Aug. 22, 1944. P. DESCOURTIS 2,356,511

PISTON AND CYLINDER SYSTEM

Filed April 2, 1942

Fig. 1

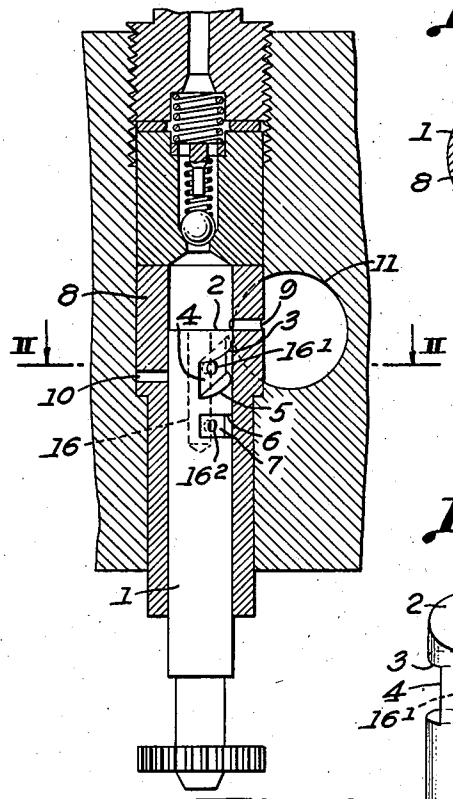


Fig. 2

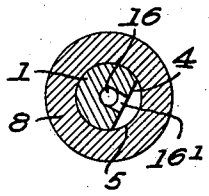


Fig. 3

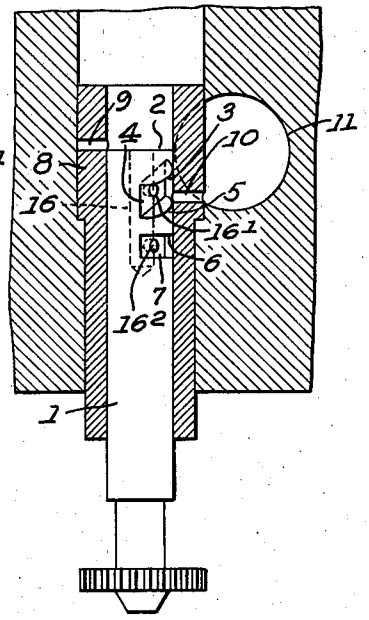


Fig. 5

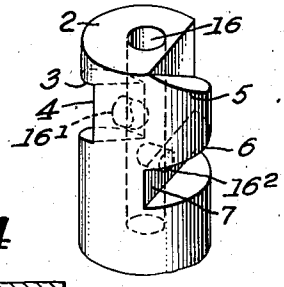


Fig. 4

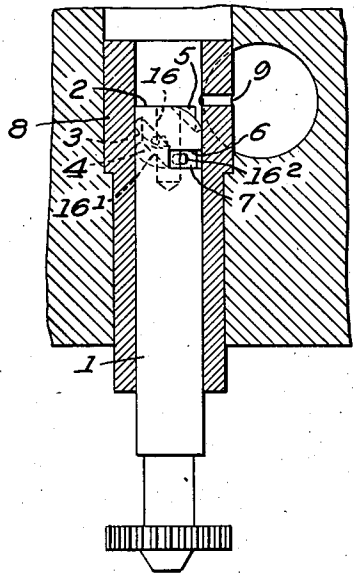
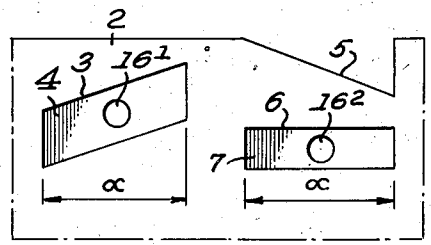


Fig. 6



Inventor:
PAUL DESCOURTIS
By Allsebrook
Attorney.

