United States Patent [19]

Roeser

[11] **3,802,805**

[45] **Apr. 9, 1974**

[54] **PUMPING APPARATUS**

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[73] Assignee: **Otto Engineering, Inc.,** Carpentersville, Ill.

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[21] Appl. No.: **152,734**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 48,981, June 24, 1970, Pat. No. 3,684,250.

[52] **U.S. Cl.** **417/398,** 417/429, 417/437, 417/489, 92/87

[51] **Int. Cl.** **F04b 35/00,** F04b 7/04

[58] **Field of Search** 417/431, 547, 557, 489, 417/429; 92/13.4, 13.41, 13.5, 13.51, 13.6, 13.7, 87

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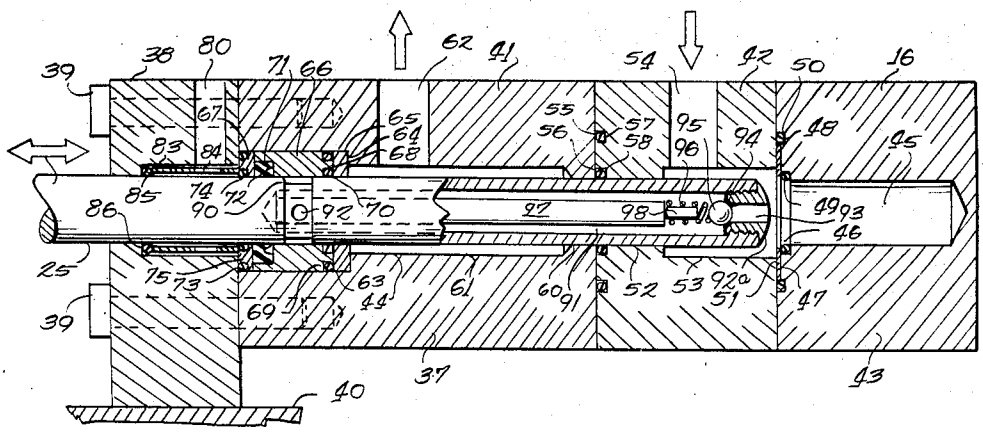
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Primary Examiner—William L. Freeh

[57] **ABSTRACT**

A pumping apparatus is provided which is particularly suitable for pumping material in measured quantities. The apparatus includes a cylinder having an axially extending bore and a piston slidably received by the bore. The cylinder bore is provided with radially enlarged inlet and outlet chambers which communicate with the exterior of the cylinder, and the piston is provided with a central bore which extends from the forward end of the piston to a transverse opening in the intermediate portion of the piston. The inlet chamber is positioned forwardly of the outlet chamber, and as the piston moves forwardly, fluid in the outlet chamber is forced through the bore of the piston, out of the transverse opening in the piston, and into the outlet chamber. A check valve within the piston bore permits the fluid to flow freely toward the opening in the piston as the piston moves forwardly but prevents the fluid from flowing from the piston opening toward the forward end of the piston. The cylinder may include stop means engagable with the piston for limiting the forward movement of the piston to permit the apparatus to pump a measured amount of fluid during each reciprocation of the piston.

