

[54] THRUST PISTON MOTORS

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[57] ABSTRACT

A control device for a thrust piston motor consisting of two normally closed auxiliary control valves and one main control valve, controlled by the auxiliary control valves, and containing a control piston adapted to be displaced by the action of the fluid medium and a control slide coupled with the control piston for controlling the direction of movement of the motor piston, and wherein the control pressure chambers are each connected by a bore provided in the control piston and a supplementary valve means connected to the control piston, with a pressure medium source and through one of the auxiliary control valves each with a low pressure zone the improvement comprising that for obtaining an externally controlled sequence of individual strokes, one control valve (first control valve) is operable externally and the other control valve (second control valve) by the motor piston during the passage through a dead centre position, wherein there is mounted, on the side of the motor piston remote from the second control valve in the motor cylinder, an abutment stop in such a manner that its distance from the second control valve is variable.

6 Claims, 5 Drawing Figures

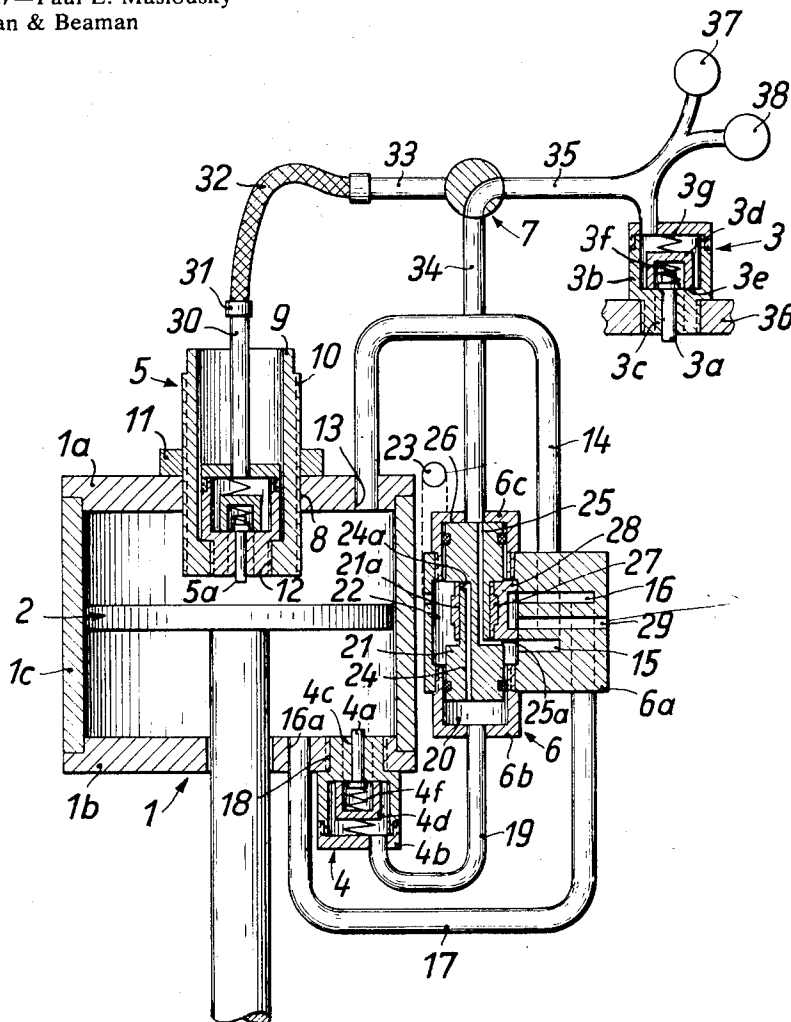


Fig. 2

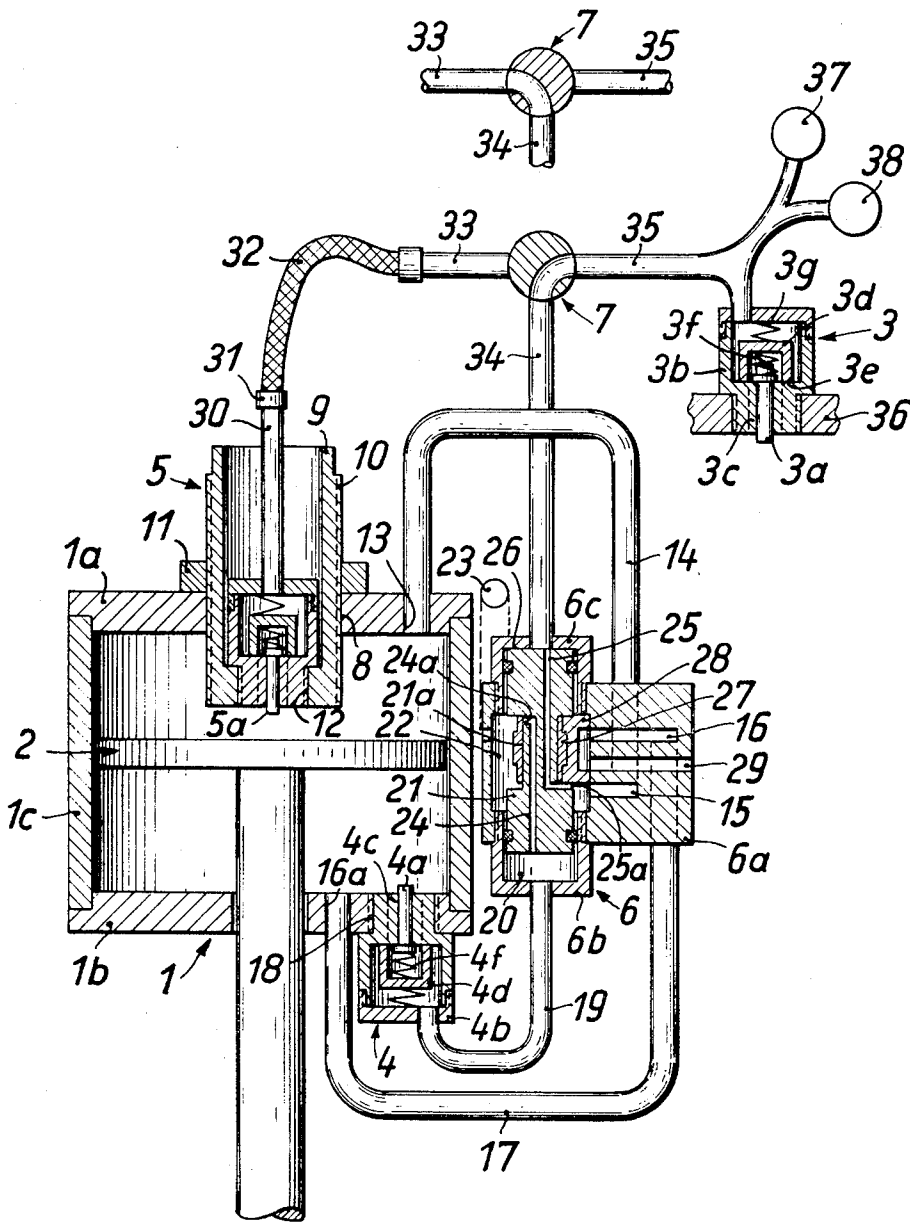


Fig. 1

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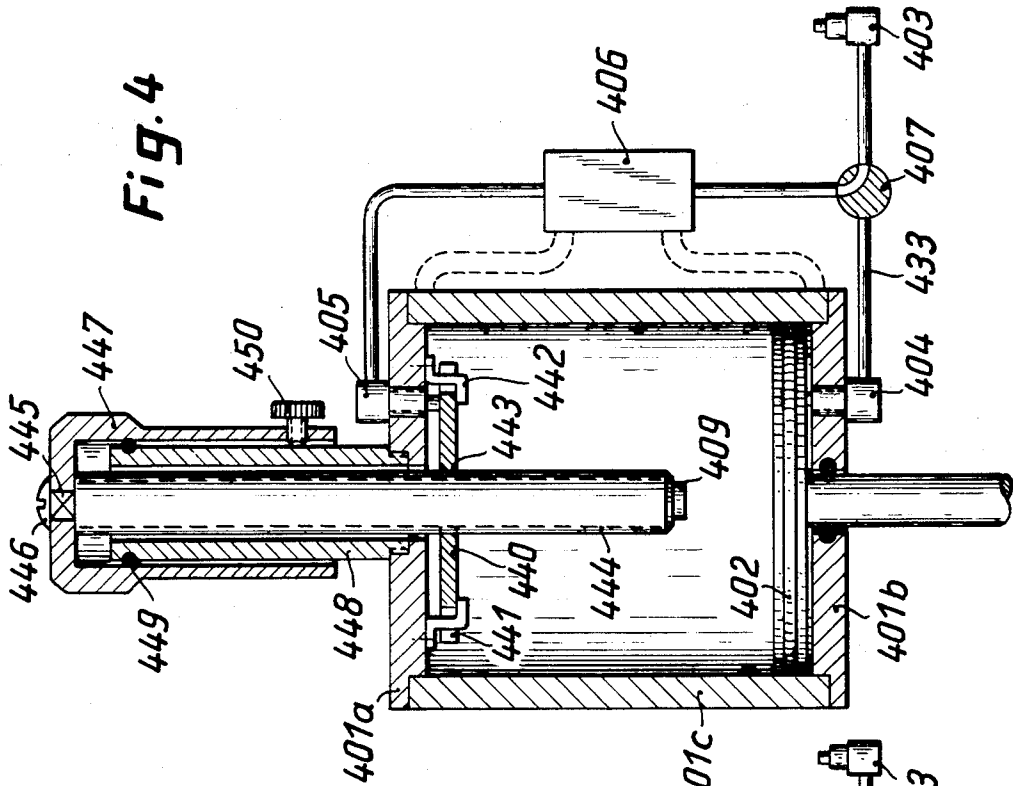


