Sept. 4, 1928. 1,683,359

P. E. KLOPSTEG

VACUUM OVEN

Filed Dec. 23, 1926 3 Sheets-Sheet 1

Fig. 1

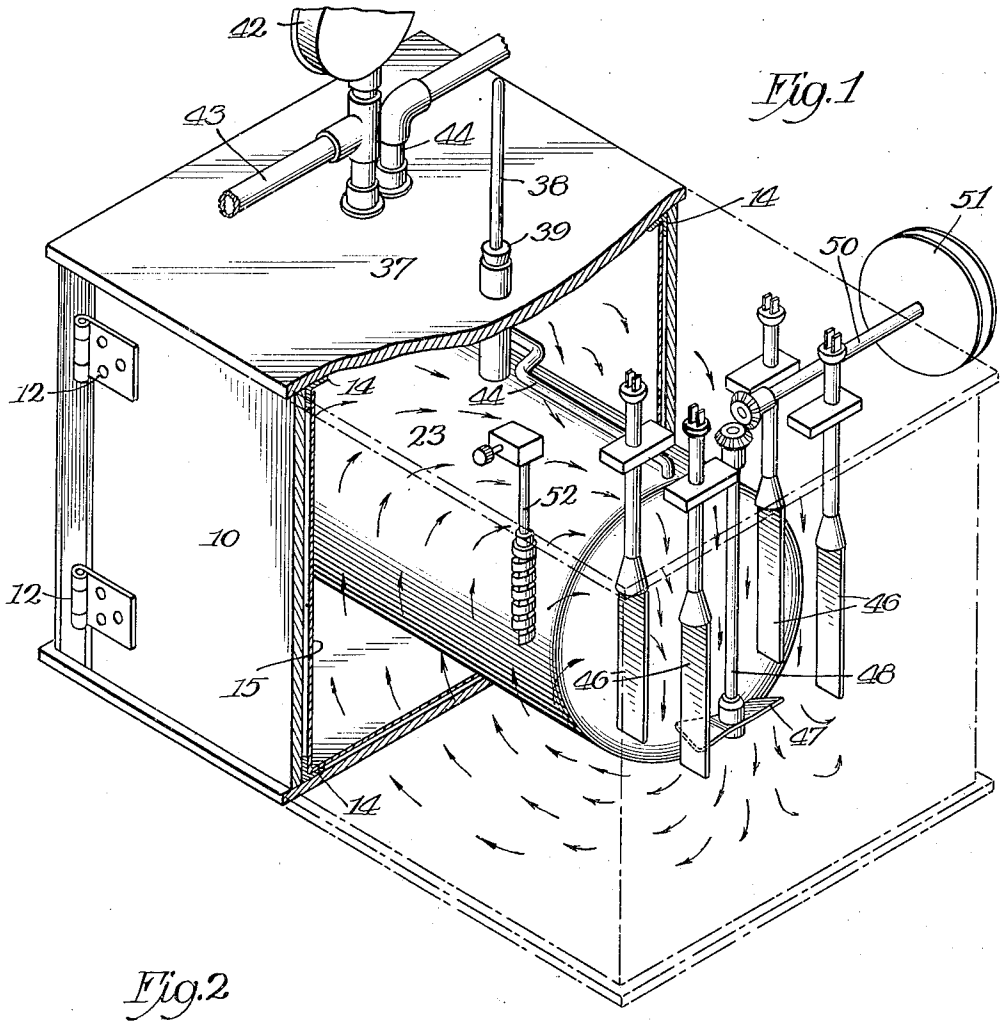

Fig. 2

