G. E. PALMER.

MAGNETIC BREAK SWITCH.

APPLICATION FILED MAY 10, 1912.

1,084,104.

Patented Jan. 13, 1914.

3 SHEETS—SHEET 1.

Fig. 1

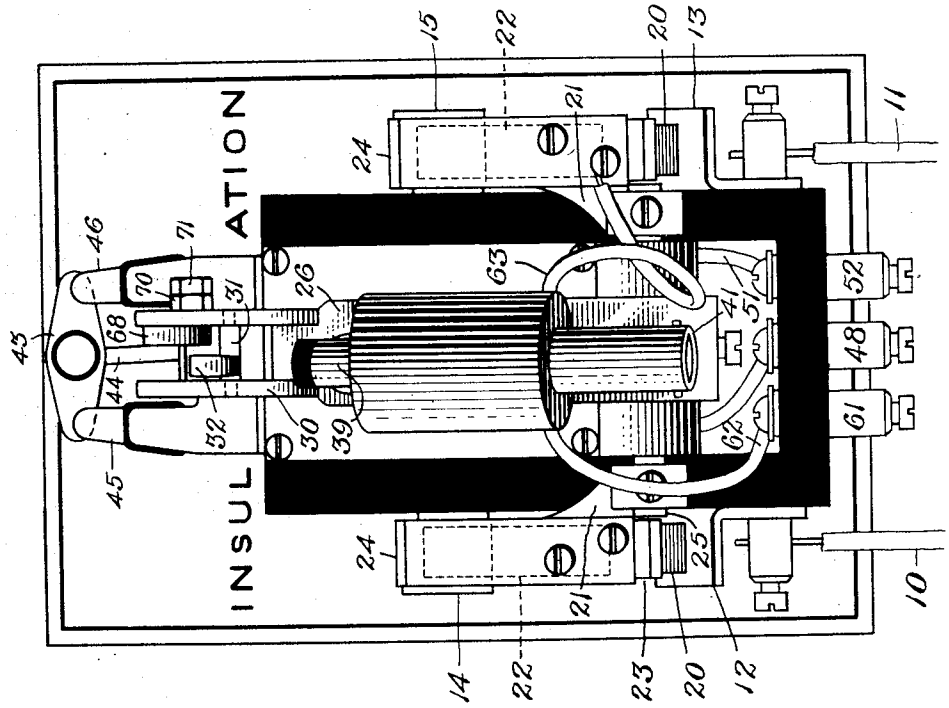
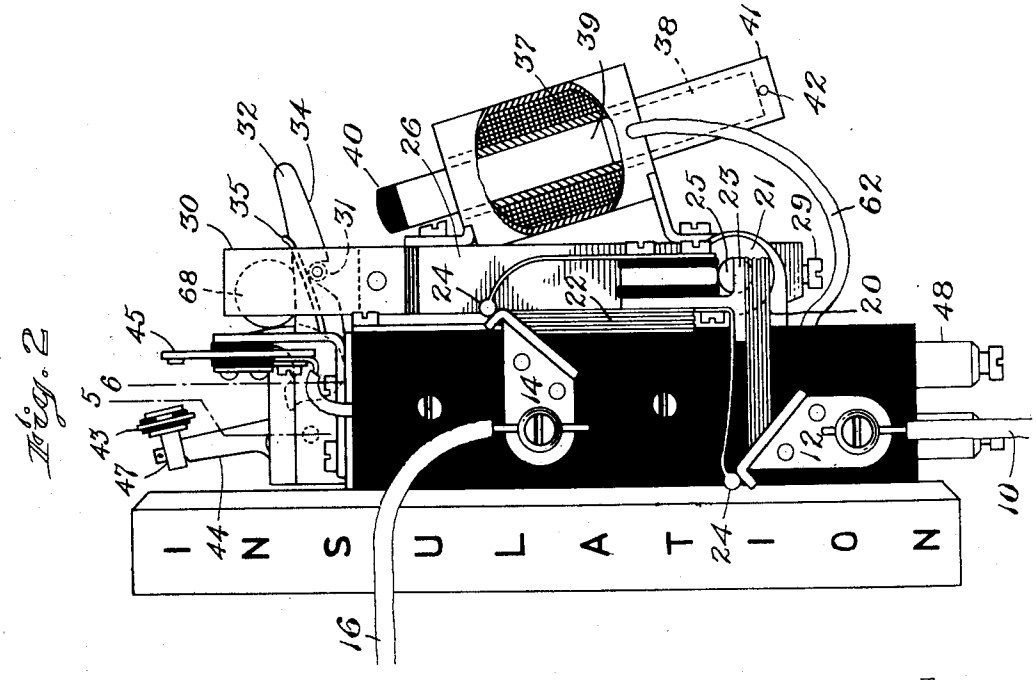


