Apr. 17, 1923.

1,451,903

C. FIELD

HEAT TRANSFERRING APPARATUS

Original Filed May 16, 1921

3 Sheets-Sheet 1

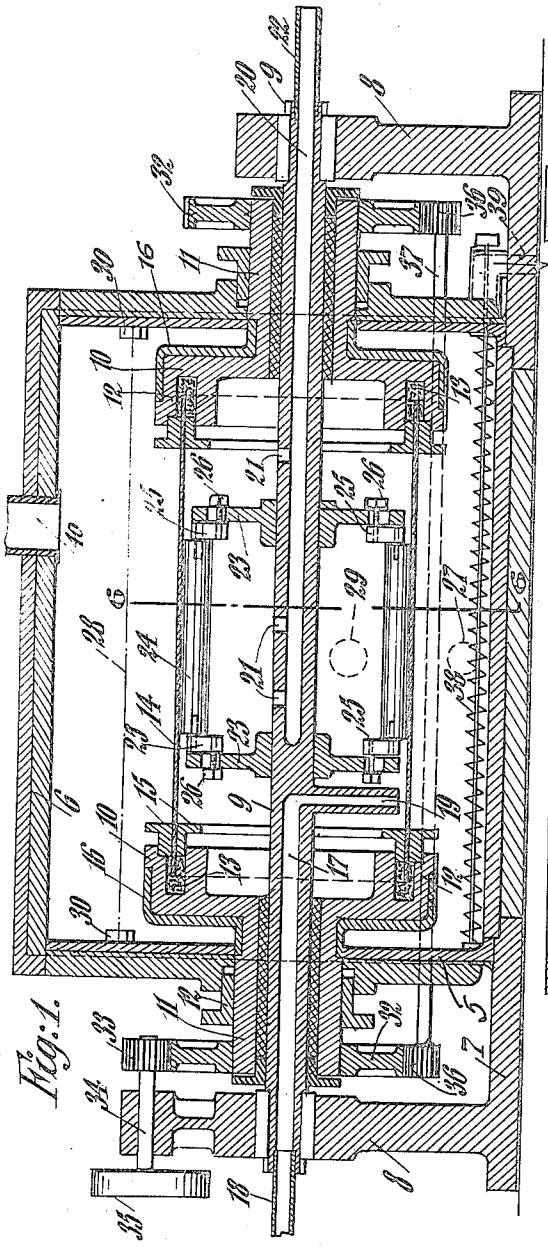


Fig. 1.

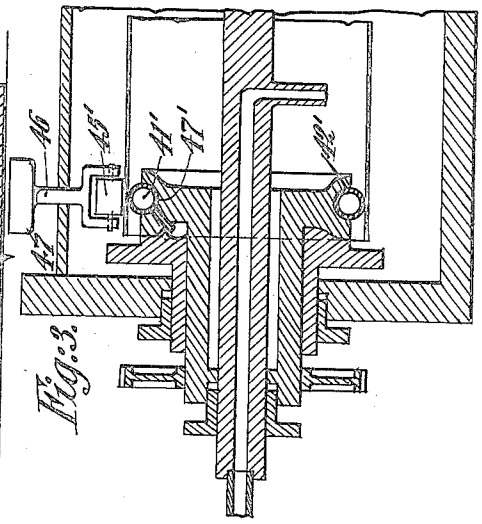


Fig. 3.

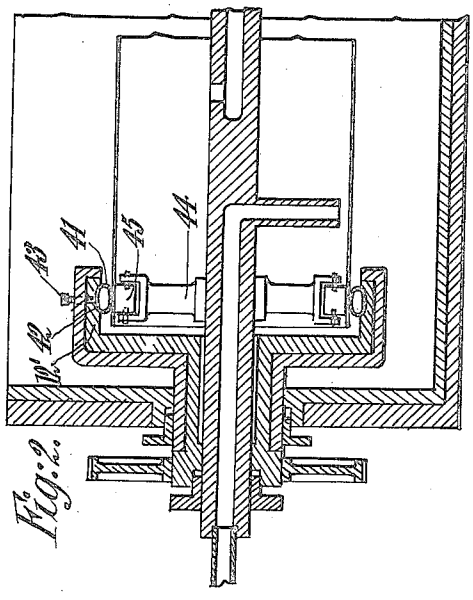


Fig. 2.

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C. FIELD

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Fig:4.

