Sept. 14, 1954 H. K. LINKS 2,688,924

PISTON PUMP, IN PARTICULAR WITH ECCENTRIC DRIVE

Filed March 8, 1950

Fig. 2

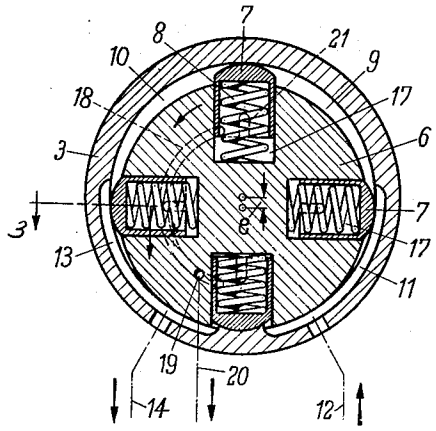
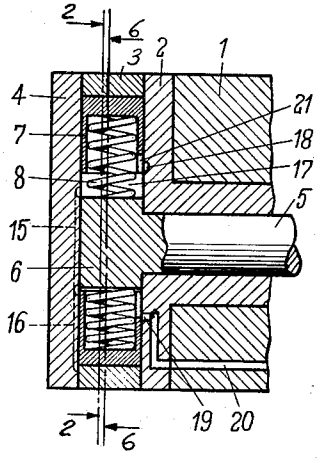


Fig. 1



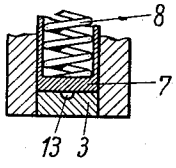


Fig. 3

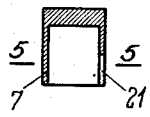


Fig. 4



Fig. 5

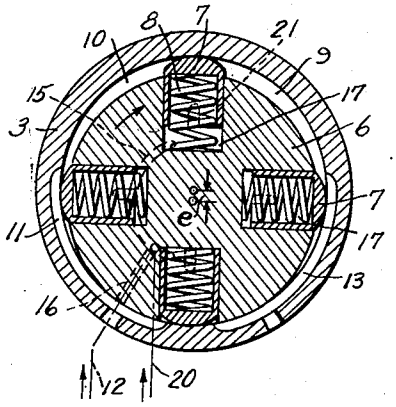


Fig. 6

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Patented Sept. 14, 1954

2,688,924

UNITED STATES PATENT OFFICE

2,688,924

PISTON PUMP, IN PARTICULAR WITH ECCENTRIC DRIVE

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Application March 8, 1950, Serial No. 148,368

Claims priority, application Germany March 8, 1949

7 Claims. (Cl. 103—4)

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The invention relates to a combined piston and vane pump, and has as its object a particularly advantageous construction. It is a purpose of the invention to deliver a hydraulic medium simultaneously to two points of work separated from each other, and under different pressures. In particular the pump may serve simultaneously as a feeding pump for an injection pump for combustion engines and as a delivery pump for the feeding of a hydraulic regulating device of the injection pump. Furthermore the pump strives at achieving a low cost construction and requiring only small space. It is a characteristic of the invention that two sides of the piston of one or more pump pistons serve to deliver different or equal volume of liquid (for instance fuel), whereby the delivery is effected at different places of distribution independently of each other.

Furthermore the invention provides for a piston pump in eccentric construction with a sickle-shaped pump space and a pump piston which rotates relatively to the case and eccentrically to the pump shaft, whereby in addition to the sickle shaped pump space, which is subdivided into separate pump spaces of variable size, simultaneously the inner ends of the pump pistons are utilized as displacement elements.

Both pump spaces can be connected with each other at the suction side and can convey on the pressure side under different delivery pressure, while for example the sickle shaped pump space (for instance as a delivery pump for an injection pump) conveys under a lower pressure than the interior pump space (which for instance supplies a hydraulic regulating device of the injection pump). The valving of the interior pump spaces which rotate relatively to the pump case is executed in a purposeful manner by valve grooves, which are arranged in segmental shape in the pump case, and which can be arranged on different radial distances from the axis of the pump shaft and on different frontal sides of the pump case bordering the interior pump spaces. The pistons, for instance, are shaped as square pistons guided between the frontal walls of the case, which are formed as separated covers.

