

Feb. 16, 1932.

J. SLISZ

1,845,852

ELECTROLYTIC HEATER

Original Filed Jan. 28, 1928 2 Sheets-Sheet 1

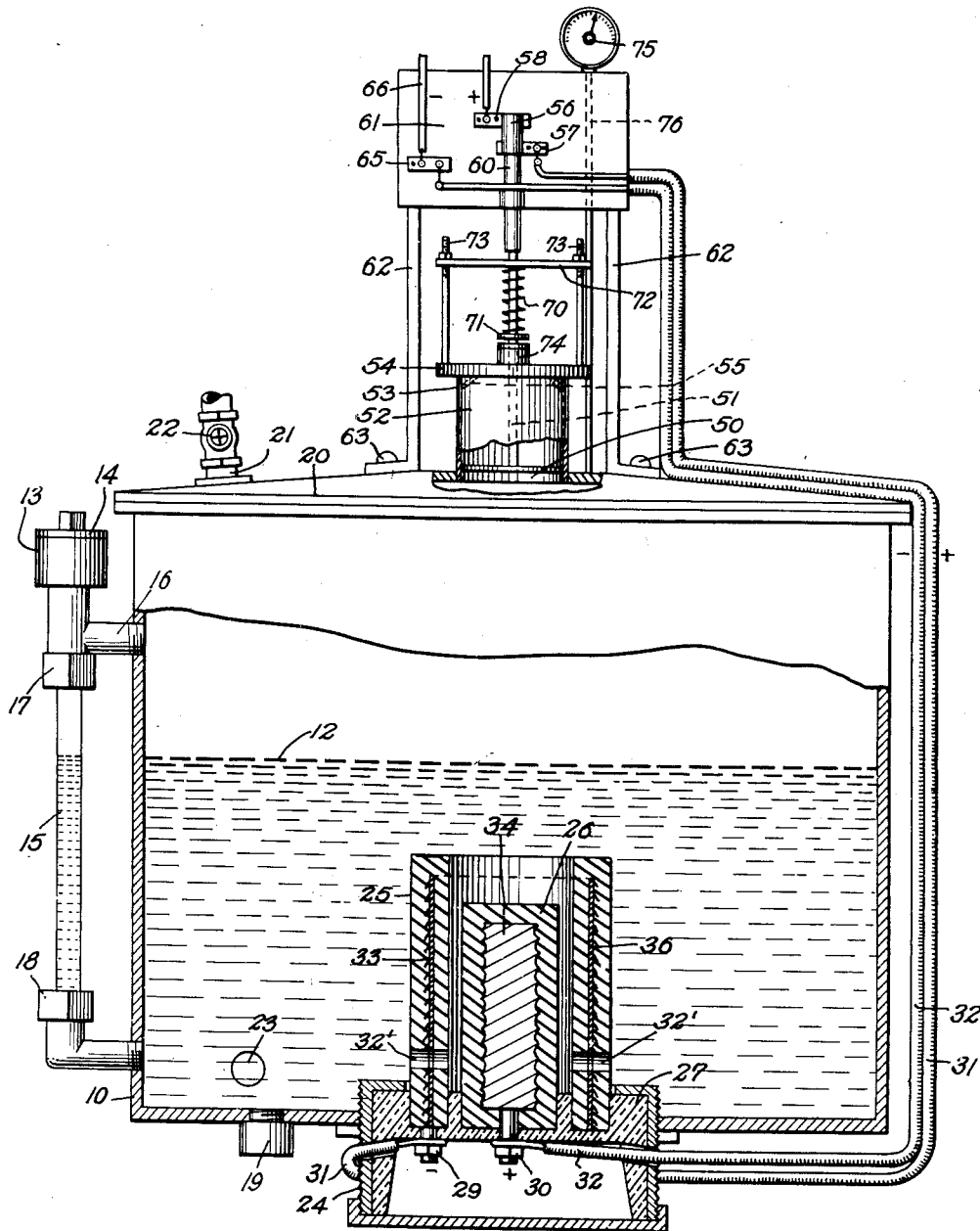


Fig. 1.

