May 16, 1939. R. POPP 2,158,084

ELECTRIC SWITCH

Filed Nov. 25, 1935 4 Sheets-Sheet 1

Fig. 1.

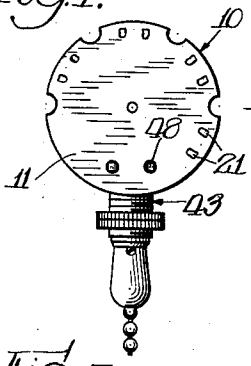


Fig. 2.

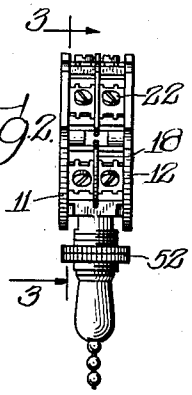


Fig. 3.

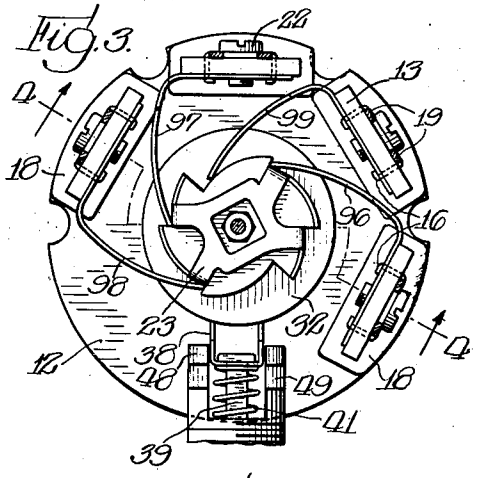


Fig. 5.

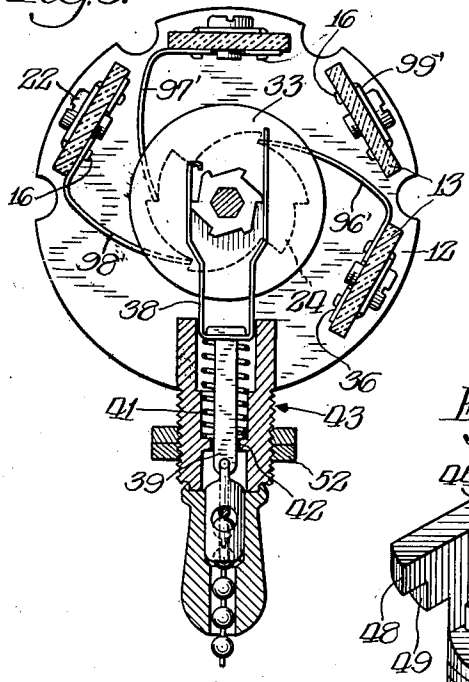


Fig. 4.

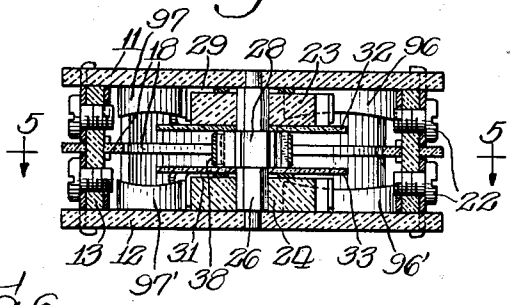


Fig. 6.

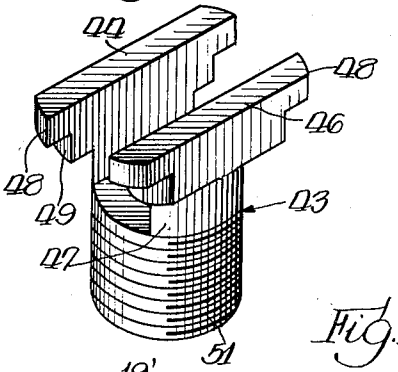


Fig. 7.

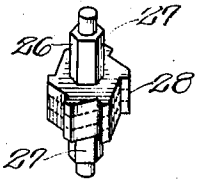


Fig. 8.

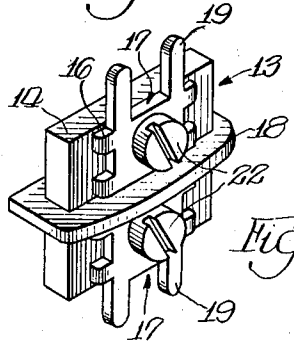


Fig. 9.

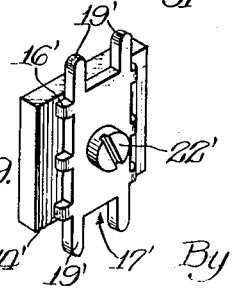
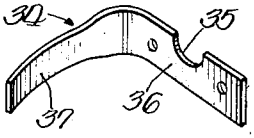


Fig. 10.



Inventor:-
Rudolf Popp,
By Foorman L. Mueller Atty.

May 16, 1939. R. POPP 2,158,084

ELECTRIC SWITCH

Filed Nov. 25, 1935 4 Sheets-Sheet 2

Fig. 11.

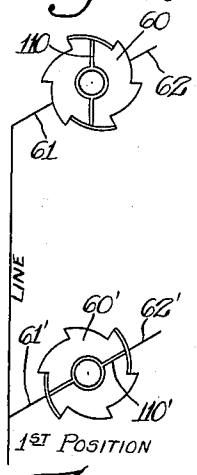


Fig. 11a

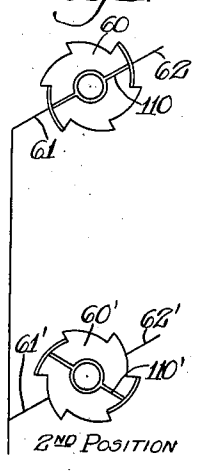


Fig. 11b

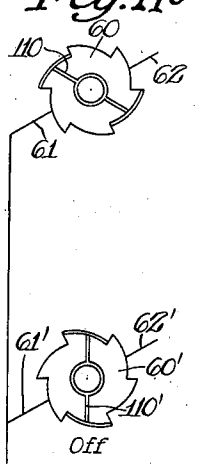


Fig. 12.

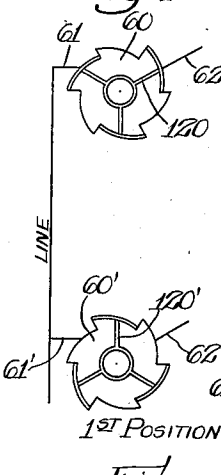


Fig. 12a

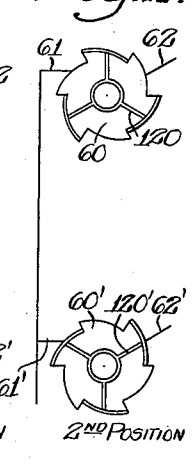


Fig. 14.

