Dec. 13, 1966 A. J. PASTENE 3,292,118

CIRCUIT BREAKERS WITH IMPROVED TRIP MECHANISMS

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Fig. 1

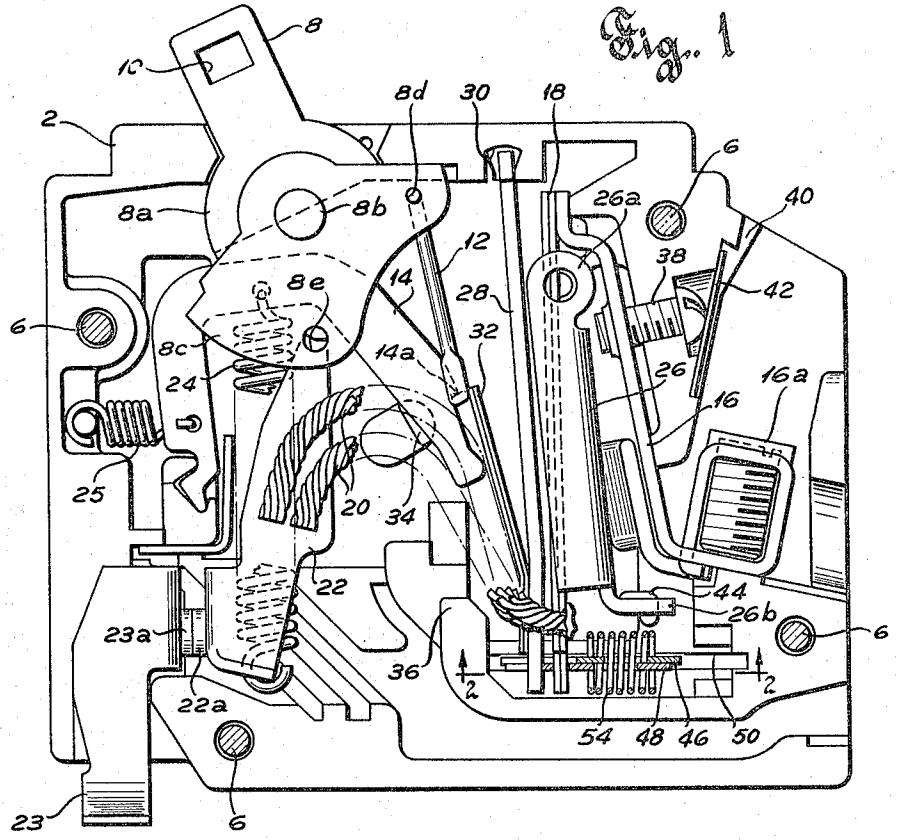
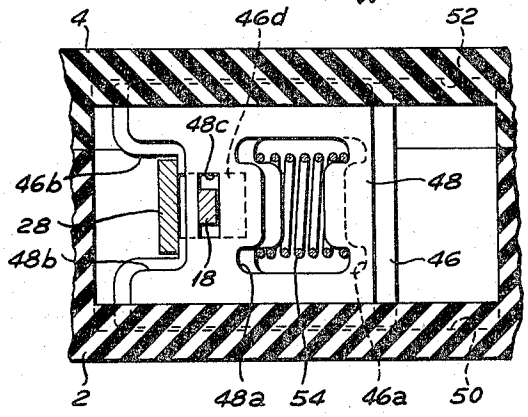