Inventor

John Slisz.

By Munson H. Lane

Attorney

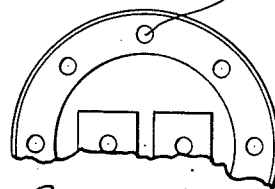
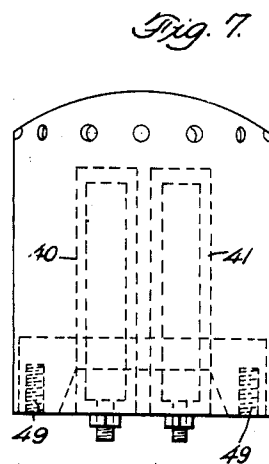
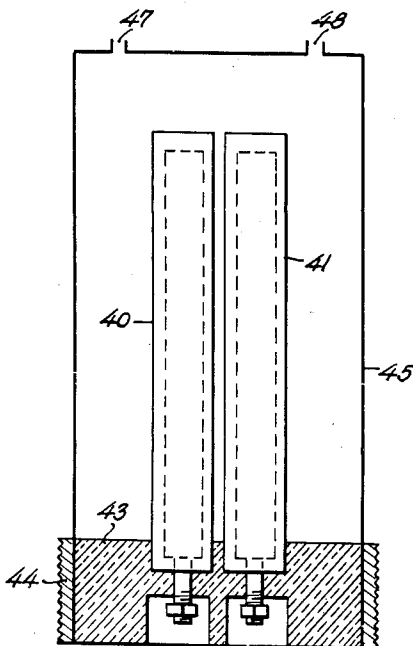
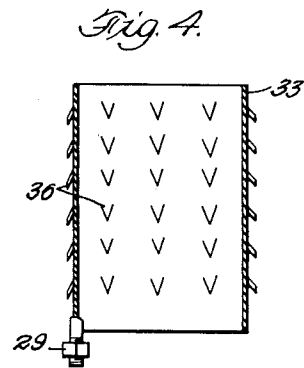
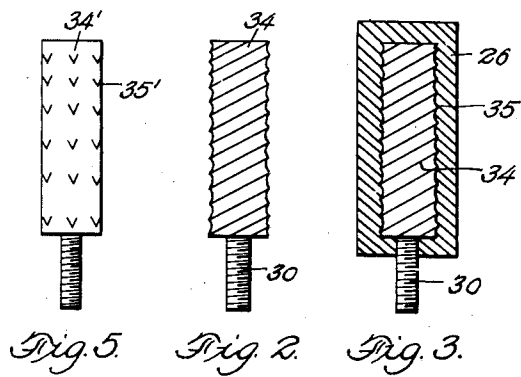
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Inventor

John Slisz

By Munson H. Lane

Attorney

UNITED STATES PATENT OFFICE

JOHN SLISZ, OF EAST ST. LOUIS, ILLINOIS, ASSIGNOR OF ONE-HALF TO JAMES R. BROCKMAN, OF ST. LOUIS, MISSOURI

ELECTROLYTIC HEATER

Original application filed January 28, 1928, Serial No. 250,167. Patent No. 1,728,450, dated September 17, 1929. Divided and this application filed April 20, 1929. Serial No. 356,860.

The invention relates to electrolytic heaters and more particularly to the type of heater in which an electrode unit is employed to heat an electrolyte, and vaporize the same, the vapor from the electrolyte being utilized for heating or other purposes.

The present application is a division of my application Serial No. 250,167, filed January 28, 1928, issued as Patent No. 1,728,450, September 17, 1929.

One of the objects of the invention is to improve the electrode unit employed. A further object is to regulate the rate of heating by definitely controlling the composition and conductivity of the electrolyte.

Other objects of the invention will appear from the more detailed description of the invention which follows. I am aware that attempts have been made to attain certain of these objects, but according to my invention the objects are attained in an improved manner.