Patented Aug. 22, 1944

2,356,511

UNITED STATES PATENT OFFICE

2,356,511

PISTON AND CYLINDER SYSTEM

Paul Descourtis, Paris, France; vested in the Alien Property Custodian

Application April 2, 1942, Serial No. 437,428
In France March 29, 1941

17 Claims. (Cl. 103—41)

The present invention relates to piston and cylinder systems of the kind in which the distributing means are provided in the form of edges and orifices carried in a suitable manner by the active surfaces of the piston and the cylinder. The invention is more especially, although not exclusively, concerned, among these systems, with pumps, and, in particular, fuel injection pumps and the like.

The object of the present invention is to provide a system of the type above mentioned which is better adapted to meet the requirements of practice than those used for the same purpose up to the present time.

According to a feature of the present invention, in a system of the kind above referred to, the distributing means are divided into at least two sets capable each of separately ensuring the working of the system, under similar or different conditions, the shifting from one to the other being obtained by a relative displacement, for instance a rotation of 180° about their common axis, of the piston and cylinder with respect to each other.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawing, given merely by way of example, and in which:

Fig. 1 is a diagrammatic axial sectional view of a piston and cylinder system for a pump, made according to a first embodiment of the present invention;

Fig. 2 is a diagrammatic transverse section on the line II—II of Fig. 1;

Fig. 3 is a view, similar to Fig. 1, showing this system in a different relative postion of the elements thereof;

Fig. 4 is an axial sectional view of a system of the same kind made according to another embodiment of the invention;

Fig. 5 is a perspective view corresponding to Fig. 4;

Fig. 6 shows the development of the edges of the active surfaces of the piston of Figs. 4 and 5.

In the following detailed description, it will be supposed that the invention is applied to the construction of an injection pump, of the mono-cylindric or poly-cylindric type, to be used for the feed of an internal-combustion engine. This pump will further be supposed to be of the kind in which the distributing means include edges or inclined surfaces, especially on the piston, variation of the pump output being obtained by a relative rotation of the piston and cylinder with respect to each other so as to modify the time at which the orifice or orifices coacting with these edges or inclined surfaces are opened and closed.

In particular, it should be remembered that, in existing pumps of this kind, the variation of the output of the pump can be obtained in three different ways, to wit: by advancing the beginning of the injection, or on the contrary by postponing the end thereof, or again by simultaneously varying the beginning and the end.

Now, it is known that some motors are preferably controlled by variations of the first kind, others by variations of the second kind, and others by variations of the third kind. It is therefore necessary to provide different interchangeable pistons corresponding respectively to these solutions.

An important object of the present invention is to obviate this drawback, and to this effect, according to a feature of the invention, the distributing means of the pump are divided into two or more distinct sets capable each of separately ensuring the distribution according to the respective types of variation of the output above mentioned. Shifting from one operation to the other is obtained by a relative displacement, for instance a rotation of given amplitude about their common axis, of the cylinder and piston.

In order to carry out this method of working, many specific embodiments may be provided by persons skilled in the art, especially according as one or several orifices are used, according to the particular arrangement that is chosen for the distributing edges or inclined surfaces, and according to the value of the amplitude of rotation of the piston and cylinder with respect to each other, this amplitude being preferably chosen equal to 180° when two different conditions of operation are to be obtained, as it will be hereinafter supposed.

According to the embodiment of Figs. 1 to 3, I make use of two sets of distribution edges, superposed along the same generatrix of the piston, to wit:

a. A first set constituted, on the one hand by the edge **2** of the piston end face which, in this example, is at right angles to the piston axis, and, on the other hand by an oblique edge **3** of a notch **4** provided laterally in the periphery of the piston;

b. A second set constituted, on the one hand by an oblique edge **5**, which in this case is parallel to edge **3** and corresponds to the same notch,

and, on the other hand, by an edge 6 at right angles to the piston axis and corresponding to a second notch 7, itself perpendicular to the piston axis.

Notches 4 and 7 are, in the known manner connected with the piston end corresponding to the face of the piston which compresses the fluid, the connecting passage being formed either in the lateral wall of the piston or on the inside thereof, as shown by the drawing (Figs. 1 and 3, conduits 16, 16^1, 16^2).

