Feb. 26, 1952 R. C. INGWERSEN 2,587,162

CIRCUIT BREAKER WITH AMBIENT TEMPERATURE AND SHOCK COMPENSATION

Filed Jan. 5, 1950

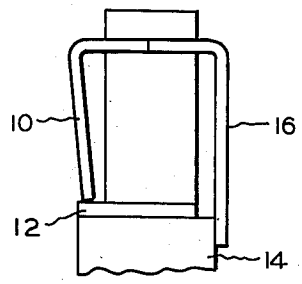

FIG. I.

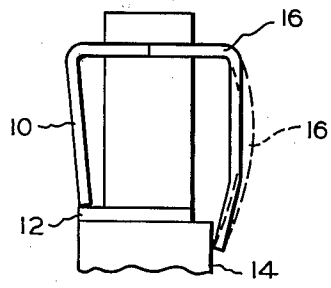

FIG. II.

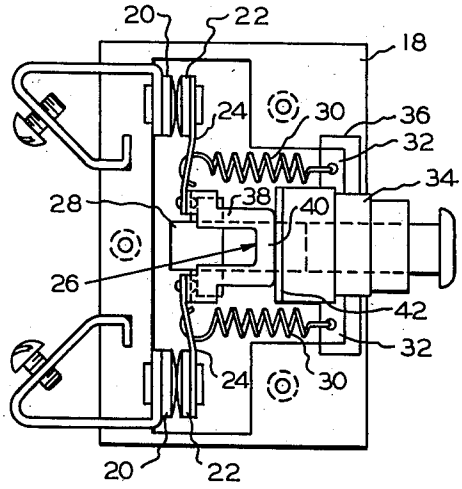

FIG. III.

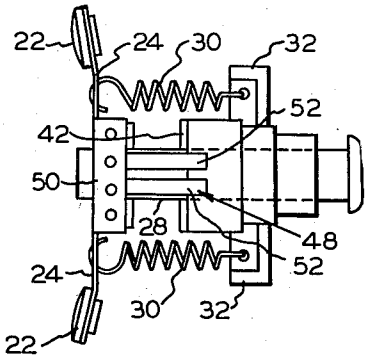

FIG. IV.

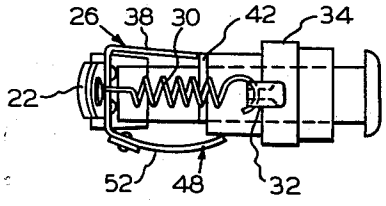

FIG. VI.

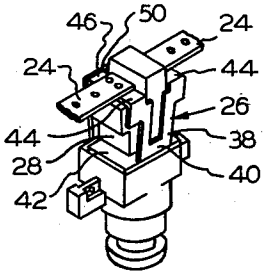

FIG. V.

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CIRCUIT BREAKER WITH AMBIENT TEMPERATURE AND SHOCK COMPENSATION

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7 Claims. (Cl. 200—116)

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This invention relates to resettable circuit breakers of the type which employs a thermal latch means adapted to hold the breaker contacts in closed position until a predetermined current overload condition is reached, when the latch means is effective automatically to cause the circuit breaker contacts to open and interrupt the circuit controlled thereby.

In connection with these thermal latch controlled circuit breakers the problem arises that whereas the thermal latch means employed can be finely and closely calibrated to function at a predetermined overload current rating, attention must be given to preventing the latch means from becoming effective to break the circuit due to any other influence than the conducted electrical current. In fact attention has to be given to preventing the thermal latch means from becoming effective to break the circuit due to influences external to the electrical current and such as involves consideration of ambient temperature conditions, as well as undue vibration and shock.

In aircraft, for instance, where these circuit breakers are employed in considerable number, it happens that the breakers become subjected to the influence of widely changing temperature and pressure conditions, as when the aircraft travels from a cold climate to a hot climate, or vice versa, or from, say, a sun-baked runway to the stratosphere. Further, in aircraft, there is the condition of excessive engine vibration to be contended with, shock due to landing, for instance, and, in military aircraft, shock and vibration arising from gun fire, all of which becomes quite important for consideration as affecting the latch means when this is thermally active by current passing therethrough. All these circumstances give rise to what is known as "nuisance trip-outs" in connection with the circuit breakers previously employed, due to the inherent flexibility of the thermal latch means employed and their inability to withstand these varying conditions.

Similar problems arise in connection with outdoor power substations and industrial installations and generally wherein these circuit breakers find use.

The present invention is based upon a full realization of the above problems and circumstances and has for its object to provide a compensation therefor, such that the thermal latch means employed on the circuit breakers will not be effected by these external influences, to the extent that the controlled electrical circuit is

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affected and the latch means is left free to handle the current rating before it is rendered effective to break the circuit.

A further object of the invention, therefore, is to provide a circuit breaker having a thermal latch means which is compensated against influence by changing ambient temperature conditions, as well as by vibration or shock, and which is adapted to function to break the circuit only under the influence of the varying electric current load.

The above and further objects and advantages in the invention will appear clear from a consideration of the following description with reference to the accompanying drawings, which include a disclosure of one particular application and form of the invention given by way of example.

In the accompanying drawings:

Figure I is a schematic view of an electro-thermal latch and ledge block assembly, as disclosed in the co-pending patent application, Serial No. 97,356, filed June 6, 1949,

Figure II is a similar view to Figure I but incorporating the ambient temperature compensating feature of the present invention.

Figure III is an elevational view of one form of circuit breaker incorporating the invention.

Figure IV is an elevational view of the movable contact, compensative thermal latch and block structure of Figure III separated from the circuit breaker casing and the fixed contacts therein,

Figure V is a perspective view of Figure IV on a reduced scale, with the latch springs removed and the contact ends of the movable contacts removed for ease of illustration, and

Figure VI is an end view of Figure IV.

Referring to the drawings, and first to Figures I and II, which illustrate the general principles involved, in Figure I the thermal latch, is as disclosed in the co-pending patent application, Serial No. 97,356, filed June 6, 1949, and involves a two-sided plate structure which includes a U-shape electro-thermally active strip 10, adapted to have latching engagement with ledge 12 on the insulator block 14, and a separate strip structure 16 which may be regarded as of double finger formation, as seen in Figure VII of said co-pending application, and is non-electrically conductive, as to the latch circuit, and serves to guide the latch strip 10 with respect to the block 14 by having sliding engagement with respect to one side of the block. In this figure, the latch assembly is to be regarded as having no temper-

ature and shock (or vibration) compensation and the thermal latch strip 10 is to be regarded as located substantially in the position which it will occupy under current load prior to snapping away from engagement with the ledge upon the overload condition being reached. Considering the latch arrangement as thus described with reference to Figure I and bearing in mind the fact that the latch strip 10 is finely calibrated to trip at a predetermined current rating, and this with respect to a standard ambient temperature, it will immediately be appreciated that if this ambient temperature (room temperature, for example) undergoes an appreciable change, this itself will have an effect upon the thermal strip, such as may well cause the latch to trip unintentionally, without any current flow occurring, if the temperature change is upward, or which will cause the latch to move further onto the ledge, if the temperature change is downward. In this last mentioned instance, when current is flowing, the latch will not be positioned to trip upon the occurrence of the predetermined current overload rating. In this connection it should be taken into account that below and above zero temperatures have to be considered.

Such are the circumstances and conditions which have to be taken into account if the latch is to be properly effective.

Referring now to Figure II, the above circumstances and conditions have been taken into account by the guide fingers 16 being made of bimetallic form and arranged so that the low expansion side is on the inside, that is, on the side adjacent the block 14.

With the latch thus modified the ambient temperature changes will be compensated for, since with an increase in ambient temperature the fingers 16 will tend to bow to the right, as viewed in Figure II, and thus cause the thermal latch strip 10 to be pulled back onto the ledge 12. The reverse action will occur for changes in ambient temperature on the downgrade.

With the bi-metallic form of the latch guide strips 16 it also happens that when current is flowing through the latch strip 10, the strip 16 will also become heated by conduction and give rise to a tendency for the latch strip 10 to be held back onto its ledge 12 until the current overload rating has been attained, thereby arresting the latch against premature tripping due to shock or vibration.

With a proper selection of the bi-metallic materials constituting the guide fingers 16 it is possible to insure that the time lag between the subjecting of the thermal latch to the overload current and the tripping of the latch is constant for any ambient temperature for the same overload current rating.

Referring now to Figures III to VI the circuit breaker shown therein, as in the case of the disclosure in said co-pending application Serial No. 97,356, filed June 6, 1949, comprises a two-part insulated casing, one part of which is indicated at 18, and has a pair of fixed electrical contacts 20 therein for operative association with a pair of movable contacts 22 carried at the ends of flexible arms 24 mounted upon a latch structure, indicated generally at 26, and piloted upon the opposite side of a block 28 of insulating material with the interposition of coil springs 30 connected between the flexible arms 24 and ears 32 on an insulator block 34 fixed in a recess 36 in the casing part 18.

The latch structure comprises a U-shape latch plate 38 the bridge part 40 of which is adapted to have latched electrical conducting engagement with a wear plate 42 on the block 34, as indicated in Figure VI. The side limbs of the U-plate 38 are bent back at their ends to provide ears 44 and these, together with similar ears 46 on a guide finger structure 48 located on the opposite side of the block 28, serve for the attachment of the flexible arms 24. Whereas, however, the latch plate 26 is electrically conductive and constitutes the electro-thermal latch part for automatically breaking the controlled circuit at overload the guide finger structure is rendered non-electrically conductive, by the interposition of the insulator strip 50.

The guide finger structure is adapted to engage the side of the block 28 remote from the latch plate 26 and serves properly to locate the latch plate with respect to this block and the wear plate 42, as well as providing the compensating effect above mentioned by the guide fingers 52 being bi-metallic and having their low-expansion side facing the latch plate, with the result explained with reference to Figure II.

The existence of a small clearance between the united ears 44 and 46 and the adjacent surfaces of the block 28 permit such adjustment as is necessary in the functioning of the compensating structure under the varying temperature conditions above mentioned.

A description of the general operation of the circuit breaker is thought unnecessary in view of the full disclosure given in the said co-pending application, Serial No. 97,356.

Having thus disclosed by invention in principle and in one practical form, what I claim as novel and wish to secure by Letters Patent is as follows:

1. An electric circuit breaker with overload protection comprising in combination, fixed contact means, movable contact means in opposed relation to said fixed contact means, structure for supporting said movable contact means for movement toward and from said fixed contact means, said structure including electrically conductive thermally responsive latch means in electrical series with said movable contact means and bi-metallic guide means, fixed guide structure on which said first structure is supported and guided for movement toward and from said fixed contact means, said fixed structure including an abutment with which said latch means engages to hold the said first structure in latched position with said contact means closed, and said fixed structure including also a guide surface with which said bi-metallic guide means engage to hold said thermal latch means properly located with respect to said abutment in the latched position.

2. An electric circuit breaker as claimed in claim 1, said bi-metallic guide means being non-electrically conductive with respect to said thermal latch means.

3. An electric circuit breaker as claimed in claim 1, said thermal latch means being mounted on said first structure to engage said abutment on one side of said fixed structure and said bi-metallic guide means being mounted on said first structure to have sliding engagement with the opposite side of said fixed structure, said bi-metallic guide means having its low expansion side on the inside facing said thermal latch means.

4. An electric circuit breaker with electrical overload protection comprising in combination,

a pair of fixed contacts, a pair of movable contacts in opposed relation to said fixed contacts, structure supporting said movable contacts for movement toward and from said fixed contacts, said structure including thermally responsive latch means in electrical connection with said movable contacts and bi-metallic guide means insulated from said latch means, fixed guide structure, said structure defining an abutment ledge on one side thereof and a guide surface on the opposite side extending perpendicularly with respect to said abutment ledge, said first structure supporting said latch means for engagement with said abutment ledge to hold the movable contacts closed against said fixed contacts and supporting said bi-metallic guide means for sliding engagement with respect to said guide surface, said bi-metallic guide means having the low expansion side thereof facing said guide surface.

5. An electric circuit breaker as claimed in claim 4, comprising spring means connected with said first structure to continuously bias said movable contacts away from said fixed contacts, said spring means being tensioned when the said latch means is engaged with said abutment ledge.

6. An electrical switch having overload protection comprising in combination, two sets of contacts, one set being movable relatively to the other set, said sets of contacts being in opposed contactable relation, a manual actuator connected with said movable contact set to move the said contact set into closed relation with respect to the other contact set, guide structure supporting said manual actuator for movement to close said contacts, said guide structure defining an abutment ledge and a guide surface extending perpendicularly with respect to said abutment ledge, a thermal latch in electrical connection with said contacts in position to engage said abutment ledge to hold said contact sets closed, said thermal latch being movable by said actuator to engage said abutment ledge, and said thermal latch incorporating bi-metallic guide means in sliding engagement with said guide surface and spring means constantly acting to

open said contacts, said bi-metallic guide means having a low temperature side and a high temperature side, said low temperature side facing said guide surface.

7. An electric switch having overload protection comprising in combination, fixed contact means, movable contact means, spring means continuously acting to separate the contacts, a thermal latch deflected by overload and arranged in electrical series with said contacts and associated with said movable contact means to move therewith as a unit, fixed structure including an abutment ledge on one side with which said latch normally engages to hold said contact means closed against the action of said spring means, said fixed structure including also a guide surface on the side thereof opposite said abutment ledge, bi-metallic guide means associated with said movable contact means and movable therewith, said bi-metallic guide means being in sliding engagement with said guide surface, and having its low temperature side facing said guide surface, a manual actuator movable in one direction to engage said thermal latch with said abutment ledge and stress said spring means while maintaining said bi-metallic guide means in engagement with said guide surface, and means associated with said actuating member and engageable with said latch upon movement of said actuator in the opposite direction to move said latch away from said guide means and out of engagement with said abutment ledge and separate said contact means.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,704,379	Aichele	Mar. 5, 1929
2,210,261	Sachs	Aug. 6, 1940
2,461,126	Overturf	Feb. 8, 1949
2,485,736	Ingwersen	Oct. 25, 1949