Mar. 3, 1925. 1,528,388

C. W. SPEIRS

RESISTOR FOR ELECTRIC HEATING

Filed Nov. 26, 1923

Fig.1.
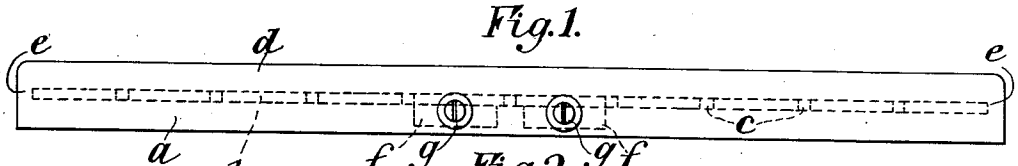


Fig.2.

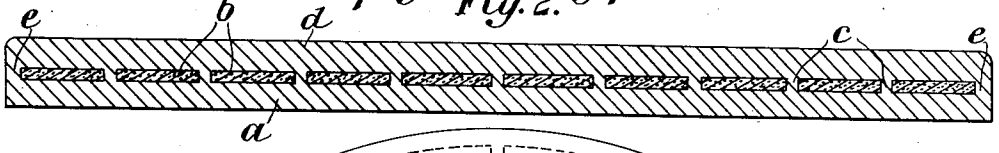
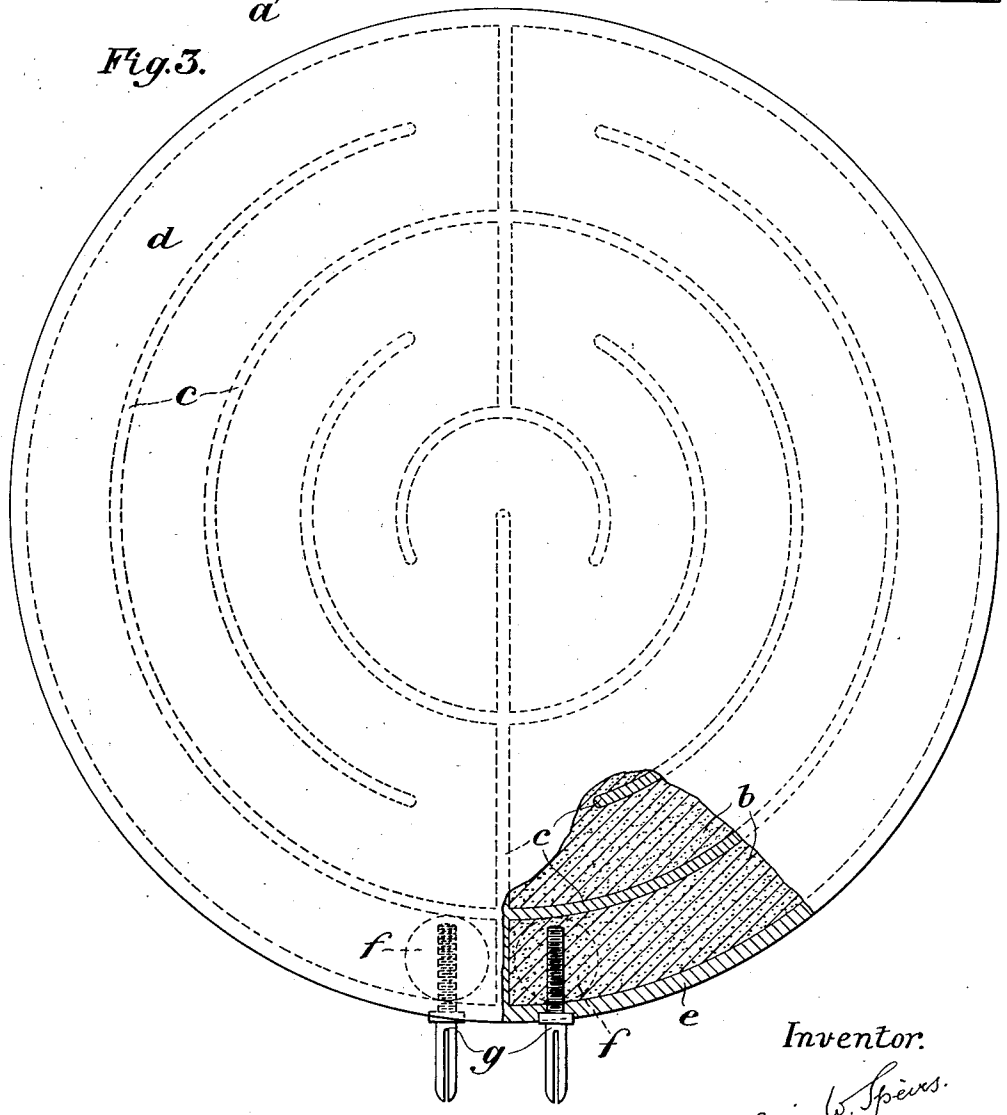


