No. 688,995. Patented Dec. 17, 1901.

E. E. GOLD.

ELECTRIC HEATER.

(Application filed Aug. 19, 1898.

(No Model.) 2 Sheets—Sheet 1.

FIG. 2.

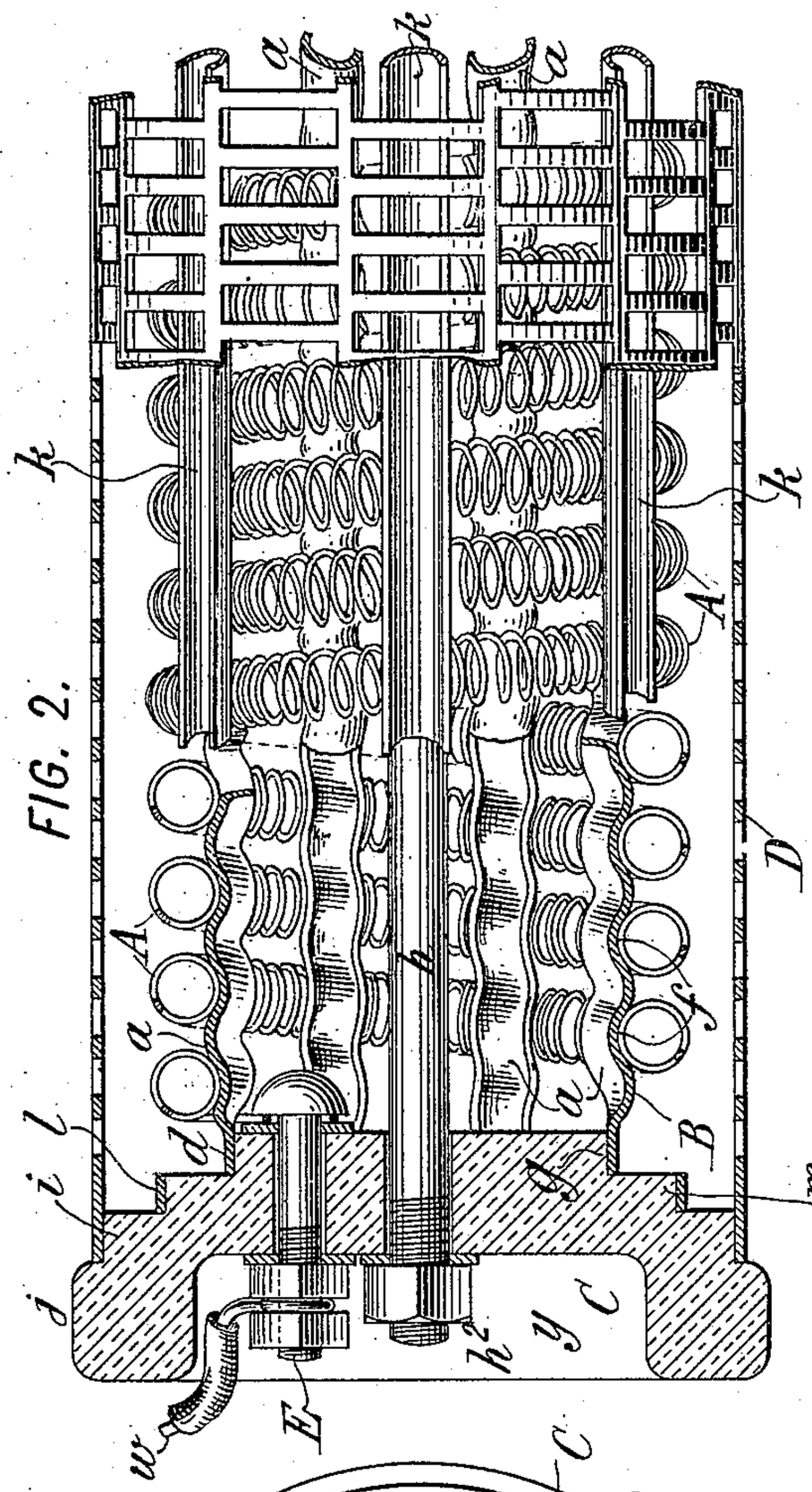


FIG. 6.

