

July 21, 1936.

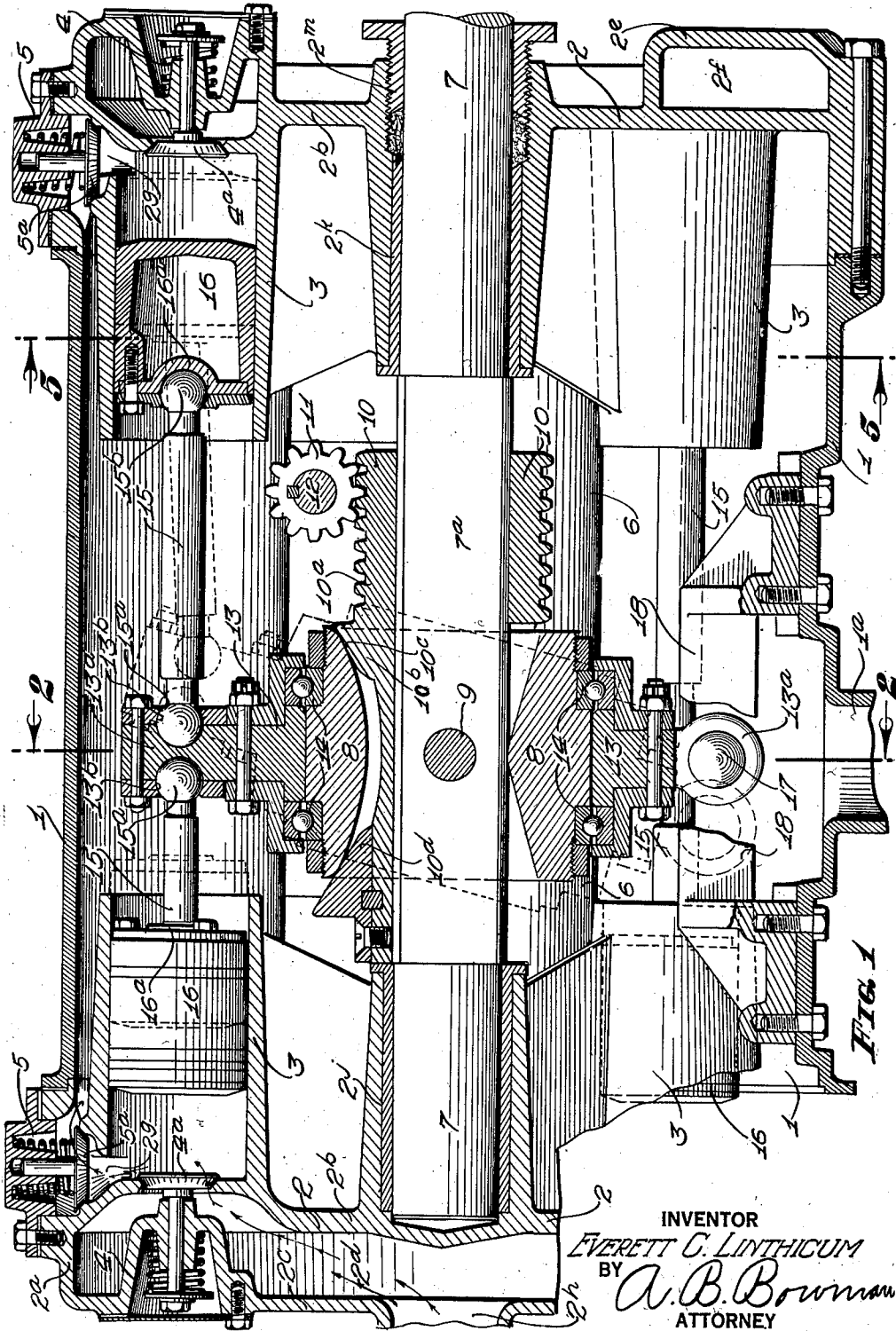
E. C. LINTHICUM

2,048,272

VARIABLE CAPACITY PUMP

Filed Nov. 22, 1932

