United States Patent [19]

Burch

[11] **3,778,739**

[45] **Dec. 11, 1973**

[54] **CIRCUIT BREAKER**

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[73] Assignee: **B/K Electric Co., Inc.**, Highland Park, Ill.

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[52] **U.S. Cl.** **337/72**, 337/75, 337/112, 337/150, 337/155, 337/215, 337/248

[51] **Int. Cl.** **H01h 71/16**, H01h 71/50

[58] **Field of Search** 337/70, 72, 75, 76, 337/112, 113, 142, 150, 152, 155, 186, 208, 213, 215, 227, 228, 236, 237, 248

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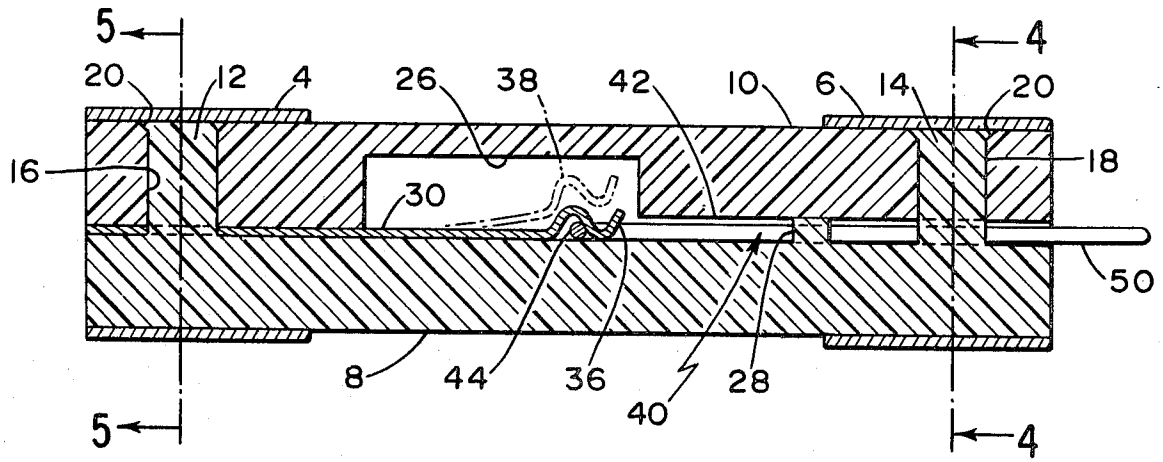
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Assistant Examiner—A. T. Grimley
Attorney—Melvin R. Jenney et al.

[57] **ABSTRACT**

A cartridge-type thermostatically operated, manually resettable circuit breaker having a strip of thermostat metal which flexes when heated by the passage of current therethrough to release a V-shaped spring member having divergent arms. The latter, when engaged by the thermostat member, is held in a position such that the arms are forced toward each other, and when the spring member is released, the resilience of the arms urges the member away from the thermostat member. The circuit connections are made to the thermostat member, and to the spring-shaped member, and separation of the thermostat member and the spring member breaks the circuit, the thermostat member and the spring wire member each constituting the only contacts in the device.

