G. F. MOORS.

ROTARY ENGINE.

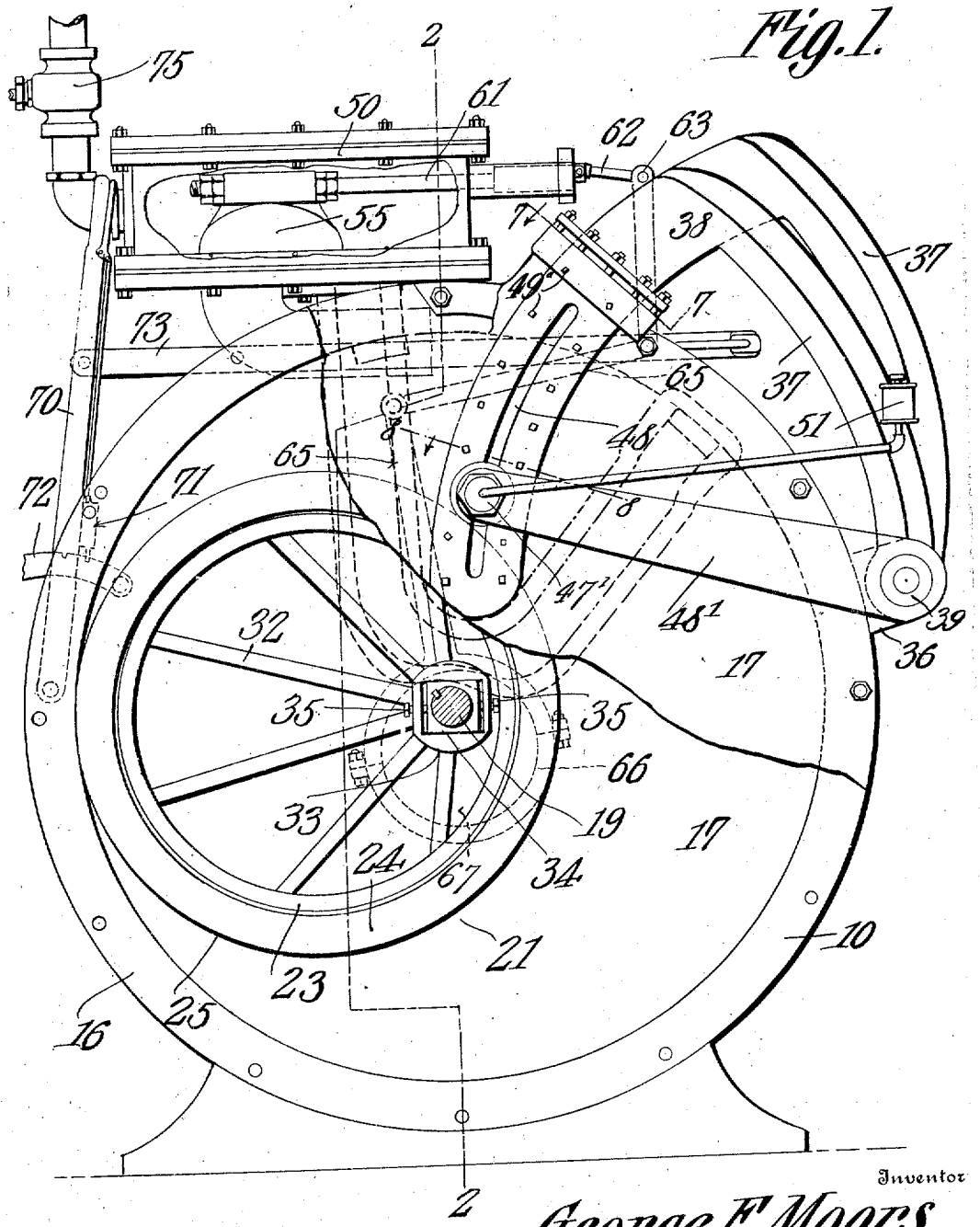
APPLICATION FILED SEPT. 11, 1908.

