

April 28, 1942.

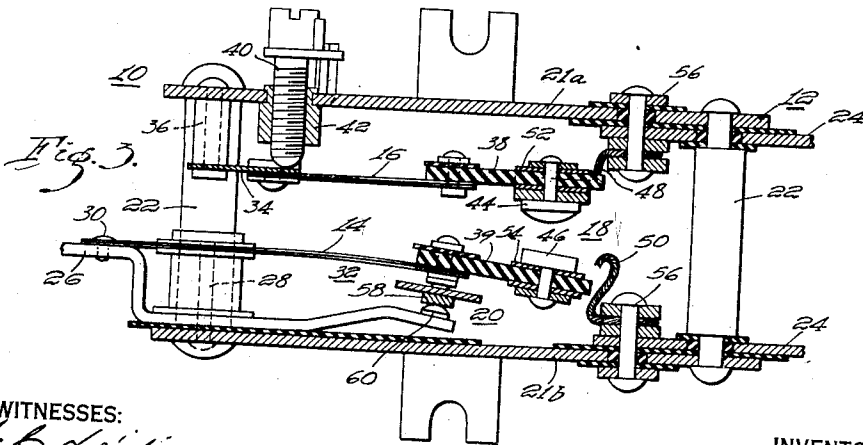
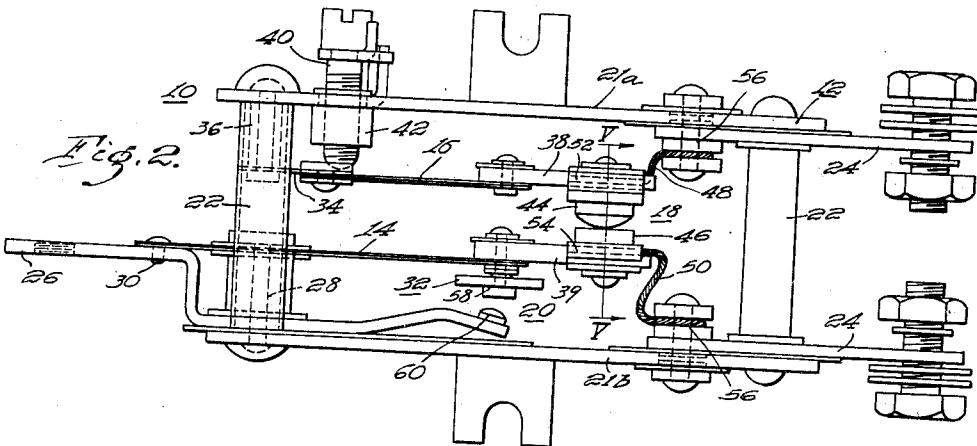
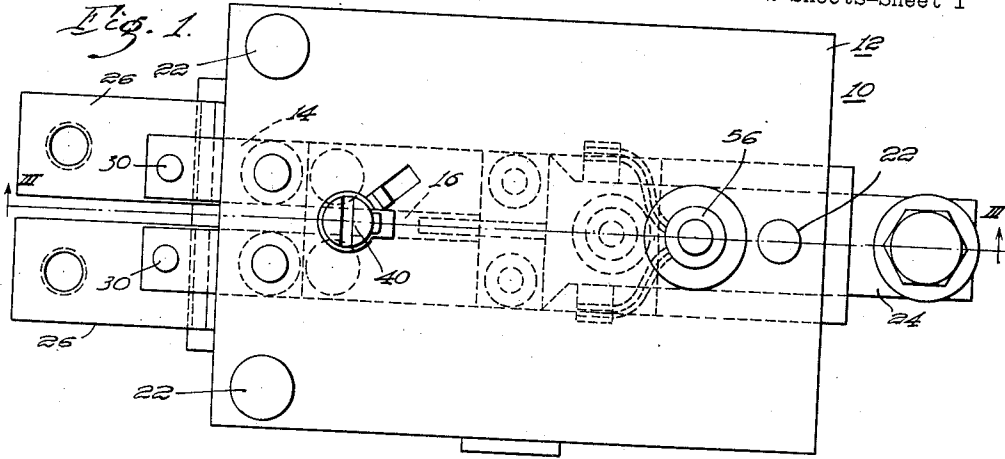
P. R. LEE

