

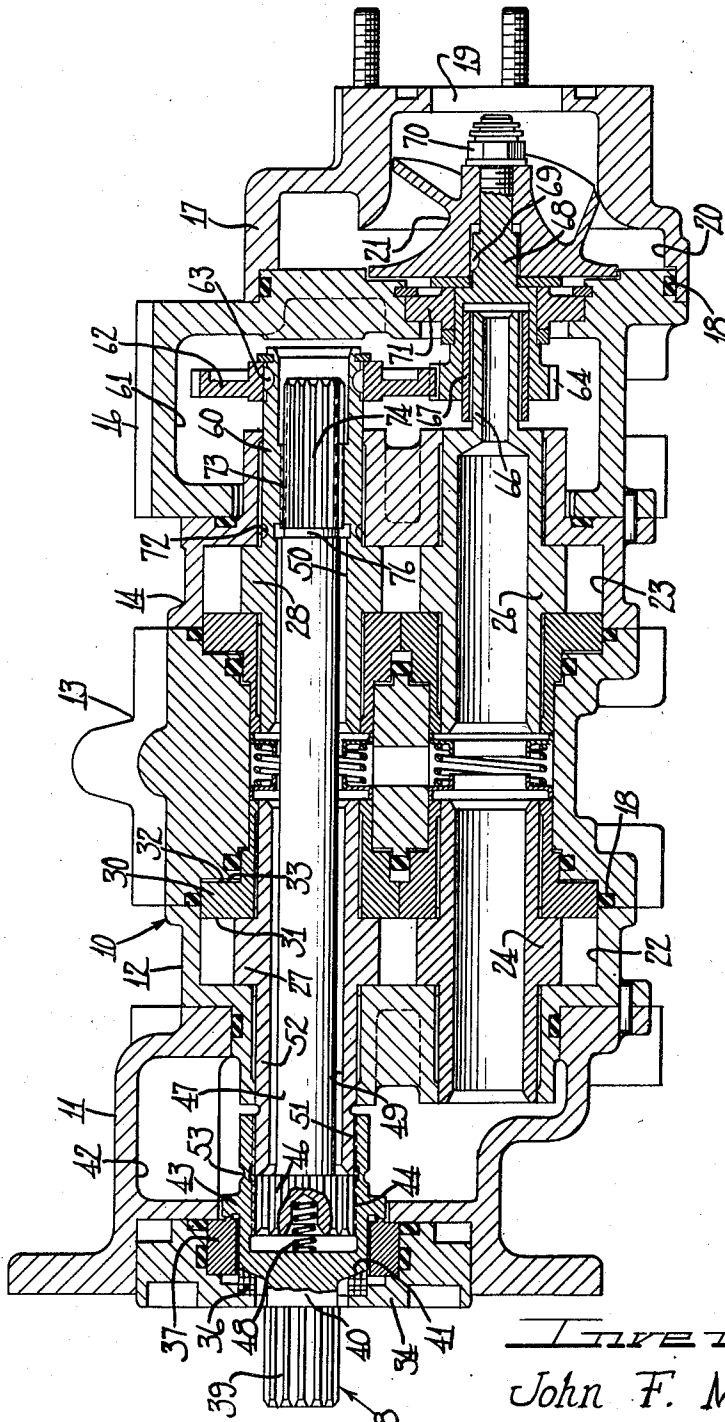
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MULTIPLE UNIT PUMP HAVING FRANGIBLE SHEAR SECTIONS

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MULTIPLE UNIT PUMP HAVING FRANGIBLE SHEAR SECTIONS

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This invention relates generally to fuel pumps and more particularly relates to a multiple unit pump including two separate gear units in series staged relation with a centrifugal pump unit, all of the impellers being enclosed within a common housing and being interrelated by a common driving mechanism particularly characterized by shear sections which will insure continued operation of related pairs of impellers despite jamming or seizure of one of the pumping units.

It is an object of the present invention to provide an improved multiple pump assembly specifically characterized by advantageous safety features.

Another object of the present invention is to provide a multiple pump which is particularly reliable for use as a fuel pump in an aircraft engine.

Yet another object of the present invention is to provide a combination centrifugal-gear pump wherein the different impellers are interconnected by a common driving mechanism having improved structural and functional characteristics.

Many other features, advantages 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 sheet of drawings in which a preferred structural embodiment of a multiple pump incorporating the principles of the present invention is shown by way of illustrative example.

On the drawings:

The single figure of the drawings illustrates a cross-sectional view of a multiple pump incorporating the structural features of the present invention.

As shown on the drawings:

The multiple pump of the present invention is indicated generally at 10 and comprises a plurality of longitudinally aligned casing sections indicated at 11, 12, 13, 14, 16 and 17, respectively. All of the casing sections 11—17 are interconnected by suitable fasteners and it will be appreciated that the usual sealing members, such as the O rings indicated at 18, are used to effect a seal-tight assembly of the various pump components.