12 Claims, 10 Drawing Figures



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SHEET 1 OF 2

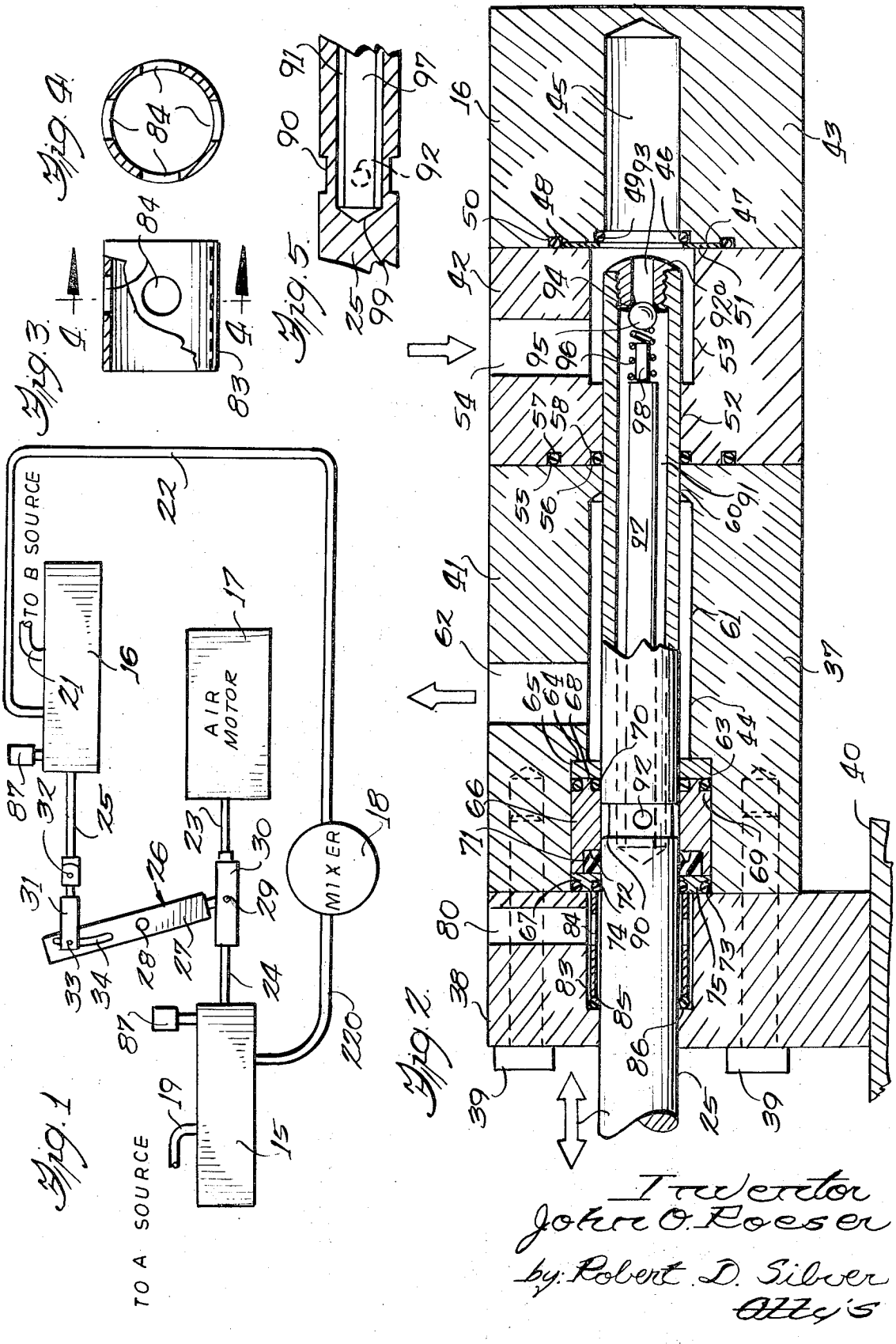


Fig. 1

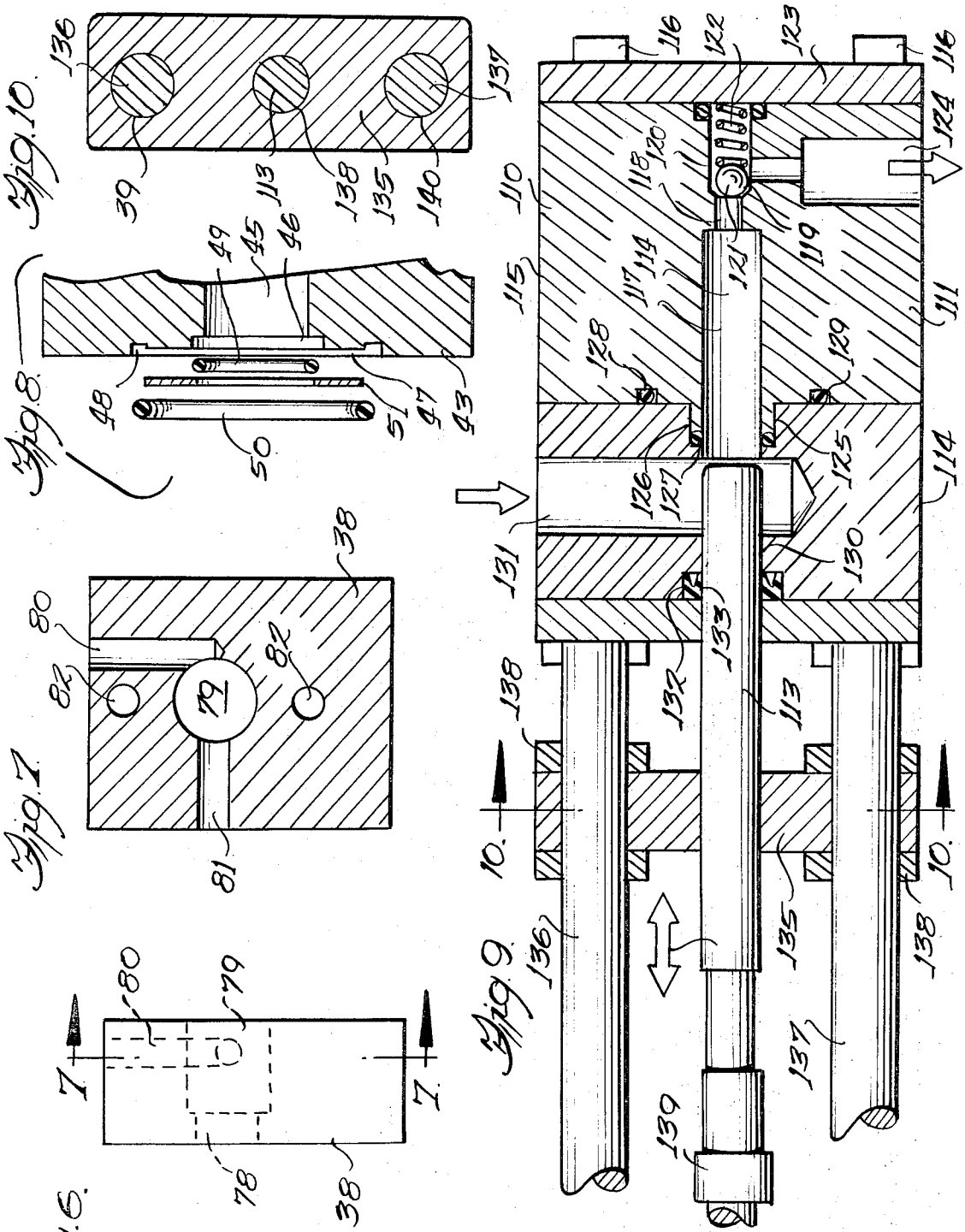
Fig. 2

Fig. 3

Fig. 4

Fig. 5

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PUMPING APPARATUS

APPLICATION

This application is a continuation-in-part of my prior application entitled, "Multi-Component Mixing Apparatus," Ser. No. 48,981, filed June 24, 1970 now Patent No. 3,684,250.

BACKGROUND AND SUMMARY

This invention relates to a pumping apparatus, and, more particularly, to a pumping apparatus which is particularly suitable for pumping measured quantities of viscous materials such as epoxy resins and the like.

As described in my said prior application, it is often desirable to deliver a mixture comprised of a plurality of flowable materials which must be mixed in definite proportions just prior to delivery, for example, multi-component flowable adhesives, sealers, foams such as epoxides, polyurethanes, polyesters, and the like.

The invention provides a pump for delivery of such flowable materials in measured quantities which can be readily disassembled for cleaning, replacement of parts, and the like. The central bore of the pump includes radially enlarged inlet and outlet chambers to provide full annular flow, and the central bore of the pumping piston is provided with a check valve which permits fluid to be pumped but which prevents reverse flow of the material as the piston is retracting. A solvent bearing is positioned rearwardly of the outlet chamber and is provided with a flushing chamber to permit the piston to be washed with solvent as the piston reciprocates. Adjustable stop means may be provided which are engagable with the piston for limiting forward movement thereof and adjustably mounted for selectively varying the amount of material pumped during each reciprocation of the piston.

DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with illustrative embodiments shown in the accompanying drawings, in which;

FIG. 1 is a schematic view of a mixing system embodying the invention;

FIG. 2 is a sectional view of one of the measuring pumps of FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view of the solvent bearing sleeve shown in FIG. 2;

FIG. 4 is an end view of the sleeve of FIG. 3;

FIG. 5 is a fragmentary sectional view of the intermediate portion of the piston shown in FIG. 2;

FIG. 6 is a side elevational view of the solvent bearing;

FIG. 7 is a sectional view taken along the line 7—7 of FIG. 6;

FIG. 8 is an enlarged exploded fragmentary view of the forward portion of the cylinder;

FIG. 9 is a sectional view of a modified pump; and

FIG. 10 is a sectional view taken along the line 10—10 of FIG. 9.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The invention will be explained in conjunction with a mixing system shown schematically in FIG. 1 for use in pumping and mixing two component materials such as epoxy resins A and B, one of which may be a base resin and the other an accelerator. The system includes

measuring pumps **15** and **16** for resins A and B, respectively, which are driven by an air cylinder or air motor **17** and which pump the resins to a mixer **18.** Pump **15** is connected to a source of the A resin by conduit **19** and supplies the A resin to the mixer through conduit **20.** Similarly, pump **16** is connected to a source of B resin by conduit **21** and pumps the B resin to the mixer through conduit **22.**

