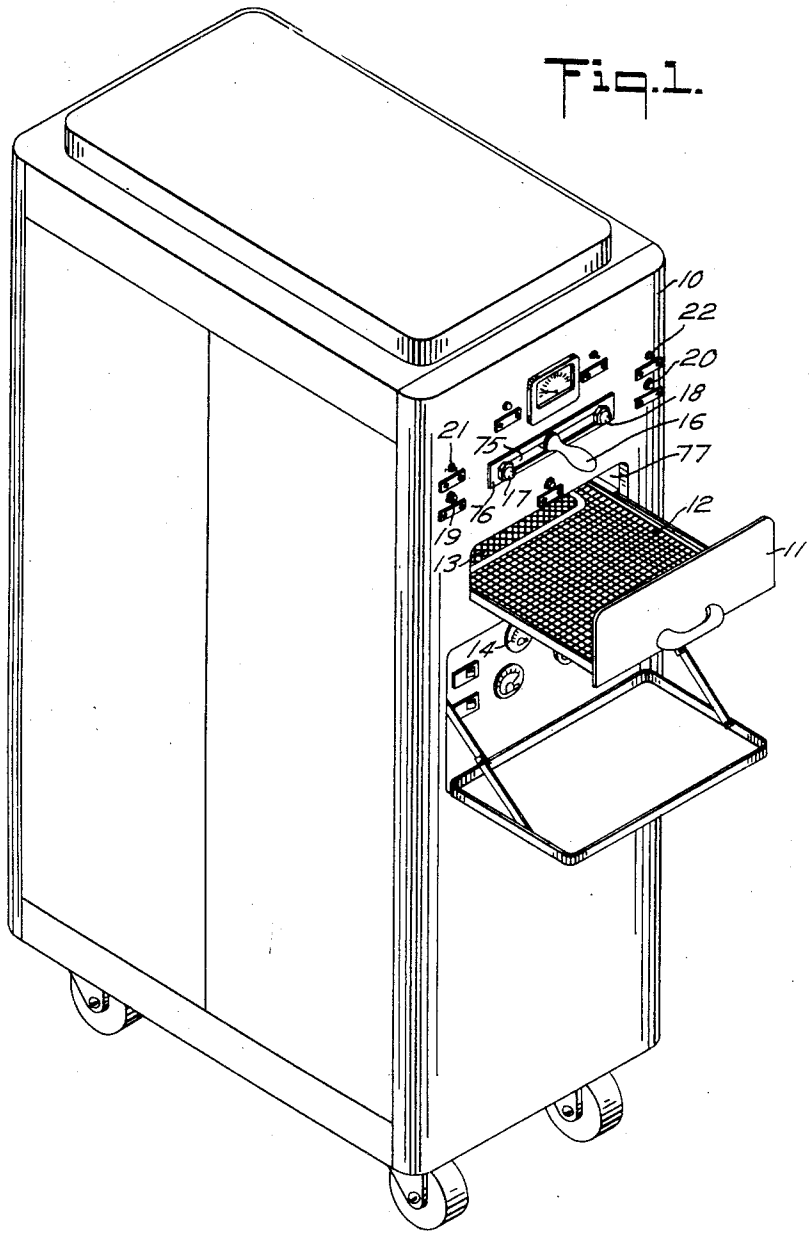
June 27, 1950 A. PROCTOR ET AL 2,512,751

DIELECTRIC HEATING SYSTEM HAVING PROVISION FOR SELECTION OF PRESET ELECTRODE SPACINGS

Filed Aug. 1, 1946

5 Sheets-Sheet 1

Fig. 1.



