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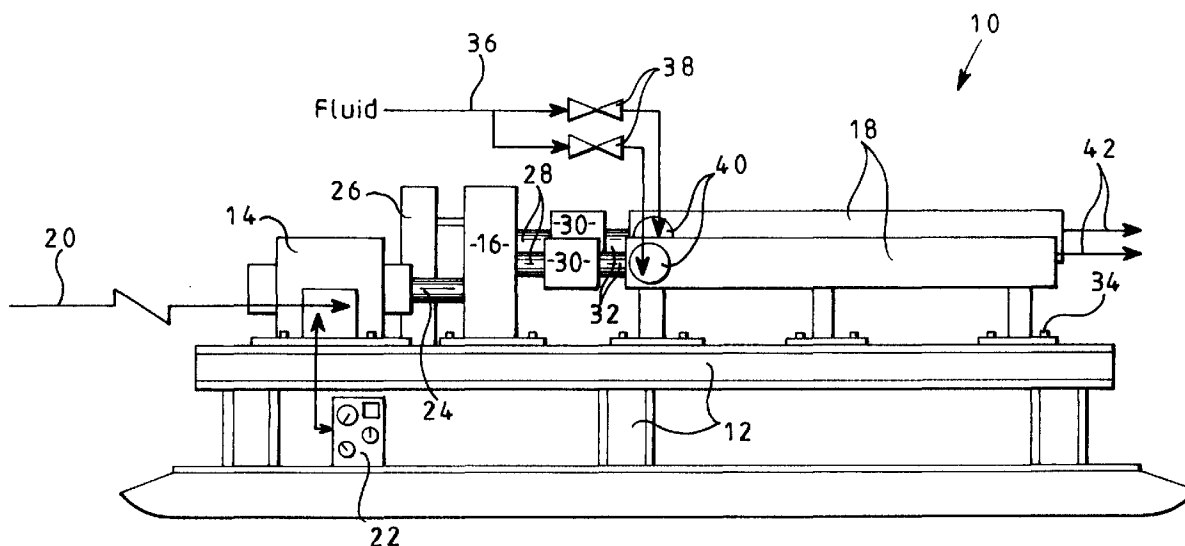
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AL LT LV MK RO SI(30) Priority: **07.05.1997 US 852476**(71) Applicant: **CAMCO INTERNATIONAL INC.****Houston, Texas 77054 (US)**(72) Inventor: **Krowski, Paul J.****Bartlesville, Oklahoma 74006 (US)**(74) Representative: **Carter, Gerald****Arthur R. Davies & Co.****27 Imperial Square****Cheltenham, Gloucestershire GL50 1RQ (GB)**(54) **Horizontal pumping system**

(57) A multi-pump horizontal pumping system has a support structure (12) with a plurality of pumps (18) horizontally connected thereto in parallel and side-by-side relationship. A gear box (16) operatively interconnects an electric motor (14) to each of the pumps with a thrust bearing (30) operatively connected to each pump shaft (32) of each pump between the gear box and each

pump. Piping (36) conveys fluids to and from the pumps in parallel or series flow. The multi-pump arrangement provides redundant pumping ability in remote locations where pumps fail more often than the electric motors, and in remote locations where size and weight considerations prevent the use of multiple single-pump horizontal pumping systems.

**FIG 1**

Description

The present invention relates to a horizontal pumping system and, more particularly, to a multi-pump horizontal pumping system.

Horizontal pumping systems are used as surface pumps to boost fluid pressure at specified volumes in applications such as water injection into a disposal well, and lifting of brine from mines to the earth's surface. Such horizontal pumping systems usually comprise a multistage centrifugal pump horizontally mounted to a skid, and driven by an electric motor. Horizontal pumping systems are made and sold by The Reda Division of Camco International Inc., Bartlesville, Oklahoma, U. S.A. In most offshore applications, there is a need for reliability of equipment due to the remote locations, as well as need for space and weight savings due to space limitations on most offshore platforms. In the past when a horizontal pumping system was used, if a relatively large volume of fluids were to be moved, then two or more separate pumping systems were needed. Yet, such additional pumping systems only added more components that could fail, as well as the additional weight and space.

