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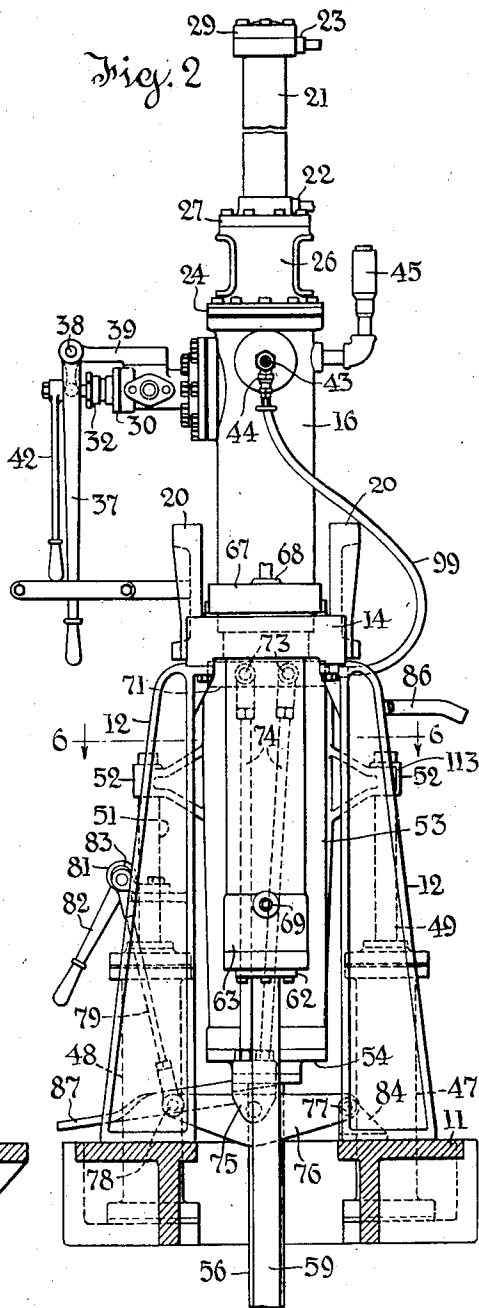
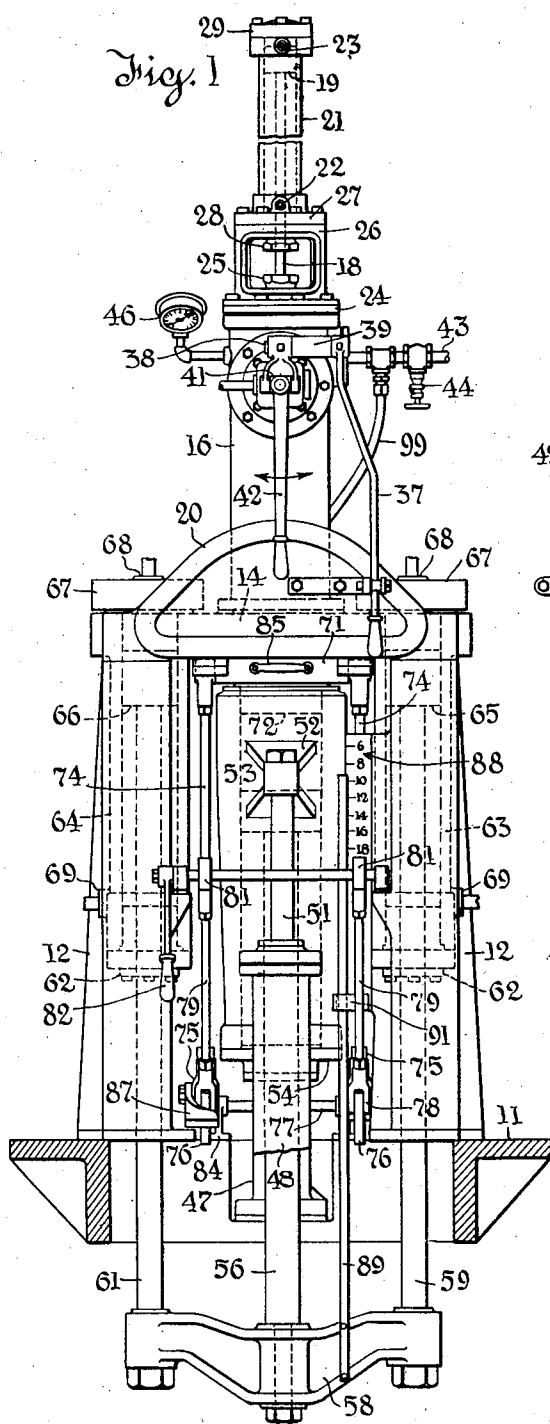
W. E. ZIEBER

2,253,880

APPARATUS FOR PRODUCING CARBON DIOXIDE SNOW BLOCKS

Filed April 27, 1940

4 Sheets-Sheet 1



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Aug. 26, 1941.