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5 Sheets-Sheet 2

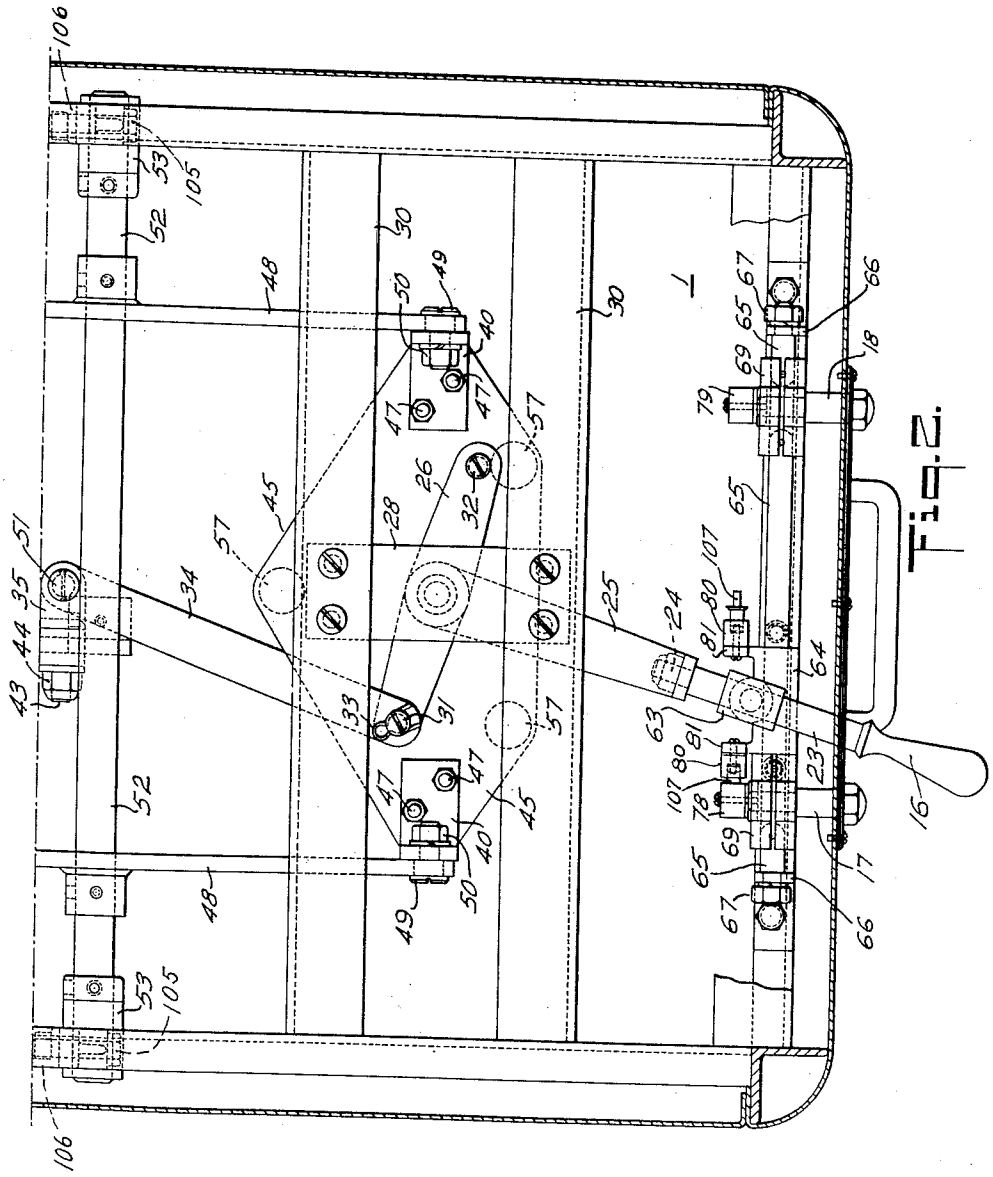


Fig. 1

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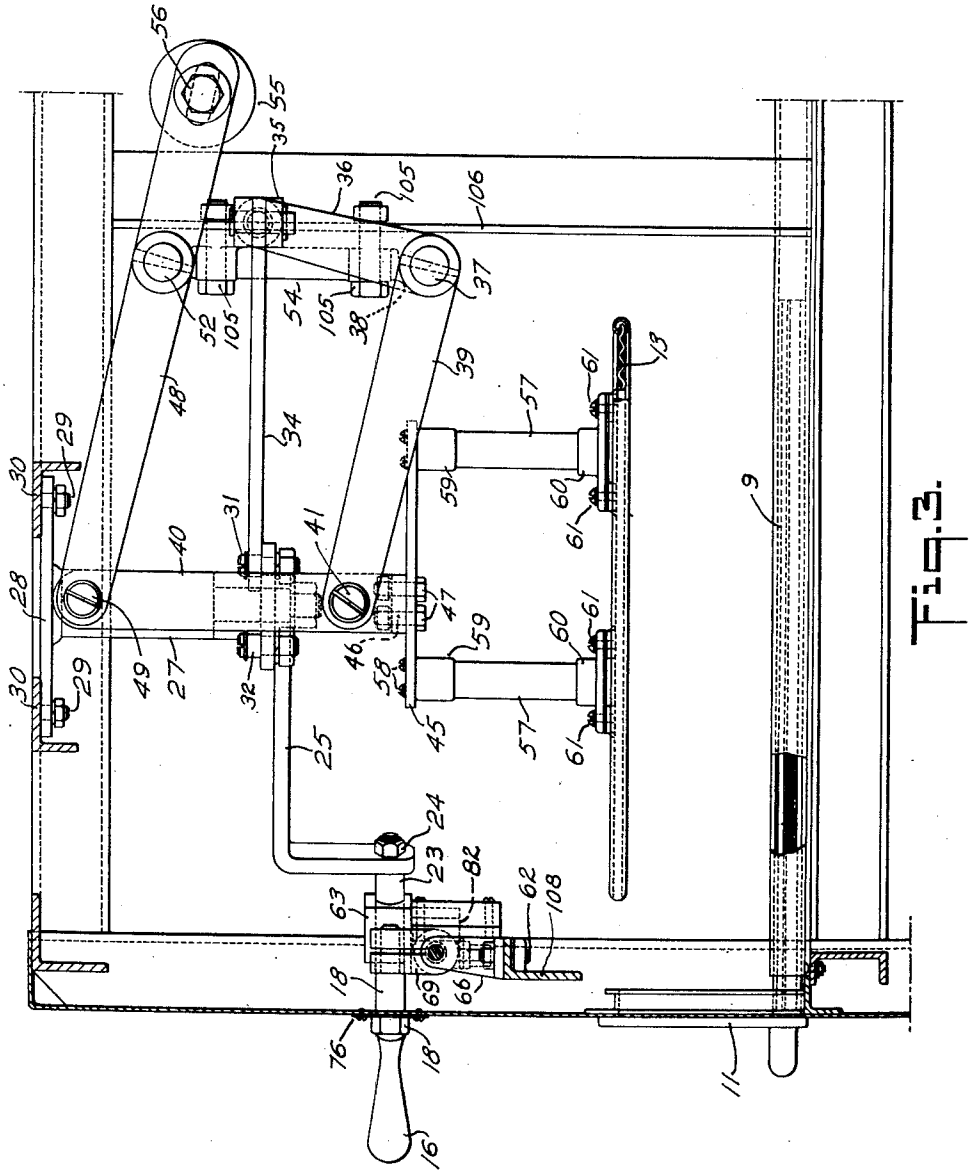