Fig. 2



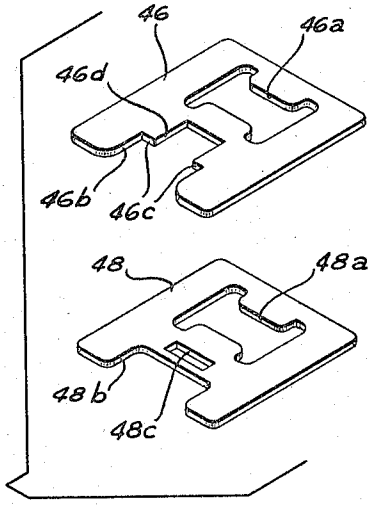


Fig. 3

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Fig. 5

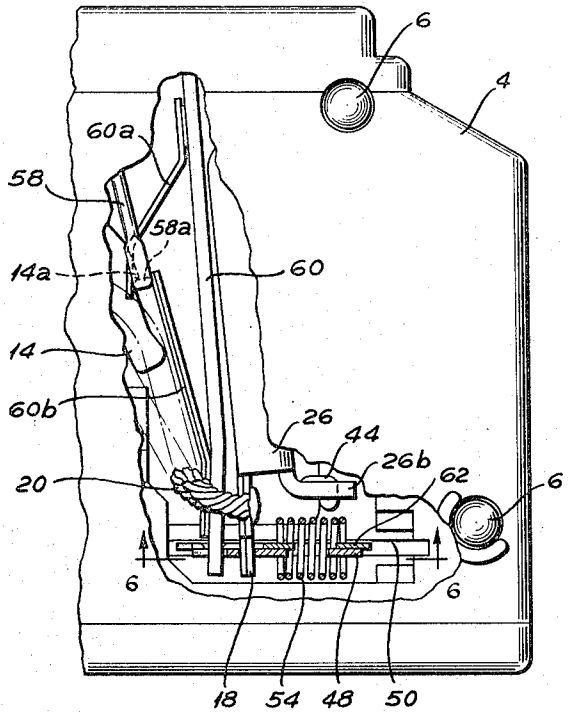


Fig. 7

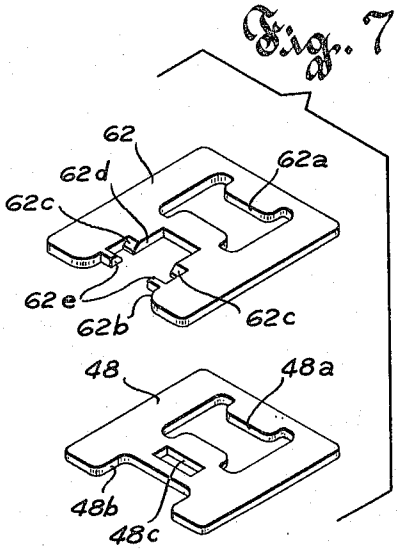


Fig. 6

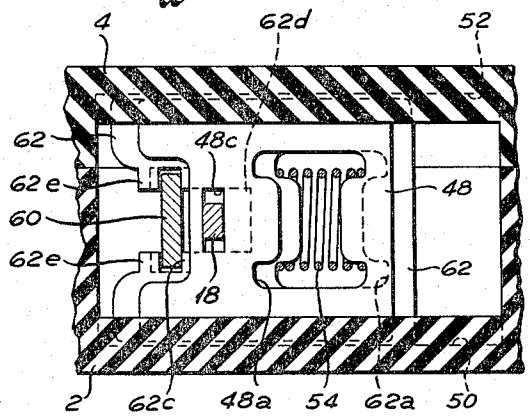
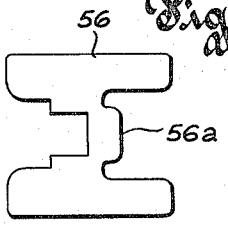


Fig. 4



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3,292,118

CIRCUIT BREAKERS WITH IMPROVED TRIP MECHANISMS

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20 Claims. (Cl. 335—37)

This invention relates to circuit breakers and more particularly to improved trip mechanisms therefor.

Circuit breakers of the type contemplated by this invention are provided with an operating handle manually movable between an "on" and "off" position to close and open the contacts. An overcenter mechanism is activated by the operating handle to effect the contact operation. A latch is provided which when engaged with the overcenter mechanism acts therethrough to maintain the contacts closed. These breakers are of the thermal and magnetic trip type whereby they respond to a continuous small overload current or respond magnetically to a large overload current to effect disengagement of the latch. As a result, the overcenter mechanism is activated or tripped to cause opening of the contacts to interrupt and thereby protect the associated circuit from excessive currents. Such tripping action also causes the operating handle to be moved from its "on" position to indicate the tripped condition.

A characteristic feature of one type of circuit breaker with which the invention can be used is that the latch is unstable, this instability being desirable and advantageous in that it affords significantly more accurate control of the tripping point of the breaker. To maintain engagement of the latch, it is necessary to apply a bias force thereto. The apparatus which normally applies such bias force is controlled by the thermal or magnetic overload current responsive mechanism to reduce or remove such force thereby to permit disengagement of the unstable latch. Then the latch can be reengaged after the thermal member has cooled sufficiently. While means for applying the bias force to the unstable latch such as that disclosed in Martin F. Koenig et al. Patent No. 3,081,386, dated March 12, 1963, has been found satisfactory, it has been found desirable to improve the function of the bias force applying means and particularly its cooperation with the thermal and magnetic overload current responsive mechanism to improve the accuracy and reliability of the tripping action. These improvements are realized by providing an improved structure which is effective, in addition to transmitting a bias force to the unstable latch, to permit tripping magnetically without disturbance or requiring response from the thermally responsive member and to reduce the stress on the thermally responsive member as it heats and to relieve the thermally responsive member of all external mechanical stress on tripping of the breaker to prevent formation of a "set."

