July 19, 1927. 1,636,486

B. R. PLANCHE

ROTARY ENGINE OR PUMP

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FIG.1

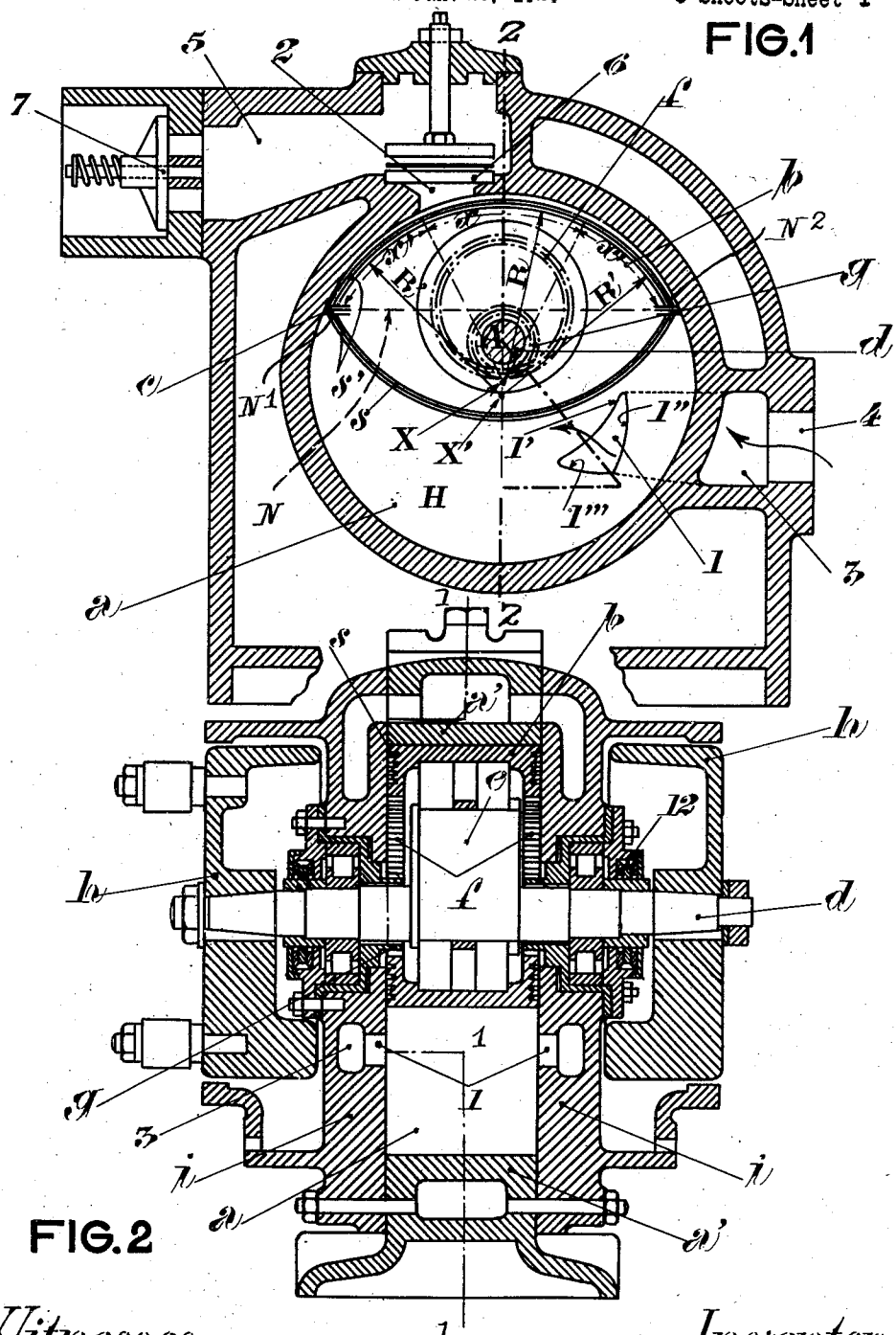


FIG.2

Witnesses

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July 19, 1927. 1,636,486

