United States Patent [19]

Newell

[11] **3,765,321**

[45] **Oct. 16, 1973**

[54] **APPARATUS FOR AIDING DISPOSAL OF SNOW BY COMPACTING IT TO GREAT DENSITY**

[75] Inventor: **Keith Newell,** Cedar Rapids, Iowa

[73] Assignee: **Sno Pac Corporation,** Buffalo, N.Y.

[22] Filed: **Dec. 3, 1971**

[21] Appl. No.: **204,533**

Related U.S. Application Data

[63] Continuation of Ser. No. 829,229, June 2, 1969, abandoned.

[52] **U.S. Cl.** ..... **100/45,** 37/10, 100/95, 100/215, 100/218, 100/232, 100/237, 100/249, 100/256, 100/269 R

[51] **Int. Cl.** **B30b 15/32**

[58] **Field of Search** ..... 100/190, 42, 43, 100/45, 95, 98 R, 215, 218, 232, 246, 247, 249, 251, 269 R, 100, 256, 237; 37/10

[56] **References Cited**

UNITED STATES PATENTS

877,193	1/1908	Holden	100/45
960,612	6/1910	Woodard	100/190
1,302,723	5/1919	Smith	100/215 X
1,966,378	7/1934	Dinzl	100/232 X
2,029,984	2/1936	Buttfield et al.	100/232 X
2,151,855	3/1939	Kobold	100/232 X
2,244,078	6/1941	Perlberg	100/232
2,537,920	1/1951	Smith	100/249
2,960,927	11/1960	Aichelen	100/208
2,997,942	8/1961	Dunham et al.	100/42
2,985,101	5/1961	Hillstrom	100/232
3,005,403	10/1961	Van Endert	100/232 X
3,141,401	7/1964	Lindemann et al.	100/232 X
3,149,428	9/1964	Hukill	37/10
3,438,320	4/1969	Raab	100/43
3,447,449	6/1969	Kostolich	100/249
3,564,993	2/1971	Tezuka	100/232 X
3,565,297	2/1971	Bladt	100/218 X

Primary Examiner—Billy J. Wilhite
Attorney—Arthur Schwartz

[57] **ABSTRACT**

Snow is dumped into a portable compressor which compresses the snow by hydraulic power through three stages into blocks of great density which require much less space than the original show and can hence be carried away with greater economy, or piled up with less commandeering of usable space. Hydraulic strokes are controlled by limit switches. When sufficient density is achieved in the final stage, the hydraulic pressure trips a switch which opens a gate so that continued cycling of the compacting apparatus ejects a highly compacted block of snow. When far enough out, it trips a switch to cause the gate to close, shearing off the projecting block, and dropping the block onto a conveyor. The combination of a swinging guard and pusher plate jointly forming one wall of the hopper permits handling huge quantities of snow.

30 Claims, 6 Drawing Figures

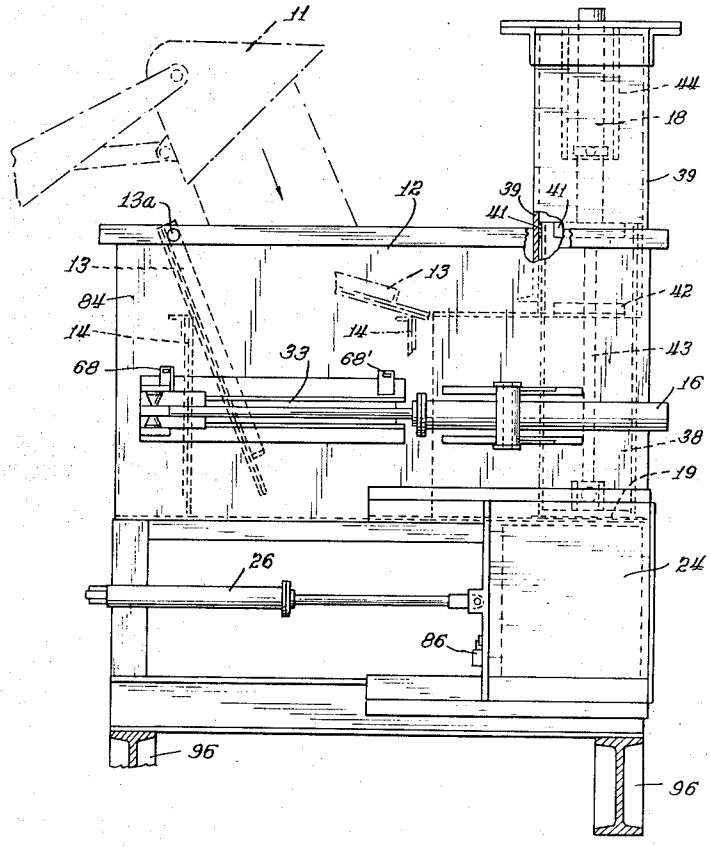


Fig. 1.