The invention is illustrated in the accompanying drawings, in which

Fig. 1 is a view partly in elevation and partly in vertical section showing a complete electric heater, equipped with means for controlling the pressure of the vapor produced by electrolytic heating of the electrolyte;

Figs. 2, 3 and 4 are details of the electrode unit shown in Fig. 1;

Fig. 5 is a modification of the electrode reinforcing element shown in Fig. 2; and

Figs. 6, 7 and 8 are modifications of the electrode unit employed in Fig. 1.

Referring in detail to the drawings, and particularly to Figs. 1, 2, 3, and 4, the reference numeral 10 denotes a suitable tank which is adapted to be filled with an electrolyte to the level indicated. The electrolyte may be supplied from a filling cup 13, provided with a screw threaded cap or plug 14, and communicating with the lower portion of the tank 10 by means of a pipe 15, which may be of glass, which thus serves as a gage for determining the level of the liquid in the tank. An upper pipe connection 16 communicates with the tank above the liquid level for the purpose of equalizing the pressure in the tank and in the gage. Suitable packing glands

and couplings are provided at 17 and 18 for insuring a tight fit for the glass gage 15.

The tank 10 may be provided with a drain 19 at the bottom, a vapor-tight top 20, a vapor take-off 21 controlled by a suitable valve, which pipe leads to a place of use, which may be a radiator where the vapor is used for heating purposes, or an engine in case the steam is used for power purposes, it being understood that the invention is of wide application. A return inlet 23 for condensed vapor is provided near the bottom of the tank.

In my heater, it is desirable to accurately determine the conductivity of the electrolyte, and thereby control its current carrying capacity. For this purpose I employ pure water, such as rain water or distilled water, and add a definite amount of a suitable acid, base or salt. The material added to the water depends upon the type of container employed. Where iron or steel containers are used, sulphuric acid may be employed in making up the electrolyte. In brass or copper containers, iodine is preferable to an acid. For containers lined with graniteware, glass, kaoline, quartz products, or as a general class lime or silicate lined, sodium chloride may be employed, since an acid would in time deteriorate the lining.

Mounted within the bottom of the tank and in contact with the electrolyte is an electrode unit. As shown, the unit is mounted in a metal casing 24, which is suitably threaded to be screwed into the bottom of the tank. The electrodes 25 and 26 are mounted within a porcelain or other insulating base 27 within the metal casing. Binding screws 29 and 30 are connected to the electrodes and to these are attached wires 31 and 32 leading from a source of current and passing through apertures in the insulating base and the metal casing. The electrode 25 is preferably the negative element, and is cylindrical in form, is considerably higher than the positive element 26, and has approximately four times greater exposed area than the positive electrode, to insure carrying off all current transmitted from the positive electrode. Openings 32' are provided in the negative element to allow passage of the electrolyte. This is im-

portant, as the level of the electrolyte may fall below the top of the negative element, and the only flow would then be through the openings 32'.

5 Just as it is important that pure water be used in preparing the electrolyte, to insure a definite conductivity, so it is also important to have electrodes which will not be disintegrated by the solution under action of electricity, and thus destroy the usefulness of the electrodes, and render the conductivity of the electrolyte uncertain. For this purpose, electrodes having surfaces of pure carbon are essential. The ordinary commercial carbon is not satisfactory, as it contains foreign substances, which, under the action of the electrolyte, set up local action and render the carbon porous. However, unreinforced pure carbon is not sufficiently resistant to shock, and accordingly it is necessary to provide reinforcing elements 33 and 34 of aluminum or German silver, which are substantially non-expanding, and not easily corroded, as well as possessing high conductivity. Aluminum is probably preferable on account of its cheapness.

In order that the carbon may adhere firmly to the reinforcing elements, the latter are roughened in a suitable manner. The positive element 34 is shown in Fig. 2 and is there shown as roughened by twisting, forming grooves 35 to which the carbon firmly adheres, as shown in Fig. 3. In Fig. 5 an alternative form of reinforcing element 34' is shown, the surface being roughened or gridded by punching or burring the sides as at 35'. Fig. 4 shows the reinforcing element 33 of the negative electrode, which is in the form of a sleeve, the surface of which is burred or gridded, to provide projections for holding the carbon in place. Obviously the shape of the electrodes may be varied as desired, being round, square, or of any suitable cross-section.

