Feb. 13, 1968 M. CLAR 3,368,478

COMPACTION APPARATUS

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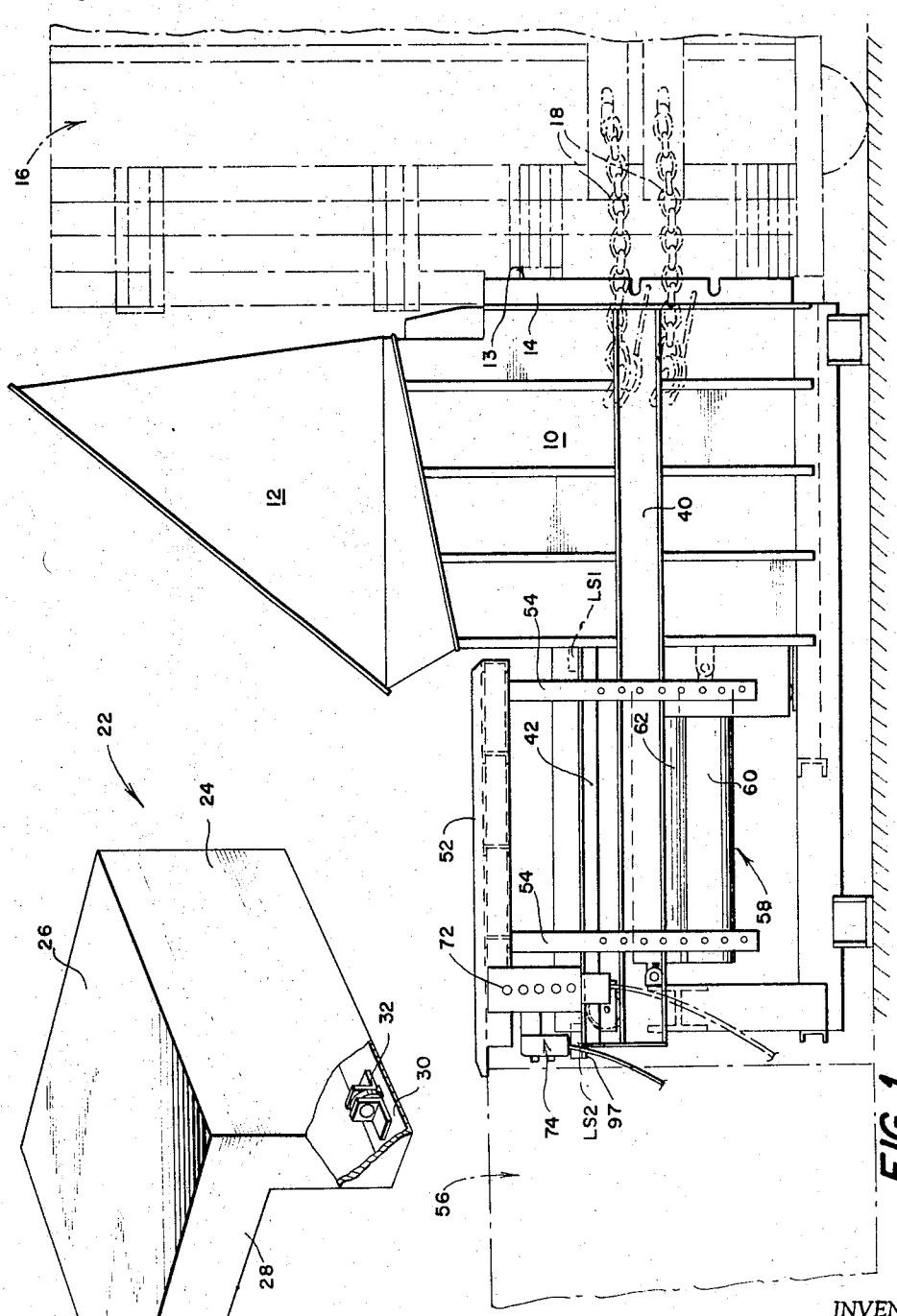


FIG. 1

FIG. 7

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COMPACTION APPARATUS

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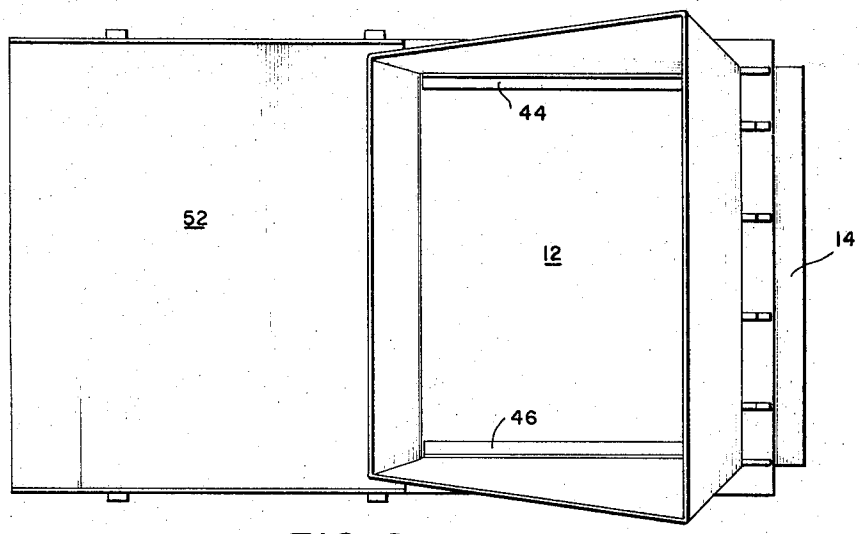


