

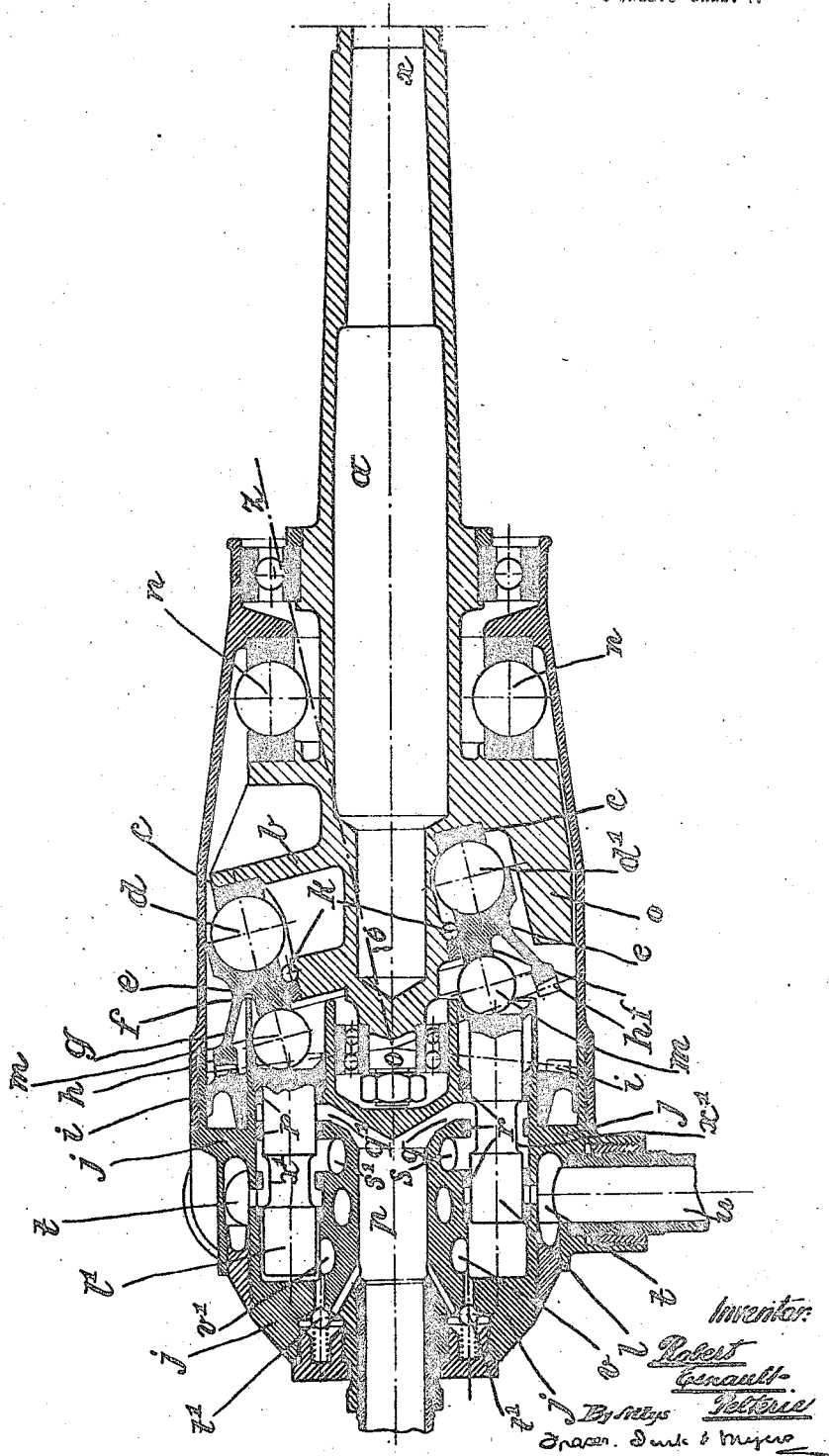
R. E. PELTERIE.
HYDRAULIC PUMP.
APPLICATION FILED MAR. 27, 1919.

1,418,672.

Patented June 6, 1922.

3 SHEETS—SHEET 1.

Fig. 1.



1,418,672.

R. E. PELTERIE.
HYDRAULIC PUMP.
APPLICATION FILED MAR. 27, 1919.

Patented June 6, 1922.

3 SHEETS—SHEET 2.

Fig. 2.

