United States Patent

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[54] **ELECTRIC CABLE WITH GROUNDING MEANS**
2 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **174/6,** 174/107, 174/115
[51] **Int. Cl.** **H01r 3/06**
[50] **Field of Search** 174/6, 37, 68, 102, 115, 107, 108

[56] **References Cited**

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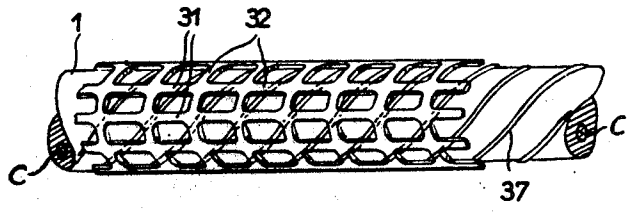
ABSTRACT: The invention resides in an electrical cable comprising a continuous insulated envelope with earth means on its outer face and a reticular sheath, of a synthetic substance, snugly fitted on said envelope and firmly applying thereagainst the said earth means.



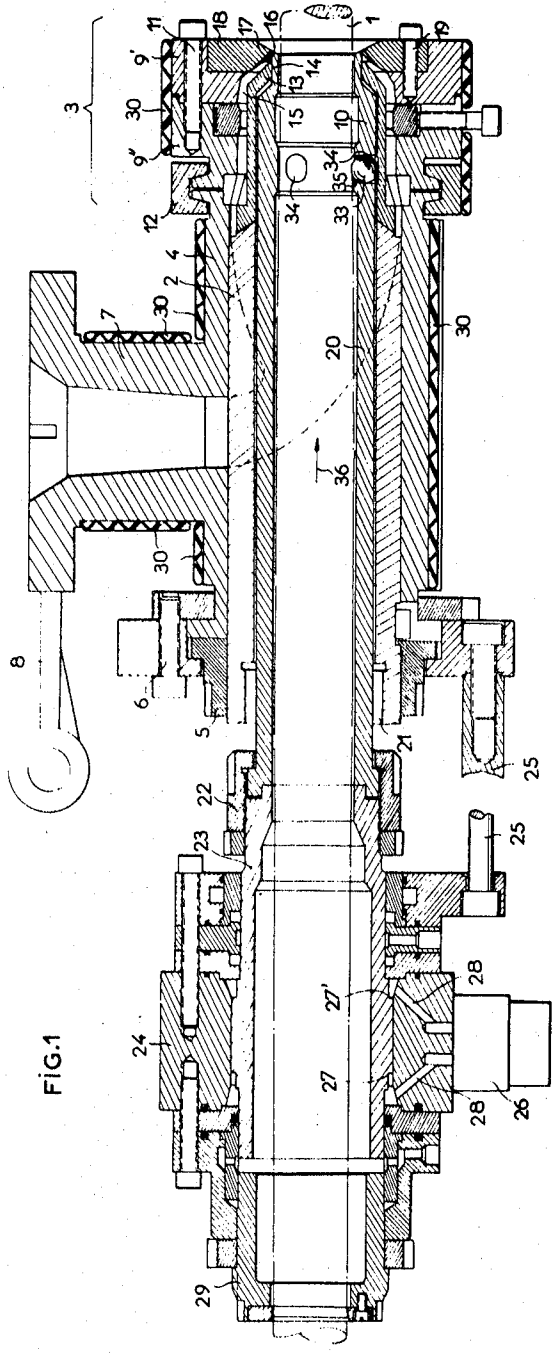


FIG.1

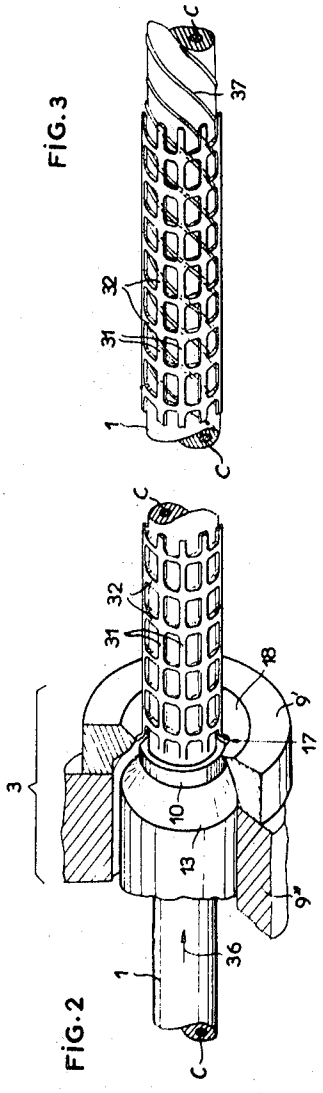


FIG.3

FIG.2

ELECTRIC CABLE WITH GROUNDING MEANS

This application is a divisional application of my pending application filed on May 18, 1967 under Ser. No. 639,379, now U.S. Pat. No. 3,473,986.

This invention relates to an electric cable and to an apparatus for covering the same with a perforate or reticular, more particularly synthetic, sheath.

The invention can cover an electric cable, inter alia for underground lines, with a perforate or reticular sheath of an insulating substance, more particularly a synthetic substance; the cable may also have external earthing conductors, in which event the provision of such a perforate or reticulate sheath which has been extruded in intimate contact with the continuous insulating covering of the cable ensures that the earthing conductors are in intimate engagement with such cable covering, the earthing conductors making electrical contact with the ground via the perforations or apertures in the insulating sheath.

For a better understanding of the invention and to show how the same may be carried into effect, reference may now be made to the accompanying drawings wherein:

FIG. 1 is a section in an axial plane through an embodiment of the apparatus according to the invention;

FIG. 2 is a perspective and partly section view of the extrusion head of the apparatus shown in FIG. 1, and

FIG. 3 shows a portion of an underground electric cable covered with a perforate or reticular insulating sheath in accordance with this invention.

The apparatus according to this invention, which is shown in FIGS. 1 and 2, is for covering an electric cable 1 with a perforate or reticular sheath of synthetic material. The apparatus mainly comprises a guide sleeve 2 whose inner diameter is large enough for cable 1 to slide without friction and which is preferably disposed horizontally, and in annular extrusion head which has the general reference 3 and whose internal diameter is very similar to the external diameter of cable 1 and which is disposed concentrically at one end of sleeve 2. The two integers 2, 3 are rigidly interconnected by an outer casing comprising : a cylindrical part 4 which extends closely around sleeve 2, their like ends being rigidly interconnected inter alia by a nut 5 and a system of bolted flanges 6; and a lateral tube 7 whose axis is substantially perpendicular to the axis of the sleeve 2 and which, when secured by means of a flange 8 to the output of some conventional form of extruding machine, for instance, a screw extruder (not shown), serves to feed head 3 with an extrudable synthetic substance. Head 3 mainly comprises two items: a stationary outer collar, comprising two fitted elements 9′ and 9″; and an inner ring 10. The two elements 9′, 9″ are secured to one another by screwed fasteners, as 11, and the element 9″ is secured to the corresponding end of the cylindrical casing part 4, inter alia through the agency of a collar 12. The collar 9, 9″ is completed by an inner element 13 which forms a downwards extension of, and is rigidly secured to, sleeve 2. The integers 9′, 13 of the outer collar 9′, 9″, 13 bound the inner lateral surface 14 of such collar, the diameter of surface 14 being slightly greater than the diameter of cable 1. An annular passage 15 is left between the element 13 and the elements 9′, 9″ of the outer collar; one end of passage 15 meets surface 14 to bound an annular extrusion orifice 16, and the other end of passage 15 communicates with the inner passage of tube 7 via a duct which is contrived in the casing associated with tube 7 and which, since it is behind the plane of FIG. 1, is shown therein merely in the form of broken lines. In the embodiment shown in FIGS. 1 and 2, the outermost lip of orifice 16, such lip being formed in the integer 9′, is formed with notches 17 (see more particularly FIG. 2) which extend towards the passage 15 and join the same near its exit 16; preferably, the notches 17 are distributed evenly around the periphery of such lip. In the embodiment shown, such lip and its notches 17 are contrived in a ring 18 which forms a releasable part of integer 9′ and which is secured to the outer ring by screwed fasteners, as 19, so that ring 18 can readily be replaced by other rings formed with differently shaped, sized and distributed notches 17. The inner ring 10 comprises an

