A. SUNDH.

VARIABLE STROKE PUMP.

APPLICATION FILED MAR. 30, 1914.

1,239,060.

Patented Sept. 4, 1917.

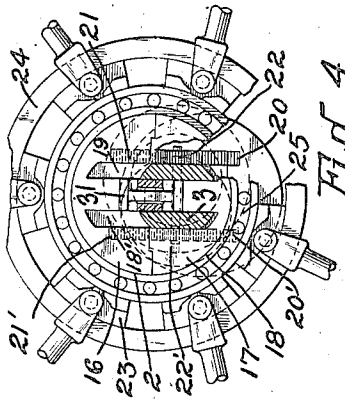


Fig. 4.

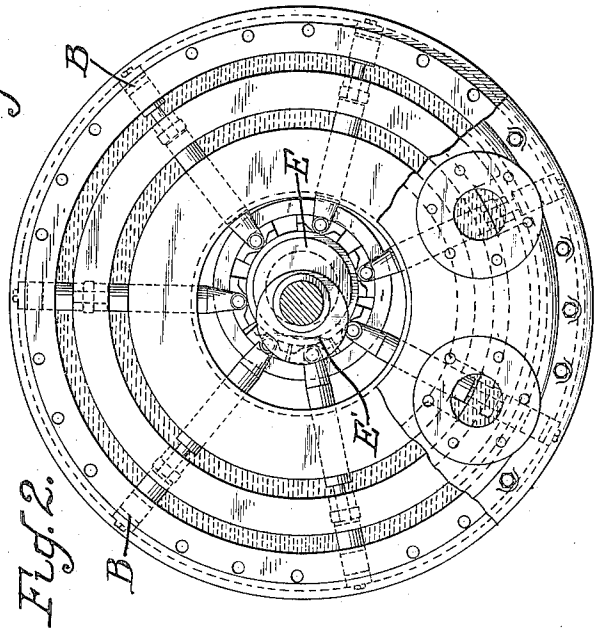


Fig. 2.

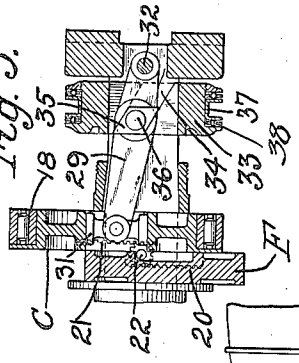


Fig. 3.

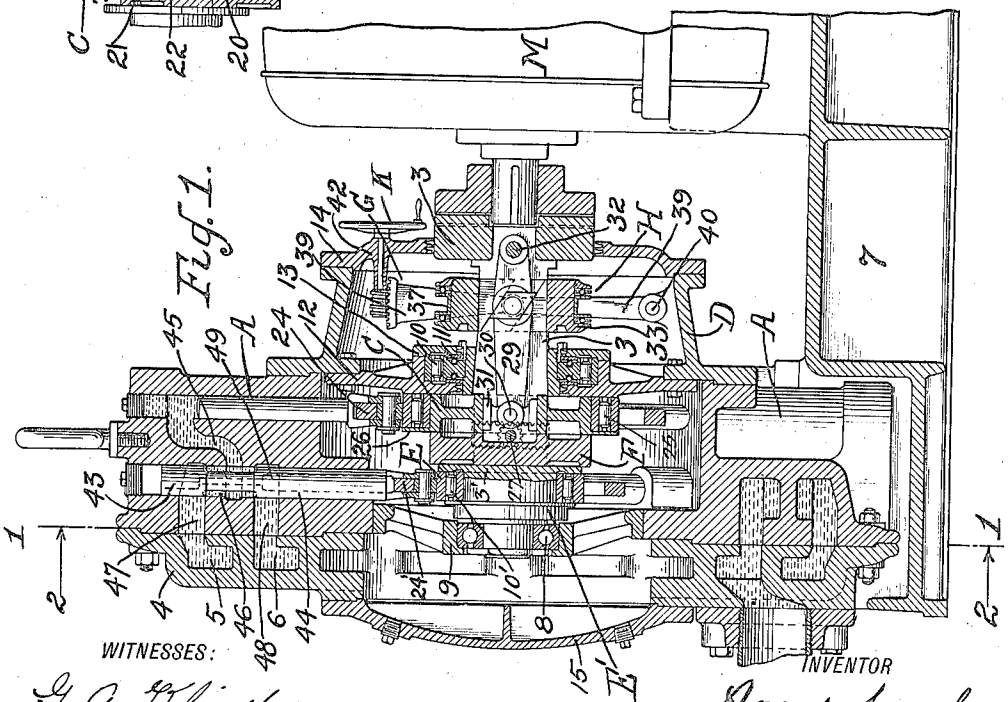


Fig. 1.

