Jan. 6, 1948. H. M. WILSON 2,434,186

COMBINED ELECTROMAGNETIC AND THERMAL PROTECTIVE CIRCUIT BREAKER SYSTEM

Filed April 22, 1943 2 Sheets-Sheet 1

FIG. 1.

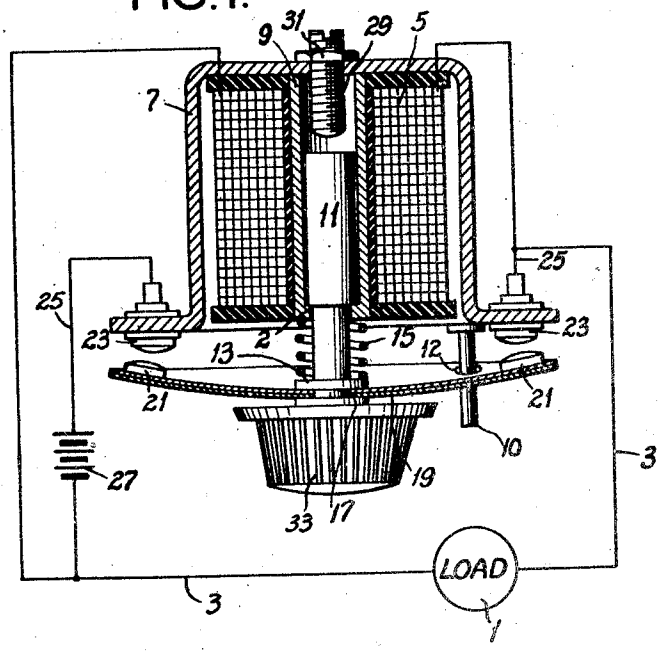
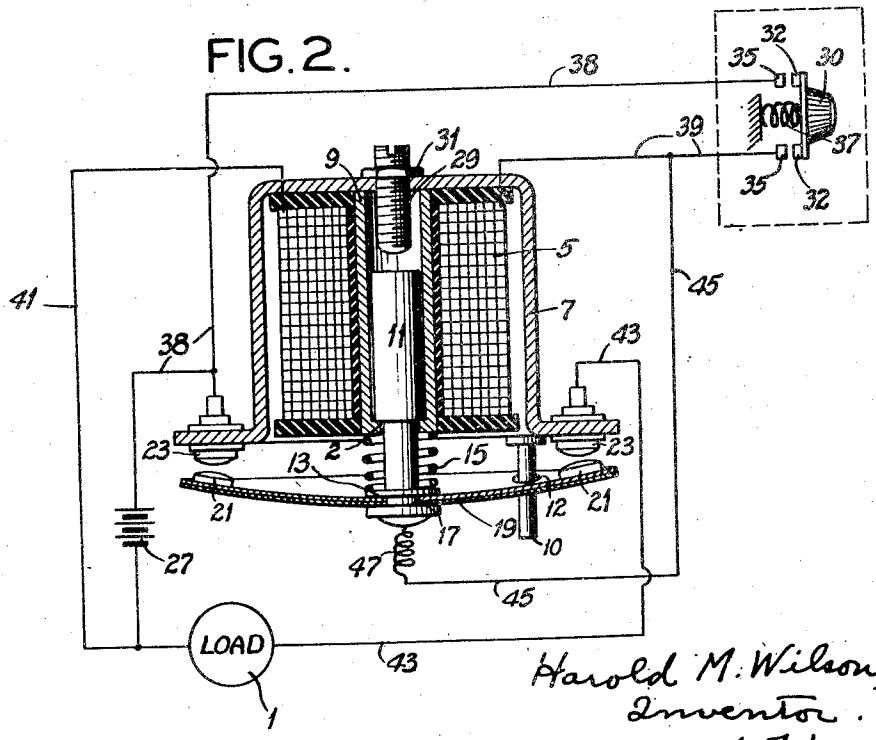


FIG. 2.



Harold M. Wilson,
Inventor.
Haynes and Koenig
Attorneys.

Jan. 6, 1948. H. M. WILSON 2,434,186

COMBINED ELECTROMAGNETIC AND THERMAL PROTECTIVE CIRCUIT BREAKER SYSTEM

Filed April 22, 1943 2 Sheets-Sheet 2

FIG. 3.

