

United States Patent [19]

Wada et al.

[11] 3,766,508

[45] Oct. 16, 1973

[54] **FLAME-PROOF COATED RESISTORS**

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[21] Appl. No.: **268,874**

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[30] **Foreign Application Priority Data**

July 13, 1971 Japan..... 46/52353

[52] **U.S. Cl.**..... 337/163, 337/166, 337/296

[51] **Int. Cl.**..... **H01h 85/00**

[58] **Field of Search**..... 337/163, 167, 227,
337/290, 296, 166; 338/256, 257, 308

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ABSTRACT

An electrical resistor of flame-proof type comprising a resistance material coated substrate formed with or without a plurality of grooves determinant of the value of the resultant resistor, wherein glass is applied thereon in various configurations for enabling the resultant resistor to quickly fuse to open an electrical circuit in which it is inserted.

10 Claims, 15 Drawing Figures

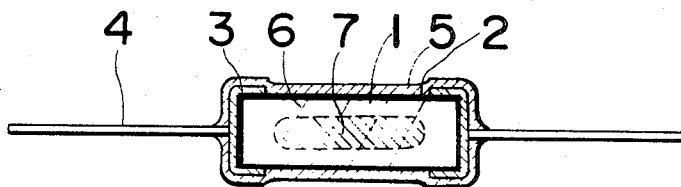


FIG. 1 PRIOR ART

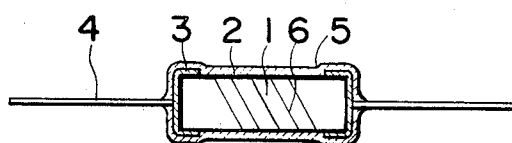


FIG. 2

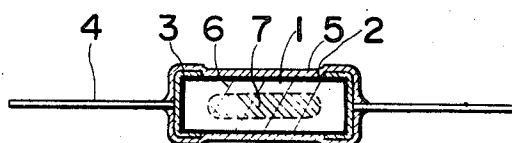


