

May 24, 1966

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3,252,600

CYCLING COMPACTOR AND EJECTION SYSTEM FOR BULK MATERIAL

Filed June 29, 1964

4 Sheets-Sheet 1

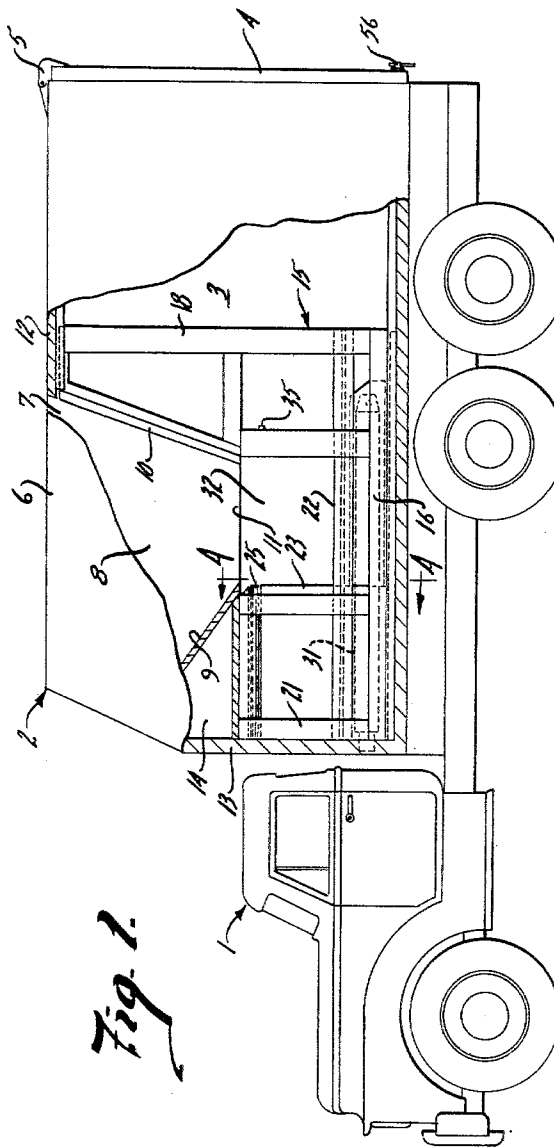


Fig. 1.

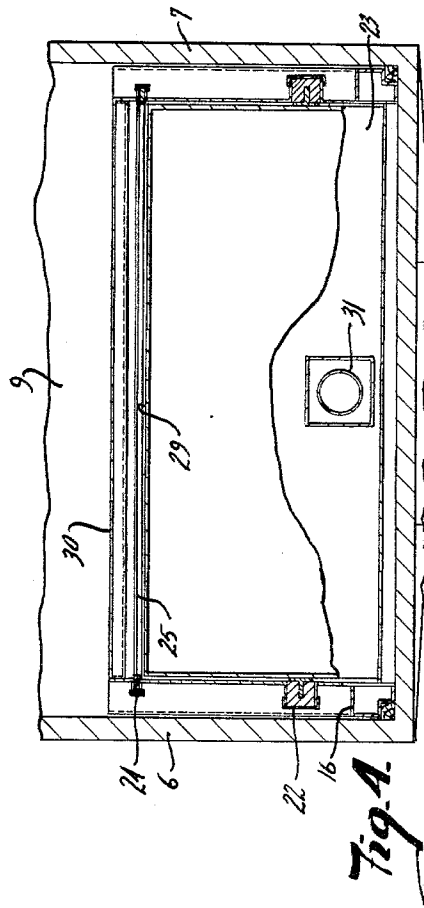


Fig. 4.

