Sept. 26, 1939. H. J. CRABBS 2,174,237

ELECTRIC SWITCH

Filed Feb. 27, 1937 2 Sheets-Sheet 1

Fig. 1.

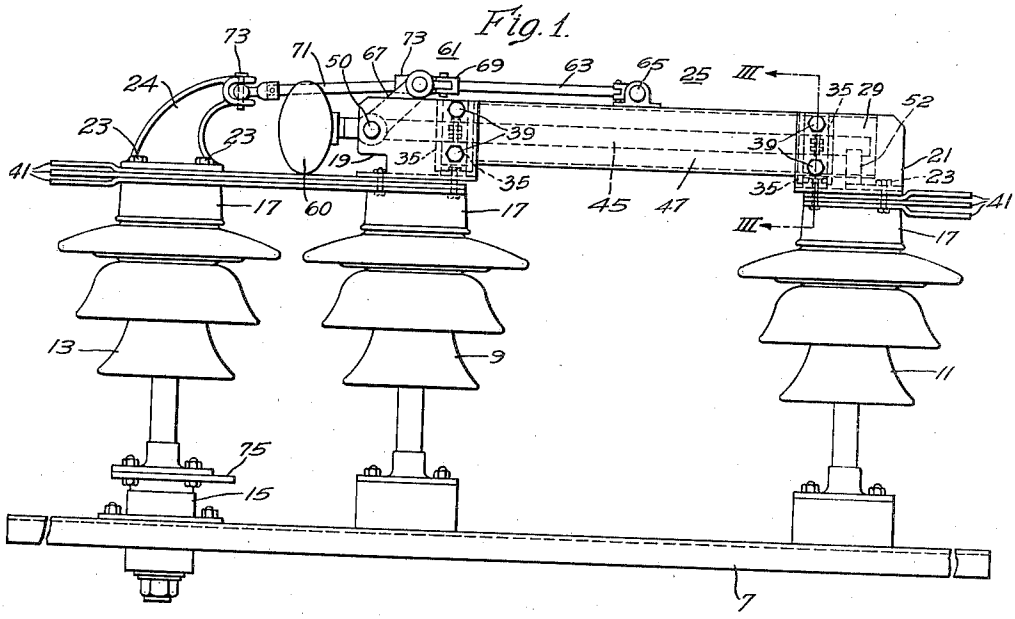


Fig. 2.

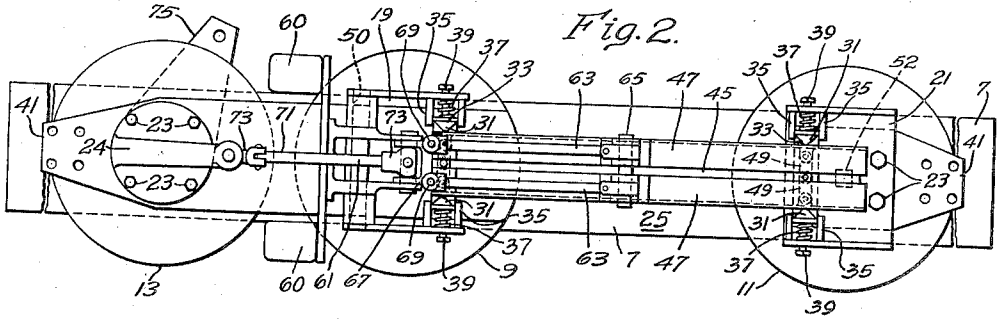
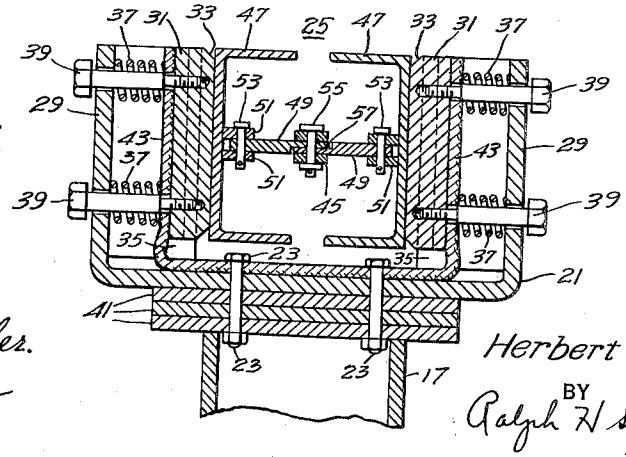


Fig. 3.