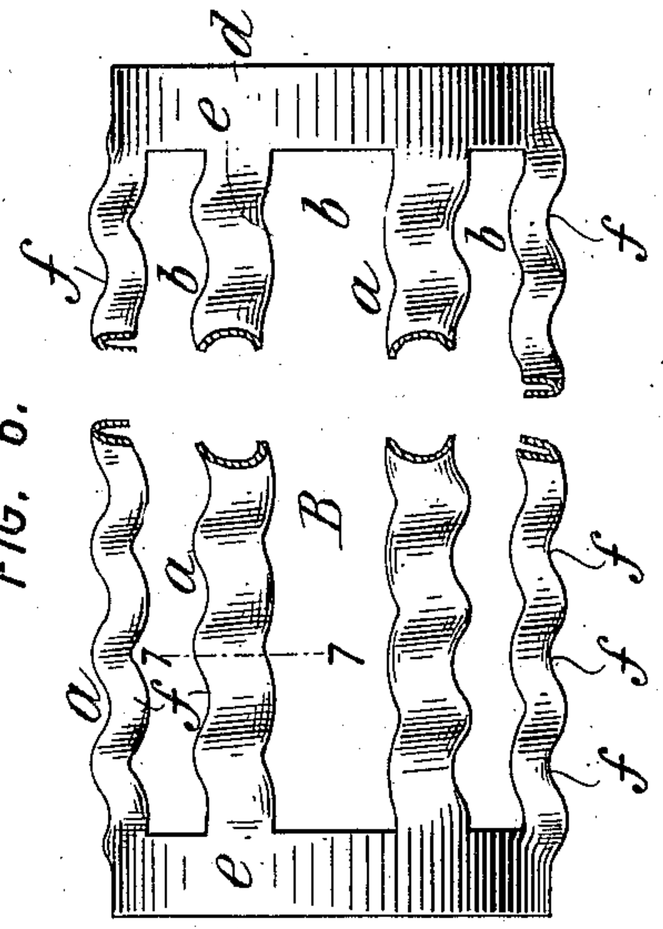


FIG. 5.

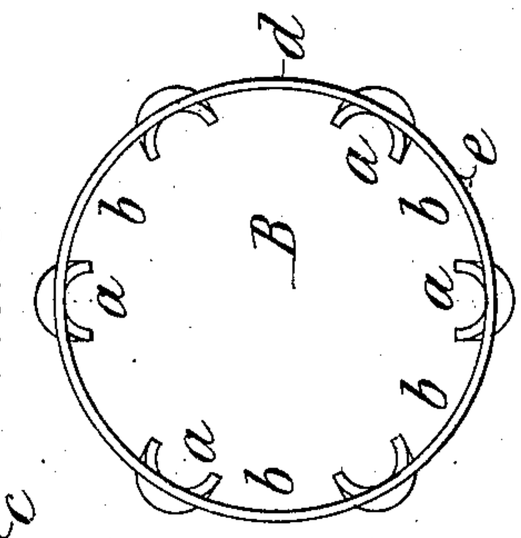


FIG. 7.

FIG. 1.

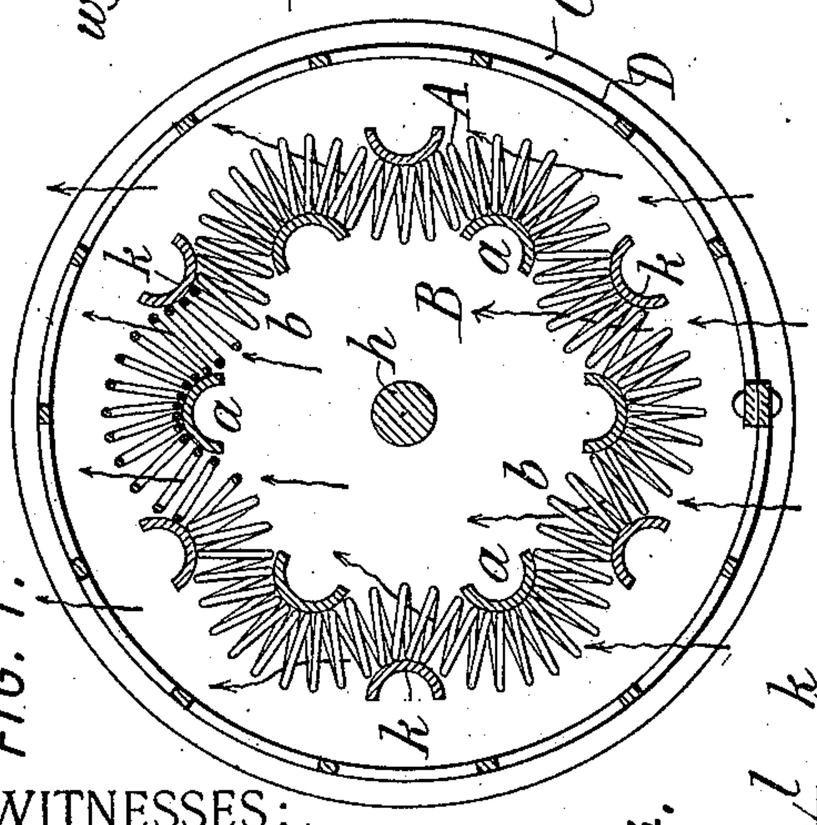


FIG. 3.

