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2 Sheets-Sheet 1

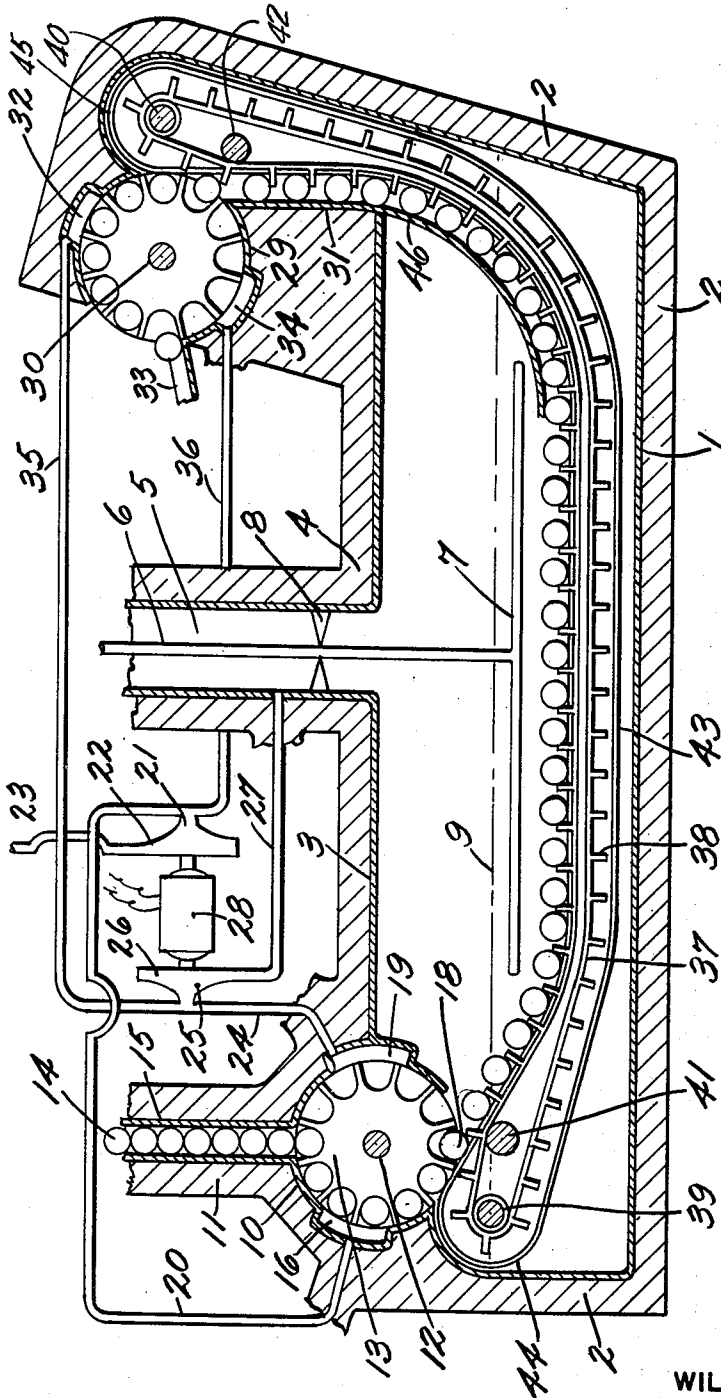


Fig. 1

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APPARATUS FOR REFRIGERATING SUCH PERISHABLE
MATERIALS AS FOODSTUFFS

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2 Sheets-Sheet 2

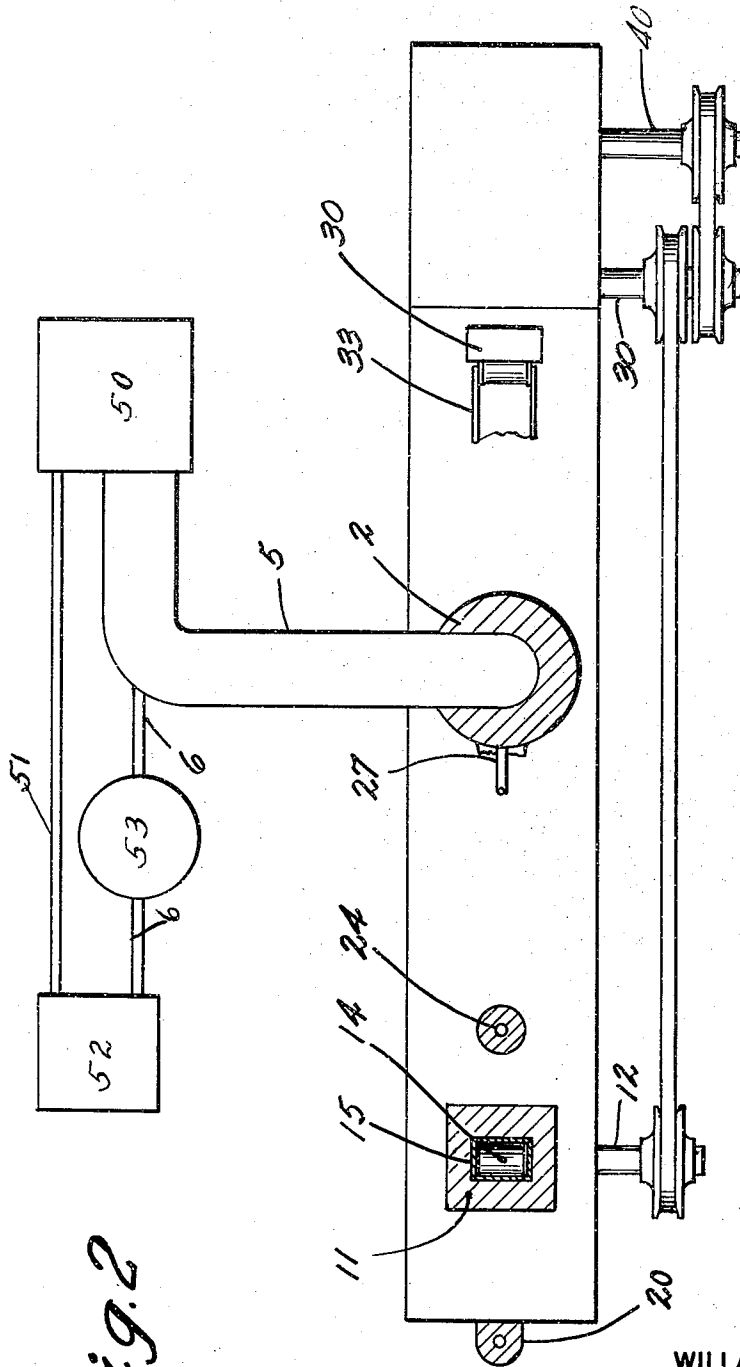


Fig. 2

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APPARATUS FOR REFRIGERATING SUCH PERISHABLE MATERIALS AS FOODSTUFFS

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5 Claims. (Cl. 62—375)

My invention relates to apparatus for refrigerating such perishable materials as foodstuffs for storage and shipment and is especially applicable to the cooling of such materials down to temperatures substantially below zero degrees F.

One object of my invention is to feed the foodstuffs in suitable containers, packages or assemblies through a bath of cold boiling liquid such as nitrogen at atmospheric pressure and to discharge the foodstuffs therefrom for other treatment or storage.

Another object of my invention is to provide means for providing the liquid nitrogen for the bath and means for removing the resultant nitrogen in gaseous phase from the bath chamber, reliequifying it and returning it to the bath.

Another object of my invention is to provide means for controlling the rate of supply of liquid in consonance with the rate of evaporation of the liquid into gaseous phase whereby the level of the liquid in the bath may remain substantially constant.

Other objects will appear from time to time throughout the specification and claims.

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a diagrammatic section through an apparatus adapted to carry out my invention;

Figure 2 is a diagrammatic plan view in part section. Like parts are indicated by like characters throughout the specification and drawings.

