

May 17, 1966

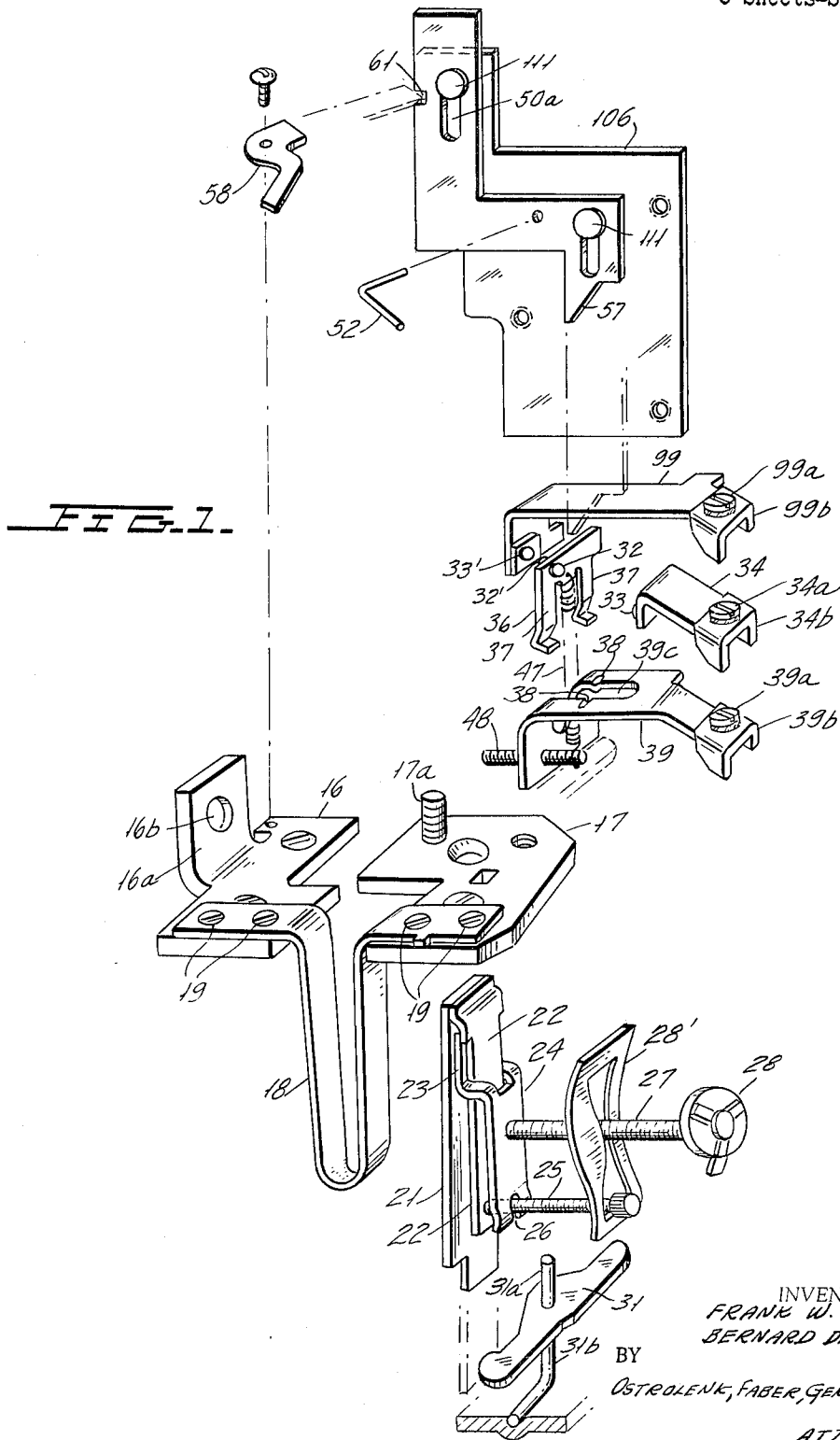
F. W. KUSSY ETAL

3,251,966

SHOCK-PROOF OVERLOAD RELAY WITH REVERSING LINK

Filed Aug. 29, 1963

5 Sheets-Sheet 1



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SHOCK-PROOF