Sept. 10, 1929. O. C. TRAVER 1,728,020

ELECTRIC SWITCH

Filed Jan. 16, 1924

Fig. 1.

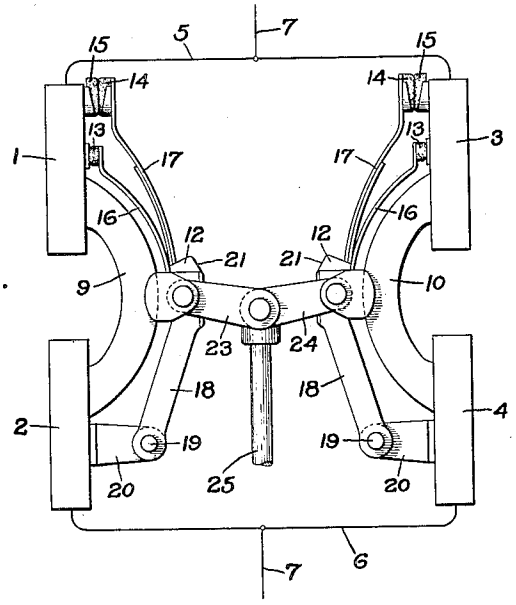
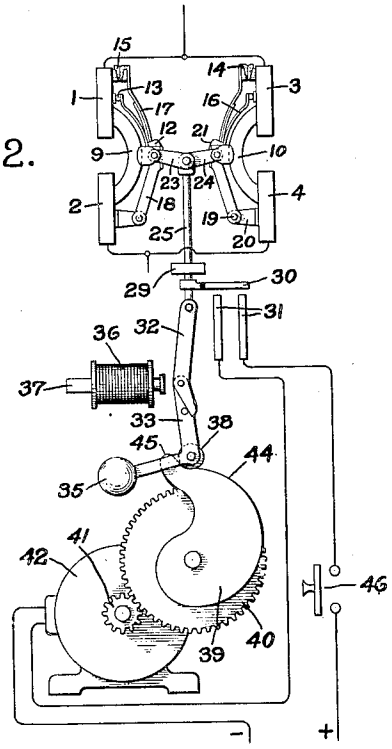


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELECTRIC SWITCH.

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My invention relates to electric switches and their operating mechanism, and particularly to switches of large capacity.

One object of my invention is to provide an improved construction of heavy duty electric switch wherein the current carrying members provide parallel paths for the current and are arranged and connected so that the magnetic effect of the current will not tend to lock the switch in closed position when tripped upon the occurrence of a heavy overload or short circuit on the line, but will have the effect rather of accelerating the opening of the switch at such times.

Another object of my invention is to provide an improved power driven mechanism for closing a heavy duty switch particularly where, by reason of the construction of the switch, the load current exerts a reaction against the closing mechanism.

In switches of large capacity the forces produced by the currents flowing through the switch members attain a magnitude which becomes of importance from a practical standpoint. Where a compact arrangement is made in which the current carrying members are not widely separated, these forces may be so great as to prevent the proper operation of the switch. It is well known that two parallel conductors carrying current in the same direction tend to attract each other and that where the currents are in opposite directions the conductors tend to repel each other. By reason of these forces, which are encountered in heavy current work, a switch which is supposed to be automatically opened in case of an overload, for example, may actually be held closed. In accordance with my invention I arrange the current carrying members of the switch so as to take advantage of these forces to insure and facilitate the proper opening of the switch. The mechanism for opening the switch does not need to exert power to overcome the magnetic holding action of the current, since such magnetic action actually forces the switch open as soon as the means, which normally holds the switch closed, is tripped. The magnetic forces become especially great in case of abnormal currents, such as are due to a short circuit on the system and the automatic opening of the switch is, therefore, rapid and certain. My arrangement which secures the advantages mentioned requires an operating mechanism for closing the switch, which not only is able to overcome the forces ordinarily required to force the switch members into good contact but is also able to overcome the magnetic forces which are present when full load current flows at the instant the contacts engage. The operating mechanism is also arranged to provide the trip-free-release feature well known in the art whereby the switch may be opened automatically in case of overload independently of the position of the operating mechanism so that the switch cannot be held closed on a short circuit, for example.

My invention will be better understood by reference to the accompanying specification and drawing and its scope will be pointed out in the appended claims.

Figure 1 is a side elevation of a switch involving my invention, and Fig. 2 is a diagrammatic view showing power driven operating mechanism therefor.

