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PRESSURE ACTUATED SWITCH

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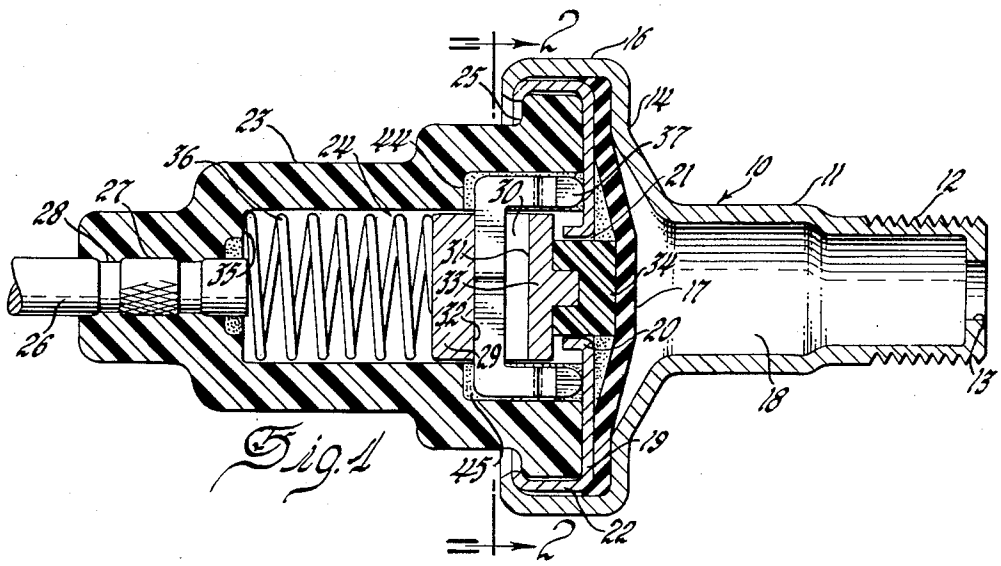


Fig. 1

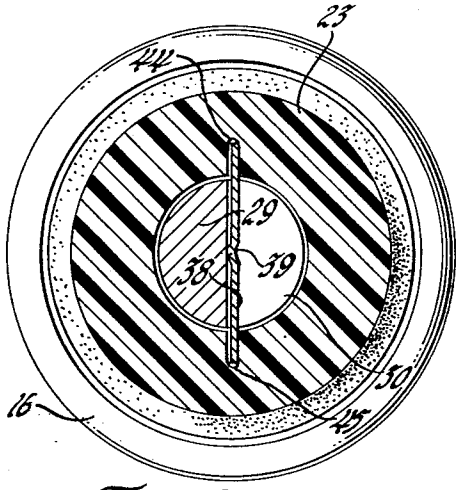


Fig. 2

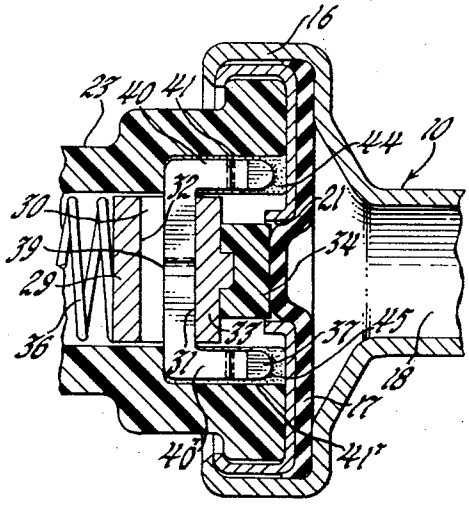


Fig. 3

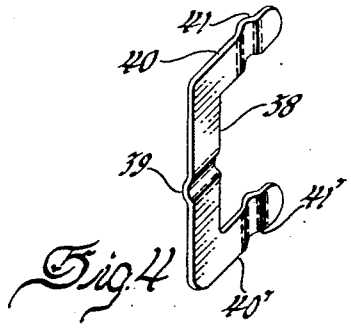


Fig. 4

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PRESSURE ACTUATED SWITCH

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This invention relates to pressure actuated electrical switches and more particularly to the differential type which is adapted to interrupt the continuity of an electrical circuit at one value of pressure and to complete the continuity at a different value of pressure.

This type of switch finds numerous application in the indication or control of a condition of a fluid pressure or related system. A specific example for which the present invention is especially well suited is the control of the compressor of an automotive refrigerating system. In such use it is desirable to provide a simple and inexpensive control switch to start the compressor in response to a low value of pressure and to shut down the compressor at a relatively high value of pressure. For automotive use, the switch must be of rugged construction, insensitive to wide variations of ambient conditions, and must be reliable in operation.

