

Oct. 28, 1941.

L. S. NEFF

2,260,636

DIAPHRAGM DEVICE

Filed Sept. 17, 1938

2 Sheets-Sheet 1

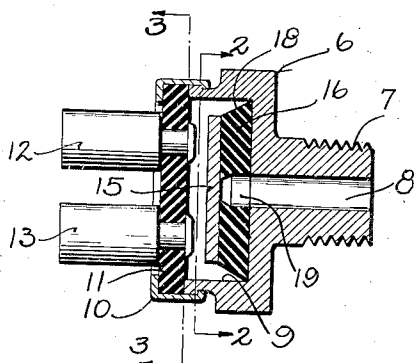


Fig. 1.

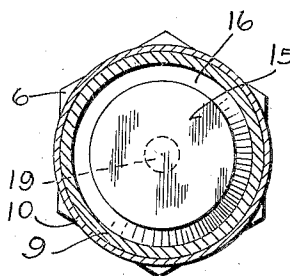


Fig. 2

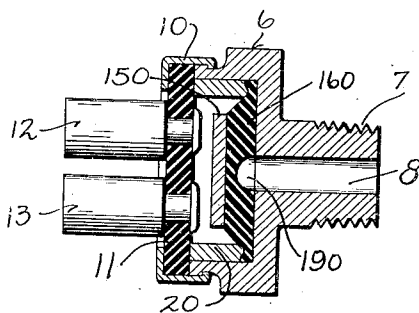


Fig. 4.

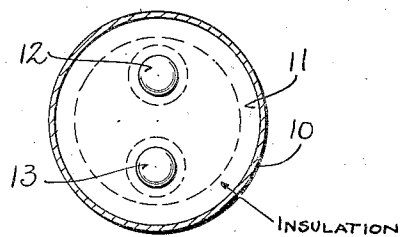


Fig. 3.

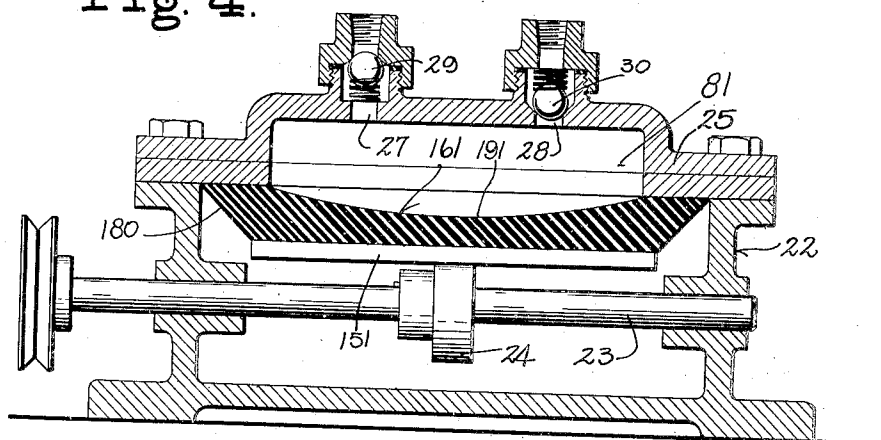


Fig. 5.

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2 Sheets-Sheet 2

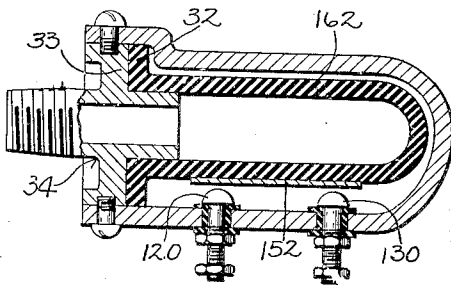


Fig. 6.

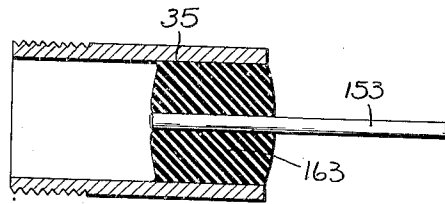


Fig. 7.

