July 29, 1947. F. B. ADAM ET AL 2,424,909

CIRCUIT INTERRUPTING DEVICE

Filed Dec. 30, 1942 4 Sheets-Sheet 1

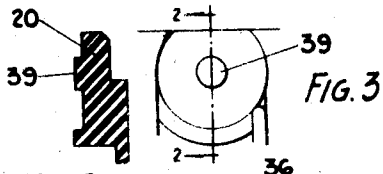

FIG. 3

FIG. 2

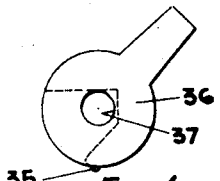

FIG. 4

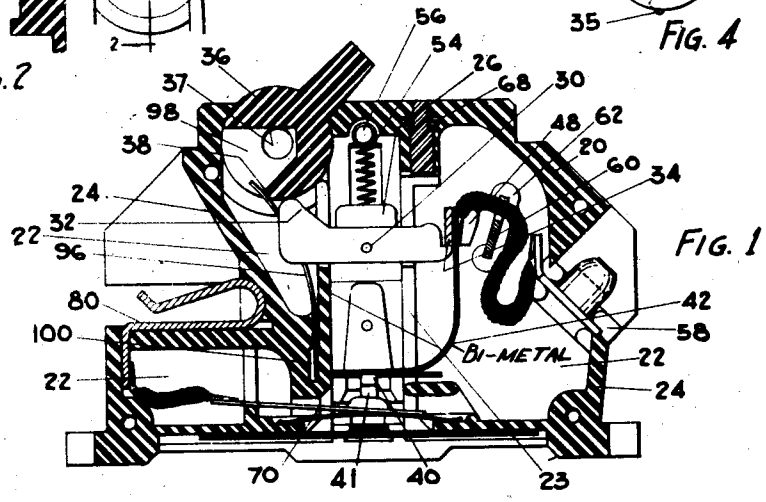

FIG. 1

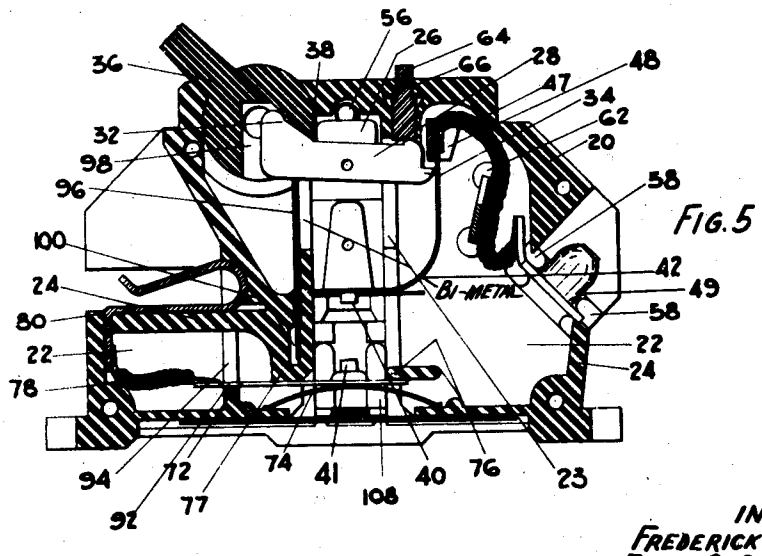

FIG. 5

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CIRCUIT INTERRUPTING DEVICE

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FIG. 6a

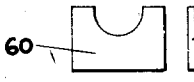

FIG. 13a

FIG. 12

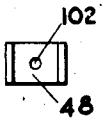

FIG. 12a

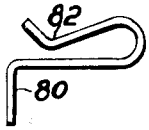

FIG. 6

FIG. 13

FIG. 14

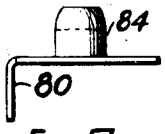

FIG. 7

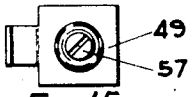