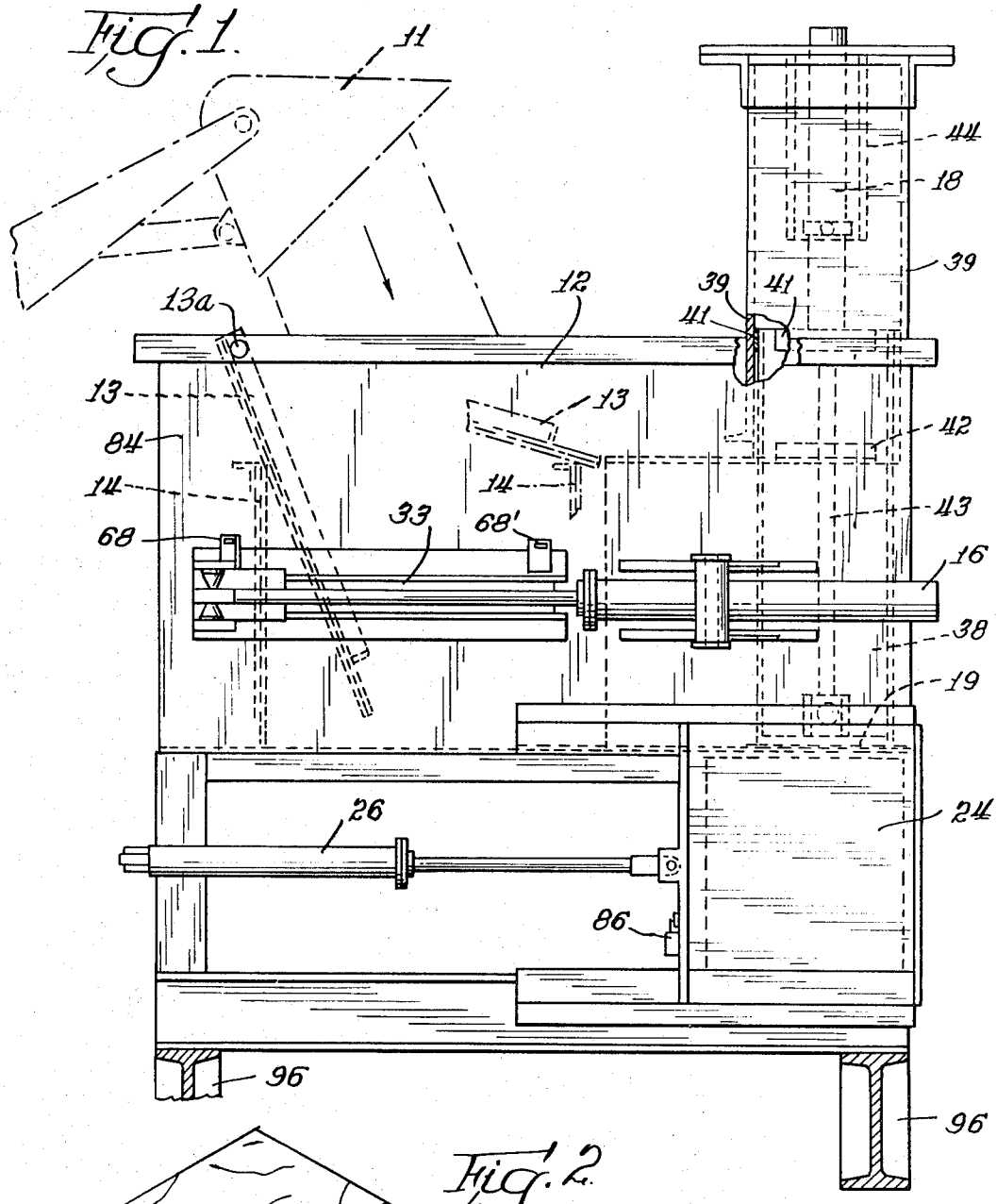
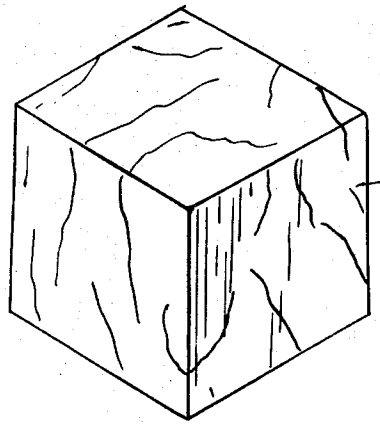


Fig. 2.



INVENTOR.
ROBERT KEITH NEWELL
BY Arthur Schwartz

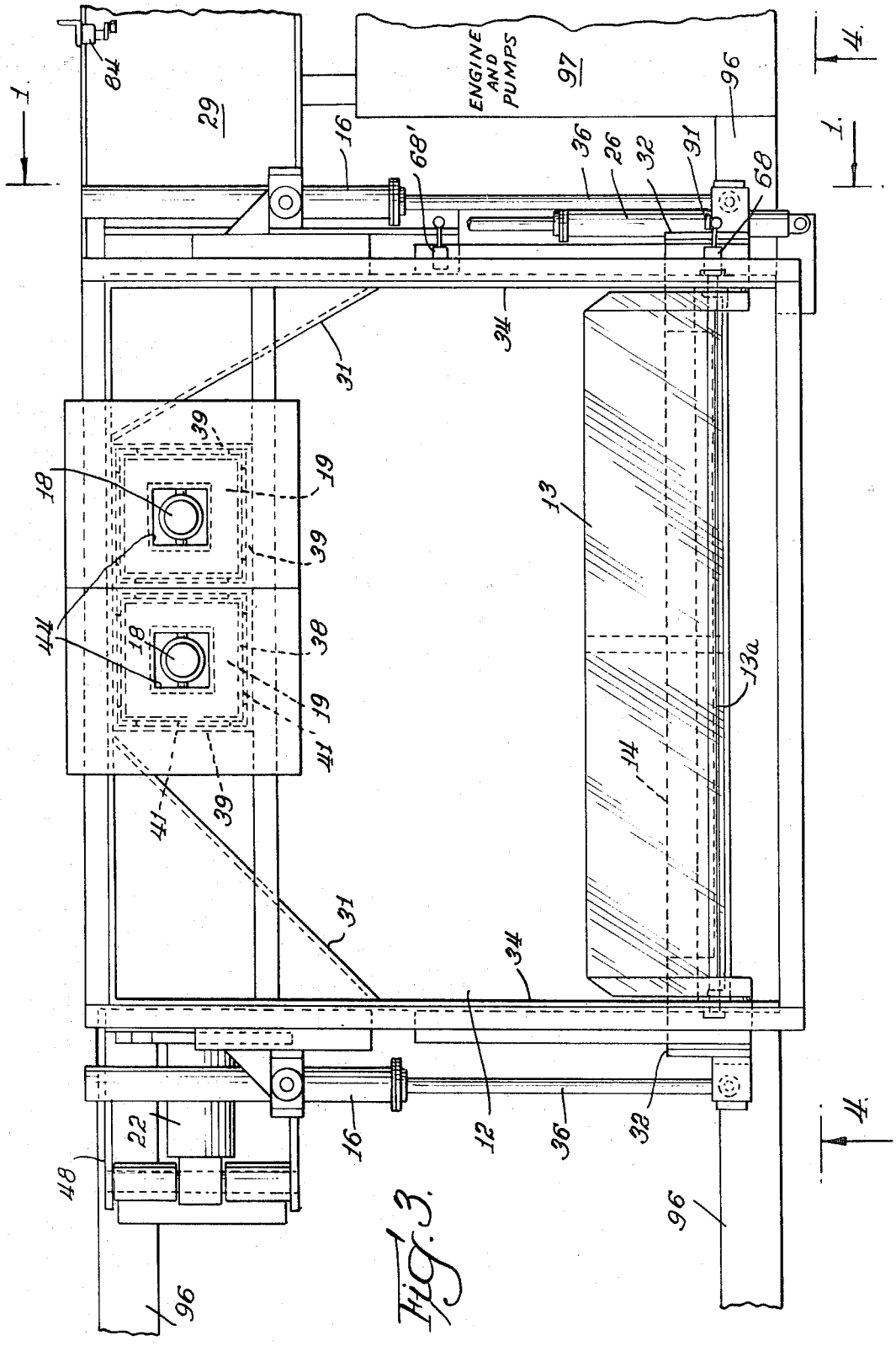
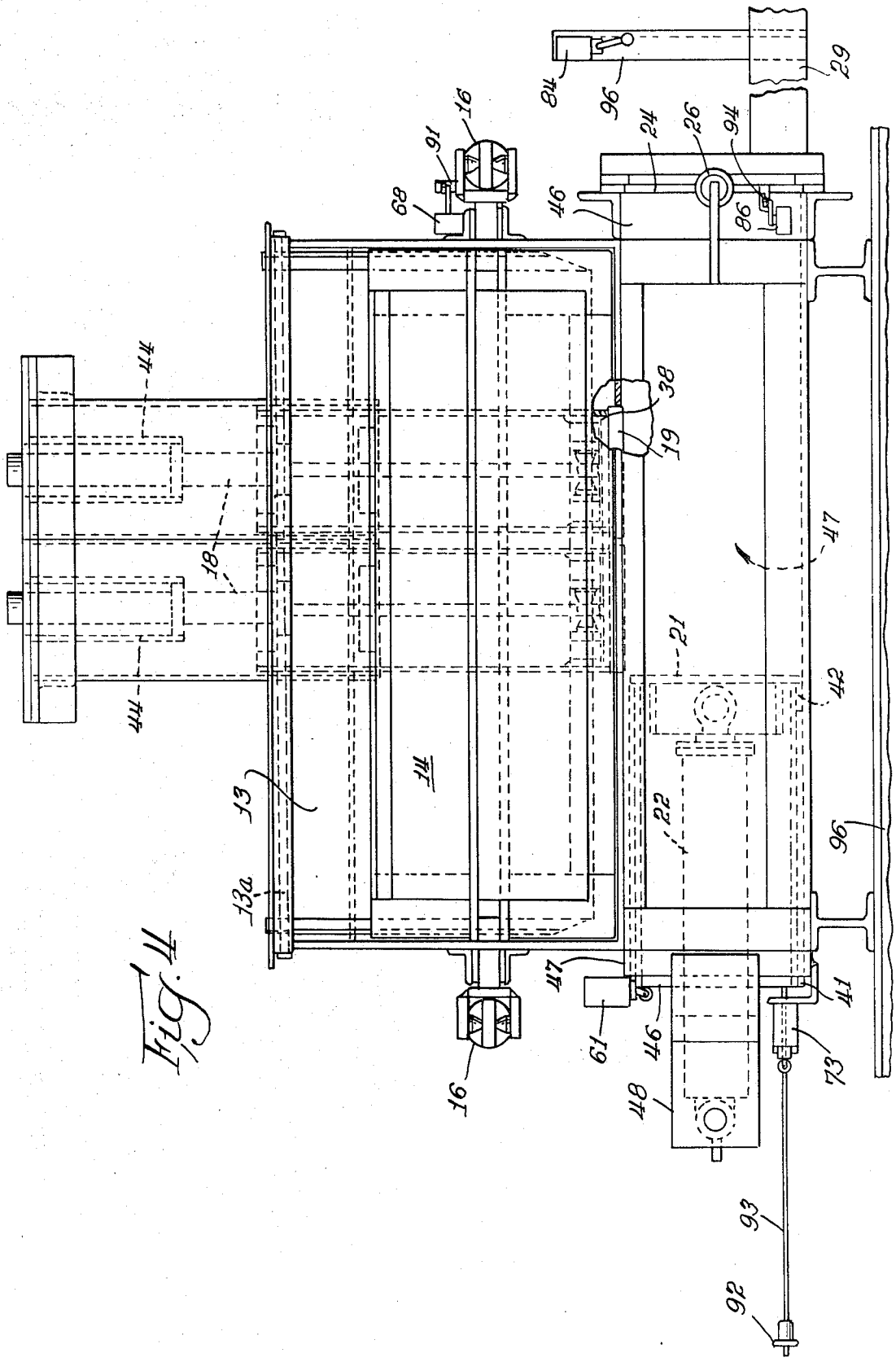

