Aug. 25, 1931. J. D. WOOD 1,820,877

ELECTRIC SWITCH

Filed July 1, 1927 4 Sheets-Sheet 1

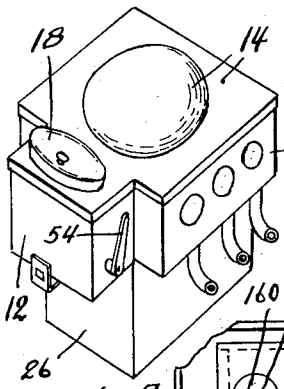


Fig. 1.

Fig. 2.

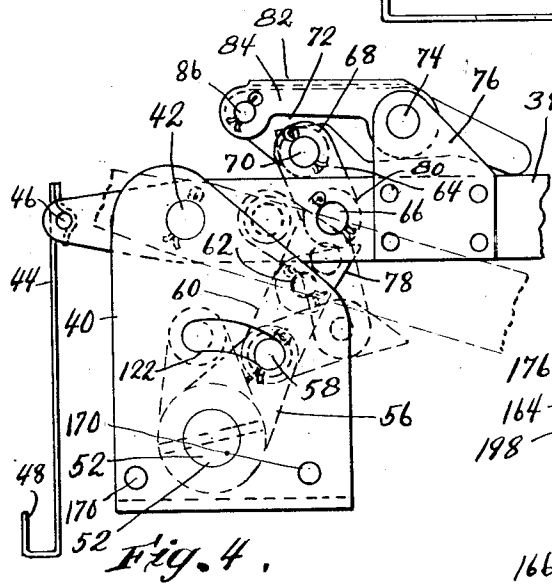


Fig. 4.

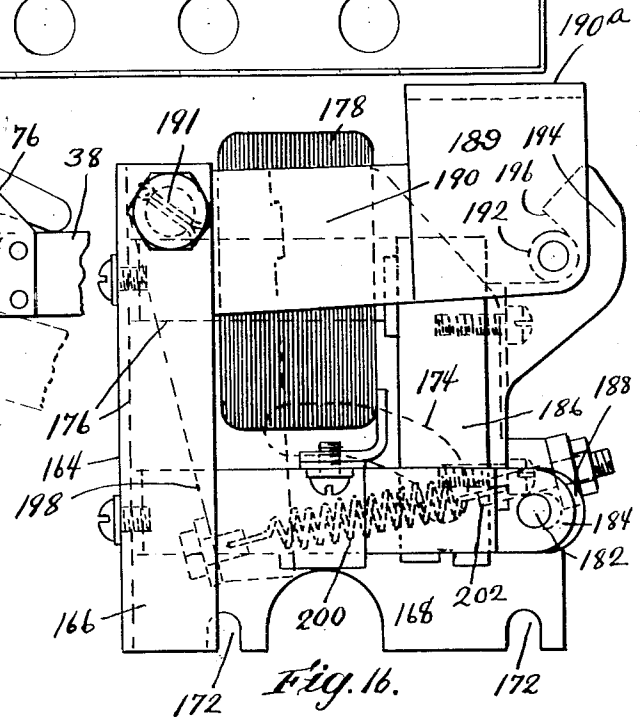


Fig. 16.

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ELECTRIC SWITCH

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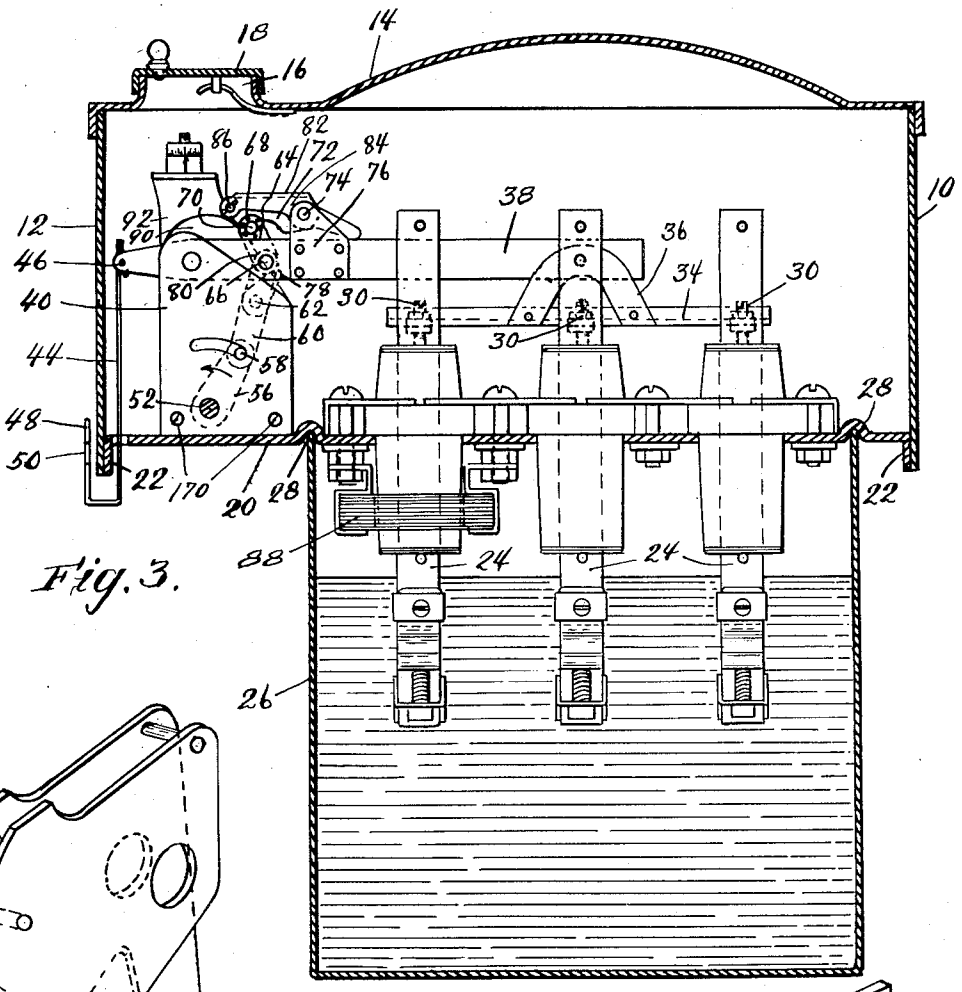


