

March 29, 1960

W. F. NOLDEN ET AL

2,930,859

ELECTRIC SWITCHES

Filed March 29, 1956

3 Sheets-Sheet 1

Fig. 1

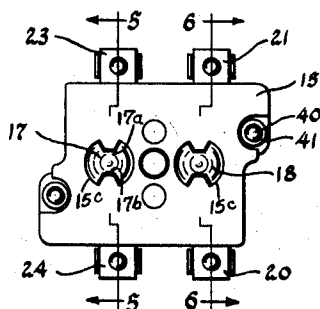


Fig. 2

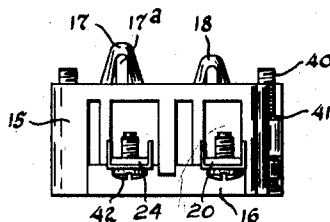


Fig. 4

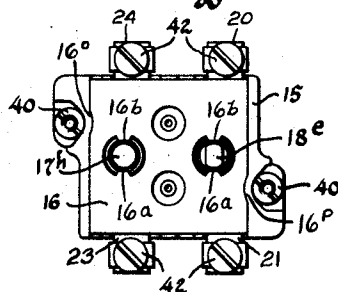


Fig. 3

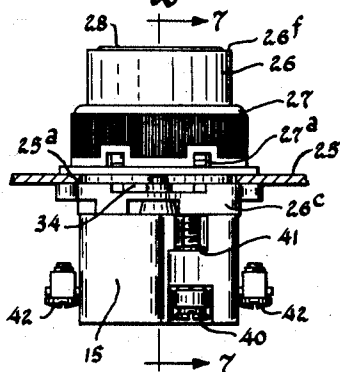


Fig. 5

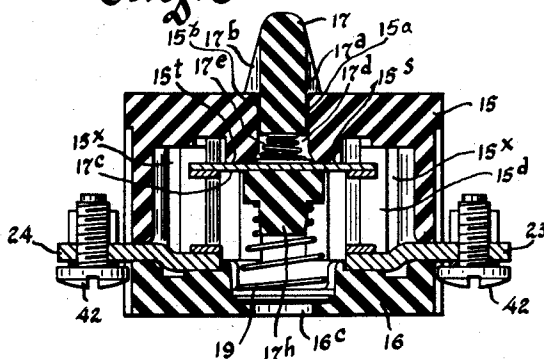
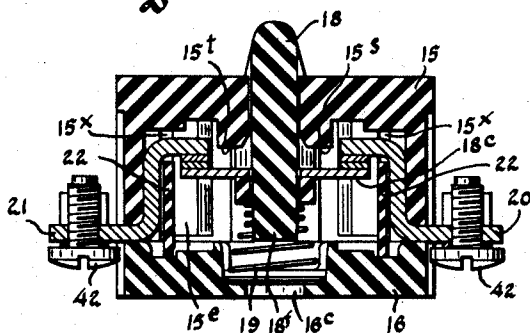


Fig. 6



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3 Sheets-Sheet 3

Fig. 10

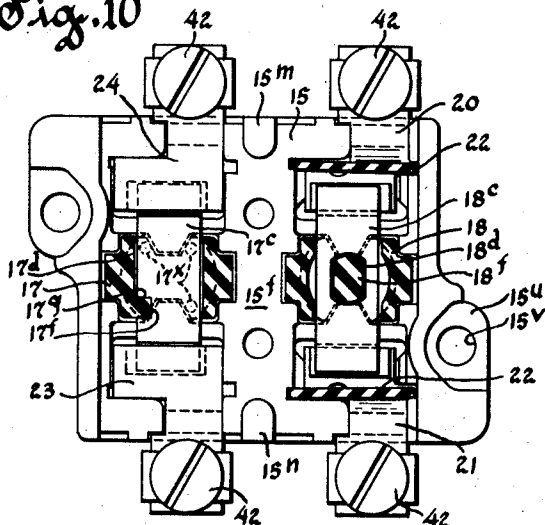


Fig. 11

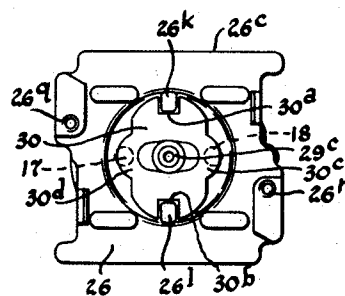


Fig. 12

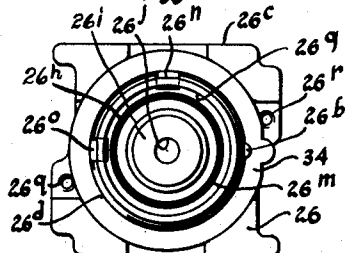


Fig. 14

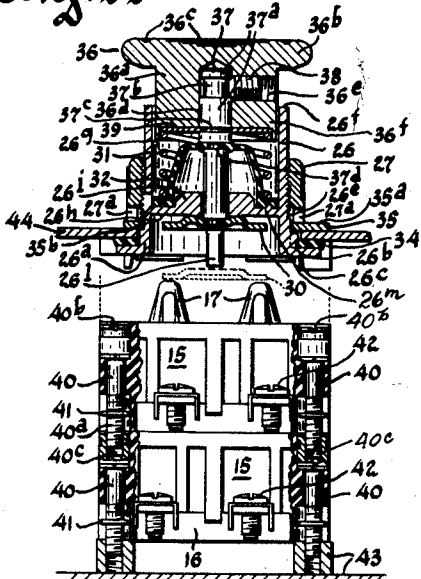
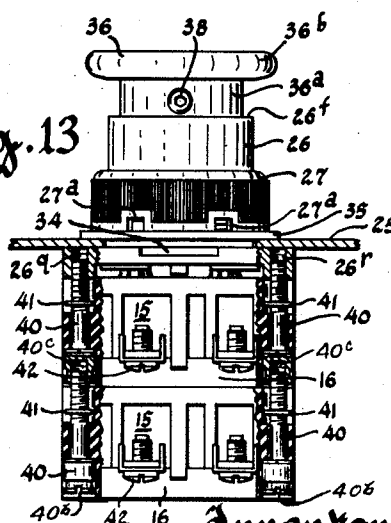


Fig. 13



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ELECTRIC SWITCHES

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16 Claims. (Cl. 200—16)

This invention relates to improvements in electric switches. More particularly the invention relates to improvements in heavy-duty type switching units adapted for use either individually or in multiple stacked relationship in conjunction with manually operable actuators of suitable form, such as pushbutton actuators, etc.

