United States Patent

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[54] **COMPACTION LOADING APPARATUS**
15 Claims, 13 Drawing Figs.

[52] **U.S. Cl.** ..... **100/50,** 100/229 A, 100/269, 100/295
[51] **Int. Cl.** **B30b 15/22**
[50] **Field of Search** 100/50, 53, 229, 269, 295, 214, 215; 53/124

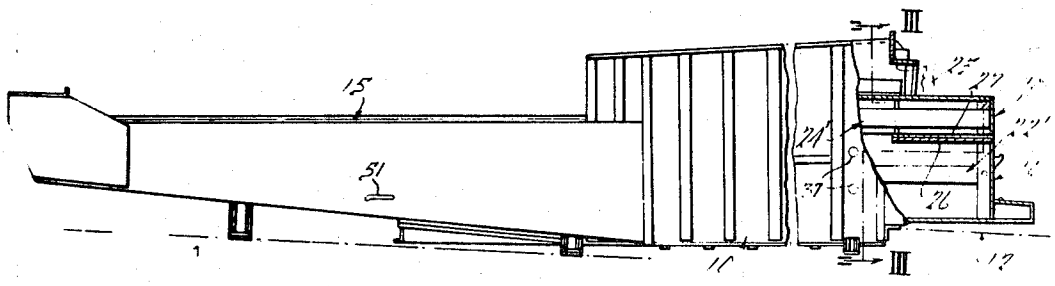
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ABSTRACT: A stationary loading and compacting mechanism particularly for injecting waste material into and pressurizing it within a large reinforced container comprises a ramming chamber to which the container to be loaded is detachably coupled, the chamber having a top charging opening into which waste material is dumped and a front outlet or ramming port alignable with a receiving port in the container. A multisectioned rectangular ram assembly consisting of lower and upper ram sections is movable through the ramming chamber and ports and part way into the container to force the material into and compress it within the container, the two sections of the ram being movable both as a unit and to a limited extent independently of each other.



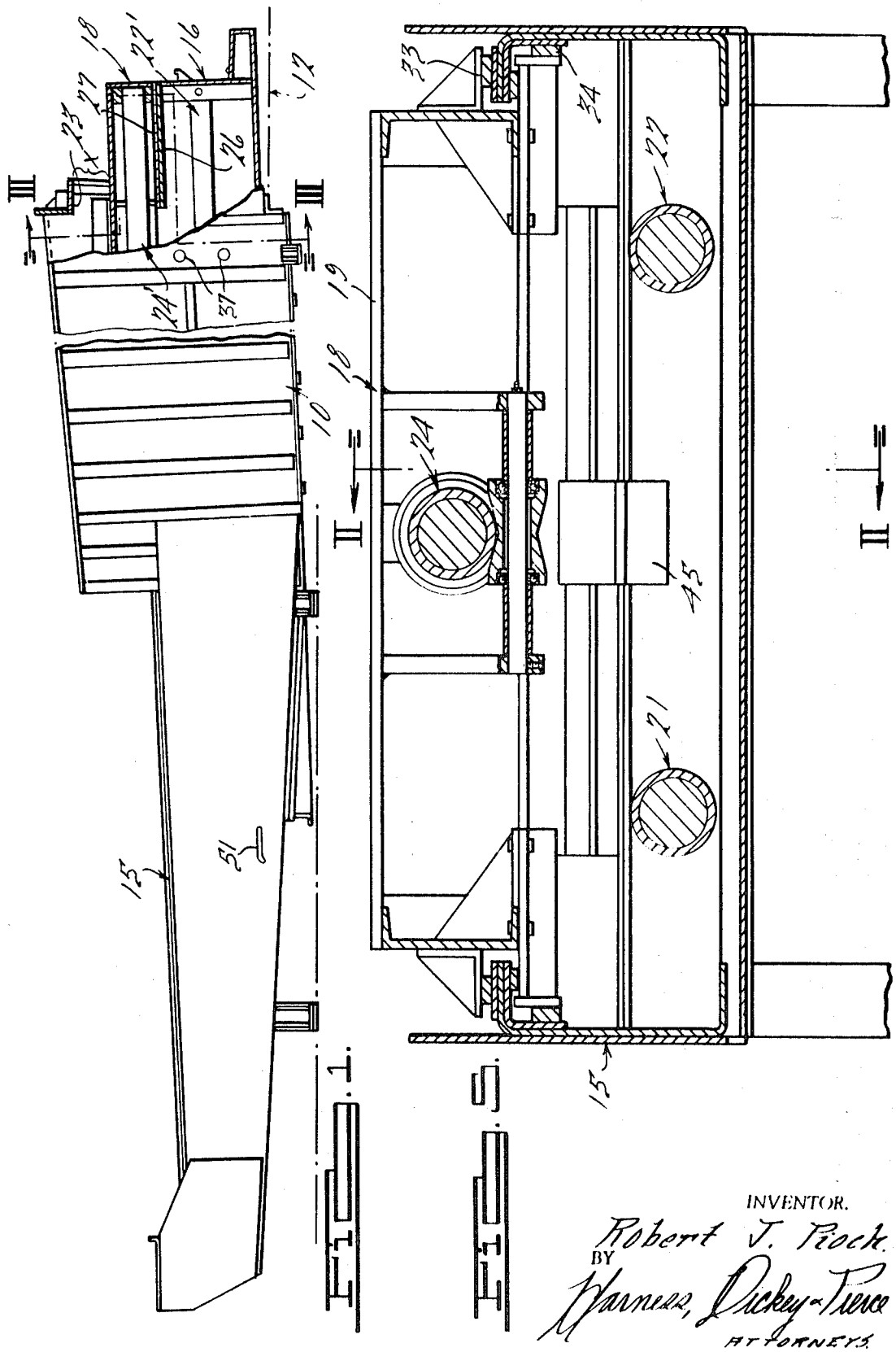
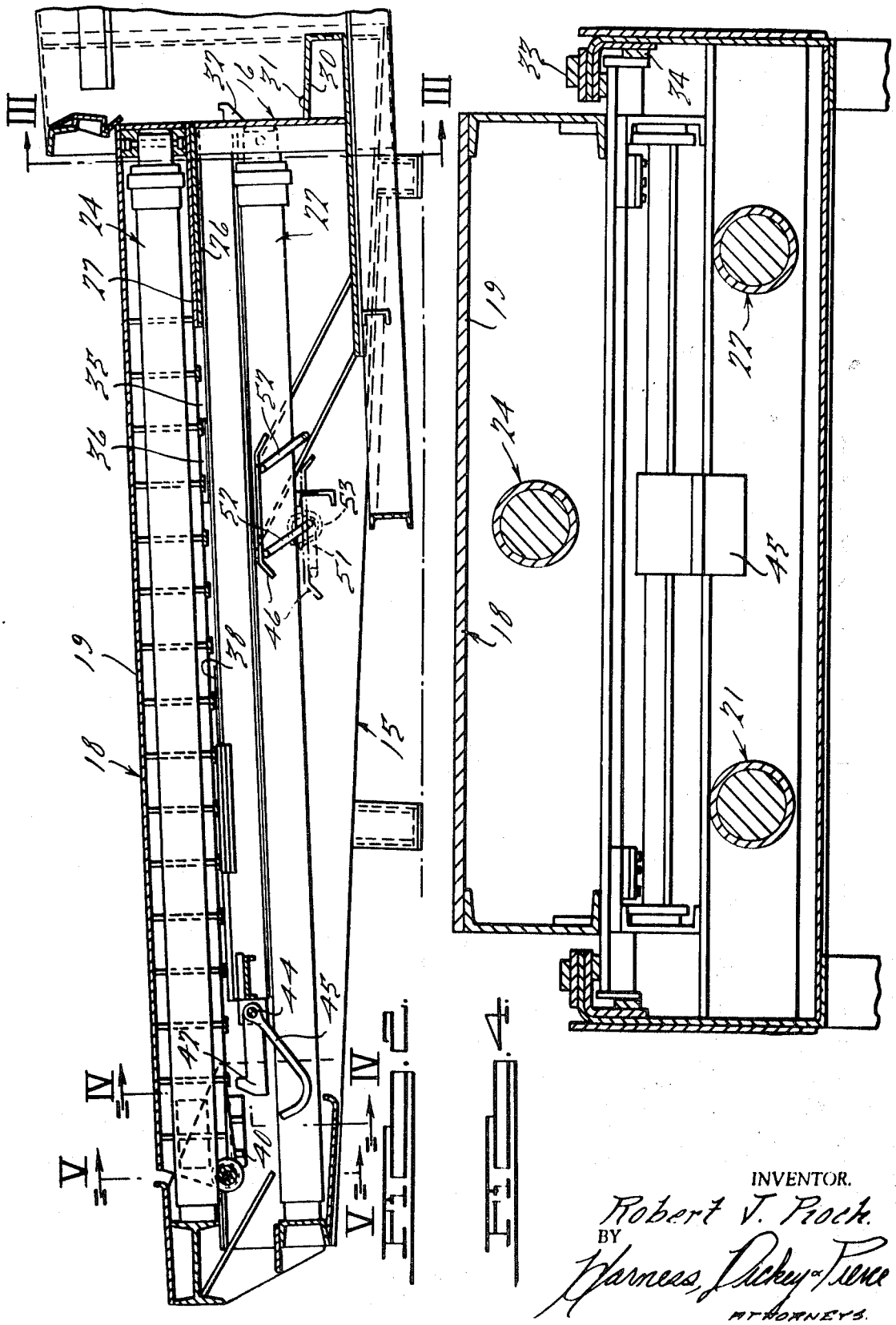