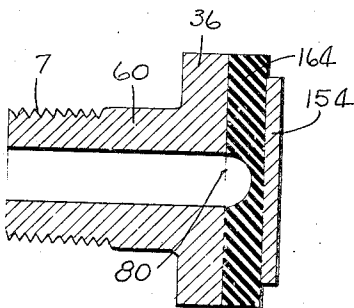


Fig. 8.

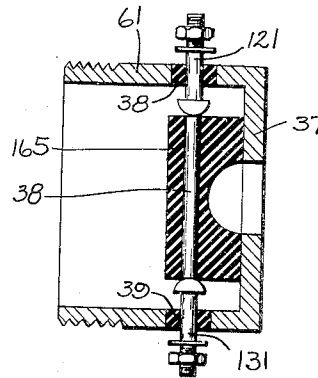


Fig. 9.

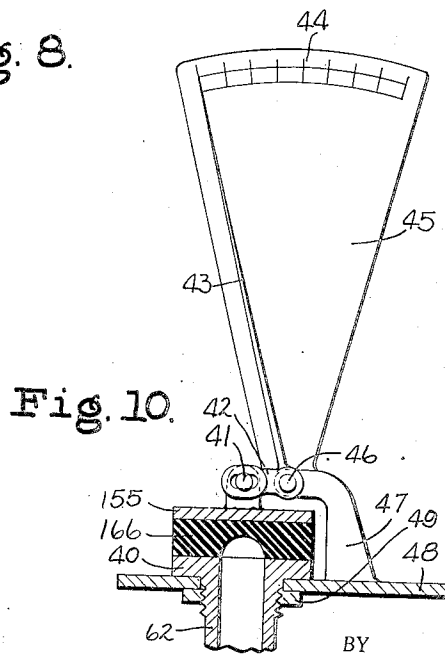


Fig. 10.

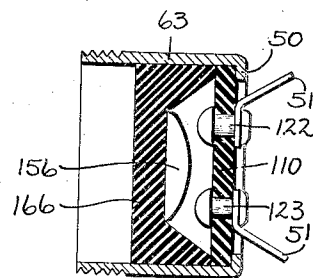


Fig. 11.

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UNITED STATES PATENT OFFICE

2,260,636

DIAPHRAGM DEVICE

Lucius S. Neff, Wauwatosa, Wis., assignor to Clum Manufacturing Company, Milwaukee, Wis., a corporation of Wisconsin

Application September 17, 1933, Serial No. 230,410

20 Claims. (Cl. 200—83)

This invention relates to improvements in diaphragm devices.

The invention has particular utility in hydraulically operable electric switches, but it is also useful in many other fields as, for example, in pumps, gauges, and the like. The drawings of the present application are to be taken as merely illustrative of some of the various applications of the invention.

It is the primary object of the invention to greatly simplify a diaphragm device and particularly an electric switch by rendering the construction less expensive and requiring fewer parts while at the same time achieving greater security against pressure leaks than has heretofore been found.

Other objects will appear from the following disclosure.

In the drawings:

Fig. 1 shows a view in axial section through a hydraulically operable electric switch embodying this invention.

Fig. 2 is a detail view thereof taken in section on the line 2—2 of Fig. 1.

Fig. 3 is a detail view taken in section on the line 3—3 of Fig. 1.

Fig. 4 is a view similar to Fig. 1, of an electric switch representing a modified embodiment of the invention.

Fig. 5 is a view in axial section through a diaphragm pump embodying the invention.

Fig. 6 is a view in axial section through a modified electric switch embodiment of the invention.

Fig. 7 is a view in axial section through a modified diaphragm device embodying the invention.

Fig. 8 is a view in axial section through a further modified diaphragm device embodying the invention.

Fig. 9 is a view in axial section through an electric switch embodiment of the invention designed for use as a pressure cut-off switch.

Fig. 10 is a view partially in side elevation and partially in axial section showing a pressure gauge embodiment of the invention.

Fig. 11 is a view in axial section showing a further modified electric switch embodiment of the invention.

Like parts are identified by the same reference characters throughout the several views.