2,280,960

CURRENT LIMITING RELAY

Filed Oct. 20, 1939

2 Sheets-Sheet 1



WITNESSES:

E. C. Hiding
H. C. Hyler

INVENTOR

Paul R. Lee

BY

W. R. Coley
ATTORNEY

April 28, 1942.

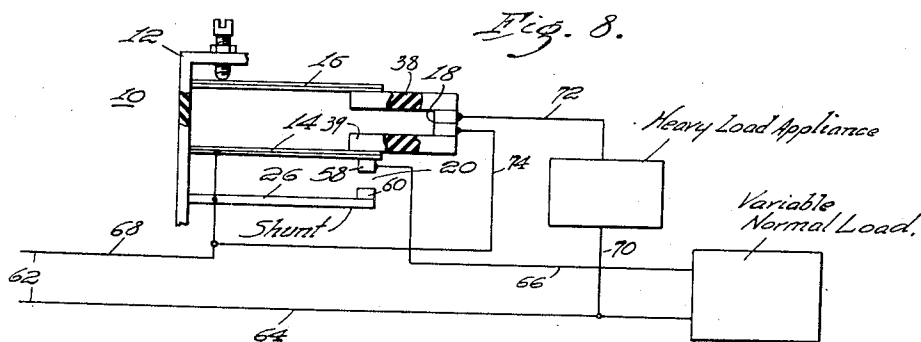
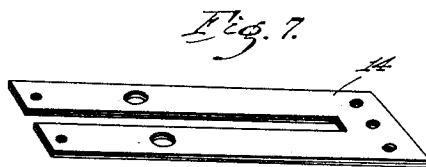
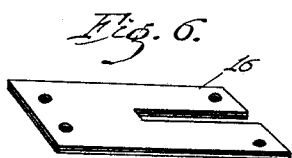
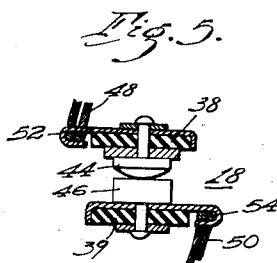
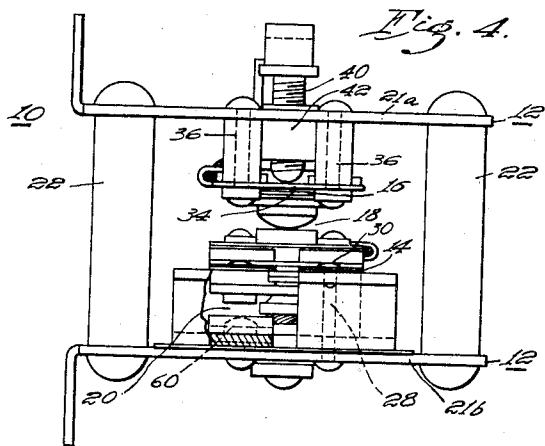
P. R. LEE

2,280,960

CURRENT LIMITING RELAY

Filed Oct. 20, 1939

2 Sheets-Sheet 2



WITNESSES:

E. B. Harding
W. H. Nepler

INVENTOR

Paul R. Lee

BY

W. R. Coley
ATTORNEY

UNITED STATES PATENT OFFICE

2,280,960

CURRENT LIMITING RELAY

Paul R. Lee, Mansfield, Ohio, assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 20, 1939, Serial No. 300,421

3 Claims. (Cl. 200—113)

My invention relates to the thermal relays and more particularly to a temperature-compensated adjustable relay.