FIG. 15a

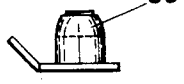

FIG. 15

FIG. 11

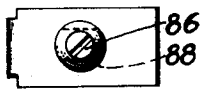

FIG. 7a

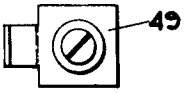

FIG. 16a

FIG. 7b

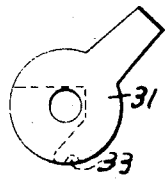

FIG. 9

FIG. 11a

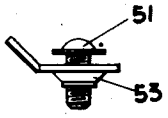

FIG. 16

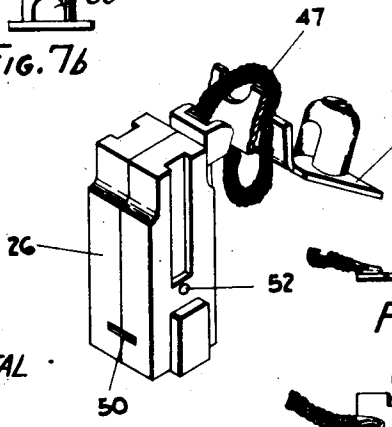

FIG. 18

FIG. 11b

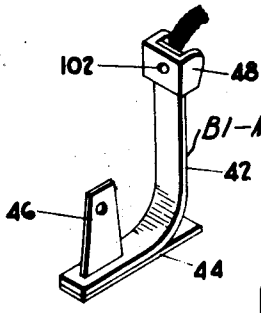

FIG. 17

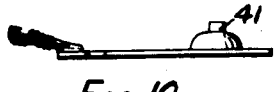

FIG. 10

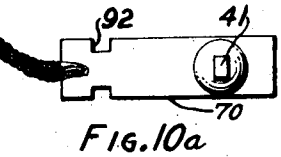

FIG. 10a

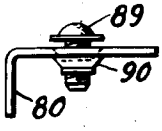

FIG. 8

FIG. 8a

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CIRCUIT INTERRUPTING DEVICE

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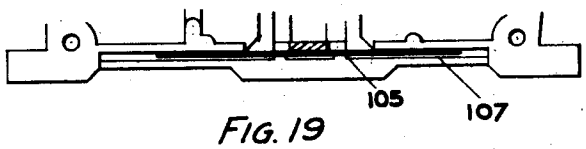

