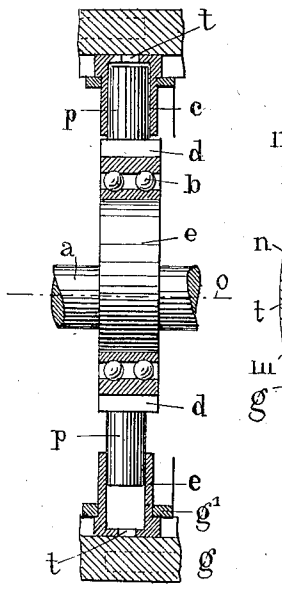
July 28, 1925. 1,547,409

M. J. B. CACAUD

HYDRAULIC TRANSMISSION

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Fig. 1.



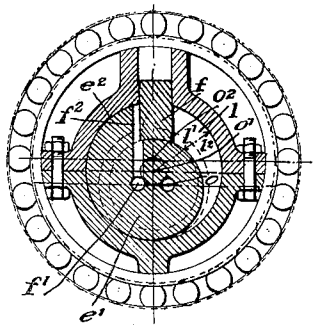
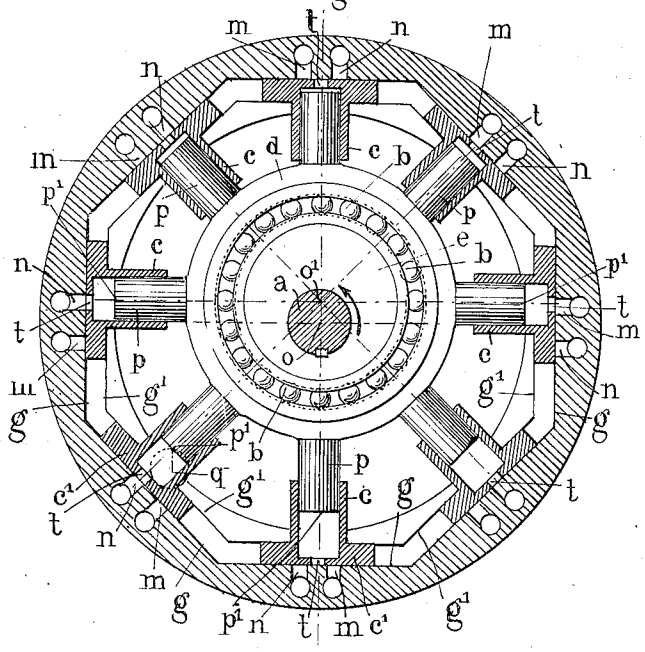


Fig. 4.