Fig. 3

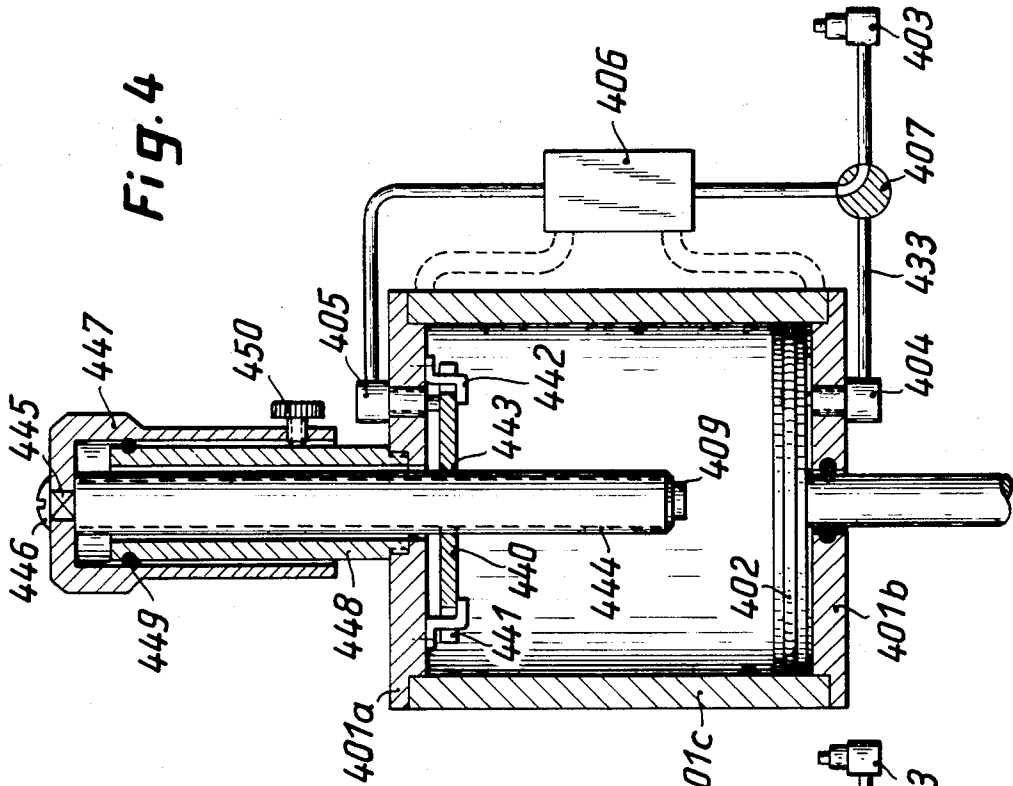
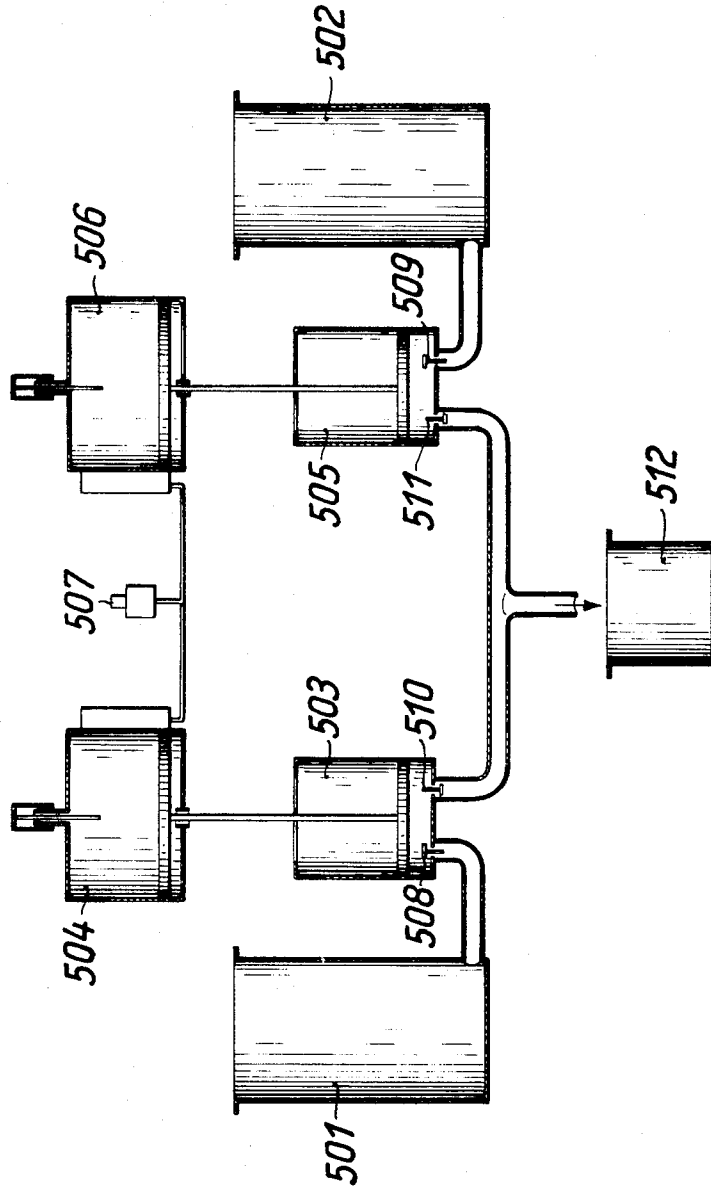


Fig. 4

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Fig. 5



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THRUST PISTON MOTORS**BACKGROUND OF THE DISCLOSURE**

The invention relates to a thrust piston motor operated with a gaseous fluid medium, comprising a control device consisting of two normally closed auxiliary control valves and one main control valve controlled by the auxiliary control valves, and containing a control piston adapted to be displaced by the action of the fluid medium and a control slide coupled with the control piston for controlling the direction of movement of the engine piston, and wherein the control pressure chambers are each connected by a bore provided in the control piston and a supplementary valve means connected to the control piston with the pressure medium source, and through one of the auxiliary control valves each with a low pressure zone.

Known thrust piston motors with linkage-less control of the type hereinbefore mentioned are unsuitable for driving working appliances which require an externally controlled sequence of individual strokes. Such appliances, e.g., charging pumps with or without variable metering of the amount of the charge, which must be operated whenever the container to be filled is located underneath the outlet of the pump.

