

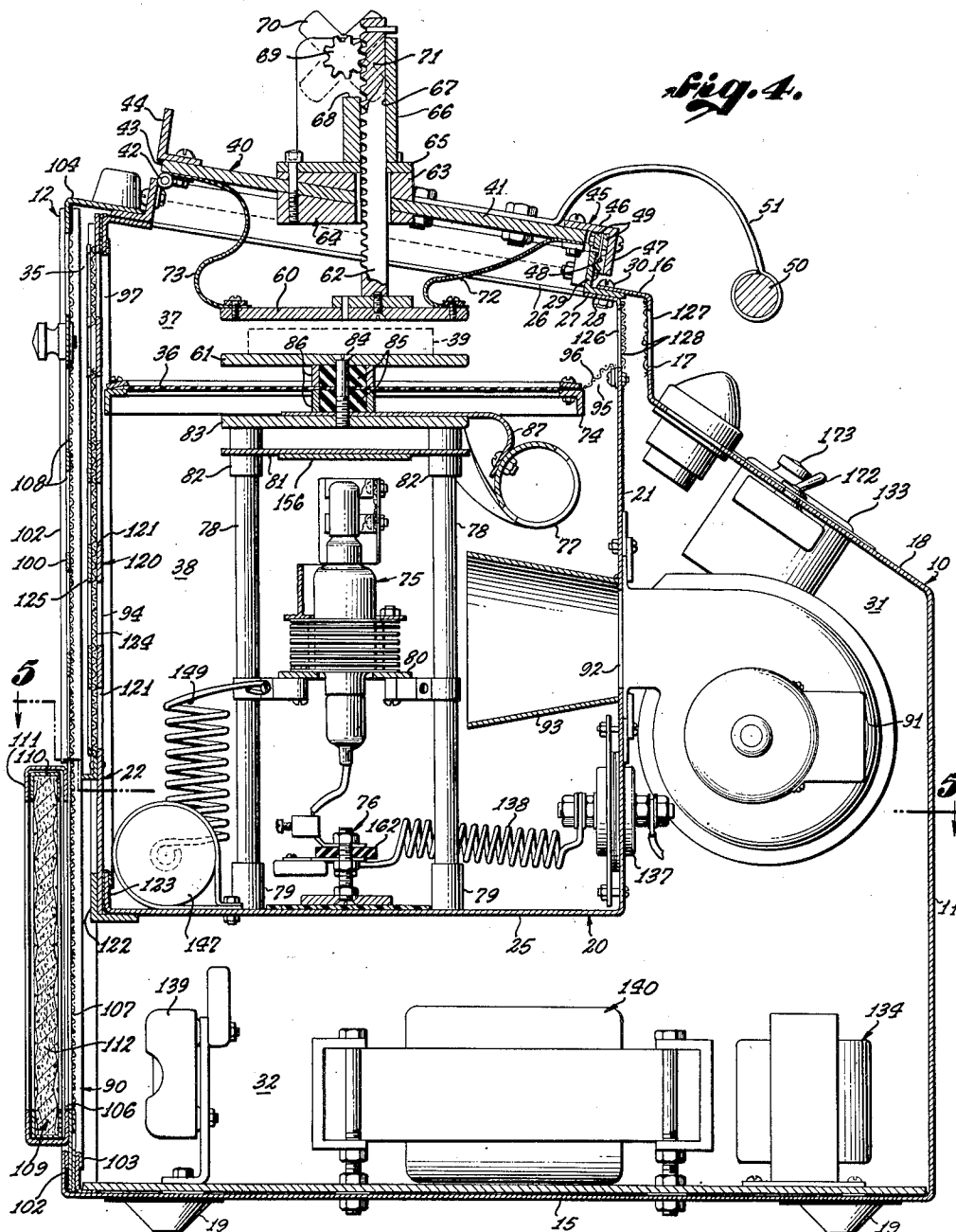
Feb. 5, 1957

A. J. SIEGMETH
DIELECTRIC HEATER

2,780,705

Filed Nov. 19, 1954

4 Sheets-Sheet 2.



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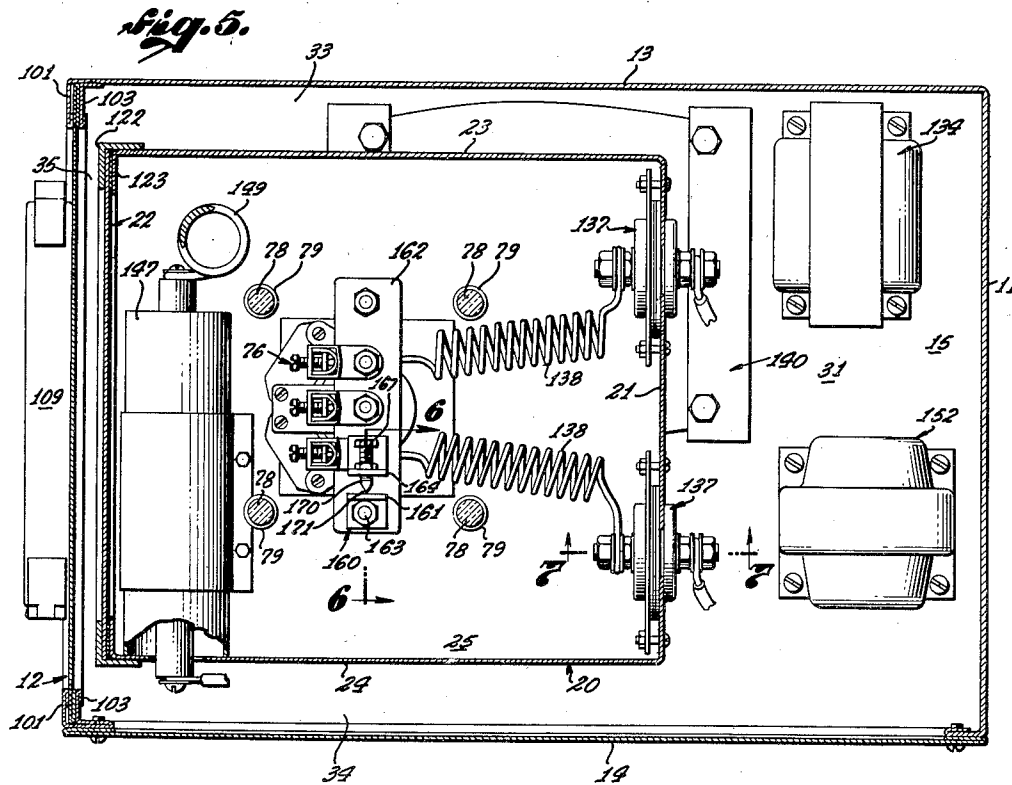
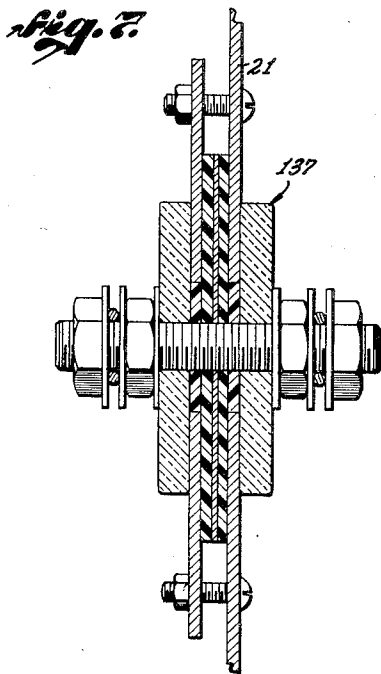
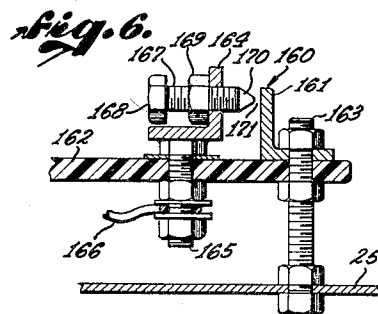
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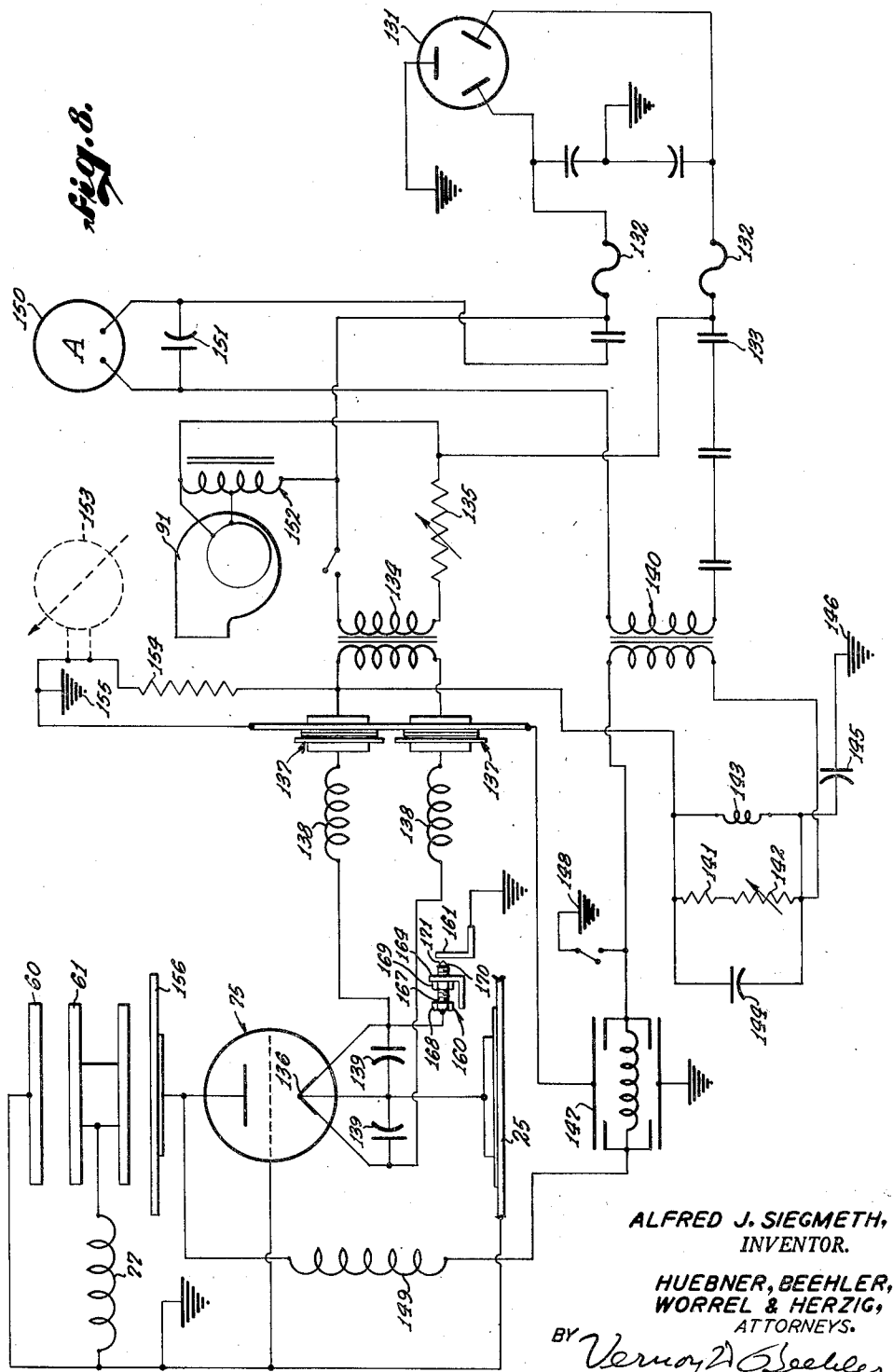
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2,780,705

DIELECTRIC HEATER

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Application November 19, 1954, Serial No. 469,951

16 Claims. (Cl. 219—10.67)

The invention relates to electric heating devices and in particular a heating device operating on the dielectric principle which makes use of high frequency oscillations to generate heat in the work in such manner that the work is uniformly heated throughout its mass at a rapid rate.

