No. 786,542. PATENTED APR. 4, 1905.

L. P. BROWN & F. J. HOLMES.

ELECTRIC HEATER.

APPLICATION FILED OCT. 17, 1904.

2 SHEETS—SHEET 1.

Fig. 1

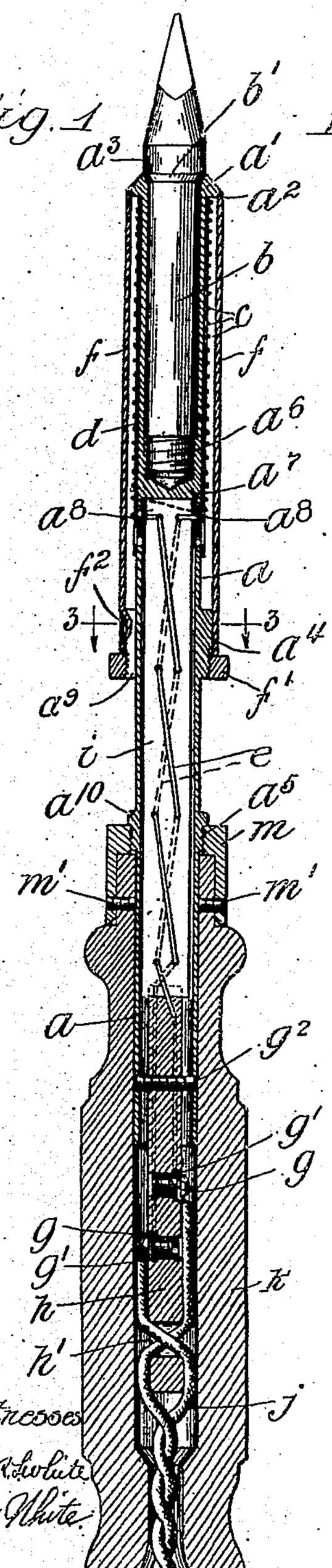


Fig. 2

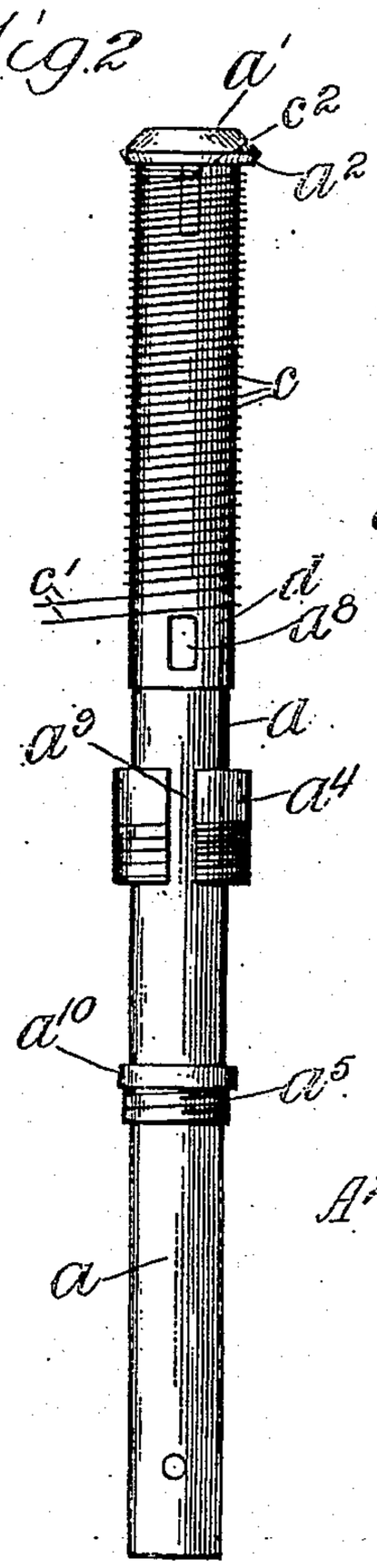


Fig. 5.

