

Nov. 27, 1945.

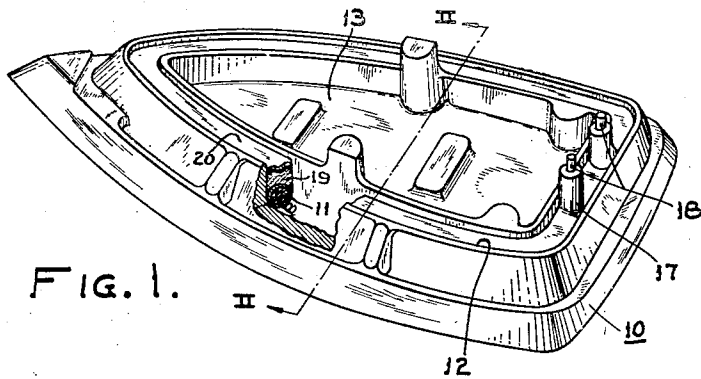
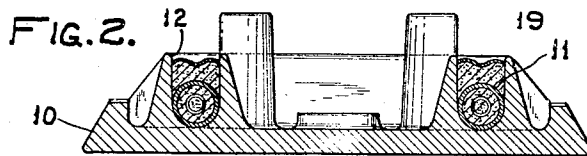
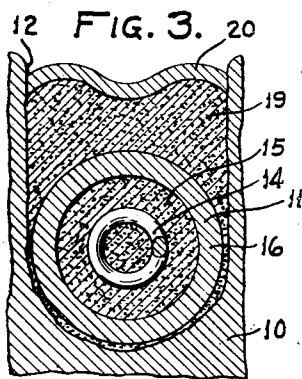
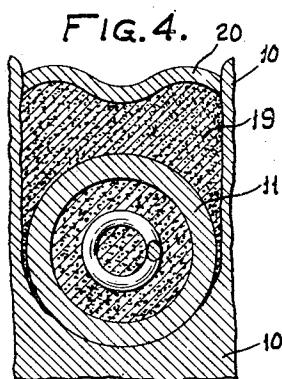
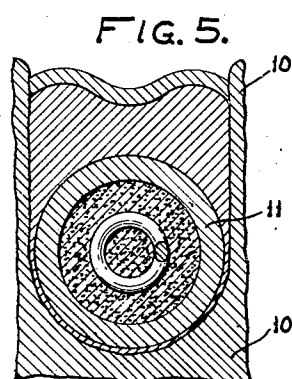
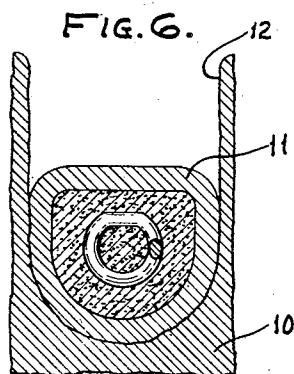
K. L. WOODMAN

2,389,588

HEATING APPARATUS

Filed Oct. 29, 1942

2 Sheets-Sheet 1



WITNESSES:

R. H. Enwall.
C. H. Lutz

INVENTOR
KENNETH L. WOODMAN.

BY *R. J. Cisinger*
ATTORNEY

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HEATING APPARATUS

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2 Sheets-Sheet 2

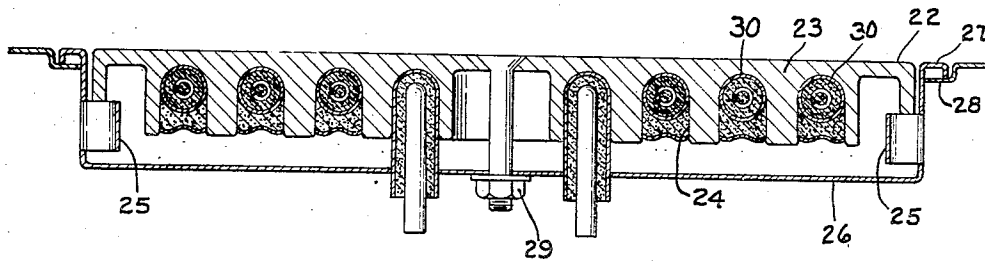


FIG. 7.

