J. F. DUBY.

ROTARY ENGINE.

APPLICATION FILED MAY 6, 1918

1,300,706.

Patented Apr. 15, 1919.

3 SHEETS—SHEET 1.

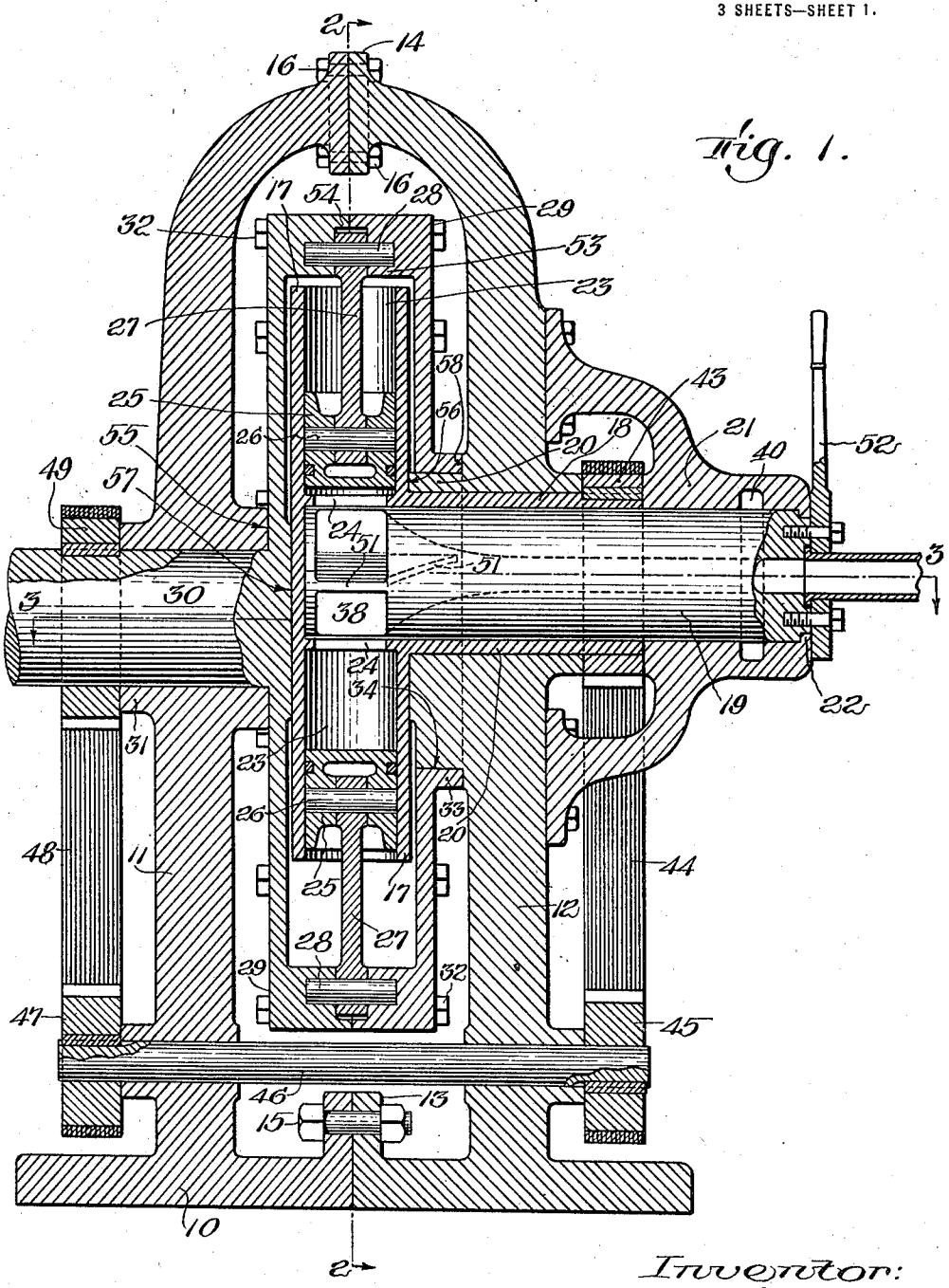


Fig. 1.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