Aug. 30, 1955 E. A. OSTROM 2,716,331

CHIP-ICE MACHINE

Filed Dec. 16, 1950 6 Sheets-Sheet 1

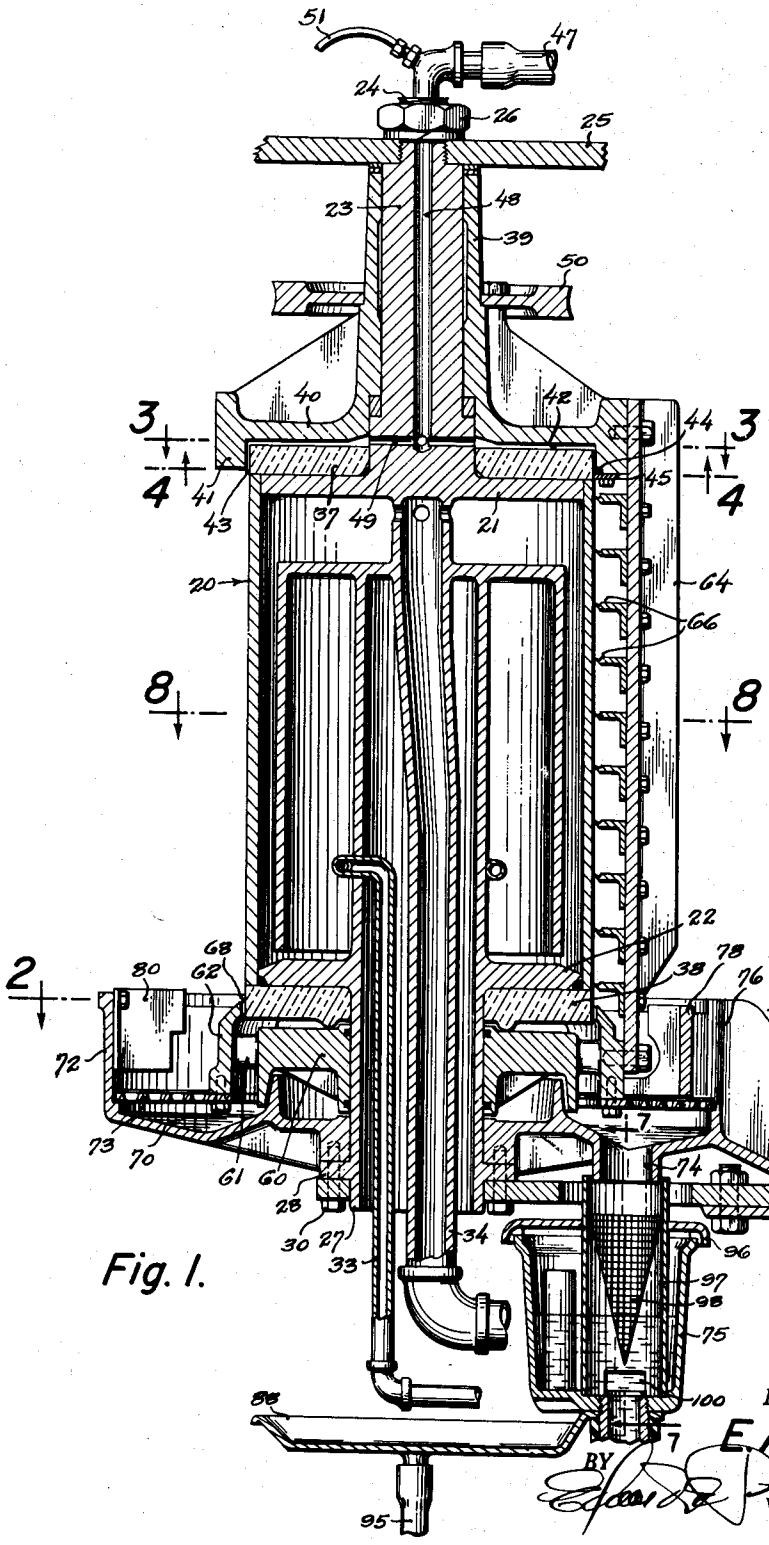


Fig. 1.

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CHIP-ICE MACHINE

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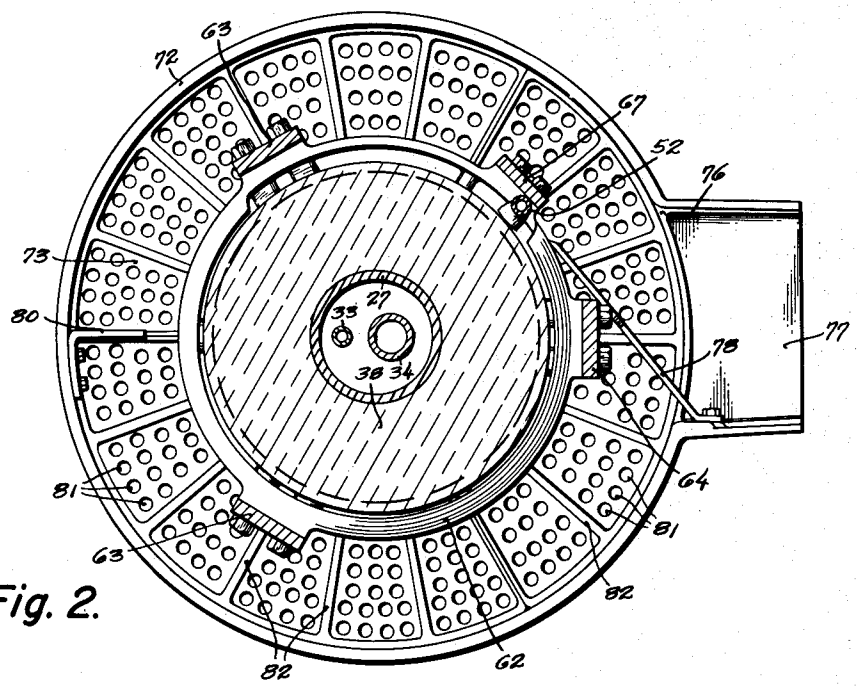