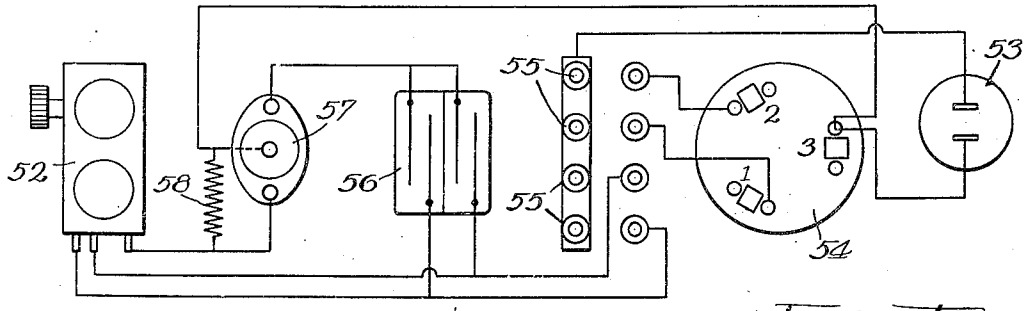

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Fig. 3

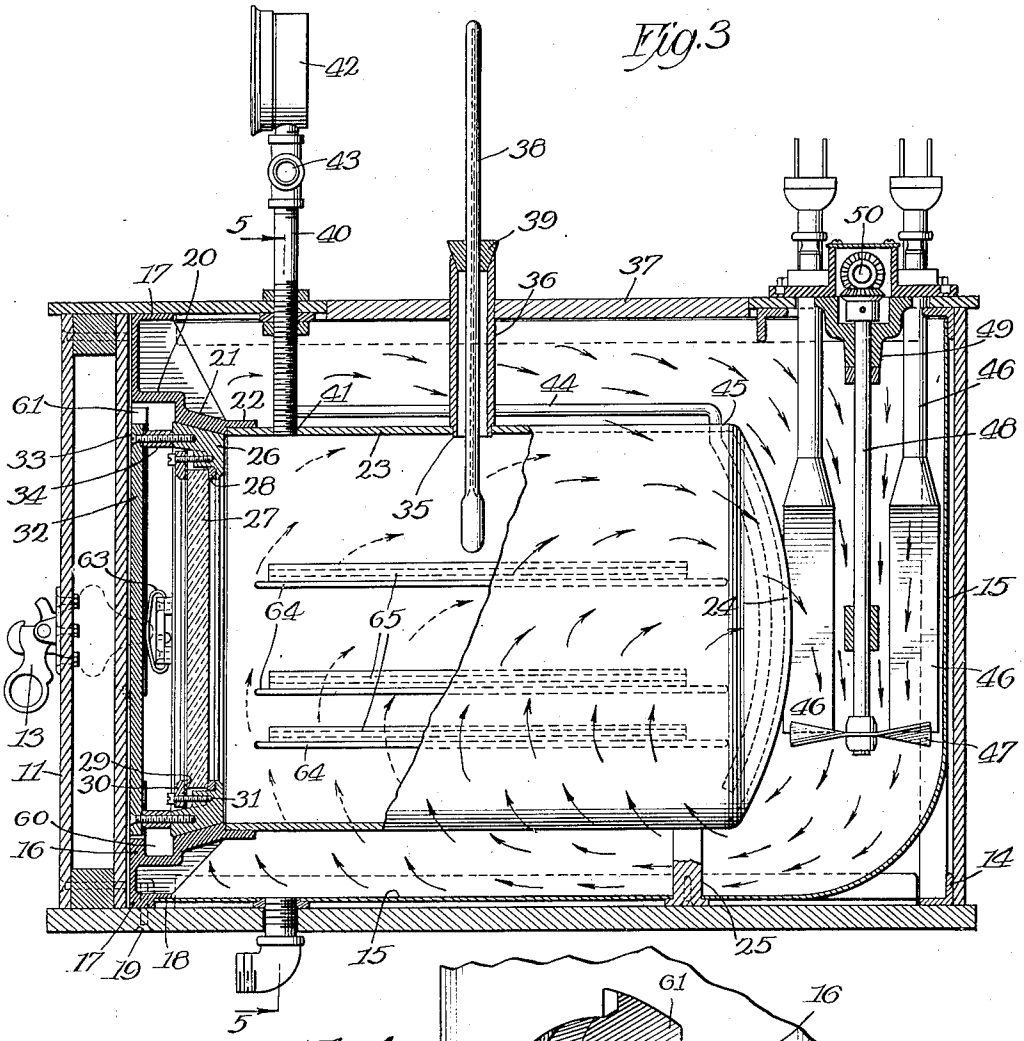

Fig. 4

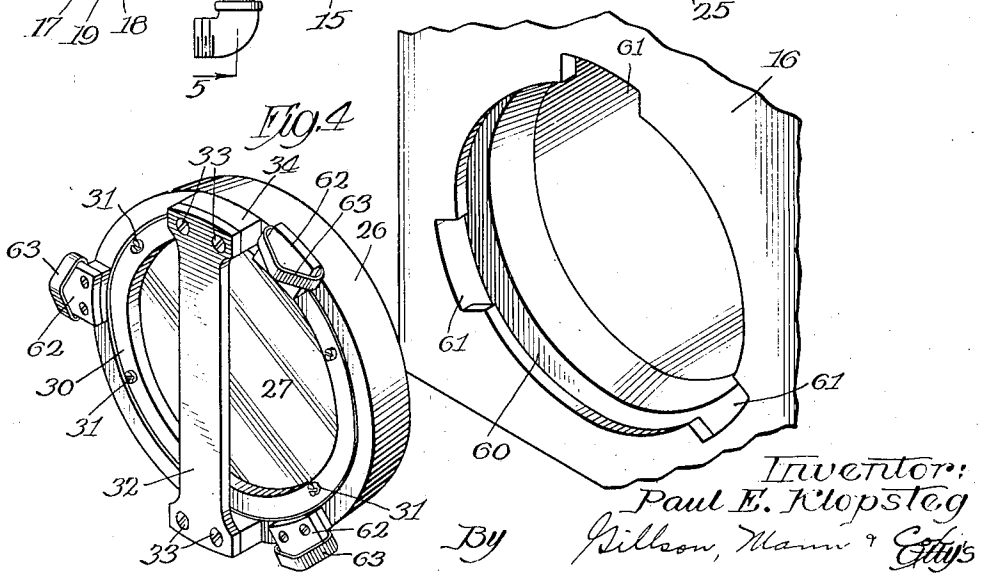