FIG. 2

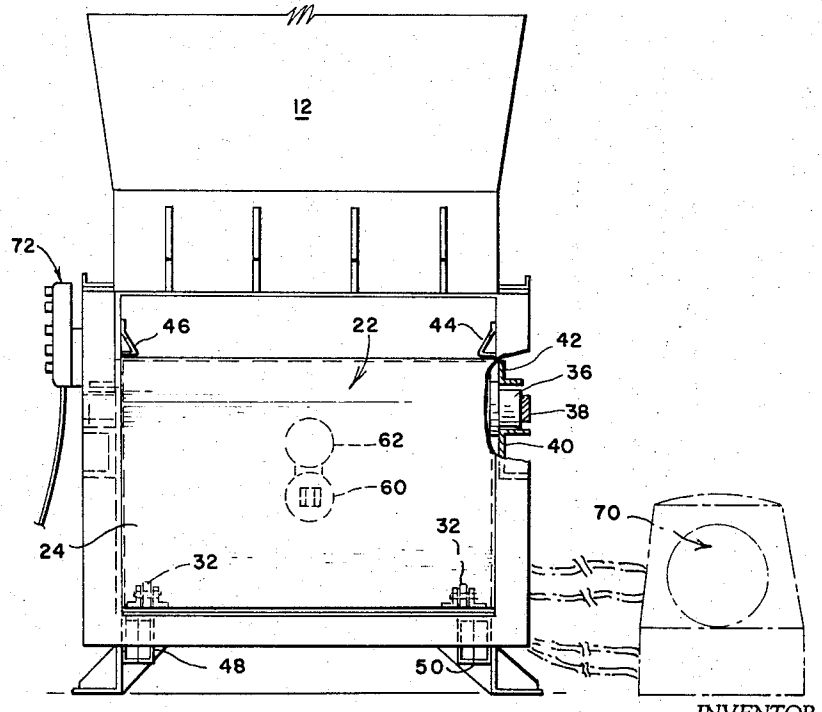


FIG. 3

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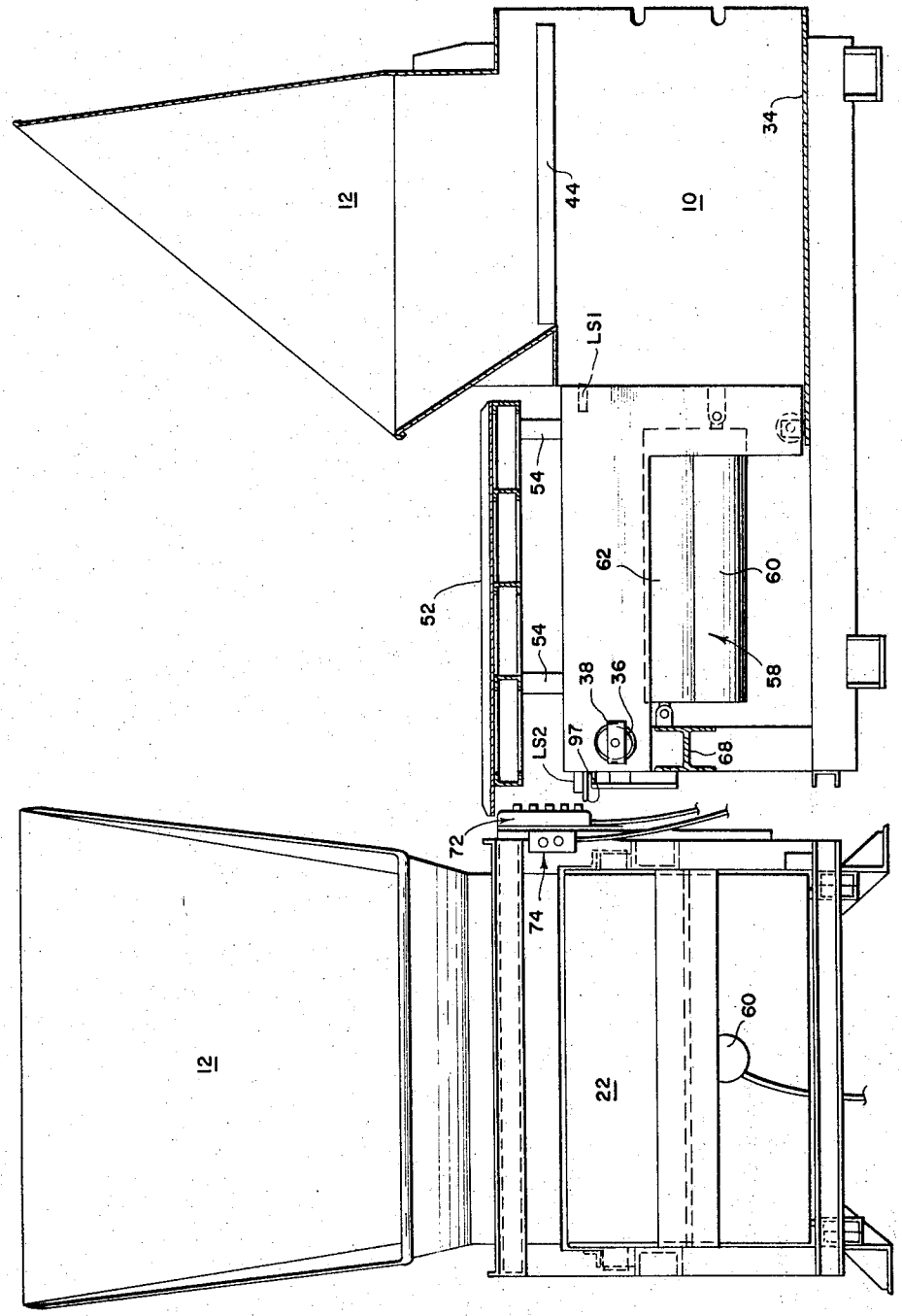