PRIOR ART

It is known for example from German Pat. No. 557 584 to operate the piston of a double-acting compressed air cylinder by means of a manually operated valve by applying pressure as desired to its two sides so that it carries out an externally controlled reciprocating movement. However, each individual movement requires the operation of the valve. Devices for providing an automatic stroke sequence are not provided so that the operation is complicated and time-wasting. In addition, there is no possibility for metering the stroke.

Another construction according to published German Pat. No. 1,299,171 relates to a compressed air motor in which it is of primary importance to achieve a quick, sudden working stroke. Here, the working stroke and the return stroke are triggered off by hand. Although this publication states, in column 9, lines 26 to 32 that, theoretically, automatic operation should be possible to achieve, concrete features with a view to solving this object are lacking. It should only be stated that, owing to the special requirement of carrying out one of the strokes in sudden, shock-like manner, such a solution would have to be of a quite different kind than would be necessary to solve the object of metering so that this publication does not contribute anything to solving this problem.

OBJECT OF THE INVENTION

The invention has the object of providing a thrust piston motor of the kind hereinbefore mentioned and which is controllable externally to achieve a sequence of individual strokes. It is a further object of the invention to provide a thrust piston motor with variable piston stroke. Furthermore, this motor should operate perfectly under all operating conditions. Its operating behaviour should be substantially independent of the frequency of the stroke sequence.

BRIEF SUMMARY OF THE INVENTION

According to the invention, in order to achieve an externally controlled sequence of individual strokes, one

control valve (the first control valve) is actuatable externally and the other control valve (second control valve) is actuatable by the motor piston when passing through a dead centre position.

In order to achieve a variation of the piston stroke, a stop member or abutment is so mounted in the motor cylinder on the side remote from the second control valve that its distance from the second control valve is variable. Preferably, the abutment is a stop bush screwed into the cylinder cover, and adapted to be secured in any position of depth by a locknut.

FURTHER FEATURES

Preferably, in addition to the individual stroke sequence, the thrust piston motor is made to oscillate automatically by an externally applied pulse. This continuous operation is necessary particularly for the operation of charging pumps, where these pumps are intended to induct a cleaning agent and to deliver the same so that the pump chamber of the pump may be cleaned when switching from one substance to be charged to another. To this end, the abutment is connected to a third control valve which is normally closed and opens towards a zone with lower pressure, and a three-way valve is connected between the first control valve and the main control valve, whereby the third control valve may be connected to the main control valve while separating the first control valve from the main control valve. When the three-way cock connects the first control valve with the main control piston, the motor piston remains in one end position until the first control valve is operated. After one reciprocating stroke, the piston stops again on reaching the abutment. The reversal in the other dead centre position is effected by the second control valve.

It is also possible to operate from the outside several thrust piston motors by means of a single first control valve. Then the controlled motors drive, e.g., pumps with different piston strokes, producing different delivery amounts, several different delivery amount may be combined together in a vessel so as to form a mixture, by means of only one externally applied actuating pulse.

DESCRIPTION OF DRAWINGS

The invention will be further described in detail with reference to the accompanying drawings, clarifying special features of the invention. In the drawings:

FIG. 1 is a basic diagram of the invention, showing in partial cross-section the arrangement with the three-way cock in one position;

FIG. 2 shows another position of the three-way cock;

FIG. 3 shows another embodiment of the thrust piston motor in accordance with the invention;

FIG. 4 shows yet another embodiment of the thrust piston motor according to the invention;

FIG. 5 shows the use of the thrust piston motor according to the invention as a metering device.

The thrust piston motor in accordance with the invention consists substantially of a cylinder 1, a piston 2, three control valves 3, 4 and 5, a main control valve 6 and a three-way cock 7.

The cylinder 1 consists of an upper cylinder cover 1a, a lower cylinder cover 1b and an annular cylinder body 1c. A sleeve-shaped abutment bush 9 with an external thread 10 is screwed into a bore 8 in the upper cylinder cover. A locknut 11, screwed on to the external thread

10, is seated on the other surface of the cylinder cover 1a, thereby fixing the abutment bush 9 in its position in the cover. At its lower end, the abutment bush 9 has a bore 12 with internal thread, into which the third control valve 5 is screwed. The third control valve 5 is actuable by the motor piston 2. Its construction will be described further below. In the cylinder cover 1a, there is also a bore 13 which communicates through a conduit 14 with a port 15 in the valve block 6a of the main control valve 6.

The piston rod of the piston 2 passes through the cylinder cover 1b. In addition, the cylinder cover has a bore 16a, connected by a conduit 17 with a port 16 in the valve block 6a. The second control valve 4 is screwed into a third bore 18 in the cylinder cover 1b, and communicates through a conduit 19 with a control pressure chamber 20 of the main control valve. Also the construction of the control valve 4, which is identical to the construction of the control valve 5, will be discussed further below.

Furthermore, the first control valve 3 is connected with the three-way cock through a conduit 35. The control valve 3 is screwed into a carrier plate 36 which may form part of a roller track on a filler path. The valve 3 is adapted to be operated by an actuating pin 3a. The valve 3 may also be a pedal operated valve, in which an operator in the filling station contacts the pin 3a with his foot.

As shown in FIGS. 1 and 2, the three-way cock 7 may connect either the first control valve 3 with the control pressure chamber 26 or the third control valve 5 with this control pressure chamber. The first position is shown in FIG. 1 and the second in FIG. 2. FIG. 1 also indicates that the control valve 3 may be used for operating further thrust piston motors 37 and 38.

In the embodiment shown, the valves 3, 4 and 5 have the same construction. They open towards a lower pressure zone. The construction will now be described with reference to the valve 3. In the housing 3b of the control valve 3 there is formed a connecting conduit 3c, which connects the interior of the control valve housing 3b with a lower pressure zone. A sealing body 3d is movably mounted in the control valve housing, and surrounds in one end position the end of the connecting conduit 3c, located in the control valve housing, sealing by means of a seal 3e. The actuating pin 3a protruding from the valve housing 3b, rests via a compression spring 3f on the sealing body 3d in such a manner that during its forward movement, first the compression spring 3f is biased and then the sealing body 3d is lifted off its seat 3e. The sealing body 3d is pressed onto its seat by means of a spring 3g.

The main control valve 6, 306, 406 has two operating positions. As known in the art, the valve applies during the response of the upper control valve 5, 305, 405, the operating pressure to the cylinder chamber above the piston 1, 301, 401, while opening the chamber under the piston to low pressure. When the lower control valve 4, 304, 404 responds, it applies the operating pressure to the cylinder chamber under the piston 1, 301, 401 and opens the chamber above the piston to low pressure. When both control valves are connected with the main control valve, the piston continues to move up and down. If one of the two control valves is disconnected through the three-way cock 7, 307, 407 and the external valve 3, 303, 403 is substituted for it, the piston carries out only a single stroke in both direc-

tions, when the external valve is actuated, and remains when stationary on the side of the disconnected control valve.

In the following, the operation of the thrust piston motor in accordance with the invention will be described. The three-way cock 7 is in the position shown in FIG. 1. In this way, the motor is prepared for single stroke sequence. In the state ready for operation, the piston 2 rests on the abutment bush 9. By operating the pin 3a, the control pressure chamber 26 is vented through the conduit 34 so that the control piston 21 moves towards the top. In the upper position, the control slide 28 connects the port 16a in the lower cylinder cover 1b through the conduit 17 with the pressure medium outlet 29. Since at the same time the working pressure chamber 22 is connected by the port 15 and the conduit 14 with the cylinder chamber above the piston, the piston 2 in FIG. 1 is pushed down. When the piston approaches bottom dead centre, it pushes the actuating pin 4a of the second control valve 4 towards the inside. The lower working chamber of the piston, the connecting conduit 4c and the interior of the sealing element 4d are affected by the lower pressure of the outlet, because the lower working chamber communicates with the outlet 29 through the bore 16, the conduit 17, the bore 16 and the slide valve 28. Working pressure prevails in the control valve housing 4b, in the conduit 19 and in the associated control pressure chamber 20, because the control piston 21 is displaced by this pressure into the end position shown. The resulting differential pressure presses the sealing hood 4d firmly onto its seat. When the actuating pin 4a has slightly lifted the sealing element 4d, the opening and the relief of the control pressure chamber takes place very rapidly. The control piston is then displaced very forcibly towards the bottom. During this displacement, the sleeve is also accelerated so that it moves further towards the bottom, when the piston 21 has already reached its bottom dead centre piston. Since then the port 24a is opened, lower control chamber 20, reduced to its minimum volume, will again close through the bore 24 the control valve 4, which has been opened by the action of the compression spring 4f and the conduit 19 will become pressurized.

Since together with the piston, the slide 28 has been moved into its end position, the conduit 17 now communicates with the annular chamber 22, carrying the operating pressure, and the upper working chamber is depressurized. The piston 2 is therefore again lifted until it comes to rest against the abutment bush 9 and is retained in this position by the pressure. A new piston stroke can be achieved only by operating the control valve 3.

In order to achieve an oscillating movement of the control piston, such as is required, e.g. for driving charging pumps for cleaning purposes, the three-way cock 7 is moved into the position shown in FIG. 2. This connects the upper control pressure chamber 26 with the third control valve 5. When the motor piston 2 moves the actuating pin 5a, the valve 5 is operated in the same manner as the valve 4. All three valves 3, 4, and 5 make possible a sudden, shock-like opening, giving rise to a sudden movement of the main control valve piston so that the motor piston 2 does not remain long in its end positions.

For changing the stroke, the locknut 11 is slackened, so that the abutment bush 9 can be rotated in the bore

8. The transmission member 31 and the flexible transfer element 32 are necessary to enable the valve 5, firmly connected to the bush 9, to be raised, lowered and rotated relative to the conduit 33.

FIG. 3 shows another arrangement, the effects of which are the same as described above. Here, merely the rollers of the two control valves 4 and 5 are reversed. The conduit 304 on the lower cylinder plate 301b communicates in this construction with the conduit to the three-way cock 307. This connects the control valve 304 with the main control valve 306 or with the externally operable valve 303. The control valve 305, adapted to be adjusted by means of the abutment bush 309 is connected by a flexible conduit 332 directly with the other side of the main control valve 306.

Compared with the arrangement in accordance with FIG. 1, this arrangement has the advantage that the piston remains stationary in its lower position when the three-way cock is switched to individual operation. The adjustable control valve 305 may therefore be adjusted to the required stroke without interference by the piston.

According to a further development of this arrangement in accordance with FIG. 4, the upper control valve 405 has exactly the same construction as the lower control valve 404 and is mounted in the same manner as the latter in the upper cylinder plate 401a. However, this upper cylinder plate 401a has mounted thereon, in front of the control valve 405, a plate 440, having along its periphery milled grooves 441 into which engage retaining angles 442, mounted on the cylinder cover 401a. The plate 440 is therefore secured against rotation, but may carry out limited movements up and down within the range of the retaining angles, which are just sufficient for operating the control valve 405.

The centre of the plate 442 is provided with a threaded bore 443 adapted to receive a spindle 444. This spindle is connected by means of a square section element 445 and a screw 446 with a cap 447 in such a manner that a rotation of the cap 447 will also entrain a rotation of the spindle 444. A sleeve 448 is firmly screwed into the cylinder cover 401a and a seal prevents the loss of compressed air when the upper cylinder chamber is vented. By rotating the cap 447, the piston stroke can again be adjusted without interference by the piston. Then, the spindle 444 is fixed by a screw 450 engaging into the cap 447, relative to the sleeve 449 and therefore relative to the cylinder. In its top position, the piston abuts against the spindle 444 and lifts thereby the plate 442 until the same operates the control valve 405.

Thus, in the arrangement of FIG. 4, the piston carries out, as in the arrangement of FIG. 3, a reciprocating movement or a single stroke movement, returning thereafter into its bottom position and remaining there, according to the position of the three-way cock. This construction has the advantage that the flexible conduit has been omitted which might lead to difficulties, while the adjusting capabilities of the piston stroke have been maintained.

