

M. BARBAROU.
HYDRAULIC CHANGE SPEED GEAR.
APPLICATION FILED DEC. 8, 1910.

1,044,846.

Patented Nov. 19, 1912.

4 SHEETS—SHEET 1.

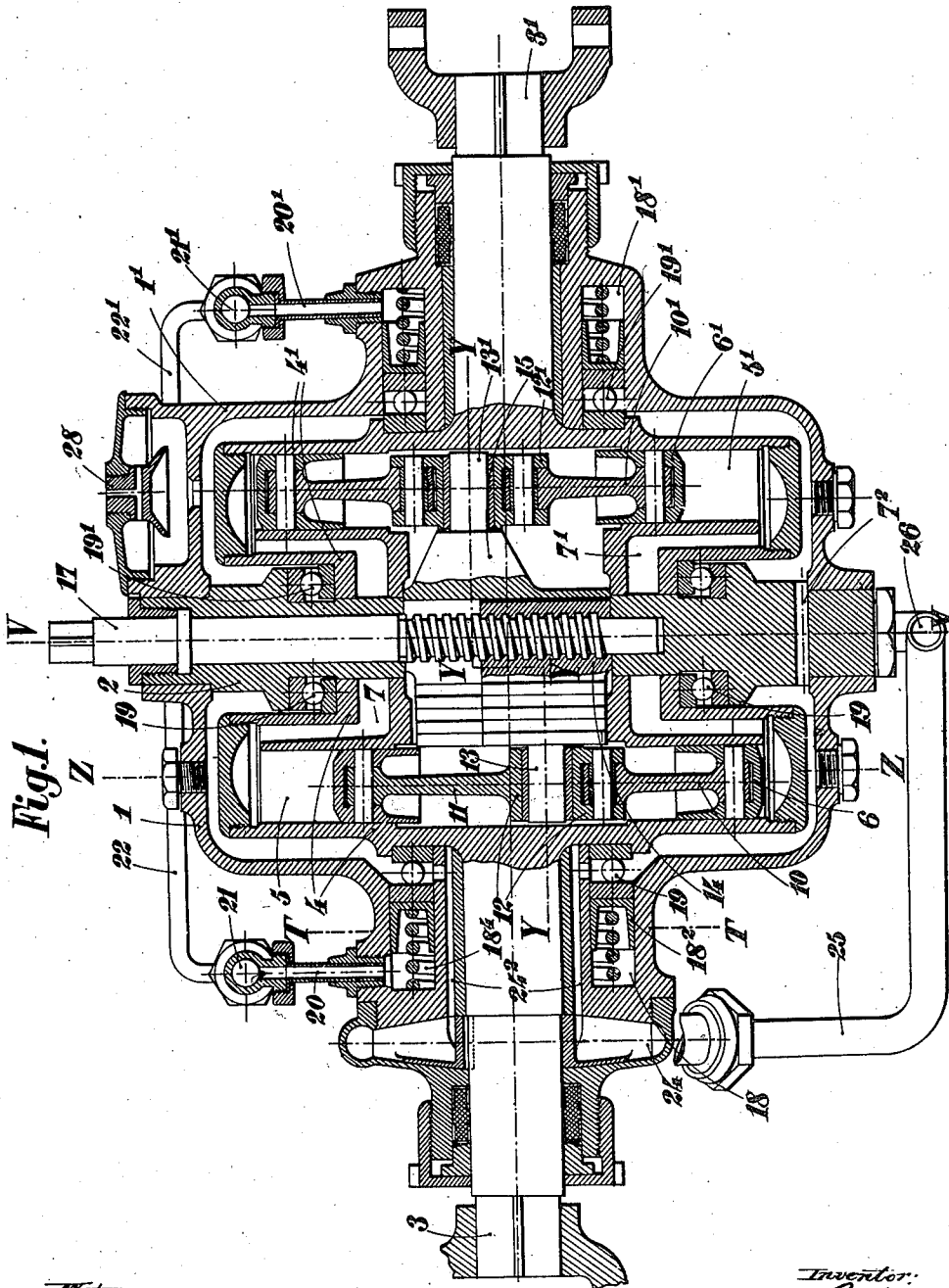


Fig. 1.