Fig. 2



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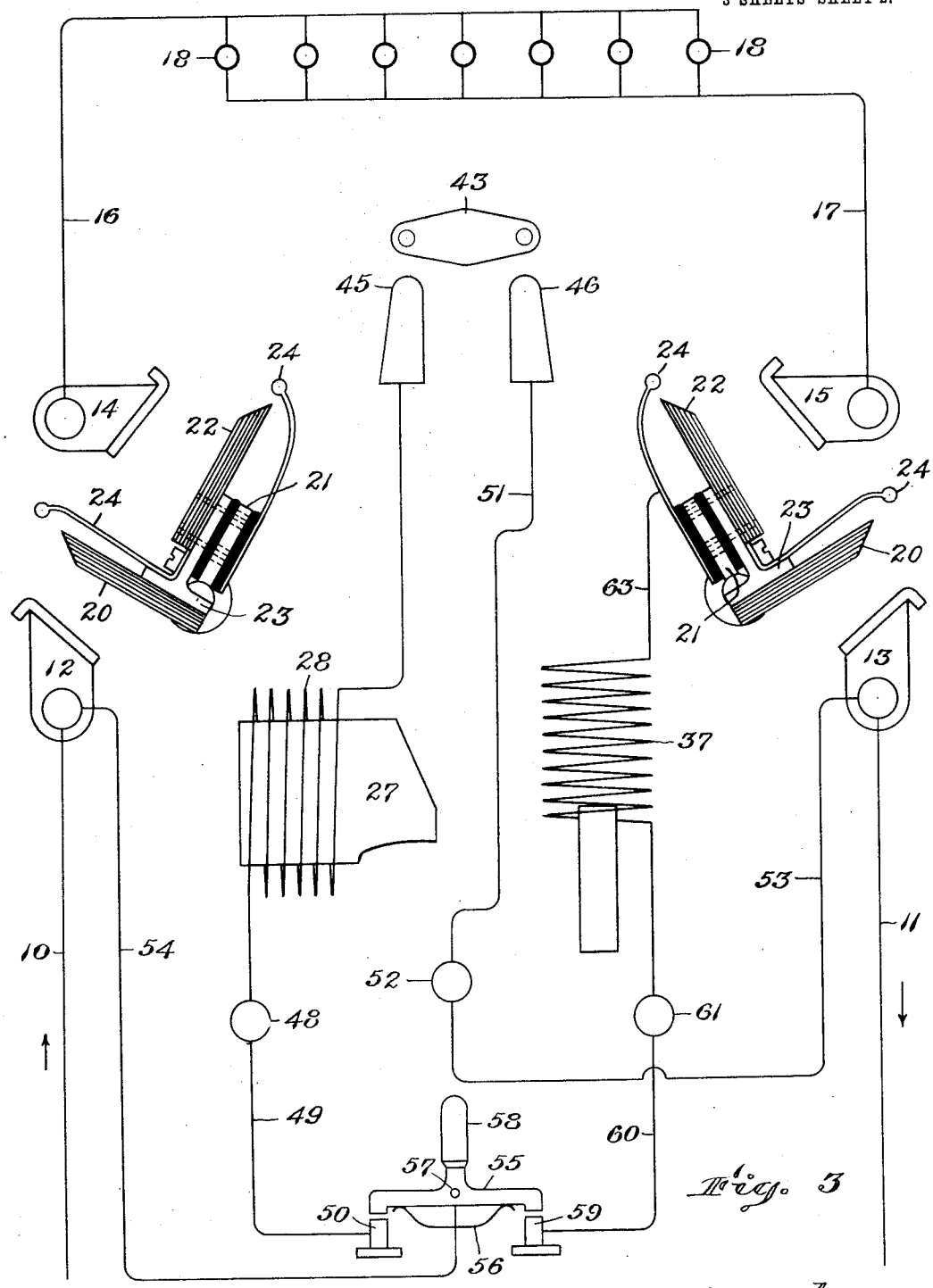


