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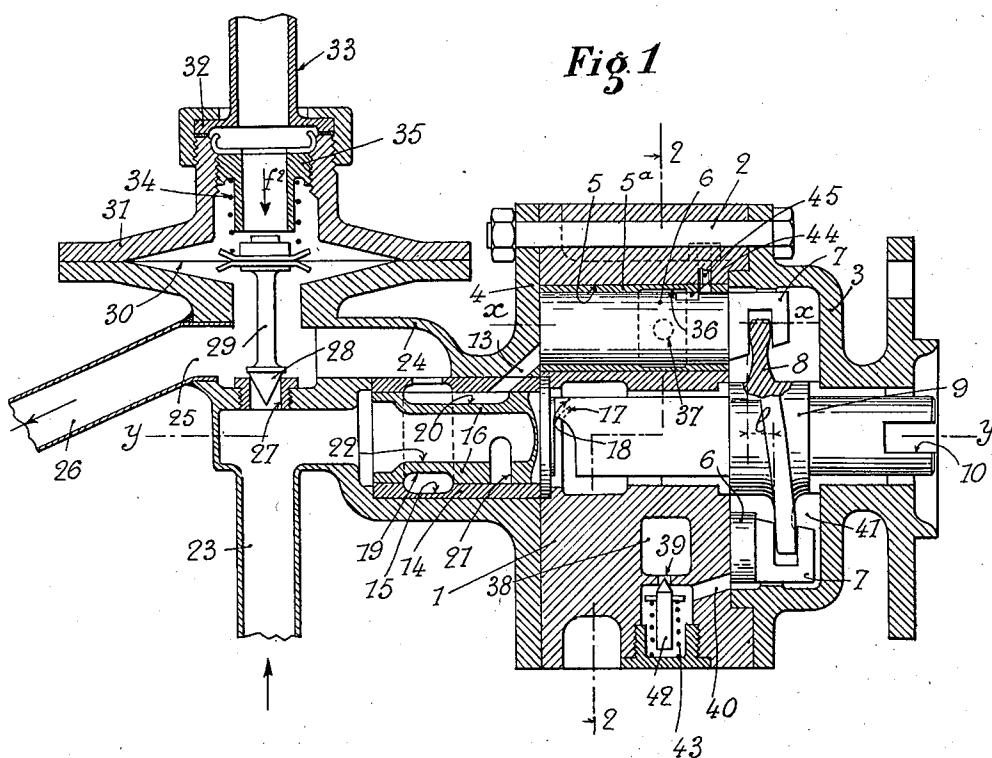
J. AIVAZ

2,013,484

PUMP

Filed Nov. 29, 1932

3 Sheets-Sheet 1



J. AIVAZ
INVENTOR

By: *Markos & Clerk*
Attys.

Sept. 3, 1935.