Fig. 3.

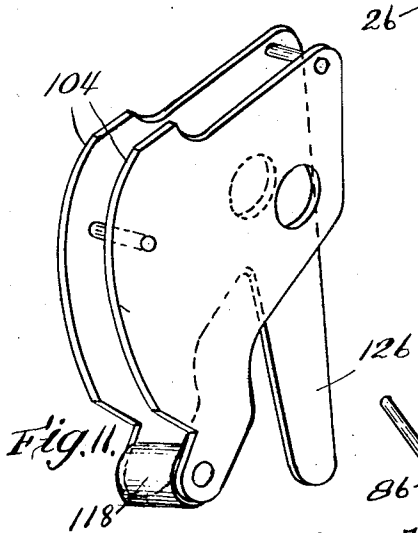


Fig. 11.

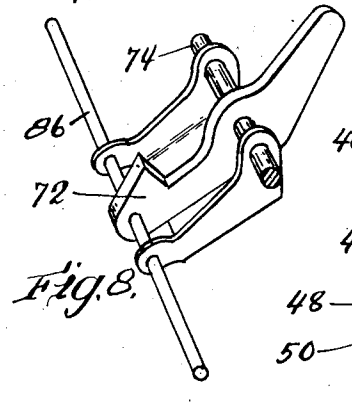


Fig. 8.

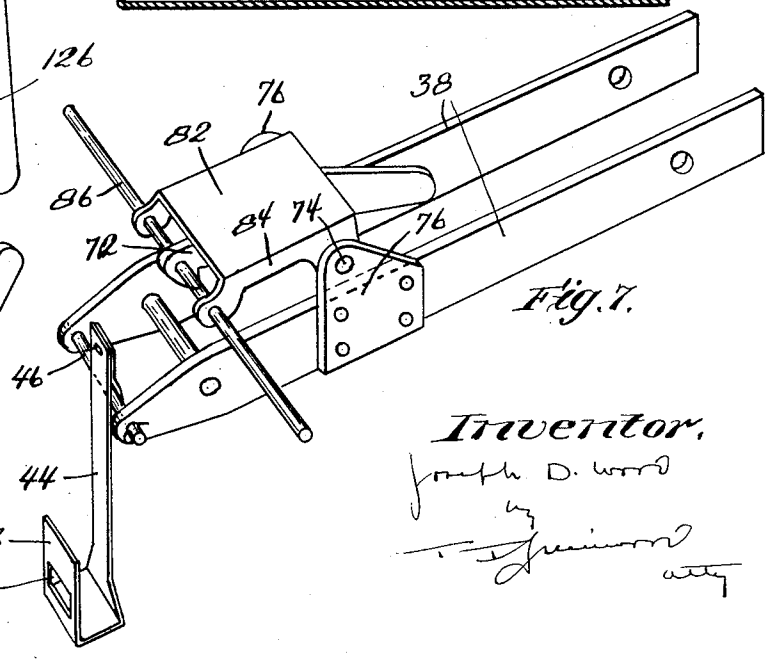


Fig. 7.