A primary object of the invention is to provide switching units of unusually small size with respect to their current controlling capacity; thus minimizing the space requirements thereof when mounted upon a panel or other suitable support.

Another object is to provide novel means for mounting the switching units and the manually operable actuators therefor so as to render the assembly thereof oil-tight.

Another object is to provide a novel form of switching unit having two separate and independent switch cavities; with sets of stationary contacts and movable contactors individual to the respective cavities.

Another object is to provide such a switching unit which is adapted to accommodate either two like insulating contactor carriers each carrying a bridging contactor for cooperation with a pair of stationary contacts to afford a pair of switches of the normally open type; or two carriers of a different form, each carrying a bridging contactor for cooperation with a pair of stationary contacts to afford a pair of switches of the normally closed type; or alternatively one carrier of each form, respectively, arranged to provide both a normally open switch and a normally closed switch in the pair.

Another object is to provide novel means for readily receiving and properly positioning the stationary contacts of the plural switch mechanisms by merely assembling said contacts in interengaging relationship to one insulating housing member and thereafter securing a second insulating housing member to the first.

Another object is to provide two novel forms of slidable or reciprocable insulating actuators for the respective types of bridging contactors, whereby either type of actuator may be utilized in either or both of the switch cavities, according to the particular desired arrangement of the respective pairs of stationary contacts within said cavities.

Another object is to provide novel and simple means for attaching a first unit (comprising a pair of switch cavities) to a suitable supporting and actuating mechanism; and for thereafter, by like means, attaching one or more additional units to the first unit and to each other, one behind another.

Another and more specific object is to provide novel and simple insulating means to insure against arc-tracking between the stationary contacts and terminals and the movable contactor of a normally closed type of switch upon separation of the contactor from the contacts when in use.

Another object is to provide a switch of the aforementioned character which is adaptable for use with vari-

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ous different known types of manually operable actuating elements.

Various other objects and advantages of the invention will hereinafter appear.

5 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 without departing from the spirit and scope of the appended claims.

10 In the drawings, Figure 1 is a top plan view, actual size, of a two-circuit switching unit, in which, for example, the left-hand actuator is adapted to control a switch of the normally open type, as best illustrated in Fig. 5, and the right-hand actuator is adapted to control a switch of the normally closed type, as best illustrated in Fig. 6, the wiring terminal screws being shown threaded upwardly into the respective terminal members.

15 Fig. 2 is a side elevational view of the switching unit shown in Fig. 1, looking toward the lowermost side in said last mentioned figure; the greater degree of projection of the left-hand (normally open type of contactor) actuator being best illustrated in this figure and in Fig. 5.

20 Fig. 3 is an end elevational view, as seen from the right-hand side of Fig. 1, but showing the switching unit attached, by a pair of fillister-head screws, to a suitable metal support and pushbutton adapter, having an integral upward extension of hollow cylindrical form which serves as a guide and/or housing for a manually operable switch actuator which is spring-biased toward its extreme outward position; said metal support extending outwardly through a suitable opening in a panel or other supporting member, and being positively restrained against rotation with respect thereto, as best illustrated at the right-hand side of Fig. 7.

25 Fig. 4 is a bottom plan view of the switching unit illustrated in Fig. 1, showing the bottom plate rigidly and permanently attached to the main body portion of the switch housing, and showing the difference in cross-sectional form of the downwardly projecting ends of the actuators for switches of the normally open and normally closed types, respectively.

30 Fig. 5 is a sectional view, on the line 5—5 of Fig. 1, looking in the direction of the arrows, showing the movable parts of the normally open type of switch in circuit interrupting position.

35 Fig. 6 is a similar sectional view, on the line 6—6 of Fig. 1, looking in the direction of the arrows, showing the movable parts of the normally closed type of switch in circuit completing position.

40 Fig. 7 is an enlarged sectional view, on the line 7—7 of Fig. 3, looking in the direction of the arrows.

45 Fig. 8 is an enlarged bottom plan view of the main insulating body portion of the double cavity switch housing; with all of the other switch parts omitted.

50 Fig. 9 is an enlarged plan view of the inner face of the bottom insulating cover member of the switch housing; with all of the other switch parts omitted.

55 Fig. 10 is a view similar to Fig. 8, with the normally open (left) switch parts and the normally closed (right) switch parts in the positions which they would normally assume when retained within the housing after the bottom cover member (see Figs. 4, 7 and 9) is attached to the main body portion of the housing; the insulating actuating members for the respective switches, and the flat punched insulating plates associated with the normally closed switch mechanism, being shown in transverse cross section, for simplicity of illustration.

60 Fig. 11 is a bottom plan view of the combined metal support and pushbutton adapter member shown in Figs. 3 and 7, said member preferably being die-cast from a suitable zinc base alloy or the like; an intermediate

part of the cylindrical portion of said member being externally threaded as shown in Figs. 7 and 14, and the base portion thereof being provided with a diagonally spaced pair of tapped openings to accommodate the threaded shanks of a pair of fillister-head screws for attachment of a switch unit thereto.

Fig. 12 is a top plan view of a metal support member like that shown in Figs. 3, 7 and 11.

