

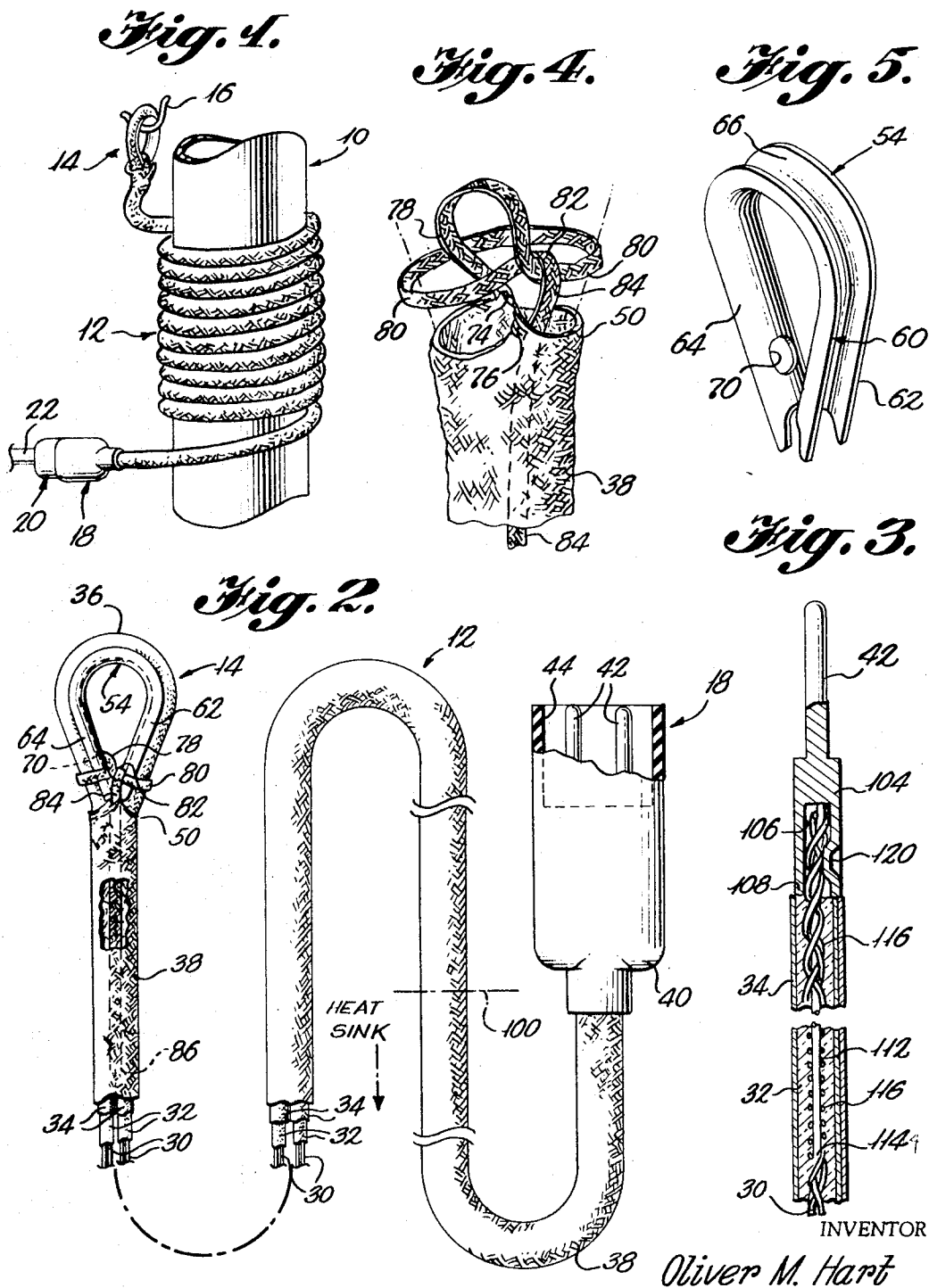
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FLEXIBLE ELECTRIC HEATING CABLE

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FLEXIBLE ELECTRIC HEATING CABLE
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6 Claims