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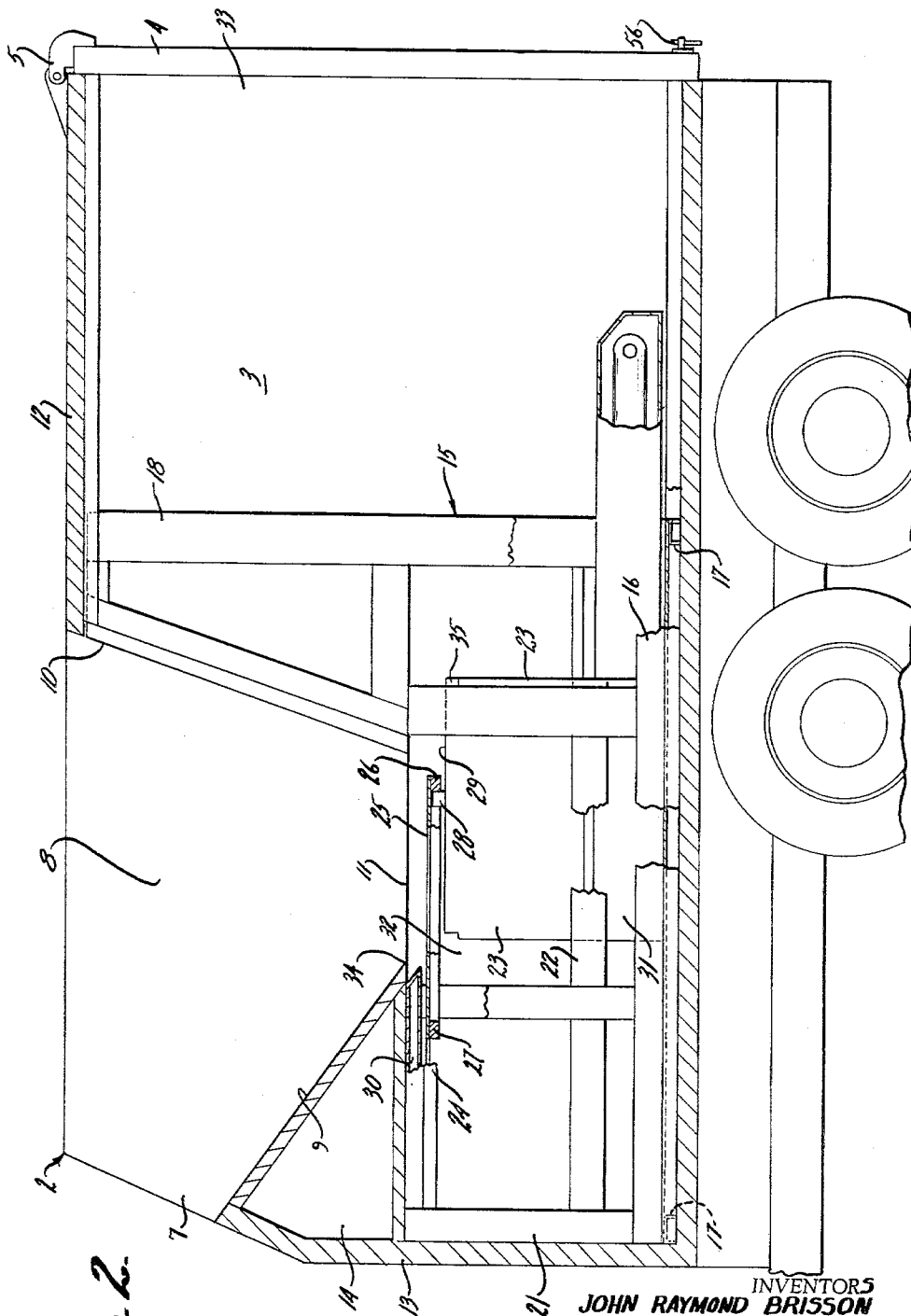
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4 Sheets-Sheet 3