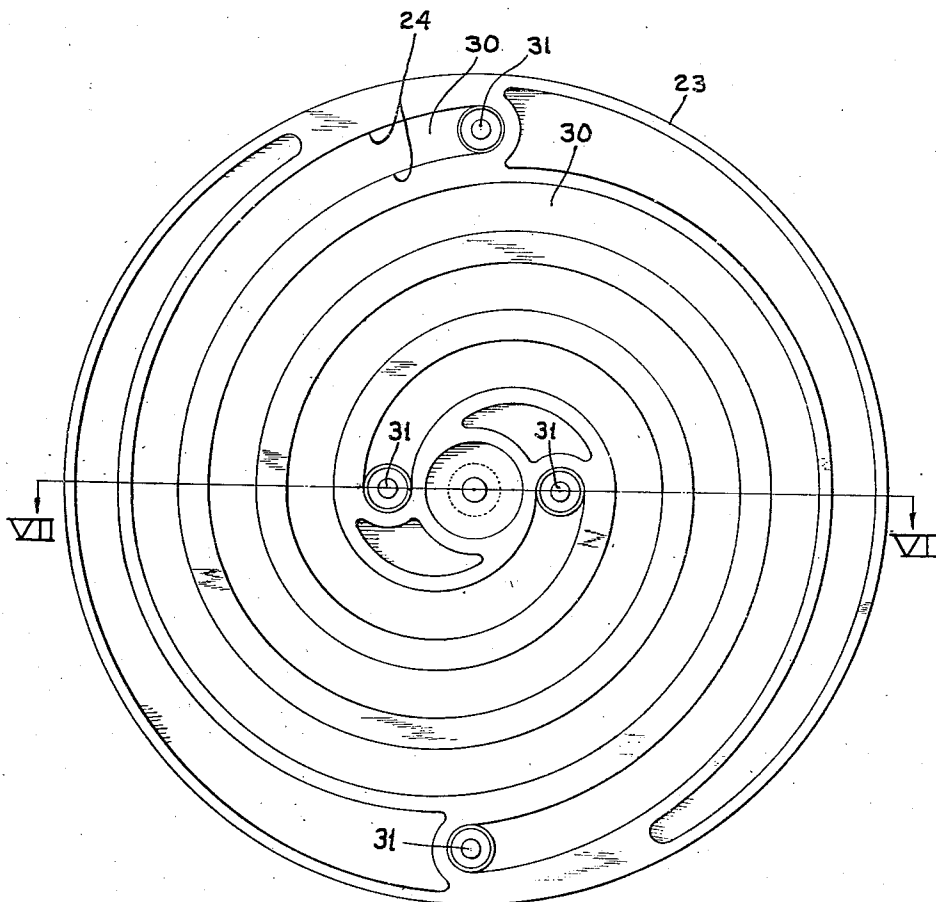


FIG. 8.

WITNESSES:

Ray E. Wall
E. H. Lutz

INVENTOR

KENNETH L. WOODMAN.

BY

R. J. Eisinger
ATTORNEY

UNITED STATES PATENT OFFICE

2,389,588

HEATING APPARATUS

Kenneth L. Woodman, Mansfield, Ohio, assignor
to Westinghouse Electric Corporation, East
Pittsburgh, Pa., a corporation of Pennsylvania

Application October 29, 1942, Serial No. 463,758

11 Claims. (Cl. 219—25)

This invention relates to heating apparatus and particularly to an improved electrical heating unit and the method of making the same.

It is an object of the invention to provide an improved metal-clad, electrical heating unit, such as a flatiron soleplate or a range surface heating element embodying a heated member having a sheathed heating element therein, which member may be ground and polished before applying the sheathed heating element thereto.

It is another object of the invention to provide an improved metal-clad, electrical heating unit, such as a flatiron soleplate or a range surface heating element, which does not require the use of metals which are now difficult to obtain, such as chromium and nickel, in the protective and heat-distributing covering.

