Feb. 25, 1969 R. L. HURTLE 3,430,164

CIRCUIT BREAKER MECHANISM

Filed Sept. 15, 1967 Sheet 1 of 2

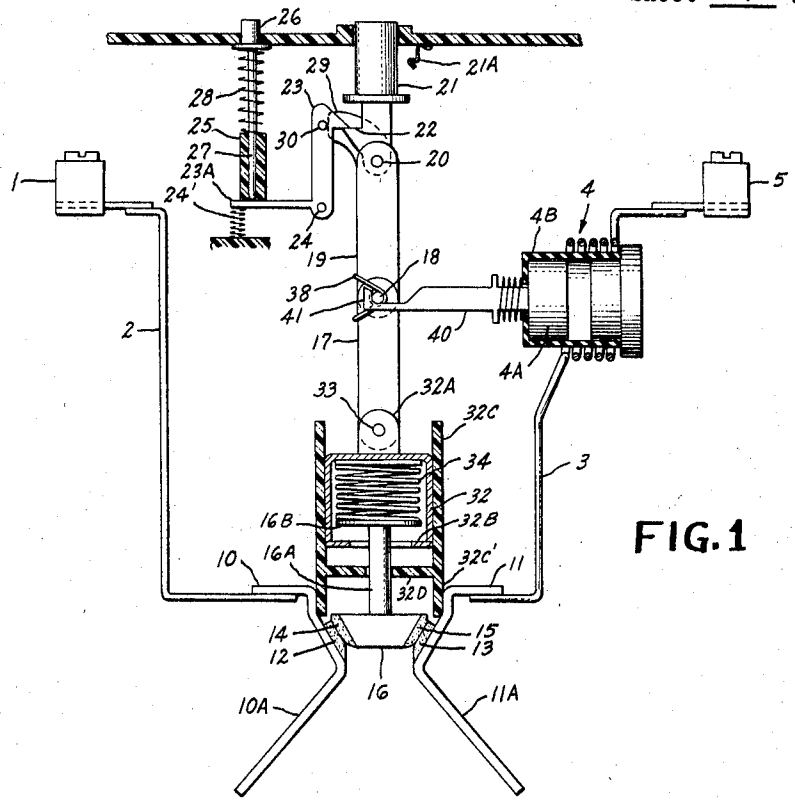


FIG. 1

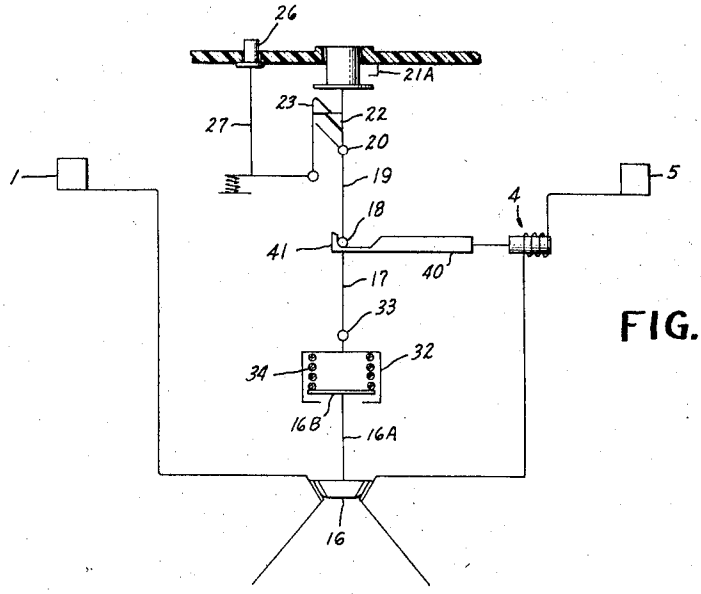


FIG. 2

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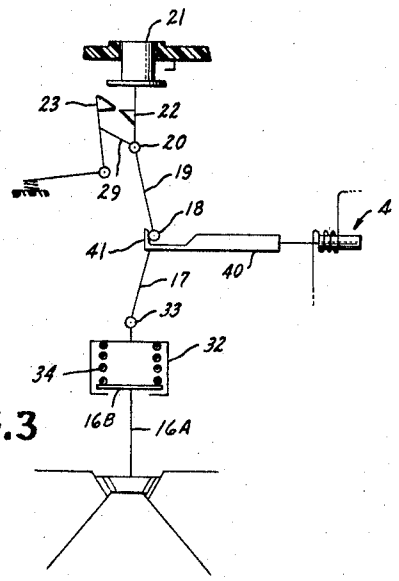