With the increasing use of both electric ranges and water heaters there is, in a large number of territories, a tendency for localized load-peaks to occur on distribution systems. These peaks usually occur on residential lines in the early evening hours, or at times when there is the possibility of both the household range and water heater being energized. To eliminate the possibility of distribution failures from such localized peaks the power companies have been required to install larger equipment, which requires substantially increased expenditures without any commensurate increase in return for such companies. To overcome this substantial increase in expenditure, I propose that the power companies install an inexpensive relay which will limit the power usage at each house which has both an electric range and water heater. In other words, the localized load-peaks would be eliminated at their source.

It is therefore an object of my invention to provide an inexpensive, rugged, efficient relay which may be installed in series with the supply circuit of each of those homes which have both an electric range and water heater and associated with the water heater so as to disconnect such water heater from the supply circuit when the maximum permissible "normal" load of the house has been reached.

A further object of my invention is to provide a thermal relay connected in a selected circuit and which, when the current flowing in the circuit exceeds a predetermined amount, will operate to reduce the flow of current within the circuit.

A further object of my invention is to provide a thermal relay adapted to limit the flow of current passing through a circuit, with means associated therewith for compensating for the changes in ambient temperature.

Another object of my invention is to provide a thermal relay having means for compensating for the changes in the ambient temperature surrounding such relay, with adjustable means associated therewith for selectively adjusting the operations of such device.

Other objects of my invention will either be pointed out specifically in the course of the following description of a device embodying my invention, or will be apparent from such description.

In the accompanying drawings:

Figures 1 and 2 are top and side elevational views, respectively, of a thermal relay embodying my invention;

Fig. 3 is a sectional view, taken along the line III—III of Fig. 1 with the relay in its inoperative position;

Fig. 4 is an end view taken from the left-hand end of Fig. 2;

Fig. 5 is a sectional view taken along the line V—V of Fig. 2;

Figs. 6 and 7 are perspective views of the bimetallic elements incorporated in the relay embodying my invention; and

Fig. 8 is a schematic wiring diagram illustrating the method of connecting the relay to a house load.

Referring to the accompanying drawings, in which like reference characters indicate like parts in the several figures, I show a thermal relay 10 comprising a supporting structure 12, a main bimetallic or thermal responsive element 14 adapted to carry current, a secondary bimetallic or thermostatic element 16 adapted to compensate for changes in the ambient temperature, main cooperating contacts 18 controlled by the respective bimetallic elements 14 and 16, and secondary contacts 20 adapted to shunt or limit the amount of current passing through the main element 14 under conditions of abnormally large power usage.

The supporting structure 12 comprises, in this instance, two plate-like members 21a and 21b rigidly attached together by means of suitable pin or rivet structures 22. Plate 21a is positioned on top of the structure, while plate 21b is located on the bottom. The pin structures 22 are adapted to space the plates apart from each other to enable the operating mechanism of the relay to be located therebetween and rigidly attached thereto.

Auxiliary or secondary terminal straps 24 are rigidly attached to the supporting structure 12 at one end thereof. One terminal strap 24 is insulatedly attached to the upper plate 21a, while the second terminal strap 24 is insulatedly attached to the lower plate 21b. The terminal straps 24 are adapted to have attached thereto the secondary or controlled circuit, and are flexibly associated with the main cooperating contacts 18 as hereinafter described. Main terminals or terminal straps 26, being two in number, are insulatedly and rigidly attached to the lower plate 21b, by means of suitable rivet structures 28. The straps 26 are, in this instance, elongated relatively narrow members which extend along the lower plate 21b. The outer or terminal ends of such straps are offset upwardly so as to be in line with the main bimetallic member 14. The inner ends of such straps 26 support the stationary contact 60 of the secondary contacts 20 below the bimetallic member 14.