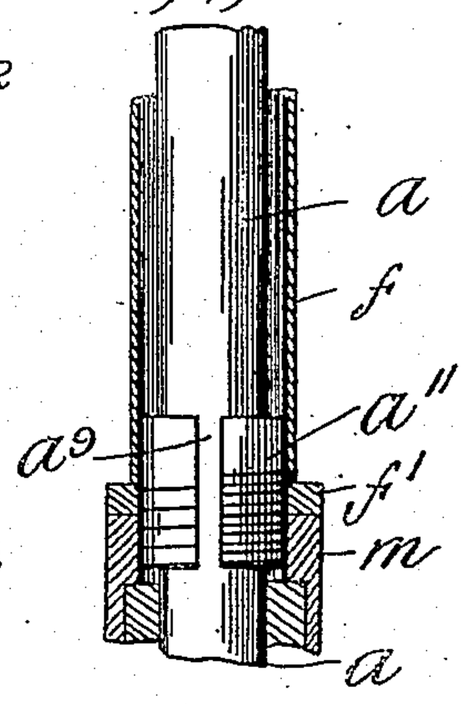


Fig. 4

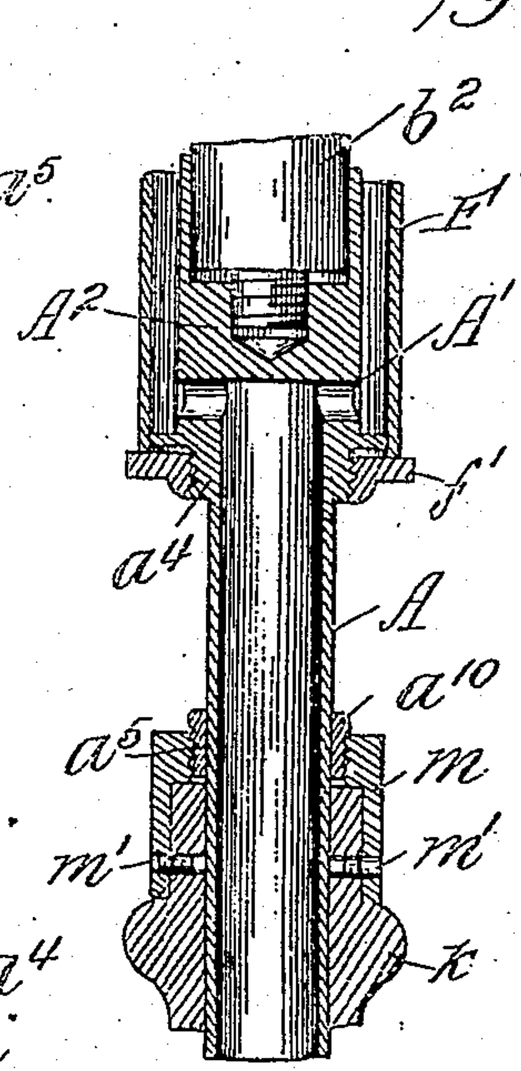
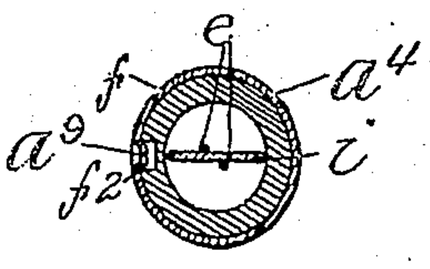


Fig. 3.



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ELECTRIC HEATER.

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2 SHEETS—SHEET 2.