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VARIABLE-STROKE PUMP.

1,239,060. Specification of Letters Patent. Patented Sept. 4, 1917.

Application filed March 30, 1914. Serial No. 828,190.

To all whom it may concern:

Be it known that I, AUGUST SUNDH, a citizen of the United States, residing in Hastings-upon-Hudson, in the county of Westchester and State of New York, have invented a new and useful Improvement in Variable-Stroke Pumps, of which the following is a specification.

My invention relates to fluid pumps or motors, and more particularly to a reciprocating pump in which the stroke of the pistons or plungers may be varied at will.

One of the objects of the invention is the provision of an improved center shifting device for a multiple plunger pump, whereby the stroke of the pump plungers can be varied from zero to maximum in both directions, and further to provide automatic means whereby the stress exerted on the drive shaft is substantially balanced throughout the entire degree of movement of the center shifting device.

Another object of the invention is the provision of pumping mechanism having piston valves associated therewith which are actuated by an eccentric on the drive shaft, and further to associate with the eccentric a balancing member, whereby the stress exerted on the drive shaft by the eccentric will be substantially balanced.

Still another object of the invention is the provision of means for positively maintaining both the pump plungers and piston valves in engagement with their associated eccentrics, and to provide means to permit a free and easy movement of the working parts.

Other detail improvements will be more particularly pointed out hereinafter, the novel combination of elements and arrangements of parts being pointed out in the appended claims.

In the accompanying drawing, Figure 1 is a side sectional view of a pump containing an embodiment of my invention, together with a prime mover for driving the same; Fig. 2 is a front view of Fig. 1, taken on the line 1—1, in the direction of the arrows 2—2; Figs. 3 and 4 are fragmentary views of the center shifting and associated balancing device.

The pump shown in Fig. 1, comprises a plurality of cylinders A, in this instance there being seven, and each cylinder having its own valve B, the latter being shown clearly in Fig. 2. The cylinders are operatively connected to an adjustable eccentric C carried on a crank shaft 3, each cylinder being radially disposed about the axis of said shaft. The valves for each cylinder are also radially disposed about the crank shaft, and are operated by an eccentric fixed on the shaft 3. The working and valve cylinders together with a member 4 having fluid chambers 5 and 6, are supported upon a substantial bed 7. The shaft 3 is supported at its left end in ball bearings 8 carried by a hub 9. At an intermediate point on the said shaft I provide additional ball bearings 10 and thrust bearings 11 which are contained in a member 12 and end plate 13. A casing D is secured to the cylinder casting, and secured thereto is an end plate 14. An end cover 15 is likewise secured to the member 4.

The plungers of each cylinder, together with the corresponding valves are all operated from the shaft 3 by means of the eccentrics C and E, respectively. The eccentric C associated with the plungers is arranged to be shifted in planes perpendicular to the axis of the shaft to effect any desired stroke from zero to maximum. Furthermore I provide a member F, which is shifted an amount equal to that of the eccentric C, but in a reverse direction.

The function of the member F is to balance the eccentric C, so that a substantially balanced stress is exerted on the shaft 3, irrespective of the degree of eccentricity of the eccentric C.

The eccentric C is composed of two halves 16 and 17, upon the outer periphery of which is shrunk or otherwise secured a hardened steel ring 18, which holds the two halves of the eccentric together. The eccentric C is provided with slots 18′ and 19, and the shaft 3 is slotted and the outer periphery thereof is cut away to fit the slots in a manner so that the eccentric C has a snug sliding fit. This construction permits the eccentric C to slide in a plane perpendicular to the axis of the shaft 3, and also effects a positive driving connection between said eccentric and the shaft. The balancing member F is likewise provided with slots similar to

those in the eccentric C, said member F having a snug sliding fit with the shaft 3. In order now to automatically effect the shifting of the member F an equal amount and in a reverse direction to that of the eccentric C, I provide rack gears 20, 20′ and 21, 21′, on the member F and eccentric C, respectively. Pinions 22 and 22′ are carried on a rod 27, and engage the rack gears 20, 20′ and 21, 21′, thus when the eccentric C is moved from a concentric to an eccentric position, the member F will be automatically shifted an equal amount in a reverse direction to that of the eccentric C. Thus it will be seen that the stress which would ordinarily exerted on the shaft 3 by the eccentric C when moved from a concentric to an eccentric position, is automatically kept in perfect balance by the member F, throughout the entire degree of movement of the eccentric.

