April 7, 1953 S. HAUGDAHL 2,633,805

PUMPING MECHANISM

Filed Aug. 12, 1948

FIG. 1

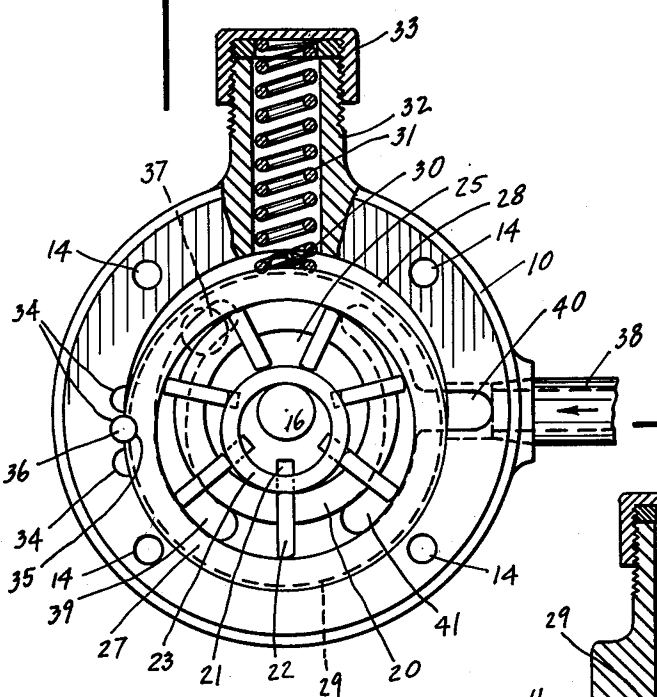


FIG. 2

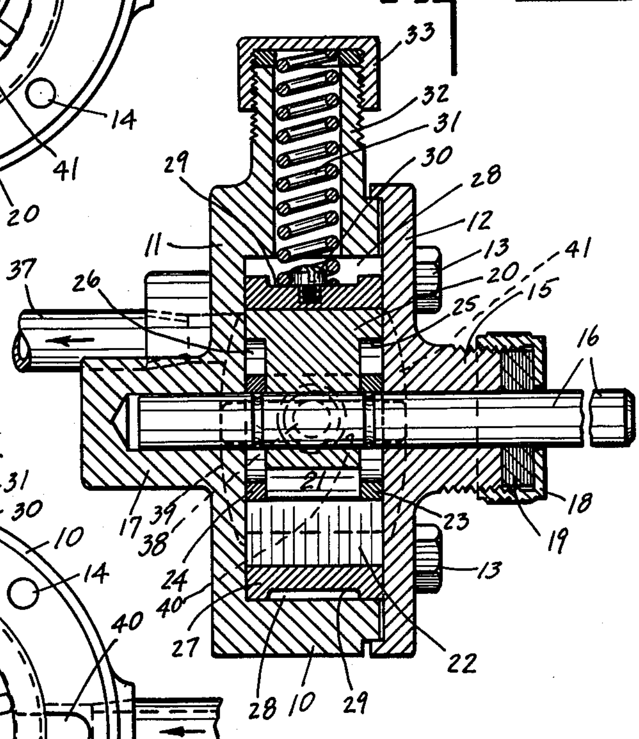
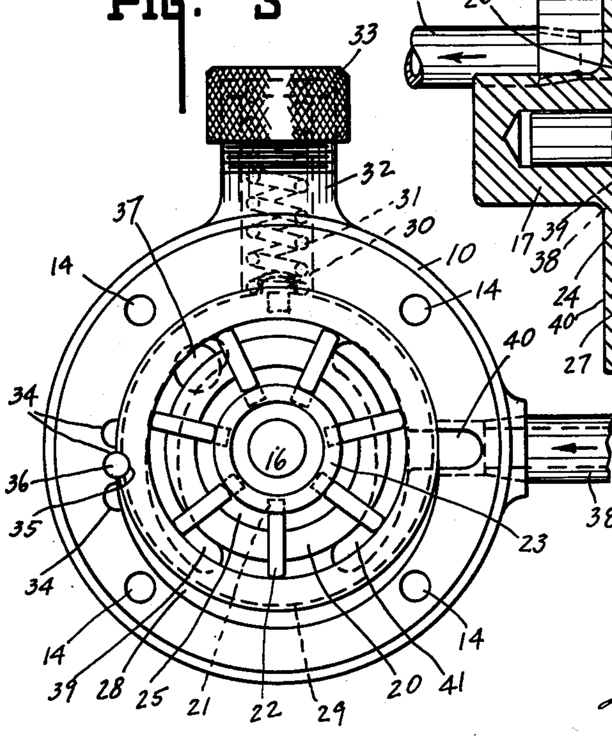


FIG. 3



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PUMPING MECHANISM

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1 Claim. (Cl. 103—120)

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This invention relates to a fluid pumping mechanism and more particularly to a pressure compensating rotary vane type pump of a character to maintain a predetermined fluid pressure irrespective of variation in speed or delivery.

In known pumps of this character wherein pressure is automatically maintained by varying the eccentricity of a pivoted pumping cylinder through pressure conditions, difficulty has been experienced in maintaining the pressure substantially constant. This difficulty is generally found in pumps of this character wherein the controlling force is exerted externally on the pumping cylinder.

It is, therefore, the object of this invention to provide a pump of this general character which will remain in constant balance and eliminate objectionable fluctuations, being positively and rapidly responsive to the effect of fluid pressure variations, or to any slight change in fluid pressure acting to control the displacement of the pump. This is accomplished by the pumping cylinder having its pivotal bearing located off-center, or as herein shown below the center of the arc of the outlet passage, and the intake passage being in direct communication with the entire chamber between the casing and the pumping cylinder, giving the latter free and unobstructed movement about its pivotal bearing. It is, therefore, proposed that the pumping cylinder, having a greater discharge pressure area above than below the pivotal bearing as herein shown, will be caused to oscillate between its eccentric pumping position and its concentric zero pumping position against a predetermined external pressure by a slight increase or decrease of the discharge pressure inside the pumping cylinder as distinguished from those pumps wherein the discharge pressure is exerted externally thereof.

The full nature of the invention will be understood from the accompanying drawings and the following description and claim:

Fig. 1 is a front elevation of the pump with the front plate removed and showing the pumping cylinder in eccentric relation to the rotor for full capacity pumping action, a portion being in section.

Fig. 2 is a central vertical section through the pump with the pumping cylinder in its full capacity pumping position.

Fig. 3 is the same as Fig. 1 with a portion in elevation and showing the pumping cylinder in its concentric idling or zero capacity position.

In the drawings there is shown a pump having

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a casing 10 of generally circular formation, said casing being formed with a back wall 11 formed integral with the peripheral wall and a removable end plate 12 adapted to be secured to the casing by the bolts 13 entering the threaded recesses 14. The end plate 12 is provided with a bearing portion 15 for receiving and mounting for rotation therein the drive shaft 16. The opposite end of the drive shaft 16 is supported for rotation in the bearing portion 17 of the end wall 11. The bearing portion 15 carries a threaded cap 18 for securing the packing 19 about the shaft. Suitable driving means is applied to the shaft 16 in the usual manner for driving the pump.

Secured to the shaft 16 for rotation thereby there is a rotor 20, said rotor being provided with a plurality of radial slots 21 for slidably receiving therein the respective vanes 22. For maintaining said vanes in their outermost position, a pair of cylindrical rings 23 and 24 are mounted about the shaft within the opposite annular recesses 25 and 26, respectively, of the rotor. Said rings serve as bearing supports for the inner ends of the vanes 22 to maintain them at all times in their most outward permitted position.

The rotor and vanes are mounted to rotate within a pumping chamber provided by the cylinder 27. Said cylinder is mounted within the chamber 28 defined by the inner wall of the casing 10. Said inner wall is generally circular with one-half thereof concentric with the axis of rotation of the rotor and of substantially the same but slightly greater radius than the pumping cylinder. The opposed inner wall of the casing is eccentric to the axis of rotation of the rotor, having its center of curvature spaced downwardly therefrom, in the position shown in the drawings, but lying in the plane extending through said axis of rotation bisecting said opposed wall sections of the casing. The pumping cylinder has its peripheral surface relieved intermediate the sides thereof, as indicated at 29, said relief permitting free passage of fluid to the half bore 40 on the intake side of the pump. Thus, no fluid will be trapped in the chamber 28 by the cylinder in a manner to resist its free action.

That portion of the cylinder located centrally of the concentric wall of the casing is provided with a projection 30 shown herein as a screw head. One end of the compression spring 31 is seated about the projection 30 to bear against the cylinder 27. Said spring extends through the bore of a nipple 32 extending radially outward from the casing, with the other end of said spring bearing against an adjustable screw cap 33.

The pumping cylinder 27 is pivoted within the casing at the discharge side thereof for oscillatory movement between its eccentric pumping position, as shown in Fig. 1, and its concentric idling position, as shown in Fig. 3. For this purpose the casing is provided with a series of half bores 34, there being shown herein three of such bores. The cylinder 27 is similarly provided with a half bore 35. A rocker pin 36 is inserted to seat in the half bore 35 of the cylinder and a selected one of the half bores 34 in the casing. Thus, the cylinder is free to rock with a minimum of frictional resistance from its eccentric position of Fig. 1 to its concentric position of Fig. 3.

The pumping chamber defined by the cylinder 27 is provided with an outlet 37 and an intake 38. The outlet 37 is in communication with an arcuate outlet passage 39 formed in the back wall 11 of the casing. The intake 38 is in communication with a half bore 40 extending transversely of the casing wall and opening therethrough to the chamber 28. At the back of the half bore an arcuate intake passage 41 is provided communicating therewith. Said arcuate intake and outlet passages have their ends approaching each other but in spaced relation to provide the necessary dam between the intake and outlet sides of the pumping chamber.

In operation, the spring 31 is set to exert a predetermined external pressure against the cylinder 27 in a direction to seat it against the eccentric wall of the casing, as shown in Fig. 1. In this position the cylinder will be positioned eccentrically with respect to the axis of rotation of the rotor so that the pump will operate under full capacity. Upon said cylinder being forced about the rocker pin 36 by the discharge pressure inside its pumping chamber, and said rocker pin being located below the center of the arc of the outlet passage 39, said cylinder 27 will be urged toward its concentric position against the predetermined pressure of spring 31. As the discharge pressure inside the pumping chamber becomes greater the pumping capacity will decrease. The differential pressure between the inside and outside of the pumping cylinder extends over that internal surface of the cylinder herein illustrated as defined by the distance between those vanes embracing the arcuate outlet passage 39. The low pressure area of said cylinder is slightly greater than the arcuate intake passage 38, the high and low pressures being separated by the vanes 32 passing between these passages. By locating the rocker pin 36 below the center of the pressure area (i. e., offset away from the application of the external force) a greater force will be exerted over that internal area of the cylinder above the rocker pin than below it. This greater force being above the rocker pin will; therefore, urge the cylinder upwardly against the tension of the spring 31, from its eccentric position of Fig. 1 toward its concentric position of Fig. 3.

Therefore, any change in the pump discharge conditions will react directly on the inner peripheral surface of the pumping cylinder rocking it about its pivotal mounting to a more concentric or eccentric position relative to the pump rotor to re-establish the balance predetermined by the external force of the spring acting upon the cylinder. Since the hydraulic forces act directly inside of the pump cylinder, the mechanism is extremely sensitive and very simple. The serious defects of fluid shock pressures with resulting fluctuations encountered in that type of pump designed to maintain pump balance through external hydraulic pressures on the pumping cylinder are entirely eliminated. Additionally, its inherent sensitivity to discharge conditions results in greater life of its driving mechanism and greater hydraulic efficiency because the input torque is always at a minimum.

At the maximum desired pressure the cylinder will be rocked to its concentric position, as shown in Fig. 3, in which position the pumping capacity will approach zero. However, should the differential pressure within the pumping chamber fall while the pump is idling or in the zero capacity position, the tension of spring 31 will cause the cylinder to be moved sufficiently to increase the capacity until the predetermined pressure is regained. Therefore, the desired fluid pressure will be maintained at all times, irrespective of discharge conditions. It will be observed, therefore, that through the control of a predetermined pressure medium in the form of the spring 31, and within the capacity of the pump, such predetermined pressure will be at all times maintained irrespective of restricted discharge or back pressure, and by reason of the practical elimination of friction in the movement of the cylinder and free passage of fluid thereabout during its rocking movement, the sustained pressure will remain substantially constant and without material fluctuation.

Due to the unresisted rotation of the rotor and vanes when in the idle or zero capacity position of the cylinder, Fig. 3, a minimum of frictional resistance will develop so as to avoid any heating of the pump even though the outlet may be closed and the pump operating at full speed. The above characteristics of the pump are particularly desirable and important in high speed pumps of this character, wherein a predetermined pressure maintenance is desired.

Whereas the invention has been shown and described herein as applied to a pumping mechanism for converting mechanical power into fluid power, it is also applicable to the conversion of fluid power into mechanical power. In the latter case, it will be apparent that the shaft 16 becomes the driven member instead of the driving member, and the outlet conduit 37 becomes the intake from a source of fluid power. In so utilizing the pump it may thereby be caused to drive the shaft 16 with a constant output torque irrespective of fluctuations in the fluid driving power.

The invention claimed is:

In a rotary pump of the vane type, a pump casing having opposed inlet and outlet fluid passages therein, a floating pump cylinder pivotally mounted within said casing, said fluid passages communicating with the interior of said pump cylinder, a bore connecting said inlet passage with the space between said cylinder and casing extending substantially entirely about said cylinder, a rotor carried by said casing rotatable within said cylinder, an external pressure medium acting on said cylinder for biasing it toward its eccentric position under a predetermined force, and a pivot member mounting said cylinder peripherally thereof within said casing on the opposite side thereof from said inlet passage and bore offset from the diametric plane transverse to the direction of force exerted by said external pressure medium and on the opposite side of said plane therefrom, said pump being characterized in that the said inlet passage opposite the pivotal mounting is in unobstructed communication with the space substantially entirely surrounding said cylinder to eliminate external resistance to the rocking movement thereof, and the fluid passage adjacent said pivotal mounting is in communication solely with the interior of said cylinder, the effective pressure area of said last-mentioned passage within said cylinder being greater on that side of the pivotal mounting towards said external pressure medium than on the other side thereof.

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