Referring first to the switch shown in Fig. 1, the stationary elements of the switch comprise four contact blocks 1, 2, 3 and 4, blocks 1 and 2 forming one pair and blocks 3 and 4 forming another pair. Corresponding blocks of the two pairs, namely blocks 1 and 3 and blocks 2 and 4 are connected together by conductors 5 and 6 and these two conductors are adapted to be connected in the line 7 as shown. Two movable bridging contact members 9 and 10 serve to control the connection respectively between the contact blocks 1 and 2 forming the one pair and the contact blocks 3 and 4 forming the other pair. Each contact member 9 and 10 is shown secured to a member 12 which carries a secondary contact 13 and a tertiary contact 14 preferably of carbon which engages a similar carbon contact 15 secured to the corresponding contact block. These secondary and tertiary contacts are carried on the ends of springs 16 and 17 respectively to engage resiliently the stationary contacts in the usual and well

known manner. Each contact carrying member 12 is shown provided with an extension 18 which is pivotally supported at 19 on a bracket 20 secured to the adjacent stationary contact. Each member 12 also has a bevel face 21, which faces strike each other when the switch is opened and serve to limit the opening movement. For moving the contact carrying blocks 12 toward and away from each other to open and close the switch I have illustrated by way of example a simple toggle mechanism comprising links 23 and 24 connected at their common pivotal point to an operating rod 25. For insulating purposes the links 23 and 24 are preferably constructed of a suitable non-conducting material, although insulation may be secured in any desired manner. In the closed position of the switch, as illustrated, the toggle is underset and when the switch is to be opened the toggle latch is tripped to allow the toggle to collapse. By arranging the movable contact members of the switch to engage adjacent sides of the stationary contact blocks and by providing an operating toggle between the movable contacts, a simple and compact arrangement is effected. By this arrangement of the contacts together with the manner of connecting of the stationary contacts with the circuit to be controlled, as shown in the drawing, advantage is taken of the magnetic effect of the current to prevent the possibility of the contacts being locked closed on an overload or short circuit since there is no tendency of the magnetic effect of the current to hold the switch in closed position. On the contrary the magnetic effect of the current will assist in effecting a quick opening of the switch when tripped out on an overload or short circuit since by reason of the fact that the current traverses the right and left halves of the switch in the same direction and the fact that these two halves are relatively close together, the magnetic flux of the two paths will encircle the entire switch and, when heavy currents are being carried, will exert a powerful contractive force on the bridging contact members 9 and 10. This force as will be readily apparent from the drawing will in no case cause a locking of the switch in closed position but on the contrary will materially assist in accelerating the opening movement thereof when, for instance, the switch is tripped out in response to an abnormal overload or short circuit.

While I have illustrated but a single pair of bridging contact members 9 and 10 it will be obvious that a plurality of pairs of such contact members may be used, arranged side by side and actuated by the same operating mechanism, in order that the switch may be made for any desired capacity.

From the above consideration, it will be seen that whenever the switch is closed with a load on the circuit, the actuating mechanism must have sufficient power not only to overcome the usual frictional resistance of the moving parts and press the contacts together with the necessary firmness for good conductivity but must overcome the above described magnetic effect. To provide the necessary force to insure a complete closing of the switch under such circumstance, particularly when the load is comparatively heavy, I have provided the motor driven cam operated mechanism illustrated by Fig. 2. The switch here shown is the same as that illustrated by Fig. 1 but in this case is drawn to a smaller scale.

The operating rod 25 extends through a guide 29 and has attached near its lower end a switch arm 30 which is shown adapted to make sliding contact with the contacts 31 whenever the main switch is not in closed position. The lower end of the rod 25 connects with toggle links 32 and 33, the latter being in the form of a bell crank which is retained at its pivotal point in a suitable guide, not shown, and carries a weight 35. The toggle formed by these links is adapted to be overset by the weight 35 and in this position is adapted to transmit vertical movement to the operating rod 25 to close the main switch. A tripping coil for the toggle is shown at 36 having a plunger 37 which coil is to be understood as representative of any electromagnetic means for causing the release of the toggle and the consequent opening of the switch under certain predetermined conditions. Pivoted to the link 33 is a roller 38 adapted to roll on the face of the cam 39 which may be connected to be driven as shown through a gear 40 and a pinion 41 from an electric motor 42.

The greater portion of the face of the cam 39 is of a general spiral form which portion merges into a portion 44 having a uniform radius and this latter portion terminates in a lip 45 which by engaging the roller 38 is adapted to limit further movement of the cam. The motor 42 is shown connected in series with the switch 30 and with a hand switch 46.

