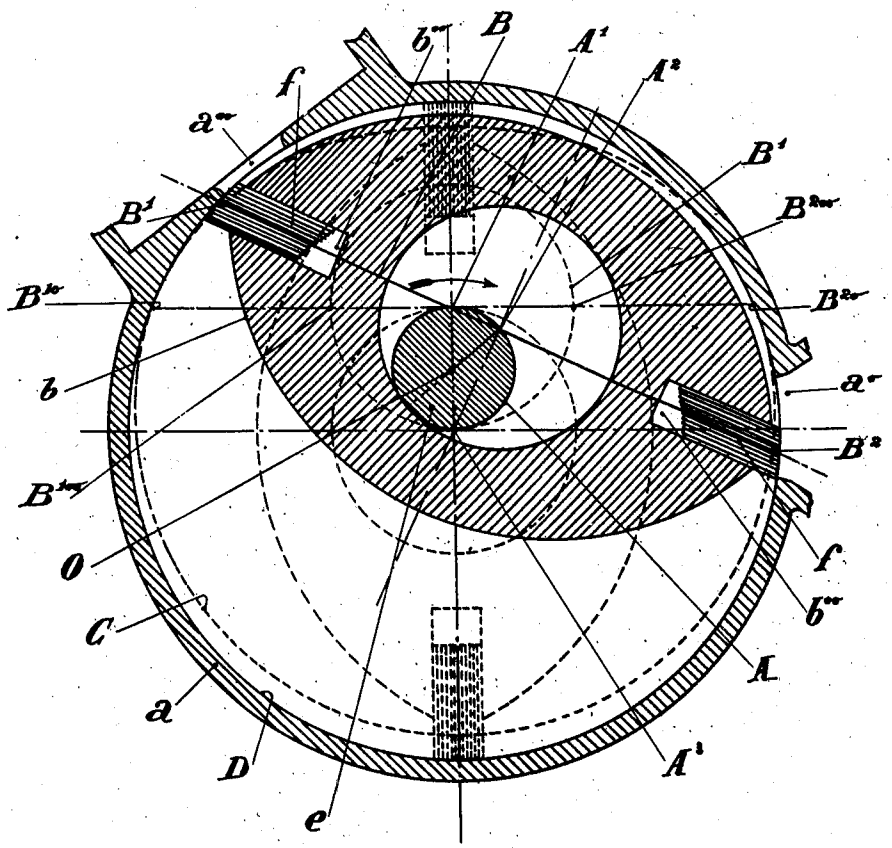
Feb. 15, 1927. 1,617,863

B. R. PLANCHE

ROTARY PUMP

Filed Aug. 31, 1921 5 Sheets-Sheet 1

FIG_1



Inventor:
Benjamin René Planche,
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Feb. 15, 1927.

