Nov. 5, 1957 H. M. WENGER 2,812,055

BARN CLEANING APPARATUS

Filed Sept. 30, 1954 4 Sheets-Sheet 1

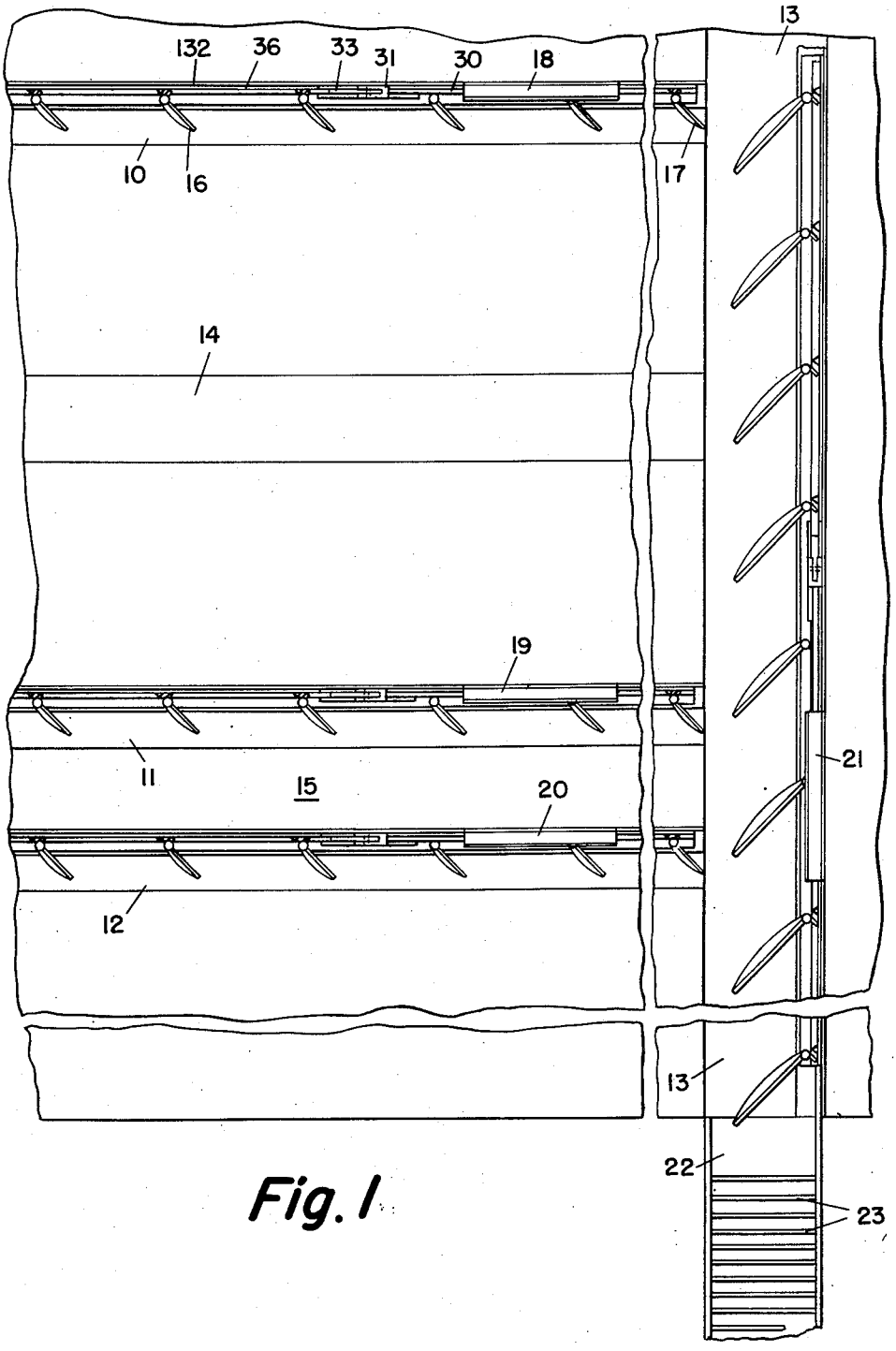


Fig. 1

Nov. 5, 1957 H. M. WENGER 2,812,055

BARN CLEANING APPARATUS

Filed Sept. 30, 1954 4 Sheets-Sheet 2

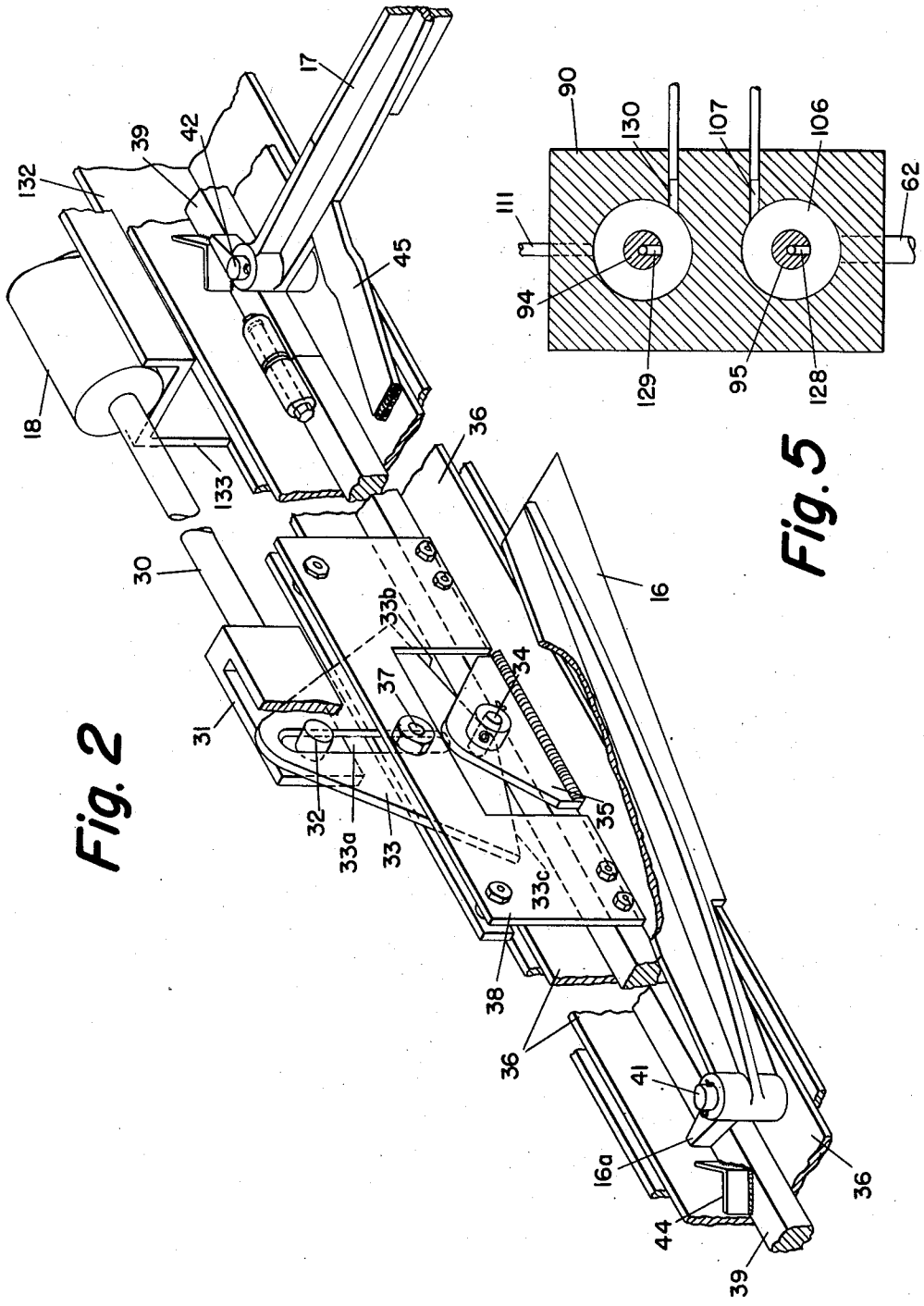


Fig. 2

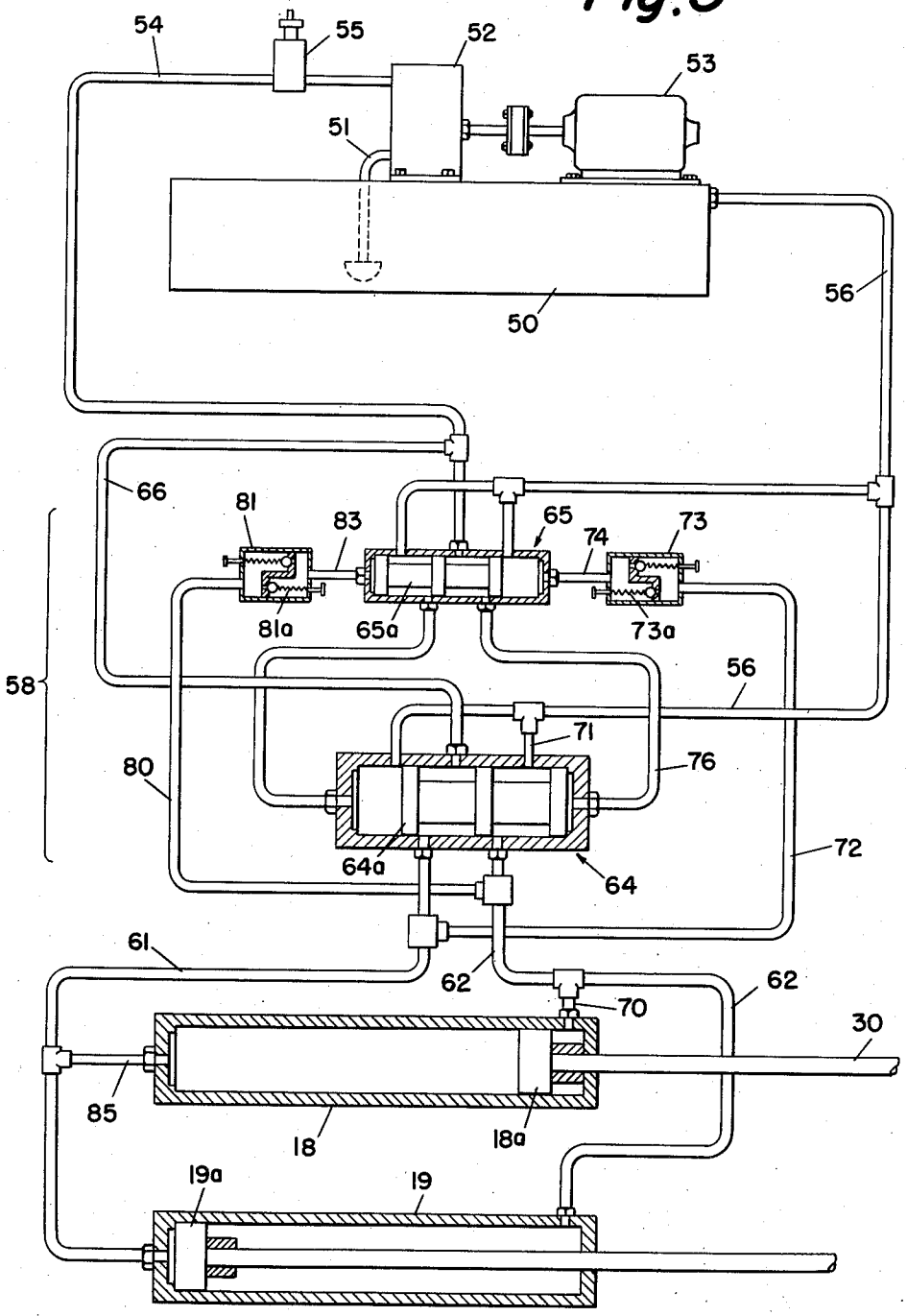
Fig. 5

Nov. 5, 1957 H. M. WENGER 2,812,055

BARN CLEANING APPARATUS

Filed Sept. 30, 1954 4 Sheets-Sheet 3

Fig. 3



Nov. 5, 1957 H. M. WENGER 2,812,055

BARN CLEANING APPARATUS

Filed Sept. 30, 1954 4 Sheets-Sheet 4

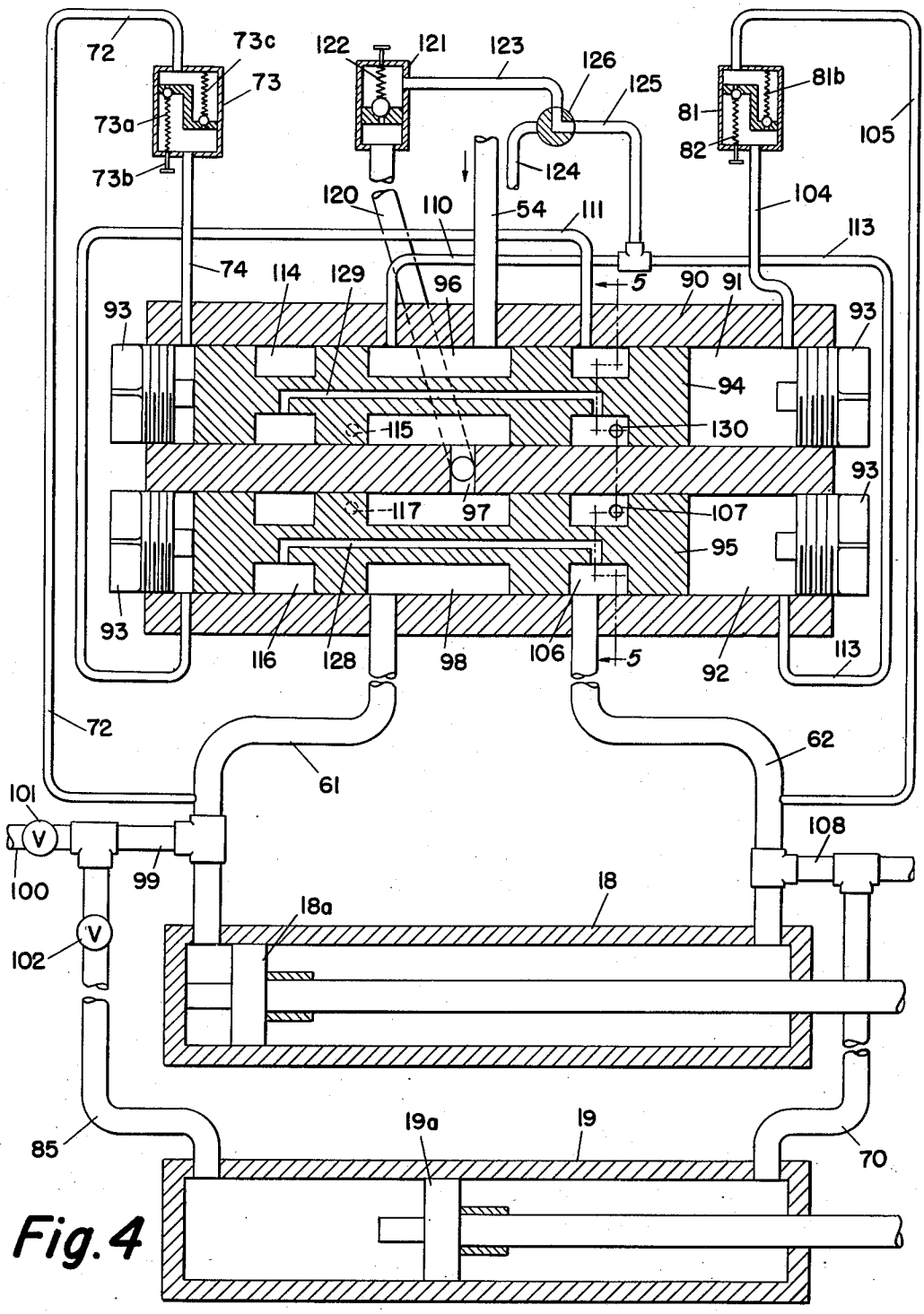


Fig. 4

United States Patent Office

2,812,055

Patented Nov. 5, 1957

2,812,055

BARN CLEANING APPARATUS

Harvey M. Wenger, Terre Hill, Pa.

Application September 30, 1954, Serial No. 459,369

5 Claims. (Cl. 198—224)

