Jan. 23, 1951 H. R. FORSMARK 2,539,241

PILOT CONTROLLED DISTRIBUTING VALVE

Filed Oct. 17, 1947 2 Sheets-Sheet 1

Fig. 1.

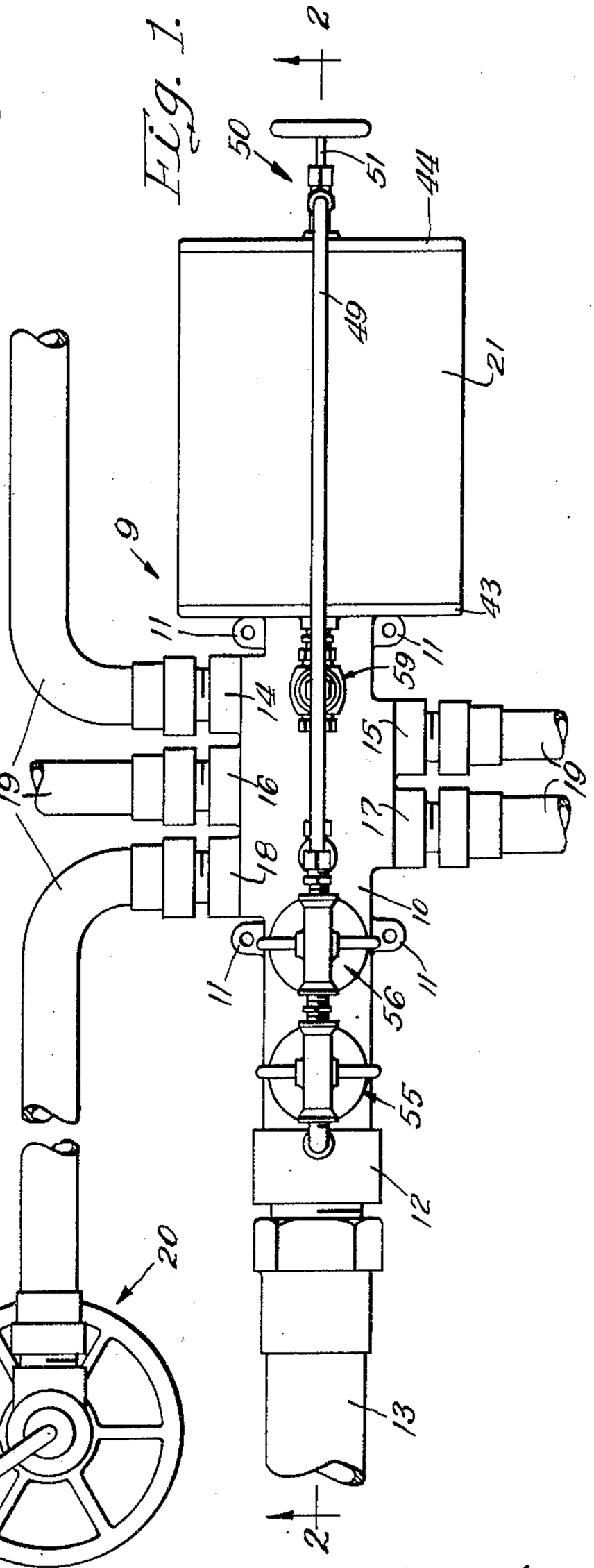
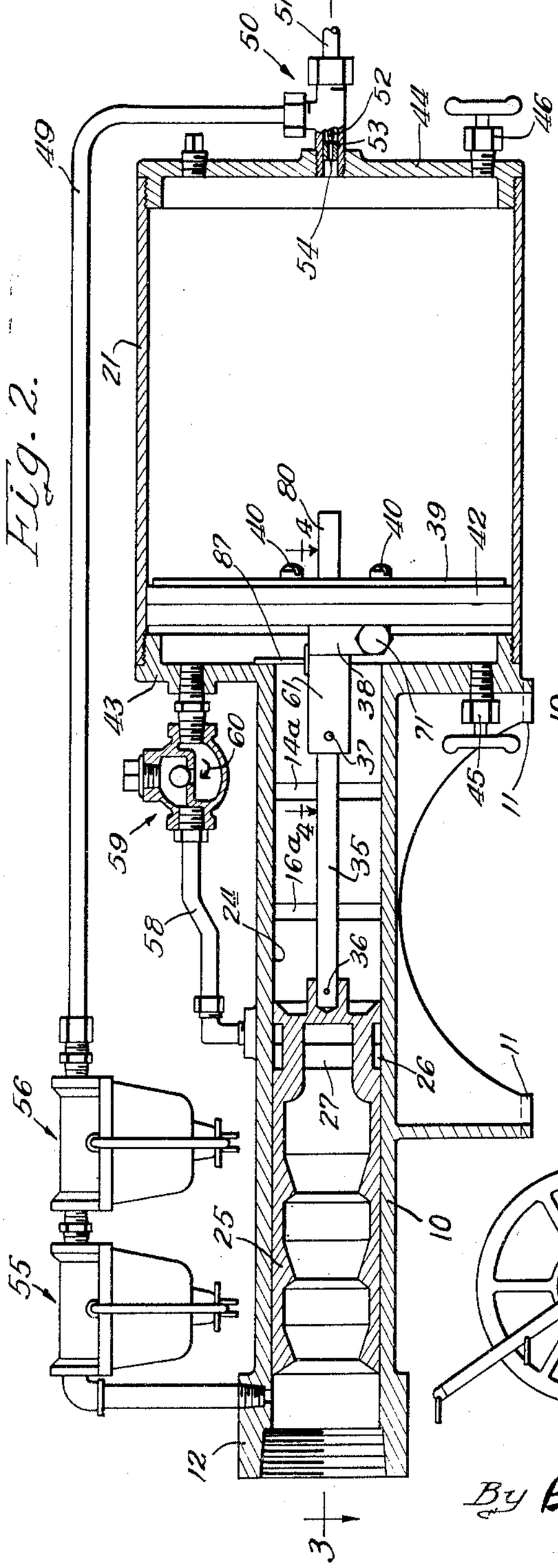


