C. R. PRATT.

PUMP.

APPLICATION FILED APR. 18, 1910.

1,019,521.

Patented Mar. 5, 1912.

3 SHEETS—SHEET 1.

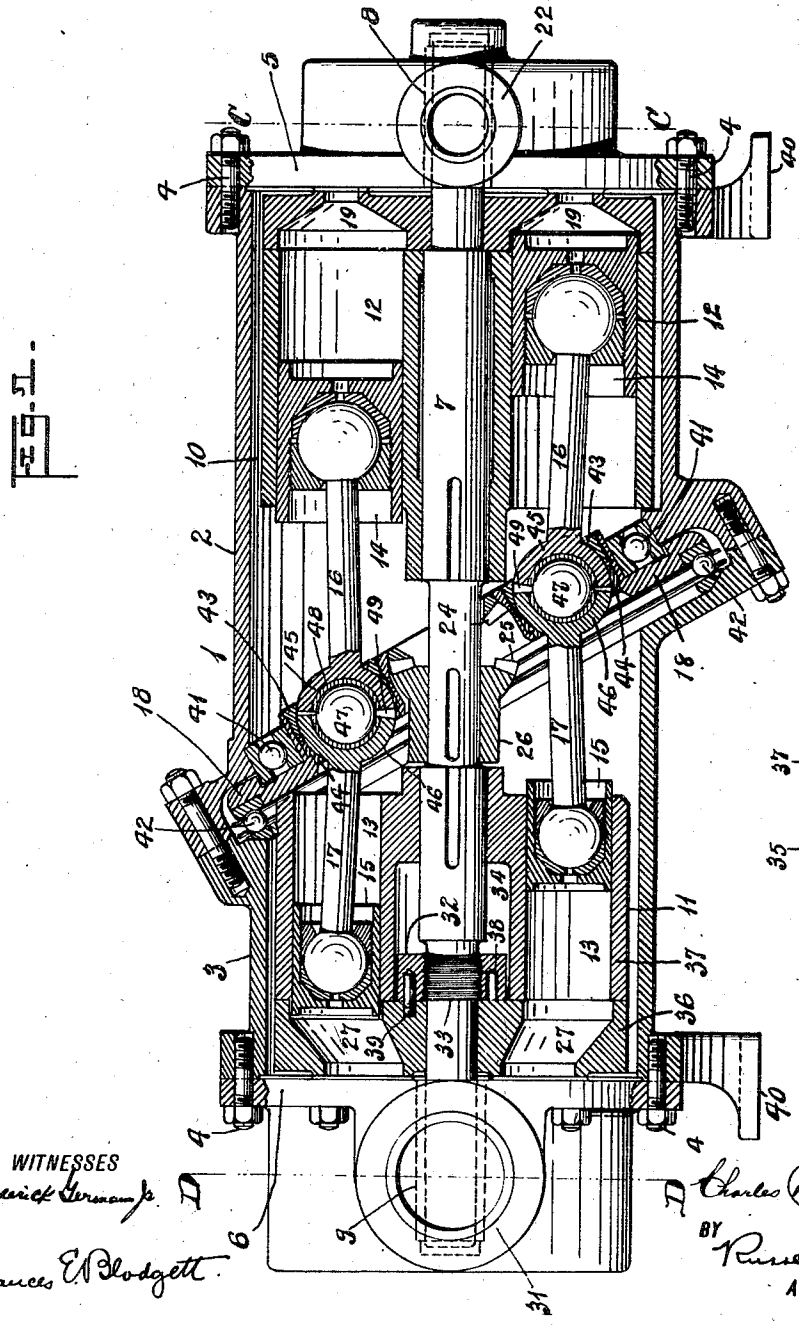

FIG. 1.

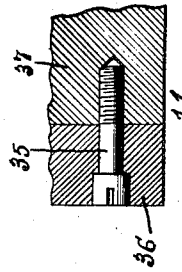

FIG. 2.