Fig. 3

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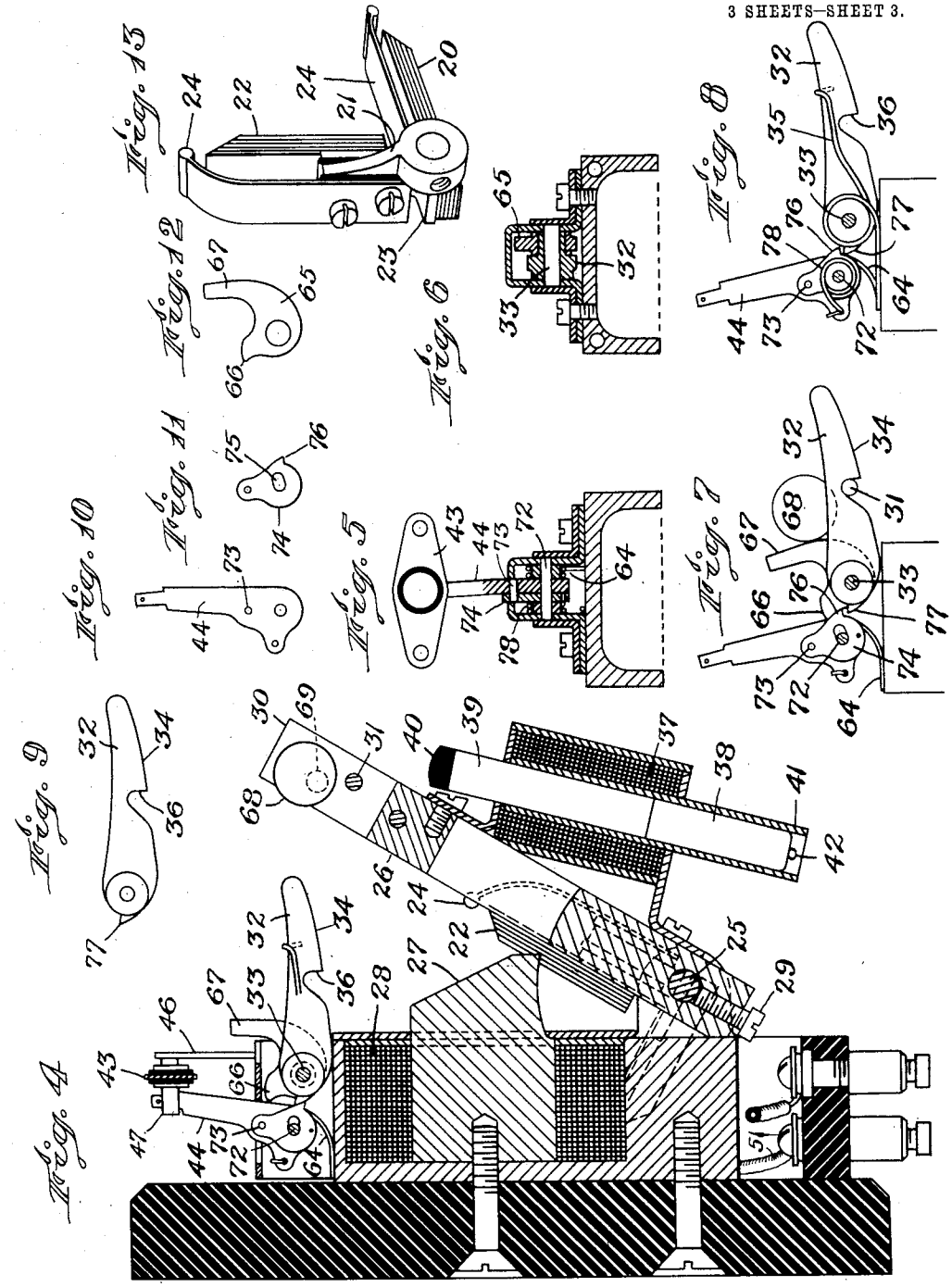
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3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

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MAGNETIC BREAK-SWITCH.

1,084,104. Specification of Letters Patent. Patented Jan. 13, 1914.

Application filed May 10, 1912. Serial No. 696,452.

To all whom it may concern:

Be it known that I, GRANVILLE E. PALMER, a citizen of the United States, and resident of Brookline, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Magnetic Break-Switches, of which the following is a specification.

The present invention relates to magnetically operated break switches, and one of its objects is to provide a switch of this character having a plurality of fixed contacts for each pole, and an equal number of movable contacts so arranged as to simultaneously make and simultaneously break connection at a plurality of points of each pole. Each pair of coactive contacts comprises a rigid contact and a flexible laminated contact, and the movable contact of each pair is so movable as to avoid destructive gouging of the rigid contact by the laminated contact. The contacts are so arranged that the break occurs at the highest point of the contacting surfaces in each case, thus avoiding the burning of the contacts by the electric arc which occurs at the instant of breaking the metallic connection. The arrangement of the contacts is also such that when the switch is opened every movable contact describes an arc of a circle which the electric arc would naturally be caused to assume by the hot air current produced thereby.

