a rate of pressure is of 21 kPa (3 psi) per second is injected into the relay.

Model 12, Graph 2

A rate of pressure rise of 50 kPa per second will operate the relay at approximately 0.30 seconds and 17.2 kPa pressure.

MAINTENANCE

NOTE: If a relay fails routine maintenance tests, it should be returned to ABB or an approved service provider for repair. Customers should not attempt to repair the relay since special equipment is needed to re-calibrate to ABB specifications. ABB may not honor any warrantees' if the relay has been opened.

1. Under normal operating conditions, the gas accumulation chamber is filled with oil. As a result, the float remains stationary and the pointer does not move. Check the gas accumulation mechanism annually by introducing air in the manner described under "Checking Operation". This will cause the pointer to move on its pivot and wipe the interface clean. If the mechanism is inoperative, remove the relay and return to ABB for refurbishing.

2. Check the insulation system annually by carrying out a megger test on the relay at 250 volts. Disconnect the wires from the terminal blocks, and megger the alarm circuit (between black and white), the trip circuit (between red and green) and to ground (black, white, red and green to ground). If a low reading is measured, disconnect the cable at the relay and check the reading again. If the reading is still low, the problem is likely in the wiring to the relay and not the relay. A low megger reading in the relay can be an indication of moisture in the relay or contamination on the contacts. The relay should be returned for refurbishing.

3. Check the pressure mechanism in the manner described under "Checking Operation". This is a 'Go' – 'No-Go' test. If the mechanism does not operate, remove the relay and return it to ABB Inc. for inspection and recalibration.

TESTING – TRIP OPERATION

To test the operation of the relay, a means must be found to apply pressure to the relay test check valve. See **Figure 5**, for test check valve. With the relay either mounted on the transformer or bench mounted this may be done through the test check valve. A suggested method of test is outlined below.

1. Close the valve to the transformer (or place a pipe plug in the .75" diameter pipe tap fitting for oil connection).

2. Loosen valve element in test check (Schrader) valve by use of the test check valve cap wrench. Connect an air supply to the test check valve as shown in Figure 4.

