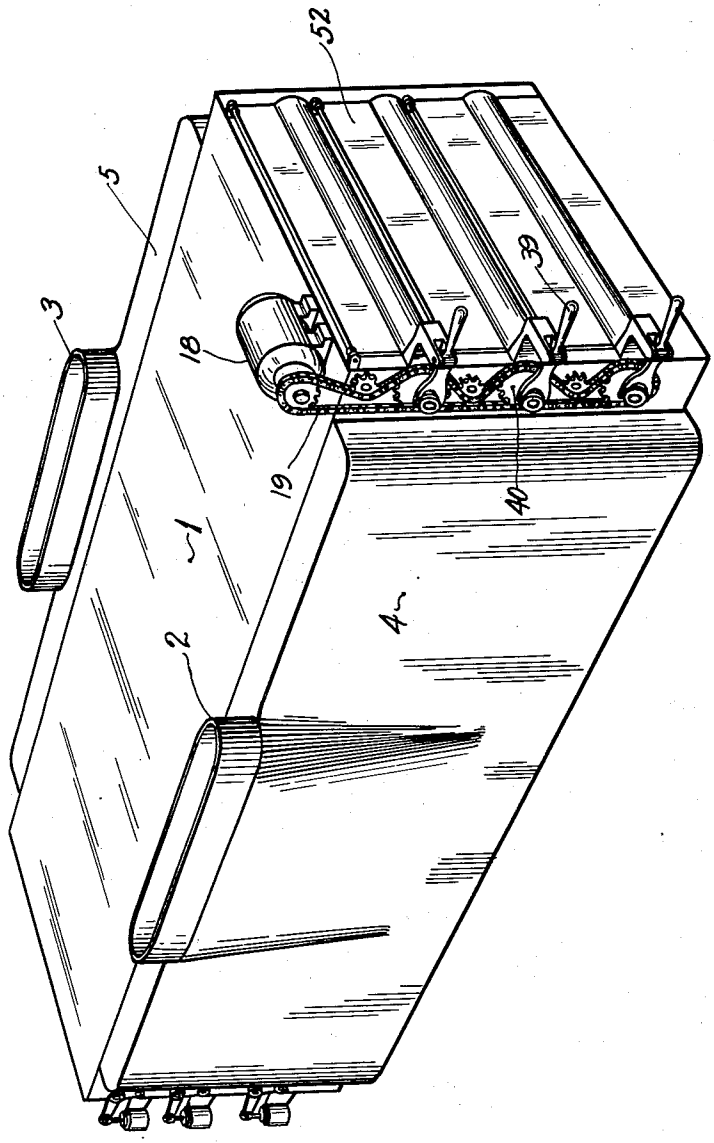
May 20, 1941. F. W. KNOWLES 2,242,527

QUICK FREEZING OF PACKAGED FOODSTUFFS

Filed July 31, 1939 2 Sheets-Sheet 1

Fig. 1



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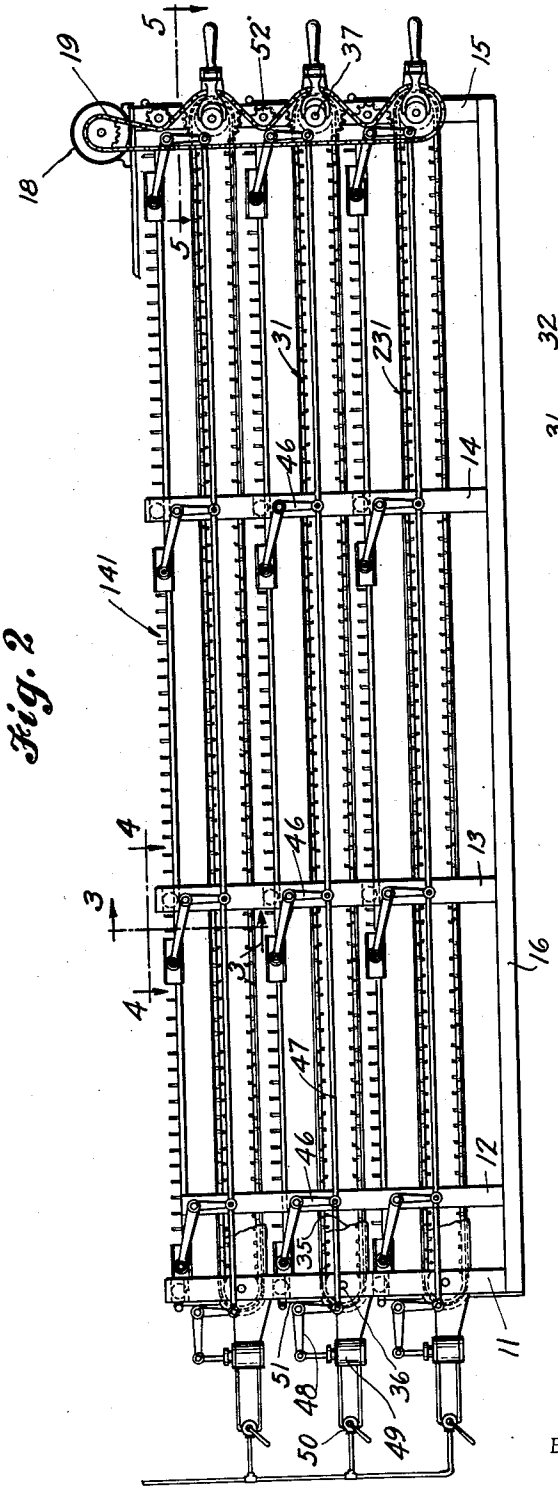


Fig. 2

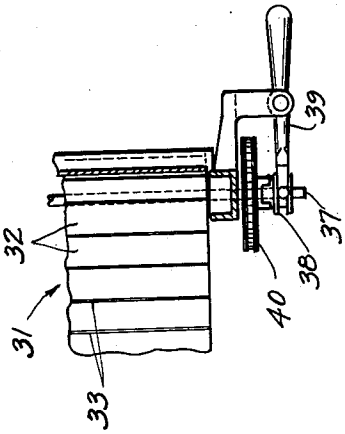


Fig. 5

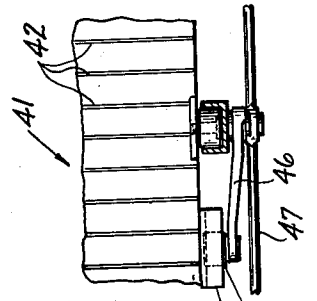


Fig. 4

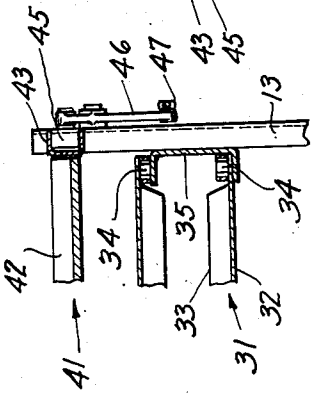


Fig. 3

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UNITED STATES PATENT OFFICE

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QUICK FREEZING OF PACKAGED FOODSTUFFS

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Application July 31, 1939, Serial No. 287,581

5 Claims. (Cl. 62—102)

The present invention relates to heat transfer apparatus. In particular, the present invention relates to refrigeration devices and processes for the quick freezing of packaged foodstuffs.

In the prior art devices the packaged article has been placed in a metallic container placed in a refrigerated liquid, or the package has been placed between or on metallic plates, either in small lots or in larger lots as on a metallic conveyor, which plates were contacted by sprays of a refrigerated liquid. This procedure always involved the problem of preventing contact of the package with the refrigerant. Another problem present in the prior devices is that of preventing damage to the package from rubbing against the walls of a container upon insertion and removal or against a cooperating belt if two were used to contact two faces of the package. Another difficulty with the use of the prior continuous operation conveyors lies in the long runs required for a given capacity and the difficulty of sealing the inlet and outlet and yet permitting the continuous passage of packages. The freezing of packages by placing them on tiered racks has required several handlings, and the freezing time has been long, upwards of eight hours.

