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Dafler et al.

[11] **3,718,162**

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[54] CIRCUIT BREAKER

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[73] Assignee: **General Motors Corporation,** Detroit, Mich.

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[21] Appl. No.: **196,010**

[52] **U.S. Cl.** **337/94,** 337/101, 337/111, 337/372

[51] **Int. Cl.**.....**H01h 61/08**

[58] **Field of Search**.....337/94, 95, 96, 99, 101, 111, 337/349, 372, 374, 375, 379

[56] **References Cited**

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3,292,070	12/1966	Hischak	337/111 UX
2,794,884	6/1957	Shaw et al.	337/96
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3,238,780	3/1966	Doyle	337/379 X
2,627,003	1/1953	Porter	337/94 UX

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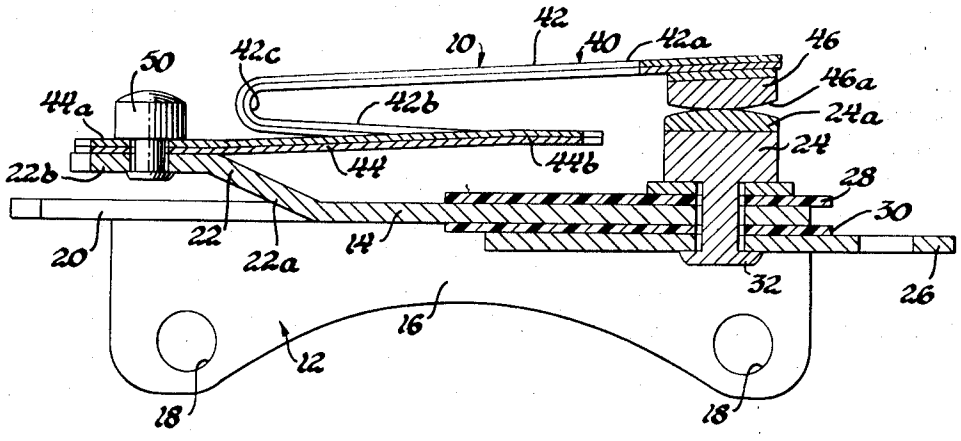
Assistant Examiner—A. T. Grimley
Attorney—W. E. Finken et al.

[57] **ABSTRACT**

In a preferred form, this disclosure relates to an overload circuit breaker having a metal base with an upwardly extending tang thereon, a stationary contact carried by, but insulated from the base, a bimetal strip including a primary U-shaped portion having one leg carrying a mobile contact adjacent its free end and overlying said stationary contact and a secondary portion supported in cantilever fashion by the tang and having its free end connected with the other leg of the U-shaped primary portion. The bimetal strip is normally self-biased toward a first position in which the mobile contact engages the stationary contact to provide a conductive path therethrough, but is movable toward a second position in which the mobile contact is disengaged from the stationary contact when a current in excess of a predetermined magnitude is passed therethrough for a predetermined interval of time. The tang on the base is bendable to adjust the spring pressure of the bimetal strip so that the predetermined time interval prior to opening of the contacts when an overload of current is passed therethrough can be readily calibrated.

