Aug. 23, 1932. H. R. TURNER 1,873,797

ELECTRIC SWITCH

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Fig. 1.

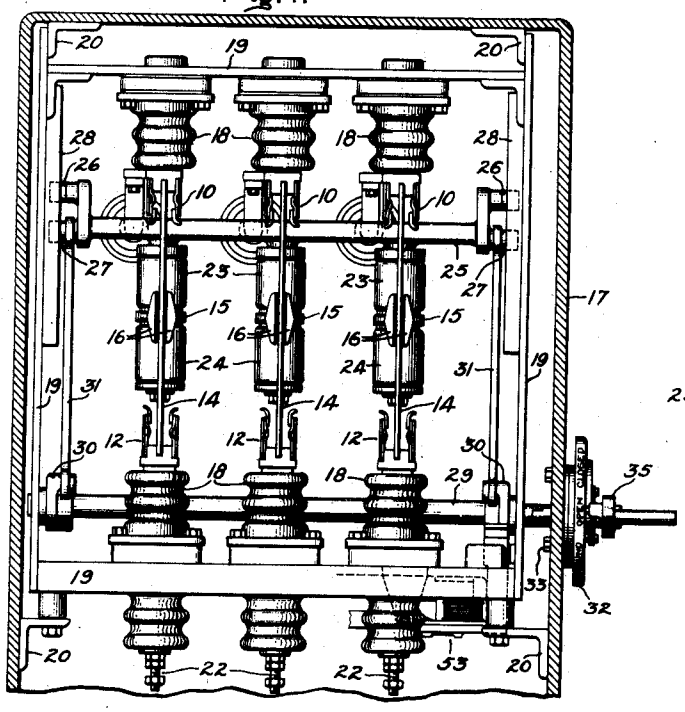

Fig. 3.

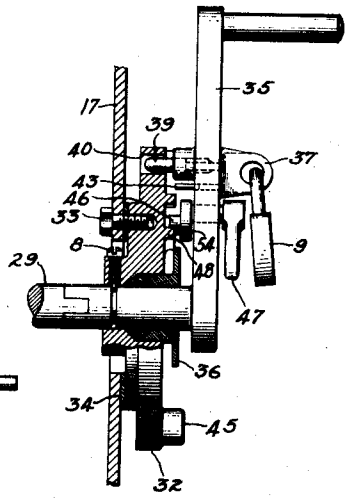

Fig. 2.

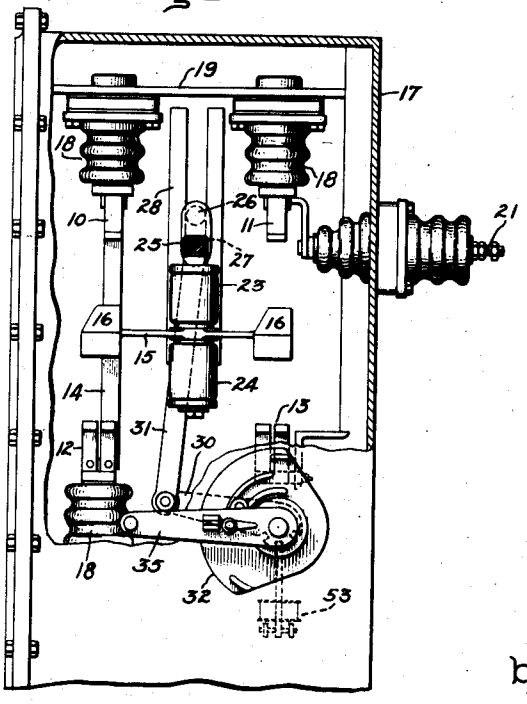

Fig. 4.

