May 28, 1929. W. KLEMENT 1,714,983

AUTOMATIC ELECTROMAGNETIC CIRCUIT BREAKER

Filed April 6, 1926

Fig. 1

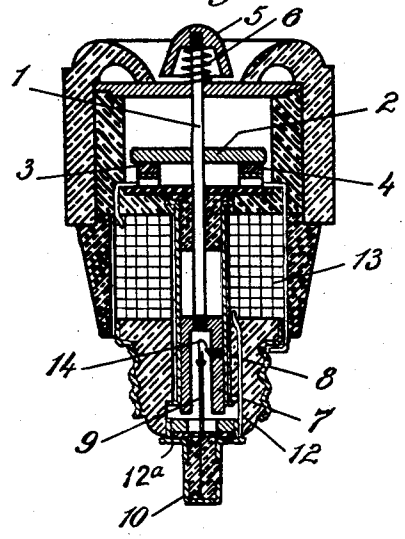


Fig. 2

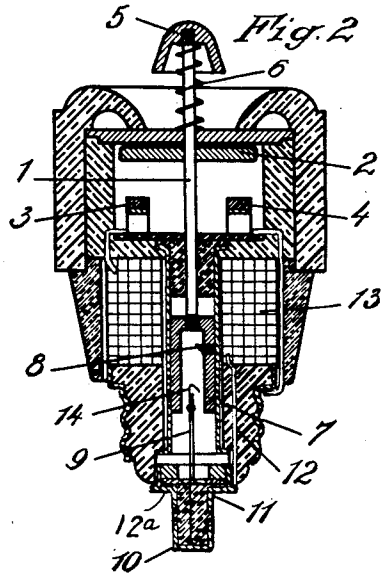


Fig. 3

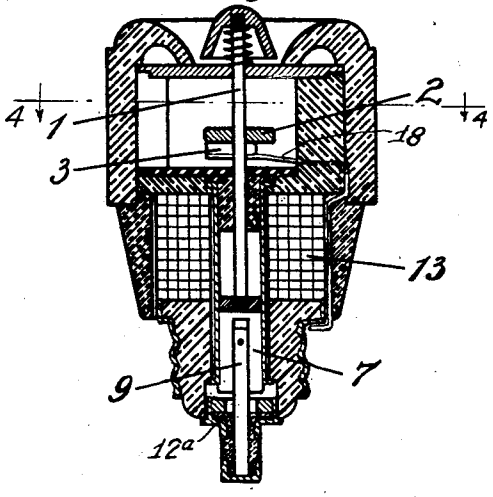


Fig. 5

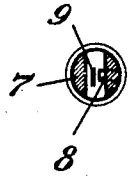


Fig. 4

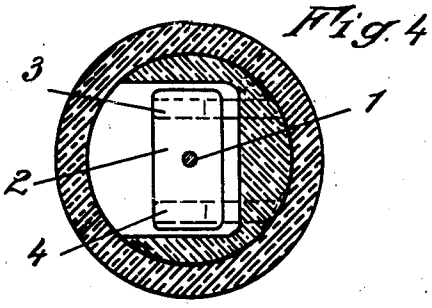
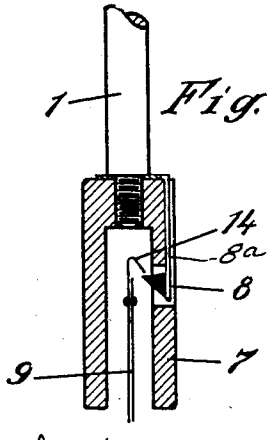


Fig. 6



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UNITED STATES PATENT OFFICE.

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AUTOMATIC ELECTROMAGNETIC CIRCUIT BREAKER.

Application filed April 6, 1926, Serial No. 100,109, and in Germany April 7, 1925.

My invention relates to automatic electromagnetic circuit breakers. It is well known that such breakers are very sensitive to current surges such as occur when motors or metal filament lamps are switched into circuit. Attempts were therefore made to develop designs which render the action of the breaker more sluggish. For this purpose heating members traversed by the current or indirectly heated by it are employed, the change of shape of the heating member under overloads being employed for controlling the switching operation. Heating wires or strips clamped at both ends and controlling the armature, the field circuit or a switch lever arrangement are in particular favour for this purpose. Double metal strips or the like have also been employed.

My invention relates to an automatic electromagnetic circuit breaker, particularly of plug shape, in which the electromagnetic action and the thermic action are brought into a novel relation to each other.