FIG. 5

FIG. 4

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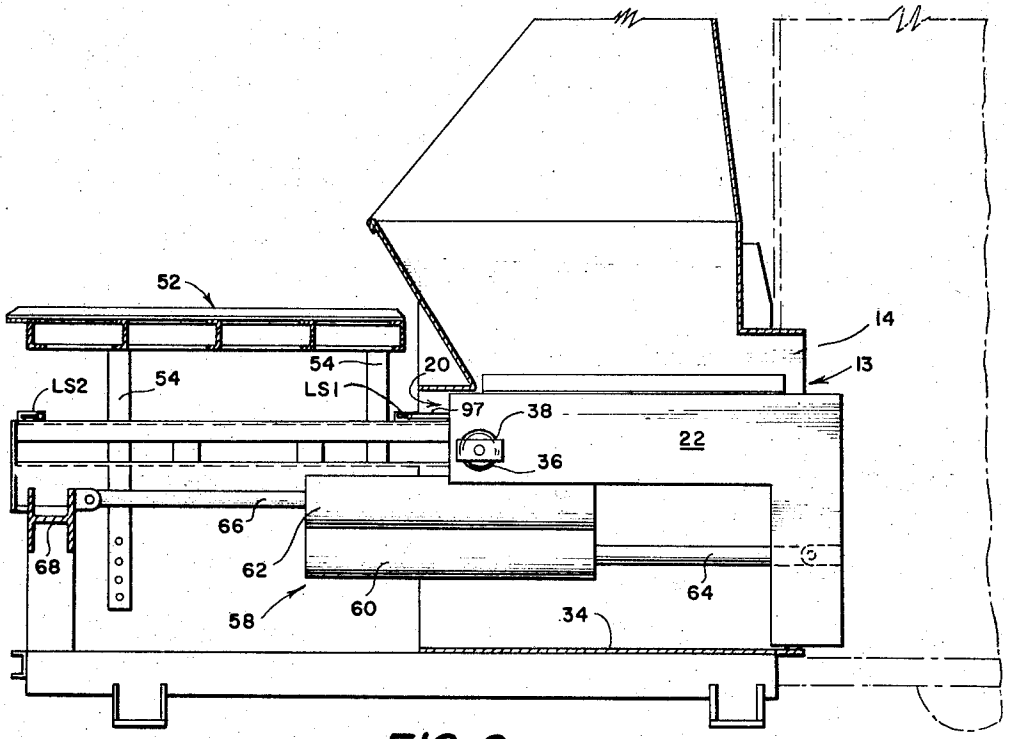