A characteristic feature of another type of circuit breaker with which the invention can be used is that the latch is stable, such as the breaker shown in FIGS. 5–7. In this type of breaker, due to the stability of the latch, the tripping means must apply a force to pull the latch open when an abnormal electrical condition occurs. While means for pulling a circuit breaker latch open have been known heretofore, it has been found desirable to improve the function of the unlatching force applying means and its cooperation with the thermal and magnetic overload current responsive elements to improve the accuracy and reliable repeatability of the tripping action. These improvements are realized by providing an improved structure in many ways similar to the structure used in conjunction with the unstable latch breaker and

which is effective to cause tripping magnetically without disturbing or requiring response from the thermally responsive tripping member and to relieve the thermally responsive member of all external mechanical stress upon tripping of the breaker.

In employing a stressed spring member in the structure undesirable lost motion is effectively eliminated to reduce susceptibility to tripping under mechanical shock and enhanced precision and reliability of response to overload currents is attained.

Accordingly, a general object of the invention is to provide novel means for affording the aforementioned improved results.

A more specific object of the invention is to provide means for increasing the accuracy and reliability of response of a circuit breaker to excessive heating or currents, by removing external stress on the thermal member following tripping thereby to avoid subjecting the thermal member to a stress larger than it can safely withstand.

Another specific object of the invention is to provide novel means for maintaining engagement of the latch mechanism in a circuit breaker and for cooperating in an improved manner with the current responsive mechanism to enhance the operating reliability of the breaker.

Another specific object of the invention is to provide in a circuit breaker means for applying a force between the thermal member and the latch to maintain engagement of the latter which force applying means does not create stress in the thermal member after tripping and which is freely movable with the thermal member upon flexure of the latter under excessive current flow.

A characteristic of the invention is to provide a circuit breaker having the aforementioned advantages and in which lost motion in the tripping mechanism can be eliminated or minimized.

Other objects and advantages of the invention will hereinafter appear.

These and other objects and advantages of the invention and the manner of obtaining them will best be understood by reference to the following description of embodiments thereof taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a front elevational view of a circuit breaker of the unstable latch type with the cover removed to show the internal mechanism, constructed in accordance with the invention;

FIG. 2 is a cross-sectional view taken along line **2—2** of FIG. 1 showing the two spring biased slide plates forming part of the tripping mechanism;

FIG. 3 is an isometric view of the two slide plates of FIGS. 1 and 2;

FIG. 4 is a top view of a modified slide plate usable in place of the upper slide plate in FIGS. 1 and 3;

FIG. 5 is a fragmentary front elevational view of a circuit breaker of the stable latch type with a portion of the cover removed to show a modified internal mechanism;

FIG. 6 is a cross-sectional view taken along line **6—6** of FIG. 5 showing the two spring biased slide plates forming part of the tripping mechanism of the modified breaker; and

FIG. 7 is an isometric view of the two slide plates of FIGS. 5 and 6.

Referring to FIG. 1, there is shown a single pole circuit breaker having an insulating housing comprised of a shallow base **2** having an open side closable by an insulating cover **4**, the latter being shown in FIG. 2 and being removed in FIG. 1 to show the internal mechanism of the breaker. The cover is rigidly secured to the base by a plurality of rivets **6** or the like. Base **2** and cover **4** are

provided at the top portions thereof with cut-out portions in registration forming a rectangular elongated opening for accommodating an operating handle **8** which extends to the exterior of the housing. Handle **8** is provided with a rectangular opening **10** therethrough for receiving a handle tie when a plurality of single pole breakers are assembled in plural-pole relation. For an illustration and description of certain portions of the operating mechanism including the contacts and overcenter mechanism which are shown but not described in detail herein, reference may be had to the aforementioned patent.

As shown in FIG. 1, the breaker is provided with a latch **12** pivotally supported on and suspended from the lower right-hand portion of operating handle **8**. An inverted U-shaped latch lever **14** is arranged for cooperation with latch **12** to maintain the contacts closed when the operating handle is in its extreme counterclockwise position as shown in FIG. 1. Latch lever **14** is pivoted at the lower end of its left leg in the base. A terminal bracket **16** is rigidly and electrically connected at the upper end thereof to the upper end of a thermal responsive member such as bimetal member **18** and the lower end of bracket **16** extends to the exterior of the housing. The outer end of bracket **16** is provided with an electrical connector **16***a* for securing an electrical conductor thereto to form a connection to the breaker. The circuit through the breaker is completed from the lower end of bimetal member **18** through one or more flexible electrical conductors **20** to a movable contact finger **22** and through the movable contact **22***a* secured thereto and a stationary contact **23***a* to an external connector clip **23** for connecting the breaker to an external circuit. An overcenter tension spring **24** connects the lower end of contact finger **22** to the central portion of latch lever **14**. A resetting spring **25** is tensioned between the left leg of laatch lever **14** and a projection in base **2**.