Further characteristics of the invention refer to a particularly effective design of the pump with reference to manufacturing and assembly, in particular also in connection with its utilization as a delivery and regulating pump for fuel injection pumps. However, the pump constructed in accordance with the invention can also be used for various other purposes, for instance, for pressure amplifiers or other hydraulic aggregates.

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Further objects and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows for purposes of illustration only one preferred embodiment and wherein:

Figure 1 shows a longitudinal section through the pump, which is for example built into an injection pump aggregate,

Figure 2 shows a vertical cross-section along the line 2—2 of Fig. 1,

Figure 3 shows a partial section along the line 3—3 of Figure 2,

Figure 4 shows a longitudinal section through one of the pistons and

Figure 5 shows a cross-section through same along the line 5—5 of Figure 4.

Figure 6 shows a cross sectional view along line 6—6 of Figure 1.

The pump serving for instance as a feeding and regulating pump for a fuel injection pump, working with fuel as a feeding fluid comprises a case which is applied to the end of the fuel injection pump case 1 and consists of the three parts 2, 3 and 4, which are bolted with each other in a disk or ring type manner. Part 2 of the case is centered in the injection pump case and serves as a bearing for pump shaft 5, which for example can be coupled directly to the camshaft of the injection pump by a clutch. Part 3 of the case is arranged eccentrically to the shaft 5 respectively to the driving disk 6, while part 4 of the case serves as a frontal cover plate. The driving disk 6, which serves as an eccentric driving link, contains four pump pistons 7, which are arranged radially, secured against turning, constructed square like sliding shoes, and which can slide between the frontal walls of the case parts 2 and 4 in corresponding slot shaped cavities of the disk 6 forming the "working spaces" for the pump pistons, and are under the action of springs 8. By the latter the rotating pistons 7 are pressed against the inside wall of the case ring 3 of the pump, which is arranged eccentrically to the driving disk 6 respectively to the shaft 5, whereby a sickle shaped space is formed between the driving or eccentric disc 6 and the case ring 3. This space is subdivided into a suction half 9 and a pressure half 10 by the pistons.

The suction half 9 is thereby connected through a groove 11 to a suction pipe 12 indicated schematically by a dotted line, the pressure half 10 through a groove 13 to a delivery pipe leading for example through a filter to the fuel injection pump to the pressure pipe 14 indicated schemati-

cally by a dotted line. The direction of rotation of the pump is for example taken as a counterclockwise direction in Figure 2, as shown by the arrow.

Furthermore a segmentally arranged groove 15 is provided concentric to the axis of the shaft 5 in the disk shaped case part 4. This groove is shown as connected with the suction pipe 12 respectively with the circumference groove 11 for the outside pump space 9 through a radial groove 16. The groove 15 is thereby located on such a radius to the axis of the driving disk 6 that it is in connection with the interior pump spaces, if those are moving on the suction side of the pump (in Figure 2 the right half of the pump). The arrangement can thereby be made in such a manner that the groove 15 is only gradually opened starting from the inside piston dead center of the piston 7 (at the bottom in Figure 2).

A valving groove 18 arranged in a corresponding segmental manner leads at 19 through a passage 20, for instance, to the hydraulic regulating device of the fuel injection pump. In contrast to the control groove 15 the valving groove 18 is arranged on a larger radius and is, for example, aligned with slots 21 in the piston 7 in such a manner that the connection between the appropriate slot 21 and the valving groove 18 is closed, when the pistons pass over from the outside to the inside dead center (left half of the pump in Figure 2).