OVERLOAD RELAY WITH REVERSING LINK

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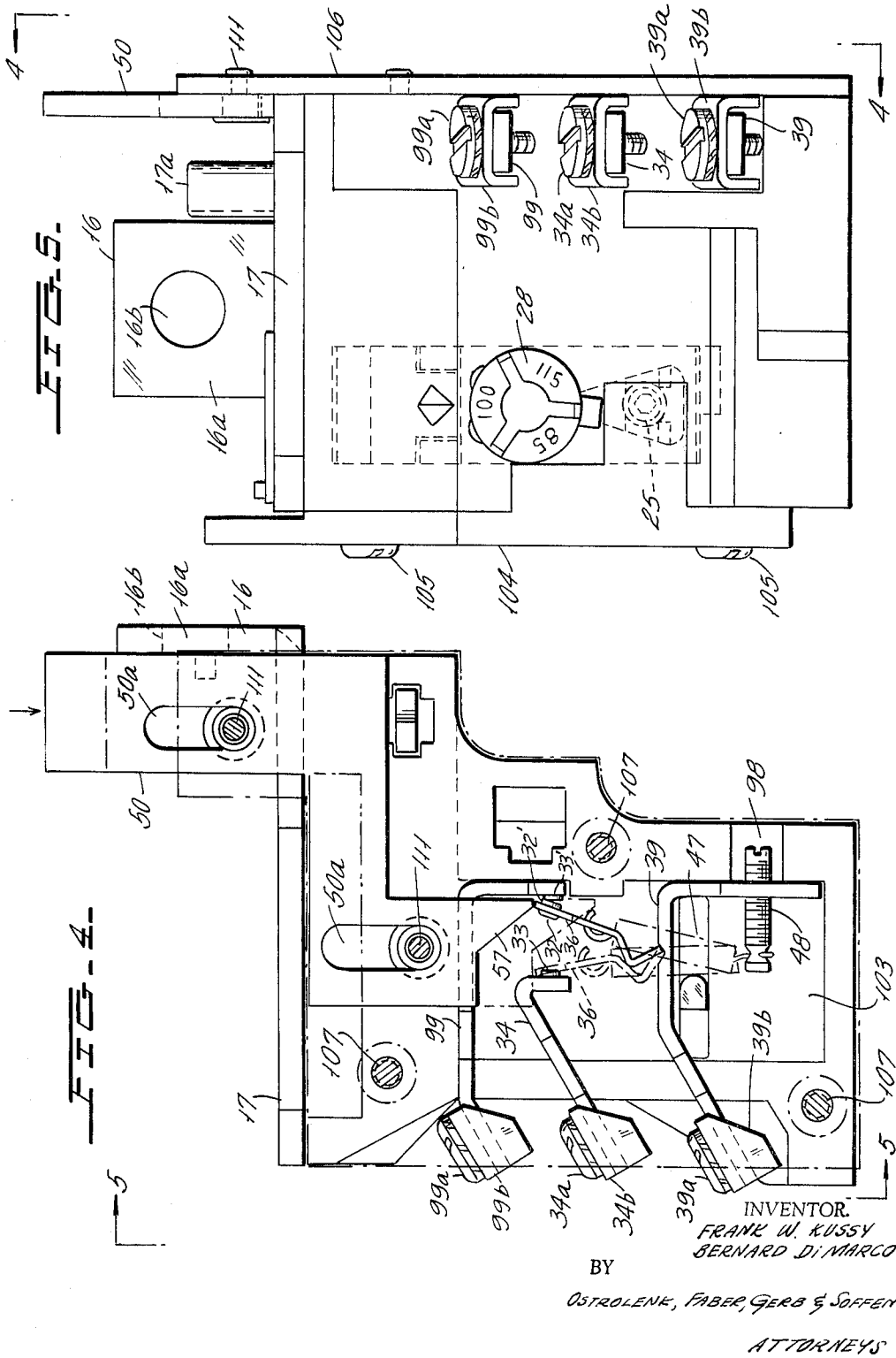
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FIG. 7.

