

[54] **PRESSURE RESPONSIVE APPARATUS
INCLUDING VALVE ACTUATING MEANS**

[75] Inventor: **Peter O. Fiore**, Cumberland, R.I.

[73] Assignee: **Texas Instruments Incorporated**,
Dallas, Tex.

[22] Filed: **Apr. 16, 1973**

[21] Appl. No.: **351,751**

[52] U.S. Cl. **200/83 S, 200/61.25, 251/149.6**

[51] Int. Cl. **H01h 35/34**

[58] Field of Search **200/83 S, 83 P, 83 J, 83 R,**
200/61.25; 251/149.4, 149.6

[56] **References Cited**

UNITED STATES PATENTS

3,133,171	5/1964	Griffith	200/83 S
3,296,590	1/1967	Dalton	200/61.25 X
3,584,168	6/1971	Halpert et al.....	200/83 S
3,592,439	7/1971	Ritchie.....	251/149.6

Primary Examiner—Robert K. Schaefer

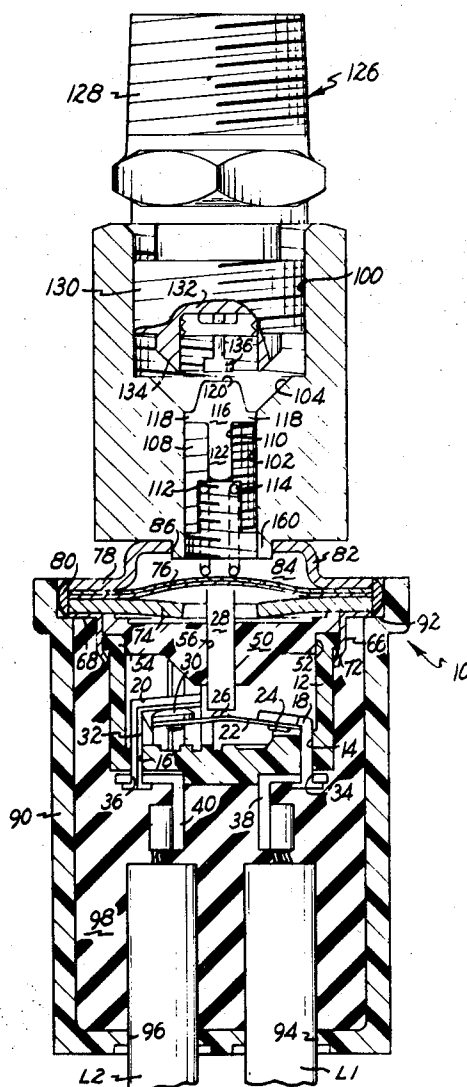
Assistant Examiner—Gerald P. Tolin

Attorney, Agent, or Firm—John A. Haug; James P. McAndrews

[57] **ABSTRACT**

A needle valve actuator is disposed in the port fitting of a pressure switch so that upon placement of the switch on a coupling containing the needle valve, the valve is automatically actuated when the switch is mounted thereon. The coupling and needle valve is located in a conduit of a refrigeration or air conditioning system to provide access to the refrigerant in the system, for instance to test the pressure level at that particular point or to recharge the system. After this is accomplished the pressure switch is placed on the nipple of the coupling and screwed into place to perform its protective or indicative function.

