

May 8, 1962

J. H. WILSON

3,033,124

MUD PUMPS

Filed June 6, 1956

8 Sheets-Sheet 1

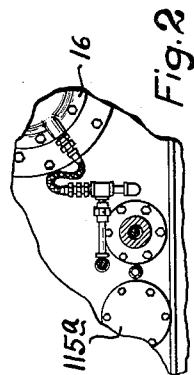
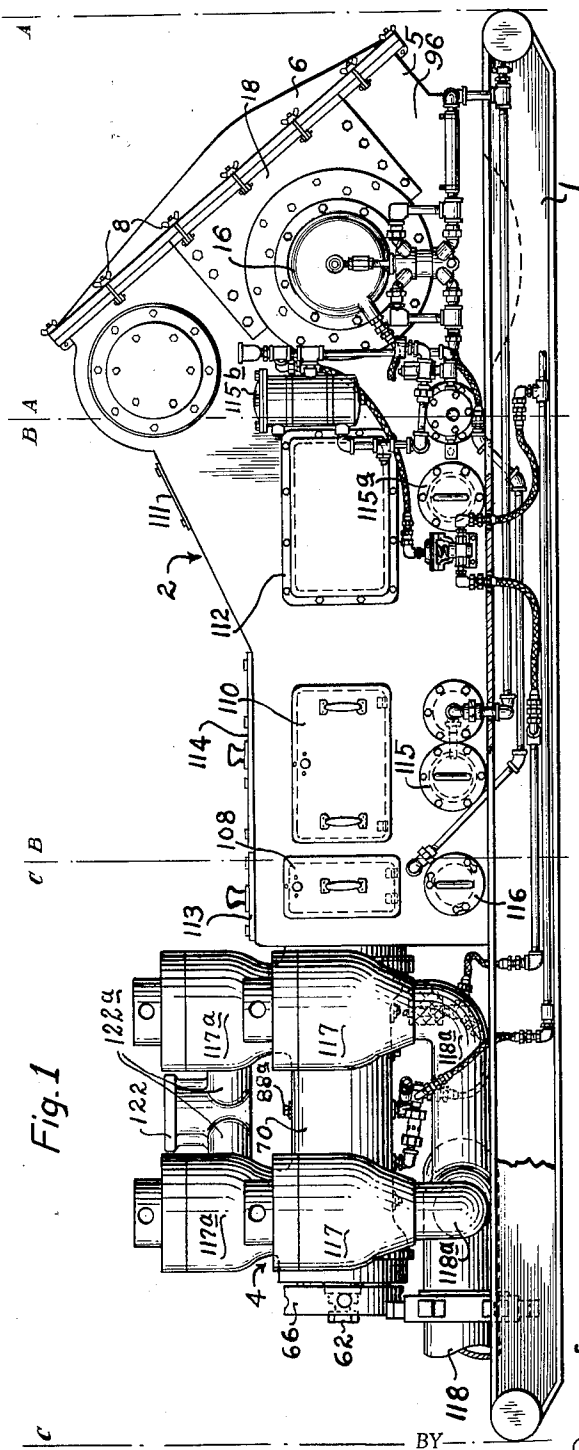


Fig. 20

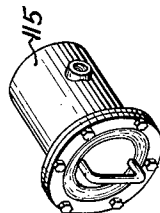
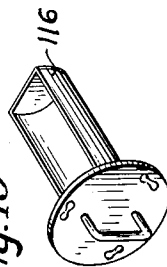