The switches shown are of a type peculiarly adapted for use in the hydraulic brake connections of a motor vehicle to operate a stop light when the hydraulic system is subject to pressure. The casing 6 carries a screw plug fitting 7 through

which a bore 8 leads to the interior of the casing. The neck portion 9 of the casing is undercut to provide a flange about which the retaining ring 10 is spun to hold a terminal head 11 in which I provide the terminals 12 and 13, which extend through the terminal head to provide contacts.

Within the casing is a moving contactor 15 which comprises a disk, preferably made of brass. The casing 6 is also preferably made of brass and the disk 16, which may conveniently be made of rubber or Neoprene or the like, is vulcanized to the end wall of the casing and to the rear face of the contact disk 15. The disk 16 preferably has a beveled margin 18 so that it is frusto-conical in form, its larger face being vulcanized to the casing. In such larger face it preferably has an opening 19 which, in the construction shown in Fig. 1, may extend completely through the disk of rubber or artificial rubber. As shown in Fig. 4, the corresponding recess 190 does not completely penetrate the rubber disk 160.

It is characteristic of the device disclosed in Figs. 1 and 4 that when pressure is applied through the duct 8 the rubber disk 16 comprising the diaphragm is under tension. In the device shown in Fig. 1 the full pressure communicated through duct 8 is applied directly to the contact disk 15 which is caused to move to the left as viewed in Fig. 1 into engagement with the terminal contacts 12 and 13 to close the circuit therebetween. In the course of such movement the entire diaphragm disk 16 is tensioned but its area of surface vulcanization to the casing is more than adequate to withstand the high load to which it is subjected in a hydraulic system.

The device shown in Fig. 4 is modified in two respects which have no direct relation to each other. As above indicated, the recess 190 in the disk 160 does not completely penetrate through the disk to the contactor 150. The other modification involves the use of an annular pressure ring 20 confined between the terminal head 11 and the margin of the disk 160 to supplement the vulcanization by a mechanical means for holding the disk in fluid pipe relation to the casing.

In this device the vulcanization of the resiliently deformable disk 160 to the casing 6 may, if desired, be dispensed with but the action of the disk is distinctly different where it is secured only at its margins, and accordingly it is preferred that even in the Fig. 4 construction the disk should be vulcanized throughout its larger face to the casing 6 and throughout its smaller face to the contact disk 150.

The device shown in Fig. 5 has a diaphragm

pump and the casing includes a base 22 providing bearings for the cam shaft 23 upon which cam 24 is mounted. Closing the base portion 22 of the casing is a closure member 25 which, for convenience of manufacture, is made in two parts comprising a cover and intervening ring as illustrated, but functions as one piece and will be referred to as one member. The closure provides a casing end wall formed with a pump chamber 81. Bores 27 and 28 communicating with the pump chamber are provided with input and output check valves 29 and 30 respectively, the valve fittings providing the usual couplings for pipe connections.

The diaphragm disk 161 is provided with a recess 191 which is co-extensive with chamber 81. Externally of such recess the disk 161 is vulcanized to the casing head or closure 25. Its side margins are beveled as indicated at 180 and its smaller face is vulcanized to a disk 151 upon which the cam 24 bears. Since the disk 161, like disks 16 and 160, is made of rubber or Neoprene or the like, it is elastically deformable and requires no springs. When compressed by the cam 24 to eject fluid from chamber 26 past the outlet check valve 30, the deformable disk 161 will, when relieved of the cam pressure, elastically resume its initial position to draw in a fresh charge of fluid past the intake check valve 29.

In the construction shown in Fig. 6 the diaphragm 162 comprises a tubular member having its flange portion 32 vulcanized to the radially extending wall 33 of the ported fitting 34. The contactor 152 is vulcanized to the side rather than the end face, of the diaphragm 162, and when the diaphragm is distended by pressure communicated through the fitting 34, the contactor engages the fixed contacts 120 and 130 to close an electrical circuit therebetween.

