United States Patent [19]

Zehner

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[45] **June 18, 1974**

[54] **RECIPROCATING PUMP**

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[21] Appl. No.: **198,667**

[52] **U.S. Cl.** **417/569,** 92/160, 92/259, 417/454

[51] **Int. Cl.** **F01b 31/10,** F04b 21/02

[58] **Field of Search** 92/255, 256, 259, 153, 92/157, 160; 417/454, 569

[56] **References Cited**

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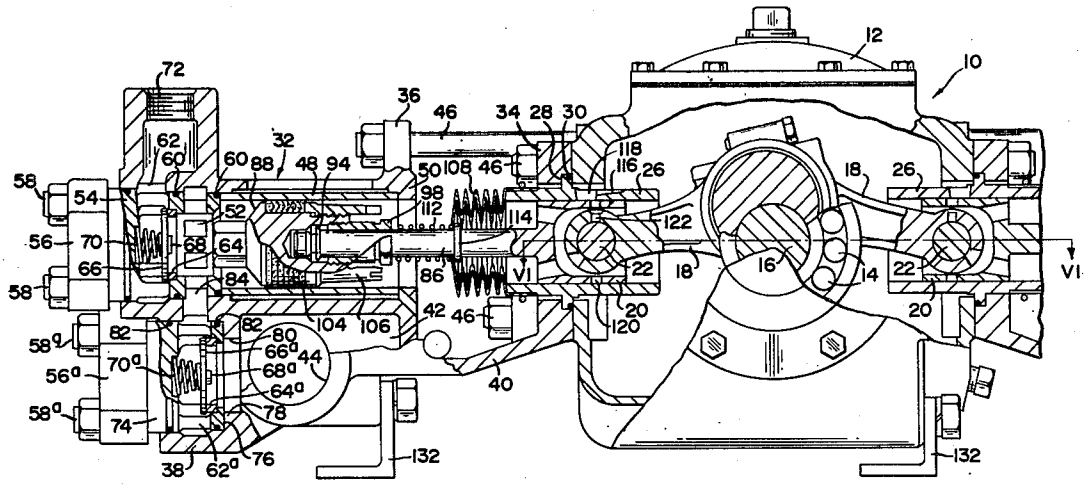
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[57] **ABSTRACT**

A reciprocating pump for liquids and adapted to quick conversion to double its pumping capacity with the addition of extra pumping cylinders. A rotary crankshaft operates through crossheads to drive pistons in the pumping cylinders, and a piston rod rigidly, but releasably, connects each piston and crosshead. Flexible bellows seal between each crosshead guide and piston rod to prevent loss of oil from the case around the piston rod to prevent any of the liquid pumped or outside dirt from reaching the case. The bellows also aid in the circulation of oil from the case to and around each crosshead and associated parts.

