

[54] ELECTRICAL HEATING CABLE

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[21] Appl. No.: 295,228

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 199,472, Nov. 17, 1971, abandoned.

[52] U.S. Cl. 219/528, 219/541, 219/544,
219/549, 219/552, 338/214, 339/97 X

[51] Int. Cl. H05b 3/56

[58] Field of Search..... 219/464, 528, 529,
219/541, 544, 549, 552, 553; 338/214;
339/97 C

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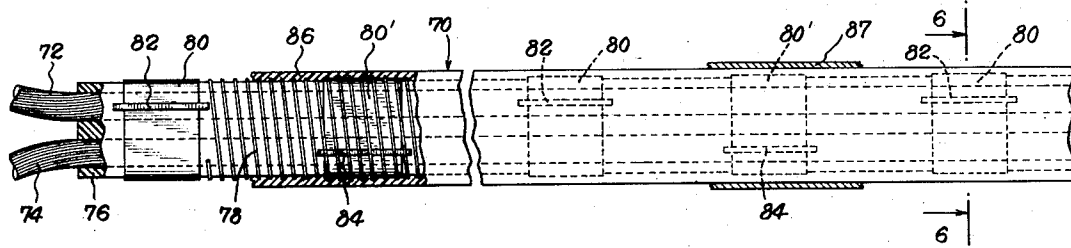
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[57] ABSTRACT

An electrical heating cable having at least two low-resistance current-carrying wires and a high-resistance, heating wire spirally wound about the current-carrying wires; in one embodiment, the current-carrying wires are bared at spaced intervals so that the high-resistance wire makes electrical contact at the bared points with one of the current-carrying wires at each interval. In another embodiment, a plurality of copper foil wraps surrounds both insulated, current-carrying wires at spaced intervals and the high-resistance, heating wire is spirally wound over the current-carrying wires and the copper foil wraps. A staple is driven through the insulation and one of the current-carrying wires at each interval so that electrical connection is made between the current-carrying wire and the heating wire at that interval. The construction permits the user to cut the cable to any length and still maintain the same current flow in any given length for the same applied voltage.

4 Claims, 7 Drawing Figures



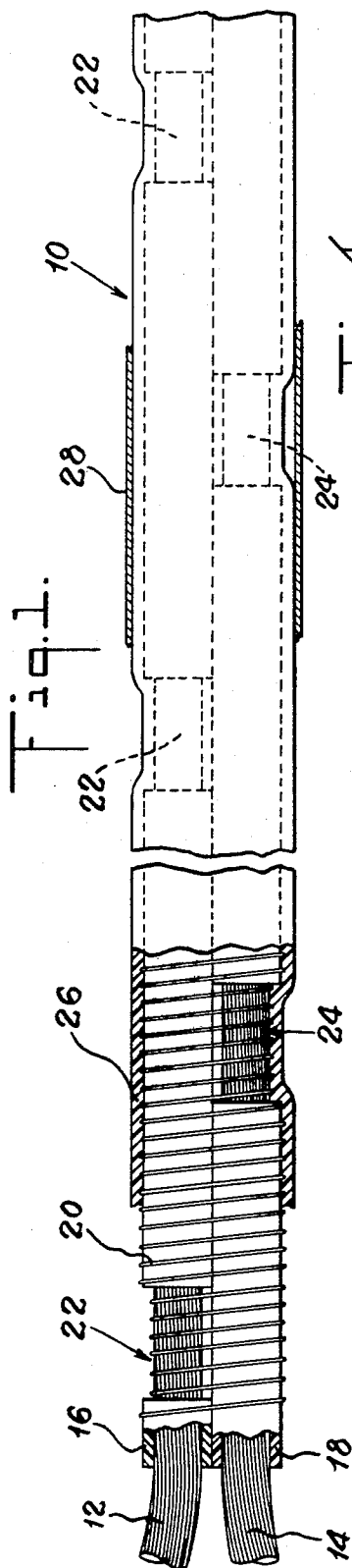


Fig. 4.