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Fig. 5

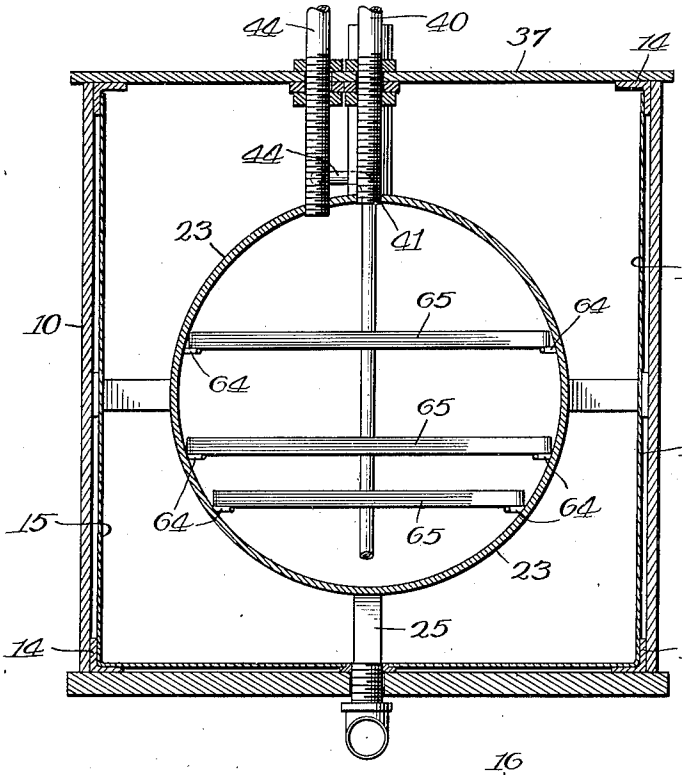
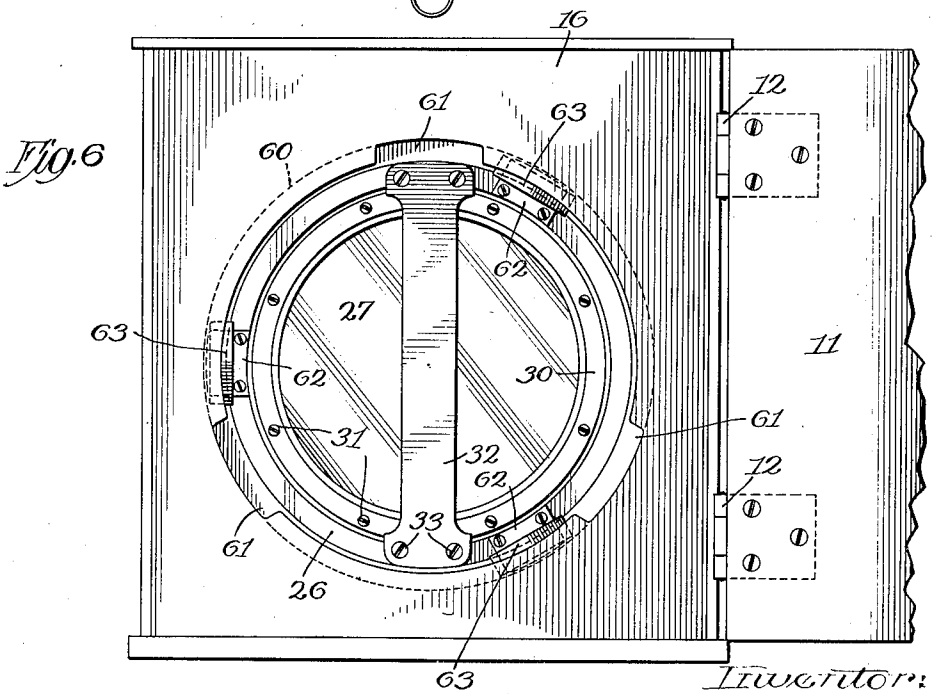