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ROTARY ENGINE OR PUMP

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FIG.3

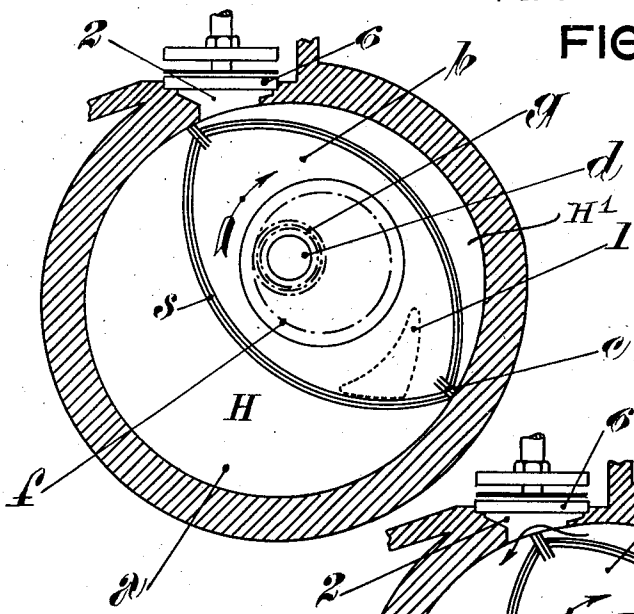


FIG.4

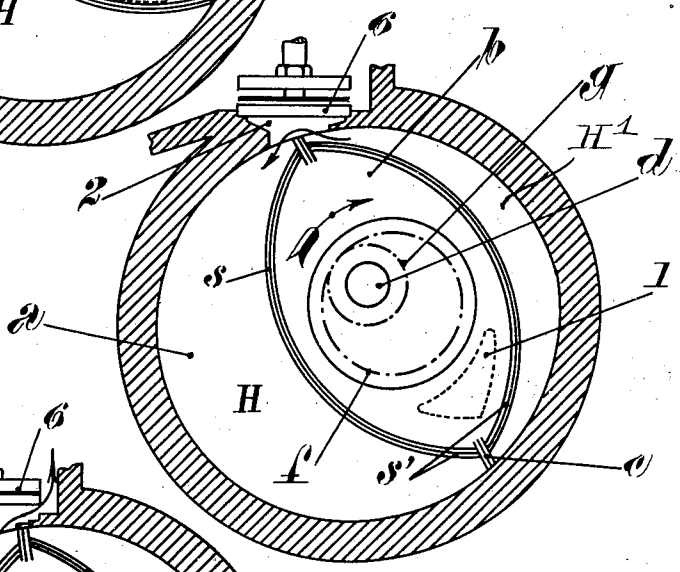
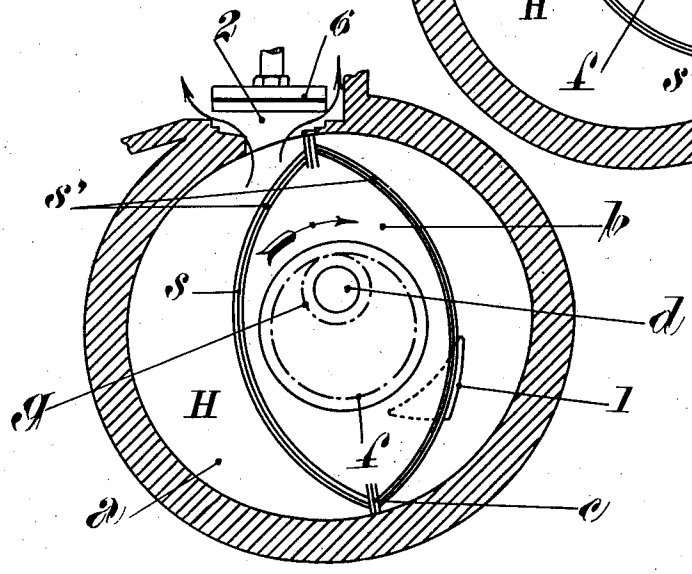


