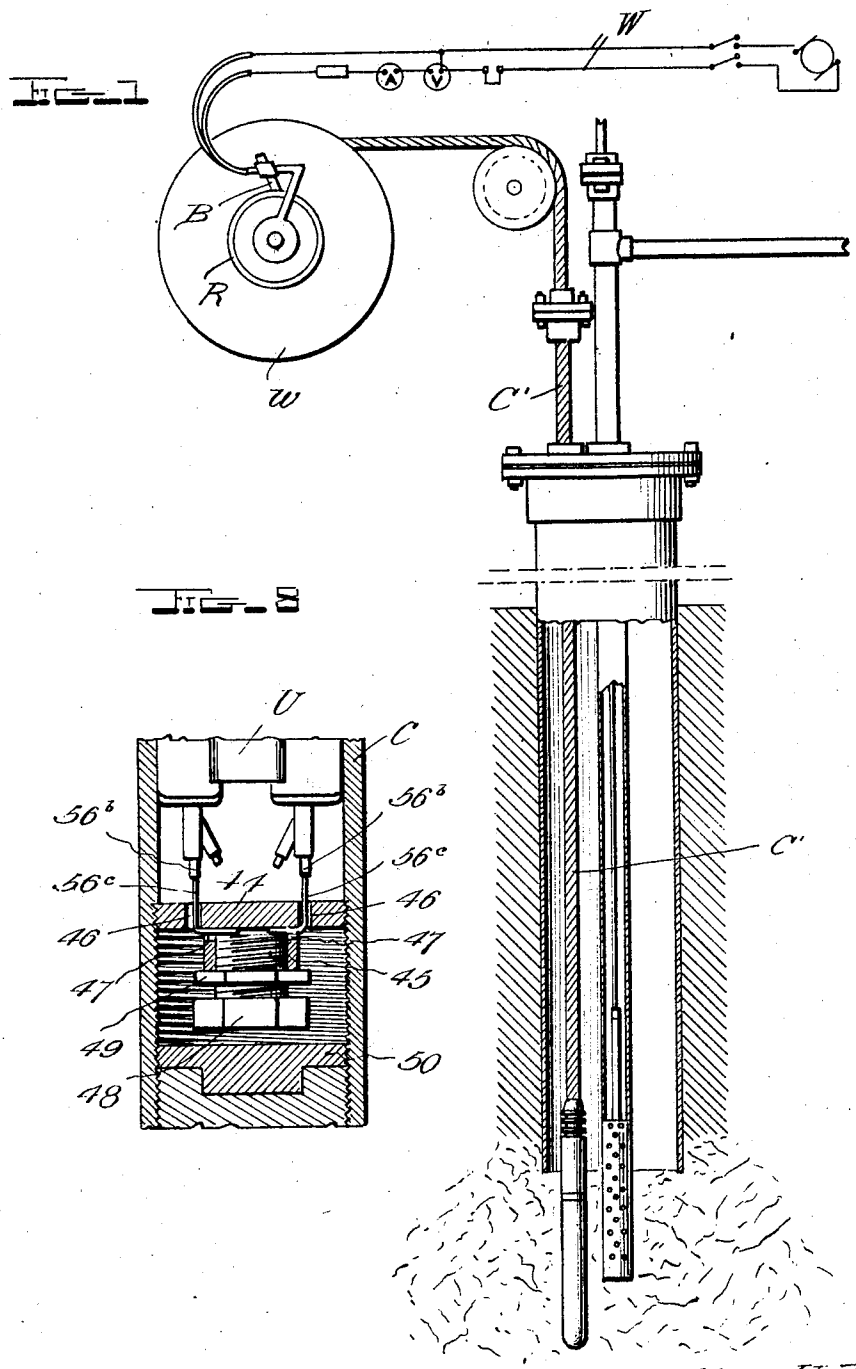
July 9, 1929. D. U. POWELL 1,720,092

ELECTRIC HEATER

Filed April 2, 1928 3 Sheets-Sheet 1



Witness

Inventor

Dalton U. Powell,

By A. B. Williamson & Co

Attorneys

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ELECTRIC HEATER

Filed April 2, 1928 3 Sheets-Sheet 2

