

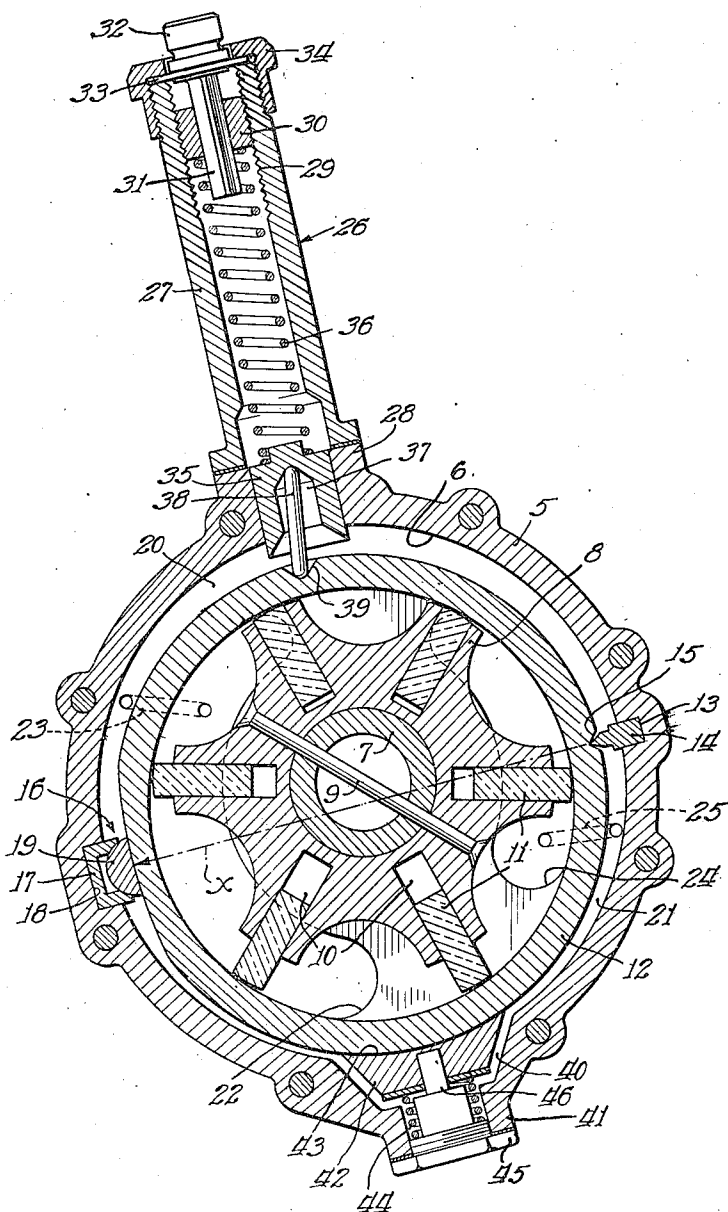
Dec. 30, 1947.

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2,433,484

MOVABLE VANE VARIABLE DISPLACEMENT PUMP

Filed Nov. 24, 1944



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UNITED STATES PATENT OFFICE

2,433,484

MOVABLE VANE VARIABLE DISPLACEMENT PUMP

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Application November 24, 1944, Serial No. 564,931

11 Claims. (Cl. 103—120)

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The present invention relates to pumps, and more particularly to pumps of the variable displacement type.

In varying the displacement in pumps of this character it is desirable, while performing this function, to create as little friction as possible. To this end I have provided an arrangement wherein friction is reduced to a minimum so that the hydraulic force, which is utilized to effect variations of displacement, is made more effective to accomplish the bodily shifting or oscillation of the chamber member, and better pressure regulation is thus secured.

It is one of the principal objects of this invention to simplify the construction of a variable displacement pump such as contemplated herein, and to improve the efficiency, operation and dependability of such pump.

Another principal object hereof is to provide a pump with an arrangement whereby the variable displacement is automatically accomplished and to do this with a minimum of friction between the members that are shifted or oscillated to alter the relative eccentricity of the pump chamber and the impeller or rotor.

Still another object hereof is to provide a pump chamber that is bodily shifted by means of the pressure fluid generated by the pump to vary the relationship of the chamber with respect to a rotor that is operating on a fixed axis and thereby effect variable displacement operation of the pump.

A further object of the invention is to provide a pump chamber that is bodily movable upon a fulcrum positioned at a side of the chamber member, the arrangement being such that the chamber is shifted by a hinging or swinging bodily movement on a fixed fulcrum, as distinguished from a sliding movement of the chamber between parallel or aligned guides. In this connection, means are provided for adjustably controlling such swinging or oscillatory movement so that the oscillations have predetermined limits.