Fig. 13 is a side elevational view of a stacked pair of switching units attached to each other and to a metal support member of the character aforementioned, as shown in fragmentary sections; said support member being adapted for one-hole mounting to a perforated panel or similar support, in the manner illustrated in Figs. 3, 7 and 13; the pushbutton operator being shown as of the enlarged or mushroom-head type, and one (non-staggered, but inverted) relationship of the terminals and their binding screws being illustrated; and

Fig. 14 is a view substantially like that of Fig. 13, but showing a base-mounted arrangement of a pair of stacked switching units, the shanks of the fillister-head screws of the lower switching unit taking into tapped openings or recesses provided in the bottom wall of a switch box or the like, and the threaded shanks of the upper pair of screws taking into the tapped recesses in the heads of the lower pair of screws; whereas the mushroom-headed manually operable switch actuator is one-hole mounted upon a switch box cover or the like, which when closed (as indicated by dotted lines) will bring the pushbutton actuated element to the position thereof illustrated in dotted lines; it being noted that a staggered relationship of the wiring terminals is provided by merely rotating one of the switching units through one hundred and eighty degrees prior to attaching the same to each other; and it being further noted that both actuating plungers of the upper unit are shown as being for switches of the normally open type.

Referring first to that form of the invention illustrated in Figs. 1 to 12, inclusive, the numeral 15 designates the main molded insulation body part of a housing for one pair of switches of the character herein contemplated; and the numeral 16 designates the molded insulating bottom cover member; it being noted that in these figures of the drawings one of the switches of the pair is shown as of the normally open type and the other switch is shown as of the normally closed type. As aforeindicated, however, the two like sets of insulating housing members 15 and 16 may each be employed to house either two switch mechanisms of the normally open type, shown in Fig. 5, or two switch mechanisms of the normally closed type, shown in Fig. 6, or one switch of each type; the contactor-actuating plungers 17 of the normally open type of switch shown in Fig. 5 differing in respect of certain structural details from the plunger 18 of the normally closed type of switch shown in Fig. 6.

More particularly describing the normally open type of switch mechanism (see Fig. 5), it will be noted that the molded insulating plunger 17 is provided on opposite sides of the approximately conical upper end portion thereof with a pair of like, parallel vertical grooves 17^a and 17^b, which accommodate and are guided by the integral inward projections 15^a, 15^b on the walls of the pair of like substantially circular openings 15^c, 15^e provided in the upper end wall of the main switch housing member 15, Figs. 1, 5, 7 and 8.

The two like switching chambers, generally designated by the reference numerals 15^d and 15^e (Figs. 5, 6, 7 and 8), are separated by a middle wall or barrier 15^f formed integrally with member 15 (see Figs. 7 and 8); and the insulating bottom cover member 16 (see Fig. 9) is likewise provided with an integral intermediate wall or barrier 16^f, which is complementary to the wall 15^f in member 15, as best illustrated in Fig. 7. Each switching chamber 15^d or 15^e is adapted to accommodate either

form of switch-actuating plunger 17 or 18 and its associated switch parts.

Member 16 is provided with a pair of like substantially circular openings 16^c, which are aligned with, but of slightly smaller diameter than, the aforementioned openings 15^c in member 15. Member 16 is further provided with pairs of integral inward projections 16^a, 16^b, which are approximately aligned with, but slightly shorter than, the aforementioned projections 15^a, 15^b on member 15.

Member 15 is provided at its upper end, as shown in Fig. 8 at 15^s, 15^h, 15ⁱ, 15^j, 15^k and 15^l, with surfaces which are coplanar with the outer face of said barrier 15^f; and said surfaces are adapted to provide a seat for those inner surface portions of bottom cover member 16 which are coplanar with the surface of the barrier wall 16^f of member 16. Also it will be noted that housing member 15 (Fig. 8) is provided at its lower face with a pair of projections 15^m and 15ⁿ, which are respectively accommodated in the correspondingly shaped recesses 16^m and 16ⁿ at the inner surface of bottom cover member 16. Similarly member 15 is provided with a pair of diagonally disposed inward projections 15^o and 15^p (Fig. 8) accommodated by the correspondingly shaped notches 16^o and 16^p in the opposite side edges of bottom cover member 16. This interlocked arrangement of cover member 16 with respect to member 15 insures against any relative movement of the same with respect to each other, especially after the various parts of the switches are assembled therebetween and the cover 16 has been riveted or otherwise permanently attached to member 15, as will be obvious.

As will be apparent from Fig. 5, if a normally open type of switch mechanism is to be assembled in either one or both of the switch chambers 15^d and 15^e in member 15, an insulating carrier member 17, having the spring-biased bridging contactor 17^c assembled with respect thereto, is inserted into the switching chamber, with member 15 inverted from the position thereof shown in Fig. 5, so that member 17 will be temporarily maintained in the position illustrated, by the effect of gravity. Prior to such insertion of member 17, however, the normally open type of bridging contactor 17^c is inserted into the substantially rectangular transverse opening 17^d provided in said member in the following manner: The coiled spring 17^e, of frusto-conical form, is applied to the upper surface of contactor 17^c and then temporarily compressed, manually or otherwise, to permit insertion of both contactor 17^c and spring 17^e into opening 17^d, and at a predetermined angle to the side walls of said opening 17^d. The reason for this is illustrated in Figs. 7 and 10, wherein the left-hand wall of the transverse opening 17^d (Fig. 10) is shown as having an integral inward projection or rib 17^f at one end thereof; and the bridging contactor 17^c is shown as provided with a rectangular notch 17^g (Fig. 10) of a size to properly accommodate rib 17^f. Said rib 17^f does not extend throughout the entire height of opening 17^d, as indicated by the showing thereof in Fig. 7. Thus the left-hand side edge of contactor 17 may be tilted upwardly during insertion thereof through opening 17^d (Fig. 7), until the notch 17^g (Fig. 10) is aligned with the upper end of rib 17^f (Fig. 7); whereupon contactor 17^c may be seated against the lower wall of said opening 17^d. The rib 17^f, as shown in Fig. 7, acts to restrain the spring 17^e against accidental outward movement from opening 17^d in one direction; whereas in practice the upper surface of contactor 17^c is preferably provided with three short upwardly projecting integral bosses (indicated by dotted lines at 17^h in Fig. 10) around the lower end of spring 17^e, to resist displacement of the larger lower end of spring 17^e in any other direction relatively to the upper surface of contactor 17^c.

