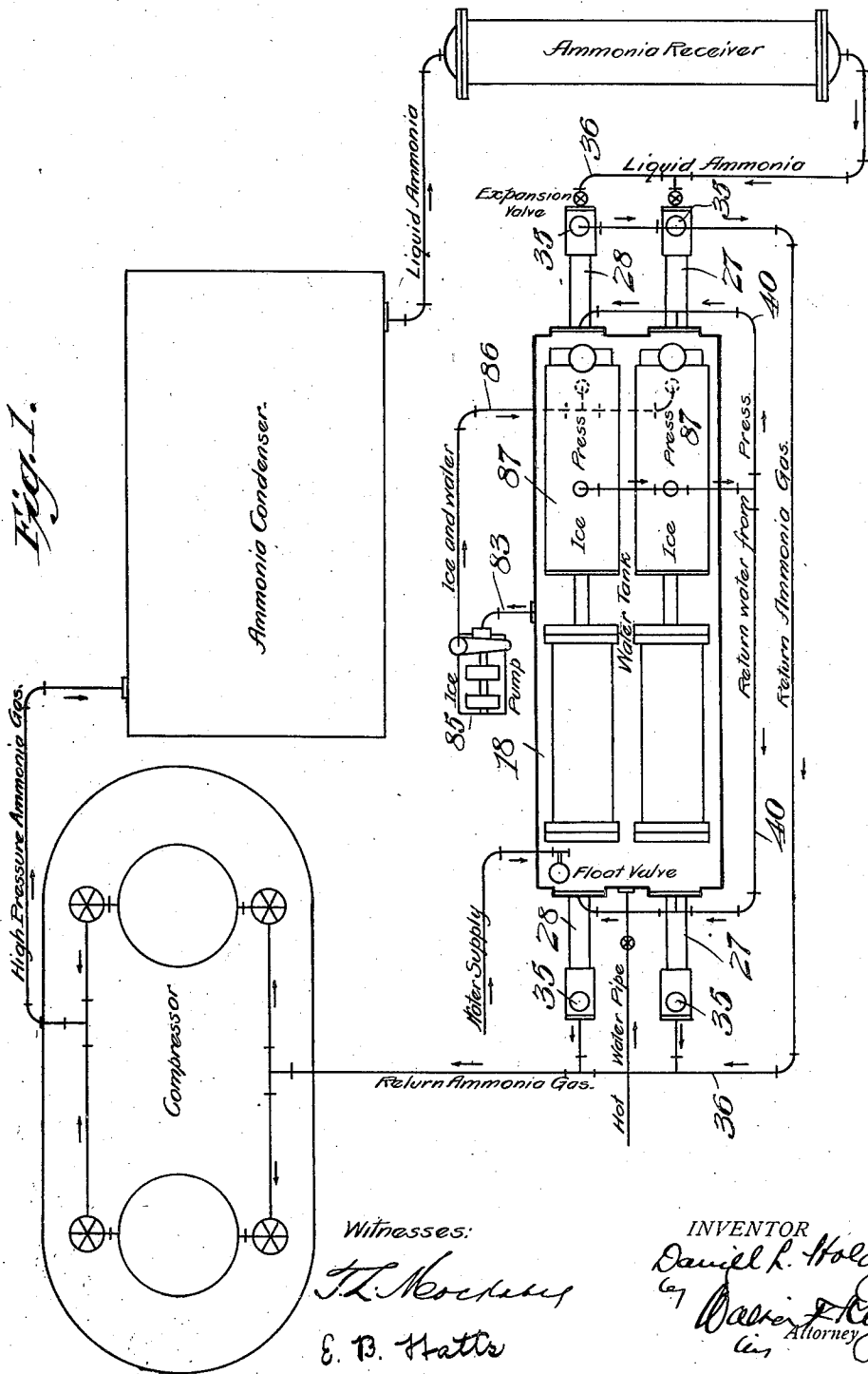


1,054,771.

D. L. HOLDEN.
ICE MACHINE.
APPLICATION FILED JUNE 30, 1910.

Patented Mar. 4, 1913.

8 SHEETS-SHEET 1.



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8 SHEETS-SHEET 2.

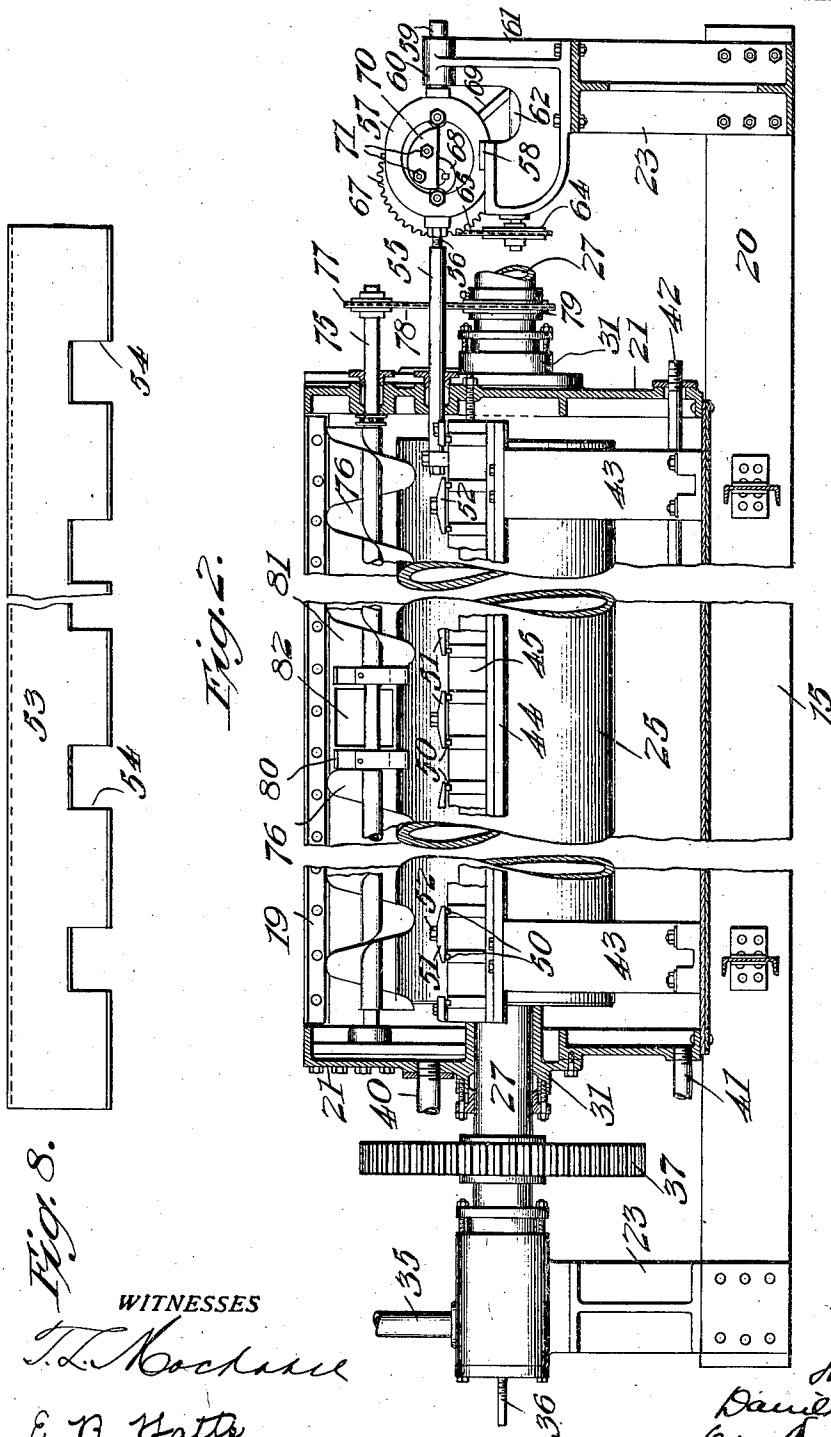


Fig. 8.

