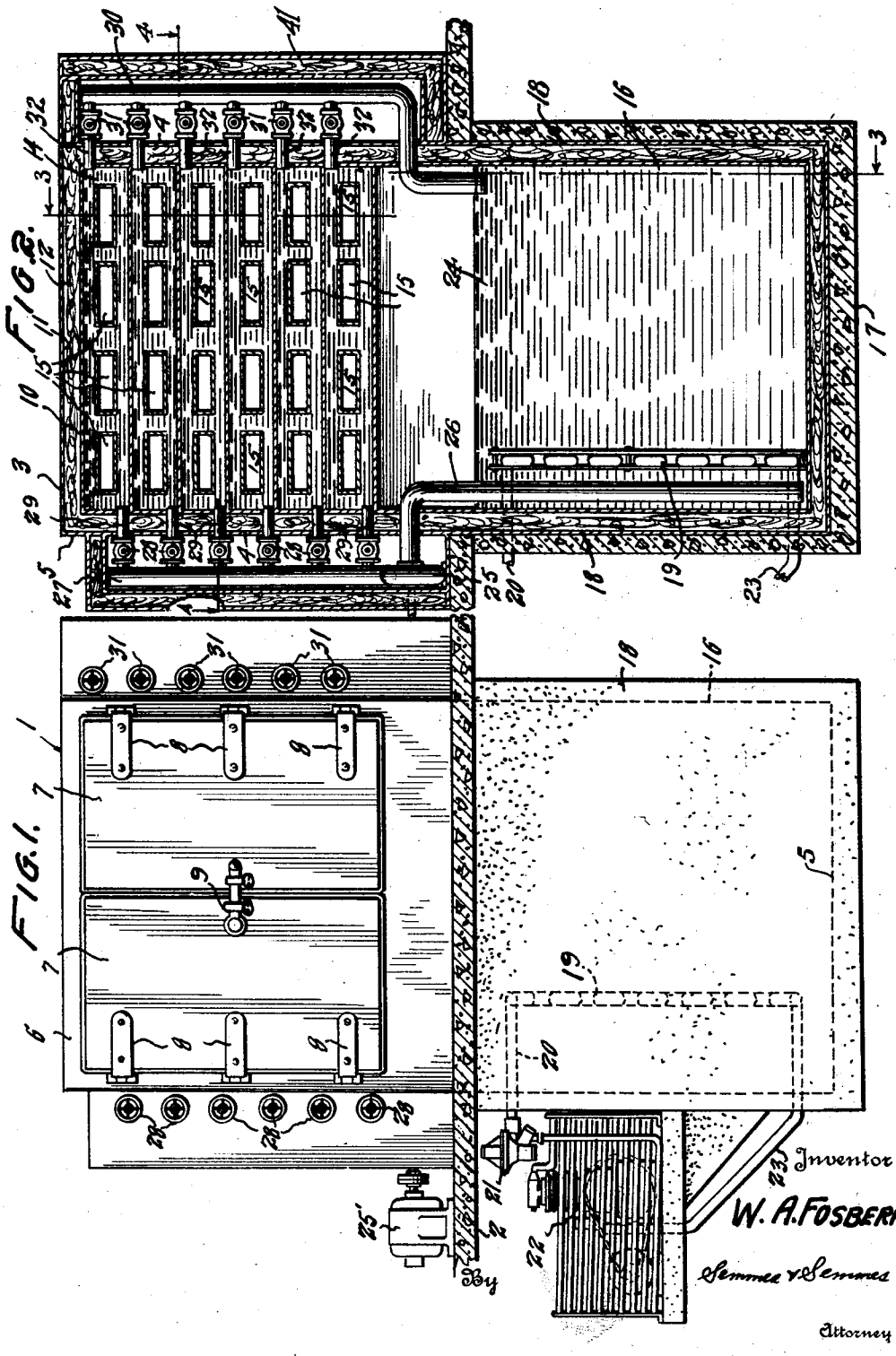
Dec. 20, 1932. W. A. FOSBERRY 1,891,305

PROCESS AND APPARATUS FOR REFRIGERATION

Filed Jan. 7, 1930 2 Sheets-Sheet 1



