March 31, 1931. G. A. BURNHAM 1,798,367

INSULATOR

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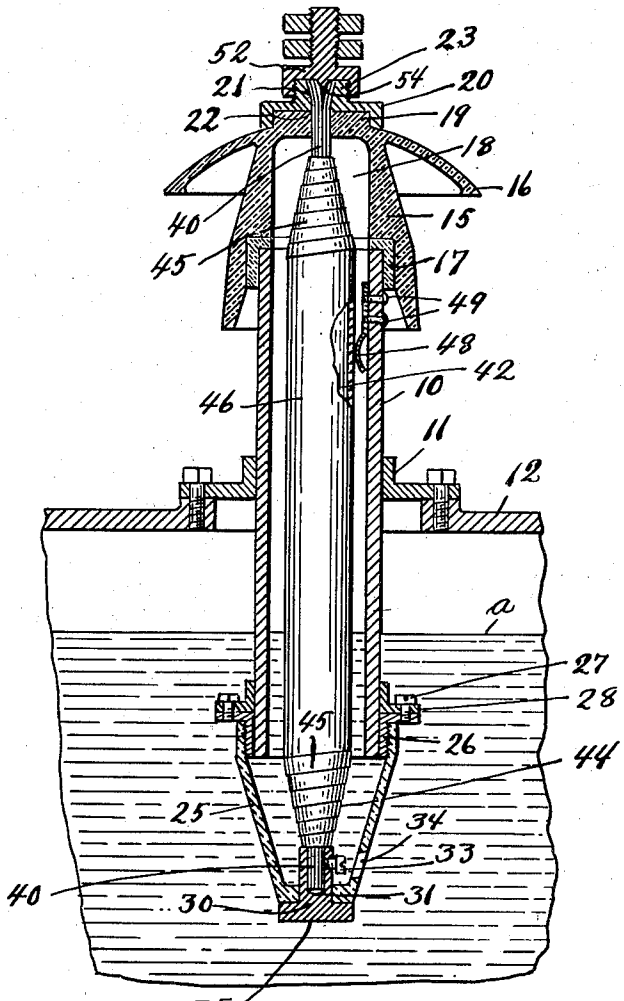

Fig. 1.

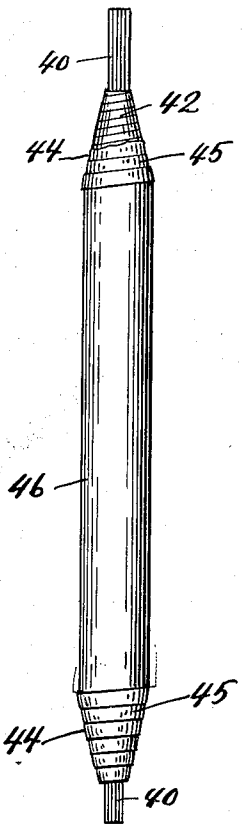

Fig. 2.

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UNITED STATES PATENT OFFICE

GEORGE A. BURNHAM, OF SAUGUS, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONDIT ELECTRICAL MANUFACTURING CORPORATION, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS

INSULATOR

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This invention relates to bushing-type insulators for electrical apparatus, as high-tension circuit-breakers, transformers, and the like, wherein the conducting lead, or stud, passes through and is supported by the bushing and terminates in contact, or attaching, members at the opposite ends thereof.

A high-tension bushing-type insulator usually fails by the puncture of the insulation within the bushing, whereupon the entire insulator, usually, must be cast aside and replaced by an electrically-sound insulator. Such insulators are relatively expensive and the failure of an insulator may represent a substantial monetary loss. This type of insulator cannot, ordinarily, be repaired so that, if the insulator fails, and a spare insulator is not on hand, the electrical apparatus may be out of commission for a substantial length of time. Consequently, a supply of spare insulators are sometimes maintained on hand from which a faulty insulator may be replaced, which necessitates a considerable monetary investment.

An object of this invention is the provision of a relatively inexpensive bushing type insulator and one in which the insulating element most likely to fail in use is relatively inexpensive and is so arranged that it may be withdrawn and replaced by a fresh element.

A further object is the provision of a renewable insulated current-conducting element for a bushing-type insulator.

A further object is generally to improve the construction of electric insulators.

Fig. 1 is a vertical sectional elevation through a bushing-type insulator embodying the invention.

Fig. 2 is a side view of a renewable insulated current-conducting element for the insulator.

The insulator embodying the invention may be used with any desirable type of electrical apparatus, and is here shown adapted especially for an oil immersed electric switch.

The insulator includes the substantially vertical metal tube or shell 10 which is of substantial length and diameter and is adapted to enclose the insulated current conductor. Said tube may be formed or provided with a supporting flange 11 intermediate its ends, by which flange the insulator may be attached securely to a support 12, which support may be the cover of an oil receptacle. The lower end of the tube may extend beneath the surface *a* of the oil and the upper end of the tube may extend for a substantial distance above the attaching flange 11, and the cover 12.