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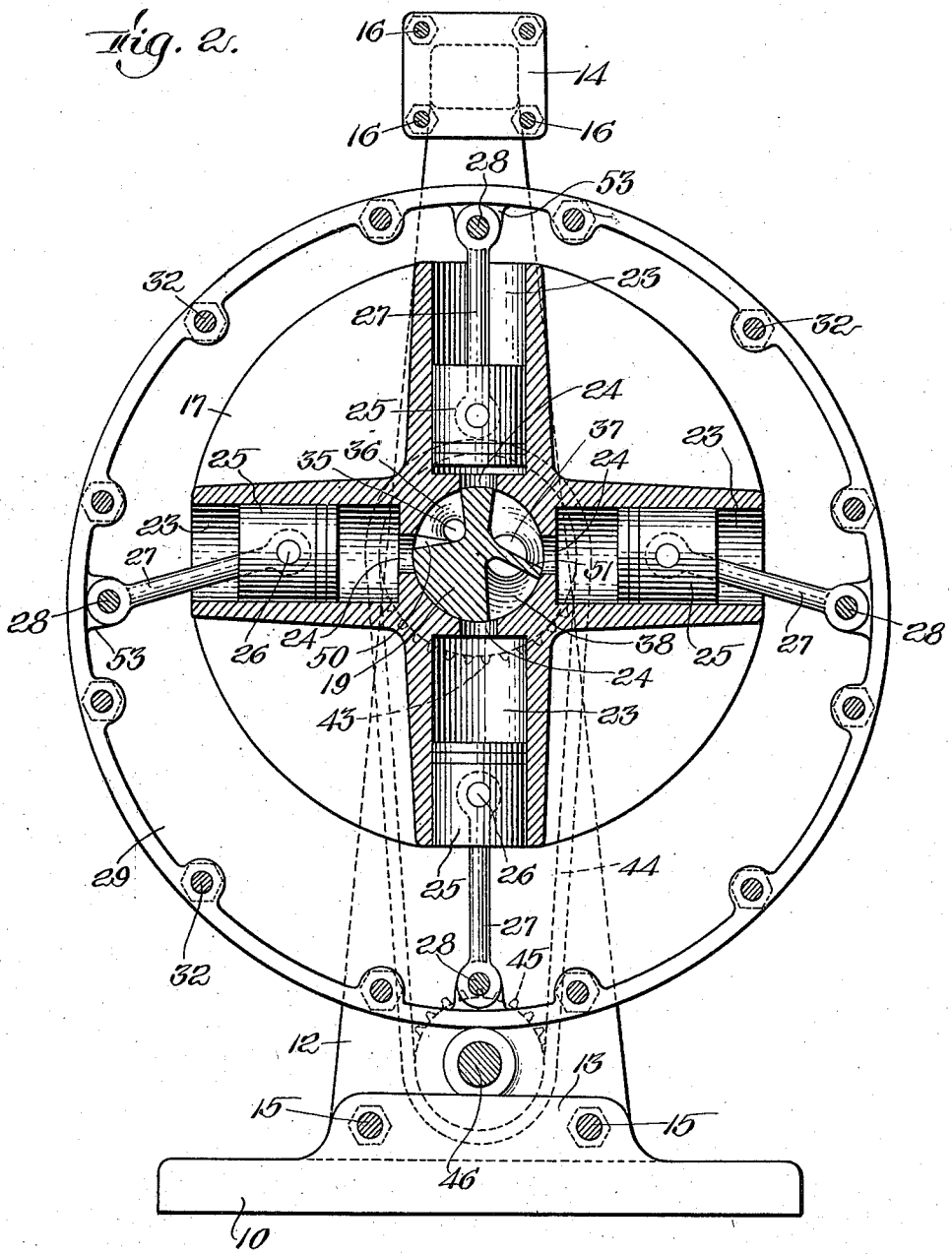
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3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