Fig. 3.

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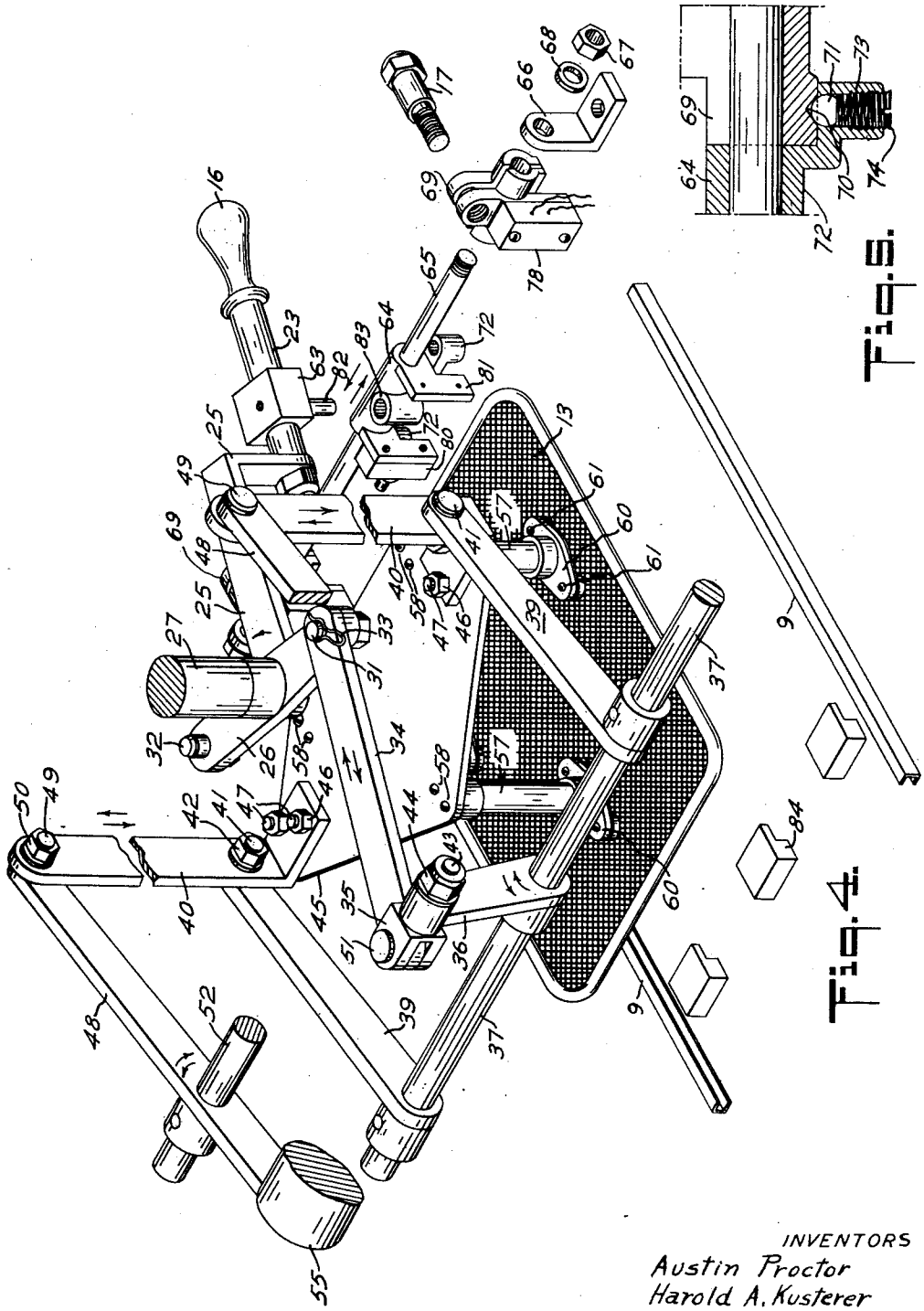