As shown in Figs. 5 and 7 the plunger 17 carrying the contactor 17^c of the normally open type of switch mechanism is provided with a substantially cylindrical,

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centrally located, downward projection 17^a formed integrally with the flat lower surface thereof; and a relatively long coiled spring 19 of substantially frusto-conical form has its reduced upper end portion surrounding projection 17^a and bearing against said flat lower surface of member 17. Assuming attachment of bottom cover member 16 to housing member 15, the enlarged lower end portion of spring 19 will be seated against the upwardly facing circular ledge 16^a, which surrounds the particular opening 16^c which may happen to be aligned therewith; it being assumed, of course, that the plunger 18 and the other parts of the right-hand (normally closed) switch mechanism, Figs. 7 and 10, will also be properly assembled with respect to housing member 15 before attachment to the latter of bottom cover member 16. As will be apparent, the aligned lugs or projections 16^a, 16^b within the respective openings 16^c, 16^d in cover member 16 are adapted for cooperation with the upper end portions of a pair of plungers 17 and/or 18 of an additional pair of switches when attached to the lower end of a housing like that shown in Fig. 7, and as illustrated in Figs. 13 and 14.

As shown in Figs. 7 and 8 each recess 15^d and 15^e is provided at its upper end with laterally curved and upwardly angled surfaces 15^a and 15^r to jointly accommodate the correspondingly shaped surfaces formed on the plungers 17, and/or 18, when employed. When a plunger 18 for a normally closed type of switch is employed, such a plunger will necessarily have the degree of spring-biased upward movement thereof limited, by reason of the engagement of its associated bridging contactor 18^c with the associated stationary contact portions of a pair of right-hand and left-hand combined stationary contact and terminal members 20 and 21; said members 20 and 21 each having a tip of silver or the like rigidly attached thereto, and bridging contactor 18^c having such a contact tip attached to each end portion thereof, as best illustrated in Fig. 6. The normal engagement of bridging contactor 18^c with the contact portions of members 20 and 21 will limit the degree of spring-biased outward movement of plunger 18, in the manner illustrated at the right-hand side of Fig. 2, and in Figs. 6 and 7. As shown at the right-hand side of Fig. 10 the normally closed bridging contactor 18^c is provided with a centrally located non-circular opening 18^d having a close sliding fit around the downward projection 18^f on plunger 18; and plunger 18 has its lower or skirt portion formed as best illustrated at the right-hand side of Figs. 7 and 10, to further assist in guiding contactor 18^c for reciprocating movement in a straight line, and in alignment with its stationary contacts.

As shown, in Fig. 6, when at least one of the switching chambers, such as 15^e, is utilized to house the parts of a switch of the normally closed type, after the stationary contact and terminal parts 20 and 21 have been inserted into the recess, as shown, a pair of flat punched insulating plates 22, or the like, of rectangular contour are inserted into the respective pairs of opposed grooves or slots 15^x (see also Fig. 8), in a relation to overlie substantially all of the inner surfaces of the vertically extending intermediate portions of the combined stationary contact and terminal members 20 and 21. This arrangement insures against any likelihood of arc-tracking between bridging contactor 18^c and the members 20 and 21 upon separation of the contact-making portions of said parts.

As indicated in Figs. 5, 7 and 10, the plunger 17 of the normally open type of switch mechanism has its outward movement limited only by reason of engagement of spaced upper surface portions of contactor 17^c with the abutments designated 15^s and 15^t and facing downwardly within each of the switching chambers 15^d and 15^e.

As will be apparent from Fig. 5, when the plunger 17 and bridging contactor 17^c are employed to provide a

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normally open type of switching mechanism in either or both of the switching chambers, a pair of right-hand and left-hand combined stationary contact and terminal members 23 and 24 will be employed; it being understood that said members 23 and 24 are preferably formed as shown from like flat, punched blanks of brass or other suitable metal of good electrical conductivity; the tapped openings therein being provided in any suitable manner; and the contact tips being rigidly and permanently attached thereto in any well known manner; it being understood that the aforementioned blanks are die-formed in one direction for right-hand members, and in the opposite direction for left-hand members. The housing member 15 and the bottom cover member 16 are provided with suitable recesses, as shown, to jointly insure proper and permanent retention of the various switch parts in properly assembled relationship.

In Figs. 3, 7, 13 and 14 we have illustrated the manner in which one or more pairs of switching units may be attached to a panel 25, formed of metal or other suitable material. Panel 25 is provided with an opening 25^a, preferably of substantially circular form to accommodate the substantially circular portion 26^a (Figs. 7 and 14) of a die-casting 26 formed of a suitable metal alloy; the flat lower end portion 26^c of said casting being of substantially rectangular contour, as best illustrated in Figs. 11 and 12. Said portion 26^a of said casting is provided at the right-hand side thereof, and near its lower end (Figs. 7, 12 and 14), with an integral outward projection 26^b, of the form best illustrated in Fig. 12. As shown in Figs. 7 and 14 the projection 26^b is adapted to fit into a notch 25^b formed in panel 25 to positively restrain the die-cast member 26 against rotary displacement with respect to said panel.

The portion 26^a of member 26 extends upwardly for the greater portion of the height of said member, as shown in Figs. 7 and 14; but said portion has a screw-thread 26^d cut therein from the upper limit thereof to a point 26^e, shown in Figs. 7 and 14; the purpose of which thread is to accommodate the internally threaded clamping or mounting ring 27 shown in said figures and in Fig. 3. Ring 27 is preferably formed with an annular inner groove at its lower end, and is provided with six or more equally spaced drainage openings or notches, as shown at 27^a in Figs. 3, 7, 13 and 14.

The upper tubular end portion 26^f of member 26 is of smaller external diameter than the externally threaded portion 26^d; and the portions 26^f and 26^d are shaped internally, by the die-casting operation, to provide the substantially cylindrical recess 26^g (Figs. 7, 12 and 14); the integral wall 26^h of which is provided by the die-casting operation. Said wall is provided centrally thereof with a circular portion 26ⁱ of substantially greater thickness, the purpose of which is to limit the degree of downward movement of the pushbutton actuating element 28 (or 36, Fig. 14) of the switch. Pushbutton element 28 is preferably composed of a suitable hard insulating material, which may be molded to the form illustrated directly onto the knurled or otherwise roughened upper end 29^a of a metal rod or plunger 29.

