(No Model.)

# H. W. LEONARD.

## ELECTRIC HEATER.

No. 522,718. Patented July 10, 1894.

Fig. 1.

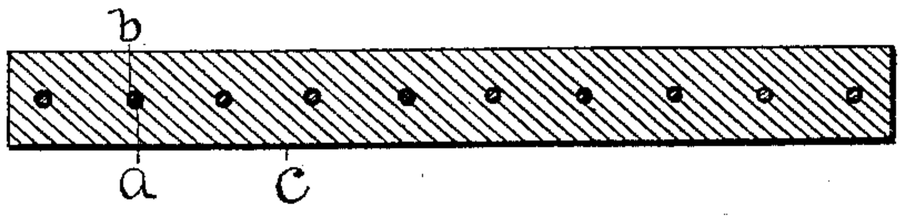



Fig. 3.

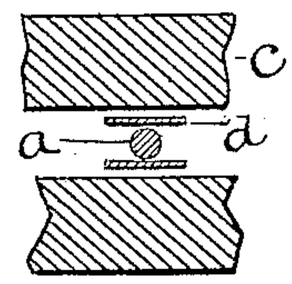



Fig. 2.

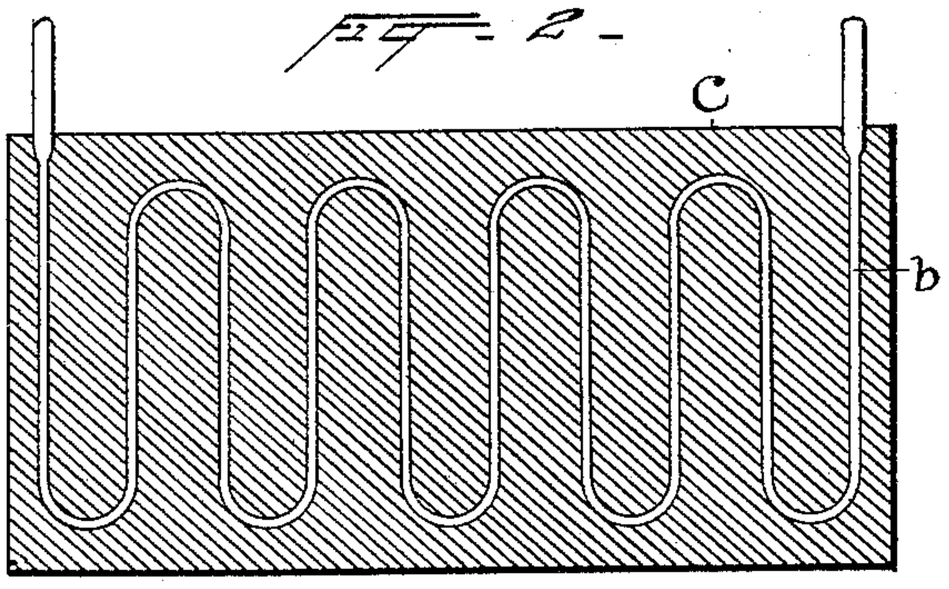



Fig. 4.

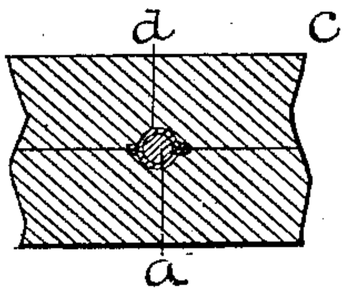



Fig. 5.