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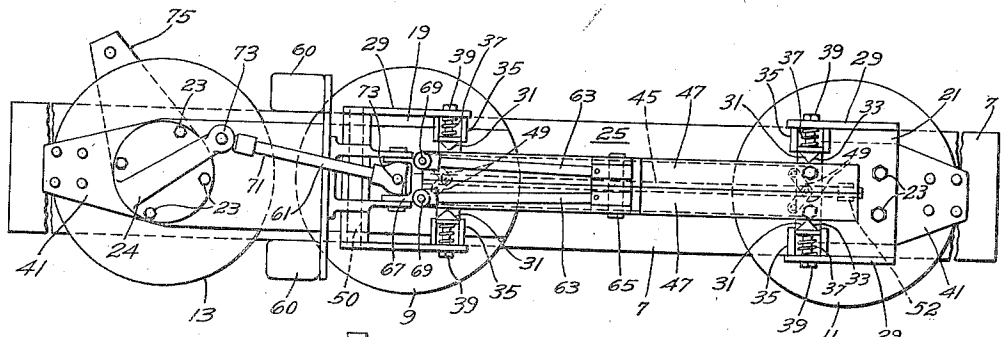
2 Sheets-Sheet 2

Fig. 4.



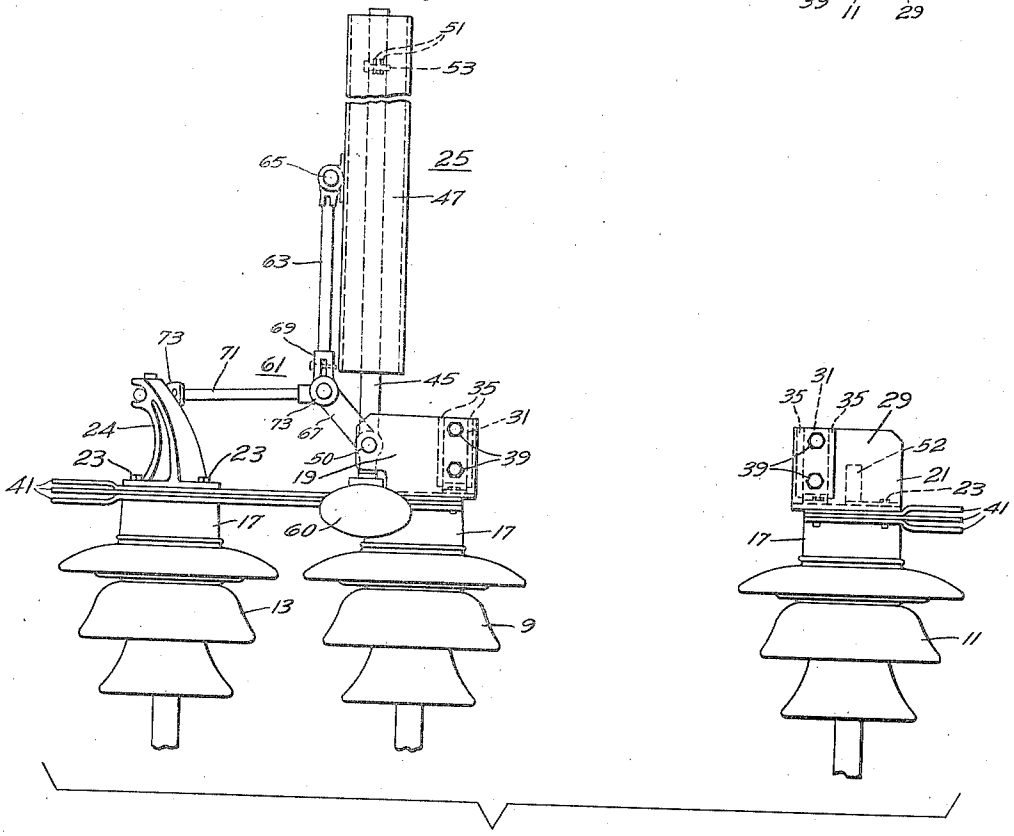


Fig. 5.