FIG. 1.

FIG. 5.

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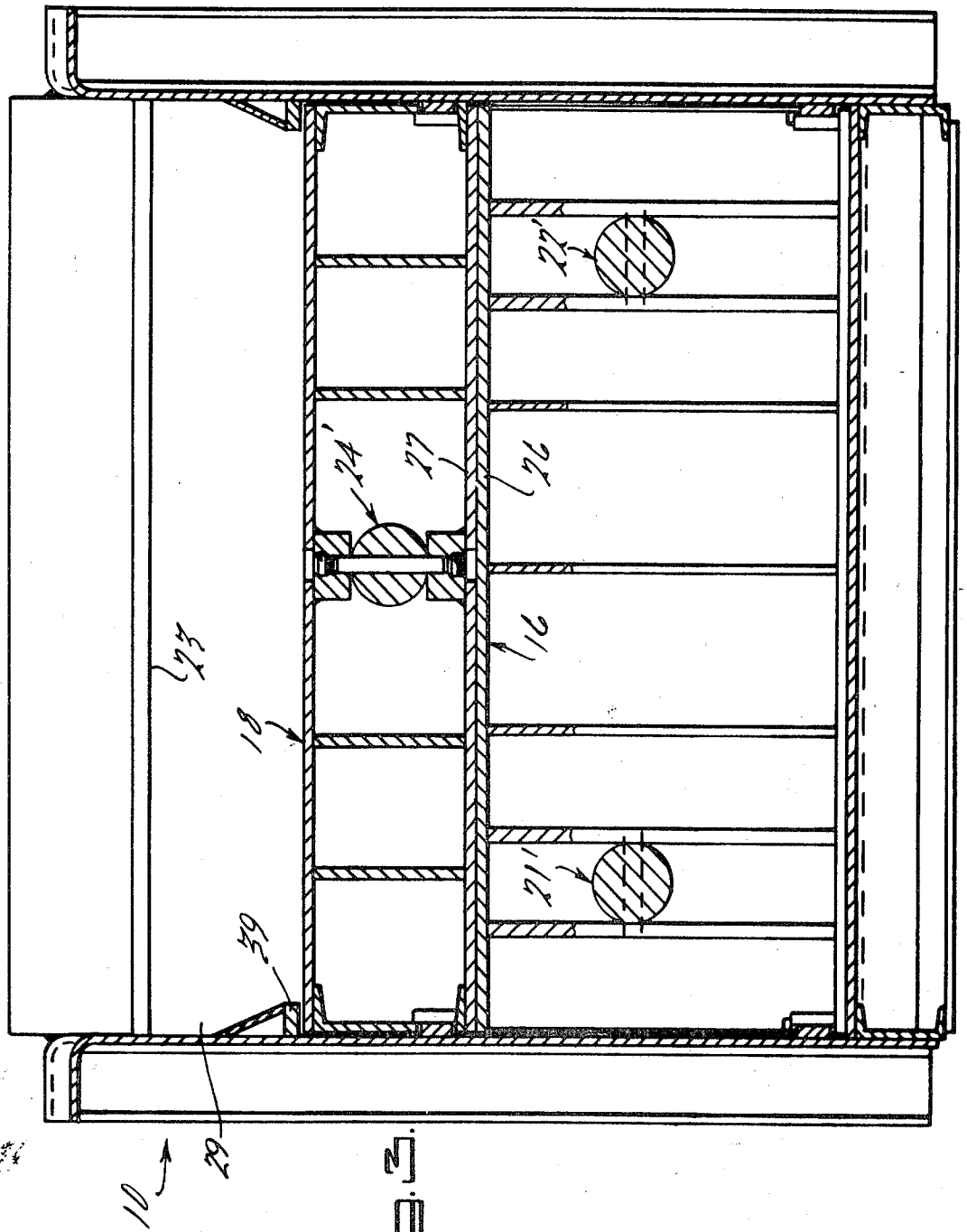