3 Claims, 6 Drawing Figures



PATENTED JUN 18 1974

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SHEET 1 OF 2

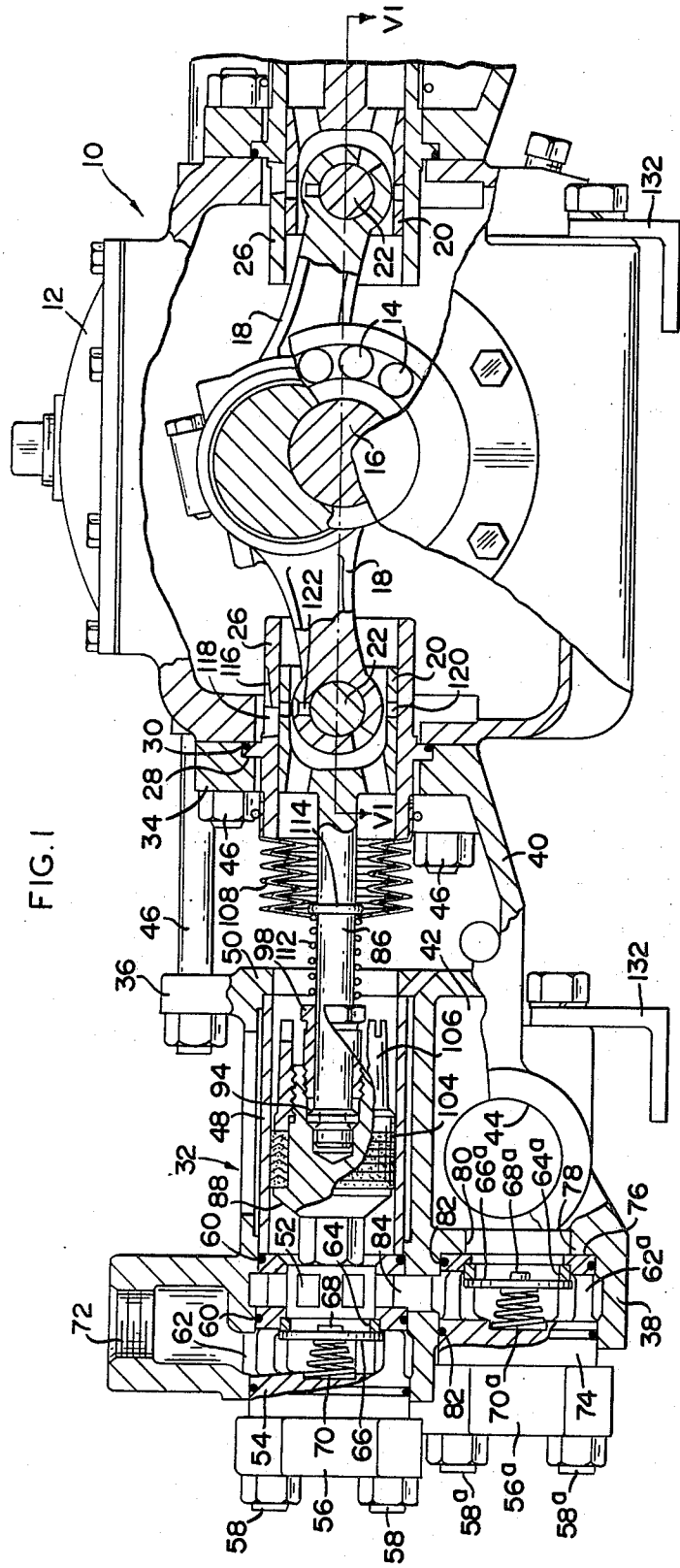