Dec. 20, 1932. W. A. FOSBERRY 1,891,305

PROCESS AND APPARATUS FOR REFRIGERATION

Filed Jan. 7, 1930 2 Sheets-Sheet 2

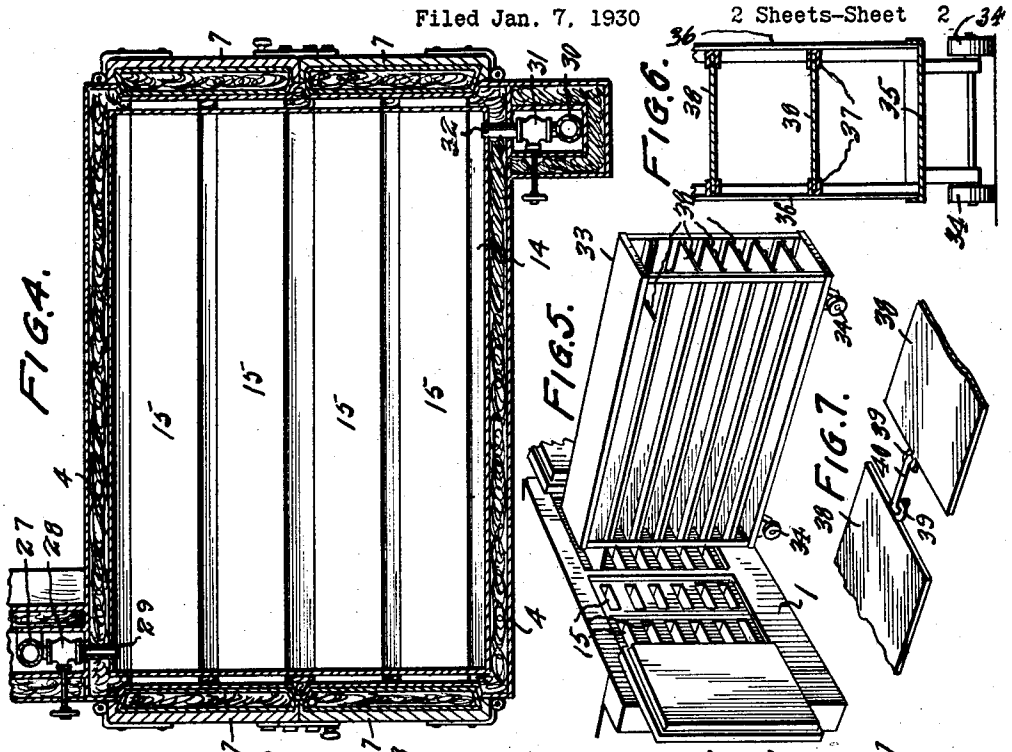


FIG. 4.

FIG. 6.

FIG. 5.

FIG. 7.

