(No Model.) 2 Sheets—Sheet 1.

E. E. GOLD.

ELECTRIC HEATER.

No. 600,417. Patented Mar. 8, 1898.

FIG. 1.

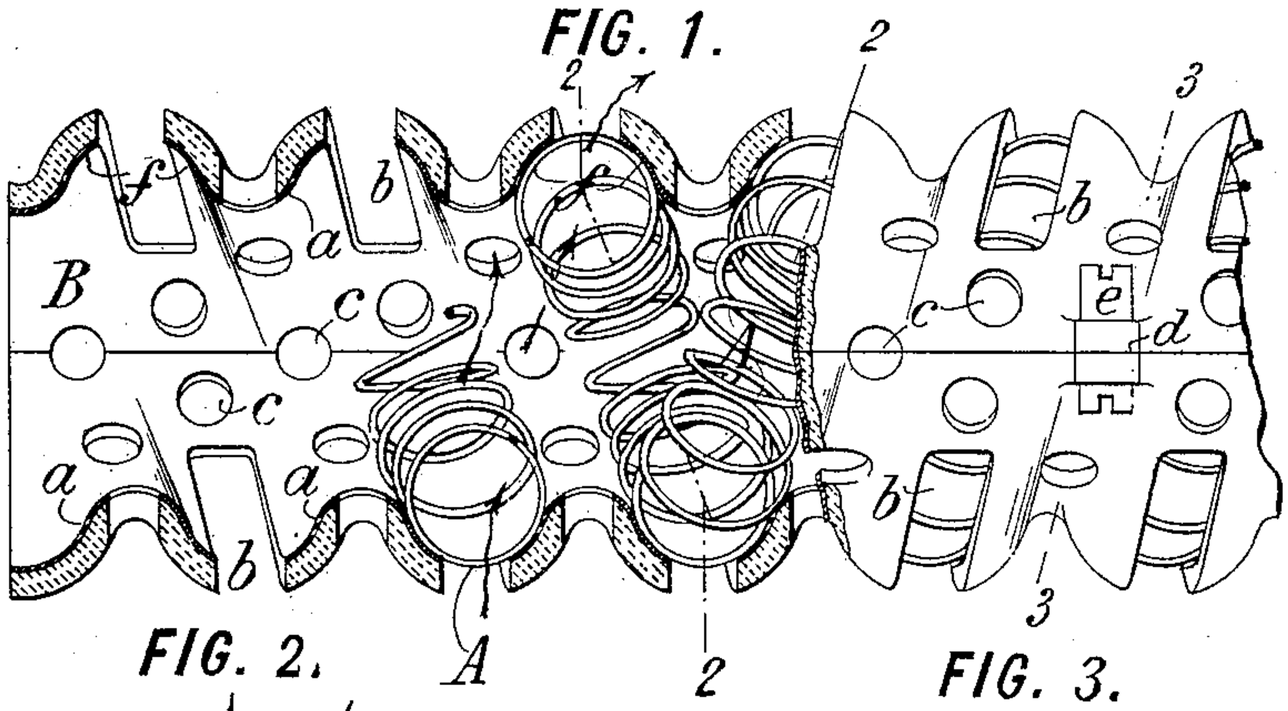


FIG. 2.

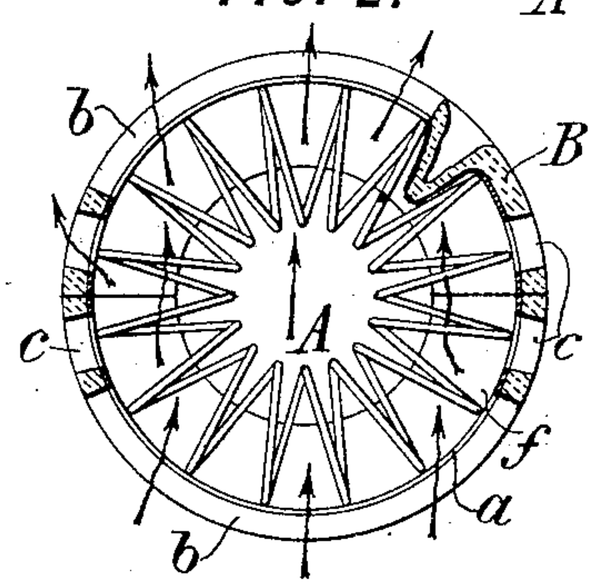


FIG. 3.