My invention consists in holding the switch rod, which is connected with a plunger core, in its switched in position by a bimetallic strip connected in series relation with the coil, the heating strip being bent at moderate overloads by the heat of the current and passing into the tripping position and the locking action of which is under strong overloads overcome by the magnetic pull on the plunger core.

In the drawing affixed hereto an embodiment of my invention is illustrated by way of example. It represents in:

Fig. 1, a longitudinal section through the electromagnetic automatic cutout or circuit breaker in the closed position.

Fig. 2, the same in the open position,

Fig. 3, the same in the closed position in longitudinal section at right angles to Fig. 1,

Fig. 4, a horizontal section through the improved cutout above the circuit closing contacts,

Fig. 5, a horizontal section through the plunger core and

Fig. 6, a vertical section through the plunger core with a locking device differing from that shown in the other figures.

Like parts are indicated by like letters of reference throughout all the figures of the drawing.

Referring to the drawing, 1 is the switch rod upon which is mounted the contact bridge 2 which effects the closing of the contacts 3 and 4 mounted on springs within the plug. The switch rod terminates at the top in a push-button 5 below which a spring 6 is disposed upon and around the switch rod. This spring has the tendency to maintain the switch rod in its open position or to return it into it. At the lower end of the switch rod is mounted a plunger 7 and upon it a locking pawl 8 of insulating material (see details in Figure 6). In the foot of the plug is arranged the heating strip 9 which may, for instance, consist of two metal strips of different coefficients of expansion. The lower end of one of the two metal strips is connected with the foot contact 10 and the lower end of the other with an annular contact part 12^a which is connected with one end 12 of the coil 13. The upper ends of the two component strips are riveted together, but the strips are spaced apart substantially throughout their entire lengths, as shown in Figures 1, 2 and 6, so that the current passes in series through the two elements of the thermostatic strips 9, when the circuit in which contact 10 and terminal 12^a are included, is closed. The free end of the bimetallic strip is provided with a hook 14.

The manner of operation of the automatic cutout is as follows: On moderate overloads the strip becomes heated and since the two metals of different coefficients of expansion are so arranged that the metal on the right-hand side has a higher coefficient of expansion than that on the left-hand side, the metal strip bends towards the left and the upper hook on the strip releases the locking pawl 8. Under the action of the spring 6 and the spring action of the contacts 3 and 4 the switch rod then passes into the open position. At small loads the magnetic action upon the plunger is only small. As soon as the plunger is, however, drawn into the magnet coil during the cutting out motion, the magnetic attraction of the coil and thereby the speed of operation is increased. The bimetallic strip 9 cools down again and assumes its original shape so that on depressing the switch rod 1 the pawl 8 is again engaged by the hook 14 of the strip 9.

In the event of heavy overloads the mag-

netic field of the coil may pull the plunger into the coil overcoming the locking action of the hook of the bimetallic strip so that the retardation connected with the release by the heating strip is eliminated. This overcoming of the lock by heavy overloads may be facilitated by making the locking pawl 8 movable upon the plunger, for instance as shown in Fig. 6 where it may be moved out of the way against the action of a spring 8a.

Since the plunger core is located outside the magnet coil only a practically negligible tractive force is exerted upon it at moderate loads and the friction at the pawl is consequently not noticeably increased by the magnetic armature attraction. The friction at the pawl thus practically only depends upon the tension of the contact springs 3 and 4 and the spring 6 under the push button. The pressure of the locking pawl against the hook of the bimetallic strip may thus be kept relatively small whereby the device is rendered very sensitive. Furthermore the result is obtained hereby, that the release takes place with the same release current intensity for direct current as for alternating current while holding pawls which are also loaded by the magnetic attraction are tripped more easily by alternating current owing to the oscillations of the armature and thus respond already at smaller currents than when the coil is excited by direct current.

The device has the further advantage that the plunger core can, except in the event of large sudden overloads, only change its position at a certain current intensity, viz when the heating strip is bent up to the point where the release takes place. Thus the present device eliminates the well known and undesirable feature, inherent to similar prior art devices, that the plunger is drawn into the coil already at low current intensities. As soon as in such earlier devices the release should take place then the plunger has already travelled part of its path and it is then frequently incapable of making the effort necessary for effecting the tripping of the circuit breaker. The tripping is consequently retarded and takes place only at a considerably greater and impermissibly high current intensity.