Fig. 2.



Inventor:
Harold R. Forsmark
By Brown, Jackson, Boettcher & Dienner Atty's.

Jan. 23, 1951 H. R. FORSMARK 2,539,241

PILOT CONTROLLED DISTRIBUTING VALVE

Filed Oct. 17, 1947 2 Sheets-Sheet 2

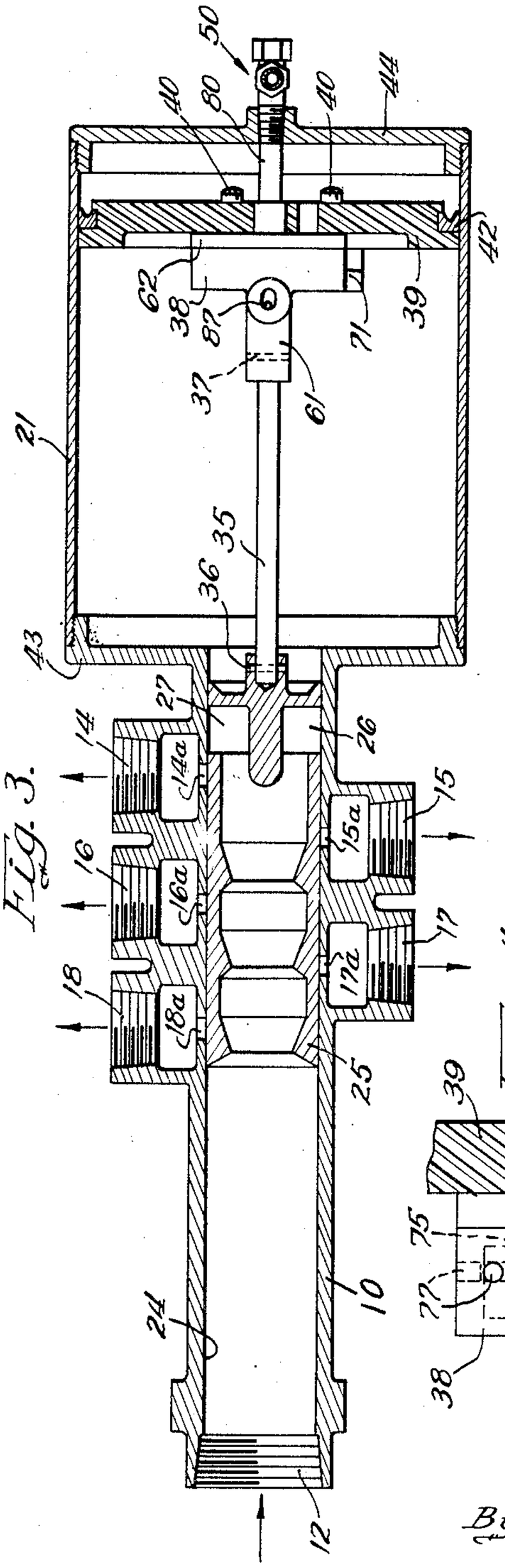


Fig. 3.

