L. HOLT.

ROTARY ENGINE.

APPLICATION FILED SEPT. 3, 1908.

917,436.

Patented Apr. 6, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

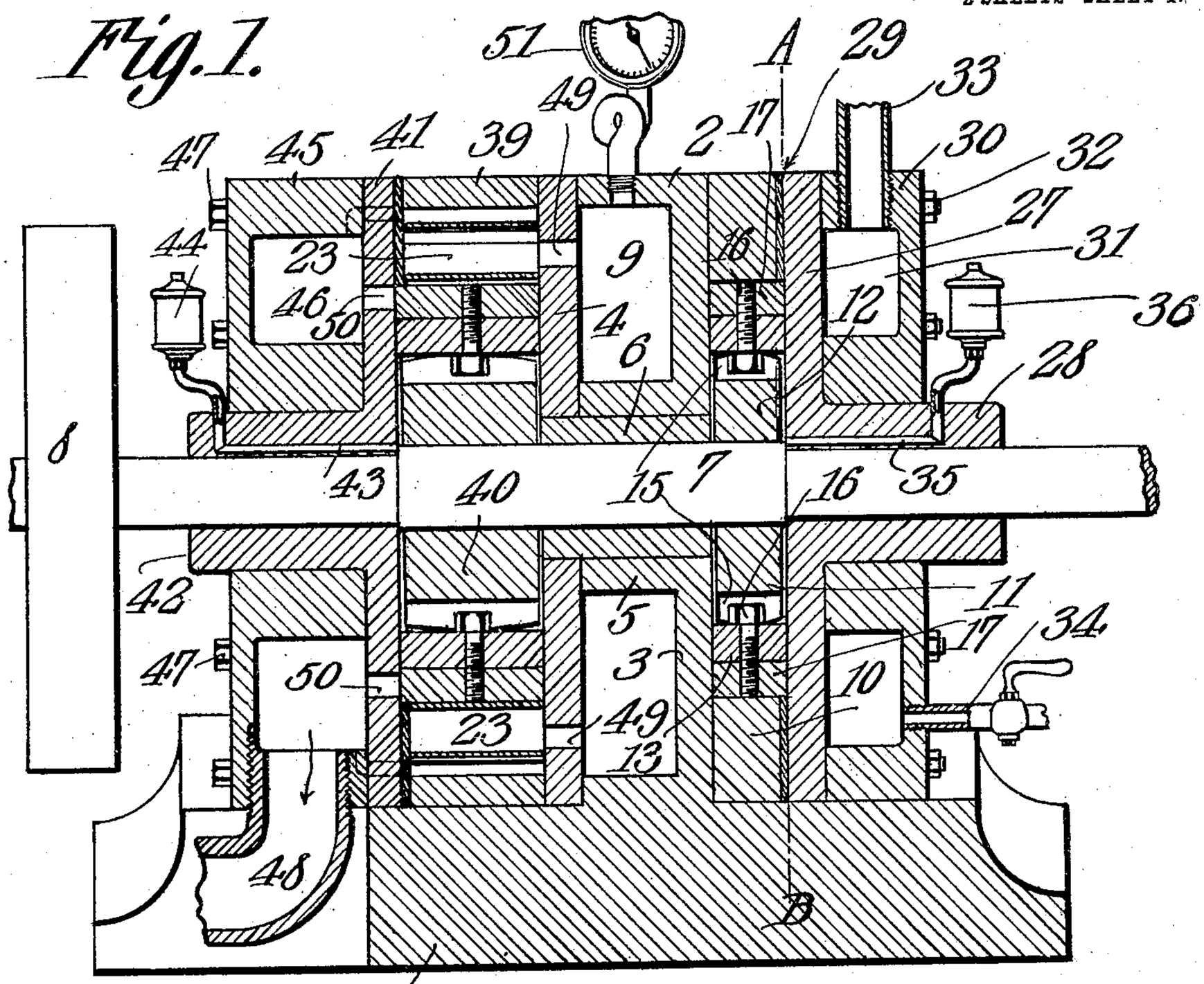
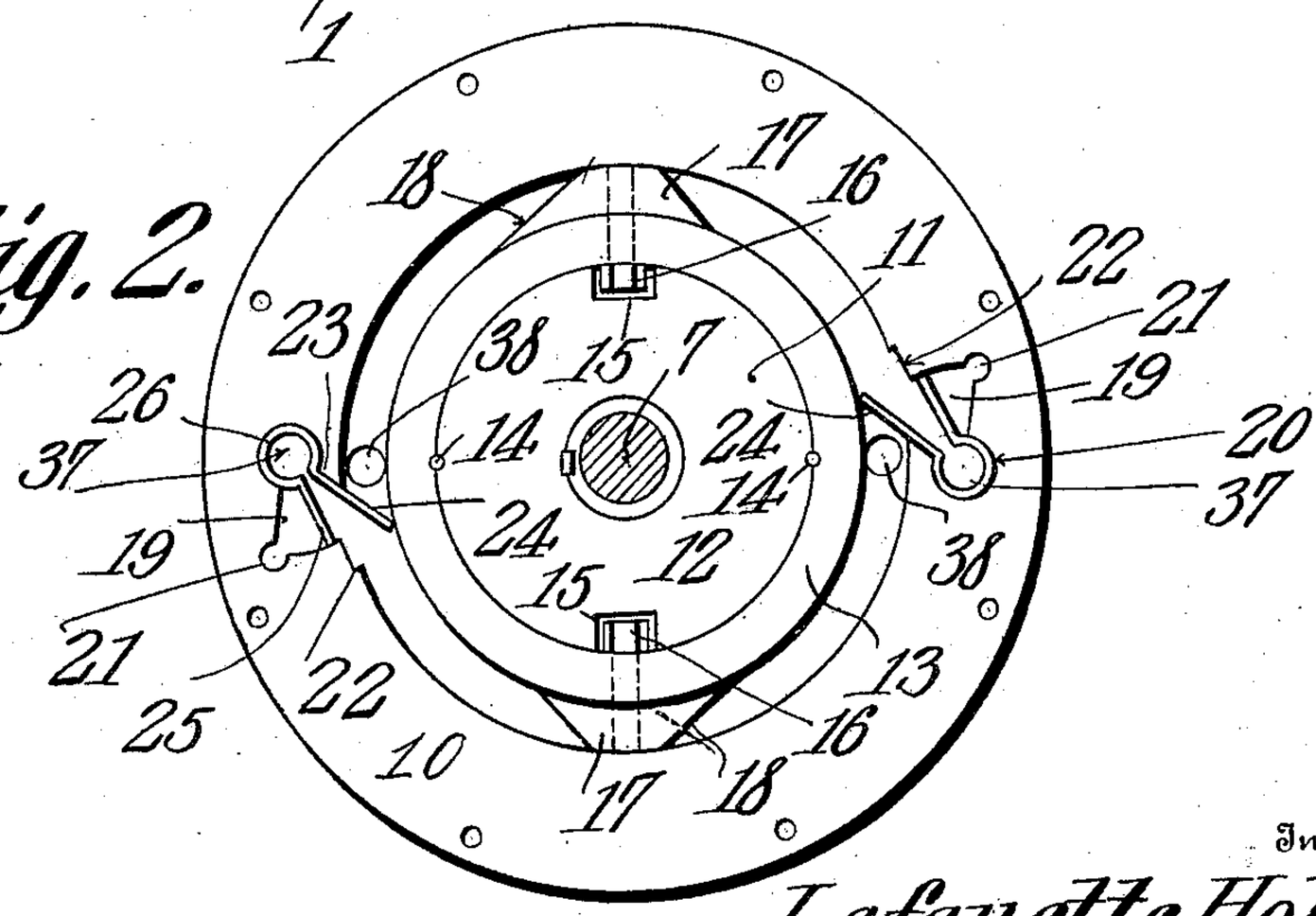