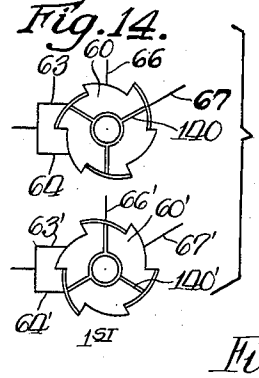


Fig. 14a

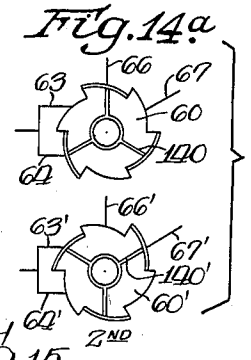


Fig. 13

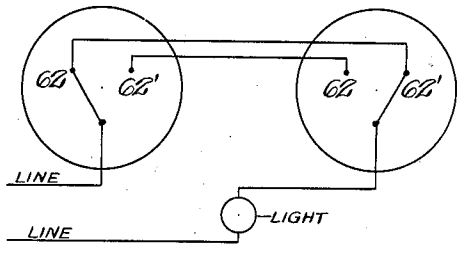


Fig. 15.

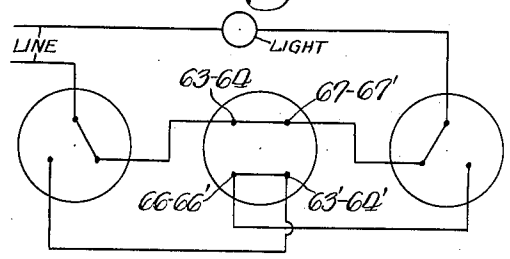


Fig. 16.

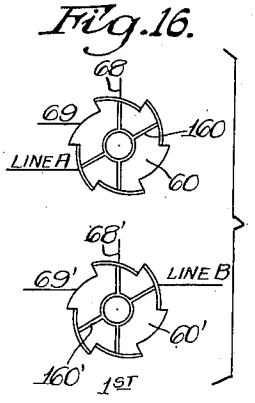


Fig. 16a

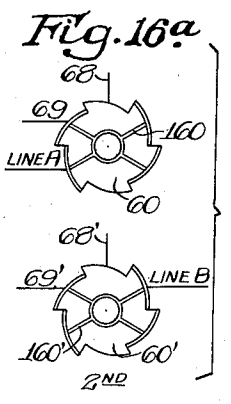


Fig. 17.

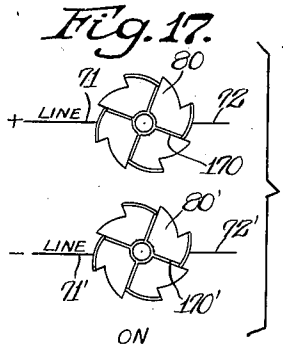
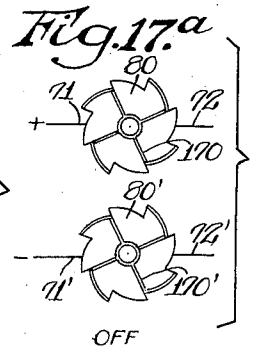


Fig. 17a



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Rudolf Popp,
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May 16, 1939. R. POPP 2,158,084

ELECTRIC SWITCH

Filed Nov. 25, 1935 4 Sheets-Sheet 3

FIG. 18.

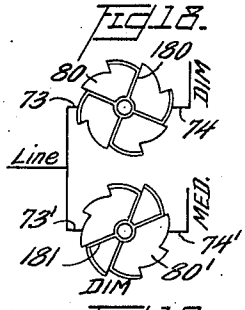


FIG. 18a.

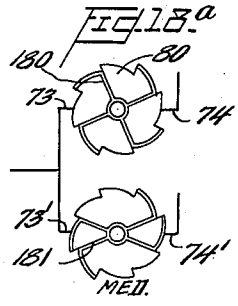


FIG. 18b.

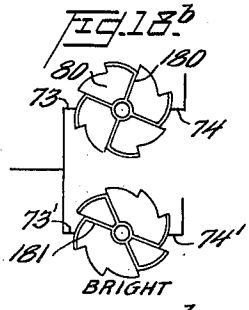


FIG. 18c.

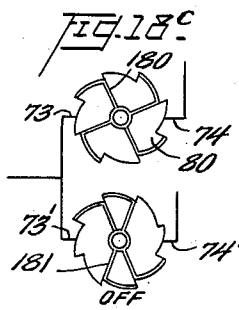


FIG. 19.

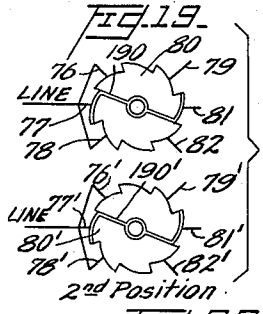


FIG. 19a.

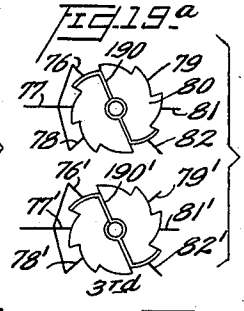


FIG. 19b.

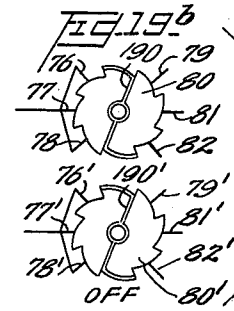


FIG. 19c.

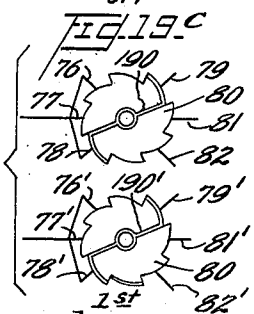


FIG. 20.

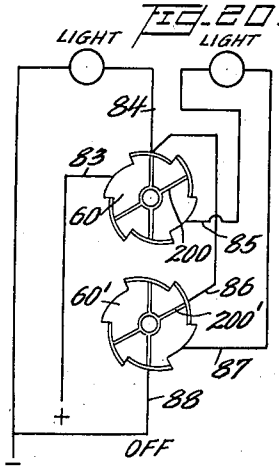


FIG. 20a.

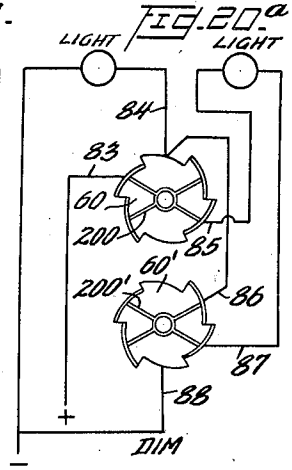


FIG. 20b.

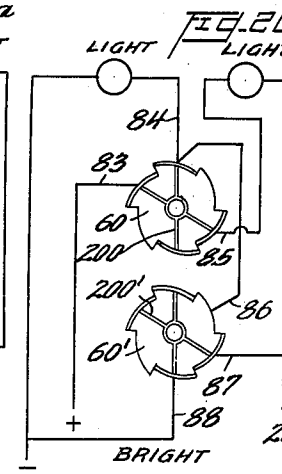


FIG. 21b.