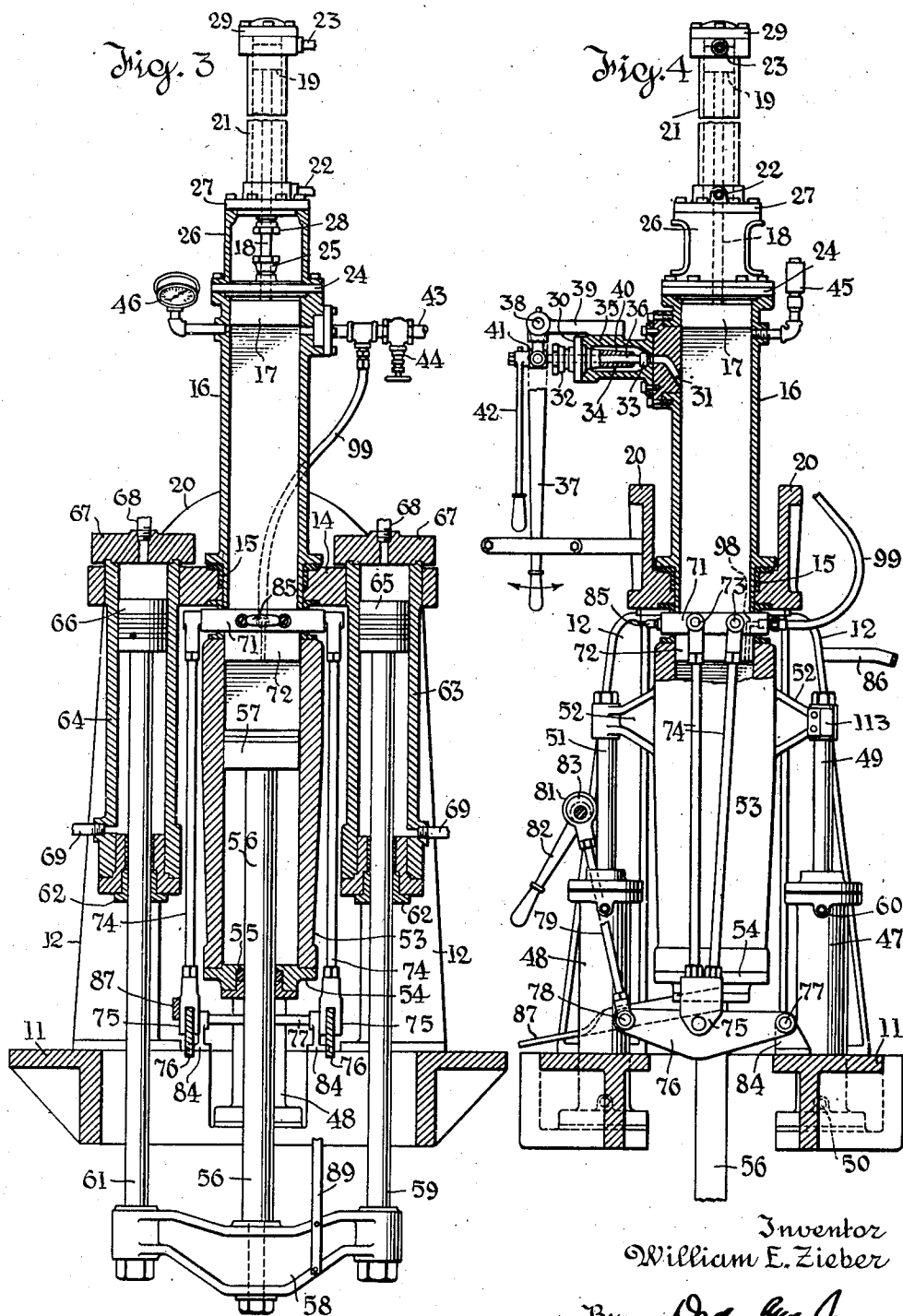
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APPARATUS FOR PRODUCING CARBON DIOXIDE SNOW BLOCKS

Filed April 27, 1940

4 Sheets-Sheet 2



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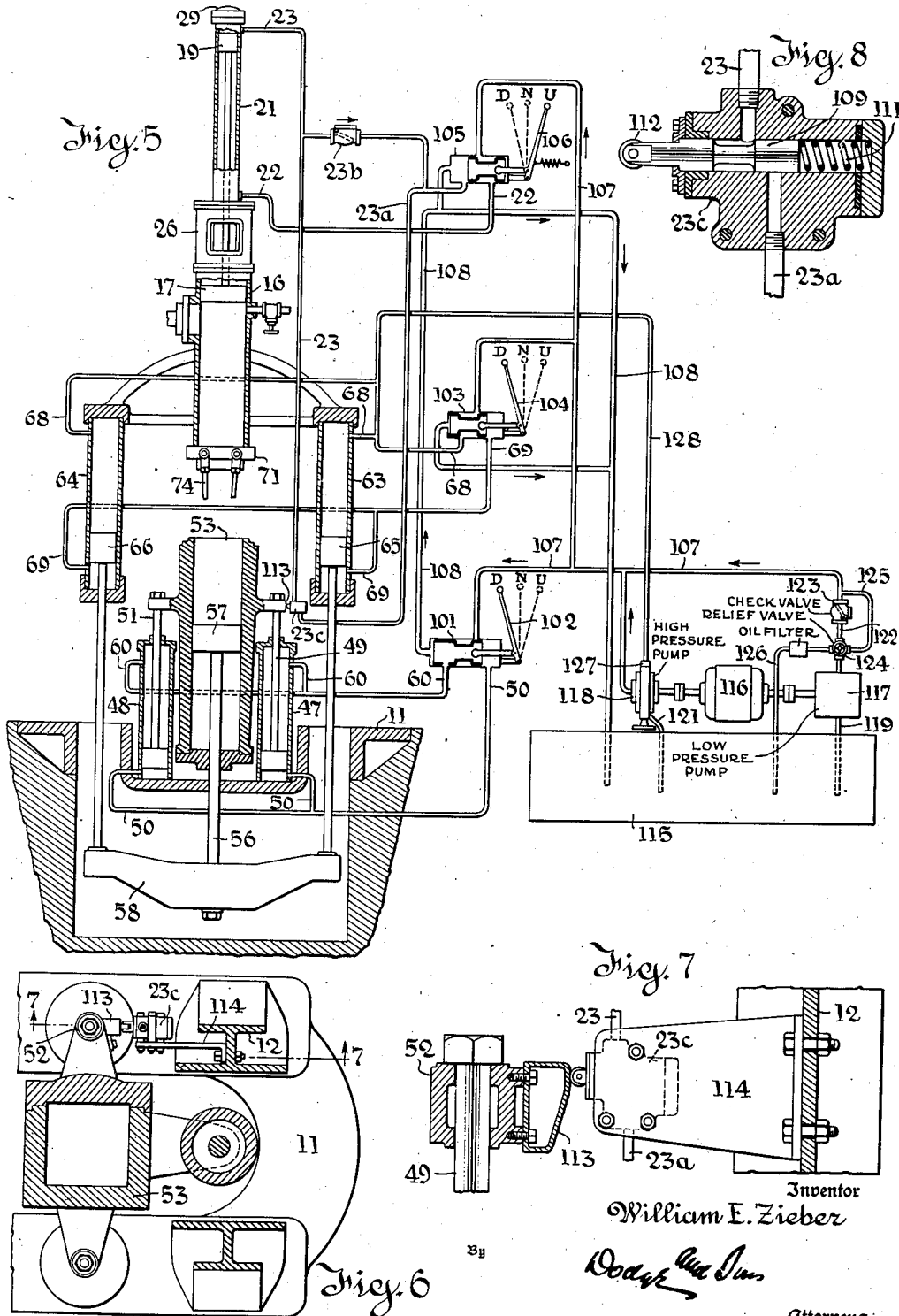
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APPARATUS FOR PRODUCING CARBON DIOXIDE SNOW BLOCKS