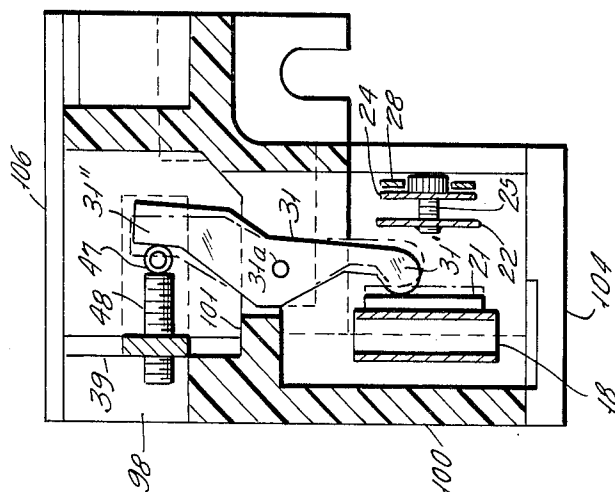
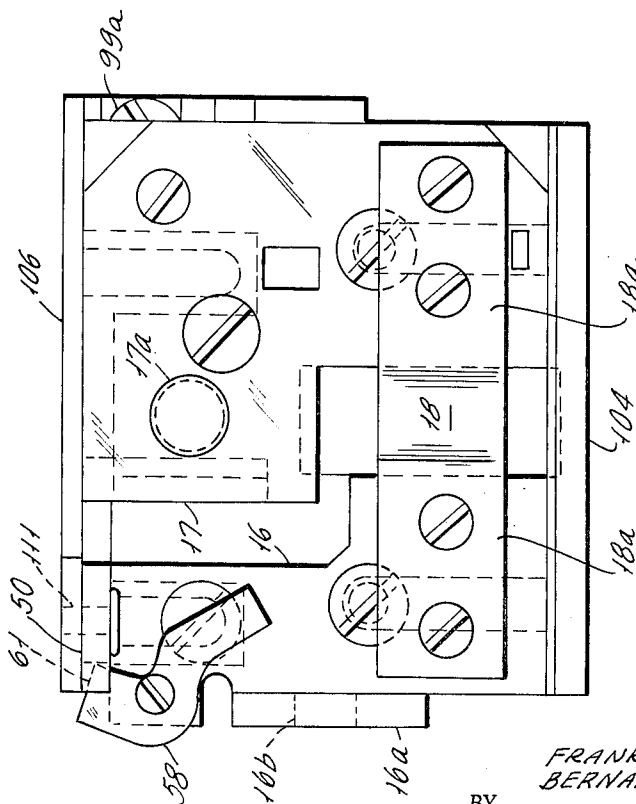


FIG. 6.



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FIG. 6.

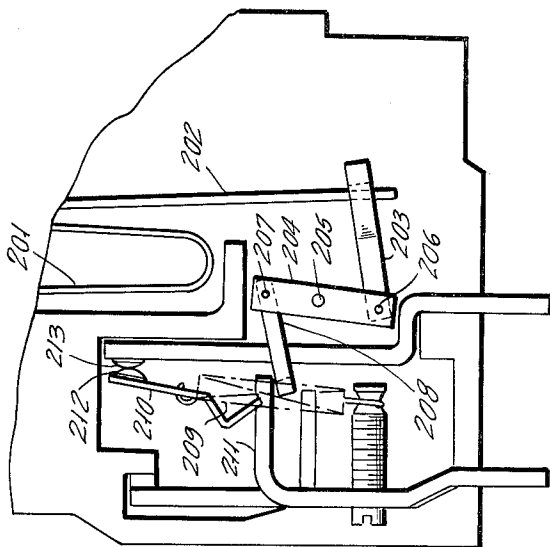


FIG. 7.