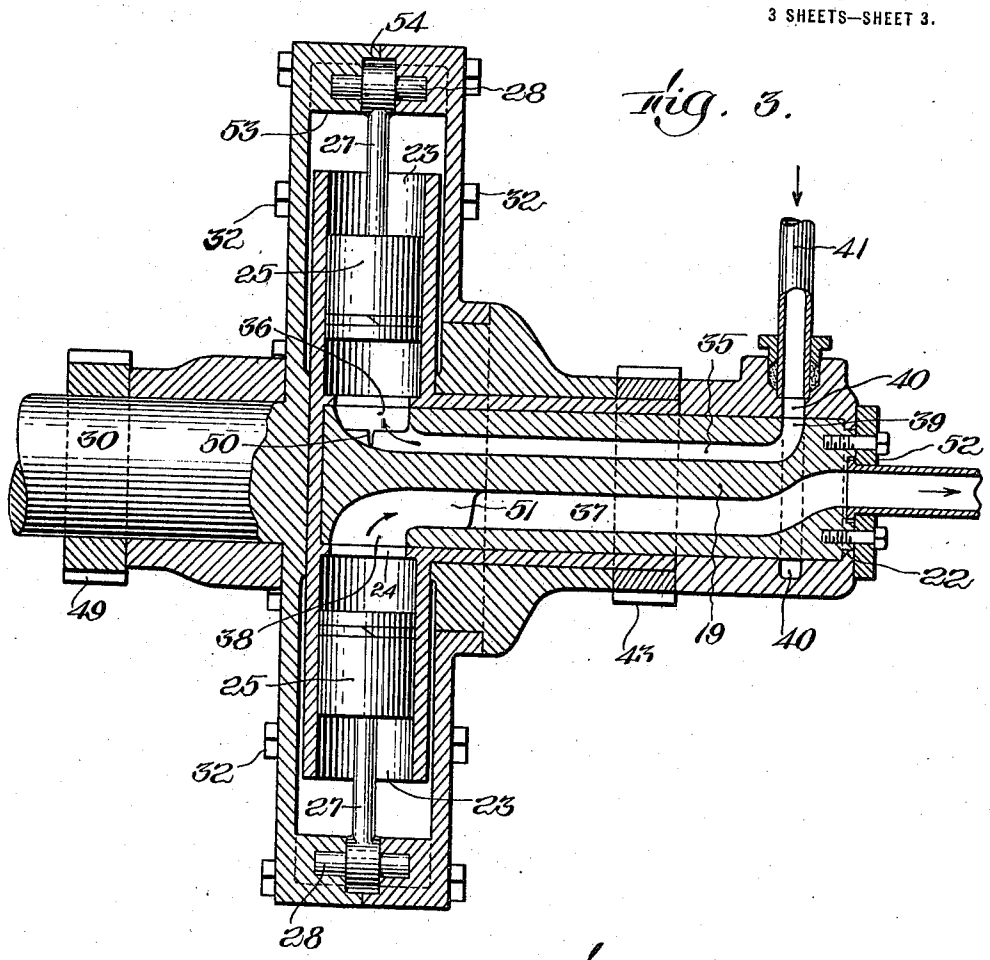


Fig. 3.

Fig. 4.

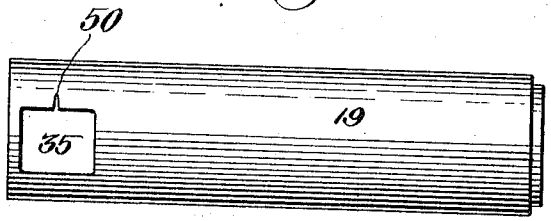
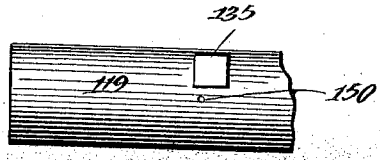


Fig. 5.



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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

1,300,706. Specification of Letters Patent. Patented Apr. 15, 1919.

Application filed May 6, 1918. Serial No. 232,964.

To all whom it may concern:

Be it known that I, JOHN F. DUBY, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented new and useful Improvements in Rotary Engines, of which the following is a specification.

This invention relates to rotary engines, and particularly to steam engines in which a plurality of pistons are connected to a driving head on a shaft, and are adapted to reciprocate in the radial cylinders of a rotor so as to impart rotary motion to said shaft.

It is the object of the invention to produce an efficient rotary engine of this particular class, and to simplify the construction thereof by avoiding the use of cranks, cams, or similar parts, thereby eliminating friction, vibration and noise to a very large extent.

Further objects are to provide for the operating of such an engine smoothly and effectively under rotary valve control, and to improve, in certain respects, the construction and operation of the valve.

The invention in its preferred form is embodied in an engine comprising a rotor mounted to rotate upon a supporting shaft and connected to drive and rotate in unison with a driven shaft, not coaxial with said rotor, but having its axis parallel thereto; said rotor being provided with radial cylinders having pistons connecting to a driving head on the driven shaft in such a manner that the expansion of steam in the cylinders will transmit rotation to the driven shaft, there being no reciprocation of the pistons relatively to the driving head which incloses the rotor and is eccentric to it. Said supporting shaft is constructed with a supply conduit for the steam, an inlet port through which the live steam is permitted to pass into the cylinders and with an exhaust port and an exhaust conduit through which the exhaust steam may pass away from the cylinders. In other words, this shaft is provided with inlet and exhaust valves, and will hereinafter be referred to as the valve shaft.

