March 18, 1930. W. LEYHAUSEN 1,750,895

AUTOMATIC CIRCUIT BREAKER

Filed March 30, 1928 4 Sheets-Sheet 1

Fig. 1

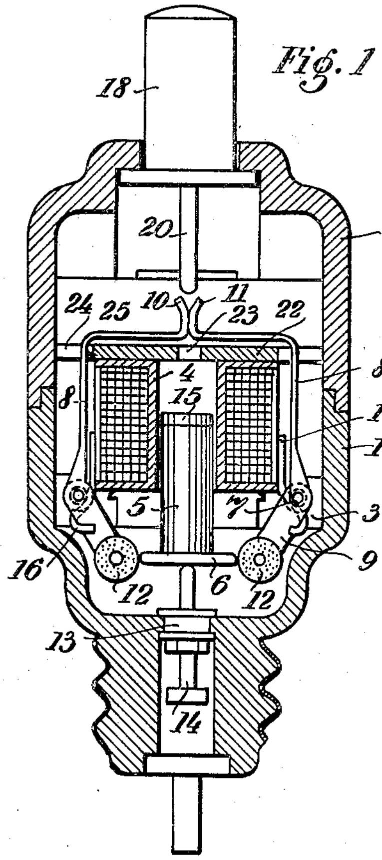


Fig. 2

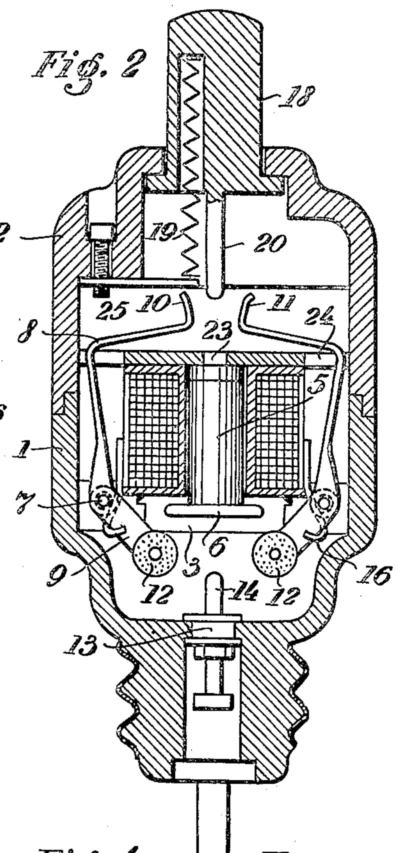


Fig. 3

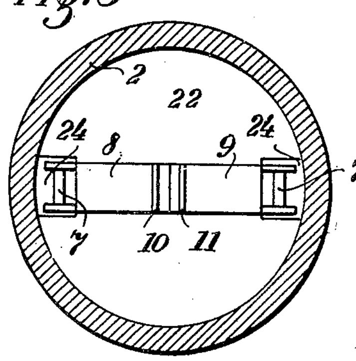


Fig. 4

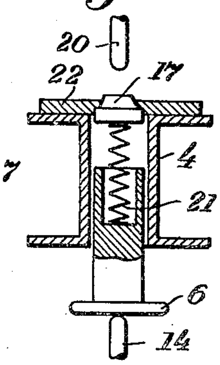
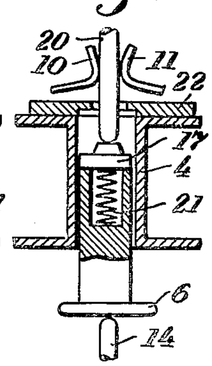


Fig. 5



Inventor:- Wilhelm Leyhausen

by [signature]