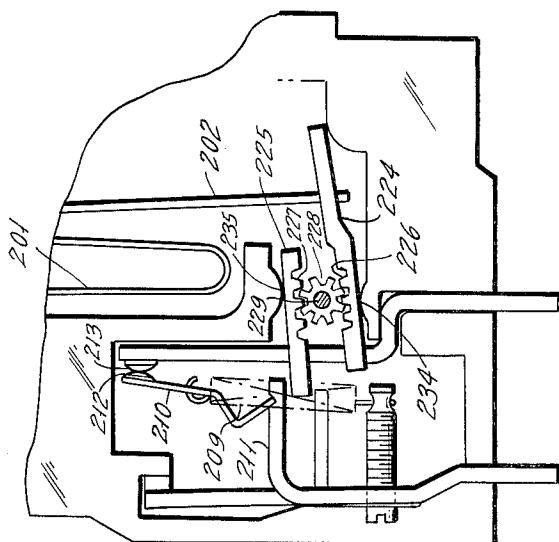


FIG. 7B.

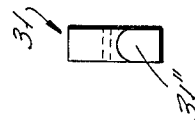
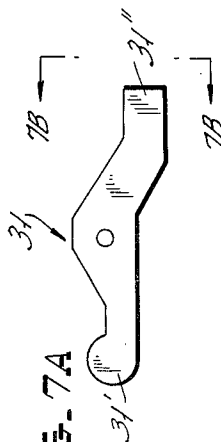


FIG. 7A

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SHOCK-PROOF OVERLOAD RELAY WITH REVERSING LINK

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7 Claims. (Cl. 200—113)

The instant invention relates to overload protective devices in general, and more particularly to a novel construction for an overload relay which permits more efficient space utilization for higher rated units and inherently possesses shock proof features.

In the Thomas et al. copending application Serial No. 225,044, filed September 20, 1962, entitled, Overload Relay for Motor Starter, and assigned to the assignee of the instant invention, there is disclosed an overload relay in which the housing is divided into a front and a rear compartment with the bimetal tripping element moving from rear to front as it is heated. The front compartment contains the bimetal and other fault detecting elements while the rear compartment contains the current carrying control elements. This type of construction has proven satisfactory for relatively low current application. However, the relatively large size elements required for high current applications bring about poor space utilization and presents certain difficulties when the construction set forth in the aforesaid copending application Serial No. 225,044 is utilized.

That is, overload relays of the type under consideration are utilized in conjunction with multiphase contactors for the control of motor circuits and are for the most part mounted directly to the load terminals of the contactor. as contactor ratings are increased the width of the contactors increases so that greater spacing must be provided between pole centers of the contactors. This also provides a greater side to side dimension in which to place the overload relays. In order to take advantage of this additional space the instant invention provides a construction wherein the bimetal and other overload sensing elements are positioned in a compartment to the side of the compartment housing control circuit current carrying elements. With such a construction, even at high current ratings the front to back dimension of the overload relay is substantially the same as the front to back dimension required for overload relays in which the overload sensing elements are located in a compartment in front of the control circuit current carrying elements.

Further, for high current applications the current carrying and overload sensing elements are of larger size. Thus, under shock conditions greater inertia forces are produced. In order to prevent these inertia forces from accidentally tripping the relay the instant invention provides a means for reversing the movement of the tripping bimetal. That is, as the bimetal is deflected in a first direction due to heating thereof the forces exerted by the bimetal on the contact arm will move the contact arm in the direction opposite to the direction of movement of the bimetal.

For the embodiment of the instant invention which utilizes side to side compartments, this is accomplished by providing a pivoted member for transmitting bimetal deflection motion to operate the contact arm. This member is pivoted at its center so that under shock conditions it is effectively a neutralized member. This invention also provides embodiments having means for reversing the action of the bimetal for constructions in which the overload sensing elements are positioned forward of the control circuit elements. One of the latter embodiments utilizes a rack and pinion arrangement for reversing motion

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while the other embodiment utilizes a pivoted member mounted to a pivot pin extending perpendicular to the plane of motion of the bimetal.

Accordingly a primary object of this invention is to provide a novel construction for an overload relay.

Another object is to provide an overload relay construction which provides efficient space utilization.

Still another object is to provide a novel overload relay having improved shock proof characteristics.