Fig. 6

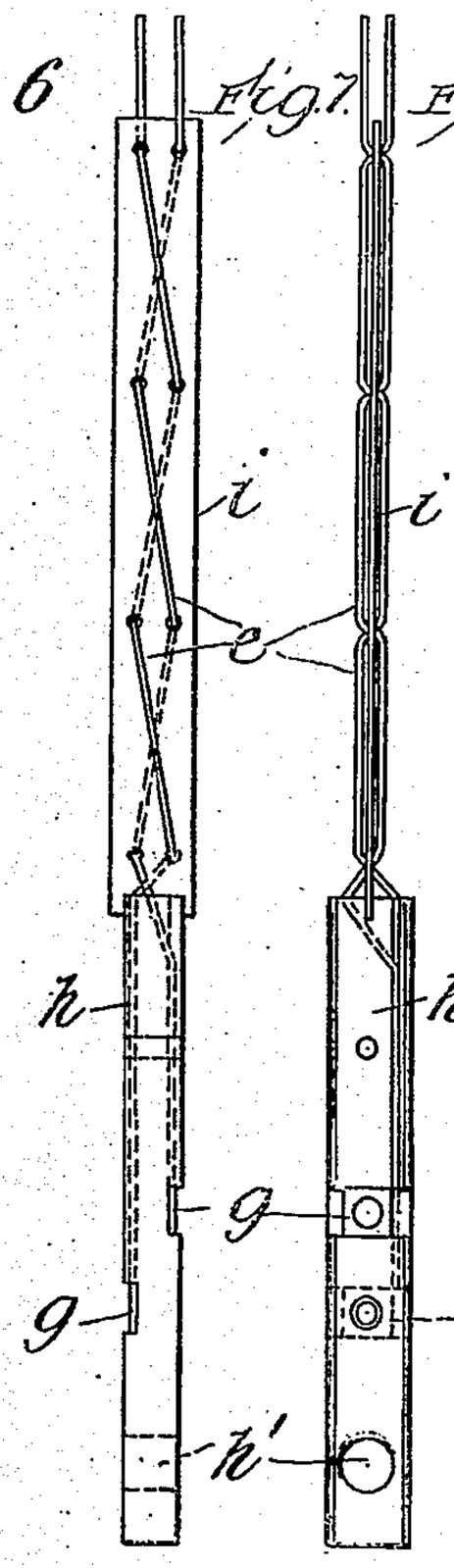


Fig. 7

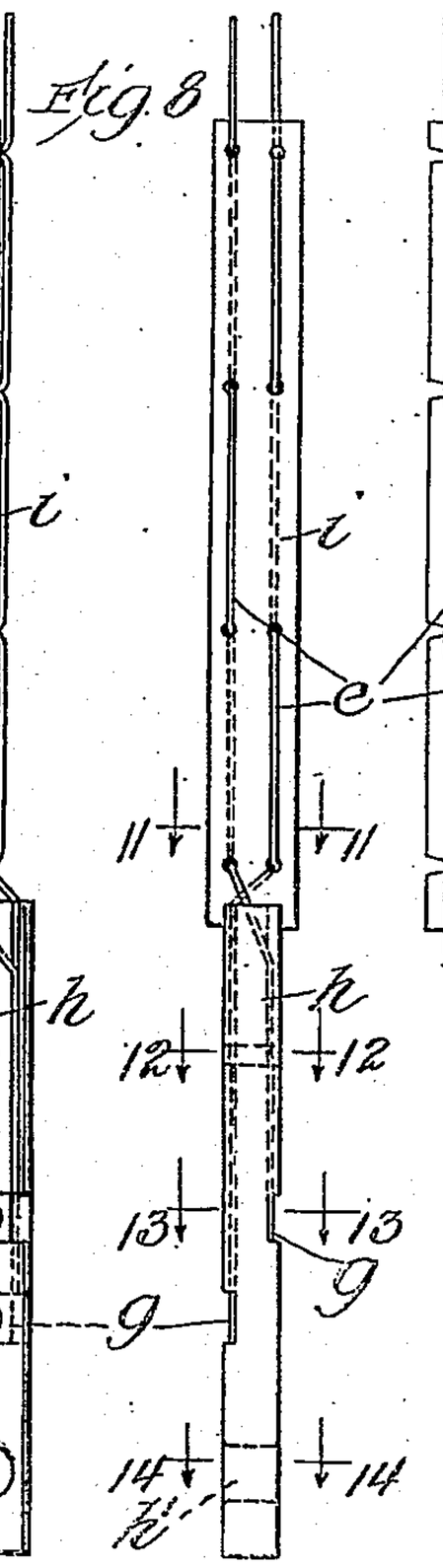


Fig. 8

Fig. 9

Fig. 11

Fig. 12

Fig. 13

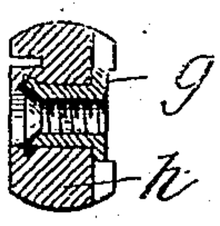


Fig. 10.

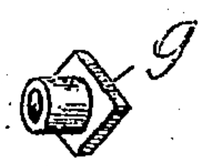


Fig. 14.

