United States Patent

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[54] **WATER COOLED ELECTRIC CABLE**
7 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **174/15,** 174/113
[51] **Int. Cl.** **H01b 7/34**
[50] **Field of Search** 174/15, 15C, 24, 68C, 47, 27, 113

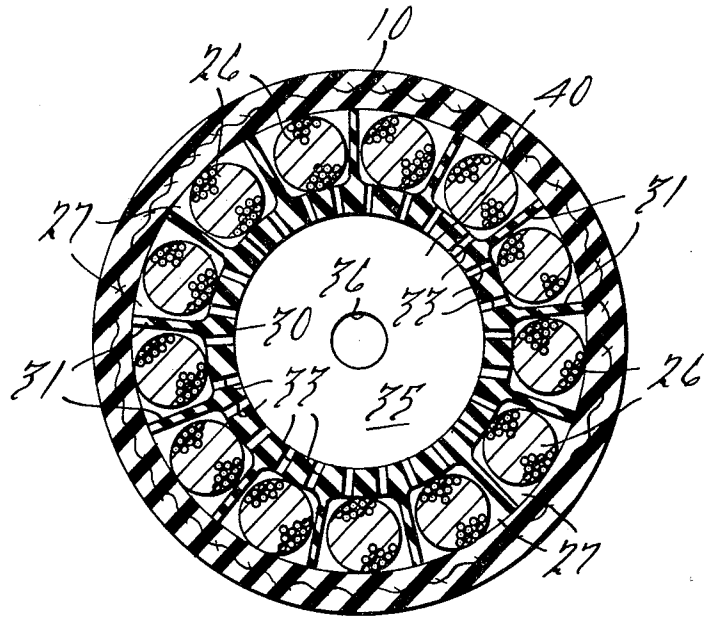
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ABSTRACT: A flexible electric cable for heavy currents comprises a flexible hoselike core having external fins extending longitudinally thereon and defining channels for flexible electrical conductors. An external hose covers the channels and the conductors. Cooling water is introduced into the interior at one end and withdrawn at the other end through electric terminals. The cylindrical wall of the internal core is provided near each terminal with a plurality of perforations connecting the interior of the core to the conductor channels in such areas near the terminals, the wall of the core member being imperforate throughout the central region of the cable. A pair of restriction elements are provided in the core, one between the imperforate mid region and each of the perforated areas. Each such restriction member has an orifice therein of lesser cross section than the total cross-sectional area of the apertures in the adjacent perforated region. At the water inlet end the restriction creates a back pressure tending to force the water radially outwardly through the wall into the channels and along the channels to the outlet end, the water then flowing inwardly through the orifices at the outlet end and into the interior of the core, from which it flows to the water outlet of the terminal.



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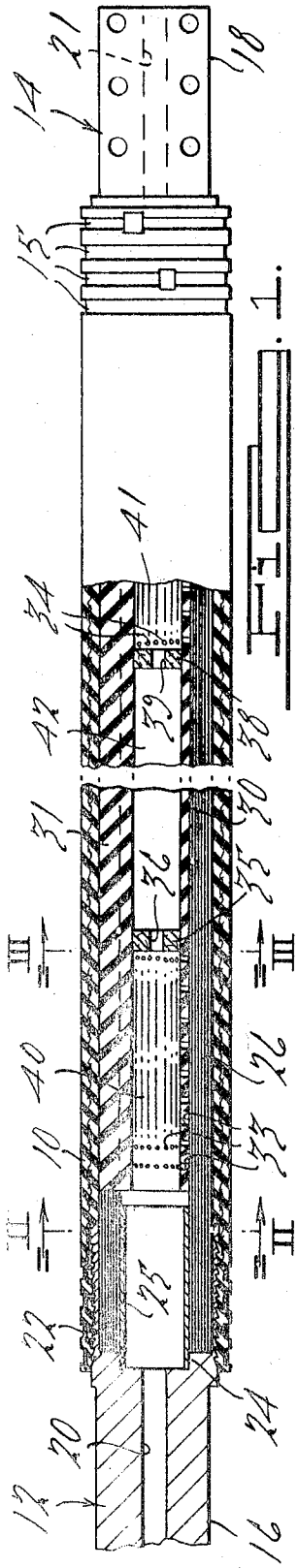


FIG. 1.