A further object is to provide a novel overload relay in which the overload sensing and tripping elements are disclosed in a compartment to the side of a compartment using the control circuit current carrying elements.

A still further object is to provide an overload relay construction including means for reversing motion of the tripping bimetal.

These as well as further objects of this invention shall become readily apparent after reading the following description of the accompanying drawings in which.

FIGURE 1 is an exploded perspective of the operating elements of an overload relay constructed in accordance with the teachings of the instant invention.

FIGURE 2 is a side elevation of the overload relay looking in the direction of arrows 2—2 of FIGURE 3 with the near side cover removed to reveal the internal elements.

FIGURE 3 is a cross section of the overload relay taken through line 3—3 of FIGURE 2 looking in the direction of arrows 3—3.

FIGURE 4 is a side view of the overload relay looking in the direction of arrows 4—4 of FIGURE 5 with the near side cover indicated in phantom.

FIGURE 5 is a front elevation of the overload relay looking in the direction of arrows 5—5 of FIGURE 4.

FIGURE 6 is a plan view of the overload relay.

FIGURE 7 is a cross-section taken through line 7—7 of FIGURE 3 looking in the direction of arrows 7—7.

FIGURE 7A is a plan view of the pivoted lever for transmitting bimetal motion.

FIGURE 7B is an end view of the lever of FIGURE 7 looking in the direction of arrow 7b—7b.

FIGURE 8 is a fragmentary view of an overload relay illustrating another embodiment of this invention.

FIGURE 9 is a fragmentary view of an overload relay illustrating still another embodiment of the instant invention.

Now referring to the figures and more particularly to FIGURES 1 through 7B. Overload relay 10 consists of a molded housing 100 divided by vertical partition 101 into side by side compartments 102 and 103. Side cover 104, secured in place by screws 105, closes off the open side of compartment 102 while side cover 106, secured in place by screws 107, closes off the open side of compartment 103. In a manner well known to the art, housing 100, including covers 104 and 106, is provided with internal depressions and protrusions which engage the electrical and active mechanical elements of overload relay 10 to operatively position these elements.

With respect to FIGURE 2, there is a top opening 14 in housing 100 which forms an entrance into compartment 102. Disposed externally of housing 100 and secured to the top thereof, are spaced apart main circuit terminals 16 and 17 with the former having an up-turned leg 16a having an aperture 16b, intended to receive a bolt (not shown) for mechanically and electrically securing overload relay 10 to a load terminal of a multiphase contactor. A generally U-shaped resistance heater element 18 is disposed within compartment 102 and includes outturned legs 18a at the free ends of the U-arms. Legs 18a are provided with clearance apertures which receive screws 19 which secure heater 18 to terminals 16, 17. Screw 17a, extending upwardly from terminal 17, is

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intended to mount a wire grip (not shown) for connecting a load cable to terminal 17.

Disposed within compartment 102 and extending generally parallel to one of the legs of heater 18 is bimetal element 21. The upper end of element 21 is fixedly secured, as by welding, to the upper end of main support member 22. Main support member 22 extends between the arms 23 at the bifurcated upper end of auxiliary support 24 and is secured to support 24 near the free ends of arms 23. The lower ends of supports 22 and 24 are spaced apart. Factory calibration screw 25 extends through slot 26 in auxiliary support 24 and is received in a threaded aperture of main support member 22. It is noted that arms 23 have two bends therein and that the cross-sectional areas of both arms 23 are less than the cross-sectional area of main support 22. Thus, upon adjustment of screw 25 the movement of main support member 22 relative to auxiliary support member 24 is accomplished by bending auxiliary support member 24.

At a point intermediate its ends auxiliary support member 24 is provided with a threaded aperture which receives field adjusting screw 27 whose enlarged head 28 is disposed externally of housing 100 at the front thereof. Bowled leaf spring 28' is disposed within compartment 102 with the ends thereof bearing against housing 100 and the center thereof bearing against auxiliary support member 24 at a point thereof near its lower end. The action of springs 28' urges main support member 22 to seat itself against bearing surface 29 internal of housing 100. Surface 29 forms a fixed point of reference about which bimetal 21 moves upon deflection thereof. Bimetal 21 is so constructed that the lower end thereof is free to deflect to the right with respect to FIGURE 2 when bimetal 21 is heated.

