Dec. 20, 1949 O. B. CURRY 2,491,956

CIRCUIT INTERRUPTER

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Fig. 2.

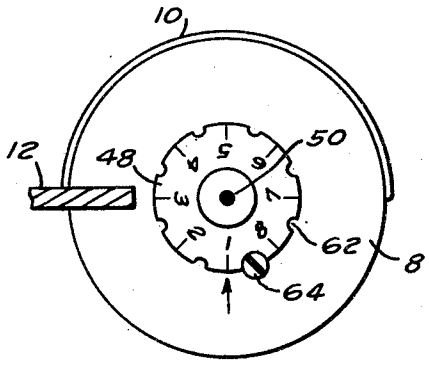
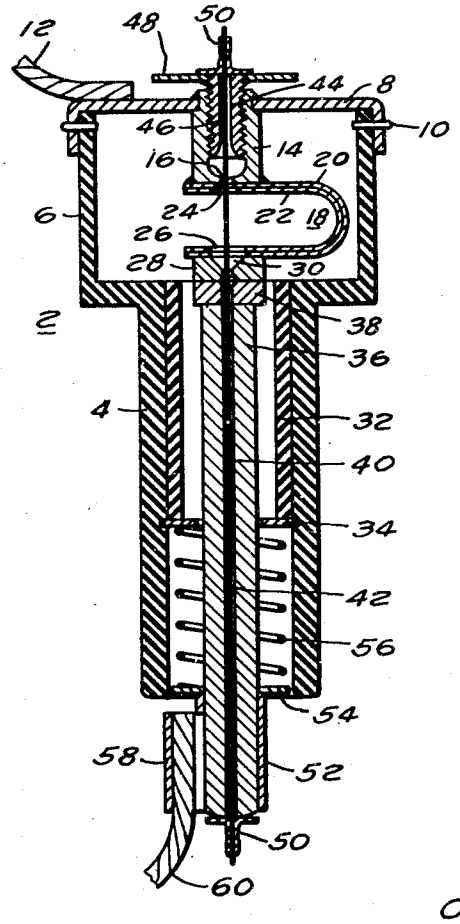


Fig. 1.



WITNESSES:

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CIRCUIT INTERRUPTER

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This invention relates generally to electric circuit interrupters, and more especially to such interrupters which are adapted to replace fuses.

To properly protect apparatus, such as transformers, which are subject to relatively light overloads, causing heating of the apparatus, it is necessary to provide circuit opening means which has thermal characteristics on opening which are coordinated as closely as possible to the thermal characteristics of the apparatus to be protected.

Circuit interrupting devices employing bimetal elements, heated in accordance with the amount of current flowing in the circuit, for controlling opening of the circuit have been found to closely approximate the thermal characteristics of apparatus of the type mentioned above, and one object of this invention is to provide a novel circuit interrupter wherein opening of the circuit is initiated by a bimetal element.

Another object of this invention is to provide a novel circuit interrupter of the type described wherein the circuit interrupting contacts are normally held closed against an opening bias by a renewable fusible strain element connected in shunt circuit relation with said contacts, and the contacts are initially separated by an overload-responsive means.

Another object of this invention is to provide in a circuit interrupter of the type described, a novel structural relationship of current carrying contacts and shunt connected fusible strain element for normally holding said contacts closed against a contact-opening bias.

Another object of this invention is to provide in a circuit interrupter of the type described, novel means for adjusting the current-responsive element of the interrupter for selecting the current values at which it will respond to open the circuit.

Still another object of this invention is to provide in a device of the type described, a novel arrangement of the parts to enable ready replacement of the renewable element thereof.

Another object of this invention is to provide a circuit interrupter having a renewable fusible element to cause circuit interruption to occur but which does not normally carry any appreciable current and is caused to fuse by other current-responsive means.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of a preferred embodiment thereof when taken in connection with the attached drawing, in which:

Figure 1 is a substantially central longitudinal

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section through a circuit interrupter constructed in accordance with this invention; and

Fig. 2 is a top plan view of the interrupter shown in Fig. 1.

