Jan. 18, 1955 J. F. MURRAY ET AL 2,699,724

MULTIPLE GEAR PUMP

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Fig. 1

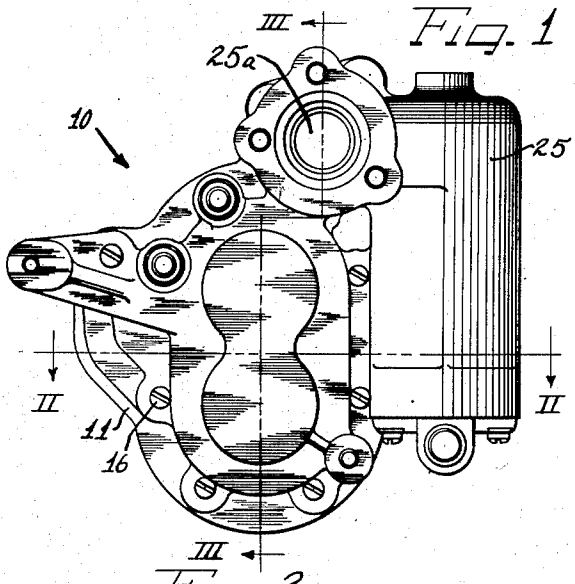

Fig. 2

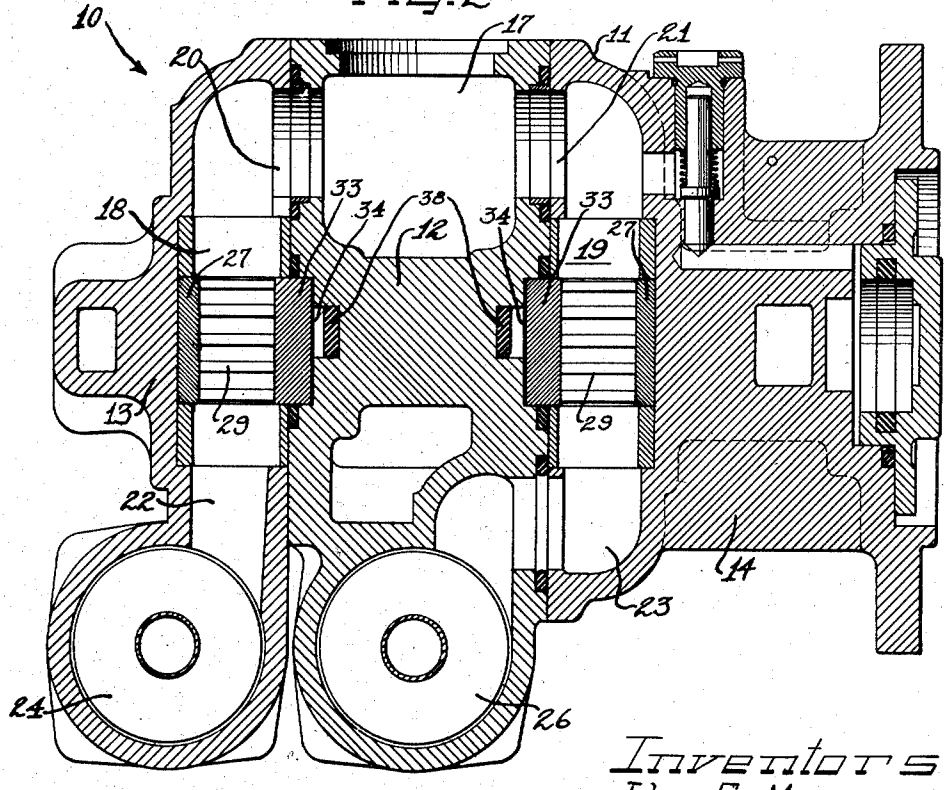

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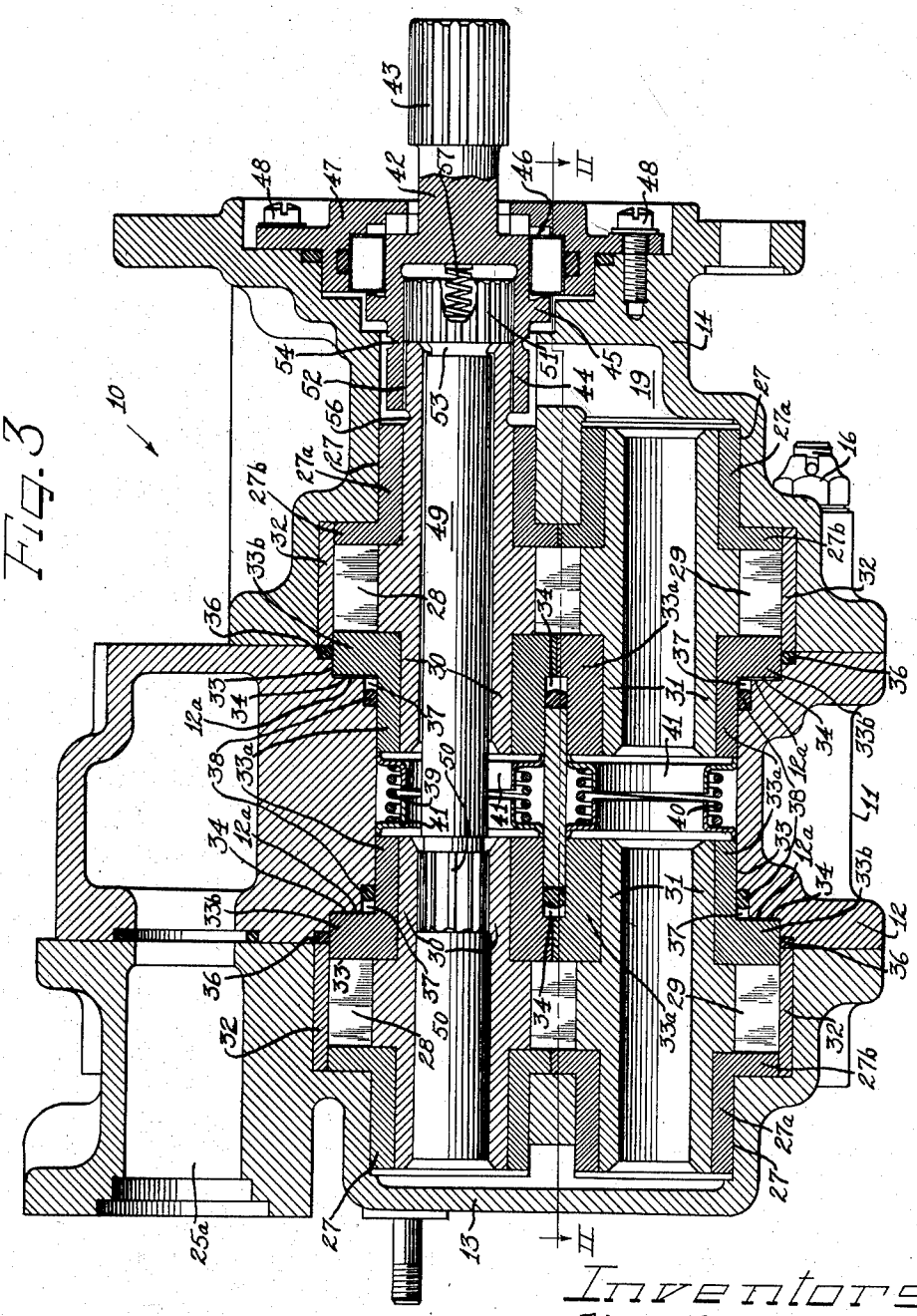
Fig. 3



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MULTIPLE GEAR PUMP

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4 Claims. (Cl. 103—4)

This invention relates generally to fluid displacement apparatus and more particularly to a multiple pumping unit incorporating a plurality of rotary fluid displacement means having pressure loaded pump sealing elements. A particular feature of the present invention includes the provision of frangible couplings between each of the fluid displacement means and a common drive means whereby interrupted operation of one of the pumping units will not interfere with an assured supply of pumping medium.

The structure of the present invention provides a particularly useful application when employed in connection with the supply of a vital fluid to a particularly strategic location, for example, the supply of fuel to the jet engines of a high altitude aircraft. Obviously in such environment interrupted supply of fuel would be critical not only from the point of view of the operator of the aircraft but also with respect to possible damage to or loss of the aircraft itself.

According to the general features of the present invention, a plurality of pressure loaded gear pumps are arranged to be driven in parallel with one another by a common drive means. A frangible coupling is provided between each of the pumping units and the common drive means so that binding or seizure of one of the pumping units will cause a corresponding frangible coupling to break and permit normal uninterrupted operation of the other of the coupling units.

It is an object of the present invention, therefore, to provide a multiple pumping structure wherein continued operation of one of the pumping units will be assured despite the binding and seizure in one of the other pumping units.

