Sept. 21, 1954 A. BODENSCHATZ 2,689,893

THERMAL MAGNETIC TRIP DEVICE

Filed Dec. 16, 1952

FIG. 1

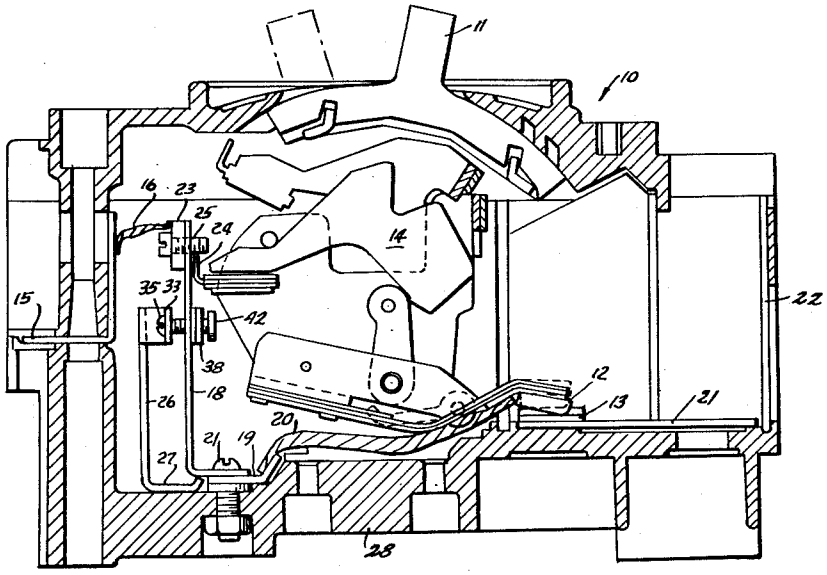


FIG. 2

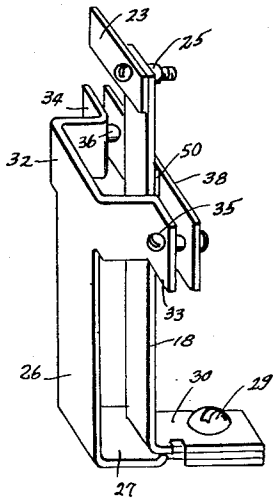
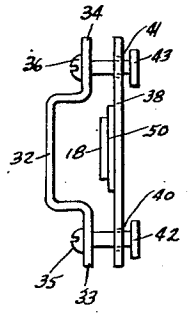


FIG. 3



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THERMAL MAGNETIC TRIP DEVICE

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7 Claims. (Cl. 200—88)

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My invention relates to small circuit breakers of the type adapted to carry 50 amperes normal load current, and is more particularly directed to a novel thermal magnetic trip device for same.

In the prior art circuit breakers of the type to which my invention relates it was usually necessary to permanently secure either the magnet or armature of the instantaneous trip unit to the bi-metal of the time delay unit. This was accomplished by either brazing or welding in order to permanently secure either the magnet or armature to one portion of the bi-metal element. This arrangement materially reduced the strength and stiffness of the bi-metal.

In some applications the armature was riveted to the bi-metallic element and thus it was necessary to reduce the cross-sectional area thereof in order to provide a proper seat for the rivet. This latter method not only substantially increased the resistivity of the bi-metal element but also made the characteristics thereof unpredictable due to the work performed thereon.

Not only does the arrangement whereby a component of the instantaneous trip mechanism is attached to the bi-metallic element affect the characteristics of the bi-metal; it also has the disadvantage of providing an alternate path for the current flow to the armature or magnet.

That is, since the armature had to be connected to the bi-metal at some point intermediate of its extreme ends, the diversion of current through the armature would result in only a portion of the entire length of the bi-metal being used for time delay trip.

Furthermore, when the armature of the instantaneous trip unit was attached to the bi-metallic element it was necessary to bend this latter unit in order to properly adjust the air gap between the armature and the magnet. That is, to obtain proper calibration to insure that the circuit breaker would have instantaneous trip at a predetermined value of fault current it is necessary to alter the magnetic air gap and/or the latch bite. However, if the armature is permanently secured to the bi-metallic element the bending of this latter unit in order to obtain a proper air gap will result in the work hardening after it has been annealed. That is, prior to the installation of the bi-metallic element in the circuit breaker it is annealed to remove any work hardening therein and hence if it is necessary to bend the bi-metallic element to obtain the desired air gap work hardening will again be introduced therein and hence defeat the desirable results of the annealing.