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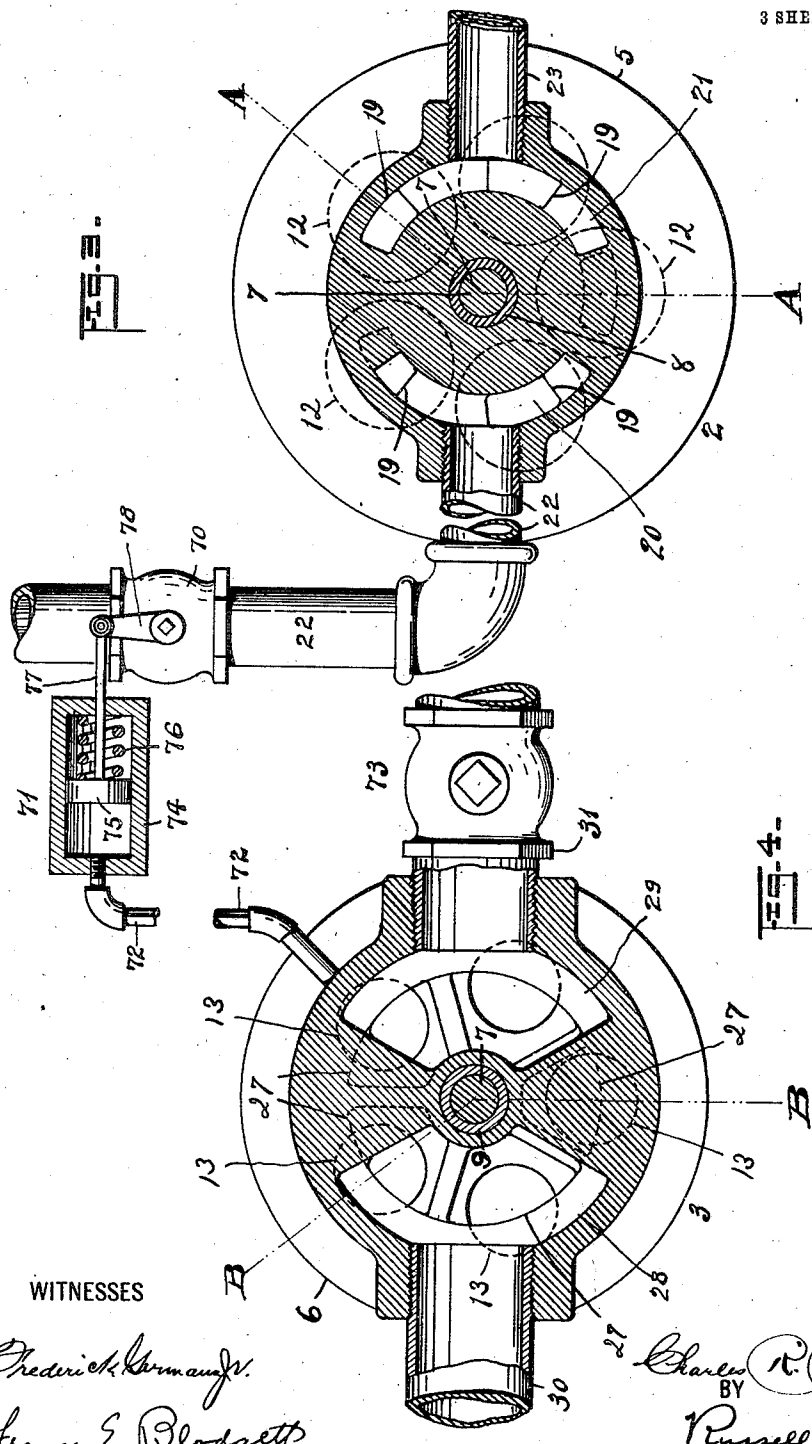

FIG. 3.

FIG. 4.

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3 SHEETS—SHEET 3.