FIG. 19

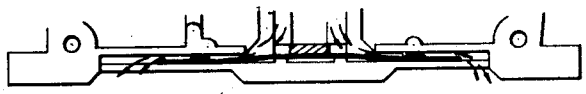

FIG. 20

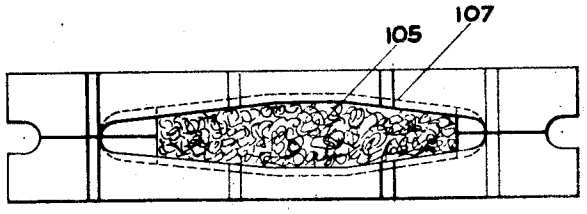

FIG. 21

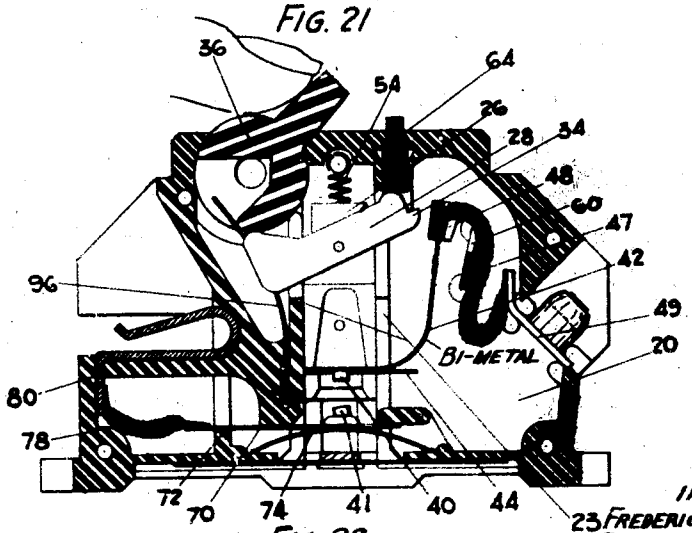

FIG 22

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CIRCUIT INTERRUPTING DEVICE

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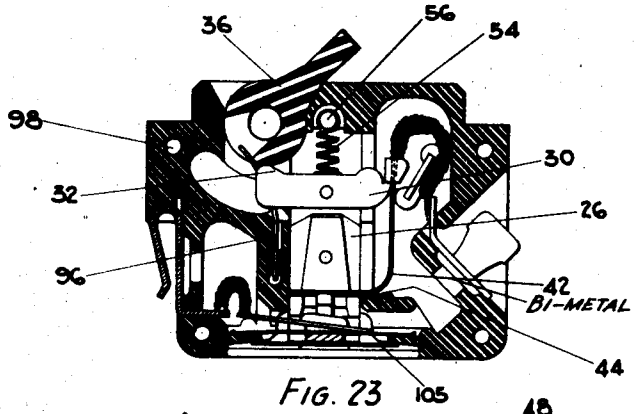

FIG. 23

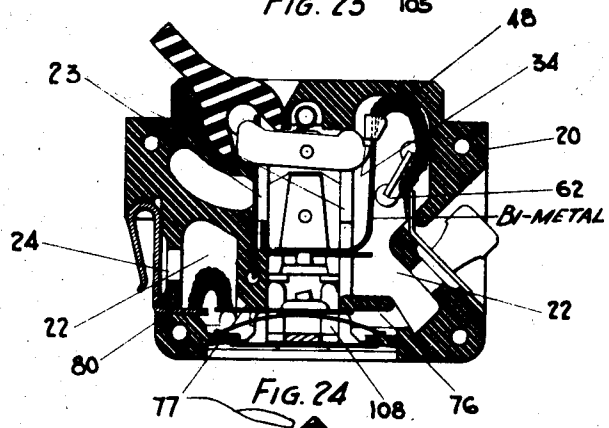

FIG. 24

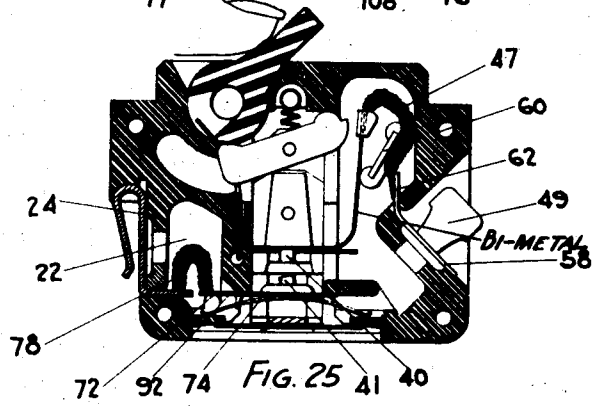

FIG. 25

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Patented July 29, 1947 2,424,909

UNITED STATES PATENT OFFICE

2,424,909

CIRCUIT INTERRUPTING DEVICE

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Application December 30, 1942, Serial No. 470,680

1 Claim. (Cl. 200—88)

1

This invention relates to improvements in circuit interrupting devices of a type shown in the patent to Frederick B. Adam and Henry M. Stieglitz, No. 2,328,767, dated Sept. 7, 1943.

It is an object of this invention to provide an improved enclosed switch or circuit breaker.

The circuit breaker of this invention is shown equipped with a floating type contact which is self-cleaning and will not freeze or stick.

Provision is also made for a magnetic type arc quencher with pole pieces properly positioned to aid in extinguishing the arc formed by the opening of the contacts.

The invention also provides means for the escape of gases from the bottom of the circuit breaker enclosure where a specially formed piece of fibre prevents the flame of the arc from escaping outside of the enclosure, but nevertheless permits gas pressure relief.

Further improvements for protecting the thermal element against excessive heat of the arc are also shown.

The circuit breaker of this invention provides a method of utilizing the magnetic field created by short-circuit currents to aid the thermal element in quicker tripping of the breaker.