In area where positive displacement pumps are used to move viscous oils with entrained sand, operators have found that the pumps fail more quickly than the electric motors and other equipment. There is a need for a pumping system that can use positive displacement pumps and still provide a redundancy so that if a pump fails the system does not need to be completely shut in while awaiting the pump to be repaired.

The present invention has been contemplated to overcome the foregoing deficiencies and meet the above described needs. Specifically, the present invention is a multi-pump horizontal pumping system comprising a support structure with a plurality of pumps horizontally connected thereto in parallel and side-by-side relationship. A gear box operatively interconnects an electric motor to each of the pumps with an intake thrust bearing section operatively connected to each pump shaft of each pump between the gear box and each pump. Piping conveys fluids to and from the pumps in parallel or series flow.

The multi-pump arrangement provides redundant pumping ability in remote locations where pumps fail more often than the electric motors, and in remote locations where size and weight considerations prevent the use of multiple separate single-pump horizontal pumping systems.

Brief description of the drawings:

Figure 1 is a side elevational view of one preferred embodiment of a horizontal pumping system of the present invention.

Figure 2 is an end elevational view of an alternate preferred embodiment of a horizontal pumping system

of the present invention.

Figure 3 is a plan view of an alternate preferred embodiment of a horizontal pumping system of the present invention.

As has been briefly described above, the present invention comprises a multi-pump horizontal pumping system that has a support structure with a plurality of pumps horizontally connected thereto in parallel and/or side-by-side relationship. A gear box operatively interconnects an electric motor to each of the pumps with a thrust bearing operatively connected to each pump shaft of each pump between the gear box and each pump. Piping conveys fluids to and from the pumps in parallel or series flow.

As shown in Figure 1, one preferred embodiment of a horizontal pumping system 10 of the present invention comprises a support structure or skid 12, an electric motor 14, a gear box or transmission 16, and two or more pumps 18. The skid 12 is preferably formed from 4"-6" steel I-beams that are bolted or welded together to form a rigid platform to which all of the other components are mounted. The electric motor 14 comprises any commercially available AC or DC electric motor from about 250 HP to about 1,000 HP. Suitable motors 14 are sold by several manufacturers, such as Siemens and General Electric. Electric power is provided to the electric motor 14 through a power cable 20, with the operation of the motor 14, as well as the pumping system 10 being controlled by the operation of various switches and gauges located on a control station 22, as is well known to those skilled in the art.

The gear box 16 comprises a commercially available gear drive transmission to increase the speed or to decrease the speed of an output shaft 24 of the motor 14. It has been found that a speed increase is needed to successfully interconnect an electric motor 14 that optimally operates at about 1,200 RPM to a centrifugal pump 18 that normally operates at about 3,600 RPM, depending upon the rate and volume of fluid to be pumped and the density of fluid to be pumped. If a progressive cavity pump is used, then a gear box 16 that decreases the speed will be needed to connect the 1,200 RPM motor 14 to a progressive cavity pump that has an optimum speed of about 450 RPM. In certain applications, a radiator 26 is provided to cool the lubrication oil/fluids within the gear box 16. The gear box 16 has a single input shaft coupled to the output shaft 24 of the motor 14, and has two or more output shafts 28. These shafts 28 are connected through thrust chambers or thrust bearings 30 to rotor shafts 32 of the pumps 18. Suitable gear boxes 16 are commercially available from Lufkin Industries.

The thrust chambers 30 are designed to absorb the thrust loads created by the operation of the pump 18 that would tend to longitudinally push against the output shafts 28, and thereby potentially destroy the bearings and gears with the gear box 16. A preferred thrust chamber 30 is made by Mingo Industries of Owasso, Oklaho-

ma, U.S.A., and sold by The Reda Division of Camco International Inc. of Bartlesville, Oklahoma, U.S.A.