Accordingly, it is an object of this invention to provide a pressure actuated switch of simple construction which is responsive at one value of pressure to interrupt an electrical circuit and responsive at a different value of pressure to complete the electrical circuit.

It is an additional object of this invention to provide a pressure actuated differential switch which is of rugged construction, reliable in operation, and economical to manufacture.

Another object is to provide a pressure actuated switch which utilizes a diaphragm and a movable contact member operatively connected through a lost motion connection to provide for differential operation.

In the attainment of these objects, an actuating means and a movable contact adapted for movement to and from engagement with a fixed contact are interconnected by a lost motion connection. The actuating means is operatively connected for displacement by a condition responsive means, such as a distendable diaphragm. The movable contact may be frictionally constrained against motion and the operating parts may be sealed within a protective housing.

A more complete understanding of the manner in which the invention is carried into effect may be had from the detailed description which follows taken with the accompanying drawings, in which:

Figure 1 is a sectional view of the inventive pressure actuated switch with the switch parts in one condition.

Figure 2 is a cross sectional view taken on line 2—2 of Figure 1.

Figure 3 is a fragmentary view of the inventive switch with the switch parts in another condition.

Figure 4 is a perspective view showing, in detail, one member of the inventive switch.

Referring now to the drawings there is shown an illustrative embodiment of the invention in a diaphragm type pressure actuated switch. The switch comprises a casing member or metal shell **10** which includes an axially extending conduit **11** terminating in a threaded portion **12** and an opening **13** for the admission of fluid pressure. The conduit **11** of the casing **10** extends into the radial

flange **14** terminating in an axially extending flange **16**. A pressure responsive diaphragm **17**, of any suitable material such as neoprene, is seated against flange **14** in sealing relation therewith to define a pressure chamber **18**. A plate member **19**, preferably of metallic construction, constitutes a fixed electrical contact and is disposed adjacent the diaphragm **17**. Plate member **19** is provided at its central portion with an axially extending annular flange **20** defining a central opening **21**. The plate **19** is provided with an axial flange **22** which engages the flange **16** of metal shell **10**.

An insulating support or casing member **23**, suitably a molded body of thermosetting phenolic plastic, defines a recess or switch cavity **24** to accommodate certain parts of the switch structure, to be described subsequently. The support member **23** is seated against the plate **19** and is provided with a radial shoulder **25**. The axial flanges **16** and **22** of the casing **10** and plate **19**, respectively, are crimped over the shoulder **25** to retain these parts in assembled relation and to compress the periphery of the diaphragm **17** between the plate **19** and the radial flange **14** to provide a fluid tight seal. Thus, the casing member **10** and casing member **23** provide a two-part housing including a pressure chamber **18** and a switch cavity **24** separated by transverse diaphragm **17**.

A terminal post **26** adapted to be connected in an external electrical circuit (not shown) extends through the support member **23** terminating in the cavity **24** and is securely retained in position by the knurled portion **27** and the undercut portions **28**. Actuating means or piston **29**, of conductive material such as brass and preferably cylindrical in cross section, is slidably disposed within the cavity **24**. The actuating means is provided with a transverse slot **30** defined by axially spaced shoulders **31** and **32**. A boss **33** is provided on actuating means **29** to retain an insulating member or bearing member **34** in alignment with central opening **21** for engaging the diaphragm **17**. Resilient means such as electrically conductive helical spring **36** is seated against a shoulder **35** in the support member **23** and engages the terminal post **26** at one end and engages the actuating means **29** at the other end providing electrical continuity therebetween. The spring **36** urges the actuating means **29** and bearing member **23** toward engagement with the diaphragm **17**.

A movable contact member **37**, adapted to be moved to and from engagement with fixed contact plate **19**, is of generally U-shape configuration having a base portion **38** and a pair of contact leg portions **40** and **40'**. The base portion is disposed in transverse slot **30** and is adapted for limited relative movement between shoulders **31** and **32** to provide a lost motion connection with the actuating means **29**. A corrugation or dimple **39** is provided on base portion **38** to insure continuous electrical contact with actuating means **29** during relative axial movement. The contact leg portions **40** and **40'** extend axially toward fixed contact plate **19** and are disposed in axial slots **44** and **45** respectively constituting guide means defined by support member **23** at opposite ends of the transverse slot **30**. The contact legs **40** and **40'** are provided with corrugations or dimples **41** and **41'**, respectively, to provide frictional engagement of the contact legs with support member **23** and thus afford limited frictional constraint against axial motion of the movable contact **37**. Concurrent motion of the movable contact **37** and the actuating means **29** occurs only when the base portion **38** is engaged by shoulder **31** or **32** of actuating means **29**.