FIG. 1

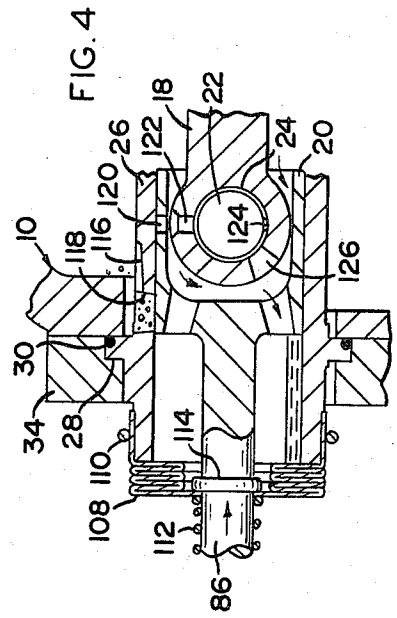


FIG. 4

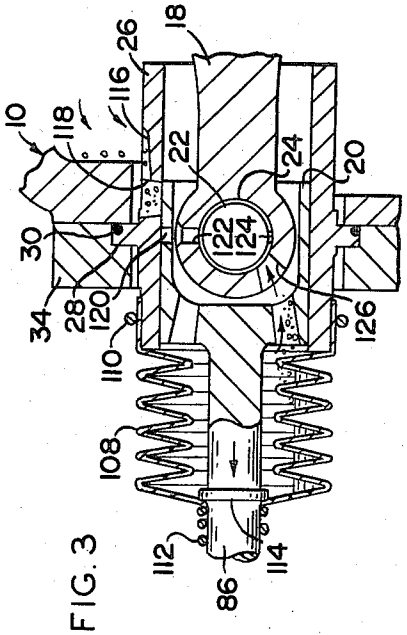
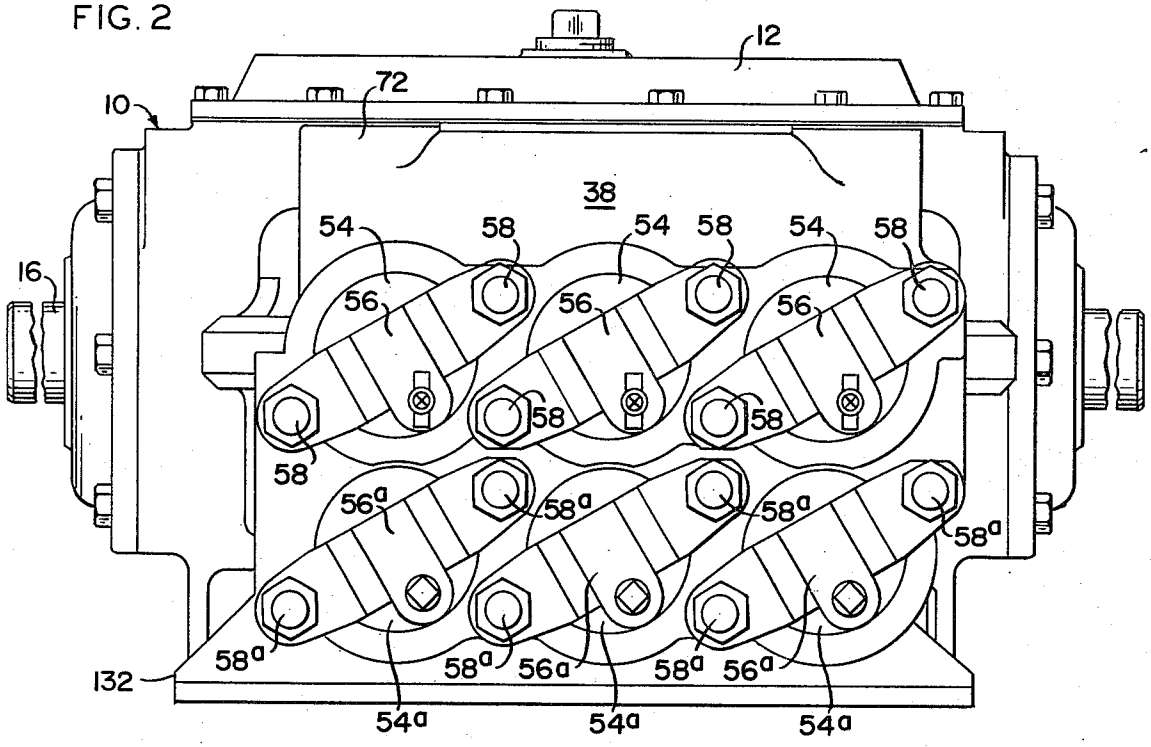