FIG. 2

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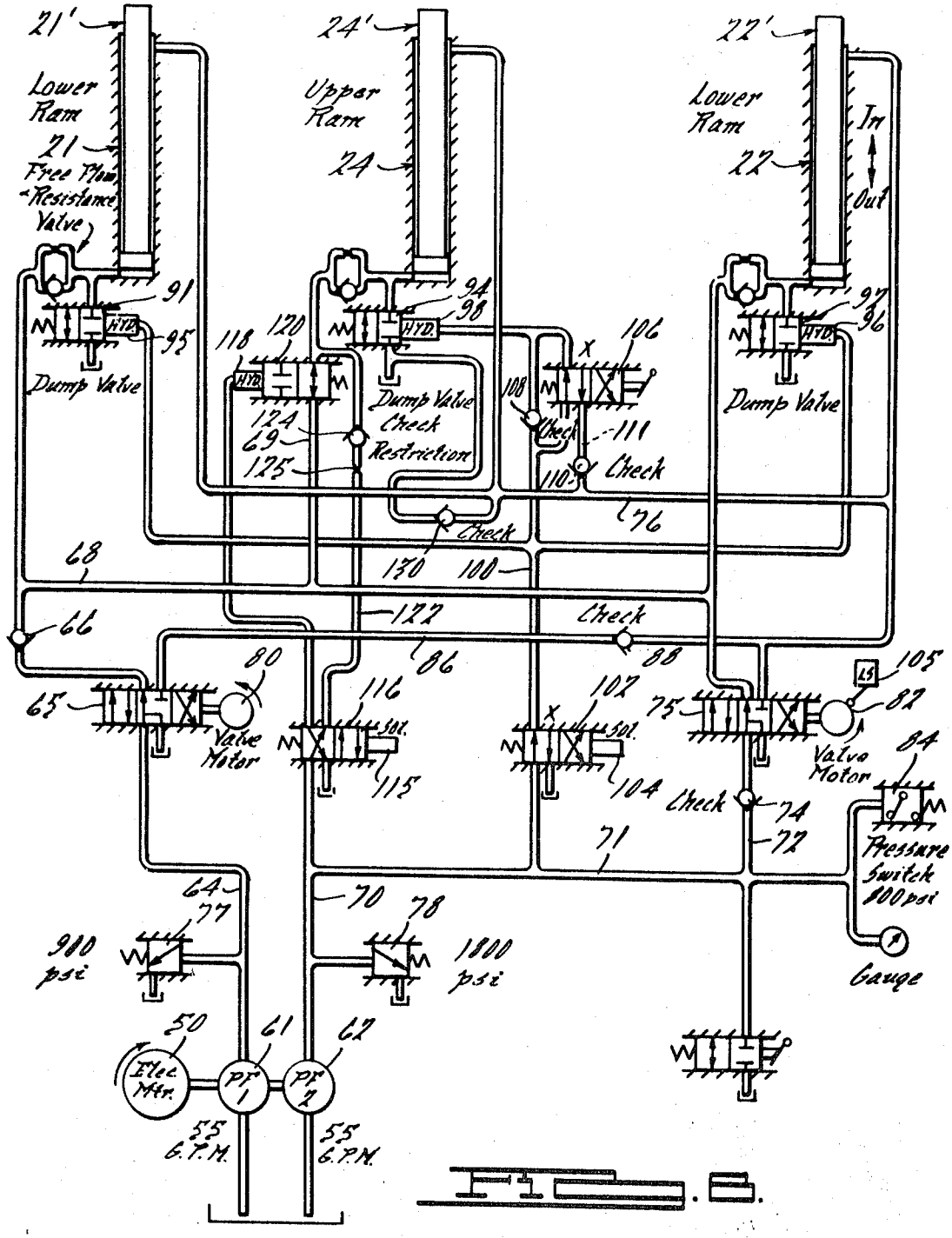


FIG. 8.

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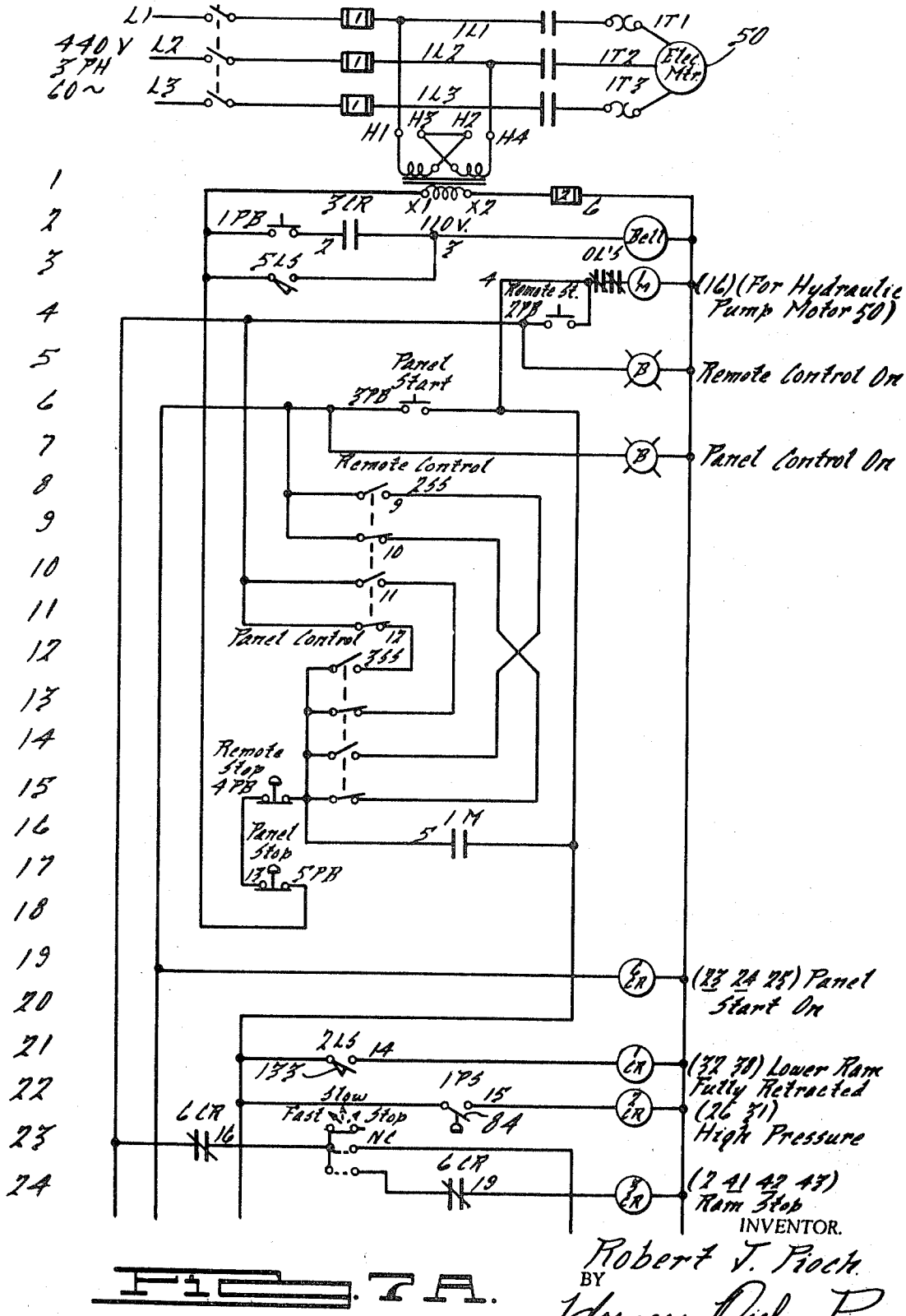


FIG. 7A.

