United States Patent

[11] **3,604,831**

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[54] **FLUTED CORE**
8 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **174/15,** 174/28
[51] **Int. Cl.** **H01b 7/34**
[50] **Field of Search** ..... 174/15, 15 C, 28, 29, 22, 23, 25

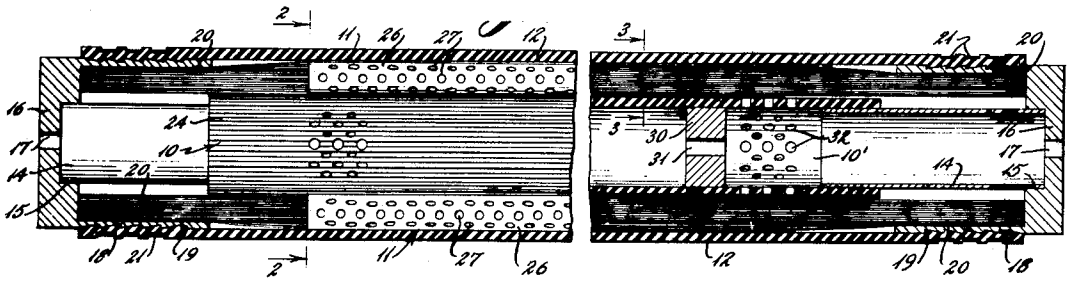
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ABSTRACT: A high-current-carrying, flexible electric cable has a central hollow core having longitudinal flutes along its exterior, conductors surrounding the core, and sheathing encasing the conductors. The core has an internal restriction adjacent to each end which permits limited flow of liquid through its hollow interior and has a perforated portion adjacent thereto toward each end of the conductor in order that liquid introduced into the core will be forced through the perforations into the interstices between the conductors and a limited portion passes through the interior of the core.



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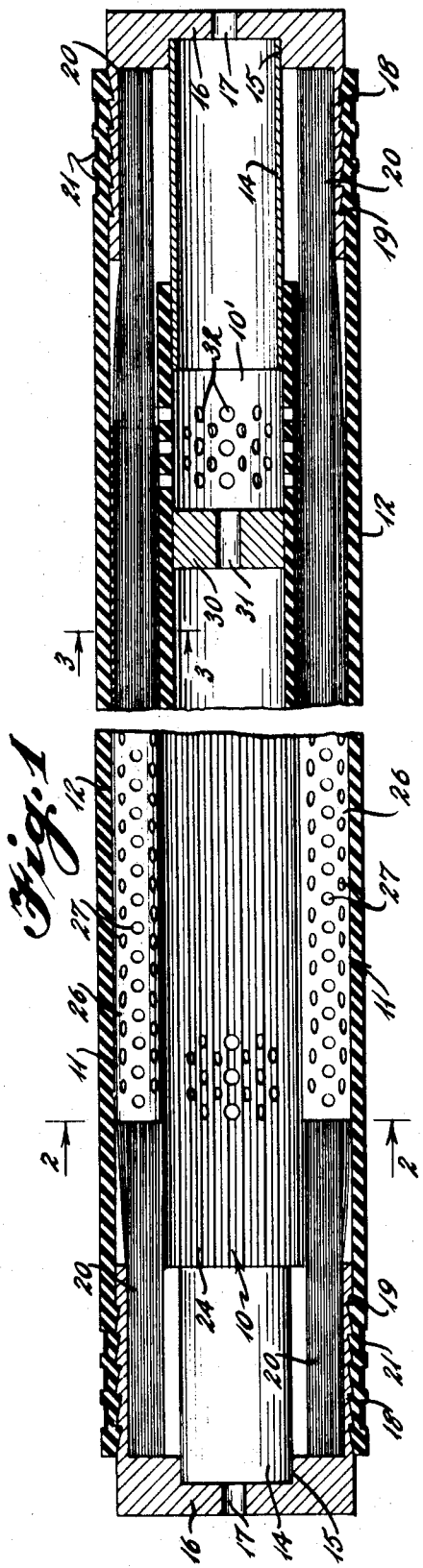