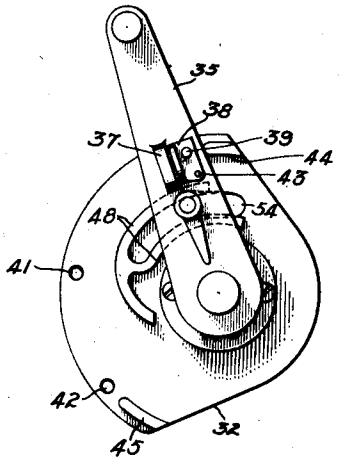

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Fig.5.

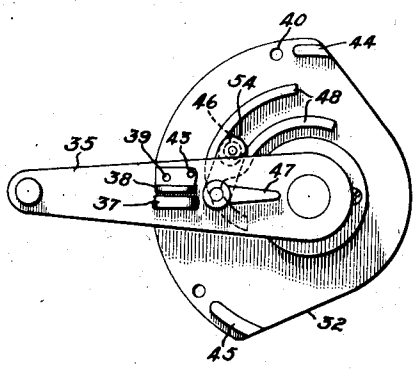


Fig.6.

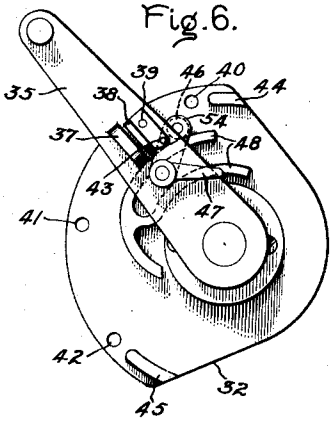


Fig.7.

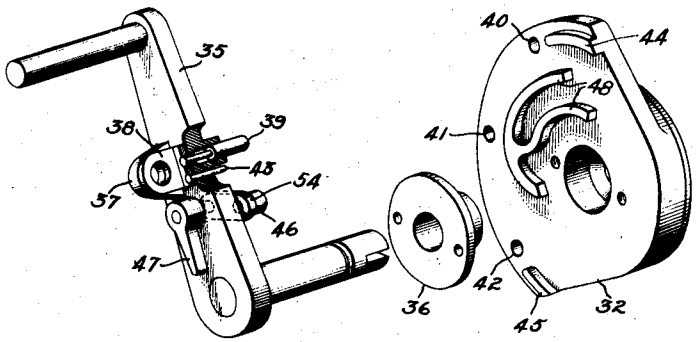


Fig.8.

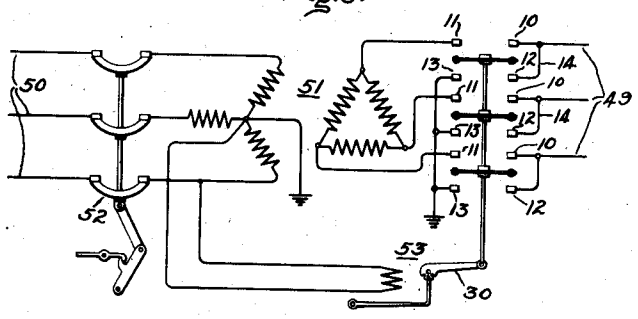
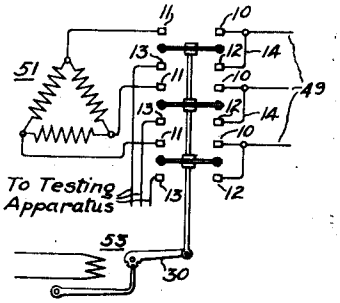


Fig.9.



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UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH

Application filed January 10, 1931. Serial No. 507,882.

My invention relates to improvements in electric switches and more particularly to multiple-throw disconnecting switches for use where space is limited and safety for both personnel and apparatus is paramount.