B. R. PLANCHE

1,617,863

ROTARY PUMP

Filed Aug. 31, 1921

5 Sheets-Sheet 2

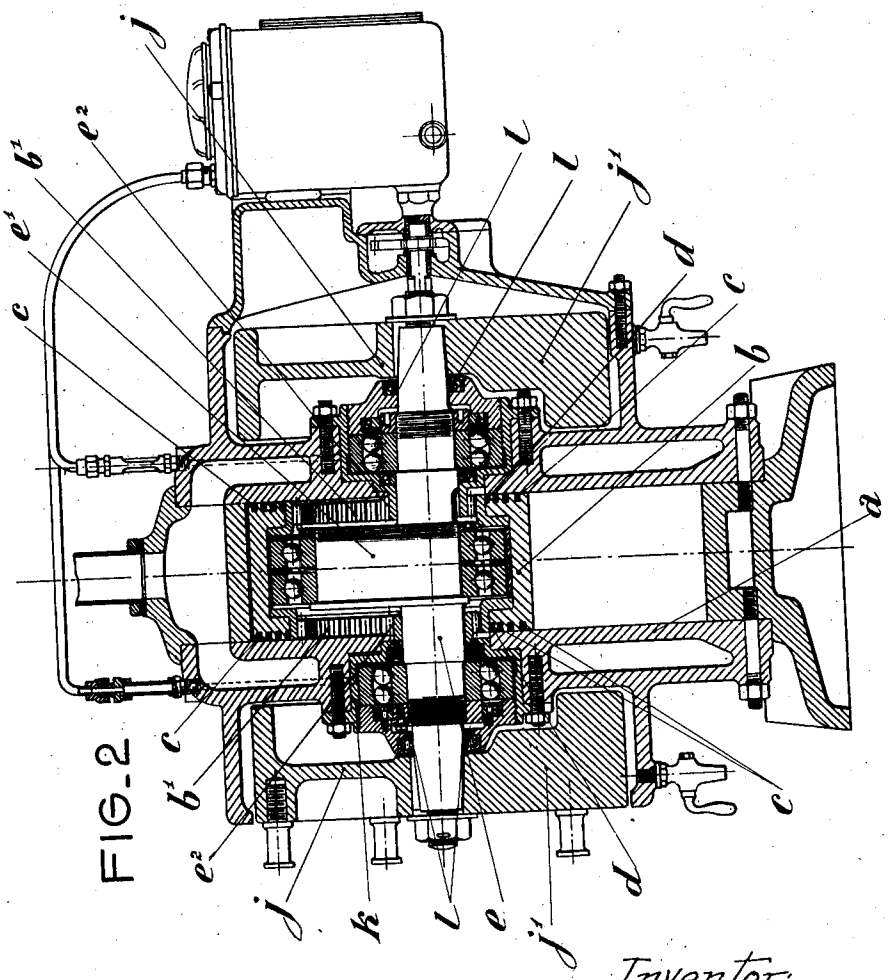


FIG_2

Inventor:
Benjamin René Planche,
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Feb. 15, 1927.

1,617,863

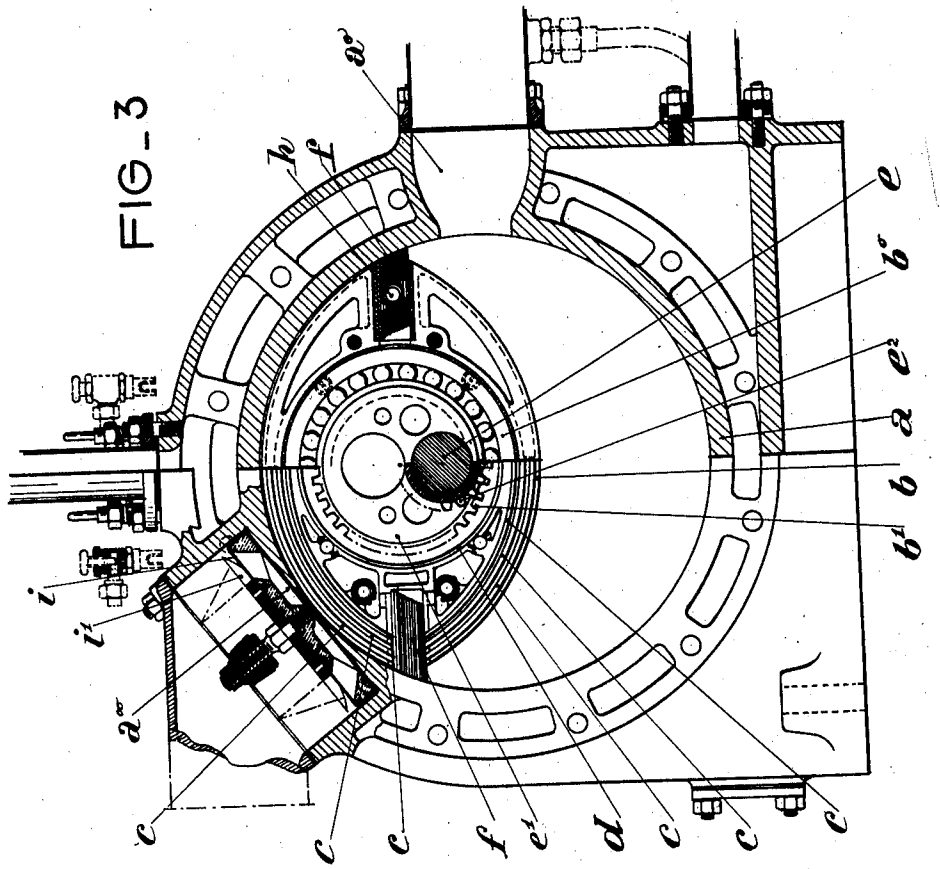
B. R. PLANCHE

ROTARY PUMP

Filed Aug. 31, 1921

5 Sheets-Sheet 3

FIG_3



Inventor:
Benjamin René Planche
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Feb. 15, 1927. B. R. PLANCHE 1,617,863