In cooperation with such a piston, I make use of a cylinder 8 provided with two orifices 9 and 10 located on diametrally opposed generatrices, these orifices being spaced apart in the axial direction of the piston and cylinder, in such manner that it is possible to bring either one of them (9, located at the upper part of the cylinder) into coaction with the first set of edges 2 and 3, or the there (10, located at the lower part of the cylinder) with the second set of edges 5 and 6.

The pump further includes:

On the one hand a control device, for instance of the cam type, for imparting rectilinear reciprocating displacements to the piston, and

On the other hand, means for producing relative rotations of the cylinder and piston with respect to each other about their common axis, so as to permit of varying the output of the pump by modification of the relative positions of the inclined edges with respect to orifices 9 and 10.

Such a system can operate in two different ways, respectively illustrated by Figs. 1 and 3.

It will be seen that, in one of these ways of working, corresponding to Fig. 1, the beginning of the injection remains invariable since it takes place when edge 2 comes to close orifice 9, that is to say always at the same time whatever be the angular position of the piston with respect to the cylinder. As the end of the injection takes place when oblique edge 3 uncovers said orifice, that is to say at a time variable in accordance with said angular position, the variation of output of the pump is obtained by varying the time at which the end of the injection takes place.

On the contrary, with the other way of working the pump, the beginning of the injection is variable, while the end is fixed.

In order to ensure the relative rotation of 180° which permits of passing from one working position to the other, I act either on the piston or on the cylinder.

For this purpose, I will merely, in some cases, act directly and manually upon the parts in question. For instance if it is desired to modify the working position of the cylinder, I remove said cylinder as it is customary to do when a part of the pump is to be examined or changed, after which said cylinder is refitted in an angular position at 180° from the preceding angular position.

But it may be advantageous, in some cases, to provide means for controlling from a distance the working position of the parts in question, which permits, in particular, simultaneously to act on the pistons or cylinders of several pump units.

These means may have their elements at least partly in common with elements of the means for varying the output of the pump.

They might further be used for adjusting the injection timing. Supposing for instance that said means act on the cylinder, by turning the latter through an angle of 180°, they might be made in such manner as to permit of effecting an initial adjustment of each of the two working positions, this adjustment producing a modification of the injection timing.

Finally, it goes without saying that suitable feed conduits are provided for supplying fuel to that of orifices 9 and 10 which is chosen.

In Figs. 1 to 3, which correspond to an embodiment in which the shifting from one of the ways of operation to the other is obtained by a rotation of 180° of the cylinder, the feed is ensured through a single conduit 11, of suitable section for enabling it to coact as well with one as with the other of said orifices, but separately.

If the shifting from one operation to the other is obtained by a rotation of the piston, I may have recourse to two conduits located at the level of the two orifices. I might also, in both cases, have recourse to a conduit surrounding the cylinder.

Instead of making use of two orifices as shown by Figs. 1 to 3, I may provide a single one, for instance by placing the two sets of inclined edges in suitable angular relation to each other, as shown by Figs. 4 to 6.

According to this embodiment, and supposing, for the sake of explanation, that the piston is divided into two portions by an axial plane, I provide, one one side of this plane, edges 2 and 3 analogous to those above described with reference to Figs. 1 to 3, with a notch 4 analogous to that disclosed by said figures. On the other side of said axial plane, I provide, on the one hand, an upper oblique edge 5 symmetrical to edge 3 with reference to said plane, and which may be constituted by a bevelled edge of the piston end, and, on the other hand, a lower edge 6, with a notch 7, said last mentioned edge and notch being perpendicular to the axis of the piston.

It will be readily understood that these two sets of edges can coact, one or the other, with the same orifice 9, thus producing two different ways of working as above explained.

The switching from one to the other can take place, in this case also, either by acting on the piston (as shown by the drawing, orifice 9 being in this disclosure fed through a lateral conduit 11) or by acting on the cylinder.

Fig. 6 shows, for the sake of clarity, the development of the distributing edges. These edges may, as in the case of Figs. 1 to 3, extend over angles α of the same order of magnitude as usually employed (say 130), since, in each of the two working positions, there is a margin of nearly 180° available for adjustment.

