

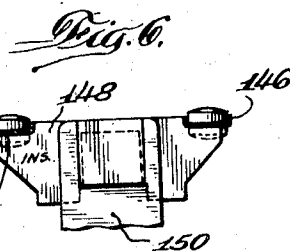
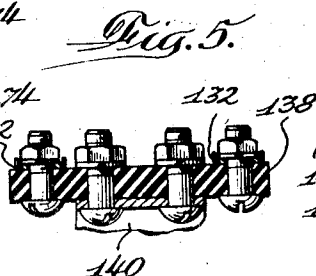
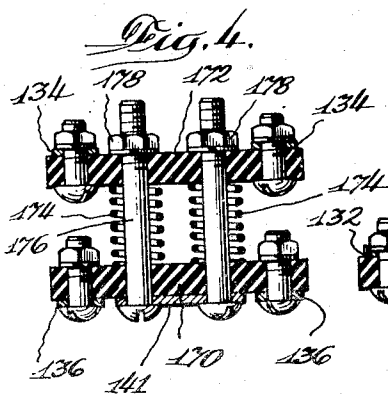
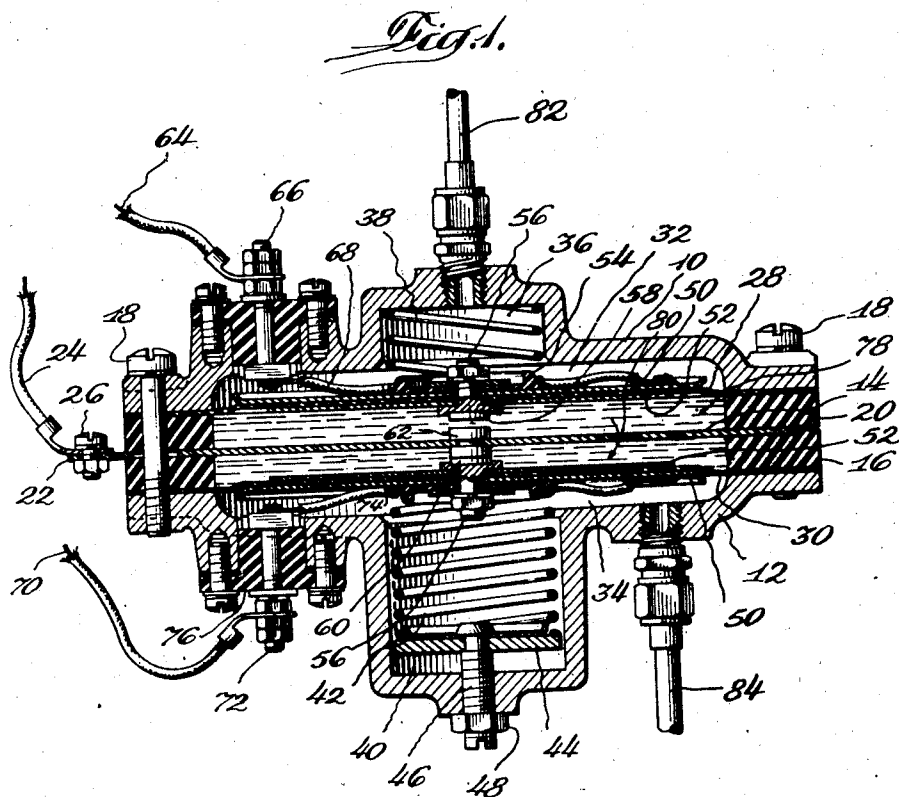
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S. E. HEYMAN ET AL
ELECTRIC SWITCH