Fig. 2.

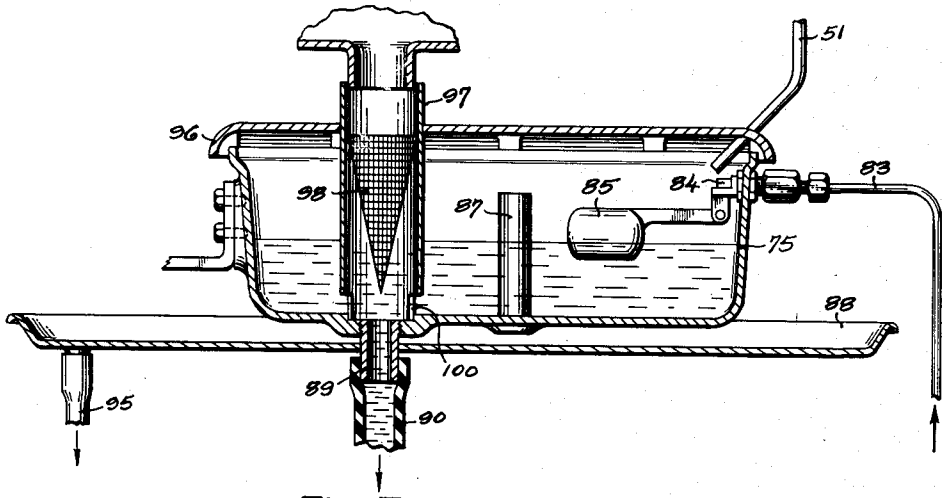


Fig. 7.

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CHIP-ICE MACHINE

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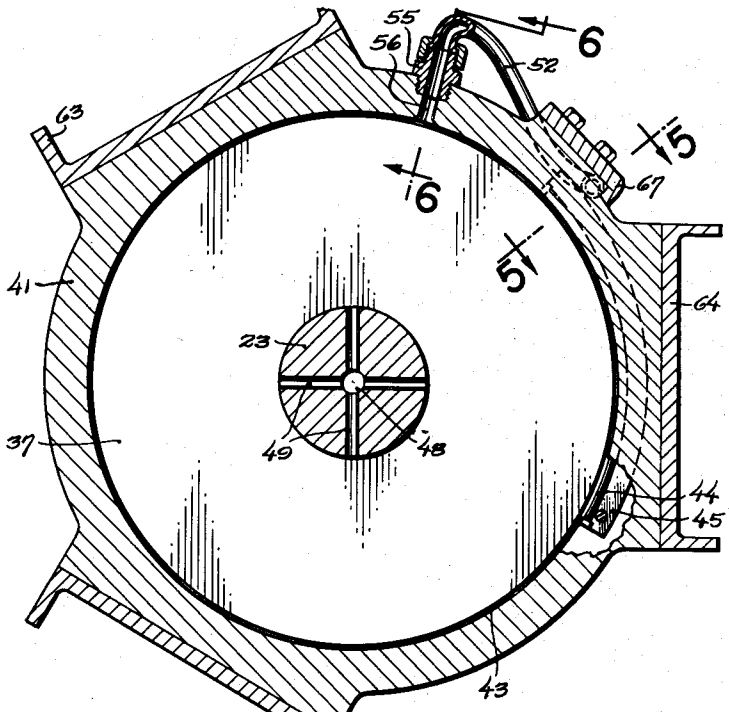


Fig. 3.