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Furthermore, when it was necessary to bend the bi-metal in order to obtain a desired air gap it not only altered the air gap but also altered the latch bite. This, of course, is an obvious disadvantage in that two factors affecting the calibration of the unit were simultaneously altered and hence a predetermined operation of the unit was difficult to obtain.

Another disadvantage of the prior art small circuit breaker arose from the fact that under short circuit conditions the overtravel of the bi-metal would engage a solid stop. That is, after the release of the cradle latch the bi-metallic element continued to move in its initial direction and was stopped by intersecting a solid mass and thereby resulted in undue stress and strain placed on the bi-metallic element.

In my novel thermal magnetic trip device I provide a structural arrangement wherein the magnet and armature are physically and structurally mounted independently of the bi-metallic element. In my instant invention both the armature-magnet and bi-metallic element are mounted at their feet or base and are arranged in such a manner that magnetic interconnection is achieved without physical interconnection.

The thermal magnetic trip device of my invention comprises a vertically extending member made of magnetic material having a horizontal arm in which rivets or pins are permanently secured. The armature is slidably mounted on the horizontally extending rivets in such a manner that the bi-metallic element is positioned between the armature and magnet. Hence, the bi-metal acts as a single turn for the instantaneous trip device.

When the leg or foot of the vertical support of the magnet is bent the air gap will be adjusted due to the slidable mounting of the armature. With this novel arrangement, brazing, welding or riveting of the armature to the bi-metal is eliminated, thereby eliminating all the disadvantages associated therewith.

Furthermore, the entire length of the bi-metallic element is used as a conducting path. Also, as above noted, since calibration of the instantaneous trip can be made by bending the leg of the magnet support there will be no difficulty in effecting the characteristics of the bi-metallic element since it need not be bent or altered to make calibration adjustments.

Furthermore, by providing a novel arrangement wherein the bi-metallic element is sandwiched between the armature and magnet the configuration of the arrangement can be so de-

signed as to provide a sufficient distance for the overtravel of the bi-metallic element in its initial course when it is caused to move by short circuit conditions.

In addition, if the bi-metallic element should engage the magnetic member during overtravel, the resilience of the magnetic member will permit these two units to travel together.

Accordingly, the undue stress and strain which was set up in the bi-metallic element when it struck a solid stop during its overtravel in certain prior art circuit breakers is completely eliminated.

It will be further noted that the provision of a structural arrangement wherein independent mounting is provided for the magnetic and thermal units enables the adjustment of the air gap without affecting the degree of latch bite.

Furthermore, with this arrangement the amount of latch bite can be readily and easily adjusted by means of the latch screw without affecting either the magnetic air gap or the position of the bi-metal.

Accordingly, a primary object of my invention is to provide a novel thermal magnetic trip device wherein the magnetic unit and thermal unit are individually and independently mounted.

Another object of my invention is to provide a small circuit breaker with a trip device in which the latch bite and air gap can be individually and independently adjusted.

Another object of my invention is to provide a time delay device in which the bi-metallic element of the long time delay will not have undue stress and strain introduced therein due to excess overtravel.

Another object of my invention is to provide a structural arrangement wherein the resistivity and stiffness of the bi-metallic element is not altered or affected by the instantaneous trip unit.

A still further object of my invention is to provide an armature unit which has relative movement with respect to the bi-metallic element and which is so constructed that neither the magnet nor the armature is secured to the bi-metallic element.

Another object of my invention is to provide a novel small circuit breaker thermal magnetic trip unit designed so that its deflection resulting from short circuit currents will not cause undue stress and strain therein.

A still further object of my invention is to provide a novel thermal magnetic trip device which enables the latch screw to be positioned at the top of the bi-metal so that the full effective length of the bi-metallic element is used for deflection. That is, even though the armature and magnet are separate and independent from the bi-metallic element the latch screw is still an integral part of the bi-metallic element.

Still another object of my invention is to provide a novel thermal magnetic trip device for small circuit breakers which eliminates the necessity of spring means for the adjustment thereof.

These and other objects of my invention will become apparent from the following description when taken in connection with the drawings in which:

Figure 1 is a side view in section showing a conventional small circuit breaker in a casing and embodying my novel thermal magnetic trip device. The circuit breaker shown in Figure 1 is of the snap-acting or quick-break, quick-make type and may be of any desirable design, for example, as shown in United States Patents Nos. 2,573,307, 2,583,174 and 2,600,223. It will be noted that although my invention is particularly directed to a circuit breaker of the snap acting type it can also be used in connection with circuit breakers known as the molded case type, as shown in United States Patents Nos. 2,586,326 and 2,421,853. Accordingly, it will be understood that the operating mechanism illustrated in the circuit breaker of Figure 1 is only illustrative of any circuit breaker to which my invention can be applied.