In accordance with the present invention, a sheathed electrical resistance is pressed into a groove formed in the body to be heated, such as the soleplate of a flatiron or the top plate of a range surface unit, with sufficient pressure to force a substantial portion of the surface of the sheath into intimate contact with the wall of the groove, so that the cooler body rapidly removes the heat from the sheath. The exposed surface of the sheath is covered by material which has good heat-conducting properties, and which is firmly pressed into the groove to provide a heat shunt or path for rapidly conducting heat away from that portion of the sheath surface not in contact with the body. By providing a path of good heat conduction from the entire surface of the sheath, the temperature of the sheath is substantially uniform throughout and is maintained low enough to permit the use of low temperature metals such as steel, which could not be employed if the sheath developed hot spots at portions where there were no means for rapidly removing the heat from the sheath.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a perspective view, partially broken away, of a flatiron soleplate made in accordance with the present invention;

Fig. 2 is a sectional view taken substantially on the line II—II of Fig. 1;

Figs. 3, 4, 5 and 6 are enlarged sectional views of a portion of the soleplate illustrated in Fig. 1 and showing several modifications of the invention;

Fig. 7 is a sectional view of a surface heating

unit such as used in electric cooking ranges and the like and in which the present invention is incorporated; and,

Fig. 8 is a bottom plan view of the top plate of the unit shown in Fig. 7.

Referring first to the embodiments of the invention illustrated in Figs. 1 to 6, the soleplate, generally indicated 10, may be of conventional outline and is provided with a sheathed heating element 11. The soleplate is preferably made of metal, such as cast aluminum or iron and, as well understood in the art, will be provided with superstructure (not shown) including a cover or shell and handle, together with thermostatic means for controlling the temperature of the soleplate. The soleplate casting may be similar to that shown in Arnold et al. Patent No. 2,222,192, granted November 19, 1940 and assigned to the assignee of the present invention. The soleplate 10 has a cast-in, channel-like groove 12 extending therearound near its edges for receiving the sheathed heating element and is provided with a central, approximately triangular recessed area 13 in which a thermostatic switch or the like, not shown, is adapted to be mounted.

The sheathed heating element 11 comprises a resistance wire 14 embedded in highly-compacted, heat-conducting, electrical insulating material 15 disposed within a tubular metal sheath 16. The manner of making the sheathed heater is well known and need not be described. The sheath may be made of steel tubing and is preferably of a size to be snugly received in the groove 12. The ends 17 of the heating element are turned up at the rear of the soleplate to facilitate connection of the terminal pins 18 of the resistance wire 14 to the usual supply cord in series with a thermostatic switch mounted in the mentioned central recess 13.

The portion of the groove 12 above the sheathed heater is filled with a cement-like material 19 and closed by a cover plate 20 like that disclosed in the mentioned Arnold et al. patent. The plate 20 serves to retain the cement in place as well as protect the same. The cement and cover plate, in addition to aiding in retaining the sheathed element within the groove 12, have the added function of providing a heat shunt or path to conduct heat, which would normally radiate upwardly from the upper surface of the sheath, to the side walls of the groove. For this reason, it is preferred to use a cement having high thermal conductivity so that the heat is rapidly removed from the sheath and the temperature of the sheath is maintained substantially uniform

throughout. A cement made of silicon carbide and water-glass has been found satisfactory for this purpose.

In practicing the invention, the soleplate 10 is cast, in the form shown in Fig. 1, with the deep channel-like groove 12 therein. This casting, which is usually rough, is ground and polished and plated, if desired, before assembling the sheathed heating element thereto. It will be appreciated that by grinding and polishing the soleplate casting before assembling the heating element thereto, any casting defects become apparent and the casting alone may be scrapped or repaired, if possible. If it were necessary to assemble the heating element prior to finishing the soleplate, defects later discovered would require scrapping of both the casting and the heating element.

In Fig. 3, there is shown one manner of securing the sheathed heating element to the soleplate. In this modification, the groove 12 is not finished but left in its rough, cast condition. If the groove is very uneven and rough, a thin slip of silicon carbide-water-glass cement is applied to the sheath before placing it in the groove. The coated sheath is then placed in the groove and pressed into place under a pressure of 10 to 15 tons per square inch so that the irregularities of the casting imbed themselves in the sheath and provide good metal-to-metal contact between the sheath surface and the adjacent surface of the groove. Any voids occurring between these surfaces are filled by the slip of silicon carbide-water-glass cement which, as previously mentioned, has been selected because of its good thermal conductivity. The groove is then filled with a thick paste of this same cement and the clamping plate 20 pressed into the groove in the manner disclosed in the Arnold et al. patent to imbed the edges of the plate in the side walls of the groove. The excess cement is then washed off and the soleplate heated for a period of approximately 16 hours at a temperature of 400 to 500° F. to dry out the cement. This drying process sets the cement and removes any moisture that might be present.