Attorney

March 18, 1930. W. LEYHAUSEN 1,750,895

AUTOMATIC CIRCUIT BREAKER

Filed March 30, 1928 4 Sheets-Sheet 2

Fig. 6

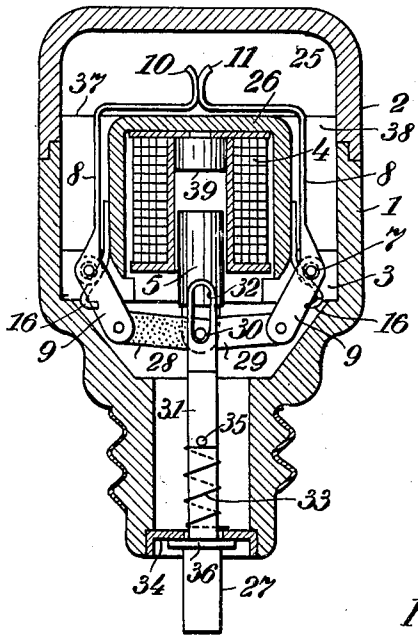


Fig. 7

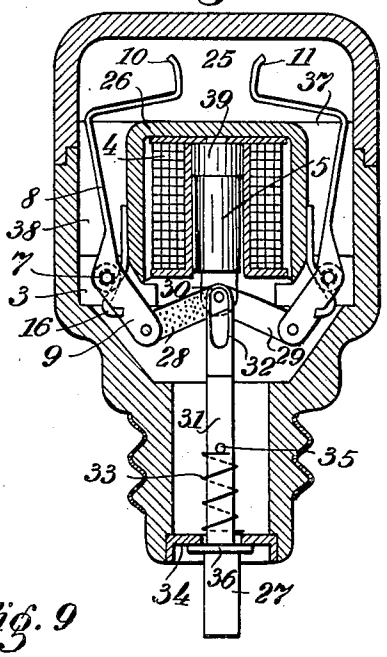


Fig. 8

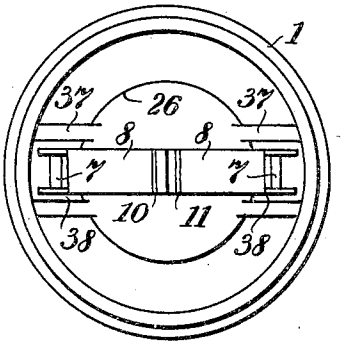
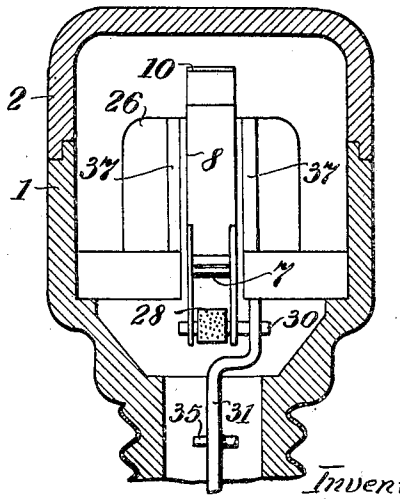


