May 8, 1962 HIROSHI UCHIDA 3,033,047

VARIABLE DISCHARGE MECHANISM OF AN AXIAL TYPE PLUNGER PUMP

Filed Jan. 6, 1960

FIG. 1.

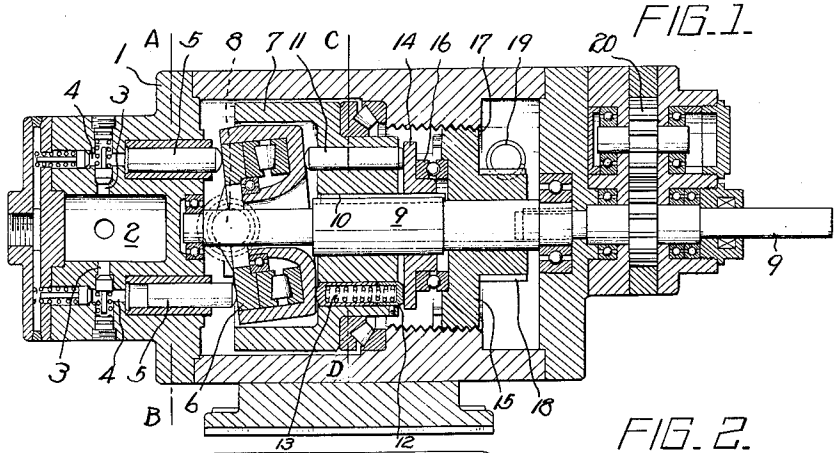


FIG. 2.

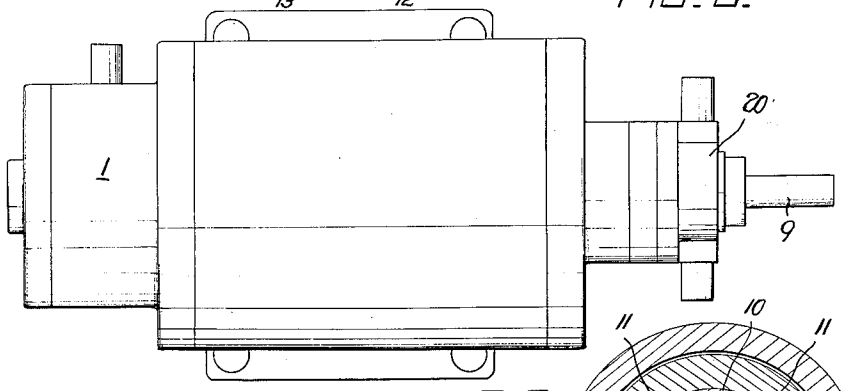


FIG. 3.

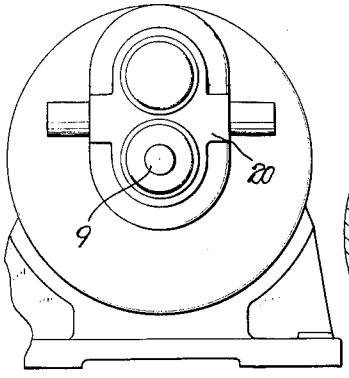


FIG. 4

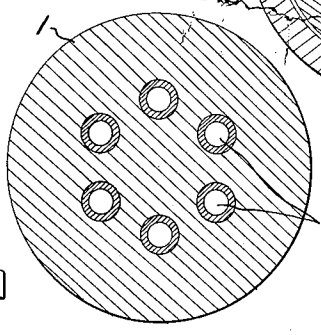
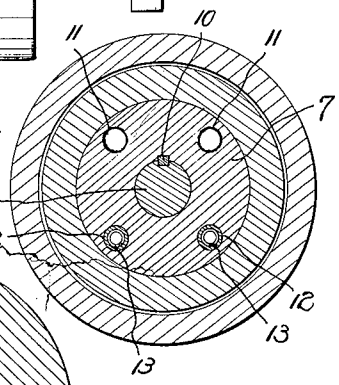


FIG. 5.



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VARIABLE DISCHARGE MECHANISM OF AN AXIAL TYPE PLUNGER PUMP

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4 Claims. (Cl. 74—60)

The present invention relates to variable discharge mechanisms and more particularly to axial-type plunger pumps having a rotary cam with an inclined surface actuating pump plunger successively in axial direction in their respective cylinder bores.

Plunger pumps of the stationary cylinder block type having several plungers and cylinders with suction and delivery valves are well known for use as constant volume discharge pumps.

In this type of pump, pumping action is provided by a rotary cam having an inclined surface moving the plungers to and fro in their cylinders. In other type of pumps having a rotary cylinder block with plungers reciprocating in their cylinder bores and a stationary cam for actuating the plungers, provision is made to vary the discharge by controlling the inclination of the cam, but adjustment of a rotary cam is accompanied by difficulty of simultaneously adjusting the actuating mechanisms of the cam.

