

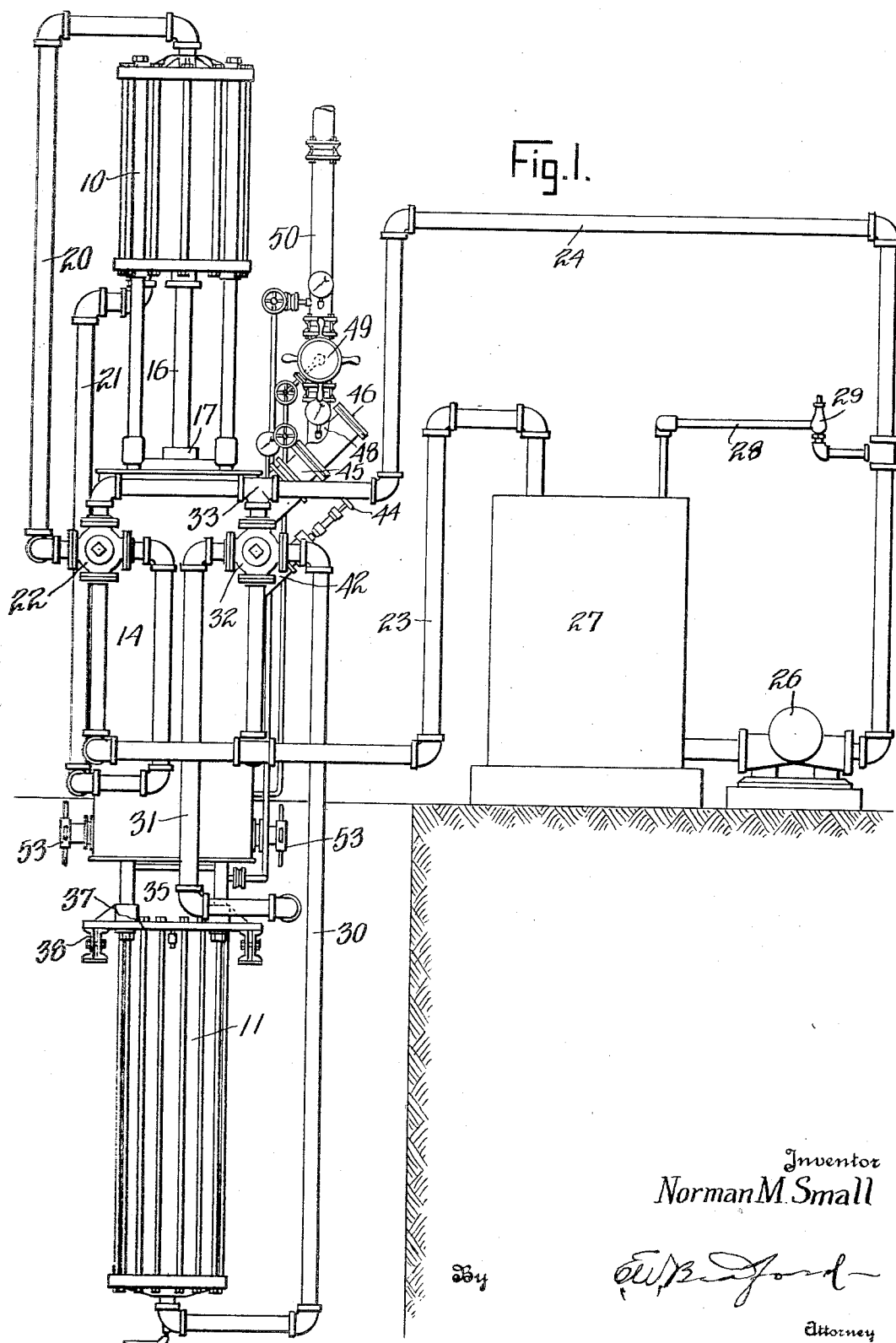
Jan. 17, 1933.