Fig. 2

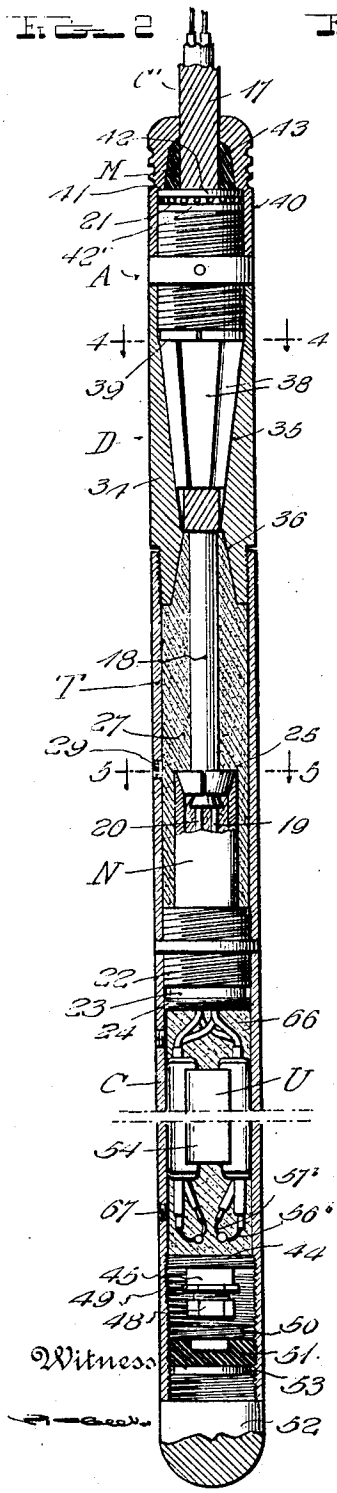


Fig. 3

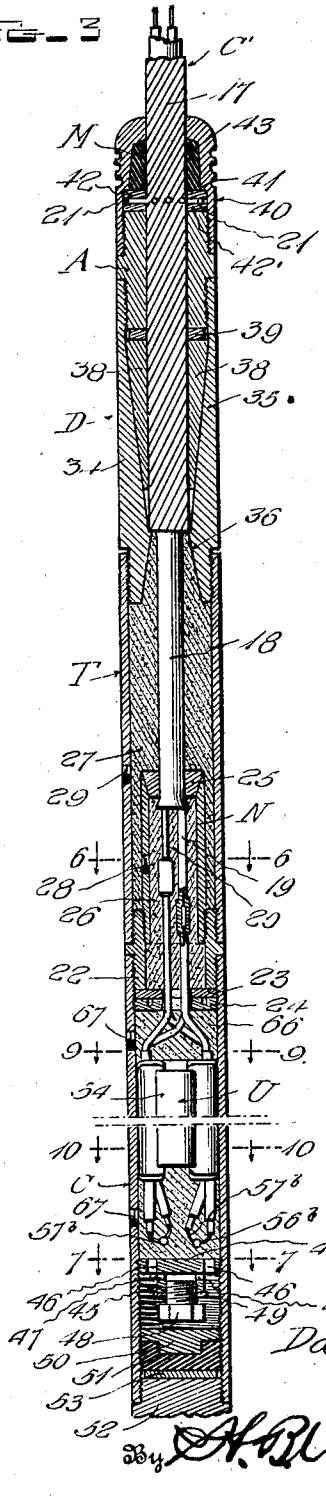


Fig. 4

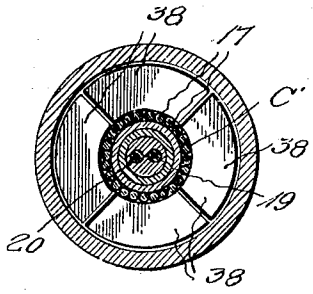


Fig. 5

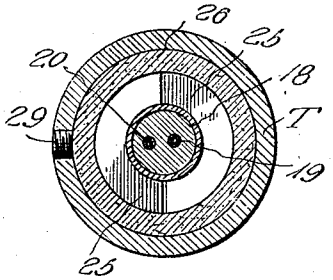


Fig. 6

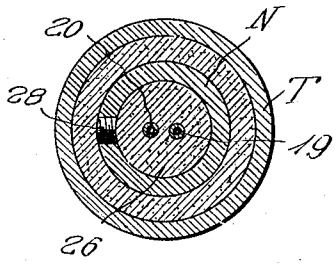
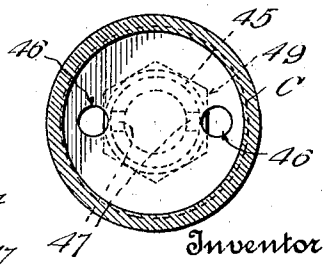