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2,174,237

ELECTRIC SWITCH

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Application February 27, 1937, Serial No. 128,198

10 Claims. (Cl. 200—48)

The invention relates to electric switches in general, and more particularly to disconnecting switches for use in electric power distribution systems.

Switches of this type are operated relatively infrequently and hence are subject to corrosion which makes operation of the switch difficult and often causes sticking of the contacts. When used outdoors, ice deposits often have the same effect. This make it difficult to open and close the switch, particularly if the blades are relatively long, and subjects the various parts to stresses for which due allowance must be made at the sacrifice of an otherwise structural economy. The contact surfaces of the switch are subject to the formation of films of foreign matter which have relatively high electrical resistance, thus materially increasing the contact resistance of the switch and producing an undesirable heating action.

The switch structures that have heretofore been known or used have not proved entirely satisfactory for use in the larger capacity power systems. When the size or number of blades are increased to meet increasing power requirements, the operating effort required becomes exceedingly large particularly in the case of large surface low pressure contacts such as have been used in knife type switches. The arrangement of the blades results in an unequal distribution of the currents flowing through the blades due to the peculiar "skin effect" of the heavy alternating currents, resulting in considerable copper wastage in the more centrally located blades.

An object of the invention is the provision of an improved switch structure in which heating and sticking effects are minimized and in which the parts are not subjected to unnecessarily large stresses during the operation of the switch.

Another object of the invention is the provision of an improved switch of high voltage and current carrying capacity which is of rugged construction and is easy to operate.

Another object of the invention is the provision of a vertical break switch embodying an improved blade structure which is capable of carrying extremely large currents with a minimum of conducting section.

Another object of the invention is the provision of a switch embodying an improved movable switch member and cooperating contact structure for securing a plurality of high pressure line contacts which minimize the contact resistance and heating of the switch, and embodying an operating mechanism which requires a minimum operating effort to open and close the switch and which also provides a wiping contact action of the movable switch member on the contacts.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to structure and operation, together with additional objects and advantages thereof will best be understood from the following detailed description of a specific embodiment thereof when read in connection with the accompanying drawings in which:

Figure 1 is a side elevational view of a switch embodying the features of the invention.

Fig. 2 is a plan view of the switch illustrated in Fig. 1.

Fig. 3 is an enlarged sectional view of a portion of the switch taken on the line III—III of Fig. 1, looking in the direction of the arrows.

Fig. 4 is a plan view similar to Fig. 2 illustrating the relative positions of the parts of the switch during the initial period of an opening operation just prior to the swinging of the switch member to the vertical open position; and,

Fig. 5 is a side elevational view of the switch illustrating the relative positions of the parts in the full open position of the switch.

The switch illustrated in the drawings is of the single-pole three-insulator vertical-break type. It includes a channel iron base 7, a pair of spaced insulators 9 and 11 rigidly supported on the base 7, and a third insulator 13 rotatably supported upon the base by a bearing 15. A metallic cap piece 17 is cemented to the top of each of the three insulators. A pair of terminals or jaw members 19 and 21 are secured to the metal cap pieces 17 of the insulators 9 and 11, respectively, and a cast crank arm 24 is secured to the cap piece of the rotatable insulator 13, by means of bolts 23. The jaw member 19 forms a pivot support for a movable switch member indicated generally at 25.

The jaw members 19 and 21 are substantially similar in structure and the same reference characters will be used for the corresponding parts of these members. Each jaw member comprises a U-shaped plate of metallic material having upwardly projecting spaced parallel legs 29 (Fig. 3). Each of the jaw members is provided with one or more pairs of spaced opposed contacts 31. The contacts are of conducting material and are provided with beveled faces which form sharp contact edges 33 for engaging the contact surfaces of the moving switch member 25. The contacts 31 form vertically disposed contact fingers and are mounted for lateral sliding movement within the jaw members by means of the projecting

spaced parallel guide plates 35 which are secured to the side walls or legs 29 of the jaw member in any suitable manner as by welding.