2,450,961

2 Sheets-Sheet 1

Filed June 16, 1945



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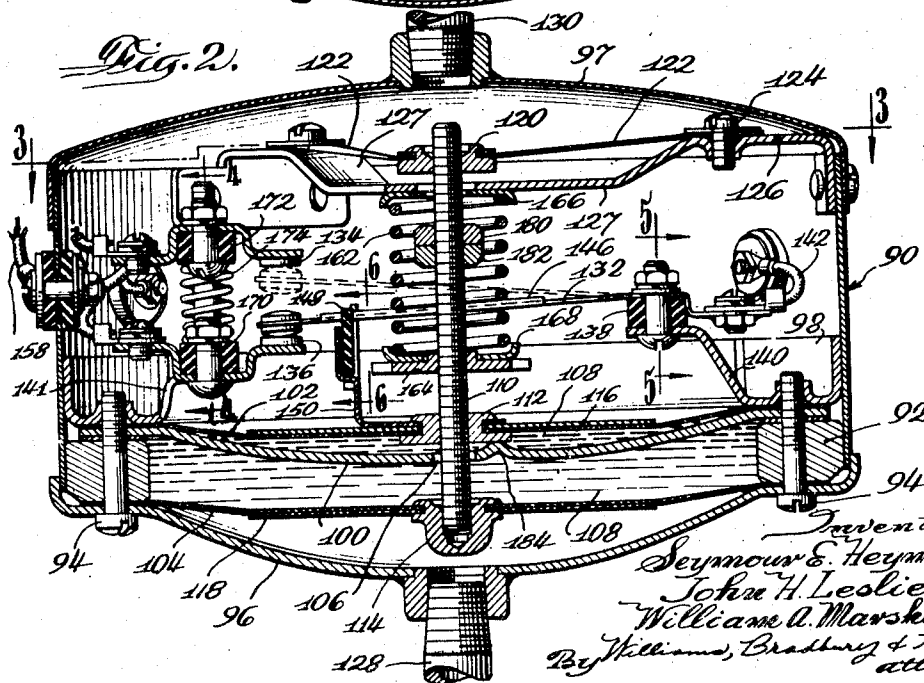
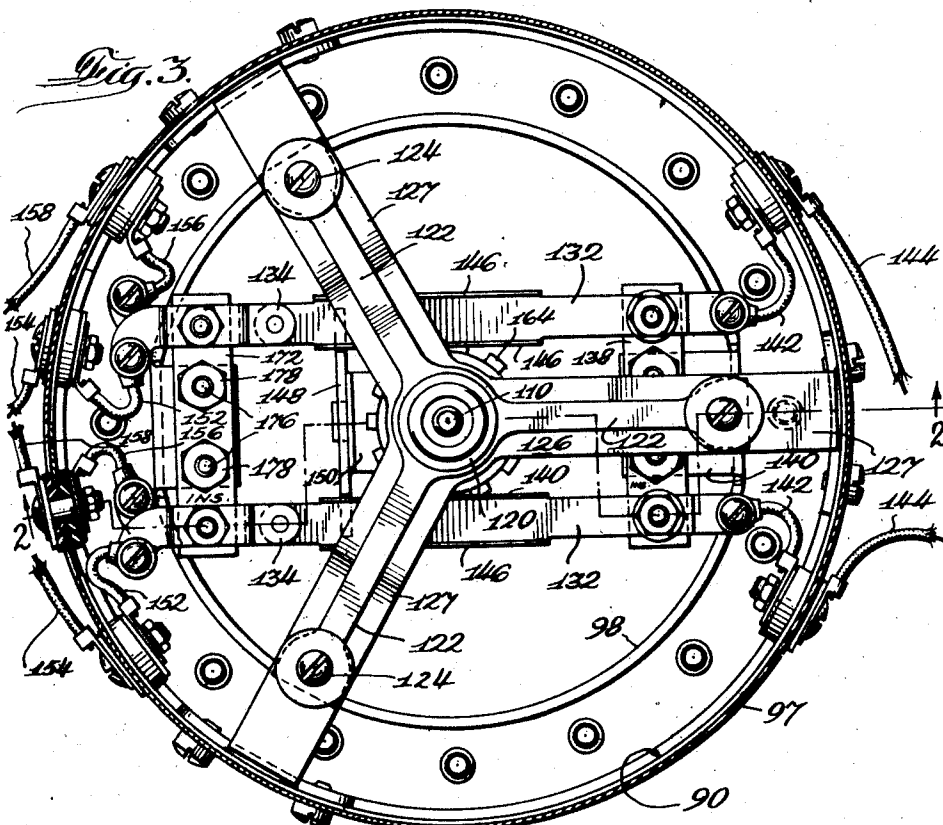
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ELECTRIC SWITCH