Fig. 6



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Patented Sept. 4, 1928. 1,683,359

UNITED STATES PATENT OFFICE.

PAUL E. KLOPSTEG, OF CHICAGO, ILLINOIS, ASSIGNOR TO CENTRAL SCIENTIFIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

VACUUM OVEN.

Application filed December 23, 1926. Serial No. 156,628.

This invention relates to vacuum ovens, and has for its principal objects to enable the temperature throughout the vacuum chamber to be maintained substantially uniform; to permit the material under treatment to be observed and measurements to be made within the chamber without affecting the vacuum; to permit the atmosphere within the chamber to be readily changed, and to generally improve ovens of this character.

Further objects and advantages of the invention will be revealed as the disclosure proceeds and the description is read in connection with the accompanying drawings, in which—

Fig. 1 is a perspective view with a portion of the casing and oil tank broken away to reveal the relationship between the parts on the inside;

Fig. 2 is a wiring diagram;

Fig. 3 is a longitudinal vertical section through the oven shown in Fig. 1;

Fig. 4 is a perspective view of a fragment of the oven and the door of the vacuum chamber displaced from its closed position;

Fig. 5 is a vertical transverse section taken on the line 5—5 of Fig. 3; and

Fig. 6 is an end view with the door of the casing open and the door of the vacuum chamber closed.

The oven is enclosed within a box-like casing 10, built of heat-insulating material, such as asbestos wall board, one end or side of which, 11, is mounted on hinges 12 and forms the main outer door adapted to be held closed by a latch 13. The pieces of wall board, or other insulating material, are mounted in any suitable manner upon a framework, indicated generally by the reference numeral 14.

Within the casing is an oil tank 15, four sides of which are made of sheet copper tinned and polished. The fifth side of the tank is formed by a head of cast brass 16, having an outer marginal flange 17 secured to the sheet copper with solder at 18, and secured to the casing by screws 19. This head also has an inwardly directed annular flange 20, provided with a conical portion 21 and a reduced and counterbored cylindrical portion 22.

A steel tank 23, closed at one end 24, has its opposite end within and soldered to the counterbored cylindrical portion 22. A small column or strut 25 steadies and supports the free end of the tank 23.

The inner wall of the conical portion 21 is ground to cooperate with a complemental ground surface on the brass casting 26, forming the frame of the door for the vacuum chamber proper. Within this frame is mounted a heavy sheet of pyrex glass 27, the margin of which is clamped between a gasket 28 on the inner side and a gasket 29 on the outer side by a ring 30 and screws 31 passing through the ring and into the body of the door frame.

As best shown in Fig. 4, the head 18 is provided with a circular groove 60 and a plurality of notches 61 communicating with the groove. The door frame 26 has a plurality of lugs 62 equipped with curved or chevron-shaped springs 63. As the door of the vacuum chamber is put in place, the lugs pass through the notches 61 and upon rotation enter the groove between the notches when the springs engage the outer wall of the groove and hold the door with the tapering ground surfaces in proper contact.

A handle 32, of heat insulating material, is secured to the door frame by screws 33 passing through the handle and spacers 34 into the frame.

At the upper side the tank 23 is perforated to receive the reduced end 35 of a tube 36, which projects upwardly through the top 37 of the casing. The joint between the tube and the tank is made tight with hard solder. A thermometer, or other measuring instrument 38, is suspended from a cork 39 in the upper end of the tube, and projects into the vacuum chamber.

A pipe 40, soldered to the tank 23 at 41, and projecting upwardly through the top 37, is equipped with a gauge 42 and connections 43 by which the chamber is put in communication with a vacuum pump.

