

May 24, 1960

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2,937,599

FLUID PUMP

Filed Aug. 25, 1955

2 Sheets-Sheet 1

FIG. 5.

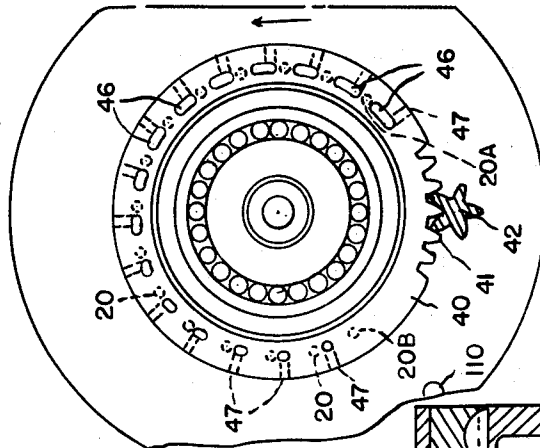
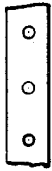


FIG. 2.

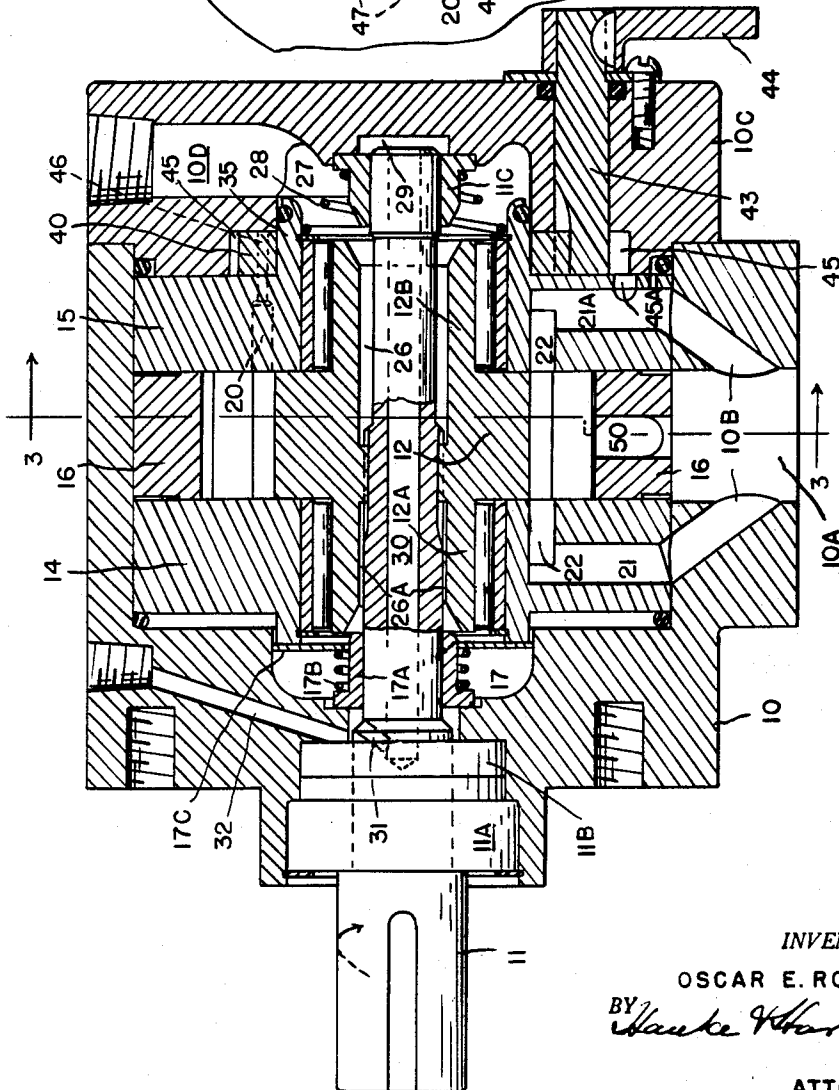


FIG. 1.

