June 28, 1932. V. BUHR 1,865,168

REFRIGERATING METHOD AND APPARATUS

Filed March 25, 1930 3 Sheets-Sheet 1

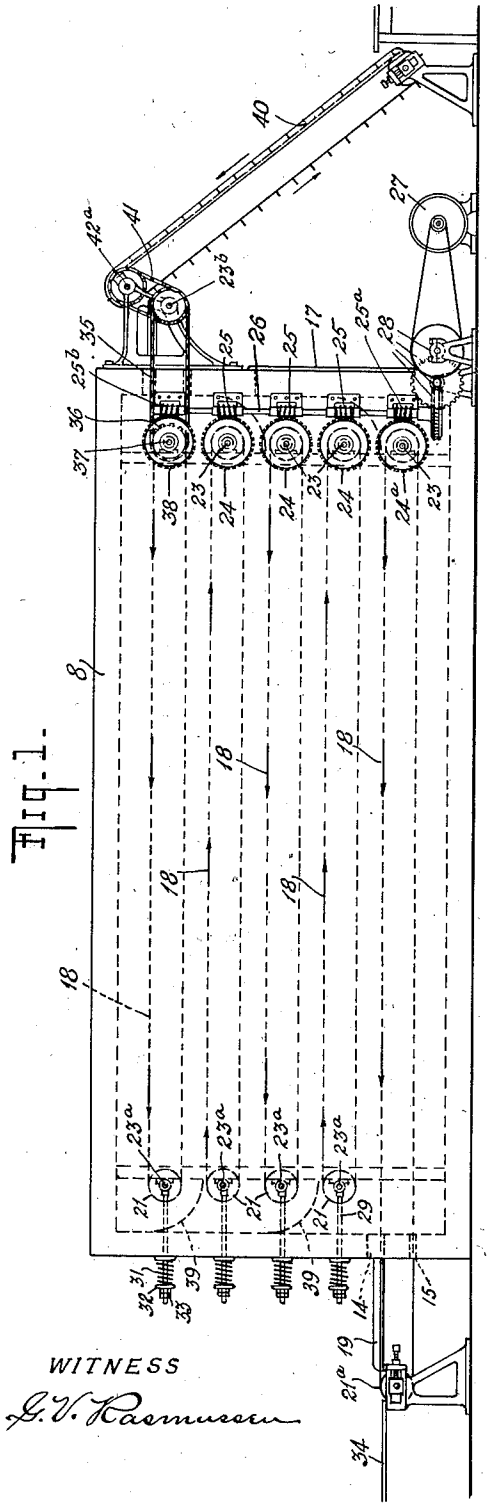

Fig. 1.

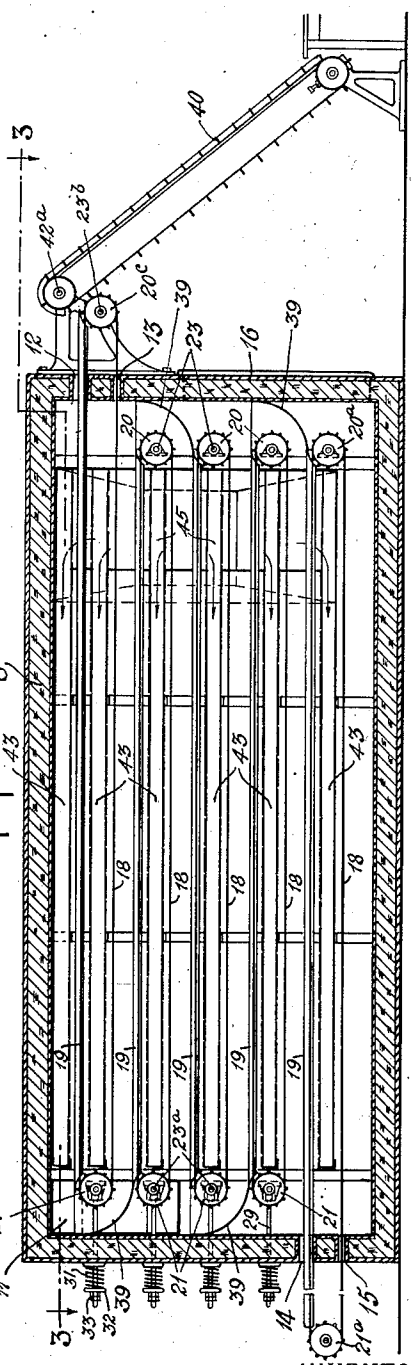

Fig. 2.