The embodiment of the invention which is disclosed herein is illustrated as being contained within a tubular holder 2 of insulating material, preferably a molded insulating material, with a lower portion 4 which is relatively small in diameter compared to a shorter upper portion 6. The upper end of holder 2 is provided with a terminal cap 8 which may be of any desired electrical conducting material such as copper or a copper alloy, and this cap is held in place by a semi-circular retaining spring 10 having the ends thereof directed inwardly to engage in apertures provided in the flange of cap 8 and in the upper end of large diameter portion 6 of the tubular holder. A terminal conductor 12 may be secured to cap 10 in any desired manner, such for example, as by soldering or the like.

A sleeve 14 having a reduced upper end which extends through a substantially central aperture in terminal cap 8 is adapted to be secured to the cap as by soldering or brazing. The lower end of the opening through sleeve 14 is smaller than the opening through the sleeve, as shown at 16, and the restriction at 16 is flared in opposite directions, for a purpose to be described. A generally U-shaped bimetal element 18 has the upper leg thereof secured to the lower end of sleeve 14, as by soldering or the like, and is provided with a flared opening 24 forming a continuation of the opening 16 in the lower end of sleeve 14. Bimetal element 18 is formed in the usual manner of a pair of laminations 20 and 22 of different metals secured together as by welding or the like. Outer lamination 20 of the bimetal element should be of a material having a relatively higher coefficient of thermal expansion than the material comprising inner lamination 22, so that upon heating of the bimetal element the leg portions thereof will approach each other.

The lower leg of bimetal element 18 is provided with a relatively large opening 26 and has secured to the under side thereof a contact member 28, preferably of an alloy which is resistant to arcing. Contact 28 is provided with a flared opening 30, the outer end of which coincides with opening 26 in the bimetal element.

The small diameter portion 4 of holder 2 is provided with a liner tube 32 of an insulating material which is capable of evolving an arc-extinguishing gas when in proximity to an electric arc, such for example, as fiber, a synthetic resin

or the like. Liner tube 32 may be inserted in portion 4 of the holder with a tight fit up against stop washer 34 which may be molded directly in portion 4 of the holder 2. A contact rod 36 which is elongated in form is provided normally in the small diameter portion of the holder, with an enlarged contact head 38 secured at the upper end thereof to engage contact 28 of bimetal element 18. Contact rod 36 is provided with a substantially central longitudinally extending bore 40 which extends not only through contact rod 36, but through contact 38 as well, and is alinged with opening 30 in contact 28, openings 26 and 24 in bimetal element 18, and with opening 16 through sleeve 14. A fusible strain wire 42 which is of a material having a relatively high electrical resistance extends through bore 40 and the openings in contacts 28 and 38 and through the openings in the bimetal element and through sleeve 14. Sleeve 14 on cap 8 is adapted to have threadedly mounted therein an adjusting sleeve 46 which has a central bore 44 for accommodating strain wire 42, with adjusting sleeve 46 being provided exteriorly of the holder above terminal cap 8 with an adjusting disk 48 having certain indicia thereon, herein illustrated as the numbers 1 through 8 equally spaced about the periphery thereof. Above disk 48 on adjusting sleeve 46, and below the lower end of contact rod 36, strain wire 42 is provided with abutment sleeves 50 secured thereto, for example, as by being crushed thereon, by some sort of crimping tool.

The lower end of contact rod 36 where it projects from holder 2 has a sleeve 52 secured thereon in any desired manner, for supporting a disk 54 above sleeve 52. A coil compression spring 56 is adapted to react between stop washer 34 and disk 54 to normally bias the contact rod and its contact 38 downwardly in a direction away from contact 28 to open the circuit when released. Sleeve 52 on the contact rod may include an offset portion 58 in which a terminal conductor 60 may be secured as by soldering or the like. Preferably adjusting disk 48 is provided with a number of substantially semi-circular notches 62 spaced around the periphery thereof and corresponding in number to the numerals on the disk, and these notches are adapted to cooperate with a lock screw 64 adapted to be threaded into a threaded opening in terminal cap 8.