The switch to which the present invention relates is provided with mechanical means for locking it in closed position.

The invention comprises means for causing the switch to open immediately if for any reason it fails to close completely. In this connection an auxiliary switch is provided which normally remains closed when the main switch is open and which is opened by the closing movement of the main switch. The auxiliary switch remains closed during the greater part of the closing movement of the main switch but is opened ever so slightly in advance of the closing of the main switch. The completion of the closing movement of the main switch is therefore effected by the momentum which the moving parts acquire prior to the opening of the auxiliary switch. Mechanism is provided for holding open the auxiliary switch after it has been opened by the closing movement of the main switch, until the main switch has thereafter been opened nearly to its limit of opening movement. If for any reason the main switch should not be completely closed after opening the auxiliary switch, the moving elements return to their initial open position, due partly to gravity and partly to the force of a spring acting upon the locking device, during which opening movement the auxiliary switch, as previously explained, is held open for the purpose of enabling the moving parts to recede to a sufficiently distant position prior to the closing of the auxiliary switch to enable the moving elements to acquire the necessary momentum during the subsequent closing movement to fully close. In the event of failure of the main switch to close properly when the controlling circuit is closed for that purpose, it immediately opens and attempts once more to close, with such rapidity that it may operate as many as four or five times within the usual period of time when a manually operated closing switch is held closed.

Other features of the invention are hereinafter explained and are illustrated on the accompanying drawings which illustrate one form in which the invention may be embodied.

On the drawings: Figure 1 represents a front elevation of the switch in closed position. Fig. 2 represents a left side elevation of the same, in which the opening magnet is broken away to expose the interior structure. Fig. 3 represents a wiring diagram relating to the switch. Fig. 4 represents a central vertical section of the switch in open position. Fig. 5 represents a vertical section of the mechanism intersected by broken line 5 of Fig. 2. Fig. 6 represents a vertical section through the mechanism intersected by broken line 6 of Fig. 2. Fig. 7 represents an elevation of the trip mechanism which controls the auxiliary switch, the position of the parts corresponding to closed position of the main switch as shown by Fig. 2. Fig. 8 represents a view similar to Fig. 7, including the springs which act in one direction upon the moving parts. Fig. 9 represents an elevation of the locking member. Fig. 10 represents an elevation of the arm which carries the movable contact of the auxiliary switch. Fig. 11 represents an elevation of a latch which is mounted upon the member shown by Fig. 10. Fig. 12 represents a lever which is ac-

tuated by the armature of the closing magnet to transmit movement to open the auxiliary switch. Fig. 13 represents a perspective view of one of the movable units of the main switch.

The same reference characters indicate the same parts wherever they occur.

Referring first to Figs. 1, 2 and 3, the main feed wires are indicated at 10 and 11. These wires are connected respectively to fixed contacts 12 and 13. A fixed contact bearing special relation to contact 12 is indicated at 14, while a similar fixed contact indicated at 15 is similarly disposed with relation to the contact 13. Conductors 16 and 17 connected respectively to the contacts 14 and 15 lead to the points where the main current is to be used. Fig. 3 includes a plurality of symbols 18 which represent incandescent lamps in circuit with the conductors 16 and 17.

A movable switch unit such as that shown by Fig. 13 is used to form connection between the stationary contacts 12 and 14, and a similar unit is used to form connection between the contacts 13 and 15. These two movable switch units are substantially identical in construction, and a description of one will be sufficient for both.

A laminated movable contact 20 is affixed to an oscillatory carrier 21 in position to engage one of the stationary contacts, while a similar laminated movable contact 22 likewise affixed to the carrier 21 is so mounted as to coöperate with the other stationary contact. The movable contacts 20 and 22 in the one case coöperate respectively with the contacts 12 and 14, while in the other case they coöperate respectively with the contacts 13 and 15. The movable contacts 20 and 22 are electrically connected with each other at all times by a metallic member 23, but the members 20, 22 and 23 are insulated from the carrier 21. Each pair of coactive contacts is provided with a spark tip 24 which prolongs the metallic connection when the switch is opened. These spark tips are movable with and electrically connected with the contacts 20 and 22 but are insulated from the carriers 21.

