

[54] IMMERSION MEANS FOR ELECTRICALLY DEFROSTING REFRIGERATION PLATES

2,859,945 11/1958 Kleist..... 62/439

2,978,877 4/1961 Long..... 62/156

[75] Inventors: Frank Raufeisen, Palatine; William E. Lauterbach, Evanston, both of Ill.

Primary Examiner—William J. Wye

Attorney—Parker, Plyer & McEachran

[73] Assignee: Dole Refrigerating Company, Chicago, Ill.

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[51] Int. Cl..... F25d 21/06

[58] Field of Search..... 62/155, 156, 157, 62/158, 80, 276

[57] ABSTRACT

A refrigeration system made up of a plurality of individual refrigeration plates each including an eutectic solution. Within each plate is a conduit for passing a refrigerant through the plate to freeze the eutectic and a heater for use in raising the temperature of the eutectic to defrost the plate. An electric circuit controls the application of refrigerant and operation of the heaters such that the plates are successively defrosted and during the application of heat to any one plate there is no application of refrigerant to any of the other plates. After the conclusion of the heating cycle on any one plate, all of the plates receive a refrigerant to freeze the eutectic solutions.

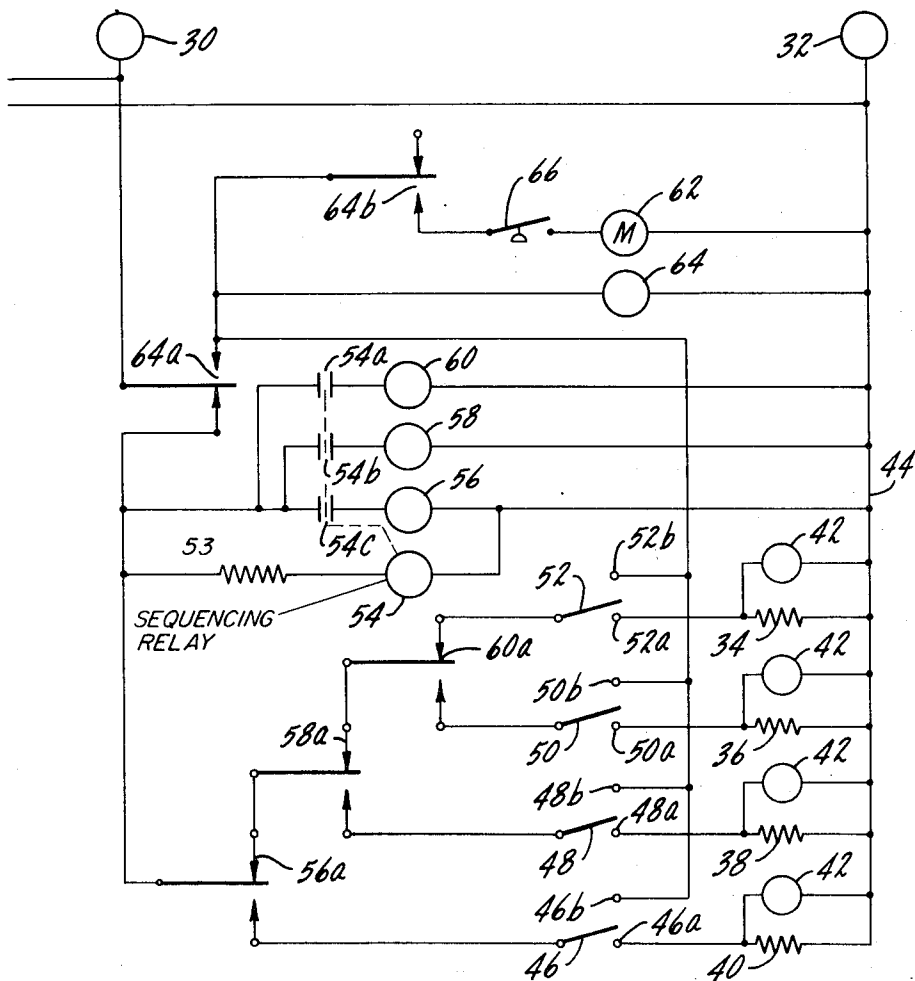
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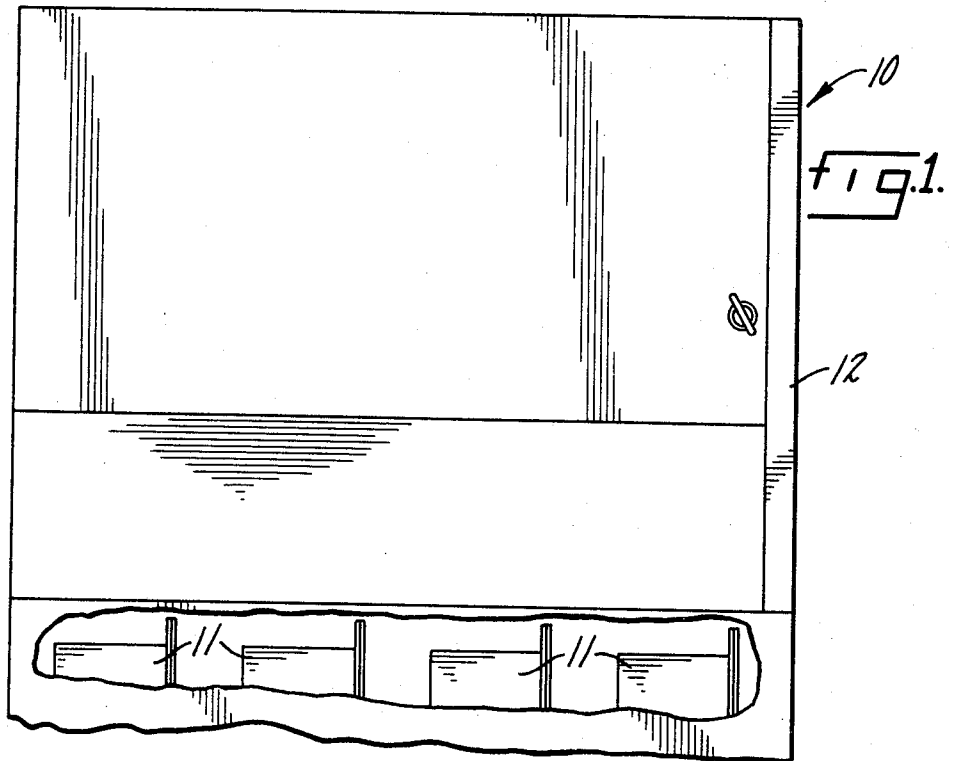
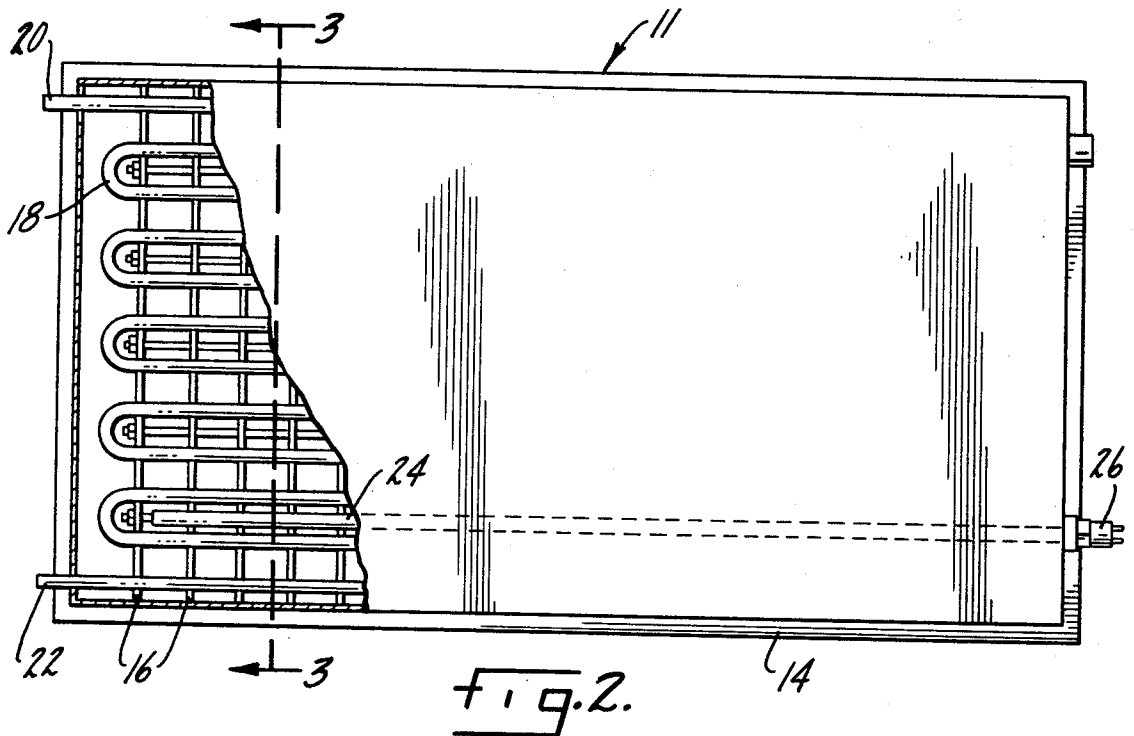
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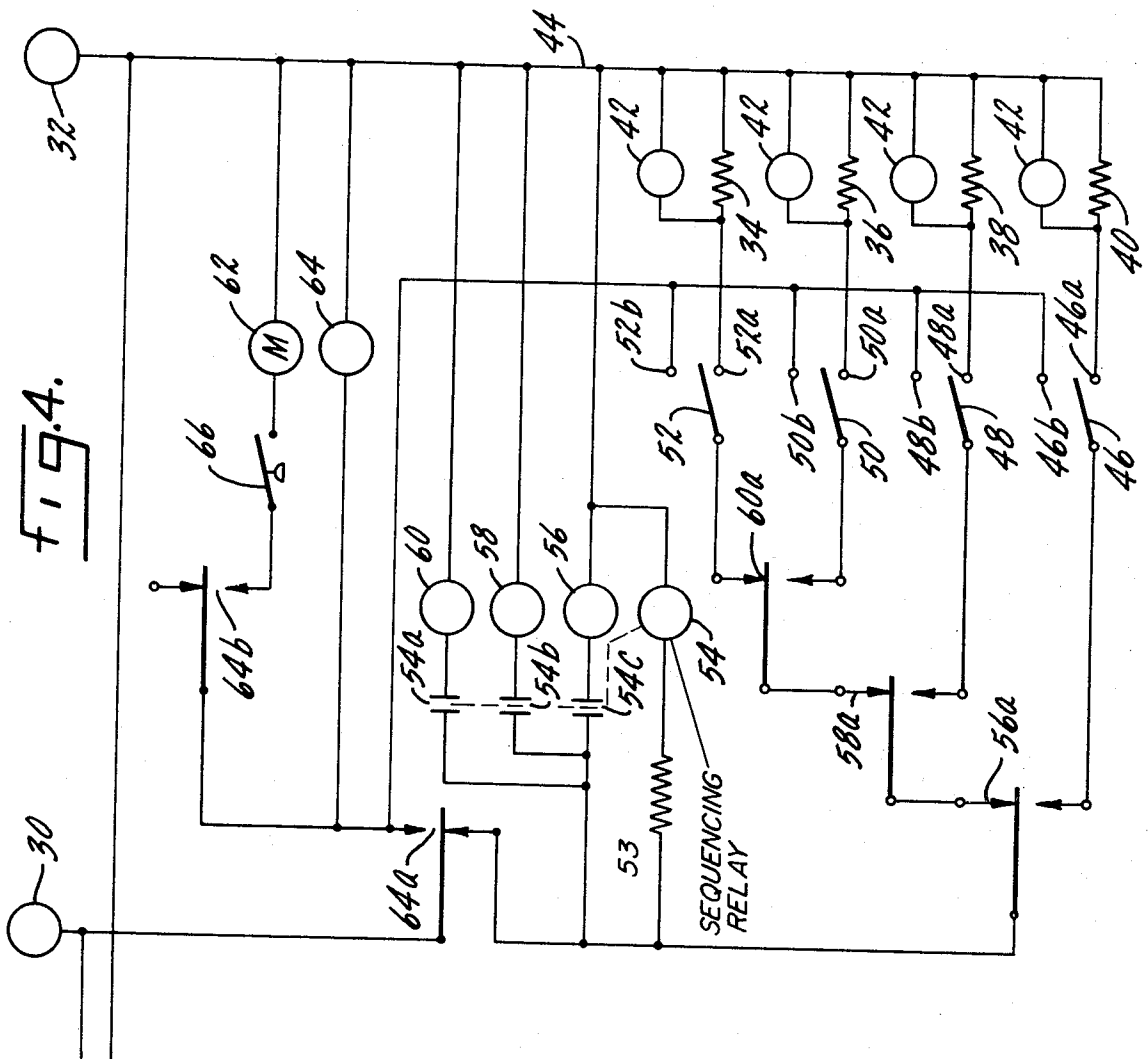
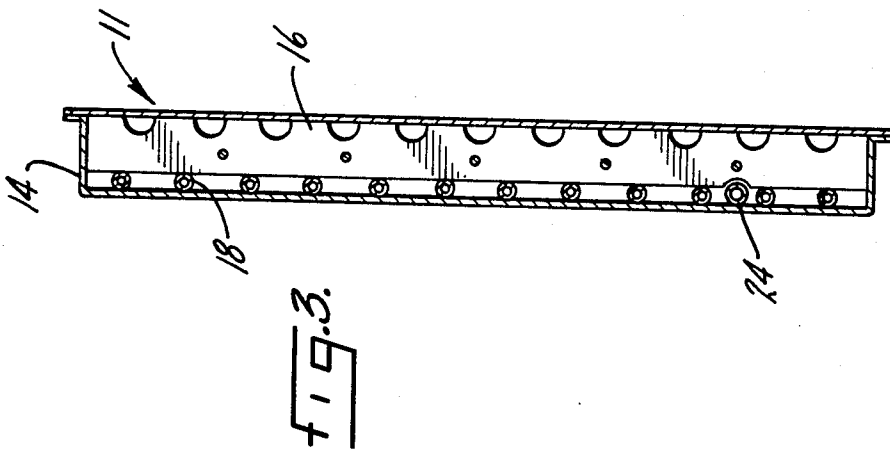
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9 Claims, 4 Drawing Figures