In Fig. 3, the surface of the sheath is shown spaced from the adjacent wall of the groove merely for the sake of illustrating the function of the slip applied to the sheath, it being understood that the slip applied to the sheath merely fills voids which occur between the rough side wall of the groove and the outer surface of the sheath, a substantial portion of the sheath being in direct contact with the wall of the groove.

In Fig. 4, there is illustrated a slightly modified form of the invention in which the walls of the groove 12 are made smooth. In this case, it is unnecessary to apply a slip of silicon carbide-water-glass cement to the sheath before inserting it in the soleplate, the pressure of 10 to 15 tons applied to the sheath in assembling it in the smooth groove being sufficient to press the surface of the sheath into substantially continuous metal-to-metal contact with the smooth wall of the groove. Otherwise the method of assembling and completing the soleplate is identical with that described in connection with Fig. 3.

In order to eliminate the necessity of handling the cement 19 and the washing and drying operations, powdered metal 21 (Fig. 5), such as iron, copper, aluminum or the like, may be used as a filling material. In this case, either a smooth or rough wall groove may be employed, and the groove may be partially filled with the powdered

metal before pressing the sheathed element into the groove if desired. After inserting the heating element in the groove and applying pressure thereto, the remainder of the groove is filled with powdered metal and compacted under high pressure either before or after applying the clamping plate. If desired, a small amount of silicon carbide-water-glass cement may be applied to the powdered metal at the upturned terminals 17 to prevent the powdered metal from leaking out.

Another method of assembling the heating element to the casting is shown in Fig. 6, wherein the groove 12 is of a width substantially identical with that of the sheathed heating element 11. The heating element is pressed into the groove with a pressure of 15 to 20 tons per square inch. This extremely high pressure forces the sheath to conform with the irregularities of the surfaces of the groove and, by virtue of this interlock between the sheath surface and the wall of the groove, the parts are permanently held together. The groove may then be filled, in the manner described above, with silicon carbide-water-glass cement or powdered metal and a cover plate applied thereto for retaining and protecting the filling material.

In Figs. 7 and 8, the invention is shown applied to a surface heating element 22, such as employed in electrical cooking ranges. The surface element comprises a cast metal top plate 23 having a pair of concentrically-arranged spiral grooves 24 provided in the under surface thereof. This top plate, as shown, is supported on spaced lugs 25 formed in the side walls of a pan 26 provided with an outwardly-turned annular flange 27 adapted to engage the margin 28 of the range top at the opening which receives the surface unit. The cast top plate may be secured to the pan by means of a central bolt and nut assembly, generally indicated 29. Two spiral, sheathed heating elements 30 are assembled in the grooves 24 in accordance with any of the methods previously described and arranged with their respective terminal rods 31 projecting down through the pan 26 for connection to a suitable source of electricity.

While the invention has been shown in several forms, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. A heating unit comprising a metallic member having a groove therein, an armored heating element comprising an outer metallic sheath enclosing a resistance element insulatedly supported therein, said armored element being disposed in said groove, said armored heating element being deformed by the application of pressure of the order of several tons per square inch so that the lower half of said sheath conforms substantially to the shape and irregularities of the adjacent surface of said groove and a substantial portion of the surface of said lower half of the sheath being in intimate contact with the adjacent surface of said groove, and material covering the portion of the surface of said sheathed element which is not in contact with said surface of said groove to provide a heat shunt over the exposed surface of said sheath.
2. A heating device comprising a metallic body having a groove therein, an electrical heating element comprising a tubular sheath having a

resistance wire embedded within electrical insulating material in said sheath, said heating element being disposed in the bottom of said groove with a substantial portion of the surface of said sheath in contact with the wall of said groove and with the lower half of said surface of the sheath in intimate contact with the surface of said groove as the result of the application of pressure of the order of several tons per square inch, and heat-conducting material filling said groove above said sheath.