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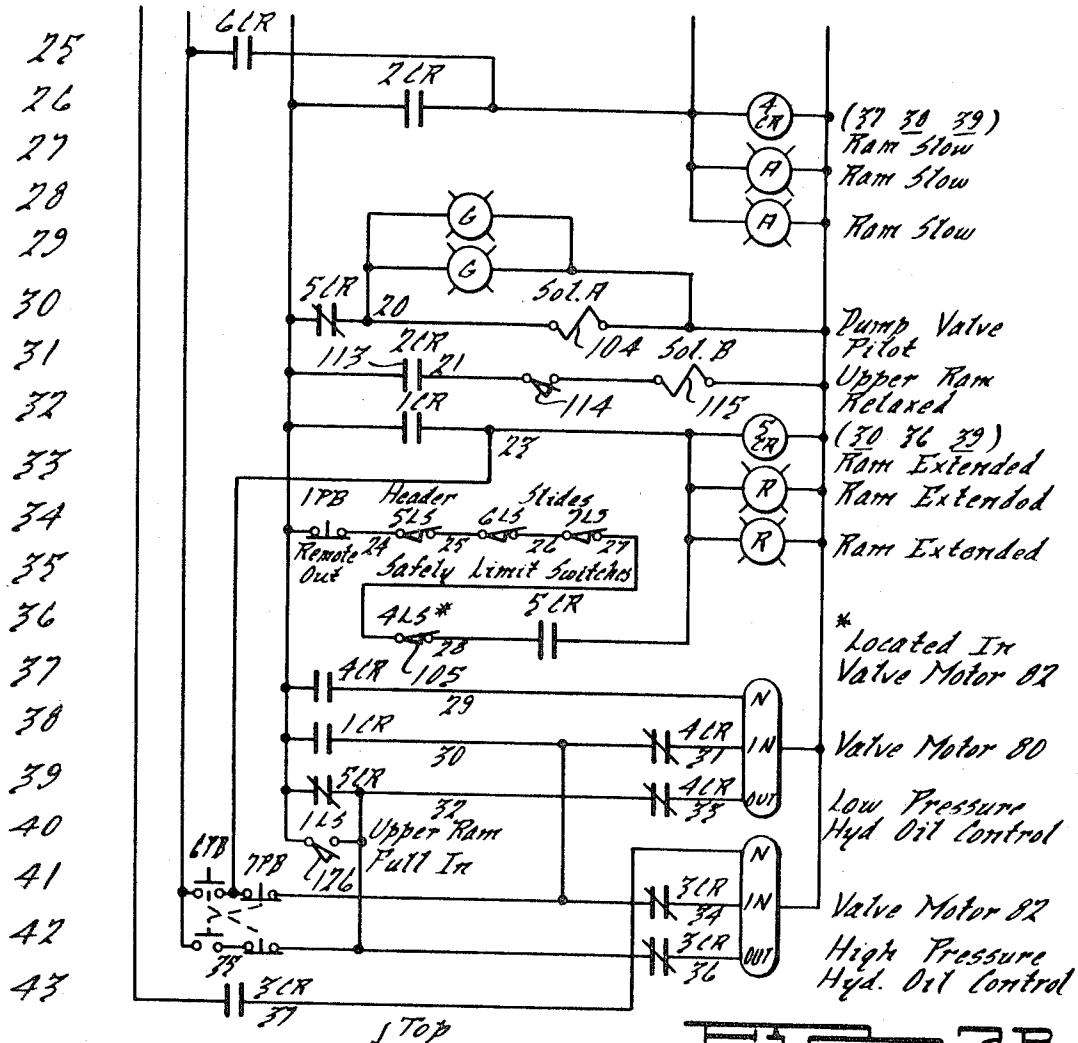


FIG. 7B.

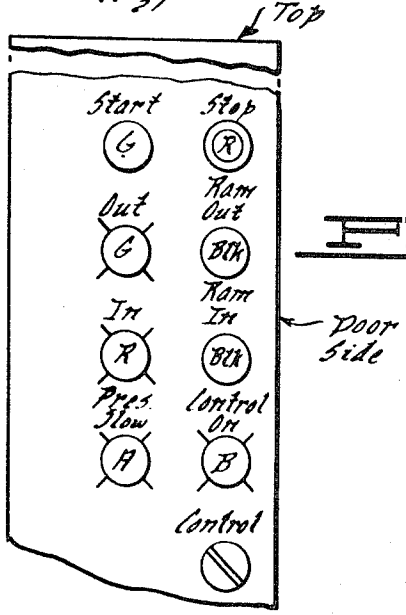


FIG. 9.

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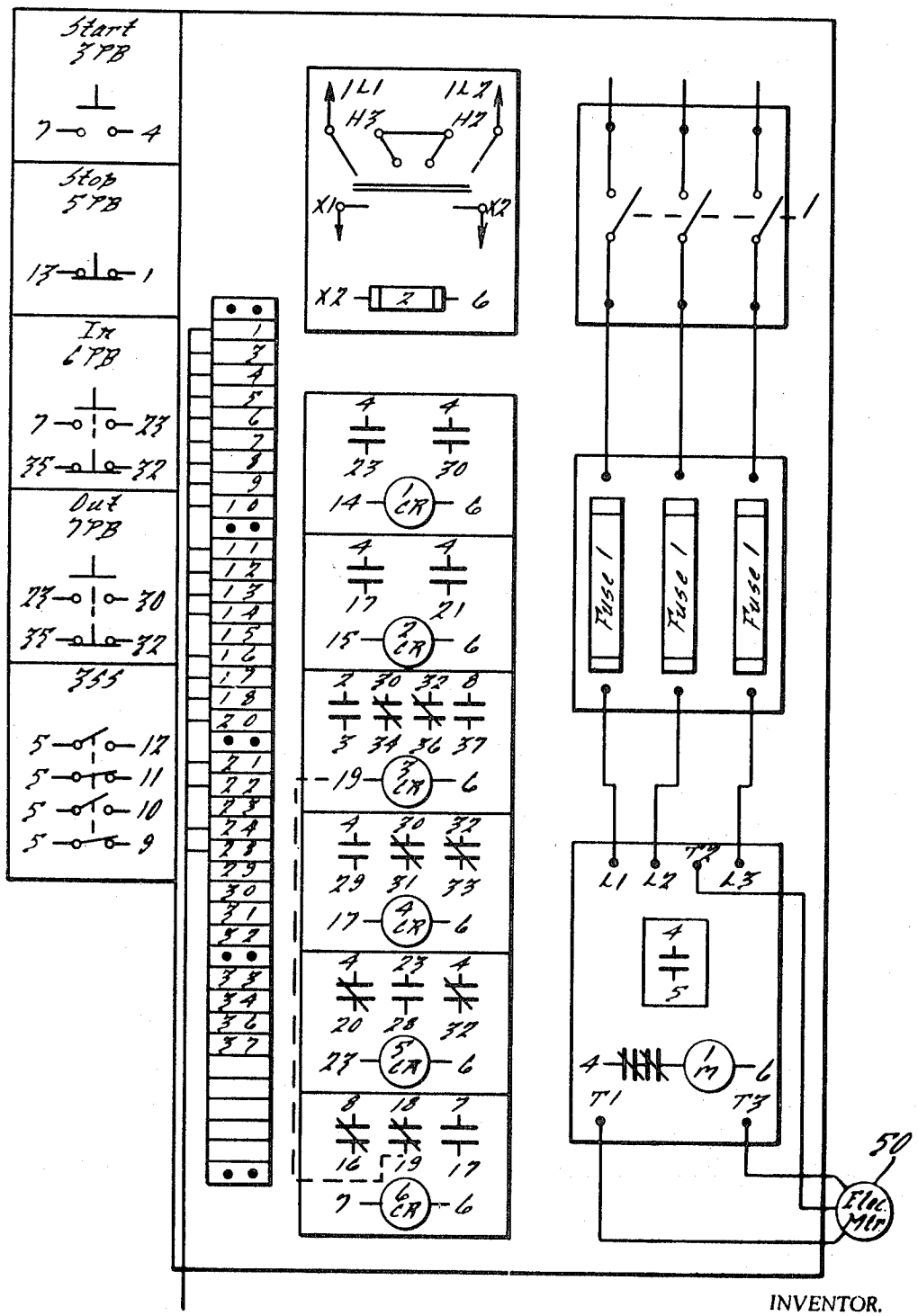


FIG. 8A.

