

Sept. 12, 1944.

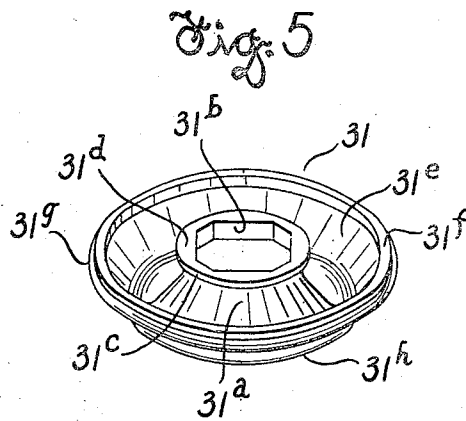
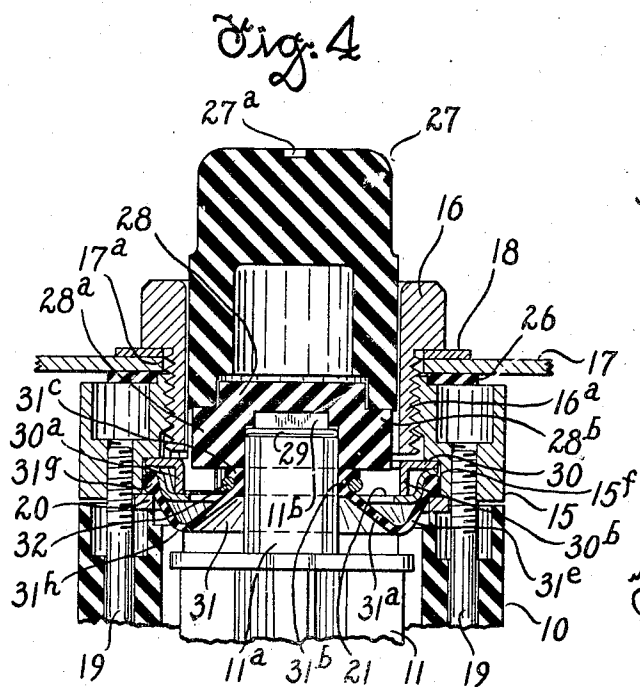
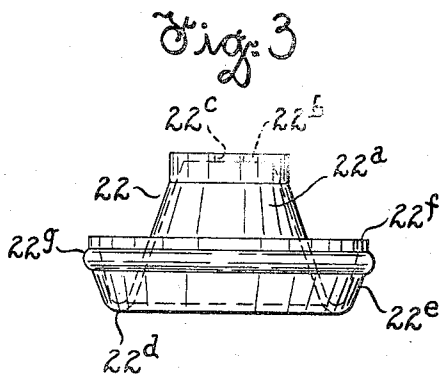
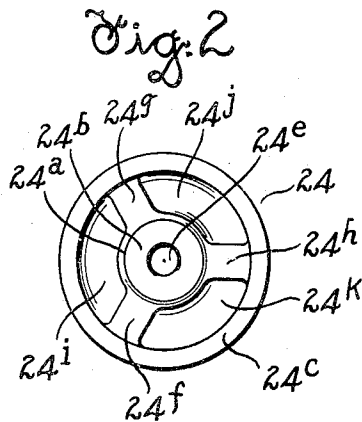
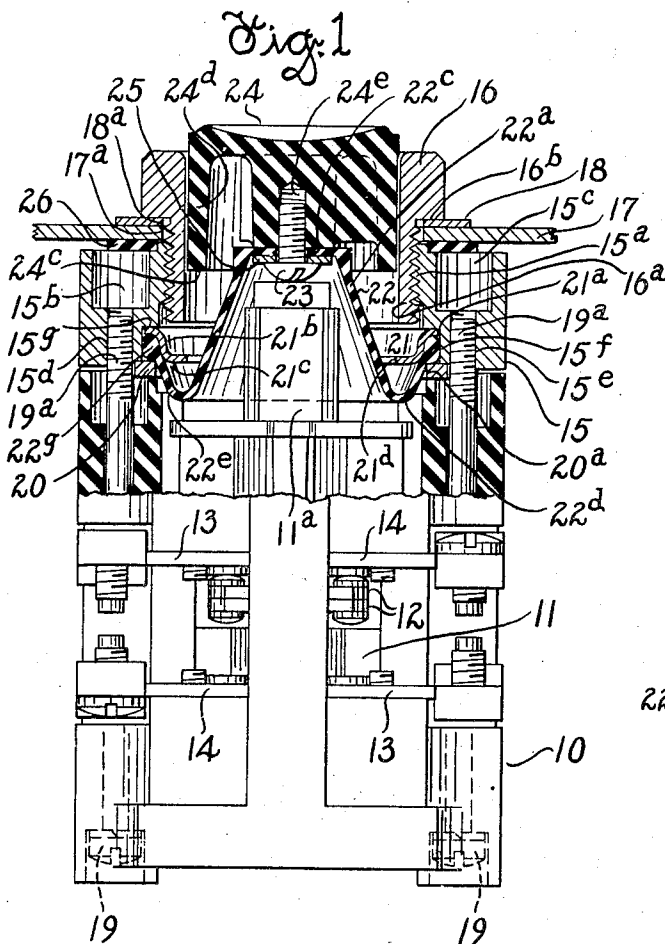
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2,357,973