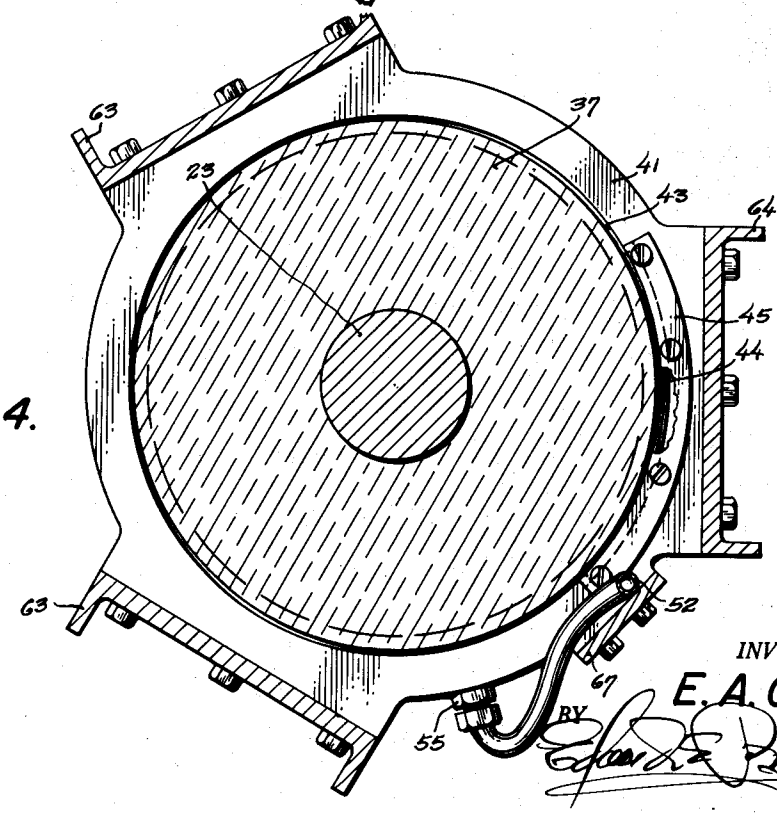


Fig. 4.

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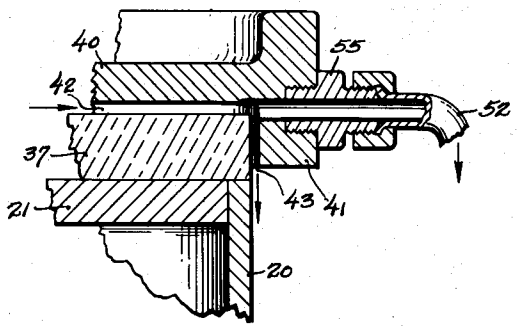


Fig. 6.

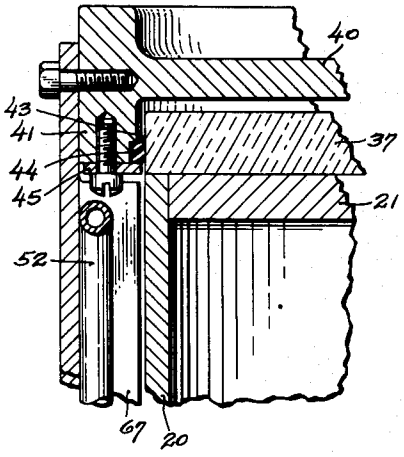


Fig. 5.

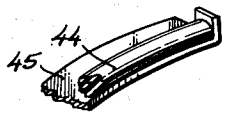
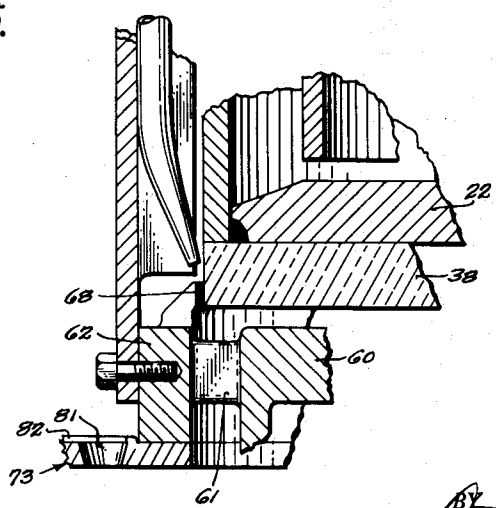


Fig. 10.



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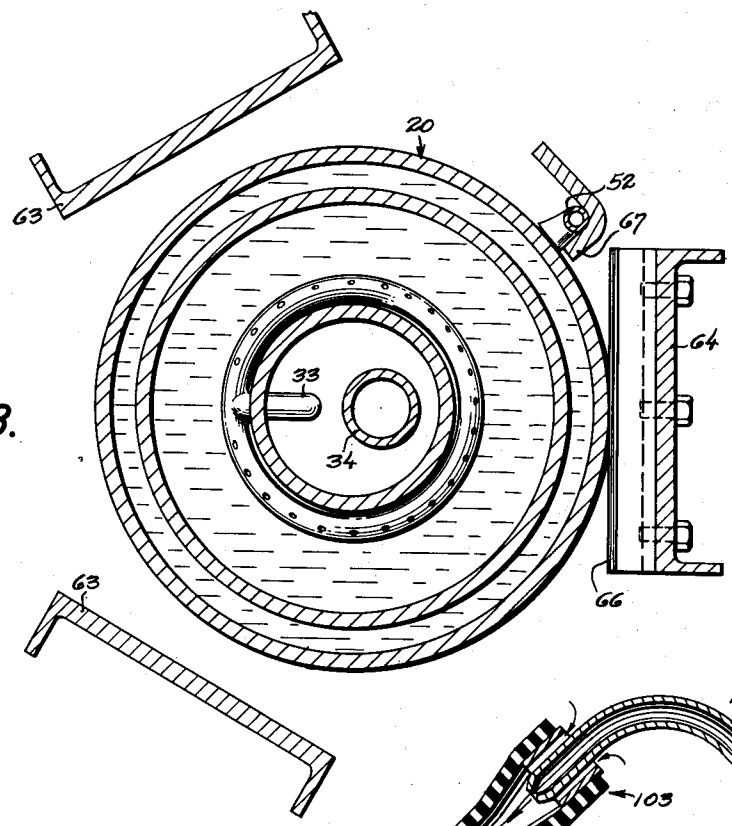


Fig. 8.