ROTARY PUMP

Filed Aug. 31, 1921 5 Sheets-Sheet 4

FIG_4

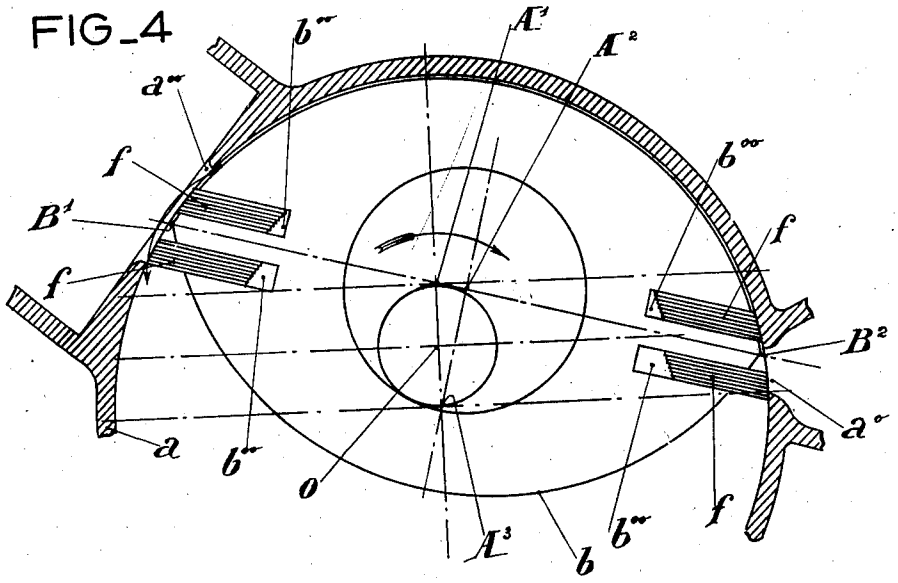


FIG_5

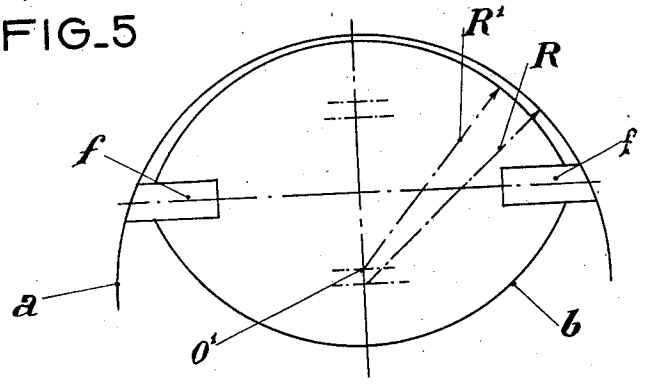
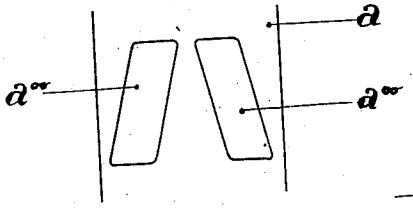


FIG_6



Inventor:
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Feb. 15, 1927. B. R. PLANCHE 1,617,863