ENGINE AND PUMPS
97
96
29
84
16
68'
68
36
26
32
91
34
31
39
19
18
44
38
41
13
13a
14
12
22
48

Fig. 3.


29
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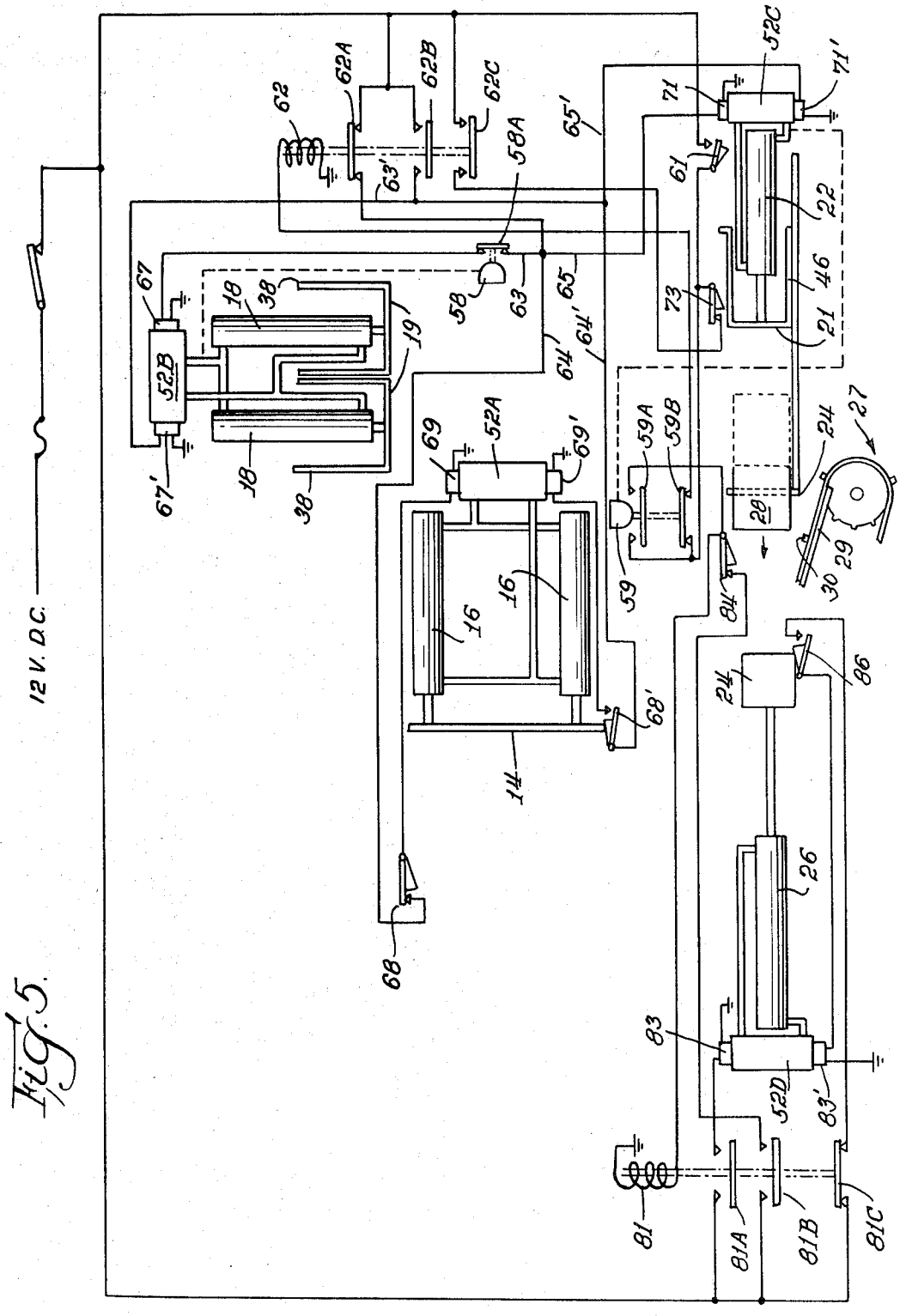
93
92