A magnetic pole piece **26** is pivotally supported at its upper end on opposed projections in the base and cover. Pole piece **26** is provided at its mid-portion with a substantially longitudinal U-shaped portion surrounding bimetal member **18** on three sides. The current flowing in bimetal member **18** energizes the magnetic pole piece and the elongated ends of the legs of the U-shaped portion form magnetic pole faces for attracting an elongated armature **28**. Armature **28** is pivoted at its upper end in suitable alined cavities **30** in base **2** and cover **4**. Armature **28** extends downwardly from its pivot alongside magnetic pole piece **26** and is normally spaced therefrom for attraction by the latter. A metallic strip member **32** is rigidly secured adjacent the lower end of armature **28**. Member **32** is bent so that its free end diverges from armature **28** into engagement with the lower yoke portion of latch latch **12** to maintain engagement between the lower end of latch **12** and a suitable catch **14***a* on latch lever **14**. While metallic member **32** is preferably a compensating bimetallic member for altering the operation of the breaker to compensate for ambient temperature changes, it will be understood that it may instead comprise a single stiff but resilient piece of metallic material attached to armature **28** if compensation is not required.

The central portion of operating handle **8** diverges downwardly into a substantially semi-circular or semicylindrical portion **8***a* to afford restricted rotation of the handle in the housing. The axis of rotation of such semicylindrical portion is provided with a pair of journals **8***b* extending in opposite directions laterally of the operating handle for pivoting the latter in the base and cover. The lower portion of handle **8** is bifurcated into a pair of like parallel enlarged portions **8***c* laterally spaced in the direction of the aforementioned axis. These parallel enlarged portions are provided at the right-hand sides thereof with alined holes **8***d* and at the lower central portion with alined holes **8***e* for receiving the outwardly bent end portions of the legs of latch **12** and contact finger **22**, respectively, to pivotally support the latch and contact finger on the operating handle. The yoke portion of latch **12** is flattened into a substantially rectangular cross-section and the upper surface thereof is formed at a predetermined downward slope toward latch lever **14** and at a small downward angle from a plane normal to the plane of the latch. This downward angle is sufficient to afford an unstable system. Thus, the sloped portion of the latch engages catch **14***a* on the latch lever when a predetermined bias force is applied thereto through compensating bimetal member **32** but slips off therefrom to trip the breaker when such force is reduced or removed. It will be apparent that latch **12** and contact finger **22** may be assembled on the operating handle by squeezing the free ends of the spaced legs thereof toward one another, inserting such ends between the spaced portions **8***c* of the handle and allowing the outwardly bent portions of the latch and contact finger to spring into holes **8***d* and **8***e*, respectively. The central portion of the cavity in base **2** is provided with a projection **34** molded therein for guiding latch lever **14** and a wall **36** extends upwardly into such cavity to form a stop for the right leg of latch lever **14** when the breaker is tripped. Terminal bracket **16** is provided intermediate its ends with a threaded hole for receiving an adjusting screw **38** threaded thereinto and extending through a slot in a wall of the base. Base **2** and cover **4** are provided with a one-way slot **40** for receiving a rating card **42** overlying and concealing the head of adjusting screw **38**.

Magnetic pole piece **26** is provided at its pivotal end integrally therewith with a pair of spaced circular portions **26***a* having alined bearing apertures for receiving the opposed projections molded in the base and cover. The other end of pole piece **26** is bent at a right angle thereto and is provided with a laterally extending projection **26***b* for engaging a molded projection **44** in base **2** to limit the clockwise piovtal movement of the pole piece. Armature **28** has a T-shaped upper end portion, the extremities of the cross on the T being received in cavities **30** in the base and cover for pivotally supporting the armature.

An important feature of the invention is the provision of a mechanism for applying a biasing force to latch **12** to maintain engagement thereof with catch **14***a* on latch lever **14**. To this end, there is provided a pair of slide plates **46** and **48**, more clearly shown in FIGS. 2 and 3. These slide plates are arranged in abutting relation and are slidably guided in opposed grooves **50** and **52** in base **2** and cover **4**. Slide plates **46** and **48** are provided with substantially I-shaped apertures **46***a* and **48***a* adjacent their right-hand ends which may be held slightly out of registration as shown by dotted lines in FIG. 2 by having portions of the plates bearing against bimetal member **18** and armature **28**, the opposed projections extending into these apertures being received within the opposite ends of a helical compression spring **54**. Spring **54** and grooves **50** and **52** maintain the slide plates in abutting relation and the spring biases apertures **46***a* and **48***a* toward registration. Plates **46** and **48** are relatively slidably movable against the compressive force of spring **54**. Plate **46** is provided at its left-hand end with a stepped slot **46***b* accommodating the free end of armature **28** against shoulders **46***c* thereof. Plate **48** is provided at its left-hand end with a slot **48***b* extending inwardly a predetermined distance to clear the free end of armature **28** affording magnetic tripping without moving bimetal member **18** and a rectangular aperture **48***c* accommodating the reduced free end of bimetal member **18** which also extends freely through the narrow portion **46***d* of the slot in plate **46** as shown in FIGS. 2 and 3.

