Nov. 4, 1969 J. WAGNER 3,476,052

HIGH PRESSURE PUMP FOR SPRAYER

Filed July 9, 1968 2 Sheets-Sheet 1

FIG 2

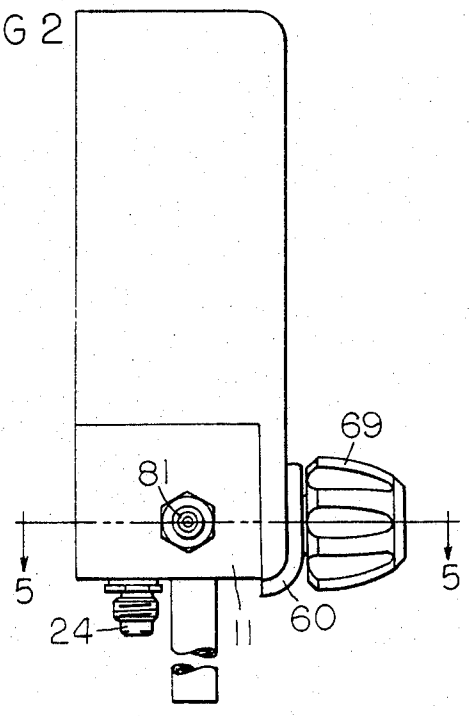


FIG 1

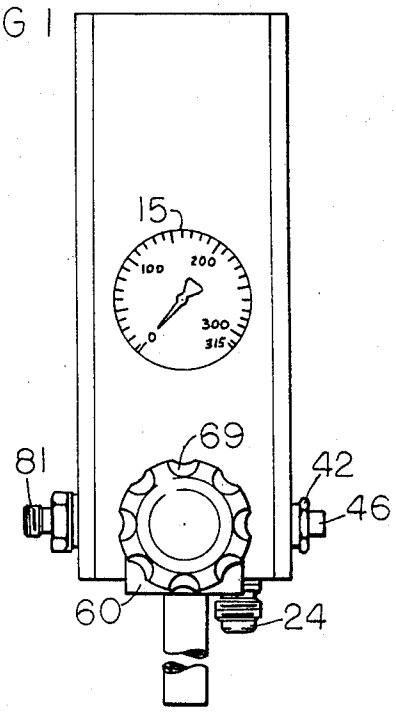


FIG 4

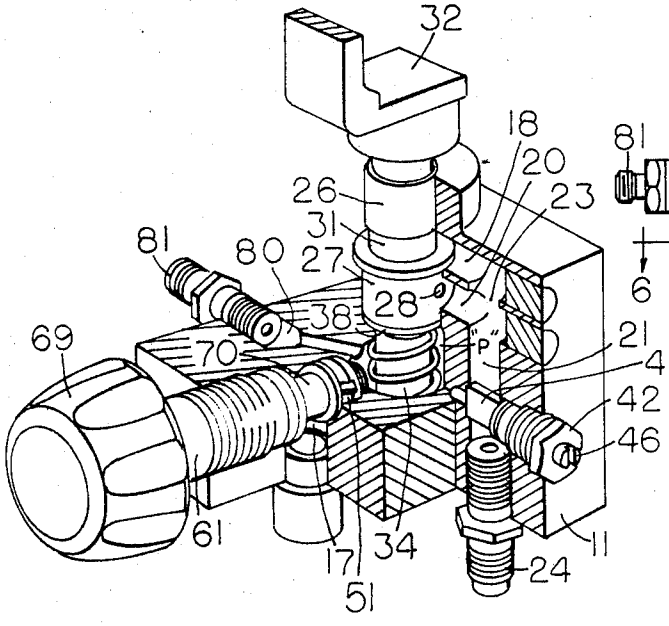
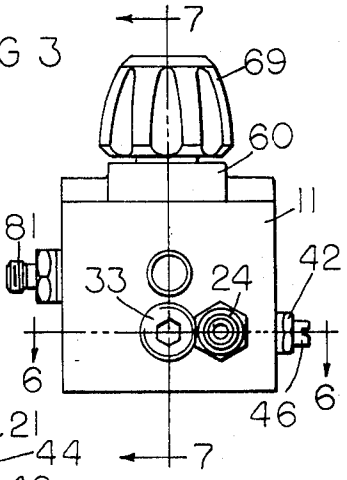


