Dec. 5, 1939. F. E. OWEN 2,182,319

ELECTRICAL HEATING UNIT

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FIG. 1.

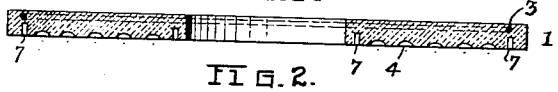


FIG. 2.

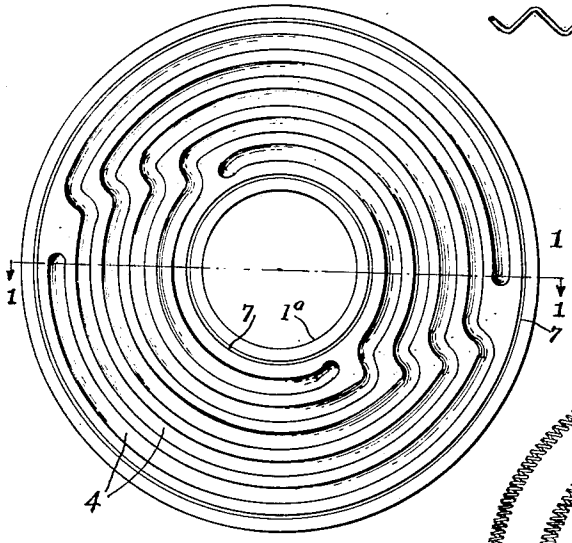


FIG. 7.



FIG. 6.

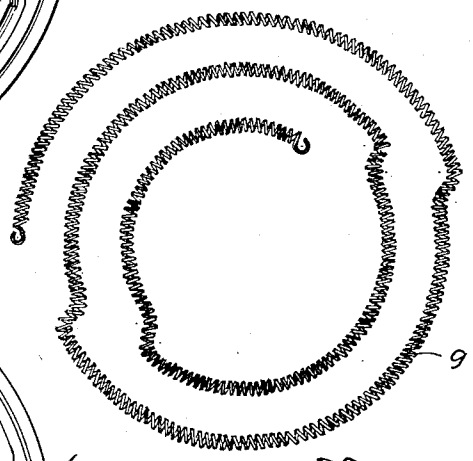


FIG. 3.

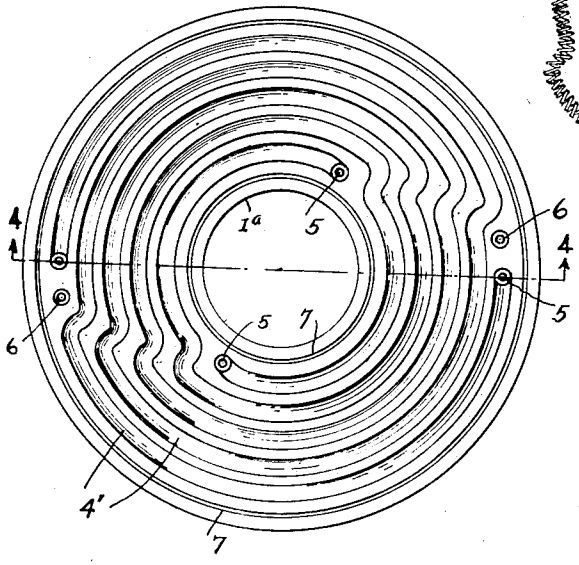


FIG. 5.

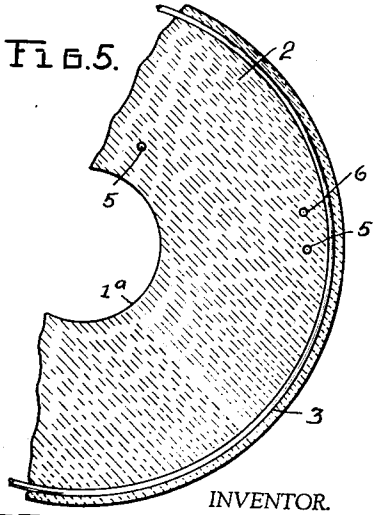
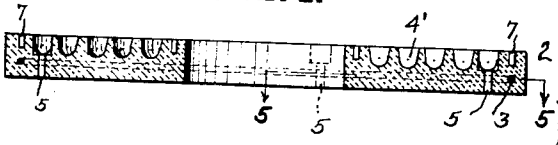


FIG. 4.