Fig. 4

Fig. 5

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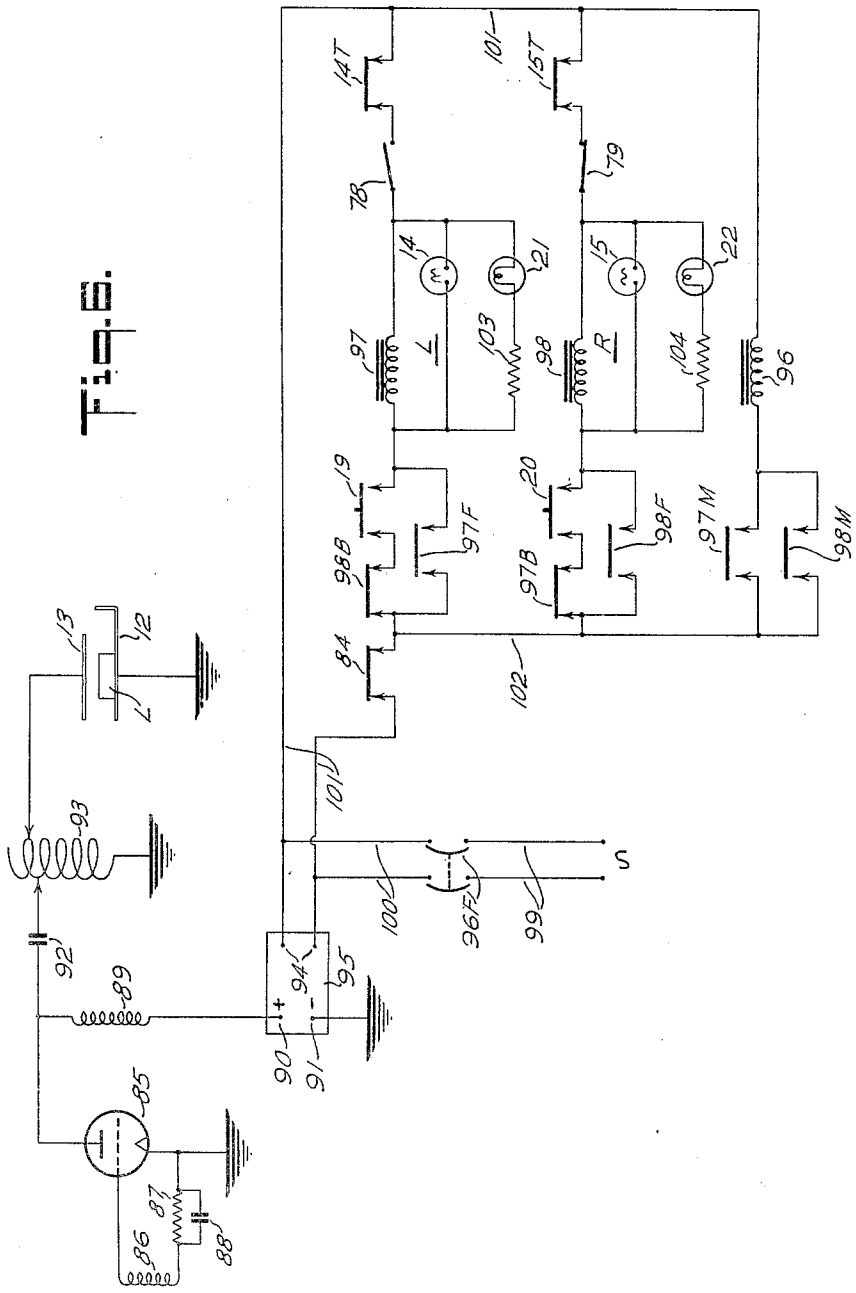
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Fig. 5.



