The present invention relates to machines of the piston type, either generating or receiving machines of the barrel type, that is to say, piston-type machines in which the pistons move in cylinders having parallel axes and formed in a barrel, the relative positions of the above-mentioned pistons being controlled by a plate to which is imparted a swash-plate or wobbling action which accompanies the reciprocating motion of the pistons; similar to these machines, the present invention more particularly although not exclusively relates to hydraulic pumps of the barrel type, since it is in this case that the invention appears to be of the greatest value.

The present invention has for its object above all to design the above-mentioned machine such that it may meet the various conditions required in practice in a more effective manner than his hitherto been the case.

The present invention mainly consists at the same time in coupling the swash-plate of the machines of the type in question to another member of the machine through the intermediary of a cardan shaft device comprising in a manner known per se an external member and an internal member, pivotally coupled to each other, and in rigidly fixing the above-mentioned swash-plate to the internal member of the cardan shaft device in such manner that the pivotal members of said cardan shaft device are removed to the periphery of said swash-plate.

Apart from this principal arrangement, the invention consists of certain other arrangements which are preferably employed at the same time and which will be described in greater detail hereunder.

The invention is more particularly concerned with a certain form of application (the application in which it is intended for use with barrel type pumps) in addition to certain forms of embodiment of the above-mentioned arrangements; and is even more especially directed by way of new industrial products, to machines of the type in question which comprise the application of the same arrangements mentioned, in addition to the parts and special tools designed for the manufacture of said machines and the fixed or moving units or installations which are equipped with similar machines.

The invention will in any case by clearly understood by means of the additional description which follows below, with reference to the accompanying drawings, it being clearly understood that said additional description and drawings are given above all by way of example and not by way of limitation.

FIGS. 1 and 2 of said drawings illustrate respectively in axial cross-section along the line I—I of FIG. 2 and in axial cross-section (at right angles to the preceding cross-section) along the line II—II of FIG. 2, a hydraulic pump of the barrel type constructed in accordance with the present invention.

In accordance with the invention and more particularly in accordance with the mode of application as well as those forms of embodiment of the various parts of said invention to which it would appear necessary to give preference, with the object, for example, of constructing a barrel type hydraulic pump, the method of operation is carried out as follows or in like manner.

Firstly as regards said pump considered as a whole and with the exception of the cardan shaft device to be provided for supporting the swash-plate of said pump, this latter can be constituted in any suitable manner and particularly by making use of the form of embodiment shown in FIGS. 1 and 2, in which:

There is rotatably mounted in a fluid-tight casing a driving shaft, one extremity of which projects beyond the above-mentioned casing and carries a driving pinion whilst the other extremity of said shaft is enlarged, preferably in the shape of a cylindrical head, said driving shaft being then advantageously supported by two bearings, namely a bearing 4 interposed between the shaft proper and a yoke 1 which is added on the casing 1, and a bearing 5 interposed between said casing and above-mentioned cylindrical head 2a;

There is keyed on the driving shaft a barrel 6 in which are formed a plurality of cylinders 7 arranged in the shape of a ring, the cylinders being parallel to the shaft 2, the bottoms of said cylinders being provided with orifices 8 which are used at the same time both for admission and delivery, enabling each cylinder to be put successively into communication, during the course of a complete revolution of the barrel 6, and by virtue of the operation of the distribution ports 9, with a suction conduit 10 and with a delivery conduit 11;

In the cylinders 7 there are slideably mounted pistons 12 coupled by connecting rods 13 to a rotatably mounted plate 14, there being preferably interposed a trunnion bearing 15 and a thrust-bearing 16 said plate 14 being rotatably mounted on a plate-cam 17 which does not rotate but is provided with respect to the axis of the shaft 2, with a variable angle of slope by pivotal movement about an axis of rotation X—X, under the action of control means which are not shown in the drawings, while the output of the pump, which is nil when the axis of the plate-cam 17 is located in the extension of the axis of the shaft 2, is progressively greater as the said plate-cam has a greater angle of slope with respect to the above-mentioned axis of the shaft 2;

With the object of imparting to the plate 14 a movement of rotation which coincides with that of the driving shaft 2 and of the above-described pinion 3, the above-mentioned plate 14 is coupled to said plate by means of a cardan shaft device which permits of variation of the slope of the plate-cam 17, an oscillating movement with respect to the barrel 6 being then imparted to the above-mentioned plate 14, the amplitude of said oscillating movement being a function of the angle of slope of the above-mentioned plate-cam 17.