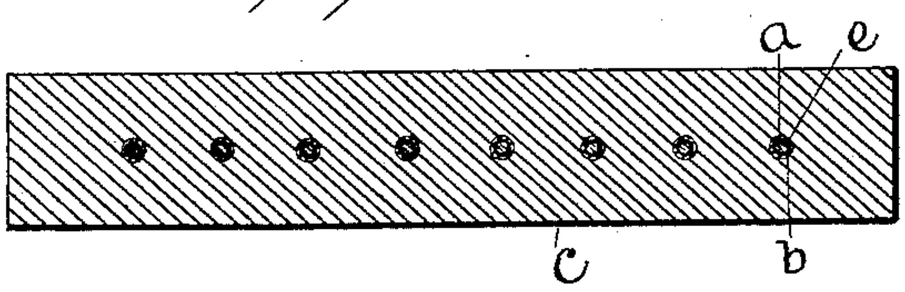
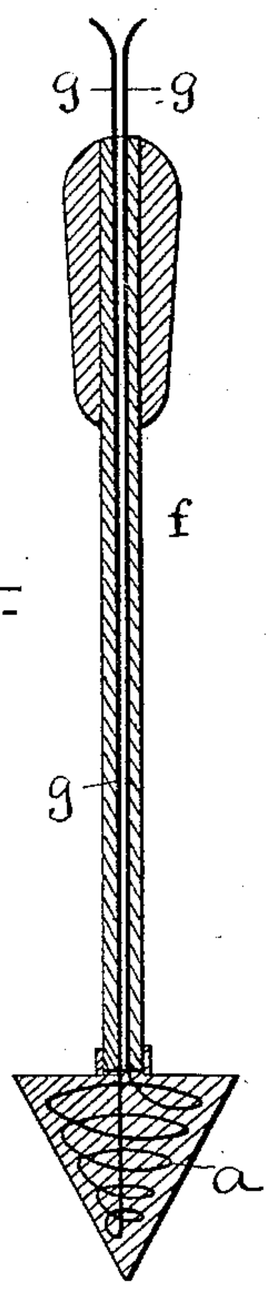



Fig. 6.

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# UNITED STATES PATENT OFFICE.

HARRY WARD LEONARD, OF NEW YORK, N. Y.

## ELECTRIC HEATER.

SPECIFICATION forming part of Letters Patent No. 522,718, dated July 10, 1894.

Application filed March 22, 1893. Serial No. 467,131. (No model.)

*To all whom it may concern:*

Be it known that I, HARRY WARD LEONARD, a citizen of the United States, residing at New York city, in the county and State of New York, have invented a certain new and useful Improvement in Electrical Heaters, of which the following is a specification.

My invention relates to electrical heating apparatus of that character in which a current of electricity is passed through a conductor which offers sufficient resistance to the current to produce the required amount of heat.

In the use of apparatus of this general character I have found it desirable that the conductor through which the current passes, and in which the heat is produced, shall be well protected from oxidation by contact with the air; that it shall be well insulated electrically, and that its insulation shall not be affected or impaired by any degree of temperature to which it may be raised; and that it should also be well protected mechanically, so that it will not be injured by any shocks or jars to which the heating apparatus may be subjected, and so that in case the temperature should be raised to too high a point, so as to fuse the metal, the metal cannot escape. It is desirable, also, that the heat produced in the conductor shall be quickly and readily conducted away from the conductor to the place where it is to be applied, so that a large amount of heat energy can be developed in the conductor, without raising its temperature to a dangerous extent, and so that a large flux of heat may be supplied from the surface without cooling the surface too rapidly. These conditions apply especially to the use of such apparatus for tools such as soldering irons, flat-irons and others, in using which the flux of heat from the surface is rapid, but in which the surface must be maintained at a high temperature and a practically constant one. It follows that in such cases the heat should be conducted from the heating conductor to the surface with the minimum drop of heat potential.

The object of my invention is to produce a heating apparatus in which these conditions shall be fulfilled in a simple and convenient manner.

In carrying my invention into effect, I make use of a conductor, usually of metal wire, which is thinly locally insulated; that is, which is itself covered with an electrical insulating covering following the line of the conductor, as distinguished from the embedding of the conductor in a mass of insulating material common to several conductors, or to several convolutions of the same conductor embedded, therein. The locally insulated conductor is embedded in a closely applied mass of metal, which completely and intimately surrounds the insulated conductor and enters between the convolutions thereof, if a sinuous conductor is employed. By this means I am enabled to produce a device in which the amount of electrically insulating material which surrounds the conductor is reduced to the minimum extent necessary to separate it electrically from the metal which surrounds it, and, since the best electrical insulators are non-conductors of heat, this results in avoiding to the greatest extent the impediment to the rapid conduction of heat away from the conductor, which has resulted from the use of masses of non-heat-conducting insulating material as heretofore. The mass of metal rapidly conducts the heat to its surface, at which it is to be used in any desired way.

The close and intimate application of the body of metal prevents any danger or difficulty from the cracking or disintegration of the insulating covering, this being held mechanically in position, under all circumstances, by the metal covering and hermetically sealed from the air thereby. Thus in the case of glass, for instance, if this becomes cracked by heat or by mechanical shock or otherwise the conductor is still protected from oxidation by the hermetical seal due to the completeness of the metal envelope and its intimate relation to the insulating material. And furthermore, if, under unusual circumstances, the conductor should be heated to its fusing point, the metal of which it is composed, being closely embraced by the surrounding parts, is unable to escape.