Said wall 26^h is provided centrally thereof with an opening 26^j of circular contour of a size to slidably accommodate the major portion of the length of plunger 29, Fig. 7. Plunger 29 is provided with a reduced lower end portion 29^b which fits within an opening located centrally of a punched and stamped sheet metal plate 30, the form of which is best illustrated in Fig. 11. As shown at 29^c in Fig. 7 the reduced lower end portion 29^b of rod 29 is upset over the lower surface of plate 30 to permanently secure said parts to each other. As shown in Fig. 11, plate 30 is provided with a pair of diametrically opposed peripheral notches 30^a and 30^b, which are continuously engaged with and guided by the co-operating projections 26^k and 26^l formed integrally with the die-cast member 26. Said projections 26^k and 26^l

extend downwardly a substantial distance beyond the main body portion of die-cast member 26, as best illustrated at 26ⁱ in Figs. 7 and 14.

Plate 30 is provided at diametrically opposite sides thereof with flat portions 30^c and 30^d, located in a common plane, which are respectively adapted to overlies the reduced upper end of the plunger 18 of a normally closed type of switch mechanism and of the plunger 17 of a normally open type of switch, as shown in Fig. 7; or to respectively overlies a like pair of plungers 17 of the normally open type of switches, as shown in Fig. 14; or a like pair of plungers 18 of the normally closed type (not shown).

Prior to insertion of pushbutton 28 and plunger 29 into the cylindrical recess 26^e, it is to be understood that one substantially coplanar end 31^a of the coiled compression spring 31 is seated against the suitably formed inner surface portion 28^a of the insulating pushbutton member 28 (Fig. 7). Thereupon a dome-shaped flexible rubber sealing member 32, having a relatively small opening 32^a formed in its upper end portion is forcibly moved upwardly over the rod 29 until it seats elastically within the peripheral groove 29^d formed in said rod. The sealing member 32 is provided at its lower end with a flat, integral, peripheral flange 32^b, which is adapted to seat against the peripheral portion of the bottom wall 26^b of cylindrical recess 26 (Fig. 7); said bottom wall having formed thereon a relatively small circular ridge or rib 26^m, for cooperation with the aforementioned flange 32^b. A flat, annular sheet metal member 33 (Fig. 7) is preferably interposed between flange 32^b and the lower end of spring 31, to substantially equalize the pressure applied to all portions of said flange. By this means we insure against entrance of oil or other liquid into the switch chambers, notwithstanding the reciprocating movement of pushbutton 28 and plunger 29 (or 37, Fig. 14) as an incident to operation of the switch parts.

Also it will be noted that a flexible rubber gasket 34 of circular contour is interposed between the lower surface of panel 25—around the opening 25^a in the latter—to further insure against entrance or seepage of oil or other liquid inwardly from the outer face of said panel.

As best illustrated in Figs. 3, 7 and 12, the die-cast supporting member 26 and the die-cast clamping or mounting ring 27 are both initially formed in the manner illustrated to insure proper drainage from the recess 26^e of any grease, oil or other liquid which may happen to enter the same when in use. Thus, in Fig. 12 the die-casting 26 is shown as provided with two external vertical grooves 26ⁿ and 26^o; the groove 26^o preferably being located diametrically opposite to the aforementioned projection 26^b, and the groove 26ⁿ being spaced (preferably clockwise) from groove 26^o a circular distance of ninety degrees, so that said grooves will face at a right angle with reference to each other. As an incident to the die-casting operation there is provided by the die parts an opening 26^p leading upwardly at an angle from each external slot 26ⁿ and 26^o and opening to the outer face of the aforementioned wall 26^h; as shown at the left-hand side of Fig. 7. If it be assumed that in both Figs. 7 and 14 the switches are so mounted in the respective panels 25 that the relatively larger portions 35^a of the indentifying-plates 35 are located in an uppermost position upon a vertically mounted panel 25, then the keying portion 35^b will be engaged with, and restrained from rotation by, the opposed side walls of one of the slots 26ⁿ or 26^o (Fig. 12); thereby insuring discharge by gravity of any liquid which may enter the cylindrical recess 26^e in member 26 (Figs. 7, 12 and 14).

The manner in which the uppermost pair of housing members 15 and 16 are attached to the die-cast supporting member 26 is best illustrated in Figs. 3 and 7; at the right-hand side thereof. Thus, the main body mem-

ber 15 of the housing is provided at each side thereof with an integral lateral extension 15^u having a vertical passage 15^v therein (see Fig. 8) to accommodate the shank portion of a screw 40. As shown in Figs. 3 and 7, each screw 40 preferably has a small fiber washer 41 strung thereon; said washer having a sufficiently tight fit to prevent fall of the screw by gravity when the parts are in the relative positions thereof shown in Fig. 7, either before or after initial threading of the screws 40 into the respective tapped openings 26^q and 26^r formed in the die-cast member 26 (see Figs. 11, 12 and 13).

The operating superstructure of the switches shown in Figs. 13 and 14 is essentially like that aforesaid, and corresponding parts have been given like numerals of reference. As shown in Figs. 13 and 14, however, the operating button 36 is shown as of the enlarged or mushroom-head type; and the same is preferably formed as illustrated from a suitable light-weight metal or other material. As shown the button 36 comprises a cylindrical lower portion 36^a and a circular upper end portion 36^b of substantially larger diameter; the upper surface of said portion 36^b being provided with a multiplicity of circular grooves or indentations 36^c (Fig. 14) forming ridges to facilitate depression thereof by a finger or by the palm of a hand. Pushbutton 36 is provided with a substantially cylindrical recess 36^d (Fig. 14) to accommodate with a free sliding fit the upper end portion 37^a of a pin 37 which is preferably formed of steel. Said upper end portion 37^a of pin 37 is peripherally cut away, or otherwise formed, at 37^b, to accommodate the inner end of a set screw 38, which is adapted to be threaded into the correspondingly threaded passage 36^e; whereby pushbutton 36 and pin 37 are attached to each other.