LIQUID-TIGHT ELECTRIC SWITCH

Filed Aug. 18, 1942

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 6

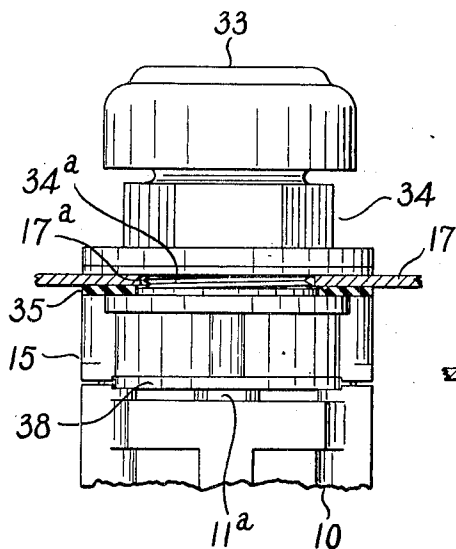


Fig. 7

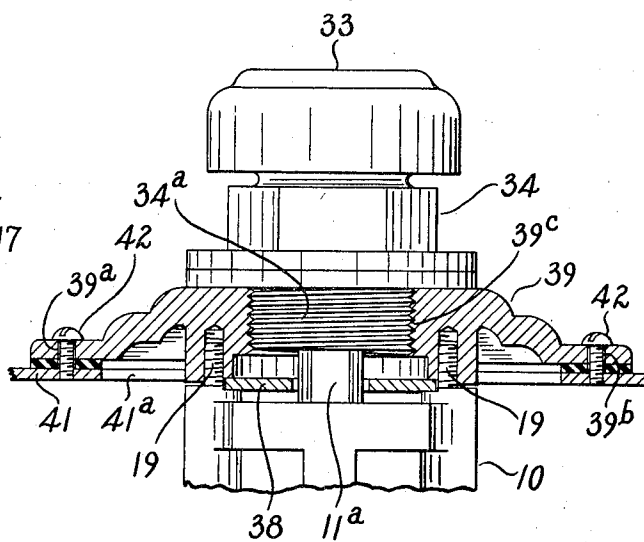


Fig. 8

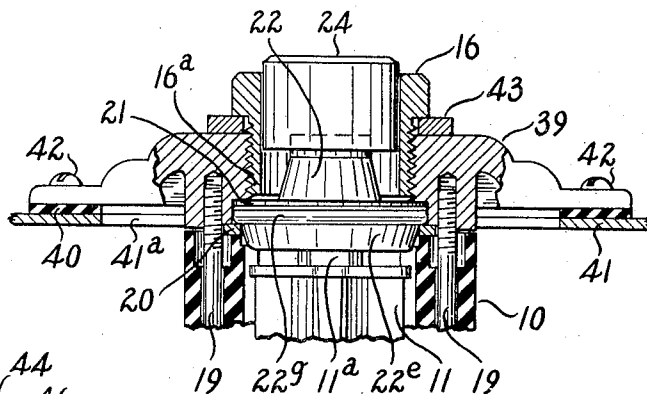
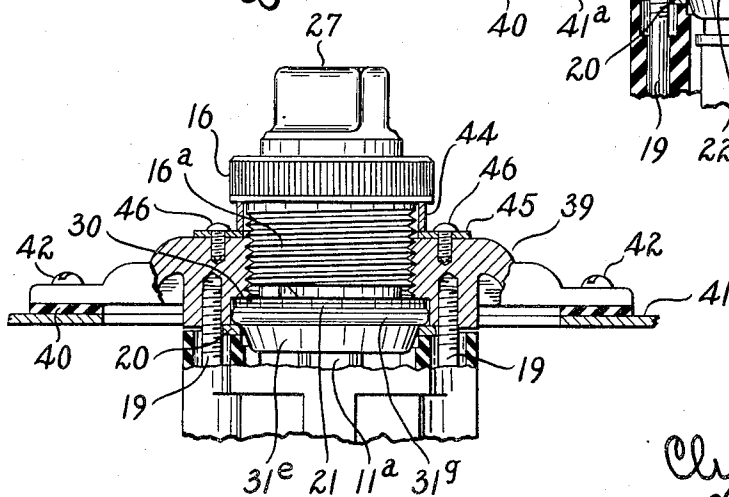


Fig. 9



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UNITED STATES PATENT OFFICE

2,357,973

LIQUID-TIGHT ELECTRIC SWITCH

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Application August 18, 1942, Serial No. 455,197

9 Claims. (Cl. 200—159)

This invention relates to improvements in liquid-tight electric switches, and the invention relates more particularly to means for rendering substantially oil-tight manually operable switches of the reciprocating contactor type.

A primary object of the invention is to improve and simplify the construction, assembly and operation of the elements which provide oil-tightness of switches of the aforementioned character.

Another object is to minimize the effect upon the operating characteristics of such a switch of the added element or elements affording oil-tightness.

