June 16, 1964 NOBORU MAEDA ETAL 3,137,776

MANUAL ELECTRIC SWITCH HAVING AUTOMATIC OVERLOAD RELEASE MEANS

Filed March 14, 1961 2 Sheets-Sheet 1

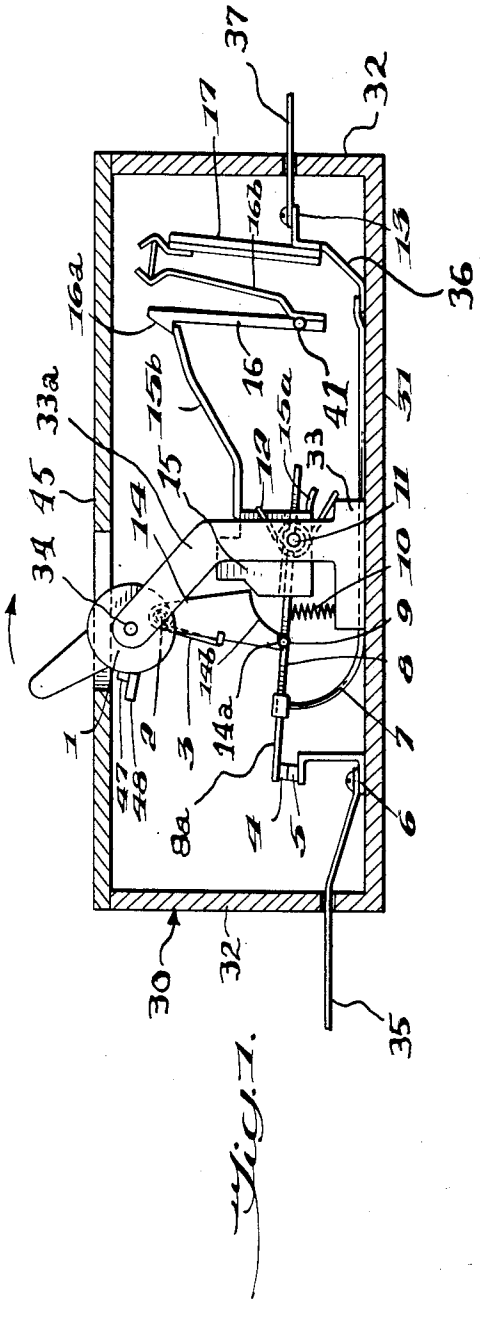

Fig. 1.

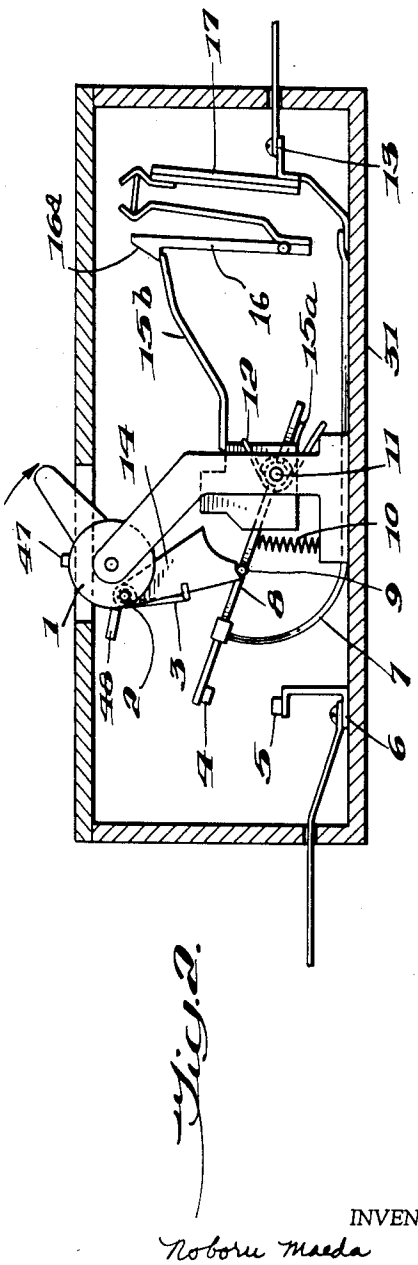

Fig. 2.

