May 5, 1970 D. J. COCHRAN 3,510,568

BUSHING TERMINAL GUARD

Filed March 6, 1968 2 Sheets-Sheet 1

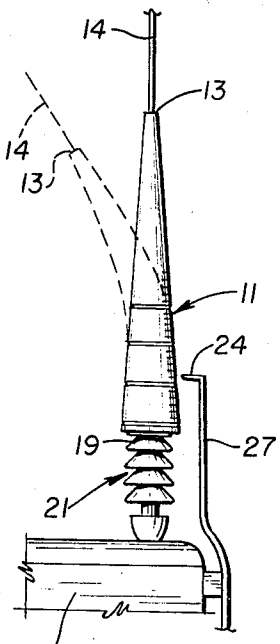

Fig_1

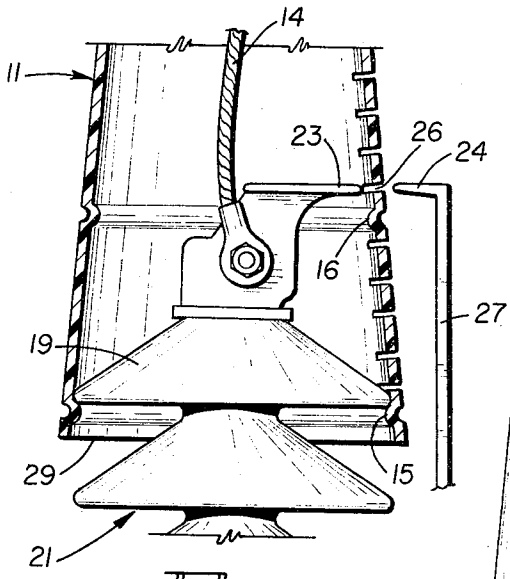

Fig_5

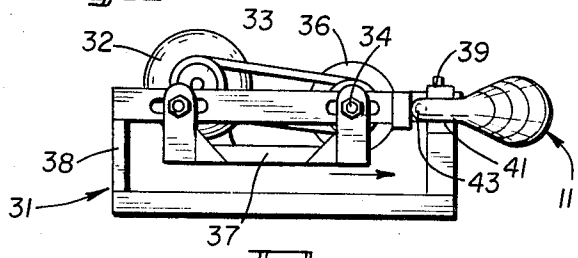

Fig_3