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

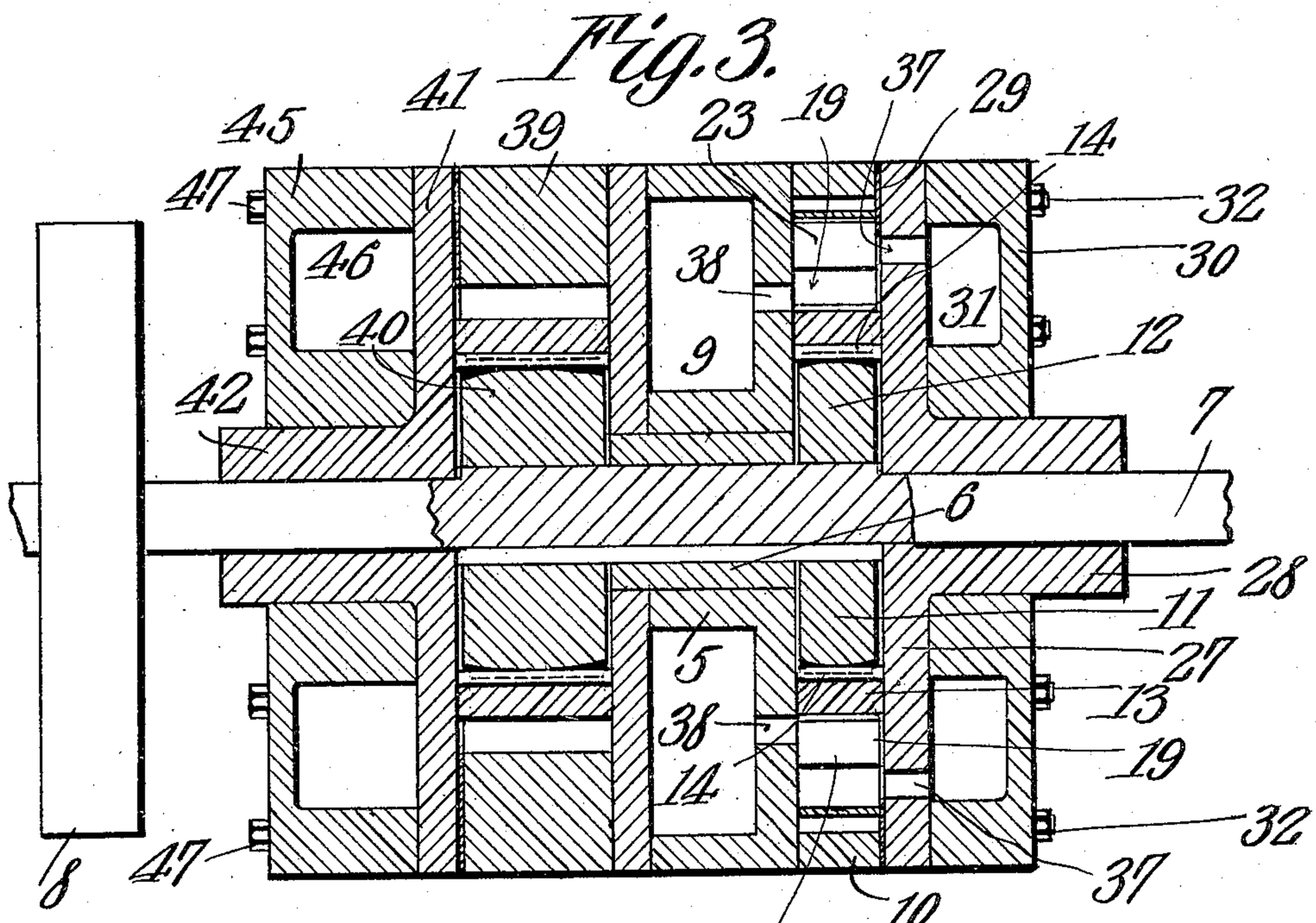

Fig. 4

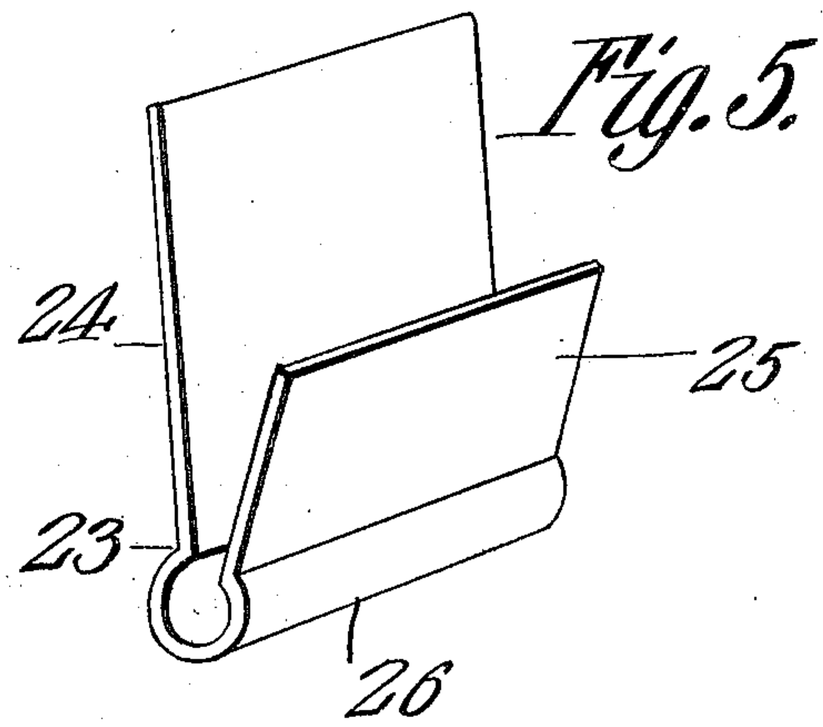

Fig. 5.

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UNITED STATES PATENT OFFICE.

LAFAYETTE HOLT, OF BURLINGTON, NORTH CAROLINA.

ROTARY ENGINE.

No. 917,436. Specification of Letters Patent. Patented April 6, 1909.

Application filed September 3, 1908. Serial No. 451,623.

To all whom it may concern:

Be it known that I, LAFAYETTE HOLT, a citizen of the United States, residing at Burlington, in the county of Alamance and State of North Carolina, have invented a new and useful Rotary Engine, of which the following is a specification.

This invention has reference to improvements in rotary engines, and its object is to produce a rotary engine preferably, though not necessarily, of the compound type, wherein all mechanical means for maintaining the valves in operative relation to the pistons are avoided, and the steam pressure is utilized for this purpose.

In a rotary engine constructed in accordance with the present invention the piston or rotor of the engine carries the abutments, and these abutments are utilized for the purpose of moving the valve out of the steam course about the piston at proper time intervals, while the valves themselves are so shaped and disposed as to direct the steam in a path tangential to the periphery of the rotor and against the active sides of the respective abutments, and the steam pressure is utilized to not only move the valve into active position but to maintain it in such forced contact with the periphery of the rotor as to make it substantially steam-tight at such point of contact.

