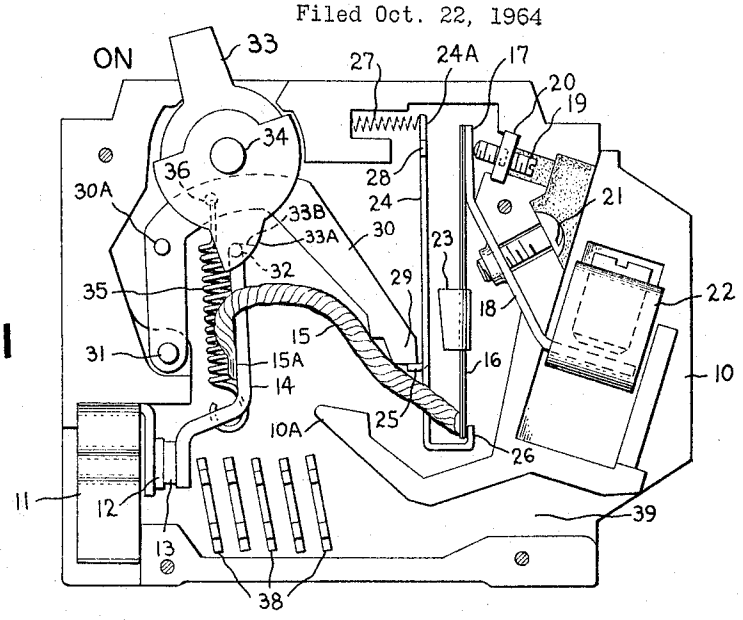
Aug. 23, 1966 D. B. POWELL 3,268,689

ELECTRIC CIRCUIT BREAKER WITH NOVEL FLEXIBLE BRAID ATTACHMENT

Filed Oct. 22, 1964

FIG. 1



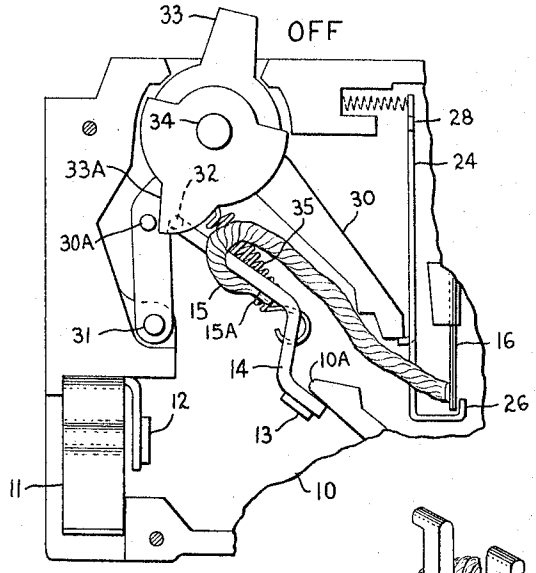


FIG. 2

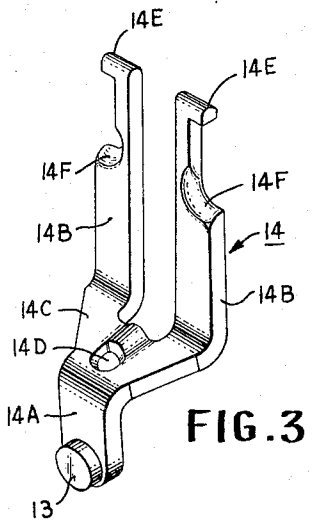


FIG. 3

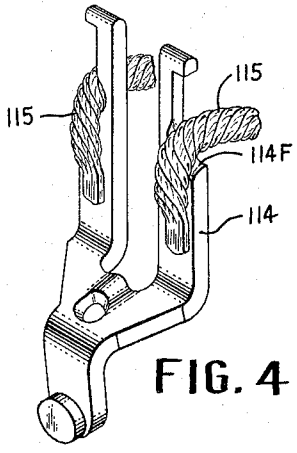


FIG. 4

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United States Patent Office 3,268,689 Patented August 23, 1966

3,268,689

ELECTRIC CIRCUIT BREAKER WITH NOVEL FLEXIBLE BRAID ATTACHMENT

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Filed Oct. 22, 1964, Ser. No. 405,759
4 Claims. (Cl. 200—116)

My invention relates to electric circuit breakers, and more particularly to electric circuit breakers of the type including a pivotally supported contact arm carrying a movable contact which is connected to other circuit breaker components by a flexible conductor or "braid."