Fig. 11


12 V. D.C.
62
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62B
62C
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58A
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67
67'
52B
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38
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52A
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69'
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17
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68'
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71'
52C
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22
46
21
73
59A
59B
59
20'
24
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84'
24'
86
26
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52D
83'
81
81A
81B
81C

Fig. 5.

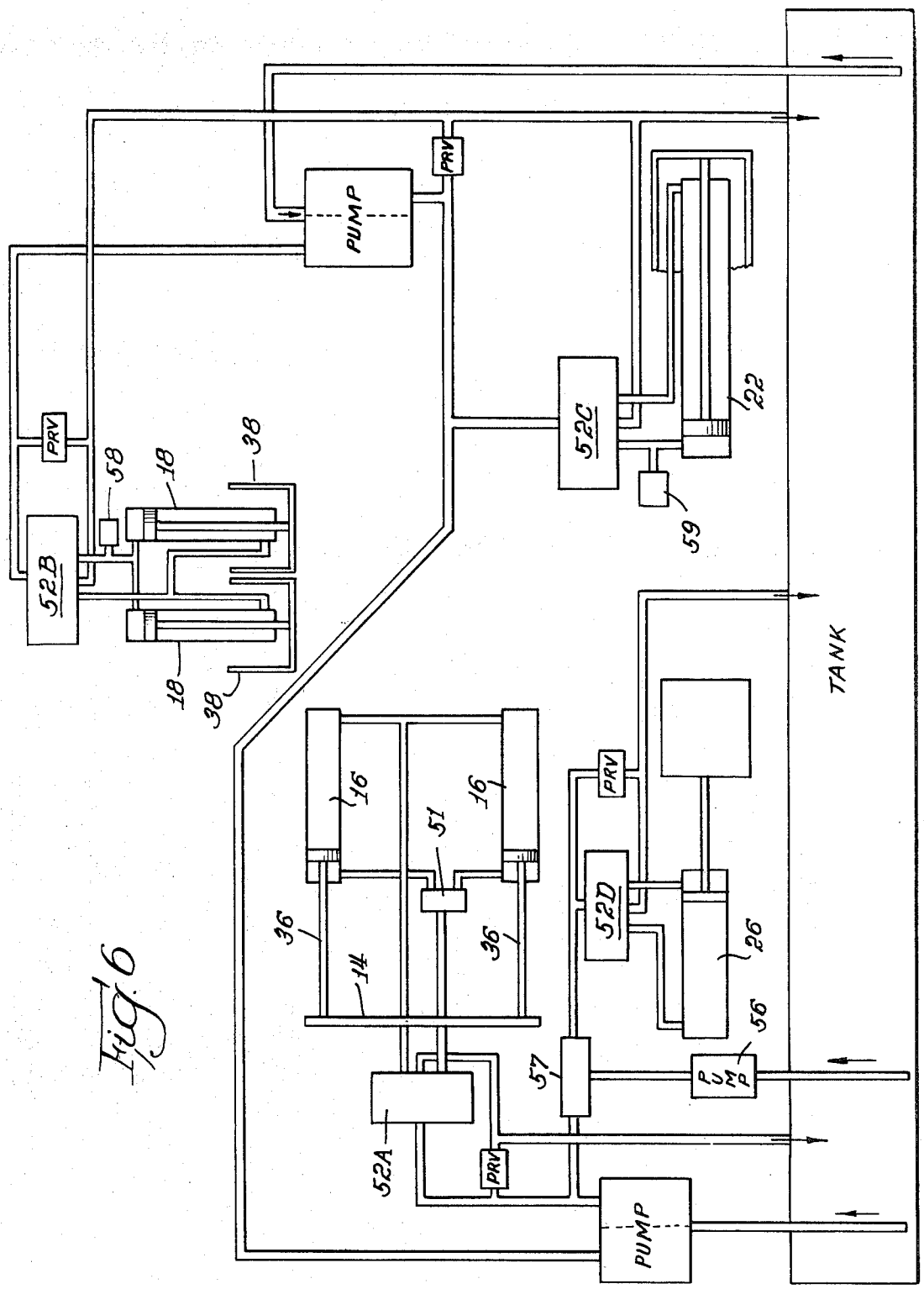
PUMP
PRV
52C
22
59
52B
58
18
38
TANK
16
51
36
14
52D
26
56
57
PUMP
52A

Fig. 6

APPARATUS FOR AIDING DISPOSAL OF SNOW BY COMPACTING IT TO GREAT DENSITY

This is a continuation of application Ser. No. 829,229, filed June 2, 1969 and now abandoned.

The removal of heavy snows has long been an unsolved problem. The snow occupies so much space that, except for occasional small areas, actual removal of the snow from the area has not been considered economically practicable. Even when machines have been available for picking up the snow and dumping it in trucks, the number of trucks which would be required has usually made the project prohibitive.

The present invention greatly aids in the solution of the problem, or extends the areas for which haulage is feasible, by greatly compacting the snow. There have been some prior suggestions, including patents, for compacting snow. However, so far as is known, the devices have not worked with sufficient satisfaction to be successful. A device according to the present invention has been built and tested and is now deemed ready for commercialization. The present disclosure is offered for public dissemination if patent protection is available.

More specific objects and advantages of the invention may be apparent from the following description and from the drawings.

DESIGNATION OF FIGURES

FIG. 1 is a view showing mainly the discharge side of the experimental model of the invention, and showing a scoop dumping snow into it.

FIG. 2 shows, in perspective, a highly compacted snow block as discharged from the machine of FIG. 1.