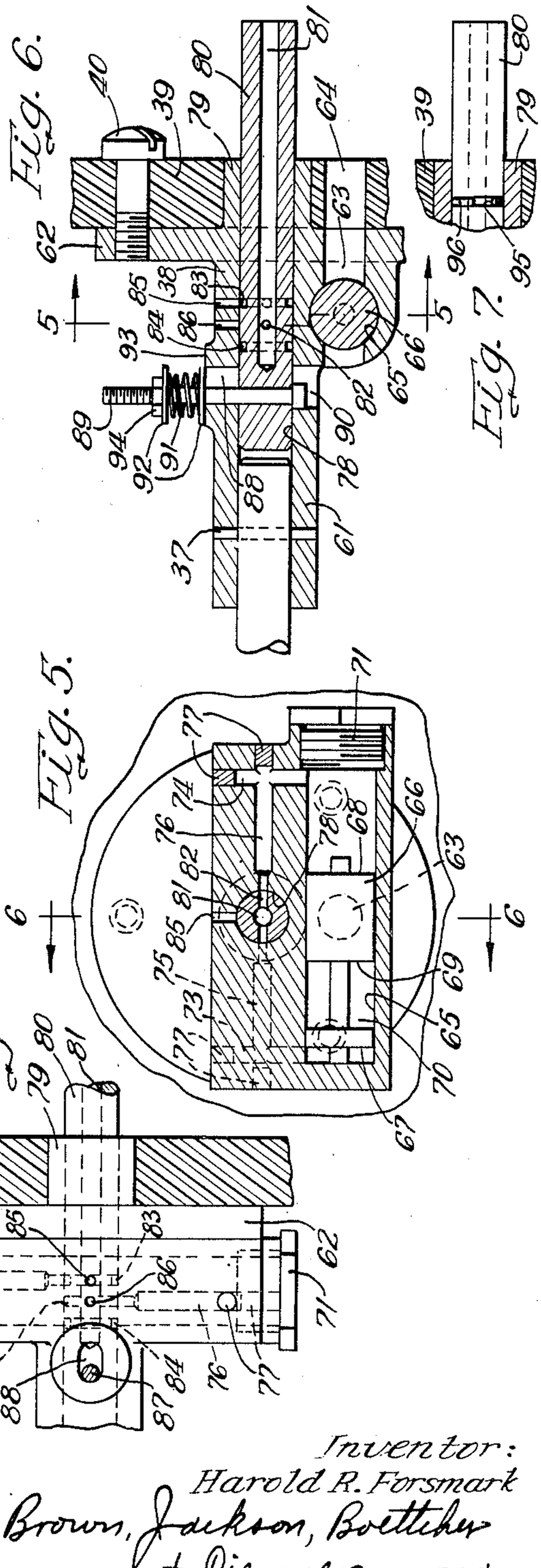


Fig. 6.

Fig. 7.

Fig. 5.

Fig. 4.

Inventor:
Harold R. Forsmark
By Brown, Jackson, Boettcher
& Dienner Atty's.

Patented Jan. 23, 1951

2,539,241

UNITED STATES PATENT OFFICE

2,539,241

PILOT CONTROLLED DISTRIBUTING VALVE

Harold R. Forsmark, Chicago, Ill., assignor to Stiger Precision Products, Inc., Chicago, Ill., a corporation of Illinois

Application October 17, 1947, Serial No. 780,483

4 Claims. (Cl. 121—157)

1

This invention relates, generally, to automatic water distributors and it has particular relation to the mechanism which controls the reciprocation of the power piston which operates the water distributor. This invention constitutes an improvement over the invention disclosed in copending application Serial No. 750,577, filed May 26, 1947 and now abandoned, and assigned to the assignee of this application. While this invention is described particularly in conjunction with automatic water distribution means, it will be understood that it can be employed for the distribution of other liquids or for the distribution of water in other applications than for lawn sprinkling and the like.

