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ELECTRICAL DRYING

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Fig. 1.

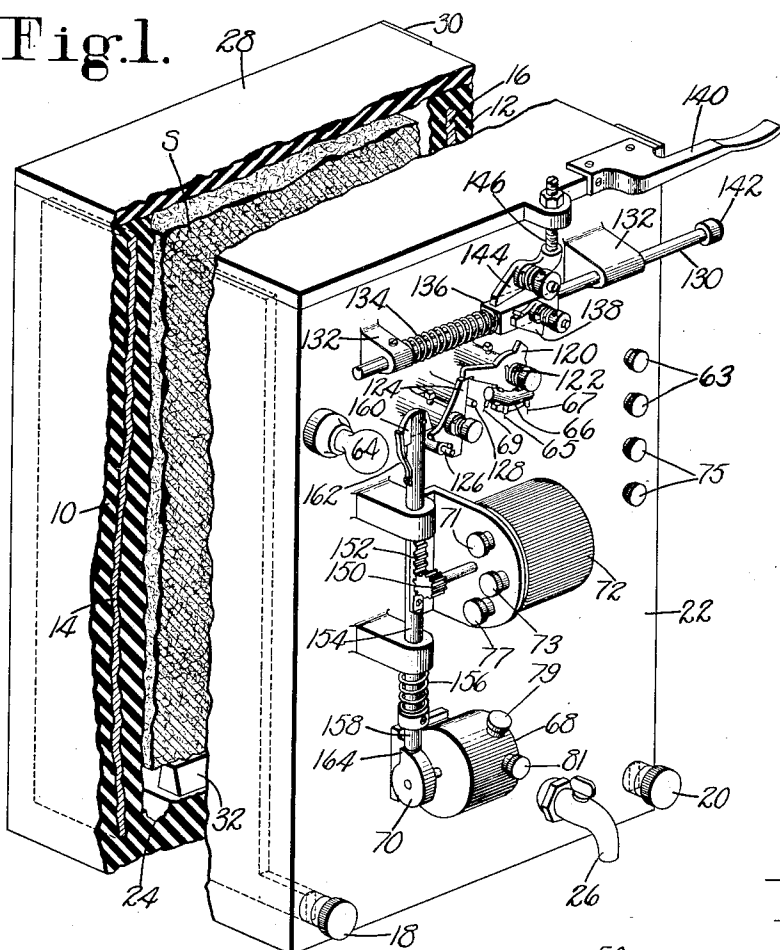
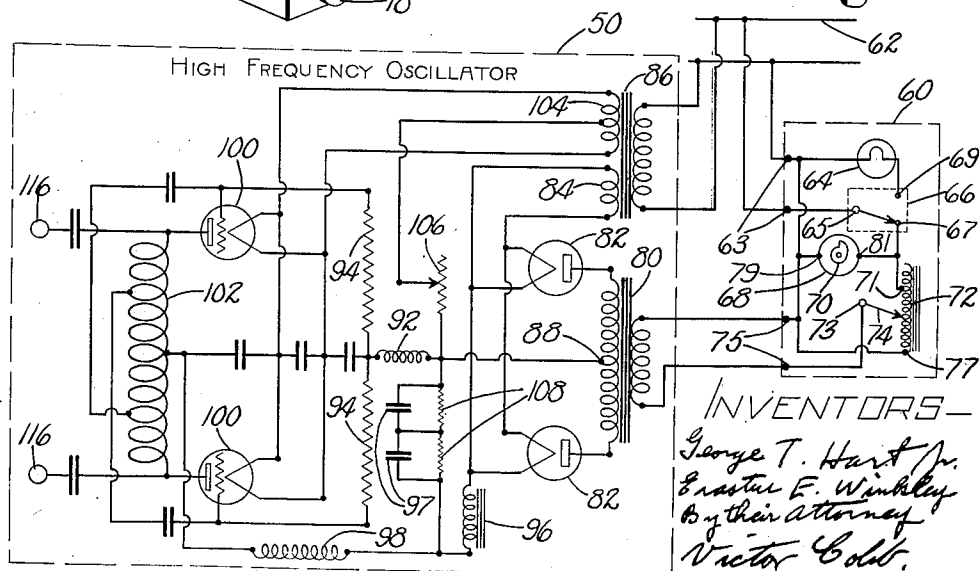


Fig. 2.



