Aug. 1, 1950 H. INGRAM 2,517,110

ELECTRIC HEATER

Filed May 14, 1947 2 Sheets-Sheet 1

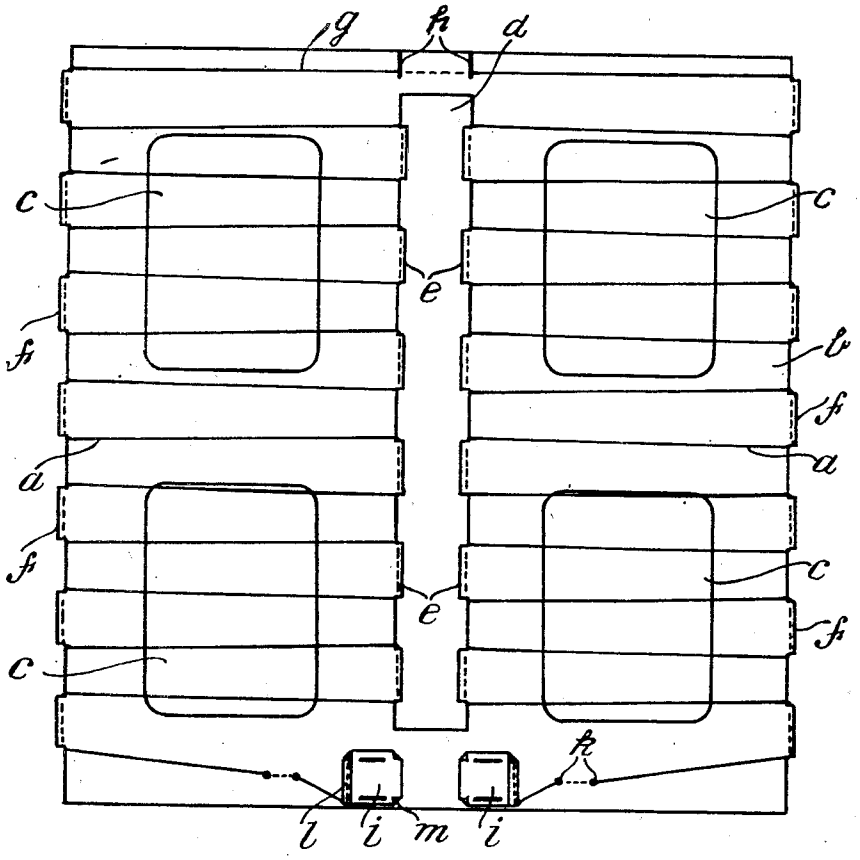


Fig. 1.

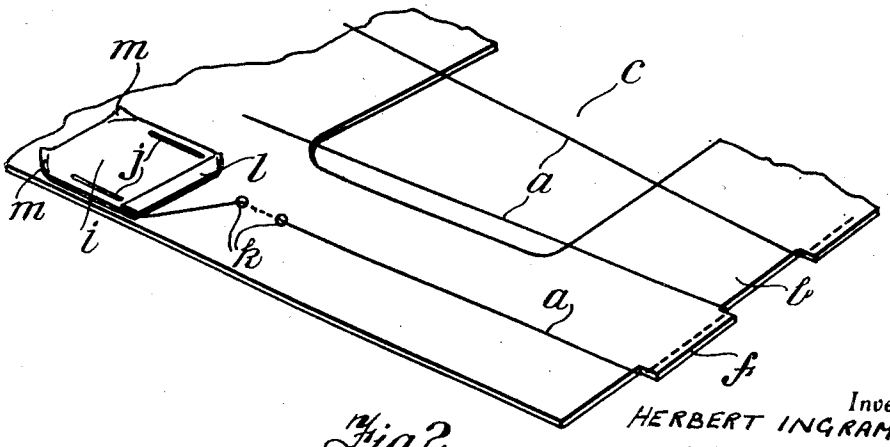


Fig. 2.