The vessel 1, impervious to liquid and gas, is surrounded by insulating walls 2 at bottom, ends and sides. The impervious cover 3, preferably of metal, not susceptible of deterioration or weakness in presence of great cold, closes the vessel 1 and is provided with insulation 4 and defines a gas exhaust passage 5. A liquid supply pipe 6 enters the vessel through the gas discharge pipe 5 and terminates in a distribution manifold 7, foraminous or apertured to permit flow of liquid therefrom into the bath area. This pipe is supported in the duct 5 by any suitable support means 8 and manifold 7 lies beneath the level 9 of the liquid in the bath so that as liquid enters the bath from the manifold, it discharges below the surface in such manner as to induce no turbulence in the gas above the surface and little if any turbulence in the contents of the bath.

A feed lock cylinder housing 10 is associated with the cover 3 and insulated as at 11. The cylinder is open at its lower side to the bath above the level of the liquid and below the cover and contains a rotary gas lock cylinder 13 mounted on shaft 12 concentric with the cylinder housing, is longitudinally grooved about its entire periphery, the length of the grooves being sufficient to accommodate a can, the width of the cylinder being sufficient to accommodate the width of a can so that cans 14 fed by any suitable mechanism may pass downwardly through the duct 15, insulated at 11 and be discharged one at a time into one of the grooves. Then as the cylinder rotates

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in a counter clockwise direction, each such pocket is presented to a vacuum chamber 16 and then discharged at 18 from the pocket into the bath chamber. The empty pockets in the periphery of the cylinder now filled with gaseous nitrogen instead of air, as rotation continues, are presented to the gas suction chamber 19.