IMMERSION MEANS FOR ELECTRICALLY DEFROSTING REFRIGERATION PLATES

SUMMARY OF THE INVENTION

The present invention relates to a refrigeration system and means for electrically defrosting refrigeration plates.

A primary purpose of the invention is a refrigeration system having a plurality of refrigeration plates and means for controlling the application of heat and cold to freeze the plates and to defrost them.

Another purpose is an electrical control system for use with a refrigeration system which controls the amount of power drawn by the system during the refrigeration and heating cycles to that customarily available at a dockside power outlet.

Another purpose is a refrigeration system of the type described including means for controlling the application of heat and cold to the plates to defrost the plates one at a time and to prevent application of refrigerant during the period of defrosting.

Other purposes will appear in the ensuing specification, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated diagrammatically in the following drawings wherein:

FIG. 1 is a side view, with portions broken away, showing a refrigeration unit including a plurality of refrigeration plates,

FIG. 2 is a side view of the plate, with the outer cover removed,

FIG. 3 is a section along plane 3—3 of FIG. 2, and

FIG. 4 is an electrical schematic of the control system described herein.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention relates to a refrigeration system in which refrigeration plates provide cooling to circulating air to maintain a proper temperature in a vehicle, such as a truck or railroad car. Such plates are normally refrozen or recharged each 24 hours during a non-use period. The plates have a tendency to accumulate frost after a period of use and it has been the practice to defrost the plates, for example by the application of surface water, on a regular interval. The present invention relates to a method of electrically defrosting the plates during the period that the plates are customarily recharged or refrozen.

Various means of electrical defrosting have been tried in the past, but all of such systems required the application of a substantial amount of electric power. The present invention provides defrosting of the refrigeration plates on a selective and sequential basis by only using the electric power customarily available at dockside where the plates are refrozen. The electrical circuit described herein controls the application of power to the refrigeration system and to the heater. There is no excessive drain of power and the normally available electric power is first used to defrost less than all of the plates, for example one, after which the power is applied to running the refrigeration system to recharge or refreeze all of the plates.