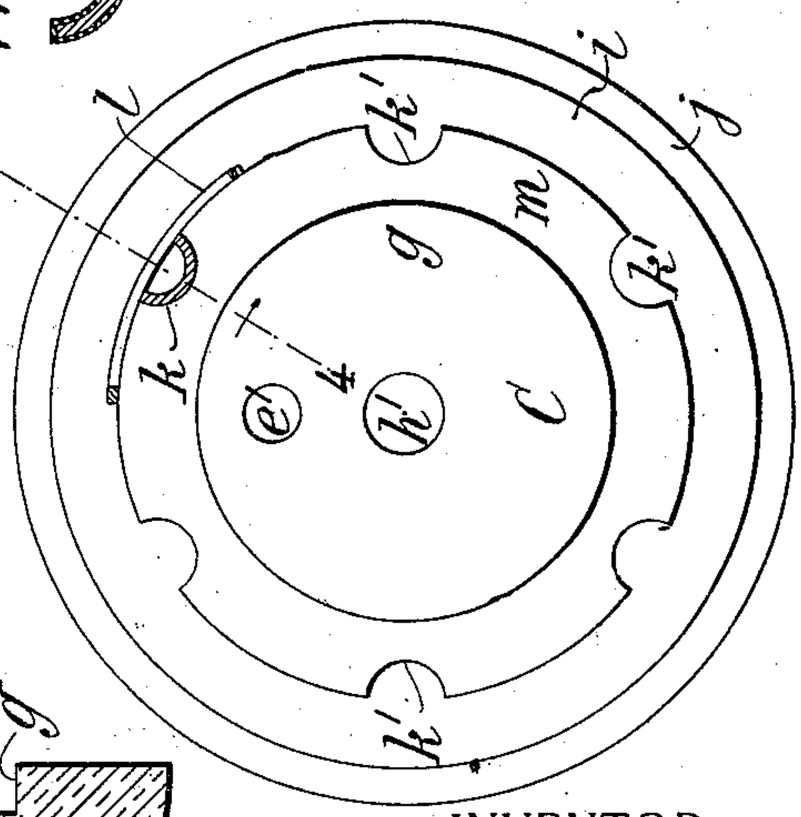
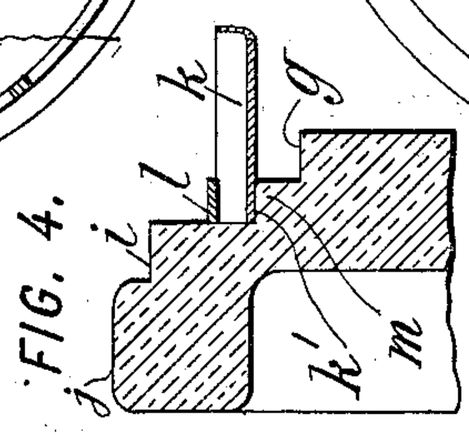


FIG. 4.



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No. 688,995. Patented Dec. 17, 1901.

E. E. GOLD.

ELECTRIC HEATER.

(Application filed Aug. 19, 1898.)

(No Model.) 2 Sheets—Sheet 2.

FIG. 8.

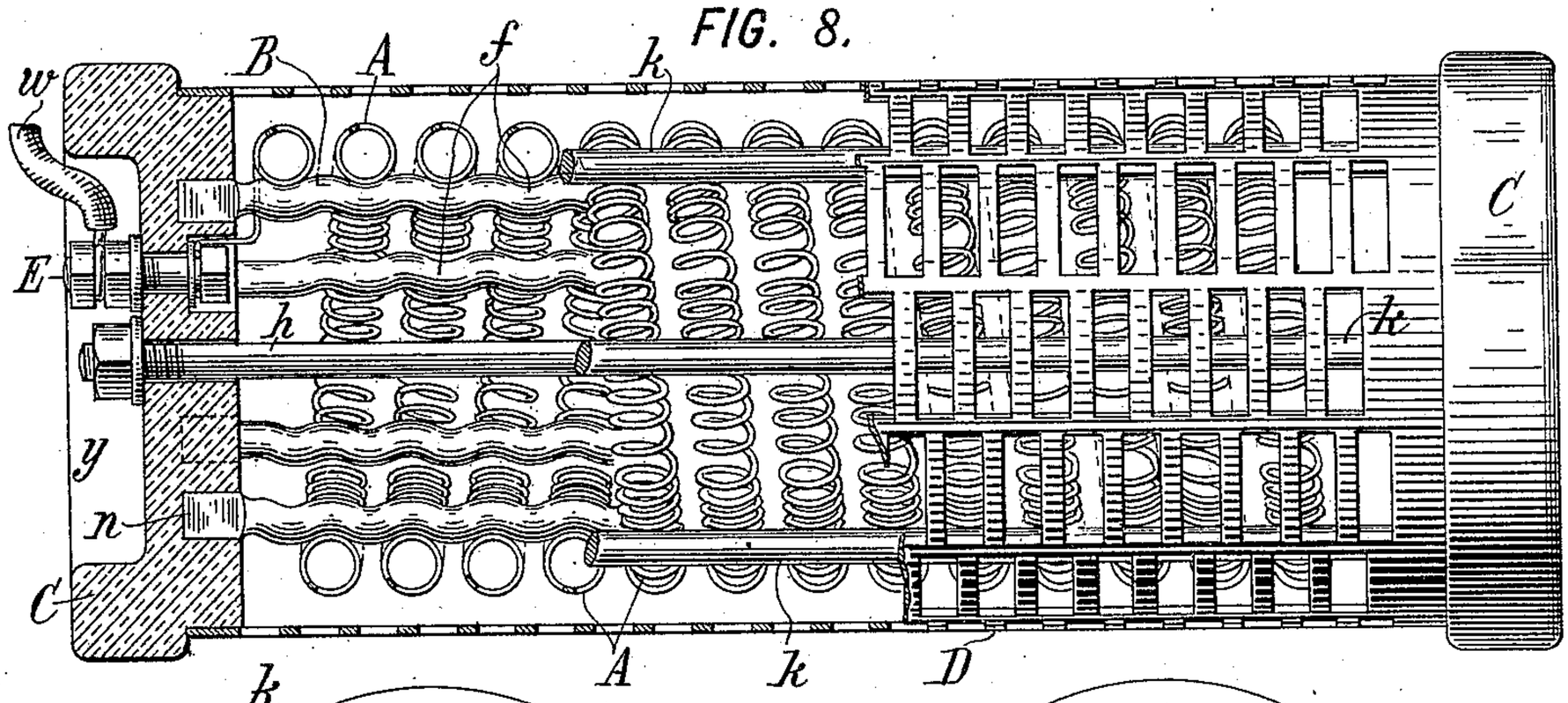


FIG. 9.

