May 29, 1956 J. L. ANDREWS 2,748,206

MULTIPLE ELECTRIC SWITCH FOR DOMESTIC RANGE

Filed Dec. 10, 1948 4 Sheets-Sheet 1

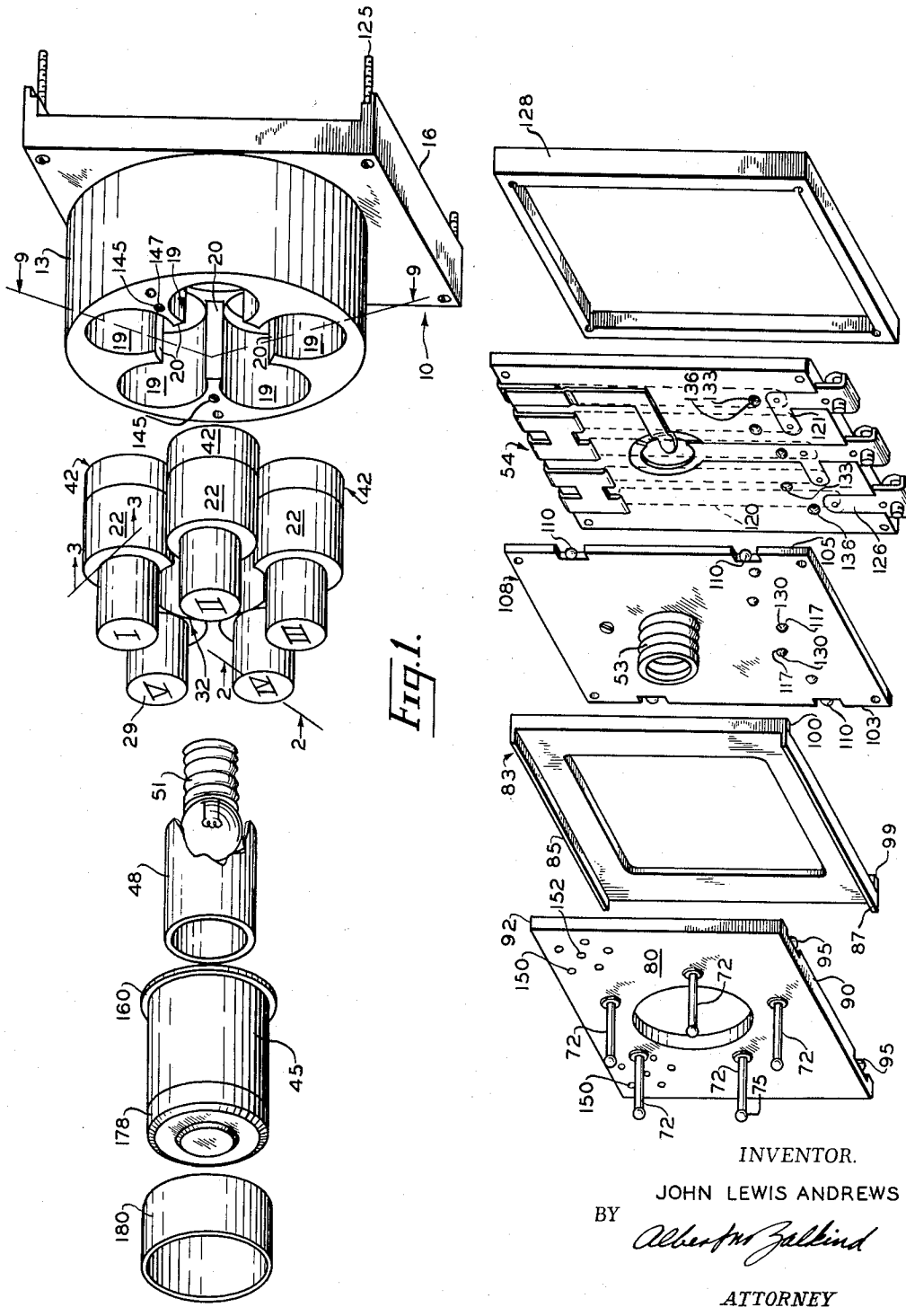


Fig. 1.

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MULTIPLE ELECTRIC SWITCH FOR DOMESTIC RANGE

Filed Dec. 10, 1948 4 Sheets-Sheet 2

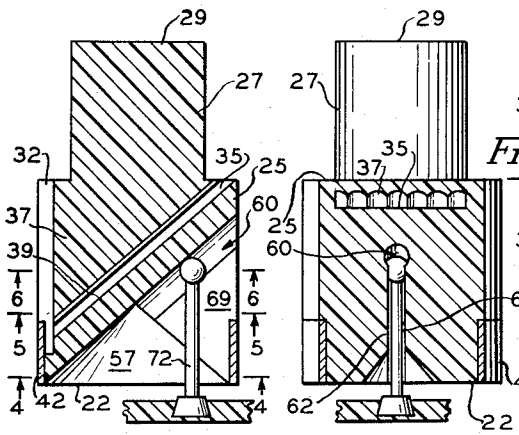


Fig. 2.

Fig. 3.

Fig. 4.

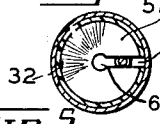
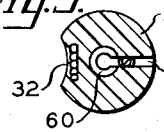


Fig. 5.



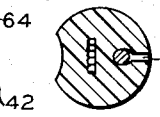


Fig. 6.

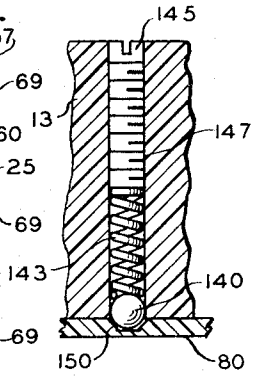


Fig. 7d.

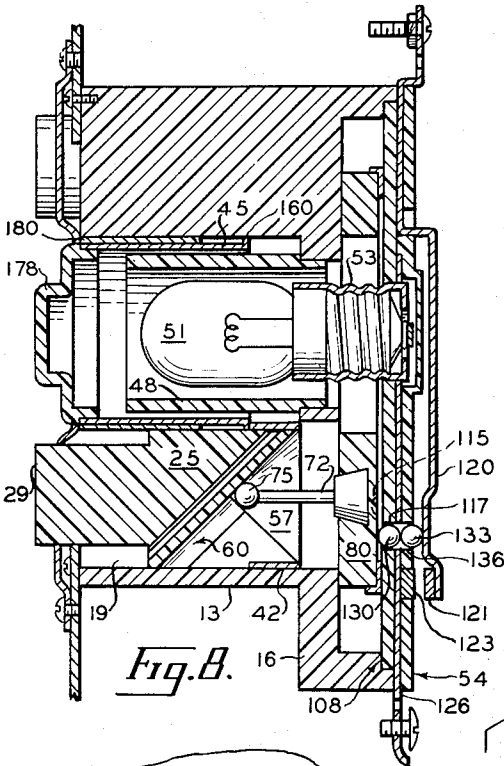


Fig. 8.

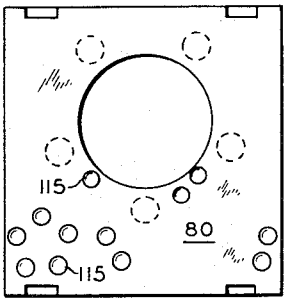


Fig. 7.

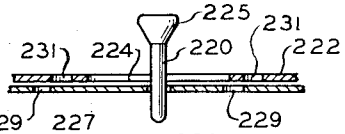


Fig. 13.

