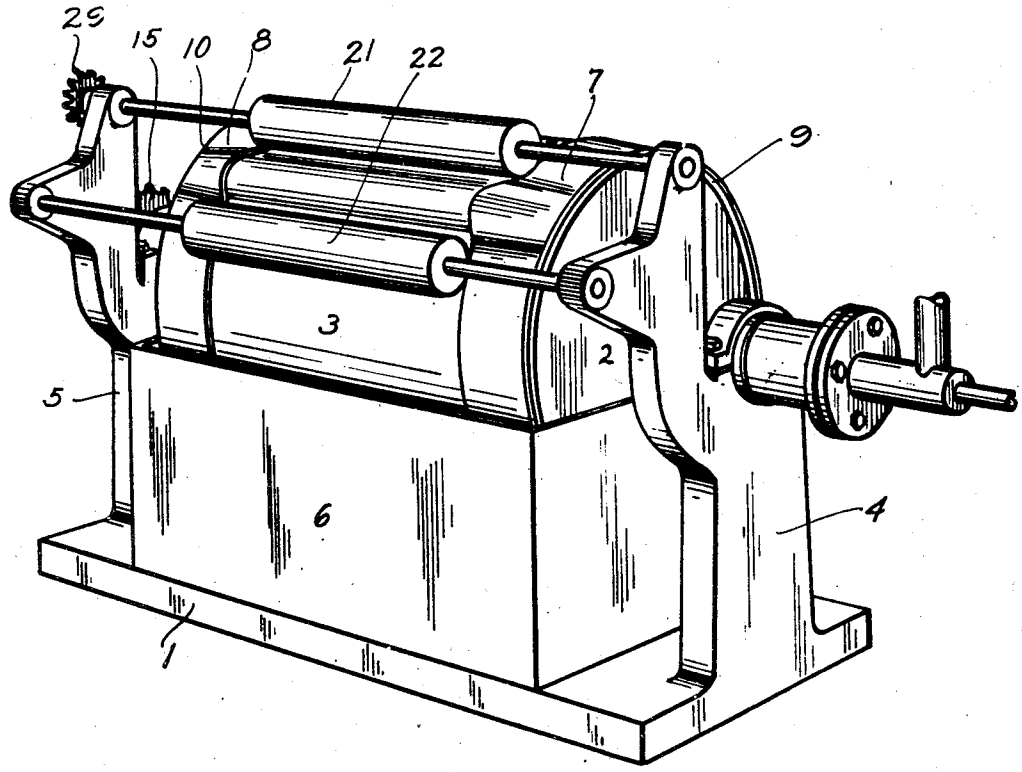
Dec. 17, 1946. F. W. KNOWLES 2,412,621

HEAT TRANSFER DEVICE

Filed June 20, 1944 2 Sheets-Sheet 1

Fig. 1



FRANK W. KNOWLES
INVENTOR.

BY Paul Bleven
ATTORNEY

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Filed June 20, 1944 2 Sheets-Sheet 2