6 Claims, 7 Drawing Figures



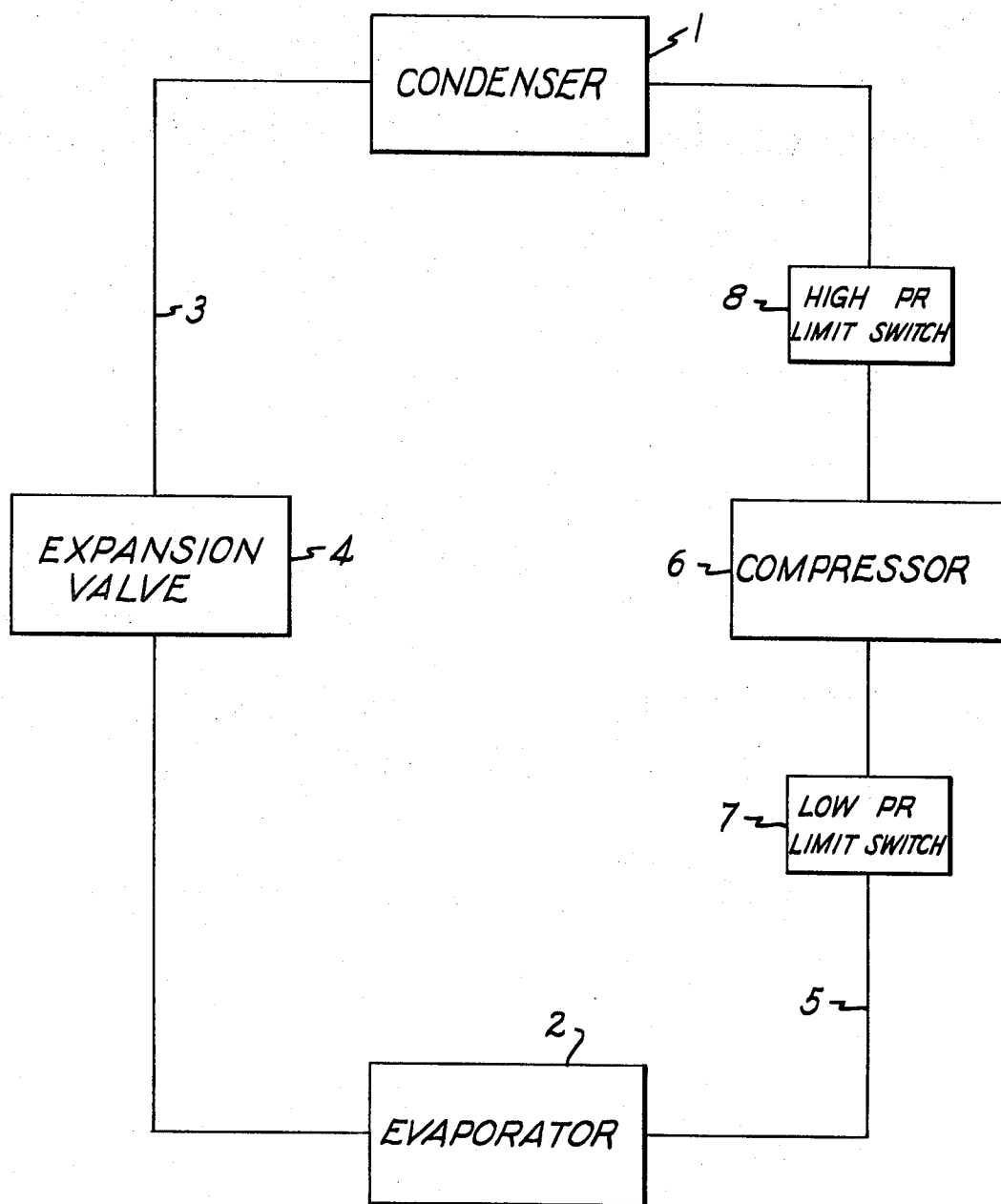


Fig. 1.

