June 30, 1942. N. B. COHEN 2,287,974

HEATING APPARATUS

Filed June 16, 1939

Fig. 1

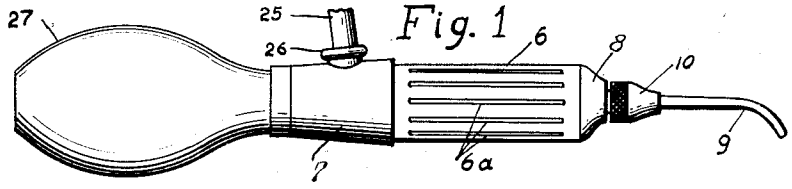


Fig. 2

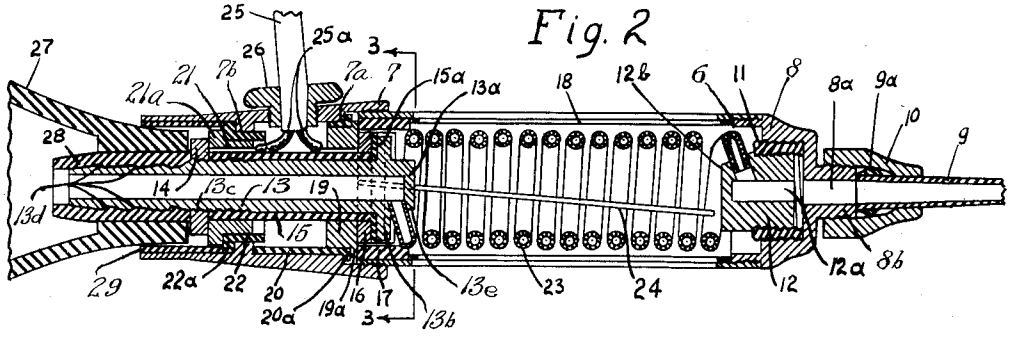


Fig. 5

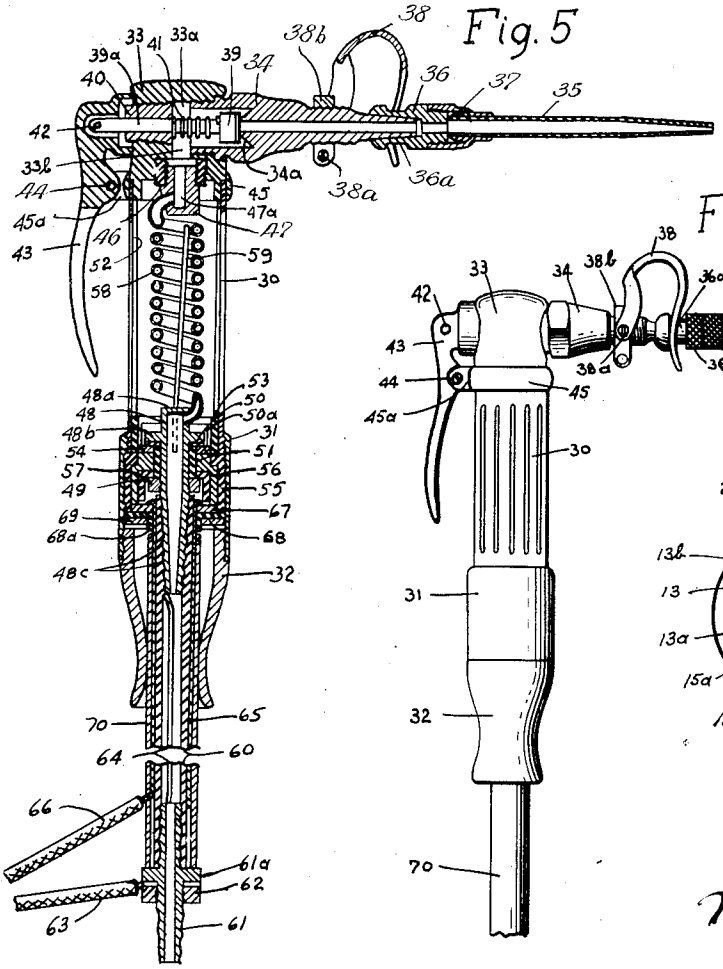


Fig. 4

Fig. 3

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HEATING APPARATUS

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4 Claims. (Cl. 219—39)

This invention relates to fluid heating apparatus and particularly to a combined fluid ejecting and fluid heating device.