Bimetal 21, upon deflection thereof, acts through lever 31 to separate movable contact 32 from stationary contact 33 in a manner to be hereinafter explained. Stationary contact 33 is mounted to one end of terminal strap 34 whose other end extends externally of compartment 103. At the front of housing 100, screw 34a mounts wire grip 34b to the end of terminal strap 34 remote from stationary contact 33. Movable contact 32 is mounted to the upper end of contact arm 36. The lower end of contact arm 36 is provided with bifurcated sections 37 whose free ends are entered into depressions 38 in the horizontally extending sections of terminal strap 39. Depressions 38 constitute pivot points for movable contact arm 36. One end of terminal strap 39 extends externally of housing 100 at the front thereof at a location below wire grip 34b. Screw 39a mounts wire grip 39b to the end of terminal strap 39 positioned externally of housing 100. Adjusting screw 48 extends through the vertical section at the other end of terminal strap 39. The portion of screw 48 to the rear of strap 39 is provided with a slot to receive a screwdriver entered through aperture 98 in the rear of housing 100. The lower end of contact aperture spring 47 is secured to the forward end of adjusting screw 48.

Spring 47 extends upwardly through the longitudinal slot 39c in strap 39 and between arms 37 of contact arm 36 with the upper end of spring 47 being anchored to contact arm 36. The position of screw 48 determines the position for the lower end of spring 47 thereby determining the point at which contacts 32, 33 will part as spring 47 is moved to the right by lever 31 upon heating of bimetal 21. Lever 31 is pivotally mounted near the center thereof to the vertically extending leg 31a of L-shaped pin 31b which is maintained in operative position by suitably formed internal formations of housing 100.

Screws 111, extending through vertical slots 50a of reset slide 50, are secured to cover 106 to provide vertical guidance for movement of slide 50 relative to cover 106. The upper leg of U-shaped spring 52 extends into

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aperture 50b of slide 50 while the lower leg of spring 52 bears against an internal formation of housing 100 so as to bias slide 50 upwardly. In this upward position inclined reset surface 57 at the lower end of slide 50 is so positioned that when lever 31 moves spring 47 sufficiently to the right of notches 38, with respect to FIGURE 4, movable contact 32 separates from stationary contact 33 by sufficient distance so that upon cooling of bimetal 21 contact 32, 33 will not automatically close.

With contacts 32, 33 separated, after reset slide 50 is moved downward with respect to FIGURE 4, surface 57 engages the upper end of contact arm 36 driving movable contact arm 36 over center, to the left with respect to FIGURE 4, so that spring 47 is effective to move contact 32 into engagement with contact 33.

For automatic resetting, slide 50 is moved inward to a position where notch 61 thereof is in line with locking member 58. Thereafter, member 58 is pivoted in a clockwise direction with respect to FIGURE 6 to the position shown in FIGURE 6 wherein locking member 58 is disposed within notch 61. This maintains reset slide 50 in its lower position. With slide 58 so positioned, surface 57 thereof limits movement of contact arm 36 to an overcenter position to the right of notches 38 with respect to FIGURE 4. Under these circumstances, upon cooling of bimetal 21 spring 47 will automatically operate contact 32 into engagement with contact 33.

Under normal operating conditions, as bimetal 21 heats the free end thereof deflects to the right, with respect to FIGURE 7 away from heater 18 and in so doing engages end 31' of lever 31 to pivot lever 31 counter clockwise about pivot 31a. Thus, the other end 31'' of lever 31 moves to the left with respect to FIGURE 7 into engagement with operating spring 47. This forces spring 47 to the left with respect to FIGURE 7 and to the right with respect to FIGURE 4 thereby separating movable contact 32 from stationary contact 33. Upon cooling of bimetal 21 the free end thereof moves back toward the heater 18 so that operating spring 47 is free to operate contact 32 into engagement with contact 33.