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ELECTRIC SWITCH

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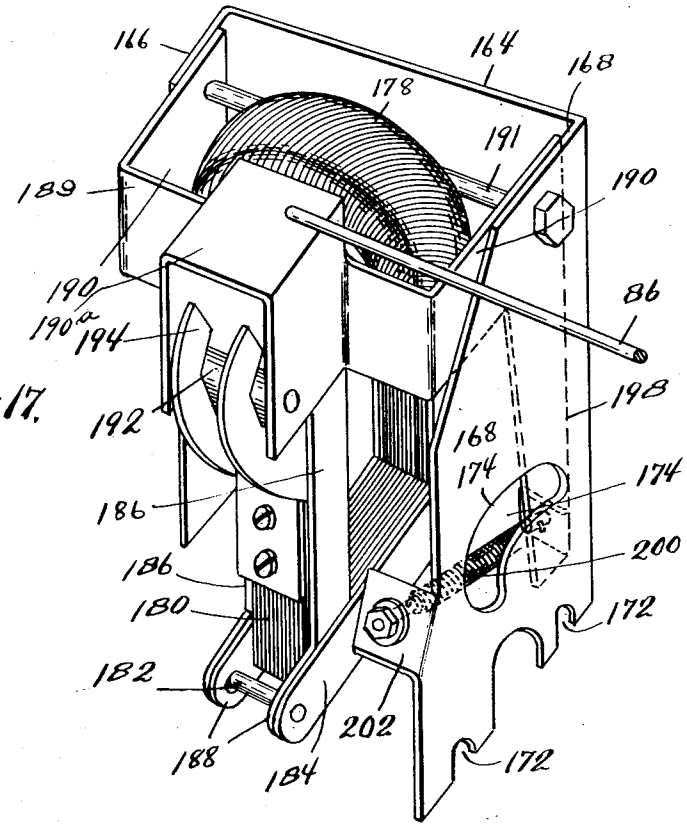


Fig. 17.

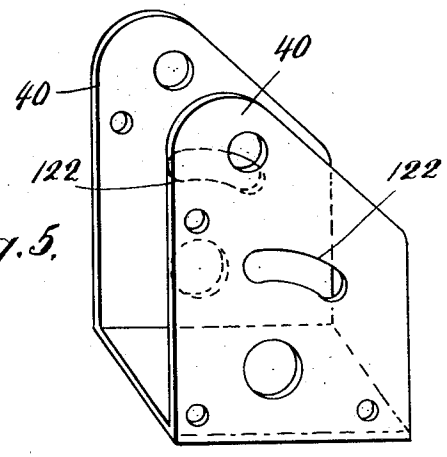


Fig. 5.

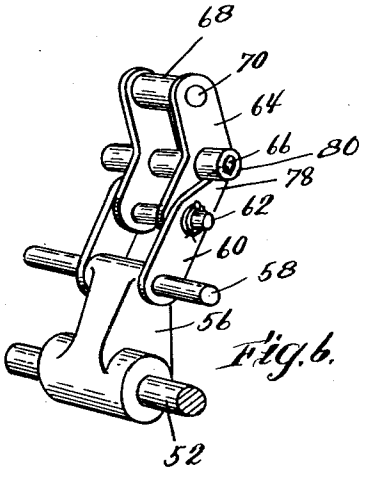


Fig. 6.

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Fig. 9.

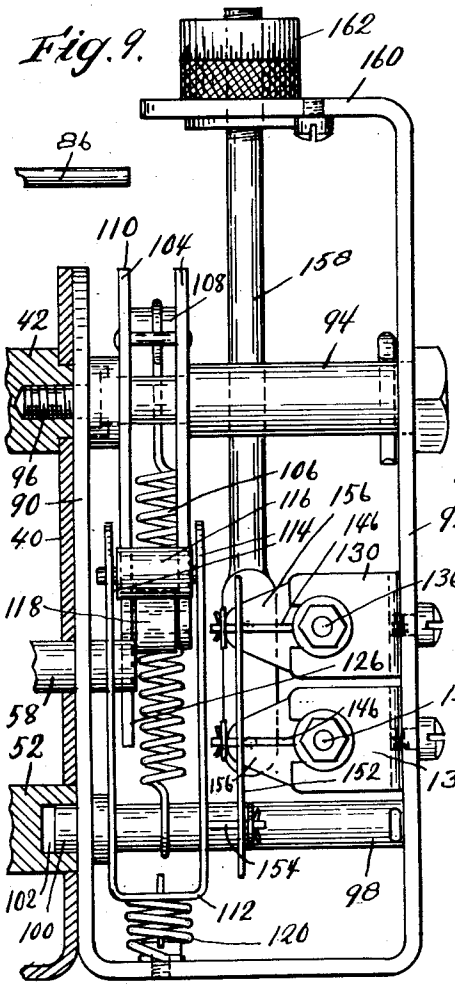
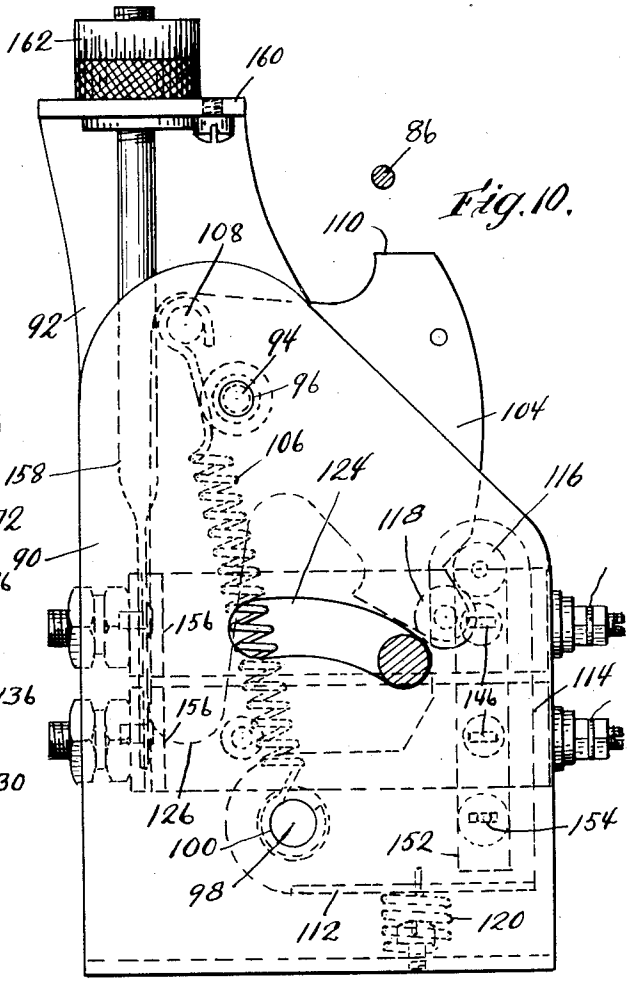