3 Sheets-Sheet 1



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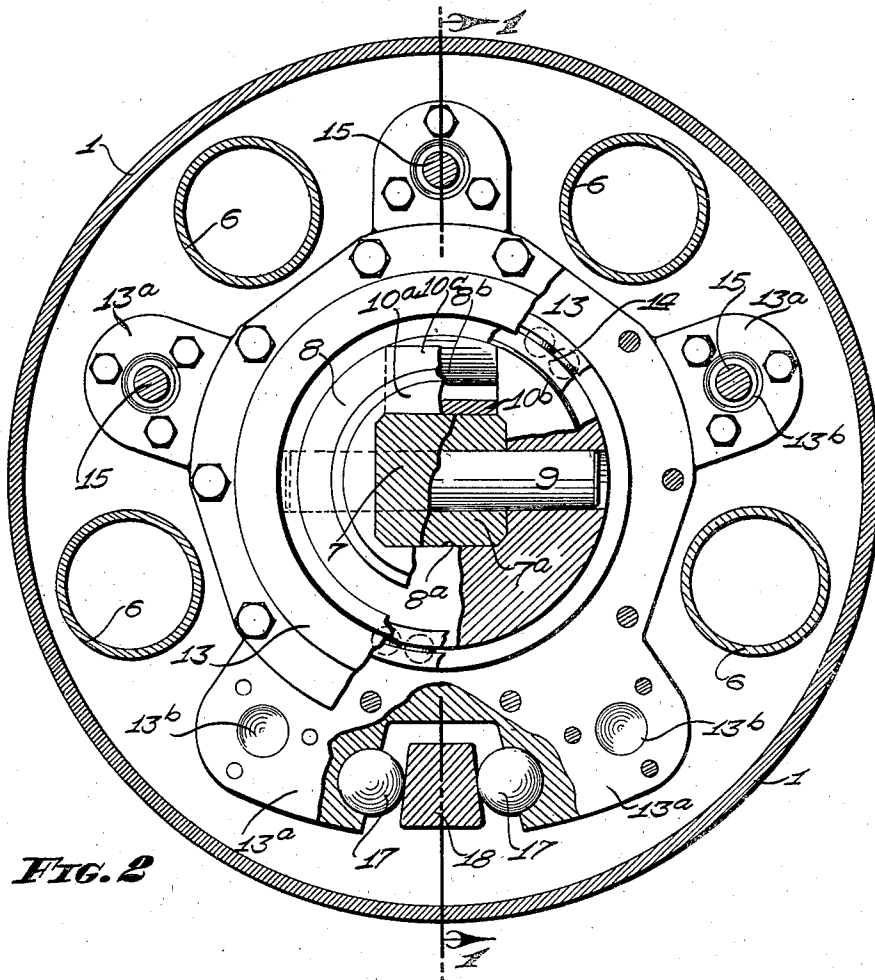


