United States Patent

Yarger

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[54] **PISTON TYPE PUMP**

[72] Inventor: **Donald L. Yarger,** 5118 Timberlane, Woodstock, Ill. 60098

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[51] **Int. Cl.**.....**F04b 49/00,** F04b 1/08

[58] **Field of Search**.....417/273, 454, 269, 567; 92/169

[56] **References Cited**

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Primary Examiner—William L. Freeh

Attorney—McCanna, Morsbach, Pillote & Muir

[57] **ABSTRACT**

A piston type pump having a cylinder sleeve mounted in a pump cartridge assembly for insertion and removal with the cartridge assembly from a bore in the pump casing. The cartridge assembly has a head portion extending across the outer end of the casing bore and a sleeve portion integral with the head portion, and the cylinder sleeve is pressed into the sleeve portion to provide a wear liner for the pump piston. Outlet passage means and outlet check valve means are provided in the head portion of the cartridge to control discharge of fluid from the pump, and inlet passage means and inlet check valve means are provided in the pump piston to control intake of fluid.

4 Claims, 2 Drawing Figures

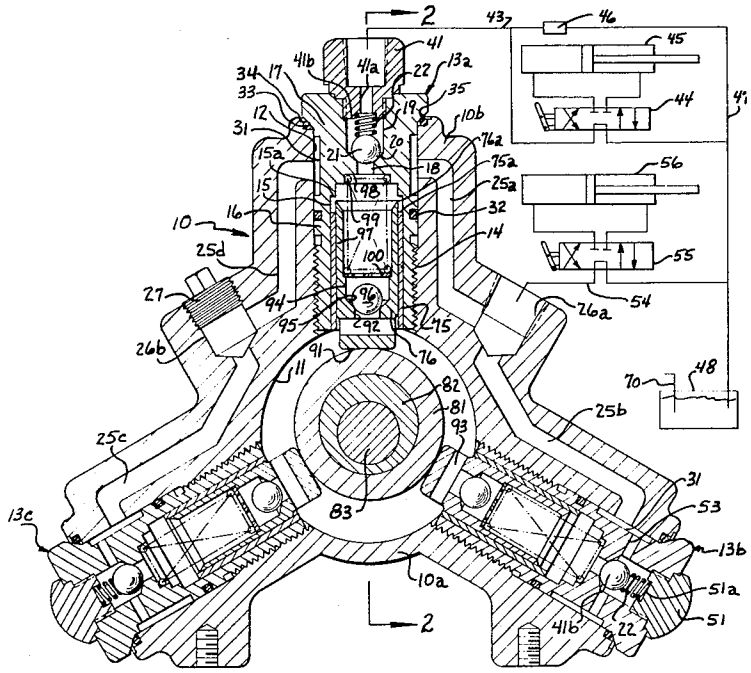


Fig. 1.

