July 8, 1958 W. R. BARRY 2,842,060

HIGH PRESSURE RECIPROCATING PUMP

Filed Oct. 10, 1955 4 Sheets-Sheet 1

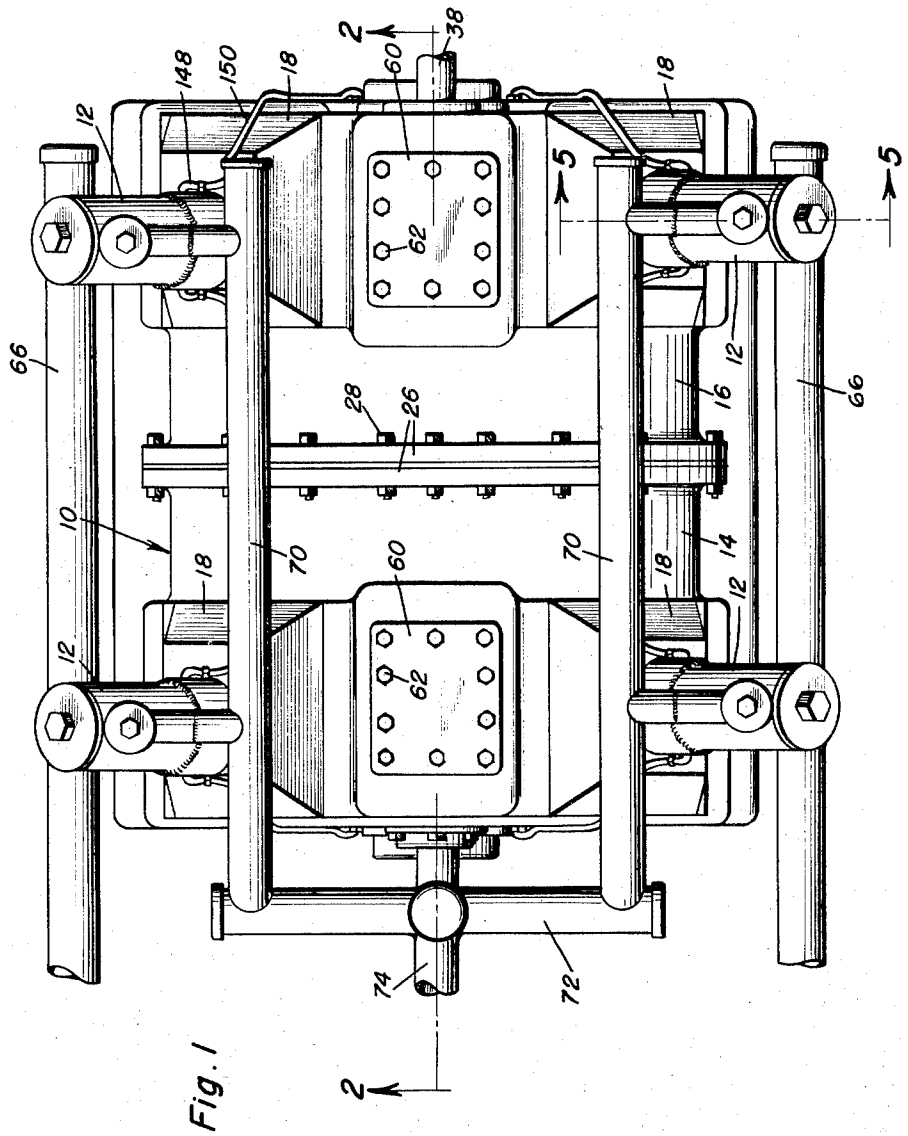



Fig. 1

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Fig. 2