The two movable switch units are affixed upon a rockshaft 25 so that they move in unison to open and close the line across the gap between the stationary contacts. The spark tips are, as usual, adapted to engage the stationary contacts when the switch is closed, and to remain in contact for a short space of time after the movable contacts 20 and 22 have been retracted from their respective stationary contacts. These spark-tips may be omitted, but it is to be understood that when used, they constitute, in effect, the longest or highest leaf of the brush, and the claims are to be read with this understanding.

The rockshaft 25 carries the armature 26 of the main closing magnet whose core is indicated at 27. The winding of the closing magnet is indicated at 28. As shown by Fig. 4, a setscrew 29 is used to affix the armature to the rockshaft. Two non-magnetic members 30 are affixed to the upper end of the armature 26 in such manner as to leave a space between them as shown by Fig. 1. A roller 31 extends across this space and its ends are mounted in bearings in the non-magnetic members. The roller engages a locking latch 32, which is mounted upon a pivot stud 33. When the armature is moved to close the main switch, the roller 31 engages the surface 34 of the locking latch and lifts the latch against the tension of a spring 35. The latch is notched to provide a shoulder 36 for engaging the roller to hold the switch in closed position.

The locking latch is lifted to release the armature by a solenoid whose winding is indicated at 37. This solenoid is mounted upon the armature 26 in such manner that its weight tends to open the main switch. The magnetizable core of the solenoid is indicated at 38. It is affixed to the lower end of a non-magnetic rod 39 which has a tip 40 of non-abrading material. The tip is adapted to strike the surface 34 of the locking latch to lift the same. The members 38, 39 and 40 constitute a movable unit which is loosely fitted so as to slide in a tube 41 which extends through the winding 37. A pin 42 in the lower end of the tube prevents the core from dropping out of the tube. The disposition of the solenoid with relation to the locking latch is such that the core 38 is lifted a considerable distance before the tip 40 strikes the latch, thus enabling the moving element to acquire sufficient momentum to strike a hammer blow on the latch which will surely lift the latch to the required extent. It will be observed that the axis of the core of the solenoid is tangential to an arc about the axis of the rockshaft 25. From this it follows that the upward thrust of the solenoid core against the locking latch causes a reactive counter thrust in the direction which forces the main switch to open position. No other force is applied to the armature or to the movable elements of the main switch for opening the switch. This action of the solenoid, its weight, and the downward pressure of the spring 35 on the locking latch, are the three forces by which the main switch is opened. The first part of the closing movement of the switch is opposed by only one of these forces, namely, the weight of the moving parts. The opposing force of the spring 35 does not occur until the roll 31 strikes the locking latch; but at that time the moving parts have acquired their maximum momentum, and, furthermore, the direction in which the

locking latch exerts its opposing force is so nearly radial with relation to the rockshaft 25 that its effect is not sufficient to overcome momentum. But if for any reason the roll 31 should fail to pass beyond the shoulder 36 the parts would be thrown back to their initial position by the counter action of the locking latch upon the roll.

The circuit for closing the current through the winding 28 of the closing magnet is controlled by an auxiliary switch whose movable contact is indicated at 43. This contact is carried by, but insulated from, an oscillatory arm 44. The switch member 43 bridges across from one stationary contact 45 to a similar stationary contact 46. Referring to Figs. 2 and 4, the mechanical connection indicated at 47 is sufficiently loose to enable the movable contact 43 to adjust itself to the stationary contacts. As shown by Fig. 3, one terminal of the winding 28 is connected to the stationary contact 45 of the auxiliary switch. The other terminal of the winding 28 is connected to a binding post 48 from which a conductor 49 runs to one stationary contact 50 of a manually operative switch. The other stationary contact 46 of the auxiliary switch is connected by a conductor 51 with a binding post 52 from which a conductor 53 runs to the stationary contact 13 of the main switch, on the side which is connected with the feed wire 11. A conductor 54 runs from the stationary contact 12 to the movable member 55 of the manually operative switch. This switch is normally held open, as shown, by a spring 56. The movable element 55 is mounted upon a pivot 57 and is provided with a handle 58. When the movable member 55 is tilted to the left it engages the stationary contact 50, but when it is tilted to the right it engages a stationary contact 59 from which a conductor 60 runs to a binding post 61. From the binding post a conductor 62 runs to one terminal of the solenoid winding 37, the other terminal of that winding being connected by a conductor 63 with one of the contacts of the movable switch unit which coöperates with the contacts 13 and 15. As shown by the diagram, this conductor 63 is connected directly to the base of the spark tip 24. Referring once again to the auxiliary switch, a spring 64 acting upon the arm 44 normally holds the switch member 43 against the contacts 45 and 46. The auxiliary switch is thus held closed when the main switch is open.