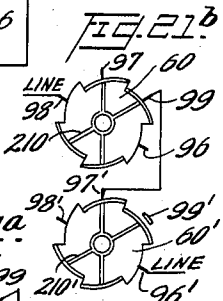


FIG. 22.

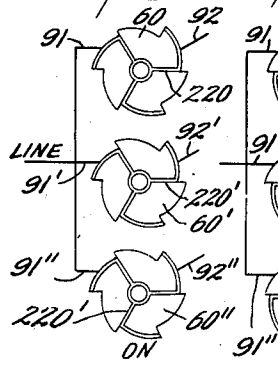


FIG. 22a.

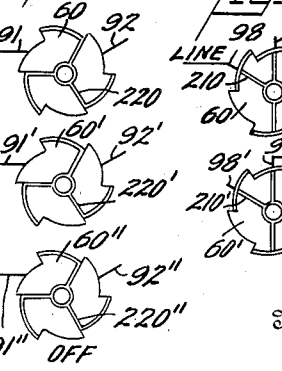
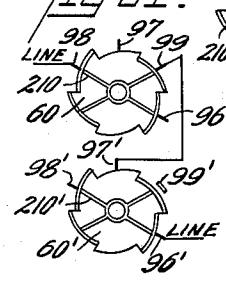


FIG. 21.

FIG. 21a.



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Attorney

May 16, 1939. R. POPP 2,158,084

ELECTRIC SWITCH

Filed Nov. 25, 1935 4 Sheets-Sheet 4

Fig. 23.

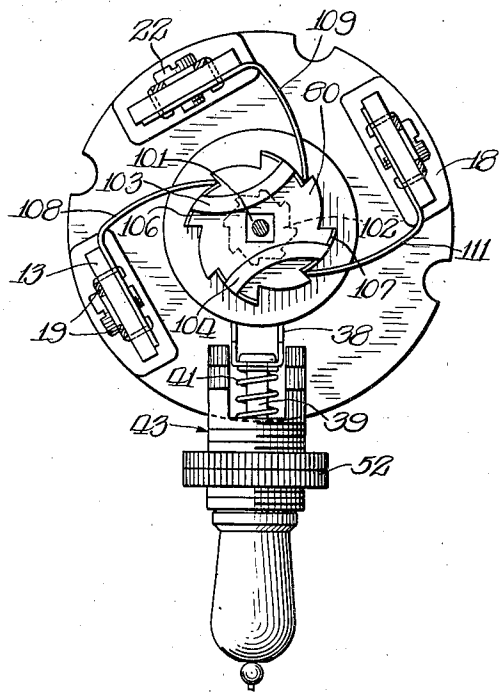
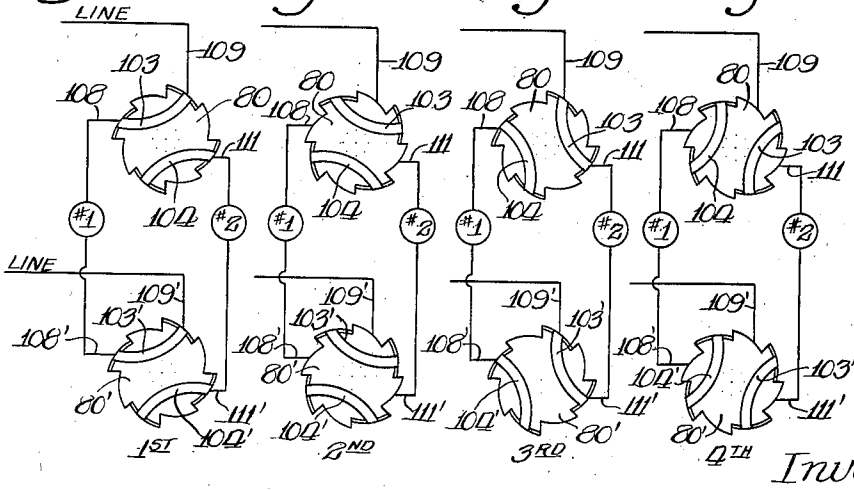


Fig. 24. Fig. 24a Fig 24b Fig. 24c



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Rudolf Popp,
By Foorman L. Mueller Atty.

Patented May 16, 1939 2,158,084

UNITED STATES PATENT OFFICE

2,158,084

ELECTRIC SWITCH

Rudolf Popp, Valparaiso, Ind., assignor to McGill Manufacturing Company, Valparaiso, Ind., a corporation of Indiana

Application November 25, 1935, Serial No. 51,466

14 Claims. (Cl. 200—64)

My invention relates in general to electrical switches and more in particular to a pull chain multi-circuit switch.

In two-way and three-way switch circuits, and in more complicated house and commercial switch installations, it has been necessary to employ several different types of switches in a single complete circuit. Specially designed expensive and cumbersome switches are often employed in some of the more complicated commercial circuits. Not only are these switches expensive, but the mounting thereof is ordinarily complicated and costly. With this situation, it has been necessary for the manufacturer to carry a large number of different types of switches in stock in order to readily supply switches for many different installations. This results in a heavy financial and inventory burden on the manufacturer and supplier, and the user is also put to an added expense for his complicated circuit installations. Furthermore, this situation has caused great inconvenience, delay and expense in the repair of switches in commercial installations, particularly where the particular type of switch needed for replacement is not readily available.

It is an object of my invention to provide an improved electrical switch for a single circuit or multi-circuit installation.

A further object is to provide such a switch with a pull chain or universal lever operation and structure permitting mounting in a canopy, cut-out box or any other ordinary installation in a very simple and inexpensive manner.

It is also an object of my invention to provide a switch of such a construction that it may be used in a high amperage circuit as successfully as in the normal current line or circuit.

A still further object of my invention is to provide such a switch that will lend itself to large quantity, low-cost production in a manner similar to the ordinary inexpensive pull chain switch for a single circuit.

It is a still further object of my invention to provide a switch with a marked flexibility in performance so as to permit almost any circuit combination in a single switch, and a flexibility of installation permitting the mounting of the switch under a great many different conditions.

One of the features of my invention is the provision of a multi-contact disc switching mechanism with a single actuating lever for simultaneous rotation of all discs.

A further feature of my switch is the provision of a plurality of contact discs with a single rotary stem therefor, and a set of contact arms and insulatingly separated terminal posts for each of the several discs, permitting each disc to be connected into a separate circuit or permitting inter-connection between circuits to the several discs by means of wires extending from one set to another of terminal posts and contact arms, and a single actuating lever for the rotary stem.

Another feature of my invention is the provision of a switch of such structure that contact discs having a varying number of teeth, differently shaped teeth, and various combinations of this structure, may be employed, to cooperate with different combinations of contact arms and terminal members, so as to provide in all an infinite variety of circuit combinations in the switch without changing its basic structure, and furthermore to accomplish these modifications quickly and simply.