3. A heating element comprising a metallic member having a groove therein, an armored heating element comprising an outer metallic sheath enclosing a resistance element insulatedly supported therein, said armored element being disposed in said groove with a substantial portion thereof in intimate contact with the adjacent surface of said groove as the result of the application to said heating element while it is in said groove of a pressure of the order of several tons per square inch, the surface of the bottom of the groove conforming substantially to the outer surface of the lower half of the metallic sheath, and material covering the portion of the surface of said sheathed element which is not in contact with said surface of said groove, and a cover plate engaging said metallic member and overlying said material to provide therewith a heat shunt over the exposed surface of said sheath.

4. The method of making an electric heating unit comprising providing a metallic member having a groove formed therein, placing a sheathed heating element in said groove, applying pressure of the order of 10 to 20 tons per square inch to said heating element to force the surface of said sheath tightly against the adjacent surface of said groove, filling said groove to a point above said heating element with material having good thermal-conducting properties, and pressing a cover plate into said groove over said material to seal said material in said groove and to provide with said material a heat shunt.

5. The method of making an electric heating unit comprising providing a metallic member having a groove therein, placing a sheathed heating element in said groove, applying pressure of the order of 10 to 20 tons per square inch to said heating element to force the surface of said sheath tightly against the adjacent surface of said groove, and filling said groove to a point above said heating element with material of good thermal-conducting properties.

6. The method of making an electrical heating unit comprising providing a metallic member having a groove therein, placing a sheathed heating element in said groove, applying pressure of the order of 15 to 20 tons per square inch to said heating element to force the surface of said sheath tightly against the adjacent surface of said groove.

7. The method of making an electrical heating unit which method comprises providing a member having a groove therein, pressing a metallic sheath electrical heating element into said groove with a pressure which is of the order of several tons per square inch and which is sufficient to deform the sheath and to provide inti-

mate contact between a substantial portion of the outer surface of said sheathed heating element and the wall of said groove, filling the remainder of said groove to a point above said heating element with material having good thermal-conducting properties.

8. The method of making an electrical heating unit which method comprises providing a member having a groove therein, pressing a metallic sheathed electrical heating element into said groove with a pressure which is of the order of several tons per square inch and which is sufficient to deform the sheath and to provide intimate contact between a substantial portion of the outer surface of said sheathed heating element and the wall of said groove, filling the remainder of said groove to a point above said heating element with material having good thermal-conducting properties, and applying a cover plate over said cementitious material.

9. The method of making an electrical heating unit which method comprises providing a member having a groove therein, pressing a metallic sheathed electrical heating element into said groove with a pressure which is of the order of several tons per square inch and which is sufficient to deform the sheath and to provide intimate contact between a substantial portion of the outer surface of said sheathed heating element and the wall of said groove, filling the remainder of said groove to a point above said heating element with material having good thermal-conducting properties, and applying a cover plate over said cementitious material, and then heating said unit to dry said material.

10. An electrical heating device comprising a flat body having a plane surface on one side thereof adapted to contact the material to be heated and having a groove in the opposite side thereof, an electrical heating element comprising a tubular sheath and a resistance wire embedded within electrical insulating material in said sheath, said heating element being pressed into the bottom of the groove by the application to said heating element while it is in the bottom of the groove of a pressure which is of the order of several tons per square inch, the lower half of the outer surface of the sheath conforming substantially to the shape of the bottom of the groove, a substantial portion of the surface of the lower half of the sheath being in intimate contact with the adjacent surface of the bottom of the groove with the irregularities of the bottom of the groove being embedded in said lower half of the sheath.

11. The method of making an electrical heating unit which comprises providing a metallic member having a groove therein, pressing a metallic sheathed electrical heating element into said groove with a pressure which is of the order of several tons per square inch and which is sufficient to force the outer surface of the lower half of the sheath to conform with the irregularities of the surface of the bottom of the groove, thereby to provide intimate contact and good heat conduction between a substantial portion of the outer surface of the sheathed heating element and the surface of the groove.

KENNETH L. WOODMAN.