FIG. 6

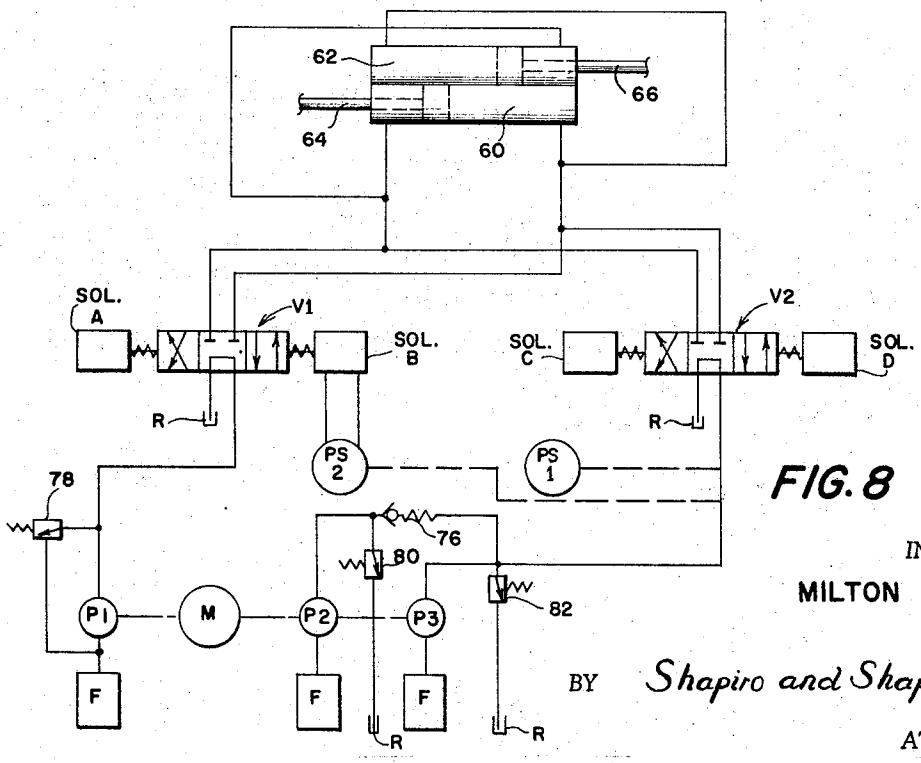


FIG. 8

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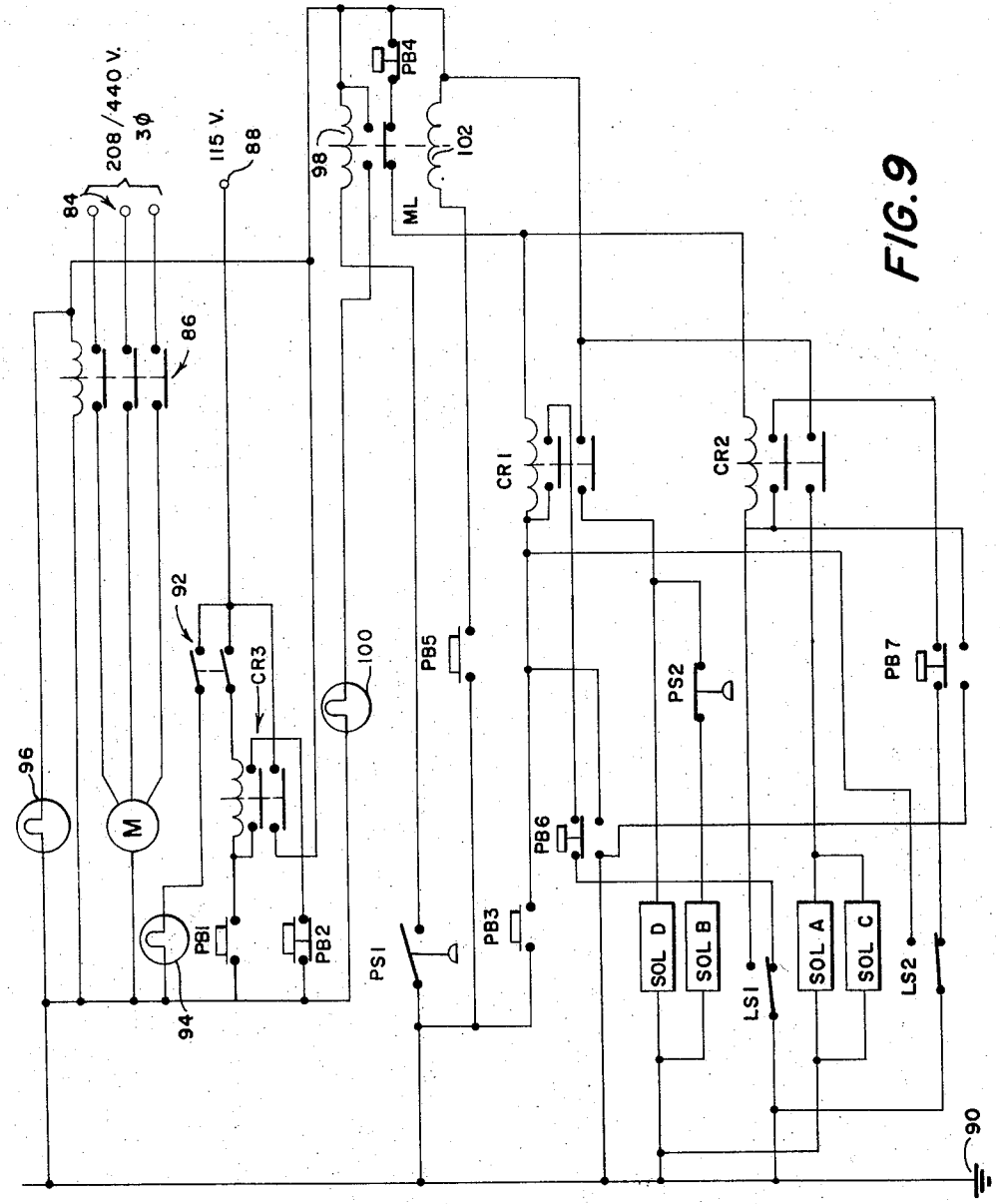


FIG. 9

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3,368,478

COMPACTION APPARATUS

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Filed Sept. 9, 1965, Ser. No. 486,082
12 Claims. (Cl. 100—50)

ABSTRACT OF THE DISCLOSURE

The disclosed stationary packer has a compaction blade with front-support rollers upon the floor of the compaction chamber and elevated rear-support rollers upon tracks extending behind the compaction chamber. The blade is driven by a dual hydraulic ram having an integral pair of cylinders arranged one above the other with piston rods extending in opposite directions. Hydraulic fluid is supplied to the cylinders from a system including multiple pumps with automatic controls for producing rapid movement of the blade with low hydraulic pressure and slower movement of the blade with high hydraulic pressure. The automatic control system cycles the blade and permits manual control of jogging.