The circuit through the interrupter illustrated on the drawing extends from the upper terminal conductor 12, through terminal cap 8 and sleeve 14, through bimetal element 18 to its contact 28, then to movable contact 38, contact rod 36 and sleeve 52 to the other terminal conductor 60. It will be observed that strain wire 42 is in parallel with part of the circuit described above in that it is electrically, as well as mechanically, associated with terminal cap 8 by way of adjusting disk 48 and sleeve 14, and is similarly associated with contact rod 36, so that it is in shunt circuit with contacts 28 and 38 as well as bimetal element 18. Inasmuch as strain wire 42 is of a relatively high resistance material, normally substantially all of the current flow through the interrupter will be in the first described circuit, namely, through bimetal element 18 and contacts 28 and 38. Very little, if any, current will flow through strain element 42. The principal function of the strain element 42 is to hold movable contact 38 in engagement with contact 28 under predetermined contact pressure. Because of the material comprising bimetal element 18 and the particular U-shape thereof, it has sufficient resiliency that in the positions of the parts shown in Fig. 1 it will be stressed a definite amount, so that a predetermined contact pressure exists between contacts 28 and 38, and this pressure is maintained by strain wire 42.

When excessive current flows through the interrupter illustrated, the bimetallic element 18 will be heated and in so doing the lower leg of the element will tend to approach the upper leg, thus relieving contact pressure on contacts 28 and 38. When contact 28 actually separates from contact 38, the circuit through the contacts is interrupted, leaving only the shunt circuit through strain wire 42 connected between terminals 12 and 60 of the interrupter. Accordingly at this time, that is, when contacts 28 and 38 actually separate, a large amount of current flows through strain wire 42 which will immediately fuse and permit compression spring 56 to rapidly move contact 38 downward through the holder. In its downward movement, contact 38 will rapidly elongate the arc which will be exposed to the walls of liner tube 32 which, in turn, will evolve an arc-extinguishing gas. The rapid elongation of the arc coupled with the action of arc-extinguishing gas thereon will quickly extinguish the arc to interrupt the circuit. It will be noted that contact 38 is larger in diameter than the opening in stop washer 34, so that at the end of circuit-opening movement the lower end of contact rod 36 will project a relatively great amount from the lower end of holder 2, to thereby indicate that the interrupter has operated to interrupt the circuit. It will be noted that by the provision of strain wire 42 extending substantially centrally through contacts 28 and 38, it not only is of assistance in centering these contacts but when the strain wire melts, the arc will have to transfer to contacts 28 and 38 because at that time, it will be substantially centrally located with respect to these contacts.

In assembling the interrupter described above and illustrated in the drawing, or in reloading the interrupter after it has operated to interrupt the circuit, it is only necessary to replace strain wire 42 in a manner such that bimetal element 18 is stressed an amount sufficient to exert pressure on contacts 28 and 38. One way in which this may be done is to remove retaining spring 10 so that terminal cap 8 may be removed, whereupon strain wire 42 with its lower sleeve 50 attached thereto can be inserted into the lower end of holder 2, through bore 40 in the contact rod, and through the openings in contacts 28 and 38. The wire may be then easily threaded through the tapered openings in the bimetal element, sleeve 14 and screw 46, whereupon terminal cap 8 can be replaced on the holder and fastened by retaining spring 10. The upper sleeve 50 can then be placed on the strain wire and contact rod 36 pushed upwardly into holder 2 until it engages contact 28. The upper sleeve 50 could then be secured to strain wire 42. With the strain wire 42 in place, adjusting disk 48 may be rotated until the point is reached where contacts 28 and 38 are just touching. The adjusting disk 48 can then be screwed outwardly a predetermined number of turns corresponding to the indicia thereon to give a predetermined deformation of bimetal element 18. Any excess in length of strain wire 42 may be clipped off at the ends and the interrupter is ready to be put back in service. In order to prevent accidental disturbance of the setting of the device, it is desirable to use a locking screw 64 for the pur-

pose of retaining adjusting disk 48 to the position to which it has been adjusted.

Another method of assembling strain wire 42 is to thread the strain wire down through the assembly from the top until upper sleeve 50 rests either on adjusting screw 46, or this screw may be eliminated and sleeve 50 may rest directly on terminal cap 8. The entire mechanism may then be supported on a crimping tool for the lower sleeve 50 and a predetermined weight attached to the protruding lower end of strain wire 42 to subject contacts 28 and 38 and the mechanism under predetermined stress and give the bimetallic element 18 a certain deformation. Lower sleeve 50 may be then crimped to strain wire 42 and the excess of the wire clipped off.

It will also be apparent that the size of strain wire 42 is far from critical since normally this wire only needs to oppose mechanical forces exerted by spring 56 and the bimetal element, since it carries substantially no current. Consequently, the size of strain wire 42 does not effect the current rating of the device. It is believed apparent from the foregoing that the interrupter disclosed herein generally comprises separable contacts which are biased apart but normally held engaged under predetermined contact pressure by a fusible strain element; however, the strain element does not determine the rating of the device, this being determined by a separate element (bimetal element 18) which operates at the desired current to cause strain wire 42 to melt by opening contacts 28 and 38 and thereby causing all of the excess current to flow through strain wire 42.

Having described a preferred embodiment of the invention in accordance with the patent statutes, it is desired that the invention be not limited to this particular device inasmuch as it will be readily apparent to those skilled in this art that many modifications and changes may be made in this particular construction without departing from the broad spirit and scope of the invention. Accordingly, it is desired that the invention be interpreted as broadly as possible and that it be limited only as required by the prior art.

I claim as my invention:

1. In a circuit interrupter, separable contacts which are biased apart, fusible strain means normally maintaining said contacts in engagement against said bias, said strain means being electrically connected in shunt relation with said contacts and being of relatively high resistance, and motive means connected with one of said contacts and responsive to excessive current flow through said contacts to initially separate said contacts to thereby transfer said current to said strain means and cause fusion of said strain means and release of said contacts for separation by said bias to interrupt the circuit.

2. In a circuit interrupter, separable contacts which are biased apart and at least one of which is resiliently mounted, fusible strain means normally maintaining said contacts in engagement against said bias while stressing said resilient contact mounting to provide predetermined pressure on said contacts, and means responsive to excessive current flow through said contacts for causing said strain means to melt.

3. In a circuit interrupter, separable contacts which are biased apart, fusible strain means normally maintaining said contacts in engagement against said bias, said strain means being electrically connected in shunt relation with said contacts and being of relatively high resistance, and a bimetal element connected with one of said contacts and responsive to excessive current flow through said contacts to initially separate said contacts to thereby transfer said current to said srain means and cause fusion of said strain means and release of said contacts for separation by said bias to interrupt the circuit.

4. In a circuit interrupter, separable contacts which are biased apart, fusible strain means normally maintaining said contacts in engagement against said bias, said strain means being positioned adjacent a lateral surface of at least the movable one of said contacts so as to be engageable by at least one of said contacts upon relative lateral movement thereof to thereby maintain said contacts properly centered, and means responsive to excessive current flow through said contacts for causing said strain means to melt.

5. In a circuit interrupter, separable contacts which are biased apart, fusible strain means normally maintaining said contacts in engagement against said bias, said strain means being electrically connected in shunt relation with said contacts and being of relatively high resistance, means responsive to excessive current flow through said contacts to initially separate said contacts to thereby transfer said current to said strain means and cause fusion of said strain means and release of said contacts for separation by said bias to interrupt the circuit, and at least a portion of said strain means positioned intermediate said contacts at least upon said initial separation of said contacts so that the arc formed upon fusion of said strain means will be transferred to said contacts.