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UNITED STATES PATENT OFFICE

2,512,751

DIELECTRIC HEATING SYSTEM HAVING PROVISION FOR SELECTION OF PRESET ELECTRODE SPACINGS

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Application August 1, 1946, Serial No. 687,786

6 Claims. (Cl. 219—47)

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This invention relates to dielectric heating systems and particularly to a dielectric heating unit whose alternate or successive loads may require different spacing of the heating electrodes and different heating periods.

In accordance with the invention, there is provided a control member, preferably operable from the exterior of the unit, to vary the electrode spacing and whose positions corresponding with predetermined spacings suited to different loads are predetermined by stops preferably adjustable from the exterior of the unit. More specifically, to adapt the unit for heating of different loads alternately delivered to two molding presses, the stops for the control member are adjusted in correspondence with predetermined minimum and maximum electrode spacings suited respectively to the different loads of the two presses, so that the operator after heating and removal of one load need only shift the control member to its other position to obtain proper electrode spacing for the next load.

Further in accordance with the invention, switches included in timing circuits, or in press-indicating circuits, or both, are adjustable concurrently with the stops for selective actuation by the control member upon its movement to the different load positions.

The invention further resides in features of combination, construction, and arrangement hereinafter described and claimed.

For a more detailed understanding of my invention and for illustration of a preferred embodiment thereof, reference is made to the accompanying drawings, in which:

Fig. 1, in perspective, shows the heating unit with the load tray partially withdrawn;

Fig. 2 is a detailed view, in plan, showing the control member and stops for determining the electrode spacing;

Fig. 3, in side elevation, shows parts appearing in Fig. 2;

Fig. 4, in perspective, and in part an exploded view, shows the operating mechanism for the movable electrode;

Fig. 5 is a detailed view, on enlarged scale, showing a latch construction; and

Fig. 6 is a simplified wiring diagram of the power supply and control circuits included in the heating unit.

Referring to Fig. 1, the heating unit 10 comprises a high-frequency generator for applying a high-frequency voltage to an upper movable electrode 13 disposed within the unit and to a lower electrode 12 forming the bottom of a load tray

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11 which may be inserted into and withdrawn from the unit through the opening 77 in the front wall or panel thereof. The channel guides 9, which slidably receive the opposite edges of the tray to ensure proper positioning of the lower electrode 12 are aligned with the opening 77. Heating units of this type are commonly used for heating preforms of dielectric material which, after being heated to temperature at which they are suitably soft, are removed from the heating unit and transferred to a molding press. The same heating unit is often used to heat preforms of different dimensions for delivery to different presses and one of the purposes of the present invention is to provide arrangements so that the operator may, once certain adjustments hereinafter described are made, quickly adapt the unit for proper rates and periods of heating of alternate loads delivered respectively to two presses.

For example, when the control member or operating handle 16 projecting from the front of the panel of the unit is thrown to the left, the spacing between the electrodes 12 and 13 is suited for heating of preforms of a certain height, the spacing being determined by the presetting of the adjustable stop 17 extending through the front of the panel. The corresponding timer 14, preset to deenergize the high-frequency generator after a predetermined time suited to the load, is set by the operator to its "start" position. With the loaded tray in its inserted position, the operator then presses the "start" button 19 and the heating period begins. As hereinafter appears, the movement of the control member 16 to the left-hand position also actuates a switch controlling the "left" press indicator lamp 21, or equivalent, so that during the heating period the operator is constantly informed that the load in the furnace is for the "left" press and that so long as the indicator lamp 21 is lighted the heating period is as yet incompleted. When the indicator goes out at the end of the heating period, the position of the control member 16 is again a reminder to the operator that the load in the heater is for the "left" press.

After the load for the "left" press is removed from the tray 11, the control member 16 is thrown to the right to position determined by the preset adjustable stop 18 extending through the front of the panel, so to change the spacing between electrodes 12 and 13 to one suited for the preforms to be heated for the "right" press. After the tray is loaded and pushed into the heating unit, the operator sets the "right" press timer, not shown in Fig. 1, to the "start" position and

then presses the "right" press starting button 20. Until the heating period is completed, the indicator lamp 22 continues to inform the operator that the load in the heater is for the "right" press and the heating period is as yet incomplete. When this indicator lamp goes out, the position of the handle 16 serves as a reminder that the load is for the correct press.

From the foregoing, it appears that once the stops 17 and 18, and the two timers, have been adjusted to suit two different types of loads, the operator thereafter may quickly adapt the unit for heating of the different loads by throwing the control member 16 from one to the other of its positions.

The preferred operating mechanism between the control member 16 and the upper electrode 13 is more fully shown in Figs. 2–4 inclusive. The control handle 16 is mounted on or forms the front end of the rod 23 which extends through the slot 75, Fig. 1, in the front panel of the heating unit. The inner end of rod 23, Figs. 2–4, is fastened by the nut 24 to the bent end of an arm 25 pivotally mounted for angular movement in a horizontal plane upon the lower end of the column 27 supported at its upper end by plate 28 which extends between the cross members 30 at the top of the unit and secured to them by the bolts 29.