FIG 3



INVENTOR
JOSEF WAGNER
BY
William Frederick Werner
ATTORNEY

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HIGH PRESSURE PUMP FOR SPRAYER

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FIG 6

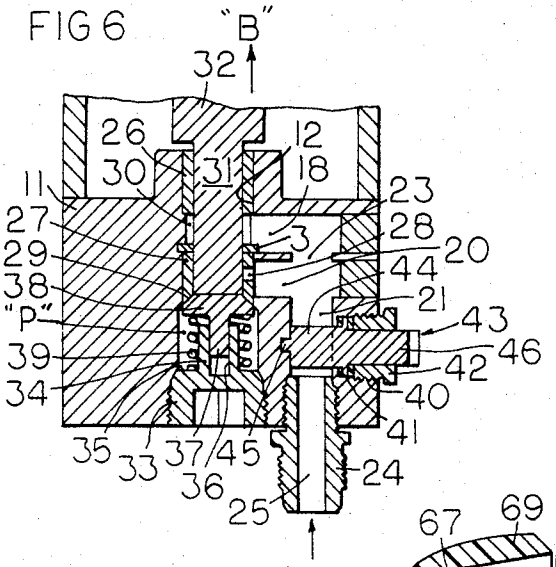


FIG 7

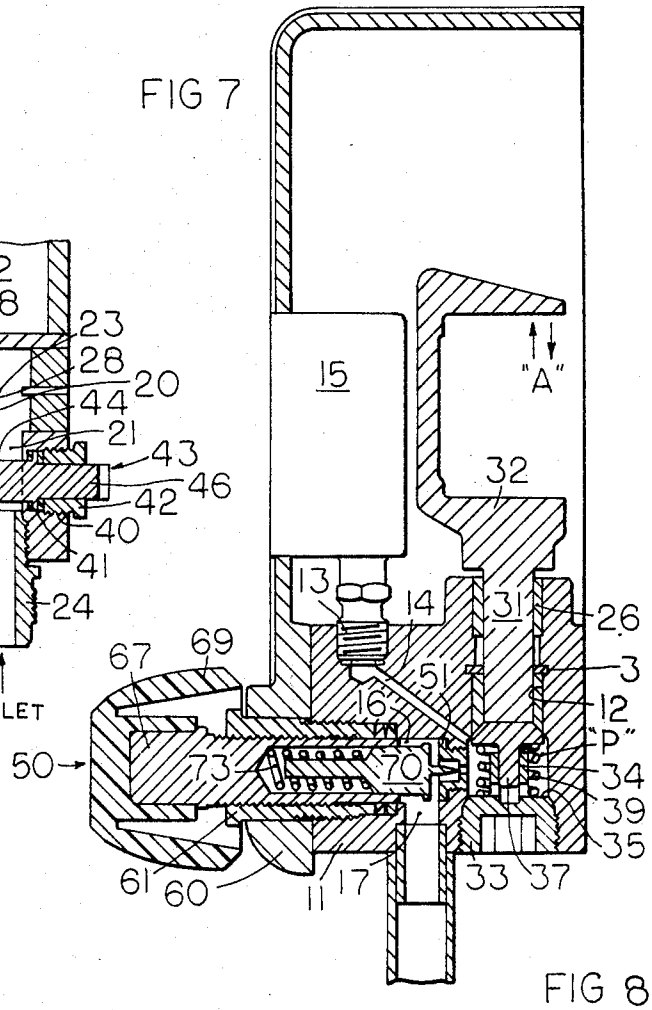


FIG 5

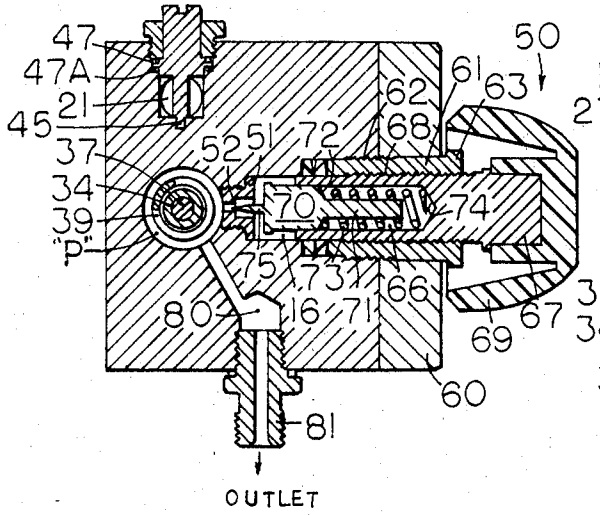
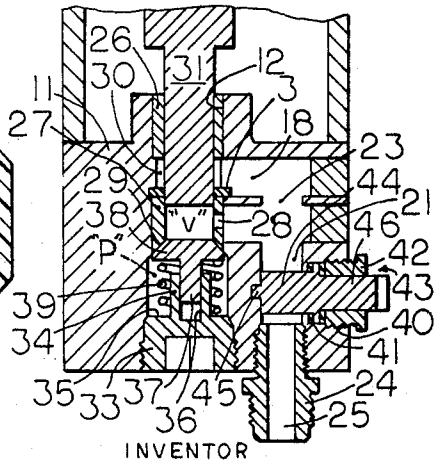


FIG 8



INVENTOR
JOSEF WAGNER
BY William Frederick Hemer
ATTORNEY

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3,476,052

HIGH PRESSURE PUMP FOR SPRAYER

Josef Wagner, 507 Postfach, 799
Friedrichshafen 12, Germany

Continuation-in-part of application Ser. No. 647,139, June 19, 1967. This application July 9, 1968, Ser. No. 743,437
Int. Cl. F04b *49/00, 19/22;* F04d *15/02*
U.S. Cl. 103—41 5 Claims

ABSTRACT OF THE DISCLOSURE

A high pressure pump for a sprayer having a positively driven piston operating a suction valve, said operation forming a pressure chamber, an outlet from said pressure chamber, a regulating valve operatively connected to said pressure chamber, a suction bore inlet, a throttle valve operatively connected to said suction bore inlet, and a leak-off conduit in communication with said suction bore inlet.

This application is a continuation-in-part of patent application, Ser. No. 647,139 filed June 19, 1967, now Patent No. 3,430,577.

This invention relates to improvements in airless sprayers such as paint sprayers. More particularly it relates to a construction for a high pressure positively driven piston pump for such sprayers, including the draining of leak-off liquid accumulating in the pump, a throttle valve, and a regulating by-pass needle valve.

Prior art pump constructions permitted paint to stick and seize the pump piston to the piston sleeve. The paint would also build up as a crust at points which were not easily accessible for cleaning.

Parent application Ser. No. 647,139, corrected some of the problems found in prior art pumps. It has been found through empirical observation that a pump piston is better served when positively driven in two directions in place of being driven in one direction against the tension of a spring, and the spring react to move the piston in an opposite direction.

In this manner, partially dried or very high viscosity paint cannot hinder the reciprocating motion of the piston. In the parent application the by-pass valve is on the pressure side of the piston. Constant re-circulation of paint leads to the heating up of the paint. To overcome this disadvantage, a throttle valve is placed on the suction side of the piston.

Accordingly, it is an object of the present invention to provide a construction wherein the pump piston is positively driven in two directions.

Another object of the present invention is to provide a piston pump with a by-pass valve on the suction side of the piston.

Still another object of the present invention is to provide means, whereby, the by-pass valve does not close completely, so that a very small amount of liquid will constantly re-circulate within the pump. In this manner, the pump piston is prevented from operating in a completely dry condition.

Other objects of the present invention will become apparent in part and be pointed out in part in the following specification and claims.

