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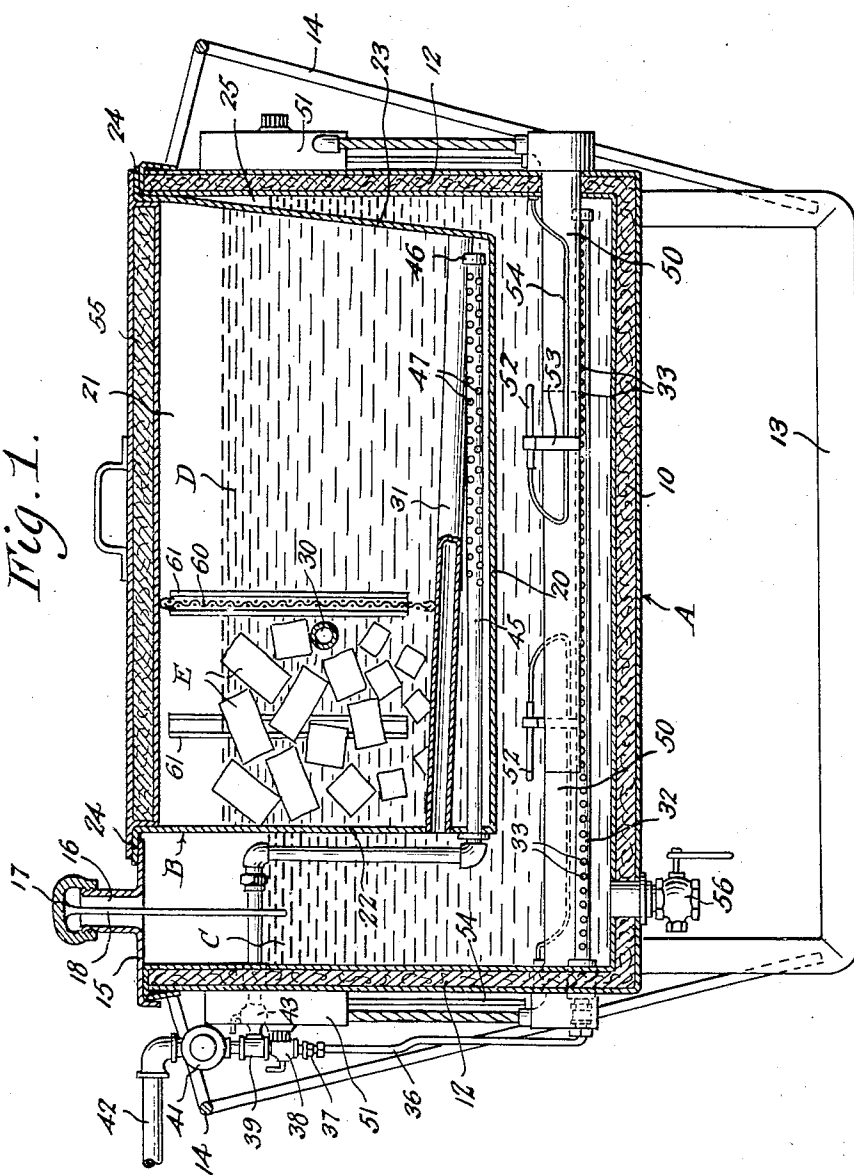
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APPARATUS FOR HEATING AND MELTING MATERIALS

Filed Oct. 25, 1944

3 Sheets-Sheet 1

Fig. 1.