This invention relates to compaction apparatus and more particularly to improvements in so-called stationary packers.

In the refuse disposal industry, stationary packers are becoming increasingly popular because of their ability to reduce the volume of refuse by about 75%. This permits a reduction in the number of containers and the number of service trips by refuse collection vehicles. However, stationary packers employed heretofore have been unduly expensive to manufacture, have lacked versatility, have had long cycle time, and have had unduly large front-to-rear dimensions.

It is accordingly a principal object of the present invention to provide improved compaction apparatus, and especially stationary packer apparatus, which overcomes the foregoing disadvantages.

Briefly stated, but without limitation, the stationary packer apparatus of the present invention has a compaction chamber with a hopper superstructure and a simple box-like compaction blade arranged to move through the compaction chamber and to compact material through a side opening in the chamber and into an adjacent container, such as the body of a vehicle. The compaction blade has a pair of front-support rollers upon the floor of the compaction chamber and a pair of elevated rear-support rollers upon tracks extending behind the compaction chamber. The blade is driven by a dual hydraulic ram having an integral pair of cylinders arranged one above the other with piston rods extending in opposite directions, Hydraulic fluid is supplied to the cylinders from a system including multiple pumps with automatic controls for producing rapid movement of the blade with low hydraulic pressure and slower movement of the blade with high hydraulic pressure. The blade cycles automatically and may also be jogged under manual control.

The foregoing and other objects, advantages, and features of the invention and the manner in which the same are accomplished will become more readily apparent upon consideration of the following detailed description of the invention taken in conjunction with the accompanying drawings, which illustrate a preferred and exemplary embodiment, and wherein:

FIGURE 1 is a side elevation view of a stationary packer of the invention with a container shown in phantom lines;

FIGURE 2 is a top plan view of the packer;

FIGURE 3 is a front elevation view of the packer, partially broken away and in section, with a power unit shown in phantom lines;

FIGURE 4 is a rear elevation view of the packer;

FIGURE 5 is a longitudinal sectional view of the packer;

FIGURE 6 is another longitudinal sectional view illustrating a different position of the compaction blade;

FIGURE 7 is a perspective view, partially broken away, illustrating the blade construction;

FIGURE 8 is a schematic diagram of the hydraulic system of the invention; and

FIGURE 9 is a schematic diagram of the electrical system of the invention.

Referring to the drawings, and initially to FIGURE 1 thereof, the stationary packer of the invention comprises a frame having a forward portion provided with a rectangular compaction chamber **10** with a rectangular inlet opening at the top communicating with a rearwardly-tipped hopper superstructure **12**. The front end of the compaction chamber has a rectangular outlet **13** surrounded by a shroud **14** adapted to fit through a corresponding opening in a container **16** shown in phantom lines. The container is conventionally a so-called pull-on or roll-off body of a refuse collection vehicle, as is well known in the industry. Conventional chains and load binders or similar couplings **18** are used to connect the container detachably to the packer, the end of the container substantially abutting the corresponding end of the packer, with the shroud **14** extending into the container.

The rear of the compaction chamber has an opening **20** (see FIGURE 6) through which a compaction blade **22** moves. The compaction blade (see FIGURE 7) is of simple rectangular box-like construction. The front wall **24** serves as the blade proper, while the top wall **26** acts to prevent the admission of material behind the blade during the packing cycle. L-shaped side walls **28** and a short bottom wall **30** complete the blade structure.

At the bottom the blade is supported upon a pair of rollers **32** located adjacent to the sides of the blade and depending through slots in the bottom wall **30** to engage and ride upon the bottom wall **34** (FIGURE 6) of the compaction chamber. A pair of flanged rollers **36** supported upon the side walls **28** by U-shaped brackets **38** support the rear of the blade upon corresponding tracks extending rearwardly from the compaction chamber. Each track is constituted by the upper flange of a longitudinal channel **40** and by the flange of a spaced longitudinal angle **42** (see FIGURES 1 and 3). As shown in FIGURES 2 and 3, longitudinal angle pieces **44** and **46** supported upon the side walls of the compaction chamber cover the lateral extremities of the top wall of the blade to prevent the admission of material between the blade and the side walls of the compaction chamber. As shown in FIGURE 3, longitudinal box frame members **48** and **50** support the weight of the blade transmitted by the lower rollers **32** to the floor of the compaction chamber. The structure of the blade and its supports is simplified without sacrificing the capacity to withstand heavy packing loads.

A platform **52** is supported behind the hopper **12** upon legs **54** (vertically adjustable on channels **40**) to permit the packer to be located adjacent to a loading dock **56**, so that material may readily be moved from the dock to the hopper, the rear side of which is much shorter than the front side to facilitate dumping of material into the hopper.

