

Nov. 5, 1935.

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2,019,759

DRY ICE REFRIGERATION

Filed Jan. 16, 1932

FIG. 1.

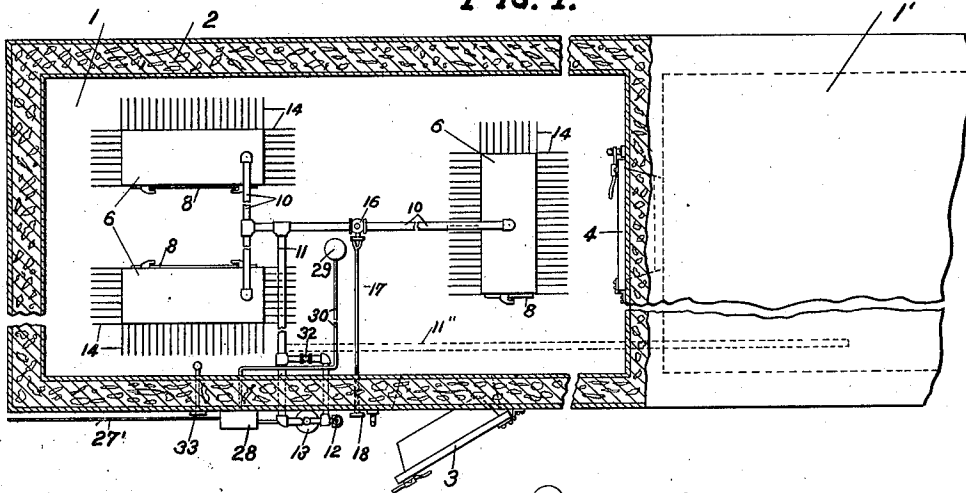


FIG. 2.

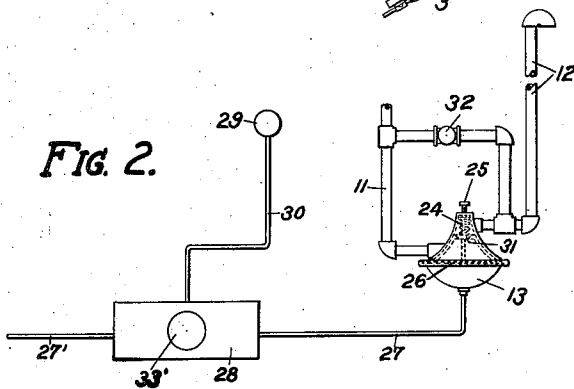


FIG. 4

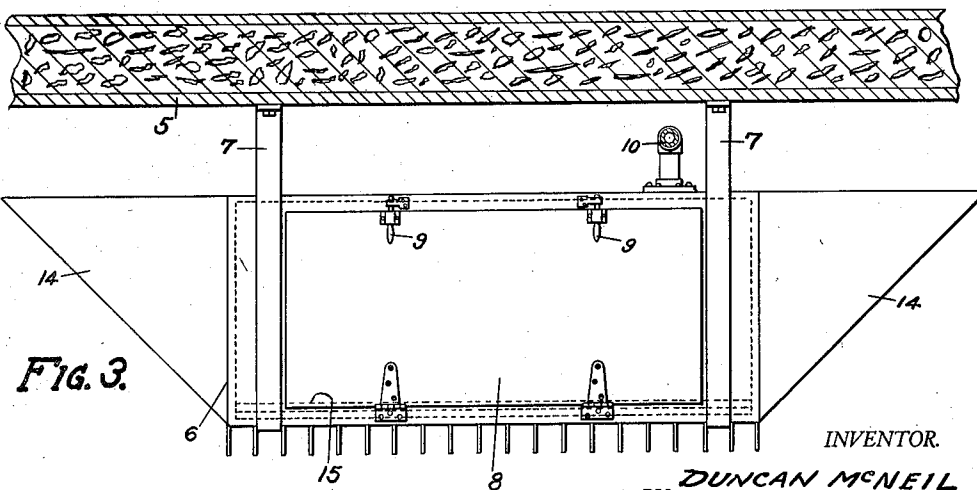
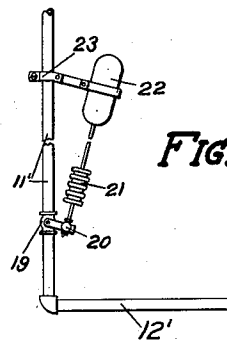


FIG. 3.