FIG. 5 shows diagrammatically the operation of a charging installation equipped with thrust piston motors in accordance with the invention. The tank 501 contains a polyester resin, the tank 502 a hardener therefor which is to be added to the first substance in a certain mixing ratio. The vessel 501 is connected with

a first metering pump 503, the piston of which is actuated by a thrust piston motor 504 in accordance with the invention. The vessel 502 is connected with a second metering pump 505, the piston of which is actuated by a thrust piston motor 506. Both thrust piston motors may be operated at choice through a switching valve assembly 507 in individual operation or in reciprocating movement.

The normal filling operation is effected in that way that, upon actuation of the switching valve assembly 507, the pistons of both motors move up and induct through the suction valves 508 and 509 a metered amount of the substance to be charged. After reaching their topmost position, the pistons return and eject the metered amounts through ejection valves 510 and 511 into the mixing tank 512.

When the metering pumps 501 and 502 are to be cleaned after a prolonged period of operation, the vessels 501 and 502 are replaced by vessels with a solvent. The thrust piston motors 505 and 506 are set at reciprocating operation and pump the solvent to the collection tank, thereby removing all resinous residues.

It is quite clear that installations of this kind can be adapted to many mixing components. The stroke adjustment of the thrust piston motors makes possible the accurate adjustment of the amounts of the constituents and this adjustment may be changed at choice during the operation.

I claim

1. A thrust piston motor operated by a gaseous pressurized fluid comprising, in combination, a cylinder having first and second heads, a piston having opposite sides and reciprocally mounted within said cylinder having a piston rod extending through one of said heads, a main control valve connected to a source of pressurized gaseous fluid, a pair of flow conduits connecting said control valve to said cylinder and communicating with opposite sides of said piston, a valve spool movably mounted within said control valve selectively connecting said flow conduits with the source of pressurized gaseous fluid and the ambient atmosphere, first and second reversing valves mounted adjacent said first and second cylinder heads, respectively, each selectively communicating with said main control valve whereby actuation of one of said reversing valves shifts said valve spool to reverse the direction of movement of said piston within said cylinder, actuating means mounted upon each of said reversing valves sensing the position of said piston as it approaches the associated cylinder head, a remote control valve located remotely from said cylinder, first conduit means connecting said remote control valve to said main control valve for controlling the position of said valve spool, and flow control valve means selectively connecting either said first reversing valve or said remote control valve with said main control valve and valve spool selectively providing single cycle or automatic operation of said main control valve and piston movement.

2. In a thrust piston as in claim 1 wherein said flow control valve means communicates with said main control valve and said valve spool, said first reversing valve and said remote control valve communicating with said flow control valve means for selective communication with said main control valve and valve spool.

3. In a thrust piston as in claim 1, abutment means mounted in said first head axially movable toward and away from said piston engageable by said piston to limit

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movement of said piston toward said first head, and means interconnecting said first reversing valve with said abutment means wherein said first reversing valve is operative to operate said main control valve and valve spool at all positions of said abutment means.

4. In a thrust piston as in claim 3 wherein said first reversing valve and said actuating means thereof are directly mounted upon said abutment means.

5. A thrust piston motor operated by a gaseous pressurized fluid comprising, in combination, a cylinder having first and second heads, a piston having opposite sides and reciprocally mounted within said cylinder having a piston rod extending through one of said heads, a main control valve connected to a source of pressurized gaseous fluid, a pair of flow conduits connecting said control valve to said cylinder and communicating with opposite sides of said piston, a valve spool movably mounted within said control valve selectively connecting said flow conduits with the source of pressurized gaseous fluid and the ambient atmosphere, first and second reversing valves mounted adjacent said first

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and second cylinder heads, respectively, each selectively communicating with said main control valve whereby actuation of one of said reversing valves shifts said valve spool to reverse the direction of movement of said piston within said cylinder, actuating means mounted upon each of said reversing valve sensing the position of said piston as it approaches the associated cylinder head, abutment means threadedly mounted on said first head axially adjustably movable toward and away from said piston engagable by said piston to limit movement of said piston toward said first head, and means interconnecting said first reversing valve with said abutment means wherein said first reversing valve is operative to operate said main control valve and valve spool at all axial positions of said abutment means.

6. In a thrust piston motor as in claim 5, wherein said first reversing valve and said actuating means thereof are directly mounted upon said abutment means.

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