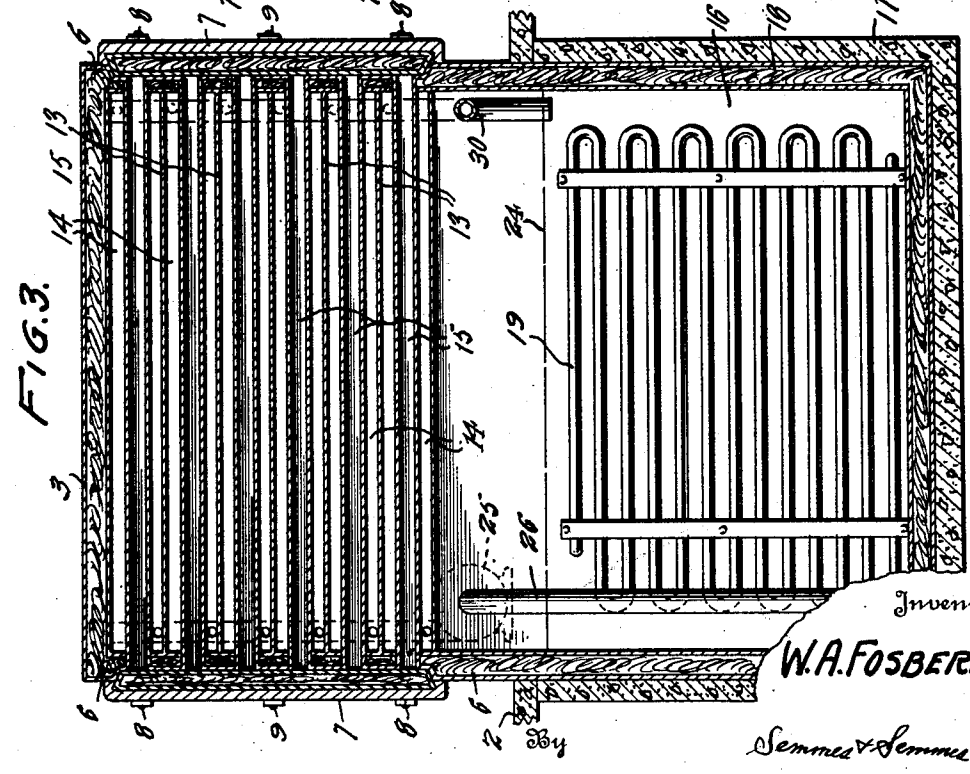


FIG. 3.

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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR REFRIGERATION

Application filed January 7, 1930. Serial No. 419,081.

The invention relates to the art of refrigeration and more particularly has reference to a process and apparatus for freezing perishable substances.

For a considerable time it has been recognized that perishable substances may be preserved by freezing them, yet it has only been within the last few years that refrigerating apparatus for preserving marine products has been employed. While the art has had considerable success with such refrigerating machines for freezing fish, either whole, loose-cut for table use, or put up in packages, these machines have nevertheless possessed certain inherent defects which it is the purpose of this invention to overcome.

Principal among these defects is the fact that refrigerating devices of this character are of highly complicated design possessing a great multiplicity of moving parts, which must be replaced from time to time. It will also be readily seen that moving parts must be oiled or greased and where oil or grease is used there is a possibility of its coming in contact with the product to be frozen. Regardless of the care taken, this naturally would result in an unsanitary condition of the frozen article.

In certain classes of these machines, it is customary to employ sprays whereby the cooling agent may come in heat exchange relationship with the article to be frozen. Such instances where this practice is employed, the article to be frozen is not entirely enclosed, and despite a great amount of care in using the sprays it very frequently happens that the cooling agent comes in direct contact with the perishable substance.

Other disadvantages in many refrigerating machines of this type arise in the fact that the cooling agent is not circulated entirely around the product to be frozen. In instances where this does occur, the perishable substances are placed in containers and the containers immersed in a chamber containing the cooling agent. While such an expedient overcomes this disadvantage, it nevertheless gives rise to another, namely, that additional mechanism for lifting must be provided upon the machine in order that the containers may be placed in and withdrawn from the cooling compartment. Another defect of refrigerating apparatus of this sort results in their bulk and the great amount of space which they occupy. Considering the small quantity of the perishable substance which may be frozen in these machines, their great size will at once be appreciated as excessive.

Where the cooling agent is circulated around the containers it is usually allowed to flow from the top of the container to the bottom, with the result that when it reaches the bottom of the container its temperature has been raised to such a degree that a stream of cold freezing agent must be injected into the bottom of the cooling chamber in order that the substances in the bottom of the container will be frozen to the same degree as that which is located at the top. In some of these machines the ends are open to room temperature. This results in heat absorption from the room in which the machine is located, and consequently a great increase in the expense of operation.

The major object of this invention is the provision of a process and apparatus for freezing perishable substances which lacks the inherent disadvantages of refrigerating apparatus and processes employed in present practice.