Dielectric heating has been practiced for a number of years and more recently has found considerable use in industry. One of the advantages in dielectric heating is that the heating operation can be accurately controlled, the work sought to be heated can be brought up to its desired temperature with sufficient rapidity to be an economic advantage in the production cycle, and that the heating operation can be advantageously located with respect to the production operation. There are, however, disadvantages prevalent in heating devices of this kind, chief among them being the difficulty in shielding the device so that the radio-frequency waves made use of in the device do not interfere with other electrical installations in the vicinity. Another difficulty in making use of known shielding principles is to so arrange a housing or container wherein the high oscillating frequencies are generated that it can be loaded and unloaded without impairing its effective operation. Further, because of the very high voltages encountered and the character of the apparatus necessary to generate dielectric heat, power tubes have been prone to wear out and give out more rapidly than necessary, thereby increasing the cost of the operation, because of inability to properly cool the power tube during certain portions of the operating cycle.

It is therefore among the objects of the invention to provide a new and improved rapidly operating dielectric heater wherein objects to be heated can be quickly loaded into the heating apparatus, rapidly and effectively heated to their desired temperature, and thereafter properly unloaded for further operation.

Another object of the invention is to provide a new and improved self-contained dielectric heater of high efficiency which is sufficiently compact and complete within itself that it can be located as a unit at any desired location in a production cycle.

Still another object of the invention is to provide a new and improved dielectric heating device which is effectively shielded so that the high frequency radio waves are properly confined within the apparatus and especially are confined against a leak past the necessary door with which the apparatus may be equipped for loading and unloading the work.

Still another object of the invention is to provide a cabinet or housing for a dielectric heater wherein a single access door for loading and unloading the work is so constructed and mounted that it shields the device with an effectiveness equal to a double walled shielding housing.

A further object of the invention is to provide a new and improved dielectric heater wherein all operative parts are contained within a double walled housing and where-

2

in a cooling and ventilating system is built into the walls of the housing so that air is brought in initially into the space between the double walls and thereafter forced first over the hottest portion of the operation, namely, around the power tube and thereafter in a more highly heated condition forced through that portion of the unit housing the work so as to simultaneously cool and ventilate the chamber in which the work has been heated, there being further provided proper shielding over the air passages so that the high radio frequencies do not escape the cabinet at those areas.

Still further among the objects of the invention is to provide a new and improved mounting means for the power tube and also for the electrodes so that they are effectively contained at a location such that the construction is simplified and at the same time the operation is greatly facilitated to accommodate different conditions and work of different character, the objects also including a protective feature for the electronic circuit such that in the case of an overload voltage, low voltage circuits will be shorted out, thereby avoiding damage to expensive portions of the electrical system.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a front perspective view of the self-contained unit housing the invention.

Figure 2 is a rear view partially broken away taken on the line 2—2 of Figure 1.

Figure 3 is a fragmentary perspective view of one side of the unit taken on the line 3—3 of Figure 1.

Figure 4 is a longitudinal sectional view of the unit showing the interior arrangement.

Figure 5 is a cross-sectional view of the unit taken on the line 5—5 of Figure 4.

Figure 6 is a fragmentary enlarged sectional view showing an overload voltage protector taken on the line 6—6 of Figure 5.

Figure 7 is a fragmentary enlarged sectional view of one of the binding posts for the power tube taken on the line 7—7 of Figure 5.

Figure 8 is a wiring diagram of the electronic circuit.

As shown on the drawings the unit comprises an outer box generally indicated by the reference character 10 having a front wall 11, a rear wall 12, and side walls 13 and 14. At their lower edges the side, front and rear walls join a bottom 15 and at their upper edges join a top 16. As noted particularly in Figures 1 and 4 the front wall 11 is set well forward of a wall section 17 to provide extra space and a sloping panel 18 provides an area for the location of various controls. Bosses 19 serve to support the outer box at a location slightly above whatever surface it may be mounted upon. In practice it has been found that the outer box may advantageously be constructed of a material such as stainless steel.

Inside of the outer box is suspended an inner box indicated generally by the reference character 20. The inner box comprises a front wall 21, a rear wall 22, side walls 23 and 24, and a bottom 25. The inner box is preferably constructed of a material such as sheet aluminum which forms in effect a closed box on all sides except the top.

The inner box has a large opening 26 extending almost entirely over the top area but bounded around the edges by a flange 27. The flange may be considered as comprising an inwardly turned rim 28 formed of the material forming the front, rear and side walls of the inner box, together with a separate angle element 29, having one leg

lying against the rim 28 and the other leg upstanding, as indicated in Figure 4. For the sake of uniformity in description the top 16 of the outer box may also be considered as a flange or rim, this being joined to the rim 28 by means of bolts 30. Mounted in this manner the inner box is suspended within the outer box and is in contact with the outer box only at the area of the rim 28. Thus suspended there is provided a space between the two boxes which may for convenience be identified as a blower space 31 at the front, and adjoining accessory space 32 between the bottoms and all communicating with spaces 33, 34 and 35 at the sides and rear respectively. It will be appreciated, therefore, that there is a double electrical shielding effect, one provided by the inner box, and the other provided by the outer box with a space between the boxes on all sides except the top.