Figure 2 is a detailed perspective view of my thermal magnetic device and illustrates the independent mounting of the armature-magnetic unit with respect to the thermal unit.

Figure 3 is a cross-sectional view taken through the armature, pins, magnet and bi-metal of the device shown in Figure 2.

Referring to the figures, the circuit breaker **10** is provided with a manually operable handle **11** having a closed position indicated by the solid lines and an open position indicated by the dotted lines. Control over the position of the cooperating contacts **12** and **13** is achieved by means of the cradle mechanism **14** which, as above noted, forms no part of my present invention.

The flow of current through the circuit breaker is as follows: From connector terminal **15** through pigtail **16**, terminal **23**, bi-metal **18**, connector **19**, movable contact arm **20**, movable contact **12**, stationary contact **13**, connector **21** to terminal **22**.

The cradle mechanism **14** is provided with a latch extension **24** which is engaged by the latch screw **25** of the bi-metal element **18**. Thus, when the components are in the position shown in Figure 1, the circuit breaker is in the latched closed position. When an overcurrent occurs, it will cause the bi-metallic element **18** to deflect to the left to thereby effect disengagement between the latch screw **25** and the latch extension **24**.

Biasing means (not shown) will cause movement of the cradle mechanism to thereby move the cooperating contacts **12** and **13** from the engaged position of Figure 1 to disengaged position.

An L-shaped magnetic member **26** having a base **27** is mounted on the bottom of the circuit breaker molded case **28** by means of a screw **29**, Bi-metallic element **18**, which has a base **30**, is also securely positioned to the circuit breaker molded case **28** by means of the screw **29**, as seen in Figures 1 and 2.

The L-shaped magnetic member **27** is provided with a horizontal extension **32** which forms the magnet of the instantaneous trip device. The magnet **32** has outwardly extending legs **33** and **34** which have rivet or pin means **35** and **36** permanently secured thereto.

The armature **38** is provided with appropriate openings **40** and **41** so that it may be slidably mounted on the shafts of the rivets or pins **35** and **36**, respectively. As seen in Figure 3, the pins **35** and **36** are provided with heads **42** and **43** which are larger than the openings **40** and **41** of the armature **38** to thereby limit the movement of the armature thereon.

Insulating means **50** is secured to the armature **38** and sandwiched between the armature and bi-metal **18** to insure electrical insulation therebetween.

When the circuit breaker **10** is subjected to normal load currents the bi-metal **18** will represent a single turn winding for the magnet **32**. The electromagnetic field created by the normal

load current will sufficiently energize magnet **32** to attract the armature **38** until it engages the bi-metal **18**, as seen in Figure 3. However, the magnetic force created by normal load current will not be sufficient to cause the armature **38** to move the bi-metal **18**, but will merely bring the former member into engagement with the latter unit.

In the event of a severe fault or short circuit condition, above a predetermined value wherein instantaneous trip is desired, the magnetic force of attraction of the magnet **32** will be sufficient to move the armature **38** to the left. Since the bi-metallic element is in the path of movement of the armature **38** the latter unit will cause the former unit to bend to the left. Since the forced bending of the bi-metal will cause disengagement between the latch screw **25** and the cradle latch extension **24** the circuit breaker will trip open without any substantial or intended time delay.

In the event that it is desired to change the thermal calibration of the circuit breaker **10** the latch screw **25**, which is in threaded engagement with the bi-metal **18**, can be screwed to either the right or left to thereby either increase or decrease the degree of latch bite.

Thus, it will be noted that calibration of the unit can be accomplished without affecting the air gap of the magnetic means. In the event that it is desired to change the magnetic calibration so that the circuit breaker will trip at a predetermined value of fault current the air gap between the magnet **32** and the armature **38** can be readily and easily adjusted without affecting the degree of latch bite between latch screw **25** and cradle extension latch **24**. This is accomplished by bending the leg **26** of the magnet **32** either to the right or to the left, which will decrease or increase, respectively, the air gap.

It will be noted that even though the magnet **32** is moved toward or away from the bi-metallic element **18** the small magnetic force created by the normal load current will always maintain the armature **38** in the position of Figure 3 so that it is immediately adjacent the bi-metal **18**. Thus, it will be seen that the adjustment of the air gap of the instantaneous trip is achieved without altering the degree of latch bite and, furthermore, is accomplished without bending or re-positioning the bi-metallic element **18**.