In FIG. 1 a refrigeration unit 10 may include a plurality, in this case four, of individual refrigeration plates 11. The plates are shown in detail in FIGS. 2 and 3. The

plates 11 are positioned within the housing 12 customarily made of sheet metal or the like. A fan or the like, not shown, is arranged to circulate air through and around the plates to provide cooling to a large area, normally containing perishable foods such as milk, vegetables, meat or the like.

As shown in FIGS. 2 and 3, each plate 11 may include an outer casing 14 enclosing the plate at the sides, top and bottom. Within the casing 14 are a plurality of ribs or dividers 16 with the interior of the casing 14 being filled by a suitable liquid or heat storage material, for example an eutectic. A conduit 18 enters the plate generally at one corner, indicated at 20, and may wind back and forth through the interior of the plate or casing and may exit at a lower area 22. The ribs 16 support the conduit 18 within the eutectic solution. Customarily a volatile refrigerant will be cycled through the conduit 18 which is in heat exchange relationship with the eutectic to freeze it. As indicated above, such a freezing or recharging cycle normally takes place during the non-use hours of the refrigeration system. The particular plates shown and described may vary considerably and, as an example, may be of the type shown in U.S. Pat. No. 2,859,945 issued on Nov. 11, 1958 to H. w. Kleist.

Positioned near the bottom of the casing 14 is a heater 24 which may be a resistance unit or the like and which is also supported by the ribs 16. An electrical connection 26 is shown at the lower right-hand side of the casing 14 and may be used for attaching the resistance or heating element 24 to a suitable source of electric power.

Each of the plates illustrated in FIG. 1 may be of the general makeup of the individual plate illustrated in FIGS. 2 and 3. Each of the plates have a conduit for circulating a volatile refrigerant to apply cold to the eutectic to freeze it. Each of the plates include preferably a single heater, although in some applications there may be more than one depending upon the size of the plate. In any event, the heater is effective to raise the temperature of the eutectic and thus to defrost the plates or assist in removing accumulated frost from the surface of the plates. Customarily frost accumulates near the bottom of the plate and thus the heater or heaters will be positioned adjacent this area.

FIG. 4 illustrates the electrical control circuit for use in regulating the application of the refrigerant and the control of the heater.

Voltage input terminals, customarily 220 volts, are indicated at 30 and 32. At the bottom right of FIG. 4 are four heater elements shown as resistances and indicated at 34, 36, 38 and 40. Assuming four plates, arbitrarily designated as plates 1, 2, 3 and 4, heater element 40 will be associated with plate 4, heater element 38 will be associated with plate 3, heater element 36 with plate 2, and heater element 34 with plate 1. A plurality of pilot lights, each identified as 42, are connected in parallel with each of the heater elements. One side of the pilot lights and of the heater elements is connected to a common bus 44, connected to terminal 32.

Thermostatically controlled relays or switches are connected to each of the heaters, with such switches or relays being indicated at 46-52. The movable contact on each of the switches 46-52 may be connected to a lower terminal, 46a-52a, or to an upper terminal, 46b-52b. The so-called "a" terminals are the defrost terminals, or defrost position of the switches, with ter-

minals "b" being the refrigeration terminals of the switches.

A sequencing relay is indicated at 54 with the plate defrost relays being indicated at 56, 58 and 60. A resistor 53 is in series with relay 54. The motor-compressor for moving the refrigerant through the evaporator coil or conduit 18 is indicated at 62 and a control relay is indicated at 64.

Relay 56 controls the operation of contacts 56a, with relay 58 controlling the operation of contacts 58a and relay 60 controlling the operation of contact 60a. The sequencing relay 54 controls the operation of contacts 54a through 54c. In like manner, control relay 64 controls the operation of contacts 64a and 64b. A pressure control switch 66, in circuit with the motor-compressor 62, completes the circuit shown in FIG. 4.