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ELECTRICAL DRYING

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This invention relates to methods of and apparatus for drying by heat produced electrically and it is illustratively described herein in connection with electrical drying in which the production of heat is effected within the material or article to be dried, by the action of an electrostatic field produced by currents of high frequency.

It is well understood that heat may be produced within articles or material by subjecting them to the action of an electrostatic field produced by currents having frequencies of the order of five to fifty or more million cycles per second. Commonly, the field is produced between spaced plates or electrodes electrically connected to a source of high frequency supply. In the manufacture of synthetic sponges, it is necessary before marketing the blocks of sponge material to remove the excess moisture therefrom. When this is done by the application of heat externally, the block of sponge material becomes heavily crusted and this crust must be cut off before the sponges can be marketed, with a resulting loss of from ten to fifteen per cent. of the material. It has also been found that many methods of drying synthetic sponge material cause a block or cake to shrink with a resulting caving-in of the sides so that the block becomes distorted. Under these conditions, there is substantial waste when the block is subdivided because of the lack of symmetry of the block.

With these conditions in mind, one object of the invention is to overcome these objectionable conditions and substantially avoid the crusting and caving-in resulting from the use of prior methods.

With this in mind, we have devised a novel method, which, in one aspect, is characterized by the subjection of the article to the action of a high-frequency electrostatic field while the article is within a closed compartment. Under these conditions, the moisture given out by the article itself quickly produces a humid atmosphere so that the tendency to crusting and uneven shrinking is substantially overcome.

After the heating action of an electrostatic field has been applied long enough to nearly complete the drying action, the temperature of the article automatically falls off unless the supply of power is increased and, from another viewpoint, this invention resides in a method of controlling the heating action of an electrical drying device by increasing the power as the drying progresses. As illustrated, this is accomplished automatically after a predetermined time,

From another point of view, our invention will be seen to reside in an improved apparatus by means of which articles may be readily subjected to the action of a high-frequency electrostatic field, thereby to heat the article and produce drying, and without danger to the user.

A feature of the invention resides in a substantially closed box-like apparatus for the reception of the material to be dried and in which the material or article is protected from direct contact with the plates or electrodes between which an electrostatic field is set up. As illustrated, the substantially closed box has walls of insulating material inside of the thickness of which are positioned plates adapted to be connected to a high-frequency circuit.

Another feature of the invention resides in a novel apparatus for controlling the application of power to the electrodes to the end that a shutting of the cover of the box will cause the power to be turned on. As illustrated, a controlling switch is arranged to be closed by a switch-operating device which is automatically released to cause a closing of the switch when the cover is closed and which is moved in the other direction to reset the operating device when the cover is opened.

In accordance with still other features of the invention and as illustrated, provision is made for varying the power supplied to the drying device by means of a time-responsive device, such as an electric clock. Also as illustrated, the supply of power to such an electric clock is terminated at the same time that the power is shut off from the heating apparatus.

These and other features of the invention are more fully described in the following specification, taken in connection with the accompanying drawing, in which,

Fig. 1 is an angular view of a sponge-receiving box with a control mechanism shown as mounted directly upon the outer surface of the box, and

Fig. 2 is a circuit diagram showing one form of high-frequency oscillator by means of which an electrostatic field may be set up and also showing the circuits of the control mechanism.

A block of sponge or other material to be dried is positioned in an enclosure such as a box, the walls 10 and 12 of which are formed from insulating material, such as bakelite, and have embedded therein plates 14 and 16 connected to terminals 18 and 20 upon the end wall 22 of the box. The interior of the box is provided with a gutter 24 which leads to a tap 26 which may be opened intermittently to draw off the collected water. The box is also provided with a closure

or cover 28 connected as by hinges 30 to the body of the box. In this box the sponge is supported upon blocks 32, the box being larger than the sponge.