The invention will be best understood from a consideration of the following detail description, taken in connection with the accompanying drawings forming a part of this specification, in which drawings:—

Figure 1 is a central vertical longitudinal section through the machine, with parts shown in elevation. Fig. 2 is a section on the line A–B of Fig. 1. Fig. 3 is a horizontal central longitudinal section through the machine with parts shown in elevation. Fig. 4 is a detail section of a portion of one of the engine rotors. Fig. 5 is a perspective view of one of the valves.

Referring to the drawings, there is shown a base 1, of suitable size and shape, and at an intermediate point of this base there is erected the cylindrical member 2, either formed in one piece with the base or secured thereto, as may be found desirable.

The member 2 is, in the particular structure shown in the drawings, provided with a closed end 3, formed in one piece with the peripheral portion of the member 2, while the other end of the member 2 is closed by a removable head or annular plate 4, to which reference will be made hereinafter. The member 2 has a central hub 5, which is appropriately bored out to receive a sleeve 6, through which latter in turn passes the shaft 7 of the machine, the said shaft being shown as carrying at one end a pulley 8, for the transmission of power through a suitable belt to the work. Within the member 2 there is formed an annular chamber 9, to which reference will presently be had.

Mounted on the base 1, or formed thereon if so desired, is an annulus 10 immediately adjacent to and of the same external diameter as the member 2, and this annulus 10 may, if so desired, be cast in one piece with the member 2.