The main bimetallic element or thermal responsive member 14 comprises, in this instance a U-shaped member (see Fig. 7). Such bimetallic member is rigidly attached to the supporting structure 12 by means of the rivets 28 and is rigidly and electrically attached to the terminal

straps 26 by means of suitable rivets 30. However, such bimetal may be welded to the terminals 26 in place of the rivets 30, if desired. The open or free ends of the bimetallic element are, in this instance, rigidly attached to the straps 26 where-
 as the closed or main end of the bimetallic element 14 is positioned within the relay 10. Each
 tine of the element 14 is electrically associated with a separate terminal strap 26, and, therefore,
 it follows that, with the terminal straps 26 elec-
 trically connected in series or parallel with the
 main or controlling circuit, the current passing
 through the controlling circuit, or a current pro-
 portional thereto, will flow through the main bi-
 metallic element 14. The bimetallic member is
 thus adapted to flex in response to the flow of
 current through such controlling circuit. In ad-
 dition, the bimetallic member 14 inherently flexes
 in response to changes in the ambient tempera-
 ture, the amount of such flexure being substan-
 tially the same in magnitude and direction as in
 the case of the compensating member 16.

Suitable means are located upon or rigidly at-
 tached to the free or inner end of the element 14
 by an insulating strip 39 for rigidly and in-
 sulatedly attaching a "movable" contact 46 there-
 to, constituting one of the cooperating contacts
 18 and being adapted to cooperate with the "mov-
 able" contact 44 as hereinafter described. In
 addition, a shunting contact structure 32 is loose-
 ly attached to the free end of the bimetallic
 member and is electrically associated therewith.
 The shunting structure 32 is adapted to contact
 the inner ends of the terminal straps 26 and to
 connect such straps in shunt to the bimetallic
 member 14 as hereinafter described. It is to be
 understood that the shunting contact structure
 32 need not be directly electrically associated
 with the bimetallic member 14 to connect the
 straps 26 in shunt thereto.

The secondary thermal responsive element 16
 comprises, in this instance, a substantially U-
 shaped member having relatively short tines.
 The secondary element 16 is resiliently attached
 to the supporting structure 10 by means of a
 flat spring or resilient member 34. The resilient
 member is rigidly attached to the free end of the
 secondary element 16 at one end thereof and to
 suitable supporting posts 36, mounted on upper
 supporting plate member 21a, at the other end
 thereof. The bimetallic member 16 is thus
 adapted to resiliently flex about the supporting
 posts 36 in an obvious manner in response to
 ambient temperature. The amount of such
 flexure is substantially the same, in magnitude
 and direction as the main bimetallic member 14.

The second or "stationary" contact 44 of the
 cooperating contacts 18 is insulatedly attached to
 the free end of the second bimetallic element 16
 by means of a suitable insulating member or
 strip 38. Contact 44 is adapted to cooperate
 with the first contact 46 insulatedly attached to
 the free end of the main bimetallic element 14.

A suitable manually operable adjusting screw
 40 is threadedly attached to upper plate 21a of
 the supporting structure 10 by means of a bush-
 ing 42. The adjusting screw 40 is positioned
 above and is adapted to contact the second bi-
 metallic member 16 at a point relatively near its
 flexible mounting. The adjusting screw 40, act-
 ing in opposition to the natural bias of bimetallic
 element 16, is thus adapted to adjust the second
 thermal responsive element 16 either downwardly
 or upwardly to any desired position. This fea-
 ture permits the thermostat to be readily ad-

justed to any desired operating value. By run-
 ning the screw 40 down, the thermostat is ad-
 justed to effect disengagement of the cooperat-
 ing contacts 18 with an increasingly higher cur-
 rent flowing through the main bimetallic element
 14. Conversely, with the screw being run up
 within the bushing 42 the contacts will become
 disengaged with a decreasingly lower flow of cur-
 rent through the controlling circuit.

