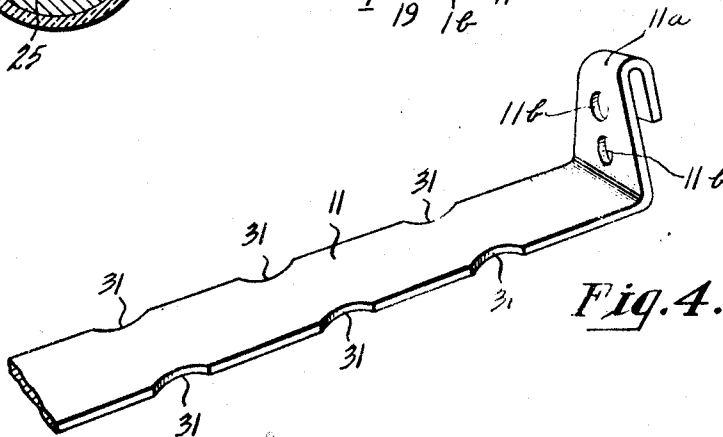
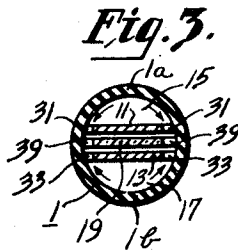
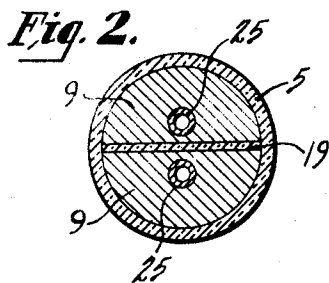


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COOLED, HIGH-FREQUENCY ELECTRIC CABLE

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COOLED, HIGH-FREQUENCY ELECTRIC CABLE

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This invention relates to electric cables, and more particularly to a cable which is especially suitable for use with high frequency induction heating apparatus, although by no means limited to such use.

In high frequency induction heating apparatus, it has been found desirable to cool not only the inductor coupling coil by means of which heating energy is applied to the work, but also the leads or conductors which connect the coupling coil to the source of high frequency energy. In many cases, it has also been found extremely desirable to provide flexible leads for connection of the coupling coil to the energy source. It has been customary to provide leads between the coupling coil and the energy source in the form of a cable. So far as I am aware, no such cable has been provided heretofore which is both flexible and can be suitably cooled.

The primary object of my present invention is to provide an improved electric cable suitable for use with high frequency induction heating apparatus, which cable is both flexible and can be readily cooled.

More particularly, it is an object of my present invention to provide a cable as aforesaid which can be manipulated easily and without strain on the operator where the cable is to be used with a hand operated applicator.

Another object of my present invention is to provide an improved electric cable as aforesaid which is quite simple in construction, economical in cost, and highly efficient in use.

In accordance with my present invention, I provide a pair of electrically conductive bands or strips together with an insulating strip therebetween and place these strips inside of a flexible, rubber tube which constitutes a conduit or sheathing. The rubber tube is preferably, although not necessarily, substantially circular in cross section and the aforesaid conductive and insulating strips extend substantially diametrically thereacross, being preferably of a width just slightly less than the internal diameter of the tubing. Thus, the conductive strips are spaced from the adjoining wall portions of the sheathing, and suitable end plugs or closures at each end of the sheathing afford electrical connection to the conductive strips and are arranged to admit a coolant at one end of the tube and to discharge the same at the other end, the coolant passing through the spaces between the conductive strips and the sheathing. If desired, the conductive and insulating strips may be formed with

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aligned passages which afford communication between the two spaces on opposite sides of the conductive strips. This permits circulation of the coolant around the conductive strips while passing through the conduit to enhance cooling.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, as well as additional objects and advantages thereof, will best be understood from the following description of one embodiment thereof when read in connection with the accompanying drawing, in which

Figure 1 is a central, longitudinal, sectional view of one form of electric cable constructed in accordance with my present invention,

Figure 2 is an enlarged, sectional view taken on the line II—II of Fig. 1,

Figure 3 is an enlarged, sectional view taken on the line III—III of Fig. 1, and

Figure 4 is a fragmentary, detail, perspective view of one of the conductive strips utilized in my novel cable.