INVENTOR.
FREDERICK E. OWEN.
BY Geo. B. Fitts
ATTORNEY.

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Fig. 8.

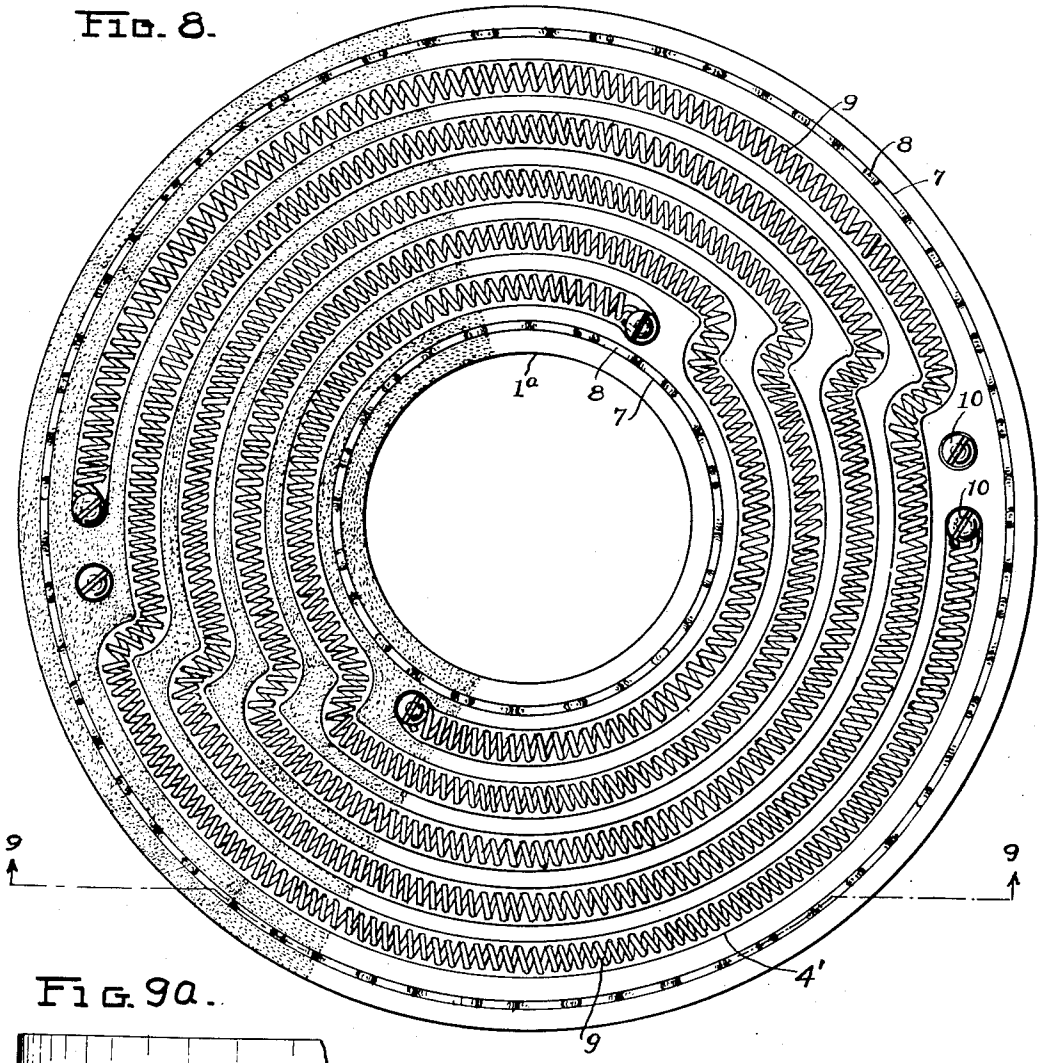


Fig. 9a.