FIG.3

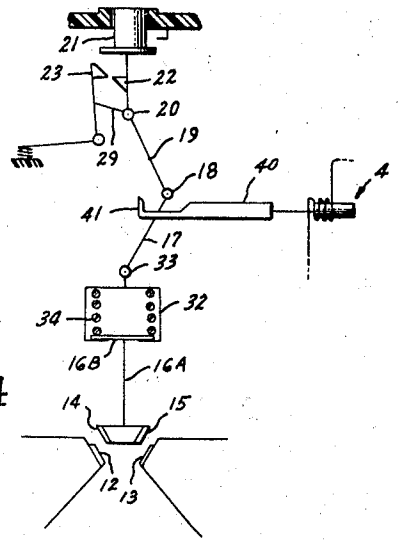


FIG.4

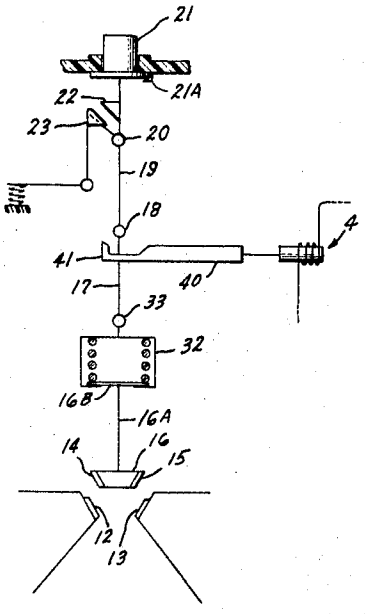


FIG. 5

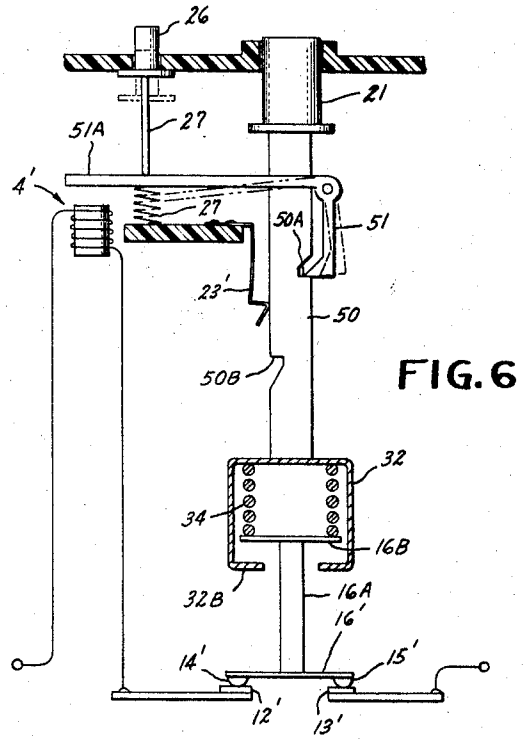


FIG. 6

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3,430,164

CIRCUIT BREAKER MECHANISM

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Filed Sept. 15, 1967, Ser. No. 668,088
U.S. Cl. 335—22 5 Claims
Int. Cl. H01h 73/36, 77/06

ABSTRACT OF THE DISCLOSURE

An electric circuit breaker operating mechanism including a single operating spring which, in the closed condition of the circuit breaker acts between a support member and a movable contact member to urge the movable contact to closed circuit position; upon the occurrence of overcurrent, the support member for the spring is released, permitting the spring to accelerate the support member in a direction away from the movable contact member; the inertia thus built up in the support member and associated parts is utilized by means of a lost-motion connection to the movable contact member, to cause opening movement of the movable contact.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to automatically operable circuit breakers, and particularly to circuit breakers of the type including a movable contact member and spring means for maintaining the contact member in closed circuit position, together with automatically operable means for causing movement of the contact member to open circuit position.

Description of the prior art

Prior art mechanisms for electric circuit breakers of the type referred to comprise two main types. The first of these types utilizes a main operating spring and a separate overriding or "kick-off" spring, which upon the occurrence of predetermined current conditions, is released to act against the contact pressure spring to move the movable contact to open circuit position. The second type utilizes an operating spring and mechanism linkage so arranged that upon the occurrence of predetermined current conditions, the line of action of the spring changes with respect to a given pivot point so as to reverse its bias on the movable contact member and move it to open circuit position.