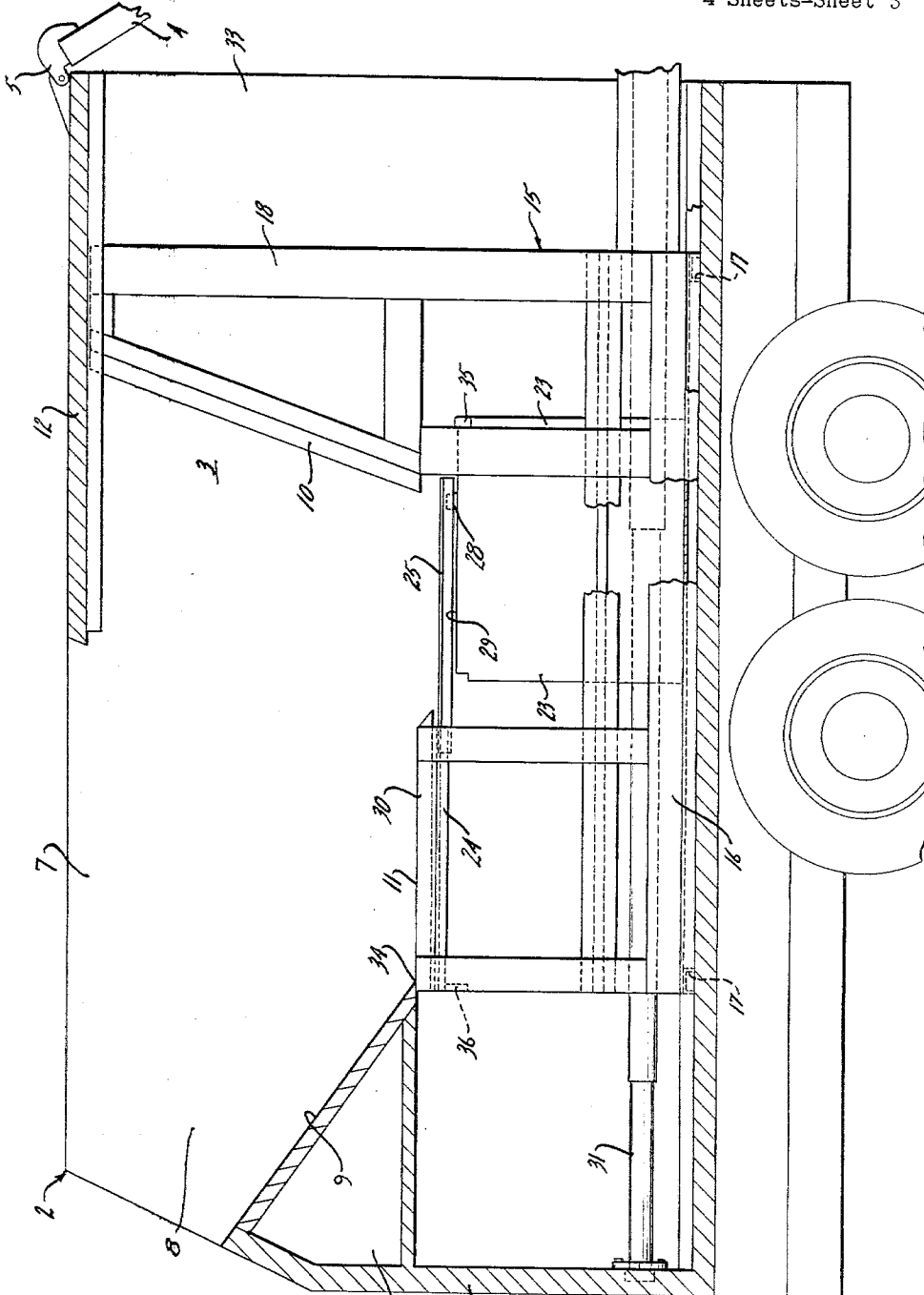


Fig. 3.

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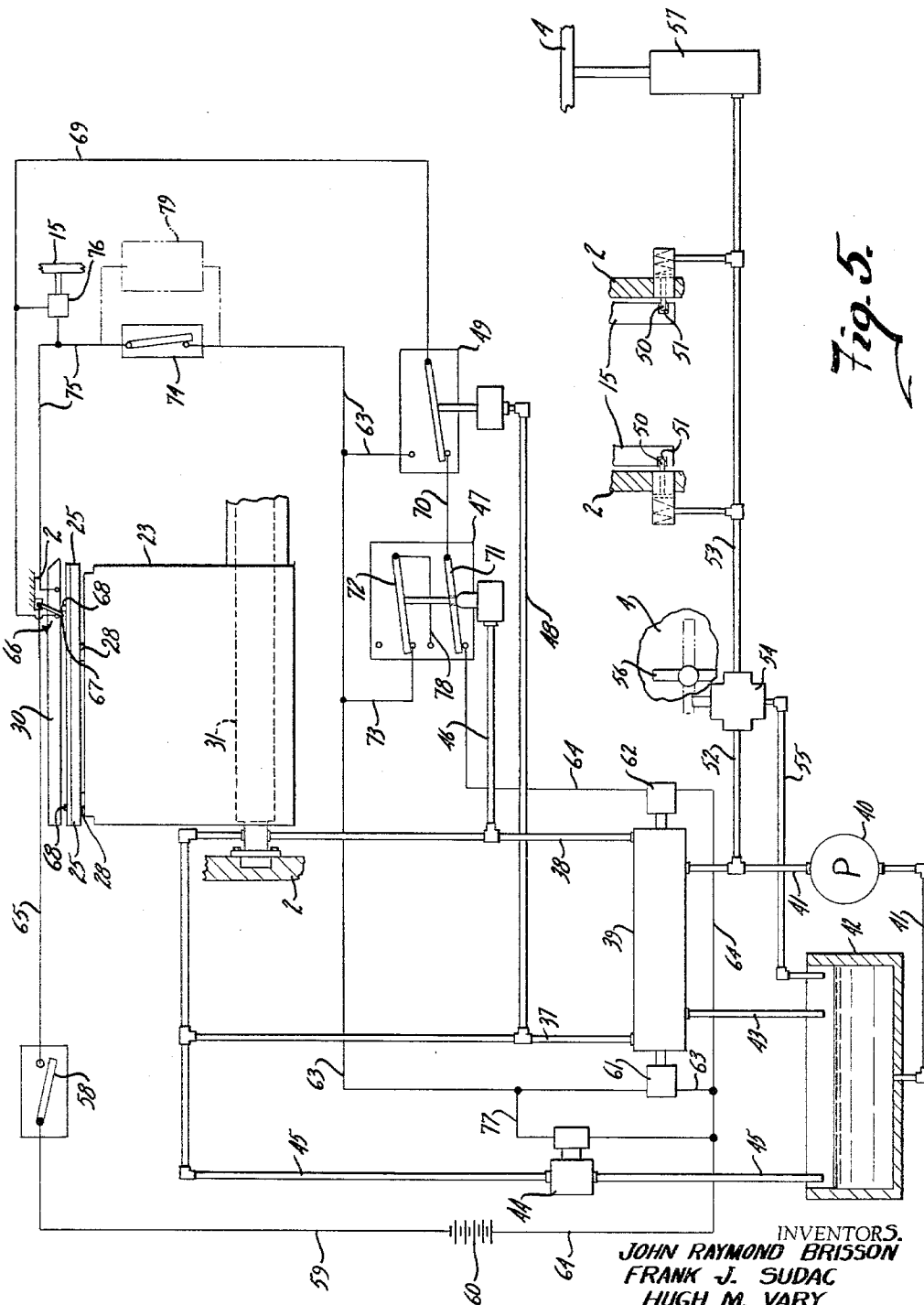
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4 Sheets-Sheet 4