WITNESS

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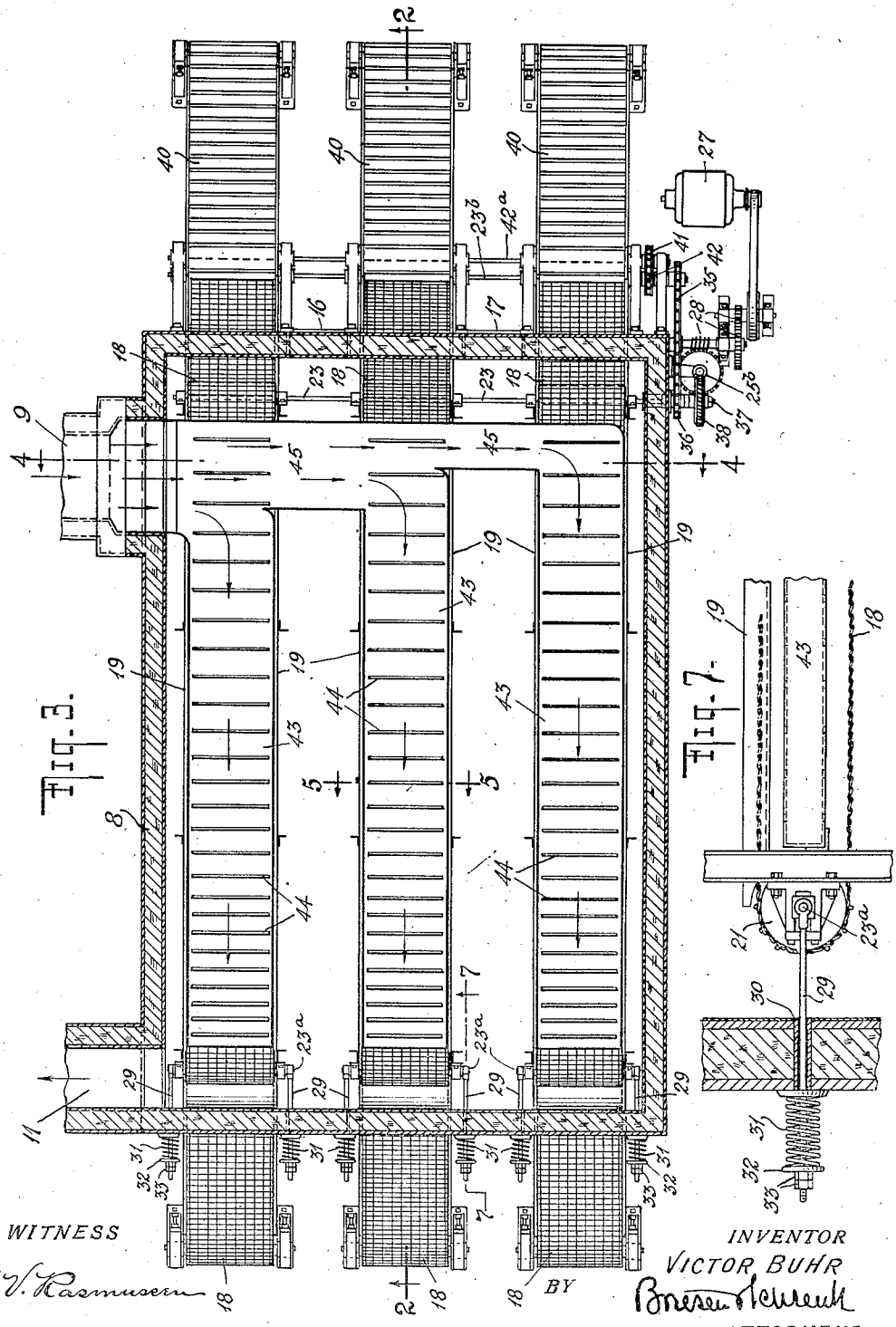

Fig. 3.

Fig. 7.

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Fig. 4.