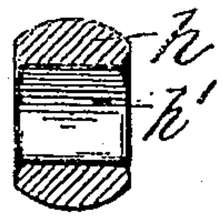
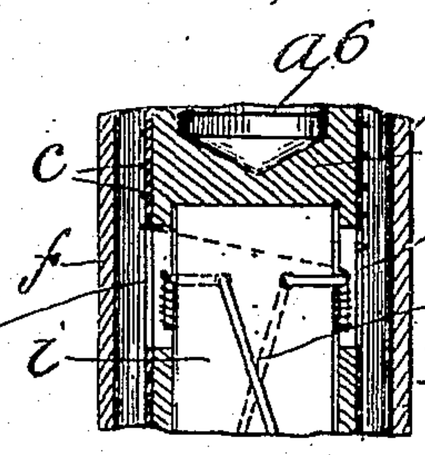


Fig. 15.



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No. 786,542. Patented April 4, 1905.

UNITED STATES PATENT OFFICE.

LOUIS P. BROWN AND FRANK J. HOLMES, OF CHICAGO, ILLINOIS.

ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 786,542, dated April 4, 1905.

Application filed October 17, 1904. Serial No. 228,826.

To all whom it may concern:

Be it known that we, LOUIS P. BROWN and FRANK J. HOLMES, citizens of the United States, residing in the city of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Electric Heaters, of which the following is a specification.

Our invention relates to improvements in heating devices in which heat is generated by electricity; and the general objects of the invention are, first, to provide a heater which shall be strong, substantial, durable, and convenient to use; second, to supply the heat efficiently at the desired portion of the device; third, to provide a construction whereby the parts may be readily assembled and be easily accessible, and, fourth, to protect the parts from mechanical damage and also from the corrosive effects of fumes and of the air, especially when the parts are hot. In obtaining these general objects a number of specific details of construction and arrangement are employed, which will hereinafter be more fully set forth. Certain of the features of our invention are applicable, broadly, to electrical heaters in general, and the accompanying claims, unless specifically restricted, are intended to be broadly construed. Certain of the features, however, are particularly adapted to soldering-tools, and for this reason a soldering-tool is shown, and the general features are illustrated in connection therewith.

We attain our objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal section of the complete device. Fig. 2 is a side view of the inner tube, showing the heating-coil thereon. Fig. 3 is a sectional view taken on the line 3 3, Fig. 1. Fig. 4 is a longitudinal section of a portion of a modified form of inner tube, together with the contiguous parts. Fig. 5 is a longitudinal section of another modification in the manner of connecting the tube to the handle and to the shell or casing. Figs. 6 and 7 are side and edge views, respectively, of the web whereon the conductors are led through the main tube. Fig. 8 is a side view of the web, showing a different manner of leading the conducting-wires thereon. In said Figs. 6, 7, and 8 the terminal block is also shown. Fig. 9 is a side view of a modified form of web. Fig. 10 is a perspective view of the preferred form of binding-post employed in connection with the terminal block. Figs. 11, 12, 13, and 14 are sectional views taken, respectively, on the lines 11 11, 12 12, 13 13, and 14 14, Fig. 8. Fig. 15 is a fragmentary detail view, drawn to an increased scale, illustrating the preferred manner of joining the conductors *c'* and *e*.

Similar letters refer to similar parts throughout the several views.

The inner tube *a* consists, preferably, of a single piece, or at least pieces brazed or otherwise permanently secured together so as to be virtually of a single piece, and said tube may be of uniform cross-section, as shown in the main figures of the drawings, or may have different cross-sections at different points, as illustrated in Fig. 4.

Upon tube *a* are the various holding devices, which may be considerably modified, but which are here illustrated in their preferred forms. At the forward extremity of the tube is formed the annular flange a', which has an exterior bevel surface a^2 and an interior bevel surface a^3 for the purposes hereinafter mentioned. Said tube also has formed thereon in its preferred form the threaded collars a^4 and a^5, although said collars may, if desirable, be contiguous and unified, as shown in Fig. 5.

