Feb. 12, 1952 E. E. NOYES 2,585,824

ELECTRIC SWITCH

Filed Jan. 27, 1948

Fig. 1

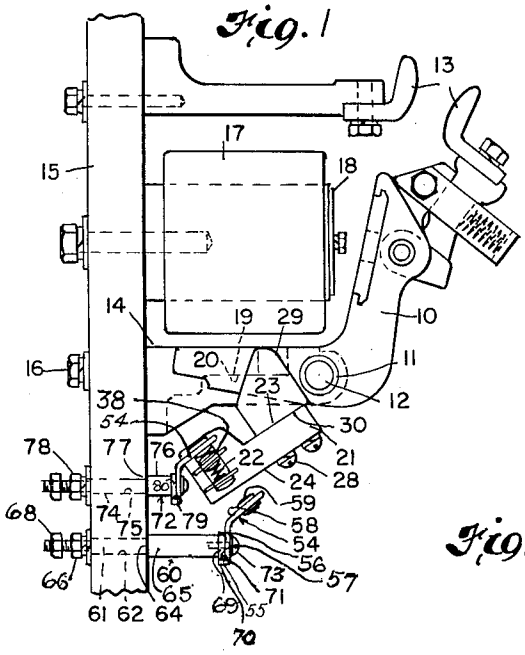


Fig. 2

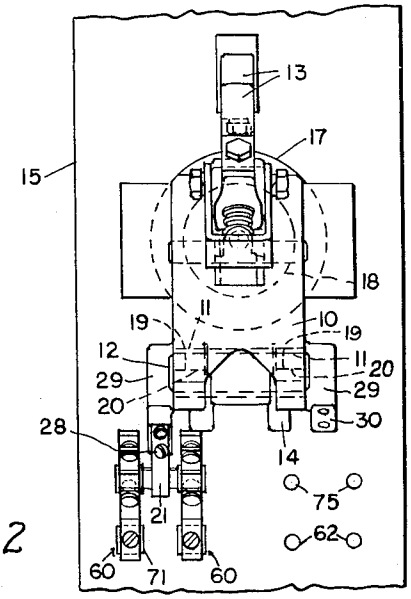
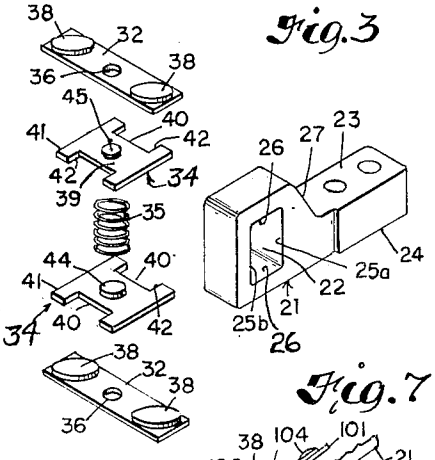


Fig. 3



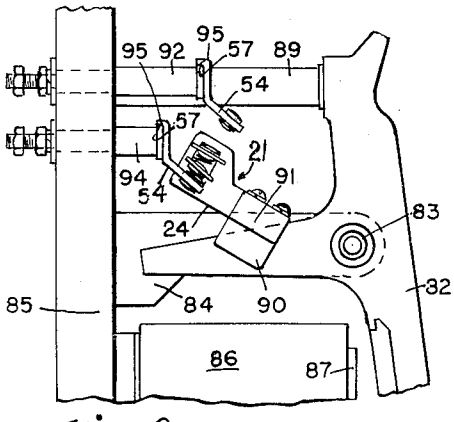
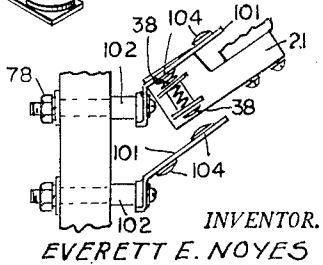


Fig. 6

Fig. 7



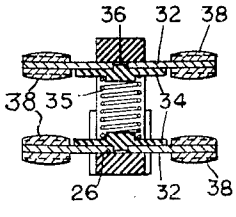


Fig. 5

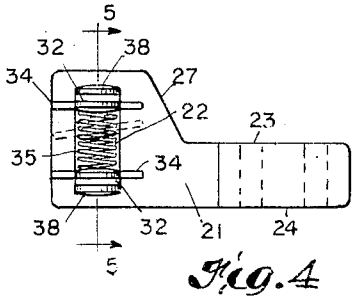


Fig. 4

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ELECTRIC SWITCH

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20 Claims. (Cl. 200—166)

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This invention relates to electric switches and more particularly to auxiliary or control circuit switches for use on electromagnetic contactors.

