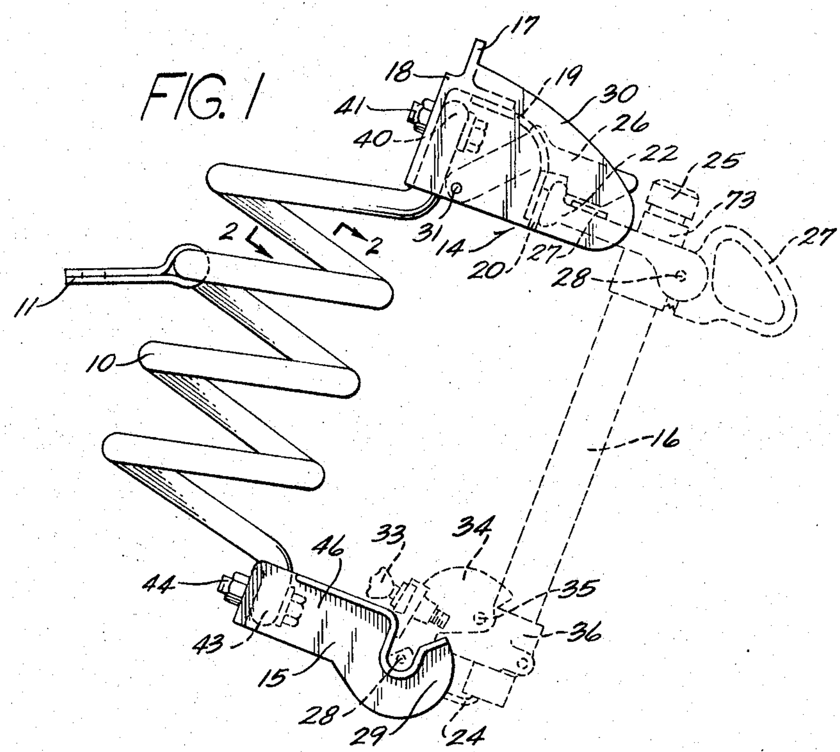
Jan. 3, 1967 R. J. BRONIKOWSKI 3,296,366

OUTDOOR HIGH TENSION INSULATOR HAVING LONG CREEPAGE PATH

Filed Dec. 23, 1965

FIG. 1



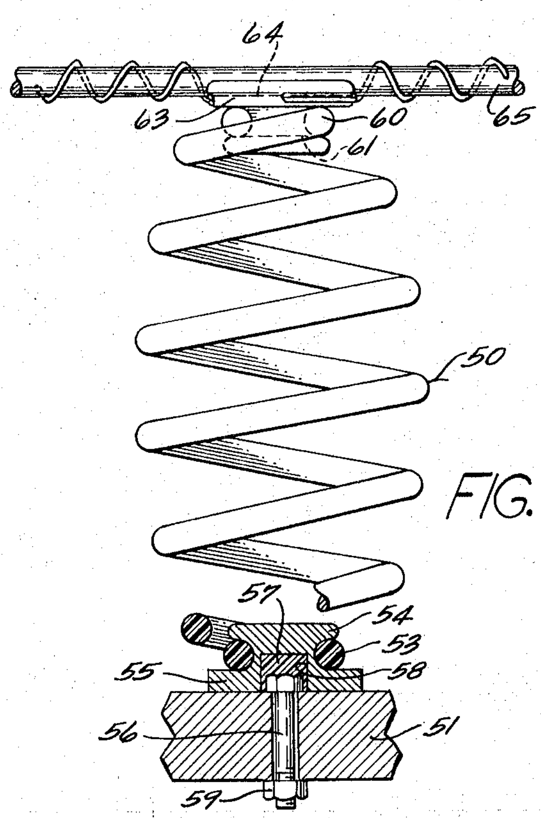


FIG. 3

FIG. 2A 

FIG 2B 

FIG. 2C 

FIG. 2D 

INVENTOR
RAYMOND J. BRONIKOWSKI

BY Lee H Kaiser

ATTORNEY

United States Patent Office

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OUTDOOR HIGH TENSION INSULATOR HAVING LONG CREEPAGE PATH

Raymond J. Bronikowski, South Milwaukee, Wis., assignor to McGraw-Edison Company, Milwaukee, Wis., a corporation of Delaware

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This invention relates to outdoor high tension insulators for electrical apparatus used on high voltage distribution and transmission systems.

High tension insulators are conventionally constructed of porcelain and are designed to withstand predetermined magnitude of power frequency and impulse voltage. When subjected to excessive voltage, the insulator should flashover, not puncture, and without the formation of a conducting surface path on the insulator. The requirement must be met against any form of lightning voltage wave, surge frequency, or climatic condition.