A pipe 44 (Fig. 1), mounted in the top 37,

passes along the top of the vacuum tank 23, as indicated best in Fig. 3, passes through and is soldered to the tank at 45, and terminates close to the bottom wall of the tank.

A cluster of four elongated electrical heating elements 46 project downwardly through the top 37 into the oil adjacent to and opposite the closed end of the tank 23. These units are arranged at the corners of a rectangle, and a propeller 47 is mounted to rotate about an axis in the intersection of the diagonals of that rectangle. The propeller is carried by an upright shaft 48, journaled in suitable bearings 49, driven by a shaft 50 equipped with a pulley 51, receiving power from any suitable source, as the motor that drives the vacuum pump.

A bi-metallic thermo-regulator 52 is suspended in the oil, and controls the heat input.

The tank 23 is provided with brackets 64 for shelves 65 upon which the material to be treated is supported.

In the wiring diagram shown in Fig. 2, 53 indicates a line connector of any suitable type, 54 a ½ off switch; 55 a group of terminals associated with the heating units 16; 52 is the thermo-regulator; 56 are condensers connected across the contacts of the thermo-regulator; 57 is a pilot light, connected across the shunt 58.

Two of the heating elements 46 are controlled by the thermo-regulator. In the diagram these are associated with the first and second groups of contacts 55. By turning the switch 54 to the point indicated 1, the third unit will be cut in and by turning it to the position 2, the third and fourth are cut in, and by turning to 3, both of these elements are cut out.

The two controlled units alone are in circuit with the shunt 58 and the light 57 will indicate whether they are on or off.

Operation.

The material to be treated having been placed within the vacuum chamber, the inner and outer doors are closed. The pipe 43 is connected with the vacuum pump and the chamber exhausted to the desired degree. The springs 63 hold the inner door closed sufficiently tight to permit the pressure within the chamber to be lowered when the atmospheric pressure brings the ground surfaces into intimate relation and seals the chamber. The heating units and propeller are set in operation, the oil passes downwardly along the heating units, strikes the curved wall of the tank 15, passes to the left in Fig. 3, along the bottom of the tank 23, rising about its side and over its top and passes back to the heating elements. In rising it also travels along the inner surface of the head 16.

Preferably the oil in the bath covers the tank 23 to a depth substantially equal to the distance between the bottom of that tank and the bottom of the bath.

The space between the outer and inner doors forms a sort of vestibule, the temperature in which becomes so high that transmission of heat outward from the glass door is largely eliminated. By proper correlation between the heating elements and the rate of circulation, the temperature of the oil is maintained uniform throughout the bath within half a degree at the most extreme points. Heat is, therefore, communicated to the steel wall of the vacuum chamber at a practically uniform rate. Heat is also communicated to the head 16 and from the head through the vestibule, the frame 26 and the pyrex glass door into the vacuum chamber from the front. Carefully taken measurements with apparatus substantially as described, indicates that the temperature within the vacuum chamber is uniform within a degree at approximately 100° C.

By means of the tube 36 and the stopper 39 the thermometer, or other measuring instrument 38, may be projected into the vacuum chamber and thereby permit readings to be taken during the operation of the oven.

If it is desired to create a particular atmosphere in the chamber, the appropriate fluid, for example nitrogen, or other fluid, may be introduced through the pipe 43 and the air permitted to escape through the pipe 44, or vice versa.

I claim as my invention:

1. In a vacuum oven, a bath comprising a container with oil therein, a vacuum chamber projecting into the oil from one side of the container, a cluster of removable electric heating units projecting into the oil from above and adjacent to the end of the vacuum chamber, and means to force the oil to travel in a circuit passing the heating element and about the vacuum chamber.

2. In a vacuum oven, a bath comprising a container with oil therein, a vacuum chamber projecting into the oil from one side of the container, a cluster of elongated heating elements projecting into the oil from the top and adjacent to the end of the vacuum chamber, and a propeller associated with the heating elements to force the oil to travel in a circuit along such elements and about the vacuum chamber.

3. In a vacuum oven, an oil bath including a metallic head and having oil therein, a vacuum chamber projecting from said head into the oil and comprising a tube closed at its free end and having its open end secured to said head, a heating element projecting into the oil and means for forcing the oil to travel in a circuit passing the heating element and about the vacuum chamber.

4. In a vacuum oven, a container with oil

therein and having a generally upright metallic head provided with a door opening, a vacuum chamber projecting into the oil and comprising a tube closed at its free end and having its open end secured to said casting at the door opening, means for heating the oil and means for circulating the oil about the vacuum chamber.

