Dec. 21, 1948. F. C. IGLEHART 2,456,945

RELAY

Filed May 16, 1944 2 Sheets-Sheet 1

Fig. 1.

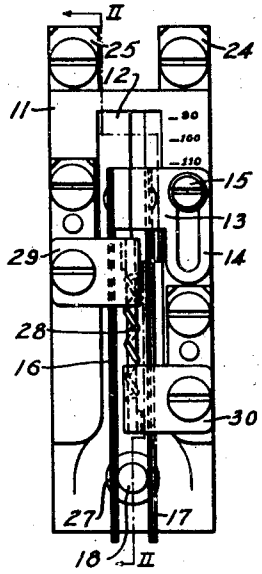


Fig. 2.

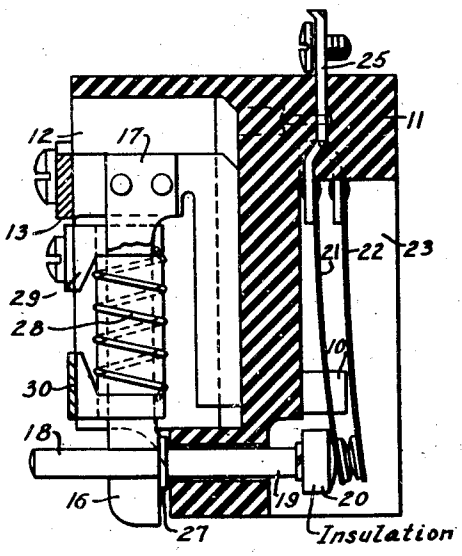


Fig. 3.

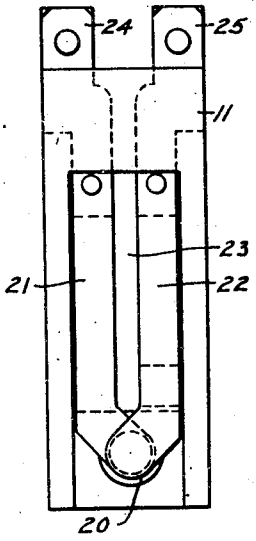
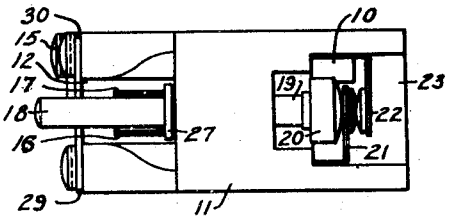


Fig. 4.



WITNESSES:

H. F. Susan.

Custis M. Avery

INVENTOR

Ferdinand C. Iglehart.

BY

Paul E. Friedemann

ATTORNEY

Dec. 21, 1948. F. C. IGLEHART 2,456,945

RELAY

Filed May 16, 1944 2 Sheets-Sheet 2

Fig 5.

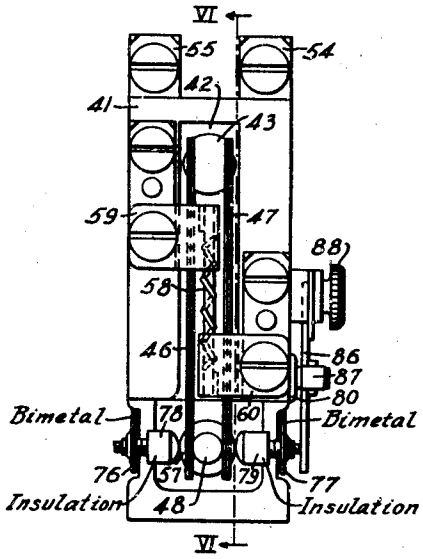


Fig. 6.