Another object is to provide oil-tight switches of either the so-called one-hole mounting type or the flush-plate type.

Another object is to provide for use of simple additional or substitute elements to render switches of a known form substantially oil-tight.

Another object is to provide for concealment of the elements which render such switches oil-tight, whereby the external dimensions and the attractive appearance of the latter is unaffected.

Another object is to provide for attainment of the advantage of oil-tightness in switches of the reciprocating contactor type without sacrificing any of the functional or operative advantages of the latter.

Another and more specific object is to provide means for rendering substantially oil-tight such reciprocating contactor switches of the rotary selector type.

Another object is to provide novel means for rendering substantially oil-tight a reciprocating contactor switch adapted for flush-plate mounting.

Another object is to provide novel and simple means for mounting such substantially oil-tight switches.

Another object is to provide novel forms of diaphragms of molded rubber or a rubber-like material to render switches of the reciprocating contactor type substantially oil-tight.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate certain embodiments of the invention which will now be described, it being understood that the embodiments illustrated are susceptible of modification in respect of certain structural details thereof within the scope of the appended claims.

In the drawings,

Figure 1 is a view, partly in vertical section and partly in side elevation, of a pushbutton

switch of the one-hole mounting type having my improved elements associated therewith to render the same substantially oil-tight, the panel, to which the switch is attached as a unit, being shown in section.

Fig. 2 is a bottom plan view of the pushbutton shown in Fig. 1.

Fig. 3 is a side elevational view of the diaphragm shown in Fig. 1, the same being molded to the form illustrated from rubber or a rubber-like material.

Fig. 4 is a fragmentary vertical sectional view of a rotary selector switch of the reciprocating contactor type having my improved elements associated therewith to render the same substantially oil-tight.

Fig. 5 is a perspective view of the diaphragm shown in Fig. 4, the same being molded from rubber or a rubber-like material.

Fig. 6 is a fragmentary side elevational view of a one-hole mounting type of reciprocating contactor switch having a mushroom head operator, the supporting panel and the gasket of rubber or rubber-like material, which assists in rendering the switch substantially oil-tight, being shown in section.

Fig. 7 is a fragmentary side elevational view of a flush-plate mounting type of reciprocating contactor switch having a mushroom head operator, the flush-plate, the metal guide and stop plate, and the flush-plate gasket of rubber or rubber-like material being shown in section.

Fig. 8 is a fragmentary sectional view of a one-hole mounted, reciprocating contactor switch of the pushbutton type shown in Fig. 1, but showing the same supported upon a flush-plate having a gasket of rubber or rubber-like material interposed between the same and a supporting panel; portions of the elements in Fig. 8 being shown in elevation, and

Fig. 9 is a fragmentary view, partly in section and partly in elevation, of a one-hole mounted, reciprocating contactor switch of the rotary selector type shown in Fig. 4, but showing the same supported upon a flush-plate as in Fig. 8.

Referring first to that form of my invention shown in Figs. 1 to 3, the numeral 10 (Fig. 1) designates a one-piece molded insulating base of the character disclosed in my application, Serial No. 449,756, filed July 4, 1942, for Electric switches. Base 10 and the switch parts associated therewith, including plunger 11, bridging contactors 12 carried by the latter, and the combined stationary contact and terminal members

13 and 14 carried by base 10, may be identical with corresponding elements of the switches shown in said application, Serial No. 449,756, and are adapted to perform corresponding functions. As disclosed in said application, Serial No. 449,756, base 10 may have attached thereto from one pair up to four pairs of said stationary contacts, and from one to four bridging contactors for cooperation with the pair or pairs of contacts. Plunger 12 is spring biased outwardly from the recess in base 10, the degree of outward movement thereof being limited by engagement of one or more of the bridging contactors with an upper pair or pairs of stationary contacts (or by engagement of said contactors with "dummy" contact elements), as described in said application, Serial No. 449,756.

The die-cast metal adapter member 15 may be identical with that designated by numeral 60 in the device of Fig. 15 of said application, Serial No. 449,756, member 15 being provided with a central, circular opening having a screw-threaded upper end portion 15^a to receive the externally screw-threaded shank portion 16^a (Fig. 1) of a hollow metal bushing, the enlarged head of which is designated by numeral 16. Head 16 is preferably vertically milled or otherwise roughened peripherally to facilitate turning or tightening thereof (as shown at 61^b in Fig. 13 of said application, Serial No. 449,756). Head 16 is provided with a downwardly facing annular clamping shoulder 16^b which is adapted to overlie the outer face of a supporting panel or cover member 17, which is shown as composed of metal. Panel 17 is provided with a circular opening 17^a to provide clearance for the shank 16^a of the bushing. In practice a punched and stamped sheet metal indicating plate 18 is interposed between annular shoulder 16^b of the bushing and the outer face of panel 17, plate 18 having an opening 18^a to accommodate the bushing shank, and said plate is preferably provided with an integral lug (not shown, but corresponding to lug 64^b in Fig. 13 of said application, Serial No. 449,756); panel 17 having at least one suitably shaped opening (not shown) to accommodate said lug, which is likewise adapted to fit into any one of four recesses provided at the upper surface of adapter 15. Two of said recesses consist of the countersinks 15^b, 15^c opening to the upper surface of adapter 15; whereas another diametrically opposed pair of recesses (not shown) is positioned at right angles to the respective countersinks 15^b and 15^c. The opening or openings in panel 17 to accommodate the lug on plate 18 will therefore be drilled or punched at any one or more of four points spaced ninety degrees apart; the lug cooperating with the wall of said opening to insure against rotary or angular displacement of plate 18.