The air cylinder or air motor can be a conventional double-acting pneumatic cylinder which includes a piston rod **23** which is connected to piston **24** of the pump **15** for reciprocating the piston. Piston **25** of the pump **16** is also driven by the air cylinder by means of a crank assembly **26** which includes a lever arm **27** pivotally mounted by a pin **28** and pivotally connected at **29** to the connecting block **30** which connects the piston rod **23** and the piston **24.** A connecting arm **31** is pivotally secured at **32** to the end of the piston **25** and includes a pin **33** which is slidable within an arcuate slot **34** provided in the lever arm **27.** Suitable nut means are provided on the pin **33** for securing the pin at any desired point along the arcuate slot. The proportions of the A and B resins which are delivered to the mixer during each reciprocation of the piston rod **23** can therefore be selectively varied by moving the pin **33** within the arcuate slot **34** to change the effective length of the lever arm between the fulcrum **28** and the connection between the lever arm and the piston **25.** As the effective length of the lever arm decreases, less resin will be pumped. The arcuate shape of the slot permits the length of the lever arm to be changed without affecting the rearwardmost or starting position of the piston, the slot lying along a circle having its center at **32.**

The mixer **18** may be of the type described in my said prior application, Ser. No. 48,981, filed June 24, 1970, and need not be described herein.

The pumps **15** and **16** are identical and will be explained with reference to pump **16** which is shown in FIG. **2.** The pump includes an elongated cylinder **37** which is secured to a solvent bearing **38** by bolts **39,** and the solvent bearing is suitably secured to a supporting frame **40** as by bolts (not shown). The particular cylinder illustrated is formed of three separate cylindrical portions, an outlet chamber block **41,** an inlet chamber block **42** and a pumping chamber block **43,** which are removably secured together by a pair of axially extending bolts which extend through blocks **43** and **42** and are threadedly engaged with the block **41.**

The cylinder is provided with a central bore **44** which extends through the blocks **41** and **42** and which terminates in the pumping block **43,** and the elongated pumping piston **25** is slidably received by the bore for reciprocation therein. The pumping block **43** defines the forward end of the bore **44** and is provided with an elongated bore **45** having a diameter just slightly greater than the diameter of the piston **25,** a radially enlarged annular groove **46,** a second annular enlargement **47,** and an annular groove **48** which extends both radially outwardly from the enlargement **47** and axially forwardly of the enlargement **47.** Referring also to FIG. **8,** O-rings **49** and **50** are received by the grooves **46** and **48,** respectively, and a washer **51,** having an outside diameter approximately the same as the inside diameter of the O-ring **50** is positioned in the enlargement **47.** The forward end of the pumping block **43** abuts the forward end of the inlet chamber block **42,** and the gasket

50 sealingly engages the block 42 to prevent the escape of the material being pumped. The O-ring 49 sealingly engages the piston 25 and is retained in the groove 46 by the washer 51, which has an inside diameter intermediate the inside and outside diameters of the O-ring 49.

The cylinder bore 44 through the block 42 is defined by a first bore 52 which has a diameter approximately the same as the diameter of the bore 45 and a radially enlarged bore 53 which defines an inlet chamber surrounding the piston. An inlet port 54 extends radially inwardly through the inlet block 42 to the inlet chamber, and the inlet port is adapted to be connected to the conduit 21 for supplying the B resin. A seal is provided between the blocks 41 and 42 by means of a pair of concentric O-rings 55 and 56 which are received by annular grooves 57 and 58, respectively, in the rearward end of the inlet block 42, the O-ring 56 also sealingly engaging the piston 25.

The central bore of the outlet chamber block 41 includes a first portion 60 having a diameter approximately the same as the diameter of the bores 52 and 45 and a radially enlarged portion 61 which defines an outlet chamber. An outlet port 62 extends radially outwardly from the outlet chamber 61 and is adapted to be connected to the conduit 22 for delivering the B resin to the mixer.

The rearward portion of the block 41 is radially enlarged still further at 63 to provide a radially extending shoulder 64, and a washer 65, a generally cylindrical sleeve 66, and a washer 67 having a generally T-shaped cross section are received in the radial enlargement 63. The washer 65 has an inside diameter of approximately the same as the diameter of the piston and abuts the shoulder 64. The forward end of the sleeve 66 also has an inside diameter approximately the same as the diameter of the piston, and the forward end of the sleeve includes a forwardly extending rib 68 which abuts the washer 65. A pair of O-rings 69 and 70 are positioned outwardly and inwardly, respectively, of the rib 68, the O-ring 69 sealingly engaging the washer 64, sleeve 66 and the outlet chamber block 37 and the washer 70 sealingly engaging the washer 65, the sleeve 66, and the piston 25. The rearward end of the sleeve 66 is provided with an annular groove 71 which receives a gasket 72 having a generally U-shaped cross section which sealingly engages the sleeve 66, the washer 67, and the piston 25.