Fig. 10.



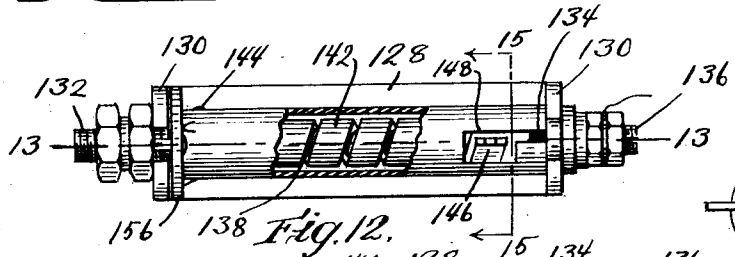


Fig. 12.

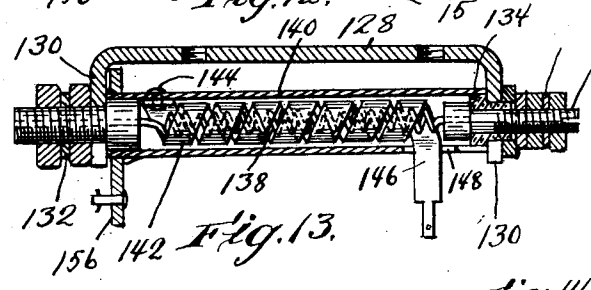


Fig. 13.



Fig. 14.

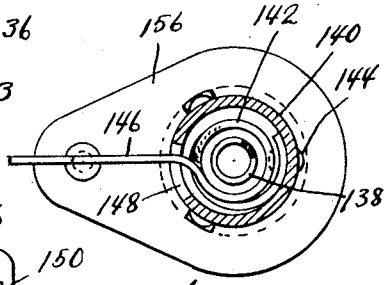


Fig. 15.

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Patented Aug. 25, 1931 1,820,877

UNITED STATES PATENT OFFICE

JOSEPH D. WOOD, OF WOLLASTON, MASSACHUSETTS

ELECTRIC SWITCH

Application filed July 1, 1927. Serial No. 202,950.

This invention relates to electric switches especially adapted although not necessarily limited to the control of electric motors.

One of the objects of the invention is the provision of an oil immersed electric switch composed of sheet metal parts and stampings so that the switch can be duplicated economically in large quantities.

A further object of the invention is the provision of an electric switch having overload and undervoltage tripping devices which are automatically reset by the switch mechanism when actuated after the switch has been tripped open.

A further object is generally to improve the construction and operation of electric switches.

Fig. 1 is a perspective view of the switch embodying the invention.

Fig. 2 is a plan view of the switch, the cover being removed to illustrate the operating mechanism.

Fig. 3 is a vertical sectional elevation of the switch with the under-voltage tripping mechanism removed.

Fig. 4 is a detail of the operating mechanism, the dotted lines indicating switch-open position of the mechanism.

Fig. 5 is a perspective detail of the mechanism supporting frame.

Fig. 6 is a perspective detail of the operating linkage in switch-closed position.

Fig. 7 is a perspective detail of the switch mechanism and illustrating particularly the arrangement of the holding and tripping latch.

Fig. 8 is a detail of the latch and its supporting frame in inverted position.

Fig. 9 is an end view of the thermal overload tripping device.

Fig. 10 is a side elevation of the device of Fig. 9.

Fig. 11 is a perspective detail of the tripping frame of the thermal tripping device.

Fig. 12 is a side view of one of the thermo-responsive elements of the overload tripping device.

Fig. 13 is a section taken along line 13—13 of Fig. 12.