Electromagnetic contactors having main contacts which carry the load current of the translating device being controlled are often provided with one or more auxiliary or control circuit switches. The auxiliary switches, which may have either normally-open or normally-closed contacts or both, are interposed in the control circuits of the controller comprising the contactor or in the control circuits of a related controller and generally serve an interlocking function to insure a desired sequence of contactor operation. Since the proper and safe operation of a complete control installation is dependent upon the ability of the control circuit switches to function repeatedly in a reliable and accurate manner, they must be rugged enough to withstand for long periods of time the mechanical and electrical abuse to which they are often subjected. On the other hand, the control circuit switches must be of limited size and require but a small amount of power for operation in order to maintain the overall size of the contactor within reasonable limits. Furthermore, the wearing parts of the control circuit switches should be easy to remove and replace and but a few different types of parts should be required for switches usable on many different sizes of both normally-open and normally-closed contactors.

It is the object of the present invention to provide an improved control circuit switch meeting all of the foregoing requirements.

Other objects are to provide an improved control circuit switch for use on electromagnetic contactors which requires no adjustment, has non-horizontal contact surfaces, has both normally-open and normally-closed double-break contacts, and is so arranged that its various parts may be easily removed and replaced.

Another object is to provide an improved bridge-type control circuit switch in which the movable normally-closed and normally-open contact bridges are completely insulated from each other.

An additional object is to provide a control circuit switch which has but two different types of contact elements although it may have both normally-open and normally-closed contacts and is usable interchangeably on both normally-open and normally-closed contactors of widely varying sizes and interrupting capacities.

The switch of this invention comprises in its preferred form an insulating bracket arranged

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for attachment to the rockable armature of a clapper-type contactor and carrying within a continuously walled opening therein a pair of identical conducting contact bridges biased apart by a helical spring and insulated from each other by insulating members interposed between the spring and the respective contact bridges. The insulating members also serve to releasably retain the spring and bridges in cooperative relation within the opening. Each of the contact bridges carries a pair of spaced contact buttons which, upon rocking movement of the armature, engage and disengage complementary stationary contact buttons. Each of the stationary contact buttons is carried by a contact bracket detachably mounted on a stud. All of the stationary contact brackets are identical whereas the studs, which extend outwardly from the supporting structure for the contactor, may be of various lengths depending upon the size and type of contactor and whether the contact button associated with the stud is to be in normally-open or normally-closed position with respect to its complementary movable contact button. Each of the stationary contact brackets has contact buttons on opposite faces thereof, respectively, which are selectively placed into operative position depending upon whether the bracket is mounted on a stud which positions it for normally-open or normally-closed operation of its operative contact. The life of each of the stationary contact brackets is thereby doubled, merely by changing its position from one stud to another.

Further objects and advantages of this invention will become apparent from the following description wherein reference is made to the drawings in which:

Fig. 1 is a side elevation of the improved control circuit switch mounted on the armature of a normally-open electromagnetic contactor;

Fig. 2 is a front elevation of the switch of Fig. 1;

Fig. 3 is an exploded view and Fig. 4 is a side elevation of the movable contact assembly;

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

Fig. 6 is a side elevation of the switch of Fig. 1 mounted on a normally-closed contactor; and

Fig. 7 is a side elevation of a modified stationary contact assembly.

Referring to Figs. 1 and 2, an armature assembly 10 which may be part of a normally-open electromagnetic contactor of the type, for example, described in L. A. Trofimov Patent No. 2,071,595 is suitably mounted for limited rotary or rocking movement by having spaced bearing por-

tions 11 rotatably received on opposing end portions of a shaft 12 carried by a supporting bracket 14 accurately positioned on and secured to an insulating panel 15 as by a pair of horizontally spaced cap screws 16. The armature 10 may carry the movable element of one or more normally-open main circuit contacts 13. Upon energization of a winding 17, the armature 10 rotates counter-clockwise (as viewed in Fig. 1) from the normal or open position in which shown into engagement with a magnetic core cap 18 thus to close the main contacts, and upon deenergization of the winding 17 returns as by gravity to its initial position where it is stopped by engagement of shouldered surfaces 19 and 20 formed on the armature 10 and on the support 14, respectively. The core cap 18 is maintained in a well-known manner a definite distance from the panel 15 and the surfaces 19 and 20 may be finished or otherwise accurately determined whereby the opposite limits of movement of the armature 10 are accurately fixed.