An equally important object of the invention is the provision of a process for freezing perishable substances wherein the substances are placed within a flue and a cooling agent is circulated entirely around the flue.

Another object of the invention is the provision of a process for freezing perishable substances which comprises the steps of rapidly lowering the temperature of the substances by circulating a cooling agent through a plurality of cooling zones and around a plurality of flues positioned therein, the perishable substances being contained within the flues.

Yet another object of the invention is the provision of a novel refrigerating cabinet having a plurality of flues positioned therein, these flues being positioned in a plurality of conduits and means for circulating a cooling

agent through any or all of the conduits and around the flues in such conduits.

A further object of the invention is the provision of a refrigerating cabinet having horizontal and vertical rows of flues extending therethrough, the horizontal flues rows being separated from each other by means of a partition forming a conduit, and means for circulating a cooling medium through the conduits and around the flues.

Yet a further object of the invention is the devising of a shut-off means to be employed in conjunction with a refrigerating cabinet whereby any portion of the cabinet may be closed down without causing the operation of the entire machine to be arrested.

Still a further object of the invention is the provision of a novel movable rack having trays thereon adapted to be placed with a refrigerating machine.

With these and other objects in view, which may be incident to my improvements, the invention consists in the parts and combinations to be hereinafter set forth and claimed, with the understanding that the several necessary elements comprising my invention may be varied in construction, proportions and arrangement without departing from the spirit and scope of the appended claims.

The invention comprehends the provision of a process and apparatus for freezing perishable substances. One method of practically effecting the concept of the invention is the provision of a refrigerating cabinet provided with a plurality of conduits having flues, adapted to contain the perishable substance, positioned therein, and means for circulating a cooling agent through any of these conduits and entirely around each of the flues. The invention further comprehends the provision of a novel movable loading rack employed in placing the perishable substances within the cabinet.

In order to make my invention more clearly understood, I have shown, in the accompanying drawings, means for carrying the same into practical effect without limiting the improvements in their useful applications to the particular constructions, which for the purpose of explanation, have been made the subject of illustration.

In the drawings:

Figure 1 is a front elevational view showing the refrigerating cabinet employed in the invention.

Figure 2 is a cross sectional elevation similar to Figure 1, but showing the flues and containers of the invention in detail.

Figure 3 is a sectional side elevation along the line 3—3 of Figure 2.

Figure 4 is a horizontal sectional view along the line 4—4 of Figure 2.

Figure 5 is a pictorial representation of the machine and shows the movable loading rack in position for placing a substance within the flues of the cabinet.

Figure 6 is a sectional elevation of the movable loading rack.

Figure 7 is a pictorial representation showing the manner in which the trays of two loading racks may be connected together.

Throughout the drawings similar reference numerals refer to like parts. There is shown in Figure 1 a refrigerating cabinet generally designated by the numeral 1, which is mounted upon a floor or other suitable support 2. The cabinet 1 is provided with a top wall 3, side walls 4, bottom walls 5, and end walls 6. As it will be observed from an inspection of Figure 4 the ends of the cabinet are provided with suitable doors 7, which are supported upon the usual hinges 8 secured to the ends of the cabinet. Each door is provided with a conventional latch 9.

While double doors have been shown, it is to be understood that if desired a single door may be used in their place without departing from the spirit of the invention.

Positioned within the cabinet so as to be in spaced apart relationship with the outer wall is an inner wall 10 which provides an inner cabinet or compartment. The inner wall 10 forms a space 11 between its outer periphery and the outer wall in which suitable heat insulating material such as is indicated by the numeral 12 is packed.

Positioned within the inner wall and extending from side to side thereof are partitions 13 which divide the space enclosed by the inner wall into conduits 14. These conduits extend downwardly for a considerable distance from the top of the cabinet, and it may be seen that with the exception of the top and the bottom conduit the partitions 13 form the top and bottom of adjacent conduits. The partitions 13, as may be observed in Figure 3, are of a length substantially equal to that of the inner cabinet and are secured to the walls thereof by any suitable means.