Fig. 9



Inventor
Wilhelm Leyhausen
by Paul Schiemer
Attorney

March 18, 1930. W. LEYHAUSEN 1,750,895

AUTOMATIC CIRCUIT BREAKER

Filed March 30, 1928 4 Sheets-Sheet 3

Fig. 10

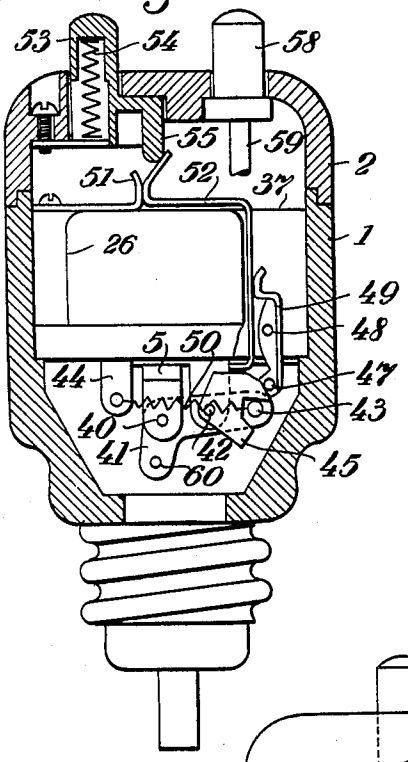


Fig. 11

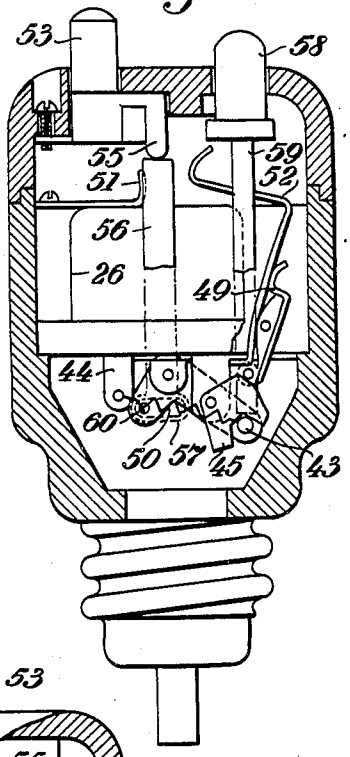
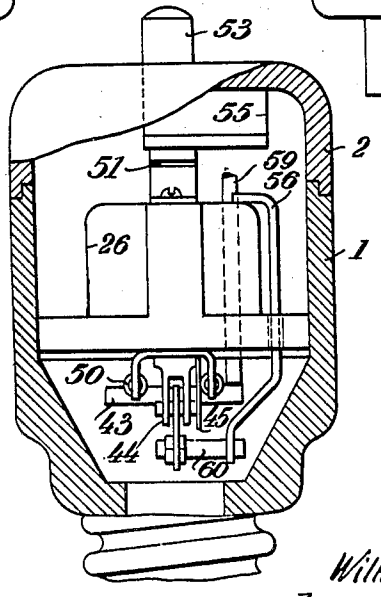


Fig. 12



Inventor
Wilhelm Leyhausen
by
Attorney

March 18, 1930. W. LEYHAUSEN 1,750,895

AUTOMATIC CIRCUIT BREAKER

Filed March 30, 1928 4 Sheets-Sheet 4

Fig. 13

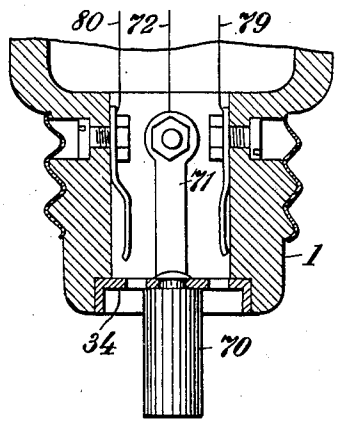


Fig. 14

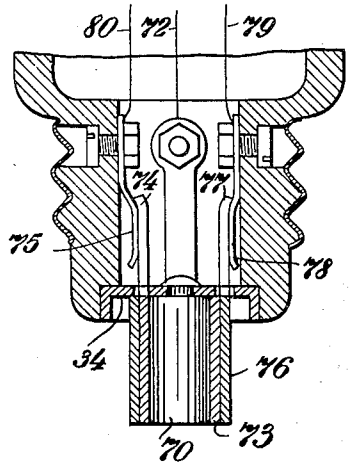


Fig. 15

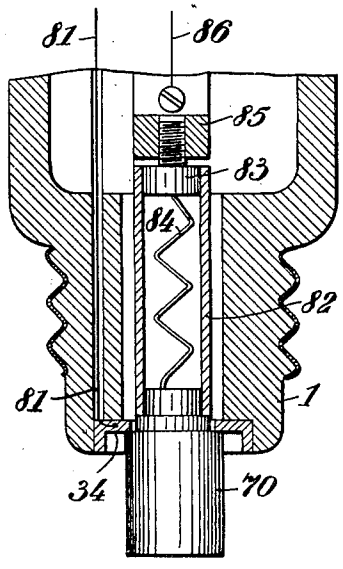


Fig. 16

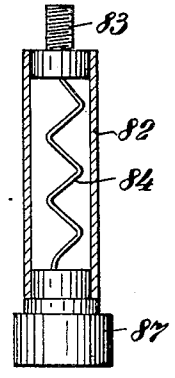
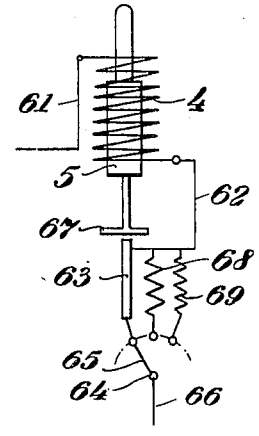


