

Sept. 12, 1950

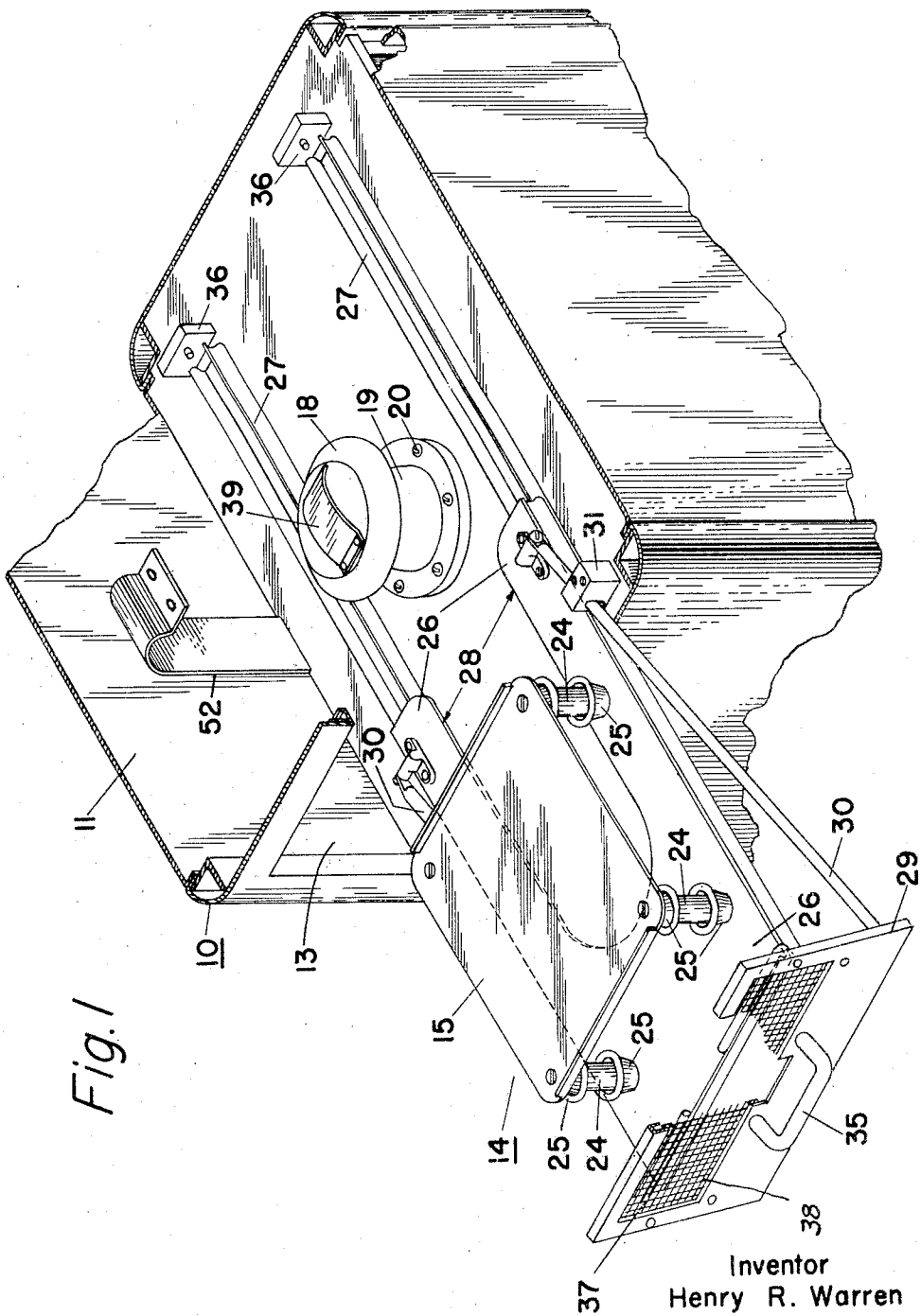
H. R. WARREN

2,522,487

DIELECTRIC HEATING APPARATUS

Filed Feb. 27, 1948

3 Sheets-Sheet 1



Inventor
Henry R. Warren

By
Woodcock and Phelan
Attorneys

Sept. 12, 1950

H. R. WARREN

2,522,487

DIELECTRIC HEATING APPARATUS

Filed Feb. 27, 1948

3 Sheets-Sheet 3

Fig. 3

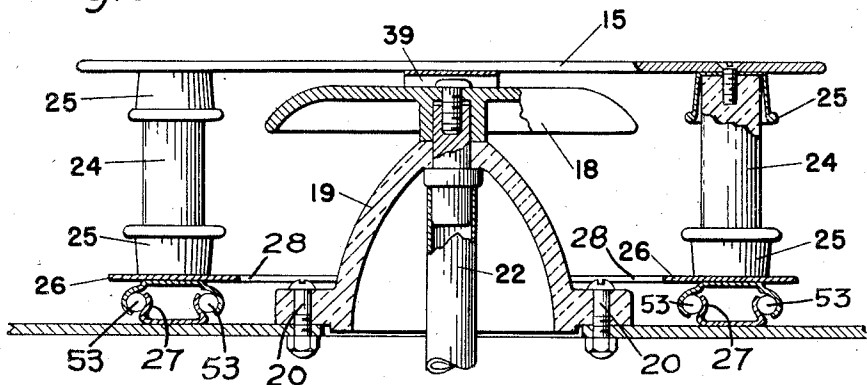


Fig. 4

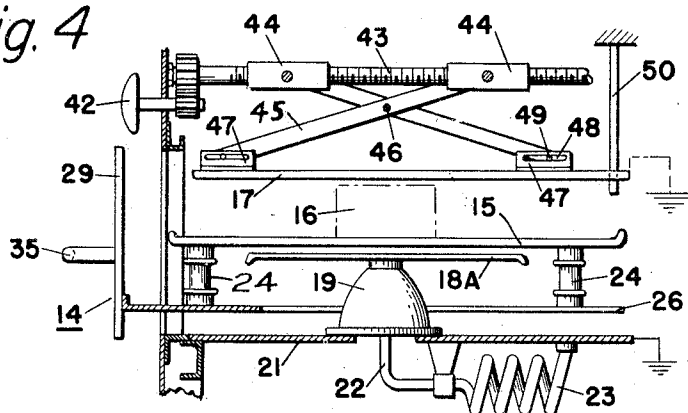
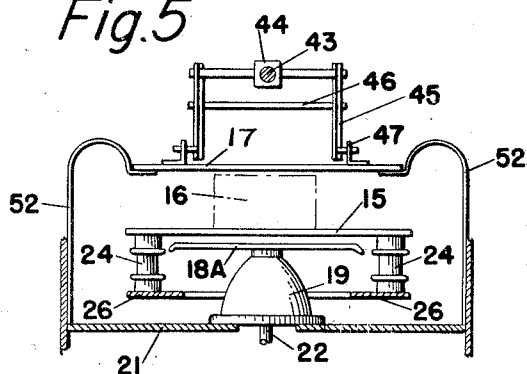


Fig. 5



Inventor
Henry R. Warren

By

Woodcock and Phelan
Attorneys

UNITED STATES PATENT OFFICE

2,522,487

DIELECTRIC HEATING APPARATUS

Henry R. Warren, Louisville, Ky., assignor to The Girdler Corporation, Louisville, Ky., a corporation of Delaware

Application February 27, 1948, Serial No. 11,560

15 Claims. (Cl. 219—47)

1

This invention relates to dielectric heating apparatus and particularly to dielectric-heating units provided with a load tray which is retractable from a compartment of the unit for loading and unloading thereof and which is insertable into that compartment for treatment of a dielectric load disposed upon a heating electrode comprised in the tray assembly.

In accordance with the present invention, the heating electrode carried by the tray is at high potential with respect to ground to afford short, direct connection to a high-frequency tank coil in a compartment below the heating compartment and the tray electrode is supported from the tray by insulators insuring that all other parts of the tray, including exposed parts such as operating handle and the tray front, are always at ground potential: more specifically, when the tray is inserted into the heating compartment for treatment of the load, the insulated tray electrode is connected, capacitively or conductively, to a high-voltage high-frequency terminal disposed within the compartment and connected to said tank coil of the compartment below.