Other objects and advantages of the invention will become apparent from the following detailed description and the accompanying drawings. Several preferred forms of the invention are shown in the accompanying drawings and hereinafter described, but it is understood that the drawings and accompanying description do not limit the invention to the forms there shown and here described, but that the invention will be defined by the appended claim.

In the accompanying drawings:

Figure 1 is a longitudinal sectional view of a circuit breaker embodying this invention. The breaker is in the "on" position.

Figure 2 is a partial cross-section of the circuit breaker housing taken along plane 2—2 of Figure 3 with the handles removed.

Figure 3 is a partial side elevation of a portion of the housing under the handle.

Figure 4 is a side elevation of the handle.

Figure 5 is the same view as Figure 1 with the circuit breaker in the "off" position.

Figures 6 to 18 are detailed views of the various parts shown in Figures 1 and 5, or substitutes therefor.

Figures 19 and 20 are longitudinal sectional views of the bottom of the circuit breaker, showing the paths provided for the escape of gases, Figure 19 showing the normal position of parts

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and Figure 20 the change in position of parts to allow the escape of gases.

Figure 21 is a bottom plan view of the circuit breaker.

Figure 22 is a longitudinal sectional view of the circuit breaker with the breaker in the "tripped" position.

Figure 23 is a longitudinal sectional view of the circuit breaker provided with an alternative form of enclosure. The breaker is here shown in the "on" position.

Figure 24 is the same view as Figure 23 with the breaker in the "manual off" position.

Figure 25 is the same view as Figure 19 with the breaker in the "tripped" position.

Referring now to the drawings, 20 is a housing or enclosure which is formed of molded plastic or other suitable material. The material is formed to provide walls 24 surrounding cavities 22 in which the operating parts are positioned. A contact carrier 26 is guided and maintained in position for sliding movement in a direction longitudinal of the housing, by the inner walls 23. The housing as shown is formed of two substantially identical half sections. The contact carrier is provided with a transverse bar 28. The transverse bar may be pivotally supported for rotation about a pivot 30. A cam surface 32 is provided on one end of the transverse bar and on the other end a projection 34 may be provided. An operating handle 36, which may be formed of a molded insulating material, is provided with openings 37 which are journaled on pivots 39 formed on the housing. The molded handle is provided with a portion 38 which acts as a follower in co-operating with the cam surface 32 of the transverse bar. A bump or projection 35 is provided on the handle for a purpose later to be described. The contacts 40 and 41 are the "make" and "break" contacts of the device. The contact 40 is the movable contact and is carried by the contact carrier 26.

An optional form of handle 31 is shown in Figure 9. In this form of handle a slot 33 replaces the bump 35 on handle 36. Either the bump or slot in co-operation with the cam surface 32 provides snap operation and aids in holding the handle in position.

The contact 40 is part of an assembly shown in detail in Figure 17, consisting of the bimetallic element 42, a strip of fibre or insulating material 44, a mounting piece 46 and a soft-iron U-shaped member 48. The fibre strip 44 is not always necessary and may be omitted if desired. A dowel pin 102 may extend through the member 48 and

bimetal 42 and serves to locate them properly while they are welded together. The copper braid 47 may then be welded to the assembly in the position shown. The assembly shown in Fig. 17 is mounted between the two half sections of insulating material of the contact carrier to form the completed contact carrier shown in Fig. 18. The rivet 52 extends through the hole shown in member 46 and the slot 50 positions member 44. The thermal element 42 extends along the outside of the insulating half sections as can be seen in Fig. 1. The contact carrier is biased in the open position by a spring 54 secured to the contact carrier at one end and to the housing at the other end by slipping it over a projection 56 which is formed integral with the housing.

Copper braid 47 electrically connects the thermal element with a terminal piece 49 shown in detail in Figure 15. Figure 16 shows an optional form of terminal piece which may replace that shown in Figure 15, provided with a screw 51 which co-operates with a cavity 53 formed in the terminal piece to clamp a wire therein.

The terminal piece shown in Fig. 15 has a cable receiving portion 55 provided with a screw 57 to clamp a cable or wire in an opening passing through the cable receiving portion under the screw 57. The construction of the braker makes it possible to substitute one type of terminal for another without changing the relation of the other parts, thus the terminal shown in Fig. 16 is easily used instead of that shown in Figure 15.