The annulus 10 forms the housing or stationary member for a piston or rotor 11, which is shown in the drawings, and more especially in Fig. 2, as composed of a disk 12, keyed to the shaft 7, and an annulus 13 mounted upon and concentric with the disk 12 and connected for rotation therewith by pins or keys 14. The disk 12 is formed with recesses 15 at diametrically opposite points in its periphery, and these recesses are provided for the heads of screws 16, extending radially outward through the annulus or ring 13, and entering suitably tapped holes in blocks 17, constituting abutments carried by the piston or rotor and shaped at their outer ends or faces to engage the inner periphery of the annulus or casting 10. The opposite ends of the abutments 17 are beveled as shown at 18, so that the outer ends of the abutments are comparatively narrow, while the faces are broad and ultimately merge into the outer periphery of the ring or annulus 13. The abutments 17 are made readily removable, so that they may easily be replaced with new abutments when, from continued use, these abutments become worn, thus avoiding the necessity of replacing the entire piston or rotor, or even a considerable portion thereof.

The disk 12 is made a little thinner than the ring 13 and its periphery is slightly rounded in the direction of its axis of rotation. This permits the disk 12 to accommodate itself to any slight inaccuracies of fitting without bringing undue strain upon the ring 13, which latter may be made to fit the interior walls of its housing with accuracy, so as

to prevent steam leaks without the necessity of special packing. Also the capability of the disk 12 for slight lateral or wabbling movement in the ring 13 compensates for wear of the shaft 7 in its bearings or of the bearings with relation to the shaft.

By making the ring or annulus 13 separate from the disk 12, this ring may be accurately made and may be readily replaced when worn. Also by making the disk 12 somewhat thinner than the ring 13 there remains a slight space between each face of the disk 12 and the corresponding walls of the inclosing chamber, and therefore any expansion of the disk 12 under the action of heat will not bring the said disk into engagement with the walls of the chamber, and any friction that might be caused thereby is avoided.

Formed in the inner walls of the annulus 10, at diametrically opposite points therein, are recesses 19 extending across the annulus in a direction parallel with the axis of the shaft 7 and opening into the interior of the annulus. The recesses 19 are substantially in the shape of a truncated sector in cross section, as best shown in Fig. 2. One side of the wide end of each recess 19 opens into the interior of the annulus 10, while the other side of the recess is remote from the interior of the annulus 10. The wide end of the recess is curved on an axis central to a cylindrical enlargement 20 of the narrow end of the sector, and where the remote side of the recess joins the curved end thereof, there is formed a side extension 21, the purpose of which will hereinafter appear. The open side of the recess is also extended along the inner periphery of the annulus 10, as shown at 22, and the purpose of this extension will also hereinafter appear.

Within each recess 19 there is located a valve 23, this valve being formed of two divergent members, or legs 24 and 25, joined at their adjacent ends by a substantially cylindrical continuation 26, the said legs 24 and 25 and the continuation or yoke 26 being all formed in one piece. The yoke 26 is of such size and shape as to fit snugly within the cylindrical extension 20 of the recess 19 and the leg 25 is of such length as to engage at its free end the curved wall at the wider end of the slot 19. The other leg 24, which constitutes the outer or active leg of the valve, is of such length that, in one limit of the movement of the valve, the free end of the leg will engage the outer peripheral surface of the ring or annulus 13, and when the valve is in the other extreme of its travel, which is toward the inner periphery of the annulus 10, then this leg 24 will be seated in the extension 22 of the slot 19, and thereby form a closure for the slot, cutting it off from communication with the interior of the annulus 11. At the same time the depth of the continuation 22 of the slot 19 is such that an abutment 17 will pass by the valve and engage the outer face of the said leg 24 only. The cylindrical yoke 26 forms a support for the valve, holding it in the recess 19, but permitting a limited movement of the valve about the longitudinal axis of said cylindrical yoke.

Applied to the face of the annulus 10 remote from the member 2, is a plate 27, formed with a hub 28, through which the shaft 7 extends. The interior of the chamber inclosed by the annulus 10, the walls 3 and the plate 27, is rendered steam-tight by suitable packing 29, introduced between the plates 27 and the corresponding face of the annulus 10.

Mounted upon the hub 28 is a casting 30, having an annular channel 31 formed in one face. The channeled face of the casting 30 is applied to the outer face of the plate 27, and the said casting is secured to the plate 27 and the latter is secured to the annulus 10 by suitable bolts 32. The chamber 31 constitutes a distributing chamber for live steam entering through a suitable pipe or conduit 33, coming from a live steam supply, and in the bottom of this chamber there may be applied a drain-pipe 34, provided with a suitable valve, so that water of condensation may be withdrawn from the chamber 31 whenever necessary.