Inside of the tube *a*, at a convenient distance from the forward extremity thereof, is formed an interior thread a^6 for receiving the threaded inner extremity of the copper tip *b*. An imperforate diaphragm a^7 is formed across tube *a* for the purpose of hermetically sealing said tube at a point within the inner extremity of the tip *b*. Said tip *b* has an annular bevel or shoulder b', which is formed in such manner that when said tip *b* is screwed tightly down into the threaded portion a^6 said shoulder b' will make air-tight contact with the bevel a^3, formed at the mouth of tube *a*. It will be understood that when copper is heated in the presence of air it gradually has formed thereon a scale of copper oxid, which

is practically a heat-insulator instead of a heat-conductor. This is detrimental to the efficiency of the device and can be avoided only by preventing the access of oxygen. With our construction when the tip *b* is screwed down tight the shoulder *b'* hermetically seals the mouth of the tube *a* and prevents the entrance of air from that direction, while the diaphragm *a'* prevents the access of air from the opposite direction.

Upon the outside of the tube *a*, upon the forward portion thereof, is a winding *c* of a conductor having high resistance, so that heat will be generated when an electric current passes through it. Said winding is of course insulated by a thin layer of mica or other material from tube *a* and constitutes one of the important features of this invention. The conductor *c'* of which the winding is composed is wound double, so that a complete circuit from the positive to the negative terminal of the winding may lie in a single layer, as best shown in Fig. 2. In this method of winding a starting loop or bend c^2 is laid, preferably, at the forward extremity of the tube, and the conductor is led in a double spiral with approximately parallel turns rearwardly toward the supply-terminals.

The preferred means for securing the forward loop c^2 in position is a strip of mica or other insulator *d*, around which the loop passes and over which the adjacent turns of the conductor pass to thereby firmly hold said strip in position. It will be seen that by this construction the conductor may be led from the rear to the forward extremity of the winding and return in a single layer, thus obviating the necessity of laying a sheet of mica or other insulator above the inleading spiral in order to bring the two ends of the conductor out at the same place.

The purpose of the winding *c* is of course to transfer heat to the tip *b*, and an advantge in having the conductor all in the same layer is that it eliminates the necessity for an extra layer of insulation, which insulation would reduce the heating effect upon tube *a* and tip *b* of any wires outside of such extra layer. Another advantage is that the two spirals may be wound on simultaneously, thus reducing the amount of time required for the process.

In the preferred form the spirals constituting the winding *c* are not exactly parallel, but gradually and uniformly increase their distance apart as they get farther away from the securing-strip *d*. The purpose for this will be evident when it is considered that the potential difference between two adjacent spirals is substantially zero at loop c^2 and is greatest at the supply-terminals. The tendency for a short circuit between any two adjacent turns decreases in the same ratio as the potential difference decreases. The less the potential difference the less is the amount of space required between the turns for insulation, and advantage is taken of this fact to decrease the space as the necessity for it is decreased. It is obvious that the closer the windings are the greater is the length of conductor which can be wound upon a given length of tube. By so arranging the coil *c* that the turns are closest together at the forward end of the tube *a* it follows that the greatest number of turns, and consequently the greatest proportion of heat, will be close to the tip *b*, the heat being thus applied in a most efficient manner.

The rear extremities of the heating-conductor *c'* are electrically connected to the forward extremities of the supply-conductors *e*, which lie chiefly within said tube, as will be hereinafter mentioned.

The winding *c* is protected by being inclosed within the shell or casing *f*, which is beveled at its forward extremity to fit against the beveled surface a^2 at the forward extremity of tube *a*. Said casing bears at its rear extremity upon the collar a^4 and is held tightly against surface a^2 by means of the jam-nut *f'*, which screws onto the threaded portion of collar a^4 and abuts against the rear extremity of said casing.

It is desirable to prevent the turning of casing *f*, and this is conveniently accomplished by providing a longitudinal slot or recess a^5 for receiving the indentation f^2, formed in said casing.

The supply-conductors *e*, before mentioned, lead backward within tube *a* to the binding-posts *g g*, which in the present instance are mounted in the terminal block *h* and will be hereinafter referred to.

In order to insulate the supply-conductors *e* from each other and from tube *a*, a web *i*, of mica or other insulating material, is placed within the tube and forms a support for said conductors. The web may be held fast in the tube in any suitable manner, preferably by being made of a width almost equal to the inner diameter of said tube. The conductors may be strung along said web in different ways, the preferred methods being shown in Figs. 6, 7, and 8, where the web has a series of perforations *i'' i''* occurring in pairs at short intervals and the conductors being threaded through them from one surface of the web to the other. The best arrangement is shown in Figs. 6 and 7, where the conductors progress zigzag across and along the web, always lying upon opposite surfaces thereof. The conductors may, however, lie parallel, as shown in Fig. 8.