15 Claims, 14 Drawing Figures



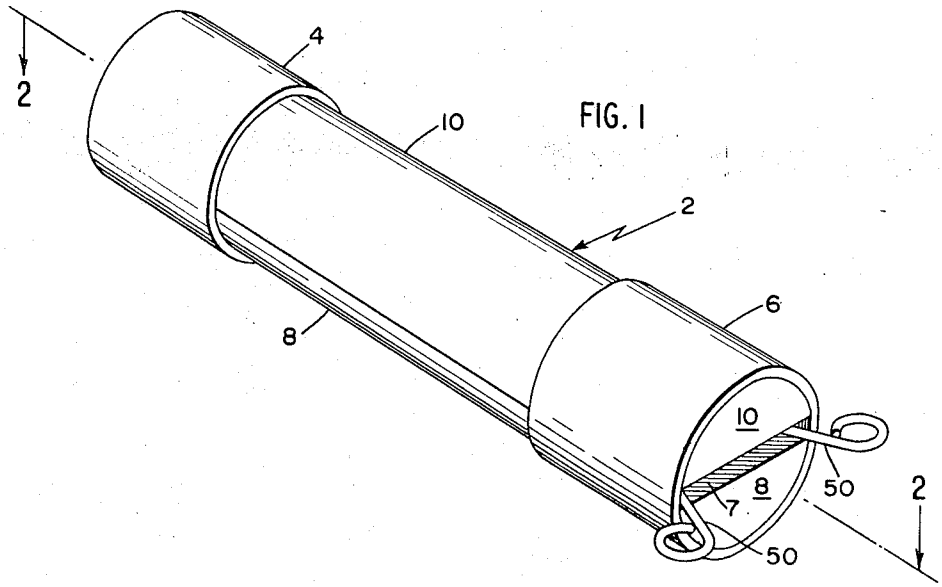


FIG. 1

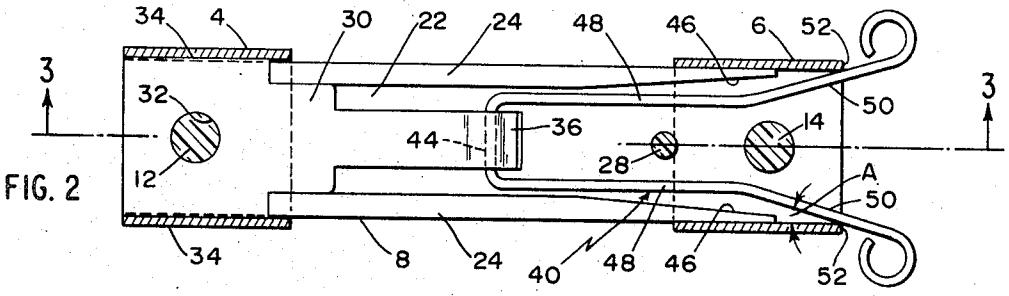


FIG. 2

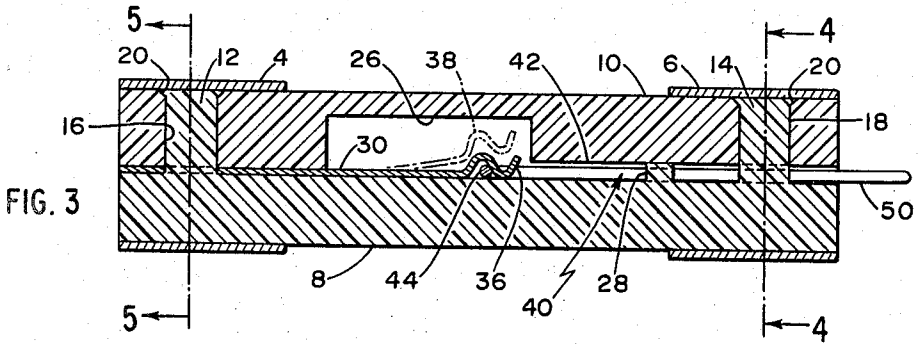


FIG. 3

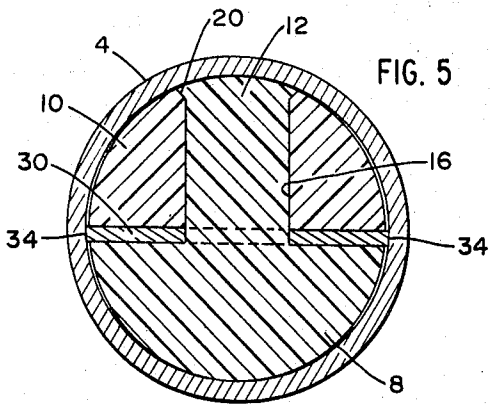


FIG. 5

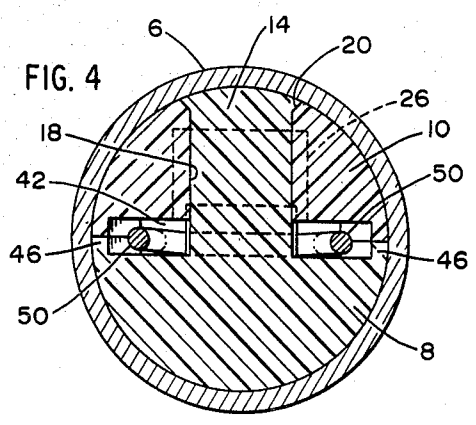


FIG. 4

FIG. 6

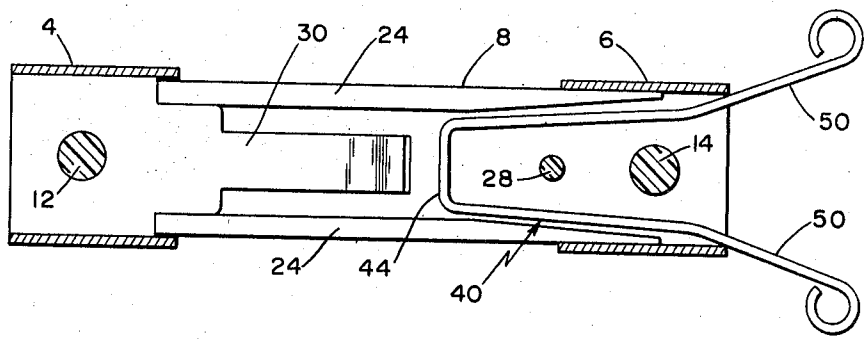
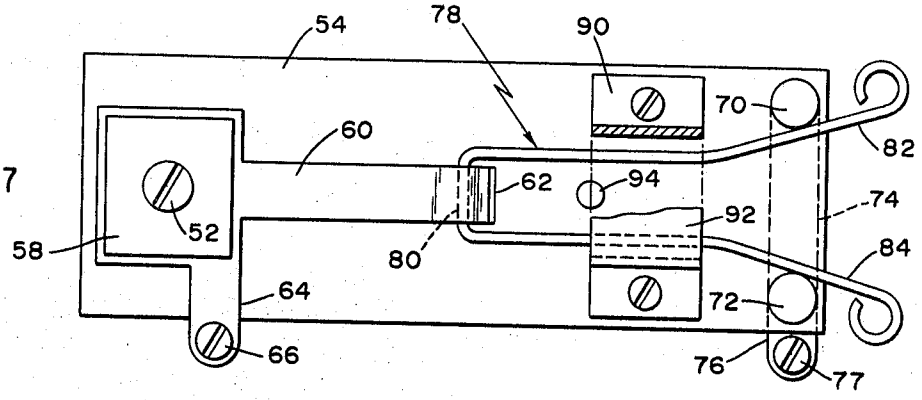