Before entering into the principal arrangement of the present invention and in order to bring out more clearly the originality and value of the said arrangement, it would seem appropriate at this point in the description to recall that in hydraulic pumps of this type which have been known up to the present time, the mentioned plate was rigidly fixed to the external member of the cardan shaft device, while the internal member of said device in that case played the part of a driving unit.

However, this mode of operation had the double disadvantage of giving rise to relatively substantial specific pressures on the pivotal mountings which transmit the driving torque from the internal member of the cardan shaft to the external member of this latter and also of obstructing the central region of the swash-plate, this latter drawback resulting in the need to increase the radial distance of the connecting rods from the axis of the shaft 2, with the further result that the radial dimensions of the swash-plate and of the barrel have also to be increased.

The principal arrangement of the present invention has precisely for its object to overcome the disadvantages mentioned above.
In accordance with the principal arrangement mentioned above, the swash-plate 14 is designed so as to be rigidly fixed to the internal member of the caridan shaft device, the transmission of the driving torque being consequently effected by the external member of the above-mentioned caridan shaft device.

In this manner and all things being otherwise equal, the specific pressures on the rotating elements of the caridan by means of which the driving torque is transmitted are reduced and on the other hand the central region of the swash-plate 14 is freed thereby making it possible to reduce the radial dimensions of said plate and of the barrel 6.

Taking into account the foregoing, and while it is also possible to proceed in a variety of different ways in order to construct a caridan shaft device of this type, which drives the swash-plate 14 at its periphery (instead of driving said plate at its central region as has hitherto been the practice), it appears to be more particularly useful to employ for this purpose the form of embodiment illustrated in the accompanying drawings, in which:

There is provided at the internal extremity of the driving shaft 2 a forked member 18 (which preferably forms part of the cylindrical head 2) the limbs of said forked member being provided at their extremities with journals 19 which are engaged in diametrically opposed bearings mounted on a ring 20 constituting the external member of the caridan shaft.

The swash-plate 14 constituting the internal member of said caridan shaft is coupled to said ring 20 by means of diametrically opposed journals 21, the line of the axis of said journals being orientated at right angles to the axis of the journals 19.

It can be seen that, following this method of construction, the journals 19 and 21 and the corresponding bearings are distributed round the periphery of the swash-plate 14, the effect of which is in fact to reduce the specific pressures produced in the above-mentioned journals and bearings and to free the central region of the above-mentioned swash-plate.

In consequence of which and irrespective of the form of construction which is adopted, there is finally obtained a hydraulic pump of the barrel type, the method of operation and the advantages of this latter having been brought out sufficiently clearly in the foregoing description to preclude the need to enter into any further explanation on this subject.

As will be understood, since it already follows from the above description, the present invention is in no way limited either to the methods of application or to the forms of construction of the various parts which have been more especially indicated; on the contrary, all alternative forms are intended to come within the scope of the invention.

What I claim is:

1. A piston machine comprising in combination a rotating shaft, a barrel fast for rotation with and coaxial with said shaft, a plurality of cylinders formed in said barrel, a corresponding plurality of pistons moving in said cylinders respectively, a caridan joint comprising a first element rigid with said shaft, a second element pivoted to said first element about a first transverse axis at right angles to said shaft, and a third element consisting of a swash plate pivoted to said second element about a second transverse axis at right angles to said first transverse axis, said swash plate being mounted inside said second element, a plurality of connecting rods each swivelled at one end to said swash plate, and at the other end to one of said pistons respectively, and means for varying the angle made by the axis of said swash plate with said shaft.

2. A piston machine as claimed in claim 1 in which said first caridan joint element is a forked member rigidly fixed to said rotating shaft and said second caridan joint element is a ring surrounding said swash plate.

3. A piston machine as claimed in claim 1, in which the rotating shaft coupled to said swash-plate through said caridan joint is the driving shaft of a pump.

4. A piston machine as claimed in claim 1, in which the rotating shaft coupled to said swash-plate through said caridan joint is the driven shaft of a motor.

References Cited in the file of this patent

UNITED STATES PATENTS

511,044 Cooper et al. 1893 Dec. 19
686,482 Smallbone 1901 Nov. 12
1,659,374 Robson 1928 Feb. 14
2,141,935 Rose 1939 Dec. 27
2,821,145 Douglas 1958 Jan. 28
2,852,230 Cornelius 1958 Sept. 16