Positioned within each conduit 14 are a plurality of flues 15, the length of which are substantially equal to the length of the cabinet 1 and the ends of which are secured to the ends of the cabinet in any suitable manner. It should be noted that each flue is unconnected with respect to any other flue, and that they are maintained in spaced apart relationship with respect to each other and with respect to the top, bottom and sides of each conduit. While the flues have been shown as having a rectilinear outline, it is to be understood any other geometrical shape may be given to them without departing from the spirit of the invention. Such shapes would include cylindrical outlines, square outlines, or any other outline desired.

The substances or products to be frozen are adapted to be placed within the flues 15 and in order to freeze them a cooling agent is cir-

culated through each of the conduits. For the purpose of providing and circulating such a cooling agent the side walls of the outer and inner cabinets have been shown as extending below the floor level so as to form a well or tank 16. The tank 16 may be supported in any suitable manner, as for example, by the foundation 17 and the retaining wall 18.

Positioned within the tank 16 is a suitable cooling coil 19 which is connected at one end, by means of pipe 20, to a pressure reducing valve 21 of a refrigerating unit 22. The other end of the cooling coil is connected by the return pipe 23 to the compressor of the refrigerating unit. While the refrigerating unit has been shown as mounted below the floor level and adjacent to the tank 16, it is to be understood that it may be located in any other position if desired. It should also be understood that the refrigerating unit shown is merely of a conventional type and any other suitable machine may be employed. Any suitable refrigerant may be employed in the refrigerating unit for cooling the freezing agent.

While the tank or well 16 has been shown as an integral part of a refrigerating cabinet, it will be appreciated that such a tank may be separately constructed if desired. In such an event the bottom of the cabinet would be on the same level as the floor or support. Likewise it is to be understood that the tank 16 could, if desired, be positioned above or on top of the refrigerating cabinet.

The purpose of the tank 16 will now be appreciated. Adapted to be contained therein is a suitable liquid cooling agent 24 which is cooled by means of the refrigerant passing through the cooling coil 19. Various brines may be used for the cooling medium if desired. For the purpose of circulating this cooling agent through the conduits 14, a pump 25, which may be of centrifugal type or any other type desired, is provided. The pump 25 is connected to an intake pipe 26 which extends into the refrigerant tank 16 substantially to the bottom thereof. By means of an electric motor 25', or other suitable mechanism, the pump is driven so as to force the cooling agent 24 through the inlet pipe 26 and out through the discharge side of the pump into an intake header 27. Connected to the intake header by means of suitable cut-off valves 28 are a plurality of discharge pipes 29. Each discharge pipe extends through the inner and outer cabinets and into a conduit 14. Thus it will be appreciated that the cooling agent may be drawn from the cooling tank 16 and forced into the conduits.

In order that the cooling agent may be continuously circulated through the conduits, an outlet header 30 is in direct communication with the cooling tank. Connected to the header 30 through suitable shut-off valves 31, are receiving pipes 32 which extend through the inner and outer compartment and into each conduit.

It should be noted that each discharge pipe 29 from the intake header is positioned at the bottom of each conduit, while the outlet pipe 32 is positioned at the top of each conduit. Moreover, as may be observed in Figure 4 the inlet and outlet headers are at opposite ends of the cabinet. By positioning the headers and the pipes connecting them with the conduits as described, it will be appreciated that the cooling agent in each conduit will be circulated around each flue arranged therein.

By the mechanism just described, it will be understood that the cooling agent may be continuously circulated from the tank 16 through the inlet pipe 26 to the pump from the discharge side of the pump to the inlet header 27, and thence to the various conduits. From each conduit the liquid may be withdrawn therefrom, through the discharge pipes 32 and discharge header 30 and returned to the tank 16, and thence after cooling may be recycled. It will also be appreciated that any conduit or any number of conduits may be cut off, by the suitable actuation of the inlet and outlet valves, from the remainder of the machine which may be continuously operated.