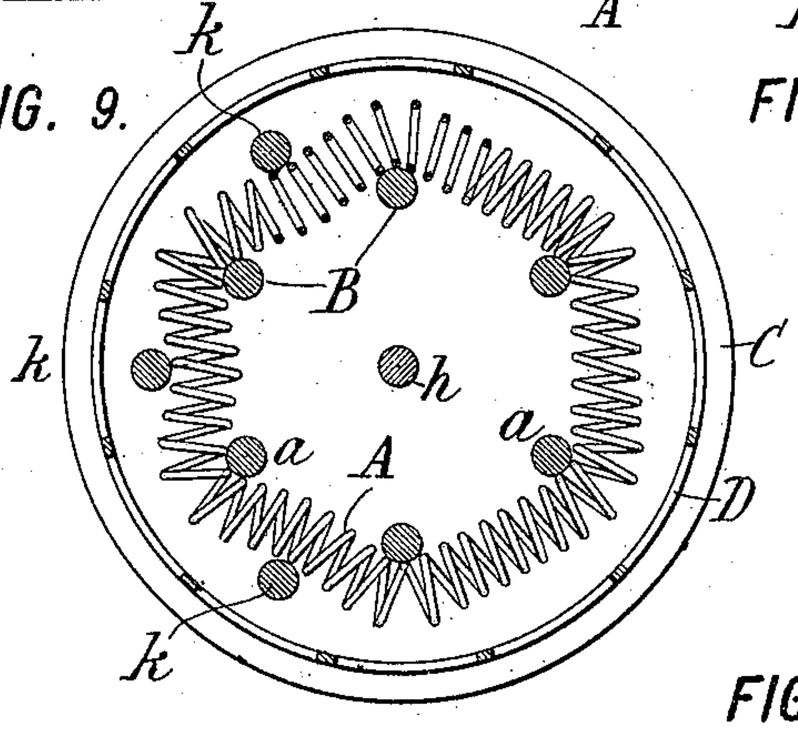


FIG. 10.

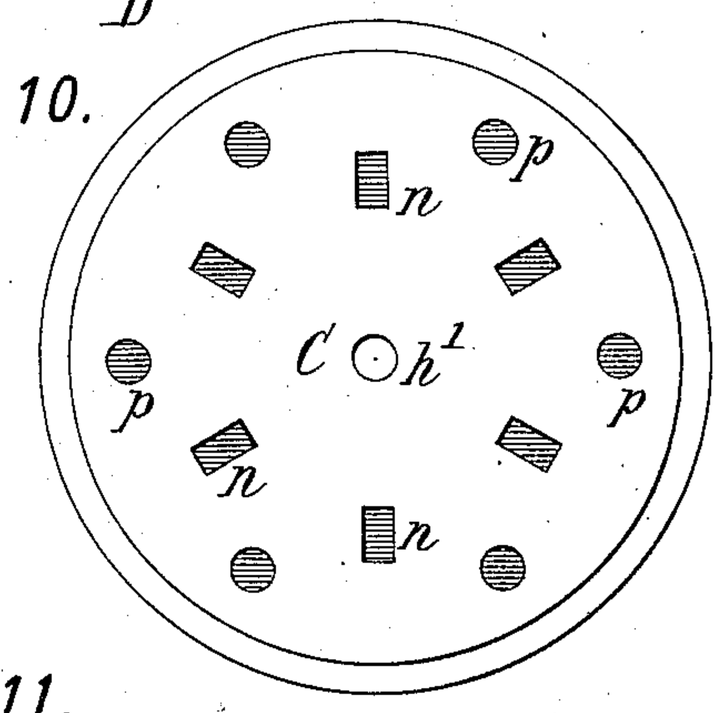


FIG. 11.

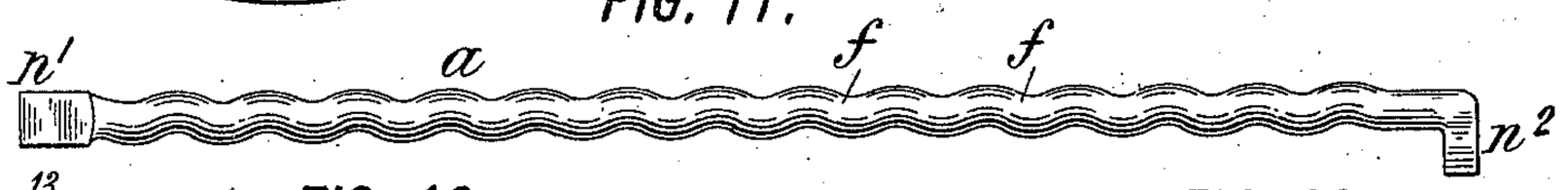


FIG. 12.