For best results, I have devised a special method of making the electrodes, which insures their purity, and the adherence of the carbon to the reinforcing elements. According to my method I first obtain finely divided carbon, made of charcoal or coal dust, which has been chemically treated to remove all foreign material. I then moisten the finely divided carbon with sugar molasses diluted in distilled water. This pasty mass is then applied to the surface of the roughened reinforcing element, which has first been coated with the molasses solution, and the whole is then placed in a mold where it is subjected to a pressure of approximately twenty tons to the square inch. The electrode, while in the mold and under pressure, is sealed with a vented plug, and is submitted to sufficient heat to thoroughly dry and bake the carbon elements. Attached to and forming part of the reinforcing elements are the binding screws, which are made of the same metal

as the reinforcement to prevent electrolysis. The electrodes are then mounted in the porcelain base, as hereinbefore described, and provided with the outer casing 24, which is screwed into the tank containing the electrolyte.

The carbon used in making the electrodes is amorphous in character and of vegetable origin. Lampblack, charcoal, coal and coke are included in this term, and the binder employed may be sugar-molasses or coal tar.

Other forms of electrode units than that shown in Fig. 1 may be employed, though this is the preferable form. As shown in Fig. 6, two like electrodes 40, 41 are attached to an insulating base, which is surrounded by a threaded casing 44. A case 45 covers the electrodes and prevents anyone from inadvertently touching a charged electrode. Openings 47, 48 are provided to permit passage of electrolyte.

A similar arrangement is shown in Figs. 7 and 8. This unit is designed for use with a container other than metal and is provided with holes 49 in its insulating base for attachment to a glass, porcelain, wood, fiber, or other container. Thus it will be seen that many different specific embodiments of the electrode unit are adapted for use in connection with my invention. In each, however, the positive and negative electrodes are composed of pure carbon, and each electrode is reinforced with a core of non-expanding metal, such as aluminum or German silver. The pure carbon will not pit, crevice or decompose, and consequently will not expose the core to the action of the electrolyte. The core, being of relatively low heat coefficient, does not expand materially when the temperature rises, and accordingly there is no danger of the outer coating of carbon being broken or cracked by such expansion. Moreover, due to the roughening of the surface of the core, by twisting, gridding, or in any suitable manner, there is no danger of the carbon coating separating from the core, as might be the case when a smooth core is employed. The electrode unit is applied to a suitable tank containing electrolyte, such as the container 10 shown in Fig. 1.

The electrode unit having been applied to the container, which is filled with electrolyte of known concentration to the level indicated in Fig. 1, and current applied to the electrodes, heating of the electrolyte takes place. When sufficient current has been supplied, steam is generated which leaves through the offtake 21 at the top of the container and passes through a radiator or the like, giving up heat, and condensing, and then returning to the container through the return opening 23. As the electrolytic solution vaporizes, less surface of the electrodes is exposed to the electrolyte and less heat is generated, thus providing an automatic regulation of the

current. In the construction shown in Fig. 1 there is a large surface of electrode exposed to the electrolyte, and consequently very efficient action is obtained.

5 It is frequently desirable that the pressure within the tank 10 shall not exceed a certain predetermined amount. Accordingly I have provided means for automatically cutting off the current to the electrodes as soon as the pressure reaches a certain point. 10 This automatic means may be regulated to operate at whatever pressure it is desired to obtain in the tank.

To accomplish this automatic regulation, I 15 provide a current cut-off valve 50 opening away from the top of the container 10, and provided with a valve stem 51 which serves as a make and break switch to automatically open or close a circuit which includes the electrodes 25 and 26, according to the vapor pressure existing within the tank.

