

- [54] DEVICE FOR HEATING AND COOLING
VARIOUS PRODUCTS**

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- [58] **Field of Search**..... 165/86, 107, 104;
18/38, 26 RR; 263/19 B; 34/57 D; 432/215, 221

- ## [56] References Cited

UNITED STATES PATENTS

- | | | | |
|-----------|---------|-------------|-----------|
| 3,411,465 | 11/1968 | Shirai..... | 34/57 D X |
| 3,227,207 | 1/1966 | Litman..... | 165/107 X |

- | | | | |
|-----------|---------|-----------------------|------------|
| 3,388,429 | 6/1968 | Barnett et al..... | 18/26 RR |
| 3,178,923 | 4/1965 | Jones et al..... | 165/107 X |
| 3,215,505 | 11/1965 | Schmalfeld et al..... | 263/19 B X |

FOREIGN PATENTS OR APPLICATIONS

- 578,432 6/1959 Canada..... 165/107

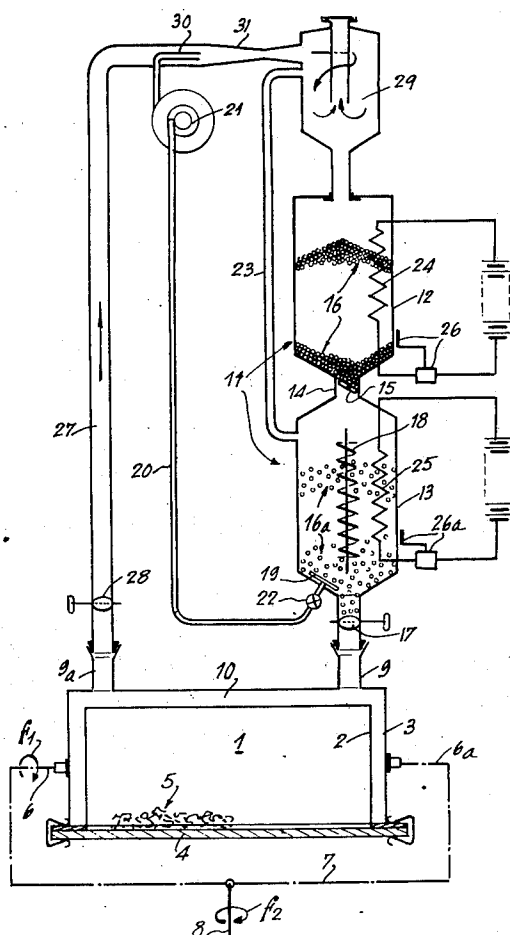
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[57] **ABSTRACT**

The device comprises two containers respectively superposed and communicating through a valve. Each container is fitted with heat exchange elements and contains a load of pulverulent material maintained in fluid state. Gaseous transfer means are provided to move a part of the load to a treatment area and therefrom to the inlet of the first container.