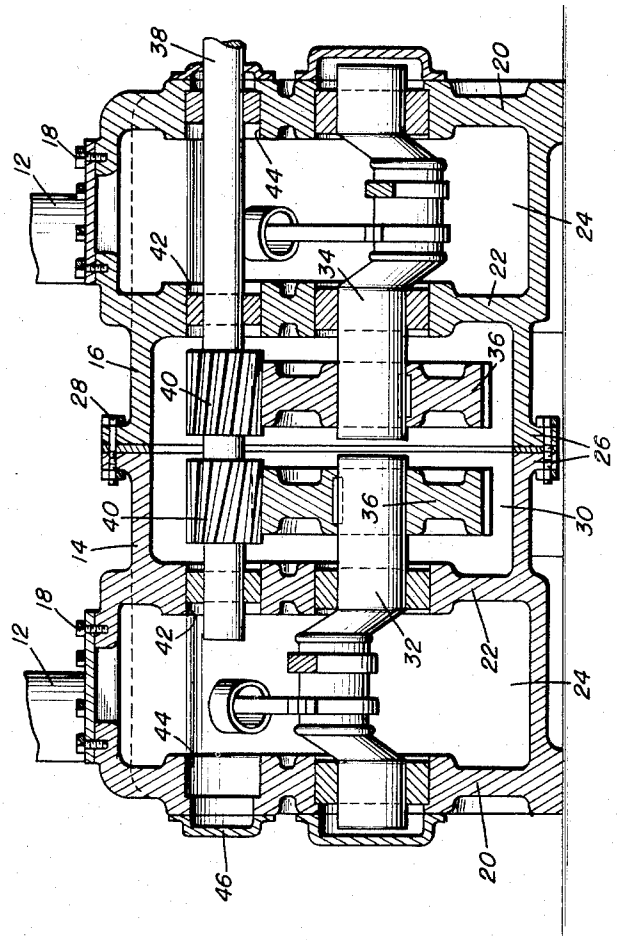
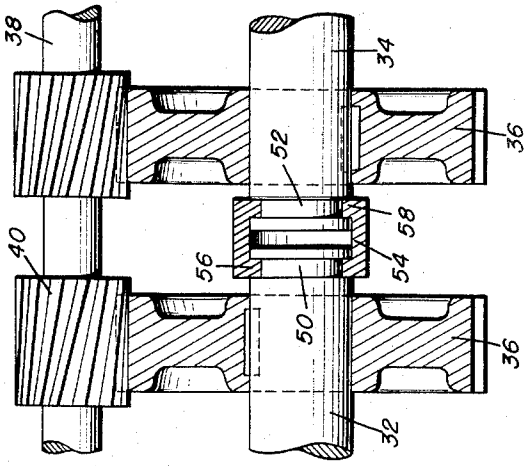



Fig. 7




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HIGH PRESSURE RECIPROCATING PUMP

