Aug. 30, 1938. W. T. WELLS 2,128,547

MULTIPLE CONDUCTOR WIRE ROPE

Filed Sept. 20, 1935

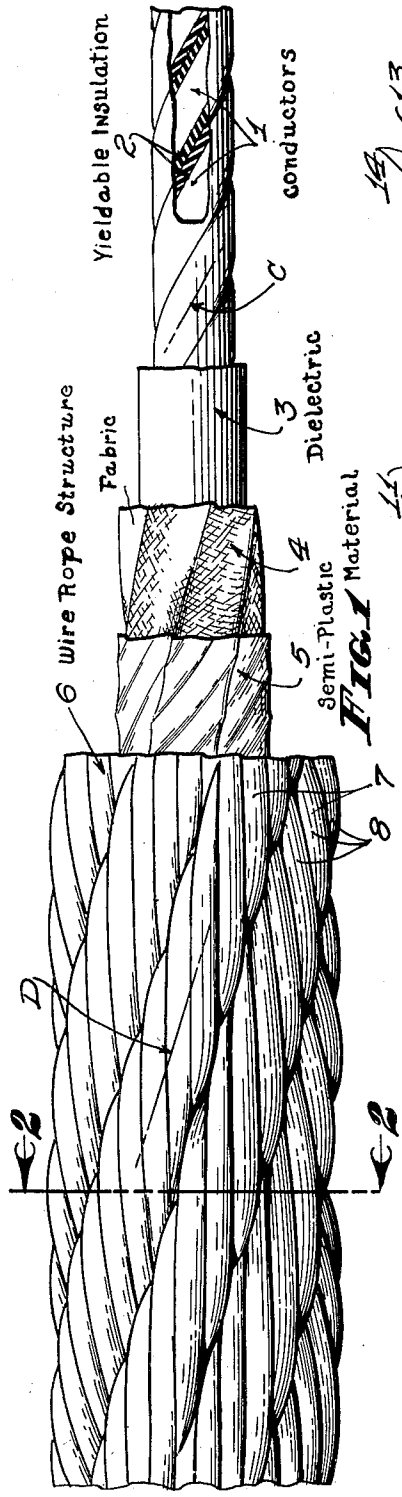

FIG. 1

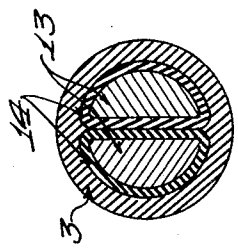

FIG. 4

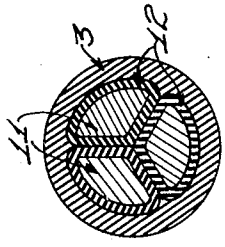

FIG. 3

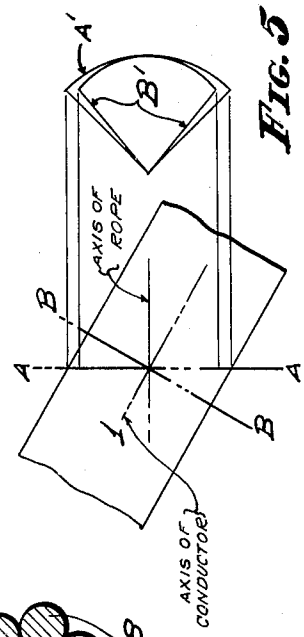

FIG. 5

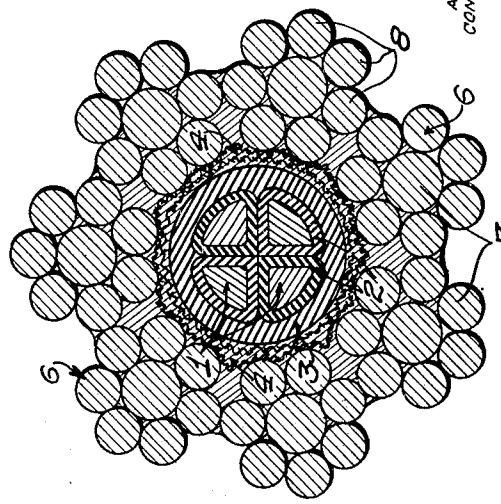

FIG. 2

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MULTIPLE CONDUCTOR WIRE ROPE

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Application September 20, 1935, Serial No. 41,456

3 Claims. (Cl. 173—266)

This invention relates to multiple conductor wire ropes and among the objects of my invention are:

First, to provide a multiple wire rope having a multiple conductor core wherein each of the strands are insulated one from the other, and the core itself is insulated against extreme hydrostatic pressure; said core fitting within the space normally occupied by the hemp core of a conventional hoisting or haulage wire rope;

Second, to provide a multiple conductor wire rope wherein each conductor is segmental in cross section, such cross section being so proportioned that when the several conductors are twisted helically about a common axis and to a predetermined pitch, their adjacent sides are substantially parallel;

Third, to provide a multiple conductor wire rope which incorporates a resilient cushion between the several helically twisted, segmentally sectioned conductors whereby the cushion permits longitudinal compression and expansion of the core without introducing stresses in the conductors, thereby enabling the conductors to be formed of dead annealed copper or similar flexible material with a low elastic limit;