ABSTRACT OF THE DISCLOSURE

A single flexible electrical resistance heating element includes an inner conductor surrounded by a layer of ceramic insulation which in turn is surrounded by a wire braid jacket. This heating element is doubled upon itself with the doubled portions in contact with one another, these doubled portions being in turn surrounded by a further wire braid jacket which holds the heating element in place. A rigid support means is provided including a pair of legs which taper toward one another and an arcuate bight portion. The midportion of the flexible heating element extends around the support means so that the bight portion defines a bend radius. A hole is formed in one leg of this support means and one end of the outer surrounding jacket extends through this hole and is wrapped around the support means and extends within the adjacent portions of the outer jacket to anchor one end thereof at the support means. A relatively short length additional conductor of greater electrical conductivity than said inner conductor is provided within opposite ends of the inner conductor adjacent to the electrical terminal plug of the apparatus so that the end of the heating means adjacent the plug will be cooler to facilitate handling.

Background of the invention

The present invention relates to a flexible electrical heating means which is especially adapted for use in heat treating welded objects or the like, and especially those having rounded or irregular shapes including surfaces other than flat surfaces.

The flexible heating means of the present invention is particularly useful for stress relieving pipes or similar welded objects. The apparatus may be used for example when welding high performance alloy steels which require pre-heat, post-heat, or both. The construction is such that the device is especially well adapted for irregular and odd shapes or configurations such as valve bodies, flanges, T-connections and the like.

In the prior art, a common procedure for heat treating odd or irregular shaped objects has been to employ a hand-held gas torch. This procedure is not satisfactory since it is quite time consuming and it is difficult to obtain uniform heating of the object up to relatively high temperatures.

Another procedure followed in the prior art is to apply a plurality of resistance heating elements to the object, requiring the services of skilled electricians. This type of procedure is unsatisfactory since it is quite time consuming and does require the services of skilled personnel.

Summary of the invention

The present invention provides an elongated flexible electrical heating means comprising a single self-contained unit which may be readily wrapped around an object to be heat treated by relatively unskilled labor in a minimum of time. The heating means of the present invention provides uniform heating throughout the object about which it is wrapped over extended periods of time. Due to the flexibility of the heating means of the present invention, it can be wrapped around objects of widely different outer contour. The electrical resistance heating element of the present invention is of such a nature as to enable the

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apparatus to be operated at temperatures ranging from ambient through 1650° F. on a continuous basis.

Means is also provided to facilitate handling of one end of the heating means even though the major portion thereof may be at a very high temperature.

An object of the present invention is to provide a self-contained flexible heating unit which can be wrapped around objects of odd or irregular configuration and which may be installed by unskilled personnel in the minimum of time; and further which will provide uniform heating of the heat treated objects over extended periods of time.

Brief description of the drawing

FIG. 1 is an elevation of a pipe illustrating the electrical resistance heating means of the present invention wrapped therearound and supported in operative position relative thereto;

FIG. 2 is a top view partly broken away illustrating the flexible heating means of the present invention;

FIG. 3 is an enlarged longitudinal section through one end of the electrical resistance heating element and illustrating the manner of connection to a prong of the associated electrical terminal plug;

FIG. 4 is a view of one end portion of the outer jacket of the flexible heating means illustrating the manner in which it is anchored in place; and

FIG. 5 is a top perspective view on an enlarged scale of the rigid support means of the apparatus.

Description of the preferred embodiment

Referring now to the drawings wherein like reference characters designate corresponding parts throughout the several views, FIG. 1 illustrates the manner in which the apparatus is adapted to be employed in connection with a pipe indicated generally by reference numeral 10. It should be understood that the metallic pipe 10 is employed as a typical application, and that the flexible heating means of the present invention can be wrapped around articles of varying outer configuration.

The heating means of the present invention is indicated generally by reference numeral 12, it being noted that the intermediate part of the heating means is wrapped around the pipe 10 in a generally spiral arrangement with the various portions of the heating means disposed closely adjacent one another. In certain instances, these portions of the intermediate part of the heating means may be spaced slightly from one another if desired.

A support end portion of the heating means is indicated generally by reference numeral 14 and includes an eye as hereinafter fully described which is illustrated as being supported by a hook member 16. Any suitable support means may be employed for holding the support end portion of the flexible heating means in position.