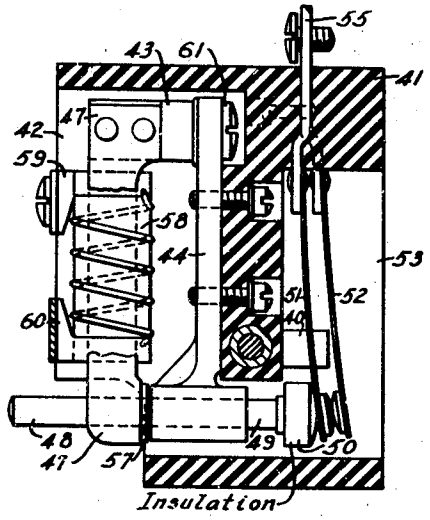


Fig. 7.

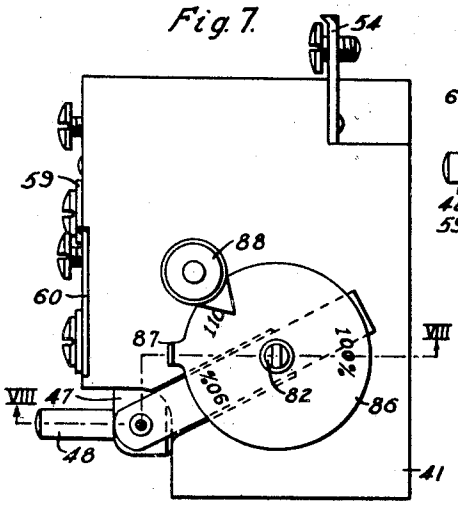
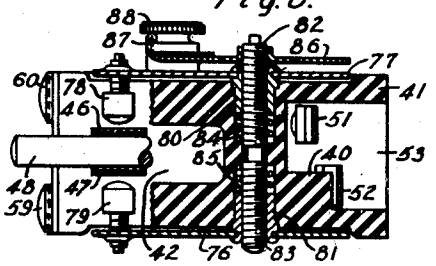


Fig. 8.



WITNESSES:

H. F. Susser

Curtis M. Avery

INVENTOR

Ferdinand C. Iglehart.

BY

Paul E. Friedemann

ATTORNEY

Patented Dec. 21, 1948 2,456,945

UNITED STATES PATENT OFFICE

2,456,945

RELAY

Ferdinand C. Iglehart, Wilkinsburg, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 16, 1944, Serial No. 535,835

7 Claims. (Cl. 200—116)

1

My invention relates to shockproof contactors and, more particularly, to electric overload relays of shockproof design.

It is essential on board of war vessels, mobile hoisting or shoveling equipment and other locations where impact shocks and severe vibrations are to be expected that the contactors of electric control devices are prevented from performing uncontrolled operations. For instance, the overload breakers and relays of electrical control equipment aboard ship must stay closed during normal operating conditions of the electric circuits to be controlled even if they are subjected to shocks and impacts caused by gun fire.

It is known to render contactors shockproof by designing their movable parts as statically and dynamically balanced masses which, when in operation, rotate about their balance axis. However, such a design is often inapplicable or impractical. It is further known to provide electric contactors with latching devices which contain a movable inertia weight for moving a latch into the path of the movable contactor assembly in response to the occurrence of shock forces. Such inertia-controlled auxiliaries render the contactors more complicated and involve the disadvantage that they prevent also an intended operation of the contactor during the periods of persisting shock forces. This is especially undesirable in the case of overload relays because it may prevent these relays from interrupting the current at the proper moment.

It is an object of my invention to provide a contactor, especially an overload relay of the latched-in type, which is shockproof in accordance with the above-mentioned requirement but requires neither a balanced design of its individual movable parts nor an additional inertia-controlled latch.

Another object allied to the foregoing is to provide a shockproof contactor of especially simple design and small size.

It is also an object of my invention to provide a shockproof overload relay which can readily be adjusted or calibrated for different current ratings.

A further object of the invention in conjunction with any of the foregoing is to devise a thermal overload relay that is not only protected from disturbances due to shock but remains also substantially unaffected by changes in ambient temperature as regards the accuracy of its tripping operation.