In accordance with a principal feature of the invention, the packer blade is driven by a dual hydraulic ram 58 having integral cylinders 60 and 62 arranged one above the other in side-by-side relation and with oppositely disposed piston rods 64 and 66 (see FIGURE 6). The rear end of piston rod 66 is pinned to support plates mounted on a transverse H-beam frame member 68, while the front end of piston rod 64 is pinned to plates mounted on the front wall of the blade. The symmetry axis of the ram may coincide with the center of the front wall of the blade. As can be seen in FIGURE 6, when the blade is extended to compact material, the cylinders move away from the H-beam 68 and the blade moves away from the cylinders, as well as from the H-beam, and through opening 13 and into the container. This operation is reversed during retraction of the blade to the position of FIGURE 5. The height of opening 13 is substantially greater than that of the blade to avoid jamming. When the container is detached, its opening is closed by conventional cross-bars or other means to prevent spilling of the refuse.

The dual ram 58 permits much shorter overall length of the packer apparatus while providing a long enough stroke for a large hopper and for extension of the blade into the container as shown in FIGURE 6. For a given length of inlet opening of the compaction chamber, the blade length need only be sufficient to occlude the opening when the blade is in its forward position. Hence, the rearward position of the blade determines the overall length of the packer, in contrast to previous packers, in which the overall length is determined by the stroke (length) of the hydraulic ram. Further reduction of the overall length is attained in the packer of the invention by having the blade overlap the H-beam support 68 (FIGURE 5) which is connected to the longitudinal frame members.

The simplicity, economy, and compactness of the apparatus of the invention is enhanced by the provision of a versatile high speed multiple-pump power unit, which will now be described with reference to the hydraulic diagram of FIGURE 8 and the electrical diagram of FIGURE 9. The power unit is indicated at 70 in FIGURE 3 in phantom lines, and electrical controls are indicated in FIGURES 1, 3 and 4 at 72 and 74.

As shown in the hydraulic schematic diagram of FIGURE 8, cylinders 60 and 62 are connected by suitable hydraulic fluid lines and control valves V1 and V2 to a system of multiple pumps P1, P2, and P3. The control valves are three-position, center neutral, solenoid operated flow-reversing valves, the central position being the normal or rest position. In the center position of the valves the lines connected to the hydraulic cylinders are blocked, and the main supply lines from the pumps are returned to the reservoir R. In the other positions of the valves connections are established between the cylinder lines and the supply lines for extending or retracting the piston rods. It will be observed that the cylinders are interconnected by their hydraulic lines to cause the piston rods of both cylinders to extend or to retract, depending upon the valve position. Since rod 66 is fixed, the cylinder unit as a whole will move in the same direction as piston rod 64.

Pumps P1 and P2 may have equal capacity, while P3 may have half the capacity of the other pumps. All three pumps are driven by electric motor M (which may be a 5-horsepower motor, for example) and withdraw fluid from the reservoir through filters F. The output of pump P1 is connected to valve V1. The output of pump P3 is connected to valve V2. The output of pump P2 is also connected to valve V2, but through a spring-loaded check valve 76. Pump P1 is by-passed by a pressure release valve 78, while pumps P2 and P3 are by-passed by pressure release valves 80 and 82, respectively.

The solenoids for controlling the valves V1 and V2 are designated Sol. A, B, C, and D. Pressure-responsive switches are shown at PS1 and PS2. Switch PS1 is used to indicate that the container is loaded, while switch PS2 controls solenoid B, as will be described hereinafter.

Referring to FIGURE 9, the motor M may be connected to terminals 84 of a three-phase 208/440-volt supply through the contacts of a relay 86. The remainder of the circuit may be operated from a 115-volt AC supply, one terminal of which is shown at 88, and the other terminal of which is grounded at 90 (lower left corner of the diagram). A main key-lock switch is shown at 92. When this switch is closed, indicator lamp 94 is lit to show that the circuit is energized. Momentary closure of start switch PB1 energizes relay CR3, causing the relay contacts to close. The upper contacts complete a holding circuit for the relay, while the lower contacts energize the motor starter relay 86, causing it to close its contacts, and also extend electric power to other relays to be described. Indicator lamp 96 lights to show that the pump motor is energized. With the valves V1 and V2 in the neutral position of FIGURE 8, the output of the pumps is merely returned to the reservoir.

If now cycle-start switch PB3 is momentarily closed, relay CR1 is energized (through the closed lower contacts of CR3), closing its contacts. The upper contacts complete a holding circuit for the relay, while the lower contacts complete an energization circuit for solenoids D and B. This causes valves V1 and V2 in FIGURE 8 to be shifted to the left, supplying fluid to the cylinders 60 and 62 from the pumps and causing the cylinders to operate in a direction which extends the packer blade 22. Since all three pumps are supplying hydraulic fluid, the delivery volume is high, and the initial movement of the blade is very rapid.

If the blade encounters material which offers enough resistance to cause the hydraulic pressure to rise appreciably, say to 600 p.s.i., pressure-responsive switch PS2 (see FIGURES 8 and 9) will open, deenergizing solenoid B, and returning valve V1 to its center position. Pump P1 is thus again returned to the reservoir, while pumps P2 and P3 continue to supply fluid. The delivery volume is reduced, however, reducing the speed of the blade.

If the hydraulic pressure continues to build up, say to 900 p.s.i., bypass valve 80 will open, by-passing pump P2 to the reservoir. Check valve 76 will close, and pump P3 will operate alone to provide hydraulic fluid at lower volume and high pressure.