In low voltage alternating current distribution systems the transformer stations at the ends of the feeders, usually cables, are located in vaults, the size of which is restricted by economic factors and underground congestion. Inasmuch as the feeder circuits are operated at relatively high voltages, ranging from 4,000 to 33,000 volts, the necessary insulation in view of the space limitations is of great importance especially for switches. Because of these limitations it is desirable to minimize failure of the insulation by using inorganic insulating materials such as ceramic material. For economy and safety, however, such materials must be so utilized as to obtain the maximum advantages from their static properties. To this end it is desirable to make use of their high resistance to compression. Moreover, contact heating, corrosion and burning should be minimized and the use of flexible conductors avoided since these, by reason of their lack of rigidity, are apt to get out of their intended places and cause short-circuits. Above all, it should not be humanly possible for a person to cause injury to himself or others in testing, operation and maintenance of the switch. In this connection, it is frequently desirable that a switch left unlocked in the open-circuit position should not remain in such position.

An object of my invention is then to provide an improved and simple switch which is compact. Another object of my invention is to eliminate flexible conductors within the switch and to provide a construction such that inorganic insulating materials can be used to the best advantage. A further object of my invention is to provide a switch which if left unlocked in the open-circuit position will automatically assume a safe circuit closing position. Other objects of my invention will appear hereinafter.

My invention will be better understood when considered in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the accompanying drawings, Fig. 1 illustrates a side elevation of a switch embodying my invention; Fig. 2 is an end elevation of the switch shown in Fig. 1; Fig. 3 is a side elevation partially in section of an operating handle mechanism for switches embodying my invention. Figs. 4, 5 and 6 are end elevations of the operating mechanism of Fig. 3, Fig. 4 illustrating one circuit closing position, Fig. 5 illustrating a circuit open position and Fig. 6 a position intermediate those shown in Figs. 4 and 5. Fig. 7 is an exploded perspective view of the mechanism of Fig. 3. Fig. 8 is a circuit diagram illustrating one application of the switch shown in Figs. 1 and 2. Fig. 9 is a circuit diagram of another application of a switch embodying my invention.

The embodiment of my invention chosen for the purpose of illustration is a three-pole, double-throw disconnecting switch including a plurality of spaced pairs of contacts 10, 11 and 12, 13, a conducting member such as a straight flat strip conductor 14 extending from one contact 10 of one pair to one contact 12 of another pair and means for engaging or bridging one pair of contacts at a time such as a cooperating movable contact 15 which has a portion adjacent the conductor 14 and is arranged for movement into contacting position between this conductor and each of the contacts connected thereby. As shown, the pairs of contacts are oppositely disposed and the conductor 14 connects corresponding contacts 10 and 12 of the two pairs. In addition to performing the function of a guide for the movable contact 15, the conductor 14 may also act as a connector between the contacts 10 and 12. For the guiding function, the portion of the bridging contact 14 adjacent the conductor 14 may be shaped to provide bifurcations 16 which straddle the conductor 14. In order to insure a good contact with a high pressure or wedging action, the contacts 10, 11, 12 and 13 may be of the jaw type illustrated and the end portions of the bridging contact wedge shaped in the manner illustrated in

Fig. 1. The end portions 16 of the bridging contact are sufficiently spaced so as to ride freely along the conductor 14 so that high pressure contact action between the contact jaws and the contact portions 16 occurs only as the wedging condition is effected near the end of the contact movement. If desired the bifurcations or end portions 16 may have a slight flexibility just sufficient to enable contacting action involving engagement of the end portions 16 with both the jaws of the contacts 10 or 12 and the conductor 14.

Where the switch is to be used in vaults with the contacts immersed in oil, a fluid-tight metallic casing 17 may be employed for the purposes of keeping the oil in and moisture and other fluids out. Within this casing the stationary contacts 10, 11 and 12 are mounted on suitable insulators 18 which are illustrated as of the porcelain type. These insulators are secured to a suitable supporting structure such as a frame 19, which may be mounted on angle brackets 20 within the casing, as shown. Where the switch, when in one of its circuit closing positions, is to act as a grounding switch, one of the contacts, for example 13, may be mounted directly on the casing, as shown in Fig. 2, and the casing suitably grounded. Otherwise the contact 13 may be insulated as are contacts 10, 11, 12. The contacts 11 and 12 are connected to terminals 21 and 22 respectively, the latter extending through the casing wall in bushings which may, if desired, be inserted in the housing of a transformer so that the switch can be secured directly to the transformer.