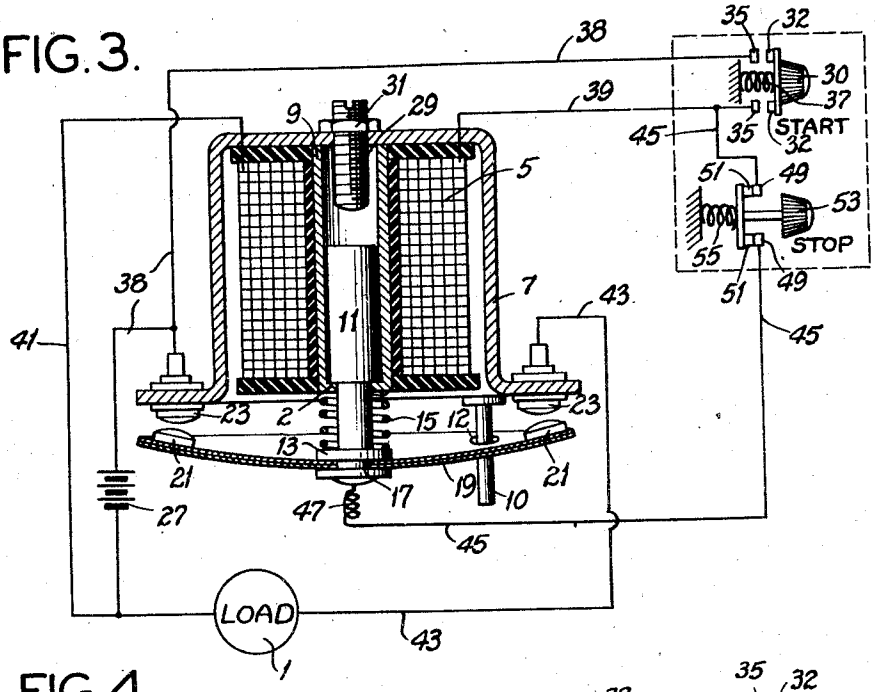
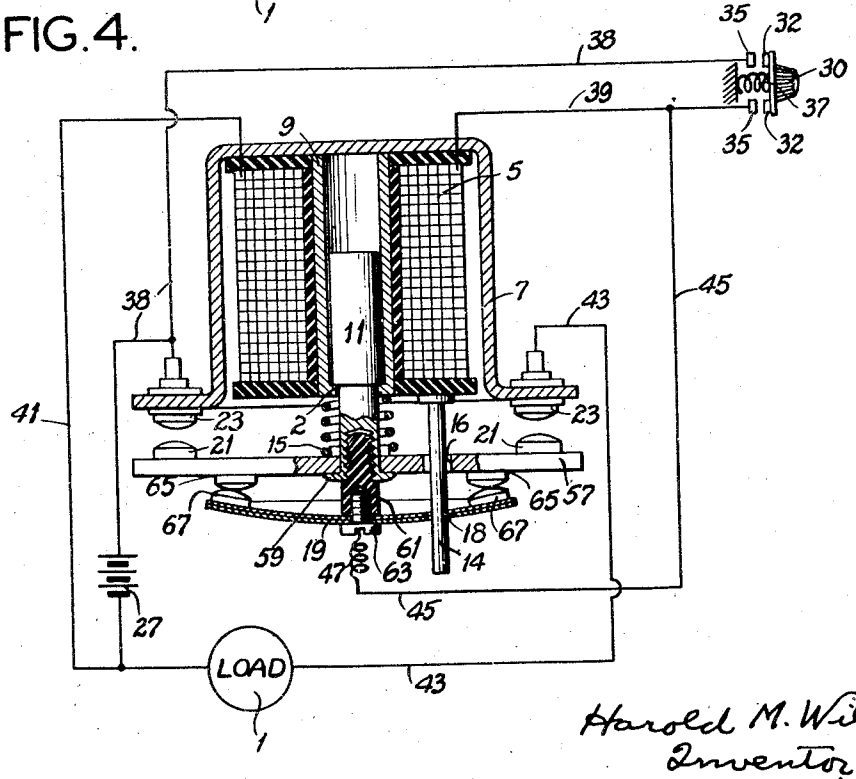


FIG. 4.



Harold M. Wilson,
Inventor.
Haynes and Koenig,
Attorneys.

Patented Jan. 6, 1948

2,434,186

UNITED STATES PATENT OFFICE

2,434,186

COMBINED ELECTROMAGNETIC AND THERMAL PROTECTIVE CIRCUIT BREAKER SYSTEM

Harold M. Wilson, Arlington, Mass., assignor to Metals & Controls Corporation, Attleboro, Mass., a corporation of Massachusetts

Application April 22, 1943, Serial No. 483,984

3 Claims. (Cl. 175—294)

1

This invention relates to circuit breakers, and with regard to certain more specific features, to remote-control circuit breakers for use on aircraft and the like.