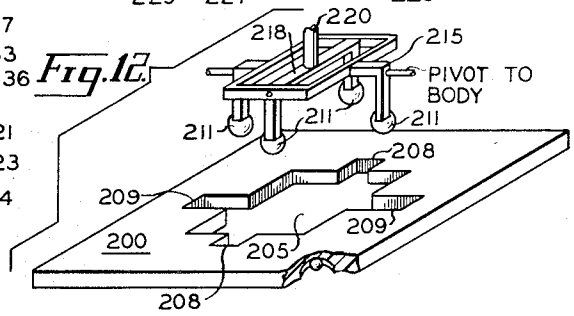


Fig. 12.

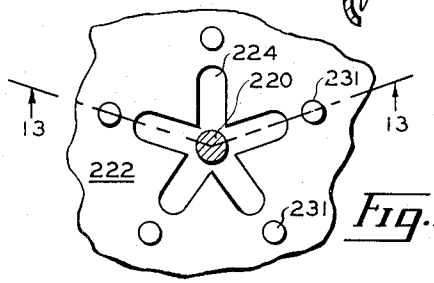


Fig. 14.

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MULTIPLE ELECTRIC SWITCH FOR DOMESTIC RANGE

Filed Dec. 10, 1948 4 Sheets-Sheet 3

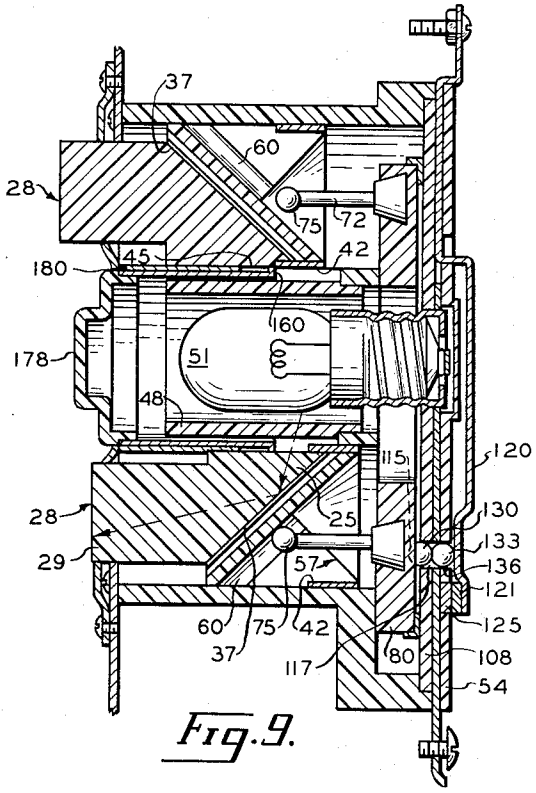


Fig. 9.

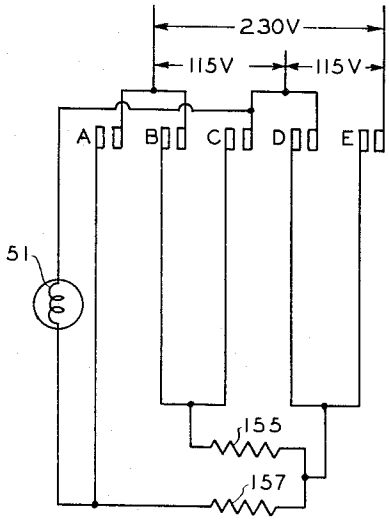


Fig. 10.

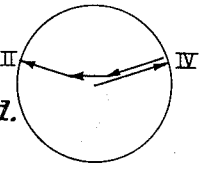


Fig. 11a.

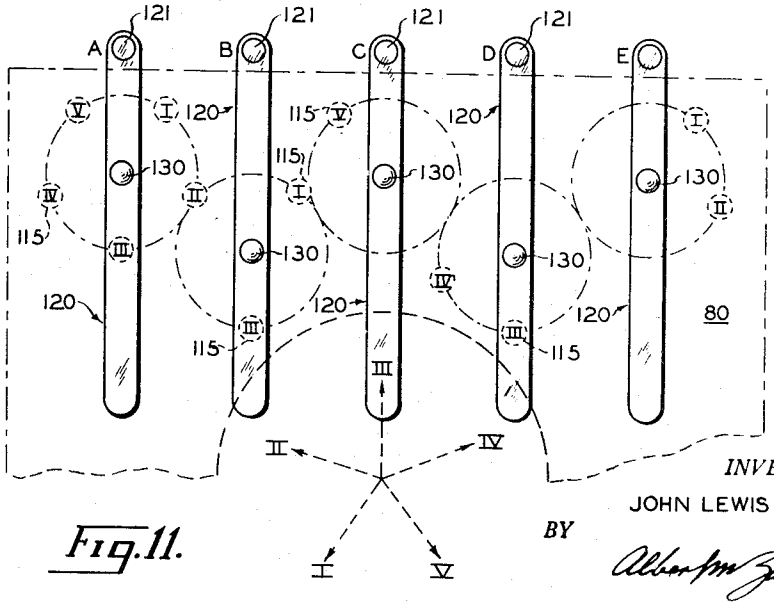


Fig. 11.

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May 29, 1956 J. L. ANDREWS 2,748,206

MULTIPLE ELECTRIC SWITCH FOR DOMESTIC RANGE

Filed Dec. 10, 1948 4 Sheets-Sheet 4

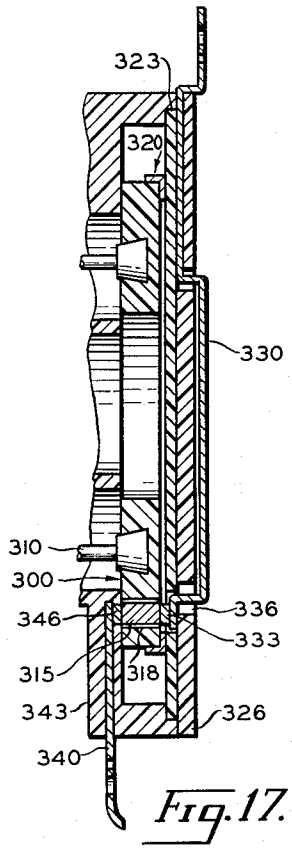


Fig. 17.

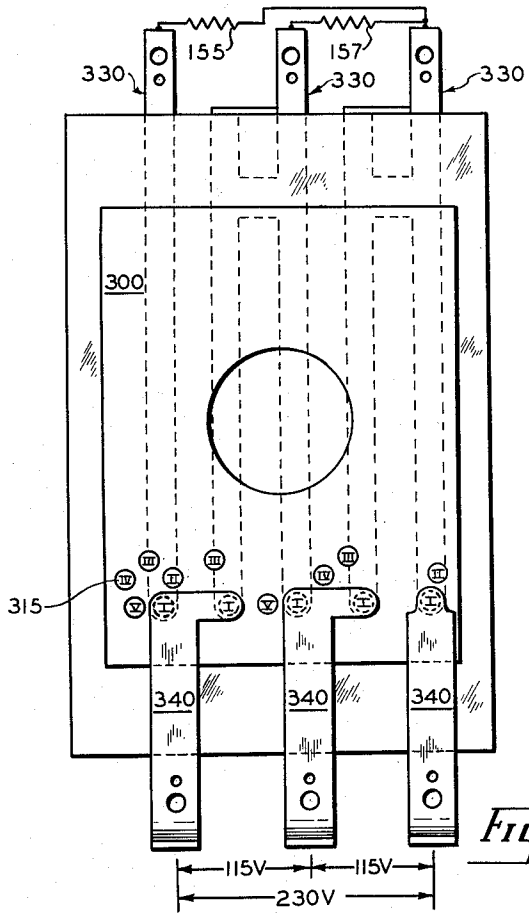


Fig. 18.