20 The valve 50 works within a valve chamber 52, provided with a cylindrical wall 53 and a top 54, through which the valve stem 51 reciprocates. Spring stops 55 are provided to limit the upward movement of the valve 50. The upper portion 56 of the valve rod 51 is provided with a metal contact member, which, when the valve 50 is in the position shown in Fig. 1, bridges two contact members 57, 58 which are in the circuit with the lead wire 59 and wire 32 which supply current to the positive electrode 26. When, however, the valve 50 is raised by the pressure within the tank 10 the conducting portion 56 of valve rod 51 is moved out of contact with the member 57, and an insulating portion 60 comes in contact therewith, thus breaking the circuit, and rendering the electrodes inoperative until the pressure within the tank falls and the valve 50 is restored to its original position, thus again closing the circuit.

The contact members 57 and 58 are preferably mounted upon a panel board 61, which may be detachably supported by brackets 62 secured to the top of the container 10 by means of screws 63. A contact 65 for a negative lead 66 may also be provided, if desired, though it will be obvious that the negative electrode may be electrically connected to the metal container, through its casing 24, and the container 10 suitably grounded by connecting the same to water pipes or the like.

In order to regulate the pressure at which the cutoff valve 50 will operate, a thrust spring 70 is provided, the tension of which may be regulated. The spring bears at one end against a plate 71 secured to the valve stem 51, and at its other end against a thrust plate 72, the position of which is regulated by means of threaded tension rods 73 connected at their lower ends to the top plate 54 of the valve chamber 53. By adjusting the position of the plate 72, the tension of the spring

70 is regulated so that the valve 50 will open at any predetermined vapor pressure within the tank. A suitable packing gland for valve rod 51 is provided at 74 to prevent steam or vapor from escaping from the cut-off valve chamber 52. In order that the pressure existing within the tank may be determined at any time, a pressure gage 75 is provided, which is connected by means of a pipe 76 with the interior of the tank 10. 75

It will be noted that all the parts of my device cooperate to permit accurate control of pressure and temperature conditions within my heating system. The purity of the electrodes and standardization of the electrolyte are essential for insuring the proper uniformity of flow of current. The shape of the electrodes and their large exposed area, together with the steam offtake 21 and intake 23, regulate the amount of heat supplied to the system. The liquid gage 15 and filler cup 13 permit accurate control of the amount of electrolyte used, while the automatic cut-off valve, together with regulating spring 70 and pressure gage 75, combine to permit the desired regulation of pressure existing within the tank. 80

From the foregoing description it will be apparent that according to my invention accurate and precise regulation of temperature conditions is rendered possible, a matter generally of considerable difficulty in heaters of this character. The elements of the heater have all been selected and combined with this end in view. Thus the electrolyte is especially prepared by the addition of acids, bases or salts in predetermined amounts, so as to have a regulated conductivity, so that a definite quantity of electricity will produce definite temperature changes. Such an electrolyte is necessarily much more corrosive than ordinary water, and consequently especial care has been taken in the preparation and selection of the electrodes. For this purpose carbon electrodes freed from impurities which would be attacked by the electrolyte have been employed, but as pure carbon is relatively weak when not reinforced, metal reinforcement is employed. The preferred metals selected are relatively non-expanding, so that when the temperature of the electrolyte rises, there is no tendency for the carbon to crack and thus allow the electrode to attack the metal. In addition, means have been provided for automatically regulating the quantity of electricity supplied to the electrodes in accordance with the pressure of the vapor produced within the heater. 85 90 95 100 105 110 115 120

The above-named elements combine to produce a heater which is completely and accurately controllable as to heat and temperature conditions. The use of a cylindrical negative electrode much larger than the positive electrode and adequately grounded, renders the device practically self-insulating. 125 130

The metal sleeve embedded within the negative electrode, according to the preferred embodiment of the invention, provides a ready means for insuring a good contact with the negative electrode.

The invention has been fully described for the purpose of illustration, but it will be obvious that many of the details may be varied without departing from the spirit of the invention.

What I claim is:—

1. In an electrolytic heater, a negative electrode consisting of an upright hollow cylinder composed of pure carbon, and having embedded therein a sleeve of gridded metal, and a positive electrode consisting of an upright rod mounted concentrically with respect to the negative electrode, and composed of pure carbon reinforced by a gridded metal rod, said negative electrode having substantially greater active surface than said positive electrode.