By positioning the flues in spaced apart relationship with respect to each other and to the walls of their conduits, it will be well understood that the cooling agent will be circulated entirely around each flue. Moreover, by the use of the inlet header, the cooling agent reaching each conduit will be substantially at the same temperature. Thus it will be unnecessary to inject an additional amount of the cooled freezing medium into the bottom conduit so as to maintain this conduit at the same temperature as the other conduits. Each conduit, it will be well seen, is substantially at the same temperature as the other conduits, and by circulating the cooling agent through the conduits at a sufficiently high velocity, the temperature change between the refrigerant entering each conduit and that discharging will be evenly spread or distributed throughout the width thereof.

In order to prevent absorption of heat by the intake and the outlet headers and the pump, these parts are enclosed within a suitable casing formed by the double wall 41 and the cabinet 1. The double wall 41 is packed with heat insulating material similar to the material 12.

For placing fish or other perishable substances within the flues for freezing, I have provided a novel movable loader, rack or carriage generally designated by the numeral 33. The rack is mounted upon wheels 34

and is provided with a bottom member or base 35 to the ends of which are secured four uprights 36. These uprights have formed thereon, directly opposite to each other, slots or guideways 37 which extend the full length of the carriage, as may be seen at Figure 5. Each pair of guideways is adapted to have a tray 38 slidably mounted therein, and upon these trays the substances or products to be frozen are placed. It should be noted that each end of each tray 38 is provided with an extended eye 39, as shown in Figure 7. Here two trays are disclosed connected to each other by means of a coupling member 40. The coupling member 40 may be detachable from each eye, or if desired, each tray may have a coupling member secured to one of its eyes.

The manner of loading the cabinet will now be at once apparent, from an inspection of Figure 5. The movable tray rack or loader, with the materials to be frozen placed upon the trays mounted therein, is positioned so that its end is directly opposite and adjacent to a vertical row of flues, the doors of the cabinet having first been opened. It should be noted that each of the guides 37 are at the same elevation as each flue. Hence by merely pushing upon the ends of the trays most distant from the cabinet, they may, with the products contained thereon, be slid into the flues.

By the use of the coupling members 40, a tray within the cabinet may be connected to a tray upon a loader positioned at either end thereof. Thus it may be seen that upon withdrawing a tray of frozen products from the end of the cabinet opposite to the loader, the tray thereon connected to the former will be pulled into a freezing flue, and after this it may be uncoupled from the tray carrying the frozen substances. If an empty tray carriage or loader is positioned at the rear of the cabinet the trays containing the frozen products may be placed thereon and wheeled to any point desired, or these trays may be withdrawn and moved in any other manner. It is evident that upon the withdrawal of the trays having the frozen material, since they are connected to the trays carrying the unfrozen material, these latter will be pulled within the cabinet. After this new loading operation the cabinet doors at both the front and rear end may be closed, and the new material or products may be frozen. Moreover, it will be appreciated that the loading operation may be effected from either end of the cabinet.

The trays may be pulled out of the cabinet either manually or by suitable power actuated mechanism. In the latter case, a suitable upright could be mounted upon a sliding carriage so as to move in a horizontal line parallel to the rear of the cabinet. On the upright would be mounted a pulley having means for slidably positioning it at elevations opposite to the different horizontal rows of flues. By running a cable over the pulley and securing it to a hook connected to the trays, it will be appreciated that upon winding this cable upon a suitable drum, a tray may be pulled out of the cabinet. Any suitable actuating mechanism for the drum such as an electric motor could be employed. Likewise a suitable guide sheave could be placed adjacent to the drum and between it and the slidable upright. By forming the upright so that it may be moved, suitable positioning of it opposite the vertical rows of the flues is allowed, while by providing the vertical movable pulley upon an upright, a suitable positioning of it opposite the horizontal flues is permitted.