Fig. 17



Inventor
Wilhelm Leyhausen
by [signature]
Attorney

Patented Mar. 18, 1930 1,750,895

UNITED STATES PATENT OFFICE

WILHELM LEYHAUSEN, OF NUREMBERG, GERMANY

AUTOMATIC CIRCUIT BREAKER

Application filed March 30, 1928, Serial No. 266,089, and in Germany August 14, 1926.

In automatic circuit breakers of the form of electromagnetic switches of threaded plug type, the utilization of the blowing action of the magnet-coil is of greatest importance for extinguishing the arc. The cutting-out speed is also of importance. This cutting out speed is, however, of no value in preventing arcing when the magnet-coil is too far from the contacts for a blowing action. Such objections reside especially in plug-switches in which the switch contacts and the releasing mechanism are arranged on the same side of the magnet-coil. In order to prevent overlapping of the arc over the releasing mechanism the latter is separated by a partition from the switch contacts and releasing mechanism situated between the coil and the contacts, but with this arrangement the coil is too far distant from the contacts to exert a sufficiently strong blowing action.

Excess current-switches have further become known in which the releasing mechanism is arranged on one side of the magnet-coil and a switch-contact on the other side of the coil. The connection between the releasing mechanism and the switch-contacts must then be conducted through the magnet-coil and generally formed by the plunger armature of the magnet-coil. Owing to this arrangement the contacts can be placed closer to the magnet-coil but this does not entirely eliminate jumping of the spark to the armature and coil and consequently to the releasing mechanism.

According to the invention these objections are avoided by disposing the releasing means for the switch elements on one side of the magnet-coil and the switch-contacts carried by said elements on the other side and arranging said elements so as to embrace the coil and extend between such sides of the coil, and by providing an insulating partition between the coil and the switch contacts. This partition may be a plane plate or the bottom-plate of a capsule which encloses the magnet-coil on all sides.

The invention relates further to the special construction of means adapted to permit of the use of a push-button device for separating the switch contacts, notwithstanding the employment of an insulating partition of the character described.

The invention has further for its object to arrange the automatic switches in such a manner that the thermic releasing device, provided on the switches besides the electromagnetic releasing device, can be made to operate at different normal current-intensities.

Several embodiments of the invention are illustrated, by way of example, in the accompanying drawings in which:—

Figs. 1 to 5 show an excess current-switch with plane-partition between the magnet-coil and the switch contacts and with a push button releasing device.

Figs. 1 and 2 show each the switch in vertical section, Fig. 1 in the cut-in position and Fig. 2 in the cut-out position.

Fig. 3 is a horizontal section taken just above the partition.

Figs. 4 and 5 show a modified closure for the aperture in the partition in two different positions.

In Figs. 6 to 9 an excess current-switch with magnet-coil enclosed in a capsule is illustrated.

Figs. 6 and 7 show each the switch in a vertical section in the cut-in and cut-out positions respectively.

Fig. 8 is a top-plan-view of the same, the lid of the casing being removed.

Fig. 9 is a vertical section through the switch, one of the switch arms being shown in elevation in Figs. 10 to 12, an excess current-switch is shown in section, comprising a modified releasing device and push-buttons for switching on and off.

Figs. 10 and 11 show the switch in the cut-in and cut-out positions respectively.

Fig. 12 shows the releasing device in elevation viewed in the direction of the switch-arm.

In Figs. 13 to 16 arrangements for adjusting the apparatus for employing different current-intensities for operating the thermal releasing device are illustrated.

Figs. 13 and 14 show one form of construction of the arrangement and

Figs. 15 and 16 show a second form of construction of the same.

Fig. 17 shows diagrammatically a variable thermal releasing device by way of example.