It is possible to notch the web, as shown in Fig. 9, and lead the conductors *e* from one edge of the web to the other; but this is less desirable, as the web is necessarily weaker, the notches having to be of considerable depth to enable the conductors to be kept at a safe distance from the inclosing tube *a*.

It is obvious that the method of mounting

the conductors *e* upon the web *i* within the tube is applicable to conduits used for a variety of purposes other than soldering-tools.

By preference the rear extremity of the web *i* is secured to the forward extremity of the terminal block *h*, before mentioned, and the conductors *e* are led along the block in grooves to the binding-posts *g*. The block is rigidly held in tube *a* by any suitable means—as, for example, the rivet g^2. (Shown in Fig. 1.) For convenience in assembling a portion of the terminal block extends beyond the rear extremity of tube *a*. In the preferred form said binding-posts *g* consist of interiorly-threaded sleeves and are let into the terminal block in the manner as best shown in Fig. 13. Said posts are electrically connected to the conductors *e* and are adapted to receive the binding-screws *g'* for making electrical contact with the supply-conductors *j*. Said supply-conductors may well consist of the ordinary lamp-cord.

The binding-posts *g* are arranged in tandem upon the terminal block, with their heads opening upon opposite sides thereof. They are preferably secured by expanding or riveting over their inner extremity, so as to engage the terminal block, as best shown in Fig. 13. The purpose of this construction of the block and binding-posts is to obtain compactness, the whole being small enough to be completely inclosed within the bore of the handle *k*.

Near the rear extremity of the terminal block is an aperture *h'*, through which the supply-conductors *j* are each led to the opposite side of the block, as best shown in Fig. 1. This crossing of the insulated conductors *j* is not essential, but is advantageous in that it relieves the binding-screws *g'* of strain in case an accidental strain is put upon said supply-conductors which lead from the exterior of the device.

The handle *k*, above mentioned, consists, preferably, of wood or similar non-conducting material and is bored longitudinally for receiving the terminal block *h* and the rear portion of tube *a*. Said handle incloses a sufficient portion of tube *a* to afford a substantial bearing thereon. Said handle is provided at its forward extremity with a ferrule *m*, preferably of metal and secured by means of the rivets *m'* or other suitable devices. In the preferred construction the ferrule is interiorly threaded, so as to screw onto the threaded collar a^5, formed upon tube *a*. In order that the ferrule and handle may be locked upon tube *a*, a shoulder a^{10} is formed upon the collar a^5, and thus affords a stop against which the ferrule may be screwed.

In the preferred construction the collars a^4 a^5 are placed at a slight distance apart, the purpose being to permit dissipation of heat back of the collar a^4, so that the handle *k* may remain perfectly cool. It is not necessary, however, that said collars be placed at a distance, and it is practicable to have them coincidental, as illustrated in Fig. 5. In said Fig. 5 the parts are the same as in Figs. 1 and 2, with the exception that the collar a^{11} takes the place of the two collars a^4 a^5, and the ferrule *m* and nut *f'* are both screwed upon the single collar a^{11}. In this arrangement the nut *f'* performs the function of the shoulder a^{10} in addition to its function of retaining the casing *f*.

It will be noted that the handle *k* is formed of a single piece, and this is rendered possible because of the compact construction of the terminal block *h* and the manner of fastening the conductors *j* to the binding-posts *g*.

When the tool is being assembled, the web *i*, with the conductors *e* thereon, is inserted into tube *a*, together with the terminal block *h*. The forward extremities of the conductors *e* are brought out through the apertures a^8, and after the winding *c* is completed the said forward extremities of the conductors *e* are soldered or otherwise electrically connected to the rear extremities of the heating-conductor *c*. Next the casing *f* is passed forward over the rear extremity of tube *a* and rigidly secured in place by means of the nut *f'*. The conductors *j* are next connected to the binding-posts *g*, and finally the handle *k*, which has been previously slipped back over the forward extremity of conductors *j*, is then moved forward over the rear extremity of the tube *a* and is screwed down into position thereon.