The pump plungers at their lower ends are bifurcated and secured to bearing blocks 23, around the outer periphery of which is a ring 24, which, as will be seen from Fig. 1, is maintained in central position by the bifurcated ends of the plungers. Roller bearings 25 are interposed between the bearing blocks 23 and the eccentric C, said bearing being maintained in position by a flange 26, and the lateral face of the member 12. The eccentric C is maintained in a central position relative to the plungers by the member 12 and the member F which bears against a collar 3′ on the shaft 3. It will be here noted that the ring 24 through the roller bearing connection serves to keep the pump plungers into engagement with the eccentric C.

The arrangement whereby the eccentricity of the eccentric C and consequently the stroke of the pump plungers can be varied at will, will now be described, said arrangement comprising a manually operable device K, which through connections G and H, actuates a lever 29, thus effecting the shifting of the eccentric C from a concentric to an eccentric position, in one direction or the other, dependent upon the direction of rotation of the hand wheel 27. The above connections in detail comprise the lever 29, which is connected at one end by a pivot 30 to a slidable bearing 31, which is centrally located in the eccentric C, and at the other end to a pivot 32 carried by the shaft 3. A collar 33 is slidable longitudinally on the shaft 3, and is provided with angular slots 34. Bearing blocks 35 carried by a pivot 36 on the lever 29 are adapted to co-act with said slots, the arrangement being such that when the collar 33 is moved either to the right or left on the shaft 3, the bearing blocks in following the slots 34 will rock the lever either in a clockwise or anti-clockwise direction, dependent of course on the direction of movement of the collar 33. The collar 33 is of course rotatable with the shaft 3, and is provided with a flanged collar 37 which is interposed between the flanges on said collar 33 and ball rings 38. A member 39 pivoted at 40, straddles the collar 33 and engages the slot formed in the collar 37, said member being actuated either in a clockwise or anti-clockwise direction through the worm and rack gear connection G. The shaft of the worm extends through a bearing 42 in the cover plate to the outside of the casing, and to the end of which is secured the hand wheel K.

Thus far in the description it is seen that the eccentric C through the roller bearings and annular ring 24 provides a positive driving connection between the shaft 3 and the pump plungers or pistons. With the parts as shown in Fig. 1, the eccentric C is concentric with the shaft 3, and consequently if the shaft 3 is rotated there will be no reciprocation of the pump plungers. Now by rotating the hand wheel in an anti-clockwise direction looking toward the left, the member 39 is rocked in a clockwise direction, which movement thereof slides the collar 33 to the right on the shaft, thus effecting a rocking of the lever 29 in a clockwise direction, thereby shifting the eccentric C from its concentric position to an eccentric position. It is to be particularly noted here that due to the system of leverage herein employed, a small movement only of the lever 39 is necessary to change the eccentricity of the eccentric C to effect the maximum stroke of the plungers. The eccentric C and associated mechanism will assume a position as illustrated in Figs. 3 and 4, upon being actuated to effect the maximum stroke of the pump plungers. It will be further noted that as the eccentric C is shifted in one direction, the member F is automatically shifted an equal amount in the reverse direction, thus as heretofore explained balancing the eccentric so that the stress exerted on the shaft is automatically balanced. The provision of this balancing member is of great importance, particularly in pumps of this character, which are adapted to be run at high speeds, since it will readily be seen that without the same, the unbalanced stress exerted on the shaft by the eccentric would as will readily be seen create noise, and excessive wear, and strain on various parts. The rotation of the hand wheel now in a clockwise direction will return the said parts to their normal position as shown in Fig. 1. By rotating the hand wheel in a reverse direction or clockwise direction with the parts as shown in Fig. 1, the eccentric C and the member F will operate in a reverse direction to that just described.