The cooperating contacts 18 comprise, in this
 instance, the contact members 44 and 46 which
 are rigidly attached to the second bimetallic
 member 16 and to the main bimetallic mem-
 ber 14 by means of an insulating member 33
 and insulating member 39, respectively. In ad-
 dition to being rigidly attached to, and insulated
 from, the free ends of the bimetallic members
 14 and 16, the contacts 44 and 46 are flexibly
 and electrically attached to the secondary termi-
 nal straps 24 by means of suitable flexible leads
 48 and 50. The flexible leads 48 and 50 are
 rigidly attached to the movable contacts 44 and
 46 by means of suitable strap-like members 52
 and 54, respectively (see Fig. 5). The strap-
 like members are, in this instance, adapted to
 fit about the insulating members 38 and 39 and
 have suitable overhanging flanges outwardly dis-
 placed from the insulating members for permit-
 ting the flexible leads 48 and 50 to be squeezably
 attached thereto.

The flexible leads 48 and 50, while being con-
 nected to the movable contacts 44 and 46, re-
 spectively, which, in turn, are movable with the
 bimetallic members 14 and 16 do not materially
 restrict the movements of such bimetallic mem-
 bers. The flexible leads 48 and 50 are rigidly
 attached to, and electrically associated with, the
 terminals 24 by means of suitable insulating
 members and rivet structures 56 in a well known
 manner. It is therefore obvious that current
 may readily pass through the terminal straps 24,
 flexible leads 48 and 50, and cooperating contacts
 44 and 46 when closed.

The secondary or shunting contacts 20 include
 a suitable movable contact 58 preferably loosely
 attached to the lower surface of the main bi-
 metal 14 and a stationary contact 60 located
 upon the inner free end of each of the main ter-
 minal straps 26. The cooperating contacts 20
 are adapted to become engaged and limit the
 downward flexing action of the main bimetallic
 member 14 when an abnormally heavy load or
 current is flowing through that member. The
 cooperation of such contacts 58 and 60 serves to
 connect the terminal straps 26 in parallel with
 or in shunt to bimetallic member 14 and mate-
 rially reduce the flow of current therethrough as
 hereinafter described.

The relay 10 is electrically associated with a
 variable normal house load, such as a range, re-
 frigerator, lights, etc., and a heavy load appli-
 ance, such as a water heater or the like, in sub-
 stantially the following manner. One side of the
 variable normal load is connected to the power
 supply 62 by line 64. The other side of such load
 is then connected to the power supply by line
 66, bimetallic member 14 and line 68. The
 shunting terminals 26 are also connected to the
 line 68 at one end and are adapted to be con-
 nected in parallel with the member 14 upon the
 engagement of contacts 58 and 60 to reduce the
 flow of current through the bimetal upon an ab-
 normally large normal load. The heavy load ap-
 pliance is connected to the power supply 62 in
 parallel with the variable normal load by means

of line 64 and 70, and line 72 cooperating contacts 18, line 74 and 68. The passage of current through the heavy load appliance accordingly, in this instance, does not control the operation of the relay 10. The energization of the heavy load appliance is thus controlled by the amount of current passing through the variable normal load and main bimetallic member 14.

The bimetallic elements 14 and 16 are mounted with respect to each other so that they will move in a complementary manner with changes in the ambient temperature. That is, the two bimetallic members 14 and 16 will each flex substantially the same magnitude and direction with all changes in the ambient temperature. In other words, the two bimetallic members have similar thermal characteristics whereby they flex a similar amount in response to changes of temperature which affect both similarly. This characteristic ensures that the relay will operate at its predetermined set value regardless of the ambient temperature or the changes in such ambient temperature.

When operating the thermal relay embodying my invention, in association with, say, a dwelling house load, in which there is a plurality of heavy current-consuming apparatus, one of which it may be desired to deenergize during periods of abnormal load conditions, the main bimetallic member 14 is connected in series with the supply circuit (see Fig. 8). However, it is preferred that the main bimetallic member 14 be connected in series with the supply circuit exclusive of the heavy apparatus as hereinabove described to prevent the main contacts 18 of such relay from "hunting" or flickering.