The invention further consists in such other novel features of construction as will hereinafter be more fully described and claimed.

In the drawings, like reference numerals are used to indicate the same or corresponding parts throughout.

Figure 1 is a longitudinal vertical section of an engine constructed in accordance with what is now considered to be a preferred embodiment of the invention.

Fig. 2 is a transverse vertical section thereof, taken in the plane indicated by the line 2—2 of Fig. 1, and looking in the direction shown by the arrows.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is an elevation of the valve shaft, showing the intake port thereof.

Fig. 5 is an elevation of one end of the valve shaft, showing a slightly modified form of intake port.

I will first describe the embodiment of the invention shown by Figs. 1 to 4, inclusive.

The engine frame which, as shown in Fig. 1, comprises a suitable base 10 and standards 11 and 12, is made in two sections, flanged at 13 and 14, and secured together by bolts 15 and 16. The rotor 17 is provided with a hollow hub 18 surrounding a non-rotating valve shaft 19, and journaled in the bearing 20, supported by the standard 12. The valve shaft 19 is held frictionally in the bracket 21, which is secured to the standard 12, so that the shaft is fixed relatively to the rotor, but is capable of being rotated slightly in the bracket 21 for purposes of adjustment, as will be hereinafter explained. The bracket 21 is provided with a flange 22 to receive the end thrust of the valve shaft. Radially arranged in the rotor 17 are the cylinders 23 which are in communication with the interior of the hollow hub 18 through the radial passages 24. Each cylinder 23 is provided with a piston 25 connected by a wrist-pin 26 connecting-rod 27 and pivot-pin 28 to the marginal portion of a driving head 29 on the driven shaft 30 at points spaced from the axis of said shaft. It will be seen that the path of rotation described by the pivot-pins 28 is a circle concentric with the axis of the driven shaft, but eccentric to the axis of the valve shaft. Supported by the standard 11 is a bearing 31 in which the driven shaft 30 is journaled. The driving head 29 is a hollow disk, inclosing the rotor, and is made in two sections, one integral with, or fixed to, the driven shaft, and the other secured to the first section by bolts 32, and provided with a hub 33

which is rotatably supported on an annular bearing 34 formed on the standard 12.

The valve shaft 19 contains an inlet conduit or channel 35 (Fig. 3), provided with an inlet or feed port 36, and also an exhaust conduit or channel 37 having an exhaust port 38. The inlet conduit 35 is continuously in communication, through a supply port 39, with an annular chamber 40 connected to a supply pipe 41, and receives live steam therefrom, the steam being delivered successively through the inlet port 36 to the passages 24 which lead to the cylinders 23. After the steam has done its work in the cylinders, it is exhausted therefrom through the passages 24, the exhaust port 38, and the exhaust conduit 37.

On the hub 18 of the rotor is fixed a sprocket 43 connected by a sprocket chain 44 with a sprocket 45 fixed on one end of an intermediate shaft 46 journaled in suitable bearings in the standards 11 and 12. On the other end of the shaft 46 is fixed a sprocket 47 connected, in turn, by a sprocket chain 48 with a sprocket 49 fixed to the driven shaft 30. These sprockets are properly proportioned to cause the rotor to rotate in unison with the driven shaft, the said sprockets, chains, and intermediate shaft constituting a means for synchronizing the movements of the rotor and the driven shaft.

Each piston makes one complete cycle of operation for each revolution of the rotor, receiving its supply of live steam through the inlet port during its intake stroke, and exhausting the expanded steam through the exhaust port during its exhaust stroke. The inlet port 36 is enlarged, as shown in Figs. 2, 3, and 4, so as to admit the proper amount of steam to the cylinders in the proper interval of time, and is further provided with a feed port extension 50 (Figs. 2 and 4), which is preferably a relatively narrow slot opening into the feed port 35 and having its greatest width where it adjoins the feed port, and narrowing therefrom throughout the remainder of its length. The feed port 36, together with its extension 50, affords communication between the inlet conduit and the cylinders for a sufficiently large proportion of the time of one revolution of the rotor to insure the maintaining of the feed port in continuous communication with some one of the cylinders. In other words, the rotor can never come to rest in such a position that the feed port is entirely out of register with any one of the passages leading to the cylinders. If the rotor comes to rest in the position indicated in Fig. 2, the steam upon being admitted to the inlet conduit will feed through the narrow port extension 50 very slowly, into the cylinder with which it communicates, until there is sufficient pressure behind the piston to cause a slight rotation of the rotor. This will bring the main portion of the feed port into register with the passage 24 when the normal amount of steam will be admitted to the next cylinder.