FIG.5



Witnesses

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ROTARY ENGINE OR PUMP

Filed Jan. 29, 1923 3 Sheets-Sheet 3

FIG. 6

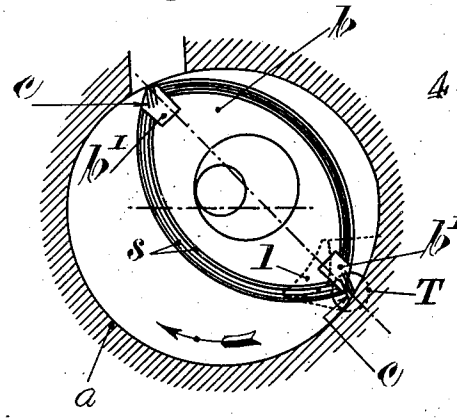


FIG. 7

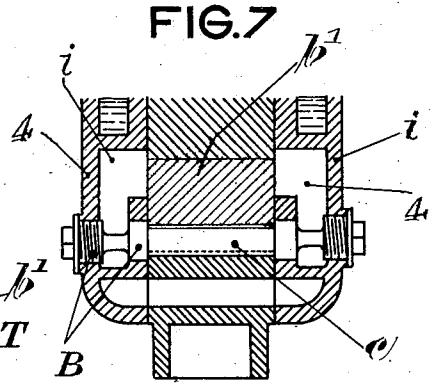


FIG. 9

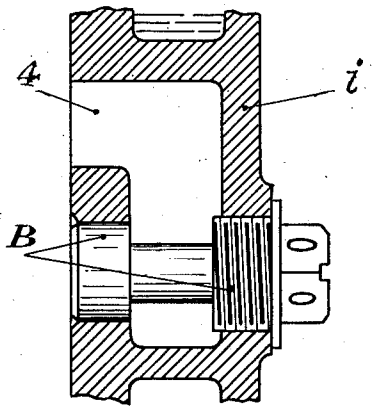


FIG. 8

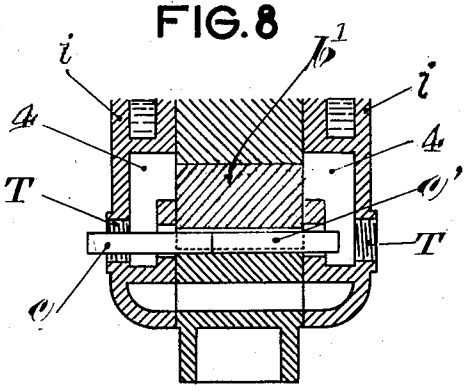


FIG. 10

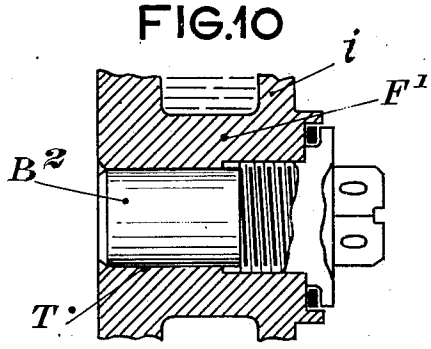
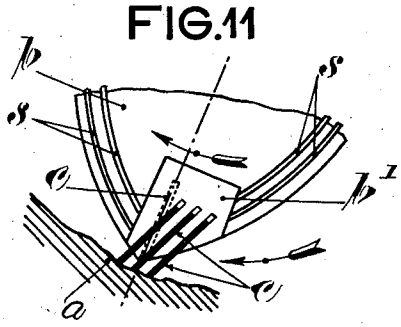


FIG. 11



Witnesses
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Patented July 19, 1927.

1,636,486

UNITED STATES PATENT OFFICE.

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ROTARY ENGINE OR PUMP.

Application filed January 29, 1923, Serial No. 615,725, and in France February 17, 1922.

Rotary pumps such as that described in Patent No. 1,340,025—18 May, 1920, and in my copending application Serial No. 497,268—31 August, 1921, are known in which a flat, spindle shaped piston rotates within a cylindrical casing the section of which is a conchoid of a circle having a chord equivalent to the length of the piston.

In this type of pump the ends of the piston are provided with slidable radial wings or blades which are kept lightly applied against the walls of the cylinder by centrifugal force and the suction and exhaust are generally effected by means of ports provided in the circumferential wall of the casing.

Experience has shown that the inlet and outlet ports thus situated have the defect of decreasing the volumetric output.

The improvements which form the object of the present invention relate:—

Firstly to the obtention of delays in the periods of inlet and outlet so as to produce expansion of the gases compressed in the injurious space between the piston and the lateral surface of the casing, and secondly to provide for as small an injurious space as possible.

I attain these objects by giving the inlet ports a particular position as described and illustrated in the accompanying drawings which represent a vacuum pump or compressor and in which

Fig. 1 is a section on line 1—1 of Fig. 2.