Referring to Figs. 1 to 3 a disk 3 is arranged in the lower part 1 of the casing 1, 2 which carries the magnet and blowing coil 4 with a plunger armature 5. Above the coil 4 a horizontal partition 22 of insulating material is mounted which has at the centre an opening 23 and two apertures 24, 24 near the edge. On axles 7, 7 the two-armed contact-arms 8, 9 are pivotally mounted. On the end of each lower arm 9 a roller 12 of insulating material is arranged, a disk 6 on the end of the plunger armature 5 being disposed between these two rollers 12, 12. The upper arms 8, 8 extend through the apertures 24, 24 of partition 22 and their contacts 10, 11 engage each other above the opening 23, when the switch is in the position ready for use. Around the axles 7, 7 springs 16 are wound which press the rollers 12 against disk 6. When excess current occurs, the plunger armature 5 is attracted by the magnet-coil 4 so that the disk 6 releases the rollers 12 and the contacts 10 and 11 move outward or away from one another under the pressure of springs 16. The switch is then in the cut-out position shown in Fig. 2.

A push-button 18 serves for closing the circuit. It is controlled by a spring 19. From the push-button extends the downwardly directed switch-rod 20 which fits in the opening 23. When the push-button 18 is depressed the switch-rod 20 pushes the armature 5 downwards into the cut-in position. The contacts 10, 11 are thereby returned to normal position so that their contact portions bear against the switch-rod and come into engagement as soon as the push-button has returned into its initial position. If at this time, however, the circuit is still overloaded another cut-out action will take place instantaneously, as will be readily understood.

The descending movement of the plunger armature 5 is limited by an adjusting screw 14 screwed through a bush 13 and by means of which the switch is adjusted to the desired intensity of releasing current. As soon as the plunger armature is attracted, an insulating piece 15 on the top-end of the same closes the opening 23 in the partition 22 so that the arc formed between the contact portions of the contacts 10, 11 will be confined to the top part of the casing and prevented from reaching the coil.

Figs. 4 and 5 show a modified construction of closure for the opening 23 of partition 22 in two different positions. A disk 17 is pressed by the pressure of a spring 21 from below into the opening 23 and normally closes the same. When the push-button 18 is depressed the switch-rod 20 pushes the disk 17 against the plunger armature 5 and depresses this armature together with the disk. When the push-button returns to its initial position, the opening 23 is instantaneously closed by the disk 17.

The partition 22 separates the arc space or chamber 25 from the coil and from the releasing device.

The excess current-switch shown in Figs. 6 to 9 differs from that shown in Figs. 1 to 3 in that the magnet-coil 4, in which an auxiliary, stationary armature 39 is mounted is enclosed by a capsule 26 and that the closing of the contacts 10, 11 is carried out by means of a stud 27 of a foot-contact. The capsule 26 is mounted on the disk 3. The two-armed contact-arms 8, 9, pivotally mounted on the axles 7, 7, are connected with one another by a toggle-lever 28, 29, the arms of which are oscillatably mounted on a common bolt 30. On this bolt 30 acts the plunger armature 5. The lever-arm 28 is made of insulating material.

When excess current occurs the plunger armature 5 is attracted and the toggle-lever is bent. The contacts 10 and 11 are moved suddenly, in opposite directions by the action of the springs 16, 16. The arc is blown to the right or left side by the coil 4. The switch is then in the position shown in Fig. 7.

To return the switch into the cut-in position stud 27 must be pulled down. To this stud 27 a rod 31 is connected, the upper end of which has a longitudinal slot 32 engaging over the pivot-bolt 30. A spiral-spring 33 wound around rod 31, the lower end of said spring resting on a plate 34 and the upper end pressing against a pin 35 fixed in rod 31, serves to hold this rod in the raised position limited by a collar 36. On the pulling down of stud 27 the toggle-lever 28, 29 is stretched again.

At either side of the arms 8 a vertical partition 37 is mounted so that channels 38 are formed which completely enclose the arms.

In the excess current-switch shown in Figs. 10 to 12 the cutting-in and out is effected by push-buttons arranged on one side (at the top) of the coil which operate through connecting rods the releasing device arranged on the opposite (bottom) side of the magnet-coil. The switch can thus be adjusted to the cutting-in position without being unscrewed from its receiving socket.