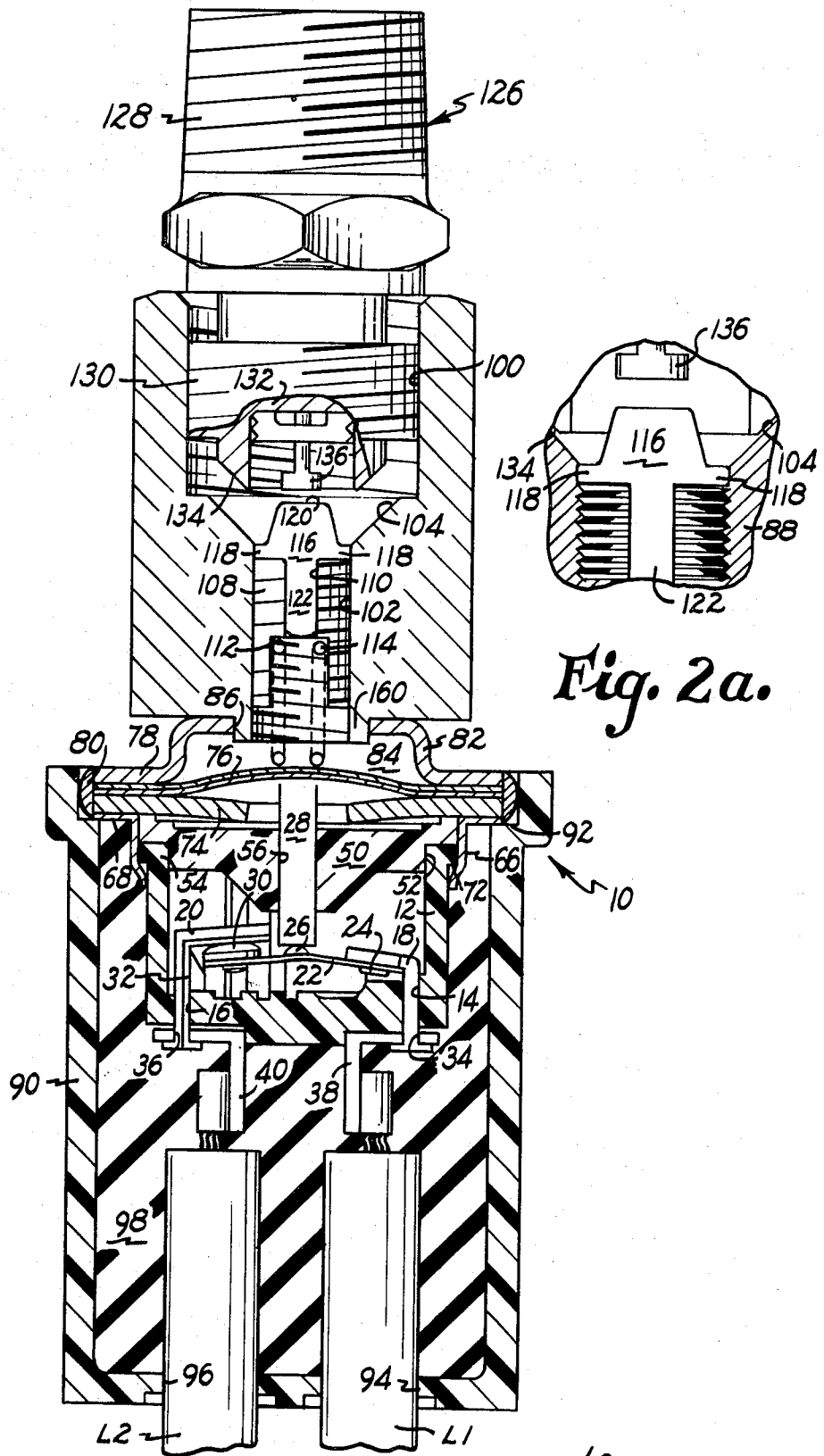


Fig. 2a.

Fig. 2.

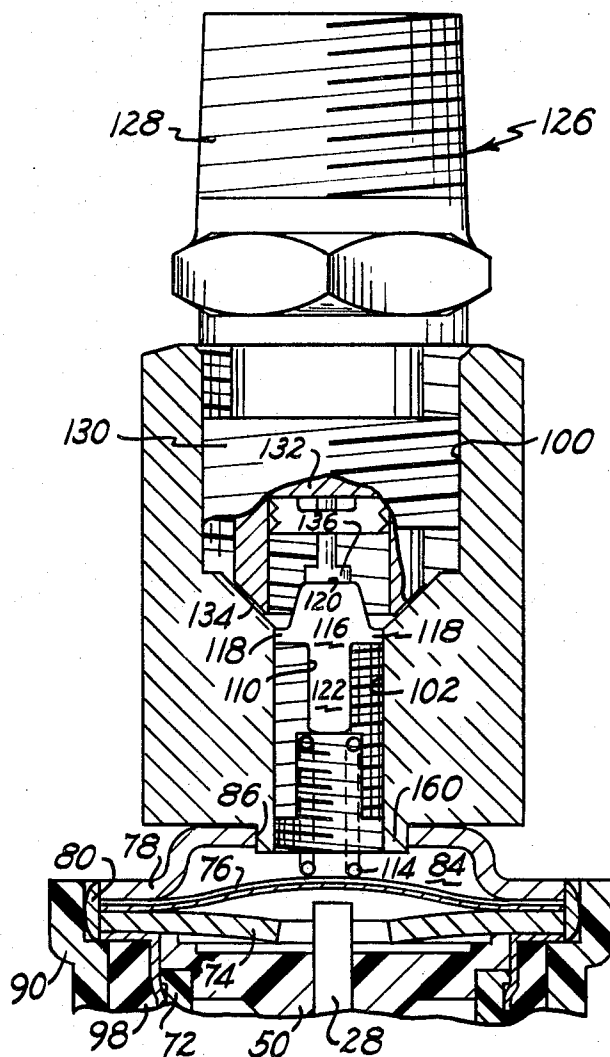


Fig. 3.