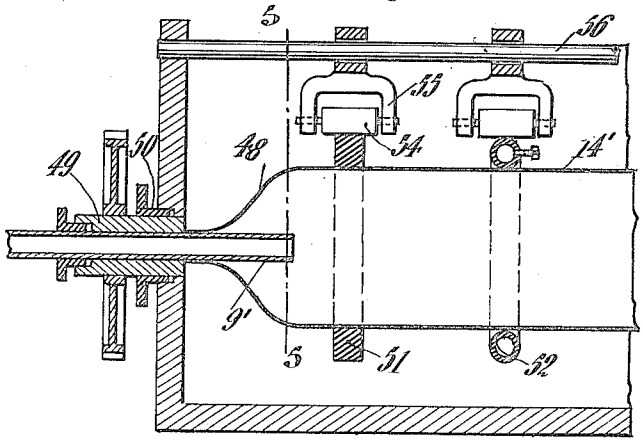


Fig:5.

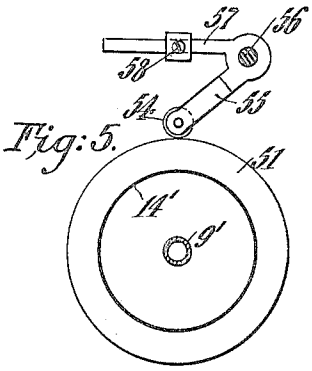


Fig:6.

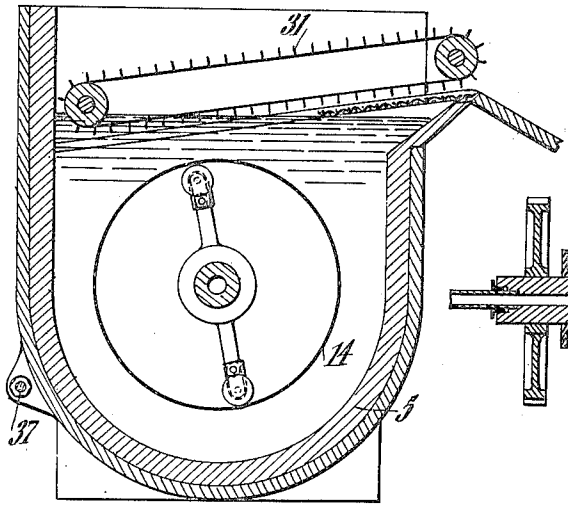


Fig:7.

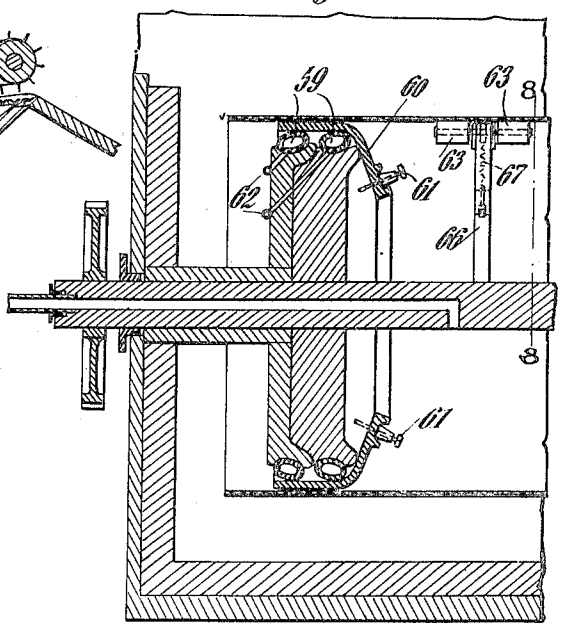
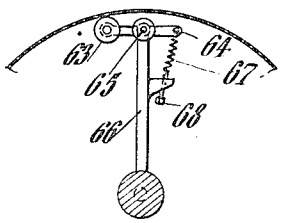


Fig:8.



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Fig: 9.

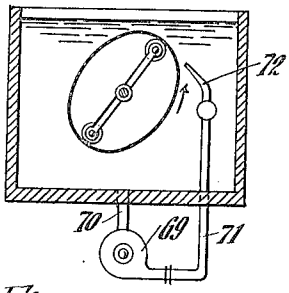


Fig: 10.

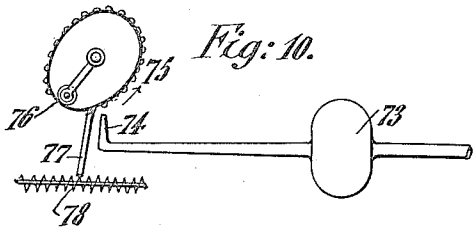


Fig: 11.