The device shown in Fig. 7 is of general utility. The fitting 35 is perfectly tubular and the diaphragm comprises a plug 163 of rubber or artificial rubber vulcanized in the end of the tube 35, and also vulcanized to the central rod 153 which constitutes the actuated member. Either pressure or vacuum transmitted through fitting 35 to the diaphragm plug 163 will subject the plug to tension, in one direction or the other, moving the actuated member 153 accordingly.

In the construction shown in Fig. 8, the arrangement is virtually identical to that shown in Fig. 1 except that the device is of more general application, there being no casing and no switch contacts. The fitting 60 has the same threaded shank 7 shown in Fig. 1 and is radially flanged at 36. The diaphragm member 164 is vulcanized to the flange 36 about the port 80 of the fitting and the actuated member 154 is vulcanized thereto as previously described.

In Fig. 9 the arrangement is such that the elastically deformable diaphragm 165 is vulcanized interiorly to the ported and otherwise closed end 37 of the casing 61. An electrically conductive rod 38 serves as a contact element extending transversely through the diaphragm 165, having its ends exposer at the sides of the diaphragm. The contacts 121 and 131 are mounted in rubber grommets 38 and 39 respectively, whereby they are insulated from the casing 61. The rubber elements 38 and 39 are sufficiently flexible to permit the contacts 121 and 131 a slight degree of yielding movement from the positions shown. When the interior of the casing 61 is not subjected to pressure a circuit is closed between contacts 121 and 131 through the con-

ductor 38. When the interior of the casing is subjected to pressure the pressure deforms the diaphragm 165 until ultimately the conductor 38 is moved to the right for a distance sufficient to break the circuit between the contacts. The outward flexing of the grommets 38 and 39 also tends to break the circuit. This device may be used as a limit switch in an air compressor and has a variety of other applications.

In Fig. 10 a device similar to that shown in Fig. 8 is used as a pressure gauge. The fitting 62 is connected with the pressure to be measured. The flanged head 40 has diaphragm 166 vulcanized thereto across the pressure supply port. The plate 155 vulcanized to the diaphragm carries a pin 41 engaged with the slotted arm of a bell crank lever 42, whereof the other arm constitutes a pointer 43 working over a scale 44 on the segmental dial 45. The bell crank lever is pivoted on a pintle 46 which, together with the dial 45, is mounted on a bracket 47 carried by plate 48. A nut 49 threaded to the shank of fitting 62, holds the plate to the fitting.

In Fig. 11 I have shown a simplified organization somewhat similar to the devices illustrated in Fig. 1 and Fig. 4. The casing 63 is entirely open at one end and is provided at its opposite end merely with a narrow annular flange 50 serving as a retainer for the dielectric terminal head 110. The contacts 122 and 123 are mounted in the terminal head in any desired manner and are provided externally with terminals 51. The premolded diaphragm 166 is cup-shaped and is vulcanized peripherally to the inner surface of the casing 63 with its flanged margins in abutment with the terminal head 110, thus fixing the position of the terminal head against the in-turned flange 50 of sleeve 63. Vulcanized centrally to the thinner portion of the diaphragm 166 is the contactor 156 which engages contacts 122 and 123 when the interior of fitting 63 is subjected to pressure.

In all the devices disclosed with the exception of that shown in Fig. 9, the deformable diaphragm is under tension when subjected to pressure. This is even true in Fig. 11, although some parts of the flange of the diaphragm there shown may be under compression. In each instance the elasticity of the deformable diaphragm would cause the diaphragm to resume the position shown in the drawing as soon as the pressure differential to which it is subjected is relieved.

I claim:

1. A device of the character described, comprising the combination with a casing provided with a substantially planiform annular wall portion and a port within said portion, of an elastically deformable body having a face vulcanized to the casing wall planiform portion immediately about said port in port-sealing relation.

2. A device of the character described, comprising the combination with a casing having an end wall provided with a port, of an elastically deformable body having spaced faces of differing area, the larger of said faces being vulcanized to said wall about said port and provided with a recess communicating with the port, the side portions of said body tapering from said larger face of the smaller face thereof.