FIG. 7



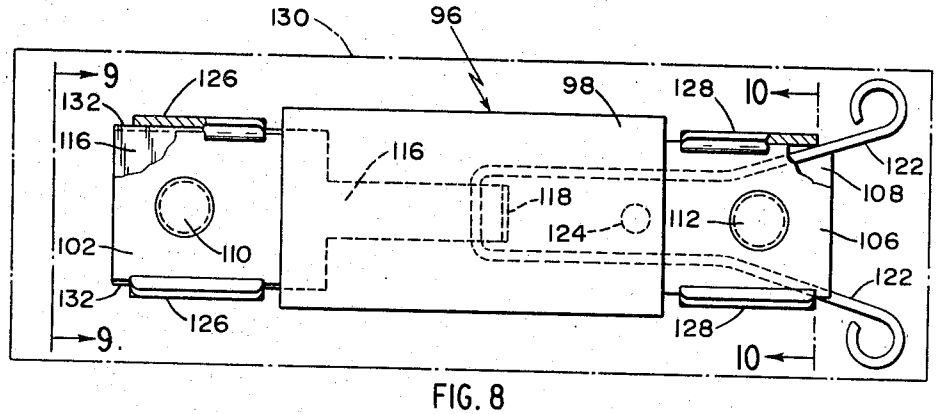
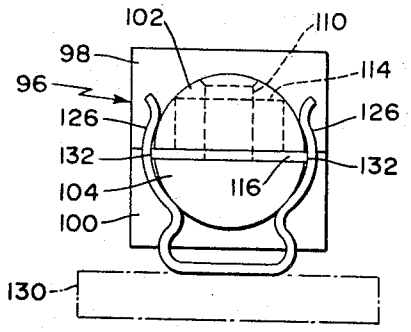


FIG. 8

FIG. 9



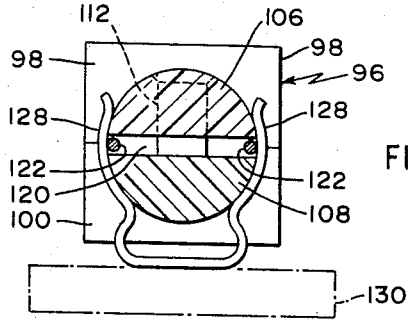


FIG. 10

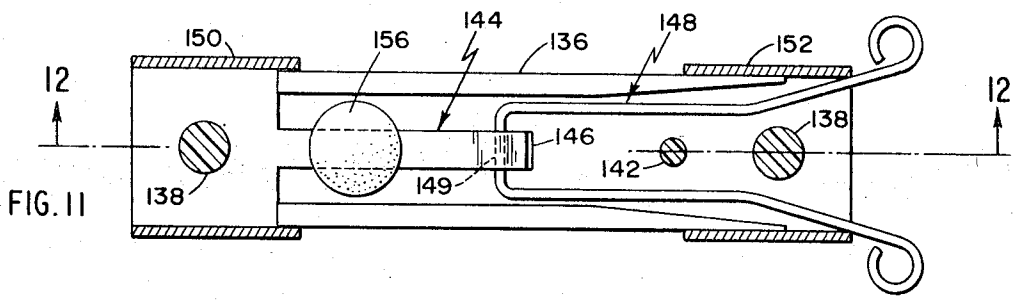


FIG. 11

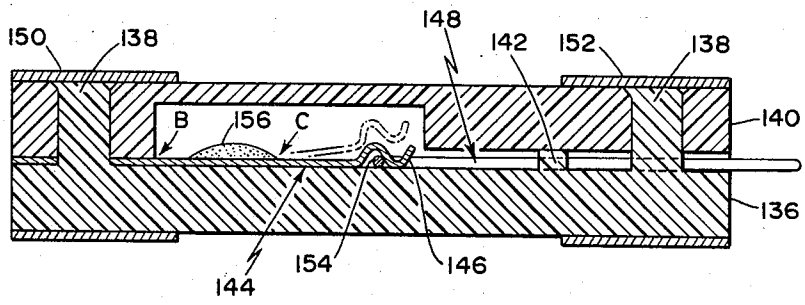


FIG. 12

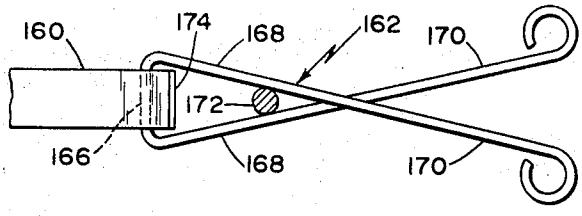


FIG. 13

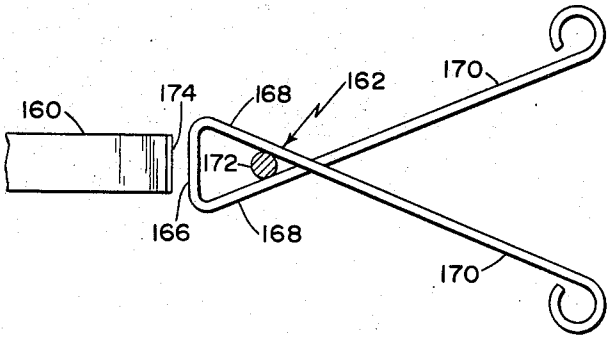


FIG. 14

CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

Thermostatically operated small circuit breakers are extensively in use, particularly for low voltage installations such as automobiles. Such circuit breakers are customarily mounted between the clips of a so-called fuse block. They take the place of a fusible type circuit breaker. Such thermally actuated cartridge type circuit breakers need to be manually resettable. Many devices of this general kind have been tried on the market but only a few are in use today. One of the troubles is that in an effort to cheapen the construction of the device, accuracy of calibration has been lessened. Another difficulty with prior art devices is many if not all are not adapted to automatic assembly. If they are assembled by machinery automatically then they generally must be calibrated by hand. Because of this, the cost of the element is higher than desired. Still another difficulty, is that in devices made very cheaply, the construction is often such that after the circuit breaker has operated one or more times, a momentary delay of the opening action will be caused by roughness between the electrical contacts. Such delay will burn out the thermal element or change its calibration.