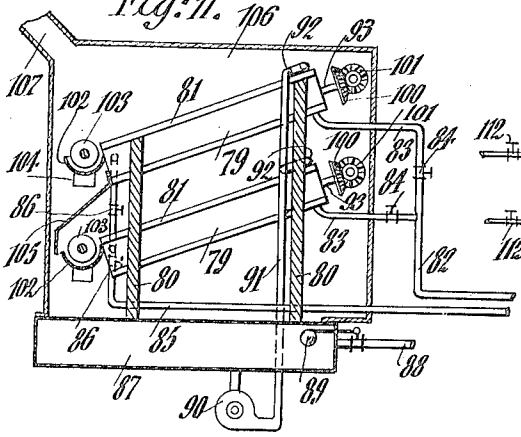


Fig: 12.

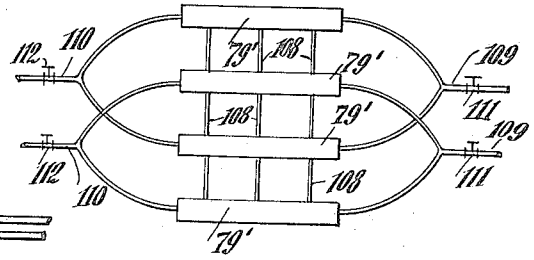


Fig: 13.

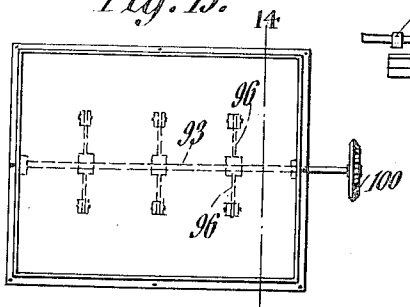


Fig: 15.

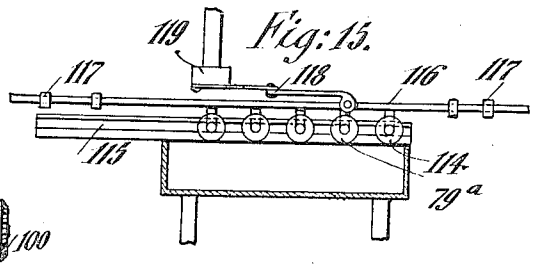
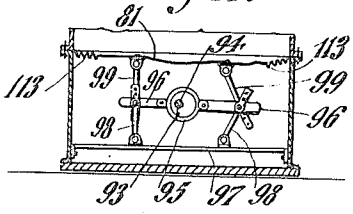


Fig: 14.



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Patented Apr. 17, 1923. 1,451,903

UNITED STATES PATENT OFFICE.

CROSBY FIELD, OF YONKERS, NEW YORK, ASSIGNOR TO CHEMICAL MACHINERY CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

HEAT-TRANSFERRING APPARATUS.

Application filed May 16, 1921, Serial No. 469,797. Renewed December 20, 1922.

To all whom it may concern:

Be it known that I, CROSBY FIELD, a citizen of the United States, and resident of the city of Yonkers, county of Westchester, and State of New York, have invented certain new and useful Improvements in Heat-Transferring Apparatus, of which the following is a specification.

This invention relates to certain improvements in heat transferring apparatus and generically considered contemplates the provision of simple and effective means for solidifying liquid or semiliquid materials and recovering the solid deposits in an expeditious and inexpensive manner and practically without loss.

More particularly, the present invention is primarily concerned with the production of flake or mush ice in large quantities for use in carrying out various chemical operations, though I do not wish to be understood as limiting the utility of the present improvement to the production of ice, since it might also be advantageously employed for the recovery of solid materials from gases or other agents in which the solids might be carried in suspension.

In accomplishing my purpose the improved apparatus may be briefly here referred to as consisting in the provision of a flexible heat transfer element with one side of which the fluid heat transfer medium is in contact whereby the fluid in immediate contact with the opposite side of said element is converted into a solid, the said element constituting a collector for the solid material, together with mechanical means for flexing or warping the heat transfer element to thereby fracture the coating of solid thereon and cause the same to readily flake off from the surface of said element so that it can be conveniently collected.

In the accompanying drawings I have illustrated several alternative forms of the apparatus, each of which embodies in its structure the fundamental principle just referred to. It will be understood, however, that the drawings should be considered only as illustrative of certain practical embodiments of the invention and not as, in any way, implying limitations thereof.

Referring to these drawings

Figure 1 is a longitudinal sectional view of one embodiment of the apparatus wherein there is employed a hollow cylindrical heat transfer element which receives the refrigerating agent.

Figure 2 is a fragmentary sectional view showing a slightly modified means for establishing a flexible connection between the ends of the rotatable heat transfer cylinder and the heads thereof.