Fig. 2.

WITNESSES

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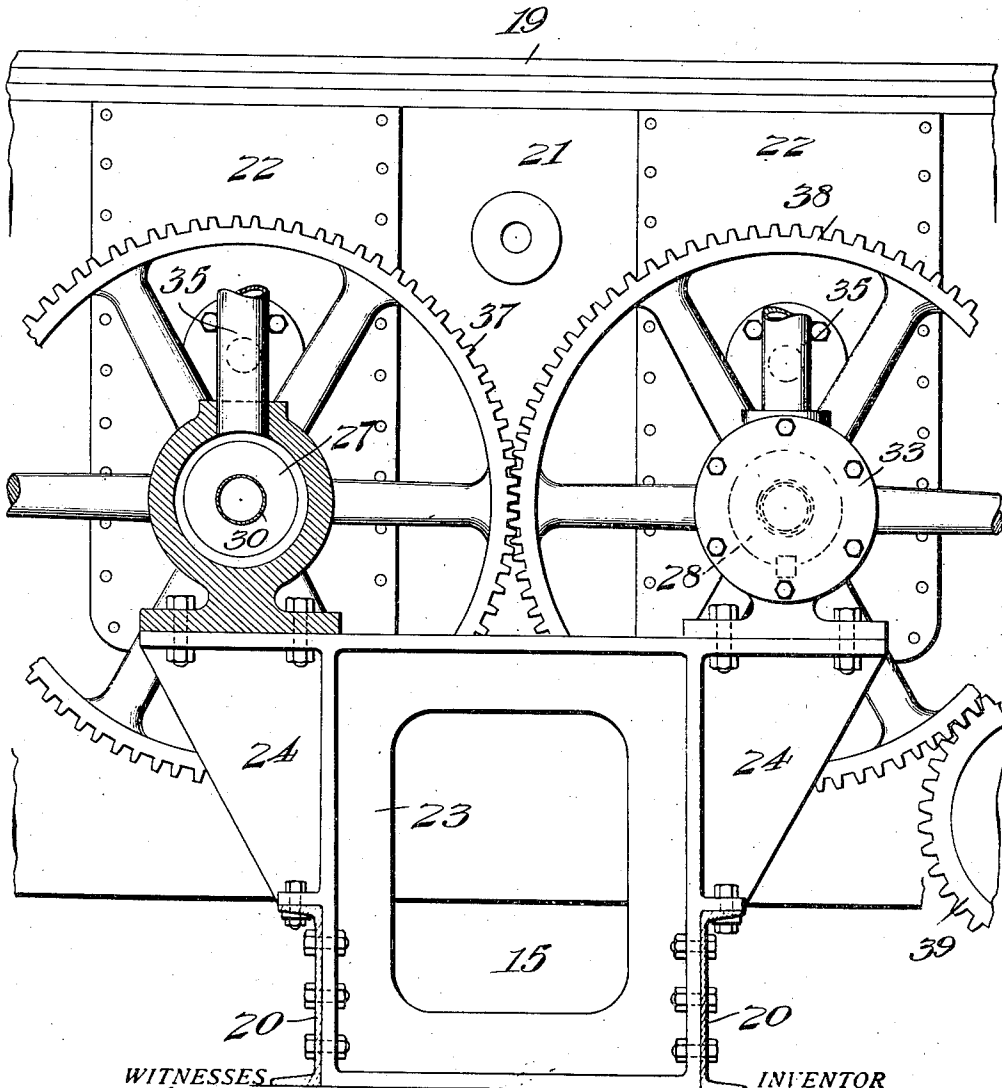
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8 SHEETS—SHEET 3.

Fig. 3.



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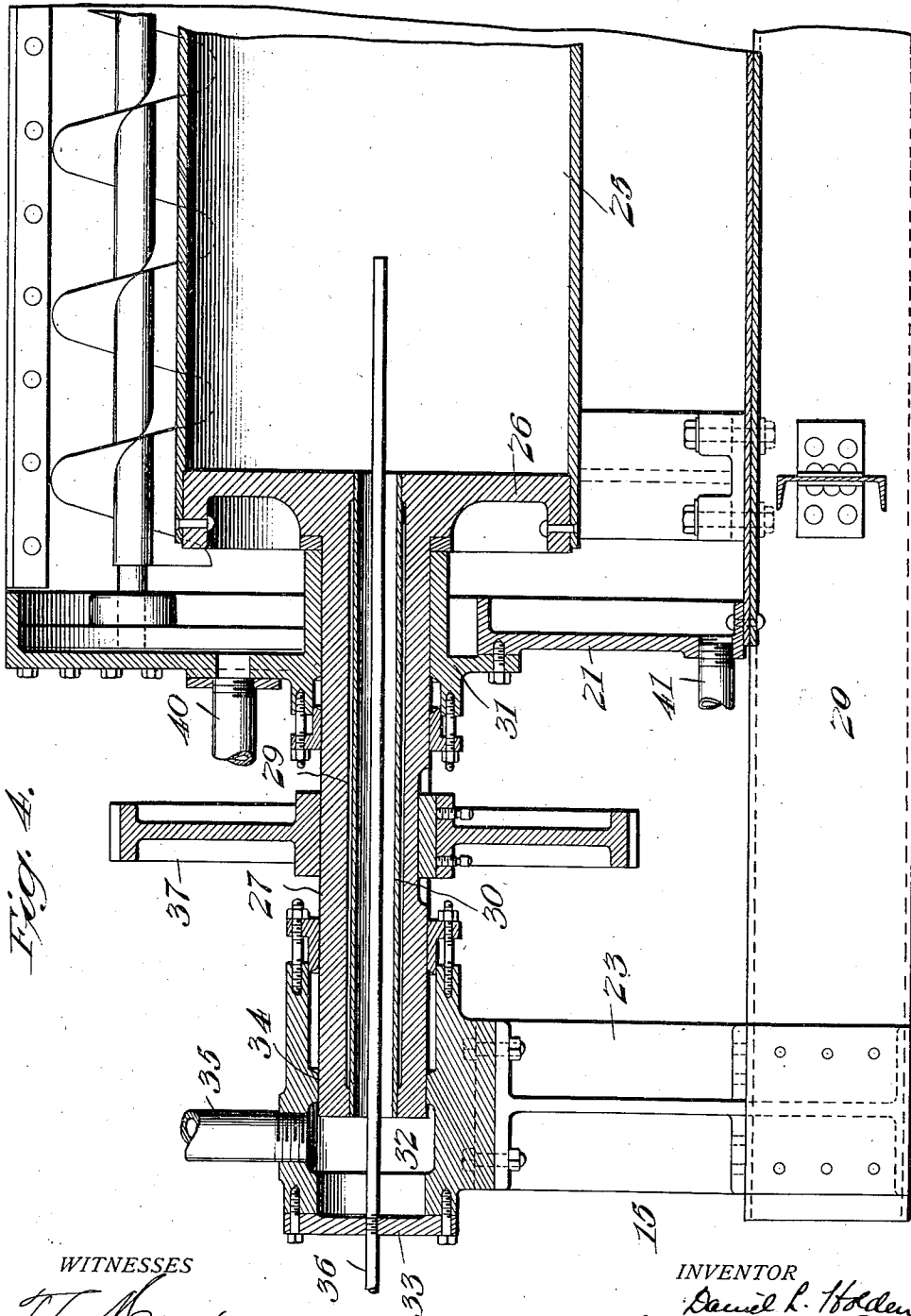


