No. 822,426. PATENTED JUNE 5, 1906.

W. A. BROWN.

ROTARY ENGINE.

APPLICATION FILED OCT. 17, 1904.

2 SHEETS—SHEET 1.

Fig. 2.

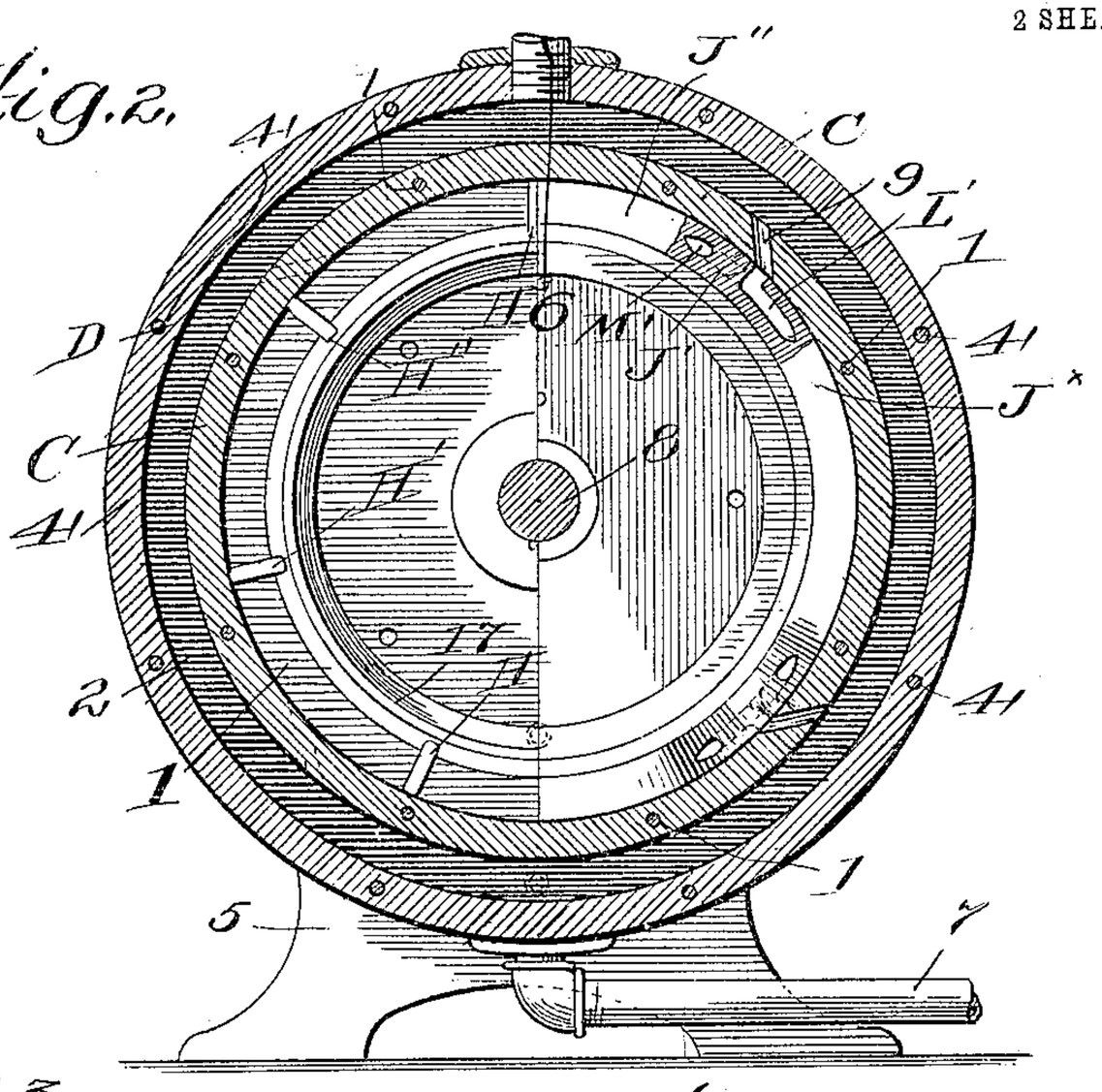


Fig. 3.