The control circuit switch of this invention is adapted to be operated by such movement of an armature member to open and close gaps in the control circuits of a controller comprising the contactor or of a related controller. The movable assembly of the control circuit switch comprises a contact carrier 21 preferably molded from suitable insulating material such as Bakelite and, as shown has a continuously walled transverse opening 22 formed in an enlarged end portion thereof. The reduced other end portion of the carrier 21 has opposing parallel surfaces 23 and 24 which, in the embodiment shown, are normal to the planes of opposing side walls 25*a* and 25*b* (Fig. 3) of the opening 22 and parallel to opposing end wall surfaces 26 of the opening. The side wall surface 25*a* of the opening 22 thus may be considered an end wall of the carrier 21 that terminates at overhanging end wall surfaces 26 of the opening. Preferably, the opening 22 is continuously walled, as shown, thus eliminating any possibility of breakage of the overhanging portions that define the end walls. The surface 24 is preferably a coplanar extension of one surface of the enlarged end portion whereas the surface 23 is displaced from the plane of the opposite surface of the enlarged end portion by an angularly disposed surface 27. The carrier 21 is secured as by screws 28 to a projection 29 formed on the armature 10 and has its surface 23 in face-to-face contact with an inwardly extending and downwardly directed finished surface 30 of the projection 29. As shown in Fig. 2, the armature 10 may have a projection 29 on each side whereby two identical control circuit switches may be accommodated on a single contactor if desired.

The shaft 12 is accurately mounted in the support 14 which in turn is accurately positioned on the panel 15 and thus the armature 10 is constrained to move in an accurately predetermined and consistently maintained path relative to the panel 15. Since the extent of movement of the armature 10 is limited by the fixed position of the core cap 18 and the shouldered surface 20 and since the surface 23 of the carrier 21 is accurately positioned on the finished surface 30 of the projection 29, the opening 22 swings in an arc definitely predetermined in length as well as in position with respect to the panel 15. As will become apparent, the accuracy of the length and location of this arc permits the elimination of adjustment features heretofore generally provided in switches of this type.

As shown most clearly in Fig. 3, a pair of identical contact bridges 32, a pair of identical retainer members 34, and a helical spring 35 are adapted to be received in the opening 22. Each of the contact bridges 32 preferably comprises a flat strip cut from suitable electrical conducting strip stock, such as copper, of rectangular cross-section and each has a central opening 36 and a pair of suitable contact buttons 38 preferably of silver alloy welded or otherwise secured in axial alignment with each other on opposite faces, respectively. Each of the contact buttons 38 has a peripheral side wall or edge which, in the illustrated embodiment, is of circular configuration, and, considering each pair of the contact buttons 38 on the same face of the bridges 32, the portions of the peripheral side walls thereof which face each other constitute shoulder areas which are spaced apart endwise of the bridge from, and face toward, each other.

The retainer members 34 are releasably engageable with the spring 35 and the carrier 21 and constrain the contact bridges 32 and the spring in operative position within the opening 22. Each of the retainer members 34, which are preferably molded from suitable insulating material, has a central portion 39 of reduced width defining a pair of opposing open slots 40. The slots 40 are intermediate of respective pairs of terminal tab portions 41 each of which has a side wall 42 constituting a shoulder area and defining an end of the adjacent slot. A cylindrical boss 44 and a cylindrical boss 45 of lesser diameter are formed in axial alignment on opposing sides, respectively, of the central portion 39 of each of the retainers 34.

The movable portion of the switch is assembled by inserting a pair of the retainers 34 into the opening 22 and then rotating them until the respective bosses 44 are directed toward each other. The width of the central portion 39 is slightly less than the distance between the side walls 25*a* and 25*b* and the length of the slots 40 is slightly longer than the distance between the side surfaces of the carrier 21 so that each of the retainer members 34 may slide freely toward and away from each other within the opening 22 while being releasably held therein by engagement of the walls 42 with adjacent opposing side surfaces of the carrier 21 near the opening 22. With the retainers 34 disposed within the opening 22, the spring 35 may be compressed and inserted between the retainers 34 and then released to permit the respective bosses 44 to enter loosely into opposing end portions of the spring 35. The peripheral side wall of each of the bosses 44 thereby constitutes a shoulder area which releasably engages the spring 35 and constrains the spring 35 in its operative position. Expansion of the spring 35 forces the retainers 34 against the opposite end walls 26 of the opening 22, respectively.