J. AIVAZ

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Fig. 2

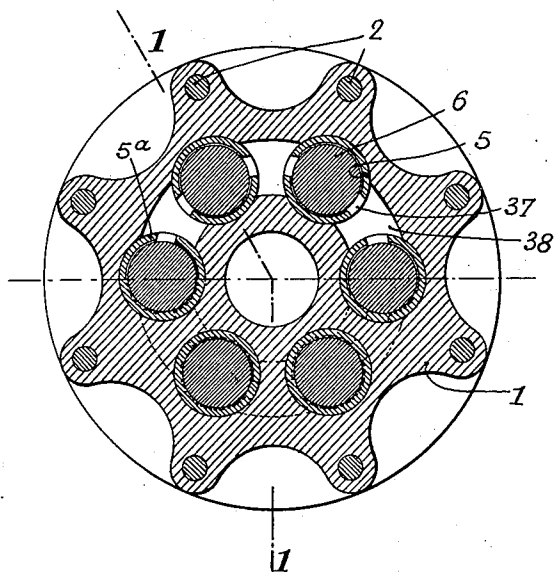


Fig. 3

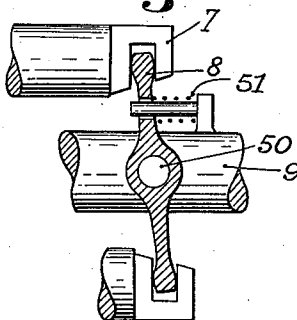


Fig. 4

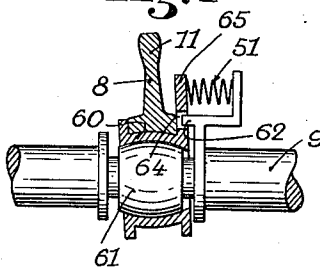


Fig. 5

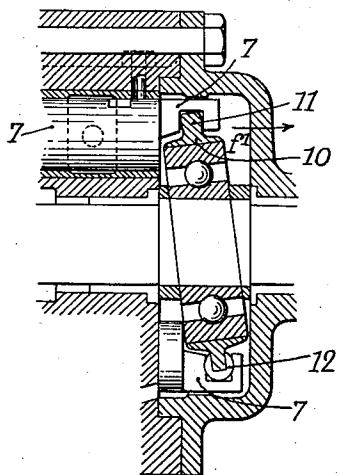
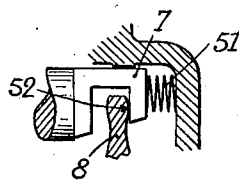


Fig. 6



J. AIVAZ
INVENTOR

By: Marks & Clerk
Attys.

Sept. 3, 1935.

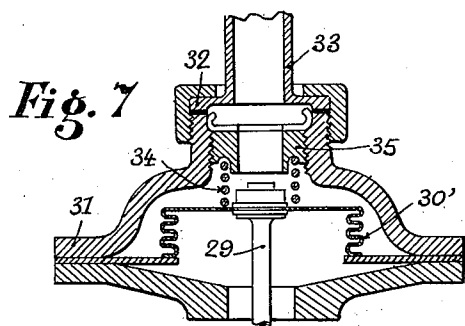
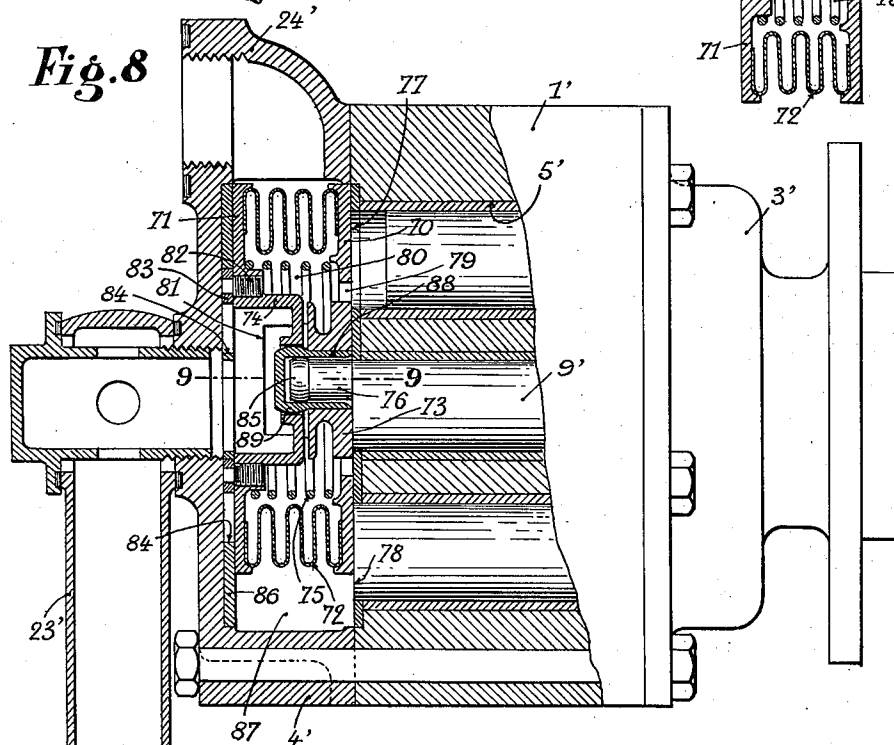
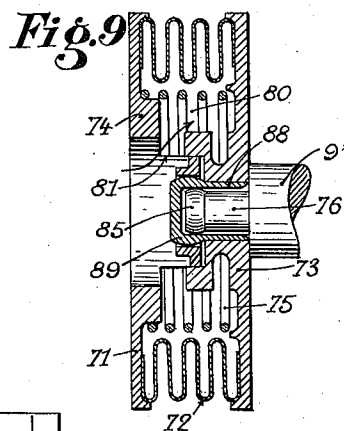
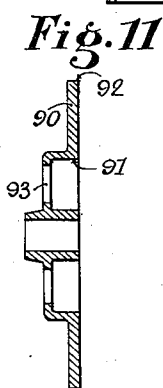
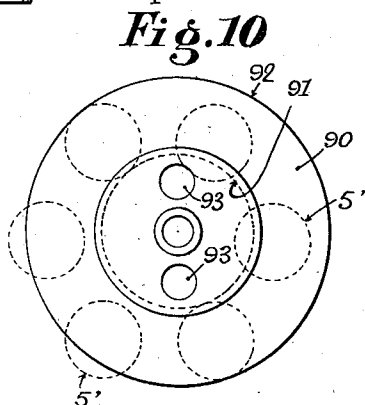
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3 Sheets-Sheet 3