These difficulties have been overcome by the present process and apparatus for performing that process.

It is an object of the present device to form a number of packages of foodstuffs in a single layer, to contact the two faces of this layer with plates refrigerated by the passage of cold air over their free faces.

It is an object of the present invention to construct a mechanism which will support a layer of packages between two plates refrigerated by currents of cold air.

It is an object of the present invention to devise a batch package freezer which may be quickly loaded and unloaded.

It is an object of the present invention to devise a mechanism and a process that will allow the superposing of a plurality of layers of packages or material in a single housing, and to directly conduct heat from both sides of each layer.

It is an object of the present invention to devise a package freezer in which a layer of packages will be supported between plates which have heat radiating fins on their surfaces out of contact with the packages.

It is an object of the present invention to devise a mechanism adapted to be placed in a housing which will allow a layer of packages to be fed into the housing by the movement of a conveyor having a metallic surface in contact with one face of the layer of packages, which mechanism will provide a plate to be placed in contact with the other face of the layer.

Another object of the present invention is to construct a device in which packages may be refrigerated between two plates which may be forced into close contact with the packages by the application of pressure to the plates.

It is an object of the present invention to devise a process which will increase the rate of freezing of packaged material over that possible with the use of previous machines.

It is an object of the present invention to devise a process for compacting a package to increase the rate of heat transfer therethrough and to increase the rate of heat transfer thereto from the compacting member.

It is an object of the present invention to devise a mechanism adapted to be placed in a refrigerated housing, which will allow a layer of packages to be fed into the housing by movement of a conveyor having a metallic surface in contact with one face of the layer of packages, which mechanism will provide a plate to be placed in contact with the other face of the layer, and which housing and mechanism will cooperate with suitable refrigerating machinery and fans to conduct refrigerated air across said conveyor and plate to cause a heat flow from the packages through the conveyor and plate into the refrigerated air.

It is an object of the present invention to provide an apparatus and process for the freezing of unpackaged material, such as fish, by placing the material on a conveyor and subjecting it to pressure between cooperating plates and the rapid circulation of refrigerated air.

It is an object of the present invention to provide a device which will freeze different sized packages without adjustment of the device.

These objects and others of the present invention are obtained by: forming an endless metallic conveyor out of a series of narrow plates placed with their long edges together; arranging a pressure plate parallel to and coextensive with the conveyor, which plate may be moved from and to the conveyor, and which may exert pressure thereupon; placing ribs on the free faces of the conveyor and pressure plate; providing means for passing currents of refrigerated air over the free faces of the conveyor plates and the pressure plate.

In actual practice several conveyors and pres-

sure plates are arranged above each other. This allows several to be placed in a single housing, and allows a single air stream to serve two plates at the same time.

In practice it would be desirable to form the plates out of aluminum or aluminum alloy to get the highest heat transfer rate possible with present industrial materials.

In the present specification, the faces of the plates in contact with the packages will be differentiated by calling the ones adapted to engage the packages the contact faces and the other faces the free faces.

Herein, the conveyor will, as a rule, be referred to as a plate, as the several plates of the conveyor do, in effect, in the top run, form a single plate.

The term "highly heat conductive material" is used to designate a metallic material that has a relatively high rate of heat conductivity as compared with the non-metals, such as cotton or wood.

A device of this type, capable of attaining the above and other objects, is illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective of a housing associated with mechanism involving the present invention.

Figure 2 is a side elevation of the device shown in Figure 1, with the housing removed.

Figure 3 is a broken section on the line 3—3 of Figure 2.

Figure 4 is a broken section on the line 4—4 of Figure 2.

Figure 5 is a broken section on the line 5—5 of Figure 2.

The perspective of Figure 1 shows a housing 1 which has associated with it the apparatus forming the subject matter of the present invention. Air is delivered to the housing through an inlet duct 2 and removed through another duct 3. Attached to and forming the side of the housing are plenum chambers 4 and 5 for controlling the flow of air to and from the various parts of the device. The air is moved by means of any suitable fan or pump, a fan of the low pressure runner type being preferable. The air is refrigerated by any suitable means. The temperature of the air should be around twenty-five degrees below zero Fahrenheit. In the embodiment shown herein, there is provided room for three runs. That is, three layers of packages may be processed at once, each as a separate layer.