FIG. 3

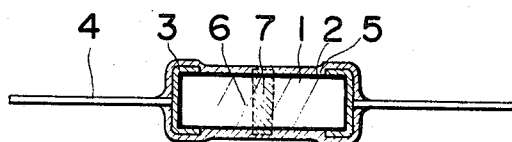


FIG. 4

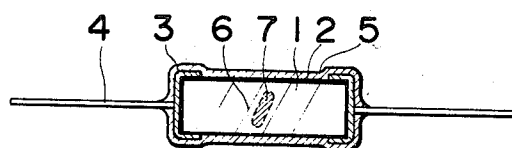


FIG. 5

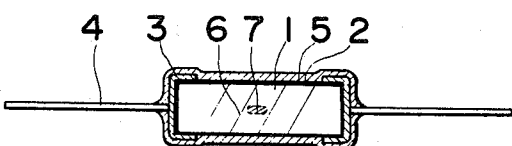


FIG. 6

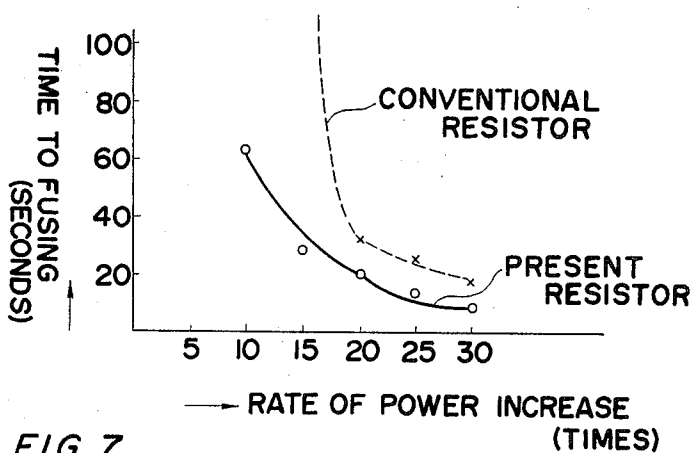


FIG. 7

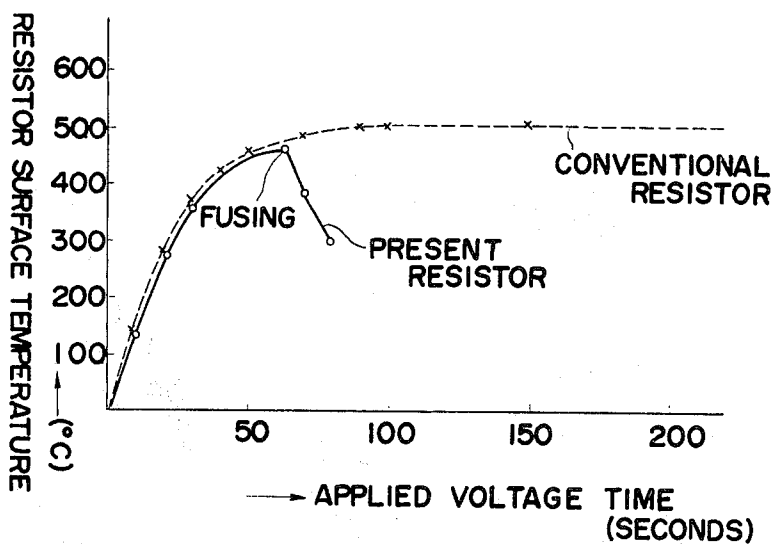


FIG. 8

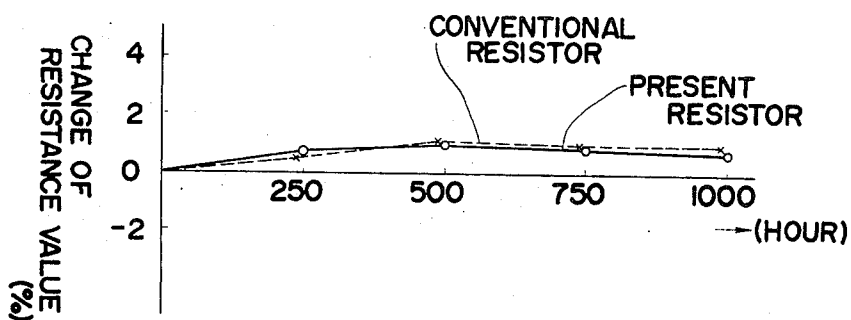


FIG. 9

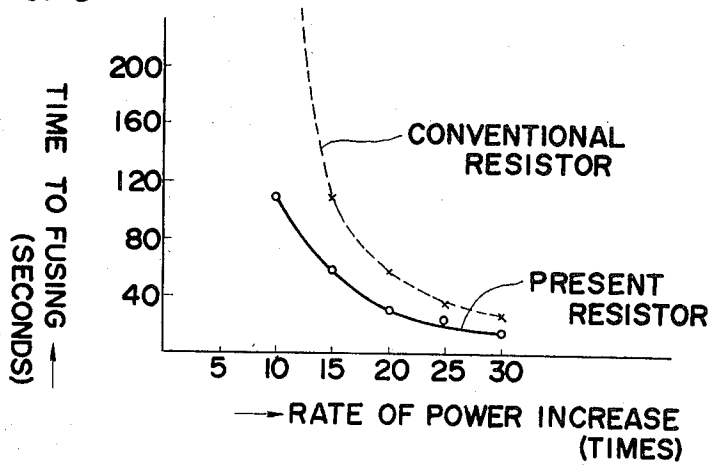


FIG. 10

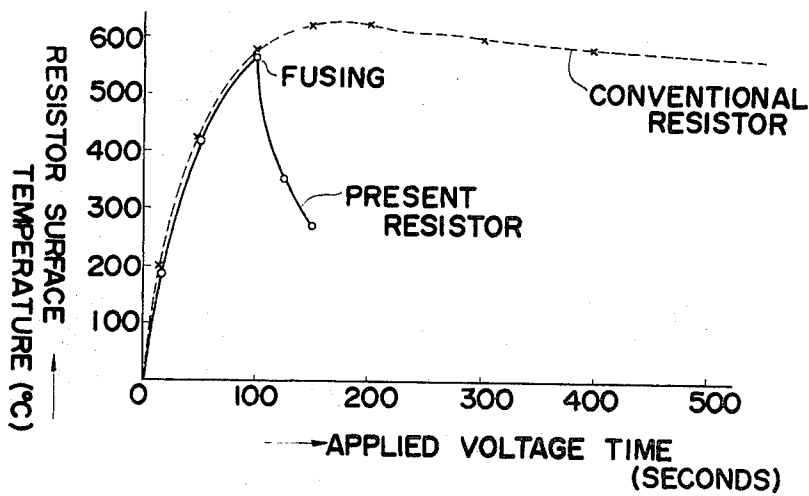


FIG. 11

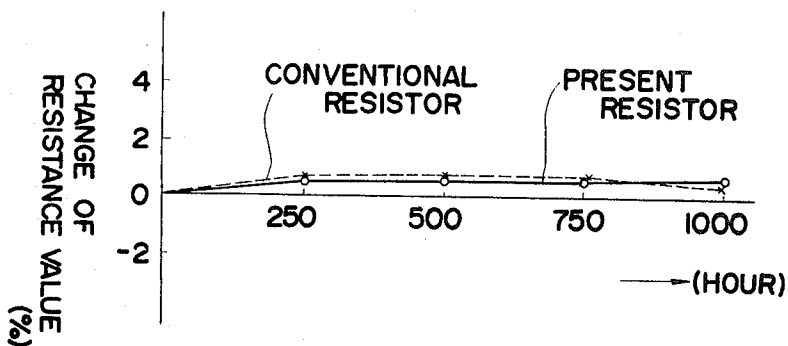


FIG. 12

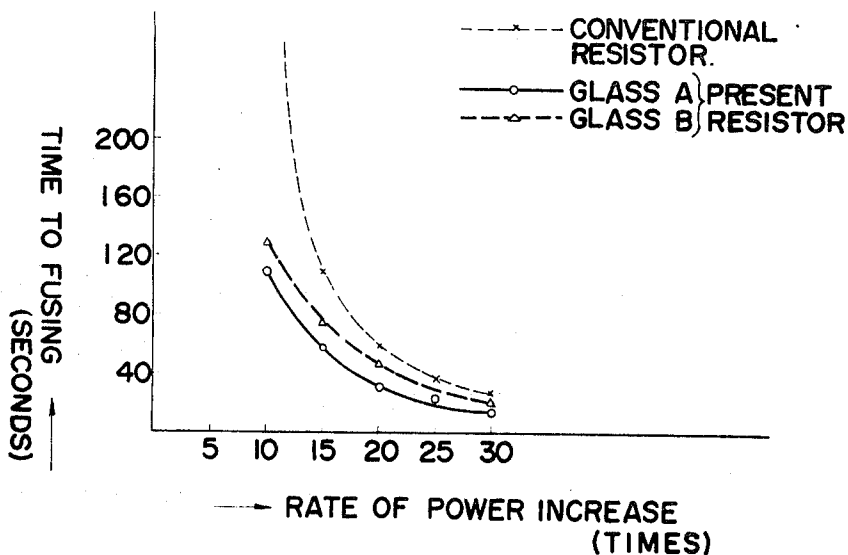


FIG. 13

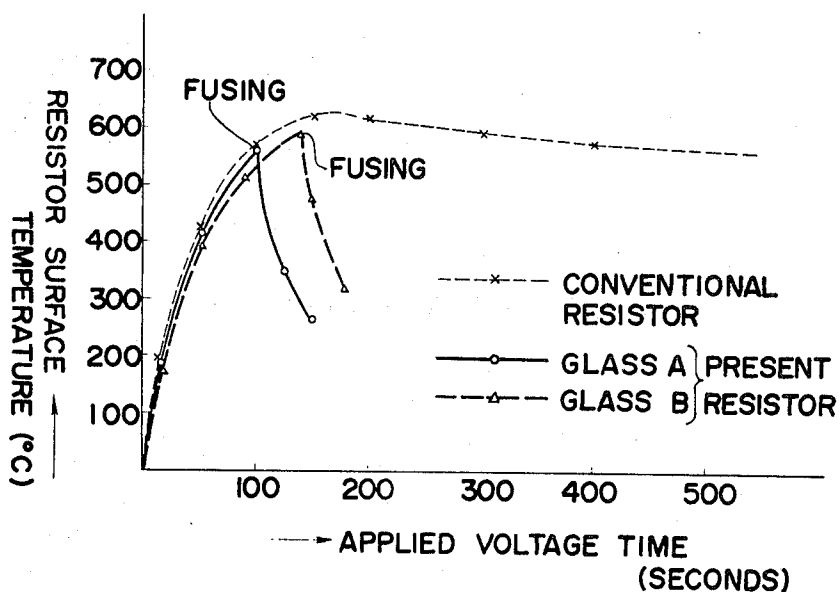