J. Aivaz

INVENTOR

By: Marks & Clerk
Attys.

UNITED STATES PATENT OFFICE

2,013,484

PUMP

Jacques Aivaz, Paris, France

Application November 29, 1932, Serial No. 644,887

In France December 7, 1931

1 Claim. (Cl. 103—173)

The present invention relates to a pump for liquids, which is chiefly adapted for the supply of fuel to internal combustion engines.

The said pump is principally characterized by the fact that it comprises, in combination, a certain number of pistons movable in parallel cylinders, a device for the positive control of the said pistons in both directions of their movement, and a single valve device which alternately connects each cylinder with the admission conduit and the delivery conduit.

According to another feature, the device controlling the pistons consists of a cam-disc rotatable on an axis parallel with the axes of the cylinders in which the said pistons operate, and equidistant from the said axes.

In one form of construction, the valve device consists of a single element which is movable in the main casing.

According to another feature of the invention, an annular chamber is provided in each cylinder, and all of the chambers of the different cylinders are in communication with one another, the lubricant being supplied to one of the said chambers by a drop-feed system.

The said drop-feed system may comprise, for example, a recess formed in one of the pistons and so situated that it may be alternately connected with the supply of the lubricant under pressure and with the chamber formed in the corresponding cylinder.

The pressure in the said chambers is maintained at a given value which exceeds the maximum pressure of the fuel or other liquid in the corresponding cylinder, by any suitable discharge system.

Further characteristics as well as the various advantages of the invention will be set forth in the following description.

In the accompanying drawings, which are given solely by way of example:

Fig. 1 is a lengthwise section of a pump in conformity to the invention, on the line I—I of Fig. 2;

Fig. 2 is a cross-section of the same, on the line 2—2 of Fig. 1;

Figs. 3 to 6 are partial sections of modifications of the device controlling the pistons;

Fig. 7 is a detail section showing the use of a metallic bellows;

Fig. 8 is a lengthwise section of a pump, relating to another form of valve device;

Fig. 9 is a partial section of the said valve device, on the line 9—9 of Fig. 8;

Figs. 10 and 11 are respectively a plan view

and a section of a detail modification of the said valve device.

In the form of construction represented in Figs. 1 and 2, the pump, which can be placed in any direction, comprises a metallic mass 1 of cylindrical or other shape, to which are secured, by bolts 2 or otherwise, two caps or end portions 3 and 4.

In the said mass 1 are formed cylindrical recesses or bores 5, whose axes $x-x$ are parallel with one another and are equidistant from the axis $y-y$ of the mass 1. Each cylinder 5 is preferably provided with an internal sleeve 5a. In each sleeve 5a is mounted a piston 6 having a U-shaped head 7, and a cam-disc 8 engages all of the heads 7 at its periphery. The said cam-disc is keyed to a shaft 9 whose axis is $y-y$, and is provided at 10 with a projecting part or like operating device. The said cam 8 has a bent form, in such manner that during one revolution of the shaft 9, it will give each piston 6 an alternate movement on the axis $x-x$ of the cylinder 5, corresponding to an amplitude l .

The said cam may obviously be formed integral with the shaft 9 or may be keyed to the latter, or further, as shown in Fig. 3, it may be pivotally mounted on an axle 50 perpendicular to the axis of rotation of shaft 9 and maintained by one or more springs 51 which bear for instance on the shaft 9 in such manner that when the delivery pressure reaches a given value, such springs will be compressed, and the cam 8 will return to the middle position, thus reducing the suction and delivery strokes and providing a total or partial self-regulation.