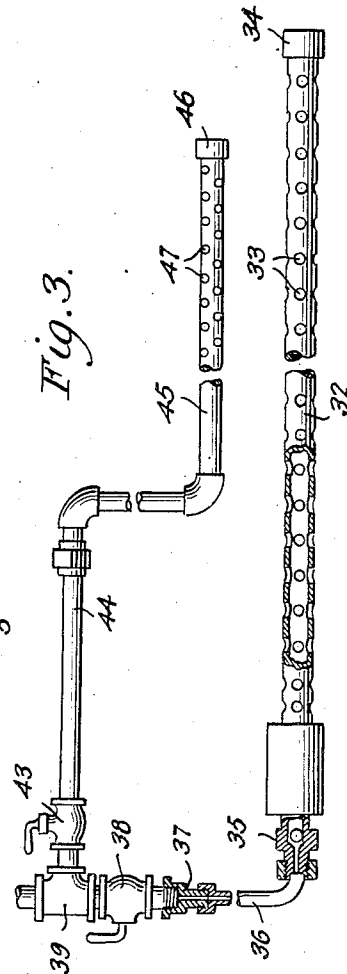
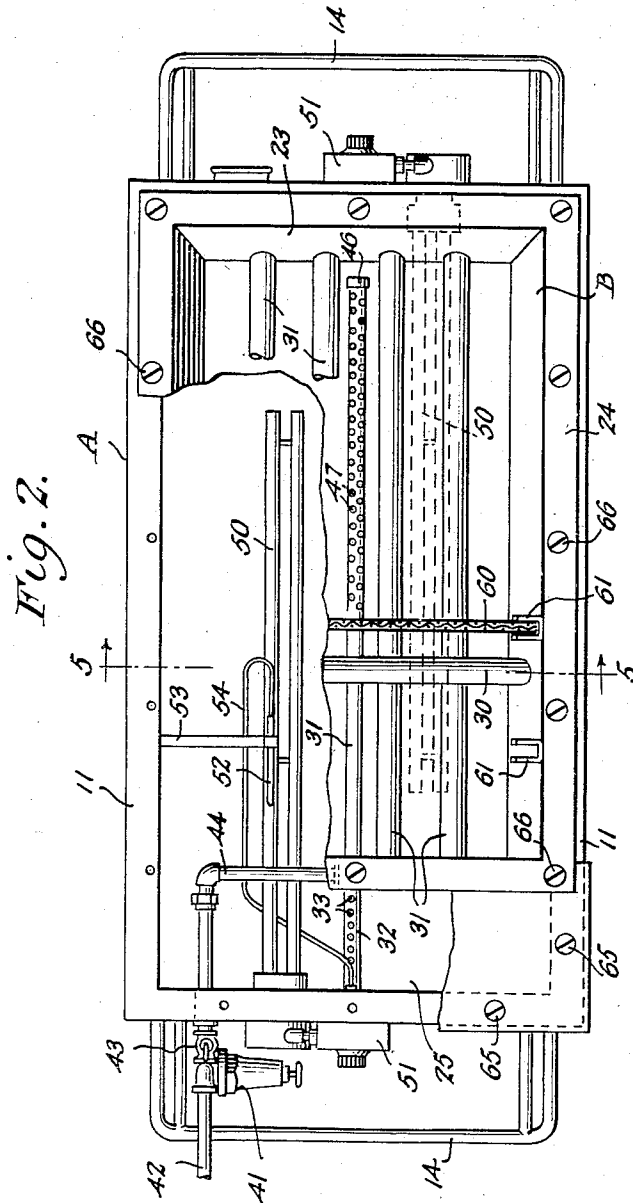
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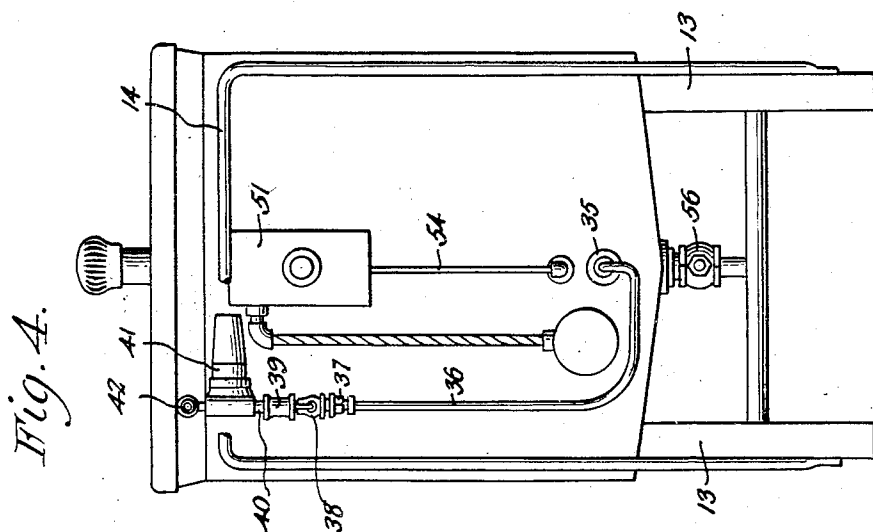
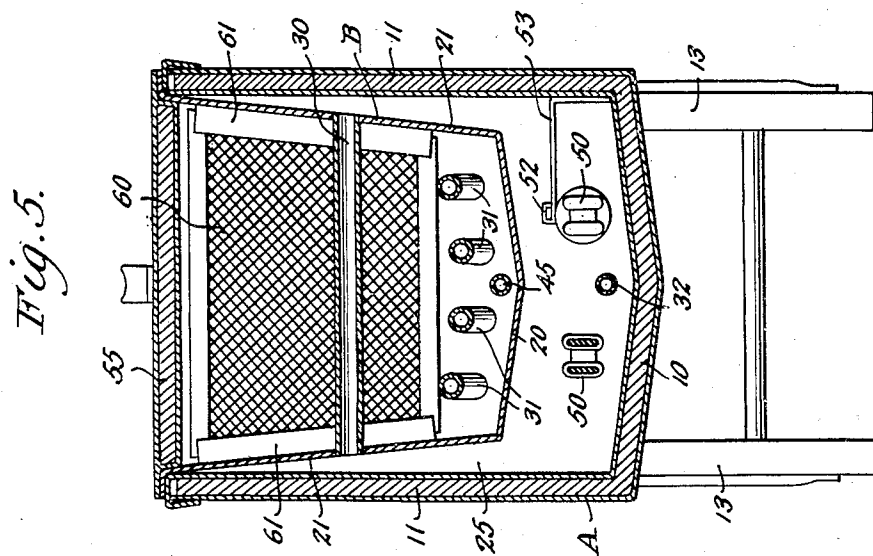
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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APPARATUS FOR HEATING AND MELTING MATERIALS