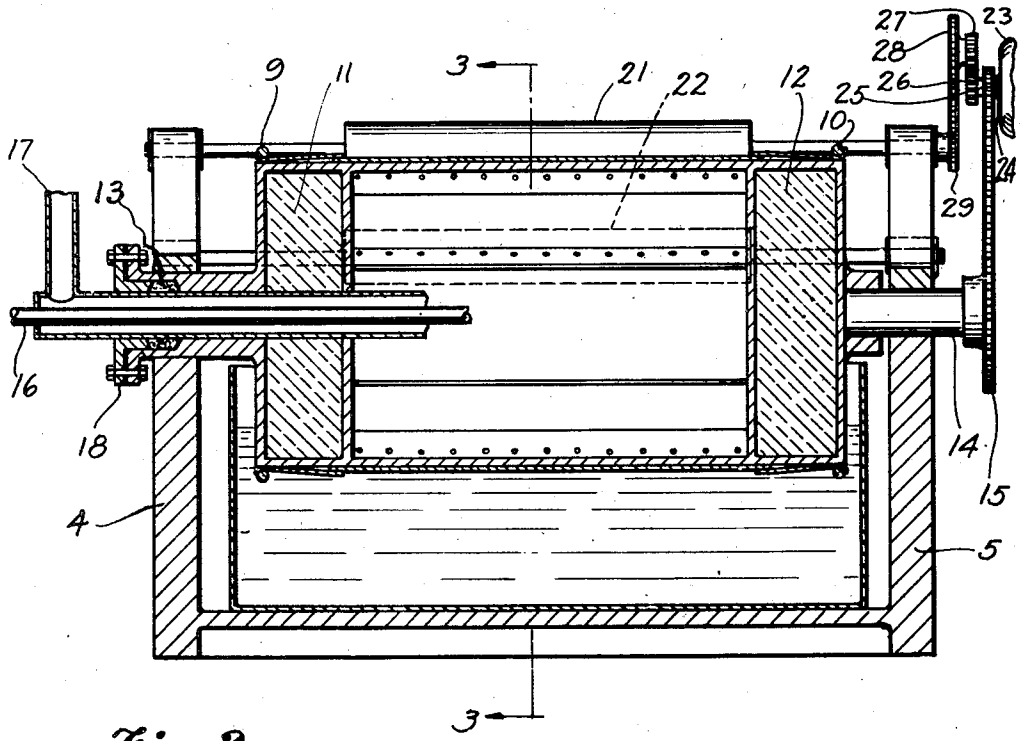


Fig 2

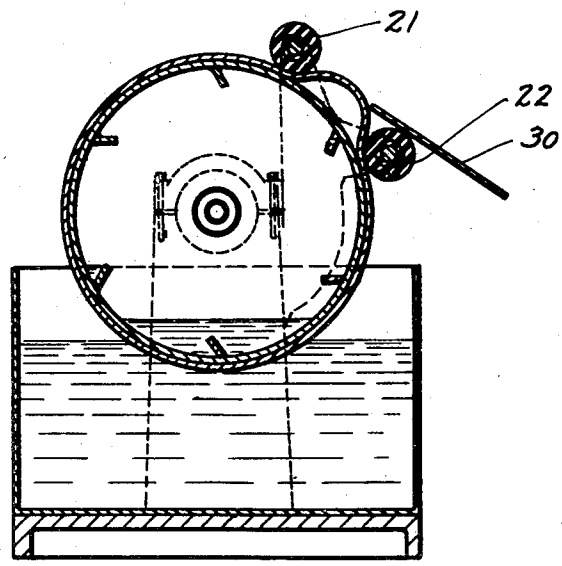


Fig. 3

FRANK W. KNOWLES - INVENTOR.

BY

Paul Bleiven

ATTORNEY

Patented Dec. 17, 1946 2,412,621

UNITED STATES PATENT OFFICE

2,412,621

HEAT TRANSFER DEVICE

Frank W. Knowles, Seattle, Wash.

Application June 20, 1944, Serial No. 541,206

6 Claims. (Cl. 62—106)

1

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 drying and concentrating arts.

The present device relates to the art of solidifying thin sheets of material upon a surface and of removing the material from that surface. Examples of such are the making of thin sheets of ice, frozen fruit juices, glue, dried milk, or other materials. The only example of material to be solidified that will be considered in the present instance is that of water.

The present device is an improvement upon the construction shown in my co-pending application, Serial No. 262,869, filed March 20, 1939, for Ice machine. The device shown in my prior application has loose end-plates which required a moving seal between the end-plates and the shaft upon which they turned. Also, most of the modifications shown in my prior application required means inside of the belt for leading it away from and back to the drum in order to change the curvature of the belt and break the ice therefrom.

