Feb. 25, 1969 W. L. ZINGA 3,429,267

MATERIAL PUMPING ASSEMBLY

Filed March 27, 1967 Sheet 1 of 6

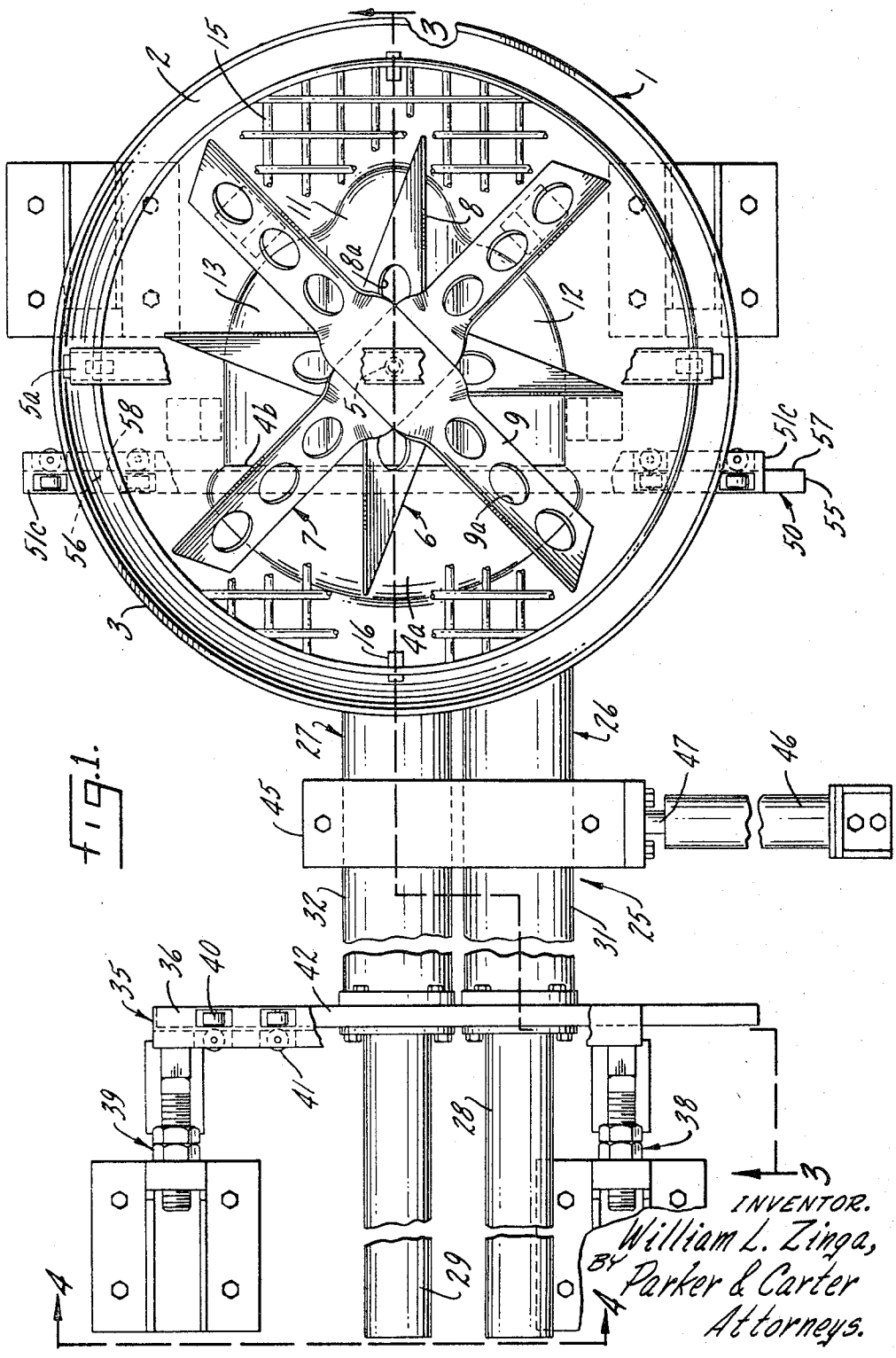


Fig. 1.

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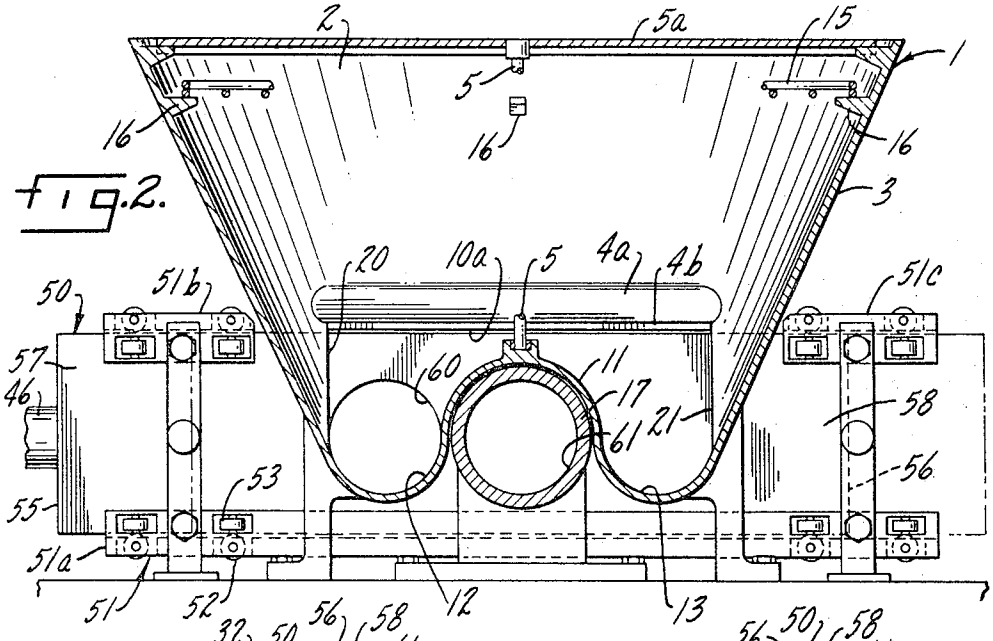


fig.2.