In the copending application above referred to a passageway is provided through the power piston which operates the water distributing means which passageway is arranged to be closed by a valve when the power piston moves forwardly. This valve is arranged to be opened to equalize the pressure on opposite sides of the power piston in order to permit its being returned for repeating the distribution cycle. The valve is operated to its final open or closed position by a spring toggle mechanism that is controlled in accordance with the movement of the power piston. This arrangement requires that there be sufficient pressure available for operating the spring toggle mechanism to and past the over center position. In some localities the water pressure may not be sufficiently high to effect this operation satisfactorily under all operating conditions. Moreover, while the spring toggle mechanism is satisfactory for many applications, it requires a number of parts which tend to increase the manufacturing cost of the apparatus and to increase the cost of its maintenance.

Accordingly, among the objects of this invention are: To provide for operating a reversing valve in an automatic water distributor solely by the water pressure without requiring the use of a spring mechanism or its equivalent for effecting the final movement of the valve; to initiate the operation of the reversing valve by contact with the ends of the cylinder in which the power piston, on which it is mounted, reciprocates; to relieve the back pressure on the side of the valve operating mechanism opposite the side to which pressure is applied for operating the same; to insure that the reversing valve is operated from one position to the other once the control mechanism therefor has been operated; to hold the control mechanism in a position to which it is operated until it is acted upon at the ends of

2

the strokes of the power piston; and to reduce to a minimum the number of parts required for the reversing valve.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiment thereof as shown in the accompanying drawings and it comprises the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference can be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a top plan view of a water distributor in which this invention is embodied;

Figure 2 is a detail sectional view taken generally along the line **2—2** of Figure 1, certain parts being shown in elevation;

Figure 3 is a longitudinal sectional view taken along the line **3—3** of Figure 2;

Figure 4 is a detail sectional view, at an enlarged scale, taken along the line **4—4** of Figure 2;

Figure 5 is a detail sectional view taken along the line **5—5** of Figure 6;

Figure 6 is a detail sectional view taken along the line **6—6** of Figure 5 and shows the reversing valve mechanism illustrated in Figures 2, 3 and 4, with a modification for holding the operating rod in either position to which it may be moved at the ends of the strokes of the power piston; and

Figure 7 is a detail fragmentary sectional view of a modified form of holding means for the operating rod.

Referring now particularly to Figure 1 of the drawings, it will be observed that the reference character **9** designates, generally, an automatic water distributor constructed in accordance with the present invention. The water distributor **9** includes a housing **10** that may be a bronze casting having integrally formed apertured feet **11** to facilitate mounting the same on a suitable foundation. The housing **10** is provided with an inlet **12** for connection to a suitable water supply under pressure, such as might be provided through a rubber hose **13** under normal city water pressure conditions. The housing **10** also may be provided with outlets **14** through **18** to which conduits **19**, such as rubber hoses or the like,

can be connected for supplying water to various individual water distributors, such as the sprinkler 20 which may be of the self-rotating type as will be understood readily. At the right hand end of the housing 10 there is positioned a power cylinder 21, the diameter of which is substantially greater than the diameter of the housing 10.

Referring now particularly to Figures 2 and 3 of the drawings, it will be noted that the housing 10 has a cylindrical opening 24 extending therethrough and registering with the inlet 12. A hollow piston 25, preferably formed of brass, is slidably mounted within the cylindrical opening 24 and it has a circumferential groove 26 and transverse openings 27 at the right-hand end for registering with ports 14*a* through 18*a* corresponding, respectively, to the outlets 14 through 18, previously referred to.

As will appear hereinafter, the piston 25 is moved by the pressure of the water quickly from left to right during the return stroke in order to again begin the distribution cycle. It is moved slowly from right to left by means which will be described presently.

It will be understood that the water which is received through the inlet 12 flows through the hollow piston 25, and as the transverse opening 28 therein moves into and out of registry with the ports 14*a* through 18*a*, the water is correspondingly permitted to flow through the outlets 14 through 18. Movement of the piston 25 during the return stroke from left to right is relatively fast as indicated. Its movement during the forward stroke from right to left is relatively slow.