When the blade reaches its forward position, a small protuberance 97 (FIGURE 6) at the rear of the blade will operate a limit switch LS1 supported on a side frame member, opening the lower contacts of the switch (FIGURE 9), closing the upper contacts, and energizing relay CR2, which closes its contacts. The opening of the lower contacts of switch LS1 breaks the holding circuit for relay CR1 and deenergizes solenoids B and D (assuming that solenoid B was not already deenergized by the opening of switch PS2). The upper contacts of CR2 complete a holding circuit for the relay, while the lower contacts complete an energization circuit for solenoids A and C. Energization of solenoids A and C moves valves V1 and V2 to the right, so as to reverse the flow of hydraulic fluid to the cylinders and to reverse the movement of the blade 22, thereby returning switch LS1 to its initial position.

The blade moves to its rear position, at which limit switch LS2 is actuated by the protuberance 97. This causes the switch to open its lower contacts and to close its upper contacts. The former action opens the holding circuit for relay CR2, deenergizing solenoids A and C, while the latter action reenergizes relay CR1, reenergizing solenoids B and D, so as to shift the valves V1 and V2 to the left and initiate a new forward movement of the blade, thereby returning switch LS2 to its initial position.

The retraction stroke of the blade is normally very rapid, because all three pumps are supplying fluid to provide a high delivery volume. The rate of movement of the blade is thus reduced only when the blade encounters a substantial load, at which time the blade moves more slowly but under higher hydraulic pressure without unduly

overloading the motor. Thus a relatively small, economical motor may be employed.

Bypass valves **78** and **82** are safety valves, valve **78** bypassing pump **P1** at 750 p.s.i., for example, and valve **82** by-passing pumps **P2** and **P3** at 1800 p.s.i., for example.

When the container is full, the hydraulic pressure builds up sufficiently to close pressure-responsive switch **PS1**, at 1700 p.s.i. for example, which completes a circuit for energizing coil **98** of a mechanical latching relay **ML**. This causes the lower contacts of the relay to open and closes the upper contacts. The holding circuits for relays **CR1** and **CR2** are thus broken, deenergizing these relays and the solenoids controlled thereby and returning valves **V1** and **V2** to neutral. Indicator lamp **100** is lit to show that the container is full. The pump motor continues to operate. Relay **ML** remains mechanically latched (even when **PS1** opens) until reset switch **PB5** is closed, to energize coil **102** and return the contacts of the relay to the position illustrated. The cycle may then again be started by closing switch **PB3**. Switch **PB4** may be opened momentarily to stop the cycle at any time during normal operations. This has the effect of opening the holding circuits for relays **CR1** and **CR2** without disturbing the latching relay **ML**. The pump motor may be deenergized by momentary opening of switch **PB2**, which breaks the holding circuit for relay **CR3** and thus deenergizes the motor starting relay **86**.

Switches **PB6** and **PB7** are forward and reverse jog switches, respectively, for manual control of the movement of the blade, and may be located on control unit **74** (FIGURE 1), which may be held remotely from the frame of the packer. Switches **PB1–PB5** may be located at control unit **72** attached to the frame. Pushing the button of switch **PB6** opens its upper contacts, to prevent completion of the holding circuit of relay **CR1**, and closes its lower contacts for energizing the relay **CR1** as long as the button is depressed. Energization of relay **CR1** completes circuits for solenoids D and B as described above. Pushing the button of **PB7** opens its upper contacts, so as to prevent completion of the holding circuit of relay **CR2**, and closes its lower contacts for energizing relay **CR2** as long as the button is depressed, thereby completing circuits for solenoids A and C as described previously. Switches **PB6** and **PB7** may thus be utilized to move the blade by any increments desired in either direction and to stop the blade in any position. Versatile manual control is thus provided. Although the limit switches **LS1** and **LS2** are circumvented during manual control, the pressure switches are still effective.

While a preferred embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that changes can be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims. Accordingly, the foregoing embodiment is to be considered illustrative, rather than restrictive of the invention, and those modifications which come within the meaning and range of equivalents of the claims are to be included therein.

The invention claimed is:

1. Compaction apparatus comprising a frame having a forward portion and a rearward portion, a compaction chamber supported upon said frame at the forward portion and provided with an inlet opening and an outlet opening, a compaction blade supported upon said frame for movement through said compaction chamber between a rearward position behind said inlet opening and a forward position adjacent to said outlet opening for compacting material in said chamber, a hydraulic ram for driving said blade and having a pair of cylinders fixed to each other in side-by-side relation, the cylinders having pistons with piston rods extending from said cylinders in opposite directions, one of said rods having an end remote from said cylinders attached to said blade and the other of said rods having an end remote from said cylinders attached to said frame rearwardly of said blade, said cylinders being supported upon said piston rods, and means for supplying hydraulic fluid to said cylinders and for causing movement of said cylinders in the same direction as said blade, said inlet opening being above said blade, said blade being of box-like construction and having a front wall constituting the compacting portion of the blade, a top wall closing said inlet opening when said blade is in its forward position, a pair of side walls, and a bottom wall, said side walls having portions extending along said top wall and depending therefrom less than the height of said front wall and having portions extending rearwardly from said front wall less than the length of the first-mentioned portions, said frame having blade support means extending rearwardly from said chamber at opposite sides of said blade which engage blade support elements upon the first-mentioned side wall portions, said frame having a transverse frame member to which said other piston rod is attached, the first-mentioned side wall portions overhanging said transverse frame member when said blade is in its rearward position.