Fig. 4.

WITNESSES

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8 SHEETS—SHEET 5.

Fig. 6.

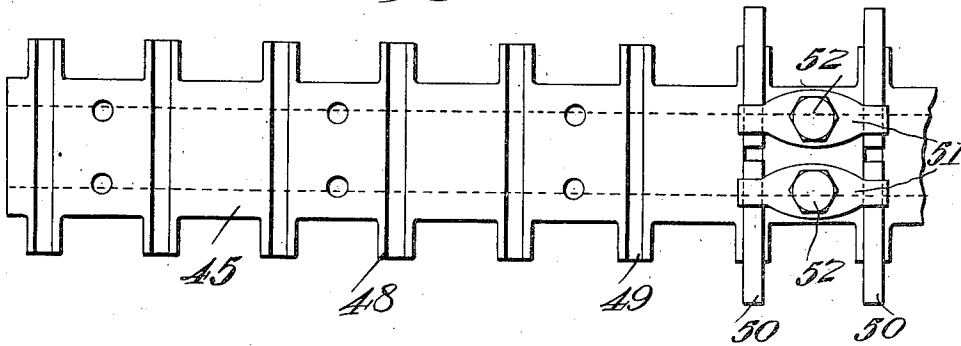


Fig. 7.

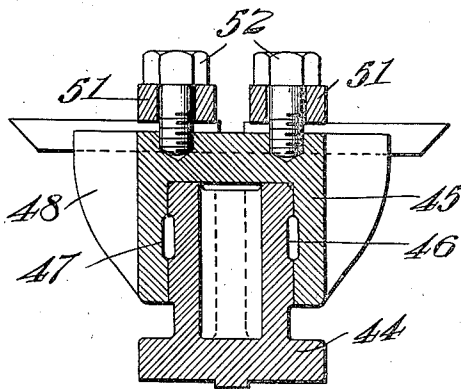
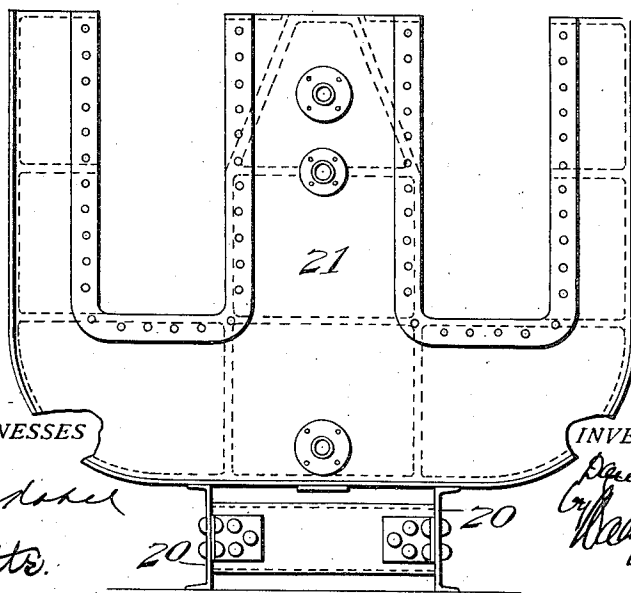


Fig. 8.



WITNESSES

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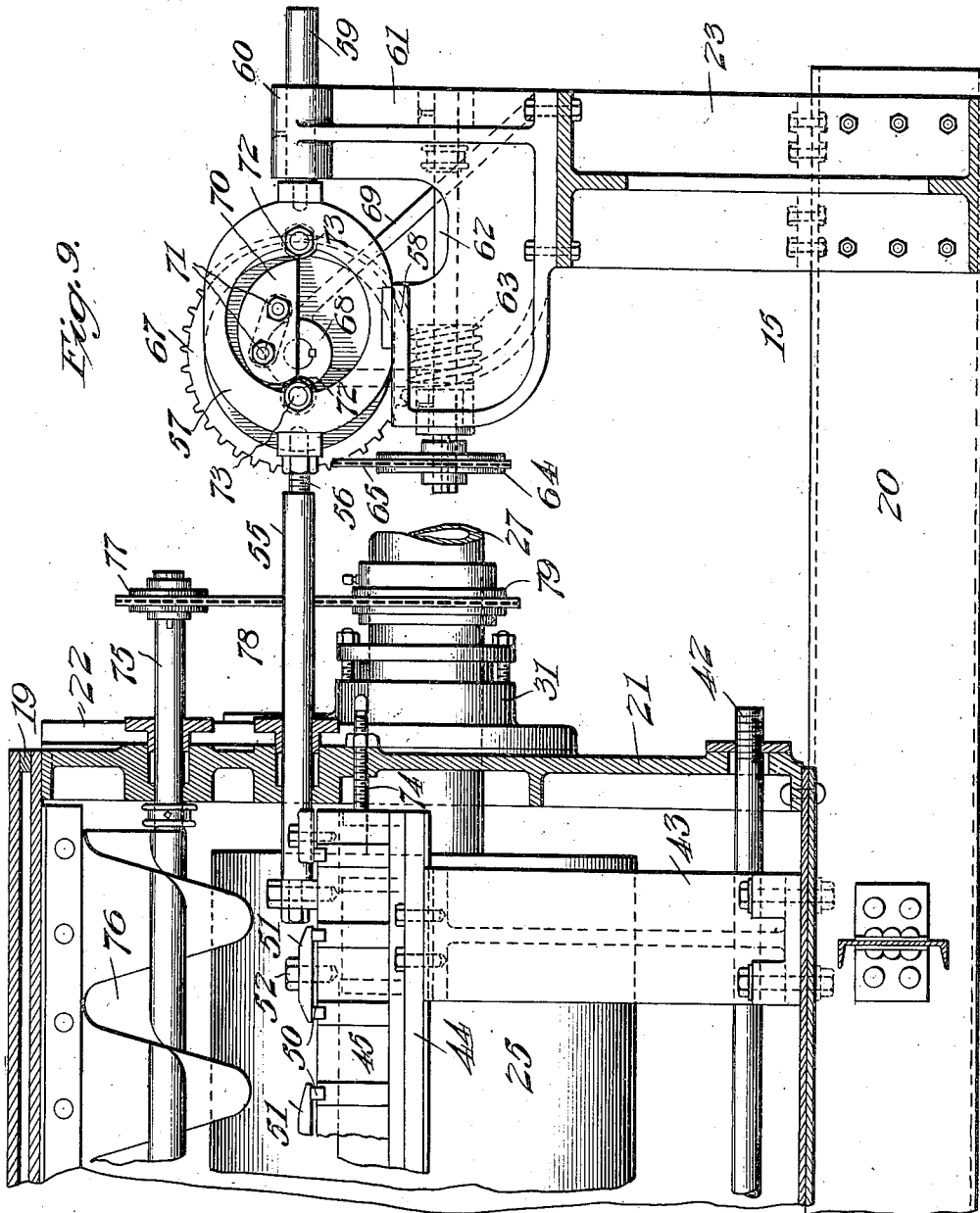
D. L. HOLDEN.
ICE MACHINE.