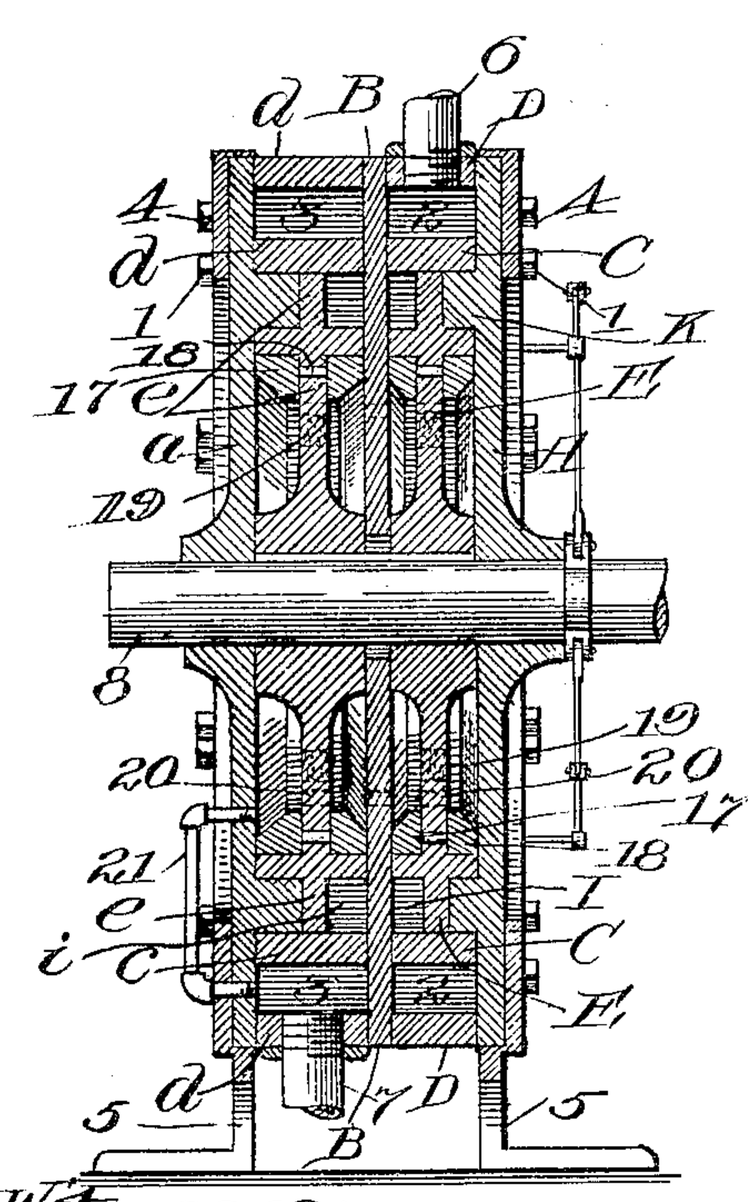
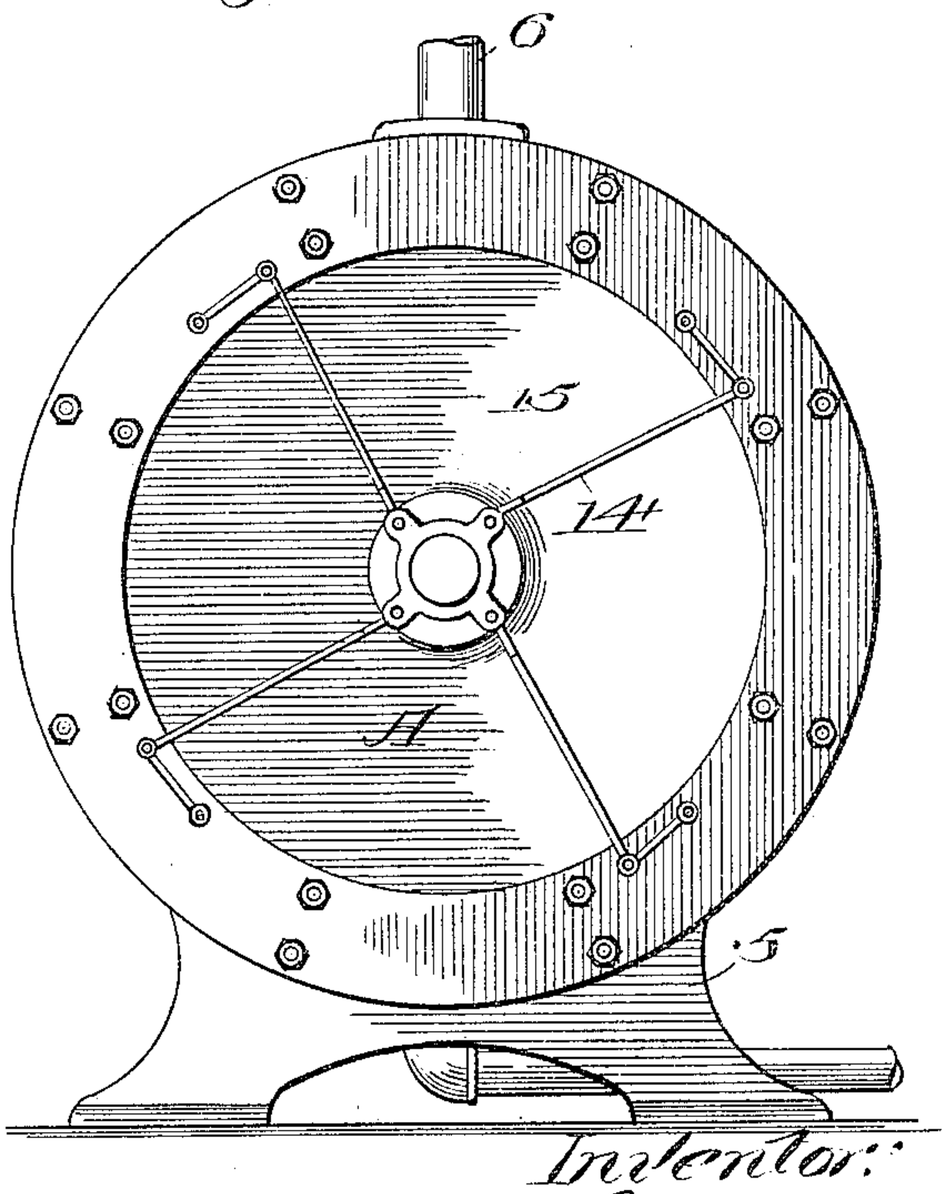


Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 5.

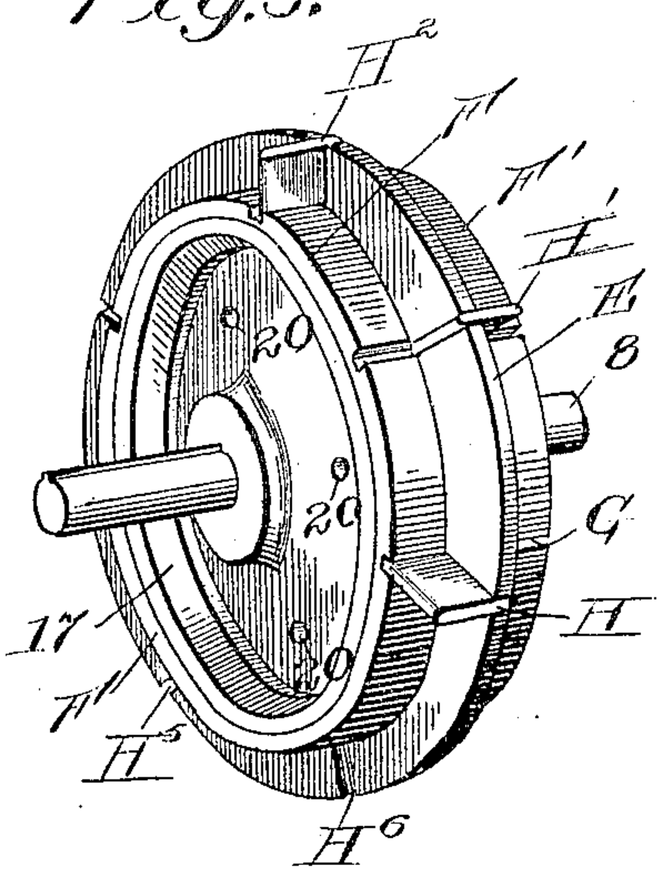


Fig. 4.