3. Place the leads from a continuity tester across the red and green leads to determine switch operation.

4. Apply pressure to trip the relay in approximately two (2) seconds. (See Approximate Characteristic Curve.)

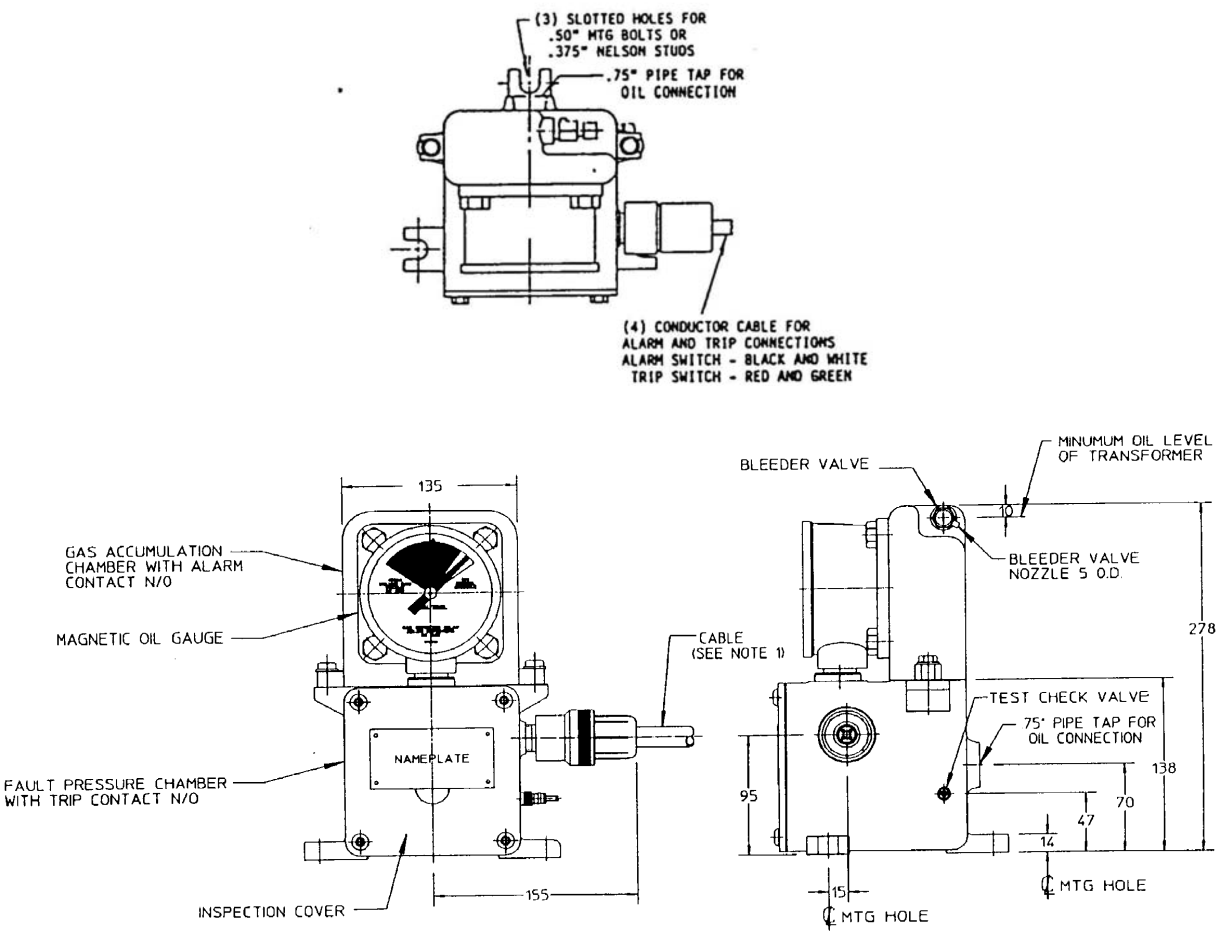
5. Greatly increasing or decreasing the time to reach trip pressure will tend to increase the pressure at which the contacts will close.

6. Between trip tests on the relay, release any pressure in the relay by venting via the bleeder valve. Also, allow approximately 3 to 5 minutes for the relay to adjust to its initial condition. Experience with each relay will determine the approximate period of time required.

7. Where the relay is mounted on the transformer, open the valve to the transformer and open the bleeder valve and close when oil runs out. Remove air supply, tighten valve element and replace cap of relay test check valve.