The operative connection between the ec-

centric E and the valves B is exactly the same as the connection between the eccentric C and the pump plunger, and therefore needs no further detailed description. The valves B are all similar to each other, each one comprising two parts or piston valves 43 and 44, which are connected together and thereby form a two part valve balanced against pressure and requiring a minimum amount of power to operate. The closed end of each plunger cylinder is connected by a passage or port to the center of a corresponding valve. For instance in Fig. 1 the plunger A is connected by a port 45 to the valve 46, said port opening into the valve between the two valve pistons 43 and 44. Other ports such as the ports 47 and 48 of each valve are all connected to the fluid chambers 5 and 6 respectively. That is to say, the ports 47 of all the valves are in communication through the chamber 5, while the ports 48 are in like manner interconnected through the chamber 6. The chambers 5 and 6 are connected through suitable pipe connections to a source of fluid supply and discharge or vice versa. It will be observed that the throw or setting of the valve eccentric E is spaced 90′ or a quarter of a revolution from that of the plunger eccentric C, and with this setting the valve will always be in a position properly to control the fluid directed to or from the plungers regardless of the adjustment of the plunger eccentric. The operation of the valves, etc., in controlling the fluid directed to or from the plungers is fully shown and described in my co-pending application, Serial No. 794,829, filed October 13, 1913, and in view thereof a detail description of said operation is thought not necessary, since the present application relates in part to detail improvements which I will now point out. It will be noted that the eccentric E which actuates the valves B causes an unbalanced condition, and in order to effect a balanced condition, or in other words to balance the shaft 3 against centrifugal force, I provide a cam E′ which is fixed to the shaft 3 in a manner to equalize or balance the eccentric E.

It will be noted with reference to the piston valves B, that the same are provided with passages 49, which extend the entire length thereof. These passages are made necessary to permit the passage of air therethrough from the air chamber at the top of the pistons, which air without the provision of said passages in the valves, would prevent the free reciprocation of the valve pistons.

It will be noted also that the connection comprising the roller bearings 10′ and the annular ring 24′ serves to positively maintain the piston valves into engagement with the eccentric E, and the friction between the working parts is reduced to a minimum, that is, between the shaft 3, and the pump plungers, and valve pistons, and furthermore the stress on the shaft 3 exerted by the eccentrics C and F is substantially balanced at all times.

The shaft 3 can be coupled or otherwise connected to any source of operating power, such as a gas engine, an electric motor M as shown, or any of the other well known types of power units.

It is to be understood that the improved center shifting device can be actuated and controlled automatically to effect any desired variation in stroke of the pump plungers from zero to maximum, instead of by the normally operable wheel as shown; and without limiting myself to the precise arrangement and construction herein set forth, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. In a variable stroke pump, the combination with a drive shaft, an eccentric on the shaft, a lever pivoted to the shaft and connected by a slidable bearing to the eccentric, and means for operating the lever, said means comprising a collar slidable on the shaft and having an angular slot coacting with an angular face on the lever.

2. In a center shifting device for pumps, the combination with a drive shaft, an eccentric carried thereby, a lever pivoted in the shaft and connected to the eccentric, a second pivoted member, and a connection between the first named lever and the second member, whereby the degree of movement of the eccentric is multiplied relatively to the degree of movement of the second named pivoted member.

3. In a center shifting device for pumps, the combination with a drive shaft, an eccentric carried thereby, a lever having one end pivoted in the shaft and the other end slidably connected with the eccentric, a slidable collar on the shaft engaging angular surfaces on the lever, said angular surfaces being positioned on the lever to effect a multiplied movement of the eccentric relative to the movement of the collar.

4. In a center shifting device for pumps, the combination with a drive shaft, a center shifting device carried thereby comprising an eccentric, and mechanism comprising a leverage system for operating the eccentric, said leverage being arranged so that the degree of movement of the eccentric is multiplied over the operative motion.

5. In a center shifting device for pumps, the combination with a drive shaft, an eccentric rotatable therewith and movable in a line perpendicular to the axis of the shaft, a lever pivoted at one end to the drive shaft and at the other to a slidable bearing in the eccentric, a collar slidable on the shaft, said collar having an angular slot, a bearing on

the lever co-acting with the angular slot, and means to operate the collar in either direction from a center position.

6. In a center shifting device for pumps, the combination with a drive shaft, an eccentric rotatable therewith and adapted to be shifted in a line perpendicular to the axis of the shaft, a lever pivoted in the shaft and connected to the eccentric through a slidable bearing, and means mounted in anti-friction bearings for operating the lever.