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CARBON DIOXIDE ICE MACHINE

Filed Nov. 25, 1930 3 Sheets-Sheet 1



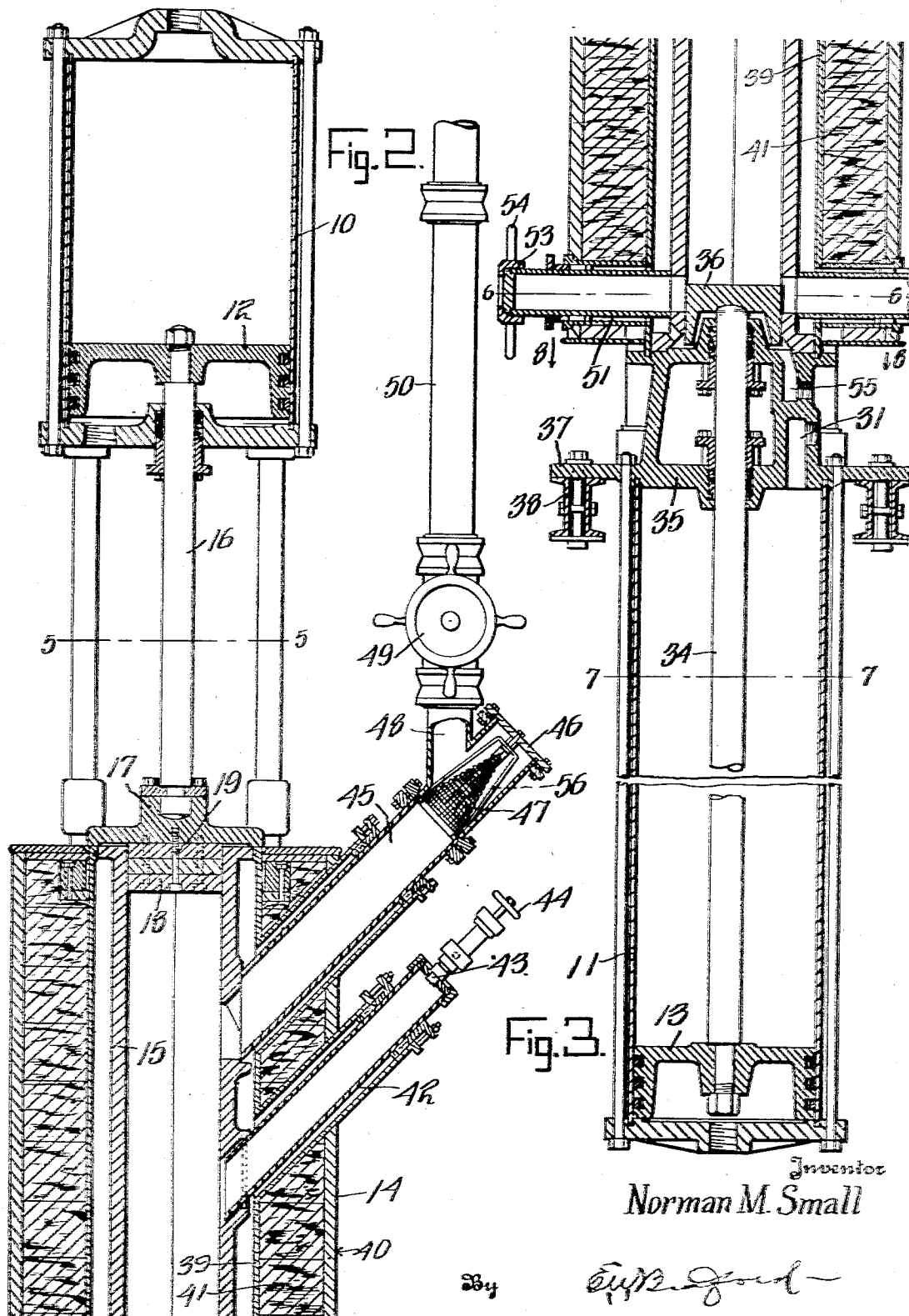
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CARBON DIOXIDE ICE MACHINE