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CYCLING COMPACTOR AND EJECTION SYSTEM FOR BULK MATERIAL

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Filed June 29, 1964, Ser. No. 378,912

11 Claims. (Cl. 214-17)

This invention relates to a cycling compactor and ejection system for bulk material, such as refuse and the like which is to be disposed of.

Generally, garbage and like refuse is often collected and placed in a large truck-mounted chamber where it is sometimes compacted to provide maximum capacity for the chamber. When the chamber is full, the truck is driven to a dump site or other desired place, the refuse removed, and the empty truck returned to its collection rounds.

The present invention is directed to substantial improvements over the refuse collection, compaction and dumping systems which have been known or used heretofore. Generally, in accordance with the invention, a truck or other vehicle is provided with a large storage chamber having a top-opening hopper section at its forward end. A pair of movable refuse handling members are disposed within the chamber, one member serving to clear refuse away from the hopper discharge outlet and to compact it, the other member cooperating with the first member to eject the compacted refuse through the chamber's rear wall. During compaction and ejection, the hopper discharge outlet is blocked off to prevent further receipt of refuse into the chamber.

A control system is provided which can be operated to give a high degree of flexibility and automatic operation to the device. Accidental tripping of the controls by accumulated or stray refuse is prevented.

In addition, a high degree of compaction pressure on the refuse is obtained, relative to the power input.

The accompanying drawings illustrate the best mode presently contemplated by the inventors for carrying out the invention.

In the drawings:

FIGURE 1 is a side elevation of an apparatus constructed in accordance with the invention with parts broken away, and showing the compaction platen and frame in normal position;

FIG. 2 is an enlarged side elevation similar to FIGURE 1 and showing the platen in short-stroke extended position;

FIG. 3 is a view similar to FIG. 2 and showing the platen and frame in extended ejection position;

FIG. 4 is a vertical section taken on line 4-4 of FIGURE 1; and

FIG. 5 is a schematic control circuit diagram for the apparatus.

As shown in the drawings, the device of the invention is adapted to be mounted on a truck 1 which may be driven from place to place for collection and discharge of refuse and the like. The trailer portion of truck 1 supports a generally rectangular body 2 forming a chamber 3 for containing certain of the mechanism of the invention and also refuse. Body 2 is closed, except for a top intake opening and rear ejection opening. A side opening, not shown, may be provided for hand loading

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if desired. The rear ejection opening may be generally coextensive with the entire rear end of body 2 and is normally closed by a tail gate 4 hinged as at 5 for opening during refuse ejection, as will be described hereinafter.

The intake opening is disposed at the forward end of the body top. It extends substantially the full width of the top so that the vertical longitudinal body walls 6 and 7 form two sides of a refuse-receiving hopper 8. The transverse front and rear walls 9 and 10 of hopper 8 are inclined toward each other to provide a decreasing area for feeding refuse through a slightly restricted discharge opening 11 disposed approximately midway between the top and bottom of chamber 3. Hopper wall 9 is secured between the body walls 6 and 7 and may in essence form part of the body itself. Rear hopper wall 10 extends to adjacent top wall 12 of body 2 about midway of the body length. However, body front wall 13 is inclined adjacent its upper end and is cut down so that front hopper wall 9 emerges and terminates forwardly. The area 14 immediately forward of hopper 8 may be utilized for oil tanks or other equipment for the control system.

For purposes of refuse handling, a large frame 15 is disposed within chamber 3 and is normally positioned in the forward portion of the chamber. For purposes of convenience, frame 15 will be referred to as the ejection frame, and it includes a base having longitudinal side runners 16 reinforced by cross braces 17. Runners 16 rest on the body floor and are adapted to slide therein for purposes to be described.

The rear portion of the frame base extends rearwardly of hopper discharge opening 11 and terminates centrally of chamber 3. This portion of the base serves to support a suitable framework 18 which extends upwardly to the top of the chamber and which is open in its lower half to permit passage of refuse therethrough, as will be described. Upper hopper wall 10 is secured to framework 18 and serves as an ejection plate, as will be described.

The front portion of the base of frame 15 is normally disposed closely adjacent the front of chamber 3, forwardly of hopper discharge opening 11. This portion of the base serves to support a second framework 21, which extends upwardly to just below the level of opening 11.