Anyway, whatever be the particular embodiment that is chosen, I obtain a system the operation of which is sufficiently clear from the preceding description to make it unnecessary to enter into further explanations. This system has, over similar systems, many advantages, among which the following may be cited:

It permits of adapting the pumps to engines of different types; and

It necessitates no modification of existing pumps, with the exception of the piston, which is different.

The invention further permits of prolonging the life of the piston. As it is known, the piston wears particularly on those of its surfaces which coact with the corresponding feed orifice. Therefore, if the wear becomes too great, it is possible, by turning the piston through an angle of 180°, to obtain its operation along zones which are not worn. Accordingly, the present invention applies to the case in which the piston is provided with two sets of distribution edges adapted to

coact separately either with the same orifice or with two distinct orifices so as to produce two ways of working, even when these two ways are similar or even identical.

On the other hand, it should be well understood that, when it is desired to obtain, by means of at least two different sets of distribution edges, different ways of working, these ways of working may differentiate from each other, or from one another, in any manner whatever. In other words, instead of having two sets of inclined surfaces or edges which are inversely disposed with respect to each other (an oblique edge in one set corresponding to a perpendicular edge in the other set), these sets may be of any shape and disposition as necessary. For instance, at least one of them may have two oblique edges, either of the same inclination or of different inclinations, and even of opposed inclinations.

It is thus possible, with a single type of piston, to adapt a given pump to two wholly different applications.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

In the claims, the word "inner" applied to one of two elements designates the one which is nearer to the part of the cylinder toward which the liquid is discharged under pressure. For instance, taking edges **3** and **5**, the "inner" edge is edge **3**.

What I claim is:

1. A pump, which comprises, in combination, a cylinder, a piston slidable in said cylinder, one of these two parts being provided with at least one port means connected with a fluid supply, at least two independent sets of distributing means carried by the other of said two parts, adapted to cooperate with said port means, said piston and cylinder being rotatable with respect to each other so as to permit of bringing either of said sets of distributing means alternatively into cooperating relation with said port means.

2. A pump, which comprises, in combination, a cylinder, a piston slidable in said cylinder, one of these two parts being provided with at least one port means connected with a fluid supply, at least two independent sets of distributing means carried by the other of said two parts, adapted to cooperate with said port means, said piston and cylinder being adjustable with respect to each other by relative rotation about their common axis so as to permit of bringing either of said sets of distributing means alternatively into cooperating relation with said port means.

3. A pump, which comprises, in combination, a cylinder, a piston slidable in said cylinder, one of these two parts being provided with at least one port means connected with a fluid supply, at least two independent sets of distributing means carried by the other of said two parts, adapted to cooperate with said port means, said piston and cylinder being adjustable with respect to each other by relative rotation about their common axis so as to permit of bringing either of said sets of distributing means alternatively into cooperating relation with said port means, each of said set of distributing means being independently adjustable by relative rotation of said piston and cylinder about their common axis.

4. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with at least one port means connected with a fluid supply, said piston being provided with an independent peripheral notch, with a conduit connecting said notch with said inner face of the piston, with at least one other independent peripheral notch and with a conduit connecting said second mentioned notch with said inner face of the piston, said notches being so located that the port means cooperate with the edge of the end face of the piston and with the inner edge of the first mentioned slot when the piston and cylinder are in a given relative angular position with respect to each other, while the port means cooperate with an edge of the second mentioned slot for another relative angular position of the piston and cylinder about their common axis, at least one of the edges of the piston which cooperates with the port means in each of said angular positions being oblique with respect to the axial direction.

5. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with at least one port means connected with a fluid supply, said piston being provided with an independent peripheral notch with at least one other independent peripheral notch and with a conduit connecting both of said notches with said inner face of the piston, said notches being so located that the port means cooperate with the edge of the end face of the piston and with the inner edge of the first mentioned slot when the piston and cylinder are in a given relative angular position with respect to each other, while the port means cooperates with an edge of the second mentioned slot for another relative angular position of the piston and cylinder about their common axis, at least one of the edges of the piston which cooperates with the port means in each of said angular positions being oblique with respect to the axial direction.

6. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with at least one port means connected with a fluid supply, said piston being provided with a peripheral notch with at least one other peripheral notch, and with a conduit connecting both of said notches with said inner face of the piston, said cylinder being adapted to have said port means connected with a fluid supply, said notches being so located that the port means cooperate with the edge of the end face of the piston and with the inner edge of the first mentioned slot when the piston and cylinder are in a given relative angular position with respect to each other, while the port means cooperates with an edge of the second mentioned slot for an angular position of the piston and cylinder about their common axis at 180° from the first mentioned relative position, at least one of the edges of the piston which cooperates with the port means in each of said angular positions being oblique with respect to the axial direction.

7. A pump, which comprises, in combination, a cylinder and piston slidable in each other and

angularly adjustable with respect to each other about their common axis, said cylinder being provided with at least one port means connected with a fluid supply, said piston being provided with an independent peripheral notch with at least one other peripheral notch, and with an axial conduit connecting both of said notches with said inner face of the piston, said notches being so located that the port means cooperate with the edge of the end face of the piston and with the inner edge of the first mentioned notch when the piston and cylinder are in a given relative angular position with respect to each other, while the port means cooperates with an edge of the second mentioned notch for another relative angular position of the piston and cylinder about their common axis, at least one of the edges of the piston which cooperates with the port means in each of said angular positions being oblique with respect to the axial direction.

8. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with two ports located on generatrices at 180° from each other and at a distance from each other in the axial direction, said piston being provided with a peripheral notch, with a conduit connecting said notch with said inner face of the piston, with another peripheral notch located substantially in line with the first in the axial direction, and with a conduit connecting said second mentioned notch with said inner face of the piston said cylinder being adapted to have either of said ports connected with a fluid supply, said two ports being so spaced apart, in the axial direction that one of them cooperates with the edge of the end face of the piston and with the inner edge of the first mentioned notch when the piston and cylinder are in a given relative angular position with respect to each other while the other port cooperates with the other edge of said first mentioned notch and with the inner edge of the second mentioned notch for a relative angular position of said piston and cylinder at 180° from the first mentioned position, at least one of the edges adapted to cooperate with each port being oblique with respect to the axial direction.

9. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with two ports located on generatrices at 180° from each other and at a distance from each other in the axial direction, said piston being provided with a peripheral notch, with an inner conduit extending therethrough and connecting said notch with said inner face of the piston, with another peripheral notch located substantially in line with the first in the axial direction, and with an inner conduit extending therethrough and connecting said second mentioned notch with said inner face of the piston, said cylinder being adapted to have either of said ports connected with a fluid supply, said two ports being so spaced apart, in the axial direction that one of them cooperates with the edge of the end face of the piston and with the inner edge of the first mentioned notch when the piston and cylinder are in a given relative angular position with respect to each other while the other port cooperates with the other edge of said first mentioned notch and with the inner edge of the second mentioned notch for a relative angular position of said piston and cylinder at 180° from the first mentioned position, at least one of the edges adapted to cooperate with each port being oblique with respect to the axial direction.

10. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with two port means connected with a fluid supply, said piston being provided with an independent peripheral notch, with a conduit connecting said notch with said inner face of the piston, with at least one other independent peripheral notch and with a conduit connecting said second mentioned notch with said inner face of the piston, said notches being so located that one port means cooperates with the edge of the end face of the piston and with the inner edge of the first mentioned slot when the piston and cylinder are in a given relative angular position with respect to each other, while the other port means cooperates with an edge of the second mentioned slot for another relative angular position of the piston and cylinder about their common axis, at least one of the edges of the piston which cooperates with the port means in each of said angular positions being oblique with respect to the axial direction.

11. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with two ports located on generatrices at 180° from each other and at a distance from each other in the axial direction, said piston being provided with a peripheral notch, with another peripheral notch substantially in line with the first notch, in the axial direction, and with a conduit connecting both of said notches with said inner face of the piston said cylinder being adapted to have either of said ports connected with a fluid supply, said two ports being so spaced apart, in the axial direction that one of them cooperates with the edge of the end face of the piston and with the inner edge of the first mentioned notch when the piston and cylinder are in a given relative angular position with respect to each other while the other port cooperates with the other edge of said first mentioned notch and with the inner edge of the second mentioned notch for a relative angular position of said piston and cylinder at 180° from the first mentioned position, at least one of the edges adapted to cooperate with each port being oblique with respect to the axial direction.

12. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis said cylinder being provided with two ports located on generatrices at 180° from each other and at a distance from each other in the axial direction said piston having its inner end face located in a plane at right angles to its axis and being provided with a peripheral notch both edges of which are oblique with respect to the axial direction, with a conduit connecting said notch with said inner face of the piston, with another peripheral notch having its inner edge at right angles to the axis of said piston, and substantially in line with the first notch in the axial direction, and with a conduit connecting said second mentioned notch with said inner face of the piston, said cylinder being adapted to have either of said ports connected with a fluid supply, said two ports being so spaced

apart, in the axial direction that one of them co-operates with the edge of the end face of the piston and with the inner edge of the first mentioned notch when the piston and cylinder are in a given relative angular position with respect to each other while the other port cooperates with the other edge of said first mentioned notch and with the inner edge of the second mentioned notch for a relative angular position of said piston and cylinder at 180° from the first mentioned relative angular position.

13. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis said cylinder being provided with a port connected with a fluid supply, one side of said piston having its inner end face located in a plane at right angles to its axis and being provided with an independent peripheral notch the inner edge of which is oblique with respect to the axial direction with a conduit connecting said notch with said inner face of the piston, the opposite side of said piston being provided with a peripheral portion oblique to the axial direction and with another independent lateral notch having its inner edge at right angles to the axis of said piston, with a conduit connecting said second mentioned notch with said inner face of the piston, said piston being adapted to have the set of edges, on either side thereof, brought into co-operating relation with said port, alternatively.

14. A pump, which comprises, in combination, a cylinder and piston slidable in each other and angularly adjustable with respect to each other about their common axis, said cylinder being provided with a port connected with a fluid supply, one side of said piston having its inner end face located in a plane at right angles to its axis and being provided with an independent peripheral notch the inner edge of which is oblique with respect to the axial direction, the opposite side of said piston being provided with a peripheral portion oblique to the axial direction and with another independent peripheral notch having its inner edge at right angles to the axis of said piston, with a conduit connecting both of said notches with said inner face of the piston, said piston being adapted to have the set of edges, on either side thereof, brought into co-operating relation with said port, alternatively.

15. In a pump, the combination of a cylinder provided with inlet means, and a piston slidable and rotatable in said cylinder and having two sets of edges, the inner edge of one set and the outer edge of the other set being in planes at right angles to the longitudinal axis of the piston, and the outer edge of said first mentioned set and the inner edge of said second mentioned set being in planes oblique to said axis, said piston being provided with a conduit having a port in the upper face of the piston and ports associated with each of said outer edges respectively, so that the edges of the respective sets will co-operate with said inlet means of the cylinder, alternatively, depending upon the relative angular positions of the cylinder and piston.

16. In a pump, the combination of a cylinder having two inlet ports, and a piston slidable and rotatable in said cylinder, and having two sets of edges, the inner edge of one set and the outer edge of the other set being in planes at right angles to the longitudinal axis of the piston, and the outer edge of said first mentioned set and the inner edge of said second mentioned set being in planes oblique to said axis, said piston being provided with a conduit having a port in the upper face of the piston and ports associated with each of said outer edges respectively, so that the edges of the respective sets will cooperate with said cylinder ports respectively and alternatively, depending upon the relative angular position of the cylinder and piston.

17. In a pump, the combination of a cylinder having an inlet port, and a piston slidable and rotatable in said cylinder and having two sets of edges, the sets being formed on diametrically opposed sides of the piston, the inner edge of one set and the outer edge of the other set being in planes at right angles to the longitudinal axis of the piston, and the outer edge of said first mentioned set and the inner edge of said second mentioned set being in planes oblique to the said axis, said piston being provided with a conduit having a port in the upper face of the piston and ports associated with each of said outer edges respectively so that the edges of the respective sets will cooperate with said cylinder port, alternatively, depending upon the relative angular positions of the cylinder and piston.

PAUL DESCOURTIS.