Other objects and features of my invention may be apparent from the following specification, taken with the drawings, in which:

Fig. 1 is a top plan view of my assembled switch mechanism out of a housing.

Fig. 2 is a side view of the switch mechanism.

Fig. 3 is a sectional view along the line **3—3** of Fig. 2.

Fig. 4 is a cross sectional view along the line **4—4** of Fig. 3.

Fig. 5 is a sectional view along the line **5—5** of Fig. 4.

Fig. 6 is a detailed view in perspective of the mounting stem for the switch.

Fig. 7 is a detailed view in perspective of the rotatable stem.

Fig. 8 is a perspective view of a terminal post with a plurality of terminal members.

Fig. 9 is a perspective view of a terminal post with a single terminal member for connection to a plurality of superimposed contact discs.

Fig. 10 is a detailed perspective view of a contact arm.

Figs. 11, 11*a* and 11*b* are diagrammatic fragmentary illustrations in successive switch positions in a typical circuit with one combination of a pair of superimposed contact discs.

Figs. 12 and 12*a* are similar illustrations of two switch positions of a modification of my switch structure.

Fig. 13 is a diagram of a circuit employing a switch as illustrated in Figs. 12 and 12*a*.

Figs. 14 and 14*a* are diagrammatic fragmentary illustrations of two switch positions in typical connections for another use of the switch of Figs. 12 and 12*a*.

Fig. 15 is a diagram of a circuit employing the switch of Figs. 14 and 14*a*.

Figs. 16 and 16*a* illustrate diagrammatically two switch positions of another possible set of connections.

Figs. 17 and 17*a* illustrate diagrammatically two switch positions of a still further possibility.

Figs. 18, 18*a*, 18*b*, 18*c* are similar illustrations of four positions of a further variation of the connections through the contact discs and terminals of the switch of my invention.

Figs. 19*a*, 19*b*, 19*c* illustrate four switch positions of a still further modification.

Figs. 20, 20*a*, and 20*b* are diagrams of a circuit including an embodiment of my switch such as illustrated in Figs. 16 and 16*a* and a pair of lights or clusters having equal wattage on both sides with such switch shown in three positions.

Figs. 21, 21*a*, and 21*b* illustrate diagrammatically three switch positions in one hook-up for the embodiment of my invention as illustrated in Figs. 1 to 5.

Figs. 22 and 22*a* illustrate diagrammatically two switch positions of a modification of my invention in which three superimposed contact discs are employed.

Fig. 23 is a plan view, with one frame plate removed similar to Fig. 3, of another modification.

Figs. 24, 24*a*, 24*b* and 24*c* illustrate four switch positions in a circuit diagram of one hook-up for the switch of Fig. 23.

In practicing my invention I provide a switch comprising switching mechanism for mounting with or without a housing and including a pair of insulating frame plates with a single actuating lever supported in a mounting stem which in turn is carried in the frame, with said lever operating a plurality of insulatingly separated superimposed or stacked contact discs rotatable within a plurality of contact arms with a set of arms for each contact disc and a corresponding terminal member for each arm. The terminal members are mounted one above another on an insulating post which also serves as a spacer for the frame plates, and are designed to retain the frame plates in spaced fixed relationship.

Referring now to the drawings, I provide a switch mechanism **10** which may be mounted if desired in the ordinary cup-shaped housing, with said mechanism including an upper frame plate **11** and a lower frame plate **12** carrying therebetween rotatably supported circuit breaking mechanism. The frame plates are spaced from one another and supported in parallel relationship by a plurality of posts **13** as shown in Fig. 8, which comprise a one-piece post **14** of insulating material having apertures therein for receiving prongs **16** on terminal members **17** mounted one above the other on the post, but insulatingly separated from one another by an apertured insulating plate **18**. The plate extends out beyond the post on all four sides so as to provide an effective insulating wall between the several terminal members on each post. The terminal members also include upstanding and downwardly extending prongs **19** which fit into corresponding apertures **21** in the top and bottom frame plates. These prongs may be upset or bent over after the switch mechanism is completely assembled between the plates to retain the same in fixed spaced relationship. The terminal screws **22** screw into each of the terminal members in the usual manner.

A modification of the post structure is illustrated in Fig. 9 wherein a one-piece insulating post **14'** carries a one-piece terminal member **17'** with a single terminal screw **22'**. This embodiment is employed where it is desired to have the same lead in electrical connection with a contact arm for each of the two contact discs. Prongs **19'** extend upwardly and downwardly to hold the frame plates in position against the post and top and bottom of the terminal member, if desired, and prongs **16'** extend through the insulating post. With a one-piece terminal member in electrical connection with the two contact discs, it is not necessary to utilize the insulating post **14'** in all switch combinations and the upper and lower frame plates may rest directly on the member **17'**, and the contact arms will be secured directly thereto as will be described.

Rotating within the frame plates is switching mechanism which includes a pair of contact discs **23** and **24** keyed to a stem or spindle **26** journalled in the upper and lower frame plates **11** and **12** respectively. The stem, as shown in Fig. 7, may be constructed of molded insulating material in one piece, or may be provided as a die-cast element with disc carrying portions **27** which may be square, hexagonal or the like, to prevent turning of the disc on the stem, and an intermediate toothed ratchet portion **28** for receiving an actuating member and serving as a spacer between the contact discs, as will be hereinafter described.

This rotating structure may also be provided as a one-piece metal stem exactly the same as the portions **27** for carrying a plurality of stamped-out metal ratchet teeth as indicated by dotted lines in Fig. 7. These may be slipped on the stem, and being keyed thereto by the respective configurations as described, rotate therewith. They serve as spacers in the same manner as described. It is necessary to provide a plurality of stamped teeth to obtain the same thickness as with the molded product because of the difficulty of punching out a single member of the desired thickness.

The contact discs **23** and **24** are provided in the usual construction, formed from an insulating material and provided with a plurality of teeth on the outer edge thereof. Although I illustrate in Figs. 3 and 5 contact discs with six teeth, I contemplate a variation of this number to increase the number of possible circuit combinations for the switch. Likewise my invention is not limited to a construction with the teeth and the contact portions the same in number or positioned the same for each of the plurality of discs. I may, for instance, employ a two-deck switch with the upper disc having six teeth and a two-contact portion bridging member as shown in Fig. 11, and with the lower disc having eight teeth with a four-contact portion bridging member as shown in Fig. 17.