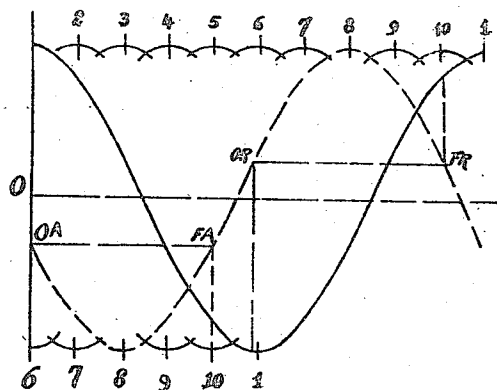
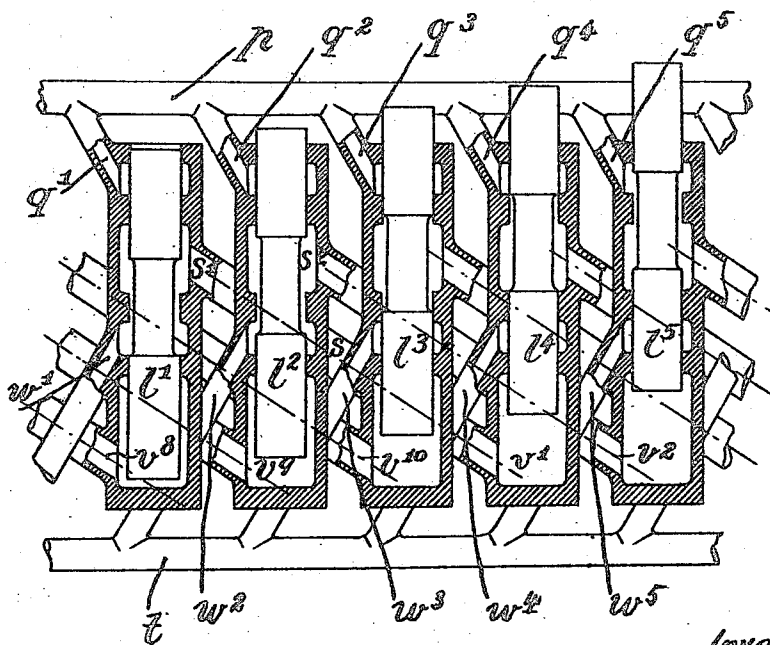


Fig. 3.



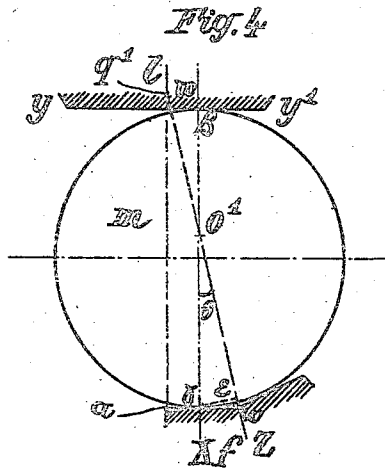
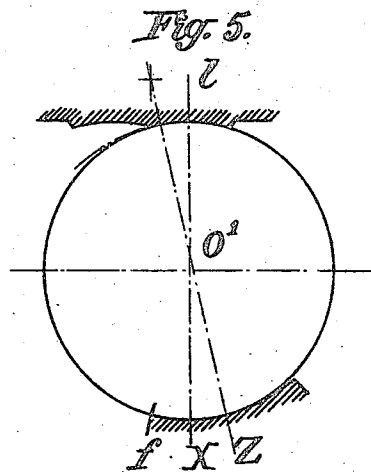
Inventor:

Robert Emault-Pelterie
By Attys

Charles, Dink & Myers

1,418,672.

3 SHEETS--SHEET 3.



Inventor:

Robert Esnault-Pelterie
By Atty's

Chasen, Jule & Rogers

UNITED STATES PATENT OFFICE.

ROBERT ESNAULT PELTERIE, OF PARIS, FRANCE.

HYDRAULIC PUMP.

1,418,672.

Specification of Letters Patent. Patented June 6, 1922.

Application filed March 27, 1919. Serial No. 285,690.

To all whom it may concern:

Be it known that I, ROBERT ESNAULT PELTERIE, a citizen of the Republic of France, residing in the city of Paris, Republic of France, have invented certain new and useful Improvements in Hydraulic Pumps, of which the following is a specification.

The present invention has for its object a hydraulic pump working at very high pressures with no matter what liquid, either as a transmitter or as a receiver of power, according as it has furnished to it mechanical energy which it transforms into a supply of liquid at high pressure, or is supplied with a liquid at high pressure and which it returns as mechanical energy.

This pump or motor principally comprises any number of cylinders arranged symmetrically around the general axis of the machine with their individual axes parallel with the said general axis.