The first of these types suffers from the disadvantage of requiring two separate springs, and also of having a high "latch pressure," complicating the release of the mechanism by automatic current responsive means. Such high latch pressure results from the fact that the overriding or "kick-off" spring must, in its most relaxed condition, be stronger than the operating spring in its most compressed condition. The second type of operating mechanism has the disadvantage of requiring relatively complicated operating mechanisms, and also of being relatively inefficient as regards utilization of spring force, since only a portion of the force of the operating spring is used to produce contact pressure in the closed circuit position of the mechanism, the remaining portion of the force of the spring being utilized to produce the shifting of the line of action of the spring upon release of the latch mechanism.

Objects of the invention

It is an object of the present invention to provide a simplified circuit breaker operating mechanism which requires only a single spring to produce force urging the contacts into engagement and also moving them apart,

without the necessity of changing the line of action of the spring.

It is another object of the invention to provide an electric circuit breaker operating mechanism of the type described which is simple, efficient, and dependable in operation.

Summary of the invention

In accordance with the invention, an electric circuit breaker operating mechanism is provided including at least one stationary contact member and at least one moveable contact member and spring means acting between the movable contact member and a normally stationary support member to provide contact closing pressure. Upon the occurrence of predetermined conditions, the stationary support member is released, and the operating spring acts on the stationary support member to impart motion thereto in a direction away from the stationary contact, thereby storing kinetic energy in the support member and its associated parts. This kinetic energy is utilized, by means of a lost motion connection with the movable contact member, to move the movable contact member in open circuit direction, the parts being latched open, pending subsequent manual reclosing operation.

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

Brief description of the drawings

In the drawings,

FIGURE 1 is a side elevation view of a circuit breaker operating mechanism incorporating the invention, the supporting and enclosing insulating casing being shown only fragmentarily for clarity;

FIGURES 2 through 5 are semi-schematic representations of the mechanism of FIGURE 1, the parts being shown in the following conditions:

FIGURE 2—closed circuit condition;

FIGURE 3—just subsequent to tripping initiation and prior to separation of the contacts;

FIGURE 4—following trip initiation and after opening of the contacts, but prior to completion of the automatic opening movement;

FIGURE 5—normal open or "tripped" condition;

FIGURE 6 is a side elevation view of another embodiment of the invention, comprising a resettable cut-out or non-trip-free circuit breaker.

Description of the illustrated embodiment

In the drawings, the invention has been shown in FIGURE 1, as incorporated in an electric circuit breaker of the general type shown and described in prior Patent 3,158,711, B. A. Piteo, Nov. 24, 1964, assigned to the same assignee as the present invention. The parts illustrated are supported and insulated by suitable insulating casing means, shown only fragmentarily. The circuit breaker illustrated includes an in-coming or load terminal **1**, having an elongated conductor **2** connected thereto, leading to an angular combined stationary contact and support member **10** spaced closely from a correspondingly shaped cooperating combined stationary contact support and arc runner member **11** which is connected by conductor **3** to a solenoid coil **4** having its other end connected to a line terminal **5**.

The contact support members **10** and **11** include stationary contacts **12** and **13** respectively which are contacted by movable contacts **14** and **15** carried by a movable bridging contact member **16**. When the bridging contact member **16** is moved upwardly, it carried with it the movable contacts **14** and **15**, separating them from the stationary contacts **12** and **13** and drawing a pair of arcs. The pair of arcs are blown by magnetic and gaseous action

into a single arc which exists subsequently directly between the runner portions **10A** and **11A** of the contact support assemblies **10** and **11**, moving outwardly therealong and becoming elongated and finally extinguished.

For the purpose of moving the bridging contact assembly **16** between open and closed circuit positions both manually and automatically, operating mechanism is provided in accordance with the invention including a pair of toggle links **17** and **19** interconnected by a toggle knee pivot pin **18**. The upper toggle link **19** is pivotally connected by a pivot pin **20** to a manually operable closing button member **21**.

The manual closing member **21** includes a latch portion **22** which is adapted to be releasably held by a latch member **23** pivotally supported at **24** in the insulating casing, not shown. The latch member **23** is generally L-shaped and includes an extending portion **23A**, which is biased by a compression spring **24'** against a stop portion **25** of the casing.