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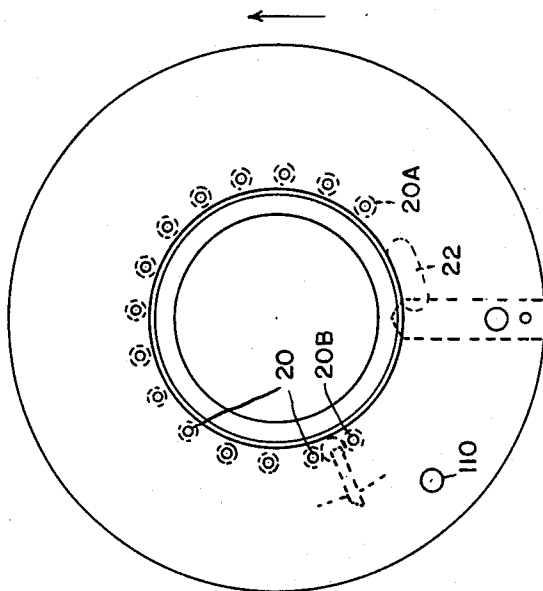


FIG. 4.

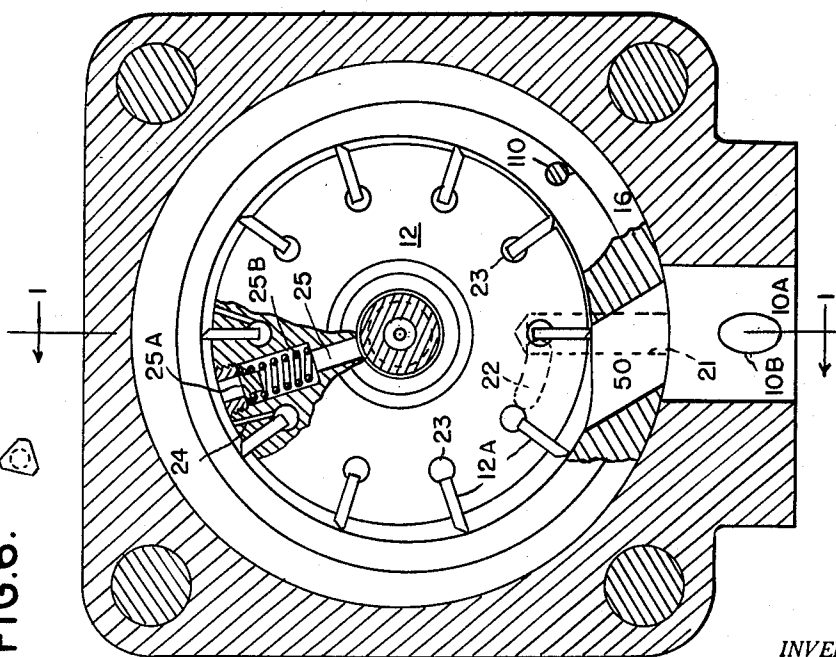


FIG. 3.

FIG. 6.

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FLUID PUMP

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5 Claims. (Cl. 103—120)

The present invention relates to fluid pumps of the vane type in which radially slidable vanes in a rotor contact a surrounding cam ring and are gradually moved inwardly to decrease the chamber between the vanes and force out the fluid.

Among the objects of the invention is to provide means whereby the pump delivery may be varied at will although the rotor speed remains constant.

Still other objects will readily occur to those skilled in the art upon reference to the following description and the accompanying drawings in which—

Fig. 1 is a longitudinal sectional view on the line 1—1 of Fig. 3.

Fig. 2 is a view in elevation of the regulating ring and associated parts as viewed from the right of Fig. 1 with the end housing member removed.

Fig. 3 is a view in elevation of the rotor and cam ring with parts in section on line 3—3 of Fig. 1.