An insulating cap may be applied to the open upper end of said tube and said cap may include the substantially cylindrical body 15 and the integral outstanding and depending flange or petticoat 16, both made of some suitable insulating material, as porcelain. Said cylindrical body 15 is or may be formed with an internal axial recess therein in which the upper end of said tube 10 is received, and said cap may be secured permanently to said tube by the cement 17, which cement forms a fluid-tight seal between the tube and the insulating cap. Said axial recess is reduced and continued in the recess 18, which recess extends within the cap for a substantial distance above and approximately co-axially with the internal bore of the tube 10. The top of the insulating cap may be formed or provided with a boss 19 over which a metal cap 20 may be disposed and to which said cap may be fixed. Said metal cap and said boss may have aligned passages 21 and 22 which are also in alignment with the recess 18 and the bore of said tube 10. Said cap may be formed or provided with the externally-screw-threaded boss 23 through which said passage 21 extends.

A hollow and conical insulating cap 25 is disposed over the lower open end of said tube 10 and extends for a substantial distance therebelow. The upper end of said insulating cap may be fixed to an annular metal ring 26, which ring may loosely surround the lower end of said tube 10 and be detachably secured, by suitable means as screws 27, to an outstanding flange 28 carried by the lower end of said tube, whereby said insulating cap may be removed from

said tube 10, when desired, thereby to expose the lower open end of the tube. An attaching member 30 is passed through and fixed in the end of said insulating cap and has a recess 31 therein adapted to receive the current-conducting member hereinafter to be described. A set screw 33 or other suitable clamping means may serve to attach the conducting member securely to said member 30; and said set screw may be accessible through an opening 34 in the side wall of said cap 25. The lower or outer end of said attaching member 30 may be suitably formed and arranged to engage an electric conductor and, as here shown, is provided with a relatively massive flat head 35 arranged to function as a contact member and to be engaged by a movable contact member, not shown, of an electric switch.

The renewable insulated conducting element also embodying the invention includes a substantially straight conductor 40 of substantial length and diameter, which is here shown as composed of a plurality of strands of smaller conductors, although it may be constructed otherwise. The conductor has a body of insulating material 42 applied to it, to cover it substantially from end to end but to leave exposed the free ends of the conductor. The insulating material may be an impregnated paper, for instance, which may be wound tightly about the conductor to produce a thickness of insulation adequate to withstand the potential adapted to be impressed on the conductor. The ends of the insulating body may be tapered down to the exposed ends of the conductor, as at 44, and the tapered ends may be covered with an insulating tape 45, whereby to seal the exposed convolutions of the insulating material. The substantially cylindrical body of the insulation may be, and preferably is, enclosed tightly in a conducting sheath, as the lead sheath 46, for protection of the insulation and also to enhance the electrical properties of the unit, said sheath serving to distribute more uniformly the electrostatic stress on the insulation and to prevent the formation of corona in the spaces between the tube 10 and the insulated conductor.

The insulated conductor is disposed within the tube 10 in the manner indicated in Fig. 1. The conducting sheath 46 preferably is substantially co-extensive the length of said tube or shell 10 and may be electrically connected with it by suitable means as the spring-finger 48 attached to the inner wall of said tube by the screw 49 and extended inwardly within said tube to bear against said sheath. The lower tapered end of the insulated conductor is disposed within the body of the conical insulating cap 25 and below the oil level and the lower exposed end of the conductor is received within the recess 31 of and securely attached detachably to and electrically connected with the attaching member 30. The upper tapered end of the insulated conductor is disposed within the recess 18 of the upper insulating cap and, preferably, above the top of said tube 10 and the exposed end of the conductor is extended through the passages 21 and 22 and secured detachably to the cap 20 in any suitable manner as by the attaching member 52, which member is screw-threaded on the boss 23 of said cap and is provided with an internal projection 54 adapted to enter between the strands of the conductor and force them apart and into wedging contact with the tapered wall 22 of said cap.

In replacing a defective insulated conductor of the insulator, the tube 10 and its insulating caps is removed from the support 12 and the lower insulating cap 25 is removed, whereby to permit a new insulated conductor to be inserted within the tube and attached to the upper cap. The lower cap is then secured to the lower end of the tube and connected with the lower end of the conductor.

The insulation carried by the conductor unit is the only part of the insulator likely to fail in use and the unit is relatively inexpensive in construction and consequently a supply of spare units may be maintained on hand, to replace a faulty unit, for a relatively small monetary investment.

For commercial reasons, I prefer to form the insulated conductor units, as above set forth and as illustrated in Fig. 2, from the commercial high tension cable, which cable, as is well known, comprises an inner conductor, an intermediate insulator, and an outer lead sheath, as illustrated and described in connection with Fig. 2. The cable is cut in short sections of suitable length, the end portions of the lead sheath are cut away to leave only the short section illustrated, and the exposed insulation is tapered down as above described to form the unit.

The construction may be otherwise modified without departing from the spirit of the invention.

I claim:

1. A bushing-type insulator having insulated end-terminals, and a flexible insulated conducting unit disposed removably within said insulator, said unit comprising a flexible conductor having its ends detachably connected with said end-terminals, a solid flexible body of insulation carried by and surrounding and in intimate contact with said conductor between its ends, and a flexible metallic sheath carried by and in intimate contact with and enclosing the major portion of the length of said insulating body.

2. A bushing-type insulator comprising the combination of a conducting shell having insulating end-portions, conducting attaching members carried by said end-portions,

and a removable conducting unit disposed within said shell comprising a conductor extended between and connected with the attaching members of said insulating end-portions of said shell, a body of insulation carried by and enclosing the major portion of said conductor, a conducting sheath carried by and enclosing the major portion of said body of insulation, and means electrically connecting said sheath and shell.

3. A bushing-type insulator comprising the combination of a conducting shell having insulating end-portions, provided with conducting attaching members and a conducting unit disposed within said shell comprising a conductor extended between the attaching members of said insulating end-portions of said shell, a body of insulation carried by and enclosing and in intimate contact with the major portion of said conductor, and an external conducting sheath carried by and enclosing and in intimate contact with the major portion of said body of insulation.

4. A bushing-type insulator comprising the combination of a conducting shell having insulating end-caps, one of which has a removable connection with said shell, conducting attaching members carried by said end-caps, and a removable conducting unit disposed within said shell comprising a conductor having exposed ends connected detachably with said attaching-members, a body of insulation carried by and enclosing and in intimate contact with said conductor between its ends, and an external conducting sheath carried by and enclosing and in intimate contact with said body of insulation and terminated short of the exposed ends of said conductor.

5. A bushing-type insulator comprising the combination of a conducting shell, insulating end-caps carried by the ends of said shell, one of which has a removable connection with said shell, conducting attaching members carried by said end-caps, and a removable conducting unit disposed within said shell comprising a conductor having exposed ends connected detachably with said attaching-members, a substantially cylindrical body of insulation carried by and enclosing said conductor between the exposed ends thereof and having tapered end-portions, and a conducting sheath carried by and enclosing the substantially cylindrical portion of said body of insulation.

6. A bushing-type insulator comprising the combination of a conducting shell, internally-recessed insulating caps carried by and extended beyond the ends of said shell, one of said caps having means to expose the interior of said shell, attaching members carried by said caps, and a conducting unit disposed removably within said shell comprising a conductor having end-terminals extended through said insulating end-caps and connected with said attaching members, a substantially cylindrical body of insulation carried by and enclosing said conductor between its end-terminals, said body of insulation having tapered end-portions disposed within the recesses in said end caps, and a conducting sheath enclosing the substantially cylindrical portion of said body of insulation.

7. A refillable bushing-type insulator comprising a conducting shell, insulating end-caps carried by the ends of said shell, one of which has a detachable connection with said shell, terminal members carried by said end-caps, and an insulated conducting unit disposed removably within said shell comprising a conductor having detachable connections with said terminal members, a body of insulation carried by and enclosing said conductor between said terminal members, and a conducting sheath carried by and enclosing said body of insulation and terminated short of the ends thereof and having a detachable electrical connection with said conducting shell.

8. A high tension insulating bushing comprising a tubular member having insulated terminal members at the ends thereof, and a section of flexible commercial metallic-sheathed, high tension cable received in said tubular member and having the exposed opposite ends of its conductor connected with said insulated terminal members and constituting the electric conductor of said bushing, the insulation of said cable constituting at least a substantial part of the insulation of said bushing.

9. A high tension insulating bushing comprising a tubular member having insulated terminal members at the ends thereof, and a section of flexible commercial, metallic-sheathed, high tension cable received in said tubular member and having the exposed opposite ends of its conductor connected with said insulated terminal members and constituting the electric conductor of said bushing, the insulation of said cable constituting at least a substantial part of the insulation of said bushing, and means to ground the metal sheath of said cable.

10. The combination with a bushing type insulator including an enclosing casing having terminal connectors, of a section of flexible metallic-sheathed high tension cable forming the insulated conducting unit within the casing and having exposed end conductor-terminals connected with said bushing terminal connectors.

11. The combination of a casing containing an insulating fluid, a metal tube extending into said casing, an insulator carried by said tube at one end immersed in said insulating fluid, a terminal member carried by said insulating member, an insulated terminal member at the opposite end of said tube, and a flexible metal sheathed cable disposed within

said tube and having the ends of its conductor connected to said terminals and its insulation immersed in said insulation fluid.

12. The combination of a casing containing an insulating fluid, a metal tube extending into said casing, an insulator carried by said tube at one end immersed in said insulating fluid, a terminal member carried by said insulating member, an insulated terminal member at the opposite end of said tube, and a flexible metal sheathed cable disposed within said tube and having the ends of its conductor connected to said terminals and its metal sheath and insulation immersed in said insulating fluid.

In testimony whereof, I have signed my name to this specification.

GEORGE A. BURNHAM.