The portion (not shown) of plate 18 having the desired legend applied thereto may therefore be positioned at any one of four different angles, depending upon the position in which the panel 17 is to be mounted, and the desired rotary position of the switch relatively to the panel. Member 15 is provided with tapped passages 15^d and 15^e which open to the respective countersinks 15^b and 15^c, said passages being adapted to receive the threaded end portions 19^a, 19^a of a pair of bolts the heads of which are located in the downwardly opening countersinks in the lower end of base 10, as shown in dotted lines at 19, 19.

A flat, punched metal plate 20 is interposed between the lower surface of adapter 15 and the upper end portion of base 10, said plate having

diametrically opposed end notches to accommodate the screw shanks 19^a, 19^a, and a relatively large central circular opening 20^a. Thus the plate 20 is quite similar to the plate 48 in Fig. 9 of said application, Serial No. 449,756, except that the opening 20^a is of substantially larger diameter than the opening 48^a in plate 48.

The lower end of the central opening through adapter 15 is in the form of a relatively large downwardly opening countersink or annular recess 15^f, the upper end wall 15^g of which forms an annular shoulder which is adapted to overlie the outwardly extending annular flange 21^a of a punched and stamped sheet metal cup washer 21. The material of cup washer 21 extends downwardly from flange 21^a, as shown at 21^b, and then inwardly, as shown at 21^c; the inwardly extending portion 21^c terminating in the peripheral wall 21^d of a circular opening, as shown.

The means for rendering the switch mechanism oil-tight preferably comprises a diaphragm 22, which is molded to the form illustrated in Figs. 1 and 3 from high quality flexible rubber or a rubber-like material. Preferably the diaphragm consists of the synthetic rubber or rubber-like material which is sold commercially under the trade name of "Neoprene." Such material is characterized by its high degree of flexibility, toughness, long life, resistance to hardening and cracking when in use, and especially by its resistance to deterioration or disintegration in the presence of oil, grease or other similar substances, which render the life of articles composed of ordinary or natural rubber relatively short.

Member 22 comprises an intermediate portion 22^a in the form of a frustrum of a cone, the flat, circular upper end wall 22^b of which is provided with a relatively small circular opening 22^c (Fig. 1) to accommodate the shank of a screw 23, as hereinafter described. Member 22 is in the form of a relatively thin web or diaphragm, and as shown said web is reflexed at 22^d to provide the upwardly and outwardly extending annular portion 22^e. Portion 22^e is provided adjacent its upper end 22^f (see Fig. 3) with a laterally extending annular bead or enlargement 22^g. As shown in Fig. 1 end 22^f and bead 22^g are positioned within the countersink 15^f in adapter 15, for compression or clamping thereof between cup washer 21 and plate 20, as an incident to tightening of screws 19.

However, prior to such assembly of diaphragm 22 with respect to adapter 15 and switch base 10 a molded insulating pushbutton 24 is attached to the diaphragm. Thus pushbutton 24 is preferably provided with a central cylindrical stud 24^a, whose flat lower end 24^b (Fig. 3) is offset upwardly from the lower edge 24^c of the periphery or skirt portion 24^d of the pushbutton. Stud 24^a is provided with a downwardly opening recess 24^e which is tapped or otherwise threaded to accommodate the shank of screw 23. A metal washer 25 is preferably interposed between the head of screw 23 and the upper end wall 22^b of diaphragm 22 to insure proper clamping of said end wall against substantially the entire end surface 24^b of stud 24^a. Further offset upwardly from the lower edge 24^c of the pushbutton are a plurality of integral struts or fillets 24^f, 24^g, 24^h, cavities or recesses 24ⁱ, 24^j, 24^k being provided therebetween. In this manner pushbutton 24 is made relatively light, while insuring adequate strength thereof.

As shown in Fig. 1, the arrangement is pref-

erably such that upon assembly of the aforementioned parts, the flat upper end of the extension 11^a of plunger 11 will underlie and engage the head of screw 23 to bias the pushbutton 24 to its normal upper position, as an incident to movement of plunger 11 and its associated contactors to their normal upper positions under the bias of said plunger as aforescribed.

From the foregoing description it will be apparent that any oil or other liquid which may enter between the periphery of pushbutton 24 and the surrounding wall of the opening in bushing 16 will be effectively trapped or stopped from entering the switch chamber, by reason of the presence of diaphragm 22.

In order to prevent the possibility of oil or other liquid entering the opening 17^a in panel 17, and thence passing exteriorly over adapter member 15 and base 10 toward the switch contacts and contactors, I prefer to provide an annular washer or gasket 26 which is interposed between the upper end portion of adapter 15 and the lower surface of panel 17. Gasket 26 is preferably punched from a sheet of synthetic rubber or rubber-like material, such as "Neoprene."