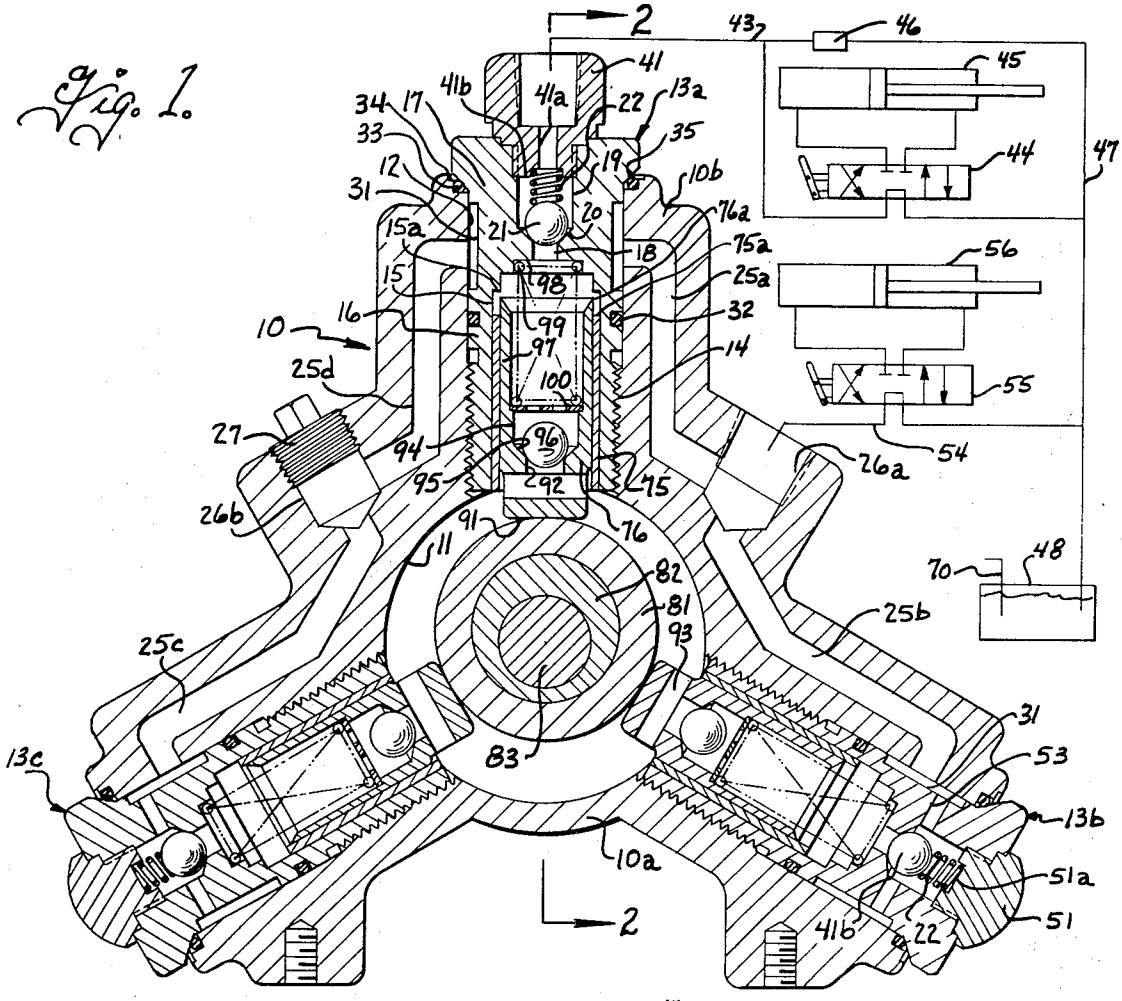
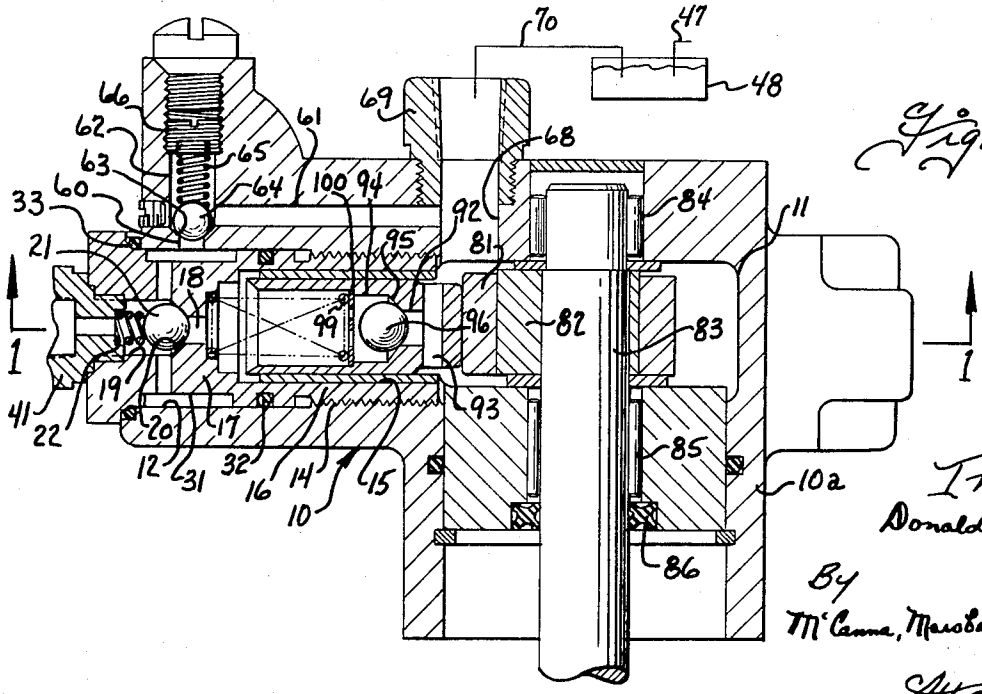