Fig. 7



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ELECTRIC HEATER

Filed April 2, 1928 3 Sheets-Sheet 3

Fig. 9

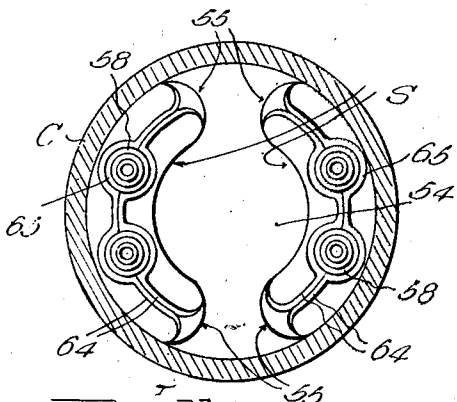

Fig. 10

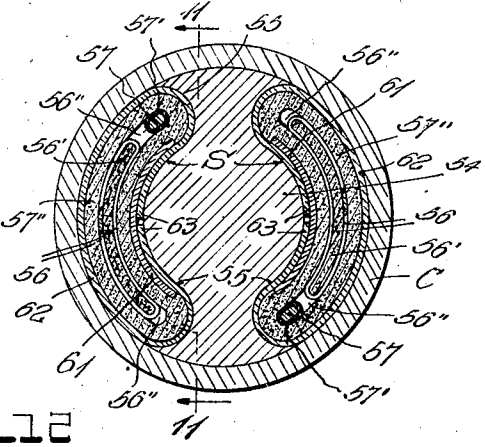

Fig. 11

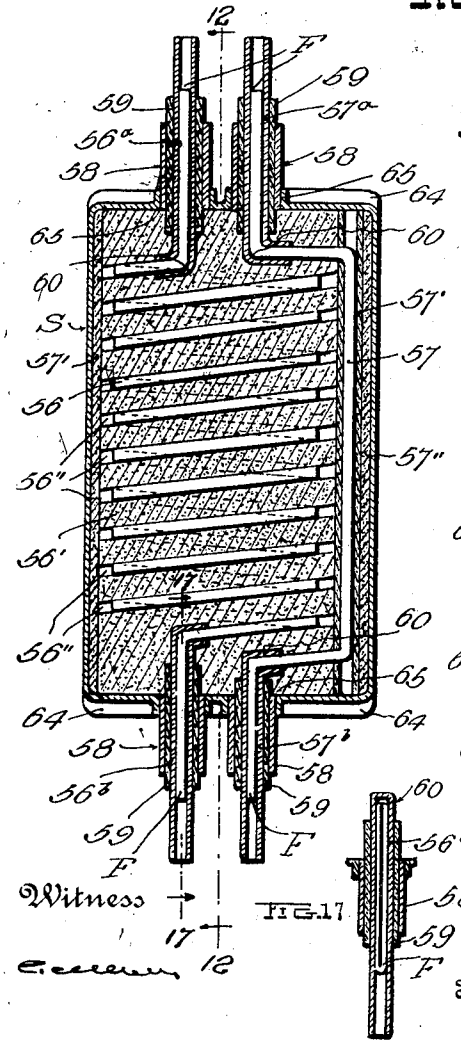

Fig. 12

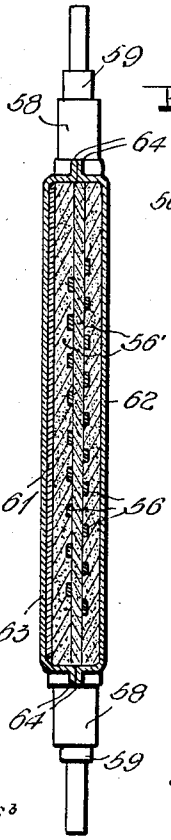

Fig. 13

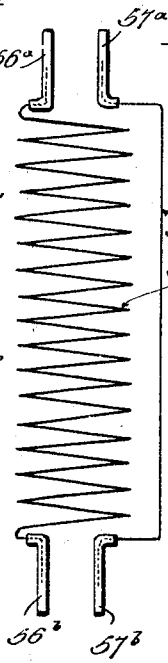

Fig. 14

Fig. 15

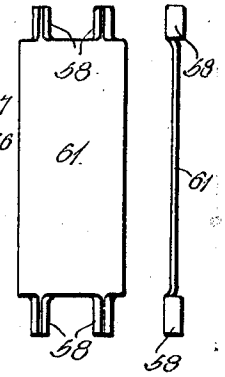

Fig. 16

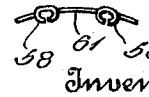

Fig. 17

Witness

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Patented July 9, 1929. 1,720,092

UNITED STATES PATENT OFFICE.

DALTON U. POWELL, OF WOODSFIELD, OHIO, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE OIL RECOVERY CORPORATION, OF WHEELING, WEST VIRGINIA, A CORPORATION OF WEST VIRGINIA.

ELECTRIC HEATER.

Application filed April 2, 1928. Serial No. 266,664.

The invention relates primarily to an electric heater intended principally for use in oil wells between the casings and the pumps or tubings thereof, although it is to be understood that the same heater construction could be used as a space heater or as an immersion heater, in other fields.

One object of the invention is to provide a new and improved heater construction in which novel provision is made to absolutely seal against entrance of moisture into the heater casing, around a current-conducting cable leading to said casing, said cable being a suspending cable for the entire heater in the present disclosure.

Another object of the invention is to provide new and improved means for tenaciously connecting the cable with the heater casing in a manner to prevent possibility of accidental disconnection.

A still further aim is to provide a construction which is such as to permit the heater to be manufactured of such small diameter as to be readily receivable between a well casing and a pump or tubing therein, without the necessity of removing said pump or tubing, this same construction however being adaptable to heaters of greater size.

Yet another object is to provide an electrical heating unit of novel construction and possessing a number of advantages to be hereinafter explained.

A still further aim is to make novel provision whereby either a two-wire system or a single wire system of wiring may be used.

With the foregoing and minor objects in view, the invention resides in the novel subject matter hereinafter described and claimed, description being accomplished by reference to the accompanying drawings.