In Figure 2 is shown a side elevation of the device shown in Figure 1, with the housing and its plenum chambers removed. The present mechanism comprises three conveyor runs. Each run is constructed and operated in the same manner as the others. The three conveyors are supported on a series of upright side channels, 11, 12, 13, 14, and 15. These channels rest upon and are tied together at the bottom by base channels 16. The tops are tied together by longitudinal channels. Suitable channels or bracing connect the opposite sides together. Of the three conveyor runs the middle one will be described in detail and its relationship with the others set forth. All of the conveyors are driven by a motor 18 mounted on top of the housing. The motor is connected to the various conveyors through the drive chain 19.

The conveyor 31 is made up of a series of narrow parallel plates 32 that are placed with their long edges together. Each plate section has on its free face one or more longitudinal fins 33. These fins are placed back from the edges a sufficient distance so that the fins on adjacent plates will not interfere when they pass around the ends. The plates are secured to, rest on, and are carried by a pair of chains, one on each edge of the conveyor. These chains in their top reach rest on top of one flange of a channel, and in their bottom reach rest inside the other flange of the same channel. This construction is shown in Figure 3 where one of the chains 34 carries the conveyor 31 on a side channel 35. At the ends of the conveyor the chains are suitably supported on sprockets which in turn are supported on and secured to suitable shafts 36 and 37. The channels 35 supporting the conveyor are in turn supported on and brace the upright side channels 11, etc. In Figure 2, the supporting channels 35 have been broken away to show the conveyors. The conveyor is driven by turning one of the end shafts supporting the sprockets at one end. As shown in Figure 5, this is accomplished by mounting on and securing to the shaft 37 one jaw 38 of a positive jaw clutch. This is secured to the shaft by means of a spline or a loose key so that the jaw may be moved along the shaft by the pivoted shifting fork 39. The other jaw is secured to a drive sprocket 40 which is freely bearinged on the shaft 37. The sprocket 40 is engaged by the drive chain 19 driven by the motor 18 which is common to all of the conveyors in the housing.

As shown in Figures 3 and 4, the pressure plate 41 may be composed of a single plate with fins welded or riveted to the free side or it may be made up of a number of channels with their flanges secured together. In the present construction the use of channels is preferred. The flanges when secured together form radiation fins 42. To add rigidity to the plate there may be provided longitudinal strips laid on top of the plate and tacked, as by welding, to the edges of the fins 42. Secured to the edges of the pressure plate are outwardly opening short channel sections 43 spaced along the plate. These sections serve as support points for the plate. Inside each of these support channels is placed a roller 45 carried on the end of a supporting bell-crank 46. The bell-cranks are pivoted on the upright channels 12, 13, 14, and 15. All of the cranks are secured to and operated by the drag link 47. The drag link is actuated by being connected to one arm of an operating crank 48 pivoted on the end upright channel 11. This operating crank is, in turn, operated by an air or hydraulic cylinder and piston 49. The operation of the cylinder is controlled by the valve 50.

The ends of the run are closed by means of pivoted doors 51 and 52 which are supported by and pivot about horizontal hinges arranged at their top edge.

The operation of the device is as follows: With all openings but the air inlet and outlet closed, the circulation of air may be started. This air will enter by the inlet duct 2 and be withdrawn through the duct 3. The plenum chambers 4 and 5 will provide the proper baffling to evenly distribute the air along the length of the device and to the various runs. The air may be deflected away from the package space and into the open spaces between the pressure plate of one run and the conveyor of the adjacent run. Air will also pass over the pressure plate 141 of the top run, and in under the upper run of the bottom conveyor 231. The speed of the air across the free faces of the plates should be