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Application October 25, 1944, Serial No. 569,322

3 Claims. (Cl. 126—343.5)

This invention is for a device for heating and melting materials and particularly those of low heat conductivity and high sensitivity to overheating and while not necessarily restricted thereto, the present invention is especially directed to a device or apparatus which is ideally adapted for heating such materials or thermoplastic substances as critical waxes, ethylcellulose stripping compounds or other equivalent materials known as "plastic skin" now being used for covering and protecting various articles or for other industrial compounds requiring complete and uniform heat distribution throughout the melt under close temperature control.

In actual practice, it has been observed that plastic stripping compounds or other equivalent substances of this character, due to their peculiar physical properties, cannot be handled by the previously known types of heating equipment heretofore employed for the usual wax dipping processes due to the fact that such compounds and substances possess little or no heat conductivity and are almost complete heat insulators, while said substances disclose a marked tendency toward phase separation at varying temperatures, in addition to exuding oil at some temperatures and when improperly heated are prone to degrade rapidly if standard heating and melting equipment is utilized.

In order to overcome the deficiencies of the usual equipment, the present invention comprehends an improved so-called indirect heating device or apparatus which is so constructed and arranged as to heat, melt and maintain the substance being treated at a substantially uniform temperature within very narrow and restricted limits so as to safeguard the melt from the danger of overheating or contact with "hot spots" on the walls of the heating receptacle, while insuring the maintenance of the melt at or above the required temperature to provide the proper plasticity and consistency thereof.

