No. 635,131. Patented Oct. 17, 1899.

E. E. GOLD.

ELECTRIC HEATER.

(Application filed Jan. 31, 1898.)

(No Model.)

FIG. 1.

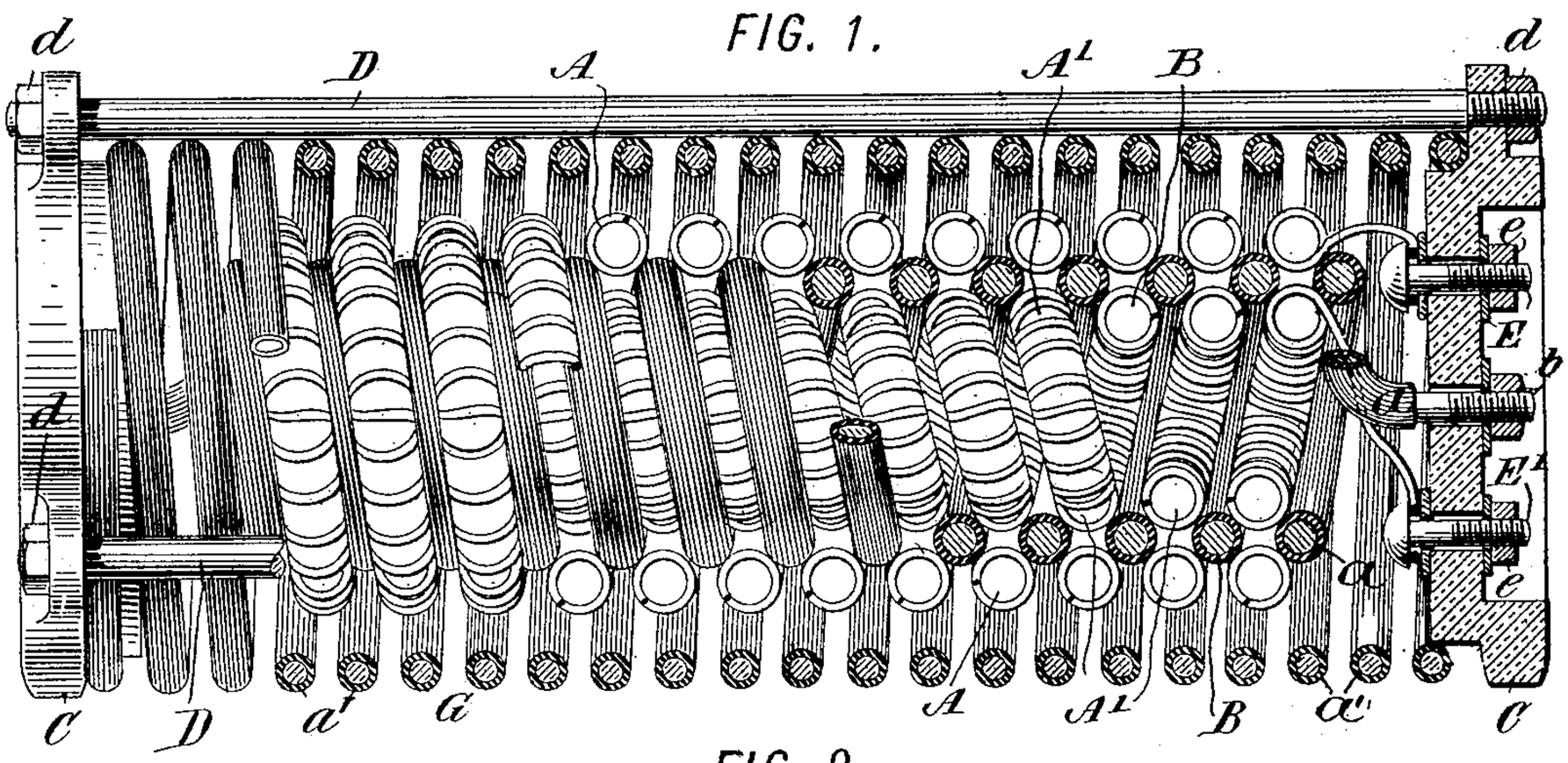


FIG. 2.