The washer 67 abuts the sleeve 66, and O-rings 73 and 74 are positioned outwardly and inwardly, respectively, of the rib 75 of the washer, the O-ring 74 sealingly engaging the piston 25, and the O-ring 73 providing a seal between the outlet chamber block 41 and the solvent bearing 38.

Referring to FIGS. 6 and 7 in addition to FIG. 2, the solvent bearing 38 is seen to be generally rectangular in elevation and is provided with a central bore 78, having a diameter approximately the same as the diameter of the piston 25 and a radially enlarged flushing chamber 79. An inlet port 80 extends downwardly from the top of the solvent bearing to communicate with the flushing chamber 79, and an outlet port 81 extends laterally outwardly from the flushing chamber. As can be seen best in FIG. 7, the inlet port 80 is laterally offset from the center of the flushing chamber to accommodate the bolt openings 82 which receive the bolts 39.

A cylindrical spacer sleeve 83 (see also FIGS. 3 and 4) is positioned within the flushing chamber and is provided with four circumferentially spaced openings 84. The spacer sleeve is spaced from outer wall of the flushing chamber 79 and the piston 25 to permit free flow of solvent within the flushing chamber, and the sleeve serves to maintain an o-ring 85 against the shoulder 86 of the flushing chamber and to maintain the O-ring 74 against the washer 67. The O-ring 85 sealingly engages both the shoulder 86 and the piston 25.

A bottle 87 (FIG. 1) of solvent is connected to the solvent inlet port 80 for gravity feed of solvent to the flushing chamber. The solvent is selected depending upon the particular material being pumped and washes the piston of any material which may escape rearwardly of the seal means provided by the gaskets 70, 71 and 74 during each reciprocation of the piston before the material can be carried externally of the cylinder where it might solidify. The solvent outlet port 81 can be kept normally closed and need be opened only when it is desired to flush the solvent from the flushing chamber or to replace the solvent with fresh solvent.

The exterior surface of the piston may be polished chrome plate, and the piston is provided with an annular groove 90 intermediate the ends thereof and an axially extending bore 91 which extends from the forward end of the piston to a point just rearwardly of the annular groove 90. Four cross-drilled holes 92 spaced 90° apart communicate the bore 91 with the annular groove 90.

The forward end of the piston bore is closed by an externally threaded cylindrical plug 92*a* which threadedly engages internal threads at the forward end of the piston. The plug 92*a* includes a central bore 93, and the rearward end of the plug provides a concave valve seat 94. A ball 95 is resiliently urged against the valve seat 94 by a helical spring 96 which is supported by an elongated rod 97. The spring 96 is ensleeved on a radially reduced end portion 98 of the rod and abuts the shoulder which joins the radially reduced end portion with the remainder of the rod. The rod is not secured to the piston but is maintained generally centrally within the bore 91 by the spring 96 which urges the forward end of the rod against the conical rearward end 99 (FIG. 5) of the bore 91. The conical end 99 is provided merely by drilling the piston to provide the internal bore 91.

The ball 95, which has a diameter larger than the opening through the plug 92*a* but a radius of curvature less than the radius of curvature of the concave valve seat 94, acts as a check valve member to permit fluid to flow through the plug member into the piston bore but prevents reverse flow. The ball also acts as a relief valve by choosing the spring 96 so that the spring exerts a greater force on the ball than is exerted by the resin flowing through the inlet port. Resin will therefore not flow past the ball until the piston begins its forward stroke.

The reduced forward end portion 98 of the rod 97 not only supports the helical spring 96 but serves as a limit stop against rearward movement of the ball 95.

The resin to be pumped can be supplied to the inlet port 54 either by gravity feed or by pressure feed, and the material flows through the inlet port into the inlet chamber 53 and the bore 45 of the pumping block 43. As the piston moves forwardly into the bore 45, the material is forced through the plug member 92*a*, past the

ball **95**, and into the piston bore. The material can flow freely around the spring **96** and the rod **97** and is forced rearwardly through the piston bore and through the cross-drilled openings **92**. As the annular groove **90** in the piston passes forwardly of the gasket **70**, the material begins to flow into the outlet chamber **61** and through the outlet port **62**. The forward end of the annular groove **90** in the piston is positioned relative to the O-ring or gasket **70** so that the forward end of the groove will not pass forwardly of the O-ring until the forward wall of the groove **90** passes forwardly of the O-ring **70** to permit the material to be forced into the outlet chamber.