Bridging spiders **29** and **31** are carried on the discs **23** and **24** respectively, with contact portions fitting onto the teeth in the usual manner as shown particularly in Figs. 3 and 4. The bridging spider may be varied as to construction in accordance with the variation in design of the contact disc, and may vary as to the number of contact portions thereon as may be understood from a consideration of Figs. 11 to 22. The upper disc **23** rests upon an insulating plate **32** which in turn is supported on the ratchet portion **28** of the rotary stem which acts as a spacer between the discs. The insulating plate **32** ex-

tends out beyond the contact portions of the bridging spider 29 carried by the disc 23 so as to effectively insulate these contacts from the lower disc 24 and prevent short circuiting due to arcing at the contacts. This plate may simply lay loose on the stem. The bridging spider 31 has its connecting portion lying on top of the disc 24, and an insulating plate 33 similar to plate 32 rests on top of the bridging spider to serve as an insulation in the same manner as previously described. The disc itself rests on the lower frame plate 12 and is of course keyed to the stem 26 as previously described.

The contact discs rotating with the stem 26 turn within a plurality of contact arms 34 (Fig. 10) rigidly secured to a corresponding frame post 13 as is shown particularly in Figs. 3 and 5. The contact arms are formed preferably of a metal which will maintain its resiliency as well as the necessary rigidity to provide a satisfactory contact with the bridging members on the contact disc. The contact arms include a mounting portion 36 apertured to receive the desired number of prongs 16 extending through the frame post from the terminal member 17, which prongs are upset on the mounting portion to retain the contact arm rigidly on the inside of the post. The contact portion 37 extends from the mounting portion 36 inwardly in a slightly curved broad arm to bear against the contact portions of the bridging members on the discs 23 and 24. As will be noted from a consideration of Figs. 4 and 10 particularly, each arm is provided with a cut-out portion 35 which is positioned, when the arm is mounted, to permit the free movement of a terminal screw 22. The terminal screws screw into threaded apertures above or below the vertical center of each member 17 as shown in Fig. 4 to permit a rather large body portion of the arm to lie above or below the screw and be secured to the post by prongs 16. The contact portion 37 of a lower arm is simply bent in an opposite direction from the contact portion 37 of an upper arm mounted as shown in Figs. 3 to 5. I have found that this contact arm on my switch makes it possible to use the same satisfactorily in rather high amperage circuits as well as at ordinary loads.

The switching mechanism is actuated by a pull chain lever and operating mechanism including a substantially U-shaped pawl 38 supported on a reciprocating pin 39 with a coiled spring 41 surrounding the pin 39 and bearing against the back of the pawl 38 as shown in Fig. 5. This structure is similar to that shown in my Patent No. 1,974,054. The outer end of the spring 41 bears against an annular seat 42 in a one-piece combination frame support and mounting stem 43 as shown particularly in Fig. 6. This mounting stem is shown in my copending application Serial No. 6,679 and as explained therein, comprises a one-piece element with a head having a pair of vertical ears 44 and 46 on a split neck 47 of such a construction that the ears serve as frame supports as well as guide posts for the reciprocating pin 39, pawl 38 and coil spring 41 carried on the pin. The ears have outwardly extending lug portions 48 which extend into corresponding apertures in the upper and lower frame plates 11 and 12 as shown in Figs. 1 and 2. The plates rest upon the edge of the fragmentary flange portions 49 set inwardly from the outer tip of the lugs 48 a distance substantially equal to the width of the material of the frame members. A cylindrical threaded portion 51 extends outwardly from the neck 47 to receive the usual threaded mounting nuts 52 for mounting the switch in a canopy, cut-out box or the like.

The mounting member 43 is preferably manufactured as a screw machine part to the shape shown in Fig. 6 and previously described. Previously, a comparable structure in the prior art switches was made of two parts, with one portion comprising a threaded collar and the other portion a U-shaped mounting bracket. The two members were soldered or welded together. In the present structure, however, it is not simply a matter of making in one piece what had previously been made in two, but as a result of the new construction a much less expensive element is provided which lends itself to production and assembly more readily, is far more sturdy, and because it is possible to extend the threaded portion right up to the frame plate as shown in Fig. 5, an entirely new result is accomplished in the mounting of the switch itself. In the prior art construction the U-shaped bracket extended out considerably beyond the frame plates to provide in all a considerably longer element than the present structure.

As indicated above, it is possible to build up, with my invention, an almost unlimited number of different circuit combinations for a very large number of different uses, both for household installations and commercial installations, by varying the number of contact discs in my switch, varying the design of the disc itself, and varying the construction of the bridging members on the contact discs. The number of terminal posts and terminal members, as well as the number of contact arms, may be varied in innumerable different combinations to cooperate with variations in discs to accomplish a desired switching mechanism. A wire jumper or the like from a terminal member for one contact disc may be extended to any other terminal member for any other of the superimposed contact discs to give a still greater variation in switching manipulation for my invention. This is most simply illustrated by diagrammatic representations as shown in Figs. 11 to 22 of the drawings. To simplify the description, six-toothed contact discs are designated by the reference character 60, and eight-toothed discs are designated by the reference character 80. The bridging members on these discs are designated by adding a zero to the number of the figure under consideration, with the upper deck or tier of the switch generally designated by these characters, and with the lower deck or tier for a two-deck switch designated by the prime (') of the reference character.

Referring now to Figs. 11, 11*a* and 11*b*, these representations illustrate a two-deck or two-contact disc switch, with contact disc 60 above, carrying bridging member 110, and contact disc 60' carrying bridging member 110' in the lower deck. The bridging members include only two contact portions and are exactly the same except that one bridging member is shown in a position 60° ahead of the other bridging member. As illustrated, the switch will require only two terminals for each of the contact discs. The line is connected to a terminal 61 in the upper tier and a corresponding terminal 61' in the lower tier. A load (not indicated) could be connected alternatively through either the terminal 62 in the upper tier or 62' for the lower tier. The first and second positions of the switch are clearly indicated and also the "off" position, wherein the bridging member of each disc is out of contact with the ter-

minal members therefor. This hook-up is typical of the circuit for a two-speed fan, two banks of lights, or in fact any installation requiring two successive steps in the operation of the switch.

Figs. 12 and 12*a* illustrate a further modification of my invention, with the first and second positions of the contact discs in the operation of the switch. This structure differs from the structure of Fig. 11 only in the bridging members 120 and 120' which have three contact portions fitting on corresponding teeth of contact discs 60 and 60' respectively with an intermediate blank tooth between each of the contact portions of the bridge. Two terminal members 61 and 62, and 61' and 62', are employed for each of the two decks. As may be seen from the drawings, the bridging member on one disc is advanced 60° ahead of the bridging means on the other disc. This structure is commonly known as a three-way switch, and is used for controlling one light unit from two places in a circuit such as shown in Fig. 13. This switch has no "off" position, and in the two positions illustrated, the terminals 62 and 62' are alternately in and out of the circuit.

As the circuit and switches are illustrated in Fig. 13, the light is on, but operating either switch turns the light off. It is understood, of course, that this embodiment of my invention may be used in a large number of other installations just as is the case with all of the modifications illustrated in Figs. 11 to 22. Each of the circles represents a complete two-deck switch as illustrated in Fig. 12.