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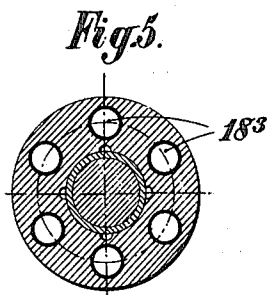
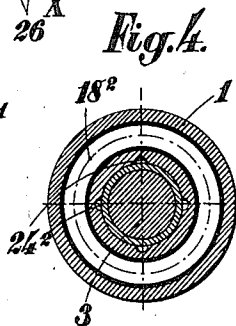
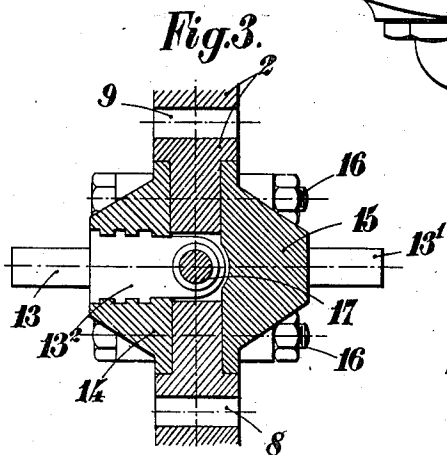
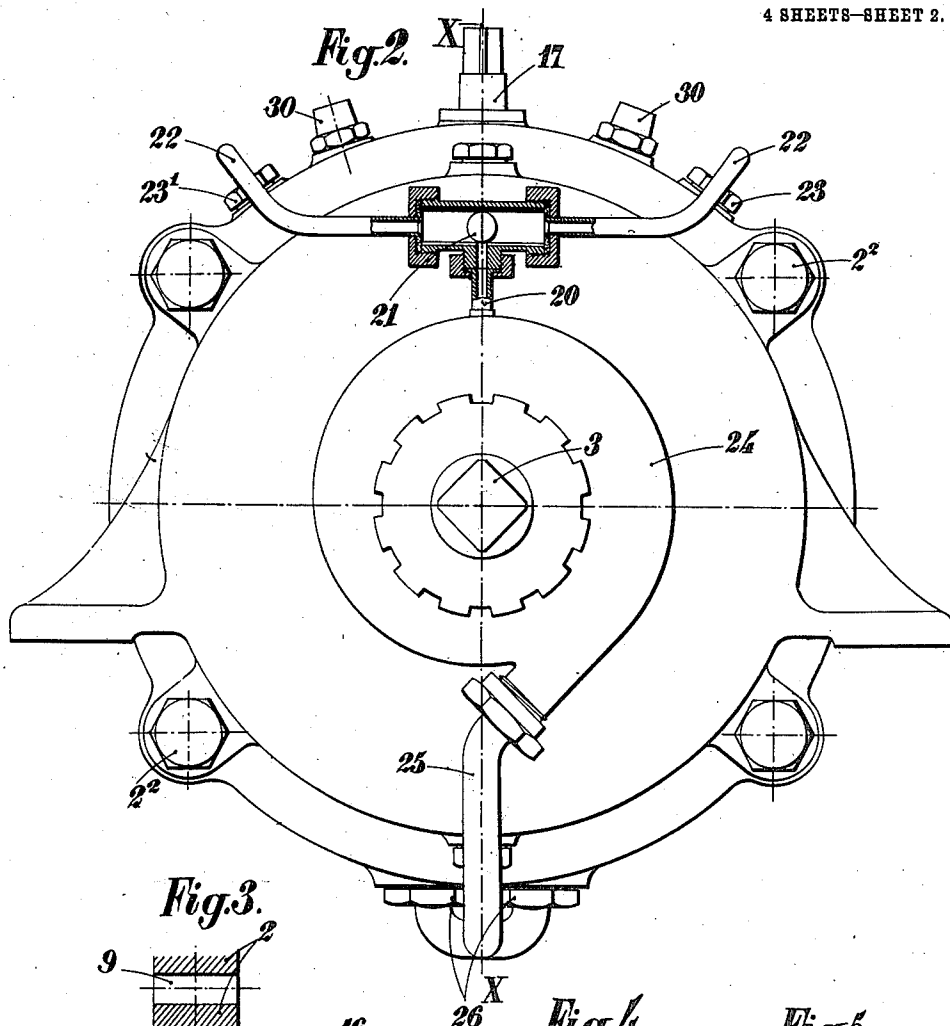
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4 SHEETS—SHEET 2.