Fig. 1 is a side elevation partly in section showing the preferred application of the heater.

Fig. 2 is an enlarged longitudinal sectional view partly in elevation showing the construction of the heater.

Fig. 3 is a longitudinal sectional view.

Figs. 4, 5, 6 and 7 are horizontal sectional views on the correspondingly numbered lines of Figs. 2 and 3.

Fig. 8 is an enlarged detail vertical section similar to a portion of Fig. 3 but showing the manner in which the resistance elements of the heating unit may be grounded for use in a one-wire system of wiring.

Figs. 9 and 10 are horizontal sectional views on lines 9—9 and 10—10 of Fig. 3, showing features of construction of the heating unit.

Fig. 11 is a vertical sectional view substantially on line 11—11 of Fig. 10 but omitting the heater casing.

Fig. 12 is a vertical sectional view on line 12—12 of Fig. 11.

Fig. 13 is a diagram of one of the resistance elements and a conducting wire to be hereinafter described.

Fig. 14 is a side elevation of a plate which is instrumental in constructing one of the shells which contain the resistance elements and the conducting wires shown in Fig. 13.

Fig. 15 is an edge view of the plate shown in Fig. 14.

Fig. 16 is an end elevation of said plate.

Fig. 17 is a detail vertical sectional view on line 17—17 of Fig. 11.

The form of construction selected for illustration, may be considered as preferred, with the understanding that within the scope of the invention as claimed, numerous variations may be made.

C denotes a tubular casing for an electrical heating unit N, or a plurality of such units suitably connected with each other, said casing being formed either of a single length of piping with appropriate adjuncts, or of a plurality of such lengths coupled together. In the present showing, the upper end of this casing is provided with an upstanding tubular neck N. A current-conducting and heater-supporting cable C′ extends downwardly to the neck N and embodies an appropriate braided, twisted or other armor 17, a sheath 18 projecting downwardly beyond said armor, and conducting means within said sheath and projecting downwardly therefrom through the neck N into the casing C, said conducting means being shown as consisting of two conductors 19—20, although if desired, a single wire system of wiring can be used. The lower end of the sheath 18 is secured in the upper end of the neck N as will be hereinafter more specifically described.