For actuating the bridging contacts 15, they are mounted between insulators 23 and 24 which are suitably secured to a cross rod 25. This rod is provided with means arranged to insure a rectilinear movement of the contacts 15. As shown, this means includes two spaced pins 26, 27 which travel in slotted guide-ways 28. Inasmuch as the switch may have to pass greater currents in the lower or grounding position, that is contact 15 bridging contacts 12 and 13, than in the upper position, bridging contacts 10 and 11, I so construct and arrange the lower contacting portion of the contacts 15 as to provide a greater current carrying capacity than the upper contacting portions and correspondingly increase the contact capacity of the contacts 12 and 13.

For actuating the movable contacts 15 to the different circuit controlling positions, I provide an operating mechanism which is arranged to maintain the switch in one circuit closing position but which, under the bias of the weight of the movable contacts 15 and their supporting structure, tends to move the contacts 15 to another circuit closing position if the switch is not in the first circuit closing position. As shown, this mechanism includes an operating shaft 29, one or more cranks 30 secured thereto, and links 31 connecting the cranks to the lower pins 27. In the upper circuit closing position of the contacts 15 where they bridge the contacts 10 and 11, each crank 30 and its associated link 31 form an overset toggle for holding the switch closed, the travel of the operating shaft 29 in the direction of overset being limited as will hereinafter appear.

For actuating the shaft 29, I provide a handle operating mechanism, which is shown in Figs. 3 to 7 inclusive, whereby to permit a predetermined or limited movement of the contacts 15 from the upper circuit closing position in engagement with contacts 10 and 11 to an intermediate circuit opening position as shown in Fig. 2 and a greater movement of the contacts 15 only on return to the upper circuit closing position and release of an interlocking device after which the contacts 15 may be moved to the lower circuit closing position in engagement with contacts 12 and 13. As shown, the handle mechanism include a supporting member such as a base 32 which is secured to the casing 17 by suitable means such as bolts 33, suitable packing 34 being interposed as shown in Fig. 3. Mounted in the base 32 so as to project therethrough within the casing to engage the shaft 29 clutch fashion for example, is an operating member or handle 35, the shaft portion of which passes through suitable packing and a gland bushing 36 to provide a fluid-tight seal. A retaining screw 8 may be used to hold the handle member 35 in engagement with the shaft 29.

For locking the operating member 35 in any one of its positions, I provide cooperating locking members 37 and 38 both of which are mounted on the operating member 35. The locking member 37 is rigid with respect to the operating member 35 but the locking member 38 is arranged for movement relatively thereto and carries a locking pin 39 which is arranged to be engaged in holes 40, 41 and 42 in the base 32, whereby to maintain the switch in its different circuit controlling positions. The locking member 38 is provided with an additional guiding pin 43 such that it cannot be turned angularly about its pin 39 and is so arranged that it cannot be withdrawn or separated from the operating handle 35. Each of the locking members 37, 38 may be provided with an opening or eye for the insertion of a padlock 9 so that the switch can be purposely locked and kept under the supervision of authorized members of the personnel in any one of the circuit controlling positions. The base is provided with motion limiting lugs 44 and 45, the former determining the overset of the toggle formed by the crank 30 and the link 31. Obviously the limiting lugs could be ad-

justable and placed elsewhere, for example to be engaged by cranks 30.