end part whose outer diameter is such that ring 10 can slide without friction in contact with surface 14 of the system 9′, 9″, 13, the internal diameter of ring 10 being such that cable 1 can pass through without friction. The central part of ring 10 is prolonged by a sleeve 20 which can slide freely inside sleeve 2, sleeve 20 emerging from the opposite end of sleeve 2 by way of sealing means 21. That end of sleeve 20 which is outside sleeve 2 is coupled, inter alia by a cap nut 22, to an annular plunger 23 slidable without friction in a double-acting cylinder 24 connected to the rear end of casing 4 e.g. by rods 25. By way of a servo valve 26, the two annular surfaces 27, 27′ of plunger 23 can be actuated alternately with a pressure fluid, such as oil or compressed air, supplied from a source (not shown) through distribution passages 28 in the wall of cylinder 24. Through the agency of means which are known but not shown, cable 1 is moved, for instance, at a uniform speed, in the direction indicated by an arrow 36 through end 29 of cylinder 24, plunger 23, sleeves 20 and 2, ring 10 and the collar formed by the elements 9′, 9″, 13. Heating sleeve 30, more particularly of the kind comprising electric resistances, are disposed around the outer collar 9′, 9″, 13, the cylindrical part 4 and tube 7, to maintain at the extrusion temperature the synthetic substance which the extruder screw (not shown) delivers to tube 7, then to the casing passage shown in broken line in FIG. 1 and then to the annular passage 15.

The apparatus according to this invention as just described operates as follows:

When annular surface 27 of piston 23 is acted on by the pressure fluid and the piston 23 is in its first end position (the position shown in FIG. 1), the plain edge of inner ring 10 is in contact with the outermost lip of the annular extrusion orifice 16 in the ring 18. The synthetic material, which is kept at its extrusion temperature by the heating sleeves 30 and which reaches the end of annular passage 15, cannot emerge therefrom via the orifice 16 but must go through the notches 17 in the outermost lip, so that the synthetic material is extruded through the various notches 17 in the form of horizontal parallel strandlike elements 31. When the pressure fluid ceases to act on surface 27 of piston 23 but the pressure fluid acts on annular surface 27′ of piston 23, so that the same moves into its second end position, the plain edge of ring 10 is slightly separated from the notched lip of orifice 16, with the result that the synthetic substance is extruded not only through the notches 17 but also into the gap between the same and the plain edge of ring 10, such edge being slightly separated from such lip; during this phase of operation, therefore, as well as the horizontal parallel strands 31 continuing to be extruded through the notches 17, a single annular strand 32 which is transverse and more particularly perpendicular to the horizontal strands 31 is extruded through the orifice 16, strand 32 also being welded to the horizontal strands 31 at their crossing places, inter alia because the notches 17 open into the annular orifice 16. Since the diameter of orifice 16 is close to the external diameter of cable 1, the transverse annular strand 32, when it shrinks upon cooling, engages closely, together with the horizontal strands 31 to which it is rigidly connected, around the continuous insulating covering or envelope of the cable 1. As the pressure fluid acts alternately on the two annular surfaces 27, 27′ of piston 23 by way of the servovalve 26, ring 10 slides reciprocatingly between its first end position, which is the position shown in FIG. 1 and in which its plain edge bears on the outermost lip of the annular orifice 16 and in which the synthetic substance is extruded in the form of horizontal strandlike elements 31, and its second end position in which the plain edge of ring 10 is slightly separated from the outermost lip of orifice 16 and in which most of the synthetic substance is extruded in the form of a single annular transverse strand 31. Consequently, since cable 1 moves at a uniform speed in the direction indicated by arrow 36, a synthetic reticular sheath formed by the cross strands 31, 32 which bound rectangular meshes is extruded in direct contact with the continuous insulating envelope of cable 1. In the embodiment under consideration, the two end positions of ring