Electric circuit breakers of the type described present a problem of avoiding breakage of the relatively fine strands of the flexible conductor or braid because of the repeated flexing thereof by motion of the contact arm between "on" and "off" positions. This problem becomes more severe the greater the angle of movement of the contact arm is, and with larger size flexible conductors. The problem is therefore greatly accentuated in so called "compact" circuit breaker designs, since the shortening of the length of the contact arm requires an increased angle of movement in order to achieve adequate contact opening distance, and since the increased ratings of such breakers require the use of relatively large flexible conductors. Since such breakers are required to pass "endurance" tests which call for the contact arm to undergo at least 10,000 operations, resulting in flexing of the flexible conductor or braid at least 20,000 times, breakage of the fine strands of the flexible conductors is quite likely to occur. Such breakage is especially likely to occur immediately adjacent the point where the flexible conductor or braid is attached to the contact arm, which is commonly done by brazing.

It is an object of the present invention to provide an electric circuit breaker including a pivotally supported contact arm which moves through a relatively large angle of movement and has a flexible conductor or braid connected thereto, the structure of the contact arm and the method of attaching the flexible conductor being such that the flexible conductor or braid is enable to withstand an extremely high number of mechanical operations without breakage.

It is a more specific object of the invention to provide an electric circuit breaker which includes a pivotally supported contact arm and a flexible conductor or braid connected thereto, the braid being connected to the contact arm in such a way as to prevent flexing closely adjacent the point of attachment of the braid to the contact arm, and also to provide a support around which the flexible conductor or braid is bent during extreme flexing, so that the conductor is not bent at an extremely sharp angle.

The invention will be more fully understood from the following detailed description, and its scope will be pointed out in the appended claims.

In the drawing,

FIGURE 1 is a side elevation view of an electric circuit breaker incorporating the invention;

FIGURE 2 is a fragmentary side elevation view similar to FIGURE 1 but showing the parts in the "off" condition;

FIGURE 3 is a perspective view of the contact arm of the circuit breaker of FIGURE 1, and

FIGURE 4 is a perspective view of the contact arm of one form of the invention suited for use with higher capacity ratings.

Referring to FIGURE 1, the invention is shown as incorporated in an electric circuit breaker comprising a generally rectangular insulating casing **10** including two generally tray-shaped casing halves which come together in a plane extending parallel to the side walls of the

casing. In FIGURE 1, the casing half nearest the observer is omitted to show the parts.

The insulating casing **10** includes a stationary "line" terminal **11** of the plug-in type, adapted to make connection with a stab or blade type contact, not shown. A relatively stationary contact **12** is supported on the line terminal **11** and cooperates with a movable contact **13** carried by a contact arm **14**. The contact arm **14**, in turn, is connected by means of a flexible conductor or a braid **15** to the movable end of an elongated bimetallic strip **16**, the other end of which is rigidly attached to the inner end **17** of a conductor strap **18**. The end **17** of the strap **18** is adjustably positioned by means of a calibrating screw **19** threadedly received in a nut **20** trapped in the insulating casing **10**. The strap **18** is fixedly mounted in the insulating casing by suitable means such as by screw **21**, and carries a load connecting terminal **22** at its outer end.

The bimetallic strip **16** carries a generally U-shaped magnetic field-piece **23** at an intermediate point which, when energized serves to attract a combined magnetic armature and latch member **24**, carrying a latch projection **25**, and including a return-bent end portion **26** extending around the movable end of the bimetallic strip **16**. The armature-latch member **24** is biased toward latching position by means of a compression spring **27**, acting on an extension **24A** of the member **24**, extending beyond its pivotal support **28** in the insulating casing **10**.

The latch projection **25** serves to normally restrain the end portion **29** of a releasable support member **30** which is pivotally supported in the insulating casing such as by means of a pivot pin **31**.

The movable contact arm **14** is pivotally supported at **32** on an insulating handle member **33** which in turn is pivotally supported at **34** in the insulating casing. A tension type operating spring **35** has one end connected to the contact arm **14** adjacent its outer end, and its other end connected to an intermediate point of the releasable support member **30** at a hole **36**. The motion of the contact arm **14** toward open circuit position is limited by its engagement with a raised boss or stop member **10A** integral with the insulating casing **10**.

For the purpose of assisting in the cooling and extinction of an arc drawn between the contacts **12** and **13**, a plurality of generally U-shaped flat metallic plates **38** are provided, which are slanted in the general direction of an arc venting passages **39**.