The vertical struts of frameworks 18 and 21 support a pair of longitudinal track members 22 which extend therebetween and which slidably support a refuse compaction platen 23 which terminates below the level of hopper discharge opening 11. The normal position of platen 23 is as shown in FIG. 1, forwardly of hopper 8 and within framework 21.

The latter framework also carries a pair of longitudinal track members 24 above track members 22 which support a slidable cover plate 25. Forwardly and rearwardly disposed transverse stop members 26 and 27 depend from plate 25 and are alternately engageable to slidably carry the cover plate with platen 23 by a transverse angle iron 28 or other suitable projection extending upwardly from the forward portion of the closed top 29 of the platen.

Additionally, framework 21 includes a closed top member 30 disposed forwardly of and just beneath opening 11 when frame 15 is in its normal position. Sliding cover plate 25 is thus normally sandwiched between platen top 29 and top member 30.

Platen 23 is adapted to be moved longitudinally by a multi-stage telescoping power cylinder 31 mounted in the front wall 13 of body 2.

General operation

In accordance with the invention, hopper 8 is adopted to receive a large charge of refuse, which tends to flow downwardly through hopper discharge opening 11 and into that portion of chamber 3 between frameworks 18 and 21. This receiving area of the chamber is designated as 32. Since hopper 8 is of somewhat larger volume than area 32, refuse will bridge upwardly through opening 11.

Power cylinder 31 is then actuated to move platen 23 from its normal position and rearwardly on tracks 22 to push the refuse from area 32 through the lower open portion of framework 18 into the storage area 33 of chamber 3. Ejection frame 15 will not move, since it is locked to the trailer body by mechanism to be described.

The compaction stroke of platen 23 brings it to a second position slightly rearwardly of hopper discharge opening 11 and substantially rearwardly of framework 21. See FIG. 2. To prevent refuse from falling from the hopper into the widening gap between the lower edge 34 of front hopper wall 9 and the front or trailing portion of platen 23, angle iron 28 will engage cover plate stop 26 when the platen is about midway of its compaction movement, thus carrying cover plate 25 along in its tracks 24 to cover the gap. The platen and cover plate together thus form a hopper bottom.

When all of the refuse has been pushed into storage area 33, cylinder 31 automatically reverses to retract the platen. Cover plate 25 remains stationary until the platen is directly beneath it, at which time angle iron 28 will engage stop 27 and the platen and cover plate will return together to their original positions. As this return occurs, refuse will again fall through opening 11 to fill area 32 and the cycle may be repeated.

Gradually, storage area 33 will fill with refuse and platen 23 will serve to compact the stored refuse as it pushes more and more material rearwardly. When area 33 is completely full, truck 1 may be driven to a dump site, whereupon rear tail gate 4 is opened. Cylinder 31 is again actuated to push platen 23 rearwardly and, if desired, the final charge of refuse is forced into storage area 33. Frame 15 is unlocked from body 2.

This time, however, the automatic compaction stroke return system is made inoperable and the cylinder control permits platen 23 to continue slightly beyond its normal compaction stroke where it will engage suitable rear stops 35 on frame 15 beneath framework 18. Continued extension of cylinder 31 will transmit the rearward force from platen 23 to frame 15 and the entire assembly will move rearwardly on runners 16. See FIG. 3. The rear platen face and the ejection plate 10 thereabove will respectively engage the lower and upper refuse portions to eject the entire load through the rear body opening.

Cylinder 31 is then automatically reversed. Frame 15 will initially remain stationary and platen 23 will retract from its third or fully extended position until it engages suitable front stops 36 on frame 15 beneath framework 21. The entire assembly will then retract to its original position.

During the initial portion of the ejection cycle, cover plate 25 will follow behind platen 23 and form with the platen a hopper bottom as in the compaction cycle. As frame 15 moves rearwardly during ejection, top member 30 will follow behind the cover plate and together therewith will form the hopper bottom beneath opening 11 to retain additional refuse in the hopper and prevent entrapment of refuse behind the platen and frame.

Control system

The combined hydraulic and electrical control system for the apparatus of the invention is shown schematically in FIG. 5.

As indicated previously, a power cylinder 31 is connected between body 2 and platen 23 to reciprocate the latter in either a short or long stroke cycle. The ends of

cylinder 31 are connected through hydraulic pack line 37 and retract line 38 to a four-way normally neutral spool-type double solenoid control valve 39 of suitable well-known construction. Hydraulic pressure is supplied by a pump 40 inserted in a hydraulic line 41 leading from an oil reservoir 42 to valve 39. A discharge line 43 connects valve 39 with reservoir 42. In addition, a normally closed hydraulic system unload solenoid valve 44 is disposed in a hydraulic line 45 connecting line 37 with reservoir 42, for purposes to be described. A further line 46 is connected to line 38 and contains a dual action pressure actuated switch 47. Another line 48 connects line 37 with a single action pressure actuated switch 49 for purposes to be described.