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Fig. 3

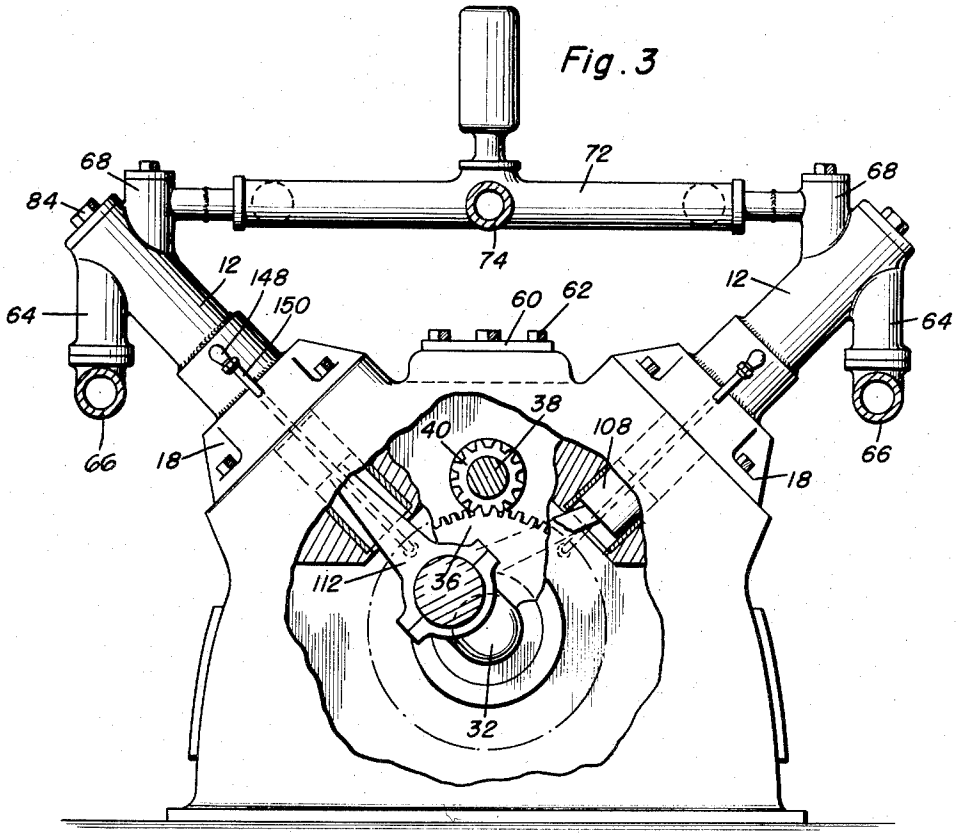
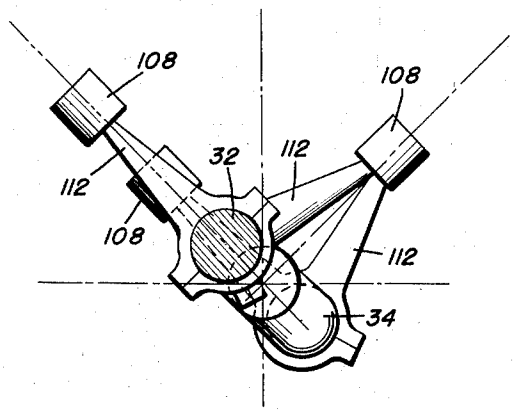



Fig. 4




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HIGH PRESSURE RECIPROCATING PUMP