ROTARY PUMP

Filed Aug. 31, 1921 5 Sheets-Sheet 5

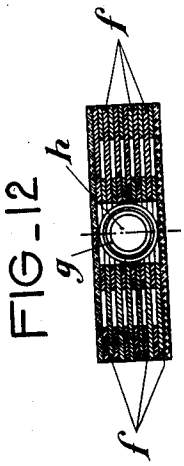


FIG_12

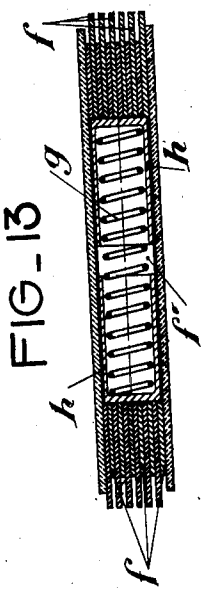


FIG_13

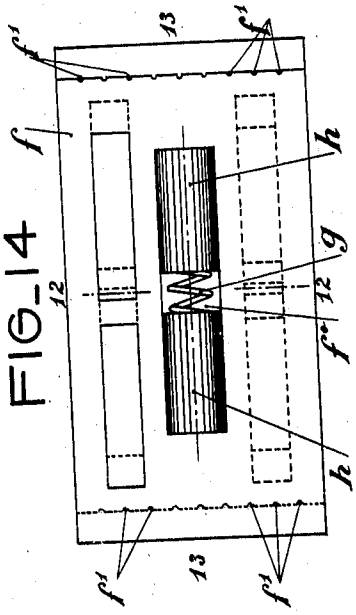


FIG_14

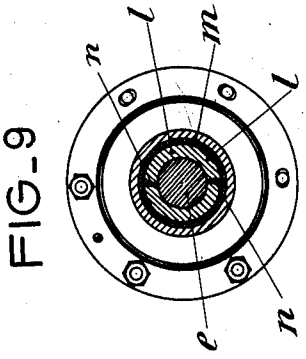


FIG_9

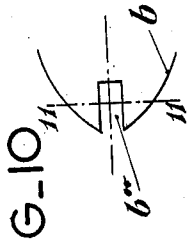


FIG_10

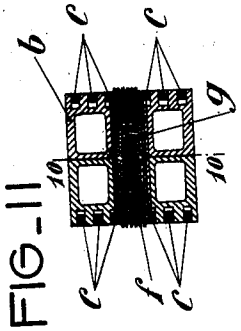


FIG_11

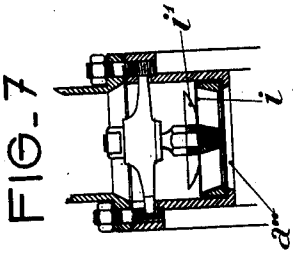


FIG_7

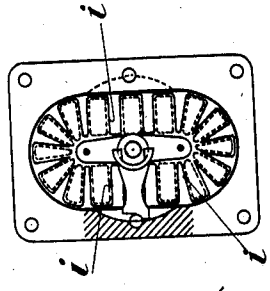


FIG_8

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Patented Feb. 15, 1927. 1,617,863

UNITED STATES PATENT OFFICE.

BENJAMIN RENÉ PLANCHE, OF VILLEFRANCHE-SUR-SAONE, FRANCE.

ROTARY PUMP.

Application filed August 31, 1921, Serial No. 497,268, and in Belgium June 25, 1920.

(GRANTED UNDER THE PROVISIONS OF THE ACT OF MARCH 3, 1921, 41 STAT. L., 1313.)

The invention relates to rotary machines notably pumps.

The improved machine is of the type comprising an eccentrically placed rotary disc piston movable in a cylinder and provided with members such as plates assuring the tightness of the disc piston in said cylinder. In my improved machine these plates are arranged in such a way that they form a deformable block, and slide one on another, this being effected by the centrifugal force produced by the rotation of the disc piston which applies the plates against the walls of the cylinder. Suitable means are provided for balancing the masses in rotation. The suction and outlet ports are arranged in such a way that during the operation of the machine the position of these ports determine delays of the opening and of the closing of the suction and flow passages and in certain cases allows a direct and momentary communication, by the delivery orifice, between the two sides of the disc piston. The delivery orifice is provided with an extra rapid closing valve.

Apart from the above particular features the invention resides in certain other arrangements which are utilizable preferably at the same time and which will be hereinafter described.

The annexed drawing illustrates the invention.

Fig. 1 is a diagrammatic section perpendicular to the axis of a rotary pump and is given to illustrate the theory of this type of machine.

Fig. 2 is an axial section of a rotary pump constructed according to the invention.

Fig. 3 is a transverse view thereof partly in section and partly in elevation.

Fig. 4 is a partial section illustrating a modification.

Fig. 5 is a view illustrating the shape of the piston disc.