More particularly, the high-voltage terminal may be shaped to serve as a corona shield for a feed-through insulator through which extends the connection from the tank coil and may be of such area that it affords substantial coupling to the tray electrode when the latter is in position for heating of a load carried thereby; or alternatively, the corona shield may be provided with or connected to a flexible or yielding contact which slidably engages the tray electrode when the tray is moved into the heating compartment.

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

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

Fig. 1 is a perspective view, with parts broken away, showing the loading tray, in retracted position, and associated parts of the dielectric heating unit;

Fig. 2 is a side view, partly in section, showing the relative position of parts appearing in Fig. 1 with the tray in heating position;

Fig. 3 is an end view, partly in section, of components appearing in Figs. 1 and 2;

Fig. 4 schematically illustrates a modification of the invention; and

2

Fig. 5 is an end view of parts appearing in Fig. 4.

Referring to Figs. 1 and 2, the dielectric heating unit comprises a cabinet or housing 10 usually and preferably formed of sheet metal attached to and supported by a metal angle framework. The top portion of the cabinet shown comprises a heating compartment 11 and a compartment 12 directly below it in which is disposed the high-frequency generating equipment. The front wall of the heating compartment 11 is provided with an opening 13 for insertion and withdrawal of a load tray 14 with which is movable a plate 15 for supporting the dielectric load 16 which may, for example, consist of one or more preforms of plastic material to be preheated for disposition in a molding press upon attainment of a desired temperature.

With the loading tray in the inserted or heating position, Fig. 2, the dielectric load 16 is subjected to the high-frequency field between the plate 15 and an upper electrode 17 disposed within the upper portion of the heating compartment and mechanically and electrically connected to the metallic structure thereof as by the ground straps 52.

With the tray electrode 15 in the "in" or heating position shown in Fig. 2, it is effectively connected to the high-voltage terminal 18 supported at the upper end of a feed-through insulator 19 which is suitably secured at its lower end, as by bolts 20, to the metal partition 21 between the compartments 11 and 12. The lead 22 extends from terminal 18 through the insulator 19 into the lower compartment 12; it is there connected to or forms a continuation of the high-frequency tank coil 23 whose other end or terminal is connected to the metal partition 21 or other suitable ground point. There is thus afforded a short connection from the high-potential end of the tank coil 23 to the heating electrode 15 which insures concentration of the tank-circuit inductance in coil 23. The minimizing of the lead inductance reduces the tendency for generation of oscillations at other than the desired mode of the associated oscillator. In addition, there is afforded a more compact arrangement of the components.

The tray electrode 15 is mechanically attached by a plurality of post insulators 24, each of which is preferably provided with corona caps 25, to the carriage 26 of the load tray 14. The carriage 26 is guided and supported by the rail members 27 suitably attached to the partition 21 and may be formed of a sheet metal plate having at its

rear edge a cut-away portion or slot 28 sufficiently wide to clear the feed-through insulator 19 and sufficiently long to permit the carriage to be pushed to its full "in" position, Fig. 2, without obstruction by the insulator. Preferably, as shown in Fig. 3, the rails 27 and the carriage runners are shaped to fit the ball bearings 53. Throughout the range of movement of the carriage 26, from "in" position (Fig. 2) to "out" position (Fig. 1), the tray electrode 15 moves parallel to the plane of the upper heating electrode 17. As the tray electrode remains horizontal during its movement, there is little tendency for the load to shift its position as the tray 14 is moved into or out of the heating compartment 11.

To facilitate and expedite loading and unloading, the front wall 29 of the tray, which serves as a door closing the opening 13 of the upper heating compartment 11 when the tray is in the heating position, is dropped to the position shown in Fig. 1 when the tray is retracted from compartment 11. As shown in Fig. 1, the upper edge of the front wall 29 drops below the plane of the tray electrode 15 so that an operator may, without obstruction by the front wall 29, put preforms or other objects on the tray for heating, and remove them from the tray after heating. Moreover, preferably and as shown, the tray 14 has no side walls which could obstruct loading or unloading. In other words, when the tray is retracted for loading or unloading, the heating electrode 15 is entirely in the clear and accessible from the front or either side of the tray.