FIG. 2

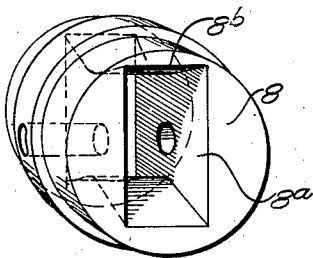


FIG. 3

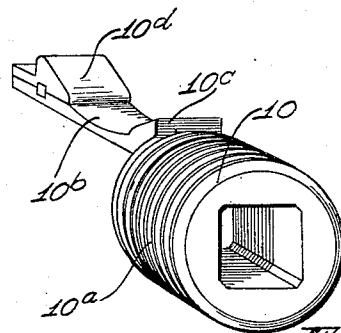


FIG. 4

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3 Sheets-Sheet 3

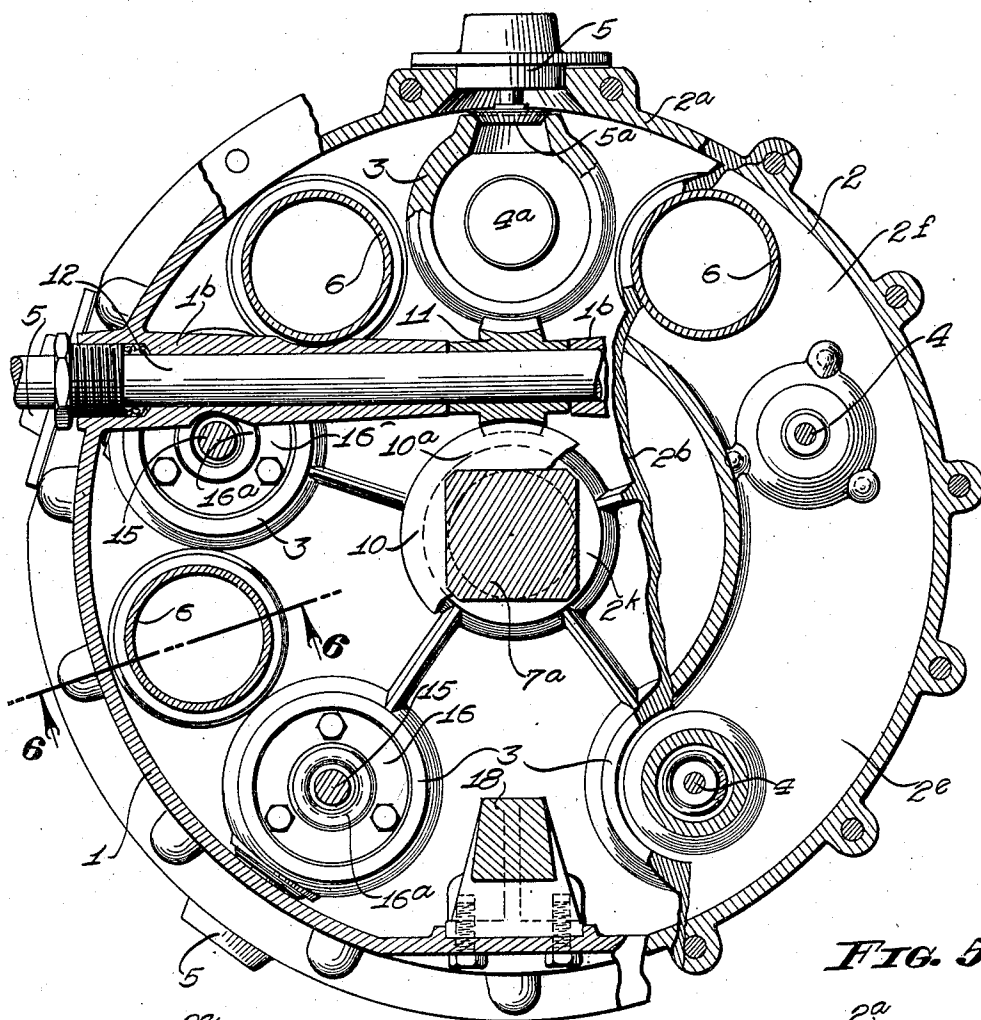


FIG. 5

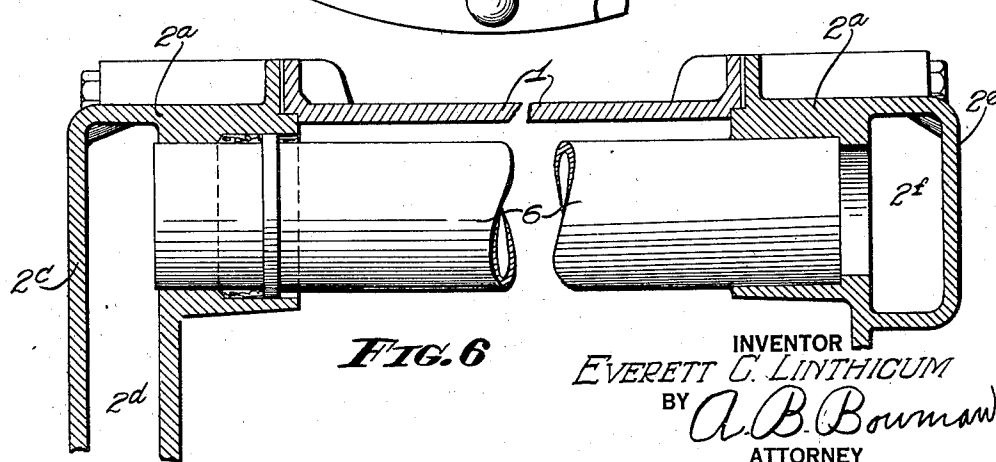


FIG. 6

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2,048,272

VARIABLE CAPACITY PUMP

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Application November 22, 1932, Serial No. 643,852

3 Claims. (Cl. 103—173)

My invention relates to variable capacity pumps, and the objects of my invention are:

First, to provide a pump of this type which has a free or neutral position in which it may rotate without performing its pumping action;

Second, to provide a pump of this type wherein the capacity of the pump may be varied at will while the pump is in operation and under a load;

Third, to provide a pump of this type in which its capacity is controlled by regulating the stroke of its several pistons, the pistons coming to rest when the pump is in its neutral position;

Fourth, to provide a variable capacity pump which is operable on either liquids or air;

Fifth, to provide a novel capacity changing means which is applicable not only to pumps but also to internal combustion engines or the like in cases where variations in the compression ratio is desirable;

Sixth, to provide a pump of this type which is inherently free from vibration, the various forces tending to balance each other; and