Fig. 2



Inventor
Donald L. Yarger

By
McCanna, Morsbach, Pillote & Mac

Attorneys

PISTON TYPE PUMP

BACKGROUND OF THE INVENTION

The pump cylinders in piston type pumps are subject to wear and it has heretofore been proposed, as disclosed in the U. S. Pat. to Yarger No. 2,675,759, to mount a cylinder sleeve in the pump casing to provide a wear liner which can be removed and replaced when it becomes worn. However, such cylinder sleeves must fit tightly in the casing to prevent leakage of fluid and it is frequently difficult to remove a worn cylinder sleeve from the pump casing.

SUMMARY OF THE INVENTION

In the present invention, cylinder sleeves which form wear liners for the pump piston are mounted cartridge bodies for insertion and removal as a unit therewith. The cartridge assemblies include a unitary cartridge body having a cartridge bore extending axially therein-to from its inner end and defining a cylinder portion at the inner end of the cartridge body and an integral head portion at the outer end, and the cylinder sleeves extend into the inner end of the cylinder portion of the cartridge body and have a radially tight fit in the cartridge bore to seal the interface between the cylinder sleeve and the cartridge body. This arrangement enables use of cartridge bodies formed of a material which can be different from the materials utilized for the pump casing and which cartridge body material is advantageously selected to provide the desired strength characteristics for withstanding the relatively high pressures commonly employed in piston pumps. The cylinder sleeve is advantageously formed of a material different from the material in the cartridge body and selected to provide the desired wear characteristics. Moreover, with this arrangement, the volumetric displacement of the pump can be varied over a relatively wide range without changing the dimensions of the pump casing or cartridge body, it being only necessary to change the internal diameter and hence the wall thickness of the cylinder sleeves, and to correspondingly change the diameter of the pump pistons which fit in the cylinder sleeves. Outlet check valves are advantageously provided in the head portion of the cartridge assemblies to control flow of fluid from the pump and the cartridge assemblies can be arranged to deliver the fluid axially from the outer end of the cartridge body to a delivery line or laterally of the cartridge body into discharge passages formed in the pump casing. The outer end of the cylinder sleeve is advantageously spaced from the adjacent end of the cartridge bore in the cartridge body to provide an annular recess at the inner end of the cylinder sleeve, and the inner of the cylinder sleeve is advantageously located intermediate the inner and outer limits of travel of the outer end of the pump piston to prevent formation of a ridge on the piston or cylinder sleeve due to wear.

Various important objects of this invention are to provide an improved piston type pump in which a cylinder sleeve wear liner is mounted in a removable cartridge to facilitate servicing and repair of the pump and replacement of the cylinder sleeve when necessary; in which the cylinder sleeve and cartridge body can be formed of relatively different materials selected to provide the desired wear characteristics and strength characteristics in the sleeve and cartridge respectively;

in which the volumetric displacement of the pump can be varied over a wide range without changing the dimensions of the pump casing or cartridge body; and in which a multiple piston type pump embodying the invention can be readily adapted for single or plural discharges.

These, together with other objects, features and advantages of the present invention will be more readily understood by reference to the following description when taken in connection with the accompanying drawings wherein:

FIG. **1** is a sectional view through a multiple piston pump embodying the present invention and taken on the plane **1—1** of FIG. **2**; and

FIG. **2** is a sectional view taken on the plane **2—2** of FIG. **1**.

In the embodiment of the invention illustrated in the accompanying drawings, the pump is of the radial piston type having three radially disposed pistons angularly spaced apart, it being understood that the number of pistons employed can be varied and may be more or less than the number illustrated and that the piston arrangement can also be varied and may, for example, comprise a series of aligned pistons operated from a cam shaft, or an axial piston pump.

