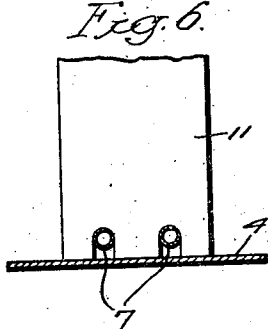
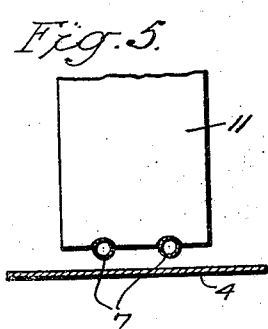
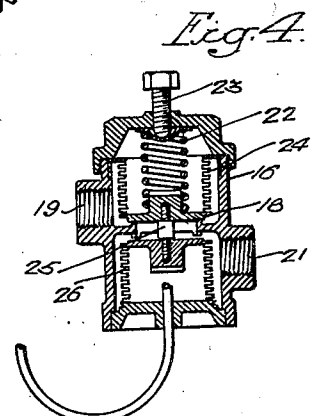
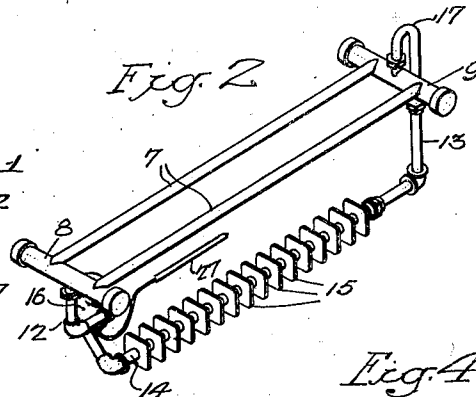
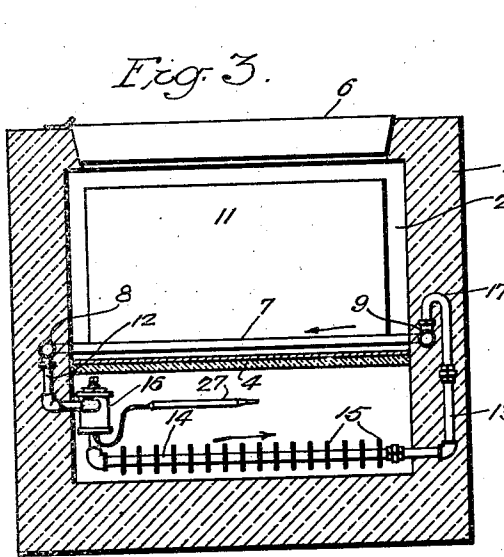
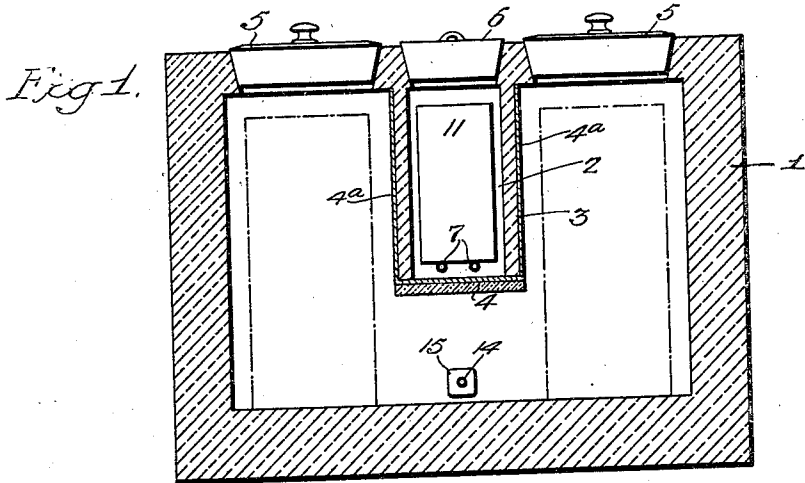


May 22, 1934.

R. WHITALL
REFRIGERATING SYSTEM
Filed Nov. 5, 1932

1,959,994



Inventor:
Richard Whitall
by his Attorneys
Lowson & Lowson

UNITED STATES PATENT OFFICE

1,959,994

REFRIGERATING SYSTEM

Richard Whitall, New York, N. Y.

Application November 5, 1932, Serial No. 641,439

13 Claims. (Cl. 62—91.5)

This invention relates to improvements in refrigerating systems, and more particularly to those systems employing a solid refrigerant medium wherein transfer of heat from the refrigerated space to the refrigerant is effected through the medium of a thermal conductor. A system employing this principle is disclosed in my co-pending application Serial Number 577,608, filed November 27, 1931.

While my invention is adapted primarily for use with solid CO₂ as the refrigerating medium, it may be used to advantage with any solid refrigerant which is capable of producing lower temperatures than those required in a given refrigerating process.