It will be apparent that shoulders **46***c* and aperture **48***c* maintain armature **28** separated from bimetal member **18** but that armature **28** is capable of movement toward bimetal member **18** against the force of spring **54**. A resilient force is transmitted from the left end of spring **54** through slide plate **46**, armature **28** and member **32** to

maintain latch **12** in engagement with catch **14***a* on the latch lever, the right end of spring **54** being held stationary by bimetal **18** acting through plate **48**. Also, the slide plate assembly is free to move in the right-hand direction when bimetal meber **18** flexes after the bimetal has flexed enough to bring the plate apertures into registration since the compression spring is in series with the latch maintaining reactive force imposed by the fixed bimetal **18**.

Let it be assumed that a small overload current flows in thermal bimetal member **18**. As the latter heats, its lower end in FIG. 1 flexes or bends in the right-hand direction. It will be apparent from FIG. 2 that initial movement of the lower end of the bimetal member in the right-hand direction allows spring **54** to move lower slide plate **48** in the right-hand direction. Such movement brings apertures **46***a* and **48***a* in the slide plates into closer registration with one another and reduces the compression in spring **54**. This action correspondingly reduces the force applied through armature **28** and member **32** to latch **12** and reduces the externally applied stress on bimetal member **18**. When the apertures in the slide plates register with one another and spring **54** has expanded as far as it can go wherein it is confined, the stress on bimetal member **18** has been reduced and the left-hand directed force normally applied through member **32** against latch **12** has been reduced. Further bending of bimetal member **18** causes movement of the two slide plates and the spring as a unit in the right-hand direction. With continuing movement, latch **12** slips off catch **14***a* to trip latch lever **14** and open the contacts.

If a sudden large overload current flows in bimetal member **18**, magnetic pole piece **26** is energized sufficiently to attract armature **28** thereto. This causes slide plate **46** to slide in the right-hand direction relative to slide plate **48**, the latter being restrained by bimetal member **18**. Spring **54** is compressed. As a result, the bias force is reduced and latch **12** slips off catch **14***a* to trip the breaker. When the overload current terminates, plate **46** is free to move in the left-hand direction to register apertures **46***a* and **48***a* and restore the armature back in the left-hand direction thereby to relieve the stress on bimetal member **18**. When the contacts are reclosed, latch **12** again bears against member **32** so that plates **46** and **48** again assume the position shown in FIG. 2 and are biased by force of spring **54**.

It will be apparent that the invention affords accurate control of the tripping point of the breaker. Spring **54** acting through slide plates **46** and **48** resiliently maintains proper separation between bimetal member **18** and armature **28** and there is no lost motion therebetween. The bias force applied to latch **12** originates as a stress in the bimetal member **18**, decreases as the bimetal heats and deflects and becomes zero, eliminating stress in the bimetal, as soon as the breaker trips. As such bias force is applied by use of the bimetal member as a reactive support, accurate adjustment thereof is afforded at adjusting screw **38**.

Since the circuit breaker described in connection with FIGS. 1–3 is of the unstable latch type, it is only necessary to reduce or remove the force applied to latch **12** to cause the breaker to trip. When such force is sufficiently reduced or removed, the angular surface of the lower yoke portion of latch **12** will slip off catch **14***a* of the latch lever to allow the breaker to trip and open the contacts. Overcenter spring **24** rotates latch lever **14** clockwise until the lower end of the right-hand leg of the latch lever stops against wall **36**. In this position, the latch lever has carried the upper end of overcenter spring **24** past contact finger **22**. As a result, the tension in spring **24** snaps the contacts open and pulls the contact finger upwardly causing rotation of operating handle **8** clockwise from its on position to its off position. Thereafter, resetting spring **25** restores latch lever **14** partially counterclockwise since the tension in spring **24** has been relieved so that catch **14***a* moves above the yoke portion of latch **12**. In this reset position, the breaker contacts can be reclosed by merely turning the operating handle back to its on position.

From the foregoing, it will be apparent that aperture **46***a* in upper slide plate **46** may be smaller than, equal to or larger in the horizontal direction in FIG. 2, than the corresponding aperture **48***a* in lower slide plate **48**. Under any one of these three conditions, there will be no lost motion between movement of thermal member **18** and tripping of the latch. Apertures **46***a* or **48***a* in either slide plate can be made larger or smaller at either end without altering the operation of the system of parts because both plates are still free in any instance to move as a unit to permit tripping and the spring will be contained in one plate or the other to relieve the bimetal of external stress. One example of a modified slide plate **56** that could be used in place of slide plate **46** is shown in FIG. 4. It will be seen that slide plate **56** is similar to slide plate **46** except that the right-hand end has been cut off leaving aperture **56***a* open. This represents an aperture that is larger only at its right-hand side than the aperture in lower slide plate **48**. With movement of the bimetal, spring **54** would be restricted by aperture **48***a* from further expansion. Then, the slide plates and spring can begin to move as a unit with further movement of the thermal member after the left-hand edges of the apertures come into registration. After tripping, spring **54** would be confined in aperture **48***a*, relieving bimetal **18** of external mechanical stress.

Referring to FIGS. 5, 6 and 7, there is shown a modified circuit breaker of the stable latch type. In this modification, reference characters like those in FIGS. 1–3 have been used for like parts. This modification differs from the unstable latch type breaker hereinbefore described in the structures of the latch **58**, the armature **60** and the upper slide plate **62**. The lower yoke portion of latch **58** is provided with an uninclined or straight surface **58***a* so that a force need not be applied to hold the latch engaged with catch **14***a* on latch lever **14**. Instead, the latch remains in engagement with the catch and must be pulled therefrom to trip the circuit breaker. For this purpose, armature **60** is provided with a hook **60***a* in the form of a spring wire, more fully described in M. F. Koenig et al. copending application Serial No. 261,345, filed February 27, 1963, now patent No. 3,214,535, dated October 26, 1965, and assigned to the assignee of this invention. This wire is secured at its upper end to the upper end portion of the armature as by welding and extends downwardly therefrom so that its lower end enters behind the yoke portion of latch **58** on one side of latch lever **14**. It will be seen that if the lower end of the armature is moved in the right-hand direction, hook **60***a* pulls the latch from the catch to trip the breaker. Otherwise, armature **60** is like armature **28** and is provided with a compensating bimetal member **60***b* similar to member **32** in FIG. 1.

To enable movement of the armature in response to thermal action, a modified upper slide plate **62** is provided. This slide plate is similar to slide plate **46** in that it is provided with an aperture **62***a* for the compression spring and a stepped slot at the left-hand end having a wide portion **62***b*, a pair of shoulders **62***c* and a narrower deep portion **62***d*. This slide plate differs from slide plate **46** in that wide portion **62***b* of the slot is provided with a pair of inwardly projecting ears **62***e* reducing the width of this portion of the slot to correspond to the width of narrow portion **62***d*. Ears **62***e* are spaced in the left-hand direction from shoulders **62***c* to just receive the opposite edge portions of armature **60** freely therebetween. As shown in FIG. 7, shoulders **62***c* and ears **62***e* are chamfered on the upper side to allow free pivoting of the armature a small amount relative to the slide plate and the shoulders and ears confine the armature to avoid significant lost motion when the slide plate is moved in the right-hand direction from the position shown in FIGS. 5 and 6.

As shown in FIG. 6, when the circuit breaker is closed, thermal bimetal member **18** holds plate **48** from moving in the right-hand direction due to the fact that the end of the bimetal extends through hole **48***c* in the slide plate. Compression spring **54** biases slide plate **62** in the left-hand direction because apertures **48***a* and **62***a* are offset from one another. As a result, shoulders **62***c* push on armature **60** and hold the upper end of compensating bimetal **60***b* snugly against the lower end of latch **58**. Under this condition, hook **60***a* is stressed so that it bears against the left side of latch **58**. When the operating handle is turned off and latch **58** lowers, hook **60***a* springs into engagement with the upper end of bimetal **60***b*. When the latch is raised, it separates hook **60***a* from the compensating bimetal member.

When thermal bimetal member **18** heats and bends in the right-hand direction, spring **54** moves slide plate **48** in the right-hand direction to the extent permitted by the thermal member and the stress on the latter decreases. When the apertures in the slide plates register with one another to restrict further expansion of spring **54**, the stress on the thermal member **18** becomes relieved and bimetal member **18** will begin to move the slide plates and spring **54** as a unit in the right-hand direction. Ears **62***e* will pull on the armature to move the armature with the thermal member **18**. As a result, hook **60** will pull latch **58** loose from catch **14***a* to trip the breaker.

Aperture **62***a* in the upper slide plate must be equal in its horizontal dimension in FIGS. 5 and 6 to aperture **48***a* in the lower slide plate and may not be smaller or larger if lost motion is to be avoided. If aperture **62***a* is smaller at its right-hand side, there will be lost motion from the point where the right-hand edges pass through registration and the spring stops expanding to the point where their left-hand edges register and slide plate **48** starts to push the spring. If aperture **62***a* is made smaller at its left-hand side, there will be lost motion from the point where the right-hand edges of the apertures pass through registration to the point where their left-hand edges coincide unless bimetal **18** sooner bears on the bottom of slot **62***d*. When the apertures are the same size, as shown, they will first register as the bimetal bends, then the bimetal will push slide plate **48** which will push the spring and the spring will push slide plate **62** to pull the armature to the right to trip the breaker without lost motion. If aperture **62***a* is made larger at its left-hand side, there will be lost motion from the point where the left-hand edges of the apertures pass through registration until the right-hand edges thereof register. If aperture **62***a* is made larger at its right-hand side, there will be lost motion from the point where the left-hand edges of the apertures pass through registration until their right-hand edges register unless bimetal **18** sooner bears on the bottom of slot **62***d*. If the right-hand end portion of slide plate **62** is cut off to enlarge the aperture in the manner of FIG. 4, the breaker will not trip until bimetal **18** engages the bottom of slot **62***d* and pushes slide plate **62** to the right.

To summarize, if aperture **62***a* is made smaller or larger than aperture **48***a*, as it should not be, slide plate **62** will remain stationary as slide plate **48** continues to move with the thermal member after spring **54** is restricted from further expansion by the smaller aperture as the case may be. This might make the tripping point uncertain because the lost motion introduced permits uncontrollable movement of the parts. Consequently, in this modification, aperture **62***a* is made equal to aperture **48***a*.

Under magnetic trip, pole piece **26** attracts armature **60** thereto. The armature moves slide plate **62** against the force of spring **54** while slide plate **48** may remain stationary depending upon bimetal activity and hook **60***a* pulls the latch from the catch to trip the breaker.

While the apparatus hereinbefore described is effectively adapted to fulfill the objects stated, it is to be understood that I do not intend to confine my invention to the particular preferred embodiments of circuit breaker mechanisms disclosed, inasmuch as they are susceptible of various modifications without departing from the scope of the appended claims.

I claim:

1. In a circuit breaker of the type having a spring biased mechanism for operating the breaker between circuit-closed and circuit-open conditions and an operating lever for actuating said operating mechanism, the combination comprising:

latch means acting on said operating mechanism to maintain the latter in its circuit-closed condition and being releasable in response to an abnormal electrical condition to trip said operating mechanism to its circuit-open condition;

a thermal responsive device having a portion which moves when heated under the influence of an excessive electro-thermal condition in the breaker;

and means coupling said movable portion to said latch means for effecting the release of the latter upon predetermined movement and being normally effective to apply a bias tending to separate said movable portion of said thermal responsive device from said latch means to prevent lost motion therebetween when said movable portion starts to move and comprising:

means in said coupling means responsive to movement of said movable portion for decreasing said bias thereby to reduce upon tripping the stress imposed on said thermal responsive device when it is hot.

2. The invention defined in claim **1**, wherein said bias decreasing means comprises:

means for reducing the stress being imposed on said thermal responsive device to zero value.

3. The invention defined in claim **1**, wherein said bias decreasing means comprises:

means for reducing the stress being imposed on said thermal responsive device to zero value before release of said latch means.

4. The invention defined in claim **1**, wherein:

said latch means is unstable and maintains said operating mechanism in circuit-closed condition in response to the bias of said coupling means and releases to trip said operating mechanism in response to said bias decreasing means.

5. The invention defined in claim **1** wherein:

said latch means is stable and maintains said operating mechanism in circuit-closed condition until a force is applied to release it;

said bias decreasing means comprising means for reducing the stress being imposed on said thermal responsive device to zero value under the influence of said movable portion;

and said coupling means comprising means responsive to continued movement of said movable portion after said stress has been reduced to zero value for pulling said latch means apart to trip said operating mechanism and said thermal responsive device again becoming unstressed following said tripping.

6. In a circuit breaker of the type having an over-center spring biased mechanism for operating the breaker between contacts-open and contacts-closed positions and a manual operating lever for actuating said operating mechanism, the combination comprising:

latch means acting on said operating mechanism to maintain the latter in its contacts-closed position and being releasable in response to a sustained overload current condition or an extreme overload current condition to trip said operating mechanism to its contacts-open position;

a thermal current responsive bimetal member anchored at one portion so that another portion deflects when

heated by sustained overload current flow therethrough;

a magnetic pole piece mounted adjacent said bimetal member for excitation by the latter in response to an extreme overload current flow condition;

an armature pivoted at one end and extending substantially parallel to the bimetal member to form a magnetic air gap with the pole piece;

means connected to said armature for releasing said latch means;

and means including confined resilient means normally coupling the deflecting portion of said bimetal member to said armature to transmit a force before and during predetermined deflection of said bimetal member through said armature to the latch means while imposing a corresponding reactive stress in said bimetal member and to permit the armature to move without the bimetal member moving.