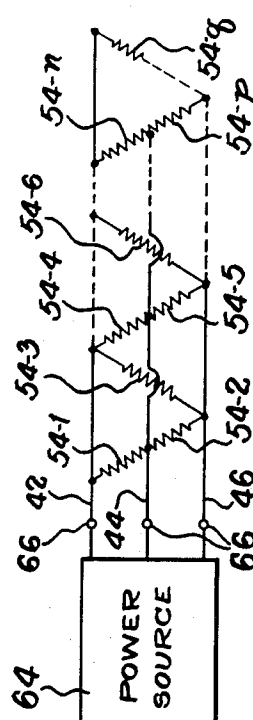
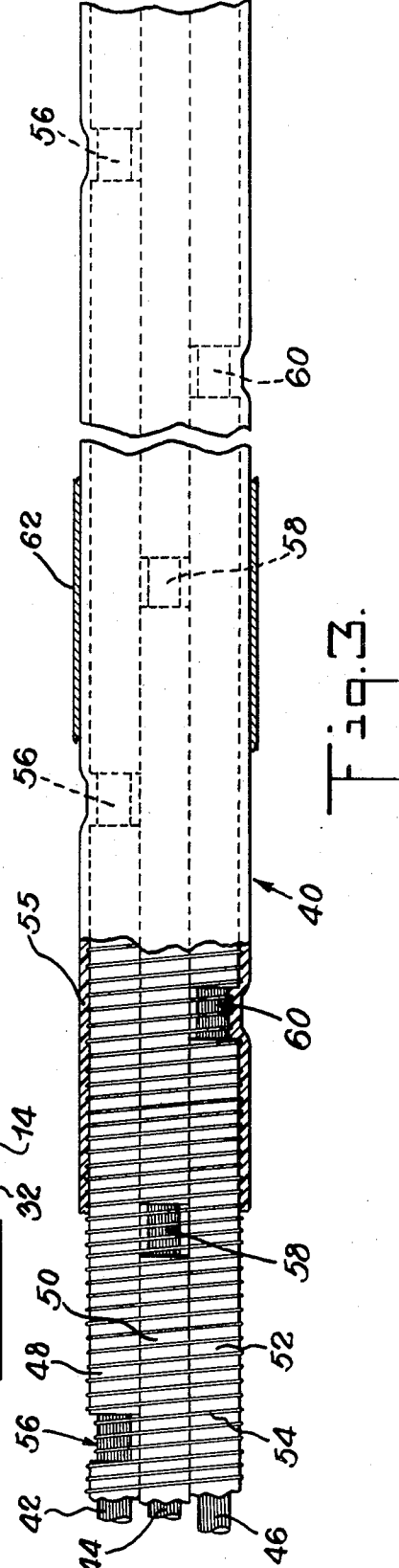
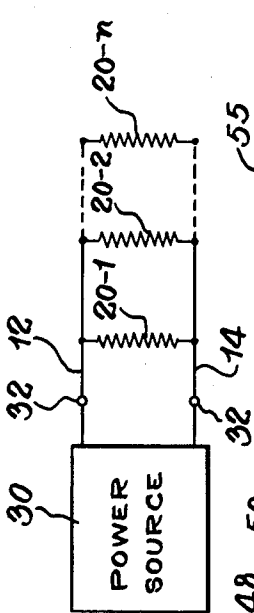
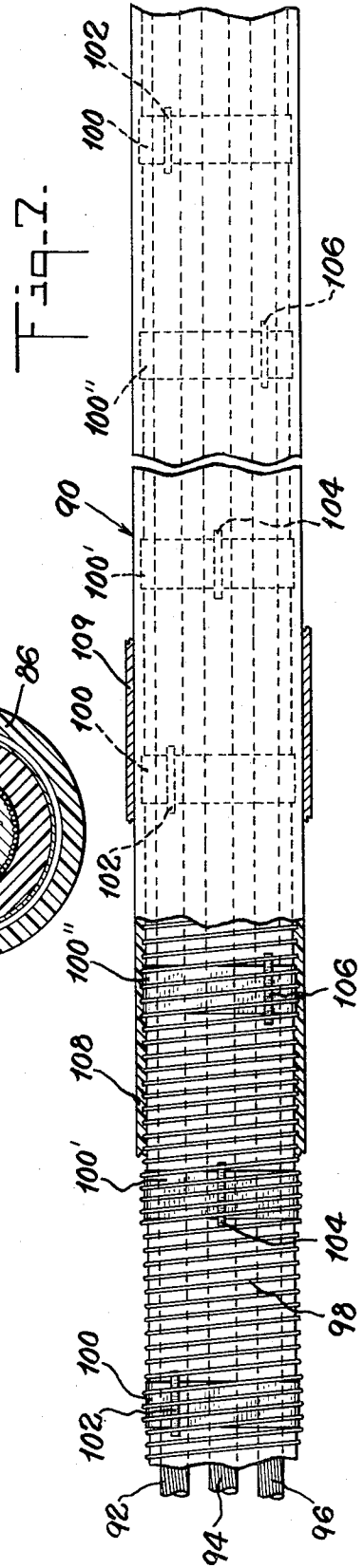
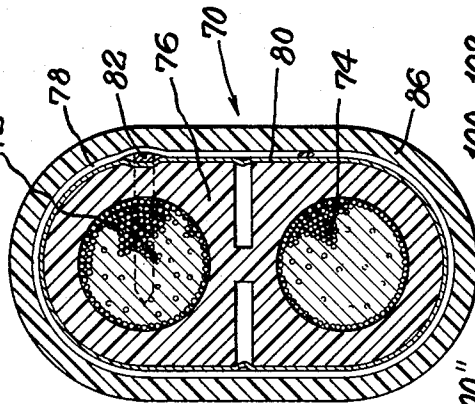
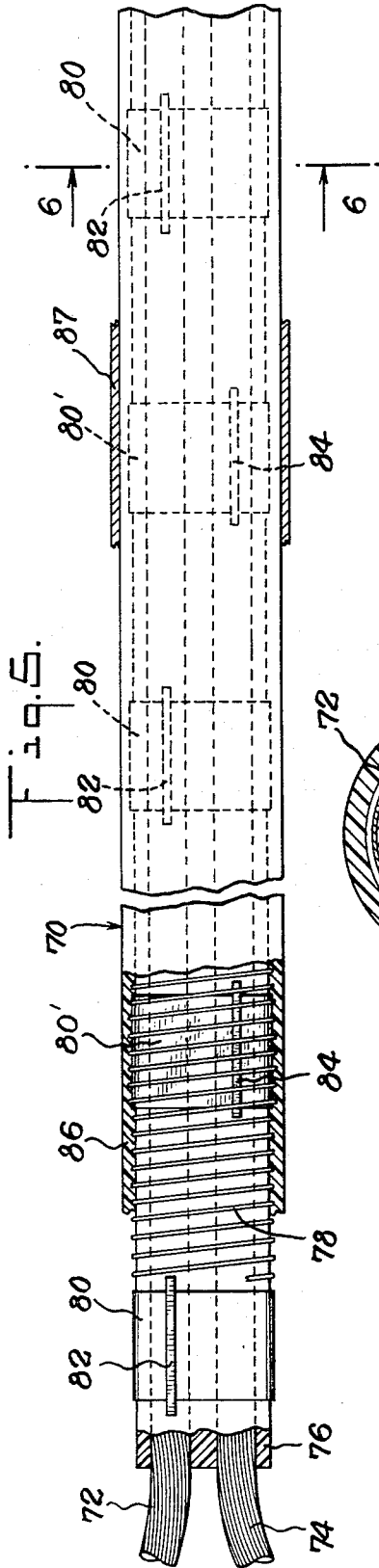