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MANUAL ELECTRIC SWITCH HAVING AUTOMATIC OVERLOAD RELEASE MEANS

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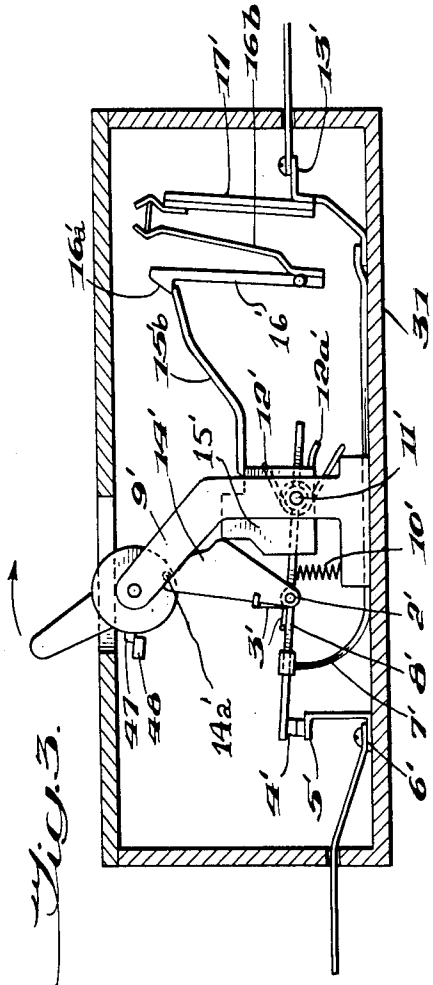

Fig. 3.

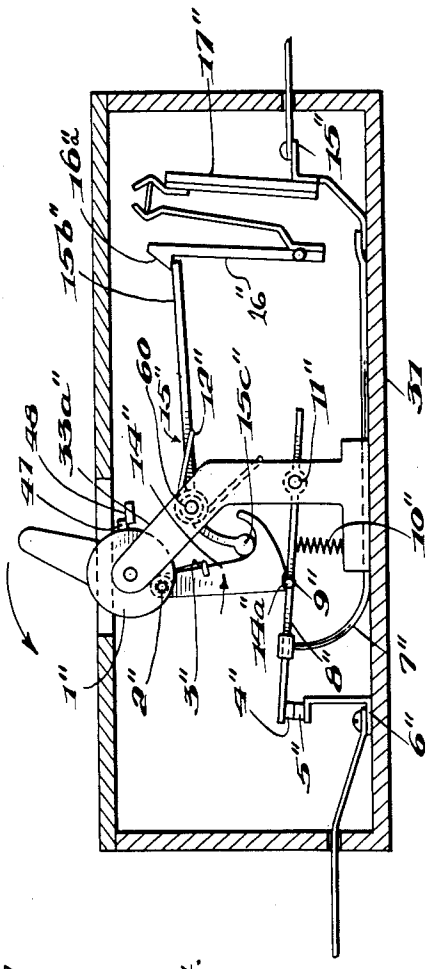

Fig. 4.

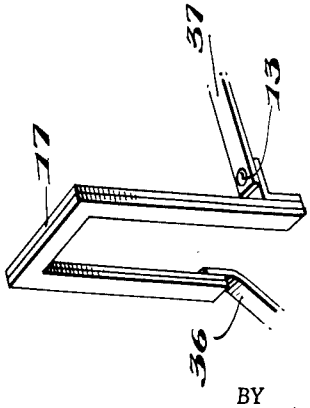

Fig. 5.

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MANUAL ELECTRIC SWITCH HAVING AUTOMATIC OVERLOAD RELEASE MEANS

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6 Claims. (Cl. 200—116)

This invention relates generally to an electric circuit breaker and more particularly to an improved manual switch or circuit breaker having automatically-operable overload release means.