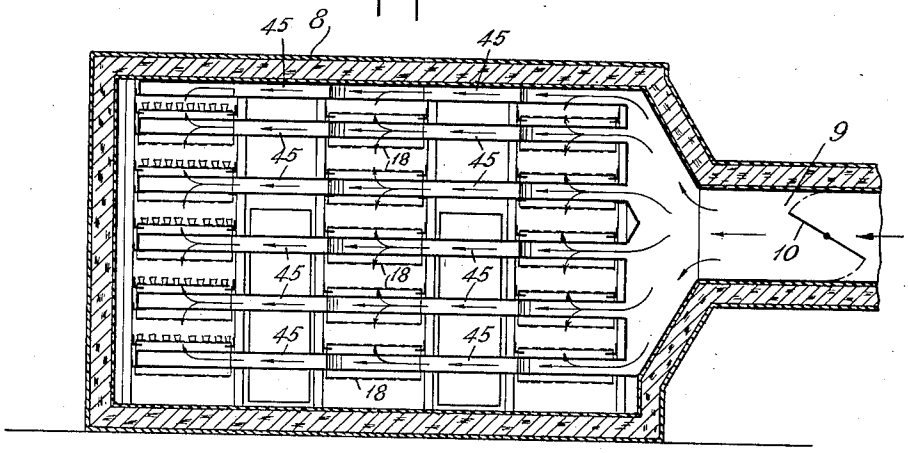


Fig. 5.

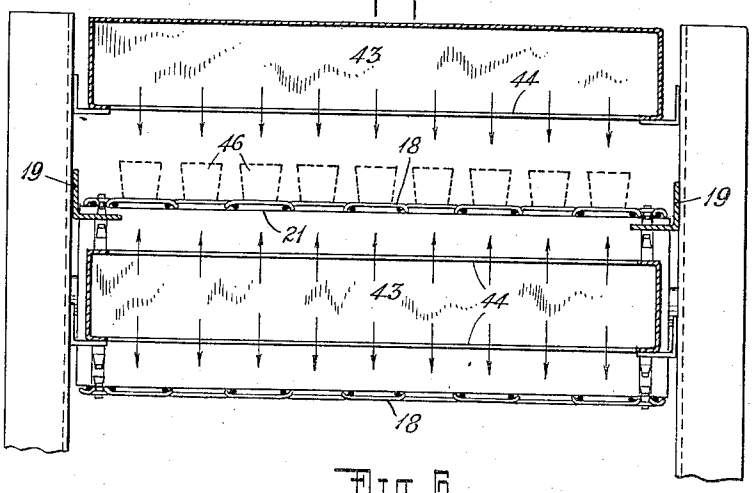
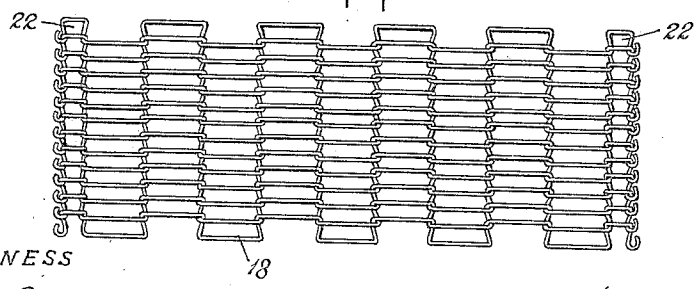


Fig. 6.



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1,865,168

UNITED STATES PATENT OFFICE

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REFRIGERATING METHOD AND APPARATUS

Application filed March 25, 1930. Serial No. 438,679.

My invention relates to refrigerating method and apparatus. It is the object of my invention to provide means for conveying packages of material through a refrigerating chamber and submitting them while in such chamber to a continuous and complete bath of a cooling gas, such as air. While my invention is intended for use particularly for the refrigeration of material already packaged in the container in which it is to be marketed, for instance, ice-cream and fruit juices, my invention is suitable also for use with material which is to be refrigerated in molds from which it is to be removed before marketing or with such material as may not necessitate the use of a container, for instance, compressed meat, compressed fish or cuts of meat.

When I speak in my specification of packages, I refer broadly to units of material whether or not the same is held in a container. While I prefer to have all the units of the material to be treated in uniform condition, both as to size, material and container (if one be used) so as to be able readily to regulate the refrigerating process for best results with every unit, it is to be understood that I do not limit my inventon to the refrigeration of units which are in uniform condition.

