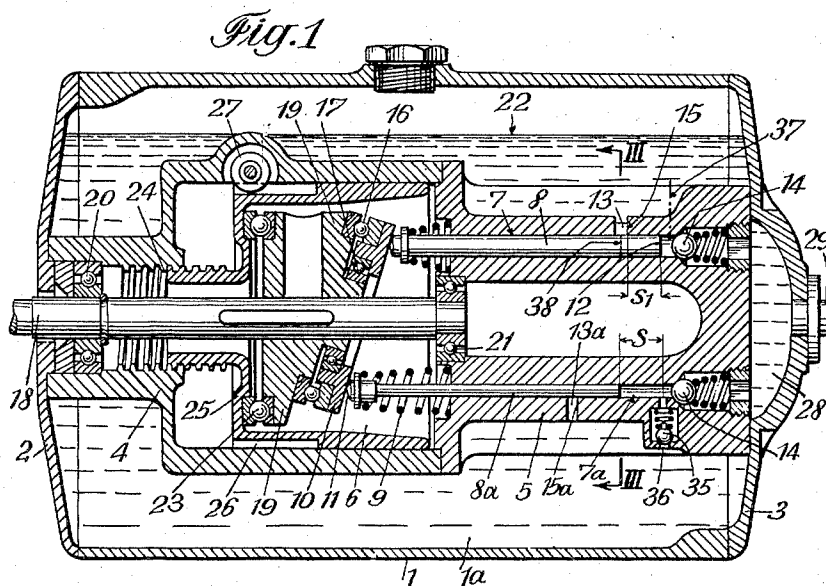
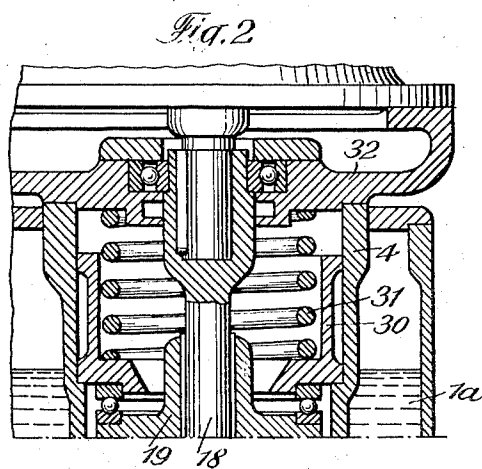
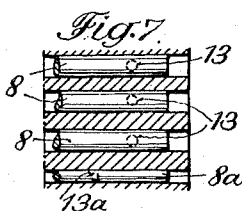
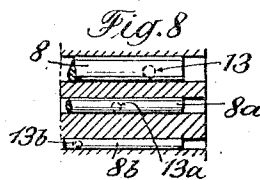
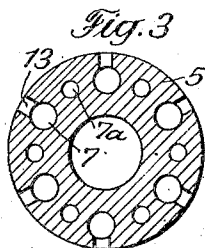
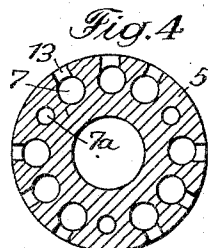
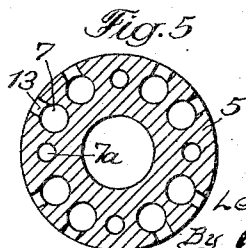


March 23, 1954

L. P. WIDMER
EXPANSIBLE-CHAMBER AND POSITIVE-DISPLACEMENT
TYPE PUMP OF VARIABLE CAPACITY
Filed Dec. 1, 1949

2,672,819



INVENTOR:

Leo Peter Widmer
By Ormon, Jackson,
Bottcher & Diener
ATTYS.

UNITED STATES PATENT OFFICE

2,672,819

EXPANSIBLE-CHAMBER AND POSITIVE-
DISPLACEMENT TYPE PUMP OF VARIABLE CAPACITY

Leo Peter Widmer, Winterthur, Switzerland, assignor to Schweizerische Lokomotiv- und Maschinenfabrik, Winterthur, Switzerland

Application December 1, 1949, Serial No. 130,384

Claims priority, application Switzerland
December 31, 1948

10. Claims. (Cl. 103—38)

1

My present invention generally relates to expandable chamber and positive-displacement type pumps of variable capacity, having a plurality of axially disposed pistons reciprocating in multiple annularly-disposed stationary cylinders, and which are driven through a wabblers plate of constant inclination. In particular, my invention relates to improvements in pumps of the type indicated, in which an axial displacement of the wabblers plate together with the pistons relative to control ports provided on the cylinders, gives origin to a change of the effective piston stroke and, thus, to a change in the pump delivery.