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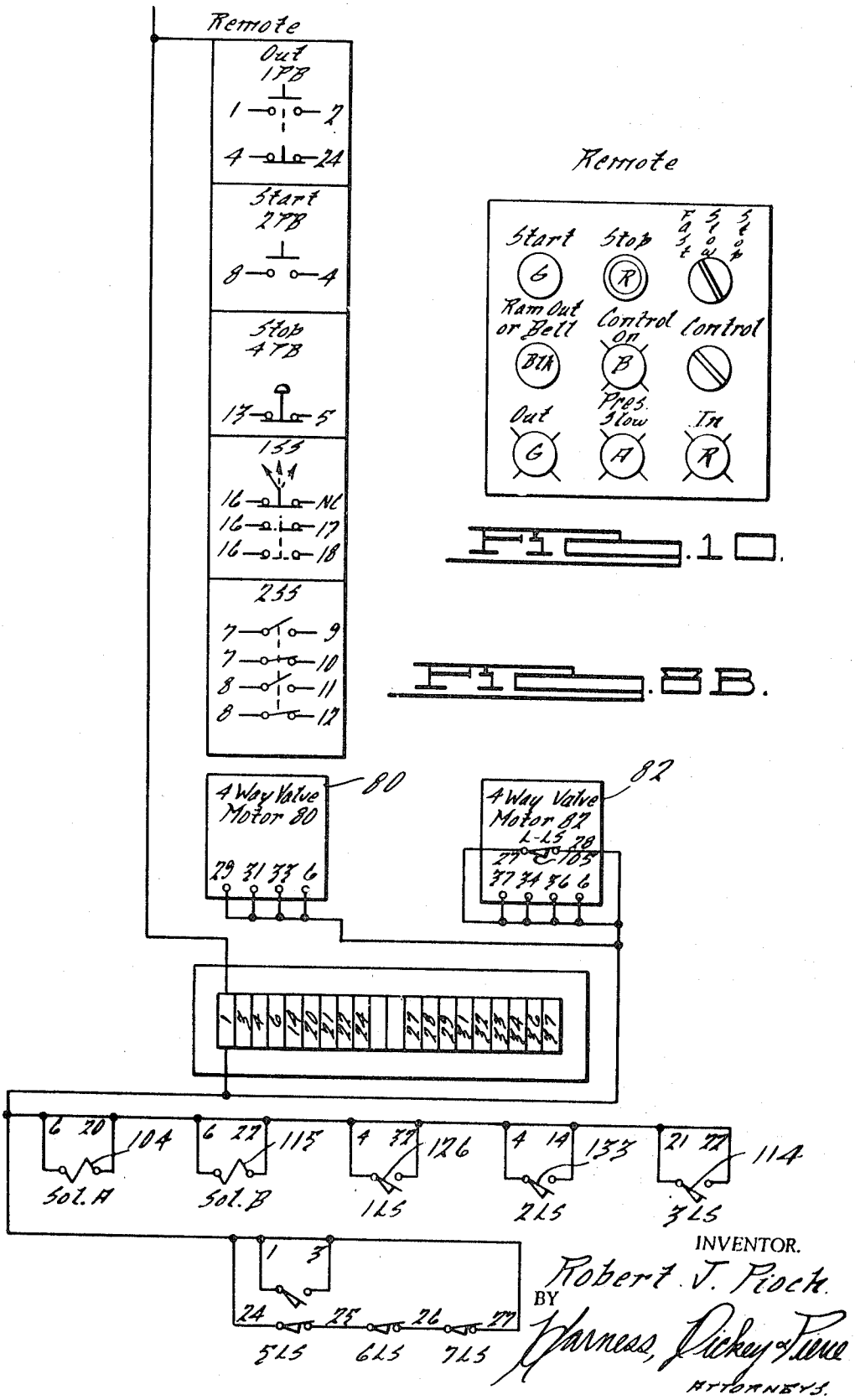


FIG. 10.

FIG. 8B.

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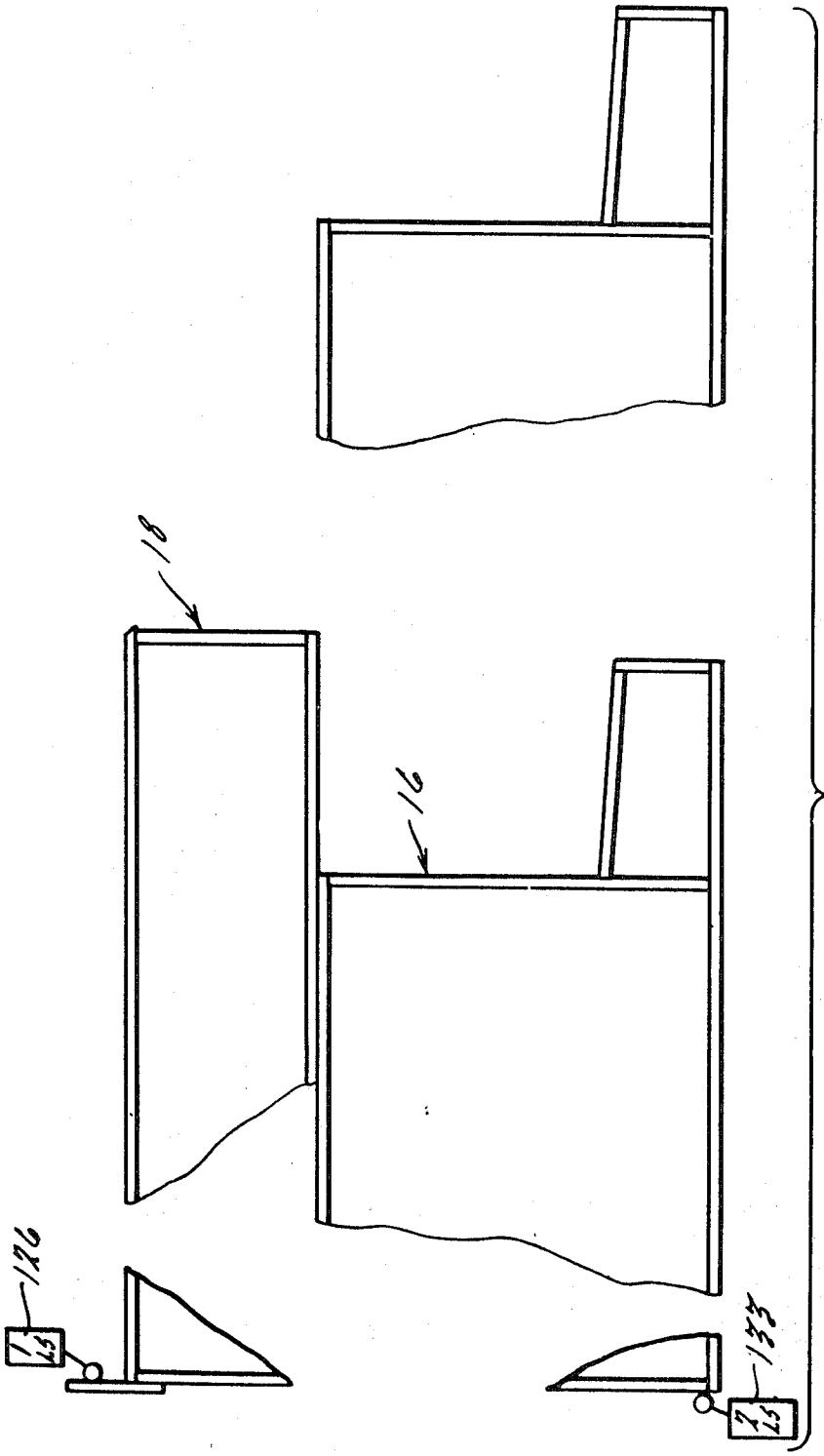


Fig. 11.

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COMPACTION LOADING APPARATUS

BACKGROUND OF THE INVENTION

Stationary compaction apparatus of the type disclosed in prior U.S. Pat. Nos. 3,250,414, 3,289,572 and 3,403,620 and which are designed to handle virtually all types of waster material from household, industrial, commercial and other activities are finding increasing usage in connection with waste handling operations of increasing magnitude. Such operations include large "transfer stations," wherein truckloads of waste material are dumped into chutes leading downwardly into a ramming chamber. The trucks or other sources of waste material may be on an upper floor and the compaction apparatus out of sight on a lower floor.