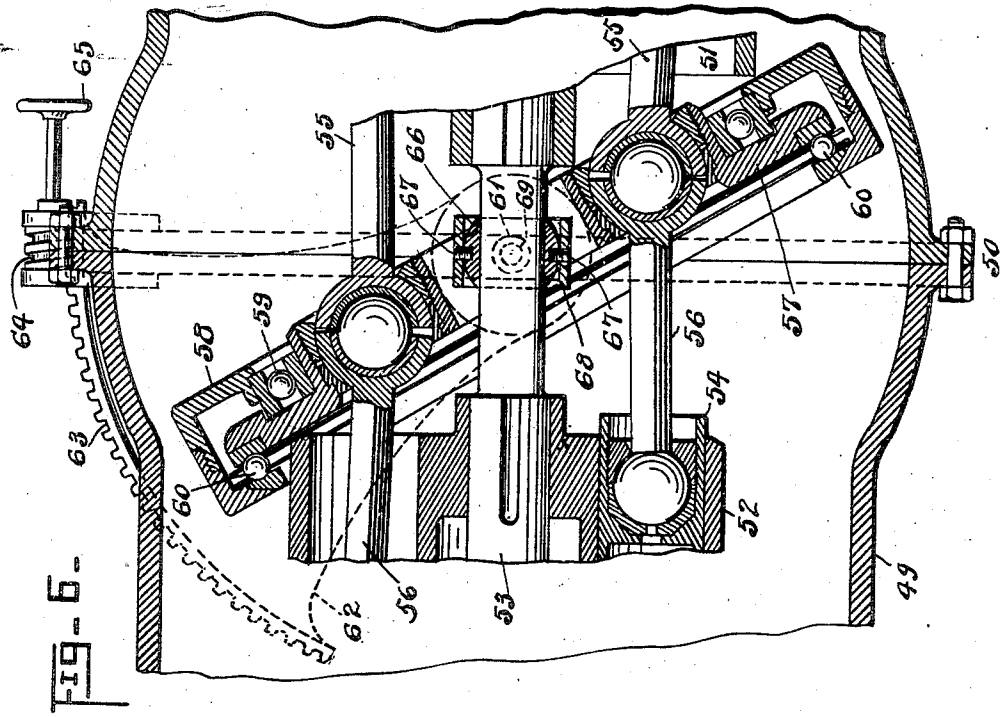

FIG. 6.

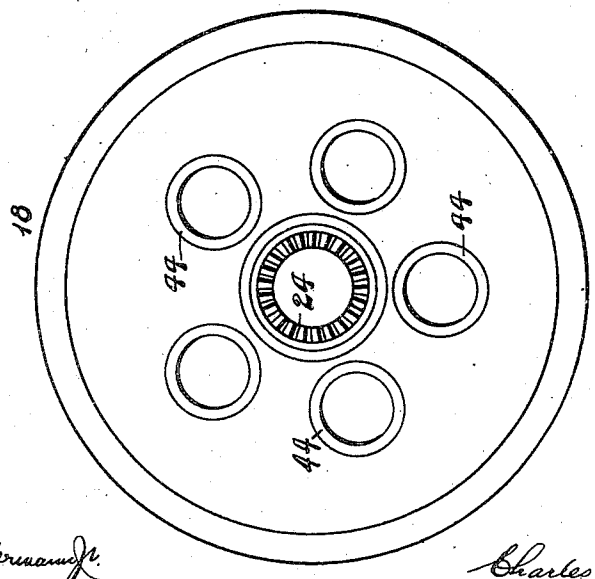

FIG. 5.

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PUMP.

1,019,521. Specification of Letters Patent. Patented Mar. 5, 1912.

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To all whom it may concern:

Be it known that I, CHARLES R. PRATT, a citizen of the United States, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain Improvements in Pumps, of which the following is a specification.

The objects of this invention are to provide improved means for transmitting motion from one fluid under pressure to another; to this end to provide for each fluid a rotary barrel with annular series of pistons and means for connecting the pistons of one barrel to those of the other; to so connect said pistons that they reciprocate in pairs consisting of a piston in each barrel; to provide means for rotating the barrels in unison; to provide means for restricting the motion of said pistons resulting from their reciprocation and the rotation of the barrels to an elliptical path; to enable such path to be varied on either side of a middle plane in which there is no reciprocation of the pistons; to cause the pumped fluids to move in continually forward directions and reduce loss of power from inertia and friction; to avoid corners and obstructions such as break up a current of fluid being pumped; to avoid the use of numerous valves; to obtain maximum efficiency; to secure a simple and compact construction, and to obtain other advantages and results as may be brought out in the following description.

Referring to the accompanying drawings, in which like numerals of reference indicate corresponding parts in each of the several figures, Figure 1 is a side view of a pump of my improved construction, showing the cylinder barrels in section on line A—A of Fig. 3 and line B—B of Fig. 4; Fig. 2 is a sectional detail illustrating the manner in which the end portion and body of certain barrels are secured together; Fig. 3 is a view of the power end of my improved pump with the end plate in section on line C—C of Fig. 1; Fig. 4 is a view of the work end of my improved pump the end plate being in section on line D—D of Fig. 1; Fig. 5 is a side view of a certain controlling disk, and Fig. 6 is a view similar to the middle part of Fig. 1, illustrating a modified construction which enables the angle of inclination of the controlling disk to be varied.

