

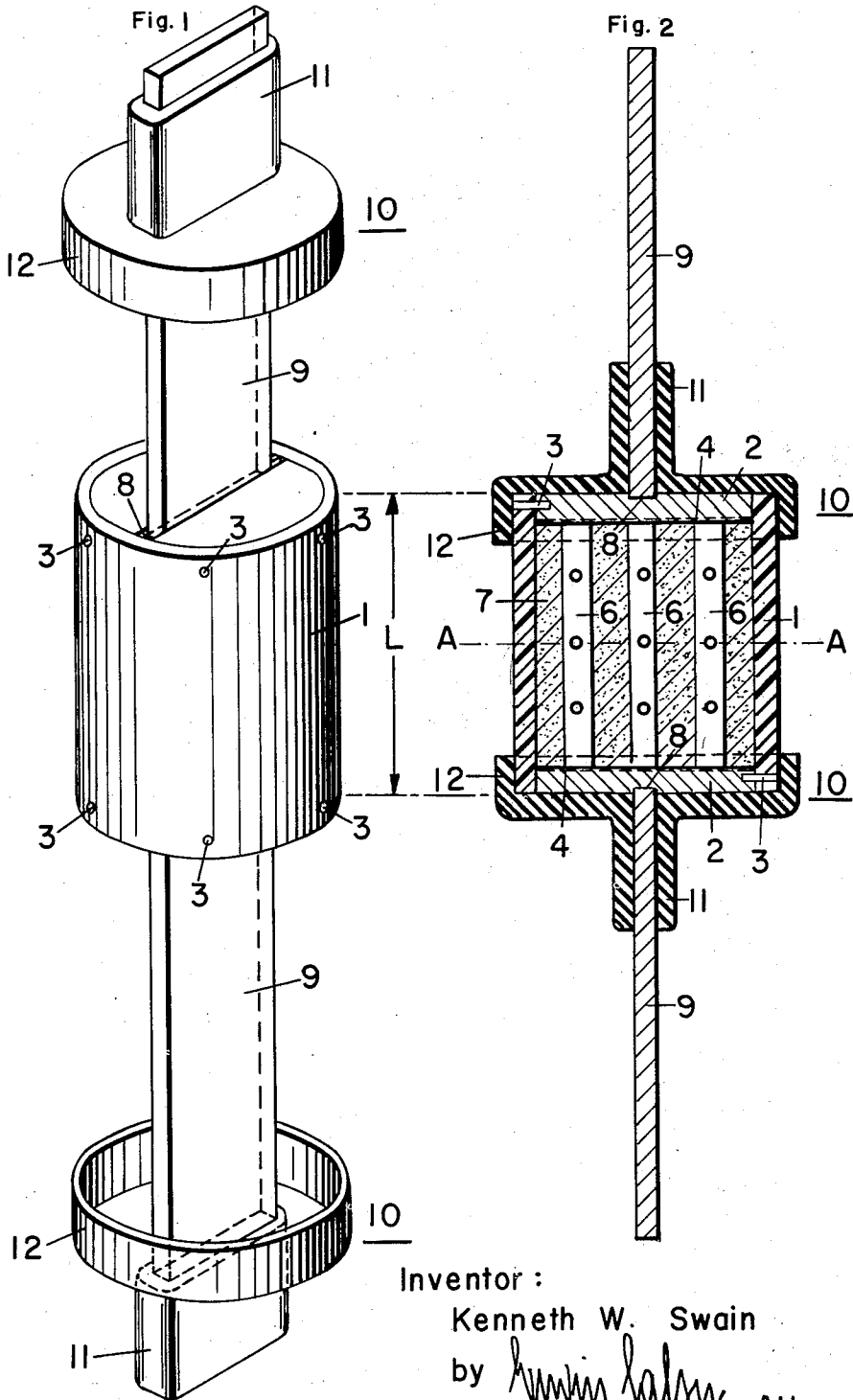
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CURRENT-LIMITING POWER FUSES OF REDUCED SIZE

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**CURRENT-LIMITING POWER FUSES OF REDUCED SIZE**

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3 Claims. (Cl. 200—131)

This invention has reference to current-limiting fuses, i. e. to fusible protective devices capable of interrupting fault currents before the fault current can reach the available peak magnitude thereof.

The current-limiting action of such fuses makes it possible to reduce arc energy, and the reduction of arc energy makes it, in turn, possible to reduce the size of the casings of such fuses, i. e. the size of the casings of such fuses may be substantially smaller than the size of the casings of fuses of the non-current-limiting type have the same electrical ratings.