5. In a vacuum oven, a container with oil therein and having a generally upright metallic head provided with a door opening, a vacuum chamber projecting into the oil and comprising a tube closed at its free end and having its open end secured to said casting at the door opening, means for heating the oil and means for circulating the oil about the vacuum chamber, and a door for the vacuum chamber of heat resisting transparent material and a heat insulating door spaced outwardly from the first door.

6. In a vacuum oven, a casing of heat insulating material having a door, an oil container within the casing and including a metallic head adjacent to the door, and provided with an opening, a vacuum chamber projecting into the oil container from said head with one end secured to the head around the margins of the opening and having its opposite end closed, a door for the vacuum chamber of heat resisting transparent material in spaced relation to the door of the casing, means to heat the oil and means to cause the oil to travel in a circuit past the heating means, about the vacuum chamber and along the head.

7. In a vacuum oven, a bath containing oil, a vacuum chamber projecting into the oil, a heating element in contact with the oil and means to cause the oil to travel in a circuit passing the heating element and about the vacuum chamber, the capacity of the heating element and the rate of circulation being so correlated that the temperature of the oil in contact with the vacuum chamber is substantially uniform.

8. In a vacuum oven, a vacuum chamber, means for communicating heat to the vacuum chamber, a tube communicating with the chamber adjacent to the top and a second tube communicating with the chamber adjacent to the bottom whereby one fluid may be introduced into the chamber through one of the tubes as another fluid is expelled through the other tube.

9. In a vacuum oven, a vacuum chamber, a door for the chamber and means comprising bayonet catches for yieldingly connecting said door to said chamber, said means including resilient mechanism for resiliently holding said door in engagement with said chamber.

10. In a vacuum oven, a box-like casing of heat insulating material having a door at one end, an oil tank within the casing having a head adjacent to the door and provided with an opening therein, a vacuum chamber comprising a tube closed at one end projecting into the oil tank from the head and having its end secured thereto in communication with the opening in the head, means for heating the oil and means for circulating the oil about the vacuum chamber.

11. In a vacuum oven, a vacuum chamber, means for communicating heat to the vacuum chamber, a tube communicating with the vacuum chamber adjacent to the top, a second tube arranged adjacent to the first tube and communicating with the chamber adjacent to the bottom whereby one fluid may be introduced into the chamber through one of the tubes as another fluid is expelled through the other tube.

12. In a vacuum oven, a vacuum chamber, means for communicating heat to the vacuum chamber, a tube communicating with the vacuum chamber adjacent to the top, a second tube arranged adjacent to the first tube extending along the vacuum chamber and downwardly adjacent to one end thereof and communicating with the chamber adjacent to the bottom thereof whereby one fluid may be introduced into the chamber through one of the tubes as another fluid is expelled through the other tube.

13. In a vacuum oven, an oil bath comprising a casing having a bottom and walls extending upwardly from the bottom, a vacuum chamber projecting into the bath from one wall and spaced from the other walls by oil, a door for the outer end chamber, means for heating the oil and means for causing it to circulate about the chamber.

14. In a vacuum oven, an oil bath comprising a casing having a bottom and walls extending upwardly from the bottom, a cylindrical vacuum chamber projecting into the bath from one of said walls and spaced by oil from the bottom and the remaining walls, means for heating the oil and means for causing the oil to circulate about the vacuum chamber.

15. In a vacuum oven, a box-like casing having a metallic head, an oil tank of smooth metal within the casing, a vacuum chamber projecting from the head into the oil tank spaced from it and covered by oil, and means for circulating the oil about the chamber.

16. In a vacuum oven, a casing having an upright metallic head, a door outside and spaced from the head, a vacuum chamber having its outer open end fixed to the head and projecting into the casing, oil surrounding the body of the chamber and covering the inner end thereof, and means for circulating the oil.

17. In a vacuum oven, a casing having an upright metallic head provided with an inwardly extending flange, a door outside

of the head, a vacuum chamber having its outer open end connected with the flange of the head and the body of the chamber projecting into the casing, oil surrounding the body of the chamber and covering the inner end thereof, and means for circulating the oil.

18. In a vacuum oven, a chamber having an inwardly tapering circular opening at one end, a door for the chamber having a complemental surface and yielding means for holding the door in place.

In testimony whereof I affix my signature.

PAUL E. KLOPSTEG.