The manner of operation of the pump is the following: When the driving disk is turning in a counterclockwise direction, the fuel is sucked in through the pipe 12 for example from the fuel container, whereby part of it passes through the circumferential groove 11 to the outside suction space 9 and the balance passes through the grooves 16 and 15 to the inside pump spaces 17. As the disk keeps turning, the fuel, which is separated in the sickle shaped outside pump space 9 and 10, is delivered through the circumferential groove 13 and the pipe 14 to the suction space of the fuel injection pump respectively to the individual injection pump cylinders. In contrast thereto the fuel which is separated in the inside pump spaces 17, is delivered through the valving groove 18 and the passage 20 to another place where it is required, for instance, for the regulating device of the injection pump, after passing the outer dead center position, as shown in the upper part of the drawing. The arrangement can thereby be made in such a manner that the pipes 14 and 20 are under considerably different delivery pressure. While, for instance, the pressure of the fuel conveyed to the injection pump in the pipe 14 is kept relatively low—for example only two atmospheres—the pressure of the fuel serving for regulating can be considerably higher and can amount to about ten atmospheres as a medium, whereby the pressure may also be dependent on the speed of rotation of the engine and thereby on the speed of rotation of the pump shaft 5.

Through the arrangement of the segmentally shaped valving grooves 15 respectively 18 which are located along different radii and on different frontal sides of the pump an effective sealing of the channels relative to each other is achieved by simplest means. However, the valving can also be effected in a different manner, if necessary. Futhermore the pump spaces 9 and 17 can be joined to different suction pipes. Also the pressure spaces 10 and 17 of the pump can supply the same pipe or point of work, if necessary.

The invention is not restricted to the described example of construction, but can be varied in any form within the scope of the individual ideas of the invention.

What I claim is:

1. Eccentric piston pump comprising a pump case, a generally cylindrical cavity therein, and a rotor arranged eccentrically in said cavity, the rotor being surrounded on both frontal sides by the pump case, and forms on its outside with the pump case a sickle shaped outside pump space, at least one work space in the rotor leading to the outside pump space, at least one pump piston slidable in said work space and provided with a skirt and a valve opening in the piston wall, whereby an interior pump space is formed in the said work space by the piston, driving means for the pump so arranged that the rotor rotates together with the work space and the pump piston relative to the pump case, and the pump piston thereby carries out a reciprocating motion in radial direction along the interior surface of the pump case and subdivides the sickle shaped outside pump space into two separate pump spaces of changing size, one suction passage and one delivery passage each for the outside and inside pump spaces, which enter into the pump spaces in such a manner that they are connected with the pump spaces successively and alternately, during rotation of the rotor and pump pistons, one segmental channel being provided in the pump case in the interior pump space on each of the two frontal sides of said cavity, said channels being closely adjacent each other as viewed normal to the axis of rotation, whereby the closing of one of said channels by said skirt occurs substantially simultaneously with the opening of the other of said channels by said valve opening to provide for a substantially continuous pumping action, one of said channels being connected with the suction passage and the other with the delivery passage for the interior pump space and being covered and uncovered alternately by the piston in such a manner that during the outward stroke of the piston the channel is connected with the suction passage and during the inward stroke of the piston the channel is connected with the delivery passage.

2. Piston pump comprising a pump housing, a rotor therein which rotates eccentrically to the housing, at least one radial working space in the rotor, a piston movable inwardly and outwardly in said radial working space and provided with a skirt and a valve opening in the piston wall, the inner end of the working space forming a pump chamber, the pump housing being formed with two segment-shaped concentric valving grooves which are valved by the piston, a suction conduit, a delivery conduit, the said pump chamber being alternately connected by one valving groove with the suction conduit and by the other valving groove with the delivery conduit, the two valving grooves each beginning and ending closely adjacent each other in the dead center positions of the pistons, as viewed normal to the axis of rotation and lying on different radii, whereby the closing of one of said grooves by said skirt occurs substantially simultaneously with the opening of the other of said grooves by said opening to provide for substantially continuous pump action.

3. Piston pump comprising a pump housing, a rotor therein which rotates eccentrically with respect to the housing, at least one radial work

space in the rotor, a piston of rectangular cross-section movable inwards and outwards in said work space, separate pump chambers at the inner and outer ends of the piston, one of the axially opposed sides of the piston being formed with a recess connecting with the inner pump chamber, a suction conduit for each pump chamber and a separate delivery conduit for each pump chamber, the inner pump chamber being alternately connected by two valving grooves with a suction conduit and a pressure conduit, the two valving grooves each beginning and ending in the region of the dead center positions of the piston and lying on different radii and one of them being valved by the inner edge of the piston while the other is valved by said recess in the piston.