For the purpose of operating the latch member **23** to release the manual member **21**, an "off" button **26** is provided, having a stem **27** projecting downwardly and having its end portion adjacent the extension **23A** of the latch member **23**. A compression spring **28** is further provided, biasing the "off" button toward its unactuated position, i.e., upwardly, at all times.

The upper toggle link **19** includes an offset extension **29** extending beyond the pivot pin **20** and having a portion adapted to engage a pin **30** carried by the latch member **23** on the occurrence of predetermined current conditions, and for a purpose to be described.

The movable contact assembly **16** includes a stem portion **16A** terminating in a generally disc-shaped upper portion **16B**. The disc-shaped portion **16B** moves slidably within a generally cup-shaped member **32**, shown in section for purposes of clarity, which includes an integral extension **32A** connected by means of a pivot pin **33** to the lower toggle link **17**.

The main operating compression spring **34** is trapped within the cup-shaped member **32** and acts between the cup-shaped member **32** and the disc-shaped portion **16B** of the movable contact member. The cup-shaped member **32** includes an inwardly directed flange portion **32B** which is bent-over after assembly of the parts therein to retain the disc-shaped portion **16B** and the operating spring **34** therein. The cup-shaped member **32** is guided for sliding reciprocating movement by means of insulating guide formations **32C** in the insulating casing. The guide portions **32C** also include extensions **32C'** and a wall **32D** which serve to restrain the arc products generated by separation of the contacts, to the immediate area between the stationary contacts **12** and **13**. The solenoid **4** includes an armature member **4A** which is slidably guided within a suitable cylindrical non-magnetic guide member **4B**. The armature **4A** is provided with a rigid extending arm **40** terminating in a hook portion **41** adjacent the knee pin **18** of the toggle linkage **17, 19**. The toggle linkage **17, 19** also includes a wire type spring **38** acting on the knee pivot **18** to constantly bias the toggle linkage **17, 19**, to straightened condition.

OPERATION

Manual operation

Assuming the parts to be in the condition illustrated in FIGURE 1 and schematically in FIGURE 2, manual opening of the contacts is achieved by depressing the "off" button **26**, which causes the rod **28** to act on the latch member **23**, rotating it counterclockwise against the bias of spring **24'** to withdraw the latch **23** from the latch projection **22** of the manual closing member **21**.

It will be observed that in the "on" condition of the parts as shown in FIGURES 1 and 2, the operating compression spring **34** is acting against the back wall of the member **32** on one hand and the disc-shaped portion **16B** of the movable contact assembly **16** on the other. Since the toggle linkage is in its set condition, and is latched by the latch **23**, the spring **34** has a normally stationary support for one end thereof, the other end acting against the movable contact member to produce contact closing pressure.

Upon the release of the latch member **23**, however, the compression spring **34** expands, moving the member **32** and the toggle linkage **17, 19**, together with the manually operable member **21** upwardly as viewed in FIGURE 1. As this motion proceeds, kinetic energy is built up in the movable members comprising the member **32**, and the toggle links **17, 19**, and the manually operable member **21**.

When the lost motion between the parts **16B** and **32B** is taken up, the momentum of the parts **32** and the links **17** and **19** in the upward direction pulls the movable contact assembly **16** upwardly to open condition as indicated diagrammatically in FIG. 5. In this position, the resilient hook **21A** engages the flange of the manual closing button **21** and holds the parts in the open condition.

Operation—Automatic tripping

Assuming the parts to be in the condition shown in FIGURE 1, if the current through the circuit breaker exceeds a predetermined amount, the pull exerted by the solenoid **4** on its armature **4A**, and through the link **40** on the pin **18**, becomes sufficient to collapse the toggle linkage **17, 19** to the right as indicated in FIGURE 3. This releases the compression spring **34**, which throws the spring actuating member **32** upwardly, with the result that its velocity and momentum are sufficient to carry the movable contact member **16**, after the lost motion has been taken up between the members **32** and **16**, upwardly, to open circuit position. At the same time, the tilting of the upper toggle link **19** also has the effect of releasing the latch member **23**. This occurs because of the action of the projection **29** on the pin **30**, rotating the latch member **23** in counterclockwise direction and disengaging it from the latch.