Seventh, to provide on the whole a novel constructed pump of the type which is particularly compact of construction, efficient in its action, and which will not readily deteriorate or get out of order.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination and arrangement of parts and portions as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon which form a part of this application, in which:

Figure 1 is a longitudinal sectional view of the pump taken through 1—1 of Fig. 2; Fig. 2 is a transverse sectional view thereof taken through 2—2 of Fig. 1; Fig. 3 is a perspective view of the hub forming part of the stroke changing mechanism; Fig. 4 is a similar perspective view of the hub tilting means also forming part of the stroke changing mechanism; Fig. 5 is another transverse sectional view generally through 5—5 of Fig. 1 with parts and portions broken away or shown in elevation to facilitate the illustration; Fig. 6 is a fragmentary sectional view through 6—6 of Fig. 5 with parts and portions shown in elevation.

Similar characters of reference refer to similar parts and portions throughout the several views of the drawings.

The pump is provided with a body casing 1,

which is cylindrical in form with outwardly flanged ends. Each end is closed by an end casing 2. The end casings continue axially from the ends of the body casing 1 for a short distance forming cylindrical portions 2a. Near their extremities the cylindrical portions 2a are closed by partitions 2b. Supported from the inner sides of the partitions 2b and extending axially into opposite ends of the casing 1 are a plurality of cylinders 3. The cylinders are disposed adjacent the cylindrical portions 2a and body casing 1 and are arranged in axially aligned pairs. Five pairs of such cylinders are illustrated but a greater or lesser number may be provided.

At the extremity of one of the end casings there is provided an end wall 2c which covers the partition 2b and is disposed in spaced relation therewith so as to form a chamber 2d occupying the end of the pump. The other end casing is provided with an annular end wall 2e which forms with the corresponding partition 2b an annular chamber 2f.

In axial alinement with each of the cylinders the end walls 2c and 2e support intake valve units 4 each of which includes an intake valve 4a which coacts with a valve seat formed in the head of the corresponding cylinder; said head constituting a part of the partition 2b.

The cylindrical portions 2a of the end casings support exhaust or discharge valve units 5, one disposed radially outwardly from each cylinder 3. Each discharge valve unit 5 includes a discharge valve 5a which extends inwardly from the cylindrical wall 2a of the corresponding end casing and coacts with a valve seat formed at the radially outward side of the corresponding cylinder 3, as shown best in Figs. 1 and 5. The valve 5a and its valve seat control a port which communicates with the interior of the corresponding cylinder adjacent its head. Around the several valves 5a the cylindrical portions of the end casings 2 are recessed so as to form a space between the end casings and cylinders whereby the discharging fluid may flow into the interior of the pump.

Between adjacent pairs of cylinders, except at the bottom, there are provided large connecting tubes 6 which communicate between the chambers 2d and 2f. The chamber 2d is provided with an inlet opening 2h, while the bottom of the body casing 1 is provided with an outlet 1a. The fluid therefore passes into the chamber 2d and into the body casing 1, either directly through the cylinders connected with the corresponding end casing or through the connect-

ing tubes to the chamber 2j and then through the cylinders connected therewith to the interior of the pump.

The end casing having the chamber 2d supports an axially inwardly extending centrally disposed blind bearing 2j, while the other end casing supports a bearing 2k. This bearing is provided with a suitable packing gland 2m. A drive shaft 7 is supported by the bearings 2j and 2k and extends outwardly through the packing gland 2m.

Between the bearings the shaft 7 is square in cross-section. A hub 8 is mounted on this portion of the shaft. Said hub has a bore there-through, designated 8a, the side walls of which bear against the side walls of the square sectioned portion, designated 7a of the shaft 7. The remaining walls of the bore 8a diverge from the center of the hub towards the opposite ends, as shown best in Figs. 1 and 3. One of such walls, designated 8b, is spaced from the corresponding side of the shaft throughout. In order to permit tilting or wobbling of the hub with respect to the shaft 7 in the desired manner, there is provided a pin 9 which extends through the square sectioned portion of the shaft and through the parallel walls of the hub 8. The axis of the pin 9 intersects the axis of the shaft 7 and is at right angles thereto.