Referring to the drawings in which similar characters of reference refer to like parts:

FIGURE 1 is a front elevational view of the pump portion of a sprayer;

FIGURE 2 is a left side elevational view of FIGURE 1;

FIGURE 3 is a bottom plan view of FIGURE 1;

FIGURE 4 is a fragmentary perspective view, partly in section of the pump housing;

FIGURE 5 is a horizontal cross-sectional view, taken on line 5—5 of FIGURE 2;

FIGURE 6 is a horizontal cross-sectional view, taken on line 6—6 of FIGURE 3;

FIGURE 7 is a horizontal cross-sectional view, taken on line 7—7 of FIGURE 3, in a plane at right angles to the plane of FIGURE 6;

FIGURE 8 is a view, similar to FIGURE 6, showing the piston in vacuum or fluid intake position.

In proceeding with this invention, reference is made to all of the figures of the drawing.

With special reference to FIGURES 4, 5, 6, 7 and 8, a block of material constitutes a pump housing **11** provided with a piston bore **12**. Piston bore **12** may be provided with a tungsten carbide bushing **26** and fastened therein, by means of a drive fit, and a tungsten carbide piston cylinder **27** having an inlet orifice **28**, a beveled valve seat **29**, and also fastened in piston bore **12** by means of a drive fit. When bushing **26** and cylinder **27** are provided as liners in piston bore **12**, a duct **30** is provided between bushing **26** and cylinder **27**. A snap ring **3** may be provided in the wall of piston bore **12** as a stop for cylinder **27**. A suction inlet bore **21**, an inlet chamber **20**, a leak-off conduit **18** and a return conduit **23** are provided in pump housing **11**. Inlet chamber **20** connects suction inlet bore **21** with inlet orifice **28**. Return conduit **23** connects leak-off conduit **18** with inlet chamber **20**, so that a fluid flow path is provided between duct **30** and inlet orifice **28**, through inlet chamber **20**. Inlet orifice **28** connects piston bore **12** with inlet chamber **20** and suction inlet bore **21**.

A piston **31** provided with a cam yoke, C shaped, follower **32** is slidably mounted in bushing **26** and piston cylinder **27**.

A support cap **33** provided with a neck **34**, shoulder **35** (FIGURE 6) and an axial bore **36** is fastened to block one end of piston bore **12**. A suction valve stem **37** provided with valve head **38** having a beveled face is slidably mounted in axial bore **36** by means of stem **37**. A coil spring **39** surrounds neck **34** and is interposed between shoulder **35** and head **38**. Coil spring **39** resiliently urges beveled face against valve seat **29**. A pressure chamber P is formed in piston bore **12** between valve seat **29** and shoulder **35**. A pressure regulating conduit **16** provides an outlet from pressure chamber P. A by-pass conduit **17** provides an outlet from pressure regulating conduit **16**. A high pressure outlet **80** (FIGURES 4 and 5) provides a fluid flow path from pressure chamber P to a fitting **81**, rotatively mounted in pump housing **11**, to which a spray gun (not shown) may be attached.

A threaded bore **40** having a base **41** is provided in pump housing **11**. A bushing **42** is rotatively mounted in threaded bore **40**. A throttle valve, generally indicated by reference numeral **43**, consists of a flat parallel sided wing **44**, a tit **45** extending from wing **44** on one end, a stem **46** projecting from the opposite end of wing **44**, and a collar **48**. Tit **45** rotatively engages a bore in pump housing **11** provided for that purpose. Stem **46** is rotatively mounted in bushing **42**. Friction washers **47**, **47A** are placed on opposite sides of collar **48**, so that the end of bushing **42** frictionally engages washers **47**, **47A** and collar **46** with base **41**.

A pressure regulating valve, generally indicated by reference numeral **50**, (see FIGURE 5) comprises a bushing **51** provided with a needle valve seat **52** and fastened in pump housing **11** at the juncture of pressure regulating conduit **16** and pressure chamber P.

A cover guard **60** is fastened to pump housing **11** by means of a bushing **61** rotatively mounted in threads **62** provided in pump housing **11**. Bushing **61** has a shoulder **63** which engages cover guard **60** so it fastens guard **60** in position.

A sleeve **65** provided with an axial orifice **66** and an enlarged head **67** is rotatively connected to bushing **61** by means of threads **68**. A knob **69** may be fastened to head **67** by means of a drive fit.