The arm 25 is secured to or formed integrally with the cross-arm 26 extending at right angles thereto and through the opposite ends of which vertically extend the pivot pins 31 and 32, either of which may be selected to couple the control member 16 to link 34. In Fig. 2 the link 34 is shown connected to the left end of cross-arm 26 by pin 31 and is retained in position by the spring clip 33 or equivalent. With the link so connected, movement of handle 16 to the left raises the electrode 13, as will hereinafter appear, whereas if link 34 is coupled to the right-hand end of arm 26, Fig. 2, by the coupling pin 32, handle 16 is moved to the right to raise the electrode 13. This provision is to permit the heating unit conveniently to be used regardless of which of the two presses requires the greater spacing of the heating electrodes and to preserve the relations above described between the left- and right-hand indicators, the timers, and the control handle positions.

The rear end of the link 34 is pivotally connected by pin 51 to the yoke member 35 pivotally mounted in the upper end of arm 36 secured to a shaft 37 supported at its opposite ends by bearings 38 at the lower end of member 54, Fig. 3, which is secured by bolts 105 to the vertical frame members 106 of the heating unit. The pin 43, Figs. 2 and 4, of the yoke 35 extends through the upper end of arm 36 and the yoke is retained in place by the nut 44 which threadably engages the projecting end of pin 43.

The pair of arms 39 secured to shaft 37 extend forwardly therefrom and are pivotally connected at their forward ends by the pins 41 to the L-shaped brackets 40, Fig. 4, the nuts 42 holding the pins in place. The bases of the brackets are held by bolts 47 and nuts 46 to the electrode-supporting plate 45. To the upper ends of brackets 40 are pivotally connected, as by pins 49, a pair of rearwardly extending arms 48 secured, as by wedge pins, to shaft 52 which extends across the unit and whose opposite ends are received by the bearing members 53, Fig. 2, which at the upper end of member 54 are secured, as above described, to the frame members 106 of the unit. The counterbalance 55, Figs. 3 and 4, is attached by bolts 56 to, and extends between, the rear extensions of arms 48. The pivot pins 49, Fig. 2, for the forward ends of the arms 48 are held in place as by nuts 50 or equivalent.

The three insulators 57 for supporting the upper electrode 13 are each provided with a mounting member 59 secured to the under face of the plate 45 by screws 58. Similarly, the lower end of each insulator is provided with a mounting member 60 fastened as by bolts 61 to the upper face of the electrode 13.

The arms 39, 48 and brackets 40 provide a parallel-motion linkage so that as the control member 16 is moved to the right or left, the electrode 13 is raised and lowered with its lower face remaining parallel to the tray electrode 12 below it so insuring uniformity of the potential gradient between the opposed surfaces of the electrodes.

Upon the rod or bar 23 of the control member is slidably mounted a block 63 from which depends a pin 82 which is received by the opening or bore 83 in the carriage 64 slidable upon the guide rod 65. The guide rod 65 is mounted immediately behind and parallel to the front panel of the heating unit by the brackets 66 through which the ends of the rod extend, the nuts 67 threadably engaging the ends of the rod to secure it to the brackets. Brackets 66 are held by bolts 62 to the cross frame member 108. The stop members 69 respectively to the left and right of the carriage 64 are bored to slide along the guide rod 65 and are slotted axially of the bore so that they may be tightened to hold them in desired position.

As most clearly appears in Fig. 4, the "left" stop 69, to the right of the drawing, is threaded to receive the threaded rear end of the adjustable stop member 17 which extends through the slot 75 in the front of the panel. By turning a wrench in engagement with the external end of the member 17, the "left" stop 69 may be loosened and slid along member 65 by pushing against the external portion of member 17. When the stop has thus been adjusted to position corresponding with the desired spacing of the electrodes 12 and 13, the member 17 may be tightened to squeeze together the two portions of the slotted member 69 and so clamp it securely in its adjusted position or guide bar 65. The "right" stop member may be similarly adjusted by stop member or bolt 18, Fig. 2, to provide a different desired spacing of the electrodes 12 and 13. Both these adjustments can, as described, be effected without need for access to the interior of the unit.