By again compressing the spring 35, the upper one of the contact bridges 32 may be inserted into the opening 22 between the top wall 26 and the uppermost retainer 34. When the opening 36 of this bridge is aligned with the boss 45, release of the spring causes the boss 45 to enter the opening 36, which in effect provides aligned recesses in opposite faces of the bridge for receiving the boss 45, whereby the upper bridge 32 is releasably held with opposite end portions thereof extending outwardly from opposite sides of

the carrier 21. The lower one of the contact bridges 32 may likewise be inserted into the opening 22 between the bottom wall 26 and the lowermost retainer 34 the boss 45 of which enters the opening 36 in the lower bridge when the lower bridge is properly positioned and the spring 35 released. The width of the contact bridges 32 is sufficiently less than the width of the opening 22 between the side walls 25 to permit the bridges to slide freely toward and away from each other, but these two dimensions are so related that the bridges are restrained from any extensive rotary movement about the common axis of the bosses 45. Thus the opposite side walls of each boss 45 provide shoulder areas which are spaced apart endwise of the retainer 34, and the opposite side walls of each opening 36 provide shoulder areas engageable therewith for constraining relative movement of each bridge 32 and its associated retainer 34. As best illustrated in Fig. 5, when the uppermost bridge 32 is in operative position, the shoulder areas which, in the form illustrated, are defined by the inner portions of the peripheral side walls of the contact buttons 38 on the under face of the uppermost bridge 32 are positioned for engagement with complementary shoulder areas defined by the opposite wall surfaces, respectively, of the uppermost retainer 34, and when the lowermost bridge 32 is in operative position, the shoulder areas defined by the inner portions of the peripheral side walls of the contact buttons 38 on the upper face of the lowermost bridge 32 are positioned for engagement with complementary shoulder areas defined by the opposite wall surfaces, respectively, of the lowermost retainer. Thus each retainer and its associated bridge are constrained by shoulder areas from relative movement endwise of the bridges out of operating position. Accordingly each of the retainers 34 serves to transmit the biasing force of the spring 35 to its associated one of the bridges 32, is constrained from movement out of the opening 22 by engagement of its walls 42 with the side walls of the carrier 21, constrains its associated one of the bridges 32 from movement out of the opening 22 by engagement between its end walls and the shoulder areas defined by a pair of the contacts 38 on that bridge, and constrains the spring 35 from movement out of the opening 22 by engagement between its boss 44 and the spring. Preferably the length of the bosses 45 is approximately the same as the thickness of the bridges 32 so that the tension of the spring 35 is approximately the same whether one or two of the bridges are in operative position.

The stationary contact portion of the control circuit switch comprises a plurality of identical contact brackets 54 preferably formed of suitable electrical conducting strip stock, such as copper, of rectangular cross section. A lower end portion 55 (as viewed in Fig. 1) of each of the brackets 54 is bent at a right angle to an intermediate portion 56 to define an upwardly directed flat surface 57, and the other or upper end portion 58 is bent at a lesser angle, preferably about forty-five degrees, away from the intermediate portion 56 in the opposite direction. A pair of suitable contact buttons 59 which may be the same as the buttons 38 are welded or otherwise secured in axial alignment with each other on opposite faces, respectively, of the portion 58 near the upper extremity thereof.

A pair of supporting studs 60 each for holding one of the contact brackets 54 are suitably

mounted in horizontal spaced relation on the panel 15. As shown, each of the studs 60 has an inner reduced portion 61 received into a complementary opening 62 in the panel and has an annular shoulder 64, defined by the junction of the reduced portion 61 and an enlarged cylindrical portion 65, in engagement with the front surface of the panel. An inner end portion of each of the studs 60 may be threaded to receive a retaining nut 66 and a conductor holding nut 68. An outer end portion 69 of each of the studs 60 is of non-circular cross-section, preferably square, and defines a downwardly directed flat surface 70 normal to an end face 71. One of the contact brackets 54 is secured to the end face 71 of each of the studs 60 as by a screw 73 with the surface 57 engaging the surface 70.

In like manner a pair of supporting studs 72 are mounted in horizontal spaced relation on the panel 15 above the studs 60 by insertion of reduced portions 74 thereof into respective spaced openings 75. The studs 72 are preferably identical with the studs 60 except that intermediate enlarged cylindrical portions 76 of the studs 72 are shorter than the corresponding portions 65 of the studs 60. An annular shoulder 77 on each of the studs 72 is held tightly against the panel 15 by a nut 78 threaded on an inner end portion of the studs and each of the studs 72 has a downwardly directed flat surface 79 on an outer end portion 80 of non-circular cross-section. The stud portions 65 and 76 are preferably cylindrical, as shown, so as to prevent the piling of dust thereon which may cause short circuits.