Prior to such attachment of cap 36 and pin 37, however, a circular washer 39, formed of a suitable metal such as steel, and having a slot extending from one side thereof to its center, is assembled onto pin 37 around the peripheral groove 37^c formed in the latter. Pin 37 will then have its upward inserting movement limited to the proper degree, to insure alinement of peripheral groove 37^b with the inner end of set screw 38; and the lower face of washer 39 will serve as a bearing or wear plate for the upper end portion of a coiled compression spring 31, like that aforementioned. Also, as will be apparent from Fig. 14, the lower end of cylindrical portion 36^a of pushbutton 36 is provided with a circular recess 36^f; the peripheral wall of which retains both the plate 39 and the upper end of spring 31 in centered position.

Pin 37 is likewise provided with a peripheral groove 37^d to be elastically engaged by the periphery of the relatively small opening in the upper end of a sealing member 32 like that aforesaid. The other parts of the operating means in Figs. 13 and 14 correspond with the parts shown in the earlier figures of the drawings, and are each adapted to function in a corresponding manner.

The switch shown in Fig. 13 is adapted for mounting upon a perforated panel 25, like that shown in Figs. 3 and 7; such mounting being effected in the same manner as aforesaid; except that the mushroom-head operator 36 will be attached only after assembly of at least the die-cast member 26 and the mounting ring 27 to the panel 25. However, it is obvious that both sets of switch housing members 15, 16 and 15, 16 may be attached to the flat lower end portion of die-cast member 26, and to each other, as by means of the two pairs of fillister-head screws 40, 40 and 40, 40, prior to attaching the assembly to panel 25 (Fig. 7) as by means of the mounting ring 27, in the manner aforementioned.

The wiring terminal screws 42 in Fig. 13 face outwardly from the rear surface of panel 25 to facilitate attachment of the circuit wires (not shown). It will also be noted that in Fig. 13 the terminal screws 42 nearest to the panel 25 are respectively alined with the respective terminal screws 42 furthest removed from panel

25. It was heretofore pointed out, however, that in Fig. 13 either the switching unit nearest to panel 25, or the switching unit farthest away from said panel, may be rotated through one hundred and eighty degrees, to provide for laterally offsetting the outermost sets of terminal screws from the innermost sets thereof, as shown, by way of example, in Fig. 14. As shown in each of Figs. 13 and 14, each of the screws 40 is provided at one end with a threaded shank 40^a, and with the head thereof both kerfed, as indicated at 40^b, and internally recessed and threaded as shown at 40^c, for the purpose herein contemplated.

Where, as in Fig. 14, the switching unit or units are to be housed within a switchbox or the like having a bottom wall or the like designated by the numeral 43, the mounting screws and the terminal screws for the switching units will be arranged in a reverse relationship from the showing in Fig. 13. Under such conditions the switch-operating elements aforementioned will be mounted as aforescribed upon the flat panel or like portion 44 of a switchbox cover member or the like having a substantially circular opening formed therein to accommodate the upper end portion of die-cast member 26, and with a notch formed in the circumference of said opening to receive the lug 26^b, whereby said member 26 is restrained against rotation relatively to said portion 44 after said parts are assembled with respect to each other.

As shown in Fig. 13 the set screw 38 is provided at its outer end with a recess of polygonal form in cross section, thus requiring a special form of wrench to effect tightening and/or removal of said set screw.

We claim:

1. In an electric switch comprising a molded insulating housing member having a pair of recesses formed therein by a straight-line molding operation and both recesses opening to each end of said housing member, a molded insulating cover member overlying one end of said housing member and adapted to be rigidly and permanently attached thereto, said cover member having a pair of openings formed therein and located centrally of the respective recesses in said housing member, a pair of molded insulating plunger members each freely slidable within either of said recesses, a pair of coiled compression springs, each spring being respectively interposed between one end of one of said plungers and an abutment forming a part of the complete insulating housing, each spring normally acting to bias its associated plunger toward a given outer extreme position, a pair of spaced stationary contacts located within each of said recesses and respectively retained in fixed position therein upon final assembly of said housing and cover members, and a pair of bridging contactors each respectively associated with one of said plungers and having a spring biased connection with the latter.

2. In an electric switch, in combination, a molded insulating housing member having a pair of recesses formed therein by a straight-line molding operation and both recesses opening to each end of said housing member, a molded insulating cover member overlying one end of said housing member and adapted to be rigidly and permanently attached thereto, said cover member having a pair of spaced openings formed therein and aligned centrally of the respective recesses in said housing member, a pair of molded insulating plunger members each insertable into either of said recesses and being slidable with respect thereto, a pair of coiled compression springs, each spring being respectively interposed between one end of one of said plungers and an abutment forming a part of the complete insulating housing, each spring normally acting to bias its associated plunger member toward a given outer extreme position, a pair of spaced stationary contacts located within each of said recesses and respectively retained in fixed position therein upon final assembly of said housing and cover members, a pair of bridging contactors each respectively associated

with one of said plungers and having a spring-biased connection with the latter, the plungers, bridging contactors, stationary contacts and associated spring means in said recesses being selected to provide switch mechanisms of either the normally closed type or the normally open type.

3. In an electric switch, in combination, a molded insulating housing member having a pair of recesses formed therein by a straight-line molding operation and both recesses opening to each end of said housing member, a molded insulating cover member overlying one end of said housing member and adapted to be rigidly and permanently attached thereto, said cover member having a pair of spaced openings formed therein and aligned with the respective recesses in said housing member, a pair of molded insulating plunger members each insertable into either of said recesses and being slidable with respect thereto, a pair of coiled compression springs, each spring being respectively interposed between one end of one of said plunger members and an abutment forming a part of the complete insulating housing, each spring normally acting to bias its associated plunger member toward a given outer extreme position, a pair of spaced stationary contacts located within each of said recesses and respectively retained in fixed position therein as an incident to final assembly of said housing and cover members, a pair of bridging contactors each respectively associated with one of said plunger members and having a spring-biased connection with the latter, the plunger member, bridging contactor, stationary contacts and associated coiled compression spring in each of said recesses being adapted to provide a switch mechanism of the normally closed type.