Since the material flows through the cross-drilled openings **92** into the annular groove **90**, there is full 360° flow of the material into the outlet chamber as soon as the forward end of the groove passes the O-ring **70**. Similarly, the radially enlarged inlet chamber **53** permits 360° flow of material through the inlet port around the forward end of the piston, and this substantially eliminates the possibility of compression lock or binding of the piston which might be caused by forcing the material through the inlet port against one side of the piston.

Because there is full circumferential flow around the forward end of the piston, this end need be positioned only slightly rearwardly of the O-ring **46** before the beginning of a pumping stroke, and the piston need travel only a short distance between the point at which the forward or inlet end of the piston is fully opened and the outlet end provided by the annular groove is fully closed and the point at which the outlet end of the piston is fully opened and the inlet is fully closed. As soon as the piston engages the O-ring **46**, the inlet chamber is completely and suddenly closed from the piston bore. At the outlet end of the piston bore, as soon as forward end of the annular groove **90** passes the O-ring **70**, the annular groove permits full 360° flow and the outlet end becomes fully opened.

At the end of the forward stroke of the piston, the air motor is reversed to retract the piston **25**, and the spring **96** forces the ball **95** against the valve seat **94** to prevent material within the piston from being sucked back into the bore **45**. As the forward end of the piston passes rearwardly of the O-ring **46**, the material in the inlet chamber is drawn into the bore **45** by the vacuum created by the withdrawal of the piston, and inward flow of the material is also aided by the pressure which may be provided at the material source or by gravity.

If it is desired to use the pump without the check valve within the piston, back flow of material from the outlet chamber **61** which might be caused by a vacuum created in the bore **45** during retraction of the piston would be prevented as soon as the forward end of the annular groove **90** passed rearwardly of the gasket **70**.

A modified pump **110** shown in FIG. **9** includes a cylinder **111** having a bore **112** and a piston **113** slidably received in the bore. The cylinder includes an outlet block portion **114** and an inlet block portion **115** which are boltably secured by bolts **116** and which are mounted on a suitable supporting frame (not shown). The outlet block **114** includes a bore **117** having a diameter substantially the same as the diameter of the piston **113**, a radially reduced outlet bore **118** which terminates in a concave valve seat **119**, and a valve bore **120**. A ball **121** is positioned within the bore **120** and is resiliently biased toward the valve seat **119** by a helical spring **122** which abuts an end cap **123** secured to the block **114** by the bolts **116**. An outlet bore **124** extends radially outwardly from the valve ball **120**.

The forward end of the block **114** includes a cylindrical projection **125** which is received by a correspondingly shaped bore **126** in the block **115**, and a seal is maintained between the blocks **114** and **115** by O-rings **127** and **128**, the latter O-ring being positioned in a groove **129** in the block **114**.

The block **115** is provided with a central bore **130** having approximately the same diameter as the piston **113**, and an inlet port **131** extends radially inwardly into communication with the bore **130**. The inlet port **131** preferably has a diameter slightly greater than the diameter of the piston and extends beyond the bore **130** to permit material to flow completely around the piston.

The rearward end of the block **115** is provided with an annular groove **132** for receiving a gasket **133** which sealingly engages the piston **113** and the end cap **134**.

The piston **113** is solid, and forward movement of the piston forces material in the bore **117** of the pumping block **114** past the ball valve **121** and through the outlet port **124**. As the piston is retracted, the ball valve is forced against the valve seat **119** by the spring **122**, and back flow of material from the outlet port is prevented. As the forward end of the piston passes rearwardly of the O-ring **127**, the vacuum within the bore **117** draws material from the inlet port **131** into the bore **117**.

Means for selectively varying the pumping stroke of the piston is provided in the form of a stop plate **135** which is slidably mounted on support rods **136** and **137** secured to the cylinder. Referring to FIG. **10**, the stop plate **135** is provided with a central opening **138** having a diameter approximately the same as the diameter of the piston **113** and a pair of outer openings **139** and **140** for receiving the support rods **136** and **137**. The stop plate may be secured at a desired point along the support rods by conventional lock nuts **138** which can be tightened about the support rods. A radially enlarged abutment **139** is carried by the piston **113**, and forward movement of the piston is stopped when the abutment engages the stop bar. The amount of material pumped during each reciprocation of the piston can thereby be accurately controlled.