In the drawings which by way of example illustrate one embodiment of an apparatus in accordance with my invention, Fig. 1 is a schematic elevation of such apparatus; Fig. 2 is a vertical section of my apparatus along the lines 2—2 of Fig. 3; Fig. 3 is a plan view of my apparatus with the top of the refrigerating chamber removed, along the line 3—3 of Fig. 2; Fig. 4 is a transverse vertical section across the apparatus along the line 4—4 of Fig. 3; Fig. 5 is a transverse vertical view along the line 5—5 of Fig. 3; Fig. 6 is a plan view of a section of the wire belt conveyer used in my apparatus; and Fig. 7 is an enlarged detail of the means for supporting some of the conveyer shafts along the line 7—7 of Fig. 3.

8 is a refrigerating chamber whose walls may be of any suitable insulated construction. This chamber is provided with an inlet conduit 9, provided with regulating valve 10, for admitting cooled air to the interior of the chamber, and an exit conduit 11 for permitting warmed air to escape therefrom.

One end of the chamber is provided with a large slot-like opening 12 and a small slot-like opening 13, and the other end with a similar large opening 14 and small opening 15. Openings 12 and 14 are of sufficient size to permit the introduction and removal respectively on the conveyor belt to be hereinafter described of the material to be refrigerated, and openings 13 and 15 are of sufficient size to permit the passage of such conveyor belt. Doors such as 16 and 17 (Fig. 3) may be provided at suitable locations in the wall of the chamber to afford access to the interior of the chamber for purposes of cleaning and repair.

A number of endless conveyor belts 18 are mounted within the refrigerating chamber, each on suitably arranged drums. These belts are of any suitable construction and are apertured for the purpose of providing as free a passage as possible for the refrigerating air. Fig. 6 illustrates a section of reticulated conveyor belt made of wire suitable for use in connection with my invention. The apparatus as shown is provided with three vertical series of conveyor belts but may be provided with a less or a greater number of such series. One of such series will now be described.

The belts lying between the topmost belt and the lowermost belt are carried and driven by drums 20 and 21 provided with sprocket teeth which engage suitable apertures in the belts—for instance, apertures 22 (Fig. 6). Below the edges of the upper sections of each belt may be arranged suitable metal strips such as angle irons 19 upon which the edges

of the belt may be supported either at all loads or in case of very high load, especially if the conveyor belt should unexpectedly slacken. The drums 20 and 21 are rotatably supported on shafts 23 and 23*a*, respectively. The drums 20 are provided with suitable gears 24 meshing with worms 25 mounted on shaft 26, which shaft is rotated by the motor 27 connected therewith by a transmission train 28. The shafts 23*a* which support drums 21 are attached at each end to rods 29 passing through apertures 30 in the wall of the refrigerating chamber, the portions extending beyond said wall being surrounded by springs 31 pressing against head 32 and held in place by nuts 33. The purpose of this arrangement is to maintain the conveyor belts in a taut condition at all times.

The lowermost belt is supported at one end by drum 20*a* mounted in the interior of chamber 8 and at the other end by drum 21*a* mounted exteriorly of such chamber, the belt passing through apertures 14 and 15. Both drums are provided with sprockets and are otherwise similar to drums 20 and 21, drum 20*a* being similarly provided with a gear 24*a* meshing with worm 25*a* mounted on shaft 26. Adjacent to the delivery end of the lowermost belt, i. e. the end exterior to the chamber 8, is provided a table 34 onto which packages carried by such conveyor belt are delivered.

The uppermost conveyor belt is supported on drum 21*c* located within the chamber 8 and drum 20*c* located exteriorly of such chamber. Drum 21*c* is similar to drums 21, and drum 20*c* is similar to drums 20, but drum 20*c* is rotated by means of a sprocket chain 35 which meshes with gear 36 mounted on shaft 37 provided with gear 38, which in turn meshes with worm 25*b* mounted on shaft 26.

The worms 25, 25*a* and 25*b* are so pitched that each conveyor will be driven in a direction opposite to that in which the adjoining conveyor is driven, the uppermost conveyor belt being so driven that its upper portion moves toward the interior of the chamber while the lowermost belt is so driven that its upper portion is moved toward the exterior of the chamber. Chutes 39 are provided at the delivery end of each of the conveyors except the lowermost one, to cause packages delivered by one of the conveyors to be guided toward the receiving end of the next lower conveyor.

In close proximity with the intake end of the chamber 8 is located a conveyor 40, of any suitable construction, for the purpose of delivering packages to such portion of the upper section of the uppermost conveyor belt as is located outside of the chamber 8. This conveyor 40 is shown as driven by a sprocket chain 41 meshing with gear 42 mounted on the shaft of drum 20*c*, which is driven by gear 38.