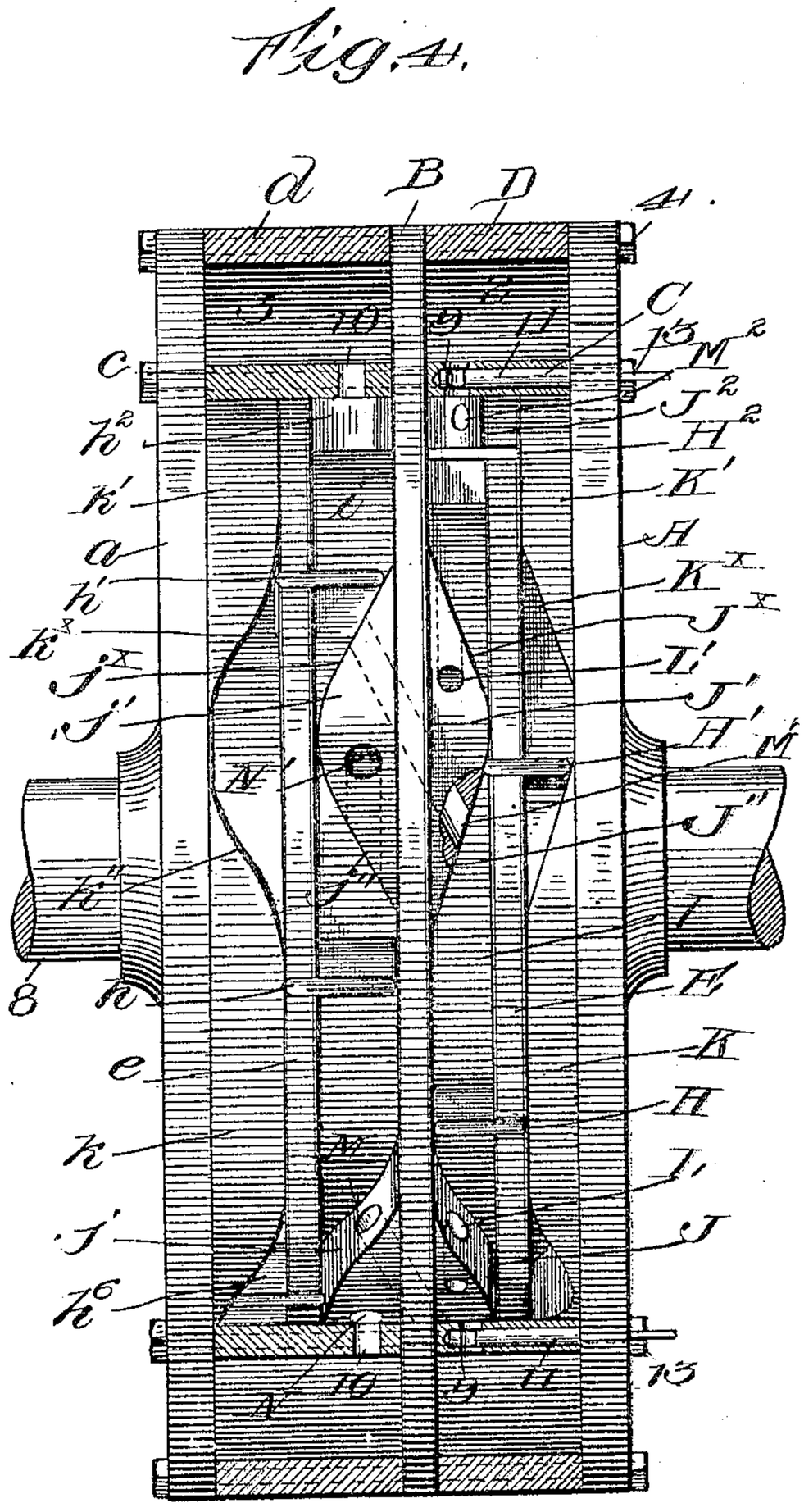
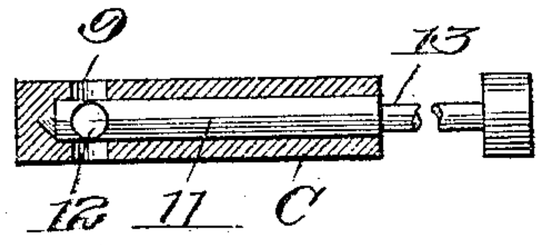