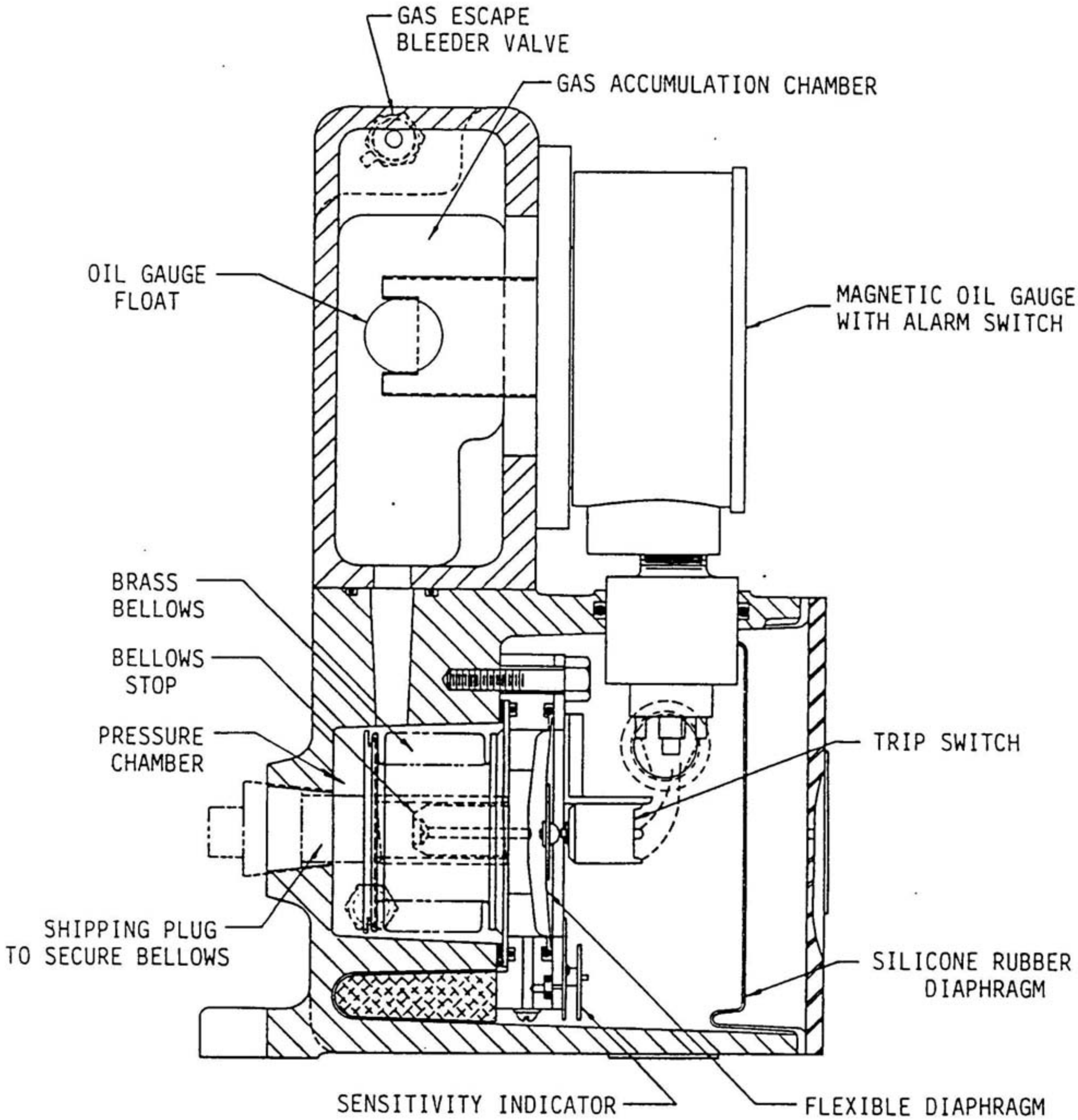
It is suggested that a pressure gauge be included in the test circuit to guard against applying excessive pressures to the relay. See instructions "Installation and Operation".

(The applied pressure should not exceed 34 kPa/5 psi.)