Fig. 1

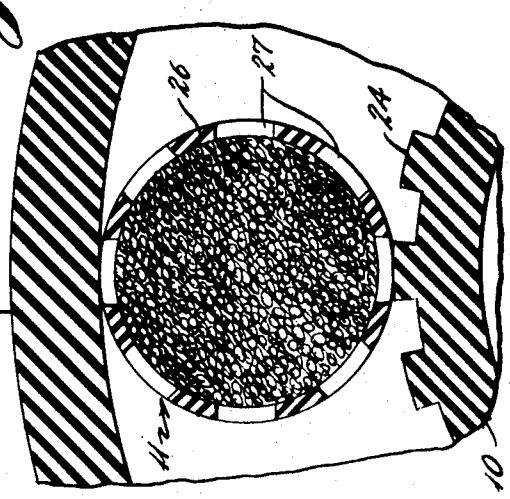


Fig. 3

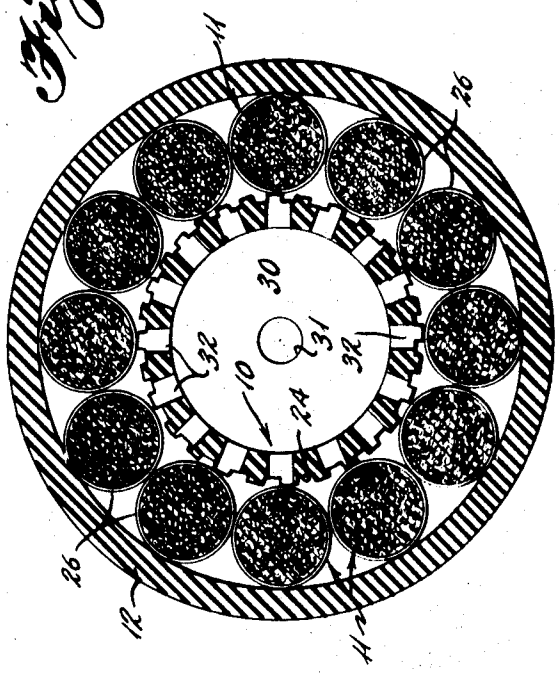


Fig. 2

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FLUTED CORE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electric cables, and more particularly to those that, because of the high density of current which is carried, require liquid cooling. Such cables are used for various purposes, including, but not limited to, electric welding.

2. Description of the Prior Art

High-current, flexible electric cables with provision for liquid cooling have been used heretofore. The common problems attendant thereto have been concerned with the provision of adequate and continuous cooling of all portions of the cable since any inadequate cooling results in early failure of the cable. Such cables are not only subjected to ordinary mechanical wear and tear but in addition, to relative movement of the conductors due to the current which is passed therethrough with frequent interruptions. While various arrangements for cooling such cable have been known, these have not provided a structure with arrangements for fluid passage as in the present invention.

SUMMARY

The present invention provides for the firm and secure engagement of a plurality of conductors about a hollow core having longitudinal flutes or grooves on its exterior which assist in holding the conductors against relative movement and promote the flow of cooling liquid evenly in contact with the conductors. The core has a perforated end portion adjacent to a restricting plug which cooperate to require a major portion of the liquid to flow past the conductors but permit the interior of the core to remain filled with liquid for additional cooling and stabilizing effect, the core additionally providing an efficient means for connecting a riser tube to the end terminal.

BRIEF DESCRIPTION OF THE DRAWING

With further reference to the drawing,

FIG. 1 is a divided longitudinal section of a cable in accordance with the present invention in which the core and conductors are illustrated in elevation on the left side of FIG. 1 and in section on the right side of FIG. 1;

FIG. 2 is a section to an enlarged scale on the line 2—2 of FIG. 1; and

FIG. 3 is a section to a still larger scale on the line 3—3 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With further reference to the drawing, the present invention includes a central core member **10** which is surrounded by a plurality of longitudinally extending conductors **11**, the latter enclosed within sheathing **12** of insulating material. At each of its ends the core member snugly receives a riser tube **14**, the other end of which is received within a recessed portion **15** of a terminal member **16** having a bore **17**. The terminal member has an outer sleeve **18** with external corrugations **19** which engage an end of the sheathing **12** between the sheathing and the uncovered ends **20** of the conductors **11**. For additionally securing the sheathing, straps **21** are bound about the ends overlying the corrugations **19**.