In general, the pump includes a casing **10** defining a chamber **11** and having a plurality of casing bores **12** which communicate at their inner end with the chamber **11** and which open at their outer ends at the outer side of the casing. The casing can conveniently comprise a casting and, in the radial piston type pump illustrated, the casing has a central portion **10***a* that defines the chamber **11** and outwardly extending portions **10***b* which have the casing bores **12** formed therein. Pump cartridge assemblies designated **13***a*–**13***c* are disposed in the casing bores **12**, which pump cartridge assemblies have a similar construction and like numerals are used to designate corresponding parts. The pump cartridge assemblies each comprise an elongated generally cylindrical body having an outer diameter dimensioned to fit in a casing bore **12** and the cartridge bodies are removably secured in the casing bores as by threads **14** formed on the inner end of the cartridge body and casing bore. The cartridge bodies have a cartridge bore **15** extending axially inwardly from the inner end of the cartridge body to form a cylinder portion **16** at the inner end of the cartridge body and a head portion **17** at the outer end, which head portion extends across the outer end of the casing bore. Outlet passage means and outlet check valve means are provided in the head portion of the cartridge and, for this purpose, a stepped bore is formed in the head portion to provide an inner reduced diameter passage **18** and an axially outer passage **19** of larger diameter with a tapered shoulder **20** therebetween to provide a valve seat. A check valve, conveniently in the form of a ball **21** is provided in the enlarged passage **19** and cooperates with the shoulder or seat **20** to control flow through the outlet passage. A lightweight spring **22** may be provided to yieldably urge the ball check **21** to its closed position.

The pump casing and cartridge assemblies are arranged so that, with a minor change in the cartridge assembly, the pump can be adapted for either single or plural discharges. In the embodiment illustrated, one

cartridge assembly 13*a* is arranged so as to deliver its output flow to one utilization circuit and the other cartridge assemblies 13*b* and 13*c* are arranged to deliver their combined flows to a second utilization circuit. As best shown in FIG. 1, the pump casing 10 has a cored discharge passages formed therein and arranged to communicate with the casing bores 12 adjacent their outer ends. In order to make the pump casing universally adaptable for either single or multiple discharges, all of the discharge passages in the casing are arranged to intercommunicate with each other and, as shown, include a first discharge passage 25*a* having one end communicating with one casing bore 12 adjacent the outer end of the cartridge assembly 13*a;* a second discharge passage 25*b* having one end communicating with another casing bore 12 adjacent the outer end of the cartridge assembly 13*b;* a third discharge passage 25 *c* communicating with yet another casing bore adjacent the outer end of the cartridge assembly 13*c;* and a fourth discharge passage 25*d* that communicates with the first-mentioned casing bore 12 adjacent the outer end of the cartridge assembly 13*a*. As will be seen from FIG. 1, discharge passages 25*a* and 25*b* communicate with each other and with a discharge fitting 26*a*. Discharge passages 25*c* and 25*d* also communicate with each other and with a second discharge fitting 26*b*. In addition, provision is made for intercommunicating discharge passages 25*a* and 25*d* so that all discharge passages intercommunicate with each other to allow discharge of fluid to either of the discharge outlets 26*a* or 26*b*. In the embodiment shown, only one discharge outlet 26*a* is utilized and the other is closed as by a plug 27.

The cartridge assemblies 13*a*–13*c* are each formed with a peripheral groove 31 located to communicate with the respective discharge passages 25*a*–25*d* and provision is made for sealing the cartridge body to the casing at points inwardly and outwardly of the peripheral groove 31. For this purpose, a first O-ring seal 32 is disposed in a groove in the periphery of the cartridge bodies inwardly of the grooves 31 and a second O-ring type seal 33 is provided between the head portion of the cartridge and the casing, outwardly of the groove 31. The second O-ring seal 32 is similar to an SAE fitting and comprises an O-ring disposed in a counterbore 34 at the outer end of the casing bore 12, which O-ring is clamped by a beveled shoulder 35 on the head portion of the cartridge body. With this arrangement, the cartridge bodies are sealed to the casing inwardly and outwardly of the groove 31 so as to prevent leakage of pump discharge fluid both inwardly toward the chamber 11 and outwardly toward the outside of the casing.

As previously pointed out, the cartridge assemblies can be adapted to either deliver separate flows or combined flows through the discharge passages 25*a*–25*c*. In the form shown, one cartridge assembly 13*a* is arranged for individual delivery and, for this purpose, has a discharge fitting 41 mounted as by threaded engagement with the outer end of the cartridge assembly 13*a*. The fitting 41 has a delivery passage 41*a* formed therein to communicate with the outlet passage 19 in the cartridge assembly and the fitting 41 is conveniently counterbored as indicated at 41*b* at its inner end to provide a seat for the spring 22. Fitting 41 is adapted for connection to one fluid utilization circuit 43 which may, as diagrammatically shown in FIG. 1, include a flow reversing valve 44 and a fluid actuator 45. A separate relief valve 46 may be provided in the utilization circuit 43 and, as shown, the relief valve 46 and the return outlet of valve 44 are connected through a return line 47 to a reservoir 48.