If more than one series of conveyor belts is to be employed, the driving elements of the additional series may receive their motive power from motor 27 by arranging corresponding drums 20, 20*a* and 20*c* on common shafts 23 and 23*b* respectively, and gears 42 on common shaft 42*a*.

Within the refrigerating chamber 8 are mounted a series of ducts 43 provided with slots 44—44 both in their upper and lower walls, the ducts 43 being so spaced that each conveyor belt passes between two of such ducts. Cooled air is conducted to each of such ducts from conduit 9, through manifolds 45—45, each such manifold supplying the ducts lying in the same horizontal plane. The slots 44—44 are spaced relatively wide apart at the intake end of each duct and progressively more closely as they approach the other end of the duct, so that the air blown from such ducts upon the conveyors will be of substantially uniform pressure along the entire length of the conveyors, it being obvious that, as the pressure of the air is reduced, more slots will be needed in order to permit the same amount to escape per unit of length of the duct. Of course, the same object can be attained by other means well known to the engineer, for instance, by making the slots at the intake end comparatively small and making them progressively larger as they approach the other end.

The packages carried through the conveyor are indicated by 46 in Fig. 5.

The operation of the apparatus is as follows:

Cold air is continuously supplied to the chamber 8 through conduit 9, manifold 45, ducts 43 and slots 44.

The packages to be refrigerated are placed on the conveyors 40 and carried by such conveyors to the uppermost of the conveyors 18, being dropped on such portions thereof as extend outside of the refrigerating chamber 8. The packages are carried by such conveyors to the other end thereof, whence they fall upon the uppermost of the chutes 39 onto the next conveyors and are thence carried in the same manner to the lowermost conveyors which deliver the packages 46 to the receiving table 34, whence they may be removed for shipment. Of course, the speed of the conveyors will have to be so regulated that the packages are not delivered to the table 34 until the desired degree of refrigeration has been obtained.

During their travel through the refrigerating chamber the packages are subjected at all times to a bath of cooled air both from the conduit immediately above and from the conduit immediately below such packages. As the conveyor belts are apertured, the bot-

toms of the packages can be readily reached by the cold air.

The condition of the packages will, of course, have to be such that they may be upset as they pass from conveyor 40, and from the delivery ends of the conveyor belts 18, without undesirable disturbance of their contents. For instance, if a liquid is to be refrigerated in a container which is not leakproof or, as in the case of layer ice cream, the layers of which must not lose their identity, the liquid must be subjected to a partial solidifying (freezing) process before the packages are placed on the conveyor 40.

All of the apparatus is preferably made of material which may readily be cleaned.

The drawings show the apparatus drawn to scale. The inside length of the refrigerating chamber 8 is 28 feet and its inside width is 16 feet 6 inches. The distance between shafts 23 and 23*a* supporting each of the conveyor belts except the uppermost one and the lowermost one is 25 feet. The width of the conveyor belt is 3 feet.

When refrigerated ice-cream, packed in two ounce paper cups, is to be treated, the belts may be driven at a speed of 2½ feet per minute. The temperature of the ice-cream as it enters the refrigerating chamber is preferably from 25° to 28° F. and the temperature of the air entering the conduit 9 is minus 30° F. If a sufficient amount of air at this temperature is supplied through such conduit, this ice-cream can be reduced to a temperature of 8° F. in about fifty minutes.

It is obvious that the number of conveyor belts and the length of each belt may be increased or decreased. Of course, if an even number of belts is used apertures 14 and 15 will have to be provided at the same end of the chamber as apertures 12 and 13, whereas if only a single belt is used the intake and exit ends and associated parts will have to be constructed in the manner shown in Fig. 2 in connection with the intake end of the uppermost belt and the delivery end of the lowermost belt.

Many other changes may be made in the construction hereinabove described without departing from the spirit of my invention. For instance, instead of the ducts, perforated pipes may be employed, and any suitable means may be provided for driving the conveyors. The conveyors may be of any desired construction and need not take the form of belts, provided they are apertured to permit the material to be subjected at all times to a continuous bath of cold air.

When in my claims I refer to air, I intend to include any other suitable refrigerating gas.

I claim:

1. The method of hardening a semi-frozen product which comprises passing the product through a refrigerating chamber and while the product is within the chamber directly impinging against opposite sides of the product separate streams of a gaseous cooling medium under pressure, and permitting such gaseous medium to expand, whereby the temperature of the product is substantially reduced.