My invention also provides means to exert a considerable impact with a small number of ampere turns, since the energy of the spring set free by the thermic tripping device pulls the plunger with acceleration into the magnetic field of the coil.

The bimetallic strip might be provided on the front of the socket instead of at the foot. It might equally well be curved while cold and straighten out when hot so that the release or tripping of the circuit breaker takes place owing to the straightening out of the thermic strip.

While I have shown my invention in a preferred form, it is obvious that many changes may be made in the details of construction and embodiment thereof without departing from the principles and spirit of my invention, I desire, therefore, that the appended claims shall be accorded the broadest construction commensurate with the language thereof, when read in the light of the prior art.

I claim as my invention:—

1. An automoatic electromagnetic circuit breaker unit comprising an insulating housing, a main current coil within said housing, a switch rod carrying contact elements and being slidingly disposed in said housing, a plunger armature disposed at one end of said rod and normally resting outside of the full coil field pull exerted at moderate overloads, means tending to move said rod and contacts and armature in the direction of the magnetic pull of said coil into and hold them in open circuit position, a thermostatic element responsive through mechanical motion to excess temperatures produced by overload current passing through the circuit breaker, said element having means for engaging and holding said switch in circuit-closing position, said means being releasable on gradual response of said element to moderate overloads.

2. An automatic electromagnetic circuit breaker comprising a plug shaped detachable body of insulating material, a main current coil disposed within said body, a switch rod carrying contact means and passing through said body and said coil, a plunger armature disposed at the lower end of said rod outside of said coil, means tending to move said rod and contact means in the direction of the magnetic coil pull into and hold them in open circuit position, a bi-metallic thermostatic strip electrically connected in series with said coil and means on said strip and said rod for engaging and holding said switch rod in circuit closing position, said strip bending at increased temperature produced by moderate overload currents and gradually passing into rod releasing position.

3. An automatic electromagnetic circuit breaker comprising a plug shaped detachable body of insulating material, a main current coil disposed within said body, a switch rod carrying contact means and passing through said body and said coil, a plunger armature disposed at the lower end of said rod outside of said coil, means tending to move said rod and contact means in the direction of the magnetic coil pull into and hold them in open circuit position, a bi-metallic thermostatic strip electrically connected in series with said coil and means on said strip and said rod for engaging and holding said switch rod in circuit closing position, said strip bending at increased temperature produced by moderate overload currents and gradually passing into rod releasing posi-

tion, said rod engaging means comprising a nose on said thermostat strip and a yielding detent on said armature engageable by said nose, said nose and detent being suitably shaped to instantly yield and release said armature in response to a strong magnetic pull upon the armature caused by heavy overloads.

4. An automatic electromagnetic circuit breaker comprising a plug shaped detachable body of insulating material, a main current coil disposed within said body, and spring contact elements mounted on said body and connected in circuit with said coil, a switch rod carrying a contact bar for bridging said contact elements, said rod passing through said body and said coil and a plunger armature disposed at the lower end of said rod outside of said coil, a spring operatively connected with said rod and tending in conjunction with said spring contacts to move said armature into the coil field in the direction of its magnetic pull to throw said bar into open circuit position, said spring adapted to hold said bar in open circuit position, a bi-metallic-thermostatic strip electrically connected in series with said coil and having a nose at its outer end, a yielding pawl on said armature engaging said nose when the contact bar closes the circuit, said strip gradually bending at increased temperature produced by moderate overload currents thereby releasing said pawl and causing said spring to function in conjunction with the magnetic coil field to open the circuit.

5. An automatic electromagnetic circuit breaker comprising a plug shaped detachable body of insulating material, a main current coil disposed within said body, and spring contact elements mounted on said body and connected in circuit with said coil, a switch rod carrying a contact bar for bridging said contact elements, said rod passing through said body and said coil and a hollow plunger armature disposed at the lower end of said rod outside of said coil, a spring operatively connected with said rod and tending in conjunction with said spring contacts to move said armature into the coil field in the direction of its magnetic pull to throw said bar into open circuit position, a bi-metallic thermostatic strip electrically connected in series with said coil and being located inside of said hollow plunger armature, said strip having a nose at its free end, a yielding pawl on said armature protruding to the interior thereof and engaging said nose when the contact bar closes the circuit against the tension of said spring, said strip gradually bending at increased temperature produced by moderate overload currents thereby releasing said pawl and causing said spring to function in conjunction with the magnetic coil field to open the circuit.

In testimony whereof I affix my signature.

WILHELM KLEMENT.