In the construction shown in Fig. 4, the cam 8, which does not rotate, is mounted on a bearing brass 60, which is in turn mounted on a partially spherical member 61 provided on the shaft 9. The said brass 60 is rotated by an arm 62 secured to the shaft and engaged in an aperture 64 formed in a flanged part 65 of the said brass. The said flanged part is urged by a spring 51; the brass 60 and its cam 8 will thus oscillate about the centre of the member 61, under the opposing effects of the spring 51 and the reactions of the delivery.

The cam 8 may be further replaced, as shown in Fig. 5, by a ball-bearing having the oblique position; the outer race 10 of the bearing, which is only subjected to an alternate movement of oscillation in the direction of the arrow f^1 , and in the contrary direction, comprises a part 11 at the periphery, which is engaged in the heads 7 of the pistons 6, and this part 11 oscillates in the head 7 after the manner of a rotula, which latter

may also be realized as shown at 12 at the lower part of Fig. 5, and herein the head 7 of the piston may be provided with a bore perpendicular to the axis of the piston and containing the spherical part 12 which is connected with the fixed race of the bearing.

In this arrangement, use may be made of a spring 51 urging towards the cam 8 a shoulder 52 formed on the head 7 of each piston 6 (Fig. 6). Said spring 51 is compressed when the delivery pressure of the pump exceeds a predetermined value.

The fluid control is effected in the following manner. Each cylinder 5 communicates, at the end opposite the head 7 of its piston 6, with a channel 13 (Fig. 1) formed in a cylindrical sleeve 14 mounted in the cap 4; said sleeve further comprises an annular recess 15. In the said sleeve is rotatable a cylindrical valve 16 whose axis is $y-y$, and the valve is rotated by the shaft 9 in any suitable manner, for instance by a projection 17 mounted on the cylinder 16 and engaged in a recess 18 in the corresponding end of the shaft 9.

In the surface portion of the cylinder 16 is an annular groove 19 coinciding with the recess 15 in the sleeve 14, which groove is extended by a recess 20 adjacent the outlet ab of the channels 13 formed in the sleeve 16. The length of the recess 20 is such that it communicates at the same time with the channels 13 of all the cylinders 5 in which the pistons operate on the delivery stroke. In the cylinder 16 is a port 21 by which its surface portion may communicate with a central conduit 22; said port is adapted to coincide with the outlets ab of the channels 13, thus connecting the conduit 22 with the cylinders operating on the admission stroke. The axial conduit 22 is in direct and permanent communication with a conduit 23 by which the liquid fuel is supplied.

The annular recess 15 in the sleeve 14 is in permanent communication, through a channel 24, with a chamber 25 which is in permanent communication with a conduit 26 by which the liquid fuel, or other liquid, is delivered to the place of use.

The said chamber 25 is further connected, by a channel 27, with the admission conduit 23, but in the idle position, said channel 27 is closed by a clack-valve 28 whose stem 29 is rigidly secured to the central part of a flexible diaphragm 30, and thus no guiding is necessary. The diaphragm consists of impermeable fabric, sheet metal or the like, and is held at its outer part between the member 4 and a suitable member 31. The said diaphragm may further consist of a metallic bellows 30' (Fig. 7). In the case of a pump for motors, a conduit 32 is mounted at 32 on the member 31, and it leads to the intake manifold of the motor. The pressure p^1 in this intake manifold which may be above or below atmospheric pressure, according to whether superchargers are or are not used for the motor, is thus exerted in the direction of the arrow f^2 upon the diaphragm 30. This pressure p^1 is completed by the adjustable action p^2 of a spring 34 mounted between the diaphragm and a ring-shaped nut 35, and thus the diaphragm is urged towards the chamber 25 by a pressure $p = p^1 + p^2$.

The surface of the diaphragm 30 is much larger than that of the valve 28; said diaphragm is substantially parallel to the conduit 24, and thus the current of liquid issuing from the pump will be practically parallel to said diaphragm.

The pump is completed by lubricating arrange-

ments. In each sleeve 5^a is an annular recess 36, and all of the recesses 36 are connected by channels 37 with an annular chamber 38 in the mass 1. Said chamber 38 is connected by channels 39-40 with a chamber 41 in which the cam 8 is rotatable. The connection between the chambers 38 and 41 is normally closed off by a clack-valve 42 urged by a spring 43 whose force is such that the said valve will only be lifted from its seating when the pressure in the chamber 38 and hence in the recesses 36 reaches a value somewhat exceeding the delivery pressure of the pump.