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,450,961

ELECTRIC SWITCH

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This invention relates to electric switches and it has a wide range of application in the control of electric circuits employed for various purposes. Particularly on airplanes or other vehicles in which there is considerable vibration it is important to provide a switch having its contact elements held either in or out of contacting position positively or with sufficient definiteness so that vibration of the structure on which the switch is mounted shall not disturb the condition of the switch. Otherwise the device controlled by the switch may operate intermittently instead of continuously as intended or may be placed in operation at times when it should be de-energized.

One object of this invention is to provide a new and improved pressure actuated electric switch having means to prevent unintended operation thereof in response to vibration.

Another object of the invention is to provide a new and improved pressure actuated electric switch having a confined hydraulic fluid serving as a cushioning medium to prevent abnormal operation of the switch.

A further object of the invention is to provide a new and improved electric switch having hydraulic cushioning means for its movable parts and in which the cushioning means will be effective independently of the position in which the switch is mounted or carried.

It is also an object of the invention to provide a new and improved electric switch in which the contact making and breaking means operates within a sealed chamber.

An additional object of the invention is to provide a new and improved electric switch having means for actuating the contact making and breaking elements mechanically but by remote control as for example through the medium of a confined fluid.

Other objects and advantages will appear from the following description taken in connection with the drawings, in which:

Fig. 1 is an axial sectional view showing the internal construction of a pressure actuated switch embodying this invention;

Fig. 2 is an axial sectional view showing a modified construction, taken at line 2—2 on Fig. 3;

Fig. 3 is a plan section taken substantially as indicated at line 3—3 on Fig. 2;

Fig. 4 is a detail section taken as indicated at line 4—4 on Fig. 2;

Fig. 5 is a detail section taken as indicated at line 5—5 on Fig. 2;

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Fig. 6 is a detail section taken as indicated at line 6—6 on Fig. 2.

As shown in Fig. 1, the switch mechanism is enclosed in a housing comprising an end wall 10 and an end wall 12 with interposed filler members 14 and 16 which engage the peripheral portions of the end walls and are secured between them by clamping bolts or screws 18. The end walls 10 and 12 will usually be of cast metal construction although for some purposes synthetic plastics might be employed for these parts. The fillers 14 and 16 are preferably of electrical insulating material because there is secured between them a partition member 20 which is preferably of electrically conductive material and which has a lug 22 extending outside the casing and beyond the peripheral outlines of the fillers 14 and 16 for attachment of a circuit lead wire 24 by means of a binding screw 26. A pair of flexible diaphragms 28 and 30 extend across the chamber formed between the end walls 10 and 12, the peripheral portions of the diaphragms being clamped between the fillers 14, 16 and the end walls 10 and 12 by the clamping action of the bolts 18. The diaphragms are spaced apart from each other and the end walls 10 and 12 are formed to provide spaces 32 and 34 between the outer faces of the diaphragms and the respective end walls.

The wall 10 includes a centrally disposed recess or pocket 36 which houses a light spring 38 engaging the central portion of the diaphragm 28 for stabilizing it; and the wall 12 is formed with a centrally disposed recess or pocket 40 which encloses a somewhat heavier spring 42 reacting between the diaphragm 30 and a plate or disc 44 carried by an adjusting screw 46 having threaded engagement with the end wall of the pocket 40 with a lock nut 48 for retaining the screw in adjusted position. Each diaphragm is secured between reinforcing plates 50 and 52; and both diaphragms carry centrally disposed insulating washers 54 for seating the springs 38 and 42 respectively. At the center of each diaphragm a bolt 56 secures the plates 50 and 52 and the washer 54 in assembled relation.