During short-stroke cycling of platen 23, frame 15 is locked to body 2. For this purpose a pair of spring-pressed locking pins 50 are mounted on body 2 and normally are urged inwardly into openings 51 in frame 15. The pin mechanism is connected through a hydraulic line 52-53 to pump line 41. For purposes of unlocking pins 50, a valve 54 is disposed between lines 52-53 and also connects through a drain line 55 to the reservoir. Valve 54 is adapted to be closed by a tail gate locking lever 56 when it is moved to the unlock position, so that pressure fluid in line 53 will actuate pins 50 to unlockingly withdraw them from openings 51 to unlock frame 15. In some instances it may be desirable to actuate valve 54 manually, rather than by lever 56.

A hydraulic cylinder and piston arrangement 57 may also be connected to line 53 so that when valve 54 closes the tail gate 4 will be automatically opened and held up until valve 54 opens, at which time the weight of the tail gate will retract the piston and line 53 will drain.

The entire control system is operated by an electric switch arrangement disposed in the cab of the vehicle truck. For this purpose, a normally open electric master control switch 58 is connected by a lead 59 to one side of a source of power, such as the vehicle battery 60. The retract solenoid 61 and pack solenoid 62 of four-way valve 39 are connected in leads 63 and 64 respectively which in turn are connected to the other side of battery 60.

Switch 58 is connected through a lead 65 to one side of a single pole double throw two position limit switch 66 which serves to control the advance and retract action of cylinder 31. For this purpose, and as shown in FIG. 5, switch 66 is suspended from body 2 and has a contact arm 67. The position of arm 67 shown is the normal platen "extend" position for switch 66. The forward and rear edge portions of cover plate 25 are provided with strikers 68 so that when the plate is moved to the extended or retracted position striker 68 will cause arm 67 to put the switch in the respective "retract" or "extend" position.

Referring again to FIG. 5, when limit switch 66 is in the platen extend position, it is connected through a lead 69 to single action pressure switch 49 which is normally in the platen extend position shown. Switch 49 is connected by a lead 70 to double action pressure switch 47 which during extension of cylinder 31 is in the position shown. Both switches 47 and 49 are of the single pole double throw type, with the former having two contact arms 71 and 72 which are independently movable. Both switches are pressure actuated and response to different pressure levels. For example, contact arm 71 may be actuable by a pressure of 200 p.s.i., arm 72 by over 2000 p.s.i., and switch 49 above 2000 p.s.i.

In the position of switch 47 shown, lead 70 is connected through arm 71 to four-way valve lead 64. In addition, a lead 73 connected to valve lead 63 is connected through contact arm 72, but the circuit is open within the switch.

A manual eject control switch 74 is also mounted in the truck cab and is normally closed. Switch 74 is disposed in a lead 75 connected between the retract side of limit switch 66 and lead 63.

In addition, a spring loaded, normally closed micro-switch 76 is interposed between leads 69 and 75, and is

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disposed to be engaged and opened by frame 15 when the latter is in its forward position.

When short-stroke compaction action of platen 23 is desired, master control switch 58 is closed. With the other switches in the position shown, electric current will flow through switch 66, lead 69, switch 49, lead 70, arm 71 of switch 47 and lead 64 to energize pack solenoid 62 and extend function of control valve 39. Hydraulic fluid will then pass through valve 39 and pack line 37 to extend cylinder 31. Fluid will return through lines 38 and 43 to reservoir 42.

As platen 23 reaches the rearward limit of its travel, cover 30 will trip limit switch 66 from the pack to the retract position. This will cut off the electrical circuit via lead 69 and momentarily center valve 39, cutting off hydraulic fluid flow through line 37 and stopping rearward movement of cylinder 31. When switch 66 reaches the retract position, current will flow through lead 75, switch 74, and lead 63 to energize retract solenoid 61 of valve 39; and through a lead 77 to energize unload valve 44. Hydraulic fluid will now flow through line 38, causing retraction of cylinder 31 and platen 23. Cylinder 31 drains through valves 39 and 44 to tank 42.

Assuming the normal operating pressure to be slightly below 2000 p.s.i., the pressure in lines 38 and 46 will cause switch arm 71 to shift to connect with a lead 78 connected to arm 72, but this has no effect since leads 69 and 70 are out of the circuit.

As platen 23 reaches its forward position, it will trip limit switch 66 over to the pack position, thereby causing the pack cycle to repeat, unless switch 58 is opened.