Fig. 4 is a view in elevation from the right of Fig. 1, of the right hand cheek plate of Fig. 1.

Fig. 5 is a fragmentary view in elevation of the regulating ring.

Fig. 6 is a plan view of an outlet valve plate.

In Fig. 1 of the drawings, the pump is indicated as consisting of a housing 10 having a fluid inlet 10A provided with branches 10B. The end of the housing is closed except for the axial opening receiving the shaft 11 mounted in a suitable bearing 11A. An oil seal 11B prevents escape of fluid around the shaft. Within the housing the shaft passes through and is splined in the rotor 12 and at its end is seated in a bushing 11C carried in the housing closure plate 10C which is also provided with a fluid outlet 10D.

The rotor 12 consists of a disc-like member provided with cylindrical axial extensions 12A and 12B and these are mounted in roller bearings in the cheek plates 14 and 15. Between the cheek plates 14 and 15 and surrounding the rotor 12 is a cam ring 16, the ring and rotor disc being of such thickness dimension as to provide a close sliding fit of the rotor disc between the cheek plates when these several parts are held together in the housing.

Surrounding the shaft opening in housing 10 is a small chamber 17 and in this chamber is located a floating bushing 17A having a flange abutting a suitable shoulder in the housing wall and held against the shoulder by a suitable spring 17B, the other end of the spring abutting an annular plate 17C lying against the cheek plate 14. The chamber 17 is in communication with the space in which lies the cheek plate 14 so that fluid under pressure in the chamber tends to force the cheek plate toward the cam ring 16.

The other cheek plate 15 by means of a suitable roller bearing supports the rotor extension 12B and is provided with a plurality of evenly spaced through passages 20, while both cheek plates are provided with radially arranged passages 21—21A, opening to the branch inlet passages 10B, and arcuate openings 22 leading to the

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rotor chamber. The two cheek plates 14 and 15 and ring 16 are accurately positioned relative to each other and to the housing by means of a dowel 110.

The disc portion of rotor 12 is provided in its periphery with a plurality of radial slots in which are slidably mounted vanes 12A and each slot terminates at its bottom in an enlarged through passage 23, the passages 23 in the rotor and the passages 22 in the cheek plates being so located as to register. Also adjacent each vane slot and leading from its bottom 23 to the periphery of the rotor disc ahead of the vane is a small passage 24.

Between each two vane slots is provided a radial passage 25 leading from the periphery of the disc to the axial opening in the rotor. The axial opening in the rotor is provided with splines for about half its length to fix it to the shaft 11, the other portion being smooth and spaced from the shaft to provide an annular outlet chamber 26 into which the passages 25 open, the latter being valved as shown at 25A in Fig. 3. The valve 25A may be a plate valve actuated by a suitable spring 25B. The form of plate is shown in Fig. 6.

The chamber 26 opens to the end of the axial rotor extension 12B and into an annular outlet or discharge chamber 27 communicating with the outlet 10D. The chamber 26 is also connected to the chamber 17 by one or more longitudinal slots 26A so as to provide pressure in the latter chamber.

The end of the shaft 11 as mentioned above, is seated in a bushing 11C and the bushing itself is seated upon a suitable shoulder in the inner face of the closure plate 10C being held against the shoulder by a suitable spring 28 abutting against the cheek plate 15. Any fluid leaking past the bushing 11C will flow into a small chamber 29 opposite the end of the shaft and through the axial end of the shaft bore 30 in the shaft 11 and pass out through the lateral opening 31 into the small chamber between bushing 17A and the oil seal 11B and out through the drain 32.

Carried in a suitable recess in the inner face of closure plate 10C and rotatably mounted upon an axially extending flange 35 on cheek plate 15 is a ring 40 provided with a short segment of gear teeth 41 which mesh with a small gear 42 fixed to or made integral with a short shaft 43 extending through the closure plate 10C and provided with a suitable handle or lever 44.