It will be noted that in the free condition of the switch with only a very low value of pressure, such as atmospheric, in chamber **18** the parts assume the relative position shown in Figure 1. The diaphragm **17** is distended away from the plate **19**, the extent of which depends upon

the properties of the diaphragm and the spring **36**. In normal operation this condition will not obtain because the low value of pressure at which the switch is calibrated to function will be sufficient to maintain the diaphragm **17** in a non-distended condition flat against the plate **19**. In this non-distended condition, the position of the actuating means is such that the movable contact is in engagement with the fixed contact **19**. The diaphragm **17** must be distended into the confines of opening **21** to cause concurrent motion of actuating means **29** and movable contact **37** to displace the latter from engagement with fixed contact **19**. This action occurs under the influence of a relatively high pressure in chamber **18**.

In operation, the inventive switch of the illustrative embodiment functions to interrupt the electrical circuit at a high value of pressure in the chamber **18** and to complete the electrical circuit upon a relatively low value of pressure in chamber **18**. In Figure 1, the switch is shown with the parts in the position assumed with a low value of pressure in the chamber **18** acting upon the diaphragm **17**. The force exerted by spring **36** is sufficient to overcome the force exerted by diaphragm **17** and to maintain the shoulder **32** of actuating means **29** in engagement with the base portion **38** of movable contact **37**. Thus, the contact legs **40** and **40'** are in engagement with the fixed contact plate **19**. The electrical circuit in this condition is completed from the terminal post **26** through the spring **36**, actuating means **29**, movable contact **37** and thence through fixed contact plate **19** to casing member **10**. Upon an increase of pressure in chamber **18** toward a predetermined high value, the force exerted thereby upon the diaphragm **17** increases until it is sufficient to overcome the force of spring **36** and to urge the diaphragm into close surface engagement with the plate **19** at which position the diaphragm is substantially non-distended. This movement displaces the actuating means **29** a distance less than that required to cause shoulder **31** to engage base portion **38** of movable contact **37**. Thus there is no movement of contact **37** and the contact legs **40** and **40'** remain in firm engagement with contact plate **19** by virtue of frictional engagement with the support member **23**. During this displacement of actuating means **29** continuous engagement of movable contact **37** with actuating means **29** is assured by the corrugation **39** and the continuity of the electrical circuit is uninterrupted. As the pressure continues to increase, the central portion of the diaphragm **17** is distended into the opening **21** in plate **19**. The fluid pressure is thus effective through the diaphragm **17** to further displace the actuating means **29** against the resistance of the spring **36**. During this portion of travel, shoulder **31** of the actuating means engages the base portion **38** of movable contact **37** and displaces the contact legs **40** and **40'** from engagement with contact plate **19**. This operating condition with the circuit continuity interrupted is illustrated in Figure 3.

Upon decrease of fluid pressure in chamber **18** toward a predetermined low value, the force exerted by the spring **36** overcomes that exerted by the diaphragm **17** on the actuating means **29** causing displacement thereof toward the diaphragm. In this portion of travel of the actuating means **29**, the movable contact **37** is retained in position by its frictional engagement with the support member **23** until the lost motion between contact **37** and actuating means **29** is taken up and shoulder **32** engages the base portion **39**. Upon further decrease of the pressure in chamber **18** the actuating means is further displaced toward the diaphragm **17** and the contact legs **40** and **40'** engage the fixed contact plate **19**. Thus, the circuit continuity is restored at the predetermined low value of pressure in chamber **18**.

Although this invention has been described with respect to a particular embodiment, this embodiment is not to be construed in a limiting sense. Many modifications and variations within the spirit and scope of the invention will now occur to those skilled in the art. For a definition of the invention, reference is made to the appended claims.

I claim:

1. A pressure actuated switch comprising a casing and a diaphragm defining a pressure chamber, said casing defining an opening for admitting fluid pressure to one side of said diaphragm, a fixed contact plate disposed adjacent the other side of said diaphragm and defining a central opening, said diaphragm being secured at its periphery between said plate and said casing, a support member secured to said casing, actuating means slidably disposed in said support member in alignment with the opening in said plate, resilient means interposed between said support member and said actuating means for urging the actuating means toward engagement with said diaphragm, a movable contact adapted to be moved to and from engagement with said fixed contact plate, said diaphragm being movable from a first condition in which it is substantially non-distended adjacent said plate to a second condition in which it is distended into the confines of said central opening under the influence of a high value of fluid pressure in said chamber, and lost motion means connecting said movable contact to said actuating means and being ineffective to cause concurrent motion of said actuating means and said movable contact until said diaphragm is moved to said second condition.