In said drawings, 1 indicates the casing of my improved pump, said casing being substantially cylindrical as shown and divided transversely into sections marked 2 and 3 in Figs. 1 to 5 inclusive. This casing has at its ends transverse plates which I have shown held in place by bolts 4, the end plate at the power end of the pump being marked with reference numeral 5, while the other one is marked 6. A shaft 7 is arranged axially of the cylindrical casing 1 with its opposite ends in bearings 8 and 9 provided therefor in the end plates 5 and 6, respectively, and upon this shaft are mounted barrels 10 and 11 each having an annular series of piston cylinders which are open at their ends toward the other barrel and have inlet and outlet ports at their opposite ends next the adjacent end plate of the casing. The cylinders of the barrel 10 at the power end of the pump are marked with reference numerals 12, while those of the other barrel 11 at the work end of the pump are marked with reference numeral 13, and in the cylinders 12 are pistons 14, while the pistons in the cylinders 13 are marked 15. The said barrels 10 and 11 are keyed upon the shaft 7 with their cylinders in alinement with each other, that is to say each cylinder 12 being in central longitudinal alinement with a cylinder 13. The pistons 14 and 15 in each pair of alined cylinders are furthermore connected, which connection I have shown in the drawings effected by rods 16 and 17 having their adjacent ends secured to a transverse disk 18 arranged across the chamber of the cylinder casing 1 between the barrels 10 and 11.

The ends of the cylinders 12 away from the disk 18 bear against the end plate 5 and have ports 19 opening out through said bearing surface. The end plate 5 has in its face next the cylinders 12 inlet and outlet ports 20 and 21 which extend along arcs of the circle in which the ports 19 of the cylinders 12 are disposed, being long enough to communicate with two or three cylinders at the same time, as shown in Fig. 3. The inlet port 20 of the end plate 5 is in communication with a pipe 22 for supplying pressure fluid, and the other port 21 has leading from itself an exhaust pipe 23. Obviously, the inlet 20 enables pressure fluid to be supplied to the cylinders, while the outlet 21 enables such fluid to be exhausted

from the cylinders. A reciprocating motion is thus given to the pistons 14 and since the outer ends of said pistons are held in the inclined transverse disk 18, this disk will be rotated upon well known principles. Such rotation of the disk 18 is transmitted through gear teeth 24 at its center meshing with other gear teeth 25 on a hub 26 fast upon the shaft 7, to said shaft, and said shaft being keyed to the barrels 10 and 11, as before stated, said barrels and disk all rotate in unison. Such rotation brings the port 19 of each cylinder 12 into alternate communication with the inlet 20 and outlet 21 of the pressure fluid supply, as will be understood.

The ends of the cylinders 13 away from the disk 18 bear against the end plate 6 of the casing and have ports 27 opening out through said bearing surface. The end plate 6 has in its face next the cylinders 13 inlet and outlet ports 28 and 29 which extend along arcs of the circle in which the ports 27 of the cylinders 13 are disposed, being long enough to communicate with two or three cylinders at the same time, as shown in Fig. 3. The inlet port 28 is in connection with a supply pipe 30, and the other port 29 has leading from itself a discharge pipe 31. This is the working or pump end of the casing, and as the barrel 11 turns its pistons 15 will draw in a fluid through the supply pipe 30 to force the same under pressure into the discharge pipe 31. A pressure fluid, as steam, applied at the power end of my improved pump will therefore enable another fluid, such as water, to be pumped at the other end of the device.

It will be understood that the two barrels 10 and 11 seat at their opposite ends or ends having ports, against the end plates 5 and 6, and said barrels are suitably spaced upon the center shaft 7 to secure the requisite contact for such seating. This is done by having a nut 32 upon a threaded portion 33 of the shaft 7, said nut being located in a cavity 34 of one of the barrels as 11 and adapted to abut against a shoulder of said barrel to hold it away from the other barrel, as clearly shown in Fig. 1. This nut 32 can be adjusted by taking out the fillister head screws 35, shown in detail Fig. 2 so that the end portion 36 of the barrel can be slid away from the portion 37. Furthermore, the nut 32 has an annular series of holes 38 any one of which may receive a pin 39 on the end portion 36 of the barrel when the latter is in place, to serve as a nut-lock.