Fig 2



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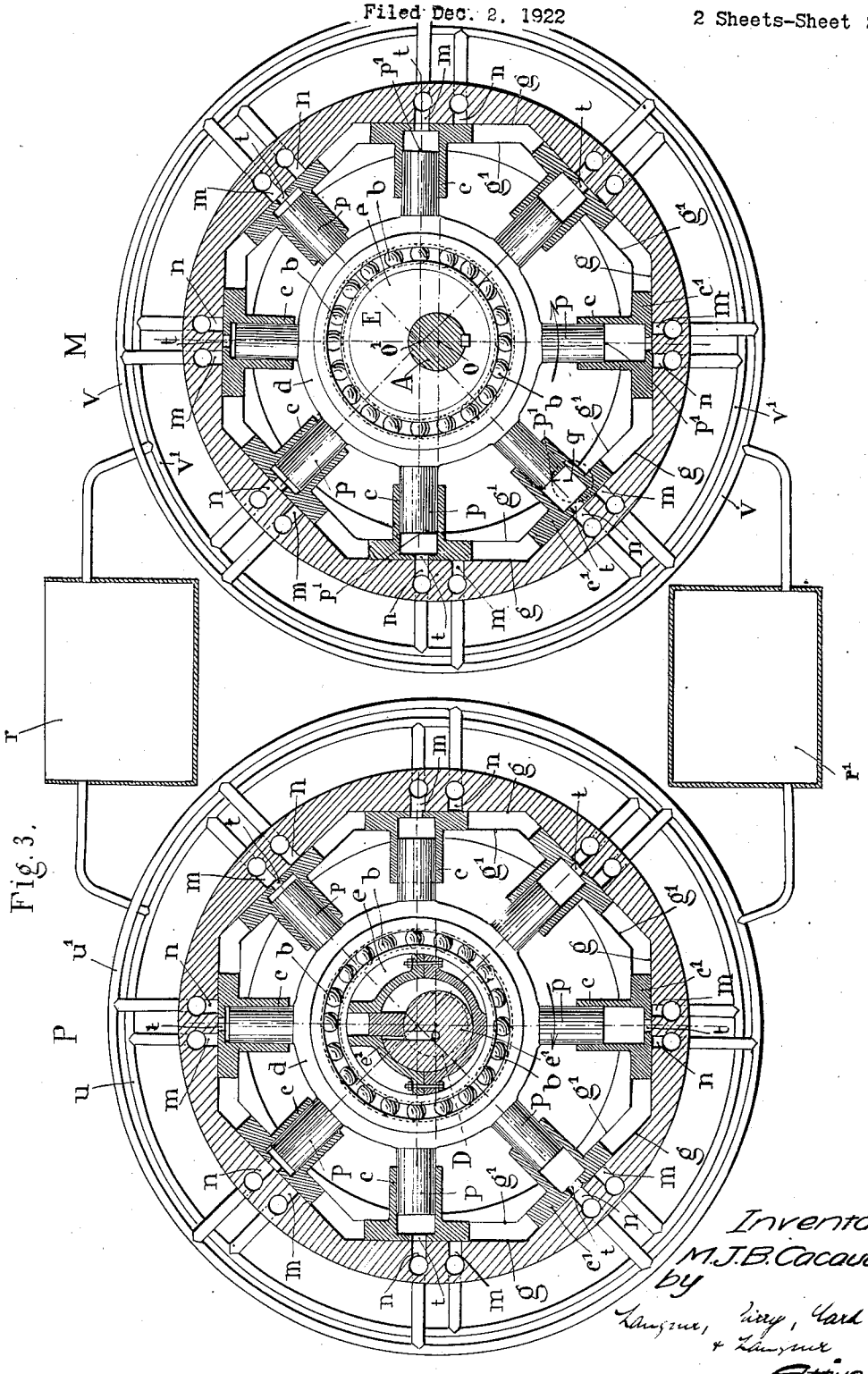


Fig. 3.

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UNITED STATES PATENT OFFICE.

MARCEL JEAN BENJAMIN CACAUD, OF TOULON, FRANCE, ASSIGNOR OF ONE-HALF TO SOCIETE ANONYME DES FORGES ET CHANTIERS DE LA MEDITERRANEE, OF PARIS, FRANCE, A CORPORATION OF FRANCE.

HYDRAULIC TRANSMISSION.

Application filed December 2, 1922. Serial No. 604,601.

To all whom it may concern:

Be it known that I, MARCEL JEAN BENJAMIN CACAUD, citizen of the French Republic, residing at 6 Avenue Vaulan, Toulon, Department of Var, France, have invented certain new and useful Improvements in Hydraulic Transmissions, of which the following is a specification.

My present invention relates to a hydraulic transmission comprising in combination a pump, a motor and conduits interconnecting the same to cause continuous flow of liquid between the said pump and motor, the pump comprising a rotary shaft, an eccentric on said shaft, and a plurality of pistons actuated by said eccentric and working in cylinders.

My transmission is intended to allow the utilisation of the power of a driving shaft, revolving at constant speed or at definitely varying speed, upon a driven shaft, the speed of which can be varied according to the resistance opposed to the driving power. The output of the pump is regulated by varying the eccentricity of said pump; to that end, the eccentric actuating the pistons of the pump comprises two eccentric members of which one is fixed on the driving shaft and the other rotatably movable relatively to the first, the relative rotation of these two eccentric members affording the resultant eccentricity desired.

This movement of relative rotation of the two eccentric members of the pump is obtained automatically in accordance with the variation of load of the motor, in such a way that the eccentricity of the pump always assumes the value required to overcome the resistance of the motor.

The motor may be similar to the pump, except that the eccentricity of the eccentric of the former is invariable.