Fig. 6 illustrates in plan the suction and outlet ports of the pump.

Figs. 7 and 8 are respectively a section and a plan view of a valve.

Fig. 9 is a cross section through the shaft of the apparatus and illustrates packing means therefor.

Figs. 10 and 11 illustrate one of the ends of the disc piston, Fig. 10 being a section on line 10—10 of Fig. 11 and Fig. 11 a section on line 11—11 of Fig. 10

Figs. 12 to 14 illustrate a detail of construction, Fig. 12 being a section on line 12—12 and Fig. 13 a section on line 13—13 of Fig. 14.

Referring to Fig. 1. Being given a circle A of which the centre is O. If a straight line B is turned round a point A′ of this circle which cuts this circle at a second point A^2 and if one forms on this straight line on each side of the point A^2 two lines equal to one another and greater than the diameter of the circle A there will be obtained on said straight line two points B^1 and B^2 the geometrical path of which will be a conchoid of the circle C.

To cause the points B^1 and B^2 to describe the said conchoid it is sufficient to turn at a constant angular speed, the point A^2 the centre of this straight line round the centre O in a manner that it will describe the circle A and at the same time turn the said straight line at half the angular speed round said point A^2. To practically obtain these two movements one can proceed as follows.

If one considers the position B^{10}—B^{20} of the said straight line for which the points A^1 and A^2 mingle (tangent to the point A^1 and if one draws a circle B^1 of a radius double the radius, of the circle A having its centre at A this circle will be tangential to the circle A at a point A^3 diametrically opposite the point A^1 and will cut the straight line B^{10}—B^{20} at two points B^{100} and B^{200}.

If after having fixed the straight line at B^{100}—B^{200} with regard to this circle B, the latter is caused to roll on the circle A it is easily demonstrated that the said straight line will pass constantly through the point A^1 and will cut the circle A at another point A^2 and that the angular speed will be double the angular speed of the straight line itself turning round the point A^2.

One can consequently by these means describe the conchoid to the points B^1 and B^2 of the straight line by making the point A^2 turn round the centre C while at the same time causing the circle B^1 to roll on the circle A.

If the two parts of the surface comprised

in the conchoid which are separated by the straight line B^1—B^2 are now examined, it can be easily seen that these two parts are equal to one another when the straight line passes through the points A^1 and A^3 and that when said straight line turns away from this position one of the surfaces increases while the other decreases and that, just at the moment when said straight line will have arrived in the position perpendicular to the first, that is to say in the position B^{10}—B^{20} at which one of the surfaces is at the maximum and the other at the minimum; the minimum surface will then start to increase and the maximum surface to decrease until the straight line having turned through 180° will have returned to the position B^{10}—B^{20}.

The conchoid of the circle C thus obtained may be inscribed inside a circle which would represent the inner part of the wall of the cylinder *a* shown in Fig. 1 the centre of which will be exactly on the middle of the top of the conchoid and of which the radius is such that the circle obtained would be tangential to this conchoid at two points B^{10} and B^{20}. It is evident that if one prolongs it on each side of the straight line B so that it meets the circle D the remarks on the subject of variations of surfaces comprised in the conchoid would continue to apply.

This being shown, to establish a pump based on the above principles, the following arrangement is suitable.

The cylinder *a* comprises two flat sides or ends and the inner surface of its circular wall is tangential to the conchoid of the circle established with the circumference A of the centre O. It is provided with an admission port a^0 and a delivery port a^{00} positioned in such a manner that when the said straight line is in the position B^{10}—B^{20} the discharge port a^{00} leads into the part of minimum section while the port a^0 leads into the part of maximum section.

In this manner a disc piston *b* Figs. 1, 2 and 3 is formed.

This piston is of lenticular shape in cross section and is terminated at its two ends by two flat faces parallel to the said cross section.

Its length is equal to the distance between the ends of the cylinder *a* and the width between the points or extremities of the spindle is equal to the distance between the points B^{10} and B^{20} and its height is less than the interior diameter of the cylinder *a*.

It is formed of two pieces fixed one against the other along a cross sectional line, concentric with its axis a cylindrical opening b^2 is provided for the housing of a bearing and it is provided on each of its flat faces with a certain number of packing members for instance the segments *c* parallel to the spindle and with a circular segment *d* concentric with the axis of said spindle.