3 Claims, 5 Drawing Figures



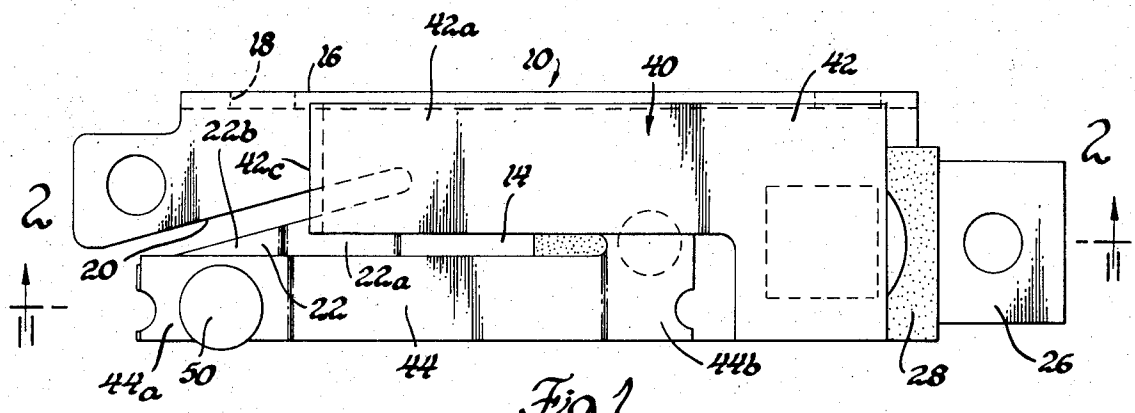


Fig. 1

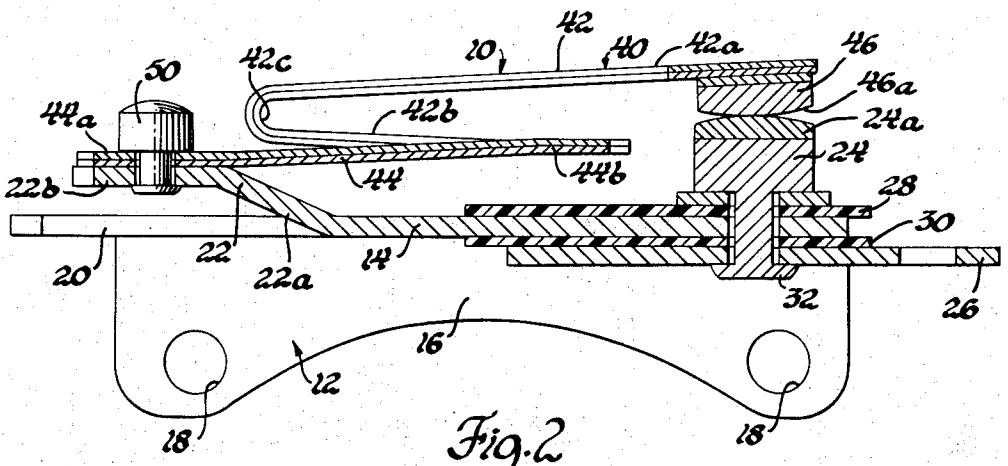


Fig. 2

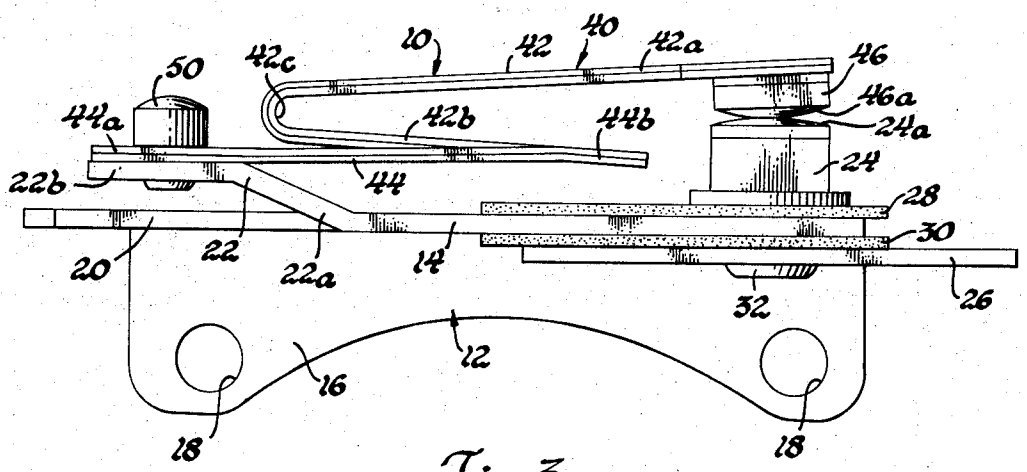
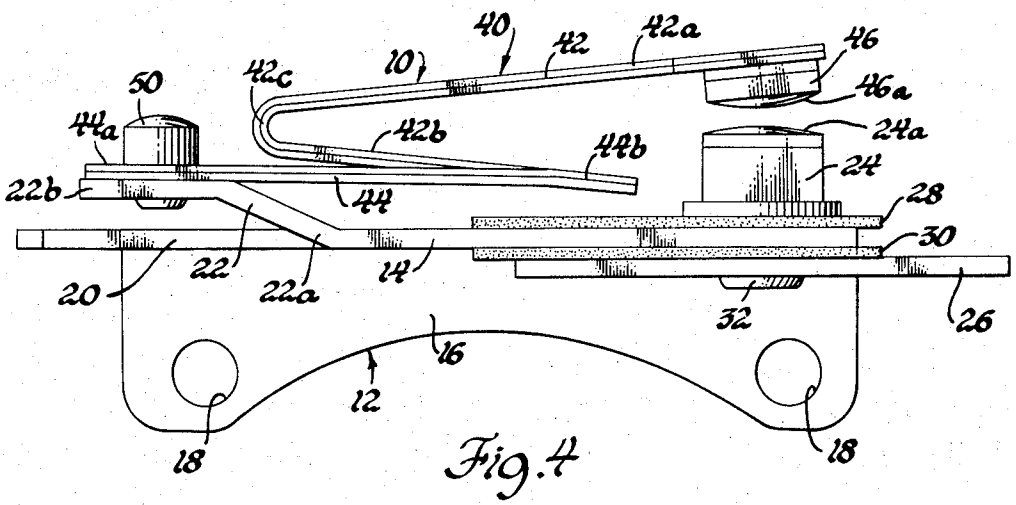


Fig. 3


40
42
42a
46
46a
10
42c
50
44a
42b
44b
24a
24
22b
44
28
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20
22
22a
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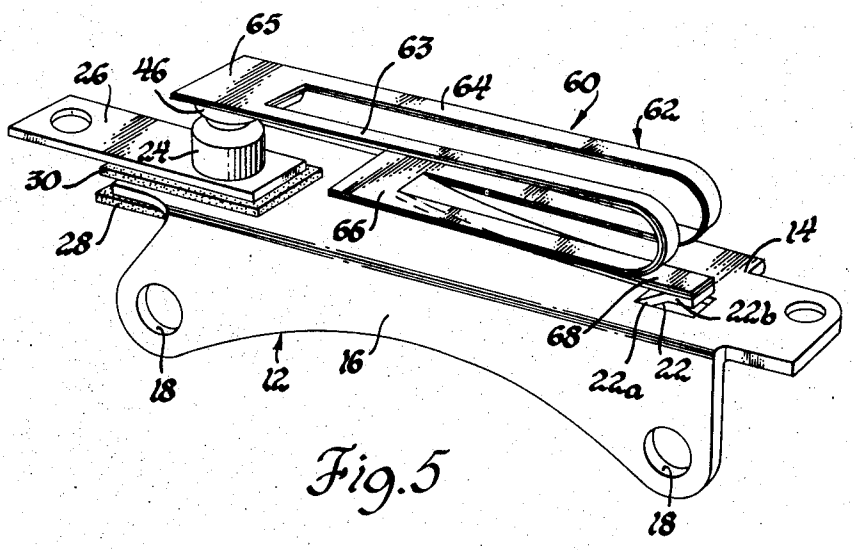
16
12
18
18

Fig. 4


65
63
64
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62
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22b
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Fig. 5

CIRCUIT BREAKER

The present invention relates to an overload circuit breaker, and in particular to an overload circuit breaker which can be readily calibrated.

It has been common to employ thermal overload circuit breakers in automotive electric motors, such as windshield wiper motors, and with the overload circuit breaker being connected in circuit with the motor so that the total motor current flows therethrough. Such an overload circuit breaker is disclosed in Wood U.S. Pat. No. 2,585,068, which circuit breaker is responsive to both ambient temperature and motor current.

The primary function of an overload circuit breaker in an electric motor is to protect the motor from destruction due to excessive heat under a stall condition. The overload circuit breaker setting is determined and calibrated by tests under stall conditions of the motor. It is well recognized that commercially available thermal overload circuit breakers cannot be economically calibrated to open at a precise time interval due to production methods and tolerances of the various parts, and accordingly, commercially available overload circuit breakers have a spread of a predetermined time interval between low and high limit trip times, which spread may be on the order of 6 to 8 seconds.

One common type of overload circuit breaker which has heretofore been used is like that disclosed in Wood U.S. Pat. No. 2,585,068, a circuit breaker which is responsive to both ambient temperature and motor current. This type of circuit breaker included a metal base, a stationary contact carried by, but electrically insulated from the base, and a two-piece bimetallic member having a primary U-shaped portion having one leg carrying a mobile contact adjacent the free end and overlying the stationary contact and a secondary portion supported in cantilever fashion by the base and having its free end welded to the other leg of the U-shaped primary portion. The bimetal was self-biased so that the upper U-shaped portion tended to keep the contacts closed. When an overload current condition existed the upper bimetal tended to open the contacts, but the lower bimetal member deflected to keep the upper one closed initially during the overload until a predetermined time period passed whereby the upper one would deflect to open the contacts. The secondary portion, since it was connected to the metal base tended to cool more rapidly and to deflect toward its normal cool position and thereby tended to keep the upper bimetal in a position in which the contacts were open for a predetermined time period before the bimetal cooled down and again closed the contacts. This time period was for approximately 10 seconds.

The above-noted type of circuit breaker, to be functional with specific types of motor applications, must operate to separate the contacts within a predetermined time interval, between low and high trip time, (16 to 22 seconds in windshield wiper motor applications). Due to production methods and the tolerance variations within individual circuit breakers being manufactured it is necessary to calibrate the bimetal strip. To calibrate the bimetal strip it was heretofore necessary to push either the primary or secondary bimetal portion down to a certain force level and predict that it would open within a certain time interval when an overload current was passed therethrough. If it did not open within a time interval, it was necessary to readjust the spring pressure by deflecting or deforming either one of the bimetal portions until the desired time interval was achieved. This method of calibrating the circuit breaker is both costly and not highly accurate.

The present invention relates to a new and improved overload circuit breaker of the above-noted type and which has less tolerance problems and better predictable heat flow characteristics than known circuit breakers of this type and can be readily and accurately calibrated.

Accordingly, an important object of the present invention is to provide a new and improved overload circuit breaker of the kind referred to above and in which the bimetal strip is supported in cantilever fashion on a tang or lever extending outward from the plane of the base and in which the tang is bendable while the breaker is being calibrated by passing an overload current therethrough to cause the bimetal strip to disengage its associated stationary contact adjacent the start of the time interval whereby subsequent use of the circuit breaker will cause the bimetal strip to open within the predetermined time interval.

Another object of the present invention is to provide a new and improved circuit breaker, as defined in the preceding object, and in which the bimetal strip is of a one-piece construction.

A further object of the present invention is to provide a new and improved method for calibrating a circuit breaker of the type referred to above which includes the steps of supporting the bimetal strip on an upwardly extending tang on the base, passing an overload current therethrough, and pushing down on the tang at the predetermined time subsequent to the start of the overload current passing therethrough to cause the bimetal strip to open the contacts adjacent the start of the predetermined interval of time whereby the overload circuit breaker is accurately calibrated.

The advantages of the above overload circuit breaker are that it can be accurately calibrated to cause the contacts to open within a predetermined time interval irrespective of the tolerance variations of the various parts of the circuit breaker. By pushing down on the tang at the start of the predetermined time interval to cause the contacts to open guarantees that the circuit breaker will always open within the predetermined time interval irrespective of the spring back characteristics of the bimetal strip, since any subsequent opening of the contacts will be intermediate the range of the predetermined time interval. Other advantages are that by using a one-piece bimetal construction a savings in material handling is achieved as well as better predictable heat flow because there is no weld between the two bimetal portions.

The present invention further resides in various novel constructions and arrangement of parts, and further objects, novel characteristics and advantages of the present invention will be apparent to those skilled in the art to which it relates and from the following detailed description of the illustrated embodiments thereof made with reference to the accompanying drawings forming a part of this specification and in which similar reference numerals or characters are employed to designate corresponding parts throughout the several views, and in which:

FIG. 1 is a top plan view of a preferred embodiment of the overload circuit breaker of the present invention;

FIG. 2 is a side elevational view looking in the direction of the arrow 2—2 of FIG. 1;

FIGS. 3 and 4 are side elevational views like that shown in FIG. 2, but showing different parts thereof in different positions; and

FIG. 5 is a perspective view of another embodiment of an overload circuit breaker of the present invention.

As representing a preferred embodiment of the present invention, FIG. 1 of the drawings shows an overload circuit breaker **10**. The overload circuit breaker **10** comprises a base **12** having a planar top portion **14** and depending side portion **16**. The side portion **16** includes a pair of openings **18** to enable the base **12** to be bolted to a suitable support within an electric motor (not shown). The top portion **14** of the base **12** includes a section which is separated therefrom by a slot **20** and which is bent upwardly or outwardly of the plane of the base to define a tang or lever **22**. The tang **22** has a first portion **22***a* integral with the top portion **14** of the base and which extends upwardly therefrom at an acute angle and a second portion **22***b* which is spaced from the plane of the top portion **14** but extends parallel thereto.

The top portion **14** of the base further carries a stationary contact **24** and a stationary male blade terminal **26**. The contact **24** and the male blade terminal **26** are electrically insulated from the base by a pair of insulated strips **28** and **30** made from a suitable electrically insulating material. The stationary contact **24** is in the form of a rivet which is staked over on the underside of the male blade terminals **26** as indicated at **32** to securely retain the stationary contact **24** and the male blade terminal **26** in place. The male blade terminal **26** is adapted to be connected to a suitable lead in the circuit for the electric motor (not shown). The stationary contact **24** has a convex upper surface **24***a* and is preferably made from a sliver-cadmium material.

The circuit breaker further includes a one-piece bimetal strip or member **40**. The bimetal member **40** is stamped from suitable strip stock and bent to the configuration shown in the drawings. It can be made from any suitable metallic materials having different coefficients of expansion. The bimetal member **40** includes an upper or primary portion **42** and a lower or secondary portion **44**. The upper portion **42** is bent into the shape of a U and has a long leg section **42***a*, a short leg section **42***b* and a bight section **42***c*. The long leg **42***a* carries a mobile contact **46** adjacent its free end which overlies the stationary contact **24**. The mobile contact **46** has a convex surface **46***a* and is preferably made from a silver-cadmium material. The lower portion **44** is rigidly connected at one end **44***a* to the portion **22***b* of the tang **22** by a rivet **50**. The lower portion **44** is substantially planar and it and the U-shaped portion **42** are supported in cantilever fashion by the tang **22**. The upper and lower portions **42** and **44** are located side by side and with the lower portion **44** being integrally connected at its other end **44***b* to the free end of the leg **42***b* of the upper portion **42**.

The bimetal member **40** is resilient and self-biased toward a first position in which the mobile contact **46** is in engagement with the stationary contact **24**, as shown in FIG. **2**, when at room temperature and no current is being passed therethrough. When a non-overload current of less than a predetermined magnitude is being passed therethrough and/or the ambient temperature rises, the upper bimetal portion **40** heats up and tends to separate the contacts **46** and **24**. However, since the lower portion **44** is also being heated it tends to move or deflect toward a position, as shown in FIG. **3**. Thus, the lower portion **44** tends to maintain a constant pressure on the upper portion **42** to maintain the contacts closed with a predetermined pressure while normal currents are passed through the bimetal member.

The lower portion **44** of the bimetal **40** also keeps the upper portion **40** in its first or closed position during the initial time period when an overload condition occurs, i.e., when a current in excess of a predetermined magnitude is passing through the bimetal member **40**. Thus, the lower member **44** will tend to deflect further downwardly. However, since the lower member **44** is directly connected to the base **12**, heat will be dissipated by conduction much more readily than heat will be dissipated by convection when the upper member **42** heats up. Thus, at a predetermined time period subsequent to an overload current passing through the bimetal member **40**, the upper portion **42** will deflect toward a second position in which the mobile contact **46** is separated from the stationary contact **24**, as shown in FIG. **4**.

The lower portion **44** also serves to hold the upper portion **40** in its open position, as shown in FIG. **4**, for a predetermined time interval, preferably approximately **10** seconds. The upper portion **42** when in its open position will tend to cool rapidly by convection, but not as rapidly as the lower portion **44**, since the lower portion **44** is directly connected to the base **12** and hence will tend to cool more rapidly due to conduction through the base. This results in the lower portion **44** cooling and deflecting upwardly to maintain the upper portion **42** in a circuit open position for a predetermined time, approximately 10 seconds.

An important feature of the present invention is the provision of the tang **22** which enables the spring pressure of the bimetal member **40** to be readily adjusted during the calibration process by bending the same so that the bimetal will deflect to open the contacts **46, 24** within a predetermined time interval subsequent to the passage of an overload current therethrough.

After the overload circuit breaker **10** is constructed and assembled as shown in the drawings, it is calibrated by connecting the base at its left end to a suitable lead and the terminal **26** to another lead in the circuit and then passing an overload current through the bimetal member **40**. Assuming that the bimetal should open within a time interval of 16 to 22 seconds subsequent to the start of an overload current passing therethrough, the person doing the calibrating would merely push down on the tang **22** with a suitable tool to deflect and bend the same toward the top portion **14** of the base **12** to cause the contacts **46** and **24** to separate at the low trip time or start of the predetermined time interval. It can be seen from FIG. **2** of the drawings that the tang **22** functions as a lever for moving the bimetal member upwardly when pushed toward the top of the base **12**. The tang **22** when pushed downwardly toward the base is permanently deformed or bent. This will insure that when the circuit breaker **10** is subsequently used in an

electric motor that it will open up within the predetermined time interval desired. Due to inherent spring back characteristics in the bimetal member **40**, the tang **22** is pressed down at the beginning or the start of the low trip time of the predetermined time interval so that the resultant time period at which it will deflect toward its open position, as shown in FIG. **4**, will be intermediate the range between 16 and 22 seconds. After the bimetal member **40** is calibrated, the circuit breaker is disconnected from the testing circuit.

From the foregoing, it can be seen that the provision of the tang **24** enables the circuit breaker to be readily and accurately calibrated and that it provides for a method of calibration which is highly accurate.

FIG. **5** shows an alternative embodiment of an overload circuit breaker **60** constructed in accordance with the provisions of the present invention. The circuit breaker **60** is identical to the circuit breaker **10**, except that a different shape bimetal member **62** is employed. The parts of the overload circuit breaker **60** which are identical to and correspond to the parts of the circuit breaker **10** have been given the same reference numerals. The bimetal member **62** has a pair of U-shaped portions **63** and **64** which are integrally connected at the free ends of the upper and lower legs by cross pieces **65** and **66**. The bimetal member **62** also has a lower or secondary portion **68** which is lanced from the upper portion and is integral at its free end with the cross piece **66**. The width of the lower portion **68** corresponds to the width between the U-shaped sections **63** and **64**. Also, the bimetal member **60** is secured to the tang **22** by welding rather than by a rivet. The operation and function of the bimetal member **62** is the same as that previously described above in connection with the bimetal member **40**.

Although the illustrated embodiments hereof have been described in great detail, it should be apparent that certain modifications, changes, and adaptations may be made in the illustrated embodiments, and that is is intended to cover all such modifications, changes and adaptations which come within the spirit of the present invention.

What is claimed is:

1. An overload circuit breaker comprising: a metal base; a stationary contact carried by, but electrically insulated from the base; a tang upstruck from said base and bent to a first position in which it is disposed above the plane of said base, said tang being supported in cantilever fashion by said base; a bimetal member including a primary U-shaped portion and a secondary portion, said secondary portion having one end connected with one leg of said primary portion and its other end connected with said tang and being supported in cantilever fashion by said tang, said primary portion having a mobile contact adjacent the free end of the other leg thereof which overlies said stationary contact, said bimetal member being self-biased toward a first position in which said mobile contact biasingly engages said stationary contact to provide conductive path therethrough when a current of less than a predetermined magnitude is passed therethrough, said bimetal being movable toward a second position in which it is disengaged from the stationary terminal to break the conductive path therethrough when a current in excess of a predetermined magnitude and for a predetermined time interval is passed therethrough, said tang being bendable relative to said base from its first position to a second position to adjust the biasing force of said bimetal member whereby the predetermined time interval during which the bimetal is caused to be moved towards its second position when a current in excess of a predetermined magnitude is passed therethrough can be varied.

2. An overload circuit breaker comprising: a metal base, a stationary contact carried by, but electrically insulated from the base; a tang integral with the base and having a first portion bent upwardly from the plane of the base to form an acute included angle with the base and a second portion bent to extend generally parallel with the base, said tang being supported in cantilever fashion by the base; a one piece bimetallic member including a primary U-shaped portion and a secondary planar portion, said secondary portion having one end secured to the second portion of said tang and being supported by said tang in cantilever fashion, said secondary portion at its free end being integrally connected with one leg of said primary portion, said secondary portion and said primary portion being disposed side by side and said primary portion having a mobile contact at the free end of its other leg which overlies said stationary contact, said bimetal member being self-biased toward a first position in which said mobile contact biasingly engages said stationary contact when a current of less than a predetermined magnitude is passed therethrough, said bimetal member being movable toward a second position in which it is disengaged from the stationary contact to break the conductive path therethrough when a current in excess of a predetermined magnitude is passed therethrough and for a predetermined time interval, said tang being bendable relative to said base to an adjusted position to adjust the biasing pressure of said bimetal member whereby the predetermined time interval during which the bimetal is caused to be moved toward its second position when a current in excess of a predetermined magnitude is passed therethrough can be varied.

3. In an overload circuit breaker having a base, a stationary contact carried by, but insulated from the base, a bimetal member including a primary U-shaped portion having one leg carrying a mobile contact adjacent its free end and a secondary portion supported in cantilever fashion by said base and having its free end connected with the other leg of the U-shaped primary portion, and in which the bimetal strip is normally self-biased toward a first position in which the mobile contact biasingly engages the stationary contact to provide a conductive path through the bimetal member, but which is movable toward a second position in which the mobile contact is disengaged from the stationary contact to break the conductive path through the bimetal member when a current in excess of a predetermined magnitude is passed therethrough for a predetermined interval of time, the improvement comprising: an upstruck bendable tang integral with said base and having a first portion extending upwardly from said base and a second free end portion extending generally parallel with said base, said second free end portion being secured to the end of said secondary portion remote from the free end of the latter, said tang being bendable relative to the plane of said base to an adjusted position

to vary the biasing pressure exerted by said bimetal member whereby the predetermined time interval during which the bimetal is caused to be moved toward its second position when a current in excess of a predetermined magnitude is passed therethrough can be adjusted.

* * * * *