Fig. 19



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8 Sheets-Sheet 2

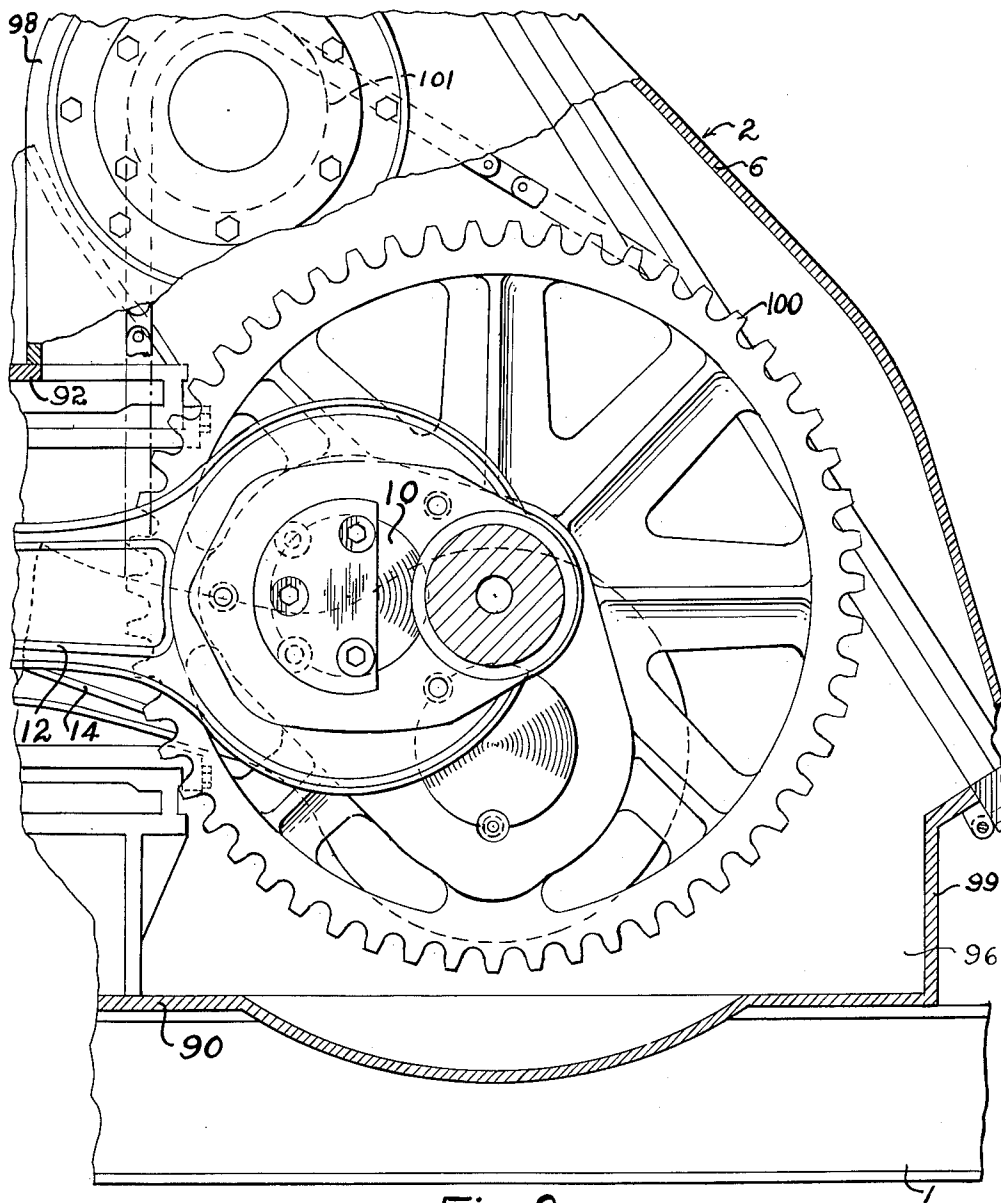


Fig. 3

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8 Sheets-Sheet 3

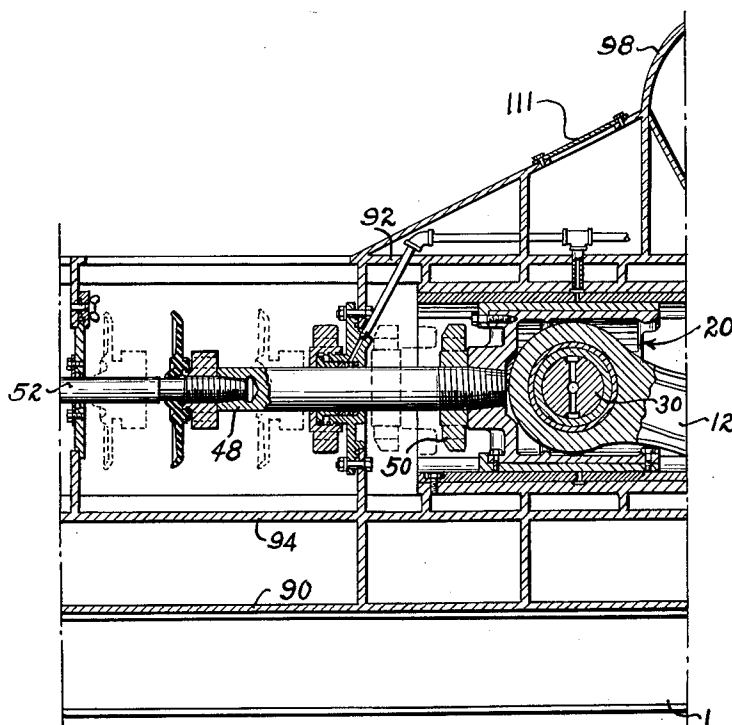


Fig. 4

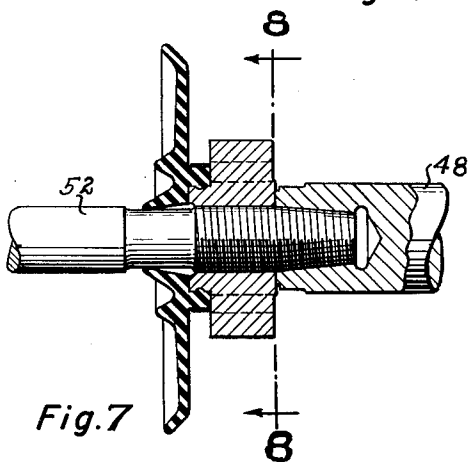


Fig. 7

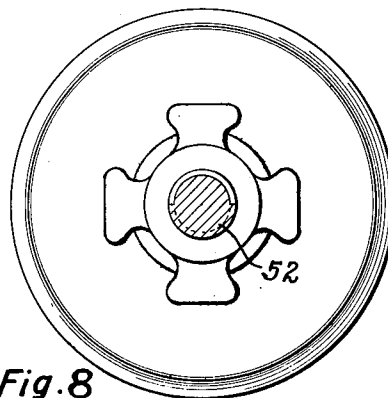


Fig. 8

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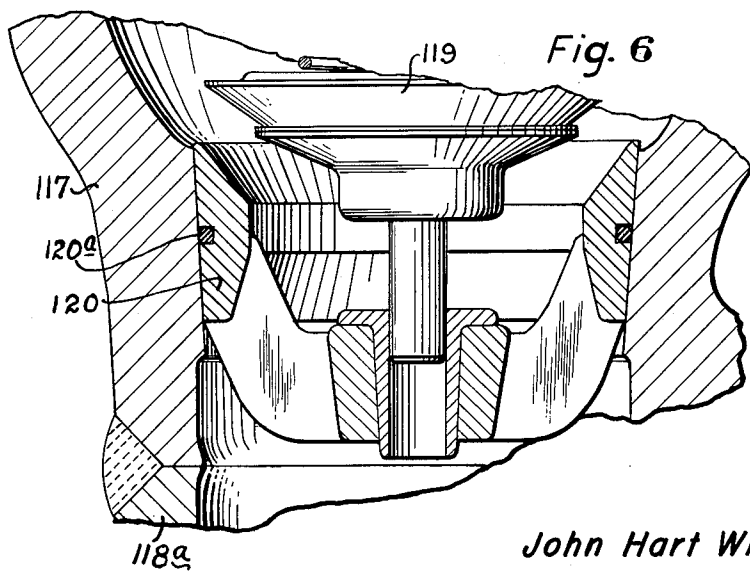
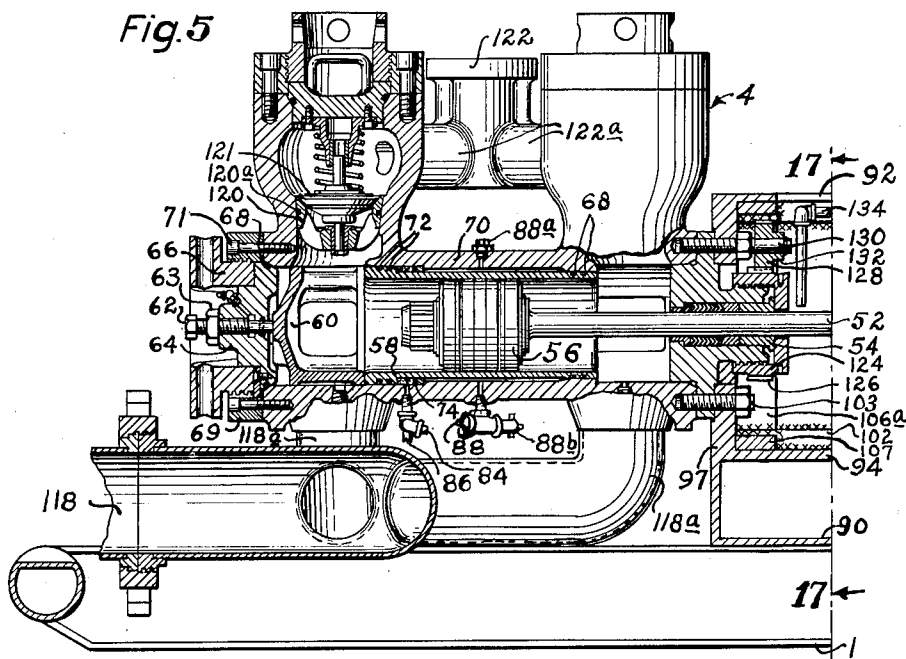
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3,033,124