Having in mind these limitations of my prior device, and the limitations found in various prior patents and co-pending applications, such as those of Crosby Field, it is an object of the present invention to construct a flake ice machine in which there is required only one moving seal in the whole device.

A further object of the present invention is to construct a device in which all of the moving parts are outside of the device and readily accessible for servicing and repair.

Another object of the present invention is the construction of a belt and drum for a flake ice machine in which the ends of the drum are insulated and in which ice will not form on the edge of the belt where it is joined to the rubber sealing skirt.

A device which will remedy these defects and achieve these objects is had by heavily insulating the ends of a rotatable and refrigerated drum, placing around the drum a flexible belt which is longer than the circumference of the drum, sealing the belt to the drum at the outer edges of the insulated ends, and employing external rolls to guide the belt away from and back to the drum to remove ice from the belt.

A machine embodying the features outlined above, and which will achieve the desired results, is shown in the accompanying drawings, in which:

2

Figure 1 is a perspective view of the device;

Figure 2 is an elevational sectional view of the device shown in Figure 1; and

Figure 3 is a transverse sectional view on the line 3—3 of Figure 2.

The perspective view of Figure 1 shows my device mounted on a platform 1, with the drum 2 and belt 3 being carried on upright pedestals 4, 5, placed at opposite ends of the base. The base also carries a tank 6 for water, and the drum and belt are placed to be partially immersed in this tank and the water contained therein. The length of the belt is greater than the circumference of the drum. The belt may be made of suitable metal, such as stainless steel, and is sealed to each end of the drum by means of a rubber skirt 7, 8. One edge of each skirt is vulcanized to an edge of the belt; the other edge of each skirt is secured to the outer edge of the drum by means of bands 9, 10, or other suitable means, which will effect a seal between the skirt and drum, and prevent progressive movement between the drum, the skirt, and the belt.

As shown in Figure 2, each end of the drum has applied or built therein a thick layer of insulation 11, 12. The drum is mounted for rotation by suitable axles 13, 14, which bear in the upper ends of the pedestals 4, 5. One of the axles 14 is solid and has on the outer end thereof a drive sprocket 15; the other axle 13 is hollow and has leading therethrough the refrigerant supply and return pipes 16, 17, with a suitable seal 18, sealing the outside of the return pipe against leakage from the inside of the drum.

A portion of the belt is led away from and back to the drum by means of the guide rolls 21, 22. These guide rolls are made up of a steel shaft covered with soft rubber; and the rolls are pressed lightly against the belt and drum. The ends of the rolls are bearinged in suitable supports attached to the pedestals 4, 5. The rotation of the drum is clockwise as shown in Figure 3, and the top roll 21 is positively driven by suitable means, while the bottom roll 22 is driven by and idles on the belt. The drive for the top roll may be from the same source as the drive for the drum, as by means of a suitable motor 23, driving through a shaft 24, having mounted thereon a sprocket 25 to drive the drum, and a gear 26 to drive the top roll 21. The drive gear 26 meshes with a countershaft gear 27 driving a sprocket 28 which in turn drives the roll sprocket 29. The countershaft gear 27 gives the proper rotation to the top roll 22, so the roll will follow the belt. The top, or drive, roll 21 is driven

at a speed so that it has a speed slightly greater than the necessary speed of the belt.

