Nov. 3, 1970 R. P. DUGGER 3,538,482

HEATING WIRE

Filed Nov. 5, 1968

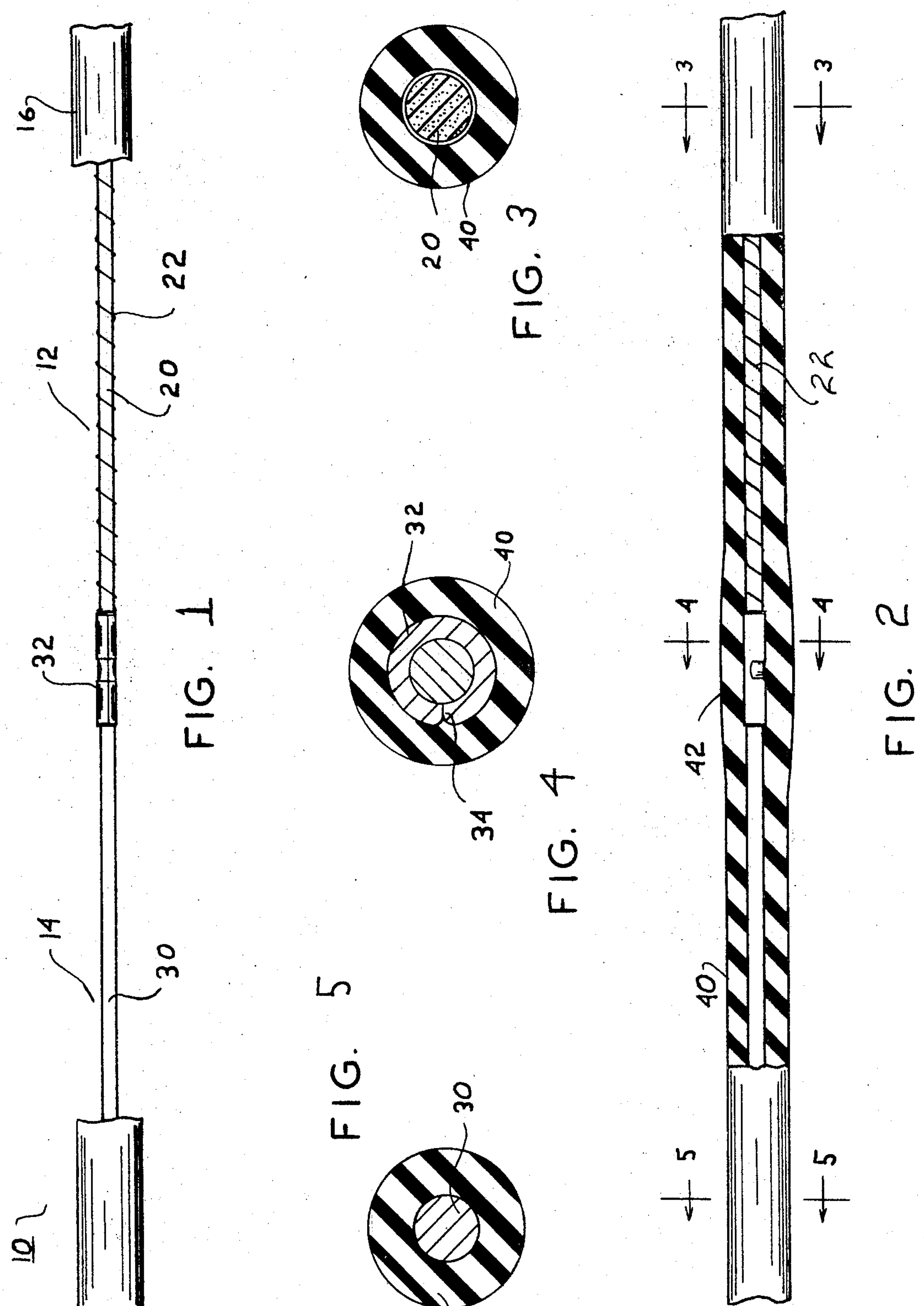

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

INVENTOR.
RICHARD R DUGGER
BY Hobbs & Green
ATTORNEY

3,538,482

HEATING WIRE

Richard Paul Dugger, South Bend, Ind., assignor to Ristance Corporation, Bremen, Ind., a corporation of Indiana

Filed Nov. 5, 1968, Ser. No. 773,496
Int. Cl. H01c 3/00; H05b 3/56
U.S. Cl. 338—214 3 Claims

ABSTRACT OF THE DISCLOSURE

A heating wire structure having a flexible core of nonconducting material, a resistance wire wound on the core, and an electrically conducting cold wire connected to the core and resistance wire by a connector clamping the end of the resistance wire and core and the cold end wire together. The resistance wire and cold end wire are enclosed by a continuous insulating layer of a substantially constant diameter throughout its length.