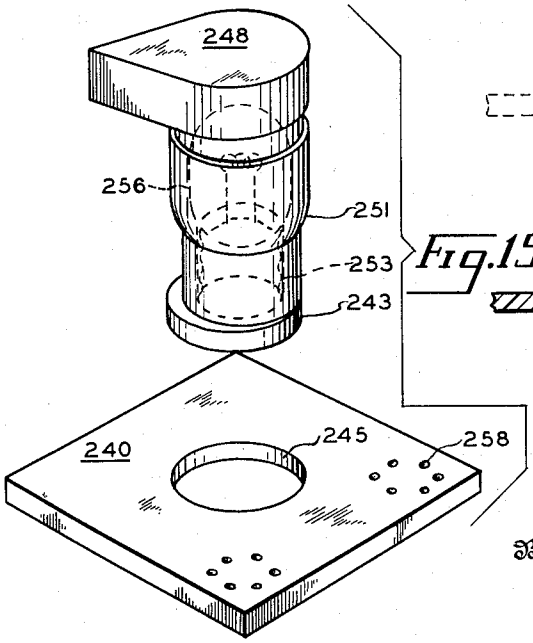


Fig. 15.

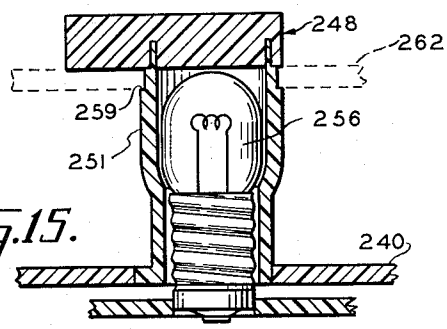


Fig. 16.

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United States Patent Office 2,748,206 Patented May 29, 1956

2,748,206

MULTIPLE ELECTRIC SWITCH FOR DOMESTIC RANGE

John Lewis Andrews, Fairfield, Ill.

Application December 10, 1948, Serial No. 64,481

31 Claims. (Cl. 200—5)

This invention relates to electric switches and more particularly to a multiple electric switch for making and breaking predetermined circuits comprising the resistance coils of a burner on an electric range, so as to provide a plurality of selective heats suitable for various types of cooking.

It is an object of my invention to provide a multiple switch structure which will be rugged, simple, and economical to manufacture.

It is another object of my invention to provide a multiple electric switch having a novel control scheme so as to eliminate any confusion on the part of an operator in selecting any desired heat.

It is a further object of my invention to provide a multiple switch which is mechanically balanced insofar as the physical forces exerted on respective parts are concerned and which has a smooth motion for all moving elements. It is an additional object of my invention to provide a multiple switch in which all parts are moving by a positive force without reliance on springs of any sort for return motion of the several manually displaceable elements.

It is a still further object of my invention to provide a multiple switch comprising a novel though simple signal or indicator system utilizing a source of illumination for indicating selective heats.

In general, I accomplish the objects of my invention by providing a plurality of transparent push buttons radially and slidably disposed in a body member, which body member carries a translatable actuator plate and a switch plate. The push buttons have reflector surfaces which coact with a source of light in such a manner that when any button is pushed inwardly with respect to the body member, a path is open for light rays from the light source to the reflector surface of that push button, the rays being reflected longitudinally thereof so as to be visible at the outer end of the button. Each button is interiorly provided with a cam surface for coacting with a respective cam follower carried by the actuator plate; the buttons are arranged so that their cam surfaces face in predetermined directions. A guide frame is employed to restrain or limit the plate to translational motion in any direction predetermined by the direction in which the cam surface of a selected push button faces. Accordingly, the actuator plate will be shifted in a direction determined by a selected push button. Additional elements are provided intermediate the actuator plate and the switch plate so that translational displacement of the actuator plate with respect to the relatively fixed switch plate in a particular direction is operative to open and/or close certain switches for setting up a desired circuit to produce a selected heat.

Objects and features of my invention not enumerated above will be made apparent by the following detailed description taken in conjunction with the appended drawings in which:

Figure 1 is an exploded view in perspective of the several elements of my device;

Figure 2 is a section through 2—2 of Figure 1;

Figure 3 is a section through 3—3 of Figure 1;

Figure 4 is a section on 4—4 of Figure 2, on a reduced scale;

Figure 5 is a section through 5—5 of Figure 2, on a reduced scale;

Figure 6 is a section through 6—6 of Figure 2, on a reduced scale;

Figure 7 is a view of the bottom of the actuator plate;

Figure 7–A shows details of an indexing means

Figure 8 is a cross sectional view of the assembled switch showing the condition wherein the pushbuttons are all in neutral position as exemplified by the single button illustrated.

Figure 9 is a section through 9—9 of Figure 1 and shows relative positions of a pair of push buttons when one of the circuits to the burner is made, it being understood that only that portion of the circuit exemplified by the closed contact shown in this figure is illustrated;

Figure 10 is the electrical layout for the several contact elements and the resistance coils of the burner;

Figure 11 is a view partially in phantom of the contact elements and the actuator plate, wherein is disclosed the several predetermined directions in which the actuator plate must translate in order to motivate pre-selected contact elements;

Figure 11*a* shows the path of motion of the actuator plate in shifting from one heat to another;

Figure 12 is a fragmentary exploded perspective view of a modified mechanism for displacing the actuator plate and constitutes an alternative means as contrasted with the push button arrangement;

Figure 13 is a fragmentary elevational view in cross section of certain of the elements of Figure 12;

Figure 14 is a fragmentary view in plan of certain elements of this modification;

Figure 15 is a perspective of the essential elements of another manual operating means for displacing the actuator plate in predetermined directions;

Figure 16 is a sectional view of certain of the elements shown in Figure 15;

Figure 17 is a section in elevation of a modified switch contact assembly; and,

Figure 18 is a plan of certain elements of the modified assembly.

With reference to Figures 1 through 11, and more particularly with reference to Figures 1 through 9, my invention comprises a body member generally indicated as **10**, of any suitable material, preferably a dielectric which may be moulded into a shape comprising a cylindrical housing **13**, and a base portion **16** (Fig. 1). The housing **13**, is provided with a plurality of bores **19**, radially disposed about the axis of the body member. Certain portions of the material forming the walls of the bores **19** is removed so that each bore is open toward the central axis and a number of arcuately faced ribs **20** are thus formed. A plurality of push buttons **22** are arranged so as to be manually slidable in respective bores **19**. By reference to Figs. 2 and 3, 8 and 9, it will be noted that each push button consists integrally of a slidable base portion **25** and an upper finger engaging portion **27**. The top surface **29**, of portion **27** is suitably engraved with indicia corresponding to the several heat stages, or "heats," in this instance being five, which are selectable by pressing the corresponding button.

The push buttons are preferably made of a transparent material and may be moulded in the form shown in Figures 2 thru 6. In moulding the push buttons a

portion of the material forming the cylindrical surface of the base 25, is omitted so as to provide an arcuate concavity 32, which forms with ribs 20, a complete circle when the buttons are inserted in bores 19. Further, a certain amount of material is omitted diagonally through the base portion 25, so as to form a relatively wide mouthed channel 35. The channel is preferably fluted as by flutes 37, at its upper portion, but may be substantially flat on its lower portion 39, as may be seen by comparing Figures 2 and 3. The fluted surface 37, acts as a reflector in such a manner that light rays emanating from the direction of the central axis of body member 13, in a manner to be hereinafter described, will be reflected upwardly from flutes 37, so as to be visible at the indicia carrying surfaces 29.

Each of the push buttons 22, is provided with a metallic shade band 42, fixed to the base thereof and having a predetermined length for coacting with a metallic shade band or sleeve 45 (Fig. 1) slidably arranged in housing 13. Band 45 is disposed about a translucent colored filter cylinder 48, which is in turn disposed about a lamp 51. The lamp is secured in a socket 53, carried by elements to be hereinafter described comprising a switch plate 54.