Such pumps permit to vary the capacity from a maximum as defined by their dimensions and rotary speed, down to zero. When, e. g., the drive motor is designed for producing a pressure of 200 atmospheres at a quarter of its maximum delivery, the pump at a relatively small back-pressure, e. g. 20 atm, is readily capable for maximum oil delivery, whereby, however, the motor power is no longer fully utilized, as will be readily appreciated. If, in known pumps of the type indicated, a greater ratio between maximum and minimum delivery is desired, the structural volume of the entire pump has to be increased, whereby the motor power and the pump structure again are not fully utilized at maximum delivery.

My present invention permits to eliminate the said drawback of known pumps of the type indicated. For such purpose, the path of axial displacement of the wabblers plate is made longer than the minimum effective piston stroke, and at least one series of cylinders is provided with control ports in such position that, when the wabblers plate is displaced from the cylinders through a distance which is slightly greater than the effective piston stroke, and at the inner dead-center position of the appurtenant pistons (i. e. the dead-center position remote from the wabblers plate), the piston control ports are at least partially uncovered so that said particular pistons no longer deliver, while the pistons of the remaining cylinders still deliver liquid at said position of the wabblers plate.

Such arrangement according to my present invention permits to obtain with pumps having the structural volume of the known type of construction, a much greater delivery at low pressure so that the ratio of delivery at maximum pressure to that at minimum pressure may be increased to 1:6 up to 1:8 or more as compared with 1:3 or 1:4 in known constructions.

Various forms of my present invention are

2

shown by way of example in the accompanying drawing, in which—

Fig. 1 shows a horizontal pump in longitudinal section;

Fig. 2 a modification of a portion of the pump, but with vertically disposed axis;

Fig. 3 a cross-section through the pump cylinders on the line III—III of Fig. 1;

Figs. 4 and 5 show a cross-section through the cylinders of two modifications; and

Figs. 6–8 show schematically the arrangement of the control ports for various modifications in development.

In Fig. 1, an inner casing 4 and a cylinder block 5 are located in the outer pump casing 1 which is closed off through the two covers 2 and 3. The block 5 comprises twelve cylinders, i. e. an even number, of which six cylinders 7 have a large bore, and six cylinders 7a a smaller bore. All the said cylinders are annularly disposed about a drive shaft 18, as shown in Fig. 3. The said bores extend in parallel relation to shaft 18, and six large-diameter pistons 8 as well as six small-diameter pistons 8a operate therein. The said pistons are pressed through springs 9 against a wabblers plate 10, abutting against the latter along a generatrix of their conically tapered heads 11.

Lateral control ports 13 and 13a open into the cylinder bores 7 and 7a respectively, and establish communication between said cylinders and an annular space 1a inside the outer casing 1. The space 1a is filled with the liquid to be delivered up to a level 22. The right-hand ends of the cylinder bores are closed off from the delivery chamber 28 through the spring-loaded balls 14 which serve as check valves. The control ports 13a in the cylinders 7a are spaced farther from the valves 14 than the ports 13 in the cylinders 7. The cylinders 7a are provided with a suction valve 35 each so that liquid may flow from space 1a into the cylinders 7a through ports 36. The ports 13 are so arranged that the pistons 8 at each revolution of a follower 19 occupy the position 38 shown by a dotted line in Fig. 1, and thus partly uncover the ports 13.

The wabblers plate 10 through ball bearings 16 and 17 is rotatably mounted on follower 19 which is keyed longitudinally displaceable to drive shaft 18. The latter is mounted in ball bearings 20 and 21 on the inner casing 4 and on the cylinder block 5. The follower 19 through ball bearings 23 abuts against an adjusting drum 25 which is rotatably or rather threadably mounted in the inner casing 4 and is axially displaceable through the threads

3

24 provided thereon. For the purpose of axially displacing the drum 25, the latter on its circumference carries a crown gear 26 with which a worm 27 meshes which is rotatably mounted in the inner casing 4.