The modification illustrated in Figs. 14 and 14*a* utilizes a pair of superimposed contact discs 60 and 60' carrying bridging members 140 and 140' of the same construction as the bridging members of Fig. 12, and with one 60° ahead of the other. In this modification, however, an additional number of contact arms is employed, with one side of the line as indicated bridged across two terminals 63 and 64 in the upper deck. The other side is bridged across corresponding terminals 63'—64' for the lower deck. A one-piece terminal member as illustrated in Fig. 9 extending over both decks is employed for the terminal points indicated by the reference characters 66 and 66', and a like terminal member is also employed for the points indicated by reference characters 67 and 67', when using the switch in a circuit as shown in Fig. 15. This embodiment of my invention is of the type generally called a four-way switch and is employed in a circuit containing two three-way switches. This circuit makes it possible to control the light or load as indicated from three different positions. A live circuit is illustrated in Fig. 15, but it is clear that by the movement of any one of the three switches the circuit would be dead and the light extinguished. By simply again moving any one of the three switches in the circuit it would again be a live circuit.

Figs. 16 and 16*a* illustrate a further modification with contact discs 60 and 60' carrying bridging members 160 and 160' with four contact portions on each. This embodiment of my invention is intended for the operation of two separate electrical circuits. A terminal and a contact arm, both represented by reference character 68, are provided for the top contact disc and a like structure 68' for the lower disc. A second terminal 69 and its counterpart 69' for the lower deck have leads extending therefrom. In the first position line A feeds through terminal 68 and line B through 68'. In the second position lines A and B feed through terminals 69 and 69' respectively. A reversing type switch may be made up from this embodiment by putting a jumper from 69 to 68', and 68 to 69', and then operating the switch in the same manner. The third position for the switch is an "off" position.

Figs. 17 and 17*a* illustrate a still further modification in which the switch acts as a single-throw, double-pole type. There are only "on" and "off" positions for this switch which has two superimposed contact discs 80 and 80' with bridging members 170 and 170' containing four contact portions lying symmetrically with one another on the upper and lower discs. Two terminals and two contact arms are provided for each disc, with one side of the line coming in to terminal member 71 on the upper disc for instance, and the other side of the line connected to a terminal 71' for the lower disc. The load is connected across terminal member 72 for the upper disc and 72' for the lower disc. This particular switch structure is used where a load requires that both legs of the circuit be broken at the same time.

In Figs. 18, 18*a*, 18*b* and 18*c* I have illustrated four positions for a further modification of my invention employing an upper contact disc 80 and a lower disc 80'. The bridging member 180 on the upper disc has four contact portions, but is so constructed as to lie on the disc with an intermediate blank tooth between each contact portion. The bridging member 181 on the lower disc, however, has four contact portions, but with two contact portions adjacent, and then two intermediate blank teeth. This switch and the hook-up indicated in the illustration is very satisfactory as a two-circuit electrolier type device. It is illustrated as used with a double filament bulb, and the four positions of the switch are indicated as Dim, Medium, Bright and Off. As may be seen from the dim position, for instance, the line is hooked to a terminal member 73 for the upper disc and 73' for the lower. The line extends from terminal 74 in the upper deck to the dim filament of the lamp, while another lead extends from the terminal 74' for the lower contact disc to the medium filament of the lamp. Either one or the other of the filaments may be lighted, and with the switch in the third positon both filaments are lighted to give the maximum illumination. It is understood, however, that this particular use of the switch is simply illustrative and this structure may be used in other similar installations.

Figs. 19, 19*a*, 19*b* and 19*c* illustrate another modification of a multi-circuit switch of my invention which may be used to control two separate circuits. Bridging members 190 and 190' are mounted on contact discs 80 and 80' respectively. These bridging members have only two contact portions, but are carried by the disc through a plurality of terminal members as 76, 77 and 78 to which a line is connected as indicated. A line is also connected to corresponding terminal members 76', 77' and 78' on the lower contact disc. Terminal members 79, 81 and 82 are indicated on the other side of the disc for leads extending to the desired load, and corresponding terminals 79', 81' and 82' are provided for the lower disc. With this switch either one source of power could be utilized, or it is possible to accommodate two sources as one A. C. and the other D. C.

It is also possible to connect the upper line to

any of the three load terminals by the rotation of the upper contact disc, and with the lower line connected into another circuit including the lower contact disc and three pilot lights, simultaneously operate the two discs and indicate the position of the top disc and the load involved, by a corresponding lighted pilot light. This structure and operation is particularly useful for controlling apparatus as a heating element, for instance. It is understood, of course, just as in the previous modifications, that the bridge on one contact disc could be set ahead or behind that on the other to give a different circuit combination.

As to Figs. 20, 20*a* and 20*b*, each shows a complete circuit having a pair of lights as a load with the switch for the circuit utilizing a pair of superimposed contact discs **60** and **60'** having bridging members **200** and **200'** similar to that shown in Fig. 16. With a pair of lights or a pair of clusters having equal wattage on both sides of the line, a dim light may be obtained with the lights in series as shown in the middle position, and a bright light when connected in parallel by the switch position as shown in the third illustration of the figure. In the first illustration the switch is at off position. For purposes of illustration the positive side of the line may be connected to terminal **83** for the upper disc, which is connected into the circuit in the appropriate position of the bridging member and terminals **84** and **85**. Terminal members **86**, **87** and **88** are used in the rotation of the lower disc.

Figs. 21, 21*a* and 21*b* are diagrams of three different switch positions in a single circuit illustrating one hook-up and use of an embodiment of my invention as shown in Figs. 1 to 5 of the drawings. In the interest of uniformity with the other circuit diagrams, the same scheme of applying reference characters is followed. To facilitate the comparison with the physical structure, the reference characters of Figs. 21, 21*a* and 21*b* as will be described, will be applied to the contacts of Figs. 3 and 5 to indicate the terminal points generally. The figure illustrates the switch of Figs. 1 to 5 with contact discs **60** and **60'** carrying bridging members **210** and **210'**. Four contact arms with corresponding terminals indicated generally by the reference characters **96**, **97**, **98** and **99**, are provided in the upper tier of the switch as shown in plan view in Fig. 3, and corresponding connections are indicated in the lower tier as shown in Fig. 5 by reference characters **96'**, **97'**, and **98'**. No contact arm is provided for the terminal **99'** in this particular hook-up and switch structure. A jumper wire extends from terminal **97'** in the lower tier of the switch to terminal **99** in the upper tier to effect an electrical connection between the two contact discs. Figs. 21, 21*a* and 21*b* illustrate the switch mechanism in three positions. The two sides of a current supply line are connected to terminals **96'** and **98**. Fig. 21 shows the switch in one line position, Fig. 21*a* shows the switch in another line position, while Fig. 21*b* shows the switch in off position. This particular embodiment of the invention has found very satisfactory application in a circuit for controlling a plurality of motors, as well as controlling a plurality of windings in a single motor. It is understood, however, that other types of loads may be controlled by this particular structure. Furthermore, although only four terminal posts have been shown, a fifth post can be added, if desired, to the left of the universal lever as shown in Figs. 3 and 5.