3. A device of the character described, comprising the combination with a casing having a wall and provided with a port, of an elastically deformable body having a larger end portion vulcanized to said wall about said port, the side portions of said body tapering from said larger

end portion to a smaller end portion thereof, said smaller end portion having vulcanized thereto a metallic plate supported by said body from said wall and subject to displacement respecting said wall upon the deformation of said body, while maintained out of contact with said wall by the taper of said body, said casing being provided with a conduit connection, the elasticity of said body yieldably maintaining said plate in a predetermined position to which it restores said plate following displacement.

4. A device of the character described comprising the combination with a conduit having a ported terminal portion, of an elastically deformable body vulcanized to said portion substantially immediately about the port thereof, fixed contact means spaced from said terminal portion, and a contactor coacting with said fixed contact means and vulcanized to said body to be yieldably positioned by the elasticity of said body subject to movement respecting said fixed contact means when said body is subjected to a pressure differential communicated thereto through said port.

5. In a device of the character described, the combination with a casing of annular form provided with an inlet port at its end, of an elastically deformable body vulcanized to said casing immediately adjacent the port and in port sealing connection thereto, a contactor plate smaller in area than the cross section of said casing vulcanized centrally to said body at the side thereof remote from said port and dependent on said body for its position in said casing, and fixed contact means mounted in said casing and upon which said contactor plate is engageable in the deformation of said body by pressure communicated thereto through said port, the elastic tension of said body being such as to retract said plate from said fixed contact means upon relief of such pressure.

6. In a device of the character described, the combination with a casing provided near one end with a port, of an elastically deformable body in adherent tension connection with said casing about the port in port closing relation, a metallic plate in adherent connection with said body and disposed centrally thereon within the casing and dependent upon the elasticity of said body for its normally retracted position, a terminal head mounted in said casing, and contact means mounted in the terminal head in the path of said plate subject to engagement thereby when said body is subjected to deformation by pressure admitted through said port, the portions of said casing and plate to which said body is connected being substantially directly opposed in the direction of movement of said plate to and from said contact means.

7. In a switch comprising a casing provided adjacent one end with a port and adjacent the other end with a contact, an elastically deformable body vulcanized in the casing immediately adjacent the port and between the port and contact in port closing relation, and a contact member mounted on said body in a position to engage said first mentioned contact upon the tension deformation of said body under pressure communicated thereto through said port, the elasticity of said body normally maintaining said member retracted and said member being wholly dependent on said body for position.

8. In a switch, the combination of a casing having a ported end wall at one of its ends and a terminal head at its other end, at least one

contact in the terminal head, and a frusto-conical elastically deformable body having faces of differential diameters, its larger face being vulcanized to said end wall about the port and provided with a recess with which the port communicates, together with a contactor plate of smaller diameter than the cross section of the interior of the casing, said plate being mounted on said deformable body and dependent thereon for its position in the casing, the deformation of the body under pressure being adapted to engage said contact plate with the contact of the terminal head and the elastic tension of the deformed body being adapted to retract said plate upon the release of such pressure.

9. A device of the character described, comprising the combination with a casing having a ported end wall, of a terminal head provided with means connecting it with the other end of the casing in spaced relation to said wall, a diaphragm of block form within the casing sealing said port, annular means in pressure engagement between the terminal head and the diaphragm whereby the periphery of the diaphragm is pressed to said wall, and a contact closing member carried by the diaphragm and adapted to engage the contact of the terminal head upon deformation of the diaphragm under pressure communicated through said port, said diaphragm being vulcanized to said member and having sufficient inherent resilience to retract said member from the terminal head upon relief of such pressure.

10. A device of the character described, comprising the combination with a conduit having a ported end, of an elastically deformable body vulcanized to said conduit end in port-sealing relation, a contact plate vulcanized to said body in spaced relation to said casing and dependent on said body for its position in said casing, and a motion transmitting member bearing on said contact plate.

11. A device of the character described, comprising the combination with a casing having a port, of an elastically deformable body vulcanized to said casing in port sealing relation, a contact plate vulcanized centrally to said body and spaced thereby from said casing, and means for positively reciprocating said contact plate with respect to said port, the area of vulcanization of said plate to said body being so large respecting the portion of said casing to which said body is vulcanized that said plate is movable respecting said casing only upon the deformation of the body as distinguished from mere flexing thereof.