Each of the contact fingers 31 is biased inwardly toward its opposed contact finger by means of a pair of compression springs 37 which are disposed between the back of the contact finger and the leg 29 of the jaw member 27. Inward movement of the contact fingers toward one another is limited by pairs of bolts 39 which pass through suitable openings provided in the legs 29 of the jaw member and which have reduced screw-threaded end portions which are screwed into the body of the contact fingers as shown in Fig. 3. The heads of the bolts 39 limit inward movement of the contact fingers by engaging the outer surface of the legs 29 of the jaw member 27. The springs 37 are held in mounted position by being disposed about the body of the bolts 39. Each of the jaw members 19 and 21 is provided with a plurality of terminal connecting plates 41 which are secured in clamped position between the base of the jaw member and the metal cap piece 17 by means of the bolts 23. The contact fingers 31 are electrically connected with their terminal connecting plates 41 by means of flexible shunts 43, the ends of which are secured to the contact fingers by means of the shoulder portions of the bolts 39 formed by the reduced screw-threaded ends of the bolts. The body portions of the shunts 43 are secured in clamped relation against the upper terminal connecting plates 41 by means of the bolts 23.

It will be noted that the sharp edges 33 of the contact fingers 31 are disposed in parallel planes, so that when the switch is in the closed circuit position the sharp edges form a plurality of high pressure line contacts between the switch member 25 and the contacts 31, thus materially reducing the normal contact resistance of the switch. The contacts 31 form what may be referred to as the contact or jaw portions of the jaw members 19 and 21.

The terminal connecting plates 41 of the jaw member 19 are of greater length than the corresponding terminal connecting plates 41 of the jaw member 21, and are provided with alined circular openings for receiving the metal cap piece 17 of the rotatable insulator 13. The terminal connecting plates 41 of the jaw member 17 thus provide an upper bearing for the rotatable insulator 13 and also serves to mechanically interconnect the insulators 9 and 13 in order to provide an equal distribution of the stresses between the insulators during the operation of the switch.

The movable switch member 25 comprises a supporting rod 45, and a pair of oppositely disposed conducting channel bars 47. The supporting rod 45 is pivoted adjacent one end to the jaw member 19 by means of a transverse pivot pin 50, so that it is supported for swinging movement into and out of engagement with the jaw member 21; the jaw member 21 being provided with a vertically disposed spring clip 52 for frictionally receiving the free end of the rod 45 in the closed position of the switch. The channel bars 47 are disposed on opposite sides of the rod 45 and each bar 47 is connected for swinging movement with the rod 45 by means of a pair of pressure securing links 49, one adjacent each end of the bar 47. The links 49 are pivotally joined at their one end to a pair of spaced lugs 51 by means of a pin 53, the lugs 51 being secured to the web of the channel bar 47 in any suitable manner as by welding. The opposite ends of the links 49 are pivotally connected to the rod 45 by means of a pivot pin 55, these ends of the links being disposed in suitable slots 57 provided in the rod 45. The links 49 which pivotally connect the channel bars 47 to the rod 45 are disposed in alinement on opposite sides of the rod 45 so that they form a toggle linkage at each end of the switch member 25 between the channel bar. The contact pressure securing toggle links 49 permit limited longitudinal and lateral movement of the channel bars 47 with respect to the supporting rod 45 and at the same time secure the channel bars 47 and supporting rod 45 for swinging movement together. The contact pressure securing toggle links 49 are adapted to cooperate with the operating mechanism to spread the channel bars apart during the latter part of the closing operation to force the webs of the channel bars 47 into pressure engagement with the sharp edges 33 of the contact fingers 31 with a wiping contact action, and function during the first part of the opening operation to move the bars 47 laterally toward one another to disengage the webs of the bars from the contact fingers 31 so as to remove the contact pressure and permit free swinging movement of the switch member 25 out of the jaw member 21. A pair of counterweights 60 are secured to the pivot end of the rod 45 for counter-balancing the switch member to minimize the operating effort required to swing the switch member to open position.

The operating means for the switch comprising, in general, the crank arm 24 secured to the rotatable insulator 13, a linkage mechanism indicated generally at 61 for connecting the crank arm with each of the channel bars 47 and the contact pressure securing links 49. The linkage mechanism 61 comprises a pair of links 63 each pivoted at one end to one of the channel bars 47 by means of a transverse pivot pin and universal joint 65 and pivoted at the opposite end to a yoke-shaped lever 67 through a universal joint 69. The ends of the legs of the yoke-shaped lever 67 are pivotally connected to the main pivot pin 50 which pivotally supports the rod 45. A connecting rod 71 connects the crank arm 24 to the yoke shaped lever 67, the rod 71 being connected to the crank 25 and the lever 67 through the agency of universal joints 73.