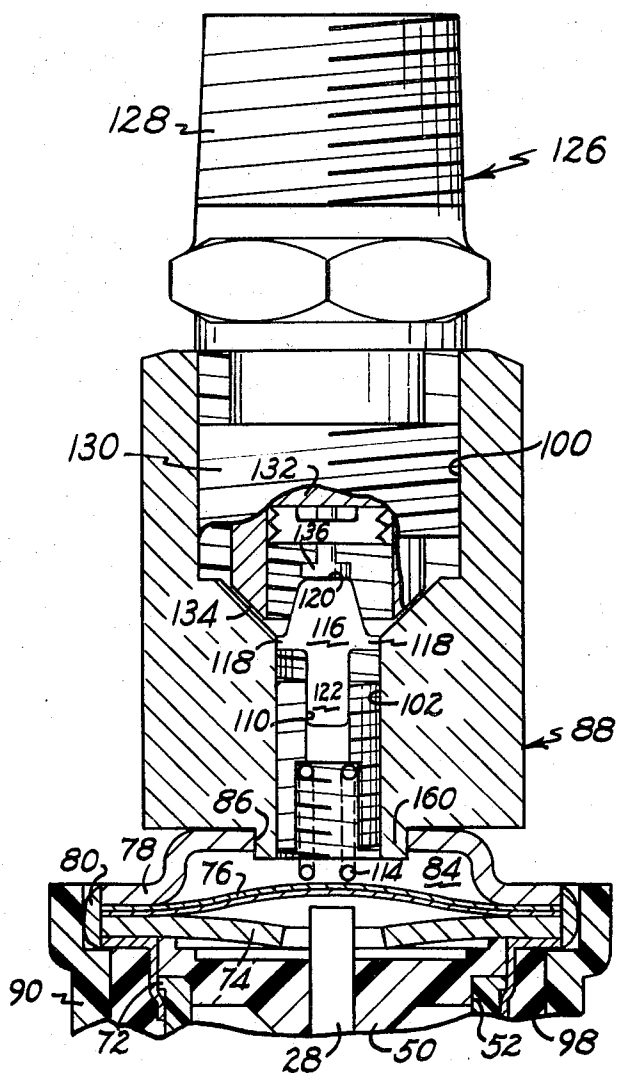


Fig. 4.

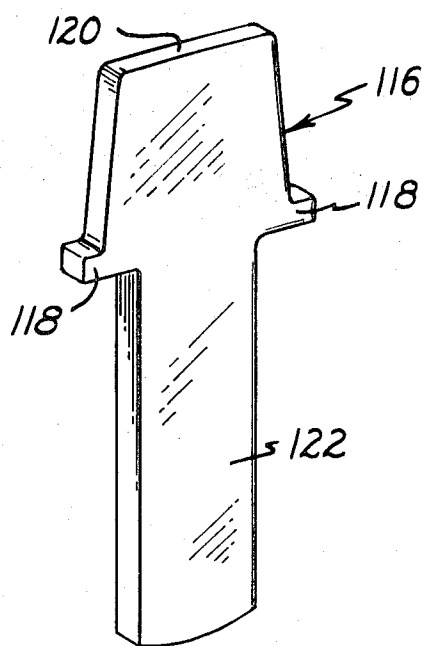


Fig. 5.

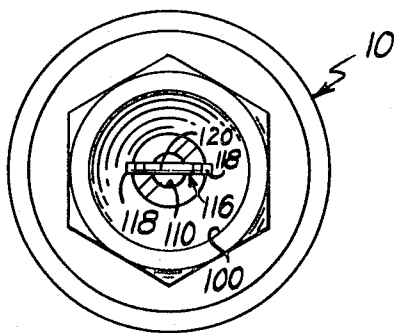


Fig. 6.

PRESSURE RESPONSIVE APPARATUS INCLUDING VALVE ACTUATING MEANS

BACKGROUND OF THE INVENTION

This invention relates generally to pressure responsive switches and more particularly to a pressure responsive switch having mounted therein valve actuating means.