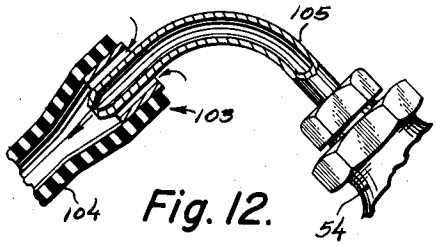
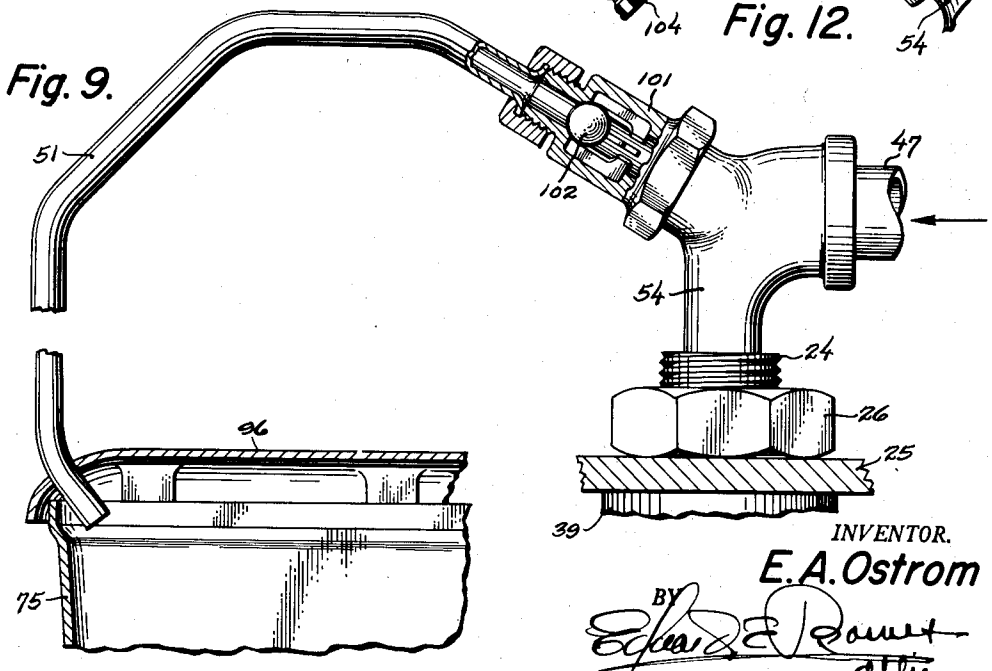


Fig. 12.

Fig. 9.



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CHIP-ICE MACHINE

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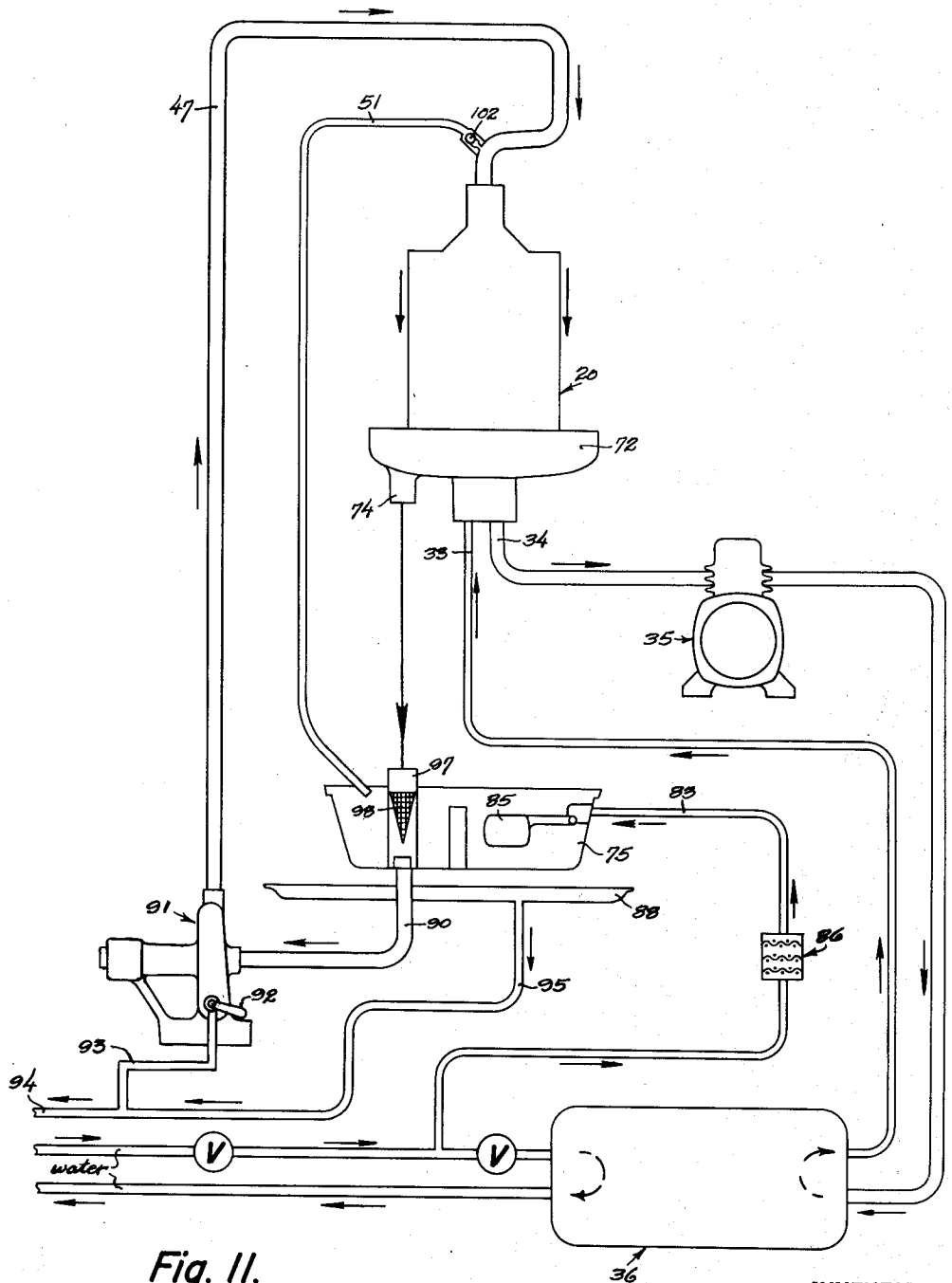