The operating means previously described is operable during a closing operation of the switch in one continuous rotating movement of the insulator 13, for swinging the switch member 25 in a clockwise direction about the pivot pin 50 to position the ends of the channel bars 47 in the space between the contact fingers 31 of the jaw members 19 and 21, and for then moving both the channel bars longitudinally and laterally with respect to the rod 45 to force the webs of the channel bars 47 into pressure engagement with the sharp edges 33 of the contact fingers 31 with a wiping contact action to secure a plurality of high pressure line contacts between the channel bars 47 and the contacts 31. The operating mechanism is also operable during an opening operation of the switch in one continuous rotating movement of the insulator 13, for moving both channel bars 47 longitudinally in a reverse direction and laterally toward one another to disengage the webs of the bars from the contact fingers 31, and for then swinging the blade member 25 to a vertical position away from the jaw members 19 and 21 as shown in Fig. 5.

Let it be assumed that the switch is in the closed circuit position as shown in Fig. 1 and it is desired to open the circuit. The rotatable insulator 13 is rotated in a counter-clockwise direction through the agency of the crank lever 75. During the first part of this rotational movement of the insulator 13, the crank arm 24 exerts a pulling force on each of the channel bars 47 which is transmitted thereto through the agency of the connecting rod 71 and the links 63. This pulling force moves both channel bars 47 longitudinally toward the left, and since the rod 45 is held stationary by its pivot 50 and the spring clip 52, the action of the pressure securing links 49 causes the channel bars to move laterally toward one another until their edges engage so as to disengage the webs of the bars from engagement with the contact fingers 31. The contact fingers 31 move inwardly with the blade until the heads of the bolts 39 engage the sides of the jaw members. This position of the parts is illustrated in Fig. 4. The continued rotation of the insulator 13 causes the crank arm 24 to swing the rod 45 out of its spring clip 52 and carry the channel bars 47 connected thereto in a counter-clockwise direction to the vertical open position as shown in Fig. 5. The switch member is caused to swing to the open position during this continued rotation of the insulator 13 because of the fact that the channel bars 47 have reached the limit of their longitudinal movement determined by the pressure securing links 49, the opposite edges of the channel bars having engaged one another.

To close the switch, the rotatable insulator 13 is rotated in a clockwise direction. This clockwise rotation of the insulator first swings the switch member in a clockwise direction about the pivot pin 50 to position the ends of the channel bars between the opposed contact fingers 31 of each of the jaw members. At this point the free end of the rod 45 will have engaged the spring clip 52 which prevents any further clockwise rotation of the switch member 25. The continued rotation of the insulator 13, after the swinging movement of the rod 45 has been stopped, causes the crank arm 24 to exert a pushing force on both channel bars 47 which is transmitted thereto through the agency of the connecting rod 71 and the links 63. This pushing force exerted by the crank arm 24 moves both channel bars 47 longitudinally with respect to the rod 45 and toward the right. This longitudinal movement of the channel bars 47 with respect to the rod 45 causes the pressure securing links 49 to move the channel bars laterally away from one another as the links 49 go into toggle position, so that the webs of the channel bars are forced into pressure engagement with the sharp edges 33 of the contact fingers 31 at both ends of the switch. The longitudinal and lateral movement of the channel bars produces a wiping contact action between the webs of the bars and the edges 33 of the contact fingers 31.

The wiping contact action is produced both during opening and during closing operations of the switch thus producing a desirable cleaning action of the contacting surfaces to effectively remove any film or corrosion that may exist on these surfaces.

The contact fingers 31 are of such length that contact is made clear across the web of each channel bar 47. The lateral spreading action of the channel bars 47 during the latter part of each closing operation, coupled with the pressure exerted by the biasing springs 37, provides a high contact pressure between the sharp edges 33 of the contact fingers 31 and the webs of the channel bars 47. It will thus be seen that the switch structure provides a plurality of high pressure line contacts between the switch member and the contacts of the jaw members which reduces the normal contact resistance of the switch and prevents any undesirable heating.

The use of the conducting channel bars oppositely arranged so that their edges face each other, provides an extremely efficient conducting means for the heavy currents flowing through the switch. The opposed channel bars form a substantially hollow conductor that resembles a hollow square in cross-section which forms an ideal conductor for the heavy alternating currents. This structure of the switch member permits the switch to carry extremely high values of alternating current with a minimum of copper section, thus materially reducing the production cost of the switch.