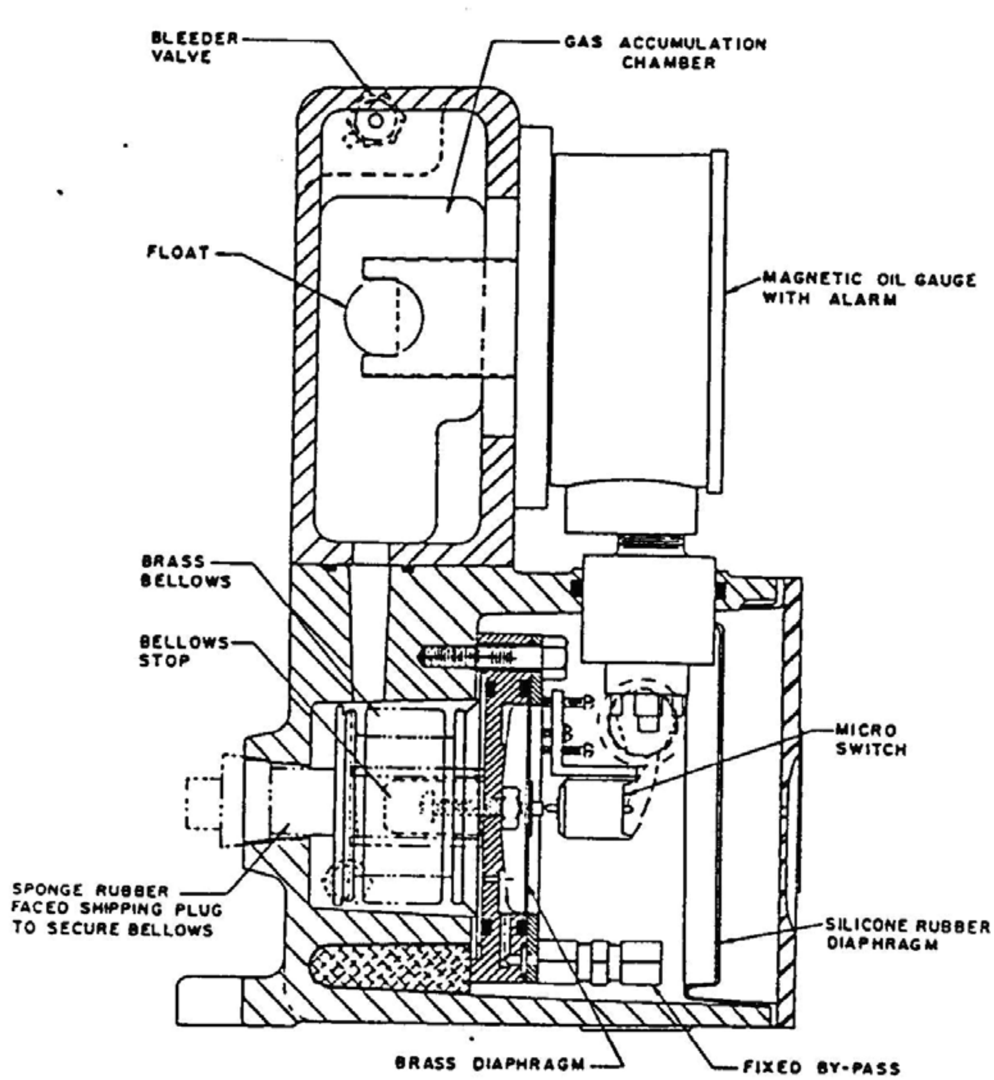
OUTLINE – GAS DETECTOR RELAY

FIGURE 1



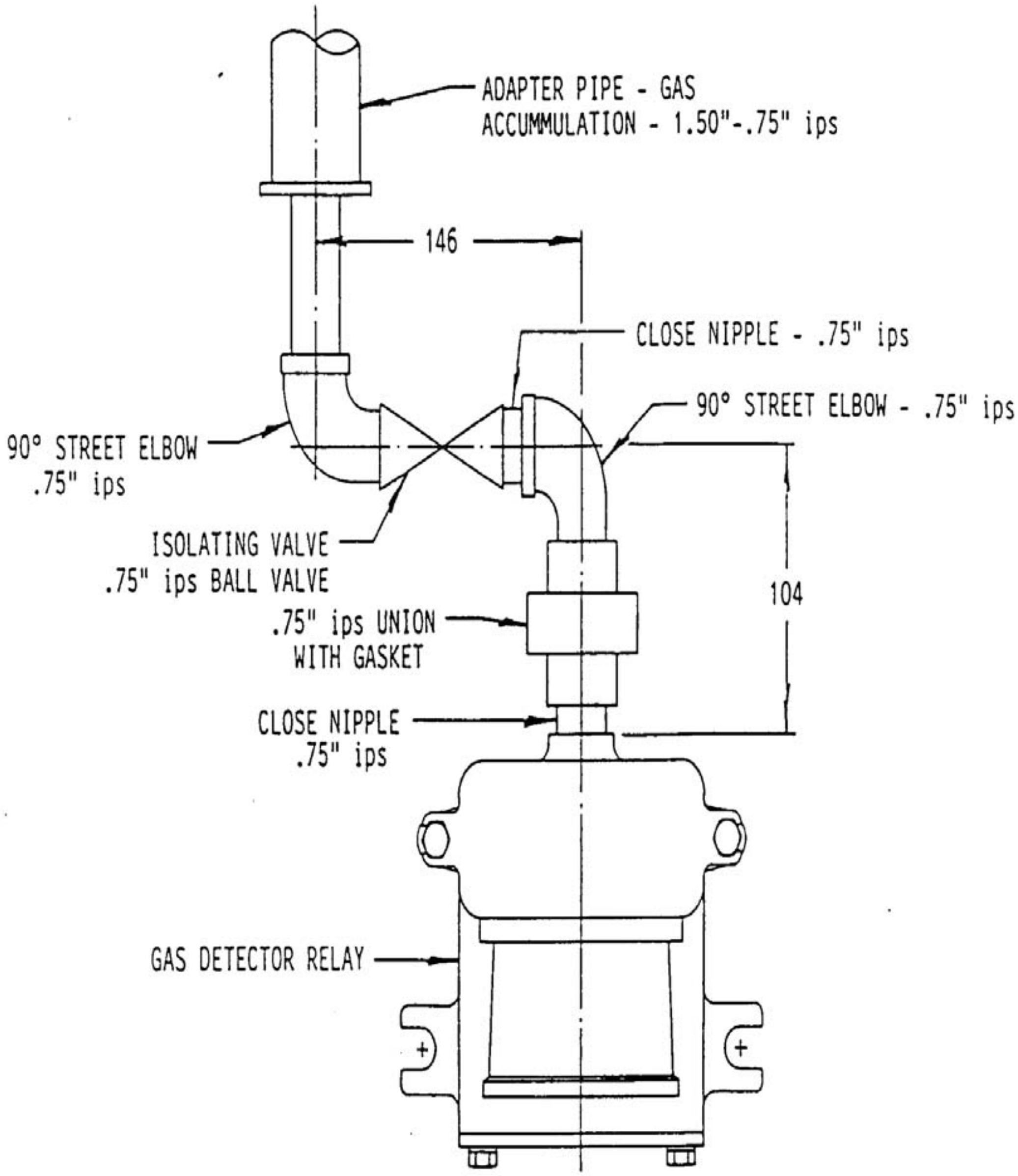
CROSS SECTION – GAS DETECTOR RELAY – MODEL 11