4. Eccentric piston pump comprising a pump case, a generally cylindrical cavity therein, and a rotor arranged eccentrically in said cavity, the rotor being surrounded on both frontal sides by the pump case, a sickle shaped outside pump space being formed between the rotor and the interior cylindrical wall of the pump case, at least one generally radial work space in the rotor, a pump piston slidable in said work space, whereby an interior pump space is formed in the said work space by the piston, a recess at the inner end of said piston connecting with said interior pump space, driving means for the pump to rotate the rotor together with its work space and the pump piston relative to the pump case whereby the pump piston is caused to reciprocate in radial direction by the said interior cylindrical surface of the pump case and subdivides the sickle-shaped outside pump space into two separate pump spaces of changing size, one suction conduit and one delivery conduit each for the outside and interior pump spaces, which connect with the pump spaces in such a manner that they are connected with the pump spaces successively and alternately during rotation of the rotor and pump pistons, one segmental channel being provided in the pump case in the region of the interior pump space on each of the two frontal sides of said cavity, one of which is connected with the suction conduit and the other with the delivery conduit for the interior pump space and which are covered and uncovered alternately by the piston in such a manner that during the outward stroke of the piston the channel is connected with the suction conduit and during the inward stroke of the piston the channel is connected with the delivery conduit in which connection the two concentrically arranged channels lie at different radii and are covered and uncovered alternately by the piston in such a manner that during the outward stroke of the piston the channel of smaller radius and which is connected with the suction conduit and valved by the inner edge of the piston is placed in communication with the pump chamber while during the inward stroke of the piston the channel of larger radius and which is connected with the delivery conduit and valved by a slot in the side of the piston is connected with the pump chamber.

5. Piston pump comprising a pump housing, a rotor which rotates relative to the housing, at least one working space in the rotor, a piston movable inwardly and outwardly in said working space and provided with a valve opening in the piston wall, the inner end of the working

space forming a pump chamber, the pump housing being formed with two segment-shaped concentric valving grooves which are valved by the piston, a suction conduit, a delivery conduit, the said pump chamber being alternately connected by one valving groove with the suction line and by the other valving groove with the delivery line, the two valving grooves each beginning and ending closely adjacent each other in the dead center positions of the pistons, as viewed normal to the axis of rotation, and lying on opposite sides of the piston, whereby the closing of one of said grooves by the piston wall occurs substantially simultaneously with the opening of the other of said grooves by said valve opening to provide for substantially continuous pump action.

6. Piston pump comprising a pump housing, a rotor therein which rotates eccentrically to the housing, at least one radial working space in the rotor, a piston movable inwardly and outwardly in said radial working space, the inner end of the working space forming a pump chamber, the pump housing being formed with two segment-shaped concentric valving grooves which are valved by the piston, a suction conduit, a delivery conduit, the said pump chamber being alternately connected by one valving groove with the suction line and by the other valving groove with the delivery line, the two valving grooves each beginning and ending in the region of the dead center positions of the pistons and lying on different radii, said piston being of rectangular cross-section, one of the axially opposed sides of the piston being formed with a recess connecting with the pump chamber, and the valving groove lying at the larger radius being valved through said recess in the piston.

7. Piston pump comprising a pump housing, a rotor therein which rotates eccentrically to the housing, at least one radial working space in the rotor, a piston movable inwardly and outwardly in said radial working space, the inner end of the working space forming a pump chamber, the pump housing being formed with two segment-shaped concentric valving grooves which are valved by the piston, a suction conduit, a delivery conduit, the said pump chamber being alternately connected by one valving groove with the suction line and by the other valving groove with the delivery line, the two valving grooves each beginning and ending in the region of the dead center positions of the pistons and lying on different radii, said two valving grooves lying on different sides of the rotor, said piston being of rectangular cross-section, with one of the axially opposed sides of the piston being formed with a recess connecting with the pump chamber, and the valving groove lying at the larger radius being valves through said recess in the piston.

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