By referring to Figure 9, it will be seen that when one of the buttons is pushed inwardly a space is opened between respective band 42 and the central band 45 whereby light rays will have access through filter 48 into the base 25 via the arcuate portion 32, and thence to the fluted reflector surfaces 37 and then outwardly therefrom so as to be brightly visible to the operator at the respective surface 29. At this time the other surfaces 29 are dimly lit since some leakage of light is purposefully permitted to their respective reflector surfaces.

The light rays as indicated by broken arrows in the lower button of Figure 9, show generally the illumination effect just described.

No attempt has been made herein to accurately portray the precise paths for the rays since different transparent materials have different reflective and refractive characteristics.

It will be noted from Figure 9 that the upper button is in an outer position and that the inner edge of the central shade band 45, engages the outer edge of shade band 42, thus substantially cutting off light from that button except for a slight desired leakage as mentioned above. It should be further noted that the arcuate surfaces 20 and 32, are in slidably contiguity with shade band 45, for support thereof and whereby all the buttons are effectively keyed by band 45 against rotation and are accordingly limited to reciprocal motion in their respective bores 19.

With respect to Figures 2 thru 6, each button is interiorly provided with a conically shaped concavity 57, which may be provided in the moulding process.

Extending from the apex of concavity 57, substantially in the direction of an element of the cone and symmetrically disposed with respect to the reflector surfaces 37, is a slot 60. Slot 60 is substantially a cylindrical channel disposed in the direction of the cone element and extends to the surface of the base 25, and it is intersected by spaced walls 62 and 64 which form a triangular slot 69, somewhat narrower than the diameter of cylindrical slot 60. The slot 69, may extend to the surface of base 25 for convenience in moulding the button, although the bottom portion of slot 69 is closed by the shade band 42.

It should be noted that the formation comprising walls 62 and 64 to form slot 69, terminating in the cylindrical channel 60, is a manufacturing expedient desirable for proper moulding of the push button, but that insofar as the particular purpose of the invention is concerned the requisite formation of the interior of the push button requires only the conical concavity 57, the cylindrical channel 60 as an extended element of the cone, and such portion of slot 69 as is necessary to permit motion within

certain limits of a respective post 72, which coacts with the openings just described. Slots 60 are symmetrically arranged with respect to the central axis of body 10 and are disposed to face in predetermined and individual directions.

By referring to Figure 8, it will be seen that post 72 is provided at its outer end with a ball 75 or other spherical surface adapted to be slidably received in channel 60. The inner end of post 72 is preferably moulded in an actuator plate 80, of any suitable dielectric substance. By referring to Figure 1 it will be recognized that plate 80 carries a plurality of posts 72, which are adapted to coact with respective push buttons. Plate 80 is slidably disposed but limited to pure translational motion, as will be hereinafter made apparent.

The neutral or "off" positions of the push buttons are such that balls 75, are near the apices of cones 57 (Fig. 8). In this position the central sleeve 45, is in engagement with the button shade bands 42. At this time, as will hereinafter be made apparent, lamp 51 is not lit and all buttons are at the same position in bores 19.

If now a push button be pressed, the respective ball 75, will slide into the respective channel 60 and a force will be exerted on respective post 72, moving it downwardly with respect to the view shown on Figure 8. By comparing Figures 8 and 9 this movement will be apparent. Further, a particularly important aspect of the operation of my switch will also be apparent, namely, the outward propulsion of the upper push button (Fig. 9), by virtue of the motion of its respective post 72 caused by sliding of the plate 80 as the lower push button was pressed in. The displaced position of plate 80 is apparent on Figure 9 with reference to the central axis. Referring back to Figure 1 it will be noted that each button having a respective post 72, protruding therein, will experience an outward force exerted thereon when any one of the buttons is pushed in. In order for this effect to take place properly the actuator plate 80 must be provided with means constraining it to pure translational motion, as pointed out above and to be hereinafter described.

An important concept to grasp at this time is the effect of the conicity of concavity 57. Thus by comparing the upper and lower push buttons of Figure 9, it will be noted that ball 75 is now disposed in channel 60 of the lower button while ball 75 of the upper button appears contiguous with some portion of the conical surface, having been motivated to the new position by shifting of plate 80. If now the upper button of Figure 9 be pressed in, a certain point of the surface of concavity 57 will bear against ball 75 and induce propulsion thereof into the respective slot 60. Whence plate 80 will be translated and cause ball 75 in the lower button to recede out of its channel 60 and force the lower button to slide outwardly; the final position of lower ball 75 then being somewhere within the respective cone 57 and contiguous therewith at some point determined by the dimensions design of these several elements. It should be noted that the surfaces of cones 57 act on respective balls 75 by physical contact therewith, depending on the space positions of the balls at any particular time, so that the net effect is to ensure only one button being in the extreme inwardly pressed position at any one time.

It will now be appreciated that the channels 60 constitute cam surfaces and that the balls 75 constitute cam followers. Accordingly, by the construction thus described I have eliminated the use of return springs for the buttons, since upon any one button being pressed a positive force is exerted on the other buttons to drive them outwardly from the neutral position shown in Figure 8. Further, when it is desired to switch from one heat to another, a selected button may be pressed which will result in outward propulsion of that button which was previously pressed, all other buttons at that time being in or approximately in the outer position shown in Figure 9.

In some instances certain of the ball followers 75 may

not be in actual physical contact with their respective cone surfaces 57, owing to slight friction of the push buttons in their bores due to previously being biased outward and not completing full return. However, such condition is immaterial since whenever any button is pushed in it becomes the dominating element causing translation of plate 80 in a specific direction determined by the directional disposition of the respective slot 60.

Plate 80 is restrained from any twisting motion and is compelled to follow a purely transational path by virtue of a guide frame 83, having side flanges 85 and 87, arranged to slidably engage parallel outer edges 90 and 92 of plate 80 (Fig. 1). If desired ball bearings 95 may be socketed in cutouts in the edges 90 and 92 so as to insure easy sliding between plate 80 and the guide frame 83. Guide frame 83 is also provided with flanges 99 and 100, adapted for sliding engagement in contiguity with the edges 103 and 105 of a guide plate 108, comprised of dielectric substance. If desired ball bearings 110 carried in notches in the edges 103 and 105 may be utilized to provide easy relative sliding between guide frame 83 and plate 108. Thus it will be seen that due to the rectangular shapes of the plates 80, 108 and frame 83, whenever any force is exerted on any cam follower 75 such force will be transmitted to the actuator plate 80 which is restricted to motion in the direction of flanges 85 and 87 or flanges 99 and 100, or as in the present case with five buttons, some combination of both directions. Accordingly, although actuator plate 80 can move in any particular direction it can do so only by pure translation and must always remain parallel to itself in relation to its edges in shifting from one position to the next.

The guide frame 83 may be comprised of sheet metal and is open at its central portion to permit substantial contiguity therethrough between the bottom surface of actuator plate 80 and the upper surface of plate 108. Actuator plate 80 is provided with a central opening so as not to interfere with the lamp socket 53, which is carried by plate 108.

With reference to Figure 7, the bottom surface of actuator 80 is provided with a plurality of conical pockets 115, there being twelve such pockets in the present instance arranged in a predetermined manner. Plate 108 is provided with a plurality of bores 117 therethrough, there being 5 in number in the present instance. The switch plate 54, carries a plurality of resilient metallic strips 120 there being 5 in number in this instance, as indicated by the dotted lines in Figure 1, each of which strips terminates in a contact button 121. Various metallic conductors are also carried by the switch plate, and the conductor and resilient strips assembly is sandwiched between plates 54 and 108 in assembling the switch; certain conductors being provided to bring current to lamp socket 53 in the manner shown. In general, the resilient strips and conductors are secured to plate 54 by having portions bent into and through slots in the plate, pressure against plate 108 serving to fixedly hold the bent portions in place. Strips 120 are disposed and thus secured on the outer face of plate 54.