2. The method of hardening a semi-frozen product which comprises passing the product through a refrigerating chamber and while within the chamber directing cold air under pressure directly against the upper and lower surfaces of the product, and permitting such gaseous medium to expand, whereby the temperature of the product is substantially reduced.

3. The method of hardening a semi-frozen product which comprises passing the product continuously through a refrigerating chamber and directing a cold gas under pressure directly against the upper and lower surfaces of the product without interrupting the passage of the latter through the chamber, and permitting such gaseous medium to expand, whereby the temperature of the product is substantially reduced.

4. In a refrigerating apparatus, a substantially closed refrigerating chamber, an apertured conveyor within said chamber, conduits for a gaseous cooling medium arranged within the chamber so as to direct the cooling medium directly against the upper and lower surfaces of products supported on the conveyor and so as to permit expansion of the gaseous medium after contacting with the surfaces of the products.

5. In a refrigerating apparatus, a substantially closed refrigerating chamber, an apertured endless conveyor mounted within said chamber, a conduit for a gaseous cooling medium arranged within the chamber above the upper run of the endless conveyor, a conduit located between the runs of the conveyor, the faces of said conduits adjacent to the upper run of the conveyor being provided with spaced openings through which the cooling medium is directed so as to impinge against the opposite faces of an article supported on the upper run of the endless conveyor.

6. In a refrigerating apparatus, a substantially closed refrigerating chamber, an apertured endless conveyor mounted within said chamber, a conduit for a gaseous cooling medium arranged within the chamber above the upper run of the endless conveyor, a conduit located between the runs of the conveyor, the faces of said conduits adjacent to the upper run of the conveyor being provided with spaced openings through which the cooling medium is directed so as to impinge against the opposite faces of an article supported on the upper run of the endless conveyor, and the said openings in the conduits being so formed and arranged as to distribute

the cooling medium evenly throughout the length of the conveyor.

7. In a refrigerating apparatus, a substantially closed refrigerating chamber, a series of vertically related apertured endless conveyors mounted within the chamber, means for driving alternate conveyors in the series in one direction and the remaining conveyors in a direction opposed thereto, a conduit for a cooling medium located within the chamber above the upper run of the top conveyor, the bottom face of the conduit being provided with spaced openings for directing the cooling medium downwardly and directly against the upper run of the top conveyor, a conduit located between the runs of the lowest conveyor, the upper face of said second conduit being provided with openings to direct the cooling medium upwardly against the upper run of the lowest conveyor, and conduits located between the runs of the intermediate conveyors, the upper and lower faces of the conduits associated with the intermediate conveyors being provided with openings for directing the cooling fluid in the direction of the upper and lower runs of the associated conveyors.

8. In a refrigerating apparatus, a substantially closed refrigerating chamber, a series of vertically related apertured endless conveyors mounted within the chamber, means for driving alternate conveyors in the series in one direction and the remaining conveyors in a direction opposed thereto, a conduit for a cooling medium located within the chamber above the upper run of the top conveyor, the bottom face of the conduit being provided with spaced openings for directing the cooling medium downwardly and directly against the upper run of the top conveyor, a conduit located between the runs of the lowest conveyor, the upper face of said second conduit beng provided with openings to direct the cooling medium upwardly against the upper run of the lowest conveyor, and conduits located between the runs of the intermediate conveyors, the upper and lower faces of the conduits associated with the intermediate conveyors being provided with openings for directing the coolng fluid in the direction of the upper and lower runs of the associated conveyors, the openings in said conduits being so formed and arranged as to distribute the cooling medium evenly throughout the length of the conveyors.

9. In a refrigerating apparatus, a substantially closed insulated refrigerating chamber a series of vertically related apertured endless conveyors mounted within such chamber, means for driving alternate conveyors in the series in one direction and the remaining conveyors in a direction opposed thereto, one end of the upper conveyor extending beyond the chamber to receive the article to be cooled therein and one end of bottom conveyor extending through the chamber to discharge the articles therefrom, conduits for a cooling medium arranged within the chamber above and below the upper run of each of the endless conveyors, the said conduits being provided with apertures to direct the cooling fluid directly against the upper and lower surfaces of the upper run of the conveyors, and the said apertures in the conduits being so formed and arranged as to distribute the cooling medium evenly through the length of the conveyors.

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