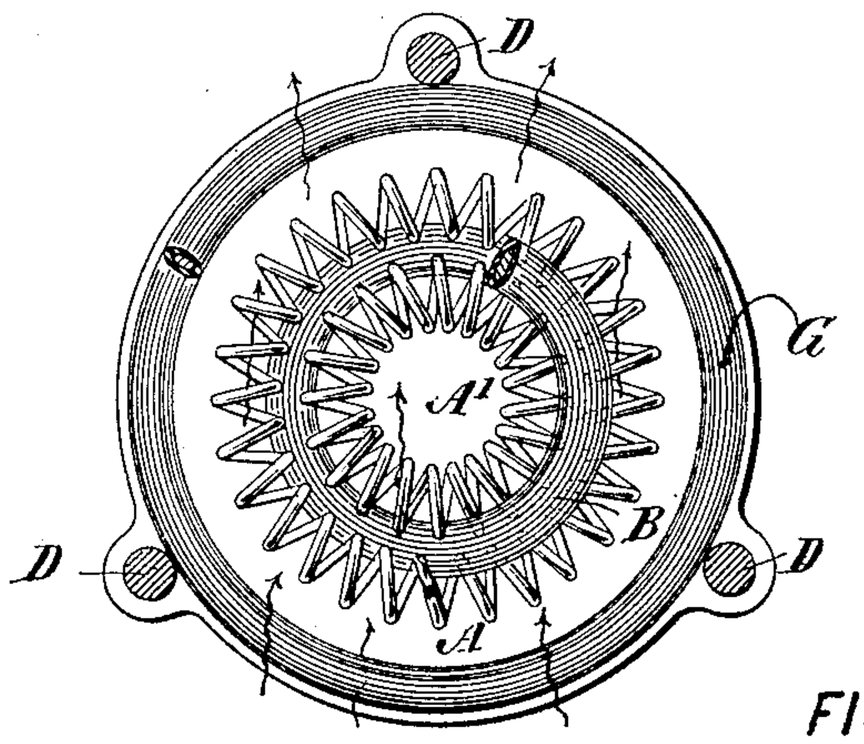


FIG. 4.

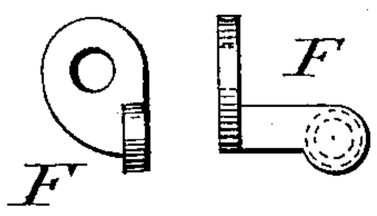


FIG. 5.