As will be apparent, upon manual depression of pushbutton 24 against the bias of plunger 11 the diaphragm 22 will bend or reflex annularly to readily accommodate the downward movement of the pushbutton, the amount of energy required to flex diaphragm 22 being relatively small or negligible, as compared with that required to overcome the bias of plunger 11. The means for rendering the switch mechanism oil-tight thus has comparatively little effect upon the operating characteristics of the switch, so that most of the switch parts (including the plunger biasing spring) may be identical with those of ordinary pushbutton switches of the present character.

As will be apparent to those skilled in the art, the panel 17, if serving as a closure for a housing, may have a gasket of the aforescribed rubber or rubber-like material underlying the peripheral portion thereof (not shown) to more completely insure oil-tightness of the switch mechanism or mechanisms associated therewith.

Figs. 1 to 3, inclusive, have been drawn to one and one-half times normal scale.

The modification illustrated in Figs. 4 and 5 may embody most of the elements of the switch of Figs. 1 to 3, and also, therefore, many of the elements disclosed in my aforementioned application, Serial No. 449,756. The elements in Fig. 4 corresponding to those of Fig. 1 have been given like numerals of reference. However, Fig. 4 discloses a rotary selector switch (which may be either the two-position type or three-position type disclosed in my prior application filed July 18, 1942, Serial No. 451,417, for Selector switches) having my improved means associated therewith to render the same substantially oil-tight.

Thus, with reference to Fig. 4, it is to be understood that the selector switch will be of either the two-position type or three-position type, depending upon the formation of the groups of cam surfaces (not shown) at the lower edge of the rotary actuating member 27 of molded insulating material, as disclosed in said application, Serial No. 451,417. Member 27, which is preferably composed of "Bakelite," is adapted to telescopically fit onto the upper end of a cap member 28 molded from like or similar material. Cap 28, in turn, is recessed to fit onto the laterally

notched upper end portion 11^b of projection 11^a of plunger 11, a spring ring 29 being forced or snapped onto said reduced end 11^b, whereby a frictional connection between plunger 11 and cap 28 is provided. The diametrically opposed sets of downwardly facing cam surfaces upon member 27 are adapted for cooperation with the diametrically opposed laterally extending lugs 28^a and 28^b upon cap 28 to effect or permit movement of plunger 11 in opposite directions respectively.

As disclosed in said application, Serial No. 451,417, member 27 is provided at its lower end with diametrically opposed laterally extending lugs (not shown) of segmental form. Said lugs are adapted to underlie the annular flat portion 30 of a punched and stamped sheet metal member, said portion 30 being adapted to seat against the upper or end wall of countersink 15^a to thereby limit the degree of upward displacement of member 27. Portion 30 is provided with an integral upstanding lug (not shown) at a predetermined point in the periphery thereof, which lug is adapted to fit within one of a plurality of notches (not shown) in said end wall of countersink 15^a, whereby rotary displacement of portion 30 is prevented. Also formed integrally with portion 30 are a pair of diametrically opposed downwardly extending lugs 30^a and 30^b which jointly cooperate with the lugs upon member 27 to limit the degree of rotation of the latter in each direction.

A cup washer 21, like that of Fig. 1, is positioned within countersink 15^a to underlie portion 30 and lugs 30^a and 30^b. Due to the presence of the cap 28 in the device of Fig. 4 the diaphragm 31, which assists in rendering the switch oil-tight, is provided with a central portion 31^a of substantially less height than the corresponding portion 22^a of diaphragm 22 (Figs. 1 and 3). Portion 31^a is provided with an opening 31^b (Fig. 5) of polygonal contour to closely fit around the projection 11^a of plunger 11, said portion 31^a being of increased thickness around opening 31^b to provide a flange 31^c having a flat upper surface 31^d which is adapted to be engaged by the flat lower face of cap member 28, when the parts are assembled as shown in Fig. 4.

A split spring ring 32 underlies the flange 31^c and surrounds the wall of opening 31^b to insure a close fit of the walls thereof around said projection 11^a of the plunger. In practice the split ring 32 may be positioned upon the neck portion of diaphragm 31 and the latter then pressed downwardly onto projection 11^a of the plunger; or the ring may be forcibly spread to provide for proper positioning thereof after sliding of said diaphragm onto projection 11^a. The portions 31^a, 31^c and 31^d of diaphragm 31 are substantially like the corresponding portions 22^a, 22^c and 22^d of diaphragm 22, the diaphragm 31 being bent or reflexed at 31^e, substantially as shown at 22^e on diaphragm 22 (Figs. 1 and 3).

It is to be understood that diaphragm 31 is preferably composed of the same material as the diaphragm 22 aforescribed. The gasket 26 of Fig. 4 is interposed between the upper end portion of adapter 15 and the lower face of panel 17, to perform the same function as in the device of Fig. 1. Portions 31^c and 31^d are clamped between the peripheral flange of cup washer 21 and the outer surface of plate 26 upon tightening of screws 19, as described in connection with Fig. 1. The manner in which the diaphragm 31 and gas-

ket 26 act to provide oil-tightness of the switch is believed to be obvious from the description of Fig. 1.