The inner box 20 has mounted therein a partition 36 of a dielectric substance, preferably sheet silicone, dividing the interior of the inner box into an upper heating chamber 37 and a lower tube chamber 38. Inasmuch as the work suggested in dotted lines by a disc 39 must be placed inside of the heating chamber and removed therefrom with considerable frequency, the provision of a large opening 26 such as has already been described at the top of the inner box is requisite. Provision of a large opening of this kind, however, necessitates that special care be given to the design and construction of a door 40. The door must have shielding characteristics comparable to the shielding characteristics of the double wall construction and also be capable of being quickly opened and closed.

To accomplish the desired result the door is constructed of a relatively thick plate 41 which spans substantially the entire open area of the opening 26. A continuous hinge 42 extends throughout the entire length of a rear edge 43 of the plate and is joined to the inner face of the upstanding portion of the flange of angle element 29 by suitable bolts. A stop 44 is provided for limiting upward tilt of the door.

On the remaining three sides of the door there is provided angle elements 45 having one leg 46 attached to the upper surface of the plate 41 and the other leg 47 extending downwardly around adjacent portions of the angle element 29 but spaced outwardly therefrom. Considerable overlap is provided. To insure a snug seal with an electrical contact a resilient flap 48 is secured to the angle element 45 on each of the three sides and spaced inwardly from the angle element at a suitable location by means of blocks 49. The flap is so formed that when the door is closed, there is a continuous line contact between the flap and the outer face of the upstanding leg of angle element 29 throughout the three sides in which the flap is located. Consequently there is a complete electrical contact entirely around the door when the door is closed.

When the door is to be opened, the operator can lift the door by means of handle 50 which is attached to the top of the plate 41 by a long arm 51, the handle preferably being of an insulating material. Inasmuch as the door and portions of the device mounted thereon is relatively heavy, counter-balance springs 52 may be provided to hold the door in an open position. Each spring 52 has one end 53 secured to the angle element 45 at the side of the door and another end 54 secured to a suitable retainer 55 on the top 16 of the outer box. The spring may be mounted on an outwardly extending end of a hinge pin 56. Contact screws 57 are mounted on a suitable bracket 58 and these may be adjusted and suitably locked so that when the door is closed a positive electrical contact between the door and the outer box is assured thereby to improve the shielding.

Within the heating chamber 37 are the negative electrode 60 and the positive electrode 61. The negative electrode is mounted so that its position can be adjusted up or down to vary the distance between itself and the positive electrode. To make the negative electrode ad-

justable, there is provided a negative electrode supporting column 62 which extends upwardly through the plate 41 and also through a pair of blocks 63 and 64 suitably apertured so as to slidably accommodate the column. A plate 65 is secured on top of the block 63 with a more snugly fitting aperture for the column 62. On the plate is a housing 66 likewise having therein an aperture 67 for slidably receiving the column 62, the aperture being broken away at 68 to facilitate mounting of a pinion 69 on an appropriate shaft at the outer ends of which are hand wheels 70. The pinion 69 meshes with a rack 71 at the upper end of the column and by manipulation of the hand wheels the column can be moved up and down, thereby changing the location of the negative electrode 60.

To assure a good electrical ground between the negative electrode and the cabinet, there are provided flexible strips 72 and 73, each securely fastened at one end to an outer edge of the negative electrode and securely fastened at the other end to the plate 41 of the cover 40 by suitable bolts. These strips form a positive electrical contact, which positive contact is not effectively supplied by the rather loose sliding fit of the column 62 in its support.

The positive electrode 61 as shown is mounted in a position parallel to and adjacent the partition 36, the partition 36 in turn being joined to a suitable bracket device 74 on the inner wall of the inner box.

A four-corner support is mounted upon the bottom 25 of the inner box, this support serving a multiple purpose in that it is designed to carry a power tube 75, connecting means 76 therefor, and the positive electrode 61, and an appropriate tank coil 77.

The support comprises essentially four upright columns 78 preferably of silicone material establishing four corners of a relatively square area. The columns are mounted in sleeves 79 secured by appropriate means to the bottom 25. Intermediate the bottoms and tops of the columns 79 is a platform 80 fastened to the columns so that its position is fixed at a desired location. The platform provides a mounting for the power tube 75. Nearer the upper ends of the columns is a capacitor 81 transversely located sleeves 82 at the tops of the columns mount a plate 83 forming part of the positive electrode. A central screw 84 extending through blocks 85 held within sleeves 86 secures the upper plate of the positive electrode to the lower plate. The tank coil 77 is mounted upon and connected to the positive electrode by means of a bracket 87.

When the dielectric heater is used for the purpose of heating discs, blocks, or other pieces of work such, for example, as blocks of plastic prior to subjecting the blocks to a molding process, the block in question is placed upon the positive electrode as suggested by the position of the disc 39. The door 40 is then closed and the power turned on. Application of the power through the power tube generates a very substantial amount of heat in the block or disc and at a relatively rapid rate. The power tube warms up to a high temperature. The temperature in the heating chamber 37 also raises considerably. Moreover, moisture present in the block or disc 39 is released and accumulates in the heating chamber. When the heating has been completed, the moisture tends to remain. For proper operation it is advisable to cool the power tube and also to both cool and ventilate the heating chamber 37 prior to the deposit therein of another block or disc to be heated. For general overall efficiency it is also desirable to circulate air between the inner box and the outer box. To this end a ventilating system is provided.

The air for ventilating and cooling enters through an air inlet opening 90, passing from there into the accessory space 32 and also circulating through the spaces 33, 34 and 35. To effect a forced circulation of air, a blower 91 is mounted in the blower space 31 in front of the front wall 21 of the inner box and behind the front wall 11 of the outer box. Any one of a number of con-

ventional blowers may be found suitable but in any event it is desirable that the blower draw air from the blower space 31 and pass it under some pressure through an air passage 92 of the front wall 21 and thence through a distributor horn 93, by means of which a stream of air is directed expressly at the power tube 75, this being the hottest portion of the operation. By this arrangement the coolest air is directed toward the portion of the apparatus most needing to be cooled. Naturally the air will be warmed considerably by coming into contact with the hot power tube. Although a small proportion of the warm air is forced outwardly through an air outlet 94 in the rear wall of the inner box, nevertheless a substantial portion of the warm air is forced through a ventilating passage 95, which passage has interposed therein an electrically shielding screen 96. Air forced through the ventilating passage 95 sweeps through the heating chamber and passes outwardly at the rear through an air outlet passage 97 carrying with it moisture released from the work together with heat generated by the heating cycle.