A still further object hereof is to provide an oscillatory or swinging pump chamber with sealing means between the proximate surfaces of the chamber member and the housing that encloses the chamber and other members of the pump. By reason of this arrangement at least two separate compartments are provided between the chamber and the housing. One of these compartments is in communication with the pressure side of the pump to receive pressure fluid therefrom for shifting the chamber on its fulcrum, and

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another of said compartments is vented to the suction side of the pump, thus effecting the oscillatory or swinging movement of the pump chamber for modifying the eccentric relationship between the chamber and the rotor and vary the displacement of the pump.

Additional objects, aims and advantages of the invention contemplated herein will be apparent to persons skilled in the art after the construction and operation of the variable displacement pump is understood from the within description.

It is preferred to accomplish the numerous objects hereof and to practice the invention in substantially the manner hereinafter full described and as more particularly pointed out in the claims. Reference is now made to the accompanying drawing that forms a part of this specification, wherein:

The figure is a sectional view taken transversely of the axis of a vane type pump showing the instrumentalities of the present invention incorporated thereon, the view being taken centrally through the pump chamber and housing.

The drawing is to be understood as being more or less of a schematic character for the purpose of disclosing a typical or preferred form of the improvement contemplated herein.

The pump arrangement shown comprises a housing 5 the interior of which is provided with a cylindrical bore 6, and the end walls of the housing are provided with bearings (not shown) for journalling a shaft 7 to which the rotor body 8 is secured in any suitable manner, preferably by a pin 9. The rotor body 8 is scalloped out as shown and the shaft 7 is hollow to reduce the weight of the rotor body. Radially disposed seats or channels 10 are formed in the rotor 8 between the scallops to receive the blades or vanes 11 that are adapted to sweep the inner surface of the pump chamber 12 that is arranged with its axis eccentric with respect to the rotational axis of the rotor and also with respect to the bore 6 of housing 5. The pump or compression chamber 12 is preferably a cylindrical sleeve that is adapted to be oscillated in order to vary the eccentricity between it and the rotor assembly.

The oscillation of the pump chamber 12 is preferably a swinging movement upon a fixed fulcrum that is located at or adjacent the outer surface of the sleeve. For this purpose the inner surface of the housing is provided with a radial groove 13 to receive the shank of a tapered or pointed blade 14, the apex of which is received

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in a groove 15 in the adjacent outer surface of the sleeve 12. Diametrically opposite the blade 14 that fulcrums the sleeve 12 there is a seal assembly 16 that comprises a holder 17 of U-shaped or channel shape mounted in a groove 18 in the housing so that the parallel flanges of the channel member project into the housing bore 6 to receive a seal shoe 19 of the rocker type. As seen in the drawing, the shoe has a semi-circular cross-section and is arranged with its curved or arcuate portion resting on the flanges of the holder 17 to position its plain side toward the outer surface of the sleeve 12. The adjacent surface of the sleeve 12 in the region of the seal assembly 16 is formed with a curve or arc that is struck from the apex of the blade 14. This facilitates the oscillatory movement of the sleeve upon its fulcrum.

The blade and seal extend across the space between the housing bore 6 and the outer surface of the sleeve 12 to divide this space into two compartments, the upper compartment being identified as 20 and the lower compartment as 21.

The sleeve 12 is preferably open at its ends and the end edges thereof are fitted against the end walls of the housing 5. The housing has an inlet or suction passage or port 22 the dimensions of which are such that it extends past a plane X struck through the assembly from the apex of the blade 14 to the center of the seal shoe 19. This inlet passage or port 22 communicates with the suction side of the pump and the upper compartment 20 between the sleeve 12 and the housing bore 6 is vented to this inlet passage or port as schematically indicated at 23. The housing 5 also has an outlet passage or port 24 communicating with the pressure side of the pump and said passage or port is of such dimensions that it extends past the plane X. The lower compartment 21 that is beneath the plane X communicates preferably with the outlet passage or port as schematically shown at 25.

