

PATENT SPECIFICATION

(11)

1 511 715

12

- (21) Application No. 35015/75 (22) Filed 22 Aug. 1975
 (31) Convention Application No. 520 751 (32) Filed 4 Nov. 1974 in
 (33) United States of America (US)
 (44) Complete Specification published 24 May 1978
 (51) INT. CL.² F04B 23/06 19/04
 (52) Index at acceptance
 F1A 1A2 1A4 1A6 3F4B1 4C 4S4



(54) MULTIPLEX PUMP

(71) We, DRESSER INDUSTRIES INC., a corporation organised and existing under the laws of the State of Delaware, United States of America, of the Dresser Building, 5 Elm & Akard Streets, Dallas, Texas, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to multiplex pumps and more particularly to multiplex pumps for use in connection with wells and well drilling.

In the drilling of oil wells in secluded and remote regions such as in jungle areas, desert areas, offshore rigs, and in far northern regions, equipment used in the drilling operation must be highly mobile and efficient, yet often must be capable of handling the highest of workloads placed on any equipment at any location.

In many of these remote regions the only access is by helicopter due to the impossibility of ground surface transportation, the lack of airstrips, or extremely hostile weather conditions.

The normal load carrying capacity of available helicopter transportation is a maximum of about 4000 pounds plus human passengers and flight crew. This greatly limits the equipment that can be used or else requires lengthy disassembly and reassembly on site of such heavy equipment as mud pumps and drawworks.

For example, many wells are drilled to such a depth that mud pumps rated at several hundred horsepower are required to maintain a proper supply of drilling mud to the drilling operation. Several pumps having such capacity are available which are of the multiplex type, mostly being a triplex design with three harmoniously

phased pumping cylinders. The available triplex pumps are of the mechanically driven single unit design having three cylinders, each 120 degrees out of phase with the other cylinders, and all combined into 50 one integral unit.

The multiplex unit is many times heavier than the maximum helicopter load. For example, a 1750 horsepower duplex mud pump available in the industry may weigh as much as 60,000 pounds. The helicopter transportation of such units is possible only after extensive disassembly of the pumps into separate components. This disassembly results in exposing the internal working parts to the elements and contamination with abrasive debris in transit and on site. It also involves a time consuming process of disassembly and reassembly often under very hostile conditions.

According to the present invention there is provided a multiplex pump adapted to be disassembled into self contained portable components; said pump comprising a plurality of self contained portable sealed driving units; pumping means attached to each of said driving units to be driven thereby to draw in and discharge fluid; drive coupling means drivingly interconnecting said driving units; and connecting means releasably connecting together the said portable components.

The invention will be better understood from the following description of preferred embodiments thereof, given by way of example only, reference being had to the accompanying drawings, wherein:

Figure 1 is a side view of a pump;

Figure 2 is a top view of a three-unit pump;

Figure 3 is a cutaway side view of a part of the pump of Fig. 1;

Figure 4 is a cutaway top view of a part of the apparatus of Figure 3; and

13 Figure 5 is a cutaway view of a pumping cylinder.

Referring to Figure 1, the individual single cylinder driving unit 13 is illustrated in a side view and is shown in operational connection with a pumping unit 11 and supported by a structural frame in the form of a skid 12. The driving unit 13 and pumping unit 11 comprise a complete pumping assembly 10.

The driving unit 13 contains an eccentric journal and connecting rod arrangement. As shown in Figure 3, the connecting rod 14 extends laterally into a shaft section 15 of housing 10a. The pumping unit 11 contains a pumping chamber for fluid, and inlet and outlet checkvalves communicating the chamber with a suction header 16 and a discharge header 17 respectively.

A shaft 18 extends laterally outward from the housing of the driving unit 13 and a journal 19 thereon rotatably supports the large end of the connecting rod 14.

Figures 3 and 4 illustrate the reciprocating connecting rod 14 rotatably mounted on the eccentric journal 19 by means of a roller bearing 20. The centre of rotation of the eccentric journal 19 is marked at C and corresponds with the central axis of the shaft 18. Shaft 18 is rotatably mounted in the housing sidewall bearing 21. Figure 3 is taken along section line 3-3 of figure 4, and illustrates the shaft 18 integrally attached to eccentric journal 19.