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8 Sheets-Sheet 4



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3,033,124

MUD PUMPS

Filed June 6, 1956

8 Sheets-Sheet 5

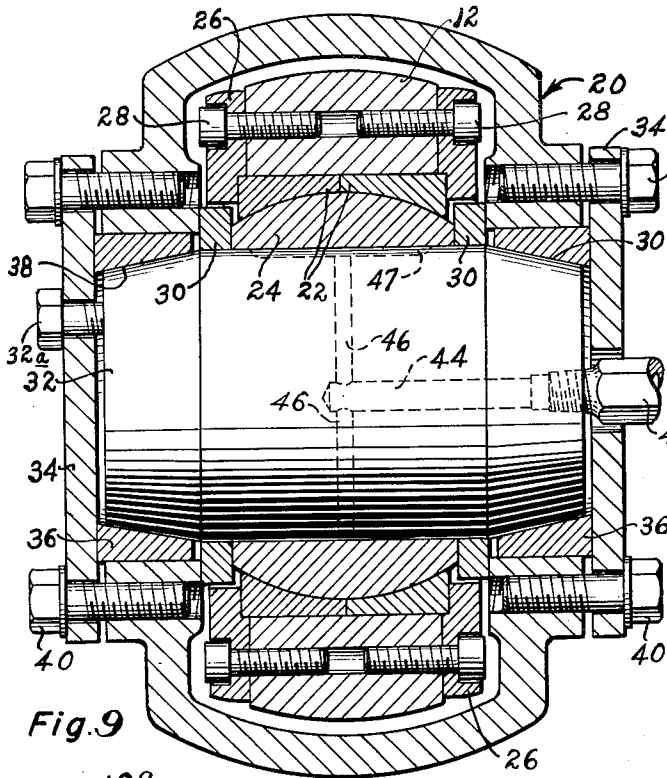


Fig. 9

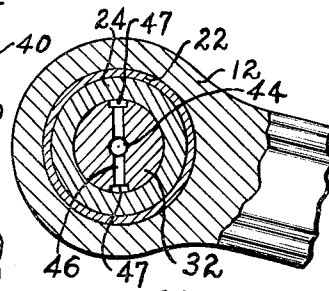


Fig. 10

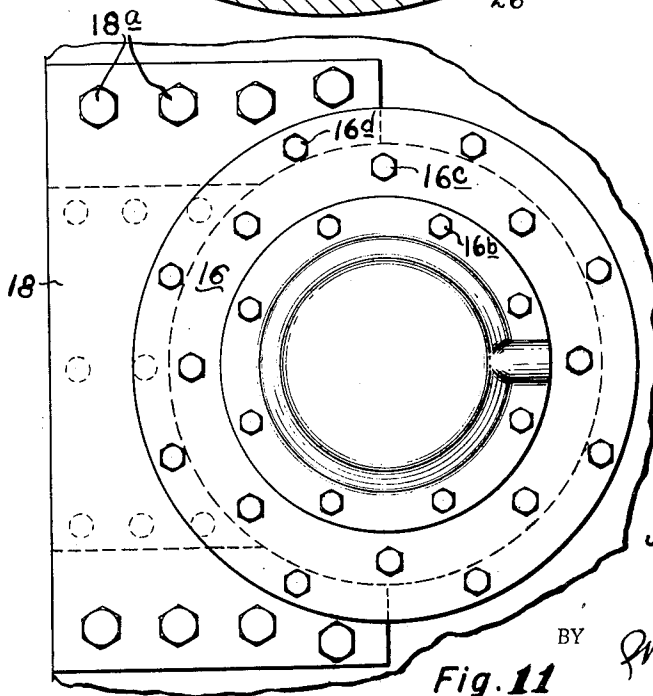


Fig. 11

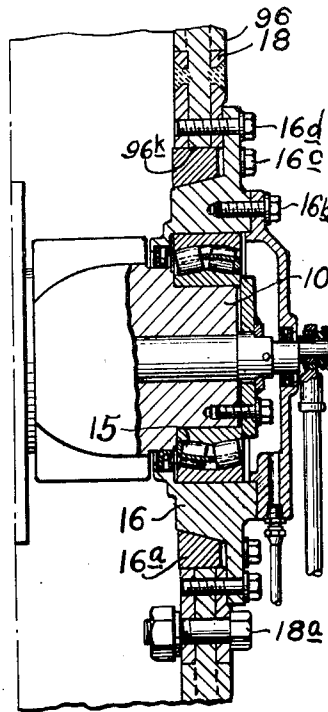


Fig. 12

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3,033,124

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Filed June 6, 1956

8 Sheets-Sheet 6

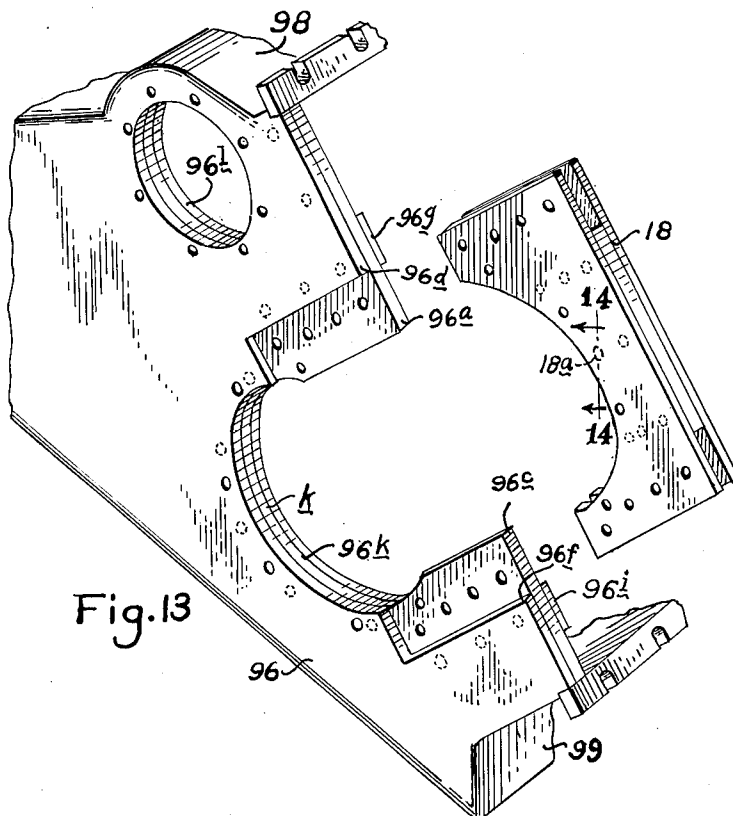


Fig. 13

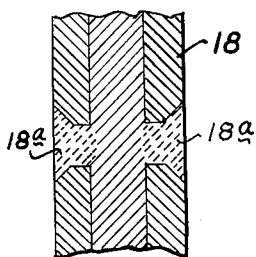


Fig. 14

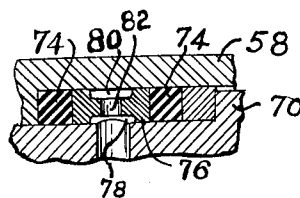


Fig. 15

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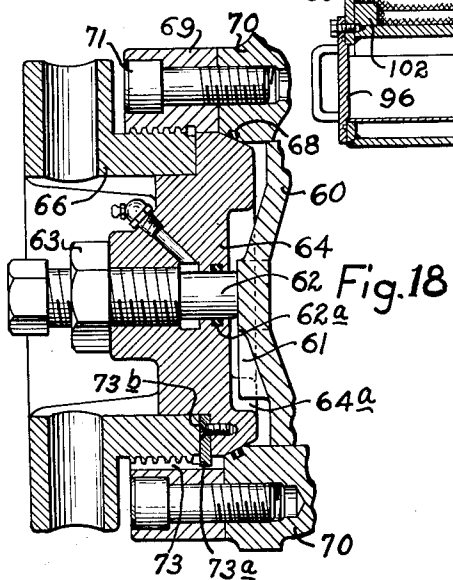