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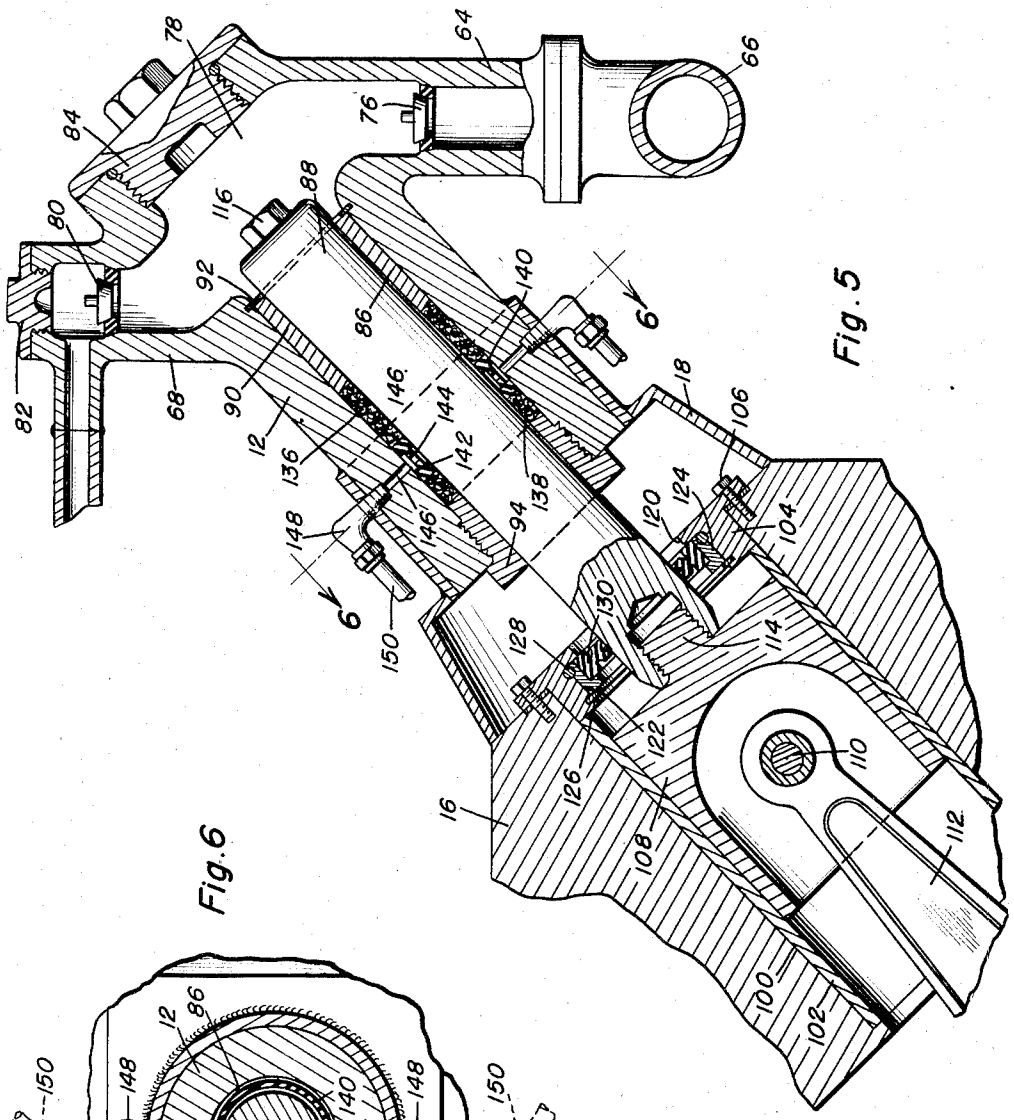



Fig. 5

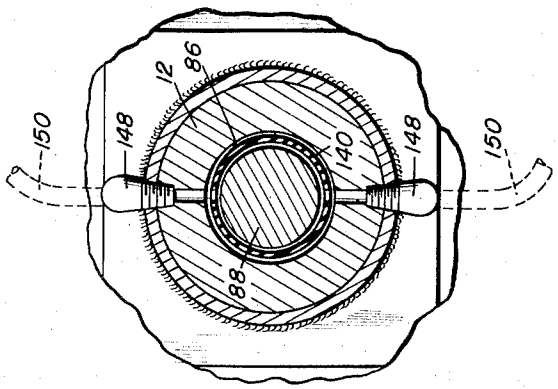



Fig. 6

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2,842,060

# HIGH PRESSURE RECIPROCATING PUMP

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Application October 10, 1955, Serial No. 539,369

11 Claims. (Cl. 103—4)

This invention comprises novel and useful improvements in a high pressure reciprocating pump, more specifically pertaining to a high pressure reciprocating pump especially adapted for producing the extremely high pressures required for oil well use, such as mud pumping, hydraulic or sand fracturing of subterranean oil formations and the like.

The primary object of this invention is to provide a high pressure reciprocating pump which shall be particularly adapted to meet the rigorous requirements of oil well use, and which shall be of extremely light weight whereby to improve its mobility.

A further very important object is to provide a pump in accordance with the preceding object and wherein the compactness of a V-type cylinder arrangement may be utilized together with radial design and upright cylinder configuration.

Another important object is to provide a pump as set forth in either of the foregoing objects wherein aligned crankshafts individually journaled in a pair of mechanically connected crank housings may be employed.

Still another important object is to provide a pump conforming to any of the foregoing objects and wherein an improved driving connection is provided between the crankshafts and a power input shaft.

An additional important object is to provide a pump drive gearing assembly in accordance with any of the above objects wherein lash in the gearing is held to a minimum and the loads and thrusts shifting from one side of the crankcase are reduced.