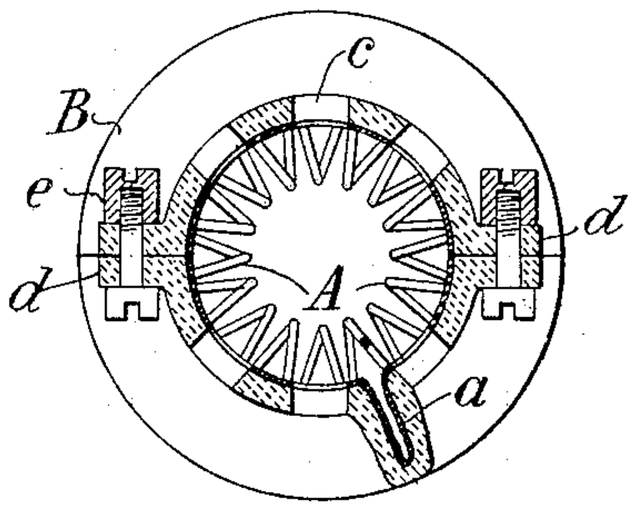


FIG. 4.

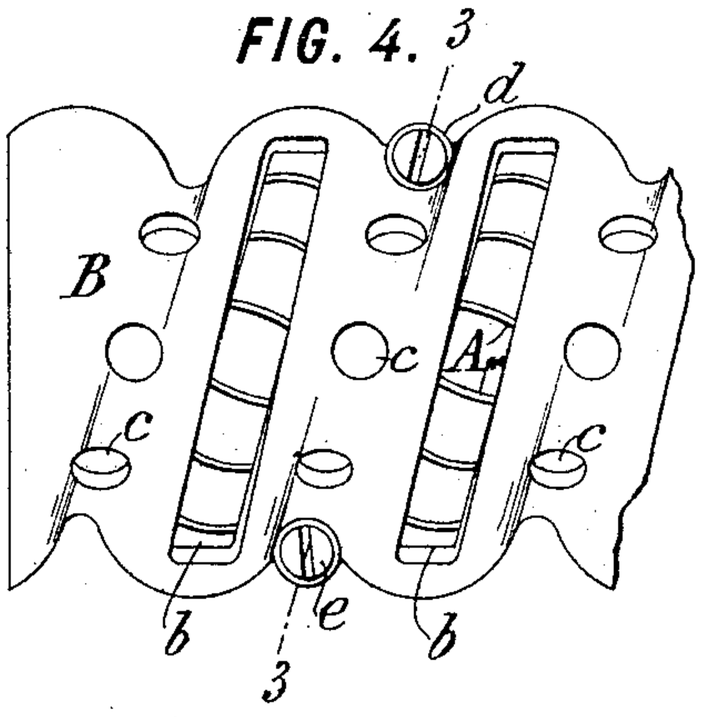


FIG. 5.

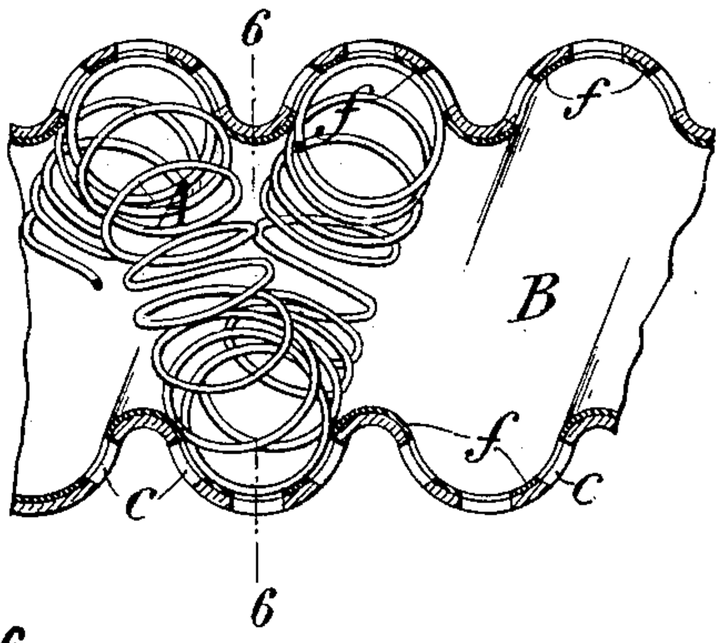
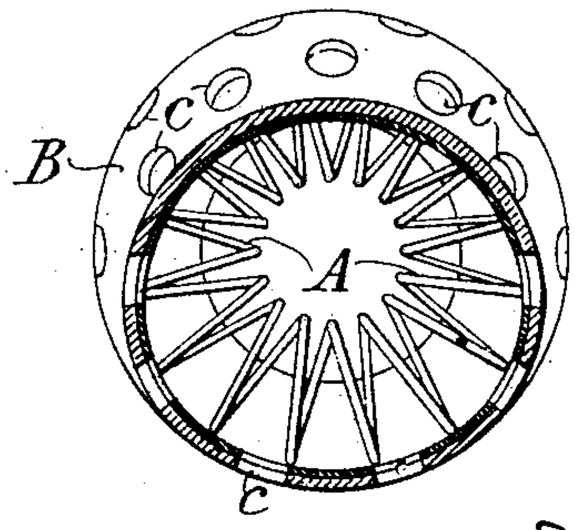