Fig. 2.





ELECTRICAL HEATING CABLE

This application is a continuation-in-part of my co-pending application Ser. No. 199,472, filed Nov. 17, 1971, now abandoned.

The invention relates to electrical heating cables which are formed in a continuous length and which may be cut to any desired length while maintaining constant current flow through each heating section for a given applied voltage.

Prior art heating cables and tapes, which are used for transferring heat from the cable to pipes or other devices, generally utilize special connectors and are generally designed and manufactured to a specific length. When one of these prior art cables is too long for the particular installation and it is cut to size, the current in the heating element increases for a given applied voltage.

Accordingly it is an important object of the invention to provide a heating cable which, for a given applied voltage, maintains the same heating current in each section regardless of the length of the cable.

It is a further object of the invention to provide such a heating cable which has at least two low-resistance, current-carrying conductors and a heating wire wound spirally about the conductors.

It is a still further object of the invention to provide such a heating cable with two current-carrying conductors.

It is yet another object of the invention to provide such a heating cable with three current-carrying conductors.

It is a still further object of the invention to provide such a heating cable which is easy to install and is capable of high heat transfer to the object being heated.

These and other objects, advantages, features and uses will be apparent during the course of the following description when taken together with the accompanying drawing.

Broadly, the invention comprises at least two, current-carrying wires which are insulated from each other and have the insulation removed at predetermined, spaced points along the wires. A spirally wound heater wire surrounds the insulated, current-carrying wires and makes electrical contact with the current-carrying wires at the bared, noninsulated points. The bared points are spaced so that when electrical connection is made to two of the current-carrying wires and voltage is applied, current flows in the heating wire.

In another embodiment, copper foil wraps surround the insulated, current-carrying wires at spaced intervals and a staple is driven through the insulation surrounding one of the current-carrying wires so that electrical contact is made between the spirally wound heater wire and the current-carrying wire at that point.