around six thousand feet per minute. This speed will provide sufficient scrubbing action on the plates to effect a rapid heat transfer and enough volume to care for the required radiation for rapid freezing. The air may be refrigerated by any desired means as such does not form part of the present invention. The temperature of the air should be around twenty-five degrees below zero Fahrenheit. The speed of this air over the free faces of the plates and fins should be around 6,000 feet per minute. At this speed the quiescent film on the plate will be reduced to a value which will give the necessary rate of heat transfer. When the temperature in the housing has been lowered or before it is lowered, if desired, one of the entrance doors such as the one **52** for the middle run **31** is opened, the conveyor is started by operating the motor **18** and obtaining engagement of the jaw clutch **38** by movement of the shifting fork, and packages are placed in contiguous rows on the conveyor plates **32** and carried into the housing. When the run is full the conveyor is stopped by disengaging the clutch, and the door is closed. The other runs may be filled in the same manner. As soon as a run is filled, the pressure plate is lowered by actuation of the respective valve such as the one **50** for controlling the admission of fluid under pressure to the cylinder and piston **49** operating the cranks and drag link associated with the pressure plate **41**. The action of this operating mechanism for the pressure plate, is not only to lower the plate into engagement with the upper surface of the layer of packages, but to exert a pressure on the packages or other material greater than the weight of the plate. This added pressure is obtained by the design of the operating linkage, the size of the cylinder and piston, and the pressure of the operating fluid. The pressure exerted should be sufficient to bring the wrappings of the packages into intimate contact with the material in the packages and to somewhat compact the material in the packages. The extent of the compacting and the pressure exerted will depend upon the kind of material in the package. Fish and meats, packaged or unpackaged, may have much pressure applied, but berries may be only slightly compacted. After the material has taken an initial set, due to freezing, the pressure may be increased. It has been found that by the present method materials may be frozen in two hours which formerly took ten in open racks. It is evident that as compared with open rack freezing the present process saves several handlings and much time. The packages are removed from the housing by opening the appropriate exit door, such as **51**, and starting the associated conveyor by actuating the respective clutch. Certain devices not herein shown may be used for feeding the packages to the desired run, and others may be used for taking them away from the conveyor. These devices do not form part of the present invention, in fact the packages may be fed and removed by hand. The housing **1** may, itself, be insulated or the room in which the housing is placed may be insulated to reduce the infiltration of heat.

The packages in any one run at a time should all be the same thickness, but the thickness of the packages may vary between those in the different runs. Also it will be obvious that no adjustments need be made to accommodate different sized packages.

Having thus described an embodiment of my invention and its operation, it will be apparent that it fulfills the objects of the invention, and I claim:

1. A refrigeration device, comprising: a first and a second plate for supporting therebetween a layer of packages in contact with opposed faces of said plates, said plates having radiation faces, radiation fins on said radiation faces, means for moving said plates to and from each other, means for refrigerating said radiator faces and fins, and means for progressing one of said plates parallel to the other to feed packages in and out of said device.

2. In a refrigeration device: a plurality of conveyor runs one above the other, means for actuating said conveyors, a pressure plate arranged above each conveyor run, means for moving each pressure plate to and from its respective conveyor and for forcing each plate against an object that may be placed between such plate and the conveyor therebelow, and means for circulating refrigerated air across the free faces of said plates and conveyors.

3. A refrigeration device, comprising: a first and a second plate for supporting therebetween a layer of packages in contact with the opposed faces of said plates, means for moving said plates to and from each other, means for progressing one of said plates relative to the other to feed packages in and out of said device, and means for refrigerating said plates.

4. A refrigeration device, comprising: a first and a second plate for supporting therebetween a layer of packages in contact with the opposed faces of said plates, means for moving said plates to and from each other, means for progressing one of said plates relative to the other to feed packages in and out of said device, and means for circulating refrigerated air across the free faces of said plates.

5. In a refrigeration device: a plurality of conveyor runs one above the other, means for actuating said conveyors to move objects in and out of said device, a plate arranged above each run, means for moving each of said conveyors and its respective plate to and from each other to confine and exert pressure upon such objects as may be placed therebetween, and means for circulating refrigerated air transversely of the longitudinal axis of and in contact with said conveyors and plates.

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