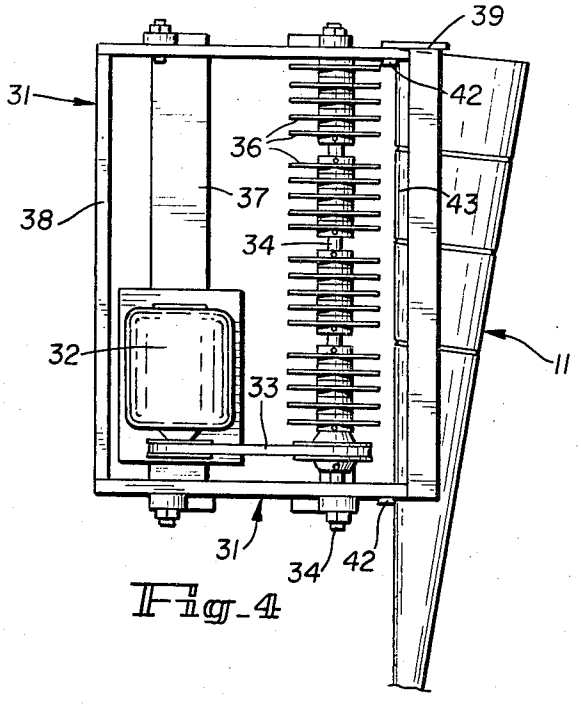

Fig_4

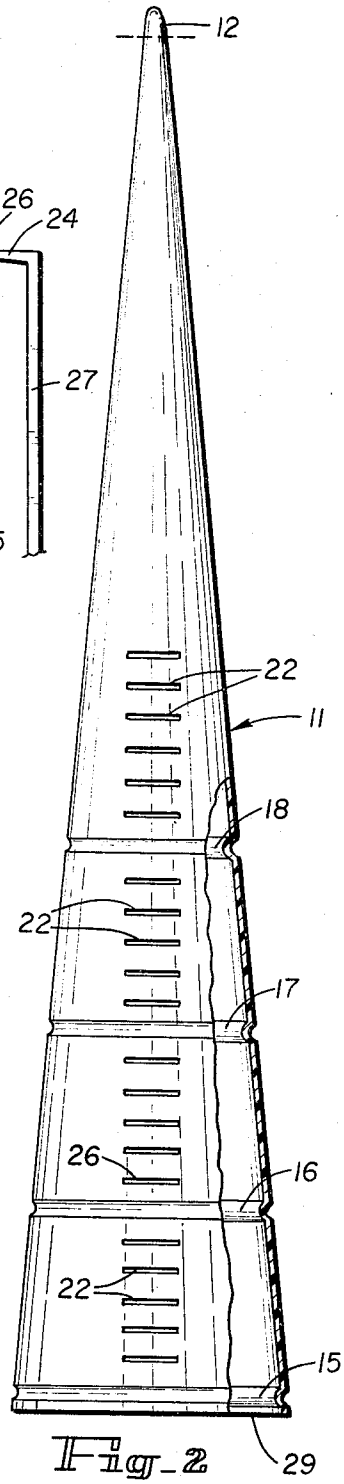

Fig_2

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BUSHING TERMINAL GUARD

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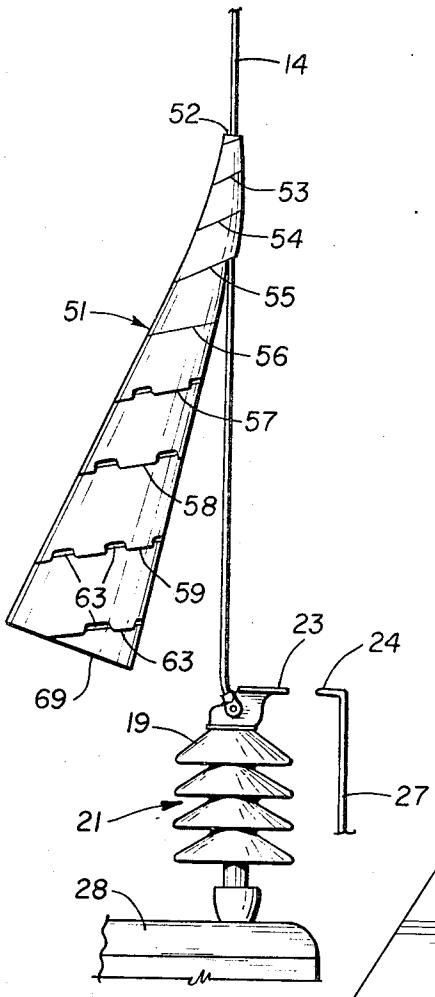

