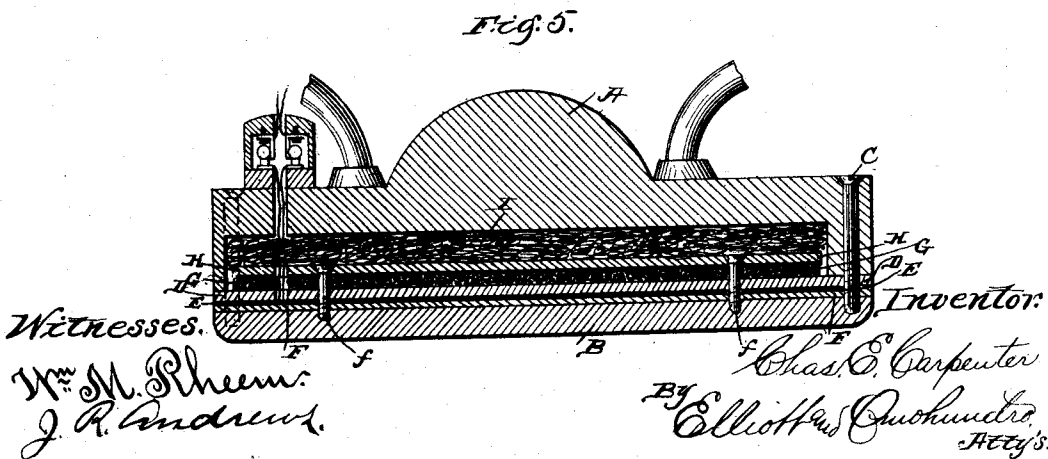
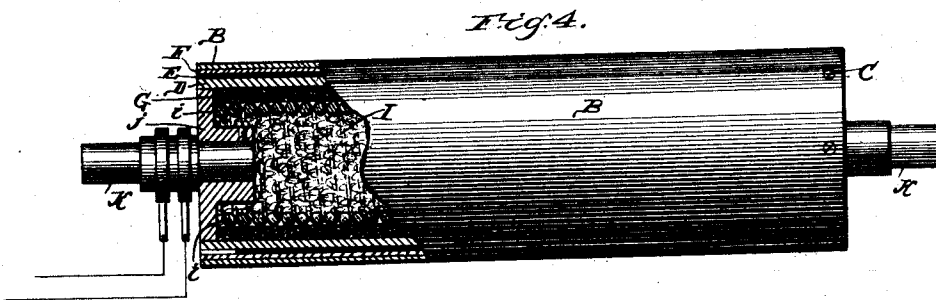
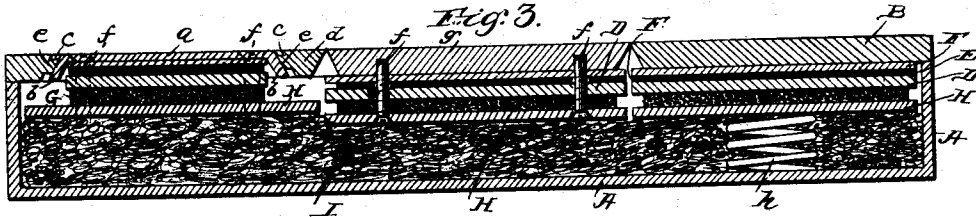
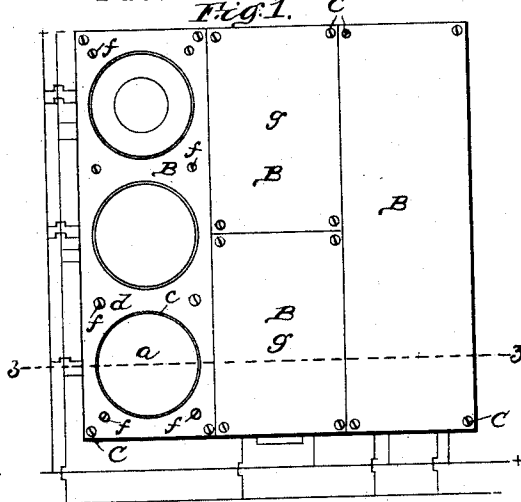
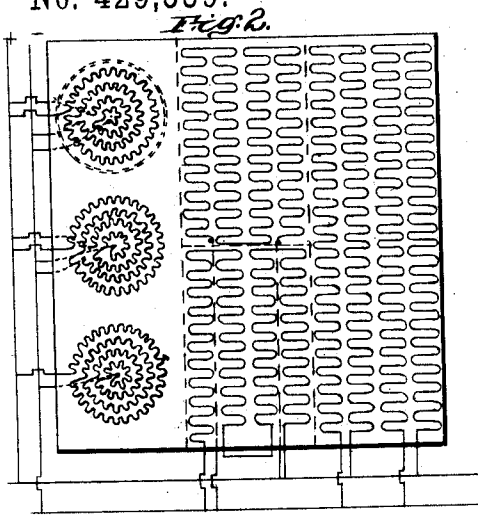