The exhaust conduit 37 is of greater diameter than the inlet conduit, to more readily take care of the exhaust steam which has greater volume than the live steam, and the exhaust port, as shown particularly in Figs. 1 and 2, is enlarged until its opening extends only slightly less than one half way around the valve shaft, so as to more efficiently take care of the exhaust, permitting two of the cylinders to be exhausting at the same time. In order to prevent the exhaust from the cylinder last coming into communication with the exhaust port from entering the cylinder ahead, and interfering with the process of exhausting therefrom, the partition 51 is provided, subdividing the exhaust port into two parts and extending down the exhaust conduit for a short distance, thus subdividing a portion of said conduit into two branches.

The valve shaft 19 is provided with a handle 52, by means of which the valve shaft may be rotated somewhat, to adjust the radial position of the inlet and exhaust ports, for the purpose of varying the time of the intake and exhaust relatively to the radial position of the cylinders about the valve shaft.

The pistons are projected successively by the entrance of the expansive fluid into the cylinders, and their projection causes the rotation of the driving head through the piston-rods. The rotation of the driving head in turn causes successive retraction of the pistons. The piston-rods and driving head therefor constitute connection between the pistons and the driven shaft including means actuated by the successive projection of the pistons to successively retract the same.

The improved engine herein described is of extremely simple construction and may consequently be manufactured at low cost. Care has been taken to so design the engine that its various parts may be easily assembled and disassembled. It will be seen that the engine may be assembled as follows: First, the driven shaft, carrying one section of the hollow driving head, is inserted in the bearing provided to receive it in one section of the frame, then the valve shaft, with the rotor supported thereon, is inserted in its bearing in the other section of the frame, and the second section of the driving head placed in position on its bearing surface on said section of the frame. Then, the pistons, connecting rods and wrist-pins having been assembled and inserted into the cylinders of the rotor, and the pins for pivoting the connecting rods to the driving head having been inserted in the connect-

ing rods, the two sections of the driving head are secured together by the bolts 32. The pivot pins 28 fit into orifices in ears 53 which project inwardly from the marginal portion of the driving head. These ears 53 are cut away, so that recesses 54 are formed when the two sections of the driving head are assembled, into which project the outer ends of the connecting rods 27. The two abutting flanges 13 of the base portion of the engine frames are then secured together by the bolts 15, and the abutting flanges 14 at the top are secured together by the bolts 16. No other fastening means is necessary to securely hold all of the parts together. The two sections of the driving head, which inclose the rotor, are confined between bearing surfaces 55, on the standard 11, and 58, on the standard 12. The rotor is confined between the bearing surfaces 57 at the inner end of the driven shaft, and 58 on the standard 12.

Inasmuch as there is no reciprocation of the pistons relatively to the drving head, and as there are no cranks or cams used in its construction, the engine is practically vibrationless and noiseless in operation, and is well adapted to run smoothly for long periods. Silent chains are preferably employed to connnect the sprockets for the purpose of further eliminating noise.

Obviously, the invention may be embodied in engines having various multiples of cylinders, and which may be further modified in many respects without departing from the spirit and scope of the appended claims. The improved valve shaft, particularly, is adapted for use in engines of widely different construction.

A slightly modified form of inlet port is illustrated by Fig. 5, in which the extension feed port, instead of being a slot opening into the inlet port on the surface of the valve shaft, is in the form of a hole 150 drilled diagonally from a point on the surface of said shaft to the inlet channel. The action of this form of extension feed port is substantially the same as that of the form first described.

An important feature of my invention is the diverging arrangement of the cylinders, their inner ends or heads being in close proximity to the rotor hub, and communicating with the interior of said hub through the short ports 24, so that the point of cut-off is close to the head of each piston. There are, therefore, no elongated conduits between the feed and exhaust ports of the valve shaft and the heads of the pistons, so that the expansive fluid is utilized more completely than would be the case if such elongated conduits were employed.

As implied in the foregoing description and in the following claims, I am not limited to the specific mechanism of either of the embodiments of the invention by the drawings, excepting as otherwise required in certain of the more limited claims.