The operation of my device is as follows: water is placed in the tank 6 so as to come near the top edge of the tank, and refrigerant is delivered to the drum from a suitable source to refrigerate the drum to an extent where ice will form on the surface of the belt as it is rotated by the drum and motor 23. As the edges of the belt are secured to the drum, the belt must follow along with the drum, and the belt will make one revolution for each revolution of the drum. However, as the belt is longer than the circumference of the drum, and as it is held against the drum by the rollers 21 and 22, there must be some slippage between the belt and the drum. This slippage is allowed by the fact that the lower roller 22 is undriven and loose, and can follow along with the belt. The top roller 21 is driven so as to go slightly faster than the belt, say 1/20 to 1/5 greater speed than the required surface speed of the belt, which is greater than the surface speed of the drum by the added length of the belt. This overdrive of the top roll tensions the belt around and against the drum, which takes up all the slack between the roll 22 and 21 the long way around the drum, while the loose roll 22 will allow the necessary slippage required by the drag of the skirts 7, 8. The speed relationship between the rolls 21, 22 may be varied in particular conditions, depending upon the size of the drum and the pull on the edge skirt, by varying the speed of the top roll and also by positively driving the loose, or bottom, roll 22; in fact the bottom roll may be driven faster than the actual belt speed in order to aid the slippage of the belt around the drum but still at a speed less than the top roll in order to maintain the bulge in the belt between the two rolls the shortest distance around the drum.

With the drum properly refrigerated, water in the tank, and the drum and rolls rotated as above described, water from the tank will collect on the belt in a thin ice sheet and be lifted out of the water tank, where, free from the water, it will freeze to a low temperature and dry out. The ice will then pass beneath the top roll 21, and, as the curvature of the belt changes, will be broken loose from the belt and separate therefrom and pass down a chute 30 to any suitable receptacle.

The insulation on the ends of the drum will prevent ice forming thereon, and with the ends of the belt attached directly to the outer ends of the drum, there is eliminated the need for any seal between a loose end and the drum.

It is to be noted that the metal portion of the belt extends over the insulated portion of the drum. This prevents the formation of ice at the point of joinder of the belt and the rubber skirt, and any tendency for ice to break the skirt from the belt.

Having thus described my invention, I claim:

1. A refrigerating apparatus, comprising: a refrigerated drum, means insulating the ends of said drum, an endless, imperforate, flexible belt,

longer than the circumference of the said drum, and placed around and in contact with said drum, means preventing progressive movement between said drum and belt, and sealing the entire length of the edges of said belt to the ends of said drum, and means for maintaining all but a small portion of said belt in contact with said drum.

2. A heat transfer device, comprising: a heat transfer drum, means insulating the ends of said drum, an endless, imperforate, flexible belt, longer than the circumference of said drum, and placed around and in contact with said drum, means preventing progressive movement between said drum and belt, and sealing the entire length of the edges of said belt to the ends of said drum, and means for maintaining all but a portion of said belt in contact with said drum.

3. A heat transfer device, comprising: a heat transfer drum, means insulating the ends of said drum, an endless, imperforate belt, longer than the circumference of said drum, and placed around and in contact with said drum, a stretchable web secured along and to each edge of said belt and to the ends of said drum, and means for maintaining all but a portion of said belt in contact with said drum.

4. A heat transfer device, comprising: a rotatable heat transfer drum, an endless, imperforate, flexible belt, which is longer than the circumference of said drum and is placed around and in contact with said drum, means sealing the entire length of the edges of said belt to the edges of said drum, and guide means outside of said belt and bearing thereon for holding all but a small portion of the length of said belt in contact with said drum.

5. A heat transfer device, comprising: a rotatable heat transfer drum, an endless, imperforate, flexible belt which is longer than the circumference of said drum and is placed around and in contact with said drum, means sealing the entire length of the edges of said belt to the edges of said drum, and a pair of spaced apart guide rolls outside of and in contact with said belt and pressing said belt against said drum, and means for driving one of said rolls to tension said belt around and against said drum except between said rolls the shortest distance around the drum.

6. A heat transfer device, comprising: a rotatable heat transfer drum, means insulating the ends of said drum, an endless, imperforate, flexible belt which is longer than the circumference of said drum and is placed around and in contact with said drum, means sealing the entire length of the edges of said belt to the edges of said drum, means for maintaining all but a small portion of the length of said belt in contact with said drum, said belt overlying the end insulation a distance to and such insulation being of a thickness to prevent a rate of heat transfer through said sealing means, such as will solidify material on said sealing means.

FRANK W. KNOWLES.