5 An electrostatic field may be set up between the plates 14 and 16 by supplying to said plates electric currents having a frequency ranging, for example, from six to forty-eight megacycles and, conveniently, a typical frequency of about four-
10 teen megacycles. Many different forms of high-frequency oscillators may be employed to supply this electrical energy. The oscillator, illustrated diagrammatically, is enclosed by the broken line 50. To this apparatus power is supplied through
15 the control apparatus within the rectangle 60 from alternating current supply mains 62 connected to the terminals 63. This control apparatus embodies a signal light 64, a switch 66, shown in Fig. 1 as of the mercury-contact, tilt-
20 ing-tube type, an electric clock 68, on the shaft of which is provided a cam 70, and an autotransformer 72 having a movable contact 74 thereby to supply a variable voltage to the terminals 15. Thence, the power is supplied to the
25 primary of a step-up transformer 80.

The filaments of the rectifier tubes 82, connected in parallel, are supplied from one secondary 84 of the transformer 86 and the filaments of the oscillator tubes 100 receive their power
30 from the secondary 104. The primary of the transformer 86 is connected to the power mains 62. The diagrammatically illustrated oscillator is of the well known push-pull type. While it is understood that any other type of oscillator may
35 be substituted to supply the high frequency electrostatic field surrounding the electrodes 14 and 16, since neither the oscillator itself nor the particular circuits employed therein form a part of this invention, only a brief description of the
40 oscillator, which has been illustrated, is given.

The plate circuits of the oscillator tubes 100 are supplied with power from the secondary of the transformer 80, rectified by the tubes 82, smoothed by the iron core inductance 96 and the
45 filter condensers 97, passed through the radio frequency choke 98 to the center point of the oscillator inductance, or "tank coil" 102, and from thence, at convenient connections, to the plates of the tubes 100; the return being from the filaments to the mid tap 88 on the transformer 80.
50

Grid biasing is accomplished by the potential drop across the resistance 108. The grids of the tubes 100 are connected to taps on the "tank coil" 102.

55 The oscillating or "tank" circuit consists of the inductance 102 and the plates 14 and 16 of the dryer box, terminals 116 being provided on the oscillator which are connected to the terminals 18, 20 on the box.

60 The purpose of the grid leaks 94, the high frequency choke 92, the adjustable resistance 106 and the several blocking, by-passing and filtering condensers is well understood by one skilled in the art.

65 The mercury switch 66 is mounted on a rocking arm 120 and is provided with a spring 122 tending to turn it counterclockwise. When in the position shown in Fig. 1, a terminal 65 will be connected to a terminal 67 at the right, as
70 viewed in Fig. 1, thereby to close the circuit from the supply main 62 through the autotransformer 72 to the output terminals 15. The switch is held in this position against the tension of the spring 122 by means of a latch 124. This latch is urged
75 in a clockwise direction into contact with a stop

128 by a spring wound around its axis and, when in that position, supports the tail of the rocking arm 120. When the latch 124 is swung to the left by an apparatus to be presently described, the rocking arm 120 is turned by the spring 122
5 to cause the mercury within the switch to interconnect the center terminal 65 with the left terminal 69 thereby to interrupt the supply of power to the autotransformer and transfer it to the signal light 64, warning the operator that the
10 power has been turned off and the drying has terminated. A stop 126 limits movement of the latch 124 in a counterclockwise direction.