When the pressure builds up in the lower compartment 21 the sleeve will be shifted upon its fulcrum from the position shown in an upward direction thus varying the eccentricity between the rotor assembly and the sleeve. The movement of the sleeve is initially resisted by a control assembly 26 that is effective upon the upper portion of the sleeve. This assembly comprises a tube 27 secured to a hollow boss 28 on the exterior of the housing and arranged with its axis radial to the axis of rotation of the rotor assembly. At its outer end the tube has internal threads 29 into which an adjusting screw 30 is turned. This screw 30 has a bore of angular cross-section to slidably receive the angular shank 31 of an adjusting nut 32 that is flanged as at 33 to rest on the outer end edge of the tube 27. The adjusting nut is secured in place by a lock-nut 34 screwed upon the threaded outer portion of the tube 27. In the bore of boss 28 there is a slidable guide member 35 and a compressed coiled spring 36 is interposed between the inner end of the guide member 35 and the adjusting screw 30 for urging the guide member 35 inwardly toward the sleeve 12. The guide member 35 has a suitably shaped bore 37 to receive the inner end of a strut or link member 38, the opposite end of said strut or link being engaged in a seat 39 in the proximate surface of the sleeve 12. This strut or link 38 is adapted to rock during the oscillatory movement of the sleeve 12 and its arrangement is such that friction between it and the sleeve is reduced to a minimum.

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Diametrically opposite the control assembly 26 the housing has a hollow boss 41 providing a suitable recess 40 in the housing wall. A stop shoe 42 is seated in recess 40 and arranged with its arcuate inner surface 43 engaging the proximate surface of the sleeve 12. The stop shoe is urged toward the sleeve 12 by a spring 44 that is interposed between said shoe and a closure cap 45 that is screwed into the boss 41. The closure cap 45 has a pin 46 that enters the shoe and assists in maintaining it in position. This arrangement exerts a light pressure against the shoe and prevents rattle or chatter thereof.

The operation of the assembly is as follows: The rotor shaft 7 is driven by any suitable prime mover, such as an electric motor or the like which causes the rotor assembly to revolve with the blades 7 thereof sweeping the inner surface of the chamber defined by sleeve 12. The inlet passage or port 22 sucks fluid from a suitable source and such fluid is compressed in the regions between the blades and it is discharged through the outlet passage or port 24. Some of the pressure fluid from the discharge passage 24 will enter the lower compartment 21 through the communicating passage 25 and pressure will build up back of the sleeve 12 until the tension of control spring 36 has been overcome, and thereafter, continued increase of pressure in the compartment 21 will move the sleeve 12 upon its fulcrum blade 14 in an upward direction thus compressing the spring 36. During this bodily swinging movement of sleeve 12 the outer portion of said sleeve that is remote or opposite the fulcrum 14 will sweep the seal member or shoe 19.

In order to predetermine the amount of pressure required to oscillate the sleeve 12 the control assembly 26 is adjusted by loosening the lock-nut 34 and then rotating the adjusting screw 32 to either tighten or loosen the tension of spring 36. When the sleeve 12 moves in the manner above described the stop shoe 42 will follow the sleeve in its oscillatory movement due to the urge of spring 44 that presses the shoe toward the surface of the sleeve. It will be seen that the oscillation of the sleeve 12 to vary the eccentricity between it and the rotor assembly is effected by the pressure fluid from the pump acting upon the chamber defining sleeve 12. Also this variation is accomplished without creating any considerable amount of friction, in fact friction is reduced to a minimum.

While this invention has been described in detail in its present preferred form or embodiment, it will be apparent to persons skilled in the art, after understanding the improvements, that various changes and modifications may be made therein without departing from the spirit or scope thereof. It is aimed in the appended claims to cover all such changes and modifications.

I claim:

1. A variable displacement pump assembly comprising a housing; a sleeve in said housing in spaced relation thereto to adapt said sleeve for bodily swinging movement in said housing; fulcrum means on which said sleeve swings, a rotor having slidable vanes operable in said sleeve in spaced relationship thereto for defining a variable displacement pump chamber; means diametrically opposite said fulcrum means dividing the space between said housing and sleeve into first and second compartments having substantially equal peripheral dimensions; means for putting said first compartment into communi-

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cation with the suction side of the pump; and means for discharging fluid from the pressure side of the pump into said second compartment and against said sleeve to swing the sleeve for varying the relationship between said sleeve and rotor.

2. A variable displacement pump assembly as defined in claim 1 wherein the sleeve is engaged by spring means to urge it in a direction opposing the swinging movement effected by the pressure in the second compartment; and the dividing means comprise a fulcrum for said sleeve, and a seal device at the opposite side of the sleeve from the fulcrum.

3. A variable displacement pump assembly comprising a hollow housing; a pump rotor having slidable vanes operable in said housing on a fixed axis; and means for effecting a varied displacement by said pump rotor, said means comprising a sleeve encompassing said pump rotor and vanes and defining a pump chamber therefor, there being a space between said sleeve and said housing; means fulcruming said sleeve for bodily movement with respect to said rotary to vary the eccentricity therebetween; a seal between said housing and sleeve diametrically opposite said fulcrum means; said fulcrum means and seal defining first and second compartments having substantially equal peripheral dimensions; means venting said first compartment to the suction side of the pump; and means admitting fluid from the pressure side of the pump to said second compartment for bodily moving said sleeve on said fulcrum means thereby to vary the relationship between said sleeve and the rotor.

4. A variable displacement pump assembly as defined in claim 3 wherein the fulcrum means is located at a point remote to the axis of the sleeve and adjacent the wall thereof.

5. A variable displacement pump assembly as defined in claim 3 wherein the fulcrum means comprises a blade extending between the housing wall and the outer surface of the sleeve.

6. A variable displacement pump assembly comprising a hollow housing having inlet and outlet ports; a pump rotor having movable vanes operable in said housing on a fixed axis; a sleeve encompassing said pump rotor and vanes and therewith defining a variable displacement pump chamber, there being an annular space between said sleeve and housing; diametrically opposite means dividing said space into a plurality of compartments having substantially equal peripheral dimensions, one of said means providing a fixed fulcrum for said sleeve for effecting bodily swinging movement of said sleeve to vary the eccentricity between said rotor and sleeve; yieldable means acting on the sleeve tending to swing said sleeve in one direction upon its fulcrum; means establishing communication between a port and at least one of said compartments; and means establishing communication between the other port and at least one other of said compartments, the compartment communicating with said outlet port being opposite said yieldable means, the pressure fluid from said outlet port thereby acting upon the sleeve to move said sleeve in opposition to the yieldable means, whereby said sleeve is swung back and forth on its fulcrum to vary the relationship of the sleeve with respect to said rotor.

7. A variable displacement pump assembly as defined in claim 6 wherein the space dividing means comprise a fulcrum blade projecting from

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the housing into engagement with an adjacent portion of the sleeve, and a seal member between the housing and the portion of the sleeve that is diametrically opposite the fulcrum blade.

8. A variable displacement pump assembly comprising a hollow housing having suction and pressure ports; an oscillatory sleeve in said housing defining a pump chamber, there being an annular space between said sleeve and housing; means at diametrically opposite sides of said sleeve dividing said annular space into first and second compartments having substantially equal peripheral dimensions and communicating respectively with said suction and pressure ports, one of said means providing a fulcrum whereon the sleeve is bodily movable; and a pump rotor having movable vanes operable in the chamber defined by said sleeve, said rotor and vanes positioned in said sleeve and operative to suck fluid into said chamber and discharge such fluid under pressure out of said chamber, whereby pressure fluid in said second compartment acting on said sleeve is adapted to swing said sleeve on its fulcrum means to vary the relationship between said sleeve and rotor.

9. A variable displacement pump assembly comprising a hollow housing; a sleeve adapted for bodily swinging movement; fulcrum means engaged with said sleeve for effecting said swinging movement of said sleeve, said sleeve spaced from said housing and defining a pump chamber, seal means diametrically opposite said fulcrum means dividing the space between said sleeve and housing into first and second compartments having substantially equal peripheral dimensions; means establishing communication between the first compartment and the suction side of the pump; means establishing communication between the second compartment and the pressure side of the pump; a pump rotor having movable vanes operable in said pump chamber in eccentric relation to said sleeve; the pressure fluid in said second compartment acting on said sleeve being adapted to swing the sleeve in one direction on its fulcrum; spring means located in a plane intersecting the plane of said diametrically opposite dividing means, said spring means acting on a portion of said sleeve in said first compartment to swing said sleeve in the other direction on its fulcrum; and means for adjusting the tension of said spring means for predetermining the force of the pressure fluid required to swing the sleeve.

10. A variable displacement fluid pump assembly comprising a housing; a sleeve spaced from and adapted for bodily swinging movement within said housing; a rotor; movable vanes on said rotor; said rotor and vanes defining a variable displacement pump chamber in said sleeve; means fulcruming said sleeve at one side thereof substantially in line with the resultant of all forces acting on the sleeve in a mid-position; means in said housing sealably engaged with said sleeve diametrically opposite said fulcrum means, thereby dividing the space between said housing and sleeve into a plurality of compartments; a first passageway means placing one of said compartments in communication with the suction side of the pump; a second passageway means adapted to discharge fluid from the pressure side of the pump into the other of said compartments to be effective against said sleeve for varying the relationship between said sleeve and rotor; yieldable strut means swingably engaging said sleeve between said fulcrum and seal means; and yieldable means urging said sleeve toward said strut means.

11. A variable displacement pump assembly as defined in claim 10, including spring means urging the strut toward said sleeve; and means for adjusting the tension of said spring means for predetermining the force of pressure fluid required to swing the sleeve.

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