It has previously been discovered in the use of solid CO₂ as a refrigerating medium that a more efficient control of the refrigerating temperatures may be had by use of an efficient thermal conductor, of aluminum for example or copper, interposed between the refrigerant and the space or material to be refrigerated and constituting preferably the sole means of heat transfer. In my aforesaid co-pending application, I have described means controlled by the temperature in the refrigerated space for regulating the operative relation between the refrigerant and the aforesaid thermal conductor, this means involving the use of heat generated at the point of application.

It is the principal object of the present invention to provide a refrigerating system of the same general characteristics but having a relatively high efficiency, and to this general end a more specific object of the invention is to provide means for regulating the operative relation between the thermal conductor and the refrigerant employing heat derived from the refrigerated areas, or from other sources affording the required differential.

Another object of the invention is to provide a device of the general character set forth wherein the regulating apparatus consists of a novel self-contained and entirely automatic heat transfer unit which when installed becomes an integral part of the refrigerating apparatus as a whole.

One embodiment of my invention is illustrated in the attached drawing, in which:

Figure 1 is a transverse sectional view through an ice cream cabinet provided with a refrigerating control made in accordance with my invention;

Fig. 2 is a detached view in perspective of the control or regulating device;

Fig. 3 is a section on the line 3—3, Fig. 1;

Fig. 4 is a view illustrating a detail of the invention, and

Figs. 5 and 6 are, respectively, semi-diagrammatic views illustrating the manner in which the regulating device operates.

With reference to the drawing, the cabinet therein shown for the purpose of illustrating my invention consists of a substantially rectangular insulated casing 1 having at its mid-portion and extending transversely across the width thereof a well 2 for reception of a refrigerating medium. The side walls 3 of the well 2 are insulated as also are the end walls, which as shown in Fig. 3 are the walls of the casing 1. The bottom wall of the well 2, however, indicated by the reference numeral 4, consists of a heavy metallic plate preferably of aluminum, copper or other metal having a factor of high thermal conductivity, and this plate is extended up the outer side walls of the well as indicated at 4a to provide a relatively large surface area exposed to the refrigerated space. The under surface of the plate 4 is preferably covered with insulation as indicated for a purpose that will appear hereinafter. The spaces between the side walls 3 of the well 2 and the oppositely positioned walls of the casing 1 are adapted in the present instance for reception of ice cream containers, which are admitted through suitable openings in the top of the casing 1 normally closed by insulated lids 5. The well 2 is also provided with a suitable cover or insulated lid 6.

In accordance with the present invention, I provide in the bottom of the well 2 and extending longitudinally thereto a pair (in the present instance) of ducts 7, these ducts being elevated slightly above the upper face of the conductor 4 and both connecting at the ends with headers 8 and 9 located in the present instance in the side walls of the casing 1. The ducts 7 are so spaced as to constitute a stable support for the body of solid refrigerant shown in Figs. 1 and 3 and indicated by the reference numeral 11. From the headers 8 and 9 pipes 12 and 13 respectively extend downwardly and connect to a pipe 14 shown in the present instance as provided with projecting fins 15, this pipe being located within the space below the well 2. The pipe 12 is provided with a valve 16 which is thermally controlled, the construction of this valve being shown in Fig. 4. The pipe 13 as shown in Fig. 3 is provided at the top with a gooseneck bend 17 which connects with the top of the header 9 and extends above the latter.

With reference to Fig. 4, it will be noted that the valve 16 comprises a casing which houses a valve element 18, this element when seated, as shown, dividing the interior of the casing into two chambers with which the ports 19 and 21 respectively communicate. The element 18 is resiliently held to its seat by a spring 22, the tension of which may be regulated through a set screw 23 at the top of the casing. The spring is surrounded by a syphon bellows 24 which seals off a portion of the upper chamber of the housing from the port 19 in obvious manner. The element 18 is connected by a stud 25 with the head of a syphon bellows 26 which seals off a portion of the lower chamber from the port 21. The interior of the bellows 26 is connected with a bulb 27 containing a suitable heat responsive medium such as ether, which by expansion under increasing temperatures expands the bellows to elevate the valve element from its seat. Regulation of the controlling temperatures may be effected through the spring 22 and set screw 23. While for convenience I have shown the bulb 27 located in the space under the well 2, it will be understood that in practice it may be located in any favorable position within the refrigerated area.