General objects of this invention are to provide an improved construction of an extremely high pressure reciprocating pump of the type adapted for oil well use, whereby the pump construction shall be of as simple and economical a character as possible; shall be so designed that servicing of the components of the pump may be effected as easily as possible; wherein a novel and improved packing assembly shall be provided for the pump piston and its piston rod; and whereby an improved lubricating means and power driving means shall be provided for the pump pistons.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a top plan view showing a preferred construction of a pump embodying therein the principles of this invention;

Figure 2 is a vertical central longitudinal sectional view taken substantially upon the plane indicated by the section line 2—2 of Figure 1, parts being broken away and showing the crankshaft and driving mechanism of the pump;

Figure 3 is an end elevational view of the embodiment



of Figure 1, a part being broken away and shown in vertical section;

Figure 4 is a diagrammatic view illustrating the relation of the four cross-heads forming a part of the embodiment of Figure 1;

Figure 5 is a detail view in vertical transverse section taken substantially upon the plane indicated by the section line 5—5 of Figure 1 and upon an enlarged scale, and showing more particularly the improved packing and lubricating means for the pump piston;

Figure 6 is a detail view taken in section substantially upon the plane indicated by the section line 6—6 of Figure 5; and

Figure 7 is a detail, sectional view of a modified construction of the pump driving mechanism.

In the oil industry the weight of the high pressure pumping units are becoming of increasing importance. It is now a very important consideration that such units shall be as light as possible in order to render them portable and yet shall be strong enough to handle large volumes of fluids at high pressure. For example, demands up to 100 gallons per minute at 10,000 pounds pressure are not uncommon for sand fracturing processes. Now existing mud pumps capable of handling these loads usually weigh about 50,000 pounds or more. The pump of this invention weighs about 10,000 pounds, a very important asset as regards mobility.

The high pressure reciprocating pump embodying the principles of this invention and illustrated by way of example in the accompanying drawings includes a crankcase, manifold and cylinder assembly; a cross-head packing assembly; and a piston packing and lubricating assembly. These novel constructions will now be considered in detail in the above given order.

*Crankcase, manifold and cylinder assembly*

As shown in the accompanying drawings, the crankcase indicated generally by the numeral **10** supports four cylinders, each indicated by the numeral **12**, in a V arrangement consisting of two rows of longitudinally aligned cylinders, the rows being disposed at a 90° angle with respect to each other, as will be apparent from Figure 3. The pump crankcase assembly, as shown in Figure 2, consists of two longitudinally aligned crankcase sections **14** and **16**, each having a pair of the cylinders **12** detachably secured thereto, as by means of a hollow pyramidal base **18** which is secured to and rises from the crankcase section and supports the cylinder as by welding or by any other suitable fastening means.

As will be best seen from Figure 2, each of the crankcase sections **14** and **16** is provided with an outer end wall **20** and an inner end wall **22** whereby crank chambers **24** are defined in the sections **14** and **16**. From the crank chambers, the cylinder sections extend towards each other and are provided with detachable mounting flanges **26** which, by means of fastening bolts **28** are detachably secured together. There is thus provided a further centrally disposed chamber **30** lying between two inner walls **22** of the two sections **14** and **16**, for a purpose to be subsequently set forth.

In the end walls of each of the crank chambers of the two crankcase sections, there is journaled a crankshaft **32** for the section **14** and **34** for the crankcase section **16**. The adjacent ends of these shafts are disposed in alignment and terminate in closely spaced aligned relation in the chamber **30**. These aligned ends are provided with driven gears **36** by means of which the two crankshafts are driven in unison. It will, of course, be understood that suitable bearings of any desired type are provided for rotatably mounting the crankshafts.

A power input for driving shaft **38** to which rotation is imparted from any suitable source, not shown, is

journaled in suitable bearings in the end walls of the two crankcase sections, this shaft extending through one of the outer walls to the exterior thereof, and extending across the central chamber **30**. Secured to this driving or input shaft are driving gears **40** which mesh with the crankshaft gears **36** for imparting rotation to the two crankshafts.