FIG. 14

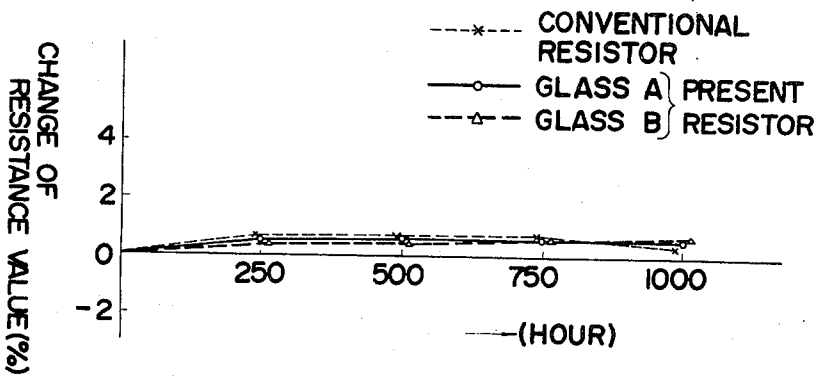
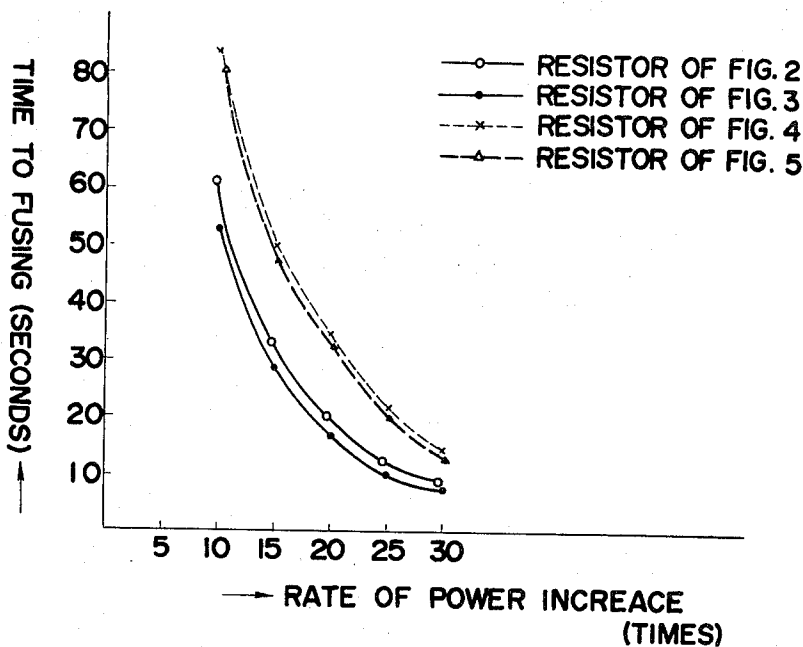


FIG. 15



FLAME-PROOF COATED RESISTORS

The present invention relates to electrical resistors which are flame-proof and which do not become heated to an extent liable to cause damage to other circuit elements when there is an overload in the circuits in which they are inserted.

More specifically, the present invention is directed to an improvement in electrical film resistors coated with resistance material such as metal, metal oxide or carbon.