APPLICATION FILED JUNE 30, 1910.

1,054,771.

Patented Mar. 4, 1913.

8 SHEETS—SHEET 6.



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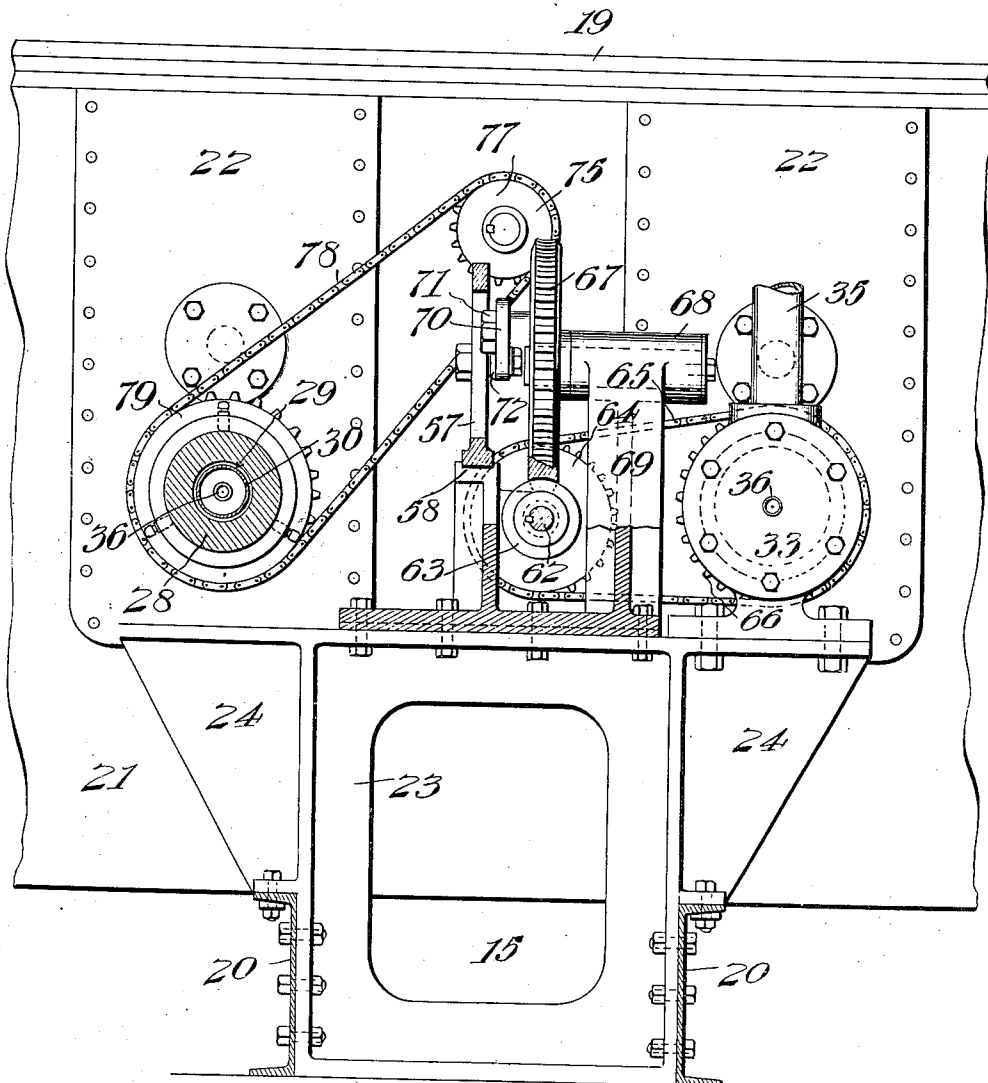
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APPLICATION FILED JUNE 30, 1910.

Patented Mar. 4, 1913.

8 SHEETS—SHEET 7.

Fig. 10.