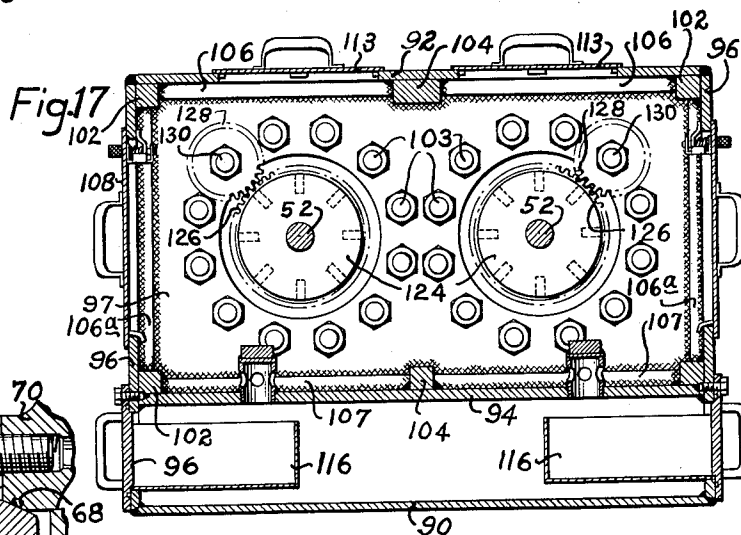
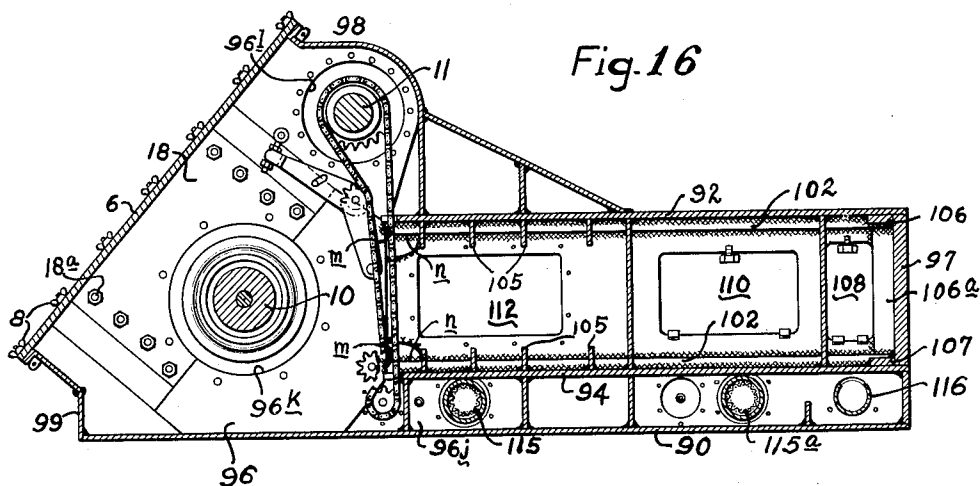
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8 Sheets-Sheet 7



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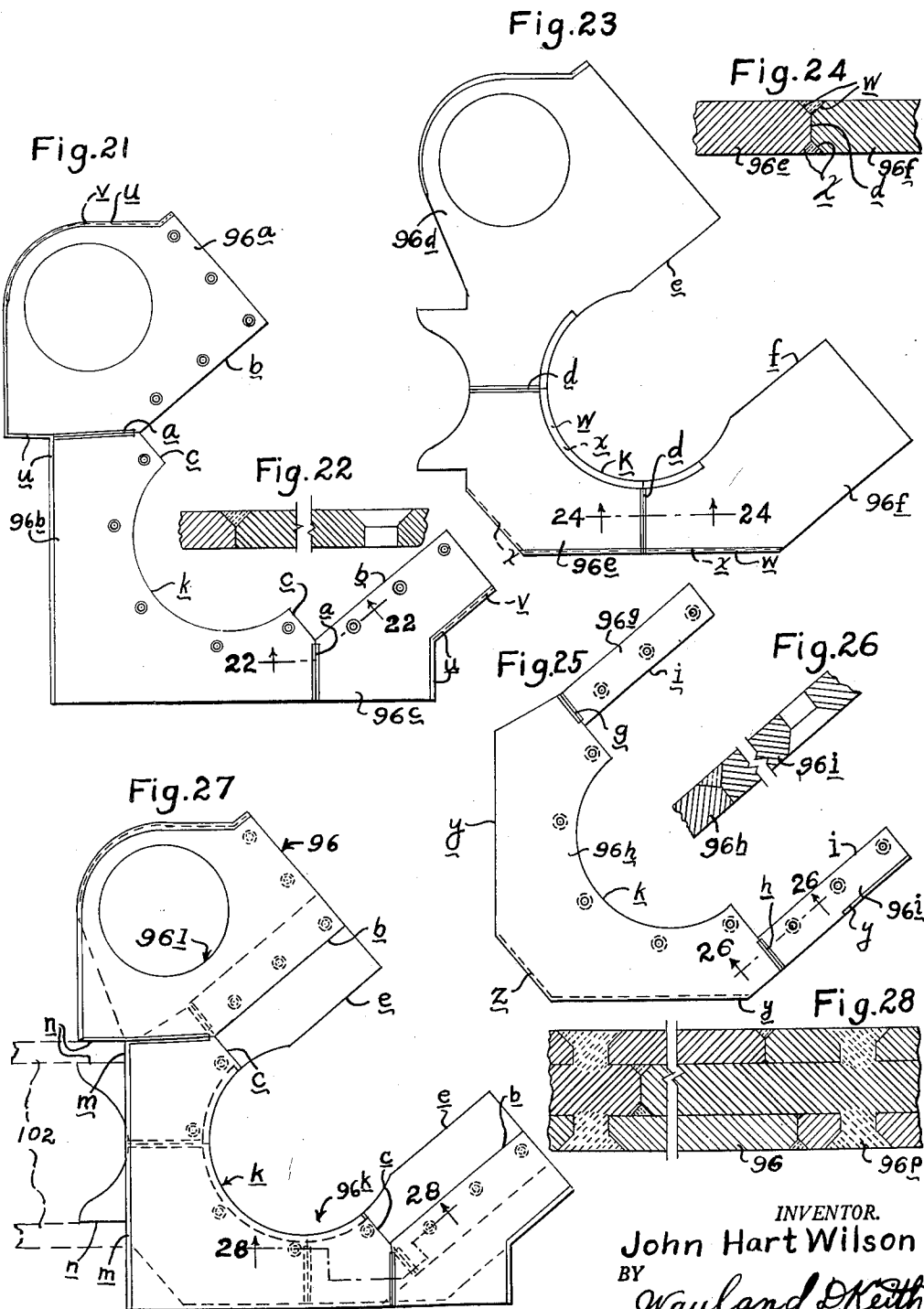
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1

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4 Claims. (Cl. 103—216)

This invention relates to improvements in pumps and more particularly to pumps used for pumping drilling fluid, such as viscous mud and/or solutions of hematites, barites, bentonite clays, gels, and other fluids carrying additives to increase the weight and/or viscosity of drilling fluid pumped into the bore hole of a well being drilled by the rotary drilling method.