FIG. 6.



WITNESSES:

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(No Model.) 2 Sheets—Sheet 2.

E. E. GOLD.

ELECTRIC HEATER.

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FIG. 7.

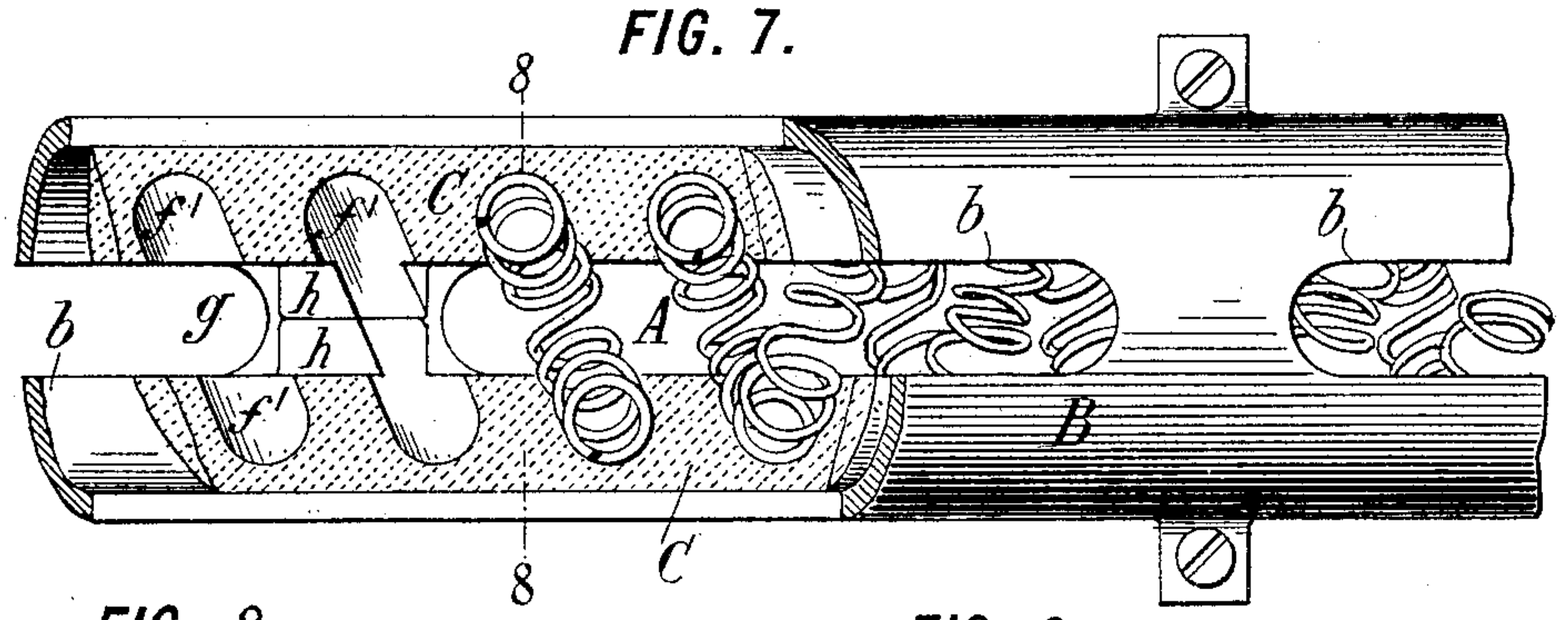

FIG. 8.

