Nov. 18, 1952 S. HAUGDAHL 2,618,224

PUMPING MECHANISM

Filed March 7, 1950 2 SHEETS—SHEET 1

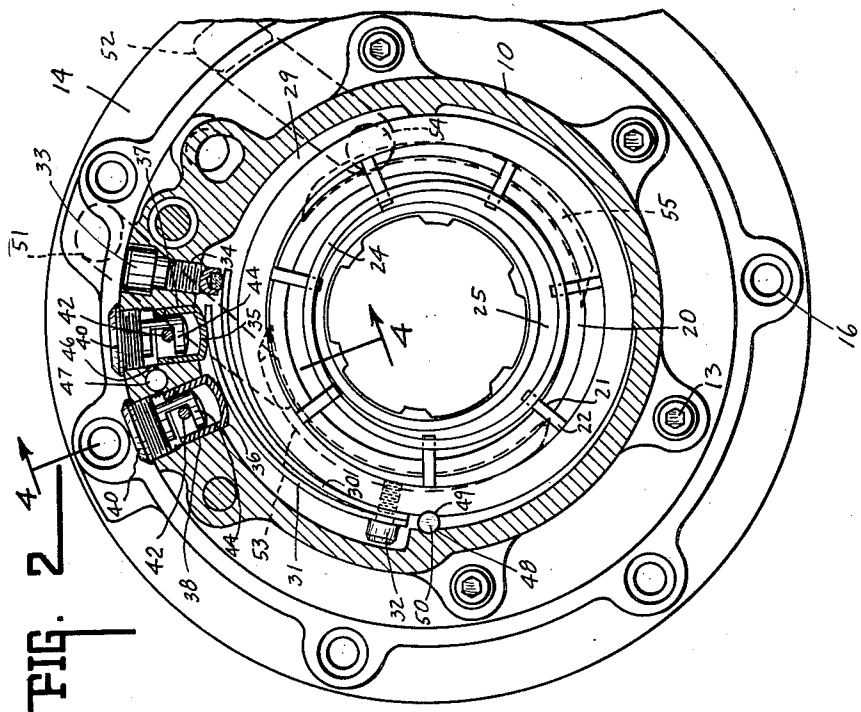


FIG. 2

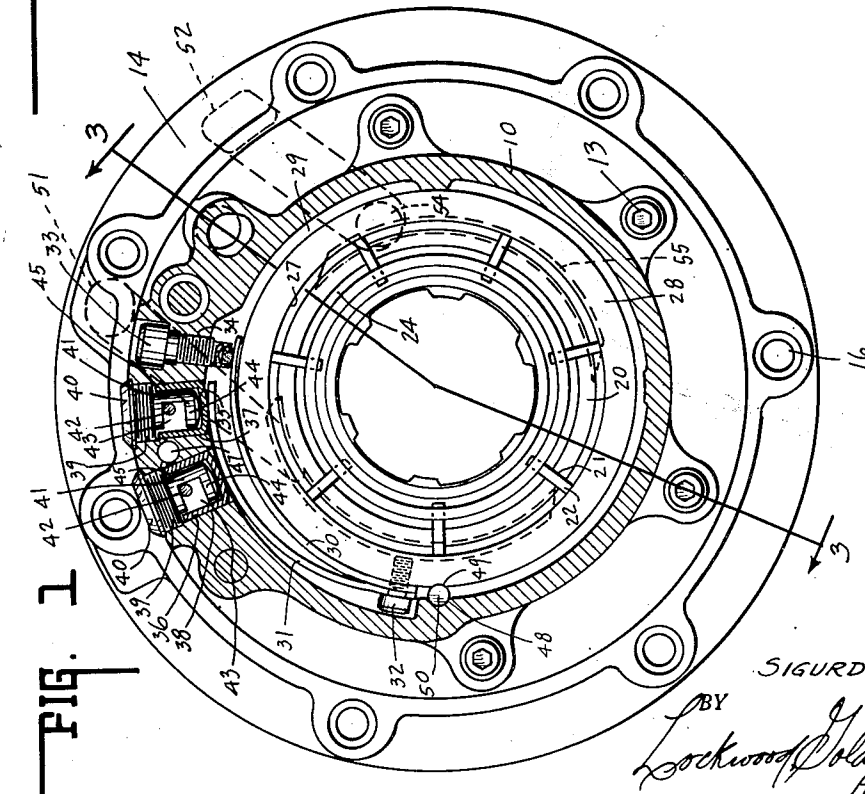


FIG. 1

INVENTOR.
SIGURD HAUGDAHL.
BY
Lockwood, Goldsmith & Galt.
ATTORNEYS.