This application is a continuation-in-part of my prior application Ser. No. 480,445, filed January 7, 1955, for Crank Assembly, now Patent No. 2,899,742, dated August 18, 1959.

Various mud or slush pumps have been proposed heretofore, but these were usually of relatively heavy construction, and the body parts of the pump were usually of heavy case construction; therefore, a pump of large pumping capacity was heavy and cumbersome in proportion to the amount of fluid handled.

The present pump is designed to include structural features which will result in a pump which is relatively light in weight, yet the construction of which will equal or exceed in strength, a much heavier pump. The pump case is provided with openings both in the sides and top thereof which provide maximum accessibility into the packing chamber, both to the piston rod glands and to the pony rod glands, and also for the removal of the piston rods.

The present pump is designed to be of such capacity as to handle a volume of fluid which will equal or exceed the amount of fluid handled by many pumps now in use, which are larger and heavier.

An object of this invention is to provide a mud pump which utilizes rigid, fabricated, plate metal case which is welded into an integral unit, so as to form the "power end" of the pump, the cylinders and valve chambers of which constitute the "fluid end" of the pump, and are of cast metal construction and are so designed as to enable the cylinders and valve assemblies to be attachably bolted to the case in aligned relation therewith.

Another object of the invention is to provide a cross-head bearing on the connecting rod of the pump, whereby the load will equalize over the entire bearing, even if the connecting rod is slightly out of alignment with the axis of the pump.

Still another object of the invention is to provide a tongue and groove bearing mounting plate, for the crank shaft of the pump, whereby the crankshaft, bearings, and associated parts may be installed in the pump as a unit, and which may be readily removed therefrom as a unit.

Yet another object of the invention is to provide a case, for the "power end" of a pump, which is of fabricated, plate and welded construction, whereby tension members are provided within the case to transmit reaction forces through the length of the pump case from the "power end" to the "fluid end" and yet maintain the bearings in aligned relation with respect to the axis of the "fluid end."

A further object of the invention is to provide a welded steel plate frame with a removable bearing cap over the main bearing housing, which is held in place by fitted bolts in double shear, in such manner that the bearing cap is readily removable, and yet, when in place with the fitted bolts installed, has very great strength, with a minimum of weight.

A still further object of the invention is to provide an oiling system for the pump mechanisms, whereby certain parts of the pump are lubricated by oil under pressure

2

from an oil pump, and whereby certain other parts of the pump are lubricated by flooding the parts with oil.

With these objects in mind, and others which will become manifest as the description proceeds, reference is to be had to the accompanying drawings, in which like reference characters designate like parts in the several views thereof, in which:

FIG. 1 is a side elevational view of the mud pump assembly, with parts broken away to show the interior construction thereof;

FIG. 2 is a fragmentary view showing a portion of the lubricating system, with parts being removed, and other parts being shown in section to bring out the details of construction;

FIG. 3 is a view, greatly enlarged, taken approximately between the lines A—A of FIG. 1, a portion of the cover housing being broken away to show the details of construction;

FIG. 4 is an enlarged, longitudinal, sectional view taken substantially between the lines B—B of FIG. 1, to show the interior details of construction of the pump;

FIG. 5 is an enlarged, longitudinal section, detail view, taken substantially between the lines C—C of FIG. 1, having certain parts broken away, and other parts shown in section to illustrate the details of construction;

FIG. 6 is a greatly enlarged, fragmentary detail, vertical sectional view through one of the valve seats and the chamber thereof, and showing the valve in full outline with an O-ring sealing element between the valve seat and the valve housing;

FIG. 7 is an enlarged, longitudinal, sectional view of a portion of the piston rod and a portion of the connecting rod, and showing a mud splash shield connected thereto;

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 7, looking in the direction indicated by the arrows;

FIG. 9 is an enlarged, transverse, sectional view taken through the cross-head, to show the details of construction;

FIG. 10 is a fragmentary view showing the end portion of a connecting rod and showing the crosshead assembly parts therein;

FIG. 11 is an enlarged, fragmentary elevational view of a crankshaft bearing housing;

FIG. 12 is a cross-sectional view taken on the line 12—12 of FIG. 1, looking in the direction indicated by the arrows; and with parts broken away and parts shown in elevation to bring out the details of construction;

FIG. 13 is a fragmentary, perspective view of a portion of the pump case, with parts shown in exploded position to show the details of construction;

FIG. 14 is a fragmentary, sectional view taken on the line 14—14 of FIG. 13, looking in the direction indicated by the arrows, and showing the laminated plates secured together by weld-rivet means;

FIG. 15 is a fragmentary longitudinal sectional view through a portion of the pump body, pump cylinder liner, and the packing gland arrangement therebetween;

FIG. 16 is a longitudinal sectional view of the fabricated case of the pump, showing the internal, reactionary thrust or tension members, and showing the oil pump driving sprockets and chain;

FIG. 17 is a sectional view taken on the line 17—17 of FIG. 5, looking in the direction indicated by the arrows;

FIG. 18 is an enlarged, fragmentary, longitudinal view of the cylinder head and cylinder liner retaining unit;

FIG. 19 is a perspective view of a removable oil sump sediment pan, shown apart from the pump;

FIG. 20 is a perspective view of a lubricant strainer unit, shown apart from the pump;

FIG. 21 is an assembled, elevational view of the outermost lamination of the laminated plates that go to make

up the crank case housing for the power end of the pump;

FIG. 22 is a sectional view taken on the line 22—22 of FIG. 21, looking in the direction indicated by the arrows;

FIG. 23 is an assembled, elevational view of the center lamination of the laminated plates that go to make up the crank case housing of the power end of the pump;

FIG. 24 is a sectional view taken on the line 24—24 of FIG. 23, looking in the direction indicated by the arrows;

FIG. 25 is an assembled elevational view of the innermost lamination of the laminated plates which go to make up the crank case housing for the power end of the pump;

FIG. 26 is a sectional view taken on the line 26—26 of FIG. 25, looking in the direction indicated by the arrows;

FIG. 27 is an elevational view of the composite of the outer, center, and inner laminations of the plates that go to make up the crank housing; and

FIG. 28 is a sectional view taken on the line 28—28 of FIG. 27, showing the manner of assembling the laminations to form the plates.