In order to prevent thoughtless operation of the switch assuming that the locking members are not padlocked I provide the handle operating mechanism with a motion limiting means which as shown includes a pin and slot mechanism. The pin 46, see Figs. 3 and 7, is carried by the operating member 35 on the lower side thereof and is movable from the upper side by the crank 47. This pin 46 engages a slot formed between projections or walls 48 on the base 32 and having one end closed as shown. When the operating handle 35 is in the closed position of the switch where the contacts 15 bridge the contacts 10 and 11, the parts of the handle mechanism are positioned as shown in Fig. 4. The pin 46 is now positioned in the slot on the base 32 and the operating handle may be moved to the position shown in Fig. 5 which is the intermediate or open circuit position of the switch shown in Figs. 1 and 2. If it is desired to move the switch to the lower position where the contacts 15 bridge the contacts 12 and 13, then the operating handle 35 must be returned to the closed position where the crank 47 may be turned to release the pin 46 from the slot on the base 32 and the handle 35 then turned counter-clockwise as shown in Fig. 6. It is therefore impossible for the operator to throw the switch from the upper circuit closing position or from the intermediate or open position to the lower or grounding position without some thought on his part whereby he may be reminded of the possibility of completing the ground connection on a line circuit, it being assumed that the circuit 49 (see Fig. 8) comes in through the terminals 22.

In the schematic circuit arrangement shown in Fig. 8 to illustrate an application of a switch embodying my invention, a polyphase high voltage circuit or feeder 49 is adapted to be connected to a low voltage network 50 through the contacts 10 and 11 of a switch such as shown in Figs. 1 and 2, a step-down transformer 51 and a circuit breaker 52. Electromagnetic interlocking means 53 may be connected across a phase of the network as shown so that whenever the circuit breaker 52 is closed and the network is energized, or the feeder 49 is energized, the electromagnet will be excited to lock the operating mechanism through notches, for example, in one of the cranks 30 so as to prevent operation of the switch on a live circuit. This insures the operator's safety since it is thus impossible to open the disconnecting switch under load.

Assuming that the feeder disconnecting switch is in the circuit closing position, that is, that the contacts 10 and 11 are bridged by the contacts 15 and that the circuit breaker 52 is closed and either the feeder 49 or the network 50 or both are energized, it will be impossible to operate the switch since the electromagnetic means 53 is energized and engages a notch in one of the cranks 30. Under these conditions, the disconnecting switch operating handle mechanism has its parts positioned as shown in Figs. 3 and 4. If for any reason it is desired to work on any of the equipment in the vault or chamber containing the transformer 51, the circuit breaker 52 and the disconnecting switch, the operator must first arrange to have the feeder circuit 49 opened, for example, at the power station and must effect the opening of the circuit breaker 52. The electromagnetic means 53 is thus deenergized and the locking of the switch mechanism thereby released. Whoever is authorized may unlock the padlock 9 thus unlocking the handle operating mechanism. Even though this mechanism were not locked prior to the opening of the circuit breaker 52 and the feeder circuit 49, it would still be impossible to move the operating handle since the electromagnetic interlocking means 53 would be engaged. Assuming, however, that the interlocking means has been released, then, after disengaging the locking pin 39 from the base 32, the operating handle 35 can be turned counter-clockwise into the circuit open position shown in Fig. 5 and the switch parts are then positioned as shown in Figs. 1 and 2. The operating handle 35 may be locked in this position, if desired, by setting the locking pin 39 in the hole 41 on the base 32 and inserting the padlock in the eyes of the locking members 37, 38 if it is desired to lock the switch against unauthorized operation.

In order further to insure safety so that the switch cannot be left in the open circuit position with the possibility of some one then moving it to the grounding position on a live circuit, I so arrange the locking member 38 that its locking pin 39 cannot enter the hole 41 unless the safety locking pin 46 is in its cooperating slot. In other words, if the pin 46 is not in its slot, the switch will go to the grounding position immediately upon release of the operating handle 35 after movement thereof from the upper circuit closing position. For this purpose the guiding pin 43 is so arranged as to be in the path of movement of the crank 54 which carries the safety pin 46 and is of such a length that, with the pin 46 out of its slot, the member 38 is raised so much that the locking pin 39 is clear of the base 32 and therefore cannot be inserted in the hole 41. Thus in moving from the upper circuit closing position it is necessary to raise the locking member 38 so that the pin 39 clears the hole 40. Then if the crank 47 is operated to move the pin 46 from the slot, the crank 54 moves under the pin 43 and the pin

39 cannot enter the hole 41. Consequently, if the operating toggle 30, 31 is released and the handle 35 not held by the operator, the switch will under the bias of gravity go to the grounding position. Therefore the switch cannot be left in the open position and then operated to the grounding position without first going to the closing position where if the circuit 49 is energized, the switch will be locked by the electromagnetic means 53.