Nov. 18, 1952 S. HAUGDAHL 2,618,224

PUMPING MECHANISM

Filed March 7, 1950 2 SHEETS—SHEET 2

FIG. 3

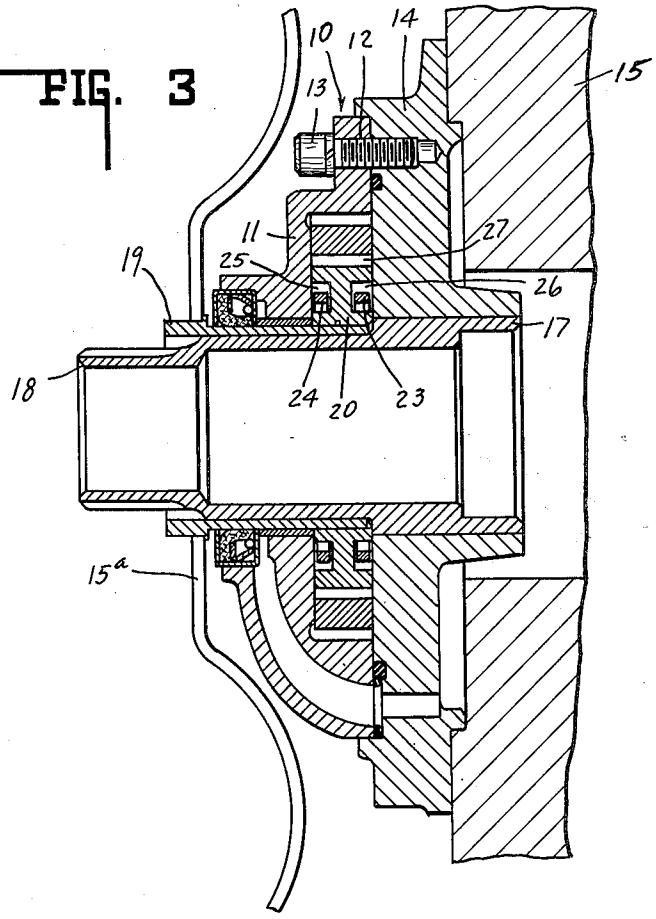
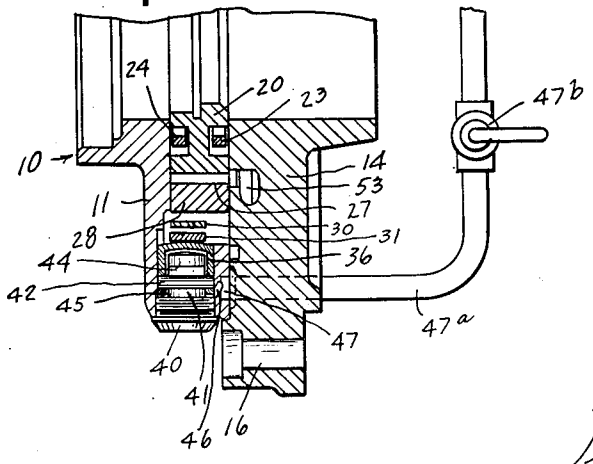


FIG. 4



INVENTOR.
SIGURD HAUGDAHL.

BY Lockwood, Goldsmith & Galt
ATTORNEYS.

Patented Nov. 18, 1952 2,618,224

UNITED STATES PATENT OFFICE

2,618,224

PUMPING MECHANISM

Sigurd Haugdahl, Jacksonville, Fla., assignor, by mesne assignments, to Haugdahl, Inc., Daytona Beach, Fla., a corporation

Application March 7, 1950, Serial No. 148,089

8 Claims. (Cl. 103—120)

1

This invention relates to a fluid pumping mechanism and more particularly to a pressure compensating rotary vane type pump of the general character shown and described in applicant's copending application Serial No. 43,894, filed August 12, 1948, for "Pumping Mechanism."

In mechanisms such as hydraulic transmissions and the like multiple fluid pressures may be required for different functions. For example: the transmission may require only 80 pounds pressure for its forward drive but 160 pounds pressure for its reverse drive. In connection with such uses, multiple pumps and controls of a character to each deliver but one predetermined pressure have been required.

It is therefore the object of this invention to provide a pump which will be positively and rapidly responsive to selective control for delivery of any one of several predetermined fluid pressures. This may be accomplished, as herein illustrated, by providing a series of spring elements carried externally of the pump cylinder but in association therewith, each element or combination thereof exerting a different predetermined pressure and being successively and automatically brought into operation by piston means actuated by fluid pressure.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

In the drawings Fig. 1 is a front elevation of the pump with the back wall removed, showing the pump cylinder in concentric relation to the rotor for zero capacity pumping action, with portions thereof shown in vertical section.

Fig. 2 is the same as Fig. 1 with the pumping cylinder in eccentric relation to the rotor for full capacity pumping action.

Fig. 3 is a sectional view taken on lines 3—3 of Fig. 1 in the direction of the arrows with the back wall in place.

Fig. 4 is a sectional view taken on lines 4—4 of Fig. 2 in the direction of the arrows with the back wall in place.

In the drawings there is shown as one modification and application of the invention, a pump having a casing 10 of generally circular formation, said casing being provided with a back wall 11 formed integral with the peripheral wall thereof. Bores 12 are formed in the back wall to receive and accommodate the bolts 13 for securing it to an adapter ring 14. This ring is in turn secured to a transmission housing 15 by bolts extending through apertures 16 formed therein. (See Figs. 1 and 2.) Extending transversely of

2

the pump and centrally thereof is a sleeve 17, one end of which is secured by press fit in the adapter ring. A reduced extension 18 is formed at the opposite end of the sleeve for supporting a torque converter and stator. The driven element thereof is indicated at 15^a.

Rotatably carried by the sleeve 17, there is provided a hollow drive shaft 19 which is driven from the element 15^a of the torque converter. Secured about the shaft 19, to be driven thereby, there is provided a pump rotor 20, said rotor being formed 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 vane spacer rings 23 and 24 is 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 to maintain them at all times in their outermost permitted position.

The rotor and vanes are mounted to rotate within a pumping chamber 27 provided by the cylinder 28. Said cylinder is mounted within the chamber 29 defined by the inner wall of the casing 10. In order to provide for the selection of at least two predetermined pressures, there is provided a pair of leaf spring members 30 and 31. The member 31 is of a length slightly less than the member 30 and overlies it. Each is secured at one end to the outer wall of the cylinder by the screw 32. The free end of spring 30 is engaged by an adjusting screw 33 which extends within the threaded aperture 34 provided in the casing 10. By adjusting this screw, the spring 30 is deflected inwardly, thereby applying a predetermined force to the pumping cylinder, such as to maintain a fluid pressure of, for example, 80 pounds.

The free end of spring 31 is engaged by the hollow pistons 35 and 36 which are positioned within the openings 37 and 38 formed through the casing wall. The outermost portion of said openings is threaded to receive the piston guides 39 having threaded heads 40 and slotted shanks 41. These shanks are enveloped by the respective pistons with a slight space therebetween. Mounted in each piston there is a transverse stop pin 42 which extends through the slot 43 of each shank. The inward movement of each piston against the spring 31, as hereinafter described, is arrested by the engagement of its pin with the innermost wall 44 of the slotted shank.

The length of each piston is such that in its retracted position a slight annular recess 45 is

formed between its periphery and the bottom surface of the piston guide head. These recesses are connected by a cross drilled passage **46** which in turn is connected to a passage **47** communicating through the line **47a** with the discharge side of the pump. A suitable valve indicated schematically at **47b**, and normally closed, is provided in the line **47a** and operative by the transmission to control the flow of the fluid to the passage **47**.

When a higher than normal pressure condition is desired, as for example when the transmission is changed from a forward to a reverse drive, said valve is thereby opened, permitting the fluid to enter passages **47** and **46**. As a result, the fluid pressure within the pumping cylinder is transferred to the annular recesses **45** adjacent the pistons, thereby forcing said pistons inwardly and causing the spring **31** to be deflected. The additional force exerted upon the pumping cylinder by the second spring will thus automatically be increased to effect a corresponding increase in the pumping pressure, for example, 160 pounds. As the back pressure within the pumping cylinder is developed, the fluid pressure transferred therefrom through the valve **47b** and the passages into the annular recesses **45** will progressively, but practically instantaneously increase until it reaches its maximum limit controlled by the tension of spring **31** and the limiting action of the stop pins **42**. Thus the increased force is not permitted to deflect spring **31** further inwardly than permitted by the stop pin **42** engaging the inner wall **44** of the piston guide member.

As described in my co-pending application above identified, the pumping cylinder is pivoted within the casing at the discharge side thereof for oscillatory movement between its eccentric pumping position, as shown in Fig. 2 and its concentric idling position, as shown in Fig. 1. For this purpose the casing is provided with a half bore **48**, there being a similar and mating half bore **49** formed in the cylinder **28**. A rocker pin **50** is inserted to seat in the half bore of the cylinder and the half bore in the casing. Thus the cylinder is free to rock with a minimum of frictional resistance from its eccentric position of Fig. 2 to its concentric position of Fig. 1.

The pumping chamber **27** defined by the cylinder communicates with an outlet **51** and an intake **52**. The outlet is in communication with an arcuate outlet passage **53** having tapered ends, formed in the adapter ring. The intake is in communication with a bore **54** extending transversely of the casing wall and opening therethrough to the chamber **29** surrounding said cylinder. At the back of the bore is an arcuate intake passage **55** also having tapered ends. 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 **30** is set to exert a predetermined external force against the cylinder **28** in a direction to dispose it eccentrically relative to the axis of rotation of the rotor so that the pump will operate at full capacity (Fig. 2). Upon said cylinder being forced about the rocker pin by the back pressure exerted within its pumping chamber, and said rocker pin being located below the center of the arc of the outlet passage, said cylinder will be urged towards its concentric position against the predetermined force exerted by spring **30** (Fig. 1). As the pressure within the pumping chamber increases the pumping capacity will decrease. The differential pressure exerted within the pumping cylinder extends over that internal surface of the cylinder herein illustrated as defined by the length of the arcuate outlet passage **53**. The low pressure area of said cylinder is substantially that of the arcuate intake passage **55**, the high and low pressures being separated by the vanes passing between these passages. By locating the rocker pin 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 **30**, from its eccentric position of Fig. 2 toward its concentric position of Fig. 1.

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 pressures act directly within 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. 1, in which position the pumping capacity will approach zero. However, should the pressure within the pumping chamber fall while the pump is idling or in the zero capacity position, the tension of spring **30** 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.

During this above described low pressure condition which may be desired for example during the forward drive of a hydraulic transmission, the second spring **31** is in its normal unstressed condition. When, however, it is desired to obtain a high pressure condition, as for example for the reverse drive of said transmission, the energizing fluid from the pumping cylinder source is admitted through the passages **47** and **46** respectively. The pressure of the fluid against the pistons causes them to move inwardly as aforesaid against the spring **31**. As a consequence of the increased tension on said spring, the pumping cylinder again is urged thereby toward its eccentric position. In this position the pump will develop increased pressure. As the back pressure within the pumping cylinder increases, the cylinder will again be urged towards its concentric position against the combined forces exerted by springs **30** and **31** in the manner described above.

Although the invention has been described as employing two pistons actuated by the energizing fluid into engagement with the spring **31**, it is obvious that one or more pistons or other energizing media may be designed to accomplish the same result. Also, any number and variations

of springs or other force exerting elements may be employed to obtain multiple selective pressures.

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 19 would become the driven member instead of the driving member, and the outlet conduit would become the intake from a source of fluid power. In so utilizing the pump it may thereby be caused to drive the shaft with a plurality of selected and constant output torques irrespective of fluctuations in the fluid driving power.

The invention claimed is:

1. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid pasages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, a resilient element in operative engagement with said cylinder under load to exert a predetermined force thereupon in a direction toward its eccentric pumping position, a second normally inactive resilient element operably associated with said cylinder, and selectively operable means on said casing movable against said second element to place it under load for increasing the force urging said cylinder in said direction.

2. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid passages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, a resilient element in operative engagement with said cylinder, an adjustable abutment screw associated with said element to place it under load to exert a predetermined force on said cylinder in a direction toward its eccentric pumping position, a second normally inactive resilient element operably associated with said cylinder, and selectively operable means on said casing movable against said second element to place it under load for increasing the force urging said cylinder in said direction.

3. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid passages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, a resilient element in operative engagement with said cylinder having means associated therewith to place it under load to exert a predetermined force on said cylinder in a direction toward its eccentric pumping position, a second normally inactive resilient element operably associated with said cylinder, and a piston on said casing communicating with said outlet passage and selectively operable under fluid pressure therefrom movable against said second element to

place it under load for increasing the force urging said cylinder in said direction.

4. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid passages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, a resilient element in operative engagement with said cylinder stressed under load to exert a predetermined force thereupon in a direction toward its eccentric pumping position, a second normally inactive resilient element operably associated with said cylinder, and piston means on said casing selectively operable to move against said second element and place it under load for increasing the force urging said cylinder in said direction, said means having a stop member adapted to limit the tension placed upon said second element.

5. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid passages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, a series of resilient elements operably associated selectively with said cylinder, only one of said elements normally being active, means on said casing movable against said one element of the series for placing it under load to exert a predetermined force on said cylinder in a direction toward its eccentric pumping position, and a second means on said casing selectively and successively movable against another of the series for placing it under load to increase the force urging said cylinder in said direction.

6. In a rotary pump of the vane type, a pump casing having oppositely positioned inlet and outlet fluid passages therein, a floating pump cylinder movably mounted within said casing, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free movement of said cylinder between concentric and eccentric positions relative to said rotor for varying the pumping capacity of said pump, an arcuate leaf spring having one end secured to said cylinder, an adjustable abutment screw extending through said casing into engagement with the free end of said spring for placing it under load to exert a predetermined force on said cylinder for urging it towards its eccentric pumping position, a second normally inactive arcuate leaf spring operably associated with said cylinder, and selectively operable means on said casing movable against said second spring to place it under load for increasing the force urging said cylinder toward its eccentric position.

7. In a rotary pump of the vane type, a pump casing having a substantially cylindrical inner wall and oppositely positioned inlet and outlet fluid passages extending through said wall, a floating pump cylinder pivotally mounted within said casing adjacent one of said passages, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free rocking movement of said cylinder between eccentric and concentric positions relative to said rotor, and an arcuate leaf spring having one end secured to

said cylinder adjacent its pivotal mounting to extend about a portion of the periphery thereof with its free end biased toward said casing for urging said cylinder to its eccentric pumping position under load, said pump being characterized in that the said fluid passage opposite the pivotal mounting is in unobstructed communication with the space surrounding said cylinder and the fluid passage adjacent said pivotal mounting is in communication solely with the interior of said cylinder, the area of said last-mentioned passage being greater on that side of the pivotal mounting toward said spring than on the other side thereof whereby a differential pressure will be applied to opposite sides of said cylinder to provide a variable capacity pump.

8. In a rotary pump of the vane type, a pump casing having a substantially cylindrical inner wall and oppositely positioned inlet and outlet fluid passages extending through said wall, a floating pump cylinder pivotally mounted within said casing adjacent one of said passages, a rotor carried by said casing rotatable within said cylinder, said mounting permitting free rocking movement of said cylinder between eccentric and concentric positions relative to said rotor, an arcuate leaf spring having one end secured to said cylinder adjacent its pivotal mounting to extend about a portion of the periphery thereof with its free end biased toward said casing, and

an adjustable abutment screw extending through said casing into engagement with the free end of said spring for placing it under load to exert a predetermined force on said cylinder for urging it toward its eccentric position, said pump being characterized in that the said fluid passage opposite the pivotal mounting is in unobstructed communication with the space surrounding said cylinder and the fluid passage adjacent said pivotal mounting is in communication solely with the interior of said cylinder, the area of said last-mentioned passage being greater on that side of the pivotal mounting toward said spring than on the other side thereof whereby a differential pressure will be applied to opposite sides of said cylinder to provide a variable capacity pump.

SIGURD HAUGDAHL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,779,757	Streckert	Oct. 28, 1930
2,433,484	Roth	Dec. 30, 1947

FOREIGN PATENTS

Number	Country	Date
513,440	Germany	Nov. 27, 1930