Thus, the disadvantages of the prior art arrangement, namely, the work hardening of the bi-metal when it is bent to adjust the air gap, is completely eliminated.

Furthermore, with this arrangement the latch and latch bite are completely independent of the magnetic means and thus adjustment of one unit will not affect the other.

Accordingly, it will be seen that with my novel thermal magnetic trip device the latch screw **25** can be positioned at one extreme end of the bi-metal **18**, independent of the magnet unit.

With this arrangement, wherein latch engagement is accomplished at one extreme end of the bi-metal, a given deflection of the bi-metal for a given degree of latch bite will cause faster tripping of the circuit breaker than an arrangement in which the latch is located at some position intermediate the ends of the bi-metallic element. Hence, my novel structural arrangement enables the full use of the large degree of deflection existing at the free end of the bi-metal.

In the illustration of Figure 1 I have shown my novel thermal magnetic device in connection with a single pole circuit breaker. However, it

will be apparent to those skilled in the art that my novel unit can be readily and easily adapted to any multi-pole circuit interrupter such as the type shown in United States Patent No. 2,583,174.

In summary I have provided a novel thermal magnetic trip device in which the instantaneous and time delay trip units are independently and individually mounted on and secured to the circuit breaker and in which the adjustment of one unit will not affect the other unit.

Furthermore, the arrangement is simple in construction and economical to manufacture.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch, said latch comprising a first and second member, said thermal element secured to said circuit interrupter on one end thereof and having the other end free, said first latch member secured to said free end of said thermal element, said magnetic circuit calibrated and adjusted without affecting engagement of said first and second latch element.

2. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch; one end of said thermal element permanently secured to said circuit interrupter, the other end of said thermal element being free; said latch adjustably secured to said free end of said thermal element, said magnetic circuit comprising a magnet and an armature, said thermal element positioned between said armature and said magnet, said armature slidably mounted on said magnet.

3. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch; said magnetic circuit comprising a magnet and an armature, said magnet having protruding pins on which said armature is slidably mounted, said thermal element positioned between said armature and said magnet, said armature and said magnet positioned with respect to each other without affecting the position of said thermal element.

4. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having

an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch, said magnetic circuit comprising a magnet and an armature, said armature slidably mounted on one magnet, said thermal means positioned between said armature and said magnet, latch means adjustably secured to one end of said thermal element, said armature-magnet and said thermal element independently and individually mounted, said thermal element effective to energize said magnetic circuit when said circuit interrupter is subjected to short circuit conditions to cause instantaneous tripping of said circuit interrupter as a result of the disengagement of said latch.

5. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch, said thermal element having a latch means adjustably secured to one end thereof, said magnetic circuit comprising a magnet and an armature, said armature slidably mounted on said magnet; insulating means, said insulating means positioned between said armature and said thermal element; said thermal element positioned between said armature and said magnet, said thermal element acting as a single turn for said magnetic circuit, said armature attracted into engagement with said thermal element by magnetic attraction from said magnet caused by normal load current flowing through said thermal element.

6. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch, said thermal element having said latch adjustably secured to one end thereof, said magnetic circuit comprising a magnet and an armature, said armature slidably mounted on said magnet; insulating means, said insulating means positioned between said armature and said thermal element; said thermal element positioned between said armature and said magnet, said thermal element acting as a single turn for said magnetic circuit, said armature attracted into engagement with said thermal element by magnetic attraction from said magnet caused by normal load current flowing through said thermal element; said magnet mounted on said circuit interrupter, said magnet and said armature adjustably positioned with respect to each other without affecting said thermal element or said latch.

7. In a circuit interrupter comprising a pair of cooperating contacts having an engaged and disengaged position, said circuit interrupter having an instantaneous and time delay trip unit, said instantaneous trip unit comprising a magnetic circuit effective to cause tripping of said circuit interrupter by disengagement of a latch, said time delay trip unit comprising a thermal element effective to cause tripping of said circuit interrupter by disengagement of said latch, said thermal element having a latch means adjustably secured to one end thereof, said magnetic circuit comprising a magnet and an armature, said armature slidably mounted on said magnet; insulating means, said insulating means positioned between said armature and said thermal element; said thermal element positioned between said armature and said magnet, said thermal element acting as a single turn for said magnetic circuit, said armature attracted into engagement with said thermal element by magnetic attraction from said magnet caused by normal load current flowing through said thermal element, said magnet adjustably positioned toward and away from said thermal element to alter the air gap between said armature and said magnet, adjustment of said air gap achieved without affecting the degree of latch bite.

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