While I have described the stop means in conjunction with the pump **110**, it will be understood that a similar stop means can be provided for the pumps **15** and **16**, and the stop means can be mounted directly on the frame rather than on the cylinders.

While in the foregoing specification, detailed descriptions of specific embodiment of my invention was set forth for the purpose of illustration, it is to be understood that many of the details herein given may be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. A positive displacement piston pump for pumping fluid comprising cylinder means having a forward end and a rearward end and an axially extending bore, a piston having a forward end portion slidably received by said bore, the piston sized to provide a substantially fluid-tight seal with the bore, and means for axially

moving the piston within the bore, the bore of the cylinder means being provided with an enlarged inlet chamber and an enlarged circumferentially extending outlet chamber spaced axially rearwardly of the inlet chamber, said cylinder means having inlet port means for communicating the inlet chamber with a source of the fluid to be pumped and outlet port means for withdrawing fluid from the outlet chamber, said piston having a bore extending axially through the center of the piston from the forward end thereof and an opening for communicating the piston bore with the bore of the cylinder means, the opening in the piston being provided in an annular groove in the piston, and sealing means within said pump for sealing the annular groove in the piston and the piston opening from the outlet chamber until the forward piston end passes forwardly of the inlet chamber, the annular groove in the piston permitting circumferential flow of fluid from the groove to the outlet chamber when the groove communicates with the outlet chamber.

2. The pump of claim **5** in which the sealing means is positioned in the bore of the cylinder means rearwardly of the outlet chamber, the distance between the forward end of the piston and the annular groove in the piston being greater than the distance between the forward end of the inlet chamber and the sealing means whereby the sealing means seals the annular groove in the piston from the outlet chamber until the forward piston end passes the forward end of the inlet chamber.

3. A positive displacement piston pump for pumping fluid comprising cylinder means having a forward end and a rearward end and an axially extending bore, a piston having a forward end portion slidably received by said bore, the piston sized to provide a substantially fluid-tight seal with the bore, and means for axially moving the piston within the bore, the bore of the cylinder means being provided with an enlarged inlet chamber and an enlarged outlet chamber spaced axially rearwardly of the inlet chamber, said cylinder means having inlet port means for communicating the inlet chamber with a source of the fluid to be pumped and outlet port means for withdrawing fluid from the outlet chamber, said piston having a bore extending axially through the center of the piston from the forward end thereof and an opening for communicating the piston bore with the bore of the cylinder means, and sealing means within said pump for sealing the piston opening from the outlet chamber until the forward piston end passes forwardly of the inlet chamber, the bore of the cylinder means including an enlarged flushing chamber spaced axially rearwardly of the sealing means, a cylindrical sleeve within the flushing chamber, the piston being slidably received by the sleeve, and an O-ring within the flushing chamber rearwardly of the sleeve, the O-ring sealingly engaging the piston and being restrained against forward movement by the sleeve, the cylinder means having a solvent inlet port for communicating the flushing chamber with a solvent and a solvent outlet port communicating with the flushing chamber for removing solvent from the flushing chamber whereby solvent washes the piston as it reciprocates within the flushing chamber.

4. The pump of claim **3** in which the sleeve is provided with a plurality of openings to permit substantially free solvent flow between the sleeve and the piston.

5. A positive displacement piston pump for pumping fluid comprising cylinder means having a forward end and a rearward end and an axially extending bore, a piston having a forward end portion slidably received by said bore, the piston sized to provide a substantially fluid-tight seal with the bore, and means for axially moving the piston within the bore, the bore of the cylinder means being provided with an enlarged inlet chamber and an enlarged outlet chamber spaced axially rearwardly of the inlet chamber, said cylinder means having inlet port means for communicating the inlet chamber with a source of the fluid to be pumped and outlet port means for withdrawing fluid from the outlet chamber, said piston having a bore extending axially through the center of the piston from the forward end thereof and an opening for communicating the piston bore with the bore of the cylinder means, and sealing means within said pump for sealing the piston opening from the outlet chamber until the forward piston end passes forwardly of the inlet chamber, the sealing means including a generally cylindrical sleeve having a central bore positioned within the cylinder means, the piston being slidably received by the sleeve, the sleeve being provided with an annular groove extending radially outwardly from the sleeve bore, and an O-ring positioned within the annular groove of the sleeve and sealingly engaging the piston.

6. The pump of claim **5** in which the sleeve includes a second annular groove extending radially outwardly from the sleeve bore, and a second O-ring positioned within the second annular groove of the sleeve and sealingly engaging the piston.