The pressure regulating by-pass valve **50**, also comprises a flat parallel sided wing **70** and a shank **71** forming a shoulder **72**. Wing **70** is rotatively mounted in axial orifice **66** with a coil spring **73** located in axial orifice **66** and interposed between shoulder **72** and the base **74** of orifice **66**. A needle valve **75** is fastened in the end of wing **70** and is adapted to engage needle valve seat **52** under the resilient force of coil spring **73**.

A pressure gauge fitting connection **13** is provided in pump housing **11**, with a by-pass conduit **14** connecting pressure chamber P, with fitting connection **13**. A pressure gauge **15** may be attached to fitting connection **13**.

A fitting **24** having a conduit **25** is rotatively mounted in pump housing **11**, with conduit **25** forming a continuation of suction bore **21**, so as to be attached to a supply of fluid.

In operation, a cam (not shown), rotates, so as to reciprocate cam follower **32**. This would be an "up" and "down" motion, the direction of arrows A in FIGURE 7. Piston **31** is therefore, positively driven, in reciprocating motion.

Reference is made to FIGURE 6. Arrow B indicates the direction (upward) of piston **31** in the fluid intake stroke. FIGURE 8 shows the piston **31** at the top of the intake stroke, and about to move into the (downward) fluid exhaust stroke.

This FIGURE 8 shows a vacuum chamber V formed between the end of piston **31** and the top of suction valve head **38**. The vacuum causes fluid to flow through suction inlet bore **21** passed wing **44** of throttle valve **43** into inlet chamber **20** and through inlet orfice **28** into vacuum chamber V. As the piston moves (downward) in the fluid exhaust stroke, valve head **38** moves away from valve seat **29** against the tension of spring **39** and the fluid, now under pressure created by the downstroke of the piston, flows into pressure chamber P. On the downstroke, the bottom of piston **31** forces the fluid in three directions, simultaneously. First, the fluid will act against valve head **38** so as to move the beveled face of valve head **38** away from valve seat **29**. The fluid will flow from pressure chamber P through high pressure outlet **80** to a tool such as a sprayer.

Secondly the fluid will flow through the clearance provided around the outside diameter of piston **31** and the inside of piston cylinder **27** and into duct **30** where the fluid flow will continue into leak-off conduit **18**, return conduit **23** and into inlet chamber **20**, so as to mix with the fluid supply in inlet chamber **20**.

Thirdly, the fluid will tend to back out through inlet orifice **28**. This orifice **28** is of a size to be too small in comparison to the volume of vacuum chamber V to make the flow through orifice **28**, inconsequential. There will also be some back pressure in inlet chamber **20**.

In the present invention let it be supposed that a paint spray gun is attached to fitting **81** and that the nozzle chosen for the spray gun has a very small orifice. The stroke of piston **31** is constant. The volume of paint pumped is therefore constant. Therefore, back pressure developes in high presure outlet **80** because the volume of paint pumped from pressure chamber P exceeds the volume of paint which can be discharged from the nozzle. To take care of this contingency, applicant places a manually operated throttle valve **43**, in the suction bore **21**. This throttle valve **43** controls the volume of fluid permitted to pass through suction inlet bore **21** and is regulated in accordance with the volume of discharge choosen, by way of the spray gun nozzle. This throttle control **43** controls the volume of fluid passing through the pump and controls the volume of fluid within the pump and thereby reduce the hazard of recirculating excess fluid (paint) which heats up when recirculated.

Paints with hammer finishes which become damaged if recirculated, may be pumped by the instant structure.

If the spray gun is shut-off or if the volume of paint is not fully discharged from pressure chamber P, the needle valve **75** of regulating by-pass valve **50** will be actuated, so as to bleed the excess volume of fluid from pressure chamber P.