The operation of the switch thus far described is as follows: Assuming that the switch is open, as shown by Fig. 4, a circuit is closed through the closing magnet by tilting the handle 58 from its neutral position to the left to place the member 55 in engagement with the contact 50. The current coming from feed wire 10 follows conductor 54, switch member 55, contact 50, conductor 49, binding post 48, closing coil 28, stationary contact 45, auxiliary switch 43, stationary contact 46, conductor 51, binding post 52, conductor 53, contact 13, to return wire 11. If the pull of the closing magnet is sufficient to carry the roll 31 past the shoulder 36, the main switch will be locked in closed position with the contacts 20 and 22 against the contacts 12 and 14 on the one side and with the contacts 20 and 22 against the contacts 13 and 15 on the other side. Current from feed wire 10 is thus transmitted through contact 12 to contact 20, to metallic member 23, to contact 22, to contact 14, to conductor 16, to lamps 18, to conductor 17, to contact 15, to contact 22, to metallic member 23, to contact 20, to contact 13, to return wire 11. When the manually operated switch is released it is automatically opened and held in its neutral position by the spring 56, thus breaking the circuit at that point through the winding 28 of the closing magnet. The circuit through the closing magnet is, however, otherwise broken by the auxiliary switch 43, which, as previously stated, is opened slightly before the completion of the closing movement of the main switch. The mechanism for operating the auxiliary magnet is shown by Figs. 4 to 12 inclusive.

A lever 65 is mounted upon the hub of the locking latch as shown by Fig. 6. This lever has a finger 66 (see Fig. 12) which is adapted to engage the arm 44 of the auxiliary switch. A finger 67 of this lever is adapted to be engaged by a member 68 affixed to one of the non-magnetic members 30 at the upper end of the armature 26. The member 68 engages the finger 67 slightly before the main switch is closed, thus rocking the lever 65 about the hub of the locking latch and causing the finger 66 to retract the auxiliary switch from the stationary contacts. The member 68, as shown, is in the form of a disk and has an eccentric stem 69 which extends through the member 30. This stem is screw-threaded, and, as shown by Fig. 1, is provided with a clamping nut 70 and binding nut 71 whereby it is held in the desired position. The disk may be turned about the axis of its stem to cause it to actuate the lever 65 sooner or later as desired with reference to the closing of the main switch. So long as the main switch is held closed by the locking latch the disk 68 will be held against the finger 67 and the auxiliary switch will be held open.

In the first part of this specification it was stated that the auxiliary switch is held open during the opening movement of the main switch in order to enable the main switch to move nearly to its maximum open position before permitting the auxiliary switch to close the circuit again through the

closing magnet. The mechanism for maintaining the auxiliary switch in open position during opening movement of the main switch is shown best by Figs. 4, 5 and 7. The swinging arm 44 of the auxiliary switch is mounted upon a pivot pin 72, and it carries a short pivot pin 73. A trip latch 74 (see Fig. 11) is pivotally mounted upon the pin 73 and is thus carried by the arm 44 in the relation shown by Figs. 4, 5 and 7. The trip latch 74 has a slot 75 and a nose 76. The slot 75 is occupied by the pivot pin 72 and renders the latch capable of a short movement about its individual pivot 73, while the pin limits such movement. The nose 76 is adapted to coöperate with a nose 77 formed upon the locking latch 32. (See Fig. 9). A spring 78 (see Figs. 5 and 8) normally presses the latch 74 toward the locking latch 32. The two noses 76 and 77 are so related as to occupy the positions shown by Fig. 4 when the main switch is open and when the auxiliary switch is closed. When the main switch is closed the locking latch is lifted, thus causing the nose 77 to move downwardly; and at the same time the auxiliary switch is opened, thus causing the nose 76 to move upwardly. During this movement the latch 74 yields sufficiently to enable the nose 76 to pass by the nose 77, after which the nose 76 is snapped forward by its spring to overlapping position, as shown by Figs. 7 and 8. Now, therefore, (although the auxiliary switch is held open by the lever 65 when the main switch is closed) as soon as the main switch begins to open, the auxiliary switch is released by the lever 65. When the auxiliary switch starts to close, the nose 76 moves down upon the nose 77 and the closing movement of the auxiliary switch is thereby arrested. The locking latch 32, of course, cannot descend to its normal position until the roll 31 has left it. The locking latch therefore holds the auxiliary switch open until after the roll 31 has passed out of engagement with the surface 34 of the locking latch. The locking latch upon being pressed down to its normal position by its spring 35 causes the nose 77 to rise, thus further opening the auxiliary switch until the angular change permits the nose 76 to escape from the nose 77. The auxiliary switch is thereupon closed by its spring 64, but this does not occur until the main switch is at or near its maximum open position.