To move the switch 66, there is provided a switch-operating device comprising a rod 130
15 slidably mounted in brackets 132 upon the face 22 of the box, this rod being normally urged to the right by a surrounding spring 134 pressing against a rectangular block 136 on the rod. The block 136 carries a one-way trigger 138 which, 20 when the rod 130 is released to the action of the spring 134, engages the upper end of the switch arm 120 and moves it into the position shown, where it is held by the latch 124. When the cover is opened, a resetting arm 140 thereon is
25 adapted to engage a head 142 on this rod thereby to move it to the left against the tension of the spring 134 and in this position it will be held by a latch 144 which is pivoted on the side of the box and is normally held in contact with the block 30
136 on the rod by a spring wound around its axis. In this movement, the trigger 138 will have passed beyond the arm of the switch-carrying member 120. When the cover is closed, a trip member
35 146, adjustably secured to the cover, is positioned to engage the latch 144 thereby to move it away from the block 136 on the rod and allow the rod to move to the right, turning the switch arm 120 to the position shown. It will be seen, then, that
40 upon closing the box, the switch is closed to turn on the power while upon opening the box, the switch-operating device is reset ready to be tripped upon the next closing of the box.

The autotransformer 72 with its terminals 71, 73 and 77 is mounted directly upon the outside
45 of the box face 22 and the movable element 74 (Fig. 2) thereof is provided with a pinion 150 engaging the rack 152 upon a vertically slidable rod 154 mounted in guides upon the face of the box. This rod 154 is normally urged downwardly by
50 a spring 156 surrounding the rod between a collar on the rod and one of the guides thereby to hold the lower end 158 of the rod in contact with the surface of the cam 70 rotated slowly by an electric motor or clock 68, the terminals 79 and 81 of
55 which are connected as shown in the circuit diagram. On the upper end of the rod is a trip 160 having a nose projecting to the right for engagement with the heel of the latch 124 and provided with a depending portion held in en-
60 gagement with the side of the rod by a flat spring 162. When the power is first turned on, the box cover having tripped the switch-actuating device and moved the switch 66 to the position shown, the rod 154 will be in engagement with the por-
65 tion of the cam 70 at the base of the flat face 164 and the trip 160 will be below the latch 124. As the drying progresses, the sponge will be held at a substantially constant temperature of ap-
70 proximately 180° F. through a major portion, say, for example, eight-tenths of the total time required for drying. It will be found, however, that as the drying nears completion, the temper-
75 ature begins to drop unless the strength of the electrostatic field is increased by increasing the

supply of power to the oscillator. This is accomplished in the illustrated apparatus by the motor-operated cam 70 which, after a predetermined time, begins to turn the movable arm 74 on the autotransformer thereby to increase the voltage supplied to the transformer 80 of the oscillator. At the same time, the trip 160 is moved past the heel of the latch 124, being allowed to turn for this purpose by the spring 162, and is ready when the lower end 158 of the rod passes the high point 164 of the cam and drops to trip the latch 124 and cause the spring 122 to shut off the power, both to the oscillator and to the motor of the electric clock 68. It will be seen that the arrangement of the switching mechanism is such that it will not be turned on again until the cover has been opened to reset the operating device 130 and then has been closed to raise the latch 144.

Thus, in operation, the sponge S having been placed within the box 10 and the box cover 28 having been closed, the switch 66 will be turned to supply power to the oscillator 50 and to the motor-operated clock 68. The oscillator will set up an electrostatic field between the plates 14 and 16 which, in a well-understood manner, will induce heating within the sponge and, as the drying progresses, cause the box to be filled with a humid atmosphere surrounding the sponge. Whenever sufficient water has been driven out of the sponge by the heat and has accumulated in the gutters 24, it may be drawn off by turning the tap 26 to the position illustrated, after which the tap will be again turned to a closed position to maintain a substantially closed compartment within the box. It may be assumed that, with sponges of substantially uniform size, the time of drying at a predetermined frequency and strength of field will be substantially uniform. The time at which the temperature within the sponge begins to drop off materially, therefore, will be predetermined and the cam 70 upon the shaft of the clock motor 68 is so designed that it will automatically increase the strength of the electrostatic field at the desired time and thereby shorten the total time required for drying by acting to prevent the temperature from falling off. This automatic change in the strength of the field may be effected by any of a variety of well-known devices and may be in response to other functions than time, such, for example, as temperature, humidity, weight or the like. Upon reaching some predetermined condition, as at the end of a predetermined time, which has been found to be sufficient to dry sponges of this size, the clock motor will cause the current to be turned off and the motor will itself be stopped by having been deprived automatically of its driving current. At the same time, the lamp 64 will be lighted, notifying the operator that the sponge may be removed.