Fig.3.



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UNITED STATES PATENT OFFICE.

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RESISTOR FOR ELECTRIC HEATING.

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To all whom it may concern:

Be it known that I, CHARLES WILLIAM SPEIRS, a subject of the King of Great Britain, residing at Battersea Works, Church Road, London, England, have invented new and useful Improvements in Resistors for Electric Heating, of which the following is a specification.

This invention relates to resistors for the conversion of electrical energy into heat and designed to have a temperature range from atmospheric to over 1,400° C. and to be used for domestic, metallurgical and general manufacturing processes.

Electric resistors as heretofore used have been chiefly of either the wire resistance or carbon and graphite type, each of which types possesses disadvantages in practice, the former owing to cost of manufacture, difficulty of mounting, limitation of temperature and unequal temperature of distribution, and the latter by reason of high conductivity and cost, the difficulty of arranging for high voltage circuits, the tendency to rapid oxidation and the difficulty in arranging suitable mounting to prevent oxidation.

The object of the invention is to provide a cheap and simple resistor which can be manufactured in almost any shape or form and arranged to supply heat exactly where required, and which, in many cases, can form part of the vessel or plant to be heated, and can attain practically the same temperature at all points of its surface. Furthermore, in the case of domestic articles, they can be immersed in water when not in use, for the purpose of cleaning.

To this end according to the invention a resistor is made as a solid continuous coherent ceramic body, in which the conducting portion is obtained by the addition of flake graphite or other powdered carbon to the ceramic body in the plastic state and is so arranged that an electric circuit is provided which is of the correct resistance to give the required temperature (at all points over its surfaces) at any given voltage and is entirely surrounded, supported and insulated by the nonconductive ceramic ware, preferably glazed on its surface.

In carrying out the invention the conducting portion of the resistor (hereinafter referred to as the conductor) may be made from a mixture of almost any good quality ball clay and a percentage of, preferably, flake graphite, but any other carbon powder can be used, varying according to the resistance required, from, say 20% to 80%. When the percentage of graphite is low, it may be advisable to add a quantity of burnt clay grog.

This conductor is moulded, when plastic, into the desired shape, and, while still plastic, is covered entirely with a coating of refractory clay, stoneware or porcelain, also in a plastic state; (this being necessary to support the conductor, both while the necessary circuits are being formed and to support, insulate and protect it in use), so that the whole, after burning, forms one continuous coherent ceramic body in which the resistor is supported and insulated.

This body may be coated with a glaze when in the plastic state, or glazed after biscuiting by methods well known in the trade, the object of the glaze being further to protect the resistor from moisture and air. For high temperatures a further protection is afforded by introducing beneath the glaze a layer of material similar to the conductor, this additional layer serving to delay oxidation.

The resistance of the conductor can be varied as required by altering the percentage of carbon and/or varying the cross section and length of the circuit.

Care should be taken to make the conductor so that equal lengths have equal resistances, whereby a uniform temperature is produced over the entire surface.

Care should also be taken to select suitable insulating and supporting bodies, so that their co-efficient of expansion is approximately the same as that of the conductor and it has been found, for example, that the same clay body can be used for the entire article if part of the clay grog in the insulating body be replaced by flake graphite for the conductor. It is to be understood, however, that the invention is not restricted to this combination as many others can be employed with the same, or approximately the same results.

To prevent undue perishing of the resistor

in the kiln, it is advisable to enclose it in a muffle before subjecting it to the burning process.