Fig. 11.

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2,716,331

CHIP-ICE MACHINE

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Application December 16, 1950, Serial No. 201,129

8 Claims. (Cl. 62—107)

This invention relates to a machine for producing chip ice, and pertains more especially to a chip-ice machine of the nature illustrated and described in pending United States patent application of James H. Lessard and Gerald M. Lees, Ser. No. 40,646, filed July 26, 1948, now Patent No. 2,585,020.

Generally considered, the Lessard-Lees machine is one which embodies a vertically disposed cylinder whose outer surface is rigid and chilled to a quick-freeze temperature. Above the cylinder and mounted for rotation about the center of the cylinder as an axis there is provided a chambered head supplied with water under pressure, and about the perimeter of this chamber an annular throat is provided for delivering a downwardly flowing unbroken stream of water over the freezing surface of the cylinder, an arcuate portion of this throat being blocked off in order that the flowing stream will curtain less than the full circumstance of the freezing surface. The sheet of ice which forms upon the freezing surface is cracked and dislodged by the action of multiple knives working in complement with a following drag bar, such knives and bar being caused to rotate in concert with the water-head about the center of the cylinder as an axis and being located below the blocked-off portion of the throat in order that the freed ice will be in a dry state. The operation is one in which an excess of water is delivered over the freezing surface, and at the bottom of the cylinder the ice is collected and the excess water recovered and returned, together with augmenting fresh water, to the water chamber of the head.

The Lessard-Lees machine represents a definite advance in the ice-making art inasmuch as its ice-making capacity is well above that of any previously existing machine of comparable size and operating cost, and the produced ice is superior from the standpoint of texture and keeping quality. The machine does, however, exhibit some faults, and it is these faults which the present invention aims to correct.

To enumerate, one objection is concerned with the chamber of the water head and its delivery throat, and particularly the instrument employed to block off a portion of this throat. The Lessard-Lees machine introduces a sectoral spacer between the top and bottom walls of the water chamber and employs the rim of this spacer as a means for blocking the throat. To prevent seepage past the plate, the plate must perforce find an exact fit with both the floor and ceiling of the water chamber and must also establish a water-tight fit against the outer internal wall of the chamber, all of which requires a close-tolerance machining operation. Should rivulets of water trickle over the area of Dry Ice lying below the plate, the same freezes thereon as surface ridges, hence destroying the uniform-thickness condition which is of paramount importance to a proper functioning of the cracking knives.

Another fault of the Lessard-Lees machine is that a vacuum develops in the head end of the machine when the water pump which circulates the water is inactivated at the close of an ice-making operation. Water in a static

condition thus becomes trapped in the water chamber, and not infrequently freezes before the slow bleeding action can clear the chamber.

Still another objection to the Lessard-Lees machine is that the drag blade, in performing its intended office of clearing the ice fragments cracked by the knives, becomes chilled to a point whereat the ice adheres thereto.

In the Lessard-Lees machine trouble has also been experienced in collecting the produced ice chips and delivering the same to a receiving bin without clogging the delivery chute.

The manner in which I overcome these several faults, and provide a machine which is perfected in several other respects, will appear in the course of the following description and claims, the invention consisting in the novel construction and in the adaptation and combination of parts hereinafter described and claimed.

In the accompanying drawings:

Fig. 1 is a transverse vertical section illustrating a chip-ice machine constructed in accordance with the now preferred embodiment of the present invention.

Fig. 2 is horizontal section on line **2—2** of Fig. 1.

Figs. 3 and 4 are horizontal sectional views drawn to an enlarged scale on lines **3—3** and **4—4**, respectively, of Fig. 1.

Fig. 5 is a fragmentary transverse vertical sectional view detailing top and bottom portions of the machine and drawn to a yet larger scale on line **5—5** of Fig. 3.

Fig. 6 is a fragmentary transverse vertical section on line **6—6** of Fig. 3 with the employed scale corresponding to that of Fig. 5.

Fig. 7 is a vertical sectional view drawn to an enlarged scale on line **7—7** of Fig. 1.

Fig. 8 is a horizontal sectional view on line **8—8** of Fig. 1, using the same enlarged scale as that of Figs. 3 and 4.

