

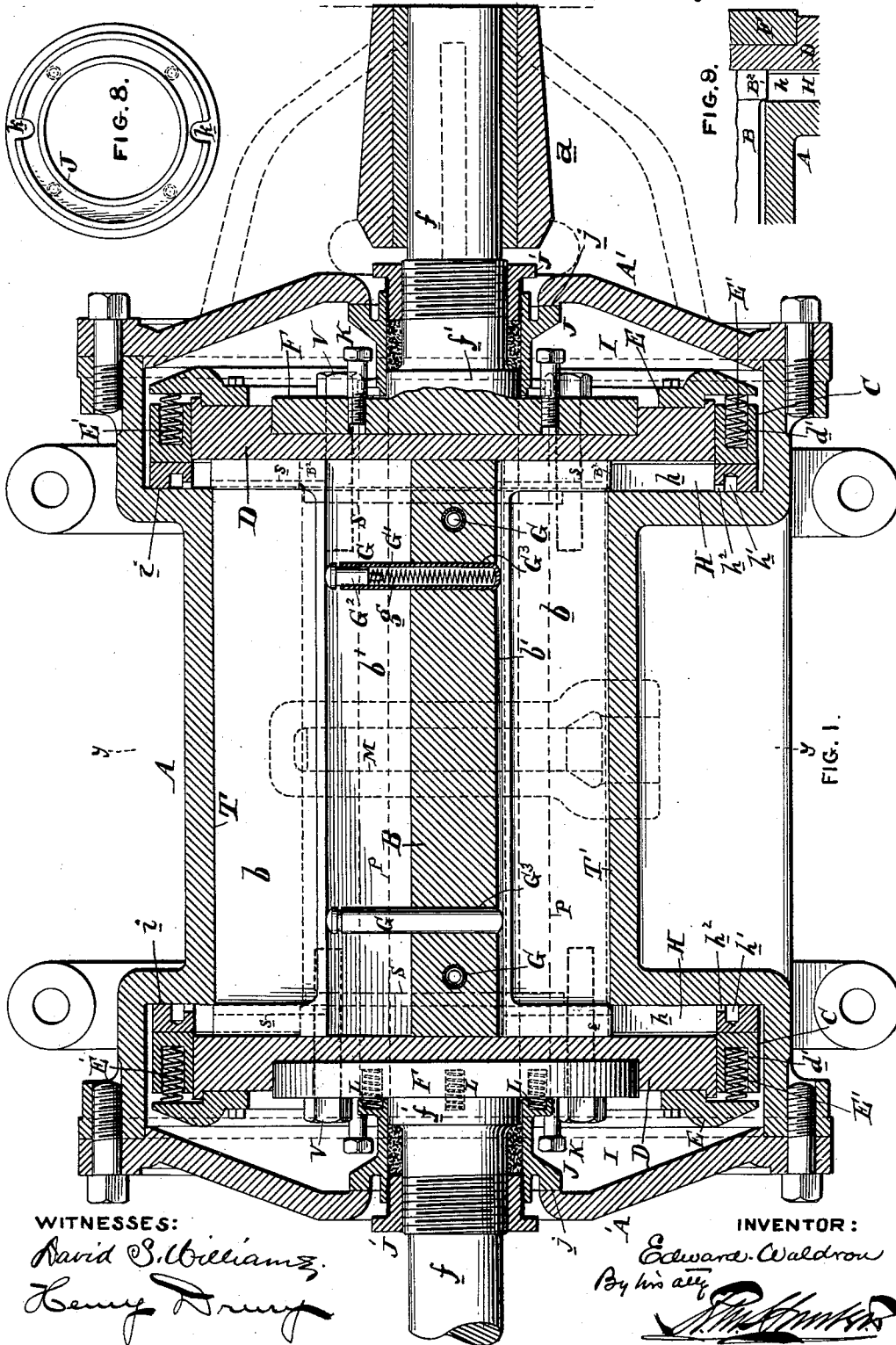
(No Model.)

3 Sheets—Sheet 1.

E. WALDRON.
ROTARY ENGINE.

No. 479,479.

Patented July 26, 1892.



(No Model.)

3 Sheets—Sheet 3.

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FIG. 4.

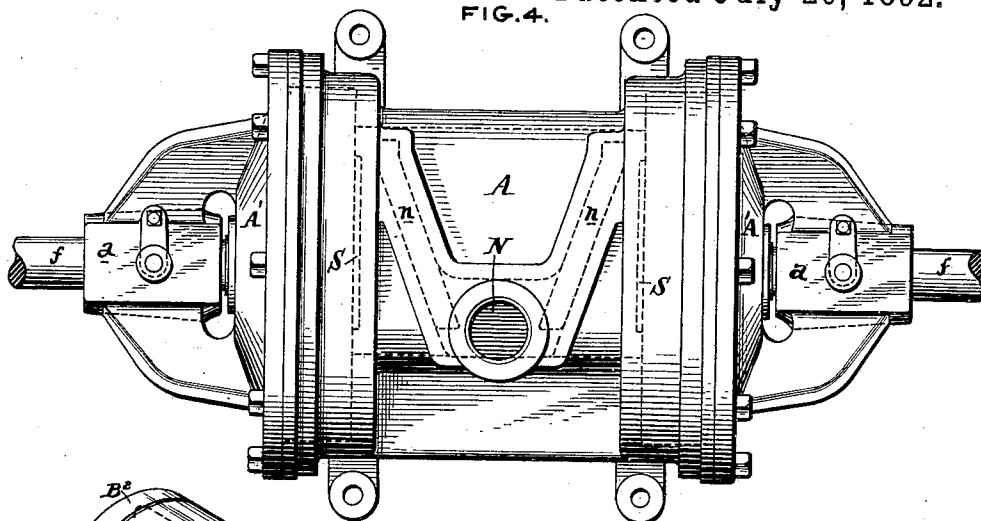


FIG. 7.

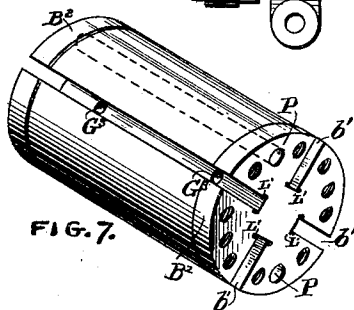


FIG. 6.

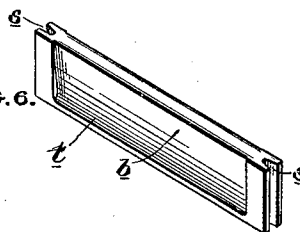
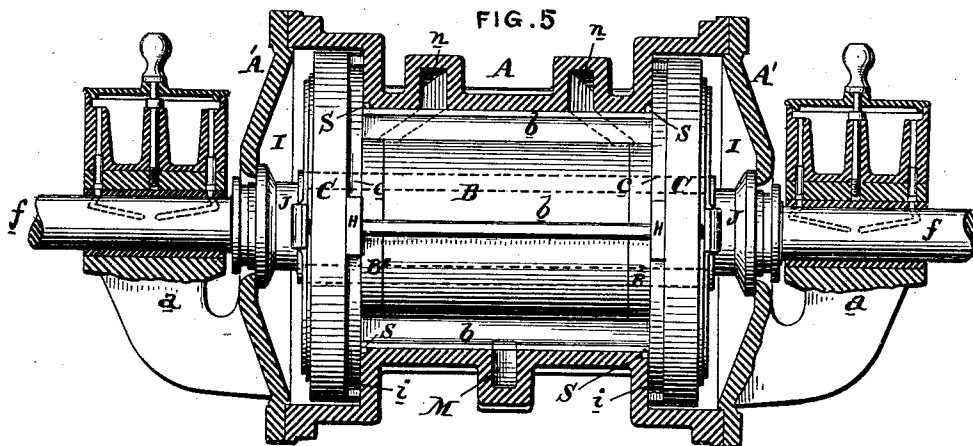


FIG. 5.



WITNESSES:

David S. Williams
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INVENTOR:

Edward Waldron
By his atty
[Signature]

UNITED STATES PATENT OFFICE.

EDWARD WALDRON, OF PHILADELPHIA, PENNSYLVANIA.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 479,479, dated July 26, 1892.

Application filed May 15, 1889. Serial No. 310,800. (No model.)

To all whom it may concern:

Be it known that I, EDWARD WALDRON, of the city and county of Philadelphia, and State of Pennsylvania, have invented an Improvement in Rotary Engines, of which the following is a specification.

My invention has reference to rotary engines; and it consists of certain improvements, all of which are fully set forth in the following specification, and shown in the accompanying drawings, which form a part thereof.

The invention set out in this specification is an improvement upon the rotary engine disclosed in Letters Patent No. 225,030, granted to me on March 2, 1880.

More particularly the invention relates to improved details of construction with the object in view of making the engine more durable, reliable, and efficient.

Referring to the drawings, Figure 1 is a sectional plan view of my improved rotary engine on line *xx* of Fig. 2. Fig. 2 is a cross-section of same on line *yy* of Fig. 1. Fig. 3 is a perspective view of a number of the details of the connecting parts between the cylinder drum and shaft, the parts being shown separated. Fig. 4 is a plan view of my improved rotary engine. Fig. 5 is a sectional elevation of same on line *zz* of Fig. 2. Fig. 6 is a perspective view of one of the pistons. Fig. 7 is a perspective of the cylinder-drum. Fig. 8 is an end elevation of one of the packing-rings for the shaft and cylinder, and Fig. 9 is an enlarged view of a portion of Fig. 1.

A is the cylinder and is provided at each end with heads *A'*, having orifices through which the piston-shafts extend. The central portions of the cylinder comprised in the parts *T T'* are concentric, and those portions comprised in the parts *T² T²* are eccentric with reference to a central line through the shafts *f*, located at each end, and the end portions adjacent to the heads *A'* are enlarged, circular, and concentric with the shafts. The heads *A'* carry the journals *a* for the shafts *f*, as shown in Figs. 4 and 5, and the central or middle part of the cylinder *A* is formed with the steam-inlet port *M* and exhaust-ports *n n*, opening into the exhaust-outlet *N*. These exhaust-ports *n n* converge from the lateral sides of the cylinder toward the middle and

unite in the outlet *N*. (See Figs. 4 and 5.) The object of this convergence is to enable the pistons to sweep the ports in such a manner that the said ports in effect travel laterally over the pistons *b* as they advance and all water of condensation is rapidly ejected with a minimum of resistance. The interior of the cylinder is made up of four surfaces—to wit, the concentric surfaces *T' T*, arranged diametrically opposite and differing in radius a distance equal to the throw of the pistons *b* in their races *b'* of the drum *B*, rotating within said cylinder, and the surfaces *T² T²*, which are eccentric or cam shaped and contain, respectively, the steam-inlet port *M* and exhaust-ports *n n*. The surfaces *T² T²* connect with the concentric surfaces *T' T'*, so as to form a continuous internal surface for the outer edges of the pistons.

An important feature is that the exhaust-ports *n n* extend down somewhat into the concentric surface *T*, and likewise the steam-port *M* is shortened a corresponding distance, so as to recede upon the surface *T²* slightly, or the surface *T* may be continued a corresponding distance toward the steam-port *M*. By examining Fig. 2 it will be observed that the two left-hand pistons *b* are just upon the ports *M* and *n*—that is, one piston is leaving the port *n* (see dotted lines) and the other piston is moving onto port *M*. While those pistons are in those positions the other two pistons on the right are not in corresponding positions with the other ends of the ports, but the upper piston is beyond the end of the exhaust-port *n*, and the lower piston is just beyond the end of the port *M*. It is necessary for the two pistons of any pair to be separated a distance equal to the distance between the edges of the ports *M n*, otherwise there would be a free escape of steam without a resulting development of power. The object of this arrangement of ports and surface *T* is to enable the piston *b*, which is approaching the exhaust-ports *n*, to remain stationary so far as radial movement is concerned until it has passed beyond the end of the exhaust-port, so as to relieve the pressure back of it, and thus reduce the friction of its radial movement. As soon as it has passed on sufficiently to enable the relief of the pressure at its back it meets the eccentric surface *T²* and commences to be pushed

inward. In this manner its inward movement is not performed against a strong lateral pressure, and hence all excessive wear of the piston in its races is overcome.

5 Another important feature of this improvement is that when the pistons come in line with the beginning of the exhaust-ports n the steam and water back of the pistons may be relieved by blowing up through the grooves s 10 in the ends of the pistons, through the grooves S in the cylinder and in front of the pistons, and out by the exhaust-ports n before the steam back of the piston has been exhausted. This is important, since it removes at once the 15 great resistance to the pistons being pushed in by the eccentric portion T^2 of the cylinder. This relief is a great advantage, for the pistons move so rapidly that it is essential to avoid all clogging or obstruction of their free 20 reciprocation. The relief of the water and steam from under the pistons in this manner before the main exhaust from back of the pistons has the advantage of relief into a space when there is the least pressure, and hence 25 the least resistance to relief. In the case of the piston passing over the steam-port M the steam exists with the initial pressure upon both sides, and consequently its outward movement is not attended with any excessive lateral friction. The moving back of the steam- 30 port M is only to correspond to the moving back of the exhaust-port n , as the edges of these ports must be separated a distance not less than ninety degrees.

35 The pistons b are made as shown in Fig. 6 and work in the races b' in the drum B and the races h in the packing-rings C . (See Figs. 2 and 3.) They are recessed on the sides, as at t , to reduce the weight and also the friction 40 in the races and consequent outward tendency due to centrifugal action. These pistons are arranged in pairs situated on diametrically-opposite sides of the drum B and pressed outward by spring distance-rods G , 45 consisting of tubes G' , open at one end and fitted with a movable head G^2 and a spring g within to push said head outward. By this means the pistons are kept normally a given distance apart and the springs admit of ad- 50 justment for any variations in the internal diameters of the cylinder. The distance-rods work through holes G^3 , which they snugly fit, and there are preferably two of such distance-pieces for each pair of pistons, as shown in Fig. 1. Each end of the drum B is preferably 55 slightly enlarged, as at B^2 , and is fitted to the several parts shown in Fig. 3, which are separated for clearness—to wit, parts C , D , E , and F . The drum is received in and fits the recess D' , and is bolted to said head D 60 and the head F of the shaft f by bolts V , Fig. 1.

Fitting over the head D with a steam-tight joint and having freedom of lateral movement is the packing-ring C , and this ring is 65 pressed forward against the face i , Fig. 1, of the cylinder by springs E' , extending into recesses d' in its rear and held in place by lugs

e of the ring E , bolted to the outside of the head D .

By removing the head A' , the shaft f , and 70 the head D the pistons may be drawn out without withdrawing the drum B . This is important.

The ring C is clearly shown in Fig. 3 and consists of an annular body portion formed 75 with a narrow rim c for contact with the surface i' , and also at four equidistant places with wedge-shaped pieces H , having races h for the pistons b . The outer ends of these races h are slotted at h^2 , and these slots lead 80 into recesses h' , Figs. 1 and 3. The object of this is to supply steam to the running surfaces and insure thorough lubrication, and thereby reduce the friction and wear, and also to act as pockets for the collection of any 85 dirt, &c.

By making the pieces H wedge-shaped I am enabled to fit them to the recesses d in the head D , Fig. 3, and thus form a steam-tight 90 joint and yet permit them to move parallel with the length of the cylinder in said recesses, and I also maintain the advantageous construction of proportioning the surface to the friction between the parts, which is proportional to the distance traveled—that is to 95 say, that as I move away from the axis of rotation of the drum and shafts of the engine the metal surface of the parts H exposed to contact with the cylinder-surface i gradually increases, and this increase is substantially 100 proportional to the increase of distance traveled. It will now be seen that the drum at each end of the cylinder A is packed by the rings C and is supported in bearings a by the shafts f . This construction has the further 105 advantage of being perfectly self-lubricating, since the outer parts of the pieces H are lubricated by the steam and water outside of the annular rim c . The annular rim c is lubricated by the steam and water passing into the slot h^2 , Fig. 1, and the inner parts of the pieces H are lubricated by the steam and water passing into the race h . The enlarged 110 ends B^2 of the drum B receive the inner ends of the wedge-shaped pieces, and as the faces of these pieces wear in working over the surfaces i' of the cylinder they may shift over the enlarged parts B^2 of the drum and compensate for wear without the least possibility of binding. This construction is shown in 120 Figs. 1, 2, and 9. I pack the shafts f where they pass through the cylinder-heads A' and make the sleeves J slide upon the inner edges of the opening in the heads, as is clearly shown at j in Fig. 1. The shaft f has an enlarged 125 portion f' adjacent to the head F , and over the enlarged portion the sleeve J fits and is pressed outward by springs L . The sleeve has a packing-gland J' , which is screwed in upon the shaft f against a packing, or, if desired, it might be screwed into the sleeve. The inner flange of the sleeve is notched, as at k , 130 Figs. 1 and 8, and through these notches are placed screws K , which are held by the head

F, and they perform the dual duty of making the sleeve rotate with the shaft f and hold it to the shaft when the head A' is removed. By this construction the packing around the shaft and between it and the sleeve J may be always maintained steam-tight and all leak-
 5 ages instantly stopped, so that no steam can escape by way of the shaft. Furthermore, the construction is one which insures all the wear
 10 coming upon the removable head A' , which can readily be removed for repairing or for permitting access to the packing ring or sleeve for repairs or other necessary purposes. Furthermore, it is possible to remove the head A'
 15 for adjusting or obtaining access to the annular ring C and its connections without dismantling the other parts, as was necessary in the case of my patent hereinbefore referred to. Furthermore, in this case all of the wear
 20 comes upon a part which is inexpensive to replace, whereas in my former patent the wear came upon one of the heads of the drum, which was expensive to replace.

Returning to the packing-ring C, I would
 25 direct attention to the fact that the wedge-pieces H project inwardly and are received in corresponding notches d in the head D, and thereby insure the ring C rotating with the drum B and pistons. It is true that the
 30 pistons of themselves would cause the ring to rotate; but their action would be uneven and would produce a strong friction on the pistons which it is desired to remove. By the construction shown the head D primarily
 35 causes the ring to rotate with the drum and pistons and relieves the pistons of any duty other than rotating the drum and its shafts. The action of the pistons on the pieces H is to rotate the ring C and drum as an unit but
 40 without any backward strain on the outer edge of the pistons. Holes P extend entirely through the drum, heads D, and F, into the spaces or chambers I at each end of the engine, so as to equalize the pressure on the out-
 45 side of the packing-rings C. (See Figs. 1, 2, 3, 5, and 7.)

On each end of the cylinder and along the extreme edges of the surfaces T^2T^2 are grooves S, hereinbefore referred to, which grooves in
 50 length correspond to the ports M and n , Figs. 2 and 5. To work in conjunction with these grooves are grooves s in the ends of the pistons, as shown in Figs. 1 and 6. The object of these grooves is to supply steam on
 55 one hand when passing the steam-port M and allow of the escape of steam and water when passing the exhaust-ports n and when the pistons are entering the drum, as before explained. The steam passes into grooves S
 60 at the bottom of the engine and then through grooves s on the ends of the pistons, beneath the pistons, and filling the bottoms of the races b' and insuring the pistons being kept positively to the interior surface of cylinder,
 65 preventing all chattering and necessity for heavy springs in the distance-rods. Once the

piston passes the end of the port M the grooves s are sealed and the steam back of the piston remains locked in. When the piston reaches the exhaust-port n , the upper
 70 grooves S are met and the steam and water are relieved, and the inward movement of the piston positively ejects the steam and water of condensation against the small resistance of the exhaust-steam, and the piston sweeps
 75 it through the exhaust-ports. Its release at the upper port is also important, because the piston must be pushed into the drum, and all resistance to such action must be removed. These grooves S s also insure the steam for
 80 lubricating purposes passing to the slots h^2 and recesses h' in the rings C and also to the space between the rings C and heads D. An examination of Fig. 2 will show that the inner ends of the piston-races b' are enlarged at L'
 85 by longitudinal grooves. While there is a limited space between the walls of the race and the distance-rods G for the passage of steam and water when the pistons reciprocate, yet it is not sufficient when the engine
 90 is running at its normal speed, and for this reason the grooves L' are employed, as they form channels for the ready escape of the steam and water of condensation to either end of the drum and to the grooves s in the
 95 ends of the pistons. The water of condensation from the steam-port passes off by drip-pipe M' and from the exhaust-port by drip-pipe O. The pistons rotate in the direction of the arrows, and during their rotation about
 100 the axis of the drum they reciprocate in pairs, and as the diameter of the cylinder is substantially the same for all lines taken through the said axis of the drum and shafts of the engine one piston recedes with substantially
 105 the same velocity as the one diametrically opposite is projected.

While I prefer the construction shown, I do not confine myself to the exact details, as they may be modified without departing from
 110 my invention.

While I have particularly described my invention as an engine, it is apparent that it may also be used as a pump, and is applicable not only for transmitting power, but
 115 also for compressing or exhausting air or gas and for measuring liquids, and such uses of the apparatus are contemplated by my invention.

Having now described my invention, what
 120 I claim as new, and desire to secure by Letters Patent, is—

1. In a rotary engine, the combination of a steam-cylinder formed with shaft-bearings at each end, a rotary drum and pistons of a
 125 length equal to the length of the cylinder, a steam-tight packing between the ends of the drum and cylinder, a shaft at each end supported in said bearings and having a flanged head bolted to the respective ends of the
 130 drum and supporting it, cylinder-heads for each end of the cylinder, and a rotatable

steam-tight packing encircling the shafts between their heads and the respective cylinder-heads through which the shafts extend.

2. In a rotary engine, the combination of the
5 cylinder having heads at each end provided with apertures of larger diameter than the shaft-sections of the engine, a rotary drum and pistons secured to the shaft-sections, sleeves surrounding the shaft-sections and
10 movable longitudinally thereon and forming annular steam-tight rotary joints with the inner faces of the cylinder-heads, packing between the sleeves and shaft-sections, glands screwed upon the shaft-sections to keep the
15 packing in place, and springs to press the sleeves outward against the inner faces of the cylinder-heads.

3. In a rotary engine, a cylinder having its inner surface formed of concentric and eccentric parts arranged alternately about the axis
20 of rotation of the shaft, and steam inlet and exhaust ports arranged diametrically opposite and of different lengths, in which the exhaust port occupies a space more than ninety
25 degrees, in combination with a rotary shaft and piston carried with the shaft and sweeping the interior face of the cylinder.

4. In a rotary engine, a cylinder having two oppositely-arranged concentric parts T¹ T' of
30 different radii and two opposite cam or eccentric parts T² T², connecting said concentric parts and respectively provided with steam and exhaust ports, in which the exhaust-port consists of two oblique ports substantially
35 covering the width of the cylinder, in combination with traveling pistons moving about a fixed axis and sweeping the interior surface of the cylinder.

5. In a rotary engine, the combination of
40 a cylinder having concentric and eccentric parts, substantially as set out, and provided with steam and exhaust ports arranged in the eccentric parts diametrically opposite and in which the adjacent edges of the two ports
45 are separated a distance corresponding to ninety degrees and in which the exhaust-port is of greater length than the steam-port, with a rotary drum arranged within the cylinder, and rotary movable pistons arranged diamet-
50 rically in pairs and movable in races formed in the drum.

6. In a rotary engine, the cylinder having an interior surface made cam or eccentric shaped, in combination with a drum provided
55 with piston-races arranged within said cylinder and of substantially equal length with the cylinder, pistons for said drum, removable heads for the ends of said drum to hold the pistons against longitudinal movement, and
60 two shafts having heads and arranged one at each end and bolted to the drum, whereby the shaft at one end can be removed and the pistons withdrawn without removing the drum.

65 7. In a rotary engine, the cylinder having interior concentric and eccentric shaped sur-

faces arranged alternately about its interior circumference and parallel end surfaces, in combination with a rotary drum and reciprocating pistons, a head bolted to each end of
70 the drum, having radial slots, and packing-rings carried by said heads, having piston guide-pieces fitting said slots and movable to and from the end surfaces of the cylinder.

8. In a rotary engine, the cylinder having
75 interior concentric and eccentric shaped surfaces arranged alternately about its interior circumference and parallel end surfaces, in combination with a rotary drum and reciprocating pistons, a head bolted to each end of
80 the drum, having radial slots, and packing-rings carried by said heads, having piston guide-pieces fitting said slots and movable to and from the end surfaces of the cylinder, and springs supported by the heads to force said
85 rings against the end surfaces.

9. In a rotary engine, the cylinder having interior concentric and eccentric shaped surfaces arranged alternately about its interior circumference and parallel end surfaces, in
90 combination with a rotary drum and reciprocating pistons, a head bolted to each end of the drum, having radial slots, and packing-rings carried by said heads, having piston guide-pieces fitting said slots and movable to
95 and from the end surfaces of the cylinder, the said rings having a thin annular contact-rim, and guide-races for the pistons.

10. In a rotary engine, the cylinder having interior concentric and eccentric shaped
100 surfaces arranged alternately about its interior circumference and parallel end surfaces, in combination with a rotary drum and reciprocating pistons, a head bolted to each end of the drum, having radial slots, and packing-
105 rings carried by said heads, having piston guide-pieces fitting said slots and movable to and from the end surfaces of the cylinder, the said rings being formed with a thin annular contact-rim having a steam-lubricating groove
110 and recess leading from the interior of the cylinder to its contact-surface.

11. In a rotary engine, the cylinder having interior concentric and eccentric surfaces arranged alternately about its interior circum-
115 ference and parallel end surfaces, in combination with a rotary drum within the cylinder, provided with reciprocating pistons, end heads for said drum rotating with it and provided with V-shaped guide notches or slots in their
120 interior surfaces, and packing-rings encircling said heads, provided with V-shaped pieces forming races for the pistons and fitting in said notches or slots in the drums.

12. In a rotary engine, a cylinder having
125 its inner surface formed of concentric and eccentric parts arranged alternately about the axis of rotation of the shaft, and steam inlet and exhaust ports arranged diametrically opposite, in which the exhaust-port ex-
130 tends over a space of more than ninety degrees, in combination with a rotary shaft and

four pistons arranged at angles of ninety degrees and carried with the shaft and sweeping the interior face of the cylinder.

13. In a rotary engine, the combination of the cylinder having heads at each end, a rotary drum and pistons within the cylinder, a shaft projecting from the drum through the head, a stuffing box or sleeve surrounding the shaft, a packing between the shaft and said box or sleeve, and springs to press the box or sleeve against the interior surface of the head and make a steam-tight rotary joint.

14. In a rotary engine, the combination of the cylinder having heads at each end, a rotary drum and pistons within the cylinder, a shaft projecting from the drum through the head, a stuffing box or sleeve surrounding the shaft, a packing between the shaft and said box or sleeve, and springs to press the box or sleeve against the interior surface of the head and make a steam-tight rotary joint, and screws, substantially as shown, to hold said box or sleeve to the drum and shaft when the cylinder-head is removed.

15. In a rotary engine, the combination of the cylinder having heads at each end, a rotary drum and pistons within the cylinder, a shaft projecting from the drum through the head, and a box or sleeve carried with the rotating shaft and forming a steam-tight joint between the shaft and cylinder-head.

16. In a rotary engine, the combination of the cylinder having heads at each end, a rotary drum and pistons within the cylinder, a shaft projecting from the drum through the head, a box or sleeve J, encircling the shaft and having an annular flange forming a steam-tight rotary joint with the cylinder-head, a packing between the box or sleeve and shaft, and a packing gland or ring for said box or sleeve.

17. In a rotary engine, the combination of the cylinder having an interior made of concentric and eccentric parts, with a rotary drum located therein and formed with radial races for the pistons provided with enlargements or channels at the bottom entirely across the drum for the ready escape of water and steam from under the pistons when moving inwardly to the ends of the drum, and pistons movably supported and made steam-tight in said races.

18. In a rotary engine, the combination of the cylinder having an interior made of concentric and eccentric parts, with a rotary drum located therein and formed with radial races for the pistons, provided with enlargements or channels at the bottom entirely across the drum for the ready escape of water and steam from under the pistons when moving inwardly to the ends of the drum, and pistons for said races, formed with grooves on their ends for the escape of the water and steam from the ends of the races to the exhaust-port.

19. In a rotary engine, a cylinder having an interior made of concentric and eccentric shaped parts and parallel end surfaces, in

combination with a rotary drum of greater length than the interior surface of the cylinder and of greater diameter on its ends than at the middle and formed with radial piston-races, heads for said drum, pistons working in the races of said drum, and a packing or skeleton ring encircling said heads of the drum and formed with guide or race pieces for the pistons, extending inward toward the enlarged diameters of the drum and moving longitudinally to make a tight joint with the end surfaces of the cylinder.