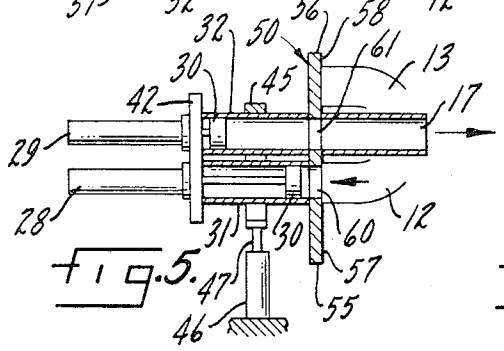


fig.5.

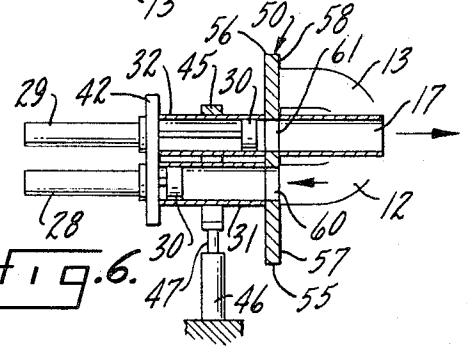


fig.6.

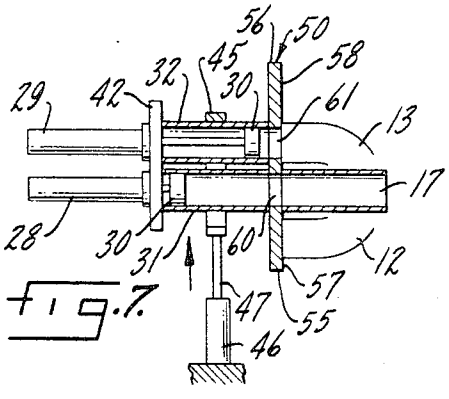


fig.7.

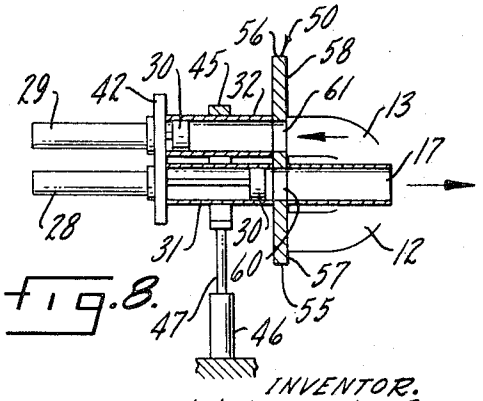


fig.8.

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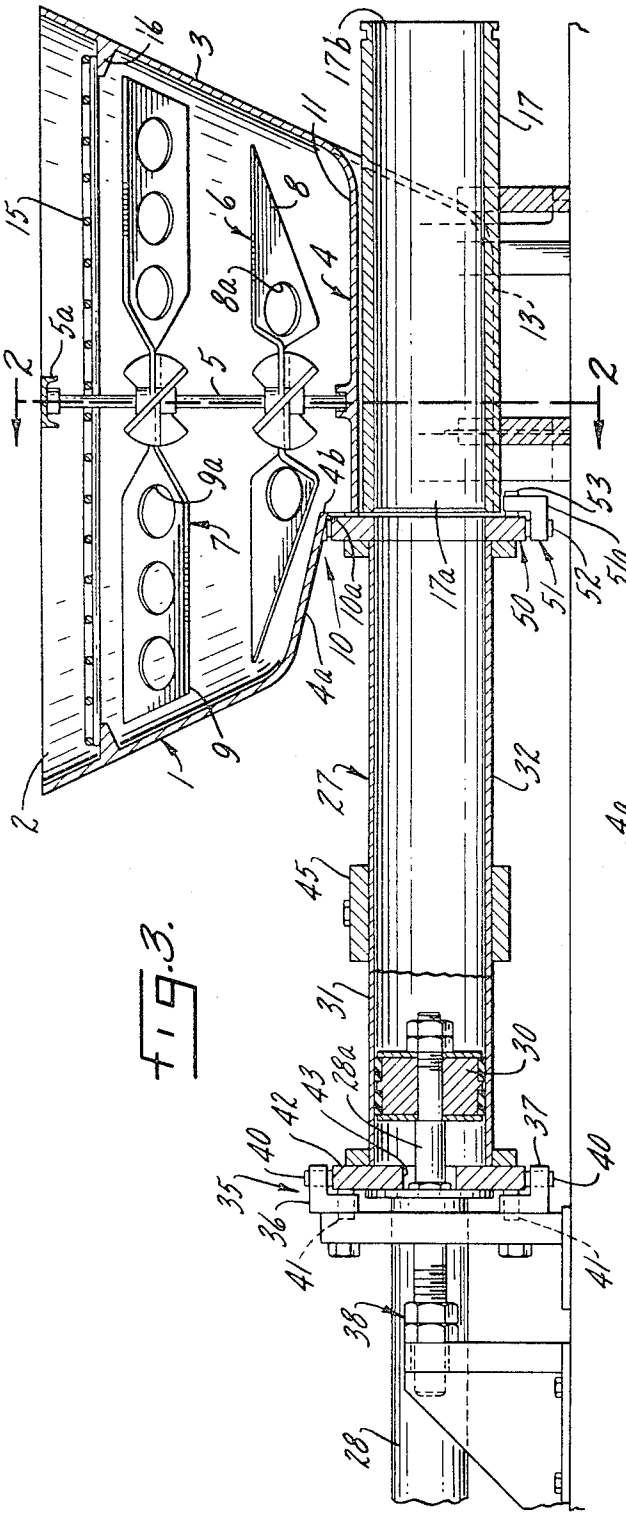


FIG. 3.