SUMMARY OF THE INVENTION

It is the general purpose of this invention to provide a cartridge type circuit breaker which may be manufactured and calibrated by automated methods, and which uses relatively few and simple parts thereby lessening the cost of making the device.

Therefore, among the several objects and advantages of the invention may be noted the provision of a circuit breaker of the above class, in which the thermally moving element and the release member thereof each constitute the only contact members in the device.

Another object of the invention is to provide a circuit breaker of the above class, in which the spring means of the device in itself performs the dual functions of being an electrical contact as well as the spring means for the device.

A further object of the invention is the provision of a device of any of the above kinds, which is accurately manufacturable and accurately calibratable, thus lessening the cost of manufacture of the device.

Still another object of the invention is the provision of a circuit breaker of any of the above classes in which means are provided for ensuring that there will be no deleterious "hand-ups" of the operating parts during opening.

Other objects and advantages will be in part pointed out hereinafter and in part obvious.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the appended claims.

In the accompanying drawings, in which five of the various possible embodiments of the invention are illustrated:

FIG. **1** is an illustration enlarged of one embodiment of the invention;

FIG. **2** is a plan view, partly in section, showing the interior of the FIG. **1** embodiment;

FIG. **3** is a sectional elevation of the FIG. **1** embodiment taken in the direction of sight lines **3—3** on FIG. **2**;

FIG. **4** is a sectional end view of the FIG. **1** embodiment taken in the direction of sight lines **4—4** on FIG. **3**;

FIG. **5** is a sectional end view of the FIG. **1** embodiment taken in the direction of sight lines **5—5** on FIG. **3**;

FIG. **6** is a plan view, similar to FIG. **2**, but showing the operating parts in a second, contact open, position;

FIG. **7** is a plan view, partly in section, of a second embodiment of the invention;

FIG. **8** is a plan view, partly in section, of a third embodiment of the invention;

FIG. **9** is an end elevation of the FIG. **8** embodiment, taken in the direction of sight lines **9—9** thereon;

FIG. **10** is a sectional end elevation of the FIG. **8** embodiment taken in the direction of sight lines **10—10** thereon;

FIGS. **11** and **12** are respectively a plan view and a side elevation, partly in section, of a fourth embodiment of the invention; and

FIGS. **13** and **14** are two views showing engaged and separated positions of the essential operative members of a fifth embodiment of the invention, the views being schematic.

Similar reference characters indicate corresponding parts throughout the several views of the drawings; and the dimensions of certain of the parts as shown in the drawings may have been modified and/or exaggerated for the purposes of clarity of illustration and understanding of the invention.

In all views shown in the drawings, the size of the embodiments has been greatly enlarged in order to make the drawings clearer.

Referring now to FIG. **1**, there is shown an illustration of one embodiment of the invention, comprising a cylindrical body **2** made of electrically insulating material such as a synthetic molded thermoplastic material, and two end caps **4** and **6** which are suitably fastened to the body **2** by conventional means such as, for example, riveting or cement. The body **2** comprises two halves **8** and **10** (see FIG. **3**), each half being generally of semi-cylindrical shape. The bottom half **8** acts as a support for operative portions of the embodiment, and the top half acts as a means for holding the operative parts in their proper location yet with freedom of motion in their operative directions. Bottom half **8** has thereon upstanding posts **12** and **14** which may be molded integrally with bottom **8**, and which pass through suitably provided holes **16** and **18** in the upper half **10** when the parts **8** and **10** are assembled. These posts are "headed over" after assembly by application of heat in order to fill a chamfer at the upper surface of the half **10** as shown at numeral **20** and thus lock the parts together.

Upper half **10** is made slightly less than half thick (in an upward direction as viewed in FIG. **3**) than the lower half, in order to provide a space between the inner faces of the two halves in which is clamped a thermal element **30** as described below, and to provide also a space **42** in which a spring member **40** can slide as described below. A pair of longitudinal and upwardly extending shoulders **24** are provided on each side of bottom half **8** to form a recess **22** in which the thermal element **30** and spring wire **50** lie. In addition, upper half

10 is provided with a recess 26 into which the end of thermal element 30 may flex upon a temperature rise thereof. Projecting upwardly from the inner face of bottom half 8 is a short post 28 which meets the inner face of upper half 10 in order to act as a support for the end thereof, and also to act as a stop to limit the motion of the spring member outwardly of the casing.

A blade 30 of thermoflexing material lies in recess 22 against the inner face of the bottom member 8, and is provided with a hole 32 which slides over the post 12. The width of blade 30 is such that its outer edges 34 project slightly beyond the diametrical width of the bottom and top members 8 and 10 at the left-hand end (as viewed) of the embodiment. Thereafter, when the conducting cap 4 is inserted over this end of the unit, the cap 4 makes electrical contact with the edges of thermal member 30. The inner end of member 30 is provided with a hook portion 36 which rests against the inner face of recess 22 when member 30 is in its normally cool condition, and which moves away from the surface of portion 8 and to the dotted line position 38 when member 30 is heated by the passage of current therethrough. Recess 26 is thus provided to permit such motion.

A spring member 40 is provided having a generally V-shape and a flat bottom 44. It lies within the recess 42. The spring shown has two arms a portion of which are approximately parallel, and other portions of which diverge away from each other. Other forms of spring units may be used, if desired, the form always being such that of a pair of legs, at least one leg has a portion divergent away from the other leg, and the legs being resilient with respect to each other. The spring 40 and the space 42 are so related that the spring can slide freely in the space but within excessive play. Stop post 28 is sized during molding so as to govern the size of space 42 during assembly of the device, thus insuring at all times that spring 40 can move freely.