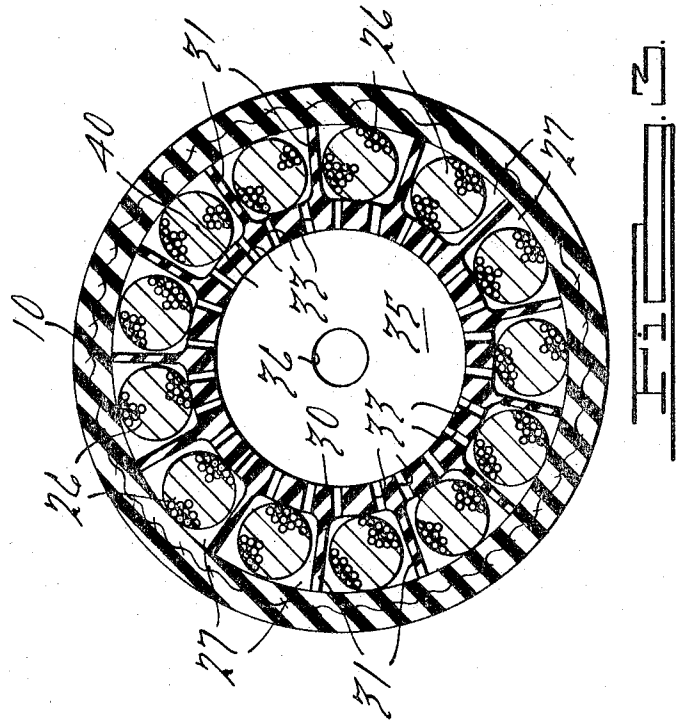


FIG. 2.

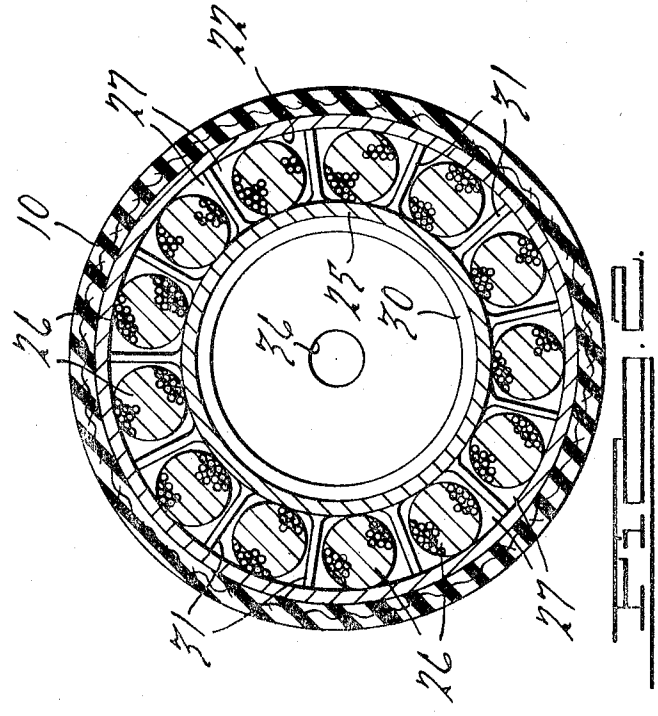


FIG. 3.

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WATER COOLED ELECTRIC CABLE

BRIEF RESUME OF THE INVENTION

In order to reduce the self-reactance of conductors for heavy alternating currents it is desirable to arrange the conductive material in a tubular area which is as large in diameter as is practicable and as thin as practicable in a radial direction. It is also frequently desirable to employ a flow of cooling water in contact with the conductors, to increase the effective current carrying capacity. The present invention aims to provide such an improved water cooled cable construction of high efficiency and low cost and wherein a long useful life is attained together with a high degree of flexibility.

The objects and advantages of the invention will become more fully apparent upon consideration of the present disclosure in its entirety.

IN THE DRAWING

FIG. 1 is a view partly in longitudinal diametric section and partly in side elevation, centrally broken away, showing a preferred embodiment of the invention, and

FIGS. 2 and 3 are cross-sectional views on a larger scale taken substantially on the lines II–II and III–III respectively of FIG. 1 and looking in the direction of the arrows.

Referring now to the drawing, reference character 10 designates the external watertight flexible casing hose of the assembly which is secured at its ends in watertight relation to the exterior of the terminals 12, 14, as by the clamping bands 15. Each terminal has at its outer end a connecting portion as 16, 18, adapted to be secured in electrically conductive relation to the source and to the apparatus to be served. It will be recognized that the precise configuration and construction of such connecting parts is variable, as design considerations may dictate, and not in itself a part of the present invention. Each terminal is provided with an internal water channel 20, 21, through one of which cooling water is introduced and through the other of which it is exhausted. The terminals may of course be similar so that description of one will suffice. At its cable end the terminal is provided with a stepped counterbore, the larger portion 22 of which extends inwardly from the cable end to a depth suitable for the wire sockets, while the smaller coaxial extension 24 of the counterbore forms a shallower socket for the inner end of a coaxial metal tube 25 secured therein and providing interiorly a passage for the cooling water and externally defining the inner wall of an annular conductor socket. A plurality of flexible stranded conductor ropes 26 are provided, soldered or otherwise secured in and electrically connected to the wire socket defined by the walls of counterbore 22 and sleeve 25.