In the accompanying drawing, forming a part hereof, and in which like numerals are employed to designate like parts throughout the same:

FIG. 1 is a plan view of one embodiment of a heating cable of the invention having two current-carrying wires;

FIG. 2 is a simplified, schematic diagram showing the electrical circuit obtained when using the embodiment of FIG. 1;

FIG. 3 is a view similar to that of FIG. 1 of a three conductor heating cable of the invention; FIG.

FIG. 4 is a simplified, schematic diagram showing an electrical circuit which may be obtained when using the embodiment of FIGURE 3;

FIG. 5 is a view similar to that of FIG. 1 of a further embodiment of the invention.

FIG. 6 is an enlarged sectional view taken along lines 6—6 of FIG. 5, viewed in the direction of the arrows; and

FIG. 7 is a view similar to that of FIG. 5 of a three conductor heating cable of the invention.

In the drawing wherein, for the purpose of illustration, there are shown preferred embodiments of the invention and wherein like numerals designate like parts throughout the same, the numeral 10 designates a two-wire cable of the invention. Cable 10 (FIG. 1) is seen to comprise a pair of low-resistance wires 12 and 14, covered respectively with an insulating cover 16 and 18, a spirally wound heater wire 20 of relatively high resistance and an outer insulating jacket 26. The insulating covers 16 and 18 and the outer insulating jacket 26 may be formed of polytetrafluorine ethylene, polyvinyl chloride or any similar flexible plastic which will remain flexible and intact throughout the temperature range to which the cable will normally be subjected.

Under certain conditions, it is desirable to provide a shield 28 of woven conductive material to serve as a ground and to resist abrasion. Wires 12 and 14 are bared of insulation at points 22 and 24, respectively, so that electrical contact is made with heater wire 20 at those points.

FIG. 2 is a simplified schematic diagram of a circuit using the cable of FIG. 1. A source of power 30 is connected to wires 12 and 14 which are of low resistance and carry the current. The applied voltage across the terminals 32 is constant and the current flow in each section of heating wire 20, namely, 20-1 20-2...20-n, also is constant. Thus, each section produces the same heating effect regardless of the number of sections being used. The user is therefore able to make a good, efficient installation and cut off any excess without affecting the efficiency of the various heating sections.

Some prior art, multiple section cables require special connector blocks to accomplish the desired electrical heating. Others require that each installation have a cable specially designed for a particular length. Clearly, the cable of the invention is ideal for field installation around pipe lines or for burial in the ground since a long continuous length can be cut to the desired length without affecting the heating efficiency adversely. Generally, when the cable of the invention is applied to a pipe, it is wound around the pipe and then covered with a heat transfer cement to facilitate transfer of heat from the cable to the pipe.

Cable 40 (FIG. 3) is seen to comprise electrical, current-carrying wires 42, 44 and 46, which are insulated from each other by insulating coverings 48, 50 and 52, respectively. A heating wire 54 is spirally wound about the three wires and makes contact with the wires at bared points 56, 58 and 60. The bared points are spaced apart for predetermined distances to keep the resistance between points at the proper value. The combination is covered by an outer insulation 55 and, if desired, by a ground shield 62.

The materials used for the construction of cable 40 are the same as those used for cable 10. Both cables 10 and 40 are shown untwisted but cables of the invention will normally be made with the current-carrying wires

twisted together to simplify manufacture and maintain the proper constructional configuration.

FIG. 4 is a schematic diagram of one possible electric circuit which may be used with the cable 40. Power source 64 is a three-phase supply and the cable is connected to terminals 66. The applied voltage across each pair of terminals 66 produces current flow in the resistances connected across those terminals. For example, the voltage applied across the terminals 66, which are connected to wires 42 and 44, produces heating in sections 54-1, 54-4...54-n. Similarly, voltage applied across the terminals 66, which are connected to wires 44 and 46, produces heating in sections 54-2, 54-5...54-p and that applied across the terminals 66, which are connected to wires 46 and 42, produces heating in sections 54-3, 54-6...54-q.

Operation and installation of cable 40 is similar to that for cable 10. It can readily be seen that the same construction may also be used for a four wire system and in other configurations.