In the event that platen 23 encounters an obstruction during its rearward pack movement, the pressure in lines 37 and 48 will increase above 2000 p.s.i., causing switch 49 to move over and connect lead 69 with lead 63, thereby energizing retract solenoid 61 of valve 39 and opening valve 44, causing fluid flow through retract line 38 to return the platen forwardly. As this occurs, pressure in lines 37 and 48 will drop to below 2000 p.s.i., since they are now draining, thus causing switch 49 to return to the position shown. The increase in pressure in lines 38 and 46 will almost instantaneously increase to above 200 p.s.i., but below 2000 p.s.i., causing arm 71 of switch 47 to connect lead 70 through lead 78, arm 72, and lead 73 to lead 63 to maintain current flow from lead 69 during retraction. At the end of retraction, the pressure in lines 38 and 46 will increase to above 2000 p.s.i., causing arm 72 of switch 47 to move over from the position shown and break the above-described holding circuit. Re-cycling will then occur, unless switch 58 is opened to permit manual removal of the obstruction.

Assuming now that it is desired to fully eject the refuse stored in chamber 33, tail gate lock lever 56 is moved to unlock position. This will open valve 54 to unlock pins 50 to free frame 15 from direct attachment to body 2. It will also actuate the hydraulic tail gate opener 57 so that the rear end of body 2 is opened. Eject switch 74 is manually opened to cut lead 75 and the platen retract side of limit switch 66 out of the circuit. If desired, switch 74 may be replaced by a micro-switch 79, shown in phantom, and which is normally closed but is opened by tail gate lever 56 when the latter is moved to unlock position.

Manual actuation of master switch 58 will again energize the circuit in a manner previously described to cause platen 23 to move rearwardly. As platen 23 reaches its rearward position, limit switch 66 will again be tripped to deenergize lead 69 and to energize lead 75. Since frame 15 is now unlocked and platen 23 engages and carries frame 15 slightly rearwardly, micro-switch 76 will now close to provide continuity of circuit from lead 75 to lead 69 to continue rearward movement of the platen and frame for complete ejection. Switch 74 is open and lead 63 is not energized.

When cylinder 31 reaches the rearward limit of its

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stroke, the pressure in lines 37 and 48 will increase to above 2000 p.s.i., which will move switch 49 to break the circuit through lead 70 and connect to lead 63, thus shifting the valve 39 to retract position. Pressure in lines 37 and 48 drop, while pressure in lines 38 and 46 increase to over 200 p.s.i., causing arm 71 to connect to 78 and lead 63. Switch 49 returns to the position shown. As platen 23 retracts, it engages the front stops of frame 15 and carries it forwardly to its initial position wherein micro-switch 76 is opened. Switch 58 should then be opened and switch 74 closed for the next pack cycle.

Should an obstruction occur during ejection, platen 23 and frame 15 will operate just as in normal reversal at the end of the ejection stroke, and will recycle if not stopped.

The invention provides a novel mechanism for receiving, compacting and ejecting refuse. Compacting is accomplished by a relatively low platen of small face area, thus distributing the entire hydraulic pressure over a small surface to achieve very high compaction efficiency with relatively low power. Under high pressure, the refuse acts as a fluid medium. The platen slides in a frame which is normally fixed to the body but which can be unlocked so that the platen and frame move rearwardly as a unit to eject the compacted refuse. The platen and an upper plate on the frame form a full height ejection surface. The entire hydraulic pressure remains the same as in compaction, but is distributed over this enlarged surface to efficiently eject the refuse out the open rear end of the body.

The cover plate which moves behind and in response to platen movement, serves as a hopper bottom and loading gate to prevent refuse from getting behind the platen. In addition, the cover plate serves as the actuating member for the cycling control system.

It may be possible to utilize two cylinders instead of the one described hereinabove without departing from the spirit of the invention. Thus, one cylinder could be mounted between frame 15 and platen 23 while the other could be mounted between body 2 and frame 15.

The system of the invention is believed to provide facility for receiving and compacting more loose refuse in a given space than prior systems using the same power. This results in reduced handling costs and fewer trips to the dump site.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In a bulk material handling system:

- (a) a body forming a generally enclosed chamber having a material receiving area and a material storage area,
- (b) a frame disposed within said chamber and movable between said areas but normally positioned in said material receiving area,
- (c) a material engaging member movably mounted in said frame and normally disposed adjacent the outer end portion thereof,
- (d) means to move said material engaging member from its normal position in said frame to a second position adjacent the inner end portion thereof, said means continuing to move said member beyond said second position and into said material storage area,
- (e) and means to lock said member to said frame when the member is in the said second position so that said frame will move into said material storage area together with said member.