The magnet-coil acting upon the plunger armature 5 is enclosed by a capsule 26. To the plunger armature 5 an elbow-lever 41 is hingedly connected by means of an axle 40, said elbow-lever being oscillatably mounted on a stationary stud 42 and controlled by dead centre-springs 50, attached at the one end to a transverse pin 43 of lever 41 and at the other end to stationary holding arms 44. On the stationary pivot-pin 42 a locking disk 45 is rotatably mounted which has a

notch 46 through which the pin 43 extends. The notch is, however, wider than the pin 43 is thick, so that a side wall of the notch will normally be spaced from the pin and will be brought to bear against said pin only after a certain part-rotation of the disk. The edge of disk 44 bears against a transverse pin 47 of a two-armed lever 49, pivotally mounted on a pivot-pin 48. When the disk 45 is in the position described, the lever 49 presses the movable spring contact 52 against the stationary contact 51. The switch is then in the switching-on position shown in Fig. 10.

When on excess current the plunger armature 5 is attracted by the magnet-coil, the elbow-lever 41 oscillates beyond the dead centre-position, the locking disk 45 remaining at rest. Then, when the lever 41 has completely moved beyond the dead centre-point, the locking disk 45 is rotated so that it releases the lever 45, and the contact-spring 52 jumps back into the position shown in Fig. 11.

For cutting-in, the push-button 53 is depressed against the action of its spring 54. With this button 53 a separating element 55 is connected which stands transversely to the contacts 51 and 52. This separating element 55 when descending acts upon a shiftable rod 56 which has at the lower end a slot 57 indicated in dash-dot-lines engaging over a bolt 60 of the elbow-lever 41. On the depression of the push-button 53 the elbow-lever 41 is therefore moved back beyond its dead centre-position and then returned by the action of the springs 50 into the position shown in Fig. 10. The locking disk 54 is rotated backward and pushes the lever 49 into the initial position and tries to press the contact-spring 52 against the stationary contact 51, this being however prevented by the lowered separating element 55.

When the push-button 53 is released, it is pushed upward together with the separating element 55 by the action of the spring 54 and the circuit is closed.

On the transverse stud 43 of the elbow-lever 41 a push-rod 59 is pressed by the action of a spring (not shown), said push-rod carrying on the top-end a push-button 58. This push-button executes the same cutting-in and out movements as the lever 41 and it is obvious that, by depressing the push-button 58, the switch member 52 may at any time be shifted to cut out position.

An arrangement which permits regulation of the thermal-releasing device of the switch to act at different nominal current-intensities is shown in Fig. 17. The current flows through the wire 61 into the coil 4 which encloses the plunger armature 5. From the coil 4 a wire 62 leads to a bimetal strip 63 and thence, through a switch-arm 65 pivotally mounted at 64, to the wire 66. Above the bimetal strip 63 a transverse arm 67 is standing which is connected to the plunger armature 5. Shunt resistances 68 and 69 of different values are connected to the wire 62 and adapted to be independently connected to the wire 66 by the switch-arm 55, and connected in parallel to the bimetal strip 63.

This arrangement operates in the following manner: On short circuits, or at short circuit-like overloads the electromagnetic releasing of the switch is instantaneously effected. The thermostat 63 serves to make the switch non-responsive to short overloadings within certain toleration time limits, but to effect release of the switch when such overloads last a longer time. When for example the thermostat 63 has been regulated for 2 amp. it will have extended in one minute at 5 amp. to such a length that it lifts the plunger armature 5 and causes the releasing of the switch. When the overloading is of shorter duration, it is without effect.

Suppose the two shunts 68 and 69 be also tuned to 2 amp. When then the switch-arm 64 is so adjusted that the bimetal strip 66 and the shunt 68 are parallel-connected, the nominal current-intensity amounts to 4 amp. and it amounts to 6 amp., when the three elements 66, 68 and 69 are parallel-connected. By adjusting the switch-arm 65 the nominal current-intensity can be altered at will. It is evident that it is not necessary that for the parallel-connecting of the resistances to the bimetallic-strip a pivoted switch-arm be provided, as the connection of the resistances can be carried out in any other manner, and the resistances may be of any type.