2. In an electrolytic heater, an insulating base, a metal case surrounding said base, a negative electrode comprising an upright sleeve composed of carbon having a reinforcing sheet of roughened metal embedded therein, a positive electrode concentrically mounted within the negative electrode, and having a metal reinforcement therein, both said electrodes having binding posts extending through said insulating base, and lead wires extending through apertures in said base and connected with said binding posts.

3. In combination in an electrolytic heater, an electrode comprising a roughened reinforcing metal element, and finely divided carbon surrounding said reinforcing element, and held in place by means of sugar molasses coated upon said reinforcing elements, and mixed with the carbon to form a binder.

4. The method of making an electrode for electrolytic heaters which consists in coating a roughened metal reinforcing element with molasses, mixing finely divided carbon with molasses, then applying a coating of the mixed carbon and molasses to the reinforcing element, and pressing the electrode in molds, and baking the electrode to thoroughly dry the same.

5. In an electrolytic heater, a container, an electrolyte, and an electrode unit adapted to be removably secured within the bottom of the container with the electrodes in contact with the electrolyte, said unit comprising an insulating base, a metal case surrounding the base and threaded to screw into the container, and a pair of electrodes secured to the insulating base, and separated from the metal case, one electrode comprising an upright carbon sleeve having a metal sheet embedded therein, the other electrode being concentrically mounted within the outer electrode and having substantially less active surface than the outer electrode.

6. In an electrolytic heater, an electrode unit having an insulating base adapted to be detachably secured within the heater, and a pair of electrodes mounted within the base, one of said units comprising a carbon sleeve having a cylindrical metal sheet completely embedded therein so as to avoid contact with the electrolyte, a binding post extending through the base and connecting with said metal sheet, a second electrode centrally mounted within the outer sleeve but spaced therefrom, and a binding post connected to said inner electrode.

7. In an electrolytic heater having an electrolyte, an electrode comprising a carbon sleeve, a metal reinforcing sheet completely embedded therein to avoid contact with the electrolyte, and a second metal reinforced carbon electrode centrally mounted within the outer sleeve, and binding posts extending through the insulating base and connected with said metal reinforcing members.

8. An electrolytic heater comprising a tank, a corrosive electrolyte of predetermined conductivity filling said tank to a predetermined level, and an electrode unit submerged within the electrolyte, said unit comprising a positive electrode and a negative electrode, each composed of pure carbon reinforced by a non-expanding metal, completely covered by the carbon, said negative electrode being in the form of a cylinder surrounding said positive electrode, and having a metal sleeve embedded therein.

9. An electrolytic heater comprising a tank containing an electrolyte of predetermined conductivity, and possessing corrosive properties, an electrode unit mounted within the tank and submerged within the electrolyte, said unit comprising a central positive electrode composed of substantially pure carbon reinforced by a non-expanding metal core embedded therein, and a negative electrode of substantially greater surface area than the positive electrode in the form of a cylinder of pure carbon completely surrounding the positive electrode, said cylinder having embedded therein a sleeve of non-expanding metal, completely covered by the carbon.

10. An electrolytic heater comprising a tank containing a corrosive electrolyte of predetermined conductivity filling said tank to a predetermined level, an electrode unit detachably mounted in the base of the tank, and submerged within the electrolyte, said unit comprising a positive and a negative electrode, each composed of pure carbon having metal reinforcement therein, the negative unit completely surrounding the positive electrode and having a metal sleeve embedded therein and completely covered by carbon.

11. An electrolytic heater comprising a tank containing a corrosive electrolyte of

predetermined conductivity filling said tank to a predetermined level, an electrode unit detachably mounted in the base of the tank, and submerged within the electrolyte, said
5 unit comprising a positive and a negative electrode, each composed of pure carbon having metal reinforcement therein, the negative unit completely surrounding the positive electrode and having a metal sleeve
10 embedded therein and completely covered by carbon, means for supplying electric current to the heater, said metal reinforcements within the electrodes serving as conductors for the current, and means for regulating
15 the quantity of current supplied.

In testimony whereof I affix my signature.

JOHN SLISZ.

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