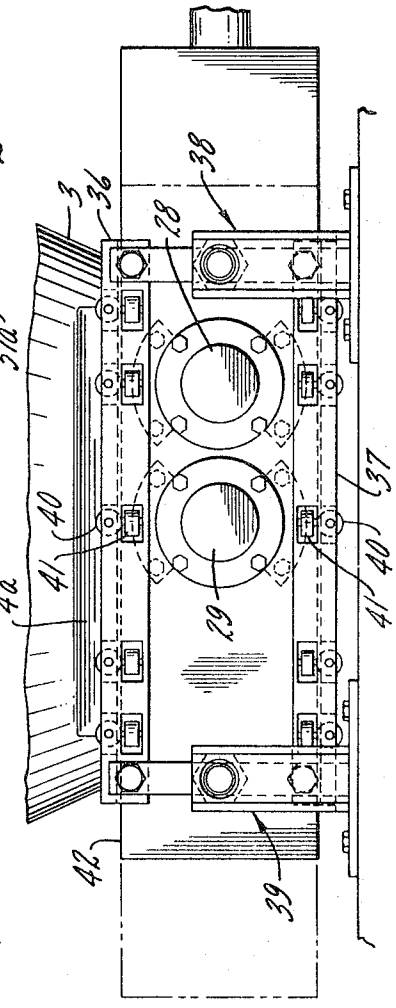


FIG. 4.

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MATERIAL PUMPING ASSEMBLY

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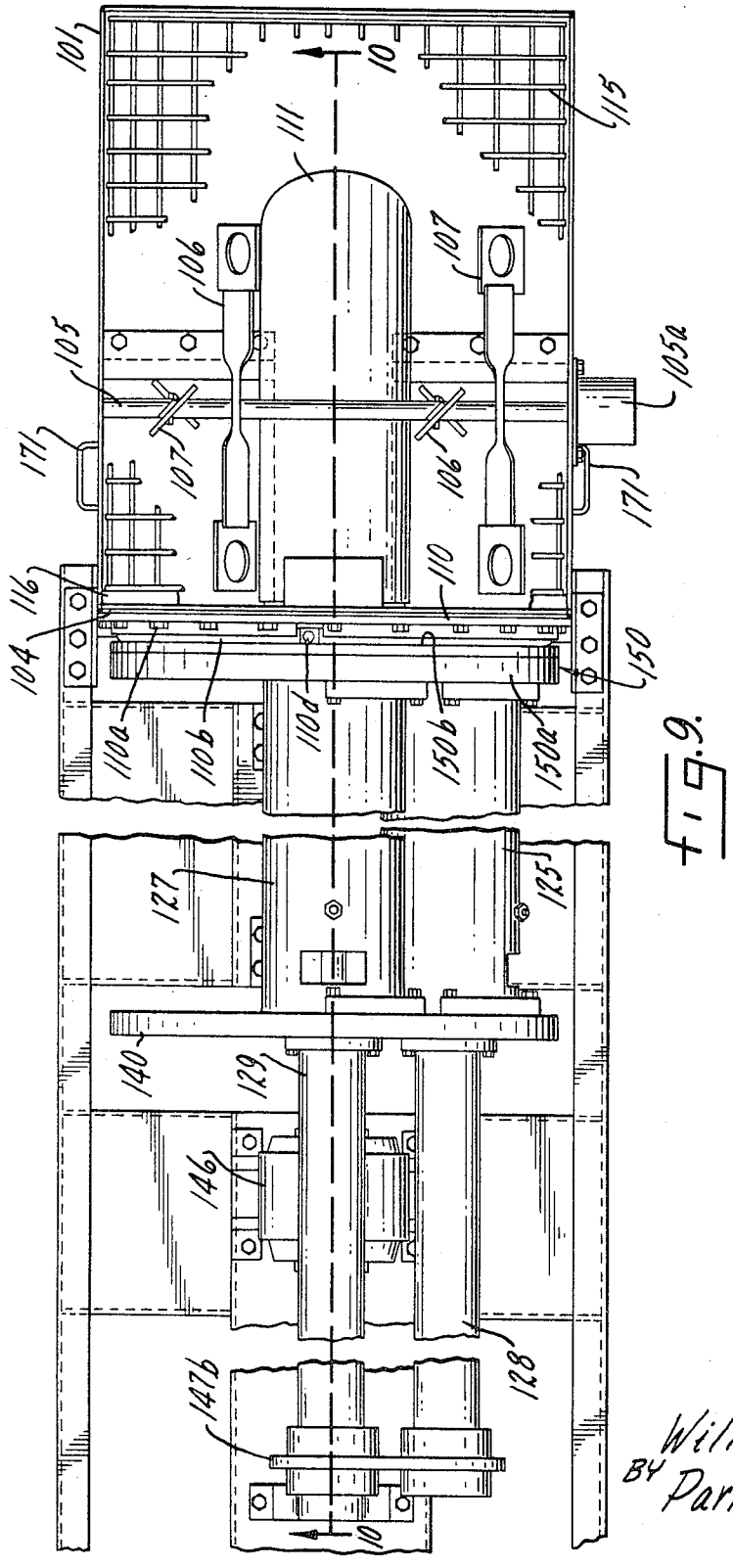


FIG. 9.

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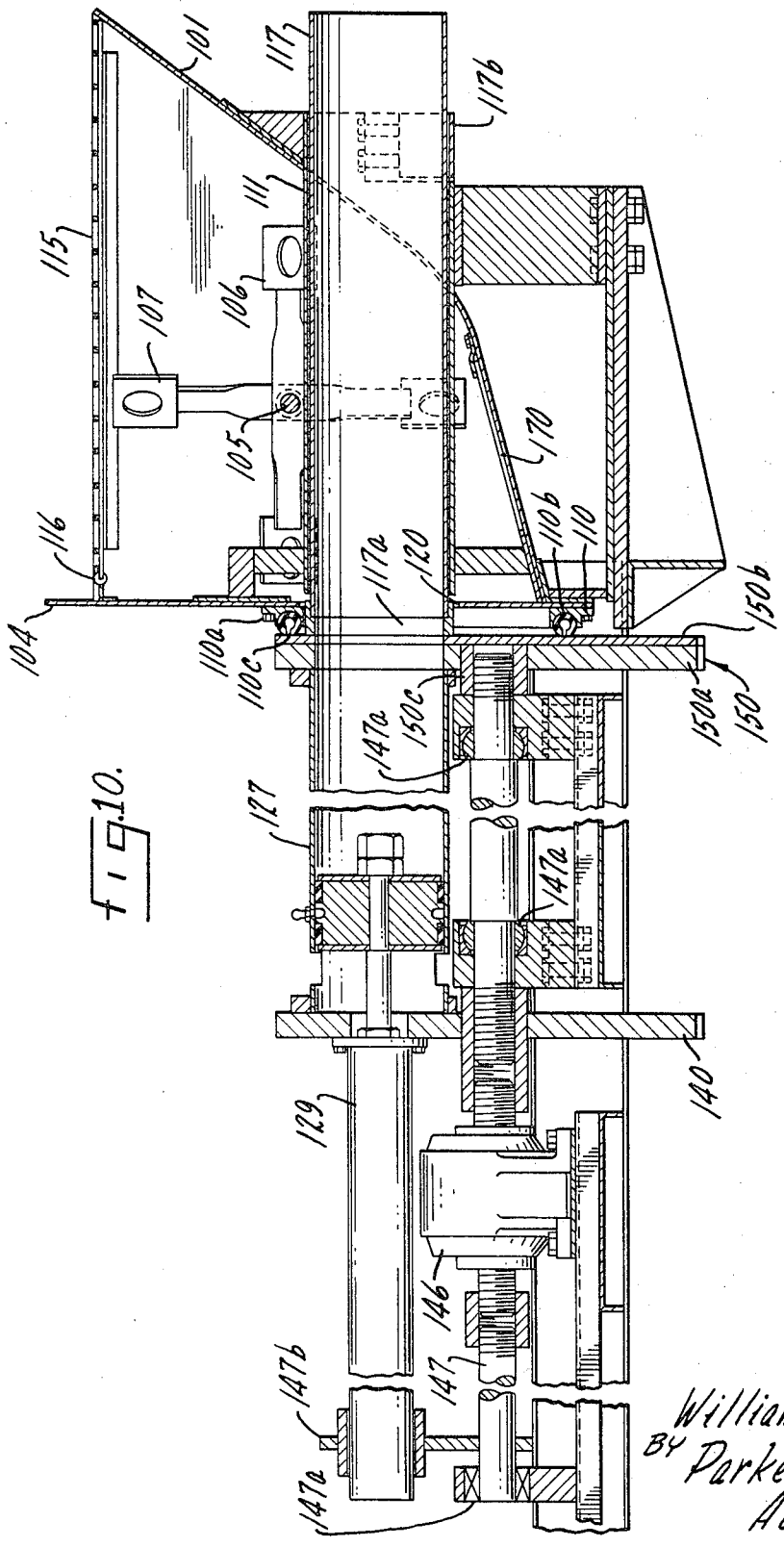


Fig. 10.

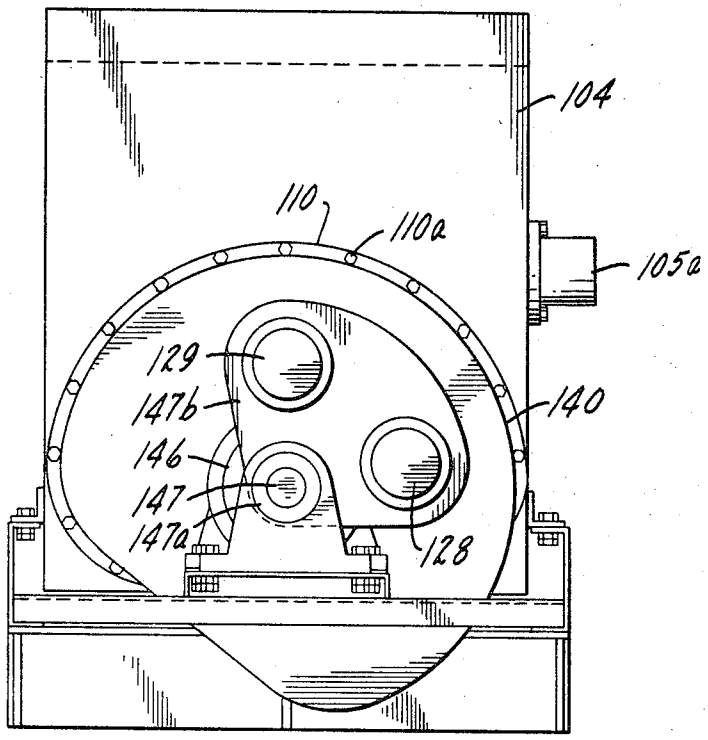
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Fig. 11.



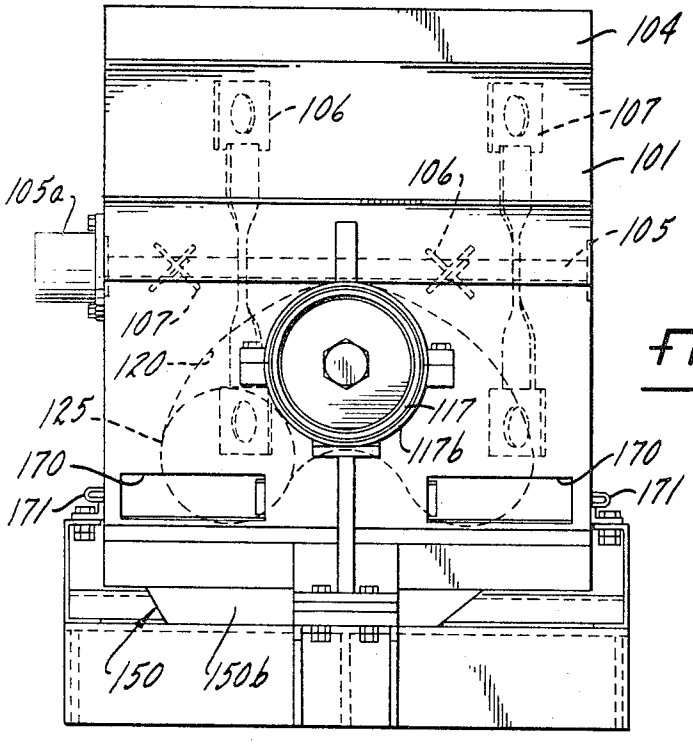


Fig. 12.

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United States Patent Office 3,429,267
Patented Feb. 25, 1969

3,429,267

MATERIAL PUMPING ASSEMBLY

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Continuation-in-part of application Ser. No. 556,657, June 10, 1966. This application Mar. 27, 1967, Ser. No. 626,234
U.S. Cl. 193—49 3 Claims
Int. Cl. F04b 17/00, 19/02, 7/00

ABSTRACT OF THE DISCLOSURE

A pump for flowable concrete and the like in which at least two cylinders are moved alternately into alignment with a hopper outlet and a distributor pipe inlet, pistons in the cylinders being alternately retracted and advanced to fill the cylinder in alignment with the hopper outlet and to expel concrete from the cylinder in alignment with the conduit inlet. A seal is provided between the movable cylinders and the hopper and conduit. Mixing-pressuring paddles and clean-out hatches are provided in the hopper.

This application is a continuation-in-part of application, Ser. No. 556,657, filed June 10, 1966, now abandoned, and entitled "Material Pumping Assembly."

This invention relates to material conveying devices and has particular relation to the field of concrete pumps.

The need for, and advantages of, concrete pumping assemblies has long been recognized. Such assemblies, capable of pumping concrete through an extended hose to a point of use are productive of numerous advantages, among which are the rapid unloading and consequent reduced turn-around time of concrete mix delivery trucks, freedom to position such trucks at a point remote from the cluttered or limited-area construction site, the avoidance of need for cranes, buckets, wheel barrels, elevators and the like and the reduced exposure of forms, electrical conduits, etc. to damage. Efforts to provide such devices have employed two fixed piston-cylinder assemblies and separate, independently operated knife, plug or butterfly valves to direct the concrete alternately to and from one cylinder and then the other. Such dual, fixed pistons thus fed into a "Y" or "Siamese" conduit and into reduced conduit diameters with which the delivery hose communicated. An alternate form employing two fixed pistons included a flipover or turntable type conduit alternating between the outlets of the two pistons. Another prior effort employed one fixed pumping piston and two or more valves of the knife, gate, hemispherical, ball or cam type to direct concrete from a hopper to the piston and from the piston to a delivery conduit. A third effort employed a flexible tube and roller means for squeezing it in the manner of a toothpaste tube. Such prior devices have, however, suffered from a number of drawbacks. The devices employing pistons, directional control valves, curved piping and reductions in piping diameters are subject to frequent plugging and resultant costly down-time. The battering of the concrete mix is injurious to valves. Turns and reductions in tubing are productive of an unmixing and a change of pattern in the aggregate distribution in the mix as the material moves through the assembly. Valves of the type previously employed and turns and reductions in tubing render cleaning difficult. Squeeze tubes require replacement as they wear.

Accordingly it is one purpose of the invention to provide a concrete pumping assembly devoid of reductions or variances in conduit or tube diameter size.

Another purpose of the invention is to provide a concrete pumping assembly devoid of turns in conduits or tubes.

Another purpose is to provide a concrete pumping assembly devoid of valves subject to contact by the concrete being pumped.

Another purpose is to provide a concrete pumping assembly devoid of the need for separate valve-operating elements.

Another purpose is to provide a pumping assembly capable of maintaining the aggregate distribution pattern of the concrete mix being pumped.

Another purpose is to provide a concrete pumping assembly productive of minimum down time.

Another purpose is to provide a concrete pumping assembly which may be easily cleaned.

Another purpose is to provide a concrete pumping assembly capable of pumping concrete to a maximum height, horizontal distance and volume.

Another purpose is to provide a concrete pumping assembly having a maximum wear life and requiring a minimum of maintenance.

Another purpose is to provide a concrete pumping assembly capable of pumping a standard economical concrete mix and requiring no special mix for pumping through said assembly.

Another purpose of the invention is to provide a concrete pump capable of efficient continuous transfer of concrete from a hopper to a point of use.

Another purpose is to provide a concrete pump assembly of maximum simplicity and economy in manufacture and use.

Another purpose is to provide a concrete pumping assembly capable of automatic continuous operation.

Another purpose is to provide a concrete pumping assembly having means for maintaining uniformity in the concrete mix to be pumped.

Another purpose is to provide a concrete pumping assembly having means for insuring desired presentation of concrete to the pumping elements of the assembly.

Other purposes will appear from time to time during the course of the specification and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

FIGURE 1 is a top plan view;

FIGURE 2 is an end view in partial cross-section taken on the line **2—2** of FIGURE 1;

FIGURE 3 is a side elevation in partial cross section taken on the line **3—3** of FIGURE 1;

FIGURE 4 is an end view taken on the line **4—4** of FIGURE 1;

FIGURES 5, 6, 7 and 8 are schematic views illustrating a pumping cycle;

FIGURE 9 is a top plan view of a variant form of the invention;

FIGURE 10 is a side view in section taken on the line **10—10** of FIGURE 9;

FIGURE 11 is an end view of the form illustrated in FIGURE 9; and

FIGURE 12 is an opposite end view of the form illustrated in FIGURE 9.

Like parts are indicated by like numerals throughout the specification and drawings.

Referring now to the drawings, the numeral **1** generally designates a hopper having an upwardly open top end **2**. The hopper **1** may be generally circular in planar configuration having a downwardly, inwardly, conically inclined circumferential wall **3**. A bottom wall **4** of the hopper **1** centrally supports an upstanding shaft **5** which in turn carries a plurality of mixer paddle and pressure members such as those shown at **6** and **7**. The paddle member **6** includes a plurality of individual paddles **8**,

shown as four in number. Each of the paddles **8** lies in an angular plane with respect to the axis of shaft **5**, is generally trowel-shaped in planar configuration and includes an aperture such as that shown at **8***a*. The paddle member **7** similarly includes a plurality of individual paddles **9**, shown as four in number. The paddles **9** similarly lie in inclined planes with respect to the axis of shaft **5**. Each of the paddles **9** is generally rectilinear in planar configuration and each includes a plurality of apertures such as that shown at **9***a*. Suitable drive means (not shown) are provided for shaft **5** and paddle members **6** and **7**, said drive means being conveniently mounted, for example, on crossbeam **5***a*.

A portion **4***a* of the bottom wall **4** is upwardly offset as indicated at **10**. As may be best seen in FIGURES 2 and 3, the bottom wall **4** has a centrally positioned, elongated, upwardly arcuate portion, such as that indicated at **11**. The portion **11** is positioned between a set of oppositely curved, paralleling bottom wall portions **12**, **13**, the portions **12**, **13** constituting laterally aligned lowermost portions of the hopper **1**.

A grate or screen **15** extends across the upper open end **2** of the hopper **1** and is supported on four equally spaced supports **16** extending inwardly from the inner surface of the wall **3**.

Positioned beneath and within the upwardly curved center portion **11** of the wall **4** and conveniently extending beyond the hopper wall **3** is a delivery or discharge conduit or tube **17**. The upwardly offset portion **4***a* of the hopper wall terminates above wall portion **11** and discharge tube **17**, to define with its inner edge **4***b* the horizontal upper edge of an opening **10***a*, the side edges of the opening **10***a* being indicated at **20** and **21**, the opening **10***a* thus extending across the hopper bottom portions **12**, **13** and the reception end **17***a* of tube **17**.

Positioned adjacent the hopper **1** is a pump assembly indicated generally by the numeral **25**. The pump assembly **25** includes a pair of parallel, adjacent concreting or pumping members **26**, **27**. Each of the members **26**, **27** includes an hydraulic operating member such as those shown at **28**, **29**. The members **28**, **29** may take the form of the conventional, well known hydraulic cylinder-piston assemblies illustrated and are therefore not shown in detail. Each member **28**, **29**, however, includes a piston rod, such as that shown at **28***a* in FIGURE 3, each of the rods extending into an axially aligned pumping cylinder, such as those indicated at **31**, **32**, the rod of each member **28**, **29** carrying a pumping piston **30** for reciprocation in its associated cylinder **31**, **32**.

A track assembly **35** includes a pair of elongated, parallel angle members **36**, **37** carried by supports indicated genrally at **38**, **39**. The track members **36**, **37** include roller elements **40** mounted for rotation about a horizontal axis and roller elements **41** mounted for rotation about a vertical axis. A rear wear plate **42** is secured to the members **28**, **29** and to cylinders **31**, **32** and extends perpendicularly in opposite directions therefrom. Plate **42** is apertured, as indicated at **43** in FIGURE 3, to provide for extension therethrough of the piston rods of members **28**, **29**. The wear plate **42** rides on rollers **40**, **41**.

A yoke **45** is secured to the cylinders **31**, **32** externally thereof and intermediate their ends. An hydraulic piston and cylinder assembly **46** has an extending rod **47** secured to the yoke **45** for reciprocal movement thereof in a path perpendicular to the path of pistons **30**.

The cylinders **31**, **32** carry at their ends opposite the wear plate **42**, a second plate member **50** which is slidable within track members **51** carrying rollers **52** mounted for rotation about a horizontal axis and rollers **53** mounted for rotation about a vertical axis. Track **51** includes the elongated lower track **51***a* and the track portions **51***b* and **51***c* on opposite sides of hopper **1**. The plate member **50**, which serves the plural functions of a support, a wear plate and a valve means, includes end portions **55**, **56** having smooth, flat forward valving surfaces **57**, **58**. The wear valve plate **50** is, intermediate its surfaces **57**, **58**, apertured as indicated at **60** and **61** in FIGURE 2. It will be observed that the apertures **60**, **61** in plate **50** are coaxial with cylinders **31**, **32** and have a diameter substantially equal to the inner diameter of the tubes **31**, **32** and to the inner diameter of the discharge tube **17**. As may be best seen in FIGURE 2, the curvature of hopper bottom wall portions **12** and **13** is such and the side edges **20**, **21** are so positioned as to align with the lower semi-circular edge of the openings **60**, **61** when said openings are positioned for reception of material from hopper **1**. Similarly, as may be best seen in FIGURE 3, the upper edge of plate **50** rides immediately below the end segment of wall portion **4***a* adjacent edge **4***b* and the limited space, if any, between said edge and said wall portion will be sealed by the concrete in hopper **1**.

Referring now to the form of the invention illustrated in FIGURES 9–12, it will be noted that the hopper **101** is of generally rectilinear planar configuration. A paddle or mixer support shaft **105** extends horizontally across the hopper **101** and is driven by a hydraulic paddle motor **105***a* carried externally on a side wall of hopper **101**. The shaft **105** carries a plurality of paddle members **106**, **107** rotatable through vertical planes, a set of paddles **106**, **107** being positioned on each side of a central rise **111** in the bottom wall of hopper **101**. A top grate **115** is supported in the upper open end of hopper **101** by a hinge **116**. A horizontally disposed discharge tube **117** extends beneath the rise **111** of hopper **101** and a clamp **117***b* secures the tube **117**. The open receiving end **117***a* of tube **117** extends forwardly of a forward vertical wall **104** of hopper **101**.

As may be best seen in FIGURE 12, a curved opening **120** is formed in the wall **104**. A ringlike valve and wear plate lubricator-seal member **110** is secured externally as by bolts **110***a* to the forward wall **104** and surrounds the opening **120** and the open end **117***a* of discharge tube **117**. Tube **110** includes a circular lubricator hose **110***b* having a forwardly disposed opening **110***c* and a connection **110***d* for supply of lubricant to the hose **110***b*.

A set of parallel pumping cylinders **125**, **127**, with which axially aligned hydraulic actuators **128**, **129** are respectively associated, are aligned with hopper **101** and with the opening **120** therein.

Since the elements **125**, **127** and **128**, **129** correspond substantially to the pumping cylinders **25**, **27** and hydraulic actuators **28**, **29** described above, they need not be further described in detail herein. A rotary hydraulic actuator or motor **146** drives a horizontally disposed shaft **147** which is rotatably journaled in supports indicated generally at **147***a*. A supporting joinder plate **147***b* positions the rear portions of the hydraulic actuators **128**, **129** and secures them to shaft **147**. A plate **140** carries on its opposite faces the actuating members **128**, **129** and the pumping cylinders **125**, **127**. The open distal end portions of the pumping cylinders **125**, **127** carry a support-and-wear-plate-valve member **150**. The member **150** comprises a rear support plate **150***a* and a forward wear-and-valve plate member **150***b*. The forward surface of member **150***b* engages the lubricant-seal member **110***b*. The member **150***a* carries a boss **150***c* supportable on an end stub portion of shaft **147**. It will be undestood that the members **150***a*, **150***b* are apertured in alignment with the material delivery or pumping cylinders **125**, **127** in the manner of sliding plate valve **58** and that members **147***b*, **140** and **150** are reciprocally rotatable in an arc with the cylinders **125**, **127** in response to rotation of shaft **147** by rotary actuator **146**.

Access hatches **170** are provided in the bottom wall of hopper **101**, beneath the paddle members on opposite sides of the rise **111**. Hatch handles **171** are provided at the side walls of hopper **101** for actuation of the access and cleanout hatches **170**.

The use and operation of the invention are as follows:

The concrete mix to be conveyed is delivered to the screen **15** at the upper open end of hopper **1**. The openings in screen **15** are of predetermined size capable of retaining undesired items of a greater size. The mix delivered through screen **15** into hopper **1** is further mixed and impelled by the blades of the impeller structures **6, 7** rotating with shaft **5**. Thus the mix is delivered to the lowermost side portions **12, 13** of the hopper **1** under the pressure created by the action of gravity in combination with the action of the impeller **6, 7**.

Referring now to the schematic showing in FIGURES 5–8, it will be observed that the concreting or pumping cylinders **31, 32** are shown in FIGURE 5 with the cylinder **31** aligned with that portion of the opening **10***a* in hopper **1** which is in turn aligned with the lowermost portion **12** of hopper **1**. With cylinder **31** thus aligned, the cylinder **32** is automatically aligned with the discharge or delivery pipe or conduit **17**. In this position the hydraulic cylinder assembly **46** is at the end of its travel in one direction and the piston rod **47** of assembly **46** is at its withdrawn position. The piston **30** in cylinder **31** is at its forwardmost position and the piston **30** in cylinder **32** is at its rearmost position.

Referring now to FIGURE 6, it will be observed that the piston **30** in cylinder **31** has been withdrawn ot its rearmost position, thus drawing a charge of concrete mix from the lowermost portion **12** of hopper **1** into and filling the open area of cylinder **31**. The surface **58** of end portion **56** on plate **50** closes the entirety of the openings **10***a* with the exception of that aligned with the aperture **60** in plate **50**, including, of course, the portion of opening **10***a* which is aligned with the lowermost portion **13** of hopper **1**.

Thus the concrete in hopper **1** is permitted to escape only through the aperture **60** in plate **50** and into cylinder **31** when the parts are shown in the position of FIGURES 5 and 6. No separate valve member and no separate valve-operating means are required, the plate **50** serving as a forward support and wear plate as well as a valve means. The valving surfaces of plate **50** are never subjected to concrete under the pumping pressure of the pistons **30**. Simultaneously with the withdrawal of piston **30** and cylinder **31** the piston **30** in cylinder **32** is moved forwardly to pump or expel concrete from cylinder **32** into and through the delivery conduit **17**, the cylinder **32** having been previously filled with concrete mix as appears hereinbelow.

Referring now to FIGURE 7, it will be observed that the rod **47** of hydraulic piston and cylinder assembliy **46** has been extended to the opposite end of its travel at which point the cylinder **31** is aligned with delivery conduit **17** and the cylinder **32** is aligned with the lowermost hopper portion **13**. With the parts in this position, the surface **57** of plate **50** will close all of the opening **10***a* in hopper **1** except for the aperture **61** in plate **50**. Upon reaching the position shown in FIGURE 7, it will be recalled that cylinder **31** had been previously filled with concrete to be conveyed, and at this point the piston **30** in cylinder **31** is moved forwardly, as appears in FIGURE 8, to pump or discharge the concrete mix from cylinder **31** into and through delivery conduit **17**. Similarly, the piston **30** of cylinder **32**, which had reached its forwardmost position in discharging concrete into pipe **17**, as appears in FIGURE 6, is withdrawn, as appears in FIGURE 8, to draw concrete mix into cylinder **32** from hopper **1** through the aperture **61** in plate **50**.

Following the action illustrated in FIGURE 8, the rod **47** of assembly **46** is again withdrawn into the position shown in FIGURE 5, at which point the sequence above described is repeated, the cylinder **32** having thus filled with concrete preparatory to discharging the same into delivery pipe **17**, as appears in FIGURE 6.

Thus the concrete is never required to turn in the process of its pumping, being acquired in a direct line of travel into cylinders **31, 32** and being delivered in a direct line of travel into and through conduit **17**. Similarly, the diameters of cylinders **31, 32**, openings **60, 61** and conduit **17** being substantially identical, the concrete moves undisturbed by reductions or variances in conduit size.

It will be realized that a source of hydraulic fluid pressure is provided and that suitable sequencing controls are included for directing fluid pressure to the opposite ends of hydraulic cylinder and piston assemblies **28, 29** and **46** in predetermined timed sequence in order to produce the reciprocating action of the rod **47** and the pistons **30** described above. Since conventional, well-known elements may be employed in such hydraulic power source, direction and sequencing, the same are not illustrated or described herein in detail.