An important object of the present invention is to provide improved means whereby material can be charged into chute and/or hopper at the top of the compaction apparatus at any time regardless of the position of the ram and without interfering with proper operation of the compactor. Another object is to incorporate improved means for preventing unusually large rigid objects or overloads which are not compressible without overstressing the equipment from interfering with proper operation of the apparatus and for eliminating any obstructing or overloading difficulty which may arise. Another object is to achieve more efficient and quicker loading and compaction of containers.

Other objects and advantages will be apparent on consideration of the present disclosure in its entirety.

BRIEF DESCRIPTION OF THE FIGURES OF DRAWING

FIG. 1 is a side elevational view partly broken away of a stationary compactor incorporating the principles of the present invention;

FIG. 2 is a longitudinal sectional view of the rear portion thereof on a larger scale, also partly broken away;

FIGS. 3, 4 and 5 are cross-sectional views taken respectively on the lines III—III, IV—IV, and V—V respectively of FIG. 2 but on a larger scale and looking in the direction of the arrows;

FIG. 6 is a schematic diagram of the hydraulic control system;

FIGS. 7A, 7B, 8A and 8B are schematic diagrams of a preferred electrical control system;

FIG. 9 is a diagrammatic elevational view of the machine-side control panel;

FIG. 10 is a diagrammatic elevational view of the remote control panel; and

FIG. 11 is a diagrammatic view showing the ram sections in various positions.

DETAILED DESCRIPTION OF THE PREFERRED FORM OF THE INVENTION

Reference character **10** designates generally the ram chamber portion of a stationary compactor. Such portion may correspond in construction to that disclosed in U.S. Pat. No. 3,289,572, and is preferably provided with similar safety means for preventing damage in event of overstressing, although such safety means forms no part of the present invention and for clarity of illustration is not shown. Means (not shown) are also provided for releasably coupling the compaction chamber to a container to be filled, the coupling means itself being omitted and the container only diagrammatically indicated at **12**, these parts also being disclosed in the aforementioned U.S. patents and forming in themselves no part of the present invention.

A rearwardly extending frame portion **15** rigid with the ramming chamber **10** contains guideways and hydraulic cylinder and piston assemblies for actuating the ramming means. The ramming means comprises complemental lower and upper ram sections respectively designated **16** and **18**, both of which are of rectangular cross section and of such uniform width as to have a smooth sliding fit within the internal sidewalls of the ramming chamber. The vertical height of the lower ram section **16** is approximately twice that of the upper section **18** which is slidable thereupon. The total height of the two sections is substantially less than the effective height of the ramming port **29**, the upper limit of which is defined by the rigid header bar **23**. In a preferred machine the overclearance ("X," FIG. **1**) thus defined is approximately 10 inches, which provides sufficient clearance for virtually all materials of an extremely rigid nature apt to be encountered, such as railroad ties, cement blocks, and the like, and the ram assembly is arranged to enter the container a distance substantially exceeding the overclearance, so that the machine will tend to clear itself of and reorient such large imcompressible materials in a manner to reduce the danger of overstressing. This is brought out in greater detail in said prior U.S. Pat. No. 3,403,620. In a preferred machine constructed in accordance with the present invention, the height of the upper ram section is 11½ inches and the height of the lower ram section **16** is 24¼ inches. At full extension, the ram assembly projects into the container approximately 18 inches.

The lower ram section **16** is powered by a pair of laterally spaced hydraulic cylinder and piston assemblies **21**, **22**, while the upper ram section is powered by a single centrally located hydraulic cylinder and piston assembly **24**. The frame structure **15** is provided with separate guiding means for the two ram sections, although in their portions which project into and beyond the ramming chamber, the upper ram section rests directly upon and is slidable on the top plate **26** of the lower ram section.

The lower ram section **16** is provided with a forwardly projecting bottom portion **30** extending the full width of and forwardly from such ram section, the projection **30** functioning to compress and lift the lowest portion of the contents of the container. Locating means **31** on top of the projection **30** are provided for a tubular or pipe-type closure element for the container, and spaced thereabove a pair of additional brackets **32** are provided, on the front of the lower ram section, for a second such closure element. The method of use of such closure elements is described in the aforementioned U.S. Pat. No. 3,250,414.

The two ram sections, during normal operation, tend to move at the same speed, although during such normal operation they are not mechanically connected to each other. The specific means for supporting and guiding the ram sections and the cylinder and piston assemblies, and other structural elements, are subject to variation as engineering considerations may dictate. In the preferred construction shown, the side plates of the section **15** which enclose the sides thereof act as structural members and carry the slideway portions as **33**, **34**. Downwardly directed guiding elements **39** are also provided extending along the sidewalls of the compaction chamber and preventing the upper section from moving upwardly away from the lower section **16**.

In FIG. **2** the ram sections are shown in their fully retracted or "out" position, in which they define the rear wall of the compaction chamber. The top plate **26** of the lower section **16** is approximately 30 inches long, in the embodiment described. A forward bottom plate **27** of the upper ram section slides on the top plate **26** of the lower section and is of the same length. A clearance space **35** corresponding to the combined thickness of the two plates, **26**, **27** is thus left in the area to the rear of such plates. An abutment block **36** rigidly secured to the bottom of the upper section **18** projects downwardly below the extending plane of the top of plate **26**. When the front faces of the ram sections are aligned, as shown in FIG. **2**, the front end of abutment block **36** is 14 inches from the rear end of plate **26**. Block **36** thus limits to 14 inches to the extent to which the top section can lead the lower section. Another abutment block **38** is secured to the top of the lower ram section farther to the rear and projects upwardly to interfere with abutment block **36** to limit the extent to which the upper ram can trail the lower ram (to a maximum of 24 inches in the preferred embodiment illustrated).

A keeper block **40** secured to a rear area of the bottom of the upper ram acts as a keeper for a swinging latch hook **42** fast on a bar **44** rockable upon a transverse axis in the lower ram. Hook **42** is engageable with the keeper **40** when the upper ram is projected (to the extent of 14 inches, in the embodiment illustrated) with respect to the lower ram, to maintain the two ram sections in such relative position under certain conditions, as will be explained hereinafter. Latch hook **42** is actuatable upwardly by a lifting arm **45** fast upon the pivot bar **44**. An actuating shoe **46** is carried by the stationary frame structure **15** at a position to be engageable by the arm **45** when the lower ram section **16** is projected sufficiently.

The shoe **46** has a horizontal top and sloping ends and in the preferred embodiment illustrated its flat top is approximately 18 inches long. It is so located that if the shoe is in the elevated position, the lifting arm rides on the shoe while the position of the lower ram is such that its front face is not more than 2 feet 10 inches behind (to the left of) the header bar **23** and not less than 14 inches to the left OF THE HEADER BAR. If at the same time the front face of the upper ram is in the region to the left of the header bar but not more than 18 inches to the left, which is the range within which jamming of the upper ram could conceivably occur (due to a large incompressible load overlying the front top corner between the upper ram and the header bar) the latch hook **42** can be used when the lower ram is 14 inches to the left of the upper ram, and if handle **51** has been raised to move the shoe **46** to raised position, the latch hook will be lifted by the shoe **46** to engage behind keeper block **40**.

If forward movement of the upper ram is arrested by an incompressible load (which arrest would occur within the aforementioned 18-inch jamming range) the lower ram continues forwardly until it is arrested, whereafter the pressure in the system rises beyond a predetermined value (e.g. 800 p.s.i.) and pressure switch **84** trips, to actuate solenoid **115**, which moves value **116** to the left and dumps the pressure in cylinder **24**, provided limit switch **114** is also closed, completely relaxing the upper ram. Limit switch **114** is held closed by the upper ram when such ram is within a predetermined distance (e.g. 18 inches) of the header bar in either direction. The lower ram then moves forwardly to the limit of its stroke or to the extent permitted by the lost motion between block **36** and block **38**, as noted, and this normally results in freeing the jam.

It will be appreciated that the range within which jamming might occur depends upon the service for which the machine is designed and the material to be handled. The forward movement of the lower ram after the upper ram has been relaxed tends to create a pocket or tunnel in any material in the container near the opening. If the machine is designed for service conditions which are severe as to possible jamming, the extent of lost motion between the blocks **36–38** may be increased, to permit the lower ram to advance more than 24 inches beyond the upper ram, in order to create a deeper pocket in event the upper ram is jammed at a position relatively far from the header bar, although the greater overclearance above the lower ram and the arresting and relaxing of the upper ram as the lower ram continues inwardly normally frees the jam so that normal operation of the compactor can continue. If the unit remains jammed, however, the lower ram is then retracted, while the upper ram remains stationary, until the lower ram is 14 inches to the rear of the upper ram (which is the position of engagement of plate **26** with block **36** and which position, as indicated above, also permits the latch hook **42** to be raised behind the keeper block **40**). Forward power is then applied to all three cylinders, and the two lower ram cylinders **21**, **22** thus also apply power to the upper ram, urging it forwardly with greater force. Inasmuch as the upper ram was also relaxed, and may have retracted slightly, due to the resiliency of the jammed material, and because room for such material has been created by the pocketing effect resulting from the independent advancement of the lower ram, the jammed material will then normally be forced into the container.

As shown in FIG. **2**, the shoe **46** is movable to the raised position, in which it is shown in full lines in that view, in which position it is operative to move the latch piece upwardly to the locked position in the manner described, and is also movable downwardly to the position in which it is shown in dotted lines, in which it is clear of the path of the arm **45**, allowing the ram sections to remain independent regardless of their position. Movement of the shoe **46** to these two positions is effected manually by a handle **51** which extends from the side of the frame extension **15** and which actuates the shoe through the agency of parallelogram linkage **52**. Handle **51** actuates the parallelogram linkage **52** through the agency of an interposed torsion spring **53**, so that the shoe can be forced downwardly to the lifting arm **45** in the event the shoe operating handle has been raised at an improper time so that the latch hook **42** cannot be raised.

FIGS. **6**, **7A**, **7B**, **8A** and **8B** show in a diagrammatic form the hydraulic and electrical elements of a system for controlling such a machine for two stations, one (FIG. **9**) at the machine and the other (FIG. **10**) remotely located, for example, on the upper loading floor.

In order to achieve a more rapid advance at light ram loads, two high capacity pumps **61**, **62** driven from a common drive motor **50** are employed. In the embodiment referred to each has an output of 55 gallons per minute.

Pump **61** delivers its output via conduit **64**, motor-operated four-way valve **65** and check valve **66** to a main forward line **68** through which fluid flows to and from the rear ends of cylinders **21**, **22**, **24**. Pump **62** delivers its output via conduits **70**, **71**, **72** and motor-operated four-way valve **75** to the main line **68** for inward movement of the pistons. During outward movement of the pistons fluid from main line **68** is vented through valve **75**. References to "inward" and "outward" refer to ram movements; "inward" or "forward" being the direction in which the rams move into the container and "outward" and "rearward" being the direction in which the ram moves out of and away from the container. Pressure limiting valve **77** limits the output pressure of pump **61** to (e.g.) 900 p.s.i., while pressure limiting valve **78** limits the output pressure of pump **62** to (e.g.) 1800 p.s.i.

The electric motor **80** of valve **65** is controlled by a pressure switch **84** connected to the output of pump **62**. At the start, both valves **65** and **75** are moved to the right from the centered drain position in which they are shown, so that fluid from both pumps is delivered via main line **68** to the rear ends of the cylinders **21**, **22** and **24** to move the rams inwardly at full speed. When the resistance encountered by the rams is sufficient to cause the output pressure of pump **62** to rise to a predetermined value, e.g., 800 p.s.i., switch **84** actuates motor **80** to shift valve **65** to the drain position shown in FIG. **6**, while the output of pump **62** continues to be delivered via valve **75** at the higher pressure to move the rams forwardly toward the full in position at half speed. Check valve **66** prevents the oil pumped by pump **62** from returning to drain at such time.

When the four-way valves **65** and **75** are moved to the left by their respective motors **80**, **82**, which occurs when limit switch **126** (FIG. **7B**) closes in response to attainment of full in position by the upper ram **18**, the connections to and from the main lines **68**, **76** are reversed, and fluid from both pumps is delivered to main return line **76** from which it is distributed to the forward ends of the cylinders to retract the rams at full speed. At such time the oil from the rear ends of the cylinders returns to the sump via conduit **68** and valve **75**, and through dump valves **91**, **92**, **94**. If during such return movement of the pistons to retract the rams any jamming should occur which caused the output pressure of pump **62** to rise to the trip pressure of pressure switch **84**, so that valve **65** shifted to the drain position, unwanted venting of the pressure output of pump **62** via valve **65** is prevented by a check valve **88** in the conduit **86** leading from the valve **65** to the distribution line **76**.

In view of the relatively high fluid volume displaced from the rear ends of the cylinders during outward movement of the rams as compared to the fluid volumes of the forward or rod

ends of the cylinders, one of the dump valves **91, 92, 94** is connected to the rear end of each cylinder and is automatically opened during outward movement, and closed during inward movement. Each dump valve is actuated by a hydraulic actuator **95, 96, 98**. The actuators **95, 96** of the dump valves of the lower ram cylinders are directly connected to the conduit **100** which communicates with a dump valve control pilot valve **102** which is actuatable by a solenoid **104**. A limit switch **105** actuated by valve motor **82** energizes solenoid **104** to move valve **102** to the left from the position shown, in which it delivers fluid to all three of the hydraulic servos **95, 96, 98**. Switch **105** maintains the solenoid **104** deenergized and valve **102** in such position, so the dump valves **91, 92, 94** are closed, during inward ram movement. Switch **105** energizes the solenoid **104** to move valve **102** to the left and vent the servos **95** and **96** during outward movement of the rams. This action occurs because servos **95, 96** are vented through valve **102**, so that valves **91, 92** which are biased to drain move to the right and dump the rear ends of the cylinder **21, 22**. It will be noted that normally the servo **98** is similarly vented through valve **102** at this time via the left section of a manual valve **106**, which bridges a check valve **108** so that fluid may blow from the servo **98** around the check valve **108** and to the line **100** and via valve **102** to drain. Under such conditions the rear ends of all of the ram cylinders are fully vented.