FIG. 3

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FIG. 2



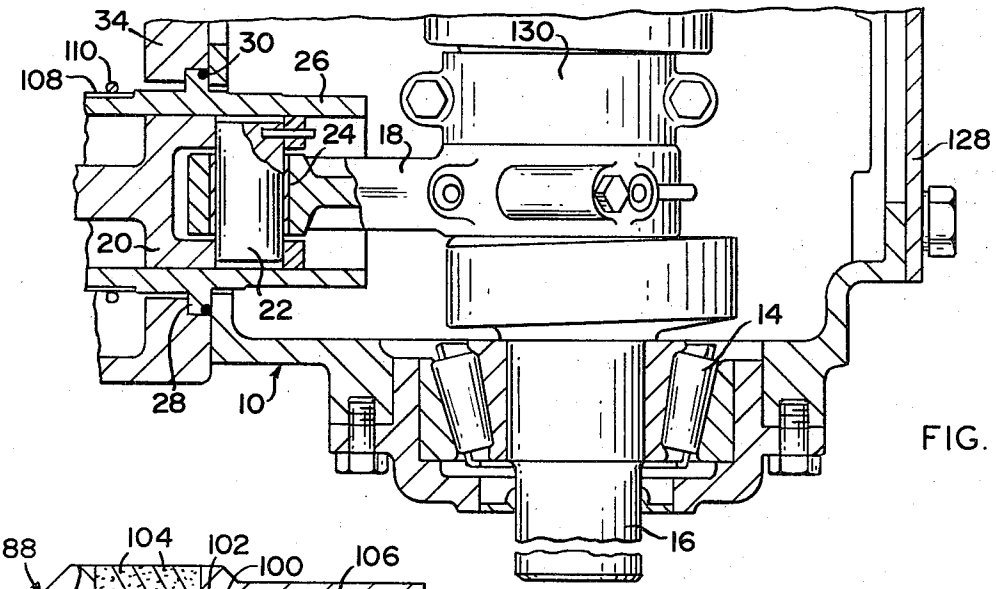


FIG. 6

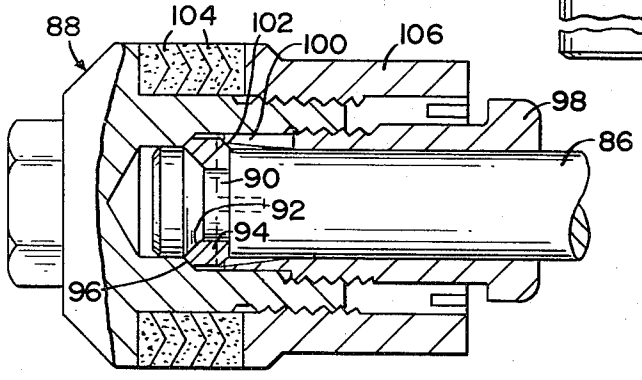


FIG. 5

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RECIPROCATING PUMP

BACKGROUND

Various receiprocating pumps have been proposed heretofore. But, most of these have not included replaceable crosshead sleeves interposed between the crankshaft and the pumping cylinders. Crossheads, as in the present invention, improve operating life, and when provision is made for improved lubrication of the crossheads and associated parts, the complete pump assembly is particularly long lived and trouble free. Also, in known reciprocating pumps for liquids, dirt or liquid pumped has been apt to work back into the crank case, or oil work out of the crank case, both of which leakages are eliminated in the present invention.

SUMMARY OF THE INVENTION

The reciprocating piston pump of the present invention includes a crank case, a crankshaft journalled therein, a plurality of crossheads slidably mounted at one side of the crank case in replaceable sleeves, and a connecting rod between each crosshead and the crankshaft. Each crosshead carries a piston rod on which is mounted a piston, and sealing means are provided between each rod and the crank case. A cylinder surrounds each piston with intake and outlet valves on each cylinder, and intake and outlet manifolds connect respectively the upstream side of the intake valves and the downstream side of the outlet valves.

Among the objects of the invention are to provide an improved liquid pump characterized by particular long life, ready serviceability, relatively low cost, and better performance. An improved oil system is provided, together with improved means for sealing dirt and liquid pumped from the crank case and preventing loss of oil from the crank case, and wherein the sealing means themselves act to supplement the oiling system. Replaceable crosshead sleeves are provided in the pump to facilitate repair. Readily operable means rigidly but releasably secure each piston to its rod, and the pump is adaptable to use with a double or a single bank of pumping cylinders. A final object is to provide an improved valve, piston, and cylinder construction.

THE DRAWINGS

FIG. 1 is a side elevational view, partially broken away in vertical cross section, of the pump of the invention in the double capacity of six cylinder version, the right hand side being largely broken away;

FIG. 2 is an end elevation of the pump of FIG. 1 showing the individual caps of the identical intake and exhaust valves;

FIGS. 3 and 4 are vertical cross sectional views of a crosshead, bellows and piston rod, and illustrate the oil flow thereabouts on the exhaust stroke and intake strokes respectively;

FIG. 5 is an enlarged sectional view illustrating the manner of releasably connecting each piston to its rod; and

FIG. 6 is substantially a horizontal cross sectional view taken on line VI—VI of FIG. 1, but with portions of the connecting rods and crankshaft shown in elevation, and of a modification of the invention wherein no pumping pistons and cylinders, crossheads, etc. are present on the right hand side of the crank case but only a cover plate.