Among the several objects of the invention may be noted the provision of a simple form of manual reset, trip-free, combination magnetic and thermal circuit breaker to protect a circuit from overheating, by opening the circuit if currents of dangerous value flow therein; the provision of certain forms of apparatus of the class described arranged to permit placement of a switch on an operating panel without the use of large copper conductors to outlying devices; and the provision of apparatus of the class described which permits the use of a remote-controlled circuit breaker as large as needed near an outlying device. Other objects will be in part obvious and in part pointed out hereinafter.

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 following claims.

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

Fig. 1 is a vertical section and wire diagram showing one form of my invention; and,

Figs. 2, 3 and 4 are similar views, respectively showing modifications.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to Fig. 1, there is shown at numeral 1 a load consisting of a motor or similar translating device in a load circuit 3. This draws current in said circuit 3. Circuit 3 includes a solenoid coil 5, fixed in a case 7 and surrounding a guide 9. Sliding in the guide 9 is a magnetic armature core 11 which has an outside head 13. This core is normally biased from the solenoid 5 by a spring 15, which reacts against the head 13. The spring 15 reacts from a flanged portion 2 of the guide 9, this flanged portion also acting as a stop limiting the outward movement of the core 11.

The head 13 passes through an opening 17 in a composite thermostatic conducting member 19. Preferably this should be of the snap-acting disc type generally known in the art as a Spencer disc. This disc is cupped and carries contacts 21 engageable with contacts 23, the latter being supported upon, but insulated from, the case 7.

2

The contacts 23 are in a battery feed circuit 25 which, when the contacts 21 and 23 are closed, places the disc 19, which is conducting, in series with the load 1 and a supply battery 27. This also closes a holding circuit through the coil 5, as will appear. The disc 19 is non-rotary, this being accomplished by a fixed pin 10 passing through an opening 12 in the disc, or other suitable means to accomplish this end may be used. This maintains alignment between contacts 21 and 23. It is to be understood however that the disc is loosely mounted on 17 between the flanges shown to permit free flexing.

At 29 is shown a threaded adjustable stop adapted to be locked in any adjusted position by means of a lock nut 31. This stop 29 is engageable by the armature 11 when the same is drawn inward by action of the solenoid coil 5. When this action occurs, the spring 15 is compressed.

A handle 33 is carried on the head 13 for manual push-pull manipulation. Operation is as follows:

The spring 15 normally biases the armature 11 along with the thermostatic disc 19 in contact-opening direction to the open circuit position shown. This breaks the battery circuit 25 so that the battery 27 does not feed the load 1. By temporarily manually pushing in on the button 33, that is, by manually resetting the switch so that the contacts 21 and 23 close, a circuit is closed including the load 1 and the battery 27, and at the same time a holding circuit is closed through the solenoid 5 which immediately engenders a flux field operating on the armature 11. This takes charge in biasing the disc 19 in contact-closing direction so as to hold shut the contacts 21 and 23. Then, even though the operator releases the button 33, the battery circuit 25 remains closed through the load 1. The operator may, however, open the circuit at will by pulling the knob 33.

Next, assuming the circuit to be closed, if an overload occurs from the load 1, more current passes through the conducting disc 19, which upon heating above a substantially predetermined temperature snaps from the curvature shown to an opposite curvature (concave downwardly instead of upwardly) which opens the circuit so as to drop the load from the battery 27 and to deenergize the solenoid 5. It will be understood that the stop 29 is set so that after the disc 19 snaps to open circuit position, and while it is still hot, it cannot be pushed into closed circuit position. Also if manually initiated reclosure is attempted under overload conditions,

even with the disc snapped back to its cold curvature, the device will open. That is to say, the device is trip-free, opening when required under overload conditions being free of manually initiated holding actions.

As soon as the solenoid 5 is deenergized, the spring 15 forces the armature 11 to the solid-line position shown, in which, when the disc 19 again cools, there will be no reclosing of the contacts 21 and 23 until a manual pushing operation is again performed upon the button 33.