The hub is positioned closer to the bearing 2j in order that the square sectioned portion 7a of the shaft may also accommodate a hub tilting member 10. The tilting member 10 comprises an annular rack portion 10a having annular rack teeth in its periphery and a rectangular bore so as to rotate with the shaft 7 but be slidable along its polygonal or square sectioned portion. From one side of the rack 10a extends an arm 10b which fits between the cutaway portion 8b of the bore 8a and corresponding side of the shaft, as shown best in Fig. 1. At the juncture of the arm 10b with the rack 10a there is formed an integral wedge element 10c. At the extended end of the arm 10b there is formed a removable wedge element 10d. The two wedge elements 10c and 10d engage the curved wall of the cut-away portion 8b so that the hub is caused to tilt or wobble about the axis of the pin 9. The various parts are preferably arranged so that the hub tilts from a position in which it coincides with that of the shaft in one direction until its axis is in the desired angular relation with that of the shaft.

The circular rack 10a is operated by a pinion gear 11 mounted on a control shaft 12 which is supported from the body casing 1 by means of bearings 1b. The shaft 12 extends from the casing and is provided with any suitable arrangement whereby the movement of the control shaft 12 and consequently the tilting of the hub may be manually controlled.

The hub 8 journals a spider 13 by means of a pair of main bearings 14. The spider 13 is provided with a plurality of radiating arms 13a which extend between the members of each pair of cylinders. Each arm 13a is provided at its opposite axial sides with socket members 13b into which fit ball portions 15a formed at the ends of connecting rods 15. The remaining ends of said connecting rods are also provided with ball portions 15b which fit into sockets 16a at the inner ends of pistons 16. The pistons 16 fit in the cylinders 3.

In order to prevent rotation of the spider 13 and thereby limit its movement to a tilting one

whereby the principal movement of the several arms 13a is reciprocal, two adjacent arms 13a support ball members 17 at their adjacent sides which engage opposite sides of a key bar 18. The key bar 18 is rigidly supported from the body casing 1. The several connecting tubes 6 extend between the remaining spaces formed by the arms 13a, as shown best in Fig. 2.

Though I have shown and described a particular construction, combination and arrangement of parts and portions, I do not wish to be limited to this particular construction, combination and arrangement, but desire to include in the scope of my invention the construction, combination and arrangement substantially as set forth in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a variable capacity pump wherein there are pairs of axially aligned cylinders, the several pairs arranged about and parallel with a common axis, a drive shaft disposed along said common axis, and pistons for said cylinders, the combination with said cylinders, drive shaft and pistons, of means for reciprocating said pistons including, a rotating element secured to said shaft and rotatable about the median line at right angles to said shaft, a non-rotating element carried by said rotating element in centered relation and tiltable therewith, an annular gear rack and extended arm means shiftable longitudinally with said shaft in operative relation with said rotating element for variously tilting said rotating element with respect to said shaft, a pinion meshing with said gear rack and means independent of said pistons and cylinders for holding said non-rotating element against rotation to minimize side thrust between said pistons and cylinders consisting of ball members supported by said non-rotating element, and a stationary key bar supported longitudinally with said shaft intermediate said ball members for guiding the same.

2. In a variable capacity pump wherein there are pairs of axially aligned cylinders arranged about and parallel with a common axis, a drive shaft disposed along said common axis, pistons for said cylinders, the combination with said cylinders, drive shaft and pistons of, means for reciprocating said pistons including a hub member rotatable with said shaft and tiltable around its median line and positioned at right angles to said shaft, a hub tilting member shiftable longitudinally with said shaft including, an annular gear rack surrounding said shaft and provided with an extended arm member engageable with said hub member for tilting the same, a pinion meshing with said gear rack, a non-rotatable element carried by said rotating element in centered relation and tiltable therewith and surrounding said shaft, said non-rotatable element carrying a pair of balls in spaced relation, and a key bar secured longitudinally with said shaft and interposed between said balls for holding said non-rotatable element against rotation but permitting its tilting movement.

3. In a variable capacity pump wherein there are pairs of axially aligned cylinders arranged about and parallel with a common axis, a drive shaft disposed along said common axis, pistons for said cylinders, the combination with said cylinders, drive shaft and pistons of, means for reciprocating said pistons including a hub member rotatable with said shaft and tiltable around

its median line and positioned at right angles to said shaft, a hub tilting member shiftable longitudinally with said shaft including, an annular gear rack surrounding said shaft and provided with an extended arm member engageable with said hub member for tilting the same, a non-rotatable element carried by said rotating element in centered relation and tiltable therewith and surrounding said shaft, said non-

rotatable element carrying a pair of balls in spaced relation, a key bar secured longitudinally with said shaft and interposed between said balls for holding said non-rotatable element against rotation but permitting its tilting movement, and pinion and control shaft means in operative relation with said annular gear rack for shifting the same.

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