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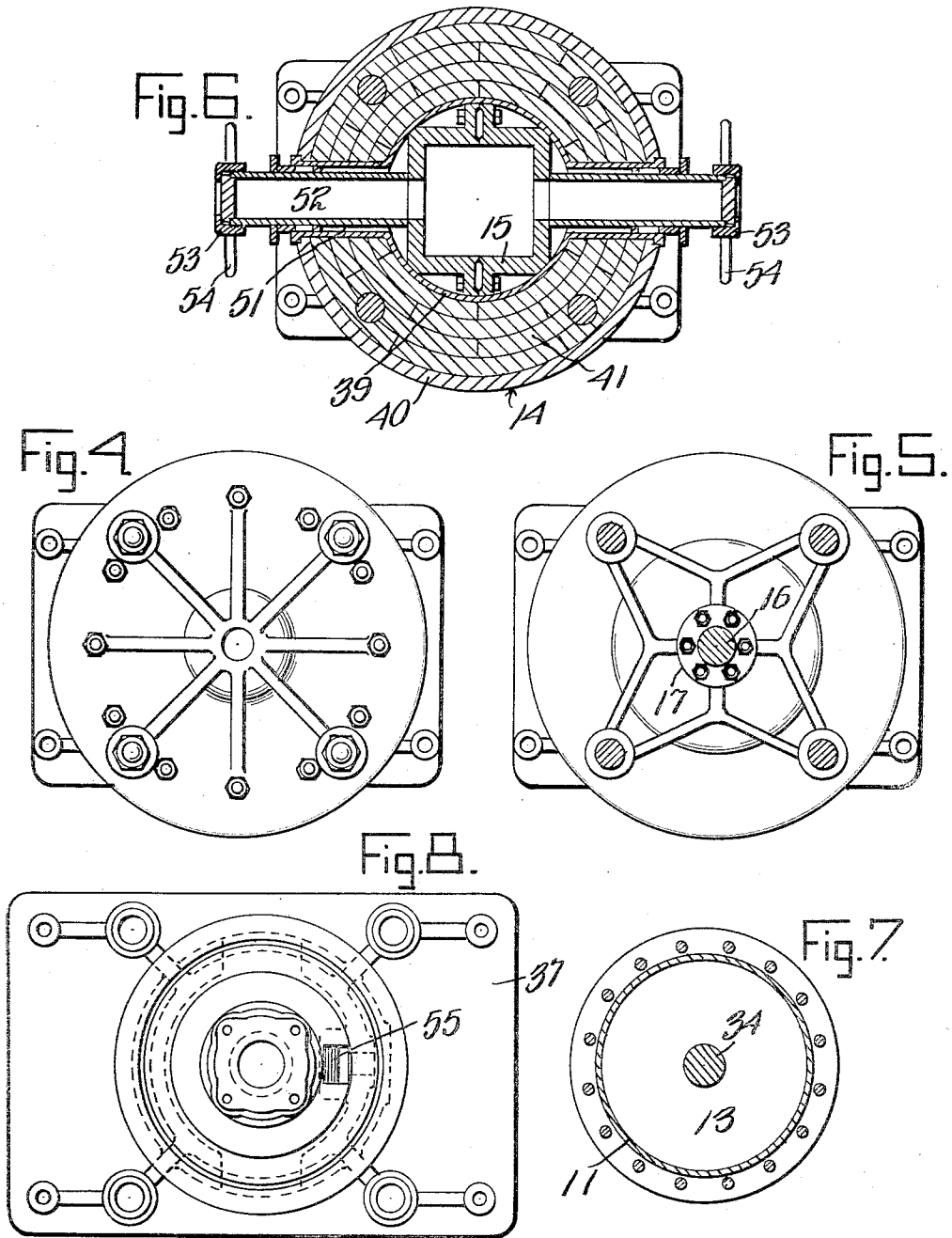
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CARBON DIOXIDE ICE MACHINE

Filed Nov. 25, 1930 3 Sheets-Sheet 3



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CARBON-DIOXIDE ICE MACHINE

Application filed November 25, 1930. Serial No. 498,138.