The operating mechanism including the crank arm 24, the linkage mechanism 61 and the contact pressure securing links 49, which connect the channel bars to the supporting rod 45, provides the high pressure contact switch structure which can be operated with a very small operating effort due to the fact that the contact pressure securing means is operable only after the switch member has been swung to closed circuit position and that is rendered inoperative before the switch member is swung to the open circuit position. The mechanism permits the switch member 25 to be moved freely into and out of engagement with the jaw members.

It will be noted that the crank arm 24 and the connecting rod 71 form a toggle arrangement which is collapsed when the switch is open and which is in toggle when the switch is closed, so that the switch cannot be blown open by magnetic reaction when carrying heavy currents.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes may be made in the structural details thereof without departing from the spirit of the invention. It is desired, therefore, that the invention be limited only by the reasonable construction of the appended claims and by the prior art.

I claim as my invention:

1. In an electric switch, a pair of spaced terminals, a switch member comprising a pair of oppositely disposed parallel channel bars for bridging said terminals, operating means for moving said switch member to move the ends of said bars from a position away from said terminals to a position in proximity to said terminals and for thereafter moving said bars longitudinally and laterally with respect to one another to force the webs of said channel bars into pressure engagement with said terminals with a wiping contact action.

2. In an electric switch, a pair of spaced terminals, a switch member pivoted about a point near one of said terminals and remote from the other, said switch member comprising a pair of switch blades for bridging said terminals, operating means operable in one continuous movement for moving the ends of said blades from a position away from said terminals to a position in proximity to said terminals and for then moving both blades longitudinally and laterally with respect to each other so as to force the blades

into pressure engagement with said terminals with a wiping contact action.

3. In an electric switch, a pair of spaced terminals, a switch member comprising a pair of switch blades for bridging said terminals, operating means operable during a closing operation in one continuous movement for successively moving said blades to move the ends thereof from a position away from said terminals to a position in proximity to said terminals and for then moving both blades longitudinally and laterally with respect to each other so as to force the ends of the blades into pressure engagement with said terminals with a wiping contact action, and operable during an opening operation in one continuous movement for moving both blades longitudinally and laterally with respect to each other so as to remove the pressure engagement of the blade ends with said terminals, and for then moving the blades freely to a position away from said terminals.

4. In an electric switch, a pair of spaced terminals, a switch member pivoted about a point near one of said terminals and remote from the other, said switch member comprising a pair of oppositely disposed parallel channel bars for bridging said terminals, operating means operable during a closing operation in one continuous movement for moving said bars to move their ends from a position away from said terminals to a position in proximity to said terminals and for then moving both bars longitudinally and laterally with respect to each other so as to force the webs of the bars into pressure engagement with said terminals with a wiping contact action, and operable during an opening operation in one continuous movement for moving both bars longitudinally and laterally with respect to each other so as to remove the pressure engagement of the webs of the bars with said terminals and for then freely moving said bars to a position away from said terminals.

5. In an electric switch, a pair of spaced jaw members each provided with a pair of spaced opposed contact surfaces, a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with said other jaw member, a pair of switch blades disposed on opposite sides of said rod and connected thereto by a contact pressure securing means which permits limited longitudinal and lateral movement of said blades with respect to said rod, actuating means connected to said blades operable in one continuous movement during a closing operation for swinging said switch member to freely position the ends of said blades in the space between said contact surfaces of said jaw members and for then operating said contact pressure securing means to move both blades longitudinally and laterally so as to force the ends of the blades in pressure engagement with said contact surfaces with a wiping contact action, and operable in one continuous movement during an opening operation for actuating said pressure securing means to move said blades longitudinally and laterally so as to remove the contact pressure and for then swinging said blades to a position away from said jaw members.

6. In an electric switch, a pair of spaced jaw members, each provided with a pair of spaced opposed contacts, a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with the other jaw member, a pair of parallel switch blades disposed on opposite sides of said rod and each connected to said rod for movement therewith by a pair of links which permit limited longitudinal and lateral movement of each blade relative to said rod, actuating mechanism comprising a rotatable crank arm and a link mechanism connecting said crank arm to said blades, said mechanism being operable during a closing operation in one continuous movement of said crank arm to swing said switch member so as to position the ends of said blades in the space between said contacts and to then move both blades longitudinally and laterally with respect to said rod to force the ends of said blades into pressure engagement with said contacts with a wiping contact action, and operable during an opening operation in one continuous movement of said crank arm to move said blades longitudinally and laterally with respect to said rod so as to remove the pressure engagement of said blades with said contacts and to then swing the blades to open position away from said jaw members.