In order to move the hollow piston 25 through its distribution stroke a connecting rod 35 is connected thereto at one end by a suitable pin 36. The connecting rod 35 is formed preferably of brass. It may be connected at its other end by a pin 37 to a tubular extension of a brass valve housing 38 which, as illustrated, is mounted on a power piston 39 and secured thereto by bolts 40. The power piston 39 is formed preferably of a phenolic condensation product and a piston ring 42 of rubber or synthetic rubber is provided around its periphery and has a liquid tight fit with the inside of the power cylinder 21.

The power cylinder 21, which may be formed of a brass tube, is threaded, as shown, at the left hand end onto an integrally formed flange 43 at the right hand end of the housing 10. A bronze cover or end plate 44 is threaded into the right hand end of the cylinder 21. Drain valves 45 and 46 are located, as shown in Figure 2, in the flange 43 and the cover or end plate 44 to permit draining of the cylinder 21 on opposite sides of the power piston 39.

The power piston 39 is moved during the forward or distribution stroke by liquid pressure applied to the right hand side thereof through a conduit 49 from the inlet 12. The rate at which a liquid, such as water, flows through the conduit 49 is controlled by a needle valve that is indicated, generally, at 50 and threaded centrally into the cover or end plate 44. The needle valve 50 comprises a stem 51 that can be rotated manually and it carries at its inner end a needle 52 that interfits with a brass needle valve seat 53 and controls the effective area of an orifice 54 therein.

With a view to preventing clogging of the orifice 54 as controlled by the needle 52, a screen filter 55 and a felt filter 56 are provided in series in the conduit 49 for removing from the liquid

flowing therethrough any foreign particles. Since the filters 55 and 56 are of conventional construction, the details thereof will not be set forth herein.

It will be understood that the power cylinder is filled with liquid on both sides of the power piston 39. As it is moved to the left, through the distribution stroke, it is necessary to permit the liquid to the left of the power piston to escape. For this purpose a conduit 58 is provided between the flange 43 and the housing 10 as shown. A ball check valve indicated, generally, at 59, is provided in the conduit 58 to permit the flow of liquid therethrough only in the direction indicated by the arrow 60. As the power piston 39 moves to the left during the forward or distribution stroke, the space to its left in the power cylinder 21 is successively placed in communication with the various ports 14*a* through 18*a*. It is during the times that such communication is not provided that it is necessary to employ the conduit 58 to relieve the pressure within the power cylinder 21 to the left of the power piston 39.

As indicated hereinbefore, the brass valve housing 38 is mounted and moves with the power piston 39. Mechanically it is a part of the piston 39 and elements described as being mounted on the valve housing 38 can be considered also as being mounted on the power piston 39.

It is necessary to equalize the pressure on opposite sides of the power piston 39 when it is moved to the right during the return stroke as impelled by pressure applied to the piston 25 in the housing 10. Also it is necessary to permit pressure to build up against the right hand side of the power piston 39 in order to move it to the left during the distribution stroke. For this purpose a reversing valve mechanism is provided within the valve housing 38 which will now be described.

As shown, the valve housing 38 has a rearwardly extending cylindrical extension 61 within which the connecting rod 35 is held by the pin 37. The housing 38 also has an integrally formed circular flange 62 which engages the rear side of the power piston 39 and into which the bolts 40 are threaded for holding the same to operate as a single unit.

As shown more clearly in Figure 6, the valve housing 38 has a passageway 63 extending therethrough which registers with a passageway 64 in the power piston 39. These passageways provide communication between the front and rear sides of the power piston 39 in order to equalize the pressure on these sides when the power piston 39 is moved through the reverse stroke from left to right. A valve mechanism operated solely under the control of the pressure in the power cylinder 21 is provided for controlling the opening or closing of the passageways 63 and 64. It will be noted that the passageway 63 intersects a transversely extending cylinder or cylindrical opening 65 in the valve housing 38. Within the cylinder 65 a control piston 66 is slidably mounted.

The control piston 66 is illustrated more clearly in Figure 5. As will appear hereinafter, pressure is applied to one or the other of its end faces 67 or 68 for operating the control piston 66 in the cylinder 65 from one extreme position to the other. The control piston 66 is illustrated in Figure 5 in the position in which the passageway 63 is closed in order to permit building up of pressure against the front side of the power piston 39 to permit it to move the hollow piston

25 slowly from right to left in order to accomplish the desired water distribution. The central portion 69 of the control piston 66 forms a valve member together with the portion which closes off the passageway 63. An annular groove 70 is provided in the control piston 66 to permit communication through the passageways 63 and 64 for equalizing pressure on opposite sides of the power piston 39. It wil be noted that the control piston 66 also constitutes a valve member for controlling the opening or closing of the passageway 63. However, if desired, separate elements can be provided for the control piston 66 and valve member 69 with a suitable mechanical interconnection therebetween. A threaded plug 71, Figure 5, may be employed for closing one end of the cylinder 65 which preferably is formed by drilling through the opening that is closed by the plug 71.