(No Model.)

C. E. CARPENTER.
ELECTRIC HEATING APPARATUS.

No. 429,559.

Patented June 3, 1890.



Witnesses.

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UNITED STATES PATENT OFFICE.

CHARLES E. CARPENTER, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO THE CARPENTER-NEVENS ELECTRO-HEATING COMPANY, OF SAME PLACE.

ELECTRIC-HEATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 429,559, dated June 3, 1890.

Application filed December 17, 1889. Serial No. 334,125. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. CARPENTER, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Improvements in Electro-Heating Apparatus, of which the following is a specification.

This invention relates to improvements in electro-heating apparatus for utilizing the heat developed by passing an electric current through a conductor of high resistance and small capacity, but is more especially designed as an improvement upon the invention set forth in my application for Letters Patent, Serial No. 319,960, filed August 6, 1889, since patented, No. 415,856, dated November 26, 1889, in which, broadly speaking, the apparatus consisted of a body of any character, a heated surface-plate therefor, an electrical resistance lying between said body and plate, a layer of electrical insulating material between said resistance and the plate, and a layer of electrical insulating but non-heating conducting material between said resistance and the body, and, in a more limited sense, to a filling or packing of non-combustible heat-insulating material lying in a recess in the body behind the elements before specified, for the purpose of aiding in directing and confining the heat to the surface-plate.

I find by experience that for the better and more efficient working of such apparatus it is necessary to keep the heat-generating resistance in firm contact with the electrical insulating sheet or substance, and in turn this electrical insulator in firm contact with the heated surface-plate, not only for the well-known reason that heat is much more quickly and efficiently transmitted when the transmitting bodies are under pressure, but because the filling of non-combustible heat-insulating material next the body of the utensil, when used for some time, will shrink and occupy less space than when first put in place, as a result of which, there being no pressure upon the resistance-supporting card or layer of material, the resistance at some points will fall away from the heated surface-plate and no longer make contact therewith. When this occurs, air-spaces are formed, and as the heat cannot be transmitted by conduction

radiation from the resistance is necessary in order to dissipate its heat, which reacts thereon, raising the temperature thereof and causing the same to become fused, thus destroying its function as a conductor of electricity by reason of the consequent breaking of the circuit.

In the prior apparatus included in my aforesaid application I relied upon the elasticity of the non-combustible heat-insulating filling substance to continually produce the necessary pressure, so as to press the electrical insulating substance to which the reflexed resistance is attached firmly in the direction of the heated surface-plate; but for the reasons before stated I have found this method not satisfactory and efficient under all conditions.

It is well known that a substance in order to be a good conductor of heat must have a loose and discontinuous structure, and if firmly compressed, as is necessary in this case, between two surfaces with a pressure tending to force them together, it would be rendered more compact and at the same time, by reason of such compactness, become a better conductor of heat.