Spring 40 is normally formed so that prior to assembly its diverging legs spread outwardly more than the inner diameter of cylindrical cap 6. When the spring is assembled in the housing as shown with end caps 4 and 6 in place and end 44 of the spring being engaged by hook 36, the legs of the spring 40 are forced inwardly toward each other and thus exert an outward force against the exposed edges of the cap 6. (It will be observed that to permit this, the upper half 10 of the body terminates short of the end of the cap 6, and also the longitudinal edge shoulders 24 are tapered slightly as illustrated by numeral 46.)

Spring member 40 has inner leg portions 48 and the outer leg portions 50. While the figure shows the leg portions 48 as approximately parallel during the operative position of the parts, this is not necessary but it will be found that the parallel relationship is conveniently shaped. However, it will be noted that in this embodiment the outer leg portions 50 must diverge from each other in order to make an angle A with the longitudinal axis of the body. (See FIG. 2.)

The device is assembled by automatic assembly and positioning machinery, for example by holding the bottom half 8 in a fixed position, and automatically moving the thermal member 30 down over the post 12 so that the member lies against the inner face of the recess 22. Cap 6 is then put on spring 40 and the spring is then automatically positioned with its end 44 at the inner side of post 28. Top half 10 is placed in position on bottom half 8 so that it bears against the thermal member 30 to hold it in position as explained above, and bears against the upper end of the post 28. The upper ends (as viewed) of the posts 12 and 14 are then heat sealed into their respective chamfers in order to hold parts 8 and 10 together, thus securing the thermal member 30 in its proper position, as well as the spring 40. End caps 4 and 6 are then forced over the ends of the tubular body and fastened in place.

After the device is assembled, the end of the spring are squeezed together sufficiently to permit moving the spring inwardly until the end 44 slides under and becomes engaged by the hook 36 as shown in FIG. 2. Spring legs 50 may then be released, and they will contact the edges of the metallic cap 6 in order to make electrical connection therewith.

It will be noted that in the device, there are only six parts: The halves 8 and 10 which form the tubular housing, the caps 4 and 6, the thermal member 30, and the spring member 50. In view of the simplicity of the parts, their manufacture can be extremely economical. In view of the few number of parts, economy is also obtained. In view of the arrangement of the parts and their simplicity, the whole device can be assembled by automatic assembly machinery.

The operation of the device as a circuit breaker is as follows: Assuming that the device has been placed in a suitable clip-type holder such as those customarily used to hold fuse-type circuit breakers in, for example, automobiles, so that the device is designed to be protected. Current then flows through the device via metallic cap 4, thermal element 30, the legs 48–50 of the spring 40, and to cap 6. When the current of the circuit reaches or exceeds current for which the device has been calibrated, the thermal element 30 heats sufficiently to move upwardly (as viewed) to release spring 40, there is, to the position showed by dotted line 38. Because of the angle A there is an outwardly directed component of force resulting from the outward bias of the spring legs against the edges of cap 6, which force is in a direction parallel to the axis of the device. As a result, the spring moves with a quick motion to the position shown in FIG. 6, at which the flat end 44 of the spring has separated from the thermostat blade 30, and has been stopped from further outward motion by means of the post 28. An electrically insulating gap now exists between the caps 4 and 6 so that the circuit is interrupted. Since no further current exists in the thermal element 30, it cools and resumes the position shown in FIG. 3. After it has done so, the spring end 44 may again be thrust under hook 36 to reset the circuit breaker. Preferably this resetting operation is done after removing the circuit breaker from its clips; and after the device is reset, it is then snapped back into its clips.

It will also be noted that in this device, and in the other embodiments, the spring member itself acts as an electrical contact and also furnishes the motive force for breaking the electrical circuit when the thermal member of the device heats through the passage of excess current therethrough.

Referring now to FIG. 7, a second embodiment of the invention is shown, which utilizes the same principle as the previous one, but which has a different construction. A base 54 of electrical insulating material is provided at one end of which is mounted a thermal element or blade 60 by suitable means such as a screw 56 and a clamping plate 58. The element is provided at

one end thereof with a hook 62 as in the FIGS. 1–6 embodiment. The blade is provided with a tab 64 for the purpose of making electrical connection therewith, set screw 66 being provided to facilitate the connection.

At the other end of the base are provided two metal posts 70 and 72, these being suitably fastened into the base as by riveting. A flat metal terminal strap 74 lies under the base and has a tab 76 extending therebeyond in which is threaded the terminal screw 77. The strap 74 is fastened to the base by the same rivets which fasten posts 70 and 72 thereto, in conventional manner.

Spring member 78 is like spring member 40 and has the flat end 80 which is engaged by the hook 62 when the parts are in their set position. The spring member has the divergent and outwardly biased leg portions 82 and 84, the legs bearing against the posts 70 and 72 as shown, and in electrical connection therewith.

Overlying spring member 78 is a retaining and bridging member 90, whose span 92 is positioned sufficiently above the surface of the base 54 as to permit the spring member to freely slide thereunder but without any excess motion away from the surface of base 54. The bridge member 90 acts to retain the spring and thus serves the function of the space 42 of the first embodiment.

A stop post 94 is provided which prevents the spring from snapping too far outwardly from the base when released.

The operation of this embodiment is the same as the FIG. 1 embodiment. When the thermal element 60 is heated by the passage of current through it, it flexes upwardly to release the end 80 of the spring member. Due to the angular relationship of the legs 82 and 84 to the posts 70, 72, and the bias of the legs thereagainst, there is set up a component of force which will move the entire spring away from the thermal element 60, thus interrupting electrical contact therebetween, and any circuit connected to tabs 64 and 76. Resetting the device is done by thrusting the spring inwardly until the end 80 is caught under the hook 62 of the thermal element 60, the legs being forced toward each other by posts 70, 72.