FIG. 3 is a view looking down on the machine shown in FIG. 1.

FIG. 4 is a view looking at the side represented by the line 4—4 of FIG. 3, the end which is at the left in FIG. 1.

FIG. 5 is a circuit diagram for the controls used in connection with the apparatus illustrated.

FIG. 6 is a hydraulic diagram for the illustrated apparatus.

GENERAL DESCRIPTION

The operation and construction of the apparatus chosen for illustration of this invention can be made clear by reference to FIGS. 1 and 4. Snow may be more or less continuously loaded into the machine as by scoop 11 of a front end loader or by a conveyor. Preferably the manner of gathering the snow somewhat compacts it. The snow is dumped into a portion 12 of the machine which may be considered a hopper although only the rear swinging wall 13 slopes inwardly and downwardly in a typical hopper fashion. A transversely extending rod 13a in the hopper 12 defines the pivotal access about which swing wall 13 pivots. A feed plate, or first stage compression plate, 14, is actuated by cylinder 16 to move the snow to the right, simultaneously compacting it. At the right-hand end of the machine as seen in FIG. 1, cylinders 18 actuate tampers 19 to compress the snow further and press it down in front of ram 21, seen in FIG. 4. Ram 21 is operated by ram cylinder 22 which further compresses the snow and moves it beyond the area of tamping, and in fact against the gate 24. When the snow has been sufficiently compacted, as determined by the fluid pressure required to actuate the ram cylinder 22, gate 24 is opened by hydraulic cylinder 26, whereupon one or more further actuations of the ram 21 will begin ejection of the firmly compacted snow block. Ejection is accomplished by adding less compacted snow behind the compacted block. When the desired length of compacted block clears the path through which gate 24 will move, cylinder 26 moves gate 24 back to its closed position, shearing off the projecting portion. It drops to conveyor 27 (See FIG. 5) as a separate block 28. The forming of a new compacted block by ram 21 continues.

FIG. 2 shows a block 28 of compacted snow such as is discharged by this machine. Such blocks are pushed along the slideway 29 by succeeding cross bars 30 (FIG. 5) carried by chains and may be discharged into a truck or removed by hand or by pick-off apparatus.

HOPPER AND FIRST STAGE

The details of the hopper and first stage of compression are perhaps seen best in FIGS. 1 and 3. The problem of moving huge quantities of snow without letting snow fall behind the moving member is solved by the combination of a swinging bridge or chute 13 and a pusher plate 14, both extending substantially the full width of the hopper 12. Jointly they form one wall of the hopper. The main purpose of bridge 13 is to keep snow from falling behind the pusher plate 14 as it advances from a position near one outer extremity of the apparatus. Thus as the feed plate 14 moves to the right, it swings the bridge or swinging wall 13 upwardly, but the bridge continues to bridge between its pivotal axis defined by shaft 13a and the pusher plate 14 so that snow cannot fall behind the pusher plate 14. With the pusher plate 14 nearly in its retracted position, as shown fully in FIG. 1, snow will slide down the swinging wall 13 into the line of movement of the pusher plate 14. As the pusher plate 14 approaches its more advanced position, an upper fragment of it being shown near its final position in FIG. 1, any snow newly deposited in the hopper 12 will be mainly supported on top of swinging wall 13. When pusher plate 14 is retracted, wall 13 will swing back down and dump the snow into the path of the next movement of pusher plate 14.

So that the snow will all be pushed into the path of tampers 19, converging guide plates 31 are provided, as seen best in FIG. 3.

The means for actuating pusher plate 14 is best seen in FIG. 3. The pusher plate 14 is provided near the center of its height with extensions 32 extending through slots 33 (FIG. 1) in the opposite side walls 34 of hopper 12. Piston rods 36 of pistons 16 are pivoted to the extensions 32.

TAMPERS

Tamper plates 19 are carried at the foot of tamper slides 38 which telescope into and partially out from tamper slideways 39. Both slides 38 and slideways 39 are substantially rectangular in cross-section. Slide pads 41 are carried on the four sides of each slide 38 at its upper end, and slide pads 42 are carried on the four sides of slideway 39 at its lower end, bearing on the outer faces of slide 38.

Each piston 43 of cylinders 18 is coupled to the base of slide 38 or to the plate 19. The cylinders 18 may either be secured at their upper ends, or may be secured at midpoints by cages 44 which provide room between them and the slideway 39 for receiving slide 38.

LAST STAGE RAM

In a manner similar to that described for the tampers, ram **21** is carried by a slide, or is the front face of a ram body **46** which moves along a slideway or compression chamber **47.** Slide pads **41** and **42** are again provided, at least along the bottom of slide **46.** The cylinder **22** is in this instance pivoted at its rear end to yoke **48,** since the few inches of extra length at this point are not as likely to make a difference as at the top where clearance is involved.

The retracted position of ram face **21,** as shown in FIG. **4,** is to the rear of the tampers **19.** It is then moved forwardly entirely past the tampers **19** so that the snow in front of it can be entirely surrounded by a compression chamber **47** of fixed walls, except for the movable gate **24.** The compression chamber **47** is made up of four sturdy plates welded along their edges to square tube construction, except that the upper plate is interrupted where the snow is pressed through it by tampers **19.**

HYDRAULIC CIRCUIT

The present hydraulic circuit is quite evident from FIG. **6.** For the most part, it needs no description. A flow divider valve **51** is provided for ensuring equal flow to the two cylinders **16** in their working stroke. Inasmuch as these operate at opposite ends of a single pressure plate **14** it is important that the pistons **36** stay nearly in step with one another.

Valves **52A, 52B, 52C** and **52D** are solenoid-actuated reversing valves, the circuitry for the solenoids being shown in FIG. **5.** They are spring-centered and in their central positions lock the cylinders and freely return pressure fluid to the reservoir.

Ram cylinder **22** is supplied by two large pumps because this is a cylinder of large diameter and hence speed of movement depends on large pumping capacity. The large diameter is, of course, to develop the high density of the snow which is desired.

Some additional speed in the operation of pressure plate **14** is provided by connecting pump **56,** which is needed primarily for gate operating cylinder **26,** through valve **57** to the line supplying pressure to control valve **52A.** In this instance the valve **57** is a flow divider valve which excludes the possibility that there might not be enough pressure in the fluid delivered to valve **52D** to operate the gate with the speed desired.

Pressure switches **58** and **59** will be described in connection with the circuitry.