FIGURE 2



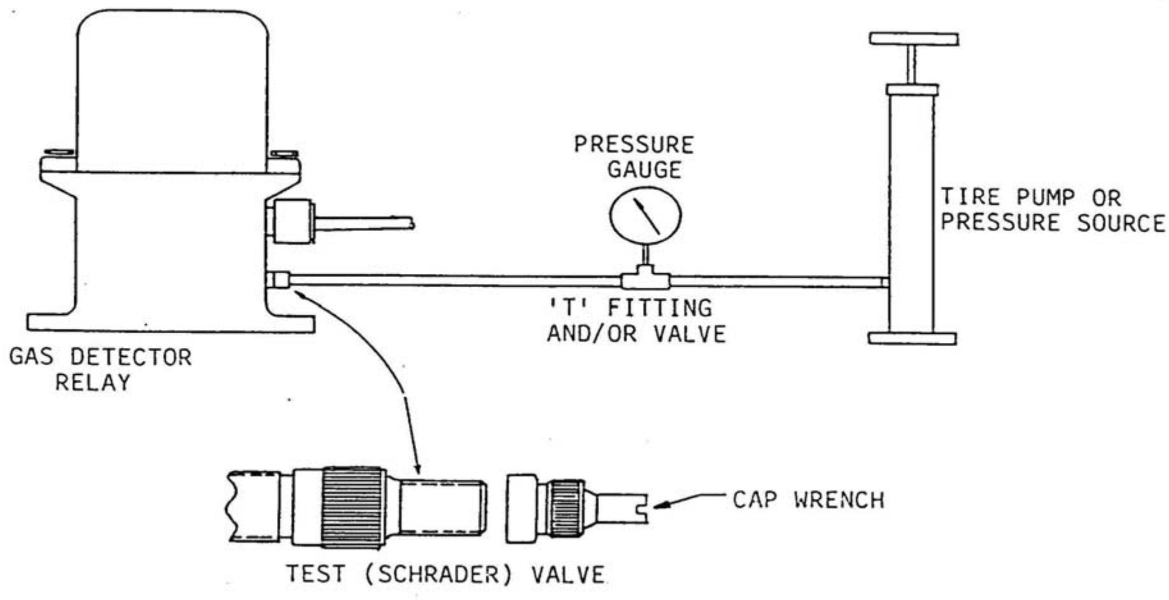
CROSS SECTION – GAS DETECTOR RELAY – MODEL 12

FIGURE 3



PIPING ARRANGEMENT – TYPICAL