Electrical heating wires of flexible construction are used extensively in home appliances, and are used for a variety of different heating purposes in appliances where relatively low temperature heating is required, such as for example, in defrosters for refrigerators and deep freeze units. The conventional heating wires of this type generally consist of a flexible core of fibreglass, an electrical resistance wire wound onto the core with the convolutions thereof spaced from one another, and an insulating material enclosing the core and resistance wire. These heating wires usually are provided with cold ends which facilitate making connections with the primary electrical circuit of the appliance. Further, the cold ends on the heating wires assist in applying the heat to the required area without appreciably heating space or areas beyond that desired to be heated. The cold ends are normally formed by either connecting an insulated cold lead by mechanical means to the resistance wire and core and encapsulating the connection in a plastic or rubber material, or by using a metal strip or small wire to shunt a section of the resistance wire. The mechanical connection type forms an effective cold end structure which is sufficiently strong and rugged to permit reliable connections with the primary circuit, but the capsule over the connection occasionally does not form a water-tight joint with the insulating material on the adjoining wires and hence renders the heating wire structure unsuitable for appliances in which the joint is subjected to water or excessive moisture. Further, this type of connection requires a number of separate steps which necessitate separate handling of the heating units, thus making the units relatively expensive. The shunted type of heating wire structure can continuously and conveniently be fabricated using normal wire fabricating machinery and practices, and the insulation is continuous over the shunt and adjacent wire and constitutes a watertight seal over the heating wire and cold ends. However, the metal shunt or wire is necessarily relatively small and is sometimes weak and unreliable, occasionally resulting in failure of the unit and/or difficulty in making suitable connections with the primary circuit. It is therefore one of the principal objects of the invention to provide a heating wire structure which combines the advantages of both of the foregoing types without including the principal disadvantages of those prior structures. The present wire structure consists basically of a nonconducting core, resistance wire wound on the core, a cold end consisting of a separate wire mechanically connected to the resistance wire and core, and a continuous insulating layer enclosing both the heating section and cold end section without interruption at the joint and elsewhere.

Another object of the invention is to provide a heating wire of the foregoing type which is substantially uniform in size throughout its length, but which is so constructed that the intended hot and cold sections can readily be identified along the wire before and during installation of the heating unit.

Still another object of the invention is to provide a relatively simple, highly reliable heating wire structure which is convenient to install and connect into the primary circuit, and which will give long trouble free service under moist and other adverse operating conditions.

Additional objects and advantages of the invention will become apparent from the following description and accompanying drawings, wherein:

FIG. 1 is an elevational view of the present heating wire with a portion of the insulation broken away to better show the internal structure of the wire;

FIG. 2 is a partial elevational and cross sectional view of the wire shown in FIG. 1;

FIG. 3 is a transverse cross sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a transverse cross sectional view taken on line 4—4 of FIG. 2; and

FIG. 5 is a further cross sectional view taken on line 5—5 of FIG. 2.

Referring more specifically to the drawings, numeral **10** indicates generally the present wire structure having heating section **12** and a cold end section **14**, the two sections being covered with an insulating material **16** extending continuously over both the heating section and the cold end section. The heating section may be of various lengths, depending upon the area to be heated by the wire, and may be bent or laid in various configurations to heat the area effectively and usually uniformly.

The heating section consists of a core **20** of fibreglass or other suitable insulating material and a resistance wire **22** of copper, nickel, or a variety of other well known heating wire materials. The resistance wire is coiled around the core in direct contact therewith, and the convolutions of the resistance wire are spaced from one another. The spacing of the convolutions may vary from one wire structure to another, depending on the intended use or the desired concentration of the heat along the resistance wire. The cold end consists of a wire **30** of copper, brass, or other suitable electrical conducting flexible wire material. The cold wire may be twisted, braided, or a single strand; however, for the most convenient installation of the wire, it is preferably relatively flexible. The cold end wire may be of any desired length; however, it would normally be within the range of six inches to three feet.

The heating wire section, i.e. core **20** and resistance wire **22**, is joined to cold end wire **30** by a clip **32** of brass or other good electrical conducting metal. The clip consists of a cylindrical sleeve of substantially the same diameter as the core **20** or cold wire **30**. However, the sleeve has a longitudinal slit **34** extending throughout its length, and before installation of the clip, a space is provided between the two edges along the slit, thus permitting the clip to slip easily onto and/or over the adjacent ends of core **20** and wire **30**. When installed, the clip overlaps the adjacent end of resistance wire **22** and forms a good electrical contact therewith. With the clip installed in the position shown in FIGS. 1 and 2, it is pressed by a suitable tool to its closed and clamping position, thus firmly clamping one end of the clip onto core **20** and in firm contact with the end of wire **22**. The opposite end of the clip is likewise firmly clamped onto the adjacent end of cold wire **30**, thus forming an effective, reliable connection between the resistance wire **22** and the conducting cold wire **30**. While normally the end of core **20** and the end of wire **30** are in substantial contact within clip **32**, the end of resistance wire **22** may overlap wire **30** in the clip. However, an effective electrical contact is obtained by the good conductivity of the clip **32** after it has been clamped onto the two wire sections **12** and **14**. After the clip has been clamped onto the ends of the two sections, it has substantially the same diameter as the two wire sections **12** and **14**, and since the clip is relatively short, the flexibility of the wire is not appreciably affected by the clip, which may or may not be flexible.