Preferably, and as shown in Figs. 1 and 2, the front wall 29 of the tray is connected to the carriage 26 by a pair of rods or bars 30 attached at their forward ends to the front wall 29 and respectively extending through the guide blocks 31 attached to the cabinet or housing 10 within the upper heating compartment adjacent the lower corners of the front opening 13. Each of the rods 30 is pivotally connected to the carriage 26 near the rear edge thereof; specifically, the rear end of each of the rods 30 is pivoted upon a pin 32 extending from a bearing bracket 23. The opening 34 in each of the guide blocks 31 is so shaped, Fig. 2, that as the tray 14 is pulled outwardly by the handle 35 attached to the front wall, the rods 30 pivot about the pins 32, allowing or forcing the front wall 29 to drop to the position shown in Fig. 1. Conversely, when the tray is pushed back into the heating compartment, the blocks 31 serve as cams raising the front wall 29 to the compartment-closing position shown in Fig. 2. The guide blocks 31 also serve as stops preventing the tray from accidentally being pulled so far forward that it would fall out of the housing and undesirably dump the load. The side bars 30, or equivalent, are below the lower electrode and, in fact, lie close to the grounded plate 26 so that they are well out of the field between the electrodes 15, 17, Figs. 1 to 5, and the field between the lower electrode 15 and the terminal plate 18A, Figs. 4 and 5. With the loading tray in its heating position, Fig. 2, it is preferably provided that the rear edge thereof shall engage one or more safety switches 36, Fig. 1, which effects or permits energization of the high-frequency generating equipment in the lower compartment 12 of the housing. With the tray in heating position, the raised front 29 of the tray protects the operator from touching or reaching dangerously close to the tray electrode 15 which is now at high potential with

respect to ground because of its engagement with, or proximity to, the high-voltage terminal 18, or equivalent.

As the electrode 15 is electrically isolated by insulators 24 from the carriage 26, rods 30, front panel 29 and handle 35, all of which are preferably of metal, these parts are at ground potential and may be touched by the operator without danger of injury or shock. When the tray is withdrawn from the heating compartment, the tray electrode 15 passes out of engagement with, or proximity to, the high potential terminal 18, and consequently, preforms or other load objects 16 may be placed thereon or removed therefrom without possibility of shock or injury even though the high-frequency generating equipment is not deenergized due to absence or failure of tray switches 36, or equivalent. Preferably, the front wall 29 of the tray is provided with a window 37, suitably covered with a guard screen 38, to permit the operator at any time to view the interior of the heating compartment to check for flash-over or other evidence of improper operation.

In the form of the invention shown in Figs. 1 to 3, there is attached to the upper face of the corona shield 13 a leaf-spring contact 39 for conductively connecting the tray electrode 15 to the high-potential lead 22. As shown in Fig. 2, the free end of the spring 39 may pass through an opening 40 in the terminal 18 with the tip of the spring bent to serve as a stop which limits the upward movement of the spring when the tray is retracted from the heating compartment. The other end of the leaf spring 39 may be secured by any suitable means, such as machine screws 41, to the high-voltage terminal 18.

In the modification of the invention shown in Figs. 4 and 5, the leaf spring 39, or equivalent, is omitted and there is no conductive connection between the tray electrode 15 and the high-voltage terminal supported by the feed-through insulator 19. Instead, in this modification, when the tray is in the heating position, it, together with the high-frequency terminal 18A, forms a condenser in series with the capacity between the heating electrodes 15 and 17. Preferably, in such case, the corona shield is of suitably large area to afford the desired coupling capacity.

In both modifications it is desirable, generally as shown in Figs. 4 and 5, to provide for adjustment of the upper, grounded electrode 17 toward and away from the plane of the tray electrode 15 so to accommodate the system for heating of different loads or to control the rate of heating. As diagrammatically shown, a knob 42 operable from the front of the cabinet 10 may be rotated to effect raising or lowering of the grounded electrode 17. Specifically, the shaft 43 driven from knob 42 may have a threaded portion for engaging the traveling nuts 44 which pivotally support the two pairs of crossed links 45. The links of each pair are pivotally connected intermediate their ends, preferably by bar 46 which serves as the common pivot structure for both pairs of links. The lower ends of each of the four links 45 are slidably pivotally connected to the plate 17 by one of the four bearing brackets 47 provided with slots 48 for receiving the guide pins 49 extending from links 45. The electrode 17 is maintained horizontal during its raising and lowering by the guide pin 50 which extends downwardly through a closely fitting hole in the electrode 17 from a fixed point on the cabinet.