FIGURE 4



TESTING – TRIP OPERATION

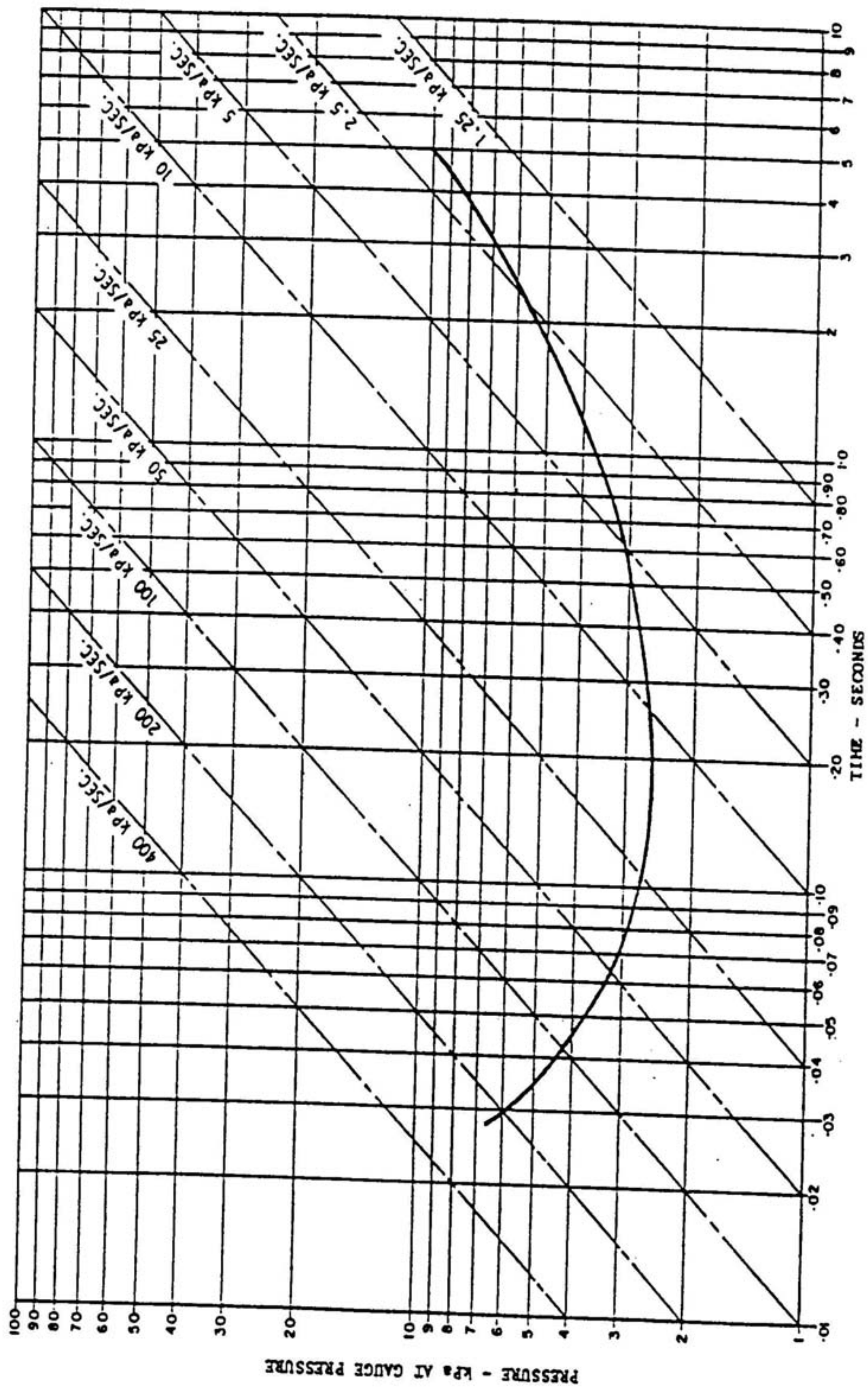
FIGURE 5

The snap action switches in the relay will break the following loads:

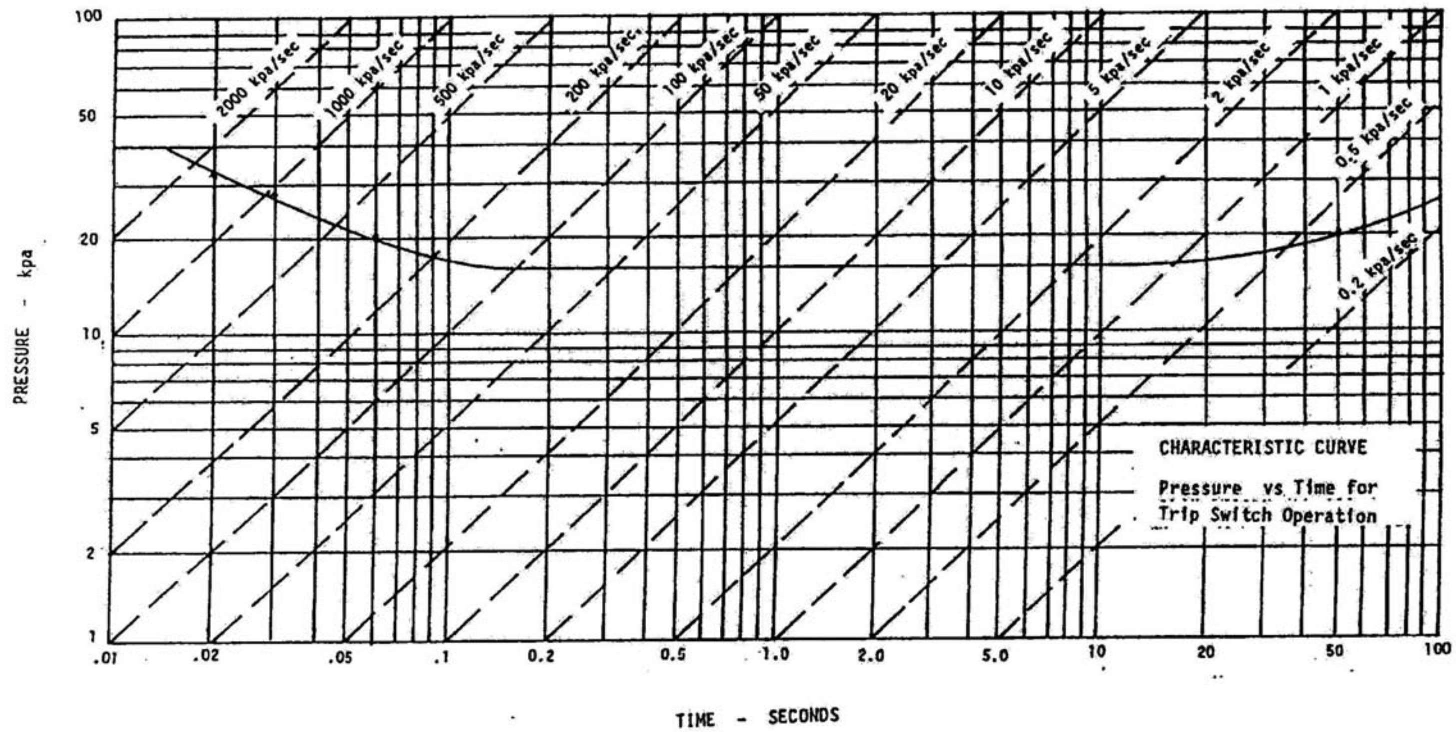
Switch	Current Rating Amperes	AC Voltage 60 Cycles	DC Voltage	Remarks
Alarm	5	115 TO 230		
	.25		120	Non Inductive
	.20		240	Non Inductive
	.043		120	Inductive
	.028		240	Inductive
Trip	15	125 to 250		
	.50		115	Non Inductive
	.25		230	Non Inductive
	.05		115	Inductive
	.03		230	Inductive

SWITCH RATINGS

TABLE 1



CHARACTERISTIC CURVE MODEL 11
(Pressure vs. Time for Trip Switch Operation)
GRAPH 1



CHARACTERISTIC CURVE MODEL 12
(Pressure vs. Time for Trip Switch Operation) GRAPH 2
GRAPH 2