Inasmuch as the passages through which air enters the unit and from which air leaves the unit must be of considerable area in order to permit free passage of air, the area must be effectively electrically shielded since otherwise the shielding effect of the entire unit would be destroyed. To properly shield the air inlet opening 90 there is provided a frame 100 of sheet material which extends substantially over the entire rear wall of the outer box except for a confining slot 101 extending around the vertical side edges and bottom. As shown in greater detail in Figures 4 and 5, the slot 101, whether on the vertical edges or on the bottom, comprises an outer flange 102 and an inner flange 103 spaced rather close together to form a snug sliding fit where the periphery of the frame 100 is adapted to slide. The fit is made snug enough so that there is a positive electric contact between the frame, which may be of the same stainless steel material, and the material of the outer box. A flat portion 104 at the upper edge of the frame is adapted to overlie the horizontal leg of the angle element 29 in firm contact therewith, which contact may be maintained by suitable screws, not shown.

At the lower end of the frame 100 there is provided an opening 106 which communicates with the air inlet opening 90. The opening 106 is covered with a metallic electrically shielding mesh 107. At the upper portion of the frame 100 are apertures 108 and for convenience the metallic mesh 107 may be extended over the entire area of the frame so as to cover all of the apertures 108.

So that inflowing air may be clean, there is provided an air filter 109 which comprises a filter frame 110 snugly fitting a confining channel 111 attached to the frame around the opening 106. The filter frame may be so mounted that it can be removed periodically in order to permit cleaning of an air filter membrane 112.

To properly shield the inner box 20 over the air outlet area 94 there is provided a frame 120 of sheet material, preferably aluminum under circumstances where the inner box is likewise constructed of aluminum. The frame contains apertures 121 slightly smaller than but coinciding with the apertures 108. To accommodate the frame 120, a flange 122 is provided extending down the side edges and across the bottom of the rear wall 22 of the inner box. A similar flange 123 is formed from the material of the inner box and occupies a position spaced from the flange 122 so as to provide a narrow slot therebetween. The frame 120 is designed to slide snugly within the slot thus formed and when in place to form a positive electric contact around the edges of the frame. A metallic mesh 124 extends over substantially the area of the frame occupied by the apertures 121 so that all of the openings of the apertures are electrically shielded. An overlying sheet 125 may be

provided to hold the mesh in place. On occasions where it is necessary to gain access to the interior of the inner box, the frame 120 may be slid upwardly within the confining slots. When it is slid downwardly in a position closing the opening comprising the air outlet 94, the frame is effectively secured in position after the frame 100 has been applied and secured in place in the manner previously described. By the structure thus defined it will be apparent that although ample openings are provided for both air inlet and air outlet, the openings are suitably electrically shielded by a metallic mesh which on the rear as described consists of mesh walls over portions of the area spaced one from another in much the same relationship as the remaining imperforate walls of the inner and outer boxes. The double shielding mesh thereby provides an effective electrically shielding effect.

The same effect is also provided for vents 126 and 127 aligned adjacent the wall section 17 at the front of the machine. Metallic meshes 128 at these locations properly shield the vents which permit outflow of a certain amount of ventilating air.

In the electronic circuit are sundry accessory elements, all of which comprise portions of the circuit and are located in various portions of the unit. A wiring diagram illustrative of the circuit is shown in Figure 8. Electric power is supplied at a three-prong connection 131 normally located at the side wall 13 adjacent the bottom rear as shown in Figure 1. Current at the three-prong connection is normally supplied at 220 volts A. C. Current from the connection passes through cartridge fuses 132 to a timer 133, there being also a direct connection to an auto transformer 134 in which is a resistor 135 which is adapted to control the filament voltage of a filament 136 in the power tube 75. The opposite side of the auto transformer 134 is connected to the filament through feed-through capacitors 137 and choke or filter coils 138. By-pass capacitors are indicated by the reference character 139.

In a portion of the circuit fed through the fuses 132 is a plate transformer 140 capable in one embodiment of the invention of a production of 4250 volts. The high side of the transformer 140 connects to resistors 141 and 142 and an overload relay 143 which are included in the same circuit as a capacitor 144 and by-pass capacitor 145 connected in turn to ground at 146. In the other branch of this circuit is a radio-frequency plate filter 147 interconnected on one point to capacitors 137, at another point to ground at 148, and at still another point to the power tube circuit through a plate choke coil 149.

Elsewhere in the circuit are located a power meter 150 associated with a by-pass capacitor 151. The blower 91 has associated with it an autotransformer 152 and a grid current meter 153 has a resistor 154 connected thereto and in turn connected to ground at 155 and to the capacitors 137. Such parts of the circuit and elements therein as have not been specifically identified are substantially conventional for circuits of this character.

The oscillator 75 is a high-frequency changer, one satisfactory model of which is RCA No. 5786 as currently identified. The oscillator is one capable of increasing the frequency to something in the nature of 90 megacycles. Associated with the power tube is a coupling capacitor 156 located immediately adjacent the positive electrode or anode 61 and its corresponding negative electrode 60, these in the form of the invention selected for the purpose of illustration being plates held in parallel relationship to each other. The tank coil 77 is shown interconnected with the positive electrode.

In the filament circuit there is located an overload voltage protector 160, this being shown also in detail in Figure 6. The overload voltage protector consists of a plate 161 secured to a dielectric sheet 162 by means of a bolt 163, the bolt being one extending into engagement with the bottom 25 of the inner box to establish a ground connection.