In certain systems, such as refrigerant or air conditioning, it is desirable to locate pressure switches at one or more locations to provide protection or indication of a particular pressure condition. For instance in an air conditioning system it may be desirable to place a high limit pressure switch on the high pressure side of a compressor to prevent excessive pressure build up by the compressor. It is also desirable in such systems to provide one or more places of access into the system conduits so that the refrigerant can be recharged or the pressure level can be tested. It is frequently desirable to place the pressure switches at one or more of these places of access. Essentially a place of access comprises a coupling mounted on the refrigerant conduit with a needle valve disposed in the coupling. In order to operatively mount the pressure switch, means must be provided to actuate the valve so that the system pressure can reach the pressure responsive diaphragm of the switch.

SUMMARY OF THE INVENTION

Briefly in accordance with this invention, valve actuation is accomplished by employing a port fitting having first and second threaded bores communicating with each other and with the pressure chamber of the switch. The first bore receives the coupling containing the needle valve while an actuator element is received in the second bore. The actuator element is formed of material having a first hardness harder than a second hardness of the port fitting and is a plate like element forced into the first thread of the second bore nearest the first bore which securely positions the element at a selected reference point. Preferably a bored calibration screw is also received in the second bore to enable adjustment of the pressure switch. The element is provided with a stem received in the bore of the screw to maintain the element along the bore axis and prevent twisting thereof and is movable relative to the screw so that the screw can be moved without affecting the position of the element. The screw is preferably adjusted before installation of the actuating element. As the port fitting is inserted into the coupling and screwed into place the actuator contacts the needle valve and moves it from the valve seat.

Thus it is an object of the invention to provide means to actuate an access valve upon mounting of a pressure switch. Another object is the provision of such means which can be used with a pressure switch having a calibration screw in its ingress without adding to the volume of the fitting and which allows adjusting movement of the screw.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings, in which the preferred embodiment of the invention is illustrated:

FIG. 1 is a schematic diagram of a system in which the invention can be employed;

FIG. 2 is a cross sectional view, partly broken away of a pressure switch provided with means to actuate an access valve, the access valve being located in a coupling with the pressure switch partly secured thereto;

FIG. 2a is a partial section of FIG. 2 showing in detail the mounting of the valve actuator element shown with the adjusting screw removed;

FIG. 3 is similar to FIG. 2 but with the pressure switch broken away and shown with the coupling seated in a seating portion of the pressure switch port with the access valve in the actuated position;

FIG. 4 is similar to FIG. 3 but with a calibrating screw shown in a different position relative to FIG. 3;

FIG. 5 is a perspective view of an actuator element used in the FIG. 2-4 device; and

FIG. 6 is a top plan view of the FIG. 2-4 device.

Dimensions of certain of the parts as shown in the drawings may have been modified to illustrate the invention with more clarity.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, FIG. 1 shows a schematic diagram of an air cooling system comprising a condenser 1 connected to an evaporator 2 through conduit 3 with expansion valve 4 located intermediate condenser 1 and evaporator 2. Conduit 5 couples evaporator 2 back to condenser 1 through a compressor 6. A low pressure limit switch may be placed on the suction side of compressor 6 while a high pressure limit switch may be placed between compressor 6 and condenser 1.

By way of example forced air passes over evaporator 2 which extracts heat therefrom, which heat is absorbed by refrigerant liquid contained in the evaporator as heat of vaporization changing the liquid to a vapor. The vapor is drawn by suction from evaporator 2 by compressor 6 which increases the pressure of the vapor and discharges the vapor from the compressor at a saturation temperature sufficiently high that the vapor can be condensed in condenser 1 across which forced cooling air passes which absorbs the heat of vaporization, condensing the vapor back to a liquid. The liquid refrigerant then is passed through expansion valve 4 to the lower pressure of the evaporator.