An object of this invention is to obtain a very simple and practical mechanism for varying the discharge of a pump of the above type by adjusting the strokes of plungers controlling the inclination of the rotary cam surface.

The accompanying drawing illustrates a preferred form of this invention in which:

FIG. 1 is a longitudinal section of a pump having a variable discharge mechanism according to this invention;

FIG. 2 is a plan view of the same;

FIG. 3 is an end view of the same;

FIG. 4 is a sectional view on line A—B of FIG. 1; and

FIG. 5 is a sectional view on the line C—D of FIG. 1.

Referring to the drawing, 1 designates a cylinder block having a suction chamber 2 communicating through radial suction paths 3 and axial delivery paths 4 to cylinders having axial plungers 5 therein. The plungers are adapted for reciprocating movements in the cylinders bored in the cylinder block 1 and are held in contact with the inclined surface of a cam 6.

The cam 6 is pivoted on the cam case 7 by a pin 8 so that the cam may be turned about the pin 8 to adjust the inclination of the cam surface. The cam case 7 is mounted on the shaft 9 by a key 10 so that the cam is rotatable with the shaft but slidable along the shaft. The back face of the cam 6 is kept in contact with a pair of push rods 11 which are movable in the axial direction and with a pair of retaining rods 12 yieldingly mounted by a spring 13 in the cam case 7.

The other ends of the push rods 11 and the retaining rods 12 projecting from the back surface of the cam case 7 are held in contact with a thrust disc 14 mounted on the shaft 9 by the key 10 so that it may slide along the shaft and turn with the shaft. A threaded disc 15 is loosely mounted on the shaft 9 and is held in contact with the thrust disc 14 by means of a thrust bearing 16. The threaded disc 15 is in engagement with the nut 17 formed on or fixed to the casing and may be moved along the shaft 9 by the engagement of a gear 18 formed on or fixed to the screwed disc 15 and a worm or rack 19 which may be controlled from the outside. 20 shows a gear pump or other suitable pump to deliver a pressure fluid to the suction chamber 2 for pressing the plungers against the cam surface and maintaining contact between them.

As the pump shaft 9 is rotated, the gear pump 20 is

operated for delivering pressure fluid to the suction chamber 2 in the cylinder block 1. At the same time, the cam 6 and the cam case 7 turn, thus giving the plungers suction and delivery strokes successively due to the inclination of the rotary cam surface.

For varying the discharge, the controlling worm is actuated. Then the gear 18 and the disc 15 formed integrally with the gear are rotated and the disc 15 moves in the axial direction along the shaft 9 due to the engagement of the disc with the nut 17. This pushes the thrust disc 14 through the intermediary of thrust bearing 16. The pair of push rods 11, accordingly, are pushed forward against the cam 6 through the cam case 7, while the other pair of retaining rods 12 retain their original position due to the yielding of the spring 13. Thus the cam 6 is moved around the pin 10 varying the inclination of the cam surface.

According to the present invention, in the axial type plunger pump comprising a stationary cylinder block, plungers reciprocating axially in the cylinders formed in the cylinder block and a rotary cam actuating the plungers successively in their cylinders, the cam is pivoted to the cam case mounted movably on the cam shaft and the inclination of the cam can be adjusted by a pair of push rods in contact both with the cam and the thrust disc mounted movably on the shaft and adjusted by a threaded disc held in engagement with a nut formed on or fixed to the inside of the casing and driven by means of a controlling worm or rack. Thus according to this invention, the discharge of the pump is readily varied even if the pump is running, by adopting very simple mechanism for varying the inclination of a rotary cam.

What is claimed is:

1. Adjustable swash plate apparatus comprising a shaft, a swash plate encircling said shaft, means pivoting said swash plate to said shaft whereby inclination of the swash plate relative to said shaft can be adjusted, displaceable means engaging said swash plate to adjust the inclination of the same relative to said shaft, resilient means engaging the swash plate and yieldably resisting adjustment of the inclination of the same, and control means to control displacement of said displaceable means.

2. Adjustable swash plate apparatus comprising a shaft, a swash plate encircling said shaft, means pivoting said swash plate to said shaft whereby inclination of the swash plate relative to said shaft can be adjusted, a case encircling and housing said swash plate, a rod extending through said case and engaging said swash plate to adjust the inclination of the swash plate relative to said shaft, resilient means engaging the swash plate and yieldably resisting adjustment of the inclination of the same, and threaded members engaging said rod to control displacement thereof.

3. Apparatus as claimed in claim 2, wherein said resilient means includes rods extending through said case and springs engaging the latter said rods and yieldably urging the same against said swash plate.

4. Apparatus as claimed in claim 3, wherein said control means comprises a gear train coupled to said threaded members to control the same.

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