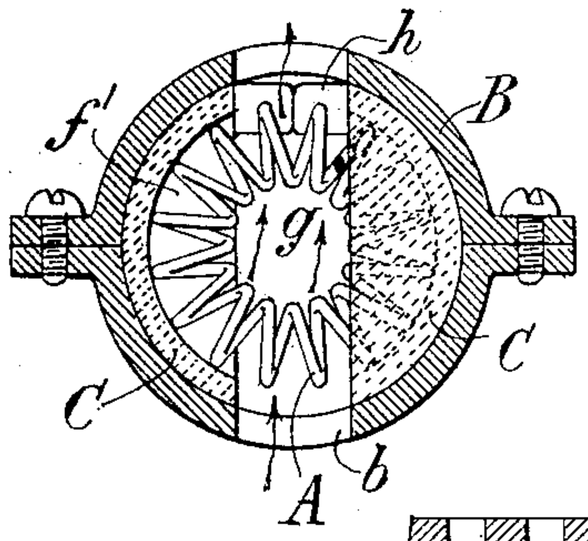

FIG. 9.

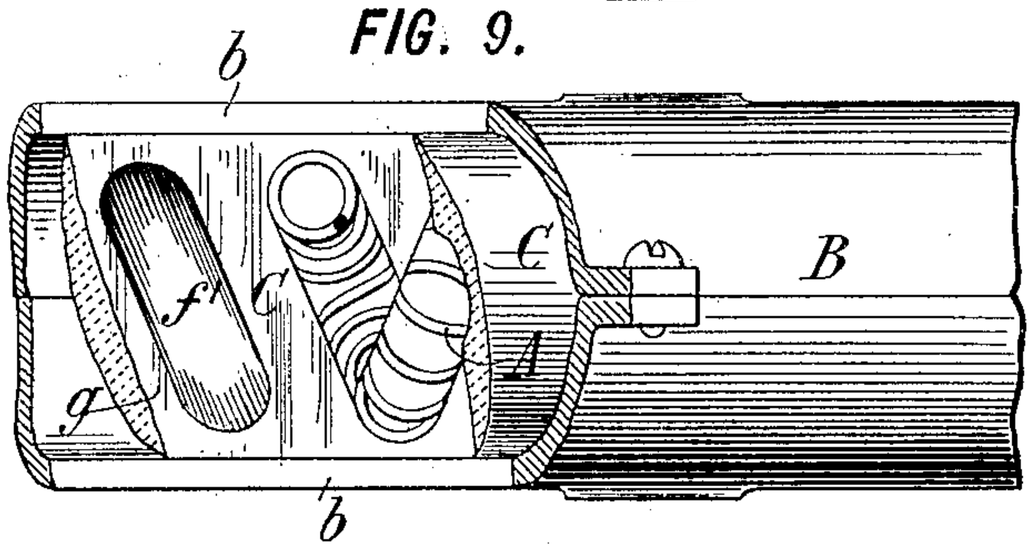

FIG. 10.

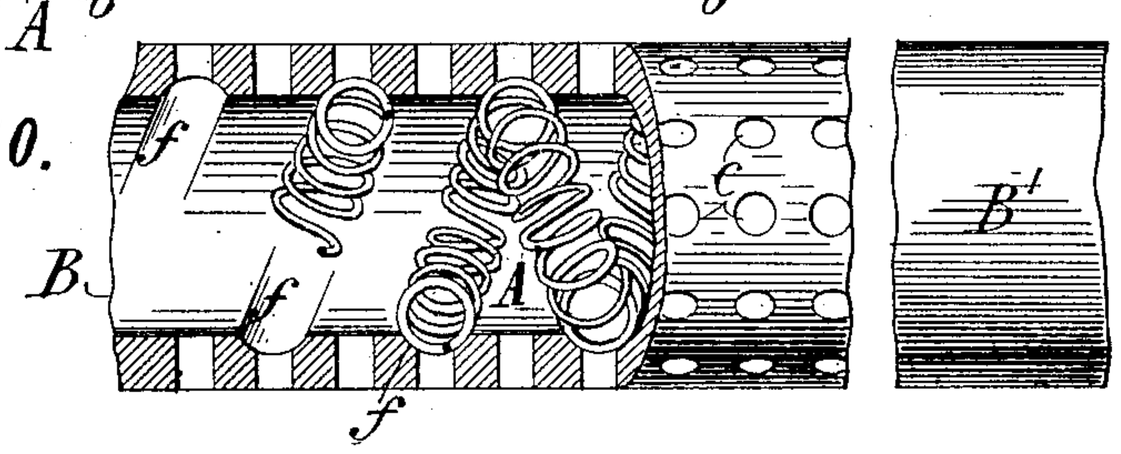

FIG. 10.[a]

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UNITED STATES PATENT OFFICE.