Fluid-tightly secured to and rising from the casing C, is a tube T of one or more sections as desired. This tube surrounds and is outwardly spaced from the neck N and the

projecting portion of the sheath 18. Fluid-tightly secured to the upper end of the tube T is a cable-clamping device D having an actuator A at its upper end, packing means M being provided at the upper end of said actuator. Portions of the armor 17 are cut and laterally directed above the lower end of said armor as denoted at 21, and in the present showing a portion of the packing means M co-operates with the actuator A in clamping these laterally projecting armor portions.

The tube T contains means around the sheath 18 serving as moisture-excluding means, said moisture-excluding means also extending around the neck N; the device D is tenaciously clamped to the lower end of the armor and a further connection is established embodying the lateral portions 21 of the cable armor, and final packing at the upper end of the device is accomplished by the packing means M. The various details of these several elements will be hereinafter specifically described, but it may be briefly stated that they perform the functions of effectively connecting the cable with the heater casing C and preventing the entrance of any moisture.

In the form of construction herein disclosed, a coupling nipple 22 connects the lower end of the tube T with the upper end of the tubing forming the wall of the casing C, the upper end of said nipple serving also as means for connecting the neck N with the body portion of said casing C. A gasket 23 is shown closing the lower end of the nipple 22 and bearing against a washer 24, threaded into the upper portion of the casing C. The upper end of neck N is shown of internally flared form to receive a downwardly tapered, transversely split wedge ring 25 which surrounds the lower end of the sheath 18. If this sheath be of metallic nature, a soldered or wiped joint is provided between it and the wedge ring 25 and between the latter and the neck N, but if said sheath be of non-metallic material, other provision may be made to establish a substantially fluid-tight connection between it and the neck N. Below the wedge ring 25, the neck N and the nipple 22 are filled with an appropriate plastic cement 26 which seals against entrance of moisture. The cable-clamping device D is threaded into the upper end of the tube T and the portion of this tube between said device D and the nipple 22 is filled with moisture-excluding cement 27. Threaded plugs 28—29 are provided in neck N and tube T, through which to inject the cement 26—27.

In the present showing, the cable-clamping device D embodies a tubular body 34 whose interior is downwardly tapered at 35, and the lower end of this body is preferably provided with an upwardly tapered socket 36 through which the sheath 18 extends, said socket being filled with some of the cement 27 to still further insure against entrance of moisture. It is the lower end of the body 34 which is threaded at 33 into the tube T and this threaded connection is of fluid-tight nature.

Within the tapered interior of the body 34, there are a number of downwardly tapered, cable-gripping wedges 38. In the present showing, a transversely split washer 39 rests on the upper ends of these wedges, and the tubular actuator A is threaded into the upper end of the body 34 into contact with said washer. This threaded connection is of fluid-tight nature and it will be understood that downward threading of the actuator A, causes depression of the wedges 38 thus crowding the latter inwardly so that they forcibly grip the cable armor, taking all suspending strain from internal parts of the cable. This suspending strain is further carried by the laterally projecting armor portions 21 and the associated means described below.

A packing-containing hood 40 is shown threaded upon the upper end of the actuator A and provided with an internal downwardly facing shoulder 41. A washer 42 abuts this shoulder another washer 42′ lies upon the upper end of the actuator A and the laterally extended armor portions 21 are clamped between said washers. Above the washer 42, the hood 40 is upwardly tapered and contains appropriate packing 43.

I have above referred to a heating unit U or to a plurality of such units, one being shown for illustrative purposes. This unit is disposed in the casing C, between the washer 24 and a partition 44 which extends horizontally across said casing and is preferably threaded into place. For purposes to appear, this partition is provided with the following structural features. A tubular boss 45 projects downwardly from said partition, openings 46 are formed in the latter at the periphery of said boss, other openings 47 are formed through the boss at the lower ends of the openings 46, a plug 48 is threaded into the boss, and a lock nut 49 is provided for said plug. Under the plug 48, a plug 50 is shown threaded into the tubing which forms the side walls of the casing C. A packing washer 51 contacts with the lower side of this plug, and another plug 52 forming the lower terminal of the casing C, holds the packing in place, a washer 53 being preferably interposed between said plug 52 and said packing.