A further object of the present invention is to provide a multiple gear pump having a plurality of pumping units to be driven in parallel with one another through a common driving means, each of the pumping units being provided with a frangible coupling yieldable in response to abnormal load conditions.

Another object of the present invention is to provide a pressure loaded gear pump having a plurality of pumping units each discharging into a separate outlet and each having separate communications between a pressure control chamber and a corresponding outlet, each pumping unit being further provided with a frangible coupling to a common driving means so that breakage of one of the couplings will permit uninterrupted operation of the other pumping units.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which a preferred embodiment of the present invention is shown.

On the drawings:

Figure 1 is a rear end elevational view of a multiple gear pump according to the principles of the present invention;

Figure 2 is a transverse cross-sectional view taken substantially along line II—II of Figures 1 and 3; and

Figure 3 is a cross-sectional view taken substantially along line III—III of Figure 1 and on a larger scale than Figures 1 and 2.

As shown on the drawings:

The multiple pump structure of the present invention is indicated generally by the reference numeral **10** and includes a multi-section housing **11** having a central body **12** with a cover **13** on one end and a cap structure **14** on the other end. The various elements of the housing **11** are retained in firm assembly by means of suitable fasteners, for example, the studs and nuts **16**.

The body **12** of the housing **11** defines a common fluid inlet passage **17** and the cover **13** and the cap **14** each defines a recess which, together with the side wall portions of the body **12**, form a plurality of pumping chambers **18** and **19**, respectively, communicating with the common inlet passage **17** through pumping chamber inlets **20** and **21**, respectively.

The pumping chambers **18** and **19** are provided with outlets **22** and **23**, respectively, which discharge into an outlet passage **24** formed by an enlarged portion on the cover **13** and an outlet passage **26** formed by an enlarged portion on the body **12**. The outlet passages **24** and **26** merge in a chamber provided by a filter casing portion **25** containing a filter and having a single outlet **25***a*.

In many respects, each of the pumping units incorporated in the multiple gear pump **10** is of identical construction. Each of the units includes a pair of fixed bushings **27—27** having a bearing portion **27***a* and an end plate portion **27***b* and being mounted in relatively fixed assembly within the cover **13** and the cap **14**.

Rotary fluid displacement means are provided in each of the pumping chambers **18** and **19** and in this embodiment include a pair of intermeshing rotary gears, for example, a pair of driver gears **28—28** and a pair of driven gears **29—29**. Each of the gears **28—28** and **29—29** are provided with tubular shafts **30** and **31**, respectively, which project outwardly from either side of the gears for journaling purposes. One end of each of the shaft portions **30** and **31** is journaled in a bearing portion **27***a* of one of the fixed bushings **27**.

The other end of each of the shaft portions **30** and **31** is journaled in a bearing portion **33***a* of one of a pair of slidable bushings **33** located in each of the pumping chambers **18** and **19**.

The slidable bushings **33** are each provided with a radially extending end plate portion **33***b*, the back face of which, together with the walls of the body **12**, forming a control pressure chamber **34**. Means are provided between each of the pressure chambers **34** and the respective outlets **24** and **26** to introduce pressurized outlet fluid pumped by each of the rotary fluid displacement means so that an axial pressure thrust may be delivered to the slidable bushings **33** to effect pressure sealed engagement of the end plate portions **33**b with the corresponding rotary fluid displacement means.

Because the components of the housing **11** are preferably made out of a light-weight material, such as aluminum or the like, it may be desirable to provide liners **32—32** for the pumping chambers **18** and **19** against which the teeth of the gears **28** and **29** may bear. It will be understood that such liners **32—32** may be made of any suitable bearing material and may be placed in the pumping chamber in various ways, for example, the liners may be inserted or integrally cast in the cover **13** and the cap **14**.

As will be noted upon the drawings, the liners **32** do not extend across the entire width of the pumping chamber but terminate short thereof to permit the insertion of a suitable O-ring gasket **36** in encircling relation to each of the end plate portions **33***b* of the slidable bushing **33** and adjacent the ends of the liners **32**. Such arrangement is conveniently provided by forming a suitable counterbore in the locale of each of the pumping chambers in a portion of the body **12**.

The body **12** is additionally counterbored as at **12***a* to receive the end plate portions **33***b* of the slidable bushings **33**, the side wall portions thereof forming the control pressure chambers **34** together with the end plate portions **33***b* of the bushings **33**.