Recently, flame-proof resistors have come into use, their purpose being to avoid flaming and burning of the resistors when there is a severe overload in the resistor inserted circuits, and thus to avoid damage to other circuit elements caused by such burning. One type of conventional electrical film resistors of the character above referred to comprises, as shown in FIG. 1 of the accompanying drawings, a substrate 1 composed of glass or a similar electrically insulating material which is usually cylindrical in shape, a thin film 2 of electrical resistance material, for example, tin oxide, applied or coated on the entire peripheral surface of said substrate, a cap or land 3 of metal or other electrically conducting material attached to each end of the coated substrate 1, a lead wire 4 soldered to each one of said caps 3 and extending therefrom for the purpose of external electrical connection and a protecting coating 5 of electrically insulating and flame-proof material applied or coated on the entire surface of the coated substrate. In this arrangement, the value of the resistor is determined by the number of grooves 6 cut in the coating of resistance material on the substrate 1, as is well known to those skilled in the art.

However, the flame-proof resistors employed hitherto tend to achieve their object only partially, since, while they are flame-proof, when there is an overload imposed on any one of the conventional resistors of the above character, there is a considerable time at which they are at or near red heat before they open the circuit with the result that, while the resistors themselves may not be subjected to damage, adjacent elements in the resistor inserted circuits may be burnt or damaged. The problems associated with such resistors have been mainly connected with the coating, and research has been directed to finding new materials for such coating, which, however, for the reasons stated above only partially solve the problems, and incidentally tend to be more difficult, and more expensive, to produce. There are also wire-wound fuse resistors which act as circuit openers upon receipt of overload, but in order to improve their fusibility their windings must be as fine as possible, with the result that they are not very reliable under ordinary conditions, and, of course, that they are not easy to manufacture.

There is therefore a need in the electronics industry for an easily and cheaply manufactured resistor which is itself flame-proof and at the same time is not liable to cause burning or damage to other circuit elements in the resistor inserted circuit. While there has been considerable research aimed at overcoming the problems associated with these resistors, there has been no really new approach.

It is accordingly an essential object of the present invention to provide an improved electrical flame-proof resistor which is free of the disadvantages inherent in

the conventional resistor of the character above referred to.

It is another object of the present invention to provide an improved resistor which rapidly opens the resistor inserted circuit upon application of a severe overload.

It is a further object of the present invention to provide an improved resistor which does not heat unduly on severe overload prior to opening the circuit, thus avoiding possible damage to other circuit elements provided on the same circuit.

It is a still further object of the present invention to provide an improved resistor which is stronger and more reliable than the conventional one.

It is a still further object of the present invention to provide an improved resistor in accordance with the objects stated above which is both cheap and easy to manufacture.

The film resistor according to the present invention, whose construction in other respects is conventional, provides a new approach, in that it is prevented from flaming or giving out sufficient heat to damage other circuit elements by a coating of glass applied in various configurations on the resistor film, and moreover uses a coating material which is easy and cheap to manufacture.

More particularly, the essential features of the present invention, which relates to flame-proof resistors, such as metal coated resistors, metal oxide coated resistors or carbon coated resistors, are that glass is coated or applied in various configurations on the resistance film coated over the entire peripheral surface of the substrate, and that when overcurrent flows the glass on the resistance film is fused by the heat evolved by the resistance film and the resistance film is subsequently melted, thus opening the resistor inserted circuit.

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with preferred embodiments thereof illustrated in the accompanying drawings, in which;

FIG. 1 is a longitudinal cross sectional view of the conventional resistor employed in the description of the background of the present invention,

FIG. 2 to FIG. 5 are each similar view to FIG. 1 showing first to fourth embodiment of the present invention,

FIGS. 6 to 14 are each showing a characteristic comparison between the conventional resistor and the resistor of the present invention, wherein FIGS. 6, 9 and 12 are diagrams showing the relationship between the power applied and the time-to-fusing, FIGS. 7, 10 and 13 are diagrams showing a surface temperature characteristic of the resistors when applied with an electrical power of 30 wattages and FIGS. 8, 11 and 14 are diagrams showing an overload standing characteristic of the resistors when applied with an electrical power of 4.5 watts, and

FIG. 15 is a diagram showing the relationship between the power applied and the time-to-fusing of the various embodiments of the present invention.

It is to be noted that, for the sake of brevity, the description of the present invention will be hereinafter made as applied to the conventional resistor of the foregoing construction and, therefore, like reference numerals employed in FIG. 1 are concurrently employed in the description of the present invention to designate like parts shown.