After the heating wire section **12** and cold wire section **14** have been joined together, as shown in FIG. 1, without the insulation, the assembled wire, which is of any desired length and preferably coiled on a spool, is fed through a plastic extruding machine which encloses the assembled wire, consisting of a series of sections of core **20**, wire **22**, a series of cold ends **30**, and clips **32**, in a plastic sheath **40** over the foregoing continuous structure including the intermittent cold end wires **30** and clips **32**, thereby forming a continuous water-proof layer completely enclosing the metal wire structure. Since the clip is substantially the same size in diameter as core **20** and wire **30**, the insulating material extruded onto the core and cold end wire is substantially uniform throughout its length, with possibly only a slight bulge at the clips. The slight bulge which can be seen at a numeral **42** may be useful when the wire is used in making an installation, in that the bulge assists in locating the heating wire sections **12** and cold end wires **14**. Since the cold end wire **30** is relatively large and inherently strong, it can be safely bent or otherwise manipulated during the installation operation to form an effective connection with the primary circuit without any likelihood of being damaged. While plastic is the preferred insulating material, other materials, including rubber or rubber-like compounds, may be used if desired.

In the fabrication of the present heating wire structure, the basic heating wire, consisting of core **20** and resistance wire **22**, is formed continuously on a wire fabricating machine and wound on a spool. This heating wire is cut in sections of the desired length and a section of cold wire **30** is joined to the ends of the heating wire and to successive sections of heating wire, forming a continuous wire structure consisting of cold wires **30** and a plurality of cores **20** with resistance wire **22** thereon, connected together by clips **32**. The insulating material is extruded on the continuous wire structure, and when the material is to be used, it is cut into the desired lengths by cutting the cold sections along their length, thus providing units having a heating section with two cold ends firmly joined thereto by clips **32** and fully insulated without interruption from one end to the other, including the two clips and the two cold ends.

The insulating material **40** is preferably of a plastic of well known composition and may be opaque or transparent, and, if opaque, may be of any desired color. If the material is transparent, the two heating and cold

end sections can readily be identified by sight. If the two sections are enclosed in an opaque material, electrical instruments can be used to determine readily where the two sections are located, and the extent of the two sections, regardless of whether or not the wire contains a slight bulge **42** at the connection. The slight bulge may be used to assist in locating the connections and the two sections by sight or feel. Further, the flexibility of the heated and non-heated sections may be different, so that the two sections can readily be identified by the flexure characteristics of the two sections. The insulating material forming sheath or layer **40** may be of various thicknesses to satisfy requirements, and it is sufficiently flexible that it will permit the wire to be placed in various configurations without substantial resistance to flexing and without developing cracks or flaws.

While only one embodiment of the present heating wire has been described in detail herein, various changes and modifications may be made without departing from the scope of the invention.

I claim:

1. A heating wire structure comprising a flexible core of fibrous, electrically nonconducting material, a resistance wire wound on said core, an electrical conducting cold wire of substantially the same size transversely as said core in alignment with said core, a metal fixture clamping said core and resistance wire at one end and said cold wire at the other end and, when in connecting position, being of a transverse size substantially the same as said core, and a layer of moisture impervious electrical insulating material disposed around said core, resistance wire and cold wire and in contact therewith and being continuous and substantially uniform in external size throughout substantially the full length of the core and cold wire, and without substantially change in transverse size from the resistance wire section to the cold wire section of the structure.

2. A heating wire structure as defined in claim **1** in which said layer of insulating material consists of plastic material.

3. A heating wire structure as defined in claim **1** in which said core is constructed of a flexible fibreglass material.

References Cited

UNITED STATES PATENTS

2,710,909	6/1955	Logan et al.	210—528 X
2,905,918	9/1959	Wagner	338—210
3,113,284	12/1963	Van Inthoudt	338—274
3,449,552	6/1969	Graves	219—542 X
Re. 26,522	2/1969	Fessenden	219—528

VOLODYMYR Y. MAYEWSKY, Primary Examiner

U.S. Cl. X.R.

219—528, 542, 549; 338—274; 174—84