Fourth, to provide a multiple conductor wire rope which eliminates any base strand or other strand disposed core coincidental with the axis of the core and therefore inherently incapable of withstanding the elongation and contraction required of the rope, all the conductors by reason of their segmental section and spaced one from the other necessarily having their axes spaced radially outward from the axis of the core and helically wound thereabout to facilitate such longitudinal expansion and contraction;

Fifth, to provide a multiple conductor wire rope wherein the several conductors of the core are given a pitch so related to the pitch of the weight-supporting stranded sheathing that untwisting and elongation of the wire rope within the predetermined load limits thereof tends to subject the conductors of the core to longitudinal compression;

Sixth, to provide a multiple stranded wire rope wherein single stranded conductors may be used in place of multiple stranded conductors without sacrificing the flexibility or other advantages inherent in multiple stranded conductors;

Seventh, to provide a multiple stranded wire rope which is fully capable of withstanding the loads imposed on a conventional wire rope of the haulage or hoisting type, and wherein the key-stoning effect inherent in the haulage or hoisting wire rope is utilized to protect the core against distortion or excessive radial compression;

Eighth, to provide a multiple conductor wire rope wherein the core is insulated against extreme hydrostatic pressure so that the wire rope may be submerged to great depths;

Ninth, to provide a multiple conductor wire rope which is particularly designed for the control and operation of electrical well tools, the wire rope being designed to withstand the abrasion occasioned by contact with the walls of the well, the tensional loads occasioned by its own weight, the weight of the tool, and any excessive loads that it might be subjected to due to hanging-up of the tool in the well, and in addition protects the core not only from the hydrostatic pressure but such pressure in combination with the heat and corrosive or dissolving qualities of the various liquids that may be present in the well.

Other objects and advantages of this invention, it is believed, will be apparent from the following detailed description of an embodiment thereof, as illustrated in the accompanying drawing.

In the drawing:

Fig. 1 is an enlarged, fragmentary, elevational view of a multiple conductor wire rope embodying my invention with the laminae broken away successively to illustrate the composite structure;

Fig. 2 is a further enlarged transverse sectional view thereof taken through 2—2 of Fig. 1, showing one form of core having four conductors;

Fig. 3 is a transverse sectional view of the core with the fabric servings omitted in which the core has three conductors;

Fig. 4 is a similar cross sectional view in which the core has two conductors; and,

Fig. 5 is a diagrammatical view illustrating for comparison the section of a conductor taken at right angles to its own axis and such a section taken at right angles to the axis of the wire rope.

In the embodiments of my invention, illustrated in Figs. 1 and 2, four conductors, designated 1, are provided. Each conductor 1 is adapted to be twisted helically and is given such a segmental section that when viewed perpendicularly to the axis of the wire rope which is along the line of A—A in Fig. 5, it is a true quadrant as indicated by A' in Fig. 5. Therefore, the true section, or section at right angles to the axis of the conductor itself, is less than such quadrant, as indicated by section B—B and the segment B' in Fig. 5. The relative areas of the two segments

A' and B' is, of course, dependent upon the pitch to which the wire is twisted.

Before or during twisting or forming of the several strands, each strand is coated, or has vulcanized thereto, an insulating and cushioning sheath of rubber or other resilient material designated 2. Such material conforms to the shape of the conductors, forming therewith resiliently walled segments or quadrants which fit together when given a predetermined pitch to define a multiple conductor of circular section, as shown in Fig. 2. The flat or radial sides of each segment are offset laterally from the radius of the multiple conductor formed thereby, due to the coating or sheathing of resilient material 2 therearound. The individual axes of the conductors are spaced radially from their common axis without necessitating a base strand that could not be helically formed, and hence inherently incapable of withstanding the necessary elongation and contraction.

The exterior of the multiple conductor formed by the individual conductors 1 and resilient sheathings 2 approaches a true cylinder and is smooth except for the slight grooves formed by the rounded sheathings 2. Around the multiple conductor so formed is applied a cylindrical wall of a flexible dielectric material 3, such as rubber. Around the rubber is a woven braiding 4 of cotton or similar material which may comprise one or more layers, which will be described in more detail hereinafter.

The core thus formed by the conductors 1, sheathings 2, dielectric material 3, and braiding 4 is intended to have approximately the same diameter as the conventional hemp core of the wire rope and by reason of the braiding and dielectric material 3, is substantially as conformable as such a hemp core.

The core is then coated thickly with a semi-plastic material 5, which will be described in more detail hereinafter.

Around the semi-plastic material is woven a wire rope structure 6 comprising groups of wires 7 wound into strands 8. The number of wires in each strand and the number of strands constituting the wire rope structure follows conventional practice in the manufacturing of wire ropes of the hoisting or haulage type.