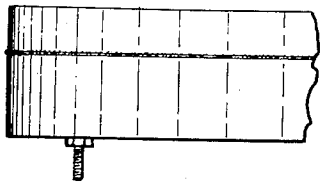
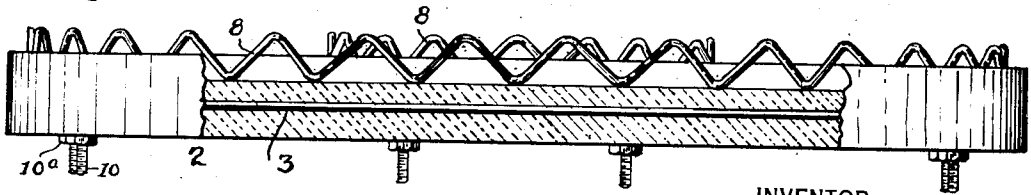


Fig. 9.



INVENTOR
FREDERICK E. OWEN.
BY Geo. B. Fitts
ATTORNEY

Dec. 5, 1939. F. E. OWEN 2,182,319

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FIG. 10.

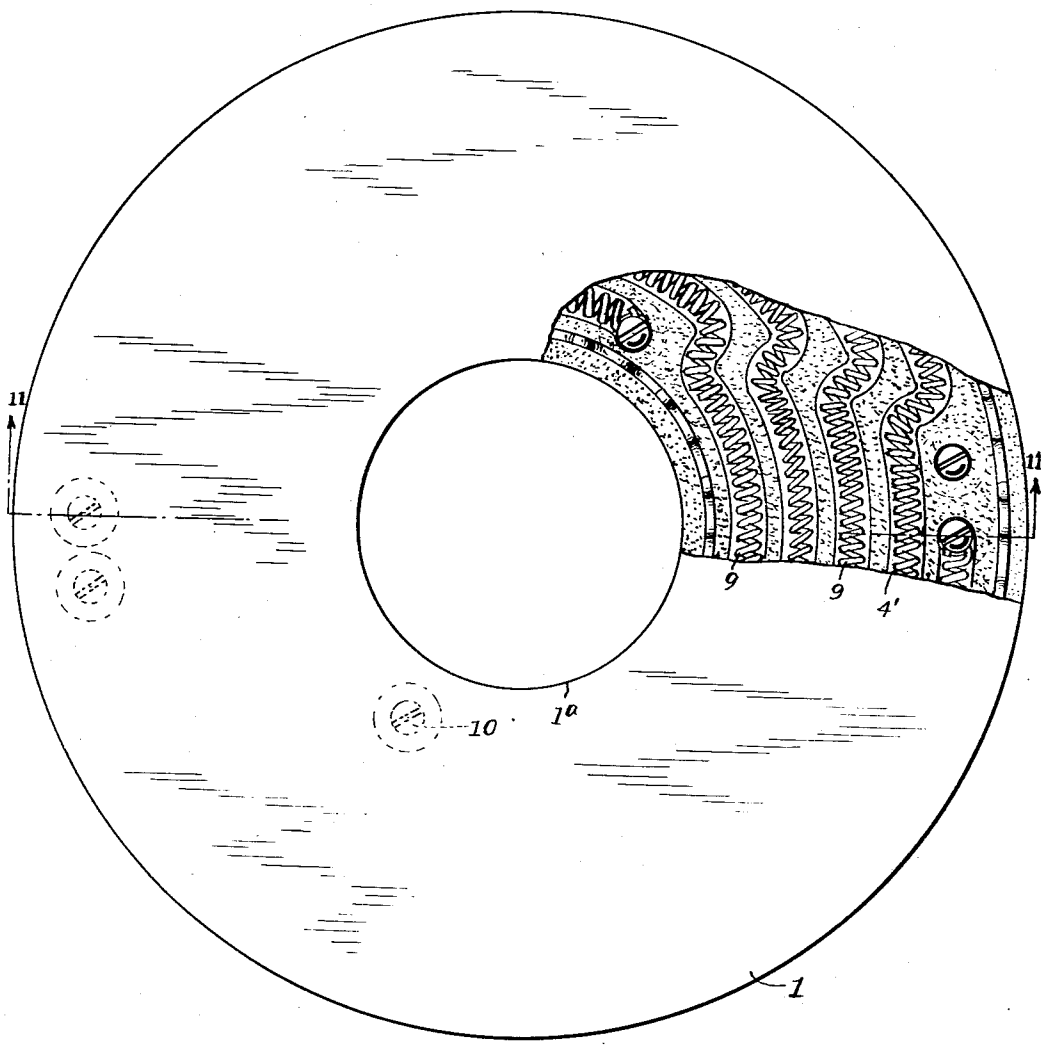
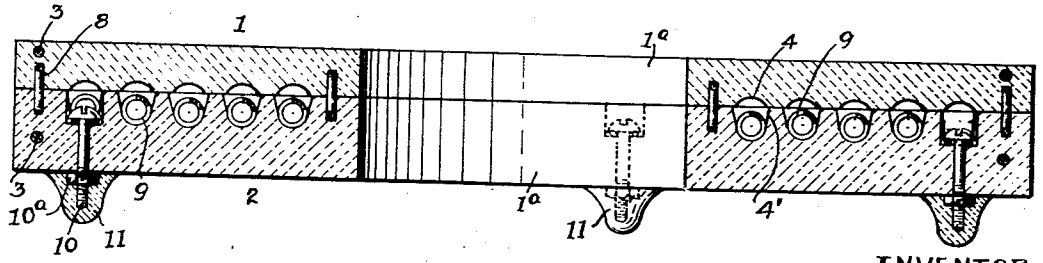