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UNITED STATES PATENT OFFICE

2,019,759

DRY ICE REFRIGERATION

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Application January 16, 1932, Serial No. 587,017

3 Claims. (Cl. 62—91.5)

This invention relates to refrigeration and has for its objects a method and apparatus for controlled cooling of food storage compartments by means of so-called "dry ice" or frozen carbon dioxide.

In the drawing accompanying this application Fig. 1 is a diagrammatic plan of a cold storage room equipped with apparatus in accordance with my invention.

Fig. 2 is an enlarged diagrammatic view of the controls and associated pipes.

Fig. 3 is an enlarged elevation of one of the dry ice containers shown in plan in Fig. 1.

Fig. 4 shows a thermostat directly connected to a gas escape control valve.

Before describing the apparatus, it would be well to draw attention to the fact that if dry ice is placed in a food chamber, its evaporation will quickly lower the temperature of the space within the chamber and also fill the space with CO₂ gas which is desirable in the preservation of some kinds of food would prevent entrance of a person into the room, unless the room were vented.

Besides this, the temperature of the room would not be under control, for if the air of the room could freely reach the dry ice to transmit its heat thereto, the temperature would drop excessively.

By my invention I control both the temperature of the room and also provide for admission of some CO₂ gas to the room or for its total exclusion as may be desired.

My invention is based on my discovery that if the dry ice is within a closed receptacle to which heat can only gain access by slow circulation of air within the heat insulated cold storage space, that the rate of its evaporation can be controlled by closing or opening a gas vent pipe leading from the receptacle out of the cold storage room preferably to the outer air. It would be dangerous to close such a vent if the receptacle were in a heated zone, but if in an insulated space, and the temperature of said space has been lowered to proper degree for cold storage, generally a few degrees above freezing, then it is no longer dangerous to close or substantially close the gas vent as the available heat for transfer to the dry ice is much less, and as a slight pressure of gas builds up in the receptacle it further retards the absorption of heat by the dry ice within.

In practice, I have found that with large cold storage rooms, using an initial charge of a thousand pounds of dry ice, and with the gas vent outwardly controlled by a thermostatic valve set to the temperature desired, a substantially uni-

form temperature of say 34° F. may be automatically maintained for many days, as shown by a recording thermometer, and at a cost much less in case of the room size boxes than would be the case if a mechanical refrigerating plant were installed, first cost and upkeep considered.

In the drawing Fig. 1 is a plan of a cold storage room 1 having thick heat-insulated walls 2, and which room is provided with a door 3 for the placing and removal of food material, and the room may communicate with one or more similar rooms 1' as by a door 4.

No importance attaches to the room construction other than it should be well insulated like any first class cold storage room or ice box construction.

Within the room and preferably suspended from the ceiling 5 at a distance of a few inches, are several dry ice receptacles 6 (one will be enough if of sufficient size or the room or box is 20 small).

These receptacles are preferably made of sheet metal such as heavy galvanized iron and are suspended from the ceiling on straps 7. Each receptacle has a door 8 at one side or one end 25 which is provided with clamping handles 9 and also with a sealing strip or gasket, not shown, so as to close substantially gas-tight. From the top of each receptacle leads a pipe 10 connected one to the other and to a pipe 11 for escape of the gas to the outer atmosphere through a vent pipe 12 under control of a pressure regulating valve 13 to be later described.

Returning to the dry ice receptacles, these may be cylindrical to better withstand pressure, or simply heavy rectangular sheet steel boxes as shown, and it is desirable that they be fitted exteriorly with heat transmitting fins 14 of sheet metal, those at the ends or sides of the receptacles being here shown cut upward at an angle 40 so as to reduce the danger of a person striking their corners, and this applies also to the outer corners of all fins used on the receptacles.

It is also desirable that the receptacles have supporting ribs or a perforated false bottom 15 to support the dry ice so that the gas pressure may act evenly about it.

On any of the gas piping within the cold storage room is a gas bleeder valve 16 for bleeding a small or controllable amount of CO₂ gas to the room if desired, and which valve is manually operated by a suitable rod 17, or other device, from a point 18 outside of the room.