By positioning the pairs of openings 62 and 75 accurately with respect to the support 14, accurately determining the exposed lengths of studs 60 and 72, and by making the brackets 54 uniform, all the contact buttons 59 are in predetermined positions along the arc of movement of the contact buttons 38 and have their respective axes substantially tangential with respect to the arc of movement, thus rendering adjustment of the control circuit switch unnecessary.

When the armature 10 is in its normal position as shown, the upwardly directed contacts 38 on the upper contact bridge 32 are in engagement with respective downwardly directed contacts 59 on the upper brackets 54 and the upper bridge 32 has been displaced from its normal position to the extent indicated (see broken line position, Fig. 4) against the bias of the spring 35 which maintains a definite contact pressure. A circuit is thus completed between the spaced studs 72 through the upper contact bridge 32. When this circuit is completed, the angular relationship of the carrier 21 with respect to the portions 58 of the upper brackets 54 is such that the upper bridge 32 is turned slightly about its longitudinal axis with the engaged contacts 38 and 59 slightly out of axial alignment. When the winding 17 is energized to move the armature 10 to its closed position, the carrier 21 swings downwardly about the axis of the shaft 12 to cause engagement of the downwardly directed contacts 38 on the lower bridge 32 with respective complementary upwardly directed contacts 59 on the lower brackets 54. This completes a circuit between the studs 60 through the lower bridge 32. Prior to engagement of the contacts 38 of the lower bridge 32 with the respective contacts 59 on the lower brackets 54, the outer surfaces of the contacts 38 and 59 lie in parallel planes. After engagement of these contacts and while the spring 35 is being compressed, the lower contact bridge 32

rotates slightly about its longitudinal axis in a counter-clockwise direction as viewed in Fig. 1. Thus a rolling engagement of the contact faces is obtained which improves their current carrying ability by removing any deposits on the contact surface and bringing the surfaces into close relationship. A similar rolling action of the contact faces of the upper normally-closed contacts is obtained when the armature 10 returns to its normal position.

It should be noted that the contact brackets 54 may be used interchangeably in normally open or normally-closed position depending upon the position and length of the associated studs, and that when interchanged different ones of the contact buttons 59 are placed into operative position.

The insulating retainers 34 prevent any possibility of a circuit being completed from a lower stud 60 to an upper stud 72 of opposite polarity through an arc drawn between separating contacts. Thus, in addition to serving as retainers for the bridges 32 and the spring 35, the retainers 34 permit the stationary contact studs to be connected at either polarity indiscriminately.

From the foregoing it is apparent that there is provided a control circuit switch of small and compact design yet one rugged enough to withstand severe service. Because of the provision of the opening 22, instead of an open slot, the bracket 21 has no reduced cross-sectional areas subjected to excessive strain.

The contact bridges may be easily removed and replaced from the front of the contactor without the use of tools, and the brackets 54 and carrier 21 are easily removed and replaced by the manipulation of screws the slotted heads of which face the front of the contactor. If only one contact bridge 32 is required, the other may be removed without impairing the operation. This is because the boss 45 which normally would enter the opening 36 in the removed bridge bears against the adjacent end wall 26 of the opening 22 thereby maintaining the proper length of the spring 35.

In Fig. 6, the control circuit switch is shown as used on a normally-closed contactor having an armature 82 mounted for limited rotary movement about a shaft 83 carried by a bracket 84 secured to a panel 85. The armature 82 may carry the movable element of one or more normally-closed main circuit contacts (not shown). Upon energization of a winding 86, the armature 82 rotates clockwise from the normal or closed position in which shown into engagement with a magnetic core cap 87 thus to open main contacts (not shown), and upon deenergization of the winding 86 returns as by the force of a spring (not shown) to its initial position against a suitable stop 89.

The armature 82 is provided with a projection 90 having an inclined finished surface 91. The carrier 21 of the movable contact assembly is secured to the projection 90 with its surface 24 in face-to-face contact with the surface 91 and the contacts 38 thereof swing in a predetermined arc upon rocking action of the armature 82. Pairs of horizontally spaced upper studs 92 and lower studs 94 are carried by the panel 85 and each of these studs receives on its outer end one of the contact brackets 54. In Fig. 6, each of the brackets 54 is inverted from the position in which shown in Figs. 1 and 2 with its flat surface portion 57 engaging a flat surface 95 formed on the upper side of the outer end portion of each of the studs 92 and 94.

When the armature 82 is in normal position, the lower contact bridge 32 as viewed in Fig. 6 completes a circuit between the studs 94 and, upon energization of the winding 86, this circuit is interrupted and a circuit completed between the upper studs 92 through the other one of the contact bridges 32. Interchanging the contact brackets 54 between upper and lower studs puts different ones of the contact buttons 59 into operative position.

In the modified stationary contact assembly of Fig. 7, a plurality of identical contact brackets 101 similar to the brackets 54 are suitably mounted in spaced relation on the outer ends of suitable studs 102, respectively, all of which are of the same length. A pair of contact buttons 104 similar to the buttons 59 are secured on opposite faces, respectively, of the outer end portion of each of the brackets 101 and are displaced axially from each other longitudinally of their respective brackets. When a pair of the brackets 101 are in mounted position on vertically aligned studs 102, respectively, as viewed in Fig. 7, the inner contact button 104 on the uppermost bracket 101 is spaced from and faces the outer contact button on the lowermost bracket. Upon interchanging the positions of lowermost and uppermost brackets 101, the outer contact button 104 on the bracket 101 that before the interchange was the uppermost now faces the inner contact button on the bracket that before the interchange was the lowermost. By proper selection of the angle of bend of the brackets 101 and the positions of the contact buttons 104, the respective axes of those contact buttons 104 which face each other may be made substantially tangent to an arc defined by swinging movement of the movable contact buttons 38 carried by the carrier 21.

Having thus described my invention, I claim:

1. An electric switch comprising a contact carrier having a guide wall surface and spaced overhanging wall surfaces extending outwardly in face-to-face spaced relation with each other from opposite end portions, respectively, of the guide wall surface, a conducting contact bridge received in the space between the overhanging wall surfaces and having opposite end portions extending outwardly beyond the opposite edges of the guide wall surface, said contact bridge slidably engaging said guide wall surface for free movement there along in a path toward and away from said overhanging wall surfaces while being constrained by said guide wall surface from extensive rotary motion about an axis normal to said overhanging wall surfaces, a spring between the overhanging wall surfaces for normally biasing said contact bridge against one of said overhanging wall surfaces, a member movable along said path and interposed between said spring and said bridge and transmitting the biasing force of the spring to the bridge, means on the member detachably engageable with the carrier for constraining said member in said path, and said member and contact bridge having mutually detachably engageable portions which constrain said contact bridge in operative position in said path.

2. An electric switch as in claim 1 characterized in that said member is of insulating material and said spring is of electrically conductive material.

3. An electric switch comprising a contact car-

rier provided with a continuous walled opening having elongated parallel side wall surfaces and opposing end wall surfaces, a conducting contact bridge received in said opening with opposite end portions extending outwardly from said opening on opposite sides of said carrier, said contact bridge slidably engaging said side wall surfaces in a path for movement along said side wall surfaces toward and away from said end wall surfaces while being constrained by said side wall surfaces from extensive rotary motion about an axis normal to said end wall surfaces, a spring between said end wall surfaces for normally biasing said contact bridge against one of said end wall surfaces, a member movable along said path and interposed between said spring and said bridge and transmitting the biasing force of the spring to the bridge, means on the member detachably engageable with the carrier for constraining said member from movement out of said opening, and said member and contact bridge having mutually detachably engageable portions which constrain said contact bridge in said path.

4. An electric switch according to claim 2 characterized in that said contact bridge is of less width throughout its length than the minimum distance between said side walls, whereby the bridge may be moved transversely of said path entirely beyond the lateral limits of said carrier while its plane is parallel to the plane of its operating position.

5. An electric switch comprising a contact carrier provided with a continuous walled opening having elongated parallel side wall surfaces and opposing end wall surfaces, a conducting contact bridge having an aperture and received in said opening with opposite end portions extending outwardly from said opening on opposite sides of said carrier, said contact bridge slidably engaging said side wall surfaces for free movement along said side wall surfaces toward and away from said end wall surfaces while being restrained by said side wall surfaces from extensive rotary motion about an axis normal to said end wall surfaces, a helical spring within said opening normally biasing said contact bridge against one of said end wall surfaces, a retainer member releasably held in said opening intermediate of said contact bridge and said spring and having opposing bosses received respectively within the helix of said spring and in said aperture, whereby said contact bridge and said spring are releasably constrained against displacement from said opening.

6. The electric switch of claim 5 characterized in that a second retainer member is releasably held in said opening intermediate of the other one of said end wall surfaces and said spring, said retainer members being identical and one of the bosses on said second retainer being received within the helix of said spring, and the other one of the bosses of said second retainer and the boss of said first named retainer in said aperture each having an axial length relative to the thickness of said contact bridge such that upon insertion of a second identical contact bridge in said opening with said other one of the bosses of said second retainer received in the aperture of the identical bridge, the tension of said spring remains substantially unchanged.

7. The electric switch of claim 6 characterized in that said second contact bridge is inserted between said second retainer member and said other one of said end wall surfaces with said other one of the bosses of said second retainer received in the aperture of the second bridge, and said retainer members are of insulating material and electrically insulate said contact bridges, respectively, from said spring and from each other.

8. An electric switch comprising a pair of identical rigid contact brackets each having a pair of contact buttons, said buttons of each bracket being secured on opposite sides thereof respectively, means detachably holding said brackets in fixed spaced relation with one of the contact buttons on one of the brackets spaced from and facing one of the contact buttons on the other one of the brackets, and said other contact buttons being so positioned on their respective brackets that, upon interchanging the position of the two brackets, the other button of each bracket interchanges position with said one button of the other bracket.

9. The switch of claim 8 characterized in that the contact buttons of each bracket are disposed in axial alignment with each other.

10. An electric switch comprising a movable contact means movable along a fixed path between limits, a pair of identical contact brackets each having a pair of contact buttons, said buttons of each bracket being secured on opposite sides thereof respectively, means detachably holding said brackets in spaced fixed relation with one contact button on one of the brackets facing one of the contact buttons on the other one of the brackets with the facing contact buttons disposed at said limits respectively of said path of movement, and said other contact buttons being so positioned upon their respective brackets that they face each other at said limits respectively upon interchanging the positions of said brackets.

11. An electric switch comprising a movable contact means movable along a fixed path between limits, a pair of identical contact brackets each having, endwise of the bracket, an innermost and an outermost contact button, said contact buttons being secured on opposite sides respectively, of their respective brackets, and means detachably holding said brackets in spaced fixed relation with the innermost contact button on one of the brackets facing the outermost contact button on the other one of the brackets with the facing contact buttons disposed at said limits respectively of said path of movement, whereby said other contact button of each bracket interchanges position with said one button of the other bracket upon interchanging the positions of said brackets.

12. An electric switch comprising a pair of identical contact brackets each having a pair of contact buttons, said buttons of each bracket being secured on opposite sides thereof respectively, means detachably holding said brackets in spaced relation with one of the contact buttons on one of the brackets spaced from and facing one of the contact buttons on the other one of the brackets and with the respective axes of the facing contact buttons approximately tangent to a common circular arc at predetermined spaced points respectively on said arc, and said other contact buttons being so positioned upon their respective brackets that, upon interchanging said brackets, said other contact buttons are spaced from and face each other with their respective axes approximately tangent to said arc at said predetermined points, respectively.

13. The electric switch of claim 12 characterized in that said contact buttons when in facing position have their respective axes at an angle to the vertical.

14. An electric switch comprising a plurality of identical contact brackets each having a pair of contact buttons, said buttons of each bracket being secured on opposite sides thereof, spaced mounting means for a first pair of said brackets, respectively, detachably holding said first pair of brackets in spaced relation with respect to each other with one contact button on one of said brackets of said first pair facing one contact button on the other one of said brackets of said first pair approximately along a non-vertical axis, spaced mounting means for a second pair of said brackets, respectively, detachably holding said second pair of brackets in spaced relation with respect to each other with one contact button on one of the brackets of said second pair facing one contact button on the other of the brackets of said second pair along a second axis approximately parallel to the first axis, a movable contact means movable substantially along said axes for bridging between said one contact button on said one bracket of said first and said one bracket of said second pair of brackets, and said other contact buttons being positioned on said brackets, respectively, so that, upon interchanging brackets having contact buttons in the same axis, said other contact buttons on said brackets face each other along said last mentioned axis.