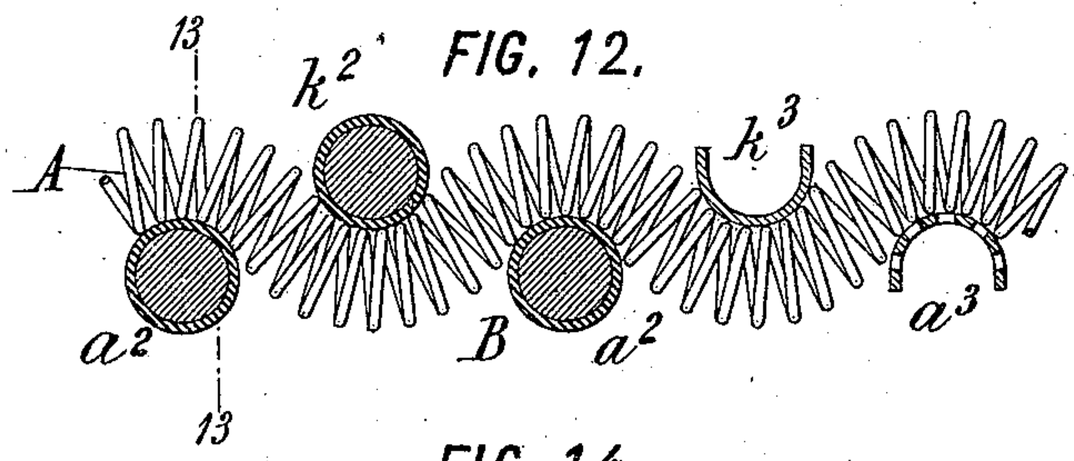


FIG. 13.

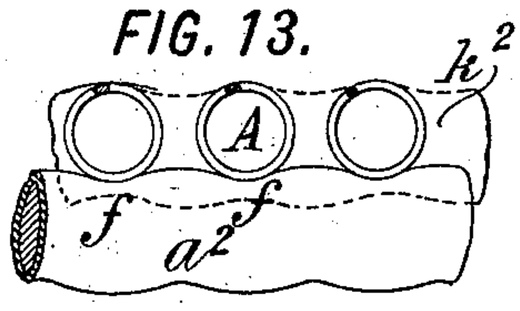


FIG. 14.

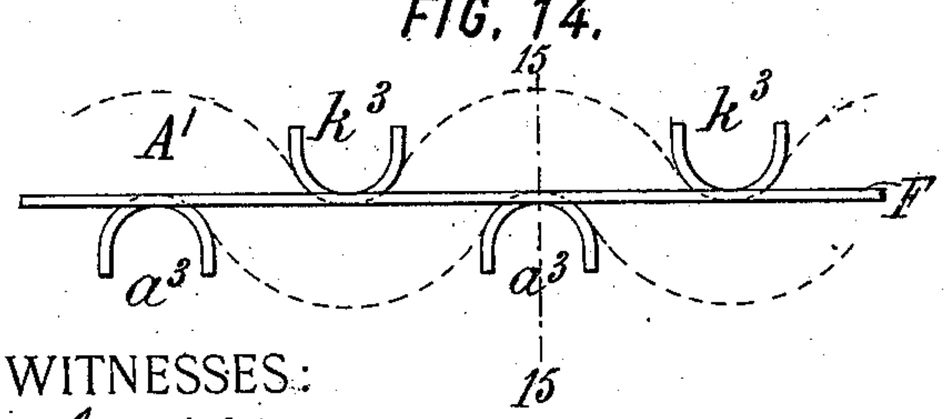
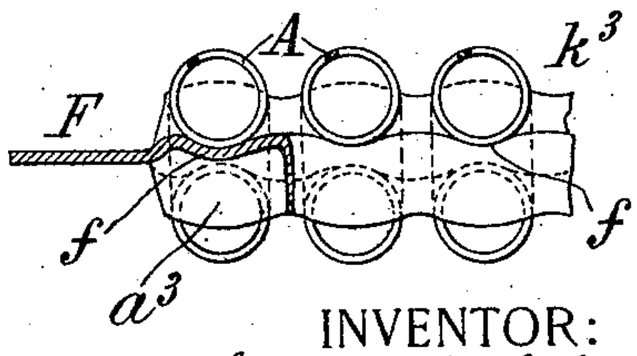


FIG. 15.



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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. 688,995, dated December 17, 1901.

Application filed August 19, 1898. Serial No. 688,971. (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 heating element is a resistant wire wound into a helix and stretched over, across, or around a suitable support, so that the helix is distended or opened and exposed to free circulation of air within and around it. In the construction of an electric heater of this character it is practically of great importance to provide for thorough ventilation of the resistant helix in order that the air may circulate freely and rapidly over the heated wires to rapidly abstract heat from them, both to efficiently heat the air and to prevent overheating of the wires.