The supply of fuel to one of the recesses 36 (the other recesses being supplied from the said recess) is assured by the corresponding piston 6 which comprises, for this purpose, a recess 44; this latter, during the motion of the piston 6, comes successively, but not simultaneously, into coincidence with the recess 36, and on the other hand, with a suitable conduit 45 for the supply of lubricant under pressure.

The operation of the said pump is as follows. Under the action of the cam 8 which is operated by the shaft 9, the pistons 6 are given an alternating movement in their cylinders. During the right-hand stroke (Fig. 1) they draw the liquid fuel or other liquid into the cylinder 5, and at this time the valve 16 connects the intake conduit 23 with the cylinder 5 through the channel 22, the port 21 and the channel 13.

When the piston 5 is on its left-hand stroke (Fig. 1) thus driving before it the liquid fuel or other liquid contained in the cylinder 5, the valve 16 connects said cylinder 5 with the chamber 25 through the channel 13, the groove 20, the recesses 19 and 15, and the channel 24.

The static pressure in the chamber 25 and in the delivery conduit 26 cannot increase above the above-mentioned force p equal to $p^1 + p^2$ and exerted in the direction of the arrow f^2 upon the diaphragm 30. In fact, when the pressure in the chamber 25 tends to exceed the value p , the diaphragm 30 is moved in the direction contrary to the arrow f^2 , and the valve 28 is lifted from its seating, thus connecting the admission with the delivery, and the excess output of the pump will thus operate in a closed circuit. It should be noted that due to the position of the diaphragm 30, which is parallel to the conduit 24, only the elastic pressure of the expelled liquid will be exerted upon the diaphragm, to the exclusion of all dynamic effort due to the current of liquid, as would be the case if the diaphragm were perpendicular to the current of liquid expelled by the pump.

As the ratio between the surfaces of the diaphragm 30 and of the valve 28 is quite considerable, the diaphragm will hardly be affected by the variable pressure prevailing in the admission conduit 23 and acting below the valve 28.

As concerns the lubrication, the piston 6 provided with the groove 44 serves the purpose of a drop-feed device; it takes up the lubricant from the channel 45 in which it is at a high pressure, and brings it into the recess 36, whence it passes through the channels 37 and the chamber 38 into the recesses 36 of the other cylinders. The pressure of the lubricant in said recesses 36 is maintained below a given value, by the discharge valve 42. This pressure much exceeds the maximum pressure of the fuel or other liquid delivered.

In consequence, the said liquid will not leak around the pistons 6, but on the contrary, the

lubricant will tend to proceed into the delivered liquid, but only in very small quantities.

The said pump according to the invention possesses numerous advantages. As above stated, the petrol (which is the fuel in general use) will not proceed into the lubricant which drives it forward, while on the contrary it is very difficult to obtain sufficient non-leaking conditions with the usual apparatus employing pistons or slide-valves. This obviates all difficulties with lubrication due to the fact that the petrol dilutes the lubricants and causes gripping of the parts.

The use of pistons allows a considerable suction at the intake end, which is due for instance to the fact that the tanks are located below the carburettor, which is usually the case for seaplanes, or when operating at low atmospheric pressures at high altitudes.

As above stated, the pump is self-regulating, with constant pressure at the delivery end, whatever be the output required of the motor. This pressure is also constant, irrespective of the pressure of the surrounding atmosphere due to the altitude, whilst the self-regulating systems usually employed in fuel pumps are only suitable for motors operating near the ground.

The delivery of the pump is constant, thus assuring excellent conditions for the feeding of carburettors in which the float must not be subjected to continual pounding of the liquid, if a constant level is to be maintained.

It should be further stated that the apparatus has a very light weight and is of a reduced size.

In the form of construction shown in Figs. 8 and 9, the body 1' of the pump is constituted in the same manner as the body 1 of the pump represented in Figs. 1 and 2, and it is closed at the ends by caps 3'-4'; the cap 4' provides for the entirely free opening of the cylindrical recesses 5' provided in the body 1'. In the cap 4' is mounted the valve device which consists of two circular discs 70-71 connected together by a metallic bellows 72 which is soldered or otherwise secured to the two discs. A spring 75 urges the disc 70 and 71 respectively upon the body 1' and upon the end of the cap 4'.