A suction pipe 20 leads from the air suction chamber 16 to the intake 21 of the blower 22 which draws air from the chamber 16 and discharges it through the duct 23. A nitrogen duct 24 leads from the gas suction chamber 19 to the intake 25 of a nitrogen blower 26 which discharges nitrogen through the duct 27 to the gas discharge conduit 5. Both these impellers are driven by any suitable power means such as an electric motor 28.

A generally similar cylindrical discharge lock housing 29 open to ambient air through part of its periphery contains lock cylinder as indicated mounted on shaft 30. A duct 31 conducts successive passages into register with the pockets as they come out of the bath and counter clockwise rotation will present them first to the gas suction chamber 32, after which the packages or cans discharge through chute 33 to any suitable point and then the pocket is presented to the air suction chamber 34. Duct 35 leads from the gas suction chamber to the blower 26 and pipe 36 leads from the air suction chamber 34 to the air blower 21 just as in connection with the feed lock.

The relationship between the lock cylinders and their housings is such that little if any gas or air flow is possible between adjacent pockets separated as they are by the fingers which come into working fit with the cylindrical walls of the housing and so as they rotate, the filled pockets containing the material to be treated, come into register with the suction chamber, a substantial proportion of the air in each pocket is withdrawn by vacuum before the chamber is open to the gaseous atmosphere of the bath and as the empty pocket comes in register with the gas suction chamber, gas is withdrawn therefrom for return to the gas exhaust pipe, this same process taking place with respect to both the intake and discharge cylinder. Little if any air is thus able to enter the bath chamber and little if any gaseous nitrogen is able to escape therefrom except through the discharge duct 5.

A flexible conveyor belt 37 having teeth 38 spaced therealong a distance corresponding to the distance between adjacent teeth in the cylinders, those teeth being so spaced as to accept one food package between each adjacent tooth. The belt 37 passes around an idler pulley 39 adjacent the feed lock and an idler pulley 40 adjacent the discharge lock. Idler rollers 41, 42 associated with the idler pulleys 39 and 40 guide the belt out of its path of tangency with respect to the two rollers as indicated. The propulsion and camming belt 43 travels around the sprockets 44, 45 and is apertured so that the teeth 38 project upwardly through the belt on the upper run and permit the belt 43 to drop away on the lower run as indicated. Driving means for the sprocket 44 drive it in consonance with the shafts 12 and 30 so that the spaces between each pair of teeth on the belt 37 register with grooves on the lock cylinders and as the belt 37 approaches toward or recedes from the line of tangency with respect to the cylinders 10 and 29, the packages are permitted to ride into or are cammed out of register with the belt so as to prevent interference by the teeth 38 with the entrance or discharge of the packages from the apparatus.

A guide arc 46 extends around the discharge end of the belt to provide a guide leading the successive packages into register with the discharge cylinder. The belts hang on the upper range between the rollers 41 and 42 and on the lower range between the sprockets 44 and 45 so that as the belt travels, individual packages will enter

the bath chamber, be immersed below the level of the liquid and finally discharged, being allowed to remain in the bath a sufficient length of time for them to be lowered to the desired temperature, the lowering of the temperature resulting from the heat flow from the package to the liquid so that the latent heat is furnished by the package to boil enough of the liquid to cause the packages to reach the desired low temperature.

The idler pulley 39, and idler rollers 41 and 42 are free running. The belts 37 and 43 interlocking causes drive applied through the sprocket shaft 40 to correlate the travel of the toothed belt 38 with the cylinders. The shafts 12, 30 and 40 are connected by any suitable means for instance, belts as indicated so that they will all operate in unison.

Referring to Figure 2, the gas discharge pipe 2 leads to a reliquefying apparatus 50 shown diagrammatically as the details of the reliquefaction form no part of the present invention. A duct 51 conducts the liquid to a storage point 52 whence the duct 6 controlled by any suitable automatic control means 53 will control the rate of inflow of liquid in consonance with the rate of evaporation of the liquid and discharge through the duct 5 to maintain the level of the bath constant. The rate of evaporation will, of course, depend upon the amount of heat introduced. Heat entering through the insulation will normally be a constant but heat brought in with the articles to be chilled will vary with the rate of supply and all that is necessary is that the control means maintain the rate of inflow of liquid to balance the rate of discharge gas. Under these circumstances, the pressure in the bath will always be maintained at atmosphere or perhaps just a little above it as a minimum as otherwise ambient air might enter. The pressure can be substantially above atmospheric if desired because the gas locks for feed and discharge make that possible without excessive wastage of nitrogen.