WITNESSES

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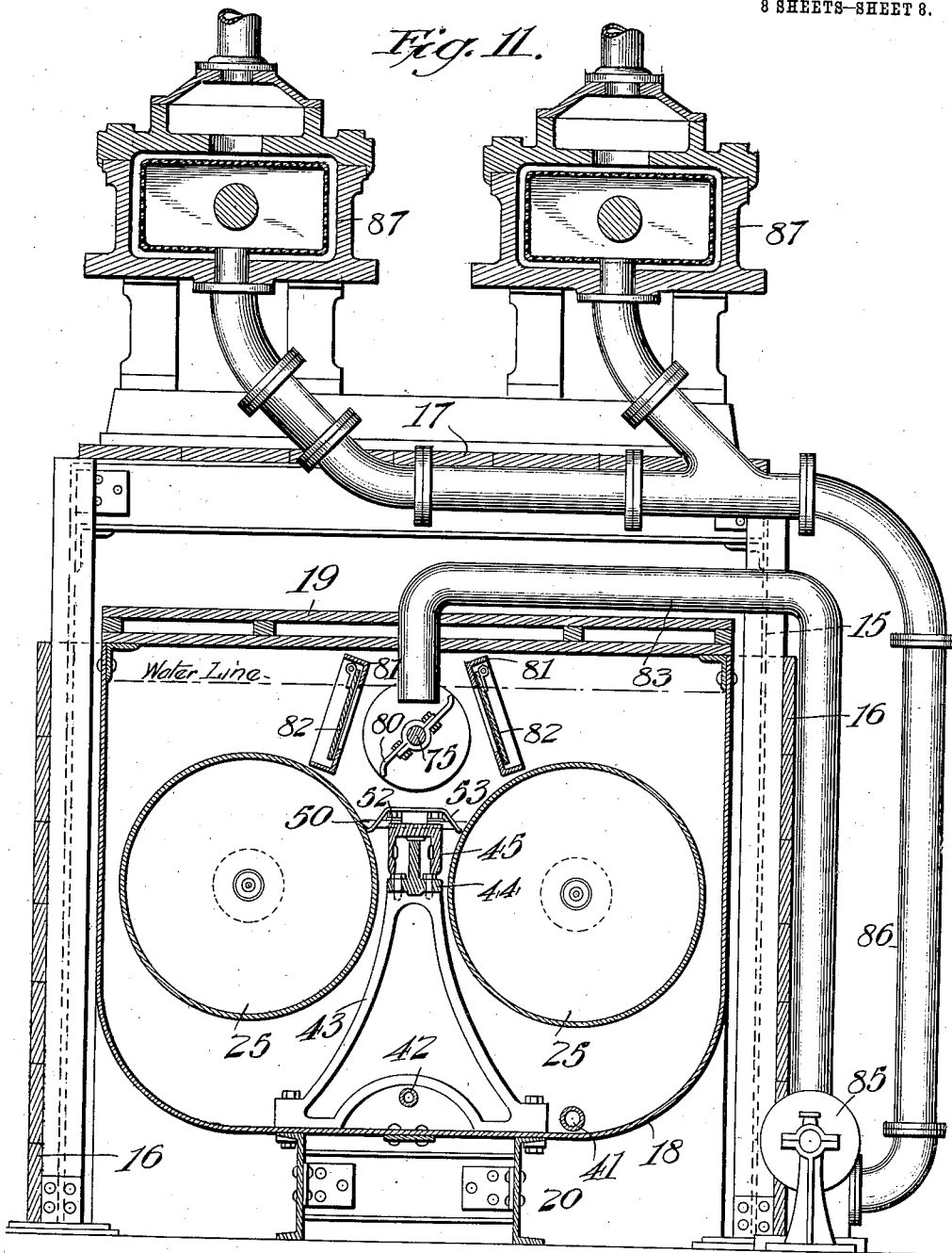
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1,054,771.

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8 SHEETS—SHEET 8.

Fig. 11.



WITNESSES

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his Attorney

UNITED STATES PATENT OFFICE.

DANIEL L. HOLDEN, OF NEW YORK, N. Y., ASSIGNOR TO FEDERAL ICE MACHINE COMPANY, A CORPORATION OF MAINE.

ICE-MACHINE.

1,054,771.

Specification of Letters Patent.

Patented Mar. 4, 1913.

Application filed June 30, 1910. Serial No. 569,796.

To all whom it may concern:

Be it known that I, DANIEL L. HOLDEN, a citizen of the United States, residing at the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Ice-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to ice machines. Its object is to provide a compact and efficient apparatus by which my regelation process of producing ice may be effectively practiced on a commercial scale.

To this end it comprises combinations and details of mechanism which recent commercial demonstration has proved are capable of carrying out my process.

In the accompanying drawings Figure 1 is a diagrammatic plan of an ice-plant showing an arrangement of the several parts of the plant and the pipe connections. Fig. 2 is a broken, side elevation of a freezing cylinder, knife-bar and operating parts with the surrounding water-tank shown in section. Fig. 3 is an elevation from the driving end of the freezing cylinder trunnions and water-tank with part in section and other parts broken and removed. Fig. 4 is a partial central section through one of the freezing cylinders with associated parts. Fig. 5 is an elevation of an end of the water-tank. Fig. 6 is a plan view of a part of the knife-bar with some of the knives in place. Fig. 7 is a sectional view taken on a line transverse of Fig. 6. Fig. 8 (on the same sheet with Fig. 2) is a broken detail of the hood or ice-shield over the knife-bar. Fig. 9 is a broken elevation of a freezing cylinder from the end opposite to that shown in Figs. 3 and 4, that is, from the knife-operating end, with the water-tank shown in section. Fig. 10 is an elevation partly in section looking in at the end shown in Fig. 9. Fig. 11 is a vertical section with the presses over the freezing cylinders illustrating a practicable arrangement for economizing space.

My apparatus is intended to be used in practising my process of ice-making by regelation in which particles of ice are cut

from an ice-sheet formed on the surface of a refrigerated cylinder rotating in water and in which the particles or spicules of ice so removed are carried to a press with a proper proportion of the water from the tank, the commingled spicules and water being then pressed to squeeze out the water and compress the moist spicules so that they regeal and form cakes of ice which are then discharged from the press.

A plant for carrying out my process necessarily comprises an apparatus for circulating a refrigerating medium. A preferred apparatus for this service is one such as is indicated in Fig. 1 of the drawings, which comprises a duplex compressor forcing an ammonia gas under high pressure to a condenser, the liquid ammonia then passing to a receiver from which it is fed through expansion valves to the regealing mechanism. In the illustration of this application, the regealing mechanism comprises parallel horizontal freezing cylinders immersed in water and rotating in opposite directions upon hollow trunnions. The liquid ammonia, fed through the hollow trunnions of the freezing cylinders, falls into the interior at an exactly regulated rate and is distributed over the inner surface of each cylinder expanding and then discharging as low-pressure gas at the opposite end of each cylinder, from whence it flows back to the compressor. Between the freezing cylinders and parallel with them is located a knife-bar carrying a series of knives whose cutting edges are held in close contact with the surface of the freezing cylinders so that when a cake of ice, of, say, approximately one-eighth of an inch thick is formed, it may be cut from the rotating cylinder, floating up in the form of ice spicules toward the surface of the water.

The knife-bar in the preferred construction illustrated forms with the two plates extending across the water-tank an ice-trough for the spicules.

In order that the ice coating may be permitted to form of the requisite thickness and to be uniformly removed from the surface of the freezing cylinders the knife-bar and the knives must be given a reciprocating movement precisely graduated to the freezing conditions. This is done by means

of a cam mechanism operating upon a connecting rod secured to the knife-bar. While the knives are operating upon certain zones of the cylinders the intervening zones are accumulating rings of ice into which on the succeeding adjustments of the knife-bar the knives are pushed or drawn. It should, however, be observed that in practice it is found expedient, if not necessary, to have the reciprocation of the knives continuous, because it appears to be practically impossible to force the knives into the sheet of ice except upon the peculiar path and shearing cut given them by the continuous reciprocation which prevents the necessity of forcing the knives directly into the side of a ring or zone of ice.