2. A pressure actuated switch comprising a metallic casing and a diaphragm defining a pressure chamber, said casing defining an opening for admitting fluid pressure to one side of said diaphragm, a fixed contact plate disposed on the other side of said diaphragm in peripheral engagement with said metal casing, said contact plate defining a central opening, an insulating support member secured to said casing and defining a switch cavity adjacent said contact plate, a terminal post extending through said support member into said cavity, actuating means having a conductive portion and slidably disposed in said cavity and extending into said central opening, a movable contact adapted to be moved to and from engagement with said contact plate, a conductive spring interposed between said terminal post and said conductive portion urging said actuating means toward engagement with said diaphragm, and a lost motion connection between said movable contact and said actuating means and including means providing continuous electrical continuity between said movable contact and said conductive portion.

3. A condition responsive switch comprising a condition responsive member movable in response to a change in condition, an insulating support member and a fixed contact disposed adjacent said condition responsive member, actuating means slidably disposed in said insulating support member and connected with the condition responsive member, a spring interposed between said insulating support member and said actuating means urging said actuating means toward said condition responsive member, axially spaced shoulders defining a transverse slot in said actuating means, said insulating support member defining an axially extending slot at one end of said transverse slot, and a movable contact member including a base portion disposed in said transverse slot and an axially extending contact leg disposed in said axial slot in frictional contact with the support member and adapted for engagement with said fixed contact.

4. A pressure actuated switch comprising a casing member and a diaphragm defining a pressure chamber, said casing member defining an opening for admission of fluid pressure to one side of said diaphragm, a support member secured to said casing and defining a switch cavity adjacent the other side of said diaphragm, a fixed contact disposed in said cavity, actuating means slidably disposed in said support member, resilient means urging said actuating means toward engagement with said diaphragm, said actuating means including axially spaced shoulders defining a transverse slot, said support member defining an axially extending slot adjacent each end of said trans-

verse slot, a generally U-shaped movable contact having a base portion disposed in said transverse slot and contact leg portions disposed in respective axially extending slots, said contact leg portions being constrained against motion by frictional engagement with said support member in said axially extending slots whereby concurrent motion of said actuating means and said movable contact occurs only when said base portion is engaged by one of said axially spaced shoulders on said actuating means.

5. A pressure actuated switch comprising a casing member and a diaphragm defining a pressure chamber, said casing member defining an opening for admission of fluid pressure to one side of said diaphragm, a support member secured to said casing and defining a switch cavity adjacent the other side of said diaphragm, a fixed contact plate disposed in said cavity adjacent said diaphragm and defining a central opening, actuating means including a bearing member in alignment with said central opening and slidably disposed in said support member, resilient means urging said actuating means toward said diaphragm, said actuating means including axially spaced shoulders defining a transverse slot, said support member defining an axial slot adjacent each end of said transverse slot, a generally U-shaped movable contact having a base portion and a pair of contact leg portions, said base portions being disposed in said transverse slot and adapted for relative motion between said spaced shoulders, said contact leg portions being disposed in respective axial slots and in frictional engagement with said support member whereby concurrent motion of said actuating means and said movable contact occurs only when said base portion is engaged by one of said axially spaced shoulders on said actuated means.

6. A pressure actuated switch comprising a metallic casing member and a diaphragm defining a pressure chamber, said casing member defining an opening for admission of fluid pressure to one side of said diaphragm, a support member secured to said casing member and defining a switch cavity adjacent the other side of said diaphragm, a fixed contact plate defining a central opening and being disposed in said cavity adjacent said diaphragm and in peripheral engagement with said metallic casing member, a terminal post extending through said support member into said cavity, actuating means including an electrically conductive portion and an insulating bearing portion slidably disposed in said support member with said bearing portion extending into said central opening, a conductive spring interposed between and terminal post and the conductive portion of said actuating means for urging said actuating means toward said diaphragm, said electrically conductive portion including axially spaced shoulders defining a transverse slot, said insulating support member defining an axial slot at each end of said transverse slot, a generally U-shaped movable contact having a base and contact leg portions, said base portion disposed in said transverse slot and including a corrugation to maintain continuous electrical contact with said conductive portion during movement of said base portion between said spaced shoulders, said contact leg portions adapted to be moved to and from engagement with said fixed contact plate and disposed in said axial slots, each of said contact leg portions being provided with a corrugation to provide limited frictional constraint against movement of said movable contact whereby concurrent motion of said actuating means and said movable contact occurs only when said base portion is in engagement with one of said shoulders.

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