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APPARATUS FOR TREATING SOLID MATERIALS WITH VOLATILE ORGANIC SOLVENTS

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Fig. 1.

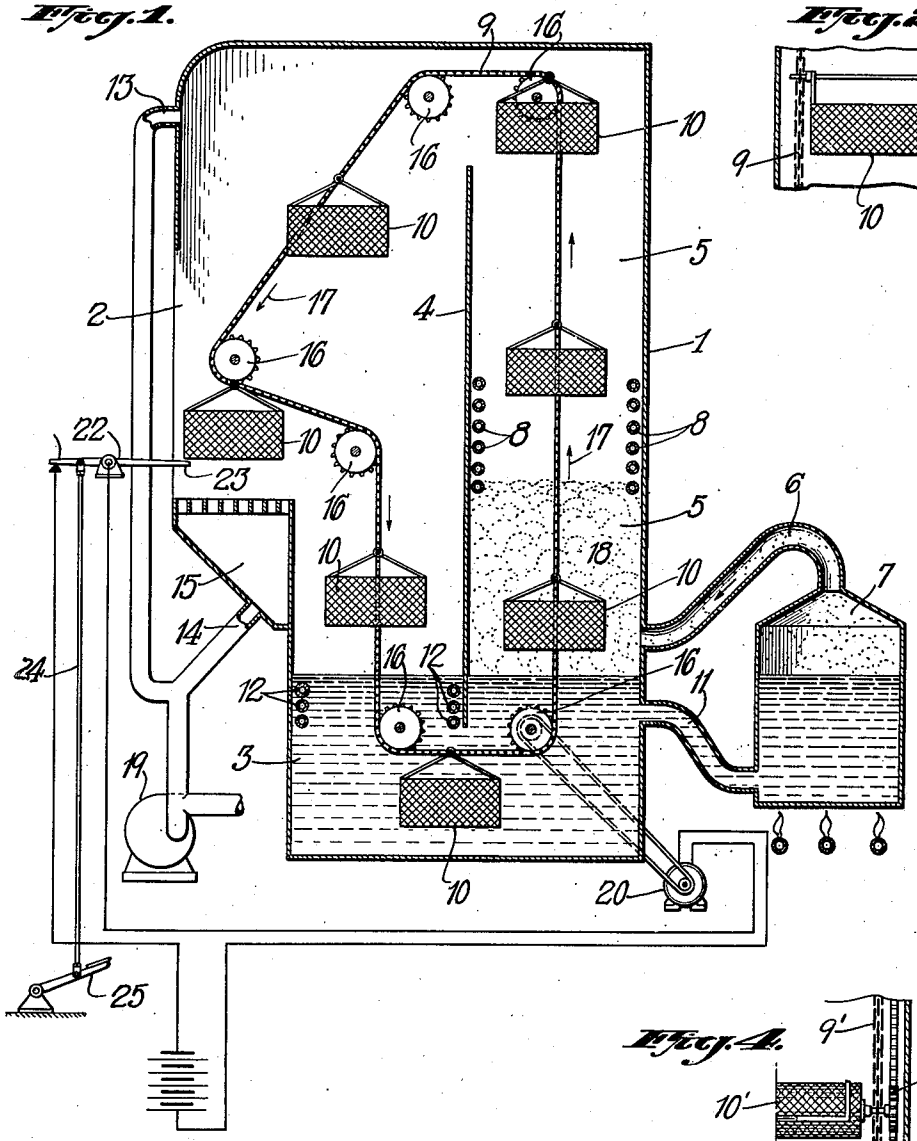



Fig. 2.




Fig. 4.

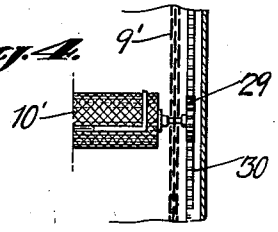
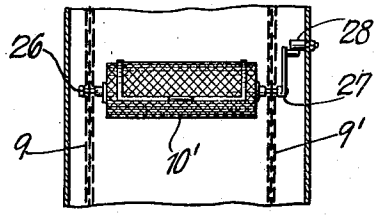



Fig. 3.




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## APPARATUS FOR TREATING SOLID MATERIALS WITH VOLATILE ORGANIC SOLVENTS

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8 Claims. (Cl. 202—169)

The present invention relates to a method and apparatus for treating solid material with volatile organic solvents.