If the switch is moved to the open position shown in Figs. 1, 2 and 5 and left in this position with the locking pin 39 in engagement with the hole 41 of the base 32, it may be that an operator or maintenance man might come along and release the member 38 and try to move the operating handle to the ground position. This of course cannot be done if the electromagnetic interlocking means 53 is energized. If however the switch is in the open position and the circuit breaker 52 is opened and in the meantime the feeder 49 has been energized, for example by closing a switch at the power station, then the interlocking means 53 would be deenergized. Now, if the operating member 35 could be moved to the ground position, a polyphase short-circuit would be put on the live feeder 49. This of course must not be done. If under these conditions the operator attempts to move the contacts 15 to the ground position bridging contacts 12 and 13, he will find it impossible to do so since the pin 46 comes to the closed end of the slot on the base 32 when the operating member 35 is in the switch open position. Consequently, the operating handle must be moved from the open position back to the closed position shown in Figs. 3 and 4 before the pin 46 can be released from the slot. However, when the operator completes this closing movement if the feeder 49 is energized, the electromagnetic interlock 53 will be energized even though the circuit breaker 52 is open. Consequently, as soon as the switch is returned to the closed position, it will be locked there by the electromagnetic interlock 53 and the operator will be unable to move it from this position. If however the feeder 49 were not energized and the circuit breaker 52 were open when this return movement to the closing position is made, the operating handle 35 would be free for movement to the ground position upon turning the crank 47 so that the pin 46 associated therewith is moved out of the slot in the base 32. The operating handle may then be moved to the grounding position with the contacts 12 and 13 bridged by the contacts 15. In this position the locking pin 39 may be engaged with the hole 42 in the base 32 and a padlock inserted through the eyes in the locking members 37 and 38 if it is desired to prevent unauthorized operation.

If at any time while the switch is in the grounding position the feeder 49 should be energized at the power source, the capacity of the contacting means in this switch position is sufficient to insure that the short-circuit thus put on the feeder would cause the opening of the feeder at the power station so that the feeder could not be maintained energized without giving notice at the power station that something is wrong.

When the operating handle is returned to the closed position shown in Figs. 3 and 4, the pin 46 will automatically fall into position in the slot of the base 32 due to the effect of gravity when the operating mechanism is mounted, as shown in Fig. 1, but obviously any other suitable biasing arrangement may be employed. It will be noted that if the switch is moved to the open-circuit position and is not held there by the pin 46 having come to the end of the travel in the slot the contacts 15 will, under the bias of gravity, drop into the grounding position, assuming of course that the electromagnetic interlocking means 53 is not excited.

In the schematic circuit arrangement shown in Fig. 9, to illustrate another application of a switch embodying my invention, the contacts 13 are not grounded as in the arrangement shown in Fig. 8 but instead are insulated and connected to suitable testing apparatus whereby the circuit 49 can be tested upon operation of the switch from one of its circuit closing positions, where the contacts 10, 11 are bridged, to the other circuit closing position, where the contacts 12, 13 are bridged.

While I have shown and described my invention in considerable detail, I do not desire to be limited to the exact arrangements shown but seek to cover in the appended claims all those modifications that fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric switch including a plurality of spaced pairs of contacts, a conducting member connecting one contact of one pair to one contact of another pair and means for bridging one pair of contacts at a time including a cooperating movable contact having a portion adjacent said member, said portion being arranged for movement into contacting position between said member and each of the contacts connected thereby, and means for actuating said movable contact to bridge each of said pairs of contacts.