**958,885.**

**Patented May 24, 1910.**

3 SHEETS—SHEET 1.

*Fig. 1.*




Witnesses

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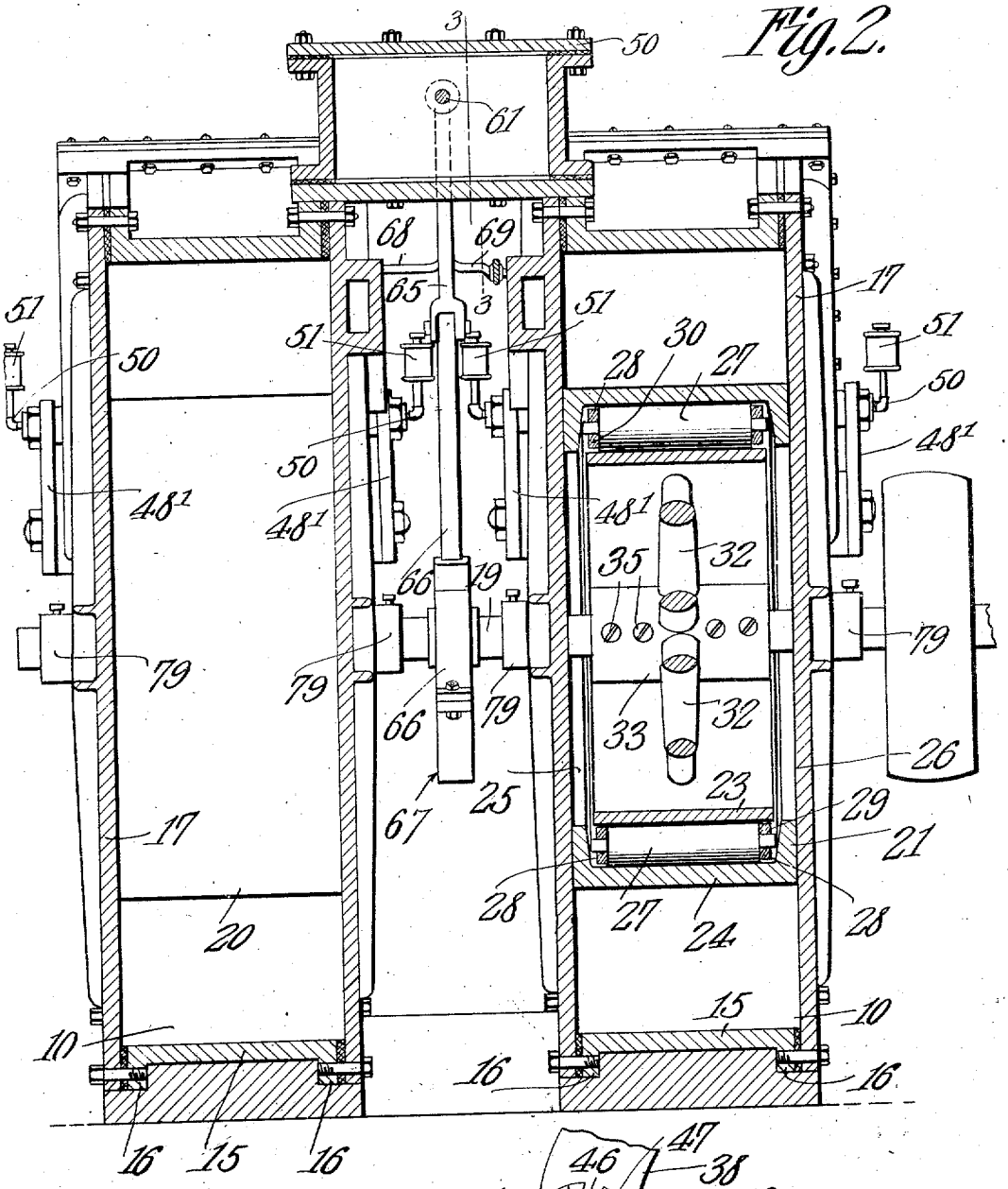
3 SHEETS—SHEET 2.