This invention relates to machines and systems for making carbon dioxide ice.

An object of the invention is to provide a machine for producing carbon dioxide snow and for compressing it into ice cakes.

A further object is to provide new and improved operating means for machines of this kind.

A further object is to provide a machine for making carbon dioxide ice into blocks of ice that will be of substantially uniform density.

Referring to the accompanying drawings, which are made a part hereof and on which similar reference characters indicate similar parts,

Figure 1 is a view in elevation of the machine,

Figure 2, a vertical section showing the snow making chamber and one of the operating cylinders,

Figure 3, a vertical section of the lower end of the snow making chamber showing another operating cylinder,

Figure 4, a plan view of Figure 2 showing the top cover plate of one of the operating cylinders,

Figure 5, a section on line 5—5 of Figure 2,

Figure 6, a section on line 6—6 of Figure 3,

Figure 7, a section on line 7—7 of Figure 3, and

Figure 8, a view on the lower end of the snow making cylinder taken on line 8—8 of Figure 3.

In the drawings numerals 10 and 11 indicate cylinders having pistons 12 and 13 movable therein and 14 indicates the ice making part of the machine having an ice making chamber 15 positioned therein, the ice making chamber being preferably square in cross section. The piston 12 is connected by means of a piston rod 16 with a head 17 which closes the end of the ice making chamber 15. The head 17 has a block 18 secured to it, the block being positioned within the end of the chamber 15. The block 18 is preferably of some good heat insulating material and serves to insulate the snow chamber from the metal

head plate 17. We have found that blocks made of hard wood serve the purpose very satisfactorily as this is a poor heat conducting medium and likewise is sufficiently hard to serve as a back against which the carbon dioxide snow may be compacted into an ice block.

Fluid conduits 20 and 21 are connected respectively to the upper and lower ends of the cylinder 10 and these lines are connected by means of a four-way valve 22 to exhaust line 23 and to pressure fluid line 24. Line 24 is connected to the discharge side of a compressor 26 and line 23 leads to a tank 27 connected to the suction side of the compressor 26 which delivers pressure fluid to the line 24. A pipe 28 having a pressure relief valve 29 therein furnishes a by-pass from the high pressure line 24 to the tank or reservoir 27. The valve 22, as stated, is a four-way valve which may be set to connect the upper end of the cylinder 10 above the piston 12 with the pressure fluid line 24 and at the same time to connect the chamber beneath the piston 12 with the exhaust line 23. Valve 22 may likewise be positioned to shut off both lines 20 and 21 so that liquid in the cylinder 10 will hold the piston 12 firmly fixed in any position to which it is moved.

During the making of ice the head 17 is held in engagement with the end of the ice making chamber with the spacing block 18 positioned within the chamber 15. When the ice is being compressed in the chamber 15 the head 17 may be raised slightly to give a sufficiently loose fit at the top of the chamber to allow entrained gas to escape from the chamber during compression.

Fluid lines 30 and 31 connect the lower and upper ends respectively of the cylinder 11 with the pressure and exhaust fluid lines 24 and 23 through a manually operable four-way valve 32, the valve 32 being connected to the fluid line 24 by a pipe connecting a T-coupling 33. The valve 32 serves to deliver pressure fluid to the upper or lower sides of the piston 13. A piston rod 34 on the piston 13 passes up through the head 17 which closes the cylinder 11 and has its upper end preferably in loose contact with plunger 36.

