Oct. 6, 1931. N. S. NELSON 1,825,811

THERMORESPONSIVE FUSE

Original Filed Nov. 22, 1926

Fig. 1.

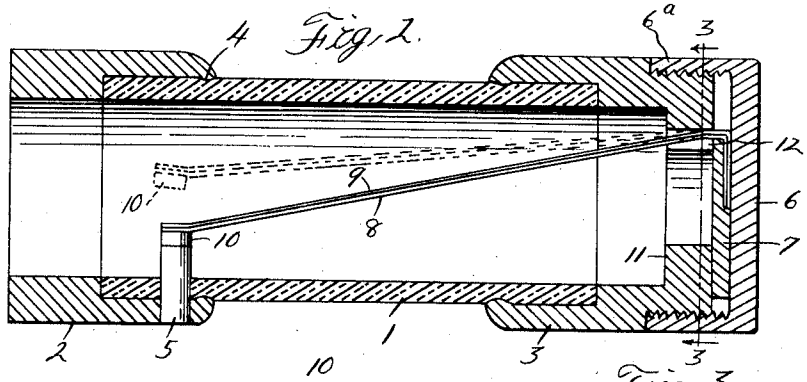


Fig. 2.

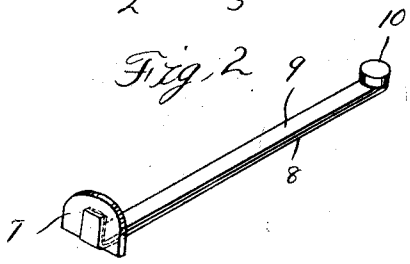
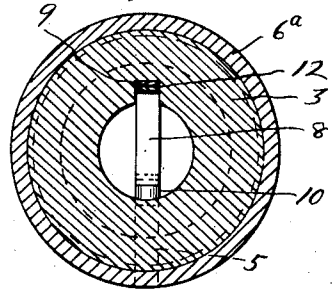


Fig. 3.



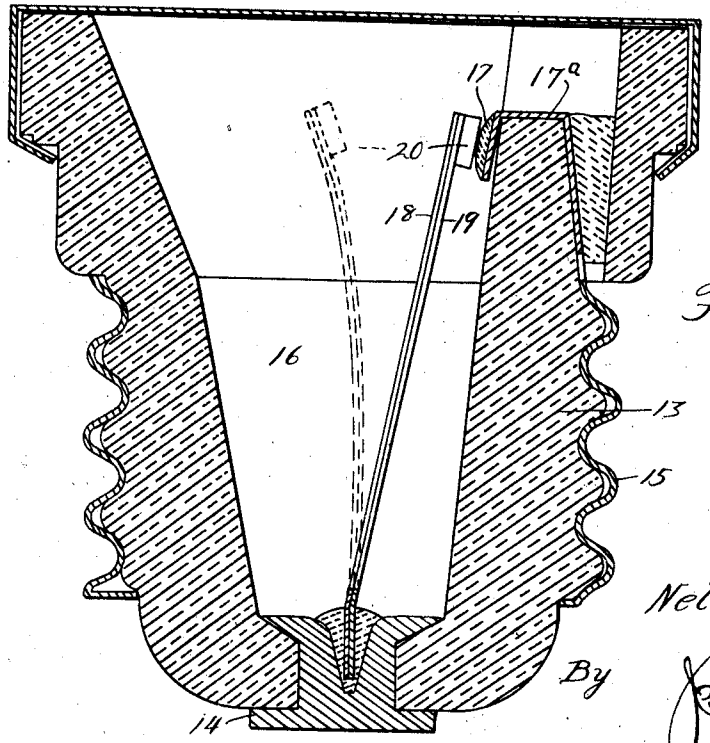


Fig. 4.

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UNITED STATES PATENT OFFICE

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THERMORESPONSIVE FUSE

Substitute for application filed November 22, 1926, Serial No. 149,949. This application filed March 5, 1929. Serial No. 344,576.

This invention relates to fuses for the protection of electrical circuits and appliances, and is a substitute for application Serial Number 149,949 filed November 22, 1926, by this applicant.

In the present state of the electrical art, the fuses employed for the above purpose are of a type comprising a short length of a conductor having a thickness adapting it to carry a certain amperage without appreciably heating, and formed of a metal that will readily fuse responsive to the heat generated by an excessive amperage. The breaking of a circuit by such a fuse leaves such circuit permanently dead or deenergized until a new fuse has been installed. Under such conditions, it is frequently necessary for the current user to remain without lights or power until the power supply company can send an employee to install a new fuse. Since the burnt-out fuses are thrown away, the waste which their use involves is a very considerable item, since every electrical installation requires at least one protective fuse.

It is the object of the present invention to provide an improved type of fuse, in which the conductor predetermining the permissible maximum current flow is adopted to automatically respond to the heat generated by excess temperatures by flexing to a circuit-breaking position, said conductor being formed of such metals as will withstand all temperatures imposed by the conditions of use, without appreciable diminution of their thermo-flexible properties.

While the use of thermo-flexible conductors for automatically breaking circuits is well known, the present invention involves a distinct contribution to the electrical art, in that it forms such a conductor of metals that will sustain the maximum temperatures encountered in actual practice, not only without fusing of said conductor, but without such resulting diminution of its thermo-flexibility as will interfere with its subsequent proper functioning.

It is here important to note that any commercially practicable substitution of thermo-flexible elements for the soft metal conductors now generally employed in fuses, necessitates employing an extraordinary type of bimetallic conductor, capable of withstanding without detriment at least a red heat, since such a heat will often be generated in such a conductor before its resultant flexing breaks the circuit, when the later is "shorted" or subjected to a sudden heavy overload, The development of such a conductor involves more than the mere uniting of two metals having melting points above the temperatures arising in use and having the necessary difference in their coefficients of expansion to cause a flexing response to heat. The essential characteristic of the metals united to form such a conductor is that they be capable of enduring the high temperatures of use without appreciable diminution of their thermo-flexibility, or capacity to return to their original position after cooling.

It is another object of the present invention to provide a thermo-flexible type of circuit breaker, adapted to replace an ordinary fuse and provided with engageable contact points that will not molecularly unite or weld under high temperature conditions, and thereby prevent the desired immediate breaking of the controlled circuit.

These and various other objects the invention attains by the construction hereinafter described and illustrated in the accompanying drawings, wherein:—

Figure 1 is an axial sectional view of a thermal cut-out of the cartridge type, embodying the present invention.

Figure 2 is a perspective view of the thermo-responsive element of said cut-out.

Figure 3 is a cross-sectional view taken upon the line 3—3 of Figure 1.

Figure 4 is an axial sectional view of a screw plug type of the improved cut-out.

In these views, the reference character 1 designates the usual tubular insulating casing of a cartridge type of cut-out. Upon the ends of said casing there is mounted fast a pair of metal collars 2 and 3 which may serve to mount the cut-out and to connect it to an electric circuit in the well known manner. Said collars are held fast upon the casing 1 by the indenting into the outer surface of said casing of portions 4 of said collars. The

collar 2 is further held in place upon the casing by a contact element 5 which is radially inserted in suitable registering apertures of said collar and casing as is best seen in Figure 1; said contact preferably projecting some distance within the casing.

The outer end of the collar 3 is externally threaded for engagement by a screw cap 6 having a suitably threaded similar flange 6*a* for embracing said collar. Between the cap 6 and the collar 3 there is clamped a metal disk 7 to which is secured one end of the bimetallic thermo-responsive arm 8, 9. The connection between said arm and disk may be established in any suitable manner, as for example, by bending the mounted end portion of the arm against the outer face of the disk and soldering it to said face. The other or free end of the arm 8, 9 carries a metal contact member 10 adapted to normally seat against the contact 5, as shown in full lines in Figure 1. The collar 3 is interiorly flanged, as indicated at 11 to provide an adequate seat for the disk 7 and preferably said flange has a channel 12 extending from side to side thereof to receive the arm 8, 9 and thus assist in establishing said arm in its proper position for engagement of the contacts. In assembling the construction, the disk 7 is seated against the flange 11 with the arm 8, 9 projecting into the casing 1, and engaging in the channel 12. The cap 6 is then threaded upon the collar 3, holding said disk and arm securely in place.

A most essential feature of the described construction is the use of such metals to form the arm 8, 9 as will not suffer a loss of thermo-responsiveness under high temperature conditions. It will, of course, be understood that the two rigidly connected strips which comprise said arm differ as regards their co-efficients of expansion. Preferably the arm 8 which has the higher coefficient will be of the following composition:—

	Per cent
Iron	63.42
Nickel	24.05
Chromium	8.14
Silicon	1.88
Manganese	.65
Carbon (by combination)	.46
Insoluble residue	1.40

The other arm 9 preferably has a composition as follows:—

	Per cent
Iron	61.95
Nickel	37.12
Silicon	.07
Manganese	.67
Carbon (by combination)	.19

so formed differ considerably as to their co-efficients of expansion and are hence highly responsive to temperature changes. The most important reason, however, for employing alloys of the compositions specified lies in the capacity of said alloys to undergo exceedingly high temperatures (as high at 1500 degrees Fahrenheit) without detrimentally affecting the power of recovery of the bimetallic element formed by said alloys.

A further highly important feature of the invention lies in the use of a non-welding metal to form the contacts 5 and 10. One example of such a metal is tungsten. The use of such a metal is essential for the reason that in use the arm 8, 9 is often subjected to sudden temperature rises such as tend to fuse the engaging points of said contacts, and such fusion would be likely to result in a partial welding together of the two contacts if the metals were of a nature to permit such an action.

In embodying the invention in a plug type of cut-out such as is illustrated in Figure 4, there is employed the usual hollow insulating body 13 open at one end and carrying a terminal button 14 at its closed end, and embraced by a second sleeve-forming terminal member 15 formed with screw threads. Within the chamber 16 of the body 13, near the mouth of said chamber there is mounted a contact 17 which is connected as indicated at 17*a* to the sleeve terminal 15. Upon the terminal 14 there is mounted one end of a bimetallic thermo-responsive arm 18, 19, which carries upon its other or free end a contact 20 coacting with the contact 17. The metals forming the arm 18, 19 are of the specified heat resistant composition and the contacts 17 and 20 are formed of tungsten or some like non-welding metal.

In either of its described and illustrated forms, the invention secures the desired advantages, and eliminates the loss of time and material involved by the burning out and replacement of fuses.

What I claim is:

1. A thermo-flexible bimetallic circuit breaker arm, retaining its power of recovery from flexure at temperatures in excess of 1500 degrees Fahrenheit, said arm comprising two rigidly connected metal strips differing as to their coefficients of expansion, the strip of lesser expansion coefficient containing a predominance of iron, more than thirty per cent of nickel, less than ten per cent of silicon, and less than one per cent each of manganese and carbon.

2. A circuit breaker arm comprising two rigidly connected metal strips, differing as to their coefficients of expansion and consequently thermo-flexible and maintaining their power of recovery at temperatures as high as 1500 degrees Fahrenheit, each of said strips containing a predominance of iron, and the strip of lower expansion coefficient containing less than twenty-five per cent of nickel, a lesser quantity of chromium, and still lesser quantities of manganese and carbon, and the

strip of lower expansion coefficient containing more than thirty per cent of nickel, less than ten per cent of silicon, and less than one per cent each of manganese and carbon.

3. A thermo-flexible bimetallic circuit breaker arm, one of the metals thereof having a higher coefficient of expansion than the other and being of approximately the following composition:

	Per cent
Iron	63.42
Nickel	24.05
Chromium	8.14
Silicon	1.88
Manganese	.65
Carbon	.46
Insoluble residue	1.40

4. A thermo-flexible, bimetallic circuit breaker arm, one of the metals thereof having a lower coefficient of expansion than the other and being of approximately the following composition:

	Per cent
Iron	61.95
Nickel	37.12
Silicon	.07
Manganese	.67
Carbon	.19

In testimony whereof I sign this specification.

NELS S. NELSON.