In Fig. 6 I have shown a one-hole mounted switch having a mushroom head type of operator, the base 10, adapter 15 and supporting panel being identical with the correspondingly designated parts of Figs. 1 and 4. Thus, as disclosed in said application, Serial No. 449,756, the mushroom head operating member 33 and the bushing 34 (whose threaded lower end 34^a cooperatively engages the threaded opening in adapter 15) are so formed and so related to each other as to provide a substantial degree of oil-tightness thereof, at least as regards splashed, sprayed or dripping oil impinging thereon, it being understood that a switch like that of Fig. 6 is usually mounted for movement of the rod or shaft of the mushroom head in a horizontal plane, instead of the vertical mounting thereof indicated in the drawings. Accordingly, it is only necessary to additionally insure against ingress of oil particles to the switch parts through the opening 17^a in panel 17; and for this purpose I provide a gasket 35 of "Neoprene," or a similar rubber-like material, which is adapted to be clamped between the upper end of adapter 15 and the inner face of panel 17 as an incident to tightening of bushing 34. As shown a metal washer of suitable thickness, or a plurality of metal washers 36 and 37 of different thicknesses may be interposed between the head of bushing 34 and the outer face of panel 17.

A plate 38 which acts as a guide for the projection 11^a of the plunger and as a stop for the lower end portion of the shaft of the mushroom head operator 33 is interposed between the lower surface of adapter 15 (Fig. 6) and the upper end of base 10, said plate being also shown in section in Fig. 7, hereof, and a like plate being employed in the devices of Figs. 16, 17 and 18 of said application, Serial No. 449,756, and designated there by the numeral 73.

The mushroom head operated switch of Fig. 7 is quite similar to that of Fig. 6, but differs from the latter in that the switch base 10 with its associated parts is attached by the pair of screws 19 to a die cast metal flush plate 39. Flush plate 39 is quite similar to that designated by numeral 33 in Figs. 20 and 21 of said application, Serial No. 449,756, but differs therefrom in respect of the provision of a plurality of bolt openings or passages along each of the four sides thereof, the intermediate openings in two of the sides of flush plate 39 being shown at 39^a and 39^b in Fig. 7; and flush plate 39 further differs in respect of the provision of an opening of relatively large diameter which is threaded, as indicated at 39^c, for cooperation with the threaded shank 34^a of bushing 34.

A gasket 40 is interposed between the flat lower face or flange portion of flush plate 39 and the upper surface of a panel 41, said gasket having openings to provide clearance for the shanks of screws 42, and panel 41 having tapped openings to accommodate said shanks. In practice the gasket 40 extends outwardly to a flush relationship to the periphery of flush plate 39 and inwardly to a flush relationship to the relatively large rectangular opening 41^a in panel 41. The gasket 40 therefore cooperates with the other elements to render the switch of Fig. 7 substantially oil-tight.

In Fig. 8 I have shown an oil-tight pushbutton switch substantially like that shown in Figs. 1

to 3, but with a flush plate mounting substantially like that shown in Fig. 7. The parts of the device of Fig. 8 corresponding to the parts of Figs. 1 and 7 have been given like numerals of reference. The manner in which the diaphragm 22 and gasket 40 act to render the switch of Fig. 8 substantially oil-tight are believed to be obvious from the descriptions of Figs. 1 and 7. As shown in Fig. 8, however, a relatively thick washer 43 is interposed between the head 16 of the bushing and the upper surface of flush plate 39 to insure against possible interference between the lower end of the bushing shank 16^a and the cup washer 21.

In Fig. 9 I have shown an oil-tight rotary selector switch substantially like that shown in Fig. 4, but with a flush plate mounting substantially like that of Figs. 7 and 8. The parts of the device of Fig. 9 corresponding to the parts of Figs. 4, 7 and 8 have been given like numerals of reference. The manner in which the diaphragm 31 and gasket 40 of Fig. 9 act to render the switch of Fig. 9 substantially oil-tight are believed to be obvious from the descriptions of Figs. 4, 7 and 8. As shown in Fig. 9, however, a metal collar or tube section 44 is adapted to be interposed between the head 16 of the bushing and a flat, annular plate 45 which is provided with suitable legends (not shown) for cooperation with a line or mark (see 27^a, Fig. 4) upon member 27 to indicate the condition of the controlled circuit or circuits. Collar 44, as shown, serves to conceal that portion of the threaded shank 16^a of the bushing which would otherwise be exposed. Indicating plate 45 is preferably attached to flush plate 39, as by means of a pair of drive screws 46, which take into suitable recesses drilled in the upper surface of said flush plate, as will be readily understood by those skilled in the art.

As will be understood by those skilled in the art, although the diaphragms 22 and 31 are preferably molded to the forms thereof shown in the drawings, they may be molded to frusto-conical form throughout the height of each of the same, with the respective beads 22^a and 31^a thereof located upon the interiors thereof; the lower ends thereof being thereafter turned inside out to provide the forms illustrated and to position said heads exteriorly thereof. Although the beads 22^a and 31^a form the major portion of the material to be clamped between cup washer 21 and plate 20, it will be apparent from Figs. 1, 4, 8 and 9 that the end portions 22^b and 31^b of the diaphragms are likewise compressed or deformed during the clamping operation to assist in providing the oil-tight connection between the peripheries of the diaphragms and the respective adapter members 15.