The casing 1 can obviously be supported in any suitable manner desired, but I have shown it provided with feet 40 for purposes of illustration. In the operation of the device said casing is preferably filled with oil. For convenience, the cylindrical casing 1 may be divided transversely on the slanting plane in which the disk 18 lies, as shown in Fig. 1, and said disk preferably rotates in ball bearings 41 and thrust bearings 42 to reduce friction. At the center of the disk are the gear teeth 24, above described, and between said center and the periphery of the disk is an annular series of seats for the piston rods, as shown in Fig. 5. Each of these seats comprises bushings 43, 44, which form a concave seat for the outside surface of the cuplike ends 45, and 46 of the pistons 16 and 17. These cup-like ends inclose a solid steel ball 47 surrounded by Babbitt metal 48 or the like, and said cup-shape ends form outwardly a spherical surface broken only by the projecting pistons and by the encircling crevice 49 which allows a slight bending of the piston rods with respect to each other. This bending is caused by each point of connection of piston rods to the disk 18 traveling in an ellipse and not a true circle, because of the incline of the disk.

The purpose of the disk 18 is to cause the pistons to travel regularly in the same elliptical path in a fixed plane, when the controlling disk is in oblique relation to the axial shaft, and obviously if it were not employed each piston as soon as it received the pressure fluid would move longitudinally its entire stroke, then turn in a plane at right angles to the shaft 7 until it reached the point of exhaust when it would move outward for its entire stroke. Furthermore, the disk 18 serves as a convenient means for rotating the barrels 10 and 11 in unison, which rotation is essential to the operation of the device, and would not be so easily or accurately obtained in any other way.

Obviously the angle of inclination of the disk 18 to the shaft 7 determines the length of stroke of the pistons, and by arranging said disk so that it can be tilted to change such angle the length of stroke and consequently the work done by the pump can be varied at will. Furthermore, by tipping the guiding disk past a point at right angles to the shaft 7 into an inclined position on the other side of said plane, the direction of pumping would be reversed as well as the amount of pumping varied. I have shown such an adjustable controlling disk in Fig. 6 of the drawings, where 49 is a portion of a casing divided transversely into sections as at 50 and containing in its chamber barrels 51 and 52 upon a center shaft 53. These barrels have pistons, one of which in a barrel 52 is shown at 54, and said pistons have piston rods 55 and 56 each alined pair of which connect to the controlling disk 57 in the same manner already described in connection with Figs. 1 to 5 inclusive. This controlling disk 57 is mounted in a carrier 58 upon ball bearings 59 and thrust bearings 60, and this carrier is adapted to tip from a vertical position both backward and

forward upon horizontally projecting trunnions 61 at its opposite sides which find bearings upon the casing 49. Said casing 49 is shown bulged at and adjacent to the connection 50 of its sections, to permit the controlling disk to tilt, although of course this might be avoided by making the cylinder larger. One of the trunnions 61 of the carrier 58 projects through the wall of the casing 49 and has fast upon itself a radial arm 62 provided at its outer end with a rack 63 extending in an arc of the circle of which said arm is the radius. A screw 64 mounted in any convenient manner, as upon the outside of the casing 49 to be turned without longitudinal movement by means of a handle 65, engages said rack 63 to swing the arm 62 and thus the controlling disk. By this means the length of stroke of the pistons can be varied and also the direction of pumping reversed without changing the direction of pressure fluid supplied to the device.

At its center the controlling disk 57 is mounted upon the shaft 53 by means of a universal joint consisting of a collar 66 fast upon the shaft 53 and having opposite trunnions 67, 67 on which a sleeve 68 is pivoted, said sleeve 68 in turn having trunnions 69 in a diametric line at right angles to that of the trunnions 61, which trunnions 69 support the annular controlling disk 57.

Preferably the pressure fluid-supply pipe 22 is provided with a throttle valve 70 which is controlled by a pump governing valve 71 which is connected by a pipe 72 with the discharge end of the device or pump, a check valve 73 being also placed in the pump-discharge beyond the said pipe 72. Any suitable and well-known construction of governor may be employed, and I have merely shown for purposes of illustration a cylinder 74 into which the pipe 72 opens so that the pressure thus admitted will force a piston 75 backward against the power of a spring 76 to hold the valve 70 open, the rod 77 of said piston being connected to an arm 78 of the valve stem. In case the pump should lose its suction, for instance, or pumping should cease, the check valve 73 sustains the pressure already pumped up and the spring 76 moves the piston 75 to close the throttle valve 70 and shut off the supply of pressure fluid.