If desired, removable wear rods may be placed upon the bottom of each flue so that each tray rests on the rods instead of on the flue bottom, thus preventing wear on the latter. Such rods are to be secured by suitable detachable fastenings and could be readily removed. They would extend longitudinally of the flue for its full length.

When the fish are to be preserved they may be either sliced and put up in packages, they may be loose-cut for the table, or whole fish may be frozen. In either event, the fish are placed upon each freezing tray so that when a tray carrying the fish is inserted within a flue, substantially all of the flue volume will be filled. By loading the flues in this manner, substantially all the air contained within the flue will be expelled and there will be very little air left between the fish and the flue walls. Hence it may be realized there will be substantially no air left within the flues that will act as a heat insulator and this will aid in shortening the freezing time. Thus it may be seen that the fish or other perishable substance is so placed within the flues as to be in heat exchange relationship with the walls thereof. Such packing or loading of the flues considerably shortens the freezing time.

The front doors of the cabinet are opened and the fish or other perishable substances are placed within the flues, as previously described, after which the doors are closed, and locked. The fish are allowed to remain in the cabinet until thoroughly frozen whereupon the front and rear doors are opened and the fish are withdrawn while simultaneously reloading the cabinet with unfrozen products, after which the doors are again closed, and the freezing operation continued.

It will be appreciated that the apparatus employed in the process just described is stationary and moreover has no moving parts, with the exception of the refrigerating unit which is essential to all refrigerating devices. Moreover, by nesting the freezing flues, a compactness is given to the cabinet and at the same time an exceedingly large freezing capacity is provided. Because of its simplicity,

it will be realized that the upkeep of the entire device is at a minimum and should, for any reason, it be found desirable to operate only a part of the machine, this may be accomplished by merely closing the valves of the inlet pipes leading to that part. Hence in case of repair, any small section of the machine may be shut off without interfering with the continuous operation of the remainder. Since there are no moving parts within the cabinet itself, unsanitary conditions arising due to grease and oil employed for lubricating these parts will be entirely eliminated. Moreover, since the products to be treated are entirely enclosed by the freezing flues there is no likelihood of the cooling medium becoming mixed with them.

The efficiency of the machine will be appreciated when it is considered that the flues are of relatively small cross section, and moreover the cooling agent passes entirely around each one of them and is in continuous circulation at any suitable velocity. By maintaining the cooling agent injected into each conduit at a temperature of from −40° F. to −50° F. a rapid heat exchange between the cooling agent and the flues will be maintained and the freezing time considerably reduced. By this method, that is, passing the cooling agent around separate flues of relatively small cross section, the freezing time is reduced to substantially 50% of that consumed in devices employed in present practice. Since the cabinet is entirely closed during freezing, there is no heat loss due to employing a partially closed cabinet or housing which is open to the atmosphere.

Although the apparatus disclosed has been described and shown as employing a refrigerating unit with means of circulating a refrigerant through coils in a cooling tank in order that a suitable cooling medium placed therein may be cooled, it will be well understood that other modes of freezing perishable substances within the flues may be employed if desired. As an example of this the flues may be cooled by the direct expansion of the refrigerant within the conduits and the tank 16 and the pump 25 could be done away with. This arrangement would further reduce the space necessary to house the apparatus. It will also be appreciated that if desired, cooling coils may be placed around the flues or as just described the refrigerant may be allowed to expand in the conduits directly.

While the invention has been disclosed as mounted upon a floor of a building, or the like, it will be appreciated that because of its compactness, it may readily be mounted upon a ship or boat, such as a fishing schooner. In such installation the fish could be prepared immediately on being caught, and frozen a short time thereafter. Likewise, while the process and apparatus is described as being applicable for the preserving of fish, it is to be understood that the invention may be applied to other forms of perishable substances without departing from the spirit or the scope of the appended claims.