Fig_6

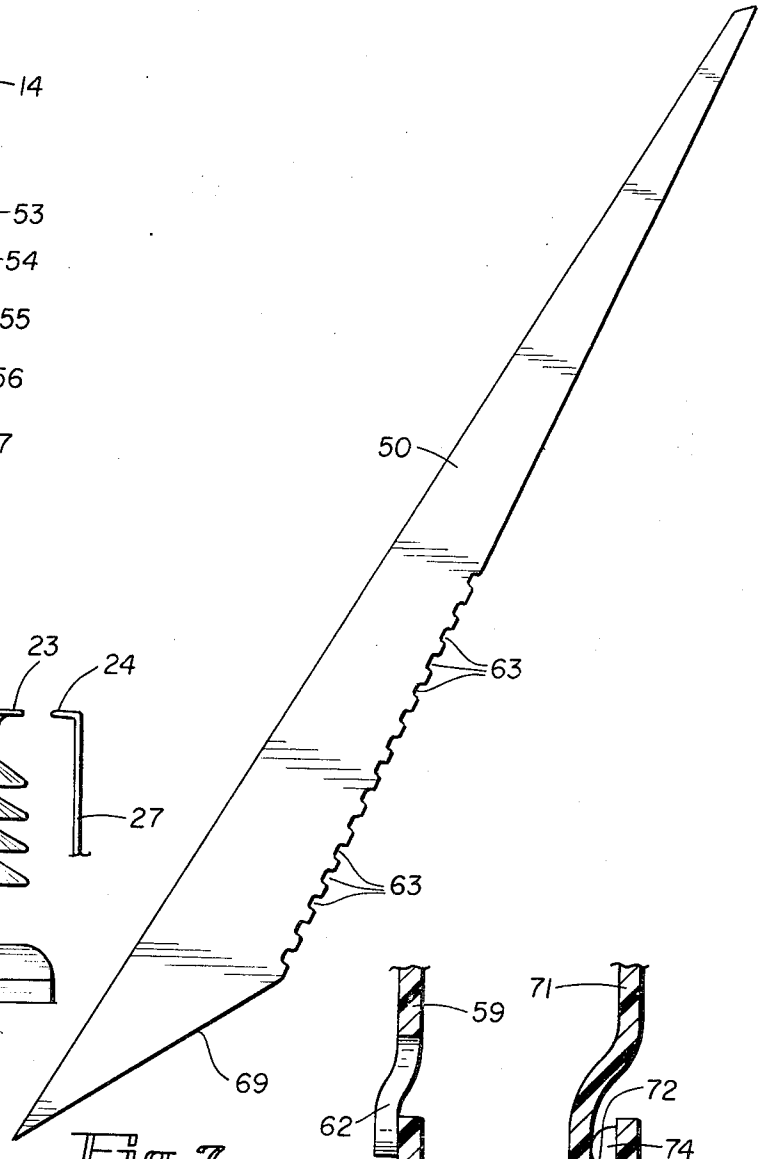

Fig_7

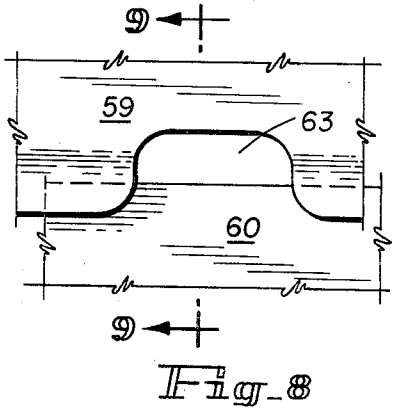

Fig_8

Fig_9

Fig_10

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BUSHING TERMINAL GUARD

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U.S. Cl. 174—5 8 Claims

ABSTRACT OF THE DISCLOSURE

A product for the protection of transformers and other electrical equipment from damage due to short circuits attributable to squirrels, birds and other animals or objects through provision of a guard or cover that may be selectively engaged on insulators of different size to protect circuit wires to an elevation or distance away from any animal or object supporting surface. The guard which fits over terminals and wires of an electrical circuit is formed of a high dielectric material, and it provides a skirt that may be changed to fit insulators of different size. Arc gap openings are provided at stepped elevations to establish moisture drain ports and electrical discharge paths for lightning energy when lightning arrestors are used. A mechanism inclusive of guide elements for machine cutting are gap slots in a flexible guard is disclosed. An embodiment of the invention provides a guard formed of a ribbon of semi-rigid dielectric material disposed in a spiral configuration to facilitate installation without interruption of power and further providing a weather protected arc gap and moisture discharge opening that may be selectively positioned at an elevation for registration with installed lightning arrestors.

BACKGROUND OF THE INVENTION

Each year many electric power installations, or even power stations, are damaged by short circuits that are attributable to squirrels, birds or other animals or objects. Squirrels often establish a bypass circuit interconnecting a transformer case and the input lead wires. On some installations or where lightning arrestors are used, birds or even small objects have caused serious damage to electrical power circuits and equipment. In addition to the inconvenience of a power outage, considerably expense can be involved in re-establshing normal operations. To avoid such problems various types of wire covers and guards have been used to prevent the short circuiting of electrical components. A type of cover or guard that can be fitted to an electrical insulator to protect the input line for a slight distance away from the insulator has been found to be highly advantageous. A major problem arises in the field, however, since it has previously been necessary to provide guards of different size to fit the various size insulators and input wires that are used. A further problem has been recognized where lightning arrestors are applied to the electrical circuit or to the power components that are to be protected. The drilling or cutting of an opening in previous squirrel guards that would register with the arc gap points of a lightning arrestor has detracted from the in-field acceptance of previous guards. To provide guards of improved design and utility, the present inventor herewith presents separate embodiments of his invention.