The disc piston thus arranged is provided with suitable means allowing it to be mounted in the cylinder *a* and of moving in this cylinder in the manner above described, these means may be constituted as follows.

A shaft *e* is arranged as shown in Figs. 2 and 3 the axis of this shaft passing through the centre O and being parallel to the axis of the cylinder *a*. This shaft is mounted in bearings in the side walls of the cylindrical casing.

The shaft is integral with an eccentric e^1 on which the disc piston is freely mounted and the axis of which is at a distance from the axis of the shaft *e* equal to the radius of the circle A; this arrangement obliges the centre of the disc-piston to describe the said circle whilst dispensing with a crank. The eccentric runs on strong ball bearings or on several bearing members having large surfaces of contact so as to diminish as much as possible the forces of pressure, per unit of surface, between the parts in frictional contact.

In order that the shaft *e* can rotate the disc piston toothed pinions e^2 are provided concentric with the shaft *e* and the disc piston with interiorly toothed crowns b^1 engaging with the teeth of the pinions e^2.

The pinions e^2 have a pitch circle equal to the diameter of the circle A and the crowns b^1 have a pitch circle equal to double the diameter of said circle A. The above described gearing imparts a positive movement to the piston relative to the eccentric. Consequently when the shaft turns in the direction indicated by the arrow in Fig. 4 the disc-piston will be displaced in the cylinder *a* and sucks the liquid being pumped through the port a^0 and discharges it through the port a^{00}.

The gearing actuating the piston is designed so as to operate the movement of the piston *b* in such a way as to promote synchronism between the speed of rotation of the crank shaft *e* and the speed of rotation of the piston round the crank shaft. The speed of rotation of the piston *b* is half than that of the shaft *e*, that is to say the piston makes one complete rotation during the period that the crank makes two complete rotations the gearing in effect giving a positive movement of the piston relative to the eccentric e^2.

To assure tightness of the disc-piston at the points thereof, one or more housings b^{00} (Fig. 4) are provided in the piston body in which superposed packing plates *f* are arranged, the outer ends of these plates being applied against the inner surface of the cylinder by the action of centrifugal force due to the rotation of the piston.

Each of these plates except the two ex-

treme ones is provided with a rectangular opening as shown in Figs. 12 to 14. The longitudinal axis of each opening is parallel to the generatrix of the cylinder a and the short axis is deaxial with respect to the middle of the plate so that the said plates overlap each other alternately so as to form two symmetrical groups and so that any one plate having one of its ends in contact with one of the ends of the cylinder the following plate will have its opposite end in contact with the other end of the cylinder. The rectangular openings are arranged relatively to one another in such a way that they form by their superpositioning a common rectangular opening f^2 in which elastic means such as a coil spring g is arranged suitable to press the two groups of plates respectively against the ends of the cylinder a with the assistance of two piston plungers h sliding between the extreme plates.

The plates of each group are preferably of unequal length so that for the position B^{10}—B^{20} of the disc piston at any one of its dead points half at least for example of these will abutt against the bottom of the housing which contains them and thus take a point of support which prevents them from entering further into the housing by the influence of exterior pressure.

To lubricate the machine an oiler is arranged inside the same with for example four regulatable feeds, two of these feeds lead to the ball bearings for the shaft e and the other two which are much greater lead adjacent to the toothed crowns e^2 in such a way that the lubricant is drawn by one of the annular segments d and projected in fine drops into the interior of the disc piston. The spray thus formed lubricates the pinions e^2 and the ball bearings. Under the action of the centrifugal force the lubricant is projected against the plates f which it flows over in passing through large holes formed in the bottom of the housings b^{00} of the said plates and then escapes.

To allow of obtaining the smallest possible and otherwise harmful space between the disc piston and the lateral surface of the cylinder when the said piston passes by its dead points and this while lessening the danger of the points of piston catching, if the piston was not perfectly adjusted, the cross section of the spindle has such shape that at each dead point the central points of the curved parts of the disc piston come in turns tangential to the cylinder a of radii R Fig. 5 and on the other hand at the extremities of the disc piston suitable play is left, this result being obtained by diminishing the radii R^1 of the curved parts of the spindle and by symmetrically removing the centres c^2 corresponding to these radii from the axis of the spindle.