EDWARD E. GOLD, OF NEW YORK, N. Y.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 600,417, dated March 8, 1898.

Application filed August 12, 1897. Serial No. 647,950. (No model.)

To all whom it may concern:

Be it known that I, EDWARD E. GOLD, a citizen of the United States, residing in the city, county, and State of New York, have invented certain new and useful Improvements in Electric Heaters, of which the following is a specification.

This invention relates to electric heaters of that class wherein the heat is generated by the passage of an electric current through a resistant wire which gives off the heat to the air or other fluid surrounding it, such fluid being kept in motion or permitted to circulate in order that it may be effective in conducting away the heat from the wire.

According to my invention I place a coil or helix of resistant wire within an insulating tubular casing or support, the convolutions of the wire being spaced apart, so as to be out of contact, and the wire being naked or substantially uncovered, so as to afford no obstacle to the rapid conduction or radiation of heat to the surrounding air. The casing may be made of insulating material, or, preferably, it may be made of metal and coated with some insulating material, such as enamel. The casing is of open-work or skeleton form, being preferably perforated or slotted to permit a free and rapid circulation of air through the tube and between the convolutions of the coil. In my preferred construction the tubular casing is internally spirally grooved or corrugated, and the wire is wound in a helix whose diameter is considerably less than the internal diameter of the tube, this helix being wound helically within the internal spiral groove in the tube, so as to be held therein by its tendency to expand.

Figure 1 of the accompanying drawings is a sectional side view of one construction embodying my invention, the heater being dissected to show the construction. Fig. 2 is a transverse section in a spiral plane denoted by the line 2 2 in Fig. 1. Fig. 3 is a transverse section in a spiral plane denoted by the lines 3 3 in Figs. 1 and 4. Fig. 4 is plan view. Fig. 5 is a fragmentary vertical mid-section, and Fig. 6 a transverse section of a modified construction. Fig. 7 is a plan, partly in horizontal section and partly dissected, showing another construction embodying my invention. Fig. 8 is a transverse section of Fig. 7 on the line 8 8 therein. Fig. 9 is a side elevation thereof, partly broken away or dissected. Fig. 10 is a sectional and dissected elevation of a further modification, and Fig. 10^a an elevation of another.

In all the figures let A designate a coil or helix of resistant wire, and B the inclosing and insulating tubular casing or support for the resistant helix.

I will first describe the construction shown in Figs. 1 to 4. Here the tubular support consists of a tube or casing B, made of any suitable material—for example, cast metal—with its inner surface provided with an insulating-coating *a* of any suitable insulating material, preferably enamel. This coating of course may extend more or less toward the exterior or may cover also the exterior; but it is only essential that it shall be applied on the interior where the tube comes in contact with the coil. The insulating-coating is applied to the tube in preference to the wire of the coil in order to leave the latter naked to thereby enable it to better radiate heat.

The tube B is perforated at intervals in any suitable way, as by means of long slots *b b* at top and bottom and round holes *c c* at intervals, as shown. The tube B is shown as being made in two sections, an upper and a lower section, which at intervals are provided with ears *d*, which are joined together, as best shown in Fig. 3, by means of screw-bolts and nuts *e*. This divided construction of the tube facilitates casting in case of a cast-metal tube and also contributes to the ease of assembling the heater. The coil A is formed by winding the resistant wire upon a mandrel of suitable diameter, thereby forming the wire into a helix and then winding this helix spirally or helically and inserting the helically-coiled helix or compound helix within the tube B, as clearly shown. For clearness I will designate the coil into which the wire is first wound on the mandrel as the "minor" helix and the larger spiral formed by coiling this helical coil as the "major" helix, the combination of the two constituting a compound helix. The tube B is constructed with an internal spiral groove or corrugation *f* of depth and width conforming more or less closely to the diameter of the minor helix. The conformation of the spiral groove corre-

sponds to the spiral of the major helix, and the pitch thereof is such as to bring the successive convolutions of the major helix somewhat close together while insuring against their coming into contact, the proportions shown in Fig. 1 being considered preferable. The wire is coiled somewhat openly in forming the minor helix and its spring tension is such as to force the convolutions thereof apart, so that the major helix as a whole tends to expand and by reason of this tension forces itself firmly into the spiral groove *f*. The wire is thus held in place in the tubular casing by its own resiliency and without requiring any means of attachment.