The opposite end portion of the flexible heating means terminates in a plug portion indicated generally by reference numeral 18 which is illustrated as being plugged into a socket member 20 which in turn is connected with a suitable electrical cable 22 connected with a power source.

In operation, the flexible heating means is initially positioned so that a support end portion thereof is held in place whereupon the heating means is wrapped around the article to be heat treated and connected with a suitable power source. Supplementary means may be provided for retaining the flexible heating means in place if such should become necessary.

Referring now to FIG. 2 of the drawings, the heating means has been cut away to illustrate the details of construction of the single flexible electrical resistance heating element which is doubled upon itself. This heating element includes a central inner conductor 30 which may comprise a Nichrome multistrand super flexible conduc-

tor. This inner conductor is surrounded by a layer of long fiber ceramic insulation 32 which in turn is further surrounded by an outer metallic braid jacket 34 which may comprise a multistrand Nichrome jacket.

It should be understood that this single flexible heating element is doubled upon itself such that the midpoint thereof as indicated by reference numeral 36 is disposed at the support end portion of the over-all heating means, while the opposite end portions of the flexible heating element are connected with the plug portion 18.

The doubled portions of the flexible heating element are retained in contact with one another by a surrounding metallic braid jacket 38 which is wrapped tightly around the doubled portions of the flexible heating element throughout the major portion of the lengths thereof. This outer metallic jacket may also comprise a multistrand Nichrome arrangement.

One end of the outer jacket 38 terminates at the molded rubber body 40 of the plug portion 18. The plug portion also includes a pair of prongs 42 disposed within a recess 44 provided in the outer end of the plug portion so that the plug portion can be plugged into a socket in the usual manner.

The opposite end 50 of the outer jacket 38 is disposed adjacent a support means indicated by reference numeral 54 disposed at the support end portion of the heating means.

Referring now to FIG. 5, the support means 54 is formed of a rigid metallic substance such as steel or the like and is generally U-shaped in cross sectional configuration throughout its length so as to provide a groove 60 which is adapted to receive the curved outer surface of the flexible heating element.

The support means includes a pair of leg portions 62 and 64 which taper toward one another in a downward direction as seen in FIG. 5, these two leg portions being interconnected by an arcuate bight portion 66. This bight portion 66 is of such a curvature so as to define a desired bend radius for the medial portion 36 of the flexible heating element. Leg portion 64 has a hole 70 formed therethrough for a purpose hereinafter described.

Referring now to FIG. 4, the details of construction of the end portion 50 of the outer jacket 38 may be clearly understood. Wire strands from substantially opposite points 74 and 76 on the end portion 50 of the jacket are braided together to form an upwardly extending braided strip 78 which is adapted to extend through the hole 70 of the support means. In other words, the strip 78 extends upwardly within the groove 60 defined by leg portion 64 of the support means and thence outwardly through the hole 70.

The strip portion 78 then extends downwardly and is bent to form an encircling band portion 80 which extends completely around the lower end of the support means as seen in FIG. 2 as well as extending around the portions of the flexible heating element disposed within the leg portions 62 and 64 of the support means.

The encircling band portion 80 then joins with a portion 82 which is bent over the initial part of the encircling band portion 80 and then a portion 84 extends downwardly from the bent-over portion 82 as seen in FIGS. 2 and 4. This downwardly extending portion extends within the adjacent part of the outer jacket 38 and terminates at a point 86 illustrated in FIG. 2.

The braided strip extending from end portion 50 of the outer jacket accordingly serves as an anchor means for this end of the outer jacket, the downwardly extending portion 84 being tightly wrapped within the outer jacket and in contact with the flexible heating element disposed therewithin so that this end portion 84 will not be pulled out. It will be noted that the terminal end 86 of end portion 84 of this braided strip is disposed a substantial distance from the end portion 50 of the outer jacket.

As seen in FIG. 2, a so-called "heat sink" is provided at one end of the heating means and starts at a point in-

dicated approximately by phantom line 100 and extends up to the plug portion 40.

Referring now particularly to FIG. 3, the construction of the heat sink is illustrated. As seen in this figure, the prong 42 of the plug includes an enlarged body portion 104 having a substantially cylindrical recess 106 formed therein which opens at the end portion 108 of the prong.