That is, the strands 7 are few in number and therefore occupy the major diameter of the wire rope. This insures what is known in the rope-making art as a pronounced "key-stoning effect." In other words, the strands tend to wedge against each other when the rope is flexed and maintain their equally spaced position around the core. When the strands exceed the number commonly used in hoisting or haulage wire ropes, the key-stoning effect becomes less pronounced and as a result, the core tends to push through and separate the strands when the rope is wound on drums and passed repeatedly over sheaves. It is mandatory for successful operation of my multiple conductor wire rope that it be capable of measuring up in all respects to the standard wire rope of the haulage or hoisting type and of the same grade of steel. It is an established fact that the core of a conventional wire rope does not add to its strength, hence no loss is occasioned by substituting my multiple conductor core. Also, the yieldable or conformable character of the fabric and semi-plastic material enables my special core to conform to the presented surfaces of the wire rope strands in the same manner as the hemp core. In other words, my special multiple conductor wire rope can be used to accomplish any function of a conventional wire rope of the same size, with the additional feature of passing current between the extremities of the rope along independent paths so that one or a number of electric tools may be both suspended and independently operated from the end of my special wire rope.

The semi-plastic material 5 is of such a character that an excess may be applied on the fabric and upon winding the sheathing thereupon, sufficient pressure is developed to cause the plastic material to impregnate the fabric as well as to fill the voids between the wires of the wire rope structure. The relationship of the wire rope structure, semi-plastic material, and core, in so far as it relates to the fabric, is more fully set forth in my copending applications Serial No. 662,901, now Patent No. 2,043,400, and No. 734,169, now Patent No. 2,043,401. As specified particularly in the last mentioned application, the semi-plastic material is impervious to water, oil, or other fluids encountered in oil wells; has high dielectric qualities; and its plasticity is such that it will stand the constrictional pressure of the wire rope structure and extreme hydrostatic pressure under the temperatures encountered in oil wells without deterioration. The semi-plastic material should exhibit adhesive characteristics, particularly for the steel of a wire rope structure, and when in its initial condition, be sufficiently fluid to properly penetrate and fill all voids and be, in itself, free of voids.

As set forth hereinbefore, all of the several conductors are wound helically about a common axis. The pitch or lay of the strands 8 is relatively long. In other words, assuming that the diameters of the multiple conductor comprising the several conductors 1 and the wire rope structure are the same, the multiple conductor would have less pitch than the wire rope structure. This is indicated by the center lines C and D in Fig. 1 in which the center line C, representing the axis of one of the conductors, occupies a greater angle than the line D, representing the axis of a strand 7, with respect to the axis of the wire rope. By reason of the fact that the pitch of the conductors is correspondingly shorter than the pitch of the strands 7, the conductors tend to elongate a greater distance for given unwinding than do the strands. However the conductors are restrained against elongating further than the strands but untwist equally therewith when the wire rope is placed under tension, so that the conductors have a tendency to compress or restrict longitudinally when the wire rope is under tension, and such compression or restriction of the conductors is permitted by the resilient material interposed between the conductors.

This minimizes all strain upon the conductors so that they may be dead annealed and, while quite flexible, may have an exceedingly low elastic limit.

This elastic limit is lower than the elastic limit of the strands of the wire rope structure.

As indicated in Fig. 3, three complementary conductors 11, each provided with a resilient sheathing 12 therearound, may be used; or as shown in Fig. 4, two complementary conductors 13, surrounded by flexible sheathing 14, may be used; and the number of conductors may be otherwise varied.

Although I have shown and described a particular embodiment of my invention, I do not intend to be limited thereto but desire to include in the

scope of my invention the constructions, combinations, and arrangements embraced in the appended claims.

The legends on Fig. 1 of the drawing are merely for the purpose of illustration and are not limitations as to any specific materials.

I claim:

1. In a hoisting and conducting cable, a weight supporting helical multi-stranded wire rope structure having lays extending in the same direction, a core therein including a plurality of separate highly flexible helical conductors having a lower elastic limit than the strands of the wire rope structure, the wire rope structure exceeding the diameter of the core and the lays of the conductors extending in the same direction as the lays of the wire rope structure, and a yieldable insulating covering for each of said conductors that permits cushioning action on the core that minimizes the effect of the stretch and contraction of the cable on the conductors.

2. In a hoisting and conducting cable, a weight supporting helical multi-stranded wire rope structure having lays extending in the same direction, a core therein including a plurality of separate highly flexible helical conductors having a lower elastic limit than the strands of the wire rope structure, the wire rope structure exceeding the diameter of the core and the lays of the conductors extending in the same direction as the lays of the wire rope structure, said wire rope structure having a relatively long lay and the conductors a relatively short lay, and a yieldable insulating covering for each of said conductors.

3. In a hoisting and conducting cable, a weight supporting helical multi-stranded wire rope structure having lays extending in the same direction, a core therein including a plurality of separate highly flexible helical conductors having a lower elastic limit than the strands of the wire rope structure, the wire rope structure exceeding the diameter of the core and the lays of the conductors extending in the same direction as the lays of the wire rope structure, said wire rope structure having a relatively long lay and the conductors a relatively short lay, a yieldable insulating covering for each of said conductors, and a semi-plastic fluid resistant and insulating material surrounding the conductors and adhering to the wire rope structure.

WALTER T. WELLS.