The cooperating contacts 18 are connected in series with one of the heavy load appliances, such as a water heater, which it is desired to deenergize during such abnormal load conditions. Assuming the controlling circuit is drawing a normal amount of power, under the maximum permissible value, the main bimetallic element 14 will remain in its upper or engaged position (see Fig. 2). However, with a continued increase of the load of the controlling or main house circuit the main bimetallic element 14 will increase in temperature due to the flow of such current therethrough. Should such current increase above a predetermined maximum value, the bimetallic element would correspondingly increase in temperature and flex downwardly so as to disengage the cooperating contacts 18.

Upon the disengagement of the cooperating contacts 18 the heavy load appliance or water heater operatively associated therewith would be disconnected from the power supply. In this way, the load consumed by the dwelling house is suitably reduced. However, the bimetallic element 14 being connected to the normal load and not directly with the water heater, such element will remain in the contact-open position during a suitable period of time, or until the current flowing through the main bimetallic element is reduced below the predetermined maximum value. The contacts 18 then become reengaged, permitting the heavy load appliance to be reconnected to the supply circuits.

However, should the normal house load, such as lights and the range, draw a current above the predetermined maximum value, the bimetallic element 14 would again move or flex downwardly. This action would normally occur only during the evening hours, or at such other time as the

housewife would be normally using the electric range.

With the range connected to the power supply, the flow of current through the main bimetallic member 14 may be substantially above said maximum value whereupon such element will continue to flex downwardly. The downward flexing action or movement of the bimetallic element 14 under such abnormal conditions will be limited by means of cooperation of the secondary contacts 20. As the secondary contacts 20 become engaged, the terminal straps 26 are connected in parallel with the bimetallic element 14, as traced above, thereby limiting its downward travel. This cooperative action correspondingly reduces the flow of current through the bimetallic element 14 and permits the bimetallic member to cool and thereby avoid excessive bimetal temperature. In addition, such member may thus start to return to its normal position upon such reduction of the normal load. This action may result in a so-called "hunting" action of contacts 20. However, the voltage across such contacts is exceptionally small as a result of which there will be very little, if any, arcing therebetween as such contacts become disengaged. However, this action does not affect the normal flow of incoming current to the household.

Upon the reduction of power or flow of current in the main household circuit to its normal operating value, the bimetal 14 will then return to its normal substantially horizontal position, permitting the contacts 18 to reengage. The heavy load appliance such as a water heater will thereby be reconnected to the power supply.

It is therefore obvious that the thermal relay embodying my invention, when connected in series with the load of a normal home, will tend to limit the flow of current of such home. In other words, the relay will tend to eliminate any localized peak-load conditions which might otherwise occur throughout the residential districts during the early evening hours.

It is to be understood that while this relay is described as being associated with a dwelling house for the purpose of reducing the flow of current thereto, such structure may be used in any other desired manner or may be associated with any other suitable circuit.

Various modifications may be made in the device embodying my invention without departing from the spirit and scope thereof, and I desire, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and the appended claims.

I claim as my invention:

1. In a current limiting device for a dwelling house electric power circuit which disconnects a portion of the household circuit when the total power demand of the household is above a predetermined value, the combination of a supporting structure, a first bimetallic member resiliently attached to the supporting structure, a movable contact insulatedly attached to said bimetallic member, a terminal means insulatedly attached to the supporting structure, means connecting the movable contact and the terminal means comprising at least in part a flexible strap, a second bimetallic member attached to the supporting structure, said members moving in a common direction a like amount with changes in ambient temperature, a second movable contact insulatedly attached to the second bimetallic member, said second contact engaging said first contact during normal operations of the device,

a second terminal means attached to the supporting structure, means at least in part flexible connecting the second contact with the second terminal means, two main terminal means positioned upon and insulated from the supporting structure, contact means positioned upon the upper surfaces of the inner ends of the main terminal means, said second bimetallic member being attached to the main terminal means whereby said second bimetallic member is in series with such main terminals, a jumper contact attached to the second bimetallic member so as to engage the contact means upon the terminal means when said second bimetallic member has flexed to its fully open position whereby the current normally flowing through the second bimetallic member will be shunted through said main terminal means, said second bimetallic member flexing in response to the passage of a current through the main terminals whereby upon such current increasing above a predetermined value said member will flex so as to disengage the cooperating first and second contacts, and adjusting means supported by the supporting structure and engaging the first bimetallic member for adjustably positioning such member to selectively determine the predetermined current for disengaging said first and second contacts.