Contact buttons 123 which form pairs with respective contacts 121, are carried by relatively fixed conductors 126. Thus switches are effected; and certain switches are connected together by virtue of bridging of certain of the metallic strips (Fig. 10).

The assembly of members 16, 80, 83, 108 and 54 is completed by means of four bolts 125 extending from base 16 and through plates 108 and 54 into a cover plate 128, thereby holding all of the members fixed with respect to each other (Fig. 1).

As best seen on Figures 8 and 9 the bores 117 in plate 108 have balls 130 provided therein. These balls engage additional balls 133, which are held in bores 136 of switch plate 54, and engage respective resilient strips 120.

When the switch is in neutral or "off" position actuator plate 80 is in position centrally so that balls 130 bear against the under surface thereof and are pressed against respective balls 133, which in turn flex their respective spring elements 120 outwardly to maintain the normal "no contact" relationship between contacts 121 and 123 (Fig. 8). On the other hand, in Figure 9, plate 80 has been shifted to such a position that a ball 130 is accommodated within a pocket 115 on the underside of plate 80, thus permitting closure between contacts 121 and 123, due to the movement of strip 120 in returning to non-flexed condition.

As understood from the foregoing, by depressing any selected push button, a definite direction of translational displacement of actuator plate 80 will take place. This is assured by the fact that the cam surfaces of the channels 60 face in certain predetermined positions. In this case the arrangement is pentagonal in aspect in order to provide a symmetrical arrangement for selection of any one of five heats, wherein certain circuits are set up by opening and/or closing of certain contact pairs to achieve respective heats. However, it should be appreciated at this time that for any number of heats other than five a corresponding number of buttons would be utilized, of at least three in number to exploit the principle of the present invention, and wherein the surfaces thereof would be symmetrically disposed to face in predetermined directions, although it will be understood that the buttons may not be radially arranged but could be oriented in some other pattern, for example, linearly.

Thus pressing any selected button in the present embodiment, will cause translation of actuator plate 80 in a predetermined direction so as to bring certain of the pockets 115, over certain of the balls 117, thus permitting engagement of respective contact pairs to set up a predetermined circuit. In order to hold the plate 80 in a selective displaced position indexing means is utilized as shown in Figure 7–A. The indexing means is duplicated in character and comprises in each instance a ball detent 140, biased against the plate 80, by a spring 143, the compression of which is made adjustable by a set screw 145. Elements 140, 143 and 145 are carried in a bore 147, in body portion 13 and balls 140 are arranged to be socketed in conical pockets 150 in the upper surface of plate 80, when the plate has reached a predetermined position corresponding to a selected heat. Pocket 152 is for "off" position.

The pockets 150, are arranged in two pentagonal groups on each side of the plate 80, whereby the pressure on the plate caused by the openings 143, is balanced to insure a smooth sliding action.

The particular manner in which translational displacement of plate 80 effects opening and/or closing of selected contact pairs will now be described in conjunction with Figures 10 and 11, wherein the contact pairs are for simplicity designated as A, B, C, D and E. Figure 10 shows an electrical diagram comprising the contact pairs and resistance coils 155 and 157 of a burner. The five heats provided for by my switch are effected by placing the coils in various series or parallel circuit combinations and impressing thereon either 115 or 230 volt line currents. Thus, for first heat, contact pairs A, B, E are closed, which places both coils in parallel across the 230 volt lines. Second heat is achieved by closing contact pairs A and E whereby coil 157 is across the 230 volt line. Third heat is obtained by closing contact pairs A, B and D whence both coils are in parallel and impressed with 115 volts. Fourth heat is effected by closing contact pairs A and D when coil 157 is impressed with 115 volts. Fifth heat is obtained by closing pairs A and C thereby placing both coils in series on 115 volts.

With reference now to Figure 11 the normal or open contact condition of the switch is depicted and it will be seen that the balls 130 shown in conjunction with their respective resilient strips 120 are all free from engagement in any of the pockets 115 of actuator plate 80.

Thus the condition for each contact pair and its respective balls is disclosed on Figure 8. When, however, plate 80 is shifted by pressing a selected button, its translational motion follows the direction of one of the arrows indicated in Figure 11 to bring certain pockets 115 over certain of the balls 130, whence such balls 130 are pressed into those pockets by the respective resilient strips 120, thus permitting closure of respective contact pairs. For example, assuming that the fourth heat has been selected the operator would press button number IV of Figure 1, shifting plate 80 in the direction of the arrow indicating the fourth heat as shown on Figure 11. Whereon plate 80 having shifted in the direction of arrow IV the respective pockets 115 (designated by Roman numeral IV) would be aligned with ball pairs 130—133 of contact pairs A and D, and the contact pairs would close. In like manner various combinations of closure of the contact pairs may be accomplished by selective directional displacement of plate 80.

It will be observed at this time that the pockets 115 are all disposed at selected corners of pentagons, there being one pentagon for each contact pair. Thus for contact pair A all points on the respective pentagon are provided with pockets 115, whereas for contact pair B pockets 115 are provided only for the first and third heats, and so on. It should be particularly noted however, that the use of a pentagon for layout predetermining the number of translational displacements of this particular switch is determined only by the fact that five heats are provided for. In other words, the fact that there happens to be five spring leaves (and five contact pairs) in this particular embodiment is a matter of coincidence. Thus, in designing a switch for any desired number of heats the translational displacement paths provided for actuator plate 80 will lie along lines from the center of a polygon to the corners thereof; a triangle being used for a three heat switch, a square or rectangle for a four heat switch, a hexagon for a six heat switch and so on.

An additional observation may now be made to the effect that when all the buttons are in the neutral position of Figure 8 wherein all the buttons are substantially in mid position with respect to their respective bores 19, pressure on a selected button will effect pure radial movement of plate 80. In other words, the plate moves in the direction of a line joining the center of the pentagonal pattern of the indexing pockets 115 with one of the corners of that pentagon. The same direction is taken with respect to the pentagonal groups of pockets 115 associated with contact pair A of Figure 11. After this heat has been selected, however, and the relative button positions taken as illustrated in Figure 9, should it be desired to change to some other heat this specific path of motion of plate 80 will be radial in the reversed direction but plate 80 will not traverse the entire distance back to the neutral position of Figure 8, but will at some point in the reverse radial motion move tranversely to the radial line corresponding to the subsequently selected heat and then along that radial line to final position. The motions involved are generally illustrated in Figure 11*a*.

An important and unique aspect in designing a switch for operation in accordance with my teaching is to have the centers of the posts or cam followers 75 spotted on a circle having a diameter slightly smaller by a fraction of an inch than the circle on which the centers of the push buttons are spotted. This will be understood from inspection of Figure 8 showing the neutral position whereat any ball 75, is in readiness to enter its respective slot 60, but remains outside of that slot in order not to impede the simultaneous motion required of the push buttons when a selected button is pressed. By laying out the pitch circles so as to be unequal as described above errors due to tolerances and looseness are avoided. Thus a smooth acting non-jamming mechanism is assured since all cam followers 75, are compelled to be out of their respective slot 60 at the time any push button is pressed.

Means are provided for positively returning all buttons to the neutral or "off" position of Figure 8, which means consists of a flange 160 on the shade band 45 and a closure dome 178, of translucent material. While shade band 45, has heretofore been described as forming an element of the illumination system of my switch, it also is utilized as an "off" push button in the sense that flange 160 is simultaneously engageable with the shade bands 42, of the push buttons. Thus by comparing Figures 8 and 9 it will be seen that when sleeve 45, is pushed in manually by finger pressure on dome 178, flange 160 will positively return, by engagement with the respective shade bands 42, all push buttons which are in the outer position back to the midway or neutral position and this action causes the push buttons so affected to displace plate 80 which in return through the respective post 72 and follower 75 effects outward motion of the push button which happens to be in the "on" or inner position. Thus all push buttons are restored to neutral upon pressing dome 178. Accordingly, all current is turned off and lamp 51, is dark.