Formations 58 are provided (Figs. 1 and 5) in the insulating material to receive and position the terminal piece 49 which may be easily slid into position when the circuit breaker is assembled.

A soft iron armature 60 is positioned in a recess or slot 62 formed in the housing. The iron piece 60 serves as an armature for the magnet 48 on the thermal element.

An indicator 64 is provided and is shown positioned in an opening 66 through the face of the housing. A spring 68 maintains the indicator in a retracted position until the indicator is struck by the transverse bar as shown in Fig. 5, whereupon it projects through the opening and is visible from the front face of the circuit breaker. The indicator is formed of a colored plastic.

The contact 41 is secured to a floating contact strip 70 which is guided and maintained in position by projections of the insulating material of the housing (see Fig. 5). The strip 70 is pivoted on a projection 72 of the housing and is biased towards the "on" position and away from the bottom of the housing by a spring 74. The projections 76 and 77 limit the upward movement of the strip 70. A piece of copper braid connects the contact strip 70 with a terminal member 80. The terminal member 80 may be any one of a number of types depending on the particular application of the circuit breaker.

A detailed view of the floating contact strip 70 is shown in Fig. 10. The notches 92 co-operate with projections or walls 94 (see Fig. 5) to hold the strip in proper operating position. The projection 72 acts as a pivot point so that the contact strip 70 moves in an arc rather than rectilinearly. This is done for the purpose of providing a sliding self-cleaning contact between the movable contact 40 and the contact 41. As the contact 40 moves rectilinearly and the contact 41 can move only in an arc, then a sliding action must take place between them.

In Figures 6, 7, and 8 are shown various substitutes for the terminal member 80 shown in

Fig. 6. In Fig. 6 the terminal member 80 is provided with an integral clip portion 82 which makes it possible for the individual circuit breakers of an assembly to be connected with the line bus bar by merely clipping them onto the bus bar. In Fig. 7 is shown a terminal equipped with a wire or cable connector 84 which is provided with a screw 86 which clamps a wire when inserted in the opening 88 shown in dotted lines. In Fig. 8 is shown a terminal equipped with a screw 89 which co-operates with a concave portion 90 of the terminal to secure a wire therein.

A straight spring 96 projects into the recess 98 of the handle at one end and at the other end is held in a recess 100 formed in the insulating material. This spring biases the handle in the "off" position. Because it is difficult to mold a narrow slot in the housing the recess 100 was formed as shown, of two relatively wide recesses offset from one another. This in effect provides a narrow slot at the offset.

Manually, the circuit breaker operates essentially as that described in the prior patent referred to above. On short-circuit however, the automatic trip action is considerably improved.

The handle 36 is normally used to open and close the circuit. This is accomplished by the follower portion 38 on the handle engaging the inclined portion 32 of the transverse bar and thus forcing the bar to the "on" position against the bias of the spring 54. The contact 40 engages the contact 41 by means of a sliding engagement as previously described, which insures that the contacts will not stick or "freeze." When the handle is moved in the opposite direction the contacts are separated by the spring 54. It can be seen that the indicator 64 is raised from the face of the circuit breaker housing whenever the contact carrier 26 is in the open position as shown in Fig. 5.

Should the current through the breaker become excessive, then the circuit breaker is tripped by action yet to be described and the parts assume the position shown in Fig. 22. The path of current is normally through the terminal 80, the copper braid 78 to the contact strip 70 and contact 41, thence to the movable contact 40 and bimetal 42, copper braid 47 and terminal 49.

The tripping of the circuit breaker may be brought about by either one of two causes or by a combination of these two causes. Thus, if the bimetallic element 42 is heated by a high abnormal current for a short time, or by a lower abnormal current for a longer period of time, it will be distorted into the position shown in Fig. 22 and allow the projection 34 of the transverse bar to slip out from under the member 48 and allow the contact carrier 26 to move to the open circuit position.

Should a short circuit occur, the heavy rush of current which flows through the bimetal and braid will create a strong magnetic field which will magnetize the soft iron magnet piece 48, and the fixed member 60, causing them to be attracted to each other. This will cause the member 48 to be pulled off of the projection 34 which will allow the circuit breaker to open.