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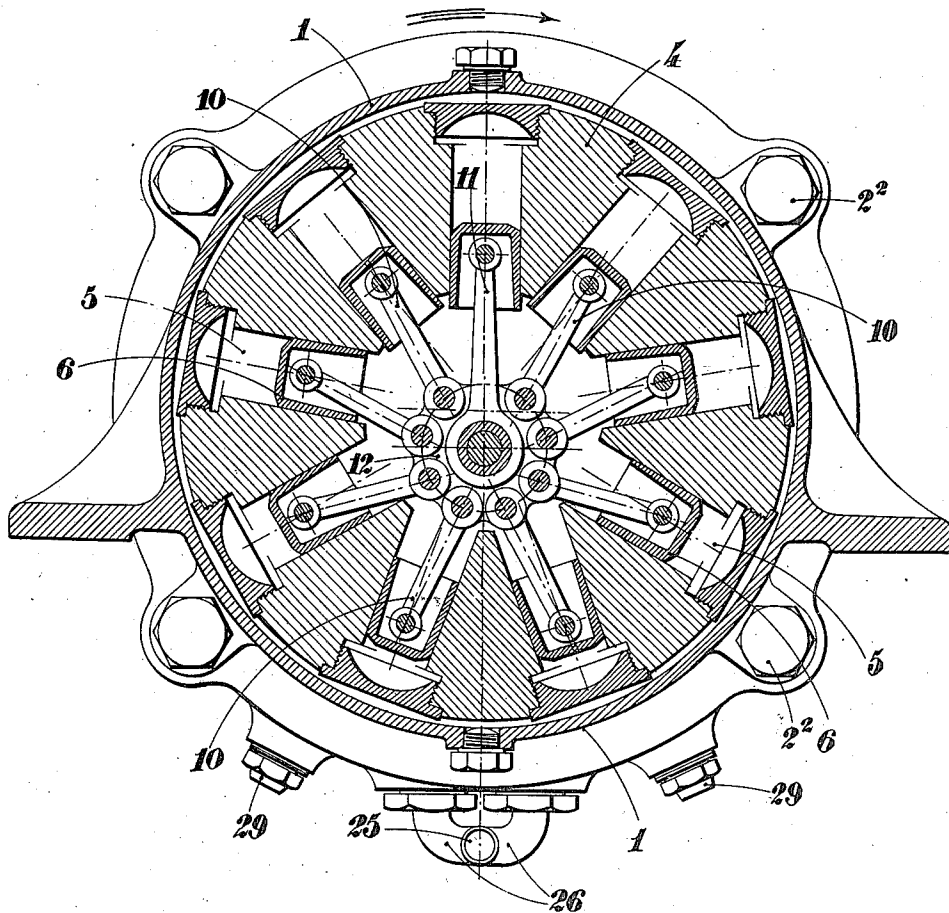
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4 SHEETS—SHEET 3.

Fig. 6.

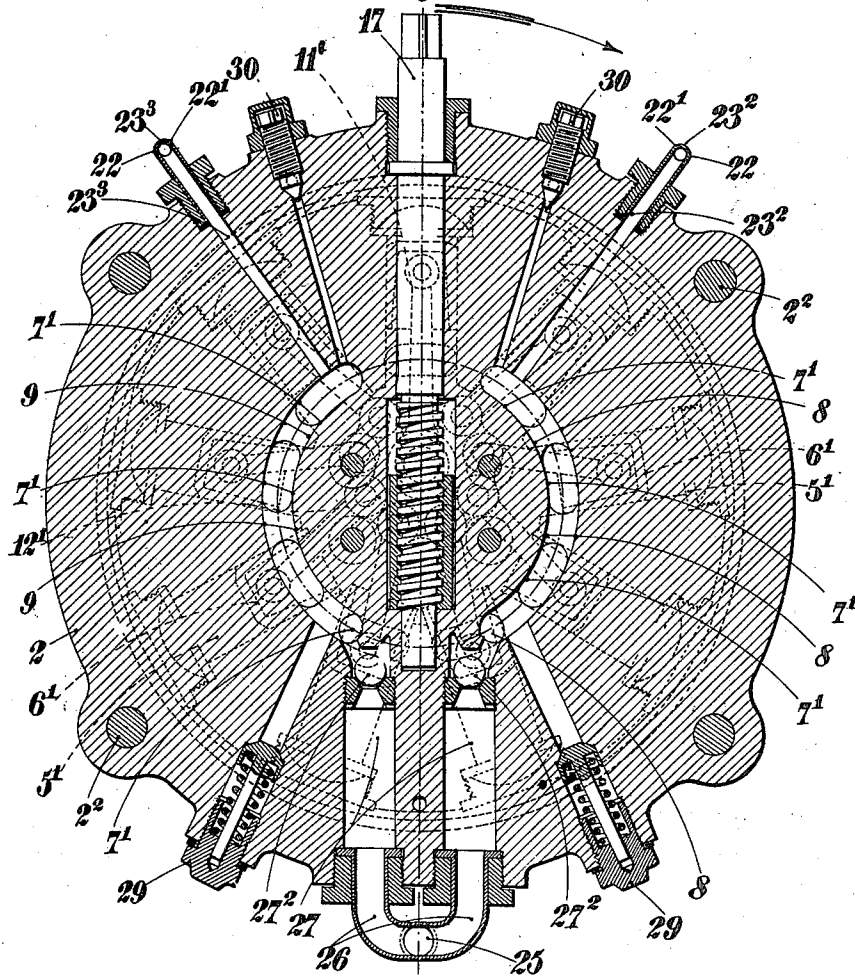


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Fig. 7.



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UNITED STATES PATENT OFFICE.

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HYDRAULIC CHANGE-SPEED GEAR.

1,044,846.

Specification of Letters Patent.

Patented Nov. 19, 1912.

Application filed December 8, 1910. Serial No. 596,213.

To all whom it may concern:

Be it known that I, MARIUS BARBAROU, a citizen of the French Republic, residing at St.-Denis, Department of the Seine, in France, have invented certain new and useful Improvements in Hydraulic Change-Speed Gear; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to a hydraulic apparatus which on being given a constant speed of rotation from any convenient source of power is capable of transmitting this same power almost integrally at speeds variable at will and in either direction. This apparatus is constituted by two systems of pumps formed by rotary cylinders arranged starwise and attached to the driving and driven shafts; the driving system forces oil into the driven system. The pistons of the driven system have an invariable stroke while the stroke of the pistons of the driving system can be modified at will, the variations of speed of the driven shaft being obtained by modifying this stroke.

An embodiment of the invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a section on the line X—X in Fig. 2. Fig. 2 is an end elevation on the driving shaft side. Fig. 3 is a section on the line Y—Y—Y—Y in Fig. 1. Fig. 4 is a section on the line T—T in Fig. 1. Fig. 5 shows a modification of the device represented in Fig. 4. Fig. 6 is a section on the line Z—Z in Fig. 1 looking toward the right. Fig. 7 is a section on the line V—V in Fig. 1 looking toward the right.

The apparatus consists of three main parts: (1) The front part comprising a system of rotary cylinder pumps the pistons of which are united by connecting rods with a crown rotating upon a fixed stud which can be rendered more or less eccentric, in such a manner as to modify the stroke of the pistons. (2) The rear part comprising a system of rotary cylinder pumps the pistons of which are connected in a similar manner

with a fixed stud and effect an invariable stroke. (3) The median part comprising a distributing plate for the liquid and in which the mechanism producing the variation of the stroke of the pistons of the pumps of the front part is mounted.

The front part comprises a casing 1 (Fig. 1) ending at one of its extremities in a surfaced face applied to the corresponding surfaced face of the distributing plate 2 with which it makes a joint. The other end forming a bearing permits of the free passage of the driving shaft 3, to which a disk 4 is secured; an uneven number of radiating recesses 5 are formed in the thickness of this disk constituting cylinder bodies for the reception of the pistons 6, 6. The disk 4 is furnished with oil passages which proceed from the cylinders 5 to oblong orifices 7 (Figs. 1 and 7) that move during running opposite two semi-circular orifices 8, 9 (Figs. 3 and 7) formed in the distributing plate 2. The passages 7 communicate alternately with the passages 8 or 9 during rather less than a half revolution.

The rear part of the apparatus comprises parts similar to those of the front portion and they are provided with the same reference numerals plus the index 1; the passages 8 and 9 are common to the conduits 7, 7 and 7¹, 7¹. The two casings 1, 1¹ are fixed to the distributing plate 2 by the bolts 2² 2². The contact faces of the disks 4, 4¹ and of the plate 2 are surfaced in such a manner as to insure a perfect joint during the rotation of the disks 4, 4¹. In the cylindrical bores 5, 5 the single acting pistons 6, 6 have their connecting rods 10, 10 pivoted around a crown 12 rotating upon a stud 13 eccentric relatively to the axis of the driving shaft 3 with which it is parallel. This crown 12 is formed by the head of a connecting rod 11 of one of the cylinders. All the front cylinders rotate with the shaft 3 and the strokes of the pistons are regulated by the eccentricity of the stud 13. Upon the distributing plate 2 the parts 14 and 15 (Figs. 1 and 3) are fitted being secured by the bolt 16. The stud 13 forms part of a nut 13² guided radially in the part 14 by multiple tongues and grooves; this nut can

be operated from the exterior by means of the screw 17 which enables the stroke of the pistons 6, 6 to be modified during running.

The stud 13¹ of the driven system mounted upon the part 15 is parallel with the driven shaft 3¹ which is in line with the shaft 3. This stud 13¹ the position of which is fixed is eccentric relatively to the shaft 3¹; it guides the pistons of the cylinders of the rear portion of the apparatus, the stroke of which is invariable; these cylinders rotate with the shaft 3¹ upon which the disk which carries them is fixed. The head of one of the rods 11¹ (Fig. 1) forms a crown 12¹ upon the periphery of which the other rods 10¹ 10¹ are pivoted.

An annular recess 18 (Fig. 1) is formed around the bearing of the shaft 3 and receives inside a cupped leather 18² subjected to the pressure of the oil delivered by the variable supply pumps with the object of insuring the adherence of the disk 4 against the distributing plate 2. A similar arrangement exists around the bearing of the driven shaft 3¹. A ball bearing 19 or 19¹ is interposed between the disk 4 or 4¹ and the hydraulic joint on the one hand and between this disk and the distributing plate 2 on the other hand. The latter bearing also serves to center the point of support of the disk 4 or 4¹ on the distributor 2.

The cupped leather 18² (Fig. 4) can be replaced by pistons 18³ 18³ (Fig. 5) located in a fixed bottom of the cavity 18 or 18¹ which forms a good joint, thereby enabling the pressure with which the disks 4, 4¹ bear upon the fixed plate 2 to be regulated.

The oil is conducted under pressure into the recesses 18 and 18² (Figs. 1 and 2) through pipes 20 or 20¹; each of these pipes is surmounted by a valve box 21 or 21¹ from which the pipes 22 or 22¹ ending at the radial conduit 23² or 23³ (Fig. 7) proceed; these conduits are formed in the thickness of the distributing plate 2. The conduit 23² communicates with the semicircular orifice 8 and the conduit 23³ with the semicircular orifice 9. The valve 21 or 21¹ closes the orifice opposite the pipe through which the oil under pressure enters the valve casing from the orifice 8 or the orifice 9. A spring 18⁴ insures sufficient initial pressure for maintaining all the parts in contact when there is no pressure in the apparatus.

A centrifugal pump 24 (Figs. 1, 2 and 7) fitted to the end of the casing 1, its pallets being mounted upon the shaft 3, draws oil from the front casing around the disk 4 through the ball bearing 19 then through the passages 24² formed around the bearing of the shaft 3. This pump forces the oil through a pipe 25 then through the pipes 26, 26 into the passages 27, 27 formed in the thickness of the distributing plate 2 to the semicircular orifices 8 and 9 inside which

there is a non-return valve 27². The object of this pump is to keep the orifices 8 and 9 always full of oil. A filling plug 28 is provided at the top of the rear casing; the latter is in communication with the front casing through an orifice 7² (Fig. 1) formed at the lower part of the distributing plate 2.

29, 29 are safety valves in communication with the orifices 8 and 9 for discharging them when the pressure exceeds the limit fixed.

30, 30 are pin screws for releasing the air which might accumulate in the upper parts of the orifices 8 and 9. They are blocked during the operation of the apparatus.

The apparatus acts in the following manner: All the pumps are single acting, the suction and forcing phases take place alternately through the conduits 7 7 for the motor pumps and through the conduits 7¹ 7¹ for the driven pumps. Assuming that the stud 13 occupies the position shown in Fig. 1 which is diametrically opposite to the fixed stud 13¹ the piston of the cylinder arranged at the top of Fig. 6 is at the lower dead center; consequently the piston of the driven cylinder at the top of Fig. 7 is at the upper dead center. The movement of rotation of the driven shaft 3 taking place in the direction indicated by the arrow, Fig. 6 when the cylinders descend to the right the driving pistons exert a forcing action in the conduits 7, 7 communicating with the semi-circular orifice 8. The conduits 7¹ 7¹ of the driven cylinders are in communication with this same orifice 8. These cylinders are also on the right hand in Fig. 7 and receive the oil under pressure; the pistons press upon the fixed stud 13 and by reaction upon the ends of the cylinders 5¹ 5¹; the disk 4¹ rotates in the direction indicated by the arrow in Fig. 7. The disk 4¹ and the driven shaft 3¹ rotate in the same direction as the disk 4 and the shaft 3.

When the driving cylinders pass beyond the vertical at the bottom of Fig. 6 and re-ascend to the left the pistons exert suction and the conduits 7 7 come in front of the semi-circular orifice 9 over which they slide in rising. At the same time the driven cylinders pass to the bottom of the same vertical line Fig. 7; they are full of oil under pressure and as soon as their conduit 7¹ comes in front of the semi-circular orifice 9 they force the oil that they contain to the induction pipe of the driving cylinders. During this time other driving cylinders drive the driven cylinders which descend to the right and the movement of rotation continues in the same direction for the two shafts 3 and 3¹. If the axis of the stud 13 is brought back into the axis of the shaft 3 the stroke of the driving pistons is zero; they do not transmit any thrust to the pistons of the driven cylinders and the

shaft 3¹ stops. If the displacement of the stud 13 be continued in the same direction it will be eccentric in the same direction as the stud 13¹; the piston of the driving cylinder arranged at the top of Fig. 6 will be at the upper dead center and will begin to exert suction as the cylinders will descend to the right, the movement of rotation being still in the direction of the arrow in Fig. 6; the same applies to all the driving cylinders which move downward. The conduits 7 7 of these cylinders come in front of the semi-circular orifice 8 which will become the suction orifice. On the other hand the pistons of the cylinders which ascend to the left exert a forcing action through the conduits 7 7 into the semi-circular orifice 9 which becomes the delivery orifice. The driven cylinders the orifices 7¹ 7¹ of which communicate with the orifice 9 are the left hand cylinders; their pistons, under the influence of the efforts exerted move away from the ends of these cylinders, the reaction of the thrust upon the ends of these cylinders produces the rotation of the shaft 3¹ in the opposite direction to the arrow Fig. 7 and the driven cylinders descend to the left. The right hand driven cylinders ascend; the conduits 7¹ 7¹ communicate with the orifice 8 which receives the oil discharged by the cylinders and supplies it to the driving cylinders which exert suction in descending to the right; the movement continues and the shaft 3¹ rotates in the opposite direction to the movement of the shaft 3.

In either direction the speed of rotation of the shaft 3¹ is caused to vary by varying the eccentricity of the stud 13, the speed of the shaft 3 remaining constant. The speeds in one direction or the other of the driven shaft 3¹ relatively to the constant speed of the driving shaft 3 are in the ratio of the deliveries per revolution of the driving pumps; they may vary from zero when the axis of the stud 13 coincides with the axis of the shaft 3 to a maximum corresponding to the position of the stud 13 most distant from the axis of rotation. The disk 4 constitutes in reality the casing of a rotary cylinder pump, and the disk 4¹ constitutes the casing of a rotary cylinder motor adapted to be driven by the aforesaid pump.

One of the important features of the invention resides in the fact that the pump and motor may be placed in quite direct communication with each other by means of the substantially semi-circular openings 8 and 9 which are cut in the distributor plate near the axis of the whole device.

A further important advantage arises from the arrangement of the thrust chambers 18, 18¹ adapted to be filled with fluid under pressure for holding the pump and motor casings tightly against the central

distributor plate, the said thrust chambers being preferably supplied with liquid from the semi-circular openings 8, 9 by way of the ducts 23² 23³ respectively.

A still further advantageous feature of the construction is the provision and arrangement of the auxiliary pump 24 which draws oil through the bearings and supplies it to the interior of the device, preferably at the lower ends of the aforesaid semi-circular openings. This auxiliary pump, in keeping said openings full of oil, prevents the formation of a vacuum in the interior of the clutch mechanism and therefore enables the clutch to operate at high speeds without being subjected to shocks.

I claim:

1. A hydraulic transmission mechanism, comprising a rotary cylinder pump having a casing, a rotary cylinder motor having a casing, a distributor plate interposed between said casings, and means to maintain the respective casings in tight contact with said distributor plate by the thrust of a fluid external to said pump and motor.

2. A hydraulic transmission mechanism, comprising a rotary cylinder motor, a rotary cylinder pump, a distributor plate interposed between the motor and pump, and thrust chambers to maintain the motor and pump in contact with the distributor plate, supplied with fluid from the interior of the device.

3. In a hydraulic transmission mechanism, the combination of a distributor plate having an opening through the same, a rotary casing comprising a plurality of cylinders, pistons in said cylinders, a shaft connected to said cylinders, a thrust chamber to hold said casing in tight contact with said distributor plate, there being passages leading from the several cylinders and adapted to register with the aforesaid opening in said plate, and a fluid connection between said opening and said thrust chamber.

4. In a hydraulic transmission mechanism, the combination of a pump having a rotary casing, a motor having a rotary casing, a distributor plate interposed between said casings and having openings to establish communication between the motor and pump, thrust chambers associated with the pump and motor respectively, to hold them in contact with said distributor plate, and fluid connections between said thrust chambers and the aforesaid openings in said distributor plate.

5. A hydraulic transmission mechanism, comprising a rotary cylinder pump, a rotary cylinder motor, a distributor plate interposed between the pump and motor and having openings to establish communication between the pump and motor, a casing inclosing the pump and motor and forming passages therewith, and an auxiliary pump to

draw fluid from said passages and return it to the openings of the distributor plate.

6. A hydraulic transmission mechanism comprising a rotary cylinder pump, a rotary
5 cylinder motor, a distributor plate interposed between the pump and motor and having means to establish communication between the pump and motor, a casing inclosing the pump and motor and forming pas-
10 sages therewith, and means to draw fluid

through said passages and supply it to the aforesaid communication establishing means of the distributor plate.

In testimony whereof I affix my signature, in presence of two witnesses.

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Witnesses:

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