In the practice of dentistry means for projecting jets of heated fluids such as air and water are regularly used. For such purpose it is quite common to use a simple syringe for ejecting water drawn from separate water heating means, and to use a simple syringe, portions of which are heated over a flame prior to each operation, for projecting a jet of air. More conveniently operable apparatus has been devised involving a tubular fluid conducting element formed of electrical resistance material so as to be usable as an electrical heating element for heating fluid passing through the interior thereof. In producing such a device serious problems are encountered in constructing the device so that the same will simultaneously be sufficiently compact, provide means for electrically insulating the combined fluid duct and heating element from externally accessible parts of the device, and incorporate a fluid duct and heating element of enough length to operate on a sufficiently high voltage and low current to enable use of a relatively small, light and flexible electrical cord for delivery of electrical energy to the device. In forms of the device supplied with fluid from a source of fluid under pressure a further problem is presented in avoiding use of individual conduit means for delivering fluid and electrical energy to the device.

A general object of the invention is to provide an electrically energized fluid heating and ejecting device of the type referred to above of such construction as to constitute a solution of all of the problems mentioned above.

A more specific object is to provide such a device wherein the tubular combined fluid duct and electrical heating element and the connections of the ends thereof to fluid inlet and outlet elements are so constructed as to enable accommodation of a maximum length of tube in a given space.

Another object is to provide fluid inlet and outlet means for the tubular duct and heating element of particularly compact construction and arranged to support said element from a shell containing the same and also electrically insulate said element from said shell.

Still another object is to provide such a device having particularly compact means for conducting fluid and electrical energy to the tubular combined duct and heating element and insulatingly supporting said element from the outer shell of the device.

Yet another object is to provide such a device having a common conduit unit for conducting both electrical current and a fluid to the parts within the shell of the device.

A further object is to provide such a device of light, compact, rugged, efficient and inexpensive construction.

A further object is to provide a device of the present character which will be of novel and improved construction.

And a further object is to provide a device of the type as stated wherein will be incorporated various improved features of construction novel both as individual entities of the device and in combination with each other.

These and other objects and advantages of the invention will be more fully set forth in the following description made in connection with the accompanying drawing, in which like references refer to similar parts throughout the several views, and in which—

Fig. 1 is a view of the exterior of an embodiment of the invention;

Fig. 2 is a partial longitudinal sectional view drawn to enlarged scale;

Fig. 3 is a cross-sectional view taken on the line 3—3 of Fig. 2 as indicated by the arrows;

Fig. 4 is a view of the exterior of another embodiment of the invention; and

Fig. 5 is a longitudinal sectional view.

Referring to the drawing and particularly to Figs. 1 to 3 inclusive, the device as shown includes an outer casing or shell consisting of a tubular barrel 6, a tubular rear portion 7 screw-threadedly joined at its forward end to the rear end of the barrel 6, and a forward portion or front end closure 8 screw-threadedly joined at its rear end to the front end of the barrel 6.

The closure 8 is provided with a central aperture 8*a* extending axially relative to the barrel 6 so as to constitute a fluid outlet element. The forward end of the closure 8 is formed into an externally screw-threaded neck or connection element 8*b* to which a nozzle 9 is attached by means of an internally screw-threaded collar or ferrule 10. The interior space of the collar 10 is forwardly tapered and contains an enlarged element 9*a* formed on the rear end of the nozzle 9.

The rear portion of the outlet aperture 8*a* of the closure 8 is of enlarged diameter and the portion of the closure 8 defining the same is internally screw-threaded. An internally and ex-

ternally screw-threaded bushing 11, formed of electrical insulating material, is screw-threadedly mounted in the enlarged rear portion of the aperture 8a and is of sufficient length to project a short distance rearwardly thereof.

An outlet member 12 of generally cylindrical form has an externally screw-threaded reduced diameter forward portion screw-threadedly mounted in the internal screw threads of the bushing 11. The reduced diameter forward portion of the outlet member 12 is of such length that the shoulder between the same and the full diameter portion abuts the rear end of the bushing 11 with the forward end of the outlet member in spaced relation with the closure 8. The outlet member 12 has a centrally located recess 12a therein extending axially thereof to a point a short distance forwardly of the rear end of the outlet member 12, the recess 12a being in communication with the forward portion of the aperture 8a and consequently with the nozzle 9. The bushing 11 supports the outlet element 12 from the closure 8 and at the same time electrically insulates the outlet element 12 from the closure 8.

A tubular fluid inlet member 13, closed at its forward end by an end wall 13a is disposed in the rear portion of the shell formed by the barrel 6, tubular rear portion 7 and closure 8 in coaxial relation therewith. A radially outwardly projecting flange 13b is provided on the inlet member 13 a short distance rearwardly of the front end thereof. External screw threads 13c carrying a burr or nut 14 are formed on the medial portion of the inlet member 13 and a series of circumferentially extending corrugations 13d are formed on the rear portion as shown.

Between the nut 14 and the flange 13b the inlet member 13 is provided with a sleeve 15 formed of electrical insulating material and having formed on the forward end thereof a flange 15a having a larger diameter than the flange 13b of the inlet member 13 and lying against the rear side thereof. An electrically conductive ring 16 is mounted on the insulating sleeve 15 immediately rearwardly of the insulating flange 15a. An electrical insulating collar 17 snugly contained in the rearmost portion of the barrel 6 encircles the inlet member flange 13b, the insulating flange 15a and the conductive ring 16. A tubular lining 18, formed of heat insulating material extends from the collar 17 to the rear limit of the closure 8 in snugly fitting relation with the internal periphery of the barrel 6.

Immediately behind and in abutment with the rear side of the conductive ring 16 is an annular backing element 19 having on the forward portion of its periphery a flange 19a abutting the rear side of the insulating collar 17 and inwardly spaced from the rear portion 7 of the shell of the device. A short distance rearwardly of the flange 19a the rear portion 7 of the shell has, on its inner periphery, a forwardly facing shoulder 7a. A moderate distance forwardly of the nut 14 the rear portion 7 has an inwardly projecting flange 7b. An electrical insulating lining or sleeve 20 snugly fitting the internal periphery of the rear portion 7 extends from the flange 7b to a point just forward of the shoulder 7a and has formed on the forward end thereof a flange 20a lying against the shoulder 7a. The forward portion of the sleeve 20, including the insulating flange 20a electrically insulates the annular backing element 19 from the rear portion 7 and functions as a compression element between the flange 19a of the backing element 19 and the shoulder 7a whereby the backing element 19 is restrained from rearward movement by the shoulder 7a.

Immediately forward of the nut 14 an electrically conductive collar 21 is placed on the insulating sleeve 15 carried by the inlet member 13. The rear end of the collar 21 is in abutment and electrical contact with the nut 14 and is provided with a flange 21a. An electrical insulating collar 22 is mounted on the periphery of the collar 21 and has a flange 22a interposed between the flange 21a of the collar 21 and the internal flange 7b of the rear portion whereby the collar 21 is electrically insulated from and yet restrained from forward movement by the flange 7b. The nut 14 is, of course, screwed forwardly on the screw threads 13c of the inlet member 13 so as to tighten up the entire above described assembly carried by the rear portion 7 and associated with the inlet member 13.

A tubular fluid conducting element 23 formed of electrical resistance metal so as to constitute an electrical heating element for heating fluid contained therewithin or passing therethrough is helically coiled about the longitudinal axis of the barrel 6 in closely spaced convolutions so as to occupy the interior space of the barrel 6 between the forward end of the inlet member 13 and the rear end of the outlet member 12. The respective ends of the fluid heating element 23 are secured to the forward end of the inlet member 13 and the rear end of the outlet member 12 for support therefrom and for communication of the interior of the fluid heating element 23 with the interior space of the inlet member 13 and the recess 12a of the outlet member 12. The manner of attachment of the ends of the inlet and outlet members 13 and 12 is arranged to enable accommodation of a maximum length of tubing forming the heating element 23 for the space available and yet avoid making sharp bends in the end portions of the heating element 23 which tend to flatten, crush or close up the tubing from which the heating element 23 is made. The inlet and outlet members 12 and 13 are each bevelled at one side thereof to form surfaces 13e and 12b sloping inwardly relative to the heating element 23 and toward the longitudinal axis thereof as shown in Fig. 2. As indicated in Figs. 2 and 3 the end portions of the tubular heating element are bent to approach the respective inclined surfaces 13e and 12b in a direction substantially normal thereto, and the inlet member 13 and outlet member 12 are apertured to receive the endmost portions of the heating element 23 and place the interior thereof in communication with the interior space of the inlet member 13 and the recess 12a of the outlet member 12. The end portions of the heating element 23 are secured and sealed to the inlet and outlet members 13 and 12 by suitable means such as soldering or brazing.

It is to be noted that the rear end of the heating element 23 is electrically connected to the inlet element 13 and hence is electrically connected to the conductive collar 21 through the nut 14. An electrical conductor 24 extending through the central space of the coiled heating element 23 is connected at its respective ends to the forward portion of the heating element 23 and the conductive ring 16. To provide access of the electrical conductor 24 to the ring 16 and electrical clearance between the conductor 24 and the flange 13b of the inlet member 13, the flange 13b and the insulating flange 15a, as shown in Fig. 3,

are each cut away at opposite sides thereof so as to have a generally rectangular peripheral shape.

From the above description it should be apparent that the ring 16 and collar 21 constitute electrical terminals for the respective ends of the coiled electrical fluid heating element 23. The respective electrical conductors 25a of a flexible electric cord 23 are electrically connected to the ring 16 and collar 21 to serve as means for conducting electrical energy to the device. To accommodate entrance of the cord into the device the rear portion 7 of the shell and the insulating lining 29 therefor are apertured, as shown in Fig. 1, and a bushing 26 is provided in the apertured portions thereof.

In connection with the cord 25 it is important that the same be relatively small, light and flexible to enable convenient use of the device without the device being impeded in manipulation thereof to an objectionable extent by the cord. In a device of the general type described, the use of a cord acceptable from the standpoint of convenience in manipulation involves a serious problem in that a tubular combined fluid duct and heating element is inherently an electrical device which operates on a relatively heavy current at a relatively low voltage and hence to obtain the necessary input in watts would require a relatively heavy electrical cord. The device, to be readily manipulatable, must be compact and hence there will not be much space therewithin for the heating element. To enable use of a relatively long tube forming the heating element, this tube may be helically coiled to form closely spaced convolutions. To further increase the length of tube which may be accommodated in a given space there has been devised the previously described manner of connection of the ends of the heating element 23 to the inlet and outlet members 13 and 12 which enables use of one or more additional convolutions of the tube 23 in a given space without undesirably sharp bends being necessary in the tube. In this manner I have been able to increase the voltage and reduce the current for the required input in watts to a point enabling a smaller sized cord 25 than could otherwise be used with a device of the same dimensions.

The corrugated rear end of inlet member 13 enables telescoping thereon of a tubular contractile fluid conducting element of any suitable type. In the case where the device is desired to be used in the manner of a syringe rather than being supplied with fluid from a source of the same under pressure, a rubber syringe bulb such as the bulb 27 may be placed on the rear end of the inlet member 13. As illustrated in the drawing, there is provided a rubber sleeve placed on the inlet member 13 and on which the neck of the bulb 27 is telescoped. The rearmost part of the rear portion 7 of the shell of the device is provided with a snugly fitting tubular lining 29 formed of electrical insulating material.

All electrically energized portions of the device are electrically insulated from the shell of the device. In this connection it is to be noted that the inlet member 13 serves the dual function of conducting both fluid and electrical current to the rear end of the tubular heating element 23 and hence is electrically alive during use of the device. However, the rear end of the inlet member 13 is rendered inaccessible from the exterior of the device by the electrical insulating material from which the bulb 27 and sleeve 28 are made.

The barrel 6 of the shell of the device may, if desired, be provided with a circumferentially extending series of spaced, longitudinally extending ventilating slots 6a as indicated in Figs. 1 and 3.

Referring now to Figs. 4 and 5, there is illustrated an embodiment of the invention particularly adapted for use where it is desired to supply fluid to the device from a source of fluid under pressure rather than to use the device in the manner of a syringe. The construction of this form of the device is generally similar to that of the previously described form except for provision of a fluid controlling valve and a common conduit assembly for fluid and electrical current, and a slightly different arrangement of certain details of the device.

A shell is provided having a forward end shown uppermost in the drawing and including a tubular slotted barrel 30, an internally threaded sleeve 31 screwed at its forward end onto the rear end of the barrel 30, a tubular rear portion screwed at its forward end into the rear end of the sleeve 31, and a head 33 screwed into the forward end of the barrel 30.

The head 33 has a diametrical aperture 33a therethrough and the portions of the head 33 defining the apperture 33a are internally threaded at both ends of the aperture. The head 33 also has an axial aperture 33b therein extending from the rear side thereof to the aperture 33a, the rear portion of the aperture 33b being of enlarged diameter and defined by an internally threaded portion of the head 33.

A longitudinally apertured nozzle-carrying member 34 is externally threaded at its inner end whereby it is threadedly mounted in one of the threaded portions of the head 33 defining the diametrical aperture 33a. A nozzle 35 is connected at its inner end to a hollow element 36 by means of a ferrule 37 screwed onto the hollow element 36 and containing an enlarged inner end portion of the nozzle 35. The outer end of the member 34 is tapered and the inner end of the hollow element 36 is apertured in a tapered manner so as to fit on the tapered end of the member 34. The periphery of the element 36 is provided with an annular groove 36a receiving the tines of a forked resilient clip 38 which is swingably connected by means of a pivot 38a to an element 38b mounted on the member 34. The clip 38 constitutes releasable means for holding the hollow element 36 on the tapered free end of the member 34. It should be apparent that the fluid passage of the nozzle 35 is in communication with the axial aperture 33b of the head 33.

Means is provided for controlling flow of fluid from the aperture 33b to the nozzle 35. For this purpose a valve seat 34a encircling the interior passage of the member 34 is formed in the inner end portion of the member 34 and a valve element 39 is carried on a valve stem 39a slidably carried in a valve stem guide comprising a centrally apertured threaded plug 40 screwed into the remaining end of the aperture 33a. A helical compression spring 41 for normally maintaining the valve 39 in closed position is disposed between the valve element 39 and the valve stem guide plug 40 in helically encircling relation with the valve stem 39a. The free end of the valve stem 39a is connected by means of a pivot 42 to the forward end of a double armed valve operating lever 43 which is swingably mounted in its medial portion on a pivot 44 carried by apertured ears 45a formed on a collar 45 encircling and secured to the barrel 30 and rear portion of the head 33 at the junction therebetween. Deflection of the rear arm of the operating lever 43

toward the barrel 30 will open the valve 39 and the spring 41 will close the valve 39 upon release of the lever 43.

An externally and internally threaded bushing 46 formed of electrical insulating material is screwed into the enlarged rear portion of the axial aperture 33b of the head 33 to tightly abut the portion of the head 33 defining the forward end of the enlarged diameter rear part of the aperture 33b. The bushing 46 is of such length as to project rearwardly of the portion of the rear end of the head 33 adjoining the bushing 46. A member having a reduced diameter externally threaded forward portion is screwed into the bushing 46 with the shoulder between the full and reduced diameter portions thereof bearing against the rear side of the bushing 46. The screw-threaded forward portion of the member 47 is shorter than the bushing 46 in order to provide electrical clearance between the forward end of the member 47 and the head 33. The member 47 is provided with a recess therein extending axially thereof from the forward end thereof to a point a short distance forwardly of the rear end thereof.

A tubular fluid inlet element 48, disposed coaxially within the sleeve 31, projects short distances therefrom forwardly into the interior of the barrel 30 and rearwardly into the interior of the rear portion 32 of the shell of the device. The forward end of the inlet element 48 is closed by a front end wall 48a and a radially outwardly projecting annular flange 48b is formed on the periphery of the inlet element 48 a short distance rearwardly of the forward end thereof. The medial portion of the inlet element 48 is threaded and carries thereon a nut 49. The rear end portion of the inlet element 48 is provided with a series of longitudinally extending annular corrugations 48c.

The flange 48b is cut away at diametrically opposite sides in substantially the same manner as the flange 13b of the first described form shown in Fig. 3. Immediately behind the flange 48b a washer 50 formed of electrical insulating material and of generally rectangular peripheral shape is placed on the inlet element 48 and is folded forwardly over the flat edge portions of the flange 48b to form forwardly projecting ears 50a. From the washer 50 to the nut 49 the medial portion of the inlet element 48 is sheathed in a sleeve 51 formed of insulating material. The barrel 30 is provided throughout the major portion of its length with a tubular lining 52 formed of heat insulating material and in its rearmost portion with a lining consisting of a collar 53 formed of electrical insulating material.

Behind the insulating washer 50 an electrically conductive ring 54 is placed on the insulating sleeve 51 with its outer periphery closely adjacent the inner periphery of the rearmost portion of the insulating collar 53. From the rear edge of the insulating collar 53 to a point a short distance forwardly of the forward end of the rear portion 32 of the shell of the device the sleeve 31 is provided with a lining sleeve 55 formed of electrical insulating material and having a rearwardly facing shoulder in its inner peripheral surface a short distance rearwardly of the rear end of the insulating collar 53.

An electrically conductive sleeve 56 extends from the rear side of the conductive ring 54, with which it is in electrical contact, to a point somewhat rearwardly of the nut 49. The forwardmost portion of the sleeve 56 is of such an internal diameter as to snugly encircle the insulating sleeve 51 and the remaining portion is of increased diameter to provide a substantial radial clearance from the insulating sleeve 51 and the nut 49. The external periphery of the conductive sleeve is stepped in diameter to correspond to the internal peripheral shape of the insulating sleeve 55 and to produce a forwardly facing shoulder abutting the rearwardly facing shoulder of the insulating sleeve 55 to be restrained thereby from forward displacement. The forward end of the insulating sleeve 55 abuts the rear end of the barrel 30 and is restrained thereby from forward displacement. A rearwardly flanged washer 57 formed of electrical insulating material is mounted on the insulating sleeve 51 immediately forwardly of the nut 49 and the flange thereof constitutes an insulating lining for the increased diameter rear portion of the conducting sleeve 56. It should be apparent that the outlet member 47 and the inlet element are both mechanically supported from and electrically insulated from the shell of the device.

A helically coiled tubular combined fluid duct and electrical heating element 58 similar to the corresponding element 23 of the first described form of the device is disposed in the interior space of the shell 50 and is connected at its ends to the outlet member 47 and inlet element 48 in substantially the same manner as described in connection with the first described form of device. An electrical conductor 59 is connected between the forward portion of heating element 58 and the electrically conductive ring 54 whereby the ring 54 constitutes an electrical terminal for the forward portion of the heating element 58. The inlet element 48 serves not only as means for conducting fluid into the heating element 58 but also as an electrical terminal for the rear end of the heating element 58.

The device of Figs. 4 and 5 is constructed for use therewith of fluid from a source thereof under pressure and consequently both fluid and electrical energy must be conducted to the part within the shell of the device. For this purpose there is provided a common conduit unit for both fluid and electrical energy. A fluid conducting tube 60 of flexible electrical insulating material such as rubber is snugly telescoped onto the rear end of the inlet element 48 for delivery of fluid therethrough to the rear end of the heating element 58. The remaining end of the tube 60 is snugly telescoped onto one end of a tubular electrically conductive element 61 of the remaining end of which is adapted to be connected to a source of fluid under pressure. The medial portion of the tubular element 61 is provided with a flange 61a rearwardly of which the periphery of the tubular element is externally screw-threaded and carries a nut 62. An end portion of an electrical conductor such as the wire 63 may be clamped between the nut 62 and the flange 61a. Within the tube 60 an electrical conductor, preferably of relatively flexible nature, extends between and is electrically connected at respective ends to the inlet element 48 and the tubular element 61 whereby an electrical circuit from the wire 63 to the rear end of the heating element 58 is completed.