SUMMARY OF THE INVENTION

Briefly stated, a first embodiment of the invention provides a guard or cover for electrical circuits which is formed of a flexible high dielectrical material. A skirt portion of the guard provides internal bead structures that are of a size to be conveniently engaged with insulators

of different size. Provision is made for fitting the guard to a particular insulator with the bead construction engaged to a first convolution of an insulator bushing. When so engaged, the guard will cover and protect a substantial length of the input lead wire so that a squirrel or other animal cannot complete a bypass circuit between the input wire and other electrical or ground components. Being flexible, the guard can be conformed to the shape of the input wire, and provision is made for close engagement between the wire and the upper end of the guard to prevent excessive ingress of moisture that may follow down along the wire. A plurality of openings are provided at various elevations of the guard. These openings serve a dual purpose, inasmuch as a lower opening provides an outlet for any moisture accumulated within the cover, and in installations where lightning arrestors are used the openings further provide a path for a lightning arc from the input line to the bypass ground wire. The mechanisms and method used for providing the openings in a flexible guard includes the use of multiple cutting wheels that are brought into cutting engagement with a deformed guard positioned within guide elements of a cutting machine.

A further embodiment of the invention provides a guard that is formed of a semi-rigid dielectric material. The cover may have a characteristic conical shape, and it will in any instance provide a continuous slot so that the guard may be introduced onto an already installed power line. When fabricated from a strip of material wound about itself, a continuous or interrupted slot will be provided at the junction between adjacent sections of the strip through which a lightning arc could pass. The actual slot or gap may be provided by notches cut in an edge of the material or by spacing one winding of the structural material away from the next adjacent winding. As in the previous embodiment, the slot or gap will also prevent the entrapment of moisture within the guard.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view showing a first embodiment of this invention as installed, with a dotted line representation showing a possible alternate position,

FIG. 2 is a front elevation in partial section showing features of said first embodiment,

FIG. 3 is a side view showing a method and mechanism for cutting slot in said guard,

FIG. 4 is a top view of such slotting operation and machine,

FIG. 5 is a partial cross-sectional elevation showing the guard positioned with respect to a lightning arrestor,

FIG. 6 is a side view showing installation of a second embodiment of the invention,

FIG. 7 is a layout showing further features of construction for the second embodiment,

FIG. 8 is a partial elevation showing details of an arc gap slot in enlarger detail,

FIG. 9 is a cross-section taken along the line 9—9 of FIG. 8, and

FIG. 10 is a cross-section showing a modified type of arc gap preserving construction.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A first embodiment of the invention, as shown in FIGS. 1–5, provides a guard **11** of conical form, the top **12** of which may be cut off to provide a top opening **13** which will closely receive an input power line **14**. The cover **11** has a plurality of internal beads **15, 16, 17** and **18** so that the guard can be applied directly to the convolutions **19** of an insulator **21**. Since all insulators are not of the same size, it is intended that the guard **11** may be cut off at a position just below any of the bead structures **15–18**

to effectively shorten the guard **11** and to coincidentally reduce the diameter of the bottom of the exposed bead **16–18**. Preferably, the guard **11** is made of a flexible and elastic material, and, accordingly, with the proper design the guard can be fitted securely to the top convolution of various sized insulators **21**. Since the guard is flexible and resilient, it can be bent to alternate shapes as shown in FIG. 1 to conform to the shape of the input wire **14**. If care is exercised in cutting off the tip **12** of the cover structure, the walls of the guard **11** will closely engage the input wire **14** to substantially prevent the introduction of water to the interior of the guard either directly or due to water that courses down the input wire **14**. In order to prevent accumulations of water within the guard **11** that might short out the electrical circuit, a plurality of openings **22** are provided in the side walls of the guard structure. In addition to providing an opening for the elimination of water and for the ventilation of the guard to prevent a moisture buildup within the device, these same openings provide an additional benefit, inasmuch as they are purposely positioned to register with the arc prongs **23** and **24** of lightning arrestors.