It is noted that when contact arm 36 is in the full open position of FIGURE 4, back contact 32 carried thereby engages signal circuit contact 33' mounted at one end of generally L-shaped terminal strap 99. Screw 99a mounts wire grip 99b to the other end of strap 99 with this end projecting externally of housing 100 at the front thereof and being positioned above wire grip 34b.

Thus, by referring to FIGURE 4 it is seen that with contact arm 36 to the left there is a complete current path from terminal strap 39, through contact arm 36, movable contact 32 and stationary contact 33 to terminal strap 34. With arm 36 to the right the current path is from terminal strap 39, through contact arm 36, movable contact 32' and stationary contact 33' to terminal strap 34.

With contacts 32, 33 in engagement, a shock force directed from back to front of housing 100 has substantially no effect upon lever 31 since its mounting at pivot 31a establishes lever 31 as a balanced or neutralized member. Thus, under these shock conditions there is practically no tendency for lever 31 to rotate because of its manner of mounting. A shock directed from back to front also tends to drive contacts 32, 33 toward closed position.

A shock blow directed from front to back does not tend to rotate lever 31 since, as previously explained, lever 31 is a neutralized member. Under these conditions operating spring 47 is required to exert a force only slightly greater than the shock force acting directly upon the extremely light weight movable contact arm 37. Thus, it is seen that overload relay 10 inherently possesses shock proof characteristics.

The embodiment of this invention illustrated in FIGURE 8 is a modification of the overload relay illustrated in the aforesaid copending application, Serial No. 225,044. In the embodiment of FIGURE 8, as heater 201 heats

bimetal 202 the lower end of bimetal 202 deflects to the right with respect to FIGURE 8. This carries link 203, connected at one of its ends to bimetal 202, to the right with respect to FIGURE 8. Lever 204, mounted at its mid-point to pivot 205, is connected by pin 206 at one end thereof to the end of link 203 remote from bimetal 202. The other end of member 204 is connected at pin 207 to one end of link 208 being operatively connected to operating spring 209. Thus, as link 203 is moved to the right with respect to FIGURE 8 lever 204 is pivoted counterclockwise moving link 208 to the left, thereby moving the central portion of operating spring 209 to the left. This causes contact arm 210, pivotally mounted to terminal strap 211, to be pivoted counterclockwise about the lower end of arm 210 which bears against strap 211 bringing about separation of movable contact 212 from stationary contact 213.

The structure illustrated in FIGURE 8 has the advantage that when a shock blow acts in the direction of arrow A such a blow acts directly upon contact arm 210 so as to close contacts 212, 213. Even though such a shock blow tends to move bimetal 202 in tripping direction the fact that the shock also tends to close contacts 212, 213 enables a relatively weak operating spring 209 to maintain contacts 212, 213 closed. Further, a shock blow directed opposite to arrow A will not cause contacts 212, 213 to separate since contact arm 210 is relatively light in weight and under these conditions bimetal 202 will be deflected toward heater 201, or in a direction opposite to the tripping direction.

The embodiment shown in FIGURE 9 provides another means for reversing the action of bimetal 202. This means comprises links 224 and 225 provided with racks 226 and 227, respectively. Both of the racks 226, 227 are in center to pin 229. The end of link 224 remote from rack 226 is in operative engagement with the free end of bimetal 202 while the end of link 225 remote from rack 227 is in operative engagement with operating spring 209. Housing formations 234 and 235, in cooperation with pinion 228, guide links 224 and 225, respectively, for substantially linear motion.

As heater 201 heats bimetal 202 the lower end thereof deflects to the right with respect to FIGURE 9 carrying link 224 to the right. This causes a counterclockwise rotation of pinion 228 so that link 225 is driven to the left with respect to FIGURE 9. The center portion of operating spring 209 is likewise driven to the left with the respect to FIGURE 9 causing contact arm 210 to rotate counterclockwise about its lower end thereby separating movable contact 212 from stationary contact 213.

While reset slide 50 has been shown mounted to cover 106, for some applications it may be preferable to mount slide 50 directly to the main molding constituting housing 100.