The bolt 56 in the diaphragm 28 carries an electrical contact button 58 and the bolt 56 in the diaphragm 30 carries a contact button 60 while the partition 20 supports a double-faced contact button 62 adapted to engage either the contact 58 or the contact 60. The contact 58 is connected to a lead wire 64 secured to a binding post 66, the connection being conveniently completed through a flexible conducting wire 68 extending from the

binding post 66 to the reinforcing plate 50 which is in contact with the bolt 56 at the center of the diaphragm 28. The contact 60 is similarly connected to a lead wire 70 through a binding post 72 and flexible conductor 74 extending inside the housing from the binding post 72 to the plate 50 associated with diaphragm 30. The binding posts 66 and 72 are secured in insulating bushings 76 which are set in suitable bosses formed in the end walls 10 and 12 respectively.

As indicated in the drawing the space between the diaphragms 28 and 30 contains a fluid medium 78 which is of the general character of the hydraulic fluid employed in brake systems and the like for transmitting movement and this fluid completely fills the space between the diaphragms and is confined by them. A small port 80 in the partition 20 affords restricted communication through the partition.

In the particular switch illustrated in Fig. 1 the spring 42 normally holds the contact 60 in engagement with the contact 62 on the partition 20, the diaphragm 30 being flexed toward the partition in this position of the parts, while the contacts 62 and 58 are shown separated. The space 32 between the diaphragm 28 and the end wall 10 is connected by a pipe or tube 82 with a source of pressure which may be gas or air pressure involved in the operation of an apparatus, as, for example, an internal combustion heater in which it is desirable that the igniter circuit shall not be closed until an air supply at a certain pressure is available for combustion or for circulation, or both. On the other hand, the air or gas supplied under pressure through the pipe 82 may be simply an operating medium for transmitting movement from a manual control device or other mechanism to the diaphragm 28. When a predetermined pressure is applied to the chamber 32 by the fluid medium acting through the pipe 82, the diaphragm 28 will be moved toward the partition 20. This will gradually force the fluid 78 through the restricted orifice 80, thus increasing the volume of fluid on the other side of the partition and forcing the diaphragm 30 away from the partition so as to separate the contacts 60 and 62, opening a circuit which includes the lead wires 24 and 70. Continued pressure on the diaphragm 28 will bring the contact 58 into engagement with contact 62, thus closing the circuit which includes the lead wires 24 and 64.

In some instances there may be only one circuit involved and the lead wire 70 may be omitted so that no particular result follows the separation of contacts 60 and 62, but for other purposes it may be desirable to control two circuits or electrical devices in the manner described. In some cases the tube 84 leading from the chamber 34 between the diaphragm 30 and the end wall 12 will be merely a vent to provide atmospheric pressure for the space 34; in other cases the control of the electrical circuits connected with the switch device may depend upon a differential, as between variable pressures applied respectively to the two diaphragms through the pipes 82 and 84. In either case, when the pressure through the pipe 82 is no longer sufficient to overcome the pressure applied through pipe 84 plus the force of the spring 42, the fluid 78 will be returned through the orifice 80 to the space between the partition 20 and the diaphragm 28, causing the contacts 58 and 62 to be separated and finally permitting the contact 60 to again engage contact 62.

In Figs. 2 to 5 inclusive there is shown a modified construction in which the contact elements

of the circuit making and breaking devices are located within the same enclosing housing as the diaphragms and retarding fluid but not within the body of the fluid itself. The housing is shown at 90 as of cylindrical form and it encloses a spacer ring 92 secured in place by bolts 94 which extend through the marginal portion of the head or bottom wall 96 of the cylindrical casing and are threaded into a flanged ring 98 permanently secured, as by welding, to the cylindrical wall 90 of the housing. The bolts 94 thus serve to hold end wall 96 in place. At the same time the clamping action of the bolts 94 secures marginal portions of a partition wall 100 between the ring 92 and the part 98 and similarly secures the marginal portions of diaphragms 102 and 104 which are located respectively above and below the wall 100. A central orifice 106 affords communication between the space above the partition 100, and the space below it enclosed within the two diaphragms, and the entire space between the diaphragms is filled with a fluid 108 which may be in the nature of the fluid employed in hydraulic brake systems.

The two diaphragms 102 and 104 are positively coupled together by means of a threaded rod 110 which engages a threaded button 112 clamped in a central opening in the diaphragm 102, and a button 114 similarly clamped in the central opening of the diaphragm 104. Stiffening discs 116 and 118 are secured respectively against the upper face of the diaphragm 102 and the lower face of the diaphragm 104 by the buttons 112 and 114. The upper end of the rod 110 is screwed into the hub 120 of a flexible three-armed spider 122, having the outer ends of its arms secured by screws 124 to a supporting member 126 mounted in the housing and attached to the cylindrical wall 90 thereof. The spider 122 thus centers and steadies the rod 110 throughout the vertical range of its movement which results from flexing of the diaphragms 102 and 104.

Such movement of the diaphragms occurs in response to changes of pressure acting against them within the housing 90; an inlet pipe 128 tapped into the bottom wall 96 will connect the housing with a source of pressure which may be gas or air pressure involved in the operation of an apparatus. The upper portion of the housing 90 is provided with an opening in the top wall 97 which may be merely a vent to atmosphere or which may be connected by pipe 130 with a second source of pressure when the device is to be responsive to the differential between the two pressures.

The vertical movement of the rod 110, in response to variations of pressure acting against the diaphragms 102 and 104, may be utilized to actuate several electric switches or contact devices; as shown, the housing 90 encloses two such devices, each comprising a movable contact arm 132 and a pair of fixed contacts 134 and 136. The arms 132 are clamped to a block 138 of insulating material supported by a bracket arm 140 which extends from the ring 98, and suitable conductor wires 142 and 144 provide electrical connections from the arms 132 extending outside the housing 90. The arms 132 are fairly flexible adjacent their securement to the block 138 but between this point and their free ends they are somewhat stiffened by marginal flanges 146 and these stiffened portions are engaged by an actuating bar 148 of insulating material which is attached to the diaphragm 102 by a bracket 150. Vertical movement of the diaphragm 102 is thus trans-

mitted to the arms 132 for causing them to engage either the contacts 134 or the lower contacts 136 for closing the circuits corresponding respectively to said contacts. The contacts 134 are provided with conductor wires 152 and 154 leading outside the housing 90 and the contacts 136 are shown with conductors 156 and 158 similarly extending outside the housing 90.

The member 126 which is anchored in the housing 90 includes radial arms 127 extending inwardly to form a substantially rigid spider and a coil spring 162 is arranged to react between this spider and a nut 164 which is adjustable on the threaded rod 110. Preferably, cupped washers 166 and 168 are interposed between the ends of the spring and the spider and nut respectively. Thus the spring may be adjusted to provide an initial biasing force operating downwardly against the diaphragms 102 and 104 in opposition to an actuating fluid pressure entering the housing through the pipe 128 and operative against the diaphragm 104, and in this manner the device may be set to respond to a predetermined pressure in that direction. If there is also a variable pressure supplied through the pipe 130 the operation of the diaphragms and actuation of the switch arms 132 will depend upon the difference between the two pressures modified by the force of the spring 162 in one direction. In any event, the movement of the diaphragms in either direction can occur only as rapidly as permitted by the transfer of fluid 108 through the orifice 106 and the dash pot effect thus produced will prevent movement of the rod 110 and bar 148 in response to vibration or jarring of the structure upon which the switch device is carried.

As shown in Figs. 2 and 4, the contacts 136 are definitely located by mounting them on a bar of insulating material 170 which is bolted to a bracket 141 extending from the ring 98. To permit adjustment of the distance between the contacts 136 and 134, the latter are secured to a bar 172 of insulating material which rests upon spacer springs 174 disposed between the bar 172 and the bar 170. The securing bolts 176 which extend through both bars are provided with nuts 178 bearing against the upper face of the bar 172 so that adjustment of these nuts will compress the springs 174 to a greater or less degree and thus shift the bar 172 and the contacts 134 vertically with respect to the contacts 136. Corresponding adjustment of the range of movement of the diaphragms 102 and 104 is effected by means of a stop nut 180 on the threaded rod 110 and a lock nut 182 associated therewith. The stop nut 180 positively limits upward movement of the diaphragms when it engages the washer 166 which abuts the under surface of the spider 126; downward movement of the diaphragms is checked when the button 112 encounters a boss 184 upraised from the surface of the partition 100 adjacent the port 106 incidentally preventing closure of the port by the button 112.