Electric circuit breakers provided with current overload responsive opening means are well known in the prior art. The present invention constitutes an improved simplified construction over the known devices and is characterized by its rugged and reliable construction, minimum number of parts, and reduced manufacturing cost.

Thus, the primary object of the present invention is to provide an improved construction for an electric circuit breaker having stationary and movable contacts, manually operable means for opening and closing said contacts, and means for automatically opening said contacts—when said contacts have been closed by said manually operable means—upon the occurrence of overload current passing through said circuit breaker.

A more specific object of the invention is to provide an electric circuit breaker having stationary and movable switch contacts, manually operable means for opening and closing said switch contacts, said manually operable means including an operating member coupled with a carrier arm for one of the contacts, and means for automatically opening said contacts—when said confacts have been closed by said manually operable means—upon the occurrence of overload current passing through said circuit breaker, said overload current opening means including a release member normally spring biased to engage and actuate the operating member of said manually operable means to release the carrier arm and thereby open said circuit breaker contacts, and overload current responsive latch means normally preventing said release member from engaging said operating member.

Other objects and advantages of the invention will become more apparent from a study of the following specification when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a longitudinal sectional view of the manual switch with automatic overload release, said switch being in the closed current-conducting state;

FIG. 2 is a longitudinal sectional view of the switch of FIG. 1 in its open current-interrupting state;

FIGS. 3 and 4 are longitudinal sectional views of two other embodiments of the manual switch with automatic overload release, each of said switches being illustrated in its closed or current conducting state; and

FIG. 5 is a view in perspective of the bimetallic member responsive to current flow through the switch contacts and which serves to effect release of a latch mechanism in the presence of an overload current resulting in actuation of the switch contacts to their open-circuit position.

Referring first more particularly to FIGS. 1 and 2, the switch includes a housing **30** having a bottom wall **31** and four side walls **32**. Secured to the bottom wall **31** is the support **33** having bifurcated arm portions **33***a* between which the switch manual operating lever **1** is pivotally mounted on horizontal shaft **34**.

Pivotally mounted upon horizontal shaft **11** extending

between the bifurcated arm portions **33***a* of support **33** is the contact carrier **8** having the movable switch contact **4** secured thereto. Coil spring **10** mounted intermediate carrier **8** and the base of the support **33** normally pivotally biases contact carrier **8** upwardly in the clockwise direction about pivot shaft **11**. The movable switch contact **4** is arranged for engagement with the stationary electrical contact **5** to which the input electrical conductor **35** is connected by means of the input terminal **6**.

Connected at one end to the electrically conductive portion **8***a* of carrier **8** is the flexible conductor **7** the other end of which is connected to an electrically conductive member **36** to which is secured in an upstanding manner one leg of a bimetallic element **17** having an inverted U-shaped configuration. The other leg of bimetallic element **17** is electrically connected to the output terminal **13** to which output line **37** is connected.

When the movable contact **4** is in engagement with the stationary contact **5**, current from input line **35** will flow through input terminal **6**, stationary and movable contacts **5**, **4**, conductive portion **8***a* of carrier **8**, flexible conductor **7**, support member **36**, the legs of the inverted U-shaped bimetallic element **17** and output terminal **13** to the output line **37**.