Fig. 14 is a side view of the member that connects the movable members of the thermal elements with the latch of the overload tripping device.

Fig. 15 is a sectional detail taken along line 15—15 of Fig. 12.

Fig. 16 is a side elevation of the undervoltage tripping device.

Fig. 17 is a perspective view thereof.

As here shown, the switch comprises a generally rectangular casing 10 in which the operating mechanism and the switch terminals are contained. The casing is provided with an offset section 12 at one end in which the tripping devices are received. The top of the casing is provided with a removable cover 14 and said cover is provided with an upstanding elongated neck 16 which in turn is provided with a removable cover 18 by which access to the tripping devices may be gained without the necessity for removing the main cover. The casing 10 is closed at the bottom by a flat plate 20 having down turned peripheral edges 22 forming a flange which is secured to the casing 10. Stationary switch members 24 are extended through apertures and are secured to said plate 20 and depend into the oil of a rectangular oil tank 26 which is secured removably to the casing and has its upper end received in a groove 28 pressed in the bottom plate 20. Said switch members 24 are described and claimed in my co-pending application Serial No. 169,340, filed February 18, 1927, and assigned to the assignee of this application.

The movable switch members are suspended from insulating rods 30, see Fig. 2, fixed to a horizontal bar 34 disposed in the casing 10 above the plate 20 and between the groups of stationary switch members. Said bar is provided with a pair of upstanding inverted U-shaped straps 36 in the middle thereof which are secured to the inner faces, and at the free end, of a pair of spaced parallel bars 38 which cooperate to form a switch operating lever. Said bars are disposed between the upstanding side walls 40 of a U-shaped supporting bracket and are pivoted on a pin 42 which is carried by said walls at the upper end thereof. Said bracket is secured to the plate 20 in the offset portion 12 of the

casing 10. Said switch lever has a depending strap 44 pivotally supported on a pin 46 extended between the free ends of the lever bars 38 and extended loosely through an aperture in the plate 20. Said strap is provided with an upturned outer end 48 which overlies the casing wall and has an aperture or window 50 therein. The casing is provided with the words "Off" and "On" disposed in superposed order behind the plate 48 and the movements of said plate are adapted to expose one or the other of the words through the window, thereby to indicate the condition of the switch.

The switch is adapted to be opened and closed manually and also to be tripped open upon overload and also upon failure or reduction of potential. To this end, the switch operating mechanism includes a shaft 52, which is journalled in the plates 40 of the mechanism-supporting frame near the bottom thereof and is extended through the side wall of the casing and is provided with a handle 54 by which the switch can be opened and closed manually. An arm 56 is fixed to said shaft within the walls 40 of the supporting bracket and is pivoted by a pin 58 to a pair of toggle links 60, best shown in Fig. 6. Said links are pivoted by pin 62 to the lower arms of bell crank levers 64 which are disposed between the bars 38 of the switch lever and are pivoted thereto by a pin 66. The upper arms of said bell crank levers carry a latch roller 68 which is journalled on a pin 70 connecting said bell crank levers and is adapted to be engaged by a latch 72 pivoted on a pin 74 carried by ears 76 of the lever bars 38 whereby to hold the mechanism releasably in the switch-closed position illustrated in Fig. 4. The toggle links 60 are provided with toes 78 which are adapted to engage a spacing roll 80 carried by the pin 66 whereby to hold the toggle in a slightly undershot position. When the latch is raised to trip the switch the weight of the movable switch members and associated parts causes the bell crank lever to rotate in a counterclockwise direction into the open position shown in the dotted lines, Fig. 4. The movement of the operating handle in a counterclockwise direction or into switch-open position serves to reset the toggle mechanism and the subsequent movement of the operating handle in the reverse direction effects the manual closing of the switch, and the locking of the switch in switch-closed position providing normal conditions prevail in the switch circuit.

The latch 72 is disposed within a supporting frame 82 having depending side walls 84 which are pivotally mounted at one end on the pin 74 close to the ears 76. The latch is provided with a long tripping pin 86 which extends through and in opposite directions beyond the free end thereof and also through and beyond the ends of the side walls 84 of the supporting frame 82. The tripping pin 86 is adapted to extend beyond opposite sides of the switch lever to be engaged and raised by both the overload and undervoltage trip devices and the arrangement of the frame 82 serves to prevent the latch from being twisted angularly due to the long leverage of the pin 86.

The overload tripping device indicated at A, Fig. 2, is disposed on one side of the switch lever and the under voltage device indicated at B is disposed on the other side of said switch lever and both are disposed in the offset extension 12 of the casing 10.

The overload tripping device is of the thermo-responsive type and is or may be energized by one or more current transformers 88, see Fig. 3, which surrounds one or more of the stationary switch members 24. The overload tripping device is formed as a unitary structure and is claimed in my co-pending application Serial No. 202,949, filed July 1, 1927.