By means of a suitable channel 35, leading to the interior of the chamber in which the rotor or piston 11 is housed, the lubricating oil, or other suitable lubricant, may be supplied from an oil-cup or other suitable reservoir 36.

The live steam chamber 31 is in communication with the interior of the annulus 10 through two diametrically opposed ports 37, leading into the interior of the yoke 26 of the valve 23.

Leading from the steam course between the outer face of the ring 13 and the inner face of the annulus 10 are exhaust ports 38 at diametrically opposite points, and these ports lead directly into the chamber 9 within the member 2.

Formed on or mounted on the base 1, on that side of the member 2 to which the plate or head 4 is applied, and, if desired, in one piece with the head or plate 4, is another annulus 39, similar to, but of greater internal diameter and greater breadth than the annulus 10. Within the annulus 39 there is housed a rotor 40, in all respects except as to size, similar to the rotor 11 housed within the annulus 10, and since the parts are the same as those carried by the rotor 11, except as to size, they will be indicated in the drawings by the same reference numerals.

Applied to the end of the annulus 39 remote from the head 4, is a plate 41, having a hub 42, through which the shaft 7 extends, and this hub is provided with a lubricant-conducting channel 43, to which channel lu-

bricant is supplied from a suitable cup or reservoir 44. Mounted on the hub 42 is a casting 45, in one side of which there is formed an annular chamber 46 and the chambered side of this casting is applied to the plate 41, the said casting and plate 41 being held to the annulus 39 by suitable bolts 47. Packing like the packing 29 before referred to may be interposed between the annulus 39 and plate 41, if desired. Leading from the lower portion of the chamber 46 is an exhaust pipe 48.

The chamber 9 is in communication with the yoke portions of the valves 23 of the annulus 39 through ports 49 and the steam course interior to the annulus 39 is in communication with the chamber 46 through appropriately located ports 50.

If now steam under pressure be admitted by the pipe 33 to the chamber 31 it will find its way through the ports 37 into the interior of the valves 23, and since the legs 24 of the valves are longer, or present more surface to the steam than the legs 25, these valves will be forced outward until the free ends of the legs 24 are in intimate contact with the outer periphery of the ring 13, and the steam enters the steam courses between the valves and adjacent abutments 17. The pressure of the steam on the live steam side of the abutments 17 will impart rotative movement to the rotor or piston 11, and this rotative movement will continue until the abutments 17 are brought into engagement with the inactive side of the legs 24 of the valves 23. The exhaust ports 38 for the steam course within the annulus 10 are immediately behind the valves, so that the abutments at this point close the said exhaust ports. The continued movement of the rotor 11 will bring the abutment 17 into engagement with the legs 24 and cause the valves to turn on their axes, until the legs 24 are seated in the extensions 22 of the recesses 19, this resulting in the cutting off of the steam supply to the steam-course within the annulus 10. As soon as the outer end of the abutments 17 has passed the outer end of the leg 24 of a valve 23, then the pressure of the live steam, which is greater upon the leg 24 than upon the leg 25, because of its superior area, will immediately cause the valve 23 to turn in a direction to force the outer end of the leg 24 against the beveled side 18 of the abutment 17, and as the abutment moves away from the valve the latter will be ultimately brought into engagement with the outer periphery of the ring 13, with however no chance for the steam to escape around the outer end of the leg 24 of the valve, since the differential pressure of the steam on this side of the valve will hold it in intimate contact with the outer periphery of the ring 13. The abutments 17 having now uncovered the exhaust ports 38, the steam still under considerable pressure will exhaust in the chamber 9, where the pressure becomes equalized, and this comparatively low pressure steam passes through the ports 49 into the valves 23 of the engine composed of the annulus 39 and rotor 40. After having performed its work in a manner similar to that already described, the steam finally passes into the chamber 46 and out through the exhaust pipes 48, either to the atmosphere or to a condenser.