The operation just described is so rapid that the main switch may be automatically opened and closed four or five times during the space of time which would usually elapse while the manually operative switch is held closed, and the momentum gained by the main switch as the result of being permitted to open nearly to its maximum open position after each failure to close insures ultimate closing in the desired manner before the manually operative switch is released unless there is something radically wrong with the switch mechanism; and neither the switch nor its auxiliary remains in a partially closed position.

The operation of opening the main switch after it has been closed in the desired manner is as follows: When the manually operative switch is moved to form connection between the movable contact 55 and the stationary contact 59, current flows from the main feed wire 10 over conductor 54, contact 55, contact 59, conductor 60, binding post 61, conductor 62, solenoid winding 37, conductor 63, spark tip 24, metallic member 23, contact 20, contact 13, and return wire 11. The solenoid core 38 is thus drawn upwardly, and a hammer blow is struck upon the locking latch 32. The roll 31 is thus released, and the impact of the solenoid core reacts upon the armature 26 in such manner as to tend to open the main switch. The opening force is augmented by the weight of the solenoid, and is supplemented by the reaction of the spring 35 which presses down the locking latch. The main switch is thus electrically opened, but the auxiliary switch is held open, as before explained, by the coöperation of the noses 76 and 77 until the movable contacts of the main switch are widely separated from their respective stationary contacts.

The important feature concerning the relation of the main switch contacts is that the electrical break between the two contacts of each pair of contacts occurs at the highest point of the contacting surfaces. When the break occurs, the current of hot air produced by the arc, of course, rises; and in the present instance the upward travel of the arc from the highest point of the contacting surfaces carries the arc away from the contacts instead of causing it to traverse the contacting surfaces and burn them. This is especially important with reference to the laminated members, because it avoids fusing the laminations to each other and leaves the laminations capable of free movement relatively to each other. The metallic breaks are simultaneous with reference to the contacts 12 and 20, 13 and 20, 14 and 22, and 15 and 22; but the four spark tips remain in contact with the members 12, 13, 14 and 15 for an instant after the laminated contacts have left the stationary contacts. It will be observed that the spark tip in each instance is above the point where the break occurs between each laminated contact and its complemental stationary contact. The four spark tips separate simultaneously from the four stationary contacts. The electrical arcs which occur at the moment when the spark tips leave the stationary contacts are caused to rise by the currents of hot air which are produced by the electrical arcs, and are thus

caused to move in a direction away from the laminated contacts. It is obvious that the contacting surfaces of the laminated contacts are removed from the course in which the electrical arcs travel. The angles at which the contacting surfaces are disposed are such that there is ample space for the rupture of the burning arc when the connection is broken, the spark tips being movable laterally as well as upwardly and leaving an unobstructed space directly above each burning arc.

There is slight flexure of the laminated contacts when the switch is opened and closed. The laminated members are disposed and moved in such manner that when the switch is closed the contacting surfaces of the laminated members are drawn slightly along the stationary contacts as distinguished from being pushed. This manner of closing the switch by drawing the laminated contacts is preferred to a motion by which the laminated contacts are moved point foremost, because the pressure of one contact against another increases when the switch is closed.

Having thus explained the nature of my said invention and described a way of constructing and using the same, although without attempting to set forth all the forms in which it may be made or all the modes of its use, what I claim is:

1. An electric switch having a plurality of fixed contacts out of vertical and horizontal alinement, a plurality of connected, cooperative movably supported contacts each having conducting members of different lengths with the longest member uppermost, and means for simultaneously moving the movable contacts into and out of engagement with the fixed contacts, the fixed and movable contacts being relatively so located that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

2. A multipolar electric switch having for each pole a plurality of fixed contacts out of vertical and horizontal alinement, a plurality of connected, coöperative pivotally supported contacts each having conducting members of different lengths with the longest member uppermost, and means for simultaneously moving the movable contacts into and out of engagement with the fixed contacts, the fixed and movable contacts being relatively so located that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

3. An electric switch having a plurality of fixed contacts and a plurality of movably supported connected coöperative contacts, each pair of coöperative contacts mounted at a different height and in a different vertical plane with reference to the other pair of contacts and with their coöperative surfaces at an angle to the horizontal plane, said movable contacts having conducting members of different lengths with the longest member uppermost, and means for simultaneously moving the movable contacts into and out of engagement with the fixed contacts, the fixed and movable contacts being relatively so located that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