Also mounted upon the dielectric sheet 162 is an angle element 164 which employs a bolt 165 serving as a binding post to secure the angle element to the sheet and also to provide a connection for a wire 166 joining the filament circuit. Mounted in the angle element is an adjusting screw 167 having a screw head 168 by means of which it may be manipulated, and a lock nut 169 to securely lock it in adjusted position. A tapered point 170 on the screw lies immediately adjacent the plate 161 so that the screw can be adjusted to vary the length of an air gap 171. It has been found in practice that a grid voltage of three to four hundred volts serves as a workable voltage for certain operating conditions. When this is the selected voltage, it is desirable to short the circuit in the event that the voltage should rise inadvertently to about double the figure, namely, about six to eight hundred volts. To set the overload voltage protector to operate at this voltage a suitable instrument can be connected in circuit with it and the adjusting screw moved to set the length of the air gap 171 so that the air between the tapered point 170 and plate 161 will break down and ionize at the selected voltage, thereby grounding the filament circuit and protecting the other elements of the circuit from damage which might result should the voltage exceed the figure for which the overload voltage protector is set.

When the device is to be operated, the door 40 is lifted by manipulation of the handle 50. This lifts the negative electrode 60 out of the way and the work can be placed directly upon and supported by the positive electrode 61. Thereafter the door 40 is closed snugly to the position illustrated in Figure 4. The negative electrode 60 should preferably not come into direct contact with the work but should lie adjacent thereto, in which position it can be set by manipulation of the hand wheels 70. Let it be assumed meanwhile that the current has been turned on in the filament circuit by use of the filament toggle switch 172. The timer 133 is then set for the proper heating cycle, 15 to 30 seconds frequently being sufficient. A start button 173 is then pressed starting the timing cycle and current will flow to the power tube generating the oscillating waves for the length of time set, the action of which will raise the work to the desired temperature. After the timer has stopped the operation, the door 40 is lifted and the work removed. The unit then is ready for heating the next work piece.

From the foregoing description it will appear that the unit described is compactly housed within the inner and outer boxes wherein all electrical elements are contained together with the mechanically functioning portions of the device. By providing a wide-open top, ready access can be had to the heating chamber so that work pieces up to the maximum size permissible due to the interior dimensions of the heating chamber can be conveniently inserted and removed. The door is so constructed that it can be lifted and lowered with a minimum of effort and will hold its position either open or closed. The shielding character of the door is comparable to the shielding character of the double walled box construction. All parts are readily accessible from the rear by removal of the frames 100 and 120 when servicing is necessary. It is further possible, should occasion require, to disconnect the inner box from the outer box and to lift the inner box from the outer box to give access to the interior of the outer box. Constructed as shown the unit can be mounted as such at any desired location in a production line or production operation to afford maximum efficiency where the heating of small objects in a production operation is necessary.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein

but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An electron cabinet heater comprising an inner box of electrical shielding material having a bottom, front and rear walls, side walls and an open top, an insulated tube support mounted in the box, a partition of insulating material separating the box into an upper heating chamber and a lower tube chamber, an outer box of electrical shielding material surrounding and spaced from all sides and bottom of the inner box and having an open top, a flanged junction between the top of the inner box and the top of the outer box thereby to support said inner box, a loading door hinged to the boxes at said junction, said door having a downwardly extending resilient rim adapted when closed to surround and press against the flanged junction, a positive electrode plate supported in the heating chamber above the partition, a negative electrode mounted in said heating chamber in spaced parallel relation to the positive electrode when the door is closed, means forming an electrical shielded air inlet passage to said chambers, and means in the wall of said inner box and in an adjacent wall of the outer box forming an electrical shielded air vent from said chambers to the atmosphere.

2. An electron cabinet heater comprising an inner box of electrical shielding material having a bottom, front and rear walls, side walls and an open top, a tube support of insulating material mounted on the bottom of the inner box, a partition of insulating material in a transversely extending position separating the box into an upper heating chamber and a lower tube chamber, an outer box of electrical shielding material surrounding and spaced from all sides and bottom of the inner box and having an open top, a flanged junction between the top of the outer box and the top of the inner box thereby to support said inner box, a loading door hinged at one edge to the flanged junction, said door having a downwardly extending resilient rim adapted when closed to surround and press against the box flanged junction, a positive electrode plate supported in the heating chamber, a negative electrode supported in said heating chamber on said door in spaced parallel relation to the positive electrode when the door is closed, means forming an electrical shielded air inlet to space between said inner and outer boxes, means in the wall of the inner box forming an air passage between said space and said tube chamber, means in said partition forming a ventilating passage from said tube chamber to said heating chamber, means in the wall of said inner box forming electrical shielded air outlets from said chambers and means in an adjacent wall of the outer box forming an electrical shielded air vent from said outlets to the atmosphere.

3. An electron cabinet heater comprising an inner box of electrical shielding material having a bottom, front and rear walls, side walls and an inner box flange around the top of the walls forming an open top, a tube support comprising columns of insulating material mounted on the bottom of the box, a partition of insulating material carried by the tube support in a transversely extending position separating the box into an upper heating chamber and a lower tube chamber, an outer box of electrical shielding material surrounding and spaced from all sides and bottom of the inner box and having an outer box flange at the top joined to the inner box flange thereby to support said inner box, a loading door hinged at one edge to the inner box flange, said door having a downwardly extending rim adapted to encompass said flanges when in closed position and having a resilient inner flap on the rim adapted when closed to surround and press against the inner box flange, a positive electrode plate supported in the heating chamber by the tube support, a negative electrode adapted to be suspended in said heating chamber on said door in spaced parallel relation to the positive electrode when the door is closed, means forming an

electrical shielded air inlet to space between said inner and outer boxes, means in the wall of the inner box forming an air passage between said space and said tube chamber and a blower in said passage, means in said partition forming a ventilating passage from said tube chamber to said heating chamber, means in the wall of said inner box forming electrical shielded air outlets from said chambers and means in an adjacent wall of the outer box forming an electrical shielded air vent from said outlets to the atmosphere.