In order to achieve these objects, my invention in one of its aspects consists in a contactor in which a contact controlling part is movable between two positions and biased for motion toward one of these positions, the movable part being straddled by two latch members which, under normal conditions, abut against a stop face of the movable part and thereby prevent it from moving under its bias. The two latch members are so disposed that they have to move away from the movable part in opposite directions in order to effect a release, and this opposite motion is produced by a current-responsive electric control element.

2

According to another feature of my invention, the two just-mentioned latch members consist of bimetal strips which extend substantially in parallel to each other and are heated in accordance with an electric load current so as to deflect simultaneously away from the movable part.

In another aspect of my invention, two bimetal strips, as just mentioned, are mounted on a carrier which is displaceable towards and away from the movable relay part to be latched by the strips. A displacement of this carrier has the effect of changing the distance between the stationary mounting of the latching strips and their points of engagement with the latched-in part. Consequently, the distance of angular deflection of these strips caused by a given current intensity is also changed. As a result, the rating of the relay can be adjusted or calibrated by displacing the strip carrier.

According to still another feature of my invention, a compensation for changes in ambient temperature is provided by means of auxiliary bimetal strips which act on the above-mentioned latching members or latching strips so as to vary their releasing deflection in dependence upon variations in ambient temperature.

The above-mentioned objects and features of my invention as well as other characteristics thereof will be apparent from the following description of the embodiments illustrated in the drawings.

Figures 1 through 4 of the drawings refer to the same embodiment of a shockproof overload relay. Fig. 1 is a top view, Fig. 2 is a cross section taken along the line denoted in Fig. 1 by II—II, Fig. 3 is a bottom view, and Fig. 4 is a front view.

Figs. 5 through 8 represent a second embodiment of the invention. Fig. 5 is a top view. Fig. 6 is a lateral sectional view taken along the plane denoted in Fig. 5 by the line VI—VI. Fig. 7 illustrates a lateral view corresponding

to Fig. 6 but showing the exterior of the relay. Fig. 8 shows a cross-section taken along the cut denoted in Fig. 7 by the line VIII—VIII.

The overload relay according to Figs. 1 through 4 has an insulating base or supporting structure 11 consisting for instance of molded material. A cavity 12 of base 11 contains a strip carrier 13 which has an extension 14 guided in a groove along the bottom of cavity 12. The carrier 13 is displaceable within the cavity and along the just-mentioned groove and has an elongated opening traversed by a setscrew 15 which permits fastening the carrier 13 in any selected position within its range of displacement. Two bimetal strips 16 and 17 are firmly mounted on the carrier 13. They extend substantially in parallel to each other and straddle the top portion 18 of a plunger 19 which is mounted in a bore of the base 11 and axially displaceable relative to the base. An insulating abutment 20 of plunger 19 rests against a resilient contact member 21 which, in the position according to Fig. 2, is in engagement with another resilient contact member 22 so as to close the circuit to be controlled by the relay. The contact members 21 and 22 are mounted on rigid terminals 24 and 25, respectively, which are molded into the base 11. The contact members 21 and 22 exert a bias on plunger 19 tending to move it towards the left (Fig. 2). However, a stop face formed by a flange 27 of plunger 19 abuts against the edges of bimetal strips 16 and 17 and prevents the plunger from following this biasing force.

A heating element 28 is arranged within the cavity 12 and between the two strips 16 and 17. It consists of an insulating carrier and a resistance wire mounted thereon and is provided with terminals 29 and 30 which are removably attached to the insulating base 11. For different current ratings, the heating element may be replaced by a correspondingly different one. For instance, for larger current ratings the heater may consist of resistance sheet material so formed that the terminals 29 and 30 are an integral part of the heater proper. The arrangement of the heater along and between the two bimetal strips secures a highly efficient heat transfer.