In the embodiment of the pump construction illustrated, it will be observed that the inner crankcase walls **22** and the outer crankcase walls **20** are respectively provided with aligned bores **42** and **44**. Suitable bearings mounted in the bores **42** and in one of the outer wall bores **44** serve to journal the power input shaft **38**.

As will be apparent from Figure 2, the driving shaft **38** may extend through either end of the crankcase assembly, the bore **44** in the outer end wall which is not used being closed, as by a closure cap **46**.

As so far described, it will be apparent that the geared connection of the members **40** and **36** serves to maintain the two crankshafts **32** and **34** in synchronized, fixed relation with respect to each other. In some instances, however, a slightly modified construction may be employed providing an additional means for maintaining the crankshafts in relatively fixed position with respect to each other. Thus, in the modified construction shown in Figure 7, the adjacent extremities of the crankshafts may be provided with circumferential grooves **50** and **52** thereon which are secured together as by a clamping ring **54** having internal annular ribs **56** and **58** which respectively seat in the grooves or channels **50** and **52** and thus prevent relative longitudinal movement of the crankshafts with respect to each other.

Disposed upon what may be termed the top surface of the crankcase sections and between the pair of cylinders on each section are closure plates **60** which, by means of bolts **62**, provide access to the interior of the individual crank chambers **24** of the two crankcase sections.

It will be observed that each of the cylinders at its outer or head portion is provided with an integral downwardly extending conduit **64** which is detachably connected to an intake conduit **66**. Thus, as shown in Figure 1, a pair of the intake conduits are disposed on opposite sides of the pump and each such intake conduit has communication with the intake pipe of a cylinder of each of the crankcase sections **14** and **16**. These intake conduits are supplied in any suitable manner, not shown, by the fluid which is to be pumped by the device.

Also integrally carried by the head portions of the cylinders and extending upwardly therefrom are discharge pipes **68**. These also communicate with discharge conduits **70**, there being provided, as shown in Figure 1, a pair of these discharge conduits each of which communicates with a pair of cylinders carried by each crankcase section. A cross-conduit **72** establishes communication between the two discharge conduits **70** and, in turn, communicates with a delivery conduit **74** by means of which the fluid is delivered from the pumping apparatus.

Referring especially to Figure 5, it will be seen that the inlet pipes **64** previously mentioned are provided with non-return upwardly opening inlet valves **76** by means of which the fluid may pass into the working chambers **78** of the head portion of the pump cylinders. Similarly, non-return discharge valves **80** are provided in the upwardly extending discharge pipes **68** and closure plugs **82** are provided in the upper ends of the latter for affording access to the non-return discharge valves. As will be further apparent from Figure 5, the head end of the cylinders is provided with a removable closure plug **84** whereby access may be had to the pump chambers **78**.

From the foregoing, it will be apparent that there has been provided a compact manifold assembly for supplying fluid to the plurality of cylinders and for delivering fluid under pressure therefrom during the operation of the pump.

As shown in Figure 5, the cylinder **12** is provided with a bore **86** in which is received a cylindrical plunger **88** constituting the reciprocating piston of the pump. These pistons are operatively connected by a power transmission assembly to the aligned crankshafts for reciprocation thereby, the upper portions of the pistons sliding through a guide and packing bushing **90** detachably secured in the upper end of the cylinder bore **86** as by a snap ring **92**, and by a packing gland **94** screw threadedly engaged in the lower end of hte bore and also constituting a guide for the piston **88**.