4. An electron cabinet heater comprising an outer box, an inner box in the outer box and having walls and a bottom spaced from the outer box, said boxes each having top openings coincident one with another, an upstanding flange common to both the inner box and the outer box, said inner box having a heating chamber at the upper end beneath the opening, a positive and negative electrode plate in the heating chamber, a door of electrical shielding material having a thickness greater than the thickness of the flange and having a hinge joined to the boxes, a rigid downwardly extending rim on said door adapted in closed position of the door to occupy a position laterally spaced from and enclosing said upstanding flange, a resilient flap on the door at the inside of the rim and spaced therefrom and adapted to resiliently engage the upstanding flange with a line contact throughout the perimeter.

5. An electron cabinet heater comprising an outer box, an inner box in the outer box and having walls and a bottom spaced from the outer box, said boxes each having top openings coincident one with another, and an upstanding flange common to both the inner box and the outer box, said inner box having a heating chamber at the upper end beneath the opening, a positive electrode plate at one side of the heating chamber, a substantially flat door of electrical shielding material having a hinge joined to the boxes, a rigid downwardly extending rim on said door adapted in closed position of the door to enclose said upstanding flange, a resilient flap on the door at the inside of the rim and spaced therefrom and adapted to engage the upstanding flange with a line contact throughout the perimeter, a negative electrode plate support extending through the door and adjustably mounted therein, and a negative electrode plate on said negative electrode support having a position when the door is closed within the inner box parallel to and spaced from the positive electron plate.

6. An electron cabinet heater comprising an outer box, an inner box in the outer box and having walls and a bottom spaced from the outer box, said boxes each having top openings coincident one with another and an upstanding flange at the top of the inner box surrounding the opening and joined throughout its entire perimeter to the outer box with a metal to metal seal, said inner box having a heating chamber at the upper end beneath the opening and a separate tube chamber at the lower end, a positive electrode plate at the bottom of the heating chamber, a door of electrical shielding material having a hinge at one edge joined to the flange on one side of the inner box, a rigid downwardly extending rim on said door adapted in closed position of the door to enclose said upstanding flange, a continuous resilient flap on the door at the inside of the rim and spaced therefrom and adapted to resiliently engage the upstanding flange with a line contact throughout the perimeter, a negative electron plate support extending through the door and adjustably mounted therein, a negative electrode plate on said negative electrode support extending beyond the open edge of the door and having when the door is closed a position within the inner box and parallel to and spaced from the positive electrode plate, resilient strips between the edges of said negative electron plate and said door, and counter-balance springs at said hinge between the door and said flange.

7. An electron cabinet heater comprising an outer box having side walls, a bottom, and a top having an opening

therein, an inner box having a flange at the top secured to the top of the outer box whereby the inner box is suspended in the outer box spaced from the walls thereof and providing communicating spaces adjacent the walls adjacent the bottom, means on a wall of the inner box forming an air passage from said spaces to the interior of said inner box, means forming an air outlet on another wall of the inner box, a frame of electrical shielding sheet material received in electrical shielding engagement with said other wall around the opening therein, said frame having apertures therethrough and electrical shielding pervious material in said apertures, means forming an opening in a wall of the outer box adjacent said other wall of the inner box and a frame of electrical shielding sheet material received in electrical shielding engagement with said last wall of the outer box, and having apertures therein coinciding with apertures in the frame for said inner box and electrical shielding pervious material in said last apertures, means in the frame of said outer box forming an air inlet opening communicating with said spaces, a filter frame over said air inlet opening and a pervious electrical shielding material over said inlet opening in said frame.

8. An electron cabinet heater comprising an outer box having side walls, a bottom, and a top having an opening therein, an inner box having a flange at the top secured to the top of the outer box whereby the inner box is suspended in the outer box spaced from the walls thereof and providing a space therearound, a partition having an opening therethrough forming upper and lower chambers in said inner box, means on one wall of the inner box forming an air passage from said space to the lower chamber of said inner box, means forming an air outlet in another wall of the inner box, a frame of electrical shielding sheet material removably received in electrical shielding engagement with said other wall of the inner box around the opening and having apertures therethrough and electrical shielding pervious material in said apertures, means forming an opening in a wall of the outer box adjacent said other wall of the inner box, and a frame of electrical shielding sheet material removably received on said wall of the outer box and having apertures therein coinciding with apertures in the frame for said inner box and electrical shielding pervious material in said last apertures, means in the frame of said outer box forming an air inlet opening communicating with said space, and a filter frame covering said last identified opening and having a pervious electrically shielding material thereover, said frame being removably secured in electrically shielding engagement with the frame in the outer box.

9. An electron cabinet heater comprising an outer box having side walls, a bottom, and a top having an opening therein, an inner box having a flange at the top secured to the top of the outer box whereby the inner box is suspended in the outer box spaced from the walls and bottom thereof and providing a blower space adjacent the front wall and an accessory space adjacent the bottom communicating with the blower space, means on an adjacent wall of the inner box forming an air passage from said blower space to the interior of said inner box, electrical shielding slot elements on the side edges and bottom of the rear wall of the inner box and means forming an air outlet surrounded by said slot elements, a frame of electrical shielding sheet material slidably received in said slot elements and having apertures therethrough and electrical shielding pervious material in said apertures, means forming an opening in the rear wall of the outer box, electrical shielding slot elements at the side edges and bottom of the rear wall of the outer box surrounding said opening and a frame of electrical shielding sheet material slidably received in said slot elements and having apertures therein coinciding with apertures in the frame for said inner box and electrical shielding pervious material in said last apertures, means in the frame of said

11

outer box forming an air inlet opening opposite said accessory space, an electrical shielding channel surrounding said opening, a filter frame in said channel and a pervious electrical shielding material in said frame and an electrical shielding grill covering said last identified opening at the inner side of said filter frame.