When the circuit connected to the heater terminals 29 and 30 is deenergized, the strips 16 and 17 are cold and press from opposite sides against portion 18 of the plunger 19. When the circuit is energized and the current below the rated tripping value, the strips 16 and 17 are heated so that they reduce somewhat their pressure on the plunger and may slightly deflect in opposite directions away from the plunger without moving out of engagement with flange 27. Upon occurrence of an overload of sufficient intensity and duration, a further divergence of the bimetal strips occurs until they move clear of the flange 27 and thereby release the plunger 19. The plunger is now moved towards the left (Figs. 2 and 4). After a limited initial motion of contact member 22, it abuts against a stop 10 formed by the insulating base 11 in its rear cavity 23, while the contact member 21 is free to continue its motion. As a result, the contact between members 21 and 22 is interrupted. In the interrupting position of plunger 19, flange 27 lies between strips 16 and 17 and hence prevents the strips from moving back into their original position while the strips are cooling down to normal temperature. In order to reset the relay, the plunger portion 18, serving as a push button, is depressed so that flange 27 is returned into the illustrated position. The bimetal strips 16 and 17, if cooled sufficiently, will now snap into the original position and again latch the relay.

If the relay, or the panel on which it is mounted, is subjected to shock or vibration, the shock or vibratory forces may be transmitted by base 11 to plunger 19 as well as to strips 16 and 17. Any component of these forces acting on the plunger in its axial direction cannot cause an opening of the contacts because the opening motion of the plunger is blocked by the latching effect of strips 16 and 17. Any component of a shock force tending to move one of the strips 16 or 17 in its releasing direction acts usually in the same direction on the second strip and hence tends to move this second strip towards its latching position. In other words, while the two strips in order to release the relay must be moved in opposite directions, the shock forces are as a rule unidirectional at any given instant and hence not apt to cause a release.

The deflection of the bimetal strips 16 at the point of engagement with the movable plunger under a given current load, depends on the distance of this point from the stationary mounting of the strips. Consequently, the rate of tripping current can be adjusted or calibrated by loosening the screw 15 and displacing the carrier 13. A displacement of the carrier and bimetal strips in the upward direction, referring to Fig. 1, decreases the rated current since less heat input is required to produce a given deflection at the latching point of the strips. Inversely, a downward displacement of the carrier increases the rated current. As shown in Fig. 1, the base 11 is preferably provided with a scale calibrated in per cent of rated current.

The overload relay, according to Figs. 5 through 8, involves the same shockproofing principle as the relay previously described, but differs therefrom by providing for a compensation of ambient temperature variations as regards their effect on the rating and accuracy of the tripping operation. The embodiment according to Figs. 5 and 8 is further provided with adjusting or calibrating means different from those of the above-described overload breaker.

Referring to Figs. 5 through 8, an insulating base 41 has two cavities 42 and 53 at opposite sides. The cavity 42 contains a carrier 43 which forms part of a rigid holder structure 44. This structure is firmly attached to the base 41. Two bimetal strips 46 and 47 have one end firmly mounted on the carrier 43 and engage the top portion 48 of a plunger 49 which is mounted in the holding structure 44 for axial motion relative thereto and carries an insulating button 50 for actuating two contact members 51 and 52. These contact members are located within the rear cavity 53 of base 41 and mounted on two respective terminals 54 and 55. The base 41 has a projection 40 for limiting the spring-biased motion of contact member 52. A flange 57 of plunger 49 serves as a stop and is engaged by the deflecting ends of strips 46 and 47 so that the plunger is normally prevented from moving under the bias produced by the contact members 51 and 52. A heater 58 is mounted between strips 46 and 47 by means of terminals 59 and 60.

As far as described in the foregoing, the relay is designed and operative similar to the first-de-

scribed embodiment and is shockproof for the same reasons as set forth in the foregoing.