My present invention aims to provide an improved insulating-support for a wire helix which shall make ample provision for ventilation, while so supporting the helix as to prevent any possible displacement or escape thereof.

In my Letters Patent No. 604,384, dated May 24, 1898, I have shown a ventilated electric heater wherein the support for the resistant helix consists of a thin foraminous tube around which the resistant helix is wound, so that air may circulate through the openings of said tubular support, into and out of the interior thereof, and into contact with all portions of the heated wires. My present invention constitutes an improved construction of such ventilating or foraminous support.

According to my present invention I construct the open-work insulating-support for the resistant helix of a grid or cage of parallel bars which are separated to form ventilating-spaces between them, the resistant helix being extended across and supported by said bars. The grid is preferably made tubular to form a cage, the bars being arranged in cylindrical order and the wire helix wound helically around the bars. To keep the helix in place and prevent its shifting in direction longitudinally of the bars, the latter are formed with successive indentations or depressions which receive the helix and form, in effect, intermittent grooves in which the helix lies. In order that the support shall have as little mass, and consequently as little heat-absorbing capacity, as possible, I prefer to make the bars of thin sheet metal, corrugated longitudinally into semitubular form to give sufficient stiffness, presenting their convex surfaces in contact with the resistant wire and enameled on said surfaces to insulate the bars from the wire. For further guarding against the displacement or escape of the wire I provide a supplemental series of bars which bear against the helix on the opposite side from the supporting-bars of said grid and alternately thereof, so as to deflect the helix into the spaces between said bars, whereby the helix is supported on both sides and at alternately opposite points.

Having thus indicated the nature of my invention, I will proceed to describe the same in its preferred and modified forms, with reference to the accompanying drawings, in which—

Figures 1 to 7, inclusive, show the preferred form, and the remaining views show modifications. Fig. 1 is a vertical transverse section. Fig. 2 is a sectional or dissected elevation of the heater, the left-hand portion being in vertical mid-section. Fig. 3 is an elevation of one of the end plates or heads. Fig. 4 is a fragmentary section thereof in the plane of the line 4 4 in Fig. 3. Fig. 5 is an end elevation of the sheet-metal ventilating support or cage of parallel bars, and Fig. 6 is a side elevation thereof, its middle portion being broken out. Fig. 7 is a transverse section of one of the bars cut, for example, on the line 7 7 in Fig. 6, showing it on a larger scale for the purpose of showing the coating of enamel. A modified construction is shown in Figs. 8 to 11, whereof Fig. 8 is a side elevation, partly dissected or broken away to show the internal construction, the left-hand end portion being in vertical mid-section. Fig. 9 is vertical transverse section. Fig. 10 is an elevation of one of the end heads. Fig. 11 is an elevation of one of the supporting-bars. Another modification is shown in Figs. 12 to 15, whereof Fig. 12 is a transverse section of a fragment of the heater, showing solid metal bars or rods at the left and corrugated sheet-metal bars at the right. Fig.

13 is a vertical section at right angles to Fig. 12 on the line 13 13 thereon. Fig. 14 is an end elevation of the support when made of sheet metal, illustrating one mode of construction thereof. Fig. 15 is a section corresponding to Fig. 13 on the line 15 15 in Fig. 14, showing the coils and sheet-metal support.

In all the figures, A designates a helix of resistant wire, preferably naked, and B designates the open-work insulating-support therefor.

I will first describe the construction shown in Figs. 1 to 7. The support B consists of a grid of parallel bars *a a*, arranged in cylindrical order to form a cage, and spaced apart to form intervening ventilating-spaces *b b*. To make the bars as light as possible and give them the minimum of heat-absorptive capacity, I prefer to make them of longitudinally-corrugated sheet metal of the semi-tubular cross-section shown in Fig. 7, their convex faces being turned outwardly, as shown in Fig. 1, so that the resistant helix comes in contact with only this convex face of each bar. To render them insulating, this convex face must be coated with some insulating material, and this is preferably done by enameling the entire bar, the coating of enamel being shown in Fig. 7 at *c*. Preferably the several bars constituting the supporting-cage are all made integrally of one sheet-metal tube, as best shown in Figs. 5 and 6. This tube, lettered *e*, is longitudinally slotted to cut out the portions *b*, constituting the spaces between the bars, while the intervening portions constituting the bars *a* are longitudinally corrugated, as described. The opposite end portions *d d* of the tube remain unaltered, constituting uninterrupted annular or ring-like ends. The bars *a a* might be straight; but I prefer to give them a sinuous contour by forming them with transverse corrugations, so as to provide successive indentations or depressions *f f*, adapted to receive the resistant helix, the several depressions being spaced apart sufficiently to receive the successive major convolutions or layers of this helix in the manner shown in Fig. 2. The purpose of these indentations or depressions is to prevent lateral displacement of the major convolutions of the helix, so as to prevent any contact between the adjacent wires of successive convolutions, such as would result in a short-circuiting of the resistant wire. The depressions *f f* are arranged to progress in a helical path around the support or cage, this being the path in which the helix is wound, so that the depressions constitute an intermittent spiral groove in which the helix may lie. The entire sheet-metal cage thus formed requires to be enameled in order to render it insulating. It might be formed of insulating material instead of metal.