CIRCUIT DIAGRAM AND SEQUENCING

The circuitry is shown in FIG. **5** and the cycling can thus be described with reference to that figure. We may start with the assumption that ram cylinder **22** is at an intermediate point in its retraction stroke, so that limit switch **61** is open and relay **62** is deenergized. Contact **62A** now completes a circuit with three branches, **63, 64** and **65.** Branch **63,** assuming pressure switch **58** is closed, energizes solenoid **67** to operate reversing valve **52B** in the direction for lowering tamper slides **38.** Branch **64,** assuming limit switch **68** to be closed, energizes solenoid **69** to actuate reversing valve **52A** in a direction to cause return of pusher plate. As pusher plate **14** reaches its fully retracted position, it opens limit switch **68,** interrupting branch circuit **64** and allowing spring-centered valve **52A** to return to neutral position.

Branch **65** energizes solenoid **71** to actuate valve **52C** in the direction for operating ram cylinder **22** to retract its ram **21.** As the movement of ram **21** trips limit switch **61,** this closes a circuit through contact **59B** of pressure switch **59** to the coil of relay **62** to energize that relay. This opens contacts **62A** to open the three branch circuits **63, 64** and **65,** and closes contacts **62B** and **62C.** Contact **62B** closes a circuit with three branches, **63', 64'** and **65'** corresponding to branch circuits **63, 64** and **65,** except for actuating movements in the opposite direction. Thus the solenoids **67', 69'** and **71'** are actuated to operate the respective valves in the opposite directions. Limit switch **68'** opens branch circuit **64'** to deenergize solenoid **69'** as the pressure plate **14** reaches its more advanced position, which happens to be the retracted positions of the cylinders **16.** Limit switches **68** and **68'** are not essential, but if the operation of pusher plate **14** is faster than the operation of the other compactors, these limit switches will save power inasmuch as the valves **52A, B** and **C** discharged to reservoir when in neutral position so that the oil flows at low pressure. At the same time, these valves lock their cylinders by cutting off flow to and from both ends of the cylinders.

As ram **21** leaves its retracted position, it allows limit switch **61** to open. However, relay **62** is maintained energized by a branch of its energizing circuit extending through limit switch **73** and holding contact **62C** of relay **62.** This holding branch is interrupted, however, as ram **21** reaches its extended position and opens limit switch **73.** Thereupon relay **62** drops its contacts to the position shown in FIG. **5,** and the cycle is repeated as first described herein. The initial movement of ram **21** allows limit switch **73** to close, but this no longer completes the circuit for energizing coil **62** because contact **62C** has dropped to the open position.

While tampers **19** are in their compacting stroke, if the snow ahead of them has become sufficiently compacted that the hydraulic fluid operating the cylinders **18** reaches a predetermined maximum, such as 1,750 pounds per square inch, pressure switch **58** will be tripped, opening its contact **58A** and allowing valve **52B** to return to its spring-centered position. It is desirable to design the sizes of parts so as to try to keep ram **21** supplied with approximately the maximum snow it can handle each stroke even though there may not be perfect or maximum feeding of snow by the pusher **14** and the tampers **19,** and the snow fall may have been fluffy. Accordingly, when there is relatively maximum feeding of heavy snow by these preliminary devices, (feeding about 60 cubic feet of snow previously compacted by gathering) the snow may reach maximum compaction intended at this stage before tampers **19** reach their fully extended position. Allowing valve **52B** to shift to its neutral position in this circumstance avoids waste of power when tampers **19** would not move much further anyway.

It is important that tampers **19** do not have to operate together. When ram **21** is half retracted, one tamper **19,** having a clear space ahead of it, may move easily and take all of the pressure fluid so that it moves fast and pushes compacted snow in front of the ram. By the time the ram moves enough further back to clear the way for the other tamper, the first will have so compacted its snow that now the other will take all the oil

and move fast enough to push or drop its compacted snow in front of ram 21 before ram 21 trips limit switch 61 and reverses both movements.

Pressure switch 59 has the important function of determining when the snow block being compacted by ram 21 has reached the intended compactness so that it should be ejected; and opening the gate to permit the ejection. Thus when the hydraulic fluid pressure driving the ram 21 forwardly reaches the predetermined limit, which we still may assume to be 1,750 pounds per square inch, pressure switch 59 is tripped. The contact 59A of this pressure switch closes the circuit to relay 81 energizing the coil of this relay. The circuit through contact 59A is also carried through limit switch 73, so that if this required degree of pressure is only reached at the end of the stroke of ram 21 it will not actuate the relay 81, but will wait one more stroke by the ram 21.

Energization of relay 81 operates its contact 81A to close the circuit to solenoid 83 which actuates valve 52D to deliver fluid under pressure to cylinder 26 in the gate opening direction. At the same time, contact 81B closes a circuit through limit switch 84 acting as a holding circuit for maintaining relay 81 energized. The gate therefore is held open independently of limit switch 73 so that the compacting apparatus may continue to cycle. When ram 21 completes its stroke, it opens limit switch 73, reversing the three compacting devices. As ram 21 retracts, tampers 19 will be advancing, pressing more partially compacted snow in front of ram 21. When ram 21 reaches its fully retracted position and closes limit switch 61, the three compactors will again reverse. This time as ram 21 pushes the snow toward blocks 28 it will reach a point of compaction at which it moves the block 28 forwardly. Limit switch 84 is so located that when the desired length of block 28 projects beyond the gateway, limit switch 84 will be opened by action of the ice block 28. This breaks the holding circuit for relay 81, and the relay 81 will be deenergized (pressure switch contact 59A now being open because pressure does not reach the maximum while gate 24 is open). Deenergization of relay 81 closes its contact 81C to establish a circuit to solenoid 83' energizing valve 52D in the direction for closing gate 24. As gate 24 reaches its closed position it opens limit switch 86.

Depending on the position of limit switch 84, gate 24 will shear the block off either by cutting into either fully compacted snow or the partially compacted snow by which the block is being pressed forwardly, assuming this is firm enough to hold the block until the cutting action begins.

A limit switch could be provided to be actuated by gate 24 as it reaches its open position for allowing valve 52D to return to neutral. However, this is not necessary because the oil from pump will not be discharged wastefully at high pressure, since the flow divider 57 will allow most of it to flow to valve 52A to aid in operation of the pressure plate 14.

In FIG. 5 the limit switches are diagrammatically shown. For the most part their physical arrangements will be a matter of convenience. Those actually used in the test machine are shown in the drawings. In FIG. 3 limit switches 68 and 68' are shown to be mounted on the side of the hopper 12, and each is actuated by a dog 91 carried by one of the extensions 32. In FIG. 4 limit switch 61 is shown carried by the compression chamber 47, and actuated by the body of the ram 21 when retracted. Limit switch 73 is shown carried by a bracket on compression chamber 47 but actuated by a dog 92 on a rod 93 which reciprocates back and forth with the slide 46 which is the body of ram 21. The limit switch 86 is carried by the compression chamber 46, near the outlet end thereof, and is engaged by a dog 94 carried by gate 24.