By my improved construction, the pressure of a pressure fluid is transmitted directly through pistons moving in an elliptical path to act directly upon another fluid to be pumped, and there is thus the least possible loss of energy by transmission. It should be noted in this connection that the controlling disk transmits no power, but simply compels all the pistons to move in the same elliptical path when said disk is in oblique relation to the axial shaft. Furthermore, in my improved pump there is no reciprocating movement given to either the pressure fluid or pumped fluid, such as there is in a reciprocating pump, nor any beating or churning of the fluid as in centrifugal pumps and the like, but the fluid moves in a continuously forward and uninterrupted flow along a path through the pump as free from friction as a large radius elbow. Again, I have avoided the use of valves and the consequent loss by wire drawing through them, and yet at the same time I secure a positive piston action, the result being that I obtain great efficiency and increased output per size, weight and cost of pump units.

The speed of the steam pistons should exceed the speed of the water pistons in order to obtain the greater possible efficiency, and it is also often the case that the water pressure required exceeds the available steam pressure so that the steam pistons need to have a greater area than the water pistons. In such a case the steam pistons can be located on a circle of greater radius than that on which the water pistons are located, thus giving said steam pistons greater speed and permitting them to be of larger area without unduly thickening the walls between the water cylinders. In this arrangement the steam pistons would of course not be in alinement with the water pistons nor connected to the disk one opposite another, as in the preferred construction, but such opposite relation is subordinate to the necessity for steam pistons of required area.

Having thus described the invention, what I claim is:

1. In a pump, two barrels in axial alinement each having an annular series of cylinders, fluid inlet and outlet means at one end of each barrel for the cylinders thereof, a controlling disk arranged between said barrels, pistons in the cylinders having rods projecting at the other ends of said barrels from the fluid inlet and outlet means and connected to said controlling disk, means for supplying fluid under pressure to one of said barrels, and means for holding said controlling disk in oblique relation to the axial line of said barrels.

2. In a pump, two barrels each having an annular series of cylinders, fluid inlet and outlet means for said cylinders at one end of each barrel, a controlling disk arranged between said barrels, pistons in the cylinders having rods projecting from the other ends of said barrels from the said fluid inlet and outlet means and connected to said controlling disk, means for holding said controlling disk in a plane oblique to the axial lines of both barrels, and means for supplying fluid under pressure to one of said barrels.

3. In a pump, two barrels each having an annular series of cylinders, fluid inlet and outlet means for said cylinders at one

end of each barrel, a controlling disk arranged between said barrels, pistons in the cylinders having rods projecting from the other ends of said barrels from the said fluid inlet and outlet means and connected to said controlling disk, means for holding said controlling disk in a plane oblique to the axial lines of both barrels, means for causing said barrels to rotate in unison, and means for supplying fluid under pressure to one of said barrels.

4. In a pump, two barrels each having an annular series of cylinders, fluid inlet and outlet means for said cylinders at one end of each barrel, a controlling disk arranged between said barrels, pistons in the cylinders having rods projecting from the other ends of said barrels from the said fluid inlet and outlet means and connected to said controlling disk, means for holding said controlling disk in a plane oblique to the axial lines of both barrels, means for rotating said barrels from said controlling disk, and means for supplying fluid under pressure to one of said barrels.

5. In a pump, two barrels in axial alinement each having an annular series of cylinders, fluid inlet and outlet means for said cylinders at one end of each barrel, pistons in the cylinders having rods projecting from the other ends of said barrels from said inlet and outlet means, means for supplying fluid under pressure to one of said barrels, and means connecting the piston rods of one barrel to those of the other and adapted to guide them in an elliptical path around the axis of rotation of said barrels.

6. In a pump, two rotary barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at one end thereof, pistons in the cylinders having rods projecting from the other ends of said barrels from said inlet and outlet means, means connecting the piston rods of one barrel to those of the other, means for supplying fluid under pressure to one of said barrels, and means for varying the stroke of all said pistons simultaneously.