In Figs. 13 and 14 the lower part of a plug-switch is illustrated, in which the alteration of the nominal current-intensity can be produced by altering the foot-contact-stud. The plug-body 1 carries the foot-contact-stud 70 which corresponds for example to a nominal current-intensity of 6 amp. It is connected by a metal strip 71 and a wire 72 to the thermostat (not shown) which is tuned to 6 amp. When the nominal current-intensity has to be increased to 10 amp., a metal-sleeve 73 is pushed over the foot-contact 70. This metal-sleeve is connected by contact-finger 74, spring 75 and wire 80 to a shunt resistance (not shown).

To adjust the switch to a nominal current-intensity of 15 amp., another sleeve 76 is pushed over the sleeve 73. The sleeve 76 is then connected by a finger 77, spring 78 and wire 79 to a shunt resistance which, together with the shunt resistance connected to sleeve 73, will be tuned to 15 amp.

Instead of the sleeves, interchangeable studs of solid cross-section may be used, the diameter or length of which corresponds to the nominal current-intensity. Figs. 15 and 16 show such an arrangement by way of example.

The metal piece 34 mounted in the plug-

body 1 is connected to a thermostat (not shown) by a wire 81. On the top-end of the stud 70 of the foot-contact a tube 82 made of electric nonconducting material is mounted, which carries in its top-end a contact-screw 83. Between this contact-screw 83 and the stud 70 a resistance 84 is arranged. The screw 83 is screwed into a contact-piece 85, which is connected to the switch by a wire 86 so that the resistance 84 acts as shunt to the thermostat. When the stud 70 is turned to the left, the screw 83 is unscrewed from the contact-piece 85, and the stud can be removed like a cartridge and another of a different value substituted therefor. The length of the stud varies in accordance with the current-intensities. Fig. 16 shows a short stud 87 designed for lighter current-intensities.

I claim:—

1. An automatic circuit breaker of the screw-plug type comprising a casing having a spark space, a magnet coil having one of its sides adjacent to said space, circuit closing contacts at the side of the coil adjacent to the spark space, releasing mechanism at the side of the coil opposite that first-named, and connecting means between said releasing mechanism and the switch contacts arranged to embrace said magnet-coil and to effect movement of said contacts on the side of the magnet-coil which faces the spark-space.

2. A circuit breaker as specified in claim 1, embodying an insulating partition between said magnet-coil and said spark-space having two apertures at diametrically opposite points for passage of said connecting-means.

3. A circuit breaker as specified in claim 1, embodying a push-button, a switch-rod on said push-button, an insulating partition between said magnet-coil and said spark-space having two apertures at opposite points near the edge thereof for passage of said connecting-means and a central opening for said switch-rod, said plunger armature closing said central opening of said partition on a circuit breaking movement of the switch contacts.

4. A circuit breaker as specified in claim 1, in which the connecting-means between said releasing mechanism and said switch-contacts comprises arms carrying members engageable with and disengageable from the plunger armature to respectively close and open the switch contacts.

5. A circuit breaker as specified in claim 1, comprising in combination with the magnet-coil, switch contacts on one side of said magnet coil, a releasing mechanism on the other side of said magnet coil and a plunger armature in said magnet coil, connecting means between said switch contacts and said releasing mechanism consisting of two contact-arms pivotally mounted at the sides of said magnet-coil, a separating disk on the lower end of said plunger armature, a roller at the lower end of each of the two-armed contact-arms, said rollers pressing against said separating disk to press together the upper ends of said contact-arms forming the switch contacts, and springs acting on said contact arms to force the switch contacts apart as soon as said rollers are released by the attracted plunger armature.

6. A circuit breaker as specified in claim 1 comprising in combination with a casing having a spark space, a magnet coil, switch contacts in said spark space and on one side of said magnet coil, a releasing mechanism on the other side of said magnet coil, means connecting said switch contacts with said releasing mechanisms, and a partition of insulating material between the coil and spark space and forming passages for said connecting means one at each side of said magnet coil.

In testimony whereof I affix my signature.

WILHELM LEYHAUSEN.