The prime object of this invention therefore is to intensify the heating effects produced by passing a current of electricity through a conductor of high resistance and small capacity by subjecting the resistance to constant pressure, tending to firmly force the same toward the surface to be heated.

Another object is to avoid the occurrence of air-spaces and the breaking of contact between the resistance and the heated surface-plate and thus prevent the fusion of the resistance and the consequent breaking of the electric current thereby.

A further object is to better confine the heat so generated to such part or parts only of the body as may be desired by subjecting the active elements of the apparatus to constant pressure and at the same time interposing between the active elements and the body a filling of heat-insulating material not under pressure. These objects are attained by the devices illustrated in the accompanying drawings, in which—

Figure 1 represents a plan view of a cooking-stove or griddle-cake baker embodying my invention; Fig. 2, a similar view showing

the top or heating plates of the stove removed, more clearly disclosing the arrangement and disposition of the resistance for said plates; Fig. 3, an enlarged transverse section on the line 3 3 of Fig. 1, illustrating several different means for producing pressure upon the resistance. Fig. 4 illustrates the application of my invention to a laundry or other heating roller, and Fig. 5 the application of my invention to a sad-iron.

Similar letters of reference indicate the same parts in the several figures of the drawings.

The apparatus shown in the drawings is similar to that illustrated in the drawings of my aforesaid application, both as to form and application, and embodies the main features thereof in substantially the same arrangement and for the same purpose, for which reason I will only refer to these features generally which are common to all the forms.

Referring by letter to the accompanying drawings, let A represent the main body of the apparatus, whether stove, iron, or other form of utensil in which such a body is desirable; B, the surface plate or plates to be heated, secured together by means of screws C or in any other well-known and convenient manner, between which are interposed, first, a card or sheet D of asbestos, cloth, or other suitable electric insulating and non-heat-conducting material, to the outer surface of which is secured a metallic resistance E, preferably consisting of wire of a refractory character reflexed back and forth over the surface of the asbestos sheet, as illustrated in Fig. 2, and preferably secured thereto by any convenient form of fastening, such as sewing with asbestos-thread, staples, or other suitable devices. This metallic resistance is separated from the heated surface-plate by another layer F, of substantially the same size and contour as the sheet D, composed of some electrical insulating substance which is non-combustible and of just sufficient thickness to prevent the wire or other material used as a resistance from coming in contact with the surface-plate to be heated—such, for instance, as very thin asbestos-paper—it being understood that this sheet, while a non-conductor of electricity, should be a good conductor of heat, and should therefore furnish as great contacting-surface for the resistance-wire as possible. The yielding character of asbestos-paper will permit the wire to sink into it so as to be partially encircled thereby, and thus afford the greatest contact-area for said wire for the transmission of its heat.

The body of the utensil should be hollow or recessed to a sufficient depth immediately back of the insulating-sheet D; but instead of filling this entire space with asbestos, fire-felt, mineral wool, or some other substance which is a non-conductor of heat, as in my aforesaid application, I first provide one or two layers G of asbestos fire-felt of substantially

the same shape and contour as the sheet D, and a compressure-plate H of sufficient thickness to stand considerable pressure without springing perceptibly, and which is forced toward the heated surface-plate by means of screws, springs, or any other equivalent devices for firmly pressing the resistance toward the surface-plate, this compressor-plate serving to bind the surface-plate, electrical insulator, resistance, the electrical insulator to which the resistance is secured, and the heat-insulating fire-felt firmly together into a compact body of active elements under considerable pressure, which may be regulated and varied at the will of the operator.

As before stated, the general features of construction are similar to and their operation identical with the corresponding elements of my said prior application, the purpose of which was to utilize the heat produced by passing a current of electricity through a conductor of high resistance and small capacity, and a detailed description of those features is not necessary; but this invention has for its object the further purpose of intensifying the heat so produced by subjecting the resistance to a constant pressure, tending to force it firmly toward the heated surface-plate, which may be accomplished by numerous devices and in various forms of apparatus, some of which are illustrated in the drawings hereto attached, and which will now be described.