*Power transmission assembly*

The power transmission assembly for transmitting power from the crankshafts to the pistons and reciprocating the latter may be best seen from the showing of Figure 5. It will be noted that the crankcase sections are provided with cylindrical bores **100**, each in alignment with one of the cylinders **12**. A sleeve or liner **102** is received within the bore **100**, being retained therein by a cylindrical ring **104** having fastening bolts **106**. A cross-head **108** in the form of a piston is slidably received within the sleeve **102** and is connected by a wrist pin **110** to a connecting rod **112**, the latter extending into the crank chambers **24**. As will be apparent from Figure 2, the connecting rods **112** of the pair of cylinders of each crankcase unit extends in the same crank chamber **24** and is secured to the crank throw of the crankshaft therein in side-by-side relation. For this purpose, the axes of the pair of cylinders carried by each crankcase section are slightly offset longitudinally from each other.

At its upper end, each cross-head member is provided with an upwardly axially extending externally threaded boss **114** to which the lower internally threaded hollow extremity of the piston **88** is releasably secured. A diametrically reduced shouldered portion **116** at the upper end of the piston provides a means whereby the piston rod may be connected to or disconnected from the cross-head.

It will thus be seen that power from any suitable source is transmitted from the shaft **38**, through the gears **40** to the gears **36** upon each crankshaft **32** and **34**; and each crankshaft, in turn, through the pair of connecting rods and cross-heads attached thereto operates the pair of reciprocating pistons received within the two pump cylinders of that section.

It is preferred, as will be apparent from the diagrammatic view of Figure 4, to dispose the two crank throws of the two crankshafts at opposite positions or at 180° with respect to each other. This arrangement is also illustrated in Figure 2, and it will thus be apparent that by virtue of the opposite disposition of the crank throws and the 90° displacement of the pair of pistons on the same crankshaft, that the four cylinders of the pump construction will discharge upon their working stroke in sequence, thereby producing a uniform flow of fluid under pressure from the pumping device.

*Cross-head packing assembly*

From Figure 5, it will be seen that the packing gland **104** is provided with a central opening **120** at its outer end and with a diametrically enlarged cylindrical bore **122** extending outwardly from its inner end. The opening and bore permit passage of the piston plunger **88** for sliding movement therethrough during the reciprocation of the cross-head **108**.

A packing assembly is received within the bore **122**. This includes a cylindrical body or sleeve **124** which is removably received within the bore **122**, being releasably retained therein as by a split ring **126**, an annular packing O-ring **128** being positioned between the outer end of the sleeve **124** and the shoulder formed by the

junction of the bore **122** and the opening **120**. Secured in the sleeve **124** is a packing or sealing ring **130** which embraces the plunger **88** and establishes a fluid-tight seal therewith.

In this manner, a fluid-tight seal is established between the reciprocating plunger and the cylindrical bore within which the cross-head reciprocates. The lubricant contained in the crankcase for lubricating the cross-heads is thus prevented from escaping therefrom.

It will be observed that the cross-head packing assembly may be easily serviced when necessary, by removing the cylinder unit through detachment of the supporting members **18** from the crankcase sections and thereafter removing and replacing the packing glands **104** and the packing assembly carried thereby.

*Piston packing and lubricating assembly*

A piston packing and lubricating assembly is provided to lubricate the piston **88** in its reciprocation through the guide bushing **90** and the packing gland **94**; and a packing assembly is provided to prevent the escape of this lubricant and also to prevent contamination of the lubricant by the drilling mud or other fluid compressed by the pump pistons.

Seated in the cylinder bore **86** adjacent the outer and inner ends of the same and respectively abutting the guide sleeve **90** and the packing gland **94** are packing means **136** and **138** which may be of any desired character. These packing means thus surround the reciprocating pump plungers **88**. Separating the two sets of packing means is a ring-like member **140** which also surrounds and slidably receives the plunger and has a snug sliding fit in the bore **86**. This ring-like member is thus disposed intermediate the packing assembly and constitutes a means for supplying lubricant to the pump plungers.