A relatively short length additional conductor indicated by reference numeral 112 is provided, this conductor being formed of a different material such as copper or the like which has substantially greater electrical conductivity than the Nichrome material of the inner conductor 30.

Conductor 112 terminates at one end at a point 114, and from this point extending toward the prong 42, the inner conductor 30 is braided around conductor 112 as indicated by reference numeral 116, the conductor 112 and the surrounding braided portion 116 of the inner conductor 30 extending within the cylindrical recess 106 provided in the prong. The enlarged body portion of the prong is crimped inwardly as indicated by reference numeral 120 to clamp the terminal ends of conductors 30 and 112 within the prong. The layer of insulating material 32 and the surrounding jacket 34 of the heating element extend up to a point closely adjacent to the end portion 108 of the prong.

It should be understood that the opposite end of the inner conductor is similarly provided with a short length additional conductor so that the opposite ends of the heating means adjacent to the plug will be much cooler during operation of the apparatus than the remaining portions of the heating element to facilitate handling thereof.

The arrangement wherein the inner conductor 30 is braided around the additional conductor 112 provides a combination of mechanical strength and heat sink capabilities of the copper material. If the end portion of the additional conductor 112 adjacent point 114 thereof should approach its melting point, the surrounding Nichrome inner conductor of the heating element will retain it in place and will not cause any breakage at this point. The current density is reduced enough in the inner conductor 30 at its point of entering into the prong 42 so that it no longer acts as a heater element. The copper conductor 112 is carrying the greatest proportion of current at this point, and accordingly the heating element is relatively cool adjacent the plug.

It is apparent from the foregoing that there is provided according to the present invention new and novel flexible heating means which comprises a self-contained flexible unit which may be wrapped around objects of rounded, odd or irregular configuration; and which may be installed by relatively unskilled personnel in a minimum amount of time; and which will give uniform heat over extended periods of time.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, and since the scope of the invention is defined by the appended claims, all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents are therefore intended to be embraced by those claims.

I claim:

1. A flexible heating cable comprising an elongated flexible electrical resistance heating element, an electrical connecting means connected at opposite ends of said heating element, and defining one end of the cable, said heating element doubled on itself and having the doubled portions thereof disposed adjacent one another throughout the major portion of the length of the heating means, said elongated flexible heating element including an inner conductor, said inner conductor being surrounded and engaged throughout substantially the length thereof from

said electrical connecting means by a layer of electrical insulation, said insulation being surrounded and engaged throughout substantially the length thereof by a metallic braid jacket, and a further metallic braid jacket disposed in surrounding engaging relationship to said doubled portions throughout substantially the length thereof to retain said doubled portions adjacent one another throughout the major portion of the length thereof, support means formed of relatively rigid material and including an arcuate portion, an intermediate portion of said flexible heating element extending around said support means and being in contact therewith to define a bend radius in said flexible heating element of substantially the same size and configuration as said arcuate portion thereby forming a loop at the opposite end of the cable, said support means including a pair of leg portions tapering toward one another, said leg portions being connected by an arcuate bight portion which serves to define said bend radius.

2. Apparatus as defined in claim 1 wherein one of said leg portions has a hole formed therethrough.

3. Apparatus as defined in claim 2 wherein one end of said further metallic braid jacket includes a portion extending through said hole in said leg portion of the support means and being wrapped around the support means and then extending within the adjacent portion of the further metallic braid jacket to anchor one end of the further metallic braid jacket.

4. Apparatus as defined in claim 1 including an additional conductor of greater electrical conductivity than said inner conductor and being in engagement with said inner conductor adjacent said electrical connecting means so as to dissipate heat.

5. Apparatus as defined in claim 1 wherein said support

means is generally U-shaped in cross-section to provide a groove for receiving said flexible heating element.

6. Apparatus as defined in claim 1 wherein one of said leg portions of the support means has a hole formed therethrough, one end portion of said further jacket extending through said hole and being wrapped around said support means and extending within the adjacent portion of said further jacket so as to serve as an anchor for said further jacket, and an additional conductor of greater electrical conductivity than said inner conductor and being in engagement with said inner conductor adjacent said electrical connecting means so as to dissipate heat.

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