Fig. 2 is a vertical section on line 2—2 of Fig. 1.

Figs. 3, 4 and 5 are diagrammatic views similar to Fig. 1 showing the rotary piston in three different positions.

Fig. 6 is a diagrammatic sectional elevation of the rotary pump and shows the piston rotating in the casing.

Fig. 7 is a partial cross section showing one end of the piston and one cheek of the casing.

Fig. 8 is a similar view illustrating how inspection of or replacement of the packing plates of the piston can be effected.

Fig. 9 is a detail view, on an enlarged scale, of a part of Fig. 7.

Fig. 10 is a modification of the detail illustrated in Fig. 9.

Fig. 11 illustrates in detail the mounting of the packing plates of the piston.

Referring to Figs. 1 and 2 the pump illustrated comprises a conchoidal cylinder *a*, provided with a cheek *i* at each end. Inside this cylinder *a* a piston *b* can rotate, the cross section of this piston being rectangular and the longitudinal section fusiform.

The breadth of this piston is equal to the distance between the two ends or cheeks of the cylinder. Its length is approximately equal to the distance between the two points N^1 N^2 measured on the diameter N which divides the piston into two halves, when the said piston is at the dead centre, as illustrated in Fig. 1.

The piston *b* is given a uniform movement of rotation by means of a crankshaft *d* which carries an eccentric *e* (Fig. 2) the collar of which is formed by the piston *b*. This piston carries on each of its two flat side faces a crown *f* with interior teeth; two fixed pinions *g* integral with the side cheeks *i* of the casing containing the piston are further mounted on the axis of the crankshaft *d*. By these means when the crankshaft is rotated, the interiorly toothed crowns *f*, mounted on the piston *b*, roll, without slipping on the fixed pinions *g* fixed to the cheeks *i* of the casing, and the rotary movement of the piston *b* in relation to the crankshaft *d* is obtained. In its rotation the centre of the piston describes a circle with a uniform movement and the piston itself rotates around its centre in the same direction but at half speed. The machine is balanced by means of two flywheels *h*; the outlet valve is placed at 6.

In the known pumps of this kind, the inlet and outlet ports are in the circumferential wall of the cylinder *a* at the points N^1, N^2. The improvement which forms the object of the present invention, consists in the position given to the two inlet ports 1. These are provided in the interior parts of the cheeks *i* (Figs 1 and 2) and are situated in the part of the casing of larger size limited by the line N^1 N^2, the outlet port 2 being placed in the circumferential wall *a'* in the part of smaller size. The inlet ports communicate with the exterior through channels 3 provided in the thickness of the

side walls and terminating at the orifice 4.

It is obvious that the piston must close the inlet ports before opening the outlet port; in the same way it must close the outlet before opening the inlets. For this purpose the edges of the blades c and the ends s' of the packings s with which the piston is provided must clear the ports 1 so as not to risk catching on the edges of these ports during the rotation of the piston, and that width of the piston b which moves over the said inlet ports and which completely closes them during a fraction of a revolution must be selected for closing the inlet ports.

These conditions are fulfilled by giving the inlet ports 1 the shape, size and position shown in Figs. 1, 3, 4 and 5. The shape is that of a distorted right-angled triangle the apex of which is directed upwards and situated at a lower level than the shaft d. The three sides are formed by portions of intersecting circles, which are described from the following points:—The side 1′ is described from the centre of the shaft d with such radius that the periphery of the gear crowns or rings f, which may comprise packings, passes along the said edge 1′, but without touching it, during the fraction of a revolution performed by the piston when passing from the position shown in Fig. 3 to the position illustrated in Fig. 5; the side 1″ and the base 1‴ are described from different points, but with an equal radius R′ which is that describing each edge of the piston. The base 1‴ is so situated that it conforms with one of the edges of the end of the piston when the latter is in the position shown in Fig. 3, whereas the side 1″ coincides with the opposite chord of the same edge when the piston occupies the position shown in Fig. 5.

In this type of pump the curve of the spindle shaped piston is a curve containing all the positions of the piston shown in Fig. 1, when the base of the cylinder is a conchoid of a circle. This containing curve I form more simply, (for each side of the piston) by a median arc of a circle x of radius R described from the point X, and two outer arcs x', x' of radius R′ described both from the point X′.

