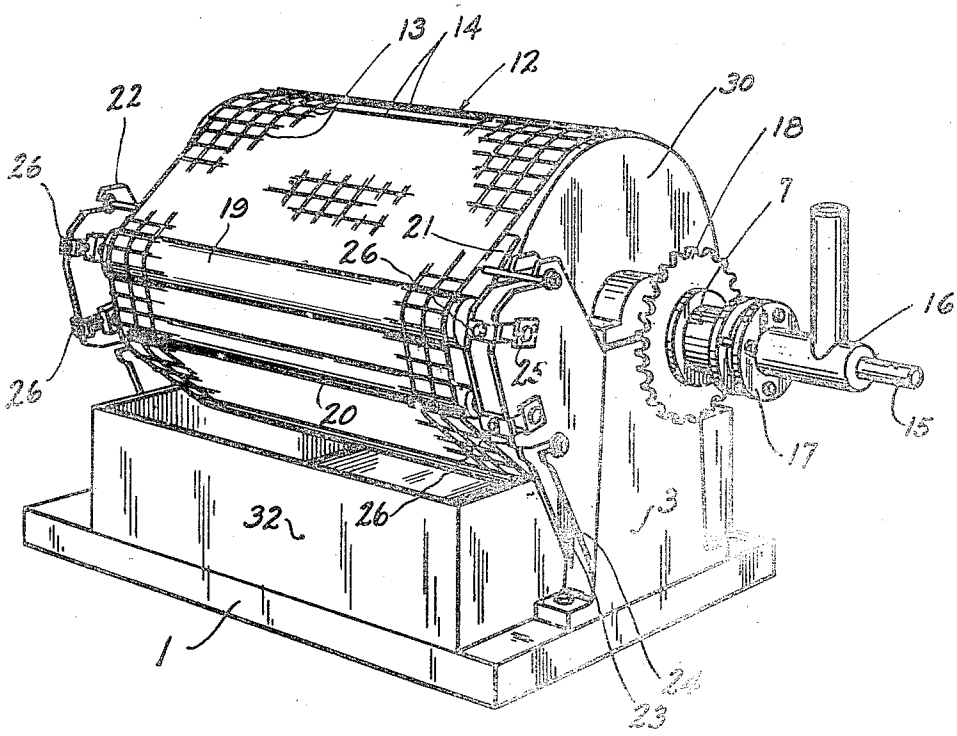
May 6, 1947. F. W. KNOWLES 2,419,953

ICE MACHINE

Filed May 3, 1940 2 Sheets-Sheet 1

Fig. 1



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ICE MACHINE

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Fig. 2

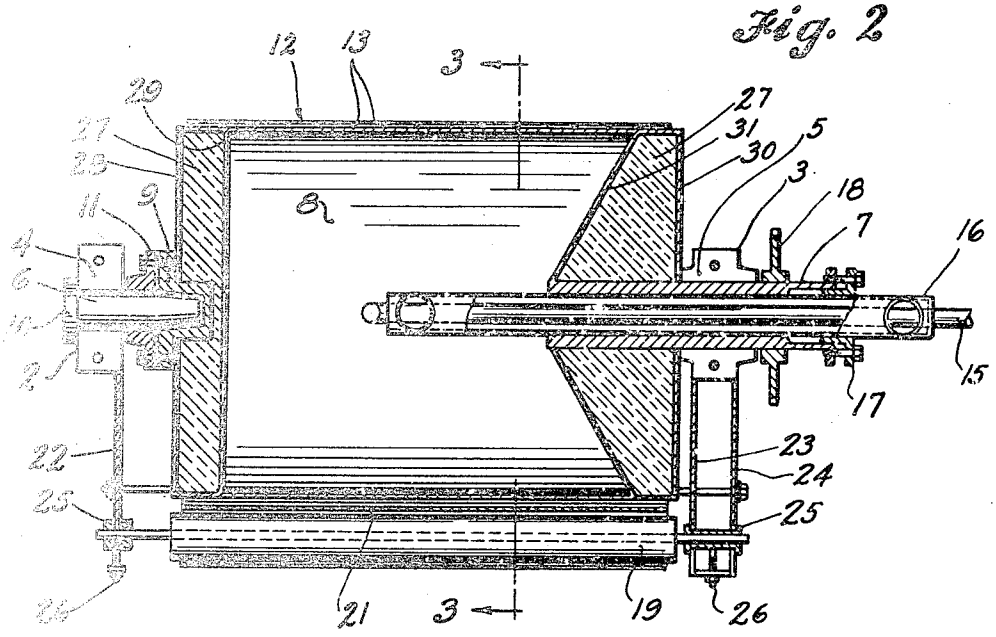
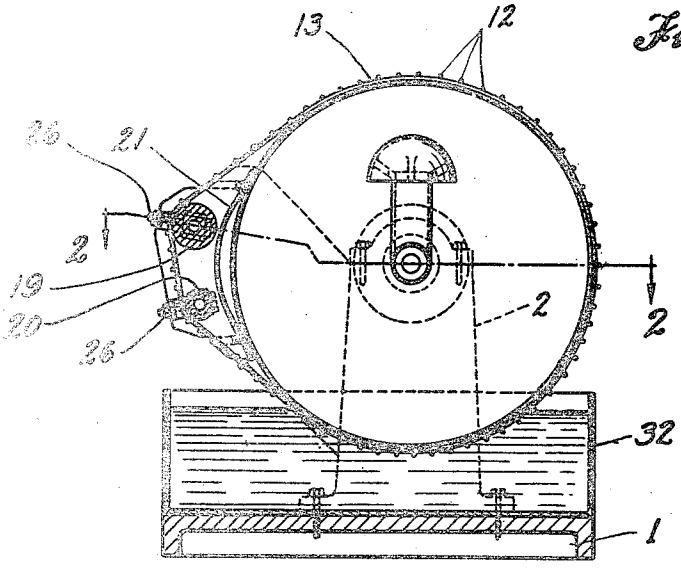


Fig. 3



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UNITED STATES PATENT OFFICE

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ICE MACHINE

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Application May 3, 1940, Serial No. 333,135

7 Claims. (Cl. 62—105)

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The present invention relates to heat transfer devices. In particular the device relates to the art of refrigeration, but some of the features of the invention are of a broader use, such as in the drier and concentration arts.

In more particular, the present device is an improvement on my co-pending application for improvement in Ice machine, Serial Number 262,869, filed March 20, 1939, which relates to the art of solidifying thin sheets of material upon a surface and of removing the material from that surface. The only example of material solidified that will be considered in the present instance is that of water, but others, as set forth in the above-mentioned application, may be acted upon.

In the device disclosed in the above-mentioned application, material was solidified upon a flexible member, such as a belt having a continuous surface, and placed around and in contact with a refrigerated or heated drum, and removed from the flexible member by the flexing thereof. In the present device, a discontinuous flexible member is used in place of a continuous member. Such a member may be a reticulated belt in the form of a woven screen, a perforated sheet, or other open construction. Such a device is of advantage as compared to a solid belt because, among other things, of the increased rate of heat conductivity.

It is an object of the present invention to devise a heat transfer device using a heat transfer drum and a reticulated belt which may be used for the solidification of material upon the belt.

It is another object of the present invention to construct such a device wherein the drum will be so insulated that the heat transfer through the end will be of such a low value that the material being acted upon and which comes in contact with the ends will not be solidified thereupon.

It is a further object of the present invention to devise a reticulated or open-work belt that may be easily and completely freed from material solidified thereon.

A further object is the provision of means for insuring the complete removal of solidified material from the reticulated belt.

A further object is the provision of a shield between the belt and the drum at the place where the belt leaves the drum, to prevent solidified material from contacting the drum at that place.

A further object of the present invention is the

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provision of a hard surfaced roll for leading the belt from the drum to change the curvature of the belt and to thus break or loosen the solidified material from the belt, and of a soft, or resilient, surfaced roll to bear against the reticulated belt and to force the solidified material out of the interstices thereof.

A further object of the present invention is to devise a reticulated belt having parallel warp wires, and parallel weft wires laid on top of, away from the face of the drum, the warp wires, and secured thereto by soldering, brazing, welding, etc.