The member **140** is provided with circumferential outer and inner grooves **142** and **144**, the former continuously communicating with lubricant inlet passages **146**, while the latter continuously opens upon the external surface of the reciprocating pump plunger **88**. By means of nipples or elbows **148** which communicate with the bores **146** and with supply conduits **150**, lubricant under pressure from any suitable source may be supplied through the packing assembly directly to the reciprocating pump plungers. It will be observed that the pressure of this lubricant will also serve to further compress the packing assemblies **136** and **138** against their respective end abutments **90** and **94**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A high pressure reciprocating pump including a pair of aligned crankcase sections, pump cylinders mounted upon each section, each section having a pair of cylinders disposed at a 90° angle, the cylinders of the two sections being positioned in longitudinal rows, pistons slidable in each cylinder, each section having a crank chamber and a crankshaft journaled therein, means connecting the pistons of each section to the crankshaft journaled therein, a power input shaft journaled in both said sections, means connecting said input shaft to each crankshaft for driving and maintaining the latter in relatively fixed relation, said sections including a compartment disposed between their crank chambers, said connecting means being housed in said compartment.

2. A high pressure reciprocating pump including a pair of aligned crankcase sections, pump cylinders mounted upon each section, each section having a pair of cylinders disposed at a 90° angle, the cylinders of the two sections being positioned in longitudinal rows, pistons slidable in each cylinder, each section having a crank chamber and a crankshaft journaled therein, means connecting the pistons of each section to the crankshaft journaled therein, a power input shaft journaled in both said sections, means connecting said input shaft to each crankshaft for driving and maintaining the latter in relatively fixed relation, said crankshafts being disposed in axial alignment, a member connected to the adjacent ends of both crankshafts for preventing relative axial movement therebetween.

3. The combination of claim 2 including a fluid inlet means and a fluid discharge means for each cylinder, the inlet means comprising a pair of conduits disposed upon the opposed sides of the two rows of cylinders and the discharge means comprising a pair of conduits disposed upon the adjacent sides of the rows of cylinders.

4. The combination of claim 1 wherein said piston connecting means comprises cross-heads slidable in bores in said sections, means securing each piston to one of said cross-heads.

5. The combination of claim 1 wherein the adjacent ends of said crankcase sections have end walls at the adjacent ends of said crank chambers and have complementary mating portions projecting towards each other beyond said end walls and defining said compartment.

6. The combination of claim 1 wherein the adjacent ends of said crankcase sections have end walls at the adjacent ends of said crank chambers and have complementary mating portions projecting towards each other beyond said end walls and defining said compartments, said crankshafts having each an end portion journaled in extending through the adjacent end wall and into said compartment.

7. The combination of claim 1 wherein the adjacent ends of said crankcase sections have end walls at the adjacent ends of said crank chambers and have complementary mating portions projecting towards each other beyond said end walls and defining said compartment, said power input shaft having an end portion extending entirely through said compartment and being journaled in both said end walls.

8. The combination of claim 1 wherein the adjacent ends of said crankcase sections have end walls at the adjacent ends of said crank chambers and have complementary mating portions projecting towards each other beyond said end walls and defining said compartment, said power input shaft having an end portion extending entirely through said compartment and being journaled in both said end walls, said end portion of said power input shaft having a pair of gears in said compartment, each of said crankshafts having a gear engaging one of said pairs of gears.

9. The combination of claim 2 wherein said member comprises a sleeve embracing said crankshafts, means preventing endwise movement of said crankshafts relative to said member.

10. The combination of claim 2 wherein said member comprises a sleeve embracing said crankshafts, means preventing endwise movement of said crankshafts relative to said member, said last means comprising cooperating mating circumferentially extending ribs and grooves in said sleeve and on said crankshafts.

11. A high pressure reciprocating pump including a pair of aligned crankcase sections, pump cylinders mounted upon each section, each section having a pair of cylinders disposed at a 90° angle, the cylinders of the two sections being positioned in longitudinal rows, pistons slidable in each cylinder, each section having a crank chamber and a crankshaft journaled therein, means connecting the pistons of each section to the crankshaft journaled therein, a power input shaft journaled in both said sections, means connecting said input shaft to each

crankshaft for driving and maintaining the latter in relatively fixed relation.

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