The pump, in the position shown of the adjusting drum 25, operates so that when shaft 18 rotates, the large-diameter pistons 8 suck liquid through the ports 13, and the small-diameter pistons 8a suck through the ports 13a, and all the pistons deliver liquid through the pressure valves 14 into the pressure chamber 28 which through a pipe 29 may be connected to any prime mover. The effective stroke of the large-diameter pistons 8 then equals the distance s_1 in that the piston end-faces 12 on over-running the control edges 15 cannot force liquid back into the space 1a. The delivery stroke of the small-diameter pistons 8a, however, equals the entire piston stroke s . When drum 25 is displaced to the left, the delivery stroke s_1 of the large-diameter pistons 8 decreases, while that of the small-diameter pistons 8a remains constant, since the latter suck through the valves 35 and not through the control ports 13a. When such displacement of drum 25 is only slightly greater than the distance s_1 , which is the maximum effective delivery stroke of the large-diameter pistons, then the delivery of the latter is reduced to zero, while the small-diameter pistons still deliver the same quantity as in the position for maximum delivery. Only when the drum 25 is still further displaced to the left, the small-diameter pistons also will deliver less when they in their outer dead-center position uncover the ports 13a so that part of the liquid sucked into the cylinders is returned through the ports 13a into space 1a. The position of the control ports 13, 13a in accordance with the form of invention shown in Figs. 1 and 3, for the sake of clarity is also shown in Fig. 6 which illustrates a developed cylindrical section through all the piston axes. In Fig. 6, the offset of the said ports is readily visible.

The advantage of the pump shown is that, in the case of pumps for which at low pressure a maximum delivery and at high pressure a minimum delivery is required, a very great delivery can be attained at low pressure by means of all the pistons, while at high pressure the large-diameter pistons may be entirely cut out so that the latter no longer load the wobbler plate 10 and thus the ball bearings 16 and 23 which therefore, have to be fitted only to the pressure of the small-diameter pistons.

In the form shown in Fig. 2, the adjusting drum 30 is not threadedly engaged, but supported through a spring 31 which in turn abuts against a cover 32 fixed to the casing 4. When the discharge pressure rises, the drum 30 is pushed upwardly through the liquid pressure acting onto the pistons, against the pressure of spring 31, so as to automatically reduce the delivery.

Instead of providing alternate large- and small-bore cylinders (in the case of twelve cylinders, e. g. six large- and six small-bore cylinders), there may be disposed nine large-bore cylinders 7 and only three small-bore cylinders 7a at a uniform spacing, as shown in Fig. 4. In similar manner, eight large-bore and four small-bore cylinders may be provided, as shown in Fig. 5 for example.

In Fig. 7, the arrangement of the control ports 13, 13a of the large- and small-bore cylinders 7 and 7a respectively, is shown in development for

4

the case of the disposition shown in Fig. 4, for a group of one small and three large pistons.

Instead of incorporating pistons of two sizes, there may be provided three groups of pistons 7, 7a, 7b of different diameters, and the control ports 13, 13a, 13b may be staggered, as shown in development in Fig. 8. In such arrangement also, the delivery decreases when the drum 25 is displaced to the left, and the ratio between maximum and minimum delivery may be made very great. In such arrangement, there may be provided, e. g. in a twelve-cylinder pump, four large, four intermediate, and four small pistons.

In the form of invention shown in Fig. 1, the large-bore cylinders may be equipped at 37 with a suction valve 35, similarly as the small-bore cylinders 7a. Such provision permits to still further increase the delivery, in the outer-most position of the adjustment drum toward the cylinders, since in such position liquid no longer may flow through the control ports 13 back into space 1a when the said ports are displaced somewhat toward the left.

In the small-bore cylinders 7a, the control ports 13a may be omitted, provided that the liquid delivered at high pressure always will be consumed by the prime movers or will be thrown off through a safety valve which is set for this high pressure.

The ports 13a in the small-bore cylinders 7a of Fig. 1 may be disposed somewhat farther to the right so as to be uncovered by the pistons 8a before the large-diameter pistons 8 entirely cease to deliver.

It further will be readily appreciated by anyone skilled in the art that the position of the control ports depends on the position of the piston end-face 12 at dead-centers. If, therefore, one group of pistons are made shorter, the position of the control ports in the respective cylinders has to be correspondingly changed, i. e. in the case of shorter pistons the said ports have to be placed further to the left.