The plates or blades pressed by centrifugal force against the circumferential wall a' of the casing a to secure the desired packing, end by wearing out after a certain period of service and it is of advantage to be able to replace them without dismounting the pump.

As it is preferable to have as little sliding movement of the plates as possible so as to reduce the effects of the pressure upon them, their position is so chosen that their point of contact on the casing is as near as possible on the point of intersection formed by the extension of the axis of the piston with the cylinder. This piston, provided with its plates, should in fact be able to preserve an almost constant length.

As the pump is provided with curved packings s on the lateral surfaces of the piston, it is necessary to prevent these packings being displaced with respect to their housing in the direction of their curve.

For this reason a holder b^1 is mounted in a recess of the piston. This holder passes right through the piston from side to side, and in order to enable one or more inclined packing plates or blades c to be easily placed therein it is so situated in relation to the axis of the piston that these holders are slightly in arrear on the movement of the piston with respect to the axis (Figs. 6 and 11). The ends of the curved packings s bear against the sides of the holders b^1, and any displacement of the packings is rendered impossible.

In order to allow of the renewal of the said plates or blades without being obliged to demount the machine, the two cheeks i (Figs. 7 to 10) are each provided with an aperture T of which the diameter is greater than the depth of the grooves serving as housing and guide to the plates c. These two apertures T are situated opposite each other, and their positions are selected so that they lie in the path of the ends of the plates c and so that, during the working of the machine, the differences of pressure between the two sides of the piston are virtually zero.

The position of the apertures T will coincide, for instance, with the channels 4 conducting the fluid to the interior of the casing a and leading to the inlet ports 1. Each of the apertures T is closed by a plug B.

By removing the two plugs B, it will be easy to renew the plates c as they can be passed in turn in front of the apertures T, and it will suffice to force out the worn out plate c with a new plate c' which will thus be automatically put in place (Fig. 8).

The position indicated is not absolutely essential and could be altered; for instance it could be situated in the water jacket, by casting therewith a projection F^1 in which a screw-threaded plug B^2 is engaged as illustrated in Fig. 10.

According as one or the other of these methods is adopted the plugs can be constructed in accordance with the types shown in detail in Figs. 9 and 10.

The exhaust valve 6 is applied on its seat either by gravity or by the counterpressure existing in the chamber 5 provided with a second spring governed valve 7. These two consecutive valves create the intermediary chamber 5 which is provided with an orifice, not illustrated, and closable by a valve actuated by automatic means in such a way that when the reservoir of compressed air

has reached the required pressure the chamber 5 communicates with the exterior and the compresser turns idly. As soon as the pressure falls in the reservoir this orifice is closed and the compresser resumes working.

The position of the exhaust valve on the periphery of the casing and at the upper part of the frame of the machine, allows facility of access thereto as the valve can be readily removed. The working is as follows:

When the piston is in the position illustrated in Fig. 1, which corresponds to the dead centre, there is below the piston a quantity of fluid sucked in and above the piston in the enlarged port opening or channel 2 a quantity which is compressed.

When the piston rotates, assuming the positions shown in Figs. 3 and 4 to be successive, the injurious space increases, so that the fluid which was compressed in that space expands, thus imparting to the piston the energy which such fluid has previously absorbed.

In the position shown in Fig. 4, the outlet port or channel 2 is opened and puts into communication the spaces H and H′ situated on opposite sides of the piston, the pressures are equalized and a slight supercompression results of the opposed quantity of fluid previously sucked in.

The piston continuing to rotate closes the outlet port and a moment later opens the inlet ports 1. From that moment the piston exerts suction during its operation until it has reached the position shown in Fig. 1.

In this position of the piston, the inlet ports are completely opened. By virtue of its kinetic energy, the fluid in the feed duct again passes into the cylinder, producing a preliminary compression of the fluid already sucked in, which compression increases at the time of passage of the fluid from the opposite side of the piston after the voluntary incomplete expansion of the injurious space as has been hereinbefore mentioned. The piston pursuing its movement gradually closes the inlet ports, then opens the exhaust port and the fluids are compressed until the outlet valve 6 opens.