7. In a center shifting device for pumps, the combination with a drive shaft, an eccentric rotatable therewith, a lever pivoted in the shaft and operatively connected to the eccentric, a collar slidable on the shaft and operatively connected to said lever, means for sliding the collar in both directions on the shaft, and anti-friction bearings interposed between the collar and said means.

8. In a center shifting device for pumps, the combination with a drive shaft, an eccentric rotatable therewith, a lever pivoted in the shaft and operatively connected to the eccentric, a collar slidable on the shaft, a connection between the lever and collar for reversing the movement of the lever when the movement of the collar is reversed, a second pivoted member for sliding the collar in either direction from center position, and anti-friction bearings interposed between the collar and the second lever.

9. In a variable stroke pump, the combination with a drive shaft, an eccentric carried thereby, a plurality of radially disposed pump pistons in the same plane operatively connected with the eccentric means to operate the eccentric in both directions from a concentric to an eccentric position to vary the stroke of the pistons, a balancing member for the eccentric, and means to shift the balancing device conjunctively with and in a reverse direction to the eccentric.

10. In a variable stroke pump, the combination with a drive shaft, an eccentric carried thereby, a plurality of radially disposed pump pistons in the same plane operatively connected with the eccentric, means to actuate the eccentric in both directions from a concentric to an eccentric position to vary the stroke of the pistons, a balancing member for the eccentric, and a connection between the eccentric and balancing member for effecting the operation of the latter conjunctively with and in a reverse direction to the eccentric.

11. In a variable stroke pump, the combination with a plurality of cylinders, piston valves for the cylinders, pistons in the cylinders, a drive shaft, an adjustable eccentric carried by the shaft for operating the pistons at variable strokes, automatically operative mechanism for balancing the eccentric, an eccentric carried by the shaft for operating the valves, and balancing means for the latter eccentric.

12. In a variable stroke pump, the combination with a drive shaft, an eccentric carried thereby, a plurality of pump pistons in the same plane, radially disposed about said drive shaft and driven by said eccentric, means to shift the eccentric in both directions from a concentric to an eccentric position to vary the stroke of the pistons, a balancing member for the eccentric, and gearing for effecting the operation of the balancing member, conjunctively with and in a reverse direction to the eccentric.

13. In a variable stroke pump, the combination with a drive shaft, an eccentric carried thereby, a plurality of pump pistons in the same plane, radially disposed about said drive shaft and driven by said eccentric, means to shift the eccentric in both directions from a concentric to an eccentric position to vary the stroke of the pistons, means to balance the eccentric, and a rack and pinion connection arranged to shift the balancing member, an equal amount and in a reverse direction to the eccentric.

14. In a variable stroke pump, the combination of a plurality of cylinders, valves for the cylinders, pistons in the cylinders, a drive shaft, bearings pivotally connected to the pump pistons and valves, means between the drive shaft and said bearings for operating the valves and pistons, and means for positively maintaining a driving connection between said operating means and the valves and pistons.

15. In a variable stroke pump, the combination of a plurality of cylinders, piston valves for the cylinders, pistons in the cylinders, a drive shaft, bearings pivotally connecting the pump pistons and valves through intermediate mechanism with the drive shaft, and an annular member for maintaining the valves and pistons in positive engagement with the intermediate mechanism for operation by the drive shaft.

16. In a variable stroke pump, the combination with a plurality of radially disposed cylinders, reciprocating valves for the cylinders, pistons in the cylinders, a drive shaft, bearings pivotally connected to the valves and pistons, intermediate mechanism between the drive shaft and said valves and pistons for operating said valves and pistons, and an annular ring for maintaining the valves and pistons in engagement with the operative means.

17. In a variable stroke pump, the combination with a plurality of radially disposed cylinders, piston valves for the cylinders, pistons in the cylinders, said valves and pistons being bifurcated at one end, bearings pivotally connected to the bifurcated end of the valves and pistons, a drive shaft,

intermediate mechanism between the drive shaft, valves and pistons for operating the valves and pistons, and an annular ring guided by the bifurcated ends of the valves and pistons for maintaining the latter in engagement with the operating means.

18. In a pump, the combination with a drive shaft, a plurality of pistons radially disposed about the drive shaft, an adjustable connection between the drive shaft and pistons for operating the latter at variable strokes, and means guided in a central position relative to the pistons for maintaining the latter in positive engagement with the operating means therefor.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUST SUNDH.

Witnesses:

WALTER C. STRANG,

JAMES G. BETHELL.