Again, it will be observed that because of the simplicity of the entire device, the simplicity of its parts and their relation to each other, the device may be automatically assembled and calibrated.

Referring now to FIGS. 8, 9 and 10, a third embodiment of the invention is shown. Referring first to FIG. 8, the body 96 of the circuit breaker comprises an upper half and a lower half as in FIG. 1, but the central portions of the bodies are of different shape, each portion 98 and 100 respectively being rectangular in cross-sectional area. (See FIGS. 9 and 10.) The end portions 102 and 104 respectively of these portions at the left-hand of the device (as viewed) and end portions 106 and 108 respectively at the right-hand (as viewed) are semi-cylindrical in shape.

Insofar as the interior construction of each half is concerned, it is the same as the interior construction of the FIG. 1 embodiment. That is, posts 110 and 112 (corresponding to posts 12 and 14) are provided which serve to clamp the parts together as in the FIG. 1 embodiment, and the interior recess 114 is provided to allow for flexing of the end of the thermal element 116 and its hook 118 the same as in the FIG. 1 embodiment. A space 120 is also provided between the halves of the casing within which the spring member 122 slides as in FIG. 1, the spring being like spring 40.

A stop member 124 is provided like stop post 28 of FIG. 1, to restrain the spring within the casing during operation and use.

A pair of conventional spring clips 126 and 128 are provided and are mounted on a base 130, the clips being aligned and sized to receive snugly the end portions of the circuit breaker.

The differences between the FIG. 1 embodiment and this embodiment are two: In the first place, the portion 96 of the body is rectangular in order to assure that when the circuit breaker is placed in the spring clips, it will be held therein in such orientation that the planes of the thermal element and the spring will lie across the wings of their respective clips as shown. The other difference is that the body is not provided with any end caps. Instead, the edges 132 of the outer end of the thermal element are dimensioned to project outside of the circular periphery of the left-hand end portion (as shown in FIGS. 8 and 9), so that when the circuit breaker is inserted in the clips, these edges come in direct electrical contact with the wings of the clip. Since there is no end cap to restrain the spring legs at the other end of the circuit breaker, the spring legs will contact the wings of clip 128 directly because of the resilient outward bias of the spring.

Thus, it will be observed that in the third embodiment, there are only four parts so far as the circuit breaker per se is concerned, that is, the upper and lower halves of the body, the thermal member itself, and the spring which serves the dual function of being both an electrical contact within the circuit breaker and also the driving force which causes the internal electric circuit of the circuit breaker to be broken when the thermal element is heated to the proper amount by the passage of current therethrough. The operation of this embodiment is the same as in the FIG. 1 embodiment, the end of the spring 122 separating from the hook on the inner end of the thermal element 116 in order to establish an electrical gap, the sole motive means for this being the outwardly extending bias of the springs against the wings of clip 128 which results in a component of force directed toward the right in the FIG. 8 view.

Since clip boards of standard dimensions are already available, particularly for automobiles in use as well as being manufactured, the present device provides an extremely simple, economical, and resettable circuit breaker which can be substituted readily for the fusible type circuit breakers now in common use. It will be noted that since the spring clip boards are well known, one of the boards has been shown only by dotted lines in schematic manner.

In reset the device the circuit breaker is pulled from its clip, and the spring is pushed into the casing until the inner end thereof engages the hook of the thermal member. It will be observed that at this stage, the legs of spring member 122 extend further outwardly than the wings of the clip 128. Therefore, in order to insert the device in the clips, the legs of the spring member are manually squeezed toward each other to the point that they will slide between the wings 128. The device is then snapped into the clips 126 and 128 and the legs released. At this point, it will be observed that because of the rectangular shape of the central portion of the body, the body will be insertable in the spring clips only with the legs of spring member 112 in the position shown in FIGS. 9 and 10, or vertical thereto. Obvi-

ously, the user will not insert the device into clips in any position other than that shown in FIGS. 9 and 10, unless it is desired to store the circuit breaker temporarily in its respective clip without any circuit connection being made, in which case the breaker may be snapped into the clips with the plane of the spring vertical to the clip board.

Referring now to FIGS. 11 and 12, a fourth embodiment of the invention is shown. It differs from the previous embodiments in the type of thermally actuable release, but is the same as to the spring motive force. A lower body part or base 136 is provided having mounting posts 138, like base 8, and an upper body part 140. The latter has holes fitting down over posts 138 to clamp the parts together just as in the FIG. 1 embodiment. A stop post 142 is provided as in the first embodiment; and a resilient blade 144 of a material having an electrical resistance such that it will become heated by the passage of current therethrough, is clamped between the upper and lower parts at one of its ends. Blade 144 has a hook 146 at its other end. The material used for blade 144 may be one of many resilient materials, but the material chosen must be one which when made in the size required, will heat to a predetermined temperature by the passage of a given current through it. (This will be further explained below.) A spring 148 like spring 48 is provided, and is positioned and used in this embodiment just as in the FIG. 1 embodiment. The unit has the metal caps 150, 152 which serve as electrical connections between the fuse-clips and the blade 144 on the one hand and the spring 148 on the other when the device is inserted in the clips.

In this embodiment, the blade 144 is biased so as to lie against the inner surface of the bottom part 136. However, its stiffness and bias are not so great as to be able to withstand the force urging the spring 148 outwardly, that is, it is not strong enough when considered as a resilient beam anchored at the point B, to prevent the end 154 of the spring from escaping from the hook 146.