Under certain conditions it may be desired to permit the lower ram section to move rearwardly without moving the upper secton until the full independent movement (e.g. 14 inches) has been reached, either to correct a jam as explained above or to prevent more material from dropping in front of the rams. This may be accomplished by means of the manual valve **106**, which, when moved to the left against its bias blocks the connection to the servo **98** from the line **100**, while outflow from servo **98** is then also prevented by a check valve **110** in line **111** leading from distribution line **76** to valve **106**. After the full independent movement is completed, the lower ram pulls the upper ram rearwardly, and fluid escapes from the rear end of upper ram cylinder **24** via valve **120**, lines **69–68** and valve **75**. This permits the lower ram to be moved back to a position which allows the closure members to be placed on the supports **31, 32** by inserting them through the ports **37**, as taught in U.S. Pat. No. 3,250,414, while the upper ram section **18** projects forwardly far enough to prevent any material which may during the pinning operation be dumped into the chute or hopper from entering the container or interfering with the pinning operation. Such independent rearward movement of the lower ram also enables the two ram sections to be latched together by means of the hook **42**, if the shoe **46** is raised, as noted above. It will be appreciated that in event of a plugging or resistant load at the top which tends to restrict forward movement of the upper ram section, the lower ram section tends to advance and to be forward of the upper section to the extent of the greater independent travel permitted in such direction (e.g. 24 inches), so that under such conditions of plugging or high resistance in the upper area, such holding back of the upper ram section leaves an effective ram clearance equal to the distance between the top of the lower ram and the header bar (dimension "X" plus the height of the upper ram section, e.g. 21½ inches).

If the pressure developed due to the obstruction is over 800 pounds, pressure switch **84** will be tripped. A limit switch **114**, in series with a circuit which also includes contacts **113** operated by pressure switch **84** and solenoid **115**, is held closed by the lower ram whenever the lower ram is in a position relatively close to alignment with the header bar **23**. In the embodiment of the invention referred to, limit switch **114** is held closed when the ram is within 18 inches on either side of a vertical line to the header bar. Energization of solenoid **115** moves valve **116** to the left, delivering fluid from pump **62** to hydraulic servo unit **118** which closes shutoff valve **120** incorporated in the line **69** which connects the main forward line **68** to the rear end of the upper ram cylinder **24**. The upper ram is therefore stopped while the lower ram continues to move forwardly. At the same time a drain line **122** which shunts the valve **120** vents the rear end of cylinder **24** through valve **116**. In flowing to drain through valve **116** the fluid from the rear end of cylinder **24** passes through a check valve **124** and restriction **125**, relaxing the pressure on the upper ram, which may then move back a short distance to release any pinching action between the upper ram and the header bar and permit the lower ram to continue to move inwardly pulling the material under the enlarged opening beneath the header bar. When the lower ram has moved inwardly to the indicated inner limit of the range of closure of limit switch **114** (18 inches) beyond the header bar) the lower ram has a remaining travel of approximately 8 inches, during which limit switch **114** is opened, deenergizing solenoid **115**, reopening the valve **120** and permitting fluid pressure to force the upper section of the ram inwardly rapidly to catch the lower section.

The cycling of the valve motors to reverse the ram for retraction from the full in position is controlled by limit switch **126** actuated by the upper ram section. Limit switch **126**, when the upper ram section reaches its full in position, actuates the valve motors **80** and **82** to reverse the valves **65** and **75** to cause retraction of the ram sections. If the machine is so completely blocked that the upper ram cannot move forwardly to trip the limit switch **126**, which may be caused either by such a complete blockage or a tripout of one of the safety switches previously referred to (shown at **5LS, 6LS, 7LS** of the line diagram FIG. 7) it may of course be necessary to manually unplug machine.

It will be recognized that the contents of the container may be of a nature which possesses considerable resiliency. When the load is under compression and the compressive force is suddenly released, the tendency of the load to reexpand may drive the ram sections and connected pistons outwardly very quickly, tending to create a negative pressure in the cylinders at the forward or rod ends which could be harmful to the sealing means for the piston rods. Under such conditions any negative pressure at the rod ends of the cylinders is relieved through check valve **130** which vents such areas under vacuum, but closes under positive pressure.

Control of reversal of the motor operated valves **65** and **75** to reproject the rams from full out position is effected by limit switch **133** actuated by the lower ram section. In the preferred embodiment illustrated, the total ram travel, which is the same for both ram sections, is approximately 12 feet. The top plate **19** of the upper ram section **18** is strong enough to withstand the impact of heavy objects and dimensioned so that when fully projected it effectively blocks the full cross section of the ram chamber.

This Detailed Description of Preferred Form of the invention, and the accompanying drawings, have been furnished in compliance with the statutory requirement to set forth the best mode contemplated by the inventor of carrying out of the invention. The prior portions consisting of the "Abstract of the Disclosure" and the "Background of the Invention" are furnished without prejudice in an effort to comply with administrative requirements of the Patent Office.

What is claimed is:

What is claimed is:

1. Apparatus for containerizing and compacting waste material or the like, of the type which includes a generally rectangular ram chamber having a top charging opening, a ramming port in one side, a rigid header bar bounding the top of the port, and rectangular ramming means spaced below the header bar and movable across the bottom of the chamber and outwardly beyond the bar through the port to extend into a container, characterized in that the ramming means comprises two superposed relatively slidable sections.

2. Apparatus as defined in claim **1** wherein said sections have limited lost motion travel with respect to one another.

3. Apparatus as defined in claim **2** including separate hydraulic cylinder and piston-type actuating means for each of said sections, and a common hydraulic supply system for the actuating means of both sections, whereby fluid delivery to the

separate actuating means, and the rate of movement of the sections, is variable in response to differences in the resistance encountered by said sections.

4. In combination with means of claim 3, relaxing means for said upper secton responsive to a predetermined relatively high pressure in said system for disabling and relieving the fluid pressure in the actuating means of the upper section without disabling the actuating means of the lower section.

5. Apparatus as defined in claim 2 including releasable means for locking said sections together to prevent such lost motion.

6. Apparatus as defined in claim 2 include separate hydraulic cylinder and piston-type actuating means for each of said section, a common hydraulic supply system for the actuating means of both sections, whereby fluid delivery to the separate actuating means, and the rate of movement of the sections, is variable in response to differences in the resistance encountered by said sections, and releasable means for locking said sections together to prevent such lost motion.

7. Apparatus as defined in claim 2 include separate hydraulic cylinder and piston-type actuating means for each of said sections, a common hydraulic supply system for the actuating means of both sections, whereby fluid delivery to the separate actuating means, and the rate of movement of sections, is variable in response to differences in the resistance encountered by said sections, and releasable means for locking said sections together with the upper section projecting forwardly farther than the lower section to prevent such lost motion and operatively connect all of the actuating means to both sections.

8. Apparatus as defined in claim 1 including separate hydraulic cylinder and piston-type actuating means for each of said sections, and a common hydraulic supply system for the actuating means of both sections, whereby fluid delivery to the separate actuating means, and the rate of movement of the sections, is variable in response to differences in the resistance encountered by said sections.

9. In combination with apparatus as defined in claim 8, means for controlling delivery of fluid to at least one of the actuating means for said sections independently, to permit moving the sections to different positions relatively to each other.

10. In combination with means as defined in claim 8, individual control means of the actuating means of each section, whereby independent projecting and retracting movement can be imparted to each section.

11. In combination with means as defined in claim 8, relaxing means for said upper section responsive to a predetermined relatively high pressure in said system for disabling and relieving the fluid pressure in the actuating means of the upper section without disabling the actuating means of the lower section.

12. In combination with means as defined in claim 11, means responsive to the position of the upper section for disabling said relaxing means when the forward end of said section is beyond a predetermined distance from said header bar.

13. Apparatus as defined in claim 1 wherein said sections are of rectangular cross section, the vertical dimension of the lower section being substantially greater than that of the upper section.

14. Apparatus as defined in claim 1 wherein the sections occupy the full width of the chamber and the upper section has a flat impervious top of a length which is not less than the sum of the length of the chamber and maximum distance which said section extends beyond said chamber and into a container when fully extended.

15. Apparatus as defined in claim 1 wherein the vertical dimension of the upper section is a substantial fraction of the total height of the two sections.