At the small end 22 of rod 14 is a cylindrical wrist pin 23 mounted by a roller bearing assembly 24 in the small end of the rod and extending outward past the sides of the rod to engage the sidewalls 25 of a crosshead 26. The crosshead 26 is slidably mounted in the housing section 15 on upper and lower slide guides 27 and 28, respectively. The journal 19, connecting rod 14, and crosshead 26 convert circular motion of the shaft 18 into lateral reciprocating motion of the crosshead along the guides 27 and 28.

A drive rod 29 having an outward projecting end flange 30 formed thereon is attached via bolts 31 to the wall 32 of the crosshead 26. The drive rod is coupled via coupling 33 to a piston rod 34 (see Figures 2 and 5).

In Figure 5 the pumping unit 11 is shown in partial schematic cross-section and comprises the piston rod 34 upon which is secured a generally cylindrical piston 35 slidable in a cylinder 36. Cylinder 36 terminates in a fluid chamber 37 which communicates with suction and discharge headers 16 and 17 via suction checkvalve 38 and discharge checkvalve 39 respectively. Operation of the pumping unit is the same as that of the normal piston-

type pump, which is well known in the industry.

Figure 2 is a top view of a multiplex pump comprising three pumping assemblies 10 aligned in parallel adjacent orientation on a single skid 12. Each pumping assembly has a crankshaft extension 18' projecting laterally outwardly from each side of the housing of the driving unit 13. Between each adjacent pair of crankshaft extensions 18' is a flexible coupling 40, each coupling comprising a left half 41 on one shaft extension and a right half 42 mounted on the adjacent shaft extension. The coupling halves 41 and 42 are flexibly mounted on the shaft extensions by means such as flexible elements, said mounting means being known in the art. The halves 41 and 42 are then joined together by releasable attachment means such as studs or bolts (not shown).

When a triplex pump as shown in Figure 2 is assembled, a coding means is used with the flexible couplings to assure that each cylinder is placed 120 degrees out of phase with the other cylinders. One preferable means of doing this is to place an extra hole in each coupling half 41 and 42 through which a guide pin can be driven during assembly. Location of bolt holes and guide pin holes is selected so that the pumping assemblies are maintained in proper 120 degree spaced phasing.

Alternatively, different numbers of bolt holes may be used in each coupling 40 to ensure that the pumping assemblies are located on the skid in proper sequence. Spacing of the bolt holes in each coupling may be varied or arranged so that the coupling halves are fitted together in the same relative position each time.

In Figures 1 and 2, a phantom line is drawn to indicate a portable single driving unit 13 which is helicopter transportable without disassembly of any of the internal parts. An entire triplex pump as illustrated in Figure 2 preferably consists of three such driving units 13, three individual, separately portable pumping units 11, a single skid 12 designed to receive the three driving units and three pumping units, a single intake header 16, a single discharge header 17, and a portable, integrally self contained reduction drive assembly 43 coupled through its output shaft 44 and a flexible coupling 40 to the shaft extension 18' of the first of the three driving units.

Reduction drive assembly 43 is a self contained sealed unit for receiving motive power through an input shaft 45 from a prime mover such as an internal combustion engine, electric motor, or other power source and converting the high RPM of the prime mover to a high-torque,

low RPM for pumping operations.

Assembly 43 comprises the two transverse substantially parallel shafts 44 and 45 rotatably and sealingly mounted in opposite sidewalls of a fluid-tight housing. The assembly 43 is transportable as a single unit by disconnection from the prime mover, from the coupling 40 and from skid 12. The shafts 44 and 45 are operationally interconnected inside the housing by means such as, for example, gears or chains arranged to provide the desired speed.