In order to provide for ambient temperature compensation and also for the purpose of calibrating the relay, two compensating bimetal strips 76 and 77 are mounted in a slanted external groove on opposite sides of the insulating base 41. Each of these strips has one end provided with insulating buttons 78 and 79, respectively. The base 41 has a transversal bore which contains two nuts 80 and 81, respectively, in engagement with two oppositely threaded portions 82 and 83 of an adjusting screw and are biased by helical compression springs 84 and 85, respectively, serving to eliminate dead play in the threaded engagement. Nut 80 is riveted to the compensating strip 77 while nut 81 is similarly attached to strip 76. The portion 82 of the double screw carries a calibrating disk 86. A projection 87 of this disk facilitates adjusting it to a desired angular position in accordance with calibrating indicia marked on the disk. A clamping screw 88 serves to secure the disk 86 in any selected position.

The heat insulating buttons 78 and 79 are so located in the path of deflection of the latching strips 46 and 47 that they exert an inward pressure on these strips as the latter approach their tripping position. This force is greater or smaller, depending upon the temperature and deflection of the compensating bimetals 76 and 77 under the influence of the surrounding air. The buttons 78 and 79 are adjusted so that they just touch the latching strips 46 and 47 in their tripped position at the coldest air temperature at which a compensation is to be effected and with the adjusting disk 86 set at 100% rated current. If such an adjustment is infeasible or inconvenient to perform when assembling the relay in the factory, some other inter-relationship of temperature, percentage or rated current and distance of the buttons from the latching strips may be chosen in accordance with a computed or tested characteristic of the bimetallic elements. After adjusting the buttons 78 and 79, they are soldered in place.

When manufacturing the relay, the bimetal strips 46 and 47 may be ground after being riveted to the carrier 43. Since the trip rod 49, which may also be ground, is secured to the rigid holding structure 44 rather than to the insulating base 41, the entire strip, holder, and plunger assembly may be calibrated as a unit by placing it in a bath of controlled temperature before the carrier 43 is rigidly joined with the structure 44, and sliding the carrier 43 forward or back along the structure 44 or rotating it until a simultaneous tripping of the two bimetal strips is obtained. The screw 61 (Fig. 6) for fastening the carrier 43 to the structure 44 is then tightened. The carrier 43 and the structure 44 may then be soldered or brazed together before mounting the calibrated assembly on the insulating base 41.

Being aware of the fact that contactors according to my invention can be modified in various respects by those skilled in the art on the basis of the foregoing disclosure and without departing from the objects and essence of the invention, I wish this specification to be understood as illustrative rather than in a limiting sense.

I claim as my invention:

1. A thermal relay comprising a support, contact means mounted on said support, a plunger member movably arranged in said support for controlling said contact means and biased for motion in a given axial direction and having radially extending stop means, two bimetal strips arranged substantially in parallel to each other and straddling said member for engaging said means when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member when heated, and current responsive heating means mounted on said support separate from said strips and disposed between said strips for heating both strips substantially equally for causing them to release said member in response to an overload current, and an adjusting device disposed for varying the heat-responsive radial travel of said strips relative to said member in order to calibrate the relay for a given current rating and having a part displaceably mounted on said support so that the position of said part is indicative of said current rating said device being associated with both said strips so that said radial travel of both said strips is changed simultaneously by a positional change of said part.

2. A thermal relay comprising a support, contact means mounted on said support, a plunger member axially movable in said support and biased for motion in one axial direction, said member having radially extending stop means, a holder displaceable in said support toward and away from the axis of said member, two bimetal strips each having one end attached to said holder, said strips being arranged substantially in parallel to each other and straddling said member for engaging said means when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member and stop means when heated, and current responsive heating means disposed between said strips for heating both substantially equally for causing them to release said member in response to an overload current.