Another factor which makes it possible to reduce the size of the casings of current-limiting fuses is the development of new insulating materials which combine substantial heat-shock resistance with increased mechanical strength. This makes it possible to allow higher internal pressures inside of current-limiting fuses than thought heretofore to be feasible. Among the new materials making it possible to design current-limiting fuses of reduced size mention may be made of synthetic-resin-glass-cloth laminates as, for instance, melamine-resin-glass-cloth laminates.

Other means making it possible to greatly reduce the size of current-limiting fuses are disclosed in United States Patent 2,592,399 to William S. Edsall et al., Current-Limiting Fuse, April 8, 1952, and in United States Patent 2,599,646 to Frederick J. Kozacka, Current-Limiting Fuse, June 10, 1952.

Heretofore only limited advantage could be taken of the possibility of reducing the size of the casing of current-limiting fuses as suggested by the aforementioned advancements, and by other advancements, in the design of current-limiting fuses. The main reason for this handicap consists in that size reduction results in a decrease of distance between live parts, and a decrease of distance between live parts might be undesirable, or even intolerable.

It is, therefore, one object of this invention to provide a new current-limiting fuse structure enabling to take full advantage of the reduction of size which has been made possible by relatively recent advancements in the design of current-limiting fuses.

Another object of the invention is to provide current-limiting fuses having casings of relatively small size wherein, in spite of general bulk reduction, the distance between live parts is as large as deemed necessary, or desirable, under the circumstances.

In the United States of America the design of current-limiting fuses is largely governed by the "Standard for Fuses" of the Underwriter Laboratories, Inc. The seventh edition (April 1955) of the aforementioned "Standard for Fuses" does not prescribe the length required for the casing. It specifies electrical ratings in terms of volts and amperes, and assigns to each electrical rating a

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"minimum distance from mid-point of fuse to nearest live part."

It is another object of this invention to provide current-limiting fuses which have considerably shorter casings than non-current-limiting fuses with comparable electrical ratings, and which fuses fully comply with the aforementioned "Standard for Fuses" in spite of their increased compactness.

Another object of the invention is to provide current-limiting fuses with an insulating structure increasing in effect the distance between live parts without significantly changing, or impairing, the heat exchange conditions of the current-limiting fuses.

Other objects and advantages of the invention will become more apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to, and forming part of, this specification.

For a better understanding of the invention reference may be had to the accompanying drawing wherein

Fig. 1 is an isometric exploded view of a current-limiting fuse embodying the invention, and

Fig. 2 is a vertical longitudinal section of the fuse shown in Fig. 1.

Referring now to the drawing, numeral 1 has been applied to indicate a substantially tubular cylindrical casing of a suitable synthetic-resin-glass-cloth laminate. The laminate is heat shock resistant, and has a high tensile strength, and is able to withstand high internal pressures. This makes it possible to minimize the internal volume of casing 1. Casing 1 is closed on both ends thereof by terminal elements 2, preferably in the form of metal plugs. Metal plugs 2 are pinned to casing 1 by a plurality of angularly displaced transverse steel pins 3. The juxtaposed surfaces of plugs 2 are provided with grooves 4 into which multi-perforated ribbon fuse link means 6 are inserted. Each ribbon fuse link 6 is held in position and conductively connected to plugs 2 by means of soft solder filled into grooves 4. The links 6 are made of a high conductivity low fusing energy metal, such as silver or copper. The choice of such a metal and the choice of a body 7 of quartz sand as arc-extinguishing filler are additional factors enabling to minimize the size of casing 1. The axially outer surfaces of plugs 2 are provided with grooves 8 each receiving one of a pair of connecting contacts 9, preferably in the shape of blade contacts. It will be apparent that blade contacts 9 are conductively connected to, and supported by, plugs 2, and that each blade contact 9 projects in an opposite direction from casing 1. Reference numeral 10 has been applied to generally indicate a pair of prefabricated caps of insulating material, each mounted on one end of casing 1. Each cap 10 has a first extension 11 overlapping a portion of one of blade contacts 9 and extending to a point preferably more remote from the median plane A—A of casing 1 than one half of the required minimum distance between live parts. The distance between the axially outer ends of extensions 11 and the plane A—A must be at least one half the required minimum distance between live parts or, in other words, the distance between the axially outer ends of extensions 11 must be at least equal to the required minimum distance between live parts. Each cap 10 has a second extension 12 overlapping a portion of casing 1. Each extension 12 is substantially shorter than one half of the length L of casing 1. Therefore a substantial portion of the length L of casing 1 is exposed to unimpeded heat exchange with the ambient.