Fig. 9 is a fragmentary vertical sectional view detailing a device embodied in the machine to preclude a vacuum from developing in the water-head when the water flow is stopped.

Fig. 10 is a fragmentary perspective view detailing the perfected device which I employ for blocking off an arcuate portion of the water-delivery throat.

Fig. 11 is a schematic view portraying the refrigerant and water circulation systems of the machine; and

Fig. 12 is a fragmentary view illustrating a device which may be used as an alternative to the device detailed in Fig. 9.

Referring to said drawings, the numeral **20** designates a hollow cylindrical drum into and from the interior of which Freon or other like or suitable refrigerant is circulated. The liquid to be frozen is supplied to the outer surface of the drum to cause such liquid to freeze and produce a sheet of ice thereon. In the following description and claims said liquid will be referred to as water in the belief that such will add to clarity in an understanding of the invention, the intention being, however, to include by this term all applicable liquids.

The drum is mounted to have its axis lie vertically and is desirably composed of stainless steel with the ends closed by top and bottom headers **21** and **22**, respectively, each welded or otherwise integrally joined to the drum proper. The top header **21** provides an upwardly extending axial prolongation **23** terminating at its upper end in a threaded neck **24**. An over-head frame-piece **25** presents an opening through which this projects, and a clamping nut **26** threads upon the neck to suspend the drum from the frame-piece. The bottom header **22** provides a tubular downwardly extending axial prolongation **27** presenting at its lower end a flange **28**, and this flange is bolted, as at **30**, to a stabilizing plate **31** which is bolted or otherwise made secure to a frame-piece **32**.

Pipes 33 and 34 accommodated within the hollow center of said prolongation 27 act respectively to feed liquid Freon into the interior of the drum and to draw off the gas which develops when this liquid boils. The refrigeration circuit in which the drum and said pipes 33 and 34 are contained is portrayed schematically in Fig. 11, comprising the usual compressor 35 and a water-cooled condenser 36. Respective plates 37 and 38 composed of Bakelite or other like or suitable insulating material overlie the top header 21 and underlie the bottom header 22 and are each screwed or otherwise secured to the related header to become a rigid part of the drum assembly. The rims of these plates are flush with the exterior surface of the drum.

The water which is to be frozen upon the drum is supplied from above, and for this purpose there is provided a wheel-like water-head having a hub section 39 journaled upon the prolongation 23 for rotation about the center of the latter as an axis, and presenting below the hub a disk 40 from which there depends a peripheral flange 41 of somewhat less depth than the thickness of the insulating plate 37 and whose inside diameter slightly exceeds the outside diameter of said plate. A thrust bearing acts to elevate the underside of this disk slightly above the plate 37 and there is thus defined between the plate and the disk a chamber 42 which communicates about its perimeter with an annular throat 43 described between the insulating plate and the skirting flange 41. At the lower or delivery end of this throat a sectoral portion thereof comprehending by preference an approximate 80° span is closed off by a dam 44 composed by preference of a neoprene strip made sectionally to an O shape, and to hold this dam in position with the material compressed to bear snugly against the outside face of said insulating plate 37 there is provided a retainer 45 secured by screws 46 to the underside of the skirting flange 41. The water, under a comparatively moderate pressure of say 2 p. s. i., is supplied by a feed pipe 47 to the head end of a center-bore 48 drilled into the prolongation 23, and thence feeds into the chamber by cross-ducts 49. The water-head turns, by preference, at 1 R. P. M. and receives its power from a motor-driven worm (not shown) driving a worm-wheel 50 bolted to the water-head. Pipes 51 and 52 serving ancillary functions which will be later described are incorporated in the fluid-feed system. The former of these pipes connects with a 3-way fitting 54 applied to the head end of the drum assembly, and the other pipe 52 connects by a fitting 55 with a duct 56 leading laterally off the water chamber.

Below the drum there is journaled for rotation upon the prolongation 27 a spider 60 whose radiating arms 61 rigidly sustain a collar 62. This collar presents a conically developed crown section rising above the lower limit of the insulating plate 36 and having an inside diameter slightly exceeding the outside diameter of said plate. Channel-iron tie-bars, indicated as three in number, extend longitudinally of the drum from the water-head above to the collar below and produce that which in effect is a substantial lantern cage. Two of these tie-bars, designated by 63 in each instance, perform only a stiffening office while the third tie-bar 64 gives support to a plurality of ice-cracking knives 66. These knives correspond in point of structure and placement with the knives illustrated and described in the above-identified Lessard-Lees application, and this is to say, structurally considered, that the cracking edges of the knives lie tangent to the perimeter of the drum and are defined by two converging faces both of which slope in a corresponding direction from the horizontal. From the standpoint of placement, the knives are so located as to perform their cracking function within a sectoral area of the drum's surface free of flowing water, and namely below that portion of the delivery throat 43 which in the present machine is blocked off by the neoprene dam 44. As

the ice is cracked by the knives it buckles radially outward between the knives and away from the freezing drum. Trailing the knives and likewise placed below said dam is a longitudinally extending drag blade 67 bolted at its upper end to the water-head and at its lower end to the collar. This blade projects into near touching relation to the drum and operates to dislodge fragments of cracked ice adhering to the drum. The above-mentioned pipe 52 is made to operate as a complement of this drag blade. Such pipe, fed with water from the chamber of the water-head, extends downwardly along the rear face of the drag blade and at its lower end presents a flow-restricting nozzle directing the discharge into the annular bottom throat 68 defined between the insulating plate 38 and the surrounding collar 62. By exchange of heat, the pipe prevents dislodged ice from adhering to the drag blade.