Pivotally connected at its upper end to the operating lever **1** by means of pivot shaft **2** is the carrier depressing member **14**. A torsion type wire spring **3** mounted upon shaft **2** serves to always bias the carrier depressing member **14** in the counter-clockwise direction about its pivot shaft **2**. At its lower end the carrier depressing member **14** has a groove **14***a* arranged for engagement with a lateral projection **9** on the carrier **8**. Thus when the switch contact operating lever is in the position shown in FIG. 1, the carrier depressing member **14** will pivot carrier **8** in the counter-clockwise direction about its shaft **11** against the biasing force of spring **10** to close movable switch contact **4** upon the stationary switch contact **5** and thus complete the current path between input terminal **6** and output terminal **13**. As will be seen from FIG. 1, when contacts **4** and **5** are closed by the pressure exerted downwardly upon the carrier arm **8** through member **14**, spring **10** will be compressed. The reactive force created in the compressed spring **10** acting upwardly through projection **9** against the member **14** causes the upper end of the latter to apply a force against shaft **2** which develops a counter-clockwise torque on lever **1** such as to bring an abutment **47** on the latter into engagement with a fixed abutment **48** constituting a part of the housing **30**. In this position of lever **1**, the axis of shaft **2** will lie somewhat to the right of a line interconnecting the axes of shaft **34** and projection **9** thus establishing an "over-center" relationship of the shaft **2** which in conjunction with the pressure from spring **10** keeps the switch contact lever **1** stabilized in the "on" position indicated in FIG. 1.

Also pivotally mounted upon the stationary pivot shaft **11** is the release member **15**. Wire spring **12** mounted upon shaft **11** normally pivotally biases release member **15** in the counter-clockwise direction about shaft **11** toward the carrier depressing member **14**. Release member **15** has a generally-longitudinally extending arm portion **15***b* which terminates beneath the projection **16***a* of the latch finger **16** as shown in FIG. 1 to latch the release member **15** against the counter-clockwise biasing force of spring **12**. The release member **15** also includes a lower tail portion **15***a* projecting rearwardly and which underlies the corresponding end of the carrier arm **8** for cooperation with the latter in a manner to be subsequently explained. Latch finger **16** is pivotally connected to one side wall of the housing **30** by means of pivot shaft **41** and has an arm **16***b* connected at its upper end to the

upper extremity of the temperature-responsive inverted U-shaped bimetallic element 17, which element consists of two metallic elements of U-shaped configuration having unequal temperature coefficients of expansion. As previously explained, the lower end of one leg of bimetallic element 17 is connected (as by welding, for example) to the electrically conductive support 36 so that the element 17 will be heated by the current flowing through it from input terminal 6 to output terminal 13.

In the switch-closed position illustrated in FIG. 1 the latch projection 16*a* will engage arm 15*b* to prevent pivotal movement of release member 15 in the counter-clockwise direction about shaft 11 which would normally occur due to the biasing force of spring 12. Upon the occurrence of current overload between the terminals 6 and 13, an accompanying temperature rise will be developed which is transmitted to the bimetallic element 17. Due to the unequal degrees of expansion of the two metallic components of the bimetallic element, the upper portion thereof will be displaced to the right in FIG. 1 to cause clockwise movement of latch 16 about its shaft 41 whereby arm 15*b* will be released from the restraining latch projection 16*a*. Spring 12 will then pivot release member 15 in the counter-clockwise direction about the shaft 11 to engage the carrier depressing member 14 and rotate the same slightly in the clockwise direction about its pivot shaft 2 (against the constant biasing force of spring 3) as shown by the arrow in FIG. 1. Upon rotational movement of carrier depressing member 14 in the clockwise direction, recess 14*a* will be brought out of engagement with carrier projection 9 which slides along the underside curved surface 14*b* whereupon carrier 8 is released for upward clockwise pivotal movement about the shaft 11 by the coil spring 10, thus breaking the electrical contact between the movable and stationary switch contacts 4 and 5. At this time, torsion spring 3 urges the member 14 in a counter-clockwise direction about the shaft 2 to thereby effect re-engagement between recess 14*a* and the projection 9, and a corresponding upward counterforce exerted through the member 14 is applied at shaft 2 to thus cause the switch lever 1 to shift clockwise into the "off" position shown in FIG. 2. Also, at the seme time that carrier arm 8 is caused to rotate clockwise to disengage contacts 4 and 5, that end of arm 8 opposite contact 4 will engage and press down upon the projecting tail part 15*a* causing the release member 15 to be shifted in the clockwise direction to its original position against the counter torque exerted thereon by spring 12 whereupon the arm 15*b* will be in the correct position to be re-engaged by latch 16*a* when the current overload has passed and bimetallic element 17 has cooled down and restored to its original position. This is the position depicted in FIG. 2 and the switch contacts can now be re-closed at any time by shifting the switch lever 1 from the "off" position shown in FIG. 2 to the "on" position shown in FIG. 1.