Limit switch 84 is carried by a post 96 upstanding from slideway 29, and as previously mentioned is actuated by the ice blocks.

Each of the limit switches may be adjustable as to its location or may have an adjustment within itself as to its position of actuation. Actually, the circuit change in each occurs slightly before the time indicated so that the associated apparatus will reach the point indicated at the end of the reaction time. With ideal positioning, the control valve will be shifted to its neutral position just in time to avoid the shock or impact effect if any controlled part reached the physical limit of its movement before the valve shifted.

CONVEYOR

It is important to remove the severed ice blocks 28 promptly and reliably. With the circuits shown, the gate might not otherwise fully open because the contact 59A of pressure switch 59 can be expected to remain closed only for an instant. Providing a reliable conveyor under the circumstances here encountered has not been as simple as was expected.

Reliability has been achieved by the style of conveyor illustrated. The severed snow block 28 drops a few inches onto a slide plate 29 along which transverse flights 30 are moved by a pair of chains each running around a pair of sprockets. The flights 30 reliably move the blocks of snow, and there is no place where snow can pack in a manner to stop operations. The sprockets continuously poke the chain free of snow. The only extensive surface on which snow can fall is plate 29 which is constantly swept clean by the flights 30.

ADDITIONAL FEATURES

The entire apparatus can be mounted on a frame of which longitudinal beams 96 may be the basic portions. A suitable engine 97 and the various pumps may also be carried by this frame. The various solenoid valves are most conveniently located beneath the floor of hopper 12, this floor being approximately level with the top of the compression chamber 47.

The apparatus is low enough in cost and simple enough to operate so that many installations may be stationary. For example, a stationarily mounted apparatus of this invention might solve the problem for a large shopping center or factory parking lot.

It is important to pack the snow to a very great density, and this apparatus can achieve this. Calculations indicate a packing pressure achieved by ram 21 of over 200 pounds per square inch. Although this may be higher density than some would insist on, it would seem to be very poor use of the invention to let the final compression fall below 175 pounds per square inch.

The density mentioned has been achieved by this invention with efficient general operation, with the pusher plate developing approximately 9 pounds per square inch on the snow. It should be understood that 9 pounds per square inch is enough to do a great deal of compacting even though the snow has already been partially compacted in handling. The pounds per square inch developed by the tampers is believed to be

at least about 35 pounds per square inch, but may vary, depending on whether the nature of the snow is such that it will squirt out from under the tampers.

Satisfactory speed of production of snow blocks of such high density as here contemplated is believed to require three stages of packing of the partially compressed snow dumped in the hopper. The necessity for this is more apparent when it is realized that the pusher plate has an area five times the total area of the tamper plates, and each feeding movement of the pusher plate displaces about 60 cubic feet. Hence parking this much snow into compression chamber expeditiously presents a problem. It is preferred to increase the dimension of the tampers seen in FIG. 2 to 2 feet to correspond to the width of the compression chamber **47**, although the desirability of this is yet to be established by test, and the illustrated form (18 inches) works well.

For the most part, hydraulic experts will have no trouble choosing suitable hydraulic components. Vickers vane pumps have been found satisfactory (3525V38A21 ICC **10**L for the twin pumps and V210 11W34C12 for the single pump). Valves used for valves **51** and **57** respectively have been 2V14-8-6-40 and 2F23-P4-4-4.

I claim:

1. Snow compacting apparatus including a hopper into which a bulk quantity of snow may be dumped, a pusher plate moveable in the lower portion of the hopper, for pushing snow in the hopper into a first confined area, partially compacting it therein; a swing-plate pivotally mounted in the hopper, said swing-plate being swung as the pusher plate pushes snow, to a position to receive snow dumped toward the hopper and dump it therein as the pusher plate returns; said pusher plate being substantially free from extensions lengthwise of its movement; hydraulic means extending along the length of the hopper for drawing the pusher plate through the hopper; second stage hydraulic compactor means movable in said first confined area for further compacting the snow and pushing it into a second confined area; and a hydraulic compacting ram movable in the second confined area for operation within a compression chamber closed by a movable gate for further compacting the snow and forming a dense snow block; means for opening the gate when a desired density has been achieved, and for closing the gate behind an ejected block, the hydraulic ram operating when the gate is open to eject the snow block along an ejection path by packing more snow behind it.

2. Snow compacting apparatus according to claim **1** including conveying means spaced below the ejection path to receive a block when severed by closing of the gate from the supporting packed snow which supports and ejects it.

3. Snow compacting apparatus according to claim **1** including conveying means spaced below the ejection path to receive a block when severed by closing of the gate from the supporting packed snow which supports and ejects it, and switch means tripped by the moving block as it clears the path for the closing of the gate.

4. Snow compacting apparatus according to claim **1** in which the pusher plate recedes to approximately the position of one outer hopper wall and moves along two adjacent hopper walls.

5. Snow compacting apparatus according to claim **1** in which the pusher plate recedes to approximately the position of one outer hopper wall and moves along two adjacent hopper walls; a swinging chute and bridge plate hanging down in front of the pusher plate when the pusher plate is retracted and swinging to bridge behind it as it advances.

6. Snow compacting apparatus according to claim **1** comprising means for compacting the snow with a force equal to at least **175** pounds per square inch.

7. Snow compacting apparatus according to claim **1** comprising means for compacting the snow with a force equal to at least about **200** pounds per square inch.

8. Snow compacting apparatus according to claim **1** in which the second stage compactor means feeds snow to the path of the ram over an area longer in the direction of ram movement than the transverse dimension of the ram.

9. A snow compactor according to claim **1** in which the second stage compactor means compacts while the pusher plate and compacting ram retract.

10. A snow compactor according to claim **1** in which the second stage compactor means compacts while the pusher plate and compacting ram retract and all are reversed automatically by a single controller.

11. A snow compactor according to claim **1** in which the second stage compactor means compacts while the pusher plate and compacting ram retract and all are reversed automatically by a single controller; and limit switch means for discontinuing the supply of pressure fluid for one stage of compaction as it reaches the limit of its movement.

12. Snow compacting apparatus including a hopper into which a bulk quantity of snow may be dumped, a hydraulically driven pusher plate movable in the hopper for pushing snow in the hopper into a first confined area, partially compacting it therein; second stage hydraulic compactor means movable in said first confined area for further compacting the snow and pushing it into a second confined area; and a hydraulic compacting ram movable in the second confined area for operation within a compression chamber closed by a movable gate for further compacting the snow and forming a dense snow block; means for opening the gate when a desired density has been achieved, and for closing the gate behind an ejected block, the hydraulic ram operating when the gate is open to eject the snow block by packing more snow behind it;

in which the second stage compactor means feeds snow to the path of the ram over an area longer in the direction of ram movement than the transverse dimension of the ram; the second stage compactor means comprising a plurality of hydraulic tampers actuated by a common fluid source but separately movable to provide successive rapid movements as the area is cleared progressively by retraction of the ram.