At this point it may be pointed out that the volume of liquid which is delivered from the water chamber through the throat 42 is in excess of the freezing capacity of the drum and issues as an unbroken uniform-thickness stream curtaining the entire circumference of the drum other than that surface of the latter underlying the neoprene dam. At the lower end of the drum the excess of water feeds through the annular throat 68 into a trough 70, such trough being bolted or otherwise firmly secured to the stabilizing plate 31 and presenting about its perimeter a relatively high wall 72 lying in outwardly spaced concentric relation to the collar 62. This wall, in complement with the collar and a floor-forming sectional grate 73 which is rigidly secured to the collar, produces an ice-collecting gutter elevated above the trough. The trough discharges through a sump-hole 74 into a subjacent water-collecting tank 75, and the gutter feeds by a side opening 76 into a discharge chute 77.

In substantially all prior chip-ice machines considerable difficulty has been experienced in obtaining a satisfactory means by which to discharge collected ice fragments without clogging the discharge opening. My rotating grate is a satisfactory answer in that it provides a power-driven conveyor which will progressively advance the collected ice to the discharge mouth 76, whereat the ice is directed through the mouth and into the chute by a stationary diverter 78 extending diagonally across the gutter. It is desirable to give the discharge mouth a circumferential span considerably greater than the width of the gutter. There is an objectionable tendency for a rather high mound of ice to build up immediately below the circumferentially moving knives 66, and this I overcome by providing a levelling blade 80 supported by the wall 72 to occupy a position in the path of the conveyed ice. I find that a single said blade is sufficient to effectively spread the ice and hold the level of the same well below the ceiling limit prescribed by the walls of the gutter but two or more such levellers can perforce be employed.

It will be self-evident that the openings 81 in the grate inherently grip fragments of the ice and are hence self-sufficient to cause the ice collected on the grate to move with the grate toward the discharge chute but I find it desirable to augment this purchase by providing radially extending ribs 82 raised very slightly above the grate proper and spaced at intervals of the circumference.

Now proceeding to describe the collecting tank 75, it will be seen from an inspection of Fig. 7 that the same has an admission opening in the side wall connecting by a supply pipe 83 with a pressure source of water supply, and provides for this admission opening a closure valve 84 controlled by a float 85. A filter 86 is provided in the supply pipe. 87 designates an overflow pipe feeding to a subjacent pan 88. A bottom discharge connects by a nipple 89 with a hose 90, and this hose leads to the low-pressure side of a pump 91. To enable the system to be drained at the termination of an

operating period, the pump occupies a low-level position and provides a normally closed cock **92** connecting the pump chamber with a gravity-flow branch **93** leading into a drain line **94**. The pan **88** also feeds by a hose **95** into this drain line. The collecting tank is fitted with a vented cover **96**, and the excess water delivered from the trough enters the tank through a stack **97**. This stack is fitted with a fine-mesh conical screen **98** for minimizing splash and desirably has its bottom opening registering with the tank's discharge opening. Slots **100** cut in the wall of the stack establish communication with the interior of the tank.

The water drawn into the low-pressure side of such pump from the collecting tank **75** is delivered from the high-pressure side to the feed pipe **47** whence it is carried by the fitting **54** into the center-bore **48** and thence by the connecting cross-ducts **49** into the water chamber of the water-head. The function of the pipe **51**, which also connects with said fitting **54**, may now be explained. In the form in which this pipe is illustrated in Fig. 9, a valve casing **101** is introduced between the pipe **51** and the fitting **54**, and received in this valve casing is a ball-check **102** arranged to close by pressure of the pumped water flowing through the fitting. The pipe extends between the fitting and the collecting tank **75**, with the end which is received within the latter lying above the water level therein and thus being exposed to the atmosphere. While being closed by the ball-check during periods when the machine is in operation, the pipe essentially becomes an air-supply duct when, by inactivation of the pump **91**, the water flow ceases and the ball-check **102** responsively opens. The admitted air enters the center-bore **48** to break the vacuum which would otherwise obtain and assures a complete discharge of all water contained in the head of the machine. Even though the chamber of the head is insulated in a degree sufficient to preclude water from freezing while it is in a dynamic condition, it develops that a static body of water contained within the head will freeze in a comparatively short period of time and aside from the liability of damage from the resulting expansion may very well still remain in a frozen condition upon the initiation of another ice-making operation. In such an event substantially the only means of clearing the head is to apply a blow-torch with even greater liability of damage to the machine. It is of moment to point out that it is not necessary to utilize a check-valve in the line which admits said vacuum-breaking air, and a modified hook-up of this nature is illustrated in Fig. 12. The arrangement is one in which a short length of looped pipe, designated by **105**, leads from the fitting into an air-vented funnel **103** and thence empties by a hose **104** into the collecting basin. The pipe **105** is so restricted as to permit little more than a trickle flow and it thus develops that a minute stream of water flows constantly from the fitting through said pipe during operating periods of the machine. Upon an inactivation of the pump the trickle flow ceases and atmospheric air enters the pipe through the vent openings of the funnel to break the vacuum.