FIG. 11.



INVENTOR.
FREDERICK E. OWEN.

BY Geo. B. Pitts

ATTORNEY.

Patented Dec. 5, 1939

2,182,319

UNITED STATES PATENT OFFICE

2,182,319

ELECTRICAL HEATING UNIT

Frederick E. Owen, East Palestine, Ohio, assignor to The Electrical Refractories Company, East Palestine, Ohio, a corporation of Ohio

Application December 14, 1936, Serial No. 115,720

1 Claim. (Cl. 219—37)

This invention relates to an electrical heating device or unit, which is adapted for various uses, for example, for electric stoves for domestic use.

One object of the invention is to provide an improved device of this character wherein the resistor element or elements are sealed substantially hermetically in suitable insulating material having dielectric properties so that the element or elements are effective for heating purposes but are adequately protected against deterioration, the construction also being advantageous in that firing or burning of the ceramic material may be effected without causing oxidation of the element or elements beyond a predetermined amount dependent upon the volume of the space in which the element or elements are mounted and confined.

Another object of the invention is to provide an improved electrical heating unit of this character wherein the resistor element or elements are insulatably encased in heat transmitting material to insure and maintain maximum heating efficiency, the casing protecting the elements from drippings and other materials and, in the preferred construction, having glazed exterior surfaces to prevent penetration of moisture and ultimate damage to the resistor elements and permit ready washing of the casing to insure sanitary conditions at all times.

Another object of the invention is to provide an improved device of this character of relatively simple construction and capable of resisting thermal shocks and relatively high temperatures to insure long life with maximum efficiency.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings, wherein

Fig. 1 is a cross sectional view of the upper section of a unit, on the line 1—1 of Fig. 2.

Fig. 2 is a plan view of the section shown in Fig. 1.

Fig. 3 is a plan view of the lower section of a unit.

Fig. 4 is a section on the line 4—4 of Fig. 3.

Fig. 5 is a fragmentary section on the line 5—5 of Fig. 4.

Fig. 6 is a plan view of a resistor.

Fig. 7 is a fragmentary view of an interlocking member.

Fig. 8 is a plan view of the lower member with parts assembled thereon.

Fig. 9 is a side elevation of the parts shown in Fig. 8, partly in section on the line 9—9 of Fig. 8.

Fig. 9a is a fragmentary side elevation.

Fig. 10 is a plan view of the completed unit, parts being broken away.

Fig. 11 is a section on the line 11—11 of Fig. 10.