To prevent this, means are provided effectively to shorten the moment arm of the blade, this means constituting a lump of material 156 which softens when heated, such sealing wax, tar etc. which is despoited over the blade at a point between the point B and hook 146, and which sticks to the surface of part 136. The wax, in effect, constitutes, while it is cold, an anchor point C for the resilient beam so that the latter is shortened. As a result, the blade is now "strong" enough to retain the end 154.

In operation, however, and assuming that the circuit breaker is in an electrical circuit to be protected, when excessive current flows through blade 144 the latter heats and softens or melts material 156. Anchor point C is temporarily made ineffective, and the anchor point shifts to point B which restores the effective full length of the beam. The latter cannot now prevent the escape of end 154 from hook 146, and the circuit breaker opens its contacts. As soon as the circuit is broken, current ceases to flow, and also the blade instantly reverts to its position shown in FIG. 12 (that is, agains the surface of body part 136). It can do so, because the wax will not have cooled enough to prevent this. Thereafter, when the wax shall have cooled to original temperature, the device may be reset by thrusting the spring inwardly of the casing to reengage hook 146 and end 154.

Suitable materials for the blade 144 may be chosen from thin spring steels, or from high resistance materials such as 72Fe, 23Cr, and 5Al; or 78.5Ni, 20Cr, 1.5Si. Many other metals having suitable resistances are well known and will suggest themselves to the person skilled in the art. The number of combinations of dimensions of the blade and material chosen for a given rating of circuit breaker is very large and impossible to list herein.

Referring now to FIGS. 13 and 14, a fifth embodiment of the invention is shown, the view being schematic since the other structural parts can be supplied by a person skilled in the art in view of the teachings of the previous embodiments.

A blade 160 is shown like any of the blades of the previous embodiments. A casing is provided such as in FIG. 1 for mounting the blade. At the other end of the housing is provided a resilient wire spring 162 which comprises a pair of crossed legs joined by inner end 166. The inner portions 168 of the legs converge toward each other in a given direction, and the outer portions 170 diverge away from each other in the same direction.

A metal post 172 is fixed in the base and the spring member is placed over the post so that the latter lies within the loop formed by the end 168 and the converging leg portions 168.

The spring member when in the circuit open position as shown in FIG. 14, is in a "relaxed" position with the divergence of portions 170 at a maximum. However, in the FIG. 13 position, the spring has been thrust in the circuit breaker housing sufficiently to bring hook 174 at the end of blade 160 (like hook 62 of FIG. 1) into catching engagement with end 166. This inward motion is opposed by the post 172 which tries to thrust the leg portion 168 apart to their original angle shown in FIG. 14. This produces a resultant force on the spring directed away from hook 174, so that when the blade 160 lifts (be it caused or permitted to do so as in any of the previous embodiments), the spring member moves from the FIG. 13 position to the FIG. 14 open contact position.

As in the previous embodiments, electrical circuit connections are made to the blade 160 and to the spring member 168–170; the latter being via post 172.

In all of the above embodiments, it will be noted that when the dimensions of the operative elements, (that is, the respective blades, spring members, internal diameter of caps 6, separation of posts 70, size of post 172, and divergence or convergence of the spring arms) for a given circuit breaker rating have been manufactured to meet commercial tolerance, very little or no adjustment as to operation need be made. This cuts the cost of manufacture considerably.

In view of the above it will be seen that the several objects of the invention are achieved and other advantageous results attained.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings, shall be interpreted as illustrative and not in a limiting sense, and it is also intended that the appended claims shall cover all such equivalent variations as come within the true spirit and scope of the invention.

Having described the invention, what is claimed is:

1. A circuit breaker comprising:

a base;

spring biasing means on the base;

a spring member having a pair of legs at least one of the legs having a portion thereof divergent from the other leg and at least said portion of the one leg being forced toward the other leg by said spring biasing biasing means when the spring member is in a first position on the base, the resilience of at least the one leg providing a component of force urging the spring member toward a second position on the base; and

heat-actuable means attached to the base and holding the spring member in the first position when at normal temperature, at least a portion of said means when heated moving to another position and releasing the spring means whereby the latter is moved by the component of force to the second position.

2. The circuit breaker of claim 1 in which the heat-actuable means and the spring member each constitutes one of a pair of contact members establishing an electrical circuit therebetween when the spring member is in the first position, and breaking the electrical circuit when the spring means is in the second position.

3. The circuit breaker of claim 1 in which the heat-actuable means is an elongated length of spring metal capable of being heated by the passage of current therethrough and attached to the base by one end; the length extending along the base; a surface lying along the length and reactive with the detent to engage the spring member; the circuit breaker including a quantity of material overlying a portion of said length at a point between said one end and the detent and anchoring the length of said surface at a point thereon; said material being capable of at least softening, when heated, to release said length from the surface at said point; the detent being adapted to hold the spring member in the first position when said length is anchored to the surface at said point, but not when the length is released from being so anchored; whereby when the material softens, the detent moves in a direction away from the surface and releases the spring member.

4. The circuit breaker of claim 1 in which the legs of the spring member are attached at inner ends thereof to a cross-member adapted to be retained by the detent, and cross each other at a point between the ends of each leg; and including an abutment extending between said legs between the point of crossing and the cross-member, whereby when the spring member is moved inwardly toward the first position, the portions of the legs outwardly of the cross point move toward each other.

5. The circuit breaker of claim 1 in which the spring member comprises a unit of spring wire having divergent legs, the legs of the unit being closer to each other when the unit is in the first position than when in the second position; and exerting a resilient force away from each other at least when in the first position; outwardly directed force of the legs having a force component urging the unit from the first position to the second position, and the heat-actuable means includes a detent portion engaging the unit to retain the latter in the first position when the heat-actuable means is at its normal temperature.