Cable 70 (FIGS. 5 and 6) is seen to comprise a pair of low resistance current-carrying wires 72 and 74 which are insulated from each other and from the surrounding environment by an insulator 76. A first plurality of thin, conductive foil wraps or strips 80 of copper, silver or similar metallic material is wrapped at spaced intervals around insulator 76 and a second plurality of thin conductive foil wraps or strips 80' is wrapped at spaced intervals around insulator 76. The two pluralities of foil strips 80 and 80' are interspersed so that each foil strip 80 has a corresponding foil strip 80' adjacent thereto. Electrically conductive staples 82 are driven through the insulator 76, overlying strips 80 and into wire 72 so that electrical contact is made between each conductive foil strip 80 and wire 72. Similarly, electrically conductive staples 84 are driven through insulator 76, overlying strips 80' and into wire 74 so that electrical contact is made between each conductive foil strip 80' and wire 74. A high resistance heating wire 78 is spirally wound along the length of cable 70 so that it makes electrical contact through the foil strips 80 and the staples 82 with wire 72 and through the foil strips 80' and the staples 84 with wire 74. An outer insulating cover 86 is used to protect and insulate the cable 70.

The electrical circuit and operation of cable 70 are the same as those of cable 10.

FIG. 7 illustrates a three conductive cable 90 which comprises low resistance, current-carrying wires 92, 94 and 96, spirally wound, high-resistance, heating wire 98 and outer insulating cover 108. Electrical contact is made between wire 92 and heating wire 98 by conductive foil wrap 100 and electrically conductive staple 102. Similarly, connection is made between wire 94 and heating wire 98 by conductive foil wrap 100' and electrically conductive staple 104 and between wire 96 and heating wire 98 by conductive foil wrap 100' and electrically conductive staple 106.

The circuit of FIG. 4 is applicable to the embodiment of FIG. 7 and the operation of cable 90 is the same as that of cable 40.

The materials used for the wires, both current-carrying and heating, and the insulating covers are the same for cables 70 and 90 as for cables 10 and 40. Conductive shields 87 and 109, which are similar to shields 28 and 62, may be used in cables 70 and 90, respectively.

While particular embodiments of the invention have been shown and described, it is apparent to those skilled in the art that modifications are possible without departing from the spirit of the invention or the scope of the subjoined claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows.

1. An electrical heating cable which maintains the same current flow for any given applied voltage in each section of predetermined length regardless of the total length of the cable comprising:

first and second electrically conductive, low-resistance wires in proximity with each other;
an electrical insulator surrounding each low-resistance wire and electrically insulating the low-resistance wires from one another;

a plurality of first strips of conductive metallic foil wound around the electrical insulator and the low-resistance wires therein and spaced therealong;

a plurality of second strips of conductive metallic foil wound around the electrical insulator and the low-resistance wires therein and spaced therealong;

said first and second strips of conductive metallic foil being spaced from one another and being located alternately along the length of the low-resistance wires such that each first strip has a corresponding next-consecutive second strip adjacent thereto;

a high resistance wire wound spirally over the insulator and the first and second strips of foil along the length of the low-resistance wires so that electrical contact is made between the foil strips and the high-resistance wire;

a plurality of first staples, each first staple overlying a corresponding first foil strip and extending through the insulator to make electrical contact between said first foil strip and the first low-resistance wire;

a plurality of second staples, each second staple overlying a corresponding second foil strip and extending through the insulator to make electrical contact between said second foil strip and the second low-resistance wire, whereby current will flow in the high-resistance wire to produce heat therefrom when an electric voltage is applied across the low-resistance wires; and

an outer insulating covering surrounding the combination of the spirally wound, high-resistance wire and the low-resistance wires.

2. The invention of claim 1 including an outer, electrically conductive shield surrounding the outer insulated covering.

3. The invention of claim 8 including:

a third electrically conductive, low-resistance wire in proximity with said first and second low-resistance wires and surrounded by said insulator;

a plurality of third strips of conductive metallic foil wound around the insulator and the low-resistance wires therein and spaced therealong, the high-resistance wire being wound over the third strips of foil;

said first, second and third strips of conductive metallic foil being spaced from one another and being located along the length of the low-resistance wires such that consecutive first and second adjacent strips have a corresponding next-consecutive third strip adjacent thereto; and

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a third staple overlying a third foil strip and extending through the insulator to make electrical contact between said third foil strip and the third low-resistance wire.

4. The invention of claim 3 including an outer, electrically conductive shield surrounding the outer insulated covering.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,757,086 Dated September 4, 1973

Inventor(s) William J. Indoe

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

Column 1, line 41, "insulted" should read --insulated--
Column 1, line 67, "FIG." should be deleted
Column 3, line 44, "tp" should read --to--
Column 3, line 57, "100'" should read --100"--
Claim 3, line 1, "8" should read --1--

Signed and sealed this 29th day of January 1974.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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