With more detailed reference to the drawings, the numeral 1 designates a base or skids, upon which a case, generally designated at 2, is mounted, as is the cylinder-valve assembly, generally designated at 4. The case 2 is of welded plate construction, as will best be seen in FIGS. 3, 4, 5, 10, 13, 14 and 16 through 18. The crank case 5 has a cover 6 attachably secured thereto by means of wing bolts 8, as will best be seen in FIG. 1.

The case 2 has a crankshaft 10 mounted transversely thereof within bearings 15 (FIG. 12). Connecting rods 12 and 14 are connected to the crankshaft 10 in a manner set forth in my co-pending application Ser. No. 480,445, Crank Shaft Assembly, filed January 7, 1955, of which this application is a continuation in part.

The crankshaft bearing assemblies 15 are mounted within the respective bearing housings 16, as will best be seen in FIG. 12, one side of each bearing housing engages a slide plate bearing cap assembly 18, so the entire crankshaft assembly may be readily removed, upon removal of the slide plates 18.

Attached to the respective throws of the crankshaft 10 are the connecting rods 12 and 14, each of which connects with crossheads, as shown in FIGS. 4 and 9, which crossheads are designated by the numeral 20. Each of the connecting rods 12 and 14 has a pair of annular bushings 22 therein, the inner surface of each bushing being spherical and which interfits in complementary relation with an annular bearing 24, which bearing 24 is preferably made of bearing bronze, and which has a spherical outer face. The annular bushings 22 are held in place by annular rings 26, which surround the bushings 22 and are bolted to the respective connecting rods 12 and 14, by means of cap screws 28.

An annular ring 30 surrounds the respective crosshead wrist pins 32, the ends of which pins 32 are tapered. There is a slight clearance, usually about .010", between the outer diameter of the annular ring 30 and the inner diameter of the annular ring 26. In this manner a limited rotary movement, of the connecting rod and associated parts about its longitudinal axis, with respect to the spherical bearing ring 24 and crosshead wrist pins 32, is possible, so as to permit a limited self-alignment of the respective parts. A cap member 34 is provided on each side of each crosshead 20, so as to hold annular wedge rings 36 in contact with the taper 38 of the crosshead wrist pins 32 and with the inner diameter of the bore of the crossheads 20. The ring 34 is held in place by means of bolts 40, as will best be seen in FIG. 9. The respective crosshead wrist pins 32 are each drilled and cross drilled to provide lubricant channels, which channels lead to grooves formed on the outer diameter of the wrist pins 32 in the respective crossheads 20. A lubrication connection 42 is screw threaded into an end of each wrist pin 32, which lubrication connection is in communication with the respective passages 44 and 46

which lead to the longitudinal grooves formed in the top and bottom only of crosshead wrist pins 32.

A pony rod 48 is screw threaded into one end of each crosshead 20, as will best be seen in FIG. 4. The threads engaging the respective crossheads are preferably tapered and each has a lock nut 50 screw-threaded onto the respective pony rods 48, so as to abut with the respective crossheads 20 to securely hold the respective pony rods 48 in place.

A piston rod 52 is screw-threaded into pony rod 48, which piston rod 52 extends through gland 54 and connects with a piston 56, which is fitted within pump liner 58. A pump cylinder liner 58 is of the character as set forth in my co-pending application Ser. No. 454,082, filed Sept. 3, 1954 for Cylinder Assembly, now Patent No. 2,832,653 dated April 29, 1958.

The cylinder and valve assembly, the cast body of which is designated generally at 4, is shown in elevation, with parts broken away, and with parts shown in section, in FIG. 5. Each cylinder and valve assembly body 4 comprises a cylinder or cylindrical cavity 70 in which is mounted a cylinder liner 58 and the outer end of which is closed by a disc-like cylinder head 64. A pump cylinder liner retainer member 60 bears against the outer end of each of the pump cylinder liners 58, the retainers 60 being held in place by screw bolts 62 which pass through each cylinder head 64 and engage bridging portions of the respective retainers 60, and which bolts 62 are held against rotation by the respective threaded nuts 63. An annular ring 69 is secured to the end of the respective cylinder and valve assemblies 4 by means of bolts 71. Each annular ring 69 receives a cylinder head 64 there-through in abutting relation with the end of the respective cylinder and valve chamber assemblies 4. Each annular ring 69 is internally screw threaded to threadably receive an externally screw threaded annular sleeve member 66 an end face of which abuts with a shoulder on cylinder head 64. An O-ring sealing element 68 is interposed between the inner face of the respective cylinder heads 64 and the end of the respective cylinder and valve chamber assemblies 4, and surrounds the respective cylinder 70 so as to form a fluid tight joint between the cylinder heads 64 and the cylinder and valve chamber assemblies 4.

The cylinder liner retainer member 60 has a radially extending lug 61 thereon at the outer end thereof (FIG. 18), which lug extends outwardly and fits into a slot 64a formed in the end of the cylinder head 64. The cylinder heads will not seat properly unless the respective lugs 61 are interfitted within the respective slots 64a, so as to maintain the cylinder retainer members in a fixed relation with respect to the cylinder heads 64. In this manner the liner retainer members will have the openings thereof in register with the respective inlet and outlet ports leading to the respective inlet and outlet valves.

Each of the annular rings 69 has a groove or keyway 73 formed longitudinally therein, which groove or keyway is adapted to receive a key 73a which is attached to the cylinder head 64 by means of a screw 73b. In this manner, when the cylinder head 64 is in place, the lugs 61 and the slots or grooves 64a are in register, and with the keys 73a fitted within the respective grooves 73, the cylinder liner retainer members 60 will be in the correct relation to the respective cylinders.

At the outer end of each cylinder 70, an O-ring 72 (FIG. 5) forms a seal between the respective pump liners 58 and the inner diameter of the bore of each cylinder 70. A packing is interposed between a stepped shoulder on each pump cylinder liner 58 and the stepped shoulder portion of the internal bore of each cylinder 70 (FIG. 15). It is preferable to have two or more packing rings, as indicated at 74, between the stepped shoulder portions, with a ring 76 therebetween, which ring 76 has external groove 78 and internal groove 80 formed therein, with the holes 82 interconnecting the grooves 78 and 80. Pipes 84 and 86 are screwthreaded into passages formed

5

within the respective cylinders 70, so as to form an outlet for any fluid that may leak past the sealing elements between the pump cylinder liners and the pump cylinders, which passages interconnect the respective outer grooves 78.