It is well known to clean articles made of metal or other solid materials which are covered with grease by treatment with organic volatile solvents such as trichlorethylene, perchlorethylene, carbon-tetrachloride, benzine, benzol, and the like, and to use for this purpose a cleaning vessel which is filled with cold, heated or vaporized solvent and which may be divided into a plurality of subchambers into which the materials to be treated are immersed consecutively for obtaining a pre- and after-cleaning treatment. It is also well known to use immersing chambers which are filled with solvents of different temperature or of different aggregate state, so that, for example, pre-cleaning may be carried out in a solvent having a temperature which is below its boiling point, and after-cleaning is carried out in vaporized solvent whereby it cannot be avoided that some of the solvent adhering to the articles vaporizes when the articles are thansferred from one immersing chamber to the other whereby the goods are completely or partially dried.

Experience has shown that for certain kinds of goods it is of advantage to prevent any drying, if only partial, of the goods in between the individual treating steps and it is an object of the present invention to provide a method and means whereby the goods are at first immersed in a liquid solvent, the temperature of which is below the boiling point, whereby the articles are pre-cleaned and then directly transferred into a chamber fed with solvent in vapor state, which chamber is sealed at the bottom with the same solvent in liquid state, so that at the transition of the goods from the first to the second chamber, no contact of the goods with air takes place. Only after the goods have further been cleaned by the solvent condensed on the goods are they brought into a cooled air zone where the rest of the solvent still adhering to the goods vaporizes and the goods are quickly dried. With this method the vapor of the solvent is in direct communication with the liquid solvent so that the latter may gradually be heated up to the boiling point, which is not desired, and means are therefore provided, according to the present invention, to cool the liquid and maintain its temperature below the boiling point.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and claims and shown in the drawing which, by way of illustration, shows what we now consider to be a preferred embodiment of our invention.

In the drawing—

Figure 1 is a diagrammatic cross sectional view of an apparatus suitable to carry out our present invention.

Figure 2 shows a detail of the apparatus shown in Figure 1, and

Figure 3 shows a modification of the detail shown in Figure 2.

Figure 4 shows a modification of the detail shown in Figure 3.

Like parts are designated by like numerals in all figures of the drawing.

1 represents a cleaning vessel, which is completely closed with the exception of a lateral opening 2 for the insertion of the goods and the lower part 3 of which is filled with a liquid solvent. By means of the vertical partition 4, a shaft-like chamber 5 is formed, the bottom of which is sealed by the liquid cleaning solvent. A tube 6 terminates into the lower part of chamber 5, through which tube solvent vapor is introduced which is produced in a heated evaporator 7 which is partly filled with a liquid solvent. The height of the vapor zone in chamber 5 is defined by the position of the cooling coils 8 located adjacent to the walls of chamber 5, because excess vapor condenses on the lower cooling tubes 8, whereas the upper tubes serve to cool the air above the vapor zone.

Within vessel 1 two endless conveyor chains 9 and 9' are arranged to which baskets 10 are connected which may be filled with the goods to be treated; the chains 9 and 9' run over guide rollers 16 in the direction indicated by the arrows 17 and pass thereby the loading opening 2 through which the goods to be treated are introduced and filled into and taken out of the baskets; the filled baskets are immersed and taken through the lower part 3, which is filled with cleaning fluid and conducted underneath the partition 4 and upwardly into shaft 5. In this shaft, after leaving the cleaning liquid, the baskets pass first through a zone 18 which is filled with vaporized solvent whereby an after-cleaning effect is obtained by said vapor which condenses on the surfaces of the goods, and then through a cooled air zone which is located above the vapor zone. In said air zone the heated goods are cooled and dried, whereafter they are brought back over the top of the partition 4 into the neighborhood of the opening 2 where they are taken from the baskets, fully cleaned. The baskets are then refilled with new and unclean goods.

The space 3 communicates with the evaporator 7 through the conduit 11 whereby the liquid level in the cleaning vessel and in the evaporator are maintained alike. The solvent carries out a complete cycle; it enters chamber 5 in vapor state, is condensed, and the condensate returned to the evaporator.

In order to obtain efficient condensation of the vapor on the goods, it is desirable that the lat-

ter enter the vapor zone at low temperature and the temperature of the goods is not increased while passing through the liquid. Since continuously hot condensate drips into the liquid from the vapor zone 18 and the cooling tubes 8 therein, the heat so introduced must be removed; this is done by means of cooling tubes 12 located within the liquid.

In spite of the action of the cooling tubes 8, it cannot be avoided that a small amount of vapor enters the upper part of the vessel 1 due to diffusion, or is carried over by the goods and the baskets 10. In order to avoid exit of such vapor through the opening 2, adjacent to said opening tubes 13 and 14 are connected which lead to a suction fan 19. Thereby continuous withdrawal and a light draft of air into the vessel through opening 2 is created. The tube connection 14 is widened out to a funnel shaped inlet 15, the upper wide opening of which funnel includes a platform means which is located beneath the basket standing at the opening 2 so that vapor adhering to said basket and goods therein is completely removed.

The chains 9 and 9' are moved by connecting a crank to be operated by hand or, as shown, a motor 20, to one of the rollers 16. The operation of the motor is preferably automatically stopped when a basket filled with cleaned goods reaches the loading opening 2, and is started by the operator when the basket is refilled with new, unclean goods. In case motor 20 is an electric motor, this may be done by arranging a switch 21 located at one end of a two arm lever 22 which is turned clockwise when a basket 10 contacts its free end 23; thereby switch 21 is opened and the current for operating the motor 20 interrupted. To lever 22 also a foot pedal 25 is connected by means of a connecting rod 24. Upon depression of said pedal by the operator, the switch 21 is closed and current is admitted to the motor 20.

Instead of baskets having cross bars which connect chains 9 and 9' as shown in Figures 1 and 2, baskets 10 as shown in Figure 3 may be used having lateral shafts 26 and 27 whereby one of said shafts, for example 27, is provided with a crank adapted to contact a stationary abutment 28 in the vessel 1. Whenever said abutment is contacted, the basket 10' is revolved about the axis 26—27 whereby the cleaning action is increased and also quick and complete drying of the goods, particularly goods of hollow construction, is assured. Provisions for revolving the baskets may be situated at any point of the apparatus, for example, in the liquid zone and/or in the vapor zone and/or in the drying zone.

Instead of providing a crank and abutment a pinion 29 and a rack 30 may be used as shown in Figure 4 whereby the baskets are revolved all the way while they travel through the solvent in liquid state, in vapor state and through the drying zone or, if the racks are arranged at certain parts only of the path of the baskets the baskets are continuously revolved while they travel through said parts.

While we believe the above-described embodiments of our invention to be preferred embodiments, we wish it to be understood that we do not desire to be limited to the exact details of process, design, and construction shown and described, for obvious modifications will occur to a person skilled in the art. For example, the opening 2 may be arranged on top instead of on the wall; a plurality of immersion chambers filled with cleaning liquid may be arranged in the lower part of vessel 1 and passed by the goods to be cleaned consecutively before they are taken into the vapor zone.

We claim:

1. The apparatus for treating solid goods with a volatile solvent comprising, in combination, a vessel having a lower portion which is filled with said solvent in liquid state, a partition in said vessel, said partition having a lower part immersed in said solvent in liquid state and forming a loading chamber and a treating chamber within said vessel, the lower parts of said chambers being sealed from one another by means of said liquid solvent, an evaporator for said solvent, said evaporator having a vapor space, a conduit connected to and connecting said vapor space and said treating chamber and terminating in said treating chamber in a mouth which is positioned above the level of the solvent in liquid state, cooling means in said treating chamber and being positioned above the mouth of said conduit whereby solvent vapor condenses on said cooling means, an opening in said loading chamber for introducing into and removing the goods to be treated from said vessel, conduits terminating into said vessel adjacent to said opening and means producing in said conduits a pressure which is lower than the pressure prevailing in said vessel, one of said second-mentioned conduits terminating below said opening in said vessel and having a funnel configuration flaring out into said loading chamber.

2. The apparatus for treating solid goods with a volatile solvent comprising a vessel having a lower portion filled with said solvent in liquid state, a partition in said vessel, said partition having a lower part immersed in said solvent in liquid state and forming shaftlike chambers within said vessel, the lower parts of said chambers being sealed from one another by means of said liquid solvent, an evaporator for said solvent, said evaporator having a vapor space, a conduit connected to and connecting said vapor space and one of said chambers and terminating in said chamber in a mouth positioned above the level of the solvent in liquid state, cooling means in that one of said chambers to which said conduit is connected, said cooling means being positioned above the mouth of said conduit whereby solvent vapor condenses on said cooling means, an endless conveyor means within said vessel and adapted to transport the goods to be treated consecutively through said chambers and from a vapor free zone through the solvent in liquid state and immediately thereafter through the solvent in vapor state and then back into the vapor free zone, containers for the goods to be treated movably directly connected to said conveyor means, contact means connected to said containers, and abutting means spaced apart and being connected to a stationary part of said vessel and being adapted to temporarily cooperate with said contact means, whereby upon contact of said contact means and said abutting means said containers are temporarily moved with respect to said conveyor means and the position of the goods in said containers is changed.

3. The apparatus for treating solid goods with a volatile solvent comprising a vessel subdivided into a plurality of chambers, one of said chambers being partly filled with said solvent in liquid state, and partly with said solvent in vapor state, an endless conveyor means within said vessel and moving consecutively through said chambers and

through said solvent in liquid state and subsequently through said solvent in vapor state, containers for the goods to be treated directly movably connected to said conveyor means, contact means connected to said containers, and abutting means spaced apart and being connected to a stationary part of said vessel and being adapted to temporarily cooperate with said contact means, whereby, upon contact of said contact means and said abutting means, said containers are temporarily moved with respect to said conveyor means and the position of the goods in said containers is changed.

4. The apparatus for treating solid goods with a volatile solvent comprising a vessel subdivided into a plurality of chambers, an endless conveyor means within said vessel and moving consecutively through said chambers, containers for the goods to be treated, a shaft-like member individually connected to said containers and to said conveyor means for individually revolvably connecting said containers with said conveyor means, a crank connected with said shaft-like member and crank actuating means spaced apart and being connected with said vessel and being adapted to temporarily actuate said crank, whereby said containers are temporarily revolved.

5. An apparatus for treating work with a volatile solvent, said apparatus comprising a vessel having a lower portion containing solvent in liquid state, a partition in said vessel and having a lower part immersed in the liquid solvent, said partition dividing said vessel into a work intake chamber and into a treating chamber, whereby the liquid solvent positively seals the lower parts of said chambers from one another, cooling means disposed in said intake chamber below the surface of the liquid solvent for cooling said solvent and preventing vaporisation in said intake chamber, solvent vapor supply means terminating in said treating chamber, cooling means disposed in said treating chamber and above the surface of the liquid solvent and above said vapor supply means for condensing the vapor and dripping the hot condensate into the liquid solvent in said treating chamber and creating a vapor treating zone between the liquid surface and said cooling means and a substantially vapor free zone above said cooling means, and work conveyor means disposed completely in said vessel and extending all around said portion for transporting the work to be treated consecutively through the relatively cool liquid solvent in said intake chamber, underneath said partition, through the relatively hot liquid solvent in said treating chamber, through the vapor zone, through the vapor free zone, above said portion and back into the intake chamber.

6. The apparatus for treating solid goods with a volatile solvent comprising a vessel having an opening for taking the goods to be treated into and removing same from said vessel, said vessel having a lower portion which is filled with said solvent in liquid state, a partition in said vessel, said partition having a lower part immersed in said solvent in liquid state and forming a loading chamber and a treating chamber within said vessel, the lower parts of said chambers being sealed from one another by means of said liquid solvent, an evaporator for said solvent, said evaporator having a vapor space, a conduit connected to and connecting said vapor space and said treating chamber and terminating in said treating chamber in a mouth which is positioned above the level of the solvent in liquid state, cooling means in said treating chamber and being positioned above the mouth of said conduit whereby solvent vapor condenses on said cooling means, a platform means adjacent to said opening and extending into said vessel, an endless conveyor means within said vessel comprising containers for the goods to be treated, and being adapted to transport the goods to be treated consecutively over said platform means and through said chambers, suction means connected with and terminating in said platform means and causing a suction effect adjacent to said opening and on said containers and goods from below when passing over said platform means.

7. The apparatus for treating solid goods with a volatile solvent comprising, in combination, a vessel having a lower portion filled with said solvent in liquid state, a partition in said vessel, said partition having a lower part immersed in said solvent in liquid state and forming shaft-like chambers within said vessel, the lower parts of said chambers being sealed from one another by means of said liquid solvent, an evaporator for said solvent, said evaporator having a vapor space, a conduit connected to and connecting said vapor space and one of said chambers and terminating in said chamber in a mouth positioned above the level of the solvent in liquid state, cooling means in that one of said chambers to which said conduit is connected, said cooling means being positioned above the mouth of said conduit whereby solvent vapor condenses on said cooling means and a vapor filled zone is created in the chamber to which said conduit is connected between the liquid level and the mouth of said conduit, and an endless conveyor means disposed completely within said vessel and extending around said partition and being adapted to transport the goods to be treated consecutively from one of said chambers, through said solvent in liquid state, underneath said partition, through said vapor zone, above said partition, and back into the chamber from which they started.

8. The apparatus for treating solid goods with a volatile solvent comprising, in combination, a vessel having a lower portion filled with said solvent in liquid state, a partition in said vessel, said partition having a lower part immersed in said solvent in liquid state and forming shaft-like chambers within said vessel, the lower parts of said chambers being sealed from one another by means of said liquid solvent, an evaporator for said solvent, said evaporator having a vapor space, a conduit connected to and connecting said vapor space and one of said chambers and terminating in said chamber in a mouth positioned above the level of the solvent in liquid state, cooling means in that one of said chambers to which said conduit is connected, said cooling means being positioned above the mouth of said conduit whereby solvent vapor condenses on said cooling means, and an endless conveyor means disposed entirely within said vessel and around said partition for moving the goods to be treated around said partition from one of said chambers into the other and back into the first chamber.

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