The other cartridge assemblies 13*b* and 13*c* are herein shown arranged to deliver their combined output to the discharge passages 25*a*–25*c*. For this purpose, the outer ends of the bores 19 are closed as by plugs 51 conveniently counterbored as shown at 51*a* at their inner ends to form a guide and seat for the springs 22. Lateral passages 53 are provided in the cartridge assemblies 13*b* and 13*c* to communicate the outlet passages 19 in the cartridge assemblies, after the check valves 41*b* therein, with the peripheral groove 31 so as to allow discharge of fluid from the cartridge assemblies 13*b* and 13*c* into the aforementioned discharge passages 25*a*–25*c*. Discharge passages 25*a*–25*c* are connected to a second fluid utilization circuit 54 herein diagrammatically shown as including a flow reversing valve 55 and a fluid actuator 56.

A built-in relief valve is advantageously provided in the pump casing for the casing discharge passages 25*a*–25. As shown in FIG. 2, the relief valve includes relief passages 60 and 61 which respectively communicate with one of the casing bores 12 adjacent the outer end thereof and with the chamber 11. The casing has an enlarged counterbore 62 aligned with the passage 60 and defining a relief valve seat 63 therebetween and a relief valve, conveniently in the form of a ball 64 is yieldably pressed against the seat as by a relief valve spring 65. The pressure exerted on the relief valve spring can be selectively adjusted as by the threaded screw 66 to thereby adjust the operating pressure of the relief valve. As also shown in FIG. 2, an inlet passage 68 is provided in the pump casing 10 and is adapted for connection as by a fitting 69 to an inlet line 70 leading to the supply reservoir 48.

Cylinder sleeves 75 are mounted in the cartridge bores 15 to provide a wear liner for the pump pistons 76. The cylinder sleeves 75 are formed of a material such as cast iron selected to provide the desired wear characteristics and are fitted tightly in the cartridge bores to seal the interface therebetween. The cylinder sleeves are preferably press-fit in the cartridge bores with their inner ends substantially coterminous with the inner end of the cartridge body, but with the outer end 75*a* of the cylinder sleeves spaced axially from the adjacent end 15*a* of the cartridge bore to provide an annular recess in the cartridge body at the outer ends of the cylinder sleeves. In order to prevent the formation of a wear ridge on either the cylinder sleeve or piston 76 during operation of the pump, the outer end 75*a* of the cylinder sleeve is located intermediate the inner and outer limits of travel of the outer end 76*a* of the piston whereby the outer end of the piston moves outwardly of the end 75*a* of the cylinder sleeve during extension of the pump piston as shown in cartridge 13*a*, and thereafter moves back into the cylinder sleeve as the piston is retracted, as shown in cartridges 13*b* and 13*c*.

The pump pistons 76 are cyclically reciprocated by an actuator, herein shown in the form of a cam ring 81

mounted on an eccentric cam **82** driven by a shaft **83**. As best shown in FIG. **2**, the shaft is rotatably supported as by bearings **84** and **85** on the pump casing, and a shaft seal **86** is provided for sealing the interface between the shaft and the pump casing.

Fluid inlet passage means and inlet check valve means are provided in the pump pistons to admit fluid from the supply chamber **11** into the motive chamber between the piston and the head of the cartridge. The pistons have a head portion **91** that engages the cam ring **81** and the fluid inlet passage includes an axially disposed passage **92** that communicates through lateral passages **93** with the supply chamber **11**. The piston is counterbored at **94** to provide an annular seat **95** around the inlet passage **92** and a check valve, herein shown in the form of a ball **96** cooperates with the seat to control inflow of fluid to the motive chamber. In the preferred embodiment illustrated, the pistons **76** are formed with a skirt **97** at their outer ends which skirt is preferably sufficiently thin to radially expand under the fluid pressure condition developed during the working stroke of the piston, to assure a tight seal between the piston and the cylinder sleeve. Piston return springs **99** are conveniently interposed between the pistons and the head portion of the cartridge and, as shown, the head portion of the cartridge is counterbored at **98** to provide a centering recess for the return springs **99**, while the other end of the return springs engage an apertured plate **100** seated on a shoulder in the piston. The plate **100** is spaced from the seat **95** a distance sufficient to allow the check valve **96** to open during the return stroke of the piston. The inlet check valves will normally close when working stroke of the piston begins. However, if desired, an inlet check valve spring (not shown) can be provided between the inlet check valve ball **96** and the plate **100**. As shown in FIG. **1**, the outer end of the skirt **97** is preferably internally chamfered to provide a thin outer edge on the piston which can be radially expanded by the fluid pressure during the working stroke of the piston to assure a tight seal between the piston and the cylinder sleeve.