For service in contaminating atmospheres, it is necessary to provide an over-surface path on the insulator of a length several times the withstand distance in air. This is frequently accomplished by increasing the diameter of the petticoats on the insulator. If a flashover should occur in service, the resultant power arc may chip off several petticoats and scorch the insulator surface. Further, porcelain members are not light in weight; are difficult to fabricate to close tolerances; and upon high impact are apt to fracture into many small flying pieces. High tension insulators of organic resin material for use indoors or within enclosures are known, but they are of such construction that it is difficult to obtain sufficient length of creepage path for a given air strike distance, and the possibility of voids occurring during the molding of the resin material introduces the danger of failure of the insulators by puncture under high voltage stress. In outdoor installations where dust, contaminants or rain may accumulate, random surface discharges or arcing, known as over-surface scintillation, are promoted and form carbonaceous deposits in the insulation which ultimately yield low resistance paths, or tracks, that destroy the utility of the insulator. Further, differential weather effects on the exposed and protected portions of the same resin insulator may unbalance the surface gradient under moist and contaminated conditions, and the resultant unbalanced voltage distribution may cause flashover of the insulator below normal withstand levels.

It is an object of the invention to provide an improved insulator having an exceptionally long creepage path per unit volume. It is a further object to provide an improved insulator having high resistance to arc tracking and surface creepage and which may be constructed of a material having relatively low puncture strength without danger of flashover of the insulator. It is a further object of the invention to provide such an improved insulator which is capable of absorbing high impact forces, such as recoil forces generated upon operation of an expulsion fuse, without rupture and without transmitting the force to the mounting.

These and other objects and advantages of the invention will be more readily apparent from the following detailed description when considered in conjunction with the accompanying drawing wherein:

FIG. 1 is an elevation view of an open type fuse cutout embodying the invention, the fuseholder being shown in dotted lines;

FIGS. 2A–2D are views taken on lines 2—2 of FIG. 1 through alternative embodiments of the invention; and

FIG. 3 is an elevation view of a post type insulator in accordance with the invention.

Referring to FIG. 1 of the drawing, a fuse cutout of the open type comprises an elongated insulator **10** in accordance with the invention secured between its ends to mounting bracket **11** and at its upper and lower ends to an upper terminal assembly **14** and a lower fuseholder supporting means **15** respectively. A fuseholder **16** shown in dotted lines is pivotally mounted at its lower end on fuseholder supporting means **15** and is normally latched at its upper end to upper terminal assembly **14**. Upper terminal assembly **14** may include an upper terminal portion **17** of a backing member **18** supporting resilient conductive members **19** which carry upper contact members **20** normally bearing against the laterally extending arm **22** of an upper contact **23** affixed to the upper end of fuseholder **16**. Fuseholder **16** comprises an expulsion fuse tube surrounding a rupturable fuse link **24** and closed at its upper end by a metallic cap **25** which is electrically connected to the upper end of fuse link **24** and to the upper contact **23**. A rotatably mounted latch member **26** normally engages laterally extending arm **22** on upper contact **23**, and a pull ring and latch release member **27** pivotally mounted on a pin **28** is adapted when operated by a hookstick to impart an upward force on latch **26**, thereby releasing laterally extending arm **22** and permitting fuseholder **16** to pivot clockwise to open position about trunnions **28** engaged within C-shaped bearing portions **29** of the fuseholder supporting means **15**. A protector hood **30**, which may be of fiber glass reinforced resin, may be affixed to backing member **18** by suitable fastening means. The lower end of fuse link **24** may be affixed by means of a thumb screw **33** to a hinge contact member **34** which is pivotally connected by a pin **35** to a metallic collar member **36** secured to the lower end of the fuse tube.

The components of the fuse cutout do not constitute part of the invention and are described only by way of example and may be similar to the elements of the fuse cutout disclosed in U.S. Patent 3,002,070 to Raymond J. Bronikowski et al. which has the same assignee as the subject invention.

Insulator **10** comprises an elongated member in the configuration of a helix having a plurality of convolutions which advance parallel to the axis of the helix so that each convolution is spaced from both adjacent convolutions in a direction parallel to said axis. The word "helix" is used in the detailed description and in the appended claims to connote a curve formed on any cylinder, not necessarily a right circular cylinder, by a straight line in a plane that is wrapped around the cylinder and is intended to cover such configuration as spindle-shape, conical volute shape, and double volute shape, i.e., a hyperboloid which is more familiar as the shape of a chair spring. Insulator **10** may be of an organic resin insulating material such as epoxy resin or polyester resin reinforced with a suitable filler such as glass fiber to increase mechanical strength. Insulator **10** may be of any desired cross section such as circular, cruciform, half-moon, Y-shape or U-shape as illustrated in FIGS. 2A–2D, and certain of the indented cross sections, such as a Y-shape cross section, form a path for rain or water to flow readily and rapidly off the insulator without leaving an accumulation of dirt or other foreign matter in its wake and providing uniform voltage grading under conditions of rainfall. Suitable materials such as hydrated alumina for preventing formation of carbonaceous deposits due to creepage may be interspersed in the resin material or coated on the surface of the insulator **10**. In certain embodiments the insulator **10** is of a material having a high resistance to arc tracking and surface creepage such as acetyl resin with a suitable filler such as filament wound glass fiber to increase mechanical strength.