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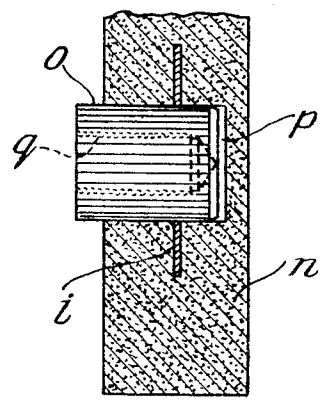


Fig. 3.

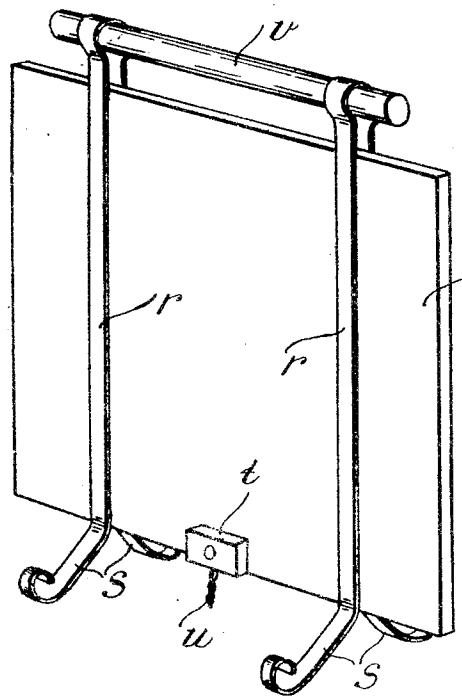


Fig. 4.

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2,517,110

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ELECTRIC HEATER

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5 Claims. (Cl. 201—73)

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This invention relates to electric heaters or radiators for domestic and other purposes and has for its object to provide an improved form of electric heater and method of constructing the same.

According to the invention an electric heater or radiator is manufactured by forming an electric resistance element wherein the coils or turns of wire are maintained in interspaced relationship, by totally enclosing the said element within a body of insulating material, by subjecting the said body to treatment by pressure and heat whereby the insulating material is caused to bond between the coils or turns of wire which are thereby completely embedded within the hardened body resulting from the heat treatment, and by subsequently providing the embedded wire or wires with means for connection to a source of electrical power supply.

The insulating material employed is of a character which will harden and form a homogeneous body under heat treatment and be sufficiently resistant to heat to remain unaffected by operation as a heater. A suitable insulating material for the purpose consists of a vitreous body in which finely divided mica and/or other dielectric materials are dispersed. In particular the insulating material employed is a micaceous insulating material formed by mixing low fusing point vitreous material with powdered mica and heating the mixture so that the mica is bonded to the vitreous material at a temperature below the point of total dehydration. The resulting product (which can be sawn, drilled or otherwise tooled) is a material resembling slate in appearance and which has a tensile strength considerably in excess of that of other porcelain or plastic insulators. This mica insulating material therefore is not to be confused with the concrete material of Miller (U. S. Patent No. 2,408,149, September 24, 1946) or the plastic material of Megow (U. S. Patent No. 2,302,256, November 17, 1942) and gives rise to the problem how to insert the electrical heating element for correct positioning within the mica material and to maintain the heating element in the exact position required during the subsequent stages of pressing and heating the material.

Reference will now be made to the accompanying drawings which illustrate the manufacture of an electric heater according to the invention and in which:

Fig. 1 is a view of a heating element wound in its former prior to enclosure in the insulating material,

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Fig. 2 is a fragmentary perspective view on an enlarged scale showing one of the terminal pads,

Fig. 3 is a detail sectional view on an enlarged scale showing one method of attaching an electrical terminal, and

Fig. 4 is a view of a completed heater.

In carrying the invention into effect an electric heater or radiator is constructed by first forming the heating element shown in Fig. 1. This is effected by winding resistance wire *a* on to a cardboard former *b* which is of rectilineal form and has a number (conveniently four) of rectangular ventilation apertures *c* cut in equispaced positions within it.