It is preferable to have the bore of the cylinder 70 slightly larger in diameter, for a portion of the length thereof, than the outside diameter of the pump cylinder liner 58, so that grease may be pumped through a grease fitting 88 into the annular space between the cylinder and the pump cylinder liner, under pressure, so as to normally prevent entrance of foreign matter, such as mud, sand or the like. A relief plug 88a is provided at the top of cylinder 70 so as to vent air to enable the filling of the annular space between the inner bore of the cylinder 70 and the cylinder liner 58. A connection 88b is provided in cylinder 70 to enable a high pressure pump connection to be attached thereto to enable the removal of the cylinder liner, as set forth in my co-pending patent application Ser. No. 454,082, Cylinder Assembly.

The "power end" of the pump case is fabricated, and is so constructed as to give maximum strength at points where strength is needed, thereby enabling the rest of the structure to be maintained at a minimum of weight.

FIGS. 3, 4, 5, 11, 12, 13, 14, 16, 17 and 21 through 28 illustrate the manner of fabricating and assembling the "power end" of the pump case. The pump case is provided with a bottom plate 90 and a top plate 92 and an intermediate, horizontal plate 94, and side plates 96. An end plate 97 is provided, as will best be seen in FIGS. 5, 16 and 17. The respective plates 90, 92, 94, 96 and 97 are welded together in such manner as to form an integral unit. Plates 98 and 99 are also secured to side plates 96, which, together with cover plate 6, form a housing for the crankshaft 10, and sprockets 100 and 101 which drive the pump.

The side plates 96, as shown in FIGS. 13 and 16, are composed of a multiplicity of plate elements welded together in laminated relation, as shown in FIGS. 21 through 28.

One of the side plates, designated generally at 96 in FIG. 27, is a composite of side plate elements 96a, 96b, 96c, 96d and 96e, 96f, 96g and 96i. The side plate elements 96a through 96c comprise an outer plate element, which is divided along the lines *a* so the abutting surfaces *a* may be machined as by grinding or the like, in order to provide a precision fit. The faces *b* and *c* are also machined, as by grinding, before the assembly of the units. The side plate elements 96a, 96b, and 96c are beveled at the abutting joints *a*, so when the surfaces *a*, *b* and *c* have been machined to a precision tolerance, the side plate elements 96a, 96b and 96c are fitted together, as shown in FIG. 1, and welded at the beveled portions throughout the greater portion of the abutting length *a* until the weld is slightly above the surface of the base metal, whereupon the surfaces of the plate are ground until the top of the weld is in the same plane as the finished face of the base metal. In this manner a precision fit may be had on all straight surfaces of the side plate elements 96a, 96b and 96c. The side plate elements 96a, 96b and 96c are beveled on the near side as indicated at *u*, shown in FIG. 21, and are beveled on the far side as indicated at *v*, so as to enable the welding of the outer side plate elements to the center side plate elements.

The side plate portions comprising the elements 96d 96e and 96f are ground or machined along the surfaces *d*, *e* and *f* to within a close tolerance, therefore, when the surfaces are abutted, the unit will be within a close tolerance of the correct size. With the surfaces *d* abutting, as shown in FIG. 23, and with the corners adjacent the abutted edges beveled, as indicated in FIG. 24, the plate elements are welded together, as indicated in FIG. 24, to form an integral plate, such as shown in FIG. 23. The grooves formed by the beveled portions of the elements are filled by weld material, whereupon, both sur-

6

faces of the plate are finished, including the finishing of the weld, until both surfaces are parallel and within the correct plane tolerance.

As shown in FIG. 23, certain portions of the periphery of the center plate elements are beveled, the bevel on the near side being indicated at *w* and the bevel on the far side being indicated at *x*, which enables the plate elements to be welded together as shown in FIGS. 21 and 23.

The inner side plate elements, as shown in FIG. 25, comprise the three elements 96g, 96h and 96i. A surface of side plate element 96g is machined and abuts with machined or ground surface 96h which abutting surfaces are indicated by the letter *g*. The corners of the adjacent abutting elements for a portion of the abutting surfaces are beveled to enable the welding of the two components together. Side element 96i is machined or ground on one end thereof so as to abut with a machined or ground surface 96h, so when these elements are fitted in abutting relation, they will be within the working tolerance required of these parts. Corners on the elements 96h and 96i are beveled for a portion of the length of the abutting faces to enable the welding of the component parts together when these elements 96g and 96i are welded to the elements 96h, the weld fills the groove formed between adjacent abutting elements slightly above the surface of the base metal, so when these are welded together, the surface of the plate may be machined or ground to a plane surface, so as to fit in side by side relation, as shown in FIG. 26. The peripheral edge is beveled at *y* on the near side and at *z* on the far side.

With the outer, center and inner side plate elements assembled, as shown respectively in FIGS. 21, 23, and 25, and with the inner surface of the outer side plate, as shown in FIG. 21, ground or finished in a plane surface, and with both sides of the center side plate element, as shown in FIG. 23, finished or ground into parallel plane surfaces, and with the outer face of the inner side plate element, as shown in FIG. 25, ground or finished to a plane surface, these side plates are placed in superposed relation, so the axis of the arcuate surface *k* is common to all three plates, with the plates occupying their respective positions, the plates are then clamped together in a jig, and welding performed on the edges until the three side plate elements are welded into a composite unit, such as shown in FIG. 27, ready to be assembled into the crank housing of the power end of the pump. Whereupon, the unit is ready to be welded, as shown in FIG. 27, at adjacent abutting edges of plates 96j and longitudinal bar members 102, with the bars 102 abutting with side plates, as indicated at *m* and with the sides of the bars contacting adjacent surfaces *n*, whereupon, the bars are welded along the abutting surfaces *m* and *n* so as to transfer reaction force from the heavy plate directly to plate 97 to which fluid cylinders are secured as by studs or the like.

After the side plates are assembled into the casing, substantially as shown in FIG. 16, and with tongue and groove slide plates 18 bolted in place, and with the outer, center and inner side plate elements stud welded together substantially in the manner shown in FIG. 14, at various points throughout the plate area of the laminated plates, the pump casing is fitted on a boring mill in such manner that holes 96k will accommodate a bearing assembly, as shown in FIG. 12, and the hole 96l will accommodate a counter-shaft assembly, as shown in FIG. 16.

After these laminated plate assemblies are machined, the slide plate 18 may be readily removed and replaced, and since the bolts are "fitted" to the exact size of the hole, the bearing hole 96k in the slide plate will fit around the anti-friction bearing in the same relation as if the unit were made of a solid plate of metal.

By having the notch formed at approximately a 45 degree angle with respect to the horizontal, the slide plate 18 will slide in tongue and groove relation in abutting relation to the bearing housing tapered ring 16a, so as to hold the bearing in secure relation yet permit ready re-

removal of the bearing with the crank shaft assembly, when desired. Since the bearing is at an angle of about 45 degrees to the horizontal the component of force exerted by the pump connecting rod transmits part of the force to the angular faces of the interfitting slide plate 18 and the housing side plates 96 and part to the fitted bolts, therefore greater strength can be obtained than if the force was transmitted directly to tension bolts, furthermore, the tongue and groove construction admits of using bolts in double shear, which enables a stronger construction to be had, with the use of lighter weight material.