In operation, the solid CO₂ refrigerant is placed within the well 2 and rests upon the pipes 7, being supported thereby from contact with the conductor 4, as illustrated for example in Fig. 5. Assuming that the temperature within the casing 1 is higher than desired, the thermostat controlling the valve 16 operates to open the valve whereby a fluid medium, such as alcohol, within the system is free to circulate therein. By the resulting circulation, occurring in the direction of the arrows, see Fig. 3, heat is carried to the pipes 7, which heat effects a sublimation of that portion of the solid CO₂ in contact with the said pipes, with the result that the ice moves by gravity downwardly around the pipes 7 until eventually it may contact with the conductor plate 4, as shown in Fig. 6. The heat-exchange relation between the conductor and the refrigerant is thus progressively improved to the point where a direct and efficient conductive path is provided through the plate 4 between the refrigerant and the space within the casing 1 which it is desired to refrigerate. The heat is progressively extracted from this space until such time as the temperature, reaching the desired low degree, actuates the thermostatic valve 16 to close the fluid system of which it forms a part. This interruption in the heat transfer cycle produced in the circulating system is immediately followed by a cooling of the pipes 7, whereas the conductor plate 4 which is still in direct conductive relation with the refrigerated space continues its function of conducting heat therefrom to the solid CO₂. Those surfaces of the body of solid refrigerant in contact with the plate 4 are thus sublimated at a more rapid rate than the surfaces contacting the pipes 7, with the result that the solid CO₂ separates itself from the conductor 4 with the production of an insulating space between the solid refrigerant and the said conductor. Transfer of heat from the refrigerated space to the solid refrigerant is thus materially decreased.

In order to prevent undue transfer of heat by conduction through the pipes 7, headers 8 and 9 and pipes 12 and 13 to the ice during those periods when such transfer is not required, I form those portions of the pipes 12 and 13 which adjoin the headers 8 and 9 of a suitable heat-insulating material such as Bakelite or hard rubber.

It will be apparent that by this device I am able to effect a highly efficient automatic regulation of temperature within the refrigerated chamber of the cabinet, the degree of cold being regulatable through adjustment of the thermostatic valve 16 as described. This regulation of temperature is effected in a manner having no adverse effect upon the operating efficiency of the refrigerator as a whole. While I prefer the illustrated embodiment, it is apparent that the pipe or coil 14 might be located exteriorly of the cabinet or in fact in any position affording the temperature differential necessary for operation of the heat transfer system. It will be noted further that the device is extremely simple in form and is in effect a self-contained and entirely automatic device which forms an integral part of the refrigerating cabinet. Provision may be made for manual operation of the valve 16 if desired.

The principle of my device is applicable to many different types of apparatus, and there may be considerable modification in the detail form of the regulating device without departure from the invention.

I claim:

1. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant, of means for supporting the refrigerant from contact with the said conductor, and means for conducting heat from a remote source to said supporting means to permit the refrigerant to contact the conductor.
2. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant, of means for supporting the refrigerant from contact with the said conductor, and means for conducting heat from the refrigerated area or material to said supporting means to permit the refrigerant to contact the conductor.
3. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant, of means for regulating the heat transfer relation between said conductor and the refrigerant, said regulating means comprising heat transfer means independent of the conductor connecting the space or material to be refrigerated with the refrigerant.
4. In a refrigerating system employing solid CO₂, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means including a secondary heat transfer system operatively associated with the refrigerant for regulating the heat transfer relation between the refrigerant and said conductor.
5. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means including a secondary heat transfer system operatively associated with the refrigerant and with the refrigerated space for regulating the heat transfer relation between the refrigerant and said conductor.
6. In a refrigerating system employing solid

- refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means including a secondary heat transfer system operatively associated with the refrigerant for regulating the heat transfer relation between the refrigerant and said conductor, and means for controlling the operation of said secondary system.
7. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means including a secondary heat transfer system operatively associated with the refrigerant for regulating the heat transfer relation between the refrigerant and said conductor and thermosensitive means for controlling the operation of said secondary system.
8. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means including a secondary heat transfer system operatively associated with the refrigerant for regulating the heat transfer relation between the refrigerant and said conductor, and means for controlling the operation of said secondary system including a control thermostat located in the refrigerated area.
9. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means for supporting the refrigerant in spaced relation to the conductor, and heat-transfer means for rendering said support inoperative.
10. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means for regulating the heat transfer relation between said conductor and the refrigerant, said regulating means including a support for the refrigerant effective to retain the latter in spaced relation with the conductor, and heat-transfer means for conducting heat to said support to permit the refrigerant to approach the conductor.
11. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means for regulating the heat transfer relation between said conductor and the refrigerant, said regulating means including a support for the refrigerant effective to retain the latter in spaced relation with the conductor, a circulating fluid system for transferring heat to said support, and means for controlling operation of said system.
12. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means for regulating the heat transfer relation between said conductor and the refrigerant, said regulating means including a support for the refrigerant effective to retain the latter in spaced relation with the conductor, a circulating fluid system for transferring heat to said support, and thermally actuated means for controlling the operation of said system.
13. In a refrigerating system employing solid refrigerants, the combination with a thermal conductor arranged for exposure both to the space or material to be refrigerated and to the refrigerant and constituting the major medium of heat transfer between the refrigerated area and the refrigerant, of means for regulating the heat transfer relation between said conductor and the refrigerant, said regulating means including a support for the refrigerant effective to retain the latter in spaced relation with the conductor, a circulating fluid system for transferring heat to said support, said system extending into the refrigerated area and being operative by temperature differential between the said support and the refrigerated space, and means for controlling operation of said system.

RICHARD WHITALL.

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