From the foregoing it is thought that the construction and operation of the piston pump will be readily understood. The cylinder sleeves provide wear liners for the pistons and are mounted in cartridges for removal as a unit therewith from the pump casing. Thus, when a cylinder sleeve becomes worn or when it is otherwise necessary to service a pump assembly, the cartridge can be removed from the pump casing and the cylinder sleeve replaced if necessary. Since the cylinder sleeve is supported by the cartridge, the material from which the cylinder sleeve is formed can be selected to provide the desired wear characteristics and the cartridge made of a different material such as cold rolled steel to provide the desired strength characteristics in the cartridge for withstanding high pump discharge pressures. Moreover, since the cartridges effectively form self-contained pumping units, the pump casing can itself be formed of a relatively low strength material such as aluminum. The cylinder sleeves, when press-fit in the cartridge bores, have their outer ends spaced from the adjacent end of the cartridge bore to provide a relief recess at the outer end of the cylinder sleeves. Moreover, the ends of the cylinder sleeves are located intermediate the inner and outer limits of travel of the outer ends of the piston so that formation of a ridge on either the cylinder sleeve or piston during use is effectively avoided.

While the embodiment of the present invention as herein disclosed constitutes a presently preferred form, it is to be understood that other forms might be adopted coming within the scope of the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A piston type pump comprising:

a. a pump casing defining a fluid supply chamber and at least one axially elongate casing bore having an inner end communicating with the supply chamber and an outer end opening at the outer side of the casing remote from the supply chamber;

b. a pump cartridge assembly having means removably mounting the same in said casing bore for assembly and removal as a unit therefrom, said cartridge assembly including:

1 a cartridge body having a cartridge bore extending axially thereinto from its inner end and defining a cylinder portion at the inner end of the cartridge body and a head portion at the outer end of the cartridge body, said head portion having outlet passage means therein communicating with the cylinder portion and an outlet check valve in said outlet passage means arranged to open for flow from the cylinder portion and to close to prevent return flow, and

2 a cylinder sleeve formed of a material different from the material of the cartridge body and disposed entirely within the inner end of said cylinder portion of the cartridge body for radial support thereby and having a radially tight fit in the cartridge bore to seal the interface therebetween, said cylinder sleeve having the outer end thereof spaced from the adjacent end of the cartridge bore to form an annular recess at the outer end of the cylinder sleeve,

c. a pump piston slidable in said cylinder sleeve defining a motive chamber between the piston and the head portion of the cartridge body, said piston having inlet passage means communicating the supply chamber with the motive chamber and inlet check valve means in the inlet passage means arranged to open for flow of fluid into the motive chamber; and

d. piston actuator means in said supply chamber operatively engaging said pump piston to cyclically reciprocate the same.

2. A piston pump according to claim **1** wherein said outer end of the cylinder sleeve is located intermediate the limits of travel of the outer end of the pump piston during reciprocation of the latter.

3. A piston pump according to claim **1** wherein said piston has a thin-walled skirt portion at the axially outer end thereof, said cylinder sleeve having the outer end thereof located intermediate the limits of travel of the outer end of the piston during reciprocation of the latter.

4. A piston type pump according to claim **1** wherein said casing has discharge passage means communicating with the casing bore adjacent the outer end of the

latter, said outlet passage means in the cartridge body opening laterally of the cartridge body after the check valve means to communicate with said discharge passage means, said means removably mounting the cartridge assembly in the pump bore includes threads on the outer periphery of the cartridge body at the inner end thereof threadedly engaging the pump bore inwardly of said fluid discharge passage means in the casing and an outwardly extending shoulder on the cartridge body at the outer end thereof engaging the pump casing around the pump bore.

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