20. In a rotary engine, the cylinder having an interior surface consisting of eccentric and concentric parts and parallel end surfaces, in combination with a rotary drum, pistons and heads therefor, and encircling packing-rings for said heads, having irregular contact-surfaces at their outer portions, consisting of a thin annular rim, and outwardly-extending parts arranged at intervals about the circumference and having steam-spaces in them for making a steam-tight joint with the end surfaces and allowing of ample lubrication.

21. In a rotary engine, the cylinder having a concentric and eccentric shaped interior, substantially as shown, and parallel end surfaces, in combination with a rotary drum, pistons and heads therefor, and encircling packing-rings for said heads, an irregular contact-surface for making a steam-tight joint with the end surfaces and allowing of ample lubrication, said surface consisting of a narrow annular rim, and guide-pieces for the pistons, said guide-pieces projecting beyond the annular rim and formed with steam-spaces extending beyond the said rim.

22. In a rotary engine, the cylinder having interior concentric and eccentric surfaces arranged alternately about its interior circumference and parallel end surfaces, in combination with a rotary drum within the cylinder provided with reciprocating pistons, and heads for the said drum, rotating with it and provided with V-shaped guide notches or slots in their interior surfaces, and packing-rings encircling said heads, provided with V-shaped pieces forming races for the pistons and fitting in said notches or slots in the drums, and springs to force said rings against the end surfaces of the cylinder.

23. In a rotary engine, a cylinder having its interior surface made of eccentric and concentric parts, in combination with a rotary drum having radial piston-races, radially-reciprocating pistons working in said races, and distance-rods formed of the tubes G', heads G², and internal spring g, acting to separate the tubes and heads for keeping the pistons out against the cylinder-surfaces.

24. In a rotary engine, the cylinder having an interior made concentric and eccentric and in which said parts each occupy ninety degrees and are arranged alternately and formed with steam and exhaust ports arranged on diametrically-opposite and eccentric sides, and also having grooves S on the end edges

of the cylinder and of a length corresponding to the exhaust-port and in which the exhaust-port occupies more space than ninety degrees, extending upon the larger concentric part, in
 5 combination with a rotating drum having radial races arranged at ninety degrees apart, and radially-reciprocating pistons for said races, having end grooves opening into the
 10 grooves S in the cylinder to relieve the water and steam under the piston before the steam in the cylinder back of the piston is exhausted.
 25. In a rotary engine, a cylinder having its inner surface formed of concentric and eccentric parts arranged alternately about the
 15 axis of rotation of the shaft, and steam inlet and exhaust ports arranged diametrically opposite, in which the exhaust-port extends over a space of more than ninety degrees and the steam-port a space of less than ninety de-
 20 grees, in combination with a rotary shaft and four pistons arranged at angles of ninety degrees and carried with the shaft and sweeping the interior face of the cylinder, whereby two spaces between the pistons may be ex-
 25 hausting while only one is receiving steam and the pistons over the exhaust are relieved before moving on the eccentric part of the cylinder.

26. In a rotary engine, a cylinder having its interior composed of alternate concentric and 30 eccentric parts and in which the concentric parts are alternately of different diameters, a steam-port arranged in one of the eccentric parts and an exhaust-port arranged in the al-
 35 ternate eccentric part and being of a length equal to that of the eccentric part and part of the concentric part, in combination with a rotating drum having its axis arranged concen-
 40 tric with the concentric parts of the cylinder and provided with piston-races separated a number of degrees corresponding to that of the concentric and eccentric parts of the cylin-
 45 der, and reciprocating pistons carried by the drum and adapted to sweep the interior of the cylinder, the whole operating to exhaust the steam from back of the pistons before the
 50 said pistons reach the eccentric portion of the cylinder, and thereby reduce the friction and wear upon the engine and allowing a higher speed to be attained.

In testimony of which invention I have here-
 unto set my hand.

EDWARD WALDRON.

Witnesses:

ERNEST HOWARD HUNTER,
 S. T. YERKES.