7. In an electric switch, a pair of spaced jaw members, each provided with a pair of spaced opposed contacts, a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with the other jaw member, a pair of parallel switch blades disposed on opposite sides of said rod and each connected to said rod for movement therewith by a pair of links which permit limited longitudinal and lateral movement of each blade relative to said rod, actuating mechanism comprising a rotatable crank arm and a link mechanism connecting said crank arm to said blades, said mechanism being operable during a closing operation in one continuous movement of said crank arm to swing said switch member so as to position the ends of said blades in the space between said contacts and to then move both blades longitudinally and laterally with respect to said rod to force the ends of said blades into pressure engagement with said contacts with a wiping contact action, and operable during an opening operation in one continuous movement of said crank arm to move said blades longitudinally and laterally with respect to said rod so as to remove the pressure engagement of said blades with said contacts and to then swing the blades to open position away from said jaw members, said contacts having parallel sharp edges for engaging said blades to provide a plurality of line contacts between said blades and said contacts when the switch is closed.

8. In an electric switch, a pair of spaced jaw members, each provided with a pair of spaced opposed contacts a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with the other jaw member, a pair of parallel switch blades disposed on opposite sides of said rod and each connected to said rod for movement therewith by a pair of links which permit limited longitudinal and lateral movement of each blade relative to said rod, actuating mechanism comprising a rotatable crank arm and a link mechanism connecting said crank arm to said blades, said mechanism being operable during a closing operation in one continuous movement of said crank arm to swing s aid switch member so as to position the ends of said blades in the space between said contacts and to then move both blades longitudinally and laterally with respect to said rod to force the ends of said

blades into pressure engagement with said contacts with a wiping contact action, and operable during an opening operation in one continuous movement of said crank arm to move said blades longitudinally and laterally with respect to said rod so as to remove the pressure engagement of said blades with said contacts and to then swing the blades to open position away from said jaw members, said link mechanism forming a toggle which is collapsed in the open position of the switch and which is in toggle in the closed position of the switch to hold said switch closed.

9. In an electric switch, a pair of spaced jaw members each provided with a pair of spring biased spaced contacts, a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with the other jaw member, a pair of parallel channel bars disposed on opposite sides of said rod with their edges facing each other, each bar being connected to said rod for movement therewith by a pair of spaced links pivotally connected at their one end to said rod and at their other ends to said bar, said links permitting limited longitudinal and lateral movement of said bars relative to said rod, actuating means for said switch member operable in one continuous movement during a closing operation for swinging said switch member so as to position the ends of said bars in the space between said contacts, and for then moving both bars longitudinally and laterally with respect to said rod to force the webs of said bars into pressure engagement with said contacts with a wiping contact action, and operable during an opening operation in one continuous movement for moving said bars longitudinally and laterally with respect to said rod to disengage the bars from said contacts with a wiping action and for then swinging said switch member to the open circuit position away from said jaw members.

10. In an electric switch, a pair of spaced jaw members each provided with a pair of spring biased spaced contacts, a movable switch member comprising a rod pivoted to one of said jaw members for swinging movement into and out of engagement with the other jaw member, a pair of parallel channel bars disposed on opposite sides of said rod with their edges facing each other, each bar being connected to said rod for movement therewith by a pair of spaced links pivotally connected at their one end to said rod and at their other ends to said bar, said links permitting limited longitudinal and lateral movement of said bars relative to said rod, actuating means for said switch member operable in one continuous movement during a closing operation for swinging said switch member so as to position the ends of said bars in the space between said contacts, and for then moving both bars longitudinally and laterally with respect to said rod to force the webs of said bars into pressure engagement with said contacts with a wiping contact action, and operable during an opening operation in one continuous movement for moving said bars longitudinally and laterally with respect to said rod to disengage the bars from said contacts with a wiping action and for then swinging said switch member to the open circuit position away from said jaw members, said contacts having parallel sharp edges for engaging the webs of said channel bars to provide a plurality of high pressure line contacts between said bars and said contacts.

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