In Fig. 2 is shown a modification in which like numerals designate like parts. The circuit in this case differs from that of Fig. 1 as follows:

A remote-control push-button switch 30 having closing contacts 32 is used for connecting contacts 35. A spring 37 normally biases open the switch 30. Thus the button 30 becomes a remote-control momentary reset device. When the contacts 32, 35 are temporarily closed, a circuit is closed from the battery over power lines 38, 39, solenoid 5, and line 41, back to the battery 27. This energizes the solenoid 5 to draw in the armature core 11, so as to close the contacts 21, 23, provided the thermostatic disc 19 is in its cold position shown in Fig. 2. As soon as the contacts 21, 23 are closed, the battery circuit is closed over line 43 through the load. Since the disc 19 carries current, a line 45 connected therewith by means of a pigtail 47 becomes energized to maintain the circuit through the solenoid 5. Therefore, the button 30 may be released without impairing the holding characteristics of the solenoid 5. The core 11 is held in against the normal expansive action of the spring 15. These conditions continue until an overload occurs in the load 1, whereupon the current in the disc 19 overheats it, so that it snaps to its opposite curvature, thus breaking the contacts 21, 23. This immediately opens the load circuit and also the solenoid circuit 5, so that the spring 15 pushes the disc 19 away from the contact 23. Hence, even if the disc snaps to its cold position, the circuit will not automatically reclose. However, it can be reclosed by pushing in the momentary contacts 30 whenever desired. This device, like the one shown in Fig. 1, is trip-free, because if an attempt is made to reclose before the disc 19 has snapped to its cold position, nothing will occur except that the armature 11 will be drawn against the stop 29 without closing the contacts 21, 23. Also, the switch will persist in reopening even though under overload conditions manually initiated reclosure is attempted after the disc has snapped back to its cold curvature.

In Fig. 3 is shown a third form of the invention, in which like numerals designate like parts. In this case, the starter button 30 is organized with the solenoid 5 as in Fig. 2, and the load 1 is organized with the battery 27, disc 19, contacts 21 and 23, as before, through circuit 43. In this case, however, the device is equipped with a remote-control stop button switch consisting of contacts 49 in the line 45 of the holding circuit and contacts 51, which are under control of a stop button 53. Circuit 45 is closed through the pigtail connection 47 with the disc 19. The contact 51 and the button 53 are biased toward closed circuit position by a spring 55. The operation of this form of the invention is like that of Fig. 2, except that the circuit may be remotely manually opened at will after having once been closed by pushing the momentary stop button 53. This breaks the holding circuit which ran from the battery 27 through the disc 19 (when cold), pigtail 47, line 45, line 39, solenoid 5, and line 41, back to the other side of the battery. Once the holding circuit is opened, the spring 15 moves the disc 19 into open circuit position, even though the disc is cold and upwardly convex.

In Fig. 4 is shown a form of the invention in which the snap-acting thermostatic disc is not called upon to carry all of the load current, but is arranged in shunt. In this figure, like numerals again designate like parts.

In this form of the invention, the contacts 21, instead of being carried upon the snap-acting disc 19, are carried upon a bus bar 57 which is riveted to the armature core 11 as indicated at 59. Threaded into the end of the core 11 is an insulating pin 61. A screw 63 holds the central portion of the snap-acting disc 19 on this insulating pin or plug 61.

An extra set of contacts 65 is carried on the bus bar 57, and these are engaged and disengaged by contacts 67 carried upon the thermostatic, snap-acting disc 19.

As in Fig. 2, a remote reset momentary contact switch 30 is shown with appurtenant parts, numbered as in Fig. 2. When momentarily pressed, this switch closes the circuit 38, 39, 41 through the battery 27 and the solenoid 5 to pull up the armature core 11. This closes the contacts 21, 23 and thus by means of the bus bar 51 closes the load circuit. This circuit includes the battery 27, contacts 21, 23, the bar 57, line 43 and the load 1. Since the disc 19 is at this time presumed to be cold, contacts 65, 67 are closed as shown, which places the disc 19 in shunt circuit with the bus bar 57. Thus current flows over the line 45 and back to the battery 27 via solenoid 5 and wire 41.

The disc 19 is calibrated to heat and snap to open circuit position at predetermined overload shunt current across the bar 57. Since the disc 19 controls a holding circuit through the solenoid 5, snapping open of the disc under overload conditions results in release of the armature core 11 and outward movement of the bar 57 under bias of spring 15. This reopens the contacts 21, 23, thus breaking the load circuit from the battery 27.