In carrying out my process I first separately shape or mold, with suitable ceramic material or composition of materials having minimum heat resistance and a low co-efficient of expansibility but with suitable dielectric characteristics, two bodies indicated generally at 1 and 2, which form the upper and lower sections or plates of a complete heating device or unit. The materials used are of a kind which, when mixed in suitable proportions, may be readily (a) molded in any well known manner as by permanent metal molds operated by a suitable press and (b) fired and when the unit is in use, insure minimum heat resistance, minimum expansion when subjected to heat, and maximum heat transmission. Each section when molded is provided with a reinforcement 3, embedded in the material. The reinforcement 3 takes the form of a wire or rod having high heat resisting characteristics and extends around and adjacent the perimeter of the section. The opposed faces of these sections are formed with one or more grooves, co-operative as later set forth, to enclose the resistor element or elements,. Two such grooves in each section are shown as illustrative of the preferred arrangement, the grooves in the upper section being designated 4 and the grooves in the lower section being designated 4'. The sections 1, 2, may be of any desired shape, for example square, rectangular, oval, etc., but are preferably round. Each shape may be formed with a central opening, as shown 1a, thereby forming a hollow member, the member in the illustrated form being of annular shape. The openings 1a permit expansion of the unit under the influence of heat and thus danger of the unit bulging is eliminated. In this illustrated shape each groove is of substantially spiral form; and where two or more grooves are provided in each section, the convolutions of one groove are disposed between the convolutions of the other groove or grooves. But it will be understood that the groove or grooves may be arranged in any desired position and relation, irrespective of the shape of the members or sections. As will be later understood, when the sections 1, 2, are assembled, each groove in one section is related throughout its length with corresponding portions of one groove in the other section. The grooves 4 in the upper section 1 are preferably of concave shape in cross section, whereas each

groove 4' in the lower section 2 is somewhat wider than the grooves 4, it has converging sides and its bottom portions are of substantially semi-circular shape in cross section substantially equal to the outside diameter of a resistor to form a continuous seat for the latter.

The lower section 2 is formed with a plurality of through openings 5, 6, one opening 5 being disposed at each end of each groove to receive an electrical terminal device and one or more openings 6 to receive fastening devices for securing the unit to a metal pan, bridge or other support in a stove.

Also, and by preference, the opposed faces of the sections 1, 2, are formed with one or more recesses 7, each recess in one section being related to the corresponding recess in the other section so that each two related recesses may receive a device 8 having portions extending into both recesses to interlock the members together. Where the sections 1, 2, are of annular shape the recesses 7 are formed adjacent the inner and outer side walls of each section, and may extend entirely around or throughout a portion of the sections. The device 8 may be formed of round or flat material and have a length co-extensive with the length of the recesses and so shaped (preferably zigzag) from end to end, that portions extend to either side of the joint between the sections 1, 2. Where the device is of zigzag shape, its legs may be long enough to engage the bottoms of the adjacent recesses. As is customary in molding bodies from clay or clay mixtures, the sections are allowed to set before they are assembled.

I next provide an interlocking device of the construction above set forth and a resistor element, indicated at 9, preferably one for each continuous groove 4'. Each resistor element consists of a coil having a length co-extensive with the groove in which it is to be seated and formed of a suitable alloy (preferably a metallic alloy) capable of withstanding high temperatures, incident to and required in the firing of the unit sections 1, 2, to ceramically weld them together, as later set forth, and/or the electric current caused to flow through it for heating purposes without deterioration. The gage of the coil is calibrated to compensate for a predetermined amount of oxidation, incident to subjecting the sections, when assembled, to the desired firing temperature, so that when the device or unit is set in operation each resistor element will supply a predetermined quantity of heat. For example, the coil may be formed of approximately 20½ gage material and when the sections are fired, the oxidation on the coil will result in providing the resistor element with a heating capacity equal to approximately 21 gage material. Each coil 9 is preferably preformed to the shape of the groove into which it is to be seated and then annealed.

Next, the resistors 9 are positioned in the grooves 4' and their ends engaged by the heads of suitable terminals 10, which are inserted in the openings 5 and secured in position by nuts 10*a*; the latter being tightened to insure electrical connection between the bolt and resistor without fracturing the section 2. Bolts 10 are also mounted in the openings 6 and secured therein by nuts 10*a*; these bolts serving as a means to mount the unit in position when installed in a stove or other support for use. The bolts 10 are of a size to snugly fit the openings 5, 6, so as to substantially seal the latter against any intake of air, the nuts 10*a* also serving to close the adjacent ends of the openings.