The degree of pressure exerted by the steam upon the valves 23, urging these valves into operative positions, depends upon the relative areas of the legs 24 and 25, the area of the active leg 24 predominating. Since the leg 25 of the valve moves in a direction lateral to the length of the recess 19, air or steam behind the leg 25 would become pocketed in the recess when the valve is moved to its inactive position. To avoid this and to substantially balance the valve, so far as the leg 25 is concerned, the side extension 21 of the recess 19 is placed in communication with the chamber 9 through a suitable port, so that the steam or air behind the valve leg 25 may surge back and forth into and out of the chamber 9.

It will be observed that the bevel or slant of each abutment 17 on the side approaching the valve is longer or more gentle than the slope of the side leaving the valve. This causes a comparatively slow closing of the valve but a quick opening of the same.

By means of the present invention there is provided an engine unit, capable of utilizing steam under high pressure, and then the exhaust from the first engine is carried into an intermediate chamber where the pressures of the successive exhausts become equalized into a comparatively uniform pressure, and this steam under lowered pressure is carried into another engine capable of working efficiently under the steam of lower pressure, and the energy developed by the steam in the second engine is transmitted to the same shaft driven by the engine working under the high pressure steam. By properly proportioning the engines, the steam which is finally exhausted through the conduit 48 will closely approach atmospheric pressure.

In order to indicate the pressure of the steam within the chamber 9 a suitable steam-gage 51 may be connected therewith.

In the foregoing description each engine is shown as supplied with a rotor or piston having but two abutments and steam is admitted to the steam-course through but two valves. It will be understood, of course, that if it be desirable a greater number of abutments and corresponding valves may be used. Again, there are but two engine units shown in the drawings, that is a high pressure engine and a low pressure engine working together, but it will be understood that a greater number of engines may be employed,

suitably graded, one with relation with the other, to utilize whatever pressure of steam may be supplied initially.

The abutments 17 have been described as made separate from the rings 13, but they may, if desirable, be made in one piece therewith.

In the structure shown the parts of one engine unit are displaced 90 degrees from those of the other engine unit, and if more than two engine units be used then the displacement of the parts will correspond thereto. The purpose of relative displacement of the parts is to insure constant torque, the engine units being designed to give substantially the same power with the respectively different steam pressures.

What is claimed is:—

1. In a rotary engine, a valve for admitting steam to the steam course, adapted to be closed by engagement of the rotor of the engine with the valve, said valve being in full and constant communication with the prime steam supply and opening in response to differential live steam pressure.

2. A rotary engine having steam inlet valves each comprising two legs of unequal length joined by a cylindrical yoke in constant and full communication with the live steam supply.

3. A rotary engine having steam inlet valves each comprising two divergent legs of unequal length joined by a cylindrical yoke in constant and full communication with the live steam supply.

4. In a rotary engine, a stator having steam ports extending across the same in a direction parallel to the longitudinal axis of the stator, said ports approximating in shape, in cross section, a truncated sector, and each having a steam inlet at one end, and a valve member housed in each port and movable into and out of the steam course of the engine about an axis parallel with the longitudinal axis of the stator, said valve comprising two legs of unequal length joined by a cylindrical yoke forming the journal support for the valve and receiving steam at one end.

5. In a rotary engine, a stator having ports leading to the steam course of the engine, said ports each communicating at one point with a steam supply and each having a passage leading therefrom at a point remote from the opening of the said port into the steam course, and a valve for each port having two unequal divergent legs and a connecting yoke for said legs coincident with the connection of the port to the steam supply, the valve directing the steam through it to the steam course with the larger leg of the valve adjacent to the steam course and the smaller leg separating the steam inlet to the port from the other passage leading from said port.

6. In a rotary engine, a rotor comprising a disk and a peripheral ring applied thereto, the disk being of less thickness than the ring in the direction of the axis of rotation.

7. In a rotary engine, a rotor comprising a disk, and a peripheral ring applied thereto, the disk being of less thickness than the ring in the direction of the axis of rotation and having its periphery where engaging the ring rounded in the same direction.

8. In a rotary engine, a rotor comprising a disk, and a peripheral ring applied thereto, the disk being of less thickness than the ring in the direction of the axis of rotation and having its periphery where engaging the ring rounded in the same direction, and abutments removably secured to the ring.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

LAFAYETTE HOLT.

Witnesses:

JAS. M. WALKER,

F. T. CHAPMAN.