6. In a circuit interrupter, separable contacts one of which is biased for movement away from the other, the other one of said contacts being mounted on a resilient bimetal element which is responsive to excess current flow through said contacts to move away from said one contact, and fusible strain means electrically connected in shunt relation with said contacts for normally holding said one contact in engagement with the other contact.

7. In a circuit interrupter, separable contacts one of which is biased for movement away from the other, fusible strain means normally holding said one contact in engagement with the other of said contacts, means responsive to excessive current flow through said contacts for causing said strain means to melt, and means associated with said strain means for manually adjusting the contact pressure exerted by said other contact.

8. In a circuit interrupter, a tubular holder of insulating material, closure means for the top of said holder and including a terminal for the interrupter, one contact mounted in said holder and electrically connected with said terminal, an arc passage in a portion of said holder, a movable contact mounted for movement through said arc passage into and out of engagement with said one contact, said movable contact being biased to move away from said one contact, a fusible strain wire connected between said movable contact and said holder for normally holding said contacts engaged under predetermined pressure, means responsive to excess current flow through said contacts to cause said wire to melt, the bottom of said holder being open, and means limiting circuit opening movement of said movable contact to an amount wherein a part mov-

able therewith projects a predetermined amount from the lower end of said holder.

9. In a circuit interrupter, a tubular holder of insulating material, closure means for the top of said holder and including a terminal for the interrupter, one contact mounted in said holder and electrically connected in series circuit relation with said terminal, an arc passage in a portion of said holder, a movable contact mounted for movement through said arc passage into and out of engagement with said one contact, said movable contact being biased to move away from said one contact, a fusible strain wire connected between said movable contact and said terminal for normally holding said contacts engaged under predetermined pressure, and a bimetal element responsive to excess current flow through said contacts and being connected to said one contact to cause said one contact to move away from the other contact.

10. In a circuit interrupter, a tubular holder of insulating material, a terminal cap for one end of said holder, separable contacts in said holder one of which is mounted on said cap and the other being biased to move through said holder away from said one contact, a strain wire normally connecting said movable contact and cap to hold said movable contact in engagement with said one contact, and motive means connected with said one contact and being responsive to excess current flow through said contacts to cause said one contact to move away from the other contact.

11. In a circuit interrupter, a tubular holder of insulating material, a terminal cap for one end of said holder, separable butt contacts in said holder one of which is mounted on said cap and the other being biased to move through said holder away from said one contact, a strain wire extending through openings in said cap and contacts, abutments secured on said wire to engage said cap and movable contact, respectively, for normally holding said movable contact in engagement with said one contact, and means responsive to excess current flow through said contacts to cause said one contact to move away from the other contact.

12. In a circuit interrupter, separable contacts one of which is mounted on a bimetal element which responds to excess current in the circuit to move said one contact away from the other of said contacts, said other contact being biased for movement away from said one contact, and a fusible strain element mechanically and electrically connecting said contacts to normally hold them in engagement, whereby on excess current in the circuit said bimetal element separates said one contact from the other to cause all of said current to flow through and melt said strain element whereupon said other contact moves under the influence of its bias away from said one contact to interrupt the circuit.

13. In a circuit interrupter, separable contacts one of which is mounted on a bimetal element of resilient material which responds to excess current in the circuit to move said one contact away from the other of said contacts, said other contact being biased for movement away from said one contact, a fusible strain element mechanically and electrically connecting said contacts to normally hold them in engagement, whereby on excess current in the circuit said bimetal element separates said one contact from the other to cause all of said current to flow through and melt said strain element whereupon said other contact moves under the influence of its bias away from said one contact to interrupt the circuit, and means for adjusting one of said elements to vary the pressure on said bimetal element and thereby vary the current value at which said bimetal element separates said one contact from the other.

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