3. A thermal relay comprising a support having two cavities at two opposite sides respectively and forming a partition which separates said cavities and has an opening extending between said cavities, contact means mounted on said support in one of said cavities, a plunger member axially movable in said support and extending through said opening from one to the other cavity, said member having a radially extending stop means and being biased for motion in one of its axial directions, two bimetal strips in said other cavity arranged substantially in parallel to each other and straddling said member for engaging said stop means when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member when heated, and current responsive heating means mounted on said support separate from said strips and disposed between said strips for heating both strips substantially equally for causing them to release said member in response to an overload current.

4. A thermal relay comprising a support having two intercommunicating cavities at two opposite sides respectively, contact means mounted on said support in one of said cavities, a plunger member axially movable in said support and extending from one to the other cavity, said member having a radially extending stop and being biased for motion in one of its axial directions, a holder slidably arranged in said other cavity so as to be displaceable toward and away from the

axis of said member, two bimetal strips each having one end attached to said holder, said strips being arranged substantially in parallel to each other and straddling said member for engaging said stop when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member and stop when heated, and current responsive heating means disposed between said strips for heating both substantially equally for causing them to release said member in response to an overload current.

5. A thermal relay comprising contact means, a plunger member movably arranged for controlling said contact means and biased for motion in a given axial direction and having a radially extending flange, two bimetal strips straddling said member for engaging said flange when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member and flange when heated, and current responsive heating means associated with said two strips for causing them to release said member in response to overload current, and two compensating bimetal strips extending transversely of said first strips and having a part disposed in the path of their heat responsive motion respectively, said compensating strips being exposed to ambient temperature for impeding the releasing motion of said first strips so as to substantially compensate the effect of changes in ambient temperature on the current responsive release operation.

6. A thermal relay comprising contact means, a plunger member movably arranged for controlling said contact means and biased for motion in a given axial direction and having a radially extending flange, two bimetal strips straddling said member for engaging said flange when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member and flange when heated, and current responsive heating means associated with said two strips for causing them to release said member in response to overload current, and two compensating bimetal strips extending transversely of said first strips and having a part disposed in the path of their heat responsive motion respectively, said compensating strips being exposed to ambient temperature for impeding the releasing motion of said first strips so as to substantially compensate the effect of changes in ambient temperature on the current responsive release operation, and a manual calibrating device connected with said two compensating

strips for varying the distance of said parts from said respective first strips.

7. A thermal relay comprising a support having two intercommunicating cavities at two opposite sides respectively, contact means mounted on said support in one of said cavities, a plunger member axially movable in said support and extending from one to the other cavity, said member having a radially extending stop means and being biased for motion in one of its axial directions, two bimetal strips in said other cavity arranged substantially in parallel to each other and straddling said member for engaging said stop means when cold in order to hold said member against its bias, said strips being mounted for moving in opposite directions radially away from said member and stop means when heated, and current responsive heating means disposed between said strips for heating both substantially equally for causing them to release said member in response to an overload current, and two compensating bimetal strips of opposite heat responsive deflection mounted on opposite sides of said support exteriorly of said cavity and transversely of said first strips and having each a part disposed in the path of heat responsive motion of one of said respective first strips for impeding said motion in dependence upon changes in ambient temperature, and a calibrating device having a shaft extending through said support and provided with two oppositely pitched threads in engagement with said compensating strips respectively for adusting the distance of said parts from said respective first strips when said shaft is rotated.

FERDINAND C. IGLEHART.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
926,584	Morris et al.	June 29, 1909
1,232,453	Cavanagh	July 3, 1917
1,294,045	Cavanagh	Feb. 11, 1919
1,683,132	Hall	Sept. 4, 1928
1,795,211	Horst	Mar. 3, 1931
1,838,664	Dubilier	Dec. 29, 1931
1,914,529	Rich	June 20, 1933
1,939,194	Angell	Dec. 14, 1933
2,302,717	Rostoker	Nov. 24, 1942
2,401,005	Lindstrom et al.	May 28, 1946

FOREIGN PATENTS

Number	Country	Date
443,870	Germany	May 12, 1927