Pressure switch 7 may be placed on the suction side of compressor 6 to indicate entry of liquid to the compressor while pressure switch 8 may be placed on the high pressure side of compressor 6 to guard against excessive pressure build up by the compressor. The construction of a switch useful for pressure switches 7 and 8 is shown in FIG. 2 wherein switch 10 comprises a cylindrical cup-shaped member 12 formed of a conventional molded electrically insulative phenolic material and formed with apertures 14, 16 for reception therein of support member 18 and stationary contact 20 respectively. Movable contact arm 22 of electrically conductive material having good spring characteristics, such as beryllium nickel, is cantilever mounted to support member 18 as by riveting at 24. Arm 22 is formed with a dimple 26 to facilitate transfer of motion from motion transfer pin 28 slidably mounted in alignment

with dimple 26. Arm 22 mounts at its free end movable contact 30 and is adapted to move into and out of engagement with a transversely extending section of contact 20. To improve electrical conductivity while minimizing additional expense, stationary contact 20, which also serves as part of the terminal structure, is preferably provided with a layer 32 of highly conductive material, such as a silver alloy. The outer ends of support 18 and stationary contact 20 pass through apertures 34, 36 of terminal member 38, 40 respectively, and are headed over to securely lock the contact assembly in the housing and to provide electrical connection to the switch via respective leads L1, L2 electrically connected thereto.

A disc 50, generally plate-shaped of electrically insulative material, is formed with an annular seating groove 52 about its periphery and is received in the distal portion of wall 54 of base 12. Disc 50 slidably mounts in a centrally located bore 56 pin 28, also of electrically insulative material such as a ceramic or glass material, and isolates the electrical switch from the diaphragm area.

Tubular member 66, which may be formed of a conventional metallic material, is provided with a radially outwardly extending flange 68 and is placed over the distal wall 54 of base 12 and attached thereto, as by crimping. A small flange 72 is provided on distal wall 54 to permit locking of the tubular member 66 to base 12. Mounted on flange 68 are calibration-stop member 74, imperforate circular diaphragm member 76 and cover 78, all hermetically secured at their periphery, as by welding at 80. Cover 78 is dished out at 82 to provide a cavity 84 sealed by diaphragm 76 and provided with bore 86 for reception therein of a port fitting 88 which is hermetically attached thereto. Port fitting 88 permits attachment to conduit 5 as will be explained in greater detail below.

Diaphragm 76 is formed into a snap-acting disc by means known in the art. During operation of the device diaphragm 76 snaps from the convex position shown in FIG. 2 looking from the pressure receiving side to an opposite concave curvature when a predetermined amount of pressure is introduced into chamber 84 through port fitting 88. The diaphragm will snap back to its original position when the pressure decreases a predetermined amount.

Cap 90 has an annular seat 92 which receives the outer peripheral portion of cover 78, diaphragm 76, calibration stop member 74 and tubular member 66. Cap 90 is provided with apertures 94, 96 for reception therethrough of insulated wires L1, L2 respectively. Cap 90 is then back filled with suitable electrically insulative material such as potting material 98.

The difference in pressure between that amount at which the diaphragm snaps in a first direction and that amount at which the diaphragm will return to its original position is controllable by calibrating the device by deforming the calibration stop member 74 explained in detail and to which reference may be had in U.S. Pat. No. 3,584,168 issued June 8, 1971 and assigned to the assignee of the instant invention.

Port fitting 88 is provided with a first threaded bore 100 in communication with a second smaller threaded bore 102, the two bores being joined by a conical seat portion 104 and communicating with cavity 84 for reception of pressure (or vacuum). Port fitting 88 is provided with boss 106 which is received in mating aper-

ture 86 in cover 78. Adjusting screw 108 is disposed in bore 102 and it also has a longitudinally extending bore 110 and a spring seat 112 for reception of spring 114 which extends from the spring seat 112 to diaphragm 76. Spring 114 and adjusting screw 108 are optional and may be used if it is desirable to selectively narrow the pressure differential of the diaphragm, however, use of the screw is preferred to facilitate mounting of valve actuating element 116.

Also disposed in the bore 102 of the port fitting is a plate like actuator element 116 formed of material such as stainless steel having a first hardness. Element 116 has transversely extending tabs 118 intermediate an actuating surface 120 and a longitudinally extending stem 122. Port fitting 88 is formed of material such as bronze or brass having a second hardness softer than that of element 116. As best seen in FIG. 2a the element is inserted into bore 102 with tabs 118 forced through the first thread of the bore to be securely fixed in the port fitting with the first thread also serving as a reference point for locating actuating surface 120. Stem 122 extends into bore 110 of adjusting screw 108 which maintains the element on the longitudinal axis of bore 102 and prevents any tendency of the element to twist. Screw 108 is preferably adjusted prior to the installation of actuator element 116. Stem 122 is sufficiently loose in bore 110 however to permit relative movement between screw 108 and stem 122.