7. The pump of claim **5** in which the piston is provided with a radially inwardly extending annular groove, the piston opening being provided through the annular groove whereby the piston opening is sealed from the outlet chamber until the annular groove of the piston passes forwardly of the O-ring.

8. A positive displacement piston pump for pumping fluid comprising cylinder means having a forward end and a rearward end and an axially extending bore, a piston having a forward end portion slidably received by said bore, the piston sized to provide a substantially fluid-tight seal with the bore, and means for axially moving the piston within the bore, the bore of the cylinder means being provided with an enlarged inlet chamber and an enlarged outlet chamber spaced axially rearwardly of the inlet chamber, said cylinder means having inlet port means for communicating the inlet chamber with a source of the fluid to be pumped and outlet port means for withdrawing fluid from the outlet chamber, said piston having a bore extending axially through the center of the piston from the forward end thereof and an opening for communicating the piston bore with the bore of the cylinder means, and sealing means within said pump for sealing the piston opening from the outlet chamber until the forward piston end passes forwardly of the inlet chamber, check valve means within the bore of the piston for permitting fluid flow from the forward end of the piston toward the piston opening when the piston is moving forwardly but preventing fluid flow from the piston opening toward the forward end of the piston when the piston is moving rearwardly, the check valve means including an externally threaded generally cylindrical plug threadedly received by the forward end of the piston bore and provided with a central opening therethrough, the rearward end of the plug

being generally concave to provide a valve seat having an opening therethrough, a ball having a diameter greater than the opening through the plug and having a radius of curvature less than the radius of curvature of the concave end of the plug, the ball being resiliently biased forwardly against the valve seat to close the opening therethrough.

9. The pump of claim **8** including a rod extending forwardly within the piston bore from the rear end of the bore, the diameter of the rod being less than the diameter of the piston bore, and a spring carried by the forward end of the rod resiliently biasing the ball against the valve seat.

10. A positive displacement piston pump for pumping fluid comprising cylinder means having a forward end and a rearward end and an axially extending bore, a piston having a forward end portion slidably received by said bore, the piston sized to provide a substantially fluid-tight seal with the bore, and means for axially moving the piston within the bore, the bore of the cylinder means being provided with an enlarged inlet chamber and an enlarged outlet chamber spaced axially rearwardly of the inlet chamber, said cylinder means having inlet port means for communicating the inlet chamber with a source of the fluid to be pumped and outlet port means for withdrawing fluid from the outlet chamber, said piston having a bore extending axially through the center of the piston from the forward end thereof and an opening for communicating the piston bore with the bore of the cylinder means, and sealing means within said pump for sealing the piston opening from the outlet chamber until the forward piston end passes forwardly of the inlet chamber, the means for axially moving the piston including a motor having a reciprocating piston rod, a pivotally mounted lever arm having a pair of ends, one end of the lever arm being pivotally connected to the piston rod of the motor, the other end of the lever arm being provided with an elongated slot, connecting means carried by the slotted end of the lever arm and secured to the piston, and means for selectively securing the connecting means in a predetermined position along the slot.

11. A pumping apparatus comprising a frame, cylinder means on the frame having an axially extending bore, a piston slidably received by the bore, means for reciprocating the piston within the bore, the cylinder means having inlet port means for communicating the bore with a source of fluid to be pumped and circumferentially extending outlet port means communicating with the bore for permitting fluid to be pumped from the bore, said piston having a bore extending axially through the center of the piston from the forward end thereof and having an opening for communicating the piston bore with the bore of the cylinder means whereby fluid may flow from the inlet port through the bore of the piston to the outlet port, the opening in the piston being provided in an annular groove in the piston, sealing means between the cylinder means and the piston for sealing the annular groove in the piston and the piston opening from the outlet port means when the annular groove in the piston is positioned rearwardly of the sealing means, the bore of the cylinder means including an enlarged flushing chamber spaced axially rearwardly of the sealing means, the cylinder means having a solvent inlet port for communicating the flushing chamber with a solvent and a solvent outlet port communicating with the flushing chamber for removing solvent from the flushing chamber whereby solvent washes the piston as it reciprocates within the flushing chamber.

12. The apparatus of claim **11** including check valve means within the bore of the piston for permitting fluid flow from the forward end of the piston toward the piston opening when the piston is moving forwardly but preventing fluid flow from the piston opening toward the forward end of the piston when the piston is moving rearwardly.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,802,805 Dated April 9, 1974

Inventor(s) John O. Roeser

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In claim 2, line 1, "5" should be --1--.

Signed and sealed this 30th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents