

R. F. SCHMIDT.
 ROTARY ENGINE.
 APPLICATION FILED DEC. 23, 1907.

938,714.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 1.

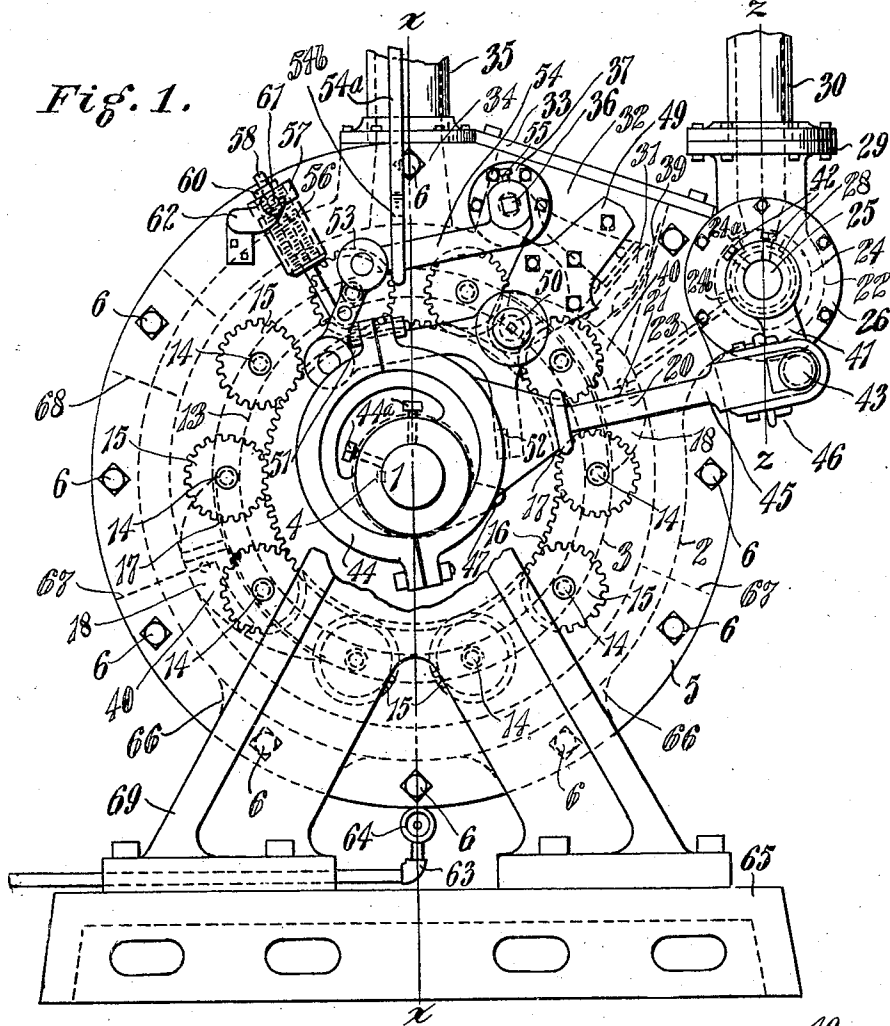


Fig. 5.

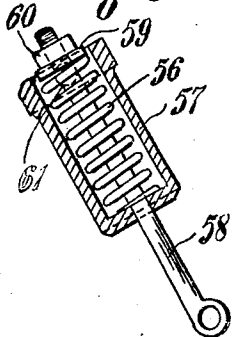


Fig. 3.

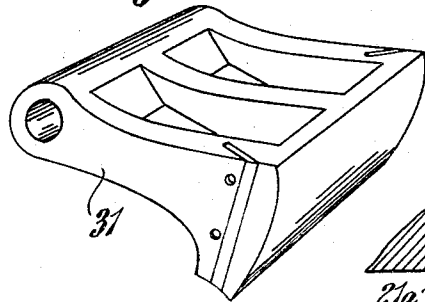


Fig. 2.

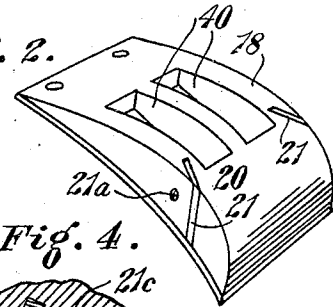
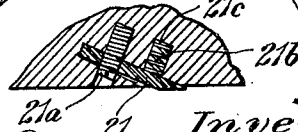


Fig. 4.



Witnesses:
 Clarence F. Fiden
 Stella Rutz

Inventor
 Rudolph F. Schmidt
 By James A. Ramsey
 Attorney

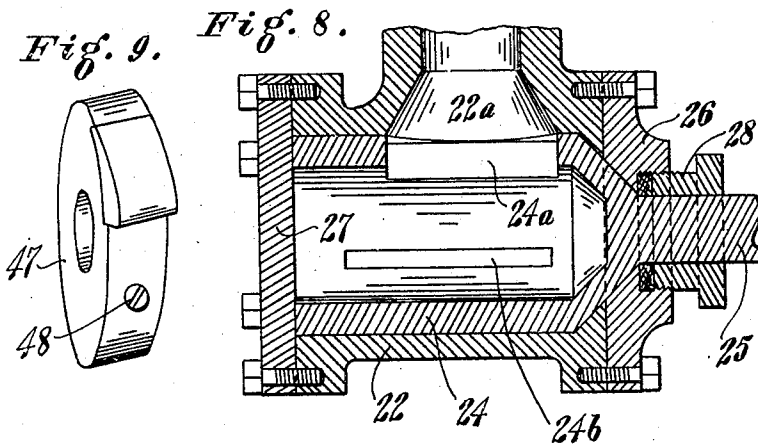
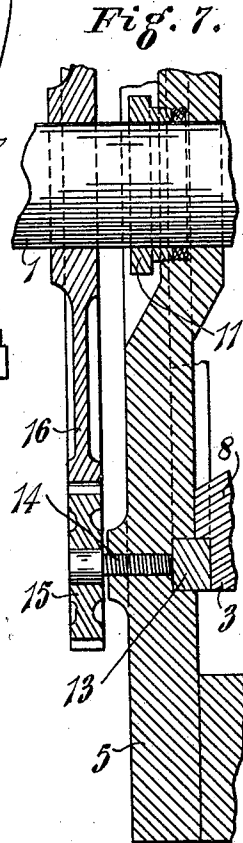
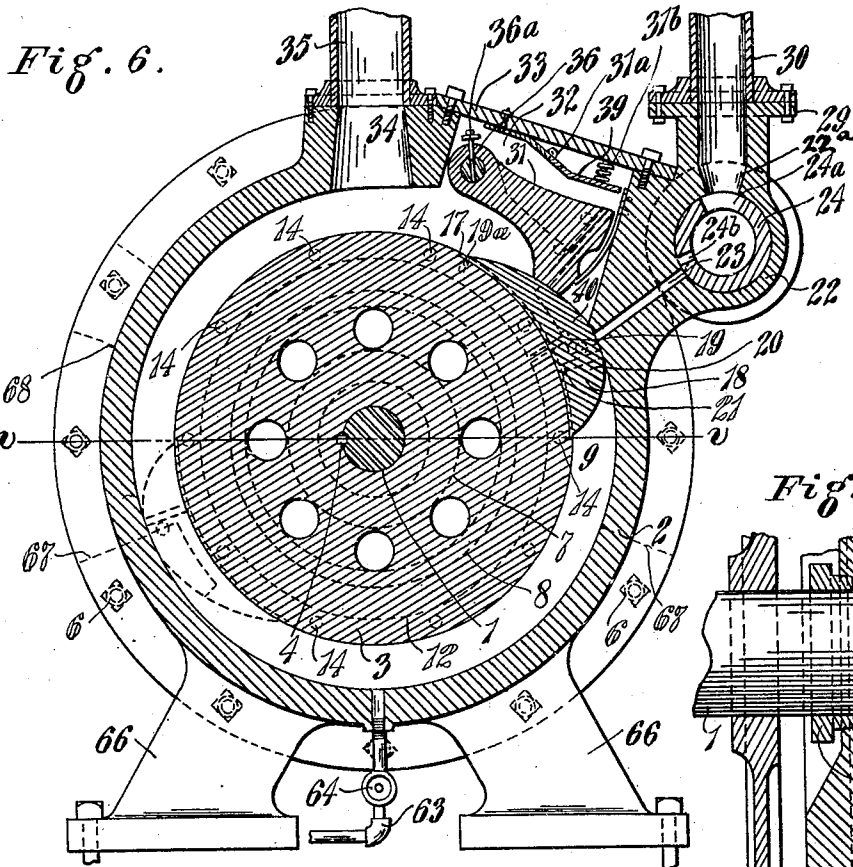
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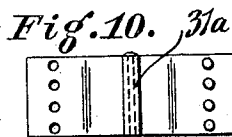
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4 SHEETS—SHEET 2.



Witnesses:
Clarna Perdue
Stella Rutz



Inventor
Rudolph F. Schmidt
By James H. Ramsey
Attorney

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4 SHEETS—SHEET 3.

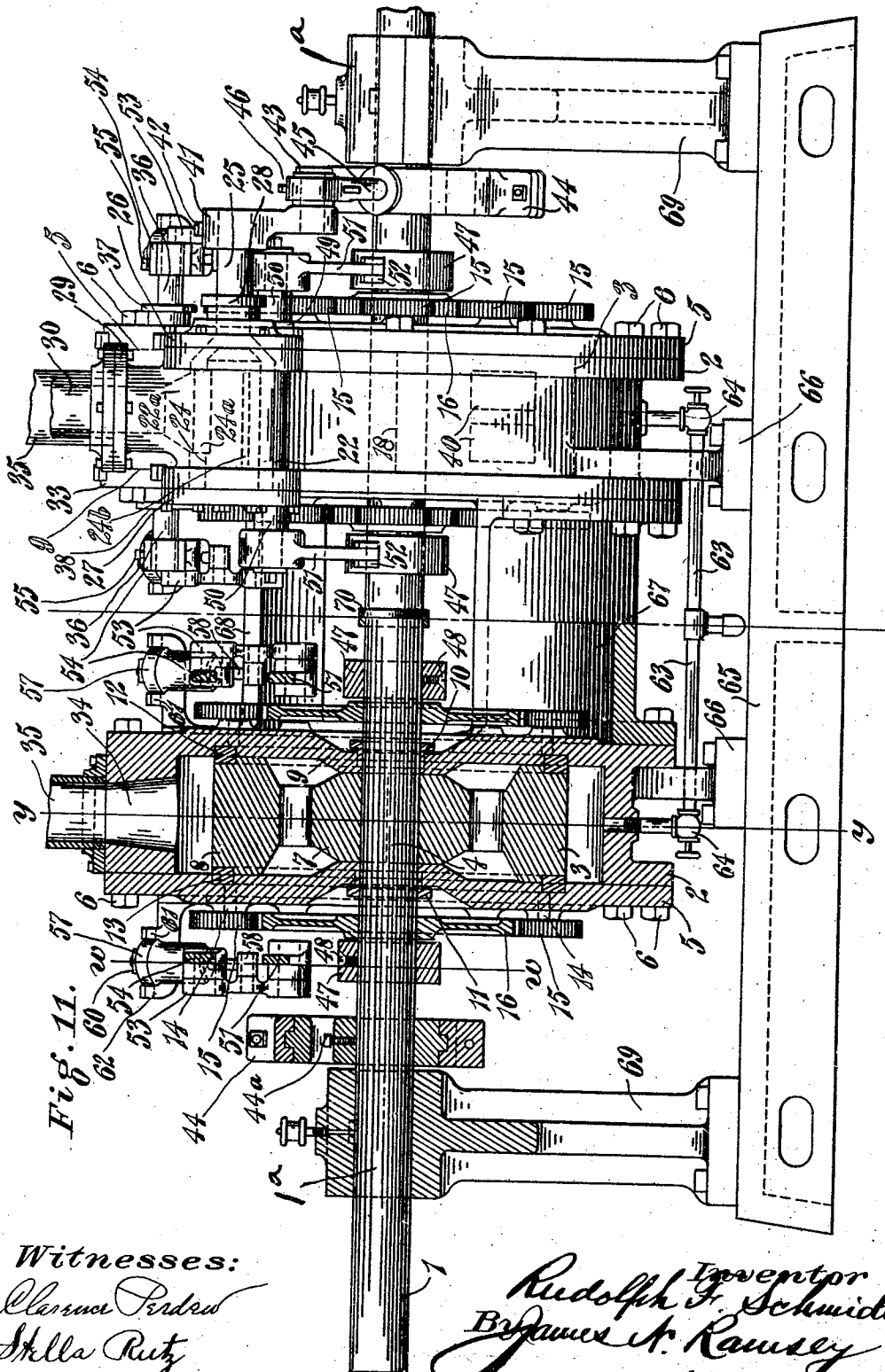


Fig. 11.

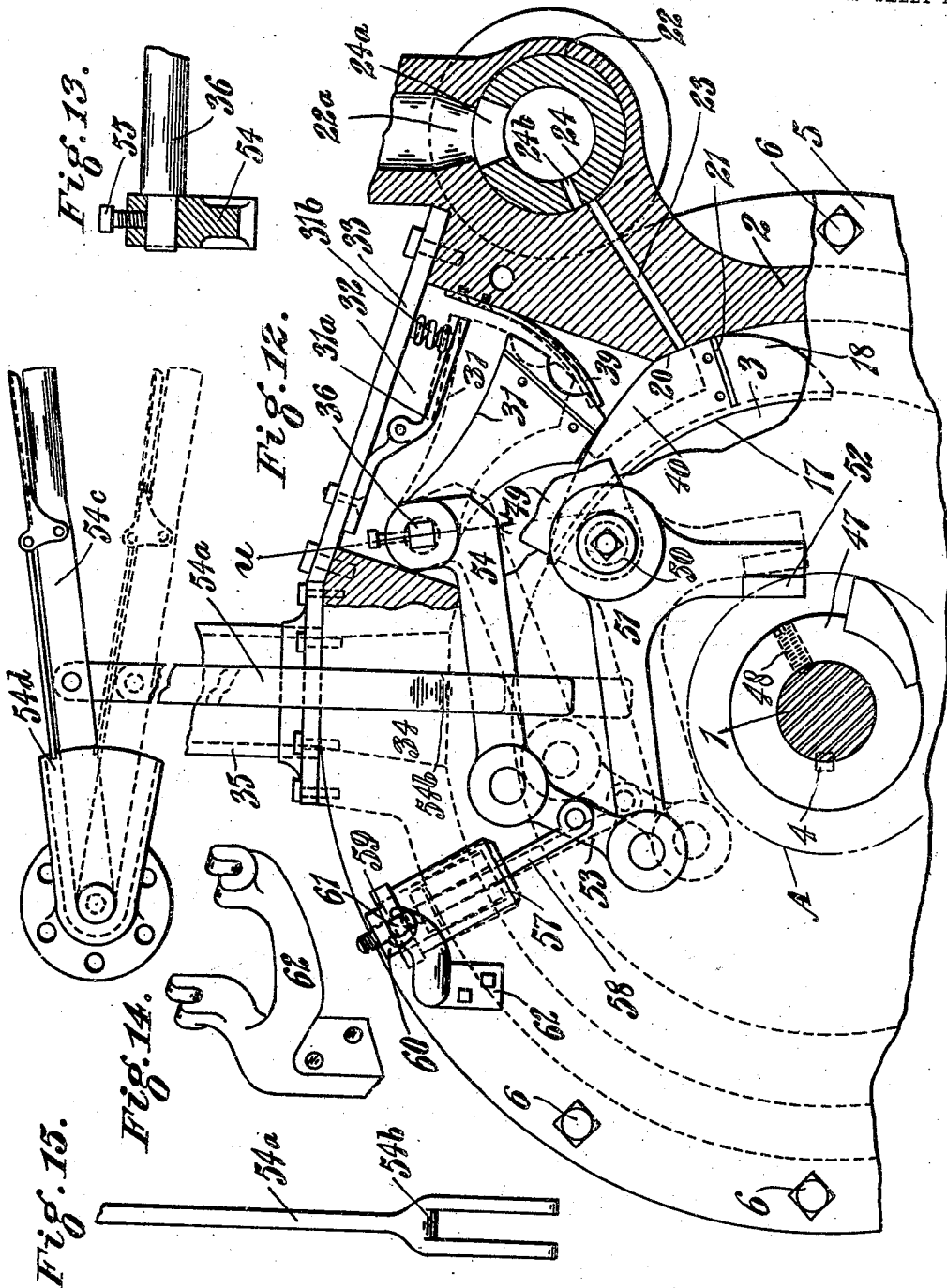
Witnesses:
Clarence Pindrow
Stella Rutz

Inventor
Rudolph F. Schmidt
By James A. Ramsey
Attorney

938,714.

Patented Nov. 2, 1909.

4 SHEETS—SHEET 4.



Witnesses:
 Clarence P. Pugh
 Stella Pugh

Inventor
 By *Rudolph F. Schmidt*
James A. Ramsey
 Attorney

UNITED STATES PATENT OFFICE.

RUDOLPH F. SCHMIDT, OF CINCINNATI, OHIO.

ROTARY ENGINE.

938,714.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, RUDOLPH F. SCHMIDT, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification.

My invention relates to motive power apparatus, the object being to provide a prime mover of simple construction and efficient in operation.

My invention consists in the parts and in the details of construction and arrangement of parts as will hereinafter be more fully described and claimed.

In the drawings: Figure 1 is an end elevation of an engine embodying my invention, part of the bearing standard being represented as broken away for the purpose of clearness of illustration. Fig. 2 is a detail perspective view of one of the piston heads. Fig. 3 is a detail perspective view of one of the pivoted abutments. Fig. 4 is a sectional detail view illustrating the construction of the spring plates for forming steam tight joints between the walls of the casing and the pivoted abutments and piston heads. Fig. 5 is a detail view illustrating the spring mechanism for operating the pivoted abutment levers, the spring casing being shown in section on a line corresponding to *w—w* of Fig. 11. Fig. 6 is a cross section, on a line corresponding to *y—y* of Fig. 11 of one of the engines, the base being omitted. Fig. 7 is a partial enlarged sectional view on a line corresponding to the line *v—v* of Fig. 6 better illustrating the arrangement of the packing ring adjustment mechanism. Fig. 8 is a section on the line *z—z* of Fig. 1 of part of the steam inlet apparatus, better illustrating the construction of the inlet valve and the casing therefor. Fig. 9 is a detail perspective view of a cam wheel for operating the pivoted abutment. Fig. 10 is a detail plan view of the hinged plate forming part of the spring cushion for the pivoted abutment. Fig. 11 is a partial side elevation and section of my invention, the section being taken on a line corresponding to *x—x* of Fig. 1. Fig. 12 is an enlarged end elevation of part of the engine, parts being broken away for better illustrating the actuating gear for the abutment member and the mechanism for holding the gear and abutment member out of

operative position, which position is represented by dotted lines. Fig. 13 is a section on the line *u—u* of Fig. 12, showing how the lever is secured on the squared end of the shaft of the abutment member. Fig. 14 is a detail perspective view of the forked bracket for sustaining the spring casing. Fig. 15 is a side elevation of part of the forked rod.

My invention as illustrated consists in two complete engines operating a single shaft 1, each of these engines consisting in a cylinder 2 concentric with the shaft 1, within which the piston wheel 3 is rigidly mounted on the shaft 1 by means of a key 4. The cylinder 2 is closed by means of the plate 5, which is secured by means of tap screws 6 taking into flanges on the cylinder. The hub 7 of the piston wheel 3 is preferably of less width than the rim 8, and the cylinder wall 9, as well as the plate 5, are indented so that they form end-thrust bearings for the hub 7. Where the shaft 1 passes through the wall 9 and plate 5, suitable stuffing boxes 10 and 11, respectively, are provided to prevent the escape of any steam which may pass the rim 8 of the piston wheel, which rim 8 is provided with stationary packing rings 12 and 13. These packing rings 12 and 13 are embedded in annular recesses in the cylinder wall 9 and plate 5, respectively, and also take into the sides of the rim of the piston wheel 3, which rim is provided with corresponding annular recesses to receive the packing rings.

For the purpose of uniformly adjusting the packing rings against the piston wheel throughout their circumference, I provide each packing ring with a series of set screws 14, each of which is provided with a pinion 15, these pinions all being in mesh with a gear 16 mounted loosely concentrically with the shaft 1, so that when one of the set screws 14 is turned to clamp the packing ring, all of the other set screws bearing against the packing ring will be simultaneously turned an equal amount.

Mounted on the rim of the piston wheel 3, in a suitable recess 17 therein, is the piston head 18 secured by tap screws 19 and 19^a. This piston head 18 conforms to the inner concave surface of the cylinder 2 in its main part 20, from which main part 20 it is inclined in both directions circumferentially of the piston wheel 3. The main part 20 is provided with spring plates 21 which are

mounted in slots in the sides of the piston head, these slots being cut at an angle to the sides, and the spring plates 21 being beveled to make uniform contact with the walls of the cylinder casing constituted by the wall 9 and the plate 5, thus making steam tight joints at the sides of the piston head. Each plate is held in its slot by a screw 21^a and pressed outward against the wall of the cylinder casing by a spring 21^b which is confined in a recess 21^c.

For admitting steam to the cylinder, a valve casing 22 is formed integral therewith, and a steam port 23 leads from the interior of the valve casing to the interior of the cylinder casing. Within this valve casing 22 the cylindrical valve 24 is mounted and accurately fitted to the interior of the valve casing. This cylindrical valve 24 has the rock shaft 25, preferably formed integral therewith, and a conical bearing is formed on the end of the cylindrical valve adjacent to its junction with the rock shaft 25, while the plate 26 closing the end of the valve casing and the part of the valve casing adjacent to the plate 26, are correspondingly recessed to receive the conical bearing of the cylindrical valve. At the other end of the valve casing 22, a plain flat plate 27 holds the cylindrical valve 22 in the valve casing, and the parts being accurately fitted, the cylindrical valve is prevented from end play thereby. A suitable stuffing box 28 is provided in the plate 26 where the rock shaft 25 extends through it. The steam enters the valve casing 22 at its top through a suitable shaped opening 22^a therein, the top of the valve casing being provided with a flange 29 to which the flange of the steam pipe 30 is bolted. The cylindrical valve 24 is provided with a segmental slot 24^a adapted to aline with the opening, so that steam may enter the interior of the cylindrical valve. This cylindrical valve is also provided with segmental slot 24^b, which is adapted to aline with the steam port 23.

The pivoted abutment 31 is mounted in the chamber 32, which is in communication with the interior of the cylinder 2 and is closed outwardly by means of a cover 33 bolted onto the cylinder casing. The exhaust outlet 34 is adjacent to the chamber 32 and leads from the interior of the cylinder casing, outside of which the exhaust pipe 35 is bolted to the casing, in alinement with the exhaust outlet. Preferably the steam port 23, chamber 32 and exhaust outlet 34 are placed as closely adjacent as is consistent with the provision of a proper amount of bearing surface for the piston head between these openings. The pivoted abutment 31 is mounted on a shaft 36 taking through the wall 9 and the plate 5 of the cylinder casing where the shaft is provided with suitable stuffing boxes 37 and 38, respectively. Positive rigid con-

nection is insured between the pivoted abutment 31 and the shaft 36 by means of suitable pins taking through the pivoted abutment and shaft and held in place by a plate as illustrated at 36^a in Fig. 6. The lower side of the pivoted abutment 31 is adapted to engage with the piston head 18 and with the periphery of the piston wheel 3 and form a steam tight joint with them. The free end of the pivoted abutment 31 is curved concentrically to the shaft 36, and a spring packing plate 39 is secured on one wall of the chamber 32 and bears against the curved free end of the pivoted abutment 31 to form a steam tight joint therewith, this plate extending entirely across the chamber 32. Plates, similar to the plates 22 on the piston head, are provided on the sides of the pivoted abutment 31 and bear against the cylinder wall 9 and plate 5 to form steam tight joints therewith. The pivoted abutment 31 is recessed on its upper surface merely for the purpose of making it lighter.

The piston head 18 is provided with recesses or pockets 40, which serve the double purpose of making it light in construction and receiving the steam at the beginning of the operation. Thus when the body part 20 of the piston head 18 has passed the steam port 23, the pivoted abutment 31 is designed to contact with the piston head, and the cylinder valve 22 being properly operated, steam will be admitted between the area of contact of the piston head 18 with the inner concave surface of the cylinder casing and the contact of the pivoted abutment 31 with the piston head, so that the piston wheel 3, and consequently the shaft 1, will be rotated by the expansive force of the steam acting between the piston head 18 and the pivoted abutment 31. The force of the steam will continue to be utilized during the revolution of the piston wheel 3 until the contacting part of the piston head 18 has passed the outlet opening 34, when the exhaust will be released to the atmosphere. From this point until the piston head can reach its initial position as above described, the momentum of the moving parts may be depended upon, after which the operation will be repeated.

The piston heads on the piston wheels of the two engines in the pair are oppositely positioned so that a balanced action is secured, while the recovery of one engine is rendered positive by the expansive force of the steam acting in the other engine, the valve 22 of which will be fully open at the time. For the purpose of properly operating the cylindrical valve 22, a rocker arm 41 is rigidly mounted on the rock shaft 25 by means of set screws 42, this rocker arm 41 being provided with a wrist pin 43. An eccentric 44 of usual construction is rigidly mounted on the shaft 1 by means of set

screws 44^a and is connected to the wrist pin 43 by means of a suitable rod 45 provided with the well known strap and wedge adjustment 46. This eccentric is so set that the segmental opening 24^b in the cylindrical valve 24 will approach the valve casing end of the steam port 23 as the piston head approaches the cylinder casing end of said port, but will not allow steam to be admitted to the cylinder casing from the valve casing until the pockets 40 in the piston head have passed from under the contacting part of the pivoted abutment 31, thus obviating the raising of the pivoted abutment by the engagement of the live steam with its under or contacting surface, which would otherwise result and cause a loss of steam, since that part of the cylinder casing on the opposite side of the pivoted abutment 31 communicates directly with the exhaust outlet 34. With the eccentric thus set and the various parts proportioned as illustrated in the drawings, the live steam will be admitted during less than half the revolution of the piston wheel 3, when the cylindrical valve 24 will have been rotated backward until the communication between the segmental opening 24^b and the steam port 23 is again broken and the admission of live steam terminated. From this point the expansive force of the amount of steam thus admitted to the cylinder is utilized until the piston head reaches the exhaust outlet as above described. It will thus be seen that with a valve gear of such construction, economical use of the steam is attained, while the force of the steam is applied in the most effective and direct manner to the shaft 1 throughout almost its entire revolution.

In order to obviate the necessity of raising the pivoted abutment 31 by the contact of the inclined surface of the piston head 18, I provide a cam wheel 47 rigidly mounted at the shaft 1 by means of the countersunk screws 48 and adapted to actuate the pivoted abutment by means of balancing levers 51 and 54 connected by links 53 to compression spring 56. The plate 49 is bolted to the outside of the cylinder casing, and in this plate is secured a stud 50 on which is pivoted the bell crank 51. One member of this bell crank 51 is preferably provided with a bearing block 52 which is adapted to engage with the periphery of the cam wheel 47, while the other member has pivoted to it the link 53 which is also pivoted to one end of the lever 54, and which lever is rigidly secured to the shaft 36 of the pivoted abutment 31. On account of the somewhat severe strain imposed during the operation of the engine at high speed in the raising of the pivoted abutment by the above described mechanism, I prefer to square the end of the shaft 36 and provide the lever 54 with a square hole to receive the squared end of the shaft 36, the

lever being held thereon by means of a set screw 55, as is best shown in Fig. 13 of the drawing.

The periphery of the cam wheel 47 is concentric with the shaft 1, upon which it is mounted, throughout such a proportion of its extent that the bearing block 52 which engages therewith, and consequently the bell crank 51, link 53, lever 54, shaft 36 and pivoted abutment 31 will remain stationary, and the pivoted abutment 31 will make contact with the periphery of the piston wheel 3, until the piston head 18 closely approaches the pivoted abutment 31, when the bearing block 52 will be engaged by the eccentric part of the periphery of the cam wheel 47 and be gradually forced outward, away from the shaft 1. This eccentric part of the periphery of the cam wheel thus forces the bearing block 52 outward at such a rate that the contacting part of the pivoted abutment 31 is raised away from the periphery of the piston wheel 3 more rapidly than the surface of the circumferentially inclined end of the advancing piston head 18 rises to make contact with it. When the main part 20 of the piston head 18, which is concentric to the shaft 1, has been carried under the abutment 31, the eccentric part of the periphery of the cam wheel 47 terminates, and the periphery of the cam wheel takes a direction substantially radially of the shaft 1, thus allowing the bearing block 52 to abruptly approach the shaft 1, and the pivoted abutment 31 to abruptly make contact with the piston head 18. As illustrated in the drawings, the pivoted abutment has just accomplished this contact, and as will be noted, the extended portion of the cam wheel has passed away from the bearing block 52 of the bell crank 51, leaving the entire pivoted abutment actuating mechanism supported by the contact of the pivoted abutment with the piston head. The various parts of this mechanism are so proportioned that they almost balance the pivoted abutment 31 thus adding to the ease of operation. By providing means for raising the pivoted abutment independently of its contact with the piston head, the undesirable violence of contact between the pivoted abutment and piston head, which would otherwise be encountered during rapid rotation of the piston wheel, is eliminated. A spring cushion is provided for the pivoted abutment consisting in a plate hinged at 31^a, this plate having one of its members bolted onto the under side of the cover 33, while the other member adjacent to the free end of the pivoted abutment 31 has spiral springs such as 31^b inserted between it and the under side of the cover 33, these springs being held in place by suitable lugs on the under side of the cover 33 and on the upper side of the member of the hinged plate. Thus the

pivoted abutment is fully under control during its movement in either the upward or downward direction and violent contact of any of the parts prevented.

For allowing positive adjustment of the contact of the pivoted abutment with the periphery of the piston wheel and with the piston head, I prefer to provide a compression spring 56, which is inclosed in a spring casing 57, and acts on the pivoted abutment actuating mechanism through the medium of the rod 58 which is pivoted to the link 53, and passing through the lower closed end of the spring casing 57 is surrounded by the spring 56 and is provided with a washer 59 in engagement with the upper end of said spring above which is a nut 60 for regulating the action of the spring. The spring casing is provided with trunnions 61 which bear in a forked bracket 62 bolted onto the cylinder casing.

Where the engine is to be used for marine purposes or any other use where a reverse motion may be required, duplicate sets of engines directly connected on the same shaft are provided, one of the sets being designed to operate in one direction and the other to operate in the opposite direction, and each of the engines is provided with a suitable forked rod 54^a adapted to embrace the lever 54 and be raised so that the crotch 54^b of the fork is out of engagement with the lever 54 and allows the reciprocation of the lever in the operation of the engine. When this rod is depressed, the crotch 54^b will engage with the lever 54 and depress it, raising the pivoted abutment 31 out of position for engagement with the piston head 18 and removing the bearing block 52 of the bell crank 51 out of position for engagement with the cam wheel 47, and allowing the engine to be freely rotated backward by the duplicate set of engines. For holding the forked rod 54^a in either raised or lowered position, a lever 54^c may be provided, having a locking mechanism adapted to engage with a sector 54^a, in which the lever is pivoted, as illustrated in Fig. 12 of the drawing. This lever may be located at any convenient position and at some distance from the engine if desired. As the bell crank 51 may be actuated by the cam wheel 47 only by the engagement of its bearing block 52 therewith, and is thus not positively connected to the cam wheel, the convenient raising of the abutment member 31 by means of the forked rod 54^b embracing the lever 54 is facilitated in a manner especially desirable where it is required to quickly reverse the engines, and where the operator must be at some distance from the engines.

While the device above described for retaining the pivoted abutment and its actuating mechanism out of operative position is desirable and obviates all unnecessary con-

tact of the parts, it will be noted that the engine may be freely rotated backward without this provision, since the piston head 18 is provided with the inclined surface which serves to support the pivoted abutment in its descent during the forward motion, and will raise it with equal facility during the reverse motion.

As illustrated, I prefer to provide each engine with a complete set of pivoted abutment actuating mechanism, as above described, on each side in order to prevent twisting strain on the shaft 36, while only one set of valve gears is provided for each engine, this valve gear hereinbefore described being adjacent to the bearings 1^a of the shaft 1.

Suitable drain pipes 63 are provided for each engine and are provided with valves 64. The cylinder casings of the two engines in the pair are supported on a bed plate 65 by means of feet 66 and secured together and braced by means of the arc shaped spacing piece 67 as well as by an additional spacing piece 68. The bearing standards 69 supporting the bearings 1^a are bolted to the bed plate 65, as are the feet 66 of the cylinder casing. The pulley 70 mounted on the shaft 1 between the two engines may be used for operating a suitable governor to regulate the supply of steam to the engine. This governor may be of any of the well known constructions used with reciprocating engines. By locating all of the valve gear, pivoted abutment operating mechanism and packing ring adjustment mechanism outside of the casings, these parts are readily accessible for adjustment and repairs, while the parts contained within the casings are extremely simple and require the minimum amount of care. The pivoted abutment is readily accessible for adjustment or repair by simply removing the cover 33 from the chamber 32.

For marine use each set should consist of three engines instead of two as herein illustrated, and the piston heads, pivoted abutment and valve operating gear would be positioned at 120° apart. This is desirable owing to the fact that with only two engines, should one of the engines stop with its piston head between the steam outlet 34 and the exhaust port 23, the other engine with its piston head opposite and with its valve almost closed, could not be provided with sufficient steam to rotate the piston head of the first engine past its steam port. For stationary use or for light service two engines, or even only one engine, provided with a fly-wheel will be sufficient, since the difficulty just described might be overcome by manually rotating the engine or engines until the piston head of one of the engines has passed its steam port; but in marine or other heavy service, the set of three engines will be required to eliminate such difficulty.

The pivoted abutment balancing levers, whereby the weight of the pivoted abutment is counterbalanced, are essential for high speed, and these levers in connection with the compression spring, with means for adjusting it, together with the cam wheel rigidly mounted upon the piston shaft and engaging with the bell crank, makes rapid connection with the pivoted abutment whereby it is raised out of the path of the piston head and at the same time permitted to engage therewith and with the piston wheel sufficiently to form a steam joint, thus insuring against undue wear of the parts.

In case of any accident to the balancing levers by which they are rendered inoperative during the operation of the engine, the piston head is so tapered as to pass under the pivoted abutment in either direction, in which case, the pivoted abutment is thrown upwardly against the hinged cushion plate and quickly returned to its position of engagement by the rebounding spring.

While I have illustrated and described a preferred construction in which two cylinders are provided, it will be understood that my invention covers an engine having one or more cylinders, the duplication of cylinders being for the purpose of increasing power and eliminating dead centers.

I claim:

1. A rotary engine composed of a cylinder casing with solid end on one side and removable head at the other side, a horizontal shaft extending longitudinally through the center of said cylinder casing, a piston wheel mounted centrally upon said shaft and being somewhat smaller than the cylinder, leaving a circular space between its periphery and the inside surface of the cylinder, a curved piston head rigidly mounted upon the periphery of the piston wheel in said circular space and adapted to engage the inside surface of the cylinder, its ends tapering to meet the surface of the periphery of the wheel, a pivoted abutment rigidly mounted upon a pin in a recess of the casing, pivoted abutment balancing levers rigidly connected to said pin to hold the pivoted abutment in position to overcome friction, a spring plate mounted upon the wall of the recess and engaging the head of the pivoted abutment to prevent steam from passing the pivoted abutment to the exhaust, a hinged plate mounted within the recess upon the recess cover, a rebounding spring interposed between said hinged plate and recess cover whereby a cushion is formed for engagement of the pivoted abutment and the pivoted abutment is caused to rebound, counteracting violent collision of the piston head and pivoted abutment, an exhaust always open providing a clear channel for the piston head, on the inside of solid end and head of cylinder a circular channel of uniform dimension

formed by a groove in the wall of the cylinder end and head respectively and by a corresponding recess upon the side of the periphery of the wheel and a split packing ring adapted to fill said recess whereby a steam tight joint is formed preventing steam from passing from the circular space to the center of the engine, and whereby the piston wheel is maintained in the center of the cylinder thus causing uniform wear of the parts and reducing friction, substantially as set forth and for the purposes specified.

2. In a rotary engine, a cylinder casing having a removable and adjustable head and having on its interior two circular packing grooves adjacent to the periphery of the piston wheel, a piston wheel mounted in said cylinder having upon each side thereof, adjacent its periphery, a circular packing recess each adapted to correspond with the adjacent packing groove of the casing, a circular steam space between the casing and piston wheel, a packing ring of uniform dimension throughout its circumference, adjustably secured in each of said packing grooves and projecting and fitting into said packing recesses, whereby the piston wheel is maintained centrally of the casing, and a uniform engagement of the piston wheel with the casing, to form a steam tight joint excluding the passage of steam from said circular steam space to the center of the engine, is obtained, a piston head on the piston wheel, a pivoted abutment adapted to co-act with the piston head, steam admission controlling apparatus, an exhaust outlet, and a series of simultaneously operable set screws directly engaging said packing rings and adapted to effect a uniform adjustment of each packing ring and maintain said adjustment against retreat at high pressure, substantially as set forth and for the purposes specified.

3. In a rotary engine, a cylinder casing in which a piston wheel is rotatably mounted on a shaft and provided with a piston head tapered at each end to meet the periphery of the piston wheel to permit of its passage in either direction under the pivoted abutment engaging it under pressure regardless of the action of the mechanism for operating the pivoted abutment, said pivoted abutment, under which the piston head is adapted to advance during the rotation of the piston wheel, a cam wheel mounted on the shaft to rotate therewith, a lever mounted to move in unison with the pivoted abutment, a bell crank adapted to make contact with the cam wheel, a link connecting said bell crank and lever, and a compression device connected to said link, said bell crank being adapted to be actuated by the cam wheel to raise the pivoted abutment out of contact with the piston head during the immediate advance of the piston head thereunder, and to allow

the pivoted abutment to abruptly make contact with the piston wheel, substantially as set forth and for the purposes specified.

4. In a rotary engine, a cylinder casing, a
5 piston wheel rotatably mounted therein, a piston head on the piston wheel, a pivoted abutment adapted to coact with the piston head, steam admission controlling apparatus, an exhaust outlet, the sides of the pivoted
10 abutment and piston head respectively being provided with inclined slots, packing plates in said slots having beveled outer edges adapted to form by the pressure of the steam against them, steam-tight engagement

with the sides of the cylinder, screws for 15 retaining the packing plates in the inclined slots and springs confined in recesses in said piston head and pivoted abutment respectively between the screw fastening and beveled end whereby the packing plates are 20 pressed outward against the walls of said cylinder casing, substantially as set forth and for the purposes specified.

RUDOLPH F. SCHMIDT.

Witnesses:

JAMES N. RAMSEY,
CLARENCE PERDEW.