Near the top of the water-tank in which the freezing cylinders are carried, and centrally of the ice-trough, is located a right-and-left screw conveyer operated, by preference, from the rotating trunnion of one of the freezing cylinders and properly gaged in its operation so that it may carry away the ice particles from each end to the middle of the tank without unduly agitating the water in the tank. In the center of the screw conveyer, one at the end of each of the helices, is located a pair of beaters which prevent the formation of lumps of ice too large to be readily carried to the presses. In the event, however, of any such occasional block or lump forming or of an undue accumulation of ice-particles the lump or mass will be forced to one side and through the swinging gate of one of the plates on the side of the ice-trough, thus preventing the clogging of the ice-trough and especially of the mouth of the ice-intake or suction-pipe which leads to a rotary pump. This pump bears such a relation to the spicule forming means that it draws in just the proper mixture of ice-particles and water. That is, a mixture so proportioned that the ice-particles are not permitted to assemble and cohere before they leave the rotary pump and are kept separated and are easily forced forward through the intake-pipe, the pump and the feed-pipes to a pair of presses working alternately. This mixture is so delivered to the presses that when the water is squeezed out the ice is in a condition to be pressed with just sufficient water to surround each particle and perfect the regelation action, thus insuring the rapid production of solid cakes of pure ice of a substantially uniform size.

In this apparatus all the parts work as a unit and it is essential that all the details should so combine in action as to produce the desired result at each stage to insure the commercial production of ice.

In the accompanying drawings 15 represents a steel-frame construction, which may

not only surround and protect the regelation mechanism, but may also serve as a support for the press mechanism as illustrated in Fig. 11, the dotted line in that figure indicating one of the I-beams of steel running up to the press platform.

16 represents a wooden or tile insulating and protecting sheathing surrounding the steel construction, or, more particularly, surrounding that portion of the construction within which is inclosed the water-tank, to be hereinafter described.

17 represents a platform of wood or tile construction carried by the steel structure and supporting the press mechanism, when it is desired to so place the presses.

18 is a water-tank having, preferably, an insulating double wooden or tile top 19, and having, preferably, a rounded bottom to prevent any churning of the water.

20 is a steel construction foundation frame to which the water-tank is bolted, and comprising longitudinal and cross-beams, as illustrated.

At each end of the tank is a frame 21 adapted to receive the trunnions of the freezing cylinders and to this frame are bolted plates 22 so as to close and seal the ends of the tank.

23 are standards which are, preferably, a part of the steel construction and which, as hereinafter described, form bearing blocks for the operative parts of the regelation mechanism, and which have webs 24 located at the points on which the driving strain is centered.

25 represents each of a pair of freezing cylinders located in and traversing the water-tank considerably below the water level and considerably above the bottom of the tank, that is, substantially as illustrated in Fig. 11. While I have shown a pair of cylinders as the preferred arrangement it is to be understood that one may be used and, more particularly, that a number of pairs or a series may be employed. Each freezing cylinder has at each end a heavy head 26 bolted to the metal rolls which form the refrigerating walls of the cylinder. The heads are preferably integral with hollow trunnions 27 and 28, one extending from opposite ends of each of the freezing cylinders. These trunnions have an expanded bore, as indicated at 29, and this forms, in connection with a comparatively thin tube 30 of metal, an annular chamber as an insulating feature.

31 represents sealed bearing blocks for each trunnion at each end of the water-tank, that is, at the front or driving end and at the opposite or rear end. These bearings have the usual glands or stuffing-boxes as indicated and may be of the form illustrated, that is, of sleeve construction bolted

to the plates at the end of the tank, or of any similar effective construction.

32 is an ammonia-box, there being one for each freezing cylinder, and each one provided with a head 33 and an oppositely extending sleeve having provision for receiving a gland as indicated. Each ammonia-box is provided with a circular bearing-ring 34, as indicated, to form a supplemental bearing for the trunnions 27 and 28, each ammonia-box, for this purpose, being firmly bolted to a standard 23.

35 is a return ammonia-pipe, one being screwed into the top of each ammonia-box and 36 is an ammonia in-feed pipe coming from the compressor and one passing through the head 33 of each of the ammonia-boxes.

The trunnion 27 carries a gear-wheel 37 keyed to it and the trunnion 28 carries a corresponding drive-wheel 38. These two gear-wheels mesh, the wheel 38 being driven by a pinion 39 which derives its power from any suitable source.

40 are pipes which carry back to the water-tank the water squeezed out by the action of the presses, as hereinafter described, there being one of these pipes leading from each press. This return water which is slightly warmer than the water in the tank discharges immediately above the trunnion bearing projecting into the water-tank near the end of the freezing cylinder, serving thus in a measure to equalize the refrigerating effect upon the head of the cylinder adjacent to the return gas-pipe. This water-supply is supplemental to the regulated water-supply indicated in Fig. 7.

41 is a pipe for discharging the water from the tank, upon occasion or when it is necessary to empty the tank.

42 is a pipe through which hot water may be introduced into the bottom of the tank when it is desired to quickly raise the temperature of the water and thereby more rapidly neutralize the refrigerating effect when the machine is to be stopped.

43 are knife-bar standards of a design preferably such as is illustrated in Fig. 11, to best accommodate themselves to the construction and action of the freezing cylinders and at the same time give a firm foundation to the series of knives which in cutting the ice from the cylinders necessarily cause great strain upon the supporting structure. The standards are bolted, as illustrated, to the bottom of the tank and flanges of the steel-foundation 20.

44 is a bar or hollow block fixed or secured in the head of the knife standard 43, and forming a guide-bar.

A cap-block 45, which may be termed the knife-bar, of substantially the same length, fits over the base-block or guide-bar 44. The base-block and cap-block have grooves

46 and 47 which are complementary and serve to reduce friction when one is reciprocated on the other, or, to state it in functional terms, when the knife-bar is reciprocated on the guide-bar.

The knife-bar 45 has at regular intervals on each side a series of webs 48. Across these webs and across the corresponding part of the knife-bar pass knife-grooves 49 in which lie a series of projecting knives 50. Each knife has a substantially rectangular body with a beveled edge so that the knife may be presented to the surface of each freezing cylinder to cut away the particles of ice with a planing action. Each knife is held in place by plates 51 and bolts 52, the arrangement being such that each plate is passed over the shank of two adjacent knives and each bolt serves to hold in place the plate and two knives. It will be observed that this knife structure is readily assembled and when assembled is powerful and steady, while at the same time being arranged so that the knife-bar and its knives may be readily reciprocated.

Over the knife-bar and carried by it lies a hood or ice-shield 53 having parts cut away as at 54 so that a knife may project through each of the cuts. This hood is an important feature not only as forming a base for the ice-trough, but also, as having especial functions. Were it not for this hood the ice-particles would build up on the irregularities, such as the bolts, nut-heads, etc., on the knife-bar to such an extent that the machine would have to be stopped to cut away the accumulated ice. The hood serves also to give an upward direction to the ice-particles. The revolving, freezing cylinder induces a current which passes along the hood and upward with the ice. The part of the hood which projects beyond the knife-bar deflects this induced current and thus directs into the current and upward particles of ice that would otherwise follow the rotation of the cylinder and be carried down away from the line of feed of the ice-particles in the ice-trough.

55 is a connecting rod or knife-operating rod secured to the knife-bar and screw-threaded as shown at one end 56, so that it may be adjustably secured to a cam-yoke 57, whose bottom rests in a slide-way 58, as indicated in Figs. 9 and 10.