Said device includes a U-shaped supporting frame having the spaced upstanding side walls 90 and 92 and is disposed against one of the upstanding walls 40 of the mechanism supporting frame and is secured thereto. To this end, a bolt 94 is passed through said walls 90 and 92 in the upper portions thereof and has a screw-threaded portion 96 which is screw-threaded into the end of the pin 42 on which the switch lever is pivoted. A pin 98 is carried by said walls 90 and 92 near the bottom thereof and has an extension 100 which is received in a recess 102 in the end of the operating shaft 52 whereby to hold the frame against rotation.

The overload tripping mechanism includes a spring actuated tripping frame which is adapted to be released upon overload to engage and raise the latch pin 86 and thereby disengage the latch. The tripping frame, see Figs. 9, 10 and 11, includes a pair of spaced plates 104 which are secured rigidly together in spaced relation and are pivoted on the bolt 94. A tensile spring 106 is connected at its upper end with a pin 108 carried by said plates and at the lower end with the pin 98 carried by the supporting frame. The spring is disposed at one side of the pivot bolt 94 so that the frame is always biased for rotation in a counterclockwise direction. The plates 104 are disposed beneath the latch pin 86 and are normally free thereof and one of said plates is provided with a flat or hammer face 110 which is adapted to strike the latch pin 86 and thereby impart a hammer blow on the latch. Said tripping frame is held in inoperative position against the action of the spring 106 by a U-shaped holding frame 112 which is pivoted on the pin 98. The side walls of said frame are formed with a pair of upwardly extended arms 114 which

overlie the plates 104 and carry a roller 116 which engages a roller 118 carried by the tripping frame. A compression spring 120 is disposed beneath the holding frame 112 and serves normally to maintain the frame yieldingly in position and thereby to maintain the tripping frame in locked position. When the holding frame is lowered the roller 116 is moved in a clockwise direction over the roller 118 and thus frees the tripping frame for upward movement under the action of the spring 106. It is one of the features of this invention to provide means to effect the automatic resetting of the tripping frame when the switch is operated manually to close it. To this end, the pin 58 carried by the arm 56 of the operating shaft is extended in both directions beyond said arm and through arcuate recesses 122 in the walls 40 of the mechanism-supporting frame and through a corresponding arcuate slot 124 in the upstanding wall 90 of the supporting frame of the overload tripping device. One of the tripping plates 104 of the tripping frame is provided with a depending arm 126 which normally is disposed out of the path of movement of the end of said pin 58. When the frame has been released to trip the switch, however, the arm is moved toward pin 58 so that when the operating handle is moved in a counterclockwise direction into a switch-open position for the purpose of resetting the switch mechanism, the pin 58 engages said arm 126 and moves the tripping frame in a clockwise direction and into holding engagement with the holding frame 112.

The tripping frame is operated by thermo-responsive means illustrated most specifically in Figs. 12 through 15. Two thermo-responsive devices are here shown both of which act separately and also conjointly upon the holding frame 112. The devices are identical and but one will be described. Each device includes a supporting bracket 128 secured to the wall 92 and having upstanding ends 130. A screw 132 is secured in one of said upstanding ends and an insulating bushing 134 is secured in the other end and a screw 136 is received in said bushing. A heating element 138 in the form of a spiral coil of resistance material is extended between and is connected to said screws and is adapted to be included in the circuit of the transformer 88 (Fig. 3) or in some other source of current responsive to the fluctuations of current in the switch circuit. A metal tube 140 surrounds said heating element and is disposed between the ends 130 of the bracket and is rotatably supported on the head of the screw 132 and upon the bushing 134. A spiral coil 142 of thermostatic metal, composed of fixedly-united superimposed metals of different coefficients of expansion, is disposed loosely within said tube and closely surrounds and is spaced from the heater element and has one end fixed to the tube by suitable means as the rivets 144. The free end 146 of said spiral member is extended freely through an aperture 148 in said metal tube. The free ends of the spiral members of both thermostatic elements are extended through vertically elongated slots 150 in a connecting strip 152 which is carried by a pin 154 fixed to the tripping frame 112. The ends of the spiral members are loose in said slots 150 so that either thermostatic element by itself or both together can move the strip 152 downwardly and thus move the holding frame 112 from holding engagement with the tripping frame.

The thermostatic elements are adjustable to vary the current and time settings thereof and for this purpose the tubes 140 are rotatable in the frame 128 and are provided with outstanding arms 156 which are connected with an adjusting rod 158 extended through an ear 160 of the side wall 92 of the supporting bracket. Said rod is provided at its upper end with an adjusting nut 162 which is screw threaded on the rod and can be rotated to raise and lower the rod and thereby the tubes 140 and the free ends of the spiral elements thus to increase or decrease the amount of expansion of the spiral elements before the devices effectively actuate the tripping device.