Fig. 6.



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UNITED STATES PATENT OFFICE.

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ROTARY ENGINE.

No. 822,426. Specification of Letters Patent. Patented June 5, 1906.

Application filed October 17, 1904. Serial No. 228,799.

To all whom it may concern:

Be it known that I, WILLIAM A. BROWN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

The particular embodiment of my invention which I have selected as an illustration of it for the purposes of this application is a double-expansion engine having a high-pressure cylinder, an annular steam supply chamber surrounding said high-pressure cylinder and having ports opening thereinto, a low-pressure cylinder, ports exhausting from the high-pressure cylinder into the low-pressure cylinder, an annular exhaust-chamber surrounding the low-pressure cylinder, and ports exhausting from the low-pressure cylinder into the annular exhaust-chamber, pistons of similar construction being arranged in the cylinders and secured to a common shaft. While I have selected this particular embodiment for the purposes of this application, it is manifest that some features of the invention may be embodied in a simplex engine by simply omitting those features which relate to the double-expansive use of the steam, and, again, the invention may be embodied in an engine having any desired number of expansive uses of the steam by the simple addition of the features that are peculiar to the double-expansive use.

The invention consists in the features of novelty that are hereinafter described with reference to the accompanying drawings, which are made a part of this specification, and in which—

Figure 1 is an elevation of the high-pressure end of an engine embodying the invention. Fig. 2 is a section thereof cutting the high-pressure cylinder in two planes. Fig. 3 is an axial longitudinal vertical section thereof. Fig. 4 is a sectional elevation of the principal parts of the engine, the rings which form the cylinders and the outer walls of the annular steam-passages being shown in axial section and the other parts being shown in elevation. Fig. 5 is a perspective view of one of the pistons. Fig. 6 is a detail of one of the governor-controlled valves for controlling the admission of steam to the high-pressure cylinder.

The two cylinders are constructed of two similar disks A and *a*, which form the outer heads, a disk B, which is common to both cylinders and forms their inner heads, and a pair of rings C and *c*, which form their sides. The three disks and the two rings are perforated for the passage of tie-bolts 1, by which they are all permanently secured together. The ring *c* is wider than the ring C, the object being to make the low-pressure cylinder larger than the high-pressure cylinder. The three disks extend radially beyond the rings C and *c*, and between their outer margins are arranged a pair of rings D and *d*, which form the outer walls of the annular live-steam chamber 2 and exhaust-chamber 3, respectively. The disks and the rings D and *d* are also perforated for the passage of tie-bolts 4. The parts form the main body of the engine and may be supported by any suitable means. In the drawings I have shown frame-sections 5 of similar construction, one located against each of the disks A and *a* and secured thereto by the before-mentioned tie-bolts 1 and 4. At some suitable point the ring D is provided with an opening with which the steam-supply pipe 6 communicates, and the ring *d* is provided with an opening with which the exhaust-pipe 7 communicates. It will thus be observed that all of the parts thus far described occupy fixed relations to each other and are stationary. The outer cylinder-heads A and *a* are provided with centrally-located openings for the passage of the shaft 8, which fits said openings so as to form a steam-tight joint, while the intermediate head B is provided with an enlarged opening which permits the free rotation of the shaft.