With the loaded tray in heating position, the operator may adjust the knob 42 and during the

adjustment observe through window 37 the position of the upper electrode 17 with respect to the top of the load.

It shall be understood the invention is not limited to the specific arrangements disclosed and that changes and modifications may be made within the scope of the appended claims. Features of construction involving the drop-front tray herein disclosed are claimed in co-pending application Serial No. 12,603 of a co-worker upon which has issued Letters Patent 2,497,945.

What is claimed is:

1. Dielectric heating apparatus comprising a compartment, a first plate within said compartment and serving as one heating electrode, a high-voltage high-frequency terminal within said compartment and spaced from said first plate, and a load tray including a second plate movable out of said compartment to receive a dielectric load to be heated and movable into said compartment between said terminal and said first plate for cooperation with said high-voltage terminal to serve as the second heating electrode.

2. Dielectric heating apparatus comprising a compartment, a first plate within said compartment and serving as one heating electrode, a high-voltage high-frequency lead, a feed-through insulator for said lead, a corona shield spaced from said first plate for protecting said insulator and connected to said lead, and a load tray supporting a second plate movable out of said compartment to receive a dielectric load to be heated and movable into said compartment between said shield and said first plate for capacitive coupling of said second plate with said corona shield to serve as the second heating electrode.

3. Dielectric heating apparatus comprising a compartment, a first plate within said compartment and serving as one heating electrode, a flexible contact within said compartment spaced and insulated from said first plate, means for connecting said flexible contact and said first plate to a source of high-frequency current, and a load tray supporting a second plate movable out of said compartment to receive a dielectric load to be heated and movable into said compartment between said flexible contact and said first plate for engagement with said flexible contact to serve as the second heating electrode.

4. Dielectric heating apparatus comprising a compartment, a grounded plate within said compartment and serving as one heating electrode, a high-voltage high-frequency lead, a feed-through insulator for said lead, a corona shield spaced from said plate, mounted on said insulator to protect it and connected to said lead, a load tray slidable into and out of said compartment, a second heating electrode, insulators for mounting said second electrode for movement with said tray and for coaction with said corona shield when the tray is within said compartment to serve as the lower heating electrode.

5. Dielectric heating apparatus comprising a compartment, a grounded plate mounted within the upper portion of said compartment and serving as one heating electrode, a high-voltage high-frequency lead, a feed-through insulator in the lower portion of said compartment for said lead, a carriage slidable into and out of said compartment, a second plate supported by insulators from said carriage and movable therewith in a path between said upper heating electrode and said insulator, said second plate supporting the dielectric to be heated, and terminal means within

said compartment connected to said lead and cooperating with said second plate when the carriage is inserted in the compartment to establish a high-frequency electric field between said heating electrodes.

6. Dielectric heating apparatus comprising a compartment having upper and lower walls, a first plate within said compartment and supported in spaced position parallel to the upper wall thereof to serve as one heating electrode, a high-potential lead, a feed-through insulator for said lead disposed within said compartment and supported by said lower wall, and a load tray movable into and out of said compartment comprising a frame which straddles said feed-through insulator, a plurality of insulators secured to said frame, and a second plate mounted upon said insulators to support the dielectric load to be treated and movable with said frame to position between said feed-through insulator and said first plate and there coacting with a terminal connected to said lead to serve as the second heating electrode.

7. Dielectric heating apparatus comprising a compartment, a grounded plate within said compartment and serving as one heating electrode, an insulated high-voltage high-frequency terminal disposed within said compartment opposite to said heating electrode, a second heating electrode disposed within said compartment between said first heating electrode and said high-voltage terminal, and carriage means for retracting said second heating electrode from said compartment for loading or unloading of dielectric material comprising members slidably supported within said compartment and upon which are mounted insulating supports for said second heating electrode.

8. Dielectric heating apparatus comprising a compartment, a grounded plate within said compartment and serving as one heating electrode, an insulated high-voltage high-frequency terminal disposed within said compartment opposite to said heating electrode, a second heating electrode disposed within said compartment between said first heating electrode and said high-voltage terminal, and a load tray slidable into and out of said compartment and including said second heating electrode and insulators for attaching it to movable structure of the tray.