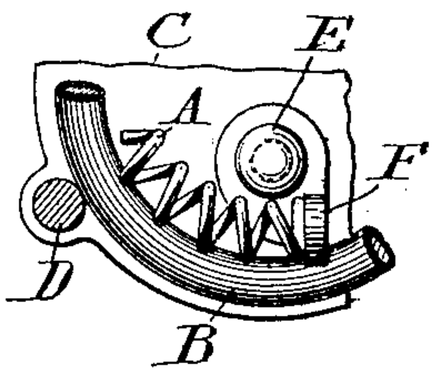
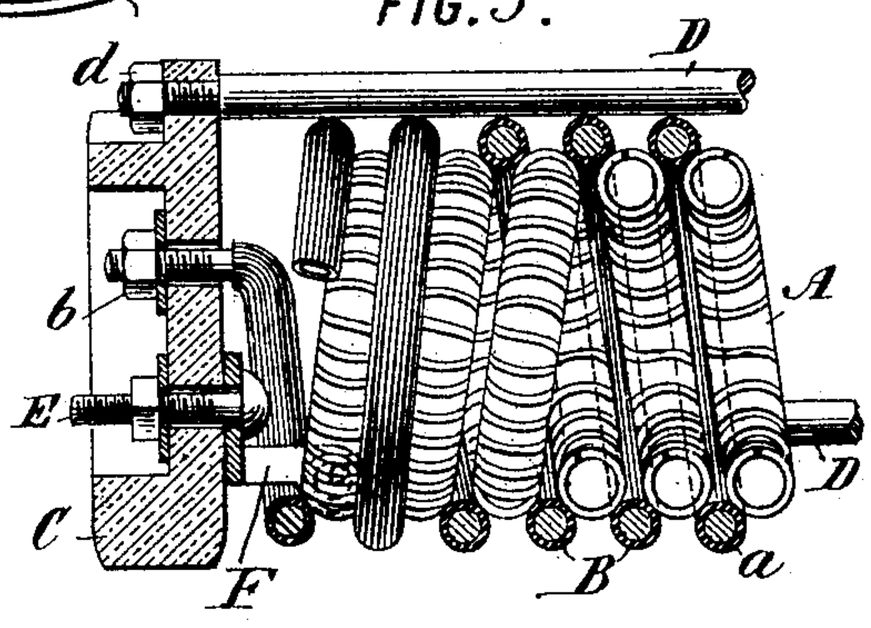


FIG. 3.



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

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 635,131, dated October 17, 1899.

Application filed January 31, 1898. Serial No. 668,528. (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 in which the heat is generated by passing an electric current through a coil or helix of resistant wire which is exposed to the air, (or other fluid,) by the circulation of which the generated heat is conducted away.

My present invention relates to means for supporting such a helix of resistant wire when such helix is wound or coiled helically into a compound helix.

My invention provides also other features of construction pertaining to electric heaters.

My invention is characterized generically by the provision of a skeleton or open-work support for the resistant helix, such support formed by coiling a wire or rod into an open helix, the supporting-helix thus formed being preferably enameled to render it insulating and making only tangential contact with the resistant helix. The resistant helix may be applied upon the helical support in three different arrangements, namely: (*a*) one in which the insulated supporting-helix has the compound resistant helix wound outside of it, (*b*) one in which it has the resistant helix wound inside of it, and (*c*) one in which there are two resistant helices, one wound outside of the support and the other wound inside of it. Of these the first (*a*) is specifically claimed in a separate or divisional application filed May 18, 1898, Serial No. 681,012.

Figure 1 of the accompanying drawings is an elevation, partly dissected away in vertical mid-section, showing my complete invention as embodied in an electric heater. Fig. 2 is a transverse section thereof. Fig. 3 is a sectional and partly-dissected elevation showing a simpler construction. Figs. 4 and 5 are details of Fig. 3.

In all the figures let A designate a helix of resistant wire and let B designate a support therefor. In Figs. 1 and 2 there are two helices, of which the inner is distinguished by being lettered A′. The resistant helix of each helix constitutes an open helix or one in which the convolutions or loops of wire are opened out or separated to permit free circulation of air between, either by being openly wound in the first instance, or, if wound closely, by being pulled open and retained in that condition upon the support. The helix is also interiorly open, being either empty or so nearly so as to afford free opportunity for circulation of air within it.