10. A cabinet electron heater comprising an outer box, an inner box suspended at upper ends of said boxes in the outer box and in spaced relation thereto, said boxes having coinciding loading openings at the tops thereof, an electron tube support mounted on the bottom of the inner box and comprising a series of columns of insulating material, a tube base mounted intermediate upper and lower ends of the columns, a partition of insulating material mounted in the inner box above the columns and dividing the interior of said inner box into a lower tube chamber and an upper heating chamber, an electrode support carried by said columns and extending through said partition, a positive electrode plate on said electrode support and in said heating chamber, and a negative electrode plate carried by said inner box in a position spaced from and parallel to said positive electrode plate when in operating position.

11. A cabinet electron heater comprising an outer box, an inner box suspended at upper ends of said boxes in the outer box and in spaced relation thereto, said boxes having coinciding loading openings at the tops thereof, an electrode tube support mounted on the bottom of the inner box and comprising a series of four silicone corner columns, a tube base mounted intermediate upper and lower ends of the columns, a platform at upper ends of the columns, and a partition of silicone material secured to walls of the inner box dividing the interior of said inner box into a lower tube chamber and an upper heating chamber, an electrode support on said platform extending through said partition, a positive electrode plate carried on said electrode support and in said heating chamber, and a negative electrode plate carried by said inner box in a position spaced from and parallel to said positive electrode plate when in operating position.

12. In an electron heater a box having side walls and a bottom, a plurality of silicone columns mounted in the box, a tube base mounted on said columns intermediate upper and lower ends, a platform on the upper ends of the columns, a sheet of silicone material on said platform, an electrode support on said platform extending through said sheet, an electrode carried on said support above the sheet and an opposite electrode carried on said box in a position spaced from the first electrode.

13. An electron heater device comprising a positive electrode element and a negative electrode element spaced one from another and adapted to receive between them an object to be heated, an oscillator power tube having elements comprising a filament, a grid and an anode, a source of electric power having respective positive and negative terminals, and an electronic circuit interconnecting said source of electric power and said tube elements, and a composite boosting and heating circuit comprising a boosting sub-circuit and a parallel resonant sub-circuit, said first identified sub-circuit comprising said anode, a coupling capacitor element, said positive electrode, a resonant coil, said grid, said filament, and a negative terminal of said power source, said capacitor element and said positive electrode having an air gap therebetween, a high frequency filter system connected between said filament and said source of electric power, said parallel resonant sub-circuit comprising said resonant coil, said positive electrode and said negative electrode, and a high voltage hot circuit between the anode and a positive terminal of the power source.

14. An electron heater device comprising a cabinet housing a heating chamber, a positive electrode element and a negative electrode element spaced one from another in said chamber and adapted to receive between them an object to be heated, an oscillator power tube

12

in said cabinet having elements comprising a filament, a grid and an anode, a source of high and low voltage of electric power having respective positive and negative terminals, and an electronic circuit interconnecting said source of electric power and said tube elements, and a composite boosting and heating circuit comprising a boosting sub-circuit and a parallel resonant sub-circuit, said first sub-circuit comprising said anode, a coupling capacitor element, said positive electrode, a resonant coil, said grid, said filament, and a negative terminal of said power source, said capacitor element and said positive electrode having comparable areas and an air gap therebetween, a high frequency filter system connected between said grid, said filament and terminals of said power source, said parallel resonant sub-circuit comprising said resonant coil, said positive electrode and said negative electrode, and a high voltage hot circuit between the anode and a positive terminal of the power source.

15. An electron heater device comprising a cabinet housing a heating chamber, a positive electrode element and a negative electrode element spaced one from another in said chamber and adapted to receive between them an object to be heated, an oscillator power tube in said cabinet outside said heating chamber and having elements comprising a filament, a grid and an anode, a source of high and low voltage of electric power having respective positive and negative terminals, and an electronic circuit interconnecting said source of electric power and said tube elements, and a composite boosting and heating circuit comprising a boosting sub-circuit and a parallel resonant sub-circuit, said first sub-circuit comprising said anode, a coupling capacitor element, said positive electrode, a resonant coil, said grid, said filament, and a negative terminal of said power source, said capacitor element and said positive electrode having comparable areas and an air gap therebetween, a high frequency filter system comprising in series a pair of choke coils and capacitors connected to opposite terminals of the low voltage source of power, a plurality of high frequency capacitors connected to said filament and a center tap thereof, a by-pass capacitor in series with said first capacitors and said grid, said parallel resonant sub-circuit comprising said resonant coil, said positive electrode and said negative electrode, and a high frequency choke between the anode and a positive terminal of the high voltage power source.

16. An electron heater device comprising a cabinet housing a heating chamber, a positive electrode plate and a negative electrode plate spaced one from another in said chamber and adapted to receive between them an object to be heated, an oscillator power tube in a portion of said cabinet outside said heating chamber and having elements comprising a filament, a grid and an anode plate, a source of high and low voltage of electric power having respective positive and negative terminals and an electronic circuit interconnecting said source of electric power and said tube elements, and a composite boosting and heating circuit comprising a boosting sub-circuit and a parallel resonant sub-circuit, said boosting sub-circuit comprising said anode plate, a coupling capacitor plate, said positive electrode, a resonant coil, said grid, said filament, and a negative terminal of said high voltage source connected in series, said capacitor plate and said positive electrode having comparable areas and a fixed air gap therebetween, a high frequency filter system comprising in series a pair of choke coils and capacitors connected to opposite terminals of the low voltage source of power, a pair of high frequency capacitors connected to said filament and to a center tap of said tube, a by-pass capacitor in series with said first capacitors and said grid, said parallel resonant sub-circuit comprising said resonant coil, said positive electrode and said negative electrode, and a high frequency choke between the anode plate and a positive terminal of the high voltage power source and means adjustably mounting one of said plates

13

whereby to vary the space therebetween and the frequency of said resonant sub-circuit for the heating of said object.

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5

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