Similarly, it will be understood that the invention herein with its source of hydraulic fluid under pressure and the sequencing controls for assemblies **28, 29** and **46** may, because of its simplicity and resulting minimum weight and bulk, be conveniently mounted on a suitable wheeled platform or truck, for mobility. Since the delivery hose (not shown) attached to the discharge outlet end **17***b* of delivery pipe **17** is normally of substantial length, such platform or truck may be positioned at a point remote from the construction site or from the point of final delivery of the concrete mix. The upper open end **2** of hopper **1** is conveniently fed from one or more concrete mix delivery trucks. When simultaneously fed from more than one such truck, the impellers **6, 7** tend to provide a blend of the mixes from such trucks when, on occasion, such mixes vary somewhat from truck to truck.

The device of the invention is capable of emptying the elongated hose attached to the discharge outlet **17***b* of delivery conduit **17** by a mere reversal of the sequencing controls for the assemblies **28, 29** and **46**. In this manner the pistons **30** of cylinders **31, 32** are withdrawn when aligned with conduit **17** to draw concrete remaining in the delivery hose respectively into the cylinders **31, 32**. Similarly, the pistons **30** are moved forward when the cylinders **31, 32** are alternately aligned with hopper portions **12, 13**, respectively. It will be understood that portions **12, 13** could be hinged and opened to deliver the concrete withdrawn from the delivery hose onto the ground beneath hopper **1**. It will be realized that the conveying hose may have a substantial length and that the hose may be raised to substantial height. Consequently, when pumping ceases, a substantial quantity of concrete mix will remain in the conveying hose which can thus be removed from the hose.

While the opening **10***a* is shown herein, it will be understood that the wall **3** could be continued below the indented portion shown at **10** and that circular openings could be provided at lowermost portions **12, 13**, the said openings being positioned for alignment with and having the diameter of the openings **60, 61** in plate **50** and the cylinders **31, 32** without departing from the nature and scope of the invention.

The device of the invention may be easily cleaned by delivery of water, for example, into the upper open end **2** of the hopper **1** promptly after the concrete-transfer operation has been completed and before any concrete remaining within the structure has hardened. The action of the device described above is then carried through, water being pumped by the pistons **30** in cylinders **31, 32** through the entire structure, including the delivery hose attached to the outlet end **17***b* of delivery conduit **17**.

The operation of the form of the invention illustrated in FIGURES 9–12 is similar to that of the form illustrated in FIGURES 1–8. In the form of FIGURES 9–12, however, the pumping cylinders **125, 127** and actuators **128, 129**, along with wear plate and valve member **150***b* are reciprocated in an arc about the axis of shaft **147**, as may be best realized, perhaps, from a view of FIGURE 11. It will be realized that the structure, when in the position illustrated in FIGURE 11, positions the pumping cylin-

der **127** in alignment with discharge tube **117** for discharge of liquid concrete or the like from the cylinder **127** into and through the tube **117**. At this position, also, the pumping cylinder **125** is aligned with that portion of the opening **120** on one side of the rise **111**, as may be seen in dotted lines in FIGURE 12. At this point the cylinder **125** is withdrawing concrete from the hopper **101** and filling itself. When the cylinder **127** has been emptied and the cylinder **125** filled, the pumping structure is rotated through an arc, i.e. to the left as the parts are shown in FIGURE 11, to position the full cylinder **125** in alignment with discharge tube **117** and the empty cylinder **127** in alignment with opening **120** on the opposite side of rise **111**. At this point the operation is, in a sense, reversed in that the cylinder **125** is emptied into discharge tube **117** and the cylinder **127** is filled from the hopper **101**. Thereupon the structure is again moved through its arc into the position shown in FIGURE 11 and the process is repeated.

Paddles **106**, **107** serve to insure proper mixing and also to facilitate complete filling of the pumping cylinders.

It will, of course, be understood that the conventional fluid pressure source, conduits, sequence controls and the like described above are equally usable with the structures of FIGURES 1–8 and 9–12.

While the invention is described herein as effective for the transfer, pumping or conveying of concrete mix and while the invention may find its primary use in the conveying of concrete mixes, it will, of course, be understood that the device of the invention is capable of pumping and conveying materials having some of the properties of concrete mixes. Thus the materials to be conveyed may vary and, whereas there has been shown and described a particular form of the invention, it will be understood that details thereof may be varied without departing from the nature and scope of the invention.

What is claimed:

1. A concrete pumping assembly including an upwardly open hopper, a fixed discharge-delivery tube extending laterally beneath a central portion of said hopper, said hopper having a pair of lowermost portions positioned on opposite sides of said discharge-delivery tube, said discharge-delivery tube and said lowermost portions being open in one direction from said hopper, a valving wear plate having a pair of apertures therethrough and a solid portion, said plate being movable across the aligned open ends of said lowermost portions and said discharge-delivery tube for axial alignment of said plate apertures with said discharge-delivery tube and with one of said lowermost portions, said solid plate portion closing the other of said lowermost portions, a pair of pumping cylinders secured to said wear plate, each of said pumping cylinders having an open end aligned with one of said plate apertures, a pumping piston in each of said cylinders, a pair of hydraulic motors secured to said cylinders, each of said motors being operatively connected to one of said pistons for reciprocation thereof within its associated cylinder, and means for moving said plate, cylinders and motors together alternatively across said lowermost portion and discharge-delivery tube openings and for reciprocating said pistons in opposite alternative directions in timed sequence whereby one of said cylinders is aligned with said discharge-delivery tube and the piston in said cylinder is advanced within said cylinder, the other of said cylinders is aligned with one of said lowermost hopper portion open ends and the piston within said last-named cylinder is withdrawn.

2. The structure of claim **1** characterized by and including a flexible seal member carried by said hopper and surrounding said open ends of said discharge delivery tube and said lowermost portions, said seal member being in continuous sealing contact with said valving wear plate at all positions thereof.

3. The structure of claim **1** wherein said lowermost hopper portions extend beneath said discharge-delivery tube and said plate, cylinders and motors are reciprocated in an arcuate path across the open ends of said discharge-delivery tube and said lowermost portion open ends.

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U.S. Cl. X.R.

103—159, 227; 222—240