This invention relates to barn cleaning apparatus, particularly to the mechanism for operating one or more conveyors, and has for an object the provision of a single hydraulic power unit for successive and automatic operation of hydraulic cylinders respectively associated with each conveyor.

The present application is a continuation-in-part of my application Serial No. 321,555, filed November 20, 1952, and now abandoned and entitled "Barn Cleaning Apparatus."

The present invention includes many of the features of United States Patent No. 2,533,676 dated December 12, 1950. In the apparatus of that patent the driving mechanism was for a time quite similar to that disclosed in United States Patent No. 2,593,470 and comprised a chain 62 by means of which the desired long stroke of the conveyor was accomplished. Such a mechanical driving mechanism is not only expensive, but a separate mechanism is required for each conveyor. In the modern dairy barn there are generally a plurality of rows of stalls for cows, thus necessitating a gutter for each row of stalls, these gutters emptying into a main cross-gutter which extends outwardly of the barn for removal of the litter therefrom.

In accordance with the present invention, only a single electric motor need be utilized to drive a single pump. In accordance with the invention, a single control apparatus is effective automatically to reverse the direction of movement of each of a plurality of pistons, but only after the last hydraulic cylinder has had its piston actuated to complete a conveyor-actuating stroke. More particularly, there is disposed in each of the gutters or troughs a reciprocating bar having pivoted paddles connected thereto. A hydraulically operated piston for each bar is connected thereto for reciprocatory movement thereof. Preferably, the paddles are positively actuated to their litter-moving positions, and thereafter they are bodily transported along the trough or gutter to move the litter toward the main gutter or outwardly of the barn.

The cylinders associated with each gutter are preferably arranged in parallel with respect to the flow of liquid from the pump and from the common control mechanism. Thus the piston associated with the paddle offering the least resistance to movement is first actuated from one limit of the stroke to the opposite limit. Thereafter, the next piston offering the next least resistance to movement is actuated. When the last piston of the group is actuated, a valve responds to the rise in back pressure automatically to transfer the flow to the opposite ends of the pistons whereupon the return stroke is initiated first with one piston and then in turn with the remaining pistons. Additional refinements are provided which will be fully outlined in the more detailed description which follows.

In addition to the foregoing details, and supplemental to the stated objects of the invention, other objects and advantages will appear as there are outlined the further

details of construction and operation in conjunction with the accompanying drawings, in which:

Fig. 1 diagrammatically illustrates a top plan view illustrating the manner in which the invention has been applied to a barn gutter system for cleaning a main gutter into which litter is fed by a plurality of lateral or auxiliary gutters;

Fig. 2 is a perspective view of the paddle flight-actuating mechanism;

Fig. 3 is a diagrammatic illustration of one form of the hydraulic operating system;

Fig. 4 is a cross-sectional view of a preferred form of the control unit, there being diagrammatically shown therewith two of the hydraulic cylinders controlled thereby; and

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Referring now to Fig. 1, there is shown more or less diagrammatically a portion of the floor of a barn or the like which includes litter troughs or gutters **10**, **11** and **12** extending laterally from a main gutter **13** disposed at a somewhat lower level to receive litter from each of the gutters **10**, **11** and **12**. The areas **14** and **15** in general include feeding bins. The cleaning unit of gutter **10** includes a plurality of paddles or flights, two of which, the paddles or flights **16** and **17**, being identified by reference characters. The paddles or flights are actuated by a hydraulic cylinder **18** in manner later to be described. The operation is such that litter from gutter **10** is transported to the main gutter **13**. Operation of the cylinders **18**, **19**, **20** and **21** occurs in succession but not in any given order. The cylinder **21** for the main gutter **13** actuates paddles or flights which may be somewhat longer than those of the laterally extending gutters, though in all other respects the manner of operation will be identical. The actuating member from cylinder **21** is preferably extended to and connected with an overhead type of conveyor **22** which extends outwardly from the barn and is inclined upwardly for discharge of its contents from an opening into a manure spreader or other suitable hopper. The overhead type of conveyor may be of the type shown in United States Patent No. 605,621, dated June 14, 1898, and comprises a plurality of vertically extending flights or paddles **23** pivoted along horizontal axes and functioning in generally similar manner to the paddles or flights associated with each of the above-described gutters or troughs.

For a more detailed understanding of the operation of the flights or paddles **16** and **17**, reference may now be made to Fig. 2 in which it will be observed that an actuating rod **30** from cylinder **18** is connected by the yoke **31** and pin **32** to an actuating plate **33** pivoted at **34** to a triangular shaped member **35** welded to an angle-actuating member **36**. Actuator plate **33** is provided with a slot **33***a* through which extends a pivot pin **37**, this pin likewise extending through a plate **38** suitably secured as by bolts to a rod **39**. The paddles **16** and **17** are mounted on vertically disposed pivots **41** and **42**, the pivots or pivot pins being secured to and carried by the angle-actuating member **36**.

It will now be assumed that hydraulic liquid is applied to the left-hand end of cylinder **18** to move the rod **30** to the right. Through the yoke **31** the actuating plate **33** is rotated about pivot **34** which temporarily will remain stationary. The rotation of plate **33** about the pivot **37** and through plate **38** will move the bar **39** in a right-hand direction as viewed in Fig. 2. As a result of the movement of bar **39** an angle-member **44** will engage an extension **16***a* of paddle **16**. As the bar **39** is moved to the right, the angle-member **44** will positively actuate the paddle **16** for rotation in a clockwise direction and

toward the open position. The right-hand side of Fig. 2 illustrates the bar **39** with its right-hand movement completed and with the paddle **17** in its fully opened position. In that position it abuts against a stop member **45**.

As the paddle **16** is moved to its fully opened position, the inclined lower surface **33***b* of member **33** is moved downwardly against the upper surface of bar **39**. When the two surfaces engage further right-hand movement of piston rod **30** results in movement of the angle-actuating member **36** to which the paddles **16** and **17** are pivotally secured. Thus the stop-members, only one of which, the member **45**, has been illustrated, and the pivot pins **41** and **42** bodily move the paddles **16** and **17** along the trough to move the litter forwardly ahead of them.

After completion of the forward portion of the stroke, the hydraulic fluid to cylinder **18** is reversed and rod **30** is then moved in the left-hand direction to rotate the plate **33** in a counterclockwise direction. When the lower surface **33***c* of plate **33** engages the upper surface of rod **39**, the angle-member **36** and the paddles **16** and **17** are bodily moved to the left. The paddles are then free to rotate in a counterclockwise direction and to the folded positions as illustrated by the position of paddle **16**. Litter in the trough or gutter engaging the back of each paddle assures its movement to the folded position in which it slides under any litter in the gutter in preparation for the next litter-moving action.

In typical installations the stroke in each direction may be as great as six feet, such a long stroke having been quite satisfactory in many installations.

Referring now to Fig. 3, one form of a suitable fluid pressure actuating system comprises a fluid reservoir **50** from which liquid is applied from a suction conduit **51** to a pressure pump **52** operated by an electric motor **53**. Liquid under pressure is thus supplied from the pump **52** by means of a fluid-delivery conduit **54** having a pressure relief valve **55** therein. Fluid or liquid is returned to the tank and pump by a return conduit **56**. The control mechanism **58** includes distributing valves for branch conduits **61** and **62** leading to the hydraulic cylinders, only two of which, **18** and **19**, are shown in Fig. 3. The device identified at **64** may be considered a control or distributing valve, while the device identified by the reference character **65** may be considered a servo-motor for controlling the valve **64**.

With the parts in the position shown, liquid under pressure is supplied by way of relief valve **55** and by way of conduits **54** and **66** to the mid-portion of valve **64**. The liquid then flows through conduit **61** to the left-hand ends of hydraulic cylinders **18** and **19**. The piston **18***a* of cylinder **18** is shown fully actuated to its right-most position, while the piston **19***a* of cylinder **19** is shown in its left-most position. Thus, the piston **18***a* having completed a stroke for its associated paddles remains at standstill, and the piston **19***a* is then moved by the application of the pressure to its right-most position.

As piston **19***a* is moved to the right, liquid is returned from the right-hand side of piston **19***a* by way of conduits **70** and **62** through the right-hand chamber of valve **64** and through conduits **71** and **56** to the supply tank **50**.

Assuming only two hydraulic cylinders, as shown in Fig. 3, as soon as the piston **19***a* is moved to its right-most position, the pump **52** will continue to supply fluid and the pressure will rapidly rise in lines or conduits **54**, **66** and **61**. The rise of pressure in line **61** is applied by way of conduit **72** to the interior of valve casing **73**. When the pressure within the casing exceeds the force developed by the spring **73***a* the ball valve opens for application of the pressure through conduit **74** into the housing of servo-motor **65** for actuation of the control plunger **65***a* to its left-most position. For convenience, the plunger **65***a* is illustrated in its left-most position to show the resultant flow of fluid under pressure by way of conduit **76** to the right-hand end of the control plunger **64***a* of valve **64**. Thus, the plunger **64***a* is positively moved to the left by the application of the full pressure of the pump **52** to the right-hand end thereof.

With the plunger **64***a* in its left-most position, fluid flow from the pump and conduits **54** and **66** is by way of the central chamber of valve **64** and through conduits **62** and **70** to the right-hand ends of hydraulic cylinders **18** and **19**. The one offering the least resistance to movement is first actuated to its left-hand position. Upon the completion of the stroke by the remaining piston, the pressure in lines **70**, **62** and **80** rises and is applied to the interior of valve casing **81**. When the pressure overcomes that of the force of spring **81***a*, the ball valve opens and the fluid pressure is applied through conduit **83** to the left-hand end of control plunger **65***a* to move it to the right. Thus, there is transfer of the pressure from the right-hand end of plunger **64***a* to the left-hand end thereof to move it to the illustrated position to initiate a further stroke of the pistons and associated rods. It may be observed that when the plunger **64***a* is in its left-hand position with the pistons **18***a* and **19***a* moving to the left, the hydraulic fluid is returned by way of conduits **85** and **61**, and **56** to the supply tank **50**.

With the foregoing understanding of the principles of the hydraulic system, reference will now be had to Figs. 4 and 5 where a preferred form of that mechanism has been illustrated. The mechanism as a whole is characterized by its one-piece construction. A single block **90** of steel or the like is drilled to form cylinders **91** and **92**, the cylinders being closed by suitable end plugs **93**. The spools **94** and **95** in general correspond with spools **65***a* and **64***a* of the modification of Fig. 3, but each of spools or control plungers **94** and **95** include four lands instead of the three illustrated in Fig. 3.

The construction will best be understood in terms of operation of the system. Assuming the application of liquid pressure by way of conduit **54** from the pump, the flow is by way of the central chamber **96**, the passage **97**, a second central chamber **98** associated with spool **95**, and by way of conduit **61** to the left-hand end of the hydraulic cylinder **18**. A line **85** is shown extending to the other hydraulic cylinder **19** as from a branch line **99**. A second branch line **100** is illustrative of additional lines which may be provided for any desired number of cylinders for operating a multiplicity of gutter cleaners. The branch lines will preferably include valves **101** and **102** for selective operation of the associated hydraulic cylinders. As illustrated, it will be seen that the piston **19***a* is being moved to the right in preference to movement of piston **18***a*. When both pistons have been moved to their extreme right-hand positions, the pressure rises in conduit **61**, the rise in pressure being transmitted by way of conduit **72** to the valve casing **73** to operate the ball valve against the bias of the spring **73***a*. It will be observed that this spring can be adjusted as by the adjusting member **73***b* to predetermine the pressure required for the opening of the valve. The spring **73***a* may be a relatively strong one as compared with the spring **73***c* which maintains normally closed the other ball valve. The size or strength of spring **73***a* is such that adequate pressure is developed on each piston to assure operation thereof from one extreme position to the other.

As soon as the ball valve is operated against the pressure of spring **73***a*, fluid under pressure is admitted by conduit **74** against the left-hand end of spool **94** to move it to the right. As spool **94** moves to the right, liquid is displaced through conduit **104**, the ball valve opening against the bias of spring **81***b* within the valve housing **81**, the liquid then flowing by way of conduit **105** and into conduit **62**. The flow of liquid is then into the chamber **106** and outwardly through an opening **107** flow-connected to the supply tank **50**, shown in Fig. 3 but omitted in Fig. 4. It may here be observed that as pistons **18***a* and **19***a* are moved to the right, there is return flow

of liquid through conduit **70**, branch line **108** and conduit **62** to the chamber **106** and thence by opening **107** to the supply tank.

As soon as the pressure is applied to the left-hand end of spool **94**, it is, of course, moved to its right-hand position and against the end of block **93**. There is transfer of pressure from the conduit **110** which leads to the right-hand end of spool **95** to a conduit **111** which leads to the left-hand end of spool **95**. Thus the spool or controlling plunger **95** is immediately actuated to its right-hand position, the liquid at the right-hand end thereof being returned by way of line **113** to the left-hand chamber **114** of spool **94** and outwardly therefrom through the opening **115** and thence to the supply tank. Flow is thereby transferred from the central chamber **98** from conduit **61** to conduit **62** for return movement of the pistons **18***a* and **19***a*, with return flow of liquid through conduits **85**, **99** and **61** through the left-hand chamber **116** of spool **95** and outwardly through opening **117** and thence to the supply tank.

The action on all parts is positive and fairly rapid. Thus when the last piston to be moved arrives at a limit of its movement a surge of back pressure frequently causes hydraulic "hammer" or a fairly loud noise in the pipes. In order to avoid the hydraulic "hammer" a fluid-connection is made as by way of conduit **120** to the interior of valve casing **121**. The valve is opened against the bias of a strong spring **122** permitting a small amount of the liquid to pass by way of conduit **123** either to the storage tank by conduit **124** or to a conduit **125**, depending upon how the two-way valve **126** is set. It has been found that the pressure relief valve **121** will avoid completely the hydraulic "hammer" and the objectionable noise and shock resulting therefrom.

In accordance with a further aspect of the invention, the valve **126** may be turned to admit liquid to conduit **125** which, it will be observed, is flow-connected to the conduit **113**. The reason for the foregoing connection is to provide "fool proof" operation and to provide assurance against a possible condition in which both of the spools or control plungers **94** and **95** might accidentally occupy positions mid-way of the bores or cylinders **91** and **92**. If such cylinders were to be in their exact mid-positions, the system would be on "dead-center," or would occupy positions in which the system would temporarily be inoperative. Even without the flow-connection, however, the starting and stopping of the pump-motor is generally adequate to produce a slight shift of one or the other of the spools to reestablish normal operation. The accidental displacement of the spools to "dead-center" has rarely occurred, and the connection through conduit **125** provides extra assurance that such occasional difficulty will never arise. By providing the return connection, an abnormal rise in pressure within the central chambers would be transmitted by way of conduit **120**, valve **121**, conduit **123**, valve **126** and conduits **125** and **113** to move the spool **95** to the left and thus assure its movement from any "dead-center" position. Thereafter, normal operation will be resumed.

To avoid a further difficulty sometimes experienced, it is to be observed the plungers have axially extending passages flow-connected with the flow chambers at the extreme ends thereof. For example, the flow passage **128** connects the chambers **106** and **116** and for the following purpose. Should liquid leak past the land of plunger or spool **95** into chamber **116** and should then leak past the end-land or piston-like structure into the end-zone, a pressure would be developed which would move the spool to the right. Such an operation cannot occur since any leakage into chamber **116** will be removed by way of passage **128**, the flow being directly into chamber **106** and outwardly through the passage **107** to the supply tank. The passage **129** performs the same function for the spool **94** with an outlet passage **130** being provided for the return flow to the storage tank.