Preferred pumps 18 for use in the present invention include 540-Series, 675-Series and 862-Series multi-stage centrifugal pumps made and sold by The Reda Division of Camco International Inc. of Bartlesville, Oklahoma, U.S.A. It should be understood that other centrifugal pumps can be used, as well as progressive cavity pumps, gear pumps, vane pumps, turbines and the like. It is preferred that each of the pumps 18 be of the same type and approximate size and fluid handling capacity; however, various pump types, sizes and configurations can be simultaneously used as is desired.

The pumps 18 are preferably mounted to the skid 12 in parallel relationship, and most preferably in side-by-side relationship, as shown in Figure 2. However, the pumps 18 may be mounted vertically, at inclined angles, not in parallel, one above another, as shown in Figure 1, or in any other arrangement as is desired. The pumps 18, the gear box 16 and the electric motor 14 include levelling bolts and shims 34 to permit the vertical and/or the side-to-side movement of the respective shafts to permit the accurate alignment of the respective shafts. The alignment is performed in any manner as is well known in the art, and is performed in order not to add additional vibrations by misalignment.

It can be seen that the present invention provides a relatively compact arrangement of components that can save space and weight over using two or more separate pumping systems, as in the past.

Suitable piping and valves are included so that the horizontal pumping system 10 can be operated in parallel or series flow. Parallel flow is shown in Figures 1 and 2, where fluid is provided through a main conduit 36, through one or more valves 38, to intakes 40 of the pumps 18. Fluids are then discharged from the pumps 18 to separate discharge conduits 42, that may or may not be merged, as shown in Figure 2. Series flow is shown in Figure 3, where fluid is provided through a main conduit 44, through a valve 46 and into an intake 48 of a first pump 50. Fluids exit the first pump 50 through a conduit 52, and are introduced into an intake 54 of a second pump 56. Fluids discharged from the second pump 56 are conveyed through a discharge conduit 58.

In the event that one or more of the pumps fail, then in the case of Figure 1, the valve 38 for the failed pump 18 is closed, the shaft 32 can be disconnected if needed, and fluids are continued to be pumped by the other pump 18. In this manner, the well need not be shut in while awaiting repair or replacement of the failed pump. In the case of Figure 3, if the first pump 50 fails, the valve 46 is closed and a by-pass valve 58 is opened, so that fluids will continue to be moved by the pump 56. In the event that pump 56 fails, an optional by-pass valve 60 is closed so that fluids can be moved through a by-pass conduit 62. It can be seen, that with the present invention, if a pump fails, then the well need not be shut in, as in the past, because one or more of the remaining

pumps can still be used.

Whereas the present invention has been described in particular relation to the drawings attached hereto, it should be understood that other and further modifications, apart from those shown or suggested herein, may be made within the scope of the claims.

Claims

1. A multi-pump horizontal pumping system comprising: a support structure; a plurality of pumps horizontally connected to the support structure; an electric motor connected to the support structure; and a gear box operatively interconnecting the electric motor to each of the pumps.
2. A multi-pump horizontal pumping system of Claim 1, wherein the pumps comprise multistage centrifugal pumps.
3. A multi-pump horizontal pumping system of Claim 1, wherein the pumps comprise progressive cavity pumps.
4. A multi-pump horizontal pumping system of any of the preceding claims, wherein the pumps are connected to the support structure in parallel relationship.
5. A multi-pump horizontal pumping system of any of the preceding claims, wherein the pumps are connected to the support structure in side-by-side relationship.
6. A multi-pump horizontal pumping system of any of the preceding claims and further comprising conduit means for conveying fluids to and from the pumps in parallel flow.
7. A multi-pump horizontal pumping system of any of the preceding claims and further comprising conduit means for conveying fluids to and from the pumps in series flow.
8. A multi-pump horizontal pumping system of any of the preceding claims and further comprising a thrust bearing operatively connected to each pump shaft of each pump.
9. A multi-pump horizontal pumping system of any of the preceding claims, wherein the gear box has a lower output RPM than input RPM.
10. A multi-pump horizontal pumping system of any of the preceding claims 1 to 8, wherein the gear box has a greater output RPM than input RPM.

