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[54] **PITOT PUMP WITH THRUST BALANCE**

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[73] Assignee: **Kobe, Inc.**, Huntington Park, Calif.

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[52] **U.S. Cl.** **415/89**, 415/104

[51] **Int. Cl.** **F04d 1/14**, F01d 3/00

[58] **Field of Search** 415/89, 88, 96, 104

[56] **References Cited**

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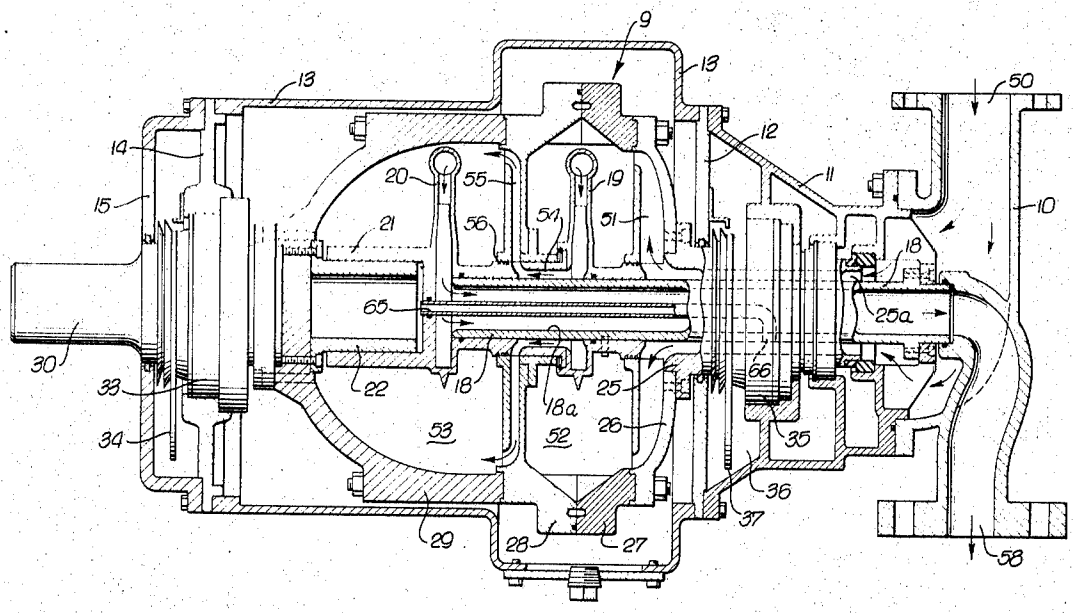
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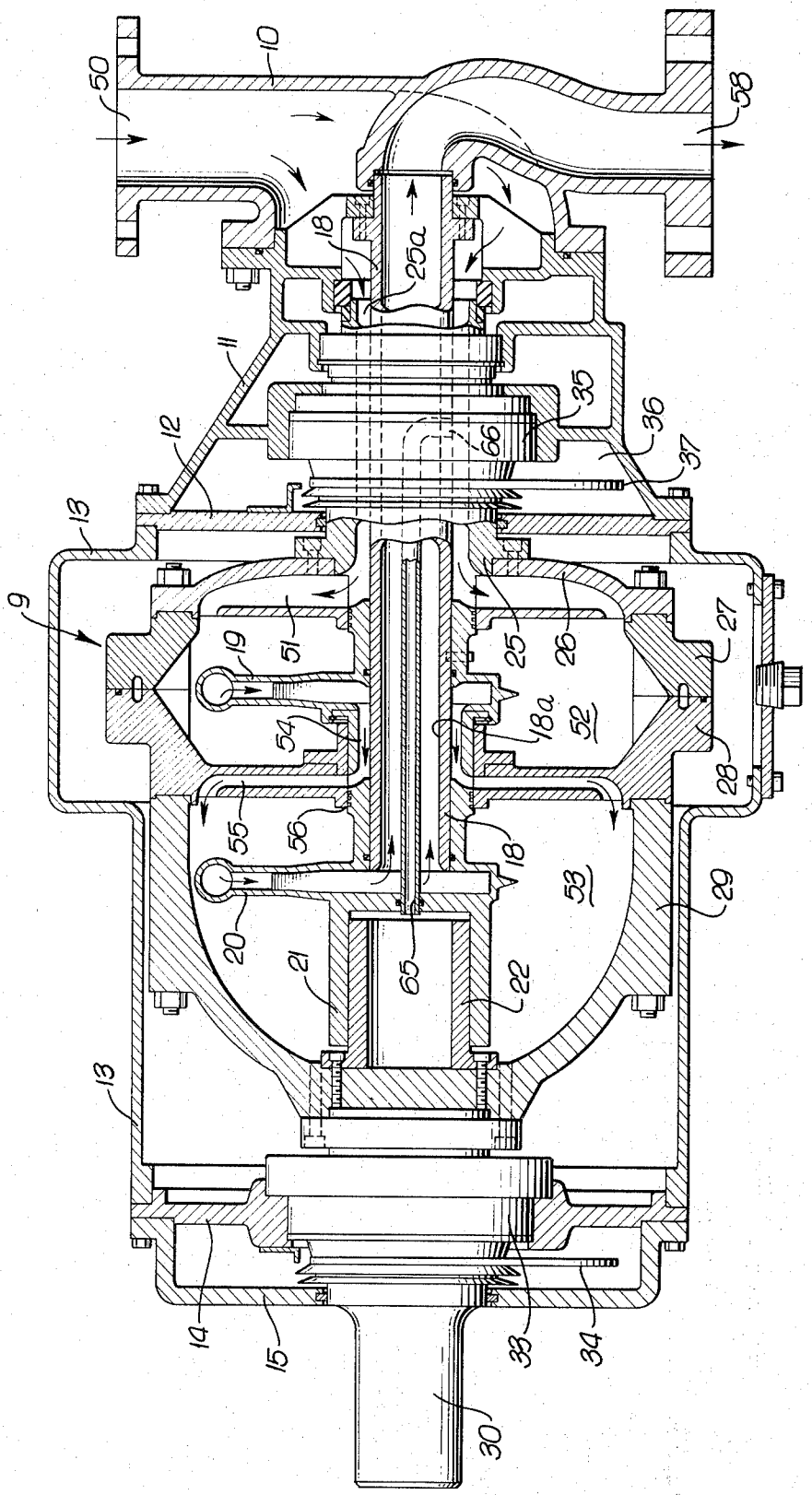
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[57] **ABSTRACT**

A pitot pump, i.e., a centrifugal pump comprising a rotating casing, means for delivering the fluid to be pumped to the interior of the casing, a pitot tube fixed within and extending radially of the rotating casing, and a discharge duct for the pitot tube coaxial with the rotating casing, with means built into the pump for balancing the fluid forces normally developed in the pump tending to move the casing axially.

3 Claims, 1 Drawing Figure




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PITOT PUMP WITH THRUST BALANCE

BACKGROUND OF THE INVENTION

The present invention relates in general to centrifugal pumps and, more particularly, to a centrifugal pump of the pitot type. A typical pitot pump comprises a rotating casing, means for delivering the fluid to be pumped to the rotating casing, a pitot tube fixed within the casing for picking up fluid adjacent the periphery of the casing with a ram effect and a fixed discharge duct for receiving fluid from the pitot tube and connected thereto, with the discharge duct coaxial with the rotating casing. A typical pitot pump is shown in the copending application of John W. Erickson, one of the inventors herein, Ser. No. 280,677, filed Aug. 14, 1972, and assigned to the same assignee as the present application.

In such a typical pump, since a fluid pressure is developed in the casing, by its rotation, substantially higher than the inlet fluid pressure and since the longitudinally spaced areas in the casing against which such pressure is exerted are unequal, there is a net longitudinal thrust on the casing tending to move it axially against its bearings. Particularly with a multistage pump, developing much higher internal pressures, the total net longitudinal thrust on the casing frequently exceeds the capacity of the bearings supporting the casing and leads to excessive bearing wear and malfunction.

SUMMARY OF THE INVENTION

The pitot pump of the present invention provides means built into it for balancing the fluid pressure thrust tending to move the rotating casing axially against its bearings so as to reduce the load on such bearings.

Other objects, advantages, features and results will more fully appear in the course of the following description.

THE DRAWING

The drawing is a vertical sectional view of a pitot pump incorporating the presently preferred embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The pitot pump has a rotating casing **9** carried in a fixed support structure, with the support structure including an inlet-outlet casting **10** bolted to a housing **11** which in turn is bolted to a baffle plate **12** and a shell **13.** Another baffle plate **14** and an end bell **15** are bolted to the shell **13.** A central duct **18** providing a longitudinal discharge passage **18***a* is carried at the right end of the housing **11** and is bolted thereto. A first pitot tube **19** and a second pitot tube **20** are carried on the duct **18,** with the second pitot tube **20** having a bearing member in the form of an end sleeve or cylindrical tubular extension **21** journalled on a bearing member having the form of a cylindrical shaft or shaft extension **22** of the casing **9.**

The casing **9** includes a sleeve **25** disposed about the duct **18** and bolted to an end bell **26.** A first casing section **27,** a second casing section **28** and an end bell **29** are successively bolted to the end bell **26,** with the shaft **22** bolted to the end bell **29.** A drive shaft **30** is bolted to the outer side of the end bell **29.**

The shaft **30** is carried in the plate **14** in a bearing **33.** An oil supply for the bearing **33** is carried in the end bell **15,** with an oil ring **34** aiding oil distribution. The bearing **33** includes a seal for blocking fluid flow between the end bell **15** and the interior of the shell **13.** The sleeve **25** of the casing **9** is supported in another bearing **35** carried in the housing **11,** with an oil supply for the bearing in the compartment **36** with an oil ring **37** positioned about the bearing. The plate **12** blocks fluid flow between the oil compartment **36** and the interior of the shell **13.**

There is a small clearance, on the order of 0.005 inches, between the interior of the sleeve **21** and the exterior of the cylindrical shaft **22,** which, due to its length and size, operates as a fluid seal to prevent any substantial leakage of fluid from the chamber **53** through such clearance, however some such leakage is desired to lubricate between such surfaces, which is an object of the invention. Such small leakage must be exhausted from the interior of the cylindrical shaft **22,** and this is done through an exhaust tube **65** which extends longitudinally in the duct **18** and opens into the annular inlet passage **25***a* at **66.** Thus, all leakage through the clearance between the sleeve **21** and cylindrical shaft **22** is discharged back into the inlet and recirculates back through the pump, which is another object of the invention.

The fluid to be pumped enters at the casting **10** through inlet passage **50** and flows through the annular passage **25***a* in the sleeve **25** and through radial passages **51** of the end bell **26** into chamber **52.**

The casing **9** is driven in rotation clockwise as seen from the right-hand end of the drawing, via the drive shaft **30,** with the pitot tube **19** picking up fluid adjacent the outer periphery of the chamber **52** with a ram effect and delivering fluid to a second chamber **53** via an annular passage **54** and radial distribution passages **55** in the casing section **28.** The pitot tube **20** operates the same way as the pitot tube **19,** delivering fluid through the discharge passage **18a** in the interior of the duct **18** to the outlet passage **58.** The pitot pump described thus far may have one stage or more than two stages as well as the two stage configuration illustrated.

For the embodiment illustrated, assuming the casing **9** has a rotational rate of about 3000 r.p.m. and a fluid inlet pressure of about 25 p.s.i.a. in the inlet passages **50** and **25***a*, the fluid pressure at the outer periphery of the chamber **52** will be about 300 p.s.i.a., the fluid pressure in the annular passage **54** will be about 600 p.s.i.a., the fluid pressure in the outer periphery of the chamber **53** will be about 900 p.s.i.a., and the fluid pressure in the discharge duct **18** will be about 1200 p.s.i.a. Also, the fluid pressure adjacent the inner periphery of the chamber **53** will be about 700 p.s.i.a.

Absent the sleeve **21,** cylindrical shaft **22,** and exhaust tube **65,** the relatively high fluid pressure in the chamber **53** would be exerted on the full left-hand area of the chamber, as seen in the drawing, whereas it would be exerted against the right-hand area of the chamber less the cross-sectional area of the pitot tube support at **56.** In such case, with the net right-hand area of the chamber **53** less than the area of the left-hand area of the chamber, there would be a net fluid force on the rotating casing **9** tending to move it longitudinally to the left, as seen in the drawing, and due to the relatively high fluid pressures involved this would, or

could, put an axial overload on the bearing **33** and engaging parts.

To prevent such overload on the bearing **33,** the cylindrical shaft **22** is made with an external diameter substantially the same as the external diameter **56,** so that the effective right and left-hand pressure areas of the chamber **53** are substantially equal and the fluid forces thereon are substantially equal. Thus, there is substantially no net fluid force exerted on the casing **9** tending to move it axially and overload the bearing **33.** The sleeve **21** also serves as an outboard support for the left-hand end of the casing **9,** as seen in the drawing, which is an additional object of the invention.

We desire to be afforded the full scope of the following claims:

1. In a pitot pump adapted to pump a fluid, the combination of:

a rotary casing rotatable about a central axis, and including an annular pump chamber;

an outer housing surrounding said rotary casing, said outer housing having an inlet port and a discharge port;

drive shaft means extending into one end of said housing and rigidly connected to said casing, said drive shaft means having a cylindrical shaft extension extending into said pump chamber and concentric with the axis thereof;

bearing means between said drive shaft means and said housing; and

generally tubular means extending longitudinally in said housing and upon which said casing is mounted for rotation, such tubular means being fixedly mounted on said housing and having an inlet passage therein communicating between said inlet port and said chamber for supply of a fluid to be pumped in said chamber, said tubular means having a pitot tube fixedly mounted thereon and extending radially in said chamber, said pitot tube having adjacent its outer end a pitot inlet facing in a direction opposite to the direction of rotation of said casing and a passage therein communicating between said pitot inlet and a longitudinal discharge passage in said tubular member, in turn communicating with said outlet, said tubular means having a cylindrical tubular extension journalling said cylindrical shaft extension of said drive shaft means, the maximum effective cross-sectional area of said tubular means in said chamber being approximately equal to the maximum effective cross-sectional area of said cylindrical shaft extension so that the fluid pressure in said chamber bears on substantially equal exposed chamber areas on said casing and on said tubular means, and means for venting said cylindrical tubular extension to a pressure much lower than that in said chamber, and approaching atmospheric pressure, so that there is substantially no net fluid force tending to move said casing axially relative to said housing to overload said bearing means.

2. In a pitot pump adapted to pump a fluid, the combination of:

a rotary casing rotatable about a central axis, and including an annular pump chamber;

an outer housing surrounding said rotary casing, said outer housing having an inlet port and a discharge port;

drive shaft means extending into one end of said housing and rigidly connected to said casing, said drive shaft means having a cylindrical shaft extension extending into said pump chamber and concentric with the axis thereof;

bearing means between said drive shaft means and said housing;

generally tubular means extending longitudinally in said housing and upon which said casing is mounted for rotation, such tubular means being fixedly mounted on said housing and having an inlet passage therein communicating between said inlet port and said chamber for supply of a fluid to be pumped to said chamber, said tubular means having a pitot tube fixedly mounted thereon and extending radially in said chamber, said pitot tube having adjacent its outer end a pitot inlet facing in a direction opposite to the direction of rotation of said casing and a passage therein communicating between said pitot inlet and a longitudinal discharge passage in said tubular member, said longitudinal discharge passage in turn communicating with said outlet, said tubular means having a cylindrical tubular extension journalling said cylindrical shaft extension of said drive shaft means, the maximum effective cross-sectional area of said tubular means in said chamber being approximately equal to the maximum effective cross-sectional area of said cylindrical sleeve so that the fluid pressure in said chamber bears on substantially equal exposed chamber areas on said casing and on said tubular means; and

an exhaust duct in said tubular means communicating between the interior of said cylindrical tubular extension and said inlet passage, the periphery of said cylindrical shaft extension and the interior of said cylindrical tubular extension having a small clearance therebetween permitting a small flow of fluid from said chamber through said clearance to lubricate the same, said flow being conducted through said exhaust duct into said inlet passage so that there is substantially no net fluid force tending to move said casing axially relative to said housing to overload said bearing means.

3. In a pitot pump adapted to pump a fluid, the combination of:

a generally cylindrical rotary casing rotatable about its central axis, including an annular pump chamber;

an outer housing surrounding said rotary casing, said outer housing having an inlet port and a discharge port;

drive shaft means extending into one end of said housing and rigidly connected to said casing, said drive shaft means having a first cylindrical bearing member extending into said pump chamber and concentric with the axis thereof;

bearing means between said drive shaft means and said housing;

generally tubular means extending longitudinally in said housing and upon which said casing is mounted for rotation, such tubular means being fixedly mounted on said housing and having an inlet passage therein communicating between said inlet port and said chamber for supply of a fluid to be pumped to said chamber, said tubular means having a pitot tube fixedly mounted thereon and

extending radially in said chamber, said pitot tube having adjacent its outer end a pitot inlet facing in a direction opposite to the direction of rotation of said casing and a passage therein communicating between said pitot inlet and a longitudinal discharge passage in said tubular member which, in turn, communicates with said outlet, said tubular means having a second cylindrical bearing member in journalled relation with said first cylindrical bearing member, the maximum effective cross-sectional area of said tubular means in said chamber being approximately equal to the maximum effective cross-sectional area of said first bearing member so that the fluid pressure in said chamber bears on substantially equal exposed chamber areas on said casing and on said tubular means;

said bearing members having a small clearance therebetween permitting small leakage flow of fluid from said chamber through said clearance to lubricate said bearing members; and

an exhaust duct in said tubular means for conducting said leakage flow into said inlet passage so that there is substantially no net fluid force tending to move said casing axially relative to said housing to overload said bearing means.

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