7. In a pump, two rotary barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at one end thereof, pistons in the cylinders having rods projecting from the other ends of said barrels from said fluid inlet and outlet means, means connecting the piston rods of one barrel to those of the other, means for rotating said barrels in unison, means for supplying fluid under pressure to one of said barrels, and means for varying the path of said pistons around the axis of rotation of the barrels from a circle to an ellipse in either direction, whereby the direction and velocity of the fluid pumped is varied.

8. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, and means for rotating the barrels in unison.

9. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, means for supplying fluid under pressure to one of said barrels, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of pistons one in each barrel held end to end, means for rotating the barrels in unison, and means for guiding said pairs of pistons in elliptical paths as the barrels rotate.

10. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, means for supplying fluid under pressure to one of said barrels, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, means for rotating the barrels in unison, and means for varying the stroke of all said pairs of pistons simultaneously.

11. The combination of two barrels in axial alinement each having an annular series of cylinders, fluid inlet and outlet means at one end of each barrel independent of the other barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel held in endwise alinement, means for rotating the barrels in unison, means for guiding said pairs of pistons in elliptical paths as the barrels rotate, and means for varying the stroke of all said pairs of pistons simultaneously.

12. The combination of two barrels in axial alinement each having an annular series of cylinders, fluid inlet and outlet means at one end of each barrel independent of the other barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, means for rotating the barrels in unison, and means for varying the path of said pairs of pistons during rotation from a circle to an ellipse in either direction, whereby the direction and velocity of the fluid pumped is varied.

13. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinder, means connecting said pistons in pairs each pair consisting of one piston in each barrel, one piston of each pair adapted to lie at one extremity of move-

ment in its cylinder when the other piston of the pair lies at the opposite extremity of movement in its cylinder, and means for rotating the barrels in unison.

14. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, a guiding member holding said pairs of pistons in fixed relation to each other, means for rotating said barrels in unison, and means for holding said guiding member at a given angle to the axis of rotation of one of the barrels.

15. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, a guiding member holding said pairs of pistons in fixed relation to each other, means for rotating said barrels in unison, means for holding said guiding member in a given position, and means for shifting the angular relation of said guiding member to the axis of rotation of one of the barrels.

16. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, a disk arranged transversely of the path of said pistons and axis of rotation of the barrels, means connecting the pistons to said disk in pairs each pair consisting of one piston in each barrel, and means for rotating the barrels in unison.

17. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, a disk arranged transversely of the path of said pistons and axis of rotation of the barrels, means for connecting the pistons to said disk in pairs each pair consisting of one piston in each barrel, and means for transmitting rotation from said disk to said barrels.

18. The combination of two rotary barrels arranged in axial alinement and each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at its end opposite the other cylinder, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston within each barrel, and means for rotating the barrels in unison.

19. The combination of two rotary barrels arranged in axial alinement and each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at its end opposite the other cylinder, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of pistons one in each barrel held end to end, means for rotating the barrels in unison, and means for guiding said pairs of pistons in elliptical paths as the barrels rotate.

20. The combination of two rotary barrels arranged in axial alinement and each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at its end opposite the other cylinder, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, means for rotating the barrels in unison, and means for varying the stroke of all said pairs of pistons simultaneously.

21. The combination of two rotary barrels arranged in axial alinement and each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel at its end opposite the other cylinder, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, means for guiding said pairs of pistons in elliptical paths around the axis of rotation of the cylinders, means for rotating the barrels in unison, and means for varying the stroke of all of said pairs of pistons simultaneously.

22. The combination of two barrels each having an annular series of cylinders, separate means for admitting and exhausting fluid from successive cylinders of each barrel, pistons in the cylinders, and means connecting said pistons in pairs each pair consisting of one piston in each barrel.

23. The combination of two barrels each having an annular series of cylinders, separate means for admitting and exhausting fluid from the successive cylinders of each barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, and means for guiding the pistons of each cylinder in an elliptical path around the axis of said cylinder.

24. The combination of two barrels each having an annular series of cylinders, separate means for admitting and exhausting fluid from successive cylinders of each barrel, pistons in the cylinders, means connecting said pistons in pairs each pair consisting of one piston in each barrel, a guiding member holding said pairs of pistons in fixed relation to each other, and means for holding said guiding member at a given angle to the axis of one of the barrels.