As shown in FIG. 5, if the largest bead **15** is engaged with a top convolution **19** of an insulator **21**, an opening **26** that is just above the bead **16** will be in position of alignment with respect to the line prong **23** and the ground prong **24** of a lightning arrestor assembly **27** which is mounted on but insulated from the transformer **28**. With this arrangement if lightning hits the power lines and is led down the input line **14**, an electrical discharge will be created across the arc prongs **23** and **24** to be carried to the ground by the lightning arrestor assembly **27**. This provision of spaced openings **22** to be registered with lightning arrestor components represents an advantage of the present invention. In connection with such installation it should be noted that while any opening **22** provides an arc path, the main structure of the guard **11** and specifically the side walls thereof surrounding the openings **22** would prevent a squirrel, cat or bird from establishing contact across the prongs **23** and **24** to cause a short circuit of the power line **14**. The construction, accordingly, prevents undesirable short circuits while permitting the escape of substantial overloads of the type occasioned by lightning bolts.

The provision of these desirable openings **22** creates a special problem in manufacturing. Since the holes are disposed upwardly at a substantial elevation above the initial base **29**, it would be difficult to provide a punch anvil of sufficient strength to operate on the interior of the conical guard. This would be especially true at the top where the interior of the guard is of small cross-section. In the present embodiment of the invention the desired holes **22** have been cut in the slope face of the guards **11**. A mechanism **31** for machine cutting these openings in the flexible guard is shown in FIGS. 3 and 4. Here it will be seen that a motor **32** is connected by a belt **33** to a cutter arbor **34**. A plurality of cutters **36** are disposed for rotation with the arbor **34**. The motor and arbor are attached to a reciprocally movable frame **37** which can be moved with respect to a support frame **38** toward and away from a guide structure **39**. The guide **39** provides a slot **41** into which the flexible guards **11** may be inserted if they are deformed. Stops **42** limit the inward movement of the guards **11** so that only a portion **43** of the side face is exposed to be cut. After the slots have been made by the cutters **36**, the frame **37** is retracted until another guard **11** may be inserted and positioned for cutting. The cutters may be of conventional mill cutter design.

Since the use of a flexible guard material not only facilitates this opening cutting function but also makes it possible to provide a guard that may be conformed to various shaped input wires **14**, the proper choice of materials is of importance in the practice of this invention. The inventor utilizes a vinyl material which has a high dielectric strength and which is substantially resistant to atmospheric deterioration. The guards may be dip formed on a heated mandril. Accordingly, less than the full length of guard could be formed without necessitating a change in mold equipment. A product having a single bead, such as the bead **18**, and a plurality of openings could be made and sold in accordance with this invention.

A separate embodiment of the invention is shown in FIGS. 6–10. In general, this embodiment again provides an electrical circuit guard **51** that may be applied to insulators **21** of transformers **28** and other electric power components. A main feature of the second embodiment of the invention is directed to an alternate method of construction so that the guard **51** is formed from a single strip of material, such as the strip **50** shown in FIG. 7. The strip **50** is wound about itself in spiral configuration to provide the desired shape. The separate convolutions **53–60** of the strip **50** are wound one about the other with the upper convolutions overlapping the lower end in such manner that a slot or gap is provided along the spiral length of the strip **50** so that the guard **51** may be introduced about an input wire **14** to be rotated until it is completely installed to surround and protect the input wire **14**.

In order that most water and moisture will be kept out of the guard **51**, the upper layers overlap the lower layers. The same gap or slot **62**, as shown in FIG. 9, which separates the inner and outer convolutions **59** and **60** not only provides a passage for the introduction of input wire **14**, but it also makes it possible to conveniently provide a plurality of arc gaps **63** which may be brought into registration with the prongs **23** and **24** of a lightning arrestor assembly **27**. When the base **69** is engaged against the top convolution **19** of the insulator **21**, the guard **51** can, of course, be freely rotated until an arc gap opening **63** is directly aligned with the prongs **23** and **24** of the lightning arrestor **27**.