Translucent dome 178, and filter 48, are held in place by manual force fits, so that should the lamp 51 require replacement, ready access may be had thereto.

Intermediate the shade band 45 and those surfaces of the housing which support it may be placed a bearing sleeve 180, which has a force fit in the body with ribs 20. While this bearing sleeve is not essential it is considered to be a matter of good design to prevent wear on ribs 20, and also serves as a stop member to limit outward movement of sleeve 45, since flange 160 is engageable with the inner edge of sleeve 180 in maximum outer position of the sleeve 45.

In the form shown in Figures 12–14 a modification of the actuator means is shown which is alternative to the use of buttons for displacing plate 80. In the modification, which is shown fragmentarily, an actuator plate 200, is utilized which is in all respects similar to plate 80 previously described except for the rectangularly arranged cut out area 205. The cut out area is provided with pairs of slots 208 and 209, adapted to accommodate ball ends 211 of a universal joint type of actuator comprising a frame 215, intended to be pivoted to the switch body and a frame 218 pivoted within frame 215. A handle element 220, is secured to frame 218 whereby the frames can be actuated in any direction so as to motivate plate 200 in any direction. Slots 209 which coact with frame 215 may be made larger than the other slots 208, to permit the greater freedom of movement required for the larger frame.

As shown in Figure 13, the handle element 220 extends outwardly of a guide plate 222, and terminates in a knob 225, for convenience in operation. Guide plate 222 is provided with pentagonally arranged slots 224, corresponding to the five heat positions required. Thus pure translational motion of plate 200 may be achieved by suitably actuating handle 220, into a selected slot 224. In this modification the guide frame element 83, of the previous form of the invention is eliminated. An aperture plate 227 having apertures 229 may be utilized below plate 222; the aperture plate is adapted to slide in the direction chosen by handle 220 which passes loosely through it. By providing apertures 231, in plate 222, it will be understood that for any selected heat a pair of apertures 229—231 may be aligned for transmission of light from any suitably provided light source (not shown).

Figures 15 and 16 illustrate a further modification of means for shifting an actuator plate 240, comprising a cam 243, adapted to rotate in an aperture 245, in plate 240. A translucent moulded knob 248 is provided which is carried by a moulded member 251. The member 251 carries a lamp socket 253, and a lamp 256, and is secured to cam 243. As shown in Figure 16 a shoulder 259 is

provided on member 251 for engagement with an escutcheon plate 262 suitably secured to a panel on the stove (not shown). Thus it will be understood that when handle 248 is rotated cam 243, will displace plate 240 to some final position depending on the selected position of the handle for a desired heat.

In this modification motion of the actuator plate 240, will not proceed directly from one circuit to another since owing to the rotary motion of cam 243 it will be necessary to momentarily pass, in some instances, through one or more heat stages to arrive at a desired heat. This is not considered a serious drawback and in fact is typical of many rotary switches shown in the prior art.

Further, no central position is possible for plate 240 whereat all circuits are deenergized. Accordingly, an off position for the switch can be effected by contriving a hexagonal displacement pattern for plate 240, i. e., for a five heat switch. Thus the sixth position of plate 240 is one of the corners of the hexagon and is the neutral or "off" position.

Whence, the indexing pockets 258 in two groups on plate 240 are at the corners of hexagonal groups and it will be understood that pockets provided on the under side of plate 240, for accommodation of the contact balls, will be arranged in hexagonal patterns as contrasted with the pentagonal patterns as illustrated in Figure 11.

Figures 17 and 18 show a modified switch assembly which may be used in a switch constructed in accordance with the principles disclosed above, i. e., in conjunction with a translatable actuator plate and a manual operator for displacing the plate in predetermined directions. In the modification, an actuator plate 300, is utilized having posts 310, operable in any manner hereinabove disclosed for shifting the plate by translational motion.

Plate 300 is provided with slidable metallic plugs 315 arranged in boxes 318 according to the patterns shown in Figure 11 for the spherical pockets 115. A guide frame 320, and guide plate 323 are provided operative in a manner heretofore described for elements 83 and 108 of Figure 1. A switch plate 326 carries a plurality of spring leaves 330 which carry contact buttons 333 that protrude into bores 336 of plate 323. Bores 336 are aligned across the plate for simplicity. A plurality of conductors 340 are provided which are moulded into the casing 343 and carry contact buttons 346.

From the above description it will be evident that displacement of plate 300 in a manner heretofore described will effect continuity between predetermined contact pairs 333—346 through one or more of the metallic plugs 315. Figure 18 shows the electrical connections suitable for this modification, coils 155 and 157 being represented. For the position of plate 300 in Figure 18, the circuit for the first heat has been completed.

It will be apparent that many changes and modifications are possible for the structure shown herein and I do not intend to limit myself to the specific illustrations given except as set forth in the appended claims.

I claim:

1. A multiple electric switch comprising a body member, a plurality of push buttons slidably supported by said body member, an actuator plate slidably disposed for motion in at least three directions on said body member, and a plurality of posts carried by said plate, each of said buttons having a cam surface disposed to selectively engage a respective post when pressed, said cam surfaces being disposed to face in predetermined relatively radially arranged directions whereby said plate will be shifted in a corresponding direction by pressure on a selected button, and means including contact members actuatable by said plate to control electric circuits.

2. A multiple electric switch comprising a plurality of at least three manually operable push buttons peripherally arranged about a central axis, a plate, body means supporting said buttons for movement towards said plate and means in said body supporting said plate for sliding movement in radial directions with respect to said central axis, cams and cam followers operatively disposed between respective buttons and corresponding portions of said plate, said cams having cam surfaces, said surfaces facing in different radial directions corresponding to the peripheral disposition of respective buttons and being engageable with respective cam followers, whereby manual operation of any button is effective to displace said plate in a radial direction corresponding to the peripheral disposition of said button, and means including contact elements operable selectively in response to directional displacement of said plate to control electric circuits.

3. A multiple electric switch comprising a body member, a plate slidably carried by said body member, means carried by said body member for constraining said plate to translational displacement, manually actuatable means for slidably displacing said plate in at least three predetermined selective radial directions with respect to an axis normal thereto and fixed with respect to said body member, and means including contact elements selectively operable by said plate as determined by directional displacement thereof for controlling electric circuits, including indexing means comprising a plurality of pockets in one face of said plate grouped in a configuration corresponding to the predetermined radial directions of translation of said plate, and a resilient detent means engageable with said pockets to hold said plate in a selected position.

4. In a switch as set forth in claim 3, including an additional group of pockets and resilient detent means therefore, said two groups being spaced apart to effect a balanced holding condition on said plate.

5. In a multiple switch, a body member, an actuator plate carried slidably thereby, a guide frame in said body member in which said actuator plate is arranged to slide, a guide plate carried by said body member and fixedly secured thereto, said guide frame being adapted to slide on said guide plate, means carried by said guide frame for restraining said actuator plate to sliding motion in a single direction relative said guide frame, means carried by said guide frame restraining the relative motion between said guide frame and said guide plate to a direction at right angles to the motion provided between said actuator plate and said guide frame, manually operable selective means for displacing said actuator plate in any one of at least three predetermined directions, and means including contact elements operable selectively by displacement of said actuator plate in predetermined directions to control respective electric circuits.