13. Snow compacting apparatus including a hopper into which a bulk quantity of snow may be dumped, a hydraulic compacting ram for operation within a compression chamber closed by a movable gate for compacting the snow and forming a dense snow block; the limit of compacting movement of the ram terminating with a substantial space ahead of it within the compression chamber; means for opening the gate when a desired density has been achieved, and for closing the gate with shearing action behind an ejected block, the hydraulic ram operating when the gate is open to eject the snow block by packing, less densely, more snow be-

hind it, and means for pushing snow from the hopper into the path of the ram, partially compacting it.

14. A compacting apparatus comprising:

a. a hopper-like structure into which a quantity of material may be deposited;

b. a pusher plate means movable relative to the lower portion of the hopper for pushing the material deposited in the hopper into a first confined area, partially compacting it therein;

c. movable plate means in the hopper cooperating with the pusher plate means for facilitating the substantially continuous reception of material into the apparatus regardless of the position of the pusher plate means;

d. power means for moving the pusher plate means toward and away from said first confined area;

e. compacting means movable in said first confined area for further compacting the material and pushing it into a second confined area;

f. a movable gate closing one portion of said second confined area;

g. means for opening said gate when a desired density of the material has been achieved and for closing said gate when a desired portion of the material has passed therethrough;

h. and a compacting ram means movable in said second confined area for further compacting the material and for ejecting a block of the material formed along an ejection path by packing more material behind it.

15. Compacting apparatus according to claim 14 wherein the block is severed by a shearing action as said gate is closed.

16. Compacting apparatus according to claim 15 including conveying means spaced below the ejection path for receiving a block when severed by the closing of said gate.

17. Compacting apparatus according to claim 15 wherein said compacting means compacts while said pusher plate and compacting ram retract and all are reversed automatically by a single controller.

18. Compacting apparatus according to claim 15 wherein the compacting means compacts while the pusher plate means and compacting ram means retract, switch means associated with each of said means for discontinuing the supply of pressure when said means reach the limits of movement.

19. Compacting apparatus according to claim 14 including a switch means tripped by the moving block as it clears the ejection path for initiating the closing of said gate.

20. Compacting apparatus according to claim 14 wherein said pusher plate recedes to a position approximating an outer hopper wall and moves along a pair of side walls.

21. Compacting apparatus according to claim 14 wherein said movable plate is swung upwardly as the pusher plate moves toward said first confined area and then downwardly to a position to receive the deposited material when the pusher plate moves away from said first confined area.

22. Compacting apparatus according to claim 14 including means for compacting the material with a force equal to at least about 175 pounds per square inch.

23. Compacting apparatus according to claim 14 wherein said compacting means in the first confined area feeds material into the path of said compacting ram means over an area longer in the direction of ram movement than the transverse dimension of said compacting ram.

24. Compacting apparatus according to claim 14 wherein said compacting means compacts while said pusher plate and compacting ram retract.

25. A compacting apparatus comprising:

a. a hopper-like structure into which a quantity of material may be deposited;

b. a power operated compacting ram means operating within a compression chamber closed by a movable gate for compacting the material and forming a dense block, the limit of compacting movement of said compacting ram means terminating a substantial distance from said gate;

c. means for automatically opening the gate when a desired density has been achieved, and for closing the gate with a shearing action behind an ejected block, said compacting ram means operating when the gate is open to eject the block by packing, less densely, more material behind it;

d. and means for pushing material from said hopper-like structure into the path of said compacting ram means, partially compacting the material.

26. Compacting apparatus according to claim 25 including an intermediate compacting stage between said pushing means and said compacting chamber.

27. Compacting apparatus according to claim 26 wherein said intermediate compacting stage includes a plurality of movable tampers.

28. Compacting apparatus according to claim 25 including means associated with said pusher means for preventing material from being deposited behind said pusher means.

29. Compacting apparatus including a hopper-like structure into which a quantity of material may be deposited, comprising:

a. a pusher plate which recedes to approximately the position of one outer hopper wall and moves along a pair of hopper walls, and converging walls opposite the pusher plate through which the pusher plate pushes the material, partially compacting it;

b. a swinging chute and bridge plate hanging down in front of the pusher plate when the pusher plate is retracted and swinging to a bridging position as the pusher plate advances;

c. a hydraulic compacting ram for operation within a compression chamber closed by a movable gate for further compacting the material and forming a dense block, means for opening the gate when a desired density has been achieved, and for closing the gate behind an ejected block, the hydraulic compacting ram operating when the gate is open to eject the block by packing more material behind it, and means for pushing material from the hopper into the path of the ram, partially compacting it;

d. second stage compactor means feeding material into the path of the compacting ram over an area longer in the direction of ram movement than the transverse dimension of the ram, the second stage compactor means comprising a plurality of hydraulic tampers actuated by a common fluid source but separately movable to provide successive rapid movements as the area is cleared progressively by retraction of the ram;

e. limit switch means for discontinuing the supply of pressure fluid for one stage of compaction as it reaches the limit of its movement;
f. switch means tripped by the moving block as it clears the path for the closing of the gate;
g. wherein the pressurized hydraulic fluid operating the hydraulic compacting ram is fed to pressure-responsive means for controlling the opening of the gate when the hydraulic pressure reaches a predetermined value equivalent to a compacting pressure of at least about 200 pounds per square inch.

30. Compacting apparatus comprising:
a. a hopper into which a quantity of material may be deposited;
b. a pusher plate movable relative to the hopper for pushing the material into a first confined area, partially compacting it therein;
c. second stage compactor means movable in said first confined area for further compacting the material and pushing it into a second confined area;
d. a compacting ram movable in the second confined area for operation within a compression chamber closed by a movable gate for further compacting the material and forming a dense block;
e. means for opening the gate when a desired density has been achieved, and for closing the gate behind an ejected block, the compacting ram operating when the gate is open to eject the block by packing more material behind it;
f. wherein the second stage compactor means feeds material to the path of the compacting ram over an area longer in the direction of ram movement than the transverse dimension of the ram;
g. the second stage compactor means including a plurality of tampers actuated by a common power source but separately movable to provide successive rapid movements as the area is cleared progressively by retraction of the ram.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,765,321 Dated October 16, 1973

Inventor(s) KEITH NEWELL

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Abstract, line 4, "show" should read --snow--.
Column 1, line 56, "access" should read --axis--.
Column 7, line 11, "parking" should read --packing--.

Signed and sealed this 15th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
☆ U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.