An additional counterbore step **37** is provided in each side of the body **12** to receive an O-ring type gasket **38**.

The slidable bushings **33** are normally biased outwardly with respect to the body **12** of the housing **11** for pressure sealing engagement with the respective rotary fluid displacement means comprising the driver gears **28—28** and the driven gears **29—29** by suitable resilient members, in the present embodiment taking the form of a coil spring **39** and a coil spring **40**, each end of which

being seated on one of a plurality of spring retainers **41** arranged to engagingly abut the ends of the bearing portions **33***a* formed on each of the slidable bushings **33**.

The two pumping units of the multiple gear pump **10** are operated in parallel and driven simultaneously by a common drive means about to be described.

A stub shaft **42** extends outwardly of the pump housings **11** and has formed thereon a plurality of splined ribs **43** for connection to a suitable motor means or other prime mover (not shown).

The inner end of the stub shaft **42** terminates in a sleeve-like collar **44** having an annular shoulder **45** for cooperation with a shaft sealing structure indicated generally by the reference numeral **46**, the details of construction of which not being necessary to the understanding of the principles of the present invention. The shaft sealing structure **46** is retained within appropriately counterbored portions of the cap **14** by means of a cover member or retainer **47** connected to the cap **14** by suitable fasteners **48**.

A drive shaft **49** extends completely through one of the tubular shafts **30** with an adequate driving clearance and extends into the other tubular shaft **30**.

The extending end of the shaft **49** is splined at **50** into interlocking driving assembly with other tubular shaft **30**.

The other end of the shaft **49** is connected to the collar **44** on the end of the stub shaft **42** by a plurality of interlocking splined ribs **51** formed between the end of the shaft **49** and the inside bore of the collar **44**.

A plurality of splined ribs **52** are formed between the outside periphery of the tubular shaft portion **30** of one of the driver gears **28** and the bore of the collar **44** near the terminal end thereof.

The shaft **49** is provided with a reduced shear neck **53** which, together with the splined ribs **50** interlocked with the mating splined ribs of the driver gear **28**, form a frangible coupling for one of the rotary fluid displacement means.

The collar **44** on the end of the stub shaft **42** is provided with a reduced shear neck **54** in approximately the locale between the splined connection of the shaft **49** to the collar **44** and the splined connection of the collar **44** to the tubular shaft **30** of one of the driver gears **28**.

The groove **56** provided in one of the tubular shaft portions **30** of one of the driver gears **28** directly adjacent the end of the collar **44** is a conventional machining relief which facilitates cutting of the splines **52**.

The reduced shear neck **54**, together with the interlocking splined ribs **52**, provide a frangible coupling for the other of the rotary fluid displacement means.

The spring **57** is provided between the shaft **49** and the stub shaft **42** in order to maintain the splined rib areas of the collar **44** in correct alignment relative to the tubular shaft portion **30** and the shaft **49**.

The provision of the frangible couplings described above provides a very desirable safety feature since binding or seizure of one of the pumping units, for example, the unit on the left-hand side of Figure 3, would result in a fracture of the frangible coupling in the locale of the reduced shear neck **53**. Since there is adequate running clearance between the shaft **49** and the tubular shaft portion **30** of the driver gear **28** on the other pumping unit, the pumping unit on the right-hand side of Figure 3 would continue to operate.

If, on the other hand, the pumping unit on the right-hand side of Figure 3 would be subjected to an abnormal operating condition through binding or seizure, the frangible coupling would fracture in the locale of the reduced shear neck **54**. However, the other pumping unit would continue to be driven through the shaft **49**.

All broken pieces are readily removed from the pump merely by removing the cover member **46**. Further disassembly is not required.

It will be apparent to those versed in the art that various minor modifications may be made to the preferred embodiment herein shown and described in considerable detail for the sake of clarity only; however, it should be clearly understood that we wish to embrace within the scope of this patent all such modifications as reasonably and properly come within the scope of our contribution to the art.

We claim as our invention:

1. A multiple pump having three longitudinally spaced coaxially aligned rotatable members provided by a stub shaft, a first driver gear inwardly adjacent thereto, and a second driver gear inwardly adjacent said first driver gear, respectively, a collar connecting said stub shaft and said first driver gear and having a first reduced shear neck formed therein outwardly of its connection to said first driver gear, and a shaft member connected to said second driver gear and extending outwardly through said first driver gear for connection to said tub shaft outwardly of said first shear neck, said shaft member having a second reduced shear neck formed therein adjacent one end thereof outwardly of said first driver gear, and inwardly of the connection of said shaft member to said stub shaft, said first and second shear necks yielding selectively under abnormal load to permit uninterrupted operation of one of said first and second driver gears upon binding of the other, whereby fragments formed upon shearing of said shear necks are positioned outside of said driver gears.

2. A multiple pump comprising a casing having an opening at one end, a cover on said casing for said opening, and at least three longitudinally spaced coaxially aligned rotatable members provided by a stub shaft extending through said cover, a first driver gear inwardly adjacent said stub shaft and a second driver gear inwardly adjacent said first driver gear, respectively, a collar connected to said stub shaft and said first driver gear, said collar having a reduced shear neck formed therein outwardly of its connection to said first driver gear providing a first frangible coupling, said driver gears having bores extending therethrough, and a shaft connected to said second driver gear in the bore thereof and extending outwardly through said bore of first driver gear and being connected to said stub shaft outwardly of said first frangible coupling, said shaft having a reduced shear neck formed therein outside of said bore of said first driver gear to provide a second frangible coupling, said first and second frangible couplings yielding torsionally to permit uninterrupted operation of one of said driver gears upon binding or seizure of the other, whereby all fragments formed upon shearing of said frangible couplings are positioned outside of said bores of said driver gears and the broken pieces of said frangible couplings are removable from said casing through said opening.

3. A multiple pump comprising a casing having an opening at one end and being recessed to provide a plurality of longitudinally spaced coaxially aligned pumping cavities inwardly of said opening, first and second rotary gear pumps in said cavities adapted to be operated in tandem, a cover for said opening, a rotatable driver member comprising a stub shaft extending from outside of said casing through said cover and providing an annular collar connected to said first pump, said collar having a reduced shear neck formed therein outside of its connection to said first pump providing a first frangible coupling, and a shaft member connected to said stub shaft and to said second pump, said shaft member having a reduced shear neck formed therein on the side of said first pump nearest the stub shaft, whereby fragments formed upon shearing of said frangible couplings are positioned at one end of the casing, said first and second frangible couplings selectively yielding when a corresponding pump binds or seizes to permit uninterrupted operation of the other pump, the broken pieces being removable through said opening.

4. A pump comprising a casing having an opening at one end and being recessed to provide a plurality of longitudinally spaced coaxially aligned pumping cavities inwardly of said opening, bushing means in each cavity, rotary intermeshing gears in said cavities journalled in said bushing means and including first and second driver gears having longitudinally adjacent bores extending therethrough in register with said opening, a cover for said opening, a rotatable driver member comprising a stub shaft extending from outside of said casing through said cover and providing an annular collar adjacent said first driver member, said collar having a reduced shear neck formed therein and having internal splines formed therein, said first driver gear having an external spline portion connected to said internal splines of said collar with said reduced shear neck between said spline portion of said first driver gear and said stub shaft, and a connecting shaft having splines formed on one end connected to said internal splines of said collar to effect a direct coupling with said stub shaft, said connecting shaft extending through said bore of said first driver gear and having its other end in said bore of said second driver gear, said

second driver gear and said connecting shaft having spline connections therebetween, said connecting shaft having a reduced shear neck formed therein inwardly of said splines at said one end outside of said spline portion of said first driver gear, whereby abrasive pieces formed by broken shear necks will be outside said bores of the driver gears and broken pieces of said driver member or said connecting shaft are removable through said opening, said shear necks yielding under abnormal load to permit uninterrupted operation of one driver gear upon binding of the other.

References Cited in the file of this patent

UNITED STATES PATENTS

693,609	Kirkwood	Feb. 18, 1902
1,218,300	Nelson	Mar. 6, 1917
1,629,121	Russel, et al.	May 17, 1927
1,665,026	Grant	Apr. 3, 1928
2,280,392	Herman, et al.	Apr. 21, 1942
2,356,322	Johnson	Aug. 22, 1944
2,361,226	Miner, Jr., et al.	Oct. 24, 1944
2,382,042	Etnyre	Aug. 14, 1945
2,401,567	Jeannin	June 4, 1946
2,412,588	Lauck	Dec. 17, 1946
2,487,449	Knudson	Nov. 8, 1949
2,491,100	Frei	Dec. 13, 1949
2,584,865	Gordinier	Feb. 5, 1952
2,665,637	Lauck	Jan. 12, 1954
2,665,638	Lauck	Jan. 12, 1954

FOREIGN PATENTS

579,582	Great Britain	Aug. 8, 1946