Although I have herein disclosed the use of diaphragms of substantially frusto-conical form, it is to be understood that if desired I may employ a diaphragm in the form of a bellows having a plurality of convolutions or corrugations. Similarly, although I have specifically described the diaphragms as composed of "Neoprene" or a similar flexible, rubber-like material, it is obvious that I may employ less flexible materials, such, for instance, as rubber or a rubber-like material reinforced by a fabric or cloth, or a fabric or cloth impregnated or otherwise treated with an oil-resistant and/or water-resistant material, such as varnish or a cellulosic material.

I claim:

1. A substantially liquid-tight switch of the re-

reciprocating contactor type, comprising a molded insulating base having a recess opening to one end thereof, a contactor-carrying plunger slidable within said recess and spring-biased outwardly therefrom, contacts carried by said base into and out of bridging engagement with which said contactor is adapted to move, an adapter member rigidly secured to the recessed end of said base, a diaphragm of flexible, liquid-tight material having a peripheral portion thereof clamped between said adapter and said recessed end of the base, said diaphragm having a central portion surrounding an outer end portion of said plunger and clamped in a given position relatively to the latter to provide for liquid-tightness of said central portion, the web of said diaphragm between said peripheral and central portions being of greater length than the distance therebetween and the same being reflexed upon itself to provide an annular trough of approximately V-form in transverse cross section, the excess length of said web being adapted to provide for movement of said plunger from its normal outer extreme position to its inner extreme position without stretching of the material of said diaphragm, whereby the manual operating force required to effect inward movement of said plunger is substantially unaffected by said diaphragm, said adapter member having a central opening therethrough to accommodate a manual operating member associated with said plunger, and said diaphragm serving to stop or trap oil entering said opening against passage into the recess of said base.

2. A substantially oil-tight switch of the reciprocating contactor type, comprising a molded insulating base having a recess opening to one end thereof, a contactor-carrying plunger slidable within said recess and spring-biased outwardly therefrom, contacts carried by said base into and out of bridging engagement with which said contactor is adapted to move, an adapter member rigidly secured to the recessed end of said base, a molded diaphragm of resilient, rubber-like material having a peripheral portion thereof clamped between said adapter and said recessed end of the base, said diaphragm having a central portion surrounding an outer end portion of said plunger and clamped in a given position relatively to the latter to provide for oil-tightness of said central portion, the web of said diaphragm between said peripheral and central portions being of greater length than the distance therebetween and the same being reflexed upon itself to provide an outwardly opening annular trough of approximately V-form in transverse cross section, the excess length of said web being adapted to provide for movement of said plunger from its normal outer extreme position to its inner extreme position without stretching of the material of said diaphragm, whereby the manual operating force required to effect inward movement of said plunger is substantially unaffected by said diaphragm, said adapter member having a central opening therethrough to accommodate a manual operating member associated with said plunger, said diaphragm serving to stop or trap oil entering said opening against passage into the recess of said base, the peripheral wall of said adapter opening having a screw-thread formed thereon, a hollow metal bushing having an enlarged head forming an inwardly facing clamping shoulder and a reduced shank externally threaded for cooperation with the screw-thread aforementioned, said shoulder being adapted to

overlie the outer face of a suitably perforated panel and said adapter member being adapted to underlie the inner face of said panel, and a gasket of resilient, rubber-like material interposed between said inner face of the panel and said adapter to insure against passage of oil from the panel opening to the exterior of said adapter and said insulating base.

3. A pushbutton operated switch of the reciprocating contactor type adapted for one-hole mounting upon a perforated panel or the like, said switch including an adapter member having a threaded central opening therethrough, the outer end of said adapter being arranged to seat against the inner surface of said panel around the perforation in the latter, a hollow metal bushing having a head adapted to seat against the outer surface of said panel and an externally threaded shank adapted to engage said threaded opening to provide for one-hole mounting of said adapter, a pushbutton reciprocable within said central opening, a flexible diaphragm of resilient, rubber-like material molded to substantially frusto-conical form, the flat upper end of said diaphragm having a relatively small opening formed therein, a screw the shank of which penetrates said opening and takes into a tapped recess in the lower end of said pushbutton, the head of said screw clamping said upper end into oil-tight engagement with said pushbutton, said diaphragm being reflexed upwardly upon itself to provide an annular web portion of substantially V-shape in transverse cross section, the outer end of the reflexed portion of said diaphragm having an annular bead formed integrally therewith, said adapter being recessed at its inner end to accommodate said bead, a recessed molded insulating base underlying said adapter, and means associated with said base to clamp said bead in oil-tight relation to said base and said adapter as an incident to securement of said base and adapter to each other.