This ring 40 is of such outer diameter as to provide an encircling space or chamber 45 in the recess in which the ring is mounted. It is also provided with openings or passages 46 arranged axially of the ring to which are connected other passages 47 leading radially to the chamber 45. The ring 40 is so located that the passages 46 are adapted to register with the passages 20 through cheek plate 15 and it should be noted, these passages 46 are not all of the same size but gradually increase in their arcuate length from an area equal to that of one of the passages 20 to an area several times the area of a passage 20.

In Fig. 3 the cam ring 16 is shown as provided with a main fluid inlet 50 and that the inner periphery of the ring is in the form of a spiral whose radius gradually decreases—clockwise—from the edge of the inlet 50 to a point ahead of the inlet and then is constant for a distance about equal to the distance between vanes. The radius then increases rapidly to provide a ramp between the short and long radius portions. The peripheral width of the inlet 50 is substantially equal to the length of the ramp.

The passages 20 are evenly spaced and located opposite the spiral portion of the cam ring, with the first one 20A (see Fig. 4) a short distance beyond (in the direction of rotation) the opening 22, the last one 20B being

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a short distance ahead of the constant radius portion of the cam ring 16. The chamber 45 open to the radial passages in ring 40 connects through a passage 45A with the branch inlet passage 21A.

As shown in Fig. 1, the passages 20 are of larger area at the end toward the pump chamber and the first one 20A, Fig. 4, is so located that the enlarged portion 23 of a vane slot reaches it immediately after leaving the inlet passage 22. The last one 20B of the passages 20 is located at the beginning of the circular portion of the cam ring.

With the ring 40 in place and the largest of the passages 46 adjacent the first passage 20A, rotary movement of ring 40 will progressively connect the passages 20 with the inlet branch passage 21A through the connecting passages 46, 47, 45, 45A—first, one passage 20, then two, then three, etc. Or, all of the passages 20 may be maintained closed.

With this progressive closing of the passages 20, the pumping operation of the several vanes may be regulated to begin immediately after leaving the inlet 50 or delayed to begin at any later desired point on the spiral cam ring, thereby controlling the output of the pump. In the operation of the pump, with the rotor turning clockwise (Fig. 3) fluid will be drawn through the inlet 10 and passage 50 into the intervane spaces and also through the passages 21—21A, 22 into the vane slots 23 as the vanes move outwardly following the cam ring.

As the slots 23 leave the passages 22, fluid is trapped under the vanes to hold them against the cam ring. As the cam ring radius decreases, the vanes are, of course, pushed into the slots, displacing the trapped fluid, some of which escapes through leakage but most of which passes through the passages 24 to the intervane space ahead of the vane, in which the pressure is higher than in the next succeeding space.

When the pressure in a space exceeds the spring pressure at the valves 25A, the fluid is of course expelled to the axial outlet.

The control ring 40 when in one extreme rotative position is set for maximum delivery and in its other extreme position is set for the minimum delivery. In the maximum delivery position, the ring is so set as to close all of the passages 20. However, movement of the ring 40, progressively opens the passages 20, opening first the passage 20 that is nearest to the inlet 50, so that the fluid in the vane slot is not trapped until vane slot has moved further upon the cam ring to the next passage 20 and as this is closed the fluid is trapped and pumping begins.

Further movement of the ring 40 will open a second and then a third and so on, those previously opened remaining open, so that it is possible to determine at what point upon the cam ring pumping will begin. Of course, opening a passage 20 permits the fluid in the vane slot to flow back to the fluid inlet through the passages 27, 45 and 45A.