6. In a multiple switch, a body member, an actuator plate carried slidably thereby, a guide frame in said body member on which said actuator plate is arranged to slide, a guide plate carried by said body member and fixedly secured thereto, said guide frame being slidably disposed on said guide plate, means for limiting said actuator plate to reciprocal sliding motion in a single direction relative said guide frame, means limiting the relative sliding motion between said guide frame and said guide plate to a direction substantially perpendicular to the direction of motion provided between said actuator plate and said guide frame, manually operable selective means for displacing said actuator plate in any one of at least three predetermined directions, and means including contact elements operable selectively by displacement of said actuator plate in predetermined directions to control respective electric circuits.

7. In a multiple switch as set forth in claim 6, wherein said actuator plate comprises a substantially rectangular member and said guide plate comprises a substantially rectangular member, and said guide frame comprises a substantially rectangular member, intermediate said plates, and wherein said means for limiting relative motion between said actuator plate and said guide frame comprises flanges carried by said guide frame on two parallel edges thereof arranged to slidingly engage corresponding edges of said actuator plate, and wherein said means for limit-

ing relative motion between said guide frame and said guide plate comprises additional flanges carried by the other two edges of said guide frame and reversely disposed with respect to said other two flanges and being arranged to slidably engage corresponding edges of said guide plate.

8. In a multiple switch, a body member, an actuator plate carried slidably thereby, means in said body member for constraining said actuator plate to translational displacement, manually operable selective means for displacing said actuator plate in any one of at least three predetermined directions, and means including contact elements operable selectively by displacement of said actuator plate in respective directions to control respective electric circuits, wherein said latter means comprises a plate fixedly secured to said body member, a plurality of bores in said plate, said contact elements being arranged on one side of said plate and having spring leaves accessible through said bores, means in said bores slidably carried thereby for engaging respective spring leaves on one side of said plate, said spring leaves having sufficient resilience to force said engaging means outwardly of the other side of said plate so as to protrude from the surface thereof, said actuator plate being adapted for sliding engagement on said fixed plate, and pockets in the contiguous surface of said actuator plate arranged to accommodate the protruding ends of certain of said spring engaging members when said actuator plate is displaced in a predetermined direction.

9. In a multiple switch, a body member, an actuator plate carried thereby, a fixed plate within said body member having a face on which said actuator plate is arranged to slide, means for constraining said actuator plate to translational displacement with respect to said fixed plate, manually operable selective means for displacing said actuator plate in any one of at least three predetermined directions, a plurality of bores in said fixed plate, a plurality of resilient spring leaves disposed on the opposite face of said fixed plate and associated with respective bores, means slidably carried in respective bores and engageable with respective leaves, and means carried by a contiguous surface of said actuator plate and selectively engagable with certain of said leaf engaging means upon displacement of said actuator plate in a predetermined direction to effect movement of said leaves, including contact means carried by said spring leaves for effecting control of electric circuits upon movement of predetermined leaves.

10. A multiple electric switch comprising a plurality of at least three push buttons and a movable actuator plate, means for supporting said buttons for manual reciprocation with respect to the plane of said plate, means for supporting said plate for reciprocation in its own plane in at least three predetermined directions, including cam and cam follower means operatively disposed intermediate said buttons and said plate, said cams having cam surfaces disposed so as to face in said three predetermined directions and being selectively engageable with respective cam followers by selective manual reciprocation of said push buttons, whereby manual pressure on a selected button operates to shift said plate in a predetermined direction, and means including contact elements selectively actuable by shifting of said plate in said predetermined directions to control electric circuits, wherein said push buttons are radially arranged about a central axis and spaced therefrom, said buttons having channels provided longitudinally on the exterior surfaces thereof and being disposed so that said channels face said central axis, and means encompassing said central axis and engaging said channels so as to key said buttons against rotation about their own axes, said key means being slidably disposed with respect to said buttons, and abutment means carried by said key means and engagable with abutment means provided on said buttons and operable to simultaneously actuate said buttons to a neutral position whereat said actuator plate is centrally disposed with respect to the axes of said buttons.

11. A multiple electric switch comprising a body member, a plurality of push buttons slidably supported by said body member, an actuator plate slidably disposed on said body member, and a plurality of posts carried by said plate, each of said buttons having a cam surface disposed to selectively engage a respective post when pressed, said cam surfaces being disposed to face in predetermined directions whereby said plate will be shifted in a corresponding direction by pressure on a selected button, and means including contact members actuatable by said plate to control electric circuits, wherein each of said buttons is provided with a conical concavity at one end thereof, each post protruding into a concavity and extending substantially to the apex of the respective cone, said cam surface in each push button comprising a channel within the body thereof and being disposed as an element of the cone therein and extending outwardly from the apex thereof, the free end of each post being engageable at all times with a respective channel or with the surface of a respective cone.

12. A multiple electric switch comprising a body member, a plurality of push buttons slidably supported by said body member, an actuator plate slidably disposed on said body member, and a plurality of posts carried by said plate, each of said buttons having a cam surface disposed to selectively engage a respective post when pressed, said cam surfaces being disposed to face in predetermined directions whereby said plate will be shifted in a corresponding direction by pressure on a selected button, and means including contact members actuatable by said plate to control electric circuits, wherein said push buttons are disposed peripherally about a central axis which is fixed with respect to said body member, said posts being arranged peripherally on said actuator plate, each of said buttons being provided with a conical concavity at one end thereof into which respective posts protrude substantially to the apex of respective concavities, said cam surfaces being disposed as elements of respective cones and extending outwardly of the apices thereof, wherein said buttons have individual axes disposed on a circle of diameter unequal to the diameter of the circle on which the axes of the posts are disposed.

13. In a multiple switch, a body member, an actuator plate, a fixed plate, said plates being carried by said body member and said actuator plate being slidably disposed with respect to said fixed plate, means in said body member for limiting said actuator plate to translational displacement, manually operable selective means for displacing said actuator plate in any one of the directions determined by the corners of a polygon, a plurality of control means carried by the actuator plate, a plurality of control means carried by said fixed plate, said two groups of means being alignable selectively by displacement of said actuator plate, for effecting control of predetermined electric circuits, wherein the means carried by said actuator plate are disposed thereon as selected corners of a plurality of polygons similar to the polygon of motion of said actuator plate and wherein said plurality of polygons is equal in number to the number of means carried by said fixed plate.

14. In a multiple switch, a body member, an actuator plate carried slidably thereby, means in said body for constraining said actuator plate to translational displacement, manually operable selective means for displacing said actuator plate in any one of at least three predetermined directions, and means including contact elements operable selectively by displacement of said actuator plate in respective directions to control respective electric circuits, wherein said manually operable means comprises a cam rotatively disposed with respect to said body member and follower means carried by said actu-

ator plate and operatively engagable by said cam, whereby manual rotation of said cam is effective to displace said actuator plate to a final position corresponding to any one of said predetermined directions.

15. In a multiple switch, a body member, an actuator plate carried slidably thereby and movable in any one of at least three predetermined directions, means including contact elements operable selectively by displacement of said actuator plate in any one of said three predetermined directions to control respective electric circuits, and manually operable means for displacing said actuator plate by translational motion comprising a universal joint, including a manually operable handle and elements directly movable thereby in any selected direction, there being respective co-acting elements carried by said actuator plate, so as to effect motion of said actuator plate in the line of motion of said handle.

16. A motion transmitting device comprising a plurality of at least three push elements, said elements being arranged in a circular arc and disposed for motion in respective paths parallel to the axis of said circular arc and each of said elements carrying a cam surface, said cam surfaces being relatively oriented in predetermined radial directions, an actuatable element supported for multi-directional motion in a plane at an angle to said paths, the degree of angularity between said cam surface and said plane of motion of said plate being less than 90° and a plurality of cam follower elements carried by said actuatable element and slidably engageable with respective cam surfaces, whereby a force exerted on any of said push elements is operative to move said actuatable element in a direction determined by the facing direction of the respective cam surface.