Fig. 2.



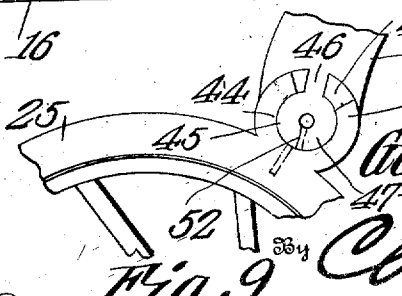




Fig. 9.

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3 SHEETS—SHEET 3.

Fig. 3.

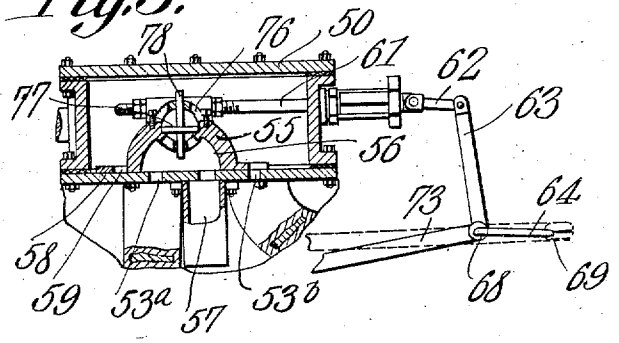



Fig. 6.

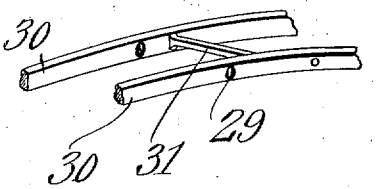



Fig. 4.

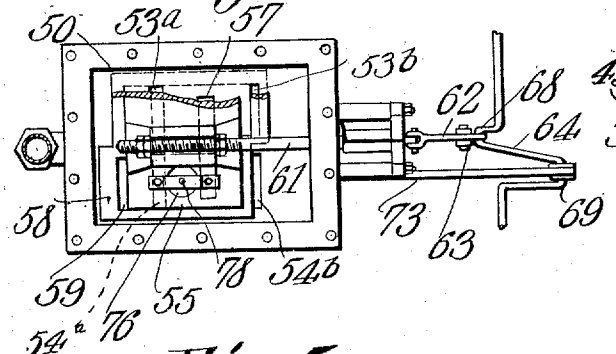



Fig. 8.

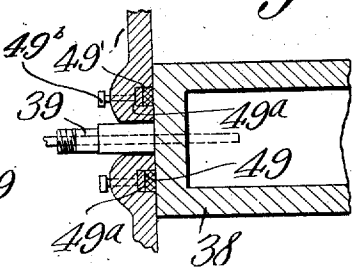



Fig. 5.

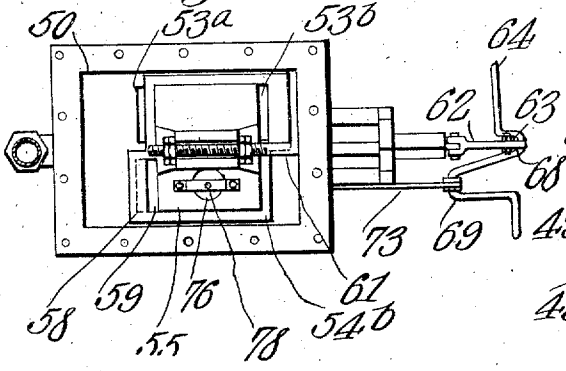
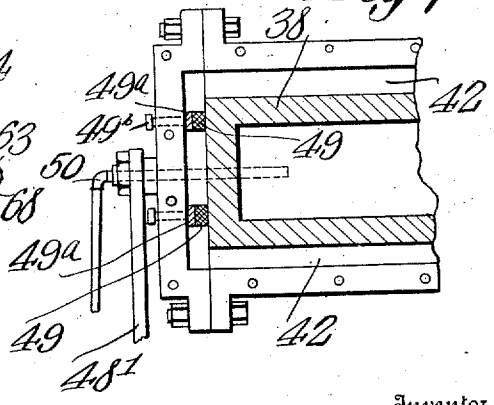



Fig. 7.

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# UNITED STATES PATENT OFFICE.

GEORGE F. MOORS, OF MOUNT VERNON, ILLINOIS.

## ROTARY ENGINE.

958,885. Specification of Letters Patent. Patented May 24, 1910.

Application filed September 11, 1908. Serial No. 452,647.

*To all whom it may concern:*

Be it known that I, GEORGE F. MOORS, a citizen of the United States, residing at Mount Vernon, in the county of Jefferson and State of Illinois, have invented a new and useful Rotary Engine, of which the following is a specification.

This invention relates to rotary engines, and has for its principal object to provide a novel form of engine in which the fluid pressure and expansive force of the steam or actuating fluid may be utilized to the best advantage.

A still further object of the invention is to provide a valve of this type in which one end of the valve controls one of the inlet ports when the piston is moving in one direction, while the opposite end of the valve is arranged to control a second inlet port when the engine is to rotate in the opposite direction, while in either position the central portion of the valve will permit the free passage of the exhaust.

A still further object of the invention is to provide a novel form of rotary engine in which the abutment and piston are connected to each other so that there is no frictional resistance, or wear between the abutment and piston, and the steam or other actuating fluid cannot leak between the two.

A still further object of the invention is to provide a revoluble piston drum having an encircling ring that is pivotally connected to the abutment and serves as a means for directly operating the latter.

A still further object of the invention is to provide a pivotally mounted abutment which is materially strengthened and reinforced so as to avoid danger of breakage or binding when subjected to heavy pressures.

A still further object of the invention is to provide a novel means for supplying lubricant to the parts of the piston and abutment exposed to frictional wear.

With these and other objects in view, as will more fully hereinafter appear, the invention consists in certain novel features of construction and arrangement of parts, hereinafter fully described, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims, it being understood that various changes in the form, proportion, size and minor details of construction may be made without departing from the spirit or sacrificing any of the advantages of the invention.

In the accompanying drawings:—Figure 1 is an elevation of an engine constructed in accordance with the invention, a portion of one of the cylinder heads and part of the steam chest being broken away in order to more clearly illustrate the construction. Fig. 2 is a transverse sectional view on the line 2—2 of Fig. 1. Fig. 3 is a vertical section on the line 3—3 of Fig. 2, showing the construction of the valve and its operating mechanism. Fig. 4 is a plan view of the slide valve and coacting parts in one operative position. Fig. 5 is a similar view of the slide valve and coacting parts in another operative position. Fig. 6 is a detail perspective view of a portion of one of the roller frames. Fig. 7 is a transverse sectional view through the abutment on the line 7—7 of Fig. 1. Fig. 8 is a similar view on the line 8—8 of Fig. 1. Fig. 9 is a detail view showing the connection between the abutment and piston.

Similar numerals of reference are employed to indicate corresponding parts throughout the several figures of the drawings.

The engine is mounted on any suitable sole plate or foundation and includes a pair of cylinders 10 of precisely the same construction and arranged in slightly spaced relation. Each cylinder comprises a main circular casting 15 having bolting flanges 16 to which the heads 17 are secured. All of the heads of the cylinders are provided with bearing openings for the reception of a main shaft 19 that extends through both cylinders and carries the two piston drums 20 and 21. These drums are mounted eccentrically with respect to the cylinders and are disposed diametrically opposite each other so that one or both of the pistons is constantly under pressure. Each of the piston drums is in the form of an annulus 23 exterior to which is another annulus 24 having one end formed with a radial web 25 and the other end provided with a corresponding web 26. The interior of each main cylinder is accurately machined to size and the webs 25 and 26 are, also, machined to fit the heads of the corresponding cylinder steamtight so that special packing is unnecessary. The external diameter of the drum 23 and the internal diameter of the ring 24 are so related that

there may be introduced between them a circular series of anti-friction rollers 27 having journals 28 at their ends seated in radial slots 29 formed at appropriate points around two parallel rings 30 that are joined at intervals by spaced junction bars or rods 31, as shown in Fig. 6. The drum 23 is supported by radial spokes 32 extending from a hub 33 carried by the shaft 19 which latter is central to the respective cylinders 10. The hub 33, however, is eccentric to the drum 23, being located close to the inner wall thereof in the particular structure shown in the drawings. The bore of the hub 33 is shown as rectangular and receives a similarly shaped block 34 of less length than the slot. The block 34 is engaged at the ends by radial set screws 35 passing through holes tapped in the hub 34 so that the drum 23 may be accurately adjusted with relation to the rings 24 and rollers 27, and thus maintain the rim of the ring 24 in constant engagement with the inner circular face of the cylinder 10.

Projecting from the main casing of each cylinder is a pair of integral pivot ears 36, and between each pair of ears is mounted an arcuate arm 37 provided with a strengthening rib or ribs, and said arm carries an abutment 38 which preferably is hollow for the purpose of reducing its weight. The abutment is curved on a line struck from the axis of the pivot bolt 39. The abutment passes through a receiving slot formed in the circular or peripheral wall of the cylinder, and the walls of the slot are extended and provided with suitable packing 42 in order to prevent leakage of steam at the sides of the abutment. The inner end of the abutment is connected to the ring 24 of the piston by a knuckle joint of such construction as to permit great freedom of movement, while preventing the passage of steam. The periphery of the ring 24 is provided with an approximately cylindrical boss 43 that extends the full width of the ring, and this boss has an approximately cylindrical opening 44 that is designed for the reception of a cylindrical block 45 at the inner end of the abutment 38 and connected to the abutment by a contracted neck portion 46. The inner end of the abutment is provided with a curved recess 47, the wall of which is shaped to conform to the periphery of the boss 43, thereby forming an effective connection that will prevent the passage of steam, while insuring free movement of the abutment.

Projecting from the end portions of the cylindrical block 45 and practically forming a continuation thereof are two arms 47′ that pass through arcuate slots 48 formed in the wall of the cylinder, and these arms are connected to the pivot bolt 39 by reinforcing arms 48′, so that there will be little or no danger of the abutment binding when subjected to heavy pressures. To prevent leakage of steam from the slot 48 the head of the cylinder is thickened at the opposite sides of the slot, as shown in Fig. 8 and in these thickened walls are formed slots arranged for the reception of arcuate packing strips 49 which rest against backing strips $49^a$ that may be adjusted by suitable bolts $49^b$. These strips extend beyond both ends of the slots and thus serve to positively prevent the escape of steam through such slots.

It will be noted that during the rotative movement of the piston the outer face of the ring 24 will slidably engage the inner circular wall of the cylinder, but the travel of the ring is comparatively slow even where the main body of the piston is rotating at high speed so that there is but little loss from friction.

In order to provide for the automatic supply of lubricant to the connection between the abutment and piston drum each of the arms 47′ is provided with an opening extending axially therethrough, and to the outer end of the opening is connected a pipe 50 which carries an oil cup 51. Each time the abutment moves down the pipe 51 is moved beyond the horizontal and lubricant will flow by gravity from the supply cup to the openings bored in the arms, and from these openings lead minute passages 52 through which the oil may flow to the connection between the abutment and piston ring, and this oil is further free to flow through the ring for the purpose of supplying lubricant to the anti-friction rollers.

Mounted above and between the cylinders is a steam chest 50 that is connected to one cylinder 10 by two ports $53^a$ and $53^b$ and to the other cylinder 10 by two ports $54^a$ and $54^b$, the ports $53^a$ and $54^a$ serving as inlet ports while the engine is moving in one direction, while the ports $53^b$ and $54^b$ serve as exhaust ports. When the piston is to rotate in the opposite direction, the ports $53^b$ and $54^b$ become inlet ports and the ports $53^a$ and $54^a$ serve as exhausts. Mounted in the steam chest is a D-valve 55. The valve is a double one, and has a single exhaust cavity 56 that is in constant communication with a main exhaust port 57. While one end of the valve is controlling the flow of steam through one of the sets of ports $53^a$ and $54^a$, or $53^b$ and $54^b$, the other set of ports is kept in communication with the exhaust cavity. As the ports must be opened in successive order owing to the location of the pistons at diametrically opposite points, each side of the valve has at each end a projecting plate 58 that is provided with a port 59 through which the steam will pass to one of the inlet ports before the end of the valves passes beyond and opens the other port. The valve stem 61 extends outside the chest and

is connected by a link 62 to a bell crank lever 63 that is mounted at the point of bifurcation on a crank shaft 64. The approximately horizontal arm of the bell crank lever is connected by a rod 65 to a strap 66 that encircles an eccentric 67 on the main shaft, the eccentric being so shaped and mounted as to properly time the movement of the valve. The shaft 64 has two cranked portions 68 and 69, and the bell crank lever is mounted on the smaller crank 68. This crank 68 lies normally with its axis in the horizontal plane of the axis of the shaft, and by rotating said shaft through an arc of approximately 180° the fulcrum point of the bell crank lever may be shifted and movement will thereby be transmitted to the valve for the purpose of shifting the latter to an extent sufficient to permit either of its ends to operate in connection with the inlet ports. To control the position of the valve, a reversing lever 70 is employed, said lever being provided with a latch bolt 71 which may be engaged with a notched quadrant 72 of the usual type, and this lever is connected by a rod 73 to the crank 69 on the shaft 64. By moving the reversing lever full over, the valve will be shifted from one extreme position to the other, and the direction of rotation of the engine will therefore be reversed. By partly shifting the lever, and then locking it by the quadrant, the lead of the valve may be adjusted, so as to effect cut off of the steam at any desired point in the rotation of the engine, so that the steam may be thereafter used expansively.

The engine is provided with a throttle valve 75 of any ordinary construction, this valve being preferably closed before the valve is shifted in reversing.

In order to prevent the formation of a vacuum or head pressure as the engine continues to run under its own momentum after steam has been shut off at the throttle 75, the D-valve 55 has its crown pierced by a port 76 normally closed by a valve 77, the stem 78 of which passes through suitable guide yokes formed on the D-valve. There is thus provided a means of communication between the steam and exhaust sides of the D-valve. When steam is shut off any tendency toward the formation of a vacuum on the steam side of the D-valve is prevented by the lifting of the valve 77, while head pressure in the cylinders is likewise relieved.

In order to prevent any tendency of the cylinder heads to spring outwardly under steam pressure, collars 79 are applied to the shaft 19, immediately adjacent to the outer walls of the cylinder heads and these collars are held to the shaft by suitable set screws.

What is claimed is:—

1. In a rotary engine, a cylinder, a shaft extending therethrough, the opposite heads of the cylinder being provided with arcuate slots, a cylindrical piston mounted eccentrically on the shaft, a ring encircling said piston, a pivotally mounted abutment extending through an opening in the curved wall of the cylinder and having its inner end connected to the piston ring, arms extending from the inner end of the abutment through said arcuate slots, packing strips arranged in the inner walls of the heads on opposite sides of said arcuate slots and bearing against the sides of the abutment, and bracing arms connected to the extended arms of said abutment.

2. In a rotary engine, a cylinder, a shaft extending therethrough, the opposite heads of the cylinder being provided with arcuate slots, a cylindrical piston mounted eccentrically upon the shaft, a ring encircling the piston, an abutment, a stuffing box arranged in the curved wall of the cylinder for the passage of the abutment, a pivotally mounted arm connected to the outer end of the abutment, a pair of arms extending from the inner end of the abutment through said arcuate slots, pivoted bracing arms connected to the extended arms of the abutment, and packing strips arranged on opposite sides of the slots and bearing against the opposite ends of the abutment.

3. In a rotary engine, a cylinder, a shaft extending therethrough, the opposite heads of the cylinder being provided with arcuate slots, a cylindrical piston mounted eccentrically on the shaft, a ring encircling said piston, an arcuate abutment pivotally connected to the ring, bracing arms connected to the inner end of the abutment, a lubricant containing cup, and a feed pipe running from the cup to the pivotal connection between the bracing arms, the abutment and the ring, said pipe being arranged to move to varying angular positions from the horizontal to permit gravity feed of lubricant during the operation of the engine.

4. In a rotary engine, a cylinder, a shaft extending therethrough, a cylindrical piston mounted eccentrically on said shaft, a ring encircling the piston and provided with a substantially cylindrical recessed boss, a pivotally mounted arcuate abutment extending through an opening in the wall of the cylinder and having a curved recess to receive the boss, and a cylindrical block extending from the abutment and fitting within the recess of the boss.

5. In a rotary engine, a cylinder, a shaft extending therethrough, an eccentrically mounted cylindrical piston carried by the shaft, a ring encircling the piston and in which said piston is free to rotate, an arm pivotally connected to the cylinder, an abutment extending from one end of the arm and into the cylinder, said abutment being

curved in an arc concentric with the pivot of the arm, coöperating means upon the ring and abutment for connecting the said ring and abutment, and braces connected to said coöperating means and extending to the pivot of the arm.

6. In a rotary engine, a cylinder, a shaft extending therethrough, an eccentrically mounted cylindrical piston carried by the shaft, a ring encircling the piston and in which said piston is free to rotate, an arm pivotally connected to the cylinder, an abutment extending from the arm and into the cylinder, said abutment being concentric with the pivot of the arm, an approximately cylindrical boss upon the ring and extending throughout the width thereof, said boss having an approximately cylindrical opening therein, a cylindrical block extending from the abutment and mounted to rock within said opening, the inner end of the abutment having a curved recess shaped to conform to the periphery of the boss.

7. In a rotary engine, a cylinder, a shaft, extending therethrough, a cylindrical piston mounted eccentrically on the shaft, a ring encircling said piston and provided with side flanges for engagement with the cylinder head, a frame movably mounted between the piston and ring, anti-friction rollers carried by and movably connected to the frame, an arcuate abutment movably mounted within the cylinder, and a steam tight connection between the abutment and ring.

8. In a rotary engine, a cylinder, a shaft extending therethrough, an eccentrically mounted cylindrical piston carried by the shaft, a ring encircling the piston and in which said piston is free to rotate, a boss extending throughout the width of the ring and having a substantially cylindrical recess therein, an arm pivotally connected to the cylinder, an arcuate abutment extending from the arm and concentric with the pivot of said arm, said abutment projecting into the cylinder, a substantially cylindrical block upon the abutment and mounted to rock within the recess in the boss, slots within the cylinder head and concentric with the pivot of the arm, braces extending from said pivot, and means extending from the block and slidably mounted within the slots for connecting the braces and block.

9. In a rotary engine, a cylinder, a shaft extending therethrough, a block upon the shaft, a cylindrical piston having an eccentrically disposed hub slidably mounted upon the block, adjusting screws engaging the opposite portions of the hub and block, a ring encircling the piston and separate therefrom, a pivotally mounted arcuate abutment slidably mounted within the cylinder, and a steam-tight knuckle connection between the abutment and ring.

10. In a rotary engine, a cylinder, a shaft extending therethrough, an eccentrically mounted cylindrical piston carried by the shaft, a ring encircling and separate from the piston, an arcuate abutment slidably mounted within the cylinder, a steam-tight knuckle connection between the abutment and ring, a pivot device outside of the cylinder, and separate connections between said pivot device and the inner and outer ends of the abutment.

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

GEORGE F. MOORS.

Witnesses:
CHAS. R. RELLER,
EARL B. HINMAN.