The purpose of the piston 36 is to compress snow which is formed in the chamber 15 into a block of ice in the upper end of this chamber. The machine is suitably mounted upon a frame 37 which may be supported on eye beams 38 or other suitable supports which form the foundation for the machine. The ice making part of the machine 14 is preferably composed of inner cylindrical drum 39 and outside logging 40 between which is placed heat insulating material 41. The ice forming chamber 15 is positioned within the inner cylinder 39. This chamber as shown is substantially square in cross section and has its corners rounded to fit within the cylindrical surface on the cylinder 39. An expansion tube 42 passes into and is attached to the snow forming chamber 15. The expansion tube 42 is held in place by some suitable arrangement or may be connected in any manner to the cylinder, the manner of connecting being immaterial. To the outer end of the pipe 42 is attached an expansion nozzle 43 controlled by a valve 44. The nozzle 43 is connected by any suitable means to a supply of cold liquid carbon dioxide under pressure, the cold liquid carbon dioxide expanding through the nozzle 43 flashes into snow in the chamber 42. Under some circumstances cold liquid carbon dioxide may be delivered at or above the triple point to the chamber 15 and subjected to a cold freezing action while kept under pressure so as to form a more dense frozen carbon dioxide. Still other methods may be employed in which the liquid carbon dioxide is delivered under pressure to the chamber after which the pressure is released and the cold liquid allowed to expand during which expansion its temperature is reduced sufficiently low to cause it to be converted into snow. While only one expansion chamber 42 is shown, under some circumstances it may be advisable to have a plurality of these positioned around the snow making chamber 15. Located adjacent to the expansion tube 42 is a relatively larger pipe 45 which likewise opens at its lower end directly into the chamber 15. The upper end of the pipe 45 is closed by a removable cap 46. Positioned within the end of the pipe 45 is a screen 47. A pipe 48 is connected to the side of the pipe 45 beyond the screen and a valve 49 connects the pipe 48 to the suction line 50. During the formation of snow in the chamber 15 the gas evolved in the chamber 15 is drawn off through the pipe 45 into the suction line 50 from which it may be delivered to the intake of the compressors of the carbon dioxide compressing system. At the bottom of the ice making part of the machine 14 is a cleaning out hole 51 in which are inserted pipes 52, the outer ends of which pipes are closed by caps 53 to which may be attached knobs or arms 54 by means of which the caps may be easily removed to permit an attendant to look

into the snow forming chamber 15 and when necessary to remove any accumulation of snow which may be in the lower part of the snow forming chamber. The piston 36 may be relatively loosely positioned in the snow forming chamber 15. As a result of this there may be a leakage of gas past the piston. In order to take care of this, a port 55 is provided to which may be connected a pipe leading to the suction of the compressor system or unless otherwise desired the gas may pass through the port 55 to the atmosphere since a relatively small amount of carbon dioxide gas will leak past the piston.

In order to thaw out an accumulation of snow which may be deposited on the screen 47 a gas line 56 is attached through which hot CO₂ gas may be blown.

In operation carbon dioxide preferably at a low temperature and under high pressure is admitted through the nozzle 43 into the chamber 42 where a portion of it forms into snow. Such of the CO₂ as vaporizes without converting into snow is drawn out through the suction line 45 through the screen 47 and valve 49 to the suction line 50 where it passes as a gas to the compressor system. As briefly stated above the snow may be formed in several ways, either by expanding into the chamber 15 at a low pressure below the triple point or by forming some snow and then raising the pressure above the triple point thereby forming a mixture of snow and cold liquid. In this process the snow is soaked with liquid carbon dioxide and when frozen in this form the blocks are almost solid blocks of ice. Under other circumstances liquid CO₂ is passed directly into the chamber 15 while the pressure is maintained at too high a point for any expansion to take place to form snow. After the chamber has been filled with CO₂ under high pressure, the pressure is released and the liquid flashes into snow, such portion of it as is not frozen being drawn off through the suction line 45. After expanding through the valve 43 for some time into the chamber 15 the chamber becomes filled or partly filled with snow. When the freezing chamber 15 is sufficiently filled with snow the usual process consists in pumping down the chamber 15 to its lowest pressure after which the suction valve 49 is closed and the valve 22 is manipulated to deliver pressure below the piston 12 to slightly raise the head 17 from the cylinder 15, thus giving a vent for the release of any gas which may be in the upper end of the snow making chamber 15. Valve 32 is then operated to admit pressure fluid to the line 30 to raise the piston 13. This operation moves the piston 36 upwards to compress the carbon dioxide snow against the block 18 forming a solid cake of carbon dioxide ice of proper density. At the same time pressure fluid is admitted by means of the four-way valve 22,