To the shaft are secured by a key or other suitable device the two rotary pistons E and *e*, the former being arranged in the high-pressure cylinder and the latter in the low-pressure cylinder. These two pistons and their accessories are for the most part of similar construction, excepting that they are of different lengths, each being appropriate to the length of its cylinder, so that a description of one of them will suffice for both. In this description similar reference-letters will be used for similar parts; but for the sake of distinction capital letters will be used for the parts of the high-pressure piston and small letters for the parts of the low-pressure piston.

The piston consists of a disk which, as before stated, is non-rotatively secured to the shaft and extends radially to steam-tight contact

with the inner surface of the ring C, or, in other words, to the inner surface of the cylinder. At a suitable distance from its periphery this disk has annular flanges F and F′ projecting equal distances on opposite sides of it, and these flanges, together with that portion of the disk which projects beyond them, are provided with equidistant longitudinal grooves G. In the drawings I have shown seven of these grooves; but in this respect the invention is not limited. In these grooves are disposed so as to be capable of sliding freely longitudinally valves H H′ H², &c., and these valves are of such size that they completely close the annular steam-space I and prevent steam from passing them. The walls of the annular steam-space are respectively the flange F of the piston, the projecting portion of the disk E, the head B, and the ring C. These taken together form a space which is of rectangular section in planes that are radial with respect to the piston and the sides of which are parallel, excepting at four equidistant points, at which abutments J J′ J², &c., are located. These abutments completely close the steam-space at their summits and are preferably integral with the head B, but may, if desired, be formed separately and attached thereto. They have several functions, the principal one of which is the affording of abutments against which the steam reacts in driving the piston, and hence this term will hereinafter be applied to them. The approach side J″ of each of these abutments—or, in other words, the side which the valves approach during the rotation of the piston—is of cam shape and has a gradual slope, which contacts with each of the valves in succession and moves the valve longitudinally and entirely out of the steam-space. In order to permit this and to return the valve to the steam-space and there hold it while it is receiving the pressure of the steam, the outer head A is provided with recesses resulting in appropriately-shaped cams K K′, &c. The portion K″ of each of these cams which is directly opposite the approach J″ of the abutments recedes so that the two surfaces are parallel and so that they move the valve back and forth in the manner described.

Having passed the summit of the abutment, the valve comes in contact with a reverse cam-surface K× on the cam K′, whereby it is moved longitudinally in the reverse direction and returned to the steam-space, the opposite surface J× of the abutment being parallel with the surface K×. Thus, it will be seen, as the piston rotates the valves are moved longitudinally back and forth into and out of the steam-space. The abutments are provided with ports L L′, &c., which communicate with ports 9, opening from the steam-chamber 2, and these ports L L′, &c., open into the annular steam-space in rear of the valves. The approach sides of the abutments are provided with exhaust-ports M M′, &c., which open into the low-pressure cylinder *i* through ports in the abutments *j j′ j²*, &c., and constitute the inlet-ports thereof.

Thus far I have described a complete and operative rotary engine in connection with the high-pressure cylinder. The operation of this engine will be apparent from an inspection of Fig. 4. Here it will be seen the valves H and H² are taking steam from the ports L and L′ and the steam in advance of said valves is exhausting through the ports M′ and M², the valves H′ and H³ (not seen in this figure) having passed the exhaust-ports M′ and M³ and having not yet arrived in positions to take steam from the ports L′ and L³. It will be observed, however, that as soon as the valve H′ passes the port L′ it will begin to take steam, and at about this time the valves H and H² will arrive at the ports M′ and M². Precisely this operation holds good as to all of the valves, so that there is no point at which some of the valves are not under full boiler-pressure.

The operation of the low-pressure piston is precisely the same, excepting that, as before stated, it takes its steam from the exhaust-ports of the high-pressure cylinder. It exhausts through ports N N′, &c., which communicate with points 10, opening into the annular exhaust-chamber 3. In order to make the pressure upon the shaft absolutely uniform, the valves of the two pistons are staggered or arranged so that the valves of one piston fall midway between the valves of the other piston.