Communication with opposite ends of the cylinder 65 is provided by the vertical ports 73 and 74, Figure 5, which intersect with horizontal ports 75 and 76. These ports are formed preferably by drilling and may be closed by suitable plugs 77. The horizontal ports 75 and 76 communicate at their inner ends with an axial opening 78 in the valve housing 38 which extends through a cylindrical extension 79 that projects through the power piston 39 as shown more clearly in Figure 6.

Slidably mounted within the axial opening 78 is a rod 80 that preferably is formed of stainless steel. The rod 80 has a longitudinally extending aperture 81 which opens into the power cylinder 21 on the right hand side of the power piston 39 and at its other end is intersected by a transverse aperture 82 which is arranged to be placed in communication with one or the other of the horizontal ports 75 or 76 depending upon the position of the rod 80. Pressure for operating the control piston 66 from one position to the other is applied through the longitudinal aperture 81 in the rod 80 and the transverse aperture 82 to one or the other of the horizontal ports 75 or 76. Depending upon the position of the rod 80, this pressure is applied either to the face 67 or the face 68 of the control piston 66. It is necessary to relieve the other face 68 or 67 of pressure and for this purpose annular grooves 83 and 84, Figure 6, are provided in the rod 80 which are arranged to register with the horizontal ports 75 and 76 respectively on appropriate positioning of the rod 80. In addition exhaust ports 85 and 86 are located in the valve housing 38 with which the annular grooves 83 and 84, respectively, can register.

It will be understood that, when the power piston 39 is moved from left to right by the application of pressure to the hollow piston 25, the projecting end of the rod 80 engages the end plate 44 so that the rod 80 is moved from its outermost position to the inner position which is shown in Figure 6. As will be described presently, pressure is then applied to the face 68 of the control piston 66 for operating the same to the position shown in Figure 5.

At the other end of its stroke the power piston 39 approaches the flange 43 of the housing 10. At this time it is desirable to move the rod 80 to its outermost position. For this purpose an operating arm 87, Figures 3 and 4, may be provided in the form of a pin which intersects the rod 80. The arm 87 extends through a slot 88 in the housing 38 and is arranged to engage the

inner surface of the flange 43 while the power piston 39 continues to move to the left.

Where it is desired to make certain that the rod 80 is not moved except at the ends of the forward and reverse strokes of the power piston 39, the construction shown in Figure 6 can be used. Here a bolt 89 extends through the rod 80 in lieu of the operating arm 87 previously described. The movement of the bolt 89 is limited by the slot 88 in the upper side of the extension 61 and by a corresponding slot 90 on the under side. A coil compression spring 91 acts between a pair of washers 92 the lower of which bears against a flat surface 93 on a boss formed on the upper side of the cylindrical extension 61. A nut 94 threaded on the bolt 89 serves to adjust the tension of the spring 91. The friction between the lower washer 92 and the flat surface 93 is sufficient to hold the rod 80 in either of its extreme positions until it is acted upon at the ends of the strokes of the power piston 39.

In Figure 7 there is illustrated an alternate form of friction device for holding the rod 80 in either of its extreme positions. This construction contemplates the use of the operating arm 87 without the spring 91 as shown in Figure 6. In this modified construction the rod 80 is provided with an annular groove 95 within which is located a C-shaped snap ring 96. The groove 95 is cut sufficiently deep so that the snap ring 96 can be compressed below the surface of the rod 80 to permit assembly of the same in the housing 38 and slidable movement thereof within the axial opening 78. In expanding the snap ring 96 provides sufficient frictional drag on the inner surface of the extension 79 to hold the rod 80 in either position to which it is operated.