To return the switch contacts to the closed position of FIG. 1, from the position shown in FIG. 2, the switch lever 1 is rotated in the counter-clockwise direction which moves shaft 2 and member 14 downwardly thus applying a downward force against projection 9 which results in a counter-clockwise rotation of carrier arm 8 until contacts 4 and 5 re-engage. Shaft 2 then moves into the "over-center" position shown in FIG. 1 to maintain contacts 4 and 5 in their closed position and switch contact lever 1 in its "on" position.

Of course, the switch may also be manually operated from the closed position of FIG. 1 to the open position of FIG. 2 by manual pivotal movement of the switch lever 1 in the clockwise direction about its pivot shaft 34. When this occurs, the axis of shaft 2 is brought across the dead center position, i.e. the line connecting the centers of projection 9 and shaft 34, from right to left as viewed in FIG. 1 which results in a momentary further depression of projection 9 against the counterforce exerted by spring 10. After the axis of shaft 2 passes across the dead center position, the torque exerted by spring 10 on the switch lever 1 which had previously been in the counter-clockwise direction now shifts to a clockwise direction accompanied by an expansion of spring 10 and rotation of carrier arm 8 in the clockwise direction to thus disengage contacts 4 and 5, and shift switch lever 1 to the "off" position. During the course of these related mechanical movements, since the release member 14 always remains biased in the counter-clockwise direction by spring 3, the projection 9 will be maintained in a latched relation with respect to its cooperative recess 14*a*. Also, assuming no current overload exists, since the latch projection 16*a* has not been released from contact with the arm 15*b*, the switch in the open position of FIG. 2 may be readily returned to the closed position of FIG. 1 merely by manually pivoting operating lever 1 in the counter-clockwise direction about its pivot shaft 34.

The embodiment of FIG. 3 differs from the embodiment of FIGS. 1 and 2 only in that the carrier depressing member 14′ is pivotally connected at its lower end to the carrier 8′ by means of the pivot axis 2′ and the projection 9′ is secured to the manual operating lever 1′. Spring 3′ on shaft 2′ serves to bias carrier depressing member 14′ in the clockwise direction about its pivot shaft 2′ to cause recess 14*a*′ to cooperatively engage the projection 9′.

The operation of the embodiment of FIG. 3 is quite similar to that of the embodiment of FIGS. 1 and 2. When the upper end of bimetallic element 17′ is distorted to the right upon current overload, latch 16*a*′ is released from engagement with the arm 15*b*′ whereby release member 15′ is quickly pivoted by spring 12′ in the counter-clockwise direction to pivot carrier depressing member 14′ in the counter-clockwise direction about its pivot shaft 2′. Groove 14*a*′ will be brought out of engagement with projection 9′ and the carrier arm 8′ will be released for upward pivotal movement about its pivot axis 11′ by the biasing action of spring 10′.

The manual opening and resetting operation of the embodiment of FIG. 3 are accomplished in the same manner as described with regard to the embodiment of FIGS. 1 and 2.

Referring now to the embodiment of FIG. 4, the carrier depressing member 14″ is pivotally connected to the manual operating lever 1″ by means of the pivot axis 2″, and the lower end of the depressing member has a groove 14*a*″ adapted to receive the lateral projection 9″ on the carrier 8″. Thus the embodiment of FIG. 4 is quite similar to that of FIGS. 1 and 2 and differs therefrom mainly by the fact that the carrier depressing member 14″ is designed for pivotal movement in the counter-clockwise direction about its pivot axis 2″ upon current overload. To this end, release member 15″ is pivotally connected intermediate the bifurcated support arms 33*a*″ at a point above the pivot axis 11″. At one end the release element 15″ has an arm portion 15*b*″ which is latched beneath the projection 16*a*″ of latch finger 16″. At its other end the release member 15″ has a downwardly bent portion 15*c*″ extending into a corresponding recess in the carrier depressing member 14″. Spring 3″ in this embodiment is designed to pivotally bias member 14″ in the clockwise direction about pivot axis 2″, and operating lever 1″ is movable in the counter-clockwise direction to operate the switch from its closed to its open position.