Regulating valve **50** is also an adjustment for the volume of fluid which will pass from pressure chamber P to high pressure outlet **80**. The rotation of knob **69** increases or decreases the compression on spring **73**. Needle valve **75** is normally engaged with needle valve seat **52** under the degree of pressure exerted upon needle valve **75**. When the fluid pressure in pressure chamber P exceeds the force of spring **73**, needle valve **75** will move away from valve seat **52** to thereby permit the fluid in pressure chamber P to by-pass needle valve **75** and flow into by-pass conduit **17** and back into the fluid container.

It will therefore, be understood, that the fluid to be pumped will determine if the regulating by-pass valve **50** is a needed structure in combination with throttle valve **43** or if either the regulating by-pass valve **50** or the throttle valve **43**, will be used separately or jointly.

Having shown and described a preferred embodiment of the present invention by way of example, it should be realized that structural changes could be made and other examples given without departing from either the spirit or scope of this invention.

What I claim is:

1. A high pressure pump for a sprayer consisting of a pump housing having a piston bore, a piston cylinder provided with an inlet orifice, means fastening said piston cylinder in said piston bore, a bushing, means fastening said bushing in said piston bore in spaced relation to said piston cylinder to provide a duct therebetween, a suction inlet bore, an inlet chamber providing a flow path between said inlet orifice and said suction bore, a leak-off conduit in communication with said duct, a return conduit between said leak-off conduit and said inlet chamber, a suction valve, means fastening said suction valve in said piston bore, a pressure chamber located in said piston bore with said suction valve controlling the flow of fluid into said pressure chamber, a high pressure outlet in communication with said pressure chamber, a piston slidably mounted in said piston cylinder and in said bushing, movement of said piston away from said suction valve creates a vacuum chamber in said piston bore, whereby fluid flows from said suction inlet bore through said inlet chamber and inlet orifice into said vacuum chamber, and reciprocation of said piston actuates said suction valve, to force fluid from said vacuum chamber past said suction valve and into said pressure chamber to said high pressure outlet, a throttle valve, and means fastening said throttle valve in said pump housing and in the flow path of said suction inlet bore, thereby to control the volume of fluid flowing into said vacuum chamber.

2. A high pressure pump for a sprayer, as claimed in claim **1**, in which said pump housing is provided with a pressure regulating conduit in communication with said pressure chamber, a by-pass conduit in communication with said pressure regulating conduit, providing a fluid flow path from said pressure regulating conduit through said pump housing, and a regulating valve, means fastening said regulating valve in said pressure regulating conduit to thereby control the fluid pressure in said pressure regulating conduit to thereby control the fluid pressure in said pressure chamber.

3. A high pressure pump for a sprayer as claimed in claim **1**, in which said piston cylinder and said bushing are fabricated from tungsten carbide material.

4. A high pressure pump for a sprayer consisting of a pump housing having a piston bore, a suction inlet bore, means providing a fluid flow path between said suction

inlet bore and said piston bore, including an inlet orifice, a throttle valve, means fastening said throttle valve in said pump housing in the flow path of said suction inlet bore, a pressure chamber in said piston bore, a high pressure outlet in said pump housing in communication with said pressure chamber, a suction valve located in said piston bore, means fastening said suction valve to said pump housing to control fluid flow into said pressure chamber, and a piston slidably mounted in said piston bore whereby actuation of said piston in one direction creates a vacuum chamber in said piston bore whereby, fluid flows from said suction inlet bore, passed said throttle valve and inlet orifice into said vacuum chamber, and actuation of said piston in an opposite direction actuates said suction valve to pressure actuate fluid past said suction valve into said pressure chamber whereby fluid may flow through said high pressure outlet, a duct provided in said piston bore, and means in said pump housing for providing a conduit from said duct to said suction inlet bore, to provide for fluid located between said piston and piston bore to be recirculated, said pump housing further including a pressure regulating conduit having an outlet in communication with said pressure chamber, a regulating by-pass valve in said regulating conduit which by-pass valve regulates the pressure within said pressure chamber.

5. A high pressure pump for a sprayer as claimed in claim 4, in which said regulating by-pass valve comprises an adjustable needle valve located at the juncture of said pressure chamber and said pressure regulating conduit.

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DONLEY J. STOCKING, Primary Examiner

WARREN J. KRAUSS, Assistant Examiner

U.S. Cl. X.R.

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