Figs. 22 and 22*a* illustrate diagrammatically a three-deck switch with a single universal lever control and following substantially the structure of Figs. 1 to 5 except to include three superimposed contact discs. As illustrated, the switch includes discs **60**, **60'** and **60''** carrying bridging members **220**, **220'** and **220''** respectively, and each bridging member having three contact portions. An eight-tooth, four-contact portion bridging member as shown in Fig. 17 could also be employed, for simply an "on" and "off" switching, as may be readily understood. This structure is particularly adaptable for circuit control for a three-phase motor, such as is used on woodworking machinery, light metal lathes and the like requiring only an "on" and an "off" position. The line is connected to terminals **91**, **91'** and **91''** for the three decks, and the load is connected to leads extending from terminals **92**, **92'** and **92''**. The "off" position of the switching mechanism is illustrated in Fig. 22*a*.

Another embodiment of my invention is illustrated in Fig. 23, and is a modification, particularly, of the switching mechanism. A two-deck switch is illustrated, with three insulating post and terminal member assemblies such as shown in Fig. 8, and with mounted contact arms as illustrated in Fig. 10. A pair of eight-tooth contact discs **80** are keyed to an actuating post **101** which also carries an eight-tooth ratchet member **102** similar to that shown in Fig. 7, and may be provided either in one piece, or a plurality of ratchet members as has been previously explained.

In this embodiment I provide a pair of bridging members **103** and **104** which are independent of one another on the contact discs, and may be designated as a split bridging member. The contact portions **106** and **107** of the bridging members **103** and **104** respectively fit over the outside of the teeth of the contact disc in the manner previously described. These bridging members may be retained on the discs by prongs extending downwardly into the disc, or the connecting portion of the bridging members may be sunk into corresponding channels in the surface of the contact disc. It is also understood that other means for securing these members in place may be employed, as desired.

A typical circuit embodying this structure is illustrated in Figs. 24, 24*a*, 24*b* and 24*c* and for purposes of comparison, terminal points **108**, **109** and **111**, as well as **108'**, **109'** and **111'** of Figs. 24, 24*a*, 24*b* and 24*c* are comparable to contact arms indicated by the same reference characters in Fig. 23. A switch accomplishing the results of the present structure may be designated a double-pole two-position switch. One side of the line, such as the positive side, may be connected through terminal **109**, while the other side, such as the minus side, may be connected to the terminal **109'**. Lamps, indicated as No. 1 and No. 2, constitute the load in this typical circuit, and lamp No. 1 is connected across terminals **108** and **108'**, while lamp No. 2 is connected across **111** and **111'**, the prime numbers of course indicating the terminals of the lower deck of the switch. In the first position indicated in Fig. 24, lamp No. 1 only is lighted, in the second position (Fig. 24*a*) both lamps are off, in the third position (Fig. 24*b*) lamp No. 2 only is lighted, while in the fourth position (Fig. 24*c*) both lamps are off. It is understood, of course, that variations of the switching mechanism as previously described may be combined with the contact discs having a split bridging structure.

Although the switching mechanism structures illustrated diagrammatically have been described as various modifications of my invention, it is understood that in some structures these are rather, simply contact, terminal, and circuit connection variations, which in some cases can be accomplished by not using part of the contact structure on the switch, and in other cases by simply changing the contact discs and the bridging member carried thereby.

As will appear from the above description, therefore, in the present invention I provide a switch which lends itself to almost any type of circuit combination for home or commercial use. The switch contains very few parts, particularly so in comparison with the cumbersome, expensive prior art switches for the same purposes described.

Providing a universal lever for operating the actuating pawl provides all the ease and convenience of operation found in the small lighting switch, in a switch adapted for almost any household or commercial installation. A minimum amount of space is required for mounting the switch, thus making it extremely satisfactory for power machinery with a direct drive from the motor to the lathe or the like where space economy is important but a highly efficient and sturdy switch is required. All the requirements for this, as well as for other illustrative installations, as described, are satisfied with the present switch at a very low cost.

Although I have illustrated and described my invention in its preferred embodiments, it is understood that I am not limited thereby, but limit my invention only by the scope of the appended claims.

I claim:

1. An electric switch adapted to be mounted in any position on electrical apparatus for control at the switch or from a position remote therefrom and from any angle thereto with a relatively small amount of actuating force on the operating means for the switch, said switch comprising in combination a frame, a pair of spaced apart independent contact discs, a ratchet unit intermediate the discs and separate therefrom, and a rotor supported in said frame for carrying said discs and unit all in axial alignment, a plurality of combination terminal means and frame supporting assemblies on the outside of said frame corresponding in length substantially with the axial length of the two-disc-ratchet assembly and each of said combination assemblies including a frame post, means for securing said post and a frame plate together at each end of the post, and a plurality of metal blocks on each post, and operating means for the discs acting on said ratchet unit, comprising a lever seated on said frame opposite the ratchet unit and connected therewith for universal action on said seat with said seat serving as a fulcrum for said lever.

2. A combination terminal and stationary brush unit for an electric switch having a plurality of stacked contact discs, said unit comprising an insulating member, a plurality of terminal blocks stacked adjacent one another over the length of the member and slightly separated from one another, means for rigidly securing each block on said member, a stationary brush at one side of each block in electrical connection therewith and supported on said insulating member by the block securing means, insulating means on said insulating member intermediate each adjacent terminal block to separate the same, and unit securing means on a block at each end of the insulating member for rigidly securing the unit in said switch.

3. An electric switch including a pair of spaced apart parallel frame plates, switching mechanism rotatably mounted between the plates, a plurality of terminal units spaced around the switch intermediate the frame plates, with at least one of said units comprising an insulating member extending between the frame plates, a terminal block at each end portion of said member, with each block having a plurality of integral lugs extending through said insulating member to rigidly secure said block thereto, and each block having an integral finger extending outwardly therefrom and through a corresponding aperture in the frame plate adjacent that block, with such fingers on said blocks upset on the outside of the frame plates to hold said plates against said insulating member and retain said unit within the frame plates.

4. An electric switch including a frame, a rotatable switching unit mounted on said frame including a plurality of separate toothed discs superimposed on one another and axially aligned, a bridging contact on each disc having a contact portion on at least two teeth thereof with an integral connecting bridge between said portions, with the bridging contact on each disc insulated from the bridging contact on each other disc in the unit, a plurality of terminal assemblies corresponding in length to the axial length of the switching unit and spaced around said frame, brushes between said contacts and said terminal assemblies, means on one terminal assembly for making an electrical conductor connection common electrically to all contact discs in said switching unit, and means on another terminal assembly for receiving electrical conductors thereon corresponding in number to the number of contact discs in said switching unit with each conductor in electrical connection with its corresponding disc and insulated from electrical connection with each other disc in the switching unit.