9. Dielectric heating apparatus comprising a compartment, a load tray movable into and out of said compartment and all of whose components including a heating electrode for supporting the load are at ground potential when the tray is retracted from the compartment, a grounded heating electrode within said compartment at one side thereof, and an insulated high-voltage high-frequency terminal disposed within said compartment at the opposite side thereof, said high-voltage terminal upon insertion of the load tray coacting with the movable heating electrode thereof to provide a high-voltage high-frequency field between said heating electrodes.

10. The combination with a metallic housing for high-frequency heating apparatus, of an upper heating electrode conductively connected to and supported by said housing, insulators, a lower electrode supported by said insulators, an opening in said housing, a load tray movable into and out of said housing through said opening and to which are attached said insulators and the lower electrode supported thereby, and a high-voltage high-frequency terminal insulated from said housing and positioned therein to be over-

lain by said lower electrode when said load tray is in said housing.

11. Dielectric heating apparatus comprising a metallic housing having a partition between upper and lower compartments, a heating electrode in the upper part of said upper compartment electrically connected to and supported by said housing, a terminal within the lower part of said upper compartment supported by and insulated from said partition, high-frequency generating means in said lower compartment including a coil, a short direct high-potential lead from said coil to said terminal, a tray slidable into and out of said upper compartment, and a second heating electrode mechanically connected to and electrically insulated from said tray for receiving a dielectric load when the tray is out of said upper compartment and for cooperating with said terminal when the tray is in said upper compartment to subject the load to a high-frequency field between said heating electrodes.

12. Dielectric heating apparatus comprising a compartment, a high-voltage high-frequency terminal in the bottom of said compartment, a grounded upper heating electrode adjustably mounted in the top of said compartment for movement toward and from said high-frequency terminal, and a load tray including a lower heating electrode movable with the tray to a position between said high-voltage terminal and said grounded upper heating electrode.

13. In a dielectric heating apparatus, a housing providing a compartment for receiving therein dielectric material to be heated, an electrode and a terminal disposed within said housing in insulated spaced relation to each other, means for effectively connecting said electrode and said terminal respectively with opposite sides of a source of high frequency electric energy, a tray structure movable into and out of said compartment through an opening in a wall thereof and including a second electrode insulated from said first mentioned electrode and from said housing, said tray structure being arranged to receive said material when said structure is in a position withdrawn from said compartment and being arranged to support said material in position to be heated by an electric field between said electrodes when said structure is in operative position in said compartment, and means operative to establish electric potential on said second electrode from said terminal when said tray structure is in its said operative position in said compartment

and to effectively electrically isolate said second electrode from said terminal when the tray structure is withdrawn from said compartment.

14. Dielectric heating apparatus comprising a compartment for receiving therein dielectric material to be heated, a first heating electrode disposed within said compartment and connected to one terminal of a high-frequency source, a second high-frequency terminal within said compartment spaced and insulated from said first heating electrode, a load tray including a second electrode movable out of said compartment to a position to receive a dielectric load to be heated and movable into said compartment to position said dielectric material between said electrodes, said second electrode when in its said receiving position being electrically isolated from said second terminal, and means operative when said second electrode is in its second mentioned position to establish an electrical connection between said second electrode and said second terminal for production of a high-frequency heating field between said electrodes.

15. Dielectric heating apparatus comprising a compartment for receiving therein dielectric load material to be heated, a load tray movable into and out of said compartment including a first heating electrode for supporting the load material, a second heating electrode mounted within said compartment and connected to one terminal of a high-frequency source, a second high-frequency terminal disposed within said compartment spaced and insulated from said second heating electrode, and means operative to establish electrical connection between said first heating electrode and said second terminal upon insertion of said load tray into an operative position in said compartment to provide a high-frequency field between said electrodes for dielectric heating of said load material, said means being operative to electrically isolate said first electrode from said second terminal upon withdrawal of said tray from its said operative position.

HENRY R. WARREN.

REFERENCES CITED

The following references are of record in the file of this patent:

Plastics, August 1947, page 31.