to pipe 20 to the upper side of the piston 12 to hold the head 17 rigid against the upward movement of the compressing piston 36. After the block has been compressed upwards the four-way valves 22 and 32 are so set that the top piston 12 is moved downward and the block of ice pressed from the top downwards. During this time the liquid in the low part of the cylinder 11 holds the piston 36 stationary while the piston 12 moves downward to compress the block of ice from the top side. In this manner a double pressing from both directions is obtained which gives a block of ice having uniform densities. It should be noted that the surface area of the piston 12 is greater than that of the piston 13 so that the differences in pressure will always keep the head 17 tightly against snow making chamber 15 while pressure fluid is admitted through the pipe 30 to raise the snow compressing piston 36. Valve for controlling the outlet port 55 may be opened if desired to relieve the gas which forms under piston 36 and which forms in the annular space surrounding the snow making chamber 15, and the inner casing 39. Thus the entire pressure in the machine is brought to approximately atmospheric pressure before the plate 17 is elevated to remove the block of solid CO₂. After the block of ice has been compressed into a compact form, valve 22 is operated so as to release pressure from the line 20 and connect this line with the exhaust line 23 and at the same time deliver pressure through the line 21 to the lower side of the piston 12 to raise the piston, to move the head 17 away from the end of the chamber 15. At the same time or immediately following the raising of the head 17 the valve 32 is manipulated to relieve the fluid pressure above the piston 13 and connect the chamber above the piston 13 with the exhaust return line 23 and apply pressure to the bottom of the piston 13 to raise the block of ice flush with the top of the snow making chamber 15 from which position the block may be removed from the machine. Sometimes in vertical machines, snow will accumulate in the bottom of the snow making chamber 15 below the piston 36. Such accumulation is likely to produce disastrous results if the piston 36 should be secured to the piston rod 34. In order to overcome this difficulty the piston 36 is of the floating type, i. e. the piston is returned by gravity to its lowermost position. Should there be an accumulation of snow beneath the piston no damage will be done since the piston rod 34 may return to its lowermost position leaving the piston suspended in the snow making chamber. When it becomes necessary to clean out the bottom of the snow making chamber 15, the floating piston 36 may be removed from the top of the opening in the chamber 15 and the snow in the bottom of the chamber may be packed

with a wooden stick, under which condition it clings sufficiently to the end of the piston rod 34 so that it may be forced to the top of the chamber 15 and removed.

It will be obvious to those skilled in the art that various changes may be made in my device without departing from the spirit of the invention and therefore I do not limit myself to what is shown in the drawings and described in the specification, but only as indicated in the appended claims.

Having thus fully described my said invention, what I claim as new and desire to secure by Letters Patent, is:

1. A machine for making carbon dioxide ice comprising a cylinder, an ice making chamber positioned within said cylinder, a relatively large tube extending into said chamber, an expansion nozzle extending into said tube, a plate covering one end of the ice making chamber, and means for holding said plate on said chamber by fluid pressure, and a piston movable in said chamber for compressing carbon dioxide into solid form in said chamber, said piston being movable on the compression stroke by an operating piston rod and returned by gravity, substantially as set forth.

2. A carbon dioxide ice machine comprising an ice making chamber, a tube projecting into the chamber, an expansion nozzle projecting into the tube, a head held against one end of the chamber, said head having blocks secured thereto extending into the chamber and forming an insulating medium between the ice to be formed in the chamber and the head, a piston movable in the ice making chamber to compress the snow in the chamber to compact it into a block of ice, said piston being removably mounted on a piston rod and operable on the compression stroke by said rod and returnable by gravity, substantially as set forth.