What I claim as new and desire to secure by Letters Patent, is:

1. A pump comprising a stationary cylinder block provided with at least two groups of parallel pump cylinder bores, a plurality of pump plungers respectively reciprocable in said cylinder bores and having the outer ends thereof extending to the exterior of said cylinder block, a rotatably mounted wobbler plate coaxing with the outer ends of said pump plungers exteriorly of said cylinder block, said wobbler-plate being mounted for slidable displacement in the direction of the axes of said pump plungers, adjusting means operatively associated with said wobbler-plate and operable slidably to displace said wobbler plate in the direction of the axes of said pump plungers towards and away from said cylinder block, resilient means biasing said pump plungers into operative engagement with the wobbler plate in all positions of slidable displacement of the plate, each of said pump cylinder bores having inlet and outlet control ports, the cylinder bores of one of said groups of bores having a control port laterally opening into the respective bore, said last-named control port being spaced in the direction toward said wobbler-plate from inner dead center position of the inner plunger end when said wobbler plate is at its innermost position with respect to the cylinder block, the distance between said last-named control port and said inner dead center position of the corresponding plunger inner end being

5

smaller than the axial length of the wobbler plate displacement path, whereby when the wobbler plate is axially moved outwardly from its innermost position through an extent greater than said distance, said last-named control port remains uncovered during the pressure stroke, and at inner dead center position of the plunger, to prevent any delivery by the group of cylinder bores provided with said control port, while the other group of cylinder bores continues to deliver.

2. A pump as set out in claim 1, in which said one group of cylinder bores are of larger diameter than the remaining cylinders.

3. A pump as set out in claim 1, in which two such groups of cylinders are provided, the pistons of one group ceasing earlier to deliver than the pistons of the other group as the wobbler-plate is slidably moved away from the cylinders.

4. A pump as set out in claim 1, in which the said control port of each of said one group of cylinder bores constitutes the sole inlet port to the respective cylinder bore.

5. A pump as set out in claim 1, in which the said control port of each of said one group of cylinder bores constitutes an inlet port to the respective cylinder bore, and wherein each of said one group of cylinder bores also includes a valved inlet port spaced from the said control port in the direction opposite said wobbler-plate.

6. A pump as set out in claim 1, in which the said other group of cylinders only each include a valved inlet port adjacent the end thereof opposite said wobbler-plate.

7. A pump as set out in claim 1, in which an even number of cylinders are provided, said one group of cylinders comprising one half of all the cylinders and being provided with bores of greater diameter than the remaining cylinders, with the large-bore and small-bore cylinders alternating in annular arrangement about the pump axis.

8. A pump comprising a stationary cylinder block provided with two groups of parallel pump cylinder bores, said bores of one group having a relatively large diameter, and said bores of the other group having a relatively small diameter, pump plungers reciprocable in said bores and having the outer ends thereof extending to the exterior of said cylinder block, said plungers having a diameter corresponding to that of the respective bores, a rotatably mounted wobbler plate coacting with the outer ends of said pump plungers exteriorly of said cylinder block, said wobbler-plate being mounted for slidable displacement in the direction of the axes of said pump plungers, adjusting means operatively

6

associated with said wobbler-plate and operable slidably to displace said wobbler plate in the direction of the axes of said pump plungers toward and away from said cylinder block, resilient means biasing said pump plungers into operative engagement with the wobbler plate in all positions of slidable displacement of the plate, each of said pump cylinders having inlet and outlet control ports, the cylinder bores of said group of relatively large bores having a control port opening laterally into the respective bores, each of said last-named control ports being spaced in the direction opposite said wobbler-plate from the inner dead center position of the plunger inner end face when said wobbler plate is at its extreme position remote from the cylinder block, the distance between each of said last-named control ports and said inner dead center position of the corresponding plunger inner end face being smaller than the axial length of the wobbler plate displacement path, whereby when the wobbler plate is slidably moved away from the cylinder block through an extent greater than said distance, said last-named control ports of the cylinder bores of larger diameter remain uncovered during the pressure stroke and at the inner dead center position of the plunger to prevent any delivery by the group of cylinder bores of larger diameter, while the group of cylinder bores of smaller diameter continue to deliver.

9. A pump as set out in claim 8, comprising twelve cylinders of which eight are of large bore and four of small bore.

10. A pump as set out in claim 8, comprising twelve cylinders of which nine have large bores and three small bores, the latter being annularly disposed at equal distances from each other about the pump axis.

LEO PETER WIDMER.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,114,565	Kovach	Apr. 19, 1938
2,193,612	Alden	Mar. 12, 1940
2,439,879	Allen	Apr. 20, 1948
2,534,153	Widmer	Dec. 12, 1950
2,578,139	Jones	Dec. 11, 1951
2,578,146	Newton	Dec. 11, 1951

FOREIGN PATENTS

Number	Country	Date
316,885	Germany	1919
867,082	France	1941