Another object of the present invention is the provision of a trunnion for one end of the heat transfer drum, that may be quickly detached from the drum to allow easy removal of the belt, and of the provision of a support for the other trunnion that will hold the drum in place while the support of the first trunnion is removed.

The word "reticulated" is used in the sense of a device having the form of a net, that is, lines, veins, or fibers crossing one another and having relatively large spaces between the lines, as shown in the drawings.

The phrase "open-work" is used generically, and includes either a reticulated structure, as above, or one of unconnected character, viz; wherein cross members are not provided.

The word "sheet" is used in the present disclosure to refer to an open-work or reticulated or solid construction of the belt wherein the thickness is less than about $\frac{1}{8}$ of an inch, a standard usual in sheet metal work to distinguish from plates.

These objects and others are attained by mounting a heat transfer drum upon trunnions supported in pedestals, placing around the drum a reticulated or open-work and endless belt which is longer than the circumference of the drum, and by applying to the belt while it is in contact with the drum the material to be solidified. The material may be applied to the belt by placing the belt and drum in a tank of the material. To prevent solidification of the material on the ends of the drum, and to reduce the transfer of heat through the ends, the ends are insulated and the face of the drum extended beyond the confining ends of the drum and over the insulation. Material is removed from the belt by changing the

curvature of the belt which loosens the material thereon. This is done by passing the belt around a roll situated parallel to the drum and close thereto. Any material that adheres to the belt after it passes around the drum is dislodged from the belt by pressing into the openings of the belt the material forming the surface of a resilient roll situated to bear against the belt just after passing over the guide roll. The solidified material is prevented from passing from the belt back onto the drum by a shield placed between the belt and drum over the area where the belt is led from the drum by the guide roll.

Devices constructed in accordance with the above, and which will attain the objects of the present invention, are hereinafter described in detail and shown in the accompanying drawings, wherein:

Figure 1 is a perspective view of one form of my device.

Figure 2 is a plan view in section of the device shown in Figure 1.

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

In the drawings, the device illustrated comprises a base 1 supporting two pedestals 2 and 3 which carry on their upper ends the bearing 4 and 5 for supporting therein the trunnions 6 and 7 which support the heat transfer drum 8. The left trunnion 6 has a tapered fit in a socket 9 secured to the left end of the drum. The trunnion is secured against end movement by means of flanges 10 and 11. The flange 11 is arranged to be secured to the socket 9 as by bolts, to prevent relative movement between the trunnion and the socket. The pedestal 2 supporting the trunnion 6 with the sliding tapered fit with the drum, is secured to the base 1 in such a manner that it may be readily disconnected therefrom, as by the use of cap screws or bolts, and the assembly of pedestal and trunnion removed from the base and the drum. The right bearing 5 is rigidly secured to the pedestal 3, the pedestal 3 is rigidly secured to the base 1, and both the bearing and the pedestal are constructed to carry the entire weight of the drum and accessories in their normal position without the aid of the other bearing and pedestal when the other trunnion 6 is removed from the socket 9.

The purpose of having one of the pedestals and trunnions readily removable from the base and drum, is to provide for the easy and rapid placing and removal of a flexible open-work belt such as the reticulated belt 12 illustrated, which is usually made endless. This belt is made up of a plurality of parallel warp wires 13 which are spaced from a half to three inches apart, and of a plurality of weft wires 14 laid over the warp. The warp and weft are secured together by spot welding, brazing, or soldering, and are spaced apart about the same distance as the warp wires. Steel wire or other suitable alloys may be used. The smoother the wire, the less will be the tendency of the solidified material to adhere thereto. This also applies to the material making up the face of the drum, a chromium or nickel face being desirable. This belt is also designated as a sheet to distinguish it from certain grid-like devices for making ice blocks or cubes, such as shown in the patent to Short, Number 2,054,101, issued Sept. 15, 1936 (Cl. 62—105).

The trunnion 7 which is permanently secured to the drum, is hollow and has fitted inside thereof two concentric pipes, the inner pipe 15 carries the incoming and the outer pipe 16 the outgoing

refrigerant. The refrigerant pipes are stationary, that is, they do not rotate with the drum. A packing gland 17 maintains a tight joint between the trunnion and the outer pipe 16. A sprocket 18 is secured to and around the trunnion 7 for rotating the drum.