10 are demarcated by the cooperation of balls, as 33, which are received in recesses 34 in sleeve 20, with the flanks of an annular groove 35 with which the internal surface of the inner tubular element 13 of the outer collar is formed.

The embodiment of the apparatus according to this invention as just described can vary considerably, all the variants falling under this invention. For instance, the sleeve 20 for coupling the inner ring 10 to the plunger 23 can, instead of sliding inside sleeve 2, slide in an annular space between sleeve 2 and the cylindrical part 4 of the casing. Also, the various elements of the collar 9', 9'', 13 can be embodied in various ways. The dimensions of the meshes of the synthetic reticular sheath can be varied by changing the releasable ring 18. The notches 17, instead of being contrived in the outermost lip of orifice 16—i.e., in ring 18— can be contrived in the edge of the inner ring 10, in which event the latter lip is plain. This latter variant can readily be devised so that the reticular sheath extruded on to the continuous covering of the cable 1 has a uniform thickness, including the crossing places of the horizontal strands 31 with the transverse strands 32 forming the sheath, for all that is needed to achieve this is for the element 13 to be so disposed as to close the entries of the notches 17 in the edge of ring 10; when the same is in its second end position in which one of the transverse annular strands 32 is extruded, extrusion of the horizontal strands 31 is interrupted. Also, the inner ring 10 can be stationary and the outer collar moving, the latter being coupled with the plunger 23 via the sliding sleeve 20; in this variant too the notches 17 can be either in the outermost lip of the annular orifice 16 or in the edge of the ring 10. Also, the axis of the apparatus need not be horizontal and can be vertical or even inclined.

Although the embodiments hereinbefore described of the apparatus according to the invention are of use for the extrusion of thermoplastics, the embodiments can readily be adapted to extrude all other extrudable substances including thermosetting plastics, viscose, glass, metals and so on.

FIG. 3 shows an embodiment of an underground electric cable in accordance with the invention, mainly comprising an ordinary cable having an appropriate number of pairs of insulated conductors C, the whole being completely enclosed in an insulator which forms the continuous casing or envelope of the cable 1. One or more external earthing conductors 37, which are helicoidal in the embodiment shown in FIG. 3, are applied to the continuous insulating envelope of the cable 1 and clamped tightly against such envelope by an insulating reticular sheath. The same secures the outer earthing conductors of the cable 1, and through the perforations in the sheath the earthing conductors can make electrical contact with the ground in which the cable is buried. In the embodiment shown in FIG. 3, the reticular sheath mainly comprises parallel longitudinal strands 31 and transverse annular strands 32 which are perpendicular to the strands 31, the strands 31, 32 being rigidly interconnected at their crossing places. The insulated reticular sheath used to cover the electrical cable according to the invention and shown in FIG. 3 may have been continuously extruded on the cable 1 through the agency of one of the embodiments hereinbefore described of the apparatus according to this invention.

I claim:

1. An electrical cable comprising an insulating envelope and at least one conductor therein, earth means in contact with the outer face of such envelope and a reticular sheath on said cable made of synthetic material and comprising circumferentially spaced parallel strands extending longitudinally of said cable and axially spaced circumferentially extending threads of the same material of substantially the same thickness as said strands integral therewith and normal thereto jointly defining substantial rectangular meshes longitudinally and circumferentially of said cable, said reticular sheath being snugly fitted over said cable, whereby said earth means is firmly pressed onto said envelope.

2. An electrical cable according to claim 1 wherein said grounding earth means consists of a conducting layer helically wound over said insulating envelope.