2. The system of claim 1 in which:

- (a) said movable material engaging member is disposed in the lower portion of said chamber and transfers bulk material from said receiving area to said storage area when the member moves from its normal position to the said second position,

- (b) and said frame includes a second material engaging member disposed at its inner end and in the upper portion of said chamber, both said members moving together when said frame and said first-mentioned member are locked together for ejecting bulk material from said storage area. 5
3. In a bulk material handling system:
- (a) a body forming a generally enclosed chamber having a forward material receiving area and a rearward material storage area, 10
- (b) a hopper disposed in the upper portion of said chamber in said material receiving area, said hopper having a discharge outlet,
- (c) a frame disposed within said chamber and movable between said areas but normally positioned in said material receiving area, 15
- (d) said frame including a material engaging member disposed rearwardly of said hopper outlet and in the upper portion of said chamber adjacent said storage area, 20
- (e) a lower material engaging member movably mounted in said frame and normally disposed beneath and forwardly of said hopper outlet.
- (f) means to cyclically move said lower member in said frame between the lower member's normal position and a second position generally beneath said upper member to push bulk material from the portion of said receiving area below said hopper outlet into said storage area. 25
- (g) means to lock said lower member to said frame when the lower member is adjacent said storage area, 30
- (h) a door disposed at the rearward end of said chamber and being openable to permit ejection of stored bulk material through a rear chamber opening.,
- (i) and means to move said locked frame and lower member into said storage area to eject material out the said rear chamber opening. 35
4. The system of claim 3 which includes: extendible closure means responsive to rearward movement of said lower member within said frame for closing off the forward portion of said hopper outlet behind the said member. 40
5. The system of claim 3 which includes:
- (a) means responsive to said normal position and said second position of said lower member for automatically re-cycling said member between said positions so that a charge of bulk material disposed in said hopper may be continuously fed in increments to said storage area, 45
- (b) and control means responsive to positioning of said lower member and frame adjacent said rear chamber opening to return the lower member and frame to normal position. 50
6. The system of claim 5 in which:
- (a) said control means (b) comprises an electro-hydraulic circuit, 55
- (b) and said control means (b) is actuated by a pressure change within the hydraulic portion of said circuit when said lower member and frame approach to adjacent said rear chamber opening. 60
7. A bulk material handling system comprising:
- (a) a body forming a generally enclosed chamber having a forward material receiving area and a rearward material storage area, 65
- (b) a hopper disposed in the upper portion of said chamber in said material receiving area, said hopper having an open discharge outlet,
- (c) a frame disposed within said chamber and movable between said areas, 70
- (d) locking means securing said frame to said body in a normal position within said material receiving area,
- (e) a material engaging member secured to said frame rearwardly of said hopper outlet and being disposed 75

- in the upper portion of said chamber adjacent said material storage area,
- (f) a lower material engaging member mounted in said frame and normally disposed beneath and forwardly of said hopper outlet, but movable in said frame between said normal position and a second position generally beneath said upper member,
- (g) means responsive to said normal and said second position of said lower member for automatically cycling and re-cycling the member between said positions so that a charge of bulk material disposed in said hopper may be continuously fed in increments to said storage area,
- (h) extendible closure means responsive to rearward movement of said lower member in said frame for closing off the forward portion of said hopper outlet behind said member,
- (i) said cycling and re-cycling means (g) being at least in part responsive to the position of said closure means,
- (j) means responsive to return movement of said lower member for retracting said closure means,
- (k) means for unlocking said frame-to-body locking means (d),
- (l) means for locking said lower member and frame together when the lower member is adjacent the said upper member,
- (m) a door disposed at the rear end of said chamber and being openable to permit ejection of stored bulk material through a rear chamber opening,
- (n) means for preventing return movement of said lower member when it is adjacent said upper member and for continuing rearward movement of the lower member so that the locked member and frame will eject said bulk material out the said rear chamber opening,
- (o) and means responsive to positioning of said lower member and frame adjacent said rear chamber opening to return the lower member and frame to normal position.
8. The system of claim 7 which includes:
- (a) a locking device for the said door,
- (b) door opening means,
- (c) and means responsive to unlocking of said door locking device to actuate said frame-to-body unlocking means (k).
9. The system of claim 7 which includes:
- (a) a locking device for the said door,
- (b) and means responsive to unlocking of said door locking device to actuate said return movement preventing means (n).
10. The system of claim 7 which includes:
- (a) a locking device for the said door,
- (b) means responsive to unlocking of said door locking device to actuate said frame-to-body unlocking means (k),
- (c) and means responsive to unlocking of said door locking device to actuate said return movement preventing means (n).
11. In a bulk material handling system:
- (a) a body forming a generally enclosed chamber having a forward material receiving area and a rearward material storage area,
- (b) a hopper disposed in the upper portion of said chamber in said material receiving area, said hopper having an open discharge outlet,
- (c) a material engaging member disposed in the lower portion of said chamber beneath said hopper outlet and movable between said material receiving area and material storage area, said member being normally positioned forwardly of said hopper,
- (d) means to move said member from its normal position to a second position at least partially rearwardly of the front edge of said hopper outlet to transfer bulk material which has fallen through said outlet from said receiving area to said storage area.

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(e) selective means to automatically return said member from said second position to said normal position,

(f) means for making said selective means inoperable so that said moving means will move said member rearwardly of said second position to a third position for discharging material from said material storage area,

(g) and means to automatically return said member forwardly from said third position and past said second position to said normal position.

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