6. The circuit breaker of claim 5 in which each of the heat-actuable means and the spring wire unit constitutes a contact member to establish an electrical circuit therebetween when the unit is in the first position, and to break the electrical circuit when the unit is in its second position, the circuit breaker including terminals in electrical contact with the heat-actuable means and with the spring wire unit at least when the latter is in engagement with the heat-actuable means.

7. The circuit breaker of claim 6 in which said spring biasing means comprises at least one abutment on the base, the said portion of the one leg bearing against the abutment when in the first position, and the abutment comprising the electrical terminal for the spring.

8. The circuit breaker of claim 6 in which the heat-actuable means comprises a blade of thermoflexive material, the detent being at the inner end of the blade.

9. The circuit breaker of claim 6 in which the heat-actuable means comprises an elongated length of spring metal capable of being heated on the passage of current therethrough, the length being attached by one end to the base and extending therealong, and having said detent at its inner end; a surface lying adjacent the length and reactive with the detent to engage said spring member; and a quantity of material overlying a small portion of said length at a point between its one end and the detent and anchoring the length to the surface at said point; said material being capable of at least softening, when heated, to release said length from the surface at said anchor point; the detent being adapted to hold the spring member in the first position when said length is anchored to the surface at said point, but not when the length is released from being so anchored; whereby when the material softens, the detent moves in a direction away from the surface and releases the spring member.

10. The circuit breaker of claim 1 in which said base comprises a hollow body of electrical insulating material; the breaker including a first metal sleeve at one end of the body; the heat-actuable means comprises a strip of thermostat metal lying inside the body and having a detent at one end positioned in opposition to a surface within the body so as to engage the inner end of the spring member when the latter is in the first position, the other end of the strip being in electrical engagement with the first metal sleeve; a second metal sleeve at the other end of the body; the spring member lying within the body with portions of said legs extending outwardly therefrom and through the second sleeve, the legs bearing against the edges of the second sleeve when the spring member is in its first position; and said second sleeves constituting electrically conducting terminals for conducting electrical current to the thermostatic strip and to the spring wire member.

11. The circuit breaker of claim 10 in which the spring member comprises a unit of spring wire having divergent legs, the legs of the unit being forcibly held closer to each other by the second sleeve when the unit is in the first position than when in the second position; the legs exerting a resilient force directed away from

each other and against the second sleeve at least when in the first position, the resilient force of the legs providing a component of force urging the spring member from the first position to the second position.

12. The circuit breaker of claim **11** in which each of the thermostatic means and the spring wire unit constitutes a contact member to establish an electrical circuit therebetween when the unit is in the first position, and to break the electrical circuit when the unit is in its second position.

13. A circuit breaker comprising:

an elongated housing having a bottom part and a cap overlying the bottom part;

heat-actuable means having outer and inner end portions, the outer end portion having edges and being secured between the bottom part and the cap at one end thereof with said edges projecting beyond the periphery of the combined cap and bottom part;

the inner end portion of the heat-actuable means having a detent and lying between the bottom part and the cap and being free to flex away from the bottom part when actuated by heat;

a spring wire member having divergent leg portions, the spring member being retained between the bottom part and the cap at the other end of the housing and being longitudinally slidable therebetween;

the spring member being adapted to occupy first and second positions in the housing, and being adapted to be engaged by the detent so as to be held in the first position;

and the inner end of the blade and the spring each constituting one of a pair of contacts within the housing engageable and separable respectively to make and break an electrical connection therewithin.

14. A combined circuit breaker and holder therefor, comprising:

a base;

first and second spring clips one at each end of the base, the clips each comprising a pair of upstanding opposed semi-cylindrical wings joined at their bottom, the wings being spaced apart a predetermined distance at the mid-points of the wings;

a circuit breaker held in said clips and having an elongated housing having a bottom part and a cap overlying the bottom part, the ends of the housing being shaped to be resiliently held in said spring clips;

heat-actuable means having outer and inner end portions, the outer end portion being secured between the bottom part and the cap at one end thereof with the edges of the outer end portion projecting beyond the periphery of the combined cap and bottom part, said edges making electrical contact with the wings of the first clip when the one end is inserted therein;

the inner end portion of the heat-actuable means having a detent and lying between the bottom part and the cap and being free to flex away from the bottom part when actuated by heat;

a spring wire member having divergent leg portions, the spring member being slidably retained between the bottom part and the cap at the other end of the housing and being adapted to occupy first and second positions in the housing; the spring member being adapted to be engaged by the detent and held in the first position against movement into the second position;

said divergent legs being constrained toward one another by the wings of the second clip when the spring member is in its first position, the legs making electrical contact with said wings and the reaction between said wings and legs providing a component of force urging the spring member toward its second position;

and the inner end of the blade and the spring each constituting one of a pair of contacts within the housing engageable and separable respectively to make and break an electrical connection therewithin.

15. The combined circuit breaker and holder therefor of claim **14** in which the heat-actuable means is a blade of thermoflexing metal.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,778,739 Dated December 11,1973

Inventor(s) Lyndon W. Burch

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 51, should read:"deleterious "hang-ups" of the operating parts during"

Column 3, line 35, should read:"freely in the space but without excessive play. Stop post"

Column 4, line 36,should read:"move upwardly (as viewed) to release spring 40, that"

Column 6, line 53, should read:"To reset the device the circuit breaker is pulled from"; line 66, should read: "with the legs of spring member 122 in the position"

Column 9, line 17, should read:"asing means when the spring member is in"

Column 10, line 59, should read: "and said first and second sleeves constituting electrically con-"

Signed and sealed this 21st day of May 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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