Thus, when a triplex pump is required quickly at an inaccessible site, it can be transported to location quickly by helicopter. The skid is brought in first, then each of the three driving units are brought in by helicopter and bolted to the skid and interconnected to each other via the flexible couplings. Each of the three pumping units is brought in separately and operationally connected to a driving unit and anchored to the skid. The fluid discharge and suction headers are flown to the site and connected to the three pumping units. The reduction drive assembly is then moved in and operationally connected to the driving units via a flexible coupling and anchored to the skid. One or more prime movers are then coupled to the input shaft of the reduction drive assembly.

Additional power input can be obtained by placing another reduction drive assembly at the opposite side of the pump connected to the shaft extension 18' of the outermost unit 13, and coupling one or more additional prime movers to the second reduction drive assembly.

Furthermore, the number of pumping assemblies used may be varied to obtain almost any pumping capacity desired by the use of multiple skids and/or different sizes of skids. The phasing of the pumping assemblies in the pump may be varied to any desired timing cycle by the use of differently coded flexible couplings 40. For instance, five or a six cylinder pump can be assembled for higher pumping capacity than the described triplex pump. In the case of a six cylinder pump the same 120 degree phasing and an additional skid may be used, or the phasing may be reduced to 60 degrees by changing the couplings 40 to ones coded at 60 degree intervals. Likewise, instead of two skids, a single large skid may be utilized.

Thus, it can be seen from the description above, that the entire components of a multiplex pump of desired capacity can be quickly flown into any drilling site and easily assembled by non specialized operators in very short time. The components of this pump are all easily interconnected because each is a sealed, self contained unit easily interconnected by such means as bolts and

studs. The assembly of the multiplex pump in the field does not require the services of highly skilled pump mechanics but can be accomplished by unskilled labourers with a minimum amount of supervision. Each unit has the internal working parts continuously sealed against the elements and handling abuse and each component is fully helicopter transportable.

WHAT WE CLAIM IS:—

1. A multiplex pump adapted to be disassembled into self contained portable components; said pump comprising a plurality of self contained portable sealed driving units; pumping means attached to each of said driving units to be driven thereby to draw in and discharge fluid; drive coupling means drivingly interconnecting said driving units; and connecting means releasably connecting together the said portable components.

2. A multiplex pump according to claim 1, further comprising reduction drive means drivingly connected to at least one of said driving units and adapted to receive rotational power from a prime mover and transfer said power to said at least one driving unit.

3. A multiplex pump according to claim 2, wherein said reduction drive means is a self contained portable sealed unit.

4. A multiplex pump according to any preceding claim wherein a drive shaft extends out of each driving unit, said drive coupling means being adapted to couple the drive shafts of adjacent units, and each said pumping means being connected to its respective driving means by a power drive means which extends laterally of the drive shaft of that driving means.

5. A multiplex pump according to any of claims 1 to 3, wherein said driving units each comprise an elongate housing; a transverse shaft rotatably supported in opposing walls of said housing; an eccentric journal fixedly secured on said shaft; an elongated connecting rod rotatably mounted at one end on said journal; and a crosshead rotatably mounted on the other end of said connecting rod and adapted for slidable movement in said housing, said crosshead being drivingly connected to said pumping means.

6. A multiplex pump according to any preceding claim wherein said drive coupling means comprises flexible couplings for maintaining proper phasing of said driving units with respect to each other.

7. A multiplex pump according to any preceding claim wherein said drive coupling means are provided with coding means for indicating when said driving units are assembled with the proper phasing with re-

low RPM for pumping operations.

Assembly 43 comprises the two transverse substantially parallel shafts 44 and 45 rotatably and sealingly mounted in opposite sidewalls of a fluid-tight housing. The assembly 43 is transportable as a single unit by disconnection from the prime mover, from the coupling 40 and from skid 12. The shafts 44 and 45 are operationally interconnected inside the housing by means such as, for example, gears or chains arranged to provide the desired speed.

Thus, when a triplex pump is required quickly at an inaccessible site, it can be transported to location quickly by helicopter. The skid is brought in first, then each of the three driving units are brought in by helicopter and bolted to the skid and interconnected to each other via the flexible couplings. Each of the three pumping units is brought in separately and operationally connected to a driving unit and anchored to the skid. The fluid discharge and suction headers are flown to the site and connected to the three pumping units. The reduction drive assembly is then moved in and operationally connected to the driving units via a flexible coupling and anchored to the skid. One or more prime movers are then coupled to the input shaft of the reduction drive assembly.