In the preferred construction of heater I provide opposite end heads or caps C C, preferably of insulating material, as porcelain. Each head has a central boss *g*, adapted to fit within the tubular or annular end *d* of the cage. The heads are drawn together by means of a central bolt *h*, which passes through a central hole *h'*, Fig. 3, in each head, and its opposite ends being screw-threaded nuts *h*² are screwed thereon to force the heads together, and thereby firmly engage them with the ends of the cage. Preferably an open-work casing D is provided for inclosing the heater, consisting of a perforated or slotted tube arranged concentrically with the cage and engaged at its opposite ends by the two end heads C C. In this the preferred construction I form the head with a concentric boss *i*, which enters within the end of the casing, and with a projecting flange *j*, which abuts against the end thereof. The casing D may be a seamless tube or it may preferably be formed with a lapped and riveted joint.

The opposite ends of the helices A are connected to binding-posts, one of which is shown in Fig. 2 and lettered E. This binding-post consists of a bolt passing through a hole *e'*, Fig. 3, in the head, its inner end engaging the end of the resistant wire and its outer end screw-threaded for receiving two nuts, one of which clamps against the head and the other clamps between the two nuts the end of the circuit-wire *w*, this being the usual construction of binding-post in such heaters. The head is formed with a recess or chamber *y* deep enough to house the ends of the bolt *h* and binding-post E and their nuts.

The heater thus described makes provision for ample ventilation through the spaces *b b*, so that the ascending currents of heated air can flow freely into contact with all portions of the helix, as indicated by the arrows in Fig. 1. By forming the support of thin corrugated sheet metal and enameling it it is made very light, so as to have the least possible heat-absorptive capacity. Hence when the electric current is first turned onto the heater the heat is immediately and rapidly given out to the air instead of requiring a considerable time in which to heat up the support around which the wire is wound.

The resistant helix A is wound on in the usual manner, stretching or distending it as it is wound, so that it lies across the bars, the successive layers or convolutions being kept apart by resting in the depressions *f f*.

With all heaters of this character wherein a helix is wound distensively around a support into a larger or compound helix there is some liability of displacement of the wire. If the wire should break, the effort of the helix to straighten out will cause it to fly outward, lying close against the casing, in which case its convolutions are liable to make contact with one another, and thereby short-circuit considerable portions of the wire, so that the resistance between the terminals is greatly diminished, and the resulting augmentation of current overheats the remaining portions of wire and burns out the heater. In ordinary use, since the portions of wire at the

bottom are traversed by cold air, while those at the top are traversed only by the air already heated by the wire below, it results that the upper portions of wire are not as efficiently cooled as the lower portions, so that the wire in this way becomes unequally heated, and the helix being under tension there is a tendency, by reason of the overheating and weakening of the upper convolutions, to stretch them open under the superior tension of the lower convolutions, so that the helix tends to crawl, reducing the amount of wire at the upper end of the heater and increasing that at the lower part, which is disadvantageous, since this is liable to cause the lower convolutions to close together and short-circuit. To avoid these disadvantages and also to afford a further safeguard against any lateral displacement of the helix, such as might short-circuit adjoining major convolutions thereof, is the purpose of an additional feature of my invention, which I will now describe.

Outside of the supporting-cage B and exterior to the helical winding of resistant wire I place a supplemental series of parallel longitudinal bars *k k*. These are preferably formed of longitudinally-corrugated sheet metal of the semitubular cross-section shown in Fig. 7 and also enameled. They are arranged alternately with the bars *a a* of the supporting-cage—that is to say, opposite the spaces *b b* between said bars—and are presented with their convex faces against the resistant winding and are forced in against this winding in such manner as to deflect it into the spaces between the bars *a a*, in the manner best shown in Fig. 1. The bars *k k* are confined in these positions in any suitable manner. One example thereof is shown, the heads C C being provided, as shown in Fig. 3, with notches *k'* at intervals, adapted to receive the ends of the bars *k*, which bars are held into these notches in any suitable manner—as, for example, by means of a ring *l*, slipped over their ends. The notches are formed in a boss *m*, projecting from the head between the bosses *g* and *i*, and the ring *l* fits around this boss *m*. Fig. 4 is a section through one notch *k'*, showing its bar *k* resting in that notch and the ring *l* holding it in place. The effect of the bars *k k* alternating with the bars *a a* is to deflect the compound helix A into a sinuous contour, as clearly shown in Fig. 1, so that it follows a wavy or zigzag path, curving first outside of the bar *a*, then inside of the bar *k*, outside of the next bar *a*, and so on. The helix is thus supported on both sides or both internally and externally. If any portion of the helix should break, the effect of confining it between the outer and inner bars would be to hold its unbroken portions in place, so that only a few of the convolutions nearest the break could contract, and these only in direction of the axis of the major helix; also, by the confining of the helix between alternately-opposite supports it is so held that the differences in tension resulting from unequal heating of different portions of the helix cannot pull it out of place or cause it to crawl from the hotter to the cooler portions.