Assuming that the main switch has been tripped open by the operation of the tripping magnet 36 and the switch 30 is thereby closed, a closing of the switch 46 by the operator causes the motor to start rotating the cam. As soon as the lip 45 passes the roller 38, the weight 35 sets the toggle links 32, 33 and upon continued rotation of the cam the roller rides on the cam face and moves the switch to closed position. When the roller reaches the portion 44 of the cam the main switch has reached its final closed position and the switch 30 opens the motor circuit. The momentum of the motor and cam may carry the cam on to the point where the lip in engaging the roller arrests

further movement. The cam obviously may be given any desired shape to compensate for variations of opposing force and to produce whatever movement of the switch is desired. It is preferably so shaped that the closing movement of the switch is more rapid at the beginning and less rapid as it reaches its final position where, as has been pointed out above, the greatest closing force may be required.

Having thus described one embodiment of my invention, I do not wish to be limited to the particular form shown and described as it will be apparent that many modifications therein may be made without departing from the scope of my invention as set forth in the appended claims.

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

1. An electric switch comprising a pair of fixed contacts, a movable bridging contact cooperating therewith, a second pair of fixed contacts spaced from said first pair of contacts, a movable bridging contact cooperating therewith, means electrically connecting together the corresponding contacts of said fixed pairs of contacts, said bridging contacts being arranged in the space between the fixed contacts and having operating mechanism adapted to move them toward each other to open the switch.

2. An electric switch comprising oppositely positioned stationary contacts, an electrical connection therebetween, a movable contact for engaging each of said stationary contacts, said movable contacts being mounted to move toward each other to disengage from the stationary contacts and means for simultaneously moving the movable contacts whereby the current flowing when the switch is closed exerts a force tending to move them toward each other.

3. An electric switch comprising oppositely positioned pairs of stationary contacts, a movable contact for bridging each of said pairs of stationary contacts, and conducting means connecting together corresponding contacts of each pair of stationary contacts, said movable contacts being mounted to move toward each other to disengage from said stationary contacts.

4. An electric switch comprising spaced pairs of stationary contacts, movable contacts arranged in the space separating said stationary contacts adapted to bridge the contacts comprising each of said pairs, and means electrically connecting together the corresponding contacts of the pairs of stationary contacts.

5. An electric switch comprising oppositely positioned pairs of stationary contacts, a pair of movable contact members adapted when separated to connect together the contacts forming each of said pairs, means electrically connecting together corresponding stationary contacts thereby causing the same direction of current flow in both of said movable contact members and means for moving said movable contact members in opposite directions.

6. An electric switch comprising opposed spaced pairs of stationary contacts, separate movable contact members for engaging each pair of stationary contacts, conductors connecting together corresponding stationary contacts thereby causing the same direction of current flow in said movable contact members, said movable contact members being arranged in the space separating said stationary contacts and an operating mechanism for simultaneously moving said movable contact members in opposite directions.

7. In combination, a switch operating member, a motor driven cam for moving the member to close the switch, and means effective when the cam reaches a predetermined position for deenergizing the motor, said cam having a lip for limiting the movement thereof after reaching the closed circuit position and the motor deenergizing position.

8. In combination, a switch operating member, a motor driven cam, a collapsible connection between the member and the cam, the cam having a portion of its face formed with a uniform radius and terminating in a lip, and a switch effective when the connection reaches the uniform radius portion of the cam to open the circuit of the motor, the lip limiting the further movement of the cam.

9. In combination, a switch operating member, a cam, a collapsible connection therebetween, means independent of the cam for causing the connection to collapse and gravity actuated means for restoring the connection to its extended condition.

10. In combination, a switch operating member, a cam, a collapsible connection adapted when in its extended condition to transmit movement from the cam to the member, an electroresponsive device for controlling the collapse of the connection, and means comprising a weight controlled by the position of the cam for restoring the connection to its extended condition.

11. An electric switch comprising two pairs of opposed fixed contacts, a movable bridging contact for each pair of fixed contacts, means for moving the bridging contacts simultaneously in opposite directions to engage the fixed contacts, and circuit connections with the fixed contacts arranged to include the bridging contacts in parallel circuits and to cause the magnetic effect of the current carried thereby to tend to move the bridging contacts to open circuit position.

In witness whereof I have hereunto set my hand this 15th day of January, 1924.

OLIVER C. TRAVER.