In brief summary, the present invention lends itself to the most complex installations of gutter cleaners, each of the hydraulic operators including cylinders and pistons being operated one after the other to actuate the flights or blades to move the litter along each associated trough or gutter and from the main gutter **13**, Fig. 1, outwardly of the barn through the inclined elevated portion of the conveyor labeled **22**. The several hydraulic actuators **18**, **19**, **20** and **21** will be operated in succession though in the order in which resistance to movement is less, the one with the least opposition to movement operating first, and the one with the greatest opposition to movement being the last to function. Ordinarily, this would be the hydraulic actuator **21** which upon completion of its stroke and the continued action of the pump causes the pressure in the responsive device **73** to rise and operate the control mechanism to reverse the fluid flow to all of the hydraulic actuators.

By utilizing hydralic actuators, each hydraulic cylinder and piston can be made as long as desired, six to eight feet by way of example. They are relatively small in diameter and lend themselves to direct attachment on the supporting angle **132** which itself is bolted or otherwise secured to the sides of the concrete gutter trough. For example, as shown in Fig. 2, the cylinder **18** rests upon an angle **133** welded to the top surface of the supporting angle **132**. The right-hand end of cylinder **18**, not shown in Fig. 2, terminates in a clevis similar to the clevis or yoke **31** and is bolted to a stationary member also welded to the frame **132**.

What is claimed is:

1. A barn cleaning apparatus comprising a plurality of troughs, a reciprocating bar having pivoted paddles disposed in each said trough, a hydraulically operated piston for each said bar connected thereto for reciprocatory movement thereof, means including lines for respectively applying hydraulic fluid under pressure to each opposite sides of said piston, a cylinder for each said piston, said means including flow connections and valves for controlling flow of the hydraulic fluid selectively first to one of said lines and then to the other of said lines for application of pressure first to one end of each of said cylinders and then to the other end of each of said cylinders, and pressure-responsive valves included in said flow connections operable in response to a rise in pressure in lines due to the movement of all of said pistons to one end of their respective strokes for transferring the flow of hydraulic fluid to reverse the movement of said pistons.

2. In combination with a hydraulic operator including a cylinder and a piston mounted therein for reciprocation, lines connected to each end of said cylinder for flow of hydraulic liquid thereto and therefrom, control means for said piston comprising supporting structure having a pair of bores, plungers disposed in each of said bores, said plungers having three reentrant portions forming chambers spaced laterally one from the other, said supporting structure having a passageway interconnecting the intermediate chambers with said plungers in any position in said bores, each of said plungers having a fluid passageway interconnecting the chambers at opposite ends thereof, said supporting structure having openings which with said plungers in one limiting position in said bores communicate with the chambers at corresponding ends of said plungers and having openings which communicate with the chambers at the opposite ends of said plungers when they are in the other limiting position in said bores for preventing rise of pressure at the respective ends of said plungers upon occurrence of leakage from said central chamber toward the end chambers, said fluid connections to opposite ends of said cylinder extending through said supporting structure and positioned relative to one of said plungers for transfer of the flow connections from said central chamber to one of said fluid connections with the plunger in one limiting position and to the other of said fluid connections with the plunger in

the other of its limiting positions, means operable upon rise of liquid pressure above that normally required to move said piston for admitting fluid to the end portion of one of said plungers for positive actuation thereof from one limiting position to the other limiting position, and a fluid connection opened by said last-named movement of said plunger for admitting fluid under pressure to move the other of said plungers from one of its limiting positions to the other limiting position.

3. The combination set forth in claim 2 in which there is a fluid connection to said central chamber, a pressure relief valve normally closing said fluid connection and operable upon pressure surges to prevent hydraulic hammer in the system.

4. The combination set forth in claim 2 in which said pressure-responsive means includes a valve biased to the closed position and operable upon actuation of said plungers for flow of liquid from said bores.

5. The combination set forth in claim 2 in which a plurality of cylinders and pistons are connected in parallel to said fluid connections, said pistons being operable one after the other from one limit of movement to the other limit of movement within their respective cylinders, said pressure-responsive valve responding to a rise of hydraulic pressure only after the last piston to be moved from one limiting position to the other limiting position to reverse said fluid connections for operation of said pistons in their opposite directions to the respective limits of their movements.

References Cited in the file of this patent

UNITED STATES PATENTS

1,952,690	Strom	Mar. 22, 1934
2,446,611	Rose	Aug. 10, 1948
2,593,340	Petraske	Apr. 15, 1952
2,675,121	Miller	Apr. 13, 1954
2,698,517	Witt	Jan. 4, 1955

FOREIGN PATENTS

640,642	Great Britain	July 26, 1950
992,359	France	July 11, 1951