More particularly, the invention resides in an indirect type heating device employing an inner receptacle or vat for receiving the material to be heated and melted and an outer receptacle or tank defining a chamber surrounding the vat and containing a fluid heat transfer medium such as a heating oil of high fire point together with immersion heating elements located within the chamber for heating and maintaining the heat transfer medium at the desired temperature to melt and maintain the contents of the vat at the desired heat or consistency or in the required

plastic or other condition while avoiding both over and under heating thereof.

As a further feature, the invention contemplates in an indirect type heating device of the indicated character, means for effecting constant circulation of the heat transfer medium with reference to the outer surfaces and through the contents of the vat by means of circulation tubes leading therethrough, together with means for agitating the melt to insure uniform heat application to all portions of the contents of the vat, thereby avoiding separation of the various components of a melt consisting of a compound.

The invention further embodies in a heating device or apparatus of the character set forth, a vat which is so constructed and arranged as to render the same useful both for heating and melting the material while keeping the solid phase isolated from a portion of the vat which is utilized for the dipping of parts in the melt.

With these and other objectives in view, the invention is set forth in greater detail in the following specification, particularly pointed out in the appended claims and illustrated in the accompanying drawings, in which:

Fig. 1 is a vertical longitudinal sectional view through a heating device or apparatus constructed in accordance with the invention.

Fig. 2 is a top plan view thereof with the vat cover removed and with a portion of the vat broken away to disclose the underlying structure.

Fig. 3 is an enlarged detail view of the piping system for effecting the forced circulation of the exchange medium and the melt agitation.

Fig. 4 is an end view of the device or apparatus as viewed from one end thereof.

Fig. 5 is a vertical transverse sectional view taken approximately on the line 5—5 of Fig. 2.

Referring to the drawings by characters of reference, A designates generally an outer container member or tank including a bottom wall 10, side walls 11 and end walls 12 which are formed of spaced inner and outer shells between which suitable heat insulation material is interposed to retain the heat within the tank and prevent undue dissipation thereof. The outer container or tank A may be supported in any desired manner to render the same portable, such as by the skids 13, while handle members 14 are provided at the opposite ends so that the device may be conveniently handled when moving the same. The upper end of the tank is open except for a portion of its length adjacent one end wall 12 thereof which is covered by a removable top sec-

tion 15 having an upstanding tubular neck 16 provided with a removable closure cap 17 having a depending gage rod 18 for a purpose to be hereinafter explained.

An inner receptacle member or vat B is provided consisting of a substantially V-shaped bottom wall 20, upwardly divergent opposite side walls 21, a vertical end wall 22 and an upstanding divergent opposite end wall 23, with an outwardly directed marginal flange 24 at the upper edges of the side and end walls. The inner receptacle or vat B is supported within the outer receptacle or tank A by the seating of the marginal flange upon and its securement to the upper edges of the side and end walls 11 and 12 and the top section 15 of said tank, so that the vat depends therefrom into the tank with the bottom and side walls of said vat and tank members spaced from each other to define therebetween a chamber 25 containing a fluid heat exchange medium C. The said heat exchange medium is preferably a liquid such as a heating oil having a high fire point of approximately 700 degrees Fahrenheit, the level of which is maintained well up near the upper portion of the vat and which level is indicated on the gage rod 18, it being understood that the heat exchange medium is introduced into the chamber 25 through the filling neck 16 when the cap 17 is removed.

The vat B is provided with one or more transverse and one or more longitudinal tubes 30 and 31 which respectively open through the side walls 21 and the end walls 22 and 23 to provide passageways for the heat exchange medium extending through the confines of the vat from the portions of the chamber 25 lying on opposite sides thereof so that the heat units of said exchange medium C are transferred not only to the portions of the contents of the vat or the melt adjacent to the bottom and side walls of said vat but throughout the central portion thereof to provide for a more uniform heat application.