In operation, rotation of the handle member **33** about its pivot **34** moves the pivotal support **32** of the contact arm **14** back and forth across the line of action of the tension spring **35**, thus moving the contact arm **14** about the pivotal support **32** between an "on" position as indicated in FIGURE 1, and an "off" position as indicated in FIGURE 2. When the parts are in the closed-circuit or "on" position as shown in FIGURE 1, an excess current or overload condition causes the bimetallic strip **16** to warp so as to move the lower end thereof to the right as viewed, engaging the return-bent end **26** of the armature-latch member **24**, and withdrawing the latch member **25** from the releasable support member **30**. When this occurs, the action of the tension spring **35** rotates the member **30** clockwise about its pivotal support **31**, moving the anchor point **36** of the spring **35** to the right as viewed and causing the line of action of the spring **35** to pass across the pivot point **32** of the contact arm **14** to automatically move the contact arm to an open-circuit position. Resetting of the breaker is accomplished by moving the handle **33** to its "off" position, causing the lower extension **33A** of the handle to engage a pin **30A** of the releasable support member **30** and rotating it in counterclockwise direction to relatched position.

In accordance with the invention, the movable contact arm **14** is designed to cooperate with the flexible conductor **15** in such a way as to minimize the flexing duty on the conductor **15**, and to prevent flexing from occuring closely adjacent the anchor-point **15A** of the braid. Accordingly, the movable contact arm **14**, as shown particularly in FIGURE 3, comprises a bifurcated member including a contact supporting portion **14A** and a pair of spaced-apart side portions **14B**. The bight portion **14C** of the contact member includes a hole **14D** receiving the end of the operating spring **35**, as shown particularly in FIGURES 1 and 2. Each of the opposed side portions **14B** terminates in a rounded bearing portion **14E** which is received in a corresponding notch **33B** of the handle **33**. In addition, each of the side portions **14B** has a notch cut therein providing a rounded shoulder **14F**. The conductive braid **15** is attached to one of the side portions **14B** of the contact number **14** at **15A** by suitable means, such as by brazing, at the *front* side thereof, just below one of the shoulders **14F**, as clearly shown in FIGURES 1 and 2. Because of this arrangement, when the contact arm moves to the "off" position as shown in FIGURE 2, the flexible conductor or braid **15** is supported adjacent its point of brazing **15A** to the contact arm **14**. Thus substantially no flexing takes place closely adjacent the brazing point **14A**, where breakage is otherwise most likely to occur. In addition, the conductor or braid **15** is supported by the shoulder **14F** in the area in which bending does take place, thereby forcing the bend to be on a larger radius than would otherwise be the case, such, for example, as if the shoulder **14F** were immediately adjacent the brazing point **15A**, or if the conductive braid were attached to the *back* side rather than to the *front* side of the contact arm **14**. (The term "front side" is used to refer to the side of the contact arm which is the same as that on which movable contact is carried.)

Circuit breakers constructed in accordance with the invention have shown an advantage over other ways of attaching a flexible conductor or braid by a factor of four to one so far as breakage is concerned. Thus, for example, circuit breakers constructed as illustrated have successfully passed endurance tests in which they were subjected to repeated on-off operations causing flexing of the conductor or braid more than 40,000 times, although other constructions tried in accordance with prior practice, experienced breakage at less than 10,000 flexures.

In the form of the invention illustrated in FIGURES 1 and 2, only a single conductive braid **15** is utilized to connect the contact arm **14** to the bimetallic strip **16**.

In FIGURE 4 there is illustrated a form of the invention suited for higher current rated circuit breakers. In this case a pair of flexible conductive braids **115** is used to conduct the current from the contact arm **114**. The operation of the invention in this form is substantially identical to that described in connection with FIGURES 1 and 2. It will be observed that both flexible conductive members **115** are protected from breakage by structure similar to that described in connection with FIGURES 1–3, including shoulder portions **114F**.

While the invention has been shown in only two specific embodiments, it will be readily apparent that many modifications thereof may readily be made, and it is therefore intended that the attached claims shall cover all such modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric circuit breaker comprising:

(a) an insulating casing,

(b) a relatively stationary contact mounted in said insulating casing,

(c) a contact arm pivotally supported in said insulating casing on a predetermined pivot support, said contact arm being movable between open and closed circuit positions and having a generally planar contact supporting portion,

(d) a movable contact mounted on one side of said contact supporting portion and movable thereby into and out of engagement with said relatively stationary contact,

(e) a relatively stationary conductive member mounted in said insulating casing at the side of said contact supporting portion of said contact arm opposite said one side,

(f) an elongated flexible conductor having one end thereof fixedly attached to said contact supporting portion of said contact arm and having its other end fixedly connected to said relatively stationary conductive member, said flexible conductor forming a bend between said ends when said contact arm is in said open-circuit position,

(g) said flexible conductor being attached to said contact arm at a predetermined point of attachment on said one side of said contact arm, said contact arm including a shoulder portion spaced away from said point of attachment of said flexible conductor, said shoulder portion being spaced from said movable contact in the direction of said pivot support, said flexible conductor extending around said shoulder portion, said shoulder portion of said contact arm being within the bend formed in said flexible conductor when said contact arm is in said open-circuit position, said shoulder preventing bending of said flexible conductor close to said point of attachment and limiting the sharpness of said bend of said flexible conductor.