I will first describe the simple or elementary construction shown in Fig. 3. The resistant wire A is first wound into a helix in any usual manner—as, for example, by winding it upon a mandrel. The resistant wire is of sufficient size and stiffness and of a metal or alloy having sufficient strength and resilience so that the wire when wound into a helix will retain its helical form. The support B is a rod, bar, or wire of the requisite stiffness and is coiled into an open helix by winding upon a mandrel much larger than that used in forming the helix A. The resistant helix A is afterward coiled around within and parallel to the supporting-helix B, thus forming it into a compound helix. The small helix formed by coiling the wire A upon its mandrel I will call the "minor" helix and the larger one formed by coiling this helix bodily I will call the "major" helix, the latter helix being essentially that formed by the axis of the minor helix, which is coiled helically parallel to the helix formed by the supporting-rod B. The successive convolutions of the supporting-rod B are spaced apart between centers somewhat wider than the exterior diameter of the minor helix A, to the end that when the resistant helix is wound within the support its successive major convolutions shall be spaced apart to afford ample insulation. At the same time the space between the convolutions of the helix B must be less than the exterior diameter of the minor helix A to prevent this helix escaping through such space. The proportions shown are considered preferable, since they afford ample support for the resistant helix and ample separation for the successive major convolutions thereof to afford the requisite insulation, while the convolutions of the supporting-helix are sufficiently separated to leave ample space between them for upward circulation of air in the manner indicated by the arrows in Fig. 3. It will be seen that by this construction

the resistant helix A is extended parallel with the supporting-rod B, so that the latter forms a continuous longitudinal support, making contact with each successive convolution of the resistant helix. The resistant helix is at each convolution supported on two successive convolutions of the helix B, so that it rests thereagainst at two points, thereby making its support firm and stiff. As these points of contact are (in the preferred construction shown) formed by the exterior tangential contact of circles, they are, in fact, mere geometrical points disposed longitudinally of the supporting-rod B at a distance apart equal to the pitch of the minor helix A. It results from this that with the exception of these minute points the entire surface of the resistant wire of the helix A is out of contact with every other part and fully exposed to the air or other surrounding medium by which its generated heat can be rapidly conducted away, so that this form of heater attains the ideal of free radiation, combined with a secure support for the resistant wire. The entire heater is, in fact, a skeleton having wide spaces through which the air may freely circulate, which spaces are crossed and subdivided at frequent intervals by the hot wires of the resistant helix, so that the air flowing through the heater is successively subdivided by these hot wires, and consequently is effectively heated. The support is also of such construction as to have the minimum of mass for a given degree of strength or rigidity, so that there is the least possible heat-absorptive property in the support consistant with its properly performing its supporting function. It results from this that the heater is highly efficient from the very instant when the electric current is turned on, since but a very small proportion of the heat is absorbed in heating up the support, and by reason of the support being so thoroughly subdivided into such slender elements as to expose a large radiating-surface it is capable of giving out the heat to the air almost as rapidly as of receiving it from the resistant wire, and hence it very quickly receives the maximum of heat which it is capable of retaining.

It is of course essential to insulate the resistant wire A from the supporting-rod B. This might be done by coating either with insulating material; but since to coat the wire A would obstruct the radiation of heat therefrom it is preferable to apply the insulation to the supporting-rod B. This insulation must be of such character as to be unaffected by the heat which is generated, and for this reason it is preferable to employ a vitreous enamel. This is found highly successful in practice, it being only necessary to employ an iron rod or wire of sufficient diameter, wind it into the helix desired, then dip it into enamel, and fire this enamel on. The ends of the rod, however, are preferably left uncoated in order that they may be screw-threaded for attaching the supporting-helix in the heater. The enamel coating is lettered *a a*.

In the construction shown in Fig. 3 it is essential that the helix A shall have an expansive stress in order that it shall press into close and firm contact with the supporting-rod. To this end the resistant wire is wound openly upon its mandrel, and in placing it within the supporting-helix its minor convolutions are forced closer together, so that it tends to expand to a larger diameter, and thereby hugs closely against the support B. The stress should be sufficient to maintain the resistant wire firmly against the support, notwithstanding the extent to which its stress may be weakened when heated by the current. No considerable degree of weakening need be allowed for, however, since in my heater, owing to the perfect ventilation, the wires are never permitted to become highly heated.