The cardboard former *b* is also formed with an elongated central slot *d* whose longer edges are recessed to form two series of lugs *e*. Similar lugs *f* are formed by recessing those outer edges of the former which are parallel to the longer edges of the slot *d*. The lugs *f* occupy positions corresponding to the recesses between the lugs *e*. The two series of lugs *e* and *f* enable the wire *a* to be wound in two series of turns, as shown in Fig. 1, the turns being maintained in their correct interspaced relationship by the loop at the end of each pair of turns passing around one of the lugs. The stretch of wire which passes at *g* completely across one end of the former is retained against displacement by passing its midportion through two notches *h* cut in the adjacent edge of the former.

At the end of the former remote from the notches *h*, the ends of the wire *a* are connected to terminal pads constructed as shown more clearly in Fig. 2. These terminal pads consist of thin copper plates *i* secured to the former by wire staples *j* or any other convenient means. To prevent displacement of the end portions of the wire they are threaded through apertures *k* in the former and their ends are secured to the plates *i* by double folding one edge *l* of each over the wire and pressing flat. The curves *m* of the plates *i* are bent at right angles to the main portions of the plates to anchor the plates securely in the insulating material which is subsequently formed around the wire assembly. The former with the wire winding arranged secured as above described is embedded within a body of micaceous insulating material prepared as above described and while this material is still in the finely divided form the wire wound former is positioned between two layers of the material in a press. The material is then pressed in the cold state, resulting in the production of a rectangular plate of a thickness which may be of

the order of half an inch. This plate is then allowed to dry at room temperature. After drying the plates are subjected to heat treatment in a furnace, the first result of which is to disintegrate the cardboard former, the airspaces *c* in the former allowing sufficient air to be trapped within the pressed plate for the cardboard former to be substantially completely consumed but in order that as little residue as possible shall remain, it is preferable to use for the purpose a cardboard with a high carbon content such as strawboard.

After furnace treatment the plate is subjected to a hot pressing operation for a short period which corrects any tendency to warp and ensures that the space initially occupied by the former is filled by the micaceous material which is thereby caused to bond between the windings of resistance wire *a*, which are maintained in their initial relative positions shown in Fig. 1.

After the heating and subsequent hot pressure operation the plate is allowed to cool and is dried in air. The edges are then ground to remove any unevenness which may have resulted from the pressing operation and the heater *n* having the form shown in Fig. 3, is then ready for use after connection thereto of electrical conductors.

This invention includes means other than that above described for positioning the electrical heating element or elements within a micaceous insulating plate. For example, instead of using a cardboard former a meshwork can be prepared in which stiff threads reinforced with asbestos constitute the warp while the weft is constituted by nickel chrome wire which is afterwards to form the resistance element. This meshwork is embedded in the micaceous powder and the heater completed in the manner already described, the meshwork allowing the insulating material to bond between the wires.

According to another form of the invention, the resistance element is constructed by looping the resistance wire around two series of pins or studs mounted in a fixed support, the loops being laid on gummed paper and when the wire arrangement is completed a further sheet of paper is laid on the assembly and caused to adhere to the first sheet with the ends of the wire loops projecting around the edges. This enables the assembly to be withdrawn from the pins and inserted within the micaceous powder as before, the paper retaining the wire turns in correct relative positions during the initial pressure application but being disintegrated by the heat treatment. The adhesive used in this form of the invention must not contain gelatine or any like substance which may be inert to the heat treatment.

In all the forms above described it is necessary to provide for electrically connecting external conductors to the embedded resistance element. After completion of the heater the plate *n* is tapped and a knurled brass plug *o* (Fig. 3) is inserted into the hole *p*, which extends through the copper plate *i* and enables electrical connection to be established. The plug *o* may be provided with a screw threaded socket *q* to receive a screw and nut of any usual form, or the plug *o* may be formed integral with a screw-threaded stud. Alternatively, a spring pressed plug can be loosely inserted in the tapped hole *p* and held in position by a cover which is screwed in position adjacent one edge of the heater plate in such a manner as to screen completely the electrical connecting means. In the completed heater shown in Fig. 4, the terminals are enclosed within a small casing *t* from which extends a flexible conductor *u*.