These cylinders act upon the shaft which is to furnish the power, by bearing upon an annular plate the axis of which represented makes an acute angle with that of the shaft which is to furnish the power, this bearing being effected through the medium of a further annular member called a cap which presses the plate through the medium of a ball stop.

The cap is on the other hand prevented from rotating by a suitable device which will be described, of such a kind that its movement is reduced to a movement of nutation.

The whole of this arrangement has been long known and forms part of public property, but the present invention is specially characterized by the manner in which this system is carried out, which both permits of great strength, great lightness and an excellent mechanical efficiency.

The most particular points thereof are:

1. The arrangement of the pistons which permits each one of them to serve as a distributing slide valve to one of the others.

2. The suppression of connecting rods and their replacement by balls which are subjected to a very peculiar movement as will be hereinafter explained.

3. The fixation of the angular situation of the oscillating cap, which is different from the Cardan system previously employed and presents over this latter a considerable advantage of simplicity and strength.

The accompanying figures, which show, by way of example, a method of practically carrying out the invention, will make the working of this pump properly understood; they relate more especially to its application as a receiver, but it will suffice simply to invert the distribution in order to make it play the part of a generator of liquid under pressure.

Figure 1 represents a general view of the motor in axial section.

Figure 2 represents a graphic view of the movement of the pistons, indicating the arrangement by which it is possible to make each of them serve as a slide valve to one of the other cylinders.

Figure 3 represents the development of a certain number of successive pistons, so as to make properly understood the communications which connect them with each other.

Figure 4 represents, on a large scale, one of the balls which serve to transmit the pressure of the piston to the oscillating cap.

Figure 5 represents a modification of this arrangement.

The shaft which is to receive the movement and transmit the power is composed of a cylindrical member *a* the outer end of which serves to transmit or receive the movement and the inner end of which carries an inclined plate *b* which itself supports the race *c* of the two stop balls *d*, *d'*, which are shown in Figure 1, and of which the other race *e*, constitutes the cap above mentioned. This cap carries a number of bosses *f* equal to the number of the pistons, as well as a conical outer extension which is terminated by a conical toothed portion or pinion *h* engaging with an identical toothed portion *i* which is centered and keyed on the fixed body *j* of the motor.

If we call θ the angle which the axis of the inclined plate *b* makes with the general axis of the motor, the two conical pinions above mentioned must obviously, to be identical, each have a total opening at the apex, equal to $(\pi - \theta)$.

The oscillating cap *e* is, furthermore, maintained concentrically on the shaft *O* by a set of balls *k*.

It will be easily understood that under these conditions that when the shaft *a* rotates about the axis *O* the plate *b* inclined upon it tends to compel the cap *e* to follow its movement.

Since this latter cannot rotate by reason

of the action of the pinions h and i , it is compelled to accomplish a movement of nutation and the bosses f thus remain constantly opposite the orifices of each of the
5 pistons, while yet moving longitudinally.

If therefore, this pump were to serve to force back a liquid under pressure when the shaft a were rotated, the pistons l would receive, through the medium of their individual ball, m , an alternate movement of
10 amplitude determined by the inclination of the plate b and by its radius.

In the case in which the pump is to serve as a motor, the liquid possessing an initial
15 pressure, even in the force mains, as has been established in French Patent No. 502,682, dated the 26 May, 1916, in the name of the applicant, the pistons l are applied against the balls m and these latter against
20 the bosses f , in such a way that if the valve gearing be suitably regulated, the pressure which the pistons exert only takes place on one of the halves of the plate b of which they also produce the rotation and consequently that of the shaft a which is connected to it.

The initial pressure may obviously be replaced or assisted by helical springs of a suitable kind, seated in each piston chamber.
30 ber.

The movement of the balls m , which is a little complicated, will be explained later on.

The total pressure which is exerted on the
35 stop d , is, on the other hand, received by the ball stop n .

The centrifugal forces due to the decentering of the plate b and of the ring c , and also the forces of inertia due to the balls
40 d , d' , to the movement of nutation of the cap and of its bosses f , its extension g and its pinion h and also to the alternate movements of the pistons l are counterbalanced by a suitable mass o which is easy, to the
45 person skilled in the art, to determine, for each type of apparatus after all these data are known.

As the applicant has more especially endeavoured to effect first and foremost a
50 realization of the invention applicable to air craft, the present pump, as described, comprises various arrangements intended to confer upon it great lightness, but these particular arrangements are given by way
55 of example only and in no way limit the invention which may also be equally well applied to industrial realizations which have no need of lightness.