When a sufficient electric current is passed through the wire to heat it, the air in the casing is thereby heated and set into circulation and a constant rising current of air is maintained, as indicated by the arrows in Fig. 2.

My improved heater is well adapted for the heating of electric street-cars and the like, being mounted or supported in any suitable way under the seats thereof and the ends of the wire coil being connected through any suitable controlling-switch in the circuit in the manner well understood. My invention enables a maximum length of resistant wire to be disposed safely and conveniently in a minimum space by means of a construction of the utmost simplicity.

It is not necessary that the tubular casing be made in halves or otherwise divided, as it may be made integral, as shown in Figs. 5 and 6. In this example the tube B may be understood as being made of sheet metal rolled into corrugated form, as shown, and suitably perforated at intervals. It is coated with an insulating glaze or enamel such as is used for sheet-metal culinary ware.

The construction shown in Figs. 7, 8, and 9 embodies a cylindrical tube B, devoid of spiral grooves, and a compound resistant helix A with intervening insulating-lining C, the latter consisting of two upright slabs of insulating material—such, for example, as plaster-of-paris—molded with segmental spiral grooves *f'* for receiving the major helix, with a clear space *g* between the two slabs for upward circulation of air, as shown in Fig. 8, the tube B being formed with coinciding slots *b b* at top and bottom. The insulating-slabs C C might be held apart by the outward or expanding tension of the helix A, but I prefer to provide the slabs at intervals with fingers or projections *h h*, which come together and thereby hold the slabs spaced apart.

In Fig. 10 I have shown the tube B made of earthenware, having perforations *c* at intervals and made internally cylindrical, except that it is formed with a spiral groove *f* for holding in place the helix A. This groove is here shown as made very shallow, being only sufficient to properly retain the helix in place. This construction is applicable to a heater where water or other liquid is to be heated by direct contact with a coil of wire, in which case the only difference in construction is that the tube is made imperforate, as shown at B' in Fig. 10[a].

The form or construction of the casing B may be greatly varied, it being only essential that it shall be adapted to support and inclose the coil or helix and that means be provided to prevent contact between the successive major convolutions of the latter, and in an air-heater that it shall be of foraminous or open-work structure adapted to permit free vertical flow of air through it.

I claim as my invention the following-defined novel features, substantially as hereinbefore specified, namely:

1. An electric heater comprising a helix of resistant wire coiled into a compound helix, combined with a support therefor, said helix being compressed against said support so that it exerts an expansive tendency.

2. An electric heater comprising a helix of resistant wire coiled into a compound helix, combined with an open-work or foraminous support therefor in the general form of a hollow cylinder, said helix being inclosed within said support, and having an expansive tendency, so that it presses outwardly into firm contact therewith.

3. An electric heater consisting of an open-work or foraminous insulating-casing of general tubular form, and a helix of resistant wire coiled spirally and inclosed in and supported throughout its entire length by said casing.

4. An electric heater consisting of a tubular insulating-casing, and a helix of resistant wire coiled spirally and inclosed in said casing, making continuous contact therewith and supported thereby.

5. An electric heater consisting of an insulating tubular casing having an internal spiral groove, combined with a helix of resistant wire coiled spirally, inclosed in said casing and expanded into the spiral groove thereof.

6. The combination with a spirally-corrugated insulating-tube, of a helix of resistant wire coiled spirally within said tube and lying in the spiral corrugation thereof.

7. The combination with a spirally-coiled helix of resistant wire, having an expansive tendency of an insulating tubular casing therefor having an internal spiral groove for supporting said helix, and longitudinally divided into sections, and means for fastening said sections together to embrace said helix.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

EDWARD E. GOLD.

Witnesses:
GEORGE H. FRASER,
THOMAS F. WALLACE.