In order to provide for an inherent or natural flow or circulation of the fluid heat exchange medium or heating oil C through the longitudinal tubes 31, said tubes are disposed at an inclination and are pitched upwardly from their juncture with the wall 23 to their juncture with the wall 22 of the vat B. For the purpose of augmenting or supplementing this inherent or natural flow or circulation, means is provided for effecting an induced flow or circulation, which means, as disclosed, is in the form of a pipe 32 located within the chamber 25 and extending longitudinally of the tank A adjacent to the bottom wall 10 thereof below the vat B. The pipe 32 is formed with a multiplicity of perforations 33 arranged longitudinally and circumferentially thereof, one end being provided with a cap 34 and the opposite end thereof protruding through one of the end walls 12 of the tank A. The protruding end of the pipe 32 is connected to and communicates with an outwardly closing, inwardly opening check valve 35, which valve in turn is connected to and communicates with a fluid pressure feed conduit 36 which fluid pressure is preferably air under pressure admitted to the conduit through a nipple 37 having a small orifice providing for a constant pressure. The nipple 37 is connected to and communicates with the outlet of a cut-off valve 38 which is connected to and communicates with one of the outlets of a T-fitting 39 connected to and communicating with a pipe 40 leading from a pressure regulator

41 communicating with an air supply line 42. The other outlet of the T-fitting 39 is connected to and communicates with a cut-off valve 43 the outlet of which is connected by a suitable conduit 44 to an agitator pipe 45 extending through the end wall 22 of the vat and extending longitudinally of and within the vat adjacent the medial portion of the bottom wall 20 thereof. The free end of the pipe 45 is closed by a cap 46 and said pipe is provided with longitudinally and circumferentially spaced perforations 47.

The heat exchange medium C is heated by means of electric immersion heaters 50, two of which are illustrated extending inwardly through the opposite end walls 12 of the tank A and disposed in laterally spaced parallel relation adjacent the bottom of the tank and on opposite sides of the circulation pipe 32. The temperature of the heat exchange medium is regulated by controlling the immersion heaters 50 by thermostat means 51 regulated by bulbs 52 supported within the tank on brackets 53 with tubes 54 leading therefrom to the thermostat means 51. The vat is preferably provided with a removable insulated cover 55 while the tank A is formed with an outlet valve 56 for draining the heat exchange medium therefrom when desired.

The compound or material D which is melted within the vat B is preferably handled in a solid or block form as indicated at E and in order to utilize a portion of the vat for dipping articles to be coated while isolating the blocks E which are added during the dipping process, means is provided which consists of a foraminated partition 60 removably supported transversely of the vat adjacent the end wall 22 in vertical channel shaped guides 61. Preferably a plurality of pairs of guides 61 are provided on the opposite side walls 21 of the vat to permit of the positioning of the partition 60 at relatively different selected distances from the end wall 22.

In use and operation the heat exchange medium in the tank or outer container A is heated and circulated through the tubes 31 by the natural tendency of the heated oil to ascend through the inclined tubes and by a forced circulation caused by the compressed air bubbling upwardly through the oil, the greater proportion of the bubbling effect occurring in that portion of the tank chamber 25 located between the end wall 12 of the tank and the end wall 22 of the vat. This creates an induction at the higher ends of the pitched longitudinal tubes 31 to augment or supplement the natural flow of the oil through the tubes. The melted compound D in the vat B is therefore heated by the conduction of the heat units from the exchange medium C through the bottom, side and end walls 20, 21, 22 and 23 and by conduction through the tubes 30 and 31 so that the heat is thus applied to the inner portions of the melt as well as the outer portions thereof. In order to insure even or more uniform application of the heat, the melt is agitated and therefore circulated or kept in motion by the introduction of compressed air therinto adjacent the bottom of the vat through the circulation pipe 45. Due to the indirect type of heating employed, it is apparent that overheating or burning is prevented as there are no "hot spots" with which the melt can directly contact and the uniformity of heat application prevents phase separation, the exuding of oil or degrading of the melt. The construction of the vat with the foraminated partition 60 permits the heating and melting of the compound and the dipping process to be accom-