The oil under pressure arrives by the
60 central pipe p which carries on its inner end an expanded portion which allows the oil to reach that part of each cylinder which serves as a slide valve for one of the others, as will be hereinafter explained.

65 In order to simplify the figure, the pis-

ton packing r have been shown diagrammatically. They may with advantage be constituted by the system of metallic packing which the applicant has patented in Great Britain under No. 107,760, dated the
70 20 June, 1917, and which are particularly adapted to the applications to high pressure liquid pumps.

They may, of course, be constituted as in any other fluidtight system.
75

In Figure 1, the piston l is shown at the right hand end of its stroke and it will be seen that in this position the circular groove x' therein puts the oil supply pipe p and its expanded portion q into communication
80 with the working chamber of another piston through the medium of the passage s . The piston l' is shown in the extreme inverse position and it will be seen that it also puts the orifice s' of the piston for which
85 it serves as a slide valve, into communication with the annular space t communicating with the exhaust pipe u .

There will also be seen in this figure the ends v , v' of the passages which cause the
90 chambers of the pistons l and l' to communicate with those which respectively serve them as a slide valve.

To prevent the pressure in the chambers from accidentally exceeding the pressure
95 which exists in the inlet pipe p (or the force pipe, if the case be that of a generator) safety valves or balls t' are arranged on each of these chambers.

The valve gear will be properly understood by the following considerations:
100

Figure 2 is a graphic view in which the abscissae represent the times or the angular movements of the motor shaft, and ordinates, the elongations of the pistons, with
105 respect to their mean position.

The sinusoid in full lines represents the elongations of piston No. 1, l' for example, and for the simplification of the figure, there have only been shown, for the other pistons, certain apexes of their respective sinusoids, each bearing its number. The pistons
110 thus act in the successive order of numeration and the pump is supposed to act as a hydraulic motor.

With the central inlet and the external circular delivery, the arrangement of communicating passages from piston to piston, necessitates that, when in the low position, each piston shall cause the one which it controls to communicate with the inlet, and in the high position with the delivery.
120

If in certain applications it is deemed preferable to use the external connection as an inlet, and the internal connection as a
125 delivery, the passages communicating with the cylinders must be appropriately rearranged.

In the one which has been adopted, it will be understood after examining Figure 130

2, that piston No. 1, must be controlled by piston No. 8, which plays in relation to it the part of a slide valve, and establishes the communications in the manner represented by the lines OA, FA, and OR, FR, the ends of which correspond respectively to the opening and closing of the inlet and delivery. In the reverse case, the aforesaid piston No. 1, must be controlled by No. 3.

10 If the pump acts as a generator, the arrangements of distribution above indicated, must both be reversed. It will be easy to the person skilled in the art to get a clear idea of these various arrangements from the preceding explanation.

15 Figure 3 represents the successive pistons l^1, l^2, l^3, l^4, l^5 which are supposed to be developed on the plane of the figure, as well as the inlet pipe p and the force pipe t diagrammatically represented in a tubular form.

20 In this figure will be found the orifices q which cause each piston to communicate, by that part which acts as a slide valve, with the inlet pipe and also the orifices and passages s, v , which cause each slide valve piston to communicate with the chamber of the one which it controls.

25 In the real arrangement of Figure 1, all these communications are constituted by holes suitably located and bored in the mass itself of the motor, so as to cause the desired cavities to communicate with each other.

30 The working of the stop balls of the pistons takes place as will now be described.

35 Figure 4 represents, on a large scale, the position of one of the balls m between the piston l , which it operates, and the boss f of the cap e .

40 For the sake of greater clearness in the description, the longitudinal movement of the piston will at first be omitted and it will be admitted that the boss f is conical about the axis O', Z , which forms with the axis O, X an angle equal to that which has been mentioned.

45 It will be supposed under these conditions, that the boss f accomplishes simply a movement of nutation, that is to say that its axis O', Z rotates about the axis O', X , with a uniform movement, but that by any suitable arrangement, the angular position of the boss f in space does not vary.

50 Under these conditions if the cone which constitutes the boss f has a total opening equal to $(\pi - \tau \theta)$ that is to say if the geometrical axis $\omega \alpha$ is parallel with the plane v', v of the end of the piston, the ball will be constantly pressed against this piston end and a geometrical axis $\omega \alpha$ of the boss f which remains constantly parallel with the plane v', v .

55 The ball does not therefore tend to escape and experience shows that if the point q' is suitably placed by adjustment to the vicinity

of the surface v', v the ball takes up a position of equilibrium for which its point of contact β describes about the centre ω of the piston, a circle of a radius $\omega \beta$ while its other point of contact γ describes on the cone a circle of a radius $\gamma \epsilon$ nearly equal to the first one. The ball ceases then to rotate upon itself, or at least is only subjected to an extremely reduced movement.