My invention is hereafter described with reference to the accompanying drawings, in which:

Fig. 1 is longitudinal section, and

Fig. 2 a transverse section of a pump used in the hydraulic transmission.

Fig. 3 is a part diagrammatic transverse section of the whole hydraulic transmission.

Fig. 4 is a detail view on an enlarged scale of a part of Fig. 3, showing the means for automatically varying the eccentricity of the pump.

As shown in Figures 1 and 2, an eccentric e is keyed upon a shaft a revolving about an axis o at constant speed; upon this eccentric there is mounted a ball bearing b, the outer face of which is secured to a crown d carrying radially a suitable number of pistons p, having the same diameter and with their axes passing through the centre o^1 of the eccentric e.

Upon these pistons p are mounted the cylinders c, the ends of which are enlarged to form feet c^1 arranged at right angles to the axes of the cylinders and adapted to move between the plane surfaces of fixed slide-ways and covers g g^1; these slide-ways form a regular polygon having for centre the axis o of the shaft a around which the eccentric e revolves, the number of sides in the polygon being equal to the number of pistons p.

It is known that if the shaft a revolves, carrying with it the eccentric e, and if the crown d is compelled to describe a translatory movement in which any straight line connected to this crown d must remain a parallel to itself, any point p^1 upon a piston p integral with this crown will describe a circle of radius equal to $o\ o^1$, about a fixed centre q, such that $p^1\ q$ is parallel to $o\ o^1$.

This known principle is carried into effect in the present case, because the axes of the cylinders c, guided by the slide-ways g g^1, are always parallel to the same direction; the crown d therefore describes the defined circular movement of translation.

The extremity p^1 of each piston describes its circle by compelling its cylinder c to move upon its slide-way g, the latter movement being identical to that of a slide valve set at 90° advance; it is at its mid-travel position when the piston is at the end of its stroke. This movement can thus be utilised for the distribution.

Consequently if t is an orifice or port in the head of the cylinder, m and n two other orifices formed in the slide-way g, the first of which communicates with a reservoir of liquid not subject to pressure, and the second with a reservoir of liquid under pressure, it will be seen that the piston p draws in liquid through the orifice m and forces it out through the orifice n; the same will apply for each of the pistons with the sole difference that the suction and delivery are

timed correspondingly to the varying inclinations of the cylinders.

At a given moment, all the cylinders which lie on the side of the straight line $o\ o^1$ in the direction of movement are on the delivery stroke, the others being on the suction stroke.

There has thus been formed a rotary pump without a special distributing slide valve.

As represented in Fig. 3, the hydraulic transmission includes a pump P and a motor M, each one of which comprises a series of pistons p, slidable in the cylinders c, the closed ends of which cylinders form distributing slide valves, by means of their sliding movement between the slide-ways $g\ g^1$.

The parts m and n of the pump P are respectively connected to headers $u\ u^1$, and the parts m and n of the motor M to headers v, v^1. The header u is connected to a tank r not under pressure, and the header u^1 to a tank r^1, under pressure The tank r is connected to the header v^1 and the tank r^1 to the header v.

The eccentric E, with center at o^1, of the motor M, is fixed to the driven shaft A, turning about axis O.

The eccentric of the pump P, which is fixed to the driving shaft D, comprises two eccentric elements (see Fig. 4) the first of which, e^1 is keyed to the driving shaft D, and has an eccentricity $o\ o^1$ equal to one half of the maximum necessary. Around this eccentric there is revoluble a second eccentric e^2, of which the centre o^2 is such that when $o\ o^1$ and o^2 are in a straight line, $o^2\ o$ is equal to twice $o\ o^1$, the total eccentricity in these conditions being $o\ o^2$.

If the eccentric e^2 is revolved around the eccentric e^1, the centre o^2 describes a circle around o^1; to each position of the eccentric e^2 there corresponds a varying total eccentricity, which will be nil when the eccentric e^2 has turned through 180° around the eccentric e^1.

It suffices therefore, in order to vary the eccentricity, to revolve the eccentric e^2 around the eccentric e^1 by the desired amount.

To automatically produce a relative rotary movement of the two eccentric elements e^1, e^2, so as to assure, at all time, a resulting eccentricity corresponding to the value of the charge of the motor, the following arrangement is used. Between the eccentric elements e^1, e^2, (Fig. 4) is a space l, and a slide valve f, separating this space into two parts, the vane being guided in the eccentric e^2 so as to be able to withdraw into the same.

The reaction of the pump pistons tends constantly to return the eccentric e^2 to the position of maximum eccentricity; if then by means of the passage f^1 formed in the eccentric e^1, the liquid under pressure is conveyed behind the vane f in the space f^2, the eccentric e^2 will tend to revolve in relation to the eccentric e^1 according to the value of the pressure thus conveyed, and the sectional area corresponding to the length $l^1\ l^2$ of the vane projecting into the cavity l.

The shape of the cavity l and the value of the pressure may be combined in such a way that to any given pressure of delivery from the pump there will correspond a state of equilibrium of the eccentric e^2 in relation to the eccentric e^1, with the corresponding resultant eccentricity.

In particular, if equilibrium exists for the minimum resistance, with the maximum eccentricity o^2, o, and a pressure within the space f^2 such that this pressure is that of the delivery, less a fixed amount, this pressure will increase proportionally more rapidly than the delivery pressure; consequently, when this latter increases, the eccentric e^2 will revolve and the useful area of the vane decreasing as a result of the shape of the cavity, there will be established a position of equilibrium of e^2 with a resultant eccentricity which can be determined in advance.

In this way variation of the speed of the driven member will take place automatically according to the resistance.

What I claim is:

1. A hydraulic transmission apparatus including, in combination, a pump, a motor, conduits connecting the pump and motor to cause continuous liquid flow between the said pump and motor, said pump comprising a rotary shaft, an eccentric on said shaft, a plurality of pistons actuated by said eccentric, cylinders in which said pistons work, the eccentric comprising two eccentric members having different centers, of which one is fixed on the said rotary shaft and the other rotatably movable relatively to the first, said eccentric members having a space therebetween, a part fast with the fixed eccentric member and bounding said space at one end, a part of the movable eccentric member bounding said space at the other end, and means for conveying into this space, a liquid under pressure to rotate the movable eccentric member relatively to the fixed eccentric member, for the purpose described.

2. A hydraulic transmission apparatus including, in combination, a pump, a motor, conduits connecting the pump and motor to cause continuous liquid flow between the said pump and motor, said pump comprising a rotary shaft, an eccentric on said shaft, a plurality of pistons actuated by said eccentric, cylinders in which said pistons work, the eccentric comprising two eccentric members having different centers, and of which one is fixed on the said rotary shaft and the other rotatably movable relatively to the first, and parts fast with the fixed ec-

centric member and bounding at one end a space of variable sectional area provided between the said eccentric members, a slide member guided in the movable eccentric member and bounding said space at the other end, and means for conveying into said space a liquid under a pressure proportional to the delivery pressure of the pump to rotate the movable eccentric member relatively to the fixed eccentric member, for the purpose described.

3. In a hydraulic transmission as claimed in claim 1, an eccentric collar positioned on the variable eccentric comprising the two eccentric members, the pistons of the pump being radially fixed upon said eccentric collar, a stationary regular polygon having plane surfaces and having its center upon the axis around which the eccentric revolves, said plane surfaces constituting slide-ways for the ends of said cylinders, and having ports connected to the suction and delivery conduits of the pump, and each of said cylinder ends having a port adapted to cooperate with the said ports to control the suction and delivery of the said pump.

4. In a hydraulic transmission as claimed in claim 2, an eccentric collar positioned on the variable eccentric comprising the two eccentric members, the pistons of the pump being radially fixed upon said eccentric collar, a stationary regular polygon having plane surfaces and having its center upon the axis around which the eccentric revolves, said plane surfaces constituting slide-ways for the ends of said cylinders, and having ports connected to the suction and delivery conduits of the pump, and each of said cylinder ends having a port adapted to cooperate with the said ports to control the suction and delivery of the said pump.

In testimony whereof I have signed my name to this specification.

MARCEL JEAN BENJAMIN CACAUD.

Witnesses:
JULES LARLONG,
PAUL PAOLI.