I will now proceed to describe that modification of my invention which is shown in Figs. 8 to 11. In these figures the bars instead of being made of corrugated or channel-shaped sheet metal are made of wire or rod, which is crimped, as shown in Fig. 11, to form the depressions or indentations *f f*. It is preferable that these bars should be coated with enamel. The bars are grouped into the cylindrical or tubular cage by having their ends embedded in recesses *n n* in the end heads C C. To prevent turning of the bars, these recesses are flattened, and the ends of the bars are flattened, as shown at *n'*, or turned laterally, as shown at n^2, Fig. 11, the recesses *n* in either case being made to fit the ends of the bars and hold them a proper distance apart. In Fig. 9 I have shown on one side bars *k k*, which are applied outside the helical winding A, while on the opposite side these bars are omitted or have not yet been applied. The right-hand side of Fig. 9 thus shows the effect of omitting the outer bars. The bars *k* are seated in sockets *p p*, Fig. 10, in the heads C C. The heating elements are inclosed in a casing D, as before described, which is held between the heads in the same manner. The heads are drawn together by a central bolt *h* in the same way as before. The outer rods *k k* are shown as being straight enameled rods, while the inner rods *a a*, constituting the cage or support B, are shown as being made sinuous to form the successive depressions *f f*, as described. The straight and sinuous rods might be transposed to substantially equal effect.

Figs. 12 and 13 show my invention as applied to a flat heater, the resistant helix A being supported on underlying bars a^2 a^2, forming the grid or main support B, and being held firmly against these bars and forced partly in between them by the overlying bars k^2. These bars have depressions *f f*. (Shown in Fig. 13.) The bars a^2 k^2 may be round enameled metal rods, as shown in Fig. 13 and in the modification at the left in Fig. 12, or they may be made of bent-up sheet metal, as shown at a^3 k^3 in Fig. 12, being of course enameled, as in Fig. 7. They may be perforated, as shown at a^3, or imperforate, as at k^3. In case the bars are formed of bent-up sheet metal they may advantageously be made in the manner shown in Figs. 14 and 15, where the lower bars a^3 and the upper bars k^3 are bent up from one sheet F of sheet metal, the upper bars being formed by bending the metal upward and the lower bars by bending it downward, as clearly shown. The dotted lines A' in Fig. 14 show the path of the helix A between the upper and lower bars,

which is the same as in Fig. 12. Fig. 15 shows the depressions or corrugations *f f* for receiving the successive layers of the helix A.

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

1. An electric heater comprising an insulating open-work support consisting of a grid of parallel bars separated to form ventilating-spaces, said grid being formed of one piece of enameled sheet metal, slotted to form said spaces, longitudinally corrugated to form the bars, and transversely corrugated to form successive depressions in the bars, and a helix of resistant wire stretched across and supported by said bars and lying in said depressions.

2. An electric heater comprising an insulating open-work support consisting of a tubular cage of parallel bars separated to form ventilating-spaces, and a helix of resistant wire wound helically around said support, said cage formed of a sheet-metal tube having continuous annular ends, longitudinally slotted between its ends to form said spaces, and the bars longitudinally corrugated to present a convex exterior.

3. An electric heater comprising an insulating open-work support consisting of a tubular cage of parallel bars separated to form ventilating-spaces, and a helix of resistant wire wound helically around said support, said cage formed of a sheet-metal tube having continuous annular ends, longitudinally slotted between its ends to form said spaces, and the bars longitudinally corrugated to present a convex exterior, and transversely corrugated to form depressions for receiving said helix, said depressions arranged to progress helically around the cage, forming an intermittent spiral groove in which said helix is wound.

4. An electric heater comprising an insulating open-work support consisting of a grid of parallel supporting-bars arranged in cylindrical order to form a tubular cage, and separated to form ventilating-spaces, a helix of resistant wire extended across and supported by said bars, and a supplemental series of bars overlying said helix on the opposite side thereof and bearing against the latter so as to deflect it into the spaces between said supporting-bars, whereby the helix is supported on both sides by said bars.

5. An electric heater comprising an insulating open-work support consisting of a grid of parallel bars arranged in cylindrical order to form a tubular cage, and separated to form ventilating-spaces, a helix of resistant wire wound helically around said support, and a supplemental series of parallel bars overlying said helix on its outer side between the bars of said cage, and bearing against said helix so as to deflect it into the spaces between said bars, whereby the helix is supported both internally and externally.

6. In an electric heater, the combination of a supporting-cage consisting of substantially parallel longitudinal bars joined to one another at their ends by annular flanges, opposite heads for supporting said cage, said heads having bosses adapted to enter said annular flanges, means for drawing said heads together to hold said cage between them, and a helix of resistant wire wound helically around said cage.

7. In an electric heater, the combination of a supporting-cage B having longitudinal bars *a a*, opposite end heads adapted to support said cage between them, a supplemental series of parallel bars *k k*, said heads having recesses receiving the ends of said supplemental bars, and a resistant helix A wound helically around said cage between its bars *a* and the outer bars *k*.

8. In an electric heater, the combination of a cage B of parallel bars *a a*, opposite end heads between which said cage is supported, a resistant helix A wound helically around said cage, a supplemental series of parallel bars *k k* arranged to bear against said helix on its outer side, said heads having recesses *k'* for receiving the ends of said supplemental bars, and means for holding said ends in said recesses.

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

EDWARD E. GOLD.

Witnesses:
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FRED WHITE.