For the support of the supporting-helix B I have shown in Fig. 3 a head or disk C, preferably of porcelain, at one end of the heater, which is duplicated at the other end in the manner shown in Fig. 1, the two heads being held rigidly apart by means of tie-rods D D, their ends being screw-threaded and having nuts *d* screwed thereon to clamp the heads tightly upon the rods. The opposite ends of the helix B are inserted through suitable holes in these heads and, being screw-threaded, have nuts *b* screwed thereon, whereby to draw them firmly against the heads to take up any looseness or slack and also preferably to slightly stretch the helix B to impart firmness and rigidity to its convolutions. The ends of the resistant wire A are connected to binding-posts E, of which one is shown, each of which clamps in place a bracket F, (shown separately in Fig. 4,) the end of which comes against the free end of the helix A and serves to take its expansive thrust, as indicated in Fig. 5, and hence to keep the helix A in place.

Where only a single helix A is required, I may either arrange the resistant helix A within the support B, as shown in Fig. 3, or I may wind it around the exterior of this support, as shown and specifically claimed in my aforesaid application, Serial No. 681,012. In some cases, however, where a greater amount of heat is required to be generated in a limited space, and hence where two resistant helices are required I, combine both arrangements in one structure. This is shown in Figs. 1 and 2, which hence illustrate an embodiment of my complete invention. In these figures the supporting-helix B is made of an enameled rod spaced apart in the same manner as already described, the helix being of sufficiently large diameter to afford room within it for one compound resistant helix, (here lettered A′,) while another compound helix (here lettered A) is mounted upon the exterior of the helical support. The supporting-helix B is held at its opposite ends in heads C C, of porcelain or other material, in

the same manner already described, and each of these heads is provided with two binding-posts, (lettered, respectively, E E′,) the former of which makes connection with one end of the outer resistant helix A and the latter with the inner resistant helix A′. The outer helix A is wound with a contractile tendency and the inner helix A′ is wound with an expansive tendency, so that both are pressed by their own stress into firm contact with the support. The successive convolutions of the supporting-helix B should be spaced apart as widely as is practicable without being so wide apart as to let the opposite helices A′ and A enter so far into them as to be in danger of touching each other, which would be liable to give rise to a short circuit. The proportion shown is deemed the best.

It is usually desirable to inclose an electric heater in a casing. Where it is for heating air, this casing must be foraminous or open to admit free circulation of air into the heater at its bottom or lower part and out of it at its top or upper part. A very simple, cheap, and suitable construction for such casing is that of an open helix of enameled wire, as shown at G in Figs. 1 and 2. The opposite ends of this helical casing are slipped onto concentric bosses formed on the respective heads C C and projecting toward each other. The wire G may be stiff enough to uphold its middle portion with sufficient rigidity when thus suspended; but I prefer to hold it rigidly in place by confining it between three (or more) tie-rods or bolts D D, extending between the opposite heads and making tangential contact with the helix G, as clearly shown in Fig. 2. The rods D D may pass inside the helix G, but preferably are exterior thereto. The helices of resistant wire are mounted concentrically within the casing, with ample space between to avoid any possible contact. If, however, by reason of the heater being of great length or for any other reason the supporting-helix should sag sufficiently to establish contact between the resistant wires and the helix of the casing, no short circuit would result by reason of the latter being made of enameled wire, the enameled coating being indicated at *a*′.

The resistant helical wires A and A′ may be connected in the same or separate circuits and may be either in series or derivation, as desired. In either case they may be joined at one end of the heater by any suitable washer or connection establishing metallic contact between the binding-posts E E′. If desired, the circuit connections may be made entirely at one end of the heater. If the helices are in series, the current will then pass from that end to the opposite end, thence from one binding-post to the other, and thence back to the first end and out. If in derivation, the current may enter through the supporting-rod B and pass to the opposite end, then branch to the two binding-posts, and then return through the two helices A A′ to the first end and be taken off from their binding-posts at that end and led to a switch by which to direct the current through either helix or both. Likewise in the construction shown in Fig. 3 the supporting-rod B may be utilized as a return-conductor in case it is desired to make both electric connections at one end of the heater.