I claim:

1. In combination, a closed gas chamber having spaced inlet and discharge ports for entrance of solid material to be treated in the chamber, a gas lock closing each port, including a rotary gas lock cylinder adapted to prevent gas travel through the port and having pockets movable toward and from the chamber and adapted to receive and convey solids through the port, suction means in the path of and adapted to register with the pockets of each gas lock cylinder as they travel toward registry with the chamber, suction means in the path of and adapted to register with the pockets of each packing means as they travel away from registry with the chamber, said suction means being adapted to attenuate the gas contents of each successive pocket as it travels both toward and from register with the chamber.

2. In combination, a closed gas chamber having spaced inlet and discharge ports for entrance of solid material to be treated in the chamber, a gas lock closing each port, including a rotary gas lock cylinder adapted to prevent gas travel through the port and having pockets movable toward and from the chamber and adapted to receive and convey solids through the port, suction means in the path of and adapted to register with the pockets of each packing means as they travel toward registry with the chamber, suction means in the path of and adapted to register with the pockets of each gas lock cylinder as they travel away from registry with the chamber, said suction means being adapted to attenuate the gas contents of each successive pocket as it travels both toward and from register with the chamber, the suction means associated with the inlet port being adapted to withdraw air from the pockets as they approach registry with the chamber and to withdraw gas from the pockets as they travel away from register with the chamber, the suction means associated with the discharge port being adapted to withdraw gas from the pockets as they recede

from registry with the chamber and to withdraw air from the pockets as they travel toward registry with the chamber.

3. In combination, a closed gas chamber having spaced inlet and discharge ports for entrance of solid material to be treated in the chamber, a gas lock closing each port, including a rotary gas lock cylinder adapted to prevent gas travel through the port and having pockets movable toward and from the chamber and adapted to receive and convey solids through the port, suction means in the path of and adapted to register with the pockets of each packing means as they travel toward registry with the chamber, suction means in the path of and adapted to register with the pockets of each gas lock cylinder as they travel away from registry with the chamber, said suction means being adapted to attenuate the gas contents of each successive pocket as it travels both toward and from register with the chamber, the suction means associated with the inlet port being adapted to withdraw air from the pockets as they approach registry with the chamber and to withdraw gas from the pockets as they travel away from registry with the chamber, the suction means associated with the discharge port being adapted to withdraw gas from the pockets as they recede from registry with the chamber and to withdraw air from the pockets as they travel toward registry with the chamber, the suction means discharging air to atmosphere and returning the gas to the chamber.

4. In combination, a closed gas chamber having spaced inlet and discharge ports for entrance of solid material to be treated in the chamber, a gas lock closing each port, including a rotary gas lock cylinder adapted to prevent gas travel through the port and having pockets movable toward and from the chamber and adapted to receive and convey solids through the port, suction means in the path of and adapted to register with the pockets of each packing means as they travel toward registry with the chamber suction means in the path of and adapted to register with the pockets of each gas lock cylinder as they travel away from registry with the chamber, said suction means being adapted to attenuate the gas contents of each successive pocket as it travels both toward and from register with the chamber, the suction means associated with the inlet port being adapted to withdraw air from the pockets as they approach registry with the chamber and to withdraw gas from the pockets as they travel away from registry with the chamber, the suction means associated with the discharge port being adapted to withdraw gas from the pockets as they recede from registry with the chamber and to withdraw air from the pockets as they travel toward registry with the chamber, the suction means discharging air to atmosphere and returning the gas to the chamber, a closed system including the chamber and means for withdrawing gas from the chamber, reliquefying it and returning it to the chamber as liquid at atmospheric pressure.

5. In combination, a closed gas chamber having spaced inlet and discharge ports for entrance of solid material to be treated in the chamber, a gas lock closing each port, including a rotary gas lock cylinder adapted to prevent gas travel through the port and having pockets movable toward and from the chamber and adapted to receive and convey solids through the port, suction means in the path of and adapted to register with the pockets of each packing means as they travel toward registry with the chamber, suction means in the path of and adapted to register with the pockets of each gas lock cylinder as they travel away from registry with the chamber, said suction means being adapted to attenuate the gas contents of each successive pocket as it travels both toward and from register with the chamber, the suction means associated with the inlet port being adapted to withdraw air from the pockets as they approach registry with the chamber and to withdraw gas from the pockets as they travel away from reg-

istry with the chamber, the suction means associated with the discharge port being adapted to withdraw gas from the pockets as they recede from registry with the chamber and to withdraw air from the pockets as they travel toward registry with the chamber, the suction means dis- 5
charging air to atmosphere and returning the gas to the chamber, a closed system including the chamber and means for withdrawing gas from the chamber, relique-
fying it and returning it to the chamber as liquid at 10
atmospheric pressure, the path of the liquid in the cham-

ber and means for propelling solids through the chamber below the level of the liquid bath.

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