17. A control device comprising a push button arranged for axial reciprocation in a fixed path, said push button being provided with a cam surface substantially enclosed in the body thereof at an angle to said path of reciprocation, said button having an end provided with an axial opening leading to said cam surface, said opening being flared outwardly toward said end and terminating at its smaller end adjacent said cam surface within the interior of said button, walls of the cavity formed by said opening comprising an additional cam surface merging into said first cam surface.

18. A control device comprising a push button arranged for axial reciprocation in a fixed path, said push button being provided with a cam surface in the body thereof at an angle to said path of reciprocation, said button having an end provided with an axial opening leading to said cam surface, said opening being flared outwardly toward said end and terminating toward its smaller end adjacent said cam surface, including a cam follower element comprising a post, extending longitudinally into said opening and comprising an upper terminal slidably engageable with said cam surface, and means for restraining said post to motion parallel to itself.

19. A control device comprising a push button arranged for axial reciprocation in a fixed path, said push button being provided with a cam surface in the body thereof at an angle to said path of reciprocation, said button having an end provided with an axial opening leading to said surface, said opening being flared outwardly toward said end and terminating in its smaller end adjacent said cam surface, including a cam follower element comprising a post extending longitudinally into said opening and comprising an upper terminal slidably engageable with said cam surface, and means for restraining said post to motion parallel to itself, wherein said opening is conically shaped as a surface of revolution, and a slot in said push button for slidably accommodating said post, said slot being co-planar with and leading to said cam surface and also to said conical opening, whereby said post may be moved in any direction parallel to itself when the upper terminal thereof engages the surface of said conical opening, but is restrained to motion in the plane of said slot when disposed therein, wherein a force extended axially on said push button is operative to actuate said post, the upper terminal thereof being displaced by the axial motion of the conical wall of said opening in a direction substantially normal to the applied pressure on said button, whence said post end is brought into sliding engagement with said cam surface upon reaching the apex of said conical opening, and thereafter slides in said slot upon continued pressure being applied to said push button, to thus effect a predetermined positioning of said post depending upon the direction of the plane containing said cam surface and said slot.

20. A multiple electric switch comprising a body member, an actuator plate slidably disposed on said body member for motion in a plurality of directions in the same plane, a plurality of elements secured to said plate and extending substantially perpendicular thereto, individual push button means associated with respective elements for exerting a thrust thereon having a force component in the plane of motion of said plate, and in a respective predetermined direction, and electrical contact means selectively actuatable by motion of said plate in said predetermined directions responsive to selective operation of said push buttons including means for restoring said push buttons simultaneously to neutral positions by engagement with certain of said buttons to effect movement of said plate, whereby a position restoring force is transmitted to others of said buttons through said elements.

21. A switch as set forth in claim 20, wherein said push buttons are reciprocal in paths normal to said plate, including cam surfaces carried by said push button engageable with respective elements carried by said plate.

22. In a multiple switch, an actuator plate, means supporting said plate for motion in a plurality of selective directions which are radially disposed with respect to a fixed axis, a plurality of push buttons arranged arcuately about said axis, cam means interiorly of said buttons comprising respective cam surfaces having portions facing radially relative said axis and portions arcuately disposed within each button and merging with the respective radially facing surface therein, and switch contact means operable selectively in response to motion of said plate as determined by selective operation of said buttons.

23. In a multiple switch, a body member, an actuator plate movably supported thereon, means in said body member for constraining said actuator plate to translational displacement, circularly arranged and manually opearble selective means for displacing said actuator plate to any one of at least three predetermined positions along paths having components which are radial and chordal with respect to the axis of the circular arrangement of the selector means, and means including contact elements operable selectively by displacement of said actuator plate in respective directions to control respective electric circuits, said selective means comprising a plurality of push buttons each having a respective cam surface facing radially toward said axis.

24. In a multiple switch, a body member, an actuator plate movably supported thereon, means in said body member for constraining said actuator plate to translational displacement, circularly arranged and manually operable selective means for displacing said actuator plate to any one of at least three predetermined positions along paths having components which are radial and chordal with respect to the axis of the circular arrangement of the selector means, and means including contact elements operable selectively by displacement of said actuator plate in respective directions to control respective electric circuits, said selective means comprising a plurality of push buttons each having an internal conically shaped cavity, the walls of which effect a cam surface.

25. In a multiple switch, a body member, an actuator plate movably supported thereon, means in said body

member for constraining said actuator plate to translational displacement, circularly arranged and manually operable selective means for displacing said actuator plate to any one of at least three predetermined positions along paths having components which are radial and chordal with respect to the axis of the circular arrangement of the selector means, and means including contact elements operable selectively by displacement of said actuator plate in respective directions to control respective electric circuits, said selective means comprising a plurality of push buttons each having a respective cam surface facing radially toward said axis and also having an internal conically shaped cavity the walls of which effect a cam surface, the radially facing cam surface of each button merging into walls of the conically shaped cam surface therein.

26. A multiple electric switch comprising a body member, a switch actuating plate slidably carried by said body member, means intermediate said body member and said switch actuating plate for constraining said plate to translational displacement wherein said means comprises a guide plate slidable in one direction relative said switch actuating plate and in a perpendicular direction relative said body member, including manually actuatable means for displacing said switch actuating plate in at least three predetermined selective directions.

27. A multiple switch comprising a body member, a plurality of selectively operable push buttons, an actuator element, means intermediate said push buttons and said actuator plate to effect motion of said element in a predetermined direction responsive to operation of a selected push button and means for ensuring that said motion is translational comprising a single plate-like guide element disposed intermediate said actuator element and said body member and translationally slidable relative to said actuator element and to said body member in respective directions which are angularly related to each other.

28. A switch as set forth in claim 27, including coacting slidably engaged restraining means intermediate said body member and said guide element, and additional coacting slidably engaged restraining means intermediate said guide element and said actuator element, each of said means being operative to respectively restrain motion of said actuator element to one of said directions relative said body member.

29. A multiple switch comprising a switch body having a plurality of apertures, a plurality of manually operable push buttons accommodated in respective apertures, cam surfaces provided within the interior of said push buttons, followers actuatable by said cam surfaces upon depressing a respective selected push button to effect a switching operation, said followers protruding inwardly into at least two of said push buttons to engage respective cam surfaces therein, said followers and surfaces being arranged so that when either of said two push buttons has been depressed from an initial position to a depressed position it will be motivated through the respective follower and cam surface engagement back to initial position upon depressing of said other push button.

30. A multiple switch comprising a switch body having a plurality of apertures, a plurality of manually operable push buttons accommodated in respective apertures, cam surfaces provided within the interior of said push buttons, followers actuatable by said cam surfaces upon depressing a respective selected push button to effect a switching operation, said followers protruding inwardly into a least two of said push buttons to engage respective cam surfaces therein, said followers and surfaces being arranged so that when either of said two push buttons has been depressed from an initial position to a depressed position it will be motivated through the respective follower and cam surface engagement back to initial position upon depressing of said other push button, said switch body having a length in the direction of the depressing motion of said push buttons substantially equal to the length of said cam surface in that same direction so as to effect lateral support for either of said two push buttons for the extent of travel of a respective cam surface relative a follower, said push buttons having smooth sliding fit within the respective apertures thereof for lateral support substantially the entire length of engagement of said followers with said respective cam surfaces.

31. A multiple electric switch comprising a body member, an actuator plate slidably carried by said body member, sliding guide means comprising a single plate-like element intermediate said body member and said actuator plate for constraining said actuator plate to translational displacement, manually actuatable means for slidably displacing said actuator plate in at least three predetermined selective directions and means including contact elements operable by said actuator plate as determined by directional displacement thereof for controlling electric circuits.

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