As will be hereinafter more fully explained, the heating unit U embodies certain terminals which are connected with each other above the partition 44 if a two-wire cable C′ be used as in Figs. 2 and 3. If terminals of the resistance elements of the unit U are to be grounded when using a one-wire system, the openings 46—47, the plug 48 and the lock nut 49 come into play as in Fig. 8.

The explanatory matter immediately pre-

ceding may be more fully understood after giving a specific description of the heating unit U. Consequently, such description follows and reference is made more particularly to Figs. 9 to 17 inclusive.

54 denotes a vertically elongated metallic core within the casing C and of cylindrical form. This core has a plurality of circumferentially spaced recesses 55 formed longitudinally in its periphery, the inner sides of said recesses being preferably concentric with the casing C. In each recess 55, there is a metallic shell S of vertically elongated, transversely curved form. Two of these shells are shown and they each contain a resistance wire 56 and a conducting wire 57. The resistance wire 56 is preferably of ribbon form and is wrapped around an insulating core 56′ having wire-receiving notches 56″. This wire 56 has terminals 56^a and 56^b at its upper and lower ends, passing to the exterior of the shell S. The conducting wire 57 is within an insulating tube 57′ contacting with core 56′, and insulation 57″ is wrapped around the parts 56, 56′ and 56″. Wire 57 is provided with terminals 57^a and 57^b projecting from the upper and lower ends of the shell S. If the resistance wires within the two shells S are to be connected in parallel, using a two-wire cable C′, each terminal 56^b is connected with the adjacent terminal 57^b, each terminal 56^a is connected to one of the conductors 19—20, and each terminal 57^a is connected to the other of these conductors. This relation is illustrated in Figs. 2 and 3. When the cable, such as C′ is provided only with a single current-conducting wire, the terminals 56^a of the resistance wires 56 are connected with this wire, and conductors 56^c are lead from the terminals 56^b through the openings 46—47 and into the tubular boss 45. The plug 48 is then tightened to clamp these conductors 56^c, establishing a ground connection between the resistance wires and the casing. The lock nut 49 is then tightened, and it will be understood that access to the parts 48—49, may be had by removing portions of the casing below them. By proper connection of the terminals, plug 48, etc., the resistance elements may be connected in series if desired, using either a one-wire or a two-wire cable.

Tubular necks 58 are shown projecting from the upper and lower ends of the shell S and lined with suitable insulation 59. The terminals 56^a—56^b and 57^a—57^b, pass outwardly through these lined necks. Each of these terminals is of tubular form, the ends of the wires with which said terminals are connected being folded upon themselves at F received in the inner ends of the tubes. Each tube and the wire end therein are jointly given an abrupt bend 60 within the shell S. This not only prevents the terminals from pulling out of the shell, but prevents the ends of the wires from pulling out of said terminals.

In the form of construction herein disclosed, the necks 58 are integral with the ends of a plate 61 forming a portion of the shell S. If desired this plate and other parts of the shell may be assembled in flat form and then curved into the shape shown in Figs. 9 and 10. Opposed to plate 61 is another sheet metal plate 62, the longitudinal edge portions 63 of this plate 62, being folded around the corresponding edge portions of the plate 61 as seen most clearly in Fig. 10. The upper and lower ends of the body portion of plate 62 and the inwardly folded portions 63 of this plate, are bent inwardly toward each other and welded or otherwise secured as at 64, closing the ends of the shell S but leaving gaps 65 through which the necks 58 pass.

The construction above described for the unit U is advantageous from a standpoint of manufacture, from one of efficiency in use, and from one of ease of installation. While in certain wiring systems, the conducting wire 57 is idle, it is instrumental in carrying out other wiring systems and in overcoming the necessity of running conductors along the exterior of the shell S or other portion of the unit U.

I prefer that the portion of the space between the parts 34—50, not filled by parts herein described, shall be filled with an appropriate moisture-excluding cement 66. To permit injection of this cement, the casing may be provided with a screw plug 67.