In case an extra large copper tip b^2 is required, as shown in Fig. 4, tube A increases its diameter at the point A'. In this construction, as before, the diaphragm A^2 will be formed within tube *a* for sealing the same, and the casing F will be of a correspondingly greater diameter.

What we claim as new, and desire to secure by Letters Patent, is—

1. In an electric heating device, a heating-coil wound in a double spiral and having its turns closer together near its loop than at a point more remote from the loop, for the purpose of reducing the danger of short-circuiting.

2. In an electric heating device, a heating-coil wound in a double cylindrical spiral backward from a loop therein, the distance between the turns gradually increasing toward the terminals of the coil.

3. In an electric heating device, a metallic heating-tip and a resistance-coil for heating the same, said coil being wound in double cylindrical spiral from a return-loop therein and said coil having its turns closer together near the said loop than at a point more remote therefrom for the purpose described.

4. In an electric heating device, a metallic heating-tip; a resistance-coil for heating the same, said coil being wound in double cylindrical spiral from a return-loop therein; and means at said loop for maintaining the same

in fixed relationship with the remaining parts of the coil, said coil having its turns closer together at said loop than at the parts more remote therefrom for the purpose of reducing the danger of short-circuiting, the loop part of said coil lying nearest to the operative portion of said tip.

5. In an electric heating device, a heating-coil, a central body around which the coil is wound in double spiral, and a strip for holding the coil at the looped extremity thereof, said strip being held in position upon the central body by means of the turns of the coil itself.

6. In an electric heating device, the combination of a heating-coil; a central body around which the coil is wound in double spiral; and a strip of insulating material for holding the coil at the loop therein, the turns of the coil adjacent to the loop passing over said strip for firmly retaining the same in position upon the said central body.

7. In an electric heating device, the combination of a heating-coil; a central body around which the coil is wound in double spiral; and a strip of insulating material for holding the coil at the loop therein, the turns of the coil adjacent to the loop passing over said strip for firmly retaining the same in position upon said central body, and the distance between the turns of the coil becoming greater as the distance from the loop increases.

8. In an electric heating device, the combination of a tube, an insulating web therein and an electric conductor mounted upon said web out of contact with said tube.

9. In an electric heating device, the combination of a tube, a web of insulating material in said tube having a width approximately equal to the inside diameter thereof, and an electric conductor mounted upon said web and passing from one surface thereof to the other at suitable intervals, to thereby remain out of contact with said tube.

10. In an electric heating device, the combination of a tube; a web of insulating material extending approximately along the center thereof, said web having perforations at suitable intervals therein; and a conductor threaded through said apertures so as to pass from one surface of the web to the other for remaining out of contact with said tube.

11. In an electric heating device, the combination of a tube; a web of insulating material extending approximately along the center thereof, said web having perforations therein substantially in pairs occuring at suitable intervals therein; and a pair of conductors threaded through said apertures from one surface of the web to the other and lying on opposite surfaces of the web at any given point therein whereby said conductors are kept out of contact with each other.

12. In an electric heating device, the combination of a metallic tip for heating the object to be heated, said tip having an annular beveled shoulder thereon between its ends; means for heating said tip; a tube for supporting said tip; and an imperforate diaphragm within said tube between the ends thereof, said tube having a beveled surface at its mouth whereonto the beveled shoulder on said tip may be wedged for sealing said tube.

13. In an electric heating device, the combination of a metallic tip for heating the object to be heated, said tip having an annular beveled shoulder thereon between its ends; means for heating said tip; a tube for supporting said tip; an imperforate diaphragm within said tube between the ends thereof; said tube having a beveled surface at its mouth; and means for tightly forcing the beveled shoulder of said tip down onto the beveled surface of said tube for sealing the mouth thereof.

14. In an electric heating device, the combination of a heating-tube having an annular beveled shoulder thereon; means for heating said tube; and a casing for inclosing said heating means, said casing having a beveled surface whereby said casing may be wedged against the beveled shoulder on said tube.