11. A multi-pump horizontal pumping system comprising: a support structure; a plurality of multistage centrifugal pumps horizontally connected to the support structure in parallel and side-by-side relationship; an electric motor connected to the support structure; a gear box operatively interconnecting the electric motor to each of the pumps, the gear box having a greater output RPM than input RPM; a thrust bearing operatively connected to each pump shaft of each pump between the gear box and each pump; and conduit means for conveying fluids to and from the pumps in parallel flow.

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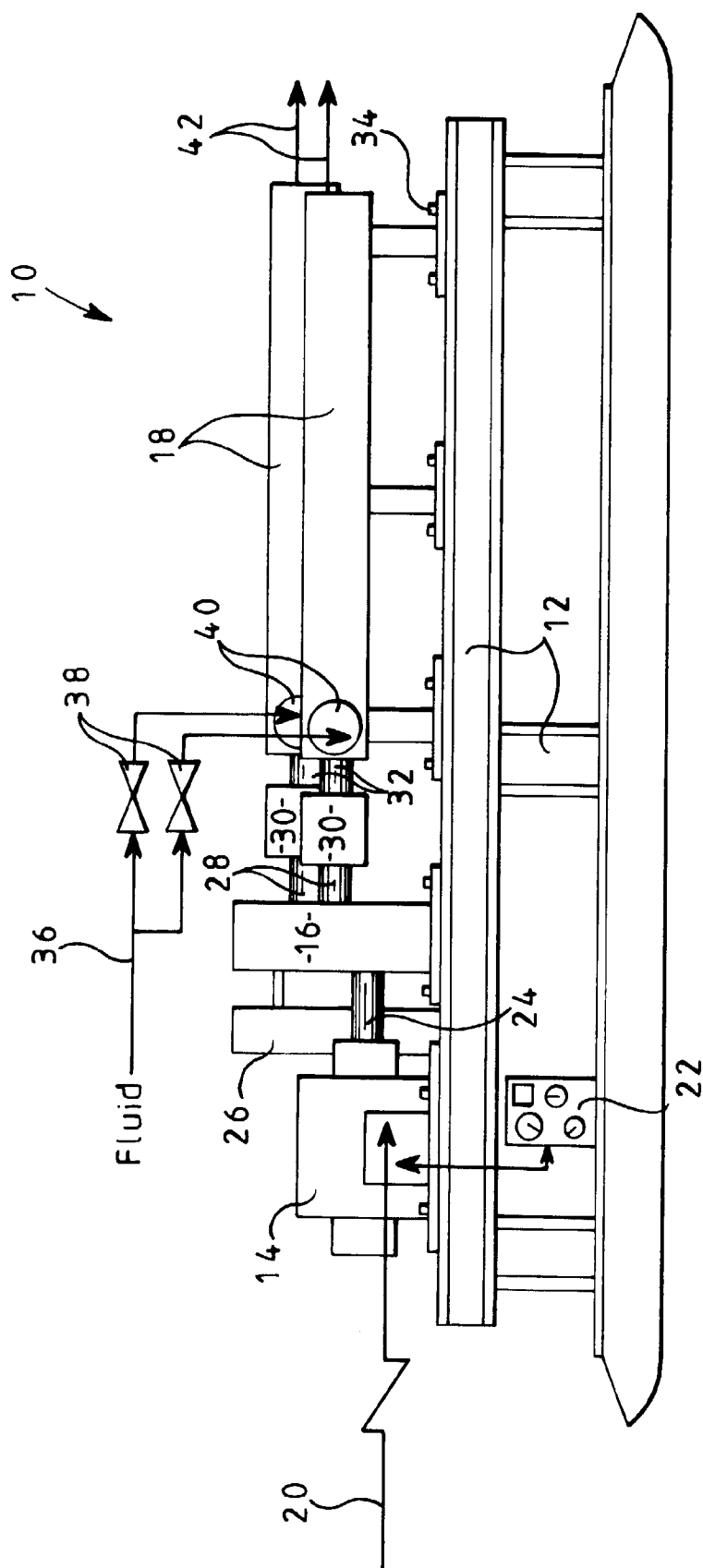


FIG. 1