4. A pushbutton operated switch of the reciprocating contactor type adapted for one-hole mounting upon a perforated panel or the like, said switch including an adapter member having a threaded central opening therethrough, the outer end of said adapter being arranged to seat against the inner surface of said panel around the perforation in the latter, a hollow metal bushing having a head adapted to seat against the outer surface of said panel and an externally threaded shank adapted to engage said threaded opening to provide for one-hole mounting of said adapter, a pushbutton reciprocable within said central opening, a flexible diaphragm of resilient, rubber-like material molded to substantially frusto-conical form, the flat upper end of said diaphragm having a relatively small opening formed therein, a screw the shank of which penetrates said opening and takes into a tapped recess in the lower end of said pushbutton, the head of said screw clamping said upper end into oil-tight engagement with said pushbutton, said diaphragm being reflexed upwardly upon itself to provide an annular web portion of substantially V-shape in transverse cross section, the outer end of the reflexed portion of said diaphragm having an annular bead formed integrally therewith, said adapter being recessed at its inner end to accommodate said bead, a recessed molded insulating base underlying said adapter, means associated with said base to clamp said bead in oil-tight relation to said base and said adapter as an incident to securement of said base and adapter

to each other, and a gasket of resilient, rubber-like material interposed between the outer end of said adapter and the inner surface of said panel to assist in rendering said switch substantially oil-tight.

5. In combination, an electric switch of the reciprocating contactor type, said switch including a recessed molded insulating base, a cast metal flush plate to the inner surface of which said base is rigidly secured, said flush plate having a relatively large screw-threaded opening formed therein, a hollow metal bushing having a head portion overlying said flush plate and a shank portion having threaded engagement with said opening, a switch operating element positioned within said bushing and accessible from the exterior thereof, said flush plate having an annular recess formed in the lower surface thereof, a diaphragm composed of flexible, rubber-like material having its peripheral edge portion positioned within said annular recess and clamped therein as an incident to rigid securement of said base to said flush plate, the central portion of said diaphragm having means associated therewith to provide for oil-tight connection thereof to a reciprocating part of the switch, and said diaphragm including a reflexed web portion between said peripheral and central portions to provide for movement of said central portion throughout its total range without requiring any substantial degree of stretching of said web portion.

6. In combination, an electric switch of the reciprocating contactor type, said switch including a recessed molded insulating base, a cast metal flush plate to the inner surface of which said base is rigidly secured, said flush plate having a relatively large screw-threaded opening formed therein, a hollow metal bushing having a head portion overlying said flush plate and a shank portion having threaded engagement with said opening, a switch operating element positioned within said bushing and accessible from the exterior thereof, said flush plate having an annular recess formed in the lower surface thereof, a diaphragm composed of "Neoprene," said diaphragm having its peripheral edge portion positioned within said annular recess and clamped therein as an incident to rigid securement of said base to said flush plate, the central portion of said diaphragm having means associated therewith to provide for oil-tight connection thereof to a reciprocating part of the switch, said diaphragm including a reflexed web portion between said peripheral and central portions to provide for movement of said central portion throughout its total range without requiring any degree of stretching of said web portion, a perforated panel to which said flush plate is rigidly but removably secured, and means including a gasket of "Neoprene" interposed between said flush plate and said panel to assist in rendering said switch substantially oil-tight.

7. In an electric switch of the reciprocating contactor type, in combination, a recessed molded insulating base, a contactor-carrying plunger slidable within said recess, a die-cast metal member to which said insulating base is rigidly secured, a perforated panel affording a support for said metal member, a resilient, synthetic, rubber-like gasket interposed between said metal member and said panel, said metal member having a relatively large threaded opening formed therein, a metal bushing having an externally threaded shank for cooperation with said opening, a reciprocating actuating member for the switch having a bearing engagement with said bushing, and means associated with said actuating member to assist in rendering said switch substantially oil-tight.

8. In an electric switch of the reciprocating contactor type, in combination, a recessed molded insulating base, a contactor-carrying plunger slidable within said recess, a die-cast metal member to which said insulating base is rigidly secured, a perforated panel affording a support for said metal member, a resilient, rubber-like gasket interposed between said metal member and said panel, said metal member having a relatively large threaded opening formed therein, a metal bushing having an externally threaded shank for cooperation with said opening, a reciprocating actuating member for the switch comprising a metal rod of circular cross section having a close sliding fit within said bushing, and means comprising a metal head of mushroom form rigidly attached to the outer end of said rod, the inner end of said mushroom head being adapted to overlap the outer end of said bushing under all conditions to assist in rendering said switch substantially oil-tight.

9. In combination, an electric switch of the reciprocating contactor type, said switch including a recessed molded insulating base, a cast metal flush plate to the inner surface of which said base is rigidly secured, said flush plate having an opening formed therein, a switch operating element positioned within said opening, said flush plate having an annular recess formed in the lower surface thereof, a diaphragm composed of flexible, liquid-tight material having its peripheral edge portion positioned within said annular recess and clamped therein as an incident to rigid securement of said base to said flush plate, the central portion of said diaphragm having means associated therewith to provide for liquid-tight connection thereof to a reciprocating part of the switch, and said diaphragm including a reflexed web portion between said peripheral and central portions to provide for movement of said central portion throughout a predetermined relatively large range corresponding to the movement of the switch contactor.

CLYDE F. ROBBINS.