The terminals **16** may be extended to form plugs of any desired nature.

The core **10** is formed of an insulating material such as rubber or a plastic such as Neoprene and has longitudinally extending flutes or grooves **24** entirely around its outer circumference. These flutes engage the sleeves **26** surrounding each of the conductors in order to assist in holding the conductors in position and to assure the passage of liquid which is exterior of the core among the conductors.

The conductor sleeves **26** on the conductors have perforations **27** throughout their length in order to permit the liquid to circulate among the interstices of the strands. Due to flexibility of the strands, spaces occur between the sleeves surrounding them, thereby permitting liquid to flow in and along all portions thereof.

Adjacent to each end of the core **10** is a plug or gate **30** forming a restriction and having an orifice **31** of reduced size. The plug may be formed of wood or other material. Adjacent to the plug and closer to the end of the conductor the core **10** has a section **10'** with perforations **32** which permit liquid received through the aperture **17** of the terminal and through the riser tube **14** to circulate outwardly among the conductors. The extent of the perforated area and the size of the perforations in the core are dependent upon the proportions of the elements which constitute the cable and upon the amount of cooling fluid that is required.

The proportions of various elements of the cable are, of course, dependent upon the number and size of cables and the cooling requirements. In the illustrated example, a relatively large number of conductors are shown and the cross-sectional area of the interior of the core is relatively large as compared to that of the conductor.

In operation, the liquid, such as water, passes into the riser tube **14**. Due to the restriction of the gate **30** a substantial portion flows outwardly through the orifices **32** and along the exterior of the core, passing among the conductors and removing heat as it does so, until it reaches the other end of the cable, whence it discharges through a similar perforated end section of the core into the riser tube, both ends being similarly constructed. A portion of the liquid passes through the orifice **31** in the gate but since its flow is restricted at the opposite end by a similar gate, it tends to keep filled the hollow portion of the core. In flowing through the central portion of the core, the liquid not only conducts away heat, but operates to resist flattening of the core and its weight reduces the mechanical reactance and thus assists in stabilizing of the cable, having a cushioning effect.

Due to the construction and arrangement of the elements, under normal conditions the water flowing through the cable is turbulent, thereby more efficiently removing heat. Various rates of flow may be used, one installation having been operated successfully at about 8 gallons per minute.

I claim:

1. A flexible, liquid-cooled electric cable comprising

a cylindrical core member of flexible, relatively stiff insulating material having a central bore, a portion of said core member which is spaced from each end thereof having a plurality of radially disposed perforations, means in the bore restricting passage therethrough, said means located adjacent to and inwardly of the portion which has perforations, the exterior of said core having a plurality of substantially uniformly spaced longitudinal grooves extending substantially the entire length thereof, said grooves providing communication between the two groups of radially disposed perforations,

a plurality of conductors extending substantially longitudinally along the exterior of said core member, each conductor formed of a bundle of wire strands, a perforated sleeve surrounding each bundle and extending longitudinally of the cable,

sheathing means enclosing said conductors,

and terminal means at each end of said core member engaging said conductors and said sheathing means.

2. The invention as defined in claim **1** and a riser tube snugly received within each outer end of said core member and engaging its respective terminal means.

3. The invention as defined in claim **1** in which said terminal means has a corrugated end portion for promoting interengagement with the interior of said sheathing means.

4. The invention as defined in claim **3** and strap means encircling said sheathing means for securing it to said terminal means.

5. The invention as defined in claim **1** in which the cross-sectional area of the bore is substantially larger than that of a conductor.

6. The invention of claim 1 in which said core member is formed of rubberlike material.

7. The invention of claim 1 in which said sheathing means is a cylinder of rubberlike material.

8. A flexible, liquid-cooled electric cable as set forth in claim 1 where each of the means located in the central bore for restricting passage therethrough is a plug disposed transversely of said bore, each plug having a substantially centrally located orifice of reduced size extending therethrough.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,604,831 Dated September 14, 1971

Inventor(s) Daniel J. Goodman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Change the title from "FLUTED CORE" to -- LIQUID COOLED CABLE WITH RESTRICTED CORE --

Signed and sealed this 25th day of January 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents