

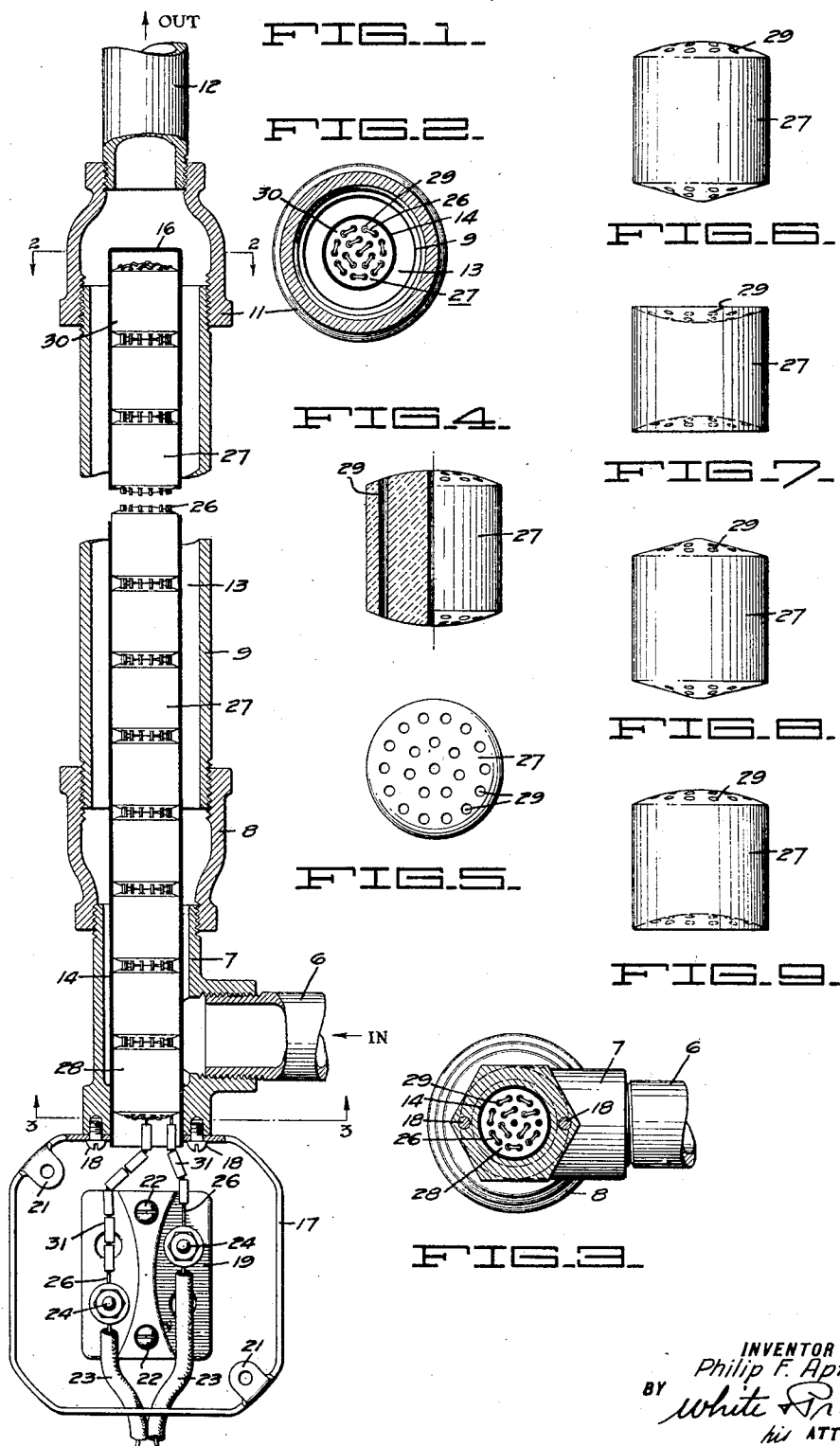
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P. F. APFEL

ELECTRIC HEATER

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UNITED STATES PATENT OFFICE.

PHILIP F. APFEL, OF SEATTLE, WASHINGTON.

ELECTRIC HEATER.

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My invention relates to electric heaters of the resistance type primarily for use in heating a current of fluid such as air or water, and relates particularly to the manner of arranging the resistance element in the heater.

An object of my invention is to provide an electric heater in which the resistance element is well insulated electrically.

Another object of my invention is to provide an electric heater in which the resistance wire and its cooperating insulators are somewhat flexible.

A further object of my invention is to provide a heating element for an electric heater in which a large amount of resistance wire may be compacted into a small space.

A further object of my invention is to provide a plurality of perforated insulators thru which the resistance wire can be easily threaded.

The invention possesses other advantageous features, some of which with the foregoing will be set forth at length in the following description where I shall outline in full that form of the electric heater of my invention, which I have selected for illustration in the drawings accompanying and forming part of the present specification. In said drawings I have shown one form of electric heater embodying my invention, but it is to be understood that I do not limit myself to such form since the invention, as set forth in the claims, may be embodied in a plurality of forms.

In the drawings:

Fig. 1 is a section on the median plane of a heater embodying my invention.

Fig. 2 is a cross section on the line 2—2 of Fig. 1.

Fig. 3 is a cross section on the line 3—3 of Fig. 1.

Fig. 4 is, on the left half, a section on the median plane of one of the insulators shown in Fig. 1, and, on the right half, is an elevation of one of the insulators of Fig. 1.

Fig. 5 is an end view of the insulators shown in Fig. 4.

Figs. 6, 7, 8 and 9 are modified forms of insulators.

My invention preferably comprises a resistance element for an electric heater including an electrically continuous conductor threaded thru a plurality of perforations in each of several serially arranged insulators.

The embodiment of my invention shown in the drawings is primarily for use in heating water and includes a nipple 6 attached to the

water supply and threaded into a T 7. To the upper threaded end of the T a reducer 8 is screwed and supports a housing pipe 9. A similar reducer 11 is attached to the upper end of the housing pipe and leads to an outlet nipple 12. An enlarged chamber 13 is thus formed between the inlet 6 and the outlet 12.

Means are provided for electrically heating the water or other fluid flowing thru the chamber 13. A thermally conductive tube 14 having a closure 16 at one end thereof is pressed into or otherwise affixed to the T 7 at its other end. Copper or another highly conductive metal is suitable material for the tube. The lower open end of the tube 14 communicates with an outlet box 17 of the standard type which is held to the lower end of the T 7 by means of suitable screws 18. Tabs 21 are provided on opposite corners of the outlet box 17 for attachment of a cover, not shown. An insulating block 19 of porcelain or comparable material is held to the box 17 by screws 22. Conductors 23 of electrical current enter the conduit box 17 at a convenient point and are secured by suitable bolts and nuts 24 on the porcelain block 19. The resistance element preferably comprises an electrically continuous conductor 26 which is secured at one end to one of the bolts 24 and, after passing thru a plurality of cylindrical bead insulators 27, enters the first of a series of insulators 28.

Each of the insulators 28 preferably comprises a cylindrical body made of electrically non-conducting material, such as porcelain, and provided with convex ends. Passing thru each of the cylindrical insulators 28 and preferably in substantial parallelism with the central axis thereof are a plurality of perforations 29 usually of circular cross section. The serially arranged insulators 28 are each provided with the same number of perforations 29 and are arranged within the tube 14 with the corresponding perforations in approximate alinement. The electrical conductor 26 enters a perforation in the first insulator 28, passes thru the corresponding perforations in the series of insulators carried within the tube 14 and emerges from the top insulator 30. It is then doubled back upon itself and is threaded in the opposite direction thru another alined series of perforations, an adjacent series preferably being used. When the conductor 26 emerges from the lower insulator 28 it is again doubled back upon itself and threaded thru an adjacent series of perfo-

5 rations 29, in the original direction. The
 conductor is threaded back and forth until it
 has filled all of the perforations 29 and pro-
 10 jects from the bottom insulator 28. The man-
 ner of threading the conductor thru the insu-
 lators is illustrated in Figs. 1, 2 and 3. Sev-
 eral insulating beads 31 are slipped over the
 projecting portion of the wire 26 and the end
 15 is secured beneath the nut 24 securing the
 other of the pair of conductors 23. By the use
 of the insulating beads 28 each of which is
 provided with a plurality of perforations, the
 electrical conductor 26 is thoroughly insulated
 20 from electrical contact with surrounding
 metal parts but is free to radiate a large
 amount of heat.

The convex ends on the adjacent insulators
 permit the wire which is being threaded there-
 thru to adjust itself slightly to allow for any
 20 misalignment of the corresponding perfora-
 tions 29 and also permit portions of the wire
 to be exposed and radiate heat directly to the
 conducting tube 14. The irregular ends also
 permit a certain amount of flexibility in the
 25 complete resistance element so that it can
 adapt itself readily to variations in contour
 or alinement of the conducting tube 14. Prefer-
 ably the insulators 27 are made of sufficient
 diameter to make a snug fit within the tube 14
 30 and maintain their position by frictional con-
 tact with the walls of the tube, eliminating
 extraneous supporting means. It is consid-
 ered preferable to have the conductor 26 a con-
 tinuous wire passed back and forth through
 35 the serially arranged insulators as has been
 described, but it is understood that the wire
 may not be mechanically continuous but can
 be several sections united to form an electri-
 cally continuous conductor.

40 Other forms of insulators such as those

shown in Figs. 6 to 9, inclusive, may be used
 upon occasion when the conditions warrant
 it to vary the amount of exposed conducting
 wire, the flexibility of the complete resist- 45
 ance unit and the ease of threading the insu-
 lators. The various individual insulators
 making up the series included in the heating
 element may all be of similar configuration, or
 they may be of different forms. For in- 50
 stance, the insulator shown in Fig. 6 can be
 used in conjunction with the insulator shown
 in Fig. 7. Various combinations of the dif-
 ferent forms of insulators will suggest them-
 selves as being specially advantageous in va- 55
 rious circumstances.

I claim:

1. An electric heater comprising an outer
 fluid circulating housing having an inlet at
 one end and an outlet at the other end, an in- 60
 ner spaced, concentrically disposed conduct-
 ing sleeve mounted at one end of the housing,
 said sleeve being closed at one end, spaced
 apertured insulating discs frictionally en-
 gaged within said sleeve and a resistance ele- 65
 ment threaded through the apertured discs.

2. An electric heater comprising an upright
 tube closed at its upper end; a flexible electric
 heating element including a plurality of sub-
 stantially axially alined insulators friction- 70
 ally retained within said tube; each of said
 insulators being provided with a plurality of
 perforations extending therethrough, and a
 single resistance wire passing a plurality of
 times back and forth through each insulator,
 the wire being exposed between successive in- 75
 sulators whereby the element may be flexed.

In testimony whereof I have hereunto set my hand.

PHILIP F. APFEL.