In the drawings the numeral **10** indicates generally a crank case having a top cover **12** and journalling in ball or roller bearings **14** a crankshaft **16** whose ends extend out of the case to be driven by a prime mover (not shown), such as an electric motor. In the embodiment of the invention illustrated, i.e., with three pumping cylinders on each side of the crank case, the crankshaft **16** is formed with three crank arms angularly separated **120** degrees, and each crank arm carries a connecting rod **18** extending to a crosshead **20** and pivotally connected thereto by a pin **22** surrounded by a bushing **24** (see FIGS. **3** and **4**). Each crosshead **20** is guided in true linear movement by a sleeve **26** having a cylindrical flange **28** about its periphery and formed with a groove to receive a sealing O-ring **30.**

Secured to each side of the crank case **10** is a pump head, shown generally at **32,** and having a base flange **34,** a middle flange **36** and an outer flange **38.** The base flange and middle flange are integrally joined with a U-shaped section **40,** and the middle flange **36** and outer flange **38** are integrally joined with an intake manifold or chamber **42** having a conduit connection opening **44.**

The base flange **34** is formed, in the embodiment of the invention illustrated, with three circular openings placed in line horizontally to receive the crosshead sleeves **26,** these openings being counter bored to receive and seal with the flanges **28** of each sleeve. Studs and nuts **46** secure the pump head **32** to the crank case **10.**

The middle flange **36** and outer flange **38** of the pump head **32** are formed with cylindrical openings in line with the crosshead sleeves **26** and each receives a cylinder **48** held against a shoulder **50** by a ported spacer ring **52** and an outlet valve plug **54.** Each valve plug **54** has a spanner bar **56** extending over its outer end and studs and nuts secure the ends of each spanner bar to the outer flange **38** and tighten each cylinder assembly together. Thus, each valve plug and cylinder assembly can be individually serviced. Sealing O-rings **60** render each valve and cylinder assembly fluid-tight.

Each outlet valve plug **54** is formed with circumferentially spaced fingers **62** which engage the ported spacer **52,** and this spacer is counter bored to receive a valve seat **64.** The seat is engaged by a valve disc **66** having a short axial stud **68** on each side gripped by a conical spring **70** snapping into a counter bore on the inner surface of the valve plug. Each valve seat and disc can be accordingly turned over in the event of wear or corrosion. An outlet port **72** formed integrally with the outer flange **38** connects to the down stream side of the outlet valves through the openings of the fingers **62** of each outlet valve plug, and through manifolding openings in the flange **38.**

The inlet valve plugs **74** are identical with the outlet valve plugs, and have identical fingers **62*a***, valve seats **64*a***, valve discs **66*a***, studs **68*a***, springs **70*a***, spanner bars **56*a*** and stud nuts **58*a***. However, a longitudinally shorter spacer **76** carries each valve seat **64*a*** and each is received against a shoulder **78** formed in horizontally aligned bores in the outer flange **38** and connected by large ports **80** with the intake chamber **42.** Sealing O-rings **82** render the intake valve assemblies fluid tight. A port **84** connects via spaced fingers **62a** the down

stream side of each intake valve to its associated pumping cylinder.

Returning to the crossheads **20,** each is formed with an integral piston rod **86** which extends to a piston **88** sliding in each cylinder **48.** Each rod is rigidly and releasably connected to its piston as best seen in FIG. **5.** The end of the piston rod is formed with a groove **90** having a beveled side **92,** and the groove receives a diametrically split wedge ring **94** having one beveled surface engaging the beveled side **92** of groove **90.** The wedge ring also has a beveled surface **96** engaging a complimentary bevel in the piston. The skirt of the piston is internally threaded and receives a nut **98** having a slotted sleeve-like extension **100** with a beveled end **102** engaging a complimentary bevel on wedge ring **94.** Thus, when nut **98** is tightened bevels **102, 96,** and **92** force the split halves of wedge ring **94** tightly into groove **90** and force the fingers of split extension **100** out against the piston to lock the piston **88** on rod **86.**

The piston **88** is grooved to receive packing **104** and a nut **106** threaded to the outside of the piston skirt controls the pressure on the packing.

Positioned between each piston rod **86** and the outer end of each crosshead sleeve **26** is a flexible bellows **108** secured in sealing relation at each end by elastic lock rings **110.** Accordingly, escape of oil from the crank case **10** is prevented, as well as entry of outside dirt or liquid pumped into the crank case. A compression spring **112** surrounds the piston rod **86** bearing at one end on nut **98** to prevent its loosening, and at its other end against elastic lock ring **110** and a shoulder **114** on the rod.