One of the primary objects of the invention is to control the degree of cold by automatically 55

closing off or opening up the gas escape pipe 11, opening it when the temperature rises too much so as to induce quicker evaporation, and closing it to restrict evaporation as the temperature falls, and this may be accomplished in various ways with existing pressure control apparatus operated by a suitable temperature responsive device or thermostat placed in the cold chamber, such for instance as a direct hook-up between an expanding and contracting thermostat with a valve on the gas escape pipe 11, as shown in Fig. 4 wherein the gas escape pipe, designated 11', is fitted with a control valve 19 pivotally and adjustably connected at 20 with the metallic bellows 21 or other movable member of a thermostat here shown as a gas or liquid bulb 22 conveniently mounted on said pipe or ceiling and exposed freely to the temperature of the cold storage room. Such a thermostat could be set to produce any desired result by moving its mounting 23 either way along the pipe or adjusting the connection 20 to change the relation of the bulb to the valve 19. Such a control may be entirely within the cold storage room with only the vent pipe 12' projecting out into free air for escape of the gas.

Or, instead of such a direct thermostatic control of the evaporation pipe, a power actuated control may be employed, one such being indicated in Figs. 1 and 2 wherein the gas passes from pipe 11 through a diaphragm type pressure regulator 13 the valve 31 normally held almost closed by spring 24, adjustable by a screw 25, and the diaphragm 26 of which regulator is exposed on its opposite side to air pressure from a small pipe 27 delivered through pipe 27' from any suitable source of compressed air and passing through any suitable thermostatically controlled regulating valve set 28, the thermostat of which is here indicated as a gas bulb 29 positioned within the storage room and its tube 30 extending to the set. Since a number of such control sets or temperature control instruments with or without temperature recording disks or tapes, either spring or electric driven, or mere relay valves, are readily available on the market no detail of it need here be given, suffice to say that responsive to increased temperature of the bulb 29 it will admit an increased air pressure through pipe 27 against the diaphragm to open the valve 31, and vice versa, by breaking the pressure as the temperature falls so that when the temperature of the room is lowered to the minimum for which the instrument is set the valve 31 will be closed, or substantially so. A safety valve 32 may be connected across the control instrument to guard against the accidental accumulation of a dangerous pressure

in the receptacles. Also, in case a reading or recording thermometer is not incorporated in the control set, it may be installed in the side of the room as at 33.

If desired to operate more than one cold storage room from the same controls, it is only required to open the door 4 between them and connect the gas escape pipe 11' from the other room to the gas escape pipe 11 of the first room as indicated in Fig. 1.

With the apparatus as described, the receptacles are filled with blocks of CO₂ ice, the doors of the receptacles sealed, cold storage room closed and thermostat set to control the gas escape valve to give the degree of cold required, and which has been proven from recording thermometers 33' either incorporated in the control set 28 or separately mounted as at 33, to the maintained substantially constant after the desired temperature was reached.

Having thus described my invention, what I claim is:

1. Apparatus for cooling a cold storage chamber comprising a closed receptacle for dry ice positioned in thermal contact with the air of said chamber, a gas escape pipe leading from the ice receptacle out of the chamber, and means operable from without the chamber for permitting escape of some gas generated by the evaporation of the ice to said chamber.

2. Apparatus for cooling a cold storage chamber comprising a plurality of receptacles for dry ice, means for closing the receptacles, interconnected gas escape pipes leading from said receptacles, and temperature responsive means exposed to the temperature of said chamber controlling the escape of gas from said pipes, the means controlling the escape of gas including a pressure regulator on the gas escape pipes, a compressed air pipe arranged for varying the regulator, and means operated by the temperature responsive device for varying the air pressure.

3. Apparatus for cooling a cold storage chamber comprising a closed receptacle for dry ice positioned within said chamber, a gas escape pipe leading from the ice receptacle out of the chamber, a valve on said pipe for controlling the escape of gas from the receptacle, power means for actuating said valve, and temperature-responsive means exposed to the temperature of said chamber for actuating said power means for opening said valve at a predetermined rise in the temperature of the atmosphere within said chamber, said power means and valve disposed outside the cold storage chamber.

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