For the purpose of controlling the admission of steam to the high-pressure cylinder each of its ports 9 is provided with a valve 11, which is in the nature of a rotary plug-valve having through it a single transverse port or passage 12, which is adapted to being brought to coincide to any desired extent with the port 9, so as to admit either a full or a limited supply of steam, depending upon the governor. The stem 13 of each of these valves passes out through the cylinder-head A, and the several stems may be connected with any suitable governor by any suitable mechanism. With this the invention is not concerned; but for the sake of completeness I have indicated in the drawings one means by which the several valve-stems may be connected to a ring 14 under the control of the governor. This ring is loosely mounted upon the shaft 8 and at equidistant points is jointed to the inner ends of links 15, the outer ends of which are jointed to levers 16, carried by the valve-stems. I have not shown a governor; but governors suitable for the purpose of turning the ring 14 under the influence of varying speeds may be purchased in open market.

Each of the pistons is provided within the

flanges F and F′ with packing-rings 17, which fit snugly against the inner faces of the flanges and are guided in their movements by pins 18, occupying sockets in the disk E of the piston. They are forced outward in opposite directions against the cylinder-heads by coiled springs 19, which occupy sockets in the disk E, as indicated by dotted lines in Fig. 3.

The disks B, E, and *e* are provided with perforations 20, which place all of the spaces between the outer cylinder-heads in communication with each other, so that any steam which may leak past the packing-rings will be balanced on opposite sides of the pistons. Any water of condensation resulting from this steam will be carried off through a drip-pipe 21 and discharged into the exhaust-steam chamber 3.

I have described the invention as relating to a rotary steam-engine; but it is manifest that it may be used with water, air, or, in fact, any fluid under pressure.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine the combination of a cylinder having two heads with opposing parallel surfaces, one of said heads being provided with abutments and said abutments being provided with suitable supply and exhaust ports, a piston having annular flanges and a centrally-located radial flange, said annular flanges and central flange having longitudinal grooves and valves arranged in said grooves and movable longitudinally, substantially as described.

2. In a rotary engine the combination of a cylinder, a rotary piston arranged therein, abutments on one of the cylinder-heads, said abutments having suitable supply and exhaust ports, a piston, valves carried by the piston and movable longitudinally, the cylinder being provided with ports registering with the ports of the abutment, and means for supplying the cylinder-ports with steam, substantially as described.

3. In a rotary engine the combination of a cylinder, a rotary piston arranged therein, abutments on one of the cylinder-heads, said abutments having suitable supply and exhaust ports, a piston, valves carried by the piston and movable longitudinally, the cylinder being provided with ports registering with the ports of the abutments, and an annular steam-supply chamber surrounding the cylinder, substantially as described.

4. In a rotary engine the combination of two cylinders having a common head, abutments carried by said head, and projecting into both of said cylinders, so as to close the steam-space, the abutments of one cylinder having supply-ports opening thereinto and exhaust-ports opening into the other cylinder and the abutments of the cylinder last aforesaid having exhaust-ports for the final escape of steam, substantially as described.

5. In a rotary engine the combination of two cylinders, a piston arranged in each cylinder and having an annular flange and a radial flange, abutments carried by the cylinder-heads and projecting over the annular flanges and into contact with the radial flanges, the remaining cylinder-heads having surfaces parallel with said abutments, valves carried by the pistons and adapted to coöperate with said abutments, the abutments of one cylinder having supply-ports opening thereinto and exhaust-ports opening therefrom and discharging into the second cylinder the abutments of the second cylinder having final exhaust-ports and the abutments of the two cylinders being staggered, substantially as described.

6. In a rotary engine the combination of three disks, two concentric rings arranged between each of the outer disks and the intermediate disk and providing two cylinders and two annular spaces surrounding them, ports through which each of said cylinders communicates with the surrounding annular space, a piston in each of said cylinders, said piston having a centrally-located radial flange, valves carried by the piston and movable longitudinally, abutments on the inner head of each cylinder, said abutments projecting in opposite directions into the cylinders and contacting with the radial flanges of the pistons, the abutments of one of said cylinders having supply-ports opening thereinto and exhaust-ports opening into the second cylinder, and the abutments of the second cylinder having final exhaust-ports, substantially as described.

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JOHN L. HANLEY.