Filed April 27, 1940

4 Sheets-Sheet 3



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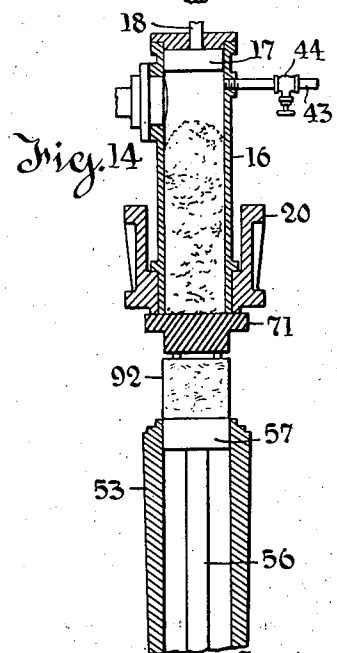
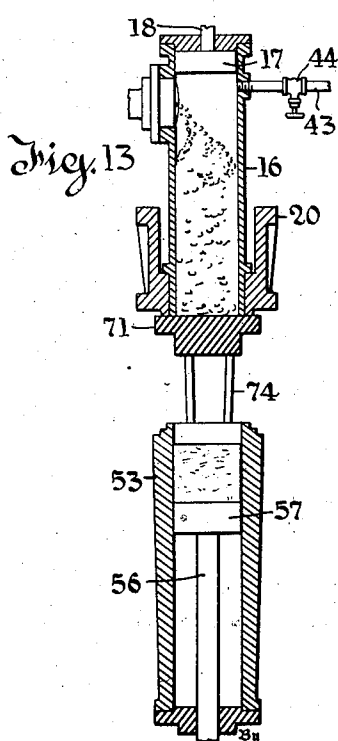
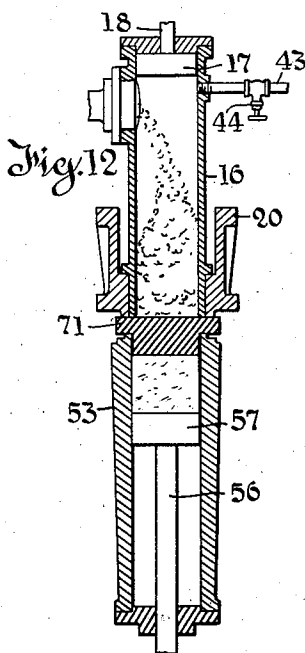
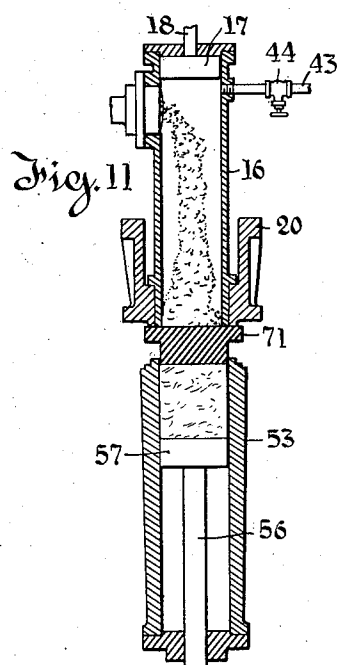
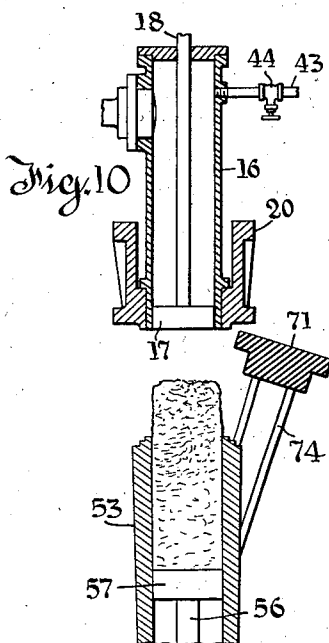
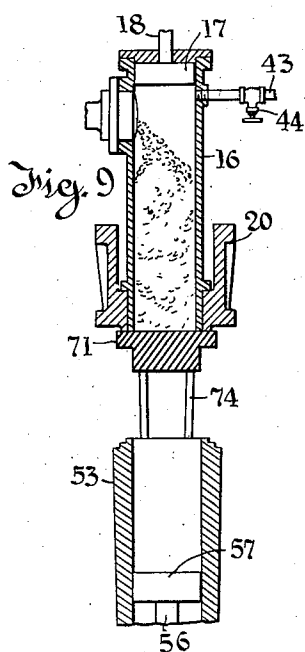
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2,253,880

APPARATUS FOR PRODUCING CARBON DIOXIDE SNOW BLOCKS

Filed April 27, 1940

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,253,880

APPARATUS FOR PRODUCING CARBON
DIOXIDE SNOW BLOCKS

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Application April 27, 1940, Serial No. 332,051

18 Claims. (Cl. 62—121)

This invention relates to a method of and apparatus for making solid carbon dioxide and particularly carbon dioxide snow blocks.

The manufacture of carbon dioxide snow, according to methods heretofore practiced, has never been a rapid process, because considerable time is required to flash the liquid into snow. If the flashing is accelerated unduly, in an effort to shorten time, the resulting drop in temperature is so great that some of the liquid tends to freeze into a solid form rather than the crystalline form commonly called "snow." That part which freezes solid has a yellowish cast which contrasts with the brilliant whiteness of the snow, with the result that when the mass is pressed into block form, the block contains yellowish streaks which are objectionable to the trade. The problem therefore is to flash the liquid into snow as rapidly as practicable, without the presence of the objectionable yellow streaks which are characteristic of too rapid snowing operation.

Snow blocks produced by apparatus of the prior art are objectionable in that the corners are soft and frequently fall away during or after the removal of the block from the press. The present invention provides for production of firm dense blocks in which the corners are strong and compact and are not subject to prior art difficulties. Hence the product is salable and attractive, and the loss of snow resulting from soft corners is definitely overcome. Prior art apparatus has also been inefficient in removing snow from the snow chamber by gravity or by use of gas pressure, the first because of the time required for such removal and the loss in gas, the second because of the loss of gas entailed and the uncertainty of effective removal. The present invention insures quick, effective and positive mechanical removal with minimum loss in time and product, and with the added advantage of performing an initial compacting of the snow before it is finally pressed.

The objects of the invention are, therefore, to provide a novel method of and apparatus for producing carbon dioxide snow, to increase the efficiency of operation and, at the same time, to produce a superior product. Numerous other objects and advantages will appear from the description when it is read in connection with the drawings, in which:

Figure 1 is a front view of one form of press embodying this invention;

Fig. 2 is a side elevation of the press shown in Fig. 1 looking from right to left as to that figure;

Fig. 3 is a view similar to Fig. 1, but with parts broken away to show the interior construction of

the snow and press chambers, and the cooperating parts;

Fig. 4 is a view similar to that of Fig. 2 with parts in section to show the snow chamber and liquid inlet;

Fig. 5 is a diagrammatic view of one form of hydraulic mechanism suitable for actuating the press, the press chambers and the actuating cylinders being shown in section and in a single plane;

Fig. 6 is a partial horizontal section substantially on the line 6—6 of Fig. 2;

Fig. 7 is a side elevation, partly in section, of the valve operating mechanism associated with the press chamber, the section being taken on line 7—7 of Fig. 6;

Fig. 8 is a sectional view through the valve of Fig. 7, with the valve in closed position;

Figs. 9 to 14 are sectional diagrammatic views illustrating the steps involved in a cycle of operation of the press.

Briefly stated, the press of the present invention involves the use of two chambers each having one end open and the chambers being in substantial longitudinal alignment with one another, one chamber being fixed and the other having an open end movable toward and from the open end of the fixed chamber. Means are provided for closing off the open end of the fixed chamber, and this closing means is also adapted to form a sealing means for the open end of the movable chamber. Means are provided to form snow in the fixed chamber and to force that snow out of the fixed chamber into the movable chamber while the two are separated. The movable chamber contains pressing means for the snow, transferred to it after formation in the snow chamber. The movable chamber may be moved away from the fixed chamber after the pressing operation to permit expulsion of a pressed block of snow. For the sake of simplicity of operation, it is preferred that the press operating means be hydraulic and include a unified control so that operation of the various components of the press may be coordinated.

Referring now to the drawings, reference character 11 designates a bed or base of any suitable construction adapted to receive and support the structural elements of the press. Supported on the base 11 are four vertical columns 12 which are tied together at their upper ends by plate 14. This plate is formed to support the fixed or snow chamber which in turn carries the motor cylinder used to actuate the plunger which displaces the formed snow from the fixed to the movable

chamber. The plate 14 is stiffened by lateral wings or flanges 20 which give it the strength necessary to withstand the loads encountered in the operation of the machine. The plate 14 has a central opening 15 in which the lower end of the upper or stationary snow chamber 16 is seated. Mounted within the chamber 16 and movable up and down therein is a ram or piston 17 controlled by a piston rod 18 and adapted to be actuated by fluid pressure supplied above or below a piston 19 working within a cylinder 21. As shown in the drawings, the inlet and discharge connections for pressure fluid to and from opposite ends of the cylinder 21 are designated 22 and 23.

As here shown, the upper end of chamber 16 is closed by a head 24, the piston rod 18 passing through a stuffing box 25 mounted in the head. A spacer member 26 is bolted to the upper face of head 24 and carries a head 27 bolted thereto and provided with a stuffing box 28 for the piston rod 18. The upper end of cylinder 21 is closed by a head 29. It will thus be seen that when pressure fluid is supplied to the pipe 22, the piston 19 is lifted and lifts with it the plunger 17. If, however, pressure fluid is supplied to the cylinder 21 through pipe 23, piston 19 moves downwardly carrying with it the piston rod 18 and the plunger 17 thus ejecting snow which as explained is formed in the chamber 16.

The snow chamber 16 is provided with means best shown in Figs. 2 and 4 for introducing sub-cooled liquid carbon dioxide under pressure into that chamber, and flashing it into snow. As shown, one wall of the chamber 16 contains a constricted inlet opening 31 of tapered nozzle formation having an inlet connection controlled by a valve 33. The valve chamber 34 is formed within a body 35, and has a transverse area substantially greater than the transverse area of the discharge end of inlet nozzle 31. Connected to valve 33 is a valve stem 36 which passes through a stuffing box 32, the rod serving to move the stem longitudinally when shifted by lever 37 pivoted at 38 to a bracket 39 and connected to a collar 41 on the valve stem 36. A cap 30 carries the stuffing box 32 and has an elongated valve stem guide 40 within chamber 34. The end of the valve stem 36 extending beyond lever 37 has rigidly secured to it a lever 42. The valve 33 seats when it is moved to the extreme right-hand position of Fig. 4 as shown. Movement of the lever 37 to the left in that figure carries the valve away from its seat to permit liquid carbon dioxide to flow through the inlet 31. If the low temperature of the liquid carbon dioxide should cause the valve 33 to freeze to its seat or if frozen particles should hold it far enough away from its seat to prevent sealing, the lever 42 may be swung to rotate and thus free the valve or ensure its sealing. It will be observed that the liquid inlet chamber 34 is of much greater cross section than the inlet 31 and this difference in cross section is relied upon to keep the liquid under sufficient pressure to prevent the formation of snow until the liquid issues from the end of the nozzle.

In addition to the liquid inlet 31, the snow chamber 16 has a flash gas offtake 43 equipped with a manual stop valve 44 which is wide open when the machine is operating. This offtake in the preferred arrangement is connected to the inlet of the first stage compressor in order to avoid loss of flash gas.

The offtake 43 is so dimensioned as to exercise a moderate throttling effect on the off-flowing gases. This does not establish any definite pres-

sure in the snow chamber, but it does limit the rate of snow formation to an extent that will prevent the formation of ice as contradistinguished from snow, and it does limit the entrainment of snow particles in the off-flowing flash gas. During the introduction of liquid, the valve 43 is wide open and does not perform any regulatory function. Such regulation as is had, is effected by the fixed size of the nozzle orifice 31 and the fixed size of the flash gas offtake connection. This relieves the operator of any manipulative control whatsoever, and does away with all pressure regulating valves or other automatic appliances. The only control which the operator exercises is to vary the duration of opening of the valve 33, according to the size of the block that he desires to form. Development of pressure within the snow chamber is, however, limited by a safety valve 45, which may be set to relieve the pressure at any definite value, preferably in the neighborhood of 100 lbs. gauge pressure. This pressure is above that normally developed in the snow chamber so that the valve 45 is merely a safety device. The chamber 16 may also be provided with a pressure gauge 46 so that the press operator can ascertain what the operating pressures within the snow chamber are. The chamber 16 and the hydraulic actuating cylinder 21 which operate the transfer plunger 17, can be, and preferably are, constructed comparatively lightly as they have no snow pressing action, and hence are never heavily stressed.

The base 11, as best shown in Figs. 2 and 4, is formed to receive and support a pair of hydraulic cylinders 47 and 48, arranged as shown, each having a piston for operating piston rods 49 and 51 rigidly attached to lugs 52 on the vertically movable press chamber 53. The press chamber 53 is closed at its lower end by a head 54. Through this head passes a rod 56, sealed by a packing gland 55 and secured to a press plunger 57 within the chamber 53. The cylinders 47 and 48 may be supplied with hydraulic pressure fluid to raise and lower the press chamber 53, through connections 50 and 60, respectively, and the construction is such that these cylinders and the piston rods moving therein serve as guides and supports for the press chamber.

The rod 56 is connected at its lower end to a yoke 58. Two piston rods 59 and 61 attached to yoke 58 pass through stuffing boxes 62 in the lower heads of hydraulic cylinders 63 and 64. Piston rod 59 carries at its upper end a piston 65, and piston rod 61 carries a similar piston 66. The cylinders 63 and 64 are mounted in plate 14 and are seated in openings therein. The upper ends of the cylinders 63 and 64 are closed by heads 67, each containing hydraulic connections 68. There are also hydraulic connections 69 at the opposite ends of these cylinders. It will be seen that when hydraulic pressure fluid is supplied through the connections 68, the pistons 65 and 66 will be lowered and will act through yoke 58 to lower the plunger 57. In similar manner, admission of hydraulic pressure fluid through connections 69 will elevate the pistons 65 and 66 and hence the plunger 57.

From the foregoing description it will be seen that mechanism is provided for forming carbon dioxide snow in the chamber 16 and also for moving plunger 17 up and down in that chamber to eject the snow. The hydraulic cylinders 47 and 48 are operative to raise and lower the press chamber 53 into and out of contact with the head 14 in alignment with the snow chamber 16.

Hydraulic cylinders 63 and 64 are effective to raise and lower the plunger 57 in the press chamber 53. It is essential that means be provided for closing the open end of snow chamber 16 during the snowing operation. Such a means is illustrated in Figs. 3 and 4 of the drawings.

Referring to Fig. 4 of the drawings, reference character 71 designates a closure plate adapted to be moved into and out of sealing engagement with the lower end of snow chamber 16 and also adapted to seal the open end of press chamber 53 in the pressing operation, at which time the parts occupy the positions shown in Figs. 3 and 4. The closure plate 71 has a depending boss or projection 72 adapted to fit into the press chamber and assist the consolidation of the snow which is transferred into that chamber from the snow chamber above. This has the effect of compacting the corners of the block as will be explained.

A vent port 98 in boss or projection 72 is connected by a flexible hose 99 with offtake 43 and serves to vent gas from the press chamber during a pressing operation. In this way the gas escaping from the block while it is being pressed is recovered along with the flash gas from the snow chamber. The plate 71 may be swung rearwardly from the position shown in Fig. 3 (toward the right in Fig. 4) out of sealing engagement with the snow and press chambers when press chamber 53 is lowered far enough to clear the projection 72. For performing this swinging function, the plate 71 carries on each lateral side a pair of spaced pins 73 connected by rods 74 to a bifurcated member 75. The members 75 straddle and are pivotally connected to the middles of levers 76 pivoted at one end at 77 to the base 11 of the press. The other ends of levers 76 have connected to them at 78 tie-rods 79 terminating at their upper ends in eccentric straps 81. Movable within the straps 81 and attached to an operating lever 82 are eccentrics 83. The pivot 77 for the bars 76 is mounted in two spaced brackets 84 so that movement of the lever 82 permits a limited upward locking movement of the pressure plate 71 with reference to snow chamber 16. Upward movement of press chamber 53 and sealing engagement between the upper end of this chamber and the lower face of plate 71 is accomplished through the hydraulic cylinders 47 and 48.

The closure plate 71 carries a handle 85 which the operator may grasp to shift the plate when it is desired to move the closure plate to or from sealing position. Rearward movement of the closure plate is limited by engagement between the plate and a U-shaped bracket 86 having its ends attached to two of the columns 12. The closure plate may be moved forwardly to sealing position by a foot treadle 87 attached to one of the bifurcated members 75, and it may be locked against the chamber 16 through lever 82.

Since the closure plate 71 is pivoted on the base of the press by rods 74 and member 76, its mounting is thermally isolated from both the snow and the press chambers and the only heat transfer that can occur between the plate and these chambers is that occasioned by direct contact between the plate and the chambers during the pressing and snowing operations. Thus, while snow being formed in the snow chamber is showered on one face of the plate and pressed in the press chamber in direct contact with the other face of the plate, the thermal isolation of the plate from the heavy metal masses of the

press is such as to avoid all freezing up of the parts and insures continuous operation of the press.

In addition to the mechanism just described, it is convenient and frequently necessary to have means for indicating the position of the press plunger 57 within the press chamber 53. As here illustrated, a column 12 (Fig. 1) carries graduations 88 with which a rod 89 attached to the yoke 58 cooperates. A suitable guide, such as 91, may be carried by the column to guide the rod 89 in its up and down movement. The graduations at 88 may be of any desired character to indicate the depth of the block being pressed or its weight.

Although various types of mechanism may be provided for operating the press, it is preferred that a unitary hydraulic mechanism be utilized. One form of mechanism is indicated simply in Fig. 5 of the drawings, the main flow paths alone being illustrated and described.

Reference should now be made to Fig. 5 which shows in diagram the three sets of piston motors used in the press, the three control valve units for the motors, and the means for developing the hydraulic pressure controlled by the control valve units and used to operate the press motors.

There are three control valve units, namely valve unit 101, with actuating lever 102, valve unit 103 with actuating lever 104, and valve unit 105 with actuating lever 106. All three valves are hollow and of the balanced piston type and all three have three similar positions, "down" indicated by the letter "D," "up" indicated by the letter "U" (which are the extreme positions of the valve), and "neutral" or mid-position indicated by the letter "N" which is a lap position in which both cylinder ports are closed so that a hydraulic lock of the controlled piston is afforded. The construction of the valve units is shown in diagram in Fig. 5. The valve proper as shown in each case is simply a hollow spool valve of the inside supply end exhaust type but may be any hydraulic piston type valve suitably ported. All three valve bodies are connected to the high pressure supply manifold 107 and to the exhaust manifold 108 as shown. The exhaust connection of the valve unit 101 leads upward so as to trap liquid in the valve, for a purpose to be explained.

The piston valve of valve unit 101 is so contrived that in its "neutral" position it blanks the connections 50 and 60 to the two ends of the motor cylinders 47 and 48. In the "up" position it connects the lower connection 50 to supply and the upper connection 60 to exhaust, while in the "down" position it connects both the upper and lower end connections 50 and 60 to exhaust. The rising exhaust connection prevents the oil from draining away from the valve body, so that as the press chamber lowers by gravity both ends of the cylinders remain oil-filled. Thus valve unit 101 in its "neutral" position can lock the press chamber. In its "up" position it admits pressure fluid below pistons in cylinders 47, 48 to lift the press chamber. In its "down" position it merely permits the press chamber to descend by gravity, by blanking supply and connecting the opposite ends of cylinders 47, 48 together.

The valves 103 and 105 are of slightly different character. They have a neutral lap position and they admit pressure selectively to one end while connecting the other end of the cylinder to exhaust. The result is that the press plunger and the ejector plunger are each capable of hydraulic

power operation in both directions. Thus the valves 103 and 105 are simply a positive lap reverse valve gear of the balanced piston type with inside supply and end exhaust.

The valve 105 is shown in its "up" position to which it is biased by a spring as shown. The connection 22 of the cylinder 21 leads directly to the body of valve 105, but a special double connection is interposed between the upper connection 23 and the body of the valve 105 for the purpose of assuring that the press chamber 53 will be in its lower position at the time the snow is ejected from the snowing chamber 16. Thus between the connection 23 to the top of cylinder 21 and the connection 23a to the valve 105 there are two parallel paths. The first of these is through check valve 23b which permits flow from 23 toward 23a but closes against reverse flow. The second connection is through a valve mechanism indicated generally by the numeral 23c applied to its valve body. This valve mechanism is shown in detail in Figs. 7 and 8.

As shown in these figures, a balanced piston valve 109 is urged by a spring 111 in an outward direction to a position in which it interrupts communication between 23 and 23a. The end of the valve 109 protrudes and carries a roller 112 which is in the path of a cam 113 moving with the press chamber 53. The actual construction and location of the cam 113 is indicated in Fig. 7 and a diagrammatic showing is adopted in Fig. 5.

In Fig. 7 the valve body 23c is shown carried on a bracket 114 bolted to the member 12, while the cam 113 is bolted to yoke 52. Assume now that controller 105 is in the "up" position and it is desired to move the piston 19 and the ejector 17 downward. Controller 106 is moved to the "down" position which connects 23a with the supply and 22 with exhaust. The supply flow cannot pass the check valve 23b and hence must pass through the valve 23c which will be open only if the press chamber is in its lowermost position. In such position the cam 113 pushes the valve 109 inward to connect 23a with 23. In this way a hydraulic interlock is provided which assures that the transfer of snow from the snowing chamber to the press chamber will occur when the press chamber is in its lowermost position.

The pressure developing mechanism is also shown in Fig. 5. 115 represents a tank or sump containing the hydraulic fluid, ordinarily oil. The return line 108 discharges freely into the tank 115. A motor 116 drives two pumps 117 and 118. The pump 117 may be of the rotary type and is of large discharge capacity, but capable of discharging against a predetermined pressure, say 400 lbs. per square inch, whereas the pump 118 is of the positive displacement type having a relatively small discharge capacity but capable of discharging against a relatively high back pressure, say 2,000 lbs. per square inch. The pump 117 has a suction connection 119 and the pump 118 has a suction connection 121 through which the pumps draw oil from the sump 115.

The pump 117 discharges through connection 122 and a check valve 123 to the high pressure supply line 107. The pump 118 discharges directly into the supply line 107. In the connection 122 and hence between the pump 117 and the check valve 123 is a relief valve 124 which responds to pressure in the high pressure line 107. To enable the relief valve 124 to respond directly to pressure beyond the valve 123, a pressure transmitting connection 125 is used. This

simply admits the pressure in the high pressure line 107 to react against the motor or pressure responsive element of the relief valve 124.

This relief valve is so adjusted that when pressure in pipe 107 exceeds the predetermined pressure (assumed above to be 400 lbs.), the valve 124 opens and unloads the pump 117. At such times the check valve 123 prevents back flow from line 107. The unloading flow is by way of the discharge connection 126.

The high pressure pump 118 has a partial unloader 127 which is subject to control by pressure in control line 128 and may be of the so-called leak stroke type. The control line 128 is connected with the connection 68, which is the connection to the upper end of the press cylinders 63 and 64.

When the press plunger 57 is lowered, there is oil pressure in connection 68. The partial unloader is so contrived that under these conditions the high pressure pump 118 develops a discharge pressure of say, 750 to 1,000 lbs. When, however, the press cylinders 63 and 64 are active for pressing operation and the connection 68 to the upper end of the press cylinder is exhausting, the partial unloader is inactive and the pump 118 develops its full discharge pressure, say 2,000 lbs. and delivers it to connection 69.

It will be obvious from the above that during ordinary movements of the hydraulic pistons and until a resistance equal to the predetermined pressure in the hydraulic cylinders is encountered, the large capacity pump 117 furnishes pressure fluid. From this it follows that the motion of the plunger will be rapid so long as they encounter no serious resistance. When the back pressure in any hydraulic cylinder builds up to the predetermined pressure, the large capacity pump 117 ceases to deliver because it is unloaded by the relief valve.

At such times the small capacity high pressure pump takes over and develops the necessary operating pressure. If the plunger 57 is not in operation in an upward direction, the maximum pressure is limited by the partial unloader mechanism 127, but if the press plunger 57 is in action the available pressure is 2,000 lbs. per square inch. In this way, rapid motion until load is encountered is provided. Reasonable pressures are provided for the ejection and transfer operations and for the raising and lowering of the press chamber 53, while a much higher pressure is available for the pressing operation developed by the upward motion of the plunger 57 alone or in conjunction with the press chamber 53.

The reason for using the cam 113 and valve 23c is to prevent the operator from performing the useless maneuver of raising the press chamber 53 to receive the charge. The charge is simply pushed out of the snow chamber and falls into the press chamber while the press chamber is in its lowermost position. Time is saved by compelling the operator to make the transfer under the conditions stated.

Referring now to Figs. 9 to 14, inclusive, the cycle of operation of the press will be described.

Fig. 9.—Closure plate 71 is sealing the lower end of the chamber 16, in which snowing is proceeding. The press chamber 53 and the press plunger 57 are in their lower positions ready to receive a charge. At the end of a snowing operation, the closure 71 is swung to one side and valve handle 106 is moved momentarily to "down" position. Because the press chamber 53 is then in its lower position, with the valve 109 held open,

piston 19 and ejector plunger 17 make a downward excursion causing the snow to fall into the press chamber 53.

Fig. 10 shows the condition at the completion of the transfer and before plunger 17 has moved up as it will do because actuator 106 is shifted to "up" position by its spring. The closure 71 is returned to its snow chamber sealing position. Then, as indicated in Fig. 11, snowing is resumed by proper manipulation of the valve handle 37. The actuator 102 is moved to "up" position until the upper end of the press chamber 53 has lapped the boss 72 on the lower face of the closure 71 slightly, at which time the controller 102 is moved to "neutral" position. Then the controller 104 is moved to "up" position, causing the press plunger 57 to move up. At this time, the dissipation of pressure in the connection 68 in control line 128 sets the pump 118 for maximum delivery pressure. Thus, the plunger 57 compresses the snow in the press chamber 53, as indicated in Fig. 11. While the controller 104 remains in "up" position, the operator shifts the controller 102 to "up" position, with the result that the press chamber 53, as well as the press plunger 57, move upwardly, finally compacting the upper end of the block, as indicated in Fig. 12, which shows the final position of the plunger and the press chamber.

Upon the completion of the pressing operation, both controllers 102 and 104 are moved to down position. The effect is to move the plunger 57 downward positively and to permit the press chamber 53 to descend by gravity as shown in Fig. 13. The controller 102 is then moved to "neutral" position, to prevent the press chamber 53 from rising, and the controller 104 is moved to "up" position to force the press head 57 upward until the cake of snow is lifted clear of the press chamber but not into contact with the closure 71 as shown in Fig. 14. When this position has been reached, the controller 104 is also moved to "neutral" position. The cake of snow is then removed, after which the controller 104 is shifted to "down" position, restoring the parts to the position of Fig. 9, ready for the next transfer and pressing cycle.

By snowing and pressing concurrently, it is possible to extend the snowing period and to avoid the freezing effects characteristic of too rapid a snowing operation.

Since one end of the block is compacted by the plunger 57 during the first part of the pressing operation and the other end of the block is compacted by boss 72 during the final concurrent movement of chamber 53 and plunger 57, all of the corners of the block are firm and dense. The use of plunger 17 to eject snow positively from the snow chamber insures quick and complete clearing of this chamber.

This application is a continuation-in-part of my application Serial No. 165,196, filed September 22, 1937.

What is claimed is:

1. Apparatus for making carbon dioxide snow blocks, comprising a snow chamber and a press chamber, each having a closed end and an open end, said chambers being disposed in end-to-end relation with their open ends adjacent each other; a single pivoted closure for sealing the open ends of both chambers simultaneously; means for injecting liquid carbon dioxide into said snow chamber to form snow therein; positive mechanical means in said snow chamber for ejecting snow therefrom; and means for pressing the car-

bon dioxide snow in said press chamber against said closure.

2. In a machine for making carbon dioxide snow blocks, a snow chamber having an open end; means for forming carbon dioxide snow in said chamber; a plunger movable in said chamber to eject snow from said open end; a press chamber movable toward and away from said snow chamber and having an open end in alignment with the open end of the snow chamber to receive snow from said snow chamber; means in said press chamber for pressing snow therein; a closure common to the open ends of both chambers; and guiding means for said closure, remote from said chambers and serving to guide the closure between an inactive position and a position in which it seals against the open end of the snow chamber and is then opposed to the open end of said press chamber.

3. Carbon dioxide snow block apparatus, comprising a support having a first open-ended chamber fixedly mounted thereon; means for forming carbon dioxide snow in said first chamber; a second chamber movably mounted on said base and having an open end facing and axially aligned with the open end of the first chamber; positively acting means for transferring snow from the first chamber into the second chamber; means for sealing the open ends of said chambers, said means being thermally isolated from said chambers except when in sealing relation to the same; and means for pressing the snow in said second chamber.

4. Carbon dioxide snow block apparatus, comprising a support having a first open-ended chamber fixedly mounted thereon; means for forming carbon dioxide snow in said first chamber; a second chamber movably mounted on said base and having an open end in alignment with the open end of the first chamber; an ejector plunger for transferring snow from the first chamber into the second chamber; a single closure shiftable into and out of alignment with said chambers; means operable to press said closure into sealing engagement with the open end of the snow chamber; means for moving the press chamber into engagement with said closure; and means for pressing the snow in said second chamber against said sealing means while said sealing means is effective to support loose snow being formed in the first chamber.

5. Apparatus for making carbon dioxide snow blocks, comprising a snow chamber and a press chamber, each having an open end, said chambers being disposed in end-to-end relation with their open ends in axial alignment; a single pivoted closure for sealing the open ends of both chambers simultaneously; means for injecting liquid carbon dioxide into said snow chamber to form snow therein; a piston in the press chamber for pressing the carbon dioxide snow against one side of said closure while snow is being formed in said snow chamber on the other side of the closure; and means movable with the piston in the press chamber and located outside of the chamber for indicating the position of said piston in said chamber.

6. Carbon dioxide snow block apparatus, comprising a support having an open-ended chamber movably mounted thereon; a piston in said chamber; means for moving said chamber; means for moving said piston in said chamber; a fixed chamber mounted on said support and having an open end facing the open end of the movable chamber; carbon dioxide snow forming

means connected to the interior of said fixed chamber; a snow ejecting plunger in said fixed chamber for transferring snow to the movable chamber; a manually operable sealing plate for closing the open end of the fixed chamber; means for locking said plate in sealing relation to said chamber; and means carried by said plate for compacting the snow in the movable chamber as the movable chamber is brought into contact with the plate in its locked position.

7. Apparatus for making carbon dioxide snow blocks, comprising a fixed snow chamber having an open end; means for injecting liquid carbon dioxide into said chamber to form snow therein; a press chamber containing a pressing means and having an open end in axial alignment with the open end of the fixed chamber and movable toward and from it; pressing means in said press chamber; means for transferring snow from said snow chamber to said press chamber; closure means adapted to seal the open ends of both of said chambers concurrently; and a projection on said closure adapted to extend into said press chamber and compact the top of the block being formed as the press chamber is moved against said closure and during the pressing excursion of said pressing means, whereby both ends of the formed block are made firm and compact.

8. Carbon dioxide snow block apparatus comprising, a stationary snow chamber open at one end; intake and offtake connections to said snow chamber for liquid and gaseous carbon dioxide respectively; a press chamber having an open end; a compressing plunger in said press chamber; means for moving the press chamber along the axis of the snow chamber; and a shiftable plate movable into and out of direct contact with the open end of said snow chamber to serve as a closure for the snow chamber when the press chamber is retracted, said plate including a projection adapted to coast with the open end of the press chamber and to form a snow confining seal therewith when the press chamber is moved toward said closure.

9. Carbon dioxide snow block apparatus comprising, a stationary snow chamber having an open end; intake and offtake connections to said chamber; a pivoted plate movable into and out of direct contact with the open end of said chamber to seal or open the same; a movable press chamber open at one end and in axial alignment with said snow chamber; a pressing plunger in said press chamber; means for moving said press chamber into direct contact with said plate when the plate is in contact with the snow chamber; and mechanical means for ejecting snow from the snow chamber into the open end of the press chamber when said plate is out of alignment with the open ends of said chambers.

10. Apparatus for making carbon dioxide snow blocks, comprising a snow chamber and a press chamber, each having an open end, said chambers being disposed in end-to-end relation with their open ends opposed, at least the press chamber being movable toward and from the other chamber; closure means for closing the open ends of said chambers, said means being movable to and from a position between the chambers and including a boss adapted to enter the open end of the press chamber and serve as a compressing abutment therein; means for injecting liquid carbon dioxide into said snow chamber to form snow therein; means for transferring said snow to the press chamber when said closure is withdrawn; a pressing plunger movable in said press

chamber; and independent means for moving said plunger and said press chamber each toward said closure means, whereby a snow block being formed in the chamber is compacted between the boss and plunger, and sharp corners on the block are secured.

11. Carbon dioxide snow block apparatus comprising a stationary snow chamber having an open end; intake and offtake connections to said snow chamber for liquid and gaseous carbon dioxide respectively; a snow ejecting plunger in said snow chamber; an open ended press chamber in axial alignment with said snow chamber and movable toward and away from said snow chamber; a shiftable closure for said snow chamber when said press chamber is retracted and for both of said chambers when the two are juxtaposed; and means effective only in the retracted position of the press chamber for actuating said snow ejecting plunger.

12. Carbon dioxide snow block apparatus comprising a base having a stationary snow chamber mounted thereon, said chamber having an open end; a press chamber movably mounted on said base in axial alignment with said snow chamber and having an open end facing the open end of the snow chamber; means for moving said press chamber toward and away from said snow chamber; a shiftable closure plate movable into and out of sealing contact with the open end of the snow chamber and adapted to serve as a closure for the snow chamber when the press chamber is retracted, or as a closure for both of said chambers when they are juxtaposed; and guiding means for supporting said plate in thermally isolated relation to both of said chambers.

13. Carbon dioxide snow block apparatus comprising a base having a stationary snow chamber mounted thereon, said chamber having an open end; a press chamber movably mounted on said base in axial alignment with said snow chamber and having an open end facing the open end of the snow chamber; means for moving said press chamber toward and away from said snow chamber; and a closure plate pivotally mounted on said base in thermally isolated relation to both of said chambers and adapted to serve as a closure for the open ends of both of said chambers simultaneously and forming the sole separating means between the loose snow in the snow chamber and the snow block in the press chamber.

14. Carbon dioxide snow block apparatus comprising a stationary snow chamber having an open end; intake and offtake connections to said snow chamber for liquid and gaseous carbon dioxide respectively; a snow ejecting plunger in said snow chamber; an open ended press chamber in axial alignment with said snow chamber and movable toward and away from said snow chamber; means for moving said press chamber toward said snow chamber; a shiftable closure for sealing the snow chamber alone or both of said chambers; and means controlled by the position of the press chamber for preventing operation of the snow ejecting plunger when the press chamber is removed from its fully retracted position.

15. Carbon dioxide snow block apparatus comprising a snow chamber having an open end; supply and offtake connections to and from said chamber for liquid and gaseous carbon dioxide respectively; a snow ejecting plunger reciprocable in said snow chamber; an open-ended press

chamber axially aligned with said snow chamber; means for guiding said press chamber in motion toward and from the snow chamber in the direction of said axis; a closure for said snow chamber; guiding means for said closure remote from said snow chamber; means for limiting the approach of said press chamber toward said snow chamber to prevent engagement of the two but permitting the press chamber to engage the closure when the latter is in position to close the snow chamber; means for actuating said ejecting plunger; and an interlock serving to inhibit actuation of said ejecting plunger except in a retracted position of said press chamber.

16. The combination defined in claim 15, in which the ejecting plunger is fluid operated, and the interlock comprises a valve shiftable by movement of the press chamber and controlling fluid which flows as an incident to operation of the ejecting plunger.

17. Apparatus for making carbon dioxide snow blocks, comprising a snow chamber and a press chamber movable with respect to said snow chamber, each of said chambers having an open end, said chambers being disposed in end-to-end

relation with their open ends in axial alignment; a closure insertable between the open ends of both chambers for sealing them simultaneously; means for shifting the closure out of alignment with said chambers into inoperative position; and means effective only when said press chamber is in a predetermined position for ejecting snow from said snow chamber.

18. Carbon dioxide snow block apparatus comprising, a stationary snow chamber having an open end; intake and offtake connections to said chamber; a pivoted closure movable into and out of direct contact with the open end of said chamber to seal or open the same; a movable press chamber open at one end and in axial alignment with said snow chamber; a pressing plunger in said press chamber; means for moving said press chamber into direct contact with said closure when the closure is in contact with the snow chamber; and means for actuating said plunger to eject snow from the snow chamber into the open end of the press chamber when said closure is out of alignment with the open ends of said chambers.

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