While the various features of construction herein described and shown, are preferably followed, attention is again invited to the fact that within the scope of the invention as claimed, numerous variations may be made. Moreover, while the specific features of heating unit construction herein disclosed are preferably used with the cable-holding and moisture-excluding means which I have described, it will be understood that a heating unit of any desired construction could be employed with these other features. Moreover, while in Fig. 1, I have shown the heater suspended in an oil well between the casing of the latter and the pump tubing, it will be understood that this use is only one of many. In the figure in question, the cable is wound upon a winch or the like *w* to be raised and lowered thereby as occasion may demand, and rings and brushes such as *r*—*b* are employed to carry the current to the wires 19—20, from the line wires W, the ends of said wires 19—20 being of course connected to said rings. Within the line, any desired and well known instruments may be used for protective and other purposes, but as they form no part of the present invention, they need not be described.

Such terms as "upper", "lower", "vertical",

"horizontally", "downwardly", etc., used in the foregoing and in the following claims, are to be considered as relative rather than limiting, as the heater may in some instances, be used in a position other than vertical.

In my co-pending U. S. application Serial No. 225,354, filed October 10, 1927, a heater casing is shown having a cable-receiving passage through which an armored cable extends for supplying current to the heater. A portion of the cable armor is outwardly bent and a sheath of the cable projects beyond said armor. Then too, relatively fixed and movable annular clamping members are provided for tightly clamping the outwardly bent armor portion to tenaciously connect the cable with the heater casing. This subject matter is of course generic to the present application but is not broadly claimed herein.

I claim:—

1. In a heater, a casing for a heating unit, a current-conducting cable secured to and extending upwardly from the upper end of said casing, a tube fluid-tightly secured at its lower end to the upper end of said casing, said tube being spaced around said cable, fluid-excluding filling means in said tube around said cable, a tubular body around said cable and fluid-tightly secured at its lower end to the upper end of said tube, cable-gripping means in said tubular body, a tubular actuator for said cable-gripping means surrounding said cable and fluid-tightly connected with the upper end of said tubular body, and packing means fluid-tightly surrounding the cable at the upper end of said actuator.

2. In a heater, a casing for a heating unit, said casing being provided with an upstanding tubular neck, a current-conducting cable fluid-tightly secured at its lower end in said neck, a tube spaced around said neck and cable, said tube being fluid-tightly secured at its lower end to the upper end of said casing and extending above said neck, fluid-excluding filling means in said tube around said neck and the tube-contained portion of said cable above said neck, a tubular body around said cable and fluid-tightly secured at its lower end to the upper end of said tube, cable-gripping means in said tubular body, a tubular actuator for said cable-gripping means surrounding said cable and fluid-tightly connected with the upper end of said tubular body, and packing means fluid-tightly surrounding the cable at the upper end of said actuator.

3. In a heater, a casing for a heating unit, said casing being provided with an upstanding tubular neck, a current-conducting cable fluid-tightly secured at its lower end in said neck, a tube spaced around said neck and cable, said tube being fluid-tightly secured at its lower end to the upper end of said casing and extending above said neck, a fluid-excluding cement in said tube around said neck and the cable, a tubular body surrounding the cable and having its lower end threaded fluid-tightly into the upper end of said tube, said lower end of said body being provided with an upwardly tapered socket through which the cable passes, said socket receiving a portion of said cement, cable-gripping means in said tubular body, a tubular actuator for said cable-gripping means surrounding said cable and fluid-tightly connected with the upper end of said tubular body, and packing means fluid-tightly surrounding the cable at the upper end of said actuator.

4. In a heater, a casing for a heating unit, a vertically disposed current-conducting cable having an armor, a sheath within and projecting beyond the lower end of said armor, and a conductor within and projecting downwardly from said sheath: means connecting the lower end of said sheath to the upper end of said casing, a tube fluid-tightly secured at its lower end to and rising from said casing around said projecting sheath portion, fluid-excluding means in the tube around said projecting sheath portion, a tubular body fluid-tightly connected at its lower end to the upper end of said tube, said tubular body surrounding the lower end of said armor, gripping means for said lower end of the armor disposed in said tubular body, actuating means for said gripping means, a portion of said armor being cut and laterally directed above said gripping means, and means connected with the upper end of said body for clamping said laterally directed armor portion.