A heater in the form of a flat plate *n* of insulating material as above described lends itself to decoration in various ways. For example, its surface or surfaces may be moulded with designs during the final heat pressing operation or it may be painted by the use of distemper or other oil-less paint. Where a very dark colour is required certain dark oil-bound paints can be used and if a copper shield is embedded on or in the moulded material certain light oil-bound paints can be used for decoration. Such copper sheet, however, would always have to be completely insulated from the wire resistance element *a*.

To use a heater as above described it is preferably mounted in slotted metal columns *r* (Fig. 4) provided with feet *s* so that the plate *n* occupies a vertical position. The structure is completed by a handle *v* to enable the heater to be carried from one position to another. Alternatively, the plate can be suspended or otherwise supported in a horizontal or inclined position according to the particular purpose for which it is to be employed. For example, a plate *n* formed as described may be used as a heating panel disposed in a recess in a wall or partition.

In addition to the above uses, the heater plates can be utilised in drying cupboards, incubators and chicken brooders for attachment to or near water pipes and tanks to prevent freezing, or for temperature raising: for vehicle heating and to prevent freezing in cooling system, either by attachment to or insertion in a suitable position on the vehicle, or by placing on the floor beneath the engine: for defrosting automobile windscreens or shop and other windows, and for prevention of moisture formation on radio and other apparatus. The plates may also be used in a horizontal position as a warming plate for chemical, industrial and domestic vessels, and as the heating plate in a photographic print dryer or glazer. Further, the plates may be surrounded by a metal shield for decorative purposes or to produce a heater which is flameproof for use in mines or in other inflammable atmospheres.

With lower wattage loadings and hence surface temperatures, they may be utilised for soil heating and other purposes where moderate heat and immunity from the effects of damp and erosion are essential.

I claim:

1. The method of manufacturing an electric heater or radiator with an electric wire resistance element embedded and totally enclosed within a body of insulating material, which comprises winding the electric wire resistance over a slotted destructible former provided with defined locations adapted for engagement by the wound wire to maintain the wire in a predetermined configuration, embedding the thus wound former within a mass of the insulating material in a finely divided or particle condition, the said material being susceptible to heat and pressure to bond and set the particles into a homogeneous whole constituting the heater body part, and subjecting the said mass, with the wire wound former therein, to heat and pressure to disintegrate the former and leave the wire bonded to the interior of the ultimately set and hardened body part.

2. The method of manufacturing an electric heater or radiator according to claim 1 wherein

the ends of the resistance wire are connected to metallic terminal pads attached to the former and adapted to receive terminal plugs or sockets after the moulding of the insulating material has been completed.

3. The method of manufacturing an electric heater or radiator according to claim 1 wherein the said former comprises a rectangular sheet of destructible material having spaced apertures therein including a central aperture and lugs formed along the edges of the said central aperture and along the edges of the sheet parallel to the said central aperture for the purpose of engaging and spacing the turns of resistance wire.

4. An electric surface heater comprising a main molded body part in the form of a flat plate or slab, said body part being composed of a micaceous insulating material and including an electric resistance element, said element being completely enclosed and embedded in the molded body part in the form of substantially parallel straight stretches of a continuous resistance wire, said wire having opposed terminal ends enclosed within said body part, electrical terminal pads also completely embedded within the molded body part and connected with said terminal ends of the resistance wire, and electric coupling means on said body part adapted for the connection of the electric power supply to said electrical terminal pads.

5. A method of manufacturing an electric heater or radiator with an electric wire resistance element embedded and totally enclosed within a body of micaceous insulating material, which comprises winding the electric wire resistance over a former having defined locations

with which the wound wire is engaged and which serve to maintain the wire, in a predetermined configuration upon the former, connecting electric terminals to the ends of the resistance wire on the former, embedding the thus wound former and electric terminal carrier within a mass of the insulating material in a finely divided or particle condition, the said material being susceptible to heat and pressure to bond and set the particles into a homogeneous whole constituting the heater body part, subjecting the said mass, with the wire wound former therein, to heat and pressure to leave the wire and electric terminals bonded to the interior of the ultimately set and hardened body part, and securing electric coupling means on the molded body part adapted for the connection of the electric power supply to said electric terminals.

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