Referring more particularly to Figs. 1 and 3, it will be observed that the surface of the stove is divided into three principal parts or sections, one of which is subdivided into two parts of half the dimensions of the original section and another into three parts circular in form and corresponding to the lids of an ordinary stove, the main plate of the section in this case constituting a support for the lids and is not intended to be heated, the heat being confined to the circular sections alone by the disposition of the resistance illustrated in Fig. 2, and the separation of the circular sections from the main body, as in my aforesaid application. In this latter case the circular lids *a* are preferably provided with annular beveled flanges *b*, fitting into corresponding openings *c* in the top or supporting plate *d* of the section, the walls of which openings are beveled correspondingly with the flanges of the surface-plate, converging from the inner to the outer surface of said plate, and provided with inwardly-projecting lugs *e*, against which the flange of the surface-plate bears, so as to leave a space or opening between the surface and top plate at all points except where the lugs occur, and thus reduce the contact between said plates, and consequently the conduction of heat from the heated surface to the supporting or top plate. This surface-plate is held firmly in position, and the resistance and other active elements are forced firmly toward it by means of screws *f*, (shown in dotted lines in Fig. 3,) which

work through said plate and engage the compressor-plate H, drawing the latter toward the surface-plate, and thus transferring the weight of all the active elements to the surface-plate, from which they are suspended by the screws. In the center or rectangular section which is subdivided the same pressure is produced by screws; but in this case it is preferable that screw-heads should not break the continuity of the surface-plate *g*, for which reason they work through the compressor-plate and the intervening layers without contact with the resistance, and screw into the surface-plate from the under side, in effect producing the same result, however, as the screws in the first-described construction. In the third section, however, the pressure is shown as produced by means of a coil-spring *h*, confined between the compressor-plate and the bottom or body of the utensil, any number of which may be employed, the expansive force thereof tending to press the elements firmly together, the surface-plate in this case being fastened direct to the body of the utensil, so as to oppose the force of the springs.

In the case of the laundry or other heated roller illustrated in Fig. 4 the compressor-plate may be formed in sections or dispensed with entirely, but preferably is of such form as to have self-contained compressor or expansive force—such, for instance, as the coiled spring *i*, fitting within the cylinder, the expansive force of which tends to press the active elements outwardly, the surface-plate, which in this case is in the form of a cylinder or shell, being preferably secured to heads *j* by screws or otherwise, to which are secured the journals *k* of the roller. Obviously, instead of the expansible coil-spring *i* its well-known equivalent in the form of an expansible-spring lining of sheet metal may be employed, and produces the same result. In both these forms the compressor performs the double function of a compressor-plate and the screws, springs, or other devices for applying pressure thereto.

In the case of the sad-iron illustrated in Fig. 5 substantially the same construction as that applied to the central section of Fig 1 may be employed, and for the same reasons, the only difference being that the parts are inverted, but otherwise are exactly the same both in construction and operation. Obviously, the distance between the compressor-plate and the heated surface-plate may be varied at will to accommodate differing thicknesses of fire-felt or heat-insulating material, and also the pressure can be varied and the shrinkage of the various layers taken up, so as to prevent looseness thereof or air-spaces intervening therebetween.

For the purpose of better confining the heat to the surface-plate and to prevent the radiation of the heat from the compressor-plates, which will eventually become hot by reason of their confinement and the comparatively

small amount of heat-insulating material between them and the heat-evolving resistance, I propose to fill the recesses in the body of the utensil behind the compressor-plate or the space intervening between it and the bottom of the utensil with some loose substance I—such as mineral wool, asbestos, or other good non-conductor of heat—which structure by reason of the employment of the loose heat-insulating or non-conducting substance not under pressure almost perfectly prevents the escape of heat, so that the bottom of the utensil or the body thereof hardly ever becomes warm. The importance of this filling for the purpose of confining the heat to the surface-plate will be appreciated when it is known that the greater the quantity of fire-felting used between the compressor-plate and the resistance the greater will be the amount of heat absorbed thereby until the temperature thereof has reached a certain degree, as a result of which the heat forced toward the surface-plate is not as great or effective as it should be until the fire-felting or other heat-insulator has become quite thoroughly heated, for which reason I prefer to employ as little of the fire-felting as possible between the compressor-plate and the resistance, which I am enabled to do in the minimum amount by the use of this loose filling of non-combustible heat-insulating material intervening between the compressor-plate and the body or bottom of the utensil.