The end of each stop member 69 engaged by the carriage or slide 64 is provided on its under surface with a recess 70, Fig. 5, for reception of a ball latch 71 resiliently mounted in a corresponding extension 72 of the carriage. As clearly shown in Fig. 5, the ball 71 is resiliently biased by a spring 73, interposed between the ball 71 and the plug 74, to project above the upper face of the carriage extension 72. The upper end of the bore which receives the ball is of reduced diameter to retain the ball. As the carriage is moved toward or from the position indicated in Fig. 5, the ball is forced downwardly by engagement with the lower face of the stop extension and so does not impede operation of handle 16. When, however, the carriage is in either of its stop-limited positions, the corresponding ball 71 moves upwardly into the recess 70 of the corresponding stop in effect to latch the handle in position and so pre-

vent its accidental displacement therefrom by vibration or jarring of the unit. The latches also hold the arm in position against the spring action of switches now discussed.

Upon the left-hand stop 69, Fig. 2, is mounted a switch 78 which is closed when the control member 16 is moved to its "left" press position. For operation of the switch 78, the carriage 64 is provided with a housing 80 secured to the left extension 81 of the carriage and from which extends a resiliently mounted plunger 107. Similarly, upon the "right" press stop 69 is mounted a switch 79 likewise actuated by a resiliently mounted plunger 107 extending from the housing 80 on the right end of the carriage 64, as viewed looking toward the outer end of handle 16, Fig. 2.

Thus, when the position of either of the externally adjustable stop members 17 and 18 is changed to predetermine the electrode spacings, the corresponding switch 78 or 79 is concurrently adjusted for operation by the operating handle or member 16 as it is moved to its right or left position. The purposes of the switches 78 and 79 will appear from the following discussion of Fig. 6.

The high-frequency generator housed in the unit 10 is preferably a self-excited oscillator, comprising thermionic tube 85, having a broadly tuned grid circuit including the inductor 86. The direct-current grid voltage is derived from the usual resistance-capacity network formed by resistor 87 and capacitor 88. The direct-current voltage of the anode of the tube is supplied by the source 95 whose high-voltage positive terminal 90 is connected to the anode through the radio-frequency choke-coil 89. The negative terminal 91 of the high-voltage circuit is connected to the cathode of the tube as by the ground or chassis connections indicated. The anode of the tube is connected, for high-frequency currents, through a blocking capacitor 92 to a tank circuit including the inductor 93 and a capacitor formed by the heating electrodes 12 and 13. The connections from the inductor 93 to the anode and to the upper electrode 13 may be variable for impedance-matching and tuning purposes. The low-voltage supply terminals 94 of the power supply 95, which may be the conventional step-up transformer, rectifier and filter arrangement, are connected to the supply-circuit conductors 100 adapted to be connected through the contacts 96F to the line conductors 99 extending to a suitable source of alternating current.

The supply conductors 100 are also connected to the branch line conductors 101 extending to control circuit components disposed within the housing 10 of the unit. When the load tray 12 is in proper heating position, it effects closure of a switch 84 to connect one of the branch conductors 101 to the control circuit conductor 102 common to all of the control circuit components hereinafter discussed and including the "start" switches 19 and 20, the indicators 21 and 22, the timer motors 14 and 15, the timer motor contacts 14T and 15T, the relays 97, 98 and their contacts, and the coil of the contactor 96 whose contacts 96F control connection of the power supply and of the control system components to the line conductors 99.

Unless the tray switch 84 is closed, none of the relay or timer circuits can be completed by closure of either of the start buttons 19 or 20. Assuming the tray 84 is in position and that the handle 16 has been thrown to the right for heating of preforms for the "right" press and the various contacts of the control circuits are in

the condition shown in Fig. 6: it should be noted that the "right" press switch 79 is closed and the "left" press switch 78 is open. Should the improper stop button, the "left" press button 19, be accidentally closed, nothing happens because this branch of the control circuit is interrupted by the open switch 78 which is closed only when the control handle 16 is in the "left" position. The failure of the indicator 21 to light, upon closure of button 19, indicates to the operator that he has made a mistake but provision of switch 78 insures that such mistake is of no consequence.

When the proper start button 20 is momentarily pressed, a circuit is completed through the back contact 97B of relay 97, the "start" switch 20, the coil of relay 98, the selected press switch 79 and the contacts 15T of the timer 15 which has been set to "start" position before depression of the switch 20. The energization of relay 98 effects movement of its forward contacts 98F to complete a seal-in or holding circuit about the push button 20 which, as above stated, is only momentarily depressed. The energization of relay 98 also effects energization, through its main contacts 98M, of the contactor coil 96 whose contacts 96F thereupon close to effect energization of the power supply 95, thus to initiate application of high-frequency voltage to the load on the tray 12. Concurrently with energization of relay 98 there is also completed a circuit through the "right" press timing motor 15 so that at the end of the preset time interval, the timer contact 15T is opened to effect de-energization of relay 98 with consequent interruption of the circuit of contactor coil 96 and de-energization of the high-frequency generator by the resulting opening of the contacts 96F. Throughout the period of energization of relay 98, the "left" press indicator 22 is energized, preferably through the current-limiting resistor 104, to indicate to the operator that a load for the right-hand press is being heated.