I claim:

1. A fluid pump comprising a pair of cheek plates having a cam ring clamped therebetween and providing a chamber, a rotor in said chamber and comprising a disc having a plurality of radially arranged slots in its periphery with vanes slidably carried therein and contacting the inner surface of said ring, a fluid inlet to said chamber and to the intervane spaces therein, the said inner surface of said ring being in the form of a spiral for the major portion of its surface with the maximum radius portion of said spiral being adjacent said fluid inlet and with its radius decreasing in the direction of rotation of said rotor to a minimum radius portion at a point just short of said fluid inlet and ramp means connecting the surface at said last mentioned point and the surface at the point of maximum radius, fluid inlets through the cheek plates located to communicate with the radial inner end of said vane slots as the vanes pass successively over said ramp means to move said vanes

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outwardly, fluid outlet means from said chamber, one of said cheek plates being further provided with a plurality of passages therethrough communicating with the radial inner end portions of said vane slots while the vanes are passing through the working zone of said pump chamber between the fluid inlet and said point of minimum radius, conduit means leading from said plurality of passages to the pump inlet to thereby relieve the fluid pressure from being trapped beneath the vanes at the inner end of said slots to thus render the same inoperative for pumping fluid, and manually adjustable means positioned adjacent said last mentioned cheek plate and between the said passages and said conduit means to prevent communication therethrough, said manually adjustable means being provided with a plurality of spaced openings therein of varying size progressively increasing in effective area of opening and adapted to register with said passages of said cheek plate so that on adjustment of said means on opening will be brought to register first with a passage in the cheek plate when the vanes are contacting the ring surface of maximum radius and thereafter to progressively and selectively bring more of said openings into register with said cheek plate passages throughout substantially the entire pumping chamber to thereby vary as desired the point at which effective pumping action will begin in said chamber and hence to vary the delivery of said pump.

2. A fluid pump comprising a pair of cheek plates having a cam ring clamped therebetween and providing a chamber, a rotor in said chamber and comprising a disc having a plurality of radially arranged slots in its periphery with vanes slidably carried therein and contacting the inner surface of said ring, a fluid inlet to said chamber and to the intervane spaces therein, the said inner surface of said ring being in the form of a spiral for the major portion of its surface with the maximum radius portion of said spiral being adjacent said fluid inlet and with its radius decreasing in the direction of rotation of said rotor to a minimum radius portion at a point just short of said fluid inlet and ramp means connecting the surface of said last mentioned point and the surface at the point of maximum radius, fluid inlets through the cheek plates located to communicate with the radial inner end of said vane slots as the vanes pass successively over said ramp means to move said vanes outwardly, fluid outlet means from said chamber, one of said cheek plates being further provided with a plurality of passages therethrough communicating with the radial inner end portions of said vane slots while the vanes are passing through the working zone of said pump chamber between the fluid inlet and said point of minimum radius, conduit means leading from said plurality of passages to the pump inlet to thereby relieve the fluid pressure from being trapped beneath the vanes at the inner end of said slots to thus render the same inoperative for pumping fluid, valve means controlling communication between said passages and said conduit means, said valve means comprising a rotatable ring provided with a plurality of spaced openings therein for varying size and arranged to register with said passages of said cheek plate, the openings being of progressively increasing area so that rotation of said ring will open and increasing number of said passages in progressive succession beginning with a passage in the cheek plate at a point where the vanes are contacting the ring surface of maximum radius and thereafter opening in progressive fashion said passages throughout the balance of the pumping chamber, and means for rotating said rotatable ring to thereby vary as desired the point at which effective pumping action will begin in said pump chamber to thereby vary the delivery of said pump.

3. The subject matter of claim 1 wherein said fluid outlet means comprises radially extending passageways through said rotor from said pumping chamber inwardly toward the axis of said rotor and communicating with

an axially disposed passage leading to the pump outlet.

4. The subject matter of claim 1 wherein said fluid outlet means from said chamber includes valve means opening at a predetermined fluid pressure.

5. The subject matter of claim 1 wherein each vane slot in the rotor is provided with a passageway from its radially inner end leading to the intervane space ahead of the vane.

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