Placed adjacent to and parallel to the drum and at one side thereof is a small roll 19 for guiding the belt away from the drum for a small part of the length of the belt. This roll is usually provided with a hard surface, such as cast iron. A second roll 20 is provided adjacent the guide roll 19, for cleaning the belt. This roll is provided with a resilient face such as soft rubber, and is tensioned against the belt a sufficient amount to embed the wires of the belt therein. Over that surface of the drum which is free of the belt, that lying in under the rolls, is placed a shield 21 which will cover that portion. This shield prevents the contact of a solidified material with the drum after removal from the belt.

The two rolls and the shield are supported in plates 22, 23, and 24. The plate 22 is supported on the left pedestal 2 and the plates 23 and 24 are supported in parallel spaced relationship on the right pedestal 3. The bearings 25 for the ends of the shafts supporting the rolls are placed in slots cut in these plates which will allow adjustment of these members to take place. The double plate is used on the right end so that this end may be very rigid and support the rolls and guard without material displacement thereof when the left support is removed. The bearings in the left support may have an entering taper to guide the roll and guard shafts into them. The position of the bearings may be adjusted by means of screws 26 secured to the plates and to the bearing blocks. The tensioning roll and the guard may be adjusted radially, and the cleaning roll may be moved normal to the belt.

The ends of the drum are double with space between the two walls of each end for the placing therein of insulating material 27. The end 28 carrying the socket 9 for the removable trunnion is a flat sheet welded or riveted to the end of the drum. Spaced from this end sheet is another sheet 29 which should be welded in place. Between the two sheets a suitable insulating material 27 is placed to reduce the transfer of heat through the end of the drums. The other end of the drum is closed by a plate 30 which may be similar to the sheet 28 for the other end. The fixed trunnion 7 used for driving the drum passes through this end sheet and is secured thereto. Spaced inwardly from this end sheet 30 and secured thereto is a conical sheet 31. The trunnion 7 also passes through this sheet 31 and is secured and sealed thereto. The space between these end sheets is also filled with the insulating material 27. The purpose of giving the conical end plate its particular shape is to reduce the transfer of heat along the trunnion and the pipes therein. If the inner end plate were to be flat and secured to the drum at the same place as the conical end, the transfer of heat through the trunnion would be greater than with the conical plate. Yet with the conical plate the heat conductive area of the drum has not been reduced. With the two plates of the double end secured to the fixed trunnion, the strength of the drum with respect to support from one end is greatly increased over that had with a single end.

A tank 32, is placed on the base and is made of such a size that it will receive the lower portion

of the drum. This tank is adapted to hold the material that is to be solidified.

The operation of the device to form ice flakes is as follows: A proper refrigerant is circulated through the pipes 15 and 16, and the drum 8 to reduce the temperature thereof to a point preferably below zero Fahrenheit. The drum is rotated by any suitable power source operating upon the sprocket 18. Water is placed in the tank 32 until the lower part of the drum is immersed. The water placed in this tank may be precooled to near the freezing point or the drum, itself, may do this. As the temperature of the water is reduced, ice will begin to form on the drum and the belt and to be carried up out of the tank. The temperature of the ice as it leaves the tank will be close to the freezing point but as it progresses around the drum its temperature is reduced, and it becomes hard and brittle. The ice will not form on the face of the drum adjacent the ends thereof, nor will it form on the ends of the drum, because of the restriction in each end of the drum to the free flow of the heat transfer medium. This restriction might be in the form of the double end alone, or the insulation and one end alone, or as shown, with the insulation between the double end. If ice were to form around the edges of the drum such would be difficult to remove. The belt need not extend out over this portion of the face upon which ice does not form, that is, it may be spaced back from the edges of the drum. However, the belt should extend beyond the restricting ends 29 and 31. As the belt leaves the drum it will carry with it the sheet of ice which has been formed. The change in the curvature of the sheet as it leaves the drum will break it up and loosen it from the belt. This loosening from the belt will be further carried on by the passage of the belt and the ice around the guide roll 19, at which point most of the ice will leave the belt and fall into any desired receptacle or chute that is properly placed. Depending upon the quality and thickness of the ice small particles may adhere to the belt after it passes the guide roll. These small pieces are removed from the belt by passing the belt over the soft and resilient roll 20 which is pressed against the belt so that the wires thereof are imbedded in the roll. This embedding action causes the small particles adhering to the belt to be stripped therefrom. The shield 21 between the belt and the drum prevents the solidified material from falling upon the drum and being caught between the drum and an element of the belt. The positions of the guide and cleaning rolls and the shield may be adjusted by moving their supporting ends in the slots in the plates 22, 23, and 24.