2. Compaction apparatus comprising a frame having a forward portion and a rearward portion, a compaction chamber supported upon said frame at the forward portion and provided with an inlet opening and an outlet opening, a compaction blade supported upon said frame for movement through said compaction chamber between a rearward position behind said inlet opening and a forward position adjacent to said outlet opening for compacting material in said chamber, a hydraulic ram for driving said blade and having a pair of cylinders fixed to each other in side-by-side relation, the cylinders having pistons with piston rods extending from said cylinders in opposite directions, one of said rods having an end remote from said cylinders attached to said blade and the other of said rods having an end remote from said cylinders attached to said frame rearwardly of said blade, said cylinders being supported upon said piston rods, and means for supplying hydraulic fluid to said cylinders and for causing movement of said cylinders in the same direction as said blade, said inlet opening being above said blade, said blade being of box-like construction and having a front wall constituting the compacting portion of the blade, a top wall closing said inlet opening when said blade is in its forward position, a pair of side walls longer at the top than at the bottom, and a bottom wall connecting said side walls adjacent to the front wall of the blade, said bottom wall having a pair of rollers adjacent to the side walls for supporting said blade upon the bottom of said chamber, said side walls having a pair of rollers adjacent to the top of said blade, and said frame having a pair of longitudinal tracks extending rearwardly from said chamber for supporting the side wall rollers.

3. The apparatus of claim **2**, said frame having a transverse frame member to which said other piston rod is attached, the side walls of said blade overhanging said transverse frame member when said blade is in its rearward position.

4. Compaction apparatus comprising a frame having a forward portion and a rearward portion, a compaction chamber supported upon said frame at the forward portion and provided with an inlet opening and an outlet opening, a compaction blade supported upon said frame for movement through said compaction chamber between a rearward position behind said inlet opening and a forward position adjacent to said outlet opening for compacting material in said chamber, a hydraulic ram for driving said blade and having a pair of cylinders fixed to each other in side-by-side relation, the cylinders having pistons with piston rods extending from said cylinders in opposite directions, one of said rods having an end remote from said cylinders attached to said blade and the other of said rods having an end remote from said cylinders attached to said frame rearwardly of said blade, said cylinders being supported upon said piston rods, and

means for supplying hydraulic fluid to said cylinders and for causing movement of said cylinders in the same direction as said blade, said fluid supplying means comprising a plurality of pumps, a motor driving all of said pumps, valve means for controlling the connection of said pumps to said cylinders and for determining the direction of movement of said blade, and means responsive to the pressure of the hydraulic fluid supplied to said cylinders for permitting all of said pumps to supply fluid to said cylinders when the hydraulic pressure is low and for permitting fewer pumps to supply hydraulic fluid to said cylinders when the fluid pressure reaches a predetermined higher level.

5. The apparatus of claim 4, the last-mentioned means comprising means for by-passing certain of said pumps.

6. The apparatus of claim 5, further comprising means for by-passing all of said pumps when the hydraulic fluid pressure reaches a predetermined still higher level.

7. In compaction apparatus having a compaction blade driven by a hydraulic ram between rearward and forward positions, valve means for controlling the supply of hydraulic fluid to said ram and for determining the direction of movement of said blade, forward and reverse relay means controlling the operation of said valve means for forward or reverse movement of said blade depending upon which of said relay means is energized, means for initiating energization of said forward relay means, each of said relay means having a holding circuit completed when the relay means is energized, a pair of limit switches corresponding, respectively, to the forward and rearward positions of said blade, the forward limit switch having a normal position for permitting completion of the holding circuit of the forward relay means and an alternate position for energizing the reverse relay means, the rearward limit switch having a normal position for permitting completion of the holding circuit of the reverse relay means and an alternate position for energizing said forward relay means, said blade having means for moving said forward limit switch from its normal position to its alternate position when said blade reaches its forward position and having means for moving said rearward limit switch from its normal position to its alternate position when said blade reaches its rearward position, whereby said relay means are energized alternately for controlling said valve means and for causing said blade to move

between its rearward and forward positions upon initial energization of said forward relay means.

8. The apparatus of claim 7, further comprising means for deenergizing said relay means to stop the movement of said blade.

9. The apparatus of claim 8, the last-mentioned means comprising a mechanically latched relay operated in response to the attainment of a predetermined hydraulic fluid pressure and having reset means for unlatching said relay.

10. The apparatus of claim 8, the last-mentioned means comprising a manually operated switch.

11. The apparatus of claim 7, further comprising selectively actuated manual switch means for energizing said forward relay means or said rearward relay means and for preventing completion of the holding circuit of the energized relay means.

12. The apparatus of claim 7, further comprising electric motor driven pump means for supplying hydraulic fluid to said valve means, further relay means for energizing the electric motor when said further relay means is energized and for establishing a holding circuit therefor, means for energizing said further relay means, and means for breaking the holding circuit of said further relay means, said further relay means comprising means for permitting the energization of said forward and reverse relay means only when said further relay means is energized.

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