The principal advantage of employing pressure in a structure as herein described is that the shrinking of all the yielding elements may be readily taken up, so as to insure at all times a perfect contact between every part of the resistance and the heated surface-plate, it of course being understood that the electrical insulating-sheet always intervenes between the resistance and the surface-plate, so that the resistance cannot fall away at any point from the surface-plate and break contact therewith, for, should this occur, air-spaces would be formed, and as the heat cannot be transmitted to the surface-plate by conduction radiation is necessary in order to dissipate the heat of the resistance which reacts upon the resistance, raising its temperature and causing the same to become fused, thus destroying its function as a conductor of electricity by the break in the circuit caused by such fusion.

Another advantage of the use of pressure in holding the active elements together is that the resistance will be buried or sunk into the insulator between it and the surface-plate, and thus be furnished with the greatest possible contacting-area for the transmission of its heat, and at the same time reduces the thickness of the intervening electrical insulator to the minimum degree of thickness, leaving only just sufficient to serve as an electrical insulator without offering any material obstruction to the transmission of the heat.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an electro-heating apparatus, the combination, with the body, the heated surface-plate thereof, an electrical resistance, a layer of electrical insulating material between said resistance and plate, and a layer of electrical insulating non-heat-conducting material between said resistance and the body, of a compressor-plate lying parallel with the surface-plate for forcing said resistance and layers toward the surface-plate, substantially as described.
2. In an electro-heating apparatus, the combination, with the body, the heated surface-plate thereof, an electrical resistance, a layer of electrical insulating material between said resistance and plate, and a layer of electrical insulating non-heat-conducting material between said resistance and the body, of a compressor-plate lying parallel with the surface-plate for forcing said resistance, a layer of heat-insulating material interposed between said compressor-plate and the second layer of electrical insulating material, and screws or their equivalent for forcing said compressor-plate toward the surface-plate, substantially as described.
3. In an electro-heating apparatus, the combination, with the body, the heated surface-plate thereof, a compressor-plate parallel with said surface-plate, and means for forcing the same toward the surface-plate, of an electrical resistance and electric insulators on each side thereof confined between said surface and said compressor plates, substantially as described.
4. In an electro-heating apparatus, the com-

bination, with the body provided with a recess therein, the heated surface-plate covering said recess, a compressor-plate located in said recess lying parallel with the surface-plate, and a filling of non-combustible heat-insulating material in said recess interposed between said compressor-plate and the body, of an electrical resistance and a layer of electrical insulating material on each side thereof confined between said compressor and surface plates, substantially as described.

5. In an electro-heating apparatus, the combination, with the body, the heating surface-plate thereof, and a compressor-plate lying parallel with said surface-plate, of an electrical resistance, a layer of electrical insulating material on each side thereof, and a layer of heat-insulating material between said members and the compressor-plate, all of which are confined between said compressor and surface plates, substantially as described.

6. In an electro-heating apparatus, the combination, with the body provided with a recess, the heated surface-plate covering said recess, a compressor-plate located in said recess parallel with the surface-plate, and a filling of non-combustible heat-insulating material in said recess between the compressor-plate and body, of an electrical resistance, a layer of electrical insulating material on each side thereof, a layer of heat-insulating material between said members and the compressor-plate, all of said members being confined between the compressor and surface plates, substantially as described.

CHARLES E. CARPENTER.

Witnesses:

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ROBT. T. LANG.