7. The invention defined in claim **6**, wherein said confined resilient means comprises:

means for eliminating the stress applied to said bimetal member when the deflecting portion thereof has moved tripping the breaker.

8. The invention defined in claim **6**, wherein said confined resilient means comprises:

means for eliminating the stress applied to said bimetal member when the armature has moved tripping the breaker and the armature has restored.

9. The invention defined in claim **6**, wherein said resilient means comprises:

a pair of slide plates lying flat against one another;

means mounting said plates for sliding movement together and relative to one another;

a spring biasing one of said plates in one direction against said armature and biasing the other plate in the other direction against the deflecting portion of said bimetal member to transmit a force to said latch means, said other plate sliding relative to the first plate when said bimetal member deflects;

and means comprising said spring for restricting the sliding movement of said other plate relative to said first plate and for eliminating the stress in said bimetal member when the breaker trips.

10. The invention defined in claim **9**, wherein sufficient clearance is provided between the armature and said other plate to allow movement of the armature in response to magnetic force to slide said first plate and compress said spring and thereby to release said latch means without moving said other plate or said bimetal member.

11. The invention defined in claim **9**, wherein said means comprising said spring consists of:

a pair of offset but overlapping apertures in said slide plates;

said spring being in compression within said apertures to bias said plates in opposite directions thereby to stress said bimetal member;

and relative movement of said plates by said spring when said bimetal member deflects causing elimination of said stress when at least first sides of said apertures move into registration preventing further expansion of said spring.

12. The invention defined in claim **11**, wherein said other plate is provided with a second aperture accommodating the deflecting end of said bimetal member.

13. The invention defined in claim **12**, wherein said first plate is provided with a slot through which said bimetal member extends with sufficient clearance to permit the latter to deflect free of said first plate.

14. The invention defined in claim **11**, wherein said first plate is provided with means confining the free end of said armature for moving said armature to release said latch means in response to further deflection of said bimetal member after said spring has expanded as far as it can go.

15. The invention defined in claim **11**, wherein the spring receiving aperture in said first plate is as large in the direction of spring expansion as the corresponding aperture in the other plate.

16. The invention defined in claim **11**, wherein the spring receiving aperture in said first plate is smaller in the direction of spring expansion than the corresponding aperture in the other plate.

17. The invention defined in claim **11**, wherein the spring receiving aperture in said first plate is larger in the direction of spring expansion than the corresponding aperture in the other plate.

18. In an electro-thermal and electromagnetic trip circuit breaker, the combination comprising:

a spring actuated mechanism for tripping the breaker from contact-closed to contact-open position and an operating lever for setting the tripping mechanism in contact-closed position;

latch means for maintaining said tripping mechanism in contact-closed position;

an elector-thermal member connected in the electric circuit of the breaker for flexing in response to continuous small overload current flow therethrough;

a magnetic member adjacent said electro-thermal member;

a pivoted armature assembly arranged for magnetic attraction by said magnetic member in response to large overload current flow through said electro-thermal member and engaging said latch means;

and means coupling said armature assembly and said electro-thermal member and comprising:

means subjecting said electro-thermal member to an externally applied stress prior to and as it deflects under continuous small overload current and being bodily movable with said deflecting electro-thermal member effecting movement of said armature assembly to release said latch means and cause tripping of the breaker;

resilient means allowing movement of said armature assembly under large overload current without moving said electro-thermal member to cause tripping of the breaker;

and means removing all externally applied stress from said electro-thermal member upon either thermal or magnetic tripping of the breaker to prevent imposing a set therein when it is hot.

19. The invention defined in claim **18**, wherein said coupling means also comprises:

means including said resilient means for returning said armature assembly into engagement with said latch means when said electro-thermal member cools and restores following thermal tripping thereby to insure latching of said latch means onto said tripping mechanism when said operating lever is reset.

20. In a circuit breaker of the type having a spring biased mechanism for operating a breaker between circuit-closed and circuit-open condition and an operating lever for actuating said mechanism, the combination comprising:

latch means acting on said operating mechanism to maintain the latter in its circuit closed condition and being releasable to trip said operating mechanism to its circuit open condition;

a thermal responsive device having a portion which moves when heated under the influence of an excessive electro-thermal condition in the breaker;

a magnetically responsive device having a movable portion responsive to excessive electromagnet conditions in the breaker;

and means coupling each said movable portion to said latch means for effecting the release of the latter upon predetermined movement and being capable of permitting action of the magnetically responsive device without motion of the thermal responsive device which coupling means eliminates external mechani-

cal stress from the thermal responsive device when the breaker trips under either thermal or magnetic action.

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