Referring more particularly to the drawing, wherein similar reference characters designate corresponding parts throughout, there is shown a flexible, rubber tube 1 of circular or substantially circular cross section having a pair of funnel-like terminal members 3 and 5 connected to the ends thereof. The members 3 and 5 are made of Bakelite or other suitable insulating material and are closed off, respectively, by cooperating closure members 7, 7 and 9, 9. The closure members 7, 7 and 9, 9 may be comprised of split cylinders of copper or other suitable, electrically conductive material.

Within the sheathing 1 and end members 3 and 5 are a pair of conductive strips or bands 11 and 13 which extend along the entire length of the sheathing (as seen in Fig. 1) and substantially diametrically thereacross (as best seen in Fig. 3). The conductive strips 11 and 13 are thus spaced from the adjoining wall portions 1a and 1b of the conduit or sheathing 1 to provide spaces 15 and 17 through which cooling water, air, or other suitable coolant may be passed. The conductive strips 11 and 13, like the sheathing 1, are flexible and are formed with offset loops 11a and 13a, the termini of which have electrical connection with the closures 7 and 9. A strip 19 of suitable insulating material is interposed between the closure members 7, 7, the conductive strips 11 and 13, and the closure members 9, 9, thereby insulating the two sets of conductors

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from each other. Like the conductors 11 and 13, the strip 19 extends diametrically across the sheathing 1 and may be of the same width as the strips 11 and 13.

The closure members or blocks 7, 7 are provided with openings through which extend conductive tubular members 21, the bores in the tubes 21 communicating with the passages 15 and 17 through suitable openings in the conductive strips 11 and 13, such as the openings 11b shown in Fig. 4. A suitable coolant, such as cold water, may be supplied to the tubes 21 and the spaces 15 and 17 through a Y-connector 23. The tubular members 21 may also serve as a means of external connection of the cable to a suitable source of high frequency electrical energy, such as a radio frequency oscillation generator (not shown), through a coupling transformer 24.

A pair of conductive, tubular members 25 which extend through the closure blocks 9, 9 also have communication with the spaces 15 and 17 and may serve as discharge tubes for the cooling fluid after it has passed through spaces 15 and 17. The conductive members 25 may be connected to an inductor coupling coil 27 or other suitable applicator in any convenient manner, and the applicator or coil 27 may be provided with an outlet 29 through which the cooling fluid may be discharged. If desired, a Y-connector similar to the connector 23 may be connected to the tubes 25 for discharging the cooling fluid, and the conductive members 25 may be connected to a suitable work or utilization circuit in a manner similar to the connection of the intake tubes 21 to the transformer 24.

From the foregoing description, it will be apparent to those skilled in the art that I have provided an improved cable which is both flexible, by reason of the flexibility of the sheathing 1, the conductors 11 and 13 and the insulating strip 19, and which can be cooled effectively in the interest of efficiency. To further increase the efficiency of cooling, the conductive strips 11 and 13 and the insulating strip 19 may be provided with a series of aligned notches or the like 31, 33 and 39, respectively, in longitudinally spaced relation along both edges thereof to provide passages through which communication is established between the spaces 15 and 17, as clearly shown in Fig. 3.

Although I have shown and described but one embodiment of my present invention, it will undoubtedly be apparent to those skilled in the art that many other forms thereof, as well as variations in the particular one described, are possible. For example, the strips 11, 13 and 19 may have a fairly tight fit in the sheathing 1 so as to substantially block off the spaces 15 and 17 from each other and the tubular members 25 may be omitted, in which case the cooling fluid will be admitted through one of the tubes 21 to pass through one of the spaces 15 and 17 to the other end of the cable, thence to the other space through suitable openings in the strips 11, 13 and 19, and finally discharged through the other tube 21. Furthermore, the sheathing or conduit 1 may be made of other material than rubber which has suitable flexibility and electrical insulating properties, particularly for high power work. It will also be apparent, no doubt, that my improved cable may be used with other than induction heating apparatus, as, for example, in apparatus used for heating dielectric materials by reason of dielectric losses produced therein. Other uses

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are also possible. I, therefore, desire that my invention shall not be limited except insofar as is made necessary by the prior art and by the spirit of the appended claims.