While there is shown and described herein certain structure embodying this invention, it is to be understood that the invention is not limited thereto or thereby but may assume numerous other forms and that it includes all modifications, variations and equivalents coming within the scope of the claims.

We claim:

1. A pressure actuated switch device comprising a closed chamber, a pair of flexible diaphragms extending across said chamber in spaced relation with a quantity of fluid confined

between them, a relatively rigid partition in the chamber disposed between said diaphragms and having a restricted orifice permitting limited flow of the fluid from one side of said partition to the other side, an electrical contact element carried by each of said diaphragms and electrical contact means carried by the partition in position to engage the other contacts, means for applying pressure against one of said diaphragms and yielding means reacting in the opposite direction against the other diaphragm.

2. A pressure actuated switch device comprising a closed chamber, a pair of flexible diaphragms extending across said chamber in spaced relation with a quantity of fluid confined between them, a relatively rigid partition in the chamber disposed between said diaphragms and having a restricted orifice permitting limited flow of the fluid from one side of said partition to the other side, an electrical contact element carried by each of said diaphragms and electrical contact means carried by the partition in position to engage the other contacts, conduit means communicating with the chamber at one side of one diaphragm for applying fluid pressure thereto, and yielding means reacting in the opposite direction against the other diaphragm.

3. A pressure actuated switch device comprising a chamber, a pair of flexible diaphragms extending across said chamber in spaced relation to each other and in spaced relation to opposite walls of the chamber respectively, a relatively rigid partition dividing the space between the diaphragms and having a restricted orifice, a quantity of fluid filling the space between the diaphragms, separate pressure means in the spaces between the diaphragms and said opposite walls of the chamber operative against the diaphragms respectively, electric contacts carried by said partition, and electrical contact elements carried by said diaphragms in positions to engage the first said contacts and movable into and out of their contacting positions by changes in the relative force of the respective pressure means.

4. A pressure actuated switch device comprising a hollow body composed of opposed end walls with fillers engaged between the peripheral portions of said end walls and forming the lateral walls of said body, clamping means securing said parts together with a relatively rigid partition dividing the space between said end walls and having its peripheral portion clamp between adjacent fillers, a pair of flexible diaphragms spaced from opposite sides of the partition respectively and peripherally supported by said fillers, a quantity of fluid confined between the diaphragms, said partition having a restricted orifice, electrical contact elements carried by said diaphragms, yielding means reacting between one of the diaphragms and the adjacent end wall, and means for applying fluid pressure between the other diaphragm and the adjacent end wall for shifting said contact elements.

5. In a pressure actuated switch as defined in claim 4, said yielding means comprising a spring, and means accessible outside the body of the device for adjusting the tension of said spring.

6. In a pressure actuated switch device as defined in claim 4, said fillers being of insulating material and the partition being of electrically conductive material with means for connecting a lead wire thereto outside the body of the device, whereby said partition cooperates with the con-

tact element of at least one of the diaphragms to complete an electric circuit.

7. A switch device comprising a pair of flexible diaphragms forming opposite walls of a chamber with a quantity of substantially incompressible fluid confined between them, a relatively rigid partition extending across the chamber between said diaphragms and having a restricted orifice, an electrical element carried on the inner face of each diaphragm and an electrical contact element carried by said partition in position to engage either of the other contacts and normally engaging one of them, and means arranged to apply pressure to the outer face of the diaphragm which carries the other contact.

8. A switch device comprising a pair of flexible diaphragms forming opposite walls of a chamber with a quantity of substantially incompressible fluid confined between them, a relatively rigid partition extending across the chamber between said diaphragms and having a restricted orifice, an electrical contact element carried on the inner face of each diaphragm and an electrical contact element carried by said partition in position to engage either of the other contacts, supporting structure for said chamber, yielding means reacting between said structure and the outer face of one diaphragm normally holding its contact in engagement with the contact on the partition, and means arranged to apply pressure to the outer face of the diaphragm.