It is thought that the invention and the manner of operation will be clear from the foregoing detailed description of my now preferred embodiment. Changes in the details of construction may be resorted to without departing from the spirit of the invention and it is accordingly my intention that no limitations be implied and that the hereto annexed claims be read with the broadest interpretation to which the employed language fairly admits.

I claim:

1. In apparatus for freezing a liquid, in combination, a cylinder disposed to locate its axis vertical and having the surface chilled to a quick-freeze temperature, a chambered head sustained in overlying relation to the cylinder and presenting a restricted delivery throat from which liquid under pressure contained in the chamber of the head flows downwardly over said freezing surface as a broad and unbroken thin stream patterned to a shape conforming substantially to the horizontal sectional profile of an arcuate portion of the freezing surface less than the full circumference, a source of liquid supply, means for supplying said liquid under pressure from the source to the chamber of the head, means for rotating the head about the center of the cylinder as an axis to cause the delivery throat to progressively advance in a direction circumferentially of the freezing surface, means supported to move in concert with the head and acting to dislodge the film of ice forming upon the freezing surface, a drag-blade also supported to move in concert with the head and extending longitudinally of the freezing surface in immediate following relation to the cracking means for ridding the freezing surface of any adhering fragments of cracked ice, said cracking means and the blade being both located to occupy positions circumferentially offset from the delivery throat so as to work upon that portion of the freezing surface which is not curtained by the flowing stream of liquid, and a pipe drawing liquid from and returning the same to the supply source and associated in heat-exchange relation with the drag-blade for holding said drag-blade at a temperature sufficiently high to preclude the ice fragments from adhering thereto.

2. A machine as defined in claim 1 in which the water is pumped to the throat through a supply line closed to the atmosphere, and having a normally closed connection opened automatically upon an inactivation of the pump for admitting vacuum-breaking air to said supply line.

3. In an ice-making machine, a rigid vertically disposed cylindrical freezing surface flushly surmounted by an integral cap of insulating material, an annular member disposed in concentric spaced relation to said cap and acting in complement with the cap to define a throat of restricted width between the two, a dam-forming strip of resilient material held under compression between said throat-forming complements to block off a minor part of the throat's full circumference, said resilient strip being fixedly secured to one of said throat-forming complements, and means for continuously delivering to the upper end of said throat the liquid which is to be frozen to have said liquid issue from the open bottom of the throat and flow downwardly over the freezing surface, said annular member and the freezing surface having progressive relative rotation so as to cause the dry zone, and namely the zone which underlies that portion of the throat which is blocked off by the damming strip, to move circumferentially relative to the freezing surface.

4. In an ice-making machine, a rigid cylindrical freezing surface, a source from which liquid to be frozen is fed to said surface to cause the liquid to freeze thereon, a carrier movable circumferentially about said freezing surface, a blade so carried by the carrier as to perform a scraping function relative to ice formed upon said surface, and a pipe fed with water and associated in direct-contact heat-exchange relation with the blade to maintain the latter at a temperature precluding the ice from adhering thereto.

5. In an ice-making machine, a rigid freezing surface, a source from which liquid to be frozen is fed to said surface to cause the liquid to freeze thereon, a blade so mounted with respect to the freezing surface as to dislodge ice formed upon said surface and lying in the path travelled by the blade when the blade and freezing surface are moved with respect to one another, means for moving the blade and freezing surface with respect to one another, and a pipe fed with liquid and associated in direct-contact heat-exchange relation with the blade to thereby maintain the latter at a temperature precluding the ice from adhering thereto.

6. In an ice-making machine, a rigid vertically disposed freezing surface, an overhead chamber normally closed to the atmosphere and presenting at its lower end

a restricted emission opening through which liquid contained under pressure in the chamber is caused to flow downwardly over said freezing surface, means for supplying the liquid to be frozen to the said chamber, and vent means connected with the chamber and arranged and adapted to vent the chamber to the atmosphere in response to a drop in pressure in the chamber due to an inactivation of the machine so that when such inactivation occurs the chamber will be automatically emptied of liquid which otherwise would be subject to freezing.

7. The structure of claim 6 in which the said vent means includes a funnel-mouthed connecting pipe and a duct of restricted flow capacity interconnected with the overhead chamber and leading into the mouth of said connecting pipe, said duct being arranged to have a continuous flow of liquid therethrough from said chamber while the machine is operating, and the funnel mouth of the connection pipe being exposed to the atmosphere so as to admit air to the duct upon an interruption of the liquid flow which exists in the duct while the machine is operating.

8. In an ice-making machine, a rigid vertically disposed freezing surface, an overhead chamber normally closed to the atmosphere and presenting at its lower end a restricted emission opening through which liquid contained under pressure in the chamber is caused to flow downwardly over said freezing surface, means for supplying the liquid to be frozen to the said chamber, and vent means connected with the chamber and arranged and adapted to vent the chamber to the atmosphere in response to a drop in pressure in the chamber due to an inactivation of the machine so that when such inactivation occurs the chamber will be automatically emptied of liquid which otherwise would be subject to freezing, said vent means including a duct interconnected with the overhead chamber and leading to the atmosphere and a check valve arranged and adapted to close the duct in response to liquid pressure in the overhead chamber and to open the duct in response to a drop in such pressure.

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