The individual conductor ropes 26 are isolated throughout their length and held in peripherally outspaced relation by a flexible core assembly formed of a suitable nonabsorbent elastomer having low frictional characteristics such as synthetic rubber. The core has a cylindrical wall 30 and integral radial fins 31 which extend outwardly therefrom to the inner wall of hose 10 to form individual longitudinal channels 27 for the conductors 26.

A plurality of water holes 33 are provided extending through the tubular wall 30 of the core in a zone 40 close to the water inlet terminal 12, and a plurality of similar holes 34 are provided through such wall of the core in a similar perforated zone 41 near the water outlet terminal 14. Between the zone 40 and the remainder of the cable the core is provided with an internal plug 35 having an orifice 36 therein, the cross-sectional area of which is less than the total cross-sectional area of the holes 33. Zone 41 is similarly isolated from the imperforate midregion 42 of the core by a similar plug 38 orifices as indicated at 39, the total cross-sectional area of orifice 39 being less than the total cross-sectional area of the holes 34.

The conductor ropes 26 and fins 31 may be helically twisted to promote flexibility of the cable. In use, the cable is supplied with a flow of cooling water introduced through the channel 20 at a rate which cannot be passed by the orifice 36 without a throttling effect. Back pressure is thereby created within the chamber defined by zone 40, thereby inducing radial outflow through the holes 33 and into and along the channels 27, the pressure exceeding that in the main central region 42 of the interior of the core. At the farther end the water flows radially inwardly through the holes 34 to the outlet channel 21.

The restriction created by the orifice 36 at the water inlet end is such as to insure an effective flow of water through all of the channels 27, although if obstructions develop in any of the channels 27, excess flow can be accommodated through the central region 42 via orifices 36 and 39.

The mechanical inertia of the cable is increased by the weight of the water in the core hose 30, and such water assists in cooling, as well as assisting to maintain the dimensions of the core. If the orifice 36 should become plugged, water can enter the core through orifice 39.

The ribs 31 are imperforate and can be made of a thickness to suit the desired electrical characteristics of the cable. Changing the thickness of the ribs does not materially change the cooling efficiency or the resistance to wear.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

I claim:

1. A liquid cooled flexible electrical conductor comprising substantially concentric radially spaced inner and outer hose portions, electrical conductor means extending longitudinally through the space between said hose portions and beyond the ends of the inner hose portion, electric terminal portions connected to the projecting ends of said conductors and sealed to the outer hose portion to define a liquid tight enclosure, inlet means for introducing liquid into one end of the inner hose portion and outlet means for exhausting liquid from the other end of the inner hose portion, perforations in said inner hose portion localized in two zones, one located near each terminal, the portion of the inner hose between said zones being imperforate, and means restricting the flow of liquid from the perforated zone nearer the inlet means to the imperforate portion of the inner hose portion.

2. A conductor as defined in claim 1 wherein said restricting means comprises an obstruction member having bypass portions of lesser cross-sectional area than the total cross-sectional area of the perforations at the zone nearer the inlet end.

3. A cable as defined in claim 1 including peripherally spaced fins extending longitudinally and radially between said hose portions defining isolated channels for a plurality of conductors.

4. Means as defined in claim 3 wherein said perforations extend through the wall of the inner hose portion between the fins.

5. A conductor as defined in claim 2 including a pair of such obstruction members one located near each of said zones and restricting flow between said zones and the imperforate portion.

6. In a unipolarity flexible water-cooled electric cable, a flexible hoselike external casing, a flexible hollow core in the casing having an internal water channel and longitudinal ribs thereon defining external channels for water and conductors, a multistrand individual conductor in each external channel, feeding means for introducing cooling water into one end of each of said channels including restricting means imposing greater resistance to flow of water into the internal channel than into the external channels, and means for withdrawing the water from the other end of each channel.

7. A unipolarity cable as defined in claim 6 wherein the core has a tubular wall carrying said ribs and which is imperforate throughout that portion of its length intermediate said feeding means and said means for withdrawing the water.