The housing section 17 is formed to provide a pump inlet 19 adapted to communicate with a source of fuel supply. The housing sections 16 and 17 together form a volute pumping chamber 20 in which is rotated a centrifugal impeller 21, thereby to initially pressurize fluid admitted into the pump through the inlet 19.

The housing sections 11—14 are formed to provide a pair of adjacent pumping cavities 22 and 23, each of which receiving a pair of intermeshing gears including driven gears 24 and 26 and a pair of driver gears 27 and 28. The gears 24, 27 cooperate to move fluid from the inlet side of the pumping cavity 22 to the outlet side thereof and the gears 26, 28 cooperate to impel fluid from the inlet side of the pumping chamber 23 to the outlet side thereof. Those versed in the art will appreciate that the gear units 24, 27 and 26, 28 are conveniently placed in series staged relation with the centrifugal impeller 21 and that the pump 10 is provided with a conventional outlet arrangement whereby the pumping medium initially pressurized by the centrifugal impeller 21 and subsequently pressurized by the gear units 24, 27 and 26, 28 is discharged to the ultimate point of utilization. For that

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reason, additional details of the pumping flow relation between the pump inlet 19 and the pump outlet is not believed to be necessary to the understanding of the principles of the present invention.

The gear units of the pump 10 are preferably of the so-called pressure loaded type, each of the gears being associated with a movable pressure loaded bushing 30 having a sealing face 31 for engaging and sealing against an adjoining side face of a corresponding gear and having a motive surface 32 spaced from an adjoining wall of the pump casing, in this instance the casing sections 13, to form together therewith a pressure control chamber 33. The pressure control chamber 33 communicates with pump discharge in the usual manner to effect pressure loading of the movable bushings against the gears.

According to the principles of the present invention, each of the driver gears 27 and 28, as well as the centrifugal impeller 21, is driven in common from a single power take-off. Referring to the lefthand side of the drawing, it will be noted that the casing section 11 is closed by a cover member 34 suitably bored and counter-bored to seat and retain a thrust ring 36 as well as a bearing and seal assembly 37 for rotatably journalling a first driving member indicated generally at 38. The driving member 38 more particularly has a splined shaft portion 39 extending outwardly of the cover member 34 which is adapted to be coupled to a suitable prime mover.

The driving member 38 has a neck portion 40 inwardly of the splined portion 39 which terminates in a radially outwardly extending bearing surface 41 engaging against the thrust ring 36. Extending inwardly into the pump and specifically into the hollow cavity 42 formed within the casing section 11 is an annular collar portion 43 formed as an integral part of the driving member 38. The collar portion 43 is splined as at 44 along the inner wall surface and therewith effects a driving relation with a correspondingly splined end portion 46 on a quill shaft 47. The splined end portion 46 of the quill shaft 47 telescopes into the collar portion 43. A coil spring 48 has one end bottomed against the driving member 38 and has its opposite end bottomed against the end of the quill shaft 47. The quill shaft 47 is sufficiently small in diameter to extend freely through a hollow bore 49 formed in the driver gear 27 as well as through a bore portion 50 formed in the driver gear 28.

The collar portion 43 is provided with a second internal splined portion indicated at 51 which lies axially adjacent the splined portion 44 and which telescopically engages a shaft extension 52 formed on the driver gear 27.

It will be understood that the shaft extension 52 has a correspondingly splined external coupling portion whereby the driver gear 27 and the driving member 38 are interconnected in co-rotatable relation.

Between the splined portions 44 and 51, the collar portion 43 of the driving member 38 is provided with a shear neck 53. Thus, if for any reason the gear pump units 24, 27 jam or seize or become otherwise inoperative, thereby setting up abnormal load conditions, the shear neck 53 will break and the end of the collar portion 43 coextensive with the splined portion 51 will, in effect, be disconnected from the driving member 38. In such event, the driving member will continue to drive the quill shaft 47 without interruption through the splined portion 44 of the collar portion 43.

At the other end of the pump, the gear 28 is provided with a shaft extension 60 which extends out of the housing section 14 into a cavity 61 formed in the housing section 16. The cavity 61, in effect, functions as a gear casing since a gear 62 is keyed as at 63 to the shaft extension 60 for co-rotation with the driver gear 28.

The gear 62 meshes with a gear 64 journaled on a reduced neck 66 integrally formed as a shaft extension

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on the driven gear 26. A bearing sleeve 67 is interposed between the neck 66 of the gear 64 whereby the gear 64 and the driven gear 26 may rotate at different rotational speeds.

For greatest efficiency, the gear units 24, 27 and 26, 28 should be rotated at a much slower speed than the centrifugal impeller 21, the rotating characteristics of the two types of impellers being different. Accordingly, the gear 62 is much larger in diameter than the gear 64 so that a speed increase will occur in the gear train within the gear case 61 to rotate the centrifugal impeller 21 at relatively high speeds.

It will be appreciated that the centrifugal impeller 21 is connected for co-rotation with the gear 64, for example, the gear 64 has an extended portion 68 to which the impeller 21 is keyed as at 69 and fastened as at 70. The gear member 64 is independently journaled by suitable bearing means 71 in the casing section 16.

According to the principles of the present invention, the shaft extension 60 on the driver gear 28 is particularly characterized by the formation of shear neck 72. The shear neck 72 is formed axially adjacent an internally splined portion 73 formed in the end of the bore 50 of the driver gear 28 and cooperating with an externally splined driving portion 74 formed on the end of the quill shaft 47. Preferably, the shear neck 72 is located at some point between the shaft extension 60 of the hub of the driver gear 28. Thus, if an abnormal load occurs because of binding or seizure of the gear pump unit 26, 28, the shear neck 72 will sever inactivating the pump unit 26, 28 while permitting the gear pump unit 24, 27 to operate in conjunction with the centrifugal impeller 21.

The quill shaft 47 is also characterized, according to the present invention, by the formation of a shear neck 76 formed adjacent the splined portion 74 and preferably between the opposite ends of the quill shaft 47. Thus, if an abnormal load is developed because of binding or seizure of the centrifugal impeller 21, only the quill shaft 47 will be broken, a separate part which can be conveniently replaced without requiring disassembly of the entire pump 10 and without requiring replacement of any of the expensive gear parts of the pump 10. Moreover, any broken parts of the quill shaft 47 can be conveniently removed from the pump merely by removing the cover member 34 at the end of the casing.

Although various minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. A multiple pump having three longitudinally spaced co-axially aligned rotatable members provided by a driving member, a first driver gear inwardly adjacent thereto, and a second driver gear inwardly adjacent said first driver gear, respectively, a collar connecting said driving member and said first driver gear and having a first reduced shear neck formed therein outwardly of its connection to said first driver gear, a shaft member connected to said second driver gear and extending outwardly through said first driver gear for connection to said driving member outwardly of said first shear neck, a fourth rotatable centrifugal impeller member, means forming a coupling and effecting a driving connection between said second driver gear and said fourth rotatable centrifugal impeller member for unison rotation, said second driver gear having a second reduced shear neck formed therein between said driving connection for said fourth rotatable centrifugal impeller member and said second driver gear, said shaft member having a third reduced shear neck formed therein intermediate the connections to said second driver gear and said driving member thereof, said first and second shear necks yielding selectively under abnormal load to permit uninterrupted

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operation of either one of said first and second driver gears in combination with said fourth rotatable centrifugal impeller member upon binding of the other, said third shear neck yielding under abnormal load upon said fourth rotatable centrifugal impeller member.

2. A multiple pump comprising a casing having an opening at one end, a cover on said casing for said opening, at least three longitudinally spaced co-axially aligned rotatable members provided by a first driving member extending through said casing, a first driver gear inwardly adjacent said driving member and a second driver gear inwardly adjacent said first driver gear, respectively, said second driver gear having a shaft extension extending inwardly adjacent said second driver gear, gear train means connected to said shaft extension, a centrifugal impeller driven by said gear train means, a collar connected to said driving member 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 said first driver gear and being connected to said driving member outwardly of said first frangible coupling, said shaft being coupled to said shaft extension of said second driver gear, said shaft extension having a second reduced shear neck formed therein between said second driver gear and the coupling between said shaft and said shaft extension, said shaft having a third reduced shear neck formed therein intermediate the connections to said second driver gear and said driving member thereof to provide a third frangible coupling, said first frangible coupling and said second shear neck yielding torsionally to permit uninterrupted operation of one of said driver gears in combination with said centrifugal impeller upon binding or seizure of the other, said third frangible coupling yielding torsionally upon binding or seizure of the centrifugal impeller.

3. In a multiple pump, a first driving member, a first driver gear longitudinally adjacent said driving member and a second driver gear longitudinally adjacent said first driver gear, respectively, said second driver gear having a shaft extension extending longitudinally adjacent said second driver gear, coupling means connected to said shaft extension, a centrifugal impeller driven by said coupling means, a collar connected to said driving member 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 said first driver gear and being connected to said driving member outwardly of said first frangible coupling, a coupling connection between said shaft and said shaft extension of said second driver gear, said shaft extension having a second reduced shear neck formed therein between said second driver gear and said coupling connection, said shaft having a third reduced shear neck formed therein intermediate the connections thereof to said coupling connection and to said driving member to provide a third frangible coupling, said first frangible coupling and said second shear neck yielding torsionally to permit uninterrupted operation of one of said driver gears in combination with said centrifugal impeller upon binding or seizure of the other, said third frangible coupling yielding torsionally upon binding or seizure of the centrifugal impeller.

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