2. An electric switch including a plurality of spaced pairs of contacts, a conducting member connecting one contact of one pair to one contact of another pair and means for bridging one pair of contacts at a time including a cooperating movable contact having a portion adjacent said member, said portion being arranged for movement into contacting position between said member and each of the contacts connected by the member, means

for actuating said movable contact to bridge each of said pairs of contacts, and means for maintaining the movable contact in one of its contact bridging positions.

3. An electric switch including two spaced pairs of oppositely disposed contacts, a conducting member connecting two corresponding contacts of said pairs, and means for bridging one pair of contacts at a time including a cooperating contact movable between said two pairs of contacts and having a portion arranged for movement into contacting position between said member and each of the contacts connected thereby and means for actuating said movable contact to bridge each of said pairs of contacts.

4. An electric switch including two spaced pairs of oppositely disposed contacts, a conducting member connecting two corresponding contacts of said pairs and means for bridging one pair of contacts at a time including a cooperating contact movable between said two pairs of contacts and having a portion arranged for movement into contacting position between said member and each of the contacts connected thereby, said movable contact being constructed and arranged to provide a greater current carrying capacity in one bridging position than in the other, and means for actuating said movable contact to bridge each of said pairs of contacts.

5. An electric switch including two spaced pairs of stationary contacts, a conducting member connecting two corresponding contacts of said pairs and means for bridging one pair of contacts at a time including a cooperating contact movable between said two pairs of contacts and having a bifurcated end portion straddling said member, the bifurcations of said portion being arranged for movement into contacting position between said member and the contacts connected thereby upon movement of said movable contact, and means for actuating said movable contact to bridge each of said pairs of contacts.

6. An electric switch including two spaced pairs of oppositely disposed stationary jaw contacts, a straight conducting member extending from between the jaws of one contact of one pair to between the jaws of the corresponding contact of the other pair and means for bridging one pair of contacts at a time including a cooperating contact movable between said pair of contacts and having a bifurcated end portion straddling said member, the bifurcations of said portion being arranged on movement of said bridging contact to move into contacting position between said member and the jaws of one of the contacts connected thereby and means for actuating said movable contact to bridge a pair of said stationary contacts.

7. An electric switch including a plurality of spaced pairs of contacts, a conducting member connecting one contact of one pair to one contact of another pair and means for engaging one pair of contacts at a time including a cooperating movable contact having a portion adjacent said member, said portion being arranged for movement into contacting position between said member and each of the contacts connected by the member, means operable when said movable contact is disengaged from one of said pairs of contacts to tend to move the movable contact to engage the other pair of contacts.

8. An electric switch including a plurality of spaced pairs of contacts, a conducting member connecting one contact of one pair to one contact of another pair and means for bridging one pair of contacts at a time including a cooperating movable contact having a portion adjacent said member, said portion being arranged for movement into contacting position between said member and each of the contacts connected by the member, and means for actuating said movable contact to bridge each of said pairs of contacts, said actuating means including means for maintaining the movable contact in one of its contact bridging positions.

9. An electric switch including a plurality of spaced pairs of contacts, a conducting member connecting one contact of one pair to one contact of another pair and means for bridging one pair of contacts at a time including a cooperating movable contact having a portion adjacent said member, said portion being arranged for movement into contacting position between said member and each of the contacts connected by the member, means for actuating said movable contact to bridge each of said pairs of contacts, and means for biasing the movable contact for movement in a direction to bridge one of said pairs of contacts.

10. An electric switch including relatively movable contacts and actuating means therefor including an operating member movable to a plurality of positions, means for permitting a limited movement of said member from one of said positions releasable when the member is in said one of said positions to permit a greater movement of the member and means for biasing said member for movement from another of said positions when the motion limiting means is released.

In witness whereof, I have hereunto set my hand this 8th day of January 1931.

HAROLD R. TURNER.