5. An electric switch including a frame, a rotatable switching unit mounted on said frame including a plurality of separate toothed discs superimposed on one another and axially aligned, a bridging contact on each disc having a contact portion on at least two teeth thereof with an integral connecting bridge between said portions, with the bridging contact on each disc insulated from the bridging contact on each other disc in the unit, a plurality of terminal assemblies each corresponding in length to the axial length of the switching units and spaced apart substantially entirely around said frame, brushes between said contacts and said terminal assemblies, with one of said terminal assemblies having a metal member extending substantially the length of that assembly and having a conductor receiving portion thereon electrically common to all of the contact discs in said unit, and with another of said terminal assemblies having a plurality of electrical conductor receiving portions thereon corresponding in number to the number of contact discs in said unit with each receiving portion thereon electrically insulated from each other conductor receiving portion on that assembly to provide an electrical connection from each conductor receiving portion to its corresponding contact disc only.

6. An electric switch comprising an open frame

having a pair of parallel plates, at least three spacing and supporting members intermediate said plates which are spaced apart and positioned substantially entirely around the outside edge of said frame, a plurality of insulatingly separated stacked contact discs rotatably carried in the frame with the axial center thereof at right angles to the pair of insulating plates, terminal means on a spacing and supporting member comprising a terminal plate corresponding to each of the plurality of contact discs, an insulating collar carried on said spacing and supporting member intermediate each two adjacent terminal plates, and a contact brush intermediate each terminal plate and its corresponding contact disc.

7. A stem mounted electric switch for complex circuit control including in combination a frame, a threaded mounting stem on the frame, a switching unit rotatably supported on said frame comprising a plurality of independent toothed discs and a ratchet device all in axial alignment and simultaneously rotatable, two contact members on each of said discs independent of and insulated from each other, a plurality of stationary brushes for each disc for engagement with the contacts thereon and in horizontal alignment with that disc, terminal assemblies at the outside portion of the frame in connection with said brushes with at least one of said assemblies having terminal portions one above the other corresponding in number and horizontal position with the toothed discs, and having an insulating member in said frame for supporting said terminal portions and supporting one of said stationary brushes for each terminal portion and with said assemblies readily accessible on the outside of said switch, and means for rotating said plurality-disc switching unit from a remote position with a relatively small amount of pulling force, with such pull exerted from any angle to the switch and with the switch mounted on said stem in any position, said means including a lever universally seated on said frame and the latter acting as a fulcrum therefor, and means connecting said lever with said ratchet device.

8. In an electric switch, a frame comprising a pair of spaced apart plates, switching mechanism rotatably supported between said plates, including a plurality of stacked insulatingly separated circuit interrupting and making means, means for supporting said plates in spaced apart relationship including a plurality of one-piece insulating posts substantially as long as the axial length of the switching mechanism positioned at intervals around said frame adjacent the outer edges thereof, and a plurality of metal terminal members rigidly secured one above the other but separated on at least one of said posts, with a terminal member for each stacked circuit interrupting and making means, and an insulating collar on a post for insulatingly separating each terminal member from an adjacent member thereon.

9. An electric switch including a plurality of stacked contact discs, a frame for carrying said discs, a plurality of insulating posts in said frame, with at least one of said posts having a plurality of stacked terminal members on one side, and a stationary contact on the other side of such one post for each of said terminal members and in electrical engagement therewith, with each of said terminal-member stationary-contact structures corresponding to one of said stacked contact discs, and insulating means separating each terminal-member-stationary-contact structure from an adjacent structure over such one of said posts.

10. An electric switch including in combination, a pair of spaced apart frame plates, switching mechanism including a plurality of stacked contact elements rotatably supported in the frame plates, and a plurality of multi-piece combination spacing and terminal units between said frame plates at spaced apart positions substantially entirely around the frame at the outer edge thereof for ready availability for securing conductors thereof, each of said units including a plate spacing member and a terminal member rigidly secured thereon, with one of said two members having lug extensions thereon for extending through an adjacent frame plate to be upset thereon to rigidly secure together such plate and unit.

11. A combination terminal and stationary brush unit for an electric switch having a plurality of stacked contact discs, said unit comprising an insulating member, a plurality of terminal blocks mounted on one face of said insulating member and one above the other over the length thereof, each of said terminal blocks having a lug at each side thereof extending through a corresponding aperture in said insulating member for upsetting on the opposite side thereof to mount said block thereon, a stationary brush on said insulating member having a mounting portion with apertures therein corresponding to the lugs on at least one of the terminal blocks for receiving said lugs, with said lugs adapted to be upset over the mounting portion of the stationary brush to rigidly secure the stationary brush and corresponding terminal block on said insulating member, insulating means on said insulating member intermediate each adjacent terminal block to separate the same, and means on said unit integral with a portion thereof at each end thereof adapted for rigidly securing said unit in an electric switch.

12. An electric switch including a plurality of axially aligned contact discs, means for supporting said plurality of discs, and a switch frame including a pair of insulating plates for rotatably supporting said means, a mounting stem rigidly secured on said frame as the sole mounting means for said switch for mounting connection at a knock-out aperture or the like, a plurality of terminal and stationary brush units in said frame and spaced around the outside thereof with at least one of said units including a spacing member intermediate the frame plates, a plurality of independent terminal blocks stacked above one another on one side of said spacing member and over the length thereof, a stationary brush corresponding to each of said blocks, mounting means for mounting said terminal block and a corresponding stationary brush on said spacing member, with the terminal block at each of the opposite ends of said unit having an extension thereon for connection with an adjacent insulating frame plate for securing each of the frame plates to the respective end of said unit, and means for rotating said contact discs including actuating means at said mounting stem adapted for movement from a remote or an adjacent position.

13. An electric switch including a plurality of axially aligned contact discs, means for supporting said plurality of discs and a switch frame for supporting said means, a mounting stem rigidly secured in said frame as the sole mounting means

for said switch for mounting connection at a knock-out aperture or the like, circuit connecting means for said switch carried in said frame around the outside of said discs with at least one of said means including an insulated post carried in said frame, a plurality of independent terminal blocks rigidly mounted on said insulated post on one side thereof and corresponding stationary brushes electrically connected with said terminal blocks and corresponding in position therewith rigidly mounted on said post, and means for rotating said contact discs including a switch arm supported at said mounting stem and adapted for movement from any angular position with respect to said switch and from a remote or adjacent position.

14. An electric switch including a frame, a plurality of rotatable superimposed insulatingly separated contact discs, each of said discs having contact means thereon, a plurality of conducting assemblies mounted in said frame and positioned around said discs, brushes between said contact discs and said conducting assemblies, means on one of said conducting assemblies for making a single electrical conductor connection thereto common electrically to all of said contact discs, and terminal means on another of said conducting assemblies for receiving thereon electrical conductors corresponding in number to all of said contact discs, with said terminal means provided in a structure wherein each electrical conductor is electrically independent of each other electrical conductor at said terminal means and the contact disc corresponding to each electrical conductor.

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