59 is a tail-rod attached to the yoke and passing through a bearing 60 carried at the top of a bracket 61, which is bolted to one of the standards 23, and on one arm of which is formed the slide-way 58 previously described.

62 is a worm-shaft carrying a worm 63 and journaled in the bracket 61.

64 is a sprocket-wheel keyed to the end of the shaft 62 and is driven by a chain 65

which receives its power from a sprocket-wheel 66 keyed to the rear end of the trunnion 27.

67 is a worm gear-wheel which is operated by the worm 63 and whose shaft is journaled at 68 in a bracket 69 which may be, if desired, integral with the bracket 61 and which, in any event, is secured beside the bracket 63 to the standards 24.

70 is a cam bolted eccentrically at 71 to one side of the gear-wheel 67.

72 are rollers oppositely journaled on stud-bolts 73 in the face of the cam-yoke 57.

74 represents a set-screw stop for the purpose of accurately regulating the extreme throw of the knife-bar.

75 is a central shaft of an ice-conveyer to which are secured left and right helical wings 76. At one end of the shaft 75, which is journaled in the walls of the water-tank, is secured a sprocket-wheel 77. The sprocket-wheel 77 is driven by a chain 78 from the sprocket-wheel 79 keyed to the trunnion 28. It may be observed that one trunnion operates the ice-conveyer while the other trunnion operates the knife-bar, and that the mechanical appliances are so arranged that the strain is thus distributed and balanced between the trunnions of the two freezing cylinders.

80 are breakers which are secured at the inner end of each helical wing of the ice-conveyer for the purpose of breaking up any lumps of ice which may happen to form.

On each side of the ice-conveyer is a plate 81 running clear across the tank, one above each cylinder and inclined at the top toward each other, so that these two plates and the knife-bar and hood form an ice-trough extending across the tank and inclosing the ice-conveyer. This trough is a most important feature of the ice-machine and the relations of the various parts which form this trough and which operate in conjunction with it determine the control of the production and supply of ice-particles.

In each of the plates is a gate or a series of gates 82. The purpose of these gates is to provide a relief when there is an over-production of ice or when any foreign substance gets into the tanks. In the latter event the gates may be pulled open by hand and the substance removed. If there should be an over-production of ice, or the ice-particles not promptly carried away the screw-conveyer will force the ice to the center where it will accumulate. In this case the gates are forced open automatically, allowing the surplus ice-particles to diffuse over the surface of the water in the tank outside of the ice-trough.

83 represents an ice-intake or suction-pipe which, in the preferred construction, runs up along the side of the wall of the tank,

passes over the top to about the center and then downward to the space between the wings of the screw-conveyer, from which it carries away the accumulated ice-particles. The ice-intake pipe leads to a rotary pump 85 and from the pump a feed-pipe 86 carries the mingled ice-particles and water to the duplicate presses 87, whose alternate action removes the water from the mixture and sends the water back through the return pipes 40 to the water-tank, and then compresses the ice-particles so that the particles and the surrounding film of water on each particle and intervening between the various particles regals and forms a cake of ice which is discharged by the action of the presses.

In this specification I have in the course of the description substantially set forth the operation of the apparatus.

It may be advantageous to briefly recapitulate the operation as a whole.

The ammonia gas (assuming that the gas-compression method of refrigerating is to be used) is compressed and forced to the condenser, thence it is passed to the ammonia receiver and thence through the ammonia in-feed pipes to the two freezing cylinders 25 which through the drive gear-wheels 37, 38 are being rotated at the proper speed within the water-tank 18. As the liquid ammonia falls from the end of the pipe 36 it strikes the bottom of the rotating freezing cylinder expanding into gas and so rapidly refrigerating the comparatively thin walls of the cylinder as to almost instantly cause the formation of an ice-film (which rapidly develops into an ice-sheet) from the water in the tank, maintained in this operation at approximately 34° F. The expanded gas finds an exit in each direction through the hollow trunnions 27, 28 and, as plainly indicated on the diagrammatic plan of Fig. 7, goes back to the compressor to be again compressed and again utilized in the familiar manner.

In the earlier stages of the operation the knives will begin to cut the ice from the cylinders 25 before the full thickness of any zone or ring of ice has been reached. In a short time, however, as the knife moves to the right, for example, each zone beyond each set of operating knives, or corresponding with the intervals between each set of knives, will have reached the proper thickness. As the parts operate the worm 63 is driven by sprocket-wheel 64 receiving power from the sprocket-wheel 66 on the trunnion 27 and rotates the sprocket gear-wheel 67. The sprocket gear-wheel in its rotation carries with it the cam 70 which is so formed and adjusted that, as it takes against a roller 72 on either side, there is a steady reciprocation either forward or backward according

to which roller is being operated upon, so that gradually the cam-yoke 57 is either forced forward or drawn back in the slide-way 58, thus gradually shifting the knife-bar and bringing the sets of knives into action on different zones of the ice on the freezing cylinders 25. The tendency of the rotating cylinders 25 would be to draw down the ice spicules, but this is prevented by the hood 53. The spicules float upward toward the surface of the water coming to rest immediately beneath the water level. They are carried from right to left to a central point by means of the conveyer-wings 76 and at this point the mouth of the suction-pipe 83 is presented so that the mass of ice-particles is drawn into the pipe with sufficient water to properly commingle the parts of the mixture, and keep the ice-particles separated so that the mixture may be delivered in the proper condition to the presses through the pipes 86 by the action of the rotary pump. The beaters 80 turn constantly so that the screw-conveyers operate on each side of the mass of ice-particles drawn over to the central point and prevent any assembling of the particles into heavy lumps. If, however, by reason of an over-production of ice-particles, or from any other cause, there should be an undue accumulation of ice-particles at the center of the ice-trough the lump or mass will be forced out through opposite gates 82 in the ice-trough plates 81, the gates yielding to permit the discharge of the lump or mass and then closing against the return. Lying in the water on the other side this lump or mass shortly disintegrates and, in any event, can produce no untoward results in the operation of the apparatus.

In this apparatus the rotation of the freezing cylinders must be precisely gaged to the action of the refrigerating medium and the formation of ice on the exterior of the cylinders. The special construction of the trunnion, the manner in which the escaping gases pass over the inflowing gas, the return of the water from the presses immediately above the trunnions, all act to equalize the effects of the refrigerating medium and the refrigeration so as to produce a uniform result. The adjustment of the knives, their number and their relation to the freezing cylinders are such also as to precisely serve to remove the desired quantity of ice from the freezing cylinders, and the relative arrangement of the knife-bar and the ice-trough plates is such as to insure a desired delivery of the ice-particles to the central accumulating point. The suction-pipe and the rotary pump are also arranged with exact reference to the conditions existing in the refrigeration going on in the water-tank, and the driving means are so adjusted and operated as to equalize the strain upon

the apparatus and produce the most measured and synchronous operation of the various parts. All these features and functions are also adjusted with reference to the action of the duplex presses and the amount of ice required to be supplied to the presses to enable a steady production of ice in the form of commercial cakes. In the detailed construction, as, for example, in the knife-bar, strength and ready adjustability have been secured, and this is true also of the frames, standards and bearings of the structure, all of which have been relatively arranged to secure the greatest economy of construction. The apparatus as a whole peculiarly lends itself to economy of space: This is due, first, to the fact that a regelation plant requires no cans or water channels, and, additionally and further, to the compact relation of the several parts of this specific structure for carrying out my regelation process.