9. A pressure actuated switch device comprising a sealed chamber with a pair of flexible diaphragms forming opposite walls of said chamber, a relatively rigid partition spaced between said diaphragms with a quantity of fluid filling the spaces between said partition and both diaphragms, said partition having a restricted orifice to permit limited flow of the fluid from one side of the partition to the other side, a support for said chamber, means for applying pressure against one of said diaphragms, yielding means reacting against the support and opposing said pressure, electrical contact means carried by said support, and means connecting one of said diaphragms to said contact means to produce actuation of said contact means upon a predetermined movement of said diaphragms.

10. A pressure actuated switch device comprising a sealed chamber with a pair of flexible diaphragms forming opposite walls of said chamber, a relatively rigid partition spaced between said diaphragms with a quantity of fluid filling the spaces between said partition and both diaphragms, said partition having a restricted orifice to permit limited flow of the fluid from one side of the partition to the other side, a support for said chamber, switch means including a fixed contact element and a movable contact element both mounted on the support, means for applying pressure against one of said diaphragms, yielding means reacting against the support and opposing said pressure, and means connecting one of said diaphragms to said movable contact member for actuating it.

11. A pressure actuated switch device comprising a sealed chamber with a pair of flexible diaphragms forming opposite walls of said chamber, a relatively rigid partition spaced between said diaphragms with a quantity of fluid filling the spaces between said partition and both diaphragms, said partition having a restricted orifice to permit limited flow of the fluid from one side of the partition to the other side, a support for said chamber, switch means including a fixed

contact element and a movable contact element both mounted on the support, means for applying pressure against one of said diaphragms, yielding means reacting against the support and opposing said pressure, a rigid member connecting a movable portion of one diaphragm with a movable portion of the other diaphragm and also connecting said diaphragms to said movable contact member for actuating it.

12. In a pressure actuated switch device as defined in claim 9, adjustable stop means positively limiting the movement of said diaphragm in response to said pressure.

13. A pressure actuated switch device comprising a sealed chamber with a pair of flexible diaphragms forming opposite walls of said chamber, a relatively rigid partition spaced between said diaphragms with a quantity of fluid filling the spaces between said partition and both diaphragms, the partition having a restricted orifice to permit limited flow of the fluid from one side of the partition to the other side, a support for said chamber, switch means including a pair of fixed contact elements spaced apart on the support and a movable contact element also mounted on the support for engagement alternatively with said fixed contacts, means for applying pressure against one of said diaphragms, yielding means reacting against the support and opposing said pressure, means connecting one of said diaphragms to said movable contact member for actuating it, and stop means positively limiting the movement of the diaphragm in either direction.

14. In a pressure actuated switch device as defined in claim 13, means for adjusting the spacing of said fixed contact elements from each other, and adjustable stop means positively limiting the movement of said diaphragm in both directions.

15. A pressure actuated switch device comprising a closed chamber, a pair of flexible diaphragms extending across said chamber in spaced relation, a relatively rigid partition in the chamber spaced between said diaphragms with a quantity of fluid filling the space between said partition and both diaphragms, said partitions having a restricted orifice to permit limited flow of the fluid from one side of the partition to the other side, said chamber including a substantially gas type compartment between its end wall and one of said diaphragms and a second gas type compartment between its opposite end wall and the other diaphragm, an opening in each end wall for applying fluid pressure against said diaphragms respectively for moving them in accordance with the differential between the respective pressures in said compartments, and electrical contact means housed in the chamber and connected to one of the diaphragms for actuation thereby in response to changes in said pressure differential.

16. In a pressure actuated switch device as defined in claim 15, a threaded rod connecting the two diaphragms and extending therefrom into one of the compartments of the chamber, a rigid spider supported in said compartment with a clearance opening at its center through which said rod extends, a flexible spider having arms attached to the rigid spider and a central portion threaded on to said rod, an adjustable nut on said rod with a spring reacting between said nut and said rigid spider biasing the diaphragms in one direction, and a stop nut on said rod en-

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gageable with the spider to limit movement of the diaphragms in the opposite direction.

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Arthur	Mar. 22, 1938
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