The buckling of the toggle linkage **17, 19** and the release of the latch **22** occurs simultaneously, leaving this assembly free to be moved upwardly by the action of the compression spring **34**. The parts, therefore, comprising the support member **32**, the toggle links **17** and **19**, and the operating button **21**, are all thrown rapidly upward upon buckling of the toggle linkage, and given an upwardly directed momentum. When the lost motion between the members **32** and **16B** is taken, up, the movable contact member **16** is moved upwardly in open circuit direction interrupting the current and releasing the armature **4A** of the solenoid **4**. The spring **38** thereupon acts to straighten the linkage **17, 19**, and the parts assume their full open position as shown in FIGURE 5 in which the surface **22'** of the support member **22** overlies the upper edge of the latch member **23**, maintaining the parts in open circuit position as indicated schematically in FIGURE 5.

The form shown in FIGURE 6 comprises a simplified, non-trip-free circuit breaker operating on the same principle as the form of FIGURE 1.

In this form, a bridging contact **16'** is held in closed position by a spring **34** acting on the rod **16A**. The spring **34** is kept compressed by a rigid push rod **50** having a detent **50A** receiving a latch member **51**. The latch member **51** is biased by a spring **27** to latching position and includes a portion **51A** serving as an armature for solenoid **4'** connected in series with the contacts.

Upon the release of latch **51** by means of the manual button **26** or by the solenoid **4'**, the spring **34** is freed to begin upward movement of the rod **50**, member **32** and button **21**, throwing these parts upward. When the lost-motion between **32** and **16B** is taken up, the rod **16A** and contacts **14'** and **15'** are moved to open position. When the rod **50** moves upwardly, the spring latch **23'**

drops into the detent **50B** and holds the parts in open condition. To reclose, the button **21** is depressed, causing the spring latch **23'** to deflect sideways until the latch **23'** slides out of the detent **50B** and the contact assembly is moved to the closed position shown.

While the invention has been shown as incorporated in two specific forms, it will be readily apparent that many modifications thereof may readily be made. Thus current-responsive means may be applied to latch **23** in the FIGURE 1 form to provide automatic opening rather than solenoid **4**. It is therefore intended by the attached claims, to cover all such modifications as come 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) a support;

(b) at least one stationary contact supported on said support;

(c) at least one movable contact supported on said support for movement between open and closed circuit positions with respect to said stationary contact;

(d) an actuating member supported on said support;

(e) spring means having one end thereof acting on said movable contact member and having the other end thereof acting on said actuating member;

(f) lost-motion connecting means connecting said actuating member and said movable contact member;

(g) operating means carried by said support for moving said actuating member to a first position in which said spring means is stressed so as to urge said movable contact toward said closed circuit position;

(h) releasable means carried by said support for restraining said actuating means in said first position;

(i) current responsive means carried by said support for causing release of said releasable means upon the occurrence of predetermined current conditions in said circuit breaker;

(j) latch means for latching said movable contact in open-circuit position;

(k) the inertia of said actuating member and said operating means following release of said releasable means being such that following take-up of said lost-motion in said connecting means between said spring-operating member and said movable contact member, said inertia causes said actuating member to move said movable contact member in open circuit direction and into latched engagement with said latch means.

2. An electric circuit breaker as set forth in claim **1** wherein said circuit breaker comprises a pair of spaced stationary contacts supported on said support and wherein said movable contact member comprises a bridging conductive member interconnecting said stationary contacts when in said closed circuit position.

3. An electric circuit breaker as set forth in claim **1** wherein said operating means for operating said actuating member comprises a pair of interconnected toggle links and releasable supporting means for supporting one end of said toggle links, the other end of said toggle links being connected to said actuating member, and means releasably restraining said toggle links in straightened condition.

4. An electric circuit breaker as set forth in claim **1** wherein:

(a) said spring means comprises a compression spring, and wherein

(b) said actuating member comprises a generally cup-shaped cylindrical member receiving said compression spring therein; and

(c) a generally disc-shaped member slidably received within said cup-shaped member and acting on said compression spring means, and

(d) means interconnecting said movable contact member and said generally disc-shaped member.

5. An electric circuit breaker as set forth in claim **4**, said circuit breaker also including an electric solenoid connected electrically in series with said contacts, said solenoid including an armature member and means connecting said armature member to said toggle linkage for collapsing said toggle linkage upon the occurrence of predetermined current conditions through said solenoid.

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U.S. Cl. X.R.

335—173