Longitudinal tension members 102 are provided at each corner of the pump case and extend from end plate 97, to which the "fluid end" of the pump is bolted by bolts 103, to the opposite end of the pump case, and are welded to the laminated side plates, in which the crankshaft bearings are journaled, as will best be seen in FIGS. 16 and 27. Medial reinforcement tension bars 104, likewise extend between end plate 97 and transverse bars 105 positioned along the top and bottom of the pump casing, as will best be seen in FIG. 16. A transverse bar 106 is secured adjacent the end plate 97 and is secured by welding to the end plate 97 and top plate 92, as well as to longitudinal tension members 102 and 104. Likewise, a transverse bar 107 is secured to intermediate plate 94, end plate 97 and longitudinal tension members 102 and 104 by welding, as will best be seen in FIGS. 16 and 17. Vertical bars 106a are provided in each corner adjacent end plate 97 and are welded to the side plates 96 and end plate 97 and to the longitudinal tension members 102. This strengthens end plate 97 against flexing and also strengthens the pump casing where strength is most needed. In this manner, the reaction force between the crank and the piston, when pumping fluid, is transmitted through these tension members throughout the length of the case, and is distributed across plate 97, to which the "fluid end" of the pump is bolted, thereby attaining maximum strength with a minimum of weight.

The pump case is provided with removable doors 108, 110 and 112 on each side thereof, as well as with removable doors 111, 113 and 114 on the top portion of the casing, thereby enabling ready access to the interior, and the openings for which the doors are provided, tend to lighten the case, at points where great strength is not needed.

The pump in general, comprises three major units, namely, the skids 1, case 2, and the valve-cylinder assemblies 4. The case 2, as will best be seen in FIGS. 12, 13, and 14, is constructed of laminated steel plates around the crankshaft bearing housings, and these plates welded to single thickness plates and to tension bars 102 and 104, which carry the load to the end plate 97, which bolts to the cylinder assembly. In this way, the construction is so designed as to have the maximum strength at the points of greatest strain, and to provide means for removing the bearing caps, so the crank assembly can be removed as a unit. These laminated plates are so ground and fitted and jig welded together as to present a case wherein the crankshaft 10 and anti-friction bearings 15 may be removed as a unit, by removing slide plate assemblies 18. The slide plate assembly is of a construction that interfits with complementary tongue and groove construction of the crank case 5, so when the parts are fitted together, a perfect bearing receptacle opening is formed therethrough, and by inserting fitted bolts through the bolt holes in the laminated plates, the bolts are placed in double shear by the reaction force of the crankshaft. Furthermore, as slide plate assembly 18 interfits within the notched portion 96k of the respective side plates 96, of the crank case, at an acute angle with respect to the line of force of the connecting rod of the pump, so that the faces of the plates 18 and 96 will take a major component of the force set up by the respective connecting rods. Therefore, much greater strength may be had by this construction than by a construction using single layer

plates, or the common construction using tension bolts to bolt on the bearing cap.

Strainer units 115 and 115a are provided, which are removably attached to the exterior of the case, so as to enable the filtering of rod lubricating oil, and crankcase lubricating oil, respectively, which passes therethrough. The strainers are readily removable for cleaning or replacement. A sludge pan 116 is provided, into which rod lubricating oil passes, before it passes through strainer 115, thereby enabling the heavy sludge to settle out into the sludge pan, where it may be readily removed, before the lubricant is passed through the strainer 115a. The strainer 115a, which filters the crankcase oil, may be removed for cleaning when necessary. A filter unit 115b is connected within the crankcase oil system for further cleaning of the crankcase oil.

Each of the cylinders 70, together with two suction valve pots 117, and two discharge valve pots 117a, are cast as an integral unit, and for a duplex pump, they are similar, except one is a right hand unit and the other is a left hand unit. An inlet pipe 118 has L-fittings 118a, which are welded thereto and to the inlet of each of the inlet valve pots. Inlet valves 119 are fitted within the respective valve pots, so that the fluid or mud can be drawn therethrough into pump cylinder 70 and cylinder liner 58, upon reciprocation of the pump piston 56.

Discharge valve pots 117a each has a discharge valve 121 therein, which directs drilling fluid outward from cylinder 70 through tapered valve seat 120, thence outward through discharge pipe 122a leading to discharge pipe 122. The valve seat 120 is grooved, as shown in FIG. 6, and has an O-ring 120a therein which forms a seal with valve pot 117a. Both the inlet and outlet valve seats are constructed in this manner.

The packing gland 54 has a threaded, cylindrical casing 124 therearound, which packing gland has gear teeth 126 thereon to mesh with a gear 128, which is mounted on one of the bolts 103, as will best be seen in FIG. 17. The gear 128 has an axial hole therethrough, and is mounted on a stud shaft 130, which shaft 130 is mounted on a cylinder head stud bolt 103, immediately above the packing gland 54. A portion 132, on the end of gear 128, is of hexagon shape, so as to enable turning the gear, by engaging a wrench on the hexagon portion thereof, which in turn, will tighten or loosen cylindrical casing 124. A pipe 134 is provided for supplying lubricant and coolant directly onto the piston rod 52, which pipe 134 is connected with a suitable source of fluid supply.

Having thus described the invention, what is claimed is:

1. In a mud pump or the like, the combination of a body having a cylindrical bore formed therein, said body having valve ports and passages formed therein which valve ports and passages are in fluid communication with said cylindrical bore, a pump cylinder liner fitted within said cylindrical bore of said body, a pump cylinder liner retainer fitted within said bore and having one end thereof in bearing relation with an end of said pump cylinder liner, the other end of said pump cylinder liner retainer having a bridging portion thereon, an annular ring having an opening therein larger than the diameter of said bore in said body and adapted to seat on an end of said body and being axially aligned with the bore thereof, bolt means bindingly securing said annular ring to said body, a disc-like cylinder head, the diameter of which is greater than the diameter of said cylindrical bore of said body and of less diameter than the opening in said annular ring, fitted against said body so as to substantially close the end of said bore, a compressible sealing element interposed between said pump body and said disc-like cylinder head so as to form a fluid tight seal between said body and said disc-like cylinder head, said cylinder head having a threaded aperture therethrough, cylinder head retaining means attachably fitted within said annular ring and being adapted to hold said disc-like cylinder head

within said annular ring and in binding engagement with said body, and screw threaded means engaging said threaded aperture in said disc-like cylinder head and abutting the bridging portion of said pump cylinder liner retainer so as to bindingly engage said pump cylinder liner 5
retainer with said pump cylinder liner.

2. A mud pump as defined in claim 1, wherein said portion of said disc-like cylinder head which abuts with said body is beveled, and wherein said body has a complementary bevel formed thereon. 10

3. A mud pump as defined in claim 1, wherein said annular ring is internally threaded, and wherein said cylinder head retaining means is externally threaded to engage said threads of said annular ring.

4. A mud pump as defined in claim 1, wherein at least 15
one of said interengaging elements has a groove formed therein, and wherein said compressible sealing element is fitted within said annular groove so as to be interposed between said pump body and said disc-like cylinder head.

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