The table below comprises data taken from the afore-

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mentioned "Standard for Fuses" of the Underwriter Laboratories, Inc.

Electrical Rating		Minimum Distance from Mid-Point of Fuse to Nearest Live Part, inches
Volts	Amperes	
250	0-30	-----
	31-60	-----
	61-100	1.631
	101-200	1.187
	201-400	1.187
600	401-600	1.531
	0-30	-----
	31-60	-----
	61-100	1.750
	101-200	2.250
	201-400	2.500
	401-600	2.687

It will be understood that this invention provides for current-limiting fuses which, when having the electrical ratings given in the first column and second column of the above table, include casings which are shorter than twice the figures indicated in the third column of the above table. The distance between the axially outer ends of extensions 11 of caps 10 are equal to, or exceed, the figures indicated in the third or last column of the above table multiplied by two.

It will also be understood that the insulating caps 10 take the place of metallic ferrules or caps which are frequently provided on current-limiting fuses.

Caps 10 may be made of any suitable insulating material, e. g. a thermosetting synthetic resin. One preferred embodiment of the invention comprises caps 10 of an elastomer, such as sulphonated polyethylene. Plastic caps, and in particular sulphonated polyethylene caps, lend themselves particularly well to color coding. Caps 10 may be used as a color coding means, in addition to their prime function of enabling size reduction without sacrificing safe and/or standard minimum distances between live parts.

It will be understood that extensions 11 and 12 form integral parts of caps 10, and that the geometry of the inner ducts defined by extensions 11 and 12 may change in accordance with the geometry of connecting contacts 9 and casing 1. The extensions 11 may be considerably longer than shown in the drawing but must always expose an axially outer end of each contact 9.

The best way of mounting caps 10 on, and securing caps 10 to, the fuse structure is by means of a temperature resistant adhesive or cement, which bonds the caps 10 to plugs 2, bonds extensions 11 to blade contacts 9, and bonds extensions 12 to the outer side of casing 1. It will be apparent that the inner diameter of extension or skirt 12 is substantially equal to the outer diameter of casing 1. If caps 10 are made of an elastomer, extensions 11 and 12 may be pre-stressed and tightly fitted under pressure upon parts 9 and 1 which helps in establishing perfect adhesive bonds between the caps 10 and the surfaces of the fuse structure to which caps 10 are affixed.

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Although this invention has been described in detail, it is to be understood that such description is intended to be illustrative rather than limiting, as the invention may variously be embodied, and is to be interpreted as claimed.

I claim:

1. A current-limiting fuse having electrical ratings conforming to the Underwriter Laboratories "Standard for Fuses," said fuse comprising a substantially tubular casing of insulating material having a shorter length than twice the "minimum distance from mid-point of fuse to nearest live part" as specified in said "Standard for Fuses," a pair of connecting contacts projecting from opposite ends of said casing, a pair of pre-fabricated caps of insulating material each mounted on one end of said casing, each of said pair of caps having a first tubular extension overlapping a portion of one of said pair of connecting contacts and extending to a point at least as remote from the median plane of said casing as said "minimum distance from mid-point of fuse to nearest live part," and each of said pair of caps having a second extension overlapping a portion of said casing and being substantially shorter in length than one half of said length of said casing.

2. A current-limiting fuse as specified in claim 1 comprising a pair of caps made of an elastomer and cemented in position on said casing and on said connecting contacts.

3. A current-limiting fuse having electrical ratings conforming to the Underwriter Laboratories "Standard for Fuses," said fuse comprising a substantially cylindrical casing of a synthetic-resin-glass-cloth laminate having a shorter length than twice the "minimum distance from mid-point of fuse to nearest live part" as specified in said "Standard for Fuses," a pair of terminal plugs each closing one end of said casing, multiperforated ribbon fuse link means of a high conductivity low fusing energy metal conductively interconnecting said pair of terminal elements, a quartz sand filler inside said casing embedding said fuse link means, a pair of blade contacts each supported by and conductively connected to one of said pair of terminal plugs and each projecting in an opposite direction from said casing, a pair of pre-fabricated caps of insulating material each mounted on one end of said casing, each of said pair of caps having a first extension overlapping a portion of one of said pair of blade contacts and extending to a point more remote from the median plane of said casing than said "minimum distance from mid-point of fuse to nearest live part," and each of said pair of caps having a second extension overlapping a portion of said casing and being substantially shorter in length than one half of said length of said casing.

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