I first coat the conductor which is to be employed, with a thin covering of insulating material, such as glass, enamel, asbestus, fire clay, mica, or any other material which is a good insulator, and is refractory, so as to withstand a high degree of heat without los-

ing its insulating qualities. Preferably the insulating material is one which is as good a conductor of heat as possible, although, as I employ a very thin coating, even the poorest conductor of heat may be employed with good results.

Various methods of applying such materials as those mentioned about wires, for the purpose of insulating them, are well known in the art, and any method which is suitable and effective may be employed for my purpose. In such of these methods as require the application of heat to the insulating material in placing them upon the conductor, such heat may either be applied externally or it may be electrically developed in the conductor as the insulation is applied. The insulated conductor is then surrounded with and embedded in a body of metal, metal being employed because metals are the best conductors of heat and are readily and conveniently applied. One way of accomplishing this is to lay the insulated conductor upon a suitable support or in a suitable mold, and pour about it a metal, such as lead, in a melted condition, so that such metal is cast or molded about the conductor, and the conductor is embedded in the midst of the body of metal. The metal covering may also be applied by pressure, if desired, and this is desirable because the very intimate mechanical contact due to the application of pressure assists greatly in the conduction of heat away from the insulated conductor.

The resulting body, composed of a thinly electrically insulated electrical conductor embedded and hermetically sealed in a closely applied mass of metal, may be employed for any purpose for which electrical heating apparatus is desired. It in some cases will form the stove or heating apparatus itself, or it may be placed in a suitable casing of other metal or material.

Such a device may also be employed as a rheostat or resistance for electrical circuits, or in other situations in which it is desired to increase the current carrying capacity by enabling the heat energy developed in it to be rapidly dissipated. The device was however especially designed with reference to its use for tools in whose operation heat is required, such as flat-irons and soldering irons.

The accompanying drawings illustrate the manner of carrying my invention into effect.

Figure 1 is a longitudinal section, and Fig. 2 a horizontal section of an electrical heating apparatus. Figs. 3 and 4 illustrate a process of applying the metal covering to the insulated conductor. Fig. 5 is a section illustrating a modification of the arrangement, and Fig. 6 an illustration of the application of my invention to a soldering iron.

In Figs. 1 and 2, *a* is a suitable wire or conductor, covered throughout its length with an insulating covering *b*, of the character before described. The wire, as shown, is laid in a series of curves, and the whole is embedded in a body of metal *c*, which, by casting, or molding, or by pressure, closely surrounds the insulated conductor, penetrating between the convolutions thereof, holding the same in place, and providing effectively for the rapid conduction of heat away from the conductor. The ends of the conductor may be provided with suitable terminals of larger wire, or of better conducting metal, extending out from the metal body. These terminals are made larger, so that the portion exposed to the air will not be heated excessively by the current.

In Fig. 3 the wire *a*, as shown, is placed between two strips or sheets *d* of mica or other similar material, and these in turn are placed between the two plates *c* of lead or other suitable metal. On the application of pressure to the lead plates, they, with the mica strips, are forced together upon the wire, the result being as illustrated in Fig. 4, that the wire is covered locally with a thin insulating covering, and the insulated wire is embedded in a closely applied metal body.

In some cases, for convenience in applying the metal to the insulated conductor, it may be desirable to have the said conductor inclosed in a metal casing before the heat conductor is cast about it. Such an arrangement is illustrated in Fig. 5, in which the conductor *a*, provided with the insulating covering *b*, is placed in a closely surrounding metal tube *e*, the whole being embedded in the metal body *c*, as before described. The metal tube *e* is so applied by squirting or otherwise so as to secure the most intimate mechanical contact possible.

In Fig. 6, *f* is the shank of a soldering iron, through which the wires *g* pass to the head of the iron. The spirally coiled wire *a*, insulated with refractory material, is shown within the head of the iron, such head being made of a solid body of copper or brass cast about the wire and surrounding it completely at every part.

What I claim is—

1. A device in which electrical energy is converted into heat, having a thinly insulated conductor embedded in, and completely surrounded by, a closely applied mass of metal, substantially as set forth.

2. In a device in which electric energy is converted into heat, the combination of a conductor, an insulating covering for such conductor of a minimum thickness necessary to electrically insulate it, and a comparatively large mass of metal, closely applied to and surrounding the said insulated conductor, throughout its entire length, substantially as set forth.

This specification signed and witnessed this 20th day of March, 1893.

HARRY WARD LEONARD.

Witnesses:
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JOHN R. TAYLOR.