Coupling 126 having opposite threaded ends 128, 130 mounts therein needle valve 132. End 128 is received in conduit 5 with valve 132 providing access to the system refrigerant. Port fitting 88 is screwed onto end or nipple 130 until beveled portion 134 on the distal end of the nipple bottoms against conical seat 104. As seen in FIG. 2 port fitting 88 has been screwed only part way onto nipple 130, needle 136 of valve 132 being spaced a short distance from actuating surface 120 of element 116 and beveled surface 134 of nipple 130 spaced a slightly greater distance from conical seat 104. Thus continued clockwise rotation of port fitting will cause needle 136 to contact surface 120 and be moved upwardly off its valve seat allowing pressure from conduit 5 to enter cavity 4 of switch 10. As seen in FIG. 6 element 116 occupies only a portion of the cross sectional area of bore 110 allowing pressure received through valve 132 to pass through bore 110. Port fitting 88 is rotated until finally conical seat 104 contacts beveled surface 134 of nipple 130 preventing further rotation. This position is illustrated in FIG. 3. FIG. 4 illustrates the adjusting screw moved to increase spring pressure on diaphragm 76 without affecting the position of actuating element 116.

Thus it will be seen that switch 10 may be removed at will to provide access to conduit 5 should testing or recharging of the refrigerant be desired. Switch 10 may then be remounted on nipple 130 automatically actuating valve 132 as port fitting 88 is screwed into place yet without affecting the ability to calibrate switch 10 in any way.

Although the invention has been described with respect to specific preferred embodiments thereof, many variations and modifications will immediately become apparent to those skilled in the art. It is therefore the intention that the appended claims be interpreted as broadly as possible in view of the prior art to include all such variations and modifications.

I claim:

1. In combination with a pressure responsive switch having a housing and a pressure responsive diaphragm mounted in the housing and movable from a first configuration to a second opposite configuration the motion from the diaphragm transmitted to a movable electric contact which is adapted to move into and out of engagement with a stationary contact upon movement of the diaphragm from one configuration to the opposite configuration and a port fitting for reception of pressure to a surface of the diaphragm, the port fitting provided with a threaded bore, a bored adjustive screw disposed in the threaded bore and a spring extending from the screw to the pressure responsive diaphragm whereby the bias of the spring can be adjusted by movement of the adjusting screw, a coupling containing an axially actuatable valve and on which the port fitting is mounted, the improvement which comprises an actuating element positioned in the port fitting in alignment with the axially actuatable valve whereby the valve is actuated upon mounting of the port fitting on the coupling, the actuator element being formed of material having a first hardness and the port fitting is formed of material having a second hardness softer than the said first hardness and the element is pressed into and cuts threads of the threaded bore of the port fitting to lock it in place, the actuator element having a stem depending therefrom, the stem extends into the bore of the adjusting screw and fits loosely enough to permit relative movement between screw and stem and tightly enough to prevent any tendency of the actuating element to twist.

2. The combination according to claim 1 in which the

actuator element has transversely extending tabs which are pressed into the said threads.

3. The combination according to claim 1 in which the port fitting is provided with a second threaded bore the bores in communication with each other, the first bore having a larger diameter than the second bore, the two bores joined by a beveled seating portion, the first bore adapted to receive the threaded end of a coupling, the coupling adapted to seat against the seating portion, the actuator element formed with two transversely extending tabs and formed of material harder than the material of the port fitting, the tabs pressed into the first thread of the second bore nearest the beveled seating portion which serves as a reference point for the position of the actuator element.

4. The combination according to claim 3 in which the actuator element has a depending stem, a bored adjusting screw is disposed in the second threaded bore with the stem extending into the bore.

5. The combination according to claim 4 in which the adjusting screw is movable relative to the actuating element.

6. A switch assembly according to claim 1 in which the coupling has a threaded nipple receivable in the first threaded bore and having a distal portion engageable with the seating portion, an axially extending needle valve is disposed in the nipple and is adapted to be contacted by an actuating surface of the actuating valve as the port fitting is threaded onto the nipple before the distal portion of the nipple engages the seating portion.

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