The particular position and shape given to the inlet ports gives great advantages. In particular the described super-compression of the gases for equalizing the pressures on each side of the piston when the packing members *c* of the ends of the piston pass the outlet port. In fact, if one assumes a certain quantity of gas under pressure to be accumulated in the injurious space, one can, above all, owing to the adopted arrangement of the ports, allow these gases to expand and obtain the reciprocation of the energy which they contain.

This greater part of the energy being recuperated, in order to prevent continuing the displacement of the piston, the "bypass" device which enables the pressures on both sides of the piston to be equalized is provided.

By this device, the residue of the gases which was not completely expanded ends by fully expanding while slightly compressing the charge which has just been sucked in.

The equalization of the pressure is effected, as shown by the arrow in Fig. 4, at the locality of the outlet port 2. It is due to the action of expansion still remaining to be obtained from the gases compressed in the injurious space and imperfectly expanded through the positions given to the ports. Therefore this energy is partly recuperated, and the intake of the following revolution is also more easily effected, which intake is facilitated by the position of the inlet ports 1, which do not open until after the communication equalizing the pressures on opposite sides of the piston has been interrupted for a certain period (Fig. 5), thus creating an extremely favourable initial depression at the moment of opening the inlet ports.

From the above it follows that the expansion of the gases contained in the injurious space is effected in three phases:—

The first phase is comprised between the positions illustrated in Figs. 1 and 3, owing to the delays given to the corresponding positions of the inlet orifices 1 and the discharge port 2; when the piston reaches the position shown in Fig. 3, the inlet orifices 1 are obstructed.

The second phase (Fig. 4) starts from the intercommunication between the two sides of the piston, as shown by the arrow. In this position the inlet ports are still obstructed by the width of the said piston.

The third phase starts from the continuation of the displacement of the piston in the cylinder before the opening of the inlet orifices, that is to say from the approximate position of the piston as shown in Fig 4 to that shown in Fig. 5.

I am aware that prior to my invention rotary engines of the type herein referred to comprising a cylindrical casing have been provided with triangular inlet ports in the side walls of the casing and with an outlet port in the cylindrical wall of the casing. I therefore do not claim such position or shape of the valves broadly; but I do claim—

1. In a rotary pump or compressor, a cylindrical casing having inlet ports in its side walls situated below the median horizontal plane of the casing and to one side of its median transverse vertical plane, and also having an exhaust port situated in its cylindrical wall above said horizontal plane and to the other side of said vertical plane; and a rotary fusiform piston in said casing having flat side faces to close the inlet ports, the said cylindrical wall of the casing hav-

ing a channel therein which is situated above said horizontal plane and to the same side of said vertical plane as said exhaust port and adjacent thereto to place the spaces on opposite sides of said piston in communication during a fraction of a rotation of the piston when the inlet and outlet ports are closed.

2. In a rotary pump or compressor, a cylindrical casing having inlet ports in its side walls situated below the median horizontal plane of the casing and to one side of its median transverse vertical plane, and also having an exhaust port situated in its cylindrical wall above said horizontal plane and to the other side of said vertical plane; a rotary fusiform piston in said casing having flat side faces to close said inlet ports, said cylindrical casing wall having a channel therein which is situated above said horizontal plane and to the same side of said vertical plane as said exhaust port and adjacent thereto to place the spaces on opposite sides of said piston in communication during a fraction of a rotation of the piston when the inlet and outlet ports are closed; removable packing plates carried by the piston; and removable plugs closing diametrically-opposed apertures formed in the side walls of the cylindrical casing to facilitate the introduction or removal of said packing plates.

3. In a rotary pump or compressor, a cylindrical casing, a flat-sided, fusiform rotary piston therein, an eccentric carrying the piston, and a shaft whereon the eccentric is mounted; said casing having in its side walls oppositely-located inlet ports in the form of curvilinear triangles to be closed by the flat sides of the piston, and admission conduits leading to such ports, the summits of said ports being directed upwards, and the three sides thereof being formed by portions of circles intersecting each other and described one from the axis of said shaft and the other two from points so determined that the base curves of said triangular ports coincide with one of the curved faces of the piston in one position of the latter, while the outer curves of said triangular ports coincide with the other curved face of the piston at another position of the latter, said ports being situated to one side of the central vertical transverse plane of said casing and at a level below the axis of said shaft.

In witness whereof I have signed this specification.

BENJAMIN RENÉ PLANCHE.