The operation of the embodiment of FIG. 4 may now be described. Upon the occurrence of current overload, latch 16″ will be displaced to the right by bimetallic element 17″ to release arm 15*b*″ which is then pivoted in the counter-clockwise direction by spring 12″ to cause carrier depressing member 14″ to be pivoted in the counter-clockwise direction about its pivot axis 2″ by the cooperation of release member bent portion 15*c*″ with the corresponding recess in the depressing member. Carrier 8″ will then be released and will be pivoted in the clock-

wise direction by the spring **10''** to break the electrical contact between movable and stationary contacts **4''** and **5''**.

The manual opening and resetting operations of the switch embodiment of FIG. 4 will be accomplished in the manner set forth above with regard to the other embodiment.

Although the current overload responsive member **17** has been illustrated and described as being a temperature-responsive bimetallic element, it is contemplated that other types of known overload release means may be utilized to operate the latch finger **16** in the various embodiments.

While in accordance with the provisions of the patent statutes we have illustrated and described the best forms and embodiments of our invention now known to us, it will be apparent to those skilled in the art that other changes may be made in the apparatus described without deviating from the scope of the invention as set forth in the following claims.

We claim:

1. An electric circuit breaker comprising a housing, a stationary electrical contact mounted in said housing, a carrier arm element pivotally mounted within said housing, a movable electrical contact mounted on said carrier arm element for engagement with and disengagement from said stationary electrical contact, first spring means normally biasing said carrier arm element in such direction as to effect disengagement between said stationary and movable contacts, a manually operable switch lever element pivotally mounted on said housing, a member interposed between said carrier arm and switch lever elements and actuatable by said switch lever element for depressing said carrier arm element and compressing said spring means to effect engagement between said stationary and movable contacts, said carrier arm depressing member being permanently pivotally connected at one end thereof to one of said elements and being releasably engaged at the other end thereof with the other of said elements, second spring means biasing said carrier arm depressing member to the engaging position with said other element and means including current overload responsive means mounted within said housing and operable upon an overload current passing through said contacts when engaged for actuating said carrier arm depressing member to disengage the same from said other element and thereby release said carrier arm to effect disengagement of said contacts, said second spring means effecting a re-engagement of said carrier arm depressing member with said other element subsequent to disengagement of said contacts.

2. An electrical circuit breaker as defined in claim 1 wherein said releasable engagement between one end of said carrier arm depressing member and said switch lever element or said carrier element is constituted by a detent.

3. An electrical circuit breaker as defined in claim 1 wherein said carrier arm depressing member is permanently pivotally connected at one end thereof to said switch lever element and releasably engaged at the other end thereof with said carrier arm element.

4. An electrical circuit breaker as defined in claim 1 wherein said carrier arm depressing member is permanently pivotally connected at one end thereof to said carrier arm element and releasably engaged at the other end thereof with said switch lever element.

5. An electrical circuit breaker as defined in claim 1 wherein said means for actuating said carrier arm depressing member in response to an overload current includes a release member pivotally mounted in said housing adjacent said carrier arm depressing member, third spring means normally biasing said release member to engage and actuate said carrier arm depressing member, and means controlled by said current overload responsive means for latching said release member in a position disengaged from said carrier arm depressing member only in the absence of an overload current.

6. An electrical circuit breaker as defined in claim 5 and wherein said release member includes a part thereof actuatable by said carrier arm element to restore said release member to said latched position when said current overload condition no longer exists.

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