Referring first to FIG. 2, prior to the application of the protecting coating 5 and after the grooves 6 have been formed on the peripheral surface of the resistance material coated substrate 1, a paste of glass, which is formed by mixing glass with adhesive material solved by the use of organic solvent is applied on the resistance film 2 on the peripheral surface of the substrate 1 in parallel relation to the longitudinal axis of the resistor substrate crossing over a plurality of grooves 6. This paste of glass, after it has been dried, is formed into a glass coating as designated by 7.

In the second embodiment of the present invention shown in FIG. 3, the glass coating 7, that has been applied in the similar manner as in the foregoing embodiment, is in the form of a ring surrounding a substantially intermediate portion of the resistor substrate and has a suitable width.

In the third embodiment of the present invention shown in FIG. 4, the glass coating 7 extends in parallel relation to and not crossing over the grooves 6 and in the fourth embodiment of the present invention shown in FIG. 5 the glass coating extends in parallel relation to the longitudinal axis of the resistor substrate and between two adjacent grooves 6 which are positioned at a substantially intermediate portion of the resistor substrate.

The present invention is further illustrated by the following non-limiting examples.

EXAMPLE I

Powdered glass was made into a paste with the mixture of adhesive material solved by the use of organic solvent and coated in the manner shown in FIG. 2 onto the metal oxide film coated on the substrate and formed with the grooves, to obtain a metal oxide coated resistor of 3 watts-1K Ω (external diameter 8 mm. length 23 mm.), which process was followed by painting with silicon insulating paint and heat treatment. The comparison was made between the fusing characteristics, surface temperature characteristics and the overload standing characteristics of this resistor and those of conventional resistors. The results are shown in FIGS. 6 to 8. As can be seen from FIG. 6, while it was more than 10 minutes before a conventional resistor fused upon application of the load of a value 15 times the rated load, the resistor of the present invention fused in about 60 seconds upon application of the load of a value 10 times the rated load. Further, as can be seen from FIG. 7, when an overcurrent flows, although the resistor was at red heat, the period in which the resistor of the present invention was at red heat was extremely short and the resistor of the present invention was quickly fused, whereas according to the prior art this condition continues for a long time. FIG. 8 shows that the overload standing characteristics of both types of resistors are essentially the same.

EXAMPLE II

Powdered glass was made into a paste with the mixture of adhesive material solved by the use of organic solvent and coated in the manner shown in FIG. 2 on to the metal film coated on the substrate and formed with the grooves to obtain a metal coated resistor of 3 watts-10 Ω (external diameter 8 mm. length 23 mm.), which process was followed by painting with silicon insulating paint and heat treatment. The comparison was made between the fusing characteristics, surface tem-

perature characteristics and the overload standing characteristics of this resistor and those of conventional resistors. The results are shown in FIGS. 9 to 11. As is shown in FIG. 9, while a conventional resistor does not fuse even after 10 minutes beginning from the application of an electrical power of a value not more than 10 times the rated power, the resistor of the present invention fused in about 100 seconds. The other characteristics represent the similar to those of the foregoing Example I.

EXAMPLE III

This example is illustrating the effect of the employment of glasses with different fusion points.

Two kinds of powdered glass, which are respectively hereinafter referred to as Glass A having the temperature of fusion at 340°C. and Glass B having that at 480°C, were mixed and made into a paste by the addition of adhesive material solved by the use of organic solvent and applied in the manner shown in FIG. 2 on to the metal coated resistor substrate formed with the grooves, to obtain a metal coated resistor of 3 watts-10 Ω (external diameter 8 mm. length 23 mm.), which process was followed by painting with silicon insulating paint and heat treatment. The comparison was made between the fusing characteristics, surface temperature characteristics and the overload standing characteristics of this resistor and those of conventional resistors. The results are shown in FIGS. 12 to 14 and are each similar to those obtained in the example II.

EXAMPLE IV

Powdered glass was made into a paste with the mixture of adhesive material solved by the use of organic solvent and then coated on the carbon coated resistor substrate formed with the grooves to obtain a carbon coated resistor of one-eighth watt-10K Ω (external diameter 1.7 mm., length 55 mm.), which process was followed by painting with silicon paint and heat treatment. The comparison was made between the fusing characteristics and the overload standing characteristics of the resistor of the present invention and those of conventional resistors.