The conductor can be made up in one or more layers, each layer being separated from the next by an insulation layer. Furthermore, any clay vessel can be moulded on or around a suitable resistor. For instance, a casserole can be made with a resistor in the bottom, or a jug with the resistor in the bottom, or round the sides, or both.

To illustrate the practical application of the invention the following description by reference to the accompanying drawing, gives a suitable method of manufacturing a simple circular heating plate suitable for working on a circuit, say, of 110 volts and giving an even temperature of about 100° C. at any part of its surface.

In the said drawing—

Figure 1 is a side view of the heating plate.

Figure 2 is a transverse section thereof, and

Figure 3 is a sectional plan view of the plate.

A plastic insulating clay is made from 40% ball clay and 60% good burnt clay grog free from iron and impurities. A suitable grog may have the following percentage composition:—

SiO_2	72%
Al_2O_3	22%
Fe_2O_3	2%
TiO_2	2%
Alkalies	2%

The conductor is made from out the same clay and grog with a good flake plumbago of about 85% carbon ground through a 20 mesh sieve and mixed in the following proportions:—

Clay	40%
Clay grog	40%
Plumbago	20%

A slab *a* of the insulating clay is rolled out on a flat surface to a thickness, say .2 of an inch. A slab *b* of the conducting mixture is then rolled out to the required thickness, varying according to the resistance required, say, .1 of an inch, and is placed above and pressed on to the insulating slab *a*, a wash of clay slip made from the ball clay being used to ensure a good firm joint.

The combined slab thus obtained is then cut to the shape required, in this case circular, and by means of a template, narrow grooves *c*, about one eighth of an inch wide, are cut through the conductor layer so that any desired circuit is obtained. These grooves *c* are filled with plastic insulating clay, as shewn, and the resistor is coated with another sheet *d* of, say, .2 of an inch thick plastic clay, and a good joint made with a wash of clay slip, and the whole mass pressed firmly together.

The edges of the slab are also preferably coated with the insulating clay, as shewn at *e*, the two extreme ends of the circuit of the conductor *b*, having worked on to them the circular blocks *f*, which, due to their graphite content, can be drilled after burning and metal plugs or screws *g* inserted for connecting the electric supply.

In cases where the temperature of the plate is sufficiently high to damage the metal terminals, graphite rods are used to connect the said plate to the said terminals so that the latter are placed outside the zone of high temperature.

A clay dish can be moulded above a plate so produced, if required.

A cylindrical vessel can also be made as follows:—A plastic mould is lined with the required thickness of insulating clay by means of a former on a jolly wheel. A layer of the plastic conductor is then worked on to the clay and a definite thickness given to the body by adjusting the former. A circuit is then cut in the conductor layer as explained above, and the grooves filled in with clay, a further coating of insulating clay being worked on with the former.

It is to be clearly understood that the same objects can be obtained by other methods of manufacture and we do not claim these methods only.

Claims:

1. A resistor for electric heating, comprising a solid continuous ceramic body in which the conducting portion is obtained by the admixture with the ceramic material of powdered carbon.

2. A resistor as claimed in claim 1, comprising a series of layers of ceramic material alternating with a series of layers of conducting material formed from ceramic material admixed with powdered carbon, the whole constituting a solid continuous coherent body.

3. A resistor for electric heating comprising a layer of ceramic material, and a superposed layer of ceramic material admixed with powdered carbon, such as flake plumbago, forming a conductor, the conductor layer being cut through along a line or lines to provide a continuous conducting section to the ends of which terminals are affixed and the grooves formed, being filled with the ceramic material, the whole constituting a solid continuous coherent body.

4. The method of producing resistors for electric heating, consisting in moulding a mixture of ceramic material and powdered carbon, such as flake graphite, and in covering the resistor so formed, whilst still plastic, with a coating of ceramic material also in a plastic state, the whole being then

subjected to a burning operation to form a continuous coherent body in which the conductor is insulated.

5. The method of manufacturing resistors for electric heating, consisting in moulding a mass of ceramic material to the desired shape, superposing thereon a layer of ceramic material admixed with powdered carbon, such as flake graphite cutting or grooving the superposed layer to form the conducting portion of the resistor, applying a further layer of ceramic material to the conducting layer and finally burning the whole, after glazing, if desired, to form a continuous solid body or mass.

CHARLES WILLIAM SPEIRS.