The switch is also adapted to be tripped open upon failure or reduction or potential of the switch circuit. The under voltage tripping device indicated generally at B, Fig. 2, is illustrated in Figs. 16 and 17 and comprises a frame 164 having spaced side walls 166 and 168. The frame is secured to the mechanism-supporting frame by screws 170, Fig. 4, which are passed through slots 172 in the bottom of the side wall 168. The side wall is also formed with an arcuate slot 174 therein through which the end of the pin 58 of the operating mechanism is freely extended for the purpose of resetting the tripping frame of the undervoltage device during the manual resetting operation of the switch mechanism. The tripping device includes the U-shaped electro-magnet 176 which is secured in vertical position to the rear wall of the supporting frame and has an actuating coil 178 on the upper leg thereof. An armature 180 is pivoted loosely by a pin 182 to side plates 184 carried by the lower leg of the electromagnet structure. Said armature is composed of a plurality of laminations held between a pair of non-magnetic side plates 186 provided with ears 188 through which the pivot pin 182 is passed.

Said side plates are relatively thick in order to obtain a substantial pivotal bearing for the armature. It has been found that if these plates are made of steel stampings the residual magnetism therein, when the energizing coil 178 is deenergized, is sufficient to hold the armature in attracted position and

thus to prevent the device from operating. Consequently, the side plates are composed of brass or other non-magnetic material. The under-voltage tripping device is also provided with a tripping frame which is adapted when released to strike a hammer blow upon the latch pin 86, and to be reset automatically during the manual movement of the operating mechanism into switch open position as a necessary step to the reclosing of the switch. The tripping frame 189 has a pair of rearwardly-extended arms 190 which are disposed adjacent the walls 166 and 168 of the supporting bracket and are pivoted on a bolt 191 carried by said walls. Said frame is provided with an upper striking face 190*a* which is adapted to be disposed beneath and free of the latch pin 86 and when the frame is released to move upwardly and strike a hammer blow on said pin, thus to release the latch. Said frame is provided with a latch roller 192 which is adapted to be engaged by a pair of upstanding arms 194 carried by the armature 180 and to bear against the upwardly inclined cam faces 196 of said arms. One of the rearwardly extended arms 190 of the tripping frame is provided with a depending ear 198 disposed adjacent the wall 168 of the supporting frame and a tensile spring 200 is connected with said arm and also with an ear 202 of the wall 168, thus to bias the tripping frame constantly for switch tripping movement. The electromagnet is adapted normally to be continuously energized, thus to hold the frame against the action of the spring. When the holding coil becomes de-energized or insufficiently energized, the spring 200 can pull the tripping frame upwardly against the weakened pull of the electromagnet, thus to effect the tripping of the switch. The armature 180 is disposed in vertical position and in front of its pivot pin so that after the tripping frame has been released, the armature falls back again against the pole faces of the electro-magnet, thus maintaining a closed magnetic circuit for the holding coil and preventing the coil from burning out.

The under voltage tripping device above described is described and claimed in a copending application of George W. O'Keeffe, Serial No. 33,858, filed May 29, 1925, assigned to the assignee of this application.

The depending ear 198 of the tripping frame normally is disposed at the rear and normally out of engaging position with the mechanism pin 58. When however, the tripping frame is released, the ear moves forwardly toward the pin 58. When the toggle mechanism is reset, the pin 58 is moved backward and is caused to engage the ear 198 and consequently moves the frame downwardly to be re-engaged by the armature of the tripping device which, if the coil 178 is normally energized, holds down the tripping frame until the next operation, the holding coil for this purpose being connected on the line side of the switch.

The structure may be otherwise modified without departing from the spirit of the invention.

I claim:

1. An electric switch having a movable switch member, contacts engaged thereby, an operating member therefor movable between switch open and closed positions, collapsible operating mechanism connecting said switch and operating members arranged to collapse and effect the opening movement of the switch member independently of corresponding movement of said operating member, said operating member adapted to be moved to open position to reset said collapsed operating mechanism for subsequent switch closing movement, a tripping device for the switch having a tripping member adapted to move from a normal set position into an operated position to trip the switch in response to a predetermined condition and to remain in such operated position until reset, means responsive to a condition of the switch circuit releasably to hold said tripping member in set condition prior to the engagement of said contacts, means controlled by said operating member in its mechanism-resetting motion to engage and reset said tripping member also, and means providing for the subsequent movement of said operating member in a switch closing direction free from engagement with said reset tripping member.

2. An electric switch having operating mechanism, a tripping device therefor having a tripping member movable from a set position into a tripping position to effect the opening of the switch and adapted to remain in such tripping position until reset, latching means for holding said tripping member releasably in set position, and means actuated by the switch mechanism prior to the movement thereof in a switch closing direction to reset said tripping member and to move in a switch closing direction free from control of said tripping device.

3. An electric switch having operating mechanism adapted to be held releasably in switch-closed position, a plurality of tripping devices for opening the switch including tripping members, movable into a mechanism-tripping position and adapted to remain in such position until reset, and a switch operating member having provision for first resetting all of said tripping members and thereafter closing the switch.

4. An electric switch having operating mechanism, a tripping device for said mechanism including a tripping member adapted to move from a set position into tripping position and remain in such position until reset, latching means responsive to a condition of the switch circuit for holding said

tripping member releasably in set position, means for holding said tripping member releasably in set position, and a switch operating member arranged to engage said tripping member to move it to set position and thereafter to disengage said reset member during the initial switch closing movement of said operating member.