Experience proves likewise that if the cap f rotates as a whole about O', X in place of following the movement of nutation which has been indicated, the ball has no stable position and escapes on the side.

60 It is now comprehensible that if the axis O', Z of the boss, in place of being the axis of nutation proper is located as in Figure 1, outside this axis, the movement just described subsists but there is added thereto a longitudinal movement corresponding to its elongations which are the greater the further the axis of the boss is from the axis of nutation, this distance allowing the stroke which it is desired to obtain for the pistons to be regulated.

65 To diminish the wear of the balls, it may be favourable to replace the conical cap of the bosses f by a spherical cap as shown in Figure 5.

70 In this case, it suffices that the centre of this spherical cap be located at the point of intersection O' (see Figure 4) of the secondary axis of nutation O', Z and of the diameter which joins the two points of contact of the ball. It is also possible to make in the face of the piston a race in the form of a torus, as shown in the upper part of Figure 5.

75 When I speak in my claims of a shaft, I mean to include both an actuating and receiving shaft depending upon whether the device is used as a pump or motor; and when I speak of my device as being adapted for use as a pump I also mean that it can be used as a motor.

80 What I claim and desire to secure by Letters Patent of the United States is:—

1. A hydraulic power transmitting device comprising a casing, a shaft in said casing, a plurality of cylinders, a piston in each cylinder, a member secured to said shaft having an operating surface inclined with respect thereto, an annular member located between said pistons and said operating surface and serving as a motion transmitting means, means to prevent rotation of said annular member but permitting a movement of nutation thereof, and free balls located between said pistons and said annular member as a means for transmitting motion therebetween.

2. A hydraulic power transmitting device comprising a casing, a shaft in said casing, a plurality of cylinders, a piston in each cylinder, a member secured to said shaft

having an operating surface inclined with respect thereto, an annular member located between said pistons and said operating surface and serving as a motion transmitting means, means to prevent rotation of said annular member but permitting a movement of nutation thereof, rollers forming an anti-friction bearing between said annular member and said operating surface, and free balls located between said pistons and said annular member as a means for transmitting motion therebetween.

3. In a hydraulic apparatus, the combination of a casing, a shaft in said casing, a plurality of cylinders in said casing, a piston in each of said cylinders, a pinion secured to said casing, an oscillating disc having a pinion adapted to co-operate with the pinion on the casing and inclined with reference to said shaft, free balls, located between the piston and disc, acting each as a connecting rod, an inclined plate secured to the shaft and balls interposed between the disc and plate.

4. In a hydraulic apparatus, the combination of a casing, a shaft in said casing, a plurality of cylinders in said casing, a piston having a flat end in each of said cylinders, a pinion secured to said casing, an oscillating disc having a pinion adapted to co-operate with the pinion on the casing and inclined with reference to said shaft and having a raceway, free balls, located between the flat ends of the pistons and raceway of the disc, acting each as a connecting rod, an inclined plate secured to the shaft and balls interposed between the disc and plate.

5. In a hydraulic apparatus, the combination of a casing, a shaft in said casing, a plurality of cylinders in said casing, a piston

in each of said cylinders, a counterweighted plate secured to said shaft, an oscillating disk, free balls, located between the piston and disk, acting each as a connecting rod, means for preventing the disc from turning and balls interposed between the disc and plate.

6. In a hydraulic apparatus, the combination of a casing, a shaft in said casing, a plurality of cylinders in said casing, a piston in each of said cylinders, a plate, an oscillating disc, free balls, located between the piston and disc, acting each as a connecting rod means for preventing the disc from turning and balls interposed between the disc and plate.

7. In a hydraulic apparatus, the combination of a casing, a shaft in said casing, a plurality of cylinders in said casing, a piston in each of said cylinders, a plurality of conduits in said casing, each connecting one of the cylinders with one of the other cylinders and helically arranged to pass each other, the intersection of the conduits and cylinders being in the form of helicoids.

8. In a hydraulic apparatus, the combination of a casing having a high pressure pipe at its center and low pressure pipes on its outer side, a shaft in said casing, a plurality of cylinders in said casing, a piston in each of said cylinders, an oscillating disc, means comprising a pinion for preventing the disc from turning, free balls, located between the piston and disc, acting each as a connecting rod, an inclined plate secured to the shaft, and balls interposed between the disc and plate.

In witness whereof, I have hereunto signed my name.

ROBERT E SNAULT PELTERIF