While the construction herein illustrated is peculiarly adapted to carry out my process there are, of course, various mechanical details which are illustrative rather than essential; and mechanical equivalents may be readily substituted for many of the parts, while retaining the desired relation and function of the parts which is the essence of my invention.

I claim:—

1. In an ice-machine, the combination of a water-tank having means for maintaining a water-level, a rotating cylinder in the tank, means for refrigerating the cylinder, knives for cutting spicules from the ice-sheet formed on the cylinder, means for shifting the knives to present them to successive zones of the ice-sheet, a suction-pipe operating immediately below the water-level in the tank, a pump communicating with the suction-pipe, a press and a pipe leading from the pump to the press.

2. In an ice-machine, the combination of a water-tank, a rotating freezing cylinder in the tank, a knife-bar holding knives adjacent to the circumference of the freezing cylinder, means for shifting the position of the knife-bar, a suction-pipe whose mouth lies immediately below the level of the water in the tank, a pump, a press and connecting pipes.

3. In an ice-machine, the combination of a water-tank, a pair of rotating freezing cylinders in the tank, an intermediate knife-bar holding knives for operating on the ice formed on the surface of the freezing cylinders, means for gradually shifting the knife-bar, a right-and-left screw-conveyer above the knife-bar, a delivery-pipe leading to the division point of the conveyer, a press and means for carrying the ice-spicules from the delivery-pipe to the press.

4. In an ice-machine, the combination of a water-tank, a pair of rotating freezing cylinders in the tank, an intermediate knife-bar holding knives for operating on the ice 5
5 formed on the surface of the freezing cylinders, a right-and-left screw-conveyer above the knife-bar bearing beaters at the inner ends of the two screw parts, and means for carrying away the ice-spicules.
- 10 5. In an ice-machine, the combination of a water-tank, a pair of rotating freezing cylinders in the tank, each cylinder having on each end a hollow trunnion which serve as passages for the refrigerating medium, a 15
movable knife-bar, a conveyer, the knife-bar being operated from one trunnion and the conveyer from the other.
6. In an ice-machine, the combination of a water-tank, a pair of rotating freezing cylinders in the tank, each cylinder having a 20
hollow trunnion at each end serving as passages for the refrigerating medium, the trunnion at one end turning in a hollow block which forms an ammonia-box, the supply-pipe for the refrigerating ammonia 25
passing through the ammonia-box and the trunnion.
7. In an ice-machine comprising a water-tank, freezing cylinders and supplemental 30
ice forming apparatus, a knife-bar for operating on the ice-sheet formed on the freezing cylinders, comprising a base-block, a cap-block fitting over the base-block, and a connecting rod secured to the cap-block and 35
a cam mechanism for advancing and retracting the cap-block to shift the position of the knives.
8. In an ice-machine comprising freezing cylinders and means for refrigerating the 40
cylinders to form ice on the exterior of them, a knife-bar for operating upon the ice comprising a base-block, a cap-block transversely grooved to receive the shanks of the knives, plates to cover the shanks of the 45
knives and securing bolts, and means for gradually reciprocating the knife-bar.
9. In an ice-machine comprising horizontal freezing cylinders and refrigerating means for forming ice on the exterior of the 50
cylinders, a knife-bar parallel with the freezing cylinders, means for gradually shifting the knife-bar and a hood or ice-shield carried by and lying over the knife-bar, the ends of the knives projecting 55
through the hood.
10. In an ice-machine, the combination of a water-tank, a rotating pair of cylinders in the tank, hollow trunnions extending from each end of each of the cylinders, intermeshing and driving gear-wheels secured to the trunnions at one end and sprocket-wheels secured to each of the trunnions at the opposite end, a knife-bar, a cam mechanism connected with the knife-bar, and a 60
screw-conveyer, the sprocket-wheel on one trunnion serving to operate the conveyer and the sprocket-wheel on the other trunnion serving to operate the cam mechanism.
11. In an ice-machine, the combination of a water-tank, parallel horizontal rotating 70
cylinders longitudinal of the tank, a standard at each end of the tank, a guide-bar secured to the tops of the standards, a knife-bar resting on the guide-bar and closing the space between the cylinders, plates forming 75
an ice-trough above the cylinders, a conveyer in the ice-trough, and means for removing the ice-spicules collected by the conveyer.
12. In an ice-machine, the combination of 80
a water-tank, a pair of rotating freezing cylinders in the tank, an intermediate knife-bar between the freezing cylinders closing the space between them and operating on each of the cylinders, an ice-trough above the 85
cylinders comprising opposing plates extending across the tank and forming an ice trough, a conveyer for the ice-particles above the knife-bar and between the plates forming the ice-trough, and a delivery-pipe 90
leading to the point of accumulation of the ice-particles in the trough.
13. In an ice-machine, the combination of a water-tank, a pair of rotating freezing cylinders in the tank, an intermediate knife- 95
bar between the freezing cylinders, opposing plates above the cylinders and extending across the water-tank, the plates and knife-bar constituting an ice-trough or channel, a screw-conveyer lying within the trough, 100
means for removing the ice-particles leading to the point of accumulation in the trough, and a yielding gate in one of the spaces adjacent to the point of accumulation.
14. In an ice-machine, the combination 105
with a water-tank, of means for forming ice-spicules, means for accumulating them at a given point at the surface of the water, means for drawing the ice-spicules and a portion of water from the tank, and a press 110
to receive the commingled spicules and water.
15. In an ice-machine, a water-tank, a pair of freezing cylinders in the tank, a knife-bar substantially closing the 115
space between the cylinders, and a plate above each cylinder forming with the knife-bar an ice-trough to guide and inclose the ice-spicules.
16. In an ice-machine, the combination of 120
a water-tank, a pair of freezing cylinders, a plate above each cylinder extending longitudinally of the tank and inclined at the top toward each other, the plates forming side walls of an ice-trough, and means for re- 125
moving the ice-spicules from the trough.
17. In an ice-machine, the combination of a water-tank, means for forming ice-spicules

in the tank, a pump located below the level of the water in the tank, a pipe connecting the pump and the tank, a press located above the tank, and a pipe connecting the pump
5 and the press.

18. In an ice-machine, the combination of a water-tank, a freezing cylinder having hollow trunnions projecting through the walls of the tank and serving as refrigerant
10 pipes, a press, means for conveying the ice-spicules and water to the press, pipes for

the return water leading from the press to a point in the tank adjacent the trunnions of the freezing cylinders.

In testimony whereof I have hereunto
signed my name in the presence of two sub-
scribing witnesses.

DANIEL L. HOLDEN.

Witnesses:

W. P. HURLBERT,
W. H. KELLER.