The delivery port is provided with a valve as shown in Figs. 3, 7 and 8 constituted by plates i of very thin flexible steel cut star shaped and covering very small orifices for the passage of the liquid. This valve has a very low inertia and consequently opens and closes very quickly permitting high working speed and besides has the advantage of preventing any return of liquid when the machine passes its dead point thus improving the mechanical and volumetrical conditions of working of this type of machine.

The said valve is provided at its upper part with an incurved abutment i^2 of the shape shown in Figs. 3 and 7 obliging all the plates to bend over their whole length and not at a single point and so limit the danger of their rupture.

For a compression pump the valves are arranged as shown in Figs. 1 and 2 so as to obtain delays in the opening and closing of the admission and outlet ports; these figures show the position of the ports a^0 and a^{00} with respect to the disc piston shown in different positions. As regards the admission these delays allow partial recovery of the work lost by the harmful space and have besides the advantage of considerably increasing the volumetric output of the machine while permitting a partial utilization of the inertia of the mass of liquid in movement. As regards the outflow this is effected with very great retardation for the purpose of allowing the lowest possible lowering of the pressure of the said fluid mass before the plates traverse the orifice a^{00}.

For a vacuum pump it is advisable to give more feeble delays and above all immediately after the disc piston has reached the end of the stroke to effect a direct communication between the two curved faces of the said piston by means of the orifice a^{00} as indicated by the arrow shown at this spot on Fig. 4 in such a way that, while supposing that this orifice is closed a little more by the outlet valve previously mentioned, the pressure in the harmful space equalized at this moment with that of the interior space of the pump about to be sucked and this without the suction orifice even communicating directly with the outlet port. This result is obtained by arranging the orifices in such a way that the delay in the opening of the exhaust is slightly greater than that of the closure of the admission and that the delay in the closure of the exhaust is slightly less than that of the opening of the admission. The admission and outlet ports have an inclined shape as shown in Fig. 6.

Tightness between the segments c and d of the disc piston against the ends of the cylinder is obtained by interposing suitable springs between the segments and the bottoms of their housings.

Balance of the masses in movement is obtained by means of fly-wheels j mounted on

the shaft e, these fly-wheels each carry a weight j^1 symmetrically placed in such a manner that the resultant power couple which they produce is equal and opposed to the couple and resultant force produced by the centrifugal force acting on the piston.

Adjustment of the position of the disc piston is effected as follows: each of the pinions e^2 is fixed to one of the ends of a bearing box k (Fig. 2) which are adjustable in such a way that they can be given different positions.

Tightness of the shaft e in the bearing boxes k is effected by providing said shaft with packings each constituted by two half rings l Figs. 2 and 9 made of antifriction metal pressed against one another by a coil spring m surmounting them; two small pins n diametrically opposite one another prevent them from turning in their housing and allow that by reason of the rotation of the shaft e the pressure of these members decreases in proportion as the friction which they create increases and vice versa.

The edge of each plate opposed to that which bears against the cylindrical surface of the cylinder comprises a sort of corrugation as at f^1 (Fig. 14). This arrangement prevents the fluids treated from passing through the channels of very small section formed alternately on each side by the plates.

The invention is not limited to the details of construction described, for instance the cross section of the disc piston instead of being in the form of a conchoid of a circle may have another shape, for instance, circular.

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

1. A rotary pump of the character described comprising a cylinder, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section and having flatside faces, means for adjusting said piston, mounted freely rotatable on said eccentric within said cylinder, means carried by said piston for effecting fluid tightness thereof in said cylinder, gearing imparting a positive movement of rotation to said piston relative to said eccentric means for admitting fluid to said cylinder, means for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft, outside said end walls and symmetrically arranged weights connected to said fly-wheels, the couple of the resultant force produced by said weights being equal and opposed to the couple and the resultant force which the centrifugal force acting on the piston produces whereby equilibrium of the masses in movement is obtained.

2. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section and having flat side faces mounted freely rotatable on said eccentric within said cylinder, means carried by said piston for effecting fluid tightness thereof in said cylinder, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, a valve for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft, outside said end walls, and symmetrically arranged weights, connected to said fly-wheels.

3. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section having a recess at each end and having flat side faces mounted freely rotatable on said eccentric within said cylinder, a series of superposed rectangular plates slidably housed in each of said recesses the outer edges of said plates being applied against the inner wall of said cylinder when said piston is rotating, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, an inlet port and an outlet port in said cylinder arranged in such a manner as to obtain equal or different delays in the opening and closing thereof, a fly-wheel mounted on each end of said shaft outside said end walls, symmetrically arranged weights connected to said fly-wheels, packing members in the flat side faces of said piston, springs acting on said packing members, spring pressed packing members for said shaft and means for preventing said last mentioned packing members rotating with said shaft.

4. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section and having flat side faces mounted freely rotatable on said eccentric within said cylinder, means carried by said piston for effecting fluid-tightness thereof in said cylinder, toothed pinions concentric with said shaft, bearing boxes with which said pinions are integral and arranged so that they can be given different angular positions to allow adjustment of said piston,

interiorly toothed crowns carried by said piston gearing with said pinions, a valve for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft, outside said end walls, and symmetrically arranged weights, connected to said fly-wheels.

5. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft a piston of lenticular cross section having a recess at each end and having flat side faces, mounted freely rotatable on said eccentric within said cylinder, a series of superposed rectangular plates slidably housed in each of said recesses the outer edges of said plates being applied against the inner wall of said cylinder when said piston is rotating, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, a valve for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft, outside said end walls and symmetrically arranged weights connected to said fly-wheels.

6. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section having a recess at each end and having flat side faces mounted freely rotatable on said eccentric within said cylinder, a series of superposed rectangular plates slidably housed in each of said recesses the outer edges of said plates being applied against the inner wall of said cylinder when said piston is rotating, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, a valve for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft outside said end walls, symmetrically arranged weights connected to said fly-wheels, packing members in the flat side faces of said piston, springs acting on said packing members, spring pressed packing members for said shaft and means for preventing said last mentioned packing members rotating with said shaft.

7. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section having a recess at each end and having flat side faces mounted freely rotatable on said eccentric within said cylinder, means for adjusting said piston, a series of superposed rectangular plates slidably housed in each of said recesses each of said plates with the exception of the top and bottom one of a series being provided with a rectangular slot, spring means within said slots adapted to press the ends of alternate plates against the end walls of said cylinder, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, a valve for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft, outside said end walls, and symmetrically arranged weights connected to said fly-wheels.

8. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston freely rotatable on said eccentric within said cylinder, said piston having flat sides and a lenticular cross section having such shape that at each dead point the middle point of the curves thereof come in turns tangential to the cylinder, suitable amount of play being left at the ends of said piston corresponding to these points, means carried by said piston for effecting fluid-tightness thereof in said cylinder, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, a valve means for admitting fluid to said cylinder, a valve for the evacuation of fluid from said cylinder, a fly-wheel mounted on each end of said shaft outside said end walls, and symmetrically arranged weights connected to said fly-wheels.

9. A rotary pump of the character described comprising a cylinder shaped to a conchoid of a circle, end walls to said cylinder, a shaft extending through said end walls parallel to and eccentrically placed with respect to the axis of said cylinder, an eccentric keyed on said shaft, a piston of lenticular cross section having a recess at each end and having flat side faces mounted freely rotatable on said eccentric within said cylinder, a series of superposed rectangular plates slidably housed in each of said recesses the outer edges of said plates being applied against the inner wall of said cylinder when said piston is rotating, toothed pinions concentric with said shaft, interiorly toothed crowns carried by said piston gearing with said pinions, an inlet port and an outlet port in said cylinder arranged in such a manner as to obtain equal or different de-

lays in the opening and closing thereof, said outlet port further allowing a direct but momentary communication between the two sides of the piston during each rotation of the latter, a fly-wheel mounted on each end of said shaft outside said end walls, symmetrically arranged weights connected to said fly-wheels, packing members in the flat side faces of said piston, springs acting on said packing members, spring pressed packing members for said shaft and means for preventing said last mentioned packing members rotating with said shaft.

In witness whereof I have signed this specification.

BENJAMIN RENÉ PLANCHE.