2. An electric circuit breaker comprising:

(a) an insulating casing,

(b) a relatively stationary contact mounted in said insulating casing,

(c) an insulating handle pivotally supported in said insulating casing,

(d) a contact arm pivotally supported in said insulating casing on a predetermined pivot support and connected to said operating handle, said contact arm being movable between open and closed circuit positions and having a generally planar contact supporting portion, a movable contact mounted on one side of said contact supporting portion and movable thereby into and out of engagement with said relatively stationary contact,

(e) a releasable support member pivotally mounted in said insulating casing,

(f) current responsive latch means normally restraining said releasable support in operative position,

(g) an elongated tension type spring interconnecting said releasable support member and said contact arm, said handle member moving said pivot support of said contact arm back and forth across the line of action of said tension spring as said operating handle is moved between open and closed circuit positions,

(h) an elongated flexible conductor having one end thereof fixedly attached to said contact supporting portion of said contact arm at said one side thereof and having its other end fixedly connected to said current responsive means, said flexible conductor forming a bend between said ends when said contact arm is in said open circuit position,

(i) said contact arm including a shoulder portion spaced away from the point of attachment of said flexible conductor, said shoulder portion being spaced from said movable contact in the direction of said pivot support, said flexible conductor extending around said shoulder portion, said shoulder portion of said contact arm being within the bend formed in said flexible conductor when said contact arm is in said open-circuit position, said shoulder preventing bending of said flexible conductor close to said point

of attachment and limiting the sharpness of said bend of said flexible conductor.

3. An electric circuit breaker comprising:

(a) an insulating casing,

(b) a relatively stationary contact mounted inside insulating casing,

(c) an elongated generally planar contact arm pivotally supported on a pivot support in said insulating casing at one end for rotation about an axis extending parallel to the major planar surface of said contact arm, and carrying a movable contact fixedly attached on one side of said contact arm at the other end thereof,

(d) operating mechanism mounted in said insulating casing and connected to said movable contact arm, said operating mechanism including a manually engageable handle member movable between "on" and "off" positions to move said contact arm between open and closed circuit positions with a snap action,

(e) a relatively stationary conductive member mounted in said insulating casing at a point spaced away from said movable contact arm,

(f) a pair of elongated flexible conductors having a first end thereof fixedly attached to points of attachment on said one side of said contact arm and each having its other end fixedly attached to said stationary conductive member,

(g) said contact arm having a pair of shoulder portions, each of said shoulder portions being spaced away a short distance from one of said first points of attachment of said flexible conductors to said contact arm, said shoulder portions being spaced from said movable contact in the direction of said pivot support,

(h) said flexible conductors being bent over said shoulder portions respectively, whereby said shoulder portions prevent said conductors from flexing at a point closely adjacent said point of attachment to said contact arm and preventing sharp bending of said flexible conductors when said contact arm moves to open-circuit position.

4. An electric circuit breaker comprising:

(a) a generally rectangular insulating casing,

(b) a relatively stationary contact mounted in said insulating casing,

(c) a manually engageable handle pivotally supported in said insulating casing,

(d) an elongated generally planar contact arm, said contact arm being bifurcated at one end to form a pair of parallel arm portions, said arm portions terminating in bearing portions having a pivotal engagement with corresponding spaced apart portions of manually engageable handle,

(e) said contact arm having a movable contact fixedly attached to the end thereof opposite said bifurcated end on a first planar surface thereof,

(f) a latch member pivotally mounted in said insulating casing,

(g) a generally U-shaped releasable support member pivotally mounted in said insulating casing at one end thereof and having the other end thereof in releasably latched engagement with said latch member,

(h) an elongated tension type spring interconnecting said releasable support member and said contact arm whereby movement of said manually engageable handle member about its pivotal support moves the pivot of said contact arm across the line of action of said tension spring and moves said contact arm about its pivot point between open and closed circuit positions with a snap action,

(i) current responsive means mounted in said insulating casing and connected to said latch member to cause releasing movement of said latch member upon the occurrence of predetermined current conditions,

(j) a pair of elongated flexible conductive members each having one end thereof connected to said current responsive means and each having the other end thereof fixedly connected each to one of said arm portions of said contact arm, on said first planar surface thereof, said arm portions of said contact arm each having a shoulder portion engaging said flexible conductive member at a point spaced from the point of attachment of said conductive member to said contact arm said shoulders being spaced from said movable contact member in the direction of said pivot support of said contact arm, whereby said shoulders prevent said flexible conductive members from flexing at a point closely adjacent to said points of attachment, and whereby said shoulders prevent said flexible conductive members from bending at too sharp a bend.

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