This same form of spiral wound construction can be used to provide a slightly modified form as shown in FIG. 10, in which an upper convolution **71** is spaced from a lower convolution **73** by spaced apart raised knobs **74**. This construction will provide a near continuous gap **72** that is interrupted only by the knobs **74**. As before, the continuous type gap **72** can be registered with the lightning arrestor prongs **23** and **24**. If lightning hits, the electrical discharge would tend to follow a slightly curved path between the prongs **23** and **24**, but this would not be a problem with the type of voltages that are involved.

In general, the second embodiment of the invention, whether gaps of the type shown at **63** or **72** are provided, provides an overlapping wound type construction which makes it possible to install a guard on an already connected input line so that service will not have to be interrupted. This is a highly beneficial feature which contributes to improved field acceptance. As in the previous embodiment, a guard **51** of substantially conical shape can be cut off at different bottom elevations to provide a guard having a base **69** of a proper size for engagement with different sized insulators. Similarly, the top **52** can be cut off to accommodate the guard **51** to wires of different size.

In the construction of guards made in accordance with this second embodiment of the invention, vinyl, glass reinforced plastics or other materials can be used. Fiber reinforced plastic can be provided that has a higher dielectric strength and that is less subject to atmospheric deterioration. The materials used should have a self-extinguishing fire characteristic. In the construction of a spiral wound type of guard, a pre-impregnated glass strip **50** could be used to facilitate fabrication operations.

The fiber reinforced plastic or other material used in the manufacture of a spiral wound guard **51** should be substantially resilient to permit the deformation required when the input wire is being inserted. The same resilience coupled with the long spiral wound construction can make it possible to provide a single form and size of guard

that could be securely applied to insulators of different size without any requirement for cutting off the bottom of the guard. With this construction a bottom of small size could be stretched to fit the guard to larger insulators.

I claim:

1. A guard to prevent the short circuiting of electrical components by blocking access to powered wire leads of said components in positions adjacent input and output insulators, lighting arrestors and other non-powered elements of said components comprising a hollow body of varying sizes along the length thereof, a small end on said body for engagement with the powered wire leads of said electrical components, and a larger end on said body for engagement with non-powered elements of said electrical components at positions adjacent said leads, said body providing a plurality of non-powered element engaging members of varied size at spaced positions on said body whereby portions of said guard at opposite ends thereof may be cut away to adapt said guard for use with wire leads and non-powered elements of varied size.

2. A guard structure as set forth in claim 1 wherein the guard body further provides a plurality of openings disposed in position along the length thereof to provide arc gap paths for lightning arrestors that may be disposed at various elevations on said electrical components.

3. A guard structure as set forth in claim 1 wherein the guard is of hollow conical form and wherein said non-powered element engaging members are separate bead structures of ring form disposed on an interior surface of said hollow conical guard..

4. A guard structure as set forth in claim 1 wherein said guard is formed of a strip of material of tapering width disposed in spiral configuration with a slot between adjacent convolutions thereof whereby said guard may be installed over in-place lead wires.

5. A guard structure as set forth in claim 4 wherein the guard is intended for near vertical disposition and wherein the edge of the spirally disposed strip of material positioned above a lower convolution thereof overlaps the edge of said lower convolution to minimize moisture ingress through said slot.

6. A guard structure as set forth in claim 5 and further comprising protrusions in spaced positions along said convoluted strip of material for contact with the next adjacent convolution whereby said slot opening is maintained.

7. A guard structure as set forth in claim 1 wherein said guard is formed of a strip of material disposed in a spiral configuration of overall hollow conical shape with a spiral slot disposed between adjacent convolutions thereof and wherein said strip of material further has a plurality of notches along an edge of said strip to provide spaced openings for arc gap paths of increased size for use on installations wherein lightning arrestors are applied to said electrical components.

8. The method for providing slot openings in the flexible body of a hollow bushing terminal guard comprising the steps of deforming curved surfaces of the body of said guard to increase the curvature thereof, introducing the deformed portion of said body into a confining guide, and subsequently cutting transverse notches in said body across and through the deformed face thereof to provide slot openings of increased width having side edges of increased angularity.

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U.S. Cl. X.R.

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