12 Claims, 3 Drawing Figures



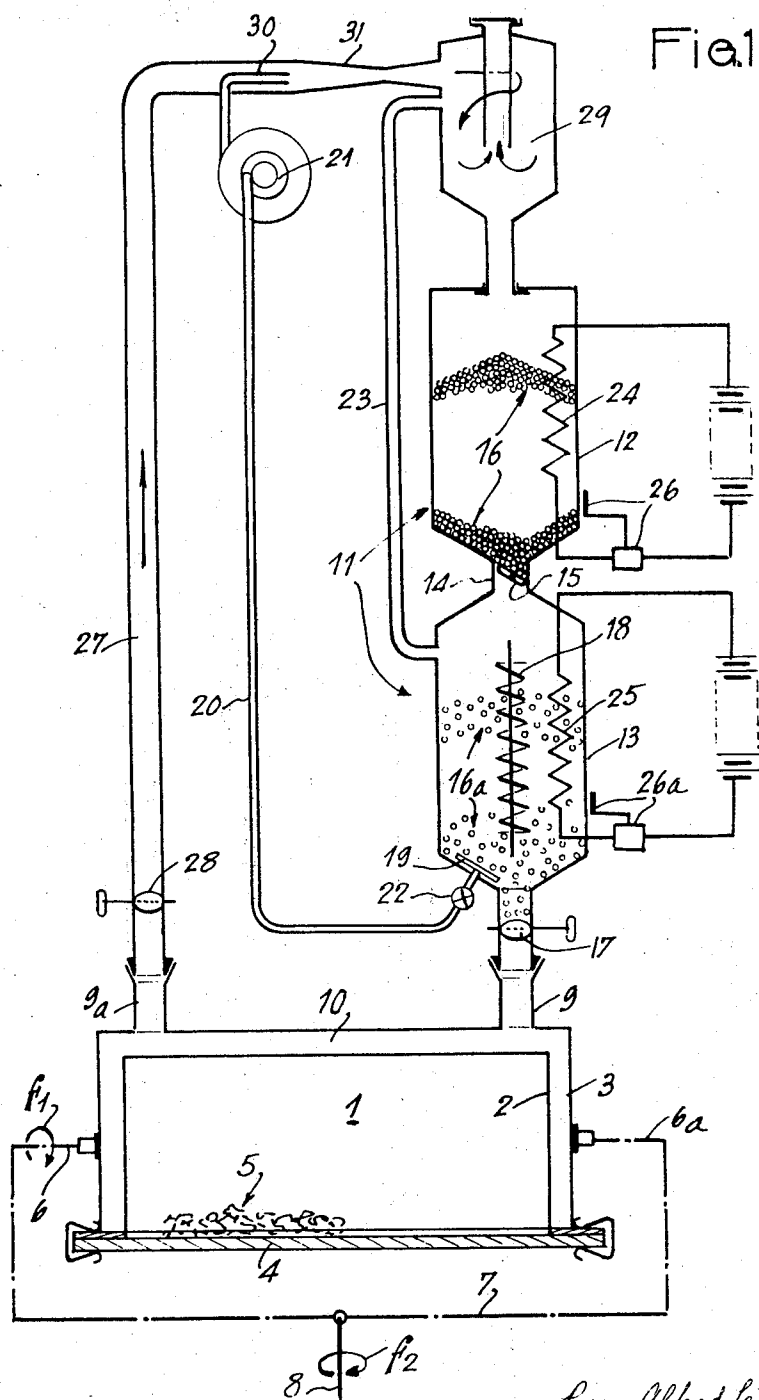
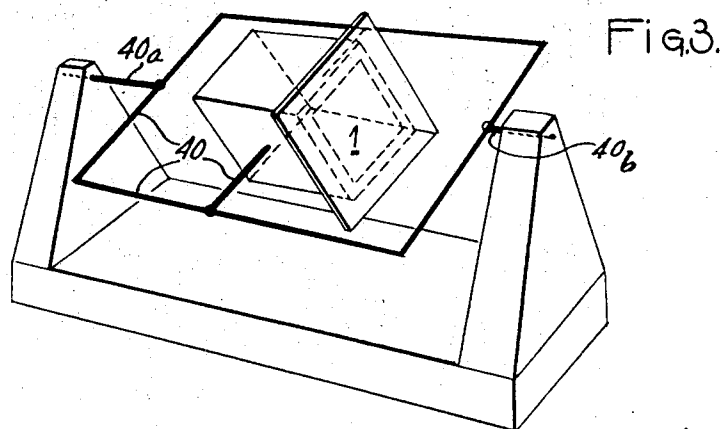
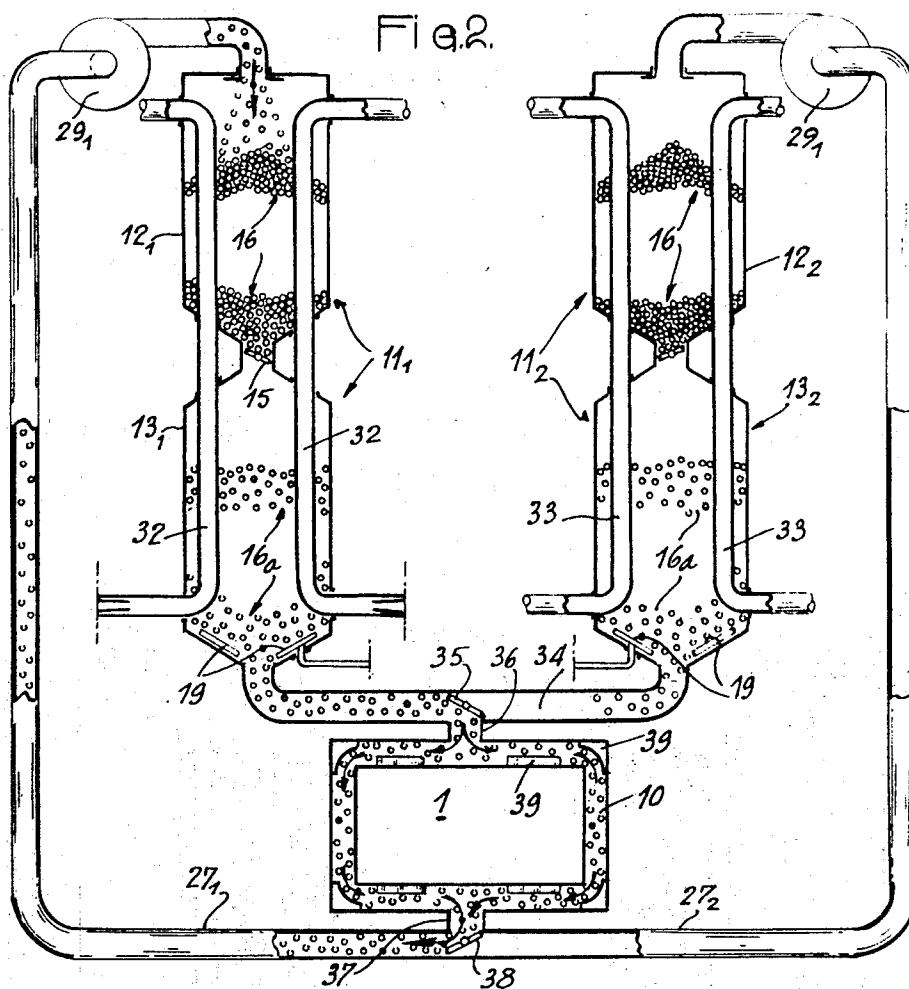


Fig. 1.

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DEVICE FOR HEATING AND COOLING VARIOUS PRODUCTS

This invention relates to a new device for heating and cooling various materials and products having to be thermically treated.

Though the invention can be applied in many cases, one of the most advantageous application thereof concerns the moulding of parts made of thermoplastic material, by the so-called "rotation process" that is, in which the mould is submitted to a rotary motion in two directions, generally orthogonal, while being heated and then cooled.

In the above process, up to now oil circulation burners have been utilized as heating devices but these devices have some disadvantages. As a matter of fact the burners do not permit to be obtained a very accurate or uniform temperature in all the parts of the mould and since an oil circulation is utilized, great care must be taken because of the explosion hazards when working at high temperature. Furthermore, the oil gets rapidly spoiled, and very tight and heat proof gaskets are necessary.

By embodying the invention, the invention becomes possible to combine the simple heating by a burner with the efficiency of oil heating and cooling, and to eliminate the disadvantages caused by the above mentioned process.

According to the invention, the device comprises at least one stove with heat exchanger components, said stove containing a load of regularly calibrated pulverulent material and being provided, on the inside, with means to maintain said load in fluid state, suction transfer means being further provided to move at least a part of the load of material in fluid state towards a cavity of a treatment area and from this cavity, up the stove inlet.

Various other characteristics of the invention will moreover be revealed by the detailed description which follows.

Embodiments of the invention are shown, by way of non-restrictive examples, in the accompanying drawings.

FIG. 1 is a diagrammatic sectional view of an embodiment of the device of the invention.

FIG. 2 is a diagrammatic sectional view similar to FIG. 1 showing a development of the invention.

FIG. 3 is a diagrammatic perspective view of a rotary moulding device embodying the invention.

In the following description, the invention is described in its application for moulding parts made of thermoplastic material, but it is well understood that the invention can be embodied in the same way to perform many other thermic treatments such as heating of various parts, containers, stills, etc., and generally for heating and cooling all materials and products which have to be brought to an accurate and uniform temperature with no part of these materials or products being submitted to a local overheating or cooling.

In the embodiment of FIG. 1 is shown a mould 1 which has two walls 2 and 3, separated from each other. The mould 1 is closed by a cover 4 and is provided to mould a part made of thermoplastic resin, the resin being put into the mould in the form of powder or granules as diagrammatically shown in 5. In rotary moulding the mould 1 is supported by shafts 6, 6a designed to make it rotate as per direction sign f_1 , these

shafts being themselves supported by a frame or cradle 7 which is driven into a rotary motion as per direction sign f_2 through a shaft 8.

Since very numerous means to carry out the control unit for the mould rotation, are known in the art and said means are not a direct part of the invention, they have been, for this reason, only diagrammatically represented and are not described with more details in the following disclosure.

The mould 1 is equipped with one or two filling and draining flanges 9, 9a which allow access to cavity 10 delimited by walls 2 and 3.

For embodying the invention, a stove 11 as been provided, said stove, including, preferentially and as shown, two containers 12 and 13 connected to each other by a neck 14 with a valve 15 provided therein.

Container 12 is at least partially filled with glass balls 16 carefully calibrated; the diameter of said glass balls can vary from some microns up to about half a millimeter.

Though, according to the invention, glass balls are preferably used, other materials in pulverulent form can be used, subject to the conditions that these products present a regular granulometry and that they be not or little abrasive that they, cannot agglomerate and further that they present a thermic inertia as important as possible.

The second container 13 is similar to container 12 and is also fitted on the lower part thereof with a valve 17. Besides, container 13 is provided with means designed to fluidify the glass balls contained therein, said means can be a simple screw 18 or other stirrer component but preferably they are composed of an air diffuser 19 set out on the lower part of the container, and the air is delivered under slight pressure through a conduit 20 connected to the outlet of compressor 21. A tap or valve 22 is provided for controlling the quantity of air brought into the container 13 and a conduit 23 is also provided on the upper part of container 13 for exhausting the air in order to maintain the inside of container 13 substantially close to the air pressure. To make the diffuser 19, many realizations are possible and, for instance, it is advantageous to provide all or a portion of the upper part of the container 13 bottom, with plates, discs or rings of porous material, particularly of bronze or fritted glass so that the air or other gas brought into said container 13 is uniformly distributed and maintain the mass of glass balls 16a that it may contain through opening of the valve 15 in a state similar to a fluid state, i.e. a fluidized state.

In the example shown in FIG. 1, the containers 12 and 13 contain heating electric resistances 24 and 25 of which the feeding is controlled by thermosensitive probes 26, 26a, respectively.

As it appears from above, when the powder or granules of thermoplastic resin 5 are to be melted in mould 1, the glass balls 16 are heated, said glass balls being pre-heated in container 12, a part of the glass balls is then transferred through the valve 15 into container 13 in which they are brought to the desired temperature, this temperature being controlled via the thermosensitive probe 26a, and being strictly the same for the balls since they are maintained stirred in the same way as molecules of a fluid. When the balls have reached a suitable temperature, mould 1 is placed under container 13 and the load of balls in fluid state that is con-

tained therein is transferred into cavity 10 of the mould through the valve 17 and flange 9 of said mould.

The balls filling the cavity 10, heat progressively the wall 2 and the mould being moved in rotation as per direction signs f_1 and f_2 , the material 5 melts and forms an even deposit on the mould walls.

The device of FIG. 1 also possible the extraction and the recuperation of the glass balls from cavity 10 of the mould. For that purpose a conduit 27 fitted with a valve 28 is connected to an appliance 29 for separating balls and air, this appliance being, for example, made in the way of a cyclone. Besides, the compressor 21 is equipped to blow air, for example by means of a nozzle 30, into the conduit 28 and towards the cyclone 29. Moreover, the nozzle 30 may be joined up to a Venturi 31.

It appears from above that when compressor 21 blows through the nozzle 30 thereof, a depression occurs in conduit 27, which causes suction of the balls contained in the cavity 10 when either the flange 9, or as shown, the flange 9a is brought opposite the tube 27.

When the mould is fitted with the two flanges 9 and 9a, as shown in FIG. 1, the filling and draining cycle of cavity 10 can be accelerated, making it possible to load and unload said cavity 10 several times if it is desired that the temperature be progressively increased in mould 1, for instance to prevent a heat shock.

It is obvious for anyone skilled in the art that the device of FIG. 1 can be utilized, in the same way for cooling. In that case it is only necessary to substitute cooling components to heating components composed of electric resistances 24, 25; for instance a coil run by a cold liquid or an evaporator from a refrigerating installation. It would not be beyond the scope of the invention to equip the stove 11 with both heating and cooling means, operating alternately.

FIG. 2 shows a development of the invention enabling to ensure indifferently the heating then the cooling in a progressive continuous cycle, of various products or materials, exactly in the same way as if a liquid were utilized, for example oil.

As shown on said FIG. 2, the device includes an heating stove 11, with two containers 12₁, 13₁ similar to those of FIG. 1 and a cooling stove 11₂ including two cooling containers 12₂ and 13₂. As previously, the containers 12₁, 12₂ respectively, are used for the storage of glass balls 16, and containers 13₁, 13₂ respectively, for the storage of glass balls 16a maintained in a fluid state, for example by air or other gas diffuser 19.

To heat and then to cool the glass balls respectively, it has been shown in FIG. 2 heat exchanger conduits 32 for the stove 11₁, and respectively 33 for the stove 11₂, with a fluid running through these exchanger conduits, for example hot gas for the conduits 32 and a cold-producing fluid for the exchanger conduits 33. The two containers 13₁ and 13₂ are connected to each other by means of a pipe 34 which is itself connected by a three-way valve 35 to a conduit 36 leading to the cavity 10 of mould 1. The cavity 10 furthermore is connected to a conduit 37 and a second three-way valve 38 at the inlet of conduit 27₁ and 27₂ through which the glass balls are respectively returned to the containers 12₁ and 12₂ through cyclone appliances 29₁ and 29₂ in relation with air compressors.

From above it appears that it is possible to make glass balls circulate continuously into cavity 10, exactly in the same way as for a fluid. In fact, in placing the three-

way valves 35 and 38 in the position shown in FIG. 2, and in operating the appliance 29₁, the balls 16a from container 13₁ are put into circulation in the whole cavity of mould 1 and then they are again sucked into tube 27₁, to be returned into the storage and preheating container 12₁ from which these balls are returned through valve 15 into container 13₁, where they are fluidized and adjusted to their final temperature.

To ensure a normal circulation into cavity 10, with no dead circulation area, it is advantageous to provide separating components 39 in this cavity. When heating in mould 1 is completed, valves 35 and 38 are simply operated so that the balls 16a from container 13₂ are put into circulation in cavity 10. In case mould 1 is utilized for rotary moulding of parts made of thermoplastic material the components for supporting mould 1, as shown in FIG. 3, are composed of tubular shafts 40 inside of which the balls are put into circulation exactly as described with reference to FIG. 2, the conduits 36 and 37 of said figure leading, for example to shaft portions 40a and 40b respectively.

The invention is not limited to the embodiments, shown and described in detail, for various modifications can moreover be applied to it without going outside of its scope.

I claim:

1. Apparatus for heating and cooling various products comprising:

a partially closed container inside of which are placed the products, said container being double-walled to delimit a closed area between said walls; inlet and outlet ducts communicating with said closed area;

at least one tank having an inlet and an outlet, said tank being connected at the outlet thereof with said inlet duct;

a first valve mounted on said inlet duct;

a charge of pulverulent particles located in said tank; heat exchange means connected to said tank for varying the temperature of said charge of particles; disturbing means located inside said tank to put said pulverulent particles in a non-cohesive state whereby said particles maintained in a non-cohesive state and heated at a desired temperature constitute a reserve of particles when said first valve mounted on said inlet duct is closed;

suction means connected to said outlet duct and to the inlet of said tank for moving the heated and in non-cohesive state particles from said tank when said first valve is opened through said closed area and from said closed area to said tank; and a second valve mounted on said outlet duct whereby said container can be removably mounted to said tank and said suction means.

2. Apparatus as set forth in claim 1 wherein said pulverulent particles are composed of fine-grained heat and cold conserving material having a diameter ranging from a few microns to 0.5 millimeter.

3. Apparatus as set forth in claim 1 wherein said disturbing means are stirrer appliances.

4. Apparatus as set forth in claim 1 wherein said disturbing means comprises a pneumatic gas diffuser placed on the bottom wall of at least one tank, said tank being then further provided with a separation appliance having a gas discharge outlet whereby separation of waste gas from said pulverulent material takes place and is eliminated from said tank.

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5. Apparatus as set forth in claim 4 wherein said separation appliance is composed of a cyclone having a casing connected to the closed area through pipes in which are provided said suction means.

6. Apparatus as set forth in claim 4 wherein said suction means are composed of a gas injection nozzle placed in a venturi upstream from said separation appliance.

7. Apparatus for heating and cooling various products comprising:

a partially closed container inside of which are placed the products, said container being double-walled to delimit a closed area between said walls, with at least one inlet aperture and one outlet aperture;

a cover to close said container;

a first tank having one input port and one output port and inside of which is provided

a charge of pulverulent particles;

a second tank having one input port and one output port and inside of which are provided together means to connect the output port of said first tank to the input port of said second tank, and to controllably permit part of said charge of pulverulent particles to pass into said second tank, heat exchange means for varying the temperature of the said particles in said second tank, and

disturbing means for the part of said charge of pulverulent particles within said second tank, said disturbing means being designed to maintain the pulverulent particles therein in a non-cohesive state, whereby the pulverulent particles maintained in a

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non-cohesive state are heated at a desired temperature thus constituting a reserve of particles at a controlled temperature; and

suction means for moving the heated pulverulent particles from the output port of said second tank towards the at least one inlet aperture of said closed area, then from said inlet to the at least one outlet aperture of said closed area and from this outlet to the input port of said first tank.

8. Apparatus as set forth in claim 7 wherein said pulverulent particles are composed of fine-grained heat and cold conserving material having a diameter ranging from a few microns to 0.5 millimeter.

9. Apparatus as set forth in claim 7 wherein said disturbing means are stirrer appliances.

10. Apparatus as set forth in claim 7 wherein said disturbing means comprises a pneumatic gas diffuser placed on the bottom wall of said second tank, said second tank being then further provided with a separation appliance having a gas discharge outlet whereby separation of waste gas from said pulverulent material takes place and is eliminated from said second tank.

11. Apparatus as set forth in claim 10 wherein said separation appliance is composed of a cyclone having a casing connected to the closed area through pipes in which are provided said suction means.

12. Apparatus as set forth in claim 10 wherein said suction means are composed of gas injection nozzle placed in a venturi upstream from said separation appliance.

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