In describing the operation of the automatic water distributor 9, it will be assumed that suitable water pressure is applied through the inlet 12 and that the power piston 39 occupies the position shown in Figure 3. In this position the longitudinally extending aperture 81 in the rod 80 registers with the orifice 54 of the needle valve 50. The velocity pressure of the water flowing through the conduit 49 is sufficient to apply an operating pressure through the aperture 81, transverse aperture 82 and ports 76 and 74 to the face 68 of the control piston 66. The control piston, which previously had been at the right hand end of the cylinder 65 as viewed in Figure 5, is promptly moved to the position there shown to permit the valve portion 69 thereof to close off the passageway 63. The back pressure otherwise applied to the end face 67 of the control piston 66 is relieved through the ports 73 and 75, annular groove 83 and exhaust port 85. Since the passageway 63 now is closed, pressure is allowed to build up against the right hand side of the power piston 39 and it is moved to the left slowly at a speed which depends upon the setting of the needle valve 50. As the transverse opening 27 in the hollow piston 25 is moved past the ports 14*a* through 18*a*, the water is distributed among the various hoses 19 as will be understood.

When the power piston 39 approaches the left hand end of the power cylinder 21, the operating arm 87 or the bolt 89 engages the inner surface of the flange 43 and prevents further movement of the pin 89 while the power piston 39 continues to move through the extent permitted by the slot 88 or the slot 88 and the slot 90 as the case may be. At this time since the control piston 66 is in such position that the passageway 63 is closed

by the valve member 69, there is a substantial differential in pressure on the opposite sides of the power piston 39, the higher pressure being applied to the front or right hand side of the piston 39 as viewed in Figure 3. This pressure is applied through the aperture 81 in the rod 80, transverse aperture 82 and ports 75 and 73 to the face 67 of the control piston 66. The control piston 66 thereupon is operated from the position shown in Figure 5 to the opposite end of the cylinder 65 and the valve member 69 uncovers the passageway 63, thereby equalizing the pressure on opposite sides of the power piston 39. The pressure otherwise applied to the other face 68 of the control piston 66 is relieved through the ports 74 and 76, annular groove 84 and exhaust port 86. Since the pressure is equalized on opposite sides of the power piston 39, the pressure applied to the hollow piston 25 is sufficient to move it and the power piston 39 quickly to the opposite end of the water distributor 9 whereupon the rod 80 is moved to the alternate position as described and the cycle is repeated.

Since certain further changes can be made in the foregoing construction and different embodiments of the invention can be made without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a device of the class described, in combination, a power piston having a passageway therethrough, a valve carried by said power piston for opening and closing said passageway; and operating means for said valve including a cylinder carried by said power piston and having ports near its ends, a control piston slidable in said cylinder for moving said valve, a rod slidably mounted on said power piston having a longitudinally extending aperture opening at one end into said power cylinder on the front side of said power piston and at the other end communicating with one or the other of said ports depending upon the position of said rod, said rod also having passageways for placing said other or said one port in communication with the rear side of said power piston to relieve the pressure on the corresponding side of said control piston, and means for moving said rod from one position to the other at the ends of the strokes of said power piston.

2. In a device of the class described, in combination, a power piston having a passageway therethrough, a housing carried by said power piston on its rear side having a passageway communicating with said passageway in said power piston, a cylinder in said housing intersecting said passageway therein, a control piston slidable in said cylinder and having a transverse opening for registering with said passageway in said housing when said control piston is at one end of its cylinder, said control piston closing off said passageway when it is at the other end of its cylinder, ports in said housing communicating between the ends of said cylinder and an opening extending through said housing and said power piston, the intersections of said ports and said opening being spaced longitudinally, a rod slidably mounted in said opening having a longitudinally extending aperture opening at one end into said power cylinder on the front side of said power piston and at the other end into one or the other of said ports depending upon the position of said rod, exhaust ports in said housing corresponding to said ports, said rod having passageways for placing one or the other of said ports in communication with the corresponding exhaust port depending upon the position of said rod, and means for moving said rod from one position to the other at the ends of the strokes of said power piston.

3. The invention, as set forth in claim 2, wherein means are provided for holding the rod in either of its operating positions until it is moved to the other position at the ends of the strokes of the power piston.

4. The invention, as set forth in claim 2, wherein the longitudinal axis of the cylinder containing the control piston extends transversely of the longitudinal axis of the power cylinder.

HAROLD R. FORSMARK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,059,126	Malthaner	Oct. 27, 1936
2,296,647	McCormick	Sept. 22, 1942

FOREIGN PATENTS

Number	Country	Date
363,973	Germany	Nov. 16, 1922