15. In an electric heating device, the combination of a heating-tube having an annular beveled shoulder thereon; a heat-generating resistance medium upon said tube; a casing for inclosing said resistance medium, said casing having a bevel at one end for contacting the shoulder on said tube; and means at the rear end of said casing for forcing and holding it against the said shoulder on said tube.

16. In an electric heating device, the combination of an electric heat-generator; a terminal block; conductors leading from said block to said heat-generator; and binding-posts on said block making contact with said conductors and adapted to be connected to suitable supply-wires, said binding-posts being arranged in tandem upon said terminal block for the purpose described.

17. In an electric heating device, the combination of a heat-generator; a tube supporting the same; a terminal block secured to said tube at the rear extremity thereof; conductors leading from said heat-generator to the terminal block; and binding-posts on said block making electrical contact with said conductors and adapted to be connected to suitable supply-wires, said binding-posts being arranged in tandem upon said terminal block, for the purpose described.

18. In an electric heater, the combination of a tube; a resistance medium mounted on said tube for generating heat; a terminal block supported on said tube; conductors leading to said terminal block and fastened thereto; other conductors leading from said terminal block to said resistance medium, said terminal block and all of said conductors being supported on said tube; and a longitudinally-bored handle rigidly secured to said tube, said

handle being adapted to circumferentially inclose said terminal block and a portion of said conductors and being independent of said terminal block and conductors.

19. In an electric heater, the combination of a tube; a resistance medium mounted on said tube for generating heat; a terminal block supported on said tube; conductors leading to said terminal block and fastened thereto; other conductors leading from said terminal block to said resistance medium, said terminal block and all of said conductors being supported on said tube; a longitudinally-bored handle adapted to circumferentially inclose said terminal block and a portion of said conductors and being independent of said terminal block and conductors; said handle screwing onto said tube from the rear end thereof; and locking means for preventing the accidental unscrewing of said handle.

20. In an electric heater, the combination of a single one-piece tube constituting the foundational structure of the device, a resistance medium wound upon one end thereof, for generating heat, conductors leading into the other end of said tube for supplying electric current to said resistance medium; and a longitudinally-bored, one-piece handle fitting over the rear end of said tube and adapted to be slid thereonto from the rear thereof.

21. In an electric heater, the combination of a tube constituting the foundational structure of the device; a resistance medium near one end thereof for generating heat; a terminal block lying partially within said tube and projecting out of the rear end thereof; supply-conductors leading from the source of energy to said terminal block; other conductors leading from said terminal block to said heat-generating medium; and a longitudinally-bored, one-piece handle fitting over the rear end of said tube and adapted to be slid thereonto from the rear thereof, said handle thereby inclosing said terminal block.

22. In an electric heater, the combination of a tube; a metallic tip rigidly secured at the forward end thereof; a heating-coil upon said tube adjacent to said tip; and a handle rigidly secured to said tube at the rear end thereof, said tip and coil and handle being all mounted on the same piece whereby the device is rigid from end to end.

23. In an electric heater, the combination of a tube having perforations in the side thereof; a metallic tip at the forward end of said tube; a heat-generating resistance medium located upon the outside of said coil adjacent to said tip; conductors leading within said tube from the rear end thereof and passing outward through the said perforations therein to join said heat-generating medium; and a web of insulating material located within said tube and supporting said conductors.

24. In an electric heater, the combination of a tube having perforations in the side thereof; a metallic tip at the forward end of said tube; a heat-generating resistance medium located upon the outside of said coil adjacent to said tip; conductors leading within said tube from the rear end thereof and passing outward through the said perforations therein to join said heat-generating medium; and a web of insulating material located within said tube and supporting said conductors to insulate the same, said web having sufficient stiffness to carry forward the free forward ends of the said conductors during assemblage, whereby the said ends may be threaded out through the apertures in said tube to be joined with said heat-generating medium.

25. In an electric heater, the combination of a tube, a handle screwing onto the rear end thereof; a metallic tip supported by said tube at the front end thereof; a heat-generating medium located on the outside of said tube adjacent to said tip; a casing outside of said heat-generating medium slidable lengthwise of said tube; a rigid, longitudinally-slotted collar upon said tube, and an inward projection upon said casing for entering the slot in said collar whereby the casing may be moved longitudinally but is prevented from turning, said casing thereby affording means whereby the device may be gripped in screwing the handle on or off.

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