Additional power input can be obtained by placing another reduction drive assembly at the opposite side of the pump connected to the shaft extension 18' of the outermost unit 13, and coupling one or more additional prime movers to the second reduction drive assembly.

Furthermore, the number of pumping assemblies used may be varied to obtain almost any pumping capacity desired by the use of multiple skids and/or different sizes of skids. The phasing of the pumping assemblies in the pump may be varied to any desired timing cycle by the use of differently coded flexible couplings 40. For instance, five or a six cylinder pump can be assembled for higher pumping capacity than the described triplex pump. In the case of a six cylinder pump the same 120 degree phasing and an additional skid may be used, or the phasing may be reduced to 60 degrees by changing the couplings 40 to ones coded at 60 degree intervals. Likewise, instead of two skids, a single large skid may be utilized.

Thus, it can be seen from the description above, that the entire components of a multiplex pump of desired capacity can be quickly flown into any drilling site and easily assembled by non specialized operators in very short time. The components of this pump are all easily interconnected because each is a sealed, self contained unit easily inter-connected by such means as bolts and

studs. The assembly of the multiplex pump in the field does not require the services of highly skilled pump mechanics but can be accomplished by unskilled labourers with a minimum amount of supervision. Each unit has the internal working parts continuously sealed against the elements and handling abuse and each component is fully helicopter transportable.

WHAT WE CLAIM IS:—

1. A multiplex pump adapted to be disassembled into self contained portable components; said pump comprising a plurality of self contained portable sealed driving units; pumping means attached to each of said driving units to be driven thereby to draw in and discharge fluid; drive coupling means drivingly interconnecting said driving units; and connecting means releasably connecting together the said portable components.

2. A multiplex pump according to claim 1, further comprising reduction drive means drivingly connected to at least one of said driving units and adapted to receive rotational power from a prime mover and transfer said power to said at least one driving unit.

3. A multiplex pump according to claim 2, wherein said reduction drive means is a self contained portable sealed unit.

4. A multiplex pump according to any preceding claim wherein a drive shaft extends out of each driving unit, said drive coupling means being adapted to couple the drive shafts of adjacent units, and each said pumping means being connected to its respective driving means by a power drive means which extends laterally of the drive shaft of that driving means.

5. A multiplex pump according to any of claims 1 to 3, wherein said driving units each comprise an elongate housing; a transverse shaft rotatably supported in opposing walls of said housing; an eccentric journal fixedly secured on said shaft; an elongated connecting rod rotatably mounted at one end on said journal; and a crosshead rotatably mounted on the other end of said connecting rod and adapted for slidable movement in said housing, said crosshead being drivingly connected to said pumping means.

6. A multiplex pump according to any preceding claim wherein said drive coupling means comprises flexible couplings for maintaining proper phasing of said driving units with respect to each other.

7. A multiplex pump according to any preceding claim wherein said drive coupling means are provided with coding means for indicating when said driving units are assembled with the proper phasing with re-



15 4 spect to each other.

8. A multiplex pump according to any preceding claim including a structural frame having support members arranged to receive said driving units thereon in releasable attachment.

9. A multiplex pump according to any preceding claim wherein said plurality of driving units comprises three units drivingly interconnected 120 degrees out of phase with each other.

10. A multiplex pump according to any of claims 1 to 8 wherein said plurality of driving units comprises five units.

11. A multiplex pump according to any of claims 4 to 10 when appendant to claim 3 wherein said power reduction drive

means comprises two self contained, sealed reduction drive assemblies, one at each side of said coupled driving units and connected flexibly to the outermost of said driving units; said reduction drive assemblies each being adapted and arranged to be operationally connected with a prime mover.

12. A multiplex pump, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

A. A. THORNTON & CO.
Northumberland House,
303-306 High Holborn,
London, W.C.1.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1978.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.



* C L H S *