3. A carbon dioxide ice making machine comprising a chamber having a tube extending at an angle into it, an expansion nozzle extending into the tube, a head for closing the chamber, a cylinder, a piston operable in the cylinder, a piston rod connecting said piston with the said chamber head, fluid pressure lines connected to a source of liquid under pressure and to said cylinder whereby said head may be held in position on the chamber, a second cylinder, a piston in the cylinder, a piston rod connected to the piston, and an ejector piston removably mounted on the other end of the piston rod and movable in the said chamber in one direction by said rod and returned by gravity, said piston serving to compress snow into a cake of ice, substantially as set forth.

4. In a carbon dioxide ice making system, an ice making chamber, a tube extending into said chamber, a nozzle extending into said tube for expanding carbon dioxide liquid into

- the tube, a head positioned to close one end of the chamber, a cylinder, a piston in the cylinder, a piston rod connecting said piston with said head to hold the head in fluid sealing contact with the chamber, fluid conduits for conducting fluid to and exhausting fluid from the cylinder to hold the head in engagement with the chamber or to remove it therefrom, a second cylinder of smaller diameter than the first-named cylinder, a piston in said second cylinder and a rod on said piston extending therefrom into an ice making chamber, a plunger removably mounted on the end of the piston rod in the ice making chamber and operated in one direction by the said rod and returned by gravity, means for conducting pressure fluid to and exhausting it from said second cylinder to move the plunger to compress carbon dioxide snow into a cake of ice and to eject the cake of ice when the said head is removed from the said chamber, substantially as set forth.
5. A carbon dioxide ice making machine comprising a cylinder, an ice making chamber positioned within said cylinder and spaced therefrom, an expansion tube extending into said chamber and a nozzle extending into said tube for expanding carbon dioxide thereinto to form snow, a head held upon said chamber, a piston movable in the other end of said chamber to compress snow into ice, and means for drawing off gaseous CO_2 from said chamber, said means being positioned adjacent the said tube, and means for thawing out the suction tube to prevent its being clogged up by frozen CO_2 , substantially as set forth.
6. A carbon dioxide ice making machine comprising a chamber in which ice is to be formed, an expansion tube extending into said chamber, a cylinder surrounding said chamber and spaced therefrom, an expansion nozzle extending into said tube, a suction tube positioned adjacent said expansion tube, a head closing said cylinder, a piston operable in the open end of the chamber to compress snow into ice in said chamber, said piston being removably mounted in the chamber and moved positively in one direction and returned by gravity, and means for drawing off gas which escapes around said piston and between the walls of said chamber and said surrounding cylinder, substantially as set forth.
7. In a carbon dioxide ice making machine, means for compressing snow into ice comprising a block loosely mounted on the end of a piston rod, said head being moved during the compressing stroke by the said rod but being returnable by gravity whereby the piston will not be injured by any obstructions in the compressing chamber during the withdrawal of the said piston rod, substantially as set forth.
8. In a carbon dioxide ice making machine,
- means for compressing frozen carbon dioxide into solid form comprising a piston rod, a piston mounted on said rod, said piston being loosely mounted in the compressing chamber and detached from the piston rod whereby upon return of the piston rod the said piston may return by gravity whereby injury to the operating mechanism will be avoided in case the said piston encounters obstacles on its return stroke, substantially as set forth.
9. A carbon dioxide ice making chamber having means for expanding carbon dioxide to form snow in the chamber, means for compressing the snow into ice in the chamber, a heat insulating head on said chamber against which said snow is compressed into ice, and a peep hole in the lower part of said chamber to permit inspection of the chamber and cleaning out any accumulation of snow in the chamber, substantially as set forth.
- In witness whereof, I have hereunto set my hand and seal at Waynesboro, Pennsylvania, this 20th day of November, A. D. nineteen hundred and thirty.
- NORMAN M. SMALL.