Figure 3 is a similar view showing another alternative form of this flexible connection.

Figure 4 is a fragmentary sectional view of another embodiment of the apparatus, illustrating a slightly different construction of the heat transfer cylinder.

Figure 5 is a sectional view taken on the line 5—5 of Figure 4.

Figure 6 is a section taken on the line 6—6 of Figure 1, showing one means which may be provided for collecting and removing the flake ice from the water containing tank.

Figure 7 is a detail sectional view of another alternative embodiment of the cylinder construction.

Figure 8 is a detail sectional view taken on the line 8—8 of Figure 7.

Figure 9 is a sectional view illustrating an auxiliary means which may be employed to facilitate the complete detachment of the fractured ice film from the surface of the flexible cylinder.

Figure 10 is a semidiagrammatic view illustrating another type of apparatus by means of which the present invention may be carried out.

In Figure 11 I have disclosed an alternative form of the apparatus wherein, in lieu of the rotating cylinder, a flexible plate is employed as the heat transferring element.

Figure 12 is a diagrammatic view showing an alternative arrangement of the construction illustrated in Figure 11.

Figure 13 is a plan view of one of the sections of the apparatus shown in Figure 11.

Figure 14 is a transverse section taken on the line 14—14 of Figure 13, and

Figure 15 is a sectional view showing a slightly different embodiment of the apparatus illustrated in Figure 11.

Referring in detail to the drawings and

more particularly to Figure 1 thereof, 5 designates a tank, the exterior of which is covered with a suitable non-heat conducting lagging, said tank having a removable top or cover 6. This tank is mounted upon a suitable supporting base 7 which is provided on its opposite ends with vertically disposed frame standards 8. In these standards the ends of a fixed shaft 9 are suitably mounted.

Cylinder heads 10, arranged within the tank 5, are freely rotatable upon the fixed shaft 9, each of said cylinder heads being provided with a central hub or extension 11 which is disposed through the stuffing box 12 in one end wall of the tank.

Each cylinder head 10 has an annular flange 12 provided with a continuous annular recess or chamber 13 to receive one end of the flexible metal cylinder wall 14. Each end of this cylinder wall is yieldingly held for longitudinal movement between inner and outer annular glands 15. The chamber 13 receives a suitable packing material which affords a water tight connection between the cylinder ends and the heads 10 while permitting of the movement of the cylinder ends in said chambers. The exterior of each of the cylinder heads is preferably covered with a suitable insulating material 16.

The fixed shaft 9 is provided with an axially extending passage 17 to which brine or other suitable heat transfer agent is supplied through the pipe 18 from a convenient source. The inner end of this passage terminates adjacent to one end of the cylinder and the shaft is formed with a radially extending tubular arm 19, constituting a continuation of said passage and through which the refrigerant is distributed within the rotating cylinder. The fixed shaft 9 is further provided with a second axially extending pasage 20 and a plurality of openings 21 afford communications between this passage and the interior of the cylinder 14. Thus, the refrigerating agent may find a free outlet through said openings and the passage 20 from which it is conducted by the pipe or conduit 22 and returned to the source of supply.

Within the cylinder 14, spaced brackets 23 having oppositely extending radial arms are secured. Rollers 24 are mounted at their ends in bearings 25 and these bearings are radially adjustable upon the bracket arms by means of screws 26. Thus, the rollers 24 may be adjusted to exert any desired pressure against the interior of the cylinder wall 14.

The fluid to be treated is admitted to the tank 5 through the opening indicated at 27, the normal level of such fluid being indicated by the broken line 28. However, it is to be understood that the fluid need not necessarily completely cover the cylinder 14, but if desired, in practice, this cylinder need only be partly submerged in the fluid. In cases where the solid to be recovered is heavier than the fluid, the fluid is admitted to the tank 5 through the opening 29, which is at a higher elevation than the opening 27. Also when only partial submersion of the cylinder is desired the excess fluid may be drawn off through this opening.

To the opposite end walls of the tank 5 at the fluid level 28 suitably supporting tracks 30 are arranged for the endless conveyor shown at 31 in Figure 6.

To each of the hub extensions 11 of the cylinder heads 10 a cog gear 32 is fixed With one of these gears, a drive pinion 33 on one end of the shaft 34 is engaged, said shaft having a belt wheel 35 on its other end to receive a belt driven from a motor or other suitable source of power. The gears 32 also mesh with the pinions 36 on the ends of a shaft 37 which is journaled in suitable bearings provided on the exterior of the tank 5. Thus, an even driving force is applied to each of the cylinder heads. In the bottom of the tank 5 a screw conveyor 38 is arranged and when the solid materials are heavier than the fluid being treated, this conveyor is operated to discharge the solid material through the outlet indicated at 39. When not being used any one of the openings 27, 29 or 39 may be closed by suitable means, not shown, so that there will be no interference with the proper functioning of the other openings.

In the operation of the apparatus as above described, assuming that it is desired to produce flake or mush ice, the water is admitted to the tank 5 through the opening 27. Brine or other refrigerating agent is supplied to the cylinder 14 and said cylinder is continuously rotated while a continuous circulation of the brine is maintained through said cylinder and the passages of the shaft 9. By keeping the brine in immediate contact with the inner surface of the flexible cylinder wall, heat will be transferred to said wall from the water which is in immediate contact with the outer surface thereof so that the water is caused to congeal and freeze thereon, forming a coating of ice, of greater or less thickness determined by the speed of rotation of the cylinder. The rollers 24 are spaced apart so that the distance between their outer peripheral portions is slightly in excess of the normal internal diameter of the cylinder 14. Thus, as the cylinder wall passes over each of these rollers, the said wall will be flexed. The cylinder ends are relieved of undue strain and possible breakage by the provision of the glands 15. With each flexure of the cylinder wall, the ice film which has formed thereon is fractured, or in other words, said film is broken up into a

multiplicity of comparatively small sections of irregular parallelogrammatic configurations. The crevices thus produced in the film of ice permits the water to freely enter, which facilitates the destruction of the adhesive force tending to retain the pieces of ice upon the metal surface of the cylinder. Thus, these small ice flakes are immediately detached from the surface of the cylinder and float to the surface of the water in the tank. The ice film is then immediately reformed on the surface of the metal cylinder and this action of flaking off the ice film and the reformation thereof goes on continuously. The ice flakes which collect upon the surface of the water are removed from the tank by the conveyor 31.

When gases or other fluids are operated upon and the recoverable solids which are recovered by the transfer of heat are of greater specific gravity than the fluid medium they will settle to the bottom of the tank. In such cases the solid materials are removed by the screw conveyor 38 while the gas passes off through the flue 40 in the top or cover of the tank 5. In such case it will be understood that the opening in the tank wall for the conveyor 31 is closed.

It is, of course, essential that the packing means 15 shall exert sufficient frictional pressure against the cylinder wall 14 so as to prevent the escape of the brine therefrom or the entrance of the fluid to the interior of said cylinder, though without impairing the desired flexibility of the connection of the cylinder ends to the heads 15.

In Figure 2 of the drawings I have illustrated a slightly modified form of this packing means for the cylinder ends wherein a continuous inflatable tube 41 is seated in a channel 42 formed in the inner face of the flange 12′ of the cylinder head. In this case, the flange is not grooved or chambered to receive the end of the cylinder, as in the construction seen in Figure 1, but the cylinder end fits within the tube 41. The inflating nipple or valve 43 for this tube extends radially through the flange of the cylinder end and is adapted to be connected by suitable tubing to a pump or other source of air under pressure.

Upon the fixed shaft 9 a radially disposed arm 44 is secured in the end of which the roller 45 is mounted, said roller bearing against the inner surface of the cylinder wall at a point in line with the point of contact of the tube 41 against the outer surface of said wall. It will be understood that if desired a greater number of rollers 45 may be employed. By means of this construction, it will be apparent that when the tube is inflated an absolutely tight connection is secured between the cylinder end and the rotating head so that the two parts will rotate as a unit. At the same time, however, the inflating tube will permit of a relatively free angular flexing movement of the cylinder wall with relation to the cylinder head.

In Figure 3 I have illustrated still another form of this packing means for the cylinder end, wherein the inflatable tube 41′ is arranged in an annular groove 42′ formed in the periphery of the rotatable heat at one end thereof which is disposed within the end of the cylinder. This tube 41′ when inflated exerts a strong outward pressure against the inner surface of the cylinder wall, which pressure is opposed by one or more rollers 45′ engaged upon the exterior of the cylinder wall and mounted in the lower ends of the rods 46 which are loosely movable through openings in the top wall of the casing and have weights 47 on their upper ends. Both of these constructions last described are very effective in practical use. However, many other alternatives for the flexible packing between the ends of the flexible cylinder and the rotating heads might be adopted.

In Figures 4 and 5 I have shown another alternative form of the invention wherein the wall of the rotating cylinder 14′ is contracted at its ends as shown at 48 to provide closures, said contracted ends of the cylinder being extended longitudinally along the fixed shaft or conduit 9′ from which the refrigerant is admitted to the interior of the cylinder and connected to the rotatable sleeve 49 which is mounted in the stuffing box 50 in the end wall of the tank or casing. If desired, the contracted ends 48 of the flexible cylinder may be corrugated in order to afford greater flexibility. Adjacent to each end of the cylinder, an annulus or gasket 51 of solid rubber or other material may be arranged thereon or on the other hand this gasket may be in the form of an inflatable tube 52. Upon the upper side of this gasket, the roller 54 mounted in the yoke 55 is engaged. This yoke is pivotally supported upon a rod 56 and is provided with an arm 57 on which an adjustable weight 58 is engaged. By properly adjusting this weight along the arm 57, the roller 54 may be caused to exert the desired pressure upon the flexible gasket and through this gasket, the wall of the cylinder 14′ will in turn be flexed so as to fracture the ice film which has formed upon the exterior surface thereof.

In Figures 7 and 8 of the drawings I have disclosed another embodiment of the invention wherein the cylinder head is arranged within the end of the cylinder and is provided upon its periphery with the two inflatable tubes or gaskets 59. Between these inflatable tubes and the wall of the cylinder a sheet of flexible packing material 60 is interposed, said packing material being extended upon the inner side of the cylinder head and secured thereto as at 61. From

this arrangement it will be understood that when the tubes 59 are inflated through the medium of the tube connections 62 the sheet of packing material 60 is forced outwardly into tight contact with the inner surface of the cylinder wall, thereby producing a fluid tight packing or seal, while at the same time affording an extensive flexible contact surface with which the cylinder wall is engaged. In this embodiment of the invention for the purpose of flexing the cylinder wall, I employ one or more pairs of rollers 63 engaged with the inner surface of said wall and mounted upon an arm 64 which is fulcrumed intermediate of its ends as at 65 upon a support 66 mounted on the central shaft extending through the cylinder. A coil spring 67 is connected to one end of this arm, and said spring is attached to the adjustable bolt or screw 68 whereby the tension may be properly regulated to cause the desired degree of pressure of the rollers 63 against the cylinder wall.

In Figure 9 of the drawings, I have illustrated an auxiliary means for facilitating the complete separation or detachment of the fractured ice film from the wall of the cylinder. This means includes a pump indicated at 69 having a direct connection 70 with the bottom of the tank. To the pump outlet a pipe or tube 71 is connected and extends upwardly into the tank, said pipe having nozzles 72 which directs jets of water under pressure against the surface of the cylinder, preferably at a point above its axial center. It will be understood, of course, that a suitable header provided with any desired part of the nozzle 72 may be connected to the upper end of the pipe 71 so that a series of jets will be projected against the fractured ice film. These jets of water entering the crevices in the film of ice exert a comparatively great force, it being understood that the jets are delivered in a direction opposite to the direction of rotation of the cylinder. These water jets in addition to the natural action of the water in the tank or casing will effect the immediate release or displacement of the small fragments of ice from the periphery of the cylinder upon the cracking of the ice film so that new ice will form thereon.

In Figure 10 of the drawings, I have illustrated another form of the invention wherein the use of a tank or container for the water or other fluid is dispensed with and the water is delivered by means of pump or other source of water under pressure indicated at 73 from a spray nozzle 74 which delivers the water in the form of a fine spray against the rotating cylinder 75. This cylinder has a flexible wall, as above referred to, and one or more flexing rollers 76 or their equivalent means is arranged within said cylinder at the desired point. Assuming that the cylinder is filled with the refrigerant circulating therethrough, the water spray immediately upon striking the peripheral surface of the cylinder wall congeals into ice, thus producing upon the surface of the cylinder a multiplicity of small ice cakes or pieces which are slightly separated from each other. It will be understood that the freezing action is practically instantaneous and there is no opportunity for the water to run or flow on the surface of the cylinder wall so that the drops of spray will unite with each other. When the cylinder passes over the roller 76, the wall thereof is flexed and by such flexing action the separate minute particles of ice become detached from the wall of the cylinder. A suitable shield 77 is provided which prevents the detached ice particles being thrown into the water spray and by which the ice particles are directed to a suitable conveyor 78.

In Figure 11 of the drawing I have illustrated another type of apparatus consisting of a plurality of similar units. In this case a series of vertically spaced boxes or compartments 79 are mounted between suitable standards or supports 80. Each of these boxes is provided with a top wall in the form of a flexible plate 81, having longitudinal side flanges, and said boxes are arranged at an inclination between the supporting standards and in parallel relation to each other.

The brine or other refrigerating agent is supplied to the upper ends of the inclined boxes through the pipe 82 having branches 83 each of which is provided with a valve 84 whereby the supply of the refrigerant to said boxes may be independently controlled. The refrigerating agent is returned to the source of supply through the pipe 85, also having branches connected to the lower ends of the respective boxes and provided with the valves indicated at 86.

Below the series of boxes 79 a water tank or reservoir 87 is arranged and is fed through the pipe 88, the float valve 89 maintaining a constant water level in said tank. A pump 90 of any suitable type forces the water under pressure from said tank through the pipe 91, said pipe having transversely disposed spray pipes 92 connected therewith and respectively disposed over the flexible plates 81 adjacent their upper ends. The water is delivered from these pipes 92 in a plurality of jets and evently distributed over the surfaces of the flexible plates.

Various mechanical devices might be provided for the purpose of flexing the plates 81, but as herein shown, I preferably provide for this purpose a shaft 93 extending longitudinally between the top and bottom walls of each box 79 and journaled in suitable bearings at the ends thereof. Upon this shaft spaced eccentrics 94 are fixed, each of

said eccentrics operating a yoke 95 having oppositely extending arms 96. A fixed bar 97 extends longitudinally above the bottom wall of the box and links 98, 99 are respectively connected at one of their ends to said bar and the flexible plate 81. The other ends of these links are connected to the arms 96, it being understood that there are two pairs of the links associated with each eccentric and arranged upon opposite sides of the shaft 93. The upper end of each shaft 93 has a beveled gear 100 fixed thereto and meshing with a similar gear 101 driven from any suitable source of power. By means of this arrangement, it will be understood from reference to Figure 14, that in the operation of the eccentrics 94 the links 98, 99 on opposite sides of the shaft 93 are alternately expanded and collapsed so that the metal plate 81 at one side of its transverse center is projected upwardly while at the other side thereof the plate is pulled downwardly, thus imparting an undulating flexing movement to said plate.

At the lower end of each of the flexible plates 81, a trough 102 is arranged in which a screw conveyor 103 is operatively mounted. The bottom portions of these troughs are foraminated or constructed of wire mesh or other reticulated material so that water may freely drain therethrough and each trough is provided with a longitudinally extending discharge channel 104 for the water. Between the lower ends of the two boxes or compartments 79 a water deflecting plate 105 is arranged so as to prevent any water which may escape the upper trough 102 from entering the lower trough.

In the operation of this form of the apparatus a continuous circulation of the brine or other refrigerant through the boxes or compartments is maintained, and a volume of water is delivered from the pipes 92 upon the upper surface of the plates 81. The heat is transferred from the water through these plates to the brine so that the water freezes in the form of a thin film of ice. The flexing mechanism for said plates is operated at a predetermined speed in accordance with the desired thickness of the ice film and a waving or undulating movement is imparted to these plates so that the ice film is fractured into relatively small fragments and freed from adhesion to said plates. The ice fragments will gravitate downwardly upon the inclined plates and into the troughs 102, from which it is carried by the conveyors 103 and discharged into suitable hoppers. Each of the boxes or compartments with the ice receiving and conveying means and flexing mechanism constitutes a separate unit and the apparatus may consist of any desired multiple of such units as the necessities of the particular case may require.

If desired an insulating cover or casing 106 may be provided for the apparatus, said casing having an outlet 107 for such vapors as may be produced in the drying of various materials.

In Figure 12 I have illustrated an alternative form of the apparatus last described, wherein both the top and bottom walls of the boxes or compartments 79′ are in the form of flexible plates. The top wall of one box is connected to the bottom wall of the next box in the series by means of a plurality of rigid standards 108, the refrigerant is admitted under pressure alternately to the adjacent boxes or compartments through the supply pipes 109 and is carried off through the outlet pipes 110, each of said pipes having branches connected to the alternate boxes or compartments in the series. These supply and outlet pipes are equipped with valves 111, 112 respectively, which are suitably connected for automatic operation so that when the valve in one of the inlet pipes is closed the valve in the corresponding outlet pipe is opened and vice versa. The pressure of the refrigerant upon the flexible walls of the boxes 79′ to which the refrigerant is being admitted expands said walls and the opposite walls of the remaining boxes of the series are forced inwardly through the medium of the connected standards 108, it being understood that the supply of refrigerant to the latter boxes has been cut off and the outlet connections are open. Thus, in this construction it will be seen that the flexing of the walls of the boxes or compartments occurs automatically and it is not necessary to provide a mechanical flexing means. The means for delivering the water upon the upper walls of the boxes or compartments, and the ice collecting means is the same as I have above described in connection with the apparatus shown in Figure 11. Preferably, the flexible wall or walls of each of the boxes or compartments is corrugated at its opposite ends as indicated at 113 so as to permit of the free flexing movement of said wall without liability of breakage or rupture thereof.

In Figure 15 I have illustrated a further modification of this type of apparatus wherein a plurality of rollers 114 are supported at their ends in the tracks or guide ways 115 and have rolling contact upon the flexible upper wall of the refrigerant receiving box or compartment as shown at 79ª. These rollers are reciprocated through the medium of a bar 116 moving in suitable guides 117, said bar being actuated by a crank arm 118 which is connected to a belt driven wheel or pulley 119. The pressure of the refrigerant in the box or compartment 79ª tends to expand the flexible top wall thereof, such expansion being resisted by

the spaced rollers 114 so that the flexible wall assume a wavy or undulating shape. Water is supplied to the upper surface of this flexible metal plate or wall as previously described, said plate serving as a means for the transference of heat from the water to the refrigerant. The water is thus frozen and converted into ice and cracked or fractured into small fragments by the flexing of said wall. Any convenient means similar to those hereinbefore referred to may be employed for removing this cracked ice so that the process of ice formation and removal of the desired thickness may go on continuously.

From the foregoing description, considered in connection with the accompany drawings, the construction and manner of operation of the several embodiments of the invention herein referred to will be readily understood. It is manifest, however, that the end in view might be accomplished by other alternative forms of this apparatus and that it may also be advantageously employed for recovering solids from gases and the drying of various materials, although I have referred to the apparatus as being primarily designed for the production of flake or mush ice. It is, therefore, to be understood that I do not desire to be limited to the exact embodiments herein described or to the precise form and construction of the detail parts thereof, but reserve the privilege of adopting all such legitimate changes as may be fairly embodied in the spirit and scope of the invention as claimed.

I claim:

1. In a heat transference apparatus, a tank adapted to contain a fluid, a cylinder rotatably mounted in said tank in contact with the fluid therein, means for circulating a heat transfer medium through said cylinder to thereby convert the fluid in contact with the cylinder wall into solid form, said cylinder wall constituting a collector of the solid deposit, and means within the cylinder for imparting an undulating movement to the wall thereof to break up the solid deposit on the outer surface of said wall and thereby facilitate its easy removal.

2. In a heat transference apparatus, a flexible heat transfer element, means for supplying a fluid to be converted into solid form to one side of said element, means for supplying a temperature controlling medium for contact with the opposite side of said element and means operatively engaged with the latter side of the flexible element to flex the same and fracture the film of solid material collecting thereon to cause said material to scale off or to separate from the flexible heat transfer element.

3. In a heat transference apparatus, a chamber through which the heat transfer medium is adapted to be circulated, said chamber having a flexible wall, means for supplying a fluid to be converted into solid form against the outer side of the chamber wall, said wall constituting a collector of the solidified material and means within the chamber for flexing said wall to fracture the film of material thereon and cause the same to flake or scale off from the surface of said wall.

4. In a heat transference apparatus, a tank adapted to receive a fluid to be converted into solid form, a cylinder rotatably mounted within said tank, means for circulating a temperature controlling medium through said cylinder, said cylinder having a flexible wall constituting means for the transference of heat between said medium and the fluid in contact with the outer surface of said wall, whereby such fluid is converted into solid form, and relatively stationary means for flexing said cylinder wall to fracture the film of material thereon and cause the same to scale off from the surface of said wall.

5. In a heat transference apparatus, a tank adapted to receive a fluid to be converted into solid form, a cylinder rotatably mounted within said tank, means for circulating a temperature controlling medium through said cylinder, said cylinder having a flexible wall constituting means for the transference of heat between said medium and the fluid in contact with the outer surface of said wall, whereby such fluid is converted into solid form, and relatively stationary means mounted within the cylinder and co-acting with the wall thereof to flex said wall and cause the film of solid material to scale off from the surface of the wall.

6. In a heat transference apparatus, a tank adapted to receive a fluid to be converted into solid form, a cylinder rotatably mounted in said tank and having spaced heads, a cylindrical wall and means affording a yielding connection between the ends of said cylindrical wall and the heads, means for circulating a temperature controlling medium through said cylinder in contact with the inner surface of said wall, said wall constituting means for the transference of heat between said medium and a fluid in contact with the outer surface of said wall, whereby said fluid is converted into solid form, and relatively stationary and means co-acting with the inner surface of said cylinder wall to flex the same and cause the film of solid material thereon to flake off from the surface of the wall.

In testimony that I claim the foregoing as my invention, I have signed my name hereunder.

CROSBY FIELD.