The hubs 73-74, which are mounted at the centres of said discs, engage a crank-pin 76 mounted in the eccentric position upon the driving shaft 9' of the pump. Thus the valve device consisting of the discs 70-71 and the bellows 72 will be displaced by an eccentric movement about the axis of the shaft 9', hence successively closing and opening the outer part of the several cylindrical recesses 5' as shown at 77-78 in Fig. 8. Ports 79 in the disc 70 permit, due to the eccentric motion of said disc, to successively establish or cut off the connection between a chamber 80 in the bellows and the different cylindrical recesses 5' of the pump. Apertures 81 in the hub 74 of the disc 71 provide a permanent connection between the chamber 80 and the fuel intake conduit 23'.

In order to maintain each port 79 in coincidence with its corresponding cylindrical recess 5', the valve device 70-71-72 is given an eccentric movement about the axis of the shaft 9, but it is prevented from rotating on its own axis, or otherwise stated, about the axis of the crank-pin 76. For this purpose, studs 82 screwed into the disc 71 carry rollers 83 guided in circular apertures 84 provided in the cap 4' or in a member 86 secured thereto.

The fuel entering through the channel 23' flows through the apertures 81 into the chamber

80 and thence through the ports 79 into the cylindrical recesses 5' which are operating on the admission stroke (as shown at the upper part of Fig. 8). The fuel driven forward out of the cylinders 5' (lower part of Fig. 8) passes through the aperture 78 into the chamber 87 of the cap 4' formed at the exterior of the bellows 72, and issues thence through the channel 24'.

In the case of an excessive pressure at the delivery end, this pressure acts upon the disc 70 which thus yields, together with the spring 75, and hence the delivered fuel is enabled to return to the admission end through the ports 79 and the chamber 80. This motion of the disc 70 can be obtained without interfering with the disc 71, by the use of a socket 88 located between the crank-pin 76 and the hubs 73-74 of the discs 70-71. The disc 70 and socket 88 may move together upon the crank-pin 76, due to the ball-shaped end 85 of said crank-pin. The socket 88 is rotatable in the hub 74 by reason of its end 89 which is also ball-shaped.

The disc 70 may be replaced, for example, by a disc 90, as shown in Figs. 10 and 11, and herein the recesses 5' will be successively closed and opened by the inner edge 91 of said disc 90, for the admission, and by the outer edge 92 for the delivery. Apertures 93 in the disc 90 connect the chamber 80 with the cylindrical recesses 5'. Since in this case the conduits for admission and delivery will depend solely upon the eccentric position of the disc 90 and are independent of the rotation of the disc 90 about its own axis, it is not necessary to provide a device which would prevent the disc 90 from rotating about the crank-pin 76, such for instance as the rollers 83 co-operating with the apertures 84 as shown in Fig. 8.

In the embodiment of Figs. 8-9 and 10-11, the plate 70 or 90 constitutes the actual distributing member. The plate 71 and the bellows 72 are only used in order to form a fluid tight compartment facing said distributing member 70. It is obvious that said compartment may be constituted in any other suitable manner by means of stationary parts. The plates 70 and 90 might also have a larger diameter so as to cover permanently the cylindrical recesses 5, and apertures would then be provided near the outer edge of said plates in order to allow said recesses to be brought into and out of communication with chamber 87.

Obviously, the said invention is not limited to the forms of construction herein described and represented, which are given solely by way of example.

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

In a pump in combination a pump body provided with a number of parallel bores opening at one end of said body, a rotatable driving shaft extending through said body, a piston in each of said bores adapted to be reciprocated in said bore, connecting means between said shaft and said pistons whereby said shaft is adapted to reciprocate said pistons in said bores through similar strokes at different stages in the successive bores, a hollow cap for the end of said body on which said bores open and provided with an inlet opening and outlet opening and leaving unobstructed said bores of said body, a distributing member in said cap comprising two substantially parallel plates connected by bellows, yielding means adapted to urge one of said plates

against said open end of said body and the other plate against the end of said cap, said distributing member separating in said cap an inlet chamber and an outlet chamber communicating permanently respectively with said inlet and outlet openings, passages in the plate adjacent said body adapted to be brought into and out of coincidence with said bores in said body, a hollow socket having one end cylindrical and engaging in the plate adjacent said body and the other

end ball-shaped and engaging in the second plate of said distributing member, and a crank-pin eccentrically carried by said driving shaft and having a ball-shaped end engaging the inner wall of said hollow socket, whereby said crank-pin is adapted to drive said socket and the two plates of the distributing member during the rotation of said driving shaft.

JACQUES AYVAZ.