25. The combination of two barrels, each having an annular series of cylinders, separate means for admitting and exhausting fluid from successive cylinders of each barrel, pistons in the cylinders, means connecting the said pistons in pairs each pair consisting of one piston in each barrel, a

guiding member holding said pairs of pistons in given relation to each other, means for holding said guiding member in given position, and means for shifting said guiding member.

26. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, a disk arranged transversely of the path of said pistons and axis of rotation of the barrels, means connecting the pistons to said disk in pairs each pair consisting of one piston in each barrel, means for rotating the barrels in unison, and means for shifting the angular relation of said disk to the axis of rotation of the barrels.

27. The combination of two barrels each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, pistons in the cylinders, a disk arranged transversely of the path of said pistons and axis of rotation of the barrels, means connecting the pistons to said disk in pairs each pair consisting of one piston in each barrel, and means for transmitting rotary motion to the barrels from said disk.

28. The combination of a shaft, two barrels fast on said shaft having cylinders arranged in alined pairs, pistons in said cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a disk arranged transversely of said shaft between the barrels, means connecting the pistons to said disk, and means for transmitting rotation from said disk to said shaft.

29. The combination of a shaft, two barrels fast on said shaft having cylinders arranged in alined pairs, pistons in said cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a disk arranged transversely of said shaft between the barrels, means connecting the pistons to said disk, means for transmitting rotation from said disk to said shaft, and means for shifting the angular relation of said disk to said shaft.

30. The combination of a shaft, two barrels fast on said shaft having cylinders arranged in alined pairs, pistons in said cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a disk arranged transversely of said shaft between the barrels, means connecting the pistons to said disk, and intermeshing gears fast one on said disk and the other on said shaft.

31. The combination of end plates each with inlet and outlet ports, separate sets of ducts one for the ports of each end plate, barrels arranged endwise one against each end plate and having an annular series of cylinders with ports adapted to register with the ports of the end plate, means for holding said barrels to the end plates, pistons in said cylinders, means connecting said pistons in pairs each pair consisting of a piston in each barrel, and means for rotating said barrels in unison.

32. In a pump, the combination of a shaft, two barrels fast on said shaft each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a controlling disk arranged transversely of said shaft between the barrels, pistons in said cylinders having rods connected to said disk, and means for supplying fluid under pressure to one of said barrels.

33. In a pump, the combination of a shaft, two barrels fast on said shaft each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a controlling disk arranged transversely of said shaft between the barrels, pistons in said cylinders having rods connected to said disk, means for supplying fluid under pressure to one of said barrels, and means for transmitting rotation between said shaft and controlling disk.

34. In a pump, the combination of a shaft, two barrels fast on said shaft each having an annular series of cylinders, fluid inlet and outlet means for the cylinders of each barrel independent of the other barrel, a controlling disk arranged transversely of said shaft between the barrels, pistons in said cylinders having rods connected to said disk, means for transmitting rotation between said shaft and disk, means for shifting the angular relation of said disk to said shaft, and means for supplying fluid under pressure to one of said barrels.

35. The combination of end plates each with inlet and outlet ports, a shaft extending between said end plates, barrels on said shaft seated one against each end plate and having an annular series of cylinders with ports adapted to register with the ports of the end plate, means for adjustably holding said barrel seated, pistons in said cylinders, means connecting the pistons of one barrel to those of the other barrel, means for supplying fluid under pressure to one of said barrels, and means for causing said barrels to rotate in unison.

36. The combination of end plates each having inlet and outlet ports, barrels seated endwise one against each end plate and having annular series of cylinders with ports adapted to register with the ports of the end plate, a shaft extending between said end plates through the barrels and engaging one of said barrels to seat the same, adjustable means upon said shaft for engaging the other barrel to seat it, a controlling disk be-

tween said barrel, pistons in said cylinders having piston rods connected to said controlling disk, means for supplying fluid under pressure to one of said barrels, and means for causing said barrels to rotate in unison.

37. The combination of end plates each having inlet and outlet ports, a shaft extending between said end plates, barrels rotatably fast on said shaft seated one against each end plate and having an annular series of cylinders with ports adapted to register with the ports of the end plate, means for adjustably holding said barrels seated, a controlling disk between said barrels, pistons in said cylinders having piston rods connected to said controlling disk, means for transmitting rotation between said disk and shaft, and means for supplying fluid under pressure to one of said barrels.

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