Nov. 9, 1926. 1,606,143

J. T. BUTTERFIELD

PROTECTIVE DEVICE

Filed April 11, 1923

Fig. 1.

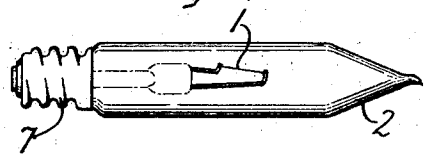
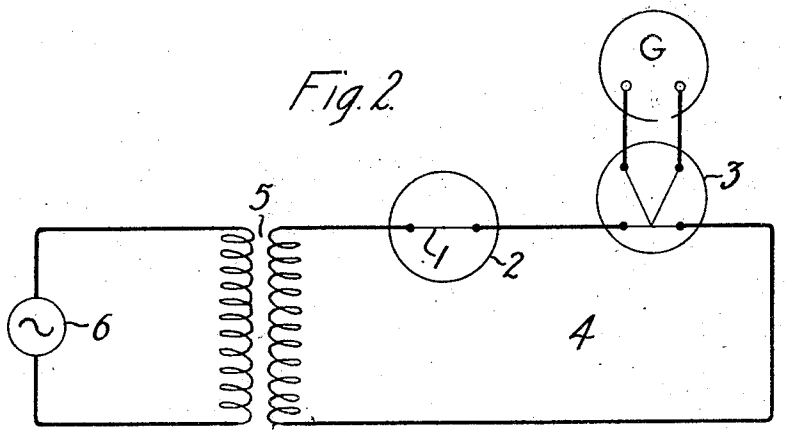


Fig. 2.



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PROTECTIVE DEVICE.

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This invention relates to protective devices and particularly to a fuse suitable for protecting delicate apparatus.

The object of the invention is in general to provide a reliable, sensitive fuse suitable for protecting very delicate electrical apparatus.

It is common practice to protect electrical apparatus against excessive current by inserting in circuit with the apparatus a fuse element which consists essentially of a fusible conductor of low melting point and of such a size that it will be melted by a lesser current than will damage the apparatus. The familiar forms of fuse elements which are available for protecting relatively rugged apparatus are not, however, suitable for protecting very delicate apparatus. The reason for this is threefold. Firstly, in order to protect some very delicate apparatus, the fusible conductor would have to be of a size which is smaller than it is practicable to manufacture and handle. Secondly very small fuse wires when used in the usual types of fuse elements may oxidize so rapidly under service that the fuse will soon blow without the passage of an excessive current. Thirdly, even when a single lot of fuses are manufactured with the greatest care to obtain uniformity, many of them will be blown only by a current which is considerably larger than the rated capacity of the fuse; and there is no suitable means for testing the individual elements without destroying them.

Some moderately sensitive apparatus can be fairly well protected by fuses made of gold, which can be formed into quite small conductors and does not oxidize. However it is impractical to protect very sensitive apparatus even by gold fuses and these, in common with other known fuses, cannot be individually tested without destroying them.

In accordance with the general features of the present invention, a fuse element is constructed with a very fine fusible wire and is rendered sensitive and reliable by placing the fusible wire in an evacuated chamber.

Referring to the drawings, Fig. 1 shows a convenient form of fuse elements constructed in accordance with the present invention and Fig. 2 shows schematically a circuit in which delicate current measuring apparatus is protected by a fuse constructed in accordance with this invention.

A fine wire 1 which may be of any suitable material is mounted in a well known manner and enclosed in an evacuated chamber 2. Leads from the fuse wire may be connected conveniently to a base 7 of the form extensively used on electric lamps. This enables the fuse to be readily inserted in the circuit through the medium of a lamp socket. The fuse wire being in an evacuated chamber, oxidation is precluded, and conduction of heat from the wire is greatly diminished, thus causing a fuse wire of a given size to melt at a lower current than would be required if the wire were exposed to the atmosphere.

This invention contemplates the use of any suitable material for fuse wire 1, but attention is called to an alloy of approximately 60% copper and 40% nickel, which may be obtained commercially under the trade name of "Advance". Many well known fuse alloys containing lead, tin, and bismuth, have a lower melting point than this alloy, but it is difficult, if not impossible to reduce a wire of such alloys to a size which will give protection to very delicate apparatus. "Advance" wire has the apparently detrimental characteristic of a higher melting point than many of the so called easily fusible alloys, but this is offset by its high resistance which causes more heat to be developed in the wire.

An additional feature of this invention is the making of the fuse wire from an alloy having a substantially zero temperature coefficient of resistance. In many instances it is of no importance whether the resistance of a fuse changes with temperature or not, but in other cases especially where measurements are being made with very small currents, it is frequently important that the conditions of the circuit remain constant. It is apparent, therefore, that if the resistance of a fuse changes with temperature, its resistance may vary considerable for different values of current, since fuses are subjected to relatively high current densisties. The alloy known as "Advance" is one of several known alloys which have a substan-

tially zero temperature co-efficient of resistance.

In Fig. 2 the fuse is shown in circuit to protect a thermocouple 3 which, in conjunction with galvanometer G measures the alternating current induced in the circuit 4 by means of transformer 5 and source of current 6. Fuses of this type have been found to be very effective for protecting thermocouples which are damaged by currents in excess of 25 milliamperes; and can be constructed to protect even more delicate apparatus. Other obvious uses to which the fuse may be put are the protection of delicate galvanometers and the vibrators of oscillographs.

Fuses constructed in accordance with the present invention are not damaged by a current which just causes them to glow; and for any given design of fuse there is a definite relation between the value of current which just causes each individual fuse to glow, and the current which will cause that fuse to open the circuit. This enables each fuse to be tested to determine its proper rating, thus avoiding the uncertainty which exists when the rating is determined by the performance of other specimens.

What is claimed is:

1. An electric fuse consisting of a filament of an alloy of approximately 60% copper and 40% nickel enclosed in an evacuated vessel.

2. An electric fuse comprising a fine wire or filament of highly ductile metal enclosed in an evacuated vessel and capable of operating to break the circuit in which it is included on a current of less than .05 ampere.

3. An electric fuse comprising a filamentary wire composed of metal of practically zero coefficient of resistance.

4. An electric fuse of such finely drawn wire that it is capable of operating to break a circuit in which it is included on a current of less than 30 milliamperes.

5. An electric fuse consisting of a fine metal filament capable of withstanding a glowing temperature without breaking down but effective to open the circuit in which it is included on a current of less than 25 milliamperes.

In witness whereof, I hereunto subscribe my name this 10th day of April A. D., 1923.

JOSEPH T. BUTTERFIELD.