5. In a heater, a casing for a heating unit, a vertically disposed current-conducting cable having an armor, a sheath within and projecting beyond the lower end of said armor, and a conductor within and projecting downwardly from said sheath; means connecting the lower end of said sheath to the upper end of said casing, a tube fluid-tightly secured at its lower end to and rising from said casing around said projecting sheath portion, fluid-excluding means in the tube around said projecting sheath portion, a tubular body fluid-tightly connected at its lower end to the upper end of said tube, said tubular body surrounding the lower end of said armor, gripping means for said lower end of the armor disposed in said tubular body, an actuator for said gripping means connected to the upper end of said tubular body, a portion of said armor being cut and directed laterally at the upper end of said actuator, and means connected with said upper end of said actuator for clamping said laterally directed armor portion.

6. In a heater, a casing for a heating unit, a vertically disposed current-conducting cable having an armor, a sheath within and projecting beyond the lower end of said

armor, and a conductor within and projecting downwardly from said sheath; means connecting the lower end of said sheath to the upper end of said casing, a tube fluid-tightly secured at its lower end to and rising from said casing around said projecting sheath portion, a tubular body around the lower end of said armor and the upper end of said projecting sheath portion, the lower end of said body having an upwardly tapered socket in which said upper end of said projecting sheath portion is disposed, and a fluid-excluding filling in said tube and socket around said projecting sheath portion.

7. In a heater, a casing for a heating unit, a current-conducting cable extending downwardly to said casing and having an armor, a portion of said armor being cut above the lower end of said armor and directed laterally, a tubular radially-contractible cable-gripping device around the cable under said laterally directed portion of the armor, and a clamping device for said laterally directed armor portion; said casing, said gripping device and said clamping device being connected.

8. In a heater, a casing for a heating unit, a current-conducting cable extending downwardly to said casing, a tubular body above the casing around said cable and having a downwardly tapered interior, cable-gripping wedges in said body between its taper and the cable, and an annular depressor for said wedges having a threaded connection with the upper end of said body, said body being connected with said casing.

9. In a heater, a casing for a heating unit, said casing having an upstanding tubular neck closed at its lower end with the exception of a conductor-receiving opening, a cable whose lower end is secured in the upper end of said neck, said cable having a conductor extending downwardly through the neck and said conductor-receiving opening, a tube fluid-tightly secured to the casing and rising therefrom around said neck and the contiguous portion of the cable, fluid-excluding means in said tube around said neck and said contiguous cable portion, and fluid-excluding means filling said neck around said conductor.

10. In a heater, a tubular casing for a heating unit, said casing having a removable closure at its lower end and a horizontal partition above said closure, said partition having a downwardly projecting tubular boss, openings from top to bottom at the outer side of said boss, and openings from the exterior to the interior of said boss, said openings permitting passage of heater terminals through said partition and into said boss, and a plug threaded into the lower end of said boss for clamping said terminals.

11. In a heater, a tubular casing, an elongated metal core therein having longitudinal circumferentially spaced recesses in its periphery whose inner sides are substantially concentric with said tubular casing, said core contacting with said casing between said recesses, transversely curved metal jackets filling said recesses and contacting with said tubular casing, and resistance elements in and insulated from said jackets.

12. In a heater, a jacket having an opening, a resistance element in and insulated from said jacket, and a tubular terminal passing through said opening and tightly receiving an end of said resistance element, said terminal and said element end jointly having an abrupt angular bend within the jacket to prevent pulling of the terminal from the element and pulling of said terminal out of said opening.

13. In a heater, a jacket, a resistance element in and insulated from said jacket and having its terminals exposed at two extremities of the latter, and a conductor in and insulated from said jacket and likewise having its terminals exposed at said extremities of the jacket.

14. In a heater jacket, a plate having a projecting sleeve on one end, and a second plate in opposed spaced relation with the first named plate and having its longitudinal edge portions folded around the longitudinal edge portions of said first named plate, the ends of said second plate being bent together to close the ends of the jacket, leaving a gap however through which said sleeve extends.

In testimony whereof I have hereunto affixed my signature.

DALTON U. POWELL.