The tube 60 is provided with an electrically conductive flexible sheath 65 which may be constructed of a plurality of small wires braided into a tubular structure. The rear end of the conductive sheath 65 is terminated a short dis-

tance forwardly of the flange 61*a* and is connected to an electrical conductor such as the wire 66. Just short of the forward end of the rubber tube 60 an electrically conductive washer 67 having substantially the same external diameter as the rear end of the conductive sleeve 56 is mounted on the sheath 65 which, at its forward end, is terminated at and both mechanically and electrically connected to the washer 67. Just rearward of the washer 67, is a washer 68 closely encircling the periphery of the sheath 65 and having such an external diameter as to fit closely in the sleeve 31 of the shell of the device. The central portion of the insulating washer 68 is provided with a rearwardly projecting flange 68*a* covering a portion of the sheath 65 immediately therebehind. A peripherally screw-threaded washer 69 fitting the internal screw-threads of the sleeve 31 of the shell of the device is disposed immediately to the rear of the insulating washer 68 with the flange 68*a* projecting through the washer 69. Screwing the washer 69 forwardly draws the conductive washer 67 into abutment and electrical contact with the rear end of the conductive sleeve 56 to complete an electrical circuit from the wire 66 to the forward portion of the heating element 58. A flexible tubular outer covering 70 formed of electrical insulating material is placed on the above described conduit unit over the conductive sheath 65 to electrically insulate the sheath 65 from the rear portion 32 of the shell of the device and from any object with which the conduit unit might come into contact. The conduit unit described above eliminates the need for separate fluid and electrical conduit units and furthermore enables the fluid conducting tube of the conduit unit to provide an additional function in that it constitutes the insulation required between the respective electrical conductors 64 and 65 and hence eliminates the weight and bulk which would be involved if separate electrical insulating means were provided.

What I claim is:

1. A heating apparatus comprising a tubular shell including spaced apart walls, a fluid conveying member fixed in each of said walls and insulated therefrom, one of said fluid conveying members being situated entirely within said tubular shell, an electrical resistance element constituted as a tubular entity within said shell and having a longitudinally extending passageway through which a fluid is adapted to be made to flow, the opposite end portions, respectively, of said electrical resistance tubular entity being secured to said fluid conveying members, respectively, in fluid conveying relation to said members, and means including at least one of said fluid conveying members for applying electrical current to said element.

2. A heating apparatus comprising a tubular shell including spaced apart walls, a fluid conveying member fixed in each of said walls and insulated therefrom, an electrical resistance element constituted as a tubular entity within said shell and having a longitudinally extending passageway through which a fluid is adapted to be made to flow, the opposite end portions, respectively, of said electrical resistance tubular entity being secured to said fluid conveying members, respectively, in fluid conveying relation to said members and said electrical resistance tubular entity being in current conducting relation to one of said members, an electrical conductor connected to said last mentioned member, and a second electrical conductor connected to said element.

3. A heating apparatus comprising a tubular shell including spaced apart walls, a first fluid conveying member fixed in one of said walls and insulated therefrom, a second fluid conveying member fixed in another of said walls and insulated therefrom, an electrical resistance element constituted as a tubular entity within said shell and having a longitudinally extending passageway through which a fluid is adapted to be made to flow, the opposite end portions of said electrical resistance tubular entity being secured to said first and second fluid conveying members, respectively, in fluid conveying relation to said members, and means for applying current to said electrical resistance element including said second fluid conveying member as a part thereof, a conductor connected to the second fluid conveying member, and a second conductor insulated from said second fluid conveying member and connected directly to said electrical resistance element at location adjacent said first fluid conveying member.

4. A heating apparatus comprising a tubular shell, a first fluid conveying member fixed at the interior of said shell and insulated therefrom, a second fluid conveying member fixed in said shell in spaced relation to said first fluid conveying member, said second fluid conveying member being insulated from said shell and accessible at the exterior thereof, an electrical resistance element constituted as a tubular entity within said shell and having a longitudinally extending passageway through which a fluid is adapted to be made to flow, the opposite end portions of said electrical resistance tubular entity being secured to said first and second fluid conveying members, respectively, in fluid conveying relation to said members, and means for applying current to said electrical resistance element, said means including said second fluid conveying member as a part thereof, a conductor connected to the second fluid conveying member and insulated from the shell, and a second conductor extending inwardly of the shell and directly connected to said electrical resistance element at location adjacent said first fluid conveying member, said second conductor being insulated from said shell and from said second fluid conveying member.

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