From the foregoing description it will be appreciated that I have provided a process for freezing perishable substances, and apparatus for performing the same. Such apparatus, it will be observed allows the product to be frozen in a clean, dry and sanitary condition. Moreover, by the use of the cabinet with separate flues nested therein the capacity for a freezing operation is greatly increased, while the time of freezing is materially reduced. It will also be apparent that I have provided an economical process for freezing perishable substances, and a simple apparatus for carrying it out.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. A refrigerating cabinet having a plurality of separate conduits formed therein, a plurality of flues positioned within said conduits, and means for closing any number of said conduits so as to circulate a cooling agent through the remainder of said conduits.

2. A refrigerating cabinet having a plurality of conduits formed therein, a plurality of flues positioned within each of said conduits, an intake and outlet header having separate connections with each of said conduits, and means for circulating a cooling agent through said intake header into each of said conduits, and into said outlet header so as to rapidly lower the temperature of a substance placed within said flues.

3. A refrigerating cabinet having a plurality of conduits positioned therein, a plurality of flues positioned within each of said conduits, a tank containing a freezing agent, means for cooling said freezing agent, and means for circulating said cooled freezing agent through each of said conduits so as to lower the temperature within each conduit to substantially the same degree.

4. In combination with a refrigerating cabinet having front and rear openings, and a plurality of vertically and horizontally disposed rows of freezing flues positioned therein, each of said flues having a tray slidably supported therein, said trays adapted to carry substances to be frozen, a movable loader therefor, said loader comprising a base, wheels mounted thereon, pairs of uprights

positioned at the ends of said base, a plurality of guideways positioned parallel to the longitudinal axis of the base, and secured to said standards, each pair of guideways being positioned upon the uprights at an elevation corresponding to the level of a flue in a vertical row, a plurality of trays, each of said trays being slidably mounted within said guideways and adapted to carry the substances to be frozen, and means for connecting each tray of unfrozen substances with a tray within the cabinet so that upon the withdrawal of the tray carrying the frozen substances, a tray of unfrozen substances will be positioned within a flue.

5. A refrigerating device comprising a cabinet having a plurality of conduits closed at both ends positioned therein, a plurality of flues within each of said conduits positioned so as to allow a cooling agent circulated through each conduit to contact with the entire surface of each flue therein, means at one side of an end of each conduit for admitting a cooling agent from a refrigerating device, other means positioned diagonally opposite to the admitting means at the other end of each conduit for allowing the return of the cooling agent to the refrigerating device, and still other means for selectively cooling the flues of any desired number of conduits.

6. A refrigerating device comprising a cabinet having a plurality of conduits closed at both ends positioned therein, a plurality of flues within each of said conduits positioned in spaced apart relationship to each other and the walls of each conduit, each of said flues being supported at its ends by the end of its conduit, an intake and outlet header having separate connections with each of said conduits, the inlet connections from the inlet header communicating with the ends of said conduits, the outlet connections to the outlet header communicating with the opposite ends of said conduits, each inlet connection being at one side of each conduit and each outlet being at the opposite side of each conduit at the opposite end and positioned above the inlet connection, and means for circulating a cooling agent through said intake header to each of said conduits and into said outlet header so as to rapidly lower the temperature of a substance placed within said flues.

7. A refrigerating device comprising a cabinet, a plurality of conduits closed at each end positioned within said cabinet in vertically arranged rows, a plurality of flues extending through each of said conduits from end to end of the cabinet, a closure at each end of the cabinet for closing the ends of said flues, and means associated with the cabinet for circulating a cooling agent through any desired number of said conduits and around the entire surface area of each of the flues therein.

8. A refrigerating device comprising a cabinet, a plurality of conduits closed at each end positioned within said cabinet in vertically arranged rows, a plurality of flues extending through each of said conduits from end to end of the cabinet, a closure at each end of the cabinet for closing the ends of said flues, an intake and outlet header having separate connections with each of said conduits, and means for circulating a cooling agent through said intake header into each of said conduits, and into said outlet header so as to rapidly lower the temperature of a substance placed within said flues.

In testimony whereof I affix my signature.

WILLIAM A. FOSBERRY.