In this Fig. 4 form of the invention, there is no need for any stop for the core 11, because the contacts 21, 23 form a stop, being all rigidly mounted. Also, the fixed alignment pin 14 passes through openings 16 and 18 in 57 and 19 respectively. This form of the invention is not trip-free, because even when the disc 19 is in hot, open position (downwardly convex) a holding circuit may be temporarily closed through the solenoid 5 by pressing button 31. However, as soon as the button is released, this holding circuit is reopened, and the circuit opened, since then there is no holding circuit through the disc 19.

It should be understood that the thermostatic member 19, while preferably composed of a snap-acting disc of the Spencer type may, under circumstances of low current value in the work circuit, be of a strip, creep-acting or other type.

It will be recognized that the coil 5 need not draw the same amount of current as the load circuit, in fact, much less. Thus, if desired, the wiring to the momentary contact switches may be made relatively small. Hence, the constructions of Figs. 2, 3 and 4 may employ momentary contact switches on an instrument panel near a pilot with as extensive an amount of the

lighter wire as is needed. The solenoid-controlled thermostatic switch may then be placed adjacent to the motor or other load without involving a large amount of heavy wire.

From Fig. 1 it will be seen that one way of initially energizing the holding circuit through the coil 5 is to push the assembly of the armature and thermostatic member (when cold) into circuit closing position. This principle may be applied to the constructions shown in Figs. 2, 3 and 4 if it is desired to eliminate the auxiliary push-button-control holding circuits. In general, the latter are desirable, since they permit the use of the small wires carrying only a small amount of current from the thermostatic switch to the control board. It is desirable to save heavy wires, particularly where there are as many of them as in an airplane. At the same time, it allows the thermostatic member 19 to be located close to the translating load member if it be desired to protect this device against overheating. For example, in such instances, the assembly of solenoid coil, solenoid armature and thermostatic member may be strapped directly to a motor or generator and the wires to the push button switch such as shown at 30 in Fig. 2 carried over to the pilot's instrument panel. The same is true of the structures shown in Figs. 3 and 4, wherein it is clear that the momentary contact make-or-break switch need not carry heavy current for operating the solenoid coil. It is to be understood however that said assembly need not be near the device 1 where the object is simply protection against overload currents. As above stated, one of the characteristics of the solenoid coil is that it may be designed for light current values.

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

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.

I claim:

1. A manually resettable trip-free circuit breaker for automatically breaking a load circuit upon overload, comprising a thermostatic switch adapted to make and break a load circuit, said switch comprising separable contacts, an electrically conductive thermostatic member controlling said contacts and included in the load circuit when the contacts are closed, said thermostatic member being adapted to open said contacts upon heating above a substantially predetermined temperature due to passage of overload current therethrough, means biasing said thermostatic member in a contact-opening direction, a solenoid which, when energized, biases said member in a contact-closing direction, a holding circuit including said solenoid and thermostatic switch whereby said solenoid is energized when said contacts are closed, manually operable means for moving said thermostatic member in contact-closing direction, and means for limiting movement of said member in contact-closing direction to prevent closing of the contacts when said member is heated above said temperature.

2. A manually resettable trip-free circuit breaker for automatically breaking a load circuit upon overload, comprising a thermostatic switch adapted to make and break a load circuit, said switch comprising separable contacts, an electrically conductive thermostatic member controlling said contacts and included in the load circuit when the contacts are closed, said thermostatic member being adapted to open said contacts upon heating above a substantially predetermined temperature due to passage of overload current therethrough, means biasing said thermostatic member in contact-opening direction, a solenoid which, when energized, biases said member in contact-closing direction, a holding circuit including said solenoid and thermostatic switch whereby said solenoid is energized when said contacts are closed, said solenoid being connected in a power circuit including a normally open manually operable switch, whereby said thermostatic member may be moved in a contact-closing direction by said solenoid by closing said manually operable switch, and means for limiting movement of said member in a contact-closing direction to prevent closing of the contacts when said member is heated above said temperature.

3. A circuit breaker as set forth in claim 2, further including a normally closed manually operable switch in said holding circuit whereby said solenoid may be deenergized to permit the biasing means to bias said thermostatic member to open the contacts.

HAROLD M. WILSON.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,761,772	Carpenter	June 3, 1930
1,764,374	White	June 17, 1930
1,708,789	Hall	Apr. 19, 1929
1,919,052	Becker	July 18, 1933
2,307,776	Grant et al.	Jan. 12, 1943
2,335,888	Stilwell	Dec. 7, 1943
666,764	Lindstrom et al.	Jan. 29, 1901
1,488,952	Stoekle	Apr. 1, 1924
1,722,741	Getchell	July 30, 1929