The magnetic trip action will operate the breaker faster in case of a short circuit than the thermal element alone and hence is desirable in operating the circuit breaker on short circuits.

It can thus be seen that the magnetic action accelerates the thermal action on short-circuits. While the thermal element is becoming distorted because of the temperature rise the magnetic ac-

tion due to the short-circuit currents accelerates the distortion of the thermal element and the breaker opens. On ordinary overloads the magnetic action has little or no effect and the breaker operates as an ordinary thermal breaker.

Details of the magnetic member **48** are shown in Fig. 12 and the armature **60** in Fig. 13.

The contact **41** is effectually inclosed by the walls of the insulating housing which surrounds it, as can be seen from Figures 1 and 5. Under this contact however, there is provided an opening in the housing (see Fig. 21.) This opening is closed by a piece of fibre identified in these figures by numeral **105**. This piece of fibre fits in slots **107** at the bottom of the housing. Thus after an arc is formed on the breaking of a short circuit, the gases may escape by following the path shown in Fig. 20 to the outside. Their contact with the fibrous material helps cool them and subdue them so that they do not reach to the outside at a high temperature. By inspection of Figures 19 and 20 the action of the gas pressure in forcing the fibre piece down to allow exit of the gases may be followed.

It can be seen that the terminal member **49** is mounted in a sloping position and enclosed on each side by a portion of the plastic housing. The sloping of the terminal makes it easier for the wireman to connect the wire to this terminal when it is enclosed on the other sides as this one is.

Numeral **108** indicates a magnetic arc quencher shown in detail in Fig. 11. It is formed of magnetic material such as soft iron and is shaped so as to be positioned in the space as shown. On short-circuits the heavy current creates a magnetic field between the tips of the arc quencher which effectively aids in extinguishing the arc formed between the contacts.

The arc quencher is formed so that the projections on the side of the contact carrier (see Fig. 18) will not interfere therewith when it is in the closed circuit position.

It can thus be seen that a circuit breaker is provided which will have an improved operating characteristic on short circuits. A magnetic trip action has been added to aid and accelerate the action of the thermal element on short circuit and yet not interfere with the action of the thermal element on prolonged overloads.

An arc quencher is provided to limit the extent of the arc and to reduce the peak current reached before the breaker opens.

A self-cleaning contact insures against failure because of frozen contacts.

Figures 23, 24 and 25 show "on," "manual off" and "tripped" positions of another forrm of the circuit breaker of this invention. The breaker here shown is arranged more compactly in a housing which may be introduced into the ordinary switch box. This makes it possible for ordinary wall switches to be replaced by switches embodying circuit breaker protection. The same numerals are used with this embodiment as the operation of the breaker is identical. The position of the terminal **80** is slightly different.

We claim:

In an automatic circuit breaker of the enclosed type, a housing of insulating material, a contact positioned in said housing, a contact carrier mounted for sliding longitudinal movement in the housing, a contact affixed to the contact carrier, a transverse bar pivoted to the contact carrier for rotary movement relative to said contact, means biasing the contact carrier to open circuit position, manual means for depressing one end of the transverse bar to move the contact carrier to closed circuit position, a thermal element carried by the contact carrier and latching the other end of the transverse bar to hold it against rotation relative to said contact, said thermal element being adapted to warp when the current through the circuit breaker exceeds a predetermined value and allow the release of the end of the transverse bar to permit the contact carrier to move to the open circuit position independently of the manual operating means, magnetic means arranged to move the thermal element in the same direction as it warps, when the current through the circuit breaker exceeds a second predetermined value, said magnetic means consisting of a magnetizable yoke mounted on said thermal element and a stationary magnetizable member mounted on said housing in proximity to the position of said yoke when the circuit breaker is in closed circuit position but remote therefrom when the circuit breaker is in open circuit position, and a flexible conductor partially surrounding said stationary magnetizable member and connected at one end to said thermal element and at the other end to a stationary part.

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HENRY M. STIEGLITZ.

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