In the construction shown in Fig. 3 the supporting-helix B, being exterior to the resistant helix, serves the functions of a casing, and by arranging the rods D (three or more in number) in tangential contact with it, so as to keep it in exact alinement, there is the same correlation between the rods and helical casing in this construction as in that shown in Figs. 1 and 2.

The word "rod" as used in this specification with reference to the support B includes not merely a small metal rod or wire, but also any suitable substitute therefor, such as rods of glass or porcelain or any material having sufficient stiffness for the purpose and either an insulator in itself or capable of being effectively coated with insulation.

I make no specific claim in my present application to the construction where the resistant helix is wound around the exterior of the supporting-helix B. The claims to this construction originally made in my present application were erased herefrom upon the filing of a divisional application specifically directed thereto, Serial No. 681,012, filed May 18, 1898.

In another application, Serial No. 701,686, filed January 9, 1899, as a division of my present application, I have claimed the means for supporting the resistant helix A by means of rods extended parallel with it and on which it rests tangentially at points separated less than the diameter of the resistant helix and independently of the resistant helix being coiled into a compound helix. I make no claim in my present application to anything claimed in my said application. Consequently my present application is in part specific to my said divisional application, No. 701,686, and is in part generic to No. 681,012.

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

1. An electric heater comprising a minor helix of resilient resistant wire coiled into a compound helix, combined with a support consisting of a helical insulating-rod extended parallel with said minor helix and exterior to the minor convolutions thereof.

2. An electric heater comprising a minor helix of resilient resistant wire coiled into a compound helix, combined with a support consisting of a helical insulating-rod extended parallel with said minor helix and exterior to the minor convolutions thereof, each of the successive convolutions of said rod supporting two of the major convolutions of said resistant helix, and each such major convolution resting against two successive convolutions of said rod.

3. An electric heater comprising a supporting-rod coiled into an open helix and a helix of resistant wire wound spirally into a major helix parallel with said supporting-rod and supported thereby by tangential contact therewith, the supporting-rod being exterior to the resistant helix and the latter being internally free for circulation of air within it.

4. An electric heater comprising a resistant helix and a supporting-rod, the latter coiled helically with its convolutions spaced apart somewhat less than the diameter of the resistant helix, and the former coiled into a compound helix the major convolutions of which extend parallel with the convolutions of said helical support, and the resistant helix wound under stress causing it to press into the spaces between the convolutions of the supporting-rod, and thereby maintain exterior tangential contact therewith at two points, both helices being wound openly for free circulation through the heater.

5. An electric heater comprising a resistant helix and a supporting-rod, the latter coiled helically with its convolutions spaced apart somewhat less than the diameter of the resistant helix, and the latter coiled into a compound helix inside of said supporting-helix, and resting in the spaces between the convolutions thereof, so as to make exterior tangential contact therewith at two points in each minor convolution, and both helices being wound openly for free circulation through the heater.

6. An electric heater comprising a supporting-helix B with open convolutions, and a resistant helix A wound compressively into a compound helix inside of said helix B, so that it rests in the spaces between adjacent convolutions thereof, and has an expansive stress pressing it into firm tangential contact therewith.

7. An electric heater comprising a supporting-helix B with open convolutions, and two resistant helices A A′, each wound into a compound helix extending parallel with the convolutions of helix B, the helix A being wound outside of, and the helix A′ being wound inside of, the supporting-helix, and having respectively contractile and expansive stresses, whereby they force themselves into firm tangential contact with the support.

8. An inclosing casing for an electric heater consisting of an open helical coil of wire admitting a free circulation of air through the heater, combined with longitudinal rods in contact therewith.

9. In an electric heater, the combination of opposite heads C C with longitudinal rods D D connecting them, and a skeleton casing extending between said heads, consisting of an open helical coil of wire making tangential contact with said rods, and a resistant wire inclosed within said casing.

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

EDWARD E. GOLD.

Witnesses:
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GEORGE H. FRASER.