I claim as my invention:

1. An electric cable comprising a hollow sheathing of insulating material, a pair of electrical conductors in said sheathing extending along the length thereof in spaced relation to each other, a pair of funnel-like terminal members of insulating material respectively connected into the ends of said sheathing, a pair of electrically conductive closure members inserted in each of said funnel-like members and closing the interior thereof off from the exterior, electrical insulating means interposed and extending between said conductors and between the two closure members of each pair for insulating said conductors and the two closures of each pair from each other, one of said conductors having electrical connection with two of said closure members, one at each end of said cable, the other of said conductors having electrical connection with the other two of said closure members, one at each end of said cable, means, extending through each of the closure members at one end of said cable and communicating with the space between said conductors and the sheathing wall, for admitting a cooling fluid to said space, and means, extending through each of the closure members at the other end of said cable and also communicating with said space, for discharging said cooling fluid.

2. An electric cable according to claim 1 characterized in that the means connected to the closure members at said one end of said cable for admitting said cooling fluid is constituted by a pair of electrically conductive tubes each having electrical connection with a separate one of said pair of closure members, said tubes being adapted to serve as a means of external connection of said cable to a source of electrical energy.

3. An electric cable according to claim 1 characterized in that the means connected to the closure members at said other end of said cable for discharging said cooling fluid is constituted by a pair of electrically conductive tubes each having electrical connection with a separate one of said closure members, said tubes being adapted to serve as a means of external connection for said cable.

4. An electric cable comprising a hollow, flexible sheathing of insulating material, said sheathing being substantially circular in cross section, a pair of conductive strips in said sheathing extending along the length thereof and substantially diametrically thereacross whereby to provide spaces between each of said strips and the adjoining wall portions of said sheathing, a strip of insulating material interposed between said conductive strips for electrically insulating said conductive strips from each other, a pair of closure members connected to said sheathing at each end and closing the interior thereof off from the exterior, and means for admitting a cooling fluid into said spaces, and providing end connections for said conductive strips through said closure members, said conductive and insulating strips being all formed with aligned passages affording communication between said spaces.

5. An electric cable according to claim 4 characterized in that said conductive strips and said insulating strip are all formed with aligned notches in their respective edges at longitudinally spaced points thereon to provide said passages.

6. An electric cable comprising a sheathing con-

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stituted of a flexible tube of insulating material, a pair of electrically conductive, flexible strips in said sheathing extending along the length thereof in spaced relation to each other, a pair of electrically conductive closure members connected to said sheathing at each end and closing the interior thereof off from the exterior, a strip of electrical insulating material interposed between said conductive strips and between the two closure members of each pair thereof for insulating said conductive strips and the two closure members of each pair from each other, said insulating strip being also flexible, one of said conductive strips having electrical connection with two of said closure members, one at each end of said cable, the other of said conductive strips having electrical connection with the other two of said closure members, one at each end of said cable, means extending through the two closure members at one end of said cable and communicating with the space between said conductors and the sheathing wall for admitting a cooling fluid to said space, and means extending through the two closure members at the other end of said cable and also communicating with said space for discharging said cooling fluid.

7. An electric cable according to claim 6 characterized in that said conductive strips are formed

with loops at their respective ends, said conductive strips being electrically connected to their respectively associated closure members at substantially the termini of said loops.

8. An electric cable according to claim 6 characterized in that said sheathing is substantially circular in cross section, and characterized further in that conductive and insulating strips extend substantially diametrically across said sheathing.

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