I claim:

1. An engine comprising a rotor having cylinders and passages connecting said cylinders with the rotor hub, pistons in said cylinders, a non-rotating valve shaft coaxial with the rotor and provided with means for admitting an expansive fluid to said passages to successively project the pistons, and for exhausting said fluid from said passages when the pistons are retracted, a driven shaft whose axis is out of alinement with the axis of the rotor, torque-transmitting connections between the pistons and the driven shaft, including a driving head fixed to, and concentric with, the driven shaft, and piston-rods connecting said head with the pistons, sprocket wheels fixed respectively to the rotor and driving shaft, an intermediate shaft having corresponding sprocket wheels, and sprocket chains connecting said wheels in pairs.

2. An engine comprising a rotor having cylinders and passages connecting said cylinders with the rotor hub, pistons in said cylinders, and a non-rotating valve shaft coaxial with the rotor and provided with means including an inlet-conduit terminating in a feed port, for admitting an expansive fluid to said passages to successively project the pistons, and with means for exhausting said fluid from said passages when the pistons are retracted, said feed port being provided with a feed-port-extension comprising a relatively narrow slot opening into said feed port and extending the surface area of said feed port transversely of said shaft, as and for the purpose specified.

3. An engine comprising a rotor having cylinders and passages connecting said cylinders with the rotor hub, pistons in said cylinders, a non-rotating valve shaft coaxial with the rotor and provided with means for admitting an expansive fluid to said passages to successively project the pistons, said means including an inlet conduit extending longitudinally of said shaft, and a feed port extending outwardly from said conduit to the cylindrical surface of said shaft, and with means for exhausting said fluid from said passages when the pistons are retracted, and a feed-port-extension of relatively small capacity leading from said feed port to a point on the surface of said shaft beyond the main opening of said feed port and in a transverse direction therefrom.

4. A valve shaft for rotary engines provided with an inlet conduit communicating through a feed port with the cylindrical surface of said shaft and having a feed-port-extension comprising a relatively narrow slot opening into said feed port and extending the surface area of said feed port trans-

versely of said shaft, said slot having its greatest width where it opens into said feed port and narrowing therefrom throughout the remainder of its length.

5. An engine comprising a frame formed of two separably connecting parts having spaced apart bearings, a valve shaft supported in said frame, a rotor journaled in one of said bearings and coaxial with said valve shaft, and provided with cylinders and with passages connecting said cylinders with said rotor hub, said shaft being provided with means for admitting an expansive fluid to said passages, and for exhausting the same therefrom, a driven shaft journaled in the other bearing, a driving head on said driven shaft, comprising two separably connecting parts concentric with said driven shaft, but eccentric to said rotor, pistons in said cylinders, and driving connections between said pistons and said driving head including rods attached to the pistons and pivoted to said driving head at points spaced outwardly from the axis of the driving shaft by means of pivot pins which project into holes bored deeply enough in each part of the driving head to receive said pins, but not deeply enough to extend through said parts.

6. An engine comprising a frame, formed of two separably connecting parts having spaced apart bearings, a valve shaft supported in said frame, a rotor journaled in one of said bearings and coaxial with and surrounding said valve shaft, and provided with cylinders and with radial passages connecting said cylinders with the rotor hub, said shaft being provided with means for admitting an expansive fluid to said passages, and for exhausting the same therefrom, a driven shaft journaled in the other bearing, a driving head on said driven shaft, comprising two separably connecting parts inclosing said rotor and concentric with said driven shaft, but eccentric to said rotor, pistons in said cylinders, and driving connections between said pistons and said driven shaft including rods attached to the pistons and pivoted to said driving head at points spaced outwardly from the axes of said driven shaft and said driving shaft, said frame and said driving head divided transversely in a vertical plane passing through the center of the cylinders.

7. An engine comprising a frame having spaced apart bearings, a valve shaft supported in said frame, a rotor coaxial with said valve shaft journaled in one of said bearings and provided with cylinders and with passages connecting said cylinders with said rotor hub, said shaft being provided with means for admitting an expansive fluid to said passages and for exhausting the same therefrom, a driven shaft journaled in the other bearing, the axes of said driven shaft and said rotor being out of alinement with, but parallel to each other, pistons in said cylinders, and driving connections between said pistons and said driven shaft, each of the parts termed respectively the frame and the driving head being composed of separably connected parts, and both of the parts divided in the same vertical transverse plane.

In testimony whereof I have affixed my signature.

JOHN F. DUBY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."