12. A device of the character described, comprising a casing having a wall and a port, and an elastically deformable body vulcanized to the wall and provided with a recessed portion exposed to pressures communicated to said casing through said port, said body being connected with the casing in port sealing position.

13. In a device of the character described, the combination with a supporting member having an opening, of a supported member, and an elastically deformable block in adhesive connection with both of said members and extending across the port and constituting a means for carrying and positioning the supported member from the supporting member, the portions of said members connected to said block being substantially directly opposed and said body being of such heavy substance and elasticity as to return said members to predetermined relative position when deformed in the displacement of said members.

14. A device of the character described, comprising inner and outer members, one of said members comprising a conduit section, an elastically deformable block vulcanized to said last mentioned section and deformable bodily when subjected to pressure differential communicated thereto through said section, said block being a means for yieldably positioning one of said members with respect to the other.

15. The combination with conduit means, of an elastically deformable body vulcanized thereto across said conduit means to constitute a diaphragm, a contactor carried by said member, electrical contacts provided with insulating mountings and normally engaged by said contactor, said body being deformable when subjected to pressure differential transmitted through said conduit means to a degree sufficient to move said contactor out of registry with said contacts.

16. The combination with a sleeve having a retaining flange, of a terminal head abutting said flange, contact means carried thereby, an elastically deformable plug vulcanized within said sleeve, and contact means vulcanized to said plug and normally free of the contact means of said terminal head, said plug being sufficiently deformable when subjected to a pressure differential communicated thereto through said sleeve to engage said contactor with said contact means and being sufficiently resilient to break such engagement when said pressure differential is released.

17. A device of the character described, comprising a fitting section having a terminal face and provided with a port opening through said face, an elastically deformable block vulcanized to said face, a contact plate vulcanized to said block in spaced relation to said face and spanning said port, the portions of said plate and face vulcanized to said block being substantially directly opposed in the direction of plate movement respecting said face and said plate being wholly dependent on said block for position and movable to and from said face under pressure differentials communicated through said port upon a change of bodily form of said block, the elasticity of said block being adapted to restore said plate to a predetermined position upon relief of said pressure differentials.

18. A device of the character described, comprising a fitting having a flange constituting a casing side wall and a face constituting a

casing end wall within said side wall, said fitting also having a port opening through said end wall face, a terminal member connected with said side wall in spaced relation to said face and constituting a casing closure, contact means mounted in the terminal head, an elastically deformable rubber block vulcanized to said end wall face within said side wall flange and recessed in registry with said port, a metal contact plate vulcanized to said block and spanning said port, whereby to be displaceable from said end wall face only upon the tensioning of the material of the block between the plate and said face subject to pressures communicated through said port, said plate being wholly dependent on said block for position and for restoration to its normally retracted position upon the relief of such pressure and being engageable with said contact means when said block is subject to pressure.

19. A device of the character described, comprising the combination with a casing member and an actuated member, of an elastically deformable block vulcanized to both of said members and adapted to accommodate relative movement therebetween only upon a bodily change of shape of said block as distinguished from the mere flexing thereof, said actuated member being wholly dependent upon said block for its position respecting said casing member and dependent on the elasticity of said block for a restoration of its initial position following deformation of said block, said casing member having a passage leading to said block for communicating pressure differentials thereto for the bodily deformation thereof, and the consequent displacement of said actuated member.

20. The combination with an annular wall providing a central port, of a member at least substantially spanning said port and directly confronting said wall in spaced relation thereto, and an elastically deformable body intervening between and bonded to substantially directly opposing portions of the member and said wall in sealing relation to said port, said member being wholly dependent on said body for position and displaceable by pressure differentials communicated through said port, and said body being yieldable primarily in elastic tension, as distinguished from mere flexion, in the movement of said member from said wall.

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CERTIFICATE OF CORRECTION.

Patent No. 2,260,636.

October 28, 1941.

LUCIUS S. NEFF.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, second column, line 69, claim 2, for the word "of" read --to--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of December, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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