The device has been constructed so that the belt may be easily removed and replaced. This is done by unbolting the left pedestal 2 from the base 1, and the flange 11 from the socket 9, and then moving the pedestal away from the drum. This action will not only remove the left support of the drum but of the rolls and the shield. As disclosed, the right supports have been made strong enough and rigid enough to carry the whole weight. Upon loosening the rolls the belt may be easily removed and a new one inserted. Upon tensioning the rolls, the pedestal may be replaced. Any slight deflection of the drum will be remedied by the taper in the socket 9 which will force the drum into the alignment when the bolts between the socket and the flange are drawn up. The entrances to the bearings for

the rolls and the shield are tapered to similarly force the shafts into alignment.

Ice made with the herein described device is in small flakes, dry, free flowing, and colder than the usual block ice.

Having thus described the construction and operation of my device, I claim:

1. In a heat transfer device: a refrigeratable drum adapted to contain a refrigerating medium, means for rotating said drum, a reticulated sheet formed of wire and constituting a belt around and in contact with said drum, water supply means located for supplying water to said belt while in contact with said drum, and means for leading said belt away from said drum whereby the ice resulting from the operation of the device will be removed from said drum.

2. In a heat transfer device: a heat transfer drum, a reticulated sheet formed of wire and constituting a belt around and in contact with said drum, means for rotating said drum and for moving said belt therewith, liquid supply means located for supplying a liquid to said drum and said belt while such are in contact with each other, and means for leading said belt away from said drum whereby the solid resulting from the operation of the device will be removed from said drum.

3. In a heat transfer device: a heat transfer drum an open-work member around and in contact with said drum, means for rotating said drum and for moving said member therewith, a roller for leading said member away from and back to said drum, and a roller having its face covered with a resilient material such as soft rubber, said roller contacting said member while such is away from said drum to force therefrom material adhering to said member.

4. In a heat transfer device: a refrigeratable drum adapted to contain a refrigerating medium, means for rotating said drum, an open-work sheet formed of wire and constituting a belt around and in contact with said drum, liquid supply means located for supplying liquid to said belt while such is in contact with said drum, and means for leading said belt away from said drum whereby the solid resulting from the operation of the device will be removed from said drum.

5. In a heat transfer device: a rotatable heat transfer drum; an open-work member around and in contact with said drum; means for rotating said drum and for moving said member therewith; and means for leading said member away from and back to said drum, and for acting upon said member while away from said drum, comprising a roller having its face covered with a resilient material such as soft rubber, said roller contacting said member while such is away from said drum to force therefrom material adhering to said member.

6. A machine for the freezing of ice comprising a rigid, rotatable drum; means for refrigerating said drum; a rotatably mounted roll spaced from the drum; wire belt means applied about the drum and said roll; means for supplying the surface of the drum with a liquid to be frozen thereon; and means for rotating the drum for the removal of the ice therefrom by said wire belt means.

7. A machine for the freezing of ice comprising a rigid, rotatable drum; means for refrigerating said drum; a second drum spaced from the first mentioned drum and rotatable about an axis parallel with the axis thereof; belting comprising

spaced apart wires trained about and engaging said drums; a layer of elastic material covering the second mentioned drum, the wires being so tensioned about the drums and the elastic material being of such thickness that the travel of the belting over the material causes the formation of depressions therein and of intervening ridges of sufficient height to remove from said belting ice adhering thereto; means for supplying the surface of the first mentioned drum with a liquid to be frozen thereon; and means for rotating said drums for the removal of the ice from the first mentioned drum by the wire belting and for the removal of ice from the belting.

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