Similarly, when the control member or handle 16 has been thrown to the left to adjust the electrode spacing to suit a load for the "left" press and to effect closure of the switch 78, and assuming that the load tray has been inserted into the unit to effect closure of the tray switch 84, the "start" button 19 is momentarily depressed to initiate heating of the load for a period determined by the setting of the timer 14. The relay 97 controls a seal-in or holding circuit including its contacts 97F and also controls the main contactor 96 through its main contacts 97M. At the end of the preset heating interval, the timer contact 14T opens the branch control circuit for the "left" press and so de-energizes the relay 97 with consequent de-energization of the contactor 96 and de-energization of the power supply 95 by opening of the line contacts 96F of relay 96. During this period the "left" press indicator 91 is energized, preferably through the current-limiting resistor 103.

As appears from the foregoing, once the stops 17 and 18 and the timers have been set in accordance with the different load requirements of the two presses, the operator need only throw the control handle 16 to the right or left and press the proper starting button in order to insure that the proper voltage is applied to each load and for a proper interval of time. It is thus insured that the heating unit may be used with maximum economy of time and also without serious consequence if the operator should inad-

vertently fail fully to insert the load tray or to press the proper "start" button.

It shall be understood the invention is not limited to the particular arrangement disclosed but that modifications and changes may be made, all, however, within the scope of the appended claims.

What is claimed is:

1. A dielectric heating system comprising spaced electrodes and suited for heating successive loads alternately requiring two different operating spacings of said electrodes, structure supporting said electrodes for relative movement with their opposing faces in parallelism, an actuating member for said structure movable in opposite directions respectively to increase and decrease the spacing between said electrodes, and preadjustable abutments respectively engaged by said actuating member upon movement thereof in said opposite directions alternately to position said supporting structure for operation of said parallel electrodes alternately with said two different spacings.

2. A dielectric heating system comprising spaced electrodes and suited for dielectrically heating successive loads alternately requiring different operating spacings of said electrodes, means operable to vary the spacing between said electrodes including a member manually movable in opposite directions respectively to increase and decrease the spacing between said electrodes, stops for limiting the movement of said member in opposite directions in predetermination of the minimum and maximum spacings of said electrodes respectively suited for the known alternate loads, and a pivoted reversing link included in said means and selectively connected to one or another pivot point to predetermine which of said opposite directions of movement of said member increases the electrode spacing and which decreases it.

3. A dielectric heating system comprising a removable load tray forming a lower electrode, an upper electrode parallel to said lower electrode, and means for raising and lowering said upper electrode including an operating member movable horizontally in opposite directions respectively to raise and lower said upper electrode, means to translate horizontal movement of said member to vertical movement of said upper electrode and to maintain parallelism of said electrodes, and stop structure adjustable to define the limits of movement of said member in said opposite directions in predetermination of proper spacing of said electrodes respectively for two different types of load.

4. A dielectric heating system comprising a lower electrode, a vertically movable upper electrode, operating means for said upper electrode including a parallel-motion linkage and a manually operable member movable in one direction to raise said upper electrode to a position of maximum electrode-spacing and in reverse direction to lower said upper electrode to a position of minimum electrode-spacing, and a motion-reversing connection between said member and said parallel-motion linkage for interchanging the said positions of said member corresponding respectively with the raised and lowered positions of said upper electrode.

5. A dielectric heating unit comprising a load-tray removable through a wall of said unit, an electrode, structure for supporting said electrode in parallelism with said tray and actuatable for vertical movement of said electrode toward and from said tray in a path clear of the path of said tray, and an actuating lever connected to said structure and extending through said wall for movement externally of the unit in opposite directions respectively to positions corresponding with two operating positions of said electrode suited for two different tray-loads.

6. A dielectric heating unit comprising spaced electrodes and suited for heating successive loads alternately requiring two different operating spacings of said electrodes and two different periods of application of radio-frequency voltage, structure supporting said electrodes for relative motion of their opposing faces in parallelism, timing devices preset to afford said different periods of voltage application, switches for selective energization of said timing devices, and an actuating member mechanically connected to said structure and selectively engaging said switches operable in opposite directions repeatedly alternately to provide said operating spacings of the electrodes and concurrently to provide the corresponding periods of application of radio-frequency voltage thereto.

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Certificate of Correction

Patent No. 2,512,751 June 27, 1950

AUSTIN PROCTOR ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 20, after the word and period "electrodes." insert *As evident from the drawings, the loaded tray may be removed from the heating unit without obstruction by the upper electrode or any of its actuating linkage.*; column 5, line 75, for "circuits" read *circuit*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of April, A. D. 1951.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.

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