15. An electric switch comprising a plurality of identical contact brackets each having a pair of contact buttons, said buttons of each bracket secured on opposite sides thereof, spaced mounting means for a first pair of said brackets, respectively, detachably holding said first pair of brackets in spaced relation with respect to each other with one contact button on one of said brackets of said first pair facing one contact button on the other one of said brackets of said first pair approximately along a non-vertical axis, spaced mounting means for a second pair of said brackets, respectively, detachably holding said second pair of brackets in spaced relation with respect to each other with one contact button on one of the brackets of said second pair facing one contact button on the other of the brackets of said second pair along a second axis approximately parallel to the first axis, a pair of conducting contact bridges each having contact end portions at opposite ends thereof, a movable contact carrier movable between and substantially parallel to said axes and defining an opening slidably receiving said contact bridges in spaced apart relation with one pair of the contact end portions extending outwardly from said opening and disposed in one of said axes in alignment with the contact buttons thereof and the other pair of contact making end portions extending outwardly from said opening and disposed in the other of said axes in alignment with the contact buttons thereof, a metal spring biasing said bridges apart, insulating retainers between said bridges respectively and said spring and shaped to hold said spring and bridges in assembled relation in said opening, and means for moving said carrier from a position wherein one of said bridges forms an electrical connection between two of said contact buttons to a position wherein the other of said contact bridges forms an electrical connection between the other contact buttons which face said two contact buttons.

16. An electric switch comprising a contact carrier provided with a continuous walled opening having elongated parallel side wall surfaces

and opposing end wall surfaces, a pair of conducting contact bridges received in said opening, each with opposite end portions extending outwardly from said opening on opposite sides of said carrier, said contact bridges slidably engaging said side wall surfaces for movement along said side wall surfaces toward and away from said end wall surfaces while being restrained by said side wall surfaces from extensive rotary motion about an axis normal to said end wall surfaces, a metal spring in said opening and between said contact bridges and normally biasing said contact bridges against said end wall surfaces, respectively, insulating means interposed between said spring and said contact bridges, respectively, and each releasably engaging the spring and carrier, means on the insulating means engaging the carrier for constraining the insulating means from movement out of the opening when in normal operating positions, means on each insulating means engaging its associated contact bridge and constraining its associated contact bridge from movement out of the opening, means on the insulating means engaging the spring and constraining said spring to operative position in said opening and each of said insulating means electrically insulating its associated contact bridge from said spring.

17. An electric switch comprising a contact carrier provided with a continuous walled opening having elongated parallel side wall surfaces and opposing end wall surfaces, a pair of elongated conducting contact bridges received in said opening each with opposite end portions extending outwardly from said opening on opposite sides of said carrier and having shoulder areas spaced apart endwise of the bridge from, and facing toward, each other, said contact bridges slidably engaging said side wall surfaces for movement along said side wall surfaces toward and away from said end wall surfaces while being restrained by said side wall surfaces from extensive rotary motion about an axis normal to said end wall surfaces, a metal spring in said opening between said contact bridges and normally biasing said contact bridges against said end wall surfaces, respectively, and insulating retaining means interposed between said spring and said contact bridges, respectively, and having spaced shoulder areas releasably engaging said shoulder areas, respectively, of said respective contact bridges for constraining the bridges in operative position within said opening, and having shoulder areas releasably engaging the spring and constraining said spring to operative position, and having additional shoulder areas releasably engaging the carrier and constraining the insulating means from movement out of said opening.

18. An electric switch according to claim 17 further characterized in that said additional shoulder areas are wall surfaces of terminal tab portions on each insulating means which engage respective outer surface areas of the carrier adjacent the opposite ends of the opening.

19. An electric switch according to claim 17 characterized further in that said spring has boss receiving openings at opposite ends, respectively, and said shoulder areas engaging the spring are side wall portions of bosses on the insulating means, respectively, and are received in said boss receiving openings, respectively.

20. An electric switch comprising a contact carrier provided with a continuous walled opening having elongated parallel side wall surfaces and opposing end wall surfaces, a pair of elon-

gated conducting contact bridges received in said opening each with opposite end portions extending outwardly from said opening on opposite sides of said carrier and having shoulder areas spaced apart endwise of the bridge from, and facing toward, each other, said contact bridges slidably engaging said side wall surfaces for movement along said side wall surfaces toward and away from said end wall surfaces while being constrained by said side wall surfaces from extensive rotary motion about an axis normal to said end wall surfaces, a metal spring in said opening between said contact bridges and normally biasing said contact bridges against said end wall surfaces, respectively, and insulating retaining means interposed between said spring and said contact bridges, respectively, and having spaced shoulder areas releasably engaging said shoulder areas, respectively, of said respective contact bridges, and having additional shoulder areas releasably engaging the carrier and constraining

the insulating means from movement out of said opening.

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