The invention provides an improved manner of lubricating the crossheads in their sleeves and also connecting rod pin **22,** and this is achieved by providing a channel **116** and oil hole **118** in each sleeve **26** which catches oil thrown by the crankshaft **16** and dripping off the wall of the crank case **10.** Oil holes **120** are provided in each crosshead **20,** and hole **122** in each connecting rod **18** for passage of oil. Each connecting rod also has an oil groove **124** and an oil passage **126.** During the reciprocating movement of each crosshead the bellows **108** acts as an oil pump and causes turbulence and splashing of the oil confined adjacent each crosshead. The resulting oil flows are shown in the pressure stroke of FIG. **3** and the suction stroke of FIG. **4.**

FIG. **6** illustrates the modification of the invention wherein pumping cylinders extend to only one side of the crank case **10** and the pump has only half of the capacity of that shown in FIG. **1.** In FIG. **6,** a cover plate **128** closes the unused half of the crank case, and a spacer collar **130** is bolted around the crankshaft on each crank arm instead of a connecting rod. FIG. **6** further shows another view of bushing **24** around pin **22,** and the manner of locking each pin **22** to its crosshead **20.**

Footer angles **132** (FIG. **1.**) provide for floor mounting of the pump and crank case assembly.

The invention employs anti-corrosion materials where needed throughout. Pumping cylinders and packing are readily replaced when worn, and all intake and exhaust valves can be readily checked and are interchangeable. Crosshead wear is kept to a minimum by the quality of its lubrication and the sleeves **26** can be replaced readily when desired. The result is a particularly long wearing and yet readily serviced pump.

In accord with the Patent Statutes the invention has been specifically illustrated and described. However, it will be understood that the invention is not to be specifically limited thereto, but that the scope of the invention is defined in the appended claims.

What is claimed is:

1. A reciprocating pump for liquids including a crank case, a crankshaft journalled in the crank case, a plurality of crossheads slidably journalled at one side of the crank case, a piston rod carried by each crosshead, a connecting rod between each crosshead and the crankshaft, sealing means between each piston rod and the crank case, a piston rigidly but removably secured on each piston rod, a cylinder surrounding each piston, an intake valve for each cylinder, an intake manifold connecting to the upstream side of each intake valve, an outlet valve for each cylinder, and an outlet manifold connecting to the downstream side of each outlet valve;

an individual sleeve for and slidably mounting each crosshead, and the sealing means between each piston rod and the crank case is a bellows secured at one end to the sleeve and at its other end to the piston rod; and

the sleeve being formed with a channel to receive oil drippings from the inside of the crank case, the sleeve has an oil hole through it connected to the channel, and each crosshead and connecting rod have aligned oil holes periodically movable beneath the oil hole in the sleeve, a pin with surrounding bushing connects each crosshead to its connecting rod, and each crosshead has openings from the bushing towards the bellows whereby the bellows acts as a pump upon reciprocating movement of the crosshead to cause a continuous flow of oil around the pin, bushing, and between each crosshead and its sleeve.

2. A reciprocating pump for liquids including a crank case, a crankshaft journalled in the crank case, a plurality of crossheads slidably journalled at one side of the crank case, a piston rod carried by each crosshead, a connecting rod between each crosshead and the crank shaft, sealing means between each piston rod and the crank case, a piston rigidly but removably secured on each piston rod, a cylinder surrounding each piston, an intake valve for each cylinder, an intake manifold connecting to the upstream side of each intake valve, an outlet valve for each cylinder, and an outlet manifold connecting to the downstream side of each outlet valve; and

each said piston is rigidly but removably secured to its piston rod by means of a nut which is rotatable on the piston rod and screws into the piston skirt, each said piston rod having an annular groove therein with a beveled side thereon facing axially rearwardly, a diametrically split wedge ring with a surface complementary to said beveled side received in said groove with said surface and side being engaged, complementary means being provided on said wedge ring and the inner end of said nut to force part of said wedge ring against said piston by tightening said nut which also forces said wedge ring into engagement with said piston rod.

3. The combination defined in claim **9** wherein

said complementary means including said wedge ring also having a second beveled surface facing axially rearwardly protruding radially of said groove, said nut having a split extension on its inner end beveled complementary to said second beveled surface and engaged therewith whereby tightening said nut forces said wedge ring into engagement with said piston rod and forces said extension out against said piston to lock said piston on its piston rod.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,817,663 Dated June 18, 1974

Inventor(s) William H. Zehner

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

Column 4, Claim 3, line 1, "Claim 9" should be -- Claim 2 --.

Signed and sealed this 8th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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