2. In a current limiting device for a dwelling house electric power circuit which disconnects a portion of the household circuit when the total power demand of the household is above a predetermined value, the combination of a supporting structure, a first bimetallic member resiliently attached to the supporting structure substantially parallel thereto, a movable contact insulatedly attached to said bimetallic member, a terminal means insulatedly attached to the supporting structure, means connecting the movable contact and the terminal means comprising at least in part of flexible strap, a second bimetallic member attached to the supporting structure substantially parallel thereto, said second bimetallic member being positioned beneath and substantially parallel to the first bimetallic member, said members moving in a common direction a like amount with changes in ambient temperature, a second movable contact insulatedly attached to the second bimetallic member, said second contact being positioned below the first contact and engaging said first contact during normal operations of the device, a second terminal means attached to the supporting structure, means at least in part flexible connecting the second contact with the second terminal means, two main terminal means having at least a part thereof positioned upon and insulated from the supporting structure intermediate the second bimetallic member and said structure, contact means positioned upon the upper surfaces of the inner ends of the main terminal means, said second bimetallic member having two outwardly extending portions joined at their inner ends to form a U-shaped member, the outer ends of said portions being attached to the main terminal means whereby said second bimetallic member is in series with such main terminals, a jumper contact attached to the second bimetallic member so as to engage the contact means upon the terminal means when said second bimetallic member has flexed to its fully open position whereby the current normally flowing through the second bimetallic member will be shunted through said main terminal means, said second bimetallic

member flexing in response to the passage of a current through the main terminals whereby upon such current increasing above a predetermined value said member will flex so as to disengage the cooperating first and second contacts, and adjusting means supported by the supporting structure and engaging the first bimetallic member for adjustably positioning such member to selectively determine the predetermined current for disengaging said first and second contacts.

3. In a current limiting device for a dwelling house electric power circuit which disconnects a portion of the household circuit when the total power demand of the household is above a predetermined value, the combination of a supporting structure having parallel portions one above the other, a first bimetallic member resiliently attached to the upper portion of the supporting structure substantially parallel thereto, a movable contact insulatedly attached to said bimetallic member, a terminal means insulatedly attached to the top supporting structure, means connecting the movable contact and the terminal means comprising at least in part a flexible strap, a second bimetallic member attached to the lower portion of the supporting structure substantially parallel thereto and elevated therefrom, said second bimetallic member being positioned beneath and substantially parallel to the first bimetallic member, said members moving in a common direction a like amount with changes in ambient temperature, a second movable contact insulatedly attached to the second bimetallic member, said second contact being positioned below the first contact and engaging said first contact during normal operations of the device, a second terminal means attached to the lower supporting structure, means at least in part flexible connecting the second contact with the second terminal means, two main terminal means having at least a part thereof positioned upon and insulated from the lower portion of the supporting structure intermediate the second bimetallic member and said structure, contact means positioned upon the upper surfaces of the inner ends of the main terminal means, said second bimetallic member having two outwardly extending portions joined at their inner ends to form a U-shaped member, the outer ends of said portions being attached to the main terminal means whereby said second bimetallic member is in series with such main terminals, a jumper contact attached to the second bimetallic member so as to engage the contact means upon the terminal means when said second bimetallic member has flexed to its fully open position whereby the current normally flowing through the second bimetallic member will be shunted through said main terminal means, said second bimetallic member flexing downwardly in response to the passage of a current through the main terminals whereby upon such current increasing above a predetermined value said member will flex downwardly so as to disengage the cooperating first and second contacts, and adjusting means supported by the upper portion of the supporting structure and engaging the first bimetallic member for adjustably positioning such member to selectively determine the predetermined current for disengaging said first and second contacts.

PAUL R. LEE.