4. In an electric switch, in combination, a molded insulating housing member having a pair of recesses formed therein by a straight-line molding operation and both recesses opening to each end of said housing member, a molded insulating cover member overlying one end of said housing member and adapted to be rigidly and permanently attached thereto, said cover member having a pair of spaced openings formed therein and aligned centrally of the respective recesses in said housing member, a pair of molded insulating plunger members each insertable into either of said recesses and being slidable with respect thereto, a pair of coiled compression springs, each spring being respectively interposed between one end of one of said plunger members and an abutment forming a part of said cover member, each spring normally acting to bias its associated plunger member toward a given outer extreme position, a pair of spaced stationary contacts located within each of said recesses and respectively retained in fixed position therein as an incident to final assembly of said housing and cover members, a pair of bridging contactors each respectively associated with one of said plunger members and having a spring-biased lost motion connection with the latter, the plunger member, bridging contactor, stationary contacts and coiled compression spring means in each of said recesses being adapted to provide a switch mechanism of the normally open type.

5. In an electric switch, in combination, a molded insulating housing member having a pair of recesses formed therein by a straight-line molding operation and both recesses opening to each end of said housing member, a molded insulating cover member overlying one end of said housing member and adapted to be rigidly and permanently attached thereto, said cover member having a pair of spaced openings formed therein and aligned centrally of the respective recesses in said housing member, a pair of molded insulating plunger members each insertable into either of said recesses and being slidable with respect thereto, a plurality of coiled compression springs, certain of said springs being respectively interposed between one end of one of said plunger members and an abutment forming a part of said cover member,

certain of said springs normally acting to bias their associated plunger members to given outer extreme positions, a pair of spaced stationary contacts located within each of said recesses and respectively retained in fixed position therein as an incident to final assembly of said housing and cover members, a pair of bridging contactors each respectively associated with one of said plunger members and each having a spring-biased lost motion connection with the latter, the plunger member, bridging contactor, stationary contacts and associated coiled compression springs in one of said recesses being adapted to provide a switch mechanism of the normally open type, and the plunger member, bridging contactor and associated coiled compression spring in the other recess being adapted to provide a switch mechanism of the normally closed type.

6. As an article of manufacture, a one-piece main insulating body member forming the major portion of a housing for a pair of electric switches of the reciprocable bridging contactor type, said body member being adapted for formation by a straight-line molding operation, a one-piece molded insulating cover member cooperatively shaped to interfit between two side walls of, and not extending beyond the length of said side walls, and to substantially cover the open lower end of said main body member, said main body member and said cover member being cooperatively formed to provide two electrically separated switching chambers, a pair of combined stationary contact and wiring terminal members associated with each recess, a pair of insulating plungers located within the respective recesses and each having a bridging contactor associated therewith, a coiled compression spring interposed between each of the respective plungers and said insulating cover member, said main insulating body member having openings formed in the upper surface thereof through which the upper ends of said plungers are normally adapted to project, and said bottom cover member having openings formed therein and aligned with the respective openings first mentioned, said last mentioned openings affording clearance for the reduced upper end portions of plungers of switches positioned therebelow and for the lower end portions of the respective plungers of the switches first mentioned upon depression of either or both of the same.

7. As an article of manufacture, a one-piece main insulating body member forming the major portion of a housing for a pair of electric switches of the reciprocable bridging contactor type, said body member being adapted for formation by a straight-line molding operation, a one-piece molded insulating cover member cooperatively shaped to interfit between two side walls of, and to substantially cover the open lower end of, said main body member, said main body member and said cover member being cooperatively formed to provide two electrically separated switching chambers, a pair of combined stationary contact and wiring terminal members associated with each recess, a pair of insulating plungers located within the respective recesses and each having a bridging contactor associated therewith, a coiled compression spring interposed between each of the respective plungers and said insulating cover member, said main insulating body member having openings formed in the upper surface thereof through which the upper ends of said plungers are normally adapted to project, one of said electric switches being of the normally open type and the other switch being of the normally closed type.

8. As an article of manufacture, a one-piece main insulating body member forming the major portion of a housing for a pair of electric switches of the reciprocable bridging contactor type, said body member being adapted for formation by a straight-line molding operation, a one-piece molded insulating cover member cooperatively shaped to interfit between two side walls of, and to substantially cover the open lower end of, said main body member, said main body member and said cover

member being cooperatively formed to provide two electrically separated switching chambers, a pair of combined stationary contact and wiring terminal members associated with each recess, a pair of insulating plungers located within the respective recesses and each having a bridging contactor associated therewith, a coiled compression spring interposed between each of the respective plungers and said insulating cover member, said main insulating body member having openings formed in the upper surface thereof through which the upper ends of said plungers are normally adapted to project, one of said electric switches being of the normally open type and the other switch being of the normally closed type, said switch of the normally closed type including a pair of punched insulating plates each respectively overlying that portion of each terminal member leading to the stationary contact associated therewith, whereby arc-tracking between the contactor and its associated terminal members is prevented.

9. As an article of manufacture, a molded insulating plunger for use in a switch of the reciprocating contactor type, said plunger having at least two sets of parallel side surfaces to restrict the same to reciprocatory and non-rotary movement within a molded insulating housing member of suitable form, one end of said plunger being of approximately conical form, the other end of said plunger having an integral centrally located portion of reduced cross section, the end surface of said last mentioned portion being located in a plane perpendicular to the axis of said plunger, to thereby provide for simultaneous operation of a plurality of plungers arranged in tandem, as an incident to stacking of two or more switches in cooperative relationship to each other.

10. A molded insulating plunger of the character set forth in claim 9, wherein the plunger is recessed to receive, and to restrain against rotary or endwise movement, a bridging type contactor of suitable form, and associated spring means to normally bias said contactor toward a predetermined position thereof relatively to said plunger.