5. An electric switch having operating mechanism, a plurality of tripping devices for said mechanism, each having a tripping member movable into tripping position and adapted to remain in such position until reset, and a switch operating member arranged to close the switch characterized by being engageable with all of said tripping members to reset them.

6. An electric switch having switch operating mechanism, a latch to hold the switch releasably in closed position having oppositely directed lateral extensions, two tripping devices disposed on opposite sides of said latch each having a tripping member disposed beneath said lateral extensions and adapted to move upwardly to engage said extensions and trip the latch, and to remain in raised position until reset, and a switch operating device engageable with both of said tripping members and adapted to move them downwardly.

7. An electric switch having a movable switch lever, switch operating mechanism connected therewith, a latch pivotally carried by said lever for holding the switch releasably in closed position, said latch having projections extended on opposite sides of said lever, and tripping devices disposed on opposite sides of said lever beneath said projections having tripping members independently movable into engagement with said projections.

8. An electric switch having a switch lever including a pair of spaced parallel bars, switch operating mechanism connected with said lever, a frame having side walls pivotally connected at one end with said bars, a latch disposed in the middle of said frame and pivotally connected with said bars, a pin extended through the side walls of said frame at the other end and through the free end of said latch, and tripping devices disposed on opposite sides of said latch beneath and engageable with the extended ends of said pin.

9. An electric switch having operating mechanism, overload-responsive and undervoltage-responsive tripping means for the switch, each having a movable member adapted to move into a switch tripping position and remain in such position until reset, and manual switch operating mechanism for closing the switch engageable with both of said tripping members to reset them prior to the closing of the switch.

10. An electric switch having a mechanism-supporting frame provided with upstanding side walls, a switch lever pivoted between said side walls, switch operating mechanism connected with said lever and including a latch for releasably holding the switch closed, electrically-actuated tripping devices carried by said side walls on opposite sides of said lever having tripping members movable into tripping positions in engagement with said latch and adapted to remain in such positions until manually reset, and a switch operating member engageable with both of said tripping members to move them into reset positions during a switch operating movement of said operating member.

11. An electric switch having a mechanism-supporting frame provided with spaced upstanding side walls, a switch lever pivoted between said side walls, switch operating mechanism connected with said lever including a latch for releasably holding the switch closed, electrically-actuated tripping devices disposed on opposite sides of said lever having tripping members movable into tripping positions in engagement with said latch and adapted to remain in such positions until manually reset, said tripping members having depending arms, and a switch actuating member having an extension disposed in position to engage both of said arms and move said tripping members into reset position.

12. An electric switch having a mechanism-supporting frame formed with spaced upstanding side walls, a switch lever disposed between and pivoted to said walls at the upper ends thereof, a manually-operable shaft extended through said walls in the lower end thereof, operating mechanism connecting said shaft and lever including a latch for releasably holding the switch closed, tripping devices including frames on opposite sides of said switch lever, each tripping device having a tripping member movable into tripping position in engagement with said latch and adapted to remain in such position until reset, and an arm carried by said manually-operable shaft between said walls having a pin extended laterally in both directions through slots in said walls and through aligned slots in said frames in position to engage said tripping members and move said tripping members into reset position.

13. An electric switch having a mechanism supporting bracket provided with spaced upstanding side walls, a switch lever disposed between said walls in the upper portion thereof, a pivot pin for said lever extended through said walls, an operating shaft extended through said walls in the lower portion thereof, operating mechanism connecting said shaft and lever, a tripping device including a frame carried by one of the walls of said supporting frame and having a pivotal tripping member, a pin on which said member is pivoted having a supporting-connection with

the end of the pivot pin for said switch lever, and a pin carried by the frame of said tripping device received in a recess in the end of said operating shaft.

14. An electric switch having operating mechanism including a member movable between switch open and closed positions, an undervoltage tripping device for the switch including an armature biased to tripping position but normally held in set position, and means controlled by the movement of said operating mechanism in a switch opening direction to move said armature into set position regardless of voltage conditions in the circuit and to release said armature upon initial movement of said mechanism in a switch closing direction, whereby immediately to recondition said tripping device for switch tripping movement.

15. An electric switch having a switch member movable between open and closed positions of the switch, collapsible operating mechanism therefor, an operating handle movable in a switch closing direction to close the switch through the set operating mechanism and movable in a switch opening direction to reset the collapsed operating mechanism, tripping mechanism to collapse the set operating mechanism and open the switch, means operated by a movement of said handle in a mechanism setting direction to set said tripping mechanism, and means independent of control by the operating handle to hold the tripping member in set position prior to the closing of the switch, said holding means having means responsive to an abnormal condition of the switch circuit to release said tripping member and effect collapse of said operating mechanism at the start of the switch closing movement of the set operating mechanism.

In testimony whereof, I have signed my name to this specification.

JOSEPH D. WOOD.