Although the apparatus has been described with particular reference to its utilization for drying articles or material, it will be understood that many of the features of the invention may be utilized wherever it is desired to produce heat. It may be for therapeutic purposes or for sterilization or cooking food-products and a variety of other uses, and the invention is not limited to its utilization for drying or to any other particular application.

Having described our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. That method of drying a synthetic sponge to prevent crusting of the sponge as the drying

progresses, which consists in raising the temperature of the article to cause the same to throw off moisture into the atmosphere, and retaining said moist atmosphere around the surface of the article.

2. That method of drying a synthetic sponge, which consists in producing heat within the sponge by subjecting the sponge to the action of a high-frequency electrostatic field, and in preventing crusting of the exterior of the sponge by maintaining a moist atmosphere around the sponge as the drying progresses.

3. That method of drying an article, which consists in producing an electrostatic field, subjecting the article to the action of said field, and increasing the effectiveness of said field as the work within the field becomes nearly dry.

4. That method of drying an article containing moisture by an electrostatic field of high frequency, which consists in supplying a current to create such a field sufficient to raise the temperature of an article positioned therein, maintaining the current substantially constant until the temperature of the article begins to drop by reason of the loss of moisture, and then increasing the current supply to accelerate the drying.

5. That method of drying an article containing excess moisture, which consists in supplying a current of predetermined value to create an electrostatic field, subjecting the article to the action of said field for a predetermined length of time, and then changing the current to vary the drying action during the remainder of the period of application of the field to the article.

6. That method of drying an article containing an excess of moisture, which consists in interposing the article in an electrostatic field produced by a current of high frequency, supplying said field with a current of known strength, and then changing the current supply as the drying progresses.

7. An apparatus for use in drying an article electrically, comprising a box forming a substantially closed compartment to receive the article to be dried and having walls of insulating material, said box being provided with plates inside the thickness of and hence covered on both faces by the insulating material of the walls of the box and adapted to be connected to a source of high frequency electric current.

8. An apparatus for use in drying an article electrically, comprising a box having walls of insulating material, plates substantially completely buried in said walls and provided with terminals for connection to an electric circuit, a cover for said box, and means for removing excess moisture as it gathers in the box.

9. An apparatus for drying an article electrically, comprising an enclosure having a movable closure, electrical drying means and a switch controlling the supply of power to said drying means, a movable switch-operating device, means including a trip member, a latch, and a spring, operated by the closing of the closure for moving said device in one direction, and means operated by the opening of the closure for moving said device in another direction to reset it.

10. In an apparatus for drying an article electrically, an enclosure having a movable closure, electrical drying means associated therewith, a switch controlling the supply of power to said drying means, a switch-operating device spring pressed in one direction, a latch holding said device against the spring pressure, means operated by movement of the closure to closed posi-

tion for tripping said latch to release said device for movement in one direction, and means operated by a movement of the closure to open position for effecting a resetting movement of the device in the other direction.

11. In an apparatus for drying an article electrically by the action of a high frequency electrostatic field, means for operatively modifying the power supplied to said field, and time-responsive means for operating said modifying means.

12. An apparatus for drying an article electrically comprising an electric heat-producing device, a device including a movable element for effecting a gradual change in the amount of power supplied to said heat-producing device,

and time-responsive means for operating the movable element of the control device.

13. An apparatus for drying an article electrically comprising an electric heat-producing device, a device including a movable element for effecting a gradual change in the amount of power supplied to said heat-producing device, electrically operated time-responsive means for operating the movable element of the control device, and a switch controlled by said time-responsive means for interrupting the supply of power to both the heat-producing device and the time-responsive device.

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