I next assemble and weld the sections 1 and 2 together. This consists, when an interlock is provided, in filling the recesses 7 with a suitable cement and inserting the interlocking devices 8 in the recesses 7 of one section; then coating the surface of one or both of the opposed faces of the sections 1 and 2, which surfaces are disposed between and exterior of the coil grooves, with a thin layer of slip (which is a cement formed of a clay solution), this step being shown in Fig. 8 by the shaded portion; and then positioning the sections together face to face (see Fig. 9*a*) with the devices 8 seated in their recesses, and causing slight relative rotary movement between the sections under pressure, the effect of which is to rub the slip into the surfaces of the sections and to insure uniform coating of the slip entirely over their opposed surfaces and seal the releated grooves 4, 4', to prevent in-flow of air thereto or out-flow of air therefrom. It will thus be seen that the slip forms a seal for the resistor element receiving spaces to confine a predetermined amount of air therein equal to the total volume of the spaces less that occupied by the elements. This volume is predetermined so that a predetermined calibrated resistance coil may be used for the purpose already set forth.

I next fill in any existing cracks at the joint between the sections around their side edges with suitable clay preferably similar to that used in making the sections 1 and 2. This supplied clay material may be smeared or pressed into the crack as shown in Fig. 9*a* and excess clay material removed in any desired manner, for example, by setting the assembled sections on a revolving table and using a suitable tool or tools to close the crack and remove the excess material.

I next enclose the exposed end of each bolt 10 and the nut 10*a* thereon with a glob or wad 11 of highly refractory open burning clay to seal the opening for the bolt; the clay used is preferably of a character which prevents permanent union with the walls of the section or plate 2. The primary purpose of the wads 11 is to hermetically seal the bolt openings against in-take of air during burning of the sections as well as to keep the openings sealed after firing of the sections until the unit is installed. As will be understood, these wads adhere to the bottom section 2, but prior to installation of the unit, they are broken to permit attachment of the electric leads and setting of the unit in position.

Next, the assembled sections are subjected to heat at approximately 150 degrees F. for any desired period of time, for example from 8 to 24 hours, to remove excess moisture.

I next cover the outer or exposed walls of the sections with a suitable glaze material which operates to make the unit when completed proof against moisture penetration as well as to provide a smooth exterior surface, whereby the unit may be readily cleaned without danger of damaging it or affecting its heat transmitting characteristics.

Next, the assembled sections are set within a suitable oven or kiln and subjected to a sufficient heat for a predetermined period of time, dependent upon the degree of temperature employed, to properly mature the composition of clay used for the sections 1, 2, the effect of the heat serving to permanently secure or ceramically weld the sections together as a unit and hermetically seal the space or areas for the elements 9 formed by the

related grooves 4, 4'. In carrying out the firing step the resistor elements are oxidized as already set forth.

This operation of firing the sections 1, 2, serves to fuse the glaze material for the purposes already set forth. In practice, I have used a temperature of approximately 2450 to 2485 degrees F. for firing the assembled sections 1, 2.

It is to be noted that when found desirable, the glaze material may be applied to the outer surfaces of the sections 1, 2, after they have been fired and welded together and then the unit subjected to heat to fuse the glaze; but in the preferred process the glaze is applied prior to the firing of the sections so that maturing of the sections and fusing of the glaze material are effected simultaneously.

It will be noted that the resistor elements are enclosed in spaces between the sections 1, 2, and sealed, the effect of which is to insure minimum deterioration through oxidation and when the sections are welded, as herein set forth, the cavities, grooves or spaces, in which the elements are positioned, are hermetically sealed to protect the elements from damage as well as deterioration from contact with air, this advantageous result being effected without affecting the heating efficiency or economical operation of the unit. The resistor elements being mounted in spaces, the convolutions of the elements are disposed in normal position and out of contact, so that danger of short circuiting occurring in each element, with resulting non-uniform heating or overheating of portions of the element is avoided.

To those skilled in the art to which my invention relates many changes in construction and widely differing embodiments and applications of the invention will be apparent without departing from the spirit and scope of the invention. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

In an electric heating unit, the combination of a pair of upper and lower plates each formed of insulating material having dielectric properties, the opposed faces of the plates being flat and formed with circuitous related grooves and related circumferential recesses forming a closed chamber when the plates are assembled face to face, a resistor element mounted within and coextensive with the groove in said lower plate, a device within said chamber and extending substantially throughout the circumference thereof and having portions extending into each said recess, means for securing said device to the walls of said recesses, whereby said plates are secured together, means for bonding together the opposed faces of said plates exteriorly of the said grooves and recesses therein to seal them, and leads leading from said element to a point exterior of said unit.

FREDERICK E. OWEN.