The upper end of insulator **10** may be disposed generally parallel to the axis of the helix and formed into a loop **40** which receives a bolt **41** for clamping backing member **18** to the insulator **10**, similarly the lower end of insulator **10** may be generally parallel to the axis of the helix and formed into a loop **43** which receives a bolt **44** for clamping insulator **10** to the cross-piece of a U-shaped lower support member **46** which is integral with the C-shaped bearings **29** of the fuseholder supporting means **15**. Mounting bracket **11** may comprise an elongated metallic member bent back upon itself in surrounding relation to a convolution of insulator **10** between the insulator ends and clamped against insulator **10**.

The convolutions of helical insulator **10** are spaced in a direction parallel to the axis of the helix and do not touch, thereby providing an extremely long helical creepage path along all the convolutions of insulator **10** in comparison to conventional insulators wherein the creepage path is approximately in an axial direction. Further, it will be apparent that the length of the helical creepage path may readily be changed by varying the helix angle. Puncture of the insulating material of insulator **10** is eliminated because the portions of conventional insulators which are subject to puncture breakdown are omitted in insulator **10**, for example, the tubular core of solid material is omitted. Recoil forces arising from rupture of fuse link **24** and expulsion of gas from fuse tube **16** are absorbed by the convolutions of insulator **10** between lower support member **46** and mounting bracket **11**, thereby preventing the high recoil forces from being transmitted to the mounting bracket. In certain embodiments of the invention subjected to high recoil forces, the insulator **10** is preferably of a material having a relatively high modulus of elasticity in shear, for example, nylon or polyacrylic resin, in order to minimize deflection.

In an alternative embodiment, the insulator **10** is of "double torsion spring" configuration wherein the convolutions above and below the mounting bracket **11** are oppositely wound, for example, the convolutions above bracket **11** may be wound clockwise and those below bracket **11** wound counterclockwise. This construction compensates for any shrinkage of the organic resin material which might be caused by further curing of the resin due to outdoor exposure since the deflection of the upper and lower ends of the insulator will be in opposite directions and thus prevent misalignment of the upper and lower contact assemblies.

FIG. 3 illustrates a post type conductor support insulator **50** embodying the invention and supported on the cross arm **51** of a power pole. Insulator **50** is helical in configuration and of spindle shape and comprises a plurality of convolutions which advance parallel to the axis of the helix and do not touch. The convolution **53** at the lower end of helical insulator **50** may be in a plane perpendicular to the axis of the helix and em-

braces a thread-shaped portion **54** of a lower support member **55** resting on cross arm **51**. The head of a bolt **56** may be secured by suitable means such as cement **57** within an aperture **58** in the bottom surface of lower support member **55**, and bolt **56** may extend through cross-arm **51** and be secured thereto by a nut **59**. The convolution **60** at the upper end of insulator **50** may also be in a plane perpendicular to the axis of the helix, and convolution **60** may embrace the thread-shaped portion **61** of an upper support member **63** of suitable insulating material and having a diametrically extending groove **64** therein for receiving a power line conductor **65**. Conductor **65** may be secured to upper support member **63** by a thin wire **66** wrapped around power line conductor **65** and the circumferential flange on upper support member **63**.

While only a few embodiments of the invention have been illustrated and described, many modifications and variations thereof will be readily apparent to those skilled in the art, and consequently it is intended in the appended claims to cover all such modifications and variations which are within the true spirit and intent of the invention.

I claim:

1. An electrical insulator having an exceptionally long creepage path per unit volume and being capable of absorbing mechanical forces comprising an elongated member of insulating material in the configuration of a helix having a plurality of convolutions which advance parallel to the axis of the helix and each of which is spaced from adjacent convolutions in a direction parallel to said axis, said material having a high modulus of elasticity in shear, said elongated member having at least one upwardly facing groove formed therein and extending along the length thereof.

2. An electrical insulator in accordance with claim **1** wherein one portion of said convolutions advance in one direction and the remainder thereof advance in an opposite direction.

3. An electrical insulator in accordance with claim **2** wherein at least the surface of said insulator is covered with a material having high resistance to arc tracking and surface creepage.

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LARAMIE E. ASKIN, *Primary Examiner.*