The results are given below and can be seen to be generally quite similar to those of any one of the preceding examples.

Fusing Characteristics

The time to fusing of the one-eighth watt-10K Ω resistor on application of the power of a value 10 times the rated load:

Conventional Resistor—still unfused even after 5 minutes

Present Resistor—fused in 10 seconds

Overload Standing Characteristics

These characteristics are each expressed in terms of the percentage of change in the resistance of a one-eighth watt-10K Ω carbon coated resistor when applied with a load of one-fifth watt for a period of time given below:

	250 hr.	500 hr.	1000 hr.
Conventional Resistor	0.64	0.96	1.20
Present Resistor	0.60	0.91	1.02

The effects on fusing characteristics of the resistor coated with the glass coating in various configurations shown in FIGS. 2 to 5 are shown in FIG. 15. The comparisons were made using 3 watts-1K Ω metal oxide

coated resistors. Reference to the figure makes it clear that better results are obtained when the glass coating is in the configuration of either of FIGS. 2 and 3.

Furthermore, care must be taken that the glass herein employed has preferably a fusing point so relatively lower that quick fusion of the resultant resistor can be ensured.

Although the present invention has been fully described in connection with the foregoing non-limiting examples, it is to be noted that the present invention should be understood as applicable to resistors whose resistance films do not have grooves cut in them, in which case a suitable configuration for the glass applied is in the form of a ring substantially as shown in FIG. 3.

What is claimed is:

1. An electrical resistor comprising a substrate of electrically insulating material, a thin film of resistance material coated on said substrate, glass applied on only a portion of said resistor film, conducting terminals provided at two ends of said resistor and lead wires soldered to said ends, respectively, and a protective coating formed over the entire surface of said coated substrate, whereby upon receipt of severe load said glass is fused by heat evolved by said resistor film to destroy said resistor film thereby permitting the resistor to open circuit in which said resistor is inserted.

2. An electrical resistor as claimed in claim 1, wherein said resistance material is metal oxide.

3. An electrical resistor as claimed in claim 1, wherein said resistance material is metal.

4. An electrical resistor as claimed in claim 1, wherein said resistance material is carbon.

5. An electrical resistor as claimed in claim 1, wherein said thin film of resistance material is provided with a plurality of grooves determinant of the resis-

tance of the resultant resistor.

6. An electrical resistor comprising a substrate of electrically insulating material, a thin film of resistance material coated on said substrate, a plurality of grooves formed in said thin film on said substrate, glass applied on only a portion of said resistor film, conducting terminals provided at two ends of said resistor and lead wire soldered to said ends, respectively, and a protective coating formed over the entire surface of said coated substrate, whereby upon receipt of severe load said glass is fused by heat evolved by said resistor film to destroy said resistor film thereby permitting the resistor to open a circuit in which said resistor is inserted.

7. An electrical resistor as claimed in claim 6, wherein the body of said glass applied on the thin film of resistance material on the substrate extends in parallel relation to the longitudinal axis of said substrate crossing a plurality of the grooves.

8. An electrical resistor as claimed in claim 6, wherein the body of said glass applied on the thin film of resistance material on the substrate extends in the form of a ring and located at a substantially intermediate portion of said substrate.

9. An electrical resistor as claimed in claim 6, wherein the body of said glass applied on the thin film of resistance material on the substrate extends in parallel relation to and not crossing over the grooves at a substantially intermediate portion of said substrate.

10. An electrical resistor as claimed in claim 6, wherein the body of said glass applied on the thin film of resistance material on the substrate extends in parallel relation to the longitudinal axis of said substrate and sandwiched between two adjacent grooves located at a substantially intermediate portion of said substrate.

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Notice of Adverse Decision in Interference

In Interference No. 99,033, involving Patent No. 3,766, 508, T. Wada and Y. Shindo, FLAME-PROOF COATED RESISTORS, final judgment adverse to the patentees was rendered Mar. 31, 1978, as to claim 2.

[Official Gazette August 8, 1978.]

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