In operation, when the vehicle containing the refrigeration unit comes in after a period of use, terminals 30 and 32 are connected to a conventional source of 220-volt power. All relays will be in the position shown. After the connection is made sequencing relay 54 will advance from its present position to the next position as it is a step-by-step relay. Assume that the next position is the closing of contacts 54a with all other contacts controlled by relay 54 remaining in the open position. This will complete the circuit through relay 60 to move contacts 60a opposite to the position shown. The thermostatic controlled switch 50 will close upon contact 50a and thus heater 36 will be connected between terminals 30 and 32 if a predetermined temperature indicating a defrost has been attained. Plate 3 will thus be placed in a defrosting condition as its heater will be applying heat to the eutectic within the plate. None of switches 46-52 is in a "refrigeration" position. At such time as the temperature of the eutectic has risen to a predetermined point, temperature control switch 50 will move from contact 50a to contact 50b. Control relay 64 will then be connected across terminals 30 and 32 and contact 64a will be moved opposite to the position shown and contact 64b will be moved down, again opposite to the position shown. Contact 64a locks in relay 64, whereas contact 64b closes the circuit to the motor-compressor 62. The pressure control switch will regulate the operation of the motor-compressor and refrigerant will be simultaneously applied to all of the plates to freeze the eutectic. At the conclusion of the refrigeration cycle, switches 50 will return to its original position.

As is indicated from the above description of the operation sequence, one plate is defrosted at a time, with the defrosting sequence being determined by sequencing relay 54. At the conclusion of the defrosting cycle for that particular plate, all of the plates are refrozen or recharged by a circulating volatile refrigerant. No plate can receive refrigerant during the defrosting cycle and thus the amount of power drawn from terminals 30 and 32 is limited to either that necessary for a single heater or that necessary to operate the compressor motor. In no event will there be refrigeration and heating going on at the same time.

Although the invention has been generally described as a system in which a single plate is defrosted at a time, if the heaters were particularly small and there were a large number of plates, it might be possible to defrost more than one plate at a time. Of importance, however, is the fact that the power drawn by the heater should never exceed that customarily available at the dockside

terminal and should normally be about the same as drawn by the compressor motor. Normally the power available at dockside is that necessary to run the compressor motor.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there may be many modifications, substitutions and alterations thereto.

We claim:

1. A refrigeration system including a plurality of refrigeration plates, each of said plates including an eutectic solution, means for applying cold to each plate to freeze the eutectic, means for applying heat to each plate to raise the temperature of the eutectic and thus to defrost the plate,

electric circuit means controlling the application of heat and cold to the plates including means for operating the plate heat applying means successively, means for preventing the application of cold to a plate during the period of heat application, and means for applying cold to all plates after the application of heat to any one of the plates.

2. The structure of claim 1 further characterized in that the means for operating the heat applying means includes means for applying heat to one plate at a time while preventing the application of cold to all plates.

3. The structure of claim 2 further characterized in that said electric circuit means includes a sequencing relay and a plurality of heat control relays.

4. A refrigeration system including a plurality of refrigeration plates, each of said plates including an eutectic solution, conduit means positioned within each plate and in heat exchange relationship with the eutectic for passing a refrigerant through the eutectic to freeze it, and a heater positioned inside of each plate and in heat exchange relationship with the eutectic,

electric circuit means for controlling the application of refrigerant to each conduit and electric power to each heater including means for operating the heaters in the plates successively, means for preventing the application of refrigerant during periods of heater operation, and means for applying refrigerant to all of the plates after operation of the heater in any one of the plates.

5. The structure of claim 4 further characterized in that said electric circuit means includes a sequencing relay for operating said heaters one at a time and in succession.

6. The structure of claim 5 further characterized by and including relay means for preventing the application of refrigerant to any plate during operation of any heater.

7. The structure of claim 6 further characterized by and including relay means for controlling the application of refrigerant to all plates after the termination of a heating operation in any one plate.

8. A refrigeration system including a plurality of refrigeration plates, each of said plates including an eutectic solution, conduit means positioned within each plate and in heat exchange relationship with the eutectic for passing a refrigerant through the eutectic to freeze it, and a heater positioned inside of each plate and in heat exchange relationship with the eutectic,

electric circuit means for controlling the application of refrigerant to each conduit and electric power to each heater including means for operating less than all of the plate heaters at any one time, means for preventing the application of refrigerant during periods of heater operation, and means for applying refrigerant to all of the plates after operation of the heater in any one of the plates.

9. The structure of claim 8 further characterized by means for heating only one plate at a time.

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