Thus, it is seen that for each of the embodiments of this invention means are provided for reversing the action of the bimetal. Because of this the direction of contact motion upon opening is opposite to the direction of bimetal movement as the bimetal is heating. In the main embodiment of this invention, illustrated in FIGURES 1 through 7B, the reversal of bimetal action is inherent in the structure and in addition the side by side compartment arrangement achieves more efficient space utilization for higher rated units.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

We claim:

1. In a circuit protective device of the class described a housing having a first compartment and a second compartment; current carrying elements including a pair

of separable contacts mounted in said first compartment, said elements also including a movable arm carrying a first of said contacts; an overcenter toggle means including said arm; fault detecting means including a current responsive bimetal disposed within said second compartment; said bimetal mounted for deflection in a first direction upon heating thereof; said arm mounted so that said first contact moves opposite to said first direction when said pair of contacts are being separated; means operatively connecting said bimetal and said toggle means for reversing motion of said bimetal to bring about separation of said pair of contacts after a predetermined deflection of said bimetal; said means connecting said bimetal and said toggle means being a single member comprising a pivotally mounted lever having one end engageable by said bimetal upon deflection thereof and having another end engageable with said toggle means to drive same over center in a direction to bring about separation of said pair of contacts.

2. A device as set forth in claim 1 in which said compartments are positioned side by side.

3. A device as set forth in claim 1 in which the lever is pivoted at a point which renders the lever essentially neutral under shock conditions.

4. A device as set forth in claim 1 in which said toggle means includes a tension spring secured at one end thereof to a point which is fixed during movement of said arm and secured at the other end thereof to said arm; said another end of said lever engageable with said spring at a point intermediate the ends thereof to drive said toggle means over center in said direction to bring about separation of said pair of contacts.

5. In a circuit protective device of the class described a housing having a first compartment and a second compartment; current carrying elements including a pair of separable contacts mounted in said first compartment, said elements also including a movable arm carrying a first of said contacts; an overcenter toggle means including said arm; fault detecting means including a current responsive bimetal disposed within said second compartment; said bimetal mounted for deflection in a first direction upon heating thereof; said arm mounted so that said first contact moves opposite to said first direction when said pair of contacts are being separated; means operatively connecting said bimetal and said toggle means for reversing motion of said bimetal to bring about separation of said pair of contacts after a predetermined deflection of said bimetal; said toggle means including a tension spring secured at one end thereof to a point which is fixed during movement of said arm and secured at the other end thereof to said arm; said means connecting said bimetal and said toggle means having one end thereof engageable by said bimetal upon deflection and having another end engageable with said spring at a point intermediate the ends thereof to drive said toggle means over center in a direction to bring about separation of said contacts.

6. In a circuit protective device of the class described a housing having a first compartment and a second compartment; current carrying elements including a pair of separable contacts mounted in said first compartment, said elements also including a movable arm carrying a first of said contacts; fault detecting means including a current responsive bimetal disposed within said second compartment; said bimetal mounted for deflection in a first direction upon heating thereof; said arm mounted so that said first contact moves opposite to said first direction when said pair of contacts are being separated; means operatively connecting said bimetal and said arm for reversing motion of said bimetal to bring about separation of said pair of contacts after a predetermined deflection of said bimetal; said means operatively connecting the bimetal and the toggle means including a pinion on a stationary pivot, a first member and a sec-

ond member; each of said members carrying a rack whose teeth are in engagement with said pinion on opposite sides thereof whereby movement of said first member in one direction causes movement of said second member in the opposite direction.

7. In a circuit protective device of the class described a housing having a first compartment and a second compartment; current carrying elements including a pair of separable contacts mounted in said first compartment, said elements also including a movable arm carrying a first of said contacts; fault detecting means including a current responsive bimetal disposed within said second compartment; said bimetal and said arm constructed of sheet material and mounted in edge to edge relationship; said bimetal mounted for deflection in a first direction upon heating thereof; said arm mounted so that

said first contact moves opposite to said first direction when said pair of contacts are being separated; means operatively connecting said bimetal and said arm for reversing motion of said bimetal to bring about separation of said pair of contacts after a predetermined deflection of said bimetal.

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