11. An electric switch comprising a plural-recessed insulating body member adapted for production by a straight line molding operation, each recess opening to both the outer and the inner ends of said body member, a pair of insulating plungers each having a tapered outer end portion adapted to normally project outwardly from the outer end of said body member through the respective openings therein upon complete assembly of the switch parts, an insulating bottom cover member seated within the recessed inner end portion of said body member in flush relationship to the latter and rigidly and permanently attached thereto, a pair of coiled compression springs respectively interposed between the lower ends of the respective plungers and said bottom cover member to normally bias said plungers toward their respective outer extreme positions, a single bridging contactor associated with each plunger and movable jointly with the latter in each direction respectively, spring means associated with the respective plungers to normally bias each of said bridging contactors toward predetermined positions with respect to their associated plungers, a pair of spaced stationary contacts located within each of said recesses and respectively clamped in fixed position as an incident to assembly of said body member and the aforementioned bottom cover member, and a single manually operable member having a part thereof normally positioned to the respective outer end portions of said plungers, said last mentioned member when operated being adapted to effect movement of said plungers toward their respective inner extreme positions.

12. An electric switch comprising an insulating body member having a pair of like recesses therein and each recess opening to both the outer and inner ends of said body member, a pair of insulating plungers each having a tapered end portion adapted to normally project outward-

ly from the upper end of said body member upon complete assembly of the switch parts, an insulating bottom cover member adapted to seat against the inwardly offset lower end portion of said body member and rigidly and permanently attached thereto in flush relationship, a 5 coiled compression spring interposed between the lower end of each of said plungers and said bottom cover member to normally bias said plungers toward their respective outer extreme positions, a bridging contactor associated with each of said plungers and initially movable 10 jointly with the latter, a plurality of pairs of spaced stationary contacts located within the respective recesses and clamped in fixed positions as an incident to assembly of said body member and said bottom cover member, and additional spring means affording a resilient lost motion 15 connection between at least one of said plungers and its associated contactor after the latter has been moved into bridging engagement with said stationary contacts.

13. As an article of manufacture, a molded insulating plunger for use in a switch of the reciprocating contactor type, said plunger having at least two sets of parallel side surfaces to restrict the same to reciprocatory and non-rotary movement within a molded insulating housing member of suitable form, and said plunger further having a reduced end portion extending outwardly 25 of said housing member and an opposite end portion within said housing member for engaging a reduced end portion of and to provide for simultaneous operation of a plunger arranged in tandem therewith and extending into said housing member as an incident to stacking a plurality of said switches in cooperative relationship to each other.

14. In combination, an electric switch having an insulating body member wherein said body member has integral lateral extensions and each extension has an aperture therethrough, a switch operator adapted for mounting upon a panel having an opening formed therein, said switch operator comprising a metal member having a bottom flange portion and a substantially cylindrical portion formed integrally therewith and extending outwardly therefrom, the outer end of said cylindrical portion being of reduced external diameter and the major portion of the remainder thereof being provided with an external screw thread, said cylindrical portion being provided at its lower end with an integral laterally projecting lug and the wall of said panel opening having a notch formed therein to interfit with said lug, an annular gasket interposed between said bottom flange and the inner surface of said panel, a clamping ring having threaded engagement with said cylindrical portion, said cylindrical portion having an integral barrier formed therein intermediate the inner and outer ends thereof, said barrier having a central opening formed therein and an outwardly projecting annular rib integrally formed on the outer surface thereof, manually operable switch actuating element comprising a pin slidably retained within said central opening, a pushbutton element non-rotatably attached to the outer end of said pin, a metal plate non-rotatably attached to the inner end of said pin, said plate being guided by a pair of projections formed within said cylindrical portion for non-rotatable, reciprocating movement inwardly of said barrier, a dome-

shaped sealing member surrounding said pin and having a peripheral flange formed on the inner end thereof and seated upon the outer surface of said barrier to cooperate with said annular rib, a rigid annular member engaging the outer surface of said peripheral flange, said pin having an annular groove formed therein and said sealing member having an opening at the outer end thereof, portions of said sealing member adjacent the last mentioned opening being adapted to positively engage each of the walls of the annular groove in said pin, a coiled compression spring interposed between the inner end of said pushbutton element and said rigid annular member, said bottom flange portion of said metal member having inwardly extending projections at opposite sides thereof, the latter having tapped openings therethrough, and mounting screws insertable through the aforementioned apertures in said lateral extensions of said body member to threadedly engage said tapped openings in said lateral projections to attach said body member of said switch to said metal member of said switch operator.

15. As an article of manufacture, a plunger assembly for use in a switch of the reciprocating contactor type comprising a molded insulating plunger and a bridging type contactor said plunger having at least two sets of parallel side surfaces to restrict the same to reciprocatory and non-rotary movement within a molded insulating housing member of suitable form, said plunger being provided with a transverse opening to receive said contactor and to restrain the latter against rotary or endwise movement, said plunger assembly being provided with associated spring means to bias said contactor toward a predetermined position relative to said plunger, and said plunger further having a reduced end portion extending outwardly of said housing member and an opposite end portion within said housing member for engaging the reduced end portion of and to provide for simultaneous operation of a plunger arranged in tandem therewith and extending into said housing member as an incident to stacking a plurality of said switches in cooperative relationship to each other.

16. The combination according to claim 15, wherein the wall surrounding said opening in said plunger is provided with an integral inward projection and said bridging contactor is provided with a notch to receive said projection in interfitting relationship.

References Cited in the file of this patent

UNITED STATES PATENTS

1,207,923	Jewell	Dec. 12, 1916
1,903,135	Rees	Mar. 28, 1933
1,996,891	Van Valkenburg	Apr. 9, 1935
2,303,833	Furnas et al.	Dec. 1, 1942
2,357,973	Robbins	Sept. 12, 1944
2,430,064	Lawson	Nov. 4, 1947
2,514,913	Tyrner	July 11, 1950
2,550,777	Cobb et al.	May 1, 1951
2,562,420	Furnas	July 31, 1951
2,707,213	Koertge et al.	Apr. 26, 1955
2,722,574	Simmons	Nov. 1, 1955
2,794,093	Morschel	May 28, 1957
2,806,907	Mazzola	Sept. 17, 1957
2,814,681	White	Nov. 26, 1957