4. A multipolar electric switch having a plurality of fixed contacts and a plurality of movably supported connected coöperative contacts for each pole, each pair of coöperative contacts mounted at a different height and in a different vertical plane with reference to the other pair of contacts and with their coöperative surfaces at an angle to the horizontal plane, said movable contacts having conducting members of different lengths with the longest member uppermost, and means for simultaneously moving the movable contacts in arcs about a common axis into and out of engagement with the fixed contacts in such manner that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

5. An electric switch having a plurality o fixed contacts and a plurality of movably supported connected coöperative contacts, each pair of coöperative contacts mounted at a different height and in a different vertical plane with reference to the other pair of contacts and with their coöperative surfaces at an angle to the horizontal plane, said movable contacts having conducting members of different lengths with the longest member uppermost, and means for simultaneously moving the movable contacts in arcs about a common axis into and out of engagement with the fixed contacts in such manner that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

6. An electric switch having a plurality of fixed contacts out of vertical and horizontal alinement having inclined flat faces arranged in intersecting planes, an oscillatory carrier, a plurality of connected flexible contacts affixed thereto at an angle to each other, the ends of said contacts being beveled in intersecting planes with the longest flexible

contact uppermost, means for oscillating the movable carrier into and out of engagement with the fixed carrier, the fixed and movable carriers being relatively so located that the uppermost member of each movable contact is first to engage and last to disengage its corresponding fixed contact, whereby unobstructed paths for the rise of the electric arcs are provided.

7. A device of the character described comprising a main switch, an electromagnet for closing the same, the movable element of said switch being connected to the armature of said magnet so as to be actuated thereby, a latch for locking said switch closed, a self-closing auxiliary switch in series with the closing magnet, mechanical means operated by the closing movement of said armature for opening said auxiliary switch just prior to complete closing of said main switch, and means for holding said auxiliary switch open during the opening movement of the main switch until the latter is nearly fully open, said holding means being adapted to release the auxiliary switch when the main switch is fully open.

8. A device of the character described comprising a main switch, an electromagnet for closing the same, means for locking said switch in closed position, a self-closing switch in series with said closing magnet, means actuated by said closing magnet for opening said self-closing switch during the closing movement of the main switch, said opening means being ineffective until the main switch is nearly closed, and means controlled by the main switch for holding open the self-closing switch until the main switch is nearly open.

9. A device of the character described comprising a main switch, an electromagnet for closing the same, a spring-pressed latch for locking said main switch closed, a self-closing switch for controlling the circuit through said closing magnet, means actuated by said closing magnet for opening said self-closing switch during closing movement of the main switch, and a spring-pressed trip-latch carried by said self-closing switch, said locking latch having a shoulder for coöperating with said trip-latch whereby the self-closing switch is held open during the opening movement of the main switch.

10. A remote-control switch for electric lighting or power circuits comprising a rock shaft, movable contacts on said rock shaft, an armature secured at its lower end to said rock shaft, a stationary electromagnet in operative relation to said armature, stationary contacts for engagement by said movable contacts, a latch for locking said armature in its closed position, and a solenoid on the outer face of said armature and arranged at an angle thereto with its core in position to engage said latch when the armature is closed, whereby when a circuit is closed through said solenoid its core trips the latch and simultaneously forces the armature and the movable contacts to open position.

11. An electrical switch mechanism comprising stationary contacts, means for supporting said contacts with their faces in inclined intersecting planes, the face of one member being below and to one side of the face of the other member, movable laminated contacts arranged at an angle and having their ends beveled in intersecting planes, and means to which said movable contact members are operatively connected and by which their beveled ends are moved into and out of contact with the faces of the stationary contact members.

12. A device of the character described, comprising a main switch, electromagnetic means for closing the same, a controlling switch in series with said means, means operative by the initial closing movement of the main switch for opening said controlling switch and thereby opening the circuit through said magnetic means before the main switch is closed; a pivoted latch for locking the main switch when it is closed, means for moving said latch about its pivot to release the main switch, and means for holding the controlling switch open during the initial opening movement of the main switch until the latter is nearly open.

13. In a device of the character described, a main switch, electromagnetic means for closing the same, a controlling switch in series with said means, means for locking the main switch in closed position, and trip mechanism for holding the controlling switch open during the opening movement of the main switch, said trip mechanism being operative by the locking means for releasing the controlling switch when the main switch is open.

In testimony whereof I have affixed my signature, in presence of two witnesses.

GRANVILLE E. PALMER.

Witnesses:
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P. W. PEZZETTI.