plished in one device or apparatus thus conserving space by eliminating the previous practice of heating and melting the compound in one receptacle and then pouring the same when melted into another receptacle for accomplishing the dipping process. The close control of the temperature by the thermostatically regulated immersion heaters permits of uniform heat application and maintenance well within the narrow limits required which in many instances have been specified as between 350 and 375 degrees Fahrenheit. Furthermore the insulation of the tank and the removable cover speeds the initial heating and reduces the heat loss when the current is shut off to the immersion heaters during non-operating hours and in an actual test run, the melt loss of heat averaged only about ten degrees per hour with all current shut off through an over night stoppage of the dipping process. With the thermostats set very low, the contents of the vat B may be kept in a semi-molten condition so that the device can be ready for operation after slightly over an hour of pre-heating on the following day. It should also be noted that by leading a portion of the conduit through the chamber 25 and through the hot oil C, the compressed air entering the agitator pipe 45 is preheated to prevent chilling of the melt.

As shown, the removable top section 15 is detachably secured in place by screws 65 so that it is normally affixed to the outer receptacle or tank A but may be removed for gaining access to the tank for facilitating the making of repairs or adjustments. The inner receptacle or vat B is also rendered removable and replaceable by securing the flange 24 thereof to the upper edge of the tank A and to the top section 15 by screws 66.

What is claimed is:

1. In a heating apparatus for melting materials of low heat conductivity, an outer tank member open at the top, an inner vat member open at the top and supported at its upper edge from the upper edge portion of the tank member with the walls of the vat member spaced from the walls of the tank member to define a chamber containing a heat exchange medium disposed in surrounding relation to the bottom and side walls of the vat member, transverse and longitudinal tubes located within and extending through the opposite side and end walls of the vat member and in communication with said chamber at the opposite sides and ends of the vat member to permit of the passage of the heat exchange medium therethrough, said longitudinal tubes being inclined to promote natural circulation of the medium, means extending into said chamber for effecting forced circulation of the heat exchange medium in said chamber and through said tubes, and

means extending into said vat below said tubes for agitating the contents thereof during the heating and melting of the same so as to maintain uniform application of the heat to all portions of the contents of the vat member.

2. In a heating apparatus for melting materials of low heat conductivity, an outer tank member, an inner vat member supported within the tank member with the walls of said vat spaced from the walls of the tank to define a closed chamber containing a heat exchange liquid surrounding the bottom and sides of the vat, transverse and longitudinal circulation tubes extending through the vat respectively between the opposite side and end walls thereof so as to define passageways closed to the vat and leading therethrough and having communication at their opposite ends with the portions of the chamber lying on the opposite sides and the opposite ends of the vat for conveying the heat exchange liquid therethrough, one set of said circulation tubes being disposed at an inclination to promote natural circulation of the heat exchange liquid therethrough, a perforated pipe section arranged within the lower portion of the vat below said circulation tubes and a perforated pipe section arranged in the lower portion of the tank adapted for admitting a fluid under pressure into the vat and tank for effecting circulation of the heat exchange liquid in the tank and agitation of the material in the vat so as to prevent overheating of said material.

3. In a heating apparatus for melting materials of low heat conductivity, an outer tank member, an inner vat member supported within the tank member with the walls of said vat spaced from the walls of the tank to define a closed chamber containing a heat exchange liquid surrounding the bottom and sides of the vat, transverse and longitudinal circulation tubes extending through the vat respectively between the opposite side and end walls thereof so as to define passageways closed to the vat and leading therethrough and having communication at their opposite ends with the portions of the chamber lying on the opposite sides and the opposite ends of the vat for conveying the heat exchange liquid therethrough, a foraminated partition arranged within the vat above said longitudinal circulation tubes extending laterally across the vat and spaced from the ends thereof to subdivide the vat into compartments through which the melted material may flow and providing one compartment for the dipping of articles to be coated and the other for receiving and retaining above said longitudinal circulation tubes solid material to be melted.

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